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CORPORATE ENVIRONMENTAL RISK MANAGEMENT
Client-Centered Solutions

Report of Subsurface Exploration and Geotechnical Engineering Evaluation South River Water Reclamation Center Upgrades Atlanta, Georgia CERM Project No. 2014-1317-005

For

Black & Veatch

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CORPORATE ENVIRONMENTAL RISK MANAGEMENT
Client-Centered Solutions

May 12, 2014

Black & Veatch
50 Hurt Plaza, Suite 1150
Atlanta, Georgia 30303

Attention: Mr. Gregory V. Goodman, P.E., P. Eng.
Senior Engineering Manager

Subject: **Report of Subsurface Exploration and Geotechnical Engineering Evaluation**
South River Water Reclamation Center Upgrades
Atlanta, Georgia
CERM Project No. 2014-1317-005

Dear Mr. Goodman:

Corporate Environmental Risk Management, LLC is pleased to provide this report of our subsurface exploration and geotechnical engineering evaluation for the referenced project. The field study and this report were accomplished in general accordance Black & Veatch's Amendment 2 to Agreement for Professional Services based on CERM Proposal No. 11p-0714-05 dated July 10, 2014.

The following report will present a brief summary of our pertinent findings and recommendations followed by our understanding of the proposed construction, methods of exploration employed, site and subsurface conditions encountered, and conclusions and recommendations regarding the geotechnical aspects of the project. Should you have any question regarding items discussed in this report, please do not hesitate to contact the undersigned.

Sincerely,
Corporate Environmental Risk Management, LLC

Kenneth A. Fluker, P.E.
Principal Engineer

GEORGIA REGISTERED No. PE029131 PROFESSIONAL ENGINEER KENNETH A. FLUKER

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1.0 SUMMARY

The following is a brief summary of our pertinent findings and recommendations. The reader is referred to the remaining text of this report for elaboration on these items.

1. The property appears generally suitable for the proposed construction from a geotechnical standpoint.

2. General subsurface conditions beneath the existing ground surface consist of previously placed fill overlying residuum followed by partially weathered rock and auger refusal materials. The existing fill extends below to depths ranging between 3 and 14 feet below the existing ground surface. Below the existing fill, residuum extends to depths ranging between 37 and 53 feet below the existing ground surface. The residuum extends to elevations ranging from 754 to 788. A partially weathered rock layer was encountered from 36 to 47 feet (elevation 272 to 261) below the existing ground surface in boring B-1A. Below the residuum, partially weathered rock extending to depths between 40 and 51 feet were encountered in three of the six borings (B-2, B-3, and B-5). The partially weathered rock extended to elevations ranging from 775 to 786. Auger refusal material was encountered in below the residuum and partially weathered rock at depths ranging between 40 and 53 feet. The auger refusal material encountered below partially weathered rock in borings B-2 and B-5 was cored to a depth of 50 feet (elevations 775 and 771, respectively) below the existing ground surface.

   Groundwater was encountered in all borings at the time of drilling to depths ranging between 20 and 38 feet below the existing ground surface. Stabilized groundwater levels were encountered at depths ranging between 13 and 33 feet below the existing ground surface. The stabilized groundwater levels were encountered at elevations ranging from 789 to 795. Stabilized water levels were recorded at elevation 790 in piezometers at boring B-1 and near boring B-6.

3. The proposed headworks building, chemical building, and digester control building may be supported on conventional shallow foundations bearing on the existing soil. The foundations for the headworks building and the chemical building may be designed using a net allowable bearing pressure of 2000 psf. The foundations for the digester control building may be designed using a net allowable bearing pressure of 3000 psf.

4. The foundations for each clarifier may be designed using a net allowable bearing pressure of 1500 psf. The foundations for the junction box may be designed using a net allowable bearing pressure of 2000 psf. The foundations for each digester may be designed using a net allowable bearing pressure of 2500 psf. Based on the anticipated bearing pressures, each clarifier's bottom slab may be designed using a modulus of subgrade reaction of 15 pci, and the junction box's bottom slab may be designed using a modulus of subgrade reaction of 34 pci. Each digester's bottom slab may be designed using a modulus of subgrade reaction of 10 pci. The proposed three tanks at the proposed chemical building may me supported on a common mat foundation designed using a modulus of subgrade reaction of 10 pci.

5. Construction of the proposed clarifiers, headworks building, and the junction box will occur below groundwater. Therefore dewatering techniques consisting of vacuum well points will be necessary to allow construction these structures below groundwater. A pump and sump arrangement for managing groundwater will likely be suitable at the proposed digester complex.

6. Excavations to the planned depths can generally be accomplished using conventional heavy earthmoving equipment.

7. The structures should be designed using Site Class “D”, as determined by the International Building Code 2012.

2.0 PROPOSED CONSTRUCTION

This project consists of improvements to the South River Water Reclamation Center. New clarifiers (4), a headworks building, a junction box, a chemical building, and a digester complex are planned for this project. The clarifiers will be oriented along line extending northwest to southeast between the north pump station and digester No. 3. The clarifiers will also be located adjacent to the northeast side of the aeration tanks. The headworks and junction box will be located at the mid point of the clarifiers’ common axis. The chemical building will be located near the southeast end of the clarifiers. The digester complex will be located northwest of digesters No. 4 and No. 5 and adjacent to the west side of Forrest Park Road.

The clarifiers will have diameters measuring about 165 feet in length. The top elevation will be about 801. The finished grade around the perimeters will vary between elevation 794 and 798. The bottom elevations at the perimeter of the clarifiers are planned to be about 786, and the bottom elevations at the center of the clarifiers are planned to be about 781. The maximum excavation for the block of concrete that encases the 36 inches diameter primary influent pipe is expected to be about 773.

The headworks building is planned as a single story structure with a basement. The plan dimensions are about 28 feet in width and 96 feet in length. The finished floor elevation at the entrance to the building is planned to be 803, and the finished floor elevation of the basement is planned to be 787. Pumps and piping will be located in the basement.

The junction box’s plan dimensions are about 17 feet in width and 64 feet in length. The top of the junction box is planned at about elevation 807, and the finish floor elevation at the bottom of the box is about 775.

The chemical building’s plan dimensions are about 25 feet in width and 38 feet in length. A secondary containment containing threes vertical tanks for ferric chloride storage will abut the southwest side (long side) of the building. The plan dimensions of the secondary containment are approximately 21 feet in width and 58 feet in length. Each vertical tank has a diameter of 12 feet and a height of 22 feet. Each tank will rest on a 14 feet diameter by 6 feet tall pedestal. The chemical building will be constructed at grade.

The new digester complex will consist of two digesters with a digester control building. The new digesters will be similar to the existing digesters No. 4 and No. 5. The existing digesters have a diameter of about 100 feet in length. The top elevations of the digesters are at about 839. The bottom elevations of the perimeter are about elevation 812, and the bottom elevation at the centers is about 797. The digester control building is a single story building with a basement. The plan dimensions are about 28 feet in width and 41 feet in length. The finished floor elevation at the building's entrance is 825, and the finished floor of the basement is approximately 812.

No additional information was available at the time of this report. The unit weight of the sludge is presumed to be at most 65 pcf. The unit weight of the ferric chloride is presumed to be at most 90 pcf. The buildings' wall and column loads are not expected to exceed 4 kips/ft and 100 kips, respectively.

3.0 METHODS OF EXPLORATION

3.1 Soil Borings

To evaluate the subsurface conditions, the property was explored by a combination of a visual site reconnaissance, drilling seven soil test borings (B-1 through B-6 and B-1A). Soil boring B-1 was terminated at a depth of 14 feet below the existing ground surface due to auger misalignment. Soil boring B-1A was drilled as an offset boring to boring B-1. Soil borings B-1A, B-3, B-4, and B-6 were drilled to a depth of 50 feet below the existing ground surface. Soil borings B-2 and B-5 were drilled to auger refusal. Soil borings B-2 and B-5 were also extended 10 and 4 feet, respectively, below their auger refusal depths using rock coring techniques to a depth of 50 feet below the ground surface. Auger borings were drilled adjacent to all soil test borings for the purpose of obtaining undisturbed tube samples, determining the depth to auger refusal, and installing a piezometer. Two piezometers were constructed for this project. One piezometer was installed within boring B-1, and the second piezometer was constructed adjacent to boring B-6. The boring locations are shown on the Site and Boring Location Plan, Figure 1, in the appendix. A typical diagram of the piezometers is provided on Figure 2 in the appendix.

The borings locations and elevations were surveyed in the field by CERM. The coordinates for Borings B-1, B-1A, and B-6 were adjusted from their initially staked locations due to offsets associated with access or utilities. The elevations of the offset borings were not adjusted because the ground surface was approximately level at the boring and staked locations. The coordinates and elevations for each boring are presented on its boring log.

All boring locations were scanned by a private utility locator using ground penetrating radar (GPR) and radio frequency detection prior to drilling. The Georgia Underground Protection Center (GA UPC) was notified as required by state law prior to drilling.

The borings were advanced by twisting continuous hollow stem auger flights into the ground. At selected intervals, Standard Penetration Resistance Testing (SPT) was performed in general accordance with ASTM D 1586, and soil samples were collected for visual classification and laboratory testing. The results of the penetration tests, when properly evaluated, provide an indication of the relative consistency of the soil being sampled, the potential for difficult excavation, and the soils ability to support loads. Select borings were advanced below their initial refusal levels by using rock coring techniques to determine the characteristics and continuity of materials below the soils refusal level. A more detailed description of the drilling and sampling process is included in the appendix of this report.

Soil samples recovered during the drilling process were returned to the office where they were classified in general accordance with the Unified Soil Classification System (USCS). Rock cores were examined and the core pieces recovered were classified by rock type, degree of hardness, percent recovered and Rock Quality Designation (RQD). Detailed descriptions of the materials encountered at each boring location, along with a graphical representation of the Standard Penetration Test results, are shown on the soil boring logs in the appendix.

3.2 Laboratory Tests

Laboratory testing consisted of performing 12 grain size analyses (ASTM C 136), 10 separate moisture content determinations (ASTM D 2216), 5 dry density tests (ASTM D 2937), and two standard tests for Unconfined Compressive Strength of Intact Rock Core Specimens (ASTM D7012-04, Method C. Laboratory test results are summarized in Table 1, and the test results are presented in the appendix.

The grain size (or particle size) analysis provides the size and percentage of gravel, sand and fines (silt and clays size fractions) by using sieves.

The moisture content is determined by taking the difference in weight between a moist sample and oven dried sample and comparing the difference in weight (water) to the oven dried weight.

The unconfined compression test is used to determine the compressive strength of the rock. The test consists of loading the rock specimen in compression along its longitudinal axis until the specimen fails in compression. The compressive strength is determined by dividing the failure load by the cross-sectional area of the rock specimen.

4.0 SITE DESCRIPTION, GEOLOGY AND SUBSURFACE CONDITIONS

4.1 Site Description

The project site is located within the existing South River Water Reclamation Center at 2640 Jonesboro Road, SE and 955 S River Industrial Blvd in Atlanta, Georgia. The topography slopes down to the south with a vertical relief of approximately 26 feet. Vegetation consists of landscaping such as grass, shrubs and trees. Existing structures consist of aeration tanks, one story buildings, and trailers associated with the water reclamation center.

4.2 Geology

The site is located in the Piedmont Physiographic Province of Georgia. The residual soils in the Piedmont are the result of the chemical and physical weathering of the underlying parent rock. The weathering profile usually results in fine grained clayey silts and silty clays near the surface, where weathering is more advanced. With depth, sandy silts and silty sands are found, often containing mica. Below the residual soils, partially weathered rock is often found as a transition above relatively unweathered rock. In local practice, partially weathered rock is arbitrarily defined as residual soils with Standard Penetration Resistances in excess of 100 blows per foot (50 blows per 6 inches), and which can be penetrated by a power auger.

4.3 Subsurface Conditions

The conditions described in the following sections, and those shown in the Appendix, have been based on interpolation of the soil test borings drilled at the site using generally accepted principles and practices of geotechnical engineering. However, conditions in this geology may vary intermediate of the tested locations, and even more so on previously developed property. Although individual soil test borings are representative of the subsurface conditions at the precise boring locations on the day drilled, they are not necessarily indicative of the subsurface conditions at other locations or other times. The nature and extent of variation between the borings may not become evident until the course of construction. If such variations are then noted, it will be necessary to re-evaluate the recommendations of this report after on-site observation of the conditions. The soil test borings encountered existing fill material, residuum, and auger refusal materials. Descriptions of the materials encountered in the borings are provided in the following sections.

4.3.1 Previously Placed Fill

Previously placed fill material was encountered in borings B-1 through B-6 and B-1A beneath the existing ground surface. The previously placed fill extends to depths ranging from 3 to 14 feet below existing ground surface. The fill is classified as silty sand with Standard Penetration Tests (SPT) ranging from 4 to 27 blows per foot (bpf). Based on the SPT results, the fill represented by these samples would be considered poorly to moderately compacted.

4.3.2 Residuum

Residuum was encountered in all borings below the previously placed fill. The residuum extends to depths ranging from 37 to 53 feet below the existing ground surface. The residuum extends to elevations ranging from 754 to 788. The residuum was classified as silty sand and sandy silt and was of low to high consistency. Standard Penetration Test results ranged from 7 to 53 bpf with 10 to 20 bpf being typical. A layer of partially weathered rock was encountered within the residuum at boring B-1A from 36 to 47 feet (elevation 272 to 261) below existing ground surface.

4.3.3 Partially Weathered Rock

Partially weathered rock (PWR) was encountered in all borings except B-4 and B-6 below the residuum. The PWR extends to depths ranging from 40 to 51 feet below existing ground surface in three of the six borings (B-2, B-3, and B-5). The partially weathered rock extended to elevations ranging from 775 to 786. A PWR layer was encountered within the residuum at a depth ranging from 36 to 47 feet below the ground surface in boring B-1A.

4.3.4 Auger Refusal

Auger refusal to the drilling process was encountered in borings B-2 and B-5 below PWR and residuum, respectively. The auger refusal depths ranged from 40 feet to 53 feet below existing ground surface. Borings B-2 and B-5 were advanced below auger refusal depths using rock coring techniques to a depth of 50 feet (elevations 775 and 771, respectively) below the existing ground surface.

A summary of the Percentage of Recovery and Rock Quality Designation (RQD) of the rock cored at each location is presented on the following table. The percentage of core recovered is measured as the amount of rock recovered as a percentage of the entire core length. The higher the percentage the more intact the rock is considered to be. RQD is a comparison of the total length of longer, intact pieces to the entire core length. A higher RQD indicates less fracturing than does a lower RQD.

Summary of Rock Cored

Core Location	Depth (Feet)	Elevation (Feet)	Core Recovered (%)	Rock Quality Designation
B-2	40-45	786-776	77	0.52
B-2	45-50	781 - 776	72	0.41
B-5	46-50	775 - 770	76	0.63

4.3.5 Groundwater

Groundwater was encountered in all borings at the time of drilling to depths ranging between 20 and 38 feet below the existing ground surface. Stabilized groundwater levels were encountered at approximate depths ranging between 13 and 33 feet below the existing ground surface. The stabilized water levels in the borings ranged between elevation 789 and 794. All borings except B-1A were backfilled with soil cuttings after obtaining stabilized groundwater levels. Boring B-1A was converted to a piezometer. A second piezometer was installed adjacent to boring B-6. The stabilized groundwater levels in the wells were measured 18 (elevation 790) and 17 feet (elevation 790) below the ground surface in wells B-1A and B-6, respectively. Groundwater fluctuations of 5 feet or more are common in this geology. Groundwater fluctuations are linked to changes in annual precipitation.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on the data gathered during this exploration, our understanding of the proposed construction, our experience with similar site and subsurface conditions and generally accepted principles and practices of geotechnical engineering. Should the proposed construction change significantly from that described in this report, we request that we be advised so that we may amend these recommendations accordingly. This report and the conclusions and recommendations provided herein are provided exclusively for the use of Black & Veatch and are intended solely for design of the referenced project.

5.1 Site Preparation

As an initial step in site preparation, all trees and unwanted vegetation should be removed, stumps grubbed and any organic topsoil stripped. Asphalt pavement should be stripped but the underlying base stone can remain in place.

All areas to receive fill should be evaluated prior to fill placement. The approval process should include proofrolling the subgrade with a fully loaded tandem axle dump truck (20 tons capacity) during a period of dry weather and under the observation of the geotechnical engineer. Any areas which "pump" or "rut" excessively under the weight of the proofrolling vehicle should be further evaluated, and may require undercutting or other remediation. The proofrolling can occasionally detect pits where stumps or other debris may have been buried, or other areas where weak surface conditions exist.

Any existing water bearing utilities beneath or near planned shallow foundations should be removed and rerouted a lateral distance at least of 10 feet beyond the edge of the foundation where practical. Following removal, their excavations should be properly backfilled as described in Section 5.2. If impractical to relocate, all water bearing utilities should be frequently checked for leaks because leaks can undermine foundation support by removing fine grains from the soil matrix.

5.2 Earthwork

The existing soils on the property visually appear suitable for reuse as structural fill. Moisture control may be necessary, primarily depending on the weather conditions at the time of construction. Any excavation near or below groundwater will produce soils excessively wet that will need substantial drying, which may not be practical. During dryer months, drying may be accomplished using mechanical means, but construction during wetter months will likely require lime or other chemical additives as a means of facilitating drying and soil compaction.

All structural fill should be compacted to at least 95 percent of the soil's standard Proctor maximum dry density, as determined by ASTM standard D 698. The upper foot of fill which will support pavements or slabs should be compacted to at least 98 percent of the soil's standard Proctor maximum dry density for improved support. In areas which are at or below the finished grade and which will support pavements or slabs, the upper 8 inches immediately below these systems should be scarified and recompacted to the 98 percent criteria. Structural fill should be free of organic material, have a plasticity index (PI) less than 20 and contain rock sizes no larger than 4 inches. Density testing should be performed by a soil technician to determine the degree of compaction and verify compliance with the project specifications. One field density test should be made for each one foot lift. Testing frequency should be increased in confined areas. Areas which do not meet the compaction specifications should be recompacted to achieve compliance. In confined areas, such as utility trenches, the use of portable compaction equipment and thin lifts of 3 to 4 inches may be required to achieve compaction.

5.3 Groundwater Control

Construction of the proposed clarifiers, headworks building, and the junction box will occur below groundwater. Therefore dewatering techniques consisting of vacuum well points will be necessary to allow construction these structures below groundwater. A sump and pump arrangement will not be practical for managing the groundwater conditions encountered at these structures.

The digester complex may encounter groundwater during its construction. A pump and sump arrangement for managing groundwater will likely be suitable at the proposed digester complex.

The depth to groundwater should be verified prior to beginning any construction operations affected by groundwater. The contractor is ultimately responsible for determining the method of dewatering. The dewatering method chosen will have a significant impact on the success of this project. The dewatering system should be established and operating well in advance of excavation. The groundwater should be lowered and remain 3 feet or more below the lowest elevation of the excavation. The dewatering system should remain functional 24 hours a day, 7 days a week until the structures are constructed and completely backfilled. The effectiveness of the dewatering system may be monitored with piezometers, and any additional well points added, if necessary.

The clarifier, headworks building and junction box should be designed to resist hydrostatic uplift forces once the dewatering system is disconnected. Considering that groundwater levels can rise 5 feet or more, the design groundwater elevation for resisting uplift should be 800. This elevation will affect the design of the digesters where the bottom elevation is proposed at 797 feet.

The resistance to hydrostatic uplift may be provided by the weight of concrete and/or helical anchors. A permanent dewatering system with drainage media around the sides and bottom of the clarifiers, digesters, and junction box may be used to reduce or eliminate the need for additional concrete or helical anchors when these structures are empty. However, the cost of operating and maintaining a permanent dewatering and drainage system may outweigh potential savings of additional concrete or helical anchors used to resist the uplift forces when the structure is empty.

Pressure relief valves in the slab and/or at the base of walls may be used for equalizing water pressures inside and outside the structures. However, pressure relief valves are not recommended as the primary method of resisting up lift due to hydrostatic pressure.

During the dewatering process, nearby buildings should be monitored for settlement. If dewatering activities are affecting the nearby buildings, dewatering activities should be suspended until the problem is resolved. If settlement of buildings is observed during the dewatering process, the structures' foundation systems may be underpinned with helical piers or micro piles to carry structural loads below the influence of the dewatering system. In some cases, the damage to buildings and utilities may be unavoidable resulting in repairs to damages after the dewatering process is completed.

5.4 Foundation Support

5.4.1 Headworks Building, Chemical Building, Digester Control Building

The proposed headworks building, chemical building, and digester control building may be supported on conventional shallow foundations bearing on the existing soil. The foundations for the headworks building and the chemical building may be designed using a net allowable bearing pressure of 2000 psf. The foundations for the digester control building may be designed using a net allowable bearing pressure of 3000 psf. These net values consider the weight of backfill and concrete below grade. The recommended bearing pressures are based on correlations with the Standard Penetration Test results. These correlations imply that a maximum total settlement of one inch is possible and a maximum differential settlement of half the total settlement is possible. Minimum foundation widths of 24 inches and 18 inches are recommended for individual column and strip footings, respectively, to preclude the possibility of localized soil bearing failures. Foundations should bear at least 18 inches below finished grades. This minimum embedment depth considers the frost depth, moisture changes in near surface soils due to drought, and the potential for near surface disturbance during the life of the foundation.

As with any construction, all foundation excavations should be evaluated by a geotechnical engineer, who will verify that the design bearing pressure is available intermediate of boring locations, and that foundations are not immediately underlain by worse conditions. If the engineer finds localized conditions of weaker or organic soil below an individual footing, the undesirable soil may be undercut depending upon the actual conditions found. Undercutting at the time of the foundation evaluation involves the engineer directing the contractor to remove undesirable soil or debris that negatively impacts the foundation design. The void remaining after undercutting is typically filled with stone aggregate or concrete. Structural fill as described in Section 5.2 may also be used to replace undercut material.

5.4.2 Clarifiers, Junction Box, Digesters, and Tanks at Chemical Building

The clarifiers, digesters and junction box may be supported on grade at the planned elevations. The foundations for each clarifier may be designed using a net allowable bearing pressure of 1500 psf. The foundations for the junction box may be designed using a net allowable bearing pressure of 2000 psf. The foundations for each digester may be designed using a net allowable bearing pressure of 2500 psf. These net values consider the weight of backfill and concrete below grade.

Based on the net allowable bearing pressures, each clarifier's bottom slab may be designed using a modulus of subgrade reaction of 15 pci, and the junction box's bottom slab may be designed using a modulus of subgrade reaction of 34 pci. Each digester's bottom slab may be designed using a modulus of subgrade reaction of 10 pci.

The proposed three tanks at the proposed chemical building may me supported on a common mat foundation in the secondary containment. The net allowable bearing pressure at the chemical building is 2000 psf. However, the maximum bearing pressure of the mat is expected to be 950 psf based of the unit weight of ferric chloride. The mat may be designed using a modulus of subgrade reaction of 10 pci based on the maximum bearing pressure.

The foundation excavations should be evaluated as described in Section 5.4.1.

5.5 Soil Supported Slabs

Building floor slabs may be soil supported, subject to the subgrade preparation and earthwork recommendations contained in this report. Crushed stone is not needed to support the slab loads and is considered optional.

5.6 Lateral Earth Pressures

Lateral earth pressures imposed on a retaining wall are a function of the soil properties, the inclination of the backfill behind the retaining wall, any surcharge loads applied behind the wall and the amount of deflection the wall system can undergo. Lateral earth pressures developed from the "active" condition are applicable for design of temporary or permanent free-standing retaining walls, if adequate wall movement can occur to fully mobilize the shear strength of the retained soil. Permanent laterally restrained walls, such as basement walls, should be designed for pressures using the full "at-rest" case. Based on the conditions found, the following equivalent fluid pressures are recommended, assuming no hydrostatic pressure, a horizontal backfill configuration, no surcharge loads, and "typical" Piedmont soils used for backfill.

Active Pressure	40 pcf
At Rest Pressure	60 pcf

Areas exposed to groundwater or surface infiltration of water should include a properly filtered footing and wall drain. The drain should include a perforated schedule 40 PVC pipe, placed in clean crushed stone, encapsulated in a 4 ounce needle punched nonwoven filter fabric.

The earth pressures provided above are for drained conditions which may not exist behind the proposed walls for structures below grade such as the clarifier, headworks building, junction box, and digesters. If drainage cannot be provided, the walls should be designed using the following earth pressures for submerged conditions.

Active Pressure	80 pcf
At Rest Pressure	90 pcf

Heavy compaction equipment should not be used to compact backfill immediately behind any retaining wall, unless the wall is designed for the increased pressure. Heavy compaction equipment should stay away from the wall a lateral distance equivalent to at least 60 percent of the wall's design height. Retaining wall backfill should be compacted to at least 95% of the soil's standard Proctor maximum dry density; therefore hand operated compaction equipment will be necessary in these areas.

Lateral loads can be resisted by passive pressures against the face of the foundation or sliding resistance on the base of the footing. An allowable equivalent fluid pressure of 75 pcf is recommended for passive resistance under submerged conditions and includes a factor of safety of about 2. An allowable equivalent fluid pressure of 150 pcf is recommended for passive resistance in drained conditions and includes a factor of safety of about 2. A factor of safety of at least 2 is recommended due to the large deflections required to mobilize full passive resistance. Additional resistance to movement can be gained by developing sliding friction on the base of the footing and an allowable friction factor of 0.4 may be used. This includes a factor of safety of about 1.5. Wall footings in areas occasionally submerged should be designed using the 75 pcf criteria for passive resistance.

5.7 Temporary Excavations

The construction of the below grade structures will require temporary excavations that are either sloped or braced for safety. If temporary slopes are used, they should be constructed no steeper than 1.5H:1V. Excavated soils should be stockpiled such that the toe of the stockpile is located no closer than 1.5 times the depth of the excavation from the surface edge of the excavation. More strict Occupational Safety Hazard Administration (OSHA) regulations may apply, and should be followed. However, if the regulations are lenient with regard to the recommendations stated previously, this office should be notified to evaluate the situation.

Shoring or Bracing may be necessary if sufficient space is not available to safely slope the sides of the excavations. The shoring or bracing system should be designed by a GA registered professional engineer.

5.8 Seismic Site Classification

Based on the data collected from the site, the structures should be designed using Site Class "D", as determined by the International Building Code 2012.

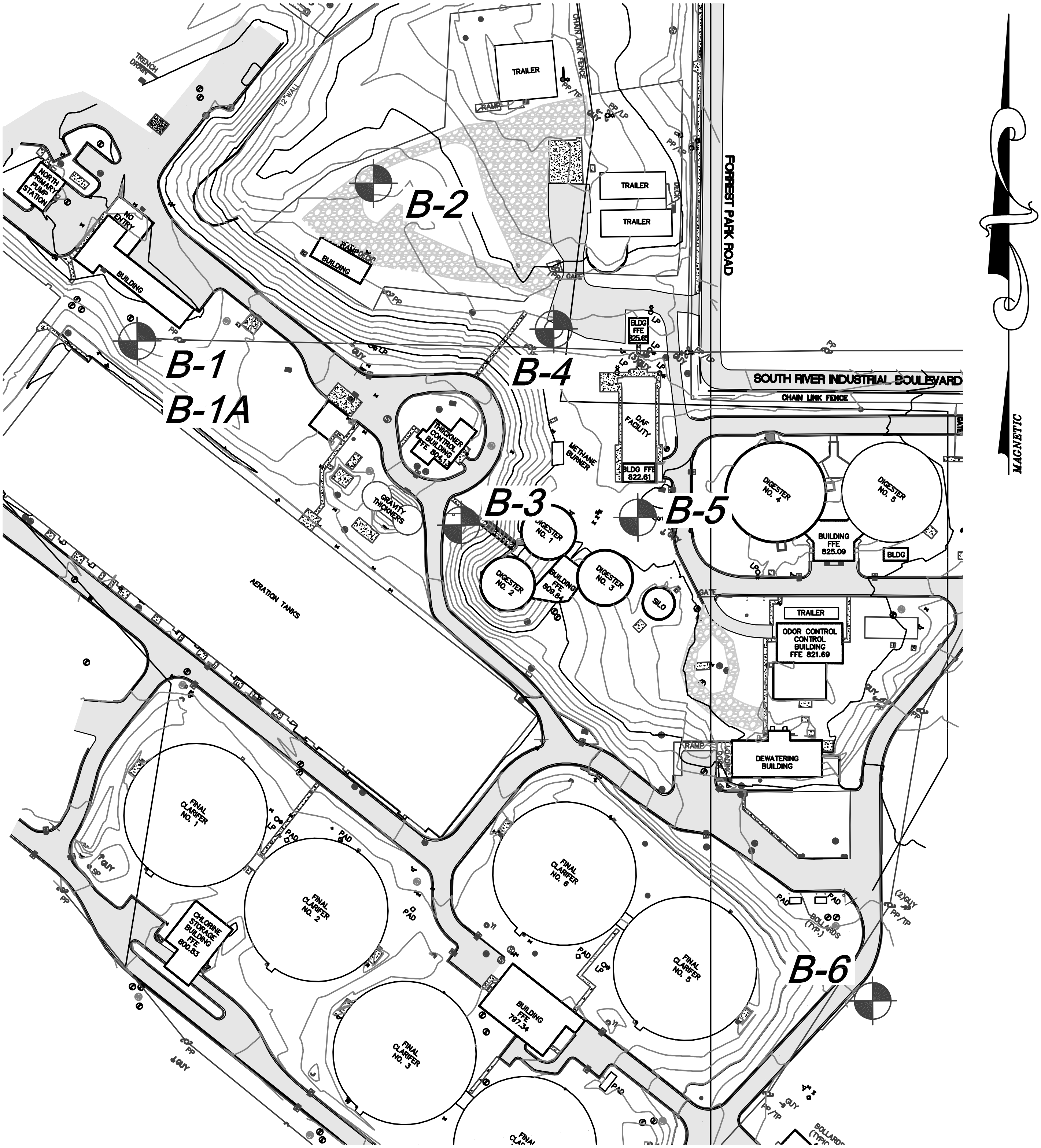
6.0 QUALIFICATIONS OF RECOMMENDATIONS

This evaluation of the geotechnical aspects of the proposed design and construction has been based on our understanding of the project and the data obtained during this study. The general subsurface conditions used in our evaluation were based on interpolation of the subsurface data between the borings. Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions will differ between boring locations, that conditions are not as anticipated by the designers, or that the construction process has modified the soil conditions. Therefore, experienced soil engineers and technicians should evaluate earthwork and foundation construction to verify that the conditions anticipated in design actually exist. Otherwise, we assume no responsibility for construction compliance with the design concepts, specifications or recommendations.

The recommendations contained in this report have been developed on the basis of the previously described project characteristics and subsurface conditions. If project criteria change, we should be permitted to determine if the recommendations should be modified. The findings of such a review will be presented in a supplemental report. Even after completion of a subsurface study, the nature and extent of variation between borings may not become evident until the course of construction. If such variations then become evident, it will be necessary to re-evaluate the recommendations of this report after on-site observations of the conditions.

These professional services have been performed, the findings derived, and recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all warranties either expressed or implied. This company is not responsible for the conclusions, opinions or recommendations of others based on these data.

APPENDIX



150 0 75 150 300

(IN FEET)
1 inch = 150 ft.

LEGEND

BORING LOCATION

NOTE: BORING LOCATIONS WERE SURVEYED BY CERM 7/16/2014.

REFERENCE: TOPOGRAPHIC SURVEYBY CERM DATED 6/5/2014.

ENGINEERS MANAGERS PLANNERS SCIENTISTS

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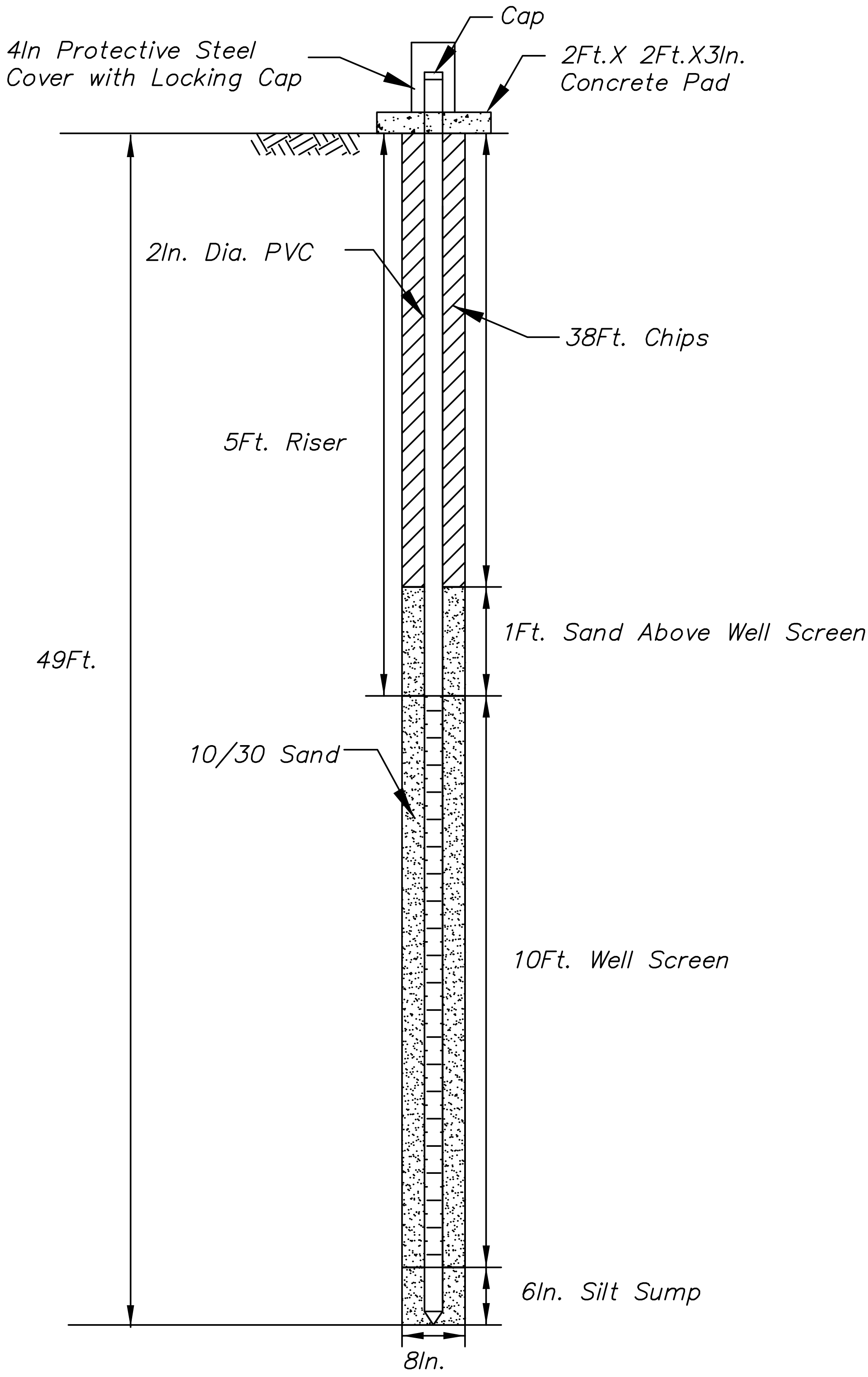
SITE AND BORING LOCATION PLAN

SOUTH RIVER WRC UPGRADES
ATLANTA, GEORGIA

PROJ. NO: 2014-1317-005

DATE: 7/17/2014

FIGURE NO. 1



TYPICAL

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PIEZOMETER DIAGRAM

SOUTH RIVER WRC UPGRADES
ATLANTA, GEORGIA

PROJECT #: 2014-1317-005

DATE: 9/5/2014

SCALE: NOT TO SCALE

FIGURE NO. 2

Summary of Laboratory Test Results
South River WRC Project
Atlanta, GA
CERM Project No. 2014-1317-005

Boring No.	Sample Depth (ft)	Natural Moisture (%)	Dry Density (pcf)	Wet Density (pcf)	Rock unconfined compression (psi)	% Passing No. 200 Sieve
B-1A	1-2.5	16.9	-	-	-	-
B-1A	13.5-15	13.0	-	-	-	20.9
B-1A	33.5-35	30.5	-	-	-	22.2
B-1A*	20-22	24.2	93.6	116.2	-	
B-2	6-7.5	25.7	-	-	-	45.5
B-2	28.5-30	11.3	-	-	-	20.2
B-2*	13.5-15.5	11.4	94.7	105.5	-	-
B-2	42.3-43.2	0.1	156.7	156.9	2577	-
B-3	13.5-15	-	-	-	-	24.8
B-3	38.5-40	16.7	-	-	-	20.9
B-3*	6-8	22.1	83.2	101.5	-	-
B-4	13.5-15	18.5	-	-	-	28.7
B-4	23.5-25	20.0	-	-	-	33.1
B-4*	13.5-15.5	19.3	92.8	110.7	-	-
B-5	8.5-10	-	-	-	-	24.3
B-5	28.5-30	-	-	-	-	21.3
B-5*	6-8	17.5	87.1	102.3	-	-
B-5	46-47	0.1	157.2	157.4	4713	-
B-6	18.5-20	-	-	-	-	17.4
B-6	38.5-40	-	-	-	-	18.7

* Auger boring offset from SPT boring.

SOIL TEST BORING PROCEDURES (ASTM D 1586 and 1587)

The soil test borings were advanced by twisting continuous auger flights into the ground. At selected intervals, soil samples were obtained by driving a standard 1.4 inch I.D., 2.0 inch O.D., split tube sampler into the ground. The sampler was initially seated six inches to penetrate any loose cuttings created in the boring process. The sampler is then driven an additional 12 inches by blows of a 140-pound "hammer" falling 30 inches. The number of blows required to drive the sampler the final foot is designated the Standard Penetration Resistance.

Relatively undisturbed samples were secured using a three-inch diameter, thin-wall steel tube sampler. In this sampling procedure, the borehole is advanced to the desired level, and the tube is lowered to the bottom of the boring. It is then pushed about two feet into the undisturbed soil in one continuous stroke. The sample and tube is retrieved from the borehole and detached from the drill string.

The samples recovered were sealed against moisture loss and were transported to the office where they were classified by an engineer in general accordance with the Unified Soil Classification System (USCS).

CORRELATION OF STANDARD PENETRATION RESISTANCE WITH RELATIVE COMPACTNESS AND CONSISTENCY

Sand and Gravel

Standard Penetration Resistance Blows / Foot	Relative Compactness
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
30 - 50	Dense
Over 50	Very Dense

Silt and Clay

Standard Penetration Resistance Blows / Foot	Relative Consistency
0 - 1	Very Soft
2 - 4	Soft
5 - 8	Firm
9 - 15	Stiff
16 - 30	Very Stiff
31 - 50	Hard
Over 50	Very Hard

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
ALLUVIUM				PT	ALLUVIUM, PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS
FILL				FILL	MATERIAL PLACED BY MAN

LOG OF BORING B-1

C·E·R·M

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

Date Completed: : 07/30/2014

Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon

Sample Legend

- Split Spoon

Ground Level Legend

- Stablized Water Level
- Time of Boring Water Level
- Borehole Collapse

Depth in Feet	Surface Elev. 808.0	Water Level	GRAPHIC	DESCRIPTION	Sample	SPT N-Value (blows/ft)
0	808			FILL: Stiff red brown fine sandy SILT (ML), micaceous	Split Spoon	14
				Very loose red brown silty fine SAND (SM), micaceous, rock fragements	Split Spoon	4
5	803			Firm red brown fine sandy SILT (ML), micaceous, rock fragements	Split Spoon	8
				Loose red brown silty fine SAND (SM), micaceous, rock fragements	Split Spoon	7
10	798					
15	793					
20	788					
25	783					
30	778					
35	773					
40						

Blow Count Graph: 10, 50

Boring terminated at 14 feet due to auger misalignment.

No groundwater encountered at time of boring.

Boring coordinates: N 1339872 and E 2237096

LOG OF BORING B-1A

C·E·R·M

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

Date Completed:	: 07/30/2014
Drilling Method	: Hollow Stem Auger
Sampling Method	: Split Spoon

Sample Legend

- Split Spoon

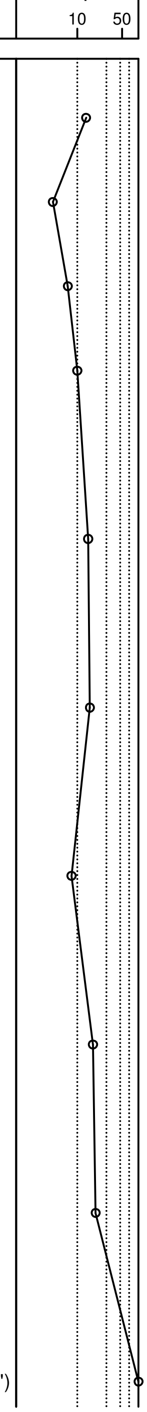
Ground Level Legend

- Stablized Water Level
- Time of Boring Water Level
- Borehole Collapse

Surface Elev. 808.0

Depth in Feet	Surface Elev. 808.0	DESCRIPTION	Sample	SPT N-Value (blows/ft)
0	808	FILL: Medium dense brown silty medium to fine SAND (SM), micaceous, rock fragements, organic material	Split Spoon	14
		Very loose to loose red brown silty fine SAND (SM), micaceous, rock fragements	Split Spoon	4
5	803		Split Spoon	7
			Split Spoon	10
10	798	RESIDUUM: Medium dense gray silty medium to fine SAND (SM), micaceous		
15	793		Split Spoon	15
		Medium dense gray silty medium to fine SAND (SM)	Split Spoon	16
20	788			
		Loose brown silty fine SAND (SM), micaceous		
25	783		Split Spoon	8
		Medium dense gray to red brown silty fine SAND (SM), micaceous, wet	Split Spoon	18
30	778			
35	773		Split Spoon	20
		PARTIALLY WEATHERED ROCK LAYER: Very dense gray silty fine SAND (SM), rock fragements, wet	Split Spoon	100(50/6")
40				

Blow Count Graph



LOG OF BORING B-1A

C·E·R·M

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

Date Completed: : 07/30/2014

Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon

Sample Legend
- Split Spoon

Ground Level Legend
- Stablized Water Level
- Time of Boring Water Level
- Borehole Collapse

Depth in Feet	Surface Elev. 808.0	Water Level	GRAPHIC	DESCRIPTION	Sample	SPT N-Value (blows/ft)	Blow Count Graph (10, 50)
40	768						
45	763				Split Spoon	100(50/3")	
				RESIDUUM: Dense tan silty fine SAND (SM), micaceous, wet			
					Split Spoon	40	
50	758						
55	753						
60	748						
65	743						
70	738						
75	733						
80							

Boring terminated at 50 feet; auger refusal encountered at 52 ft in adjacent auger boring.

Undistrubed tube sample taken at 20-22 feet in adjacent auger boring.

Boring coordinates: N 1339872 and E 2237099

LOG OF BORING B-2

C·E·R·M

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

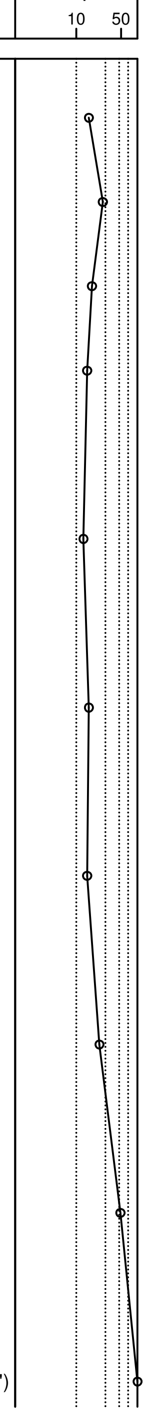
Date Completed:	: 07/28/2014
Drilling Method	: Hollow Stem Auger
Sampling Method	: Split Spoon

Sample Legend
- Split Spoon
- Rock core

Ground Level Legend
- Stablized Water Level
- Time of Boring Water Level
- Borehole Collapse

Depth in Feet	Surface Elev. 826.0	Water Level	DESCRIPTION	Sample	SPT N-Value (blows/ft)
0	826		FILL: Medium dense red brown silty fine SAND (SM), micaceous	Split Spoon	16
				Split Spoon	27
5	821		RESIDUUM: Medium dense red brown silty fine SAND (SM), micaceous	Split Spoon	18
			Stiff brown fine sandy SILT (ML), micaceous	Split Spoon	15
10	816				
15	811			Split Spoon	13
			Medium dense gray silty fine SAND (SM), micaceous	Split Spoon	16
20	806				
			- - rock fragements at 23.5 to 25 feet	Split Spoon	15
25	801				
				Split Spoon	24
30	796				
		Stablized Water Level	Very dense gray silty fine SAND (SM)	Split Spoon	53
35	791	Time of Boring Water Level			
			PARTIALLY WEATHERED ROCK : Very dense gray silty fine SAND (SM), wet Auger refusal at 40 ft. Rock coring commenced.	Split Spoon	100(50/1")
40					

Blow Count Graph



LOG OF BORING B-2

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

Date Completed:	: 07/28/2014
Drilling Method	: Hollow Stem Auger
Sampling Method	: Split Spoon

Sample Legend: Split Spoon; Rock core

Ground Level Legend: Stablized Water Level; Time of Boring Water Level; Borehole Collapse

Depth in Feet	Surface Elev. 826.0	Water Level	GRAPHIC	DESCRIPTION	Sample	SPT N-Value (blows/ft)	Blow Count Graph (10, 50)
40	786			1st RUN Moderately soft to hard gray broken competent GRANITIC GNESIS Recovery : 77% RQD : 0.52	Rock core		
45	781			2nd RUN Moderately hard to hard light to dark gray broken competent GRANITIC GNESIS Recovery: 72% RQD: 0.41	Rock core		
50	776						
55	771						
60	766						
65	761						
70	756						
75	751						
80							

Rock coring terminated at 50 feet

Undistrubed tube sample taken at 13.5-15.5 feet in adjacent auger boring.

Boring coordinates: N 1340039.2 and E 2237340.0

LOG OF BORING B-3

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

Date Completed: : 07/29/2014

Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon

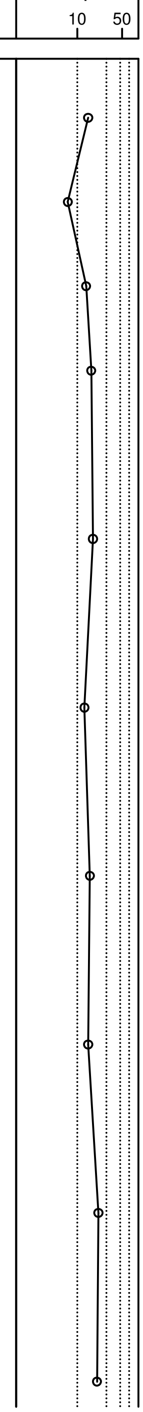
Sample Legend
- Split Spoon

Ground Level Legend
- ▼ Stablized Water Level
- ▽ Time of Boring Water Level
- ◆ Borehole Collapse

Depth scale (Depth in Feet / Surface Elev. 804.0): 0 – 804; 5 – 799; 10 – 794; 15 – 789; 20 – 784; 25 – 779; 30 – 774; 35 – 769; 40

DESCRIPTION	Sample	SPT N-Value (blows/ft)
FILL: Medium dense brown silty medium to fine SAND (SM), micaceous	Split Spoon	15
RESIDUUM: Loose to medium dense brown silty medium to fine SAND (SM), micaceous	Split Spoon	7
	Split Spoon	14
	Split Spoon	17
▼	Split Spoon	18
	Split Spoon	13
	Split Spoon	16
	Split Spoon	15
Medium dense to dense brown silty medium to fine SAND (SM), micaceous, wet ▽	Split Spoon	22
	Split Spoon	21

Blow Count Graph



LOG OF BORING B-3

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

Date Completed: : 07/29/2014

Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon

Sample Legend
- Split Spoon

Ground Level Legend
- Stablized Water Level
- Time of Boring Water Level
- Borehole Collapse

Depth in Feet	Surface Elev. 804.0	Water Level	GRAPHIC	DESCRIPTION	Sample	SPT N-Value (blows/ft)	Blow Count Graph (10, 50)
40	764						
45	759				Split Spoon	46	
				PARTIALLY WEATHERED ROCK : Very dense gray silty fine SAND (SM), rock fragement, wet	Split Spoon	100(50/3")	
50	754			Boring terminated at 50 feet; auger refusal encoutered at 51 feet in adjacent auger boring.			
55	749						
60	744						
65	739						
70	734						
75	729						
80							

Undistrubed tube sample taken at 6-8 feet in adjacent auger boring.

Boring coordinates: N 1339682.9 and E 2237431.6

LOG OF BORING B-4

C·E·R·M

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

Date Completed: : 07/29/2014

Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon

Sample Legend

⊠ Split Spoon

Ground Level Legend

▼ Stablized Water Level

▽ Time of Boring Water Level

◆ Borehole Collapse

Depth in Feet	Surface Elev. 825.5	Water Level	DESCRIPTION	Sample	SPT N-Value (blows/ft)
0	825		FILL: Medium dense red brown silty medium to fine SAND (SM)	⊠	18
			RESIDUUM: Loose red brown silty medium to fine SAND (SM), micaceous	⊠	10
5	820		Medium dense brown silty medium to fine SAND (SM), micaceous	⊠	18
				⊠	16
10	815				
				⊠	12
15	810				
			Medium dense brown silty fine SAND (SM)	⊠	11
20	805				
			Medium dense dark brown silty medium to fine SAND (SM), micaceous	⊠	11
25	800				
				⊠	16
30	795	▼			
				⊠	15
35	790				
		▽	Medium dense brown silty medium to fine SAND (SM), micaceous, wet	⊠	12
40					

Blow Count Graph

10 50

C·E·R·M

LOG OF BORING B-4

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

Date Completed: : 07/29/2014

Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon

Sample Legend: Split Spoon

Ground Level Legend: Stablized Water Level; Time of Boring Water Level; Borehole Collapse

Depth in Feet	Surface Elev. 825.5	Water Level	GRAPHIC	DESCRIPTION	Sample	SPT N-Value (blows/ft)	Blow Count Graph (10, 50)
40	785						
43.5–45	780			- - rock fragements at 43.5 to 45 feet.	Split Spoon	17	
48.5–50	775			- - rock fragements at 48.5 to 50 feet.	Split Spoon	18	

Boring terminated at 50 feet; auger refusal encountered at 52 feet in adjacent auger boring.

Undistrubed tube sample taken at 13.5-15 feet in adjacent auger boring.

Boring coordinates: N 1339887.2 and E 2237527.9

Depth scale: 40, 45, 50, 55, 60, 65, 70, 75, 80
Elevation scale: 785, 780, 775, 770, 765, 760, 755, 750

LOG OF BORING B-5

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

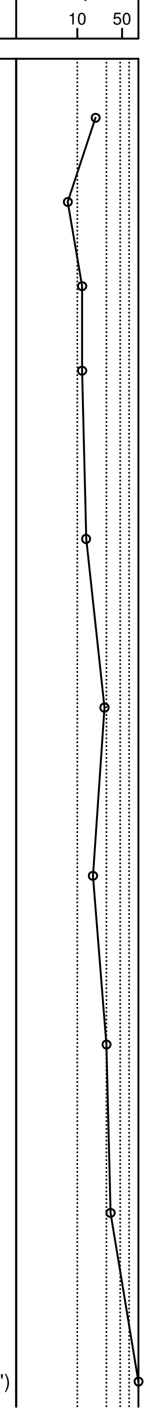
Date Completed:	: 07/29/2014
Drilling Method	: Hollow Stem Auger
Sampling Method	: Split Spoon

Sample Legend
- Split Spoon
- Rock core

Ground Level Legend
- Stablized Water Level
- Time of Boring Water Level
- Borehole Collapse

Depth in Feet	Surface Elev. 821	Water Level	DESCRIPTION	Sample	SPT N-Value (blows/ft)
0	821		FILL: Medium dense red brown silty medium to fine SAND (SM), rock fragements.	Split Spoon	20
			RESIDUUM: Loose brown silty fine SAND (SM)	Split Spoon	7
5	816		Medium dense brown silty fine SAND (SM), micaceous	Split Spoon	12
10	811			Split Spoon	12
			Medium dense brown silty medium to fine SAND (SM)	Split Spoon	14
15	806				
			Medium dense gray silty medium to fine SAND (SM), micaceous	Split Spoon	28
20	801				
			Medium dense dark brown silty fine SAND (SM), micaceous,	Split Spoon	18
25	796	Stablized Water Level			
30	791			Split Spoon	30
			Dense brown silty medium to fine SAND (SM), wet	Split Spoon	35
35	786	Time of Boring Water Level			
			PARTIALLY WEATHERED ROCK : Very dense gray silty fine SAND (SM), rock fragements, wet	Split Spoon	100(50/1")
40			Auger refusal at 46 ft. Rock coring commenced.		

Blow Count Graph



C·E·R·M

LOG OF BORING B-5

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

Date Completed: : 07/29/2014

Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon

Sample Legend: Split Spoon; Rock core

Ground Level Legend: Stablized Water Level; Time of Boring Water Level; Borehole Collapse

Depth in Feet	Surface Elev. 821	Water Level	GRAPHIC	DESCRIPTION	Sample	SPT N-Value (blows/ft)	Blow Count Graph (10, 50)
40	781						
45	776				Split Spoon	100(50/3")	
				1st RUN Hard dark gray broken competent GRANITIC GNESIS Recovery: 76% RQD: 0.63	Rock core		
50	771			Rock coring terminated at 50 feet Undistrubed tube sample taken at 6-8 feet in adjacent auger boring. Boring coordinates: N 1339690.8 and E 2237615.7			
55	766						
60	761						
65	756						
70	751						
75	746						
80							

LOG OF BORING B-6

C·E·R·M

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

Date Completed: : 07/30/2014

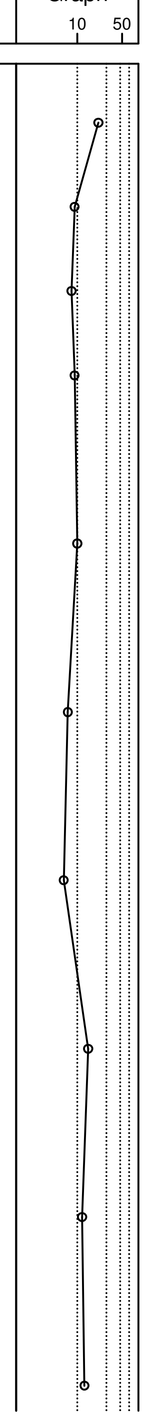
Drilling Method : Hollow Stem Auger
Sampling Method : Split Spoon

Sample Legend
- Split Spoon

Ground Level Legend
- ▼ Stablized Water Level
- ▽ Time of Boring Water Level
- ◆ Borehole Collapse

Depth in Feet	Surface Elev. 807.0	Water Level	DESCRIPTION	Sample	SPT N-Value (blows/ft)
0	807		FILL: Medium dense gray rock fragements.		
				Split Spoon	22
			Loose red brown silty medium to fine SAND (SM), micaceous		
				Split Spoon	9
5	802				
				Split Spoon	8
				Split Spoon	9
10	797				
			RESIDUUM: Stiff red brown fine sandy SILT (ML), micaceous		
				Split Spoon	10
15	792				
		▼	Loose gray silty fine SAND (SM), micaceous		
				Split Spoon	7
20	787	▽			
			Loose gray silty medium to fine SAND (SM), micaceous, wet		
				Split Spoon	6
25	782				
			Medium dense brown silty medium to fine SAND (SM), micaceous, wet		
				Split Spoon	15
30	777				
				Split Spoon	12
35	772				
				Split Spoon	13
40					

Blow Count Graph



LOG OF BORING B-6

Project: South River WRC Project
Location: Atlanta, GA

CERM Project No: 2014-1317-005

Date Completed:	: 07/30/2014
Drilling Method	: Hollow Stem Auger
Sampling Method	: Split Spoon

Sample Legend: Split Spoon

Ground Level Legend: Stablized Water Level; Time of Boring Water Level; Borehole Collapse

Depth in Feet	Surface Elev. 807.0	Water Level	GRAPHIC	DESCRIPTION	Sample	SPT N-Value (blows/ft)	Blow Count Graph (10, 50)
40	767						
45	762				Split Spoon	20	
50	757				Split Spoon	20	
55	752						
60	747						
65	742						
70	737						
75	732						
80							

Boring terminated at 50 feet; auger refusal encountered at 53 feet in adjacent auger boring.

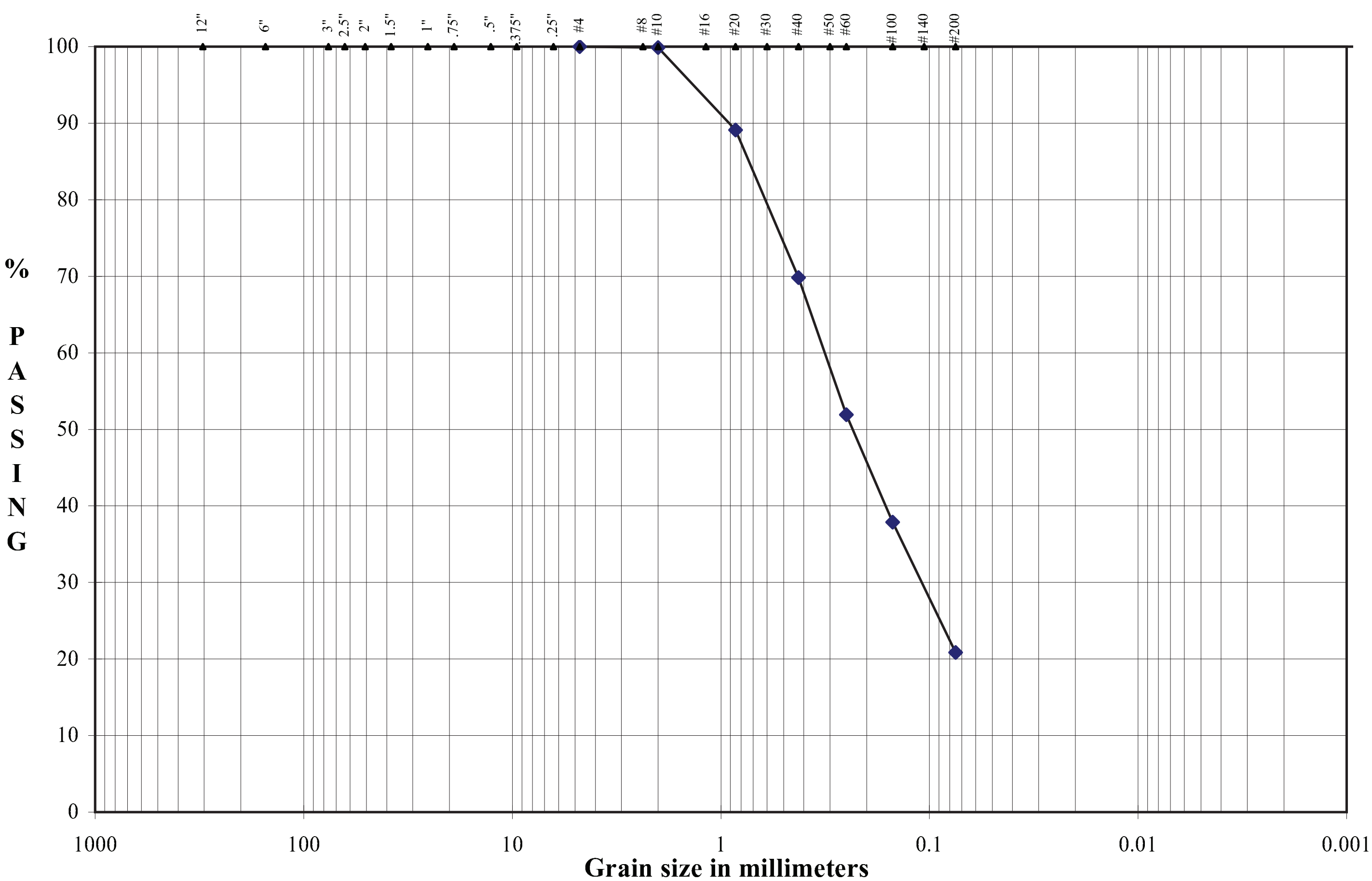
Boring coordinates: N 1339176 and E 2237861

T.E.S.T. TIMELY ENGINEERING SOIL TESTS, LLC	1874 Forge Street Tucker, GA 30084 Phone: 770-938-8233 Fax: 770-923-8973 Web: www.test-llc.com	Tested By	AV
		Date	08/07/14
		Checked By	[signature]

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Jar
Sample ID	18477/B-1A	Depth/Elev.	13.5-15'
Location	-	Add. Info	-

ASTM D 6913 (D 422 old version), D 1140, C 136, C 117 / AASHTO T 88, T 27, T 11, T 311
Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Particle-Size Analysis



Boulders	Cobbles	Gravel		Sand			Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt-Clay

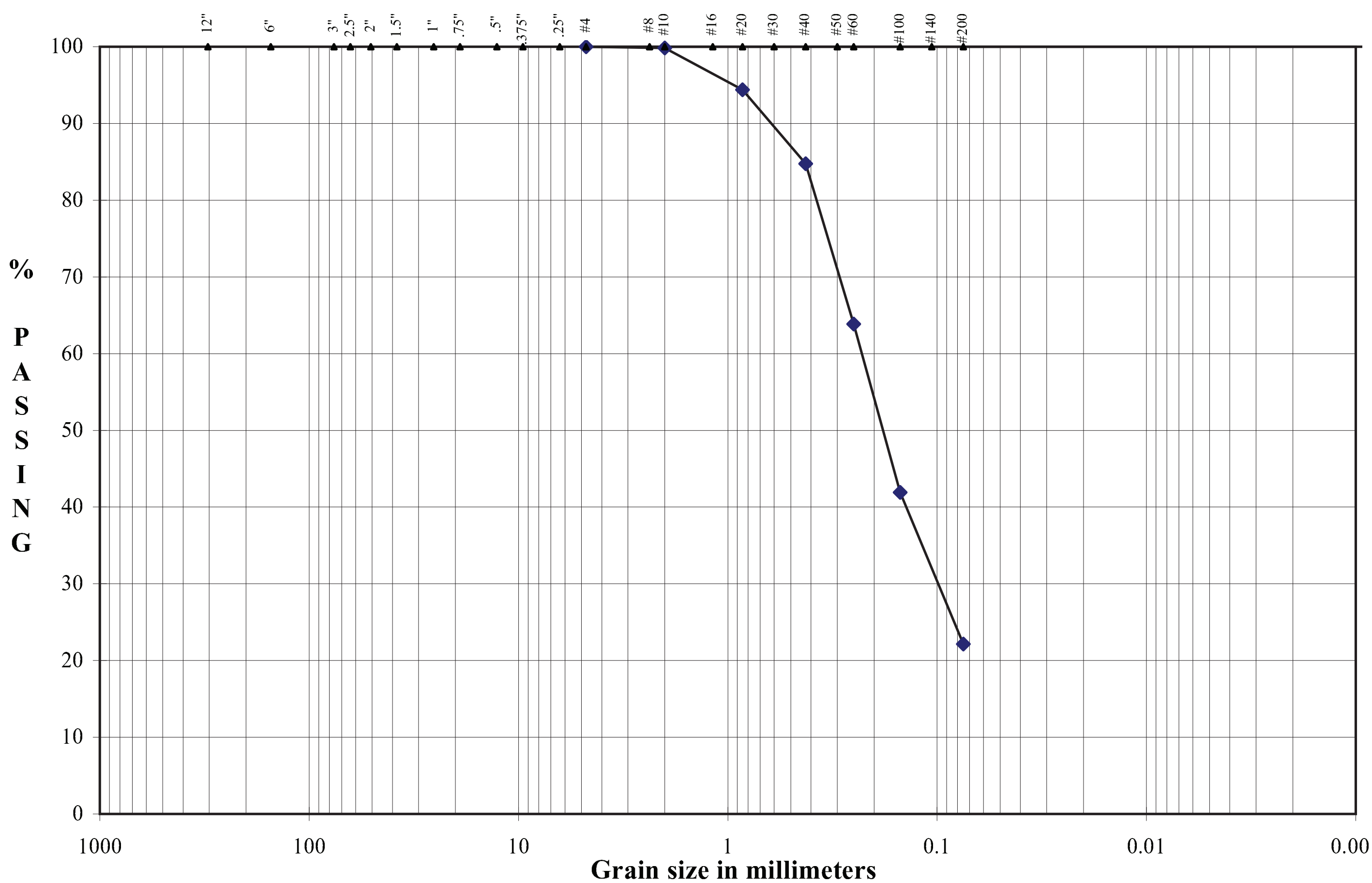
D_{10}	NA	mm
D_{30}	NA	mm
D_{60}	NA	mm
Cu	NA	
Cc	NA	

T.E.S.T. TIMELY ENGINEERING SOIL TESTS, LLC	1874 Forge Street Tucker, GA 30084 Phone: 770-938-8233 Fax: 770-923-8973 Web: www.test-llc.com	Tested By	AV
		Date	08/07/14
		Checked By	

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Jar
Sample ID	18478/B-1A	Depth/Elev.	33.5-35'
Location	-	Add. Info	-

ASTM D 6913 (D 422 old version), D 1140, C 136, C 117 / AASHTO T 88, T 27, T 11, T 311
Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Particle-Size Analysis



Boulders	Cobbles	Gravel		Sand			Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt-Clay

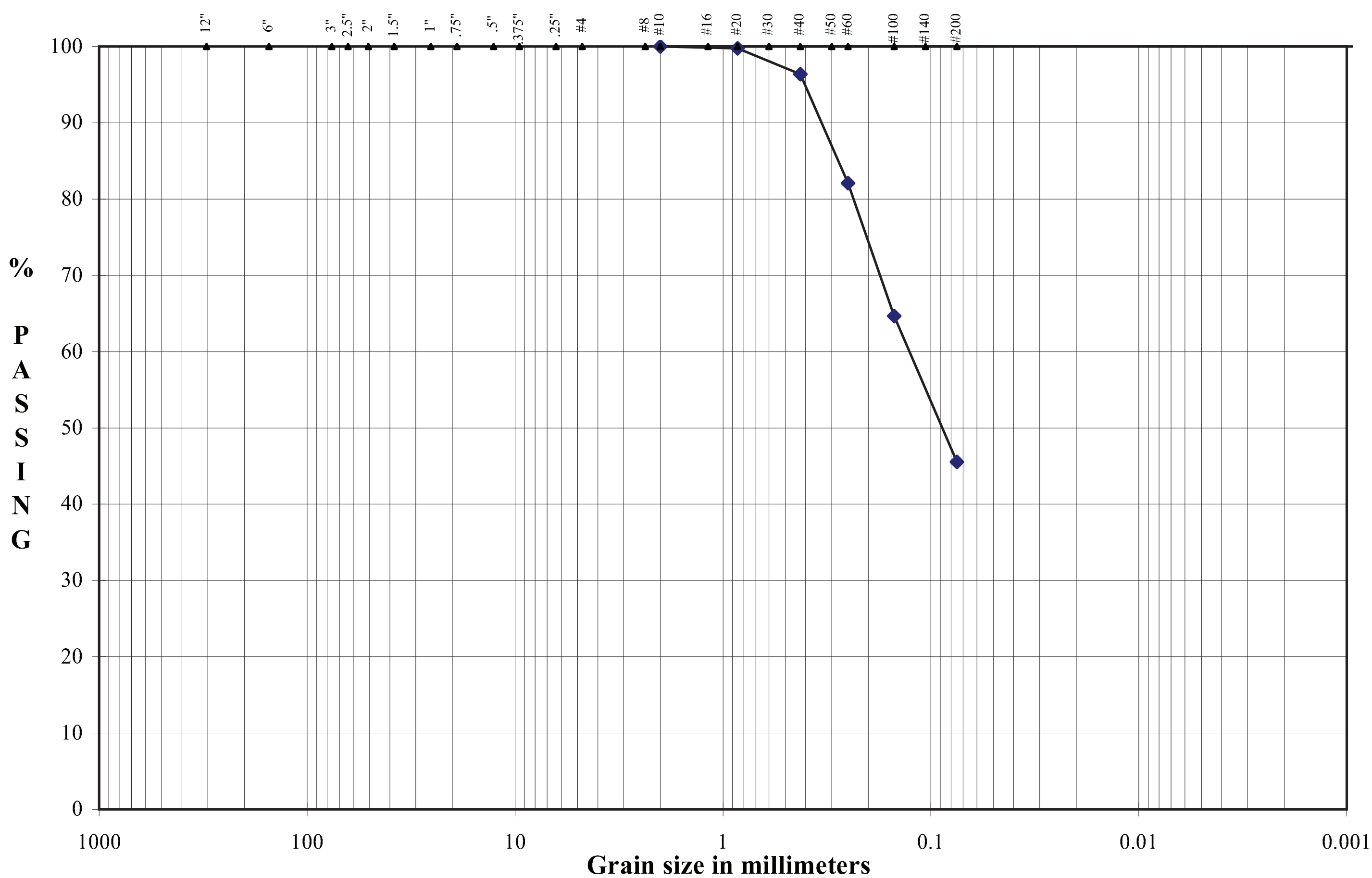
D_{10}	NA	mm
D_{30}	NA	mm
D_{60}	NA	mm
Cu	NA	
Cc	NA	

T.E.S.T. **TIMELY ENGINEERING SOIL TESTS, LLC**	1874 Forge Street Tucker, GA 30084 Phone: 770-938-8233 Fax: 770-923-8973 Web: www.test-llc.com	Tested By	AV
		Date	08/07/14
		Checked By	LB

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Jar
Sample ID	18480/B-2	Depth/Elev.	6-7.5'
Location	-	Add. Info	-

ASTM D 6913 (D 422 old version), D 1140, C 136, C 117 / AASHTO T 88, T 27, T 11, T 311
Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Particle-Size Analysis



Boulders	Cobbles	Gravel		Sand			Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt-Clay

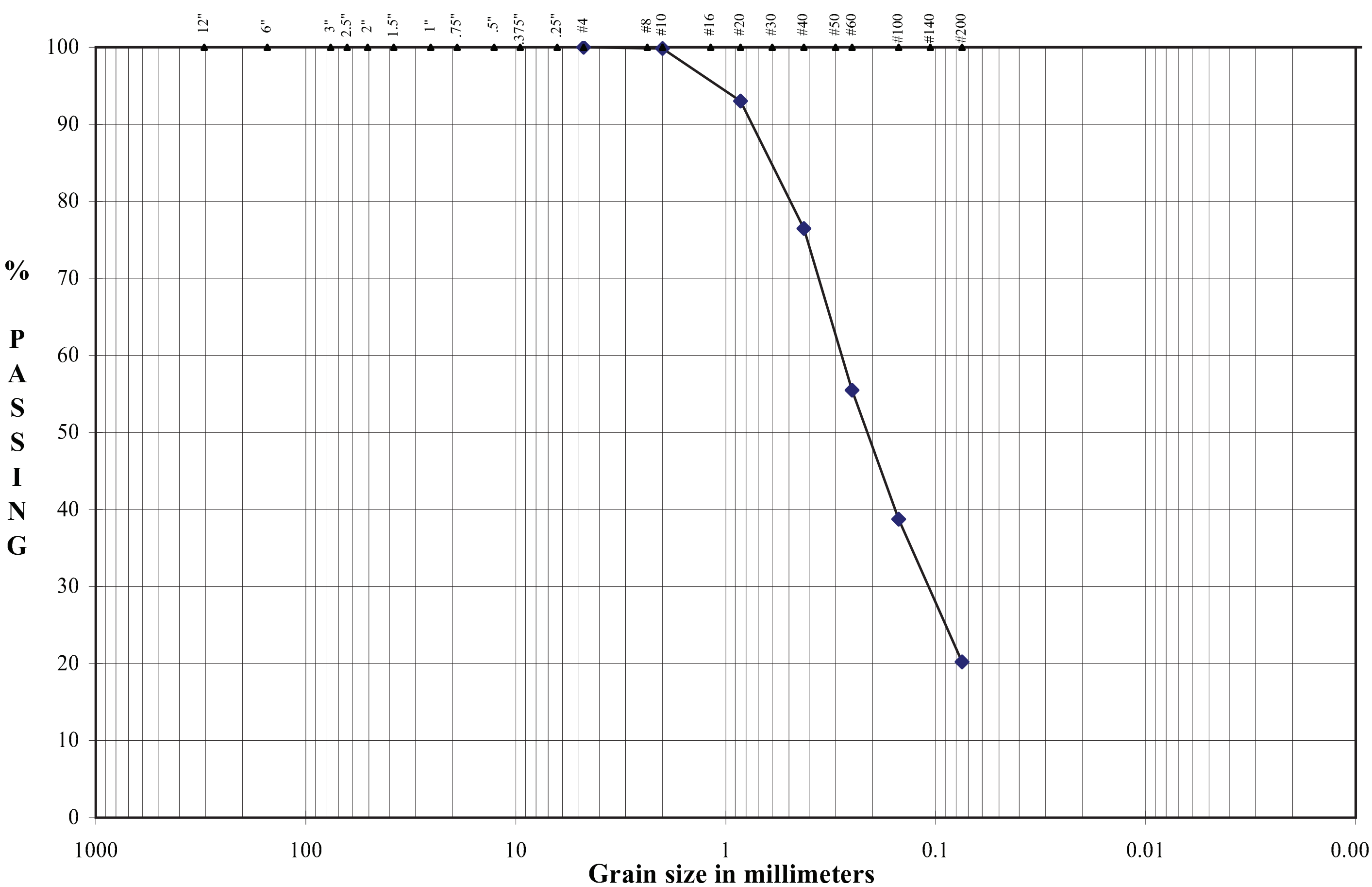
D_{10}	NA	mm
D_{30}	NA	mm
D_{60}	NA	mm
Cu	NA	
Cc	NA	

TIMELY ENGINEERING SOIL TESTS, LLC	1874 Forge Street Tucker, GA 30084 Phone: 770-938-8233 Fax: 770-923-8973 Web: www.test-llc.com	Tested By	AV
		Date	08/07/14
		Checked By	[signature]

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Jar
Sample ID	18481/B-2	Depth/Elev.	28.5-30'
Location	-	Add. Info	-

ASTM D 6913 (D 422 old version), D 1140, C 136, C 117 / AASHTO T 88, T 27, T 11, T 311
Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Particle-Size Analysis



Boulders	Cobbles	Gravel		Sand			Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt-Clay

D_{10}	NA	mm
D_{30}	NA	mm
D_{60}	NA	mm
Cu	NA	
Cc	NA	

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		Date	08/07/14
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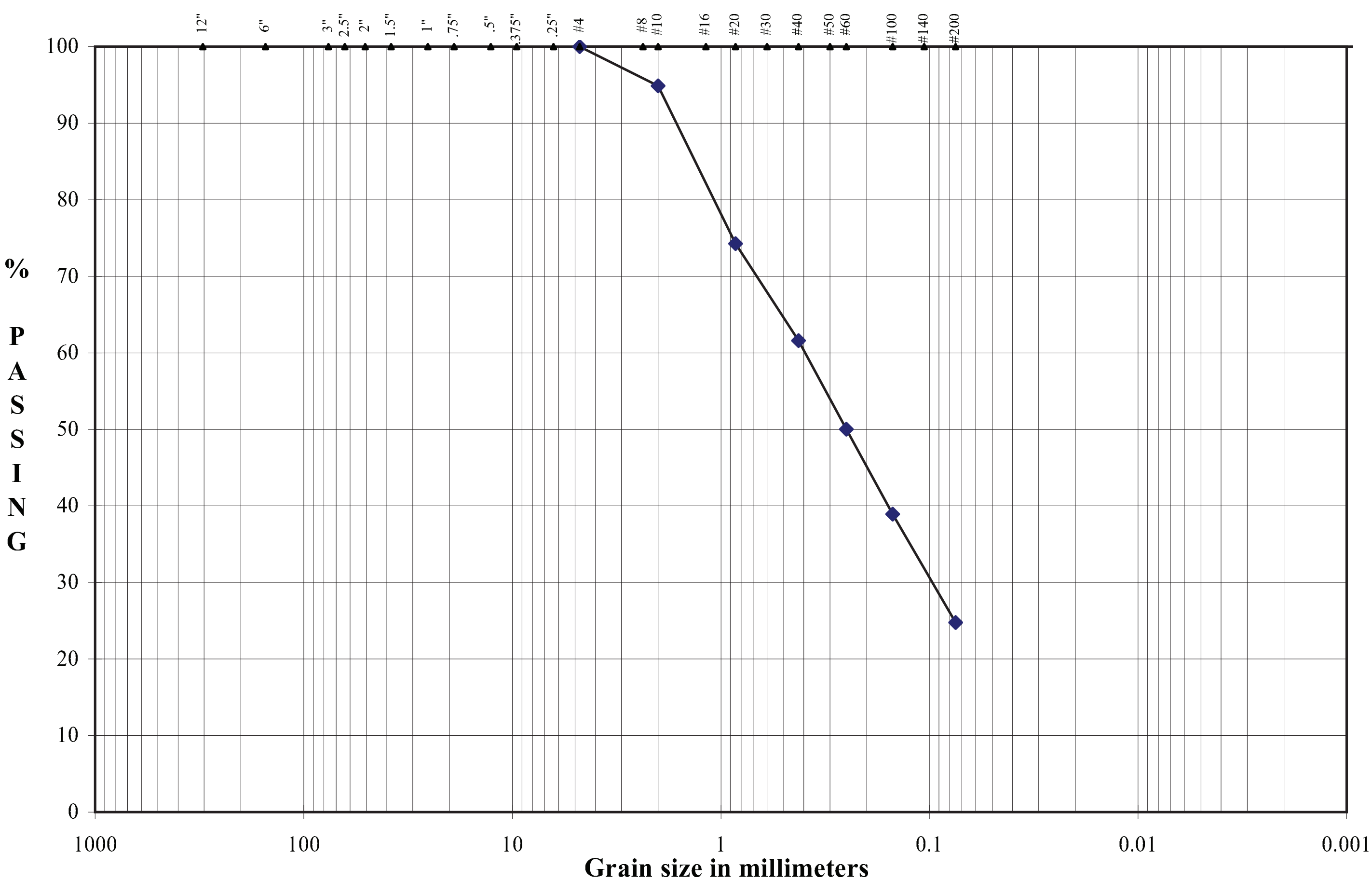
Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Jar
Sample ID	18484/B-3	Depth/Elev.	13.5-15'
Location	-	Add. Info	-

ASTM D 6913 (D 422 old version), D 1140, C 136, C 117 / AASHTO T 88, T 27, T 11, T 311
Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Particle-Size Analysis



Boulders	Cobbles	Gravel		Sand			Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt-Clay

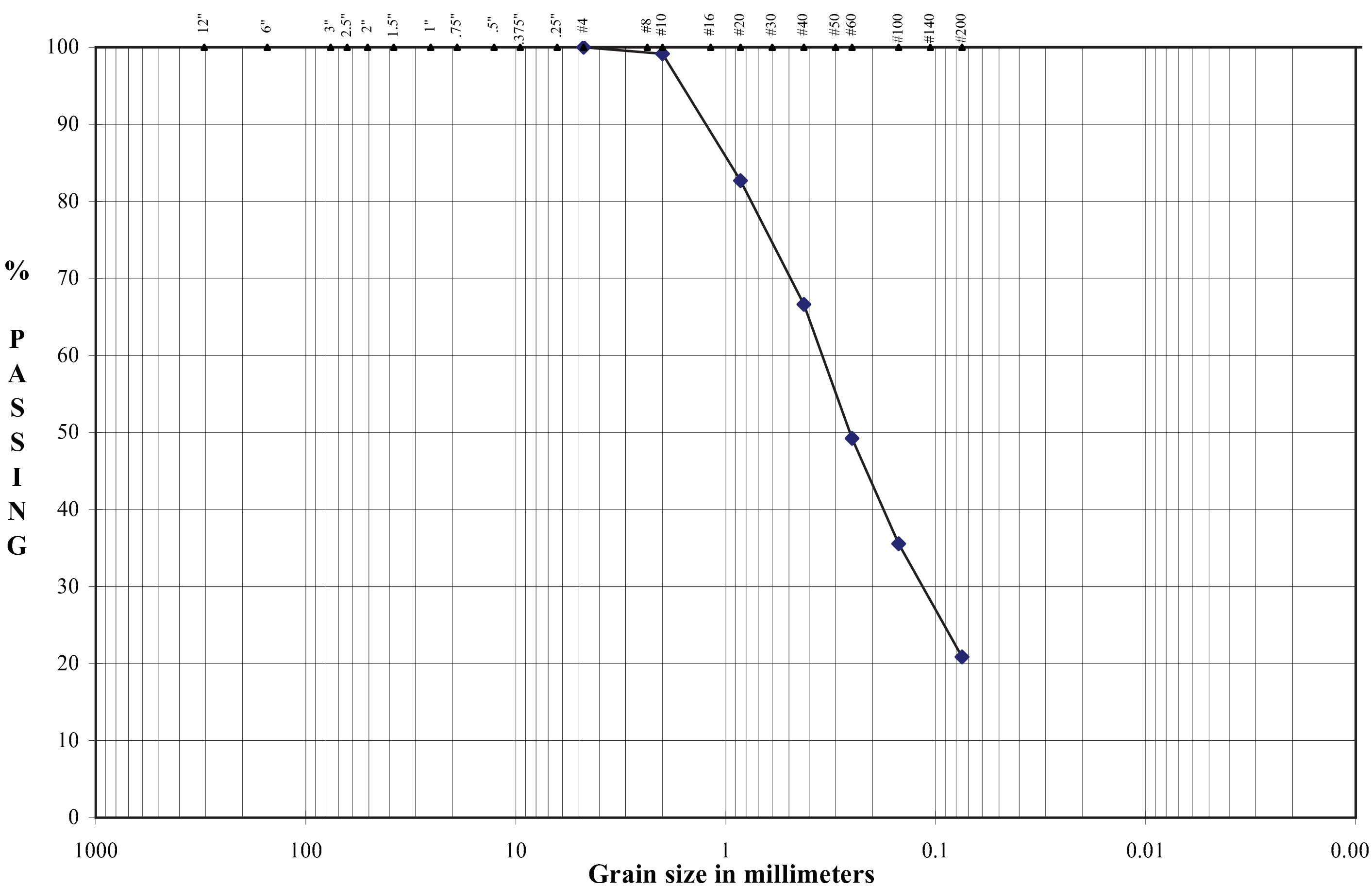
D_{10}	NA	mm
D_{30}	NA	mm
D_{60}	NA	mm
Cu	NA	
Cc	NA	

	T IMELY ENGINEERING SOIL TESTS, LLC	1874 Forge Street Tucker, GA 30084 Phone: 770-938-8233 Fax: 770-923-8973 Web: www.test-llc.com	Tested By	AV
			Date	08/07/14
			Checked By	[signature]

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Jar
Sample ID	18485/B-3	Depth/Elev.	38.5-40'
Location	-	Add. Info	-

ASTM D 6913 (D 422 old version), D 1140, C 136, C 117 / AASHTO T 88, T 27, T 11, T 311
Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Particle-Size Analysis



Boulders	Cobbles	Gravel: Coarse	Gravel: Fine	Sand: Coarse	Sand: Medium	Sand: Fine	Fines: Silt-Clay

D_{10}	NA	mm
D_{30}	NA	mm
D_{60}	NA	mm
Cu	NA	
Cc	NA	

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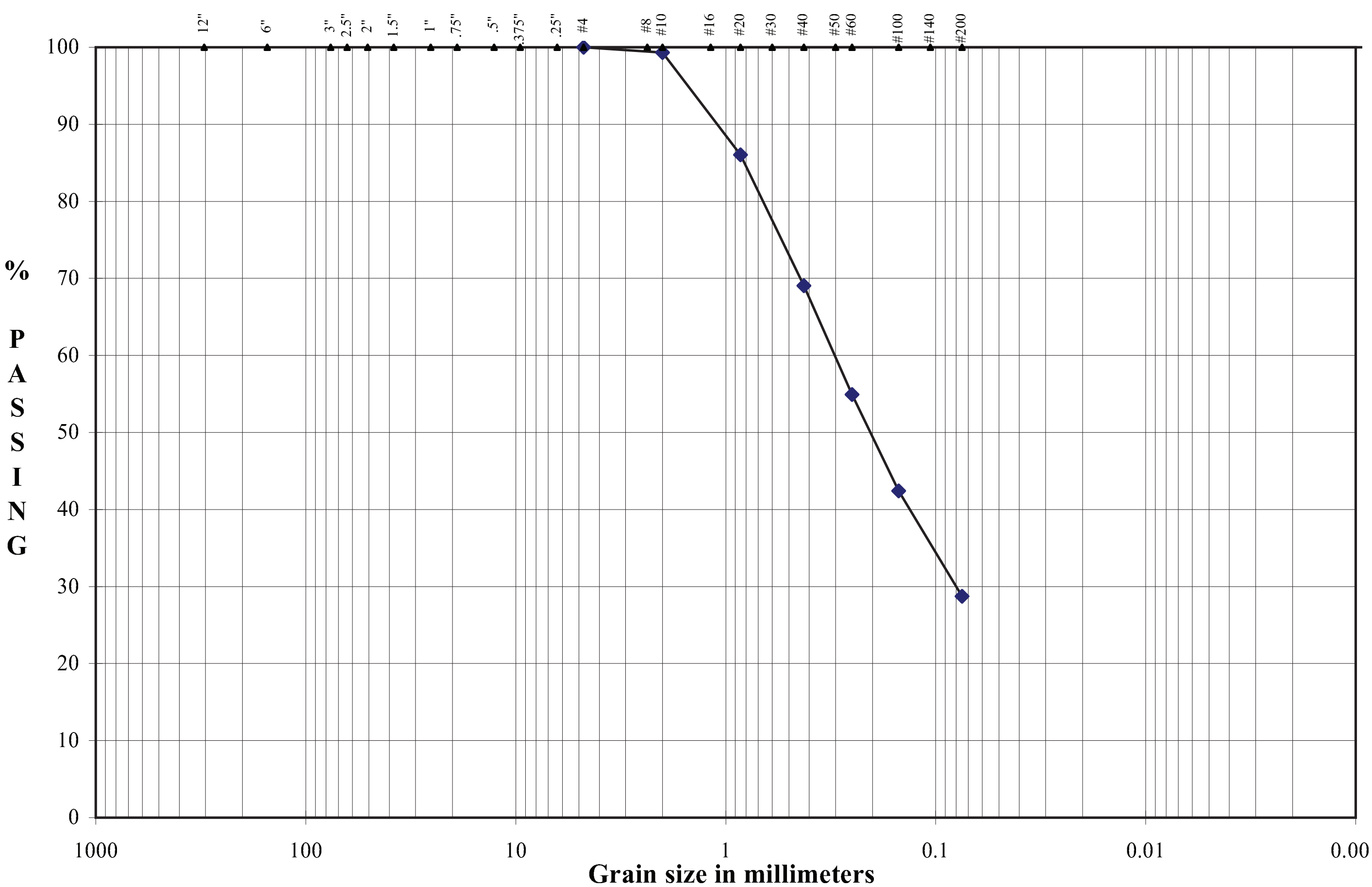
		Date	08/07/14
		Checked By	

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Jar
Sample ID	18487/B-4	Depth/Elev.	13.5-15'
Location	-	Add. Info	-

ASTM D 6913 (D 422 old version), D 1140, C 136, C 117 / AASHTO T 88, T 27, T 11, T 311
Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Particle-Size Analysis



Boulders	Cobbles	Gravel		Sand			Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt-Clay

D_{10}	NA	mm
D_{30}	NA	mm
D_{60}	NA	mm
Cu	NA	
Cc	NA	

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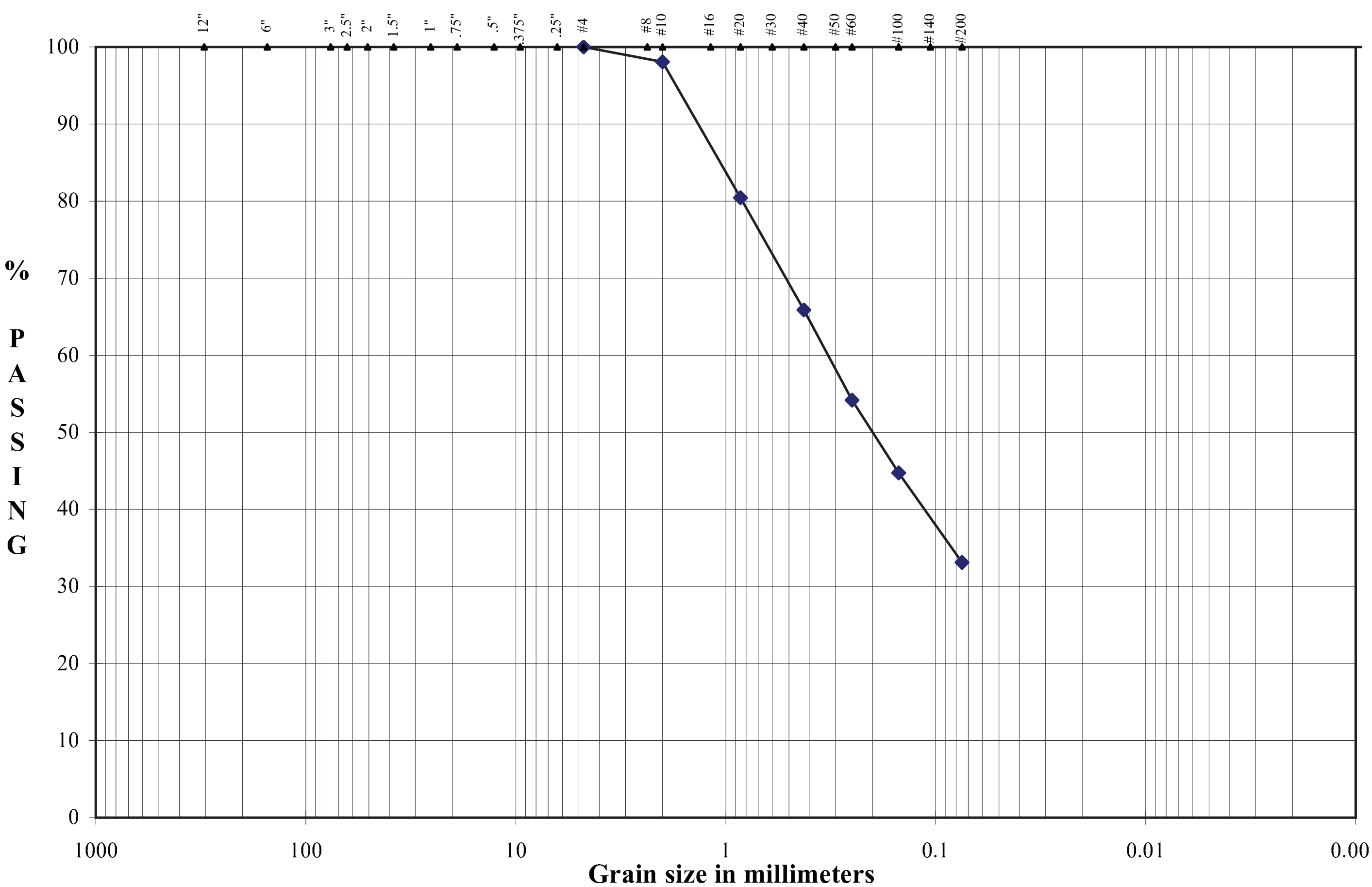
Date	08/07/14
Checked By	[signature]

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Jar
Sample ID	18488/B-4	Depth/Elev.	23.5-25'
Location	-	Add. Info	-

ASTM D 6913 (D 422 old version), D 1140, C 136, C 117 / AASHTO T 88, T 27, T 11, T 311
Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Particle-Size Analysis



Boulders	Cobbles	Gravel		Sand			Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt-Clay

D_{10}	NA	mm
D_{30}	NA	mm
D_{60}	NA	mm
Cu	NA	
Cc	NA	

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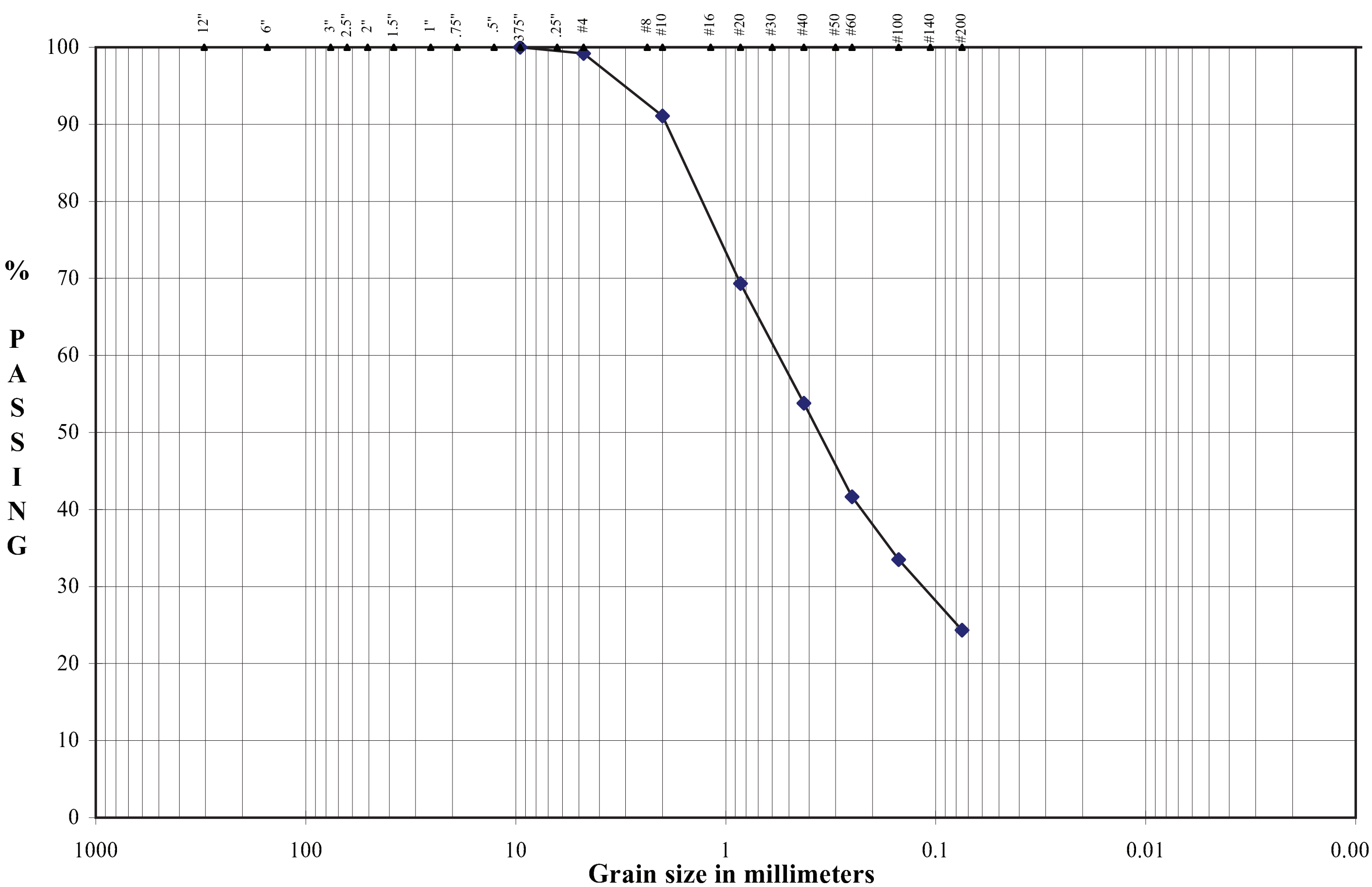
		Date	08/07/14
		Checked By	[signature]

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Jar
Sample ID	18490/B-5	Depth/Elev.	8.5-10'
Location	-	Add. Info	-

ASTM D 6913 (D 422 old version), D 1140, C 136, C 117 / AASHTO T 88, T 27, T 11, T 311
Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Particle-Size Analysis



Boulders	Cobbles	Gravel		Sand			Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt-Clay

D_{10}	NA	mm
D_{30}	NA	mm
D_{60}	NA	mm
Cu	NA	
Cc	NA	

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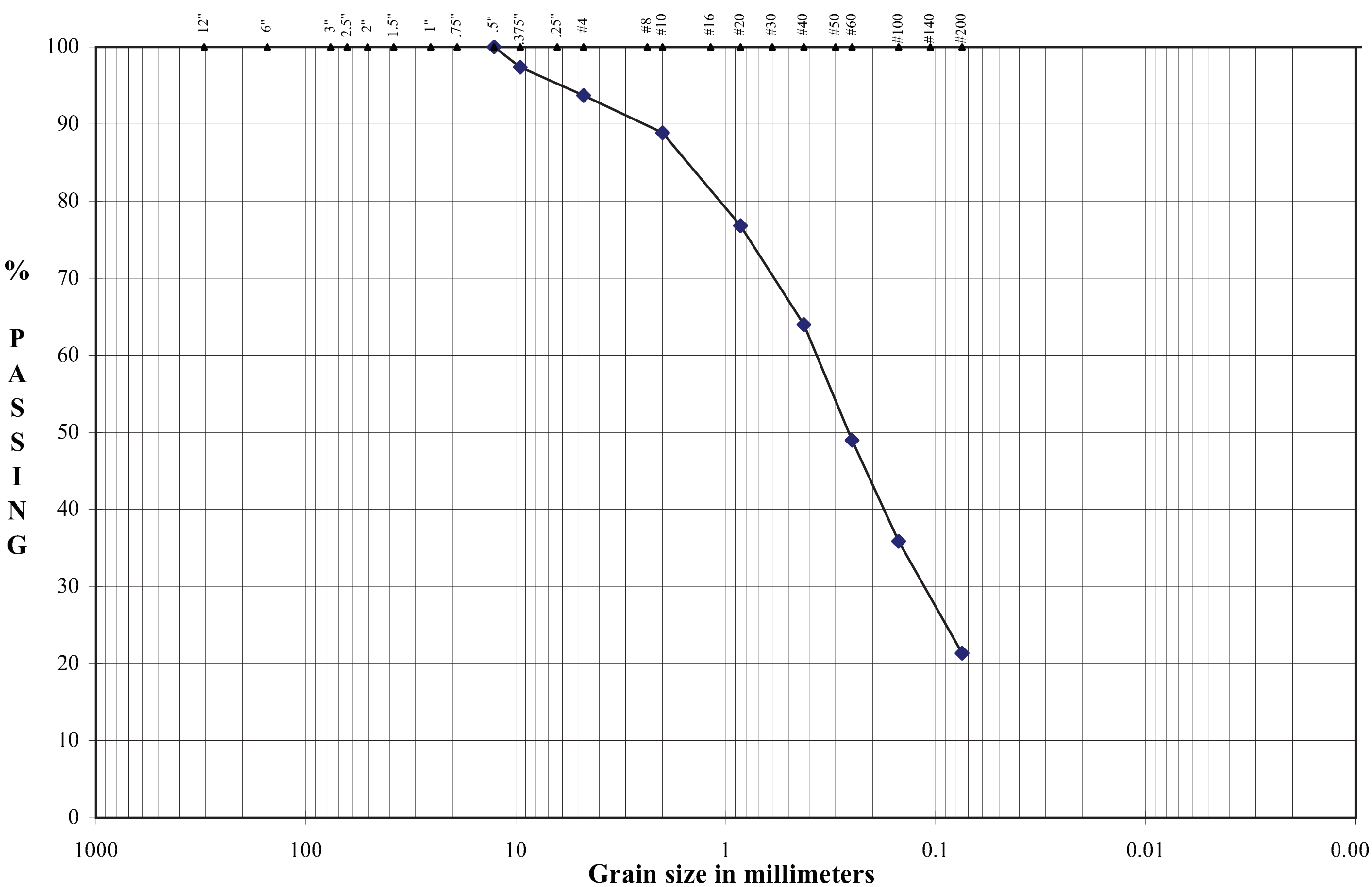
		Date	08/07/14
		Checked By	

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Jar
Sample ID	18491/B-5	Depth/Elev.	28.5-30'
Location	-	Add. Info	-

ASTM D 6913 (D 422 old version), D 1140, C 136, C 117 / AASHTO T 88, T 27, T 11, T 311
Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Particle-Size Analysis



Boulders	Cobbles	Gravel		Sand			Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt-Clay

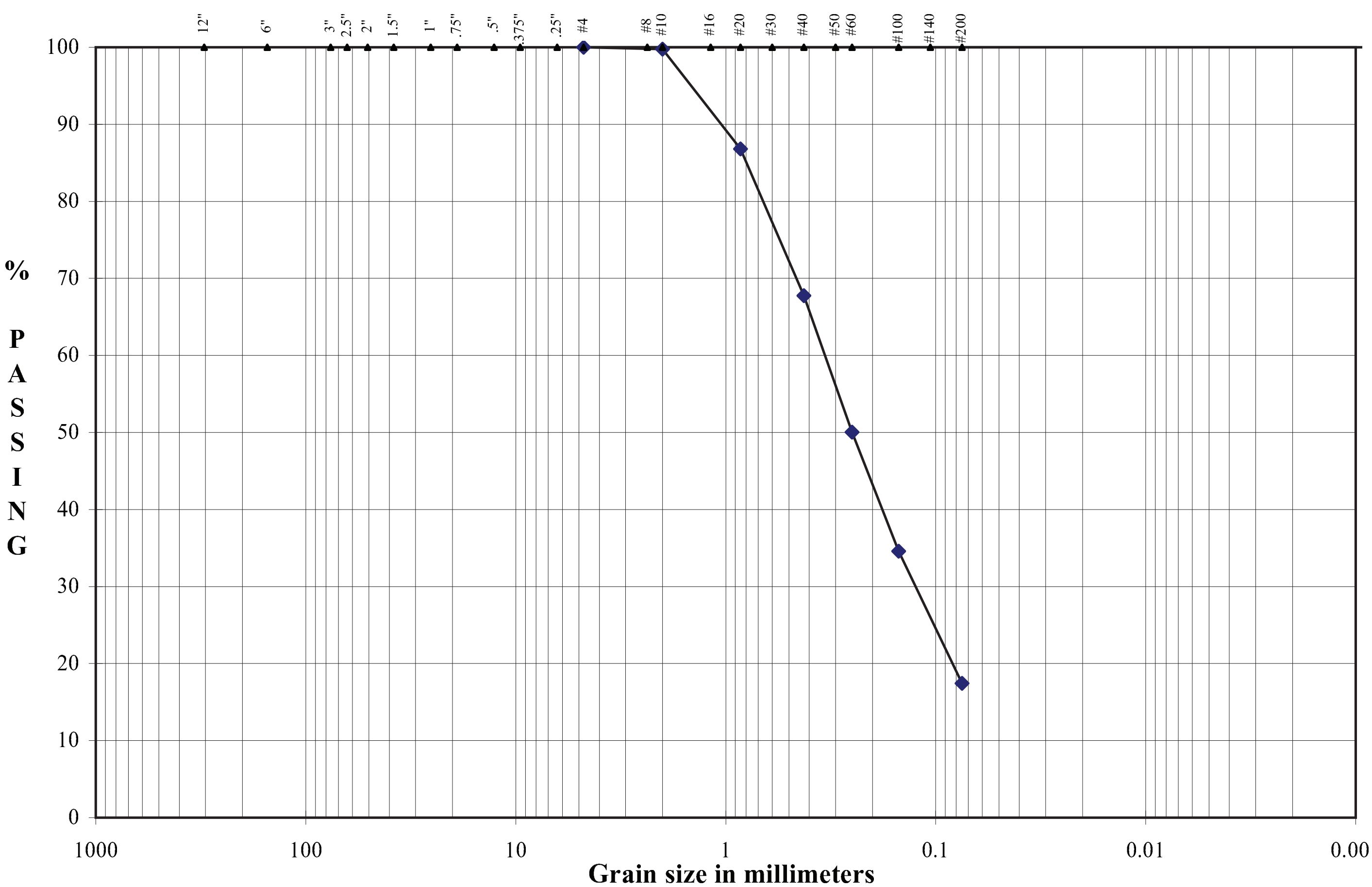
D_{10}	NA	mm
D_{30}	NA	mm
D_{60}	NA	mm
Cu	NA	
Cc	NA	

TIMELY ENGINEERING SOIL TESTS, LLC	1874 Forge Street Tucker, GA 30084 Phone: 770-938-8233 Fax: 770-923-8973 Web: www.test-llc.com	Tested By	RI
		Date	08/07/14
		Checked By	[signature]

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Jar
Sample ID	18494/B-6	Depth/Elev.	18.5-20'
Location	-	Add. Info	-

ASTM D 6913 (D 422 old version), D 1140, C 136, C 117 / AASHTO T 88, T 27, T 11, T 311
Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Particle-Size Analysis



Boulders	Cobbles	Gravel		Sand			Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt-Clay

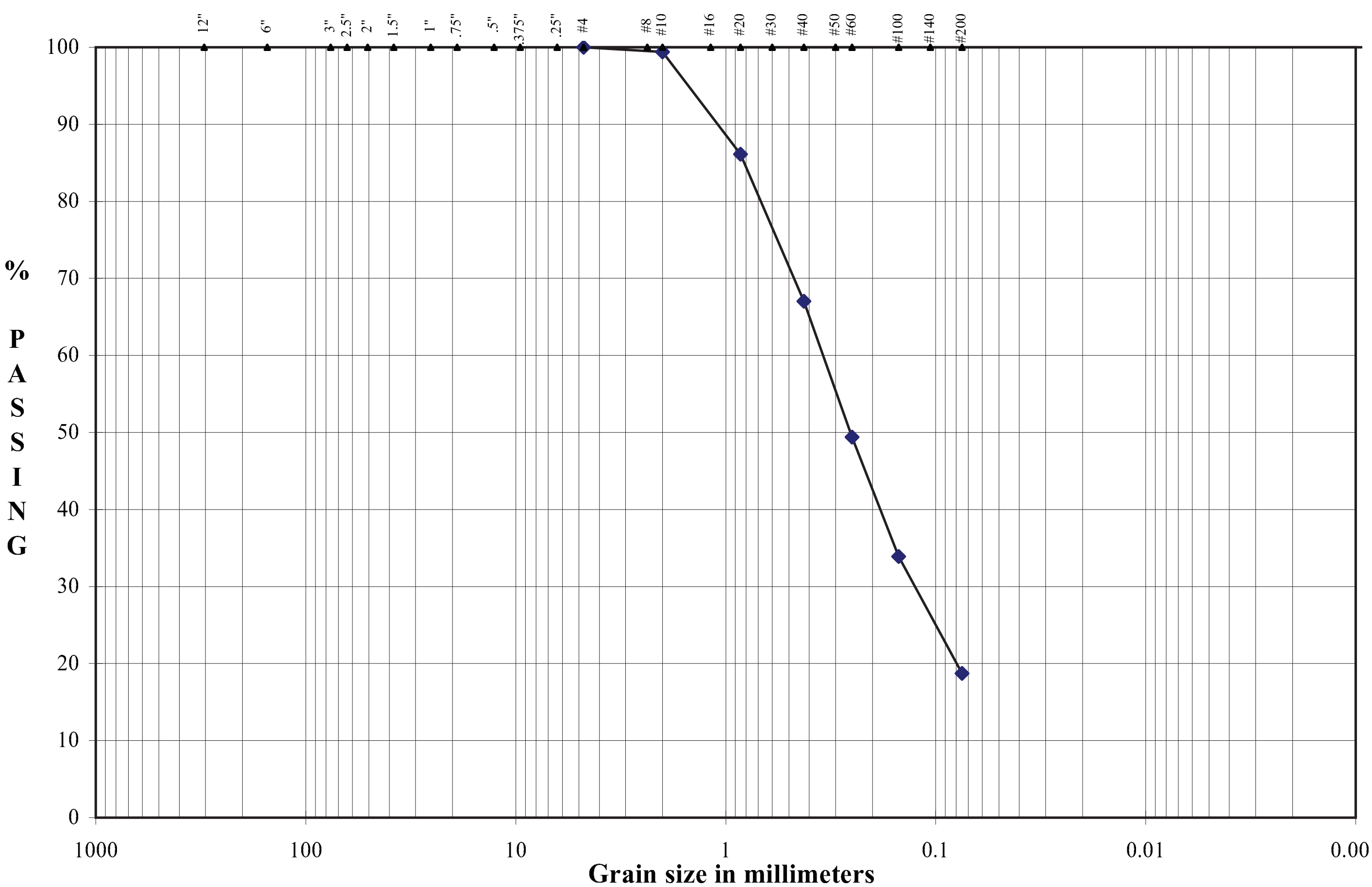
D_{10}	NA	mm
D_{30}	NA	mm
D_{60}	NA	mm
Cu	NA	
Cc	NA	

T.E.S.T.	TIMELY ENGINEERING SOIL TESTS, LLC	1874 Forge Street Tucker, GA 30084 Phone: 770-938-8233 Fax: 770-923-8973 Web: www.test-llc.com	Tested By: RI Date: 08/07/14 Checked By:

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Jar
Sample ID	18495/B-6	Depth/Elev.	38.5-40'
Location	-	Add. Info	-

ASTM D 6913 (D 422 old version), D 1140, C 136, C 117 / AASHTO T 88, T 27, T 11, T 311
Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

Particle-Size Analysis



Boulders	Cobbles	Gravel		Sand			Fines
		Coarse	Fine	Coarse	Medium	Fine	Silt-Clay

D_{10}	NA	mm
D_{30}	NA	mm
D_{60}	NA	mm
Cu	NA	
Cc	NA	

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Tested By	RI
Date	08/08/14
Checked By	[signature]

ASTM D7012-04, Method C (Previous ASTM Method D 2398)

Standard Test Method for Unconfined Compressive Strength of Intact Rock Core Specimens

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Rock Core
Sample ID	18483/B-2	Depth/Elev.	42'4"-43'2"
Location	-	Add. Info	-

SAMPLE DATA

Initial Height, in	4.554
Initial Diameter, in	1.861
Height-to-Diameter Ratio	2.45
Area, in^2	2.72
Volume, in^3	12.39
Mass of Sample, g	510.30
Wet Density, pcf	156.9
Dry Density, pcf	156.7
Stress Rate, psi/min	1031

WATER CONTENT DETERMINATION

Mass of Wet Sample and Tare, g	628.90
Mass of Dry Sample and Tare, g	628.30
Mass of Tare, g	126.30
Moisture, %	0.1

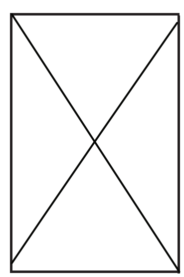
Note: Water content was obtained after shear from entire sample.

TEST DATA

Load Cell ID #	266
Compression Device ID #	267
Balance ID #	139/142
Digital Caliper ID #	15/28
Oven ID #	12

Maximum Load at Failure, lbf	7010
Specimen Cross-sectional Area, in^2	2.72
Compressive Strength at Failure, psi	**2577**
Time of Testing, min	2.50
Temperature during testing, C^o	26.5

Failure Sketch



DESCRIPTION

NA

REMARKS

Test specimen was prepared in accordance with ASTM D4543.

TIMELY ENGINEERING SOIL TESTS, LLC

1874 Forge Street Tucker, GA 30084
Phone: 770-938-8233
Fax: 770-923-8973
Web: www.test-llc.com

Tested By	RI
Date	08/08/14
Checked By	[signature]

ASTM D7012-04, Method C (Previous ASTM Method D 2398)

Standard Test Method for Unconfined Compressive Strength of Intact Rock Core Specimens

Client Pr. #	2014-1317-005	Lab. PR. #	1455-01-1
Pr. Name	South River WRC Project	S. Type	Rock Core
Sample ID	18493/B-5	Depth/Elev.	46-47'
Location	-	Add. Info	-

SAMPLE DATA

Initial Height, in	4.394
Initial Diameter, in	1.861
Height-to-Diameter Ratio	2.36
Area, in^2	2.72
Volume, in^3	11.95
Mass of Sample, g	493.90
Wet Density, pcf	157.4
Dry Density, pcf	157.2
Stress Rate, psi/min	2357

WATER CONTENT DETERMINATION

Mass of Wet Sample and Tare, g	581.20
Mass of Dry Sample and Tare, g	580.80
Mass of Tare, g	125.10
Moisture, %	0.1

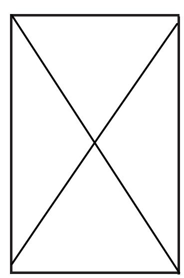
Note: Water content was obtained after shear from entire sample.

TEST DATA

Load Cell ID #	266	Digital Caliper ID #	15/28
Compression Device ID #	267	Oven ID #	12
Balance ID #	139/142		

Maximum Load at Failure, lbf	12820
Specimen Cross-sectional Area, in^2	2.72
Compressive Strength at Failure, psi	**4713**
Time of Testing, min	2.00
Temperature during testing, C^o	26.5

Failure Sketch



DESCRIPTION

NA

REMARKS

Test specimen was prepared in accordance with ASTM D4543.