GEOTECHNICAL EXPLORATION

Report on:

Geotechnical Exploration
Proposed Pavement Improvements
Northville Township Police Department
Northville Township, Michigan

Prepared For:
Spicer Group, Inc.
230 S. Washington Avenue
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GeoTran Project No.: 16-05003G-10
June 23, 2016

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June 23, 2016
GeoTran Project No.: 16-05003G-10

RE: Report on Geotechnical Exploration
Proposed Pavement Improvements
Northville Township Police Department
Northville Township, Michigan

Dear Mr. Simmon:

We are pleased to submit this report of our geotechnical exploration for proposed pavement improvements at the Northville Township Police Department in Northville Township, Michigan. This study was performed in accordance with the scope of services outlined in our proposal No. 16-05003G, dated May 24, 2016 and your authorization letter dated June 6, 2016.

We appreciate the opportunity to be of service to you on this project. If you have any questions regarding this report or if we can be of further assistance, please feel free to contact us at (810) 229-6805.

Sincerely,
GeoTran Consultants, LLC

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Project Engineer

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Project Manager

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Attachments

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1.0 INTRODUCTION

This report presents the results of our geotechnical exploration for proposed pavement improvements at the Northville Township Police Department in Northville Township, Michigan. The site location, relative to existing streets and topographic features, is shown on the Site Location Map, Figure No. 1 of the Appendix.

The purpose of our services was to explore and evaluate the general pavement and subsurface conditions at the site and to develop pavement and related site preparation recommendations for the proposed project. Conclusions and recommendations presented in this report are based on the subsurface conditions encountered at the locations of our explorations and our understanding of the proposed project. Conditions may vary between boring locations, and should not be extrapolated to other areas without our prior review.

2.0 SITE AND PROJECT CHARACTERISTICS

The site of the proposed pavement improvements project is situated on the premises of the Northville Township Police Department facility located at 41600 Six Mile Road in Northville Township, Wayne County. This location is on the north side of Six Mile Road and northeast of its intersection with Winchester Drive. Currently, the site is improved with an existing building and an asphalt-paved surface parking lot with associated entrance drives. The parking lot is located east of the on-site building. Other features at the site include storm drainage, concrete curbs, trees and landscaping. Township Hall Road, which borders the facility to the south and extends between Six Mile Road and Winchester Drive, is the primary access roadway to the facility. The existing asphalt pavement in the parking lot area generally exhibits flat to sloping grades. Residential developments are located to the east and northwest of the subject site, with commercial developments to the south beyond Township Hall Road. An open grassy field is located to the north of the on-site parking lot. Elevation within the investigated areas at the site generally ranges from about 841 feet near its northwest corner to about 811 feet near the southeast corner. Utilities are known to be present beneath the site but were not encountered during this investigation.

Present plans call for pavement improvements at the site. The improvements may consist of rehabilitation involving crush and shape or new pavement construction with associated new curbs and concrete slab areas. We anticipate the traffic mix using the new pavement will consist of passenger vehicles, police cars and occasional heavy duty garbage trucks and snowplows during winter.

3.0 FIELD EXPLORATION

Geotechnical field exploration for the project was conducted on June 10, 2016. Existing pavement conditions within proposed improvement areas at the site were explored by completing a total of 12 exploratory pavement cores. In addition, at each of the pavement core locations, a soil boring was performed to a depth of 5 feet below existing grade. The core/boring numbers are designated as SB-1 through SB-12 with the approximate locations shown on the Pavement Core/Soil Boring Location Plan, Figure No. 2 of the Appendix. The pavement cores and soil borings were performed under the full-time technical observation of our field engineering representative. The exploratory core/boring locations were marked in the field by our representative using unsophisticated methods, and therefore, are considered approximate. The site ground surface elevations at the as-drilled pavement core/boring locations were estimated based on topographic survey drawing provided by Spicer Group and should be considered approximate.

The pavement cores were performed by our coring subcontractor (FMG). Existing asphalt pavement surface at each location was cored using a 6-inch diameter diamond-tipped core barrel to allow for more accurate measurement of asphalt thickness. The collected asphalt pavement cores were visually examined in the field for composition, material thickness and overall general condition. A photographic summary of the pavement cores, with thickness measurements and general condition is included as Figure No. 16 in the Appendix.

Soil borings (SB-1 to SB-12) were performed by our subcontractor DLZ/American Drilling under the full-time technical observation of a field engineer with our firm. The soil borings were drilled using a truck-mounted CME 75 drilling rig. Continuous flight, hollow-stem augers having an inside diameter of 2¼ inches were used to advance the borings to the explored depth. Soil samples were obtained in the borings typically at intervals of 2½ feet. In general, the samples were obtained using a 1⅜-inch inside-diameter split-barrel sampler and the Standard Penetration Test (SPT) method (ASTM D 1586), described on the attached General Notes, Figure No. 3.

It is noted that an unknown obstruction was encountered at an approximate depth of 3 feet during drilling at the originally marked location of SB-7. As such, this boring was offset about 10 feet from the original location, profile drilled to 3½ feet, followed by regular SPT sampling to the bottom of the boring.

Soil samples obtained from the borings were classified in the field by our representative, sealed in containers and transported to our office for further examination. We will retain these samples for a period of 60 days after the date of this report. At that time, we will dispose of the samples unless we are otherwise instructed.

Upon the completion of drilling and sampling operations, and following subsequent groundwater observations, all borings were backfilled using excavated materials and pavement surface repaired with asphalt cold patch.

4.0 GENERAL PAVEMENT AND SUBSURFACE CONDITIONS

We have evaluated the soil and groundwater conditions encountered in the borings and have presented these conditions in the form of individual Logs of Soil Boring, Figure Nos. 4 through 15 of the Appendix. In addition to subsoil stratification, the logs present observed groundwater levels, sampling information and other pertinent data. General Notes defining the nomenclature used on the logs and within the text of this report are presented on Figure No. 3. We have prepared the boring logs on the basis of visual field classification.

The stratification indicated on the boring logs represents the subsurface conditions at the actual explored locations. Variations in subsurface conditions may occur between these locations. In addition, the stratigraphic lines represent the approximate boundary between material types. The transition from one material type to another may be gradual than indicated.

Existing Pavement Conditions:

The results of our field investigation indicate that existing pavement at the explored locations (SB-1 to SB-12) generally consists of asphaltic materials of variable thickness. Observations regarding thickness, composition and general condition of the individual pavement cores are appended to this report in the form of Pavement Core Photo Summary, Figure No. 16. The thickness of existing asphalt pavement layer observed at each cored location is tabulated below:

Soil Boring Number	Asphalt Layer Thickness (Inches)	Soil Boring Number	Asphalt Layer Thickness (Inches)
SB-1	5¼	SB-7	5
SB-2	5	SB-8	4½
SB-3	3¾	SB-9	4
SB-4	3½	SB-10	3¼
SB-5	6	SB-11	6
SB-6	5	SB-12	4¼

Based upon visual observations of the investigated areas and cores obtained, the existing asphalt pavement at the site generally appears to be in poor to fair condition. The pavement surface showed various types of distresses including weathering, fatigue cracks, longitudinal and transverse cracks, and occasional potholes. Underlying the asphaltic materials, a layer of gravelly sand fill base with an average thickness of slightly over 3½ inches was observed at all cored locations. No aggregate base course layer was observed at the locations explored.

Subsoil Conditions and Evaluations

Underlying the asphalt paving, a base layer of gravelly sand fill was encountered at all boring locations (SB-1 to SB-12). Beyond asphalt and base layer sand fill materials, eight of the boring locations (SB-4, SB-6 to SB-12) encountered additional existing fill deposits to depths ranging from 2 feet to explored depth of the borings. SB-8 through SB-11 encountered fill materials to their explored depth (5 feet). The exact depth and lateral extent of fill materials at the site should be expected to vary between the boring locations. The existing fills consist of cohesive and granular materials with occasional root fibers and concrete fragments. The cohesive fills consist of brown sandy clay, brown to dark brown silty clay and gray to dark gray silty clay. The granular fills consist of brown to dark brown sand, gray to dark gray clayey sand, brown silty sand and brown or gray gravelly sand. SPT values (or N-values) for granular fills ranged from 9 to 25 blows per foot (bpf) indicative of loose to medium dense conditions.

Underlying the existing fill soils at SB-1, SB-2, SB-4 and SB-12, native granular soils consisting of brown sand were encountered to the explored depth (5 feet) of these borings. Underlying the existing fill soils at borings SB-3 and SB-5, native silty clay soils of medium to stiff consistency underlain by brown sand soils were encountered to the explored depth of 5 feet within these borings. Native brown silty clay soils of very stiff to hard consistency were encountered below the fill soils at boring locations SB-6 and SB-7 to their explored depth. The N-values for native granular soils where encountered within the borings ranged from 7 to 19 bpf, indicative of loose to medium dense conditions.

We consider the existing fill materials and native soils to be suitable for the direct support of new pavements provided some settlement can be tolerated and suitable site conditioning measures including in-place compaction, proof-rolling and/or other techniques are used in accordance with the procedures outlined in the Site Preparation section of this report.

5.0 GROUNDWATER CONDITIONS AND CONTROL

Groundwater level observations were made at each boring location during and immediately upon completion of borings. Groundwater was encountered during drilling at an approximate depth of about 5 feet within boring SB-12. Dry conditions were observed during drilling in the remaining eleven borings. Likewise, dry conditions were observed within all borings upon completion. Fluctuations in the groundwater levels should be anticipated with seasonal variations and following periods of heavy or prolonged precipitation. Therefore, the actual hydrostatic water levels or the presence of perched groundwater, if any, should be anticipated to fluctuate depending on variations in precipitation, surface runoff, infiltration, site topography, local irrigation and drainage. Static groundwater levels including fluctuations in groundwater levels can only be determined through observations made in cased boreholes or observation wells over a prolonged period of time. The installation of cased boreholes was beyond the scope of the current exploration.

Based on the available groundwater level information, we generally do not anticipate significant groundwater-related problems to be encountered in relatively shallow construction excavations, such as those anticipated for this project. However, depending upon the required depth of excavations, the locations of perched or wet bearing granular strata and the amount of precipitation prior to and during construction, some minor amounts of groundwater infiltration can be expected to be encountered within construction excavations. In addition, we recommend that proper grades be maintained throughout construction in order to provide for rapid runoff of precipitation to reduce water ponding and the potential for water infiltration. We anticipate that accumulations of surface water runoff or groundwater seepage can be controlled by pumping from sumps formed at the base of the excavations. A layer of crushed concrete or coarse aggregate may be used to stabilize any unstable or wet soils (if present) at the bottom of excavations. The contractor should be prepared to provide adequate dewatering and erosion control measures during construction capable of maintaining dry and stable excavations.

6.0 SITE PREPARATION

Although specific information regarding final grades is not presently available, we anticipate that finish grades will be relatively close to the existing grades. Regardless of the amount of earthwork required to achieve design grades, we recommend that all earthwork operations be performed under adequate specifications and be properly observed and controlled in the field. In general, all site grading activities and pavement rehabilitation or reconstruction should be performed in accordance with project specifications, unless noted otherwise in this report.

For purposes of full pavement reconstruction, all areas that will support new pavements or engineered fill should be properly prepared. Prior to starting earthwork operations in areas where improvements will consist of new pavement construction, the existing asphalt pavement, surface debris and/or any other unsuitable materials should be removed from these areas and disposed of outside the construction limits. All existing utility lines should be protected or relocated and/or removed outside of the proposed construction areas as deemed appropriate. Any utilities to be left in the construction areas should be evaluated for their effect on the proposed project and vice versa. All existing backfill around utilities should be checked for compaction and suitability to meet the project requirements and improved, if necessary.

Following completion of clearing and general site grading operations, the surface should be rough graded to facilitate drainage and to accommodate the proposed pavement section. The subgrade resulting from the removal of existing pavement, upper fill materials and/or any unsuitable soils is expected to consist of granular or cohesive fill materials based on soil borings completed for this investigation. All areas of exposed subgrade soils should be evaluated for stability before placement of any engineered fill, base course or the new pavement section.

After rough grade is established, the exposed granular areas of subgrade should be thoroughly proof-compacted (compacted in-place) using a medium weight, smooth drum vibratory roller making a minimum of ten passes in each of the two perpendicular directions, where practical. Proof-compaction is intended to densify near surface loose granular soils or granular soils that have been disturbed by site clearing and grading operations, thereby improving their load supporting capability. If the operation of the vibratory roller is observed to decrease the stability of the subgrade by drawing water towards the subgrade surface, vibration should be discontinued and the roller should be operated in the static mode. The use of a plate compactor or hoe-pak may be more practical than use of a vibratory roller in areas with limited space available for equipment performing proof-compaction. Any areas that exhibit excessive movement during proof-compaction should be re-compacted, undercut and replaced with engineered fill or improved by using other methods depending on the site conditions at the time of construction. If undercutting is used, the undercut should be to a minimum depth of 12 inches and the resulting excavation properly backfilled with compacted granular fill materials such as Michigan Department of Transportation (MDOT) Class II or 21AA or as dictated by field conditions.

In addition to proof-compacting operation, in areas, where the exposed subgrade consists of cohesive soils, the subgrade should be thoroughly proof-rolled using a heavy rubber-tired vehicle such as loaded dump truck or scraper. Areas of subgrade that exhibit excessive pumping or rutting during the proof-rolling operation should be stabilized by aeration, drying and re-compaction, if weather conditions are favorable, or by removal of the yielding soils and their replacement with compacted engineered fill. In the event, the subgrade becomes unstable, the subgrade may be undercut an additional 12 inches, then a one-foot layer of 1-inch by 3-inch crushed concrete or stone can be placed atop a woven geotextile, such as Mirafi 500X to stabilize the subgrade.

Following completion of proof-compaction or proof-rolling activities within areas receiving new pavements and provided the subgrade is satisfactory, it is recommended that the pavement layers be placed as soon as possible to avoid disturbance to the finished subgrade. Any further disturbance to the subgrade prior to placement of pavement layers should be corrected appropriately by re-compacting and/or repairing of the disturbed areas in order to minimize the risk for premature failure of the new pavement.

Care should be exercised during grading and any fill placement operations at the site. The traffic of heavy equipment, including heavy compaction equipment, may create pumping and general deterioration of the on-site subgrade soils, and in particular the clayey soils (these soil are expected to be sensitive to softening when wet or when disturbed by construction traffic), if excess surface water is present due to ponding or freeze-thaw cycles. We recommend that the site grading be performed so as to provide for rapid runoff of precipitation to reduce the potential for water infiltration. The grading, if at all possible, should be performed during a dry season.

The contractor should exercise discretion when selecting equipment sizes and should control surface runoff while the subgrade soils are exposed. In any event, positive surface drainage should be established as soon as possible. Additionally, it is recommended that the contractor avoid trafficking the construction areas with heavy trucks. Rather, transported materials should be unloaded away from the construction areas and pushed where needed with lightweight equipment. Therefore, depending on weather conditions and the type of equipment and construction procedures used, surface instability may develop in parts of the site. If this occurs, the in-place stabilization and/or undercutting procedures outlined above would again become necessary.

Excavations near existing structures, pavements and below grade utilities that are to remain should be performed with special care so as not to undermine these facilities. Provisions for temporary cribbing and bracing or earth support of the exposed soil should be made as appropriate, preserving the integrity of existing facilities. Wherever, old construction materials, such as concrete slabs or pads, rubble, etc. are encountered, they should be removed to a depth of at least 18 inches below the final subgrade elevation; any slabs or pads encountered below this depth should be thoroughly broken up prior to the placement of new engineered fill to allow for passage of water.

Material for backfill or engineered fill required to achieve design grades should preferably consist of free-draining and well-graded non-organic granular soils, such as soil meeting the requirements of MDOT Class II granular material. However, the on-site soils that are non-expansive, free of organic matter including pulverized asphalt can also be used for engineered fill, provided that they are placed under favorable weather conditions to control moisture and pending evaluation by a qualified representative of the geotechnical engineer to verify their suitability for use as engineered fill. The gradation of pulverized material should be tested during construction to conform that the material meets the gradation required for MDOT 21AA aggregate base. We recommend that the grading contractor have equipment on site during earthwork operations for both drying and wetting fill soils. We do not anticipate significant problems in controlling moistures within the fill during dry weather, but moisture control may be difficult during winter months or extended periods of rain.

Engineered fill should be placed in uniform horizontal lifts, in thickness compatible with the type and condition of material being placed, area of placement and type of compaction equipment being used. In general, we recommend that lifts not exceed 12 inches (unless noted otherwise in the report) in loose thickness. It is recommended that engineered fills supporting pavements be compacted to achieve at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction test (ASTM D 1557). Other types of compaction equipment may require reducing or allowing increased lift thickness in order to achieve suitable compaction. In confined areas, portable and lightweight compaction equipment and thinner lifts may be required

to achieve the specified degree of compaction. All fill materials should be placed and compacted at or near optimum moisture content. In-situ density tests should be performed to verify that proper compaction is achieved. Should, the results of the in-situ tests indicate that specified compaction limits are not obtained, the areas represented by such tests should be reworked and retested as required until the specified limits are reached. All fill materials should be placed and compacted at or near the optimum moisture content. Frozen materials should not be used as fill, nor should any fill be placed on a frozen subgrade.

7.0 PAVEMENT DESIGN RECOMMENDATIONS

The subgrade resulting from satisfactory completion of site preparation activities is expected to be suitable for the support of flexible (asphalt) and rigid (concrete) pavements. We anticipate the subgrade soils at the site to consist of granular or cohesive fill soils and native granular and cohesive soils. According to the Unified Soil Classification System (USCS), these soil types can be classified as SP, SM, CL and SC. While the granular soils consisting of sand are generally expected to have acceptable drainage characteristics and are slightly susceptible to frost penetration, the silty sands, sands of finer grain size and cohesive soils consisting of clay tend to have poor to fair drainage characteristics and are susceptible to frost penetration. Additionally, silty and fine-grained sands and clay soils are subject to deformation and tend to become unstable under repeated loads and such conditions are significantly aggravated by the presence of poor subsoil drainage. Following proper subgrade preparation recommended in Section 6 above and considering the effects of seasonal moisture changes and temperature variations, an effective California Bearing Ratio (CBR) on the order of 4 should be achieved for the subgrade soils encountered at the site. For design purposes, a soil resilient modulus value of 3,500 pounds per square inch (psi) may be assigned to the site subgrade soils.

The existing asphalt pavement thicknesses observed at the investigated locations ranged from about 3¼ to 6 inches with an estimated average thickness of slightly over 4½ inches. The existing pavement at the site is considered to be in fair to poor condition and lacks a distinct aggregate base. The soil directly underlying the existing pavement is gravelly sand fill and is not considered a standard aggregate base. Based on the data developed during the field investigation and our understanding of the project and traffic information provided for the site, we have developed pavement cross sections using AASHTO guidelines for the following full or partial re-construction types of rehabilitation options. Although, the preferred full re-construction option may initially appear to be cost prohibitive when compared to partial re-construction, the full re-construction is expected to provide the longest term fix and most effective rehabilitation approach.

Option 1 – Full Re-construction

If a service life of 20 years is desired for the new pavement areas, we would recommend that the existing pavement be removed in its entirety and replaced with a new pavement section. The full re-construction will consist of placement of a new natural limestone aggregate base course and Hot Mix Asphalt (HMA) section. Removal of the existing pavement may be performed by general excavation, pulverizing in-place followed by excavation.

Where unstable or failed subgrade is apparent after removal of existing pavement, the subgrade should be undercut at least 12 inches. The areas should be backfilled with MDOT 21AA crushed limestone aggregate base. Alternatively, these areas could be backfilled with pulverized asphalt material. Backfill for undercut areas or other excavations should be placed in uniform layers not more than 8 inches in loose thickness, and compacted to at least 95 percent of the maximum dry density as determined by the Modified Proctor Compaction test (ASTM D 1557).

After the site preparation operations are complete, the new HMA pavement section may consist of the following cross section for a 20-year design life.

HMA Section – Parking Lot/Drives/Entry Areas
1.5 inches of MDOT 13A HMA Wearing Course over
2.5 inches of MDOT 13A HMA Leveling Course over
8 inches of compacted MDOT 21AA Dense-Graded Aggregate Base

Option 2 – Partial Re-construction with Pulverized Asphalt Base

We have also examined an alternative pavement rehabilitation option involving use of pulverized asphalt pavement to serve as the base course, with a lesser pavement life expectancy on the order of 10 years than full reconstruction option. The partial re-construction option involves performing full-depth pulverization of the existing pavement, grading and shaping the pulverized material as base course for new pavement, proof-compacting pulverized base, installing supplemental aggregate base course materials as necessary to achieve plan grade or cross section, and installing new a HMA section. This option provides the necessary structural support and is considered more cost-effective since the pulverized materials will be used in place of conventional natural aggregate base; however, pulverized materials are expected to have less favorable drainage characteristics.

It is noted that if pulverizing, grading and placement of new HMA pavement is offered as an alternate, this work is dependent on site grades and site features being able to accommodate raising of the pavement grade that results from the re-use of pulverized materials. In areas where vertical tolerances are tight, suitable site grading, material removals or other procedures will be required to accommodate the proposed pavement section. For the pulverization method, the

existing pavement materials may be stockpiled on-site and re-used as undercut backfill material, as appropriate.

Where unstable or failed subgrade is apparent after removal of existing pavement, the subgrade should be undercut at least 12 inches. The areas should be backfilled with MDOT 21AA crushed limestone aggregate base. Alternatively, these areas could be backfilled with pulverized asphalt grindings meeting the grading requirements for MDOT 21AA. Backfill for any undercut areas or excavations should be placed in uniform layers not more than 8 inches in loose thickness, and compacted to at least 95 percent of the maximum dry density as determined by the Modified Proctor Compaction test (ASTM D 1557). Further, where the thickness of the pulverized asphalt is not sufficient, the balance of the base could consist of MDOT 21AA aggregate materials. After grading and compaction of the pulverized materials, a seal coat should be applied to the compacted pulverized surface prior to placement of the new HMA layers. After the above operations are complete, the new pavement may consist of the following pavement cross section for a 10-year design life.

HMA Section (Using Pulverized Asphalt)
2 inches of MDOT 13A HMA Wearing Course over
2.5 inches of MDOT 13A HMA Leveling Course over
6 inches of compacted Pulverized Asphalt Base mixed with subgrade soils

At garbage dumpster pads or other truck loading areas, the pavement will be subject to heavy concentrated wheel loads. This frequently results in rutting of asphalt pavements and ultimately in failure. Therefore, we recommend that an air-entrained Portland cement concrete pavement of at least 8 inches in thickness underlain by minimum 6 inches of MDOT 21 AA dense-graded aggregate base be used in these areas, with the concrete pavement constructed for supporting the concentrated wheel loads from garbage or other heavily loaded delivery trucks servicing such locations. A modulus of subgrade reaction value of 100 pounds per cubic inch (pci) may be used for the design of concrete pavements constructed on existing fill or engineered fill at the site and provided the site subgrade conditioning recommendations outlined in the Site Preparation section of this report are followed. For concrete pavements, concrete should have a minimum 28-day flexural strength of 650 pounds per square inch (psi) and a compressive strength of 3,500 psi or greater. Concrete placement, joint sawing, curing and joint sealing should be in accordance with the project specifications.

It is noted that the above pavement cross-sections have been prepared in absence of any real time data on traffic counts, volume or frequency of vehicles, etc. Traffic loading used in our analysis was estimated based on the general traffic information provided to us and our experience with similar types of facilities. We believe that the above sections will be sufficient for the applications anticipated at the facility. If additional information regarding traffic or other data

become available or are developed, please contact us so that we may review our assumptions and revise the provided pavement sections, as necessary.

All pavement and base materials are described in the MDOT 2012 Standard Specifications for Construction. The HMA materials are specified in Section 501, with Portland cement concrete pavement materials specified in Section 601. The aggregate materials for base course are specified in Section 902. The pulverization of existing asphalt pavement (crushing and shaping) is described in Section 305 of the standard specifications.

General Pavement Considerations

Design for drainage is of the utmost importance to minimize detrimental effects that may shorten the serviceable life of the new pavement. Final elevations in the new pavement areas should be designed to provide positive surface drainage. The pavement should be crowned or sloped in order to promote surface drainage and prevent water ponding. We recommend that a minimum slope of 1.5 percent and preferably 2 percent be provided to achieve these drainage measures. In addition, the subgrade should be similarly sloped to provide effective subsurface drainage. We recommend that stub or finger sub-drains be provided around catch basins and in other low lying areas of the pavement to minimize accumulation of water above and within the frost susceptible subgrade soils. The stub drains should be at least 20 feet long and extend in three to four perpendicular directions from each catch basin. Consideration should be given to installing edge sub-drains beneath pavement structure adjacent to landscaping areas and along curbs since such areas can become a source of water infiltration into the pavement; the drains should be connected to nearby catch basins. Edge drains should also be used at pavement edges and along the edges of entry or perimeter drives and tied into drainage structures. Edge and stub drains should be protected with filter fabric and drainage aggregates to prevent the migration of soil fines into the drains.

For constructability purposes, the pavement design should be the same section throughout the areas receiving new pavement. The subgrade should be excavated deep enough to accommodate the placement of the recommended pavement section. For new HMA pavement, performance grade asphalt cement should be used in the production of all HMA mixtures. A bond coat of emulsion should be required between the HMA courses and applied in a uniform manner over the surface. HMA mixtures should not be placed in the rain or when moisture on the surface to be paved will prevent satisfactory paving. Each HMA lift should be compacted to no less than 97 percent of the maximum density as determined by the Marshall Method (50 blows). Reclaimed Asphalt Pavement (RAP) should not be used in the wearing course. The project documents should reflect the actual HMA placement specifications to be used for construction, which may supersede the above guidelines.

Construction traffic should be kept to a minimum on the new HMA pavement. If construction traffic is expected on the pavement structure, a higher initial lift thickness could be used and placement of final lift could be delayed until the majority of the construction activities are complete. This approach will help to repair any localized failures, if they occur, as well as reduce potential damage from the load on the new paving. Areas of damaged courses should be repaired prior to the placement of any upper layer courses.

At entry driveway approaches and intersections, localized pavement reconstruction will likely be needed in order to maintain pavement grades throughout the approaches and the intersections. This could be accomplished by over excavating into subgrade soils the approximate thickness of the new pavement section for maintaining grades.

If partial re-construction option is chosen, prior to pulverizing the existing asphalt pavement in place, the design team should verify to assess if the vibrations and impact resulting from the process will damage any existing infrastructure such as utilities and nearby buildings. The existing pavement may be pulverized uniformly using crush and shape methods and the resulting base course of pulverized material shaped and graded into the new design cross section. The seasonal limitations for preparing the pulverized base should be specified in the project documents. Where the pulverized thickness is not sufficient to attain plan grade or cross section, the balance of the base could consist of supplemental aggregate meeting MDOT 21AA grading requirements. Crushed concrete is also considered suitable for use as supplemental material. It is recommended that unit pricing provision for surplus pulverized material, removed and property of the contractor be included in the contractor's proposal. If undercuts or export of materials is not desired, the site grades will need to be increased. Extending and mixing a few inches of pulverized material into existing sand fill base and/or subgrade soils will help to provide a more stabilized base for the new HMA section. As mentioned earlier, it is noted that the construction of pulverization option is dependent on site grades and site features being able to accommodate raising pavement grade that could result from the use of pulverized asphalt materials.

All construction techniques should conform to the most recent local, county and state standard specifications as appropriate. The pavement recommendations presented above are intended to provide a serviceable pavement for an extended period of time. However, it should be recognized that all pavements require regular maintenance and occasional repairs to keep the pavements in serviceable condition. The need for such maintenance and repairs is not necessarily indicative of premature pavement failure. If appropriate maintenance and repairs are not performed in a timely manner, the serviceable life of the pavement could be substantially reduced.

8.0 TEMPORARY EXCAVATIONS

Any excavations greater than 4 feet should be properly sloped or otherwise structurally retained to provide stable and safe working conditions. In areas where there is inadequate space to allow for proper side slopes for trenches and other excavations, vertical walls with properly designed and installed lateral bracing, or a combination of slopes and braced vertical walls may be used. Temporary excavations under dry weather conditions may be sloped at 1½ (H): 1(V) or flatter. Flatter slopes may be required if clean and/or loose granular soils or groundwater seepage is encountered along the slope face. Steeper cuts may be utilized for excavations less than 4 feet deep depending on the strength and homogeneity of the soils observed in the field.

In all cases, Michigan Department of Labor and Regulatory Affairs (LARA) requirements, i.e., the Michigan Occupational Safety and Health Act (known as MIOSHA) and related regulations, as well as any additional local regulations or owner requirements, must be followed and adequate protection provided for workers, underground utilities and adjacent structures. In no case should the un-braced slope height, slope inclination, or the un-braced excavation depth (including utility trench excavation depth) exceed those specified in local, state and federal safety regulations. The contractor is solely responsible for designing and constructing stable, temporary excavations and must sheet, shore, slope, or bench the sides of the excavations as necessary to maintain stability of both excavation sides and bottom. The contractor's proposed excavations, support systems and sequence of construction should be reviewed by an experienced Michigan-licensed professional engineer prior to allowing the contractor to commence work.

Construction traffic and excavated material stockpiles should be kept away from excavations a minimum distance equal to the full depth of the excavation, unless the resulting surcharge loads are accounted for in the design of the lateral bracing system. In addition, the effect of existing structures or other nearby facilities should also be considered in the design of the bracing system. During wet weather, surface runoff water should be prevented from entering the excavation, and collected and disposed of outside the construction limits. To prevent runoff from adjacent areas from entering the excavation, a perimeter berm may be constructed at the top of the slope. Un-braced excavations may experience some minor localized instability (such as sloughing). To reduce potential sloughing, excavated slopes should be covered with plastic sheeting for protection from rain and moisture changes.

9.0 DATA REVIEW AND FIELD VERIFICATION

We should be provided the opportunity to review geotechnical portions of the final plans and specifications. The purpose of the review will be to verify that the intent of recommendations presented in our report have been correctly interpreted and included in the design of the project.

Experience indicates that actual subsurface conditions may vary from those generalized on the basis of pavement cores/soil borings made at specific locations. Therefore, it is recommended that a qualified firm be retained to provide observation and testing services during the site preparation and construction phases of the proposed project. This is to confirm that expected subsurface conditions are present and to observe compliance with the design concepts, specifications and recommendations. Also, field verification allows appropriate design or construction changes to be made in a timely manner if subsurface conditions differ from those anticipated prior to the start of construction.

10.0 LIMITATIONS

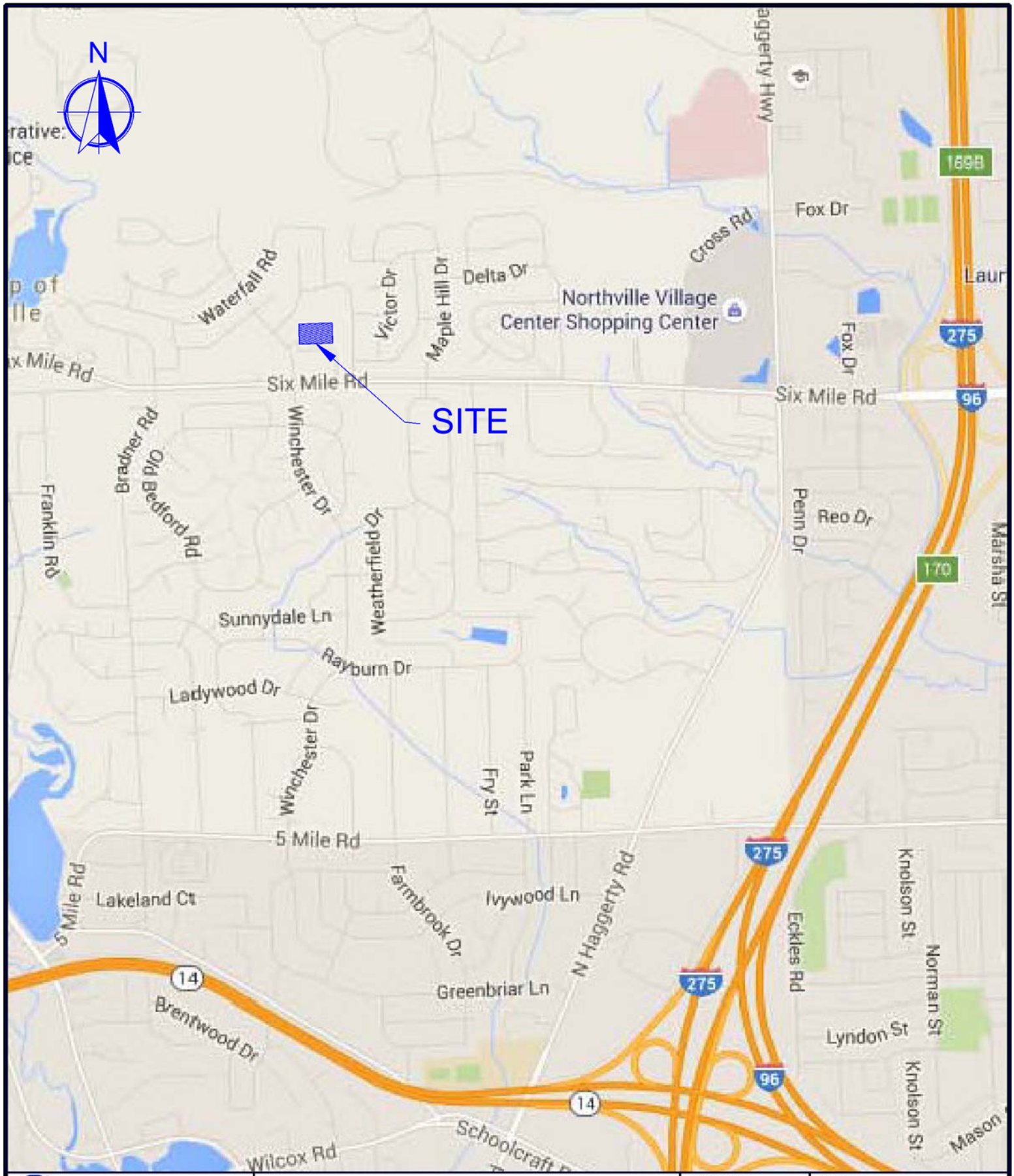
This report is intended for specific use in the design and construction of the proposed pavement improvements at the site of the Northville Police Department facility in Northville Township, Wayne County, Michigan, as described in this report. Our work was performed in accordance with the prevailing standard of practice in this area, at the time the work was performed. No other warranty or representation, expressed or implied, is included or intended in this report.

Our evaluations and recommendations for this project were developed utilizing subsurface information from the exploratory pavement cores/soil borings completed at the site. At this time, we would like to note that these field explorations only depict the pavement and soil conditions at the specific locations and time at which they were made. The conditions at other locations on the site may vary from those occurring at the locations that we have explored to date. If significant variations are exposed during construction, they should be brought to our attention as it may become necessary for us to re-evaluate the recommendations of this report.

This report reflects our opinion as of this date, based on the results of the study described herein and on the information provided during the course of the study. The results of this study may not be relied upon by entities other than Spicer Group design team and the project owner without the prior knowledge and written consent of GeoTran. The scope of the current investigation was limited to evaluation of subsurface conditions for the support of pavements and other related aspects of the proposed improvements. No hydrologic, chemical or environmental testing or analyses were performed as part of this geotechnical exploration.

GeoTran
Consultants, LLC

Appendix



GeoTran Consultants, LLC
GEOTECHNCIAL ENGINEERING AND CONSULTING SERVICES
10315 E. GRAND RIVER SUITE 201 BRIGHTON, MI 48116
PHONE: 810-229-6805
FAX: 810-229-6561
WWW.GEOTRANCONSULTANTS.COM

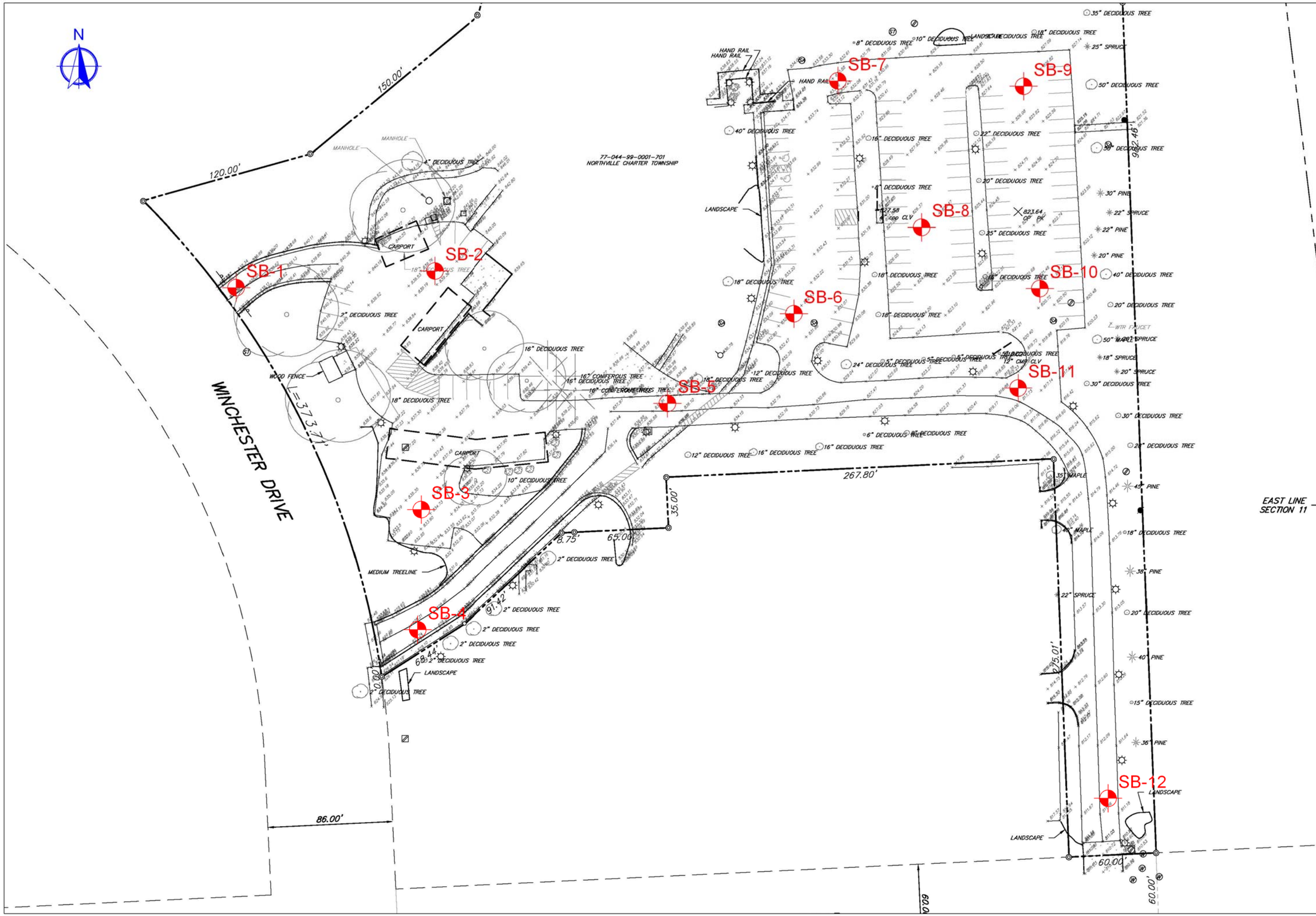
SITE LOCATION MAP

NORTHVILLE TOWNSHIP POLICE DEPARTMENT

PAVEMENT IMPROVEMENTS

NORTHVILLE TOWNSHIP, MICHIGAN

PROJECT NO.: 16-05003G-10	FILE NAME: 16-05003G-10_001.DWG	
DRAWN BY: D. YIP	DATE: 6/17/2016	FIGURE NO.: 1
REVIEWED BY: M. LUCKHAM	DATE 6/20/2016	
SCALE: NOT TO SCALE	SHEET NO.: 1 OF 1	



GeoTran Consultants, LLC

GEOTECHNICAL ENGINEERING AND CONSULTING SERVICES

10315 E. GRAND RIVER, SUITE 201
BRIGHTON, MICHIGAN 48116

PHONE: (810)-229-6805
FAX: (810)-229-6561

WWW.GEOTRANCONSULTANTS.COM

PAVEMENT CORE/ SOIL BORING LOCATION PLAN
NORTHVILLE TOWNSHIP POLICE DEPARTMENT
PAVEMENT IMPROVEMENTS
NORTHVILLE TOWNSHIP, MICHIGAN

LEGEND:

SB-1 PAVEMENT CORE/SOIL BORING LOCATION

SOIL BORINGS WERE PERFORMED BY DLZ/AMERICAN DRILLING ON JUNE 10, 2016 UNDER THE OBSERVATION OF GEOTRAN CONSULTANTS, LLC.

PAVEMENT CORES WERE PERFORMED BY FMG.

DRAWING REFERENCE:
BASE PLAN PROVIDED BY SPICER GROUP, INC.

PROJECT NO.:	16-05003G-10
DRAWN BY:	D. YIP
DATE:	06-17-2016
REVIEWED BY:	M. LUCKHAM
DATE:	06-18-2016
FILE:	16-05003G-10-002.dwg
SCALE:	1 IN = 300 FT
FIGURE NO.:	2

SHEET 1 OF 1

GeoTran Consultants, LLC

GENERAL NOTES

TERMINOLOGY

Unless otherwise noted, all terms utilized herein refer to the Standard Definitions presented in ASTM D 653.

SAMPLE DESIGNATIONS

AS - Auger Sample - directly from auger flight
BS - Miscellaneous Sample - bottle or bag
SS - Split Spoon Sample - ASTM D 1586
LS - Split Spoon Sample S with Liner Insert 3 inches in length
ST - Shelby Tube Sample - 3 inch diameter unless otherwise noted
PS - Piston Sample - 3 inch diameter unless otherwise noted
RC - Rock Core - NX core unless otherwise noted
CS - Continuous Sample - from rock core barrel or Continuous sampling device
VS - Vane Shear
HA - Hand Auger Sample
PID - Photo Ionizataion Detector

PARTICLE SIZES

Boulders - Greater than 12 inches (305mm)
Cobbles - 3 inches (76.2mm) to 12 inches (305mm)
Gravel - Coarse - 3/4 inches (19.05 mm) to 3 inches (76.2mm)
Fine - No. 4 - 3/16 inches (4.75mm) to 3/4 inches (19.05 mm)
Sand - Coarse - No. 10 (2.00mm) to No. 4 (4.75mm)
Medium - No. 40 (0.425mm) to No. 10 (2.00mm)
Fine - No. 200 (0.074mm) to No. 40 (0.425mm)

CLASSIFICATION

The major soil constituent is the principal noun, i.e., clay, silt, sand, gravel. The second major soil constituent and other minor constituents are reported as follows:

Second Major Constituent (percent by weight)	Minor Constituent (percent by weight)
Trace - 1 to 12%	Trace - 1 to 12%
Adjective - 12 to 35% (clayey, silty, etc.)	Little - 12 to 23%
And - Over 35%	Some - 23 to 33%

COHESIVE SOILS

Consistency	Unconfined Compressive Strength (psf)	Approximate Range of (N)
Very Soft	Below 500	0 - 2
Soft	500 - 1000	3 - 4
Medium	1000 - 2000	5 - 8
Stiff	2000 - 4000	9 - 15
Very Stiff	4000 - 8000	16 - 30
Hard	8000 - 16000	31 - 50
Very Hard	Over 16000	Over 50

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

COHESIONLESS SOILS

Density Classification	Relative Density %	Approximate Range of (N)
Very Loose	0 - 15	0 - 4
Loose	16 - 35	5 - 10
Medium Dense	36 - 65	11 - 30
Dense	66 - 85	31 - 50
Very Dense	86 - 100	Over 50

Relative density of cohesionless soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modified; i.e., silty clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils; i.e., silty clay, trace of sand, little gravel.

DEPOSITIONAL FEATURES

Parting - as much as 1/16 inch thick
Seam - 1/16 inch to 1/2 inch thick
Layer - 1/2 inch to 12 inches thick
Stratum - greater than 12 inches thick
Pocket - small, erratic deposit of limited lateral extent
Lens - lenticular deposit
Varved - alternating seams or layers of silt and/or clay and sometimes fine sand
Occassional - one or less per foot of thickness
Frequent - more than one per foot of thickness
Interbedded - applied to strata of soil or beds of rock lying between or alternating with other strata of different nature

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0" outside-diameter, 1-3/8" inside-diameter, split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).

LOG OF SOIL BORING NO.: SB-1

GeoTran Consultants, LLC

Project Name: Northville Township Police Department Pavement Improvements

Project Location: Northville Township, Michigan

Project Number: 16-05003G-10

Client: Spicer Group, Inc.

Date: 6/10/2016

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 838 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Loss on Ignition (%)
838								0						
							PAVEMENT: ASPHALT (5-1/4") 837.6	0.4						
							BASE: Brown GRAVELLY SAND 837.3	0.7						
837								1						
							Medium Dense Brown SAND with Trace of Gravel							
836							836.0	2						
	SS-1	15	6 7 8	15				2.0						
835								3						
							Medium Dense Brown SAND with Trace to Little Gravel and Trace of Silt							
834								4						
833	SS-2	18	8 9 9	18			833.0	5						
							End of Boring at 5.0 ft.	5.0						
832														

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 5 ft

Drilling Contractor: DLZ/American Drilling

Driller: M. Schmidt

Drilling Method:
CME 75 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials and pavement repaired with cold patch.

Groundwater Levels:

At Time of Drilling: Dry

End of Drilling: Dry

Notes:

Logged By: M. Luckham **Reviewed By:** D. Yip

Figure No.: 4

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 6/23/16 11:06 - E:\GEOTRAN GOOGLE DRIVE\GEOTRAN -MAIN\PROPOSALS_PROJECTS\2016\16-05003G_NV POLICE STATION\REPORT\RID\16-05003G-10.GPJ

LOG OF SOIL BORING NO.: SB-2

GeoTran Consultants, LLC

Project Name: Northville Township Police Department Pavement Improvements

Project Location: Northville Township, Michigan

Project Number: 16-05003G-10

Client: Spicer Group, Inc.

Date: 6/10/2016

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 839.5 ft ±	DEPTH (ft) 0	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Loss on Ignition (%)
							PAVEMENT: ASPHALT (5")							
839							839.1 / 0.4							
							BASE: Brown GRAVELLY SAND							
							838.7 / 0.8	1						
838								2						
837	SS-1	10	5 5 9	14										
							Loose to Medium Dense Brown SAND with Trace of Clay and Silt	3						
836								4						
835														
	SS-2	15	5 5 4	9			834.5	5						
834							End of Boring at 5.0 ft. / 5.0							

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 5 ft

Drilling Contractor: DLZ/American Drilling

Driller: M. Schmidt

Drilling Method:
CME 75 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials and pavement repaired with cold patch.

Groundwater Levels:

At Time of Drilling: Dry

End of Drilling: Dry

Notes:

Logged By: M. Luckham **Reviewed By:** D. Yip

Figure No.: 5

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 6/23/16 11:06 - E:\GEOTRAN GOOGLE DRIVE\GEOTRAN -MAIN\PROPOSALS_PROJECTS\2016\16-05003G_NV POLICE STATION\REPORT\RID\16-05003G-10.GPJ

LOG OF SOIL BORING NO.: SB-3

GeoTran Consultants, LLC

Project Name: Northville Township Police Department Pavement Improvements

Project Location: Northville Township, Michigan

Project Number: 16-05003G-10

Client: Spicer Group, Inc.

Date: 6/10/2016

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 835 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Loss on Ignition (%)
835								0						
							PAVEMENT: ASPHALT (3-3/4") 834.7	0.3						
							BASE: Brown GRAVELLY SAND 834.4	0.6						
834								1						
833							Medium to Stiff Brown SILTY CLAY with Trace to Little Sand	2						
	SS-1	8	3 2 3	5	2000									
832							832.0	3						
								3.0						
831							Loose Brown SAND with Trace of Silt and Gravel	4						
830	SS-2	15	3 4 5	9			830.0	5						
							End of Boring at 5.0 ft.	5.0						
829														

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 5 ft

Drilling Contractor: DLZ/American Drilling

Driller: M. Schmidt

Drilling Method:
CME 75 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials and pavement repaired with cold patch.

Groundwater Levels:

At Time of Drilling: Dry

End of Drilling: Dry

Notes:

Logged By: M. Luckham **Reviewed By:** D. Yip

Figure No.: 6

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 6/23/16 11:06 - E:\GEOTRAN GOOGLE DRIVE\GEOTRAN -MAIN\PROPOSALS_PROJECTS\2016\16-05003G_NV POLICE STATION\REPORT\RID\16-05003G-10.GPJ

LOG OF SOIL BORING NO.: SB-4

GeoTran Consultants, LLC

Project Name: Northville Township Police Department Pavement Improvements

Project Location: Northville Township, Michigan

Project Number: 16-05003G-10

Client: Spicer Group, Inc.

Date: 6/10/2016

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 828 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Loss on Ignition (%)
828								0						
							PAVEMENT: ASPHALT (3-1/2") 827.7							
							BASE: Brown GRAVELLY SAND 827.5	0.3						
								0.5						
827								1						
826							FILL: Stiff Brown SANDY CLAY with Trace of Silt and Gravel	2						
	SS-1	8	5 5 5	10										
825							825.0	3						
								3.0						
824							FILL: Loose Brown SAND with Trace of Silt and Occasional Pockets of Clay	4						
823	SS-2	18	3 3 4	7			823.0	5						
							End of Boring at 5.0 ft.	5.0						
822														

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 5 ft

Drilling Contractor: DLZ/American Drilling

Driller: M. Schmidt

Drilling Method:
CME 75 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials and pavement repaired with cold patch.

Groundwater Levels:

At Time of Drilling: Dry

End of Drilling: Dry

Notes:

Logged By: M. Luckham **Reviewed By:** D. Yip

Figure No.: 7

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 6/23/16 11:06 - E:\GEOTRAN GOOGLE DRIVE\GEOTRAN -MAIN\PROPOSALS_PROJECTS\2016\16-05003G_NV POLICE STATION\REPORT\RID\16-05003G-10.GPJ

LOG OF SOIL BORING NO.: SB-5

GeoTran Consultants, LLC

Project Name: Northville Township Police Department Pavement Improvements

Project Location: Northville Township, Michigan

Project Number: 16-05003G-10

Client: Spicer Group, Inc.

Date: 6/10/2016

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 837 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Loss on Ignition (%)
837								0						
							PAVEMENT: ASPHALT (6")							
							836.5	0.5						
							BASE: Brown GRAVELLY SAND							
							836.2	0.8						
836								1						
835							Stiff Brown SILTY CLAY with Little SAND and partings with oxidation (orange)	2						
	SS-1	14	4 3 3	6	3000									
834							834.0	3						
								3.0						
833							Loose Brown SAND with Trace of Silt	4						
832	SS-2	12	3 5 5	10			832.0	5						
							End of Boring at 5.0 ft.	5.0						
831														

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 5 ft

Drilling Contractor: DLZ/American Drilling

Driller: M. Schmidt

Drilling Method:
CME 75 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials and pavement repaired with cold patch.

Groundwater Levels:

At Time of Drilling: Dry

End of Drilling: Dry

Notes:

Logged By: M. Luckham **Reviewed By:** D. Yip

Figure No.: 8

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 6/23/16 11:06 - E:\GEOTRAN GOOGLE DRIVE\GEOTRAN -MAIN\PROPOSALS_PROJECTS\2016\16-05003G_NV POLICE STATION\REPORT\RID\16-05003G-10.GPJ

LOG OF SOIL BORING NO.: SB-6

GeoTran Consultants, LLC

Project Name: Northville Township Police Department Pavement Improvements

Project Location: Northville Township, Michigan

Project Number: 16-05003G-10

Client: Spicer Group, Inc.

Date: 6/10/2016

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 832 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Loss on Ignition (%)
832								0						
							PAVEMENT: ASPHALT (5")							
							831.6	0.4						
							BASE: Brown GRAVELLY SAND							
							831.3	0.7						
831								1						
							FILL: Loose Brown SAND with Trace of Silt and Gravel							
830							830.0	2.0						
	SS-1	10	5 5 3	8			FILL: Very Stiff Gray and Dark Gray SILTY CLAY with Little Sand, Trace of Root Fibers and Black Streaks							
829							829.0	3.0						
828							Hard Brown SILTY CLAY with Trace of Sand and Gravel	4						
827	SS-2	12	3 6 7	13	8500		827.0	5.0						
							End of Boring at 5.0 ft.							
826														

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 5 ft

Drilling Contractor: DLZ/American Drilling

Driller: M. Schmidt

Drilling Method:
CME 75 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials and pavement repaired with cold patch.

Groundwater Levels:

At Time of Drilling: Dry

End of Drilling: Dry

Notes:

Logged By: M. Luckham **Reviewed By:** D. Yip

Figure No.: 9

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 6/23/16 11:06 - E:\GEOTRAN GOOGLE DRIVE\GEOTRAN -MAIN\PROPOSALS_PROJECTS\2016\16-05003G_NV POLICE STATION\REPORT\RID\16-05003G-10.GPJ

LOG OF SOIL BORING NO.: SB-7

GeoTran Consultants, LLC

Project Name: Northville Township Police Department Pavement Improvements

Project Location: Northville Township, Michigan

Project Number: 16-05003G-10

Client: Spicer Group, Inc.

Date: 6/10/2016

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 832.5 ft ±	DEPTH (ft) 0	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Loss on Ignition (%)
							PAVEMENT: ASPHALT (5") 832.1	0.4						
832							BASE: Brown GRAVELLY SAND 831.8	0.7						
							FILL: Dark Gray SILTY CLAY with Little Sand	1						
831														
							830.5	2						
830	SS-1	12	3 5 5	10	>9000		Very Stiff to Hard Brown and Gray SILTY CLAY with Trace of Sand and Gravel 2.0							
								3						
829														
								4						
828														
	SS-2	12	3 4 5	9	7000		827.5	5						
827							End of Boring at 5.0 ft. 5.0							

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 5 ft

Drilling Contractor: DLZ/American Drilling

Driller: M. Schmidt

Drilling Method:
CME 75 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials and pavement repaired with cold patch.

Groundwater Levels:

At Time of Drilling: Dry

End of Drilling: Dry

Notes:

Logged By: M. Luckham **Reviewed By:** D. Yip

Figure No.: 10

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 6/23/16 11:06 - E:\GEOTRAN GOOGLE DRIVE\GEOTRAN -MAIN\PROPOSALS_PROJECTS\2016\16-05003G_NV POLICE STATION\REPORT\RID\16-05003G-10.GPJ

LOG OF SOIL BORING NO.: SB-8

GeoTran Consultants, LLC

Project Name: Northville Township Police Department Pavement Improvements

Project Location: Northville Township, Michigan

Project Number: 16-05003G-10

Client: Spicer Group, Inc.

Date: 6/10/2016

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 826 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Loss on Ignition (%)
826								0						
							PAVEMENT: ASPHALT (4-1/2") 825.7	0.3						
							BASE: Brown GRAVELLY SAND 825.4	0.6						
825								1						
							FILL: Hard Brown and Gray SILTY CLAY with Trace of Sand 824.0	2.0						
824								2						
	SS-1	15	6 5 4	9										
823								3						
							FILL: Loose Gray CLAYEY SAND with Root Fibers and Black Streaks 821.5	4.5						
822								4						
							FILL: Very Stiff Dark Gray SILTY CLAY with Trace of Sand and Root Fibers 821.0	5.0						
821	SS-2	12	2 3 3	6				5						
							End of Boring at 5.0 ft.							
820														

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 5 ft

Drilling Contractor: DLZ/American Drilling

Driller: M. Schmidt

Drilling Method:
CME 75 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials and pavement repaired with cold patch.

Groundwater Levels:

At Time of Drilling: Dry

End of Drilling: Dry

Notes:

Logged By: M. Luckham **Reviewed By:** D. Yip

Figure No.: 11

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 6/23/16 11:06 - E:\GEOTRAN GOOGLE DRIVE\GEOTRAN -MAIN\PROPOSALS_PROJECTS\2016\16-05003G_NV POLICE STATION\REPORT\RID\16-05003G-10.GPJ

LOG OF SOIL BORING NO.: SB-9

GeoTran Consultants, LLC

Project Name: Northville Township Police Department Pavement Improvements

Project Location: Northville Township, Michigan

Project Number: 16-05003G-10

Client: Spicer Group, Inc.

Date: 6/10/2016

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 826 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Loss on Ignition (%)
826								0						
							PAVEMENT: ASPHALT (4") 825.7							
							BASE: Brown GRAVELLY SAND 825.4	0.3						
825							FILL: Loose Brown and Dark Brown SAND with Trace of Clay and Silt 824.0	0.6 / 1						
824								2						
	SS-1	12	6 6 4	10			FILL: Very Stiff Dark Brown SILTY CLAY with Trace of Sand 823.0	2.0						
823								3						
822							FILL: Loose Dark Gray CLAYEY SAND with Trace of Silt and Root Fibers 821.0	3.0 / 4						
821	SS-2	12	2 3 6	9				5						
820							End of Boring at 5.0 ft.	5.0						

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 5 ft

Drilling Contractor: DLZ/American Drilling

Driller: M. Schmidt

Drilling Method:
CME 75 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials and pavement repaired with cold patch.

Groundwater Levels:

At Time of Drilling: Dry

End of Drilling: Dry

Notes:

Logged By: M. Luckham **Reviewed By:** D. Yip

Figure No.: 12

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 6/23/16 11:06 - E:\GEOTRAN GOOGLE DRIVE\GEOTRAN -MAIN\PROPOSALS_PROJECTS\2016\16-05003G_NV POLICE STATION\REPORT\RID\16-05003G-10.GPJ

LOG OF SOIL BORING NO.: SB-10

GeoTran Consultants, LLC

Project Name: Northville Township Police Department Pavement Improvements

Project Location: Northville Township, Michigan

Project Number: 16-05003G-10

Client: Spicer Group, Inc.

Date: 6/10/2016

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 821 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Loss on Ignition (%)
821								0						
							PAVEMENT: ASPHALT (3-1/4") 820.7	0.3						
							BASE: Brown GRAVELLY SAND 820.4	0.6						
820								1						
819							FILL: Very Stiff Dark Gray and Gray SILTY CLAY with Trace of Sand, Gravel and Root Fibers	2						
	SS-1	12	4 3 4	7										
818							818.0	3						
								3.0						
817							FILL: Loose Brown SILTY SAND with Trace of Gravel and Root Fibers	4						
816	SS-2	14	5 5 5	10			816.0	5						
							End of Boring at 5.0 ft.	5.0						
815														

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 5 ft

Drilling Contractor: DLZ/American Drilling

Driller: M. Schmidt

Drilling Method:
CME 75 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials and pavement repaired with cold patch.

Groundwater Levels:

At Time of Drilling: Dry

End of Drilling: Dry

Notes:

Logged By: M. Luckham **Reviewed By:** D. Yip

Figure No.: 13

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 6/23/16 11:06 - E:\GEOTRAN GOOGLE DRIVE\GEOTRAN -MAIN\PROPOSALS_PROJECTS\2016\16-05003G_NV POLICE STATION\REPORT\RID\16-05003G-10.GPJ

LOG OF SOIL BORING NO.: SB-11

GeoTran Consultants, LLC

Project Name: Northville Township Police Department Pavement Improvements

Project Location: Northville Township, Michigan

Project Number: 16-05003G-10

Client: Spicer Group, Inc.

Date: 6/10/2016

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 818 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Loss on Ignition (%)
818								0						
							PAVEMENT: ASPHALT (6")							
							817.5	0.5						
							BASE: Brown GRAVELLY SAND							
							817.2	0.8						
817								1						
							FILL: Medium Dense Gray GRAVELLY SAND with Trace of Gravel and Concrete Fragments							
816							816.0	2.0						
	SS-1	15	4 8 4	12			FILL: Very Stiff Dark Gray SILTY CLAY with Trace of Sand, Gravel and Root Fibers							
815							815.0	3.0						
							FILL: Stiff Brown and Gray SILTY CLAY with Little Sand							
814							813.5	4.5						
813	SS-2	15	3 3 7	10			FILL: Loose Brown CLAYEY SAND with Trace of Silt and Gravel							
							813.0	5.0						
							End of Boring at 5.0 ft.							
812														

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 5 ft

Drilling Contractor: DLZ/American Drilling

Driller: M. Schmidt

Drilling Method:
CME 75 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials and pavement repaired with cold patch.

Groundwater Levels:

At Time of Drilling: Dry

End of Drilling: Dry

Notes:

Logged By: M. Luckham **Reviewed By:** D. Yip

Figure No.: 14

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 6/23/16 11:06 - E:\GEOTRAN GOOGLE DRIVE\GEOTRAN -MAIN\PROPOSALS_PROJECTS\2016\16-05003G_NV POLICE STATION\REPORT\RID\16-05003G-10.GPJ

LOG OF SOIL BORING NO.: SB-12

GeoTran Consultants, LLC

Project Name: Northville Township Police Department Pavement Improvements

Project Location: Northville Township, Michigan

Project Number: 16-05003G-10

Client: Spicer Group, Inc.

Date: 6/10/2016

SAMPLE DATA						PROFILE DESCRIPTION			LABORATORY DATA					
ELEV. (ft)	SAMPLE TYPE/ NUMBER	REC. (in.)	BLOWS/ 6 INCHES	STD. PEN. RESIST. N-VALUE	POCKET PEN. (psf)	GRAPHIC LOG	GROUND SURFACE ELEVATION: 811.5 ft ±	DEPTH (ft)	MOIST. CONT. (%)	DRY DENSITY (pcf)	UNCONF. COMP. ST. (psf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	Loss on Ignition (%)
								0						
811							PAVEMENT: ASPHALT (4-1/4") 811.1	0.4						
							BASE: Brown GRAVELLY SAND 810.8	0.7						
810							FILL: Medium Dense Brown GRAVELLY SAND with Trace of Clay, Silt and Concrete Fragments	1, 2						
809	SS-1	16	7 10 15	25										
							808.5	3						
808							Medium Dense Brown SAND with Trace of Silt	3.0, 4						
807														
	SS-2	15	9 11 8	19			806.5	5						
806							End of Boring at 5.0 ft.	5.0						

Stratification lines represent approximate boundaries; In-situ, transition may be gradual.

Total Drilling Depth: 5 ft

Drilling Contractor: DLZ/American Drilling

Driller: M. Schmidt

Drilling Method:
CME 75 Truck Mounted Drilling Rig, Using 2-1/4-inch I.D. Hollow Stem Auger to End of Boring.

Backfill Procedure:
Borehole backfilled with excavated materials and pavement repaired with cold patch.

Groundwater Levels:

At Time of Drilling: 5 ft

End of Drilling: Dry

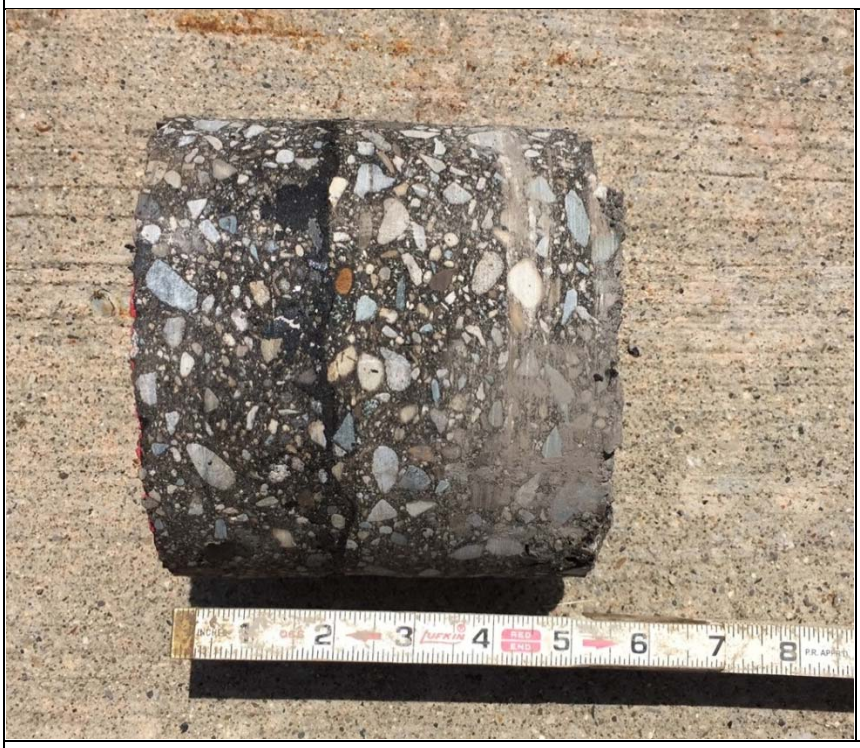
Notes:

Logged By: M. Luckham **Reviewed By:** D. Yip

Figure No.: 15

GEOTRAN LOG OF SOIL BORING - GEOTRAN STD-2012.GDT - 6/23/16 11:06 - E:\GEOTRAN GOOGLE DRIVE\GEOTRAN -MAIN\PROPOSALS_PROJECTS\2016\16-05003G_NV POLICE STATION\REPORT\RID\16-05003G-10.GPJ

PHOTOGRAPH NO. 1



Pavement Core Number:
SB-1

Approximate Ground Surface Elevation:
838 ft

Pavement Type:
Asphalt

Pavement Thickness:
5¼ inches

General Pavement Condition:
Fair

PHOTOGRAPH NO. 2

Pavement Core Number:
SB-2

Approximate Ground Surface Elevation:
839.5 ft

Pavement Type:
Asphalt

Pavement Thickness:
5 inches

General Pavement Condition:
Fair

PHOTOGRAPH NO. 3

Pavement Core Number:
SB-3

Approximate Ground Surface Elevation:
835 ft

Pavement Type:
Asphalt

Pavement Thickness:
3¾ inches

General Pavement Condition:
Fair

PHOTOGRAPH NO. 4

Pavement Core Number:
SB-4

Approximate Ground Surface Elevation:
828 ft

Pavement Type:
Asphalt

Pavement Thickness:
3½ inches

General Pavement Condition:
Fair

PHOTOGRAPH NO. 5

Pavement Core Number:
SB-5

Approximate Ground Surface Elevation:
837 ft

Pavement Type:
Asphalt

Pavement Thickness:
6 inches

General Pavement Condition:
Fair

PHOTOGRAPH NO. 6

Pavement Core Number:
SB-6

Approximate Ground Surface Elevation:
832 ft

Pavement Type:
Asphalt

Pavement Thickness:
5 inches

General Pavement Condition:
Poor

PHOTOGRAPH NO. 7

Pavement Core Number:
SB-7

Approximate Ground Surface Elevation:
832.5 ft

Pavement Type:
Asphalt

Pavement Thickness:
5 inches

General Pavement Condition:
Fair

PHOTOGRAPH NO. 8

Pavement Core Number:
SB-8

Approximate Ground Surface Elevation:
826 ft

Pavement Type:
Asphalt

Pavement Thickness:
4½ inches

General Pavement Condition:
Fair

PHOTOGRAPH NO. 9

Pavement Core Number:
SB-9

Approximate Ground Surface Elevation:
826 ft

Pavement Type:
Asphalt

Pavement Thickness:
4 inches

General Pavement Condition:
Fair

PHOTOGRAPH NO. 10

Pavement Core Number:
SB-10

Approximate Ground Surface Elevation:
821 ft

Pavement Type:
Asphalt

Pavement Thickness:
3¼ inches

General Pavement Condition:
Fair

PHOTOGRAPH NO. 11

Pavement Core Number:
SB-11

Approximate Ground Surface Elevation:
818 ft

Pavement Type:
Asphalt

Pavement Thickness:
6 inches

General Pavement Condition:
Fair

PHOTOGRAPH NO. 12

Pavement Core Number:
SB-12

Approximate Ground Surface Elevation:
811.5 ft

Pavement Type:
Asphalt

Pavement Thickness:
4¼ inches

General Pavement Condition:
Fair