Geotechnical Engineering Report

Canaan Valley State Park Improvements

Davis, West Virginia

November 11, 2011

Terracon Project No. N2115063

Prepared for:

Chapman Technical Group
Charleston, West Virginia

Prepared by:

Terracon Consultants, Inc.
Charleston, West Virginia

November 11, 2011

Chapman Technical Group
200 Sixth Avenue
St. Albans, WV 25177

Attn: Mr. Joe Bird, ASLA
Senior Vice President

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Re: Geotechnical Engineering Report
Canaan Valley State Park Improvements
Davis, West Virginia
Terracon Project No. N2115063

Dear Mr. Bird:

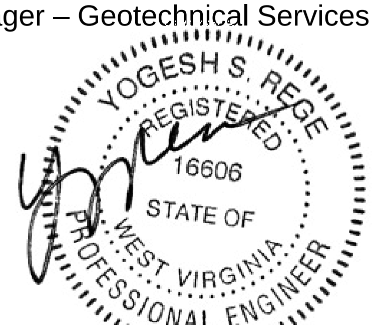
Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal number PN2110173 dated June 29, 2011. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork, site preparation and the design and construction of foundations and floor slabs for the proposed improvements.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Yogesh S. Rege, P.E.
Senior Associate
Department Manager – Geotechnical Services

Todd A. Griffith, P.E.
Project Geotechnical Engineer



Enclosures
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EXECUTIVE SUMMARY

A geotechnical engineering report has been completed for the proposed Canaan Valley State Park ski resort improvements project planned near Davis, West Virginia. Sixteen (16) borings, designated B-2 through B-17 (Boring B-1 was cancelled), were performed to depths ranging from about 5½ to 31 feet below the existing ground surface. This report provides our recommendations for earthwork, site preparation, and design and construction of foundations and floor slabs for the proposed improvements.

The following geotechnical considerations were identified:

- We understand that the project consists of improvements to the Canaan Valley State Park ski resort. The proposed improvements will include construction of a new beginner slope and a warming lodge plaza.

- The beginner slope will be constructed in an area which is partially occupied by two large ponds. These ponds are proposed to be drained and backfilled. Once the ponds are drained the soft sediments at the bottom should be completely removed to expose at least stiff or medium dense natural soils or bedrock, prior to placement of structural backfill. Any seepage within the ponds should be drained and provided with an outlet for long term drainage prior to backfilling the ponds with structural fill.

- Many of the borings in the area of the beginner slope indicated existing uncontrolled fill. The fill indicated relatively high organic content, variable moisture contents, consistency and composition. Therefore, if this fill is left in place, it can result in uneven settlement of the beginner slope surface due to consolidation and degradation of the underlying poor quality and poorly compacted fill. This may result in required maintenance, such as re-grading and leveling of the slope. We also understand that lightly loaded structures such wooden decks and a conveyor lift will be located in this area. These structures can be damaged as well due to uneven settlements.

- If the owner accepts the risk associated with settlement of the uncontrolled fill causing unevenness of the proposed beginner slope surface in the future, then the fill may be left in place in its current state. If this is not acceptable, the fill should be undercut and replaced with compacted structural fill. It may be possible to reuse some of the undercut material if found to meet the requirements of structural fill.

- If the existing fill in the area of the beginner slope is to remain in place we recommend that the foundations of the proposed lightly loaded structures be supported on natural soils or bedrock below the existing fill, unless the owner accepts the risk associated with uneven settlements resulting in distress and damage of these structures due the uncontrolled fill.

- Boring B-17 was performed within the proposed footprint of the warming lodge and encountered about 8 feet of existing fill comprised of silty clay with topsoil and organics. Based on information provided by Chapman Technical Group, we understand that this area was previously excavated and the material was used as structural fill elsewhere. The excavation was then backfilled with uncontrolled fill/topsoil material. This fill material is not considered suitable for the support of the proposed lodge building. Therefore we recommend that the fill be undercut and replaced with well compacted structural fill material within and 5 feet beyond the building lines.

- Boring B-16 performed in the area of the proposed storage building encountered about 3 feet of existing fill. We understand that the storage building will be a pole barn type structure and will not have a floor slab. Therefore, we recommend that the foundations for the poles bear below the existing fill soils and complete removal and replacement of the fill within the building footprint area is not necessary.

- Support of structures and new fill on or above existing fill soils is discussed in this report. However, even with the recommended construction testing services, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill.

- Moderately high plasticity lean to fat clays were encountered in the area of the warming lodge. These types of soils have moderate to high shrink swell potential. Therefore, we recommend creation of 12-inch thick layer of low-volume change material beneath the proposed floor slabs and asphalt / concrete parking areas to reduce the potential adverse effects of moderate to high shrinking/swelling of the underlying soils. However, even if these procedures are followed, some movement and at least minor cracking in the structure should be anticipated. The severity of cracking and other damage such as uneven floor slabs will probably increase if any modification of the site results in excessive wetting or drying of the soils. Eliminating the risk of movement and distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. We would be pleased to discuss other construction alternatives with you upon request.

- We understand that concrete demolition debris is being considered for use as backfill within the existing pond areas of the beginner slope. We recommend if concrete debris is to be used, it be processed and broken down to allow proper placement and compaction. Large slabs of concrete should not be used. We recommend that that maximum size of the concrete pieces be limited to less than about 12 inches. Alternating layers of concrete and soil fill can be considered to fill in voids within the concrete fill. The concrete layer thickness should be limited to about 12 to 18 inches and soil layer thickness should be limited to that recommended under the **Section 4.2.2** of this report. We recommend that at least the top 3 feet of the subgrade in the beginner slope consist of soil structural fill material. In fill areas that will support structures, soil structural fill is recommended beneath and at least 10 feet beyond the proposed structures footprint to allow for uniformly compacted fill material.

- Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that Terracon be retained to monitor this portion of the work.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
CANAAN VALLEY RESORT BUILDING ADDITIONS
DAVIS, WEST VIRGINIA

Terracon Project No. N2115063
November 11, 2011

1.0 INTRODUCTION

A geotechnical engineering report has been completed for the proposed Canaan Valley State Park ski resort improvements project planned near Davis, West Virginia. Sixteen (16) borings, designated B-2 through B-17 (Boring B-1 was cancelled), were performed to depths ranging from about 5½ to 31 feet below the existing ground surface. This report provides our recommendations for earthwork, site preparation, and design and construction of foundations and floor slabs for the proposed improvements. Logs of the borings along with a boring location plan are included in Appendix A of this report.

The purpose of this report is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork
- foundation design and construction
- slab design and construction

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Improvements	The project will include construction of the following: Warming Lodge Building – 40' x 40' Storage Building – 20' x 40 ' Beginner Slope Conveyor lift Wooden decks
Building construction	Warming Lodge Building – Masonry and wood structure Storage Building – Pole building
Finished floor elevation	Warming Lodge Building – 3484.5 feet Storage Building – 3484.0 feet
Cut and fill slopes	No steeper than 2H:1V
Maximum Site Grading	Cut: 10 feet (assumed) Fill: up to 20 feet

ITEM	DESCRIPTION
Maximum allowable settlement	Building Columns: 1-inch (assumed) Building Walls: 1-inch (assumed)
Free-standing retaining walls	None known for site development
Below Grade Areas	We understand that below grade construction will not be included with this project.

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	Canaan Valley Ski Resort, Canaan Valley, West Virginia
Current ground cover	Two ponds (about 5 feet and 15 feet deep), existing buildings, parking and drive areas.
Existing topography	Gently rolling to steep topography

3.0 SUBSURFACE CONDITIONS

3.1 Geology

Canaan Valley lies in a transition zone known as the Folded Plateau (Kulander and Dean, 1986) between the Appalachian Valley and Ridge and the Appalachian Plateau. The Folded Plateau is approximately 25 to 30 miles wide in the Canaan Valley region and is characterized by broad synclines adjacent to relatively narrow anticlines. At the surface, Canaan Valley is a broad breached anticline and the rock in the center of the valley is nearly flat. Resistant sandstones of the Kanawha Formation form a horseshoe pattern around the northern plunge of the anticline and are absent to the south.

Specifically, the underlying rock stratum in the project area consists of the Greenbrier Limestone. This limestone is approximately 400 feet thick in this region and can be subdivided into six units in the area from the Denmar Limestone, Taggard Shale, Pickaway Limestone, Union Limestone, Greenville Shale, and Alderson Limestone (Fedorko et. al, 1994). Karst features, including caverns, sinkholes and highly irregular rock surfaces are common features within the Greenbrier formation. The Union Limestone is responsible for the development of numerous well-developed cave systems throughout the region.

Please note that our current scope of work for this project did not include exploration of karst features such as sinkholes, caves, irregular rock surfaces, voids, etc. In order to explore and investigate these features, a geophysical study combined with deep borings with rock coring would be required.

Terracon

3.2 Typical Profile

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs in Appendix A of this report. Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

3.2.1 Beginner Slope Area – Borings B-2 through B-7 and B-15

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered	Consistency/Density/ Hardness
Stratum 1	7.5 to 25 feet in Borings B-2, B-3, B-4, B-7 and B-15	Fill – clayey gravel, clayey sand, lean clay, gravelly lean clay, cobbles and boulders with rock fragments and organics	N/A
Stratum 2	2.5 feet in Boring B-5 and 20 feet in Boring B-7	Clayey sand with gravel	Very loose to loose
Stratum 3	Undetermined in Borings B-3 and B-6 as these borings were completed within this stratum; 8 to 20 feet in Borings B-4 and B-5	Sandy lean clay and gravelly lean clay	Soft to very stiff
Stratum 4	Undetermined in Borings B-2, B-4, B-5, B-7 and B-15 as borings were terminated within this stratum	Limestone, shale, and siltstone	Soft to hard

3.2.2 Warming Lodge Plaza Area – Borings B-8 through B-17

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered	Consistency/Density/ Hardness
Stratum 1	2 feet in Boring B-12 3 feet in Boring B-16 8 feet in Boring B-17	Fill – lean clay and silty clay with topsoil and organics	N/A
Stratum 2	2.5 feet in Boring B-14	Clayey gravel	Medium dense
Stratum 3	3 to 18.5 feet in Borings B-8 through B-13, B-16 and B-17	Silty clay, lean to fat clay, and lean clay	Medium stiff to very stiff
Stratum 4	Undetermined: borings were terminated within this stratum	Siltstone, sandstone, sandy siltstone and shale	Soft to hard

3.3 Groundwater

The boreholes were observed while drilling and after completion for the presence and level of groundwater. The water levels observed are noted on the attached boring logs, and are summarized below.

Boring Number	Depth to groundwater while drilling, ft.	Depth to groundwater after drilling, ft.
B-2	11	N/E
B-3	N/E	N/E
B-4	15	15
B-5	4	5 *
B-6	10	N/E
B-7	7.5	12
B-8	N/E	2 *
B-9	N/E	N/E
B-10	N/E	N/E
B-11	N/E	N/E
B-12	N/E	N/E
B-13	N/E	N/E
B-14	N/E	N/E
B-15	N/E	N/E
B-16	N/E	N/E
B-17	N/E	N/E

N/E – Not encountered

* – Water readings after completion of boring may have been affected due to introduction of water during rock coring process.

Due to the apparent karst topography at this site, the groundwater levels can be highly variable. Groundwater level fluctuations can also occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The following geotechnical considerations were identified:

- We understand that the project consists of improvements to the Canaan Valley State Park ski resort. The proposed improvements will include construction of a new beginner slope and a warming lodge plaza.

- The beginner slope will be constructed in an area which is partially occupied by two large ponds. These ponds are proposed to be drained and backfilled. Once the ponds are drained the soft sediments at the bottom should be completely removed to expose at least stiff or medium dense natural soils or bedrock, prior to placement of structural backfill. Any seepage within the ponds should be drained and provided with an outlet for long term drainage prior to backfilling the ponds with structural fill.

- Many of the borings in the area of the beginner slope indicated existing uncontrolled fill. The fill indicated relatively high organic content, variable moisture contents, consistency and composition. Therefore, if this fill is left in place, it can result in uneven settlement of the beginner slope surface due to consolidation and degradation of the underlying poor quality and poorly compacted fill. This may result in required maintenance, such as re-grading and leveling of the slope. We also understand that lightly loaded structures such wooden decks and a conveyor lift will be located in this area. These structures can be damaged as well due to uneven settlements.

- If the owner accepts the risk associated with settlement of the uncontrolled fill causing unevenness of the proposed beginner slope surface in the future, then the fill may be left in place in its current state. If this is not acceptable, the fill should be undercut and replaced with compacted structural fill. It may be possible to reuse some of the undercut material if found to meet the requirements of structural fill.

- If the existing fill in the area of the beginner slope is to remain in place we recommend that the foundations of the proposed lightly loaded structures be supported on natural soils or bedrock below the existing fill, unless the owner accepts the risk associated with uneven settlements resulting in distress and damage of these structures due the uncontrolled fill.

- Boring B-17 was performed within the proposed footprint of the warming lodge and encountered about 8 feet of existing fill comprised of silty clay with topsoil and organics. Based on information provided by Chapman Technical Group, we understand that this area was previously excavated and the material was used as structural fill elsewhere.

The excavation was then backfilled with uncontrolled fill/topsoil material. This fill material is not considered suitable for the support of the proposed lodge building. Therefore we recommend that the fill be undercut and replaced with well compacted structural fill material within and 5 feet beyond the building lines.

- Boring B-16 performed in the area of the proposed storage building encountered about 3 feet of existing fill. We understand that the storage building will be a pole barn type structure and will not have a floor slab. Therefore, we recommend that the foundations for the poles bear below the existing fill soils and complete removal and replacement of the fill within the building footprint area is not necessary.

- Support of structures and new fill on or above existing fill soils is discussed in this report. However, even with the recommended construction testing services, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill.

- Moderately high plasticity lean to fat clays were encountered in the area of the warming lodge. These types of soils have moderate to high shrink swell potential. Therefore, we recommend creation of 12-inch thick layer of low-volume change material beneath the proposed floor slabs and asphalt / concrete parking areas to reduce the potential adverse effects of moderate to high shrinking/swelling of the underlying soils. However, even if these procedures are followed, some movement and at least minor cracking in the structure should be anticipated. The severity of cracking and other damage such as uneven floor slabs will probably increase if any modification of the site results in excessive wetting or drying of the soils. Eliminating the risk of movement and distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. We would be pleased to discuss other construction alternatives with you upon request.

- We understand that concrete demolition debris is being considered for use as backfill within the existing pond areas of the beginner slope. We recommend if concrete debris is to be used, it be processed and broken down to allow proper placement and compaction. Large slabs of concrete should not be used. We recommend that that maximum size of the concrete pieces be limited to less than about 12 inches. Alternating layers of concrete and soil fill can be considered to fill in voids within the concrete fill. The concrete layer thickness should be limited to about 12 to 18 inches and soil layer thickness should be limited to that recommended under the **Section 4.2.2** of this report. We recommend that at least the top 3 feet of the subgrade in the beginner slope consist of soil structural fill material. In fill areas that will support structures, soil structural fill is recommended beneath and at least 10 feet beyond the proposed structures footprint to allow for uniformly compacted fill material.

- Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that Terracon be retained to monitor this portion of the work.

In the following paragraphs we have provided our geotechnical recommendations:

4.2 Site Preparation and Earthwork

All areas to be developed should be completely stripped of vegetation and topsoil to expose the underlying subgrade. The existing ponds will have to be completely drained and all of the soft sediments at the bottom should be completely undercut. The bottom of the undercut should expose at least stiff cohesive soils, medium dense granular soils or bedrock. Seepage within the ponds will have to be provided with a drainage outlet. If the provision for drainage is not made, it can lead to saturation of the structural fill that is placed within these areas. This can cause softening and settlement of the fill. Another option would be to use granular structural fill made of durable limestone aggregate for backfilling the ponds if long-term drainage provisions cannot be made. Dewatering measures after draining of the ponds during construction would still be required with the granular structural fill option if groundwater seepage is encountered.

We recommend that the nearby structures should be monitored during the draining and dewatering of the ponds as lowering of the water level in the ponds may cause settlement of the surrounding nearby structures. If any movement or distress to these structures is observed, the dewatering should be discontinued and the geotechnical engineer should be consulted.

Due to the presence and thickness of existing fill throughout the beginner slope site, a proof rolling program is very important to evaluate soft or unstable areas and undercutting or stabilization needs if the owner decides not to completely undercut and replace the existing fill soils. As previously stated, complete undercutting and replacement of the existing fill would be required to eliminate the risks associated with uneven and unpredictable settlements associated with the uncontrolled fill.

We recommend that the existing fill in the warming lodge area should be completely undercut and replaced with structural fill material. The excavated fill material is not considered suitable for reuse as structural fill due to the presence of topsoil and organics.

Proofrolling should be accomplished using a pneumatic-tired fully loaded (minimum 20 ton) tandem-axle dump truck and consist of a minimum of 3 passes by the proof rolling equipment. Soft, medium stiff or yielding areas discovered during proofrolling should be undercut or stabilized.

After the removal of unsuitable subgrade material, and prior to the placement of structural fill in areas below design grade, the subgrade should be scarified, moisture conditioned to within -2 to +3% of the material's optimum moisture content, and recompacted to the density recommended in **Section 4.2.2** below. This process will help to further delineate soft or disturbed areas. Unstable areas identified during scarification and recompaction should either be stabilized or undercut to expose stable material. If isolated soft or unstable areas are encountered, it may be necessary to place a layer of crushed stone to stabilize the subgrade and help expedite construction. If extensive soft or unstable conditions are encountered during site preparation, additional mechanical or chemical stabilization of the soils may be required. Terracon can assist with developing appropriate stabilization procedures based on conditions encountered during construction.

We recommend creation of 12-inch thick layer of low-volume change material beneath the proposed floor slabs and asphalt and concrete parking areas in the Warming Lodge Plaza area to reduce to adverse effects of the underlying moderate to high shrink-swell soils.

New structural fill to be placed on existing sloping ground should be properly benched into the existing slope. The benches should be made wide enough for proper placement and compaction by construction equipment. The benches should expose stiff/medium dense natural soils or bedrock.

4.2.1 Structural Fill Material Requirements

Structural fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Lean clay	CL (LL<40)	All locations and elevations
Lean to fat clay [2]	CL/CH (40<LL<50)	> 1.5 ft. below building finished grade
Fat clay [2]	CH (LL >50)	> 1.5 ft. below building finished grade
Well graded granular	SW or GW [3]	All locations and elevations
Low Volume Change Material [4]	CL, SW or GW and (LL<40 & PI<22)	All locations and elevations
On-Site Soils	Varies	The existing fill indicated high organic content at many locations. Some of the fill material may be suitable for reuse as structural fill, provided it meets the requirements stated herein and is free of organic matter and debris.

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.
2. Delineation of lean to fat clays should be performed in the field by a qualified geotechnical engineer or their representative.
3. Crushed limestone aggregate, limestone screenings, or granular material such as sand, gravel or crushed stone containing at least 18% low plasticity fines.

4. Low plasticity cohesive soil or granular soil having at least 18% low plasticity fines.

4.2.2 Structural Fill Compaction Requirements

Item	Description
Fill Lift Thickness	9-inches or less in loose thickness when heavy, self-propelled compaction equipment is used. 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used.
Minimum Compaction Requirement [1, 2] **Below Foundations and Slabs-on-grade**	98% of the material's maximum dry density value as determined by ASTM Standard Test Method D 698 (Cohesive Soil) 75% of material's maximum relative density value per ASTM Standard Test Methods D 4253 and D 4254 or 98% of the material's maximum dry density value as determined by ASTM Standard Test Method D 698 (Granular Material)
Moisture Content - Cohesive Soil	Generally -2% to +3% of optimum as determined by ASTM Standard Test Method D 698
Moisture Content - Granular Material [3]	Workable moisture level

1. We recommend that each lift of structural fill be tested by Terracon for moisture content and compaction prior to the placement of additional structural fill. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. If granular material is a coarse sand or gravel, and is of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate.
3. The gradation of a granular material affects its stability and the moisture content required for proper compaction.

4.2.3 Construction Considerations

Unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. The use of light construction equipment would aid in reducing subgrade disturbance. The use of remotely operated equipment, such as a backhoe, would be beneficial to perform cuts and reduce subgrade disturbance. Should unstable subgrade conditions develop, subgrade stabilization measures will be necessary. Consideration could be given to providing a layer of crushed stone over the prepared building subgrade to provide a working mat in order to help expedite construction.

Upon completion of cutting, filling, and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab construction.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Health and Safety Administration (OSHA) regulations to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

The geotechnical engineer and/or their representative should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills; backfilling of excavations into the completed subgrade, and just prior to construction of building floor slabs.

4.3 Warming Lodge Building and Storage Building Foundations

Boring B-17 was performed in the area of the lodge building. This boring encountered about 8 feet of fill comprised of silty clay with topsoil and organics. This fill material is not considered suitable for the support of the proposed lodge building. Therefore we recommend that the fill be undercut and replaced with well compacted structural fill material within and 5 feet beyond the building lines. After these measures are implemented, the proposed building can be supported on shallow footing foundations.

Boring B-16 was performed in the area of the proposed storage building. This boring encountered about 3 feet of existing fill during drilling. We understand that no floor slab is proposed in this building. Therefore, the existing fill material may remain in place. However, we recommend that the foundations for the poles bear below the existing fill soils within the at least stiff natural soils.

The building foundations can then be designed using an allowable bearing capacity of 3,000 psf for footings bearing on new structural fill material or at least stiff soils.

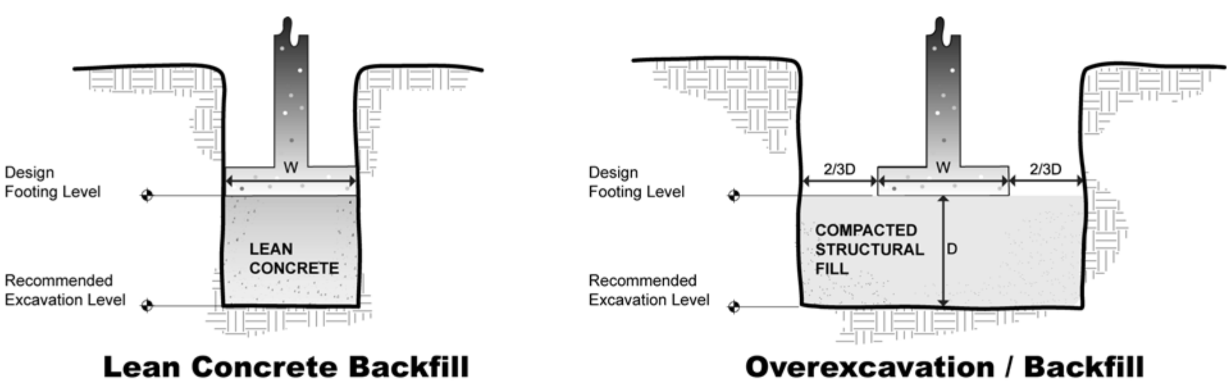
4.3.1 Design Recommendations

DESCRIPTION	SHALLOW FOOTINGS
Allowable bearing pressure [1]	3,000 psf
Minimum dimensions	30 inches for column footings 18 inches for wall footings
Minimum embedment below finished grade for frost protection [2]	36 inches
Approximate total settlement [3]	1 inch
Estimated differential settlement [3]	¾ inch

1. Assumed that the foundations bear on at least stiff natural soils.
2. For exterior foundations depth below the lowest adjacent exterior grade.
3. The foundation settlement will depend upon the variations within the subsurface profile.

4.3.2 Construction Considerations

If unsuitable bearing soils are encountered in footing excavations, the excavations should be extended deeper to suitable soils and the footings could bear directly on these exposed soils at the lower level or on lean concrete backfill placed up to bottom of footing elevations in the excavations. The footings could also bear on properly compacted backfill extending down to the suitable soils. Overexcavation for compacted backfill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation. The overexcavation should then be backfilled up to the footing base elevation with well-graded granular material placed in lifts of 9 inches or less in loose thickness and compacted to at least 98 percent of the material's maximum standard Proctor dry density (ASTM D-698). Overexcavation for lean concrete backfill will not have to be laterally widened. The overexcavation and backfill procedures are described in the figure below.



NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

4.4 Floor Slab

4.4.1 Design Recommendations

ITEM	DESCRIPTION
Floor slab support	Subgrade prepared according to **Section 4.2** [1]
Modulus of subgrade reaction	100 pounds per square inch per in (psi/in) for point loading conditions
Aggregate base course [2]	4 inches

1. Floor slabs should be structurally independent of any building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation. A 12-inch thick low volume change layer should be created below the floor slab subgrade.
2. The floor slab design should include a capillary break, comprised of free-draining, compacted, granular material at least 4 inches thick.

Slabs-on-grade should be isolated from structures and utilities to allow for their independent movement. Joints should be constructed at regular intervals as recommended by the American Concrete Institute (ACI) to help control the location of any cracking. Keyed and doweled joints should be considered. A higher than normal percentage of steel bar reinforcement should be used in floor slabs supported over the existing fill to provide additional strength and help control crack displacement. The owner should be made aware that differential movement between the slabs and foundations could occur.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

4.4.2 Construction Considerations

Some of the cohesive soils encountered in the borings are known to possess moderate to high shrink swell potential. Therefore, the areas which expose these soils should include a 12-inch thick low volume change zone and be prepared as described in **Section 4.2** of this report.

On most project sites, the site grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may not be suitable for placement of base rock and concrete and corrective action will be required.

We recommend the area underlying the floor slab be rough graded and then thoroughly proofrolled with a loaded tandem axle dump truck prior to final grading and placement of base rock. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly compacted fill. All floor slab subgrade areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to placement of the base stone and concrete.

4.5 Pavement Subgrade

Subgrade preparation recommendations presented in this report should be followed. As indicated in **Section 4.2** of this report, we recommend a 12-inch low volume change zone beneath pavements subgrades for this project.

We recommend that the existing subgrade in the pavement areas be proofrolled and prepared in accordance with recommendations provided in **Section 4.2**. This surficial proofroll and compaction will help to provide a stable base for the placement and compaction of new structural fill, and delineates low density, soft, or disturbed areas that may exist below subgrade level. Unsuitable material encountered at subgrade design elevation should be further undercut and replaced with structural fill.

Groundwater levels should be maintained at least 3½ feet below pavements at all times to increase subgrade performance and pavement life. In addition, water can collect in granular base courses placed over cohesive soil subgrades, resulting in subgrade pumping and premature pavement deterioration. If this minimum separation cannot be achieved, consideration could be given to installing subdrains in conjunction with a permeable granular base course. If subdrains are not provided, the granular base material should consist of a dense-graded crushed stone, and be compacted to at least 98% of the material's maximum dry density.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soil thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soil. The civil design for the pavements with these conditions should include features to restrict or to collect and discharge excess water from the islands. Examples of features are edge drains connected to the storm water collection system or other suitable outlet and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Based on cohesive soil subgrade conditions, considering on-site near surface soil, flexible pavement design consisting of asphaltic concrete paving can be based on a CBR value of 3 and a resilient modulus of 4,500 psi. For rigid concrete pavement, a modulus of subgrade reaction of 100 pci can be used for design.

Long term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventive maintenance. The following recommendations should be considered the minimum:

- Site grading sloped away from the pavements;
- The subgrade and the pavement surface have a minimum ¼ inch per foot slope to promote proper surface drainage.
- Consider appropriate edge drainage and pavement under drain systems,
- Install joint sealant and seal cracks immediately,

Preventive maintenance should be planned and provided for through an on-going pavement management program. Preventive maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Preventive maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance.

4.6 Seismic Considerations

Code Used	Site Classification for Warming Lodge Plaza
2006 International Building Code (IBC) [1]	C [2]

1. In general accordance with the *2006 International Building Code,* Table 1613.5.2.
2. The 2006 International Building Code (IBC) requires a site soil profile determination extending a depth of 100 feet for seismic site classification. The current scope requested does not include the required 100 foot soil/bedrock profile determination. Borings for the project extended to a maximum depth of approximately 31 feet and this seismic site class definition considers that similar or better conditions continue below the maximum depth of the subsurface exploration. Additional exploration to deeper depths could be performed to confirm the conditions below the current depth of exploration. Alternatively, a geophysical exploration could be utilized in order to attempt to justify a higher seismic site class.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Support of structures and new fill on or above existing fill soils is discussed in this report. However, even with the recommended construction testing services, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: YSR	Project No. N2115063	Terracon Consulting Engineers & Scientists	SITE LOCATION PLAN
Drawn by: YSR	Scale: N.T.S	912 Morris Street Charleston, West Virginia 25301	CANAAN VALLEY STATE PARK IMPROVEMENTS
Checked by: TAG	File Name: SLP	PH. (304) 344-0821 FAX. (304) 342-4711	DAVIS, WEST VIRGINIA
Approved by: YSR	Date: 10/21/2011		EXHIBIT A-1

Approximate Boring Locations

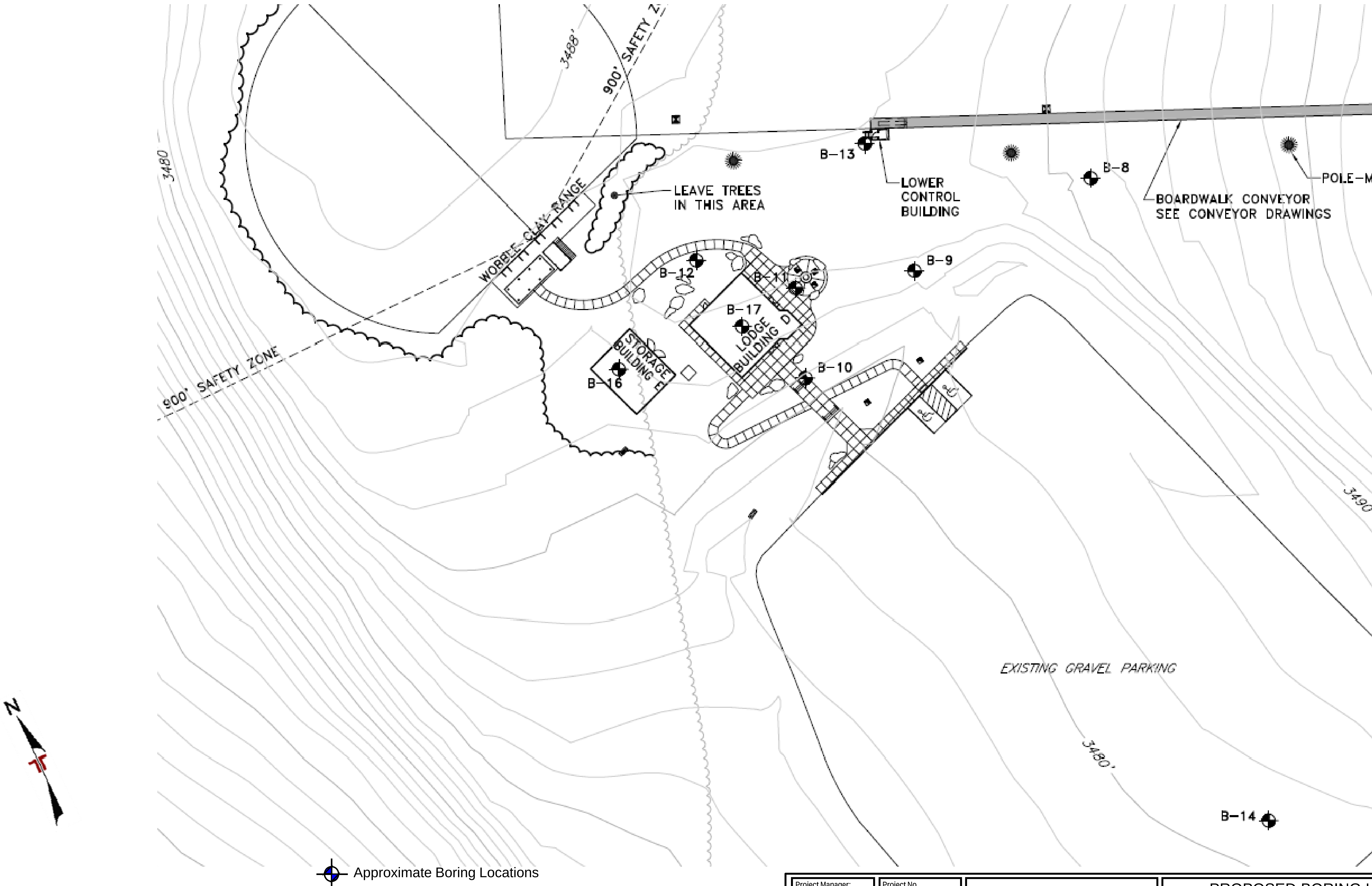
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: YSR	Project No. N2115063		
Drawn by: YSR	Scale: N.T.S.		
Checked by: TAG	File Name: BLP-N2115063		
Approved by: YSR	Date: 10/21/2011		

Terracon
Consulting Engineers & Scientists
912 Morris Street Charleston, West Virginia 25301
PH. (304) 344-0821 FAX. (304) 342-4711

PROPOSED BORING LOCATION PLAN
CANAAN VALLEY STATE PARK IMPROVEMENTS
BEGINNER SLOPE
DAVIS, WEST VIRGINIA

EXHIBIT
A-2



Approximate Boring Locations

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: YSR	Project No. N2115063	Terracon Consulting Engineers & Scientists	PROPOSED BORING LOCATION PLAN
Drawn by: YSR	Scale: N.T.S.		CANAAN VALLEY STATE PARK IMPROVEMENTS
Checked by: TAG	File Name: BLP-N2115063	912 Morris Street Charleston, West Virginia 25301	WARMING LODGE PLAZA
Approved by: YSR	Date: 10/21/2011	PH. (304) 344-0821 FAX. (304) 342-4711	DAVIS, WEST VIRGINIA

EXHIBIT A-3

LOG OF BORING NO. B-2

CLIENT
Chapman Technical Group

SITE
Davis, West Virginia

PROJECT
Canaan Valley Resort Ski Slope Improvements

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3489 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
FILL, clayey gravel, reddish brown, gray and brown, siltstone and shale gravel			1	SS	18	5	15			
			2	SS	18	7	17			
5 — 3484	5									
FILL, clayey gravel, trace sand and organics (grass), reddish brown with trace gray, siltstone and shale gravel			3	SS	18	10	14			
			4	SS	9	4	14			LOI=4.0%
	10		5	SS	12	4	18			
- Free water at 15'	15		6	SS	12	8	22			LOI=4.5%
20 — 3469	20									
LIMESTONE, fine grained, slight weathering, dark gray, moderately hard, abundant high angle joints			7	SS	3	50/.3				
			1	DB	6	RQD 75%				
			2	DB	54	RQD 10%				
- Fractured zone at 23' to 24.7' (24.7 — 3464.5)										
SHALE, slight weathering, dark gray, moderately hard, thin bedded (fissile)	25									
- Iron stained vertical fracture from 24.7' to 28.2'			3	DB	60	RQD 30%				
31 — 3458	30									
BORING COMPLETE										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
▽ 11	WD	▼	AB
▼		▼	

Exhibit A-4

Terracon

BORING STARTED	9-22-11		
BORING COMPLETED	9-22-11		
RIG	CME-45C	FOREMAN	JWW
LOGGED	JRB	JOB #	N2115063

LOG OF BORING NO. B-3

CLIENT
Chapman Technical Group

SITE
Davis, West Virginia

PROJECT
Canaan Valley Resort Ski Slope Improvements

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3480 ft

DEPTH (ft) / ELEV.	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf	
0.5 / 3479.5	**FILL**, road base material (cinders and gravel)			1	SS	12	18	4			
	FILL, clayey gravel with sand, reddish brown, sandstone fragments			2	SS	4	17	6			
7.5 / 3472.5		5		3	SS	3	5	9			LOI=9.4%
9 / 3471	**SANDY LEAN CLAY WITH GRAVEL**, reddish brown, very stiff, sandstone gravel, fine to coarse sand		CL	4	SS	18	17	12		9000*	
	Auger Refusal on possible bedrock **BORING COMPLETE**			5	SS	0	50/0				

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
	∇ N/E	WD	▼ N/E	AB
	▼		▼	
	Exhibit A-5			

Terracon

BORING STARTED			9-22-11
BORING COMPLETED			9-22-11
RIG	CME-45C	FOREMAN	JWW
LOGGED	JRB	JOB #	N2115063

LOG OF BORING NO. B-4

CLIENT: **Chapman Technical Group**	
SITE: **Davis, West Virginia**	PROJECT: **Canaan Valley Resort Ski Slope Improvements**

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3467 ft

DESCRIPTION	Depth / Elev.	DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
FILL, clayey gravel, reddish brown, sandstone and siltstone gravel				1	SS	12	10	10			
				2	SS	18	13	9			
		5		3	SS	18	5	8			LOI=4.2%
				4	SS	18	8	7			
- Trace organics at 10'		10		5	SS	3	14	10			
▼	15 / 3452	15									
GRAVELLY LEAN CLAY WITH SAND, reddish brown with gray, soft			CL	6	SS	18	3	34			
	20 / 3447	20									
SHALE, severe weathering, reddish brown, soft				7	SS	18	25				
	21.5 / 3445.5										
BORING COMPLETE											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
▽ 15	WD	▼ 15	AB	
▼		▼		
Exhibit A-6				

Terracon

BORING STARTED	9-21-11		
BORING COMPLETED	9-21-11		
RIG	CME-45C	FOREMAN	JWW
LOGGED	JRB	JOB #	N2115063

LOG OF BORING NO. B-5

CLIENT
Chapman Technical Group

SITE
Davis, West Virginia

PROJECT
Canaan Valley Resort Ski Slope Improvements

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3454 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	Atterberg Limits
CLAYEY SAND WITH GRAVEL, reddish brown, loose		SC	1	SS	18	5	19			
2.5 — 3451.5										
SANDY LEAN CLAY WITH GRAVEL, reddish brown, very stiff, sandstone gravel		CL	2	SS	18	15	12			LL=26, PI=10
	5	CL	3	SS	18	17	12			
8 — 3446			4	SS	18	24				
SHALE, severe weathering, reddish brown, soft	10		5	SS	18	33				
15 — 3439	15									
SILTSTONE, moderate weathering, reddish brown and dark gray, moderately hard to hard, vertically fractured and jointed			6	SS	18	50/.3				
			1	DB	54	RQD 13%				
20.8 — 3433	20									
BORING COMPLETE										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft		
▽ 4 WD	▼ 5 AB	

Exhibit A-7

Terracon

BORING STARTED	9-21-11
BORING COMPLETED	9-21-11
RIG CME-45C	FOREMAN JWW
LOGGED JRB	JOB # N2115063

REVISED BORING LOGS N2115063 BORING LOGS.GPJ TERRACON.GDT 10/21/11

LOG OF BORING NO. B-6

CLIENT: **Chapman Technical Group**

SITE: **Davis, West Virginia**

PROJECT: **Canaan Valley Resort Ski Slope Improvements**

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3437 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
	LEAN CLAY WITH GRAVEL, trace sand, reddish brown with dark gray, medium stiff		CL	1	SS	18	5	18			
	2.5 — 3434.5										
	GRAVELLY LEAN CLAY, trace sand, reddish brown with dark gray and brown, stiff		CL	2	SS	18	8	13			
		5	CL	3	SS	18	10	12			
	- With sand at 7.5' to 14'		CL	4	SS	18	11	14			
	- Wet at 10' ∇	10	CL	5	SS	18	7	13		2000*	
	14 — 3423										
	BORING COMPLETE			6	SS	0	50/0				

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				BORING STARTED	9-22-11		
∇ 10	WD	▼ N/E	AB	BORING COMPLETED	9-22-11		
▼		▼		RIG	CME-45C	FOREMAN	JWW
Exhibit A-8				LOGGED	JRB	JOB #	N2115063

LOG OF BORING NO. B-7

CLIENT: **Chapman Technical Group**

SITE: **Davis, West Virginia**

PROJECT: **Canaan Valley Resort Ski Slope Improvements**

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3465 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf	
	FILL, lean clay with sand, reddish brown, wet			1	SS	4	4	37			
	2.5 — 3462.5										
	FILL, cobbles and boulders (shale and sandstone)			2	SS	0	50/0	10			
	5 — 3460	5									
	FILL, gravelly lean clay, reddish brown with dark gray and brown, sandstone and limestone gravel			3	SS	18	7	17			
	7.5 — ▽ 3457.5										
	FILL, clayey sand with gravel, reddish brown, trace organics (grass)			4	SS	5	5	16			LOI=5.2%
	10 — 3455	10									
	CLAYEY SAND WITH GRAVEL, reddish brown, very loose, free water ▼		SC	5	SS	6	3				
		15	SC	6	SS	0	0				
	20 — 3445	20									
	SHALE, moderate weathering, reddish brown, soft			7	SS	18	46				
	21.5 — 3443.5										
	BORING COMPLETE										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
▽ 7.5	WD	▼ 12	AB	
▼		▼		
Exhibit A-9				

Terracon

BORING STARTED	9-21-11		
BORING COMPLETED	9-21-11		
RIG	CME-45C	FOREMAN	JWW
LOGGED	JRB	JOB #	N2115063

LOG OF BORING NO. B-8

CLIENT
Chapman Technical Group

SITE
Davis, West Virginia

PROJECT
Canaan Valley Resort Ski Slope Improvements

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3491 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
	SILTY CLAY, reddish brown, medium stiff to stiff		CL ML	1	SS	18	4	24		3500*
	3 ... 3488			2	SS	18	85			
	SILTSTONE, moderate weathering, reddish brown with dark gray, medium hard to moderately hard, fractured and jointed throughout, shaley and sandy zones	5		3	SS	6	50/.5			
				1	DB	60	RQD 0%			
		10		2	DB	60	RQD 25%			
	15.5 ... 3475.5	15								
	BORING COMPLETE									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
N/E	WD	2	AB
Exhibit A-10			

Terracon

BORING STARTED	9-21-11		
BORING COMPLETED	9-21-11		
RIG	CME-45C	FOREMAN	JWW
LOGGED	JRB	JOB #	N2115063

LOG OF BORING NO. B-9

CLIENT: **Chapman Technical Group**

SITE: **Davis, West Virginia**

PROJECT: **Canaan Valley Resort Ski Slope Improvements**

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3485 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	LEAN / FAT CLAY, reddish brown, medium stiff to stiff		CL	1	SS	12	6	24		9000*
	3 — 3482			2	SS	18	22			
	SHALE, severe weathering, reddish brown, soft									
	5 — 3480	5								
	SILTSTONE, moderate weathering, moderately hard, sandy zones, thin bedded			3	SS	6	50/0			
				4	SS	6	54			
	10 — 3475	10								
	10.8 — 3474 **SHALE**, moderate weathering, reddish brown, medium hard			5	SS	9	50/.3			
	BORING COMPLETE									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
	N/E	WD	N/E	AB
	Exhibit A-11			

Terracon

BORING STARTED	9-20-11
BORING COMPLETED	9-20-11
RIG CME-45C	FOREMAN JWW
LOGGED JRB	JOB # N2115063

LOG OF BORING NO. B-10

CLIENT: **Chapman Technical Group**

SITE: **Davis, West Virginia**

PROJECT: **Canaan Valley Resort Ski Slope Improvements**

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3483 ft

Depth (ft)	Description	Elevation (ft)
0–6	**LEAN CLAY**, trace sand and gravel, reddish brown, soft to medium stiff	3477
6–7.5	**SILTSTONE**, sandy, moderately severe weathering, reddish brown, medium hard, fractured	3475.5
7.5–15.5	**SILTSTONE**, moderate weathering, grayish brown, medium hard to moderately hard, thin bedded	3467.5
15.5	**BORING COMPLETE**	

USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	Atterberg Limits
CL	1	SS	8	3	25		3000*	
CL	2	SS	18	6	21		4000*	LL=32, PI=12
	3	SS	18	17				
	4	SS	18	55				
	5	SS	18	72				
	6	SS	6	50/.5				

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
	▽ N/E	WD	▼ N/E	AB
	▽		▽	
	Exhibit A-12			

Terracon

BORING STARTED	9-20-11		
BORING COMPLETED	9-20-11		
RIG	CME-45C	FOREMAN	JWW
LOGGED	JRB	JOB #	N2115063

LOG OF BORING NO. B-11

CLIENT: **Chapman Technical Group**

SITE: **Davis, West Virginia**

PROJECT: **Canaan Valley Resort Ski Slope Improvements**

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3486 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	Atterberg Limits
LEAN / FAT CLAY, trace sand and gravel, reddish brown, medium stiff to stiff		CL	1	SS	18	5	18		5000*	
		CL	2	SS	18	8	30		4500*	LL=44, PI=19
	5	CL	3	SS	18	7	15		9000*	
8 — 3478										
SILTSTONE, moderate weathering, grayish brown, medium hard			4	SS	18	52				
	10		5	SS	18	50				
15 — 3471										
SANDSTONE, moderate weathering, brown with dark brown, medium hard	15		6	SS	12	50/.5				
16 — 3470										
BORING COMPLETE										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
∇ N/E	WD	▼ N/E	AB	

Exhibit A-13

Terracon

BORING STARTED	9-20-11		
BORING COMPLETED	9-20-11		
RIG	CME-45C	FOREMAN	JWW
LOGGED	JRB	JOB #	N2115063

LOG OF BORING NO. B-12

CLIENT	
Chapman Technical Group	
SITE: Davis, West Virginia	PROJECT: Canaan Valley Resort Ski Slope Improvements

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3488 ft

GRAPHIC LOG	DESCRIPTION	Depth, ft	Elev., ft
	FILL, lean clay with gravel, trace organics (roots and wood fragments), reddish brown	2	3486
	LEAN CLAY, trace sand and gravel, reddish brown, medium stiff to stiff	8	3480
	SILTSTONE, complete weathering, brown with trace reddish brown, soft	10	3478
	SANDSTONE, moderate weathering, brown, moderately hard	12.3	3475.5
	SANDSTONE, severe to moderately severe weathering, brown, soft to medium hard	18.9	3469
	SANDSTONE, medium grained with shale inclusions, slight weathering, light gray with dark gray, hard, moderately fractured	22.4	3465.5
	SANDSTONE, slight weathering, light gray, hard to very hard, well cemented	26	3462
	BORING COMPLETE		

USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	Atterberg Limits
	1	SS	18	6	26			
CL	2	SS	18	5	30		4000*	LL=38, PI=15
CL	3	SS	18	9	20		8500*	
	4	SS	18	30	16			
	5	SS	6	50/.5				
	1	DB	6	RQD 0%				
	2	DB	38	RQD 0%				
	3	DB	60	RQD 22%				
	4	DB	60	RQD 20%				

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
N/E	WD		AB

Exhibit A-14

Terracon

BORING STARTED	9-20-11		
BORING COMPLETED	9-20-11		
RIG	CME-45C	FOREMAN	JWW
LOGGED	JRB	JOB #	N2115063

LOG OF BORING NO. B-13

CLIENT: **Chapman Technical Group**

SITE: **Davis, West Virginia**

PROJECT: **Canaan Valley Resort Ski Slope Improvements**

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3487 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
LEAN CLAY WITH GRAVEL, trace sand, reddish brown with dark gray, medium stiff to stiff		CL	1	SS	4	7	16		
		CL	2	SS	18	9	18		
5.5 — 3481.5	5		3	SS	18	30			
SILTSTONE, complete to moderate weathering, reddish brown, soft to medium hard, shaley and sandy zones			4	SS	12	50/.5			
	10		5	SS	18	90			
15 — 3472	15		6	SS	12	50/.5			
SILTSTONE, moderate weathering, grayish brown, moderately hard, thin bedded									
20 — 3467	20		7	SS	16	50/.4			
SANDSTONE, moderately severe weathering, brown, medium hard									
21.4 — 3465.5									
BORING COMPLETE									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
	N/E	WD	N/E	AB

Exhibit A-15

Terracon

BORING STARTED	9-21-11		
BORING COMPLETED	9-21-11		
RIG	CME-45C	FOREMAN	JWW
LOGGED	JRB	JOB #	N2115063

LOG OF BORING NO. B-14

CLIENT
Chapman Technical Group

SITE
Davis, West Virginia

PROJECT
Canaan Valley Resort Ski Slope Improvements

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3481 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
2.5	**CLAYEY GRAVEL**, reddish brown, medium dense, sandstone and siltstone gravel, high clay content (3478.5)		GC	1	SS	18	21	14		
4	**SILTSTONE**, moderate weathering, reddish brown, medium hard, thin bedded (3477)			2	SS	7	50/.2			
5.5	**SANDSTONE**, moderate weathering, dark gray, moderately hard, fractured (3475.5)	5		3	SS	6	50/.5			
	BORING COMPLETE									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
∇ N/E	WD	▼ N/E	AB
▼		▼	

Exhibit A-16

Terracon

BORING STARTED	9-22-11		
BORING COMPLETED	9-22-11		
RIG	CME-45C	FOREMAN	JWW
LOGGED	JRB	JOB #	N2115063

REVISED BORING LOGS N2115063 BORING LOGS.GPJ TERRACON.GDT 10/21/11

LOG OF BORING NO. B-15

CLIENT: **Chapman Technical Group**

SITE: **Davis, West Virginia**

PROJECT: **Canaan Valley Resort Ski Slope Improvements**

Boring Location: As Shown on Test Boring Location Plan

Approx. Surface Elev.: 3530 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	
FILL, clayey gravel, reddish brown, siltstone and shale gravel			1	SS	18	3	25			
2.5 — 3527.5										
FILL, lean clay with gravel, trace sand and organics (roots and wood fragments), brown with dark gray			2	SS	18	2	42			LOI=11.3%
	5		3	SS	18	15	37			
- Large wood fragment at 7.5'			4	SS	12	4	52			
	10		5	SS	18	2	33			
	15		6	SS	18	4	32			LOI=12.2%
	20		7	SS	12	8	22			
25 — 3505	25									
SILTSTONE, clayey, slight weathering, reddish brown, moderately hard, few moderate angle slickensided surfaces			8 1	SS DB	0 60	50/.1 RQD 48%				
- Unconfined compressive strength at 27.4' = 235 tsf										
30.1 — 3500	30									
BORING COMPLETE										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
	∇ N/E	WD ▼	AB
	▼	▼	

Exhibit A-17

Terracon

BORING STARTED	9-22-11		
BORING COMPLETED	9-22-11		
RIG	CME-45C	FOREMAN	JWW
LOGGED	JRB	JOB #	N2115063

LOG OF BORING NO. B-16

CLIENT
Chapman Technical Group

SITE
Davis, West Virginia

PROJECT
Canaan Valley Resort Ski Slope Improvements

Boring Location: As Shown on Test Boring Location Plan

GRAPHIC LOG (depth)	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N** BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: DRY UNIT WT pcf	TESTS: UNCONFINED STRENGTH, psf
0.2	**TOPSOIL**									
3	**FILL**, silty clay with topsoil, sandstone fragments, and organics, dark brown			1	SS	10	6			
5.5	**LEAN TO FAT CLAY**, brown, very stiff		CL	2	SS	16	19			
6.5	**SILTY CLAY**, with sandstone, brown, very stiff	5								
7	**SANDSTONE**, very severely weathered, brown, soft		CL	3	SS	9	50/0.3			
	AUGER REFUSAL @ 7 feet									
	BORING COMPLETE									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft				
	▽ N/E	WD	▼ N/E	AB
	▽		▽	
	Exhibit A-18			

Terracon

BORING STARTED	11-2-11
BORING COMPLETED	11-2-11
RIG CME-55Track	FOREMAN CS
LOGGED YSR	JOB # N2115063

LOG OF BORING NO. B-17

CLIENT: **Chapman Technical Group**

SITE: **Davis, West Virginia**

PROJECT: **Canaan Valley Resort Ski Slope Improvements**

Boring Location: As Shown on Test Boring Location Plan

Depth to base, ft	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
0.1	**TOPSOIL**									
3	**FILL**, silty clay with topsoil and organics, dark brown, strong organic odor			1	SS	15	6			
8	**FILL**, silty clay with topsoil and organics, dark brown			2	SS	16	19			
		5		3	SS	12	20			
18.5	**SILTY CLAY**, very severely weathered siltstone, brown, thin bedded, very stiff to hard	10	CL ML	4	SS	18	52			
		15	CL ML	5	SS	16	28			
20	**SANDSTONE**, moderate weathering, gray, moderately hard	20		6	SS	1	50/0.1			
	AUGER REFUSAL @ 20 feet									
	BORING COMPLETE									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

**CME 140H SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
N/A	WD	N/E	AB
Exhibit A-19			

BORING STARTED	11-2-11
BORING COMPLETED	11-2-11
RIG CME-55Track	FOREMAN CS
LOGGED YSR	JOB # N2115063

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Field Exploration Description

The boring locations were staked in the field by Chapman Technical Group personnel. The ground surface elevations at the boring locations were either provided by Chapman Technical Group or estimated from the ground surface elevation contours shown on the provided site plans. The elevations shown on the boring logs are rounded to the nearest foot. The locations and elevations of the borings should be considered accurate only to the degree implied by the means and methods used to define them. The approximate boring locations are indicated on the attached Boring Location Plan.

The borings were drilled with a track-mounted rotary drill rig using continuous flight hollow-stem augers to advance the boreholes. Samples of the soil encountered in the borings were obtained using the split barrel sampling procedures.

In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a 140-pound CME auto-hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in-situ relative density of cohesionless soils and consistency of cohesive soils.

A CME automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. A significantly greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. This higher efficiency has an appreciable effect on the SPT-N value.

The soil samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions.

The borings were extended into the bedrock with a NQ2-size double tube-swivel core barrel. Percent recovery and rock quality designation (RQD) were calculated for the core samples and are noted at their depths of occurrence on the boring logs. RQD is the percent of total length cored consisting only of rock pieces at least 4 inches or more in length and is a measure of the integrity of the rock mass in-situ. Rock quality, in terms of RQD, can generally be designated as excellent (90%-100%), good (75%-90%), fair (50%-75%), poor (25%-50%) and very poor (<25%). The recovered samples were sent to the laboratory for testing and classification.

A field log of each boring was prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling, as well as, the driller's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

APPENDIX B
LABORATORY TESTING

Laboratory Testing

Moisture content tests were performed on samples in the laboratory. In addition Atterberg Limits, organic content, and unconfined compression tests were performed on selected soil and rock samples. A hand penetrometer was used to estimate the approximate unconfined compressive strength of some cohesive samples. The hand penetrometer has been correlated with unconfined compression tests and provides a better estimate of soil consistency than visual examination alone. Results of the laboratory tests are presented on the boring logs where possible and included in the appendix.

As a part of the laboratory testing program, the soil samples were classified in the laboratory based on visual observation, texture, and the limited laboratory testing described above. The soil descriptions presented on the boring logs for native soils are in accordance with our enclosed General Notes, General Notes – Description of Rock Properties and the Unified Soil Classification System. The estimated group symbol for the USCS is also shown on the boring logs, and a brief description of the Unified System is included in this report.

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-$^3/_8$" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2" O.D., 3" O.D., unless otherwise noted	PA:	Power Auger (Solid Stem)
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	BCR:	Before Casing Removal
WCI:	Wet Cave in	WD:	While Drilling	ACR:	After Casing Removal
DCI:	Dry Cave in	AB:	After Boring	N/E:	Not Encountered

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 - 15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 50	Dense
> 50	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	≥ 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75 to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

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UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]					Soil Classification	
					Group Symbol	Group Name[B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH		GM	Silty gravel[F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel[F,G,H]
S	ands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]		SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH		SM	Silty sand[G,H,I]
			Fines Classify as CL or CH		SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line[J]		CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]		ML	Silt[K,L,M]
		organic	Liquid limit - oven dried	< 0.75	OL	Organic clay[K,L,M,N]
			Liquid limit - not dried			Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line		CH	Fat clay[K,L,M]
			PI plots below "A" line		MH	Elastic Silt[K,L,M]
		organic	Liquid limit - oven dried	< 0.75	OH	Organic clay[K,L,M,P]
			Liquid limit - not dried			Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10} \quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

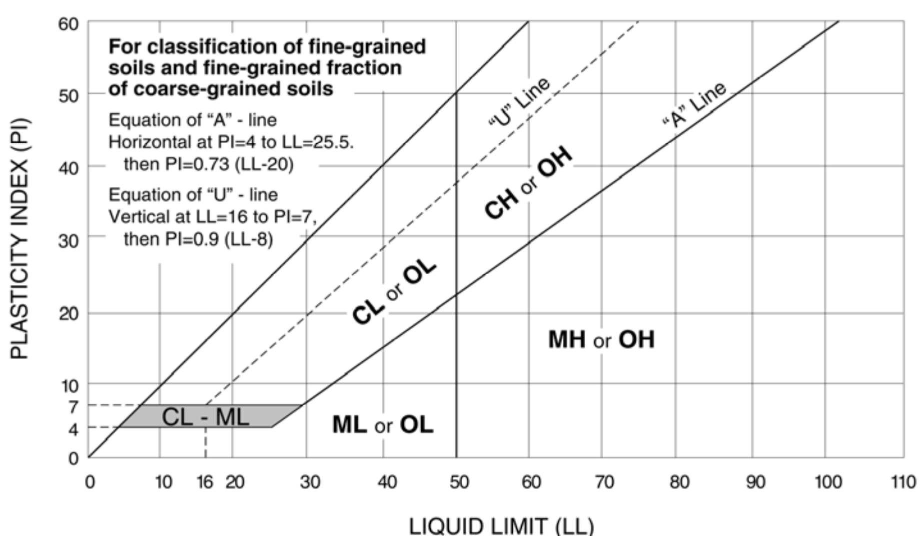
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Terracon

EXHIBIT C-2

Form 111—6/98

GENERAL NOTES

Description of Rock Properties

WEATHERING

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" not discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)

Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding and Foliation Spacing in Rock[a]

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

Rock Quality Designator (RQD)[b]		Joint Openness Descriptors	
RQD, as a percentage	Diagnostic description	Openness	Descriptor
Exceeding 90	Excellent	No Visible Separation	Tight
90 – 75	Good	Less than 1/32 in.	Slightly Open
75 – 50	Fair	1/32 to 1/8 in.	Moderately Open
50 – 25	Poor	1/8 to 3/8 in.	Open
Less than 25	Very poor	3/8 in. to 0.1 ft.	Moderately Wide
		Greater than 0.1 ft.	Wide

a. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.

b. RQD (given as a percentage) = length of core in pieces 4 in. and longer/length of run.

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers, 1976.
U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.