HICKORY HAVEN AND SAMARY FOREST SANITARY SEWER

TECHNICAL SPECIFICATIONS

Goochland County, Virginia

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COMMONWEALTH OF VIRGINIA
BRUCE W. STRICKLAND JR.
Lic. No. 056612
6/16/21
PROFESSIONAL ENGINEER

June 16, 2021
Project Number 42792

HICKORY HAVEN AND SAMARY FOREST SANITARY SEWER

Technical Specifications

Engineer:
Timmons Group
1001 Boulders Parkway, Suite 300
Richmond, VA 23225
Contact: Bruce Strickland, P.E.
Phone: 804-200-6389
Fax: 804-560-1438

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SECTION 01 1100 SUMMARY OF WORK

1. GENERAL

1.1 DESCRIPTION

A. This Section includes requirements of a general nature applicable to the Contract.

B. The Work includes but is not limited to the following:

1. The construction of approximately 8,300 linear feet of 8″ diameter sanitary sewer, approximately 320 linear feet of 2″ sanitary force main and all necessary structures and laterals to serve the existing residential developments of Hickory Haven and Samary Forest in Goochland County, Virginia.

1.2 REFERENCE DOCUMENTS

A. Applicable Codes, Specifications, and Standards:

1. All references to codes, specifications, and standards referred to in the Contract Documents shall be the latest edition, amendment and/or revision of such reference standard in effect as of the date of Bid Opening for this Contract.

2. These Codes, Specifications and Standards are by reference incorporated into these contract documents. In the event of a conflict, the more stringent as determined by the Engineer shall prevail.

B. Documents on the Site

1. The Contractor shall maintain, on the site, copies of all appropriate documents including codes, specifications, permits, and reference standards referred to for this project.

1.3 ABBREVIATIONS AND SYMBOLS

1.	AASHTO	American Association of State Highway and Transportation Officials
2.	ACI	American Concrete Institute
3.	ANSI	American National Standards Institute
4.	ASCE	American Society of Civil Engineers
5.	ASME	American Society of Mechanical Engineers
6.	NHI	National Hydraulics Institute
7.	ASTM	American Society for Testing and Materials
8.	AWWA	American Water Works Association
9.	BOCA	Building Officials Code Administration, Inc.
10.	NACE	National Association of Corrosion Engineers
11.	NEC	National Electrical Code
12.	OSHA	Occupational Safety and Health Administration
13.	VAUSBC	Virginia Statewide Unified Building Code
14.	VDOT	Virginia Department of Transportation
15.	VSWCC	Virginia Soil and Water Conservation Board

1.4 CONTRACTOR'S RESPONSIBILITIES

A. The Contractor shall, at his own expense, obtain any and all permits and surety required and shall be responsible for all submittals necessary to obtain said permits required in the Contract Documents.

B. Use of Premises and Off-Site Work

1. Facility Property – The Contractor may use the areas shown on the plans for the staging and storage of materials and equipment. The Contractor may access the other areas of the site for the purpose of construction and installation. The Contractor is required to coordinate the use of areas with the Owner in accordance with Section 01 31 00 Coordination.

2. Lands by Contractor - Any land and access thereto not furnished by the Owner that the Contractor deems necessary for the work, temporary construction facilities, access and egress, or for storage of materials shall be provided by the Contractor at no cost to the Owner. The Contractor shall confine his apparatus and storage to such additional areas as he may provide at his expense. The Contractor shall obtain permits and written approvals from the appropriate jurisdictional agency and or property owner for use of the premises not furnished as described above, and all off- site areas which include but are not limited to off-site borrow pits and waste areas. Such permits and approvals must specify treatment of said areas during and at the completion of construction. Copies of all permits and approvals shall be furnished to the Engineer before utilization of the areas.

3. Private and Public Property - The Contractor shall not enter upon private property for any purpose without obtaining written permission from the property owner. Letters of permission from property owners shall be filed with the Engineer prior to entering private property.

C. The Contractor shall not load nor permit any part of any structure to be loaded with weights that could endanger the structure, nor shall he subject any part of the work to stresses or pressures that could endanger it.

D. Public Convenience

1. The Contractor shall, at all times, so conduct his work as to ensure the least possible obstruction to traffic and inconvenience to the Owner, the general public, and the businesses and residences in the vicinity of the work, and to ensure the protection of persons and property. Fire hydrants on and adjacent to the work shall be kept accessible to fire fighting equipment at all times. Temporary provisions shall be made by the Contractor to ensure the use of sidewalks and the proper functioning of all gutters, stormwater systems, drainage ditches, and culverts, etc. such that they shall not be obstructed.

E. Measurements

1. All dimensions shown on existing work and all dimensions required for work that is to connect to existing work shall be verified by the Contractor by actual measurement of the existing work. Any discrepancies between the Contract Documents and the existing conditions shall be referred to the Engineer before any work affected thereby has been completed.

F. Coordination

1. Phases of the construction of the project which involve the temporary interruption of essential services (water, electricity, etc.) shall be scheduled in consultation with the Engineer, and shall be not of longer duration than essential to accomplish the purpose for such interruptions. Liaison with the Engineer in this matter shall be a salient feature of this Contract.

2. The Contractor shall notify the Engineer and the Owner not less than 48 hours in advance of commencing work. The Owner shall be given no less than 48 hours

notice in advance of the time and date of making any connections and will advise the Contractor as to a suitable time and date.

G. The Contractor, at his own expense, shall retain the services of a registered Land Surveyor to establish the necessary horizontal and vertical control in order to construct the proposed work in the proper location. Cut sheets performed by a registered Land Surveyor shall be delivered to the Engineer 48 hours prior to installation of any work.

H. Contractor Checklist: This checklist is intended to be a guide and to assist the Contractor in determining what items need to be submitted to the Owner/Engineer or what services need to be performed by the Contractor. The checklist is not intended to be an all-inclusive list of services to be performed by the Contractor, and does not relieve the Contractor of the responsibilities stipulated within these specifications.

Contractor Checklist for Major Items to be Performed and/or Submitted

Required as Part of This Contract		Description of Submittal Item or Service to be Performed	Check Once Item is Completed
Yes		Diagram of location of fuel storage areas on plans	
Yes		Diagram of location of temporary sanitary Facilities on plans	
	No	Statement of payment of taxes	
Yes		Affidavit of payment of debts and claims	
Yes		Affidavit of release of liens	
Yes		Construction schedule of work prior to the commencement of any work	
Yes		Updates of the construction schedule if work does not follow the original schedule	
	No	Schedule of values (shows the value of each kind of work) prior to first application for payment	
Yes		Schedule of shop drawing submittals	
	No	Schedule of estimated monthly payments (within 30 days after contract date	
Yes		Material and products schedule (include in construction schedule)	
Yes		List of product substitutions (for a period of 30 days after contract date)	
Yes		All required permits (e.g., building permit, land disturbance permit, etc.)	
	No	Field office located at project site with the following equipment: 1) Telephone 2) Message recording unit 3) Water and sanitary facilities Temporary field office for use by the Engineer that is approximately 150 square feet and includes: 1) One stick file 2) One drawing table 3) One stool 4) One non-folding desk chair 5) One desk 6) One four-drawer lockable filing cabinet	

Required as Part of This Contract		Description of Submittal Item or Service to be Performed	Check Once Item is Completed
Yes		Shop drawings and product data	
	No	Samples	
Yes		Layout data/schedule for pipe joining and special connections	
Yes		Copies of survey cut sheets	
	No	Diary or log book recording significant construction activities, meetings, weather conditions, etc.	
Yes		Progress reports submitted with each application for payment	
Yes		Test results (e.g., concrete cylinder tests, compaction tests, etc.)	
Yes		One signed original and 3 copies of inspections or approvals of work required to be inspected by local code or law	
	No	Project photographs (a minimum of 10 photos per month during contract) that include two glossy color prints (8 in. x 10 in.) and each negative	
Yes		Product guarantees, certificates, and warranties	
Yes		Contractor's one-year standard warranty for all work	
	No	Operation and Maintenance Manuals	
	No	Spare parts and maintenance materials	
Yes		One complete set of contract drawings and one project manual recording all changes to the work to indicate actual installation	
Yes		Application and Certificate for Payment in appropriate format	
Yes		Monthly progress meetings	
	No	Preliminary inspection and testing (a demonstration that individual components of equipment/work have been completed) scheduled a minimum of 20 days before the pre-final inspection is scheduled.	
Yes		Pre-final inspection (a demonstration that all individual project components function and are coordinated with other systems) scheduled a minimum of 20 days before the final inspection.	
Yes		Final inspection (a demonstration that all elements of the project are ready to be placed in operation and all work has been substantially completed) scheduled a minimum of 20 days before completion date.	
	No	Calibration test results performed by competent experienced test engineers	
	No	Nameplates on all devices	
	No	Brass tags on each field mounted device	
Yes		List of manufacturers, suppliers, and subcontractors who participated in the construction of the project	

2. PRODUCTS – NOT USED

3. EXECUTION – NOT USED

END OF SECTION

SECTION 01 2200
MEASUREMENT AND PAYMENT

1. GENERAL

1.1 SUMMARY OF WORK

A. The work shall be as described by these Contract Documents and shall consist of providing all labor, equipment, materials and services necessary for the installation of the project described by these Contract Documents.

B. Estimated quantities are not guaranteed and are solely for the purpose of comparison of Bids and final payment for all unit price Bid items will be based on actual quantities, determined as provided in the Contract Documents.

1.2 WORK SEQUENCE AND SCHEDULING

A. CONTRACTOR shall coordinate the work with the OWNER or their designee.

1.3 MEASUREMENT AND PAYMENT

A. For the information and guidance of bidders, the following explanation of the bid form items is made herein. The omission of reference to any item in this description shall not, however, alter the intent of the bid form or relieve the Contractor of the necessity of furnishing such as a part of the contract. The quantities set forth in the bid form are approximate and are given to establish a uniform basis for the comparison of bids. The Owner reserves the right to increase or decrease the quantity of any class or portion of the work during the progress of construction. The Owner will not compensate the Contractor for restocking fees or loss of anticipated profit for those items deleted from the contract.

B. The Contractor shall be responsible for all construction layout. The centerline of all mains and bends, valves and other appurtenances shall be staked prior to construction.

C. Payments shall be made on the basis of work actually performed in completing each item in the Contractor's bid proposal, such work including, but not limited to the furnishing of all necessary labor, materials, equipment transportation, clean-up and all other appurtenances to complete the construction and installation of the work to the configuration and extent as shown on the drawings and as described in the specifications.

1.4 DEFINITIONS

A. For purposes of measurement and payment the following terms shall have the meaning assigned to each.

1. Main Trench: A trench essentially parallel to rights-of-way or property lines and in which the proposed utility lines are to be installed.

2. Service Trench: A trench essentially perpendicular to main trenches and in which the proposed utility service pipes are to be installed.

B. Classified Excavation: The removal and disposal of earth, hardpan or rock materials according to the following:

1. Earth Excavation: The removal and disposal of pavement, less than 4 inches thick, underground structures and utilities indicated to be demolished and removed, and all other materials encountered not classified as hardpan or rock excavation.

2. Hardpan Excavation: The removal and disposal of material that cannot be removed from the trench without the use of an air spade or blasting. Indurated clay, shale or sand with cementitious materials is typical of this material.

3. Rock Excavation: The removal and disposal of all solid rock that cannot be excavated without continuous and systematic drilling and blasting or continuous use of rock excavation equipment. Boulders 1/2 cu. yd. or more in volume, solid rock, and rock in ledges are typical of this material.
4. Hand Excavation: Excavation made with hand tools when in the opinion of the Engineer such excavation is necessary.
5. Test Hole Excavation: Excavation made at the direction of the Engineer for any purpose related to work.
6. Concrete Paving Removal: Removal of paving greater than 4 inches thick, including concrete curbs, gutters and sidewalks.

C. Measurement and Payments for Excavation:

1. Hardpan and Rock: Main line trench shall be computed and paid for according to the actual depth of the hardpan or rock to the invert of the pipe plus the 6 inch bedding material the actual length of the trench, and, for main line trench, the actual width of the trench not to exceed a width of 36 inches for pipe 12 inches and less in diameter. The width of the service trench shall be 2 feet. For pipe over 12 inches in nominal diameter up to but not including 36 inches nominal diameter, the trench width shall be the outside diameter of the pipe barrel plus 24 inches, and trench depth shall be based on the depth of rock to the outside barrel of the pipe plus 6 inches. For pipe 36 inches, or greater in nominal diameter, the trench width shall be the outside diameter plus 36 inches and trench depth shall be based on the depth of rock to the outside barrel of the pipe plus 6 inches. Where the trench width is not calculated to a foot or half-foot, the measurement shall be rounded to the next 6 inches. Manhole and structure excavation shall be for the depth encountered including the base and 6 inch cushion of bedding material. The horizontal dimensions shall assume a square extending 1 foot beyond the exterior walls of the structure when forming is not required and 2 feet when forming is required. Payment for rock excavation in trench will not be allowed for this distance.
2. Earth: Main line trench and service trench, when payment is to be computed on a volumetric basis shall be computed as set forth for hardpan and rock, except that the depth shall be in accordance with the cut sheet, which is the bottom of the pipe for water main and the invert of the pipe for gravity lines. When excavation payments are on a depth basis, measurements shall be from the ground surface at the centerline of the trench to the invert of the pipeline.
3. Bedding in rock, hardpan or earth: Bedding required for pipe laid in rock, hardpan, or earth shall be included in the unit excavation price for these items.
4. For trenches, the pay width for single pipe excavation shall be the nominal diameter of the pipe, plus 12 inches or a minimum width of 24 inches. When two or more pipes are laid in the same trench, the trench width shall be the sum of the nominal diameters of the 7-8 pipe plus 12 inches plus 6 inches for each space between the pipes. For lowering or raising mains, the trench width shall be 48 inches. When pay width is not an even foot or half foot it shall be increased to the nearest foot or half foot.
5. Unauthorized excavation consists of removal of materials beyond indicated elevations or specified widths, without written approval of Engineer. Unauthorized excavation shall be replaced at Contractor’s expense.

6. Hardpan or rock excavation shall not be backfilled until Engineer has verified that such excavation was required and has determined the hardpan or rock profile.

D. Lowering excavation: Excavation made to permit the lowering or raising of water main and accessories.

E. Water main accessories shall consist of all valves, retainer glands, fittings, boxes and the like, other than pipe that are a part of the water system.

2. PRODUCTS

2.1 GRAVITY SEWER

A. The CONTRACTOR shall provide all labor, equipment, materials, and services necessary for the following **BASE BID** items.

1. Hardpan and Rock Excavation

   a. Price per cubic yard of hardpan excavation defined under classified excavation above. Pay depth for sewer lines shall be depth to invert plus 6 inches. The payment for hardpan and rock excavation, whether in main or service trenches shall include excavation, dewatering, hauling, off-site disposal of unapproved materials, furnishing and placing of approved select backfill material, materials, labor, equipment, blast monitoring, as required for the lawful removal of rock material.

2. Hand Excavation

   a. Price per cubic yard for hand excavation when specifically authorized by the Engineer. Work done under this item will be limited to that required to protect trees, utility poles or structures that would otherwise be removed during the course of machine excavation. No allowance shall be made under this item for hand excavation necessary to locate or protect culverts and underground utilities.

3. Removal of Unsuitable Soil and Replacement with Select Material

   a. Price per cubic yard of select material provided as directed by the Engineer. Payment under this item shall include the removal of unsuitable material and replacement with select material because of unstable foundation below the pipeline as well as material provided because the excavated material is unsuitable for proper backfilling of the trench. Surplus excavation from other portions of the project will be compensated for under this item only when the haul distance exceeds 1000 feet. Payment for select material required when pipe is laid in rock and/or hardpan and for backfill because of the inability to use hardpan or rock removed from the trench shall be included in the price bid for hardpan and/or rock. Payment shall be based upon the quantity of select material required for a trench with pay width as specified for hardpan excavation trenches for same depth and pipe diameter, and a select material depth as provided. Payment for furnishing and installing imported backfill material shall include haul and offsite disposal of unsuitable materials. Payment shall include provision of imported material, compaction, and dewatering. The quality of imported materials shall be as indicated on the on the drawings.

4. Stone on Private Roads, Entrances, and Driveways.

a. Price per linear foot of pipeline trench and service trench, surfaced with approved stone. Stone shall be placed to the same depth as the original, with a minimum of 4 inches. Payment shall include provision of imported material, and compaction.

5. Additional Stone Pavement Replacement

   a. Payment for additional pavement replacement with approved stone in areas NOT indicated on the drawings; to be performed at the direction of the Owner's representative. The work under this item shall include all materials and labor for traffic control, surface preparation (scarification), overlay, compaction, and smooth rolling of stone surface with a minimum thickness of 4 inches. This shall not be used to replace pavement damaged due to contractor's carelessness or neglect, which shall be repaired at the contractor's sole expense.

6. Replacement of Road Base

   a. Price per linear foot of main trench and service trench. Work under this item shall consist of providing 10 inches of compacted crushed road base material. The application of surface treatment is not a part of this item.

7. Replacement of Plant Mix Pavement – VDOT Roads

   a. Price per linear foot of main trench and service trench for replacement of roadway surfacing with plant mix pavement consisting of 6 inches of BM-25.0A and 1.5 inches of SM-9.5A or the depth of the existing pavement, whichever is greater. The work under this item shall include sawcutting existing pavement, milling, and overlayment as shown on the drawings and required by VDOT standards.

8. Replacement of Surface Treated Pavement on Private Entrances

   a. Price per linear foot of main trench and service trench for the restoration of surface treated pavement on private entrances and driveways. Price shall include sawcutting existing pavement and the furnishing and installation of a double surface treatment.

9. Additional Asphalt Pavement Replacement on Private Entrances

   a. Payment for additional pavement replacement in areas NOT indicated on the drawings; to be performed at the direction of the Owner's representative. The work under this item shall include complete cleanup, milling, overlay and replacement of pavement where directed by the Owner's representative. This shall not be used to replace pavement damaged due to contractor's carelessness or neglect, which shall be repaired at the contractor's sole expense.

10. Replacement of Concrete Private Drive

    a. Price per linear foot for the restoration of private concrete drives. Price shall include sawcutting the existing concrete at the nearest control joint and the furnishing and installation of concrete to replace private drive in kind.

11. Concrete for Encasement

    a. Price per cubic yard of concrete furnished and used for constructing such structures.

12. Furnish and Install 8" PVC Gravity Sewer (0-6 Feet) (In-Situ Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of

the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with in-situ material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

13. Furnish and Install 8" PVC Gravity Sewer (6-8 Feet) (In-Situ Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with in-situ material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

14. Furnish and Install 8" PVC Gravity Sewer (8-10 Feet) (In-Situ Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with in-situ material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

15. Furnish and Install 8" PVC Gravity Sewer (10-12 Feet) (In-Situ Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with in-situ material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

16. Furnish and Install 8" PVC Gravity Sewer (12-14 Feet) (In-Situ Backfill)

a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with in-situ material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

17. Furnish and Install 8" PVC Gravity Sewer (14-16 Feet) (In-Situ Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with in-situ material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

18. Furnish and Install 8" PVC Gravity Sewer (16-18 Feet) (In-Situ Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with in-situ material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

19. Furnish and Install 8" PVC Gravity Sewer (0-6 Feet) (Select Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with select material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

20. Furnish and Install 8” PVC Gravity Sewer (6-8 Feet) (Select Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with select material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

21. Furnish and Install 8” PVC Gravity Sewer (8-10 Feet) (Select Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with select material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

22. Furnish and Install 8” PVC Gravity Sewer (10-12 Feet) (Select Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with select material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

23. Furnish and Install 8” PVC Gravity Sewer (12-14 Feet) (Select Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with select material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All

cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

24. Furnish and Install 8" PVC Gravity Sewer (14-16 Feet) (Select Backfill)
    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with select material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.
25. Furnish and Install 8" PVC Gravity Sewer (16-18 Feet) (Select Backfill)
    a. Payment will be made at the contract unit price per linear foot for the pipe installed at specified depth and shall include all necessary labor and materials for laying of the pipe, connection to manhole, dewatering if required, excavation, bedding and backfill with select material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.
26. Furnish and Install 6" PVC Service Tee
    a. Price for each service tee furnished and installed. Payment under this item shall be in addition to the footage payment for the main line pipe.
27. Furnish and Install 4" PVC Service Tee
    a. Price for each service tee furnished and installed. Payment under this item shall be in addition to the footage payment for the main line pipe.
28. Furnish and Install 6" X 4" Service Wye
    a. Price for each service wye furnished and installed. Payment under this item shall be in addition to the footage payment for the main line pipe.
29. Furnish and Install 6" PVC Service Lateral (In-Situ Backfill)
    a. Payment will be made at the contract unit price per linear foot for the pipe installed, including an adequate plug and marker at the upper end of the connection, and connection to the service tee. The length of the connection shall be the horizontal distance from the centerline of the main sewer to the upper end of the connection, plus the length of vertical pipe installed for stacked connections. Payment shall include all necessary labor and materials for laying of the pipe, installing the cleanout, dewatering if required, excavation, bedding and backfill with in-situ material, compaction, traffic control, erosion and sediment control, and testing. The work under this item shall include complete cleanup and restoration

of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

30. Furnish and Install 6" PVC Service Lateral (Select Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed, including an adequate plug and marker at the upper end of the connection, and connection to the service tee. The length of the connection shall be the horizontal distance from the centerline of the main sewer to the upper end of the connection, plus the length of vertical pipe installed for stacked connections. Payment shall include all necessary labor and materials for laying of the pipe, installing the cleanout, dewatering if required, excavation, bedding and backfill with select material, compaction, traffic control, erosion and sediment control, and testing. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

31. Furnish and Install 4" PVC Service Lateral (In-Situ Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed, including an adequate plug and marker at the upper end of the connection, and connection to the service tee. The length of the connection shall be the horizontal distance from the centerline of the main sewer to the upper end of the connection, plus the length of vertical pipe installed for stacked connections. Payment shall include all necessary labor and materials for laying of the pipe, dewatering if required, excavation, bedding and backfill with in-situ material, compaction, traffic control, erosion and sediment control, and testing. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

32. Furnish and Install 4" PVC Service Lateral (Select Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed, including an adequate plug and marker at the upper end of the connection, and connection to the service tee. The length of the connection shall be the horizontal distance from the centerline of the main sewer to the upper end of the connection, plus the length of vertical pipe installed for stacked connections. Payment shall include all necessary labor and materials for laying of the pipe, dewatering if required, excavation, bedding and backfill with select material, compaction, traffic control, erosion and sediment control, and testing. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be

included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

33. Furnish and Install 2" HDPE Force Main (In-Situ Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed and shall include all necessary labor and materials for laying of the pipe, appurtenances, force main connections, connection to manhole, dewatering if required, excavation, bedding and backfill with in-situ material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

34. Furnish and Install 2" HDPE Force Main (Select Backfill)

    a. Payment will be made at the contract unit price per linear foot for the pipe installed and shall include all necessary labor and materials for laying of the pipe, appurtenances, force main connections, connection to manhole, dewatering if required, excavation, bedding and backfill with select material, compaction, traffic control, erosion and sediment control, and testing. Measurement of the pipe will be to the nearest foot along the centerlines. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

35. Furnish and Install Standard Manhole

    a. Payment will be made at the contract unit price per vertical foot installed and shall include all necessary labor and materials for installing the manhole, furnishing and installing frame and cover, grouting inverts, dewatering if required, excavation, bedding and backfill, compaction, traffic control, erosion and sediment control, and testing. Measurement shall be actual depth to the invert of the sewer line, plus the 8-inch concrete base. No extra payment shall be allowed for bedding when rock excavation is encountered, nor will an extra allowance be allowed for deep manholes requiring thicker walls. The work under this item shall include complete cleanup and restoration of existing features disturbed during construction (including utilities and drainage structure replacement), and other improvements shown on the drawings (including new grading of swales, vegetative screening, and fences). All cost of permits shall be included in the unit price bid. Full payment will not be made until cleanup and restoration are complete.

36. Furnish and Install Manhole Drop Connection

    a. Payment will be made at the contract unit price per furnishing and installation of manhole drop connection as shown in Standard Details.

37. Permanent Grading, Topsoiling, Seeding, and Strawing

    a. Price per linear foot of main trench and service trench for permanent grading, topsoiling, seeding (including fertilizing and liming), strawing, and/or

hydroseeding where indicated on the plans. No separate payment will be made for temporary grading, topsoiling, seeding, and strawing. Topsoil and its placement shall comply with the requirements of the Contract Documents.

3. EXECUTION – NOT USED

END OF SECTION

SECTION 01 3100
COORDINATION

1. GENERAL

1.1 SUBMITTALS

A. Informational

1. Statement of Qualifications (SOQ) for Land Surveyor or Civil Engineer.

2. Bypass Pumping Plan.

1.2 UTILITY NOTIFICATION AND COORDINATION

A. The Contractor will coordinate the Work with various utilities within the Project limits. The Contractor will notify applicable utilities prior to commencing work and if damage occurs, or if conflicts, or emergencies arise during execution of the Work.

1.3 FACILITY OPERATIONS

A. Continuous operation of the Owner's facilities is of critical importance. The Contractor shall schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.

B. The Contractor shall perform the Work continuously during critical connections and changeovers, and as required to prevent interruption of the Owner's operations.

C. When necessary the Contractor shall plan, design, and provide various temporary services, utilities, connections, temporary piping, access, and similar items to maintain continuous operation of the Owner's facility.

D. The Contractor shall not close lines, open or close valves, or take other actions which would affect the operations of the existing systems, except as specifically required by the Contract Documents and after authorization by the Owner and Engineer. Such authorization will be considered within 48 hours after receipt of the Contractor's written request.

E. Contractor shall not proceed with work affecting the facility's operation without obtaining Owner's and Engineer's advanced approval.

1.4 REFERENCE POINTS AND SURVEYS

A. Contractor's Responsibilities:

1. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.

2. In the event of a discrepancy in data the Contractor shall request clarification before proceeding with the Work.

3. The Contractor shall retain the services of a Professional Land surveyor or Civil Engineer registered in the State of Virginia, who shall perform or supervise the engineering and surveying necessary for the construction staking and layout.

4. The Contractor shall maintain a complete and accurate log of the survey Work as it progresses as a Record Document.

5. On request of the Engineer, the Contractor shall submit documentation.

6. The Contractor shall provide competent employee(s), tools, stakes, and other equipment and materials as Engineer may require to:
   a) Establish control points, lines, and easement boundaries.
   b) Check layout, survey and measurement Work performed by others.

c) Measure quantities for payment purposes.

2. PRODUCTS – NOT USED

3. EXECUTION

3.1 CUTTING FITTING AND PATCHING

A. Cut, fit, adjust, or patch Work and work by others, including excavation and backfill as required, to make the Work complete.

B. Obtain prior written authorization from the Engineer before commencing the Work to cut or otherwise alter:

1. Structural reinforcing steel, structural column or beam, elevated slab, trusses, or other structural member.
2. Weather – or moisture-resistant elements.
3. Efficiency, maintenance, or safety element.

C. Work of others.

1. Refinish surfaces to provide an even finish.
2. Refinish continuous surfaces to nearest intersection.
3. Refinish entire assemblies.
4. Finish restored surfaces to such planes, shapes, and textures that no transition between existing work and Work is evident in finished surfaces.
5. Restore existing work, underground facilities, and surfaces that are to remain in completed Work including concrete-embedded piping, conduit, and other utilities as specified and as shown.
6. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.
7. Fit Work airtight pipes, sleeves, ducts, conduit and other penetrations through surfaces and fill voids.
8. Remove specimens of installed Work for testing when requested by the Engineer.

END OF SECTION

SECTION 01 3119
PROJECT MEETINGS

1. GENERAL

1.1 REQUIREMENTS INCLUDED

A. Contractor participation in preconstruction conferences.

B. Contractor participation of progress meetings and pre-installation conferences.

1.2 PRECONSTRUCTION CONFERENCES

A. Engineer will administer preconstruction conference for execution of Owner-Contractor Agreement and exchange of preliminary submittals.

B. Attendance: Owner, Engineer, Contractor, major Subcontractors, representatives of Quality Control firm(s).

1.3 PROGRESS MEETINGS

A. Engineer shall schedule and administer project meetings throughout progress of the work at maximum monthly intervals, as well as administer called meetings, and pre-installation conferences.

B. Engineer shall make physical arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies within seven (7) days to Contractor, participants, and those affected by decisions made at meetings.

C. Attendance: Contractor's Superintendent, Contractor's Project Manager, major Subcontractors and Suppliers; Owner and Engineer as appropriate to agenda topics for each meeting.

D. Suggested Agenda: Review of Work progress, status of progress schedule and adjustments thereto, delivery schedules, submittals, maintenance of quality standards, pending changes and substitutions, and other items affecting progress of Work.

1.4 PRE-INSTALLATION CONFERENCES

A. When required in individual specification Section, Contractor shall convene a pre-installation conference prior to commencing work of that Section.

B. Require attendance of entities directly affecting, or affected by, work of the Section.

C. Review conditions of installation, preparation and installation procedures, and coordination with related work.

2. PRODUCTS – NOT USED

3. EXECUTION – NOT USED

END OF SECTION

SECTION 01 3300
SUBMITTALS

1. GENERAL

1.1 REQUIREMENTS INCLUDED

A. Procedures

B. Schedule of Submittals

C. Construction Progress Schedules

D. Shop Drawings

E. Product Data

F. Manufacturer's Instructions

G. Operation & Maintenance Manuals

1.2 PROCEDURES

A. Contractor is required to provide submittals for all materials and equipment furnished and installed under this contract.

B. Contractor shall deliver submittals to Engineer.

C. Transmit each item with Submittal cover attached.

1. Number submittals by specification section and revision number (e.g. 013000-1 for initial submission of schedule of submittals.)

2. Submit only one item per cover. Highlight all deviations from the Contract Documents, and provide explanation/justification for deviation.

3. Complete all portions of the form above the Contractor's signature line. Incomplete submittals or submittals with unhighlighted deviations will be returned unreviewed.

D. Submit initial progress schedules, and schedule of submittals in duplicate within 15 days after date of Owner-Contractor Agreement. After review by Engineer revise and resubmit as required. Submit revised schedules with each Application for Payment, reflecting changes since previous submittal.

E. Comply with progress schedule for shop drawings, product data, and manufacturer's instructions related to Work progress, and coordinate submittal of related items.

F. Allow a minimum of two weeks' review time.

G. Distribute copies of reviewed submittals to appropriate parties. Instruct recipients to promptly report any inability to comply with provisions.

1.3 SCHEDULE OF SUBMITTALS

A. Contractor to provide to Engineer a Schedule of Submittals for all products used during construction 2 weeks prior to the start of work.

B. Submit the number of copies required by the Contractor, plus three for the Engineer to retain.

1.4 CONSTRUCTION PROGRESS SCHEDULES

A. Submit horizontal bar chart with separate bar for each major trade or operation, identifying first work day of each week. Show relationships between critical path items and indicate lead times for equipment and materials delivery, etc.

B. Show complete sequence of construction by activity, identifying work of separate stages and other logically grouped activities. Show projected percentage of completion for each item of Work as of time of each Application for Progress Payment.

C. Construction schedule shall consider the following typical number of weather days, (i.e. > 0.10" of precipitation) as well as days following during which site conditions may impede progress of the work. The Contractor will not be allowed a time extension due to inclement weather conditions if the total number of inclement weather days for the duration of the project is less than the total inclement weather days indicated below.

J	F	M	A	M	J	J	A	S	O	N	D
6	6	7	6	6	6	8	6	5	5	5	6

D. Submit the number of copies required by the Contractor, plus three for the Engineer to retain.

E. Determination of actual rain days will be based on data published by NOAA for the gauging station nearest the project site, which will be identified at the pre-construction meeting.

F. At each monthly progress meeting, prepare a Monthly Project Summary Report (form included with this section) and attach to the revised project schedule.

1.5 SHOP DRAWINGS

A. Submit the number of copies required by the Contractor, plus three for the Engineer to retain.

1.6 PRODUCT DATA

A. Mark each copy to identify applicable products, models, options, and other data; supplement manufacturer's standard data to provide information unique to the Work.

B. Submit the number of copies required by the Contractor, plus three for the Engineer to retain.

1.7 MANUFACTURER'S INSTRUCTIONS

A. Submit manufacturer's printed instructions for delivery, storage, assembly, installation adjusting, and finishing.

B. Submit the number of copies required by the Contractor, plus three for the Engineer to retain.

2. PRODUCTS – NOT USED

3. EXECUTION

3.1 SHOPDRAWINGS AND SUBMITTALS

A. Contractor shall keep a copy of all shop drawings and submittals on the project site for the duration of the contract

END OF SECTION

(See Monthly Project Summary Report which follows)
(See Submittal Cover which follows)

MONTHLY PROJECT SUMMARY REPORT

MEETING DATE: _____

Is the project on Schedule? _____Yes _____No

Number of weeks AHEAD of Schedule _____

Number of weeks BEHIND Schedule _____

List items from Schedule which are **AHEAD OF SCHEDULE**:

_____

List items from Schedule which are **RIGHT ON SCHEDULE**:

_____

List items from Schedule which are **BEHIND SCHEDULE**:

_____

If behind, what is the Contractor doing to get back on schedule?

_____

_____

When does the Contractor anticipate the Project to be back on Schedule? Date: _____

Are there any outstanding change order items? _____Yes _____No

If so, list them:

_____

_____

Adverse Weather Summary

	J	F	M	A	M	J	J	A	S	O	N	D
Scheduled												
Actual												
Balance												

SUBMITTED:_____ DATE: _____

SIGNED: _____ TITLE: _____

Submittal Cover

No. ___-___

Project: Project #:

To: Timmons Group
Attn:
1001 Boulders Parkway, Suite 300
Richmond, Virginia 23225

From:

Date Submitted: Review Requested Not Later Than:

Submittal Information and Contractor's Representation

Subject: _____

Pursuant to Specification Section(s): _____ Drawing No(s). _____

Submitted as: ☐ Specified Item ☐ "Equal" Item ☐ Substitution ☐ _____

Items Submitted: _____

_____

The Contractor's submittal of items for the Engineer's review and approval constitutes a representation that the items proposed have been reviewed thoroughly by the Contractor and found to be in conformance with the requirements of the Contract Drawings and Specifications. All deviations have been clearly listed in the submittal package and an explanation provided for the deviation.

Contractor's Reviewer (sign): Date:

Review Information

Timmons Group:
Received on: _____ Forwarded for review to: _____

Reviewer:
Received On: _____ Reviewed by: _____

Review is for general compliance with the Contract Documents. Nothing in this review shall be taken as permitting variation from the Contract Documents, unless specifically stated by the reviewer in writing. Sole responsibility for correctness of dimensions, options, details, quantities, and safety during fabrication and erection shall remain with the Contractor. EVALUATION OF INSTALLATION FOR FINAL ACCEPTANCE WILL BE BASED ON THE CONTRACT DOCUMENTS, NOT THE SUBMITTALS, EXCEPT AS SPECIFICALLY APPROVED OTHERWISE IN WRITING.

☐ No Exceptions Taken ☐ Rejected ☐ Resubmission Not Required

☐ Revise and Resubmit ☐ Submit Specified Item ☐ _____

Comments: _____

_____

_____

_____

_____

Returned to Timmons Group: Returned to Contractor:

SECTION 01 4000
TESTING AND INSPECTION

1. GENERAL

1.1 REQUIREMENTS INCLUDED

A. Concrete Testing and Inspection

1.2 INSPECTION SERVICES

A. The Owner shall retain the services and be responsible for payment for an independent inspection firm or firms (Inspection Firm) to provide onsite inspection.

1.3 CONTRACTOR FURNISHED TESTING SERVICES

A. At the time of the Preconstruction Conference, the Contractor shall provide to the Engineer and Owner the identity of the concrete testing firm and laboratory (QC Firm) proposed to perform the field quality control measure. The Contactor shall be responsible for the costs of the field quality control measures at no additional cost to the Owner.

B. The QC firms shall not be authorized to:

1. Release, revoke, alter, or expand on the requirements of the Contract Documents.
2. Approve or accept any portion of the Work.
3. Perform any duties of the Contractor.

C. In coordination with the QC firms, the Contractor shall:

1. Cooperate with testing personnel, to provide access to the work and to the Manufacturer's operations where applicable.
2. Secure and deliver to the QC firm(s) adequate quantities of representational samples of materials proposed to be used and which require testing.
3. Provide to the QC firm the preliminary design mix proposed to be used for concrete, and other materials mixes which require control.
4. Furnish incidental labor and facilities:
   a) To provide access to the Work to be tested.
   b) To obtain and handle samples at the project site or at the source of the product to be tested.
   c) To facilitate inspections and tests.
   d) For storage and curing of test samples.
5. Notify the QC firm sufficiently in advance of operations to allow for firm assignment of personnel and scheduling of tests.

D. Copies of test results and product test reports shall be transmitted in quantities required by the Engineer directly from the QC firm, and shall not be handled or received by the Contractor prior to being received by the Engineer.

E. Testing services other than those called for in these Contract Documents may be called for by the Owner to check compliance with the specification requirements. When

tests indicate compliance with specifications, the testing service charges shall be borne by the Owner, but when non-compliance with specifications is indicated, the testing service charges shall be the Contractor's responsibility and be deducted from the Contract sum.

1.4 INSPECTION AND TESTING

A. Equipment Installation

1. All equipment shall be installed in accordance with the Manufacturer's installation instructions. The O & M Manual for the specific equipment shall be on hand during the inspection phases for confirmation of correct installation. Contractor shall have on site a copy of the O & M Manual with the installation instructions for review by the Inspection Agency and Engineer.

B. Inspection

1. The Inspection Firm has the right to inspect all material and equipment at all stages of development or fabrication, and shall be allowed access to the site and to the Contractor's and Supplier's shops to conduct such inspections. Inspection by the Inspection Firm shall not release the Contractor from responsibility or liability with respect to material or equipment.

2. When specified inspections or tests are required by the Contract Documents, the Work involved shall not proceed beyond that point until such inspections or tests have been completed and approved by the Inspection Firm. The Contractor shall inform the Inspection Firm of the progress of the Work and shall give the Inspection Firm a minimum of three working days written notice of appropriate times for specified inspections and tests. The Contractor shall insure that the portion of Work to be inspected is safe, accessible, dry, ventilated and well lit.

3. When local codes or laws require approval and inspection of the Work by other agencies or organizations before installation or operation, the Contractor shall obtain such approval and submit one signed original and three copies of the approval to the Inspection Firm.

4. That portion of the Work subject to the provisions of the Virginia Uniform Statewide Building Code shall be constructed in accordance with the latest version.

5. The Work shall be subjected to continuous inspection by the Inspection Firm and a formal inspection by the Engineer: All required labor, materials, equipment, instruments, lubricants and incidentals necessary to perform these inspections shall be furnished by the Contractor. This includes providing competent and experienced personnel, who are authorized representatives of the Manufacturers of the equipment furnished, to assist the Contractor in the installation, testing and adjustments of the equipment to perform in accordance with the Contract Documents. Before proceeding to the next inspection, all discrepancies and deficiencies observed during each inspection shall be noted and corrected and, if directed by the Engineer, the inspection shall be rescheduled and re-performed at no additional cost to the Owner.

6. Pre-final Inspection: The Contractor shall schedule in accordance with his construction schedule and with the approval of the Engineer a Pre-final Inspection to take place a minimum of 10 days before the Contractor's date of substantial completion. The Pre-final Inspection shall fully demonstrate to the Engineer or Inspecting Firm that all individual project components function as required by the Contract Documents and that all systems are internally coordinated, as well as coordinated with other systems. Equipment shall be operated and required system tests performed. In addition, the

Contractor shall demonstrate that all major site work has been brought to final configurations and restoration initiated. All items of deficiency noted for correction shall be completed before the Final Inspection is scheduled. The Engineer will prepare a punch list of items to be accomplished prior to Final Acceptance.

7. Final Inspection : After the Contractor has shown that all systems and project work are completed and deficiencies noted in the Pre-final Inspection are corrected, a Final Inspection of the project including a test and demonstration of all equipment and systems shall be scheduled. This Inspection shall take place a minimum of 20 days before the Contractor's scheduled Final Completion date. Correction of the deficiencies noted in the Pre-final Inspection shall be accomplished before the Engineer will approve the scheduling of the Final Inspection. This Inspection shall demonstrate that all elements of the project are ready to be placed in operation and all work has been fully completed in accordance with the Contract Documents.

C. Equipment Testing: Test procedures as specified in the Contract Documents or as otherwise required shall be coordinated and demonstrated during the Pre-final and Final Inspections. Each test shall be scheduled and performed by the Contractor in the presence of the Engineer or Inspection Firm. All required labor, materials, equipment, instruments, lubricants and incidentals to perform the tests shall be furnished by the Contractor. This shall include providing competent and experienced personnel, who are authorized representatives of the Manufacturers of the equipment furnished, to assist the Contractor in the installation, testing and adjustments of the equipment to perform in accordance with the Contract Documents. Before proceeding to the next test, all discrepancies and deficiencies observed during each test shall be noted and corrected and, if directed by the Engineer, the test rescheduled and re-performed at no additional cost to the Owner.

1. Pre-final Test: During the Pre-final Inspection, equipment shall be operated and tested to fully demonstrate to the Engineer that it works as a unit and a part of the entire system in accordance with the Contract Documents and that all systems are internally coordinated as well as coordinated with other systems. All items of deficiencies and required adjustments noted during this Test shall be corrected before the Final Inspection is scheduled.

2. Final Test: After all equipment and systems have passed the Pre-final Inspection and are completely installed with controls, instrumentation, safety devices and all items of Work completed including correction of deficiencies, and adjustments, the Final Inspection and Test shall be scheduled. This Test shall consist of continuously operating the equipment and systems without interruption under actual operating conditions for a period of 14 days to demonstrate that all are fully operative and ready to be permanently placed in operation. The Contractor shall be responsible for operation during the Final (14 day) Test, including provision of and payment for all materials and operation costs necessary for the Tests. Should there be any disruption during the 14 day period, the Contractor shall make necessary adjustments and reschedule the Test from its beginning.

D. Acceptance: The Engineer shall recommend to the Owner that the Work be accepted upon the Contractor’s completion and to the satisfaction of the Owner, all of the Work required by the Contract Documents and all items identified on the punchlist prepared by the Engineer and Contractor, if any, at the time of the Final Inspection. The Contractor is required to coordinate with the Engineer reinspections of Work listed on the punchlist. The Engineer may require the Contractor to have groups of punchlist items completed prior to reinspecting the Work. The Owner shall accept the Work upon the recommendation by the Engineer and completion of all of the Work required by the Contract Documents and all

punchlist items; all Operation and Maintenance Manuals , “as-built” drawings, Certificates and Written Warranties having been submitted and approved by the Engineer.

2. PRODUCTS – NOT USED

3. EXECUTION – NOT USED

END OF SECTION

SECTION 01 5000
TEMPORARY FACILITIES AND ENVIRONMENTAL PROTECTION

1. GENERAL

1.1 TEMPORARY FACILITIES

A. General:

1. Temporary facilities and protective devices include, but are not limited to, the following items: temporary barricades, fences, bridges, guards, temporary utilities, steel plates over trenches, maintenance of traffic and project identification signs.

2. All materials used in construction of the above mentioned items of work shall be of such size, shape and strength as to be suitable for the use intended.

3. The Contractor shall conduct construction operations in such a manner as to cause as little inconvenience as possible to the general public, and the Owner. Wherever required, the Contractor shall erect and maintain signs, fences, barricades, and pedestrian bridges and provide guards and flagmen for the protection of the public.

4. The Contractor shall take positive measures to prevent at all times, entry to the site of the work and storage areas by children, animals, and unauthorized adults.

B. Furnish and construct temporary fencing as needed to fence off excavation, storage, and operating areas. All temporary fences erected by the Contractor shall be substantially constructed, and neat in appearance.

1. Barricade or close all openings in roadways, floors, walls, or other parts of structures or walkways while the openings are not in regular use. Barricades shall be substantial and neat in appearance.

C. Unless otherwise specified, the existing systems shall remain in service during the entire construction period for the project. The Contractor shall provide temporary measures as necessary to maintain operation of the system. The Contractor shall provide water at no cost to the Owner. The Contractor shall assure the availability of drinking water for his work force.

D. The Contractor shall make the necessary arrangements and provide all temporary electrical service and lighting required during the entire construction period. The cost of electricity used shall be borne by the Contractor. The electrical service shall be sufficient capacity and characteristics to supply the proper current for the various types of construction tools, motors, welding machines, lights, heating plant, pumps, and other work required. All necessary temporary wiring, panel boards, outlets, switches, lamps, fuses, controls, and accessories shall be provided.

E. The Contractor shall provide and maintain an adequate number of temporary toilets with proper enclosures as necessary for use of workmen during construction. The Contractor shall keep toilets clean and comply with local and State health requirements and sanitary regulations. Toilet facilities shall be the prefabricated chemical type unless otherwise permitted.

F. The Contractor shall be responsible for provisions of temporary heating, including all costs of equipment and installation, fuel and attendance, whenever and for such periods as such heating may be required, either because of general weather conditions to prevent freezing, to provide suitable working conditions, or to assure progress of the operation within the established scheduled time for curing of concrete.

1.2 MAINTENANCE OF TRAFFIC

A. The Contractor shall be responsible for maintaining a normal through traffic flow in accordance with County and VDOT requirements.

B. The Contractor shall provide temporary facilities as required for pedestrian and vehicular access to properties adjacent to or contiguous to the project. Should it be necessary to temporarily interrupt access, the Contractor shall so notify the Engineer, and after securing the Engineer's approval, the Contractor shall notify all affected parties of the time, extent, and duration of the interruption.

C. The Contractor shall not obstruct any driveway longer than two (2) hours without providing an alternate temporary access to the property.

1.3 ENVIRONMENTAL PROTECTION

A. The Contractor shall be responsible for furnishing all necessary items for fulfilling the Work described herein for Environmental Protection including prevention and control of erosion and sedimentation that results directly or indirectly from the project. The Contactor shall also be responsible for compliance with the Erosion and Sediment Control Plan shown on the approved contract drawings.

B. Prevention of Water Pollution:

1. The Contractor shall take all such precautions in the conduct of his operations as may be necessary to avoid contaminating the water in adjacent watercourses or water storage areas.

2. All earthwork, moving of equipment, and other operations likely to create silting, shall be conducted so as to minimize pollution of water courses and water storage areas.

3. Water used during the work which has become harmful and contaminated with oil, bitumins, or objectionable chemicals, sewage or other pollutants, shall be disposed of so as to avoid affecting all nearby waters and lands. Under no circumstances shall the Contractor discharge pollutants into any watercourse or water storage area. The Contractor shall not allow water used in aggregate processing, concrete curing, foundation, and concrete lift cleanup, or any other waste, to enter a stream. When water from adjacent natural sources is used in the Work, intake methods shall be such to avoid contaminating the source of supply or becoming a source of erosion.

C. Noise and Air Pollution Control

1. The Contractor shall conduct his operations so as not to violate any applicable ordinances, regulations, rules, and laws in effect in the area pertaining to noise and air pollution.

D. Preservation of Natural Resources

1. All construction operations, cleanup, and the condition of the adjacent terrain upon completion of the work shall fully comply with all applicable regulations and laws concerning the preservation of natural resources.

E. Dust Control

1. Throughout the entire construction period, maintain dust control by use of water sprinklers or chemical dust control binder as may be approved by the Engineer and VDOT.

1.4 CONFINED SPACE REQUIREMENTS

A. The Contractor shall be responsible for all practices and procedures, either singularly or in combination, required for entry into a confined space area as defined by the Virginia Occupational Safety and Health Codes Board. Such practices include, but are not limited to:

1. Preparation
2. Atmospheric Testing
3. Attendants and Rescue Teams
4. Permit Systems
5. Training
6. Special Equipment and Tools
7. Tripods, Safety Harnesses, Retrieval Lines, and Respiratory Protection

B. The Contractor shall be required to conform to requirements stipulated in the Occupational Safety and Health Administration regulations.

1.5 CLEANING DURING CONSTRUCTION

A. Control accumulation of waste materials and rubbish; periodically dispose of off-site.

B. Clean areas prior to start of finish work; maintain areas free of dust and other contaminants during finishing operations.

2. PRODUCTS – NOT USED

3. EXECUTION – NOT USED

END OF SECTION

SECTION 01 6000
MATERIAL AND EQUIPMENT

1. GENERAL

1.1 DEFINITIONS

A. Products:

1. New items for incorporation in the Work whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock and may also include existing materials or components required for reuse.

2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.

3. Items identified by Manufacturer's product name, including make or model designation, indicated in Manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.2 DESIGN REQUIREMENTS

A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of latest edition of Virginia Statewide Uniform Building Code.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at elevations shown on Drawings.

B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of 0 °F to 104 °F.

1.4 PREPARATION FOR SHIPMENT

A. When practical, have the factory assemble products, mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.

C. Extra Materials, Special Tools, Test Equipment, and Expendables:

1. Furnish as Required by Individual Specifications.

D. Schedule:

1. Ensure that shipment and delivery occur concurrently with shipment of associated equipment.

2. Transfer to the Owner shall occur immediately subsequent to the Contractor's acceptance of equipment from Supplier and any required O&M Manuals have been delivered to and approved by the Engineer.

E. Packaging and Shipment:

1. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.

F. Prominently Displayed on Each Package, the Following:

1. Manufacturer's part nomenclature and number, consistent with the Operation and Maintenance Manual identification system.
2. Applicable equipment description.
3. Quantity of parts in package.
4. Equipment Manufacturer.

G. Delivery of Materials:

1. Notify the Engineer upon arrival for transfer of materials. Replace extra materials and special tools found to be damaged or otherwise inoperable at time of transfer to the Owner.
2. Request a minimum 7-day advance notice of shipment from the Manufacturer. Upon receipt of the Manufacturer's advance notice of shipment, promptly notify the Engineer of anticipated date of equipment arrival.
3. Factory Test Results: Reviewed and accepted by the Engineer before product shipment as required in individual Specification Sections.

1.5 DELIVERY AND INSPECTION

A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at the Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.

B. Deliver products in undamaged condition, in the Manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.

C. Unload products in accordance with the Manufacturer's instructions for unloading or as specified, and record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.

D. Remove damaged products from the Site, and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.6 HANDLING, STORAGE, AND PROTECTION

A. Handle and store products in accordance with the Manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with Section 01 50 00, TEMPORARY FACILITIES AND ENVIRONMENTAL PROTECTION.

B. Provide the Manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by the Owner.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in. storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.

D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 °F. Protect electrical, instrumentation, and control products, and insulation against moisture, water, and dust damage. Connect and operate continuously all space heaters furnished in electrical equipment.

E. Store fabricated products above ground on blocking or skids, prevent soiling or staining, and store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.

G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.

H. Hazardous Materials: Prevent contamination of personnel, storage building, and Site. Meet requirements of product specification, codes, and Manufacturer's instructions.

2. PRODUCTS

2.1 GENERAL

A. Provide the Manufacturer's standard materials suitable for service conditions unless otherwise specified in the individual Specifications.

B. Where product specifications include a named Manufacturer, with or without model number, and also include performance requirements, named Manufacturer's products must meet the performance specifications.

C. Like items of products furnished and installed in the Work shall be end products of one Manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, Manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.

D. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

E. Provide interchangeable components of the same Manufacturer, for similar components, unless otherwise specified.

F. Equipment, Components, Systems, Sub-systems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, State, and local health and safety regulations.

G. Regulatory Requirement: Coating materials shall meet Federal, State, and Local requirements limiting the emission of volatile organic compounds and for worker exposure.

H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated ½" mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.

I. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with AHJ's adopted edition of the Virginia Uniform Statewide Building Code. Where required by the VUSBC, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the VUSBC in order to provide a basis for approval under NEC.

2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

J. Equipment Finish:

1. Provide the Manufacturer's standard finish and color, except where specific color is indicated.

2. If the Manufacturer has no standard color, provide equipment with gray finish as approved by the Engineer.

K. Special Tools and Accessories: Furnish to the Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, hand wheels, chain operators, special tools, and other spare parts as required for maintenance.

L. Lubricant: Provide initial lubricant recommended by the equipment Manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by the Owner.

2.2 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.

2. Two or more items of the same type shall be identical, by the same Manufacturer, and interchangeable.

3. Design structural members for anticipated shock and vibratory loads.

4. Use 1/4" minimum thickness for steel that will be submerged, wholly or partially, during normal operation.

5. Modify standard products as necessary to meet performance Specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible Oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform are required.
3. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
4. Provide constant-level oilers or oil level indicators for oil lubrication systems.
5. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.3 SOURCE QUALITY CONTROL

A. Where Specifications call for factory testing to be witnessed by the Engineer, notify the Engineer not less than 14 days prior to scheduled test date, unless otherwise specified.

B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).

C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion

3. EXECUTION

3.1 INSPECTION

A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

3.2 INSTALLATION

A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

B. No shimming between machined surfaces is allowed.

C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Repaint painted surfaces that are damaged prior to equipment acceptance.

E. Do not cut or notch any structural member or building surface without specific approval of Engineer.

F. Handle, install, connect, clean, condition, and adjust products in accordance with the Manufacturer's instructions, and as may be specified. Retain a copy of the Manufacturer's instruction at the Site, available for review at all times.

G. For material and equipment specifically indicated or specified to be reused in the Work:

1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.

2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.3 LUBRICANTS

A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by the Owner.

END OF SECTION

SECTION 01 7000
CLOSEOUT PROCEDURES

1. GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including but not limited to the following:

1. Inspection procedures
2. Warranties
3. Final cleaning

B. See Divisions 2 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 SUBSTANTIAL COMPLETION

A. Record Drawings: The Contractor shall maintain an accurate set of Record Drawings and Specifications throughout the Work. The Contractor shall prepare marked prints showing the installed locations and sizes of all underground or concealed portions of the Work that are different from those shown in the Contract Documents. These Drawings shall be based on the set kept at the project site and shall also show any other changes made to the project during construction. These Drawings shall be submitted to the Engineer at completion of the Work.

Record Drawing information shall include the following as a minimum, where applicable:

1. Size, horizontal and vertical location of any existing utilities uncovered during the course of the Work. This shall include telephone cables and conduits, fiberoptic cables and conduits, television cables, electrical cables and conduits, gas lines, water lines, sewer force mains, sanitary sewers, storm sewers, and the like.
2. To all cleanouts new and existing, size of service lines installed, and the like.
3. Location of lines plugged or capped.
4. Sizes and types of materials used and changes in sizes and types of materials. Rims and inverts of all manholes installed or tied into shall be provided.
5. The Record Documents are a specific contract requirement of the Contractor. Final payment will not be issued until said documents have been submitted to the Engineer in an acceptable form.

B. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in the request.

1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Advise the Owner of pending insurance changeover requirements.
3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Obtain and submit releases permitting the Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
5. Prepare and submit the Project Record Documents, final completion construction photographs and photographic negatives if available, damage or settlement surveys,

property surveys, and similar final record information.

6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with the Manufacturer's name and model number where applicable.
7. Make final changeover of permanent locks and deliver keys to the Owner. Advise the Owner’s personnel of changeover in security provisions.
8. Complete startup testing of systems.
9. Submit test/adjust/balance records.
10. Terminate and remove temporary facilities from the Project site, along with mockups, construction tools, and similar elements.
11. Advise the Owner of changeover in heat and other utilities.
12. Submit changeover information related to the Owner's occupancy, use, operation, and maintenance.
13. Complete final cleaning requirements, including touchup painting.

14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

C. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, the Engineer will either proceed with inspection or notify the Contractor of unfulfilled requirements. The Engineer will prepare the Certificate of Substantial Completion after inspection or will notify the Contractor of items, either on the Contractor's list or additional items identified by the Engineer, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. Results of the completed inspection will form the basis of requirements for Final Completion.

1.3 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of the list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by the Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order.

2. Organize items applying to each space by major element, including categories for individual walls, and equipment, and building systems.

1.4 FINAL COMPLETION

A. Preliminary Procedures: Before requesting the final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment according to the General Conditions.

2. Submit a certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by the Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.

3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

4. Instruct the Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training DVD’s.

B. Inspection: Submit a written request for Final Inspection for acceptance. On receipt of request, the Engineer will either proceed with inspection or notify the Contractor of unfulfilled requirements. The Engineer will prepare a final Certificate for Payment after inspection or will notify the Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

2. PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by the Manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces

3. EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal, State and Local environmental and antipollution regulations.

B. Cleaning: Clean each surface or unit to condition equal to original plant condition. Comply with the Manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Final Completion for entire Project or for a portion of Project:
   a) Clean Project site, yard, and grounds, in areas disturbed by construction activities, of rubbish, waste material, litter, and other foreign substances.
   b) Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c) Remove tools, construction equipment, machinery, and surplus material from the Project site.
   d) Clean exposed exterior and interior hard-surfaced finishes to a dirt free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   e) Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   f) Sweep concrete floors broom clean in unoccupied spaces.
   g) Remove labels that are not permanent.
   h) Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      i. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
   i) Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
   j) Replace parts subject to unusual operating conditions.
   k) Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
   l) Clean light fixtures, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
   m) Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful, or

dangerous materials into drainage systems. Remove waste materials from the Project site and dispose of lawfully.

3.2 SUBSTANTIAL COMPLETION

A. Contractor shall demonstrate to the Owner and Engineer that each until process functions and performs in accordance with the plans, specifications, and the Manufacture's design criteria.

B. The Contractor shall coordinate the date, time, and duration of the performance testing and demonstration with the Owner and Engineer.

C. The Contractor shall correct deficiencies identified by the Owner or Engineer during performance demonstration prior to rescheduling a subsequent performance demonstration.

D. Once the Contractor has demonstrated that each unit process functions and performs as required, the Engineer shall advice the Contractor in writing as to the date of Substantial Completion.

E. The punch list of items to be corrected before the date of the final completion will be attached to the notification of substantial completion.

3.3 FINAL COMPLETION

A. The Contractor shall coordinate with the Owner and Engineer confirmation that each item appearing on the punch list has been corrected.

B. Once all punch list items have been corrected, the Engineer shall issue the Certificate of Final Completion.

END OF SECTION

SECTION 02 0000
SITE CONDITIONS

1. GENERAL

1.1 DESCRIPTION

A. Existing utility facilities and structures are shown in accordance with the best available information. The Engineer and / or the Owner shall not be responsible for the completeness or accuracy thereof nor for any deductions, interpretations, or conclusions drawn there from. Forty-eight hours in advance of work in the vicinity of existing facilities, the Contractor shall notify "Miss Utility" by calling 800-552-7001. The Contractor shall verify to his own satisfaction, the actual locations of existing facilities prior to construction in their vicinity.

1. Should the Contractor, in the course of his operations, encounter any underground utilities, the presence of which was not previously known or of a different type than shown, he shall immediately notify the Engineer and take all precautions necessary to support and protect the utility and maintain continuous service until said utilities can be adjusted by the appropriate owners or other corrective measures taken.

2. Relocations by others arranged by and for the convenience of the Contractor shall be at no additional cost to the Owner.

3. The Contractor shall be responsible for filing all requests with public utility corporations, jurisdictional agencies, or other owners to make all adjustments to public utility fixtures and appurtenances within or adjacent to the limits of construction. Furnish copies of all such requests and replies to the Engineer. The Contractor shall be responsible for coordinating his activities with said body. Additional costs resulting from a lack of coordination between the utilities and Contractor shall be at no additional cost to the Owner, and extension of time, therefore, will not be granted.

4. Damage caused to utilities either directly or indirectly by the Contractor shall be repaired and the facilities restored to their original condition to the satisfaction of the Engineer and the utility owner, at no additional cost to the Owner.

B. Work in Vicinity of Existing Utilities

1. At least 48 hours prior to starting work in the vicinity of utility structures and appurtenances, the Contractor shall notify "Miss Utility" as stated hereinbefore. The Contractor, at his own expense, shall support and protect all utility structures and appurtenances in accordance with the Contract Documents and/or the Owner's requirements and shall take any other steps necessary to protect the structures from disturbance and damage.

C. Access to Utilities Facilities

1. The Contractor shall at all times permit free and clear access to the various affected facilities by personnel of the utility for the purpose of inspection, maintenance, providing additional service requirements and the construction of new facilities. When personnel of the utility are working within the limits of work to be performed by the Contractor, the Contractor will not be relieved of his responsibility for the maintenance and protection of such facilities.

D. When local codes or laws require notification of work to agencies or departments, the Contractor shall be responsible for providing such notification.

2. PRODUCTS – NOT USED

3. EXECUTION – NOT USED

END OF SECTION

SECTION 03 3000
CAST-IN-PLACE CONCRETE

1. GENERAL

1.1 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for Building and Environmental Structures as follows:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.
4. Suspended slabs.
5. Concrete toppings.
6. Building frame members.
7. Building walls.
8. Concrete encasement.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.

E. Samples: For waterstops.

F. Welding certificates.

G. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

H. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Waterstops.
6. Curing compounds.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Vapor retarders.
11. Repair materials.

I. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

C. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301-99, "Specification for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

F. Preinstallation Conference: conduct conference at Project site to comply with requirements in Division I.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
   a) Contractor's superintendent.
   b) Independent testing agency responsible for concrete design mixtures.
   c) Ready-mix concrete manufacturer.
   d) Concrete subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

2. PRODUCTS

2.1 MANUFACTURERS

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.

2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
   a) High-density overlay, Class 1 or better.
   b) Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
   c) Structural 1, B-B or better; mill oiled and edge sealed.
   d) B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4-by-3/4 inch, minimum.

E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed when welding is indicated.

C. Plain-Steel Wire: ASTM A 82, as drawn.

D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
   a) Fly Ash: ASTM C 618, Class C.
   b) Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 120.

B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal except as otherwise limited by ACI 318-99, paragraph 3.3.2..

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing more than 0.1% chloride ions.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2. Retarding Admixture: ASTM C 494/C 494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.7 WATERSTOPS

A. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals. Factory fabricate corners, intersections, and directional changes.

1. Products:
   a) JP Specialties, Inc.; Earth Shield TPE-Rubber.
   b) Vinylex Corp.; PetroStop.
   c) WESTEC Barrier Technologies, Inc.; 600 Series TPE-R.
2. Profile: Ribbed with center bulb.
3. Dimensions: 4 inches by 3/16 inch thick; nontapered.

2.8 VAPOR RETARDERS

A. Plastic Vapor Retarder: ASTM E 1745, Class C, or polyethylene sheet, ASTM D 4397, not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

2.9 FLOOR AND SLAB TREATMENTS

A. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture when indicated..

B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces when indicated.

2.10 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

2.11 RELATED MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

C. Reglets: Fabricate reglets of not less than 0.0217-inch- thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

D. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.

4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.

3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.

4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.13 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Ground Granulated Blast-Furnace Slag: 50 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use corrosion-inhibiting admixture in concrete mixtures when indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.14 CONCRETE MIXTURES FOR NON-ENVIRONMENTAL BUILDING ELEMENTS

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Slump Limit: 4 inches; 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
3. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery.

B. Foundation Walls: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Slump Limit: 4 inches; 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
3. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery.

C. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Slump Limit: 4 inches, plus or minus 1 inch.
3. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
4. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

D. Suspended Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Slump Limit: 4 inches, plus or minus 1 inch.
3. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

4. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

E. Concrete Toppings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Slump Limit: 4 inches, plus or minus 1 inch.
3. Air Content: Do not allow air content of troweled finished toppings to exceed 3 percent.
4. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd.

2.15 CONCRETE MIXES FOR ENVIRONMENTAL AND LIQUID RETAINING STRUCTURES

A. Footings: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Slump Limit: 4 inches; 8 inches for concrete with verified slump of 2 to 4 inches before adding high range water-reducing or plasticizing admixture, plus or minus 1 inch.
3. Air Content: 6 percent plus or minus 1.5 percent at point of delivery.

B. All other concrete: Proportion normal weight concrete mixture as follows:

1. Minimum compressive strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Material Ratio: 0.45.
3. Minimum Cementitious Materials Content: 540 lbs/cu. yd.
4. Slump Limit: 4 inches plus or minus 1 inch.
5. Air Content: 6 percent plus or minus 1.5 percent at point of delivery. Do not allow air content of troweled finished floors to exceed 3 percent

2.16 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.17 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

3. EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.

2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.

2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less

than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps. Lace overlaps with wire.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints in Slabs-on-Grade: After removing formwork, install bond break strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend bond break strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

2. Terminate full-width bond break strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.

3. Install bond break strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

D. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Notify Soils Engineer to permit inspection of sub-base a minimum of 24 hours prior to placement of reinforcing steel and concrete. Soils Engineer shall inspect and approve all foundation subgrades prior to placing concrete (See Division 2).

C. Notify Inspection service to permit inspection of reinforcing steel a minimum of 24 hours prior to concrete placement. Notify Owner 24 hours prior to any scheduled concrete pour.

D. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.

2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

H. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Forms used for formed concrete shall produce a smooth formed finish.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces to receive a rubbed finish and to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

2. Apply to concrete surfaces exposed to view or permanently exposed to process liquids.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction.

1. Apply scratch finish to surfaces indicated and to receive: concrete floor toppings; to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot- long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 1/8 inch

E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after trowel finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

F. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.

2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.

3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a) Water.
   b) Continuous water-fog spray.
   c) Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   a) Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   b) Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project..

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a) After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

3.14 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.

2. Do not apply to concrete that is less than 28 days' old.

3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor

elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: Contractor will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Testing Agency shall provide certification of field and laboratory technicians for qualifications required in ACI 318-08, Section 5.6.1.

B. Inspections:

1. Steel reinforcement placement.

2. Steel reinforcement welding.

3. Headed bolts and studs.

4. Verification of use of required design mixture.

5. Concrete placement, including conveying and depositing.

6. Curing procedures and maintenance of curing temperature.

7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172, as modified in these specifications, shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
   a) When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M. Samples shall be taken from concrete pump discharge hose when concrete is transported by concrete pump.
    a) Cast and laboratory cure two sets of two 6 x 12 cylinder specimens or two sets of three 4 x 8 cylinder specimens for each composite sample. Test specimen size shall be agreed upon by A/E and testing agency before construction.
    b) Cast and field cure two sets of cylinder specimens for each composite sample for formed elevated slab or beam elements.
6. Compressive-Strength Tests: ASTM C 39-05.
    a) 6 x 12 Specimens: Test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    b) 4 x 8 Specimens: Test one set of three laboratory-cured specimens at 7 days and one set of three specimens at 28 days.
    c) A compressive-strength test shall be the average compressive strength from a set of specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Engineer.
12. Additional testing and inspecting will be at Contractor's expense.

13. Correct deficiencies in the Work that test reports and inspections indicate dos not comply with the Contract Documents.

END OF SECTION

SECTION 31 1000
SITE CLEARING

1. GENERAL

1.1 DESCRIPTION

A. This section provides for general site clearing operations, including trees and vegetation removal, protection of existing trees to be left standing, and clearing and grubbing.

B. Provide barricades, coverings, safety fence or other types of protection necessary to prevent damage to existing facilities and appurtenances not indicated to be removed, and improvements on adjoining properties.

1. Restore all improvements damaged by this work to their original condition, and acceptable to the Owner or other parties or authorities having jurisdiction.

C. Protect existing trees and other vegetation indicated to remain in place against cutting, breaking, or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary fences, barricades or guards as required to protect trees and vegetation to be left standing. Any excavations within the tree drip line shall be by hand.

D. Burning where allowed by local ordinances will be permitted.

2. PRODUCTS – NOT USED

3. EXECUTION

3.1 CLEARING

A. Remove from the site and permanent easements: trees, brush, shrubs, down timber, rotten wood, rubbish, other vegetation as well as fences, and incidental structures necessary to allow for new construction.

B. Clearing work shall be restricted to area within rights-of way or easements or within "Construction Limits" indicated on Drawings.

C. Undisturbed stumps and roots which will be a minimum of 5 feet below finished grade, and will not be located under or within 10 feet of any structure or pipe line, may be left in place. Tops of stumps left in place shall not be more than 3 inches above original grade.

3.2 EXISTING TREES AND SHRUBS

A. Trees and shrubs that are to remain within "Construction Limits" will be indicated on Drawings or conspicuously marked on site.

B. Ownership to Trees: Unless otherwise noted, trees within the "Construction Limits" shall become the property of the Contractor and shall be removed from the site.

3.3 GRUBBING

A. Grub areas within and to a point 10 feet outside of all structures and pipe lines, areas to receive fill where finished grade will be less than 3 feet above existing grade, cut areas where finished grade will be less than 2 feet below existing grade, transitional areas between cut and fill, and any area to receive control fill.

B. Remove from the ground to a depth of 18 inches, all stumps, roots ½-inch and larger,

C. organic material and debris.

D. Use only hand methods for grubbing inside the drip lines of trees which are to remain.

3.4 CLEANING

A. Clean up debris resulting from site clearing operations continuously with the progress of the work.

B. Remove all waste material from site.

C. Remove debris from site in such a manner as to prevent spillage. Keep pavement and area adjacent to site clean and free from mud, dirt and debris at all times. All paved areas shall be swept at the end of each workday.

END OF SECTION

SECTION 31 2300
TRENCHING AND BACKFILLING

1. GENERAL

1.1 DESCRIPTION

A. Work included in this section includes trenching and backfilling for underground pipelines and related structures only.

B. Reference Specifications Are Referred to By Abbreviation As Follows:

1. American Society for Testing and Materials --- ASTM
2. American Association of State Highways and

   Transportation Officials ---------- AASHTO
3. Virginia Department of Transportation --------- VDOT

B. Store and use explosives in accordance with Federal, State and Local regulations. The Contractor shall be responsible for and shall satisfactorily correct all damage resulting from use of explosives.

C. Contractor shall provide compaction testing by a licensed, independent testing agency approved by Goochland County for Developer contracts. The testing shall be performed by agency personnel in the presence of the County Construction Inspector. The testing company shall submit the results to the County Engineer.

D. Locate existing utilities, culverts and structures, above and/or below ground, before any excavation starts. Coordinate work with utility companies. Protect, maintain in service, and prevent damage to utilities not designated to be removed. When utilities are encountered and are not shown on Drawings or when location differs from those shown on Drawings, notify County Engineer for instructions before proceeding.

E. The Contractor shall contact the power company when working in the vicinity of overhead power line poles. The power company shall hold poles and shield/ground lines as required and all costs associated with this task shall be paid by the Contractor.

2. PRODUCTS

2.1 GENERAL

A. Pipe Bedding Fill

1. Granular fill shall meet requirements for coarse aggregates, ASTM C3, size No. 57.

B. Select Backfill

1. Select fill shall be in accordance with VDOT 2007 Road and Bridge Standards, Section 207.01, Table II-6
2. Aggregate fill shall be an approved uniformly graded mixture of crushed stone or crushed and uncrushed gravel with 100 percent passing a 1-1/2 in. sieve and not more than 5 percent passing a No. 4 sieve. ASTM D448, size No. 56.
3. Clean earth fill shall be an approved material free of debris, roots, frozen materials, organic matter, rock or gravel larger than 1-1/2 inches in any dimension or other harmful, deleterious matter.

4. All select fill shall be capable of being compacted to 100% in accordance with ASTM D698.

5. Contractor shall submit a job mix for approval with Laboratory Testing Reports. Retesting will be by visual examination and at the discretion of the County Inspector.

C. Concrete for bedding, backfill or encasement shall be 3000 psi.

D. Riprap, where shown on the Drawings shall conform to VDOT Specification Sec. 414.03 Dry Riprap - as indicated on Drawings.

3. EXECUTION

3.1 GENERAL

A. Strip existing topsoil, leaf mold and organic materials, meeting topsoil requirements of Section 10 - "Seeding." Deposit in storage piles separate from other excavated material.

B. Where the trench width exceeds the allowable width, the Contractor at his own expense shall provide for increased loads on pipe as directed by the Engineer.

C. Unauthorized excavation consists of the removal of material beyond indicated subgrade elevations or side dimensions without specific approval of the County Engineer. Where unauthorized excavations occur, restore these areas to the elevations and dimensions shown on the Drawings with granular fill.

D. Where removal of unsatisfactory material is due to fault or negligence of the Contractor, by inadequate shoring or bracing, dewatering, material storage or other failure to meet specified requirements, any work deemed necessary by the Engineer to correct the faulty condition shall be performed at no additional cost.

3.2 EXCAVATION AND BEDDING

A. Open trenches only so far in advance of pipe laying as permitted by the County Engineer.

B. The width of the trench at and below the top of the pipe shall not exceed the width of the trench as defined in Section 7.

C. Pressure Pipe

1. Ductile Iron Pressure lines shall be installed with Class C-1 bedding as indicated in the Standard Drawings.

2. PVC pressure lines 4" and larger shall be installed with Class C bedding.

3. Pressure pipe 3" and smaller of PVC, polyethylene pipe and copper tubing shall be backfilled with 6 inches of sand all around.

4. Excavate for bell holes at each joint so that entire barrel of pipe shall be fully supported the entire length.

5. Where rock is encountered, excavate 6 inches below the bottom of the pipe for bedding in granular material or sand as appropriate.

D. GRAVITY PIPE

1. Ductile Iron gravity sewer lines shall be installed with a minimum of 6 inches of

granular bedding (Class C).

2. Bedding for PVC Pipe shall be Class B or better.

E. All pipes shall be installed in a dry trench. Dewater excavation as necessary to provide proper protection. If deemed necessary, the Engineer may require continuous dewatering 24 hours per day by adequate pumpage or well-points until backfilling is completed. The method, and equipment used for dewatering shall be subject to the approval of the County Engineer and be shall be at no cost to the County.

F. All soil is unclassified unless indicated otherwise.

G. All foundation soils and subgrades shall be tested by the Testing Agency to determine subgrade soil. Where unsuitable soil is encountered, excavate to depth determined by the County Engineer and replace with select backfill thoroughly and uniformly compacted.

H. Where underground streams or springs are found, provide temporary drainage and notify County Engineer.

I. Remove from project site and dispose of material unsatisfactory for backfill, trash, and all excess material continuously with the progress of the work.

J. Remove shoring and all form materials, unless ordered to remain.

K. Where rock is encountered so that a manhole, vault, or other structure will bear entirely on rock, it shall be used to support the foundation. Where only a part of the foundation would bear on rock, excavate to an even depth of 8 inches below the entire structure and back-fill with aggregate fill and thoroughly compact. Provide a minimum of 8 inches between rock excavation and sides of structures.

L. Compact select fill pipe bedding by tamping or rodding to prevent settlement.

3.3 SHEETING

A. Maintain trench walls in a safe condition at all times. The Engineer reserves the right to require the use of sheeting and/or shoring at any time the Engineer deems it necessary.

B. Sheeting and shoring left in place shall be cut off to a depth of not less than 18 inches below grade.

3.4 COMPACTION

A. Refer to Section 1, paragraph 1.1.34 D. for the compaction requirements.

B. Where compaction 90 percent or greater is required, test reports shall be submitted to the Department prior to Substantial Completion (e.g., for private development projects, prior to Tentative Acceptance).

C. Test reports are not required where the trench is completely backfilled with select stone backfill.

3.5 BACKFILL

A. Backfill trench to a compacted depth of 1 foot over the pipe with clean select fill. Backfill shall be properly placed uniformly on each side of the pipe and compacted as required. Do not backfill on muddy or frozen soil, or with muddy or frozen soil.

B. Backfill trench from 1 foot above the pipe to grade with clean earth fill free of stones larger than 3 inches or 1/2 the layer thickness, whichever is smaller. Layers shall not

exceed 12 inches, except that under road shoulders and under existing or future paved areas, layers shall not exceed 8 inches. Backfill shall be compacted to the density specified for the areas in which it is located except that minimum compaction in any area shall be to the density of the adjacent soil. Settlement may be achieved by puddling mechanical tamping, or other means as determined by the Contractor, which shall satisfy the compaction requirements.

C. Excavation depressions caused by removal of stumps or other clearing operations to firm subgrade, fill with clean earth fill and compact as specified.

D. Around and adjacent to structures, backfill shall be of material of suitable stability and perviousness. Backfill shall be placed in 6-inch layers, each layer being compacted by approved means. No backfill shall be placed against a structural wall until all connecting structural members are in place. It shall be the Contractor's responsibility to provide compaction to such a degree that the resultant subsidence after placing shall not be detrimental to the stability or appearance of the structure or adjacent areas. The Contractor shall provide adequate protection to all structures during backfilling and use every precaution to avoid damaging or defacing them.

E. Compact soil materials using equipment suitable for materials to be compacted and work area locations.

F. Compact aggregate fill placed under manholes and other structures to required density.

3.6 GRADING

A. Uniformly grade all areas within the limits designated on the Drawings, including adjacent transition areas. Finish surfaces within specified tolerances with uniform levels or slopes between points where elevations are shown and existing grades.

B. Finish all surfaces free from irregular changes.

C. Finish subgrade areas to receive topsoil to within 0.10 foot of required subgrade elevations.

D. Shape subgrade under walks to line, grade, and cross-section to within 0.10 foot of required subgrade elevations.

E. Shape subgrade under pavement to line, grade, and cross-section to within ½-inch of required subgrade elevations.

F. Protect newly graded areas from traffic and erosion. Repair and reestablish grade in settled, eroded, or rutted areas to the specified tolerances.

G. Where compacted areas are disturbed by subsequent construction or adverse weather scarify the surface, reshape and compact to the required density. Use hand tamper for recompaction over underground utilities.

3.7 UTILITIES TO BE ABANDONED OR REMOVED

A. When underground utilities are to be abandoned in place, plug, cap, or seal with concrete at the "Construction limits" or at points shown.

B. Remove underground utilities indicated on the Drawings to be removed and backfill resulting excavation with suitable material, compacted as specified. Plug, cap, or seal utilities with concrete, at the construction limits or at points shown.

C. All abandoned underground pipe shall be removed or filled with flowable fill.

3.8 EROSION CONTROL

A. Comply with local erosion control ordinance and with the latest edition of the "Virginia Erosion and Sediment Control Handbook" by the Virginia Soil and Water Conservation Commission to control erosion and sedimentation.

B. All applicable erosion and siltation control measures shall be taken prior to work starting.

C. No more than 100 feet of trench shall be open at any one time without the approval of the County Engineer. At the end of end of the day all but the last length of pipe installed shall be backfilled.

D. All utility lines, not in streets, shall be mulched with hay or straw and seeded as soon as possible after backfill.

E. Any disturbed area, not paved, sodded or built upon by November 15 is to be seeded on that date with oats, abruzzi rye, or equivalent and mulched with hay or straw.

F. Protect graded areas from the action of the elements. Settlement or other damage that occurs prior to acceptance of the work shall be repaired and grades satisfactorily reestablished.

G. Repair after cleanup: Upon completion of construction work after spoils and debris have been removed, regrade any areas disturbed by operations.

3.9 CLEAN UP

A. Keep area of work cleaned up at all times and promptly remove all materials and debris not intended for incorporation in the Work. Broom clean the surfaces of all paved areas immediately after backfilling operations.

B. Maintain backfilled trenches from the nuisance of dust, mud or settling during the entire length of the Contract and for a period of one year following Final Acceptance of the Work.

C. In the event the Contractor fails to satisfy these requirements to the satisfaction of the County, or otherwise prosecute the Work in a reasonable or proper manner, and after a reasonable period of time has elapsed after notification by the County of unsatisfactory conditions, the Owner reserves the right to employ outside services to take such corrective action as deemed necessary by the County Engineer. The cost incurred in taking corrective actions will be deducted from any monies due the Contractor by the Owner or such other means of collection as may be available to the Owner.

3.10 PREPARATION FOR FINAL INSPECTION

A. Locate and adjust all manholes, valve boxes, etc. to final grade and flush out all gravity pipelines as necessary prior to final inspection by County Engineer.

END OF SECTION

SECTION 32 9219
SEEDING

1. GENERAL

1.1 DESCRIPTION

A. Reference Specifications are referred to by abbreviation as follows:

1. American Society for Testing and Materials ------- ASTM

B. Submit two copies of following.

1. Seed Test Report
2. Fertilizer Analysis

C. Materials shall be delivered in unbroken containers, clearly marked by the manufacturer as to contents. Seed, limestone, and fertilizer shall be labeled as to proportions, analysis and quality. Store all materials in a manner affording protection from damage by weather or vandalism.

D. Seed only when wind velocity is less than 15 miles per hour.

2. PRODUCTS

2.1 GENERAL

A. Topsoil shall be the top 6 inches of original soil from the site, unless otherwise noted on the Drawings. Topsoil obtained off-site shall be fertile, friable loam, containing not less than 2 percent by weight, of finely divided, decomposed vegetable matter. Topsoil shall be free of subsoil, clay lumps, brush, weeds, roots larger than 1/2 diameter, stones larger than ½-inch diameter and other material toxic or harmful to growth.

B. Fertilizer shall meet requirements of Federal Specification O-F-241. Provide fertilizer that is complete, inorganic, uniform in composition and suitable for application with approved equipment.

1. Proportions of fertilizer nutrients shall be the following:

a. 5 lbs. of actual nitrogen

b. 10 lbs. of actual phosphate

c. 5 lbs. of actual potash

C. Grass seed, tested within 6 months of sowing, shall have the following characteristics.

1. Permanent Seeding shall be in accordance with Table 3.32 D. from the Virginia Erosion and Sediment Control Handbook:

	Total Lbs. Per Acre
Minimum Care Lawn	
- Commercial or Residential	175-200 lbs.
- Kentucky 31 or Turf-Type Tall Fescue	95-100%
- Improved Perennial Ryegrass	0-5%
- Kentucky Bluegrass	0-5%

High-Maintenance Lawn	200-250 lbs.
- Kentucky 31 or Turf-Type Tall Fescue	100%
General Slope (3:1 or less)	
- Kentucky 31 Fescue	128 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop*	20 lbs.
	150 lbs.
Low-Maintenance Slope (Steeper than 3:1)	
- Kentucky 31 Fescue	108 lbs.
- Red Top Grass	2 lbs.
- Seasonal Nurse Crop*	20 lbs.
- Crownvetch**	20 lbs.
	150 lbs.

*Use seasonal nurse crop in accordance with seeding dates as stated below:

February 16th through April	Annual Rye
May 1st through August 15th	Foxtail Millet
August 16th through October	Annual Rye
November through February 15th	Winter Rye

**Substitute Sericea lespedeza for Crownvetch east of Farmville, VA. (May through September use hulled Sericea; all other periods, use unhulled Sericea). If Flatpea is used in lieu of Crownvetch, increase rate to 30 lbs./acre. All legume seed must be properly inoculated. Weeping Lovegrass may be added to any slope or low-maintenance mix during warmer seeding periods; add 10-20 lbs./acre in mixes.

D. Temporary Seeding shall be in accordance with Table 3.31 B. from the Virginia Erosion and Sediment Control Handbook.

Seeding Dates	Species	Percentages (Min.)			Rate Lb. Acre
		Weight	Purity	Germ.	
Sept. 1-Feb. 15	50/50 Mix of Annual Ryegrass & Cereal (Winter) Rye	100	98	85	100
Feb. 16 – April 30	Annual Rye Grass	100	96	85	100
May 1-Aug31	German Millet	100	98	80	50

E. For seeding of wetlands or other specific applications, the Engineer shall submit a site-specific seeding schedule.

F. Lime shall be ground agricultural grade limestone containing not less than 85 percent calcium and magnesium carbonates. Fineness shall be such that 100 percent will pass a No. 20 sieve, not less than 50 percent will pass a No. 100 sieve. Burnt lime or hydrated lime may be substituted in equivalent carbonates, if requested.

G. Type I mulch shall be “Hold/Gro” erosion control fabric manufactured by Gulf States Paper Corporation, P. 0. Box 3199, Tuscaloosa, Alabama 35401. The fabric shall be manufactured of materials which degrade in 6 to 8 months under outdoor exposure.

H. Type II mulch composed of threshed straw of cereal grain, pipe needles or wood fiber shall be free of objectionable weed seeds or other harmful material.

I. Asphalt adhesive for use with Type II mulch shall be emulsified asphalt meeting requirements of ASTM D977, Grade SS-1.

J. Synthetic mulch binder for use with Type II Mulch: Curasol, DCA-70, Petroset, or Terra Tack.

K. Sod shall be composed of at least 70 percent of Kentucky 31 tall fescue and be cut to provide a minimum thickness of 2 inches. Vegetation more than 5 inches in height shall be cut to 3 inches or less before sod is lifted.

3. EXECUTION

3.1 TEMPORARY SEEDING

A. Use in areas when final grading has not been completed or when permanent seeding cannot be done due to the specified permanent seeding dates. Also use in easements where no permanent seeding is required as shown on Drawings.

B. Apply fertilizer at a rate of 15 lbs. of 10-20-10 per 1000 sq. ft. (600 lbs. per acre) or equivalent.

C. For loose soil, work lime and fertilizer into soil and then seed. For packed or hard soil, loosen top layer while working lime and fertilizer into soil and then seed at the rate required for the temporary seeding species.

D. Seed only between February 15 and November 15. Use mulching or sodding between November 15 and February 15.

E. For lawn areas, the permanent seed mix shall be used for temporary seeding during the specified planting periods. Any areas receiving temporary seeding shall be reseeded with permanent seed in accordance with these specifications.

3.2 SEEDING

A. Prepare soil for permanent seeding by tillage of topsoil in place to loosen thoroughly and break up all clods to a depth of 6 inches. Remove all stumps and roots, coarse vegetation, stones larger than 1-1/2 inches and all construction debris. Soil shall be worked by suitable agricultural equipment to a depth of not less than 4 inches. Rake to a uniform, smooth and drainable surface.

1. Apply lime and fertilizer uniformly and mix well into top 4 inches of seed bed. Apply lime at the rate of 100 lbs. per 1000 sq. ft. to achieve a pH of 6.0 to 7.5. Apply fertilizer at the rate of 50 lbs. of 5-10-5 per 1000 sq. ft. or 25 lbs. of 10 - 20-10 per 1000 sq. ft. Rates should be adjusted for other grades of fertilizer.

B. Sow permanent grass seed between dates of March 1 and April 15 or September 1 and October 15.

C. Sow permanent seed by mechanical seeder as follows:

1. Mix seed thoroughly with clean dry sawdust and broadcast at a rate of 6 lbs. of

seed per 1000 sq. ft. in cross directions to ensure uniform distribution. Rake surface lightly and roll with appropriate type of lawn roller weighing maximum of 150 lbs. per foot of width.

2. Apply either Type I or Type II mulch uniformly leaving not more than 10 percent of the soil surface exposed.
    a. Type I mulch.
        i. Apply in accordance with manufacturer's instructions.
    b. Type II mulch.
        i. Apply uniformly to depth of approximately 1-1/4 inches uniformly leaving not more than 10 percent of the soil surface exposed.
3. Anchor mulch by the following methods.
    a. Apply light tack coat of asphalt emulsion:
    b. In residential areas, apply synthetic mulch binder at rate recommended by manufacturer.
    c. On slopes steeper than 4 horizontal to 1 vertical fasten heavy jute mesh to wooden stakes.

D. Remove all soil or staining of finished walks, drives and parking areas resulting from seeding work. Maintain paved areas in clean condition.

E. Establishment and Acceptance of Seeding
1. The Contractor shall maintain all seeded areas until final acceptance of the project and shall restore or replace any portion of the seeding work that is found defective or which becomes damaged prior to final acceptance. Restoration or replacement work shall include the reestablishment of the grade or profile of the area, replacement of topsoil, refertilization, reseeding, and remulching as directed by the Engineer. When the damage consists only of the displacement of mulch, the mulch shall be replaced within 7 days.
2. Water as required to keep soil moist during germination period.
3. If mowing is required to properly maintain all seeded areas until final acceptance, the following criteria shall apply:
    a. When grass reaches height of 3 ½ to 4 inches, mow to height of 2- ½ inches.
    b. Maintain grass height between 2 ½ and 4 inches.
    c. Do not remove more than 33 percent of total height of grass in one mowing.
4. Reseed and mulch all spots without a uniform stand of grass.
5. Final project inspection shall not be scheduled until the vegetation is acceptable to the Engineer.
6. Correct or repair all undue settling as evidenced by complaints received within one year after final inspection.

END OF SECTION

SECTION 33 3000
SANITARY SEWERAGE

1. GENERAL

1.1 DESCRIPTION

A. Work included in this Section consists of all gravity sanitary sewers, force mains, manholes, valves, air vents and all related equipment or material as indicated on the construction plans.

1. Reference Specifications are referred to by abbreviation as follows:
2. American National Standards Institute ---------- ANSI
3. American Society for Testing and Materials -------- ASTM
4. American Water Works Association ---------- AWWA
5. American Railway Engineering Association -- ---- AREA

2. PRODUCTS

2.1 GENERAL

A. Submit shop drawings on all products supplied and installed in the project in accordance with submittals procedures.

B. Provide certified test results of pipe testing.

2.2 UNDERGROUND PRESSURE PIPE

A. Ductile Iron Pipe

1. Ductile iron pipe shall meet the requirements of AWWA Class 52 and rubber-gasket joints shall meet the requirements of AWWA C111 3" through 24" pipe shall be, at a minimum, class 52 with a working pressure of 350 psi. Pipe shall have a single cement-mortar lining and a bituminous seal coat conforming to the requirement of AWWA C104. A minimum of 5% of the pipe furnished shall be gauged for roundness full length and so marked. Pressure class of pipe shall be increased if the specific installation warrants it.

B. Polyvinylchloride (PVC) Pipe

1. PVC pipe shall meet requirements of AWWA C900 (DR-14, CL. 200) for sizes up to 12". Joints shall be in accordance with manufacturer's instructions and ASTM D2564, D2464, D2467, D319, and F477. If working pressures over 150 psi are encountered ductile iron pipe shall be used. Cell classification for water pipe shall be 12454-B

C. Polyethylene pipe

1. 3 Inches and Smaller -Pipe shall be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D3350-02 with a cell classification of PE: 445574C/E. Pipe shall have a manufacturing standard of ASTM D2737 (copper tubing size), ASTM D2239 (iron pipe size, controlled inside diameter) and ASTM D 3035 (iron pipe size, controlled outside diameter). Pipe shall have a pressure class as specified on the plans. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipes shall be suitable for use as pressure conduits, and per AWWA C901, have nominal burst values of three

2. times the Working Pressure Rating (WPR) of the pipe. Pipe shall also have the following agency listing of NSF 14.

3. 4 Inches and Larger - Pipe shall be manufactured from a PE 4710 resin listed with the Plastic Pipe Institute (PPI) as TR-4. The resin material will meet the specifications of ASTM D3350 with a cell classification of PE: 445574C/E. Pipe shall have a manufacturing standard of ASTM F714. Pipe O.D. size shall be ductile iron pipe size (DIPS). Pipe shall be pressure class as indicated on the plans. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All pipes shall be suitable for use as pressure conduits, listed as NSF 61, and per AWWA C906. Pipe shall have a nominal burst value of three and one-half times the Working Pressure Rating (WPR) of the pipe. Peak flow water velocity of 5 ft/sec shall be used in the hydraulics engineering design.

2.3 GRAVITY PIPE

A. Polyvinylchloride (PVC)

1. For pipes sized 4-inch through 15-inch, pipe shall meet requirements of ASTM D3034 type PSM SDR-26 or of ASTM F1760 DR-26 having reprocessed-recycled content.

2. For pipe sized 18-inch through 27-inch, pipe shall meet requirements of ASTM D3212.

B. Ductile Iron

1. Ductile Iron Pipe shall meet the requirements of ductile iron pressure pipe minimum Class 52 or as recommended by the pipe manufacturer for the depth of bury whichever is greater.

2.4 PRESSURE PIPE UNDERGROUND FITTINGS

A. Ductile Iron Fittings

1. Fittings for PVC pipe and DI pipe shall be ductile iron. Ductile iron fittings shall be in accordance with AWWA C110 or AWWA C153. Pressure ratings shall be a minimum of 350 psi for fittings 24-inch and smaller and 250 psi for 30-inch. All fittings shall have a single cement mortar lining on the interior and a bituminous seal coating on the exterior. Fittings shall have mechanical joints conforming to the requirements of AWWA C111. Bolts for mechanical joint fittings shall be high strength, corrosion resistant low alloy steel with hexagon nuts having a minimum yield point of 45,000 psi in accordance with AWWA C111. Mechanical joint bolts shall be torqued with a torque wrench as per manufacturer's recommendations.

2. Couplings for underground or buried service shall be ductile iron mechanical joint in accordance with underground ductile fittings in this section.

B. Polyethylene Pipe Fittings

1. Fittings for polyethylene pipe shall be manufactured specifically for the intended use and be approved by the piping manufacturer to be compatible with their product. All fittings shall have a working pressure rating equal to or greater than the pipe and shall meet all requirements of NSF 61.

2. Butt Fusion Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02 and approved for AWWA use. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded & fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the plans. Fabricated fittings are to be manufactured using Data Loggers. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records. All fittings shall be suitable for use as pressure conduits, and per AWWA C906, shall have a nominal burst value of three and one-half times the Working Pressure Rating (WPR).

3. Electrofusion Fittings shall be PE3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02. Electrofusion Fittings shall have a manufacturing standard of ASTM F1055. Fittings shall have a pressure rating equal to the pipe. All electrofusion fittings shall be suitable for use as pressure conduits, and per AWWA C906, have nominal burst values of three and one-half times the Working Pressure Rating (WPR).

4. Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be PE 3408 HDPE, Cell Classification of 345464C as determined by ASTM D3350-02. Flanged and Mechanical Joint Adapters shall have a manufacturing standard of ASTM D3261.

C. Thrust Restraint

1. Contractor shall install concrete thrust blocks at all tie in points and as indicated on the contract drawings or as directed by the Project Representative based upon field conditions. Thrust blocks shall be sized as indicated on the thrust block Standard Details. Concrete shall have 3,000 psi strength at 28 days, and shall meet the requirements of ASTM C94.

2. All pipe fittings, plugs, caps, tees, and bends in underground ductile iron or PVC piping shall be restrained utilizing Megalug Series 1100 retainer glands by EBAA Iron Sales, Inc. (or approved equal) for ductile iron pipe and Megalug Series 2000PV retainer glands by EBAA Iron Sales, Inc. (or approved equal) for PVC pipe. Glands shall be manufactured of ductile iron conforming to ASTM A 536-80. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and C153/A21.53. Twist-off nuts shall be used to insure proper actuating of the restraining devices. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2.

3. All ductile iron bell and spigot pipe joints shall be restrained using US Pipe Field Lok 350 type gaskets or harness type restraints utilizing Megalug Series 1700 retainer glands by EBAA Iron Sales, Inc. (or approved equal). If all joints are not required to be restrained the minimum restrained lengths and locations shall be indicated on the drawings. Gaskets shall be manufactured by the pipe manufacturer to be compatible with their pipe.

4. PVC pipe bell and spigot joints shall be restrained on either side of valves and fitting for a length to be indicated on the drawings. Harness type restraining devices shall be used on bell and spigot pipe joints utilizing Megalug Series

2800 restraint harness by EBAA Iron Sales, Inc. (or approved equal).

2.5 ABOVE GROUND OR EXPOSED PRESSURE PIPE

A. Ductile Iron Pipe

1. Ductile iron pipe installed above ground, inside buildings or underground vaults, shall be flanged ductile iron pipe class 53 in accordance with AWWA C115 (ANSI A21.15). Unless indicated otherwise on the drawings, pipe shall have Class 125 flanged joints utilizing factory installed screwed flanges (no uniflange type flanges are permitted) meeting the requirements of ANSI B 16.1, outside coating shall be red primer, and gaskets for flanged pipe shall be 1/8" thick full face red rubber. All steel flanges mating to flat face flanges shall have the raised face machined off. Pipe shall have a single cement mortar lining with asphaltic seal coat meeting the requirements for AWWA C104.

B. Ductile Iron Fittings

1. Fittings for ductile iron pipe shall be flanged ductile iron in accordance with AWWA C110. Fittings up to 30" diameter shall have a minimum working pressure rating of 250 psi. Unless indicated otherwise on the drawings, pipe shall have Class 125 flanged joints meeting the requirements of ANSI B 16.1, outside coating shall be red primer, and gaskets for flanged pipe shall be 1/8" thick full face red rubber. Fittings shall have a single cement-mortar lining and a bituminous seal coat conforming to the requirement of AWWA C104.

2. Couplings for above ground or exposed service shall be Dresser Style 38 or approved equal. Transition couplings shall be Dresser Style 162 or approved equal. All couplings shall be rodded unless otherwise noted.

3. Flange adaptors shall only be used for final connections to equipment or to allow for disassembly of pipe for equipment maintenance in approved locations. Flange adaptors are not to be used to make up for misaligned pipe. Flanged Adapters shall be JCM flanged coupling adaptors model 301R or approved equal. Uniflanges are not permitted.

C. PVC Pipe and Fittings

1. PVC pipe shall only be used for chemical piping in sizes 1" and smaller without special approval by the County Engineer.

2. All PVC pipe and fittings shall be socket weld schedule 80.

3. When transitioning from metal to PVC, the PVC adaptor shall always be a male NPT fitting inside of a female NPT metal fitting. Should the metal fitting be a male thread, a metal coupling shall be installed to provide a female thread for the PVC adaptor.

D. Stainless Steel Pipe and Fittings

1. All stainless steel pipe shall be Schedule 40 type 304 unless specified by equipment manufacturers or for chemical compatibility to be 316.

2. Stainless steel pipe shall be threaded with threaded fittings.

2.6 PLUG VALVES

A. Plug Valves shall be the non-lubricated eccentric type with resilient faced plugs. Port area shall be at least 80 percent of the full pipe area. Bodies shall be cast iron

with welded nickel, raised seats. Valves shall have permanently lubricated corrosion resistant bearings in the bonnet and body.

B. Packing and packing glands shall be accessible without having to disassemble valves. Packing shall be adjustable.

C. Valves shall have resilient plug facings suitable for the service intended and shall provide dead-tight shutoff. Opening the valve shall cause the plug to be raised off the seat without scraping the seat or body walls.

D. Plug valves shall be gear operated unless otherwise shown or specified, and shall open counter-clockwise. Exposed plug valves (located above ground, inside buildings, valve vaults, etc.) shall be flanged and provided with gear operated hand wheel actuators complete with valve position indicators.

E. Plug valves for direct burial service shall be provided with right angle worm gear operators. Buried valves shall be provided with adjustable cast-iron valve boxes and extension stems to grade.

F. A tee wrench shall be provided for operation of the buried valve.

G. Inside iron or steel surfaces of valves and exterior surfaces of valves which are to be buried in the ground shall be given two coats of asphalt varnish meeting the requirements of Fed. Spc. TT-V-51a. Exterior iron or steel surfaces of other valves shall be painted as specified for the pipelines in which they are installed.

H. 4" plug valves must pass a 3" spherical solid.

I. Plug valves shall be Dezurik, Milliken or approved equal.

2.7 CHECK VALVES

A. Swing check valves

1. 3 inch and larger

a. Check valves 3" and larger shall be Class 125 flanged ends ductile iron body bronze mounted, bronze disc facing, swing type lever and weight check valves in accordance with AWWA C508. Flanged end dimension and drilling shall comply with ANSI B 16.1, Class 125. Check valves 3" through 24" shall have a 250 psig maximum working pressure.

b. Check valves shall have an adjustable air decelerator (air cushion) installed on the outside of the valve to control valve closing.

c. All check valves shall have a factory installed limit switch to indicate close position for flow confirmation.

d. Valves shall be Apco series CVS 250, Val-Matic series 7900S-S, Milliken Series 8501 or approved equal.

2. Check valves 2" and smaller shall be class 150 bronze or stainless steel y-pattern swing check valves with threaded ends. Valves shall be Crane figure 137 (bronze), Crane Aloyco figure 49 or approved equal.

2.8 TRACER WIRE

A. Copper tracer wire shall be THHN, 12 gauge, insulated with a green colored insulation. Wire shall be secured to the pipe every 8 feet and within 12 inches on either side of fittings.

B. Tracer wire access boxes shall be installed no more than 1000 feet apart and adjacent to all inline valves on force mains. A concrete mow collar shall be installed at finished grade around all tracer wire access boxes.

C. Wire Connectors

1. Connector, Wire, Set Screw Pressure type for use with No. 12 stranded wire size.

2. Holub Industries MA-2 or equivalent

3. Ideal Industries Model 30-222 or equivalent

D. Wire nuts shall not be allowed underground or in electric manholes or pull boxes.

2.9 TRACER WIRE ACCESS BOXES

A. The tracer wire access boxes shall be made of cast iron with a permanently attached 3" x 12" ABS tube with a flared end to secure it in the ground. Its tamper-resistant cast iron locking lid has stainless steel terminal connectors on the bottom side to which tracer wires are attached. Lid is opened using a standard AWWA pentagon key. Enough slack shall be coiled inside the box to allow the removal of the lid. Lid shall be marked sewer.

2.10 MARKING TAPE

A. Tape shall be 3.5 mill polyethylene tape 3" in width with a 14 gauge metallic core, with the continuous printed message, "Caution - Sewer Line Buried Below." Tape shall be style 48288 as manufactured by the Seton Safety and Identification or approved equal.

2.11 STEEL CASING PIPE

A. Steel casing pipe for boring or jacking under highways and railroads shall meet the requirements of ASTM A139, Grade B. Nominal pipe diameter and wall thickness shall be as indicated on the Standard Drawings. No protective coating or lining will be required. Casing pipe laid in an open cut shall be, steel pipe.

2.12 MANHOLES

A. Precast reinforced concrete manholes shall be constructed in accordance with Standard Drawings for the type and size of manhole indicated on the Drawings.

B. Provide tongue and groove joints in manhole sections with a preformed groove in the tongue for placement of an O-ring type round, rubber gasket.

1. Gasket shall comply with requirements of ASTM C361.

2. Gasket shall provide the sole element in sealing the joint from either internal or external hydrostatic pressure.

C. Liners for acid-resistant manholes shall be of fiberglass reinforced polyester (FRP) or polyvinylchloride (PVC) or high-density polyethylene (HDPE) construction and shall be installed to protect the precast manhole sections from the inside base of the manhole to the base of the manhole frame. The connection of the pipe to the manhole shall be sealed with the liner in a manner to eliminate any exposed concrete surfaces that could be subject to damage by corrosive gases.

1. FRP liners shall consist of a 3/16-inch thick fiberglass reinforced polyester with a 15 mil gel coat interior surface. The polyester resin shall be similar to Dion

No. 6694. Joints between sections of the liner shall be sealed with joint sealant.

2. PVC liners shall consist of polyvinylchloride plates, not less than 0.060-inch thick, with integral bonding ribs and shall be similar to Amercoat "T-Lock Amer-Plate". Joints between sections of liner shall be welded in accordance with the manufacturer's instructions by T-Lock certified welders.

3. HDPE liners shall be AGRU "Sure Grip" HDPE Concrete Protective Liner. Joints between sections of the liner shall be welded in accordance with the manufacturer's instructions by Agru certified welders. Minimum liner thickness shall be 0.078 inches.

D. Manhole steps shall be corrosion-resistant and shall be one-inch square cast iron, rubber-covered steel or aluminum. The steps shall conform to the dimensions shown in Standard Drawings. Manhole steps shall be aligned to minimize conflicts with future connections to manhole. For sewers up to 15 inches in diameter, steps should be placed over the bench. Manhole steps shall not be placed on the downstream side of the manhole. Steps shall be installed at a maximum spacing of 12 inches.

E. Manhole frames and covers shall be molded of gray cast iron conforming to ASTM A48, Class 30. Castings shall be coated with a coal tar pitch varnish, to which sufficient oil has been added to make a smooth coating, tough and tenacious when cold, but not tacky or brittle. Seating surfaces between frame and cover shall be machined. The dimensions and weights shall conform to the requirements shown in Section 6 -Standard Drawings.

F. Manhole frame and covers shall be manufactured by Capitol Foundry, Neenah Foundry, or approved equal. Manhole covers shall be labeled "SEWER"

G. Manholes shall be supplied with flexible connectors to allow connection of sewer pipes to the manholes. The manholes shall be cored at the factory and supplied with the appropriate flexible connectors. The connector shall be Kor-N-Seal, Press-Seal with a stainless steel expander ring, or approved equal.

H. Sealant for manhole frames shall be a one-component polyurethane sealant similar to Sika "Sikaflex" Series 1A.

2.13 SURGE ANALYSIS

A. A Surge Analysis shall be performed on sewer force mains under the following conditions:

1. Pumping systems with a total dynamic head greater than 50 ft if the flow is greater than about 500 gal/min.

2. High lift pumping systems with a check valve

3. Any system in which column separation can occur including:

a. Systems with high points.

b. A force main that needs automatic air venting or air vacuum valves.

c. A pipe line with a long (more that 300 ft) steep gradient followed by a long, shallow gradient.

d. Force mains larger than 8 inches when longer than 1000 ft.

2.14 PRESSURE GAUGES

A. Pressure gauges shall be mounted on a wafer pressure isolator ring (sensor ring) by the sensor ring manufacturer.

B. Pressure gauges shall be of all stainless steel construction, 3.5 to 4 inch case size, accuracy of 1% over the entire dial arc and a ¼" NPT bottom connection, Pressure range shall be as indicated on the drawings.

C. Gauges shall be graduated so the system operating pressures are in the middle third of the scale.

D. Pressure gauges shall be Ashcroft stainless steel case 1009 pressure gauges or approved equal.

2.15 WAFER PRESSURE ISOLATORS RING (SENSOR RING)

A. Wafer pressure isolator rings shall be designed to permit pressure measurement on slurries and other hard-to-handle fluids without compromising gauge function. Isolation ring shall consist of a metal ring with an elastomer inner tube filled with silicone instrument oil. Center section of isolator ring shall be carbon steel. End plates shall be Acetal Homo Polymer (or 316 stainless steel, Kynar, Teflon) and elastomeric sleeve shall be Nitrile (or EPDM, Viton).

B. Wafer pressure isolator rings shall fit inside the bolt circle of 150# ANSI flanges (or shall be provided with appropriate spacers for 300# or 600# flanges). Face to face length of the wafer pressure isolator ring shall conform to specification MSS-SP67. Wafer pressure isolator ring shall be flow through design with flexible rubber sleeve around full circumference. The center section shall have a cavity behind the rubber sleeve filled with silicone fluid to transfer pressure to the gauge.

C. All pressure instruments attached to the wafer pressure isolator ring shall be rigidly supported by a post at least 0.875 inches diameter welded to the isolator. On wafer pressure isolator rings with more than one instrument, all connections shall be 1/2" NPT as a minimum. 1/4" NPT fittings are not acceptable. The wafer pressure isolator ring shall not have a fill plug that can be inadvertently removed with the resultant loss of fill fluid.

D. The wafer pressure isolator ring shall be vacuum filled and permanently sealed at the factory with a modular seal consisting of a rubber membrane and needle fitting to allow removal and replacement of pressure instruments without compromising the vacuum fill. The needle fitting shall have both 1/4" NPT(F) thread and 1/2 NPT(M) threads. The wafer pressure isolator ring shall be capable of operating under pressure with all instruments removed with no loss of fill fluid, without isolating valves. Pressure instruments shall be attached to the wafer pressure isolator ring with a hand tightened lock ring. It shall be possible to remove, rotate or attach pressure instruments to the wafer pressure isolator ring without requiring the use of any tools. The wafer pressure isolator ring shall be permanently filled with high viscosity silicone instrument oil to damp out surges or pressure spikes without a separate snubber.

E. Max operating pressure without leakage: 1,000 psig

F. Wafer pressure isolator ring shall be Onyx Valve Co model PSW, Red Valve Company Series 40 or equal.

2.16 PIPE SUPPORTS

A. Pipes shall be supported by steel pipe hangers, clamps, brackets, rods and inserts as required to support the imposed pipe loads. Hangers in general shall be new, manufactured of carbon steel and hot dipped galvanized after fabrication or 304 stainless steel.

B. Pipes 2 ½ inches and larger shall be supported with adjustable floor stand type pipe supports as detailed on the drawings. Pipe supports shall be Standon Model S89 flange support, Standon Model S96 cradle support as manufactured by Material Resources, Inc. or approved equal.

C. Pipes 2" and smaller shall be supported from the floor, walls or ceiling depending on the type of building construction. Pipe supports for these size pipes shall be as manufactured by Unistrut Building Systems, B-Line or approved equal. Supports shall consist of floor stands, wall brackets or clevis type hangers. Strut and appurtenances shall be stainless steel. Clips for copper tubing shall be copper coated. Minimum threaded rod size shall be 3/8 inch.

D. Ductile Iron and steel pipe supports shall be spaced in accordance with the following schedule:

Pipe sizes (inches)	½ - 3/4	1- 1 1/4	1 ½ - 2	3 – 4
Max spacing (feet)	4	6	8	10

E. PVC pipe supports shall be spaced in accordance with the following schedule:

Nominal pipe size (inches)	½ - 3/4	1 - 1 1/4	1 1/2 - 2	3 - 4
Max spacing (feet)	2.5	3	4	6

F. Maximum spacing between pipe supports shall be 10 feet for all pipes 6” and above. This is a maximum spacing and does not take into account valves, fittings, flow meters, risers, drops and other devices. Locations where these are installed will require additional supports.

G. In addition to the above, pipe supports shall be located as per the following:

1. Maximum spacing as indicated above.
2. Maximum of 12 inches from all horizontal and vertical changes in direction.
3. On the suction and discharge of pump piping to eliminate pipe stresses on the pump flanges.
4. On the connections to all equipment to eliminate pipe stresses on the equipment connections and allow equipment removal.
5. On the inlet and outlet piping to the water meter to allow the removal of the

water meter.

6. At the location of valves, fittings or other devises that cause additions weight to the piping.
7. Additional pipe supports as indicated on the drawings.

3. EXECUTION

3.1 GENERAL

A. Take all precautions necessary to ensure that pipes, valves, fittings, and related items are not damaged in unloading, handling and placing in trench. Examine each piece of material just prior to installation to determine that no damage has occurred. Remove any damaged material from the site and replace with undamaged material.

1. Keep pipes clean. Exercise care to keep foreign material and dirt from entering pipes during storage, handling and placing in trench. Close ends of in-place pipes at the end of any work period to prevent entry of animals and foreign material.
2. Bed pipe as specified in Section 9 - Trenching & Backfilling.
3. Do not lay pipe when weather or trench conditions are unsuitable.
4. Separation of sanitary sewer lines and water lines shall be in accordance with Virginia Department of Health Regulations.

3.2 GRAVITY SEWER PIPE

A. Lay gravity sewers so as to maintain a true alignment and grade as indicated on Drawings. After completion, the pipe shall exhibit a full circle of light when lighted at one manhole and viewed from the next.

B. Commence laying gravity sewers at the lowest point on a section of line and lay pipe with the bell ends uphill.

C. Pipe joint. Preparatory to making pipe joints on gravity sewer lines, clean and dry all surfaces of joint pipe and jointing material. Use lubricants, as recommended by the manufacturer. Place, fit, join and adjust the jointing materials or factory fabricated joints as recommended by the manufacturer to obtain the degree of water tightness required. As soon as possible after the joint is made, place sufficient backfill material, as specified under Section 9 - Trenching & Backfilling, along each side of the pipe to resist forces that might tend to move the pipe off line and grade and sufficient backfill to prevent floating.

D. All sanitary sewer gravity mains buried underground shall have a detectable tracer buried in the trench approximately 18 inches above the conduit but no less than 18 inches below grade.

E. Complete backfilling as specified under Section 9 - Trenching & Backfilling. Place backfill over the pipe immediately after the pipe has been laid. Provide ductile iron pipe where cover over main line sewer pipe is less than 5.5 feet in public roads and 3.5 feet in easements.

3.3 SEWER FORCE MAIN

A. Install force main with a minimum depth of cover of 42 inches over the top of the pipe where no grades are shown on the drawings.

B. Where grades on the force main conflict with existing pipes or structures, lay force main to additional depth with a uniform vertical curve to provide proper clearance without the use of fittings. No additional payment will be allowed for additional excavation. Provide allowance for expansion as directed by County Engineer.

C. Lay force main pipe with bell ends facing the direction of laying. Where grade is 10 percent or greater, pipe shall be laid uphill with bell ends upgrade.

D. All sanitary sewer force mains buried underground shall have a detectable tracer buried in the trench approximately 18 inches above the conduit but no less than 18 inches below grade. The detectable tape shall comply with the product specifications as detailed in the previous Section 12.2.17.

E. Copper tracer wire shall be taped directly to the top of the pipe and be installed in a continuous traceable manner. The tracer wire shall be connected to any air-release valves (ARV) along the force main alignment. The tracer wire shall comply with the product specifications as detailed in the previous Section 12.2.18.

3.4 JOINING PIPE

A. Join mechanical joint pipe as follows:

1. Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating and other foreign matter from the joint. Paint the bell and spigot with soap solution (half cup granulated soap dissolved in 1-gallon water). Slip cast-iron gland on spigot end with lip extension of gland toward end of pipe. Paint rubber gasket with or dip into the soap solution and place on the spigot end with thick edge toward the gland.

2. Push the spigot end forward to seat in the bell. Then carefully press the gasket into the bell so that it is located evenly around the joint. The gland is moved into position, bolts inserted, and nuts screwed finger tight, then tighten all nuts to torque listed below.

Bolts Size- Inches	Torque Ft. - Lbs.
5/8	40 - 60
¾	60 - 90
1	70 - 100
11/4	90 – 120

3. Tighten nuts on alternate sides of the gland until pressure on the gland is equally distributed.

4. Permissible deflection in mechanical joint pipe shall not be greater than ½ of that listed in AWWA C600.

B. Join push-on joint pipe as follows:

1. Thoroughly clean inside of the bell and 8 inches of the outside of the spigot end of the joining pipe to remove oil, grit, excess coating, and other foreign matter. Flex rubber gasket and insert in the gasket recess of the bell socket. Apply a thin film of gasket lubricant, supplied by pipe manufacturer, to the gasket and the spigot end of the joining pipe.

2. Start spigot end of pipe into socket with care. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack type device. Field cut pipe shall have the end filed to match the manufactured spigot end.

3. Permissible deflection in push-on joint pipe shall not be greater than 1/2 of that listed in AWWA C600.

3.5 THRUST RESTRAINT

A. Provide reaction anchors of concrete blocking at all points of tie-in to existing pressure pipe lines, Provide mechanical joint retainer glands at all fittings, valves, plugs, caps and other changes in directions or dead ends of pressure pipelines.

B. Concrete reaction anchors shall bear against undisturbed earth and shall be of the size and shape indicated on the contract drawings.

C. Use metal harness restraints for bell and spigot piping whereas indicated on the contract drawings to be restrained.

D. Use Mechanical Joint restraining glands for all Mechanical joint pipe as indicated on the drawings to be restrained.

E. All pressure pipe joints at pump stations with-in the fence boundaries shall be restrained.

F. On sewer force mains, restraint calculations shall be provided on the drawings and length of restrained joints shall be indicated on the drawings.

3.6 SEWER PIPELINE

A. Encase sewer pipelines crossing under highways and railways in a steel casing pipe. The casing pipe shall be of the diameter and wall thickness indicated on the Standard Drawings. Installation of the steel casing pipe shall be by jacking, boring or open cut if permitted.

B. The installation shall meet the requirements for installation of pipelines carrying nonflammable substances under railway tracks. All permits shall be obtained prior to beginning work, from the Railway Company or VDOT. Copies of the permits shall be submitted to the County engineer for approval.

C. Casing and carrier pipe shall be installed in accordance with the Standard Details.

3.7 CONSTRUCT SERVICE CONNECTIONS FROM SEWER MAIN TO PROPERTY LINE AS FOLLOWS:

A. Service connections shall be in accordance with the Standard Drawings.

B. Place a wye and 45 degree fittings of the required size in accordance with the Standard Details where a service connection is to be constructed. Lay pipe from the connection to the property line on a grade of not less than 1/4 in. per foot for 4" pipe or 1/8 in. per foot for 6" pipe. Close service connection at the property line with a watertight plug.

C. Install service connections on existing 12" and smaller sewer mains with a compression type wye cast iron saddle as manufactured by Geneco or approved equal. Secure saddle to the pipe with a 24 gauge stainless steel strap and two nickel-bronze T bolts. Make connections of this type by machine tapping or cutting the pipe. Use O-ring type gasket to ensure a watertight connection. On pipe larger than 12" a straight cast iron saddle may be used.

D. Service connections from manholes shall be ductile iron or PVC pipe.

E. Determine the depth of service connections by the deepest of the following:

1. Provide 5 foot cover at the edge of the road paving or 15 feet from the centerline of the street.

2. Provide 36 inches of cover at the bottom of highway ditches.

3. Provide 5 feet of cover at the property line when property is above street.

4. Where the above conditions cannot be met for a 4" pipe at ¼" per foot slope, the line shall be changed to a 6" pipe at 1/8" per foot. If the 6" pipe cannot meet the above conditions the pipe shall be 6" ductile iron and incased in concrete where the depth of cover is less than 36 inches.

F. Place a 2-inch x 4-inch solid piece of lumber at the end of each service connection. The 2-inch x 4-inch marker shall be set vertically and extend from the invert to six inches above grade.

G. Provide ductile iron pipe where cover over service connections is less than 5.5 feet in public right of way and 3.5 feet in easements.

3.8 TESTING GRAVITY SEWER LINES AND MANHOLES.

A. All gauges used for testing shall be calibrated gauges with a minimum of a 4-1/2" dial with a mirrored back.

B. Sanitary sewer lines 24 inches in diameter and smaller shall be tested after backfill using a low-pressure air test in accordance with ASTM C828. Sewer lines larger than 24 inches in diameter and manholes shall be tested by infiltration or exfiltration as hereinafter detailed. All sewer manholes shall be tested by a vacuum test in the presence of the County Inspector. Tests shall be conducted on short sections of sewer line, i.e., between manholes, or at the end of each day's work. Provide all labor, materials, tools, and equipment necessary to make the tests. All equipment and methods used shall be acceptable to the County Engineer.

C. Testing of Gravity Sewer Pipes

1. Testing: All structures required to be watertight and all piping and appurtenances shall be tested for leakage by CONTRACTOR under the direction of County.

2. Gravity sewer pipes testing shall be done by air pressure test as specified herein.

3. Air Test: CONTRACTOR shall plug the pipe and shall conduct a low pressure air test to determine the acceptability of the completed work. CONTRACTOR shall furnish all men, materials, and supplies necessary to assist in the conducting of this test. This air test shall conform to UNI-BB-6-79 or latest revision.

4. The air testing equipment shall be Air-Lock, as manufactured by Cherne Industrial, Inc., or approved equal. All air used shall pass through a single control panel. Individual air hoses shall be used from control panel to pneumatic plugs; from control panel to sealed line for introducing low pressure air; and from sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

5. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe tested. The plugs shall resist internal test pressures without requiring external bracing or blocking. Plugs shall be tested prior to installation in the pipe run. A joint of pipe shall be sealed at both ends with the plugs to be used in the sewer test. Air shall be introduced into the plugs to 25 psi. The sealed pipe shall then be pressurized to 9 psi. The plugs shall withstand this pressure without bracing or movement. The tested line segment shall be plugged and pressurized to 4.0 psi greater than the ground water back pressure but not to exceed 9 psi. The line shall be allowed to stabilize for 2 minutes after pressurization. After the pressure has stabilized, the air pressure shall be decreased slowly to 3.5 psi (greater than ground

water back pressure) and the timing shall commence. The time for the pressure to drop 1 psi from 3.5 psi shall be recorded. The minimum acceptable time durations are shown on Table I. If the elapsed time to drop 1 psi is less than that shown on Table I, then the air loss shall be considered excessive and the section of pipe has failed the test.

6. Summary of Method: Plug the section of the sewer line to be tested. Introduce low-pressure air into the plugged line. Use the quantity and rate of air loss to determine the acceptability of the section being tested.

7. Preparation of the sewer line: Flush and clean the sewer line prior to testing, thus serving to wet the pipe surface as well as clean out any debris. A wetted interior pipe surface will produce more consistent results. Plug all pipe outlets using approved pneumatic plugs with a sealing length equal to or greater than the diameter of the line being tested to resist the test pressure. Give special attention to laterals.

8. Ground Water Determination: Install a one-half inch capped galvanized pipe nipple, approximately 12 inches long, through the manhole on top of the lowest sewer line in the manhole. Immediately prior to the line acceptance test, the ground water elevation shall be determined by removing the pipe cap and blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic hose to the pipe nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in the plastic hose.

9. Procedures: Determine the test duration for the section under test by computation from the applicable formulas shown in ASTM C828. The pressure-holding time is base on an average holding pressure of 3.0 psi gauge or a drop from 3.5 psi to 2.5 psi gauge.

TABLE I
SPECIFICATION TIME REQUIRED FOR A 1.0 PSIG PRESSURE DROP
FOR SIZE AND LENGTH OF PIPE INDICATED Q=.0015

PART 1A

Pipe Diameter (in.)	Minimum Time (min:sec)	Length for Minimum	Time for Longer	Specification Time for Length (L) Shown (min:sec)			
				100'	150'	200'	250'
4	3:46	597	.380 L	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40
8	7:34	298	1.520	7:34	7:34	7:34	7:34
10	9:26	239	2.374	9:26	9:26	9:26	9:53
12	11:20	199	3.418	11:20	11:20	11:24	14:15
15	14:10	159	5.342	14:10	14:10	17:48	22:15
18	17:00	133	7.692	17:00	19:13	25:38	32:03
21	19:50	114	10.470	19:50	26:10	34:54	43:37
24	22:40	99	13.674	22:47	34:11	45:34	56:58
27	25:30	88	17.306	28:51	43:16	57:41	72:07
30	28:20	80	21.366	35:37	53:25	71:13	89:02
33	31:10	72	25.852	43:05	64:38	86:10	107:43
36	34:00	66	30.768	51:17	76:55	102:34	128:12

PART 1B

Pipe Diameter (in.)	Minimum Time (min:sec)	Length for Minimum	Time for Longer	Specification Time for Length (L) Shown (min:sec) 300'	350'	400'	450'
4	3:46	597	.380 L	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:42	6:24
8	7:34	298	1.520	7:36	8:52	10:08	11:24
10	9:26	239	2.374	11:52	13:51	15:49	17:48
12	11:20	199	3.418	17:05	19:56	22:47	25:38
15	14:10	159	5.342	26:42	31:09	35:36	40:04
18	17:00	133	7.692	38:27	44:52	51:16	57:41
21	19:50	114	10.470	52:21	61:00	69:48	78:31
24	22:40	99	13.674	68:22	79:46	91:10	102:33
27	25:30	88	17.306	86:32	100:57	115:22	129:48
030	28:20	80	21.366	106:57	124:38	142:26	160:15
33	31:10	72	25.852	129:16	150:43	172:21	193:53
36	34:00	66	30.768	153:50	179:29	205:07	230:46

10. Add air until the internal air pressure of the sewer line is raised to approximately 4.0 psi gauge. After an internal pressure of approximately 4.0 psig is obtained, allow time for the air pressure to stabilize. The pressure will normally show some drop until the temperature of the air in the test section stabilizes.
11. When the pressure has stabilized and is at or above the starting test pressure of 3.5 psi gauge, commence the test. Before starting the test, the pressure may be allowed to drop to the 3.5 psig. Record the drop in pressure for the test period. If the pressure has dropped more than 1.0 psi gauge during the test period, the line shall be presumed to have failed. The test may be discontinued when the prescribed test time has been completed even though the 1.0 psig drop has not occurred.
12. The test procedure may be used as a presumptive test which enables the installer to determine the acceptability of the line prior to backfill and subsequent construction activities.
13. If the pipe to be tested is submerged in ground water, the test pressure shall be increased to 1.0 psi for every 2.31 feet the ground water level is above the invert of the sewer.
14. Safety: The air test may be dangerous if, because of lack of understanding or carelessness, a line is improperly prepared.
15. It is extremely important that the various plugs be installed and braced in such a way as to prevent blowouts. In as much as a force of 250 lb./f. is exerted on an 8 inch plug by an internal pipe pressure of 5 psi, it should be realized that sudden expulsion of a poorly installed plug or of a plug that is partially deflated before the pipe pressure is released can be dangerous.
16. As a safety precaution, pressurized equipment shall include a regulator or relief valve set slightly over the test pressure to avoid over-pressurizing and damaging an otherwise acceptable line. No one shall be allowed in the manholes during testing.
17. Table: The air test table above has been prepared utilizing applicable formulas from ASTM C828-76T. It is based on an allowable air loss of 0.0015 cu. ft/minute per square foot of internal pipe surface, a maximum air loss per test section of 3.5 cu. ft/minute and a minimum significant air loss per test section of 1.0 cu. ft/minute. It applies when testing one pipe diameter only and for convenience ignores 4 inch and

6-inch lateral sewers, which in most instances create only insignificant differences in test time.

3.9 MANHOLE NEGATIVE AIR PRESSURE (VACUUM) TEST

A. Vacuum Test shall be in accordance with ASTM C1244.

1. All lift holes and any pipes entering the manhole are to be plugged. A vacuum will be drawn and the vacuum drop over a specified time period is used to determine the acceptability of the manhole.
2. The values recorded are applicable only to the manhole being tested and at the time of testing.

B. Preparation of the Manhole.

1. All lift holes shall be plugged.
2. All pipes entering the manhole shall be temporarily plugged, taking care to securely brace the pipes and plugs to prevent them from being drawn into the manhole.

C. Procedure.

1. The test head shall be placed at the top of the manhole in accordance with the manufacturer's recommendations.
2. A vacuum of 10 inches of mercury shall be drawn on the manhole, the valve on the vacuum line of the test head closed, and the vacuum pump shut off. The time shall be measured for the vacuum to drop to 9 inches of mercury.
3. The manhole shall pass if the time for the vacuum reading to drop from 10 inches of mercury to 9 inches of mercury meets or exceeds the values indicated in Table 2.
4. If the manhole fails the initial test, necessary repairs shall be made by an approved method. The manhole shall then be retested until a satisfactory test is obtained.

TABLE 2
MINIMUM TEST TIMES FOR VARIOUS DIAMETER MANHOLES.

	Diameter (in.)		
Depth (ft.)	48	60	72
	Time (sec.)		
8	20	26	33
10	25	33	41
12	30	39	49
14	35	46	57
16	40	52	67
18	45	59	73
20	50	65	81
22	55	72	89
24	59	78	97

5. For manholes less than 8 feet in depth the minimum value listed shall be used. For other manhole diameters or greater depths, refer to ASTM C1244.

D. Test for leakage of gravity sewers using either the infiltration or exfiltration test. Allowable leakage shall be 100 gallons per inch of pipe diameter per mile per 24 hours up to a maximum of 2400 gallons per mile per 24 hours.

1. Use infiltration test when ground water is at least 4 feet above pipe crown along entire length of line to be tested. Plug the pipe at the upper manhole. Install suitable measuring device at the next lowest manhole. Measure the amount of water flowing through the outlet after flow has been stabilized.

2. Ground water determination: Use same procedure as "low pressure air test" above.

3. Use exfiltration test when ground water is less than 4 feet above the pipe crown. Plug the pipe at the lower manhole. Fill the line and manhole to 4 feet above pipe crown or top of manhole whichever is less. Let the water stand until pipe as reached maximum absorption and until all trapped air has escaped, 4 hours minimum. After maximum absorption is reached, refill manhole to original level. After 30 minutes, record difference in level and convert to gallons. Subtract manhole loss to obtain pipeline loss. Manhole loss is found by plugging inlet and outlet and filling manhole with water to 4 feet above pipe crown or top of manhole whichever is less. Let water stand one hour to reach maximum absorption. Refill to original level. After 30 minutes, check difference in level and convert to gallons. Manhole leakage shall not

exceed 1/2 gallon per hour.

E. All gravity sanitary sewers are to be CCTV'd prior to acceptance into the county system.

3.10 FORCE MAIN TESTS SHALL BE AS FOLLOWS:

A. Supply the pumps, water, calibrated gauges and meters, and all the necessary apparatus. Notify the Owner and County Engineer or his representatives at least 48 hours in advance of the test date and perform tests in presence of County Engineer or his representative.

B. Hydrostatic pressure test. After the line has been backfilled and at least seven days after the last concrete anchor block was poured, a hydrostatic pressure test shall be performed. Carefully fill the system with water at a velocity of approximately 1 foot per second while necessary measures are taken to eliminate all air. After the system has been filled, raise the pressure by pump to 1-1/2 times the working pressure or 150 psi, whichever is greater. Measure the pressure at the lowest point in system with the gauge compensated for elevation. Maintain the pressure for at least two hours. If pressure cannot be maintained, determine the cause, repair and repeat the test until successful.

C. A leakage test shall be conducted concurrently with the pressure test. Leakage shall be determined with a calibrated test meter, furnished by the Contractor. Leakage is defined as the quantity of water required to maintain a pressure with 5 psi of the specific test pressure, after air has been expelled and the pipe filled with water. Leakage shall not exceed the amount calculated by the following formula:

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

In which **L** is the allowable leakage, in gallons per hour; **S** is the length of pipeline tested, in feet; **D** is the nominal diameter of the pipe, in inches; and **P** is the average test pressure during the leakage test in pounds per square inch gauge.

D. All visible leaks shall be repaired regardless of the amount of leakage.

E. No leakage will be allowed for welded steel pipe. If leaks are revealed by test, make repair by re-welding. Peening of leaks will not be allowed.

3.11 MANHOLE CONNECTIONS

A. Existing Manhole Tie-In: A flexible pipe-to-manhole connector shall be used in the connection of the sewer pipe to precast manholes, where stubs or bricked-up openings (B.U.O.) do not exist.

B. The connector shall be installed by coring the manhole wall. Acceptable connectors shall be as specified. Connectors are to be installed in strict accordance with the manufacturer's recommendations.

C. The connection shall be installed in the manhole wall by activating the expanding mechanism in strict accordance with the recommendation of the connection manufacturer.

D. The connector shall be of a size specifically designed for the pipe material and size being utilized on the project.

E. This provision shall apply to both main line and service connections.

3.12 CCTV INSPECTION

A. Work included in this Section consists of all gravity sanitary sewers and all related equipment or material as indicated on the construction plans.

B. Required Deliverables:

   1. Submit a letter of CCTV completion.

   2. Submit a CD of the information as discussed below.

C. For new installations, the Contractor shall, following construction, conduct a final video inspection of all gravity pipes and a visual inspection of all manholes and wet wells) Copies of reports of this inspection shall be submitted to the County Engineer for approval.

D. The Contractor shall be responsible for all traffic control related items. This shall include flagging, all applicable signage, and/or detours as designated by the more stringent authority in the design plans, the Goochland County Standards and Specifications, and the VDOT MUTCD design manual (latest editions of all.)

E. After cleaning, the manhole sections shall be visually inspected by means of closed-circuit television. The inspection will be done one manhole section at a time and the flow in the section being inspected will be suitably controlled as specified. All CCTV inspections shall be performed in accordance with PACP standards including the specific date and time of inspection.

F. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture of the entire periphery of the pipe. The camera shall be operative in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of the Owner's Representative; and if unsatisfactory, equipment shall be removed and no payment will be made for an unsatisfactory inspection.

G. The camera shall be moved through the line in either direction at a moderate rate, stopping when necessary to permit proper documentation of the sewer's condition. In no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line. If, during the inspection operation, the television camera will not pass through the entire manhole section, the Contractor shall set up his equipment so that the inspection can be performed from the opposite manhole. If, again, the camera fails to pass through the entire manhole section, the inspection shall be considered complete noted as Survey Abandoned and no additional inspection will be required.

H. Camera head shall rotate at all joints and lateral connections to show a 360 degree picture.

I. When manually operated winches are used to pull the television camera through the line, telephones or other suitable means of communication shall be set up between the two manholes of the section being inspected to insure good communications between members of the crew.

J. The importance of accurate distance measurements is emphasized. Measurement for location of defects shall be above ground by means of a meter device. Marking on the cable, or the like, which would require interpolation for depth of manhole, will not be allowed. Accuracy of the distance meter shall be checked by use of a walking meter,

roll-a-tape, or other suitable device, and the accuracy shall be satisfactory to the Owner's Representative. Documentation of the television results shall be as follows:

1. Television Inspection Logs: Electronic media location records shall be kept by the Contractor and will clearly show the location, by distance in 1/10 of a foot or nearest mm, from the manhole wall, in relation to an adjacent manhole of each infiltration point observed during inspection. In addition, other points of significance such as locations of building sewers, unusual conditions, roots, storm sewer connections, cracks, fractures, broken pipe, presence of scale and corrosion, and other discernible features, as defined in the PACP defect codes, will be recorded on electronic media and a copy of such records will be supplied to the Owner.
2. Digital photographs of the pipe condition and all defects shall be taken by the Contractor. Photographs shall be located by distance in 1/10 of a foot or nearest mm, from the manhole wall, in relation to an adjacent manhole.
3. Electronic media recordings: The purpose of electronic media recording shall be to supply a visual and audio record of problem areas of the lines that may be replayed by the Owner. Each original electronic media recording of conditions and defects will be delivered to the Customer upon completion of a specific line section.
4. All CCTV Inspection be performed by CCTV personnel who are trained and certified in the use of NASSCO's Pipeline Assessment and Certification Program (PACP)©.

3.13 PAYMENT

A. Only the linear foot for each existing pipe segment will be measured for payment. No additional payment will be made for measurements made from the center of manholes or by using the CCTV footage if the footage starts recording prior to entering the pipe segment or after exiting the pipe segment.

B. No reimbursement will be made by Goochland County for any delays caused by others.

END OF SECTION

APPENDIX A

GEOTECHNICAL ENGINEERING REPORT

GEOTECHNICAL ENGINEERING REPORT

HICKORY HAVEN AND SAMARY FOREST SEWER
GOOCHLAND COUNTY, VIRGINIA

JOB NUMBER: 42792

PREPARED FOR:

GOOCHLAND COUNTY
P.O. BOX 10
GOOCHLAND COUNTY, VIRGINIA 23063

SEPTEMBER 6, 2019

TIMMONS GROUP

YOUR VISION ACHIEVED THROUGH OURS.

TABLE OF CONTENTS

APPENDICES

EXECUTIVE SUMMARY

For your convenience, this report is summarized in outline form below. This brief summary should not be used for design or construction purposes without reviewing the more detailed conclusions and recommendations contained in this report.

1. The subsurface exploration included a visual site reconnaissance, performance of 11 test borings to depths of approximately 9 to 15 feet below the ground surface, seismic refraction testing and quantitative laboratory testing.

2. The borings encountered approximately 2 to 12 inches of surficial topsoil (forest litter) and pavement sections. Beneath the ground surface cover, Borings B-01 and B-02 encountered existing fill soils to depths of four and six feet. These soils consisted of lower consistency clays and silts. Beneath the ground surface cover and fill, undisturbed residual soils were encountered to depths up to 15 feet below the ground surface. These soils consisted of low to high consistency clays, silts and sands.

3. Weathered rock was encountered in Borings B-01, B-02, B-03, B-04, B-06, B-08 and B-09 at depths ranging from approximately 4 to 11.5 feet below the existing ground surface to boring termination depths.

4. Material refusing auger advancement was encountered in Boring B-01 at a depth of approximately 9 feet below the ground surface. Auger refusal materials could represent competent bedrock, hard lenses within the weathered rock profile, or boulders.

5. Based on the borings and seismic refraction study, we expect bedrock excavation will be required in the western portion of the site, in the vicinities of Borings B-01, B-02, and possibly B-06. The eastern portion of the site appears to consist of a more deeply weathered soil profile.

6. We recommend that site grading be conducted during the typically warmer summer months.

7. On-site soils, excluding topsoil or debris-laden soils, should be suitable for re-use as structural fill. Where the sewer line is located within the roadway, we recommend that the trench backfill consist of VDOT 21A or VDOT 21B aggregate.

TIMMONS GROUP
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1001 Boulders Parkway
Suite 300
Richmond, VA 23225

P 804.200.6500
F 804.560.1016
www.timmons.com

September 6, 2019

Goochland County
P.O. Box 10
Goochland County, Virginia 23063

Attention: Mr. Matt Longshore

Re: **Geotechnical Engineering Report**
Hickory Haven and Samary Forest Sewer
Goochland County, Virginia
Timmons Group Project No. 42792

Mr. Longshore:

Timmons Group is pleased to submit this geotechnical engineering report for the referenced project. The objectives of our services were to explore subsurface conditions and provide our geotechnical recommendations for site grading.

1. PROJECT INFORMATION

The project is located in Goochland County, Virginia. A Site Vicinity Map is shown on Figure 1. The project will consist of installing a new sanitary sewer that services residential properties located long Holly Lane, Oak Lane, Birch Road and Whippoorwill Road. The proposed sanitary will consist of an 8-inch PVC pipe and will embedded approximately 8 to 15 feet below the existing ground surface.

2. FIELD EXPLORATION

The field exploration included a visual site reconnaissance by a representative of Timmons Group performance of 11 soil test borings (B-01 through B-11), and performance of seismic refraction testing. A summary of the boring and seismic refraction explorations are summarized below.

2.1 Soil Test Borings

Boring locations were selected by Timmons Group. A representative of Timmons Group established boring locations in the field using GPS equipment. Approximate boring locations are shown on Figure 2 in Appendix A.

Borings were performed to depths of approximately 9 to 15 feet below the existing ground surface with hollow stem auger drilling techniques. Split-spoon samples of subsurface soils were taken within soil test borings at approximate 2-foot intervals above a depth of 10 feet and at 5-foot intervals below 10 feet. Several bulk samples of near-surface soil cuttings were also collected. Standard Penetration Tests were conducted in conjunction with split-spoon sampling in general accordance with ASTM D 1586-99.

Water levels were measured in open boreholes at the time of drilling. Upon completion, boreholes were then backfilled up to the original ground surface with drill cuttings. Representative portions of split-spoon soil samples and the bulk samples were returned to our laboratory for quantitative testing and visual classification in general accordance with Unified Soil Classification System guidelines.

Boring logs and a generalized soil profile (Figure 3), which present specific information from the borings, are included in the Appendix. Stratification lines shown on the boring logs and profile are intended to represent approximate depths of changes in soil types. Naturally, transitional changes in soil types are often gradual and cannot be defined at particular depths. Ground surface elevations shown on these documents were interpolated from a topographic plan and should be considered approximate.

2.2 Seismic Refraction Testing

Seismic refraction testing was conducted by Forrest Environmental Services, Inc. along segments of the of the proposed sanitary sewer line. The test locations were selected after review of the soil test boring data. Thirteen alignments were tested along segments of the proposed sewer line. Results of this testing are provided in Appendix D.

3. LABORATORY TESTING

Laboratory testing was performed on representative split-spoon and bulk soil samples obtained from the borings. This testing consisted of natural moisture content, Atterberg limits, grain size analyses and Standard Proctors. Laboratory tests were performed in general accordance with applicable ASTM procedures. Individual laboratory test data sheets are provided in the Appendix. A summary of laboratory test data is provided in the tables below.

Natural Moisture and Classification Tests

Boring	Sample	Depth (Feet)	Natural Moisture Content (%)	Atterberg Limits			Grain Size Analysis			USCS Classification
				LL	PL	PI	% Sand	% Fines*	% Gravel	
B-02	S-2	2-4	24.6							CH**
B-04	Bulk	0-5	20.4	48	21	27	39.0	60.6	0.4	CL
B-04	S-3	4-6	26.7							ML**
B-05	S-3	4-6	30.0	58	33	25	32.5	67.3	0.2	MH
B-07	S-3	4-6	25.2	52	34	18	14.1	85.9	0.0	MH
B-08	Bulk	0-5	15.5	44	26	18	51.7	47.7	0.6	SC
B-09	S-2	2-4	20.0							CH**
B-10	S-1	0-2	25.0							ML**
B-10	S-3	4-6	20.9							ML**
B-11	Bulk	0-5	21.4	14	13	1	64.4	35.0	0.6	SM
B-11	S-1	0-2	13.3							SM**

*****Material passing No. 200 sieve (clay and silt)

******Visual Classification

Standard Proctor Testing

Boring	Depth (Feet)	Natural Moisture Content (%)	Standard Proctor		USCS Classification
			Optimum Moisture Content (%)	Maximum Dry Density (pcf)	
B-04	0-5	20.4	16.2	106.5	CL
B-08	0-5	15.5	15.5	111.0	SC
B-11	0-5	21.4	10.3	121.3	SM

Based on the Atterberg limits testing, near-surface soils are of low to high plasticity. Based on comparison of natural moisture contents to the optimum moisture content of the bulk sample, near-surface soils typically appear near to wet optimum moisture. The time of year the grading occurs will likely have a significant impact on the moisture levels of near-surface soils.

4. SITE GEOLOGY

According to the 1993 Geologic Map of Virginia, the site is located in the Piedmont Physiographic Province of Virginia. The Piedmont is characterized by low, rounded hills composed of saprolitic soils overlying folded metamorphic and igneous bedrock. Locally, the site appears to be underlain by the Mylonite Gneiss, Newark Supergroup Breccia and Newark Supergroup Triassic Sandstone. The majority of soils in the Piedmont were formed from the chemical weathering of parent bedrock and are termed “residual” soils.

5. SUBSURFACE CONDITIONS

The following is a summary of subsurface conditions encountered during the exploration.

5.1 Ground Surface Cover

The majority of the borings encountered approximately 2 to 6 inches of surficial topsoil (forest litter). Boring B-01 encountered 4 inches of surficial asphalt pavement underlain by 8 inches of aggregate base, and Boring B-04 encountered 4 inches of surficial gravel.

5.2 Existing Fill Soils

Beneath the ground surface cover, Borings B-01 and B-02 encountered existing fill soils to depths of four and six feet, respectively. These soils consisted of medium stiff to stiff highly plastic clay (CH), lean clay (CL) and silt (ML). Standard Penetration Test (SPT) N-values within the fill were 5 to 9 blows per foot (bpf).

5.3 Residual Soils

Beneath the fill in the above borings and below the ground surface cover in the remaining borings, undisturbed residual soils were encountered to depths up to 15 feet below the ground surface. These soils consisted of soft to hard highly plastic clay (CH), elastic silt (MH), lean clay (CL), silt (ML), loose to dense clayey and silty sands (SC, SM). SPT N-values within the soil profile ranged from 3 to 47 blows per foot (bpf).

5.4 Weathered Rock

Weathered rock was encountered in Borings B-01, B-02, B-03, B-04, B-06, B-08 and B-09 at depths ranging from approximately 4 to 11.5 feet below the existing ground surface to boring termination depths. Weathered rock is defined as a residual material having Standard Penetration Test N-values of 60 blows per foot or greater. Weathered rock was sampled primarily as silty sand (SM) and silt (ML).

5.5 Auger Refusal Materials

Materials refusing auger advancement was encountered in Boring B-01 at a depth of approximately 9 feet below the ground surface. Auger refusal materials could represent competent bedrock, hard lenses within the weathered rock profile, or boulders. The table below provides a summary of weathered rock and refusal elevations.

Weathered Rock and Auger Refusal Encountered Elevations

Boring	Approximate Ground Surface Elevation (Feet)	Approximate Boring Termination Elevation	Approximate Elevation of Weathered (Feet)	Approximate Elevation of Auger Refusal (Feet)
B-01	193.5	173.5	187.5	184.5
B-02	194	179	188	N.A.
B-03	225	210	219	N.A.
B-04	212	197	201.5	N.A.
B-05	220	205	N.A.	N.A
B-06	184	169	180	N.A
B-07	210	195	N.A.	N.A
B-08	208	193	196.5	N.A
B-09	198	183	186.5	N.A
B-10	207	192	N.A.	N.A
B-11	179	164	N.A.	N.A

N.A. – Not Available

5.6 Groundwater

At the time of exploration, water was encountered in Borings B-01 and B-11 at depths of 7.5 and 7.6 feet below the ground surface. It is important to realize that groundwater levels will fluctuate with changes in rainfall and evaporation rates. In addition, perched groundwater could be encountered within near-surface soils, particularly after rainfall.

6. EVALUATION OF SEISMIC REFRACTION DATA

The seismic refraction data was compared to the boring data in an attempt to confirm the seismic velocity that represents bedrock. The report by Forrest Environmental Services, Inc. (Appendix D) indicates that bedrock typically exhibits a seismic velocity greater than 5,000 feet per second.

Only one boring (B-01) encountered auger refusal, and that was at a depth of approximately 9 feet below the existing ground surface. The beginning of the SR Line 1 data (Appendix D) indicates a seismic velocity of approximately 5,000 feet per second near the refusal depth, which is consistent with the expectation by Forrest Environmental Services, Inc. Boring B-02 did not encounter refusal, but it did encounter very hard weathered rock (SPT N-value of 50 blows in 1 inch of penetration) at a depth of approximately 14 feet below the ground surface. It is likely that auger refusal material is present within a few feet of the termination depth of Boring B-02. The SR Line 1 data indicates a seismic velocity near 5,000 to 6,000 feet per second at the Boring B-02 termination depth of 14 feet. Although auger refusal data is limited, a reasonable assumption is

that bedrock is present where the SR Line data seismic velocities of 5,000 feet per second or greater.

7. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based upon our borings, laboratory testing, engineering analysis, and past experience with similar projects and subsurface conditions.

7.1 Site Preparation

Within the project limits, site preparation should begin with clearing and grubbing of existing trees, stripping of topsoil, removal of pavement sections, and removal of any other unsuitable materials. Approximately 2 to 12 inches of ground surface cover was encountered in the borings. However, in wooded areas, removal of root mat associated with trees will likely cause stripping depths to be greater than actual topsoil depths. In addition, stripping activities often mix topsoil with underlying "clean" soils and cause stripping depths to be greater than actual topsoil depths, particularly during wet periods of the year. Topsoil should be wasted from the site or permanently stockpiled outside the proposed construction limits.

7.2 Excavations

We expect that excavations for the sewer will extend through moderate to high consistency soils, weathered rock, and mass rock. Based on the borings, the seismic refraction data and our review of anticipated excavation depths, we expect excavation of mass rock could be encountered in the vicinities of Borings B-01, B-02, and possibly B-06. The field data suggests that remainder of the proposed sewer, particularly the eastern portion of the project, is located in more deeply weathered soil profiles. Zones of weathered rock are still expected to be encountered, but most of the encountered weathered rock is considered to be "soft weathered rock" with SPT N-values between 60 blows per foot and 50 blows in 4 inches of penetration (50/4").

Soil types with respect to trench safety must be evaluated on a case-by-case basis. The Contractor should be responsible for all site safety, including the determination of appropriate trench safety measures according to OSHA guidelines. Water was encountered in two of the borings at depths of approximately 7.5 and 7.6 feet. The contractor is responsible for controlling and removing water that collects in excavations.

Our comments regarding excavation of on-site materials are presented in the following sections.

7.2.1 Moderate to High Consistency Soils

Local excavation of moderate to higher consistency soils will likely require the use of a large track-mounted excavator equipped with rock teeth. However, the rate of excavation in the higher consistency soils is typically slow.

7.2.2 Weathered Rock

Our experience is that confined excavations into soft weathered rock (SPT N-values of 60 blows per foot to 50/4") are practical with the above referenced excavator, but the excavations becomes slower and more difficult as the SPT N-value increases, particularly for SPT N-values exceeding 50/6". Weathered rock materials with SPT N-values greater than 50/4" are considered "hard" weathered rock and will likely require preloosening with blasting or use of a hoe ram. Again, most of the weathered rock encountered in the borings was softer weathered rock.

7.2.3 Mass Rock

Mass rock will require preloosening with blasting or use of a hoe ram.

It is important to note that the success of ripping in mass excavation areas and confined excavations is dependent upon many factors. These include weakness seams within the rock, orientation of the seams, skill of the operator, and the diligence with which the contractor pursues excavation.

If blasting is performed, a pre-blast survey of nearby structures should be performed. In addition, blast-induced vibrations on nearby structures should be monitored and should be such that they do not cause damage to these structures.

7.3 Re-use of On-site Soils as Structural Fill

Soils encountered in the borings, excluding those with more than 5 percent organics or debris, should be suitable for re-use as structural fill, provided the moisture content can be properly controlled. We do not recommend on-site soils be reused as backfill for the sewer line trench within the roadways. Backfill within the roadway should consist of granular offsite material as detailed in Section 7.4 below.

Based on visual observation and comparison of the measured natural moisture contents of the bulk soil samples to the optimum moisture contents from the Standard Proctor tests, near-surface soils appear dry to wet of optimum moisture. Prevailing weather conditions will have a significant impact on the amount of moisture manipulation (i.e., drying or wetting) required prior to fill placement. Fine-grained soils are often difficult to dry and manipulate, even during favorable weather conditions.

7.4 Structural Fill

The following recommendations are made for structural fill.

- Sewer Line Outside of the Roadway – On-site soils used as structural fill should be free of debris, contain less than 5 percent organics, have a maximum liquid limit (LL) of 55, and a maximum plasticity index (PI) of 30.
- Sewer Line Within the Roadway – Because portions of the sewer line will be installed in the roadway, we recommend the backfill consist of VDOT 21A or VDOT 21B stone.

Fill should be placed in maximum 8 to 10-inch loose lifts and compacted to at least 95 percent of the Standard Proctor maximum dry density (ASTM D 698). Within the roadways, the final 12 inches of structural fill relative to finished subgrade should be compacted to at least 100 percent of the Standard Proctor maximum dry density. Structural fill should be maintained within 3 percent points of optimum moisture during placement and compaction.

Site preparation, including fill placement and compaction, should be observed by a qualified soils technician working under the direction of the Geotechnical Engineer. During fill placement, a sufficient amount of in-place density tests should be conducted to confirm that compaction and fill moisture is in accordance with our recommendations.

8. LIMITATIONS OF REPORT

The recommendations contained in this report are made on the basis of the site information made available to us and the surface and subsurface conditions that existed at the time of the exploration. While this exploration has been conducted in accordance with generally accepted geotechnical engineering practices, there remains some potential for variation of the subsurface conditions in unexplored areas of the site. If the subsurface conditions encountered during construction vary significantly from those presented in this report, we should be notified to reevaluate our recommendations. No other warranty, expressed or implied, is made as to the professional advice included in this report.

9. CLOSURE

We appreciate this opportunity to be of service to you on this project. If you have any questions regarding this study or if we can be of further assistance, please contact us at (804) 200-6500.

Respectfully submitted,
TIMMONS GROUP

Julian M. Ruffin IV, P.E.
Geotechnical Engineer
VA Registration No. 050631

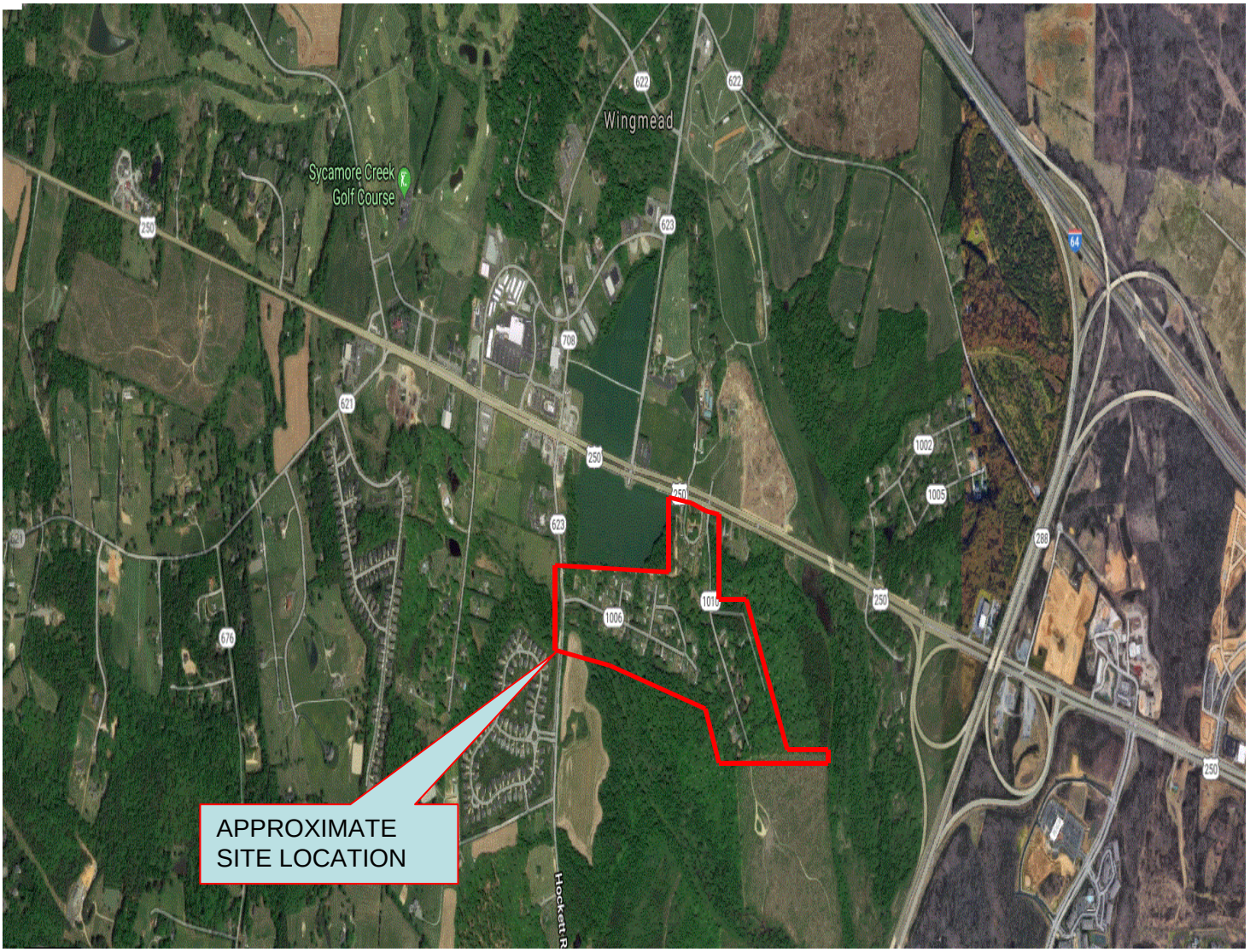
COMMONWEALTH OF VIRGINIA
JNR
9/6/19
J NATHAN REEVES
No. 049619
PROFESSIONAL ENGINEER

J. Nathan Reeves, P.E.
Geotechnical Engineer
VA Registration No. 049619

APPENDIX A

FIGURES

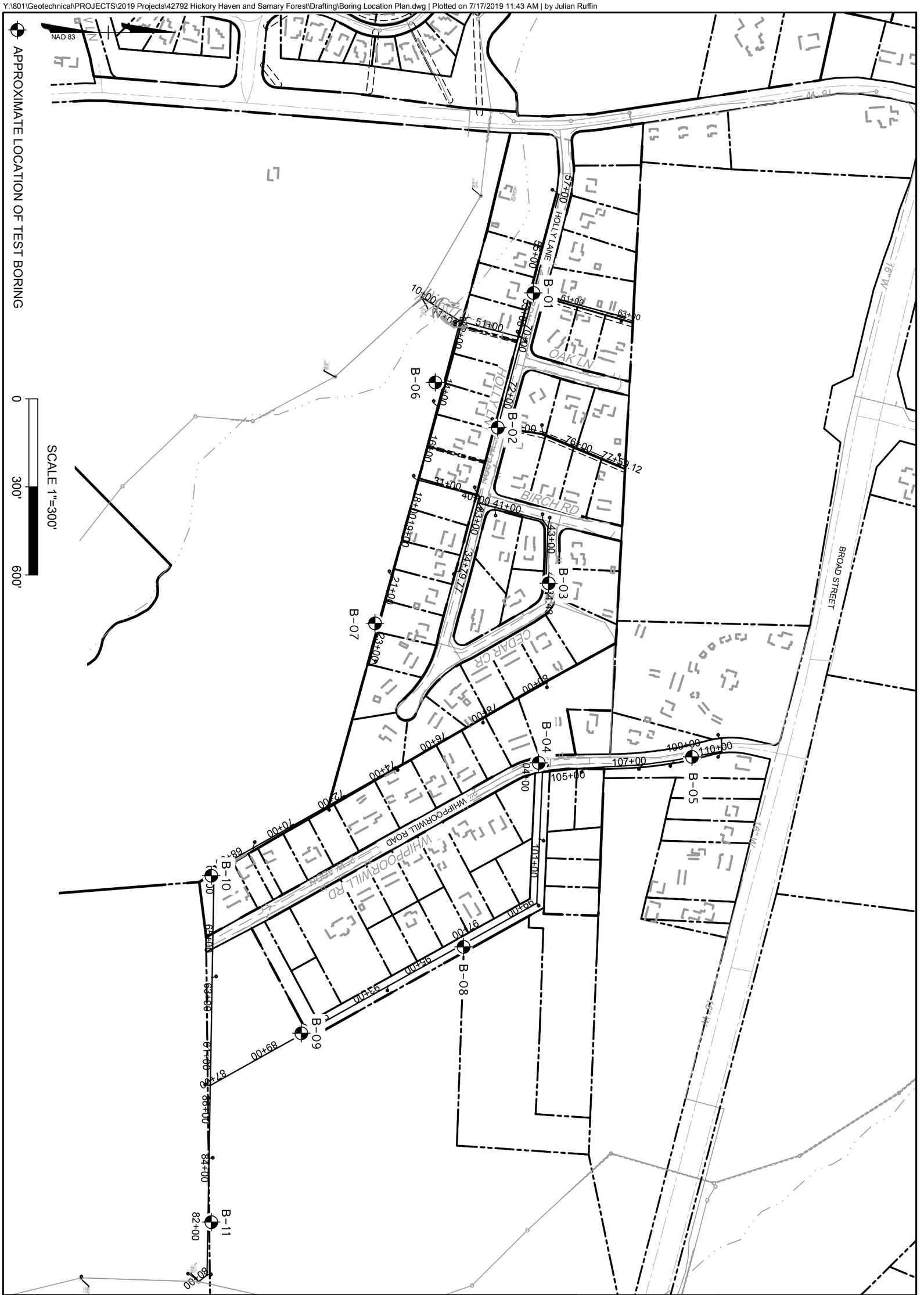
NORTH



Source: Google Maps

SCALE: NTS	TIMMONS GROUP YOUR VISION ACHIEVED THROUGH OURS.	**SITE VICINITY MAP** HICKORY HAVEN AND SAMARY FOREST SEWER GOOCHLAND COUNTY, VA	FIGURE 1
CHECKED BY: JNR			
PLOTTED BY: JMR			
DATE: 8-14-2019	PROJECT NUMBER: 42792		

Y:\801\Geotechnical\PROJECTS\2019 Projects\42792 Hickory Haven and Samary Forest\Drafting\Boring Location Plan.dwg | Plotted on 7/17/2019 11:43 AM | by Julian Ruffin



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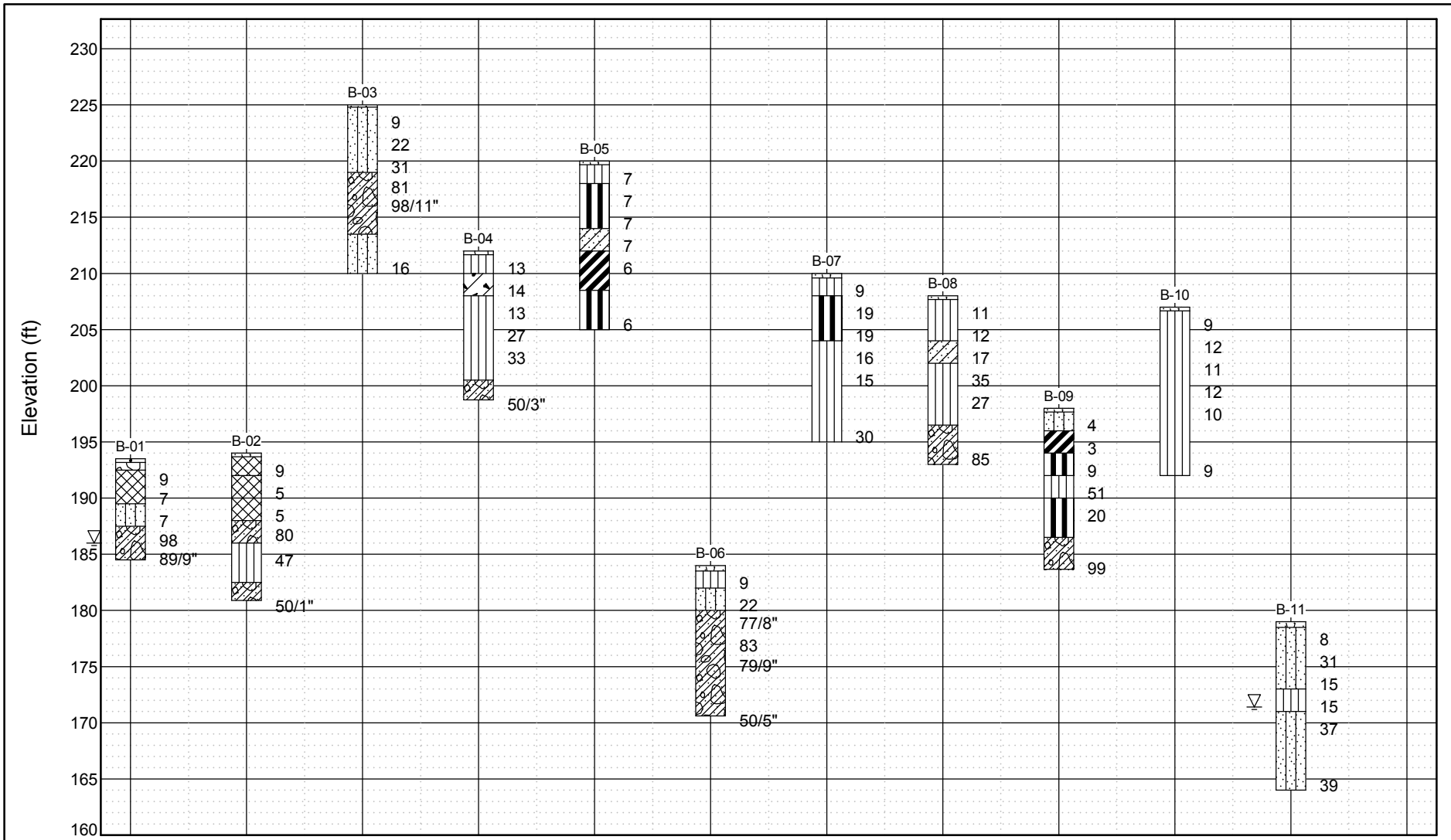
THIS DRAWING PREPARED AT THE
Corporate Headquarters
1001 Boulders Parkway | Richmond, VA 23225
TEL 804.200.6500 FAX 804.560.1016 www.timmons.com

SHEET NO.	JOB NO.	HICKORY HAVEN AND SAMARY FOREST SEWER	SCALE	CHECKED BY	DESIGNED BY	DRAWN BY	DATE
2	33947.033	GOOCHLAND COUNTY - VIRGINIA	AS SHOWN	N. REEVES	----	J. RUFFIN	6.18.2019
		BORING LOCATION					

DATE	REVISION DESCRIPTION



Lithology Symbols

- Asphalt
- Fill (made ground)
- Weathered Rock
- Silt
- Poorly-graded Gravel
- Silty Sand
- Topsoil
- Low Plasticity Clay

Groundwater Symbols

▽ At End of Drilling ▼ At 24 Hours

Exploration Symbols

B-01 (Exploration ID)

13 (N-Value)

53% 98%(RQD REC)

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Fence Diagram

Hickory Haven and Samary Forest Sewer
Goochland County, Virginia

PROJECT NUMBER	DRAWN BY	DATE DRAWN
42792	JR	8.14.2019
HORIZONTAL SCALE NTS	APPROVED BY	FIGURE
VERTICAL SCALE NTS	NR	3

APPENDIX B

BORING LOGS

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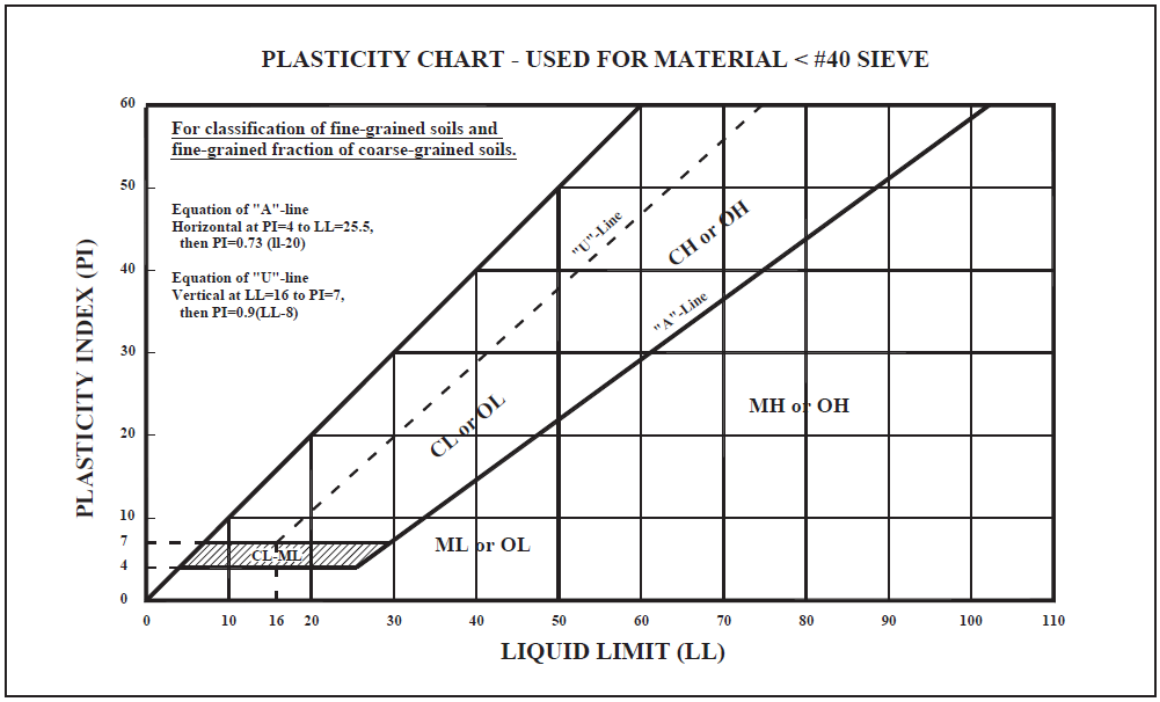
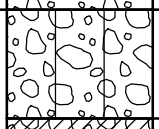
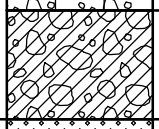
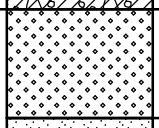
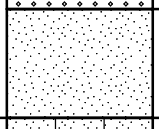
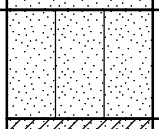
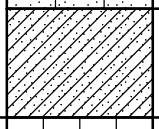
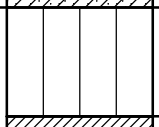
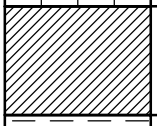
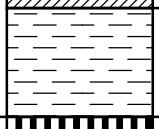
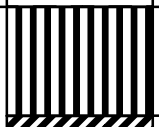
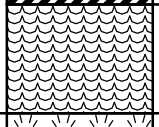
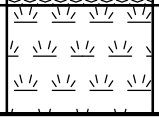
KEY TO BORING LOG TERMINOLOGY

Relative Density – Used for soils with less than 50% passing No. 200 sieve		Consistency – Used for soils with 50 percent or more passing No. 200 sieve	
Relative Density	**SPT N-Value (blows/ft)**	**Consistency**	**SPT N-Value (blows/foot)**
Very Loose	0 to 3	Very Soft	0 to 1
Loose	4 to 9	Soft	2 to 4
Medium Dense	10 to 29	Medium Stiff	5 to 8
Dense	30 to 50	Stiff	9 to 15
Very Dense	Greater than 50	Very Stiff	16 to 30
		Hard	31 to 50
		Very Hard	Greater than 50

Grain Size Terminology (U.S. Standard Sieves)		Natural Moisture Content	
Term	**Particle Size**		
Boulder	12 inches +	Dry	Very little apparent moisture, dusty
Cobble	3 to 12 inches		
Coarse Gravel	¾ to 3 inches	Moist	Damp, but no free water visible
Fine Gravel	#4 to ¾ inches		
Coarse Sand	#10 to #4		
Medium Sand	#40 to #10	Wet	Visible free water, or in cohesive soil, clearly saturated
Fine Sand	#200 to #40		
Silt and Clay	<#200		



SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	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
	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
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

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BORING B-01

PROJECT NUMBER 42792 **PROJECT NAME** Hickory Haven and Samary Forest

CLIENT Goochland County **PROJECT LOCATION** Goochland County, Virginia

DATE STARTED 7/12/2019 **COMPLETED** 7/12/2019 **GROUND ELEVATION** 193.5 ft **HOLE DEPTH** 9 feet

DRILLING CONTRACTOR Fishburne Drilling, Inc. **BOREHOLE WATER LEVELS:**

DRILLING METHOD Hollow Stem Auger ▽ **AT END OF DRILLING** 7.50 ft / Elev 186.00 ft not encountered

LOGGED BY Julian Ruffin **CHECKED BY** ▼ **AT 24 HOURS DRILLING** ---

NOTES **CAVE DEPTH**

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0		ASPHALT: (4 Inches)		S-1, SPT 4-4-5 (9)			
		AGGREGATE BASE: (8 Inches)					
		SANDY SILT, (ML): gray, moist, stiff, trace organics, fill		S-2, SPT 4-4-3-7 (7)			
	190						
5		SILTY SAND, (SM): light brown and gray, fine to medium grained, moist, loose		S-3, SPT 3-3-4-9 (7)			
		SILTY SAND WITH GRAVEL, (SM): brown, fine to coarse grained, wet, very dense, weathered decomposed rock ▽		S-4, SPT 25-48-50 (98)			
	185	Brown and gray		S-5, SPT 89/9"			

Refusal at 9.0 feet.
Bottom of borehole at 9.0 feet.

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BORING B-02

PROJECT NUMBER 42792 **PROJECT NAME** Hickory Haven and Samary Forest

CLIENT Goochland County **PROJECT LOCATION** Goochland County, Virginia

DATE STARTED 7/12/2019 **COMPLETED** 7/12/2019 **GROUND ELEVATION** 194 ft **HOLE DEPTH** 13.1 feet

DRILLING CONTRACTOR Fishburne Drilling, Inc. **BOREHOLE WATER LEVELS:**

DRILLING METHOD Hollow Stem Auger **AT END OF DRILLING** --- not encountered

LOGGED BY Julian Ruffin **CHECKED BY** **AT 24 HOURS DRILLING** ---

NOTES **CAVE DEPTH**

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0	194	TOPSOIL: (4 Inches)		S-1, SPT 7-5-4-4 (9)			
		SANDY LEAN CLAY, (CL): light orangeish brown and gray, moist, stiff, trace organics, fill					
		FAT CLAY WITH SAND, (CH): brown and gray, moist, medium stiff, trace organics, fill		S-2, SPT 2-3-2-2 (5)			
	190	SANDY SILT, (ML): light brown and gray, moist, medium stiff, fill		S-3, SPT 2-3-2-4 (5)			
5		SILTY SAND, (SM): light gray, fine to coarse grained, moist, very dense, with rock fragments, weathered decomposed rock		S-4, SPT 13-26-54 (80)			
	185	SANDY SILT, (ML): light brown and gray, moist, hard		S-5, SPT 29-22-25-43 (47)			
10		SILTY SAND, (SM): gray, fine to coarse grained, moist, very dense, with rock fragments, weathered decomposed rock		S-6, SPT 50/1"			
		Bottom of borehole at 13.1 feet.					

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BORING B-03

PROJECT NUMBER 42792 **PROJECT NAME** Hickory Haven and Samary Forest

CLIENT Goochland County **PROJECT LOCATION** Goochland County, Virginia

DATE STARTED 7/12/2019 **COMPLETED** 7/12/2019 **GROUND ELEVATION** 225 ft **HOLE DEPTH** 15 feet

DRILLING CONTRACTOR Fishburne Drilling, Inc. **BOREHOLE WATER LEVELS:**

DRILLING METHOD Hollow Stem Auger **AT END OF DRILLING** --- not encountered

LOGGED BY Julian Ruffin **CHECKED BY** **AT 24 HOURS DRILLING** ---

NOTES **CAVE DEPTH**

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0	225	TOPSOIL: (2 Inches) SILTY SAND, (SM): orangeish brown, fine to coarse grained, moist, loose, contains mica Light gray, medium dense, contains gravel		S-1, SPT 5-4-5-9 (9) S-2, SPT 5-9-13-18 (22)			
5	220	Light brown and gray, dense		S-3, SPT 10-13-18-29 (31)			
		SILTY SAND, (SM): light brown and gray, fine to coarse grained, moist, very dense, weathered decomposed rock		S-4, SPT 19-28-53 (81) S-5, SPT 98/11"			
10	215						
		SILTY SAND, (SM): light brown and gray, fine to coarse grained, moist, medium dense		S-6, SPT 23-9-7-11 (16)			
15	210	Bottom of borehole at 15.0 feet.					

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BORING B-04

PROJECT NUMBER 42792 **PROJECT NAME** Hickory Haven and Samary Forest

CLIENT Goochland County **PROJECT LOCATION** Goochland County, Virginia

DATE STARTED 7/8/2019 **COMPLETED** 7/8/2019 **GROUND ELEVATION** 212 ft **HOLE DEPTH** 13.25 feet

DRILLING CONTRACTOR Fishburne Drilling, Inc. **BOREHOLE WATER LEVELS:**

DRILLING METHOD Hollow Stem Auger **AT END OF DRILLING** --- not encountered

LOGGED BY Julian Ruffin **CHECKED BY** **AT 24 HOURS DRILLING** ---

NOTES **CAVE DEPTH**

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0	212	GRAVEL: (4 Inches)		S-1, SPT 8-6-7-7 (13)			
		SANDY SILT, (ML): light brownish gray, moist, stiff					
	210	SANDY LEAN CLAY, (CH): orangeish brown and gray, moist, stiff		S-2, SPT 5-6-8-9 (14)			
5		SANDY SILT, (ML): light brown and light gray, moist, stiff, trace mica		S-3, SPT 4-6-7-10 (13)			
	205	(ML): dark orangeish brown and gray, very stiff, contains mica		S-4, SPT 8-13-14-21 (27)			
		(ML): light gray and light gray, hard, trace rock fragments		S-5, SPT 10-17-16-19 (33)			
10							
	200	SILTY SAND, (SM): light whiteish gray, fine to coarse grained, moist, very dense, trace rock fragments, weathered decomposed rock		S-6, SPT 50/3"			
		Bottom of borehole at 13.3 feet.					

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BORING B-05

PROJECT NUMBER 42792 **PROJECT NAME** Hickory Haven and Samary Forest

CLIENT Goochland County **PROJECT LOCATION** Goochland County, Virginia

DATE STARTED 7/8/2019 **COMPLETED** 7/8/2019 **GROUND ELEVATION** 220 ft **HOLE DEPTH** 15 feet

DRILLING CONTRACTOR Fishburne Drilling, Inc. **BOREHOLE WATER LEVELS:**

DRILLING METHOD Hollow Stem Auger **AT END OF DRILLING** --- not encountered

LOGGED BY Julian Ruffin **CHECKED BY** **AT 24 HOURS DRILLING** ---

NOTES **CAVE DEPTH**

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0	220	TOPSOIL: (4 Inches) SANDY SILT, (ML): light brown, moist, medium stiff		S-1, SPT 3-3-4-4 (7)			
		SANDY ELASTIC SILT, (MH): reddish brown and light brown, moist, medium stiff		S-2, SPT 3-3-4-5 (7)			
5	215	Dark orangeish brown and light brown, moist, trace gravel		S-3, SPT 2-3-4-6 (7)			
		CLAYEY SAND, (SC): light brown, fine to coarse grained, moist, loose		S-4, SPT 2-3-4-2 (7)			
		SANDY FAT CLAY, (CH): light brown and light gray, moist, medium stiff		S-5, SPT 2-3-3-4 (6)			
10	210						
		SANDY ELASTIC SILT, (MH): light grayish brown, moist, medium stiff					
15	205			S-6, SPT 3-3-3-4 (6)			

Bottom of borehole at 15.0 feet.

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BORING B-06

PROJECT NUMBER 42792 **PROJECT NAME** Hickory Haven and Samary Forest

CLIENT Goochland County **PROJECT LOCATION** Goochland County, Virginia

DATE STARTED 7/12/2019 **COMPLETED** 7/12/2019 **GROUND ELEVATION** 184 ft **HOLE DEPTH** 13.4 feet

DRILLING CONTRACTOR Fishburne Drilling, Inc. **BOREHOLE WATER LEVELS:**

DRILLING METHOD Hollow Stem Auger **AT END OF DRILLING** --- not encountered

LOGGED BY Julian Ruffin **CHECKED BY** **AT 24 HOURS DRILLING** ---

NOTES **CAVE DEPTH**

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0		TOPSOIL: (6 Inches)		S-1, SPT 2-4-5-6 (9)			
		SANDY SILT, (ML): light brown, moist, stiff					
		SILTY SAND WITH GRAVEL, (SM): light brown, fine to coarse grained, moist, medium dense		S-2, SPT 11-8-14-17 (22)			
	180						
5		SILTY SAND WITH GRAVEL, (SM): light brown, fine to coarse grained, moist, very dense, weathered decomposed rock		S-3, SPT 77/8"			
				S-4, SPT 22-33-50 (83)			
	175			S-5, SPT 79/9"			
10							
		Bottom of borehole at 13.4 feet.		S-6, SPT 50/5"			

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BORING B-07

PROJECT NUMBER 42792 **PROJECT NAME** Hickory Haven and Samary Forest

CLIENT Goochland County **PROJECT LOCATION** Goochland County, Virginia

DATE STARTED 7/12/2019 **COMPLETED** 7/12/2019 **GROUND ELEVATION** 210 ft **HOLE DEPTH** 15 feet

DRILLING CONTRACTOR Fishburne Drilling, Inc. **BOREHOLE WATER LEVELS:**

DRILLING METHOD Hollow Stem Auger **AT END OF DRILLING** --- not encountered

LOGGED BY Julian Ruffin **CHECKED BY** **AT 24 HOURS DRILLING** ---

NOTES **CAVE DEPTH**

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0	210	TOPSOIL: (5 Inches) SANDY SILT, (ML): orangeish brown, moist, stiff		S-1, SPT 3-4-5-7 (9)			
		ELASTIC SILT, (MH): reddish brown, moist, very stiff, trace sand		S-2, SPT 5-9-10-13 (19)			
5	205	Orangeish brown		S-3, SPT 6-8-11-14 (19)			
		SANDY SILT, (ML): light brown and light brownish gray, moist, very stiff		S-4, SPT 5-7-9-14 (16)			
10	200	(ML): stiff		S-5, SPT 4-5-10-9 (15)			
15	195	(ML): light brown and gray, very stiff		S-6, SPT 8-14-16-15 (30)			

Bottom of borehole at 15.0 feet.

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BORING B-08

PROJECT NUMBER 42792 **PROJECT NAME** Hickory Haven and Samary Forest

CLIENT Goochland County **PROJECT LOCATION** Goochland County, Virginia

DATE STARTED 7/8/2019 **COMPLETED** 7/8/2019 **GROUND ELEVATION** 208 ft **HOLE DEPTH** 15 feet

DRILLING CONTRACTOR Fishburne Drilling, Inc. **BOREHOLE WATER LEVELS:**

DRILLING METHOD Hollow Stem Auger **AT END OF DRILLING** --- not encountered

LOGGED BY Julian Ruffin **CHECKED BY** **AT 24 HOURS DRILLING** ---

NOTES **CAVE DEPTH**

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0	208	TOPSOIL: (4 Inches)		S-1, SPT 3-5-6-8 (11)			
		SANDY SILT, (ML): light brown, moist, stiff, trace mica					
	205			S-2, SPT 4-5-7-9 (12)			
5		CLAYEY SAND, (SC): light grayish brown, fine to coarse grained, moist, medium dense		S-3, SPT 5-7-10-13 (17)			
		SANDY SILT, (ML): gray, moist, hard, contains mica		S-4, SPT 9-17-18-26 (35)			
	200						
		(ML): light brown and gray, very stiff		S-5, SPT 10-13-14-18 (27)			
10							
		SILTY SAND, (SM): brown and light brownish gray, fine to coarse grained, moist, very dense, contains mica, weathered decomposed rock					
	195						
15				S-6, SPT 22-36-49-51 (85)			

Bottom of borehole at 15.0 feet.

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BORING B-09

PROJECT NUMBER 42792 **PROJECT NAME** Hickory Haven and Samary Forest

CLIENT Goochland County **PROJECT LOCATION** Goochland County, Virginia

DATE STARTED 7/8/2019 **COMPLETED** 7/8/2019 **GROUND ELEVATION** 198 ft **HOLE DEPTH** 14.33 feet

DRILLING CONTRACTOR Fishburne Drilling, Inc. **BOREHOLE WATER LEVELS:**

DRILLING METHOD Hollow Stem Auger **AT END OF DRILLING** --- not encountered

LOGGED BY Julian Ruffin **CHECKED BY** **AT 24 HOURS DRILLING** ---

NOTES **CAVE DEPTH**

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0		(4 Inches)					
		SILTY SAND, (SM): light brownish gray, fine to coarse grained, moist, loose, trace roots		S-1, SPT 1-2-2 (4)			
	195	SANDY FAT CLAY, (CH): light brown and gray, moist, soft		S-2, SPT 2-1-2-2 (3)			
5		ELASTIC SILT WITH SAND, (MH): light brown and gray, moist, stiff, trace mica		S-3, SPT 3-4-5-5 (9)			
		SANDY SILT, (ML): brown and gray, moist, very hard, trace mica		S-4, SPT 14-22-29-33 (51)			
	190	SANDY ELASTIC SILT, (MH): brown and light gray, moist, very stiff, trace mica		S-5, SPT 9-10-10-15 (20)			
10							
		SANDY SILT, (ML): light grayish brown, moist, very hard, trace mica, weathered decomposed rock					
	185			S-6, SPT 17-49-50 (99)			

Bottom of borehole at 14.3 feet.

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BORING B-10

PROJECT NUMBER 42792 **PROJECT NAME** Hickory Haven and Samary Forest

CLIENT Goochland County **PROJECT LOCATION** Goochland County, Virginia

DATE STARTED 7/8/2019 **COMPLETED** 7/8/2019 **GROUND ELEVATION** 207 ft **HOLE DEPTH** 15 feet

DRILLING CONTRACTOR Fishburne Drilling, Inc. **BOREHOLE WATER LEVELS:**

DRILLING METHOD Hollow Stem Auger **AT END OF DRILLING** --- not encountered

LOGGED BY Julian Ruffin **CHECKED BY** **AT 24 HOURS DRILLING** ---

NOTES **CAVE DEPTH**

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0	207	TOPSOIL: (4 Inches)					
		SANDY SILT, (ML): light brown, moist, stiff, contains roots, trace mica		S-1, SPT 2-4-5-6 (9)			
	205			S-2, SPT 4-5-7-9 (12)			
5				S-3, SPT 4-5-6-9 (11)			
	200			S-4, SPT 4-5-7-6 (12)			
				S-5, SPT 2-4-6-8 (10)			
10							
	195						
				S-6, SPT 2-3-6-9 (9)			
15		Bottom of borehole at 15.0 feet.					

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BORING B-11

PROJECT NUMBER 42792 **PROJECT NAME** Hickory Haven and Samary Forest

CLIENT Goochland County **PROJECT LOCATION** Goochland County, Virginia

DATE STARTED 7/8/2019 **COMPLETED** 7/8/2019 **GROUND ELEVATION** 179 ft **HOLE DEPTH** 15 feet

DRILLING CONTRACTOR Fishburne Drilling, Inc. **BOREHOLE WATER LEVELS:**

DRILLING METHOD Hollow Stem Auger ▽ **AT END OF DRILLING** 7.60 ft / Elev 171.40 ft

LOGGED BY Julian Ruffin **CHECKED BY** ▼ **AT 24 HOURS DRILLING** ---

NOTES **CAVE DEPTH**

DEPTH (ft)	ELEVATION (ft)	MATERIAL DESCRIPTION	SYMBOL	SAMPLING BLOW COUNTS (N-VALUE)	POCKET PEN. (tsf)	LAB TESTS	REMARKS
0		TOPSOIL: (6 Inches)		S-1, SPT 3-5-3-3 (8)			
		SILTY SAND, (SM): light brown and gray, fine to coarse grained, moist, loose, trace gravel					
		Dense		S-2, SPT 6-9-22-13 (31)			
	175						
5		Light gray, medium dense, trace mica		S-3, SPT 7-7-8-7 (15)			
		SANDY SILT, (ML): dark brown and light gray, moist, stiff, contains clay lenses, trace mica ▽		S-4, SPT 6-5-10-14 (15)			
	170	SILTY SAND, (SM): brown, fine to medium grained, moist, dense, trace mica		S-5, SPT 7-13-24-30 (37)			
10							
	165	Dark brown, contains mica		S-6, SPT 7-13-26-39 (39)			
15							

Bottom of borehole at 15.0 feet.

APPENDIX C

LABORATORY TEST RESULTS

Grain Size Analysis

ASTM D422

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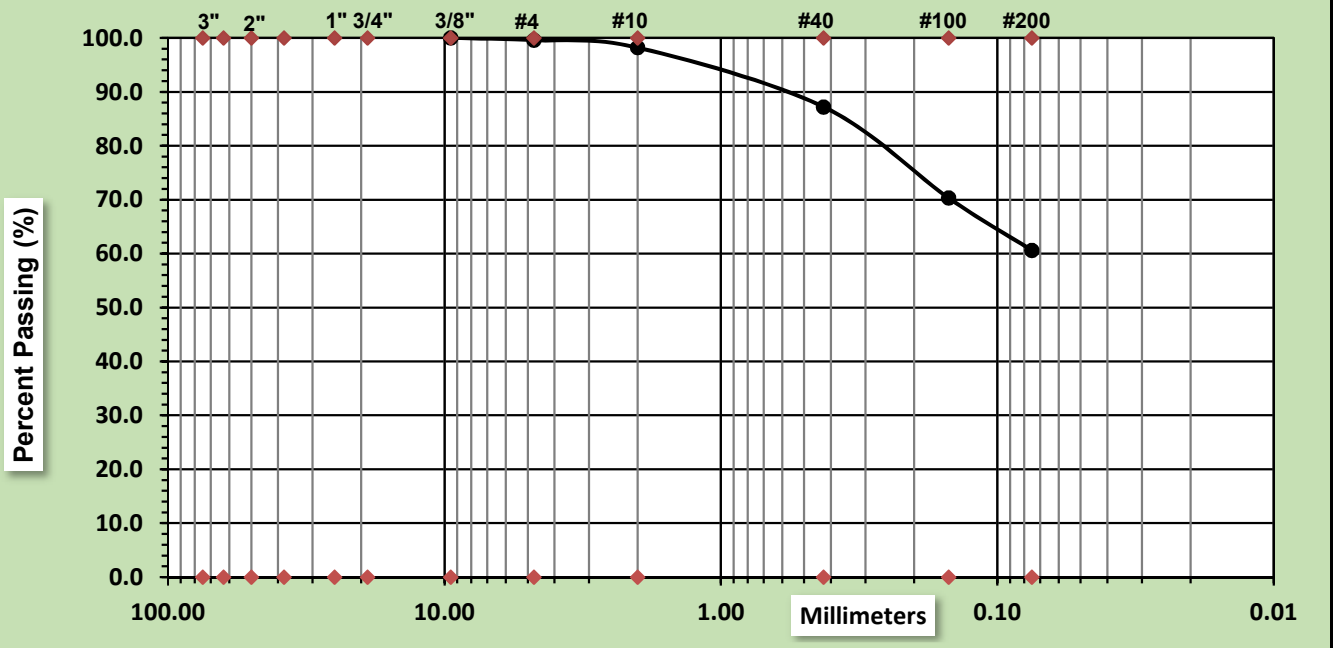
PROJECT INFORMATION

Project #:	42792	Report Date:	7/20/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/16/19 to 7/18/19
Project Location:	Goochland County, Virginia	Tested By:	MLT and KP
Client Name:	Goochland County		

SAMPLE INFORMATION

Location:	B-04	Sample #:	Bulk	Sample Date:	7/8/2019
Depth:	0 to 5 feet	Offset:	N/A	Lab Control #:	2200

Material Description: Yellow-brown, SANDY LEAN CLAY, trace gravel (CL)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 mm and > 0.005 mm
Coarse Sand	< 4.75 mm and > 2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	3/8"	Coarse Sand	1.4%	Fine Sand	26.6%
Gravel	0.4%	Medium Sand	11.0%	Silt & Clay	60.6%
Liquid Limit	48	Plastic Limit	21	Plastic Index	27
Specific Gravity	---			Moisture Content	20.4%

Description of Sand & Gravel Particles: ***Rounded*** *x* ***Angular*** *x*
Hard and Durable *x* ***Soft*** ***Weathered and Friable***

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/20/19
Technical Responsibility	*Signature*	*Position*	*Date*

Information included in this report relates only to material sampled at the time of testing.

Liquid Limit, Plastic Limit and Plasticity Index

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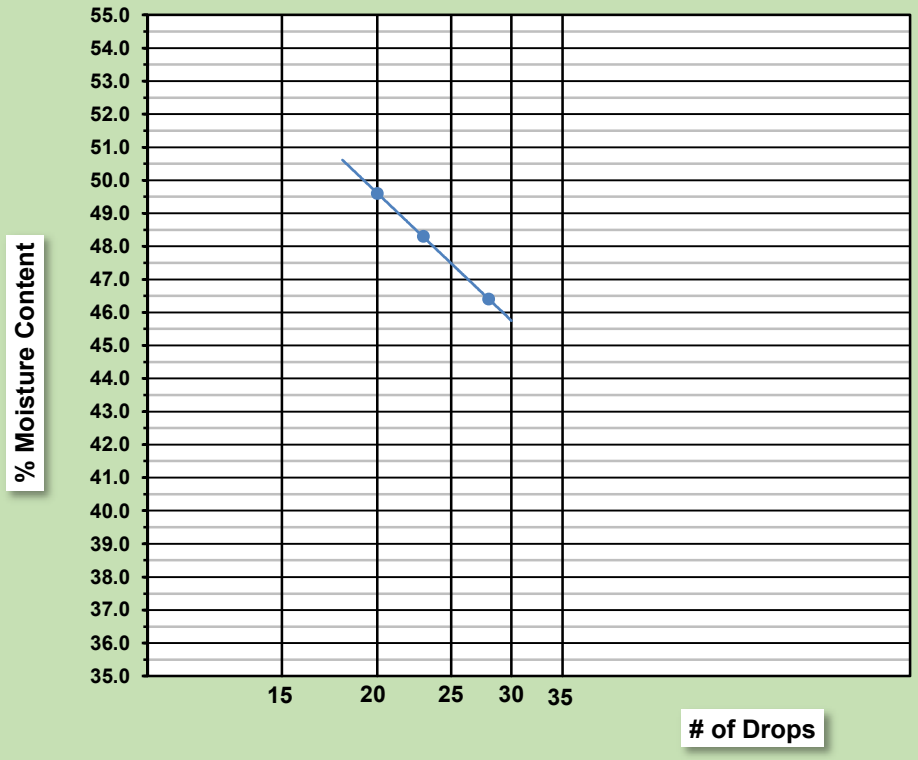
PROJECT INFORMATION

Project #:	42792	Report Date:	7/20/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/19/19 to 7/20/19
Project Location:	Goochland County, Virginia	Tested By:	MLT and KP
Client Name:	Goochland County		

SAMPLE INFORMATION

Location:	B-04	Sample #:	Bulk	Sample Date:	7/8/2019
Depth:	0 to 5 feet	Offset:	N/A	Lab Control #:	2200

Material Description: Yellow-brown, SANDY LEAN CLAY, trace gravel (CL)



Soil Properties	
As-Received Moisture Content	20.4%
Specific Gravity	---
Liquid Limit	48
Plastic Limit	21
Plastic Index	27
Group Symbol	CL
%Passing	
3"	
2.5"	
2"	
1.5"	
1"	
3/4"	
3/8"	100.0
#4	99.6
#10	98.2
#40	87.2
#100	70.3
#200	60.6

The specimen was air dried then prepared in general accordance with ASTM D4318 Section 11.2.

The Liquid Limit was determined using a Multi-Point Method with a Flat Grooving Tool.

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/20/19
Technical Responsibility	*Signature*	*Position*	*Date*

MOISTURE-DENSITY RELATIONSHIP REPORT

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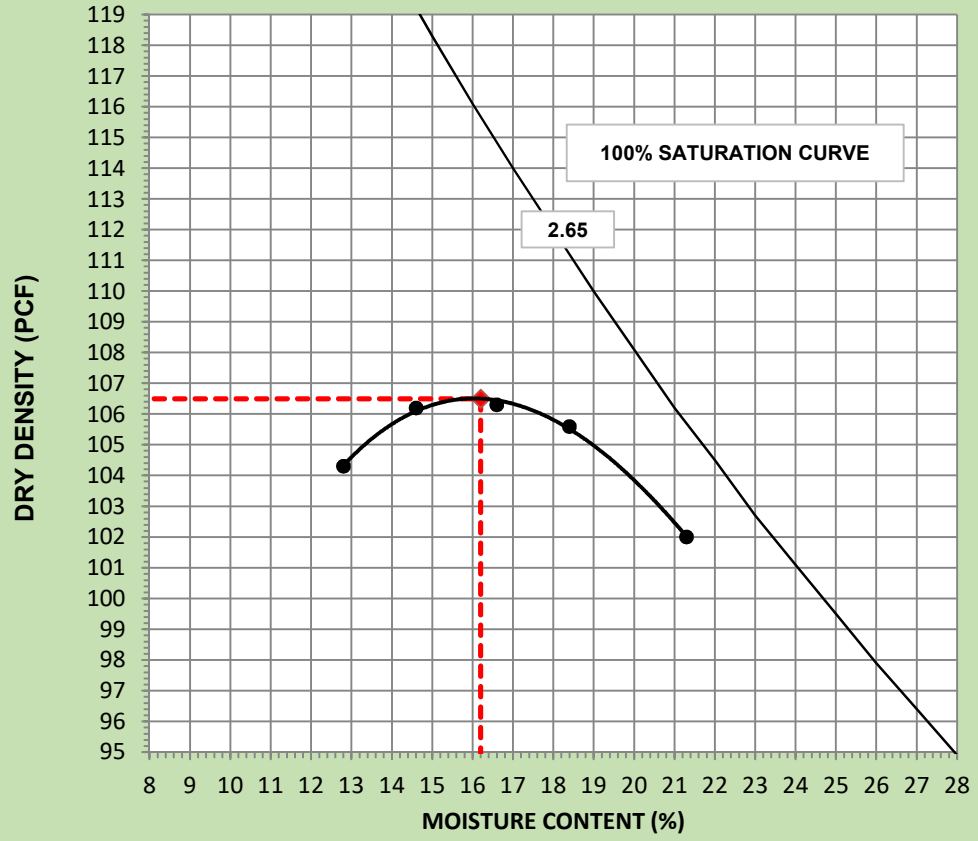
PROJECT INFORMATION			
Project #:	42792	Report Date:	7/22/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/19/19 to 7/20/19
Project Location:	Goochland County, Virginia	Tested By:	MLT and KP
Client Name:	Goochland County		

SAMPLE INFORMATION					
Location:	B-04	Sample #:	Bulk	Sample Date:	7/8/2019
Depth:	0 to 5 feet	Offset:	N/A	Lab Control #:	2200
Material Description:	Yellow-brown, SANDY LEAN CLAY, trace gravel (CL)				

Maximum Dry Density **106.5** **PCF** **Optimum Moisture Content** **16.2** **%**

ASTM D698 - Method A



Soil Properties	
As-Received Moisture Content	20.4%
Assumed Specific Gravity	2.65
Liquid Limit	48
Plastic Limit	21
Plastic Index	27
%Passing	
1.5"	
3/4"	
3/8"	100.0
No. 4	99.6
No. 10	98.2
No. 40	87.2
No. 200	60.6
Corrected Moisture-Density	
MDD (pcf)	---
OMC (%)	---
Assumed Properties of Oversize Fraction	
Sp.Gr.(OD)	---
Absorption	---

The Moisture-Density Curve Displayed relates only to material passing a No. 4 sieve.
Air-dried material passing a No. 4 sieve was compacted with a circular, manual rammer.

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/22/19
Technical Responsibility	*Signature*	*Position*	*Date*

Grain Size Analysis

ASTM D422

TIMMONS GROUP
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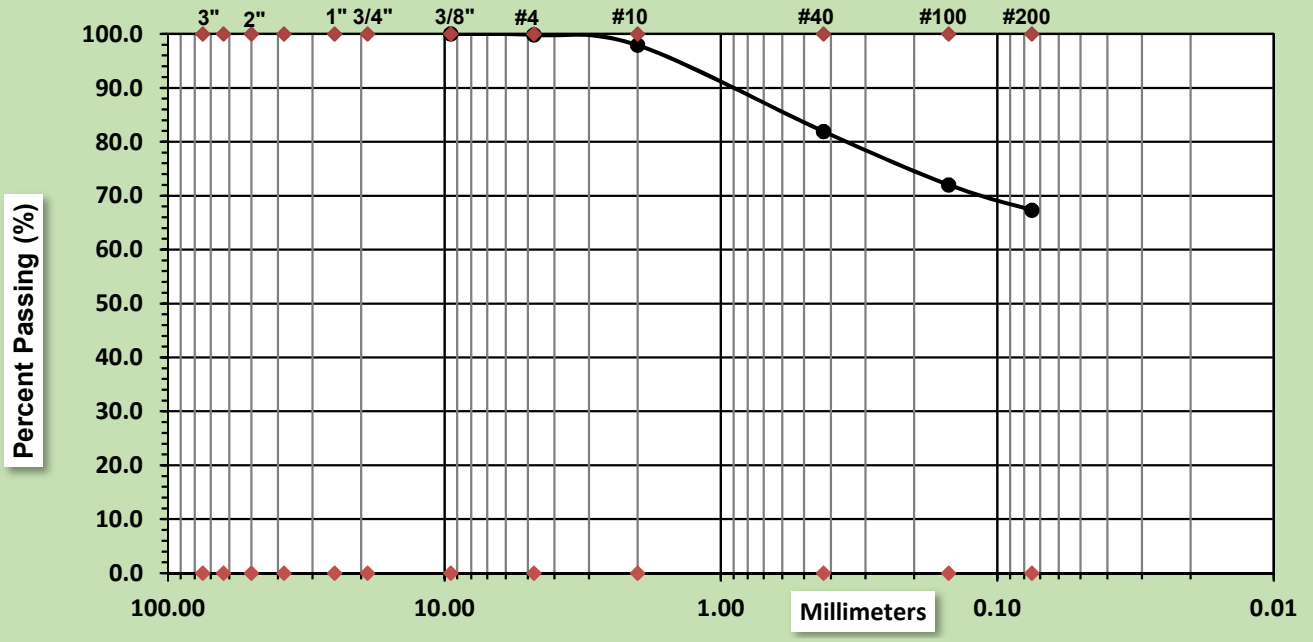
PROJECT INFORMATION

Project #:	42792	Report Date:	7/20/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/16/19 to 7/18/19
Project Location:	Goochland County, Virginia	Tested By:	MLT and KP
Client Name:	Goochland County		

SAMPLE INFORMATION

Location:	B-05	Sample #:	S-3	Sample Date:	7/8/2019
Depth:	4 to 6 feet	Offset:	N/A	Lab Control #:	2203

Material Description: Dark orange-brown and light brown, SANDY ELASTIC SILT, trace gravel (MH)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 mm and > 0.005 mm
Coarse Sand	< 4.75 mm and > 2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	3/8"	Coarse Sand	1.9%	Fine Sand	14.6%
Gravel	0.2%	Medium Sand	16.0%	Silt & Clay	67.3%
Liquid Limit	58	Plastic Limit	33	Plastic Index	25
Specific Gravity	---			Moisture Content	30.0%

Description of Sand & Gravel Particles: ***Rounded*** x ***Angular*** x

Hard and Durable x ***Soft*** ***Weathered and Friable***

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/20/19
Technical Responsibility	*Signature*	*Position*	*Date*

Information included in this report relates only to material sampled at the time of testing.

Liquid Limit, Plastic Limit and Plasticity Index

ASTM D4318

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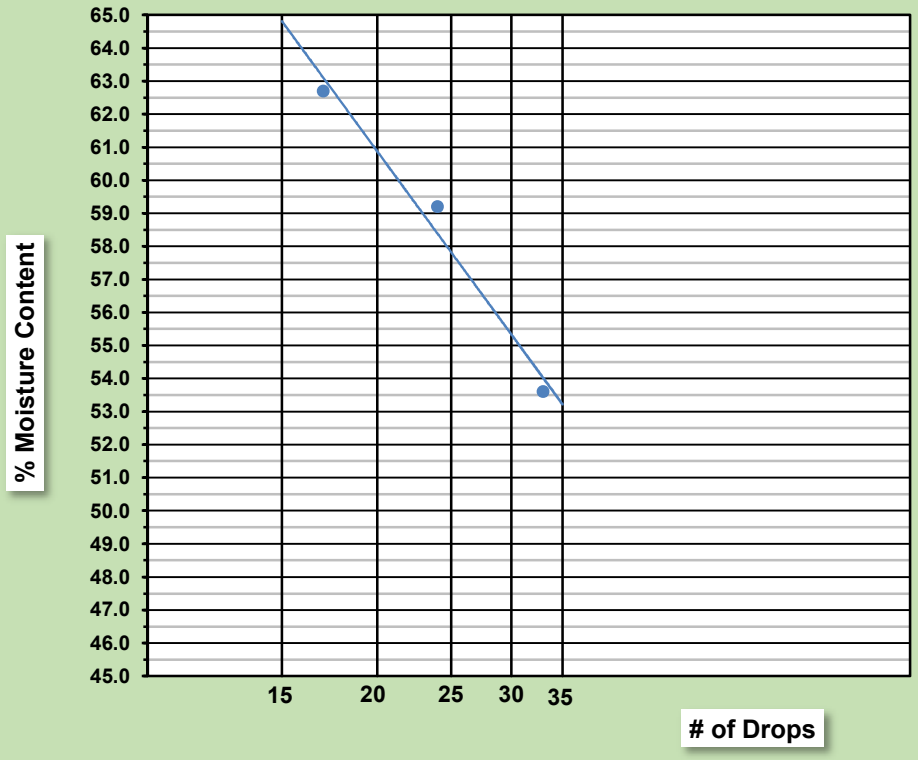
PROJECT INFORMATION

Project #:	42792	Report Date:	7/20/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/19/19 to 7/20/19
Project Location:	Goochland County, Virginia	Tested By:	Ken Pruner
Client Name:	Goochland County		

SAMPLE INFORMATION

Location:	B-05	Sample #:	S-3	Sample Date:	7/8/2019
Depth:	4 to 6 feet	Offset:	N/A	Lab Control #:	2203

Material Description: Dark orange-brown and light brown, SANDY ELASTIC SILT, trace gravel (MH)



Soil Properties	
Natural Moisture Content	30.0%
Specific Gravity	---
Liquid Limit	58
Plastic Limit	33
Plastic Index	25
Group Symbol	MH
%Passing	
3"	
2.5"	
2"	
1.5"	
1"	
3/4"	
3/8"	100.0
#4	99.8
#10	97.9
#40	81.9
#100	72.0
#200	67.3

The specimen was air dried then prepared in general accordance with ASTM D4318 Section 11.2.

The Liquid Limit was determined using a Multi-Point Method with a Flat Grooving Tool.

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/20/19
Technical Responsibility	*Signature*	*Position*	*Date*

Grain Size Analysis

ASTM D422

TIMMONS GROUP
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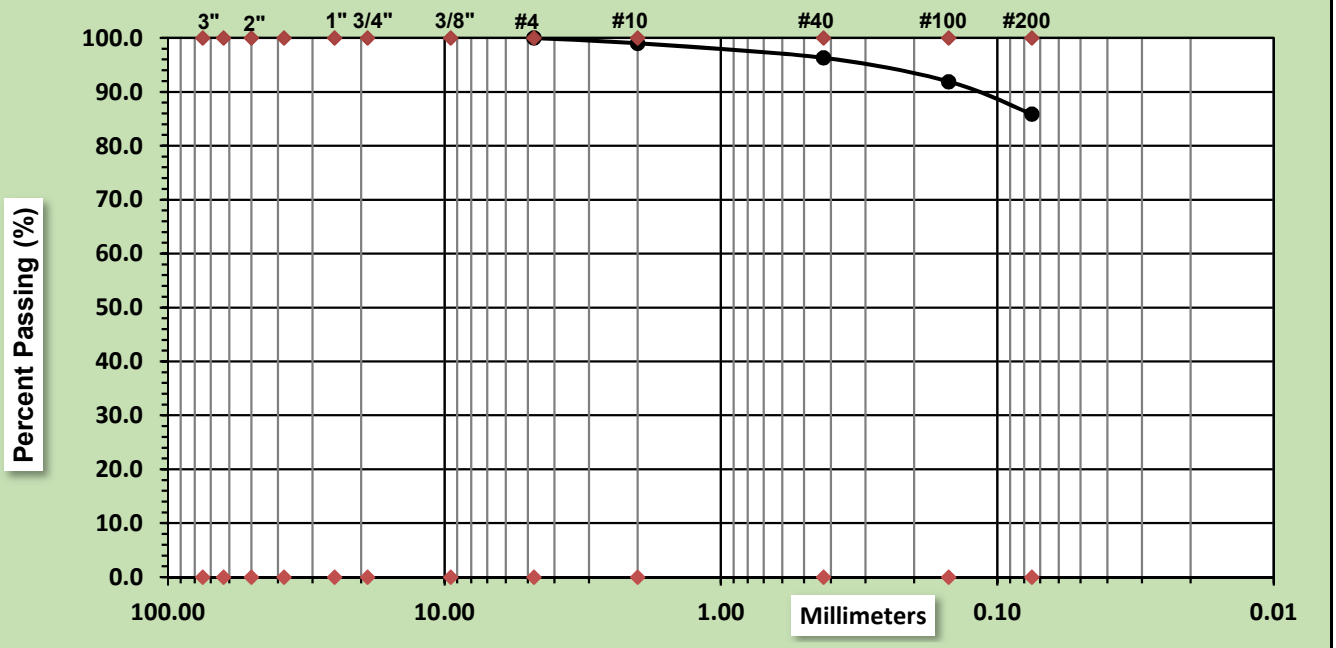
PROJECT INFORMATION

Project #:	42792	Report Date:	7/20/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/16/19 to 7/18/19
Project Location:	Goochland County, Virginia	Tested By:	MLT and KP
Client Name:	Goochland County		

SAMPLE INFORMATION

Location:	B-07	Sample #:	S-3	Sample Date:	7/12/2019
Depth:	4 to 6 feet	Offset:	N/A	Lab Control #:	2204

Material Description: Orange-brown, ELASTIC SILT, trace sand (MH)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 mm and > 0.005 mm
Coarse Sand	< 4.75 mm and > 2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	#4	Coarse Sand	1.0%	Fine Sand	10.4%
Gravel	0.0%	Medium Sand	2.7%	Silt & Clay	85.9%
Liquid Limit	52	Plastic Limit	34	Plastic Index	18
Specific Gravity	---			Moisture Content	25.2%

Description of Sand & Gravel Particles: ***Rounded*** x ***Angular*** x

Hard and Durable x ***Soft*** ***Weathered and Friable***

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/20/19
Technical Responsibility	*Signature*	*Position*	*Date*

Information included in this report relates only to material sampled at the time of testing.

Liquid Limit, Plastic Limit and Plasticity Index

ASTM D4318

TIMMONS GROUP
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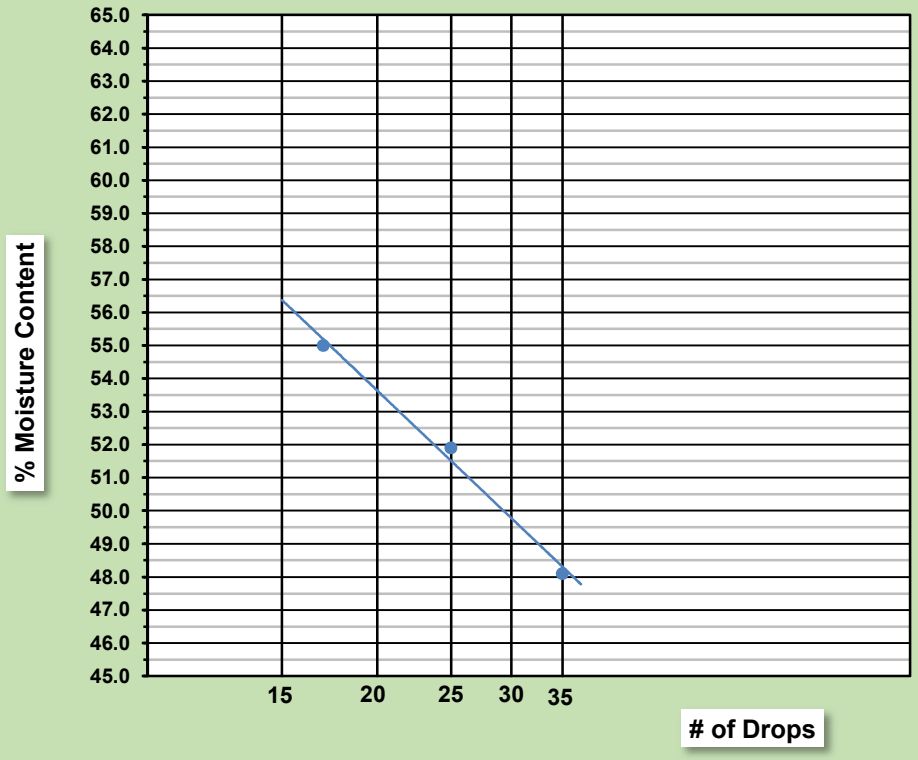
PROJECT INFORMATION

Project #:	42792	Report Date:	7/20/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/19/19 to 7/20/19
Project Location:	Goochland County, Virginia	Tested By:	Ken Pruner
Client Name:	Goochland County		

SAMPLE INFORMATION

Location:	B-07	Sample #:	S-3	Sample Date:	7/12/2019
Depth:	4 to 6 feet	Offset:	N/A	Lab Control #:	2204

Material Description: Orange-brown, ELASTIC SILT, trace sand (MH)



Soil Properties	
Natural Moisture Content	25.2%
Specific Gravity	---
Liquid Limit	52
Plastic Limit	34
Plastic Index	18
Group Symbol	MH
%Passing	
3"	
2.5"	
2"	
1.5"	
1"	
3/4"	
3/8"	
#4	100.0
#10	99.0
#40	96.3
#100	91.9
#200	85.9

The specimen was air dried then prepared in general accordance with ASTM D4318 Section 11.2.

The Liquid Limit was determined using a Multi-Point Method with a Flat Grooving Tool.

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/20/19
Technical Responsibility	*Signature*	*Position*	*Date*

Grain Size Analysis

ASTM D422

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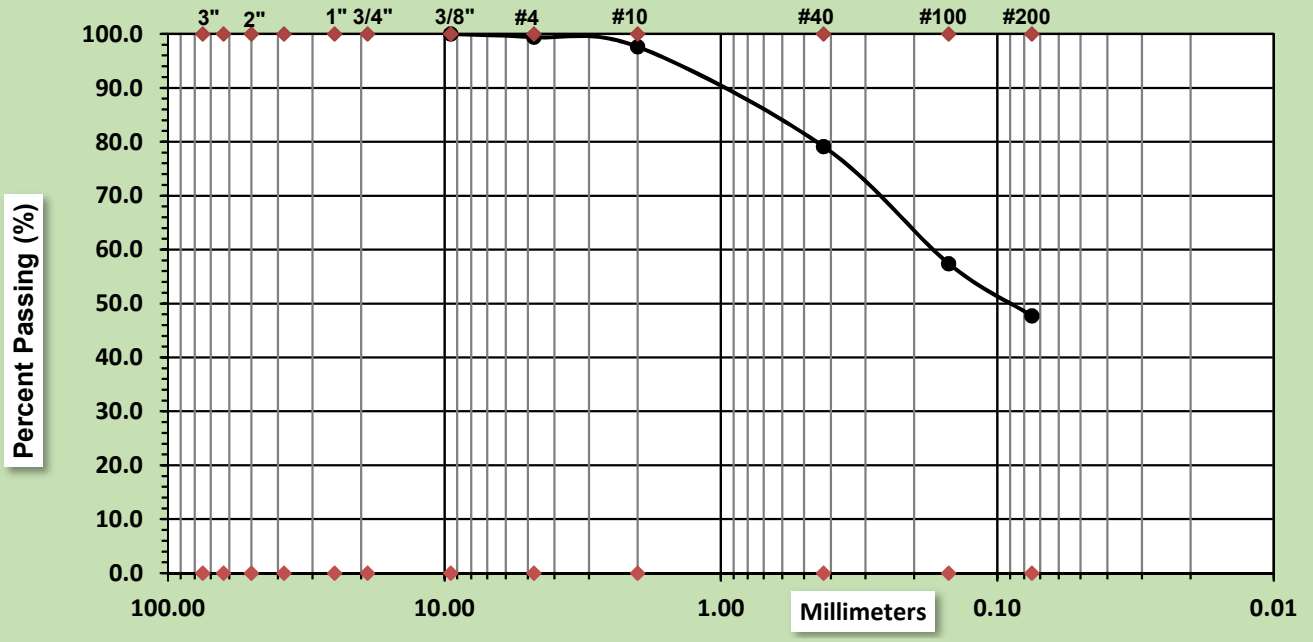
PROJECT INFORMATION

Project #:	42792	Report Date:	7/20/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/16/19 to 7/18/19
Project Location:	Goochland County, Virginia	Tested By:	MLT and KP
Client Name:	Goochland County		

SAMPLE INFORMATION

Location:	B-08	Sample #:	Bulk	Sample Date:	7/8/2019
Depth:	0 to 5 feet	Offset:	N/A	Lab Control #:	2201

Material Description: Brown, fine to coarse CLAYEY SAND, trace gravel (SC)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 mm and > 0.005 mm
Coarse Sand	< 4.75 mm and > 2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	3/8"	Coarse Sand	1.8%	Fine Sand	31.4%
Gravel	0.6%	Medium Sand	18.5%	Silt & Clay	47.7%
Liquid Limit	44	Plastic Limit	26	Plastic Index	18
Specific Gravity	---			Moisture Content	15.5%

Description of Sand & Gravel Particles: ***Rounded*** ***Angular*** *x*
Hard and Durable *x* ***Soft*** *x* ***Weathered and Friable***

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/20/19
Technical Responsibility	*Signature*	*Position*	*Date*

Information included in this report relates only to material sampled at the time of testing.

Liquid Limit, Plastic Limit and Plasticity Index

ASTM D4318

TIMMONS GROUP
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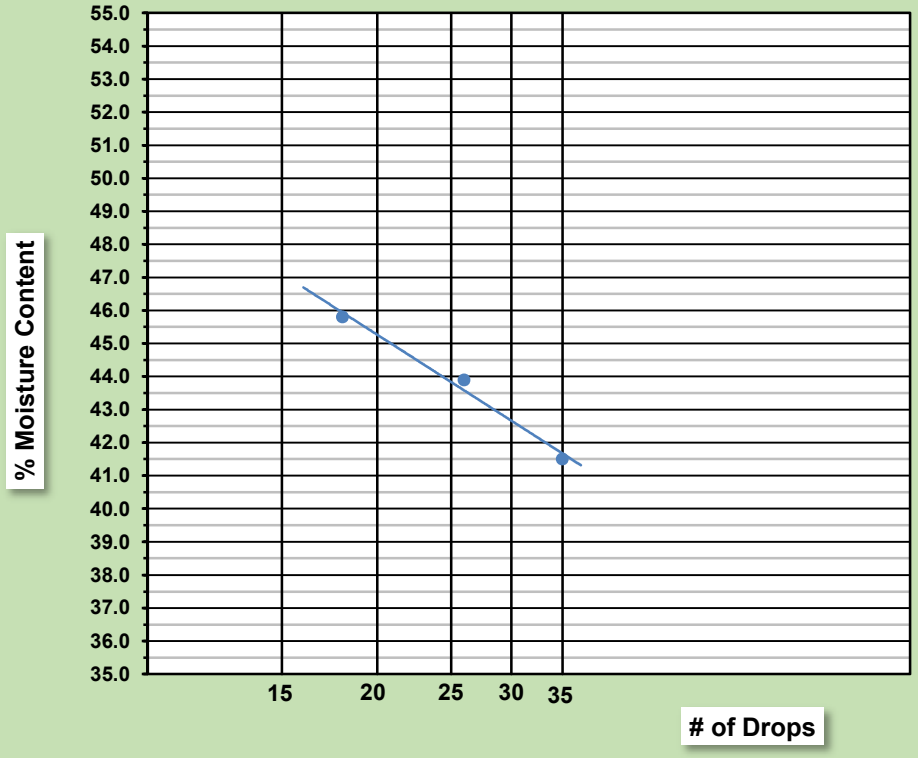
PROJECT INFORMATION

Project #:	42792	Report Date:	7/20/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/19/19 to 7/20/19
Project Location:	Goochland County, Virginia	Tested By:	Ken Pruner
Client Name:	Goochland County		

SAMPLE INFORMATION

Location:	B-08	Sample #:	Bulk	Sample Date:	7/8/2019
Depth:	0 to 5 feet	Offset:	N/A	Lab Control #:	2201

Material Description: Brown, fine to coarse CLAYEY SAND, trace gravel (SC)



Soil Properties	
As-Received Moisture Content	15.5%
Specific Gravity	---
Liquid Limit	44
Plastic Limit	26
Plastic Index	18
Group Symbol	CL
%Passing	
3"	
2.5"	
2"	
1.5"	
1"	
3/4"	
3/8"	100.0
#4	99.4
#10	97.6
#40	79.1
#100	57.4
#200	47.7

The specimen was air dried then prepared in general accordance with ASTM D4318 Section 11.2.

The Liquid Limit was determined using a Multi-Point Method with a Flat Grooving Tool.

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/20/19
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-Compaction
Revision No. 1.1
Revision Date: 05/18/18

MOISTURE-DENSITY RELATIONSHIP REPORT

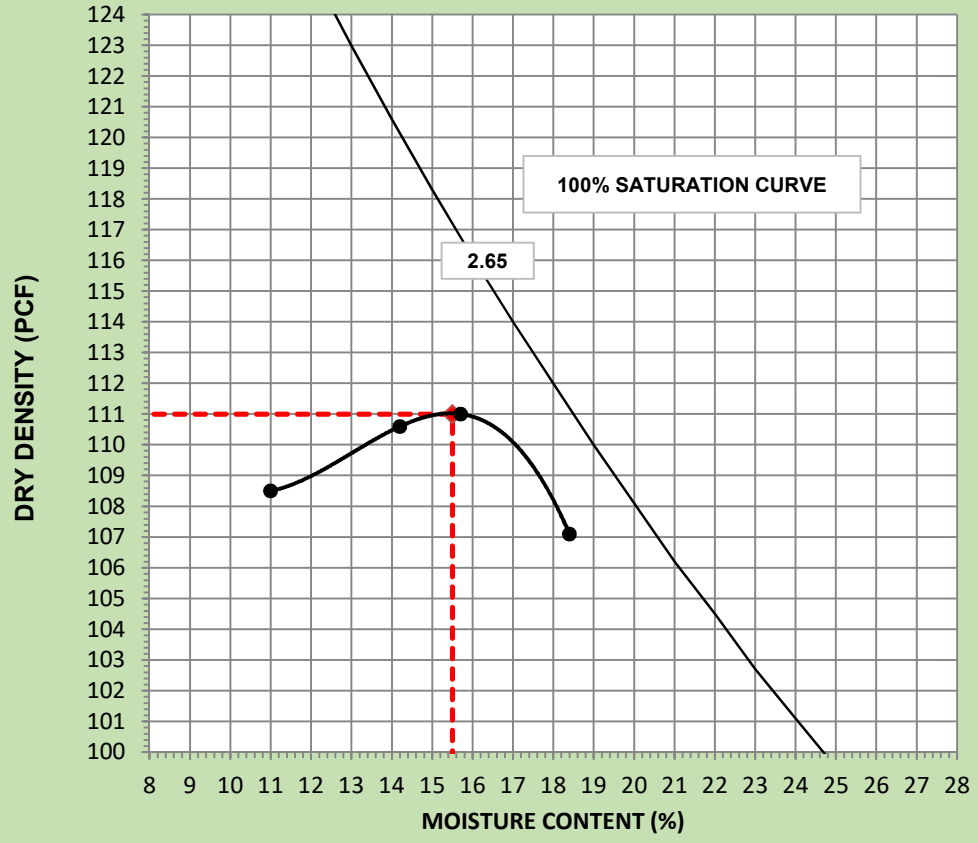
TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

PROJECT INFORMATION			
Project #:	42792	Report Date:	7/20/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/19/19 to 7/20/19
Project Location:	Goochland County, Virginia	Tested By:	MLT and KP
Client Name:	Goochland County		

SAMPLE INFORMATION					
Location:	B-08	Sample #:	Bulk	Sample Date:	7/8/2019
Depth:	0 to 5 feet	Offset:	N/A	Lab Control #:	2201
Material Description:	Brown, fine to coarse CLAYEY SAND, trace gravel (SC)				

Maximum Dry Density **111.0** **PCF** **Optimum Moisture Content** **15.5** **%**

ASTM D698 - Method A



Soil Properties	
As-Received Moisture Content	15.5%
Assumed Specific Gravity	2.65
Liquid Limit	44
Plastic Limit	26
Plastic Index	18
%Passing	
1.5"	
3/4"	
3/8"	100.0
No. 4	99.4
No. 10	97.6
No. 40	79.1
No. 200	47.7
Corrected Moisture-Density	
MDD (pcf)	---
OMC (%)	---
Assumed Properties of Oversize Fraction	
Sp.Gr.(OD)	---
Absorption	---

The Moisture-Density Curve Displayed relates only to material passing a No. 4 sieve.
Air-dried material passing a No. 4 sieve was compacted with a circular, manual rammer.

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/20/19
Technical Responsibility	*Signature*	*Position*	*Date*

Grain Size Analysis

ASTM D422

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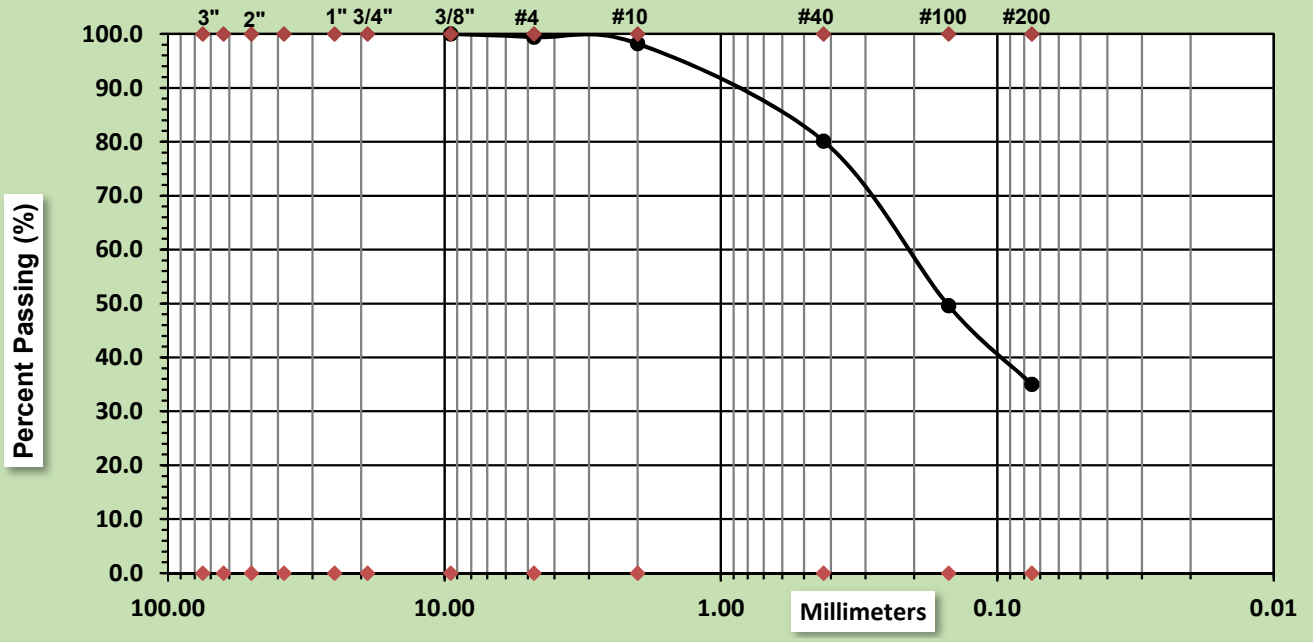
PROJECT INFORMATION

Project #:	42792	Report Date:	7/20/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/16/19 to 7/18/19
Project Location:	Goochland County, Virginia	Tested By:	MLT and KP
Client Name:	Goochland County		

SAMPLE INFORMATION

Location:	B-11	Sample #:	Bulk	Sample Date:	7/8/2019
Depth:	0 to 5 feet	Offset:	N/A	Lab Control #:	2202

Material Description: Gray, fine to coarse SILTY SAND, trace gravel (SM)



Cobbles	< 300 mm (12") and > 75 mm (3")	Fine Sand	< 0.425 mm and > 0.075 mm (#200)
Gravel	< 75 mm and > 4.75 mm (#4)	Silt	< 0.075 mm and > 0.005 mm
Coarse Sand	< 4.75 mm and > 2.00 mm (#10)	Clay	< 0.005 mm
Medium Sand	< 2.00 mm and > 0.425 mm (#40)	Colloids	< 0.001 mm

Maximum Particle Size	3/8"	Coarse Sand	1.2%	Fine Sand	45.1%
Gravel	0.6%	Medium Sand	18.1%	Silt & Clay	35.0%
Liquid Limit	14	Plastic Limit	13	Plastic Index	1
Specific Gravity	---			Moisture Content	21.4%

Description of Sand & Gravel Particles: ***Rounded*** *x* ***Angular***
Hard and Durable *x* ***Soft*** ***Weathered and Friable***

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/20/19
Technical Responsibility	*Signature*	*Position*	*Date*

Liquid Limit, Plastic Limit and Plasticity Index

ASTM D4318

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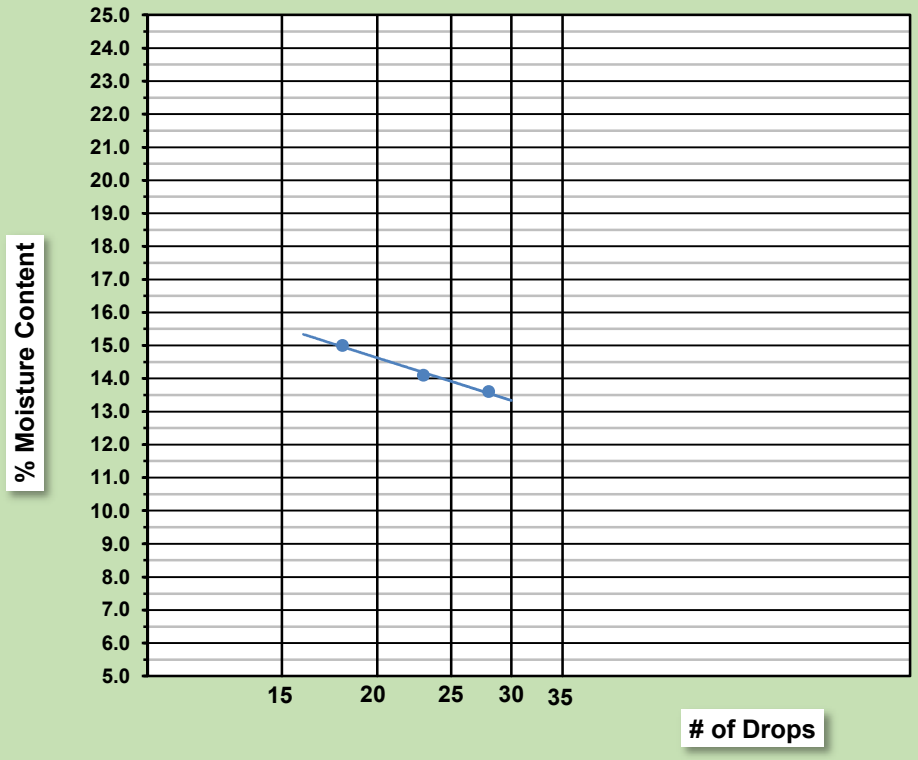
PROJECT INFORMATION

Project #:	42792	Report Date:	7/20/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/19/19 to 7/20/19
Project Location:	Goochland County, Virginia	Tested By:	Ken Pruner
Client Name:	Goochland County		

SAMPLE INFORMATION

Location:	B-11	Sample #:	Bulk	Sample Date:	7/8/2019
Depth:	0 to 5 feet	Offset:	N/A	Lab Control #:	2202

Material Description: Gray, fine to coarse SILTY SAND, trace gravel (SM)



Soil Properties	
As-Received Moisture Content	21.4%
Specific Gravity	---
Liquid Limit	14
Plastic Limit	13
Plastic Index	1
Group Symbol	ML
%Passing	
3"	
2.5"	
2"	
1.5"	
1"	
3/4"	
3/8"	100.0
#4	99.4
#10	98.2
#40	80.1
#100	49.6
#200	35.0

The specimen was air dried then prepared in general accordance with ASTM D4318 Section 11.2.

The Liquid Limit was determined using a Multi-Point Method with a Flat Grooving Tool.

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/20/19
Technical Responsibility	*Signature*	*Position*	*Date*

Form No. TR-Compaction
Revision No. 1.1
Revision Date: 05/18/18

MOISTURE-DENSITY RELATIONSHIP REPORT

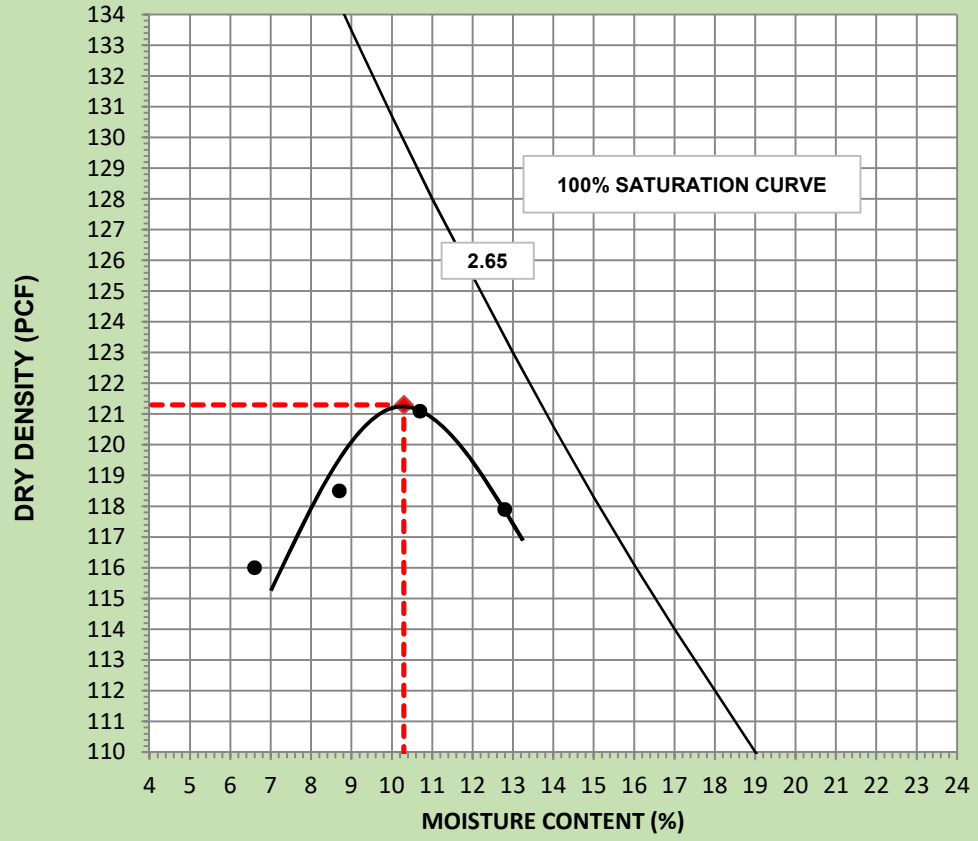
TIMMONS GROUP
YOUR VISION ACHIEVED THROUGH OURS.

PROJECT INFORMATION			
Project #:	42792	Report Date:	7/20/2019
Project Name:	Hickory Haven/Samary Forest Sewer Design	Test Date(s):	7/19/19 to 7/20/19
Project Location:	Goochland County, Virginia	Tested By:	MLT and KP
Client Name:	Goochland County		

SAMPLE INFORMATION					
Location:	B-11	Sample #:	Bulk	Sample Date:	7/8/2019
Depth:	0 to 5 feet	Offset:	N/A	Lab Control #:	2202
Material Description:	Gray, fine to coarse SILTY SAND, trace gravel (SM)				

Maximum Dry Density **121.3** **PCF** **Optimum Moisture Content** **10.3** **%**

ASTM D698 - Method A



Soil Properties	
As-Received Moisture Content	21.4%
Assumed Specific Gravity	2.65
Liquid Limit	14
Plastic Limit	13
Plastic Index	1
%Passing	
1.5"	
3/4"	
3/8"	100.0
No. 4	99.4
No. 10	98.2
No. 40	80.1
No. 200	35.0
Corrected Moisture-Density	
MDD (pcf)	---
OMC (%)	---
Assumed Properties of Oversize Fraction	
Sp.Gr.(OD)	---
Absorption	---

The Moisture-Density Curve Displayed relates only to material passing a No. 4 sieve.
Air-dried material passing a No. 4 sieve was compacted with a circular, manual rammer.

References / Comments / Deviations:

Matthew Thornton	Matthew Thornton	Laboratory Manager	7/20/19
Technical Responsibility	*Signature*	*Position*	*Date*

APPENDIX D

GEOPHYSICAL REPORT

Geophysical Survey
Hickory Haven and Samary Forest
Holly Lane and Whippoorwill Road
Manakin-Sabot, Virginia

Prepared For:

Timmons Group

1001 Boulders Parkway, Suite 300
Richmond, Virginia 23225

Prepared By:

Forrest Environmental Services, Inc.

3057 Crosen Court
Oak Hill, Virginia 20171
(703) 648-9090

August 2019

FES Project No. 19197

Table of Contents

List of Figures

1.0 Introduction

Forrest Environmental Services, Inc. (FES) performed a geophysical survey at Hickory Haven and Samary Forest located on Holly Lane and Whippoorwill Road in Manakin-Sabote, Virginia on the 30th and 31st July 2019 and 5th and 6th August 2019. The survey consisted of a seismic refraction survey (SR) to determine depth to bedrock and bedrock rippability.

13 seismic refraction (SR) lines were conducted at the site. The SR survey covered approximately 4,600 linear feet.

The geophone spacing was 10 feet and used 24 geophones for the SR lines 1 through 8. The total distance of SR lines 1 through 13 was approximately 250 feet during collection.

The Hickory Haven site is located within the Piedmont Physiographic Province of Virginia. The site geology includes the Mylonite Gneiss. No bedrock outcrops or float were observed during the section. The site consists of grass field.

Topographically, the site slopes downhill mostly to the south. Survey locations and physical features are shown in Figure 1. Details of the geophysical survey are described in the following sections

2.0 Equipment and Procedures

Seismic refraction theory is based upon the physical characteristics of compressional waves as they travel through the subsurface. The velocity of these waves is dependent upon the density of the travel medium.

Seismic refraction measures density, thickness, and depth of geological strata using sound (acoustic) waves transmitted into the subsurface. Sound waves travel at different velocities in various soils and rocks and are refracted at the interface between layers. Geophones receive the vibrations of the sound energy and translate them to electrical signals. The signals are displayed on a seismograph.

Refraction soundings use the travel times of compressional sound waves (P-Waves) to determine depth to bedrock, the thicknesses, and velocities of subsurface materials. Refraction sounding is based on measuring the first-arrival travel time from the sound source to the geophone. The first-arrival time versus distance to the geophone is plotted and the data is inverted into a model of subsurface velocities.

The seismic refraction survey used a 24-channel Geode Seismograph that was connecting to a laptop which collected data from a geophone spread consisting of 24 10-Hertz geophones. The source was a 12-pound hammer striking an aluminum plate and stacked 6 to 8 times at five different positions per array. Seismic lines 1 through 13 used geophones at 10 foot intervals. Line 1 through 13 sources were placed at 10 feet from each end at stations 0 feet and 250 feet and three sources at the middle of the seismic array at stations 65 feet, 125 feet, and 185 feet.

3.0 Interpretation Methods

The seismic refraction method is based on three important assumptions:

- Acoustic velocity increases with depth;
- Sufficient acoustic velocity contrast exists between layers to allow differentiation between adjacent strata of interest; and
- The layers have sufficient thickness to permit detection.

Time versus distance plots of the first-arrival sound waves were used to locate depth of bedrock. The inverse of the slope of the time versus distance curves is the velocity of the strata.

Filters, sampling intervals, etc., were all performed in field. The raw data was reduced and interpreted using WinSIP Software (Rimrock Geophysics, Inc.). WinSIP aids in determining "first picks". Rayfract Seismic Refraction Tomography Software (Intelligent Resources, Inc.) was used to calculate arrival times, constructing time vs. distance graphs, and forming seismic cross-sections. The ground surface elevations were determined by interpolating between contours from a USGS topographic quadrangle map.

Typical seismic overburden seismic velocities are approximately less than 2,500 feet/second (purple). Weathered or soft rock seismic velocities typically range from 2,500 to 5,000 feet per second (blue and green). Bedrock velocities typically measure greater than 5,000 feet per second (yellow to red).

4.0 Survey Results

The objective of the SR survey was to locate determine depth to bedrock and bedrock rippability.

SR Line 1 indicates depth to bedrock about 10 feet below ground surface at approximately 140 feet East to about 30 feet below ground surface at approximately 1,050 feet East (Figure 2).

SR Line 2 indicates depth to bedrock about 20 feet below ground surface at approximately 0 feet North to about 25 feet below ground surface at approximately 210 feet North (Figure 3).

SR Line 3 indicates depth to bedrock appears to be about 45 feet below ground surface at approximately 0 feet East to about 35 feet at approximately 220 feet East (Figure 4).

SR Line 4 indicates depth to bedrock appears to be about 12 feet to 18 feet below ground surface (Figure 5).

SR Line 5 indicates depth to bedrock appears to be about 10 feet below ground surface (Figure 6).

SR Line 6 indicates depth to bedrock about 15 feet to 20 feet below ground surface (Figure 7).

SR Line 7 indicates depth to bedrock appears to be about 10 feet at approximately 110 feet East to about 20 feet below ground surface at approximately 440 feet East (Figure 8).

SR Line 8 indicates depth to bedrock appears to be about 20 feet at approximately 50 feet East to about 35 feet below ground surface at approximately 180 feet East (Figure 9).

SR Line 9 indicates depth to bedrock appears to be about 60 feet below ground surface (Figure 10).

SR Line 10 indicates depth to bedrock appears to be about 16 feet to 20 feet below ground surface (Figure 11).

SR Line 11 indicates depth to bedrock appears to be about 40 feet at approximately 250 feet East to about 60 feet below ground surface at approximately 70 feet East (Figure 12).

SR Line 12 indicates depth to bedrock appears to be about 20 feet to 25 feet below ground surface (Figure 13).

SR Line 13 indicates depth to bedrock appears to be about 20 feet below ground surface (Figure 14).

The geophysical survey indicated depth to bedrock to be about 10 feet below ground surface at the eastern section of Holly Lane to about 70 feet below ground surface south of Whippoorwill Road. Bedrock appears to be typically require removal by blasting, ripping, or hoe-ramming, rock trenching/sawing or other suitable rock excavation methods.

Photo 1 - SR Line 10

Forrest Environmental Services, Inc.

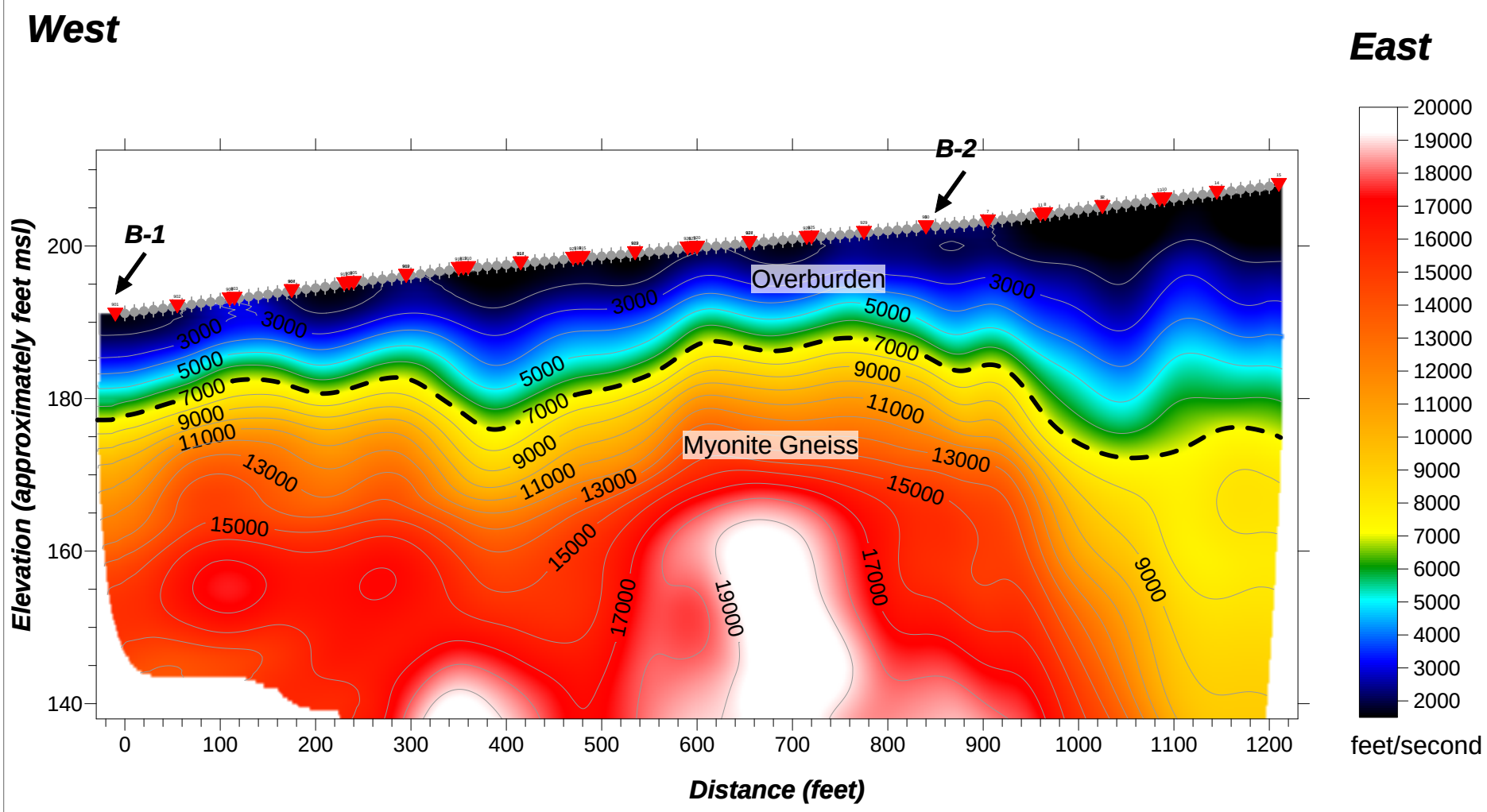
Oak Hill, Virginia

(703) 648-9090

www.fesinc.net

DATE: August 2019	SCALE: 1 inch ~ 500 ft	TITLE: ***Geophysical Site Map Hickory Haven and Samary Forest Holly Land and Whippoorwill Road Manakin-Sabot, Virginia***	
DRAWN BY:	APPROVED BY:		
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF1	CLIENT: Timmons Group	FIGURE: **1**

SR Line 1 RMS error 0.8%=0.38ms 20 WET iters. 50Hz Width 3.0% initial GRADIENT.GRD Vers. 3.35



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Oak Hill, Virginia
(703) 648-9090
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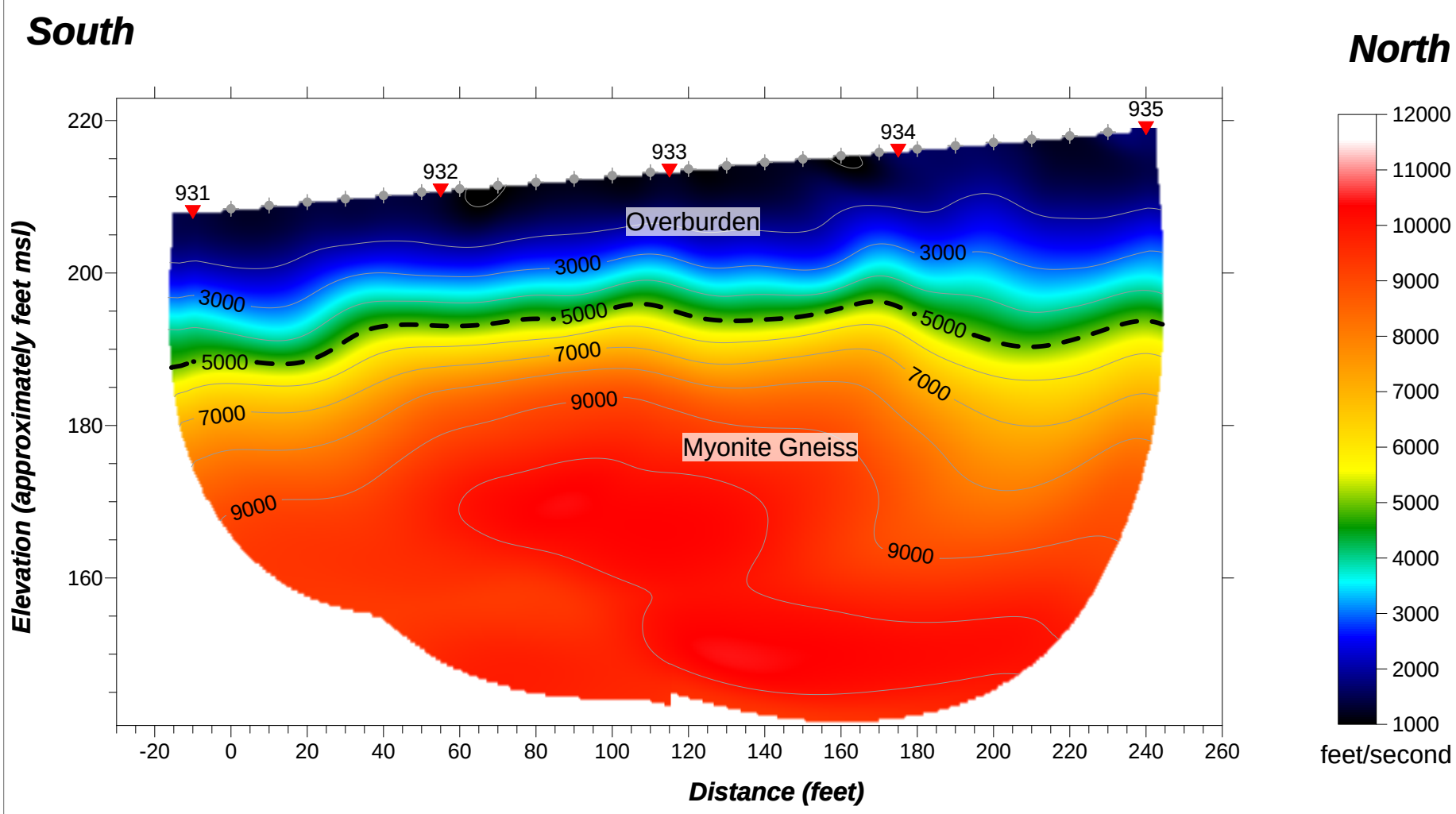
DATE: August 2019	SCALE: shown	TITLE: ***SR Line 1***	
DRAWN BY:	APPROVED BY:	***Hickory Haven and Samary Forest***	
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF2	***Holly Lane***	
CLIENT: Timmons Group		***Manakin-Sabot, Virginia***	FIGURE: **2**

SR Line2 RMS error 0.9%=0.42ms 20 WET iters. 50Hz Width 3.5% initial GRADIENT.GRD Vers. 3.35



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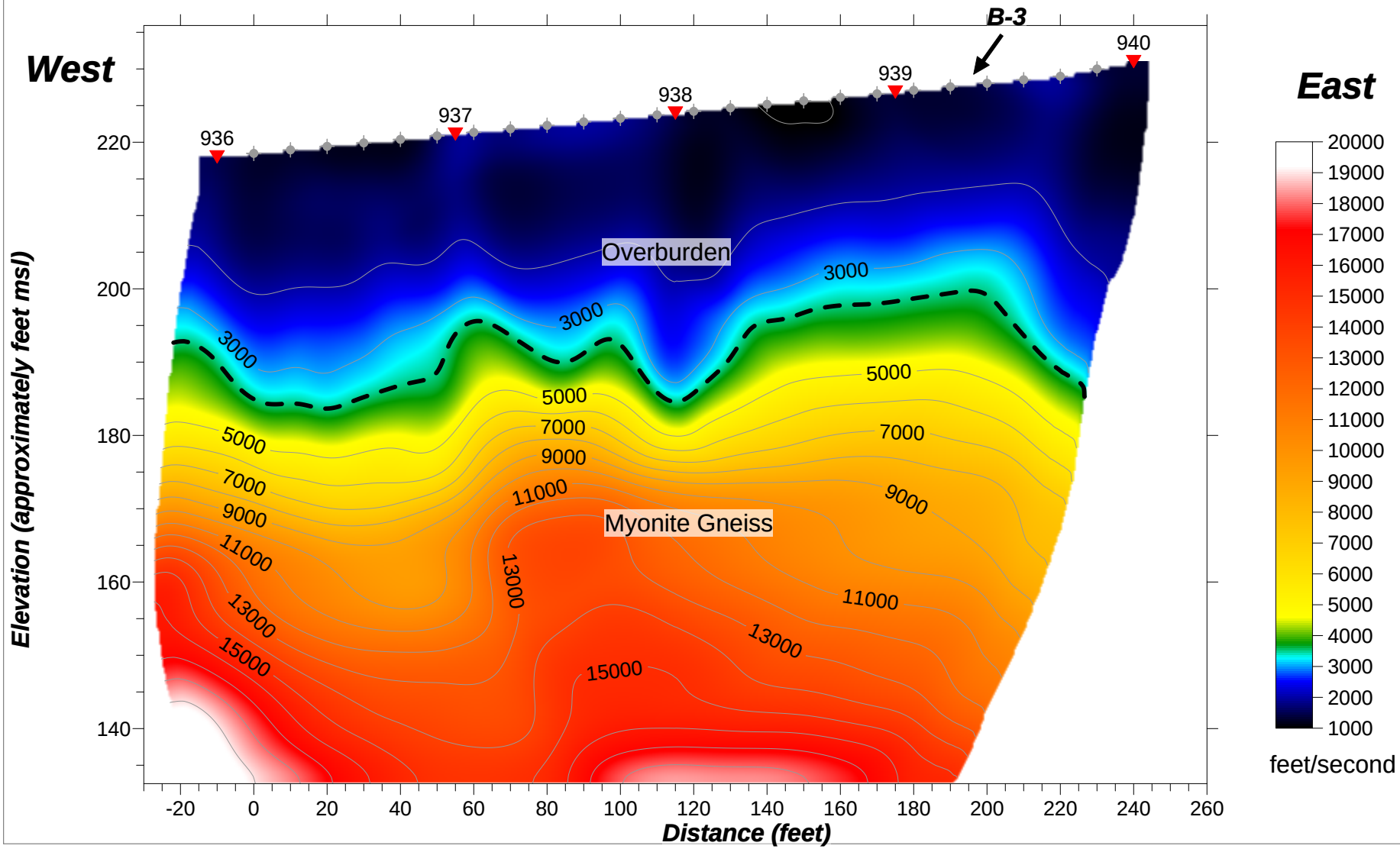
DATE: August 2019	SCALE: shown	TITLE: ***SR Line 2***	
DRAWN BY:	APPROVED BY:	***Hickory Haven and Samary Forest***	
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF3	***Birch Road***	
CLIENT: Timmons Group		***Manakin-Sabot, Virginia***	FIGURE: **3**

SR Line 3 RMS error 1.8%=1.29ms 20 WET iters. 50Hz Width 4.0% initial GRADIENT.GRD Vers. 3.35



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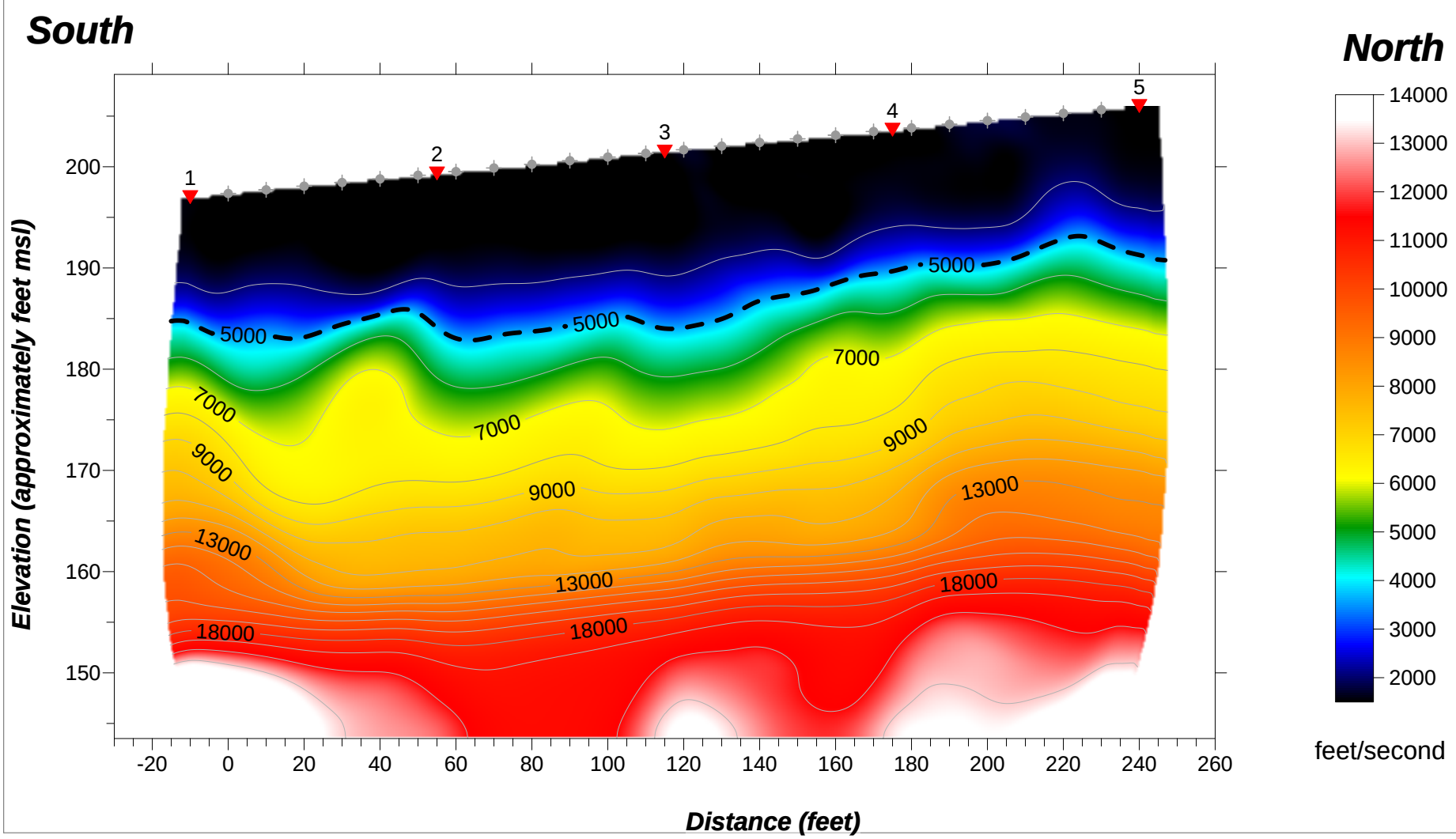
DATE: August 2019	SCALE: shown	TITLE: ***SR Line 3***	
DRAWN BY:	APPROVED BY:	***Hickory Haven and Samary Forest***	
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF4	***Cedar Circle***	
CLIENT: Timmons Group	FIGURE: **4**	***Manakin-Sabot, Virginia***	

SR Line 4 RMS error 0.9%=0.58ms 20 WET iters. 50Hz Width 4.0% initial GRADIENT.GRD Vers. 3.35



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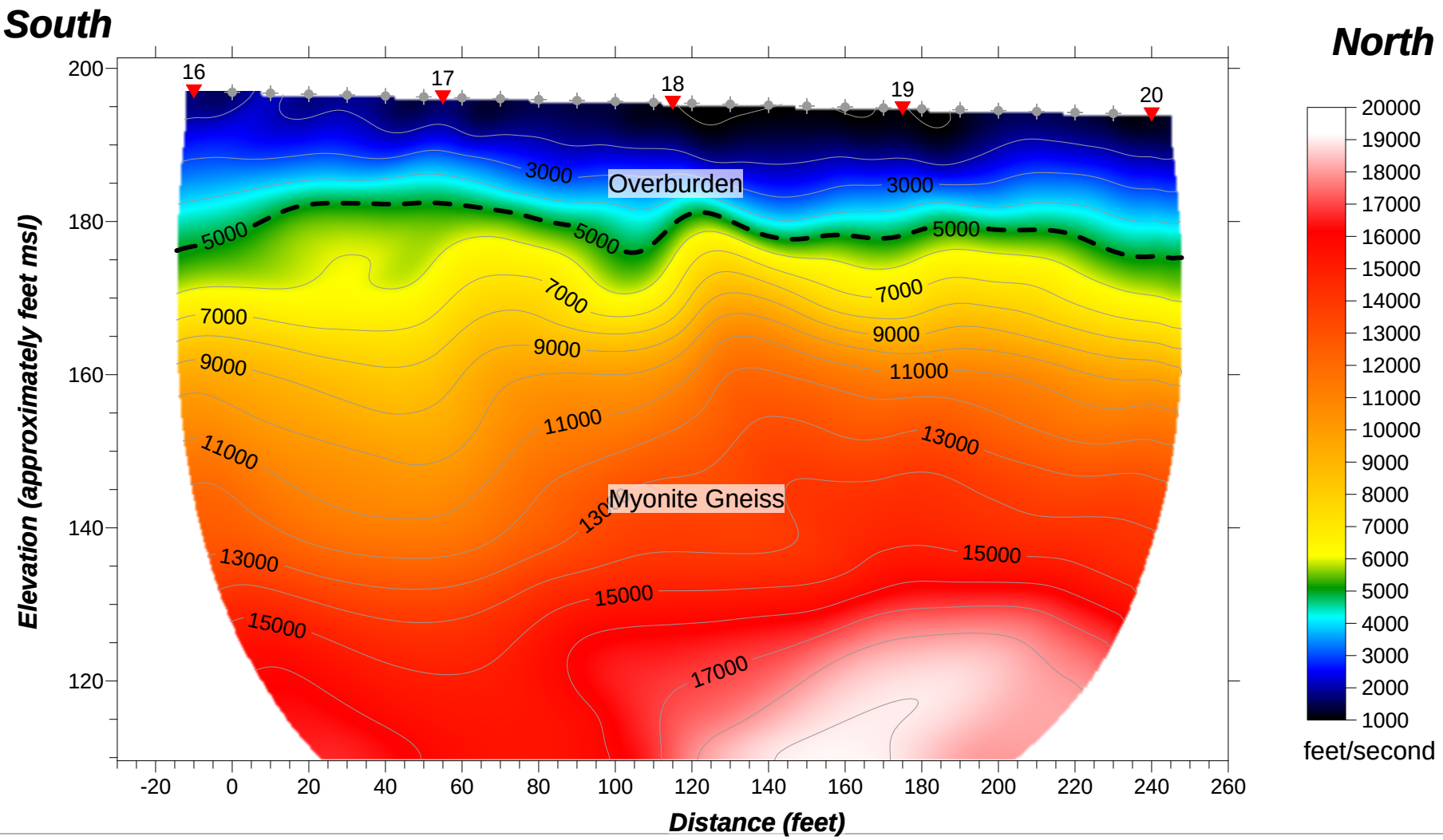
DATE: August 2019	SCALE: shown	TITLE: ***SR Line 4 Hickory Haven and Samary Forest Holly Lane Manakin-Sabot, Virginia***	
DRAWN BY:	APPROVED BY:		
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF5	CLIENT: Timmons Group	FIGURE: **5**

SR Line 5 RMS error 0.9%=0.33ms 20 WET iters. 50Hz Width 3.0% initial GRADIENT.GRD Vers. 3.35



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(703) 648-9090
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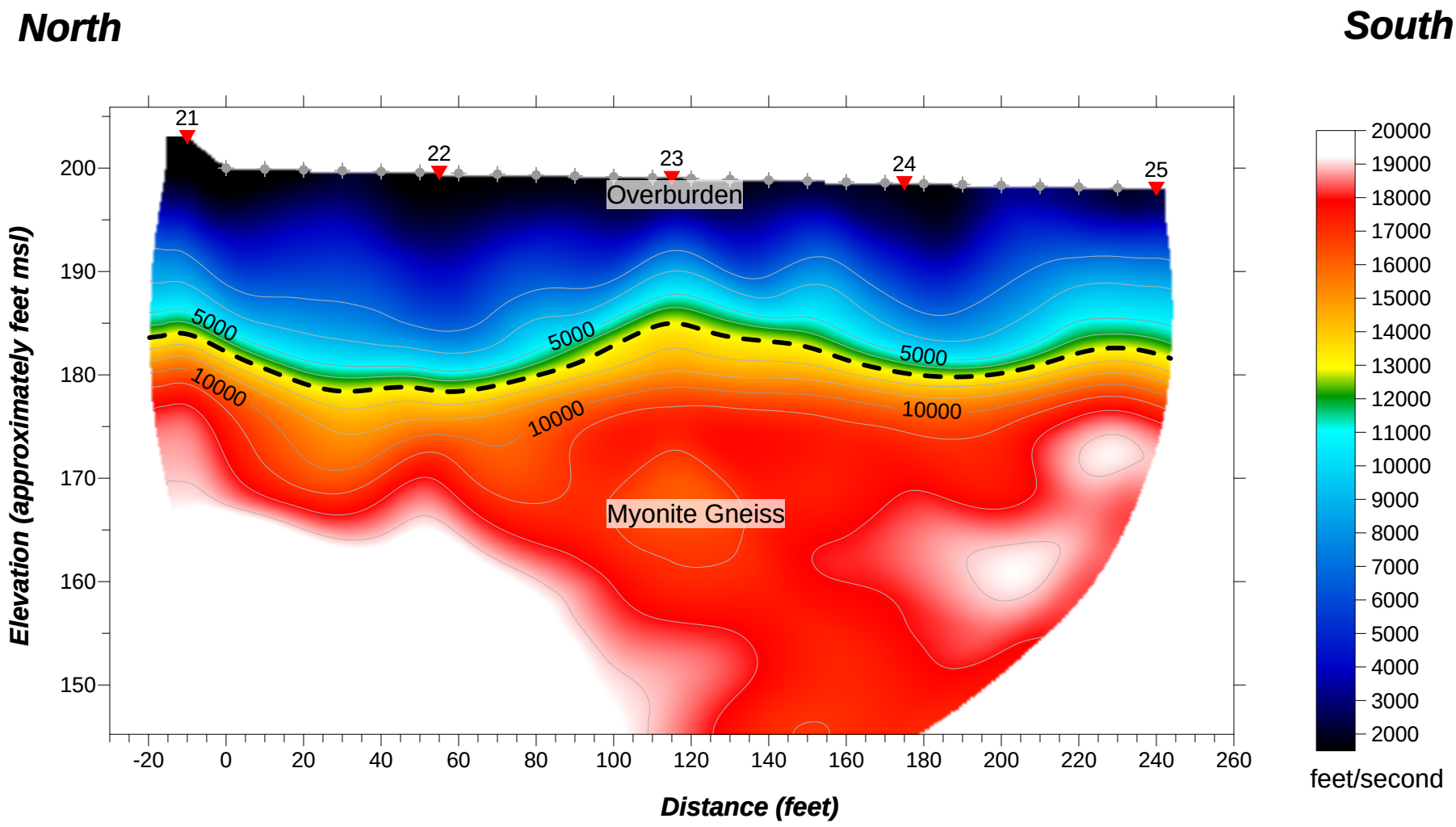
DATE: August 2019	SCALE: shown	TITLE: ***SR Line 5***	
DRAWN BY:	APPROVED BY:	***Hickory Haven and Samary Forest***	
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF6	***Holly Lane***	
CLIENT: Timmons Group		***Manakin-Sabot, Virginia***	FIGURE: **6**

SR Line 6 RMS error 1.4%=0.30ms 20 WET iters. 50Hz Width 2.2% initial GRADIENT.GRD Vers. 3.35



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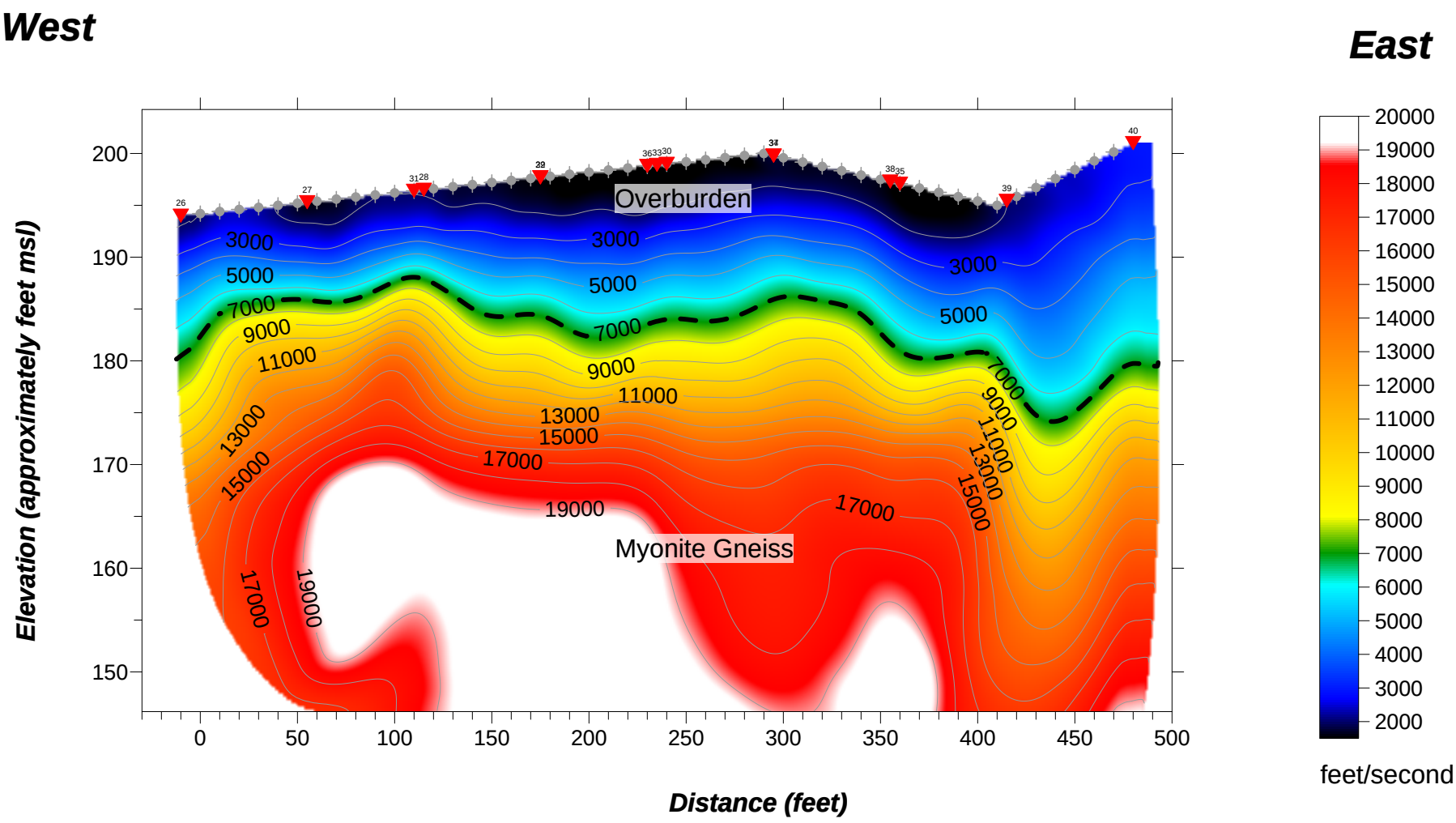
DATE: August 2019	SCALE: shown	TITLE: ***SR Line 6***	
DRAWN BY:	APPROVED BY:	***Hickory Haven and Samary Forest***	
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF7	***Holly Lane***	
CLIENT: Timmons Group		***Manakin-Sabot, Virginia***	FIGURE: **7**

SR Line 7 RMS error 1.0%=0.28ms 20 WET iters. 50Hz Width 2.5% initial GRADIENT.GRD Vers. 3.35



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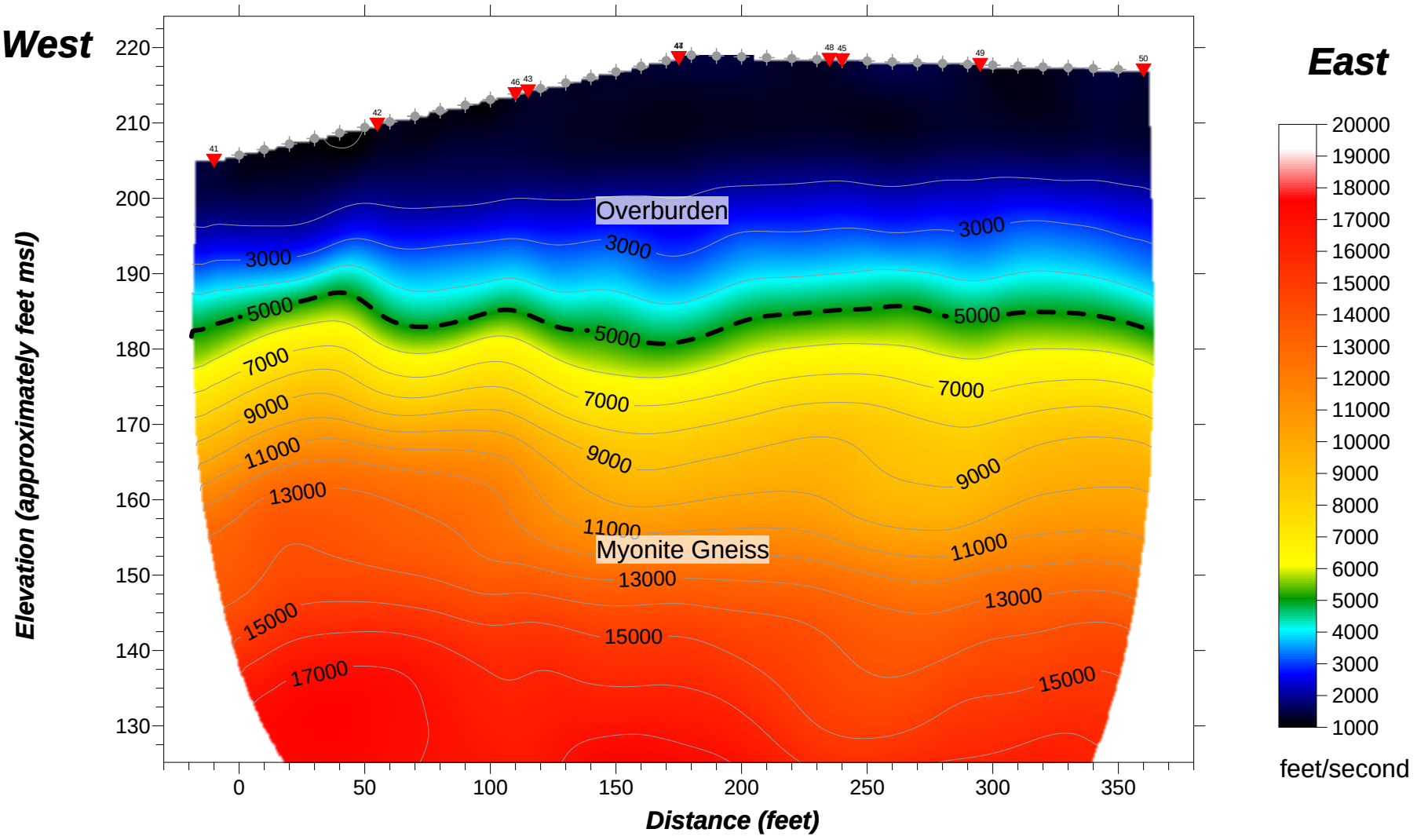
DATE: August 2019	SCALE: shown	TITLE: ***SR Line 7 Hickory Haven and Samary Forest Holly Lane Manakin-Sabot, Virginia***	
DRAWN BY:	APPROVED BY:		
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF8	CLIENT: Timmons Group	FIGURE: **8**

SR Line 8 RMS error 0.8%=0.44ms 20 WET iters. 50Hz Width 3.5% initial GRADIENT.GRD Vers. 3.35



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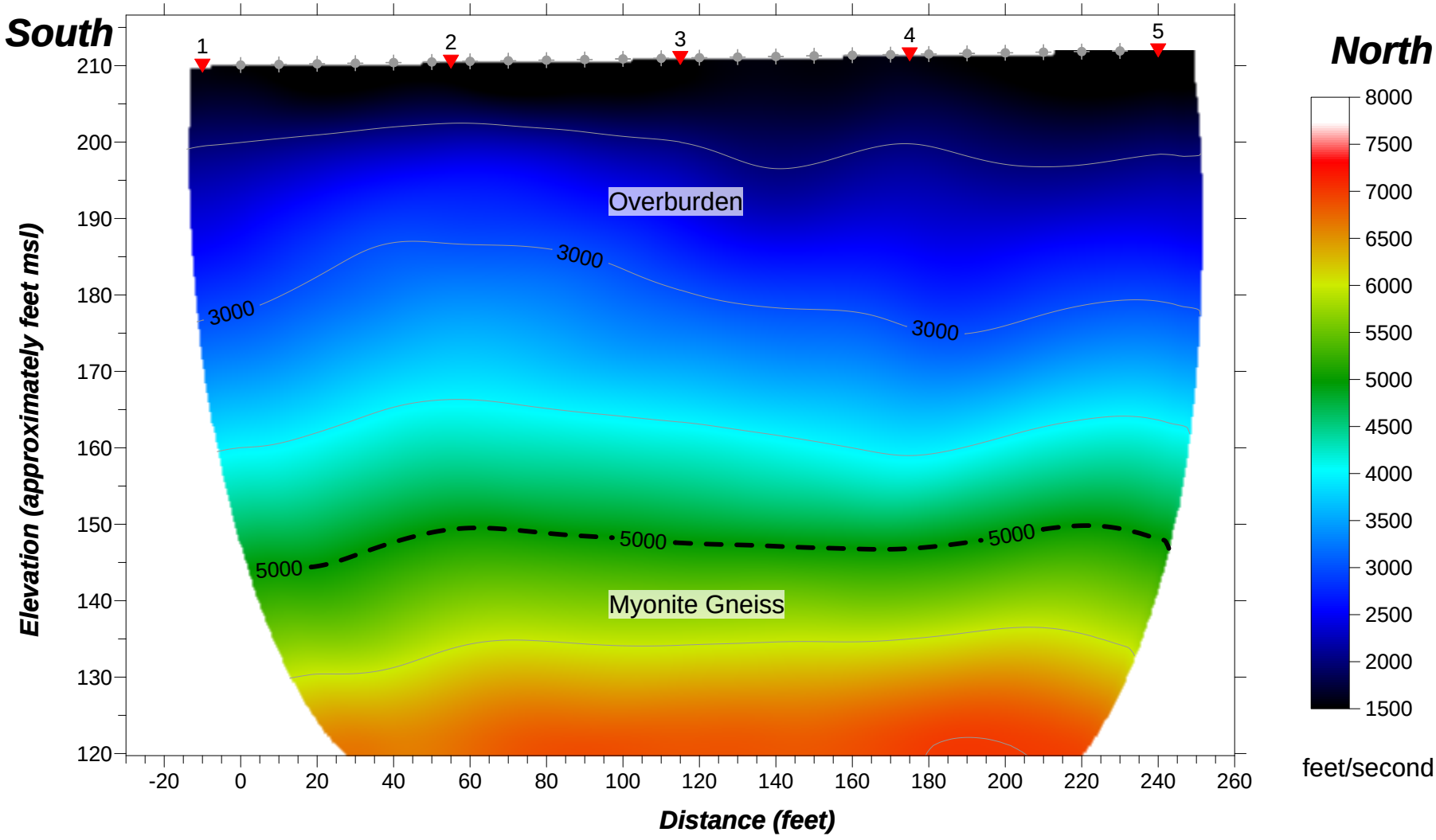
DATE: August 2019	SCALE: shown	TITLE: ***SR Line 8 Hickory Haven and Samary Forest Holly Lane Manakin-Sabot, Virginia***	
DRAWN BY:	APPROVED BY:		
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF9	CLIENT: Timmons Group	FIGURE: **9**

SR Line 9 RMS error 0.7%=0.54ms 20 WET iters. 50Hz Width 9.0% initial GRADIENT.GRD Vers. 3.35



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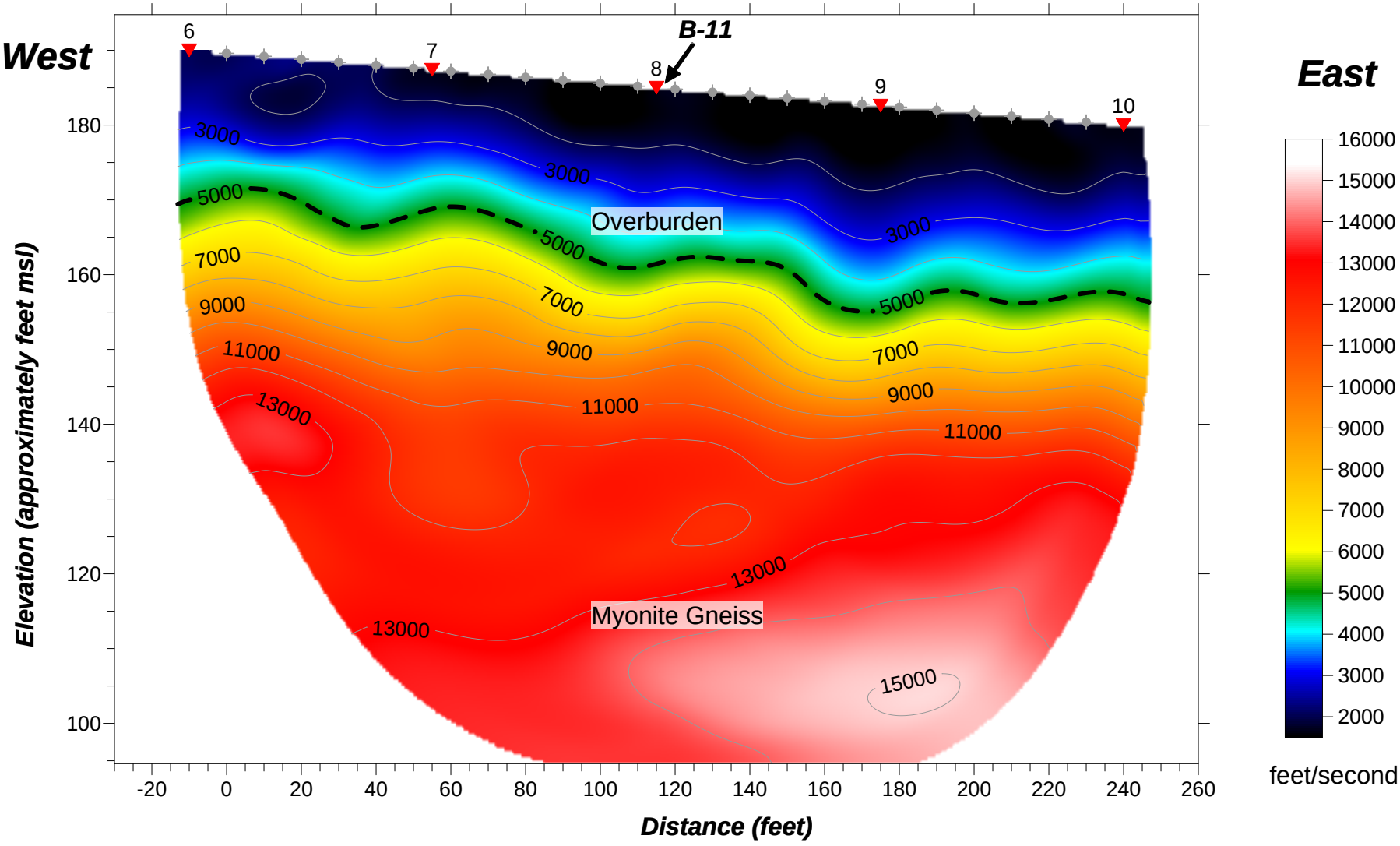
DATE: August 2019	SCALE: shown	TITLE: ***SR Line 9 Hickory Haven and Samary Forest Whippoorwill Road Manakin-Sabot, Virginia***	
DRAWN BY:	APPROVED BY:		
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF10	CLIENT: Timmons Group	FIGURE: **10**

SR Line 10 RMS error 1.0%=0.38ms 20 WET iters. 50Hz Width 3.0% initial GRADIENT.GRD Vers. 3.35



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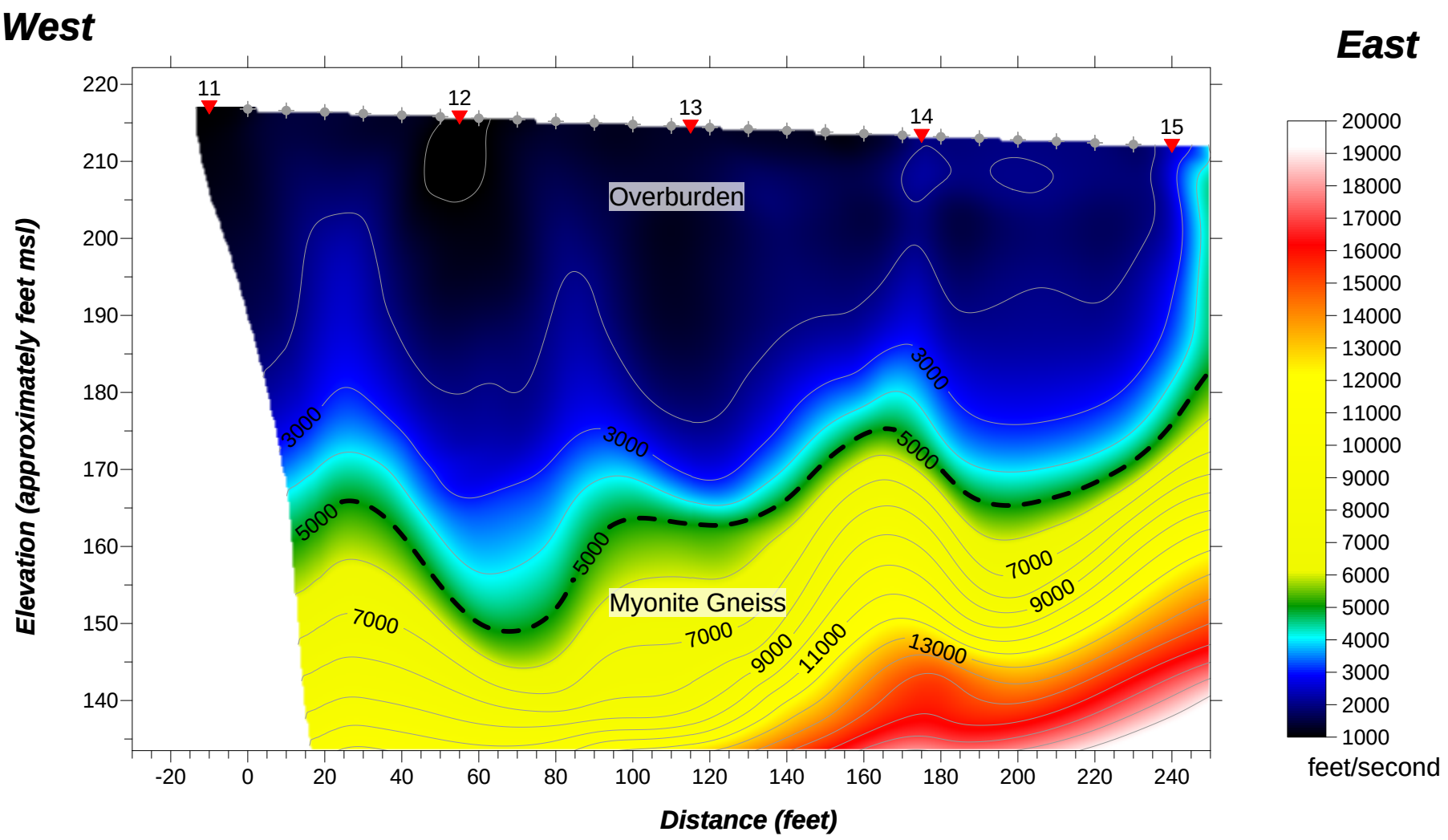
DATE: August 2019	SCALE: shown	TITLE: ***SR Line 10 Hickory Haven and Samary Forest Whippoorwill Road Manakin-Sabot, Virginia***	
DRAWN BY:	APPROVED BY:		
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF11	CLIENT: Timmons Group	FIGURE: **11**

SR Line 11 RMS error 3.2%=2.48ms 20 WET iters. 50Hz Width 4.5% initial GRADIENT.GRD Vers. 3.35



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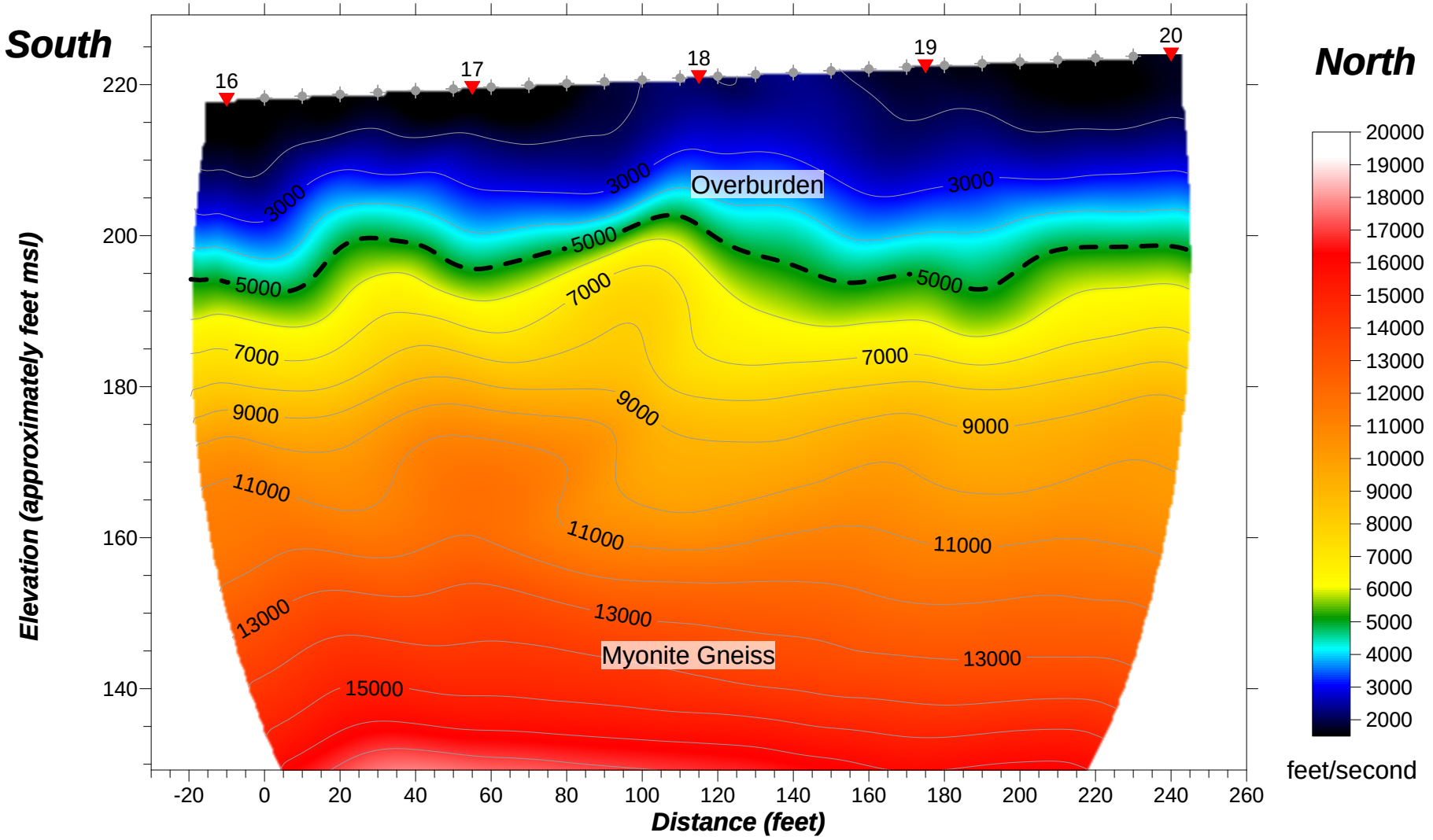
DATE: August 2019	SCALE: shown	TITLE: ***SR Line 11 Hickory Haven and Samary Forest Whippoorwill Road Manakin-Sabot, Virginia***	
DRAWN BY:	APPROVED BY:		
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF12	CLIENT: Timmons Group	FIGURE: **12**

SR Line 12 RMS error 0.8%=0.37ms 20 WET iters. 50Hz Width 3.0% initial GRADIENT.GRD Vers. 3.35



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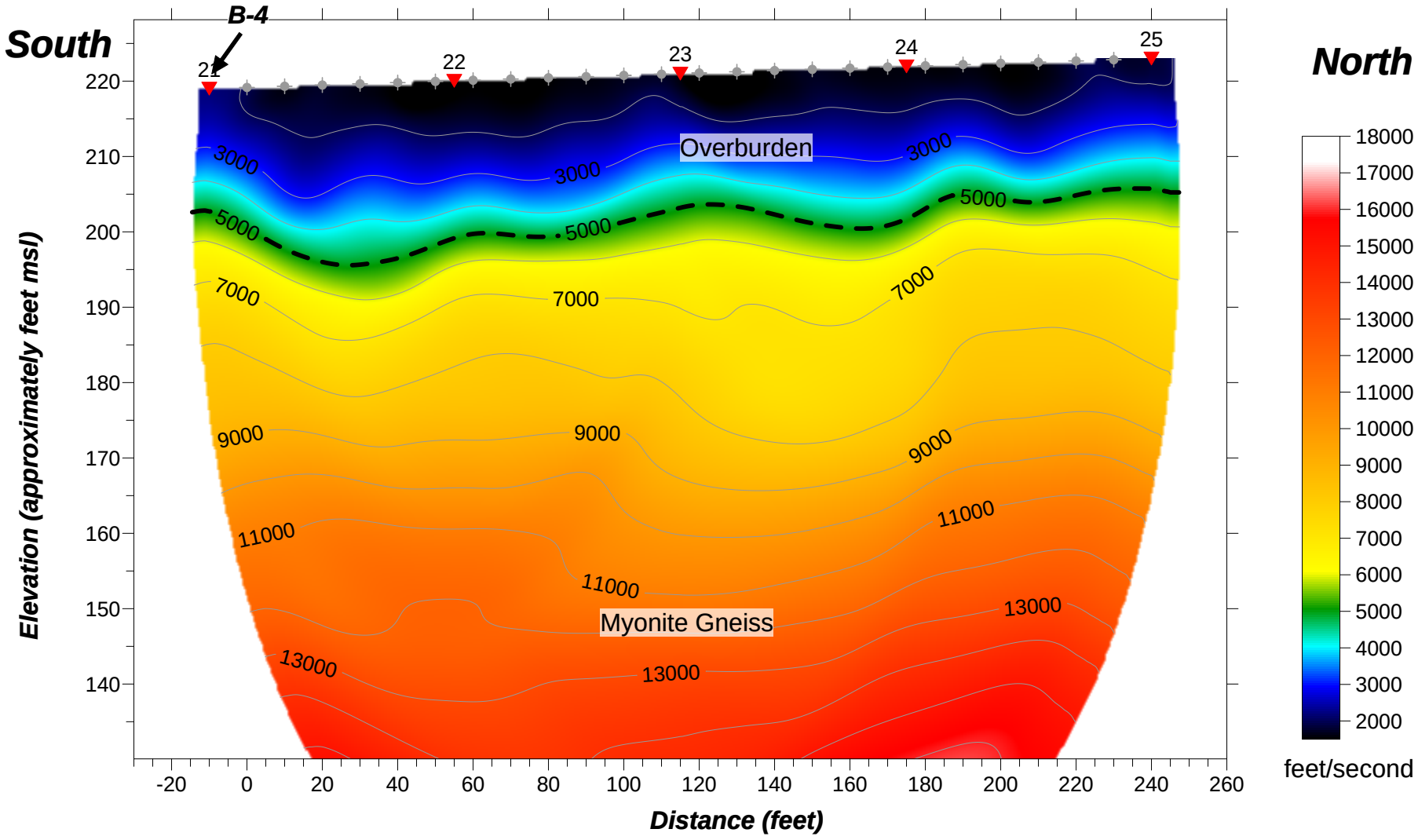
DATE: August 2019	SCALE: shown	TITLE: ***SR Line 12 Hickory Haven and Samary Forest Whippoorwill Road Manakin-Sabot, Virginia***	
DRAWN BY:	APPROVED BY:		
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF13	CLIENT: Timmons Group	FIGURE: **13**

SR Line 13 RMS error 1.0%=0.40ms 20 WET iters. 50Hz Width 3.0% initial GRADIENT.GRD Vers. 3.35



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DATE: August 2019	SCALE: shown	TITLE: ***SR Line 13***	
DRAWN BY:	APPROVED BY:	***Hickory Haven and Samary Forest***	
		Whippoorwill Road	
		Manakin-Sabot, Virginia	
JOB NO.: 19197	DWG. NO./ REV. NO.: THHVAF14	CLIENT: Timmons Group	FIGURE: **14**