IFB NO. 19002-FY21-31 RE-BID
LEESBURG EXECUTIVE AIRPORT
NORTH HANGARS

ADDENDUM NO. 1

MARCH 17, 2022

ITEM NO. 1: PRE-BID MEETING SIGN-IN SHEET

Please refer to the pre-bid meeting sign-in sheet (Attachment A) included with this addendum.

ITEM NO. 2: PRE-BID MEETING QUESTIONS AND CLARIFICATIONS

Town staff and the Town's Engineer from Talbert and Bright gave a summary of the project scope and bid documents, providing clarification on several items and answering several questions.

General Bid Information:

- All bid documents are on the Town's bid board (www.leesburgva.gov).
- By registering for updates on the bid board, contractors will receive a courtesy email when addenda or other information is posted.
- Questions must be submitted to CapitalBidQuestions@leesburgva.gov by March 14, 2022 at 5:00 p.m.
- Bids must be submitted by March 24, 2022 at 3:00 p.m. Bidders must submit bids electronically via eVA (the Commonwealth's eProcurement Website) at www.eva.virginia.gov. eVA does not allow a partially submitted bid - contractor must ensure complete bids with pricing for every line item are submitted by the bid deadline.
- Required bid response forms are on Pages 8 thru 34 of the IFB. Bidders may use the checklist on Page 8 to assist them with their bid submittal. Bidders are required to submit all bid submission forms in their entirety including signatures and date.
- A bid bond in the amount of 5% of the contractor's total price is required. A copy must be submitted via eVA as a part of the bid submission package and the hard copy must be submitted within two (2) business days of the bid opening to the Town's Procurement Office at the following address: Procurement Office, Town of Leesburg, 25 West Market Street, Leesburg VA 20176.
- The contract time is 280 calendar days to substantial completion and an additional 30 days to final completion.
- Liquidated damages are $1,000 per day for any day that exceeds the contract time or any approved time extension.
- The Town is anticipating to issue an "Administrative Notice to Proceed" after the contract is executed to give the contractor the ability to get submittals and shop drawings for review and approval so that long lead time items do not affect the contract duration.

- The permits for this project are discussed on the cover sheet (Note B.8) of the plans, which specifies who is responsible for the required permits.
- The DBE participation goal is 11.34% of the federally funded work (mainly site work excluding the hangar buildings)
- The contractor is required to follow the construction phasing per project plans and documents and must coordinate access to existing hangars with the airport on a daily basis.

General Scope of the Project:

The project includes the construction of:

- One 26 unit T-Hangar building that includes two bathrooms, vestibule, storage room as well as maintenance storage area;
- A three unit – 60'x60' Corporate hangar building as a bid additive which will include infra-red heating as identified in the bid form;
- Site Work: Associated with the two buildings is the construction of an aircraft parking apron, construction of a parking lot, phased erosion and sediment controls, utility installation (including waterline, sewer line, power), construction of a retaining wall at the north corner of the project, drainage improvements, an underground storage system, and landscaping.

Specifications Highlights:

The federal requirements for Buy American only pertains to the federally funded work, which is primarily the site work. The federally funded work excludes the water and sewer utility lines and the buildings. The project plans identify the federally funded Airport Improvements Program (AIP) areas.

The project specifications include the general provisions and the building general performance specifications. The contractor is required to provide the design documents to build the hangars and retaining wall portions of the project, since this is a performance based specification. As such, the contractor needs to include the following, but is not limited to building plans, structural designs, steel erection drawings, retaining wall design, and sizing of power cables to the hangar buildings as outlined in the project specifications.

General hangar eave heights (top of hangars):

- T-hangars - 18'
- Corporate hangars - 28'

General hangar door information:

- Hangar doors will be typical bi-fold doors
- T-hangar openings - 42'x14' with one end unit requiring an opening of 48'x14'.
- Corporate hangar openings - The clear opening will be 60'x18'

Insulation:

- Corporate hangars – required
- T-hangars - not required with the exception of the bathroom, vestibule, storage and maintenance areas.

Vents, Windows and Air Conditioning:

- There are no windows in the hangars and no air condition system.
- There is vent fan with a motorized damper in the lobby area of the bathrooms.

Liner Panels:

- Corporate Hangars - required up to at least the first purlin
- T-hangars – not required

Site Access:

- Access to the project will be from Old Tolbert Lane.
- The contractor will be responsible for the security of access to the job site as well as the staging area.

Geotechnical Information:

- Geotechnical subsurface data has been provided as Appendix C of the project specifications in the IFB.
- Additional geotechnical subsurface information has been attached as **Attachment B** to this addendum.
- If the contractor requires additional geotechnical borings, study, and or analysis, the contractor shall include the cost of the additional geotechnical work in the bid price.

Waterline:

- The water line is a complete loop system starting at Miller Drive and will tie into the T-hangars on the southeast end of the project

Sanitary System:

- The sanitary force main includes a grinder pump and will tie into the existing gravity system.

Gutters:

- Gutters are required on the buildings and will be tied into the underground drainage system.

Pre-Bid Questions and Answers:

Question 1: When do you anticipate start of construction?
Answer 1: The contractor is to hold their prices for sixty days, with anticipation of executing the contract by the end of May 2022 and starting construction (Administrative Notice to Proceed) in early June 2022.

ITEM NO. 3: QUESTIONS AND CLARIFICATIONS

Interested bidders shall be mindful of the following responses to the questions received and clarifications:

1. Question: Per the pre-bid conference the hangers will be design build so is it acceptable to bid Lot 1 items only and still be responsive?
   Response: No, contractor must ensure complete bids with pricing for every line item.

2. Question: One of my DIP suppliers called and they said that shortly after this project bid last year, Leesburg adopted a spec to have all DIP and fittings zinc coated. Does this spec apply to this project or are the specifications grandfathered in?
   Response: All DIP and fittings to be Zinc Coated or Town approved equal including DIP water main with Polyethylene Encasement.

3. Question: The 'Parking Lot Pavement Detail' on Sheet 20 specifies P-401 asphalt pavement whereas the Apron Details show VDOT SM-12.5A. Is it the intent of the Town to have SM-12.5A in the parking lot as well?
   Response: Yes, all asphalt for this project will be VDOT SM-12.5A.

4. Question: Given the current volatility of petroleum market, will the contractor be given the opportunity to receive a price adjustment for fluctuations in asphalt cement?
   Response: Price adjustment will not be allowed for this bid.

5. Question: I write to find out where I can obtain the balance of the plans for the hanger project. I downloaded the posted plans on EVA and found the same documents on the city website. The posted plans are very specific about the civil requirements for the project but have no architectural details. Questions arise like the eve height of the building, size of doors, interior finishes, and on and on. Please advise where the balance of the documents can be obtained.
   Response: A performance specification was included in the specification book. The scope of work requires the contractor to provide all design and plan development necessary to meet all requirements of the International Building Code (latest edition), the Virginia Uniform Statewide Building Code (latest edition), all current local and state codes, all local energy codes and be ADA compliant. Where conflicts occur with the noted standards and the requirements noted in the specification, the more stringent requirements shall govern. It is the responsibility of the Contractor to research and verify that the most current design criteria are met with regards to fire safety, building loads (Loudoun County) as well as meeting all permit requirements. The work shall include plan preparation, local building plan approval, foundation design, concrete foundation construction, structural design and framing, erection, electrical design, electrical plan preparation, electrical installation and plumbing design as specified, and erection/installation of the same. The requested information is included in Section B-100 of the project specifications.

6. Question: Can you please confirm whether the quantity of 4,250 tons SM-12.5A (Lot 1, Bid item 41) includes both the apron pavement as well as the parking lot pavement?
   Response: Yes, the noted quantity includes both the apron and the parking lot.

7. Question: Please provide the pre-bid meeting agenda and attendance sheet.
   Response: See Items No. 1 and No. 2 above.

8. Question: Please confirm the executive hangars will not require fire walls, and only the T-hangar building will have 2 hour fire walls which are identified in the specification.
   Response: The contractor is responsible for researching all permit requirements. The items noted in the specification are minimum requirements and are to be confirmed by the contractor.

9. Question: Please confirm no fee will be required for the right of way permit from the Town of Leesburg for the water line tie in.
   Response: Fees associated with permits required by the Town and Loudoun County for the project will be waived.

10. Question: Please provide NOVEC's plan for power primary and secondary power.
    Response: NOVEC's plan for primary power is depicted on the construction plans (Ref Sheet 7). Power will be run from the existing power pole located on the north side of Old Tolbert Lane. The power will be run to a transformer then to the meter rack. Secondary power will need to be sized by the building electrical engineer based on the design building loads.

11. Question: Please clarify the GC's requirement's for secondary power (Conduit, Feeder, Etc).
    Response: Secondary power will need to be sized by the building electrical engineer based on the design building loads. Conduits for secondary power have been provided as depicted on Sheet 7 of the plans.

12. Question: Please clarify where linear panels, and what height they are needed in both the executive and T Hangars.
    Response: Liner panel will not be required in the T-Hangar. The liner panel shall be provided on the backside of end walls, back walls, partition wall and lower portion of the bi-fold doors of the Corporate Hangar.

13. Question: The T Hangar building layout provided in Exhibit 2.1 and the building outlined on sheet 7 of the civil plans do not match please clarify the building dimensions. If Exhibit 2.1 is incorrect please update.
    Response: The T- hangar building layout noted on Exhibit 2.1 is correct.

14. Question: Please confirm the Town will obtain the grading permit, and will initiate the building permit with Loudon County and will not be responsible for fees for either of these permits, but will be responsible for submitting the design package for the building permit.
    Response: The contractor is responsible to provide the Town with the complete building and retaining wall design packages to initiate the building permit with Loudoun County. The Town will provide the VADEQ VSMP, Loudoun County grading permit and initiate the Loudoun County building permit. Fees and bonds for these permits will be paid by the owner (Ref Note 8, Cover Sheet).

15. Question: Please confirm the electric will be one meter, single phase in and out and no sub-meters are required for this project.
    Response: One meter is proposed. Secondary power will need to be sized by the building electrical engineer based on the design building loads. Conduits for secondary power have been provided as depicted on Sheet 7 of the plans.

16. Question: Please confirm the gas company will bring the gas to the meter at the building.
    Response: Washington Gas will meet with the Town and contractor to identify the final location of the gas meter and will draft the alignment and obtain the proposed easement. The gas service will be provided to the meter from the gas company.

17. Question: Please confirm there are no obstruction lighting requirements for helicopters housed in the hangars.
    Response: No obstruction lights are required.

18. Question: What will the security requirements be for the project?
    Response: Badging is not required on the airport. The contractor will be required to provide his own means for securing his staging area and all equipment and materials. Temporary fencing is required, as noted on Sheet 5, to provide a secure site for the duration of the project. All gates are to be managed and locked at the end of each day's work. The general contractor is responsible for the conduct of his crews and all sub-contractors.

19. Question: Please confirm the required 7460 with the FAA has already been submitted and approved.
    Response: All 7460's have been submitted and determinations received.

20. Question: Will the asphalt design be static or dynamic? For both the taxiway and the tie-downs?
    Response: The asphalt has been designed utilizing the FAA's pavement design procedures noted in FAARFIELD based on the fleet mix established by the airport's current Airport Master Plan.

21. Question: What is the cure period for Asphalt?
    Response: The amount of time from final asphalt placement to allowing traffic on the asphalt will be determined by the contractor. Generally, 1-2 days is allowed before light traffic can be allowed on it (i.e., pickup trucks). It is anticipated that aircraft would not be allowed on it until all work is complete which could be several weeks after paving is complete. It will be the contractor's responsibility to protect the finish surface prior to final acceptance form the owner.

22. Question: Confirm the buildings will be for the storage of aircrafts only. No hazardous materials stored, or maintenance of aircraft within the hangars.
    Response: The two buildings will be for storage of aircraft only.

23. Question: Executive hangars – is the 7'-4" liner panel to be provided on backside of end walls, back walls, partition wall, and lower portion of the bi-fold doors?
    Response: The liner panel shall be provided on the backside of end walls, back walls, partition wall and lower portion of the bi-fold doors of the Corporate Hangar.

24. Question: Is a fuel containment curbing required at the base of interior partition walls?
    Response: A fuel containment curb is not required by the airport. If the building official requires curbing, then it will need to be provided.

25. Question: Please confirm a floor slope and drain is not required in any of the hangars.
    Response: Sloped floors and drains shall be installed if required by code.

26. Question: Confirm buy American preference will not apply to the hangar buildings, or utilities (water, sewer & electric).
    Response:—Buy American will not apply to building items or utilities. It is required for components as shown on the plans and in the bid form as eligible for FAA payment including but not limited to asphalt, stone, pavement marking, tie-down anchors, stormwater drainage structures, erosion and sediment control measures, barricades, temporary fence, seed material, mulch material and seal coat material.

27. Question: Are the 2" force main pipe and fittings to be schedule 40 or schedule 80?
    Response: Schedule 40.

28. Question: Confirm P401 lining is not required on this project.
    Response: P401 lining is not required.

29. Question: Please specify the required eve height for the hangars.
    Response: The eave height for the T-Hangar shall be 18'. The eave height for the Corporate Hangar is 28'.

30. Question: Please confirm NOVEC will be providing the meter base for the T-hanger and corporate hangar.
    Response: NOVEC will be providing the meter base for the T-hangar and Corporate Hangar power. The contractor will be responsible for installing the meter base. NOVEC will provide and install the meter.

31. Question: Please confirm the contractor will not be charged for the permit fee of the segmental retaining wall.
    Response: See answer to Question #9 above.

32. Question: Bid form line item 4 is for rock excavation. Please clarify if this is for trench or mass rock excavation.
    Response: The bid item is for mass rock excavation.

33. Question: PSP-20 states electrical blastic caps shall not be permitted on or within 1,000 feet of the airport property, however 152-1.2 paragraph b. states rock excavation as "all solid rock in ledges, in bedded deposits, in unstratified masses, and conglomerate deposits which are so firmly cemented they cannot be removed without blasting or using rippers". 152-2.1 paragraph A states "Blasting will be permitted as directed by the RPR and in accordance with the following.." Is blasting allowed for rock removal within the limits of this project site or not?
    Response: Blasting is permitted.

34. Question: Please confirm as stated in the pre-bid that the tanks do not need to be storm tech, but equal in performance.
    Response: All materials noted in the specifications are minimum requirements. A system equal to storm tech is acceptable.

35. Question: Please provide the anticipated date the contractor will not be allowed to work due to the annual air show.
    Response: Saturday, September 24, 2022.

36. Question: Pruning specifications note an arborist shall perform all pruning, please confirm this is the responsibility of the Contractor.
    Response: There is no pruning required for this project.

37. Question: PSP-26 requires the contractor to provide a separate field office equipped with electrical power, heat/AC, lighting, telephone service, 6'x3' desk, desk chair, water cooler, printer/scanner/fax/copier machine and replacement ink, internet service, sanitary facility and trash can. Please confirm this is accurate, and the engineer's field office will not be in the airport building.
    Response: The Town will provide office space for our on-site resident engineer. This field office is NOT required.

38. Question: PSP-28 states the work includes an equipment rack, that also includes lightning protection, grounding rods etc. Please clarify where the equipment rack is being provided. Please also confirm if lightning protection is required.
    Response: The equipment rack is shown on Sheet 7 just south of the new parking lot. Lightning protection is required as depicted on Sheet 22.

39. Question: PSP-31 states the knox box as a pay unit of per each, however the bid form does not have a separate line item for the knox box. Please clarify where this cost should be included in the bid form, and how payment will be established.
    Response: The Knox Box (3200 Series) pay items is included in the bid form just after the 24' Manual Slide Gate and before the Sign Panel.

40. Question: PSP-36 states the contractor shall provide and install tie-down anchors, and the payment will be per each, however the bid form does not have a separate line item for the tie down anchors. Please clarify where this cost should be included in the bid form, and how payment will be established.
    Response: The tie-down anchors pay item is included in the bid form just after Gate Relocation and before Demolition.

41. Question: The vestibule door in the T-hangar is called out to be a trifab II 451-T system by Kawneer or similar. Please confirm the only glazing in the vestibule is the glass door.
    Response: That is correct.

42. Question: On 101-3.5 paragraph B, it states the t hangars shall be designed for a maximum aircraft load of 30,000 lbs, and must have a minimum of 6" slab with No. 6 – 6"6" wire reinforcement, and a 6-mil vapor barrier placed between the slab and the ground. Is the vapor barrier to be lapped or taped?
    Response: The vapor barrier can be lapped.

43. Question: What are the FF and FL minimum requirements for the 60'x60' corporate hangar slabs.
    Response: The FF and FL minimums will need to be determined by the designer and established in the architectural specifications. These values shall meet industry standards for the construction of hangars.

44. Question: 101-3.6 D General Building Limitations states the structure erected shall be limited to the noted height and area limitations, and then lists the maximum hangar area as 12,000 SF. Please confirm this is in regard to the Corporate Hangars, which is 10,800 SF, and not the 52'x588' T Hangars, which is 30,576 SF.
Response: Yes, this is associated to the corporate hangar. A fire wall will be used to reduce the fire area for the T-hangar. Fire wall type and construction shall meet current codes.

45. Question: 101-4.1 states "building construction/fabrication and delivery, foundation design, foundation construction including excavation, building erection, plumbing and electrical work will be measured on a lump sum basis…". This does not list the FRP for the bathroom walls and ceiling, or the ceramic tile for the floors as being included in the lump sum, and the bid form does not include a break out. Please clarify what line item all finishes are to be included for the T-hangars.
Response: All finishes shall be included in the line item for 26-Unit T-Hangar Electrical/Lighting. As per the specifications, a schedule a values will be required from the successful bidder.

46. Question: Are the gates outlined in 162-2.4 to have barbed wire included as outlined in 162-2.2?
Response: Yes, the gates are to include barbed wire.

47. Question: Are temporary markings to be eradicated in the same manner as existing markings as outlined in 620-3.3 paragraph b?
Response: Yes

48. Question: 315.08 Liquid asphalt cement states "when a pay item, will be measured in tons and will be paid for at the contract unit price per ton". Please confirm this means that it is the contractor's responsibility to account for the future increase, or decrease of liquid asphalt at the time of bid, and not monetary adjustment will be made for the cost increase or decrease of liquid asphalt at the time of placement.
Response: See answer to question #4 above. There is no measurement of liquid asphalt for this project. No modification of compensation will be provided for future increases or decreases in the cost for liquid asphalt.

49. Question: Please confirm if concrete trucks, and asphalt laying equipment must follow the marking and lighting of vehicle guide lines outlined in CSPP sheet 4 of 13.
Response: Yes, all equipment including concrete trucks and asphalt equipment shall follow the requirements established in the Construction, Safety and Phasing Plan.

50. Question: Boring Z-1 ended at an elevation of 65' but it is not stated why. Did this boring hit refusal, or was the boring only intended to go down 4.5'?
Response: There were three pages to the Z-1 boring log. The boring was terminated at a total depth of 65'.

51. Question: Please confirm the undercutting detail for footing foundations, that can be anticipated per the ECS Geotechnical report are accounted for in bid form line items 5, and not the unit price foundation lines 95 and 101. If they are to be included in lines 95 and 101, please provide a % the Contractor is to assume for unsuitable subgrade for the foundation.
Response: Line Item 5 in the bid form includes undercut for footing foundations.

52. Question: Civil sheet 12 shows a temporary VDOT DI-7 drop inlet, please confirm this is the same VDOT STD DI-7 listed on the bid form as number 24, and should include installation and removal of the temporary structure.
    Response: Yes, this DI-7 is a temporary structure. The contractors bid price shall include installation and removal.

53. Question: 101-3.4 calls out 24 gage panels for walls and roofs. PEMB standards utilize 26 gage panels for roofing and exterior walls. 24 gage will cost more to the client and is harder to source. Please confirm if the GC shall price 24 gage panels, or if 26 gage is acceptable.
    Response: 26 gage is acceptable.

54. Question: Please confirm the roof slope for both T hangars and corporate hangars as 101-3.4 paragraph e is unclear between a 1:12 and a 4:12 roof slope.
    Response: The roof slope is 1:12.

55. Question: Per IFB on page 44 "This construction is expected to begin in the Spring/Summer of 2022 and be fully completed by Spring of 2024." This does not align with the duration given during the Pre-bid meeting nor the construction time on page 52 of the IFB. Please advise what the timeline of construction is.
    Response: The Town anticipates the execution of the contract by the end of May 2022 with start of construction (Administrative Notice to Proceed) by early June 2022. The "Administrative Notice to Proceed" is to give the contractor the ability to get submittals and shop drawings for review and approval so that long lead time items do not affect the contract duration. The formal contract time will commence on the effective date of "Construction Notice to Proceed (NTP)". The Construction NTP will be agreed upon between the Town and Contractor once long lead time items have been ordered and delivery dates established so that the Contractor is not unfairly burdened with contract time constraints.

56. Question: Is the design phase included in the duration of construction timeline? Please clarify full duration of project including design timeline.
    Response: Design and securing permits will be handled under an Administrative Notice to Proceed prior to issuance of the Construction ~~a~~ Notice to Proceed. The Town will work with the contractor in approving plans through the submittal process and securing the necessary permits for the work.

57. Question: How is price to be submitted? Bid Form in IFB says to submit unit price bid form but then states that it is for reference only. Is the reference only referring to the quantities? Please clarify.
    Response: Bid pricing is to be submitted electronically via eVA, as stated on the bid form and in the Submission of Bids section on Page 47 of the IFB. Line item entries will be made directly on the site.

58. Question: Advise is the duration of construction is flexible due to lead times for pre-engineered building is approximately 8 months.
    Response: See response to question 55 and 56.

59. Question: Is the intent to award the project based on best price or best value?
    Response: The project will be awarded based on the lowest responsive, responsible bidder. Refer to the "Consideration of Bids & Bid Opening" section of the IFB on Page 48.

60. Question: Please confirm is sprinkler systems are required to be included in corporate hangars, T-hangars, and restrooms/storage rooms. If so, please provide direction for the main sprinkler line to come into the buildings.
    Response: Sprinklers are not included in the bid.

61. Question: Advise if any communication/security scopes are needed for this project.
    Response: Communication/Security is not included in the scope of this project.

62. Question: If the total schedule is to be from Spring 2022 - Spring 2024, please provide for a material allowance given the duration of two years. If not, subcontractors will be looking to purchase the material immediately and place in storage. Will there be the option to invoice immediately?
    Response: See response to question 55 and 56. If a contractor is able to acquire materials in advance of the formal construction NTP, the Town will entertain payment for delivered materials. In order to entertain this, all material invoices would need to be submitted, materials have to be stored in a known location and tagged specifically for this project, in accordance with the Town's General Conditions.

63. Question: Please advise if AISC certification is needed for either factory welds and field welds for fabricators and/or installers.
    Response: Certifications shall be those required by the architect, structural engineer or those required to meeting industry or permitting standards.

64. Question: Section 101-2.2 of the building documents requires that the contractor provide special inspections as required by building code. Current building code requires special inspections by the owner. Please clarify.
    Response: The contractor shall include the cost of special inspections in the respective price for each building (T-hangar and Corporate Hangar). The cost shall be identified in the schedule of values after contracts have been executed. Special inspections will not relieve the contractor of the requirements for quality control of the construction.

65. Question: Please confirm the final height for the corporate hangar is 28'.
    Response: The anticipated height is 28'.

66. Question: Please confirm the final height for the t-hangar is 18'.
    Response: The anticipated height is 18'.

67. Question: Advise if roof pricing should include non-exposed fasteners of if the fasteners can be exposed.
    Response: Exposed fasteners are acceptable.

68. Question: Please provide the explosion proof requirements.
    Response: Explosion proof requirements are those determined by local building code and other applicable codes.

69. Question: Confirm that all equipment is to be priced as electric and not gas fired units.
    Response: All equipment is to be electric.

70. Question: Page P-152-3, States the following. Please advise if a dump site for excess fill will be provided to the Contractor or if the Contractor needs to find a waste site.

    "The grade shall be maintained so that the surface is well drained at all times.

    When the volume of the excavation exceeds that required to construct the embankments to the grades as indicated on the plans, the excess shall be used to grade the areas of ultimate development or disposed as directed by the RPR. When the volume of excavation is not sufficient for constructing the embankments to the grades indicated, the deficiency shall be obtained from borrow areas."

    Response: A waste site is not available on site. The contractor will be required to find an offsite waste area for all excess material generated from the construction (Reference Note 37, Sheet 2).

Bidders must take due notice and be governed accordingly. This addendum must be acknowledged as indicated in the Invitation for Bid or your bid may not be considered.

For the Town of Leesburg,
Renée M. LaFollette, P.E.
Public Works & Capital Projects Director
Town of Leesburg, Virginia
Email: CapitalBidQuestions@leesburgva.gov
Bid Board: http://www.leesburgva.gov/bidboard

END OF ADDENDUM NO. 1

Project: Leesburg Executive Airport North Hangars

Office of
CAPITAL PROJECTS

We build it right!

Date & Time: Thursday, March 3, 2022, 10:00 a.m.

	Name	Organization	Phone	Email
1	TJ Spensieri	Cooper Building Services	804-543-3646	tspensieri@cooperbuilds.com
2	Scott Moffat	Crisak Incorporated	571-388-8544	smoffat@crisak.com
3	John Massey	Tanks Direct	240-957-1372	john.massey@tanksdirect.com
4	Dan Chiljean	Coastal Steel Structures		
5	Dylan Bowers	Laurita, Inc. Sitework, utilities, demolition contractor	office 304.296.3638 cell 304.276.3638	dbowers@laurita.com
6	Erick Smith	William A Hazel	815.509.8185	
7	Melissa Hill	Meridian Construction Co., Inc.	301-670-1677	mhill@meridianconstructionco.com
8	Stanley Pleskonko	TranSystems	Cell - 717.329.0896	smpleskonko@transystems.com
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ECS Mid-Atlantic, LLC

Geotechnical Engineering Report

Leesburg Executive Airport North Apron Development

Sycolin Road SE
Town of Leesburg, Loudoun County, Virginia

ECS Project Number 01:29694

January 24, 2020

January 24, 2019

Steven T. Peterson, P.E.
Talbert & Bright
10105 Krause Road
Suite 100
Chesterfield, Virginia 23832

ECS Project No. 01:29694

Reference: Geotechnical Engineering Report
Leesburg Executive Airport North Apron Development
Sycolin Road SE
Town of Leesburg, Loudoun County, Virginia

Dear Mr. Peterson:

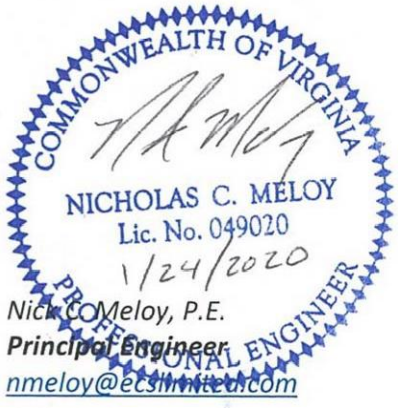
ECS Mid-Atlantic, LLC (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the above-referenced project. Our services were performed in general accordance with our Proposal No. 01:59781-GP, dated May 29, 2019. This report presents our understanding of the geotechnical aspects of the project, along with the results of the field exploration and laboratory testing conducted, and our design and construction recommendations.

It has been our pleasure to be of service to you during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify the assumptions of subsurface conditions made for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,

ECS Mid-Atlantic, LLC

James N. Swiggett, P.E.
Senior Project Engineer
jswiggett@ecslimited.com



Nick C. Meloy, P.E.
Principal Engineer
nmeloy@ecslimited.com

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EXECUTIVE SUMMARY

The following summarizes the main findings of the exploration, particularly those that may have a cost impact on the planned development. Further, our principal foundation and pavement recommendations are summarized. **Information gleaned from the executive summary should not be utilized in lieu of reading the entire geotechnical report.**

The project site is bound by Old Tolbert Lane to the North, portions of existing runway, taxiway, and hangar areas to the west and south, and Miller Drive SE to the east. The site appears to be a largo open undeveloped area covered with grass. The project includes the design and construction of a new 26-unit T-hangar and multiple 60 foot by 60 foot hangars. The finished floor elevation of the structures is not yet known. The proposed construction also includes stormwater management (SWM) facilities, pavement drive/taxiways, and associated utilities. Based on the plans provided to us, the topography ranges from a high of approximately EL. 390± feet in the eastern side of the site and a low of approximately EL. 380± feet in the western side of the site.

The subsurface conditions were explored by drilling 12 soil test borings within the area of the proposed hangars and pavements. The borings were advanced to depths on the order of 1.3± feet to 25± feet below the existing ground surface. Borings BH-6 through BH-12 were advanced to the planned termination depth of 10± feet to 25± feet. Auger refusal was encountered at a depth of 1.3± feet to 17± feet below the existing ground surface in Borings BH-1 through BH-5. Groundwater was encountered while drilling in Borings BH-6 and BH-7 at depths of 18± feet and 13± feet below the existing ground surface, respectively.

Up to approximately 2± inches of topsoil was encountered in all of the borings with the exception of BH-8. Boring BH-8 was performed within the existing taxiway area and encountered approximately 2.25± inches of asphalt underlain by 7± inches of base stone material. Beneath the cover material, the 12 soil borings generally consisted of up to 4.5± feet to 25± feet of firm to hard Fat and Lean CLAYS (CH,CL) and loose to dense SILT (ML) underlain by very dense weathered siltstone. Soft Lean CLAY (CL) was encountered in Boring BH-11 between the surface and about 2 feet below grade. Very dense weathered limestone conglomerate was encountered in Boring BH-2 at a depth of 13.5 feet below the existing ground surface. Layers of high plasticity Fat CLAY (CH) was encountered in Borings BH-6 and BH-12 at a depth of 2± feet to 12± feet below the existing ground surface.

The planned buildings can be supported by conventional shallow foundations consisting of individual column footings and continuous wall footings bearing on natural soils or engineered fill material. In general the site appears suitable for construction of the proposed development. Due to the presence of carbonate rock at the site, there is an inherent risk of sinkhole formation. It is recommended that infiltration of stormwater be avoided and liners be provided for all stormwater management features to limit infiltration.

The primary factors that could affect the proposed development are a shallow rock surface, the potential for soft clays and carbonate rock, and the potential for perched groundwater. In order to better evaluate the potential for sinkhole development at the site, we recommend additional exploration be performed. Further details of the additional exploration are provided in the report.

1.0 INTRODUCTION

1.1 GENERAL

The purpose of this study was to provide geotechnical information for the design of building foundations, paved parking areas and drive lanes, and associated underground utilities. The recommendations developed for this report are based on project information and drawings supplied by Talbert & Bright. This report contains the results of our subsurface explorations and laboratory testing programs, site characterization, engineering analyses, and recommendations for the design and construction of the project.

1.2 SCOPE OF SERVICES

To obtain the necessary geotechnical information required for the design and construction of the proposed north apron expansion, soil test borings were performed at locations selected by Talbert & Bright and reviewed by ECS. These borings were located at regular intervals within the proposed building and pavement areas. A laboratory-testing program was also implemented to characterize the physical and engineering properties of the subsurface soils. This report discusses our exploratory and testing procedures, presents our findings and evaluations and includes the following.

- A brief review and description of our field and laboratory test procedures and the results of testing conducted.
- A review of surface topographical features and site conditions.
- A review of area and site geologic conditions.
- A review of subsurface soil stratigraphy with pertinent available physical properties.
- Final copies of our soil test boring logs.
- Recommendations for site preparation and construction of compacted fills, including an evaluation of on-site soils for use as compacted fills and delineation of potentially unsuitable soils and/or soils exhibiting excessive moisture at the time of sampling.
- Recommended foundation types.
- Recommended cut and fill slope design criteria.
- Evaluation of California Bearing Ratio test results and recommendations for use in final design of asphalt concrete pavements for pavement parking areas.
- Evaluation and recommendations relative to groundwater control.
- Recommendations for design and construction of drainage structures and stormwater management facilities.
- An evaluation of soil and rock excavation issues.

1.3 AUTHORIZATION

Our services were provided in accordance with our Proposal No. 01:59781-GP dated May 29, 2019, as authorized by you on December 4, 2019, and includes the Terms and Conditions of Service outlined with our Proposal.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION

The project site is located off of Sycolin Road at the Leesburg Executive Airport in Loudoun County, Virginia. The site is bound to the north by Old Tolbert Lane, to the east by Miller Drive SE, to the south and west by existing runways, taxiways, and hangar areas. The figure below depicts the general location of the project based on the description above for reference. A larger to-scale site location diagram is included in the appendix.

Figure 2.1.1 Site Location

2.2 CURRENT SITE CONDITIONS

The project site is located in an undeveloped portion on the northern end of the Leesburg Executive Airport. Based on the plans provided to us, the topography ranges from a high of approximately EL. 390± feet in the eastern side of the site and a low of approximately EL. 380± feet in the western side of the site. Based on a review of available aerial photography, the site appears to have generally been undeveloped between 1988 and approximately 2002 when aerial images show earthwork in progress on the subject site. Following 2002, the site appears to have been relatively undisturbed. A review of available topographic maps indicates that grades were not significantly altered prior to 1990.

If any of the information is inaccurate, either due to misunderstanding or due to design changes that may occur later, ECS should be contacted in order to provide additional or alternate recommendations that may be required. The project boundaries, as well as the existing and proposed site features, are included on the diagrams included in Appendix A of this report.

2.3 PROPOSED CONSTRUCTION

Based project site plans provided to us and prepared by Talbert & Bright, we understand that the project will consist of the design and construction of a new 26-unit T-hangar and multiple 60 foot by 60 foot hangars. The finished floor elevation of the structures is not yet known. Based on our conversations with you, we understand that the aircraft utilizing the new structures and pavements will have a weight of less than 60,000 pounds. The proposed construction also includes stormwater management (SWM) facilities, pavement drive/taxiways, and associated utilities.

The description of the proposed project is based on the information provided to us by your office or other design team members. If any of the information is inaccurate, either due to misunderstanding or due to design changes that may occur later, we recommend that we be contacted in order to provide additional or alternate recommendations that may be required.

2.3.1 Site Civil Features

The proposed hangars will be surrounded by asphalt paved taxiways for airplane transport. Stormwater is currently proposed to be managed by a network of dry swales, underground piping and trench drains located within and adjacent to the taxiways. Additional dry utilities are not shown on the provided plans but are assumed to be part of the proposed development plan.

2.3.2 Structural Information/Loads

The following information explains our understanding of the structures and their loads:

Table 2.3.2.1 Design Values

SUBJECT	DESIGN INFORMATION / EXPECTATIONS
Building Footprint	Multiple Hangers: 60ft x 60ft and 730ft x 60ft
# of Stories	1
Usage	Airplane storage, 60,000 lbs or less each
Framing	Steel framing with cast-in-place foundations and slab
Column Loads	150 kips or less
Wall Loads	5 kips per ft or less
Lowest Finish Floor Elevation	Not available
Column Spacing	Max bay spacing 60ft x 30ft

3.0 FIELD EXPLORATION

3.1 FIELD EXPLORATION PROGRAM

The field exploration was planned with the objective of characterizing the project site in general geotechnical and geological terms and to evaluate subsequent field and laboratory data to assist in the determination of geotechnical recommendations.

3.1.1 Test Borings

The subsurface conditions were initially explored by drilling a total of 12 soil test borings throughout the proposed expansion and development. Of the total 12 borings, 5 borings were performed in the area of the proposed hangar area, 6 borings within the proposed pavement/SWM areas, and 1 within the existing taxilane pavement. It is noted that he original field exploration program was planned to include 4 additional auger probe borings and 4 infiltration test borings within the proposed stormwater management facilities. During our exploration the infiltration borings and tests were cancelled due to the presence of limestone conglomerate residual soils and bedrock.

Based on site conditions, an all-terrain vehicle (ATV)-mounted drill rigs was utilized to drill the soil test borings. Borings were generally advanced to planned depths below the current ground surface, unless auger refusal caused termination at a more shallow depth. Subsurface explorations were completed under the general supervision of an ECS geotechnical engineer or engineering geologist.

Boring locations were identified in the field by ECS personnel using GPS techniques prior to mobilization of our drilling equipment. The approximate as-drilled boring locations are shown on the Boring Location Diagram in Appendix A. Ground surface elevations noted on our boring logs were interpolated from the topographic site plan provided to us by Talbert & Bright.

Standard penetration tests (SPTs) were conducted in the borings at regular intervals in general accordance with ASTM D 1586. Small representative samples were obtained during these tests and were used to classify the soils encountered. The standard penetration resistances obtained provide a general indication of soil shear strength and compressibility.

3.2 REGIONAL/SITE GEOLOGY

The site is located within the central portion of the Culpeper Triassic Basin, which extends from the Rapidan River near Madison, Virginia to just west of Frederick, Maryland. The Culpeper Basin is a structural trough, or half-graben, that formed as a result of tensional tectonic activity during the Triassic Geologic Period (±250 million years ago). The tensional tectonic activity that formed the Culpeper Basin ultimately grew to form the current Atlantic Ocean. In the down dropped portion of the basin, a playa lake formed which was subsequently filled by erosional deposits primarily from the Blue Ridge to the west and, to a lesser extent, from the Piedmont to the east. In the Leesburg area, carbonate sediments as well as carbonate cementing agents have formed karst producing bedrock formations. The Leesburg member of the Balls Bluff

Formation is a known karst landform producer. There are two mapped caves just north of Leesburg. Formations that border the Leesburg member can contain sufficient carbonate clasts to form karst like soil conditions.

During sedimentation of the basin, the western border fault periodically reactivated which has led to the shallow (17 to 27º) westward dip of basin strata observed today. After sedimentation of the basin, border fault reactivation resulted in cyclic layers of basalt and sandstone rock along the western margin of the basin. Late in the formation of the basin, local tectonic activity occurred which caused the basin sediments to be intruded by igneous magma forming dikes, sills, and lopoliths of diabase granite bedrock.

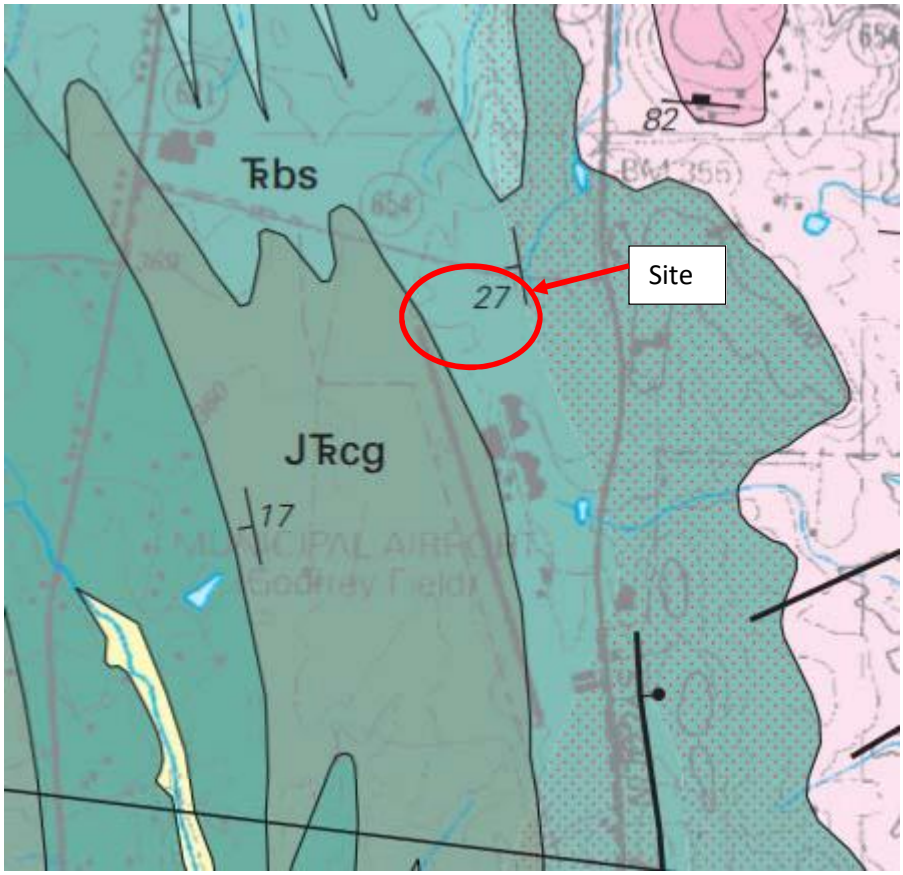


Figure 1: Geologic map of Loudoun County, Virginia
(USGS OF-99-150, Southworth, Burton, Schindler, and Froelich)

The Geologic Map of Loudoun County, Virginia indicates that the site is underlain by the Fluvial and Deltaic Member of the Balls Bluff Siltstone (TRbs) and Goose Creek Member (JTrcg) of the Catharpin Creek Formation. The Fluvial and Deltaic Member consists of thinly bedded reddish brown silty sandstone and clayey and sandy siltstone. The Goose Creek Member consists of a conglomerate rock that is interbedded with pebbly sandstone. While the predominant clast type within the Goose Creek Member is quartzite, there is a minor amount of carbonate clasts present. Where carbonate clasts are present in significant concentrations, karst-like conditions can develop. Both rock types were encountered in our borings.

The natural soils, which have resulted from the in-place physical and chemical weathering of the underlying lenticular sandstones and conglomerate are composed primarily of residual clayey or silty soils with increasing amounts of sand with depth. The granular nature of the residual soils generally increases with depth as does the percentage of rock fragments. These layers are termed weathered rock due to their rocklike structure (saprolite) but exhibit characteristics which qualify them as soil. Typically, the soil to rock transition is gradual in the sandstone and conglomerate bedrock; however, within areas of increased carbonate content transitions from soil to rock can be abrupt. Rock types containing carbonate based constituents typically weather faster than adjacent non-soluble rocks which can create drastic changes in the elevation of the bedrock over short distances. Float boulders and rock lenses are also common features in this area.

3.3 KARST TERRAIN CONSIDERATIONS

The site is located within close proximity to the Leesburg Member of the Balls Bluff Siltstone (mapped just to the north of the site by Loudoun County) which is a limestone conglomerate rock that is known to have problematic karst issues. Additionally, lenses of material belonging to the Goose Creek Member of the Catharpin Creek Formation are known to contain minor amounts of carbonate material. As noted above, soils and rock fragments consistent with conglomerate bedrock were encountered in several borings performed. Based on our involvement with other projects in this area, the karst terrain can present development concerns. Therefore, we are providing information should these conditions be encountered during site development.

Karst terrain is characterized by caves, caverns, voids, soil domes, internal drainages, losing streams, and topographical features such as sinkholes and closed depressions. A highly variable top of rock profile is commonly encountered. These features are the result of the dissolution of soluble bedrock such as limestone, dolostone and evaporites by groundwater and/or the infiltration of surface water. As water enters fractures, bedding planes and other bedrock discontinuities within soluble bedrock, it slowly dissolves the rock and enlarges the discontinuities. Over geologic time, this results in the formation of solution channels or underground passages and ravines which may develop into surficial manifestations such as sinkholes and closed depressions. The dissolution of bedrock is generally a very slow process. However, soil may be eroded, or raveled, into the enlarged bedrock fractures creating soil domes and eventually surface depressions and potential sudden ground subsidence. Grading and excavations by man often hastens the formation of karst manifestations as new surface and subsurface drainage pathways are formed where water is allowed to flow and/or pond.

The bedrock within the general geographic region, particularly north of the subject site, is characterized by soluble carbonate lithologies interbedded with non-carbonate lithologies. These carbonate formations are generally highly calcareous, moderately to highly solution prone, and typically weather differentially to produce a pinnacled top of rock profile. A pinnacled top of rock is characterized by areas of shallow bedrock, termed pinnacles, with intervening areas of deeper soils, termed cutters. The degree of weathering or solutioning is often controlled by lithological variations and structural orientations. Where structural discontinuities, such as faults or joints, intersect or in areas which are highly fractured, solutioning is intensified creating low areas and

seams that are typically filled with residual clay soils. Conversely, more competent, high areas represent slightly too non-fractured lithologies that are often coarser grained and only slightly solution prone.

Due to the natural weathering and residual soil development processes in karst terrain, the surficial soils occasionally exhibit higher densities/consistencies than the underlying soils closer to the bedrock interface. Deeper soils tend to exhibit lower in-situ density and strength and generally have higher silt content with corresponding lower clay content. Therefore, the residual soils encountered near the soil/bedrock interface tend to be of lower bearing capacity. In addition, the soils near this interface may be in a saturated condition due to the development of perched groundwater on top of the bedrock.

Considering the presence of carbonate rock encountered at the project site, there is an inherent risk of sinkhole development that could impact the proposed structures. Additional exploration consisting of electrical resistivity imaging (ERI), pneumatic hammer probes, and/or additional soil borings with rock probes may be performed to further assess the possibility of sinkhole development or ongoing sinkhole activity at the subject site. Additional exploration will primarily be focused on evaluating the depth and profile of the bedrock within critical areas of the site along with anomalous areas of excessively soft or wet soils that could indicate active raveling within the subsurface. We recommend that the additional exploration consist of a staged approach starting with a geophysical evaluation using ERI. ERI will provide a 2-dimensional profile along selected transects that will aid in guiding additional test boring locations. Following completion of ERI, selected areas will be drilled using conventional drilling techniques, SPT testing, and rock coring. If the ERI and drilling indicate subsurface conditions that are indicative of incipient sinkhole activity, probing with an air-track drill may be performed to further delineate areas of concern and more thoroughly evaluate the consistency of the bedrock.

It should be noted that sinkhole development is unpredictable and subsurface explorations cannot completely eliminate the possibility of sinkhole development at a project site. Therefore, some risk of sinkhole development will always exist for the site given its geologic location. It is noted that there are not any sinkholes currently mapped at the site or in the immediate area as mapped by Loudoun County. The nearest mapped sinkhole is located about 0.75± miles west-northwest of the site on the property of Heritage High School.

3.4 SOIL SURVEY MAPPING

The natural soils which have resulted from the in-place physical and chemical weathering of the underlying bedrock are composed primarily of residual clayey or silty soils with increasing amounts of sand with depth. The granular nature of the residual soils generally increases with depth as does the percentage of rock fragments. These layers are termed weathered rock due to their rocklike structure but exhibit characteristics which qualify them as soil. The soil to rock transition in sandstone and conglomerate lithology is generally gradual but can be abrupt in carbonate rich environments.

In addition, we have also reviewed the available Loudoun County Soils Mapping. Table 3.4.1 briefly presents the pertinent characteristics of the soil types mapped at this site.

Table 3.4.1 Soil Type Characteristics by Mapping Unit (per Loudoun County)

Mapping Unit	Soil Group	Typical Terrain	Parent Rock	Problems/Limiting Factors	Soil Class
14B	Manassas Silt Loam	Concave upland positions	Triassic Siltstone and Shales	Low bearing capacity & short duration perched water tables	IV
73B	Penn Silt Loam	Sloping Convex Landscapes	Siltstones and Shales	Perched Water Tables	I
73C	Penn Silt Loam	Sloping Convex Landscapes	Siltstones and Shales	Shallow to Rock	I
78A	Dulles Silt Loam	Nearly Level Landscapes	Siltstones and Shales	Low Soil Strength, Prolonged Perched Water Table	IV

According to the Loudoun County Soils Mapping, the site is generally in an area mapped with Class I to Class IV soils, corresponding to good to very poor potential for general site development. The soils mapped as Class IV soils are typically due to a seasonal perched/high water table and low strength soils.

Perched Water Tables, Low Bearing Capacity/Soil Strength Soils, and Shallow Rock

Engineering recommendations addressing the possible presence of soils with perched water tables are addressed in the Groundwater Observations section, in the section entitled Construction Groundwater Control, and in the General Construction Considerations section. Low Bearing Capacity and Low Soils Strength soils are discussed in the Foundation Design section. Shallow rock is discussed in the Rock Excavation section.

In order to depict the soil types, geologic mapping information and Loudoun County Soil Survey information for the project site was compiled onto two overlays (Sheets 2 and 3) which are included in Appendix A of this report. The overlays were taken by applying AutoCAD procedures to digitize various maps produced by the U.S. Geological Survey (USGS) and the Natural Resource Conservation Service (NRCS). As in any field mapping situation, there may be discrepancies between field conditions and map conditions due to a variety of factors including misidentification of soil types, errors in scaling, and problems with regard to "digitizing" the various maps. Therefore, the soil, bedrock, and geologic boundaries depicted on the diagrams should be considered approximate.

3.5 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published geological and soils mapping. The following sections provide generalized characterizations of the soil and rock strata encountered during our subsurface exploration.

Table 3.5.1 Subsurface Stratigraphy

Approximate Depth Range (ft)	Stratum	Description	Ranges of SPT(1) N-values (bpf)
0-0.75 feet (Surface cover)	n/a	Surface cover includes up to 2± inches of topsoil. 2.25± inches of asphalt and 7± inches of gravel base material was encountered at Boring BH-8.	N/A
0.25-25 feet	I	Residual Soft to hard Fat and Lean CLAYS (CH,CL) and loose to dense SILT (ML)	4 to 43
0 feet to End of Boring	II	Very Dense Weathered Siltstone and Limestone Conglomerate Rock	>60

Notes: (1) Standard Penetration Test

Auger refusal was encountered in Borings BH-1 through BH-5 and BH-8 between the depths of 2.3 feet and 17 feet below existing grades. A rock fragment obtained from boring BH-2 was tested with hydrochloric acid to aid in identifying carbonate rock and strong effervescence was observed.

3.6 GROUNDWATER OBSERVATIONS

Groundwater was encountered while drilling in Borings BH-6 and BH-7 at depths of 18± feet and 13± feet below the existing ground surface, respectively.

Water levels were measured in our borings as noted on the soil boring logs in Appendix B. Groundwater depths measured at the time of drilling ranged from 15 to 16.4 feet below ground surface, between EL. 364.5 to EL 367 ft in Borings BH-6 and BH-7. Stabilized groundwater level readings were obtained in Borings BH-2 and BH-4 approximately 24 hours after completion of drilling. Stabilized groundwater depths ranged between 3 feet and 9 feet, between EL. 378 to EL 387 ft. Variations in the long-term water table may occur as a result of changes in precipitation, evaporation, surface water runoff, construction activities, and other factors. Based on these observations it is expected that the water tables observed are associated with a perched water table.

The site geology is conducive to the occurrence of perched water. Perched water occurs as precipitation that enters the site, either directly or from overland flow from adjacent properties, begins to percolate through the near surface soils. Once the water percolation reaches the bedrock it begins to flow at the intersection of the rock and the soil. This groundwater flow continues down gradient with the water table occasionally surfacing to form as springs and intermittent streams. In karst prone geology, the groundwater levels can change abruptly depending on the level of dissolution and fracturing within the bedrock. Only in the lowest lying areas and adjacent to existing creeks is a shallow groundwater table typically in a continuous condition. Otherwise, it is usually related to precipitation, although springs may exist in the lower lying areas for extended periods of time without recharge from precipitation. Therefore, the groundwater conditions at this site are expected to be significantly influenced by surface water runoff and precipitation.

The highest groundwater observations are normally encountered in the late winter and early spring. Variations in the location of the long-term water table may occur as a result of changes in precipitation, evapo-transpiration, surface water runoff, and other factors not immediately apparent at the time of this exploration. The site may also be subject to severe desiccation during extended dry periods. Therefore, earthwork operations, especially in the winter and spring months are more likely to encounter difficulties with perched conditions than those operations undertaken in the summer or fall.

3.7 INFILTRATION TESTING

Infiltration testing for the proposed stormwater management areas was proposed for this project. However, weathered limestone conglomerate was encountered in Boring BH-2 at a depth of 13.5 feet below the existing ground surface. The project site is located in an area underlain by bedrock that contains carbonate material and known karst conditions exist in the vicinity of the project site. The addition of water into the subsurface from infiltrating stormwater management facilities can exacerbate raveling of soils into bedrock voids and accelerate sinkhole development. Therefore, it is typical practice to limit infiltration by installation of liners around stormwater management facilities in karst prone areas. Based on the above reasoning, the infiltration testing was cancelled during the field exploration.

4.0 LABORATORY TESTING

The laboratory testing performed by ECS for this project consisted of selected tests performed on samples obtained during our field exploration operations. Classification and index property tests were performed on representative soil samples obtained from the test borings in order to aid in classifying soils according to the Unified Soil Classification System and to quantify and correlate engineering properties.

An experienced geotechnical engineer visually classified each soil sample from the test borings on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS) and ASTM D-2488 (Description and Identification of Soils-Visual/Manual Procedures). After classification, the geotechnical engineer grouped the various soil types into the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs are approximate; in situ, the transitions may be gradual, rather than distinct.

Select soil samples were chosen for additional testing which includes moisture content, Atterberg Limits, Grain Size analysis, and California Bearing Ratio testing. The results of this additional testing can be found in Appendix C. The soil samples obtained from this exploration will be retained at our laboratory for a period of 60 days from the time drilling was completed. After 60 days from completion of drilling, they will be discarded unless we receive other direction from you.

5.0 DESIGN RECOMMENDATIONS

5.1 BUILDING DESIGN

The design recommendations outlined in this report are based on the 12 soil test borings performed within the proposed expansion and development limits. The following sections provide recommendations for foundation design, soil supported floor slabs, and seismic design parameters.

5.1.1 Foundations

ECS was not provided with proposed finished floor elevations or structural loading information at the time of writing this report. Based on past experiences with similar structures, we have assumed that column loads will be on the order of 100 kips or less and wall loads will be on the order of 5 kips/linear foot or less for the hangars. When actual structural loads are determined, ECS must be informed so that we may re-evaluate our recommendations.

The design team should be sensitive to the fact that the foundations for the portions of the hangar in the area of Boring B-3, B-4, B-5, and B-8 will bear at or near the elevation of auger refusal. The foundation for the remainder of the building are expected to bear on existing soils or new engineering fill material. Total allowable settlement of the proposed structure must be limited to the allowable differential settlement between bearing strata. Our settlement calculation using our assumed loads estimates differential settlement up to ¾ inches for adjacent foundations bearing on rock or weathered rock and natural soils. Our settlement calculation assumes that any unsuitable or wet/saturated existing fill and/or highly plastic soils are removed and replaced with new engineered fill in accordance with the Fill Placement section of this report. The design should consider the potential differential settlement for any connected areas or utilities between the differing bearing strata. Settlement estimates presented herein are based on the assumed loading above.

Provided subgrades and structural fills are prepared as discussed herein, the proposed structure can be supported by conventional shallow foundations: individual column footings and continuous wall footings. The design of the foundation shall utilize the following parameters:

Table 5.1.1.1 Foundation Design

Design Parameter	Column Footing	Wall Footing
Net Allowable Bearing Pressure (Stratum I Soil/Structural Fill) [1]	2,000 psf	2,000 psf
Acceptable Bearing Soil Material	Engineered Fill or Stratum I and II	Engineered Fill or Stratum I and II
Minimum Width	24 inches	18 inches
Minimum Footing Embedment Depth (below slab or finished grade)	24 inches	24 inches
Estimated Total Settlement	< 0.75 inch	< 0.75 inch
Estimated Differential Settlement	0.5 to 0.75 inches between columns	0.5 to 0.75 inches between columns

1. Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.

The allowable soil bearing pressure refers to that pressure which may be transmitted to the foundation bearing soils in excess of the final minimum surrounding overburden pressure. During construction, the bearing capacity at the final footing excavation should be tested in the field by the Geotechnical Engineer of Record (GER), or their authorized representative to document that the in-situ bearing capacity at the bottom of each footing excavation is adequate for the design loads.

Layers of high plasticity Fat CLAY (CH) was encountered in Borings BH-6 and BH-12 at a depth of 2± feet to 12± feet below the existing ground surface. High plasticity Fat CLAY (CH) was not encountered in any of the other borings performed. If encountered, these materials should be completely stripped from the building pads and pavement areas prior to foundation construction as these materials will not provide suitable bearing capacities. The recommendations provided in the Highly Plastic Soils section of this report should be followed. The presence or absence of high plasticity soils should be documented by the soils technician using hand auger probes at the time of footing observation and testing.

We recommend that continuous footings have a minimum width of 1.5 feet. The minimum dimensions recommended above help reduce the possibility of foundation bearing failure and excessive settlement due to local shear or "punching" action. In addition, footings should be placed at a depth to provide adequate frost cover protection. Therefore, we recommend footings be placed at a minimum depth of 2 feet below the finished grade. A Typical Foundation Detail is included in Appendix D for reference purposes.

If soft or unsuitable soils are observed at the footing bearing elevations, the unsuitable soils should be undercut and removed. Any undercut should be backfilled with suitable lifts of compacted structural fill, or lean concrete ($f'_c \geq 1{,}000$ psi at 28 days) up to the original design bottom of footing elevation; the original footing shall be constructed on top of the hardened lean concrete.

5.1.2 Floor Slabs

The on-site natural soils (with the exception of the Fat CLAY (CH) soil) and any imported fill soils meeting the criteria presented in the Earthwork Operations are considered suitable for support of the lowest floor slabs, although moisture control during earthwork operations, including the use of discing or appropriate drying equipment, may be necessary.

The finished floor elevation of the new buildings was not provided. The slab for the buildings will likely bear on new structural fill or the Stratum I or II material. This material is likely suitable for the support of a slab-on-grade, however, there may be areas of soft or yielding soils that should be removed and replaced with compacted structural fill in accordance with the recommendations included in this report. The following graphic depicts our soil-supported slab recommendations:

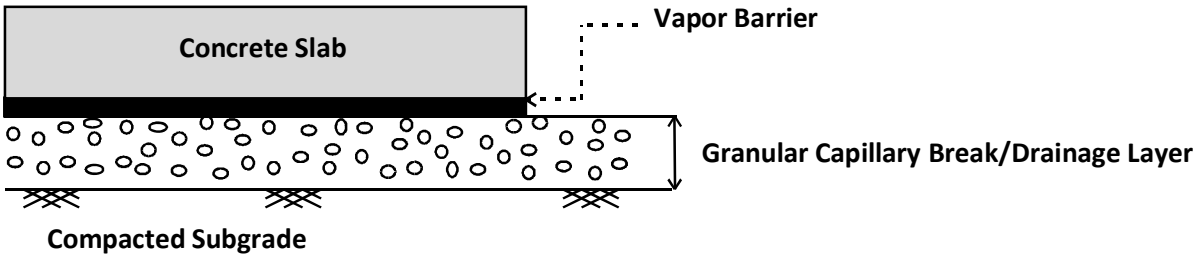


Figure 5.1.2.1

1. Drainage Layer Thickness: 4 inches minimum
2. Drainage Layer Material: Granular material – Less than 2% fines
3. Subgrade compacted to 95% maximum dry density per ASTM D698

Subgrade Modulus: Provided the placement of Structural Fill and Granular Drainage Layer per the recommendations discussed herein, the slab may be designed assuming a modulus of subgrade reaction, k_1 of 100 pci (lbs/cu. inch). The modulus of subgrade reaction value is based on a 1 foot by 1 foot plate load test basis.

Slab Isolation: Ground-supported slabs should be isolated from the foundations and foundation-supported elements of the structure so that differential movement between the foundations and slab will not induce excessive shear and bending stresses in the floor slab. Where the structural configuration prevents the use of a free-floating slab, the slab should be designed with suitable reinforcement and load transfer devices to preclude overstressing of the slab. Maximum differential settlement of soils supporting interior slabs is anticipated to be less than 1 inch in 40 feet.

High Plasticity Soils: If high plasticity soils are encountered at or within 2 feet below the slab subgrade surface, it is recommended that the high plasticity soils be removed to a depth of 2 feet below the bottom of slab and replaced with a non-expansive, granular fill material that is placed and compacted in accordance with the recommendations contained within this report.

5.1.3 Seismic Design Considerations

Seismic Site Classification: The International Building Code (IBC) 2015 and Chapter 20 of ASCE 7 require site classification for seismic design based on the upper 100 feet of a soil profile. Three methods are utilized in classifying sites, namely the shear wave velocity (v_s) method; the unconfined compressive strength (s_u) method; and the Standard Penetration Test Resistance (N-value) method. Where site specific data are not available to a depth of 100 feet, appropriate soil properties are permitted to be estimated by the registered design professional preparing the soils report based on known geologic conditions. The seismic site class definitions for the weighted average of either the SPT N-values or the shear wave velocities in the upper 100 feet of the soil profile are presented in Chapter 20 of ASCE 7 and in the table below.

Table 5.1.3.1 Seismic Site Classification

Site Class	Soil Profile Name	Shear Wave Velocity, Vs, (ft./s)	N value (bpf)
A	Hard Rock	Vs > 5,000 fps	N/A
B	Rock	2,500 < Vs ≤ 5,000 fps	N/A
C	Very dense soil and soft rock	1,200 < Vs ≤ 2,500 fps	>50
D	Stiff Soil Profile	600 ≤ Vs ≤ 1,200 fps	15 to 50
E	Soft Soil Profile	Vs < 600 fps	<15

In the absence of actual shear wave (V_s) data, we utilized the Standard Penetration Test (SPT) N-values recorded from the borings. Considering the shallow rock surface encountered at this site and our experience with other projects in the area, we recommend that the design for the buildings be based on a seismic site classification of Site Class D. The Site Class definition should not be confused with the Seismic Design Category designation, which the Structural Engineer typically assesses. If a higher site classification is beneficial to the project, ECS would be pleased to discuss additional testing capabilities in this regard.

Ground Motion Parameters: In addition to the seismic site classification noted above, ECS has determined the design spectral response acceleration parameters following the IBC 2015 methodology. The Mapped Reponses were estimated from the free U.S. Seismic Design Maps available from the OSHPD website (http://seismicmaps.org/). The design responses for the short (0.2 sec, S_{DS}) and 1-second period (S_{D1}) are noted in bold at the far right end of the following table.

Table 5.1.3.2 Ground Motion Parameters *(IBC 2015 Method)*

Period (sec)	Mapped Spectral Response Accelerations (g)		Values of Site Coefficient for Site Class		Maximum Spectral Response Acceleration Adjusted for Site Class (g)		Design Spectral Response Acceleration (g)	
Reference	Figures 1613.3.1 (1) & (2)		Tables 1613.3.3 (1) & (2)		Eqs. 16-37 & 16-38		Eqs. 16-39 & 16-40	
0.2	S_S	0.124	F_a	1.6	$S_{MS}=F_aS_s$	0.198	$S_{DS}=2/3\ S_{MS}$	0.132
1.0	S_1	0.052	F_v	2.4	$S_{M1}=F_vS_1$	0.125	$S_{D1}=2/3\ S_{M1}$	0.083

5.2 SITE DESIGN CONSIDERATIONS

The site generally appears suitable for the design and construction of the proposed north apron expansion. The primary factors that could affect the proposed development are a shallow rock surface, the potential for soft clays and carbonate rock, and the potential for perched groundwater. More detailed analysis and recommendations are included in the following sections.

5.2.1 Pavement Considerations

Subgrade Characteristics: Based on the results of our soil test borings, it appears that the soils that will be exposed as pavement subgrades, exposed in cuts and placed as fill, will consist mainly of Lean CLAY (CL) or SILT (ML). For design purposes a CBR value equal to 2/3 of the average tested

value should be used; therefore, a CBR value of 4 should be utilized based on the results of our CBR testing. It should be noted that a tested CBR value of 3 was obtained from the sample of Fat CLAY (CH) material encountered in Boring BH-12. This material is not considered suitable for use as pavement subgrade material and was not included in the above average value. The pavement design assumes subgrades consist of suitable materials evaluated by ECS and placed and compacted to at least 98 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D 698) in accordance with the project specifications.

Rigid Concrete Pavements: For heavy-duty traffic areas, the Portland cement concrete pavement section should consist of air-entrained Portland cement concrete having a minimum 28-day compressive strength of 4,000 psi. The rigid pavement section should be provided with construction joints at appropriate intervals per Portland Cement Association (PCA) requirements. The construction joints should be reinforced with dowels to transfer loads across the joints.

Weather Restrictions: In this region, asphalt plants may close during the months of December, January, and/or February if particularly cold weather conditions prevail. However, this can change based on year to year temperature fluctuations. Daily temperatures from December to February will often stay below 40°F, limiting the days that asphalt placement can occur.

5.2.2 Stormwater Management Facilities

Based on the preliminary plans provided to us by Talbert & Bright, three stormwater management facilities are proposed as part of this project. One is labeled as a dry swale and located in the northwestern portion of the site. The other two are shown within a proposed pavement area on the southern end of the site and assumed to be an underground vault system. No further details of elevations of the proposed SWM facilities were provided.

Infiltration testing was not performed within the proposed stormwater management facilities due to the presence of underlying bedrock that contains carbonate material and known karst conditions that exist in the vicinity of the project site. We do not recommend that the stormwater management facilities be designed as infiltration ponds. We recommend that in these areas, perforated PVC underdrains be utilized with the addition of a pond liner or an underground vault system be constructed.

Pond Liner: We recommend a pond liner be included at the bottom and the sides in areas of the proposed stormwater management facilities. This is especially important since infiltration of water can exacerbate raveling of soils into bedrock voids and accelerate sinkhole development. If used, the proposed liners should consist of a minimum of 1 foot of compacted clay (CL or CH) materials with an additional 1 foot layer of compacted soil above it for protection. The liner should consist of a moderate to high plasticity clay, classified as CL/CH and have at least 30% clay sized particles, plasticity index greater than 15, liquid limit greater than 40, and a maximum permeability of $1x10^{-6}$cm/sec. We also recommend the soils for the liner be installed at 2 to 3 percentage points above optimum moisture content and compacted to 95% of the maximum dry density.

It is anticipated that the surficial materials excavated from site may be suitable for reuse as liner materials provided that gravel sized particles are limited to less than 10% by weight of the material. Sufficient amounts of clayey materials should be present on the site; however, as an

alternative, an artificial liner consisting of a geosynthetic membrane (30-mil poly liner or equivalent) can be utilized. The geosynthetic liner must be installed according to manufacturer instructions.

5.2.3 Karst-Related Risk and Construction Issues

Karst geology presents the developer with unique hazards and these hazards significantly increase the risk associated with developing a site. Risks associated with developing in Karst can include the formation of sinkholes that may form beneath buildings, roadways, utility lines, stormwater management ponds, dams, and other manmade structures. These features can occur as a gradual erosion of soils into the subsurface causing settlement damage to structures over a long period of time, or rapidly in the case of a sudden cover collapse sinkhole as has been witnessed in the recent past in other areas of the country. In addition to sinkhole hazards, the sudden collapse of cave roofs due to overloading by structures can also occur. Karst hazards may sometimes lead to personal injury but rarely do they result in loss of life. Property damage due to Karst hazards can range from simple inconvenience to catastrophic property loss.

When developing in karst prone geology, there is always a risk that karst hazards may impact the project, either during construction, or years and decades after the completion of construction. Creating new drainage channels and impoundments for stormwater management activities during land development, collection of groundwater in utility pipelines, leaking utilities, and pumping of groundwater for mining or water supply purposes are some human influences that have led to the development of unsuspected karst problems.

6.0 SITE CONSTRUCTION RECOMMENDATIONS

6.1 SUBGRADE PREPARATION

6.1.1 Stripping and Grubbing

The subgrade preparation should consist of stripping all surface cover materials, topsoil, and any other soft or unsuitable material from the structure and pavement areas. We recommend that site stripping depths account for the topsoil and possible variations in topsoil thickness between boring locations. We recommend the earthwork clearing be extended a minimum of 10 feet beyond the building and pavement limits. Stripping limits should be extended an additional 1 foot for each foot of fill required at the building's exterior edge. The limits discussed in this paragraph define the expanded building and pavement limits.

If encountered, pockets of highly plastic soils remaining after grading operations, should be removed to the depths described in the Highly Plastic Soils section of this report. Care must be exercised to identify additional unsuitable materials, and cause their removal. Procedures such as proofrolling, observation, or test pitting operations may be utilized to assist in identifying the presence of unsuitable materials, as required.

The preparation of fill subgrades, as well as proposed buildings or pavement subgrades should be observed on a full-time basis. These observations should be performed by the GER, or their representative, to document the unsuitable materials that have been removed, and that the subgrade is suitable for support of the proposed construction and/or fills. Procedures such as proofrolling, observation, or test pitting operations may be utilized to assist in identifying the presence of unsuitable materials, as required.

Pavement areas should be thoroughly evaluated with proofrolling at the time of construction to identify areas that may be unsuitable. We recommend that the GER or their authorized representative be present during initial stripping and during excavation of the building footprint to help in delineating suitable and unsuitable materials. Any unsuitable areas identified should be undercut and replaced with suitable fill material compacted as described in this report or otherwise remediated as directed by the GER.

Soil bridging lifts within the expanded building and pavement limits should not be used. Excessive settlement of the structures may occur when bridging lifts are utilized in structural areas. Any soft areas should be removed or stabilized in place with geosynthetics and engineered fill as necessary. Recommendations regarding in-place stabilization of soft or unsuitable subgrade materials should be provided by the GER at the time of construction.

6.1.2 Proofrolling

After removing all unsuitable surface materials, cutting to the proposed grade, and prior to the placement of any structural fill or other construction materials, the exposed subgrade should be examined by the GER or authorized representative. The exposed subgrade should be thoroughly proofrolled with previously approved construction equipment having a minimum axle load of 10 tons (e.g. fully loaded tandem-axle dump truck). The areas subject to proofrolling should be

traversed by the equipment in two perpendicular (orthogonal) directions with overlapping passes of the vehicle under the observation of the GER or authorized representative. This procedure is intended to assist in identifying any localized yielding materials. In the event that unstable or "pumping" subgrade is identified by the proofrolling, those areas should be marked for repair prior to the placement of any subsequent structural fill or other construction materials. Methods of repair of unstable subgrade, such as undercutting or moisture conditioning or chemical stabilization, should be discussed with the GER to determine the appropriate procedure with regard to the existing conditions causing the instability. A test pit(s) may be excavated to explore the shallow subsurface materials in the area of the instability to help in determined the cause of the observed unstable materials and to assist in the evaluation of the appropriate remedial action to stabilize the subgrade. Any soft or unsuitable materials encountered during this proofrolling should be removed and replaced with an approved backfill compacted to the criteria given below in the section entitled Structural Fill and Placement.

6.1.3 Construction Groundwater Control

The long term continuous groundwater table at the site is expected to be well below the depth of auger/sampler refusal. However, groundwater conditions encountered at the site are strongly influenced by surface water flow and infiltration. Specifically, water that enters the site migrates downward to the interface of the fill soils, natural soil, and rock. Once the water reaches the less permeable natural soil or rock, the water travels laterally, often over large distances. Such perched groundwater conditions may be encountered during construction operations. The perched groundwater conditions are seasonal in nature. While perched groundwater conditions may not be encountered during the summer months, such conditions can occur in the winter and late spring months.

It is common to have "springs" develop in areas which were previously dry once initial grading operations have commenced. The degree of fracturing within the rock materials can be increased and altered significantly by grading operations. These conditions should be anticipated and can be handled through the use of French drains installed on the uphill side of any excavations performed on site. In addition, French drains may need to be installed in areas where springs develop.

The surface of the site should be kept properly graded in order to enhance drainage of the surface water away from the proposed building and pavement areas during the construction phase. We recommend that an attempt be made to enhance the natural drainage without interrupting its pattern.

It is critically important that planning operations consider construction groundwater control. One of the more cost effect techniques that can be utilized for groundwater control, we believe, is through the prudent utilization of French drains, and in planning utility installations. For example, any utility installation that requires a gravity feed, such as sewer lines, can be effectively converted into "French drains" to help assist in groundwater control. A French Drain Installation Detail in included in Appendix D of this report.

Details of a typical french drainage installation are included as an attachment to this report. If utilized, the French drain should consist of a filter fabric lined trench filled with No. 57 stone or equivalent open graded stone. A minimum of 4-inch diameter PVC pipe may be placed in the

stone bed to enhance water flow. After this installation has been completed, the filter fabric should be wrapped over the top of the gravel and pipe whereupon placement of fill may proceed to grade.

6.1.4 Subgrade Stabilization

Subgrade Benching: Fill should not be placed on ground with a slope steeper than 5H:1V, unless the fill is confined by an opposing slope, such as in a ravine. Otherwise, where steeper slopes exist, the ground should be benched so as to allow for fill placement on a horizontal surface.

Subgrade Compaction: Upon completion of subgrade documentation, the exposed subgrade within the 10-foot expanded building and 5-foot expanded pavement and embankment limits should be moisture conditioned to within ±3% of the soil's optimum moisture content and be compacted with suitable equipment (minimum 10-ton roller) to a depth of 10 inches. Subgrade compaction within the expanded building, pavement, and embankment limits should be to a dry density of at least 95% of the Standard Proctor maximum dry density (ASTM D698). ECS should be called on to document that proper subgrade compaction has been achieved.

Subgrade Compaction Control: The expanded limits of the proposed construction areas should be well defined, including the limits for buildings, pavements, fills, and slopes, etc. Field density testing of subgrades will be performed at frequencies in Table 6.1.4.1.

Table 6.1.4.1 Frequency of Subgrade Compaction Testing

Location	Frequency of Tests
Expanded Building Limits	1 test per 2,500 sq. ft.
Pavement Areas	1 test per 10,000 sq. ft.
Outparcels/SWM Facilities	1 test per 2,500 sq. ft.
All Other Non-Critical Areas	1 test per 10,000 sq. ft.

Subgrade Stabilization: Is some areas, particularly low-lying, wet areas of the site, undercutting of excessively soft materials may be considered inefficient. In such areas the use of a reinforcing geotextile or geogrid might be employed, under the advisement of ECS. Suitable stabilization materials may include medium duty woven woven geotextile fabrics or geogrids. The suitability and employment of reinforcing or stabilization products should be determined in the field by ECS personnel, in accordance with project specifications.

6.2 EARTHWORK OPERATIONS

6.2.1 Structural Fill and Placement

Product Submittals: Prior to placement of Structural Fill, representative bulk samples (about 50 pounds) of on-site and off-site borrow should be submitted to ECS for laboratory testing, which will include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications.

Satisfactory Structural Fill Materials: In general, new Structural Fill materials for use as backfill, or for support of pavements should consist of an approved material, free of organic matter, debris, cobbles, and rock fragments greater than 4 inches in diameter. The Structural Fill should also have a Liquid Limit and Plasticity Index less than or equal to 45 and 20, respectively, unless they are shown to have "very low" expansion potential. Unacceptable Structural Fill materials include topsoil and organic materials (OH, OL, and PT), and high plasticity Elastic SILT (MH) or Fat CLAY (CH) that cannot be shown to have "very low" expansion potential.

The onsite soil may be reused as Structural Fill provided that it does not contain organic matter or foreign debris, are not highly plastic, are not environmentally impacted and conform to the criteria outlined above. Most of the on-site surficial soils will be suitable for use as fill. Additional laboratory testing, consisting of Atterberg limits and expansion index testing, should be performed to further define areas of high plasticity soils. It is also possible that soils classified as low plasticity Lean CLAY or SILT (CL or ML) will have high plasticity indices that will make them unsuitable for use as fill. The suitability of any on-site materials for reuse as engineered fill should be evaluated at the time of construction by the GER or their authorized representative.

Care should be exercised to not mix highly plastic soils with other suitable soils. Unacceptable fill soils may be placed in non-structural areas or treated with lime to modify their properties. The suitable on-site soil may require moisture content adjustments, such as the application of discing or other drying techniques or spraying of water prior to use as controlled fill materials. The planning of earthwork operations should recognize and account for these efforts and increased costs.

6.2.2 Karst Related Earthwork Recommendations

As noted previously, the project site is located in an area underlain by bedrock that contains carbonate material and known karst conditions exist in the vicinity of the project site. The carbonate rocks in the site vicinity can form karst topography with highly variable rock surfaces due to solutioning in water over long periods of time. Therefore, limited risk of sinkhole development does exist at the site given its geologic location and the subsurface conditions encountered.

Although sinkholes stem from geologic conditions within the underlying rock, they are often triggered by changes in the surface and subsurface drainage patterns. In order to reduce the potential for future sinkhole development which could impact overall project performance, positive surface drainage should be maintained both during and after construction. We recommend that the following preventative measures be followed, where practical, to reduce the potential inducement of sinkhole formation in proposed development areas.

1. All earthwork operations should be graded to drain away from the building and structural areas at all times. Upon completion of daily earthwork operations, the ground surface should be sealed by thorough rolling to reduce infiltration of precipitation and facilitate runoff.

2. All sediment control management facilities should be located outside of planned construction areas. Inlets associated with storm drain systems should not be utilized as temporary sediment control devices during construction.

3. During construction, care should be taken to reduce the ponding of surface water in and/or adjacent to the building and structures. The foundations should be excavated and poured the same day, if possible, or the founding soils must be provided with a mud mat.

4. Visual observations during all earthwork operations should be carried out in order to detect any previous unexposed or recently created collapse features. Any such feature should be called to the GER's attention for remedial improvement.

5. Final site grading should include sloping grades and piping of downspouts away from the building and structural areas.

6. All storm piping should be designed such that joints and structure tie-ins remain watertight with allowance for some settlement. Leaking storm pipes promote subsurface seepage and can instigate sinkhole development in the form of surficial dropouts with little or no warning.

Areas identified to be suspect during the initial earthwork phase should be further explored during construction to determine the extent, both vertically and horizontally, of possible solution activity. We recommend that all available geotechnical data be made available to the GER and/or their onsite representative during earthwork operations.

6.2.3 Compaction

Structural Fill Compaction: Structural Fill materials should be placed in lifts not exceeding 8 inches in loose thickness and moisture conditioned to within ±3 percentage points of the optimum moisture content. Where Structural Fill will have a total thickness not exceeding 8 feet, the soil should be compacted to a minimum of 95% of the maximum dry density obtained in accordance with ASTM Standard D 698, Standard Proctor Method or Virginia Test Method (VTM-1). The upper 6-inches of subgrades for pavement areas should be compacted to a minimum of 100% of VTM-1 or ASTM D 698.

In any areas where the total depth of Structural Fill will exceed 8 feet, we recommend that these fill zones be placed as early as possible in the earthwork operations phase. Where the fill depth will be 8 feet or more, we recommend that the fill soils be compacted to a minimum of 98% of the maximum dry density obtained in accordance with ASTM D-698 or VTM-1, for the full depth of the fill. The purpose of the higher compaction criteria is to reduce differential settlement between natural cut soils and controlled fill soils.

Fill Compaction Control: The expanded limits of the proposed construction areas should be well defined, including the limits of the fill zones for buildings, pavements, and slopes, etc., at the time of fill placement. Grade controls should be maintained throughout the filling operations. All filling operations should be observed on a full-time basis by a qualified representative of the construction testing laboratory to determine that the minimum compaction requirements are being achieved. Field density testing of fills will be performed at the frequencies shown in Table 6.2.3.1, but not less than 1 test per lift.

Table 6.2.3.1 Frequency of Compaction Tests in Fill Areas

Location	Frequency of Tests
Expanded Building Limits	1 test per 2,500 sq. ft. per lift
Pavement Areas	1 test per 10,000 sq. ft. per lift
Utility Trenches	1 test per 200 linear ft. per lift
Outparcels/SWM Facilities	1 test per 2,500 sq. ft. per lift
All Other Non-Critical Areas	1 test per 10,000 sq. ft. per lift

Compaction Equipment: Compaction equipment suitable to the soil type being compacted should be used to compact the subgrades and fill materials. Sheepsfoot compaction equipment should be suitable for the fine-grained soils (Clays and Silts). A vibratory steel drum roller should be used for compaction of coarse-grained soils (Sands) as well as for sealing compacted surfaces.

Fill Placement Considerations: Because of the moisture and disturbance sensitive nature of the silt and clay soils at the site, the initial 1 to 2 lifts of fill may need to be compacted without vibratory efforts. Vibratory compaction equipment may cause disturbance of the near surface site soil and upward migration of moisture into the engineered fill which could inhibit compaction efforts. After placement of the initial one to two lifts, vibratory compaction can proceed, if appropriate.

Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and all frozen or frost-heaved soils should be removed prior to placement of Structural Fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

At the end of each work day, all fill areas should be graded to facilitate drainage of any precipitation and the surface should be sealed by use of a smooth-drum roller to limit infiltration of surface water. During placement and compaction of new fill at the beginning of each workday, the Contractor may need to scarify existing subgrades to a depth on the order of 4 inches so that a weak plane will not be formed between the new fill and the existing subgrade soils.

Drying and compaction of wet soils is typically difficult during the cold, winter months. Accordingly, earthwork should be performed during the warmer, drier times of the year, if practical. Proper drainage should be maintained during the earthwork phases of construction to prevent ponding of water which has a tendency to degrade subgrade soils. Alternatively, if these soils cannot be stabilized by conventional methods as previously discussed, additional modifications to the subgrade soils such as lime or cement stabilization may be utilized to adjust the moisture content. If lime or cement are utilized to control moisture contents and/or for stabilization, Quick Lime, Calciment® or regular Type 1 cement can be used. The construction testing laboratory should evaluate proposed lime or cement soil modification procedures, such as quantity of additive and mixing and curing procedures, before implementation. The contractor should be required to minimize dusting or implement dust control measures, as required.

Where fill materials will be placed to widen existing embankment fills, or placed up against sloping ground, the soil subgrade should be scarified and the new fill benched or keyed into the existing material (see VDOT Road and Bridge Specification Section 303.04(h)). Fill material should

be placed in horizontal lifts. In confined areas such as utility trenches, portable compaction equipment and thin lifts of 3 inches to 4 inches may be required to achieve specified degrees of compaction.

We recommend that the grading contractor have equipment on site during earthwork for both drying and wetting fill soils. We do not anticipate significant problems in controlling moisture within the fill during dry weather, but moisture control may be difficult during winter months or extended periods of rain. The control of moisture content of higher plasticity soils is difficult when these soils become wet. Further, such soils are easily degraded by construction traffic when the moisture content is elevated.

6.2.4 High Plasticity Soils

High plasticity Fat CLAY (CH) was encountered in Borings BH-6 and BH-12 at a depth of 2± feet to 12± feet below the existing ground surface, but was not encountered within any of the borings performed for this project. Highly plastic soils may be encountered elsewhere onsite in unexplored areas or between sampled locations. These soils can develop significant shrink/swell problems with variations in moisture content. If the field work is conducted during the winter or early spring months, it is expected that even the non-plastic clay and silt soils at the surface may need to be removed or dried prior to fill placement. As earthwork operations proceed, additional Atterberg Limits and Expansion Index tests are recommended in order to evaluate suitability of questionable on-site soils. High plasticity soils that cannot be shown to have "very low" expansion potential should be dealt with in accordance with the recommendations presented below.

Where expansive soils are encountered at foundation bearing level, the foundations may either step down to bear at a depth of 5 feet below finished exterior grade, or the footings may be undercut and backfilled to the original bearing elevation. Undercutting of the footings and backfilling with granular backfill or gravel is not recommended, as this would create a reservoir condition that could saturate the plastic soils. Undercut footings shall be backfilled with properly compacted, suitable fine grained soil or preferably, lean concrete to the original bearing elevation. Footings undercut in plastic clay soils should be excavated using a neat excavation and backfilled entirely with lean concrete. If the footings are stepped down to bear at a minimum depth of 5 feet below the finished exterior grades, the footings may bear on either high or low plasticity soils. At this depth, the footings are considered to be below the depth of seasonal moisture variation. In addition, floor slabs and pavements constructed in areas of high plasticity soils should be underlain by at least 2 feet of compacted, non-expansive suitable fill.

6.2.5 Rock Excavation

The excavation of soil and weathered rock can have a substantial impact on the cost and schedule of the proposed construction. This discussion considers two general classes of materials for purposes of describing excavatability. Residuum and weathered rock will be used as the terms for the materials to be excavated. It should be noted that depth to rock is highly variable on this site. Drastic changes in the rock elevation over short distances, isolated rock lenses, and float boulders are possible features on this site. The contractor should be prepared to remove rock in areas between boring locations during mass grading and excavation activities.

In mass excavations for general site work, overburden soils with standard penetration test N-values of 30 bpf or less can usually be removed with conventional earth excavation equipment. Residual soils or soft weathered (saprolitic) rock with N-values of 30 to 60 bpf can generally be removed with conventional earth moving equipment. Very dense and hard soils and more weathered phases of weathered rock (Stratum IV) will generally require the use of a large single-tooth ripper, dozers, and/or track-mounted backhoes for excavation. Typically, weathered rock which can be penetrated by soil augers (such as those used in this subsurface exploration) can be excavated after being loosened with a large single-tooth ripper. However, materials exhibiting N-values of 50 blows for 1 inch of penetration, typically defined as refusal material, will be more difficult to excavate and generally require blasting and other rock excavation techniques. The actual excavatability of the bedrock material will be greatly controlled by in-situ jointing and bedding and may vary from location to location.

In confined excavations, such as utility trenches, excavation of dense residual soils typically requires the use of large track-mounted backhoes. Excavation of harder phases of weathered rock (Stratum IV) typically requires the use of large track-mounted backhoes or pneumatic spades. Refusal materials (apparent rock) normally require blasting in trench excavations. Blasting is not recommended for this site as disturbance from blasting operations could exacerbate any incipient karst features, such as sinkholes.

Based on boring data obtained during the exploration, we anticipate that materials requiring difficult excavation techniques will be encountered during site grading and excavation to planned grades in most of the proposed cuts of more than 1 feet to 7 feet deep in the areas of borings B-3, B-4, B-5, and B-8. Weathered rock and rock was encountered at many of the boring locations and may result in excavation difficulties during earthwork operations.

When reviewing this data for planning purposes, consideration of the excavation capabilities of different equipment will be necessary. For example, a backhoe will likely not be able to excavate weathered rock materials as easily as a track hoe or ripper. At the same time, ripping may not be an appropriate excavation method for the desired activities. The values derived herein have been provided for informational purposes and are not intended to suggest or recommend excavation methods for utility infrastructure.

Irregularities in the base of the footing foundation are acceptable, if rock materials are encountered. For the purposes of bid documentation, any irregularity of up to one foot vertically for ten feet of horizontal distance is acceptable provided that the minimum foundation dimensions indicated on the approved plans are provided. As noted above, blasting is not recommended for sites underlain by carbonate rock.

6.2.6 Siltstone Considerations

Weathered siltstone material was encountered within Borings BH-1, BH-3, BH-4, BH-5, and BH-8 at a depths on the order of 0± feet to 12.5± feet below the existing ground surface. We anticipate that any siltstone materials removed during grading operations will likely be used as engineered fill. Reuse of these materials as engineered fill will require that they be properly manipulated to a suitable gradation prior to placement. The weathered siltstone material at this site will typically

excavate in relatively large, blocky and platy pieces, which are difficult to compact for suitable long-term performance. Also, these materials can experience rapid degradation due to weathering over relatively short periods of time, once exposed to air and water conditions. The rate of degradation and durability of the rock are dependent upon the level of metamorphism and constituent sedimentary materials.

For the purposes of this report, all siltstone materials at the site will be considered nondurable. Durability is the term used to describe the ability of a rock or rock-like material to withstand long-term chemical and mechanical weathering without size degradation. Larger pieces of silstone, which break up as rock-like fragments in the initial excavation, must be compacted with sufficient compaction energy to substantially break them down into soil size particles during construction. Nondurable siltstone materials removed in blast and ripping excavations may be used as fill if suitably decomposed by mechanical effort. Any siltstone excavated from the site and used as earthwork fill should have a well-graded grain size distribution with rock and soil particles ranging from clay or silt size particles to a maximum size of 6 inches in diameter with 2-inch thick plates. Particles larger than this should be decomposed by mechanical compaction equipment to achieve the desired grain size distribution. A minimum uniformity coefficient, C_u, of 6 should be used to identify the proper grain size distribution and the samples should have a minimum of 20% passing the #200 sieve and 50% passing the #40 sieve. Variations from these recommendations should be evaluated by the GER prior to fill placement.

Laboratory classification and Proctor compaction tests should be performed on samples that have been broken down by compaction equipment to be used for compaction of the fill. This may require manipulation of the material prior to obtaining samples for testing. Samples obtained should be representative of the materials intended to be used as fill with respect to gradation. It has been our experience that engineered fills constructed of siltstone materials tend to perform better when placed at moisture contents slightly wet of optimum. The water associated with moisture levels on the wet side of the optimum moisture content is believed to aid in the physical and mechanical breakdown of siltstone particles, as well as reduce the tendency of the soil matrix to absorb water after fill placement.

6.3 FOUNDATION AND SLAB OBSERVATIONS

Protection of Foundation Excavations: Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, a 1 to 3-inch thick “mud mat” of “lean” concrete should be placed on the bearing soils before the placement of reinforcing steel.

Footing Subgrade Observations: Most of the soils at the foundation bearing elevation are anticipated to be suitable for support of the proposed structure. It will be important to have the geotechnical engineer of record observe the foundation subgrade prior to placing foundation concrete, to confirm the bearing soils are what was anticipated. If soft or unsuitable soils are observed at the footing bearing elevations, the unsuitable soils should be undercut and removed.

Any undercut should be backfilled with lean concrete ($f'_c \geq 1{,}000$ psi at 28 days) up to the original design bottom of footing elevation; the original footing shall be constructed on top of the hardened lean concrete.

Slab Subgrade Verification: A representative of ECS should be called on to observe exposed subgrades within the expanded building limits prior to Structural Fill Placement to assure that adequate subgrade preparation has been achieved. A proofrolling using a drum roller or loaded dump truck should be performed in their presence at that time. Once subgrades have been prepared to the satisfaction of ECS, subgrades should be properly compacted and new Structural Fill can be placed. Existing subgrades to a depth of at least 10 inches and all Structural Fill should be moisture conditioned to within -1/+3 percentage points of optimum moisture content then be compacted to the required density. If there will be a significant time lag between the site grading work and final grading of concrete slab areas prior to the placement of the subbase stone and concrete, a representative of ECS should be called on to verify the condition of the prepared subgrade. Prior to final slab construction, the subgrade may require scarification, moisture conditioning, and re-compaction to restore stable conditions.

6.4 UTILITY INSTALLATIONS

Utility Subgrades: The soils encountered in our exploration are expected to be generally suitable for support of utility pipes. The pipe subgrade should be observed and probed for stability by ECS to evaluate the suitability of the materials encountered. Where rock is encountered at the utility subgrade it should be removed to at least 8 inches below and 6 inches on either side from the utility. Any loose or unsuitable materials encountered at the utility pipe subgrade elevation should be removed and replaced with suitable compacted Structural Fill or pipe bedding material.

Utility Backfilling: The granular bedding material should be at least 4 inches thick, but not less than that specified by the project drawings and specifications. Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the requirements for Structural Fill given in this report. Compacted backfill should be free of topsoil, roots, ice, or any other material designated by ECS as unsuitable. The backfill should be moisture conditioned, placed, and compacted in accordance with the recommendations of this report.

Utility Excavation Dewatering: It is possible that perched water may be encountered by utility excavations which extend below existing grades. It is expected that removal of perched water which seeps into excavations could be accomplished by pumping from sumps excavated in the trench bottom and which are backfilled with VDOT Size No. 57 stone or open graded bedding material. Should water conditions beyond the capability of sump pumping be encountered, the contractor should submit a Dewatering Plan in accordance with project specifications.

Excavation Safety: All excavations and slopes should be made and maintained in accordance with OSHA excavation safety standards. The contractor is solely responsible for designing and constructing stable, temporary excavations and slopes and should shore, slope, or bench the sides of the excavations and slopes as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should

slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. ECS is providing this information solely as a service to our client. ECS is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

6.5 TEMPORARY AND PERMANENT SLOPES

Temporary fill slopes constructed of onsite native silty or clayey soils should be limited to a maximum gradient of approximately 2H:1V. The temporary slopes should also be thoroughly vegetated to help minimize erosion of the surficial soils. Temporary excavation slopes cut in the native soils should be no steeper than as indicated by OSHA and VOSHA protocol. Permanent slopes constructed of native soils should generally be 3H:1V or flatter. Slopes steeper than 3H:1V should be designed by the GER. Gradients as steep as 2H:1V may be achieved through the use of select aggregate or engineered rock fills, as well as through the installation of geosynthetics in native soils, but again, must be designed by the GER. Small landscape berms (less than 4 feet in height) may be as steep as 1H:1V but should be compacted as structural fill and thoroughly vegetated immediately upon completion.

6.6 GENERAL CONSTRUCTION CONSIDERATIONS

Existing Utilities: Any existing utilities that are not planned to be reused should be removed, along with any unsuitable backfill materials, and capped at the property lines, or rerouted around the property and reconnected. The suitability of any existing utilities and utility trench backfill that will remain in place should be evaluated for structural support in the field by the GER. Care should be exercised during site grading operations so as not to damage any utilities that are to remain.

Moisture Conditioning: During the cooler and wetter periods of the year, delays and additional costs should be anticipated. At these times, reduction of soil moisture may need to be accomplished by a combination of mechanical manipulation and the use of chemical additives, such as lime or cement, in order to lower moisture contents to levels appropriate for compaction. Alternatively, during the drier times of the year, such as the summer months, moisture may need to be added to the soil to provide adequate moisture for successful compaction according to the project requirements.

Subgrade Protection: Measures should also be taken to limit site disturbance, especially from rubber-tired heavy construction equipment, and to control and remove surface water from development areas, including structural and pavement areas. It would be advisable to designate a haul road and construction staging area to limit the areas of disturbance and to prevent construction traffic from excessively degrading sensitive subgrade soils and existing pavement areas. Haul roads and construction staging areas could be covered with excess depths of aggregate to protect those subgrades. The aggregate can later be removed and used in pavement areas.

Foundations: Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are dug. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, we recommend that a 1 inch to 3 inch thick "mud-mat" of "lean" concrete be placed on the bearing soils before the placement of reinforcing steel.

Surface Drainage: Surface drainage conditions should be properly maintained. Surface water should be directed away from the construction area, and the work area should be sloped away from the construction area at a gradient of 1 percent or greater to reduce the potential of ponding water and the subsequent saturation of the surface soils. At the end of each work day, the subgrade soils should be sealed by rolling the surface with a smooth drum roller to minimize infiltration of surface water.

Excavation Safety: Cuts or excavations associated with utility excavations may require forming or bracing, slope flattening, or other physical measures to control sloughing and/or prevent slope failures. Contractors should be familiar with applicable OSHA codes to ensure that adequate protection of the excavations and trench walls is provided.

Erosion Control: The surface soils may be erodible. Therefore, the Contractor should provide and maintain good site drainage during earthwork operations to maintain the integrity of the surface soils. All erosion and sedimentation controls should be in accordance with sound engineering practices and local requirements.

7.0 CLOSING

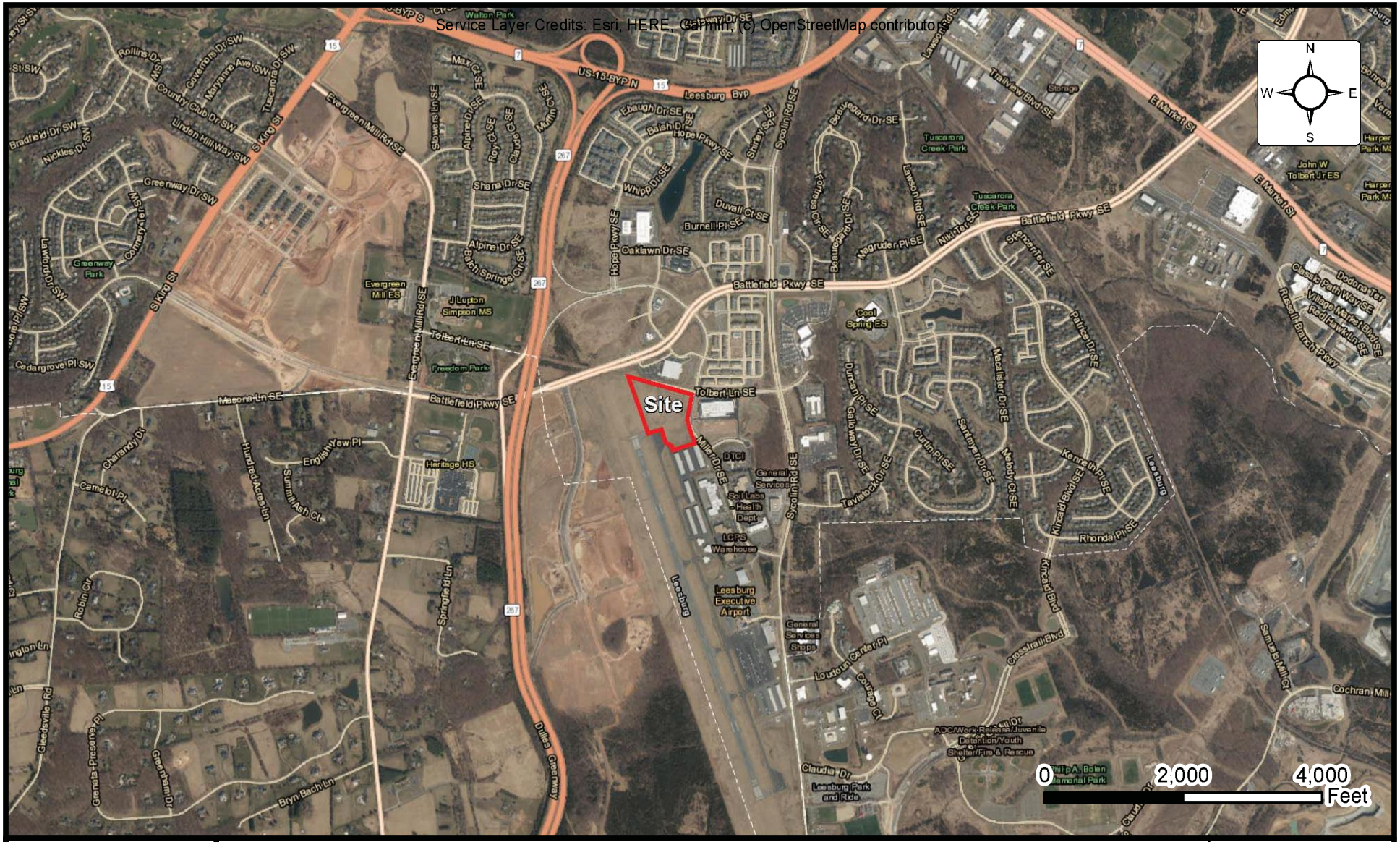
ECS has prepared this report of findings, evaluations, and recommendations to guide geotechnical-related design and construction aspects of the project. The analysis and recommendations submitted in this report are based upon the data obtained from the soil borings and tests performed at the locations as indicated on the Boring Location Diagram and other information referenced in this report. This report does not reflect any variations that may occur between the test locations. In the performance of the subsurface exploration, specific information is obtained at specific locations at specific times. However, it is a well-known fact that variations in soil and rock conditions exist on most sites between boring locations and also such situations as groundwater levels vary from time to time. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, it will become necessary for a reevaluation of the recommendations for this report after performing onsite observations during the construction period and noting the characteristics and variations.

This report was prepared for the sole use of Talbert & Bright and its consultants, the only intended beneficiaries of our work. The scope is limited to this specific project and locations described herein and our description of the project represents our understanding of the significant aspects relative to it. In the event of any change in the nature or location of the proposed construction outlined in this report or the accompanying plans and specifications, we should be informed so that the changes can be reviewed and the conclusions of this report modified or approved in writing by the design engineer. If any of this information is inaccurate, either due to our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted immediately in order that we can review the report in light of the changes and provide additional or alternate recommendations as may be required to reflect the proposed construction.

We recommend that ECS be allowed to review the project's plans and specifications pertaining to our work so that we may ascertain consistency of those plans/specifications with the intent of the geotechnical report. Field observations, monitoring, and quality assurance testing during earthwork and foundation installation are an extension of and integral to the geotechnical design recommendation. We recommend that the owner retain these quality assurance services and that ECS be allowed to continue our involvement throughout these critical phases of construction to provide general consultation as issues arise. ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

APPENDIX A – Drawings & Reports

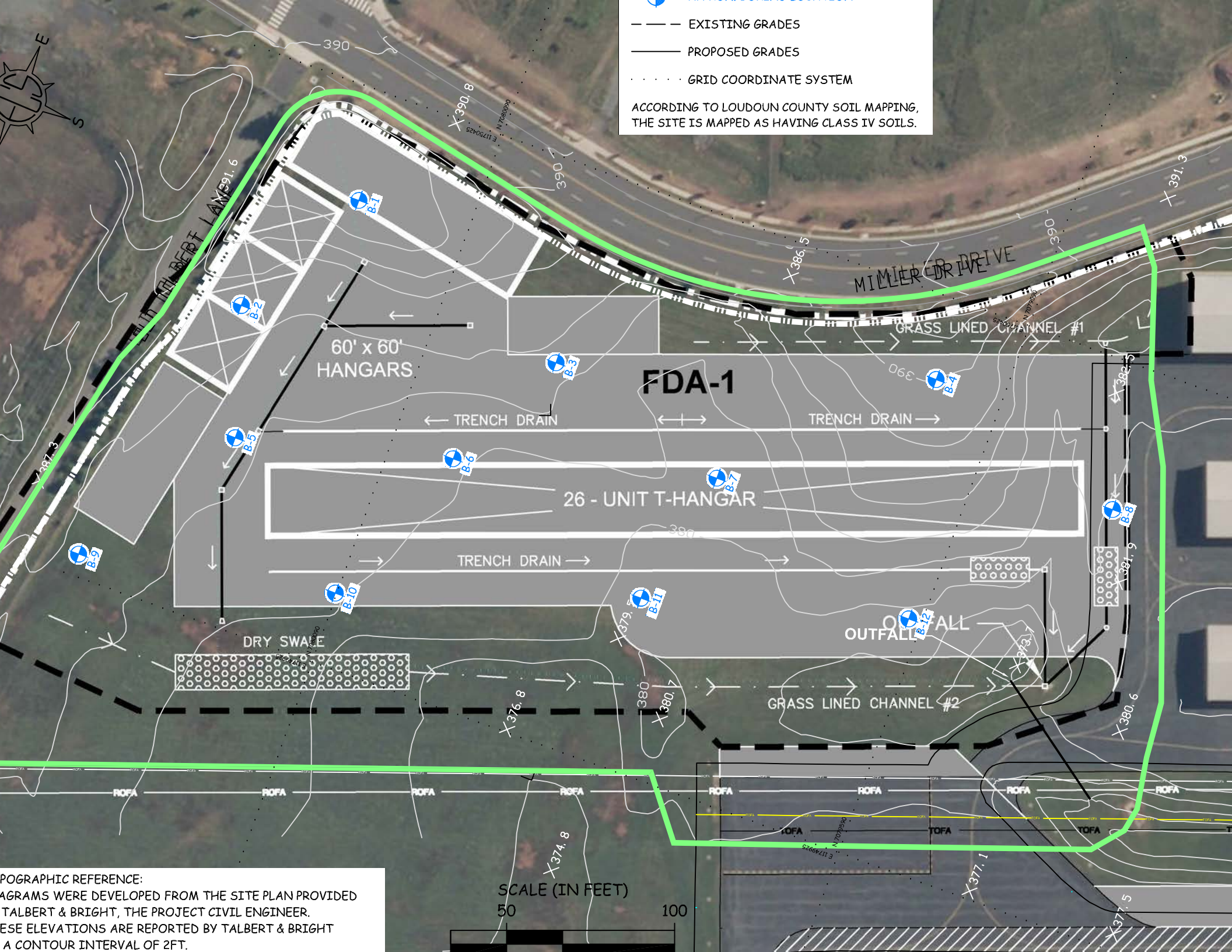
Site Location Diagram
Boring Location Diagram
Soils Mapping Diagram



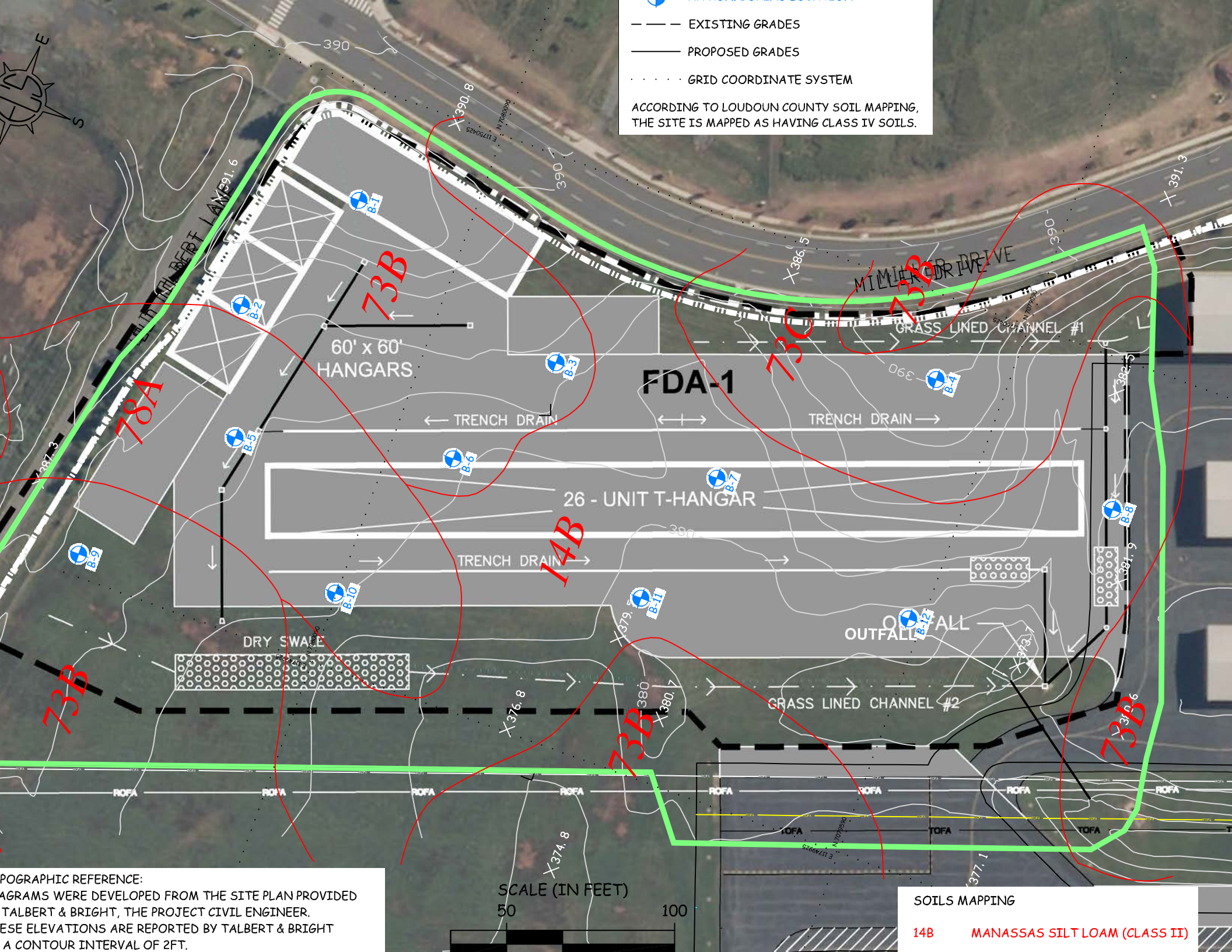
Site Location Diagram
NORTH APRON DEVELOPMENT - LEESBURG EXECUTIVE AIRPORT

SYCOLIN ROAD, LEESBURG, VIRGINIA
TALBERT & BRIGHT

ENGINEER	JNS
SCALE	1 " = 2000 '
PROJECT NO.	01:29694
SHEET	1 OF 1
DATE	1/10/2020



POGRAPHIC REFERENCE:
AGRAMS WERE DEVELOPED FROM THE SITE PLAN PROVIDED
TALBERT & BRIGHT, THE PROJECT CIVIL ENGINEER.
ESE ELEVATIONS ARE REPORTED BY TALBERT & BRIGHT
A CONTOUR INTERVAL OF 2FT.


EXISTING GRADES
PROPOSED GRADES
GRID COORDINATE SYSTEM
ACCORDING TO LOUDOUN COUNTY SOIL MAPPING, THE SITE IS MAPPED AS HAVING CLASS IV SOILS.
TALBERT LANE
MILLER DRIVE
60' x 60' HANGARS
FDA-1
26 - UNIT T-HANGAR
TRENCH DRAIN
TRENCH DRAIN
TRENCH DRAIN
GRASS LINED CHANNEL #1
GRASS LINED CHANNEL #2
DRY SWALE
OUTFALL
OUTFALL
78A
73B
73B
73C
73B
14B
73B
B-1
B-2
B-3
B-4
B-5
B-6
B-7
B-8
B-9
B-10
B-11
B-12
ROFA
TOFA
390
391.6
390.8
386.5
391.3
387.3
381.9
376.8
380.7
374.8
377.1
SCALE (IN FEET)
50
100
POGRAPHIC REFERENCE:
AGRAMS WERE DEVELOPED FROM THE SITE PLAN PROVIDED
TALBERT & BRIGHT, THE PROJECT CIVIL ENGINEER.
ESE ELEVATIONS ARE REPORTED BY TALBERT & BRIGHT
A CONTOUR INTERVAL OF 2FT.
SOILS MAPPING
14B MANASSAS SILT LOAM (CLASS II)

APPENDIX B – Field Operations

Reference Notes for Boring Logs
Boring Logs BH-1 through BH-12

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]	
	ASPHALT
	CONCRETE
	GRAVEL
	TOPSOIL
	VOID
	BRICK
	AGGREGATE BASE COURSE
	FILL[3] MAN-PLACED SOILS
GW	WELL-GRADED GRAVEL gravel-sand mixtures, little or no fines
GP	POORLY-GRADED GRAVEL gravel-sand mixtures, little or no fines
GM	SILTY GRAVEL gravel-sand-silt mixtures
GC	CLAYEY GRAVEL gravel-sand-clay mixtures
SW	WELL-GRADED SAND gravelly sand, little or no fines
SP	POORLY-GRADED SAND gravelly sand, little or no fines
SM	SILTY SAND sand-silt mixtures
SC	CLAYEY SAND sand-clay mixtures
ML	SILT non-plastic to medium plasticity
MH	ELASTIC SILT high plasticity
CL	LEAN CLAY low to medium plasticity
CH	FAT CLAY high plasticity
OL	ORGANIC SILT or CLAY non-plastic to low plasticity
OH	ORGANIC SILT or CLAY high plasticity
PT	PEAT highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS			
SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION		
DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS		
UNCONFINED COMPRESSIVE STRENGTH, Q_P[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Firm
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS	
SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
Dual Symbol *(ex: SW-SM)*	10	10
With	15 - 20	15 - 25
Adjective *(ex: "Silty")*	≥25	≥30

WATER LEVELS[6]		
▽	WL	Water Level (WS)(WD) (WS) While Sampling (WD) While Drilling
▽	SHW	Seasonal High WT
▼	ACR	After Casing Removal
▽	SWT	Stabilized Water Table
	DCI	Dry Cave-In
	WCI	Wet Cave-In

[1] *Classifications and symbols per ASTM D 2488-09 (Visual-Manual Procedure) unless noted otherwise.*

[2] *To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.*

[3] *Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-**FILL**)].*

[4] *Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).*

[5] *Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf).*

[6] *The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.*

[7] *Minor deviation from ASTM D 2488-09 Note 16.*

[8] *Percentages are estimated to the nearest 5% per ASTM D 2488-09.*

CLIENT	Job #:	BORING #	SHEET
Talbert & Bright	01:29694	BH-1	1 OF 1

PROJECT NAME	ARCHITECT-ENGINEER
North Apron Development - Leesburg Executive Airport	Talbert & Bright

SITE LOCATION: Sycolin Road, Leesburg, Loudoun County, VA

NORTHING	EASTING	STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% - — - REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ▶ LOSS OF CIRCULATION

SURFACE ELEVATION 394

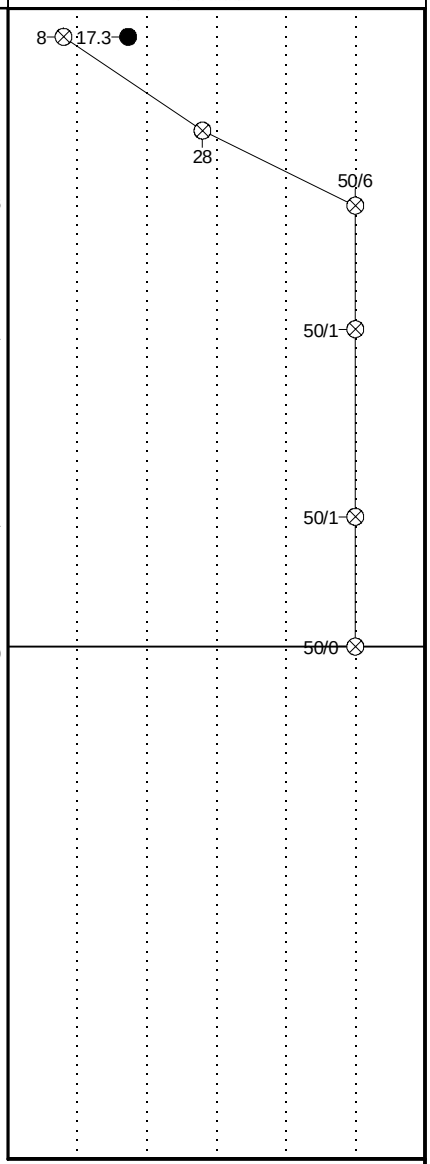
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18			3 4 4
	S-2	SS	18	18		390	9 13 15
5	S-3	SS	6	6			50/6
	S-4	SS	1	1		385	50/1
10							
	S-5	SS	1	1		380	50/1
15	S-6	SS	0	0			50/0
						375	
20							
						370	
25							
						365	
30							

Topsoil Thickness [2"]
(CL) LEAN CLAY, brown, moist, firm to very stiff

WEATHERED SILTSTONE SAMPLED AS LEAN CLAY WITH GRAVEL, reddish brown, moist, very hard

WEATHERED SILTSTONE, reddish brown, moist, very dense

AUGER REFUSAL @ 17'



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL DRY WS ☐ WD ☒	BORING STARTED 12/31/19	CAVE IN DEPTH 9.5
WL(SHW) WL(ACR) DRY	BORING COMPLETED 12/31/19	HAMMER TYPE Auto
WL	RIG CME 550 ATV FOREMAN A. Rodas	DRILLING METHOD 2.25 HSA

CLIENT	Job #:	BORING #	SHEET
Talbert & Bright	01:29694	BH-2	1 OF 1

PROJECT NAME: North Apron Development - Leesburg Executive Airport

ARCHITECT-ENGINEER: Talbert & Bright

SITE LOCATION: Sycolin Road, Leesburg, Loudoun County, VA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% - - - REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

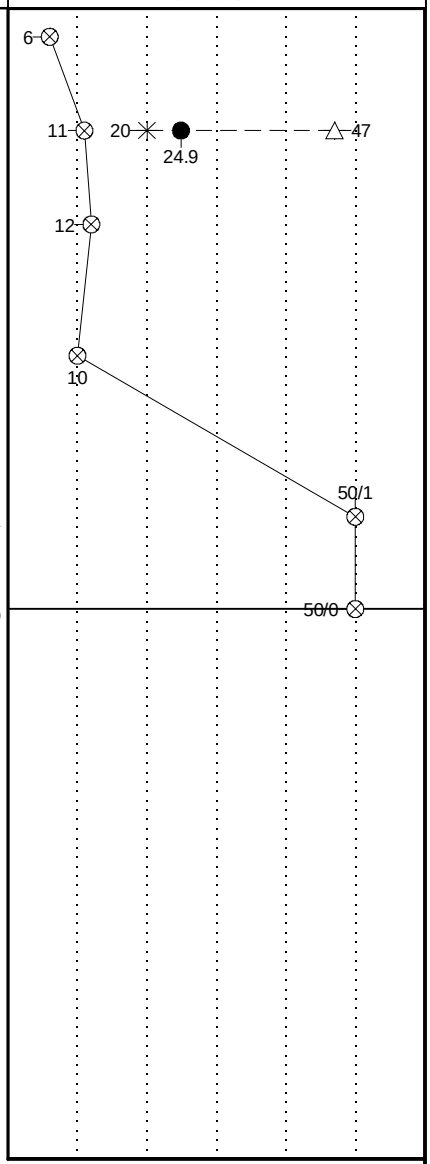
STANDARD PENETRATION BLOWS/FT

ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 387

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18	Topsoil Thickness [2"] (CL) LEAN CLAY, trace sand, brown, moist, firm to stiff		385	3 3 3
	S-2	SS	18	18				3 5 6
5	S-3	SS	18	18				3 6 6
					(CL) SANDY LEAN CLAY, trace gravel, brown, moist, stiff		380	
	S-4	SS	18	18		▽		4 6 4
10							375	
	S-5	SS	1	1	WEATHERED LIMESTONE CONGLOMERATE, purple, moist, very dense			50/1
15	S-6	SS	0	0	AUGER REFUSAL @ 16'		370	50/0
20							365	
25							360	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL DRY WS ☐ WD ☒	BORING STARTED 12/30/19	CAVE IN DEPTH 9
▽ WL(SHW) ▽ WL(ACR) DRY	BORING COMPLETED 12/30/19	HAMMER TYPE Auto
▽ WL 9.0' 24 hours	RIG CME 550 ATV FOREMAN A. Epinoza	DRILLING METHOD 2.25 HSA

CLIENT	Job #:	BORING #	SHEET
Talbert & Bright	01:29694	BH-3	1 OF 1

PROJECT NAME: North Apron Development - Leesburg Executive Airport

ARCHITECT-ENGINEER: Talbert & Bright

SITE LOCATION: Sycolin Road, Leesburg, Loudoun County, VA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% - - - REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 384

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	9	6	Topsoil Thickness [2"]			5 50/3
					WEATHERED SILTSTONE SAMPLED AS SANDY LEAN CLAY WITH GRAVEL, reddish brown, moist, very hard			
					AUGER REFUSAL @ 1.3'			
					Boring was offset 5 ft south and reattempted. Auger refusal was encountered @ 2.3 ft			
5							380	
10							375	
15							370	
20							365	
25							360	
30							355	

50/3

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL DRY WS ☐ WD ☒	BORING STARTED 12/31/19	CAVE IN DEPTH 0.5
WL(SHW) WL(ACR) DRY	BORING COMPLETED 12/31/19	HAMMER TYPE Auto
WL	RIG D-50 ATV FOREMAN C. Gudial	DRILLING METHOD 2.25 HSA

CLIENT	Job #:	BORING #	SHEET
Talbert & Bright	01:29694	BH-4	1 OF 1

PROJECT NAME: North Apron Development - Leesburg Executive Airport

ARCHITECT-ENGINEER: Talbert & Bright

SITE LOCATION: Sycolin Road, Leesburg, Loudoun County, VA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

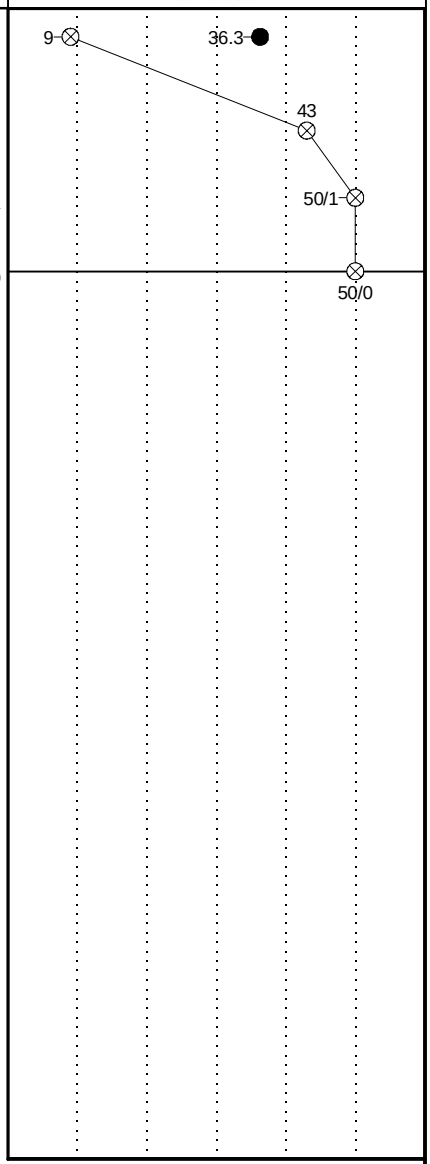
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 390

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	12	Topsoil Thickness [2"] (CL) LEAN CLAY, trace gravel, brown, moist, stiff		390	2 5 4
	S-2	SS	18	18	(CL) SANDY LEAN CLAY, reddish brown, moist, hard	▽		11 17 26
5	S-3	SS	1	1	WEATHERED SILTSTONE, reddish brown, moist, very hard		385	50/1
	S-4	SS	0	0	AUGER REFUSAL @ 7'			50/0
10							380	
15							375	
20							370	
25							365	
30							360	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL DRY WS ☐ WD ☒	BORING STARTED 12/30/19	CAVE IN DEPTH 4.7
WL(SHW) WL(ACR) DRY	BORING COMPLETED 12/30/19	HAMMER TYPE Auto
WL 3.0' 24 hours	RIG CME 550 ATV FOREMAN A. Rodas	DRILLING METHOD 2.25 HSA

CLIENT	Job #:	BORING #	SHEET
Talbert & Bright	01:29694	BH-5	1 OF 1

PROJECT NAME: North Apron Development - Leesburg Executive Airport

ARCHITECT-ENGINEER: Talbert & Bright

SITE LOCATION: Sycolin Road, Leesburg, Loudoun County, VA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

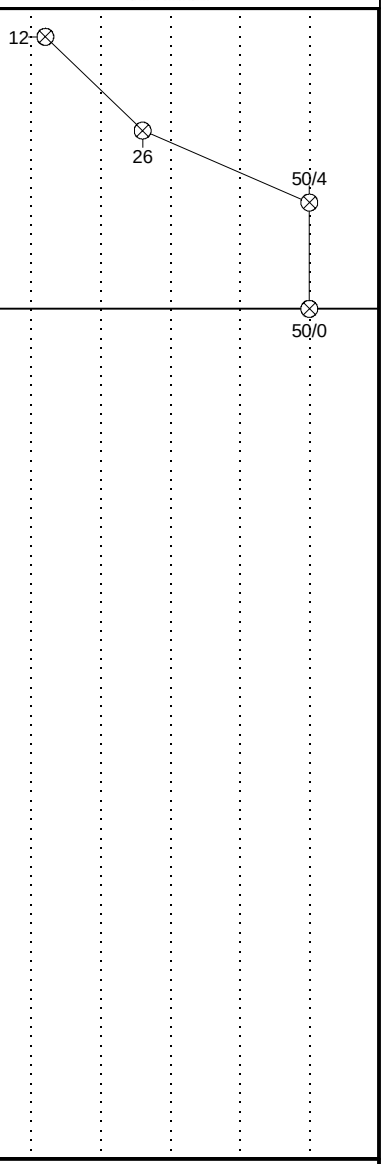
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 384

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"	DESCRIPTION OF MATERIAL
0	S-1	SS	18	18			4 6 6	Topsoil Thickness [2"] (ML) SILT, brown, moist, medium dense
	S-2	SS	18	18		380	5 12 14	
5	S-3	SS	4	4			50/4	WEATHERED SILTSTONE SAMPLED AS GRAVELLY SILT, reddish brown, moist, very dense
	S-4	SS	0	0		375	50/0	AUGER REFUSAL @ 8'
10						370		
15						365		
20						360		
25						355		
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL DRY WS ☐ WD ☒	BORING STARTED 12/31/19	CAVE IN DEPTH 4.5
WL(SHW) WL(ACR) DRY	BORING COMPLETED 12/31/19	HAMMER TYPE Auto
WL	RIG CME 550 ATV FOREMAN A. Rodas	DRILLING METHOD 2.25 HSA

CLIENT	Job #:	BORING #	SHEET
Talbert & Bright	01:29694	BH-6	1 OF 1

PROJECT NAME: North Apron Development - Leesburg Executive Airport

ARCHITECT-ENGINEER: Talbert & Bright

SITE LOCATION: Sycolin Road, Leesburg, Loudoun County, VA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

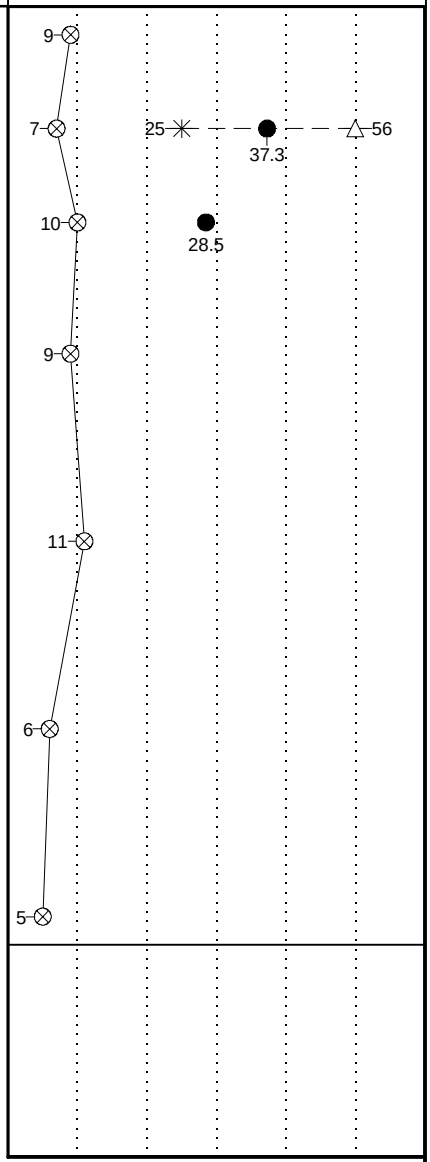
STANDARD PENETRATION BLOWS/FT

ENGLISH UNITS

BOTTOM OF CASING ▰ LOSS OF CIRCULATION

SURFACE ELEVATION 382

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18	Topsoil Thickness [2"] (CL) LEAN CLAY, trace gravel, brown, moist, stiff		382	3 4 5
	S-2	SS	18	18	(CH) FAT CLAY, brown, moist, firm		380	3 3 4
5	S-3	SS	18	18	(CL) LEAN CLAY, reddish brown, moist, stiff		375	3 5 5
	S-4	SS	18	18	(CH) FAT CLAY, trace sand, brown, moist, stiff		370	4 4 5
10	S-5	SS	18	18	(CL) SANDY LEAN CLAY WITH GRAVEL, reddish brown, moist, firm to stiff	▽	365	5 6 5
15	S-6	SS	18	18		▽	360	2 4 2
20	S-7	SS	18	18			355	2 2 3
25					END OF BORING @ 25'			
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 18 WS ☐ WD ☒	BORING STARTED 12/30/19	CAVE IN DEPTH 16
▽ WL(SHW) ▼ WL(ACR) 15	BORING COMPLETED 12/30/19	HAMMER TYPE Auto
▽ WL	RIG CME 550 ATV FOREMAN A. Epinoza	DRILLING METHOD 2.25 HSA

CLIENT	Job #:	BORING #	SHEET
Talbert & Bright	01:29694	BH-7	1 OF 1

PROJECT NAME: North Apron Development - Leesburg Executive Airport

ARCHITECT-ENGINEER: Talbert & Bright

SITE LOCATION: Sycolin Road, Leesburg, Loudoun County, VA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC%

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 381

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18		380	3 4 7
	S-2	SS	18	18			3 3 3
5	S-3	SS	18	18		375	4 5 7
	S-4	SS	18	18			3 3 3
10						370	
	S-5	SS	18	18			3 3 4
15						365	
	S-6	SS	18	18			2 2 3
20						360	
	S-7	SS	18	18			3 3 5
25						355	
30							

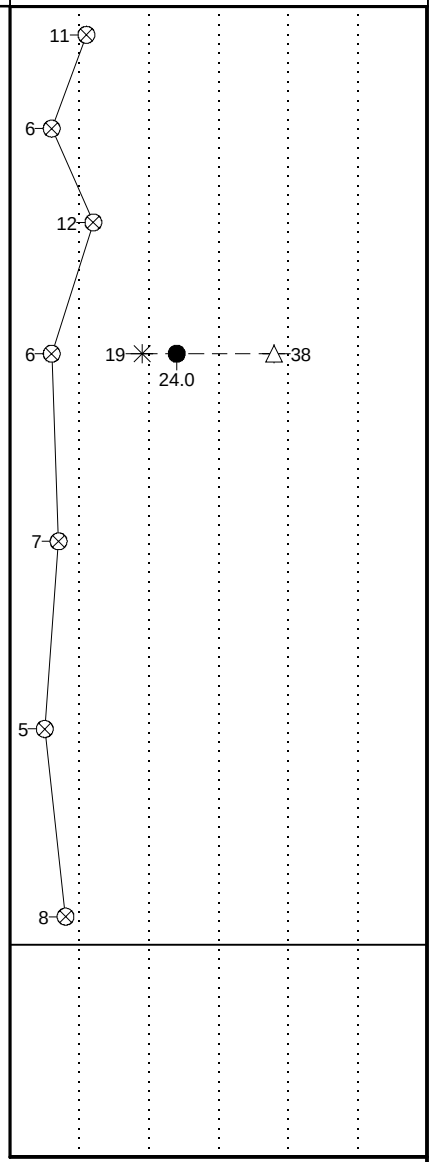
Topsoil Thickness [2"]

(CL) LEAN CLAY WITH SAND, brown, moist, firm to stiff

(CL) SANDY LEAN CLAY, trace gravel, brown, moist, stiff

(CL) SANDY LEAN CLAY WITH GRAVEL, brown, moist, firm

END OF BORING @ 25'



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 13.0 WS ☐ WD ☒	BORING STARTED 12/30/19	CAVE IN DEPTH 18.4
WL(SHW) WL(ACR) 16.4	BORING COMPLETED 12/30/19	HAMMER TYPE Auto
WL	RIG CME 550 ATV FOREMAN A. Epinoza	DRILLING METHOD 2.25 HSA

CLIENT	Job #:	BORING #	SHEET
Talbert & Bright	01:29694	BH-8	1 OF 1

PROJECT NAME: North Apron Development - Leesburg Executive Airport

ARCHITECT-ENGINEER: Talbert & Bright

SITE LOCATION: Sycolin Road, Leesburg, Loudoun County, VA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

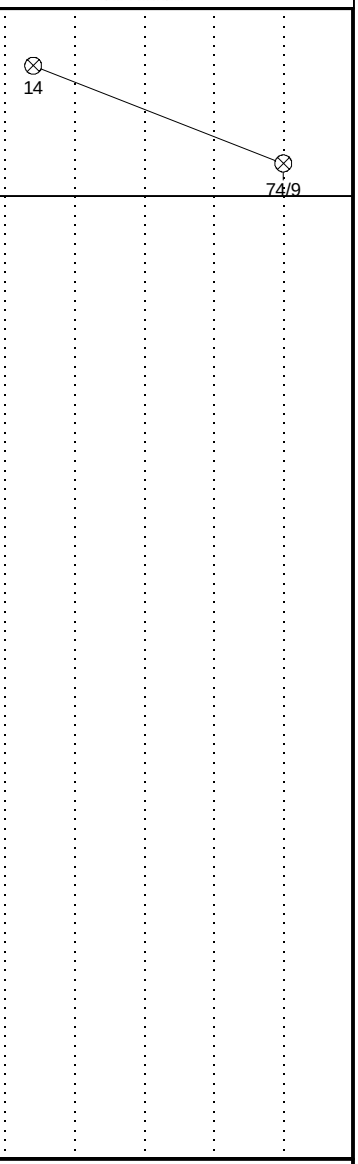
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 382

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Asphalt Thickness [2.25"]			
					Gravel Thickness [7"]			
	S-1	SS	18	18	(CL) LEAN CLAY WITH SAND, trace gravel, reddish brown, moist, stiff		380	3 5 9
	S-2	SS	15	15	WEATHERED SILTSTONE SAMPLED AS SILT, reddish brown, moist, very dense			10 24 50/3
5					END OF BORING @ 5'		375	
10							370	
15							365	
20							360	
25							355	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL DRY WS ☐ WD ☒	BORING STARTED 12/31/19	CAVE IN DEPTH 3
WL(SHW) WL(ACR) DRY	BORING COMPLETED 12/31/19	HAMMER TYPE Auto
WL	RIG CME 550 ATV FOREMAN A. Epinoza	DRILLING METHOD 2.25 HSA

CLIENT	Job #:	BORING #	SHEET
Talbert & Bright	01:29694	BH-9	1 OF 1

PROJECT NAME	ARCHITECT-ENGINEER
North Apron Development - Leesburg Executive Airport	Talbert & Bright

SITE LOCATION: Sycolin Road, Leesburg, Loudoun County, VA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

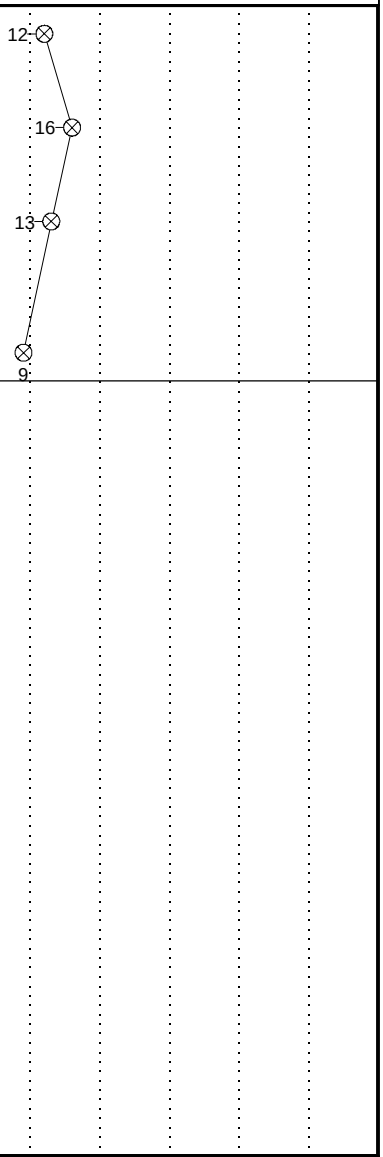
STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 386

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18	Topsoil Thickness [2"] (CL) LEAN CLAY WITH SAND, brown, moist, stiff to very stiff		385	3 3 9
	S-2	SS	18	18				4 8 8
5	S-3	SS	18	18	(ML) SILT, reddish brown, moist, medium dense		380	5 5 8
	S-4	SS	18	18	(CL) LEAN CLAY, trace sand, brown, moist, stiff			3 4 5
10					END OF BORING @ 10'		375	
15							370	
20							365	
25							360	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL DRY WS ☐ WD ☒	BORING STARTED 12/31/19	CAVE IN DEPTH 5.8
WL(SHW) WL(ACR) DRY	BORING COMPLETED 12/31/19	HAMMER TYPE Auto
WL	RIG D-50 ATV FOREMAN C. Gudial	DRILLING METHOD 2.25 HSA

CLIENT	Job #:	BORING #	SHEET
Talbert & Bright	01:29694	BH-10	1 OF 1

PROJECT NAME: North Apron Development - Leesburg Executive Airport

ARCHITECT-ENGINEER: Talbert & Bright

SITE LOCATION: Sycolin Road, Leesburg, Loudoun County, VA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% - - - REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 382

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	17		382	2 4 5
	S-2	SS	18	18		380	2 3 4
5							
	S-3	SS	18	18		375	4 4 7
	S-4	SS	18	18			4 8 10
10						370	
15						365	
20						360	
25						355	
30							

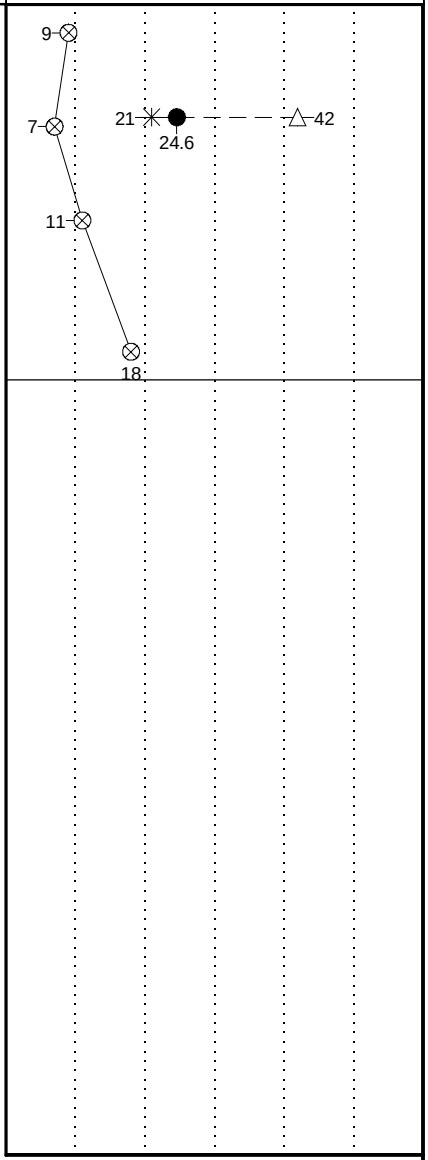
Topsoil Thickness [2"]

(CL) LEAN CLAY, trace gravel, brown, moist, firm to stiff

Bulk Sample from 2-4'

(ML) SILT, reddish brown, moist, medium dense

END OF BORING @ 10'



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL DRY WS ☐ WD ☒	BORING STARTED 12/31/19	CAVE IN DEPTH 7.9
WL(SHW) WL(ACR) DRY	BORING COMPLETED 12/31/19	HAMMER TYPE Auto
WL	RIG D-50 ATV FOREMAN C. Gudial	DRILLING METHOD 2.25 HSA

CLIENT	Job #:	BORING #	SHEET
Talbert & Bright	01:29694	BH-11	1 OF 1

PROJECT NAME: North Apron Development - Leesburg Executive Airport

ARCHITECT-ENGINEER: Talbert & Bright

SITE LOCATION: Sycolin Road, Leesburg, Loudoun County, VA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 380

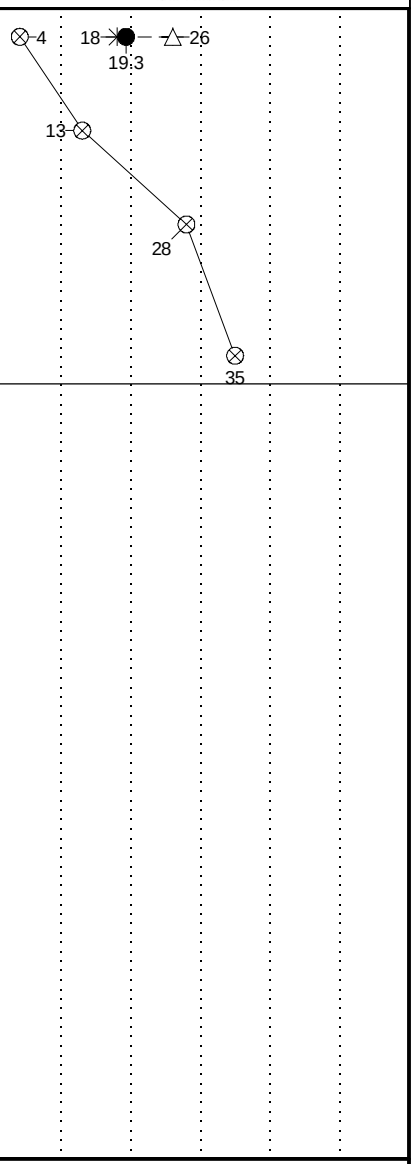
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	15		380	2 2 2
	S-2	SS	18	18			3 5 8
5						375	
	S-3	SS	18	18			8 13 15
	S-4	SS	18	18			8 14 21
10						370	
15						365	
20						360	
25						355	
30						350	

Topsoil Thickness [2"]

(CL) LEAN CLAY WITH SAND, brown, moist, soft

(ML) SILT, reddish brown, moist, medium dense to dense

END OF BORING @ 10'



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL DRY WS ☐ WD ☒	BORING STARTED 12/31/19	CAVE IN DEPTH 8
WL(SHW) WL(ACR) DRY	BORING COMPLETED 12/31/19	HAMMER TYPE Auto
WL	RIG D-50 ATV FOREMAN C. Gudiel	DRILLING METHOD 2.25 HSA

CLIENT	Job #:	BORING #	SHEET
Talbert & Bright	01:29694	BH-12	1 OF 1

PROJECT NAME: North Apron Development - Leesburg Executive Airport

ARCHITECT-ENGINEER: Talbert & Bright

SITE LOCATION: Sycolin Road, Leesburg, Loudoun County, VA

NORTHING | EASTING | STATION

CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% - - - REC% ———

PLASTIC LIMIT% | WATER CONTENT% | LIQUID LIMIT%

STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING | LOSS OF CIRCULATION

SURFACE ELEVATION 380

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	14		380	3 4 4
	S-2	SS	18	10			2 3 3
5	S-3	SS	18	15		375	3 3 5
	S-4	SS	18	18			3 4 4
10						370	
15						365	
20						360	
25						355	
30						350	

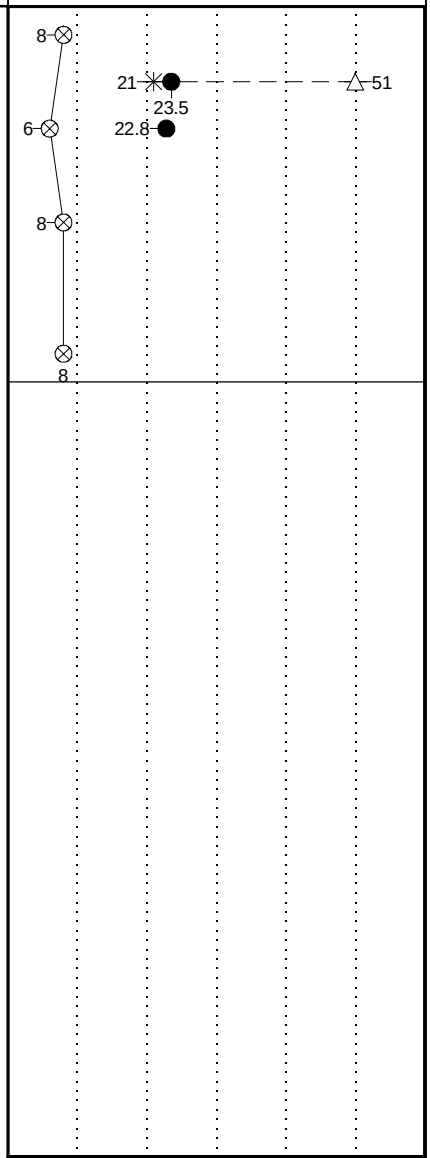
Topsoil Thickness [2"]

(ML) SILT, trace gravel, trace sand, brown, moist, loose

(CH) FAT CLAY WITH SAND, trace gravel, brown, moist, firm
Bulk Sample from 2-4'

(CL) LEAN CLAY WITH SAND, trace gravel, brown, moist, firm

END OF BORING @ 10'



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL DRY WS ☐ WD ☒	BORING STARTED 12/31/19	CAVE IN DEPTH 8
WL(SHW) WL(ACR) DRY	BORING COMPLETED 12/31/19	HAMMER TYPE Auto
WL	RIG D-50 ATV FOREMAN C. Gudial	DRILLING METHOD 2.25 HSA

APPENDIX C – Laboratory Testing

Laboratory Test Results Summary
Liquid and Plastic Limits Test Report
Particle Size Distribution Report
Standard Proctor Test Results
California Bearing Ratio Test Results

Laboratory Testing Summary

Sample Source	Sample Number	Start Depth (feet)	End Depth (feet)	Sample Distance (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Other
							LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
BH-1	S-1	0.0	1.5	1.5	17.3									
BH-2	S-2	2.5	4.0	1.5	24.9	CL	47	20	27	75.2				
BH-4	S-1	0.0	1.5	1.5	36.3									
BH-6	S-2 S-3	2.5 5.0	4.0 6.5	1.5 1.5	37.3 28.5	CH	56	25	31	79.0				
BH-7	S-4	8.5	10.0	1.5	24.0	CL	38	19	19	51.1				
BH-10	BS-1	2.0	4.0	2.0	24.6	CL	42	21	21	85.8	106.9	20.2	5.4	
BH-11	S-1	0.0	1.5	1.5	19.3	CL	26	18	8	74.0				
BH-12	BS-1 S-2	2.0 2.5	4.0 4.0	2.0 1.5	23.5 22.8	CH	51	21	30	84.2	102.4	22.2	3.2	

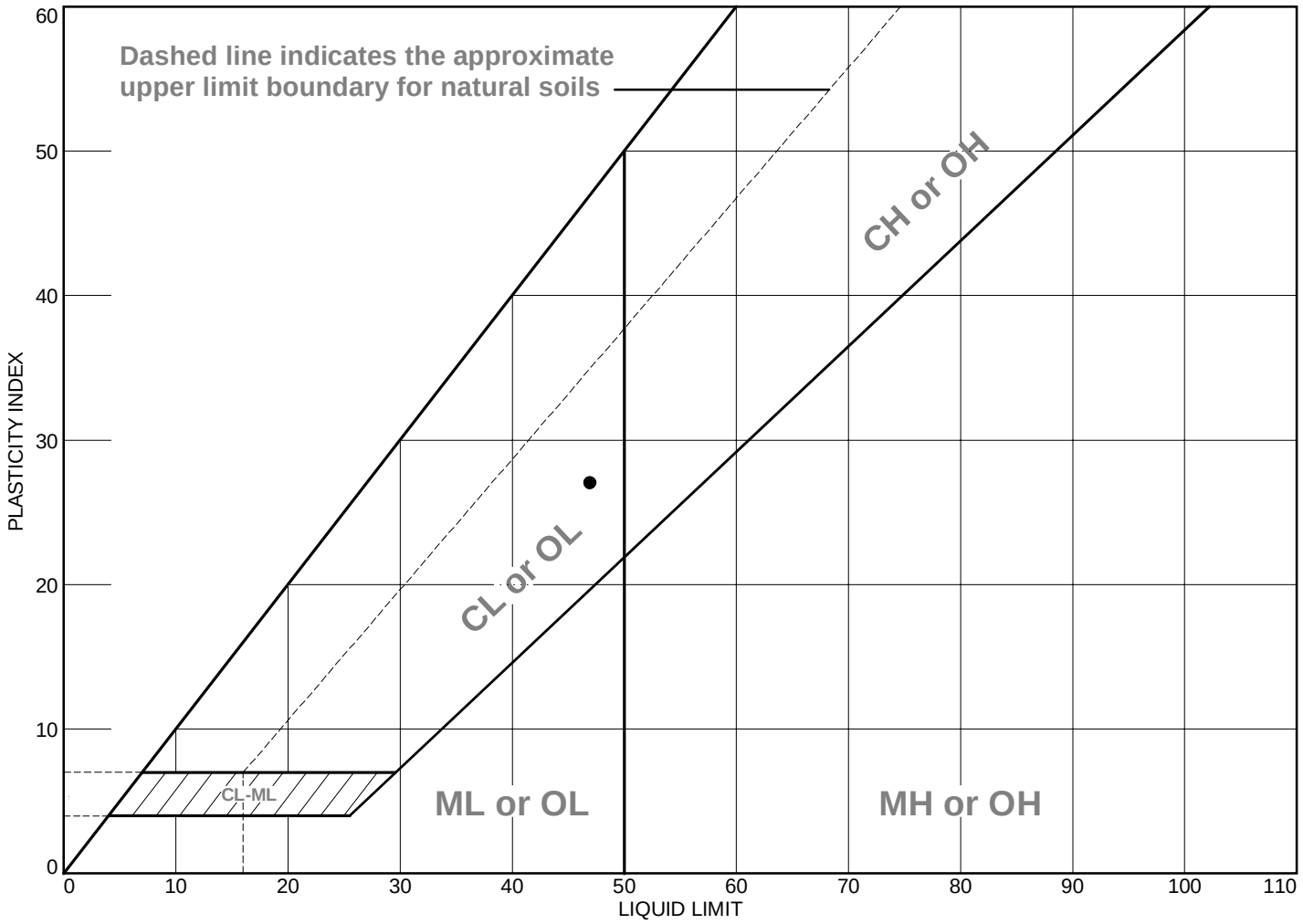
Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

Project No.	**01:29694**
Project Name:	**North Apron Development - Leesburg Executive Airport**
PM:	**Jimmy Swiggett**
PE:	**Nick Meloy**
Printed On:	**Friday, January 17, 2020**

ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	LEAN CLAY WITH SAND, brown, moist, stiff	47	20	27	83.4	75.2	CL

Project No. 29694 **Client:** Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

●**Source of Sample:** BH-2 **Depth:** 2.50-4.00 **Sample Number:** S-2

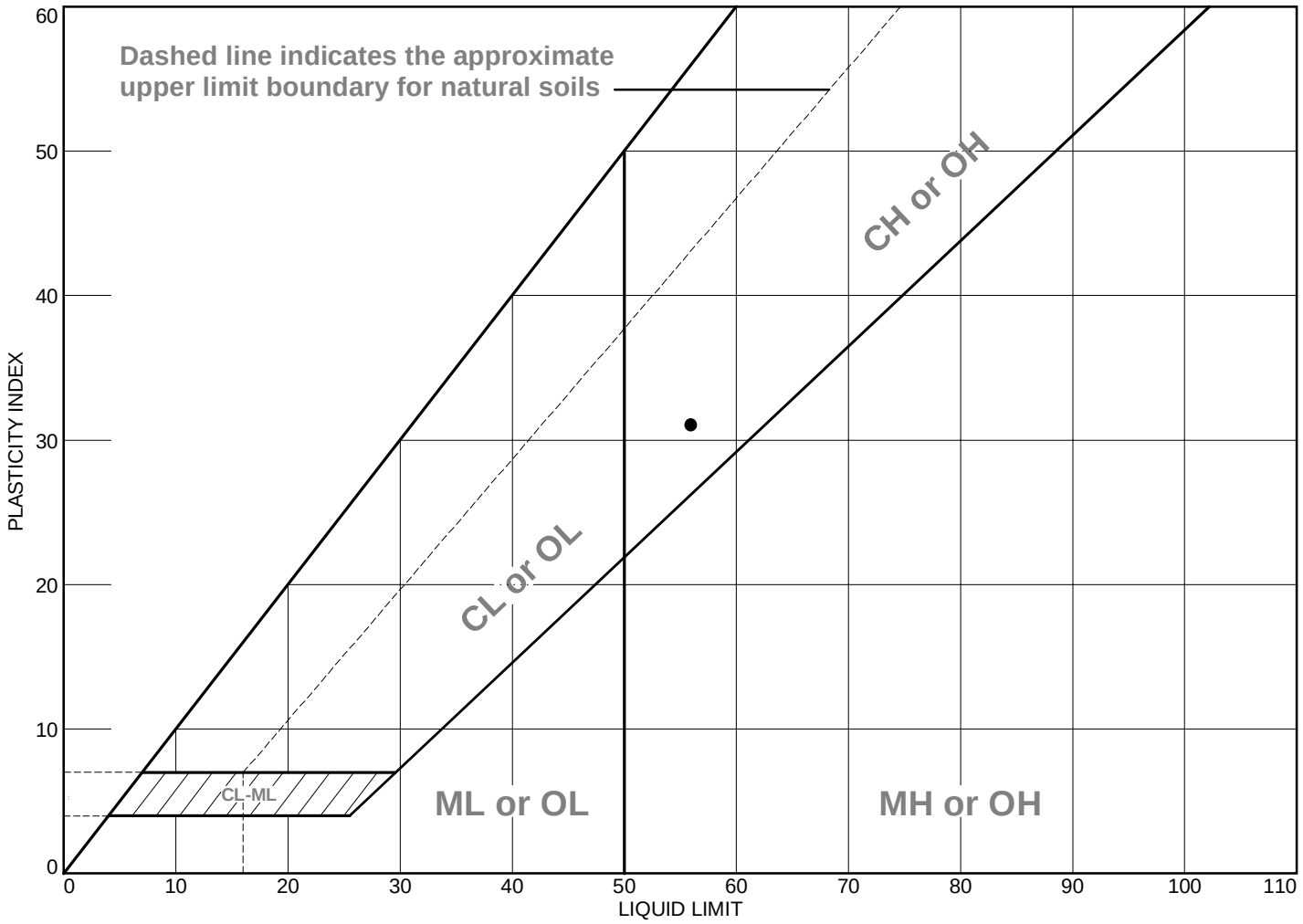
Remarks:

ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Figure

Tested By: HNT1 **Checked By:** DVT

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	FAT CLAY WITH SAND, brown, moist, firm	56	25	31	87.3	79.0	CH

Project No. 29694 **Client:** Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

●**Source of Sample:** BH-6 **Depth:** 2.50-4.00 **Sample Number:** S-2

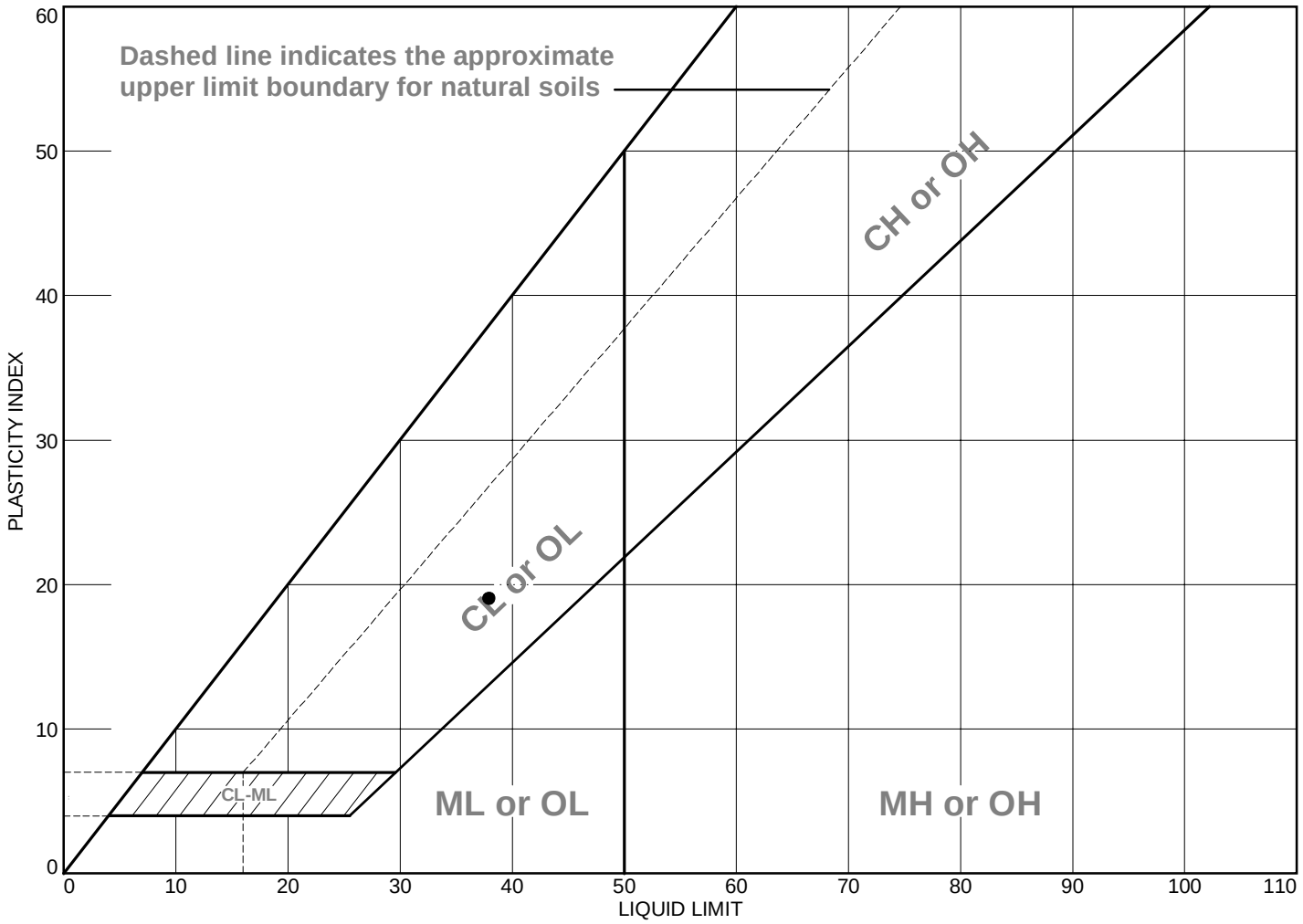
Remarks:

ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Figure

Tested By: HTN1 **Checked By:** DVT

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	SANDY LEAN CLAY, brown, moist, stiff	38	19	19	58.0	51.1	CL

Project No. 29694 **Client:** Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

●**Source of Sample:** BH-7 **Depth:** 8.50-10.00 **Sample Number:** S-4

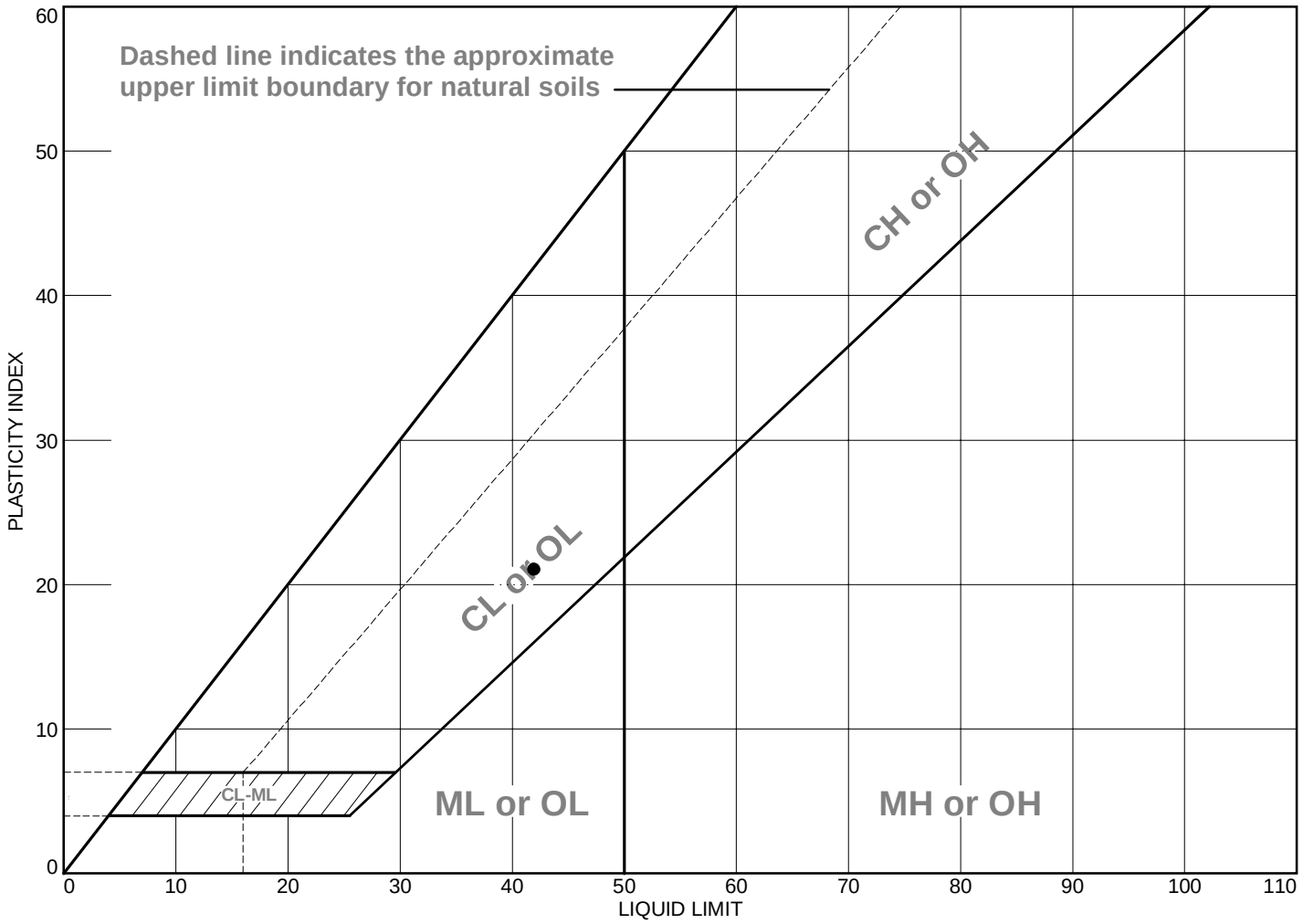
Remarks:

ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Figure

Tested By: HTN1 **Checked By:** DVT

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	LEAN CLAY, brown, moist, firm	42	21	21	97.1	85.8	CL

Project No. 29694 **Client:** Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

●**Source of Sample:** BH-10 **Depth:** 2.00-4.00 **Sample Number:** BS-1

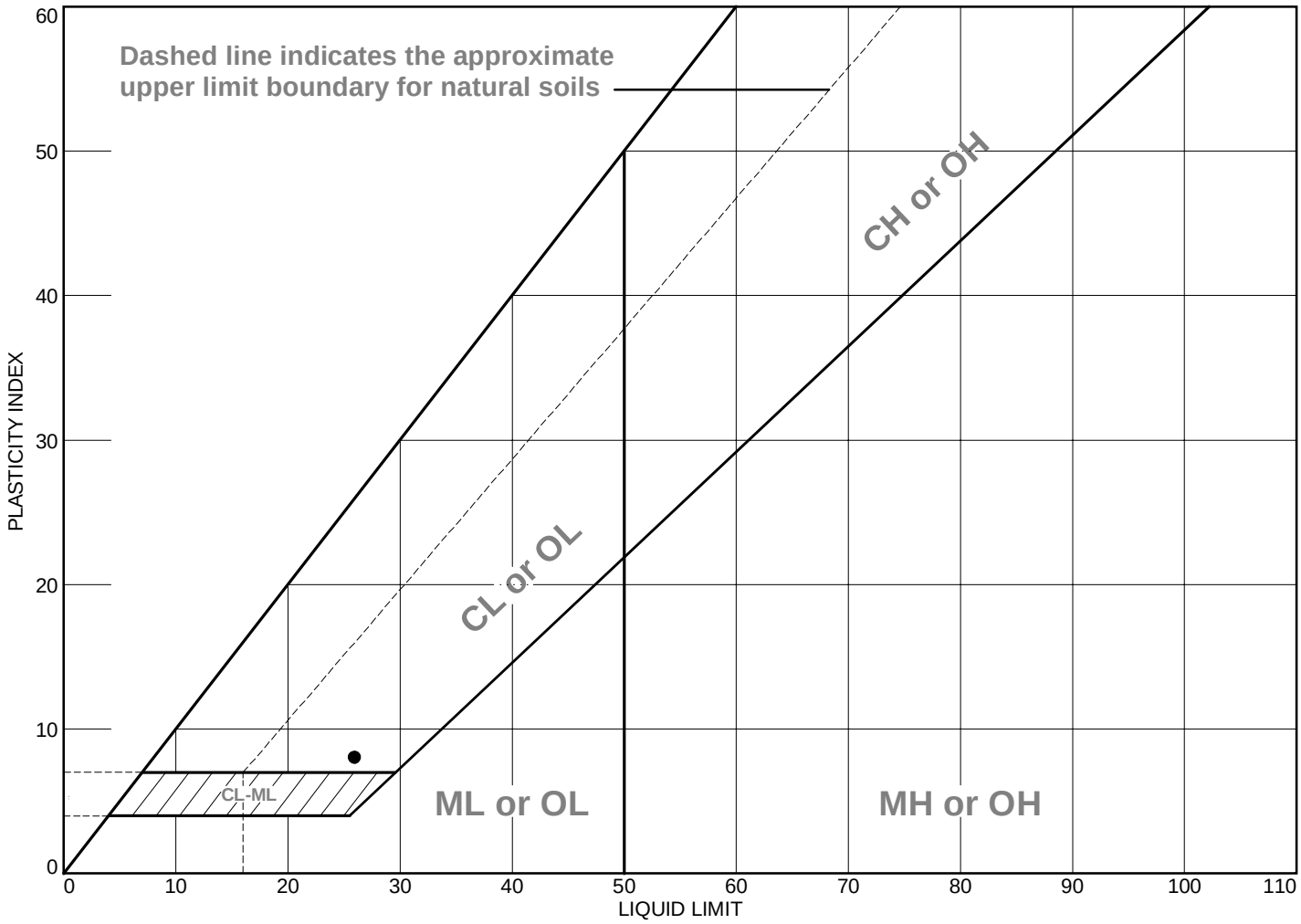
Remarks:

ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Figure

Tested By: HTN1 **Checked By:** DVT

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	GRAVELLY LEAN CLAY, brown, moist, soft	26	18	8	80.4	74.0	CL

Project No. 29694 **Client:** Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

●**Source of Sample:** BH-11 **Depth:** 0.00-1.50 **Sample Number:** S-1

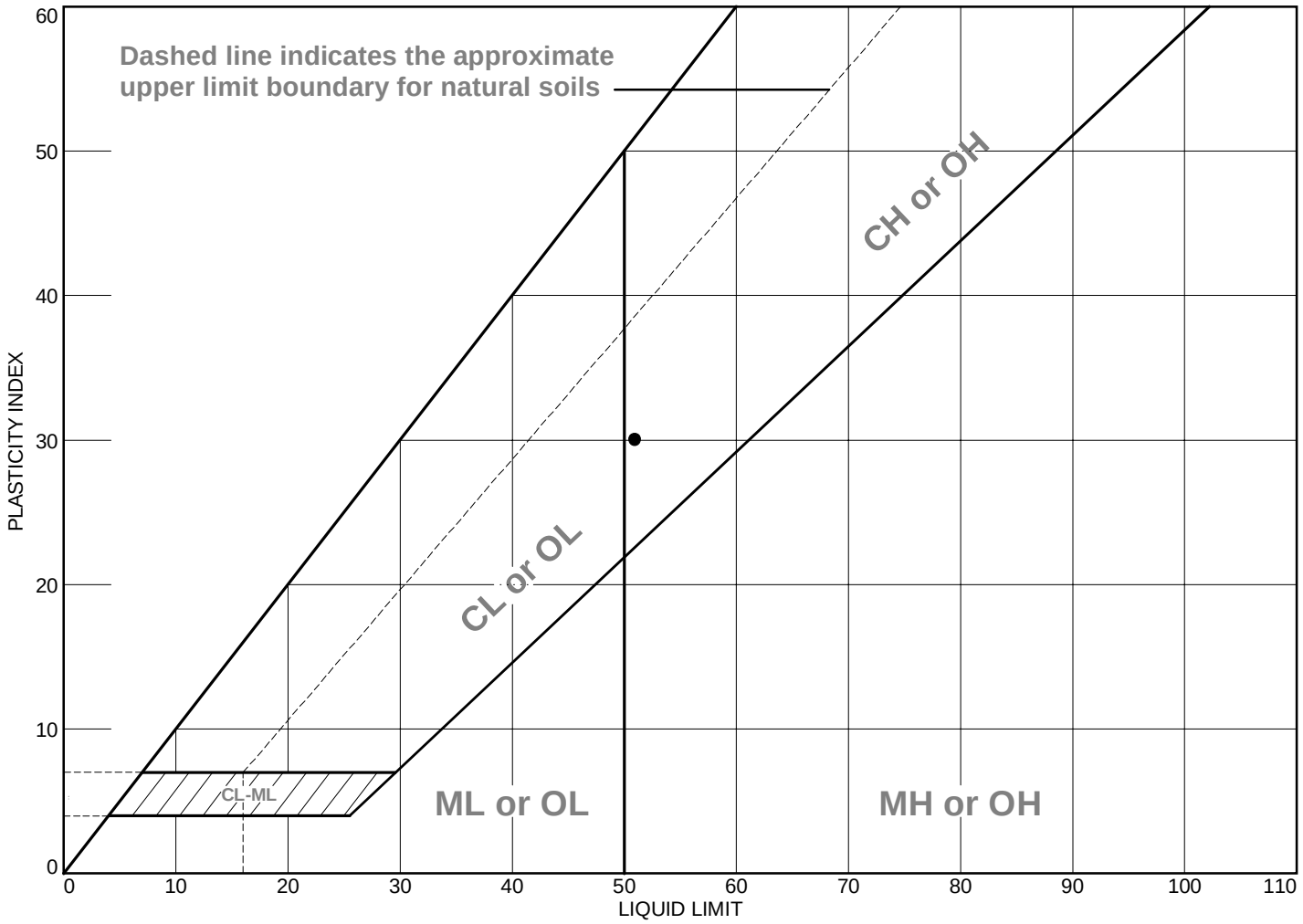
Remarks:

ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Figure

Tested By: KV **Checked By:** DVT

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	FAT CLAY WITH SAND, brown, moist, firm	51	21	30	95.2	84.2	CH

Project No. 29694 **Client:** Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

●**Source of Sample:** BH-12 **Depth:** 2.00-4.00 **Sample Number:** BS-1

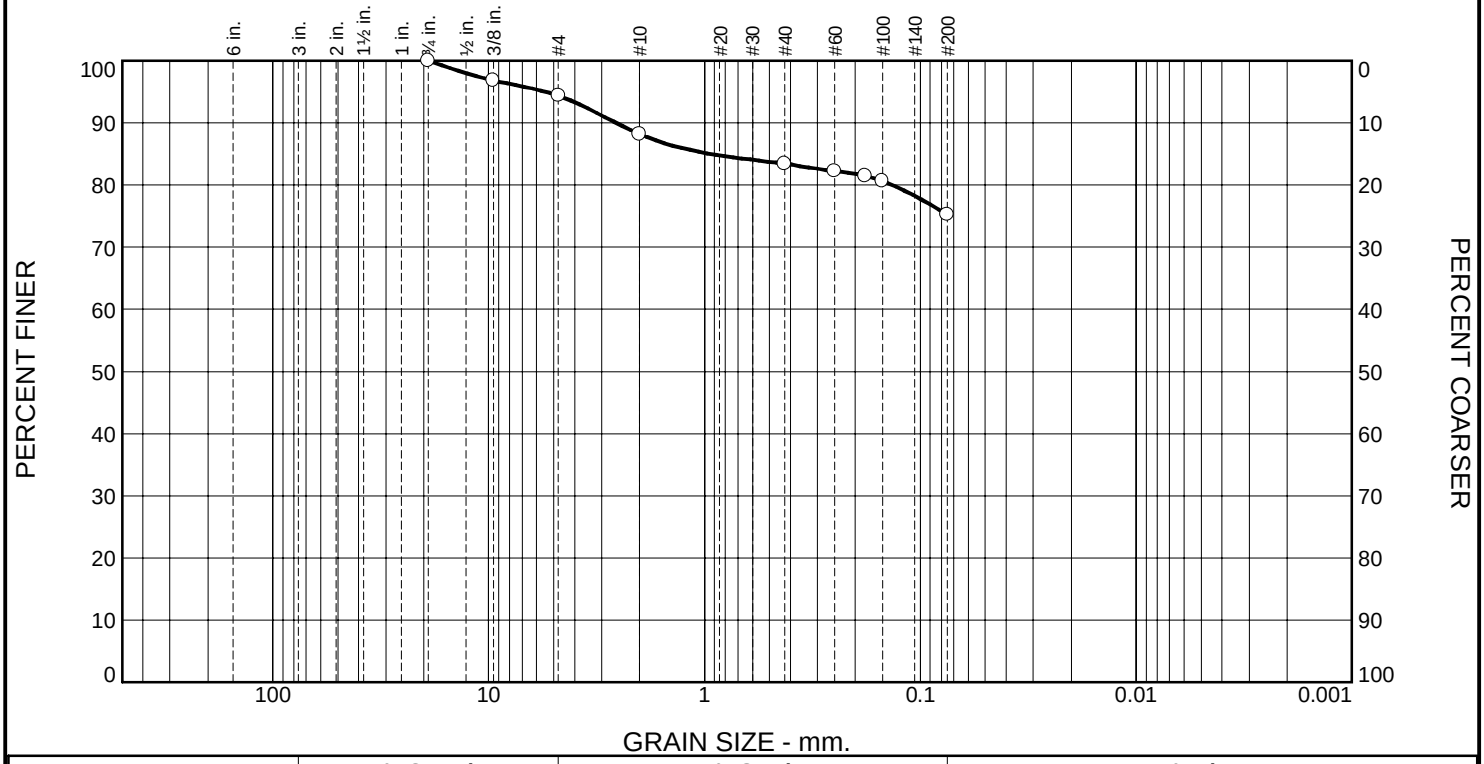
Remarks:

ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Figure

Tested By: HTN1 **Checked By:** DVT

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.6	6.2	4.8	8.2	75.2	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
0.75	100.0		
.375	96.8		
#4	94.4		
#10	88.2		
#40	83.4		
#60	82.3		
#80	81.5		
#100	80.6		
#200	75.2		

* (no specification provided)

Material Description

LEAN CLAY WITH SAND, contains slight rock fragments, brown, moist, firm

Atterberg Limits (ASTM D 4318)

PL= 20 **LL=** 47 **PI=** 27

Classification

USCS (D 2487)= CL **AASHTO (M 145)=** A-7-6(20)

Coefficients

D_{90}= 2.5683 D_{85}= 0.9342 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 1/13/20 **Date Tested:** 1/15/20

Tested By: KV

Checked By: DVT

Title: LM

Source of Sample: BH-2 **Depth:** 2.50-4.00
Sample Number: S-2 **Date Sampled:**

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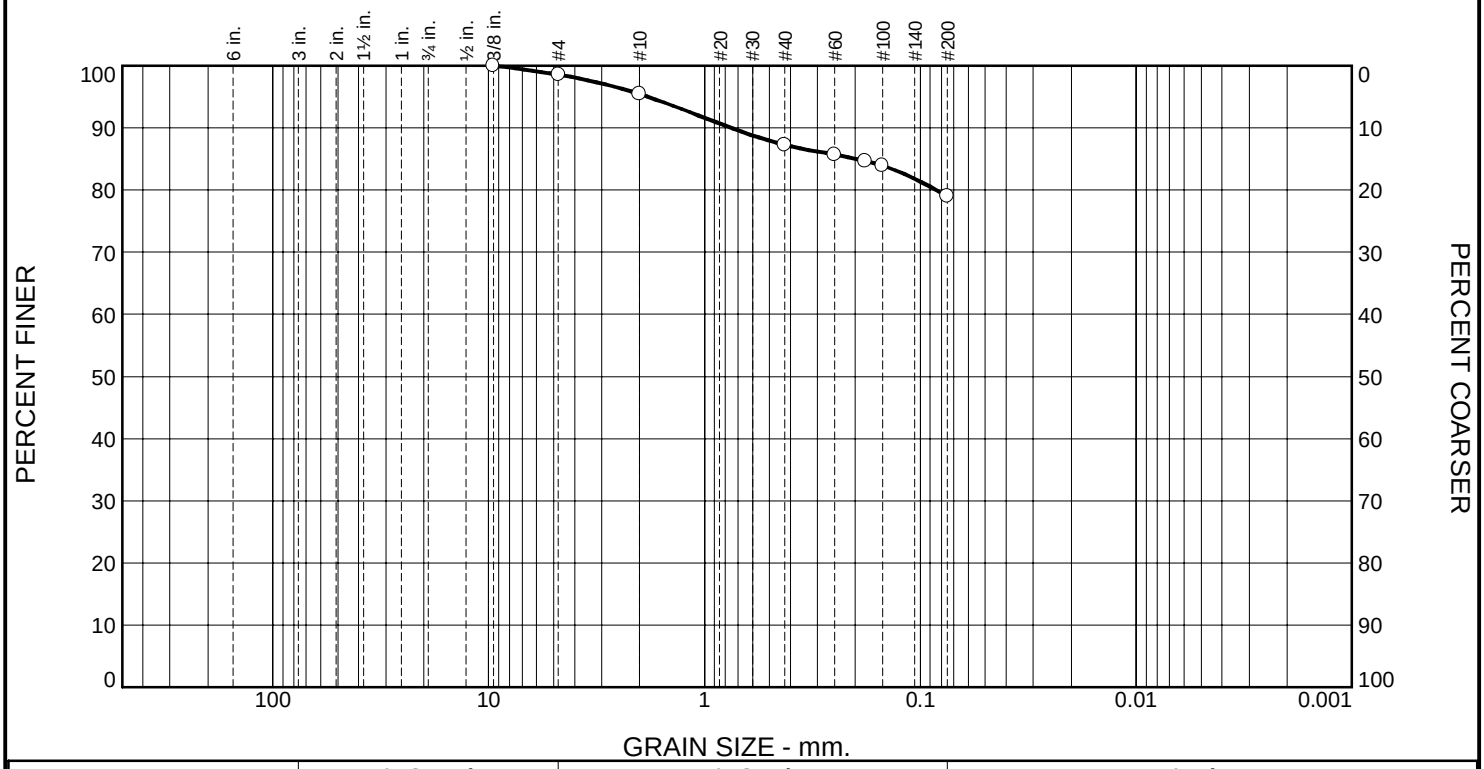
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Client: Talbert & Bright
Project: North Apron Development - Leesburg Executive Airport

Project No: 29694 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	3.2	8.1	8.3	79.0	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
.375	100.0		
#4	98.6		
#10	95.4		
#40	87.3		
#60	85.7		
#80	84.7		
#100	83.9		
#200	79.0		

* (no specification provided)

Material Description

FAT CLAY WITH SAND, brown, moist, firm

Atterberg Limits (ASTM D 4318)

PL= 25 **LL=** 56 **PI=** 31

Classification

USCS (D 2487)= CH **AASHTO (M 145)=** A-7-6(26)

Coefficients

D_{90}= 0.7544 D_{85}= 0.1992 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 1/13/20 **Date Tested:** 1/15/20

Tested By: KV

Checked By: DVT

Title: LM

Source of Sample: BH-6 **Depth:** 2.50-4.00
Sample Number: S-2

Date Sampled:

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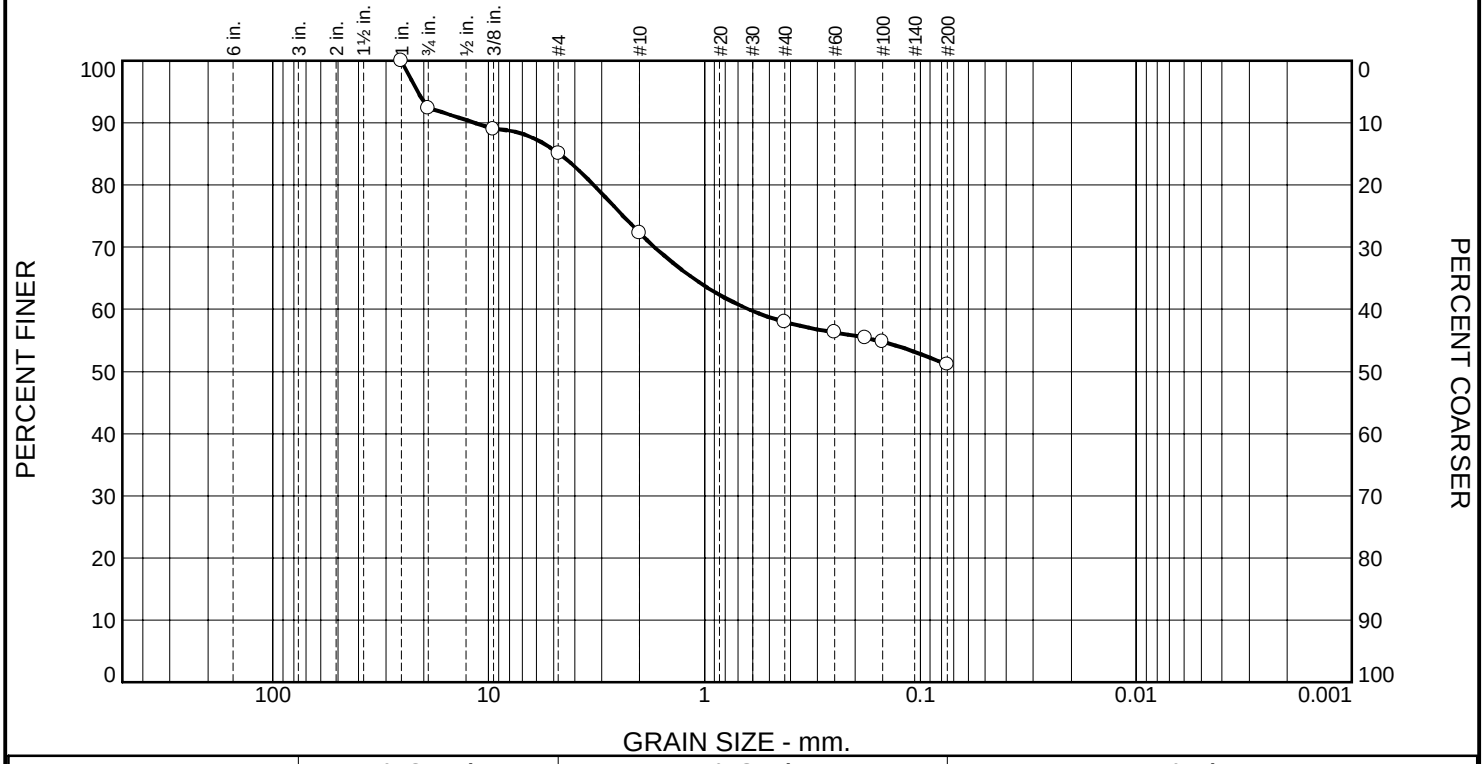
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Client: Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

Project No: 29694 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.6	7.3	12.8	14.3	6.9	51.1	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.0	100.0		
0.75	92.4		
.375	89.0		
#4	85.1		
#10	72.3		
#40	58.0		
#60	56.3		
#80	55.4		
#100	54.8		
#200	51.1		

* (no specification provided)

Material Description

SANDY LEAN CLAY, trace gravel, brown, moist, stiff

Atterberg Limits (ASTM D 4318)

PL= 19 **LL=** 38 **PI=** 19

Classification

USCS (D 2487)= CL **AASHTO (M 145)=** A-6(6)

Coefficients

D_{90}= 11.5981 D_{85}= 4.6934 D_{60}= 0.6217
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 1/13/20 **Date Tested:** 1/15/20

Tested By: KV

Checked By: DVT

Title: LM

Source of Sample: BH-7 **Depth:** 8.50-10.00
Sample Number: S-4

Date Sampled:

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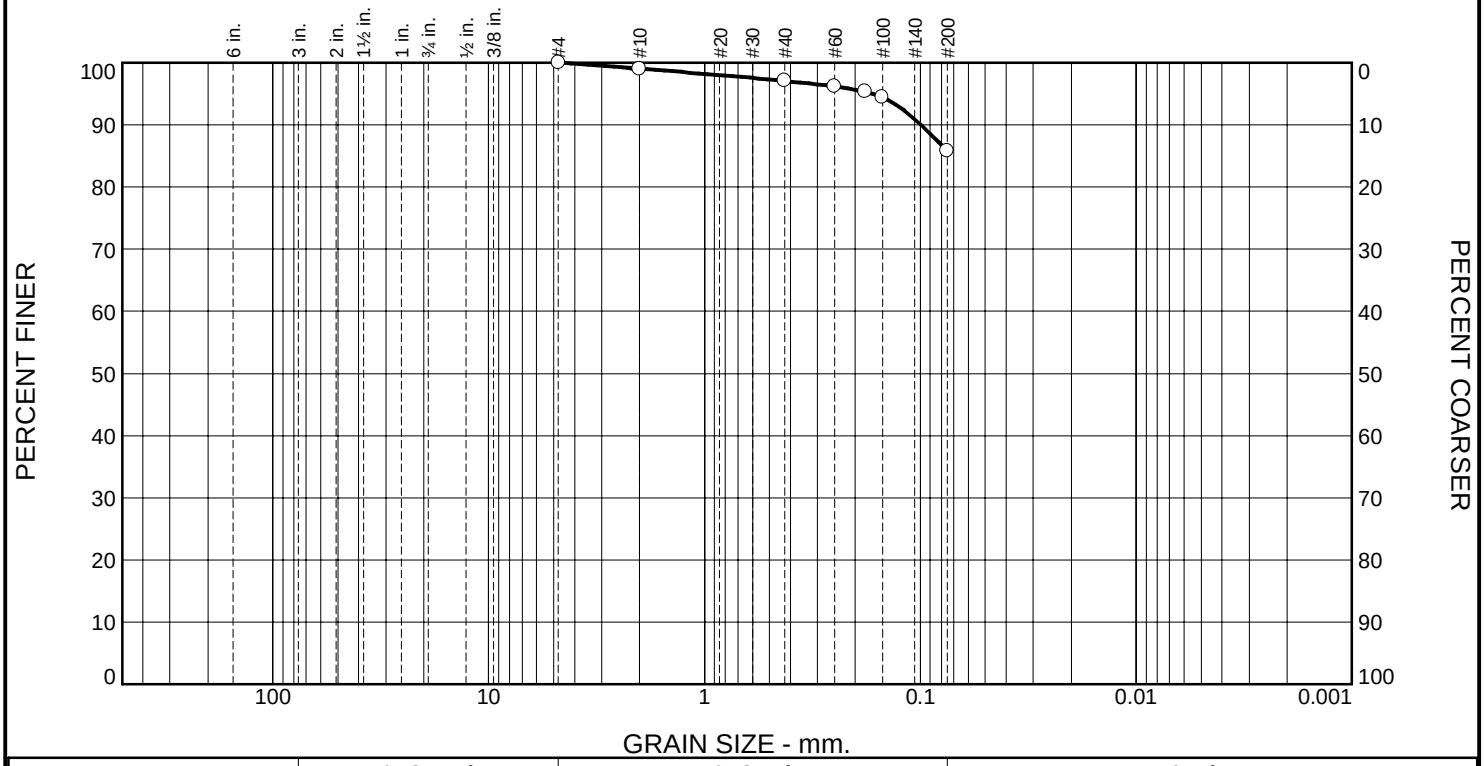
Phone: (703) 471-8400
Fax: (703) 834-5527

Client: Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

Project No: 29694 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.0	1.9	11.3	85.8	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.0		
#40	97.1		
#60	96.2		
#80	95.3		
#100	94.4		
#200	85.8		

* (no specification provided)

Material Description

Lean Clay Light Brown (0% +4)

Atterberg Limits (ASTM D 4318)

PL= 21 **LL=** 42 **PI=** 21

Classification

USCS (D 2487)= CL **AASHTO (M 145)=** A-7-6(19)

Coefficients

D_{90}= 0.0994 D_{85}= D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 1/8/20 **Date Tested:** 1/9/20

Tested By: KV

Checked By: DVT

Title: LM

Source of Sample: BH-10 **Depth:** 2.00-4.00 **Date Sampled:** 1/10/20

Sample Number: BS-1

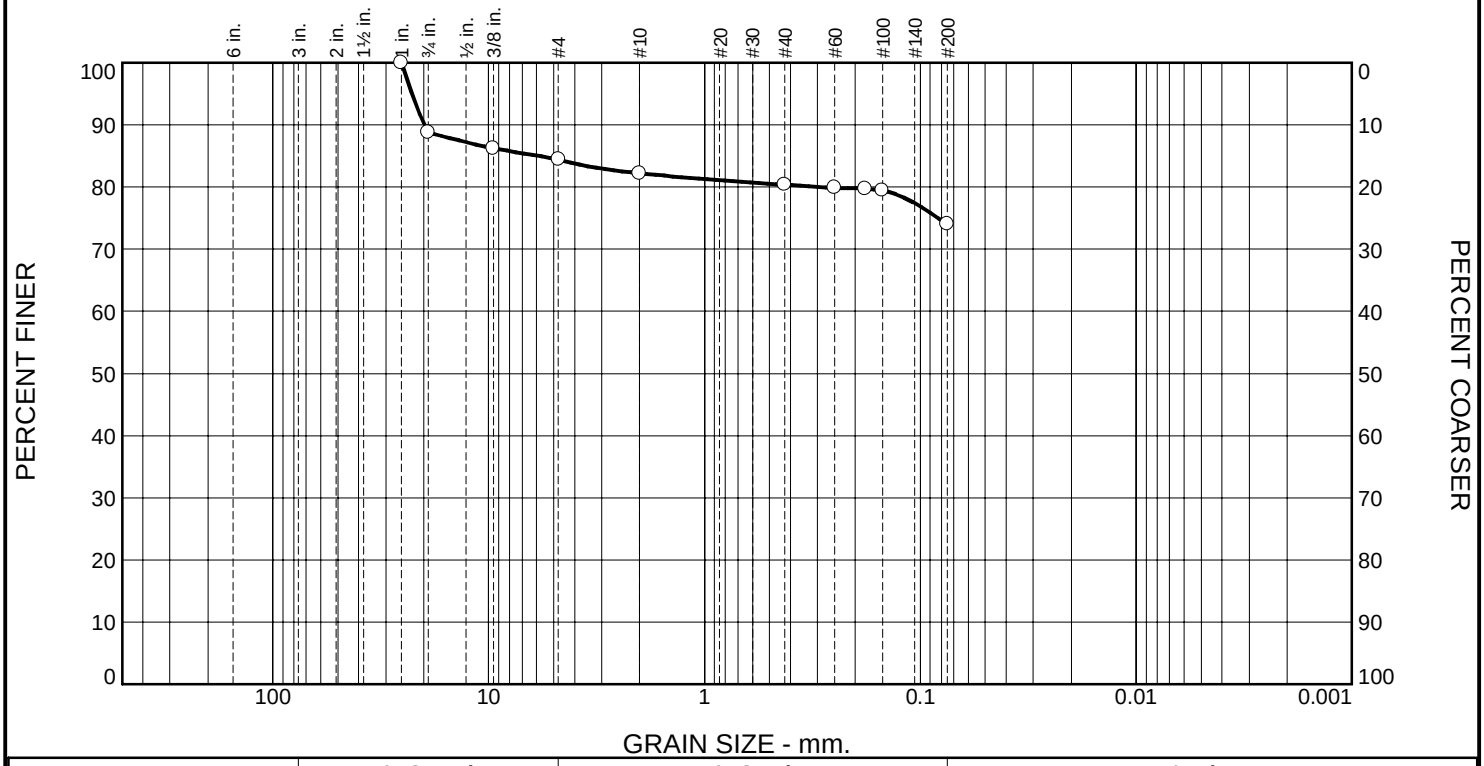
ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Client: Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

Project No: 29694 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	11.2	4.3	2.3	1.8	6.4	74.0	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.0	100.0		
0.75	88.8		
.375	86.3		
#4	84.5		
#10	82.2		
#40	80.4		
#60	79.9		
#80	79.7		
#100	79.4		
#200	74.0		

* (no specification provided)

Material Description

GRAVELLY LEAN CLAY, brown, moist, soft

Atterberg Limits (ASTM D 4318)

PL= 18 **LL=** 26 **PI=** 8

Classification

USCS (D 2487)= CL **AASHTO (M 145)=** A-4(4)

Coefficients

D_{90}= 19.8361 D_{85}= 5.8630 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 1/13/20 **Date Tested:** 1/14/20

Tested By: KC

Checked By: DVT

Title: LM

Source of Sample: BH-11 **Depth:** 0.00-1.50
Sample Number: S-1

Date Sampled:

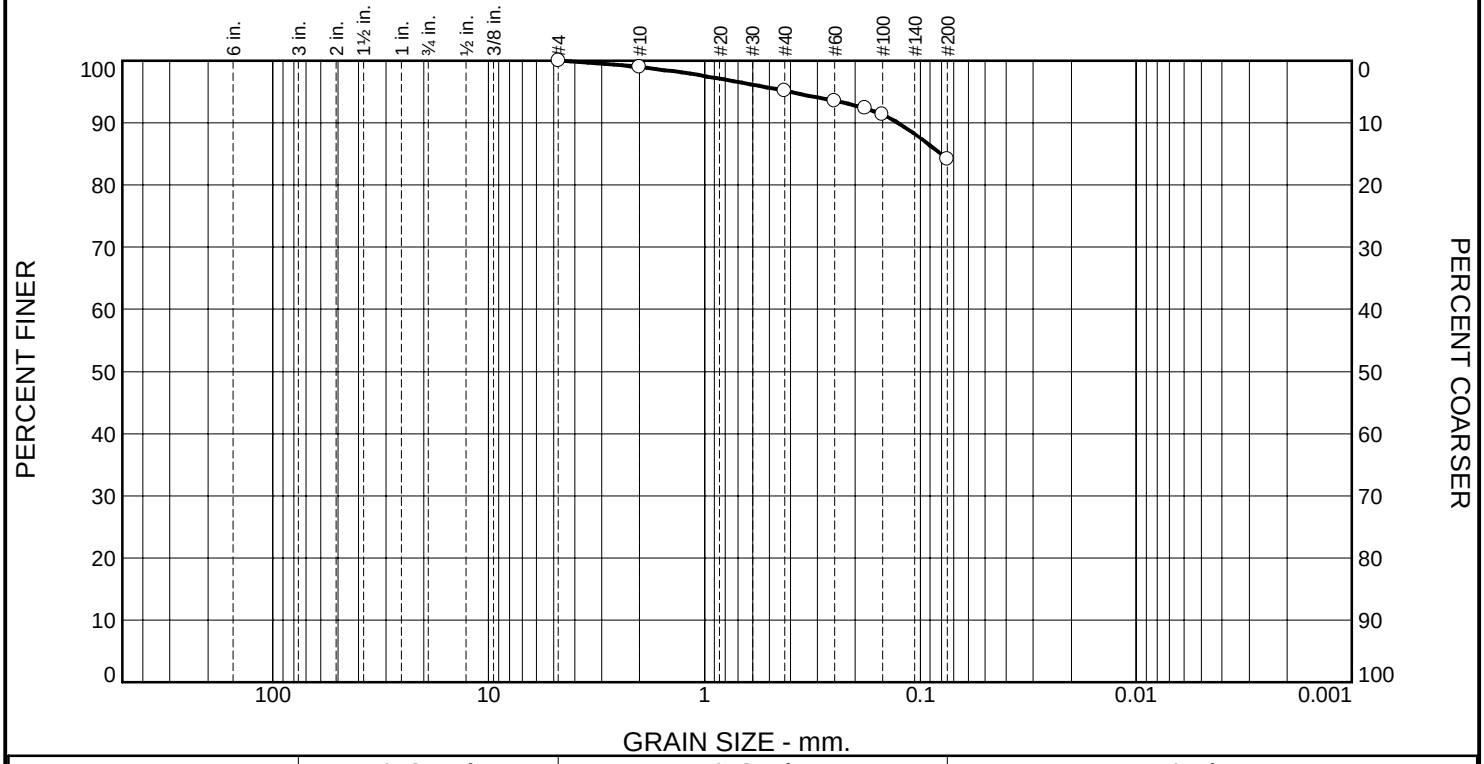
ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Client: Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

Project No: 29694 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.0	3.8	11.0	84.2	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
#4	100.0		
#10	99.0		
#40	95.2		
#60	93.5		
#80	92.3		
#100	91.3		
#200	84.2		

* (no specification provided)

Material Description

Fat Clay with Sand Brown (0% +4)

Atterberg Limits (ASTM D 4318)

PL= 21 **LL=** 51 **PI=** 30

Classification

USCS (D 2487)= CH **AASHTO (M 145)=** A-7-6(26)

Coefficients

D_{90}= 0.1269 D_{85}= 0.0803 D_{60}=
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 1/9/20 **Date Tested:** 1/10/20

Tested By: KV

Checked By: DVT

Title: LM

Source of Sample: BH-12 **Depth:** 2.00-4.00 **Date Sampled:** 1/10/20
Sample Number: BS-1

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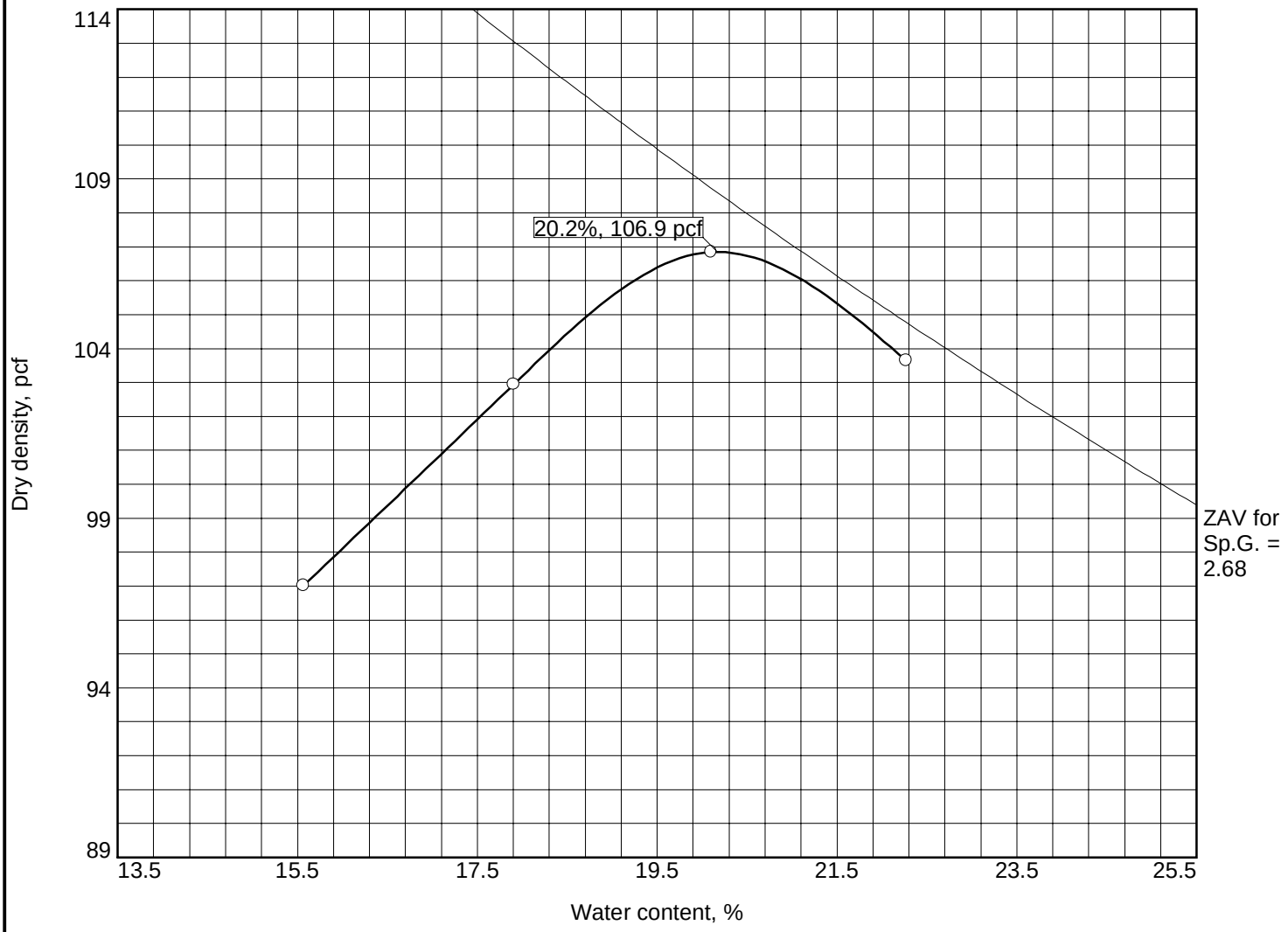
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Client: Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

Project No: 29694 **Figure**

COMPACTION TEST REPORT



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
2.00-4.00	CL	A-7-6(19)	24.6	2.6	42	21	0.0	85.8

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 106.9 pcf Optimum moisture = 20.2 %	LEAN CLAY, brown, moist, firm

Project No. 29694 **Client:** Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

Date: 1/9/20

○ **Source of Sample:** BH-10 **Sample Number:** BS-1

Remarks:

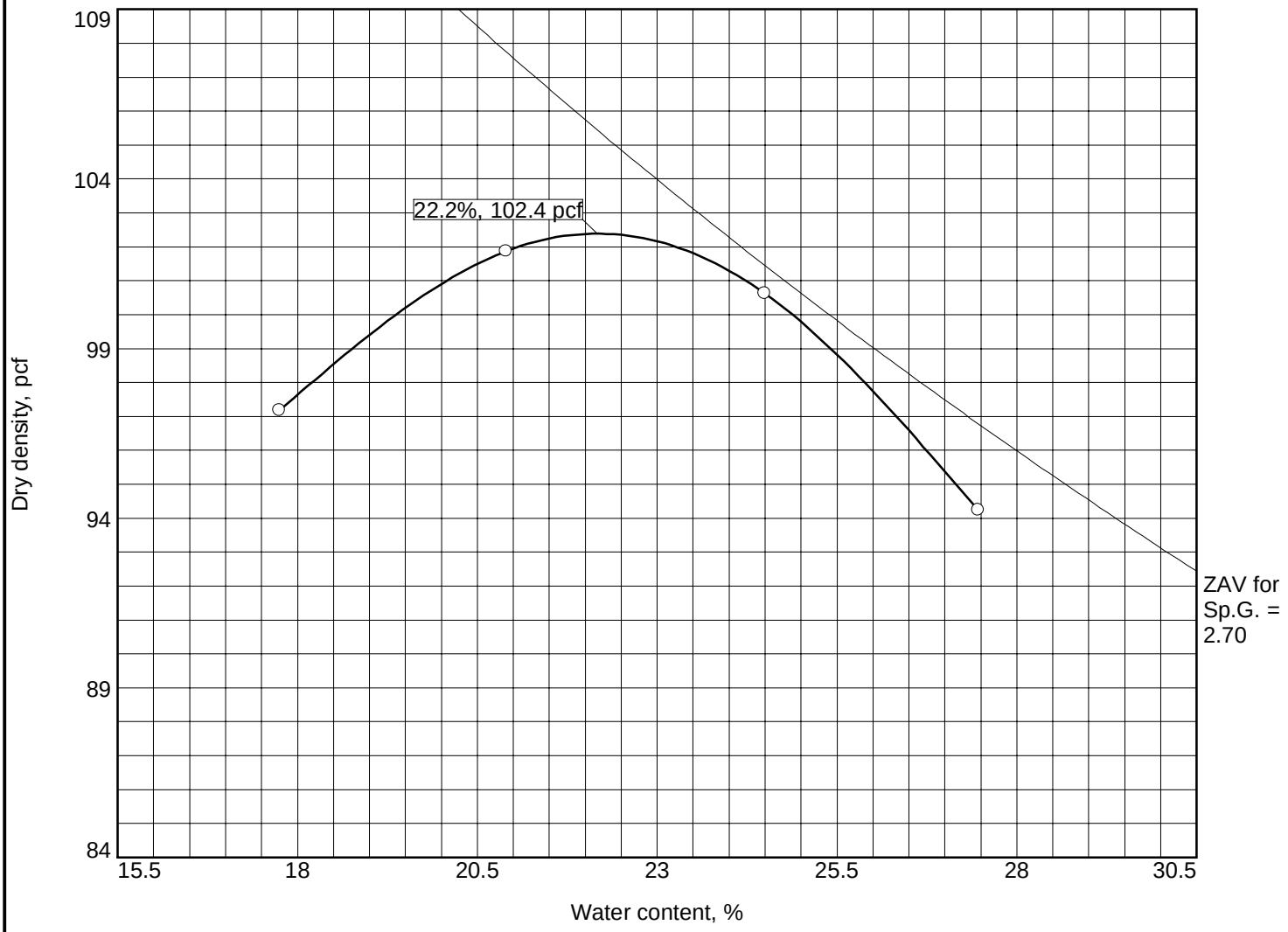
Date Received: 1/8/20

ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Figure

Tested By: HNT1 **Checked By:** DVT

COMPACTION TEST REPORT



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
2.00-4.00	CH	A-7-6(26)	23.5	2.6	51	30	0.0	84.2

TEST RESULTS

Maximum dry density = 102.4 pcf

Optimum moisture = 22.2 %

MATERIAL DESCRIPTION

FAT CLAY, brown, moist, firm

Project No. 29694 **Client:** Talbert & Bright

Project: North Apron Development - Leesburg Executive Airport

Date: 1/9/20

○ **Source of Sample:** BH-12 **Sample Number:** BS-1

Remarks:

Date Received: 1/8/20

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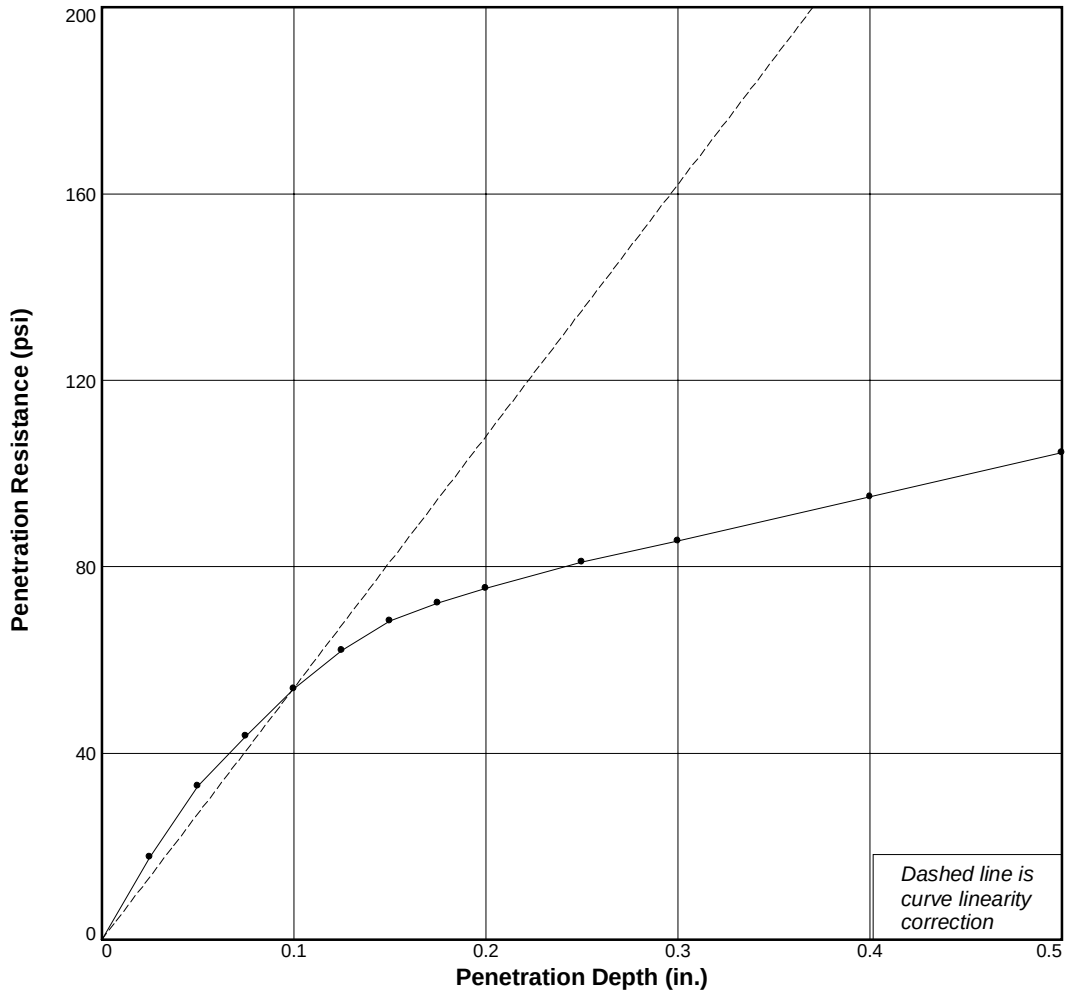
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Figure

Tested By: KV **Checked By:** DVT

BEARING RATIO TEST REPORT
ASTM D1883-14



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	107.8	100.8	19.8	105.9	99.1	22.3	5.4	5.0	0.000	10	1.8
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
LEAN CLAY, brown, moist, firm	CL	106.9	20.2	42	21

Project No: 29694

Project: North Apron Development - Leesburg Executive Airport

Source of Sample: BH-10 **Depth:** 2.00-4.00

Sample Number: BS-1

Date Sampled: 1/10/20 **Date Received:** 1/8/20

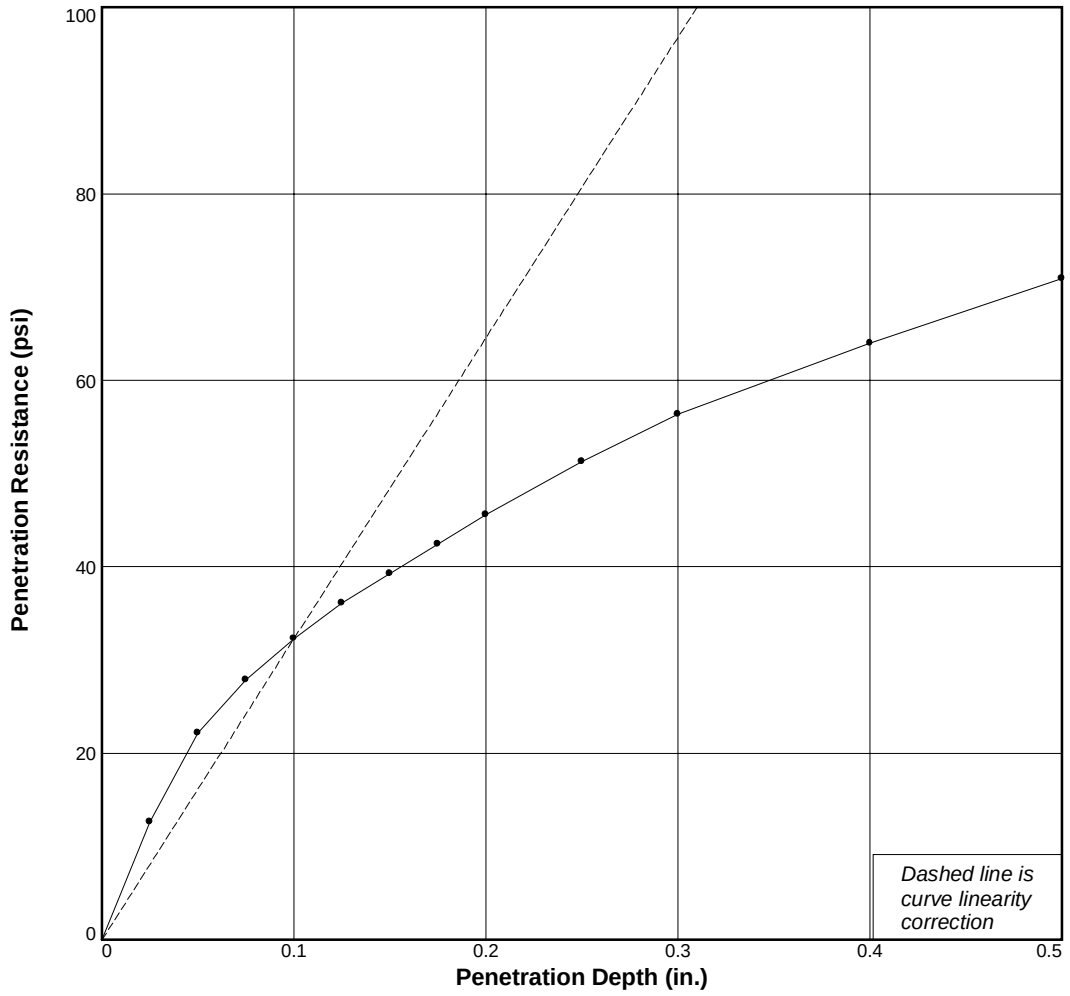
ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Test Description/Remarks:

Figure _____

Tested By: KV **Checked By:** DVT

BEARING RATIO TEST REPORT
ASTM D1883-14



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	102.8	100.4	22.5	100.2	97.9	30.8	3.2	3.0	0.000	10	2.6
2 △											
3 □											

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
FAT CLAY, brown, moist, firm	CH	102.4	22.2	51	30

Project No: 29694

Project: North Apron Development - Leesburg Executive Airport

Source of Sample: BH-12 **Depth:** 2.00-4.00

Sample Number: BS-1

Date Sampled: 1/10/20 **Date Received:** 1/9/20

ECS MID-ATLANTIC, LLC
14026 Thunderbolt Place, Suite 100
Chantilly, VA 20151-3232
Phone: (703) 471-8400
Fax: (703) 834-5527

Test Description/Remarks:

Figure _____

Tested By: KC **Checked By:** DVT

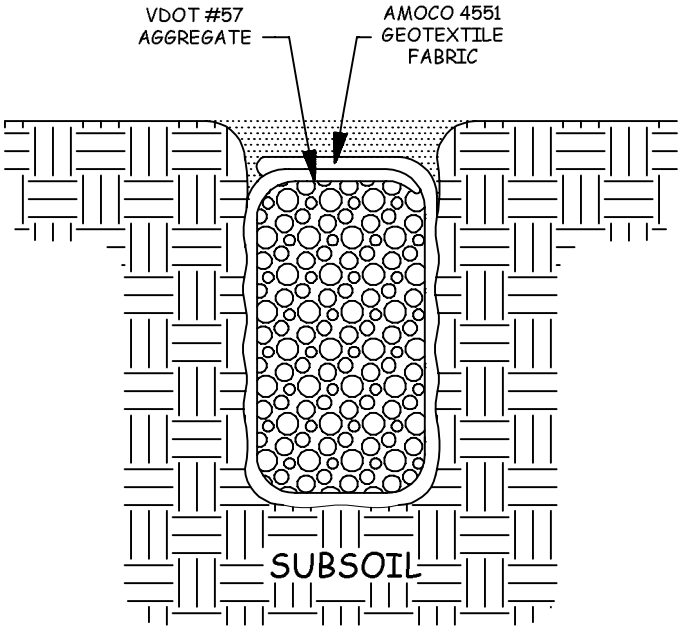
APPENDIX D – Supplemental Report Documents

French Drain Installation Procedure
Typical Foundation Detail

FRENCH DRAIN
INSTALLATION PROCEDURE

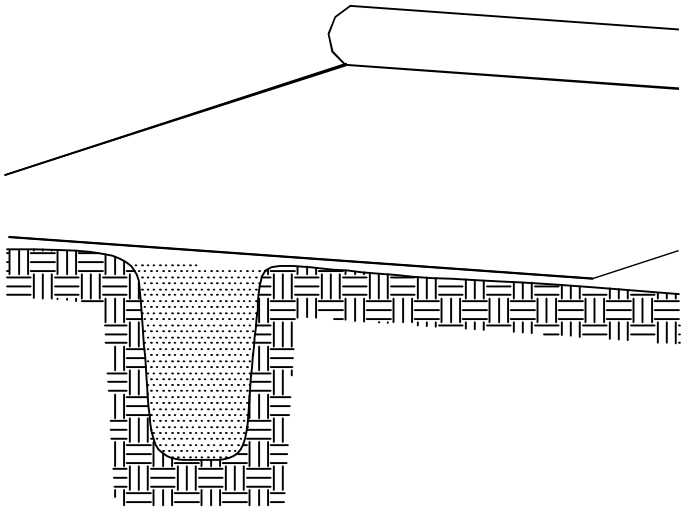
NOT TO SCALE

FINAL CONFIGURATION



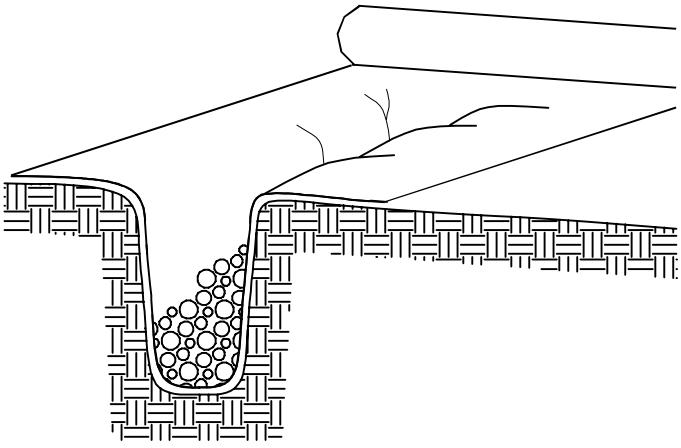
SUBDRAIN USING FILTER FABRIC

STEP 1



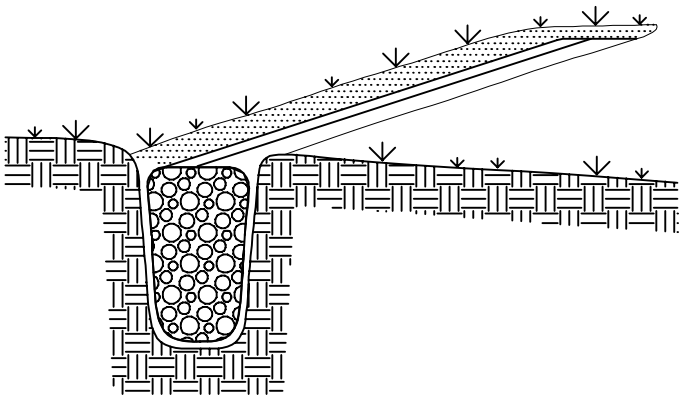
FABRIC IS UNROLLED DIRECTLY OVER TRENCH

STEP 2



THE TRENCH IS FILLED WITH AGGREGATE

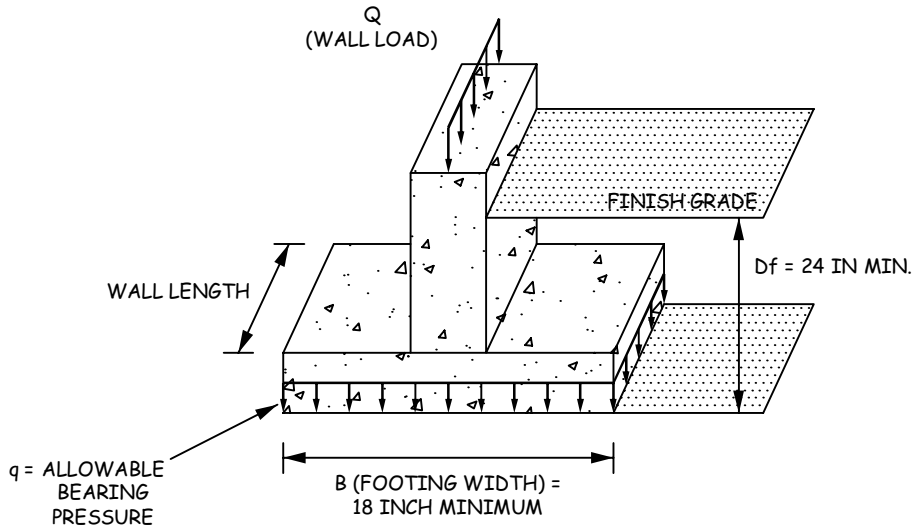
STEP 3



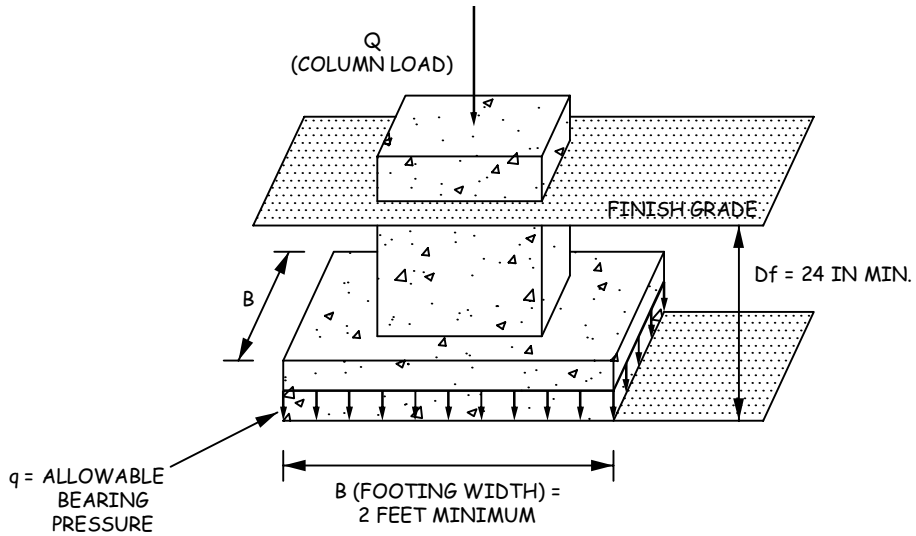
THE FABRIC IS LAPPED CLOSED AND
COVERED WITH BASE STONE

ECS LLC
MID-ATLANTIC

CONTINUOUS FOOTING



COLUMN FOOTING



TYPICAL FOUNDATION DETAIL

NOT TO SCALE

ECS LLC
MID-ATLANTIC