55 Walkers Brook Drive, Reading, MA 01867 (HQ)
Tel: 978.532.1900

New Britain Landfill Solar Development
CTEC Solar, LLC
Weston & Sampson Project No. ENG22-1107

November 2, 2022

Mr. Michael Morrison
CTEC Solar, LLC
1 Griffin Road, #200
Bloomfield, CT 06002

RE: Geotechnical Engineering Report
New Britain Landfill Solar
Berlin, Connecticut

INTRODUCTION

Weston & Sampson Engineers, Inc. (Weston & Sampson) is pleased to present our geotechnical engineering report for the proposed solar photovoltaic (PV) project at the existing New Britain Landfill at 142 Deming Road in Berlin, Connecticut. Our understanding of the project is based on review of September 28, 2022, Permitting Plans prepared by CTEC Solar.

EXISTING SITE CONDITIONS

The existing New Britain Landfill covers an area of approximately 14-acres and is bounded by Deming Road to the north, wooded areas to the east, west, and south with the Mattabesset River beyond to the south and Willow Brook beyond to the west as shown in *Figure 1 – Locus Map*. The landfill is grass covered with a gravel access road at the northeast corner of the landfill that extends to the central portion of the landfill. An isolated wetland area is located to the east and south of the landfill. Based on our review of an available Final Closure Plan documented in December 2008, the landfill was capped with a minimum 24 inch layer consisting of an approximately 6-inch-thick vegetative support layer over approximately 18 inches of clayey cover soils containing between 20 and 70 percent of fines over the waste material.

The landfill surface plateau is located in the central portion of the site and slopes down on all sides from approximately El. 104.5 to El. 50.0. From El. 96 to the top of the plateau, the slope is inclined at approximately 1 to 3 degrees and from El. 50 to El. 96 the slope is inclined as steep as approximately 17 degrees. All elevations herein are in feet (ft.) and reference the North American Vertical Datum of 1988 (NAVD88).

PROPOSED CONSTRUCTION

The project includes construction of 26 ground-mounted solar PV arrays on the landfill plateau where the slopes are inclined at approximately 1 to 3 degrees. The PV arrays encompass an area of approximately 5 acres with 3,228 modules and an approximate power generation of 540 Watts per module (total of 1.74 MW). The project also includes construction of a minimum 50-foot long construction entrance road on the northeast side of the landfill. Proposed site features are shown in *Figure 2 – Site Plan*.

The foundation type that will support the array modules was not available at the time of this report, but we assume the modules will be supported on precast concrete ballasts. Based on our experience with similar projects, the ballasts are typically installed on the landfill surface or on leveling fill, such as crushed stone or gravel, without removing vegetative and organic materials.

Information on ballast dimensions and stresses imposed on the landfill surface was not available at the time of this report. We assume, however, that the ballasts will measure approximately 3 ft. wide by 9 ft. long and that the maximum stress imposed on the landfill surface by each ballast will be approximately 800 pounds per square foot (psf), or 5.6 pounds per square inch (psi), including wind and snow stresses. Proposed elevations were also not available, but we assume that existing ground surface elevations will only be adjusted (filled) to level below the ballasts.

Construction of temporary access roads could be required on the landfill to provide access and support for construction vehicles during construction. The locations of these roads will likely be determined prior to construction.

FIELD EXPLORATION PROGRAM AND CONDITIONS ENCOUNTERED

Subsurface conditions were explored at the New Britain Landfill on October 19, 2022 by completing 12 hand excavations (test pits) labeled TP-1 through TP-12 to depths ranging from approximately 0.5 to 1.0 ft. at the approximate locations shown on *Figure 1*. Weston & Sampson geotechnical staff completed the test pits using a steel hand shovel and prepared logs for each excavation.

The test pits were performed in the area of proposed ballast foundations to assess the thickness and characteristics of the cover soils above the Low Permeability Layers. Descriptions of the subsurface conditions are discussed below and in the test pit logs in *Attachment A*. Variations may occur and should be expected outside and between test pit locations.

An approximately 6 to 12-inch-thick vegetative support layer was encountered at the ground surface in each of the explorations, except for TP-10 and TP-12, which were performed at the existing access road. This layer was generally comprised of a mostly fine to medium sand with some non-plastic fines, trace gravel, and occasional organics (roots and leaves). This layer is classified as a Silty Sand (SM) according to the Unified Soil Classification System (USCS).

At TP-10 and TP-12, an 11-inch-thick layer of well graded gravel with little to some sand and trace organics (roots) was encountered at the ground surface. This layer is classified as a Well-Graded Gravel with Sand (GW) according to the USCS.

Cover soils consisting of clayey soils with varying amounts of silt and sand were encountered in each of the borings below the vegetative support layer or below the gravel layer at TP-10 and TP-12. The cover soil was encountered at depths ranging from 6 to 12 inches. Once the clayey cover soil layer was identified below the vegetative cover, the test pits were terminated so we did not inadvertently penetrate the underlying waste material.

Groundwater was observed in TP-10 at a depth of approximately 9 inches. Slow seepage with minor caving was observed at this location. The groundwater observed was likely due to perched groundwater conditions from recent precipitation. Perched groundwater conditions could exist near the landfill surface during and after periods of extended wet weather.

GEOTECHNICAL ASSESSMENT

The following analyses for the ballast foundations and access roads were performed based on our field observations, the ballast foundation dimensions and loading conditions stated above, and assumed construction vehicle types stated below.

Ballast Foundations

Direct Bearing Stress on the Cover Soils

Industry standards typically requires that vertical stresses imposed on the capping layers not exceed 7 psi to limit the potential for damage. The new leveling fill (where required) and ballast foundations will impose additional vertical stresses on the capping layer. Vertical stresses imposed on the 24-inch capping layer by up to 3 ft. of leveling fill and ballast foundations are estimated to range from approximately 4.7 to 5.6 psi, which is below the maximum allowable value of 7.0 psi. This is based on assumed ballast dimensions of 9-ft-long by 3-ft wide and maximum total ground contact stress of 800 psf (5.6 psi). The highest stresses imposed are expected in areas where the cover soils are thinnest, and the leveling fill is thickest. These stresses should be re-evaluated during final design when actual ballast stresses and leveling fill thicknesses are known.

Cap Soil Settlement
Stresses imposed on the landfill by the ballast foundations and any leveling fill will induce settlement of the cap soils in the immediate vicinity of the foundations. Based on cap soil conditions encountered in the explorations and an assumed maximum ballast foundation stress of 800 psf, we estimate settlement of the cap soils in the vicinity of the foundations will be less than 1-inch provided the cap soils are dry at the time of construction.

Waste Compression
Long-term compression of the waste, independent of stresses imposed by the PV system and additional leveling fill, is expected due to natural decomposition of the landfill waste materials. Relatively gradual surface deflections from deep-seated waste compression should be expected. The surface deflections are not expected to affect PV array performance other than the need for periodic realignment and adjustment of the racking systems.

We have not conducted field explorations extending into the waste to estimate waste thickness and characteristics. However, the new loading on the landfill surface imposed the PV system is relatively minor and is not expected to contribute significantly to ongoing compression of the waste mass.

Veneer Stability
Given that the portion of the landfill in the proposed array areas are only sloped up to approximately 3 degrees, veneer stability between the leveling fill and the vegetative support layer is not of particular concern. A Factor of Safety (FS) value of 1.5 is the generally the accepted minimum value against veneer stability failure.

Although the same slope applies to the underlying interface between the vegetative layer and the clayey soils, we did check this veneer stability. We have assumed the cohesion to be zero, which means the factor of safety against veneer failure for both capping layer types is governed by an infinite slope analysis. The analysis considers the interface friction angle between the clayey cover soil and the vegetative support layer, the weight of these layers, water seepage flow parallel to the slope, and the saturated thickness of the vegetative support soils.

For this infinite slope analysis, we assumed fully saturated soil conditions and a saturated unit weight value of 120 psf for the vegetative support and clayey cover soils. We do not have information on the interface friction angle value, so we conservatively estimated this value at 26 degrees. We can refine our analysis if information on the saturated thickness and interface friction angle become available.

Given our assumed values, our analysis suggests that adequate FS values against veneer stability failure exist in areas on the landfill where the ground surface is sloped 16 percent (9 degrees) or less. If locations in the array areas where the ground surface is inclined steeper than 16 percent, drainage relief in the form of subsurface drains or other measures will be required to reduce the saturated thickness to acceptable values so that a minimum FS value of 1.5 can be attained. The magnitude of reduced saturated thickness necessary for a FS of 1.5 will vary depending on ground surface inclinations and capping soil thicknesses. If changes to the proposed array locations should change, we should have the opportunity to review saturated thicknesses calculated with drainage relief features to evaluate FS values against veneer stability failure at various locations in the array area.

Construction Access Roads

Direct Bearing Stress on the Low Permeability Soil Layer – Construction Equipment and Vehicles
LGP Equipment – Low pressure ground (LPG) equipment, such as tracked dozers, skid steers, and excavators, typically impart ground stresses less than 7 psi, and should be used where possible for all work required on the landfill surface. Tracked equipment, however, can create ruts in the landfill cover soils particularly when the soils are saturated. All ruts should be repaired as required by the Post Closure Use Permit (PCUP) that will be prepared for the project by others.

Heavy Construction Vehicles – Ground stresses imposed by heavy construction vehicles can exceed 60 psi for fully loaded dump trucks, concrete trucks, or flat-bed trucks carrying pre-cast concrete ballasts and related array equipment. If off-cap staging of array foundations and equipment is not possible, construction of a temporary/permanent access road(s) on the landfill will be required for heavy equipment vehicles to access the array area. Access roads with at least 36-inches of soil cover above the capping layer) are generally required to maintain stresses of less than 7 psi on the capping layer for the heaviest equipment. However, during final design, the actual minimum soil cover thickness should be assessed based on information provided by the contractor on specific equipment that will be used for this project (e.g., fully loaded vehicle weight, axle load distribution, and tire ground contact area).

Thickness and grain size distribution requirements of new fill material along access roads and placement and compaction recommendations are discussed below.

CONSTRUCTION CONSIDERATIONS

Ballasts Subgrades – The ballast subgrades should be prepared according to the manufacturer recommendations and guidelines but should include at least a minimum 3-inch-thick layer of compacted crushed stone or ballast leveling fill (as discussed below) to increase resistance to ballast sliding.

Ballast Leveling Fill – Leveling fill needed below ballasts should consist of Dense Graded Crushed Stone for Subbase, such as CTDOT M1.02 Coarse Aggregate. The leveling fill should be placed in 6-inch-thick maximum loose lifts with each lift compacted until firm and stable. The fill should extend a minimum of 12-inches beyond all sides of the ballasts and should be sloped at 2H:1V or flatter.

Access Roads
We understand that a permanent construction entrance is proposed at the northeast side of the landfill and it will be used to support heavy construction vehicles during construction. As previously discussed, the minimum soil cover thickness along access roads that will support heavy construction vehicles should be 36-inches. Test pit TP-12 was completed in the area of the proposed entrance, while TP-10 and TP-12 were completed along the existing gravel access road. The gravel subbase at these locations was approximately 11-inches over clayey cover soils. Therefore, at least 25-inches of new fill placed and compacted on the landfill subgrades should be anticipated along the construction entrance and any other permanent access roads to protect the capping layer.

Temporary access roads supporting heavy construction vehicles could be needed along other areas of the landfill surface depending on the Contractor's means and methods. The vegetative support thicknesses in test pits completed outside the proposed permanent access road area ranged from approximately 6 to 12-inches.

<u>Subgrades</u> – All grass/weeds and vegetative support layers (if present) should be removed below the permanent access roads, including at least 5 ft. beyond the edges of the road and, if encountered to expose the clayey cover soils. The subgrade should be compacted with multiple passes of tracked construction equipment.

<u>New Fill</u> – New fill needed to construct permanent and temporary access roads should consist of Dense Graded Crushed Stone for Subbase. Access road subgrades should be prepared, and fill placed and compacted as recommended below.

A heavy, woven geotextile fabric (Mirafi RS380i or equal) should be used to separate the Dense Graded Crushed Stone for Subbase from the prepared access road subgrade. Each width/length of geotextile sections should be overlapped in accordance with the manufacturer's recommendations, but not less than 2 ft. Dense Graded Crushed Stone for Subbase in all areas should be placed in 8-inch maximum loose lifts with each lift compacted to at least 92 percent of the materials maximum dry density as determined by ASTM Specification D1557.

Slopes created along the shoulders of access roads should be constructed no steeper than 3H:1V. The roads and shoulders should be sufficiently wide such that construction vehicles maintain a lateral distance of at least 2 ft. between the wheels and the crests of the slopes.

LIMITATIONS

We have prepared this report for use by the Client and members of the design and construction team for the subject project and this site only. The data and report can be used for estimating purposes, but our report, conclusions, and interpretations should not be construed as a warranty of the subsurface conditions and are not applicable to other sites. Additional information about interpretation and use of this report is included in *Attachment B.*

Test pits indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect subsurface conditions that may exist outside or between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, reevaluation will be necessary. As noted in the report, the explorations did not penetrate through the landfill liner and our scope does not include an estimate of settlement due to the long-term compression of the waste. Deep-seated settlement of waste material is highly variable and difficult to quantify.

Site development plans and design details were considered preliminary at the time this report was prepared. If changes are made in site grades, configuration, design loads, or type of construction, the conclusions and recommendations may not be applicable. We should be consulted to review final design drawings and specifications to see that our recommendations are suitably followed. If design changes are made, we should be retained to review our conclusions and recommendations and provide a written evaluation or modification. Additional geotechnical engineering analyses and explorations may be necessary.

The recommendations in this report are preliminary as actual subsurface conditions may differ from those interpreted based on our subsurface explorations. In order for our recommendations to be considered final, we must be retained to observe the actual subsurface conditions encountered during construction. Our observations will allow us to interpret the actual conditions present during construction and adapt our recommendations if needed.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time this report was prepared. No warranty or other conditions, expressed or implied, is given.

Very truly yours,

WESTON & SAMPSON, INC.

Carolyn Conlee, Ph.D, PE (MA)
Project Engineer

Robert J. Bukowski, PE
Principal Engineer

Joseph P. Laird, PE (MA and RI)
Senior Project Manager

Attachments:

Figure 1 – Locus Map
Figure 2 – Site Plan
Attachment A – Test Pit Logs
Attachment B – Important Information about This Geotechnical-Engineering Report

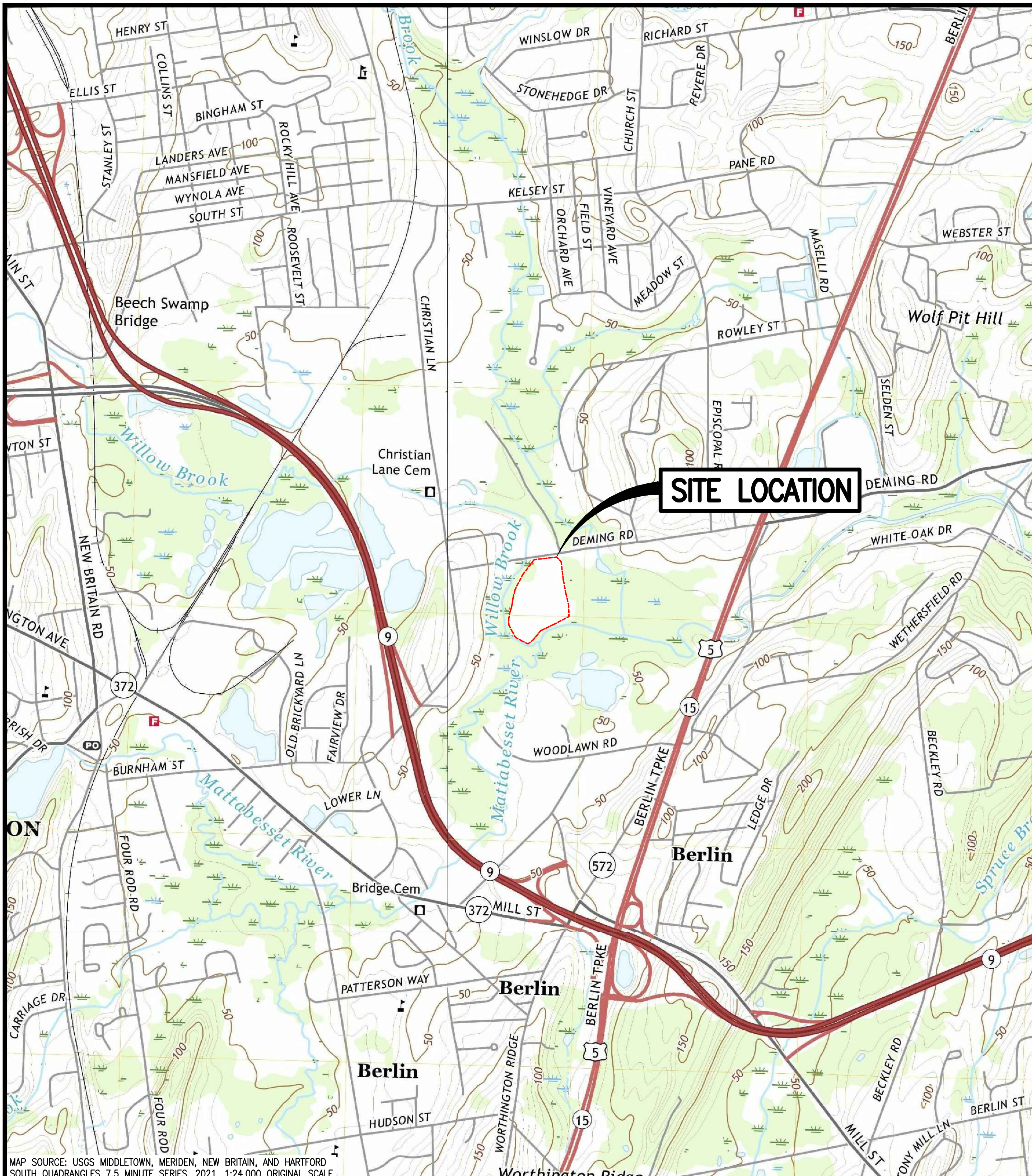


FIGURE 1
NEW BRITAIN LANDFILL SOLAR DEVELOPMENT
142 DEMING ROAD, BERLIN, CT

LOCUS MAP

SCALE: 1"=2000'

0 2000 4000

Weston & Sampson

\\wse03.local\WSE\Projects\Private\CTEC\New Britian\Geotechnical\Plans\Figure 1 _Locus Map.dwg

Exhibit D

NOTES:

1. TEST PITS COMPLETED BY HAND EXCAVATION AND OBSERVED BY WESTON & SAMPSON ENGINEERS, INC. ON OCTOBER 19, 2022.
2. LOCATIONS SHOWN ON THIS PLAN ARE APPROXIMATE AND BASED ON FIELD MEASUREMENTS WITH HANDHELD GPS.
3. THIS DRAWING IS BASED ON AN AUGUST 2022 EXISTING CONDITIONS SURVEY COMPLETED BY MARTIN SURVEYING ASSOCIATES, LLC.

LEGEND:

TP-1 — TEST PIT DESIGNATION AND APPROXIMATE LOCATION

N

150 75 0 150 300

SCALE: 1"=150'

FIGURE 2
SITE PLAN

NEW BRITAIN LANDFILL SOLAR DEVELOPMENT
BERLIN, CT

DESIGNED BY: SW	CHECKED BY: CC	DATE: OCTOBER 2022

Weston & Sampson

\\wse03.local\WSE\Projects\Private\CTEC\New Britian\Geotechnical\Plans\Figure 2_Site Plan.dwg

Weston & Sampson

New Britain Landfill Solar Development

TEST PIT ID: TP-1

WSE Project: ENG22-1107

142 Deming Road, Berlin, CT

CONTRACTOR:	**Weston & Sampson Engineers, Inc.**	TEST PIT LOCATION:	**See Attached Figure**	DATE START:	**October 19, 2022**
OPERATOR:	**Richard Manandhar**	PLAN DIMENSIONS:	**Length: 2.0 ft. , Width: 2.0 ft.**	DATE FINISH:	**October 19, 2022**
LOGGED BY:	**Richard Manandhar**	SEEPAGE REMARKS:	**No Seepage Observed**	GROUND EL:	**97.0 ± (NAVD88)**
CHECKED BY:	**Carolyn Conlee, PE**	CAVING REMARKS:	**No Caving Observed**	FINAL DEPTH:	**0.9 ft.**
EQUIPMENT:	**Hand Shovel**	BACKFILL MATERIAL:	**Excavated Soil**	GRID COORDS:	**N:793558 ± / E:1001257 ±**
BUCKET TYPE:	**N/A**	OTHER COMMENTS:		GRID SYSTEM:	**NAD83 State Plane (CT)**

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Grass area.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Silty sand (SM) - Brown; moist; mostly fine to medium SAND, some non plastic fines, trace gravel; occasional roots; **[VEGETATIVE SUPPORT LAYER] 11 inches thick.** *Change to low plasticity fines at 4 inches.*		
					[0.9] Additional higher plasticity cover soils encountered at 11 inches. **Exploration ended at 0.9 ft.**
5				92	

TP-1

Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

Exhibit D

Weston & Sampson

TEST PIT ID: TP-2

New Britain Landfill Solar Development

142 Deming Road, Berlin, CT

WSE Project: ENG22-1107

CONTRACTOR:	**Weston & Sampson Engineers, Inc.**	TEST PIT LOCATION:	**See Attached Figure**	DATE START:	**October 19, 2022**
OPERATOR:	**Richard Manandhar**	PLAN DIMENSIONS:	**Length: 2.0 ft. , Width: 2.0 ft.**	DATE FINISH:	**October 19, 2022**
LOGGED BY:	**Richard Manandhar**	SEEPAGE REMARKS:	**No Seepage Observed**	GROUND EL:	**101.0 ± (NAVD88)**
CHECKED BY:	**Carolyn Conlee, PE**	CAVING REMARKS:	**No Caving Observed**	FINAL DEPTH:	**0.5 ft.**
EQUIPMENT:	**Hand Shovel**	BACKFILL MATERIAL:	**Excavated Soil**	GRID COORDS:	**N:793404 ± / E:1001208 ±**
BUCKET TYPE:	**N/A**	OTHER COMMENTS:		GRID SYSTEM:	**NAD83 State Plane (CT)**

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Grass area.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Silty sand (SM) - Brown; moist; mostly fine to medium SAND, some low plasticity fines, trace fine to coarse gravel; occasional roots; **[VEGETATIVE SUPPORT] 6 inches thick.**		
					[0.5] Additional higher plasticity cover soils encountered at 6 inches. **Exploration ended at 0.5 ft.**
5				96	

TP-2

Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

Weston & Sampson

New Britain Landfill Solar Development

TEST PIT ID: TP-3

WSE Project: ENG22-1107

142 Deming Road, Berlin, CT

CONTRACTOR:	**Weston & Sampson Engineers, Inc.**	TEST PIT LOCATION:	**See Attached Figure**	DATE START:	**October 19, 2022**
OPERATOR:	**Richard Manandhar**	PLAN DIMENSIONS:	**Length: 2.0 ft. , Width: 2.0 ft.**	DATE FINISH:	**October 19, 2022**
LOGGED BY:	**Richard Manandhar**	SEEPAGE REMARKS:	**No Seepage Observed**	GROUND EL:	**101.0 ± (NAVD88)**
CHECKED BY:	**Carolyn Conlee, PE**	CAVING REMARKS:	**No Caving Observed**	FINAL DEPTH:	**0.9 ft.**
EQUIPMENT:	**Hand Shovel**	BACKFILL MATERIAL:	**Excavated Soil**	GRID COORDS:	**N:793404 ± / E:1001370 ±**
BUCKET TYPE:	**N/A**	OTHER COMMENTS:		GRID SYSTEM:	**NAD83 State Plane (CT)**

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Grass area.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Silty sand (SM) - Brown; moist; mostly fine to medium SAND, some low plasticity fines, trace fine to coarse gravel; occasional roots; **[VEGETATIVE SUPPORT] 11 inches thick.**		
					[0.9] Additional higher plasticity cover soils encountered at 11 inches. **Exploration ended at 0.9 ft.**
5				96	

TP-3

Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

Exhibit D

Weston & Sampson

New Britain Landfill Solar Development

TEST PIT ID: TP-4

WSE Project: ENG22-1107

142 Deming Road, Berlin, CT

CONTRACTOR:	**Weston & Sampson Engineers, Inc.**	TEST PIT LOCATION:	**See Attached Figure**	DATE START:	**October 19, 2022**
OPERATOR:	**Richard Manandhar**	PLAN DIMENSIONS:	**Length: 2.0 ft. , Width: 2.0 ft.**	DATE FINISH:	**October 19, 2022**
LOGGED BY:	**Richard Manandhar**	SEEPAGE REMARKS:	**No Seepage Observed**	GROUND EL:	**100.5 ± (NAVD88)**
CHECKED BY:	**Carolyn Conlee, PE**	CAVING REMARKS:	**No Caving Observed**	FINAL DEPTH:	**0.8 ft.**
EQUIPMENT:	**Hand Shovel**	BACKFILL MATERIAL:	**Excavated Soil**	GRID COORDS:	**N:793263 ± / E:1001164 ±**
BUCKET TYPE:	**N/A**	OTHER COMMENTS:		GRID SYSTEM:	**NAD83 State Plane (CT)**

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Grass area.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Silty sand (SM) - Brown; moist; mostly fine to medium SAND, some low plasticity fines, trace fine to coarse gravel; occasional roots; **[VEGETATIVE SUPPORT] 9 inches thick.**		
					[0.8] Additional higher plasticity cover soils encountered at 9 inches. **Exploration ended at 0.8 ft.**
				96	
5					
				91	

TP-4

Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

Weston & Sampson

New Britain Landfill Solar Development

TEST PIT ID: TP-5

WSE Project: ENG22-1107

142 Deming Road, Berlin, CT

CONTRACTOR:	**Weston & Sampson Engineers, Inc.**	TEST PIT LOCATION:	**See Attached Figure**	DATE START:	**October 19, 2022**
OPERATOR:	**Richard Manandhar**	PLAN DIMENSIONS:	**Length: 2.0 ft. , Width: 2.0 ft.**	DATE FINISH:	**October 19, 2022**
LOGGED BY:	**Richard Manandhar**	SEEPAGE REMARKS:	**No Seepage Observed**	GROUND EL:	**101.0 ± (NAVD88)**
CHECKED BY:	**Carolyn Conlee, PE**	CAVING REMARKS:	**No Caving Observed**	FINAL DEPTH:	**1.0 ft.**
EQUIPMENT:	**Hand Shovel**	BACKFILL MATERIAL:	**Excavated Soil**	GRID COORDS:	**N:793098 ± / E:1001140 ±**
BUCKET TYPE:	**N/A**	OTHER COMMENTS:		GRID SYSTEM:	**NAD83 State Plane (CT)**

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Grass area.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Silty sand (SM) - Brown; moist; mostly fine to medium SAND, some non plastic fines, trace fine to coarse gravel; occasional roots; **[VEGETATIVE SUPPORT] 12 inches thick.**		
					[1.0] Additional higher plasticity cover soils encountered at 12 inches. **Exploration ended at 1.0 ft.**
5				96	

TP-5 - 1

Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

Weston & Sampson | **New Britain Landfill Solar Development** | # TEST PIT ID: TP-6

WSE Project: ENG22-1107 | **142 Deming Road, Berlin, CT**

CONTRACTOR:	**Weston & Sampson Engineers, Inc.**	TEST PIT LOCATION:	**See Attached Figure**	DATE START:	**October 19, 2022**
OPERATOR:	**Richard Manandhar**	PLAN DIMENSIONS:	**Length: 2.0 ft. , Width: 2.0 ft.**	DATE FINISH:	**October 19, 2022**
LOGGED BY:	**Richard Manandhar**	SEEPAGE REMARKS:	**No Seepage Observed**	GROUND EL:	**103.0 ± (NAVD88)**
CHECKED BY:	**Carolyn Conlee, PE**	CAVING REMARKS:	**No Caving Observed**	FINAL DEPTH:	**1.0 ft.**
EQUIPMENT:	**Hand Shovel**	BACKFILL MATERIAL:	**Excavated Soil**	GRID COORDS:	**N:793153 ± / E:1001336 ±**
BUCKET TYPE:	**N/A**	OTHER COMMENTS:		GRID SYSTEM:	**NAD83 State Plane (CT)**

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Grass area.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Silty sand (SM) - Brown; moist; mostly fine to medium SAND, some non plastic fines, trace fine to coarse gravel; occasional roots; **[VEGETATIVE SUPPORT] 12 inches thick.**		
					[1.0] Additional higher plasticity cover soils encountered at 12 inches. **Exploration ended at 1.0 ft.**
5				98	

TP-6

Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

Exhibit D

Weston & Sampson

New Britain Landfill Solar Development

TEST PIT ID: TP-7

WSE Project: ENG22-1107

142 Deming Road, Berlin, CT

CONTRACTOR:	**Weston & Sampson Engineers, Inc.**	TEST PIT LOCATION:	**See Attached Figure**	DATE START:	**October 19, 2022**
OPERATOR:	**Richard Manandhar**	PLAN DIMENSIONS:	**Length: 2.0 ft. , Width: 2.0 ft.**	DATE FINISH:	**October 19, 2022**
LOGGED BY:	**Richard Manandhar**	SEEPAGE REMARKS:	**No Seepage Observed**	GROUND EL:	**96.0 ± (NAVD88)**
CHECKED BY:	**Carolyn Conlee, PE**	CAVING REMARKS:	**No Caving Observed**	FINAL DEPTH:	**0.6 ft.**
EQUIPMENT:	**Hand Shovel**	BACKFILL MATERIAL:	**Excavated Soil**	GRID COORDS:	**N:793182 ± / E:1001556 ±**
BUCKET TYPE:	**N/A**	OTHER COMMENTS:		GRID SYSTEM:	**NAD83 State Plane (CT)**

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Grass area.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Silty sand (SM) - Brown; moist; mostly fine to medium SAND, some non plastic fines, trace fine to coarse gravel; occasional roots; **[VEGETATIVE SUPPORT] 7 inches thick.**		
					[0.6] Additional higher plasticity cover soils encountered at 7 inches. **Exploration ended at 0.6 ft.**
5				91	

TP-7

Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

Exhibit D

Weston & Sampson

New Britain Landfill Solar Development

TEST PIT ID: TP-8

WSE Project: ENG22-1107

142 Deming Road, Berlin, CT

CONTRACTOR:	**Weston & Sampson Engineers, Inc.**	TEST PIT LOCATION:	**See Attached Figure**	DATE START:	**October 19, 2022**
OPERATOR:	**Richard Manandhar**	PLAN DIMENSIONS:	**Length: 2.0 ft. , Width: 2.0 ft.**	DATE FINISH:	**October 19, 2022**
LOGGED BY:	**Richard Manandhar**	SEEPAGE REMARKS:	**No Seepage Observed**	GROUND EL:	**101.0 ± (NAVD88)**
CHECKED BY:	**Carolyn Conlee, PE**	CAVING REMARKS:	**No Caving Observed**	FINAL DEPTH:	**0.8 ft.**
EQUIPMENT:	**Hand Shovel**	BACKFILL MATERIAL:	**Excavated Soil**	GRID COORDS:	**N:793055 ± / E:1001274 ±**
BUCKET TYPE:	**N/A**	OTHER COMMENTS:		GRID SYSTEM:	**NAD83 State Plane (CT)**

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Grass area.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Silty sand (SM) - Brown; moist; mostly fine to medium SAND, some non plastic fines, trace fine to coarse gravel; occasional roots; **[VEGETATIVE SUPPORT] 10 inches thick.**		
					[0.8] Additional higher plasticity cover soils encountered at 10 inches. **Exploration ended at 0.8 ft.**
5				96	

TP-8

Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

Exhibit D

New Britain Landfill Solar Development

142 Deming Road, Berlin, CT

TEST PIT ID: TP-9

WSE Project: ENG22-1107

CONTRACTOR:	**Weston & Sampson Engineers, Inc.**	TEST PIT LOCATION:	**See Attached Figure**	DATE START:	**October 19, 2022**
OPERATOR:	**Richard Manandhar**	PLAN DIMENSIONS:	**Length: 2.0 ft. , Width: 2.0 ft.**	DATE FINISH:	**October 19, 2022**
LOGGED BY:	**Richard Manandhar**	SEEPAGE REMARKS:	**No Seepage Observed**	GROUND EL:	**98.0 ± (NAVD88)**
CHECKED BY:	**Carolyn Conlee, PE**	CAVING REMARKS:	**No Caving Observed**	FINAL DEPTH:	**0.9 ft.**
EQUIPMENT:	**Hand Shovel**	BACKFILL MATERIAL:	**Excavated Soil**	GRID COORDS:	**N:792949 ± / E:1001129 ±**
BUCKET TYPE:	**N/A**	OTHER COMMENTS:		GRID SYSTEM:	**NAD83 State Plane (CT)**

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Grass area.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Silty sand (SM) - Brown; moist; mostly fine to medium SAND, some non plastic fines, trace fine to coarse gravel; occasional roots; **[VEGETATIVE SUPPORT] 11 inches thick.**		
					[0.9] Additional higher plasticity cover soils encountered at 11 inches. **Exploration ended at 0.9 ft.**
5				93	

TP-9

Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

Exhibit D

Weston & Sampson

New Britain Landfill Solar Development

TEST PIT ID: TP-10

WSE Project: ENG22-1107

142 Deming Road, Berlin, CT

CONTRACTOR:	**Weston & Sampson Engineers, Inc.**	TEST PIT LOCATION:	**See Attached Figure**	DATE START:	**October 19, 2022**
OPERATOR:	**Richard Manandhar**	PLAN DIMENSIONS:	**Length: 2.0 ft. , Width: 2.0 ft.**	DATE FINISH:	**October 19, 2022**
LOGGED BY:	**Richard Manandhar**	SEEPAGE REMARKS:	**Slow Seepage at 0.7 ft.**	GROUND EL:	**104.5 ± (NAVD88)**
CHECKED BY:	**Carolyn Conlee, PE**	CAVING REMARKS:	**Minor Caving**	FINAL DEPTH:	**0.9 ft.**
EQUIPMENT:	**Hand Shovel**	BACKFILL MATERIAL:	**Excavated Soil**	GRID COORDS:	**N:793255 ± / E:1001307 ±**
BUCKET TYPE:	**N/A**	OTHER COMMENTS:		GRID SYSTEM:	**NAD83 State Plane (CT)**

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Gravel area.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Well graded gravel with sand (GW) - Gray; moist to wet; mostly fine to coarse GRAVEL, little fine to coarse sand; trace roots.		
					[0.9] Additional higher plasticity cover soils encountered at 11 inches. **Exploration ended at 0.9 ft.**
				100	
5					
				95	

TP-10

Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

Weston & Sampson

New Britain Landfill Solar Development

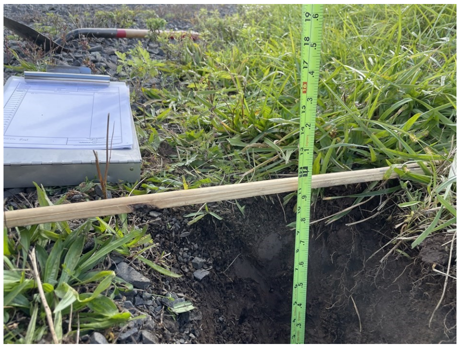
142 Deming Road, Berlin, CT

TEST PIT ID: TP-11

WSE Project: ENG22-1107

CONTRACTOR:	**Weston & Sampson Engineers, Inc.**	TEST PIT LOCATION:	**See Attached Figure**	DATE START:	**October 19, 2022**
OPERATOR:	**Richard Manandhar**	PLAN DIMENSIONS:	**Length: 2.0 ft. , Width: 2.0 ft.**	DATE FINISH:	**October 19, 2022**
LOGGED BY:	**Richard Manandhar**	SEEPAGE REMARKS:	**No Seepage Observed**	GROUND EL:	**88.0 ± (NAVD88)**
CHECKED BY:	**Carolyn Conlee, PE**	CAVING REMARKS:	**No Caving Observed**	FINAL DEPTH:	**0.9 ft.**
EQUIPMENT:	**Hand Shovel**	BACKFILL MATERIAL:	**Excavated Soil**	GRID COORDS:	**N:793353 ± / E:1001517 ±**
BUCKET TYPE:	**N/A**	OTHER COMMENTS:		GRID SYSTEM:	**NAD83 State Plane (CT)**

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Gravel area.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Silty sand with gravel (SM) - Brown; moist; mostly fine to medium SAND, some non plastic fines, little fine to coarse gravel; occasional roots; **[VEGETATIVE SUPPORT] 11 inches thick.**		
					[0.9] Additional higher plasticity cover soils encountered at 11 inches. **Exploration ended at 0.9 ft.**
5				83	



TP-11

Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

Exhibit D

Weston & Sampson

New Britain Landfill Solar Development

TEST PIT ID: TP-12

WSE Project: ENG22-1107

142 Deming Road, Berlin, CT

CONTRACTOR:	**Weston & Sampson Engineers, Inc.**	TEST PIT LOCATION:	**See Attached Figure**	DATE START:	**October 19, 2022**
OPERATOR:	**Richard Manandhar**	PLAN DIMENSIONS:	**Length: 2.0 ft. , Width: 2.0 ft.**	DATE FINISH:	**October 19, 2022**
LOGGED BY:	**Richard Manandhar**	SEEPAGE REMARKS:	**No Seepage Observed**	GROUND EL:	**63.0 ± (NAVD88)**
CHECKED BY:	**Carolyn Conlee, PE**	CAVING REMARKS:	**No Caving Observed**	FINAL DEPTH:	**0.9 ft.**
EQUIPMENT:	**Hand Shovel**	BACKFILL MATERIAL:	**Excavated Soil**	GRID COORDS:	**N:793580 ± / E:1001512 ±**
BUCKET TYPE:	**N/A**	OTHER COMMENTS:		GRID SYSTEM:	**NAD83 State Plane (CT)**

DEPTH BELOW GROUND SURFACE [VERTICAL FT.]	SAMPLE TYPE GRAPHIC	STRATIGRAPHY LOG	STRATUM IDENTIFICATION AND DESCRIPTION	ELEVATION SCALE SHOWN TO NEAREST FT.	REMARKS, OTHER TESTS, AND INSTALLATIONS
			Surface: Gravel area.		Note: Values in brackets preceeding a remark indicate depth below ground surface (in feet) corresponding to the remark.
			Well graded gravel with sand (GW) - Gray and brown; moist; mostly fine to coarse GRAVEL, some fine to coarse sand; trace roots.		
					[0.9] Additional higher plasticity cover soils encountered at 11 inches. **Exploration ended at 0.9 ft.**
5				58	

TP-12 - 2

TP-12

Refer to the attached index sheets for important information about this log including general notes, legends, and guidance on description methods and procedures.

Exhibit D

GUIDE TO SUBSURFACE EXPLORATION LOGS

Weston & Sampson

INDEX SHEET 1
GENERAL INFORMATION

GENERAL NOTES AND USE OF LOGS

1.) Explorations were made by ordinary and conventional methods and with care adequate for Weston & Sampson's study and/or design purposes. The exploration logs are part of a specific report prepared by Weston & Sampson for the referenced project and client, and are an integral part of that report. Information and interpretations are subject to the explanations and limitations stated in the report. Weston & Sampson is not responsible for any interpretations, assumptions, projections, or interpolations made by others.

2.) Exploration logs represent general conditions observed at the point of exploration on the date(s) stated. Boundary lines separating soil and rock layers (strata) represent approximate boundaries only and are shown as solid lines where observed and dashed lines where inferred based on drilling action. Actual transitions may be gradual and changes may occur over time.

3.) Soil and rock descriptions are based on visual-manual examination of recovered samples, direct observation in test pits (when permissible), and laboratory testing (when conducted).

4.) Water level observations were made at the times and under the conditions stated. Fluctuations should be be expected to vary with seasons and other factors. Use of fluids during drilling may affect water level observations. The absence of water level observations does not necessarily mean the exploration was dry or that subsurface water will not be encountered during construction.

5.) Standard split spoon samplers may not recover particles with any dimension larger than 1-3/8 inches. Reported gravel conditions or poor sample recovery may not reflect actual in-situ conditions.

6.) Sections of this guide provide a general overview of Weston & Sampson's practices and procedures for *identifying* and *describing* soil and rock. These procedures are predominantly based on ASTM D2488, *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)*, the International Society of Rock Mechanics (ISRM) standards, and the *Engineering Geology Field Manual* published by the Bureau of Reclamation. Not all aspects of this guide relating to description and identification procedures of soil and rock may be applicable in all circumstances.

SAMPLER GRAPHICS

- Split Spoon (Standard) — 2" OD, 1-3/8" ID
- Split Spoon (Oversize) — 3" OD, 2-3/8" ID
- Shelby or Piston Tube — 3" OD, 2-7/8" ID
- Double-Tube Rock Core Barrel — 2" Core Diameter
- Direct Push with Acetate Liner — Various Liner Sizes
- A — Auger Sample *(from cuttings or hand auger)*
- G — Grab Sample *(manual, from discrete point)*
- C — Composite Sample *(multiple grab samples)*

WELL GRAPHICS

- Cement concrete seal around casing or riser pipe
- Bentonite seal around casing or riser pipe
- Cement grout seal around casing or riser pipe
- Soil backfill around riser pipe or beneath screen
- Gravel backfill around screen or riser pipe
- Sand backfill around screen or riser pipe (filter sand)
- Solid-wall riser; Sch. 40 PVC, 1" ID unless noted otherwise
- Slotted screen; Sch. 40 PVC, 1" ID with machined slots

CAVING / SEEPAGE TERMS

The following caving and/or seepage terms may appear on a test pit log.

Caving Term	Criteria
Minor	less than 1 cubic ft.
Moderate	1 to 3 cubic ft.
Severe	greater than 3 cubic ft.

Seepage Term	Criteria
Slow	less than 1 gpm
Moderate	1 to 3 gpm
Fast	greater than 3 gpm

KEY TO WATER LEVELS

- ▼ Observed in exploration during advancement.
- ▽ Measured in exploration at completion, prior to backfilling or well installation.
- Measured in exploration after the stated stabilization period, prior to backfilling, or in well installation if noted.

DEFINITIONS OF COMMON TERMS

Sample Recovery Ratio - The length of material recovered in a drive or push type sampler over the length of sampler penetration, in inches (e.g. 18/24).

Standard Penetration Test (*SPT*) - An in-situ test where a standard split-spoon sampler is driven a distance of 12 or 18 inches (after an initial 6-inch seating interval) using a 140-lb. hammer falling 30 inches for each blow.

SPT Blows - The number of hammer blows required to drive a split-spoon sampler each consecutive 6-inch interval during a *Standard Penetration Test*. If no discernable advancement of a split spoon sampler is made after 50 consecutive hammer blows, 50/X indicates *sampler refusal* and is the number of blows required to drive the sampler X inches.

SPT N-Value (*N*) - The uncorrected blow count representation of a soil's penetration resistance over a 12-inch interval after an initial 6-in. seating interval, reported in blows per foot (bpf). The N-value is correlated to soil engineering properties.

Auger Refusal - No discernable advancement of the auger over a period of 5 minutes with full rig down pressure applied.

Casing Refusal (Driven) - Casing penetration of less than 6 inches after a minimum 50 blows of a drop hammer weighing 300 lbs. or a minimum 100 blows of a drop hammer weighing 140 lbs.

PID Measurement - A measurement (electronic reading) taken in the field using a photoionization detector (PID) to detect the presence of volatile organic compounds in a soil sample. Values are reported as benzene equivalent units in parts per million (ppm) unless noted otherwise.

Rock Quality Designation (RQD) - A qualitative index measure of the degree of jointing and fracture of a rock core taken from a borehole. The RQD is defined as the sum length of solid core pieces 4 inches or longer divided by the run (cored) length, expressed as a percentage. Higher RQD values may indicate fewer joints and fractures in the rock mass.

Fill (Made Ground) - A deposit of soil and/or artificial waste materials that has been placed or altered by human processes.

LABORATORY TESTS AND FIELD MEASUREMENTS

MC	Moisture Content	IC	1D Incremental Consolidation
OC	Organic Content	VS	Laboratory Vane Shear
PL	Plastic Limit	US	Unconfined Compression
LL	Liquid Limit	TC	Triaxial Compression
GC	Gravel Content	PP	Pocket (Hand) Penetrometer
SC	Sand Content	TV	Torvane (Hand Vane)
FC	Fines Content	PID	Photoionization Detector
DS	Direct Shear	FID	Flame Ionization Detector

BORING ADVANCEMENT METHODS

Hollow-Stem Auger Drilling - Utilizes continuous flight auger sections with hollow stems to advance the borehole. Drill rods and a plug are inserted into the auger stem to prevent the entrance of soil cuttings into the augers.

Rotary Wash Drilling - Utilizes downward pressure and rotary action applied to a non-coring bit while washing the cuttings to the surface using a circulating fluid injected down the drill rods. The borehole is supported with either steel casing or the drilling fluid. Where a casing is used, the borehole is advanced sequentially by driving the casing to the desired depth and then cleaning out the casing. The process of driving and cleaning the casing is commonly referred to as the 'drive-and-wash' technique.

Continuous Sampling - Includes a variety of methods and procedures during which the borehole is advanced via continuous recovery of soil samples. *Direct Push* sampling is a common method that uses static downward pressure combined with percussive energy to drive a steel mandrel into the ground at continuous intervals while recovering soil samples in disposable acetate liners.

Rock Coring - Utilizes downward pressure and rotary action applied to a core barrel equipped with a diamond-set or tungsten carbide coring bit. During conventional coring, the entire barrel is retrieved from the hole upon completion of a core run. Wireline coring allows for removal of the inner barrel assembly containing the actual core while the the drill rods and outer barrel remain in the hole. Various types and sizes of core barrels and bits are used.

GUIDE TO SUBSURFACE EXPLORATION LOGS

Weston & Sampson[SM]

INDEX SHEET 2
SOIL DESCRIPTION

SOIL CONSTITUENTS

Naturally occurring soils consist of one or more of the following matrix constituents defined in terms of particle size.

Constituent		U.S. Sieve Size			Observed Size (in.)		
Gravel	(Coarse)	3/4 in.	-	3 in.	3/4	-	3
Gravel	(Fine)	No. 4	-	3/4 in.	1/5	-	3/4
Sand	(Coarse)	No. 10	-	No. 40	1/16	-	1/5
Sand	(Medium)	No. 40	-	No. 10	1/64	-	1/16
Sand	(Fine)	No. 200	-	No. 40	1/300	-	1/64
Fines	(Silt or Clay)	Smaller than		No. 200	Less than		1/300

SOIL IDENTIFICATION

Soil identification refers to the grouping of soils with similar physical characteristics into a category defined by a **group name** and corresponding **group symbol** based on estimation of the matrix soil constituents to the nearest 5% and simple manual tests. Proportions of cobbles, boulders, and other non-matrix soil materials are not considered during this procedure but are included in the overall soil description if observed or thought to be present. Refer to the following descriptions and tables adapted from ASTM D2488.

Coarse-Grained Soil - Coarse-grained soils contain fewer than 50% fines and are identified based on the following table.

Primary Constituent	Fines Percent	Type of Fines and Gradation		Group Symbol	Group Name [1]
GRAVEL	≤ 5%	well graded		GW	Well graded gravel
% gravel		poorly graded		GP	Poorly graded gravel
>	10%	clayey	well graded	GW-GC	Well graded gravel with clay
% sand		fines	poorly graded	GP-GC	Poorly graded gravel with clay
		silty	well graded	GW-GM	Well graded gravel wth silt
		fines	poorly graded	GP-GM	Poorly graded gravel with silt
	15% to	clay fines		GC	Clayey gravel
	45%	silt fines		GM	Silty gravel
SAND	≤ 5%	well graded		SW	Well graded sand
% sand		poorly graded		SP	Poorly graded sand
≥	10%	clayey	well graded	SW-SC	Well graded sand with clay
% gravel		fines	poorly graded	SP-SC	Poorly graded sand with clay
		silty	well graded	SW-SM	Well graded sand with silt
		fines	poorly graded	SP-SM	Poorly graded sand with silt
	15% to	clay fines		SC	Clayey sand
	45%	silt fines		SM	Silty sand

[1] If soil is a gravel and contains 15% or more sand, add "with sand" to the group name. If soil is a sand and contains 15% of more gravel, add "with gravel" to the group name.

Inorganic Fine-Grained Soil - Fine-grained soils contain 50% or more fines and are identified based on the following table.

Plasticity Criteria	Dry Strength	Coarse Fraction S = Sand, G = Gravel		Group Symbol	Group Name [1]
Medium	Medium	< 15% S + G		CL	Lean clay
	to high	≥ 30%	% S ≥ % G	CL	Sandy lean clay
		S + G	% S < % G	CL	Gravelly lean clay
Non-	None	< 15% S + G		ML	Silt
plastic	to low	≥ 30%	% S ≥ % G	ML	Sandy silt
		S + G	% S < % G	ML	Gravelly silt
High	High to	< 15% S + G		CH	Fat clay
	very high	≥ 30%	% S ≥ % G	CH	Sandy fat clay
		S + G	% S < % G	CH	Gravelly fat clay
Low to	Low to	< 15% S + G		MH	Elastic silt
Medium	medium	≥ 30%	% S ≥ % G	MH	Sandy elastic silt
		S + G	% S < % G	MH	Gravelly elastic silt

[1] If soil contains 15% to 25% sand or gravel, add "with sand" or "with gravel" to the group name.

Organic Fine-Grained Soil - Fine-grained soils that contain enough organic particles to influence the soil properties are identified as Organic Soil and assigned the group symbol **OL** or **OH**.

Highly Organic Soil (Peat) - Soils composed primarily of plant remains in various stages of decomposition are identified as Peat and given the group symbol **PT**. Peat usually has an organic odor, a dark brown to black color, and a texture ranging from fibrous (original plant structure intact or mostly intact) to amorphous (plant structure decomposed to fine particles).

SOIL DESCRIPTION

Soils are *described* in the following general sequence. Deviations may occur in some instances.

Identification Components

(1) Group Name and Group Symbol

Description Components

(2) Consistency (Fine-Grained) or Apparent Density (Coarse-Grained)
(3) Color (*note, the term "to" may be used to indicate a gradational change*)
(4) Soil Moisture
(5) Matrix Soil Constituents (Gravel, Sand, Fines)
  └→ Proportion (*by weight*), particle size, plasticity of fines, angularity, etc.
(6) Non-Matrix Soil Materials and Proportions (*by volume*)
(7) Other Descriptive Information (Unusual Odor, Structure, Texture, etc.)
(8) [Geologic Formation Name or Soil Survey Unit]

SPT N-VALUE CORRELATIONS

Consistency	SPT N-Value	Apparent Density	SPT N-Value
Very soft	0 - 2	Very loose	0 - 5
Soft	2 - 4	Loose	5 - 10
Medium stiff	4 - 8	Medium dense	10 - 30
Stiff	8 - 15	Dense	30 - 50
Very stiff	15 - 30	Very dense	> 50
Hard	> 30		

SOIL MOISTURE

Dry............................... Apparent absence of moisture; dry to the touch.
Moist............................Damp but no visible water.
Wet............................. Visible free water; saturated.

PROPORTIONS / PERCENTAGES

Proportions of gravel, sand, and fines (excluding cobbles, boulders, and other constituents) are stated in the following terms indicating a range of percentages by weight (to nearest 5%) of the minus 3-in. soil fraction and add up to 100%.

Mostly .... 50% - 100%
Some .... 30% - 45%
Little .... 15% - 25%
Few .... 5% - 10%
Trace........................ Less than 5%

Proportions of cobbles, boulders, and other non-matrix soil materials including artificial debris, roots, plant fibers, etc. are stated in the following terms indicating a range of percentages by volume (to the nearest 5%) of the total soil.

Numerous .... 40% - 50%
Common .... 25% - 35%
Occasional .... 10% - 20%
Trace........................ Less than 5%

PLASTICITY (FINES ONLY)

Non-plastic..................Dry specimen ball falls apart easily. Cannot be rolled into thread at any moisture content.
Low.............................Dry specimen ball easily crushed with fingers. Can be rolled into 1/8-in. thread with some difficulty.
Medium.......................Difficult to crush dry specimen ball with fingers. Easily rolled into 1/8-in. thread.
High............................ Cannot crush dry specimen ball with fingers. Easily rolled and re-rolled into 1/8-in. thread.

COBBLES AND BOULDERS

Cobbles - Particles of rock that will pass a 12-in. square opening and be retained on a 3-in. sieve.

Boulders - Particles of rock that will not pass a 12-in. square opening.

Note: Where the percentage (by volume) of cobbles and/or boulders cannot be accurately or reliably estimated, the terms "with cobbles", "with boulders", or "with cobbles and boulders" may be used to indicate observed or inferred presence.

Exhibit D

GUIDE TO SUBSURFACE EXPLORATION LOGS

Weston & Sampson

INDEX SHEET 3 ROCK DESCRIPTION

ROCK DEFINITION

Where reported on an exploration log, *rock* is defined as any naturally formed aggregate of mineral matter occurring in larges masses or fragments. This definition of rock should not be taken as a replacement for any definitions relating to rock and/or rock excavation defined in construction documents. Intensely weathered or decomposed rock that is friable and can be reduced to gravel size particles or smaller by normal hand pressure is identified and described as soil. Poorly indurated formational materials which display both rock-like and soil-like properties are identified and described as rock followed by the soil description. In such cases, the term "poorly indurated" or "weakly cemented" is added to the rock name (e.g. weakly cemented sandstone).

ROCK IDENTIFICATION

Rock is identified by a combination of *rock type* (igneous, metamorphic, or sedimentary) followed by the the *rock name* (e.g. granite, schist, sandstone).

ROCK DESCRIPTION

Rock descriptions are presented in the following general sequence. The detail of description is dictated by the complexity and objectives of the project.

Identification Components

(1) Rock Type and Name

Description Components

(2) Rock Grain Size (*for clastic sedimentary rock*)
(3) Crystal Size (*for igneous and metamorphic rock*)
(4) Bedding Spacing (*for sedimentary rock*)
(5) Color
(6) Hardness and Weathering Descriptors
(7) Fracture Density
(8) [Geologic Formation Name]

ROCK QUALITY DESIGNATION

$$RQD (\%) = \frac{\Sigma \text{ Length of intact core pieces} \geq 4 \text{ inches}}{\text{Total length of core run (inches)}} \times 100$$

The RQD should correlate with the fracture density in most cases. Higher RDQ values generally indicate fewer joints and fractures.

GRAIN / CRYSTAL SIZE

Grain Size for Clastic Sedimentary Rock

The names of clastic sedimentary rocks are generally based on their predominant clast or grain size (e.g. fine sandstone, medium sandstone, coarse gravel conglomerate, cobble conglomerate, siltstone, claystone).

Crystal Size for Igneous and Metamorphic Rock

Grain Size Description	Average Crystal Size (in.)
Very coarse grained (pegmatitic)	Greater than or equal to 3/8
Coarse-grained	Between 3/16 and 3/8
Medium-grained	Between 1/32 and 3/16
Fine-grained	Between 1/250 and 1/32
Aphanitic	Less than or equal to 1/250

BEDDING SPACING

Bedding Description	Thickness / Spacing
Massive	Less than 10 ft.
Very thickly bedded	3 ft. to 10 ft.
Thickly bedded	1 ft. to 3 ft.
Moderately bedded	4 in. to 1 ft.
Thinly bedded	1 in. to 4 in.
Very thinly bedded	1/4 in. to 1 in.
Laminated	Less than 1/4 in.

Note: Bedding is generally only applicable to sedimentary or bedded volcanic rocks.

HARDNESS

Hardness	Criteria
Extremely hard	Cannot be scratched with a pocketknife or sharp pick. Can only be chipped with repeated heavy hammer blows.
Very hard	Cannot be scratched with a pocketknife or sharp pick with difficulty. Breaks with repeated heavy hammer blows.
Hard	Can be scratched with with a pocketknife or sharp pick with difficulty. Breaks with heavy hammer blows.
Moderately hard	Can be scratched with a pocketknife or sharp pick with light or moderate pressure. Breaks with moderate hammer blows.
Moderately soft	Can be grooved 1/16 in. deep with a pocketknife or sharp pick with moderate or heavy pressure. Breaks with light hammer blow or heavy manual pressure.
Soft	Can be grooved or gouged easily with a pocketknife or sharp pick. Breaks with light to moderate manual pressure.
Very soft	Can be readily indented, grooved, or gouged with fingernail, or carved with a pocketknife. Breaks with light manual pressure.

WEATHERING (INTACT ROCK)

Weathering Description	Discoloration and/or Oxidation	General Characteristics
Fresh	Body of rock and fracture surfaces are not discolored or oxidized.	Rock texture unchanged. Hammer rings when crystalline rocks are struck.
Slightly weathered	Discoloration or oxidation limited to surface of, or short distance from, fractures. Most surfaces exhibit minor to complete discoloration.	Rock texture preserved. Hammer rings when crystalline rocks are struck. Body of rock not weakened.
Moderately weathered	Discoloration or oxidation extends usually throughout. Fe-Mg minerals appear rusty. All fracture surfaces are discolored or oxidized.	Rock texture generally preserved. Hammer does not ring when rock is struck. Body of rock slightly weakened.
Intensely weathered	Discoloration or oxidation throughout. Feldspar and Fe-Mg minerals altered to clay to some extent. All fracture surfaces are discolored or oxidized and friable.	Rock texture altered by chemical disintegration. Can usually be broken with moderate to heavy manual pressure or by light hammer blow . Body of rock is significantly weakened.
Decomposed	Discoloration or oxidation throughout but resistant minerals such as quartz may be unaltered. All feldspar and Fe-Mg minerals are completely altered to clay.	Resembles a soil; partial or complete remnant rock structure may be preserved. Can be granulated by hand. Resistant minerals may present as stringers or dikes.

FRACTURE DENSITY

Description	Observed Fracture Density
Unfractured	No fractures
Very slightly fractured	Core lengths greater than 3 ft.
Slightly fractured	Core lengths mostly from 1 ft. to 3 ft.
Moderately fractured	Core lengths mostly from 4 in. to 1 ft.
Intensely fractured	Core lengths mostly from 1 in. to 4 in.
Very intensely fractured	Mostly chips and fragments

Note: Fracture density is based on the fracture spacing in recovered core, measured along the core axis (excluding mechanical breaks).

Exhibit D

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

Exhibit D

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals' plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for information purposes only.* To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer's services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration. Confront the risk of moisture infiltration*** by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GBA GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org