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March 30, 2007

Via Facsimile

Ms. Karen Anderson
Kling Stubbins
2301 Chestnut Street
Philadelphia, PA 19103-3035

RE: Project No. 5992.GB
Geotechnical Evaluation
Proposed Dover Transit Center
Dover, Delaware

Dear Ms. Anderson:

Duffield Associates, Inc. (Duffield Associates) has completed our Geotechnical Evaluation for the proposed Dover Transit Center. Enclosed are three (3) copies of our report summarizing the subsurface conditions observed at the site and providing recommendations for the design and construction of the proposed multi-modal transit center. These services were provided in general accordance with our agreement dated October 5, 2006 (authorized to proceed with drilling field work on January 29, 2007).

We appreciate this opportunity to be of continued service to Kling Stubbins. Should you have any questions concerning this evaluation, please do not hesitate to contact us.

Very truly yours,

DUFFIELD ASSOCIATES, INC.

Dawn M. Appelbaum, P.E.
Geotechnical Engineer

Stacy B. Ziegler, P.E.
Senior Geotechnical Engineer

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Enclosure: Geotechnical Report (3 bound copies)

DUFFIELD ASSOCIATES

GEOTECHNICAL EVALUATION
PROPOSED DOVER TRANSIT CENTER

DOVER, DELWARE

March 2007

Prepared for:

Kling Stubbins
2301 Chestnut Street
Philadelphia, Pennsylvania 19103-3035

Prepared by:

Duffield Associates, Inc.
Consultants in the Geosciences
5400 Limestone Road
Wilmington, Delaware 19808-1232

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Project No. 5992.GB

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EXECUTIVE SUMMARY

This report summarizes Duffield Associates, Inc.'s (Duffield Associates) geotechnical evaluation for the proposed multi-modal transit center to be constructed in Dover, Delaware. The proposed development consists of an approximately 1,800-square foot single-story structure, as well as bus stalls, canopied areas, paved parking areas, and a stormwater management area. No information regarding the proposed final grades or anticipated structural loads were provided at the time of this evaluation. Therefore, it was assumed that minor regrading (i.e., cuts/fills of 3 feet or less) will be required to achieve the finished grades. Additionally, maximum column of 50 kips and maximum wall loads of 3 kips/foot were assumed for the proposed structure. It was also assumed that the single-story structure is to be steel-framed. Currently, the site of the proposed Dover Transit Center is gently sloped, with existing grades ranging from approximately elevation 26 feet in the northwest corner to approximately elevation 23 feet in the southeast corner of the site (project datum, NGVD 1929). It is understood that the site was previously used as a storage yard for George & Lynch, Inc., a sitework contractor. The ground surface is generally covered with stone or topsoil; however, several bituminous concrete paved areas and concrete slabs were observed at the ground surface throughout the site. Additionally, several residential structures (which were occupied at the time of this evaluation) are located near the northwestern corner of the project site. It is understood that these residential structures will be demolished as part of the proposed site development.

Three (3) Standard Penetration Test borings, extending to depths of approximately 30 feet below the ground surface, were performed in the vicinity of the proposed building and stormwater management area. Additionally, ten (10) test pits, extending to depths ranging from approximately 3¾ to 11½ feet below the existing ground surface, were performed in the proposed roadway and parking areas. Beneath a surficial layer of topsoil, stone, or bituminous concrete, the subsurface conditions observed at the site can generally be described as loose to dense, silty sands. A layer of medium consistency silty clay, ranging in thickness from approximately 2½ to 5 feet, was observed in two of the test borings a depth of approximately 13 feet below the existing ground surface. A layer of miscellaneous fill material, ranging in thickness between approximately 3 and 6 feet, was encountered in one test boring and several test pits and was observed to consist of soil mixed with construction debris (i.e., bituminous concrete, brick, charred wood, metal and millings). Additionally, an approximately 4-foot thick surficial layer of bituminous concrete and a buried concrete slab were encountered within or adjacent to the proposed building footprint. Groundwater was encountered during the performance of the field program at depths ranging from approximately 6 to 10 feet below the ground surface, corresponding to elevations ranging from approximately 16 to 22 feet (NGVD 1929). Groundwater mapping by the Delaware Geologic Survey (DGS) indicates groundwater levels ranging from approximate elevation 15 to 20 feet, based on the 1964 mapping.

Based on the observed subsurface conditions and assumed building loads, it is Duffield Associates' opinion that the proposed single-story structure could be supported on a shallow foundation system and slab-on-grade. A maximum net allowable bearing pressure of 3,000 pounds per square foot is recommended for the design of foundations founded on the natural site soils. Total settlement is estimated to be on the order of 1 inch and post-construction differential settlement is estimated to be less than ½ inch. Building foundations should be supported on the natural site soils (described herein as Strata C, D and E). The surface stratum of bituminous concrete, stone, topsoil, and miscellaneous fill soils (Strata A-1, A-2, A-3, and B) are not considered suitable for supporting a shallow foundation system and should be removed where encountered from beneath the proposed building foundations and slab.

Due to the previous use of the site, the presence of miscellaneous debris and remnants of structures should be anticipated at the site, and construction budgets should include a contingency for addressing these conditions.

More detailed conclusions and recommendations for design and construction of the foundations, floor slabs, stormwater management area, and pavements for the proposed site are provided in the following report.

I. INTRODUCTION

This report summarizes Duffield Associates, Inc.'s (Duffield Associates) geotechnical evaluation for the proposed Dover Transit Center to be constructed in Dover, Delaware. Included in this report is a summary of the data obtained during field and laboratory testing programs and a discussion of the subsequent geotechnical analysis. Recommendations for the design and construction of the proposed building foundations, slab, stormwater management features, and site pavements are also provided. These services were performed in general accordance with an agreement between Duffield Associates and Kling Stubbins, dated October 5, 2006 (authorized to proceed with drilling fieldwork on January 29, 2007).

To assist with this evaluation, Duffield Associates has been provided with the following:

- A Request for Proposal (RFP) from the Delaware Department of Transportation (DelDOT) dated June 21, 2006, which included a project description, scope of services, design parameters, and a conceptual site plan (5 pages);

- A conceptual sketch titled "Dover Transit Center, Dover, Delaware, Scheme F," as prepared by Kling Stubbins, dated January 31, 2007; and

- A drawing titled "Topographic Survey for property known as Dover Transit Center, Water & Queen Street, Lands Now or Formerly of the State of Delaware," as prepared by Merestone Consultants, Inc., dated November 2, 2006.

Based on this information and discussions with your office, it is understood that it is proposed to construct a multi-modal transit center consisting of an approximately 1,800-square foot single-story structure, as well as bus stalls, canopied areas, paved parking areas, and a stormwater management area. No information regarding the proposed final grades or anticipated structural loads were provided at the time of this evaluation. Therefore, it was assumed that minor regrading (i.e., cuts/fills of 3 feet or less) will be required to achieve the finished grades. Additionally, maximum column of 50 kips and maximum wall loads of 3 kips/foot were assumed for this evaluation. It was also assumed that the single-story structure is to be steel-framed.

The approximate 5-acre site is located in Dover, Delaware and is bounded to the north by Water Street, to the east by Queen Street, to the west by West Street, and to the south by a commercial property, as indicated on the site location map included in Appendix A of this report. Currently, the site of the proposed Dover Transit Center is gently sloped, with existing grades ranging from approximately elevation 26 feet in the northwest corner to approximately elevation 23 feet in the southeast corner of the site (project datum, NGVD 1929). It is understood that the site was previously used as a storage yard for George & Lynch, Inc., a sitework contractor. The ground surface is generally covered with stone or topsoil; however, several bituminous concrete paved areas and concrete slabs were observed at the ground surface throughout the site. Additionally, several residential structures (which were occupied at the time of this evaluation) are located in the northwestern corner of the project site. It is understood that these residential structures will be demolished as part of the proposed site development.

No utilities were delineated within the proposed building footprint or project site by Miss Utility. Several utilities were delineated around the perimeter of the site, including water, sanitary sewer and stormwater. Overhead utility lines were also noted on the perimeter of the site.

II. FIELD AND LABORATORY TESTING PROGRAMS

A. STANDARD PENETRATION TEST BORINGS

Three (3) Standard Penetration Test borings (performed in general accordance with ASTM D 1586), designated as TB-1 through TB-3 and extending to depths of approximately 30 feet below the ground surface, were performed at the site on March 8, 2007. Two of the test borings (TB-1 and TB-2) were located within the footprint of the proposed single-story structure and the third test boring (TB-3) was located within the proposed stormwater management area. The approximate locations of test borings are indicated on the location sketch included in Appendix A of this report. The test boring locations were approximated in the field using existing site features by a representative of Duffield Associates and corresponding ground surface elevations were estimated from topographic information provided.

The test borings were performed by Feldmann Brothers, Inc. of Newark, Delaware, as a subcontractor to Duffield Associates, utilizing a truck-mounted Diedrich D-50 drill rig with hollow stem augers. Duffield Associates' representative was present to review the performance of the test borings. Test boring logs, which describe the conditions observed during the field exploration program, are included in Appendix B of this report. The boreholes were backfilled with the soil cuttings after completion of the drilling. Excess soil was mounded above each boring location to compensate for potential future settlement of the boring backfill. However, additional settlement and softening of the soil replaced in the boreholes may occur, resulting in a depression or hole in the ground surface. Consequently, future maintenance and restoration of the site may be required.

B. BACKHOE EXCAVATED TEST PITS

Ten (10) backhoe-excavated test pits were performed at the site on March 9, 2007. The test pits were extended to depths ranging from approximately 3¾ to 11½ feet below the existing ground surface. The approximate test pit locations are indicated on the location section included in Appendix A of this report. Ground surface elevations at the test pit locations were estimated from the topographic information provided.

The test pits were performed using a CASE 590L rubber-tired backhoe and operator provided by Feldmann Brothers, Inc. as a subcontractor to Duffield Associates. Duffield Associates' representative was present during the performance of the test pits. Logs describing conditions observed are included in Appendix B of this report. At completion of the test pits, the pits were backfilled with the excavated material and leveled off with the surrounding grades. No additional compactive effort or site restoration was performed. Further restoration of the test pit locations was beyond the scope of services performed for this geotechnical evaluation.

C. LABORATORY TESTING

Following completion of the field program, soil samples were returned to Duffield Associates' laboratory for testing of selected samples. The laboratory testing program for this evaluation included the determination of natural water content (ASTM D 2216), and silt/clay content (percent finer than a No. 200 sieve, ASTM D 1140) for a total of 8 soil samples obtained during the field evaluation. The results of these laboratory tests are included on the test boring logs included in Appendix B of this report.

No environmental characterization of the site soils was performed for this evaluation. It is understood that an environmental site assessment was previously performed by others.

III. SUBSURFACE CONDITIONS

A. GENERALIZED SITE GEOLOGY

Regional mapping by Delaware Geologic Survey (DGS) indicates the project site to be located within the Coastal Plain Physiographic Province. Regional geologic mapping by DGS indicates that the formations in the vicinity of the project site consist of two major geologic units, the Pleistocene Age Columbia Formation, and the underlying Miocene Age Calvert Formation. The Columbia Formation typically consists of gravelly, fine to medium sands with some interbedded silts and clays. The underlying Calvert Formation consists of predominantly sandy silt to medium to coarse grained sand soils, some of which function as confined aquifers. Based on DGS mapping, the depth to bedrock in the general area of the site is estimated to be on the order of 1,000 feet.

B. STRATIGRAPHIC CONDITIONS

Beneath a surficial layer of topsoil, stone, or bituminous concrete, the subsurface conditions observed at the site can generally be described as loose to dense, silty sands. The surficial layer of bituminous concrete encountered at the ground surface in test boring TB-2, located in the southeast portion of the site and the southern portion of the proposed building area, was observed to be approximately 4 feet thick. Additionally, a concrete slab, approximately 9 inches thick, was encountered below the surficial stone layer during the excavation of test pit TP-10, located adjacent to the northern portion of the proposed building area.

A layer of medium consistency silty clay, ranging in thickness from approximately 2½ to 5 feet, was observed in test borings TB-1 and TB-2 at a depth of approximately 13 feet below the existing ground surface.

A layer of miscellaneous fill material, ranging in thickness between approximately 3 and 6 feet, was encountered in test boring TB-3, and in test pits TP-3, TP-7, and TP-8 and was observed to consist of soil mixed with construction debris (bituminous concrete, brick, charred wood, metal and millings). Test pit TP-3, located in the southeast corner of the site, terminated at approximately 3¾ feet below the existing ground surface due to refusal on apparent bituminous concrete and milling debris. A petroleum odor was observed in soil samples collected during the performance of test borings TB-2 and TB-3 and test pit TP-4 at depths ranging from approximately 1 to 7 feet below the existing ground surface.

For discussion purposes, subsurface conditions encountered can be further described as follows:

SUBSURFACE STRATUM	APPROXIMATE THICKNESS (FT.)	GENERALIZED DESCRIPTION[1]
A-1[2]	1 – 4	Bituminous Concrete
A-2[3]	½ – 1 ½	Stone
A-3[4]	1	Topsoil
B[5]	3 – 6	APPARENT FILL: Dark gray/black SILT, little to some fine sand, trace coarse sand, trace gravel, trace organics OR black, dark brown, gray fine SAND, little silt, trace to little gravel, trace to little debris (wood, metal, bituminous concrete, brick, millings) trace organics (dry) (petroleum odor observed) USCS: ML, SM
C	4 –13½	Brown, orange fine to medium SAND, trace to little silt, trace gravel, trace coarse sand, trace clay, trace mica (dry to wet) USCS: SM, SP-SM
D[6]	2½ – 5	Light gray, black CLAY, little silt, trace fine sand (dry) USCS: CL
E	-- [7]	Orange, gray fine SAND, trace to some coarse sand, trace to some silt/clay, trace to little gravel (wet) USCS: SM

NOTES:
1. The soil descriptions utilized herein and on the test boring logs are defined in the General Notes within Appendix C.
2. Stratum A-1 only observed in TB-2 and TP-1.
3. Stratum A-2 only observed in TP-2, TP-3, TP-4, TP-6, TP-8, and TP-10.
4. Stratum A-3 only encountered in TP-5.
5. Stratum B only observed in TB-3, TP-3, TP-7, and TP-8. Stratum B not fully penetrated in TP-3 at 3.7 feet below existing ground surface.
6. Stratum D only observed in TB-1 and TB-2.
7. Stratum F not fully penetrated in the test borings or test pits.

Groundwater was observed during the performance of the test borings in the proposed building area at depths ranging from approximately 6 to 8.5 feet below the existing ground surface, corresponding to elevations ranging from approximately 17.5 to 22 feet (project datum). In the proposed stormwater management area, groundwater was encountered at a depth of approximately 8 feet below the existing ground surface, corresponding to an elevation of approximately 18 feet (project datum). Groundwater was encountered during the performance of test pits in the proposed loop road alignment at depths ranging from approximately 9 and 10 feet below the existing ground surface, corresponding to elevations ranging from approximately 16 to 16.5 feet (project datum). A summary of the groundwater elevations observed during the field program is provided in the table below.

TB /TP No.	Depth (ft) (below existing ground surface)	Approximate Groundwater Elevation (ft) (NVGD 1929)
TB-1	6	22
TB-2	8.5	17.5
TB-3	8	18
TP-4	9	16
TP-6	9	16
TP-9	10	16.5

Groundwater was not observed in test pits TP-1, TP-2, TP-3, TP-5, TP-7 and TP-8, which were terminated at depths ranging from approximately 3¾ and 11 feet below the ground surface.

The groundwater levels observed at the site are consistent with Duffield Associates' previous experience in the general vicinity of the site and with published groundwater data for the area. Groundwater mapping by DGS indicates groundwater levels ranging from approximate elevation 15 to 20 feet, based on the 1964 mapping. Due to seasonal and annual variations in precipitation, groundwater fluctuations on the order of 3 to 5 feet may be observed.

IV. DISCUSSION OF ANALYSIS

A. BUILDING FOUNDATIONS AND SLAB-ON-GRADE

Based on the subsurface data obtained during this evaluation, it is Duffield Associates' opinion that the "natural" site soils (described herein as Strata C, D and E), encountered beneath the surficial layers of bituminous concrete, stone, topsoil, and miscellaneous fill soils (Strata A-1, A-2, A-3, and B), are generally suitable for supporting the proposed structure on a shallow foundation system and slab-on-grade. Structural fill, placed and compacted over "natural," undisturbed soils as recommended in this report, is also considered suitable for supporting a shallow foundation system. Analysis indicates that the building foundations bearing on the natural soils or on compacted structural fill could be sized for a maximum allowable bearing pressure of 3,000 pounds per square foot (psf). This analysis has assumed a shallow foundation system with a minimum width of 3 feet for isolated footings and 2 feet for continuous footings, and a minimum burial depth of 18 inches.

Miscellaneous fill soils (containing varying amounts of debris) were encountered at several locations across the site, including within the proposed building footprint. A 4-foot thick surficial layer of bituminous concrete was encountered in test boring TB-2, located in the southern portion of the proposed building area, and a concrete slab, approximately 9 inches thick, was encountered below the surficial stone layer during the excavation of test pit TP-10, located adjacent to the northern portion of the proposed building area. Other construction debris materials were also encountered in other portions of the site and, due to the previous site use, the presence of miscellaneous fill should be anticipated in other areas of the site beyond the test boring and test pit locations. Due to their unknown consistency and potential variability, miscellaneous fill materials (described herein as Stratum B) encountered within the building area are <u>not</u> considered suitable for support of shallow foundations and slab-on-grade and should be removed in their entirety and replaced with compacted structural fill.

Estimates of foundation settlement were also performed to aid in evaluating the effects of the assumed building loads on the subsurface conditions. Based on this analysis, it is estimated that maximum total foundation settlement for the proposed structure should be on the order of 1 inch or less. Due to the generally unsaturated characteristics and the presence of granular soils beneath the proposed foundations, most of the estimated settlement should occur relatively quickly following the application of loads. Post-construction settlement is estimated to be on the order of 1 inch or less, with differential settlements between typical column or wall spacings of 20 feet within the footprint of the building estimated to be ½ inch or less between adjacent columns. These magnitudes of total and differential settlement are generally considered to be within tolerable limits for steel-framed structures. However, the actual settlement tolerance of the building should be verified with the project's structural engineer. If actual loading and/or grading conditions vary significantly from the assumptions of this analysis, Duffield Associates should be contacted to review and possibly modify this analysis.

B. SITE PAVEMENTS

Final grading information was not provided at the time of this evaluation; however, it is assumed that minor regrading (i.e., net cuts/fills of 3 feet or less) will be required to achieve the finished pavement grades. Based on the test pits performed in the proposed roadway and parking areas, the subsurface conditions generally consisted of a surficial layer of bituminous concrete, stone, or topsoil overlying predominately granular soils. Miscellaneous fill materials and debris, extending to depths up to approximately 6 feet below the existing ground surface, were also encountered in some of the proposed pavement areas of the site.

The presence of the miscellaneous fill materials should be considered in the design of the site pavements. Several alternatives exist for construction of the site pavements. Typically, the least risk alternative would be to remove the miscellaneous fill materials in their entirety and replace them with structural fill. A more economic alternative for the site pavements is to construct them over the miscellaneous soil fills following preparation of the pavement subgrade as explained below. However, additional risk of uneven pavement settlement and future maintenance (i.e., pavement overlays) exists with this approach relative to complete removal and replacement of the miscellaneous fill.

To reduce the potential for differential settlement if the fill is left in place, the pavement area subgrade should be proofrolled and densified with several passes of a smooth drum roller. Large construction debris and remnants of former foundations or slab encountered in proposed pavement areas should be removed to a depth of approximately 2 feet below the pavement base, to reduce the risk of localized, abrupt differential settlement. A geotextile beneath the pavement section is also recommended to help bridge over the variable fills and reduce piping of soils into possible voids in the debris fill. If the proposed grading is such that fills are required in the pavement areas, any existing bituminous concrete could be left in place; however, it is recommended that the existing bituminous concrete be milled in-place and recompacted to allow drainage of the pavement base course.

C. STORMWATER MANAGEMENT AREA

Test boring TB-3 was performed in the general vicinity of the proposed stormwater management area. The subsurface conditions in this area was observed to consist of approximately 5 feet of fill materials with trace amounts of debris overlying predominately granular (i.e., sandy) soils with varying amounts of fine-grained soils (i.e., silt and clay). Groundwater was encountered in the test boring at a depth of approximately 8 feet below the existing ground surface (corresponding to approximate elevation 18 feet) and in nearby test pits at depths ranging from approximately 9 to 10 feet below the existing ground surface (corresponding to approximate elevation 16 feet).

At the time of this evaluation, proposed stormwater management area design information was not available; however, it is assumed that the stormwater management area may consist of a shallow, excavated pond. Depending upon the proposed basin bottom elevation, the basin could be designed as either a "wet" basin or a "dry" basin. Duffield Associates can provide further recommendations regarding the stormwater management area design once basin bottom elevations have been determined.

Based on the proposed stormwater management area location, it appears that the majority of the excavated materials for the proposed basin may consist of silty sands. These granular soils could be utilized as structural fill in the proposed building and pavement areas. However, if embankments need to be constructed as part of the stormwater management pond construction, they should be constructed in accordance with the SCS Small Pond Code 378. Import of low permeable soils (i.e., clay) will likely be required for construction of embankment core trenches.

V. CONCLUSIONS AND RECOMMENDATIONS

Based on the data obtained in the field and laboratory testing programs and the subsequent geotechnical analysis, the following conclusions and recommendations are presented.

A. DESIGN

1. **Allowable Foundation Bearing Capacity.** It is Duffield Associates' opinion that the natural site soils (described herein as Strata C, D, and E) are generally considered suitable for supporting the proposed structure on a shallow foundation system. These soils were encountered beneath the surficial layers of bituminous concrete, stone, topsoil, and miscellaneous fill soils (Strata A-1, A-2, A-3, and B). Structural fill, placed over the natural site soils, compacted and reviewed, as recommended in this report, is also considered suitable for supporting shallow building foundations. It is recommended that the proposed foundations be designed for a maximum net allowable bearing pressure of 3,000 psf.

2. **Apparent Fill Soils.** The surface stratum of bituminous concrete, stone, topsoil, and miscellaneous fill soils (Strata A-1, A-2, A-3, and B) are <u>not</u> considered suitable for support of shallow foundations or slab-on-grade and should be removed in their entirety, if encountered, beneath the building foundations or slab. A 4-foot thick layer of bituminous concrete and an existing concrete slab were encountered within or adjacent to the proposed building footprint during the field program performed for this evaluation. Other construction debris materials were encountered in other portions of the site and, due to the previous site use, the presence of miscellaneous fill should be anticipated throughout the site. It is recommended that construction budgets include a contingency for addressing these conditions. Where these materials are removed, soils containing regulated debris should be disposed of in accordance with state and federal regulations, or reused on site as fill in landscaped areas.

3. **Foundation Burial Depth and Size**. The base of all exterior spread footings in areas exposed to frost should be placed at least 32 inches below final exterior grade. Interior foundations in insulated areas should be placed at least 18 inches below the proposed finished floor elevation. If a winter construction schedule is proposed for the foundations, provisions for the protection of shallow foundations from frost heave during construction should be included in the contract specifications. All isolated column footings should be at least 3-feet wide and all continuous wall footings should be at least 2-feet wide, regardless of bearing pressure.

4. **Slab-on-Grade**. Ground-supported floor slabs should be designed as free floating and should not be connected to the structural elements (e.g., walls,

framing, etc.) of the building. Isolation joints should be utilized at the interface of proposed ground-supported floor slab and structural elements to accommodate potential differential settlement. A minimum 10 mil polyethylene vapor barrier and free draining subbase, consisting of at least 4 inches of poorly-graded crushed stone aggregate, such as AASHTO SP-57 stone, should be provided beneath all floor slabs. Subgrade conditions should be modeled for design utilizing a subgrade modulus, K_S, of 150 pci.

5. **Handling and Disposal of Miscellaneous Fill Materials.** Variable miscellaneous fill materials containing construction debris (e.g., bituminous concrete, brick, charred wood, metal and millings) were observed in the test borings and test pits performed at various locations throughout the site. Duffield Associates did not evaluate the environmental quality of the miscellaneous fill material as part of this geotechnical evaluation. The miscellaneous fill materials were observed to contain various amounts of miscellaneous debris that may be classified as regulated solid waste by the State of Delaware, Department of Natural Resources and Environmental Control (DNREC) and may require disposal at a regulated facility. Contract documents should anticipate costs associated with the removal, disposal, and replacement of these materials. If possible, the reuse of soils on site might limit characterization and disposal costs.

6. **Control Joints**. Masonry walls should be provided with frequent control joints placed at architecturally convenient locations, such as windows and doorways, to provide a "preferred" location for the differential settlement to occur without cracking the walls.

7. **Pavement Design.** The subsurface conditions in the proposed pavement area generally consisted of a surficial layer of bituminous concrete, stone, or topsoil overlying predominately granular soils. Miscellaneous fill materials and debris, extending to depths up to approximately 6 feet below the existing ground surface, were also encountered in some areas of the site. The presence of the miscellaneous fill materials should be considered in the design of the site pavements. Typically, the least risk alternative would be to remove the miscellaneous fill materials in their entirety and replace them with structural fill; however, a more economic alternative for the site pavements is to construct them over the miscellaneous soil fills following subgrade preparation.

   To reduce the potential for differential settlement over a short distance if the fill is left in place, the pavement area subgrade should be proofrolled and densified with several passes of a smooth drum roller. Large construction debris, and remnants of former foundations and slab should be removed, if encountered, to a depth of approximately 2 feet below the pavement base. A geotextile beneath the pavement section is also recommended to help bridge over the variable fills and reduce piping of soils into possible voids in the debris fill. If the proposed grading is such that fills are required in the pavement areas, any existing bituminous concrete could be left in place; however, it is recommended that the existing bituminous concrete be milled in-place and recompacted to allow drainage of the pavement base course.

Based on an anticipated traffic loading consisting primarily of passenger vehicles and buses and the subgrade conditions encountered, the following pavement sections are recommended.

Car Parking Area Pavements

1-1/2 inches	Bituminous Concrete Wearing Course, Type C
2-1/2 inches	Bituminous Concrete Binder Course, Type B
8 inches	Graded Aggregate Base Course, Type B
	Non-woven Geotextile Fabric, Geotex 601, or equivalent
12 inches	Total Depth

Roadway Pavements

2 inches	Bituminous Concrete Wearing Course, Type C
3 inches	Bituminous Concrete Binder Course, Type B
12 inches	Graded Aggregate Base Course, Type B
	Non-woven Geotextile Fabric, Geotex 601, or equivalent
17 inches	Total Depth

All pavement construction and materials should conform to the Delaware Department of Transportation Standard Specifications for Roadway and Bridge Construction, dated August 2001 and as subsequently revised.

8. **Seismic Design Parameters**. Based on subsurface conditions encountered during the field exploration at the site and review of regional geologic maps, an "S_2" soil profile type for analysis of seismic conditions, as defined by Table 1612.3.1 of the 1996 BOCA Building Code, or Site Class "D" as defined by Table 1615.1 of the 2000 International Building Code is recommended.

9. **Site Grading**. Site grading should be designed to provide positive drainage away from the proposed building site and pavement areas. Positive site drainage should be maintained throughout the construction activities.

10. **Stormwater Management Area.** Other than the location, the conceptual details regarding the proposed stormwater management area were not developed at the time of this evaluation. Assuming that the stormwater management area will include a relatively shallow excavation depth, with little or no embankments, the following recommendations are provided:

- Construct the stormwater basin in accordance with the Soil Conservation Service Small Pond Code 378 and guidelines provided by DNREC.

- Depending upon the proposed basin bottom elevation, the basin could be designed as either a "wet" basin or a "dry" basin.

- From the limited information available, it appears that the stormwater management area will consist of an "excavated" pond. However, if embankments are required, predominately fine-grained soils should be utilized for construction of the embankment core and cut-off trench due to their relatively low permeability characteristics. It will likely be required to import these soils, as clay soils were generally not observed at the site at shallow depths.

11. **Assumptions.** Due to the limited information available at the time of this evaluation, the analysis has been based on assumptions regarding design loads and finished floor elevations for the proposed structure. These assumptions should be verified by the project team prior to the completion of their design. If the proposed loading conditions vary from those assumed herein, Duffield Associates should be notified to possibly modify the recommendations provided herein, as required.

B. CONSTRUCTION

1. **Proofroll and Subgrade Preparation**. At the start of construction, the proposed building area should be cleared of bituminous concrete, stone, topsoil, and previously placed fill material. If any existing foundations or slabs are encountered, they should be removed in their entirety from the proposed building footprint. Following rough grading and prior to footing excavation, placement of fill, or construction of the floor slab, it is recommended that the exposed subgrade be proofrolled. The proofroll should be performed using a minimum 10-ton vibratory roller or a fully loaded tandem dump truck in the presence of a qualified soils technician working under the supervision of a geotechnical engineer. The purpose of the proofrolling is to densify the exposed subgrade and to identify yielding subgrade conditions. Yielding subgrade conditions encountered within the proposed building and pavement areas should be undercut to firm subgrade conditions and be backfilled in accordance with the recommendations of this report. Provisions for the undercutting and subsequent replacement of these materials should be anticipated by the construction contract documents and project budget estimates. The subgrade review should also confirm the consistency and texture of the exposed soils with the conditions encountered by this evaluation as described herein.

2. **Foundation Subgrade Review**. All foundations and slabs should be placed on firm, dry, non-frozen subgrade. Foundation excavations should be reviewed by a qualified technician working under the supervision of a geotechnical engineer who is familiar with the recommendations of this report. Subgrade review should be performed prior to the placement of reinforcing steel or concrete and should verify the presence of natural "undisturbed" soils consisting of medium or stiffer consistency silts or medium density sands. If these conditions are not encountered at the proposed foundation depth, additional excavation should be performed until they are uniformly encountered across the base of the foundation excavation, or, if acceptable to the project geotechnical engineer, densified in place. Foundation undercut areas should be backfilled with structural fill as recommended herein or, if acceptable to the project's structural engineer, the base of foundation elevation could be lowered to the suitable subgrade soils.

3. **Existing Foundations.** Based on Duffield Associates' observations during the performance of the field testing program, several residential structures are currently located in the northeast corner of the site. It is understood that these structures will be demolished as part of the site development. All foundations and debris associated with these structures or with other former structures encountered during construction should be removed in their entirety and backfilled with structural fill, placed, and compacted in accordance with the recommendations of this report.

4. **Re-use of On-Site Soils as Structural Fill.** It is assumed that only minor regrading (i.e., net cuts/fills of less than 3 feet) will be required to achieve the proposed finished floor elevation for the building. On-site soils free of organic material, debris and rock fragments in excess of 3 inches in their largest dimension may be suitable as structural fill. If sufficient quantities of suitable on-site soils are not available for structural fill, imported borrow consisting of predominately granular soils conforming to the requirements of Delaware Department of Transportation Standard Specifications Select Borrow, Type G should be utilized. AASHTO SP-57 stone could also be utilized as structural fill at locations as recommended by the project engineer, and should be considered for localized, relatively deep fills such as foundation undercuts or trenches where utilities are removed, and as a base beneath the slab.

5. **Compaction Requirements**. Structural fill utilized within the proposed building area should be placed in loose lifts with a maximum thickness of 8 inches. Each lift of fill placed within the proposed building area (defined as the area extending at least 5 feet beyond the building perimeter) should be compacted to at least 95% of the maximum dry density as determined by the Modified Proctor test (ASTM: D 1557). Structural fill for utility trenches and wall backfill located outside of the proposed building, as well as pavement area fills, should be compacted to at least 90% of the maximum dry density.

The placement and compaction of structural fill should be monitored on a full-time basis by a qualified technician under the supervision of a geotechnical engineer.

6. **Groundwater Control**. Groundwater was encountered at the site at depths ranging from approximately 6 to 10 feet below the ground surface, corresponding to elevations ranging from approximately 16 to 22 feet (project datum). Based on the subsurface conditions encountered, regional groundwater conditions should be below the depth of typical shallow foundations. However, due to the observed interlayering of texturally variable soils, it is considered possible that localized perched groundwater may be encountered at relatively shallow depths within the footing or utility excavations. If groundwater is encountered, localized sumping may be required. Wherever significant quantities of groundwater are encountered during foundation and utility trench excavations, it may become necessary for the resulting excavation to be over excavated by several inches and backfilled with AASHTO SP-57 stone to facilitate sumping and protect the exposed subgrade during construction.

7. **Protection of Subgrade Soils**. Subgrade soils disturbed by precipitation and construction traffic should be either scarified and recompacted, or undercut and replaced with structural fill as previously discussed. Subgrade disturbance could be reduced by maintaining positive surface drainage, by establishing and maintaining a sump throughout the construction period, and by limiting construction traffic on the exposed subgrade soils. Where construction traffic is required over the subgrade soils, construction of a temporary haul road, consisting of at least 8 inches of crushed stone (Delaware No. 3 Stone, "choked off" with Type A aggregate) over a geotextile fabric (e.g., Geotex 315 or equivalent) should be considered. A thicker stone section will likely be required for prolonged heavy use by trucks. Additional stone can be added later as needed.

8. **Excavation Safety**. All utility and foundation excavation should be performed in accordance with OSHA guidelines. Typically, the previously placed fill soils and the predominately granular soils can be characterized as Type C soils by OSHA CFR Part 1926 Excavation Standards. Should it be required, all temporary sheeting and shoring should be designed by a qualified engineer registered in the State of Delaware.

9. **Subsurface Data**. All contractors interested in bidding on phases of this work which involve subsurface conditions should be given full access to this report so that they can develop their own interpretations of the available data.

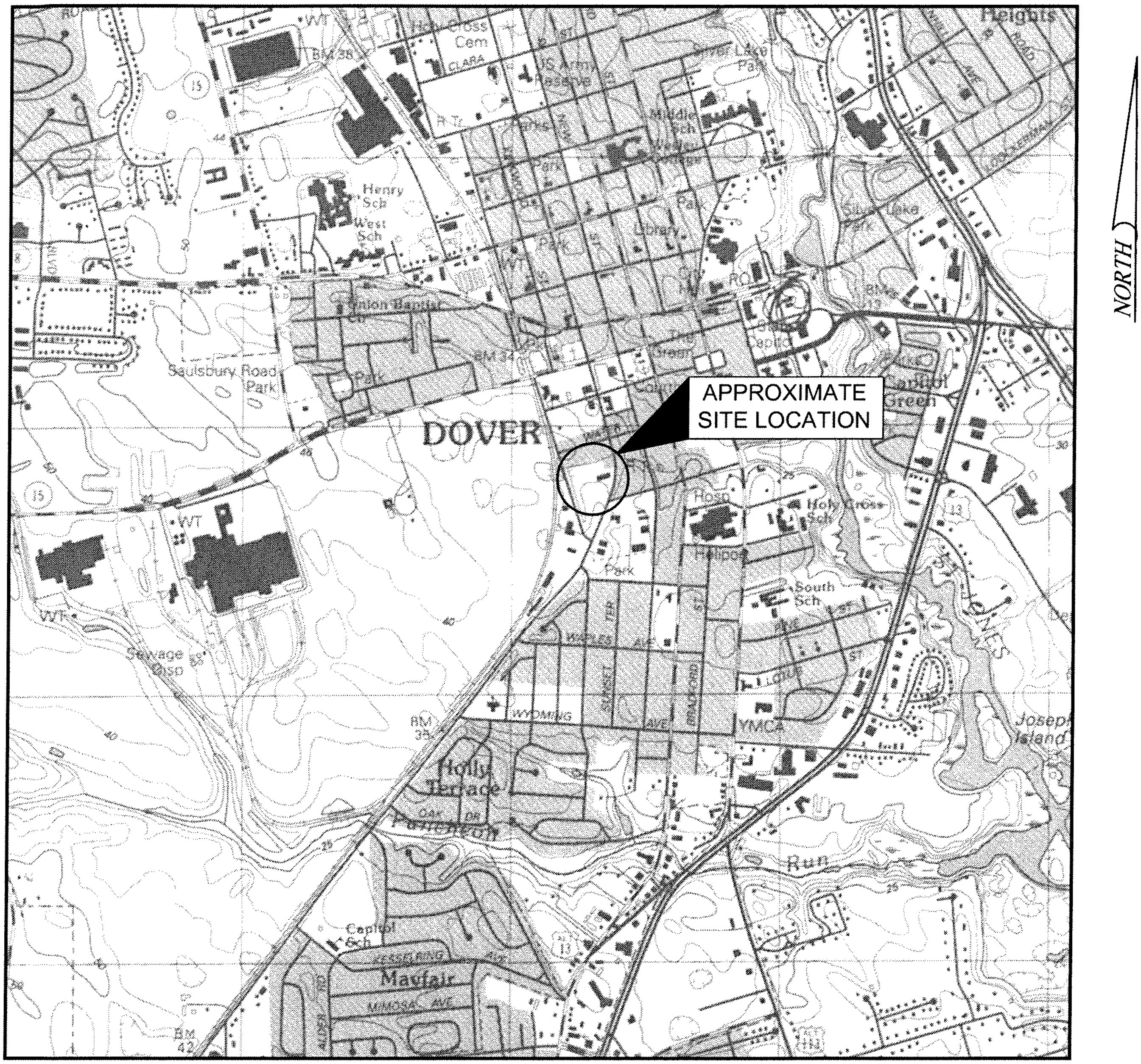
These recommendations have been prepared according to generally accepted soil and foundation engineering standards and are based on the conditions encountered by the sampling performed at the site. It is noted that, although soil quality has been inferred from the interpolation of the sampling data, subsurface conditions beyond the sampling points are, in fact, unknown. As a result, these recommendations may require modifications based on the conditions encountered and exposed during construction excavation. Should any conditions encountered during construction differ from those described in this report, this office should be notified immediately in order to review and possibly modify these recommendations. The cost for this construction review is not part of the existing agreement. This report applies solely to the size, type, and location of the building described herein. In the event that changes are proposed, this report will not be considered valid unless the changes have been reviewed and the recommendations of this report modified and reapproved in writing by Duffield Associates, Inc.

WORD\5992GB.0307-DOVERTRANSIT.RPT

APPENDIX A

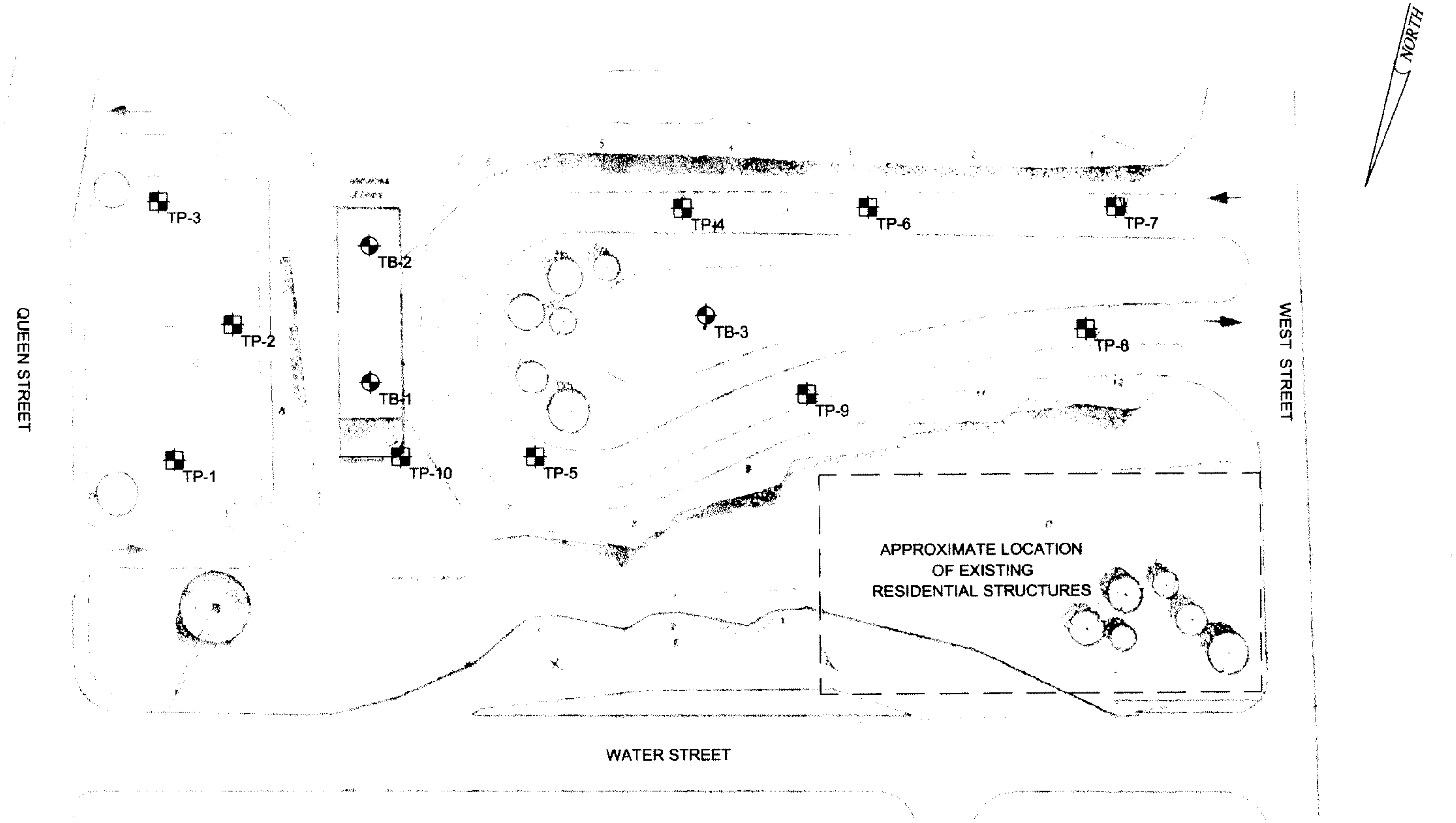
SITE LOCATION MAP

TEST BORING AND TEST PIT LOCATION SKETCH



NOTE:
THIS SITE LOCATION SKETCH IS ADAPTED FROM THE U.S.G.S. TOPOGRAPHIC MAP, 7.5 MINUTE SERIES, FOR DOVER, DELAWARE 1993.

DATE: 20 MARCH 2007	SITE LOCATION SKETCH	DESIGNED BY: KMY	DUFFIELD ASSOCIATES *Consultants in the Geosciences*
SCALE: 1"=2000'	**DOVER TRANSIT CENTER**	DRAWN BY: MCM	5400 LIMESTONE ROAD WILMINGTON, DE 19808-1232 TEL. (302)239-6634 FAX (302)239-8485
PROJECT NO. 5992.GB		CHECKED BY: DMA	OFFICES IN PHILADELPHIA, PA GEORGETOWN, DE AND STONE HARBOR, NJ
SHEET: FIGURE 1	DOVER ~ KENT COUNTY ~ DELAWARE	FILE: A-5992GB-01	E-MAIL: DUFFIELD@DUFFNET.COM



KEY:

TB-1 - APPROXIMATE TEST BORING LOCATION

TP-1 - APPROXIMATE TEST PIT LOCATION

NOTE:

THIS SKETCH IS ADAPTED FROM A DRAWING TITLED "DOVER TRANSIT CENTER," PREPARED BY DELAWARE DEPARTMENT OF TRANSPORTATION AND DATED JANUARY 31, 2007.

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AND GEORGETOWN, DE
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DESIGNED BY:	KMY
DRAWN BY:	MCM
CHECKED BY:	DMA
FILE:	A-5992GB-01

TEST BORING AND TEST PIT LOCATION SKETCH

DOVER TRANSIT CENTER

DOVER ~ KENT COUNTY ~ DELAWARE

DATE:	20 MARCH 2007
SCALE:	1"=60'
W.O. NO.	5992.GB
SHEET:	FIGURE 2

APPENDIX B

TEST BORING LOGS (3)

TEST PIT LOGS (10)

DUFFIELD ASSOCIATES

Consultants in the Geosciences

TEST BORING TB-1

Proposed Dover Tansit Center
Water and Queen Streets
Dover, DE

Date Started	: March 8, 2007	Drilling Equipment	: Truck-mounted Diedrich D-50
Date Completed	: March 8, 2007	Drilling Methods	: SPT (ASTM D1586), HSA
Logged by	: KMY	Surface Elevation	: ±28
Weather	: Sunny, 32 °F		
Driller/Agency	: Ben Feldmann/Feldmann Brothers		

Sample Condition: Remolded

Water Levels: ▼ During Drilling; ▽ At completion

Depth in feet	Layer Depth feet	USCS	DESCRIPTION	Sample Number	Blows per 6 inches	Recovery (ft)	Moisture Content (%)	Percent Passing 200 Sieve	WATER LEVEL
0		SP-SM	Light brown, orange-brown fine SAND, trace-to-little silt, trace coarse sand (dry)	S-1	2-3-4	1.2			
			Light orange, orange-brown fine SAND, trace silt, trace mica (dry)	S-2	3-4-4	1.3			
5			Light orange, orange fine-to-medium SAND, trace coarse sand, trace gravel, trace silt, trace mica (moist)	S-3	4-4-3	1.2			▽
10			Orange, light brown fine-to-medium SAND, little silt, trace gravel (wet)	S-4	2-2-2	1.3	25.9	18.9	
	11.8	CL	Light gray CLAY, little silt, trace fine sand (dry)	S-5	1-2-3	1.5	43.9	97.5	▼
15	16.8	SM	Orange, light brown fine-to-medium SAND, little coarse sand, trace-to-little silt (wet)	S-6	5-11-18	1.4			
20			Orange, gray fine SAND, some clay, some silt (wet)	S-7	1-1-2	1.4	26.2	23.7	
25			Orange, light gray fine-to-medium SAND, trace coarse sand, trace silt (wet)	S-8	4-6-10	1.5			
30	30.0								

NOTES:
1. Water level observed at ±15.1 feet below the existing ground surface (b.e.g.s.) during the performance of drilling.
2. Upon completion, borehole caved at ±6.8 feet b.e.g.s., with water level at ±3.4 feet b.e.g.s.

DUFFIELD ASSOCIATES
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TEST BORING TB-2

Proposed Dover Tansit Center
Water and Queen Streets
Dover, DE

Date Started : March 8, 2007
Date Completed : March 8, 2007
Logged by : KMY
Weather : Sunny, 32 °F
Driller/Agency : Ben Feldmann/Feldmann Brothers
Drilling Equipment : Truck-mounted Diedrich D-50
Drilling Methods : SPT (ASTM D1586), HSA
Surface Elevation : ±26

Sample Condition: Remolded
Water Levels: ▼ During Drilling; ▽ At completion

Layer Depth feet	USCS	DESCRIPTION	Sample Number	Blows per 6 inches	Recovery (ft)	Moisture Content (%)	Percent Passing 200 Sieve	Water Level
3.8		Bituminous Concrete (Asphalt)	S-1A	10-10-11	1.5			
5.5	ML	Dark brown SILT, little fine sand, trace gravel, trace organics (dry) (petroleum odor observed)	S-1B					
	SM	Dark brown, brown fine SAND, little silt, trace mica (dry) (petroleum odor observed)	S-2	1-2-4	1.2			▽
9.5		Light brown, dark brown fine-to-medium SAND, trace clay (wet)	S-3A	2-6-9	1.0			▼
11.8	GC	Light brown, gray GRAVEL, some silty-clay, some fine-to-medium sand (moist-to-wet)	S-3B					
	CL	Black, gray CLAY, little silt, trace fine sand (dry)	S-4	2-2-4		45.6	94.4	
15.9		Black, gray CLAY, little silt (dry)	S-5A	2-12-17	0.9			
	SP-SM	Orange, brown fine-to-medium SAND, trace-to-little coarse sand, trace gravel (wet)	S-5B					
		Orange, brown fine-to-medium SAND, some coarse sand, little gravel, trace clay (wet)	S-6A	4-11-26	1.5			
		Yellow, light orange, light brown gray fine-to-medium SAND, little silt (wet)	S-6B					
		Orange, gray fine SAND, little-to-some clay, trace silt (wet)	S-7	1-2-2	1.0	24.0	19.0	
30.0		Orange, yellow, gray fine-to-medium SAND, trace coarse sand, trace silt (wet)	S-8	12-17-17	0.9			

NOTES:
1. Water level observed at ±15 feet below the existing ground surface (b.e.g.s.) during the performance of drilling.
2. Washed out for samples S-6 through S-8.
3. Upon completion, borehole caved at ±12 feet b.e.g.s, with water level observed at± 7.2 ft b.e.g.s.

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TEST BORING TB-3

(Page 1 of 1)

Proposed Dover Tansit Center Water and Queen Streets Dover, DE	Date Started : March 8, 2007 Date Completed : March 8, 2007 Logged by : KMY Weather : Sunny, 32 °F Driller/Agency : Ben Feldmann/Feldmann Brothers	Drilling Equipment : Truck-mounted Diedrich D-50 Drilling Methods : SPT (ASTM D1586), HSA Surface Elevation : ±26	

Sample Condition: Remolded

Water Levels: ▼ During Drilling; ▽ At completion

Depth in feet	Layer Depth feet	GRAPHIC	USCS	DESCRIPTION	SAMPLES	Sample Number	Blows per 6 inches	Recovery (ft)	Moisture Content (%)	Percent Passing 200 Sieve	WATER LEVEL
0											
				APPARENT FILL: Dark gray, black SILT, little-to-some fine sand, trace coarse sand (dry) (petroleum like odor observed)	⊠	S-1	6-10-14	1.0			
				APPARENT FILL: Gray fine SAND, little silt, trace debris (charred wood fragments) (dry)	⊠	S-2	1-2-2	1.2			
5	5.5										
				POSSIBLE FILL: Brown, light brown, gray fine-to-medium SAND, some clay (moist)	⊠	S-3	1-1-2	1.2	21.6	21.8	▽
											▼
10				Orange fine SAND, little silty clay, trace medium sand (moist-to-wet)	⊠	S-4	1-2-1	1.5	26.6	17.9	
15				Orange, light brown medium-to-coarse SAND, little fine sand, trace-to-little gravel, trace clay (wet)	⊠	S-5	4-5-11	1.0			
			SM								
20				Orange medium-to-coarse SAND, trace fine sand, trace gravel (wet)	⊠	S-6	1-4-10	1.3			
25				Gray, orange fine SAND, little silt/clay, trace coarse sand (wet)	⊠	S-7	1-2-2		24.1	17.5	
30	30.0			Orange, gray fine-to-medium SAND, little coarse sand, trace gravel, trace silt (wet)	⊠	S-8	4-9-10	0.9			

NOTES:
1. Water level observed at ±8.7 feet below the existing ground surface (b.e.g.s.) during the performance of drilling.
2. Washed out for samples S-6 through S-8.
3. Upon completion, borehole caved at ±9 feet b.e.g.s. with water level at ±6.8 ft b.e.g.s.

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT DESCRIPTIVE LOG

PROJECT: Dover Transit Center

PROJECT NO.: 5992.GB

CLIENT: Kling

DATE: March 9, 2007

LOGGED BY: KMY

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
1	0 — 1	Bituminous concrete
	1 — --	
	(S-1 at 1')	Light orange, light brown fine SAND, little-to-some clayey-silt (moist), USCS: SM
	(S-2 at 4')	Light yellow, light brown fine-to-medium SAND, trace silt (dry), USCS: SM
	(S-3 at 8')	Light yellow, light brown, fine-to -medium SAND, trace silt (moist), USCS: SM
	(S-4 at 11')	Orange fine SAND, little silt, trace medium sand, trace mica (moist), USCS: SM

NOTES:

(1) Test pit excavated by Feldmann Brothers personnel utilizing a Case 590L rubber-tired backhoe.
(2) Test pit terminated at approximately 11 feet below the existing ground surface (b.e.g.s.).
(3) No seepage was observed during performance of the test pit.

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT DESCRIPTIVE LOG

PROJECT: Dover Transit Center

PROJECT NO.: 5992.GB

CLIENT: Kling

DATE: March 9, 2007

LOGGED BY: KMY

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
2	0 — ¾	Stone
	¾ — 2½ (S-1 at 1½')	Brown SILT, trace-to-little fine sand (dry-to-moist); USCS: ML
	2½ — 5 (S-2 at 4')	Orange, orange-brown, fine-to-medium SAND, trace-to-little gravel, trace coarse sand, trace silt (moist), USCS: SM
	5 — -- (S-3 at 6')	Yellow-brown fine SAND, trace silt, trace mica (moist), USCS: SM

NOTES:

(1) Test pit excavated by Feldmann Brothers personnel utilizing a Case 590L rubber-tired backhoe.
(2) Test pit terminated at approximately 10½ feet below the existing ground surface.
(3) No seepage was observed during performance of the test pit.

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT: Dover Transit Center

PROJECT NO.: 5992.GB

CLIENT: Kling

DATE: March 9, 2007

LOGGED BY: KMY

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
3	0 — ¾	Stone
	¾ — 2 (S-1 at 1⅓')	APPARENT FILL: Black, dark brown fine SAND, little gravel, little silt, trace-to-little debris (wire, bolts)
	2 — 2½	APPARENT FILL: Bituminous concrete / brick
	2½ — 3¾	APPARENT FILL: ¾ inch stone
	3¾ — --	APPARENT FILL: Bituminous concrete /millings

NOTES:

(1) Test pit excavated by Feldmann Brothers personnel utilizing a Case 590L rubber-tired backhoe.
(2) Test pit terminated at approximately 3¾ feet below the existing ground surface due to refusal on debris.
(3) No seepage was observed during performance of the test pit.

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Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT: Dover Transit Center

PROJECT NO.: 5992.GB

CLIENT: Kling

DATE: March 9, 2007

LOGGED BY: KMY

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
4	0 — 1	Stone
	1 — 1½	Orange fine-to-medium SAND, little gravel
	1½ — 3 (S-1 at 2½)	Black SILT, little fine sand (dry), (petroleum odor observed), USCS: ML
	3 — -- (S-2 at 4½)	Light brown fine SAND, little silt, trace clay (dry-to-moist), USCS: SM
	(S-3 at 8¼)	Brown, orange fine-to-medium SAND, trace silt, trace gravel (wet), USCS: SM

NOTES:

(1) Test pit excavated by Feldmann Brothers personnel utilizing a Case 590L rubber-tired backhoe.
(2) Test pit terminated at approximately 9 feet below the existing ground surface (b.e.g.s.).
(3) Slight seepage was observed at 9 feet b.e.g.s. during performance of the test pit.
(4) Caving of excavation walls observed at approximately 6 feet (b.e.g.s.).

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Consultants in the Geosciences

TEST PIT DESCRIPTIVE LOG

PROJECT: Dover Transit Center

PROJECT NO.: 5992.GB

CLIENT: Kling

DATE: March 9, 2007

LOGGED BY: KMY

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
5	0 — 1	Topsoil
	1 — 4 (S-1 at 2)	Orange, brown fine SAND, little-to-some silt, trace mica, trace gravel (moist), USCS: SM
	4 — -- (S-2 at 5½)	Orange, brown fine-to-medium SAND, trace-to-little clay (moist), USCS: SP
	(S-3 at 7½)	Orange, dark brown medium SAND, trace fine sand, trace silt, trace mica (moist), USCS: SP

NOTES:

(1) Test pit excavated by Feldmann Brothers personnel utilizing a Case 590L rubber-tired backhoe.
(2) Test pit terminated at approximately 11 feet below the existing ground surface.
(3) No seepage was observed during performance of the test pit.

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TEST PIT DESCRIPTIVE LOG

PROJECT: Dover Transit Center | PROJECT NO.: 5992.GB

CLIENT: Kling | DATE: March 9, 2007

LOGGED BY: KMY

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
6	0 — 1½	Stone
	1½ — --	
	(S-1 at 3)	Orange, brown fine SAND, trace coarse sand, trace silt, trace mica (dry), USCS: SP
	(S-2 at 4)	Orange, brown, fine SAND, trace medium sand, trace silt, trace mica (moist-to-wet), USCS: SP

NOTES:

(1) Test pit excavated by Feldmann Brothers personnel utilizing a Case 590L rubber-tired backhoe.
(2) Test pit terminated at approximately 9 feet below the existing ground surface.
(3) Seepage was observed at 9 ft during performance of the test pit.
(4) Caving of excavation walls observed at approximately 6 feet (b.e.g.s.).

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT: Dover Transit Center — PROJECT NO.: 5992.GB

CLIENT: Kling — DATE: March 9, 2007

LOGGED BY: KMY

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
7	0 — 3	FILL: Debris (charred wood fragments, metal, brick)
	3 — 7 (S-1 at 4½)	Orange, brown fine SAND, trace coarse sand, trace gravel, trace silt (moist), USCS: SP
	7 — -- (S-2 at 7)	Light brown, gray fine SAND, some -to-and clay, trace coarse sand (moist-to-wet), USCS: SC
	(S-3 at 10)	White fine SAND, some clay (wet), USCS: SC

NOTES:

(1) Test pit excavated by Feldmann Brothers personnel utilizing a Case 590L rubber-tired backhoe.
(2) Test pit terminated at approximately 10½ feet below the existing ground surface (b.e.g.s.).
(3) No seepage was observed during performance of the test pit.
(4) Caving of excavation walls observed at approximately 7 feet (b.e.g.s.).

DUFFIELD ASSOCIATES
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TEST PIT
DESCRIPTIVE LOG

PROJECT: Dover Transit Center PROJECT NO.: 5992.GB

CLIENT: Kling DATE: March 9, 2007

LOGGED BY: KMY

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
8	0 — 1	Stone
	1 — 1¼	Bituminous Concrete
	1¼ — 3 (S-1 at 2)	APPARENT FILL: Orange, yellow-orange fine-to-medium sand, little-to-some gravel, trace silt, trace brick (moist)
	3 — 5 (S-2 at 3¾)	Dark brown, dark gray fine SAND, some-to-and silt, trace coarse sand (moist), USCS: SM
	5 — -- (S-3 at 7)	Orange, light gray fine SAND, some clay, trace-to-little silt, trace gravel (moist), USCS: SM

NOTES:

(1) Test pit excavated by Feldmann Brothers personnel utilizing a Case 590L rubber-tired backhoe.
(2) Test pit terminated at approximately 11 feet below the existing ground surface.
(3) No seepage was observed during performance of the test pit.

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT DESCRIPTIVE LOG

PROJECT: Dover Transit Center

PROJECT NO.: 5992.GB

CLIENT: Kling

DATE: March 9, 2007

LOGGED BY: KMY

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
9	0 — 1½ (S-1 at 1)	Orange, light yellow fine-to-medium SAND, some to and gravel, trace-to-little silt (wet), USCS: SM
	1½ — 3 (S-2 at 2½)	Brown, orange fine SAND, little silt, trace coarse sand, trace gravel, (moist), USCS: SM
	3 — -- (S-3 at 4⅓)	Light brown, brown fine SAND, little clay, trace silt (moist), USCS: SC
	(S-4 at 10)	Brown, orange fine SAND, some clay (wet), USCS: SC

NOTES:

(1) Test pit excavated by Feldmann Brothers personnel utilizing a Case 590L rubber-tired backhoe.
(2) Test pit terminated at approximately 10½ feet below the existing ground surface (b.e.g.s.).
(3) Seepage was observed at 10 ft during performance of the test pit.
(4) Caving of excavation walls observed at approximately 8½ feet (b.e.g.s.).

DUFFIELD ASSOCIATES
Consultants in the Geosciences

TEST PIT
DESCRIPTIVE LOG

PROJECT: Dover Transit Center

PROJECT NO.: 5992.GB

CLIENT: Kling

DATE: March 9, 2007

LOGGED BY: KMY

Test Pit No.	Depth Range (feet below existing ground surface)	Generalized Soil Description
10	0 — ½	Stone
	½ — 1¼	Concrete slab
	1¼ — 4½ (S-1 at 3)	Brown, light brown clayey-silt, little fine sand, trace mica (moist), USCS: ML
	4½ — -- (S-2 at 6½)	Light orange, light brown fine SAND, trace silt, trace mica (moist), USCS: SM
	(S-3 at 11)	Orange fine SAND, trace-to-little silt, trace mica (moist-to-wet), USCS: SM

NOTES:

(1) Test pit excavated by Feldmann Brothers personnel utilizing a Case 590L rubber-tired backhoe.
(2) Test pit terminated at approximately 11½ feet below the existing ground surface (b.e.g.s.).
(3) No seepage was observed during performance of the test pit.
(4) Caving of excavation walls observed at approximately 6 feet (b.e.g.s.).

APPENDIX C

GENERAL NOTES

GENERAL NOTES

DUFFIELD ASSOCIATES uses the following definitions and terminology to classify and correlate the field and laboratory samples.

VISUAL UNIFIED CLASSIFICATIONS: The soil samples are described by color, major constituent, modifiers (by percentage), and density (or consistency). Coarse Grained or Granular Soils have more than 50% of their dry weight retained on a No. 200 sieve; they are described as: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a No. 200 sieve; they are described as: clays or clayey silts if they are cohesive and silts if they are noncohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency and their plasticity.

The Unified Soil Classification symbols are:

COARSE GRAINED SOILS

GW - Well graded gravels
GP - Poorly graded gravels
GM - Silty gravels
GC - Clayey gravels
SW - Well graded sands
SP - Poorly graded sands
SM - Silty sands
SC - Clayey sands

FINE GRAINED SOILS

ML - Silts of low plasticity
CL - Clays of low to medium plasticity
OL - Organic silt clays of low plasticity
MH - Silts of high plasticity
CH - Clays of high plasticity
OH - Organic silt clays of high plasticity
PT - Peat and highly organic soils

SIZE DESCRIPTION

F - Fine
M - Medium
C - Coarse
G - Gravel

MODIFIERS (PERCENTAGE)

Tr -	Trace	1 - 10%
Ltl -	Little	11 - 20%
Some		21 - 35%
& -	And	36 - 50%

COLOR

Or - Orange
Yel - Yellow
Br - Brown
Blk - Black
Gr - Gray
R - Red
Vc - Varicolored
Dk - Dark
Lt - Light

DENSITY: COARSE GRAINED SOILS

Very loose	4 blows/ft or less
Loose	5 to 10 blows/ft
Medium	11 to 30 blows/ft
Dense	31 to 50 blows/ft
Very Dense	51 blows/ft or more

CONSISTENCY: FINE GRAINED SOILS

Very soft	2 blows/ft or less
Soft	3 to 4 blows/ft
Medium	5 to 8 blows/ft
Stiff	9 to 15 blows/ft
Very stiff	16 to 30 blows/ft
Hard	31 blows/ft or more

NOTE: The Standard Penetration Test "N" value is the number of blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler, except where otherwise noted.