Wilson, Donna

From:	Wilson, Donna
Sent:	Friday, December 18, 2015 4:40 PM
To:	Jason Gibson (Jason@64portables.com); Sue Gibson (sue@64portables.com); Jeffrey Gerlock (jeff.gerlock@gmail.com)
Cc:	Tony Gallagher (tony.gallagher@ncdenr.gov); Ellen Lorscheider (ellen.lorscheider@ncdenr.gov)
Subject:	Carolina Compost application, soil liner requirements
Attachments:	Carolina Compost ltr concerning soil liner.pdf; Guidance for Carolina Compost application.docx; Example CQA report for completed construction.pdf; Example CQA plan for clay liner 2.pdf; Example CQA plan for clay liner 1.pdf

Mr. Gibson, attached is a letter and supporting documents concerning the soil liner requirements for the Carolina Compost application.

If you have questions please let me know.

Donna J. Wilson
Environmental Engineer
Solid Waste Section, Division of Waste Management
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PAT MCCRORY
Governor

DONALD R. VAN DER VAART
Secretary

LINDA CULPEPPER
Director

December 18, 2015

Mr. Jason Gibson
1570 Kepley Rd
Lexington, NC 27292

Re: Carolina Compost, Application for a Type 4 Compost Facility, Davidson County

Dear Mr. Gibson:

This week I have reviewed your application focusing on just the construction aspects of the soil liner, to determine if a Permit to Construct could be issued for this project. This part of the application should be the most complex portion of the application because it involves engineering design and planning. This part of the application is incomplete.

In your initial application dated December 2014, it is stated that the site will have a clay liner for the pad. My review comments dated May 2015 requested a description of the soil testing to confirm that it meets the permeability requirements.

In the revised application dated July 2015, it is stated that the soil would be tested for field density and Proctors. In my response comments dated August 2015, I provided more guidance as to the detail needed for the construction and testing. The pad would need to be constructed similar to a landfill liner pad, and should follow construction and testing rules referenced in the landfill rules. The application should provide a description of construction details, testing and construction quality assurance (CQA). I also included an example list of types of testing and frequencies.

In the revised application dated November 2015, the response to this comment was that the area would be tested following the standards in my letter and following the rules that I had referenced. The actual technical description and CQA plan was not provided.

The application portion of the soil pad construction should contain technical details of how the soil pad will be constructed and should include a CQA plan. I have attached some guidance as to generally what the technical details and CQA plan should contain; however, this submittal should be prepared by a qualified registered professional engineer, specific to this project.

I have also included two examples of CQA plans for other soil liner/pad/cover construction projects, to illustrate how this submittal should appear. We have additional examples that can be provided upon request. I have also included an example of a CQA report, which is submitted after construction to certify that a project was built in accordance with the approved plan and requirements.

If you have any questions, please contact me at (919) 707-8255 or by email at donna.wilson@ncdenr.gov.

Sincerely,

Donna J. Wilson

Donna J. Wilson, Environmental Engineer, Solid Waste Section
Division of Waste Management, Department of Environmental Quality

cc: Jeff Gerlock

Guidance for Carolina Compost application

12-18-2015, Donna Wilson

This guidance only contains the major points and does not represent everything that should be in the technical documents and construction quality assurance (CQA) plan. This portion of the application should be prepared and signed/sealed by a qualified North Carolina registered professional engineer, with experience in installing low permeability liners (1×10^{-7} cm/sec), similar to landfill soil liners.

Construction of the facility must be in accordance with good engineering practices, supervised by a qualified North Carolina registered engineer, and meet the following:

a. An 18 inch compacted pad must be constructed for the required area. The required area consists of the unloading area, feedstock storage area, composting area, curing area, areas that will receive runoff from those areas, and the stormwater/wastewater pond. The area includes ditches or pathways that lead to the stormwater/wastewater pond.

b. All areas of the finished compacted pad must have a protective layer or some other method of protection to prevent damage and desiccation of the pad.

c. The sedimentation/wastewater pond must be constructed in accordance with requirements of sedimentation and erosion control, and wastewater discharge.

d. The soil borrow source should be tested for parameters and frequency similar to the following (but should be **determined by the site project engineer** based on good engineering practices and site specific conditions):

   i) Visual Classification, ASTM D2487, each load, USCS classification of CL, CH, MH, ML, CH-MH, CL-ML.
   ii) Moisture content, ASTM D2216, 1 sample/2000 cubic yard (cy) or each change in material type.
   iii) Particle/Grain size analysis, ASTM D422, 1/2000 cy, confirm classification and minimum 50% passing no. 200 sieve.
   iv) Atterburg limits, ASTM D4318, 1/2000 cy, liquid limit greater than 30 and plasticity index greater than 15.
   v) Moisture-density-permeability relationship, 1/5000 cy.
   vi) Permeability, ASTM D5084, 1/10,000 cy, 1x10-7 cm/sec at 95% maximum standard dry density, moisture content 2% to 6% above optimum.

e. Installation of the soil pad must meet the following; however testing parameters and frequency should be **determined by the site project engineer** based on good engineering practices and site specific conditions.

   i) Minimum 18 inch compacted pad, constructed to meet a permeability of 1×10^{-7} cm/sec, placed in 6 inch compacted lifts, with scarification between each lift

ii) Particle size/Gradation test – 1/acre/lift
iii) Atterburg limits test – 1/acre/lift
iv) Moisture content test –2/acre/lift
v) In-place density test – minimum of 3/acre/lift
vi) Proctor test – 1/5000 cy per soil type
vii) Clod size, visual test – each lift. Soil material must be free of particles greater than three inches in any dimension.
viii) Permeability, in-place STEI test – 1 per acre
ix) Permeability, remolded test – 1/10,000 cy
x) Hydraulic conductivity test –1/ac/lift
xi) Thickness measurement – 8 locations per acre (for total thickness)
xii) Holes made for testing must be completely filled in with bentonite
xiii) Compaction – 95% Proctor, moisture content 2% to 6% above optimum.
xiv) Soil conditioning, placement, and compaction must be maintained within the range identified in the moisture-density-permeability relation.

f. The CQA plan should also discuss the contents of the CQA report that will be submitted following construction which should at a minimum contain:

i) Discussion and results of all quality assurance and quality control testing including lab and field testing results, documentation of any failed test results, descriptions of procedures used to correct the improperly installed material and results of all retesting performed.
ii) Drawings and text noting any deviation from the plans.
iii) Comprehensive narrative, including but not limited to, installation procedures, daily or summary field reports from the project engineer and a series of color photographs of major project features.
iv) The seal of the project engineer, who shall be a qualified North Carolina registered professional engineer, and a certification that construction was completed in accordance with the CQA plan and acceptable engineering practices.

Construction Quality Assurance Manual

Phase 3
Shotwell C&D Landfill
Wake County, North Carolina
NC Solid Waste Permit No. 92-26

Prepared for:

Shotwell Landfill, Inc.
Wendell, NC

PERMIT ISSUE DOCUMENTS

October 2009

Prepared by:

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SHOTWELL LANDFILL, INC.
C&D LANDFILL - PHASE 3

CONSTRUCTION QUALITY ASSURANCE MANUAL

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SECTION 1.0
GENERAL

1.1 INTRODUCTION

This Construction Quality Assurance (CQA) Manual has been prepared to provide the Owner, (Design) Engineer, and CQA Engineer the means to govern the construction quality and to satisfy landfill certification requirements under current solid waste management regulations.

More specifically, this CQA Manual addresses the soils components of the landfill.

The CQA Manual is divided into the following sections:

- Section 1.0 General
- Section 2.0 CQA Documentation
- Section 3.0 Earthwork CQA
- Section 4.0 Final Cover System CQA

1.2 DEFINITIONS RELATING TO CONSTRUCTION QUALITY

1.2.1 Construction Quality Assurance (CQA)

In the context of this Manual, Construction Quality Assurance is defined as a planned and systematic program employed by the Owner to assure conformity of the earthwork installation with the project drawings and the project specifications. CQA is provided by the CQA Engineer as a representative of the Owner and is independent from the Contractor. The CQA program is designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service.

1.2.2 Construction Quality Control (CQC)

Construction Quality Control refers to actions taken by the Contractor to ensure that the materials and the workmanship meet the requirements of the project drawings and the project specifications.

1.2.3 CQA Certification Document

At the completion of construction, a certification document will be prepared by the CQA Engineer and submitted to State Solid Waste Regulators. The certification report will include all CQA testing performed by the CQA Engineer.

1.2.4 Discrepancies Between Documents

The Contractor is instructed to bring discrepancies to the attention of the CQA Engineer who shall then notify the Engineer for resolution. The Engineer has the sole authority to

determine resolution of discrepancies existing within the Contract Documents (this may also require the approval of State Solid Waste Regulators). Unless otherwise determined by the Engineer, the more stringent requirement shall be the controlling resolution.

1.3 PARTIES TO CONSTRUCTION QUALITY ASSURANCE

1.3.1 Description of the Parties

The parties to Construction Quality Assurance and Quality Control include the Owner, Engineer, Contractor, CQA Engineer, and Soils CQA Laboratory.

1.3.1.1 Owner

The Owner is Shotwell Landfill, Inc., who owns and/or is responsible for the facility.

1.3.1.2 Engineer

The Engineer is responsible for the engineering design, drawings, and project specifications for the landfill. The Engineer is an official representative of the Owner. The Engineer serves as communications coordinator for the project, initiating the meetings outlined in **Section 1.7**. The Engineer shall also be responsible for proper resolution of all quality issues that arise during construction. The Engineer is G.N. Richardson & Associates, Inc.

1.3.1.3 Contractor

The Contractor is responsible for the construction of the landfill. The Contractor is responsible for the overall CQC on the project and coordination of submittals to the CQA Engineer. Additional responsibilities of the Contractor are defined by the project specifications.

1.3.1.4 CQA Engineer

The CQA Engineer is a representative of the Owner, is independent from the Contractor, and is responsible for observing, testing, and documenting activities related to the CQA of the earthworks at the site. The CQA Engineer may make field observations and review submittals for the Engineer and is responsible for notifying the Owner and Engineer of all quality issues that arise during construction. The CQA Engineer is also responsible for issuing a facility certification report, sealed by a Professional Engineer registered in The State of North Carolina.

1.3.1.5 Soils CQA Laboratory

The Soils CQA Laboratory is a party, independent from the Owner, that is responsible for conducting geotechnical tests on conformance samples of soils and aggregates used in structural fills. The services of the Soils CQA Laboratory are coordinated by the CQA Engineer and are paid for by the Owner.

1.3.2 Qualifications of the Parties

The following qualifications are required of all parties involved with the CQA of all materials for the landfill. Where applicable, these qualifications must be submitted by the Contractor to the Owner and Engineer for review and approval.

1.3.2.1 Contractor

Qualifications of the Contractor are specific to the construction contract and independent of this CQA Manual.

1.3.2.2 CQA Engineer

The CQA Engineer will act as the Owner's Quality Assurance Representative. The CQA Engineer will perform CQA testing to satisfy the requirements of this CQA Manual and will prepare the CQA certification document. The CQA Engineer will have experience in the CQA aspects of landfill construction, and be familiar with ASTM and other related industry standards. The activities of the CQA Engineer will be performed under the supervision of a Registered Professional Engineer.

1.3.2.3 Soils CQA Laboratory

The Soils CQA Laboratory will have experience in testing structural fills and be familiar with ASTM and other applicable test standards. The Soils CQA Laboratory will be capable of providing test results within 24 hours or a reasonable time after receipt of samples depending on the test(s) to be conducted, as agreed to at the outset of the project by affected parties, and will maintain that standard throughout the installation.

1.4 SCOPE OF CONSTRUCTION QUALITY ASSURANCE MANUAL

The scope of this CQA Manual includes the CQA of the earthwork for the subject facility. The CQA for the selection, evaluation, and placement of the soils is included in the scope.

1.5 UNITS

In this CQA Manual, all properties and dimensions are expressed in U.S. units.

1.6 REFERENCES

The CQA Manual includes references to the most recent version of the test procedures of the American Society of Testing and Materials (ASTM). **Appendix A** contains a list of these procedures.

1.7 CQA MEETINGS

To facilitate the specified degree of quality during installation, clear, open channels of communication are essential. To that end, meetings are critical.

1.7.1 Pre-Construction Meeting

A Pre-Construction Meeting will be held, attended by the Engineer, the CQA Engineer, the Contractor, and representatives from any other involved parties. In accordance with 15A NCAC 13B.0541(b)(1), the meeting will address the construction management organization, respective duties during construction, and periodic reporting requirements for test results and construction activities.

1.7.2 CQA Progress Meetings

Progress meetings will be held between the Engineer, the CQA Engineer, the Contractor, and representatives from any other involved parties at the frequency dictated in the project specifications or, at a minimum, once per month during active construction. These meetings will discuss current progress, planned activities for the next week, and any new business or revisions to the work. The CQA Engineer will log any problems, decisions, or questions arising at this meeting in his daily or periodic reports. Any matter requiring action which is raised in this meeting will be reported to the appropriate parties. These meetings will be documented by the Engineer and minutes will be transmitted to affected parties.

1.7.3 Problem or Work Deficiency Meetings

A special meeting will be held when and if a problem or deficiency is present or likely to occur. At a minimum, the meeting will be attended by the Engineer, the CQA Engineer, the Contractor, and representatives from any other involved parties. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

- define and discuss the problem or deficiency;
- review alternative solutions; and
- implement an action plan to resolve the problem or deficiency.

The meeting will be documented by the Engineer and minutes will be transmitted to affected parties.

1.8 CONTROL VERSUS RECORD TESTING

1.8.1 Control Testing

In the context of this CQA Manual, Control Tests are those tests performed on a material prior to its actual use in construction to demonstrate that it can meet the requirements of the project plans and specifications. Control Test data may be used by the Engineer as the basis for approving alternative material sources.

1.8.2 Record Testing

Record Tests are those tests performed during the actual placement of a material to demonstrate that its in-place properties meet or exceed the requirements of the project drawings and specifications.

SECTION 2.0
CQA DOCUMENTATION

2.1 DOCUMENTATION

An effective CQA plan depends largely on recognition of construction activities that should be monitored and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of quality assurance activities. The CQA Engineer will document that quality assurance requirements have been addressed and satisfied.

The CQA Engineer will provide the Owner and Engineer with his daily and weekly progress reports including signed descriptive remarks, data sheets, and logs to verify that required CQA activities have been carried out. These reports shall also identify potential quality assurance problems. The CQA Engineer will also maintain at the job site a complete file of project drawings, reports, project specifications, a CQA Manual, checklists, test procedures, daily logs, and other pertinent documents.

2.2 DAILY CQA REPORT

The CQA Engineer's reporting procedures will include preparation of a daily report which, at a minimum, will include the following information, where applicable:

- a unique identifying sheet number for cross referencing and document control;
- date, project name, location, and other identification;
- data on weather conditions;
- a reduced-scale Site Plan showing all proposed work areas and test locations;
- descriptions and locations of ongoing construction;
- descriptions and specific locations of areas, or units, of work being tested and/or observed and documented;
- locations where tests and samples were taken;
- a summary of test results;
- calibrations or recalibrations of test equipment, and actions taken as a result of recalibration;
- off-site materials received, including quality verification documentation;
- decisions made regarding acceptance of units of work, and/or corrective actions to

be taken in instances of substandard quality;

- summaries of pertinent discussions with the Contractor; and
- the CQA Engineer's signature.

The daily report must be completed at the end of each CQA Engineer's shift, prior to leaving the site. This information will be submitted weekly to and reviewed by the Owner and Engineer.

2.3 CQA PROGRESS REPORTS

The CQA Engineer will prepare a summary progress report each week, or at time intervals established at the pre-construction meeting. As a minimum, this report will include the following information, where applicable:

- a unique identifying sheet number for cross-referencing and document control;
- the date, project name, location, and other information;
- a summary of work activities during the progress reporting period;
- a summary of construction situations, deficiencies, and/or defects occurring during the progress reporting period;
- summary of all test results, failures and retests, and
- signature of the CQA Engineer.

The CQA Engineer's progress reports must summarize the major events that occurred during that week. Critical problems that occur shall be communicated verbally to the Engineer immediately as well as being included in the weekly reports. The CQA Engineer's weekly report must be submitted to the Owner and Engineer no later than the Monday following the week reported.

2.4 CQA PHOTOGRAPHIC REPORTING

Photographs shall be taken by the CQA Engineer at regular intervals during the construction process and in all areas deemed critical by the CQA Engineer.

These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. These records will be presented to the Engineer upon completion of the project.

In lieu of photographic documentation, videotaping may be used to record work progress, problems, and mitigation activities. The Engineer may require that a portion of the documentation be recorded by photographic means in conjunction with videotaping.

2.5 DEFICIENCIES

The Owner and Engineer will be made aware of any significant recurring nonconformance with the project specifications. The Engineer will then determine the cause of the non-conformance and recommend appropriate changes in procedures or specification. When this type of evaluation is made, the results will be documented, and any revision to procedures or project specifications will be approved by the Owner and Engineer.

2.6 DESIGN AND/OR PROJECT TECHNICAL SPECIFICATION CHANGES

Design and/or project specification changes may be required during construction. In such cases, the CQA Engineer will notify the Engineer. The Engineer will then notify the appropriate agency, if necessary.

Design and/or project specification changes will be made only with the written agreement of the Engineer, and will take the form of an addendum to the project specifications. All design changes shall include a detail (if necessary) and state which detail it replaces in the plans.

2.7 FINAL CQA REPORT

At the completion of each major construction activity at the landfill unit, the CQA Engineer will certify all required forms, observation logs, field and laboratory testing data sheets including sample location plans, etc. The CQA Engineer will also provide a final report which will certify that the work has been performed in compliance with the plans and project technical specifications, and that the supporting documents provide the necessary information.

The CQA Engineer will also provide summaries of all the data listed above with the report. The Record Drawings will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.). All surveying and base maps required for development of the Record Drawings will be done by the Contractor's Construction Surveyor. These documents will be certified by the Contractor and delivered to the CQA Engineer and included as part of the final CQA (Certification) report.

It may be necessary to prepare interim certifications, as allowed by the regulatory agency to expedite completion and review.

At a minimum, the items shown in **Table 2.1** shall be included in the Final CQA Report. Note that some items may not be applicable to all projects.

2.8 STORAGE OF RECORDS

All handwritten data sheet originals, especially those containing signatures, will be stored by the CQA Engineer in a safe repository on site. Other reports may be stored by any standard method which will allow for easy access. All written documents will become property of the Owner.

TABLE 2.1A: FINAL CQA REPORT GENERAL OUTLINE

1.0 Introduction
2.0 Project Description
3.0 CQA Program
    3.1 Scope of Services
    3.2 Personnel
4.0 Earthwork CQA
5.0 Final Cover System CQA (As Applicable)
6.0 Summary and Conclusions
7.0 Project Certification

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Appendix A Design Clarifications and Modifications
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Appendix C Photographic Documentation
Appendix D CQA Reporting
    D1. CQA Reports
    D2. CQA Meeting Minutes
Appendix E Earthwork CQA Data
    E1. CQA Test Results - Control Tests
    E2. CQA Test Results - Record Tests
Appendix F Final Cover System CQA Data
Appendix G Record Drawings
    G1 Subgrade As-Built
    G2 Vegetative Soil Layer As-Built

SECTION 3.0
EARTHWORK CQA

3.1 INTRODUCTION

This section of the CQA Manual addresses earthwork (excavation and embankment) and outlines the soils CQA program to be implemented with regard to material approval, subgrade approval, field control and record tests, and resolution of problems.

3.2 EMBANKMENT MATERIAL APPROVAL

All material to be used as compacted embankment shall be approved in advance by the CQA Engineer. Approval is based upon successful completion of CQA control testing outlined below. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

3.2.1 Control Tests

The procedure for CQA testing during excavation and stockpiling (including existing stockpiles) is outlined below.

Each load of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be rejected or routed to separate stockpiles consistent with its end use. Appropriate entries shall be made in the daily log.

During stockpiling operations, control tests, as shown on **Table 3.1**, will be performed by the CQA Engineer prior to placement of any compacted embankment.

3.3 SUBGRADE APPROVAL

The CQA Engineer shall verify that the compacted embankment subgrade is constructed in accordance with the project specifications.

3.4 EARTHWORK CONSTRUCTION

3.4.1 Construction Monitoring

A. Earthwork shall be performed as described in the project specifications.

B. Only soil previously approved by the CQA Engineer (see **Section 3.2**) shall be used in construction of the compacted embankment. Unsuitable material will be removed prior to acceptance by the CQA Engineer.

C. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed. The surface preparation (e.g. wetting, drying, scarification, etc.) shall be completed before the CQA Engineer will allow placement

of subsequent lifts.

D. The CQA Engineer shall monitor protection of the earthwork during and after construction.

3.4.2 Control Tests

The control tests, as shown on **Table 3.2**, will be performed by the CQA Engineer prior to placement of compacted embankment.

3.4.3 Record Tests

The record tests, as shown on **Table 3.2**, will be performed by the CQA Engineer during placement of compacted embankment.

3.4.3.1 Record Test Failure

Recompaction of the failed area shall be performed and retested until the area meets or exceeds requirements outlined in the specifications.

3.4.4 Judgmental Testing

During construction, the frequency of control and/or record testing may be increased at the discretion of the CQA Engineer when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- the rollers slip during rolling operation;
- the lift thickness is greater than specified;
- the fill material is at an improper moisture content;
- fewer than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- the rollers may not have used optimum ballast;
- the fill materials differ substantially from those specified; or
- the degree of compaction is doubtful.

3.5 DEFICIENCIES

The CQA Engineer will immediately determine the extent and nature of all defects and deficiencies and report them to the Owner and Engineer. All defects and deficiencies shall be properly documented by the CQA Engineer. The Contractor will correct defects and deficiencies to the satisfaction of the CQA Engineer. The CQA Engineer shall observe all retests on repaired defects.

TABLE 3.1: CQA TESTING PROGRAM FOR EMBANKMENT MATERIAL APPROVAL

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS:		
Visual Classification	ASTM D 2488	Each Soil
Moisture-Density Relationship	ASTM D 698	5,000 CY per Each Soil

TABLE 3.2: CQA TESTING PROGRAM FOR COMPACTED EMBANKMENT

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See **Table 3.1**)		
RECORD TESTS:		
Lift Thickness	-----	Each Lift
In-Place Density	ASTM D 2922[1]	20,000 ft^2 per lift & 1 per 500 LF/lift of Berms (< 200 ft. base width)
Moisture Content	ASTM D 3017[2]	20,000 ft^2 per lift & 1 per 500 LF/lift of Berms (< 200 ft. base width)

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937. For every 10 nuclear density tests perform at least 1 density test by ASTM D 1556, ASTM D 2167, or ASTM D 2937 as a verification of the accuracy of the nuclear testing device.
2. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959. For every 10 nuclear moisture tests perform at least 1 moisture test by ASTM D 2216, ASTM D 4643, or ASTM D 4959 as a verification of the accuracy of the nuclear testing device.

SECTION 4.0
FINAL COVER SYSTEM CQA

4.1 INTRODUCTION

This section of the CQA Manual addresses the vegetative soil layer and soil liner of the final cover system. This section outlines the CQA program to be implemented with regard to material approval, construction monitoring, and resolution of problems.

4.2 VEGETATIVE SOIL LAYER

4.2.1 Vegetative Soil Layer Material Approval

The CQA Engineer shall verify that the following are provided and installed in accordance with the project drawings, specifications, and this CQA Manual.

A. Review the proposed source of vegetative soil layer for conformance with the project specifications.

B. Conduct material control tests in accordance with **Table 4.1**.

4.2.2 Vegetative Soil Layer Installation

The CQA Engineer will monitor and document the construction of all final cover system components for compliance with the project specifications. Monitoring the construction work for the components of the final cover system includes the following:

- conduct record tests on the vegetative soil layer in accordance with **Table 4.1**.

4.3 SOIL LINER

4.3.1 Soil Liner Material Approval

All material to be used as soil liner shall be approved in advance by the CQA Engineer. Approval is based upon successful completion of CQA control testing outlined below. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

4.3.1.1 Control Tests

The procedure for CQA testing during excavation and stockpiling (including existing stockpiles) is outlined below.

Each load of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be rejected or routed to separate stockpiles consistent with its end use. Appropriate entries will be made in the daily log.

During stockpiling operations, control tests, as shown on **Table 4.2**, will be performed by the CQA Engineer prior to placement of any soil liner material.

4.3.2 Subgrade Approval

The CQA Engineer will verify that the soil liner subgrade is constructed in accordance with the project specifications.

4.3.3 Test Fill Construction

A test fill meeting the requirements of the project specifications will be constructed using the same construction methods, equipment, and material to be used for the soil liner component. The test fill construction will be conducted prior to or coincide with the beginning of construction of the soil liner component.

Construction equipment and methods will be reviewed by the CQA Engineer prior to test fill placement.

4.3.3.1 Control Tests

The control tests, as shown on **Table 4.3**, will be performed by the CQA Engineer prior to placement of soil liner material in the test fill.

4.3.3.2 Record Tests

The record tests, as shown on **Table 4.3**, will be performed by the CQA Engineer during placement of soil liner material in the test fill.

4.3.3.2 Test Fill Completion

The test fill program is completed when the Contractor has shown that the soil liner constructed using the same construction methods, equipment, and material to be used in construction of the soil liner will satisfy project specifications. No soil liner can be placed until the test fill program is completed.

4.3.4 Soil Liner Construction

4.3.4.1 Construction Monitoring

A. Soil liner shall be placed as described in the applicable section(s) of the project specifications using the construction methods, equipment, and material demonstrated in the test fill construction.

B. Only soil previously approved by the CQA Engineer (see **Section 2.0**) shall be used in construction of the soil liner. Unsuitable material will be removed prior to acceptance by the CQA Engineer.

C. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed. The surface preparation (e.g. wetting, drying, scarification, etc.) shall be completed before the CQA Engineer will allow placement of subsequent lifts.

D. The CQA Engineer will monitor protection of the soil liner during and after construction.

E. The liner surface shall be sprinkled with water as needed to prevent desiccation. Should desiccation occur, the last lift shall be reconstructed in accordance with the project specifications. Standing water should not be present on the soil liner.

F. Frost heave or other damage due to freezing shall require lift reconstruction in accordance with the project specifications.

G. The CQA Engineer will inspect the soil liner and certify that it is in accordance with the project specifications and approved plans prior to the Contractor beginning installation of overlying vegetative support soil.

H. The finished soil liner shall be free of all rock protrusions. All cracks and voids shall be filled and the surface made uniform. This shall be accomplished by final dressing of the soil liner with smooth-drum rollers and hand raking. No rubber tired vehicles are permitted on the final dressed surface unless authorized by the CQA Engineer.

4.3.4.2 Control Tests

The control tests, as shown on **Table 4.4**, will be performed by the CQA Engineer prior to placement of soil liner material.

4.3.4.3 Record Tests

The record tests, as shown on **Table 4.4** and as described below, will be performed by the CQA Engineer during placement of soil liner material.

A. Each lift will be checked visually for soil clods, rocks, debris, plant materials and other foreign material. Any such material which does not meet specified requirements shall be identified and removed prior to and during the compaction process.

B. The thickness of the loose lift will be measured at random locations after spreading and leveling is completed. Loose lift thickness should not exceed the depth of penetration of the compaction feet.

C. Moisture content will be monitored by the CQA Engineer prior to compaction. If the soil is drier than the specified minimum moisture content, water will be added

and the lift will be disced to distribute the moisture evenly.

Results of testing will be certified within 7 days of soil liner placement.

Record Test Failure

The following procedures shall be used in the event of density or hydraulic conductivity test failure:

A. Failed Density Test: Recompaction of the failed area shall be performed and retested until the area meets or exceeds requirements outlined in the specifications.

B. Failed Hydraulic Conductivity Test: The area of failure shall be localized and reconstructed in accordance with the project specifications. This area will be retested as outlined within the plan by the CQA Engineer. Optionally, at least five replicate samples shall be obtained and tested by the Contractor in the immediate vicinity of the failed test. If all five samples pass, then the initial failing test will be discounted. However, should the replicate samples confirm the failure of the soil liner to meet specifications, the area of failure shall be localized, reconstructed, and retested as described above.

4.3.4.4 Judgmental Testing

During construction, the frequency of control and/or record testing may be increased at the discretion of the CQA Engineer when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- the rollers slip during rolling operation;
- the lift thickness is greater than specified;
- the fill material is at an improper moisture content;
- fewer than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- the rollers may not have used optimum ballast;
- the fill materials differ substantially from those specified; or
- the degree of compaction is doubtful.

4.3.4.5 Perforations In Soil Liner

All holes shall be patched with compacted soil liner or sodium bentonite compacted and hydrated in the holes.

4.4 DEFICIENCIES

The CQA Engineer will immediately determine the extent and nature of all defects and deficiencies and report them to the Owner and Engineer. All defects and deficiencies shall be properly documented by the CQA Engineer. The Contractor will correct defects and deficiencies to the satisfaction of the CQA Engineer. The CQA Engineer shall observe all retests on repaired defects.

TABLE 4.1: CQA TESTING PROGRAM FOR FINAL COVER SYSTEM

COMPONENT	PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS:			
Vegetative Soil Layer:	Visual Classification	ASTM D 2488	Each Load
RECORD TESTS:			
Vegetative Soil Layer:	Thickness	Survey and/or Hand Auger	1 per 10,000 ft^3

TABLE 4.2: CQA TESTING PROGRAM FOR SOIL LINER MATERIAL APPROVAL

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS:		
Visual Classification	ASTM D 2488	Each Soil
Moisture Content	ASTM D 2216	2,000 CY per Each Soil
Grain Size Analysis	ASTM D 422	2,000 CY per Each Soil
Atterberg Limits	ASTM D 4318	2,000 CY per Each Soil
Moisture-Density Relationship	ASTM D 698	5,000 CY per Each Soil
Hydraulic Conductivity - Lab Remolded	ASTM D 5084[3]	10,000 CY per Each Soil

TABLE 4.3: CQA TESTING PROGRAM FOR SOIL LINER TEST FILL

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See **Table 1**)		
Moisture-Density Relationship	ASTM D 698[4]	1 per lift
Hydraulic Conductivity - Lab Remolded	ASTM D 5084[3,4]	1 per lift
RECORD TESTS:		
Lift Thickness	-----	Each Lift
Atterberg Limits	ASTM D 4318	1 per lift
Grain Size Analysis	ASTM D 422	1 per lift
In-Place Density	ASTM D 2922[1]	3 per lift
Moisture Content	ASTM D 6938[2]	3 per lift
Hydraulic Conductivity - Undisturbed (Shelby Tube)	ASTM D 6938[3]	1 per lift

TABLE 4.4: CQA TESTING PROGRAM FOR SOIL LINER

PROPERTY	TEST METHOD	MINIMUM TEST FREQUENCY
CONTROL TESTS: (See **Table 1**)		
RECORD TESTS:		
Lift Thickness	-----	Each Lift
In-Place Density	ASTM D 6938[1]	10,000 ft^2 per lift
Moisture Content	ASTM D 6938[2]	10,000 ft^2 per lift
Hydraulic Conductivity - Undisturbed (Shelby Tube)	ASTM D 5084[3]	40,000 ft^2 per lift

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937. For every 10 nuclear density tests perform at least 1 density test by ASTM D 1556, ASTM D 2167, or ASTM D 2937 as a verification of the accuracy of the nuclear testing device.
2. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959. For every 10 nuclear moisture tests perform at least 1 moisture test by ASTM D 2216, ASTM D 4643, or ASTM D 4959 as a verification of the accuracy of the nuclear testing device.
3. Maximum effective confining pressure and hydraulic gradient as required by the project specifications. Backpressure as recommended by ASTM D 5084.
4. These tests performed on the test fill may count toward the minimum frequencies

Appendix A

Reference List of Test Methods

SHOTWELL LANDFILL, INC.
C&D LANDFILL - PHASE 3

CQA MANUAL
APPENDIX A: REFERENCE LIST OF TEST METHODS

American Society American Society of Testing and Materials (ASTM):

ASTM D 422	Standard Test Method for Particle Size Analysis of Soils.
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
ASTM D 2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
ASTM D 2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
ASTM D 2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
ASTM D 2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
ASTM D 2937	Standard Test Method for Density of Soil in Place by the Drive Cylinder Method.
ASTM D 3017	Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM D 4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
ASTM D 4959	Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method.

Technical Specifications

Shotwell C&D Landfill - Phase 3
Wake County, North Carolina
NC Solid Waste Permit No. 92-26

Prepared for:

Shotwell Landfill, Inc.
Wendell, NC

PERMIT ISSUE DOCUMENT

October 2009

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PRINTED ON 100% RECYCLED PAPER

SHOTWELL LANDFILL, INC.
C&D LANDFILL - PHASE 3

TECHNICAL SPECIFICATIONS

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SECTION 02110

SITE PREPARATION

Site Preparation: Site Preparation includes clearing, grubbing, and stripping operations which precede the proposed construction.

A. DESCRIPTION

1. General:

a. The Contractor shall furnish all labor, material, and equipment to complete Site Preparation in accordance with the Contract Drawings and these Specifications.

b. Principal items of work include:

1. Notifying all authorities owning utility lines running to or on the property. Protect and maintain all utility lines to remain and cap those that are not required in accordance with instructions of the Utility Companies, and all other authorities having jurisdiction.

2. Clearing the site within the clearing limits, including removal of grass, brush, shrubs, trees, loose debris, and other encumbrances except for trees to remain.

3. Boxing and protecting all areas to be preserved.

4. Removing all topsoil from designated areas and stockpiling on site where directed by the Engineer for future use.

5. Disposing from the site all debris resulting from work under this Section.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Excavation	02222
Embankment	02223

B. MATERIALS Not Used.

C. SUBMITTALS Not Used.

D. CONSTRUCTION

1. Clearing of the Site:

a. Clearing limits, as shown on the Contract Drawings, shall be established by the Contractor's Surveyor. Once established, the clearing limits shall be inspected and approved by the Engineer prior to clearing the affected areas.

b. Before removal of topsoil, and start of excavation and grading operations, the areas within the clearing limits shown on the Contract Drawings shall be cleared and grubbed.

c. Clearing shall consist of cutting, removal, and satisfactory disposal of all trees, fallen timber, brush, bushes, rubbish, fencing, and other perishable and objectionable material.

Should it become necessary to remove a tree, bush, brush, or other plants outside the clearing limits, the Contractor shall do so only after permission has been granted by the Engineer.

d. Excavation resulting from the removal of trees, roots, and the like shall be filled with suitable material, as approved by the Engineer, and thoroughly compacted per the requirements contained in Section 02223, Embankment, of these Specifications.

e. In temporary construction easement locations, only those trees and shrubs shall be removed which are in actual interference with excavation or grading work under this Contract, and removal shall be subject to approval by the Engineer. However, the Engineer reserves the right to order additional trees and shrubs removed at no additional cost to the Owner, if such, in his opinion, they are too close to the work to be maintained or have become damaged due to the Contractor's operations.

2. Stripping and Stockpiling Existing Topsoil:

a. Existing topsoil and sod on the site within areas designated on the Contract Drawings shall be stripped to whatever depth it may occur, and stored in locations directed by the Engineer.

b. The topsoil shall be free of stones, roots, brush, rubbish, or other unsuitable materials before stockpiling.

c. Care shall be taken not to contaminate the stockpiled topsoil with any unsuitable materials.

3. Grubbing:

a. Grubbing shall consist of the removal and disposal of all stumps, roots, logs, sticks, and other perishable materials to a depth of at least 6 inches below ground surfaces.

b. Large stumps located in areas to be excavated may be removed during grading operations, subject to the approval of the Engineer.

4. Disposal of Cleared and Grubbed Material:

All trees, stumps, roots, and bushes shall be removed from the site and disposed of by the Contractor.

END OF SECTION

SECTION 02222

EXCAVATION

Excavation: Excavation includes excavating, sealing, hauling, scraping, undercutting, removal of accumulated surface water or ground water, stockpiling, and all necessary and incidental items as required for bringing the landfill and related structures to the specified lines and grades.

A. DESCRIPTION

1. General:

The Contractor shall furnish all labor, material, and equipment required to complete Excavation of the landfill area and related structures in accordance with the Contract Drawings and these Specifications, except as noted below:

a. Clearing and grubbing and removal of topsoil is addressed in Section 02110, Site Preparation, of these Specifications.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Site Preparation	02110
Embankment	02223
Erosion and Sedimentation Control	02270
Roadway Work	02500
CQA Manual	Attached

3. Quality Assurance:

Quality Assurance during Excavation will be provided by the Owner as described in the accompanying Project CQA Manual.

4. Definitions:

a. Excavation: shall consist of the removal and satisfactory disposal and/or stockpiling of materials located with the limits of construction including widening cuts and shaping of slopes necessary for the preparation of roadbeds, landfill slope areas, cutting of any ditches, channels, waterways, entrances, and other work incidental thereto.

b. Borrow: shall consist of approved on-site material required for the construction of embankments/fills or for other portions of the work.

c. Select Borrow: shall consist of approved off-site material required for the construction of embankments/fills, roadway subgrade, backfilling, or for other portions of the work as shown on Contract Drawings or in these Specifications. The Contractor shall make his own arrangements for obtaining select borrow and pay all costs involved.

d. Unsuitable Material: is any in-place or excavated material which contains undesirable materials, or is in a state which is not appropriate; in the opinion of the CQA Engineer, for the intended use or support of planned structures, embankment, or excavation. This may include but not be limited to organic material, waste/refuse, soft, or wet material not meeting required specifications, etc.

e. Unsuitable Materials Excavation (Overexcavation): shall consist of the removal and satisfactory disposal of all unsuitable material located within the limits of construction. Where excavation to the finished grade section shown results in a subgrade or slopes of unsuitable material, the Contractor shall overexcavate such material to below the grade shown on the Contract Drawings or as directed by the Engineer and CQA Engineer.

B. MATERIALS

Excavation shall include the removal of all soil, weathered rock, boulders, conduits, pipe, and all other obstacles encountered and shown on the Contract Drawings or specified herein.

C. SUBMITTALS Not Used.

D. CONSTRUCTION

1. The Contractor shall conduct Excavation activities in such a manner that erosion of disturbed areas and off site sedimentation is absolutely minimized as outlined in Section 02270, Erosion and Sedimentation Control, of these Specifications.

2. The Contractor shall excavate to the lines and grades shown on the Contract Drawings and stockpile all suitable excavated materials. As the excavation is made, the materials will be examined and identified to the CQA Engineer.

   The Contractor will perform all surveys necessary to establish and verify lines and grades for all Excavation, including pipe excavations, soil overexcavation, and anchor trenches.

3. Stockpiling:

The Contractor shall stockpile the materials in appropriate stockpiles as approved by the CQA Engineer.

Stockpiles shall be properly sloped and the surfaces sealed by the Contractor at the end of each working day, or during the day in the event of heavy rain, to the satisfaction of the Engineer.

4. The Contractor shall protect all existing facilities and structures including, but not limited to, existing utilities, monitoring wells, signs, grade stakes, etc. during the grading and stockpiling operations.

5. All excavations shall be made in the dry and in such a manner and to such widths as will give ample room for properly constructing and inspecting the structures and/or piping they are to contain and for such sheeting, timbering, pumping, and drainage as may be required.

6. The Contractor shall be responsible for the control of surface and subsurface water, when necessary.

7. Excavation slopes shall be flat enough to avoid sloughs and slides that will cause disturbance of the subgrade or damage of adjacent areas. Slides and overbreaks which occur due to negligence, carelessness, or improper construction techniques on the part of the Contractor shall be removed and disposed of by the Contractor as directed by the Engineer at no additional cost to the Owner.

8. The intersection of slopes with natural ground surfaces, including the beginning and ending of cut slopes, shall be uniformly rounded. All protruding roots and other vegetation shall be removed from slopes.

9. The bottom of all excavations for structures and pipes shall be examined by the CQA Engineer for bearing value and the presence of unsuitable material. If, in the opinion of the CQA Engineer, additional Excavation is required due to the low bearing value of the subgrade material, or if the in-place materials are soft, yielding, pumping and wet, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted structural fill, or material directed by the CQA Engineer. No payment will be made for subgrade disturbance caused by inadequate Dewatering or improper construction methods.

10. Any areas excavated below design subgrade elevations by the Contractor, unless directed by the CQA Engineer, shall be brought back to design elevations at no cost to the Owner. The Contractor shall place and compact such material in accordance with Section 02223, Embankment, of these Specifications.

11. The Contractor shall dispose of excess or unsuitable excavation materials on-site at location(s) approved by the Owner.

12. The Contractor shall properly level-off bottoms of all excavations. Proof-rolling shall be conducted with appropriate equipment.

13. Upon reaching subgrade elevations shown in excavation areas, the Contractor shall scarify subgrade soils to a minimum depth of 6" and obtain the CQA Engineer's approval of quality. If unsuitable materials are encountered at the subgrade elevation, perform additional excavations as approved by the CQA Engineer to remove unsuitable materials.

14. Overexcavation and Backfill:

    Where subgrade materials are determined to be unsuitable, such materials shall be removed by the Contractor to the lengths, widths and depths approved by the CQA Engineer and backfilled with suitable material in accordance with Section 02223, Embankment, of these Specifications unless further excavation or earthwork is required. No additional payment will be made for such excavation and backfill 1 foot or less than the finished subgrade. Unsuitable material excavation greater than 1 foot beneath the finished subgrade shall be made on a unit price basis for excavation and backfill, only as approved by the Engineer and CQA Engineer prior to the work. Unit price for overexcavation and backfill greater than 1 foot in depth shall include disposal of unsuitable materials.

15. All cuts shall be brought to the grade and cross section shown on the Contract Drawings, or established by the Engineer, prior to final inspection.

16. The Contractor shall protect finished lines and grades of completed excavation against excessive erosion, damage from trafficking, or other causes and shall repair any damage at no additional cost to the Owner.

17. Trench Excavation:

    a. All pipe Excavation and trenching shall be done in strict accordance with these Specifications, all applicable parts of the OSHA Regulations, 29 CFR 1926, Subpart P, and other applicable regulations. In the event of any conflicts in this information, safe working conditions as established by the appropriate OSHA guidelines shall govern.

    b. The minimum trench widths shall be as indicated on the Contract Drawings. Enlargements of the trench shall be made as needed to give ample space for operations at pipe joints. The width of the trench shall be limited to the maximum dimensions shown on the Contract Drawings, except where a wider trench is needed for the installation of and work within sheeting and bracing.

c. Except where otherwise specified, excavation slopes shall be flat enough to avoid slides which will cause disturbance of the subgrade, damage to adjacent areas, or endanger the lives or safety of persons in the vicinity.

d. Hand excavation shall be employed wherever, in the opinion of the Engineer, it is necessary for the protection of existing utilities, poles, trees, pavements, obstructions, or structures.

e. No greater length of trench in any location shall be left open, in advance of pipe laying, than shall be authorized or directed by the Engineer and, in general, such length shall be limited to approximately one hundred (100) feet.

f. Pipe Bedding: All pipe bedding shall be as shown on the Contract Drawings, unless otherwise specified herein.

18. Sheeting and Bracing:

a. The Contractor shall furnish, place, and maintain such sheeting and bracing which may be required to support sides of Excavation or to protect pipes and structures from possible damage and to provide safe working conditions in accordance with current OSHA requirements. If the Engineer is of the opinion that at any point sufficient or proper supports have not been provided, he may order additional supports put in at the sole expense of the Contractor. The Contractor shall be responsible for the adequacy of all sheeting and bracing used and for all damage resulting from sheeting and bracing failure or from placing, maintaining, and removing it.

b. The Contractor shall exercise caution in the installation and removal of sheeting to insure that excessive or unusual loadings are not transmitted to any new or existing structure. The Contractor shall promptly repair at his expense any and all damage that can be reasonably attributed to sheeting installation or removal.

c. All sheeting and bracing shall be removed upon completion of the work.

19. If grading operations are suspended for any reason whatsoever, partially completed cut and fill slopes shall be brought to the required slope and the work of seeding and mulching or other required erosion and sedimentation control operations shall be performed at the Contractor's sole expense.

END OF SECTION

SECTION 02250

SOIL LINER (FINAL COVER)

Soil Liner: The Soil Liner serves as a hydraulic containment barrier in the final cover system.

A. DESCRIPTION

1. General:

a. The Contractor shall furnish all labor, material, and equipment to complete installation of the Soil Liner including borrowing, hauling, screening, mixing, stockpiling, discing, compacting, drying or wetting, removal of surface water, removal of all previously placed material affected by adverse weather conditions or construction disturbance, final grading and sealing, and all necessary and incidental items as detailed or required to complete the Soil Liner, all in accordance with the Contract Drawings and these Specifications.

b. The Contractor shall provide suitable soil from an on-site or off-site borrow site that meets all requirements outlined in these Specifications for Soil Liner.

Off-site borrow sources shall be approved in advance by the Engineer. The Contractor shall be responsible for all submittals required for Engineer approval of off-site borrow sources.

2. Related Work:

Related Contract Work is described in the following sections of the Specifications:

Work	Section
Vegetative Soil Layer	02258

3. Reference Standards:

The latest revision of the following standards of the American Society of Testing and Materials (ASTM) are hereby made a part of these Specifications.

ASTM D 422	Standard Test Method for Particle Size Analysis of Soils.
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).

ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
ASTM D 2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
ASTM D 2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
ASTM D 2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
ASTM D 2937	Standard Test Method for Density of Soil in Place by the Drive Cylinder Method.
ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM D 4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
ASTM D 4959	Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method.
ASTM D 5084	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
ASTM D 6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

4. Quality Assurance:

Quality Assurance during placement of Soil Liner will be provided by the Owner.

B. MATERIALS

All material for Soil Liner shall conform to the requirements shown in Table 1 of this section.

C. SUBMITTALS

The Contractor shall submit the following to the CQA Engineer:

1. Before approval is given to proceed with test fill construction, the Contractor shall submit descriptive information on compaction equipment to be used for construction of the Soil Liner.

2. Off-Site Borrow Sources (If Applicable):

   a. For each off-site borrow source for Soil Liner soils, the Contractor shall provide the following information at least four weeks prior to placement of the Soil Liner:

      (1) The name, location, and owner of proposed borrow site, including a topographic map and location map of the site.

      (2) A certification submitted by an independent Registered Professional Engineer that the proposed borrow site contains a minimum of double the in-place volume of Soil Liner required to complete the work.

      (3) A certification submitted by an independent Registered Professional Engineer that the proposed borrow soils meet the requirements for Soil Liner outlined in these Specifications. Certification shall include the following minimum testing and test frequency:

Test	Min. Number of Tests
Atterberg Limits (ASTM D 4318)	10
Grain Size (with Hydrometer) (ASTM D 422)	10
Standard Proctor (ASTM D 698)	5
Natural Moisture Content (ASTM D 2216)	10
Hydraulic Conductivity (Lab Remolded) (ASTM D 5084)	5

      Testing samples for certification shall be obtained from well distributed locations within the proposed borrow area. All test data shall be submitted with the soil certification.

   b. The Contractor shall be responsible for maintaining quality of the Soil Liner borrow source throughout construction and shall ensure that the borrow soil meets the project criteria outlined in these Specifications. The Contractor shall cooperate with the CQA Engineer so that the CQA Engineer has unlimited access to the borrow area during construction for the purposes of sampling and testing borrow soil.

c. If the borrow source does not meet the requirements outlined in these Specifications, the Contractor shall be responsible for providing an alternative borrow source at no cost to the Owner.

D. CONSTRUCTION

1. General:

a. All placement and compaction of Soil Liner shall be performed only when the CQA Engineer is informed by the Contractor of intent to perform such work.

b. The Contractor shall place and compact the Soil Liner to the lines and grades shown on the Contract Drawings with the exception that a 0.15 foot overbuild at the Contractor's expense is allowed. Thickness requirements are minimum values. The Contractor will perform all surveys necessary to establish and verify lines and grades for all Soil Liner.

2. Borrow Soils:

a. The Contractor may haul borrow soil to an on-site stockpile area. Unless otherwise allowed by the Engineer, borrow soil cannot be hauled directly to the containment area for placement and compaction unless each load is monitored and approved by the CQA Engineer prior to loading at the borrow site.

b. Any borrow soil not meeting the requirements for Soil Liner shall be rejected and removed from the project site by the Contractor at no cost to the Owner.

3. Test Fill Construction:

The Contractor shall construct a test fill prior to construction of Soil Liner. The test fill shall be at least 20 feet wide by 50 feet long and shall be compacted in lifts to the full design thickness. The Contractor shall use materials and equipment for test fill construction that the Contractor intends to use during construction.

No Soil Liner construction may be performed until the test fill construction is confirmed to be adequate in accordance with the Project CQA Manual.

The Contractor shall amend construction techniques or equipment in order to meet all criteria outlined for Soil Liner in these Specifications at no cost to the Owner.

4. Subgrade Preparation:

a. The CQA Engineer shall inspect the exposed subgrade prior to placement of Soil Liner to assure that all rocks, topsoil, vegetation, roots, debris, or other deleterious materials have been removed.

b. Prior to placement of Soil Liner, the exposed subgrade shall be proofrolled using a static smooth-drum roller, loaded tandem axle dump truck, or other suitable equipment in the presence of the CQA Engineer. Any soft or unsuitable subgrade materials revealed before or during the in-place compaction shall be removed as directed by the CQA Engineer and replaced with Soil Liner.

5. Placement and Compaction:

a. All Soil Liner shall be placed in loose lifts no greater than the height of the feet on compaction equipment to be used. The loose Soil Liner shall be free from clods or rocks which exceed the sizes in Table 1. Where excessive sized clods do occur, the Contractor shall break up the clods using methods approved by the CQA Engineer.

b. Lift compaction shall be performed with an appropriately heavy, properly ballasted, penetrating-foot compactor. Compaction equipment shall be the same as used in the test fill, unless otherwise approved by the Engineer.

Each lift shall be compacted prior to placement of succeeding lifts. The maximum lift thickness shall be as shown in Table 2. In confined areas, mechanical equipment, suitable for small areas and capable of achieving the density requirements, shall be required.

c. The exposed surface of Soil Liner shall be protected from adverse weather conditions or desiccation of the soil. This is commonly done by rolling the surface of the Soil Liner with a smooth-drum roller at the end of each work day. Alternative means of protecting the Soil Liner may be employed by the Contractor.

d. The in-place Soil Liner shall conform to the requirements shown in Table 2 of this section. If Soil Liner does not meet the specified requirements, the Contractor shall rework the material, as may be necessary and continue compaction to achieve these requirements, or remove and replace the material to achieve the specified requirements, at Contractor's expense.

e. Any Soil Liner surface which is smooth, has a moisture content outside of the specified moisture content range, as defined by ASTM D 698, or exhibits evidence of desiccation cracking ½ inch deep or greater, shall be scarified to a depth of 1 to 3 inches and brought to a proper moisture content prior to placement of a subsequent lift. This includes any Soil Liner surface that was previously seal rolled for protection.

f. No Soil Liner shall be placed or compacted when soil temperatures are so low as to produce ice lenses in the Soil Liner borrow soil.

g. Soil Liner placed on side slopes shall be placed and compacted in lifts which are parallel to the slope. Lift criteria shall be as described herein.

h. Locations of control stakes, in-place density tests, thickness checks, or other samples in the Soil Liner shall be patched with compacted Soil Liner or sodium bentonite compacted and hydrated in the holes.

6. Surveying:

After completion of a segment of Soil Liner, but before installation of subsequent layers, the Soil Liner shall be surveyed (by test pit or hand auger) on a 100 foot grid to ensure the minimum specified thickness of Soil Liner has been achieved.

TABLE 1: SOIL LINER MATERIAL REQUIREMENTS

PROPERTY	TEST METHOD	VALUE
Visual Classification	ASTM D 2488	Clean natural fine-grained soil free from organics, debris, or other detrimental material. Soil type as required to achieve the hydraulic conductivity criteria.
Clod Size	-----	Maximum = ¾ inch (or less if required to achieve hydraulic conductivity criteria)
Gradation	ASTM D 422	Max. = 1½ inches
Atterberg Limits	ASTM D 4318	As required based on soil type.
Hydraulic Conductivity (Lab Remolded) (Compacted Soil Barrier)	ASTM D 5084[3]	$\leq 1 \times 10^{-5}$ cm/s at a density of $\geq$ 95% maximum standard dry density and a moisture content $\geq$ optimum moisture content[4]

TABLE 2: IN-PLACE SOIL LINER REQUIREMENTS

PROPERTY	TEST METHOD	VALUE
Density	ASTM D 6938[1]	≥ 95% maximum standard dry density[4]
Moisture Content	ASTM D 6938[2]	≥ optimum moisture content[4]
Maximum Lift Thickness (Compacted): (Compacted Soil Barrier)	-----	9 inches
Hydraulic Conductivity (Shelby Tube): (Compacted Soil Barrier)	ASTM D 5084[3]	$\leq 1 \times 10^{-5}$ cm/s
Completed Thickness: (Compacted Soil Barrier)	Survey	18 inches minimum

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937.
2. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959.
3. Maximum effective confining pressure and maximum hydraulic gradient as follows. Backpressure as recommended by ASTM D 5084. Modifications of the maximum hydraulic gradient may be allowed by the Engineer depending on actual hydraulic conductivity values.

Material	Maximum Effective Confining Pressure (psi)	Maximum Hydraulic Gradient
Compacted Soil Barrier ($k \leq 1 \times 10^{-5}$ cm/s)	5	15

4. Or as otherwise determined by remolded samples to achieve hydraulic conductivity criteria.

END OF SECTION

Construction Quality Assurance Manual

Johnston County Landfill Facility
Smithfield, North Carolina

Prepared for:

Johnston County Department of Solid Waste Services
Smithfield, North Carolina

December 2013

NC LIC. NO. C-0828 (ENGINEERING)

SMITH+GARDNER

14 N. Boylan Avenue, Raleigh NC 27603 | 919.828.0577

PRINTED ON 100% RECYCLED PAPER

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Johnston County Landfill Facility
Smithfield, North Carolina

Construction Quality Assurance Manual

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APPENDIX

Appendix A Reference List of Test Methods

1.0 GENERAL

This Construction Quality Assurance (CQA) Manual has been prepared to provide the Owner, (Design) Engineer, and CQA Engineer the means to govern the construction quality and to satisfy landfill certification requirements under current solid waste management regulations.

More specifically, this CQA Manual addresses the soils and geosynthetics components of the liner, the leachate management, and the final cover systems (as applicable) of the municipal solid waste (MSW) and construction and demolition debris (C&D) landfill units at the facility.

The CQA Manual is divided into the following sections:

- Section 1.0 General
- Section 2.0 CQA Documentation
- Section 3.0 Earthwork CQA
- Section 4.0 Soil Liner CQA
- Section 5.0 Geomembrane CQA
- Section 6.0 Leachate Management System CQA
- Section 7.0 Geotextile CQA
- Section 8.0 Drainage Geocomposite CQA
- Section 9.0 Geosynthetic Clay Liner CQA
- Section 10.0 Final Cover System CQA

1.1 Definitions Relating to Construction Quality

1.1.1 Construction Quality Assurance (CQA)

In the context of this Manual, Construction Quality Assurance is defined as a planned and systematic program employed by the Owner to assure conformity of the liner, leachate management, and final cover systems installation with the project drawings and the project specifications. CQA is provided by the CQA Engineer as a representative of the Owner and is independent from the Contractor and all manufacturers. The CQA program is designed to provide adequate confidence that items or services meet contractual and regulatory requirements and will perform satisfactorily in service.

1.1.2 Construction Quality Control (CQC)

Construction Quality Control refers to actions taken by manufacturers, fabricators, installers, and/or the Contractor to ensure that the materials and the workmanship meet the requirements of the project drawings and the project specifications. The manufacturer's specifications and quality control (QC) requirements are included in this CQA Manual by reference only. A complete updated version of each geosynthetic component manufacturer's QC Plan shall be incorporated as part of the Contractor's CQC Plan.

1.1.3 CQA Certification Document

At the completion of construction, a certification document will be prepared by the CQA Engineer and submitted to State Solid Waste Regulators. The certification report will include documentation of all QC testing performed by the Geosynthetics Manufacturers, all CQC testing performed by the Geosynthetic Installers, and all CQA testing performed by the CQA Engineer.

1.1.4 Discrepancies Between Documents

The Contractor is instructed to bring discrepancies to the attention of the CQA Engineer who shall then notify the Engineer for resolution. The Engineer has the sole authority to determine resolution of discrepancies existing within the Contract Documents (this may also require the approval of State Solid Waste Regulators). Unless otherwise determined by the Engineer, the more stringent requirement shall be the controlling resolution.

1.2 Parties to Construction Quality Assurance

1.2.1 Description of the Parties

The parties to Construction Quality Assurance and Quality Control include the Owner, Engineer, Contractor, Geosynthetics Manufacturer, Geosynthetics Installer, CQA Engineer, Geosynthetics CQA Laboratory, and Soils CQA Laboratory.

1.2.1.1 Owner

The Owner is Johnston County, North Carolina, who owns and/or is responsible for the facility.

1.2.1.2 Engineer

The Engineer is responsible for the engineering design, drawings, and project specifications for the liner, leachate management, and final cover systems. The Engineer is an official representative of the Owner. The Engineer serves as communications coordinator for the project, initiating the meetings outlined in **Section 1.6**. The Engineer will also be responsible for proper resolution of all quality issues that arise during construction. The Engineer is Smith Gardner, Inc.

1.2.1.3 Contractor

The Contractor is responsible for the construction of the subgrade, earthwork, and for placement of the liner, leachate management, and final cover systems. The Contractor is responsible for the overall CQC on the project and coordination of submittals to the CQA Engineer. Additional responsibilities of the Contractor are defined by the project specifications.

1.2.1.4 Geosynthetics Manufacturer

The Geosynthetics Manufacturer(s) is (are) responsible for the production of the geosynthetic components used in landfill construction. The Manufacturer(s) is (are) responsible for Quality Control (QC) during manufacture of the geosynthetic components, certification of the properties of the geosynthetic components, and field installation criteria.

1.2.1.5 Geosynthetics Installer

The Geosynthetics Installer(s) is (are) routinely a subcontractor of the Contractor and is (are) responsible for field handling, storing, placing, seaming, protection of (against wind, etc.), and other aspects of the geosynthetics installations. The Installer may also be responsible for transportation of these materials to the site, and for the preparation and completion of anchor trenches.

1.2.1.6 CQA Engineer

The CQA Engineer is a representative of the Owner, is independent from the Contractor, and is responsible for observing, testing, and documenting activities related to the CQA of the earthworks at the site, and the installation of the soil and geosynthetic components of the liner, leachate management, and final cover systems. The CQA Engineer may make field observations and review submittals for the Engineer and is responsible for notifying the Owner and Engineer of all quality issues that arise during construction. The CQA Engineer is also responsible for issuing a facility certification report, sealed by a Professional Engineer registered in The State of North Carolina.

1.2.1.7 Geosynthetics CQA Laboratory

The Geosynthetics CQA Laboratory is a party, independent from the Owner, that is responsible for conducting tests on conformance samples of geosynthetics used in the liner, leachate management, and final cover systems. The Geosynthetics CQA Laboratory service cannot be provided

by any party involved with the manufacture, fabrication, or installation of any of the geosynthetic components. The services of the Geosynthetics CQA Laboratory are coordinated by the CQA Engineer and are paid for by the Owner.

1.2.1.8 Soils CQA Laboratory

The Soils CQA Laboratory is a party, independent from the Owner, that is responsible for conducting geotechnical tests on conformance samples of soils and aggregates used in structural fills and the liner, leachate management, and final cover systems. The services of the Soils CQA Laboratory are coordinated by the CQA Engineer and are paid for by the Owner.

1.2.2 Qualifications of the Parties

The following qualifications are required of all parties involved with the manufacture, fabrication, installation, transportation, and CQA of all materials for the liner, leachate management, and final cover systems. Where applicable, these qualifications must be submitted by the Contractor to the Owner and Engineer for review and approval.

1.2.2.1 Contractor

Qualifications of the Contractor are specific to the construction contract and independent of this CQA Manual.

1.2.2.2 Geosynthetics Manufacturers

Each Geosynthetics Manufacturer must satisfy the qualifications presented in the project specifications.

1.2.2.3 Geosynthetic Installer(s)

The Geosynthetic Installer(s) will be trained and qualified to install the geosynthetics components of the liner, leachate management, and final cover systems. Each Geosynthetics Installer must meet the requirements of the project specifications and be approved by the Engineer. The Geomembrane Installer must be approved by the Geomembrane Manufacturer.

1.2.2.4 CQA Engineer

The CQA Engineer will act as the Owner's Quality Assurance Representative. The CQA Engineer will perform CQA testing to satisfy the requirements of this CQA Manual and will prepare the CQA certification document. The CQA Engineer will have experience in the CQA aspects of the construction and testing of landfill liner, leachate management, and final cover systems, and be familiar with ASTM and other related industry standards. The activities of the CQA Engineer will be performed under the supervision of a Registered Professional Engineer.

1.2.2.5 Geosynthetics CQA Laboratory

The Geosynthetics CQA Laboratory should be certified by the Geosynthetics Accreditation Institute, will have experience in testing geosynthetics, and be familiar with ASTM, GRI, and other applicable test standards. The Geosynthetics CQA Laboratory will be capable of providing test results within 24 hours or a reasonable time after receipt of samples depending on the test(s) to be conducted, as agreed to at the outset of the project by affected parties, and will maintain that standard throughout the installation.

1.2.2.6 Soils CQA Laboratory

The Soils CQA Laboratory will have experience in testing structural fills, soil liners, and aggregates, and be familiar with ASTM and other applicable test standards. The Soils CQA Laboratory will be capable of providing test results within 24 hours or a reasonable time after receipt of samples depending on the test(s) to be conducted, as agreed to at the outset of the project by affected parties, and will maintain that standard throughout the installation.

1.3 Scope of Construction Quality Assurance Manual

The scope of this CQA Manual includes the CQA of the soils and geosynthetic components of the liner, leachate management, and final cover systems for the subject facility. The CQA for the selection, evaluation, and placement of the soils is included in the scope.

1.4 Units

In this CQA Manual, all properties and dimensions are expressed in U.S. units.

1.5 References

The CQA Manual includes references to the most recent version of the test procedures of the American Society of Testing and Materials (ASTM) and/or the Geosynthetic Research Institute (GRI). **Appendix A** contains a list of these procedures.

1.6 CQA Meetings

To facilitate the specified degree of quality during installation, clear, open channels of communication are essential. To that end, meetings are critical.

1.6.1 Soil Liner CQA Meeting

Prior to the start of the soil liner system construction a CQA Meeting will be held. This meeting will include all parties then involved, including the Engineer, the CQA Engineer, and the Contractor.

The purpose of this meeting is to begin planning for coordination of tasks, anticipate any problems which might cause difficulties and delays in construction, and, above all, review the CQA Manual to all of the parties involved. It is very important that the rules regarding testing, repair, etc., be known and accepted by all.

This meeting should include all of the activities referenced in the project specifications.

The meeting will be documented by the Engineer and minutes will be transmitted to all parties. The Soil Liner CQA Meeting and the Geosynthetics CQA Meeting may be held as one meeting or separate meetings, depending on the direction of the Engineer.

1.6.2 Geosynthetics CQA Meeting

A CQA Meeting will be held at the site prior to placement of the geosynthetics. At a minimum, the meeting will be attended by the Engineer, the CQA Engineer, the Contractor, and the Geosynthetic Installation Superintendent(s).

The purpose of this meeting is to begin planning for coordination of tasks, anticipate any problems which might cause difficulties and delays in construction, and, above all, review the CQA Manual to all of the parties involved. It is very important that the rules regarding testing, repair, etc., be known and accepted by all.

This meeting should include all of the activities referenced in the project specifications.

The meeting will be documented by the Engineer and minutes will be transmitted to all parties. The Soil Liner CQA Meeting and the Geosynthetics CQA Meeting may be held as one meeting or separate meetings, depending on the direction of the Engineer.

1.6.3 CQA Progress Meetings

Progress meetings will be held between the Engineer, the CQA Engineer, the Contractor, the Geosynthetic Installation Superintendent(s), and representatives from any other involved parties at the frequency dictated in the project specifications or, at a minimum, once per month during active construction. These meetings will discuss current progress, planned activities for the next week, and any new business or revisions to the work. The CQA Engineer will log any problems, decisions, or questions arising at this meeting in his daily or periodic reports. Any matter requiring action which is raised in this meeting will be reported to the appropriate parties. These meetings will be documented by the Engineer and minutes will be transmitted to affected parties.

1.6.4 Problem or Work Deficiency Meetings

A special meeting will be held when and if a problem or deficiency is present or likely to occur. At a minimum, the meeting will be attended by the Engineer, the CQA Engineer, the Contractor, and representatives from any other involved parties. The purpose of the meeting is to define and resolve the problem or work deficiency as follows:

- define and discuss the problem or deficiency;
- review alternative solutions; and
- implement an action plan to resolve the problem or deficiency.

The meeting will be documented by the Engineer and minutes will be transmitted to affected parties.

1.7 Control Versus Record Testing

1.7.1 Control Testing

In the context of this CQA Manual, Control Tests are those tests performed on a material prior to its actual use in construction to demonstrate that it can meet the requirements of the project plans and specifications. Control Test data may be used by the Engineer as the basis for approving alternative material sources.

1.7.2 Record Testing

Record Tests are those tests performed during the actual placement of a material to demonstrate that its in-place properties meet or exceed the requirements of the project drawings and specifications.

2.0 CQA DOCUMENTATION

An effective CQA plan depends largely on recognition of construction activities that should be monitored and on assigning responsibilities for the monitoring of each activity. This is most effectively accomplished and verified by the documentation of quality assurance activities. The CQA Engineer will document that quality assurance requirements have been addressed and satisfied.

The CQA Engineer will provide the Owner and Engineer with his daily and progress reports including signed descriptive remarks, data sheets, and logs to verify that required CQA activities have been carried out. These reports will also identify potential quality assurance problems. The CQA Engineer will also maintain at the job site a complete file of project drawings, reports, project specifications, a CQA Manual, checklists, test procedures, daily logs, and other pertinent documents.

2.1 Daily CQA Report

The CQA Engineer's reporting procedures will include preparation of a daily report which, at a minimum, will include the following information, where applicable:

- a unique identifying sheet number for cross referencing and document control;
- date, project name, location, and other identification;
- data on weather conditions;
- a reduced scale Site Plan showing all proposed work areas and test locations;
- descriptions and location of ongoing construction;
- descriptions and specific locations of areas, or units, of work being tested and/or observed and documented;
- locations where tests and samples were taken;
- a summary of test results;
- calibrations or recalibrations of test equipment, and actions taken as a result of recalibration;
- off-site materials received, including quality verification documentation;
- decisions made regarding acceptance of units of work, and/or corrective actions to be taken in instances of substandard quality;

- summaries of pertinent discussions with the Contractor and/or Geosynthetic Installers; and

- the CQA Engineer's signature.

The daily report must be completed at the end of each day. This information will be submitted to the Engineer for review on a routine basis and to the Owner upon request.

2.2 CQA Progress Reports

The CQA Engineer will prepare summary progress reports at time intervals as requested by the Engineer or Owner or upon a total project shutdown. As a minimum, this report will include the following information for the reporting period, where applicable:

- a summary of work activities performed;

- a summary of construction situations, deficiencies, and/or defects;

- a summary of all test results, failures, and retests;

- a compilation of daily CQA reports; and

- the CQA Engineer's signature.

Critical problems that occur will be communicated verbally to the Engineer immediately as well as being included in the progress reports.

2.3 CQA Photographic Reporting

Photographs will be taken by the CQA Engineer at regular intervals during the construction process and in all areas deemed critical by the CQA Engineer. These photographs will serve as a pictorial record of work progress, problems, and mitigation activities. Videotaping may be used to supplement photographs in the documentation of work progress, problems, and/or mitigation activities. These records will be presented to the Engineer upon completion of the project.

2.4 Deficiencies

The Owner and Engineer will be made aware of any significant recurring non-conformance with the project specifications. The Engineer will then determine the cause of the non-conformance and recommend appropriate changes in procedures or specification. When this type of evaluation is made, the results will be documented, and any revision to procedures or project specifications will be approved by the Owner and Engineer.

2.5 Design and/or Project Technical Specification Changes

Design and/or project specification changes may be required during construction. In such cases, the CQA Engineer will notify the Engineer. The Engineer will then notify the appropriate agency, if necessary.

Design and/or project specification changes will be made only with the written agreement of the Engineer, and will take the form of an addendum to the project specifications. All design changes will include a detail (if necessary) and state which detail it replaces in the plans.

2.6 Final CQA Report

At the completion of each major construction activity, the CQA Engineer will certify all required forms, observation logs, field and laboratory testing data sheets including sample location plans, etc. The CQA Engineer will also provide a final report which will certify that the work has been performed in compliance with the plans and project technical specifications, and that the supporting documents provide the necessary information.

The CQA Engineer will also provide summaries of all the data listed above with the report. The Record Drawings will include scale drawings depicting the location of the construction and details pertaining to the extent of construction (e.g., depths, plan dimensions, elevations, soil component thicknesses, etc.). All surveying and base maps required for development of the Record Drawings will be done by the Contractor's Construction Surveyor. These documents will be certified by the Contractor and delivered to the CQA Engineer and included as part of the final CQA (Certification) report.

It may be necessary to prepare interim certifications, as allowed by the regulatory agency, to expedite completion and review.

At a minimum, the items shown in **Table 2.1** will be included in the Final CQA Report. Note that some items may not be applicable to all projects.

2.7 Storage of Records

All handwritten data sheet originals, especially those containing signatures, will be stored by the CQA Engineer in a safe repository on site. Other reports may be stored by any standard method which will allow for easy access. All written documents will become property of the Owner.

Table 2.1A Final CQA Report General Outline (Liner System)

1. Introduction
2. Project Description
3. CQA Program
    a. Scope of Services
    b. Personnel
4. Earthwork CQA
5. Soil Liner CQA
6. GCL CQA
7. Geomembrane CQA
8. Leachate Management System CQA
9. Geotextile CQA
10. Drainage Geocomposite CQA
11. Summary and Conclusions
12. Project Certification

Appendices

- Appendix A Design Clarifications and Modifications
- Appendix B Piezometer Abandonment (if applicable)
- Appendix C Photographic Documentation
- Appendix D CQA Reporting
    - E1. CQA Reports
    - E2. CQA Meeting Minutes
- Appendix F Earthwork CQA Data
    - F1. CQA Test Results - Control Tests
    - F2. CQA Test Results - Record Tests
- Appendix G Soil Liner CQA Data
    - G1. CQA Test Results - Control Tests
    - G2. CQA Test Results - Record Tests
- Appendix H Interface Shear Strength Test Data
- Appendix I GCL CQA Data
    - I1. Manufacturer's Product Data Submittals and Quality Control Certificates
    - I2. Geosynthetics Inventory - GCL
    - I3. CQA Test Results - Material Control Tests
    - I4. GCL Installation Certification
- Appendix J Geomembrane CQA Data
    - J1. Manufacturer's Product Data Submittals and Quality Control Certificates
    - J2. Geosynthetics Inventory - Geomembrane(s)
    - J3. CQA Test Results - Material Control Tests
    - J4. Subgrade Acceptance Certificates
    - J5. Trial Seam Logs
    - J6. Panel Placement Logs
    - J7. Panel Seaming Logs

Table 2.1A (Continued):

J8.	CQC Test Results - Nondestructive Seam Testing Report Forms
J9.	CQC Test Results - Destructive Seam Testing Report Forms (Field)
J10.	CQA Test Results - Destructive Seam Testing Report Forms (Laboratory)
J11.	Repair Logs
J12.	Geomembrane Installation Certification
Appendix K	Leachate Management System CQA Data
K1.	Manufacturer's Product Data Submittals and Quality Control Certificates
K2.	CQA Test Results - Drainage Aggregate
K3.	CQA Test Results - Protective Cover
K4.	CQC Test Results - Pressure Testing of HDPE Transmission Piping
K5.	CQC Test Results - Leak Testing of Precast Concrete Structures
K6.	Documentation of Pump Start Up
Appendix L	Geotextile CQA Data
L1.	Manufacturer's Product Data Submittals and Quality Control Certificates
L2.	Geosynthetics Inventory - Geotextiles
L3.	CQA Test Results - Material Control Tests
Appendix M	Drainage Geocomposite CQA Data
M1.	Manufacturer's Product Data Submittals and Quality Control Certificates
M2.	Geosynthetics Inventory - Drainage Geocomposite
M3.	CQA Test Results - Material Control Tests
Appendix N	Record Drawings
N1.	Subgrade As-Built
N2.	Soil Liner As-Built
N3.	Geomembrane As-Built(s)
N4.	Leachate Collection Media As-Built
N5.	HDPE Pipe As-Built
N6.	Protective Cover As-Built

Table 2.1B Final CQA Report General Outline (Final Cover System)

1. Introduction
2. Project Description
3. CQA Program
    a. Scope of Services
    b. Personnel
4. Earthwork CQA
5. Final Cover System CQA
6. Geomembrane CQA
7. Geotextile CQA
8. Drainage Geocomposite CQA
9. Summary and Conclusions
10. Project Certification

Appendices

- Appendix A Design Clarifications/Modifications
- Appendix B Photographic Documentation
- Appendix C CQA Reporting
    - C1. CQA Reports
    - C2. CQA Meeting Minutes
- Appendix D Earthwork CQA Data
    - D1. CQA Test Results - Control Tests
    - D2. CQA Test Results - Record Tests
- Appendix E Final Cover System CQA Data
    - E1. Manufacturer's Product Data Submittals and Quality Control Certificates
    - E2. CQA Test Results - Drainage Aggregate
    - E3. CQA Test Results - Vegetative Soil Layer
    - E4. CQC Test Results - Pressure Testing of HDPE Piping
- Appendix F Interface Shear Strength Test Data
- Appendix G Geomembrane CQA Data
    - G1. Manufacturer's Product Data Submittals and Quality Control Certificates
    - G2. Geosynthetics Inventory - Geomembrane
    - G3. CQA Test Results - Material Control Tests
    - G4. Subgrade Acceptance Certificates
    - G5. Trial Seam Logs
    - G6. Panel Placement Logs
    - G7. Panel Seaming Logs
    - G8. CQC Test Results - Nondestructive Seam Testing Report Forms
    - G9. CQC Test Results - Destructive Seam Testing Report Forms (Field)
    - G10. CQA Test Results - Destructive Seam Testing Report Forms (Laboratory)
    - G11. Repair Logs
    - G12. Geomembrane Installation Certification

Table 2.1B (Continued):

Appendix H	Geotextile CQA Data
H1.	Manufacturer's Product Data Submittals and Quality Control Certificates
H2.	Geosynthetics Inventory - Geotextiles
H3.	CQA Test Results - Material Control Tests
Appendix I	Drainage Geocomposite CQA Data
I1.	Manufacturer's Product Data Submittals and Quality Control Certificates
I2.	Geosynthetics Inventory - Drainage Geocomposite
I3.	CQA Test Results - Material Control Tests
Appendix J	Record Drawings
J1.	Subgrade As-Built
J2.	Geomembrane As-Built
J3.	HDPE Pipe As-Built
J4.	Vegetative Soil Layer As-Built

3.0 EARTHWORK CQA

This section of the CQA Manual addresses earthwork (excavation and embankment) and outlines the soils CQA program to be implemented with regard to material approval, subgrade approval, field control and record tests, and resolution of problems.

3.1 Embankment Material Approval

All material to be used as compacted embankment shall be approved in advance by the CQA Engineer. Approval is based upon successful completion of CQA control testing outlined below. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

3.1.1 Control Tests

The procedure for CQA testing during excavation and stockpiling (including existing stockpiles) is outlined below.

Each load of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be rejected or routed to separate stockpiles consistent with its end use. Appropriate entries will be made in the daily log.

During stockpiling operations, control tests, as shown on **Table 3.1**, will be performed by the CQA Engineer prior to placement of any compacted embankment.

3.2 Subgrade Approval

The CQA Engineer will verify that the compacted embankment subgrade is constructed in accordance with the project specifications.

3.3 Earthwork Construction

3.3.1 Construction Monitoring

A. Earthwork shall be performed as described in the project specifications.

B. Only soil previously approved by the CQA Engineer (see **Section 3.1**) shall be used in construction of the compacted embankment. Unsuitable material will be removed prior to acceptance by the CQA Engineer.

C. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed. The surface preparation (e.g.

wetting, drying, scarification, etc.) shall be completed before the CQA Engineer will allow placement of subsequent lifts.

D. The CQA Engineer will monitor protection of the earthwork during and after construction.

3.3.2 Control Tests

The control tests, as shown on **Table 3.2**, will be performed by the CQA Engineer prior to placement of compacted embankment.

3.3.3 Record Tests

The record tests, as shown on **Table 3.2**, will be performed by the CQA Engineer during placement of compacted embankment.

3.3.3.1 Record Test Failure

Recompaction of the failed area shall be performed and retested until the area meets or exceeds requirements outlined in the specifications.

3.3.4 Judgmental Testing

During construction, the frequency of control and/or record testing may be increased at the discretion of the CQA Engineer when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- the rollers slip during rolling operation;
- the lift thickness is greater than specified;
- the fill material is at an improper moisture content;
- fewer than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- the rollers may not have used optimum ballast;
- the fill materials differ substantially from those specified; or
- the degree of compaction is doubtful.

3.4 Deficiencies

The CQA Engineer will immediately determine the extent and nature of all defects and deficiencies and report them to the Owner and Engineer. All defects and deficiencies will be documented by the CQA Engineer. The Contractor shall correct defects and deficiencies to the satisfaction of the CQA Engineer. The CQA Engineer will observe all retests on repaired defects.

Table 3.1 CQA Testing Program for Embankment Material Approval

Property	Test Method	Minimum Test Frequency
Control Tests:		
Visual Classification	ASTM D 2488	Each Soil
Moisture-Density Relationship	ASTM D 698	5,000 CY per Each Soil

Table 3.2 CQA Testing Program for Compacted Embankment

Property	Test Method	Minimum Test Frequency
Control Tests: (See **Table 3.1**)		
Record Tests:		
Lift Thickness	-----	Each Lift
In-Place Density	ASTM D 6938[1]	20,000 ft^2 per lift & 1 per 500 LF/lift of Berms (< 200 ft. base width)
Moisture Content	ASTM D 6938[2]	20,000 ft^2 per lift & 1 per 500 LF/lift of Berms (< 200 ft. base width)

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937. For every 10 nuclear density tests perform, at least 1 density test by ASTM D 1556, ASTM D 2167, or ASTM D 2937 as a verification of the accuracy of the nuclear testing device.

2. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959. For every 10 nuclear moisture tests, perform at least 1 moisture test by ASTM D 2216, ASTM D 4643, or ASTM D 4959 as a verification of the accuracy of the nuclear testing device.

4.0 SOIL LINER CQA

This section of the CQA Manual addresses the soil liner component of the liner system and outlines the soils CQA program to be implemented with regard to material approval, subgrade approval, test fill construction, field and laboratory control and record tests, and resolution of problems.

4.1 Soil Liner Material Approval

All material to be used as soil liner shall be approved in advance by the CQA Engineer. Approval is based upon successful completion of CQA control testing outlined below. Such testing can be performed either during excavation and stockpiling or from existing stockpiles prior to use.

4.1.1 Control Tests

The procedure for CQA testing during excavation and stockpiling (including existing stockpiles) is outlined below.

Each load of soil will be examined either at the borrow source or the stockpile area. Any unsuitable material will be rejected or routed to separate stockpiles consistent with its end use. Appropriate entries will be made in the daily log.

During stockpiling operations, control tests, as shown on **Table 4.1**, will be performed by the CQA Engineer prior to placement of any soil liner material.

4.2 Subgrade Approval

The CQA Engineer will verify that the soil liner subgrade is constructed in accordance with the project specifications.

4.3 Test Fill Construction

A test fill meeting the requirements of the project specifications will be constructed using the same construction methods, equipment, and material to be used for the soil liner component. The test fill construction will be conducted prior to or coincide with the beginning of construction of the soil liner component.

Construction equipment and methods will be reviewed by the CQA Engineer prior to test fill placement.

4.3.1 Control Tests

The control tests, as shown on **Table 4.2**, will be performed by the CQA Engineer prior to placement of soil liner material in the test fill.

4.3.2 Record Tests

The record tests, as shown on **Table 4.2**, will be performed by the CQA Engineer during placement of soil liner material in the test fill.

4.3.3 Test Fill Completion

The test fill program is completed when the Contractor has shown that the soil liner constructed using the same construction methods, equipment, and material to be used in construction of the soil liner will satisfy project specifications. No soil liner can be placed until the test fill program is completed.

4.4 Soil Liner Construction

4.4.1 Construction Monitoring

A. Soil liner shall be placed as described in the applicable section(s) of the project specifications using the construction methods, equipment, and material demonstrated in the test fill construction.

B. Only soil previously approved by the CQA Engineer (see **Section 4.1**) shall be used in construction of the soil liner. Unsuitable material will be removed prior to acceptance by the CQA Engineer.

C. All required field density and moisture content tests shall be completed before the overlying lift of soil is placed. The surface preparation (e.g. wetting, drying, scarification, etc.) shall be completed before the CQA Engineer will allow placement of subsequent lifts.

D. The CQA Engineer will monitor protection of the soil liner during and after construction.

E. The liner surface shall be sprinkled with water as needed to prevent desiccation. Should desiccation occur, the last lift shall be reconstructed in accordance with the project specifications. Standing water should not be present on the soil liner.

F. Frost heave or other damage due to freezing shall require lift reconstruction in accordance with the project specifications.

G. The CQA Engineer will inspect the soil liner and certify that it is in accordance with the project specifications and approved plans prior to the Contractor beginning installation of overlying geosynthetics.

H. The finished soil liner shall be free of all rock protrusions. All cracks and voids shall be filled and the surface made uniform. This shall be accomplished by final dressing of the soil liner with smooth-drum rollers and hand raking. No rubber tired vehicles are permitted on the final dressed surface unless authorized by the CQA Engineer.

I. The surface on which the overlying geosynthetics are to be placed shall be maintained in a firm, clean, and smooth condition and shall be within the acceptable moisture range before and during the geosynthetics installation.

4.4.2 Control Tests

The control tests, as shown on **Table 4.3**, will be performed by the CQA Engineer prior to placement of soil liner material.

4.4.3 Record Tests

The record tests, as shown on **Table 4.3** and as described below, will be performed by the CQA Engineer during placement of soil liner material.

A. Each lift will be checked visually for soil clods, rocks, debris, plant materials and other foreign material. Any such material which does not meet specified requirements shall be identified and removed prior to and during the compaction process.

B. The thickness of the loose lift will be measured at random locations after spreading and leveling is completed. Loose lift thickness should not exceed the depth of penetration of the compaction feet.

C. Moisture content will be monitored by the CQA Engineer prior to compaction. If the soil is drier than the specified minimum moisture content, water will be added and the lift will be disced to distribute the moisture evenly.

Results of testing will be certified within 7 days of soil liner placement.

4.4.3.1 Record Test Failure

The following procedures shall be used in the event of density or hydraulic conductivity test failure:

A. Failed Density Test: Recompaction of the failed area shall be performed and retested until the area meets or exceeds requirements outlined in the specifications.

B. Failed Hydraulic Conductivity Test: The area of failure shall be localized and reconstructed in accordance with the project specifications. This area will be retested as outlined within the plan by the CQA Engineer. Optionally, at least five replicate samples shall be obtained and tested by the Contractor in the immediate vicinity of the failed test. If all five samples pass, then the initial failing test will be discounted. However, should the replicate samples confirm the failure of the soil liner to meet specifications, the area of failure shall be localized, reconstructed, and retested as described above.

4.4.4 Judgmental Testing

During construction, the frequency of control and/or record testing may be increased at the discretion of the CQA Engineer when visual observations of construction performance indicate a potential problem. Additional testing for suspected areas will be considered when:

- the rollers slip during rolling operation;
- the lift thickness is greater than specified;
- the fill material is at an improper moisture content;
- fewer than the specified number of roller passes are made;
- dirt-clogged rollers are used to compact the material;
- the rollers may not have used optimum ballast;
- the fill materials differ substantially from those specified; or
- the degree of compaction is doubtful.

4.4.5 Perforations In Soil Liner

All holes shall be patched with compacted soil liner (if allowed by the project specifications) or sodium bentonite compacted and hydrated in the holes.

4.5 Deficiencies

The CQA Engineer will immediately determine the extent and nature of all defects and deficiencies and report them to the Owner and Engineer. All defects and deficiencies will be documented by the CQA Engineer. The Contractor shall correct defects and deficiencies to the satisfaction of the CQA Engineer. The CQA Engineer will observe all retests on repaired defects.

Table 4.1 CQA Testing Program for Soil Liner Material Approval

Property	Test Method	Minimum Test Frequency
Control Tests:		
Visual Classification	ASTM D 2488	Each Soil
Moisture Content	ASTM D 2216	2,000 CY per Each Soil
Grain Size Analysis	ASTM D 422	2,000 CY per Each Soil
Atterberg Limits	ASTM D 4318	2,000 CY per Each Soil
Moisture-Density Relationship	ASTM D 698	5,000 CY per Each Soil
Hydraulic Conductivity - Lab Remolded	ASTM D 5084[3]	10,000 CY per Each Soil

Table 4.2 CQA Testing Program for Soil Liner Test Fill

Property	Test Method	Minimum Test Frequency
Control Tests: (See **Table 4.1**)		
Moisture-Density Relationship	ASTM D 698[4]	1 per lift
Hydraulic Conductivity - Lab Remolded	ASTM D 5084[3,4]	1 per lift
Record Tests:		
Lift Thickness	-----	Each Lift
Atterberg Limits	ASTM D 4318	1 per lift
Grain Size Analysis	ASTM D 422	1 per lift
In-Place Density	ASTM D 2922[1]	3 per lift
Moisture Content	ASTM D 6938[2]	3 per lift
Hydraulic Conductivity - Undisturbed (Shelby Tube)	ASTM D 5084[3]	1 per lift

Table 4.3 CQA Testing Program for Soil Liner

Property	Test Method	Minimum Test Frequency
Control Tests: (See **Table 4.1**)		
Record Tests:		
Lift Thickness	-----	Each Lift
In-Place Density	ASTM D 6938[1]	10,000 ft^2 per lift
Moisture Content	ASTM D 6938[2]	10,000 ft^2 per lift
Hydraulic Conductivity - Undisturbed (Shelby Tube)	ASTM D 5084[3]	80,000 ft^2 per lift

Notes:

1. Optionally use ASTM D 1556, ASTM D 2167, or ASTM D 2937. For every 10 nuclear density tests, perform at least 1 density test by ASTM D 1556, ASTM D 2167, or ASTM D 2937 as a verification of the accuracy of the nuclear testing device.

2. Optionally use ASTM D 2216, ASTM D 4643, or ASTM D 4959. For every 10 nuclear moisture tests ,perform at least 1 moisture test by ASTM D 2216, ASTM D 4643, or ASTM D 4959 as a verification of the accuracy of the nuclear testing device.

3. Maximum effective confining pressure and hydraulic gradient as required by the project specifications. Backpressure as recommended by ASTM D 5084.

4. These tests performed on the test fill may count toward the minimum frequencies established in **Table 4.1**.

Appendix A

Reference List of Test Methods

Construction Quality Assurance Manual
Johnston County Landfill Facility
Smithfield, North Carolina

Construction Quality Assurance Manual
Appendix A: Reference List of Test Methods

American Society American Society of Testing and Materials (ASTM):

ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
ASTM D 422	Standard Test Method for Particle Size Analysis of Soils.
ASTM D 698	Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
ASTM D 792	Standard Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
ASTM D 1004	Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
ASTM D 1505	Standard Test Method for Density of Plastics by the Density-Gradient Technique.
ASTM D 1556	Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
ASTM D 1603	Standard Test Method for Carbon Black in Olefin Plastics.
ASTM D 2167	Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
ASTM D 2216	Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
ASTM D 2434	Standard Test Method for Permeability of Granular Soils (Constant Head).
ASTM D 2488	Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
ASTM D 2937	Standard Test Method for Density of Soil in Place by the Drive Cylinder Method.

ASTM D 3042	Standard Test Method for Insoluble Residue in Carbonate Aggregates.
ASTM D 4318	Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
ASTM D 4533	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
ASTM D 4632	Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
ASTM D 4643	Standard Test Method for Determination of Water (Moisture) Content of Soil by the Microwave Oven Method.
ASTM D 4716	Standard Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products.
ASTM D 4751	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
ASTM D 4959	Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating Method.
ASTM D 5084	Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.
ASTM D 5199	Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes.
ASTM D 5261	Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
ASTM D 5596	Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
ASTM D 5641	Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
ASTM D 5820	Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.

ASTM D 5887	Standard Test Method for Measurement of Index Flux Through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter.
ASTM D 5993	Standard Test Method for Measuring Mass per Unit of Geosynthetic Clay Liners.
ASTM D 5994	Standard Test Method for Measuring Core Thickness of Textured Geomembrane.
ASTM D 6241	Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile Related Products Using a 50 mm Probe.
ASTM D 6392	Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.
ASTM D 6496	Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners.
ASTM D 6693	Standard Test Method for Determining Tensile Properties of Nonreinforced Flexible Polyethylene and Nonreinforced Polypropylene Geomembranes.
ASTM D 6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
ASTM D 7005	Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites.

Permit No.	Scan Date	DIN
3606-MSWLF-1997	**12/29/2014**	**22566**

RECEIVED
December 18, 2014
Solid Waste Section
Asheville Regional Office

APPROVED DOCUMENT
Division of Waste Management
Solid Waste Section
Date January 2, 2015 By

December 15, 2014

Digitally signed by Larry Frost
DN: cn=Larry Frost, o=Division of Waste Management, ou=Solid Waste Section, email=larry.frost@ncdenr.gov, c=US
Date: 2015.01.06 11:43:35 -05'00'

RECEIVED
DEC 18 2014
SOLID WASTE SECTION
ASHEVILLE REGIONAL OFFICE

Mr. Edward F. Mussler, III
Section Chief, Permitting Branch
NCDENR - DWM - Solid Waste
217 West Jones Street
Raleigh, NC 27603

Re: Construction Quality Assurance Certification Report for Cell 2C
Gaston County Landfill – Unit II, Phase 1 - Cell 2C (Permit No. 36-06)
CHA Project Number 21420

Dear Mr. Mussler:

CHA Consulting, Inc. , (CHA) is submitting this final Certification Report for the Gaston County Landfill (Landfill) Unit II, Phase 1 – Cell 2C construction.

The enclosed report provides all CQA/CQC activities for subgrade preparation and soil liner placement, geomembrane installation, geocomposite installation, protective cover placement, and leachate collection stone and piping installation for Unit II, Phase I – Cell 2C. Key aspects of certification are summarized as follows:

- **Landfill Subgrade Certification –** Shield Engineering, Inc. (Shield) performed CQA monitoring and testing of the subgrade preparation as a subcontractor to CHA. Draper Aden Associates (DAA) performed the CQC monitoring and testing of the subgrade preparation. Bateman Civil Survey Company (BCS) provided the survey elevation measurements on the subgrade. Based on Shield's and DAA's monitoring and field test data, and on the survey measurements by BCS, it is CHA's opinion that the Cell 2C subgrade was prepared in general accordance with the approved Construction Plans and Specifications and the current NCDENR solid waste rules and regulations.

- **Compacted Clay Liner Certification –** Shield performed CQA monitoring and testing of the clay liner construction. DAA performed the CQC monitoring and testing of the clay liner construction. The general requirements for the clay liner were a thickness of 2 feet and a maximum permeability of 1×10^{-7} cm/sec. BCS provided the survey elevation measurements on the clay liner. Based on Shield's and DAA's monitoring and field test data, and on the survey measurements by BCS, it is CHA's opinion that the Cell 2C clay liner was constructed in general accordance with the approved Construction Plans and Specifications and with current NCDENR solid waste rules and regulations.

- **Geomembrane Liner Certification** – National Lining (National) a subcontractor to T&K Construction, LLC (T&K) installed and tested the geomembrane. Shield performed inspection and CQA monitoring and testing of the geomembrane installation. DAA performed the CQC monitoring and testing of the geomembrane installation. Based on National's, Shield's, DAA's monitoring and test data, and the manufacturer's material certifications, it is CHA's opinion that the Cell 2C geomembrane liner was installed in general accordance with the approved Construction Plans and Specifications and with current NCDENR solid waste rules and regulations.

- **Geocomposite Certification** – National installed the drainage geocomposite. Shield performed CQA monitoring and testing of the geocomposite installation. DAA performed the CQC monitoring and testing of the geocomposite installation. Based upon Shield's CQA, DAA's CQC monitoring and test data, and the manufacturer's material certifications, it is CHA's opinion that the Cell 2C geocomposite was installed in general accordance with the approved Construction Plans and Specifications and in accordance with current NCDENR solid waste rules and regulations.

- **Protective Cover Certification** – T&K placed the operational cover. DAA performed the CQC monitoring and testing of the protective cover materials. Shield performed CQA monitoring and testing of the operational cover. The general requirements for the operational cover material are 24 inches in thickness and a minimum permeability of 1×10^{-4} cm/sec. BCS provided the survey elevation measurements on the operational cover. Based on Shield's CQA monitoring and testing and DAA's CQC monitoring and testing, and BCS's elevation measurements, it is CHA's opinion that the Cell 2C operational cover was constructed in general accordance with the approved Construction Plans and Specifications and with current NCDENR solid waste rules and regulations.

- **Leachate Collection Pipe and Stone Certification** – T&K installed the leachate collection stone and piping. DAA performed the CQC monitoring. Shield performed inspection and CQA monitoring of the collection pipe and stone installation. Based on Shield's CQA monitoring and testing and DAA's CQC monitoring and testing, it is CHA's opinion that the Cell 2C leachate collection system was constructed in general accordance with the approved Construction Plans and Specifications and with current NCDENR solid waste rules and regulations.

Based on our review of all the CQA and CQC data provided by Shield, DAA, and BCS, it is our opinion that the Landfill Unit II – Phase I Cell 2C was constructed in general accordance with:

- The Construction Technical Specifications, Quality Assurance Plan, and Drawings prepared by CHA Consulting, Inc., dated May 2012;
- The conditions of Permit to Construct No. 36-06, issued May 13, 1997, modified November 15, 2007;
- The requirements of Rule 15A NCAC 13B .1624 (b) (16) (C); and
- Acceptable engineering practices.

CHA and Gaston County would like to thank you and the Solid Waste Section staff for your assistance throughout this process.

If you have any questions regarding this Certification Report, please do not hesitate to call me at (704) 527-3227.

Sincerely,

Jack R. Miller, P.E.
Project Manager

JRM/der

Enclosure

cc: Ray Maxwell, P.E., Gaston County
Marcie Smith, Gaston County

CHA

GASTON COUNTY LANDFILL
UNIT II, PHASE 1 - CELL 2C

CERTIFICATION REPORT

DECEMBER 2014

CHA
design/construction solutions

Permit No.	Scan Date	DIN
3606-MSWLF-1997	**12/29/2014**	**22566**

RECEIVED
December 18, 2014
Solid Waste Section
Asheville Regional Office

GASTON COUNTY LANDFILL
UNIT II PHASE I – CELL 2C

CERTIFICATION REPORT

DECEMBER 2014

Prepared for:

Gaston County
P.O. Box 1578
Gastonia, NC 28053-1578

Prepared by:

CHA
8720 Red Oak Boulevard, Suite 505
Charlotte, North Carolina 28217
N.C. License No. F-1165

Project Number
21420

LIST OF APPENDICES

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APPENDIX C — CQC FOR SITE PREPARATION

Subgrade Soil Laboratory Test Results and Certification
Subgrade As-Built Map

APPENDIX D — CQC FOR CLAY LINER

Clay Liner Borrow Source Characterization Study
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Clay Liner (Soil Liner) Laboratory Data
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APPENDIX E — CQC FOR GEOMEMBRANE

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CQC Record Keeping:
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CQC Destructive Seam Strength Results
Installer Record Keeping:
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- Seaming Log
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- Geocomposite Resin Certification
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CQC Transmissivity Test Results

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Laboratory Test Results
Structural Fill
Soil Liner Test Pad
Soil Liner
Geosynthetics Liner
Protective Cover Liner
Shear and Peel Test Results

APPENDIX A

Party Responsibilities Table

The following table is a list of key parties involved during the construction of the Gaston County Landfill – Unit II, Phase 1 — Cell 2C and their respective roles:

Party	Role
Gaston County	Facility Owner and Operator.
CHA Consulting, Inc. (CHA)	Project design engineer and project manager providing oversight and coordination between all parties, clarification of design and contract issues, technical support, review of shop drawings, review of pay requests, and implementation of quality assurance.
T&K Construction, LLC (T&K)	General Contractor responsible for all aspects of construction through its own forces as well as subcontractors. General Contractor was also responsible for providing required CQC services for all synthetics installation.
National Lining	Subcontractor to General Contractor responsible for the installation of the geomembrane liner and geocomposite. The geomembrane was manufactured and provided by Agru America. The drainage geocomposite was manufactured and provided by SKAPS Industries.
Draper Aden Associates (DAA)	Provided CQC inspection and testing services as a subcontractor to General Contractor.
Shield Engineering, Inc. (Shield)	CQA subconsultants to Project Design Engineer providing direct quality assurance testing for subgrade preparation, soil liner placement, and quality assurance supervision for the installation of HDPE liner, drainage geocomposite, operational cover, and the HDPE piping system.
Bateman Civil Survey Company	Licensed Surveyor providing record surveys of subgrade, clay liner, and operational cover.

APPENDIX B

CQC Certification Letter

Draper Aden Associates
Engineering • Surveying • Environmental Services

46 W. Washington Street
Coats, North Carolina 27521
(910) 897-7070 • Fax (910) 897-6767
www.daa.com

December 11, 2014

Mr. Lonnie Burgess
T&K Construction, LLC
235 County Road 1242
Vinemont, Al 35179

Re: **Soils Construction and Conformance Certification**
Gaston County Landfill
Unit II – Phase I – Cell 2C MSWLF Construction
DAA No. R08281N-06G

Dear Mr. Burgess:

Attached, you will find our compiled Laboratory and Field Documentation for the earthwork testing performed at the above referenced project site. Our scope of services included inspections and testing of approximately 5 acres (4.78) of Low Permeability Cohesive Soil Liner and Protective Cover soil. Limited Structural Fill/ Subgrade compaction testing was also performed as documented below.

Inspection and Field Testing

Structural Fill / Subgrade

While the majority of the site was cut down to grade, some areas of fill were required. The drainage ditch located at the tie-in of the existing cell was found to be soft after proofrolling with a fully loaded off-road vehicle. This area was cut down approximately 4 to 5 feet to firm underlying soils and backfilled with approved soils in lifts of approximately 8" compacted thickness on September 23-24, 2014.

The northern portion of the Cell 2C berm was constructed last to facilitate vehicle entry during construction. The berm was constructed on October 22, 2014 with compacted lifts of approved structural fill material.

Prior to any Cohesive Soil Liner being place the entirety of the cell floor was proofrolled with no other soft areas observed. All field testing met the minimal 95% compaction requirement.

Soil Borrow Study

In our soils laboratory, we performed Atterberg Limits, Grain Size Analysis, Natural Moisture Content, Standard Proctor, and Hydraulic Conductivity tests on bulk samples sampled at off-site borrow areas. Our detailed laboratory results are attached. Testing was performed at the frequencies indicated below:

Test	*ASTM Designation*	*Frequency Required*	*Frequency Performed*
Grain Size Analysis	D422 and D1140	12	12
Atterberg Limits	D4318	12	12
Standard Proctor	D698	12	12
Hydraulic Conductivity	D5084	12	12

The soils encountered were classified by using the Standard Classification of Soils (ASTM D2487) using information obtained from Grain Size Analysis and Atterberg Limits. Their maximum dry density and optimum moisture content were found using the Standard Proctor Method (ASTM D698). The excavated soils were Red-Brown to Brown in color.

The samples of soil from within the footprint of the proposed borrow area primarily classified as Sandy Fat CLAY (CH) and ranged in permeability from 3.4 x 10-8 cm/sec to 9.8 x 10–8 cm/sec. A "permeability window" indicating the approximate range of moisture content and dry density to achieve a lab permeability of 1.0 x 10-7 cm/sec or less was created to guide field placement.

Cohesive Soil Test Pad

The following tests were conducted on the test pad:

Test	*ASTM Designation or Other Test Method*	*Frequency Required*	*Frequency Performed*
Compacted Subgrade Density	D6938, D2937	3 per test pad	3 per test pad
Compacted Subgrade Moisture Content	D6938, D2937	3 per test pad	3 per test pad
Compacted Density	D6938, D2937	5 per lift	5 per lift
Compacted Moisture Content	D6938, D2937	5 per lift	5 per lift
Atterberg Limits	D4318	5 per test pad	5 per test pad
Particle Size	D1140	5 per test pad	5 per test pad
Hydraulic Conductivity	D5084	1 per lift	1 per lift
Hydraulic Conductivity (Recompacted)	D5084	1 per lift	1 per lift
Standard Proctor	D698	1 per test pad	4 per test pad
Modified Proctor	D1557	1 per test pad	1 per test pad

During our site visits on September 30 and October 1, 2014 quality control testing was performed on the Soil Liner Test Pad. The project specifications require a 24-inch thick Soil Liner Test Pad. The soil was placed within the test pad area in four compacted 6-inch lifts. Density tests plotted in the permeability "window", which resulted in sufficient compaction and acceptable amounts of moisture.

In addition to our field testing, Shelby tubes samples were obtained and laboratory permeability and classification tests were performed. The Soil Liner Test Pad produced in-place and re-compacted permeabilities ranging from 4.8 x 10-8 cm/sec to 9.7 x 10 –8 cm/sec. Samples were classified as Sandy Fat CLAY (CH). Our field density tests and laboratory results are attached.

Cohesive Soil Liner

The following tests were conducted on the Cohesive Soil Liner:

Test	***ASTM Designation or Other Test Method***	***Frequency Required***	***Frequency Performed***
Compacted Density	D6938, D2937	1 per 10,000 ft^2	1 per 10,000 ft^2
Compacted Moisture Content	D6938, D2937	1 per 10,000 ft^2	1 per 10,000 ft^2
Atterberg Limits	D4318	1 per acre per lift	1 per acre per lift
Particle Size	D1140	1 per acre per lift	1 per acre per lift
Hydraulic Conductivity	D5084	1 per acre per lift	1 per acre per lift
Standard Proctor	D698	1 per 5,000CY	1 per 5,000CY

Draper Aden Associates provided quality control observation and testing as the cohesive soil liner was constructed for the Phase I - Cell 2C from October 2 through October 24, 2014. Liner soils were placed and compacted within the cell area in four 6-inch lifts. Field density testing confirmed that an acceptable degree of compaction was achieved during the soil liner placement. Testing also confirmed that the range of soil moistures was satisfactory. In addition to our field density testing, Shelby tube samples were obtained and laboratory permeability and classification tests were performed. The Cohesive Soil Liner produced acceptable permeabilities ranging from 1.9x 10-8 cm/sec to 9.9 x 10 –8 cm/sec. Samples were classified as Sandy Fat CLAY (CH), Sandy Elastic SILT (MH), and Sandy Lean CLAY (CL). Our field density tests and laboratory results are attached.

Protective Cover Soil

A 24-inch permeable, protective soil cushion layer was installed above the geotextile component of the liner system. This layer had gradation, permeability and carbon content performance specification requirements. Random samples were taken in the field and laboratory tested at the following frequencies:

Test	*ASTM Designation or Other Test Method*	*Frequency Required*	*Frequency Performed*
Carbonate Content	D4373	1 per Source	1 per Source
Hydraulic Conductivity	D5084	1 per 3,000 CY	1 per 3,000 CY
Particle Size	D422	1 per 1,500 CY	1 per 1,500 CY

Samples of the Protective Cover Soils produced acceptable permeabilities ranging from 1.5 x 10-3 cm/sec to 1.8 x 10 –3 cm/sec. Samples were classified as Silty SAND (SM).

Conclusions

Based on our field documentation, laboratory test results and geotechnical engineering experience, we conclude that the earthwork installed on the above referenced project site has been completed in substantial compliance with the project design specifications and quality assurance program as issued by CHA, of Charlotte, North Carolina dated May, 2014.

If you should have any further questions, please feel free to contact us at (910) 897-7070.

Sincerely,
DRAPER ADEN ASSOCIATES

NORTH CAROLINA PROFESSIONAL SEAL 15399 12-11-2014 ENGINEER C. TYRUS CLAYTON, JR.

C. Tyrus Clayton Jr., P.E.
CQA Certifying Engineer

Attachments
Field and Laboratory Documentation
cc: file

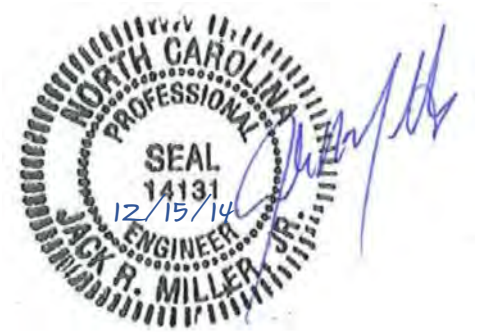
APPENDIX D

CQC for Clay Liner

COMPACTED CLAY LINER CERTIFICATION

T&K Construction, LLC, installed the compacted clay liner. Draper Aden Associates (DAA) performed the CQC monitoring and testing and Shield Engineering, Inc. (Shield) performed the CQA monitoring and testing. The general requirements for the clay liner were a thickness of 2 feet and a maximum permeability of 1 x 10^{-7} cm/sec. Based on observations and data provided by DAA and Shield, along with the certified as-built drawing of the completed clay liner prepared by Bateman Civil Survey Company, it is CHA's opinion that the Unit II, Phase 1 – Cell 2C clay liner was constructed in general accordance with the approved Construction Plans and Specifications and with current NCDENR solid waste rules and regulations.

The services provided for this project were performed with the care and skill ordinarily exercised by reputable members of the profession practicing under similar conditions at the same time and in the same or similar locality. No warranty, expressed or implied, is made or intended by rendition of these consulting services or by furnishing oral or written reports of the findings made. This Report has been prepared for the exclusive use of the County.



Jack Miller, PE
Project Manager
CHA Consulting, Inc.
N.C.P.E. No. 14131

Clay Liner
Borrow Source Characterization Study

SOIL BORROW STUDY

(INCLUDING STRUCTURAL FILL PROCTOR DATA)

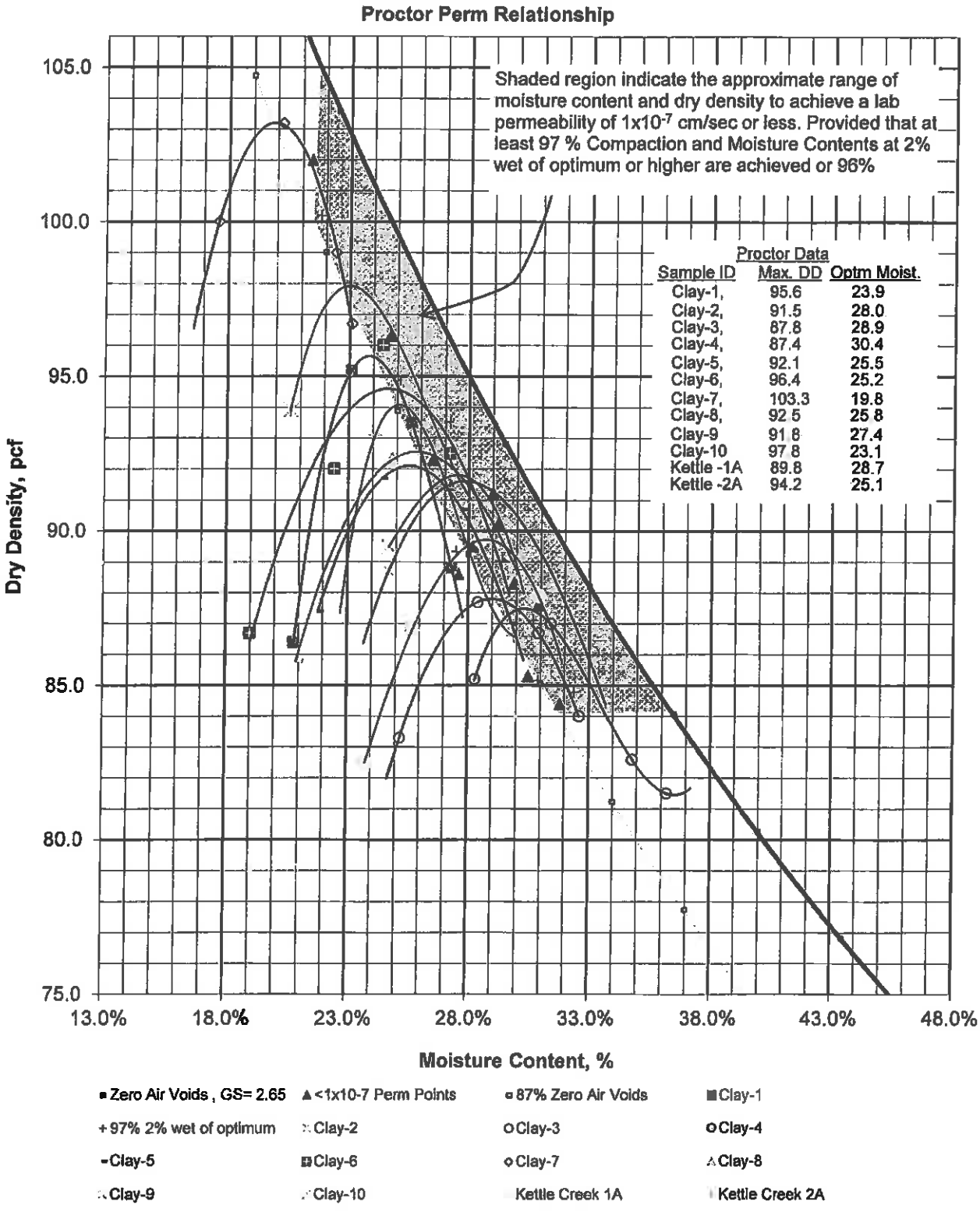
Proctor/ Perm Summary

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC

DAA # R08281-05G

Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services



Lab Data Summary

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC

DAA # R08281-05G

Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample Data							
Sample ID	Clay-1	Clay-2	Clay-3	Clay-4	Clay-5	Clay-6	Clay-7
Sample Depth	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Classification Data							
Natural Moisture Content, %	25.7%	16.8%	19.9%	29.0%	28.2%	27.1%	20.4%
Liquid Limit	57	55	68	70	59	60	52
Plastic Limit	29	29	28	32	26	29	24
Plastic Index	28	26	40	38	33	31	28
Passing No. 200 Sieve, %	65.3%	63.8%	70.9%	70.6%	60.1%	63.6%	56.8%
USCS Group Symbol	CH	CH	CH	CH	CH	CH	CH
Standard Proctor Data							
Maximum Dry Density, pcf	95.6	91.5	87.8	87.4	92.1	96.4	103.3
Optimum Moisture Content, %	23.9%	28.0%	28.9%	30.4%	25.5%	25.2%	19.8%
Permeability Data							
Compacted Dry Density, pcf	92.3	88.3	85.3	84.4	88.6	91.5	102.0
Percent Compaction, %	96.5%	96.5%	97.2%	96.6%	96.2%	94.9%	98.7%
Compacted Moisture Content, %	26.5%	29.9%	30.5%	31.8%	27.6%	27.2%	21.4%
Deviation from Optimum	2.6%	1.9%	1.6%	1.4%	2.1%	2.0%	1.6%
Permeability, cm/sec	3.8E-08	9.8E-08	8.7E-08	9.3E-08	9.7E-08	7.6E-08	5.5E-08

Lab Data Summary

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC

DAA # R08281-05G

Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample Data

Sample ID	Clay-8	Clay-9	Clay-10	Kettle Ck 1A	Kettle Ck 2A
Sample Depth	N/A	N/A	N/A	N/A	N/A
Classification Data					
Natural Moisture Content, %	25.6%	27.9%	23.9%	33.2%	23.3%
Liquid Limit	53	57	51	63	54
Plastic Limit	22	26	24	25	31
Plastic Index	31	31	27	39	24
Passing No. 200 Sieve, %	66.5%	68.4%	62.4%	66.8%	55.1%
USCS Group Symbol	CH	CH	CH	CH	MH
Standard Proctor Data					
Maximum Dry Density, pcf	92.5	91.8	97.8	89.8	94.2
Optimum Moisture Content, %	25.8%	27.4%	23.1%	28.7%	25.1%
Permeability Data					
Compacted Dry Density, pcf	91.2	90.2	96.3	87.6	89.5
Percent Compaction, %	98.6%	98.3%	98.5%	97.6%	95.0%
Compacted Moisture Content, %	29.0%	29.2%	24.7%	30.9%	28.2%
Deviation from Optimum	3.2%	1.8%	1.6%	2.2%	3.1%
Permeability, cm/sec	3.4E-08	4.0E-08	5.7E-08	5.6E-08	7.3E-08

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID	Clay-1
Sample Depth	N/A
Visual Sample Description	Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	24
Pan Wt	186.22 grams
Pan + Soil (wet)	422.20 grams
Pan + Soil (dry)	373.88 grams
Natural Moisture Content	*25.7%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	251.33 grams
Percent Passing No. 200 Sieve	65.3%
Pan + Soil retained on No. 4 sieve (dry)	186.35 grams
Percent Passing No. 4 Sieve	99.9%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	20	27	30
Pan ID	105	201	103
Pan Wt	29.27	27.68	27.38
Pan + Soil (wet)	46.09	41.60	41.39
Pan + Soil (dry)	39.79	36.61	36.39
Moisture Content	60%	56%	55%
Liquid Limit	58	56	57
Liquid Limit	*57*		

Plastic Limit

Pan ID	352	354
Pan Weight	9.13	9.18
Pan + Soil (wet)	19.49	19.40
Pan + Soil (dry)	17.22	17.09
Moisture Content	28%	29%
Plastic Limit	*29*	
Plastic Index	*28*	

USCS Classification: ASTM D 2487

Group Symbol	**CH**
Group Name	**Sandy Fat CLAY**

Grain Size Distribution Calculations

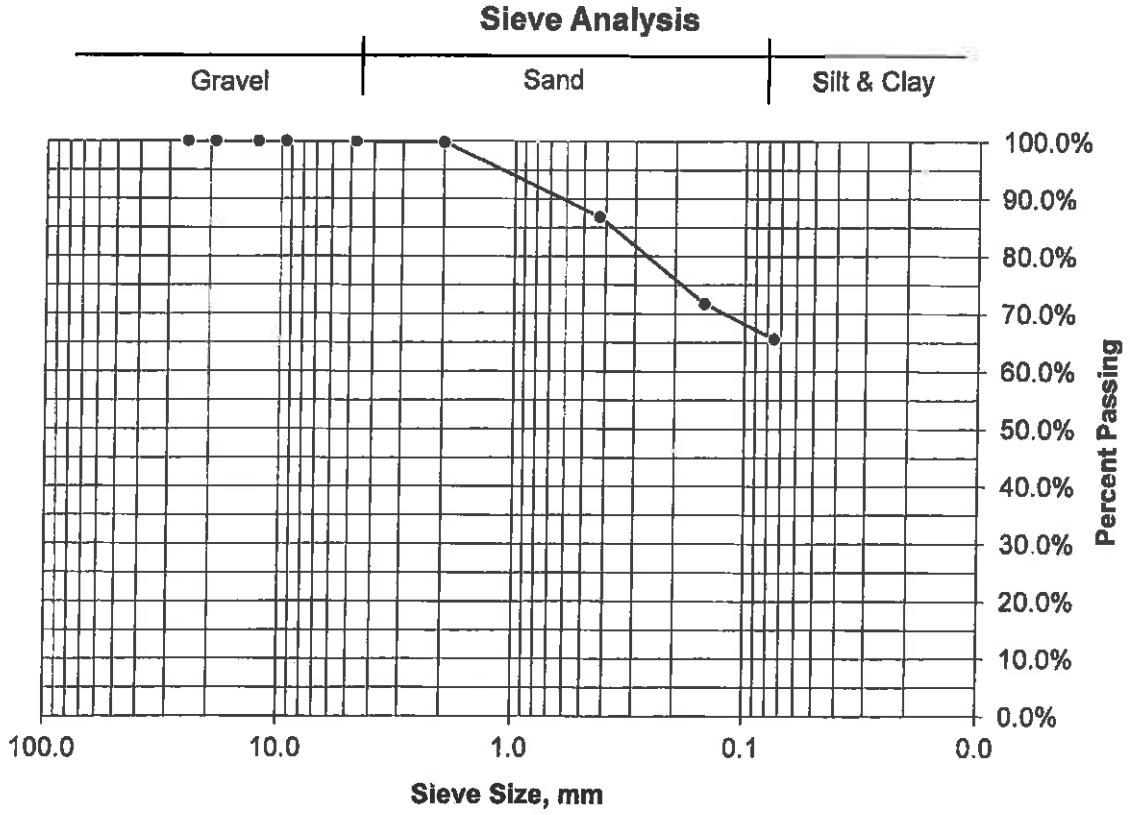
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-1
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.13	0.1%	4.75	99.9%
No. 10	0.25	0.1%	2.0	99.8%
No. 40	24.37	13.0%	0.425	86.8%
No. 100	28.20	15.0%	0.15	71.8%
No. 200	11.59	6.2%	0.075	65.6%
Pan	0.39	0.2%		
Total	64.93	34.4%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

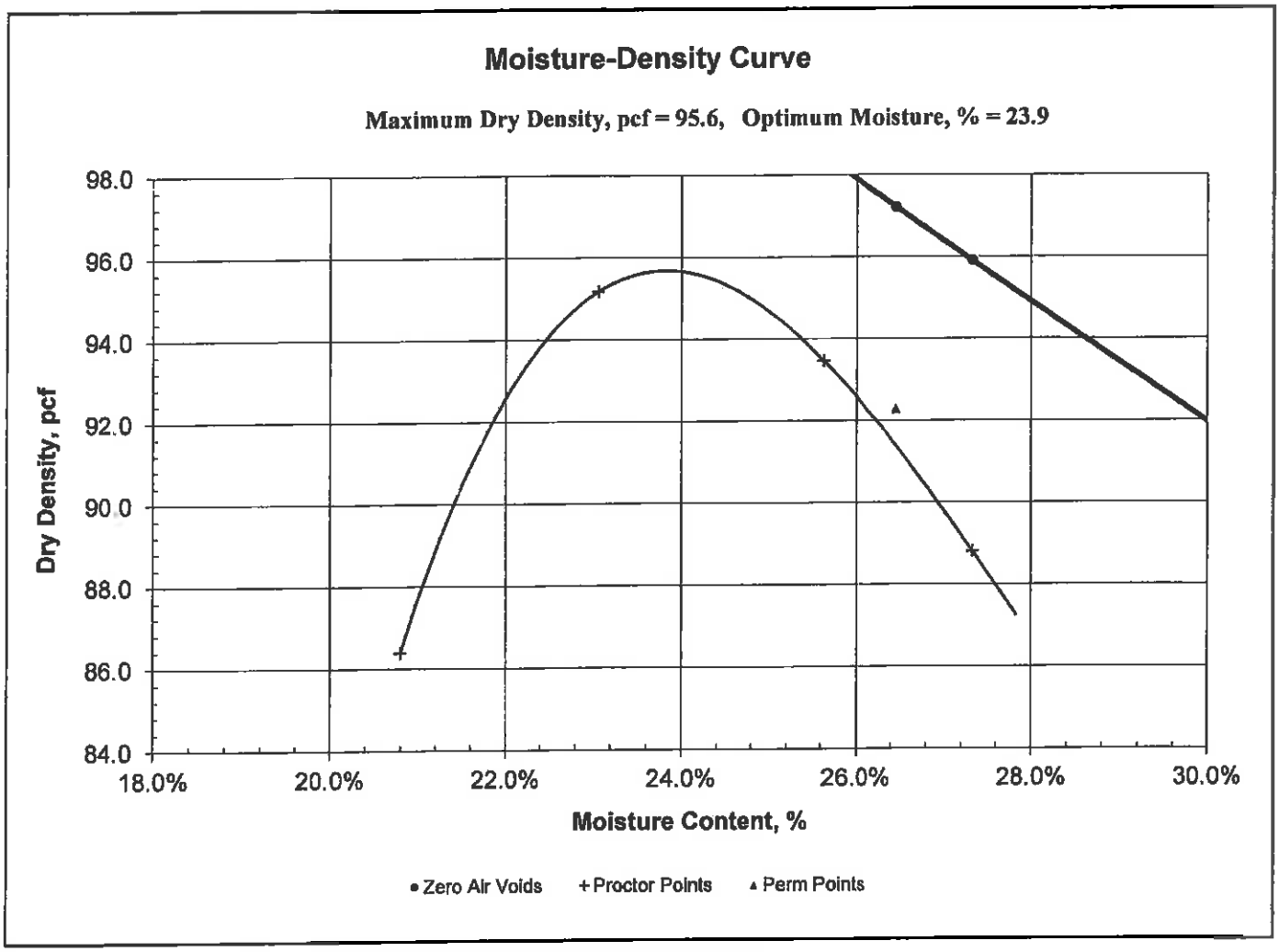
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Clay-1
Sample Depth	N/A
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	20.8%	23.1%	25.6%	27.3%	
Dry Density, pcf	86.4	95.2	93.5	88.8	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Clay-1
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.14
Sample Diameter, in: 2.84
Sample Condition: Remolded

Moisture Content

Pan Wt	9.01	grams
Pan + Soil (wet)	132.01	grams
Pan + Soil (dry)	106.28	grams
Moisture Content	*26.5%*	

Dry Density

Soil (wet)	608.30	grams
Wet Density	116.7	pcf
Dry Density	*92.3*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712
Effective Stress, psi	10.0
Pearment Liquid Temp.(°C):	20.3 De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	44.2%
Actual Volume of Voids	143.7 ml
Porosity	44.2%
Saturation	88.5%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
8-Sep 5:20	16.200		1.400				
8-Sep 5:21	15.800	0.013	1.416	0.013	1.00	23.30	2.2E-07
8-Sep 5:22	15.650	0.005	1.423	0.005	1.00	22.65	8.5E-08
8-Sep 5:23	15.500	0.005	1.429	0.005	1.00	22.40	8.6E-08
8-Sep 5:24	15.400	0.003	1.433	0.003	1.00	22.16	5.8E-08
8-Sep 5:25	15.300	0.003	1.437	0.003	1.00	21.99	5.9E-08
8-Sep 5:26	15.250	0.002	1.439	0.002	1.00	21.83	2.9E-08
8-Sep 5:27	15.200	0.002	1.441	0.002	1.00	21.75	3.0E-08
8-Sep 5:32	14.900	0.009	1.453	0.009	1.00	21.66	3.6E-08

Average Permeability 3.8E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65		
Final Weight of Sample	621.40 grams		
Final Moisture Content	29.2%	Final Sample Length, in:	3.14
Percent Voids	44.0%	Final Sample Diameter, in:	2.83
Actual Volume of Voids	142.6 ml	Wet Density	119.7 pcf
Porosity	44.0%	*Dry Density*	*92.6* pcf
Saturation	98.4%		

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-2
Sample Depth N/A
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	16
Pan Wt	189.45 grams
Pan + Soil (wet)	396.85 grams
Pan + Soil (dry)	367.02 grams
Natural Moisture Content	*16.8%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	253.68 grams
Percent Passing No. 200 Sieve	63.8%
Pan + Soil retained on No. 4 sieve (dry)	189.45 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	20	26	35
Pan ID	91	104	351
Pan Wt	24.53	26.23	13.66
Pan + Soil (wet)	34.90	40.07	26.17
Pan + Soil (dry)	31.15	35.24	21.84
Moisture Content	57%	54%	53%
Liquid Limit	55	54	55
Liquid Limit	*55*		

Plastic Limit

Pan ID	78	353
Pan Weight	4.24	9.11
Pan + Soil (wet)	14.27	19.79
Pan + Soil (dry)	11.99	17.40
Moisture Content	29%	29%
Plastic Limit	*29*	
Plastic Index	*26*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

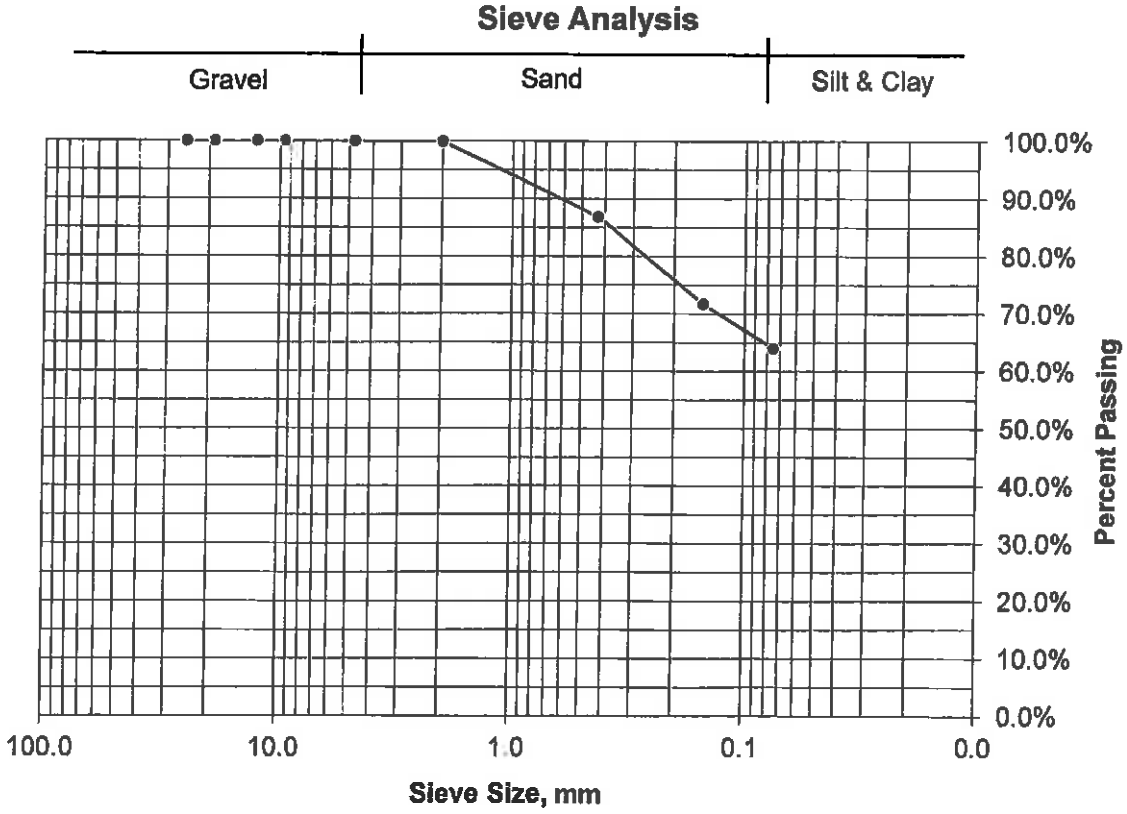
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-2
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.17	0.1%	2.0	99.9%
No. 40	23.25	13.1%	0.425	86.8%
No. 100	26.88	15.1%	0.15	71.7%
No. 200	13.67	7.7%	0.075	64.0%
Pan	0.30	0.2%		
Total	64.27	36.0%		



Proctor Test Report

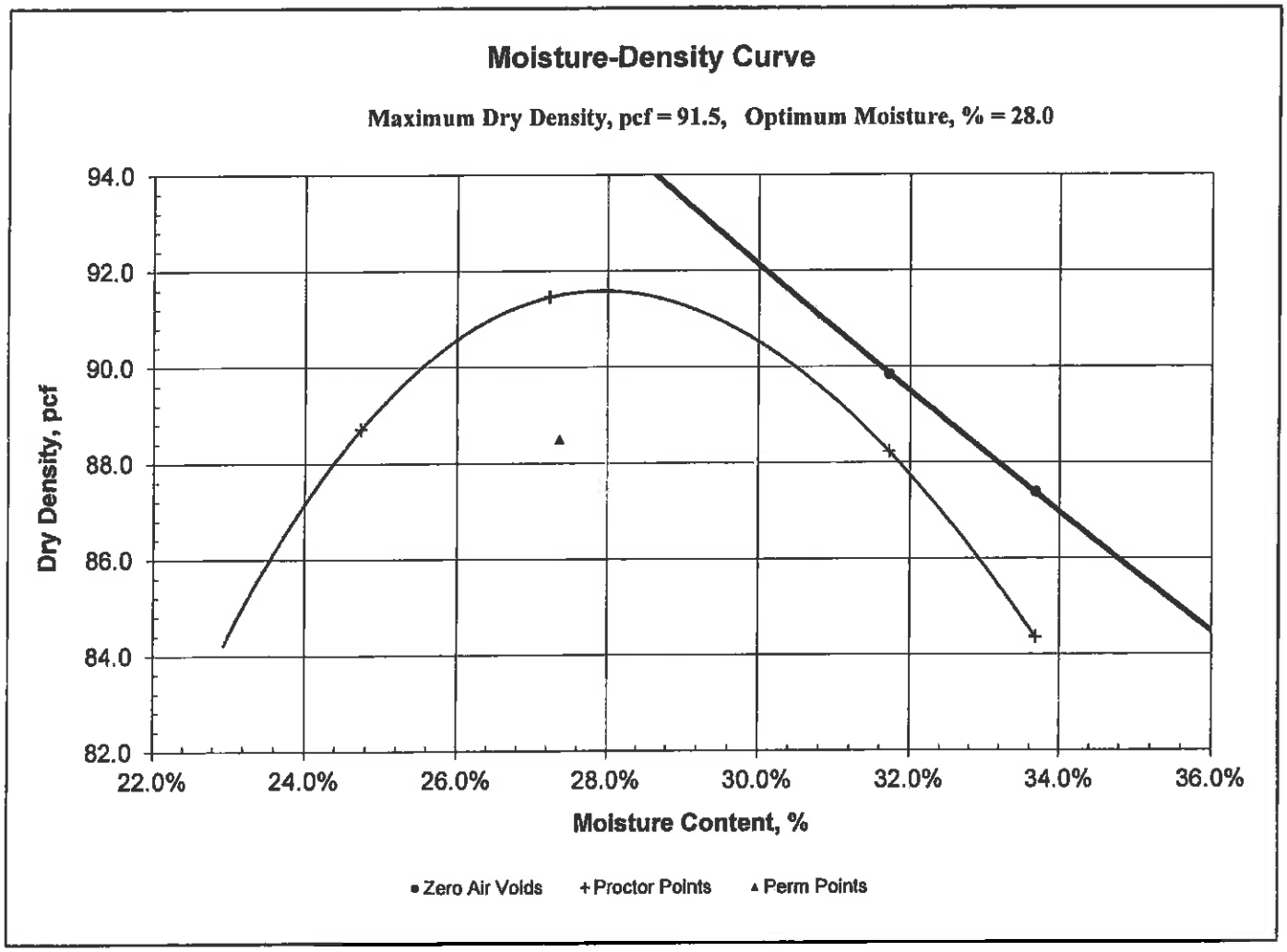
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Clay-2
Sample Depth	N/A
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data	#1	#2	#3	#4	#5
Moisture Content	24.7%	27.2%	31.7%	33.7%	
Dry Density, pcf	88.7	91.5	88.2	84.4	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Clay-2
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.58
Sample Diameter, in: 2.87
Sample Condition: Remolded

Moisture Content

Pan Wt	8.94	grams
Pan + Soil (wet)	205.31	grams
Pan + Soil (dry)	160.12	grams
Moisture Content	*29.9%*	

Dry Density

Soil (wet)	695.60	grams
Wet Density	114.7	pcf
Dry Density	*88.3*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	21.0	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	46.6%
Actual Volume of Voids	176.3 ml
Porosity	46.6%
Saturation	90.8%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
22-Sep 10:08	16.000		1.200				
22-Sep 10:09	15.050	0.030	1.239	0.030	1.00	20.45	6.0E-07
22-Sep 10:10	14.500	0.017	1.261	0.017	1.00	19.09	3.7E-07
22-Sep 10:11	14.100	0.013	1.278	0.013	1.00	18.30	2.8E-07
22-Sep 10:12	13.850	0.008	1.288	0.008	1.00	17.72	1.8E-07
22-Sep 10:13	13.700	0.005	1.294	0.005	1.00	17.36	1.1E-07
22-Sep 10:14	13.550	0.005	1.300	0.005	1.00	17.15	1.1E-07
22-Sep 10:15	13.450	0.003	1.304	0.003	1.00	16.93	7.5E-08
22-Sep 10:23	12.450	0.031	1.345	0.031	1.00	16.79	9.8E-08

Average Permeability 9.8E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65		
Final Weight of Sample	697.42 grams		
Final Moisture Content	30.2%	Final Sample Length, in:	3.55
Percent Voids	44.8%	Final Sample Diameter, in:	2.83
Actual Volume of Voids	164.2 ml	Wet Density	118.8 pcf
Porosity	44.8%	*Dry Density*	*91.2* pcf
Saturation	98.6%		

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-3
Sample Depth N/A
Visual Sample Description Red-Brown Fat CLAY with Sand

Natural Moisture Content: ASTM D 2216

Pan ID	11
Pan Wt	187.54 grams
Pan + Soil (wet)	379.60 grams
Pan + Soil (dry)	347.76 grams
Natural Moisture Content	*19.9%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	234.14 grams
Percent Passing No. 200 Sieve	70.9%
Pan + Soil retained on No. 4 sieve (dry)	187.70 grams
Percent Passing No. 4 Sieve	99.9%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	19	24	32
Pan ID	7	5	65
Pan Wt	11.17	11.06	11.04
Pan + Soil (wet)	23.85	25.59	21.83
Pan + Soil (dry)	18.64	19.70	17.56
Moisture Content	70%	68%	65%
Liquid Limit	67	68	67
Liquid Limit	*68*		

Plastic Limit

Pan ID	315	317
Pan Weight	9.14	8.09
Pan + Soil (wet)	19.47	21.26
Pan + Soil (dry)	17.20	18.40
Moisture Content	28%	28%
Plastic Limit	*28*	
Plastic Index	*40*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Fat CLAY with Sand**

Grain Size Distribution Calculations

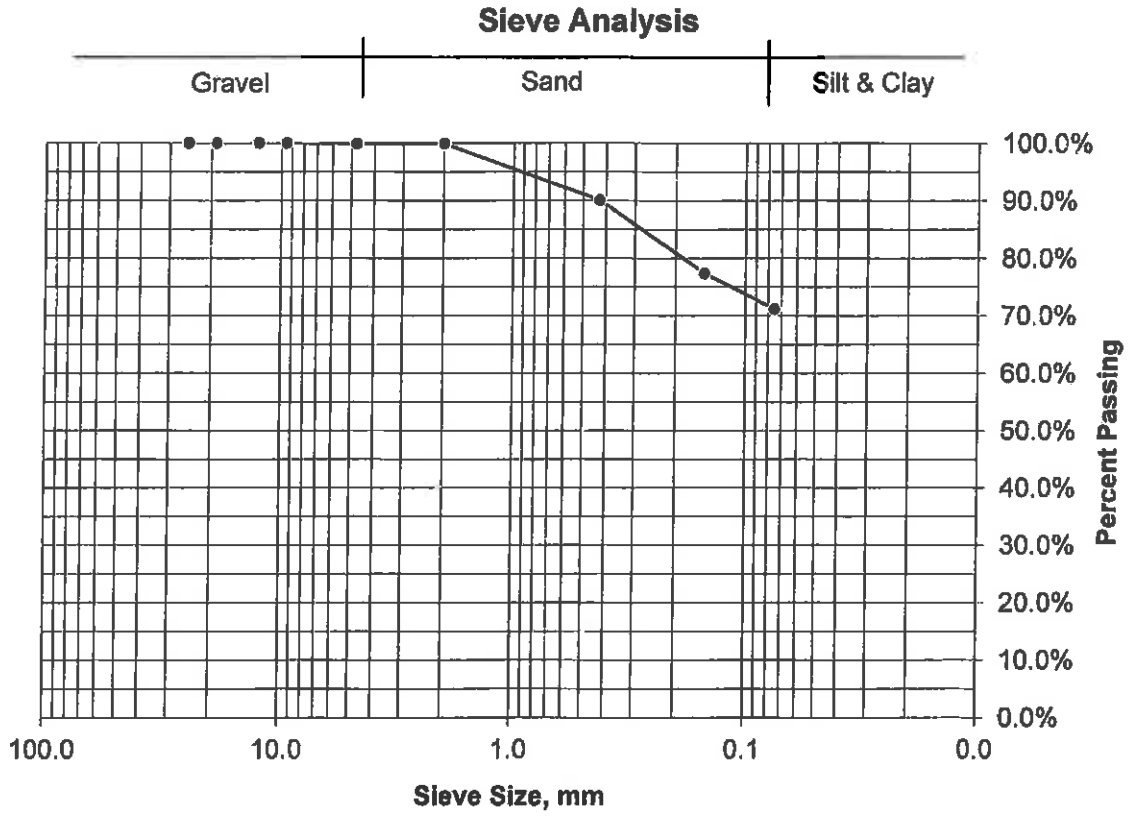
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-3
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.16	0.1%	4.75	99.9%
No. 10	0.00	0.0%	2.0	99.9%
No. 40	15.72	9.8%	0.425	90.1%
No. 100	20.42	12.7%	0.15	77.3%
No. 200	9.89	6.2%	0.075	71.2%
Pan	0.18	0.1%		
Total	46.37	28.8%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

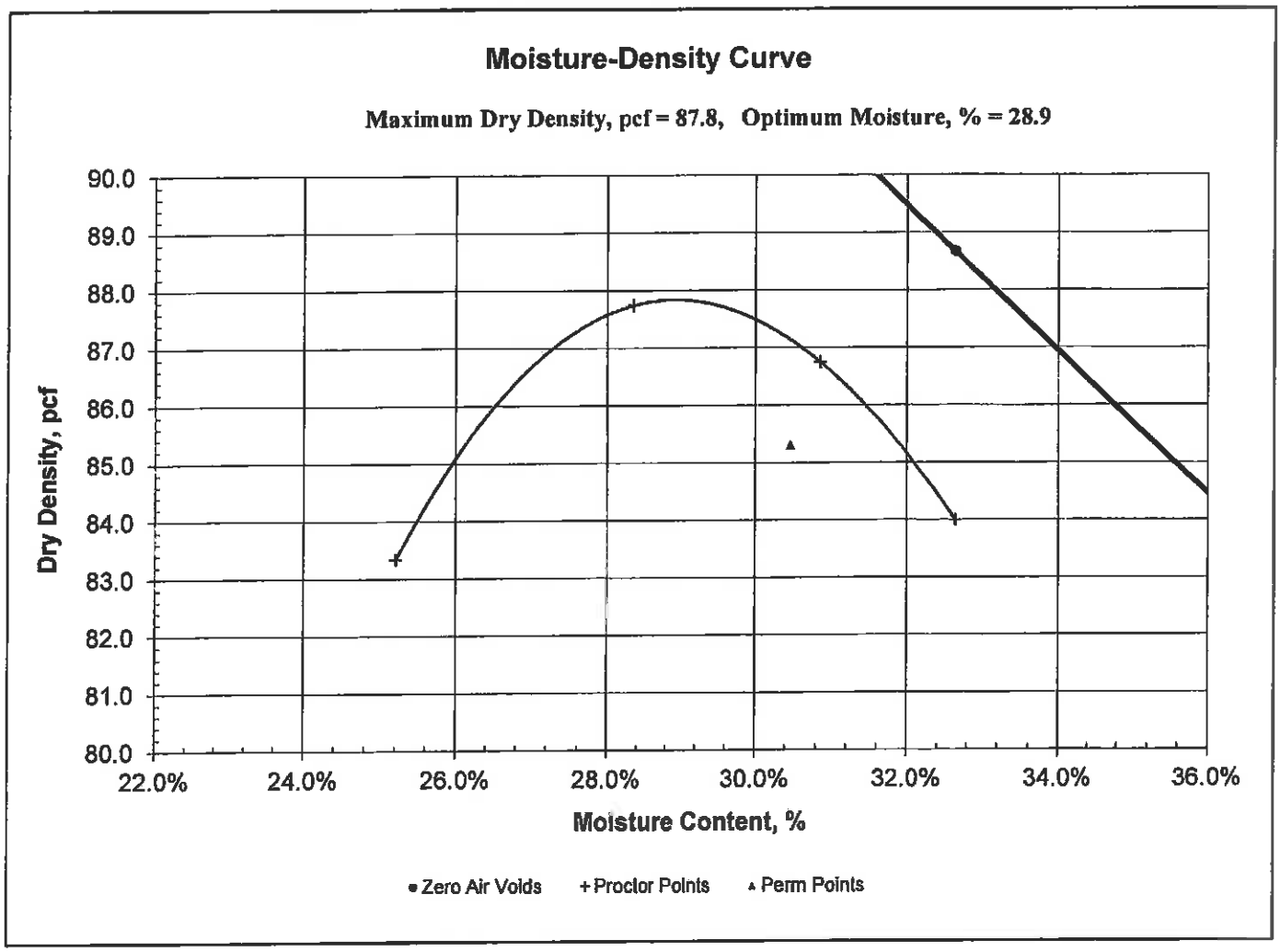
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Clay-3
Sample Depth	N/A
Sample Classification	Fat CLAY with Sand
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	25.2%	28.4%	30.9%	32.6%	
Dry Density, pcf	83.3	87.7	86.7	84.0	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Clay-3
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.45
Sample Diameter, in: 2.85
Sample Condition: Remolded

Moisture Content

Pan Wt	8.94	grams
Pan + Soil (wet)	204.01	grams
Pan + Soil (dry)	158.46	grams
Moisture Content	*30.5%*	

Dry Density

Soil (wet)	644.40	grams
Wet Density	111.3	pcf
Dry Density	*85.3*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712
Effective Stress, psi	10.0
Pearment Liquid Temp (°C):	20.7 De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	48.4%
Actual Volume of Voids	174.9 ml
Porosity	48.4%
Saturation	86.0%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
22-Sep 11:32	16.900		1.200				
22-Sep 11:33	15.900	0.031	1.241	0.031	1.00	22.49	5.8E-07
22-Sep 11:34	15.400	0.016	1.261	0.016	1.00	21.00	3.1E-07
22-Sep 11:35	15.000	0.013	1.278	0.013	1.00	20.25	2.5E-07
22-Sep 11:36	14.800	0.006	1.286	0.006	1.00	19.66	1.3E-07
22-Sep 11:37	14.650	0.005	1.292	0.005	1.00	19.36	9.9E-08
22-Sep 11:38	14.500	0.005	1.298	0.005	1.00	19.14	1.0E-07
22-Sep 11:39	14.400	0.003	1.302	0.003	1.00	18.91	6.7E-08
22-Sep 11:44	13.800	0.019	1.327	0.019	1.00	18.76	8.3E-08

Average Permeability 8.7E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	658.17 grams
Final Moisture Content	33.3%
Percent Voids	47.3%
Actual Volume of Voids	167.2 ml
Porosity	47.3%
Saturation	98.2%

Final Sample Length, in:	3.43
Final Sample Diameter, in:	2.83
Wet Density	116.2 pcf
Dry Density	*87.2* pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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Sample ID Clay-4
Sample Depth N/A
Visual Sample Description Red-Brown Fat CLAY with Sand

Natural Moisture Content: ASTM D 2216

Pan ID	23
Pan Wt	194.06 grams
Pan + Soil (wet)	386.33 grams
Pan + Soil (dry)	343.08 grams
Natural Moisture Content	*29.0%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	237.91 grams
Percent Passing No. 200 Sieve	70.6%
Pan + Soil retained on No. 4 sieve (dry)	194.29 grams
Percent Passing No. 4 Sieve	99.8%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	18	24	32
Pan ID	64	69	71
Pan Wt	10.91	10.94	10.93
Pan + Soil (wet)	19.88	23.58	22.80
Pan + Soil (dry)	16.10	18.38	18.00
Moisture Content	73%	70%	68%
Liquid Limit	70	70	70
Liquid Limit	*70*		

Plastic Limit

Pan ID	83	13
Pan Weight	4.22	4.31
Pan + Soil (wet)	15.03	14.60
Pan + Soil (dry)	12.44	12.12
Moisture Content	32%	32%
Plastic Limit	*32*	
Plastic Index	*38*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Fat CLAY with Sand**

Grain Size Distribution Calculations

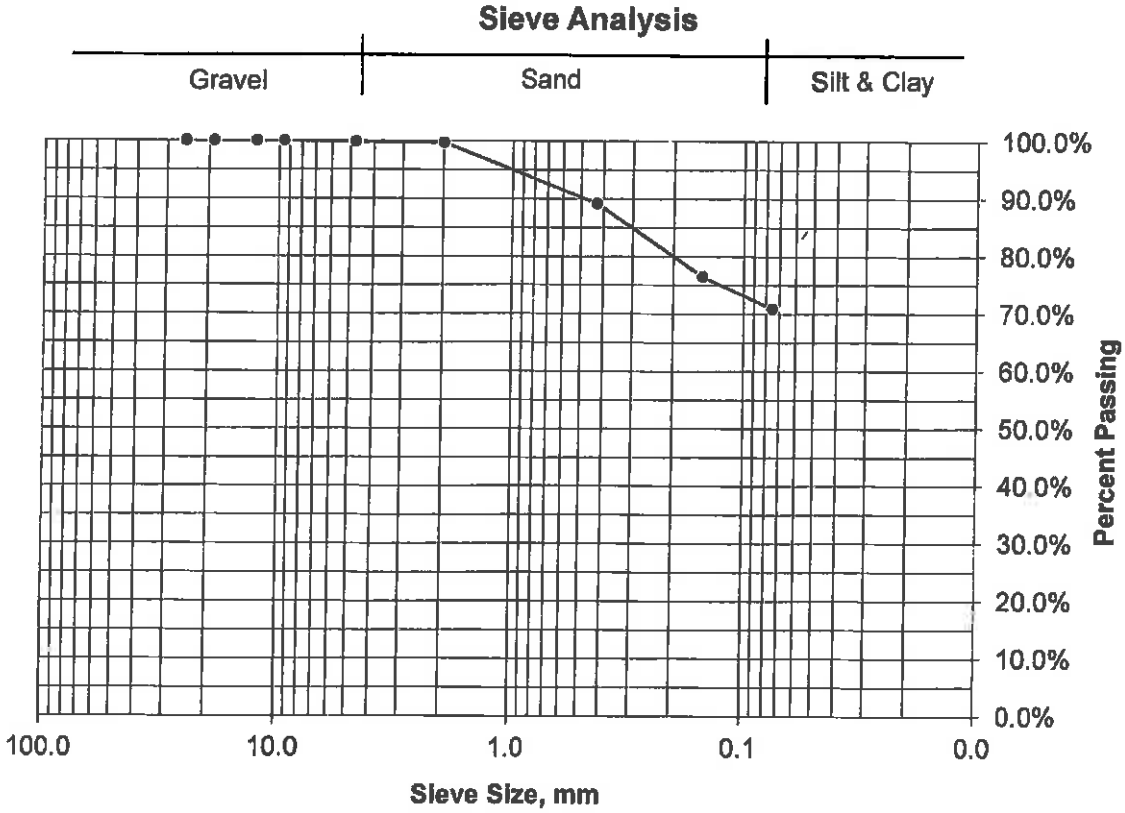
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-4
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.23	0.2%	4.75	99.8%
No. 10	0.21	0.1%	2.0	99.7%
No. 40	15.73	10.6%	0.425	89.1%
No. 100	18.85	12.6%	0.15	76.5%
No. 200	8.31	5.6%	0.075	70.9%
Pan	0.13	0.1%		
Total	43.46	29.1%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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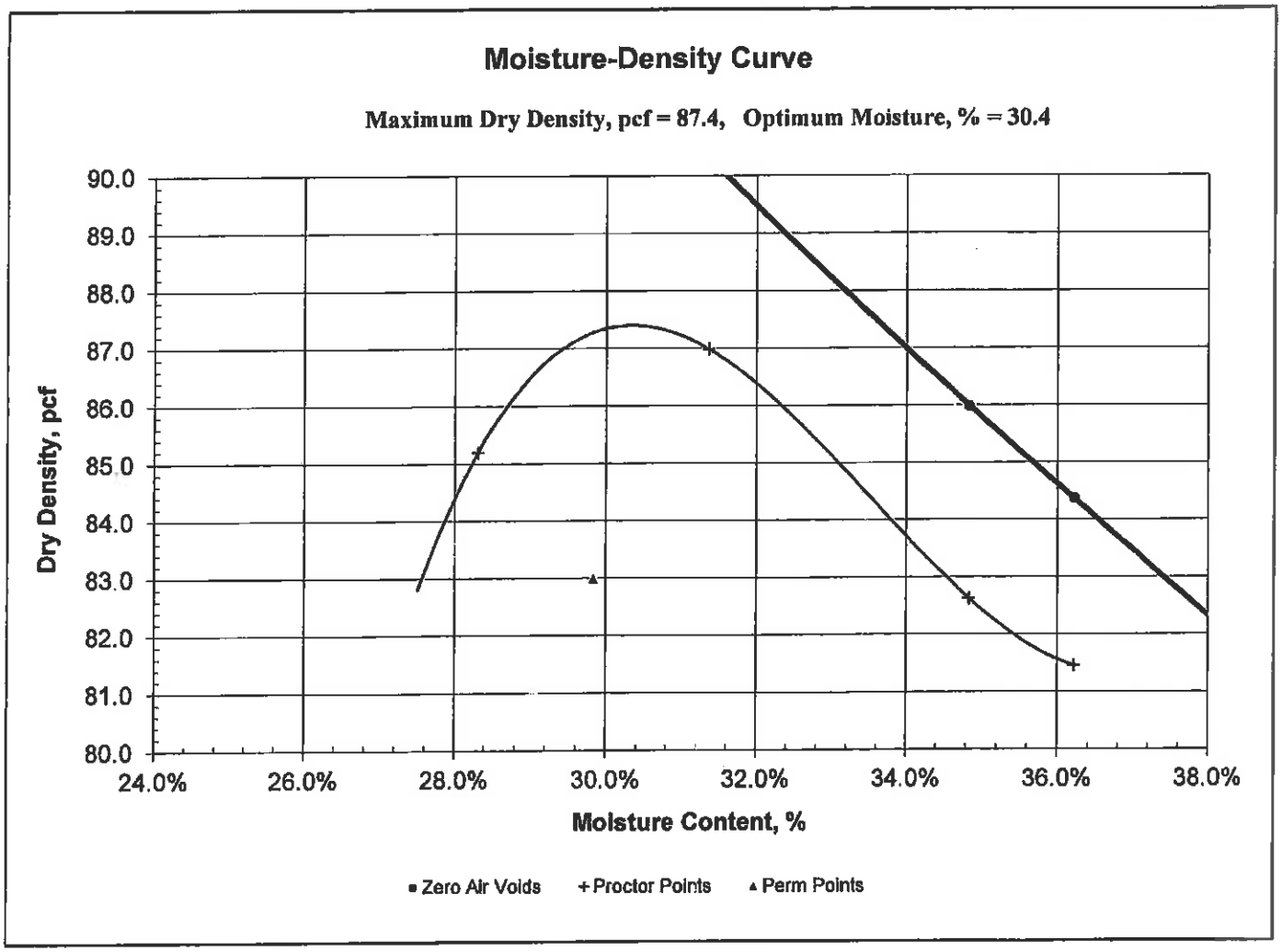
Soil and Test Method Data

Sample ID	Clay-4
Sample Depth	N/A
Sample Classification	Fat CLAY with Sand
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	28.3%	31.4%	34.8%	36.2%	
Dry Density, pcf	85.2	87.0	82.6	81.5	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Clay-4
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.50
Sample Diameter, in: 2.85
Sample Condition: Remolded

Moisture Content

Pan Wt	9.27	grams
Pan + Soil (wet)	187.59	grams
Pan + Soil (dry)	144.61	grams
Moisture Content	*31.8%*	

Dry Density

Soil (wet)	653.11	grams
Wet Density	111.2	pcf
Dry Density	*84.4*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712
Effective Stress, psi	10.0
Pearment Liquid Temp (°C):	20.4 De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	49.0%
Actual Volume of Voids	179.6 ml
Porosity	49.0%
Saturation	87.7%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
22-Sep 14:53	16.950		1.300				
22-Sep 14:54	14.300	0.083	1.409	0.083	1.00	22.09	1.7E-06
22-Sep 14:55	13.300	0.031	1.449	0.031	1.00	18.20	7.3E-07
22-Sep 14:56	12.900	0.013	1.466	0.013	1.00	16.73	3.1E-07
22-Sep 14:57	12.650	0.008	1.476	0.008	1.00	16.14	2.0E-07
22-Sep 14:58	12.500	0.005	1.482	0.005	1.00	15.77	1.2E-07
22-Sep 14:59	12.400	0.003	1.486	0.003	1.00	15.55	8.2E-08
22-Sep 15:00	12.300	0.003	1.490	0.003	1.00	15.41	8.3E-08
22-Sep 15:05	11.800	0.016	1.511	0.016	1.00	15.26	8.5E-08

Average Permeability 9.3E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	661.00 grams
Final Moisture Content	33.3%
Percent Voids	47.0%
Actual Volume of Voids	166.0 ml
Porosity	47.0%
Saturation	99.6%

Final Sample Length, in:	3.47
Final Sample Diameter, in:	2.81
Wet Density	116.8 pcf
Dry Density	*87.6* pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-5
Sample Depth N/A
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	42
Pan Wt	192.27 grams
Pan + Soil (wet)	388.73 grams
Pan + Soil (dry)	345.50 grams
Natural Moisture Content	*28.2%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	253.41 grams
Percent Passing No. 200 Sieve	60.1%
Pan + Soil retained on No. 4 sieve (dry)	192.27 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	18	28	33
Pan ID	108	109	98
Pan Wt	33.16	25.02	30.35
Pan + Soil (wet)	43.42	37.47	41.75
Pan + Soil (dry)	39.48	32.98	37.68
Moisture Content	62%	56%	56%
Liquid Limit	60	57	57
Liquid Limit	*59*		

Plastic Limit

Pan ID	316	356
Pan Weight	9.07	9.11
Pan + Soil (wet)	19.68	19.24
Pan + Soil (dry)	17.43	17.22
Moisture Content	27%	25%
Plastic Limit	*26*	
Plastic Index	*33*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

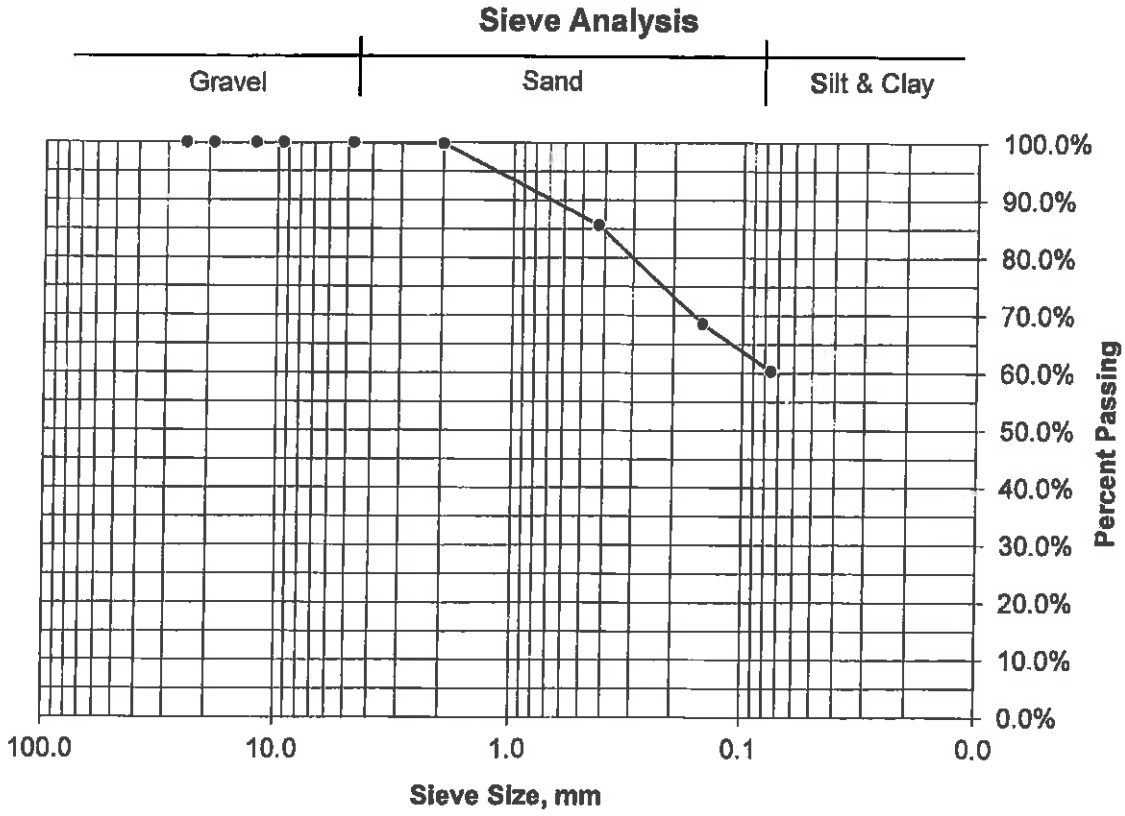
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-5
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.22	0.1%	2.0	99.9%
No. 40	21.73	14.2%	0.425	85.7%
No. 100	26.21	17.1%	0.15	68.6%
No. 200	12.63	8.2%	0.075	60.3%
Pan	0.36	0.2%		
Total	61.15	39.7%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
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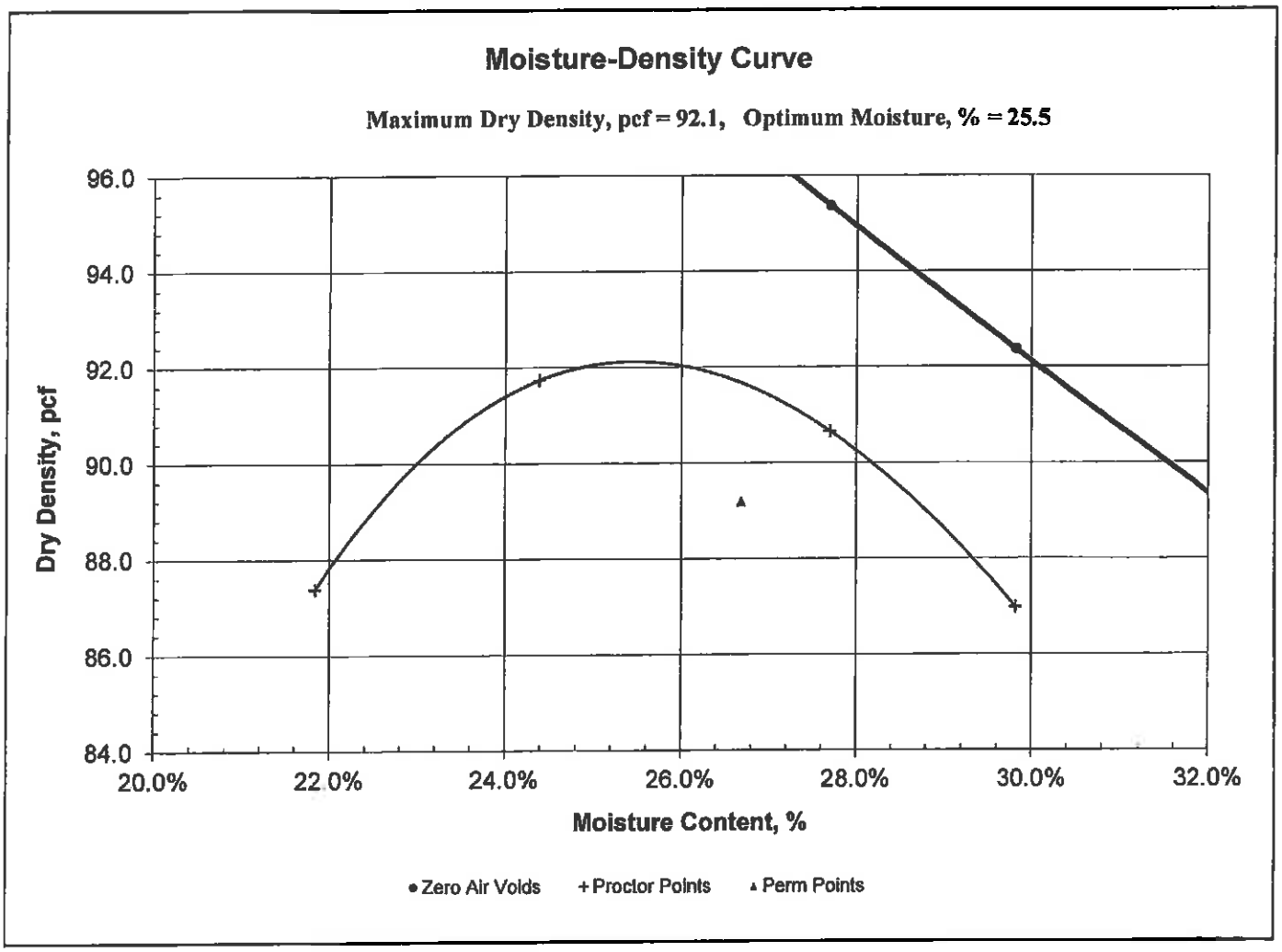
Soil and Test Method Data

Sample ID	Clay-5
Sample Depth	N/A
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	**21.8%**	**24.4%**	**27.7%**	**29.8%**	
Dry Density, pcf	**87.4**	**91.7**	**90.7**	**87.0**	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Clay-5
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.44
Sample Diameter, in: 2.86
Sample Condition: Remolded

Moisture Content

Pan Wt	6.53	grams
Pan + Soil (wet)	183.34	grams
Pan + Soil (dry)	145.10	grams
Moisture Content	*27.6%*	

Dry Density

Soil (wet)	657.01	grams
Wet Density	113.0	pcf
Dry Density	*88.6*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.7	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	46.4%
Actual Volume of Voids	168.5 ml
Porosity	46.4%
Saturation	84.3%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
22-Sep 12:02	16.950		1.100				
22-Sep 12:03	15.800	0.036	1.147	0.036	1.00	22.79	6.6E-07
22-Sep 12:04	15.050	0.024	1.178	0.024	1.00	21.06	4.6E-07
22-Sep 12:05	14.850	0.006	1.186	0.006	1.00	19.94	1.3E-07
22-Sep 12:06	14.700	0.005	1.192	0.005	1.00	19.64	9.7E-08
22-Sep 12:07	14.500	0.006	1.200	0.006	1.00	19.42	1.3E-07
22-Sep 12:08	14.350	0.005	1.206	0.005	1.00	19.12	9.9E-08
22-Sep 12:09	14.250	0.003	1.211	0.003	1.00	18.89	6.7E-08
22-Sep 12:14	13.600	0.020	1.237	0.020	1.00	18.75	9.0E-08

Average Permeability 9.7E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	674.08	grams
Final Moisture Content	30.9%	
Percent Voids	44.3%	
Actual Volume of Voids	154.3	ml
Porosity	44.3%	
Saturation	100.0%	

Final Sample Length, in:	3.37	
Final Sample Diameter, in:	2.84	
Wet Density	120.7	pcf
Dry Density	*92.2*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-6
Sample Depth N/A
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	8
Pan Wt	187.24 grams
Pan + Soil (wet)	390.06 grams
Pan + Soil (dry)	346.87 grams
Natural Moisture Content	*27.1%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	245.40 grams
Percent Passing No. 200 Sieve	63.6%
Pan + Soil retained on No. 4 sieve (dry)	187.24 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	20	24	33
Pan ID	64	63	69
Pan Wt	10.96	10.83	10.95
Pan + Soil (wet)	21.03	22.79	20.93
Pan + Soil (dry)	17.21	18.24	17.25
Moisture Content	61%	61%	58%
Liquid Limit	59	61	60
Liquid Limit	*60*		

Plastic Limit

Pan ID	14	78
Pan Weight	4.28	4.26
Pan + Soil (wet)	14.69	14.41
Pan + Soil (dry)	12.38	12.05
Moisture Content	29%	30%
Plastic Limit	*29*	
Plastic Index	*31*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

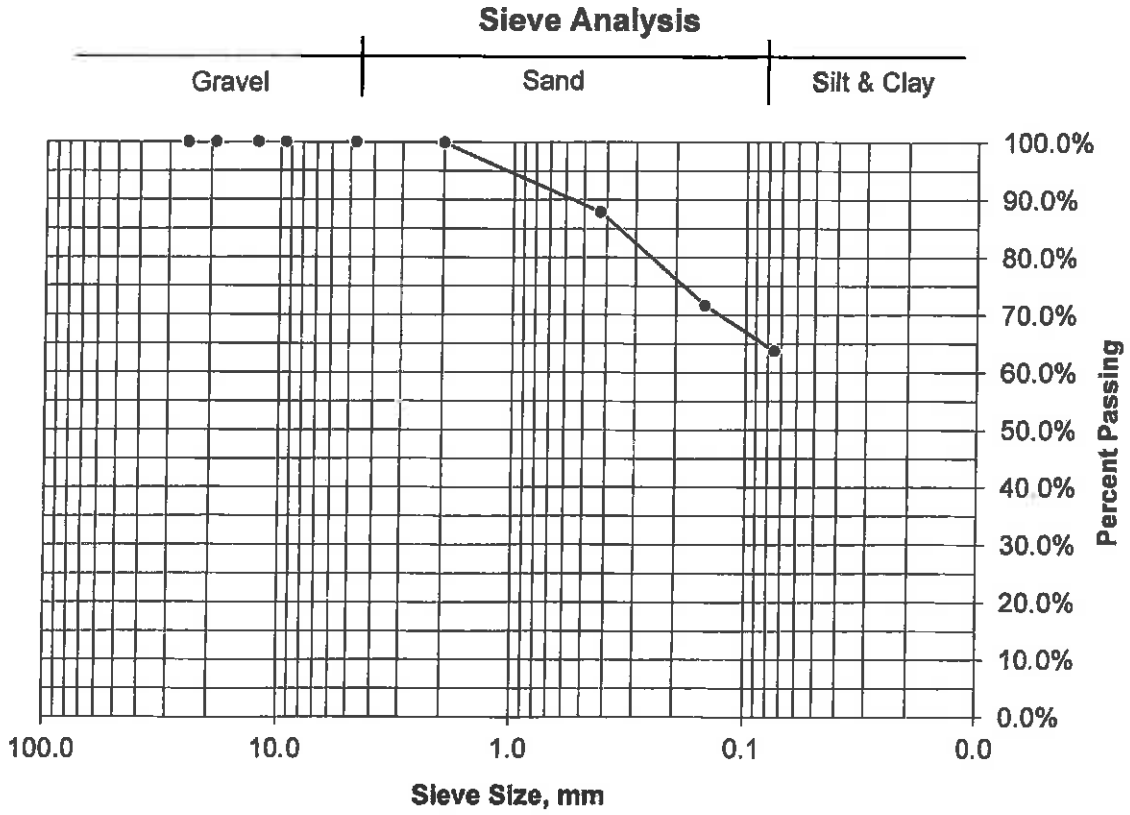
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-6
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.15	0.1%	2.0	99.9%
No. 40	19.23	12.0%	0.425	87.9%
No. 100	25.80	16.2%	0.15	71.7%
No. 200	12.70	8.0%	0.075	63.7%
Pan	0.25	0.2%		
Total	58.13	36.3%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
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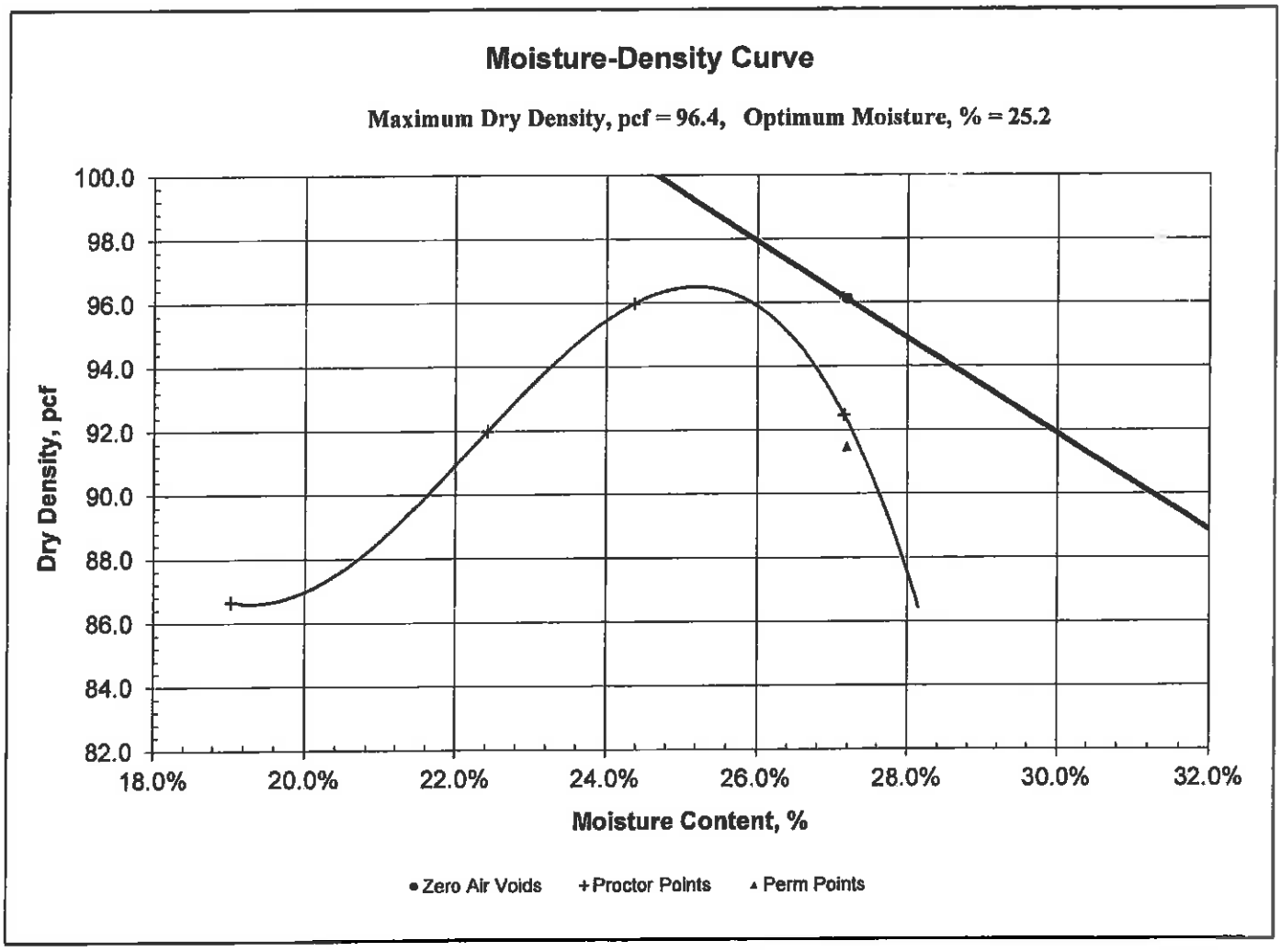
Soil and Test Method Data

Sample ID	Clay-6
Sample Depth	N/A
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	19.0%	22.4%	24.4%	27.2%	
Dry Density, pcf	86.7	92.0	96.0	92.5	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Clay-6
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.36
Sample Diameter, in: 2.86
Sample Condition: Remolded

Moisture Content

Pan Wt	9.34	grams
Pan + Soil (wet)	194.79	grams
Pan + Soil (dry)	155.15	grams
Moisture Content	*27.2%*	

Dry Density

Soil (wet)	658.35	grams
Wet Density	116.3	pcf
Dry Density	*91.5*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.6	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	44.7%
Actual Volume of Voids	157.8 ml
Porosity	44.7%
Saturation	89.2%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeability, k cm/sec
22-Sep 12:16	16.950		1.100				
22-Sep 12:17	16.450	0.016	1.120	0.016	1.00	23.28	2.8E-07
22-Sep 12:18	16.250	0.006	1.129	0.006	1.00	22.52	1.1E-07
22-Sep 12:19	16.100	0.005	1.135	0.005	1.00	22.21	8.6E-08
22-Sep 12:20	15.900	0.006	1.143	0.006	1.00	21.98	1.2E-07
22-Sep 12:21	15.700	0.006	1.151	0.006	1.00	21.67	1.2E-07
22-Sep 12:22	15.600	0.003	1.155	0.003	1.00	21.37	5.9E-08
22-Sep 12:23	15.500	0.003	1.159	0.003	1.00	21.22	6.0E-08
22-Sep 12:28	14.950	0.017	1.182	0.017	1.00	21.06	6.8E-08

Average Permeability 7.6E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65		
Final Weight of Sample	666.59 grams		
Final Moisture Content	28.8%	Final Sample Length, in:	3.33
Percent Voids	42.5%	Final Sample Diameter, in:	2.82
Actual Volume of Voids	144.6 ml	Wet Density	122.4 pcf
Porosity	42.5%	*Dry Density*	*95.0* pcf
Saturation	100.0%		

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-7
Sample Depth N/A
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	26
Pan Wt	194.63 grams
Pan + Soil (wet)	472.90 grams
Pan + Soil (dry)	425.80 grams
Natural Moisture Content	*20.4%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	294.61 grams
Percent Passing No. 200 Sieve	56.8%
Pan + Soil retained on No. 4 sieve (dry)	194.63 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	18	25	35
Pan ID	9	7	65
Pan Wt	11.10	11.12	10.96
Pan + Soil (wet)	19.66	21.14	22.80
Pan + Soil (dry)	16.65	17.70	19.00
Moisture Content	54%	52%	47%
Liquid Limit	52	52	49
Liquid Limit	*52*		

Plastic Limit

Pan ID	76	83
Pan Weight	4.23	4.23
Pan + Soil (wet)	18.17	17.51
Pan + Soil (dry)	15.46	14.87
Moisture Content	24%	25%
Plastic Limit	*24*	
Plastic Index	*28*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

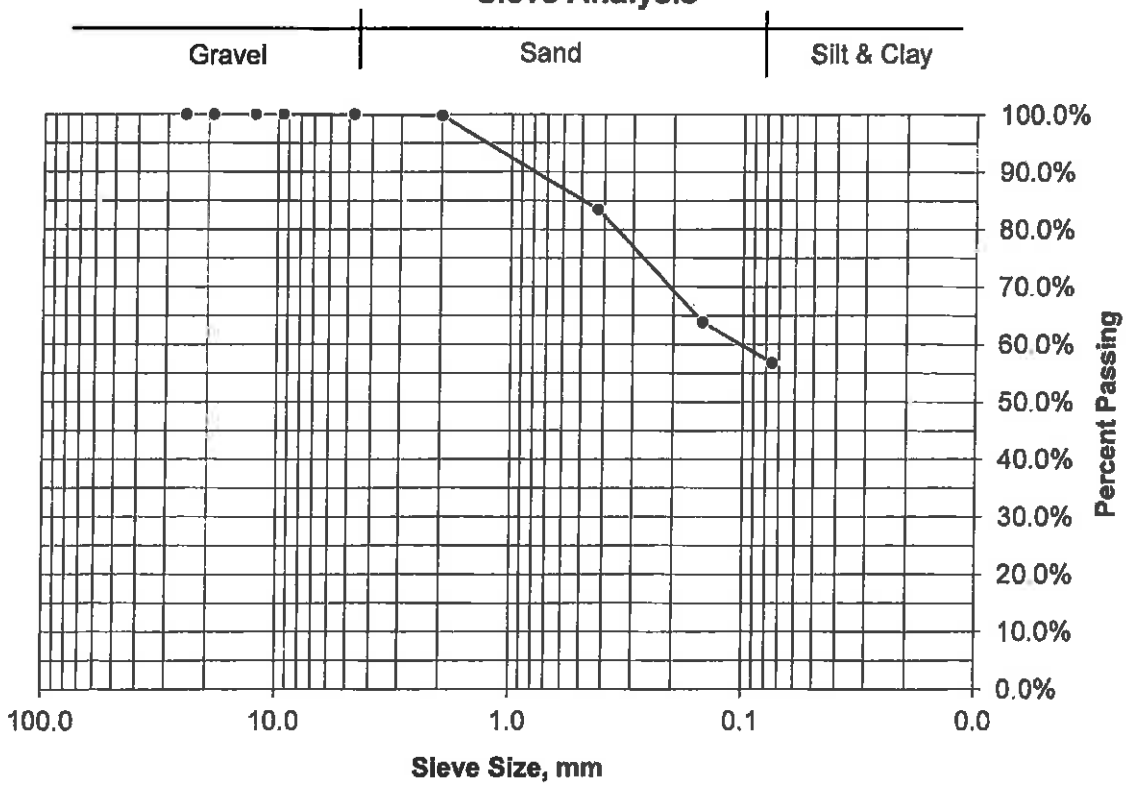
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-7
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.48	0.2%	2.0	99.8%
No. 40	37.73	16.3%	0.425	83.5%
No. 100	45.31	19.6%	0.15	63.9%
No. 200	16.38	7.1%	0.075	56.8%
Pan	0.15	0.1%		
Total	100.05	43.2%		

Sieve Analysis



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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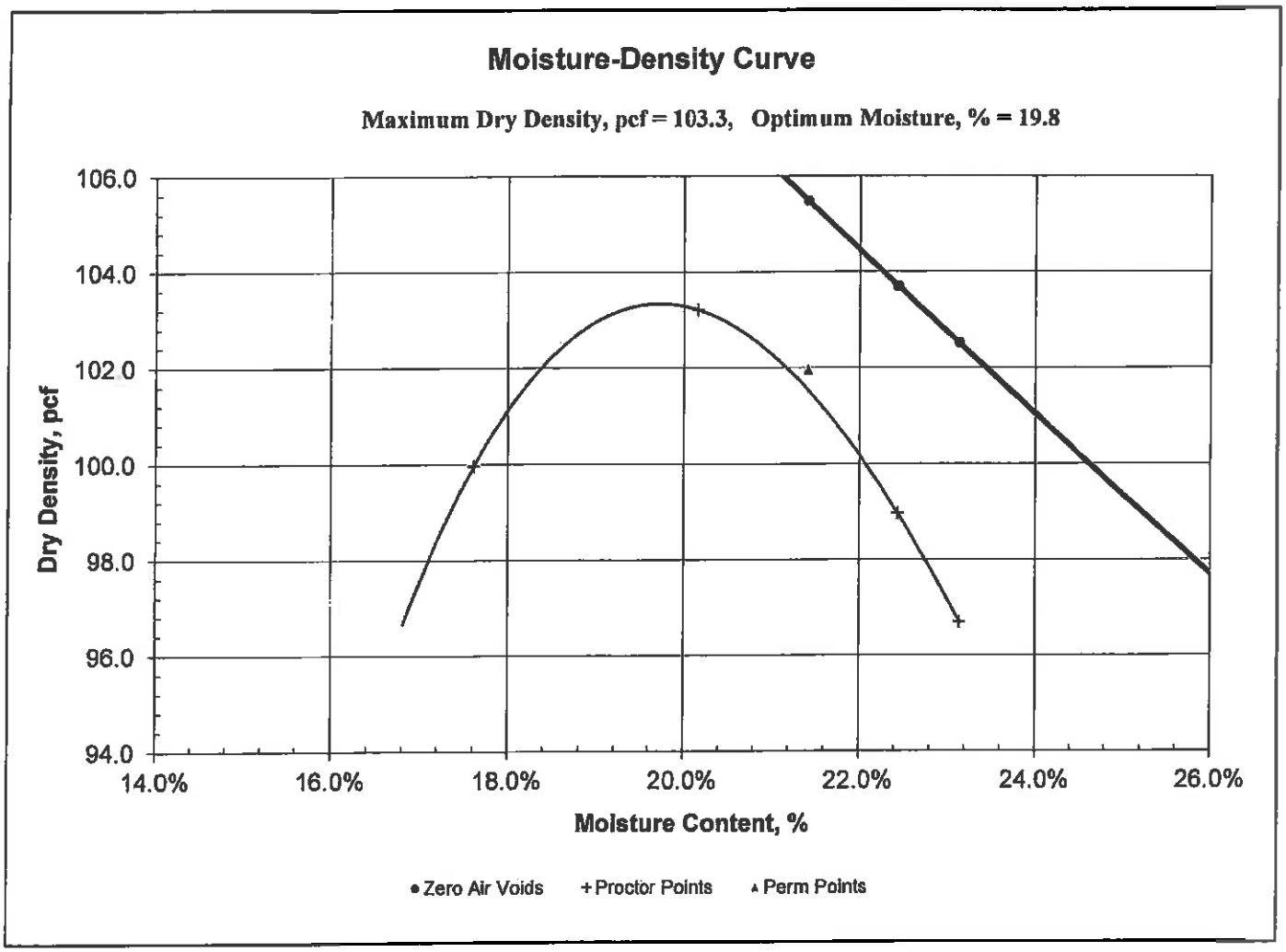
Soil and Test Method Data

Sample ID	Clay-7
Sample Depth	N/A
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	17.6%	20.2%	22.4%	23.1%	
Dry Density, pcf	100.0	103.2	99.0	96.7	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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Sample ID: Clay-7
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.16
Sample Diameter, in: 2.83
Sample Condition: Remolded

Moisture Content

Pan Wt	8.98	grams
Pan + Soil (wet)	139.31	grams
Pan + Soil (dry)	116.32	grams
Moisture Content	*21.4%*	

Dry Density

Soil (wet)	645.90	grams
Wet Density	123.8	pcf
Dry Density	*102.0*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp (°C):	20.4	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	38.3%	
Actual Volume of Voids	124.8	ml
Porosity	38.3%	
Saturation	91.3%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
8-Sep 4:50	16.300		1.400				
8-Sep 4:51	15.900	0.013	1.416	0.013	1.00	23.28	2.3E-07
8-Sep 4:52	15.650	0.008	1.427	0.008	1.00	22.62	1.4E-07
8-Sep 4:53	15.400	0.008	1.437	0.008	1.00	22.22	1.5E-07
8-Sep 4:54	15.200	0.006	1.445	0.006	1.00	21.81	1.2E-07
8-Sep 4:55	15.100	0.003	1.449	0.003	1.00	21.49	6.0E-08
8-Sep 4:56	15.000	0.003	1.453	0.003	1.00	21.32	6.1E-08
8-Sep 4:57	14.900	0.003	1.457	0.003	1.00	21.16	6.1E-08
8-Sep 5:02	14.600	0.009	1.470	0.009	1.00	21.00	3.7E-08

Average Permeability 5.5E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65			
Final Weight of Sample	647.60	grams		
Final Moisture Content	21.7%		Final Sample Length, in:	3.16
Percent Voids	38.5%		Final Sample Diameter, in:	2.84
Actual Volume of Voids	125.9	ml	Wet Density	123.7 pcf
Porosity	38.5%		*Dry Density*	*101.6* pcf
Saturation	91.9%			

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-8
Sample Depth N/A
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	36
Pan Wt	193.83 grams
Pan + Soil (wet)	389.38 grams
Pan + Soil (dry)	349.47 grams
Natural Moisture Content	*25.6%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	245.90 grams
Percent Passing No. 200 Sieve	66.5%
Pan + Soil retained on No. 4 sieve (dry)	193.83 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	19	29	30
Pan ID	102	103	201
Pan Wt	23.97	27.40	27.66
Pan + Soil (wet)	35.57	39.51	41.03
Pan + Soil (dry)	31.43	35.33	36.53
Moisture Content	55%	53%	51%
Liquid Limit	54	54	52
Liquid Limit	*53*		

Plastic Limit

Pan ID	4	314
Pan Weight	9.05	9.16
Pan + Soil (wet)	19.24	19.56
Pan + Soil (dry)	17.45	17.68
Moisture Content	21%	22%
Plastic Limit	*22*	
Plastic Index	*31*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

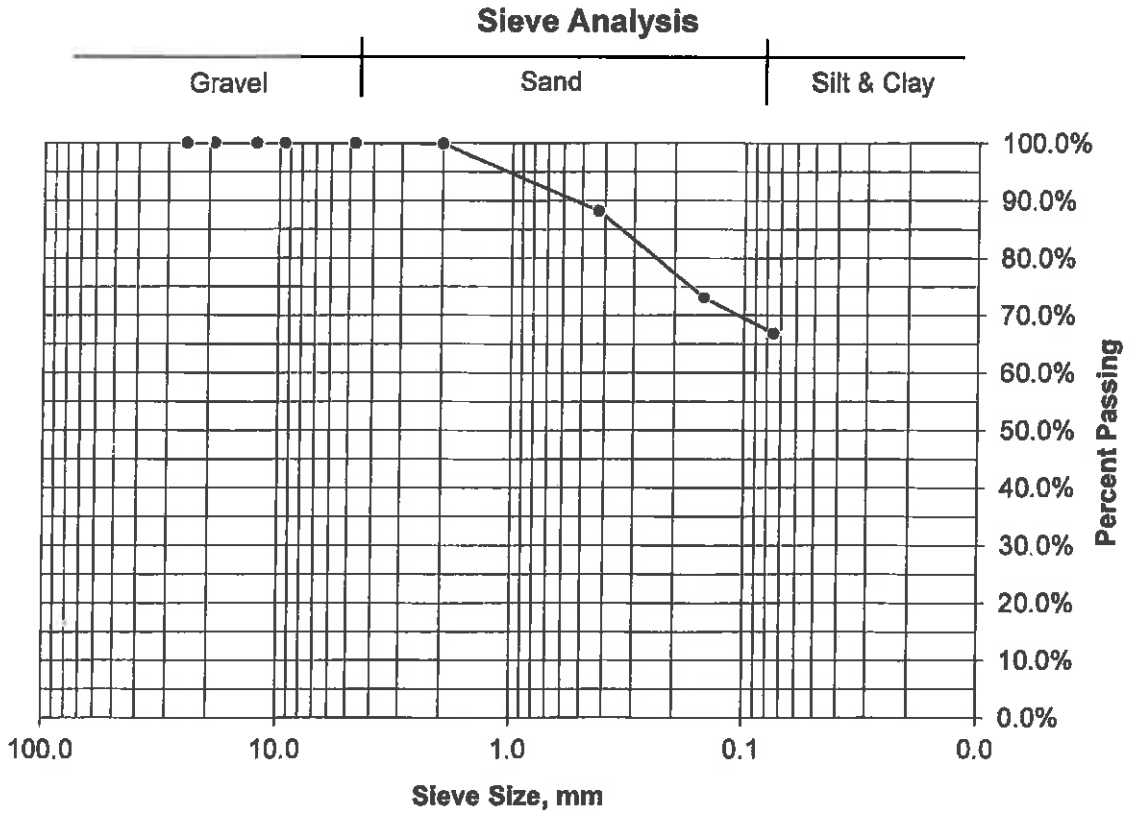
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-8
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.16	0.1%	2.0	99.9%
No. 40	18.18	11.7%	0.425	88.2%
No. 100	23.50	15.1%	0.15	73.1%
No. 200	9.70	6.2%	0.075	66.9%
Pan	0.00	0.0%		
Total	51.54	33.1%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

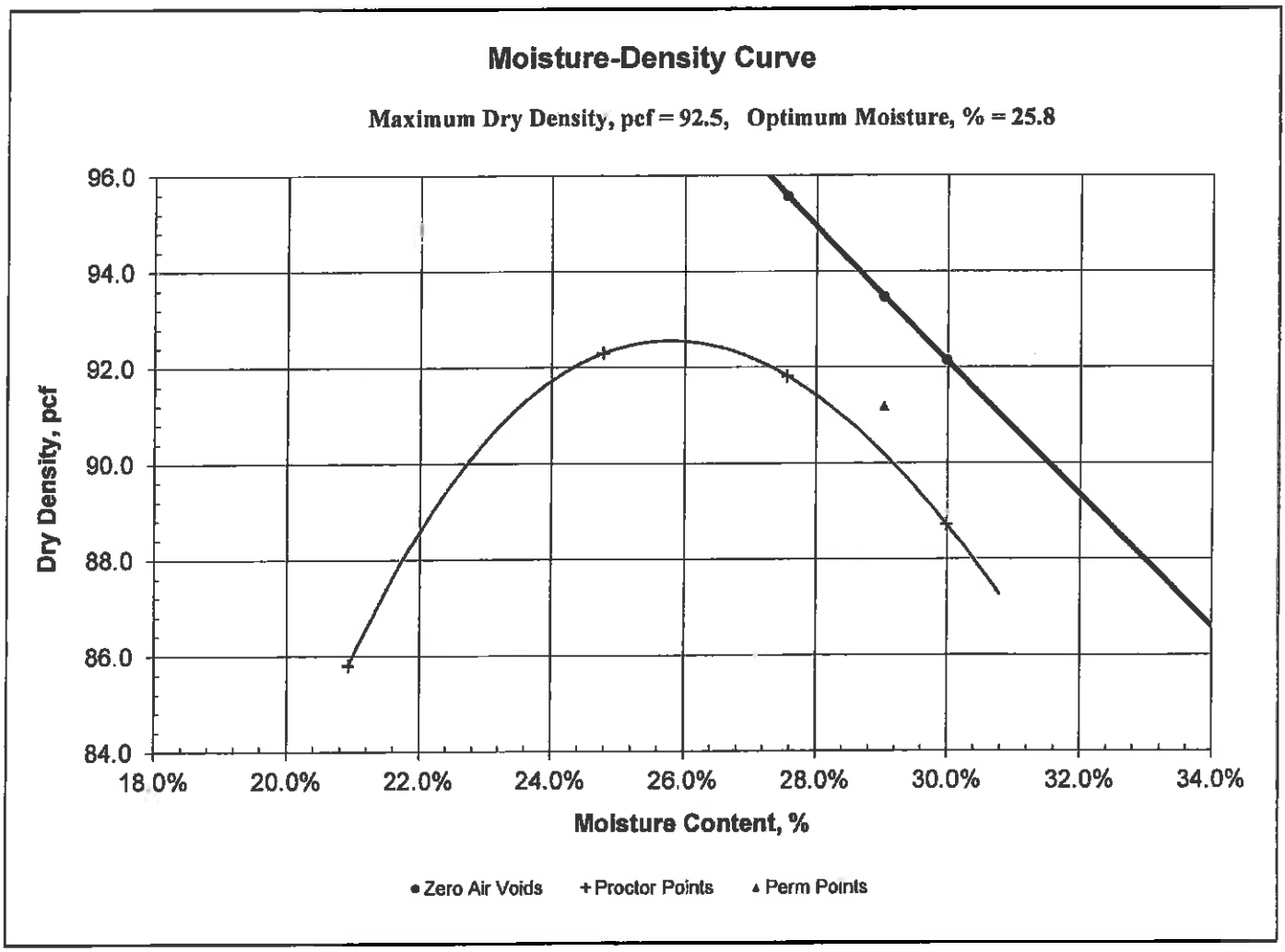
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Clay-8
Sample Depth	N/A
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	**20.9%**	**24.8%**	**27.6%**	**30.0%**	
Dry Density, pcf	**85.8**	**92.3**	**91.8**	**88.7**	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
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Sample ID: Clay-8
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.19
Sample Diameter, in: 2.84
Sample Condition: Remolded

Moisture Content

Pan Wt	9.61	grams
Pan + Soil (wet)	140.74	grams
Pan + Soil (dry)	111.24	grams
Moisture Content	*29.0%*	

Dry Density

Soil (wet)	624.20	grams
Wet Density	117.7	pcf
Dry Density	*91.2*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712
Effective Stress, psi	10.0
Pearment Liquid Temp (°C):	20.0 De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	44.8%
Actual Volume of Voids	148.5 ml
Porosity	44.9%
Saturation	94.6%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
8-Sep 5:04	16.200		1.400				
8-Sep 5:05	16.000	0.006	1.408	0.006	1.00	22.95	1.1E-07
8-Sep 5:06	15.850	0.005	1.414	0.005	1.00	22.62	8.5E-08
8-Sep 5:07	15.750	0.003	1.418	0.003	1.00	22.38	5.7E-08
8-Sep 5:08	15.650	0.003	1.423	0.003	1.00	22.22	5.8E-08
8-Sep 5:09	15.550	0.003	1.427	0.003	1.00	22.06	5.8E-08
8-Sep 5:10	15.500	0.002	1.429	0.002	1.00	21.90	2.9E-08
8-Sep 5:11	15.450	0.002	1.431	0.002	1.00	21.82	2.9E-08
8-Sep 5:16	15.300	0.005	1.437	0.005	1.00	21.73	1.8E-08

Average Permeability 3.4E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	626.00 grams
Final Moisture Content	29.4%
Percent Voids	44.5%
Actual Volume of Voids	146.4 ml
Porosity	44.5%
Saturation	97.2%

Final Sample Length, in:	3.18
Final Sample Diameter, in:	2.84
Wet Density	118.8 pcf
Dry Density	*91.8* pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-9
Sample Depth N/A
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	6
Pan Wt	195.45 grams
Pan + Soil (wet)	462.20 grams
Pan + Soil (dry)	404.00 grams
Natural Moisture Content	*27.9%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	261.27 grams
Percent Passing No. 200 Sieve	68.4%
Pan + Soil retained on No. 4 sieve (dry)	195.90 grams
Percent Passing No. 4 Sieve	99.8%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	15	28	34
Pan ID	98	108	109
Pan Wt	30.33	33.14	25.00
Pan + Soil (wet)	44.96	49.27	39.23
Pan + Soil (dry)	39.36	43.67	34.21
Moisture Content	62%	53%	55%
Liquid Limit	58	54	57
Liquid Limit	*57*		

Plastic Limit

Pan ID	314	356
Pan Weight	9.13	9.10
Pan + Soil (wet)	19.34	19.23
Pan + Soil (dry)	17.23	17.10
Moisture Content	26%	27%
Plastic Limit	*26*	
Plastic Index	*31*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

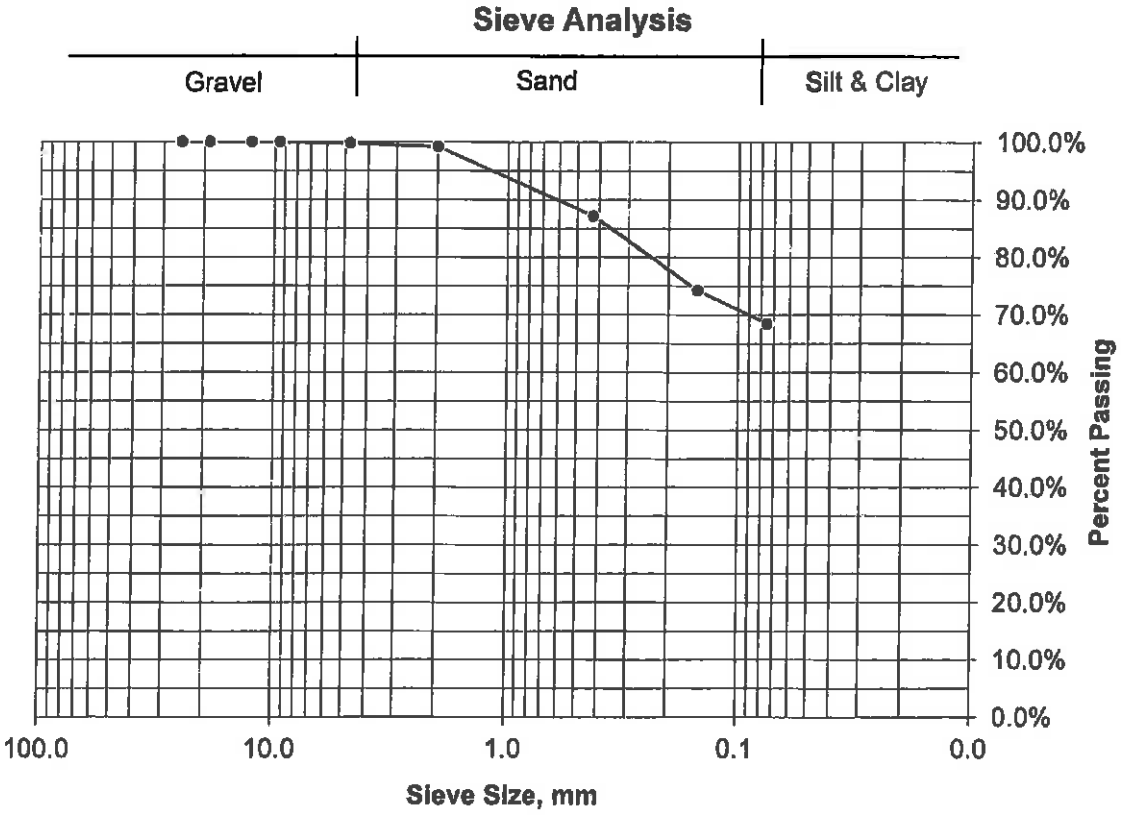
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-9
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.45	0.2%	4.75	99.8%
No. 10	1.27	0.6%	2.0	99.2%
No. 40	25.05	12.0%	0.425	87.2%
No. 100	26.93	12.9%	0.15	74.3%
No. 200	12.01	5.8%	0.075	68.5%
Pan	0.10	0.0%		
Total	65.81	31.5%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

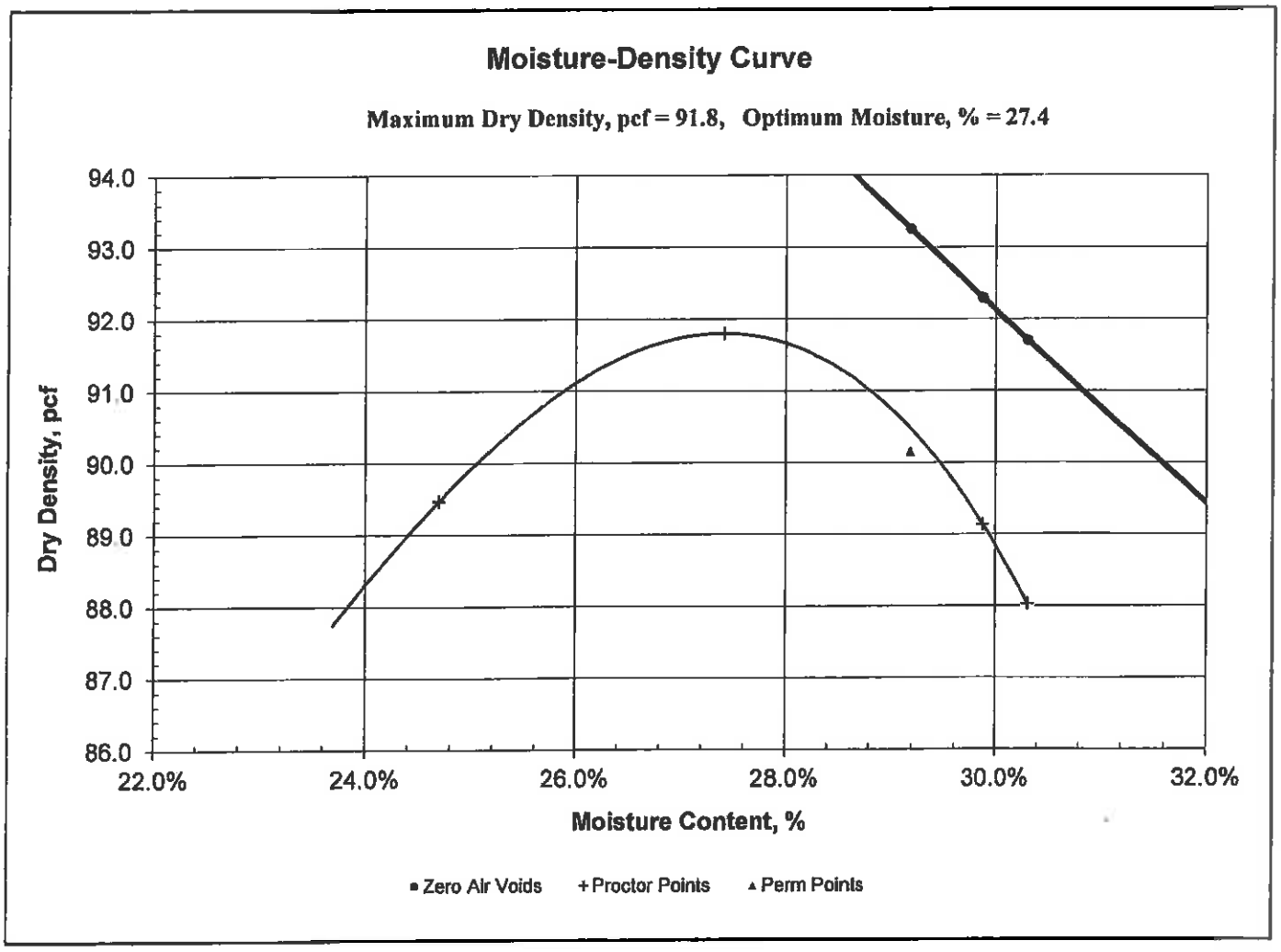
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Clay-9
Sample Depth	N/A
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	24.7%	27.4%	29.9%	30.3%	
Dry Density, pcf	89.5	91.8	89.1	88.0	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Clay-9
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.13
Sample Diameter, in: 2.84
Sample Condition: Remolded

Moisture Content

Pan Wt	9.31	grams
Pan + Soil (wet)	141.67	grams
Pan + Soil (dry)	111.77	grams
Moisture Content	*29.2%*	

Dry Density

Soil (wet)	606.70	grams
Wet Density	116.5	pcf
Dry Density	*90.2*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.1	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	45.5%
Actual Volume of Voids	147.8 ml
Porosity	45.5%
Saturation	92.7%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
8-Sep 5:45	15.800		1.400				
8-Sep 5:46	15.550	0.008	1.410	0.008	1.00	22.70	1.4E-07
8-Sep 5:47	15.400	0.005	1.416	0.005	1.00	22.29	8.7E-08
8-Sep 5:48	15.300	0.003	1.420	0.003	1.00	22.05	5.8E-08
8-Sep 5:49	15.200	0.003	1.425	0.003	1.00	21.88	5.9E-08
8-Sep 5:50	15.100	0.003	1.429	0.003	1.00	21.72	5.9E-08
8-Sep 5:51	15.050	0.002	1.431	0.002	1.00	21.55	3.0E-08
8-Sep 5:52	15.000	0.002	1.433	0.002	1.00	21.47	3.0E-08
8-Sep 5:57	14.650	0.011	1.447	0.011	1.00	21.39	4.3E-08

Average Permeability 4.0E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65		
Final Weight of Sample	613.60 grams		
Final Moisture Content	30.7%	Final Sample Length, in:	3.14
Percent Voids	45.6%	Final Sample Diameter, in:	2.84
Actual Volume of Voids	148.7 ml	Wet Density	117.5 pcf
Porosity	45.6%	*Dry Density*	*89.9* pcf
Saturation	96.8%		

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-10
Sample Depth N/A
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	32
Pan Wt	191.80 grams
Pan + Soil (wet)	469.50 grams
Pan + Soil (dry)	416.00 grams
Natural Moisture Content	*23.9%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	276.00 grams
Percent Passing No. 200 Sieve	62.4%
Pan + Soil retained on No. 4 sieve (dry)	191.80 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	19	29	34
Pan ID	103	101	105
Pan Wt	27.54	24.01	29.26
Pan + Soil (wet)	41.41	42.25	41.79
Pan + Soil (dry)	36.59	36.27	37.64
Moisture Content	53%	49%	50%
Liquid Limit	52	50	51
Liquid Limit	*51*		

Plastic Limit

Pan ID	315	316
Pan Weight	9.14	9.07
Pan + Soil (wet)	19.52	20.97
Pan + Soil (dry)	17.57	18.57
Moisture Content	23%	25%
Plastic Limit	*24*	
Plastic Index	*27*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

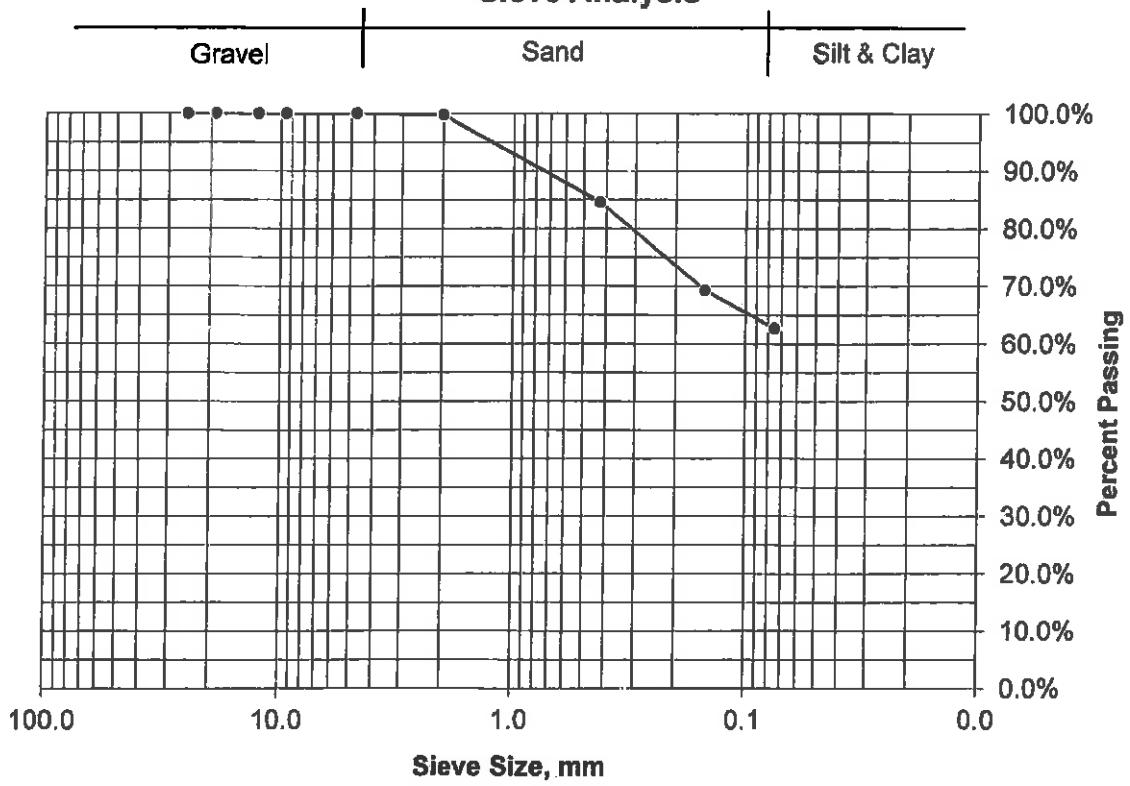
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Clay-10
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.60	0.3%	2.0	99.7%
No. 40	34.05	15.2%	0.425	84.5%
No. 100	34.16	15.2%	0.15	69.3%
No. 200	14.80	6.6%	0.075	62.7%
Pan	0.56	0.2%		
Total	84.17	37.3%		

Sieve Analysis



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

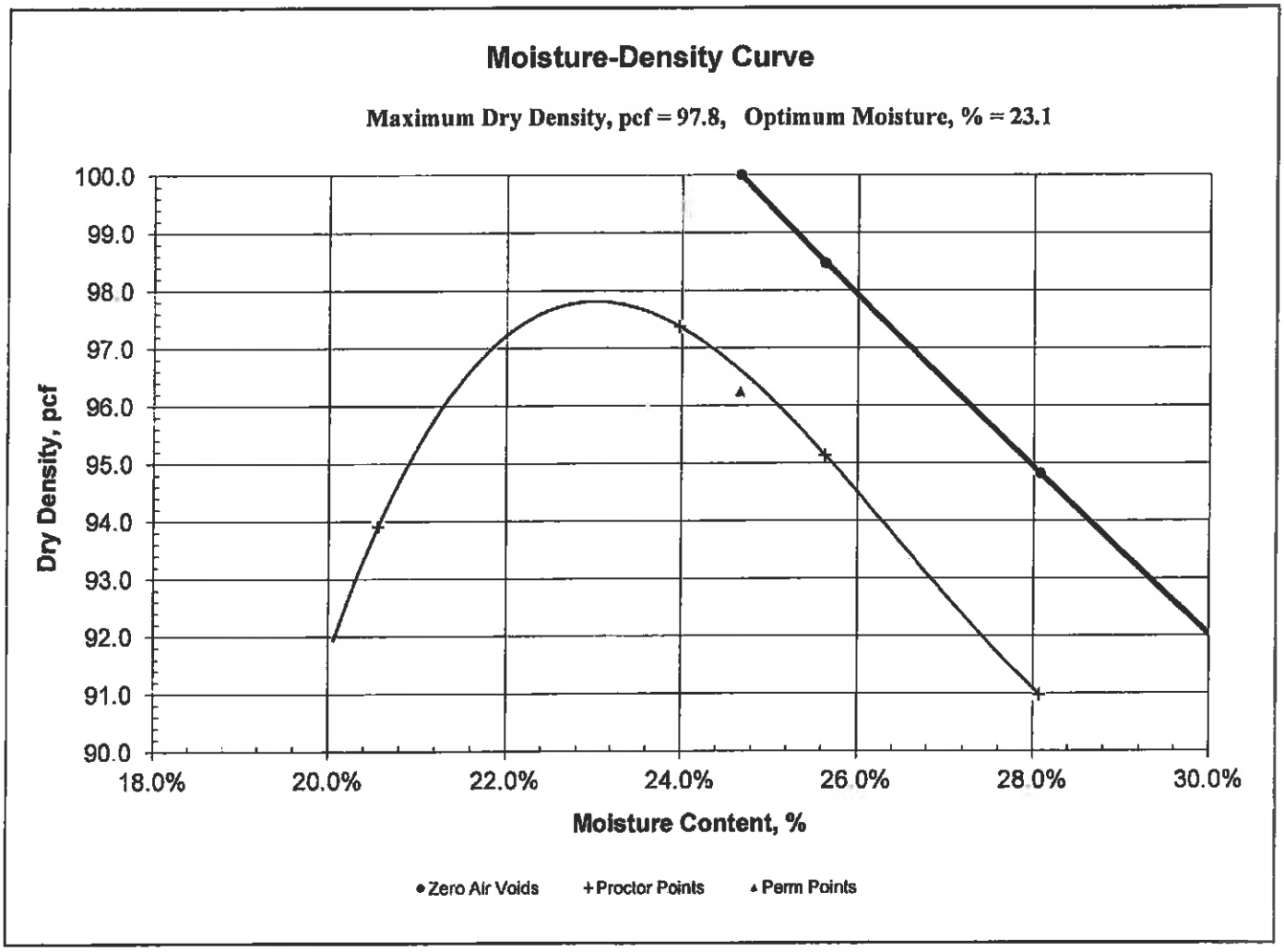
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Clay-10
Sample Depth	N/A
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	20.6%	24.0%	25.6%	28.1%	
Dry Density, pcf	93.9	97.4	95.1	91.0	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Clay-10
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 2.92
Sample Diameter, in: 2.84
Sample Condition: Remolded

Moisture Content

Pan Wt	9.11	grams
Pan + Soil (wet)	145.58	grams
Pan + Soil (dry)	118.58	grams
Moisture Content	*24.7%*	

Dry Density

Soil (wet)	583.60	grams
Wet Density	120.0	pcf
Dry Density	*96.3*	pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712
Effective Stress, psi	10.0
Pearment Liquid Temp.(°C):	20.5 De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	41.8%
Actual Volume of Voids	126.8 ml
Porosity	41.8%
Saturation	91.0%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
8-Sep 6:00	16.500		1.400				
8-Sep 6:01	16.200	0.009	1.412	0.009	1.00	25.52	1.5E-07
8-Sep 6:02	16.000	0.006	1.420	0.006	1.00	24.99	1.0E-07
8-Sep 6:03	15.850	0.005	1.427	0.005	1.00	24.64	7.8E-08
8-Sep 6:04	15.700	0.005	1.433	0.005	1.00	24.37	7.9E-08
8-Sep 6:05	15.550	0.005	1.439	0.005	1.00	24.11	8.0E-08
8-Sep 6:06	15.450	0.003	1.443	0.003	1.00	23.84	5.4E-08
8-Sep 6:07	15.350	0.003	1.447	0.003	1.00	23.67	5.4E-08
8-Sep 6:12	15.000	0.011	1.461	0.011	1.00	23.49	3.9E-08

Average Permeability 5.7E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65		
Final Weight of Sample	599.90 grams		
Final Moisture Content	28.1%	Final Sample Length, in:	2.92
Percent Voids	41.4%	Final Sample Diameter, in:	2.83
Actual Volume of Voids	124.9 ml	Wet Density	124.1 pcf
Porosity	41.4%	*Dry Density*	*96.9* pcf
Saturation	100.0%		

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Kettle Creek Farm 1A
Sample Depth N/A
Visual Sample Description Red-brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	38
Pan Wt	193.84 grams
Pan + Soil (wet)	414.70 grams
Pan + Soil (dry)	359.64 grams
Natural Moisture Content	*33.2%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	248.91 grams
Percent Passing No. 200 Sieve	66.8%
Pan + Soil retained on No. 4 sieve (dry)	193.84 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	16	29	35
Pan ID	91	104	107
Pan Wt	24.61	26.25	25.11
Pan + Soil (wet)	34.85	38.09	37.89
Pan + Soil (dry)	30.70	33.59	33.20
Moisture Content	68%	61%	58%
Liquid Limit	65	62	60
Liquid Limit	*63*		

Plastic Limit

Pan ID	315	317
Pan Weight	9.13	8.03
Pan + Soil (wet)	19.73	20.19
Pan + Soil (dry)	17.64	17.79
Moisture Content	25%	25%
Plastic Limit	*25*	
Plastic Index	*39*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

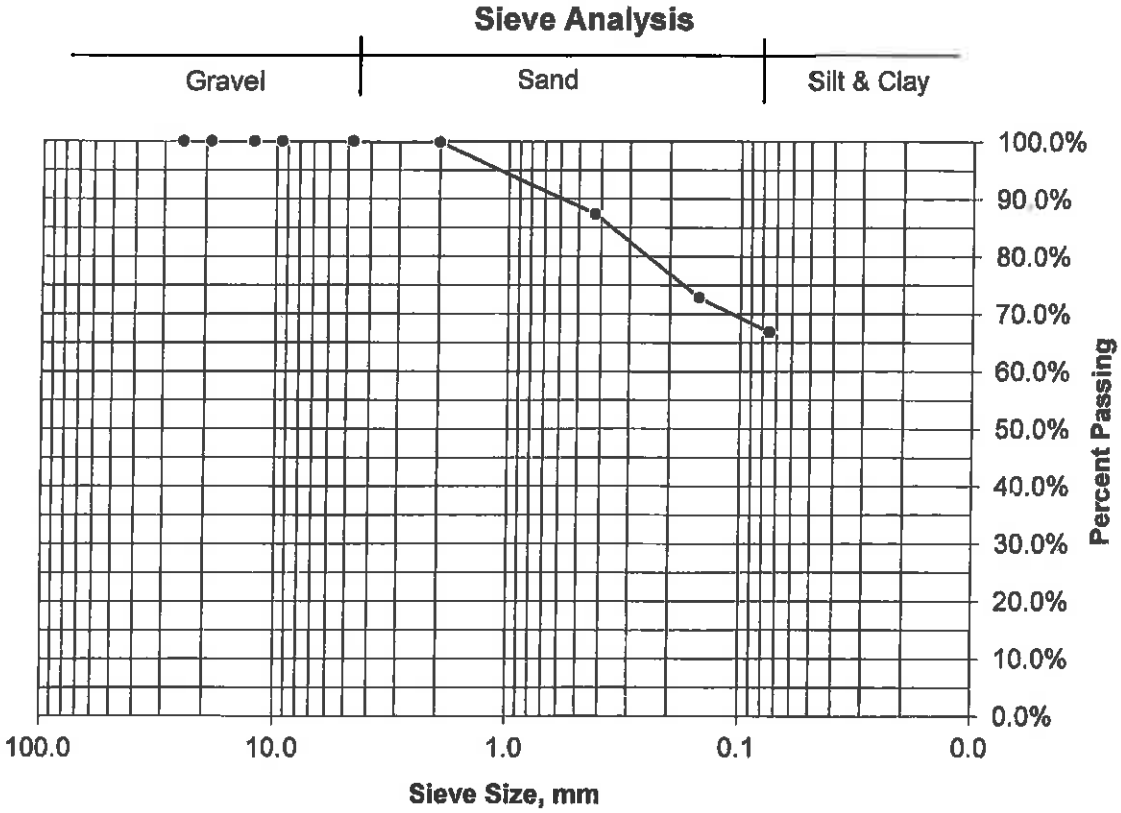
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Kettle Creek Farm 1A
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.27	0.2%	2.0	99.8%
No. 40	20.65	12.5%	0.425	87.4%
No. 100	24.15	14.6%	0.15	72.8%
No. 200	9.91	6.0%	0.075	66.8%
Pan	0.37	0.2%		
Total	55.35	33.2%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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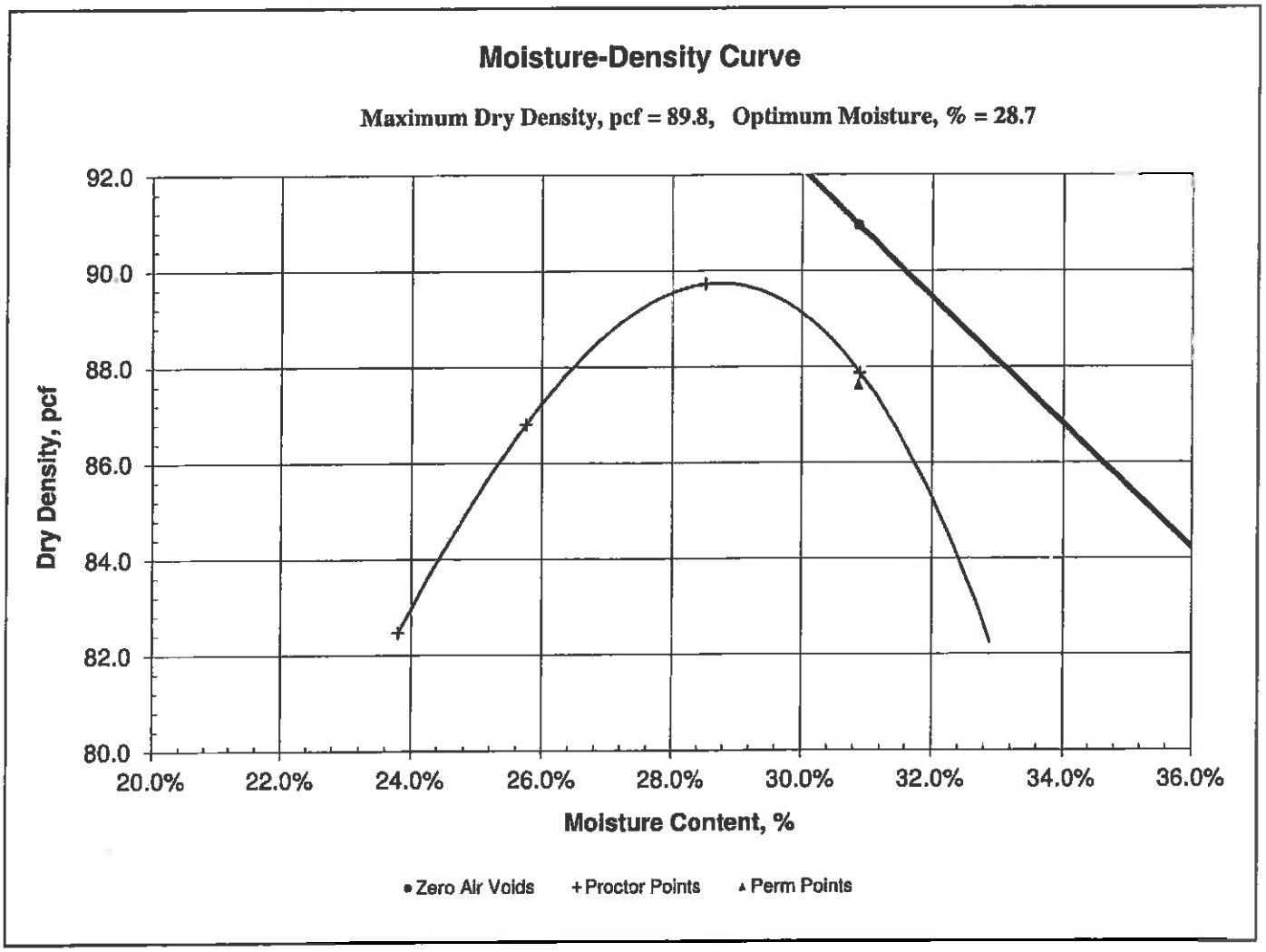
Soil and Test Method Data

Sample ID	Kettle Creek Farm 1A
Sample Depth	N/A
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	23.8%	25.7%	28.5%	30.9%	
Dry Density, pcf	82.5	86.8	89.7	87.9	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Kettle Creek Farm 1A
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.13
Sample Diameter, in: 2.85
Sample Condition: Remolded

Moisture Content

Pan Wt	8.95	grams
Pan + Soil (wet)	198.13	grams
Pan + Soil (dry)	153.50	grams
Moisture Content	*30.9%*	

Dry Density

Soil (wet)	599.18	grams
Wet Density	114.7	pcf
Dry Density	*87.6*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.1	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	47.0%
Actual Volume of Voids	153.3 ml
Porosity	47.0%
Saturation	92.2%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
1-Aug 9:21	16.900		1.100				
1-Aug 9:22	16.300	0.019	1.125	0.019	1.00	24.94	3.1E-07
1-Aug 9:23	16.050	0.008	1.135	0.008	1.00	23.96	1.3E-07
1-Aug 9:24	15.900	0.005	1.141	0.005	1.00	23.54	8.2E-08
1-Aug 9:25	15.750	0.005	1.147	0.005	1.00	23.30	8.3E-08
1-Aug 9:26	15.600	0.005	1.153	0.005	1.00	23.05	8.4E-08
1-Aug 9:27	15.500	0.003	1.157	0.003	1.00	22.81	5.6E-08
1-Aug 9:29	15.350	0.005	1.163	0.005	1.00	22.64	4.3E-08
1-Aug 9:34	15.000	0.011	1.178	0.011	1.00	22.39	4.0E-08

Average Permeability 5.6E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65		
Final Weight of Sample	606.60 grams		
Final Moisture Content	32.5%	Final Sample Length, in:	3.10
Percent Voids	46.3%	Final Sample Diameter, in:	2.84
Actual Volume of Voids	149.0 ml	Wet Density	117.6 pcf
Porosity	46.3%	*Dry Density*	*88.8* pcf
Saturation	99.8%		

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Kettle Creek Farm 2A
Sample Depth N/A
Visual Sample Description Red-brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	34
Pan Wt	192.83 grams
Pan + Soil (wet)	432.00 grams
Pan + Soil (dry)	386.75 grams
Natural Moisture Content	*23.3%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	279.93 grams
Percent Passing No. 200 Sieve	55.1%
Pan + Soil retained on No. 4 sieve (dry)	192.83 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	16	21	31
Pan ID	91	96	104
Pan Wt	24.54	24.92	26.23
Pan + Soil (wet)	36.85	41.25	46.11
Pan + Soil (dry)	32.27	35.32	39.41
Moisture Content	59%	57%	51%
Liquid Limit	56	56	52
Liquid Limit	*54*		

Plastic Limit

Pan ID	356	353
Pan Weight	9.14	9.14
Pan + Soil (wet)	17.73	17.74
Pan + Soil (dry)	15.69	15.70
Moisture Content	31%	31%
Plastic Limit	*31*	
Plastic Index	*24*	

USCS Classification: ASTM D 2487

Group Symbol **MH**
Group Name **Sandy Elastic SILT**

Grain Size Distribution Calculations

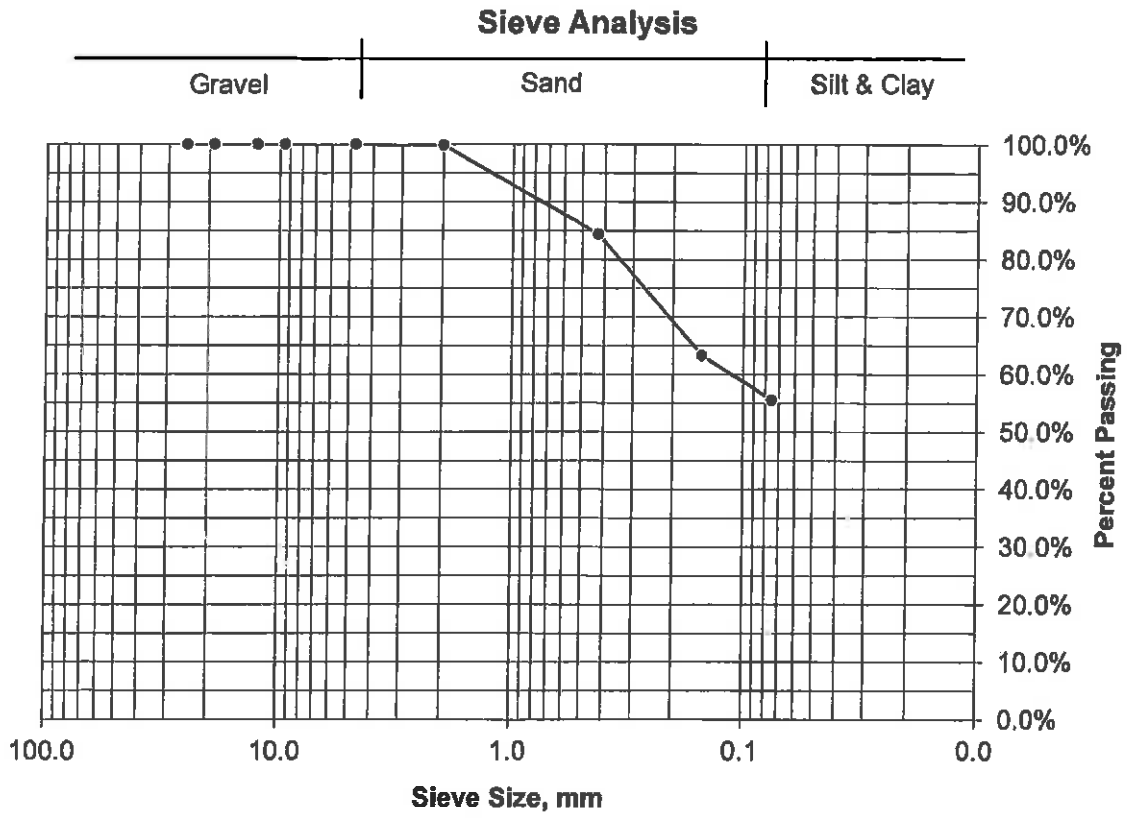
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Kettle Creek Farm 2A
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.23	0.1%	2.0	99.9%
No. 40	30.02	15.5%	0.425	84.4%
No. 100	40.82	21.0%	0.15	63.4%
No. 200	15.12	7.8%	0.075	55.6%
Pan	0.54	0.3%		
Total	86.73	44.4%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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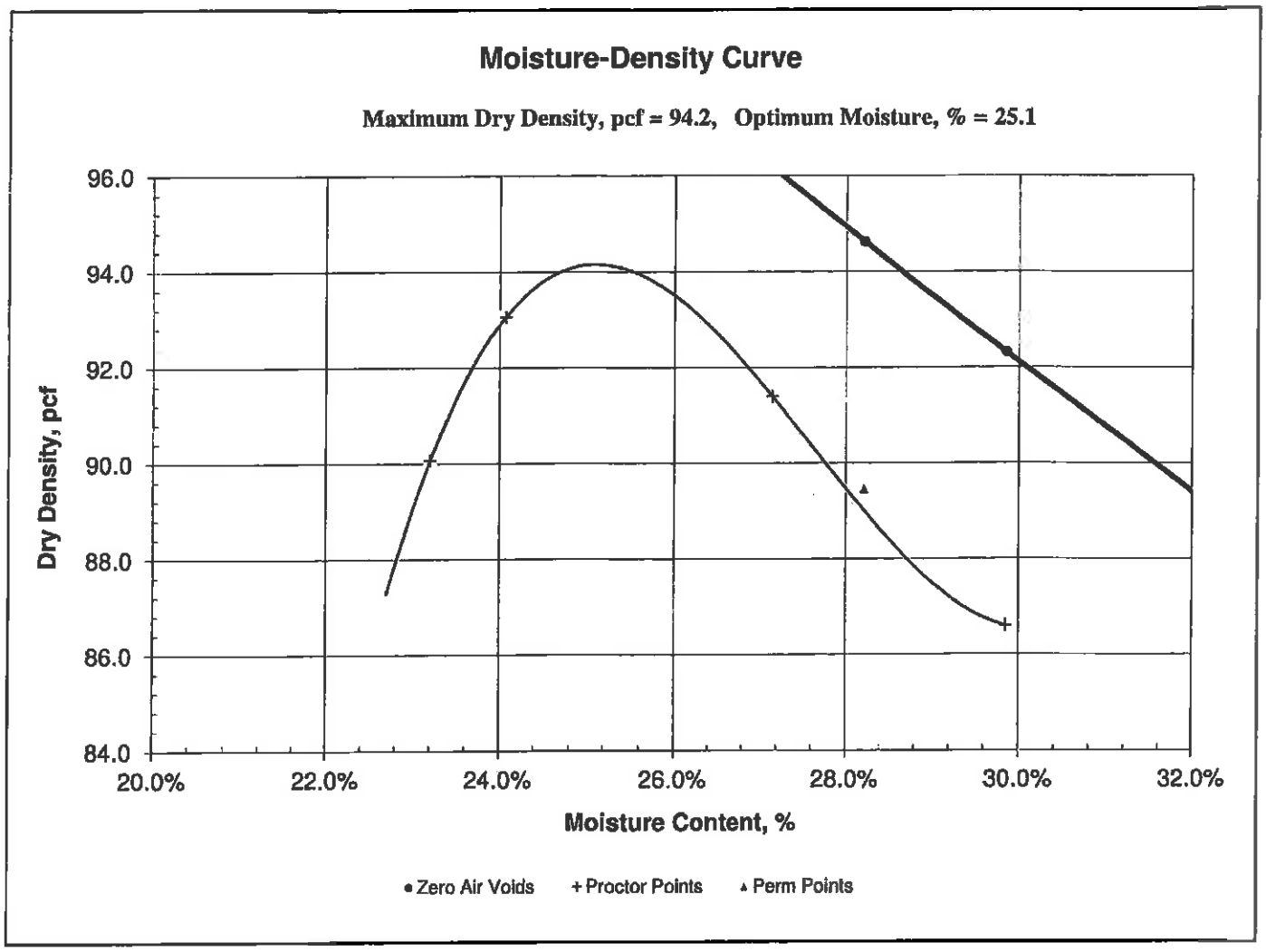
Soil and Test Method Data

Sample ID	Kettle Creek Farm 2A
Sample Depth	N/A
Sample Classification	Sandy Elastic SILT
USCS Group Symbol	MH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	23.2%	24.1%	27.1%	29.9%	
Dry Density, pcf	90.1	93.1	91.4	86.6	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Kettle Creek Farm 2A
Sample Depth: N/A
Permeability Method: ASTM D5084
Sample Length, in: 3.15
Sample Diameter, in: 2.85
Sample Condition: Remolded

Moisture Content

Pan Wt	8.99	grams
Pan + Soil (wet)	242.98	grams
Pan + Soil (dry)	191.50	grams
Moisture Content	*28.2%*	

Dry Density

Soil (wet)	606.91	grams
Wet Density	114.7	pcf
Dry Density	*89.5*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.1	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	45.9%
Actual Volume of Voids	151.6 ml
Porosity	45.9%
Saturation	88.1%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
1-Aug 9:43	16.950		1.100				
1-Aug 9:44	16.550	0.013	1.116	0.013	1.00	24.86	2.1E-07
1-Aug 9:45	16.200	0.011	1.131	0.011	1.00	24.21	1.9E-07
1-Aug 9:46	16.050	0.005	1.137	0.005	1.00	23.64	8.1E-08
1-Aug 9:47	15.900	0.005	1.143	0.005	1.00	23.39	8.2E-08
1-Aug 9:48	15.750	0.005	1.149	0.005	1.00	23.15	8.3E-08
1-Aug 9:49	15.600	0.005	1.155	0.005	1.00	22.90	8.4E-08
1-Aug 9:50	15.500	0.003	1.159	0.003	1.00	22.66	5.6E-08
1-Aug 9:55	14.900	0.019	1.184	0.019	1.00	22.49	6.9E-08

Average Permeability 7.3E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65		
Final Weight of Sample	618.80 grams		
Final Moisture Content	30.7%	Final Sample Length, in:	3.15
Percent Voids	45.7%	Final Sample Diameter, in:	2.85
Actual Volume of Voids	150.6 ml	Wet Density	117.3 pcf
Porosity	45.8%	*Dry Density*	*89.7* pcf
Saturation	96.5%		

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Structural Fill - 1
Sample Depth N/A
Visual Sample Description Light Brown Silty SAND

Natural Moisture Content: ASTM D 2216

Pan ID	33
Pan Wt	193.70 grams
Pan + Soil (wet)	488.50 grams
Pan + Soil (dry)	461.10 grams
Natural Moisture Content	*10.2%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	346.95 grams
Percent Passing No. 200 Sieve	42.7%
Pan + Soil retained on No. 4 sieve (dry)	196.86 grams
Percent Passing No. 4 Sieve	98.8%
Soil Classifies as	*Coarse-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	15	23	33
Pan ID	64	63	69
Pan Wt	10.91	10.87	11.02
Pan + Soil (wet)	24.80	23.24	26.64
Pan + Soil (dry)	20.60	19.54	22.22
Moisture Content	43%	43%	39%
Liquid Limit	41	42	41
Liquid Limit	*41*		

Plastic Limit

Pan ID	23	73
Pan Weight	4.40	4.31
Pan + Soil (wet)	17.79	14.69
Pan + Soil (dry)	14.66	12.28
Moisture Content	31%	30%
Plastic Limit	*30*	
Plastic Index	*11*	

USCS Classification: ASTM D 2487

Group Symbol **SM**
Group Name **Silty SAND**

Grain Size Distribution Calculations

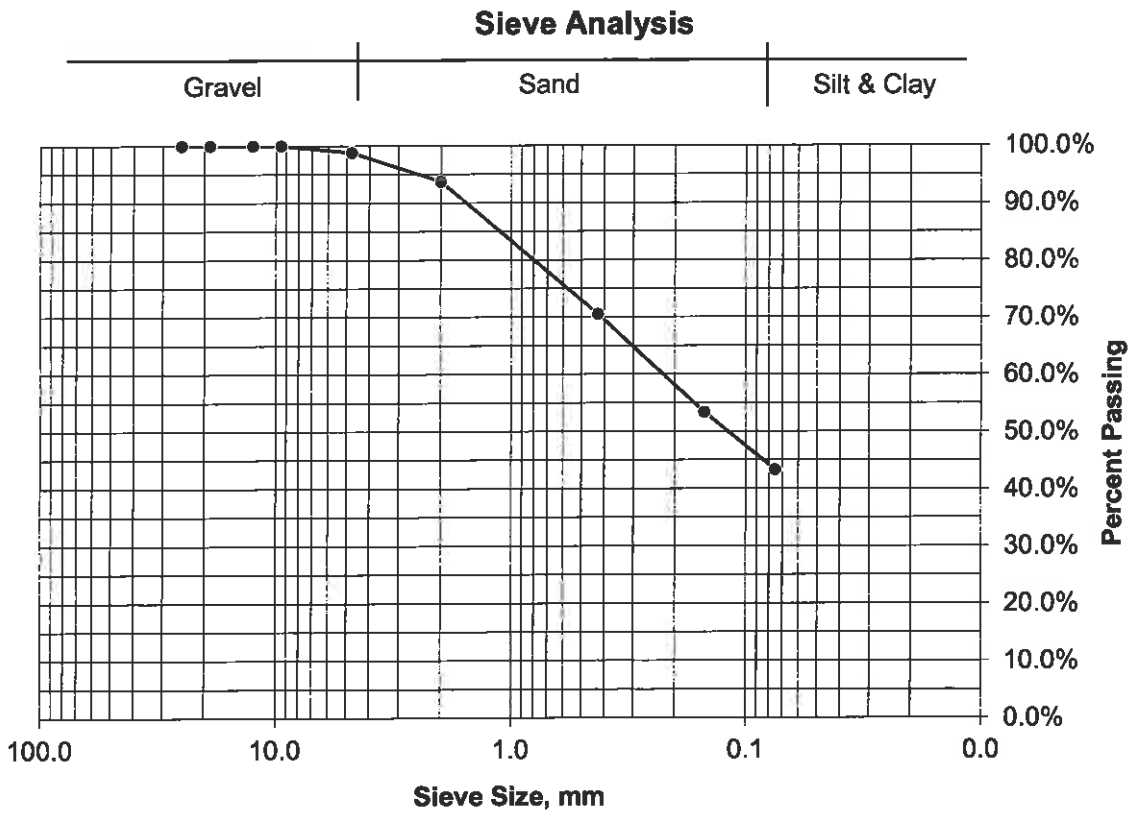
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Structural Fill - 1
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	3.16	1.2%	4.75	98.8%
No. 10	13.53	5.1%	2.0	93.8%
No. 40	62.19	23.3%	0.425	70.5%
No. 100	45.77	17.1%	0.15	53.4%
No. 200	27.05	10.1%	0.075	43.3%
Pan	1.16	0.4%		
Total	152.86	56.7%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
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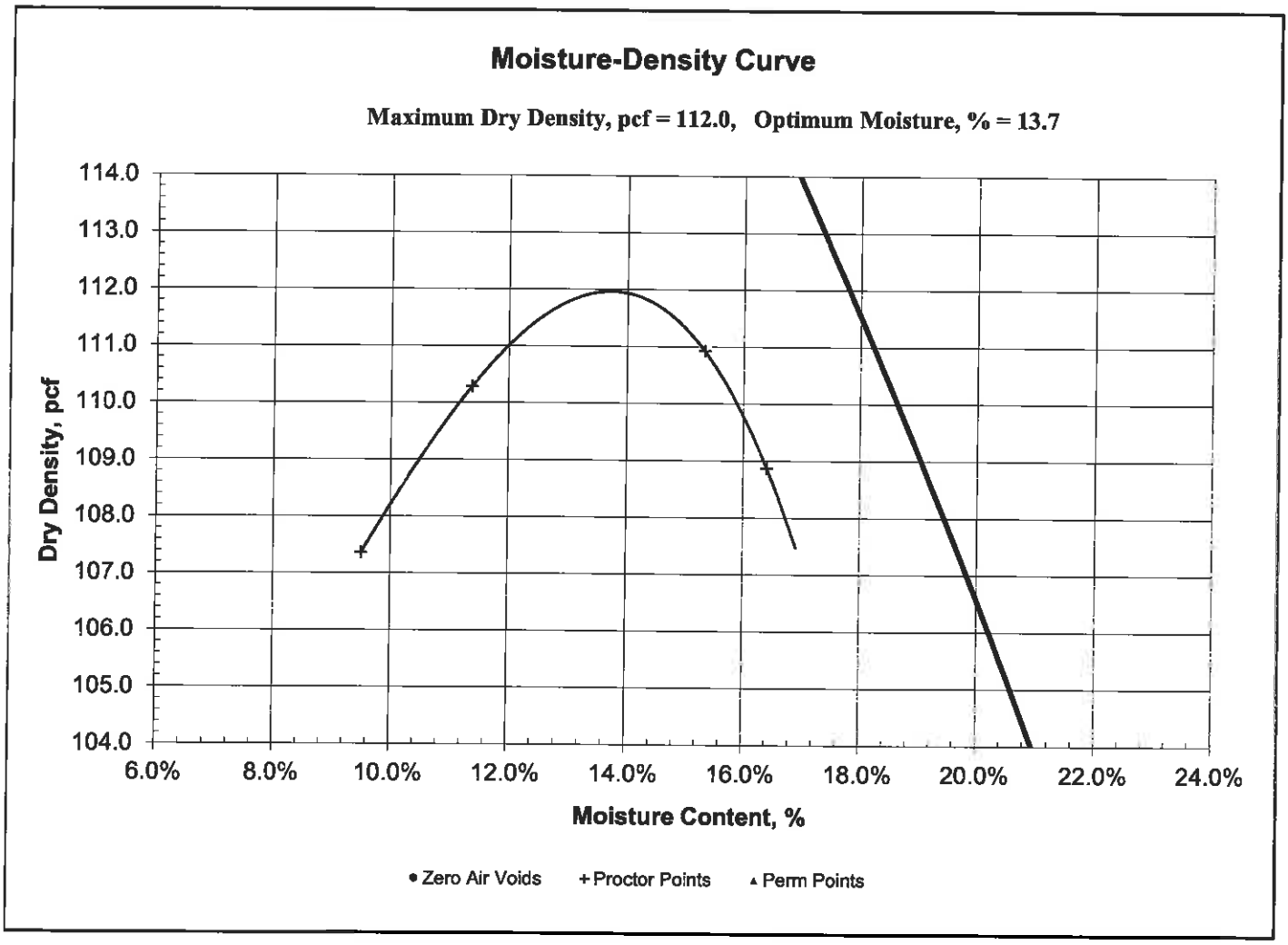
Soil and Test Method Data

Sample ID	Structural Fill - 1
Sample Depth	N/A
Sample Classification	Silty SAND
USCS Group Symbol	SM
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	**9.5%**	**11.4%**	**15.3%**	**16.4%**	
Dry Density, pcf	**107.4**	**110.3**	**110.9**	**108.9**	



Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
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Sample ID	Structural Fill - 2
Sample Depth	N/A
Visual Sample Description	Light Brown Silty SAND

Natural Moisture Content: ASTM D 2216

Pan ID	37
Pan Wt	193.68 grams
Pan + Soil (wet)	487.00 grams
Pan + Soil (dry)	464.90 grams
Natural Moisture Content	*8.1%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	414.10 grams
Percent Passing No. 200 Sieve	18.7%
Pan + Soil retained on No. 4 sieve (dry)	195.04 grams
Percent Passing No. 4 Sieve	99.5%
Soil Classifies as	*Coarse-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows			
Pan ID			
Pan Wt		Non-Plastic	
Pan + Soil (wet)			
Pan + Soil (dry)			
Moisture Content			
Liquid Limit	0	0	0
Liquid Limit	*0*		

Plastic Limit

Pan ID		
Pan Weight		
Pan + Soil (wet)		Non-Plastic
Pan + Soil (dry)		
Moisture Content		
Plastic Limit	*0*	
Plastic Index	*0*	

USCS Classification: ASTM D 2487

Group Symbol	**SM**
Group Name	**Silty SAND**

Grain Size Distribution Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
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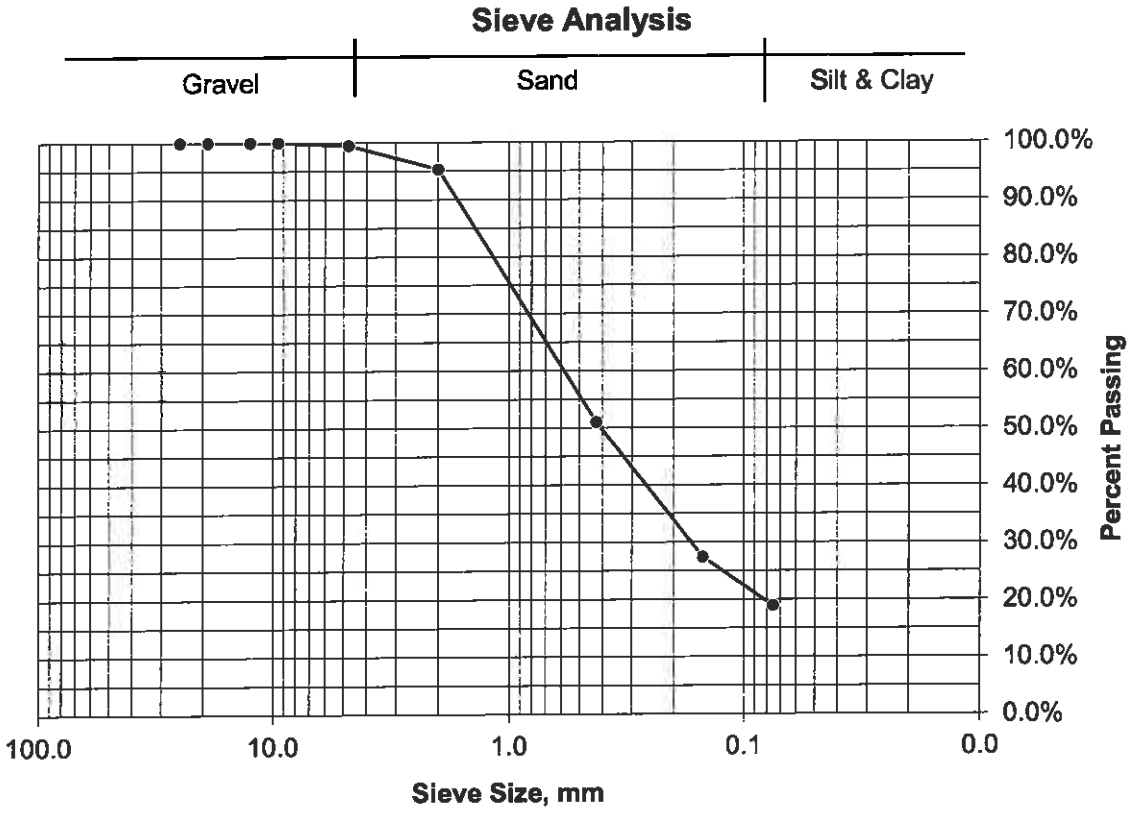
Sample ID Structural Fill - 2
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	1.36	0.5%	4.75	99.5%
No. 10	11.35	4.2%	2.0	95.3%
No. 40	120.18	44.3%	0.425	51.0%
No. 100	63.93	23.6%	0.15	27.4%
No. 200	23.10	8.5%	0.075	18.9%
Pan	0.00	0.0%		
Total	219.92	81.1%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
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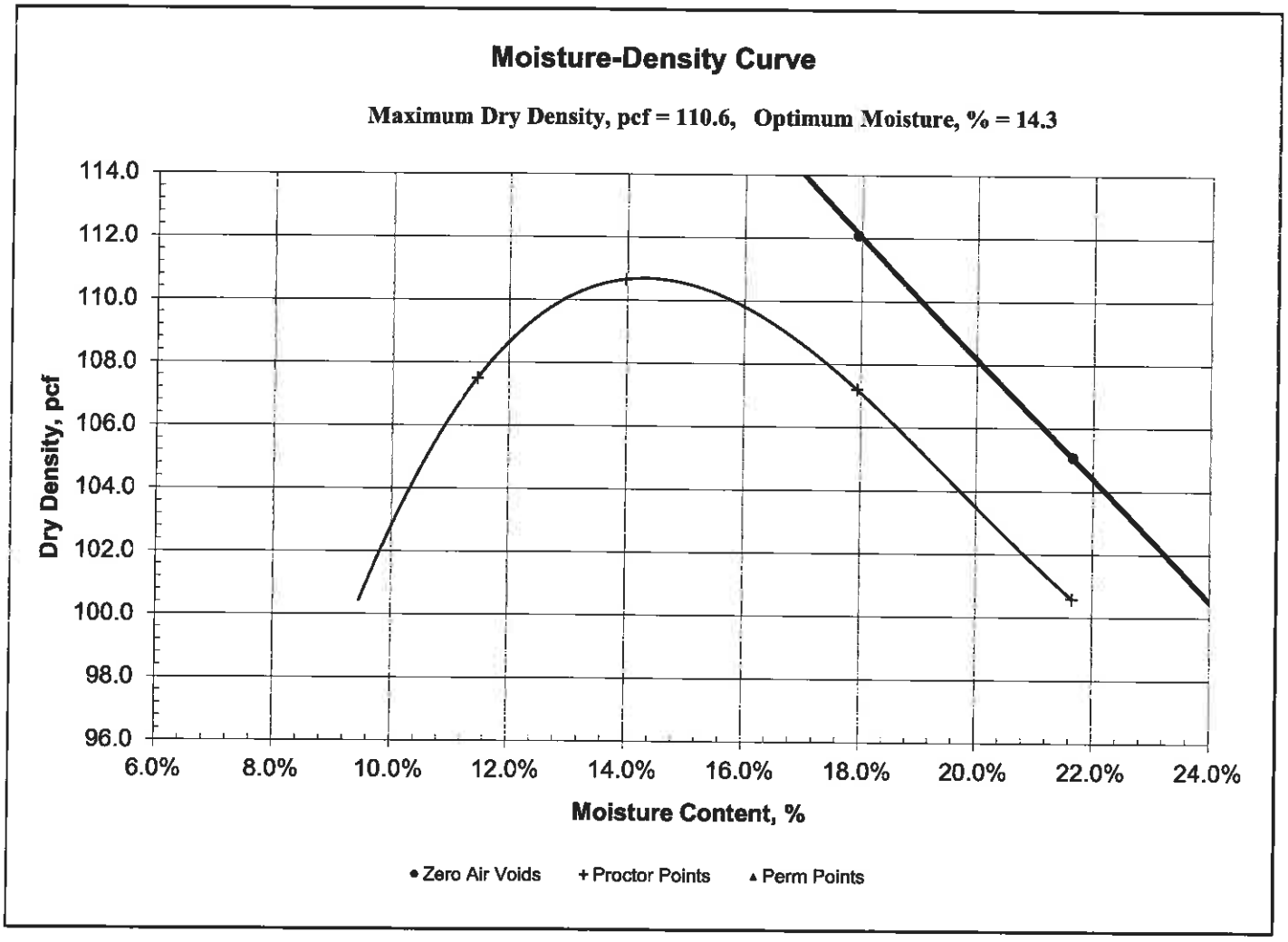
Soil and Test Method Data

Sample ID	Structural Fill - 2
Sample Depth	N/A
Sample Classification	Silty SAND
USCS Group Symbol	SM
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	**11.5%**	**14.0%**	**17.9%**	**21.7%**	
Dry Density, pcf	**107.5**	**110.7**	**107.2**	**100.6**	



Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Fill-01
Sample Depth N/A
Visual Sample Description Light Brown Silty SAND

Natural Moisture Content: ASTM D 2216

Pan ID	20
Pan Wt	189.94 grams
Pan + Soil (wet)	348.13 grams
Pan + Soil (dry)	319.70 grams
Natural Moisture Content	*21.9%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	269.97 grams
Percent Passing No. 200 Sieve	38.3%
Pan + Soil retained on No. 4 sieve (dry)	190.06 grams
Percent Passing No. 4 Sieve	99.9%
Soil Classifies as	*Coarse-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	17	22	35
Pan ID	112	312	351
Pan Wt	13.73	13.92	13.67
Pan + Soil (wet)	32.08	28.40	30.68
Pan + Soil (dry)	26.31	24.11	26.08
Moisture Content	46%	42%	37%
Liquid Limit	44	41	39
Liquid Limit	*41*		

Plastic Limit

Pan ID	14	23
Pan Weight	4.27	4.35
Pan + Soil (wet)	19.69	18.13
Pan + Soil (dry)	15.74	14.66
Moisture Content	34%	34%
Plastic Limit	*34*	
Plastic Index	*7*	

USCS Classification: ASTM D 2487

Group Symbol **SM**
Group Name **Silty SAND**

Grain Size Distribution Calculations

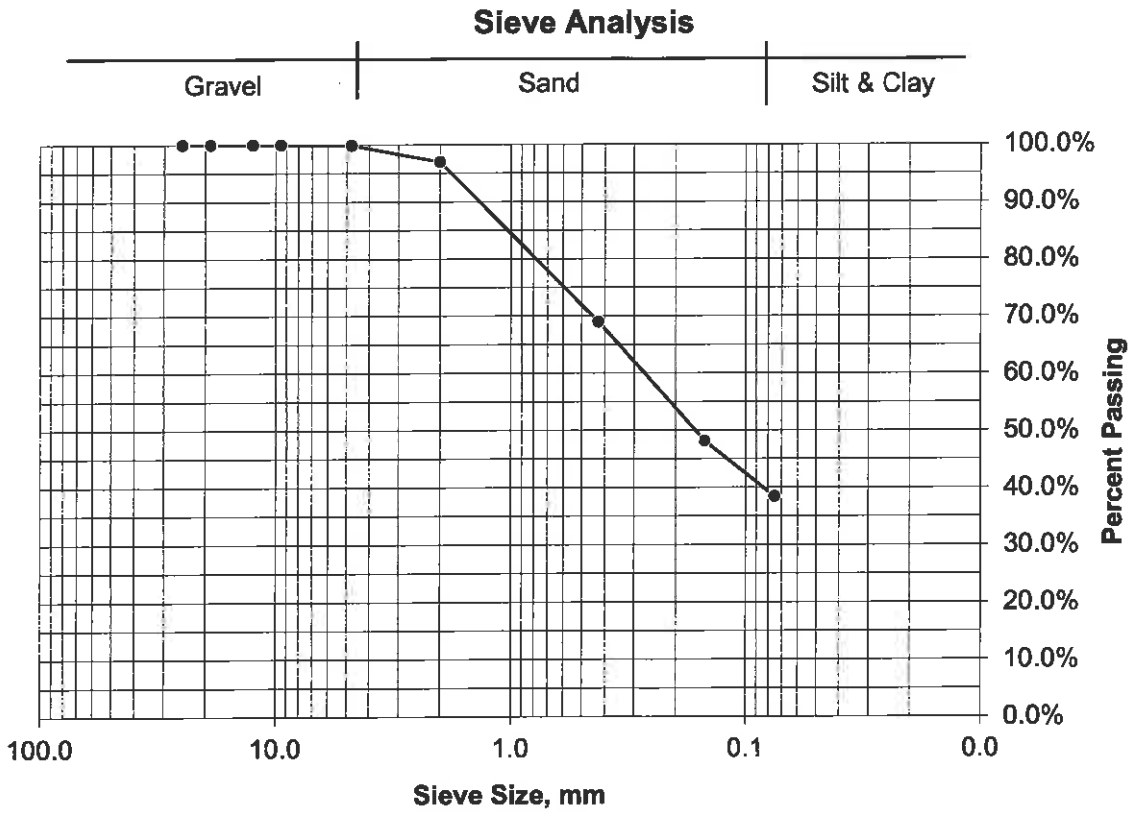
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Fill-01
Sample Depth N/A

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.12	0.1%	4.75	99.9%
No. 10	3.82	2.9%	2.0	97.0%
No. 40	36.33	28.0%	0.425	69.0%
No. 100	26.97	20.8%	0.15	48.2%
No. 200	12.63	9.7%	0.075	38.4%
Pan	0.16	0.1%		
Total	80.03	61.6%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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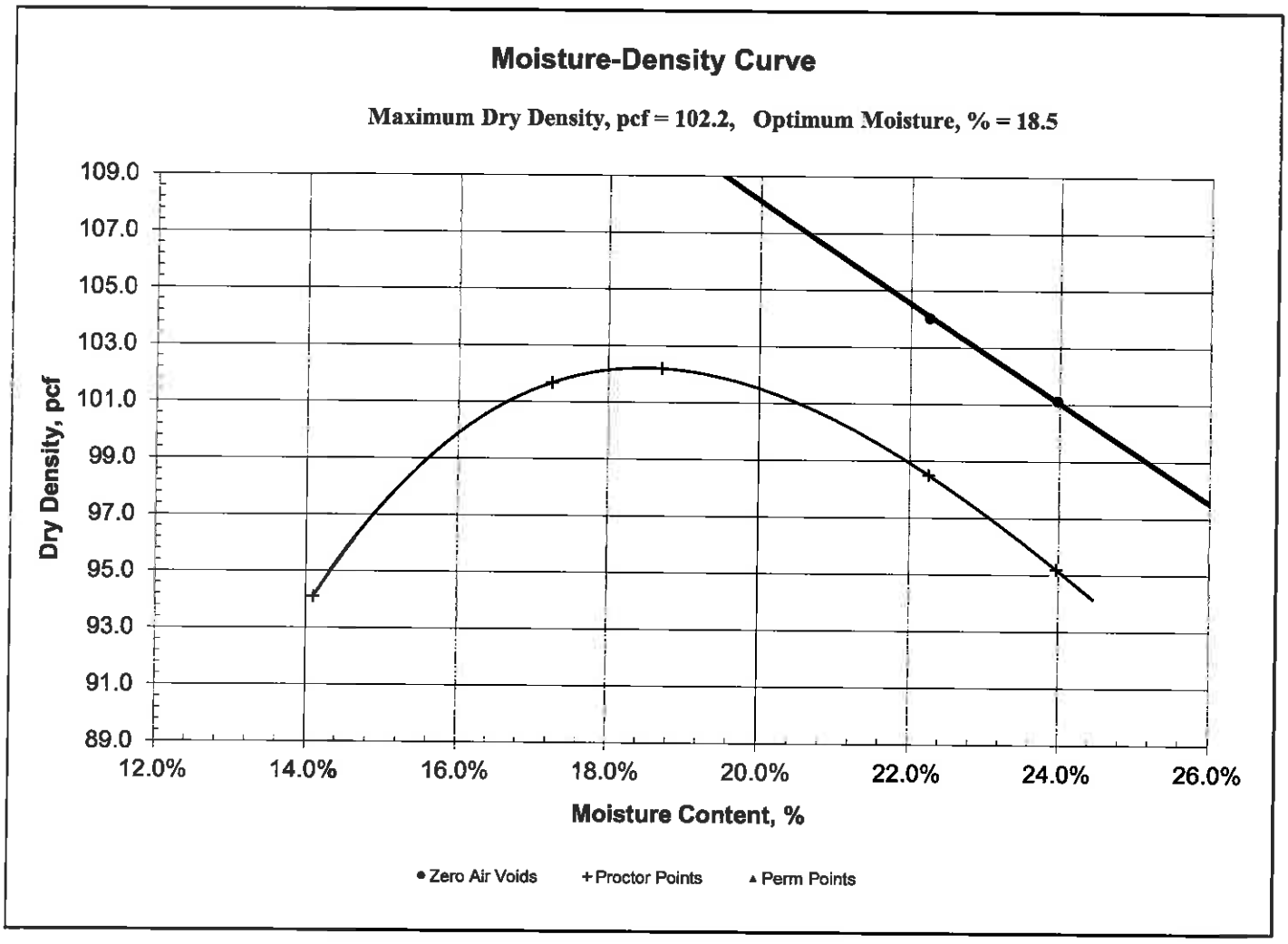
Soil and Test Method Data

Sample ID	Fill-01
Sample Depth	N/A
Sample Classification	Silty SAND
USCS Group Symbol	SM
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	**17.3%**	**18.7%**	**22.3%**	**24.0%**	**14.1%**
Dry Density, pcf	**101.7**	**102.2**	**98.5**	**95.2**	**94.1**



Clay Liner
Test Pad Report

TEST PAD DATA

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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Sample ID Test Pad, Lift 1
Sample Depth Lift 1
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	16
Pan Wt	189.42 grams
Pan + Soil (wet)	359.51 grams
Pan + Soil (dry)	326.10 grams
Natural Moisture Content	*24.4%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	242.64 grams
Percent Passing No. 200 Sieve	61.1%
Pan + Soil retained on No. 4 sieve (dry)	189.42 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	16	21	31
Pan ID	92	104	169
Pan Wt	25.61	26.28	27.15
Pan + Soil (wet)	39.08	36.57	39.92
Pan + Soil (dry)	33.31	32.35	34.97
Moisture Content	75%	70%	63%
Liquid Limit	71	68	65
Liquid Limit	*67*		

Plastic Limit

Pan ID	358	41
Pan Weight	1.91	1.92
Pan + Soil (wet)	12.13	11.97
Pan + Soil (dry)	9.91	9.85
Moisture Content	28%	27%
Plastic Limit	*27*	
Plastic Index	*40*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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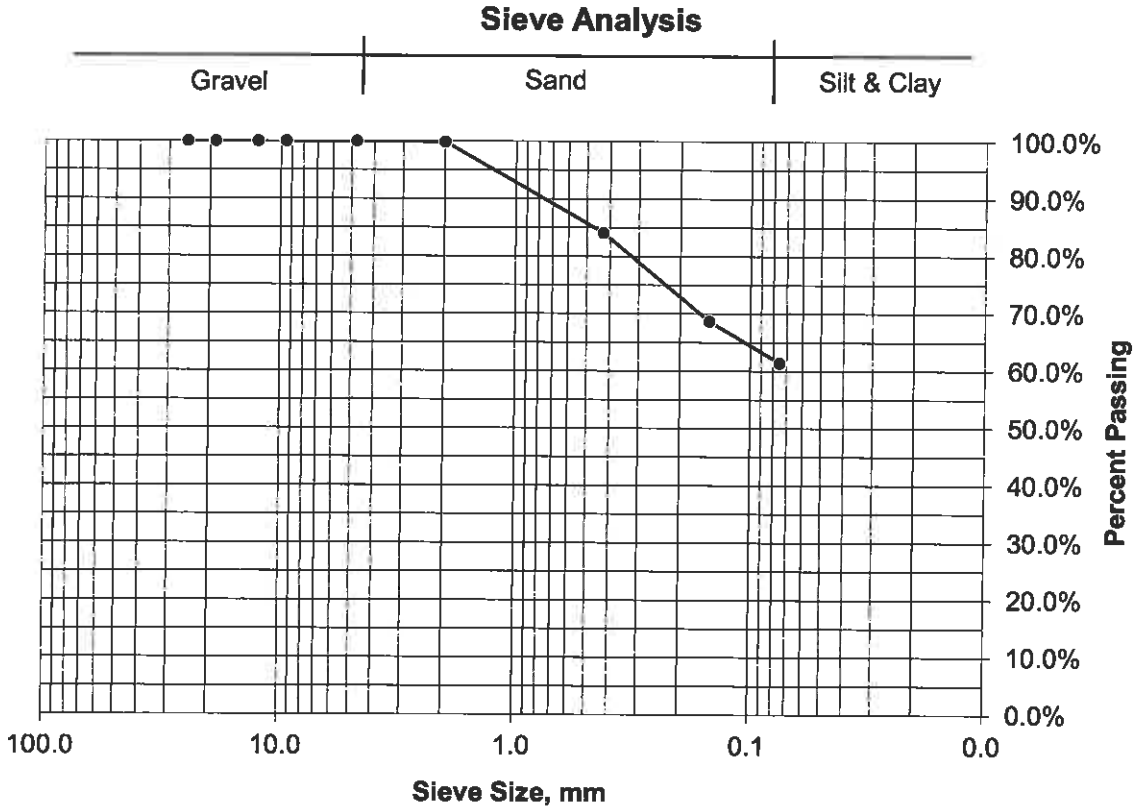
Sample ID Test Pad, Lift 1
Sample Depth Lift 1

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.16	0.1%	2.0	99.9%
No. 40	21.66	15.8%	0.425	84.0%
No. 100	21.00	15.4%	0.15	68.7%
No. 200	9.89	7.2%	0.075	61.4%
Pan	0.10	0.1%		
Total	52.81	38.6%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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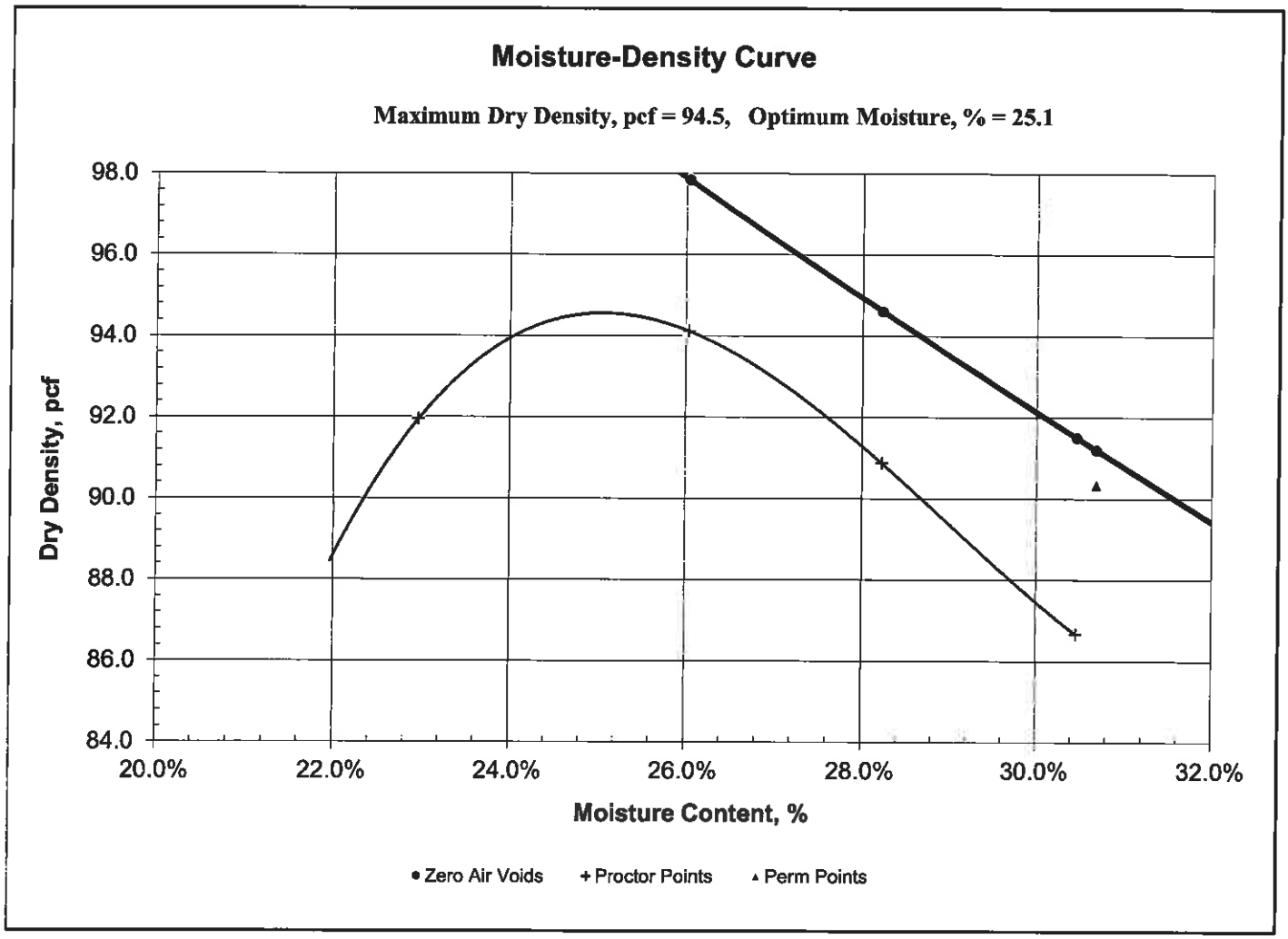
Soil and Test Method Data

Sample ID	Test Pad, Lift 1
Sample Depth	Lift 1
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	**23.0%**	**26.0%**	**28.2%**	**30.5%**	
Dry Density, pcf	**91.9**	**94.1**	**90.9**	**86.7**	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Test Pad, Lift 1
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.35
Sample Diameter, in: 2.83
Sample Condition: Remolded

Moisture Content

Pan Wt	9.06	grams
Pan + Soil (wet)	191.78	grams
Pan + Soil (dry)	148.88	grams
Moisture Content	*30.7%*	

Dry Density

Soil (wet)	653.57	grams
Wet Density	118.1	pcf
Dry Density	*90.3*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.6	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	45.4%
Actual Volume of Voids	156.7 ml
Porosity	45.4%
Saturation	97.9%

Permeability Trials

Time min	Infuent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
9-Oct 9:26	16.300		1.200				
9-Oct 9:27	16.050	0.008	1.210	0.008	1.00	22.24	1.5E-07
9-Oct 9:28	15.850	0.006	1.218	0.006	1.00	21.86	1.2E-07
9-Oct 9:29	15.700	0.005	1.225	0.005	1.00	21.55	9.0E-08
9-Oct 9:30	15.550	0.005	1.231	0.005	1.00	21.32	9.1E-08
9-Oct 9:31	15.450	0.003	1.235	0.003	1.00	21.09	6.1E-08
9-Oct 9:32	15.350	0.003	1.239	0.003	1.00	20.94	6.2E-08
9-Oct 9:33	15.250	0.003	1.243	0.003	1.00	20.79	6.2E-08
9-Oct 9:38	14.800	0.014	1.261	0.014	1.00	20.63	5.7E-08

Average Permeability 6.1E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	647.58	grams
Final Moisture Content	29.5%	
Percent Voids	44.5%	
Actual Volume of Voids	151.4	ml
Porosity	44.5%	
Saturation	97.4%	

Final Sample Length, in:	3.25	
Final Sample Diameter, in:	2.85	
Wet Density	118.8	pcf
Dry Density	*91.7*	pcf

Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: TP-ST-1
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.39
Sample Diameter, in: 2.84
Sample Condition: Undisturbed

Moisture Content

Pan Wt	9.38	grams
Pan + Soil (wet)	121.00	grams
Pan + Soil (dry)	97.77	grams
Moisture Content	*26.3%*	

Dry Density

Soil (wet)	675.23	grams
Wet Density	119.8	pcf
Dry Density	*94.9*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.5	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	42.6%	
Actual Volume of Voids	149.9	ml
Porosity	42.6%	
Saturation	93.8%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeability, k cm/sec
3-Oct 8:39	16.500		1.200				
3-Oct 8:40	16.200	0.009	1.212	0.009	1.00	22.30	1.7E-07
3-Oct 8:41	16.000	0.006	1.220	0.006	1.00	21.84	1.2E-07
3-Oct 8:42	15.850	0.005	1.227	0.005	1.00	21.54	9.0E-08
3-Oct 8:43	15.700	0.005	1.233	0.005	1.00	21.31	9.1E-08
3-Oct 8:44	15.600	0.003	1.237	0.003	1.00	21.09	6.1E-08
3-Oct 8:45	15.500	0.003	1.241	0.003	1.00	20.93	6.1E-08
3-Oct 8:46	15.400	0.003	1.245	0.003	1.00	20.78	6.2E-08
3-Oct 8:51	15.000	0.013	1.261	0.013	1.00	20.63	5.0E-08

Average Permeability 5.9E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	678.50	grams
Final Moisture Content	26.9%	
Percent Voids	41.4%	
Actual Volume of Voids	142.3	ml
Porosity	41.4%	
Saturation	100.0%	

Final Sample Length, in:	3.34	
Final Sample Diameter, in:	2.83	
Wet Density	123.1	pcf
Dry Density	*97.0*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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Sample ID	Test Pad, Lift 2
Sample Depth	Lift 2
Visual Sample Description	Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	23
Pan Wt	194.05 grams
Pan + Soil (wet)	363.86 grams
Pan + Soil (dry)	329.16 grams
Natural Moisture Content	*25.7%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	244.57 grams
Percent Passing No. 200 Sieve	62.6%
Pan + Soil retained on No. 4 sieve (dry)	194.40 grams
Percent Passing No. 4 Sieve	99.7%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	15	28	31
Pan ID	71	105	69
Pan Wt	10.93	29.28	10.97
Pan + Soil (wet)	22.37	42.28	23.78
Pan + Soil (dry)	17.68	37.25	18.85
Moisture Content	69%	63%	63%
Liquid Limit	65	64	64
Liquid Limit	*65*		

Plastic Limit

Pan ID	78	81
Pan Weight	4.24	4.30
Pan + Soil (wet)	15.00	14.39
Pan + Soil (dry)	12.54	12.00
Moisture Content	30%	31%
Plastic Limit	*30*	
Plastic Index	*35*	

USCS Classification: ASTM D 2487

Group Symbol	**CH**
Group Name	**Sandy Fat CLAY**

Grain Size Distribution Calculations

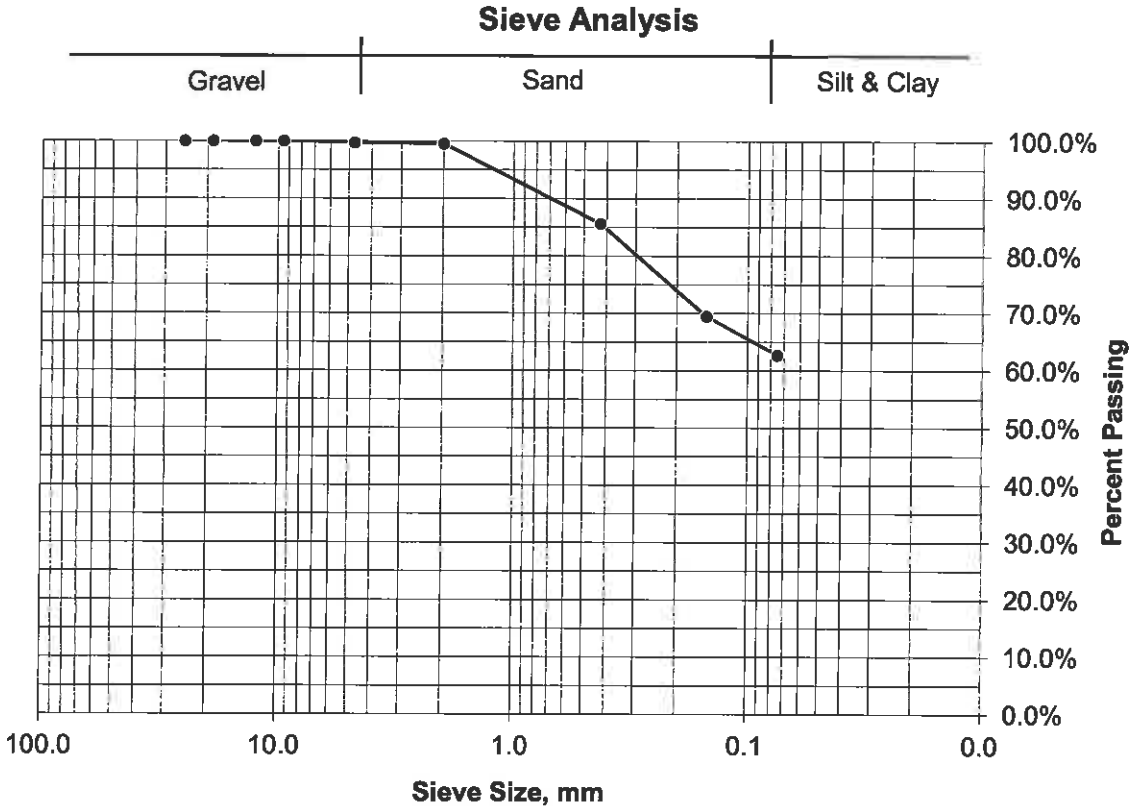
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Test Pad, Lift 2
Sample Depth Lift 2

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.35	0.3%	4.75	99.7%
No. 10	0.26	0.2%	2.0	99.5%
No. 40	18.80	13.9%	0.425	85.6%
No. 100	21.88	16.2%	0.15	69.4%
No. 200	9.13	6.8%	0.075	62.7%
Pan	0.21	0.2%		
Total	50.63	37.3%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

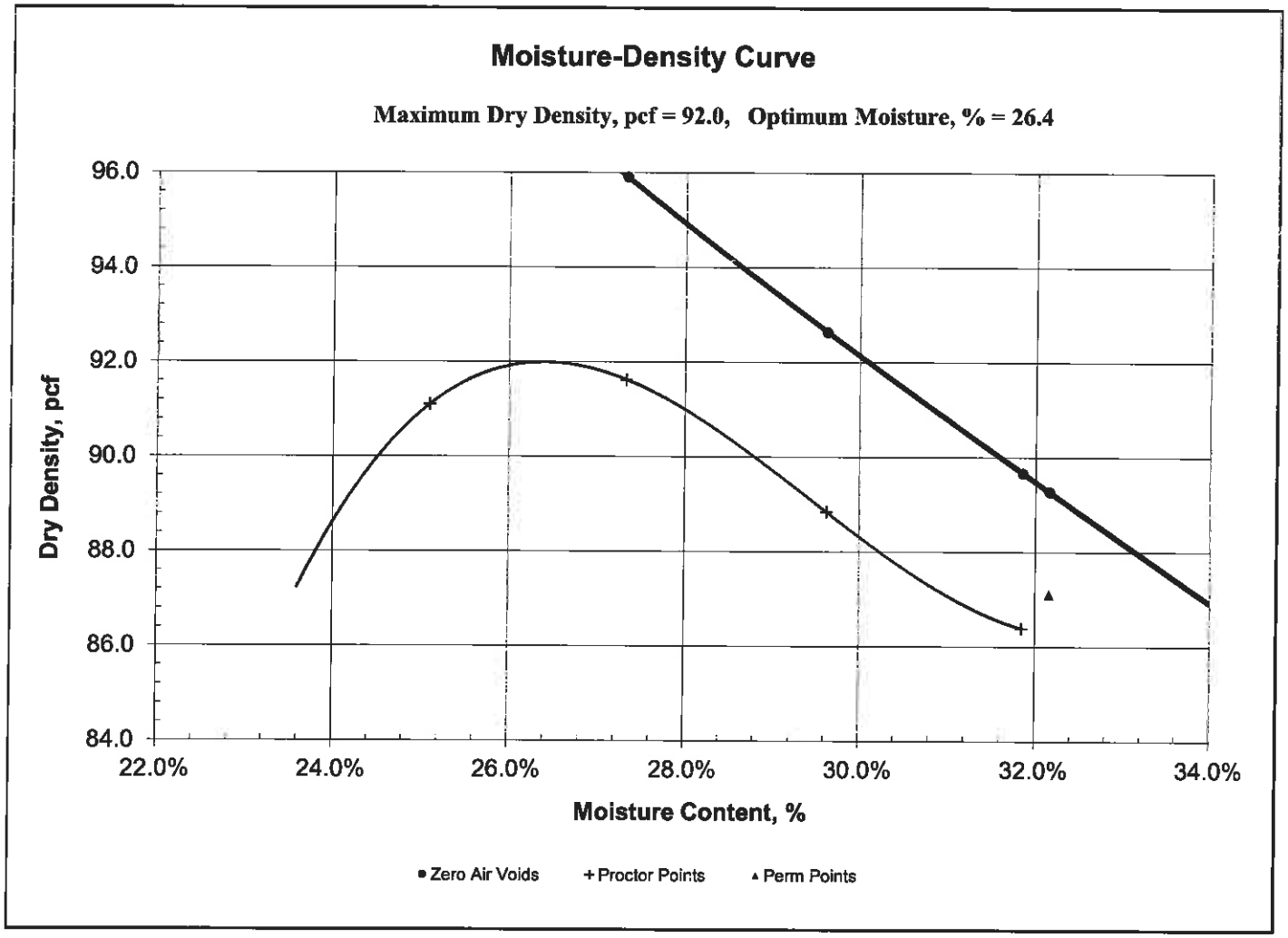
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Test Pad, Lift 2
Sample Depth	Lift 2
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	**25.1%**	**27.3%**	**29.6%**	**31.9%**	
Dry Density, pcf	**91.1**	**91.6**	**88.8**	**86.4**	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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Sample ID: Test Pad, Lift 2
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 3.39
Sample Diameter, in: 2.85
Sample Condition: Remolded

Moisture Content

Pan Wt	9.04	grams
Pan + Soil (wet)	185.83	grams
Pan + Soil (dry)	142.81	grams
Moisture Content	*32.2%*	

Dry Density

Soil (wet)	652.65	grams
Wet Density	115.1	pcf
Dry Density	*87.1*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.3	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	47.3%
Actual Volume of Voids	167.4 ml
Porosity	47.3%
Saturation	94.9%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
9-Oct 8:50	16.000		1.200				
9-Oct 8:51	15.700	0.009	1.212	0.009	1.00	21.58	1.8E-07
9-Oct 8:52	15.550	0.005	1.218	0.005	1.00	21.12	9.1E-08
9-Oct 8:53	15.350	0.006	1.227	0.006	1.00	20.89	1.2E-07
9-Oct 8:54	15.200	0.005	1.233	0.005	1.00	20.59	9.3E-08
9-Oct 8:55	15.100	0.003	1.237	0.003	1.00	20.36	6.3E-08
9-Oct 8:56	15.000	0.003	1.241	0.003	1.00	20.21	6.3E-08
9-Oct 8:57	14.900	0.003	1.245	0.003	1.00	20.06	6.4E-08
9-Oct 9:09	13.850	0.033	1.288	0.033	1.00	19.91	5.8E-08

Average Permeability 6.2E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	650.21	grams
Final Moisture Content	31.7%	
Percent Voids	45.9%	
Actual Volume of Voids	158.2	ml
Porosity	45.9%	
Saturation	98.9%	

Final Sample Length, in:	3.32	
Final Sample Diameter, in:	2.84	
Wet Density	117.8	pcf
Dry Density	*89.4*	pcf

Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: TP-ST-2
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 3.39
Sample Diameter, in: 2.85
Sample Condition: Undisturbed

Moisture Content

Pan Wt	194.76	grams
Pan + Soil (wet)	429.95	grams
Pan + Soil (dry)	379.45	grams
Moisture Content	*27.3%*	

Dry Density

Soil (wet)	687.88	grams
Wet Density	121.4	pcf
Dry Density	*95.3*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.6	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	42.4%	
Actual Volume of Voids	149.9	ml
Porosity	42.4%	
Saturation	98.6%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
3-Oct 8:55	16.450		1.200				
3-Oct 8:56	16.200	0.008	1.210	0.008	1.00	22.22	1.4E-07
3-Oct 8:57	16.000	0.006	1.218	0.006	1.00	21.84	1.2E-07
3-Oct 8:58	15.900	0.003	1.223	0.003	1.00	21.54	5.9E-08
3-Oct 8:59	15.800	0.003	1.227	0.003	1.00	21.39	6.0E-08
3-Oct 9:00	15.700	0.003	1.231	0.003	1.00	21.23	6.0E-08
3-Oct 9:01	15.600	0.003	1.235	0.003	1.00	21.08	6.1E-08
3-Oct 9:02	15.550	0.002	1.237	0.002	1.00	20.93	3.1E-08
3-Oct 9:10	15.050	0.016	1.257	0.016	1.00	20.86	3.9E-08

Average Permeability 4.8E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65			
Final Weight of Sample	692.40	grams		
Final Moisture Content	28.2%		Final Sample Length, in:	3.36
Percent Voids	41.3%		Final Sample Diameter, in:	2.83
Actual Volume of Voids	143.2	ml	Wet Density	124.5 pcf
Porosity	41.3%		*Dry Density*	*97.1* pcf
Saturation	100.0%			

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Test Pad, Lift 3
Sample Depth Lift 3
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	27
Pan Wt	193.79 grams
Pan + Soil (wet)	390.24 grams
Pan + Soil (dry)	348.30 grams
Natural Moisture Content	*27.1%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	248.03 grams
Percent Passing No. 200 Sieve	64.9%
Pan + Soil retained on No. 4 sieve (dry)	193.99 grams
Percent Passing No. 4 Sieve	99.9%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	19	21	35
Pan ID	65	1	64
Pan Wt	10.96	11.30	10.97
Pan + Soil (wet)	23.10	22.41	21.73
Pan + Soil (dry)	18.05	17.89	17.49
Moisture Content	71%	69%	65%
Liquid Limit	69	67	68
Liquid Limit	*68*		

Plastic Limit

Pan ID	23	83
Pan Weight	4.35	4.25
Pan + Soil (wet)	14.68	14.36
Pan + Soil (dry)	12.33	12.02
Moisture Content	29%	30%
Plastic Limit	*30*	
Plastic Index	*38*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

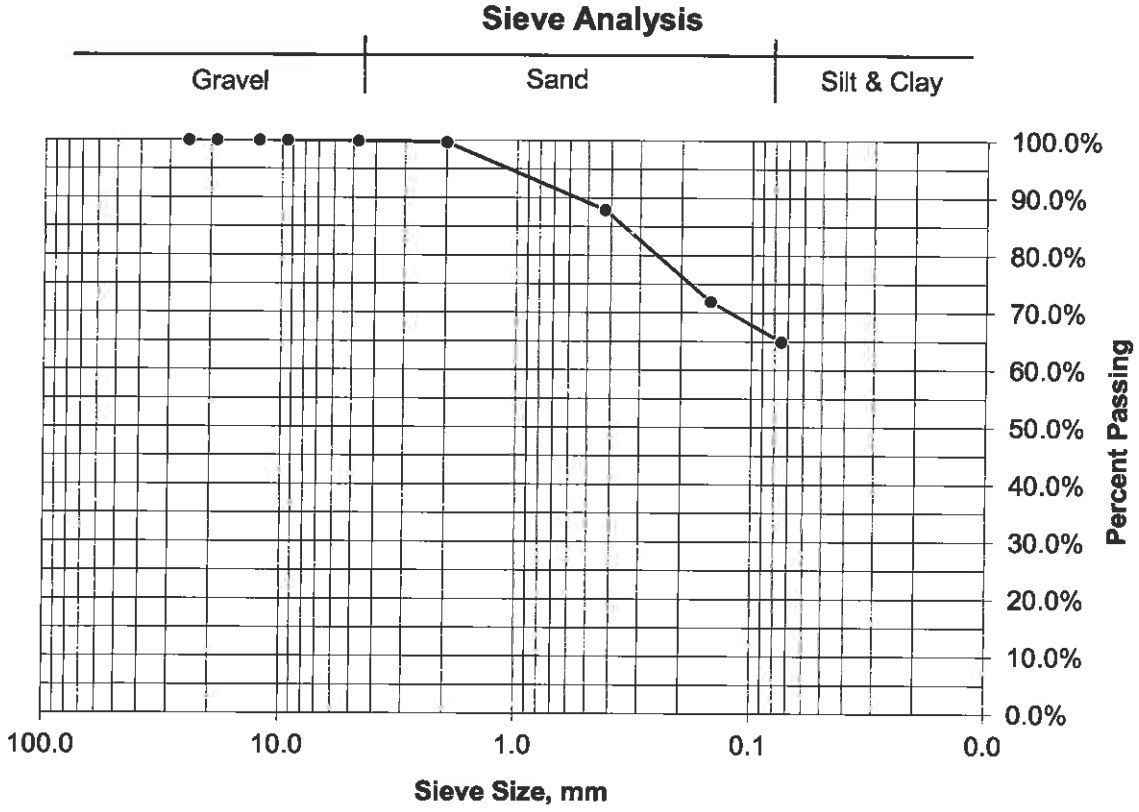
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Test Pad, Lift 3
Sample Depth Lift 3

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.20	0.1%	4.75	99.9%
No. 10	0.29	0.2%	2.0	99.7%
No. 40	18.17	11.8%	0.425	87.9%
No. 100	24.69	16.0%	0.15	71.9%
No. 200	10.84	7.0%	0.075	64.9%
Pan	0.12	0.1%		
Total	54.31	35.1%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

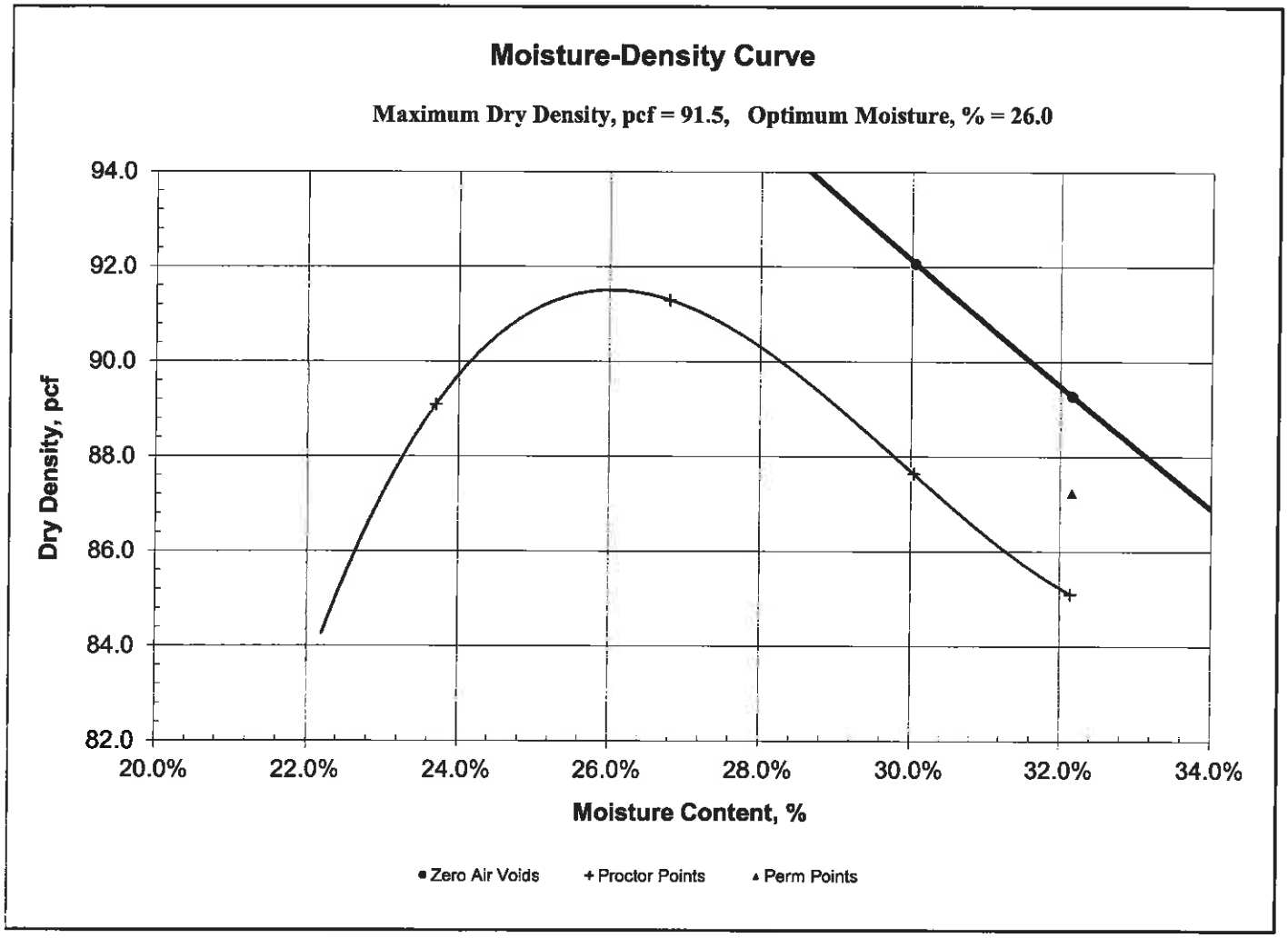
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Test Pad, Lift 3
Sample Depth	Lift 3
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	**23.7%**	**26.8%**	**30.0%**	**32.1%**	
Dry Density, pcf	**89.1**	**91.3**	**87.6**	**85.1**	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID:	Test Pad, Lift 3
Sample Depth:	Lift 3
Permeability Method:	ASTM D5084
Sample Length, in:	3.33
Sample Diameter, in:	2.87
Sample Condition:	Remolded

Moisture Content

Pan Wt	9.04	grams
Pan + Soil (wet)	185.83	grams
Pan + Soil (dry)	142.81	grams
Moisture Content	*32.2%*	

Dry Density

Soil (wet)	654.60	grams
Wet Density	115.3	pcf
Dry Density	*87.2*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.9	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	47.2%
Actual Volume of Voids	167.4 ml
Porosity	47.2%
Saturation	95.2%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
9-Oct 9:11	16.650		1.200				
9-Oct 9:12	16.100	0.017	1.223	0.017	1.00	22.90	3.1E-07
9-Oct 9:13	15.800	0.009	1.235	0.009	1.00	22.05	1.7E-07
9-Oct 9:14	15.550	0.008	1.245	0.008	1.00	21.59	1.5E-07
9-Oct 9:15	15.350	0.006	1.253	0.006	1.00	21.21	1.2E-07
9-Oct 9:16	15.200	0.005	1.259	0.005	1.00	20.90	9.0E-08
9-Oct 9:17	15.050	0.005	1.266	0.005	1.00	20.67	9.1E-08
9-Oct 9:18	14.900	0.005	1.272	0.005	1.00	20.43	9.2E-08
9-Oct 9:23	14.150	0.024	1.302	0.024	1.00	20.20	9.6E-08

Average Permeability 9.2E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	652.31	grams
Final Moisture Content	31.7%	
Percent Voids	46.0%	
Actual Volume of Voids	159.1	ml
Porosity	46.0%	
Saturation	98.7%	

Final Sample Length, in:	3.28	
Final Sample Diameter, in:	2.86	
Wet Density	117.7	pcf
Dry Density	*89.3*	pcf

Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: TP-ST-3
Sample Depth: Lift 3
Permeability Method: ASTM D5084
Sample Length, in: 3.28
Sample Diameter, in: 2.84
Sample Condition: Undisturbed

Moisture Content

Pan Wt	193.62 grams
Pan + Soil (wet)	405.12 grams
Pan + Soil (dry)	361.08 grams
Moisture Content	*26.3%*

Dry Density

Soil (wet)	645.40 grams
Wet Density	118.2 pcf
Dry Density	*93.6* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712
Effective Stress, psi	10.0
Pearment Liquid Temp.(°C):	20.4 De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	43.4%
Actual Volume of Voids	148.0 ml
Porosity	43.4%
Saturation	90.8%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
3-Oct 9:12	16.150		1.200				
3-Oct 9:13	15.400	0.024	1.231	0.024	1.00	22.51	4.4E-07
3-Oct 9:14	15.000	0.013	1.247	0.013	1.00	21.34	2.4E-07
3-Oct 9:15	14.600	0.013	1.263	0.013	1.00	20.71	2.5E-07
3-Oct 9:16	14.400	0.006	1.272	0.006	1.00	20.08	1.3E-07
3-Oct 9:17	14.250	0.005	1.278	0.005	1.00	19.77	9.8E-08
3-Oct 9:18	14.100	0.005	1.284	0.005	1.00	19.54	9.9E-08
3-Oct 9:19	13.950	0.005	1.290	0.005	1.00	19.30	1.0E-07
3-Oct 9:24	13.300	0.020	1.317	0.020	1.00	19.06	9.0E-08

Average Permeability 9.7E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	659.70 grams
Final Moisture Content	29.1%
Percent Voids	44.5%
Actual Volume of Voids	154.7 ml
Porosity	44.5%
Saturation	96.1%

Final Sample Length, in:	3.29
Final Sample Diameter, in:	2.86
Wet Density	118.5 pcf
Dry Density	*91.8* pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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Sample ID	Test Pad, Lift 4
Sample Depth	Lift 4
Visual Sample Description	Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	6
Pan Wt	195.41 grams
Pan + Soil (wet)	393.14 grams
Pan + Soil (dry)	351.72 grams
Natural Moisture Content	*26.5%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	252.63 grams
Percent Passing No. 200 Sieve	63.4%
Pan + Soil retained on No. 4 sieve (dry)	195.61 grams
Percent Passing No. 4 Sieve	99.9%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	17	29	35
Pan ID	351	12	65
Pan Wt	13.66	11.26	10.97
Pan + Soil (wet)	24.26	26.42	29.09
Pan + Soil (dry)	20.05	20.75	22.38
Moisture Content	66%	60%	59%
Liquid Limit	63	61	61
Liquid Limit	*62*		

Plastic Limit

Pan ID	122	22
Pan Weight	2.41	4.31
Pan + Soil (wet)	12.50	14.47
Pan + Soil (dry)	10.17	12.10
Moisture Content	30%	30%
Plastic Limit	*30*	
Plastic Index	*32*	

USCS Classification: ASTM D 2487

Group Symbol	**CH**
Group Name	**Sandy Fat CLAY**

Grain Size Distribution Calculations

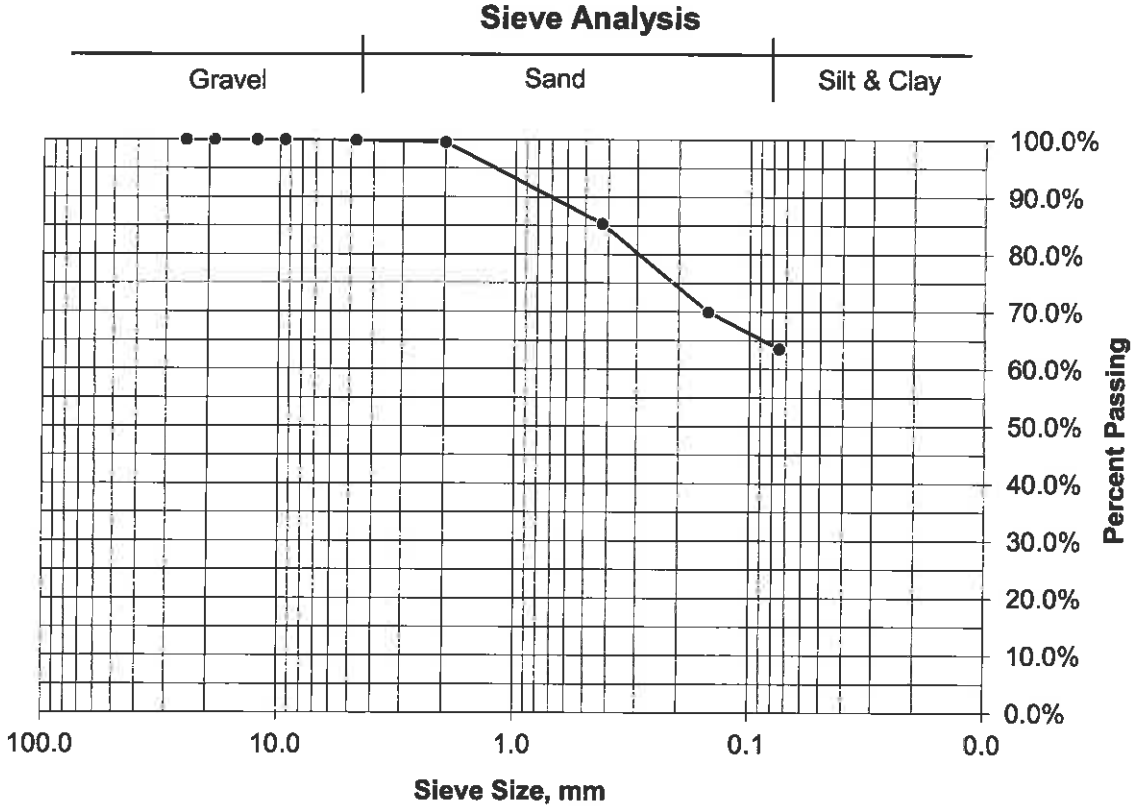
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID Test Pad, Lift 4
Sample Depth Lift 4

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.20	0.1%	4.75	99.9%
No. 10	0.49	0.3%	2.0	99.6%
No. 40	22.25	14.2%	0.425	85.3%
No. 100	24.03	15.4%	0.15	70.0%
No. 200	10.01	6.4%	0.075	63.5%
Pan	0.18	0.1%		
Total	57.16	36.5%		



Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
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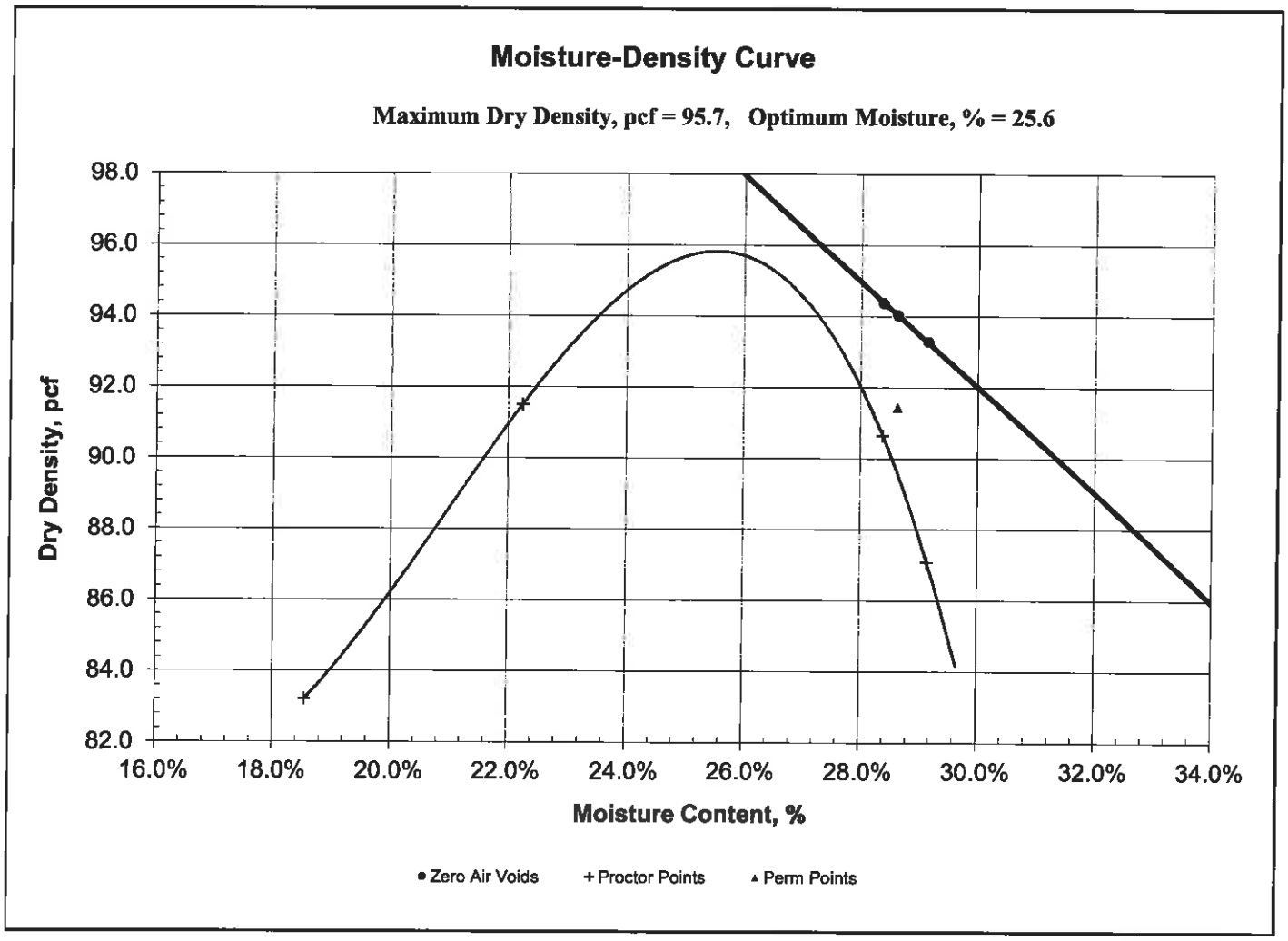
Soil and Test Method Data

Sample ID	Test Pad, Lift 4
Sample Depth	Lift 4
Sample Classification	Sandy Fat CLAY
USCS Group Symbol	CH
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	**18.6%**	**22.2%**	**28.4%**	**29.2%**	
Dry Density, pcf	**83.2**	**91.5**	**90.6**	**87.1**	



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: Test Pad, Lift 4
Sample Depth: Lift 4
Permeability Method: ASTM D5084
Sample Length, in: 3.35
Sample Diameter, in: 2.85
Sample Condition: Remolded

Moisture Content

Pan Wt	8.94	grams
Pan + Soil (wet)	188.67	grams
Pan + Soil (dry)	148.67	grams
Moisture Content	*28.6%*	

Dry Density

Soil (wet)	657.03	grams
Wet Density	117.6	pcf
Dry Density	*91.5*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.7	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	44.7%	
Actual Volume of Voids	155.8	ml
Porosity	44.7%	
Saturation	93.9%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
10-Oct 8:52	16.750		1.200				
10-Oct 8:53	16.500	0.008	1.210	0.008	1.00	22.96	1.4E-07
10-Oct 8:54	16.300	0.006	1.218	0.006	1.00	22.58	1.1E-07
10-Oct 8:55	16.100	0.006	1.227	0.006	1.00	22.27	1.2E-07
10-Oct 8:56	15.950	0.005	1.233	0.005	1.00	21.96	8.8E-08
10-Oct 8:57	15.800	0.005	1.239	0.005	1.00	21.73	8.9E-08
10-Oct 8:58	15.700	0.003	1.243	0.003	1.00	21.50	6.0E-08
10-Oct 8:59	15.600	0.003	1.247	0.003	1.00	21.35	6.0E-08
10-Oct 9:04	15.000	0.019	1.272	0.019	1.00	21.19	7.4E-08

Average Permeability 7.1E-08 cm/sec

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	658.91	grams
Final Moisture Content	29.0%	
Percent Voids	42.4%	
Actual Volume of Voids	141.7	ml
Porosity	42.4%	
Saturation	100.0%	

Final Sample Length, in:	3.30	
Final Sample Diameter, in:	2.81	
Wet Density	122.9	pcf
Dry Density	*95.3*	pcf

Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: TP-ST-4
Sample Depth: Lift 4
Permeability Method: ASTM D5084
Sample Length, in: 3.48
Sample Diameter, in: 2.84
Sample Condition: Undisturbed

Moisture Content

Pan Wt	183.99	grams
Pan + Soil (wet)	429.30	grams
Pan + Soil (dry)	377.32	grams
Moisture Content	*26.9%*	

Dry Density

Soil (wet)	687.27	grams
Wet Density	118.9	pcf
Dry Density	*93.7*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.7	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	43.3%	
Actual Volume of Voids	156.3	ml
Porosity	43.3%	
Saturation	93.2%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
3-Oct 9:28	16.100		1.200				
3-Oct 9:29	15.750	0.011	1.214	0.011	1.00	21.16	2.1E-07
3-Oct 9:30	15.550	0.006	1.223	0.006	1.00	20.64	1.3E-07
3-Oct 9:31	15.400	0.005	1.229	0.005	1.00	20.34	9.5E-08
3-Oct 9:32	15.250	0.005	1.235	0.005	1.00	20.12	9.6E-08
3-Oct 9:33	15.100	0.005	1.241	0.005	1.00	19.90	9.7E-08
3-Oct 9:34	14.950	0.005	1.247	0.005	1.00	19.68	9.8E-08
3-Oct 9:35	14.850	0.003	1.251	0.003	1.00	19.46	6.6E-08
3-Oct 9:41	14.150	0.022	1.280	0.022	1.00	19.31	8.0E-08

Average Permeability 8.5E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	693.10	grams
Final Moisture Content	28.0%	
Percent Voids	42.6%	
Actual Volume of Voids	151.8	ml
Porosity	42.6%	
Saturation	99.8%	

Final Sample Length, in:	3.43	
Final Sample Diameter, in:	2.84	
Wet Density	121.4	pcf
Dry Density	*94.9*	pcf

Proctor Test Report

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: LTW

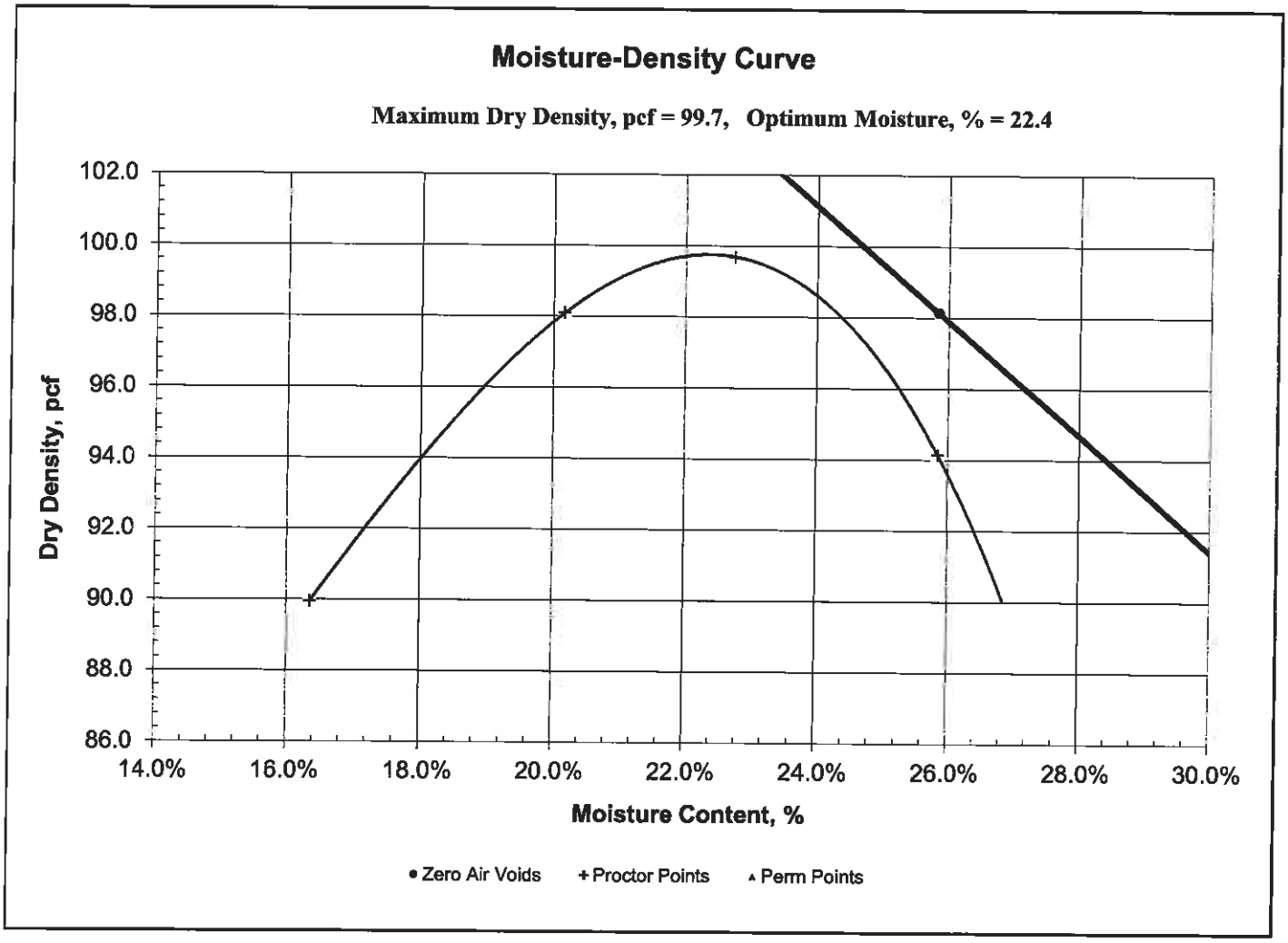
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	Test Pad, Modified
Sample Depth	Lift 4
Sample Classification	#DIV/0!
USCS Group Symbol	#DIV/0!
Test Method	ASTM D1557, Method A, with mechanical hammer
Sample Preparation	Air dried and sieved through a #4 sieve.
Mold Size, in	4.0

Test Data

	#1	#2	#3	#4	#5
Moisture Content	**16.4%**	**20.2%**	**22.8%**	**25.8%**	
Dry Density, pcf	**89.9**	**98.1**	**99.7**	**94.1**	



Clay Liner
(Soil Liner) Laboratory Data

SOIL LINER LAB DATA

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID	P-1-1
Sample Depth	Lift 1
Visual Sample Description	Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	3
Pan Wt	193.04 grams
Pan + Soil (wet)	347.54 grams
Pan + Soil (dry)	314.56 grams
Natural Moisture Content	*27.1%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	235.41 grams
Percent Passing No. 200 Sieve	65.1%
Pan + Soil retained on No. 4 sieve (dry)	193.04 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	17	25	32
Pan ID	5	62	71
Pan Wt	11.10	10.98	10.94
Pan + Soil (wet)	21.87	22.86	20.15
Pan + Soil (dry)	17.75	18.41	16.73
Moisture Content	62.0%	59.9%	59.1%
Liquid Limit	59	60	61
Liquid Limit	*60*		

Plastic Limit

Pan ID	358	3.55
Pan Weight	1.93	1.92
Pan + Soil (wet)	9.40	9.84
Pan + Soil (dry)	7.70	8.10
Moisture Content	29.5%	28.2%
Plastic Limit	*29*	
Plastic Index	*31*	

USCS Classification: ASTM D 2487

Group Symbol	**CH**
Group Name	**Sandy Fat CLAY**

Grain Size Distribution Calculations

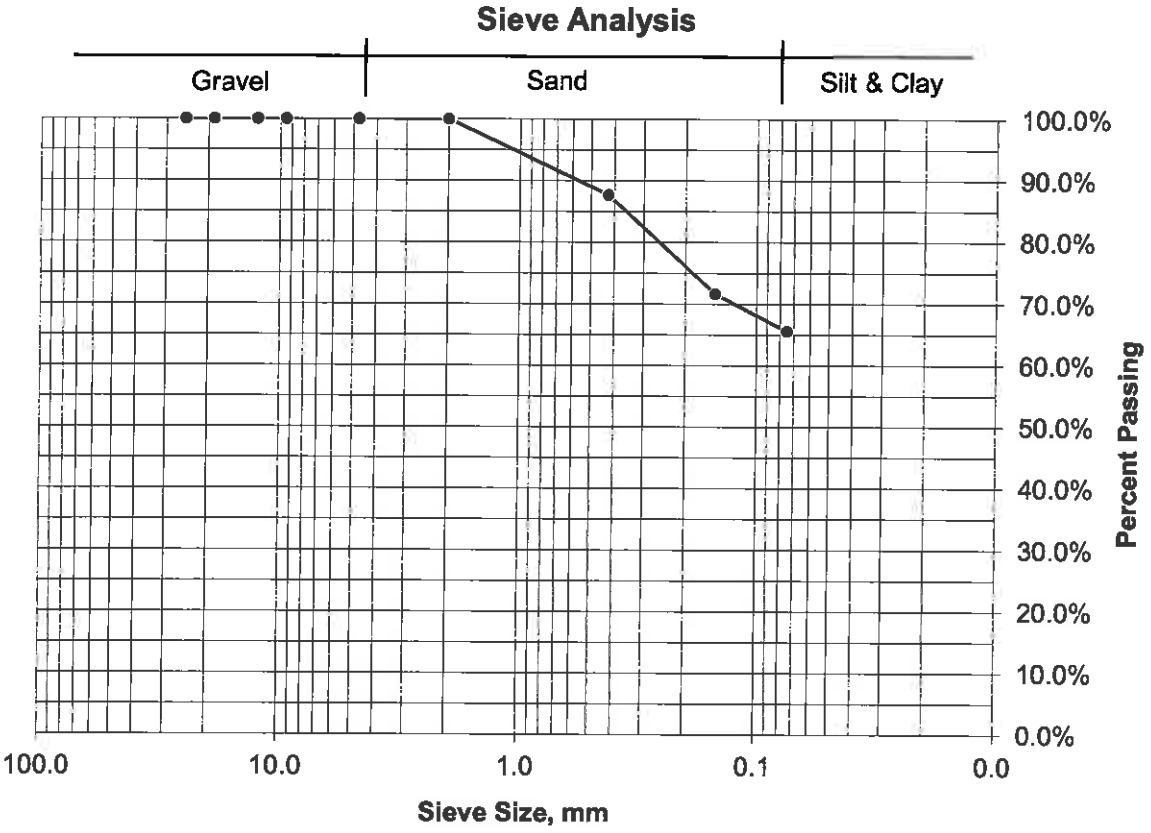
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-1-1
Sample Depth Lift 1

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.00	0.0%	2.0	100.0%
No. 40	14.91	12.3%	0.425	87.7%
No. 100	19.53	16.1%	0.15	71.7%
No. 200	7.32	6.0%	0.075	65.6%
Pan	0.00	0.0%		
Total	41.76	34.4%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-1-1
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 2.52
Sample Diameter, in: 2.83
Sample Condition: Undisturbed

Moisture Content

Pan Wt	193.04	grams
Pan + Soil (wet)	347.54	grams
Pan + Soil (dry)	314.56	grams
Moisture Content	*27.1%*	

Dry Density

Soil (wet)	494.95	grams
Wet Density	118.8	pcf
Dry Density	*93.4*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.5	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	43.5%
Actual Volume of Voids	113.1 ml
Porosity	43.5%
Saturation	93.4%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
6-Oct 10:30	17.150		1.150				
6-Oct 10:31	16.950	0.006	1.158	0.006	1.00	31.41	8.3E-08
6-Oct 10:32	16.750	0.006	1.166	0.006	1.00	31.00	8.4E-08
6-Oct 10:33	16.550	0.006	1.175	0.006	1.00	30.59	8.5E-08
6-Oct 10:34	16.350	0.006	1.183	0.006	1.00	30.18	8.6E-08
6-Oct 10:35	16.200	0.005	1.189	0.005	1.00	29.77	6.5E-08
6-Oct 10:36	16.000	0.006	1.197	0.006	1.00	29.47	8.8E-08
6-Oct 10:37	15.850	0.005	1.203	0.005	1.00	29.06	6.7E-08
6-Oct 10:44	14.700	0.036	1.250	0.036	1.00	28.75	7.7E-08

Average Permeability 7.4E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65		
Final Weight of Sample	498.75 grams		
Final Moisture Content	28.1%	Final Sample Length, in:	2.47
Percent Voids	42.6%	Final Sample Diameter, in:	2.84
Actual Volume of Voids	109.1 ml	Wet Density	121.6 pcf
Porosity	42.6%	*Dry Density*	*94.9* pcf
Saturation	100.0%		

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-1-2
Sample Depth Lift 2
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	3
Pan Wt	193.11 grams
Pan + Soil (wet)	389.51 grams
Pan + Soil (dry)	344.75 grams
Natural Moisture Content	*29.5%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	247.69 grams
Percent Passing No. 200 Sieve	64.0%
Pan + Soil retained on No. 4 sieve (dry)	193.11 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	19	28	34
Pan ID	169	5	63
Pan Wt	27.15	11.09	10.82
Pan + Soil (wet)	37.80	22.05	21.67
Pan + Soil (dry)	33.51	17.85	17.59
Moisture Content	67.5%	62.1%	60.3%
Liquid Limit	65	63	63
Liquid Limit	*64*		

Plastic Limit

Pan ID	81	78
Pan Weight	4.30	4.24
Pan + Soil (wet)	14.38	16.48
Pan + Soil (dry)	12.08	13.72
Moisture Content	29.6%	29.1%
Plastic Limit	*29*	
Plastic Index	*35*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

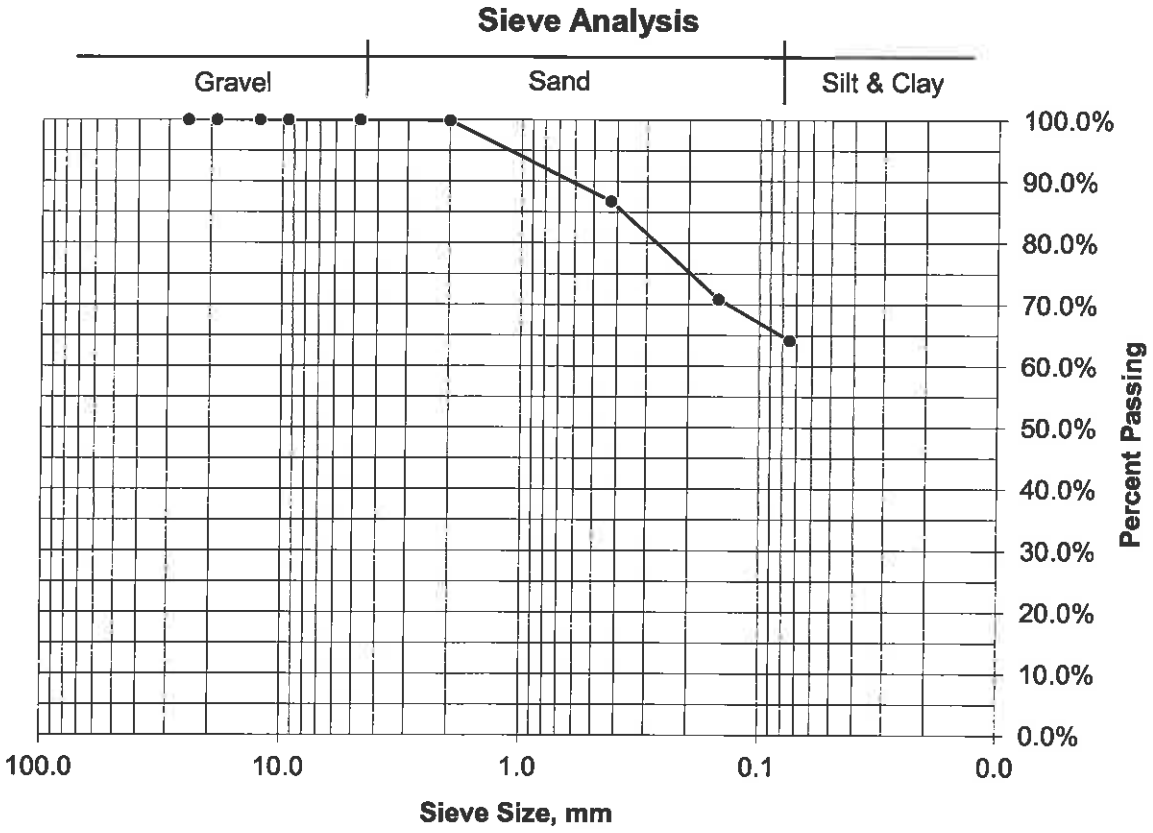
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-1-2
Sample Depth Lift 2

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.14	0.1%	2.0	99.9%
No. 40	19.91	13.1%	0.425	86.8%
No. 100	24.11	15.9%	0.15	70.9%
No. 200	10.17	6.7%	0.075	64.2%
Pan	0.21	0.1%		
Total	54.54	35.8%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-1-2
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 3.27
Sample Diameter, in: 2.83
Sample Condition: Undisturbed

Moisture Content

Pan Wt	193.11	grams
Pan + Soil (wet)	389.51	grams
Pan + Soil (dry)	344.75	grams
Moisture Content	*29.5%*	

Dry Density

Soil (wet)	634.17	grams
Wet Density	117.6	pcf
Dry Density	*90.8*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.8	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	45.1%	
Actual Volume of Voids	151.9	ml
Porosity	45.1%	
Saturation	95.2%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
9-Oct 8:14	16.800		1.200				
9-Oct 8:15	16.500	0.009	1.212	0.009	1.00	23.56	1.7E-07
9-Oct 8:16	16.250	0.008	1.223	0.008	1.00	23.09	1.4E-07
9-Oct 8:17	16.000	0.008	1.233	0.008	1.00	22.70	1.4E-07
9-Oct 8:18	15.750	0.008	1.243	0.008	1.00	22.31	1.5E-07
9-Oct 8:19	15.550	0.006	1.251	0.006	1.00	21.91	1.2E-07
9-Oct 8:20	15.400	0.005	1.257	0.005	1.00	21.60	9.0E-08
9-Oct 8:21	15.250	0.005	1.263	0.005	1.00	21.36	9.1E-08
9-Oct 8:26	14.500	0.024	1.294	0.024	1.00	21.13	9.4E-08

Average Permeability 9.9E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	637.24	grams
Final Moisture Content	30.1%	
Percent Voids	45.2%	
Actual Volume of Voids	152.6	mi
Porosity	45.2%	
Saturation	96.7%	

Final Sample Length, in:	3.23	
Final Sample Diameter, in:	2.85	
Wet Density	117.9	pcf
Dry Density	*90.6*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-1-3
Sample Depth Lift 3
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	35
Pan Wt	192.87 grams
Pan + Soil (wet)	349.30 grams
Pan + Soil (dry)	320.53 grams
Natural Moisture Content	*22.5%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	246.74 grams
Percent Passing No. 200 Sieve	57.8%
Pan + Soil retained on No. 4 sieve (dry)	195.33 grams
Percent Passing No. 4 Sieve	98.1%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	18	24	34
Pan ID	109	96	101
Pan Wt	25.02	24.83	24.04
Pan + Soil (wet)	35.46	38.91	33.82
Pan + Soil (dry)	31.62	33.90	30.50
Moisture Content	58.2%	55.2%	51.4%
Liquid Limit	56	55	53
Liquid Limit	*55*		

Plastic Limit

Pan ID	2	353
Pan Weight	9.00	9.12
Pan + Soil (wet)	19.99	19.79
Pan + Soil (dry)	18.05	17.88
Moisture Content	21.4%	21.8%
Plastic Limit	*22*	
Plastic Index	*33*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

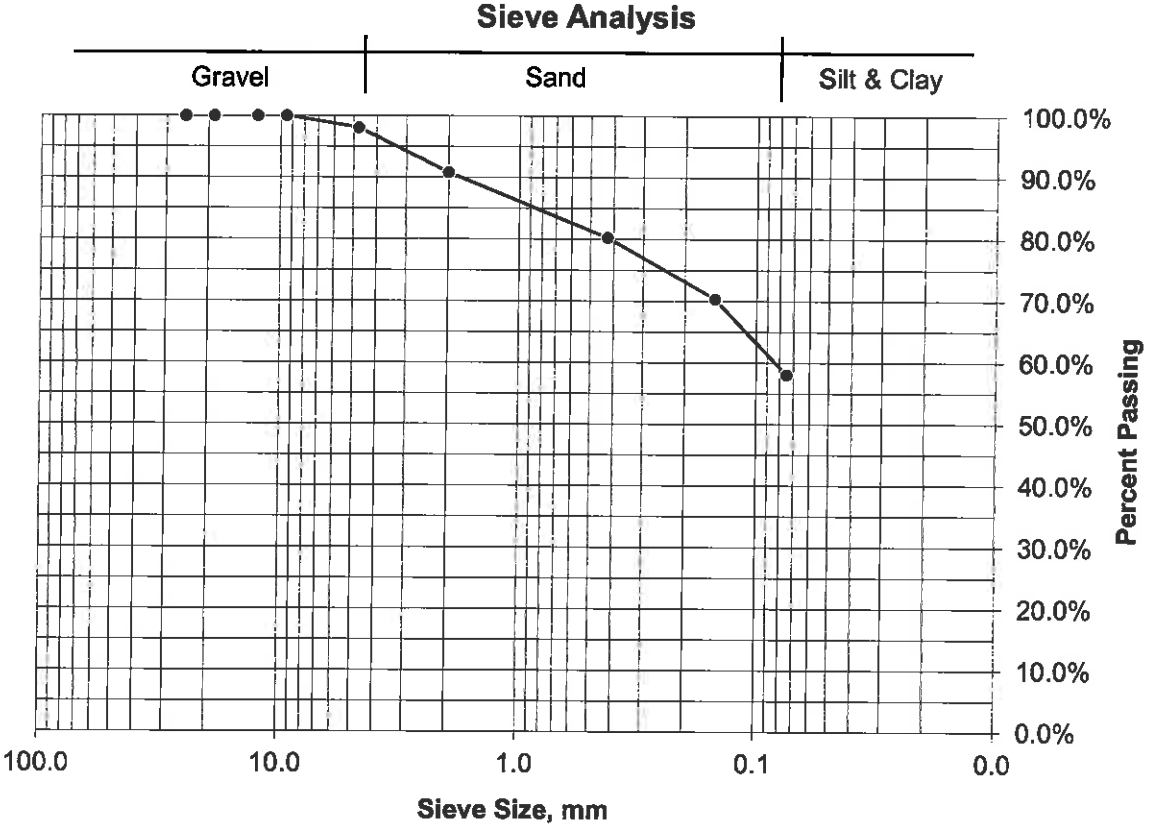
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-1-3
Sample Depth Lift 3

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	2.46	1.9%	4.75	98.1%
No. 10	9.26	7.3%	2.0	90.8%
No. 40	13.47	10.6%	0.425	80.3%
No. 100	12.67	9.9%	0.15	70.3%
No. 200	15.64	12.3%	0.075	58.1%
Pan	0.00	0.0%		
Total	53.50	41.9%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-1-3
Sample Depth: Lift 3
Permeability Method: ASTM D5084
Sample Length, in: 3.47
Sample Diameter, in: 2.85
Sample Condition: Undisturbed

Moisture Content

Pan Wt	192.87 grams
Pan + Soil (wet)	349.30 grams
Pan + Soil (dry)	320.53 grams
Moisture Content	*22.5%*

Dry Density

Soil (wet)	716.87 grams
Wet Density	123.8 pcf
Dry Density	*101.0* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712
Effective Stress, psi	10.0
Pearment Liquid Temp.(°C):	20.9 De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	38.9%
Actual Volume of Voids	140.7 ml
Porosity	38.9%
Saturation	93.7%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
15-Oct 7:54	16.800		1.100				
15-Oct 7:55	15.600	0.038	1.149	0.038	1.00	22.36	7.1E-07
15-Oct 7:56	15.150	0.014	1.168	0.014	1.00	20.58	2.8E-07
15-Oct 7:57	14.950	0.006	1.176	0.006	1.00	19.91	1.3E-07
15-Oct 7:58	14.800	0.005	1.182	0.005	1.00	19.61	9.8E-08
15-Oct 7:59	14.650	0.005	1.188	0.005	1.00	19.39	9.9E-08
15-Oct 8:00	14.500	0.005	1.194	0.005	1.00	19.17	1.0E-07
15-Oct 8:01	14.350	0.005	1.200	0.005	1.00	18.95	1.0E-07
15-Oct 8:06	13.700	0.020	1.227	0.020	1.00	18.72	9.1E-08

Average Permeability 9.8E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	722.83 grams
Final Moisture Content	23.6%
Percent Voids	37.6%
Actual Volume of Voids	132.8 ml
Porosity	37.6%
Saturation	100.0%

Final Sample Length, in:	3.46
Final Sample Diameter, in:	2.82
Wet Density	127.6 pcf
Dry Density	*103.2* pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-1-4
Sample Depth Lift 4
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	31
Pan Wt	182.99 grams
Pan + Soil (wet)	438.08 grams
Pan + Soil (dry)	386.75 grams
Natural Moisture Content	*25.2%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	268.22 grams
Percent Passing No. 200 Sieve	58.2%
Pan + Soil retained on No. 4 sieve (dry)	183.09 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	20	28	31
Pan ID	103	107	169
Pan Wt	27.39	25.09	27.15
Pan + Soil (wet)	40.78	39.18	42.61
Pan + Soil (dry)	35.76	34.15	37.17
Moisture Content	60.0%	55.5%	54.3%
Liquid Limit	58	56	56
Liquid Limit	*57*		

Plastic Limit

Pan ID	22	76
Pan Weight	4.32	4.24
Pan + Soil (wet)	16.46	15.19
Pan + Soil (dry)	13.59	12.64
Moisture Content	31.0%	30.4%
Plastic Limit	*31*	
Plastic Index	*26*	

USCS Classification: ASTM D 2487

Group Symbol **MH**
Group Name **Sandy Elastic SILT**

Grain Size Distribution Calculations

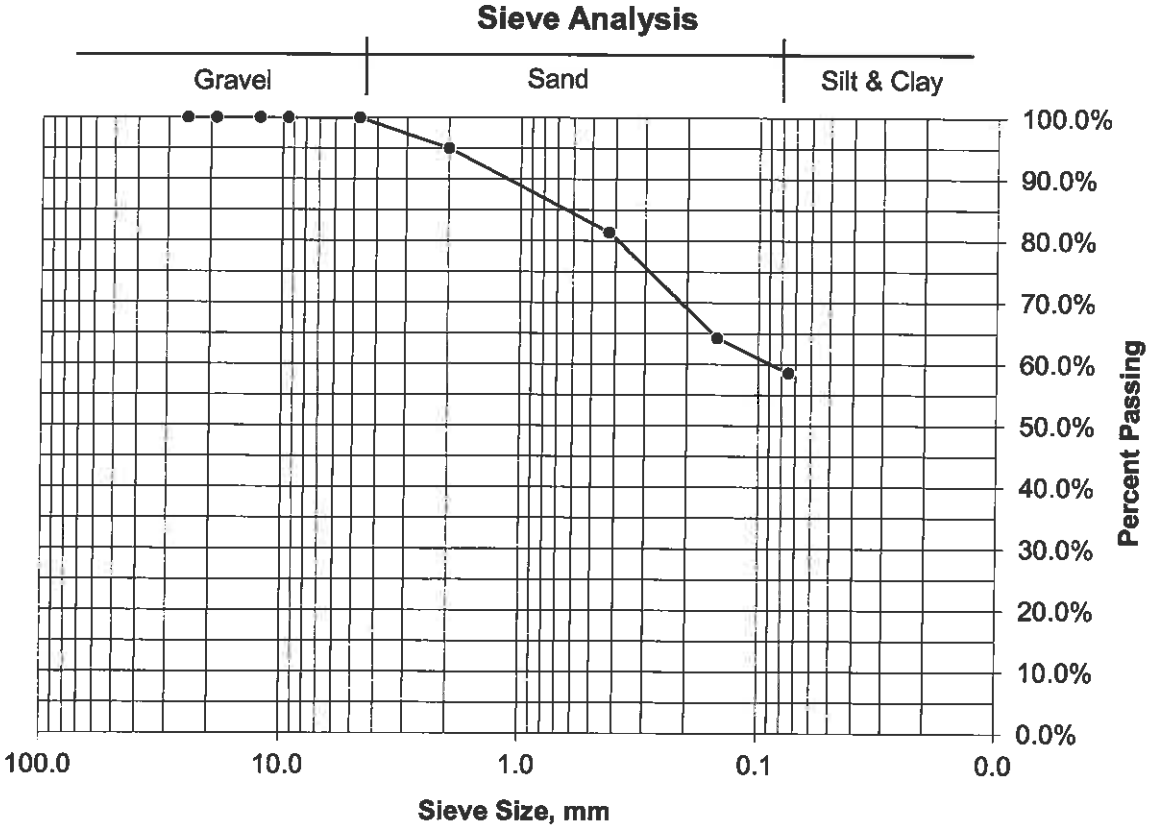
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-1-4
Sample Depth Lift 4

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.10	0.0%	4.75	100.0%
No. 10	10.11	5.0%	2.0	95.0%
No. 40	27.76	13.6%	0.425	81.4%
No. 100	34.81	17.1%	0.15	64.3%
No. 200	11.60	5.7%	0.075	58.6%
Pan	0.40	0.2%		
Total	84.78	41.4%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-1-4
Sample Depth: Lift 4
Permeability Method: ASTM D5084
Sample Length, in: 3.33
Sample Diameter, in: 2.83
Sample Condition: Undisturbed

Moisture Content

Pan Wt	182.99	grams
Pan + Soil (wet)	438.08	grams
Pan + Soil (dry)	386.75	grams
Moisture Content	*25.2%*	

Dry Density

Soil (wet)	666.37	grams
Wet Density	121.2	pcf
Dry Density	*96.8*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	21.1	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	41.5%
Actual Volume of Voids	142.4 ml
Porosity	41.5%
Saturation	94.2%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
22-Oct 14:11	15.500		1.200				
22-Oct 14:12	15.300	0.006	1.208	0.006	1.00	21.22	1.2E-07
22-Oct 14:13	15.200	0.003	1.212	0.003	1.00	20.91	6.2E-08
22-Oct 14:14	15.100	0.003	1.216	0.003	1.00	20.75	6.2E-08
22-Oct 14:15	15.000	0.003	1.220	0.003	1.00	20.60	6.3E-08
22-Oct 14:16	14.900	0.003	1.225	0.003	1.00	20.45	6.3E-08
22-Oct 14:17	14.800	0.003	1.229	0.003	1.00	20.29	6.4E-08
22-Oct 14:18	14.700	0.003	1.233	0.003	1.00	20.14	6.4E-08
22-Oct 14:23	14.450	0.008	1.243	0.008	1.00	19.98	3.3E-08

Average Permeability 5.6E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	667.84	grams
Final Moisture Content	25.5%	
Percent Voids	41.5%	
Actual Volume of Voids	142.5	ml
Porosity	41.5%	
Saturation	95.1%	

Final Sample Length, in:	3.26	
Final Sample Diameter, in:	2.86	
Wet Density	121.4	pcf
Dry Density	*96.7*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-2-1
Sample Depth Lift 1
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	10
Pan Wt	184.01 grams
Pan + Soil (wet)	357.96 grams
Pan + Soil (dry)	319.74 grams
Natural Moisture Content	*28.2%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	234.00 grams
Percent Passing No. 200 Sieve	63.2%
Pan + Soil retained on No. 4 sieve (dry)	184.01 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	19	25	32
Pan ID	9	312	350
Pan Wt	11.17	13.88	13.96
Pan + Soil (wet)	24.69	25.70	25.34
Pan + Soil (dry)	19.67	21.37	21.32
Moisture Content	59.1%	57.8%	54.6%
Liquid Limit	57	58	56
Liquid Limit	*57*		

Plastic Limit

Pan ID	19	13
Pan Weight	4.37	4.29
Pan + Soil (wet)	14.42	14.39
Pan + Soil (dry)	12.18	12.16
Moisture Content	28.7%	28.3%
Plastic Limit	*29*	
Plastic Index	*28*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

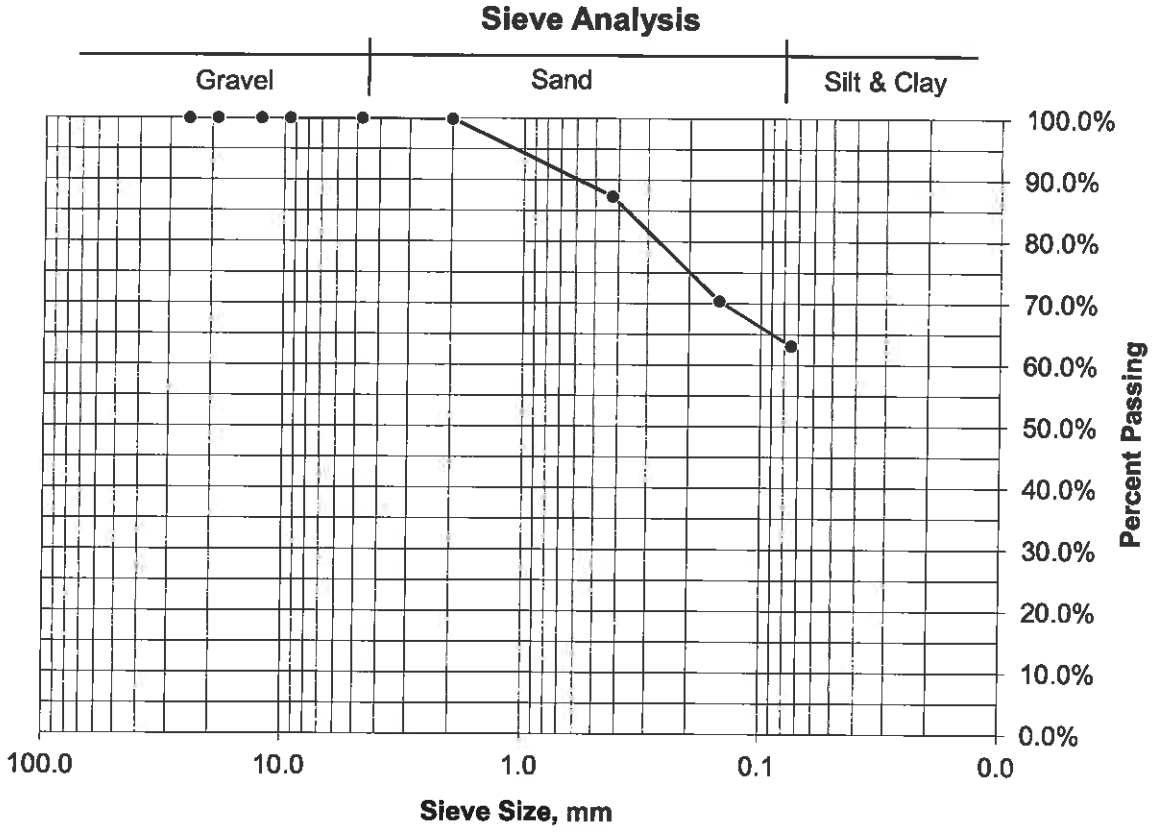
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-2-1
Sample Depth Lift 1

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.12	0.1%	2.0	99.9%
No. 40	17.02	12.5%	0.425	87.4%
No. 100	23.04	17.0%	0.15	70.4%
No. 200	9.90	7.3%	0.075	63.1%
Pan	0.00	0.0%		
Total	50.08	36.9%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-2-1
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.24
Sample Diameter, in: 2.84
Sample Condition: Undisturbed

Moisture Content

Pan Wt	184.01	grams
Pan + Soil (wet)	357.96	grams
Pan + Soil (dry)	319.74	grams
Moisture Content	*28.2%*	

Dry Density

Soil (wet)	644.19	grams
Wet Density	119.4	pcf
Dry Density	*93.2*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.9	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	43.7%	
Actual Volume of Voids	147.1	ml
Porosity	43.7%	
Saturation	96.3%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
7-Oct 8:08	16.150		1.200				
7-Oct 8:09	15.950	0.006	1.208	0.006	1.00	22.83	1.1E-07
7-Oct 8:10	15.800	0.005	1.214	0.005	1.00	22.52	8.6E-08
7-Oct 8:11	15.700	0.003	1.218	0.003	1.00	22.28	5.8E-08
7-Oct 8:12	15.600	0.003	1.223	0.003	1.00	22.12	5.8E-08
7-Oct 8:13	15.500	0.003	1.227	0.003	1.00	21.96	5.8E-08
7-Oct 8:14	15.450	0.002	1.229	0.002	1.00	21.80	2.9E-08
7-Oct 8:15	15.400	0.002	1.231	0.002	1.00	21.72	2.9E-08
7-Oct 8:21	14.900	0.016	1.251	0.016	1.00	21.64	5.0E-08

Average Permeability 4.2E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	642.57	grams
Final Moisture Content	27.8%	
Percent Voids	42.2%	
Actual Volume of Voids	138.8	ml
Porosity	42.3%	
Saturation	100.0%	

Final Sample Length, in:	3.17	
Final Sample Diameter, in:	2.84	
Wet Density	122.1	pcf
Dry Density	*95.5*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-2-1
Sample Depth Lift 1
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	10
Pan Wt	184.01 grams
Pan + Soil (wet)	357.96 grams
Pan + Soil (dry)	319.74 grams
Natural Moisture Content	*28.2%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	234.00 grams
Percent Passing No. 200 Sieve	63.2%
Pan + Soil retained on No. 4 sieve (dry)	184.01 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	19	25	32
Pan ID	9	312	350
Pan Wt	11.17	13.88	13.96
Pan + Soil (wet)	24.69	25.70	25.34
Pan + Soil (dry)	19.67	21.37	21.32
Moisture Content	59.1%	57.8%	54.6%
Liquid Limit	57	58	56
Liquid Limit	*57*		

Plastic Limit

Pan ID	19	13
Pan Weight	4.37	4.29
Pan + Soil (wet)	14.42	14.39
Pan + Soil (dry)	12.18	12.16
Moisture Content	28.7%	28.3%
Plastic Limit	*29*	
Plastic Index	*28*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

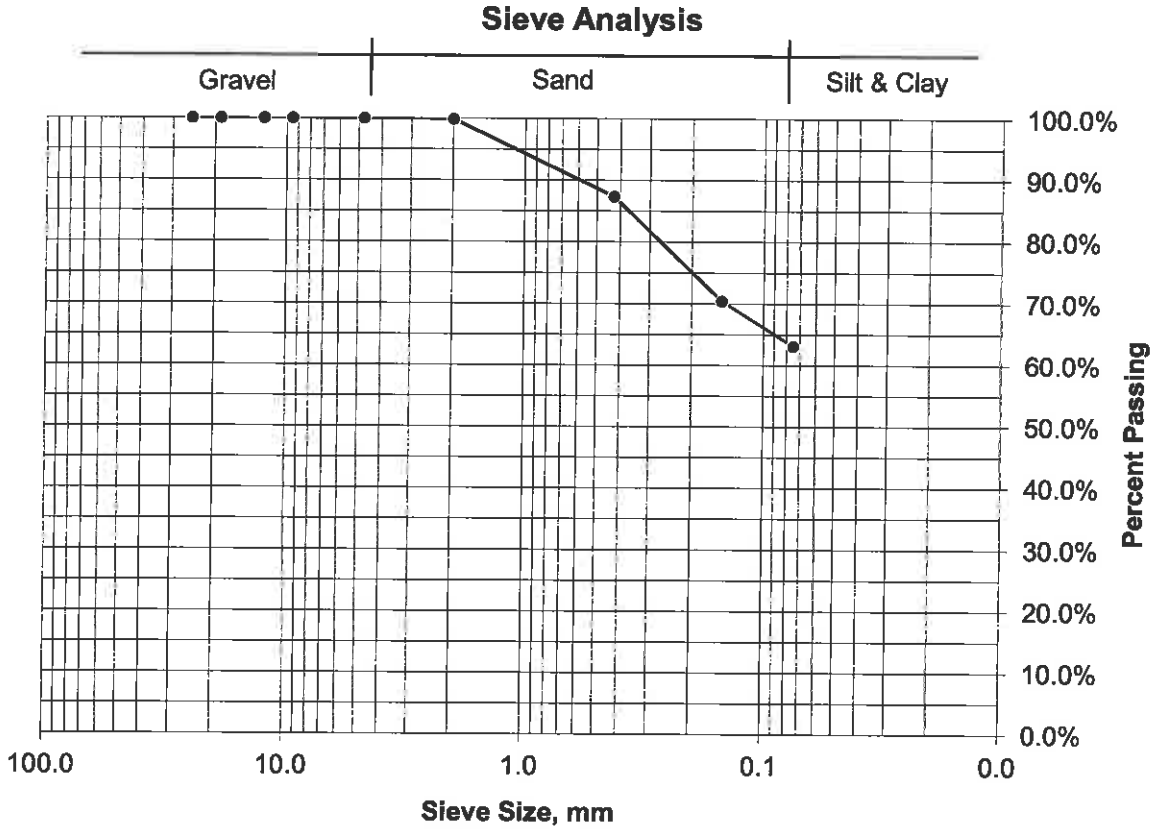
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-2-1
Sample Depth Lift 1

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.12	0.1%	2.0	99.9%
No. 40	17.02	12.5%	0.425	87.4%
No. 100	23.04	17.0%	0.15	70.4%
No. 200	9.90	7.3%	0.075	63.1%
Pan	0.00	0.0%		
Total	50.08	36.9%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-2-1
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.24
Sample Diameter, in: 2.84
Sample Condition: Undisturbed

Moisture Content

Pan Wt	184.01	grams
Pan + Soil (wet)	357.96	grams
Pan + Soil (dry)	319.74	grams
Moisture Content	*28.2%*	

Dry Density

Soil (wet)	644.19	grams
Wet Density	119.4	pcf
Dry Density	*93.2*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.9	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	43.7%
Actual Volume of Voids	147.1 ml
Porosity	43.7%
Saturation	96.3%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
7-Oct 8:08	16.150		1.200				
7-Oct 8:09	15.950	0.006	1.208	0.006	1.00	22.83	1.1E-07
7-Oct 8:10	15.800	0.005	1.214	0.005	1.00	22.52	8.6E-08
7-Oct 8:11	15.700	0.003	1.218	0.003	1.00	22.28	5.8E-08
7-Oct 8:12	15.600	0.003	1.223	0.003	1.00	22.12	5.8E-08
7-Oct 8:13	15.500	0.003	1.227	0.003	1.00	21.96	5.8E-08
7-Oct 8:14	15.450	0.002	1.229	0.002	1.00	21.80	2.9E-08
7-Oct 8:15	15.400	0.002	1.231	0.002	1.00	21.72	2.9E-08
7-Oct 8:21	14.900	0.016	1.251	0.016	1.00	21.64	5.0E-08

Average Permeability 4.2E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	642.57	grams
Final Moisture Content	27.8%	
Percent Voids	42.2%	
Actual Volume of Voids	138.8	ml
Porosity	42.3%	
Saturation	100.0%	

Final Sample Length, in:	3.17
Final Sample Diameter, in:	2.84
Wet Density	122.1 pcf
Dry Density	*95.5* pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-2-2
Sample Depth Lift 2
Visual Sample Description Red-Brown Sandy Elastic SILT

Natural Moisture Content: ASTM D 2216

Pan ID	8
Pan Wt	187.08 grams
Pan + Soil (wet)	429.28 grams
Pan + Soil (dry)	379.31 grams
Natural Moisture Content	*26.0%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	266.20 grams
Percent Passing No. 200 Sieve	58.8%
Pan + Soil retained on No. 4 sieve (dry)	187.08 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	15	28	35
Pan ID	96	109	169
Pan Wt	24.83	25.03	27.16
Pan + Soil (wet)	40.73	38.93	43.02
Pan + Soil (dry)	34.95	34.23	37.92
Moisture Content	57.1%	51.1%	47.4%
Liquid Limit	54	52	49
Liquid Limit	*52*		

Plastic Limit

Pan ID	314	354
Pan Weight	9.13	9.14
Pan + Soil (wet)	20.84	21.52
Pan + Soil (dry)	18.15	18.68
Moisture Content	29.8%	29.8%
Plastic Limit	*30*	
Plastic Index	*22*	

USCS Classification: ASTM D 2487

Group Symbol **MH**
Group Name **Sandy Elastic SILT**

Grain Size Distribution Calculations

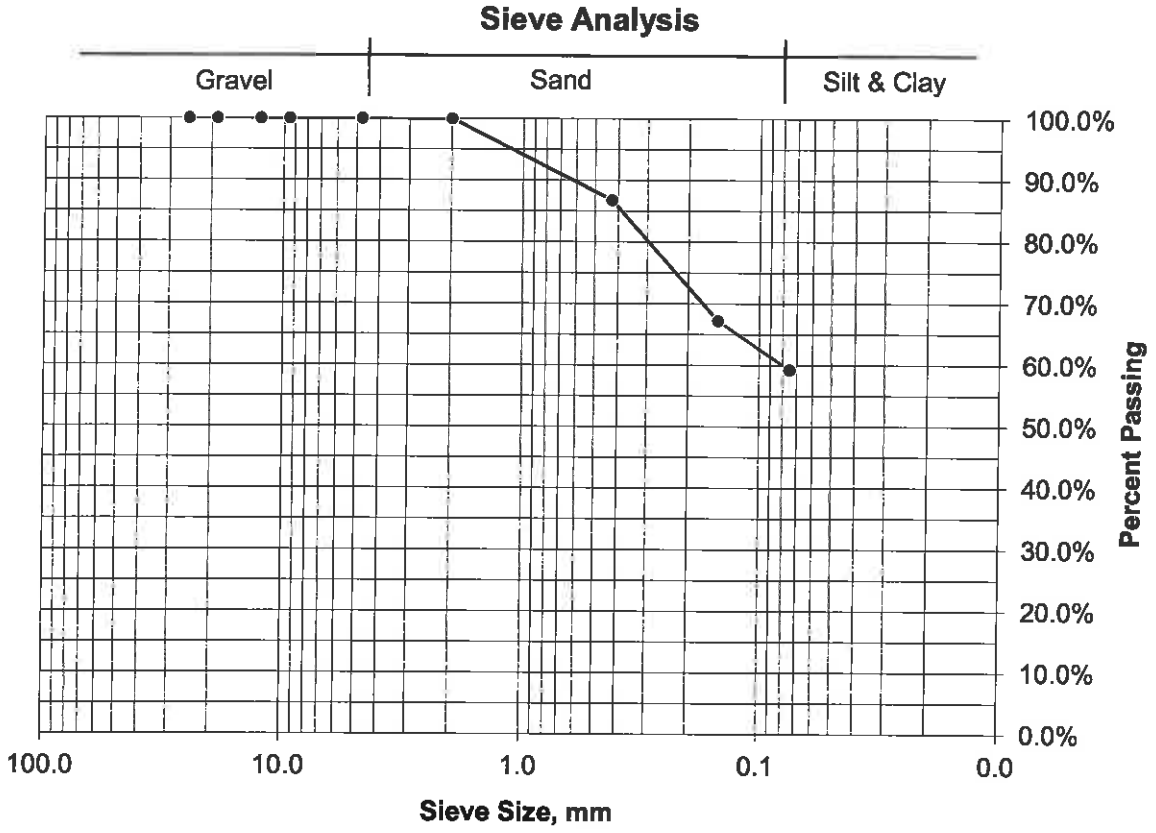
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-2-2
Sample Depth Lift 2

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.14	0.1%	2.0	99.9%
No. 40	25.28	13.2%	0.425	86.8%
No. 100	37.62	19.6%	0.15	67.2%
No. 200	15.23	7.9%	0.075	59.3%
Pan	0.46	0.2%		
Total	78.73	40.7%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-2-2-A
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 3.01
Sample Diameter, in: 2.81
Sample Condition: Undisturbed

Moisture Content

Pan Wt	9.64	grams
Pan + Soil (wet)	188.18	grams
Pan + Soil (dry)	153.91	grams
Moisture Content	*23.8%*	

Dry Density

Soil (wet)	600.76	grams
Wet Density	122.6	pcf
Dry Density	*99.0*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.8	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	40.1%
Actual Volume of Voids	122.7 ml
Porosity	40.1%
Saturation	94.0%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
15-Oct 7:30	16.750		1.100				
15-Oct 7:31	16.400	0.011	1.114	0.011	1.00	25.69	1.8E-07
15-Oct 7:32	16.150	0.008	1.125	0.008	1.00	25.09	1.3E-07
15-Oct 7:33	15.950	0.006	1.133	0.006	1.00	24.66	1.1E-07
15-Oct 7:34	15.800	0.005	1.139	0.005	1.00	24.32	8.1E-08
15-Oct 7:35	15.650	0.005	1.145	0.005	1.00	24.07	8.2E-08
15-Oct 7:36	15.500	0.005	1.151	0.005	1.00	23.81	8.3E-08
15-Oct 7:37	15.350	0.005	1.157	0.005	1.00	23.55	8.4E-08
15-Oct 7:42	14.450	0.028	1.194	0.028	1.00	23.30	1.0E-07

Average Permeability 8.8E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	609.70	grams
Final Moisture Content	25.6%	
Percent Voids	38.8%	
Actual Volume of Voids	116.0	ml
Porosity	38.8%	
Saturation	100.0%	

Final Sample Length, in:	2.99
Final Sample Diameter, in:	2.79
Wet Density	127.2 pcf
Dry Density	*101.2* pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID	P-2-3
Sample Depth	NA
Visual Sample Description	Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	3
Pan Wt	193.04 grams
Pan + Soil (wet)	451.82 grams
Pan + Soil (dry)	402.94 grams
Natural Moisture Content	*23.3%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	286.70 grams
Percent Passing No. 200 Sieve	55.4%
Pan + Soil retained on No. 4 sieve (dry)	193.04 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	18	23	32
Pan ID	9	63	71
Pan Wt	11.19	10.86	10.93
Pan + Soil (wet)	22.38	22.52	21.00
Pan + Soil (dry)	17.90	18.03	17.25
Moisture Content	66.8%	62.6%	59.3%
Liquid Limit	64	62	61
Liquid Limit	*62*		

Plastic Limit

Pan ID	74	82
Pan Weight	4.30	4.27
Pan + Soil (wet)	14.78	14.92
Pan + Soil (dry)	12.39	12.42
Moisture Content	29.5%	30.7%
Plastic Limit	*30*	
Plastic Index	*32*	

USCS Classification: ASTM D 2487

Group Symbol	**CH**
Group Name	**Sandy Fat CLAY**

Grain Size Distribution Calculations

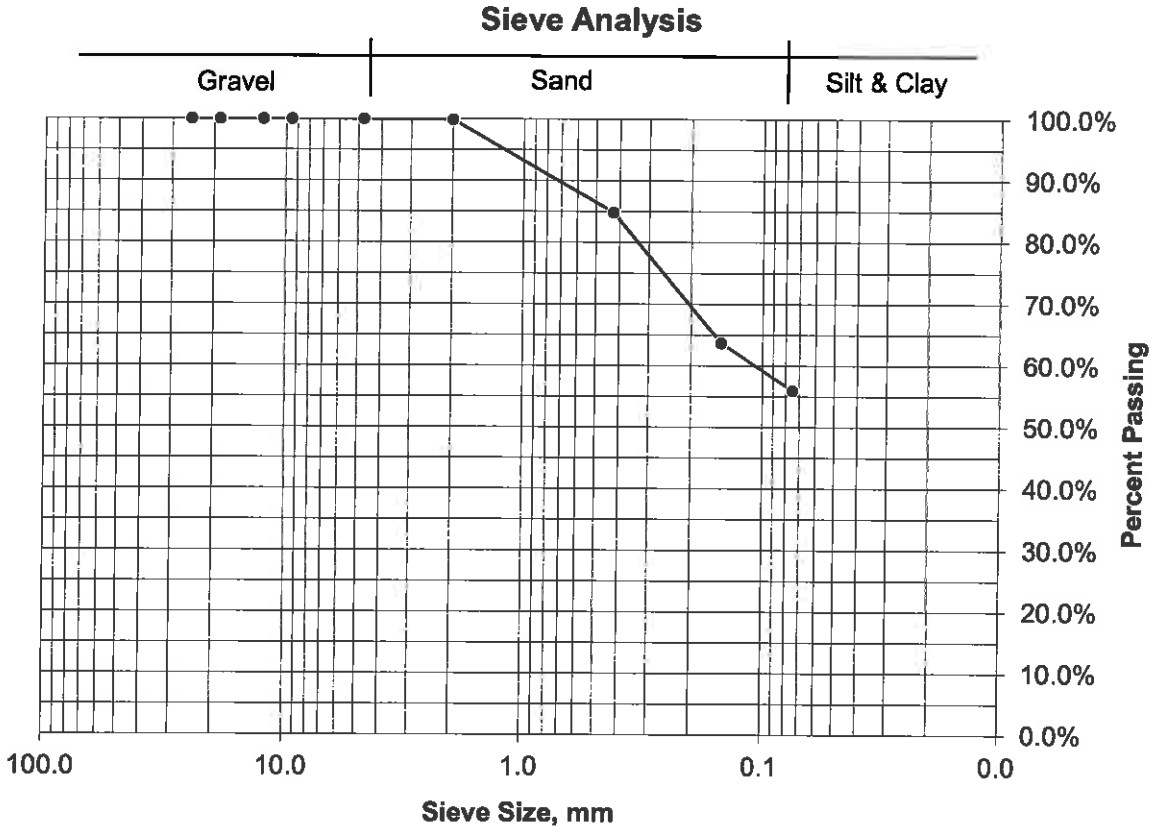
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-2-3
Sample Depth NA

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.25	0.1%	2.0	99.9%
No. 40	31.50	15.0%	0.425	84.9%
No. 100	44.42	21.2%	0.15	63.7%
No. 200	16.23	7.7%	0.075	56.0%
Pan	0.64	0.3%		
Total	93.04	44.0%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-2-3
Sample Depth: NA
Permeability Method: ASTM D5084
Sample Length, in: 3.34
Sample Diameter, in: 2.83
Sample Condition: Undisturbed

Moisture Content

Pan Wt	193.04	grams
Pan + Soil (wet)	451.82	grams
Pan + Soil (dry)	402.94	grams
Moisture Content	*23.3%*	

Dry Density

Soil (wet)	686.47	grams
Wet Density	124.2	pcf
Dry Density	*100.7*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	21.1	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	39.1%	
Actual Volume of Voids	134.8	ml
Porosity	39.1%	
Saturation	96.2%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
15-Oct 7:14	16.800		1.100				
15-Oct 7:15	16.600	0.006	1.108	0.006	1.00	23.25	1.1E-07
15-Oct 7:16	16.400	0.006	1.116	0.006	1.00	22.94	1.1E-07
15-Oct 7:17	16.150	0.008	1.127	0.008	1.00	22.63	1.4E-07
15-Oct 7:18	15.900	0.008	1.137	0.008	1.00	22.24	1.5E-07
15-Oct 7:19	15.750	0.005	1.143	0.005	1.00	21.86	8.9E-08
15-Oct 7:20	15.600	0.005	1.149	0.005	1.00	21.63	9.0E-08
15-Oct 7:21	15.450	0.005	1.155	0.005	1.00	21.40	9.1E-08
15-Oct 7:26	14.650	0.025	1.188	0.025	1.00	21.17	1.0E-07

Average Permeability 9.2E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	692.83	grams
Final Moisture Content	24.4%	
Percent Voids	37.0%	
Actual Volume of Voids	123.3	ml
Porosity	37.0%	
Saturation	100.0%	

Final Sample Length, in:	3.31	
Final Sample Diameter, in:	2.80	
Wet Density	129.7	pcf
Dry Density	*104.2*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-2-4
Sample Depth NA
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	10
Pan Wt	184.09 grams
Pan + Soil (wet)	461.20 grams
Pan + Soil (dry)	402.90 grams
Natural Moisture Content	*26.6%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	271.98 grams
Percent Passing No. 200 Sieve	59.8%
Pan + Soil retained on No. 4 sieve (dry)	190.56 grams
Percent Passing No. 4 Sieve	97.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	18	22	31
Pan ID	12	6	71
Pan Wt	11.25	11.21	10.93
Pan + Soil (wet)	24.37	26.54	25.78
Pan + Soil (dry)	19.21	20.83	20.47
Moisture Content	64.8%	59.4%	55.7%
Liquid Limit	62	58	57
Liquid Limit	*59*		

Plastic Limit

Pan ID	75	43
Pan Weight	4.22	1.93
Pan + Soil (wet)	14.89	12.66
Pan + Soil (dry)	13.03	10.77
Moisture Content	21.1%	21.4%
Plastic Limit	*21*	
Plastic Index	*38*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

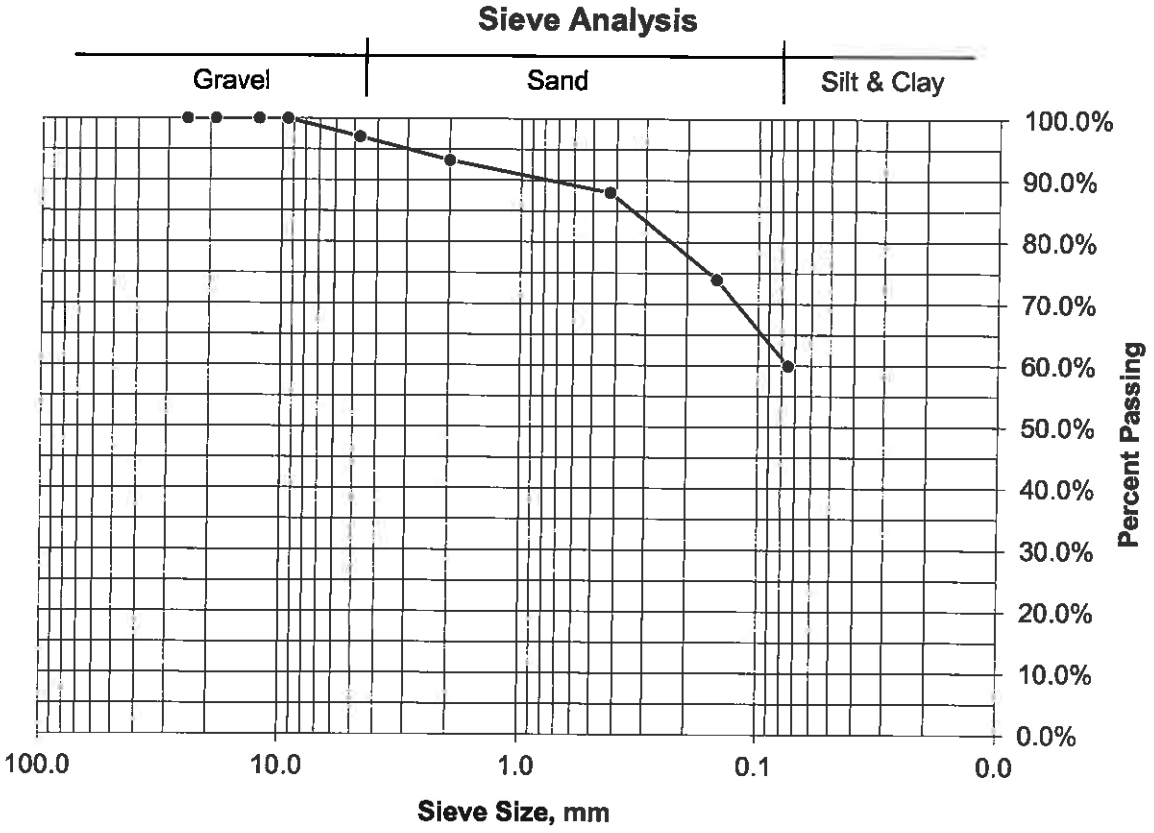
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-2-4
Sample Depth NA

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	6.47	3.0%	4.75	97.0%
No. 10	8.29	3.8%	2.0	93.3%
No. 40	11.39	5.2%	0.425	88.0%
No. 100	30.91	14.1%	0.15	73.9%
No. 200	30.62	14.0%	0.075	59.9%
Pan	0.00	0.0%		
Total	87.68	40.1%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-2-4
Sample Depth: NA
Permeability Method: ASTM D5084
Sample Length, in: 3.45
Sample Diameter, in: 2.87
Sample Condition: Undisturbed

Moisture Content

Pan Wt	184.09	grams
Pan + Soil (wet)	461.20	grams
Pan + Soil (dry)	402.90	grams
Moisture Content	*26.6%*	

Dry Density

Soil (wet)	705.00	grams
Wet Density	120.2	pcf
Dry Density	*94.9*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.9	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	42.6%
Actual Volume of Voids	155.9 ml
Porosity	42.6%
Saturation	95.1%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
23-Oct 9:36	17.100		1.600				
23-Oct 9:37	16.750	0.011	1.614	0.011	1.00	22.21	2.0E-07
23-Oct 9:38	16.500	0.008	1.625	0.008	1.00	21.69	1.5E-07
23-Oct 9:39	16.350	0.005	1.631	0.005	1.00	21.32	8.9E-08
23-Oct 9:40	16.150	0.006	1.639	0.006	1.00	21.09	1.2E-07
23-Oct 9:41	16.000	0.005	1.645	0.005	1.00	20.79	9.1E-08
23-Oct 9:42	15.850	0.005	1.651	0.005	1.00	20.57	9.2E-08
23-Oct 9:43	15.700	0.005	1.657	0.005	1.00	20.35	9.3E-08
23-Oct 9:48	15.000	0.022	1.686	0.022	1.00	20.12	8.9E-08

Average Permeability 9.1E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	707.07	grams
Final Moisture Content	27.0%	
Percent Voids	99.4%	
Actual Volume of Voids	35165.7	ml
Porosity	99.4%	
Saturation	0.4%	

Final Sample Length, in:	344.90	
Final Sample Diameter, in:	2.82	
Wet Density	1.2	pcf
Dry Density	*1.0*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-3-1
Sample Depth Lift 1
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	4
Pan Wt	194.41 grams
Pan + Soil (wet)	374.02 grams
Pan + Soil (dry)	332.72 grams
Natural Moisture Content	*29.9%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	244.38 grams
Percent Passing No. 200 Sieve	63.9%
Pan + Soil retained on No. 4 sieve (dry)	194.43 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	18	25	31
Pan ID	70	93	65
Pan Wt	11.00	30.12	10.97
Pan + Soil (wet)	25.17	42.92	23.73
Pan + Soil (dry)	19.69	38.12	19.05
Moisture Content	63.1%	60.0%	57.9%
Liquid Limit	61	60	59
Liquid Limit	*60*		

Plastic Limit

Pan ID	74	18
Pan Weight	4.27	4.32
Pan + Soil (wet)	14.30	14.68
Pan + Soil (dry)	12.21	12.53
Moisture Content	26.3%	26.2%
Plastic Limit	*26*	
Plastic Index	*34*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

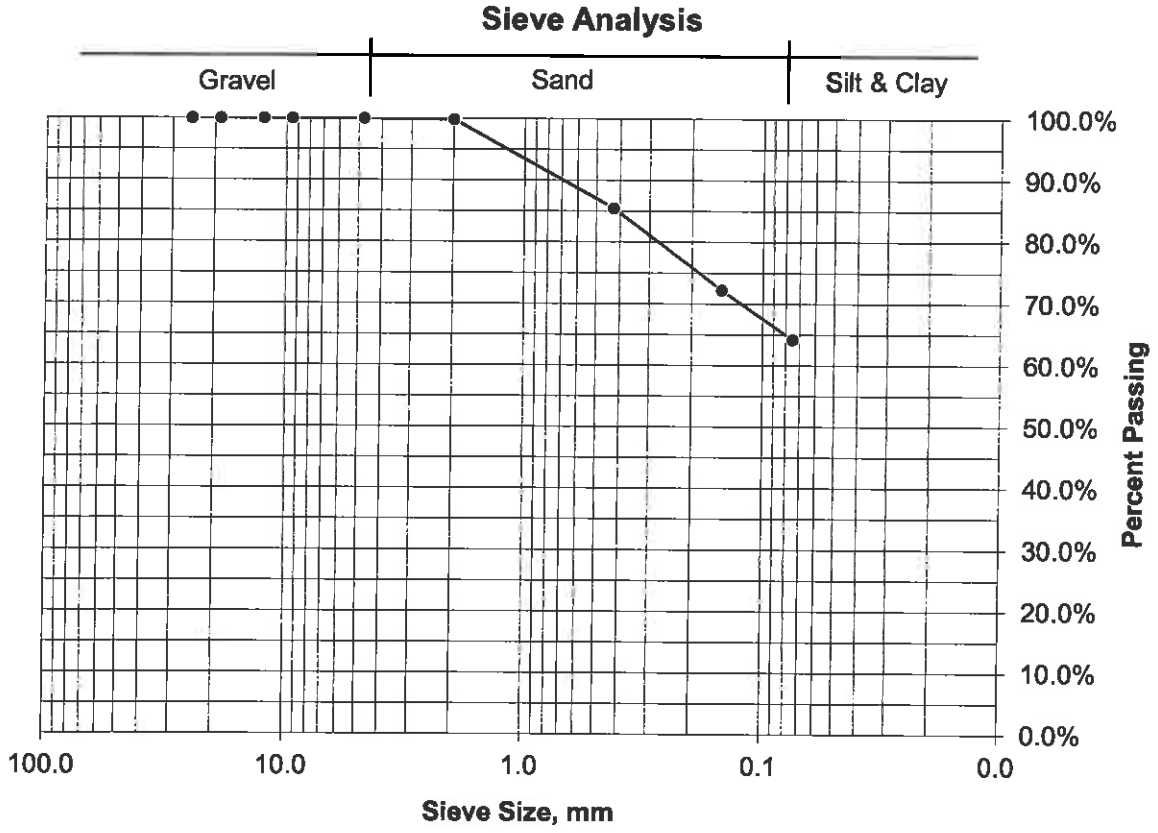
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-3-1
Sample Depth Lift 1

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.02	0.0%	4.75	100.0%
No. 10	0.21	0.2%	2.0	99.8%
No. 40	19.85	14.4%	0.425	85.5%
No. 100	18.35	13.3%	0.15	72.2%
No. 200	11.10	8.0%	0.075	64.2%
Pan	0.18	0.1%		
Total	49.71	35.8%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-3-1
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 2.92
Sample Diameter, in: 2.84
Sample Condition: Undisturbed

Moisture Content

Pan Wt	194.41	grams
Pan + Soil (wet)	374.02	grams
Pan + Soil (dry)	332.72	grams
Moisture Content	*29.9%*	

Dry Density

Soil (wet)	576.12	grams
Wet Density	118.4	pcf
Dry Density	*91.2*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.8	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	44.8%	
Actual Volume of Voids	136.1	ml
Porosity	44.8%	
Saturation	97.3%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
8-Oct 9:00	16.550		1.200				
8-Oct 9:01	16.150	0.013	1.216	0.013	1.00	26.01	2.0E-07
8-Oct 9:02	15.800	0.011	1.231	0.011	1.00	25.30	1.8E-07
8-Oct 9:03	15.500	0.009	1.243	0.009	1.00	24.69	1.6E-07
8-Oct 9:04	15.300	0.006	1.251	0.006	1.00	24.16	1.1E-07
8-Oct 9:05	15.150	0.005	1.257	0.005	1.00	23.80	8.1E-08
8-Oct 9:06	14.950	0.006	1.266	0.006	1.00	23.54	1.1E-07
8-Oct 9:07	14.800	0.005	1.272	0.005	1.00	23.19	8.3E-08
8-Oct 9:12	13.950	0.027	1.306	0.027	1.00	22.92	9.8E-08

Average Permeability 9.3E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	576.62	grams
Final Moisture Content	30.0%	
Percent Voids	42.9%	
Actual Volume of Voids	125.7	ml
Porosity	42.9%	
Saturation	100.0%	

Final Sample Length, in:	2.86	
Final Sample Diameter, in:	2.82	
Wet Density	122.8	pcf
Dry Density	*94.5*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-3-2
Sample Depth Lift 2
Visual Sample Description Red-Brown Sandy Lean CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	23
Pan Wt	193.93 grams
Pan + Soil (wet)	405.06 grams
Pan + Soil (dry)	364.10 grams
Natural Moisture Content	*24.1%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	265.87 grams
Percent Passing No. 200 Sieve	57.7%
Pan + Soil retained on No. 4 sieve (dry)	193.93 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	20	28	32
Pan ID	98	101	201
Pan Wt	30.37	23.99	27.68
Pan + Soil (wet)	43.63	37.75	41.34
Pan + Soil (dry)	39.46	33.48	37.08
Moisture Content	45.9%	45.0%	45.3%
Liquid Limit	45	46	47
Liquid Limit	*45*		

Plastic Limit

Pan ID	14	18
Pan Weight	4.30	4.35
Pan + Soil (wet)	15.17	15.67
Pan + Soil (dry)	12.98	13.29
Moisture Content	25.2%	26.6%
Plastic Limit	*26*	
Plastic Index	*19*	

USCS Classification: ASTM D 2487

Group Symbol **CL**
Group Name **Sandy Lean CLAY**

Grain Size Distribution Calculations

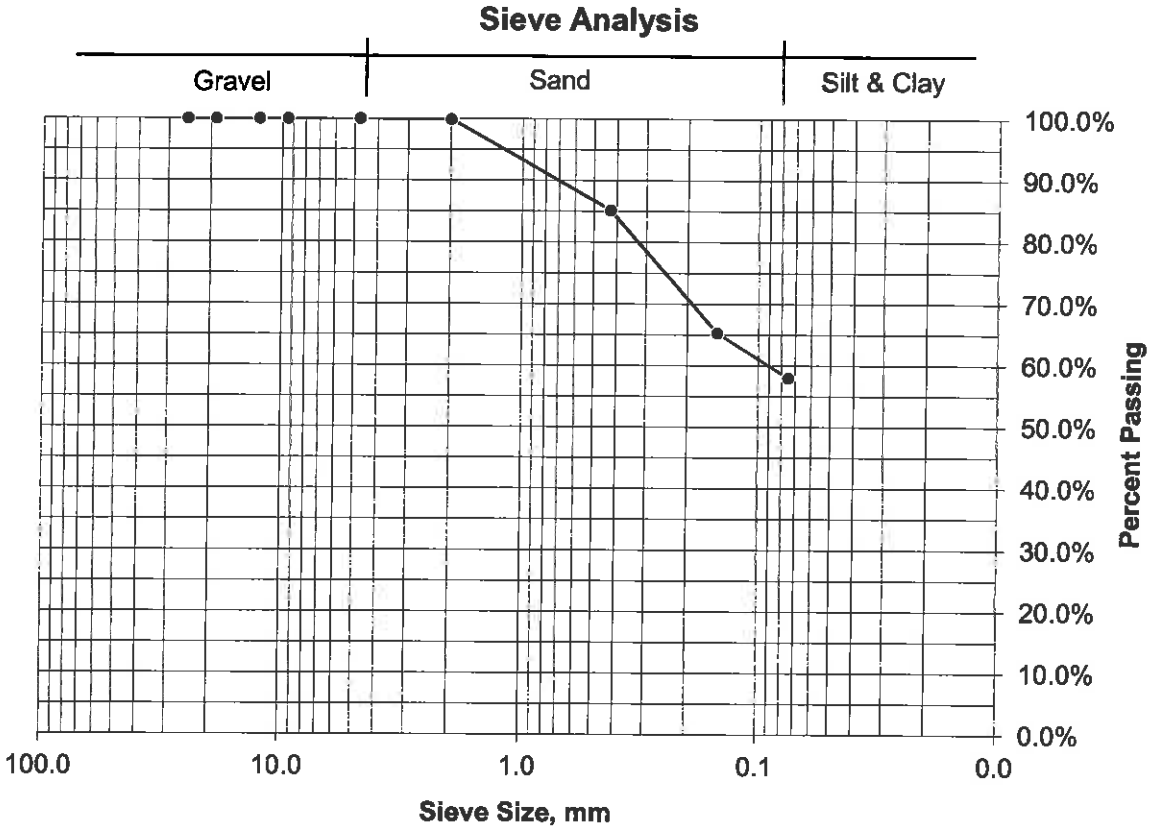
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-3-2
Sample Depth Lift 2

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.18	0.1%	2.0	99.9%
No. 40	25.01	14.7%	0.425	85.2%
No. 100	33.82	19.9%	0.15	65.3%
No. 200	12.40	7.3%	0.075	58.0%
Pan	0.27	0.2%		
Total	71.68	42.0%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-3-2
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 3.22
Sample Diameter, in: 2.85
Sample Condition: Undisturbed

Moisture Content

Pan Wt	193.93	grams
Pan + Soil (wet)	405.06	grams
Pan + Soil (dry)	364.10	grams
Moisture Content	*24.1%*	

Dry Density

Soil (wet)	676.08	grams
Wet Density	125.9	pcf
Dry Density	*101.5*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.8	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	38.6%
Actual Volume of Voids	129.4 ml
Porosity	38.6%
Saturation	100.0%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
13-Oct 8:18	17.050		1.200				
13-Oct 8:19	16.800	0.008	1.210	0.008	1.00	24.35	1.3E-07
13-Oct 8:20	16.650	0.005	1.216	0.005	1.00	23.95	8.0E-08
13-Oct 8:21	16.500	0.005	1.223	0.005	1.00	23.71	8.1E-08
13-Oct 8:22	16.350	0.005	1.229	0.005	1.00	23.47	8.2E-08
13-Oct 8:23	16.250	0.003	1.233	0.003	1.00	23.23	5.5E-08
13-Oct 8:24	16.150	0.003	1.237	0.003	1.00	23.07	5.6E-08
13-Oct 8:25	16.050	0.003	1.241	0.003	1.00	22.91	5.6E-08
13-Oct 8:34	15.250	0.025	1.274	0.025	1.00	22.75	5.1E-08

Average Permeability 5.4E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	678.19	grams
Final Moisture Content	24.5%	
Percent Voids	38.4%	
Actual Volume of Voids	128.1	ml
Porosity	38.4%	
Saturation	100.0%	

Final Sample Length, in:	3.19	
Final Sample Diameter, in:	2.85	
Wet Density	126.8	pcf
Dry Density	*101.9*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-3-4
Sample Depth NA
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	24
Pan Wt	186.16 grams
Pan + Soil (wet)	388.65 grams
Pan + Soil (dry)	353.74 grams
Natural Moisture Content	*20.8%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	241.25 grams
Percent Passing No. 200 Sieve	67.1%
Pan + Soil retained on No. 4 sieve (dry)	187.59 grams
Percent Passing No. 4 Sieve	99.1%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	18	23	35
Pan ID	109	101	96
Pan Wt	25.03	24.03	24.85
Pan + Soil (wet)	40.66	36.16	36.42
Pan + Soil (dry)	34.85	31.71	32.58
Moisture Content	59.2%	57.9%	49.7%
Liquid Limit	57	57	52
Liquid Limit	*56*		

Plastic Limit

Pan ID	74	79
Pan Weight	4.26	4.24
Pan + Soil (wet)	14.36	14.35
Pan + Soil (dry)	12.42	12.42
Moisture Content	23.8%	23.6%
Plastic Limit	*24*	
Plastic Index	*32*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

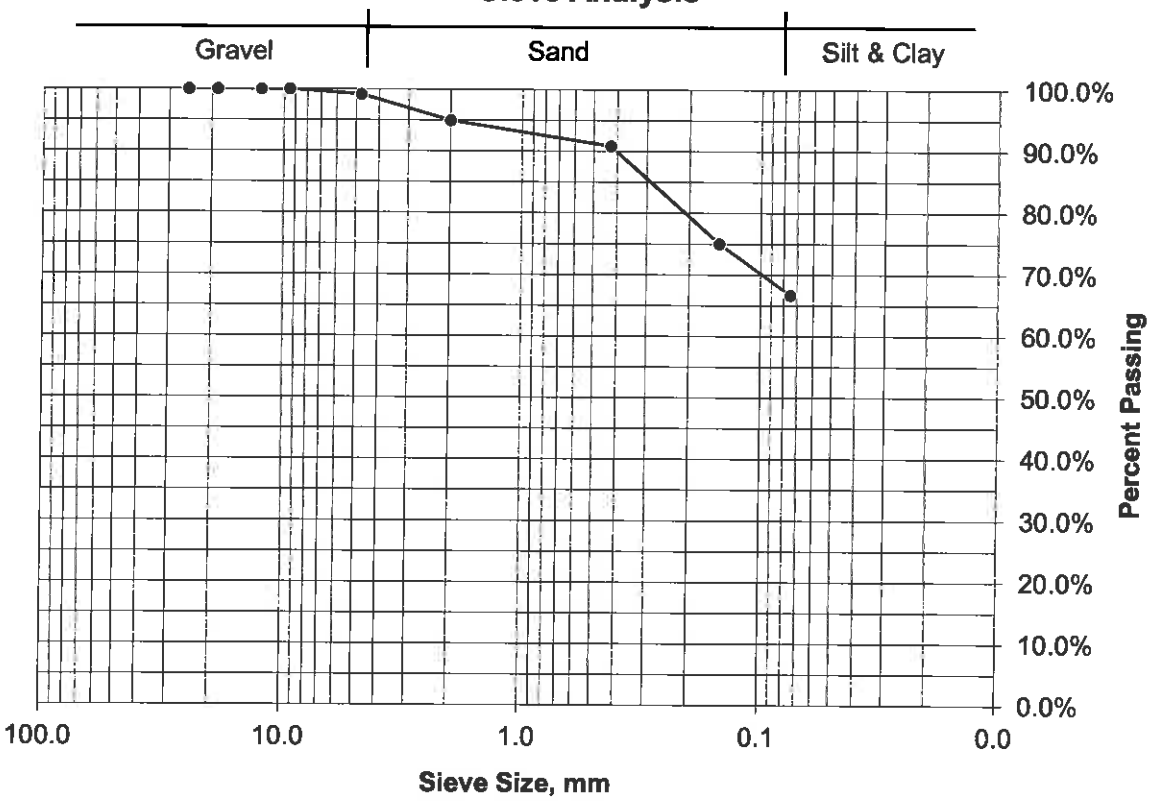
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-3-4
Sample Depth NA

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	1.43	0.9%	4.75	99.1%
No. 10	7.04	4.2%	2.0	94.9%
No. 40	6.89	4.1%	0.425	90.8%
No. 100	26.51	15.8%	0.15	75.0%
No. 200	13.89	8.3%	0.075	66.7%
Pan	0.00	0.0%		
Total	55.76	33.3%		

Sieve Analysis



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-3-4
Sample Depth: NA
Permeability Method: ASTM D5084
Sample Length, in: 3.03
Sample Diameter, in: 2.85
Sample Condition: Undisturbed

Moisture Content

Pan Wt	186.16	grams
Pan + Soil (wet)	388.65	grams
Pan + Soil (dry)	353.74	grams
Moisture Content	*20.8%*	

Dry Density

Soil (wet)	632.30	grams
Wet Density	124.6	pcf
Dry Density	*103.1*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.9	De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	37.6%
Actual Volume of Voids	119.2 ml
Porosity	37.6%
Saturation	91.5%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
23-Oct 7:25	18.900		1.000				
23-Oct 7:26	18.850	0.002	1.002	0.002	1.00	29.22	2.2E-08
23-Oct 7:27	18.800	0.002	1.004	0.002	1.00	29.13	2.2E-08
23-Oct 7:28	18.750	0.002	1.006	0.002	1.00	29.05	2.2E-08
23-Oct 7:29	18.700	0.002	1.008	0.002	1.00	28.96	2.2E-08
23-Oct 7:31	18.650	0.002	1.010	0.002	1.00	28.88	1.1E-08
23-Oct 7:32	18.600	0.002	1.012	0.002	1.00	28.79	2.2E-08
23-Oct 7:34	18.500	0.003	1.016	0.003	1.00	28.71	2.2E-08
23-Oct 7:39	18.250	0.008	1.027	0.008	1.00	28.54	2.2E-08

Average Permeability 1.9E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	631.74	grams
Final Moisture Content	20.7%	
Percent Voids	36.0%	
Actual Volume of Voids	110.9	ml
Porosity	36.0%	
Saturation	97.8%	

Final Sample Length, in:	2.97	
Final Sample Diameter, in:	2.84	
Wet Density	127.8	pcf
Dry Density	*105.9*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-4-1
Sample Depth Lift 1
Visual Sample Description Red-Brown Fat CLAY with Sand

Natural Moisture Content: ASTM D 2216

Pan ID	23
Pan Wt	193.90 grams
Pan + Soil (wet)	403.13 grams
Pan + Soil (dry)	355.36 grams
Natural Moisture Content	*29.6%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	240.62 grams
Percent Passing No. 200 Sieve	71.1%
Pan + Soil retained on No. 4 sieve (dry)	194.02 grams
Percent Passing No. 4 Sieve	99.9%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	16	25	33
Pan ID	4	104	71
Pan Wt	10.98	26.28	10.92
Pan + Soil (wet)	24.63	36.32	21.16
Pan + Soil (dry)	19.05	32.46	17.33
Moisture Content	69.1%	62.5%	59.8%
Liquid Limit	66	62	62
Liquid Limit	*63*		

Plastic Limit

Pan ID	352	315
Pan Weight	9.08	9.15
Pan + Soil (wet)	19.15	22.39
Pan + Soil (dry)	16.81	19.27
Moisture Content	30.3%	30.8%
Plastic Limit	*31*	
Plastic Index	*32*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Fat CLAY with Sand**

Grain Size Distribution Calculations

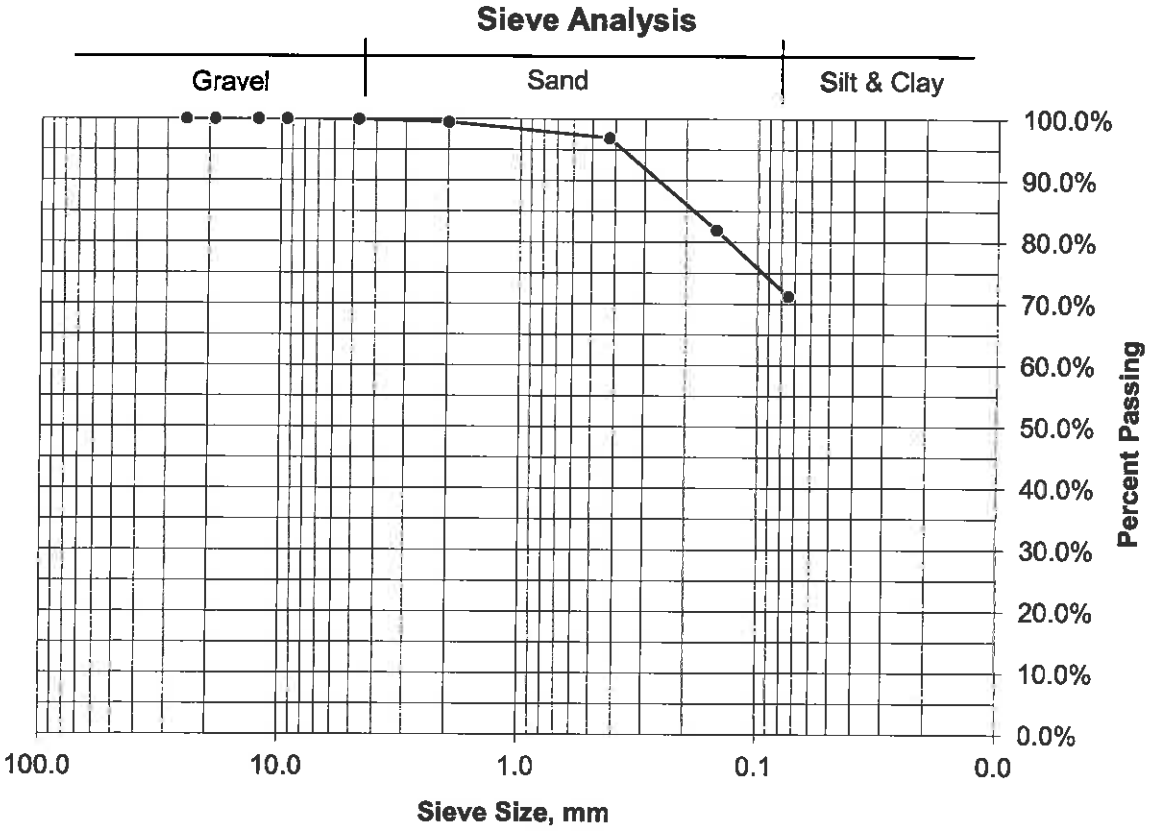
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-4-1
Sample Depth Lift 1

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.12	0.1%	4.75	99.9%
No. 10	0.76	0.5%	2.0	99.5%
No. 40	4.08	2.5%	0.425	96.9%
No. 100	24.15	15.0%	0.15	82.0%
No. 200	17.34	10.7%	0.075	71.2%
Pan	0.11	0.1%		
Total	46.56	28.8%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-4-1
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.18
Sample Diameter, in: 2.86
Sample Condition: Undisturbed

Moisture Content

Pan Wt	193.90	grams
Pan + Soil (wet)	403.13	grams
Pan + Soil (dry)	355.36	grams
Moisture Content	*29.6%*	

Dry Density

Soil (wet)	637.79	grams
Wet Density	119.2	pcf
Dry Density	*91.9*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.4	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	44.4%	
Actual Volume of Voids	148.3	ml
Porosity	44.4%	
Saturation	98.2%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
8-Oct 9:16	16.850		1.200				
8-Oct 9:17	16.700	0.005	1.206	0.005	1.00	24.32	7.8E-08
8-Oct 9:18	16.600	0.003	1.210	0.003	1.00	24.07	5.3E-08
8-Oct 9:19	16.500	0.003	1.214	0.003	1.00	23.91	5.3E-08
8-Oct 9:20	16.400	0.003	1.218	0.003	1.00	23.75	5.3E-08
8-Oct 9:21	16.300	0.003	1.223	0.003	1.00	23.59	5.4E-08
8-Oct 9:22	16.250	0.002	1.225	0.002	1.00	23.43	2.7E-08
8-Oct 9:23	16.200	0.002	1.227	0.002	1.00	23.35	2.7E-08
8-Oct 9:28	15.900	0.009	1.239	0.009	1.00	23.26	3.3E-08

Average Permeability 3.5E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	640.62	grams
Final Moisture Content	30.2%	
Percent Voids	44.6%	
Actual Volume of Voids	149.7	ml
Porosity	44.6%	
Saturation	99.2%	

Final Sample Length, in:	3.18	
Final Sample Diameter, in:	2.86	
Wet Density	119.2	pcf
Dry Density	*91.6*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-4-2
Sample Depth Lift 2
Visual Sample Description Red-Brown

Natural Moisture Content: ASTM D 2216

Pan ID	3
Pan Wt	193.12 grams
Pan + Soil (wet)	365.56 grams
Pan + Soil (dry)	328.44 grams
Natural Moisture Content	*27.4%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	250.32 grams
Percent Passing No. 200 Sieve	57.7%
Pan + Soil retained on No. 4 sieve (dry)	193.12 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	19	26	34
Pan ID	103	21	72
Pan Wt	10.60	11.07	11.21
Pan + Soil (wet)	21.64	23.18	25.39
Pan + Soil (dry)	16.78	18.00	19.49
Moisture Content	78.6%	74.7%	71.3%
Liquid Limit	76	75	74
Liquid Limit	*75*		

Plastic Limit

Pan ID	314	354
Pan Weight	9.14	9.13
Pan + Soil (wet)	19.38	18.56
Pan + Soil (dry)	17.06	16.45
Moisture Content	29.3%	28.8%
Plastic Limit	*29*	
Plastic Index	*46*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

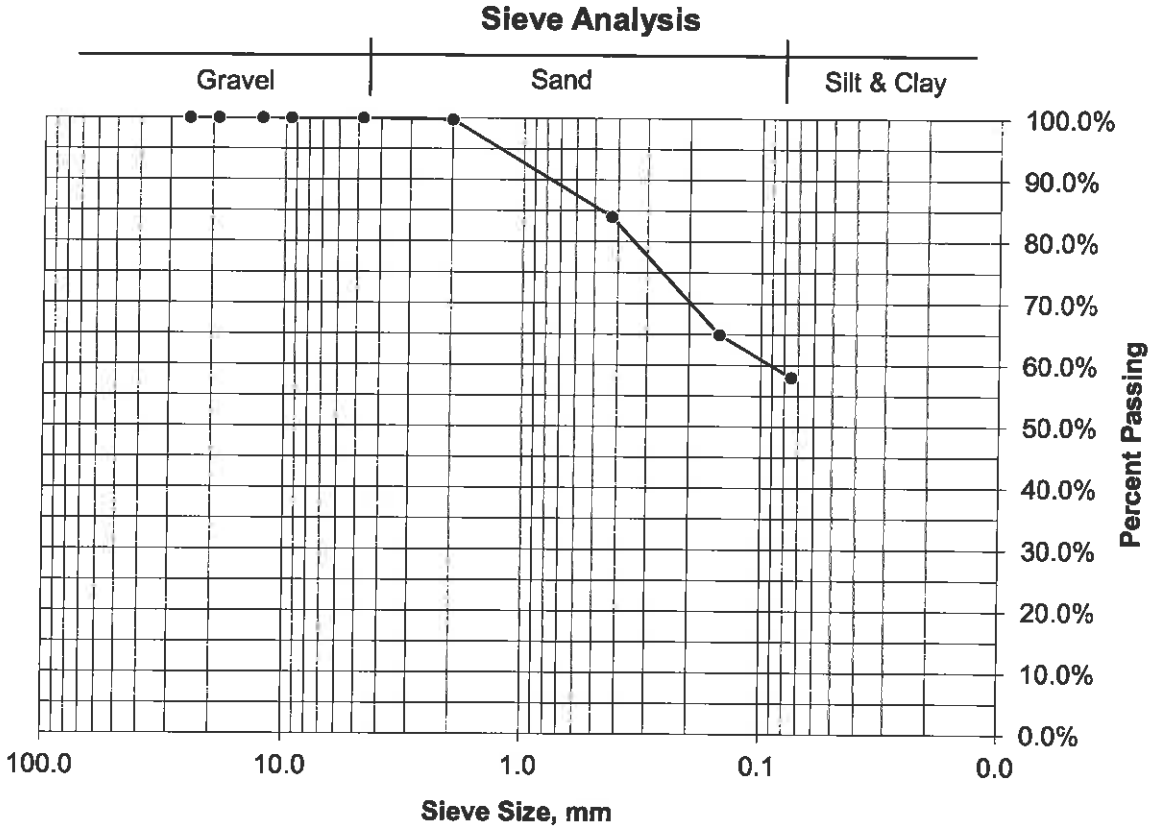
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-4-2
Sample Depth Lift 2

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.35	0.3%	2.0	99.7%
No. 40	21.28	15.7%	0.425	84.0%
No. 100	25.80	19.1%	0.15	64.9%
No. 200	9.38	6.9%	0.075	58.0%
Pan	0.38	0.3%		
Total	57.19	42.0%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-4-2
Sample Depth: Lift 2
Permeability Method: ASTM D5084
Sample Length, in: 2.47
Sample Diameter, in: 2.84
Sample Condition: Undisturbed

Moisture Content

Pan Wt	193.12 grams
Pan + Soil (wet)	365.56 grams
Pan + Soil (dry)	328.44 grams
Moisture Content	*27.4%*

Dry Density

Soil (wet)	488.04 grams
Wet Density	118.4 pcf
Dry Density	*92.9* pcf

Test Conditions

Backpressure, psi	40.0
Cell Pressure, psi	50.0
Influent Buret Area, cm^2	0.03142
Effluent Buret Area, cm^2	0.76712
Effective Stress, psi	10.0
Pearment Liquid Temp.(°C):	21.0 De-aired Water

Initial Data

Assumed Specific Gravity	2.65
Percent Voids	43.8%
Actual Volume of Voids	112.6 ml
Porosity	43.8%
Saturation	93.3%

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
13-Oct 8:37	16.100		1.200				
13-Oct 8:38	15.700	0.013	1.216	0.013	1.00	29.78	1.7E-07
13-Oct 8:39	15.400	0.009	1.229	0.009	1.00	28.95	1.3E-07
13-Oct 8:40	15.100	0.009	1.241	0.009	1.00	28.33	1.4E-07
13-Oct 8:41	14.900	0.006	1.249	0.006	1.00	27.70	9.3E-08
13-Oct 8:42	14.700	0.006	1.257	0.006	1.00	27.28	9.4E-08
13-Oct 8:43	14.500	0.006	1.266	0.006	1.00	26.87	9.6E-08
13-Oct 8:44	14.300	0.006	1.274	0.006	1.00	26.45	9.7E-08
13-Oct 8:49	13.350	0.030	1.313	0.030	1.00	26.04	9.7E-08

Average Permeability 9.6E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65
Final Weight of Sample	490.89 grams
Final Moisture Content	28.2%
Percent Voids	43.1%
Actual Volume of Voids	109.3 ml
Porosity	43.1%
Saturation	98.7%

Final Sample Length, in:	2.45
Final Sample Diameter, in:	2.84
Wet Density	120.7 pcf
Dry Density	*94.2* pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-4-3
Sample Depth Lift 3
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	26
Pan Wt	194.50 grams
Pan + Soil (wet)	435.01 grams
Pan + Soil (dry)	387.96 grams
Natural Moisture Content	*24.3%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	278.54 grams
Percent Passing No. 200 Sieve	56.6%
Pan + Soil retained on No. 4 sieve (dry)	194.50 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	15	29	32
Pan ID	93	101	105
Pan Wt	30.10	24.01	29.26
Pan + Soil (wet)	50.46	41.26	47.23
Pan + Soil (dry)	42.98	35.46	41.36
Moisture Content	58.1%	50.7%	48.5%
Liquid Limit	55	52	50
Liquid Limit	*52*		

Plastic Limit

Pan ID	317	354
Pan Weight	8.10	9.14
Pan + Soil (wet)	20.19	20.98
Pan + Soil (dry)	17.58	18.38
Moisture Content	27.5%	28.1%
Plastic Limit	*28*	
Plastic Index	*24*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

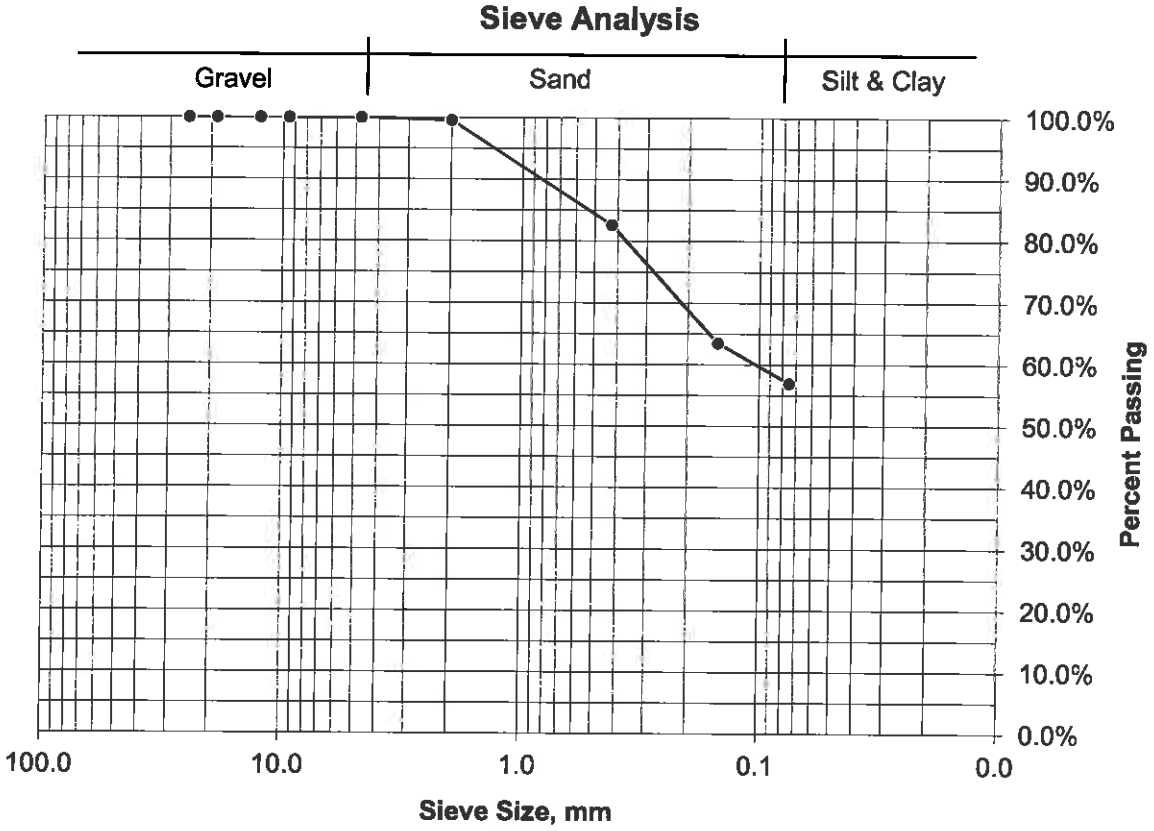
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-4-3
Sample Depth Lift 3

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.81	0.4%	2.0	99.6%
No. 40	32.78	16.9%	0.425	82.6%
No. 100	37.03	19.1%	0.15	63.5%
No. 200	12.72	6.6%	0.075	56.9%
Pan	0.39	0.2%		
Total	83.73	43.1%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-4-3
Sample Depth: Lift 3
Permeability Method: ASTM D5084
Sample Length, in: 3.20
Sample Diameter, in: 2.85
Sample Condition: Undisturbed

Moisture Content

Pan Wt	194.50	grams
Pan + Soil (wet)	435.01	grams
Pan + Soil (dry)	387.96	grams
Moisture Content	*24.3%*	

Dry Density

Soil (wet)	662.08	grams
Wet Density	123.7	pcf
Dry Density	*99.5*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	21.1	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	39.8%	
Actual Volume of Voids	133.0	ml
Porosity	39.8%	
Saturation	97.4%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
22-Oct 12:54	15.500		1.200				
22-Oct 12:55	15.200	0.009	1.212	0.009	1.00	22.09	1.7E-07
22-Oct 12:56	15.100	0.003	1.216	0.003	1.00	21.60	5.9E-08
22-Oct 12:57	15.000	0.003	1.220	0.003	1.00	21.44	6.0E-08
22-Oct 12:58	14.900	0.003	1.225	0.003	1.00	21.28	6.0E-08
22-Oct 12:59	14.800	0.003	1.229	0.003	1.00	21.12	6.1E-08
22-Oct 13:00	14.700	0.003	1.233	0.003	1.00	20.96	6.1E-08
22-Oct 13:01	14.600	0.003	1.237	0.003	1.00	20.80	6.1E-08
22-Oct 13:06	14.400	0.006	1.245	0.006	1.00	20.64	2.5E-08

Average Permeability 5.2E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	664.82	grams
Final Moisture Content	24.8%	
Percent Voids	38.6%	
Actual Volume of Voids	126.6	ml
Porosity	38.7%	
Saturation	100.0%	

Final Sample Length, in:	3.16	
Final Sample Diameter, in:	2.84	
Wet Density	126.6	pcf
Dry Density	*101.5*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-4-4
Sample Depth
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	36
Pan Wt	193.76 grams
Pan + Soil (wet)	424.30 grams
Pan + Soil (dry)	379.51 grams
Natural Moisture Content	*24.1%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	259.42 grams
Percent Passing No. 200 Sieve	64.7%
Pan + Soil retained on No. 4 sieve (dry)	194.69 grams
Percent Passing No. 4 Sieve	99.5%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	15	22	32
Pan ID	91	94	169
Pan Wt	24.56	23.80	27.18
Pan + Soil (wet)	35.24	34.00	41.11
Pan + Soil (dry)	31.21	30.44	36.43
Moisture Content	60.6%	53.6%	50.6%
Liquid Limit	57	53	52
Liquid Limit	*54*		

Plastic Limit

Pan ID	29	122
Pan Weight	2.40	2.43
Pan + Soil (wet)	12.49	12.50
Pan + Soil (dry)	10.69	10.66
Moisture Content	21.7%	22.4%
Plastic Limit	*22*	
Plastic Index	*32*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

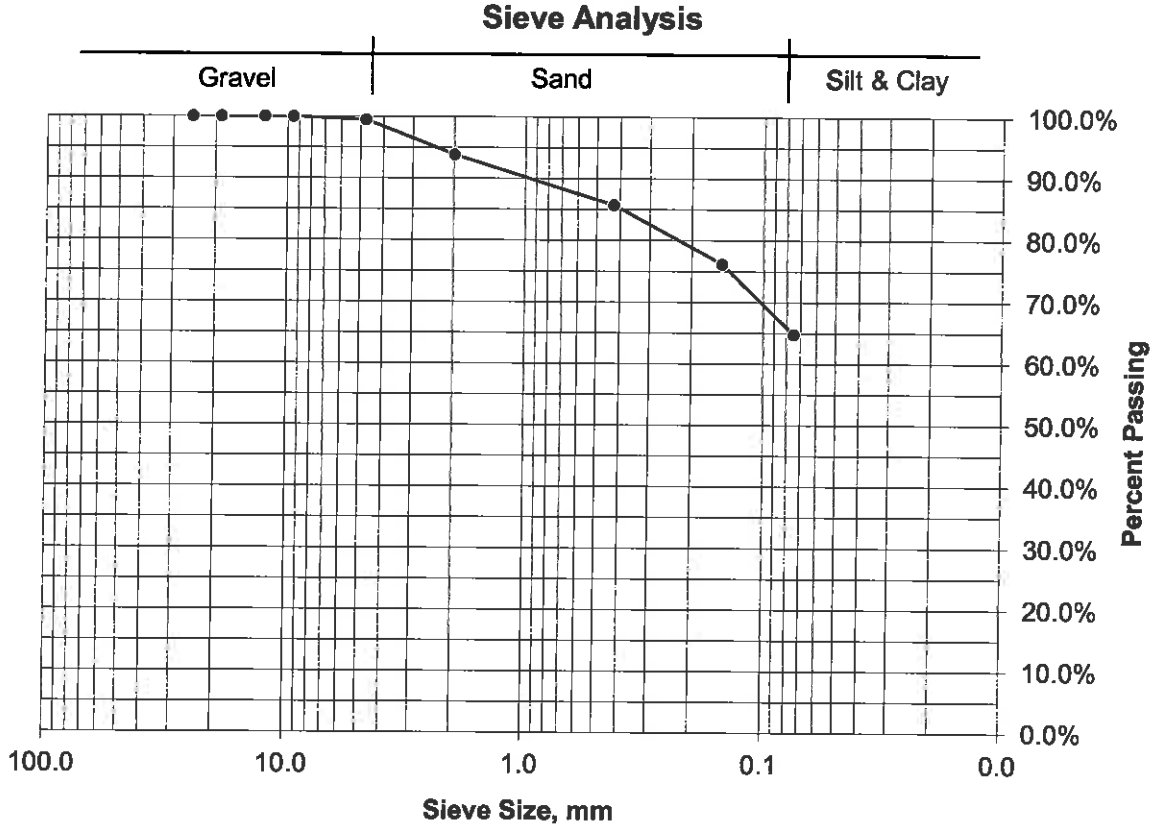
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-4-4
Sample Depth 0

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.93	0.5%	4.75	99.5%
No. 10	10.49	5.6%	2.0	93.9%
No. 40	15.08	8.1%	0.425	85.7%
No. 100	17.78	9.6%	0.15	76.2%
No. 200	21.16	11.4%	0.075	64.8%
Pan	0.23	0.1%		
Total	65.67	35.2%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-4-4
Sample Depth: 0
Permeability Method: ASTM D5084
Sample Length, in: 3.86
Sample Diameter, in: 2.83
Sample Condition: Undisturbed

Moisture Content

Pan Wt	193.76	grams
Pan + Soil (wet)	424.30	grams
Pan + Soil (dry)	379.51	grams
Moisture Content	*24.1%*	

Dry Density

Soil (wet)	775.72	grams
Wet Density	121.7	pcf
Dry Density	*98.0*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	21.2	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	40.7%	
Actual Volume of Voids	162.0	ml
Porosity	40.7%	
Saturation	93.0%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
23-Oct 9:10	18.200		1.600				
23-Oct 9:11	17.900	0.009	1.612	0.009	1.00	21.25	1.8E-07
23-Oct 9:12	17.600	0.009	1.625	0.009	1.00	20.85	1.9E-07
23-Oct 9:13	17.300	0.009	1.637	0.009	1.00	20.45	1.9E-07
23-Oct 9:14	17.100	0.006	1.645	0.006	1.00	20.05	1.3E-07
23-Oct 9:15	16.950	0.005	1.651	0.005	1.00	19.78	9.8E-08
23-Oct 9:16	16.800	0.005	1.657	0.005	1.00	19.58	9.9E-08
23-Oct 9:17	16.650	0.005	1.663	0.005	1.00	19.38	1.0E-07
23-Oct 9:22	16.000	0.020	1.690	0.020	1.00	19.18	8.9E-08

Average Permeability 9.7E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	775.99	grams
Final Moisture Content	24.2%	
Percent Voids	40.2%	
Actual Volume of Voids	158.6	ml
Porosity	40.2%	
Saturation	95.2%	

Final Sample Length, in:	3.80	
Final Sample Diameter, in:	2.84	
Wet Density	122.8	pcf
Dry Density	*98.9*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-5-1
Sample Depth Lift 1
Visual Sample Description Red-Brown Sandy Fat Clay

Natural Moisture Content: ASTM D 2216

Pan ID	30
Pan Wt	193.53 grams
Pan + Soil (wet)	369.26 grams
Pan + Soil (dry)	333.86 grams
Natural Moisture Content	*25.2%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	252.01 grams
Percent Passing No. 200 Sieve	58.3%
Pan + Soil retained on No. 4 sieve (dry)	193.92 grams
Percent Passing No. 4 Sieve	99.7%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	15	22	35
Pan ID	105	109	169
Pan Wt	29.37	25.03	27.14
Pan + Soil (wet)	43.26	38.74	41.82
Pan + Soil (dry)	38.07	33.74	36.59
Moisture Content	59.7%	57.4%	55.3%
Liquid Limit	56	57	58
Liquid Limit	*57*		

Plastic Limit

Pan ID	78	79
Pan Weight	4.25	4.28
Pan + Soil (wet)	15.17	15.50
Pan + Soil (dry)	12.68	13.03
Moisture Content	29.5%	28.2%
Plastic Limit	*29*	
Plastic Index	*28*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

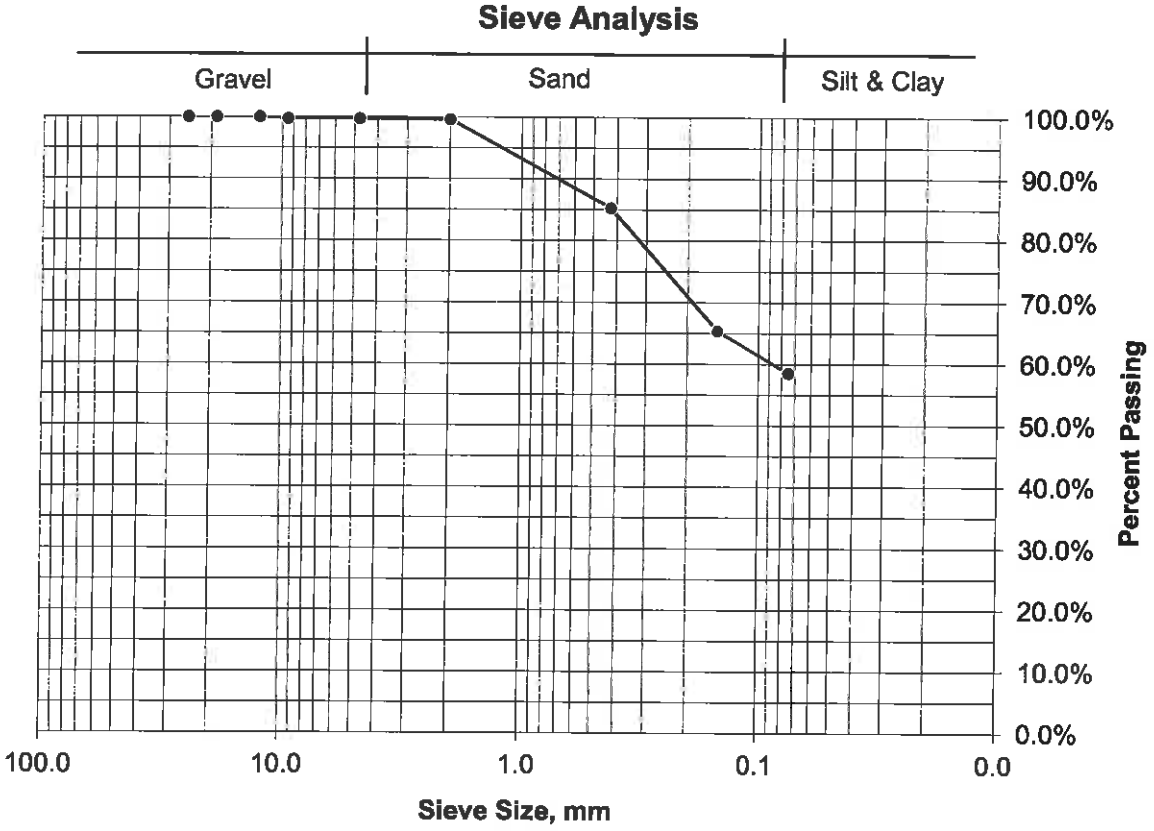
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-5-1
Sample Depth Lift 1

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.39	0.3%	9.5	99.7%
No. 4	0.00	0.0%	4.75	99.7%
No. 10	0.11	0.1%	2.0	99.6%
No. 40	20.19	14.4%	0.425	85.3%
No. 100	27.84	19.8%	0.15	65.4%
No. 200	9.62	6.9%	0.075	58.6%
Pan	0.18	0.1%		
Total	58.33	41.4%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-5-1
Sample Depth: Lift 1
Permeability Method: ASTM D5084
Sample Length, in: 3.00
Sample Diameter, in: 2.83
Sample Condition: Undisturbed

Moisture Content

Pan Wt	193.53	grams
Pan + Soil (wet)	369.26	grams
Pan + Soil (dry)	333.86	grams
Moisture Content	*25.2%*	

Dry Density

Soil (wet)	639.50	grams
Wet Density	128.7	pcf
Dry Density	*102.8*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.7	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	37.8%	
Actual Volume of Voids	117.3	ml
Porosity	37.8%	
Saturation	100.0%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
10-Oct 9:07	16.400		1.200				
10-Oct 9:08	16.200	0.006	1.208	0.006	1.00	25.03	1.0E-07
10-Oct 9:09	16.050	0.005	1.214	0.005	1.00	24.68	7.9E-08
10-Oct 9:10	15.950	0.003	1.218	0.003	1.00	24.43	5.3E-08
10-Oct 9:11	15.850	0.003	1.223	0.003	1.00	24.25	5.3E-08
10-Oct 9:12	15.750	0.003	1.227	0.003	1.00	24.08	5.4E-08
10-Oct 9:13	15.650	0.003	1.231	0.003	1.00	23.91	5.4E-08
10-Oct 9:14	15.600	0.002	1.233	0.002	1.00	23.74	2.7E-08
10-Oct 9:19	15.250	0.011	1.247	0.011	1.00	23.65	3.9E-08

Average Permeability 4.3E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	640.58	grams
Final Moisture Content	25.4%	
Percent Voids	37.3%	
Actual Volume of Voids	114.7	ml
Porosity	37.3%	
Saturation	100.0%	

Final Sample Length, in:	2.95	
Final Sample Diameter, in:	2.85	
Wet Density	130.0	pcf
Dry Density	*103.7*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-5-2
Sample Depth NA
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	15
Pan Wt	188.19 grams
Pan + Soil (wet)	402.74 grams
Pan + Soil (dry)	363.29 grams
Natural Moisture Content	*22.5%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	262.87 grams
Percent Passing No. 200 Sieve	57.4%
Pan + Soil retained on No. 4 sieve (dry)	188.19 grams
Percent Passing No. 4 Sieve	100.0%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	15	24	32
Pan ID	97	94	2000
Pan Wt	26.14	23.82	25.73
Pan + Soil (wet)	43.59	38.40	40.87
Pan + Soil (dry)	37.10	33.05	35.66
Moisture Content	59.2%	58.0%	52.5%
Liquid Limit	56	58	54
Liquid Limit	*56*		

Plastic Limit

Pan ID	313	352
Pan Weight	9.12	9.08
Pan + Soil (wet)	23.07	20.52
Pan + Soil (dry)	19.98	18.00
Moisture Content	28.5%	28.3%
Plastic Limit	*28*	
Plastic Index	*28*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

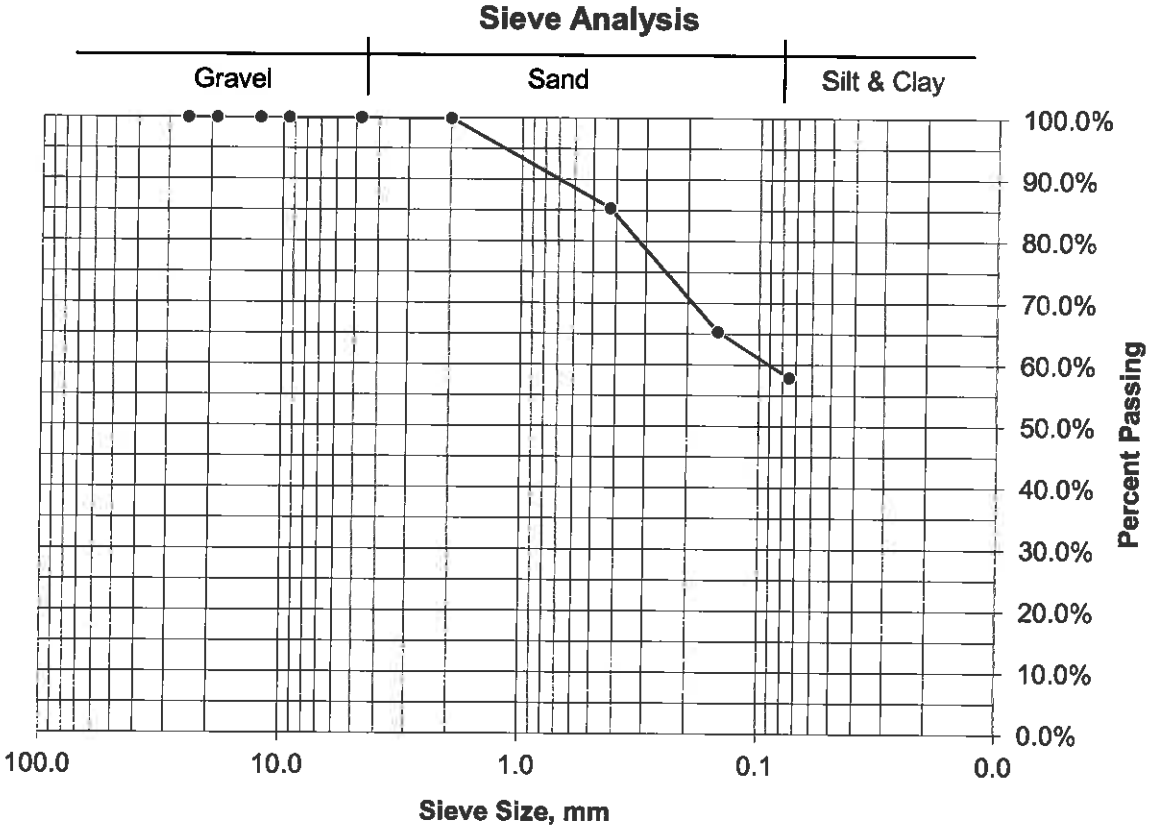
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-5-2
Sample Depth NA

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.20	0.1%	2.0	99.9%
No. 40	25.44	14.5%	0.425	85.4%
No. 100	35.03	20.0%	0.15	65.4%
No. 200	13.05	7.5%	0.075	57.9%
Pan	0.61	0.3%		
Total	74.33	42.1%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-5-2
Sample Depth: NA
Permeability Method: ASTM D5084
Sample Length, in: 3.47
Sample Diameter, in: 2.84
Sample Condition: Undisturbed

Moisture Content

Pan Wt	188.19	grams
Pan + Soil (wet)	402.74	grams
Pan + Soil (dry)	363.29	grams
Moisture Content	*22.5%*	

Dry Density

Soil (wet)	716.87	grams
Wet Density	124.2	pcf
Dry Density	*101.4*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	21.0	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	38.7%	
Actual Volume of Voids	139.4	ml
Porosity	38.7%	
Saturation	94.6%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
15-Oct 7:54	16.800		1.100				
15-Oct 7:55	15.600	0.038	1.149	0.038	1.00	22.36	7.2E-07
15-Oct 7:56	15.150	0.014	1.168	0.014	1.00	20.58	2.8E-07
15-Oct 7:57	14.900	0.008	1.178	0.008	1.00	19.91	1.6E-07
15-Oct 7:58	14.700	0.006	1.186	0.006	1.00	19.54	1.3E-07
15-Oct 7:59	14.600	0.003	1.190	0.003	1.00	19.24	6.7E-08
15-Oct 8:00	14.500	0.003	1.194	0.003	1.00	19.09	6.7E-08
15-Oct 8:01	14.400	0.003	1.198	0.003	1.00	18.95	6.8E-08
15-Oct 8:06	13.700	0.022	1.227	0.022	1.00	18.80	9.8E-08

Average Permeability 7.5E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	722.83	grams
Final Moisture Content	23.5%	
Percent Voids	37.6%	
Actual Volume of Voids	132.8	ml
Porosity	37.6%	
Saturation	100.0%	

Final Sample Length, in:	3.46	
Final Sample Diameter, in:	2.82	
Wet Density	127.6	pcf
Dry Density	*103.3*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-5-3
Sample Depth Lift 3
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	21
Pan Wt	193.88 grams
Pan + Soil (wet)	457.60 grams
Pan + Soil (dry)	417.07 grams
Natural Moisture Content	*18.2%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	286.60 grams
Percent Passing No. 200 Sieve	58.5%
Pan + Soil retained on No. 4 sieve (dry)	193.88 grams
Percent Passing No. 4 Sieve	100.0%

Soil Classifies as Fine-Grained Soil

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	19	27	34
Pan ID	61	201	62
Pan Wt	10.99	27.67	10.96
Pan + Soil (wet)	25.32	42.56	23.41
Pan + Soil (dry)	20.31	37.59	19.40
Moisture Content	53.8%	50.1%	47.5%
Liquid Limit	52	51	49
Liquid Limit	*51*		

Plastic Limit

Pan ID	29	122
Pan Weight	2.40	2.42
Pan + Soil (wet)	12.46	12.54
Pan + Soil (dry)	10.34	10.42
Moisture Content	26.7%	26.5%
Plastic Limit	*27*	
Plastic Index	*24*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

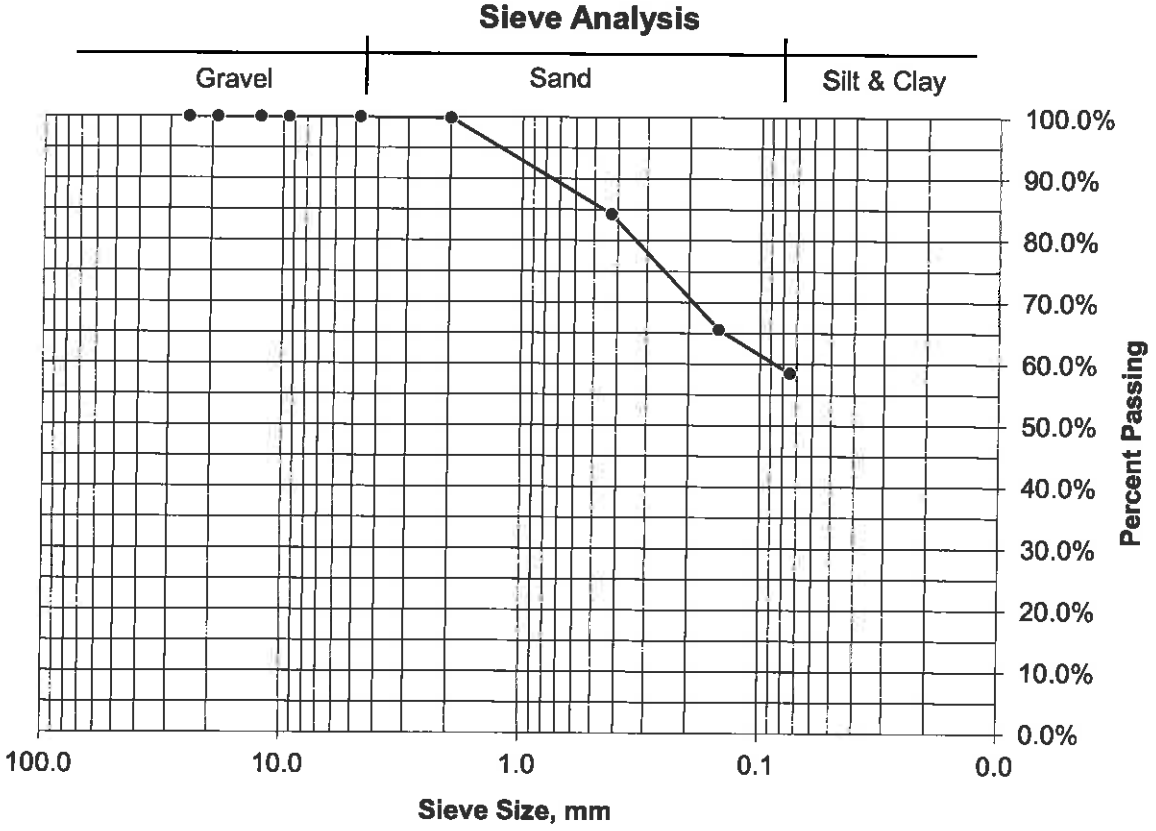
Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-5-3
Sample Depth Lift 3

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	0.00	0.0%	4.75	100.0%
No. 10	0.35	0.2%	2.0	99.8%
No. 40	34.76	15.6%	0.425	84.3%
No. 100	41.70	18.7%	0.15	65.6%
No. 200	15.69	7.0%	0.075	58.6%
Pan	0.20	0.1%		
Total	92.70	41.4%		



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-5-3
Sample Depth: Lift 3
Permeability Method: ASTM D5084
Sample Length, in: 3.39
Sample Diameter, in: 2.86
Sample Condition: Undisturbed

Moisture Content

Pan Wt	193.88	grams
Pan + Soil (wet)	457.60	grams
Pan + Soil (dry)	417.07	grams
Moisture Content	*18.2%*	

Dry Density

Soil (wet)	714.36	grams
Wet Density	125.0	pcf
Dry Density	*105.8*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	20.9	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	36.0%	
Actual Volume of Voids	128.5	ml
Porosity	36.0%	
Saturation	85.4%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
22-Oct 13:53	16.200		1.200				
22-Oct 13:54	16.000	0.006	1.208	0.006	1.00	21.88	1.2E-07
22-Oct 13:55	15.850	0.005	1.214	0.005	1.00	21.57	8.8E-08
22-Oct 13:56	15.750	0.003	1.218	0.003	1.00	21.34	5.9E-08
22-Oct 13:57	15.650	0.003	1.223	0.003	1.00	21.19	6.0E-08
22-Oct 13:58	15.600	0.002	1.225	0.002	1.00	21.04	3.0E-08
22-Oct 13:59	15.550	0.002	1.227	0.002	1.00	20.96	3.0E-08
22-Oct 14:00	15.500	0.002	1.229	0.002	1.00	20.89	3.0E-08
22-Oct 14:05	15.250	0.008	1.239	0.008	1.00	20.81	3.1E-08

Average Permeability 3.0E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	728.13	grams
Final Moisture Content	20.4%	
Percent Voids	35.6%	
Actual Volume of Voids	126.2	ml
Porosity	35.6%	
Saturation	97.9%	

Final Sample Length, in:	3.38	
Final Sample Diameter, in:	2.85	
Wet Density	128.2	pcf
Dry Density	*106.5*	pcf

Soil Classification Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-5-4
Sample Depth NA
Visual Sample Description Red-Brown Sandy Fat CLAY

Natural Moisture Content: ASTM D 2216

Pan ID	16
Pan Wt	189.42 grams
Pan + Soil (wet)	394.92 grams
Pan + Soil (dry)	357.09 grams
Natural Moisture Content	*22.6%*

Coarse or Fine Grained: ASTM D 422

Pan + Soil retained on No. 200 sieve (dry)	262.18 grams
Percent Passing No. 200 Sieve	56.6%
Pan + Soil retained on No. 4 sieve (dry)	192.68 grams
Percent Passing No. 4 Sieve	98.1%
Soil Classifies as	*Fine-Grained Soil*

Atterberg Limits: ASTM D 4318

Liquid Limit

No of Blows	16	25	32
Pan ID	102	93	104
Pan Wt	23.98	30.07	26.21
Pan + Soil (wet)	36.28	43.89	41.35
Pan + Soil (dry)	31.48	38.84	36.03
Moisture Content	64.0%	57.6%	54.2%
Liquid Limit	61	58	56
Liquid Limit	*58*		

Plastic Limit

Pan ID	74	78
Pan Weight	4.26	4.21
Pan + Soil (wet)	15.14	16.70
Pan + Soil (dry)	13.06	14.33
Moisture Content	23.6%	23.4%
Plastic Limit	*24*	
Plastic Index	*34*	

USCS Classification: ASTM D 2487

Group Symbol **CH**
Group Name **Sandy Fat CLAY**

Grain Size Distribution Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

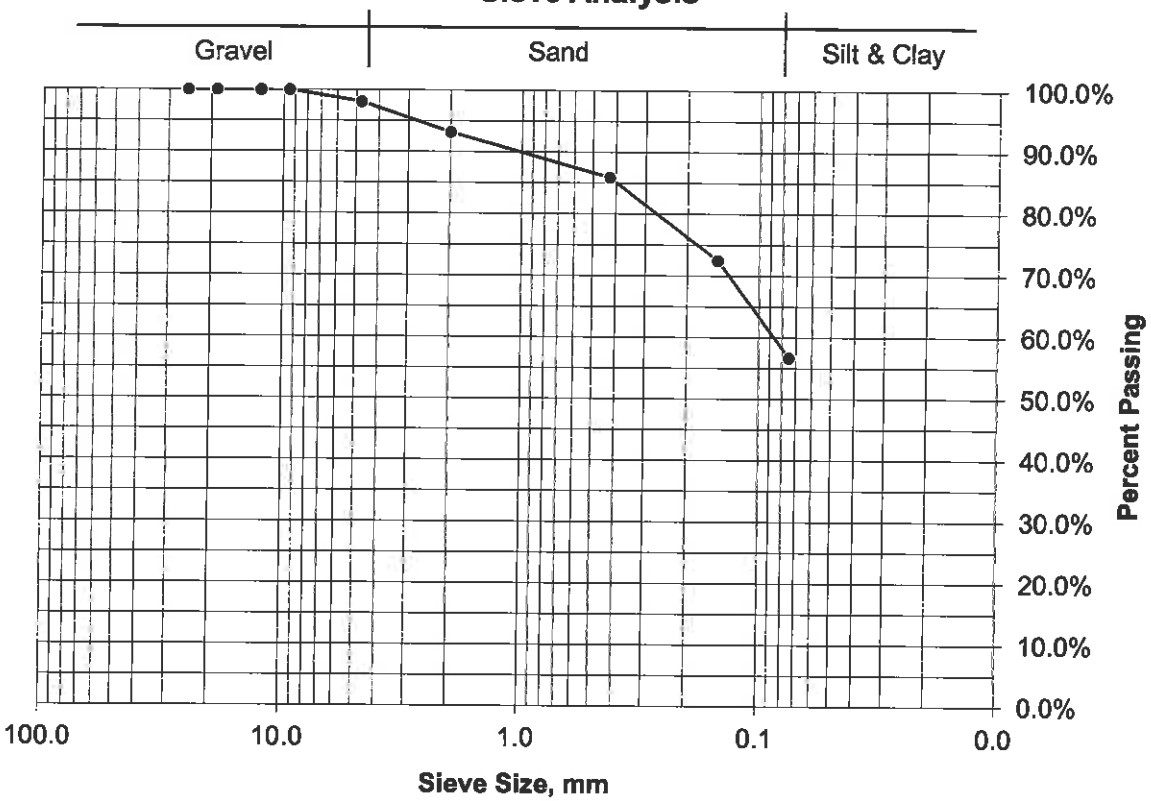
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID P-5-4
Sample Depth NA

Mechanical Sieve Analysis: ASTM D 422

Sieve Size	Weight Retained	Percent Retained	Sieve Size, mm	Percent Passing
1"	0.00	0.0%	25.0	100.0%
3/4"	0.00	0.0%	19.0	100.0%
1/2"	0.00	0.0%	12.5	100.0%
3/8"	0.00	0.0%	9.5	100.0%
No. 4	3.26	1.9%	4.75	98.1%
No. 10	8.21	4.9%	2.0	93.2%
No. 40	12.18	7.3%	0.425	85.9%
No. 100	22.53	13.4%	0.15	72.5%
No. 200	26.43	15.8%	0.075	56.7%
Pan	0.15	0.1%		
Total	72.76	43.3%		

Sieve Analysis



Permeability Calculations

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Sample ID: P-5-4
Sample Depth: NA
Permeability Method: ASTM D5084
Sample Length, in: 3.90
Sample Diameter, in: 2.87
Sample Condition: Undisturbed

Moisture Content

Pan Wt	189.42	grams
Pan + Soil (wet)	394.92	grams
Pan + Soil (dry)	357.09	grams
Moisture Content	*22.6%*	

Dry Density

Soil (wet)	792.79	grams
Wet Density	120.1	pcf
Dry Density	*98.0*	pcf

Test Conditions

Backpressure, psi	40.0	
Cell Pressure, psi	50.0	
Influent Buret Area, cm^2	0.03142	
Effluent Buret Area, cm^2	0.76712	
Effective Stress, psi	10.0	
Pearment Liquid Temp.(°C):	21.4	De-aired Water

Initial Data

Assumed Specific Gravity	2.65	
Percent Voids	40.7%	
Actual Volume of Voids	167.8	ml
Porosity	40.8%	
Saturation	87.0%	

Permeability Trials

Time min	Influent Head, cm	Influent Flow, cm^3	Effluent Head, cm	Effluent Flow, cm^3	Flow Deviation Ratio	Gradient mm-Hg	Permeabilty, k cm/sec
21-Oct 10:23	14.800		1.200				
21-Oct 10:24	14.400	0.013	1.216	0.013	1.00	17.24	3.0E-07
21-Oct 10:25	14.250	0.005	1.223	0.005	1.00	16.72	1.1E-07
21-Oct 10:26	14.100	0.005	1.229	0.005	1.00	16.52	1.1E-07
21-Oct 10:27	14.000	0.003	1.233	0.003	1.00	16.32	7.7E-08
21-Oct 10:28	13.900	0.003	1.237	0.003	1.00	16.19	7.8E-08
21-Oct 10:29	13.800	0.003	1.241	0.003	1.00	16.06	7.9E-08
21-Oct 10:30	13.700	0.003	1.245	0.003	1.00	15.92	7.9E-08
21-Oct 10:35	13.200	0.016	1.266	0.016	1.00	15.79	8.1E-08

Average Permeability 7.9E-08 cm/sec Corrected for 20°C

Final Data

Assumed Specific Gravity	2.65	
Final Weight of Sample	811.49	grams
Final Moisture Content	25.5%	
Percent Voids	41.3%	
Actual Volume of Voids	171.6	ml
Porosity	41.3%	
Saturation	96.0%	

Final Sample Length, in:	3.89	
Final Sample Diameter, in:	2.88	
Wet Density	121.8	pcf
Dry Density	*97.1*	pcf

Proctor Test Report

Gaston Landfill
DAA # R08281-05G
Prepared By: RJL

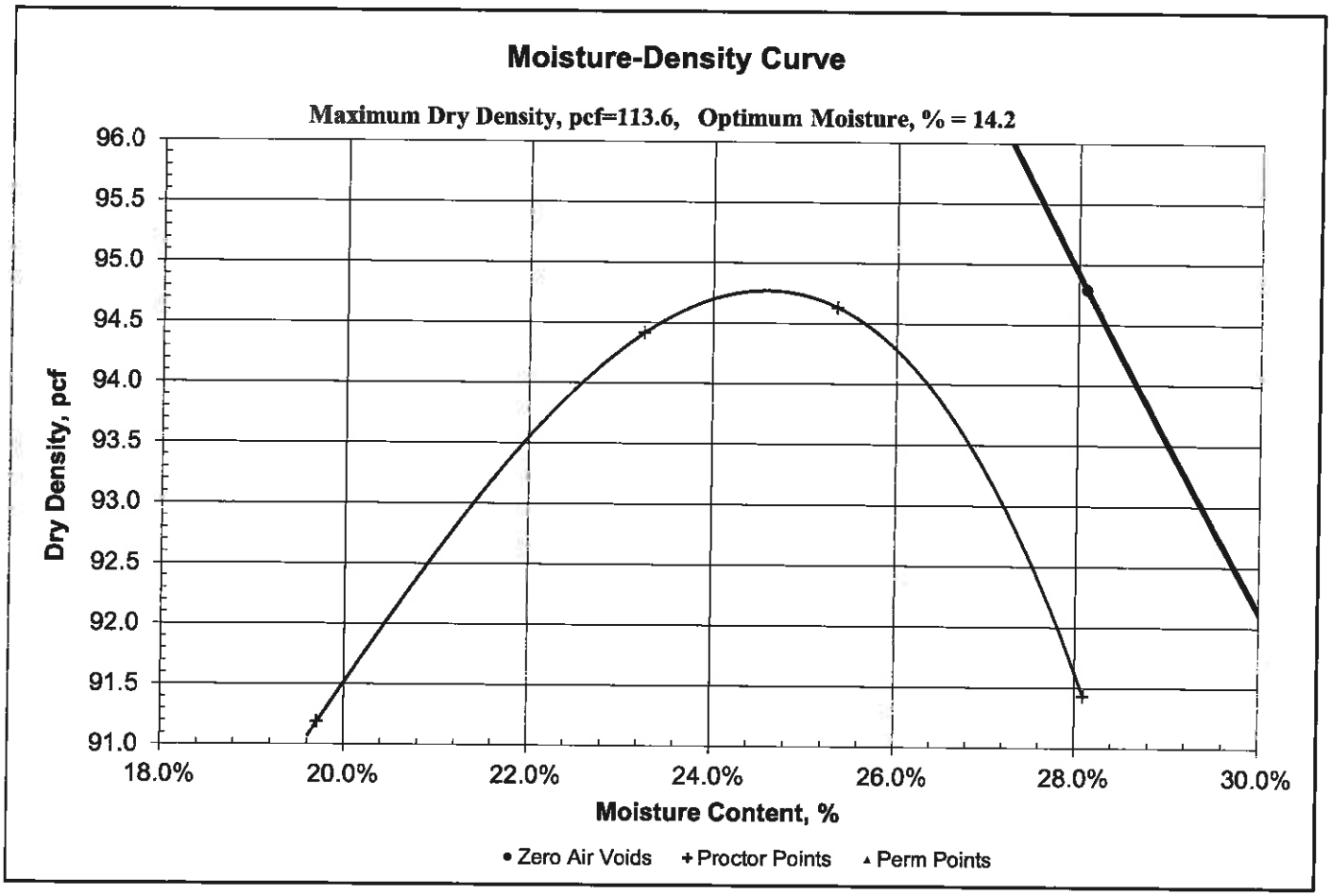
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	CS-1
Sample Depth	N/A
Sample Classification	#DIV/0!
USCS Group Symbol	#DIV/0!
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0
Assumed Specific Gravity:	2.65

Test Data

	#1	#2	#3	#4	#5
Wt. Mold	9.175	9.175	9.175	9.175	
Wt Mold + Soil (wet), lbs	12.810	13.125	13.050	13.075	
Wet Density, pcf	109.2	118.6	116.4	117.1	0.0
Wt Pan, g	9.14	8.91	8.93	8.91	
Wt Pan + Soil(wet), g	275.88	356.98	282.89	251.21	
Wt Pan + Soil(dry), g	231.96	286.60	231.21	198.07	
Zero Air Void Density, pcf, Gs= 2.65	108.6	98.9	102.3	94.8	
Moisture Content	**19.7%**	**25.3%**	**23.2%**	**28.1%**	
Dry Density, pcf	**91.2**	**94.6**	**94.4**	**91.4**	



Proctor Test Report

Gaston Landfill
DAA # R08281-05G
Prepared By: RJL

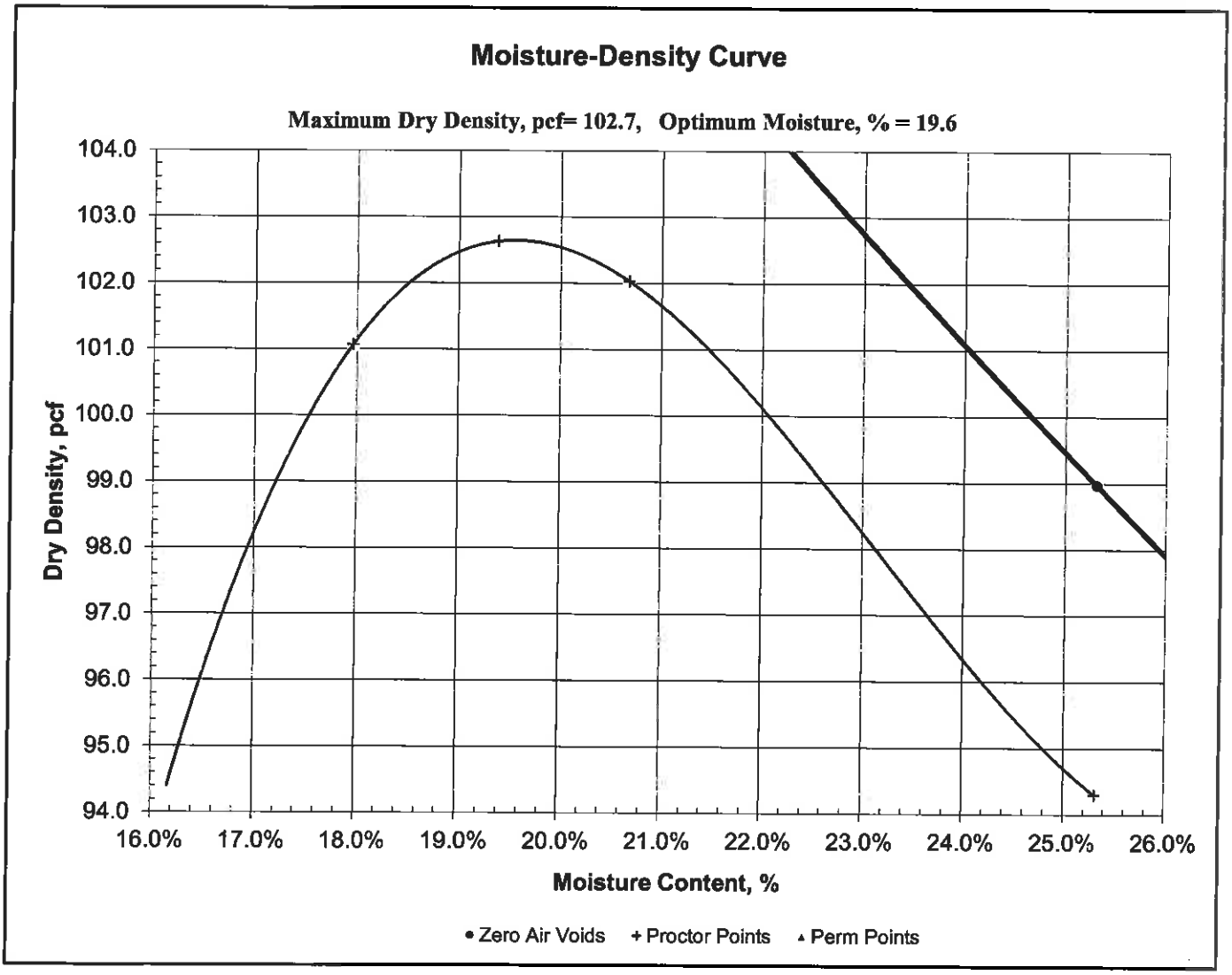
Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services

Soil and Test Method Data

Sample ID	CS-2
Sample Depth	N/A
Sample Classification	#DIV/0!
USCS Group Symbol	#DIV/0!
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0
Assumed Specific Gravity:	2.65

Test Data

	#1	#2	#3	#4	#5
Moisture Content	**18.0%**	**19.4%**	**20.7%**	**25.3%**	
Dry Density, pcf	**101.1**	**102.6**	**102.0**	**94.3**	



Proctor Test Report

Gaston Landfill
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
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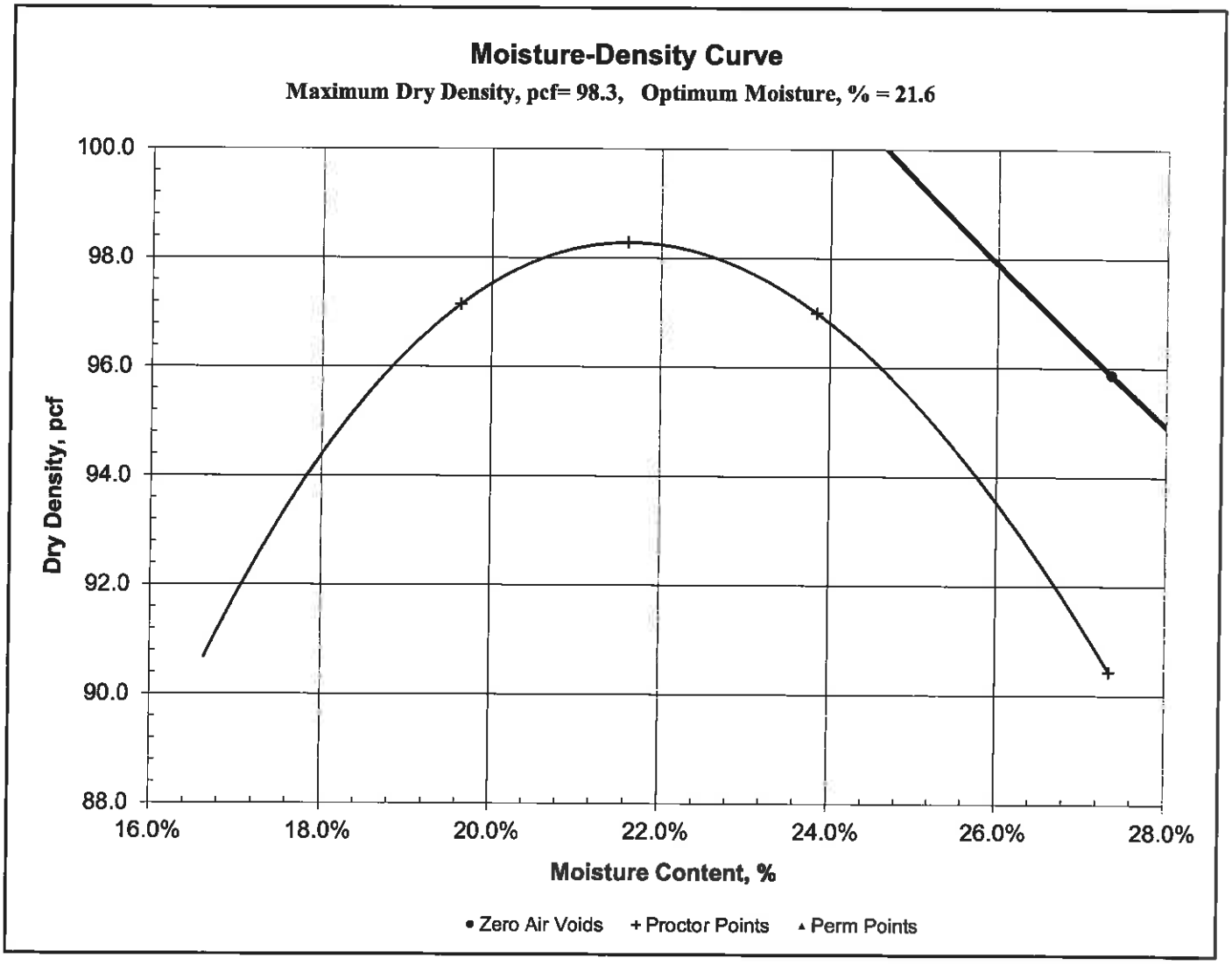
Soil and Test Method Data

Sample ID	CS-3
Sample Depth	N/A
Sample Classification	#DIV/0!
USCS Group Symbol	#DIV/0!
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0
Assumed Specific Gravity:	2.65

Test Data

	#1	#2	#3	#4	#5
Moisture Content	19.6%	21.6%	23.8%	27.3%	
Dry Density, pcf	97.1	98.3	97.0	90.4	



Proctor Test Report
Gaston Landfill
DAA # R08281-05G
Prepared By: RJL

Draper Aden Associates
Blacksburg • Richmond, Virginia
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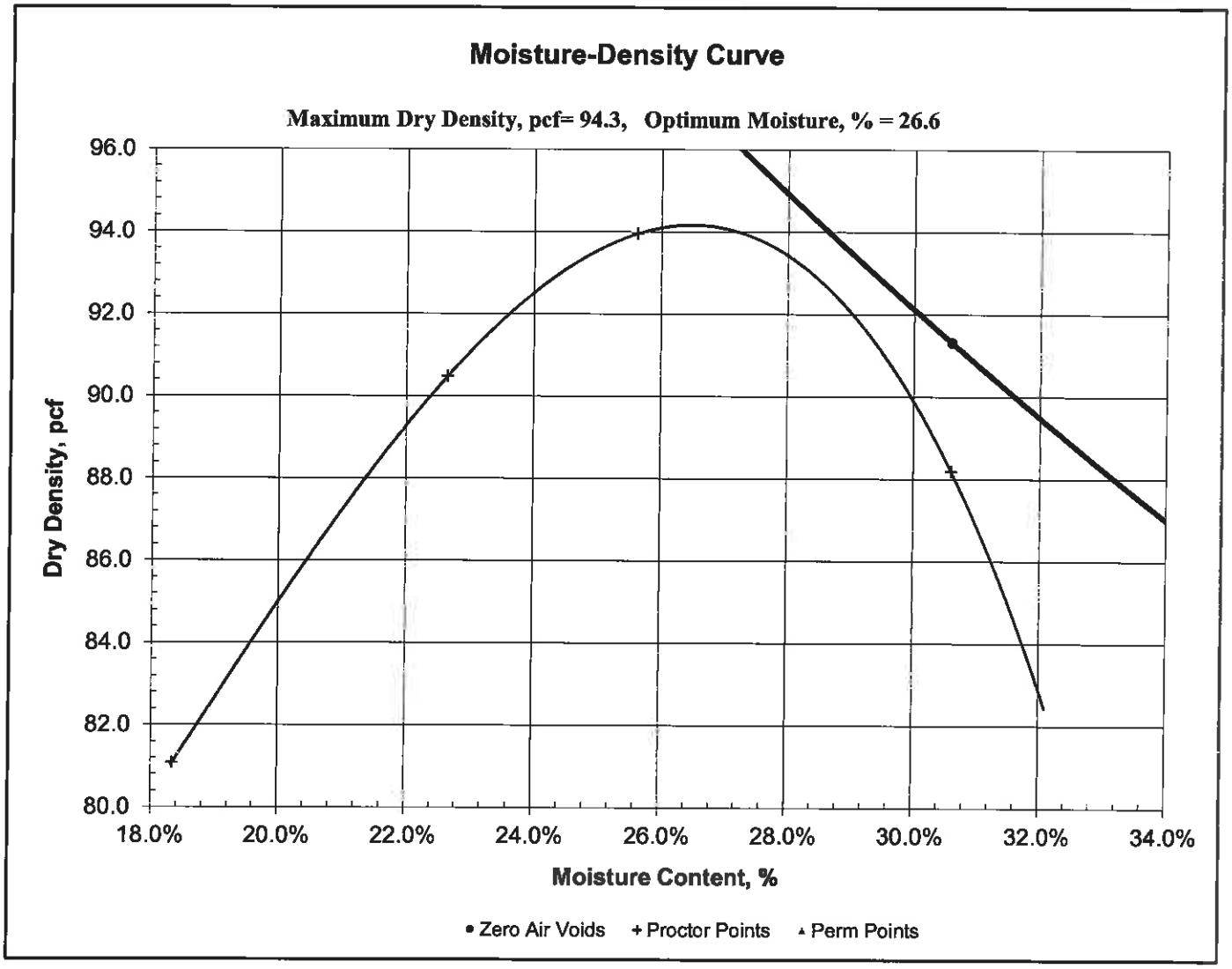
Soil and Test Method Data

Sample ID	CS-4
Sample Depth	N/A
Sample Classification	#DIV/0!
USCS Group Symbol	#DIV/0!
Test Method	ASTM D698, Method B, with mechanical hammer
Sample Preparation	Air dried and sieved through a 3/8" sieve.
Mold Size, in	4.0
Assumed Specific Gravity:	2.65

Test Data

	#1	#2	#3	#4	#5
Moisture Content	**18.3%**	**22.6%**	**25.6%**	**30.6%**	
Dry Density, pcf	**81.1**	**90.5**	**94.0**	**88.2**	



Clay Liner
Field Density Testing

FIELD DENSITY TESTING DATA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 9/30/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		Test Pad	Subgrade	-	125.0	107.0	16.8%	110.6	96.8%	14.3%	2.5%		
2		Test Pad	Subgrade	-	125.9	107.3	17.3%	110.6	97.0%	14.3%	3.0%		
3		Test Pad	Subgrade	-	126.0	108.0	16.7%	110.6	97.6%	14.3%	2.4%		
4		Test Pad	Subgrade	-	125.9	107.4	17.2%	110.6	97.1%	14.3%	2.9%		
1		Test	Pad	1	120.9	92.9	30.1%	92.5	100.5%	25.8%	4.3%		
2		Test	Pad	1	122.1	93.8	30.2%	92.5	101.4%	25.8%	4.4%		
3		Test	Pad	1	119.9	92.3	29.9%	92.5	99.8%	25.8%	4.1%	DC	TP-ST-1
4		Test	Pad	1	121.8	93.6	30.1%	92.5	101.2%	25.8%	4.3%		
5		Test	Pad	1	121.0	93.5	29.4%	92.5	101.1%	25.8%	3.6%		
1		Test	Pad	2	119.0	91.9	29.5%	92.5	99.3%	25.8%	3.7%		
2		Test	Pad	2	121.1	93.2	29.9%	92.5	100.8%	25.8%	4.1%		
3		Test	Pad	2	119.8	92.2	30.0%	92.5	99.6%	25.8%	4.2%		
4		Test	Pad	2	121.2	93.1	30.2%	92.5	100.6%	25.8%	4.4%		
5		Test	Pad	2	120.6	92.8	30.0%	92.5	100.3%	25.8%	4.2%	DC	TP-ST-2

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

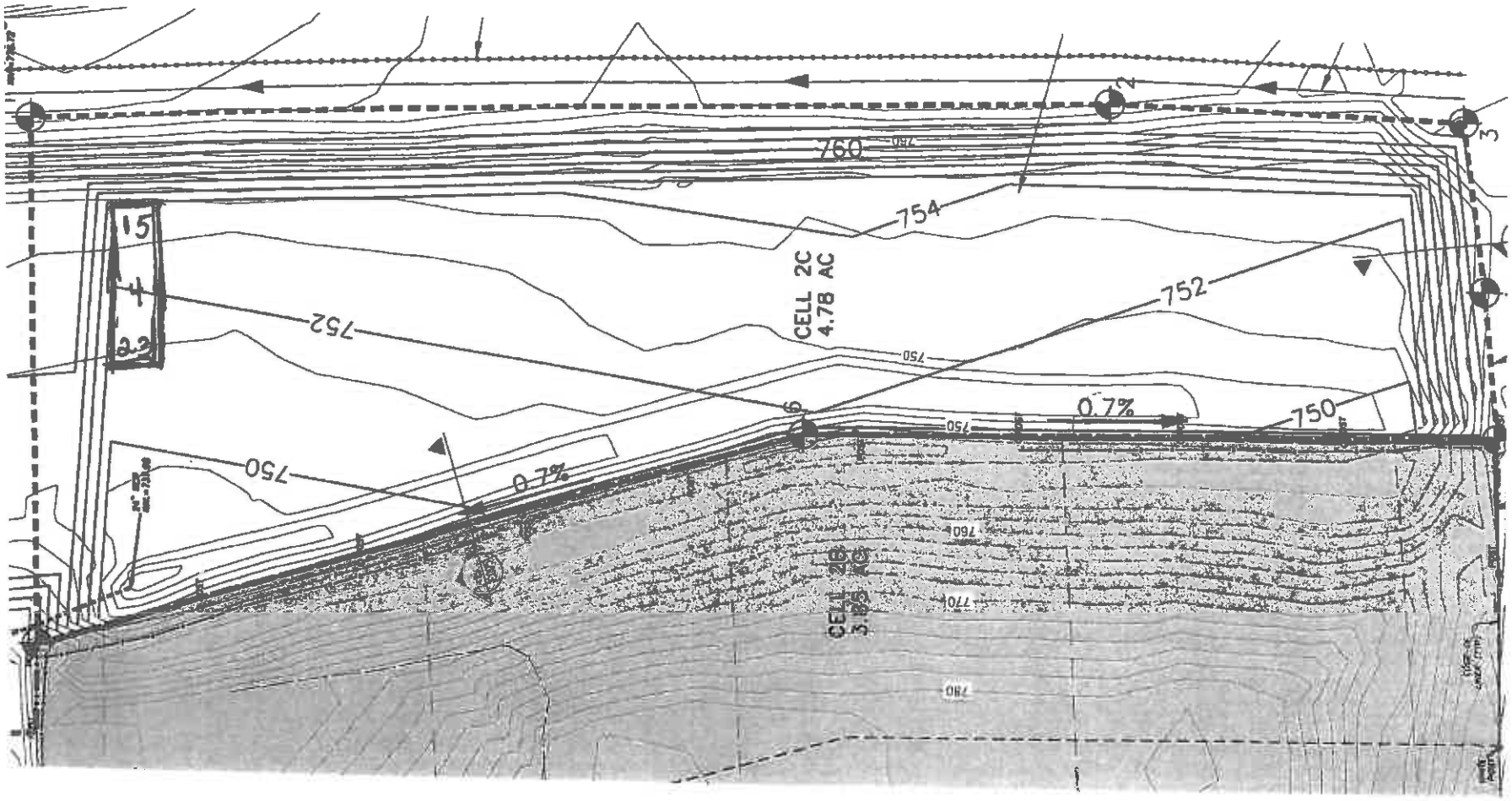
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfil
PROJECT #: R08281N-05G
DATE: 9/30/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
3	See	Map	1	1.32	5.30	119.5	374.5	492.1	464.0	31.4%	91.0	92.5	98.3%	25.8%	5.6%
5	See	Map	2	1.32	5.31	119.8	374.5	488.2	461.3	31.0%	91.5	92.5	98.9%	25.8%	5.2%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Test Pad Lift 1

Location Plan Date: 9/30/14	T&K - Gaston County LF Expansion DALLAS, NC DAA# R08281-05G	Draper Aden Associates Engineering • Surveying • Environmental Services Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/1/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		Test	Pad	3	122.2	94.4	29.4%	91.8	102.9%	27.4%	2.0%		
2		Test	Pad	3	120.0	91.5	31.1%	91.8	99.7%	27.4%	3.7%		
3		Test	Pad	3	120.2	91.3	31.6%	91.8	99.5%	27.4%	4.2%	DC	TP-ST-3
4		Test	Pad	3	119.7	92.4	29.6%	91.8	100.6%	27.4%	2.2%		
5		Test	Pad	3	120.2	92.3	30.2%	91.8	100.6%	27.4%	2.8%		
1		Test	Pad	4	123.6	95.0	30.1%	91.8	103.5%	27.4%	2.7%		
2		Test	Pad	4	119.1	91.8	29.8%	91.8	100.0%	27.4%	2.4%		
3		Test	Pad	4	121.4	92.5	31.3%	91.8	100.7%	27.4%	3.9%		
4		Test	Pad	4	118.0	90.4	30.6%	91.8	98.4%	27.4%	3.2%		
5		Test	Pad	4	119.9	92.3	29.9%	91.8	100.5%	27.4%	2.5%	DC	TP-ST-4

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

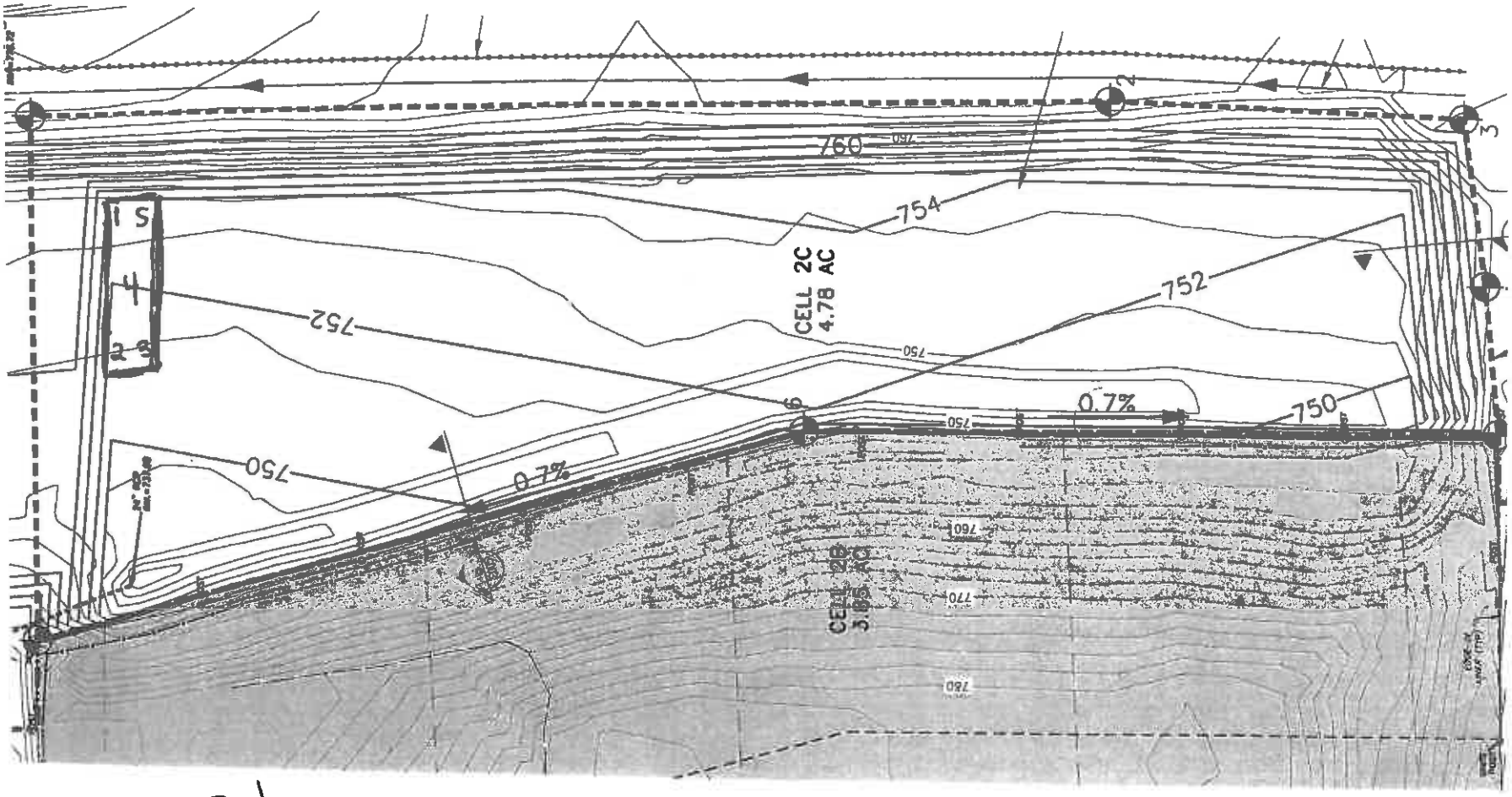
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfil
PROJECT #: R08281N-05G
DATE: 10/1/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
3	See	Map	3	1.32	5.36	121.3	374.5	478.6	454.1	30.8%	92.8	91.8	101.1%	27.4%	3.4%
5	See	Map	4	1.32	5.28	118.9	374.5	484.2	458.1	31.2%	90.6	91.8	98.7%	27.4%	3.8%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Test Pad
Lifts 2-4

Location Plan	T&K - Gaston County LF Expansion DALLAS, NC	Draper Aden Associates *Engineering • Surveying • Environmental Services*
Date: 10/1/14	DAA# R08281-05G	Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/2/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	1	122.2	94.8	28.9%	96.4	98.3%	25.2%	3.7%		
2		See	Map	1	122.9	94.8	29.6%	96.4	98.4%	25.2%	4.4%		
3		See	Map	1	123.3	95.3	29.4%	96.4	98.8%	25.2%	4.2%		
4		See	Map	1	124.2	96.5	28.7%	96.4	100.1%	25.2%	3.5%	DC	P-1-1
5		See	Map	1	123.1	95.3	29.2%	96.4	98.8%	25.2%	4.0%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

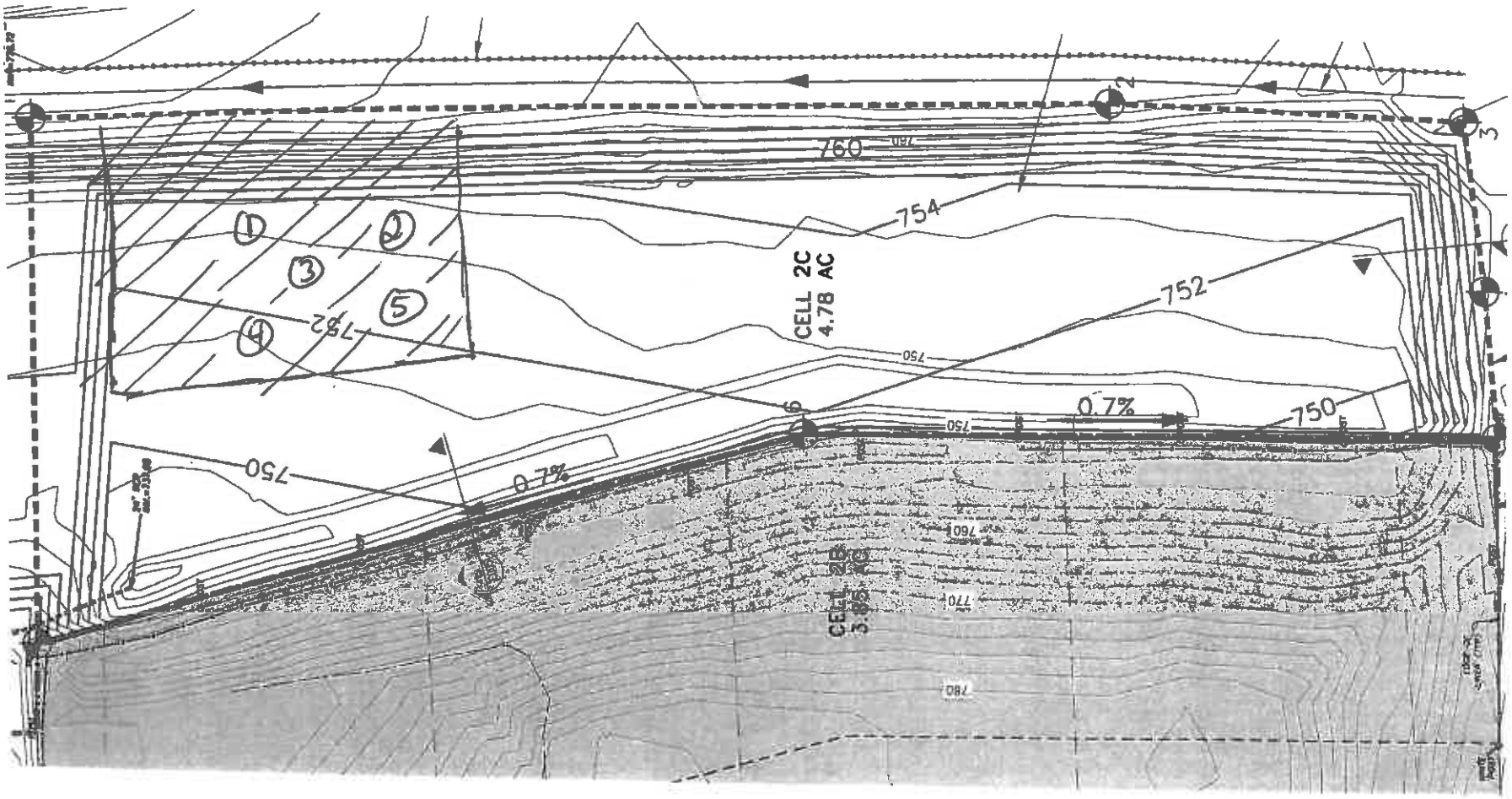
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfil
PROJECT #: R08281N-05G
DATE: 10/2/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
4	See	Map	1	1.32	5.43	123.4	374.5	500.2	471.9	29.1%	95.6	96.4	99.2%	25.2%	3.9%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Lift 1

Location Plan	T&K - Gaston County LF Expansion DALLAS, NC	Draper Aden Associates *Engineering • Surveying • Environmental Services*
Date: 10/2/14	DAA# R08281-05G	Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/3/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	1	122.1	94.5	29.2%	96.4	98.0%	25.2%	4.0%		
2		See	Map	1	120.5	93.5	28.9%	96.4	97.0%	25.2%	3.7%		
3		See	Map	1	121.8	94.0	29.6%	96.4	97.5%	25.2%	4.4%		
4		See	Map	1	120.7	93.6	29.0%	96.4	97.1%	25.2%	3.8%	DC	P-2-1
5		See	Map	1	121.1	94.1	28.7%	96.4	97.6%	25.2%	3.5%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

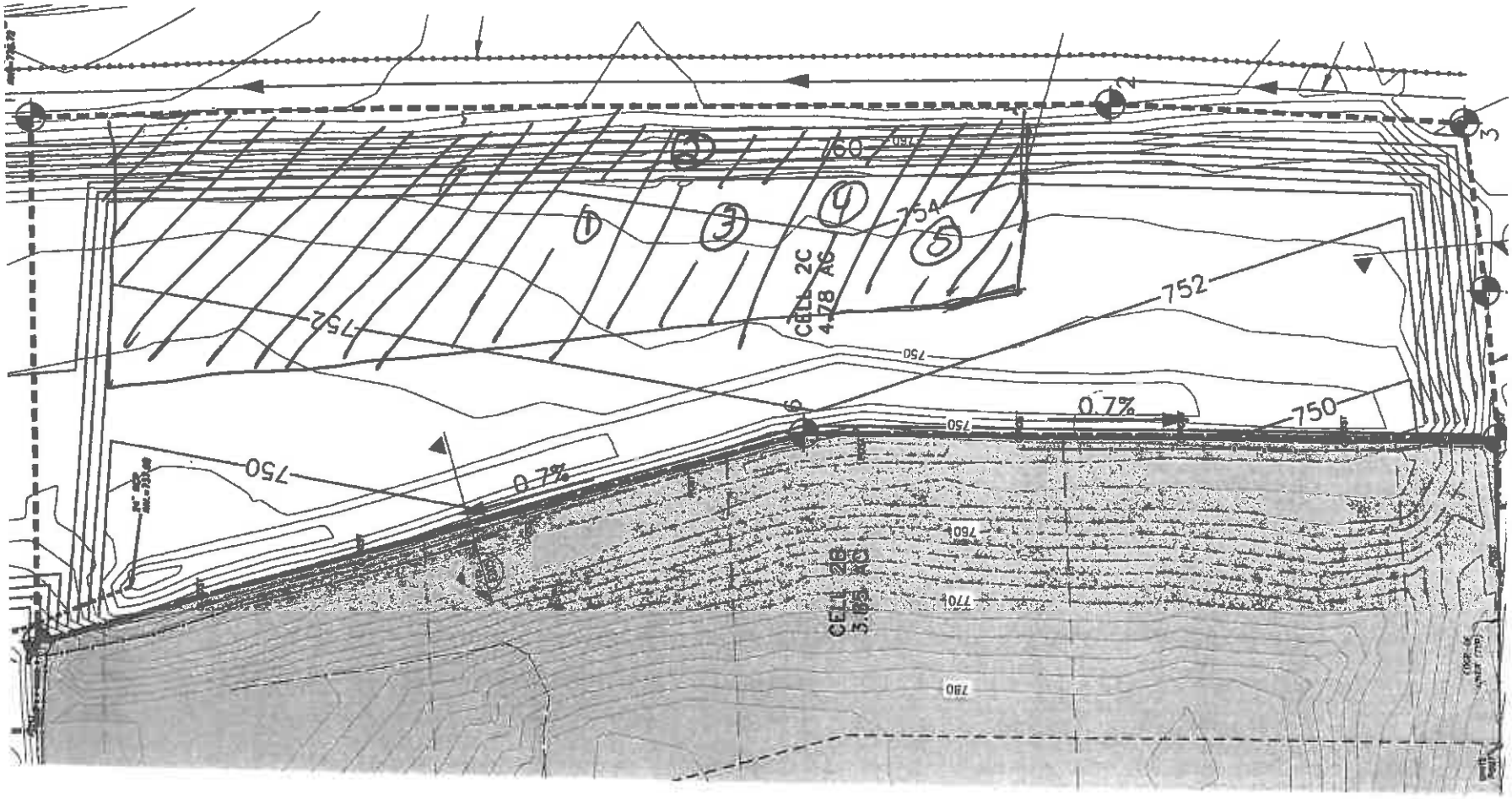
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfil
PROJECT #: R08281N-05G
DATE: 10/3/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
5	See	Map	1	1.32	5.30	119.5	374.5	493.4	468.0	27.2%	94.0	96.4	97.5%	25.2%	2.0%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Lift 1

Location Plan	T&K - Gaston County LF Expansion DALLAS, NC	Draper Aden Associates *Engineering • Surveying • Environmental Services*
Date: 10/3/14	DAA# R08281-05G	Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/6/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	1	121.7	95.5	27.4%	96.4	99.1%	25.2%	2.2%		
2		See	Map	1	120.4	94.0	28.1%	96.4	97.5%	25.2%	2.9%		
3		See	Map	1	122.4	95.4	28.3%	96.4	99.0%	25.2%	3.1%		
4		See	Map	1	120.1	93.5	28.5%	96.4	97.0%	25.2%	3.3%		
5		See	Map	1	120.7	93.6	29.0%	96.4	97.1%	25.2%	3.8%	DC	P-3-1
6		See	Map	1	119.1	93.6	27.3%	96.4	97.1%	25.2%	2.1%		
7		See	Map	1	119.2	93.7	27.2%	96.4	97.2%	25.2%	2.0%	DC	P-4-1
8		See	Map	1	121.6	95.1	27.9%	96.4	98.6%	25.2%	2.7%		
9		See	Map	1	119.8	93.6	28.0%	96.4	97.1%	25.2%	2.8%		
10		See	Map	1	120.3	93.7	28.4%	96.4	97.2%	25.2%	3.2%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

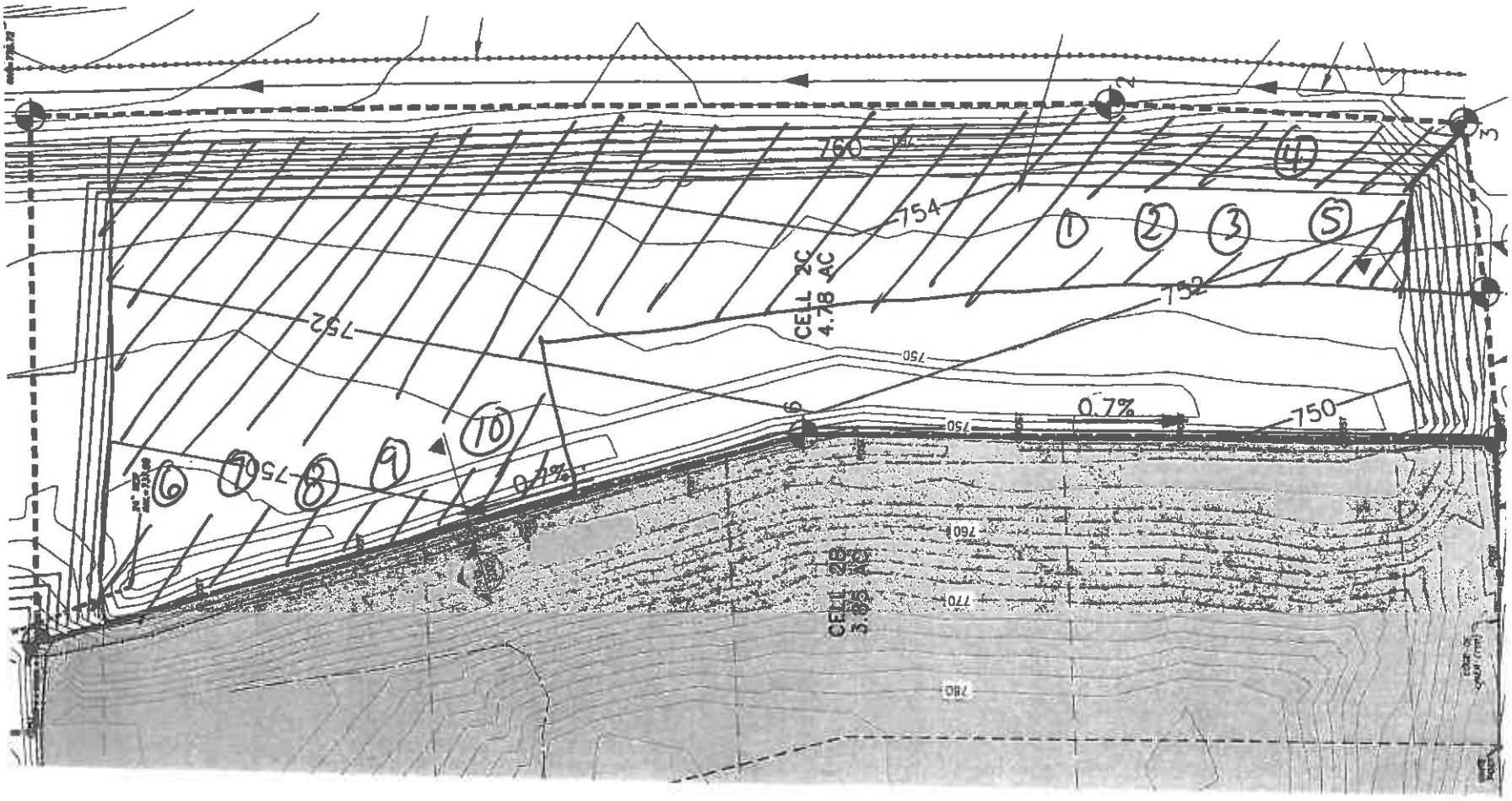
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfil
PROJECT #: R08281N-05G
DATE: 10/6/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
5	See	Map	1	1.32	5.33	120.4	374.5	493.4	467.2	28.3%	93.9	96.4	97.4%	25.2%	3.1%
7	See	Map	1	1.32	5.33	120.4	374.5	506.6	477.6	28.1%	94.0	96.4	97.5%	25.2%	2.9%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Lift 1

Location Plan	T&K - Gaston County LF Expansion DALLAS, NC	Draper Aden Associates *Engineering • Surveying • Environmental Services*
Date: 10/6/14	DAA# R08281-05G	Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/7/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	1	118.6	92.4	28.4%	92.5	99.9%	25.8%	2.6%		
2		See	Map	1	120.5	93.3	29.1%	92.5	100.9%	25.8%	3.3%		
3		See	Map	1	118.4	91.4	29.6%	92.5	98.8%	25.8%	3.8%	DC	
4		See	Map	1	118.5	91.1	30.1%	92.5	98.5%	25.8%	4.3%		
5		See	Map	1	119.3	92.0	29.7%	92.5	99.4%	25.8%	3.9%		
1		See	Map	2	119.9	92.1	30.2%	92.5	99.6%	25.8%	4.4%		
2		See	Map	2	117.9	90.8	29.9%	92.5	98.1%	25.8%	4.1%		
3		See	Map	2	118.8	92.4	28.6%	92.5	99.9%	25.8%	2.8%		
4		See	Map	2	119.1	92.7	28.5%	92.5	100.2%	25.8%	2.7%		
5		See	Map	2	118.6	91.2	30.0%	92.5	98.6%	25.8%	4.2%	DC	P-1-2

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

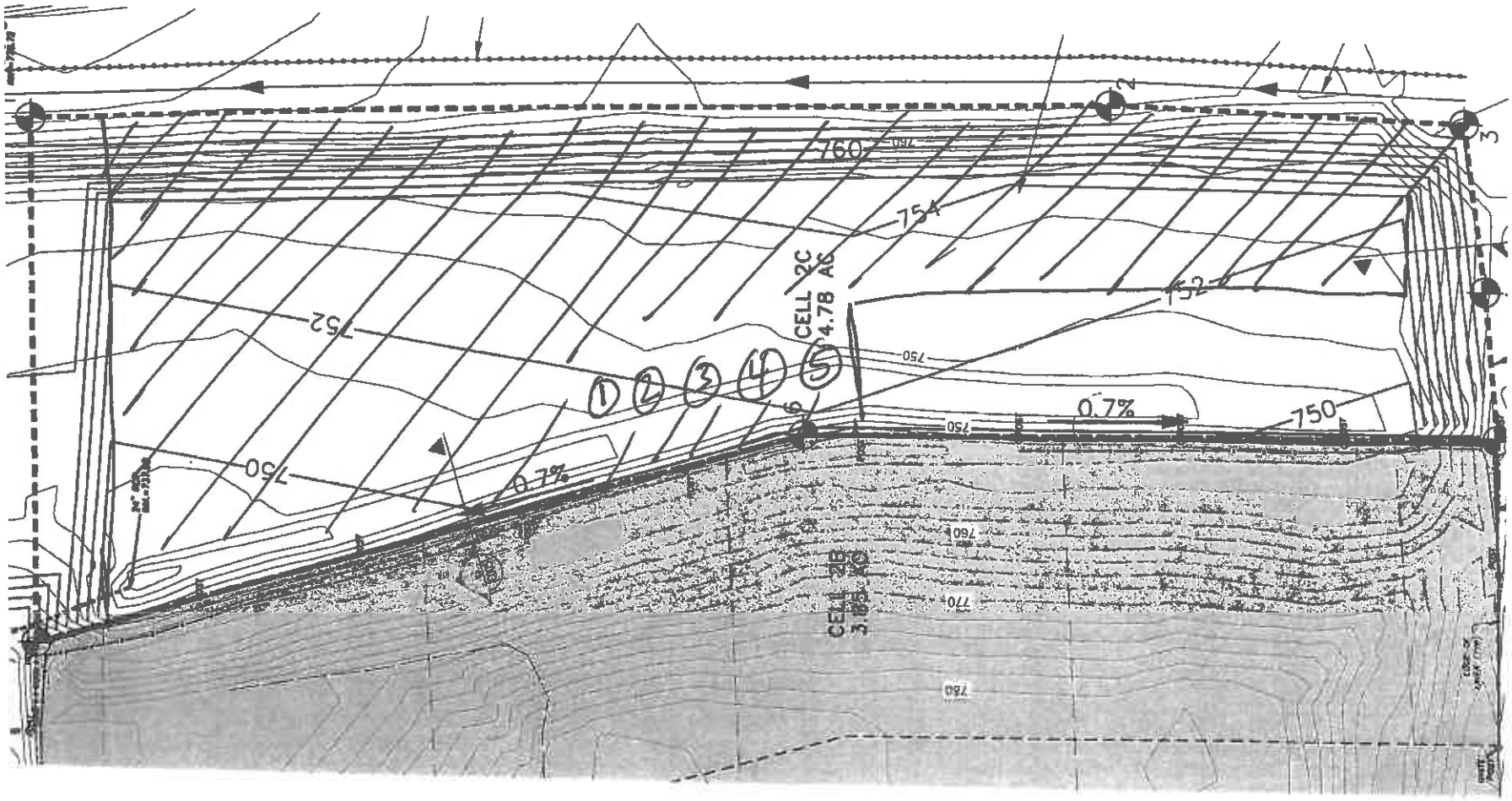
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfil
PROJECT #: R08281N-05G
DATE: 10/7/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
3	See	Map	1	1.32	5.28	118.9	374.5	498.3	470.8	28.6%	92.5	92.5	100.0%	25.8%	2.8%
5	See	Map	2	1.32	5.24	117.7	374.5	487.6	462.4	28.7%	91.5	92.5	98.9%	25.8%	2.9%

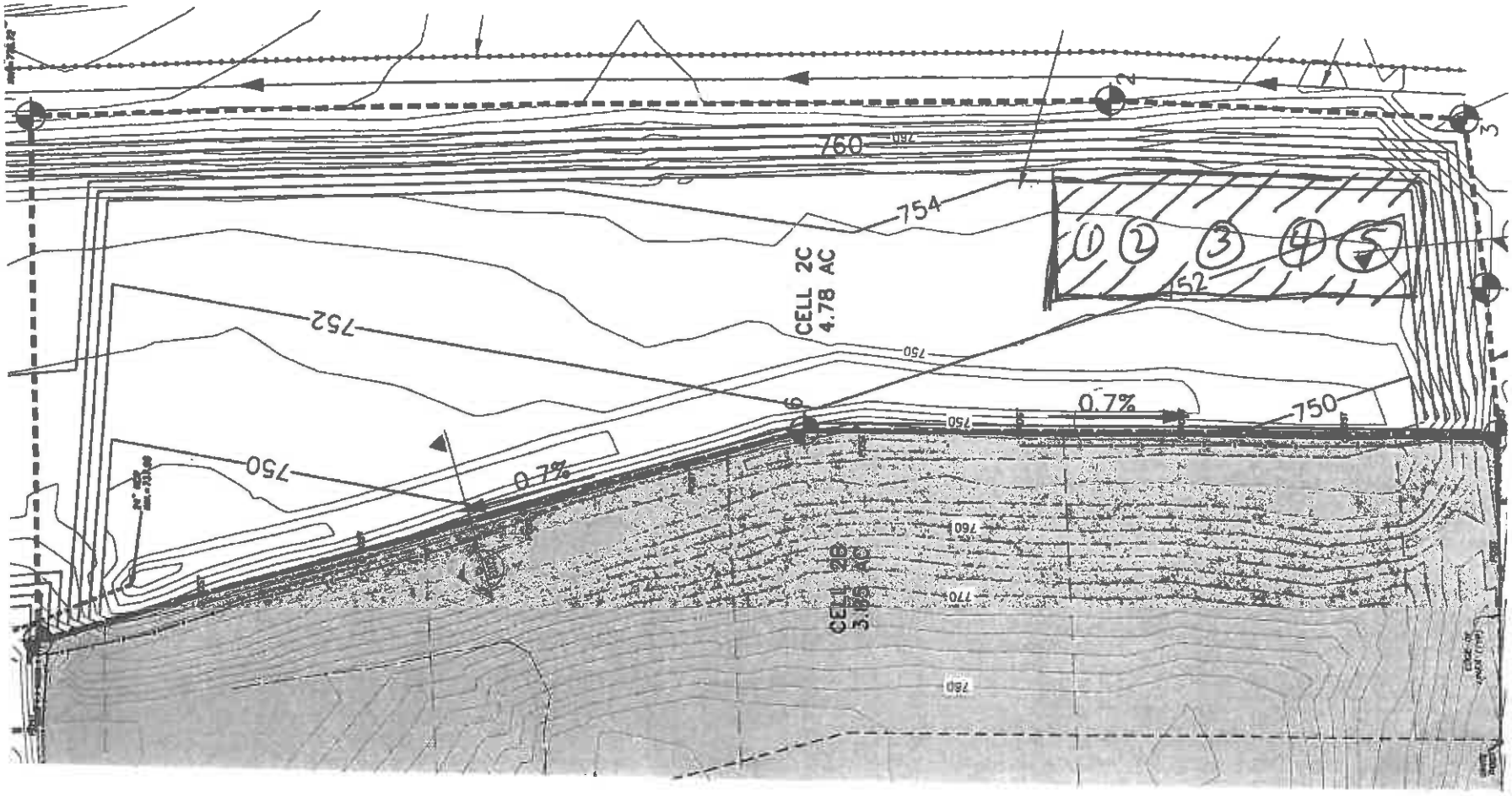
M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Lift 1

Location Plan	T&K - Gaston County LF Expansion DALLAS, NC	Draper Aden Associates *Engineering • Surveying • Environmental Services*
Date: 10/7/14	DAA# R08281-05G	Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA



Lift 2

Location Plan

Date: 10/7/14

T&K - Gaston County LF Expansion
DALLAS, NC

DAA# R08281-05G

Draper Aden Associates
Engineering • Surveying • Environmental Services
Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/8/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	1	121.4	95.7	26.8%	97.8	97.9%	23.1%	3.7%		
2		See	Map	1	120.5	95.7	25.9%	97.8	97.9%	23.1%	2.8%		
3		See	Map	1	121.8	96.2	26.6%	97.8	98.4%	23.1%	3.5%		
4		See	Map	1	121.4	96.0	26.4%	97.8	98.2%	23.1%	3.3%		
5		See	Map	1	121.1	95.9	26.3%	97.8	98.0%	23.1%	3.2%	DC	P-5-1
1		See	Map	2	124.3	97.9	27.0%	97.8	100.1%	23.1%	3.9%		
2		See	Map	2	120.2	95.5	25.9%	97.8	97.6%	23.1%	2.8%		
3		See	Map	2	122.6	97.2	26.1%	97.8	99.4%	23.1%	3.0%		
4		See	Map	2	119.9	95.7	25.3%	97.8	97.8%	23.1%	2.2%		
5		See	Map	2	120.7	94.9	27.2%	97.8	97.0%	23.1%	4.1%	DC	P-2-2

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

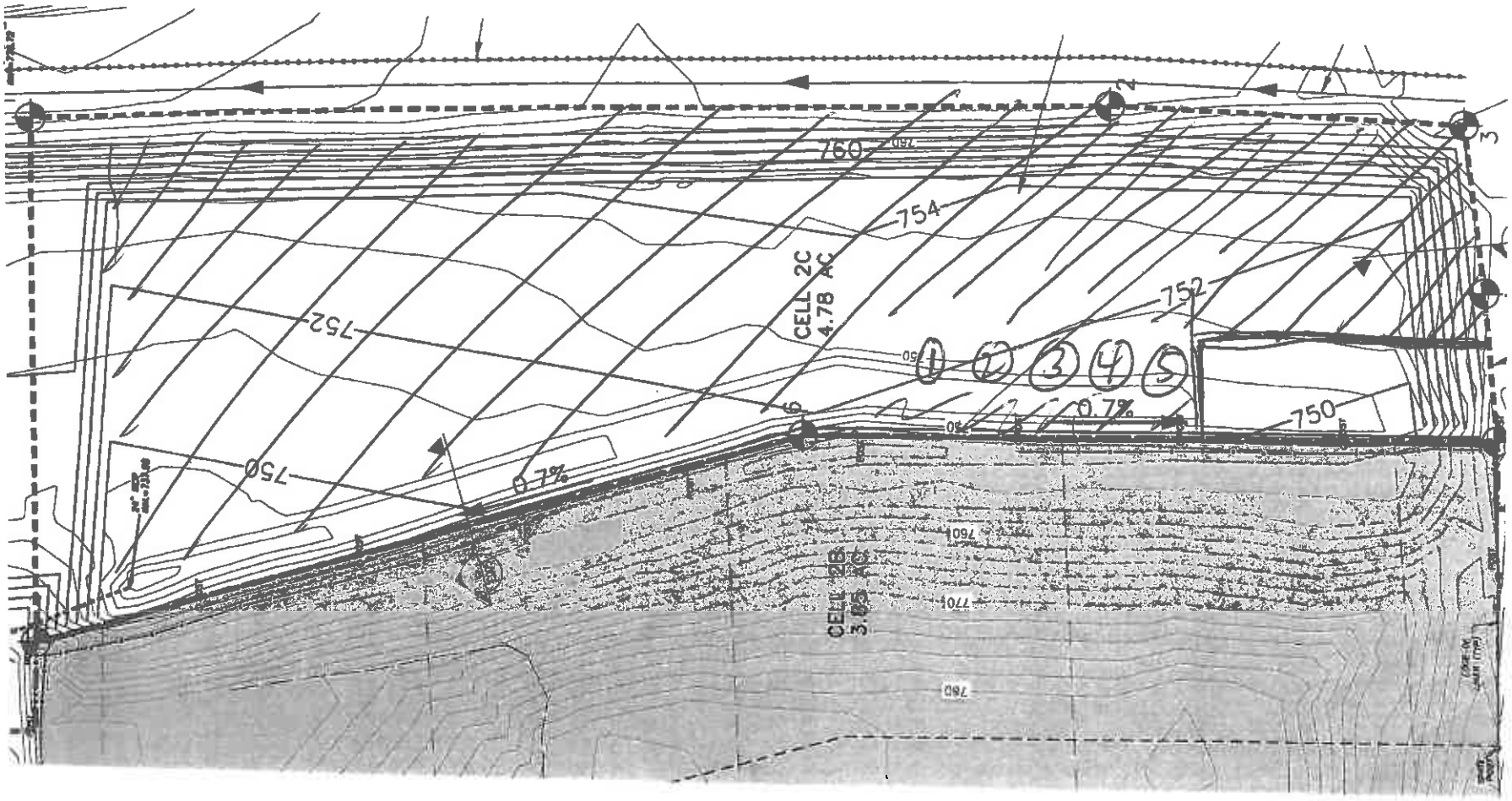
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfil
PROJECT #: R08281N-05G
DATE: 10/8/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
5	See	Map	1	1.32	5.39	122.2	374.5	490.5	465.8	27.1%	96.2	97.8	98.4%	23.1%	4.0%
5	See	Map	2	1.32	5.37	121.6	374.5	501.8	475.3	26.3%	96.3	97.8	98.5%	23.1%	3.2%

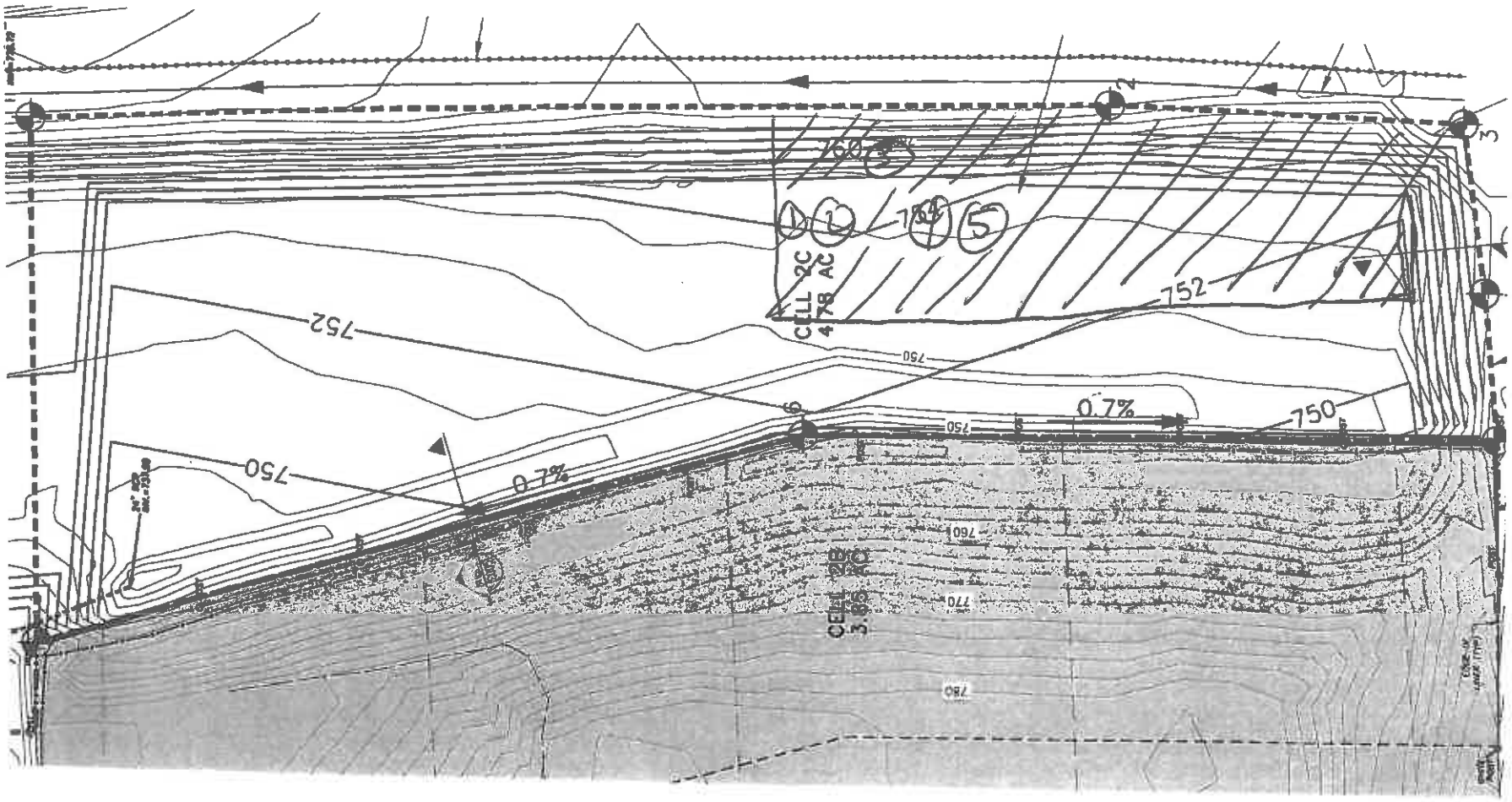
M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Lift 1

Location Plan	T&K - Gaston County LF Expansion DALLAS, NC	Draper Aden Associates *Engineering • Surveying • Environmental Services*
Date: 10/8/14	DAA# R08281-05G	Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA



Lift 2

Location Plan	T&K - Gaston County LF Expansion DALLAS, NC	Draper Aden Associates *Engineering • Surveying • Environmental Services*
Date: 10/8/14	DAA# R08281-05G	Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/9/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	2	123.1	97.6	26.1%	97.8	99.8%	23.1%	3.0%		
2		See	Map	2	125.1	99.8	25.4%	97.8	102.0%	23.1%	2.3%		
3		See	Map	2	126.9	100.6	26.2%	97.8	102.8%	23.1%	3.1%		
4		See	Map	2	127.0	100.5	26.4%	97.8	102.7%	23.1%	3.3%	DC	
5		See	Map	2	122.9	97.0	26.7%	97.8	99.2%	23.1%	3.6%		
6		See	Map	2	123.7	98.3	25.9%	97.8	100.5%	23.1%	2.8%		
7		See	Map	2	124.3	97.9	27.0%	97.8	100.1%	23.1%	3.9%		
8		See	Map	2	122.0	96.4	26.5%	97.8	98.6%	23.1%	3.4%		
9		See	Map	2	125.0	99.2	26.0%	97.8	101.4%	23.1%	2.9%	DC	P-3-2
10		See	Map	2	119.2	95.3	25.1%	97.8	97.4%	23.1%	2.0%		
11		See	Map	2	118.5	91.9	28.9%	94.2	97.6%	25.1%	3.8%		
12		See	Map	2	117.6	91.9	28.0%	94.2	97.5%	25.1%	2.9%		
13		See	Map	2	119.1	92.5	28.8%	94.2	98.2%	25.1%	3.7%	DC	P-4-2
14		See	Map	2	118.4	92.3	28.3%	94.2	98.0%	25.1%	3.2%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

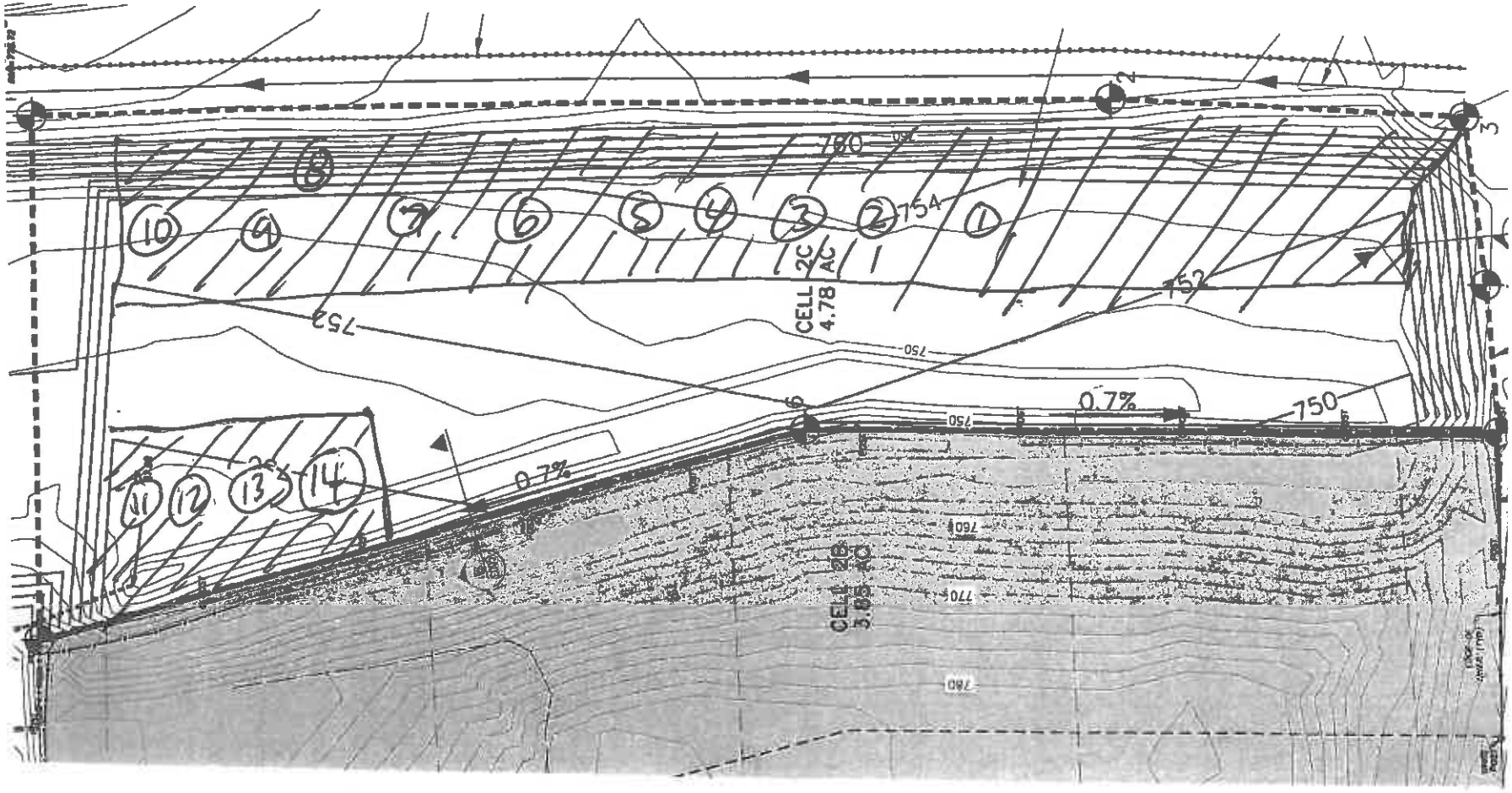
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/9/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
4	See	Map	2	1.32	5.51	125.8	374.5	510.9	482.0	26.9%	99.2	97.8	101.4%	23.1%	3.8%
9	See	Map	2	1.32	5.52	126.1	374.5	506.4	478.8	26.5%	99.7	97.8	102.0%	23.1%	3.4%
13	See	Map	2	1.32	5.32	120.1	374.5	496.0	469.0	28.6%	93.4	94.2	99.2%	25.1%	3.5%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Lift 2

Location Plan	T&K - Gaston County LF Expansion DALLAS, NC	Draper Aden Associates *Engineering • Surveying • Environmental Services*
Date: 10/9/14	DAA# R08281-05G	Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/10/2014
PAGE 1 of 2

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	1	117.6	91.7	28.2%	92.1	99.6%	25.5%	2.7%		
2		See	Map	1	115.5	90.2	28.0%	92.1	98.0%	25.5%	2.5%		
3		See	Map	1	117.0	91.6	27.7%	92.1	99.5%	25.5%	2.2%		
4		See	Map	2	118.5	93.0	27.4%	92.1	101.0%	25.5%	1.9%	DC	
1		See	Map	2	116.3	90.8	28.1%	92.1	98.6%	25.5%	2.6%		
2		See	Map	2	115.8	90.5	27.9%	92.1	98.3%	25.5%	2.4%		
3		See	Map	2	114.4	89.7	27.6%	92.1	97.3%	25.5%	2.1%		
4		See	Map	2	116.2	90.8	28.0%	92.1	98.6%	25.5%	2.5%		
5		See	Map	2	115.6	90.3	28.0%	92.1	98.1%	25.5%	2.5%		
6		See	Map	2	115.6	89.5	29.1%	92.1	97.2%	25.5%	3.6%	DC	
7		See	Map	2	117.2	91.8	27.6%	92.1	99.7%	25.5%	2.1%		
8		See	Map	2	115.9	90.3	28.4%	92.1	98.0%	25.5%	2.9%		
9		See	Map	2	115.3	89.5	28.8%	92.1	97.2%	25.5%	3.3%		
10		See	Map	2	116.0	90.0	28.9%	92.1	97.7%	25.5%	3.4%		
11		See	Map	2	116.6	91.0	28.2%	92.1	98.8%	25.5%	2.7%	DC	

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/10/2014
PAGE 2 of 2

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
12		See	Map	2	115.8	89.8	28.9%	92.1	97.5%	25.5%	3.4%		
13		See	Map	2	116.1	89.9	29.2%	92.1	97.6%	25.5%	3.7%		
14		See	Map	2	117.0	91.1	28.4%	92.1	98.9%	25.5%	2.9%		
15		See	Map	2	117.9	92.4	27.6%	92.1	100.3%	25.5%	2.1%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

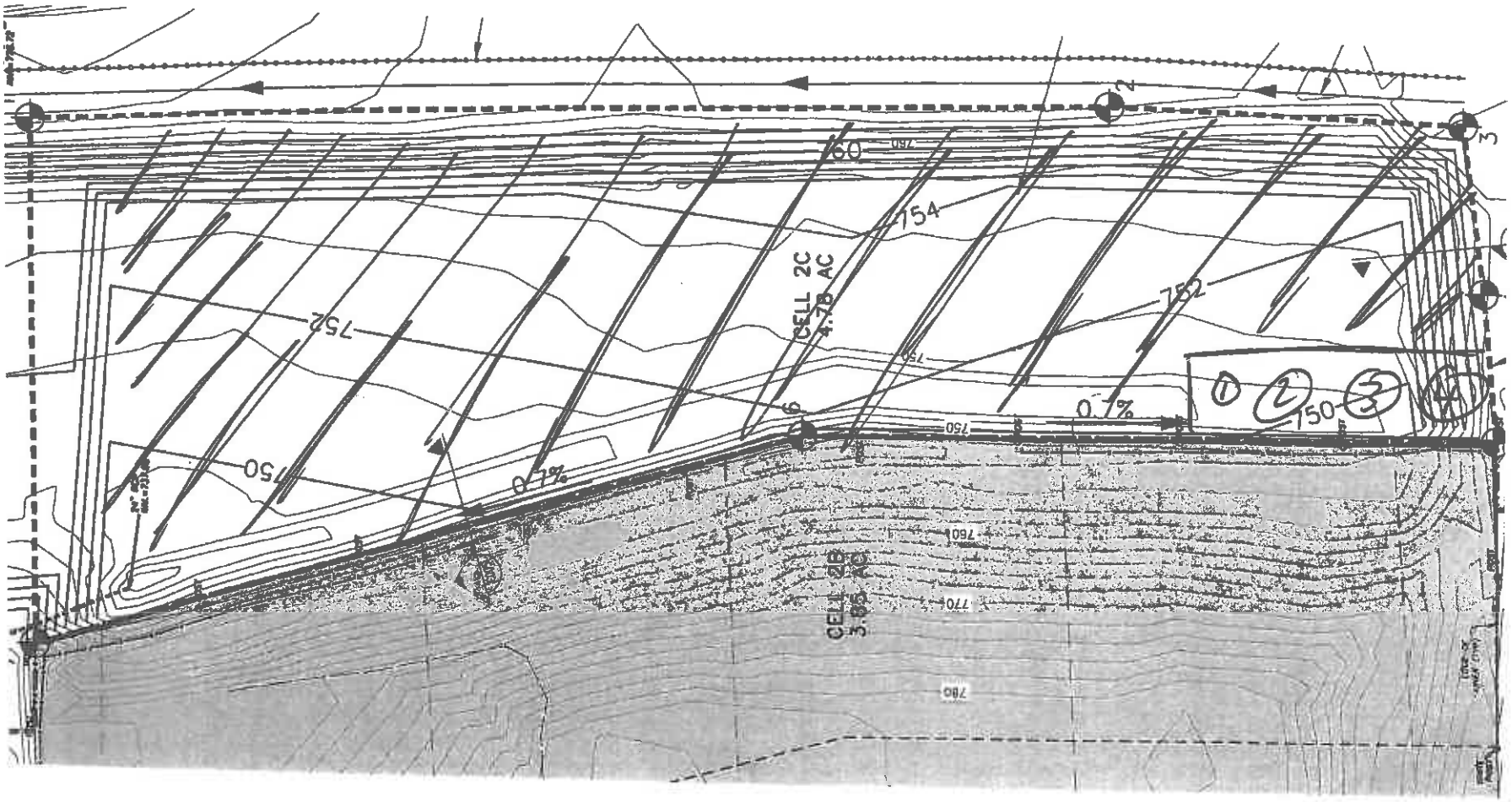
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/10/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
4	See	Map	2	1.32	5.29	119.2	374.5	504.2	475.0	29.1%	92.4	92.1	100.3%	25.5%	3.6%
6	See	Map	2	1.32	5.21	116.8	374.5	498.6	470.5	29.3%	90.4	92.1	98.1%	25.5%	3.8%
11	See	Map	2	1.32	5.22	117.1	374.5	500.0	471.8	29.0%	90.8	92.1	98.6%	25.5%	3.5%

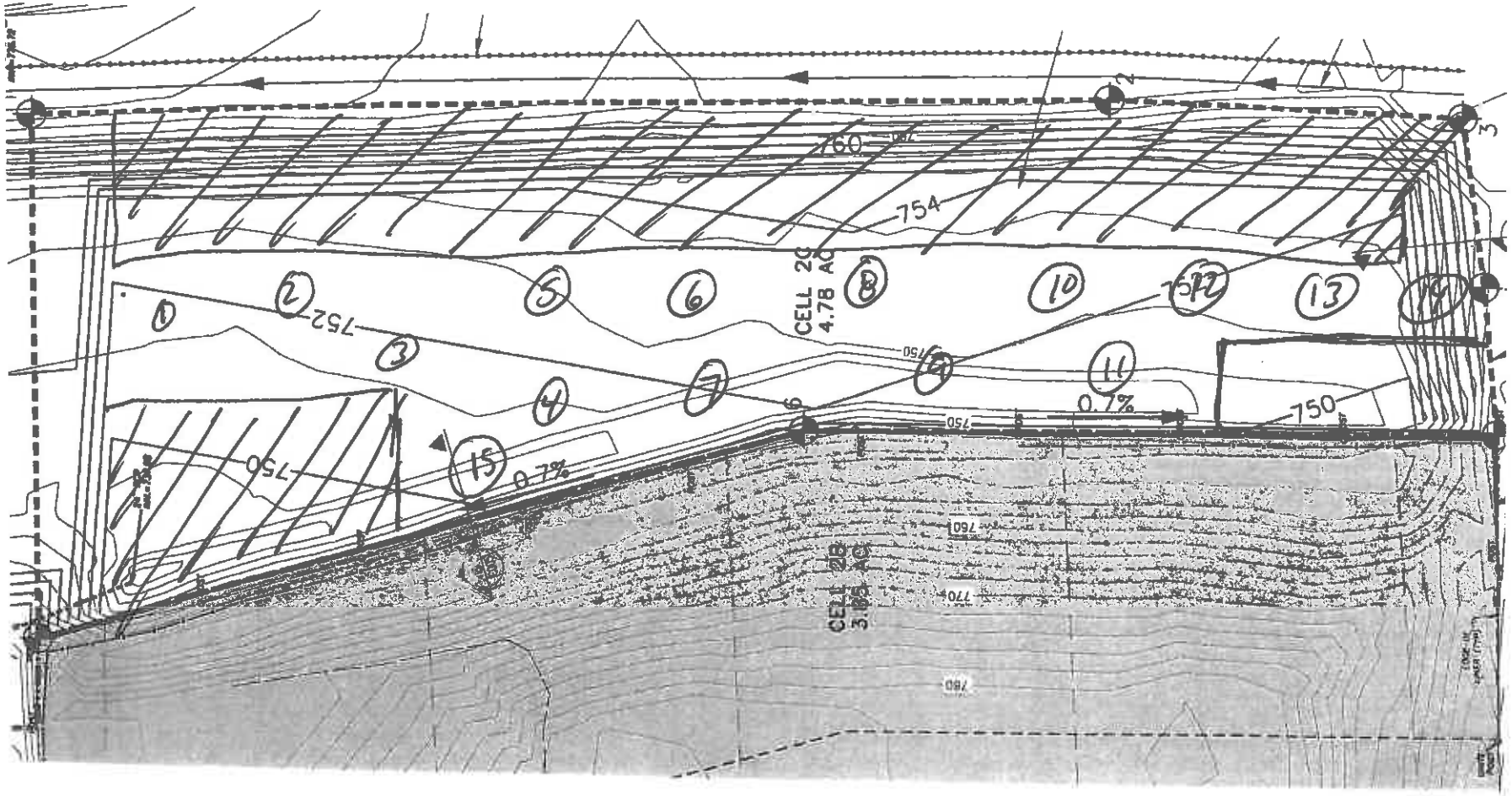
M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Lift 1

Location Plan Date: 10/10/14	T&K - Gaston County LF Expansion DALLAS, NC DAA# R08281-05G	Draper Aden Associates Engineering • Surveying • Environmental Services Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA



Lift 2

Location Plan

Date: 10/10/14

T&K - Gaston County LF Expansion
DALLAS, NC

DAA# R08281-05G

Draper Aden Associates
Engineering • Surveying • Environmental Services
Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/11/2014
PAGE 1 of 2

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	2	117.9	91.9	28.3%	92.5	99.3%	25.8%	2.5%		
2		See	Map	2	118.6	91.9	29.1%	92.5	99.3%	25.8%	3.3%		
3		See	Map	2	119.0	92.1	29.2%	92.5	99.6%	25.8%	3.4%	DC	P-5-2
4		See	Map	2	118.4	91.3	29.7%	92.5	98.7%	25.8%	3.9%		
5		See	Map	2	117.5	91.1	29.0%	92.5	98.5%	25.8%	3.2%		
1		See	Map	3	119.2	92.5	28.9%	92.5	100.0%	25.8%	3.1%	DC	P-2-3
2		See	Map	3	118.6	91.8	29.2%	92.5	99.2%	25.8%	3.4%		
3		See	Map	3	117.8	92.1	27.9%	92.5	99.6%	25.8%	2.1%		
4		See	Map	3	118.8	92.5	28.5%	92.5	99.9%	25.8%	2.7%		
5		See	Map	3	119.9	92.9	29.1%	92.5	100.4%	25.8%	3.3%		
6		See	Map	3	120.0	93.0	29.0%	92.5	100.6%	25.8%	3.2%		
7		See	Map	3	119.1	92.4	28.9%	92.5	99.9%	25.8%	3.1%		
8		See	Map	3	119.5	93.4	27.9%	92.5	101.0%	25.8%	2.1%		
9		See	Map	3	119.4	92.4	29.2%	92.5	99.9%	25.8%	3.4%		
10		See	Map	3	118.3	91.6	29.1%	92.5	99.1%	25.8%	3.3%	DC	P-3-3

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/11/2014
PAGE 2 of 2

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
11		See	Map	3	118.4	91.6	29.3%	92.5	99.0%	25.8%	3.5%		
12		See	Map	3	119.1	92.3	29.0%	92.5	99.8%	25.8%	3.2%		
13		See	Map	3	117.6	91.3	28.8%	92.5	98.7%	25.8%	3.0%		
14		See	Map	3	118.5	92.1	28.7%	92.5	99.5%	25.8%	2.9%		
15		See	Map	3	118.9	92.3	28.8%	92.5	99.8%	25.8%	3.0%	DC	P-5-3

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

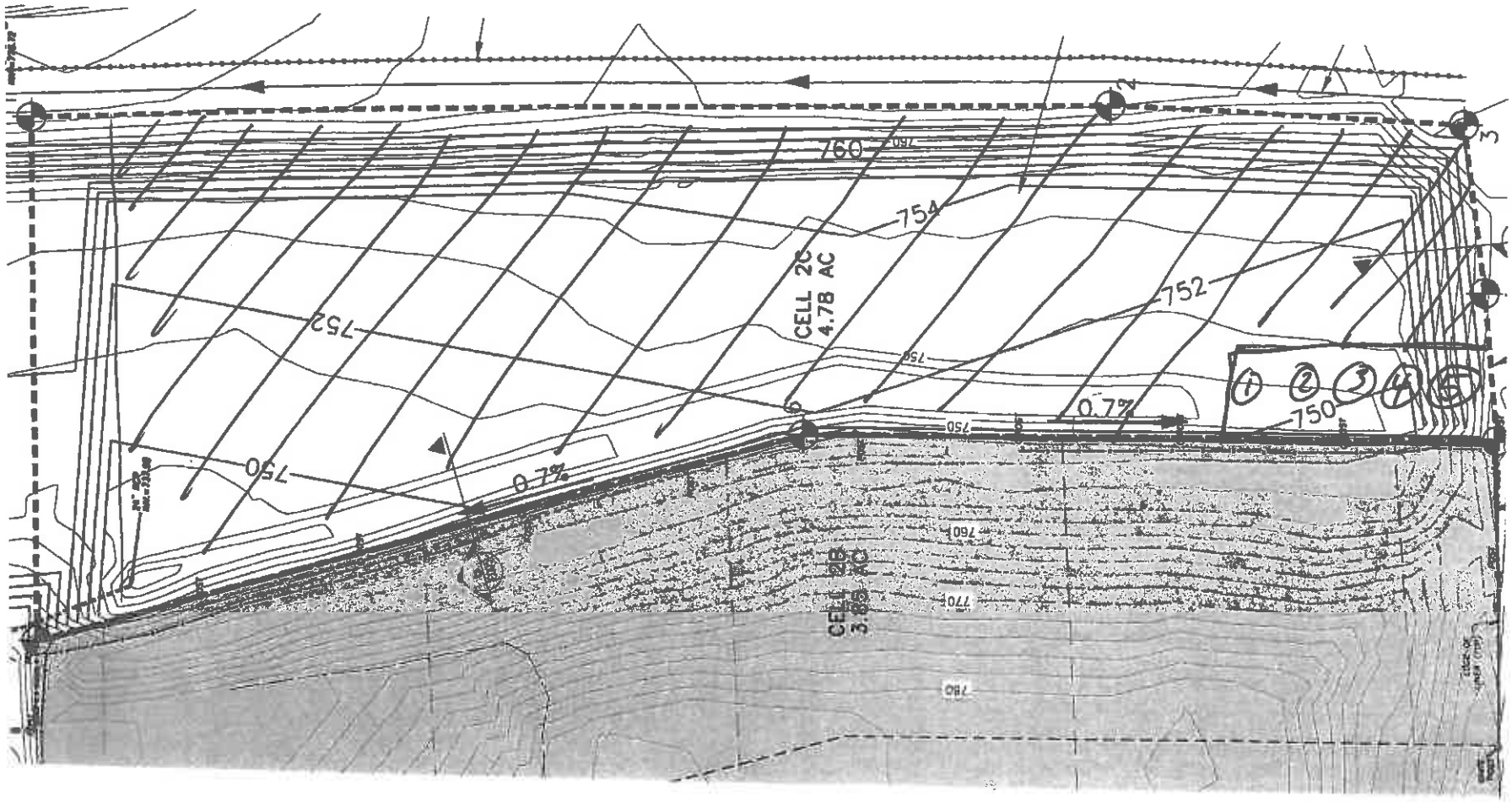
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/11/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
3	See	Map	2	1.32	5.28	118.9	374.5	501.4	472.8	29.1%	92.1	92.5	99.6%	25.8%	3.3%
1	See	Map	3	1.32	5.29	119.2	374.5	498.5	470.1	29.7%	91.9	92.5	99.4%	25.8%	3.9%
10	See	Map	3	1.32	5.30	119.5	374.5	510.6	479.6	29.5%	92.3	92.5	99.8%	25.8%	3.7%
15	See	Map	3	1.32	5.30	119.5	374.5	495.4	468.0	29.3%	92.4	92.5	99.9%	25.8%	3.5%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Lift 2

Location Plan

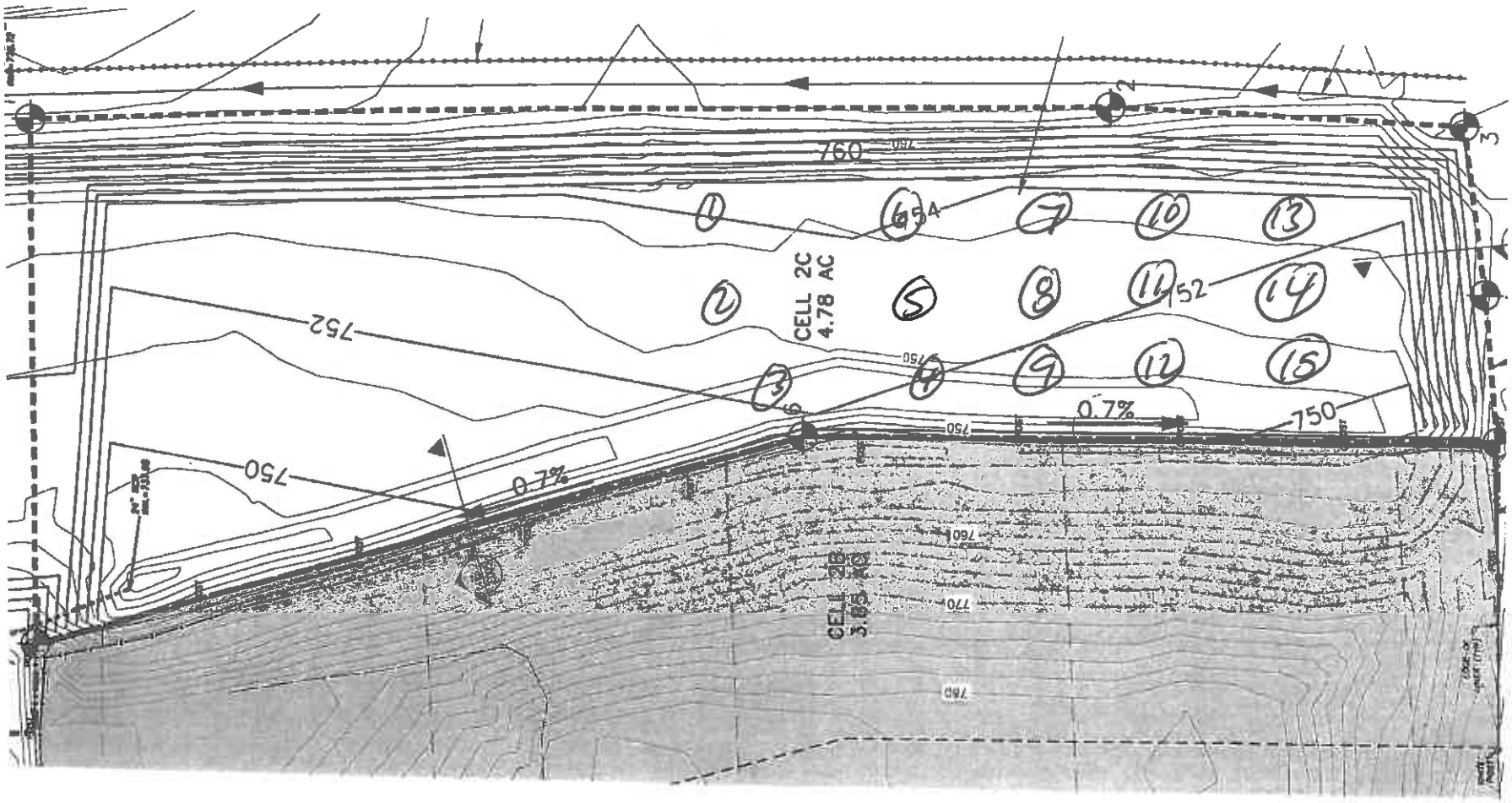
Date: 10/11/14

T&K - Gaston County LF Expansion
DALLAS, NC

DAA# R08281-05G

Draper Aden Associates
Engineering • Surveying • Environmental Services

Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA



Lift 3

Location Plan

Date: 10/11/14

T&K - Gaston County LF Expansion
DALLAS, NC

DAA# R08281-05G

Draper Aden Associates
Engineering • Surveying • Environmental Services
Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/13/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	3	117.9	92.2	27.9%	92.5	99.7%	25.8%	2.1%		
2		See	Map	3	117.1	91.2	28.4%	92.5	98.6%	25.8%	2.6%		
3		See	Map	3	117.5	91.0	29.1%	92.5	98.4%	25.8%	3.3%		
4		See	Map	3	118.6	92.8	27.8%	92.5	100.3%	25.8%	2.0%		
5		See	Map	3	117.9	91.3	29.1%	92.5	98.7%	25.8%	3.3%	DC	
6		See	Map	3	118.2	91.7	28.9%	92.5	99.1%	25.8%	3.1%		
7		See	Map	3	119.0	92.5	28.7%	92.5	100.0%	25.8%	2.9%		
8		See	Map	3	117.4	90.9	29.2%	92.5	98.2%	25.8%	3.4%		
9		See	Map	3	118.2	91.7	28.9%	92.5	99.1%	25.8%	3.1%		
10		See	Map	3	118.8	92.5	28.4%	92.5	100.0%	25.8%	2.6%	DC	
11		See	Map	3	118.6	92.8	27.8%	92.5	100.3%	25.8%	2.0%		
12		See	Map	3	118.1	91.5	29.1%	92.5	98.9%	25.8%	3.3%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

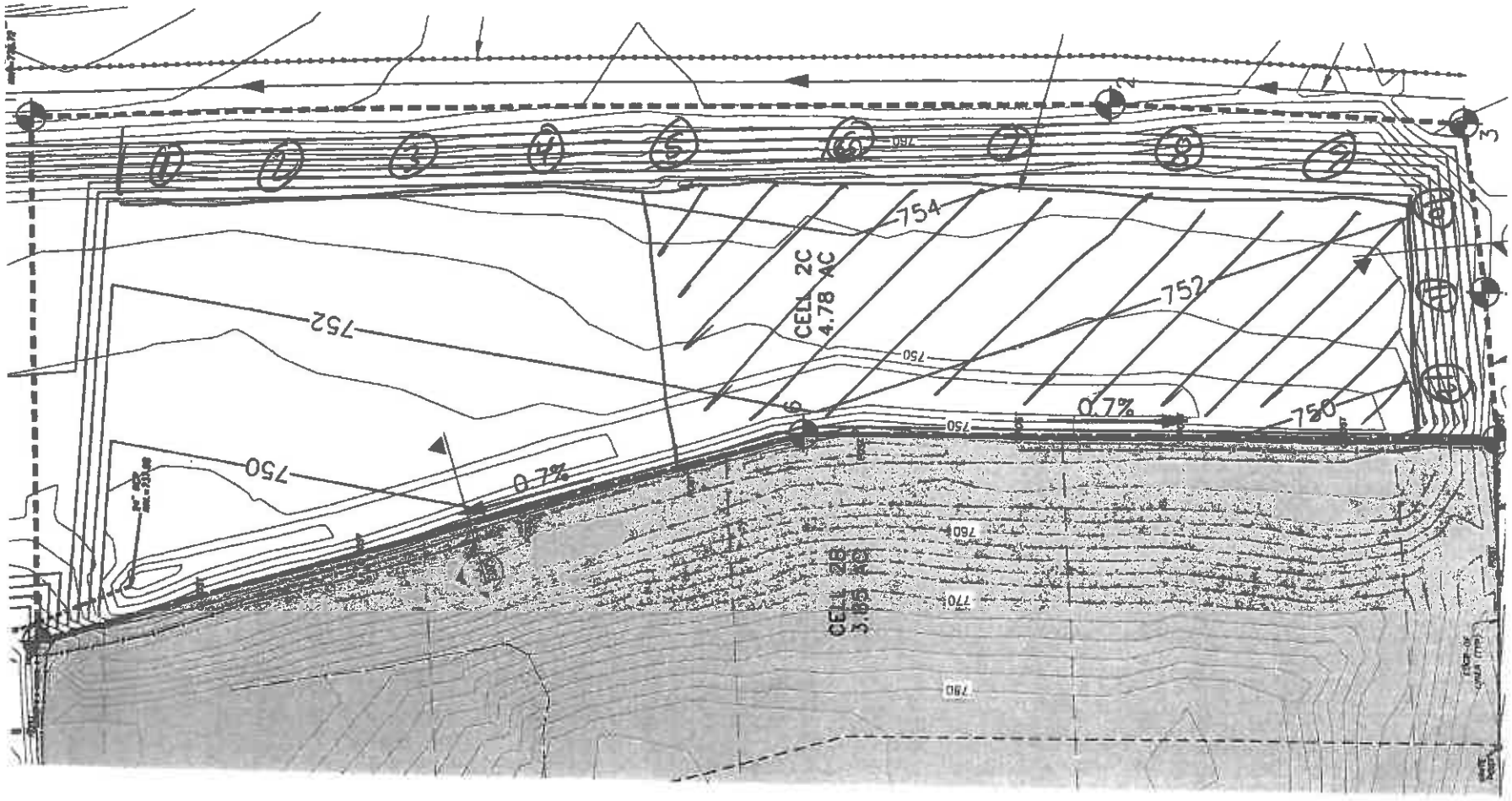
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/13/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
5	See	Map	3	1.32	5.27	118.6	374.5	510.0	478.9	29.8%	91.4	92.5	98.8%	25.8%	4.0%
10	See	Map	3	1.32	5.29	119.2	374.5	497.6	470.2	28.6%	92.7	92.5	100.2%	25.8%	2.8%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Lift 3

Location Plan

Date: 10/13/14

T&K - Gaston County LF Expansion
DALLAS, NC

DAA# R08281-05G

Draper Aden Associates
Engineering • Surveying • Environmental Services

Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/17/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	3	125.4	101.9	23.1%	103.3	98.6%	19.8%	3.3%		
2		See	Map	3	127.0	102.6	23.8%	103.3	99.3%	19.8%	4.0%		
3		See	Map	3	122.5	100.3	22.1%	103.3	97.1%	19.8%	2.3%		
4		See	Map	3	125.5	102.5	22.4%	103.3	99.3%	19.8%	2.6%	DC	P-1-3
5		See	Map	3	122.5	100.2	22.3%	103.3	97.0%	19.8%	2.5%		
6		See	Map	3	123.6	100.4	23.1%	103.3	97.2%	19.8%	3.3%		
7		See	Map	3	124.1	100.4	23.6%	103.3	97.2%	19.8%	3.8%		
8		See	Map	3	125.2	101.0	24.0%	103.3	97.7%	19.8%	4.2%		
9		See	Map	3	122.8	100.3	22.4%	103.3	97.1%	19.8%	2.6%		
10		See	Map	3	123.3	100.3	22.9%	103.3	97.1%	19.8%	3.1%	DC	P-4-3
1		See	Map	4	123.9	98.2	26.2%	97.8	100.4%	23.1%	3.1%		
2		See	Map	4	119.7	95.0	26.0%	97.8	97.1%	23.1%	2.9%		
3		See	Map	4	119.8	95.2	25.9%	97.8	97.3%	23.1%	2.8%		
4		See	Map	4	122.2	96.4	26.8%	97.8	98.5%	23.1%	3.7%	DC	P-5-4

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

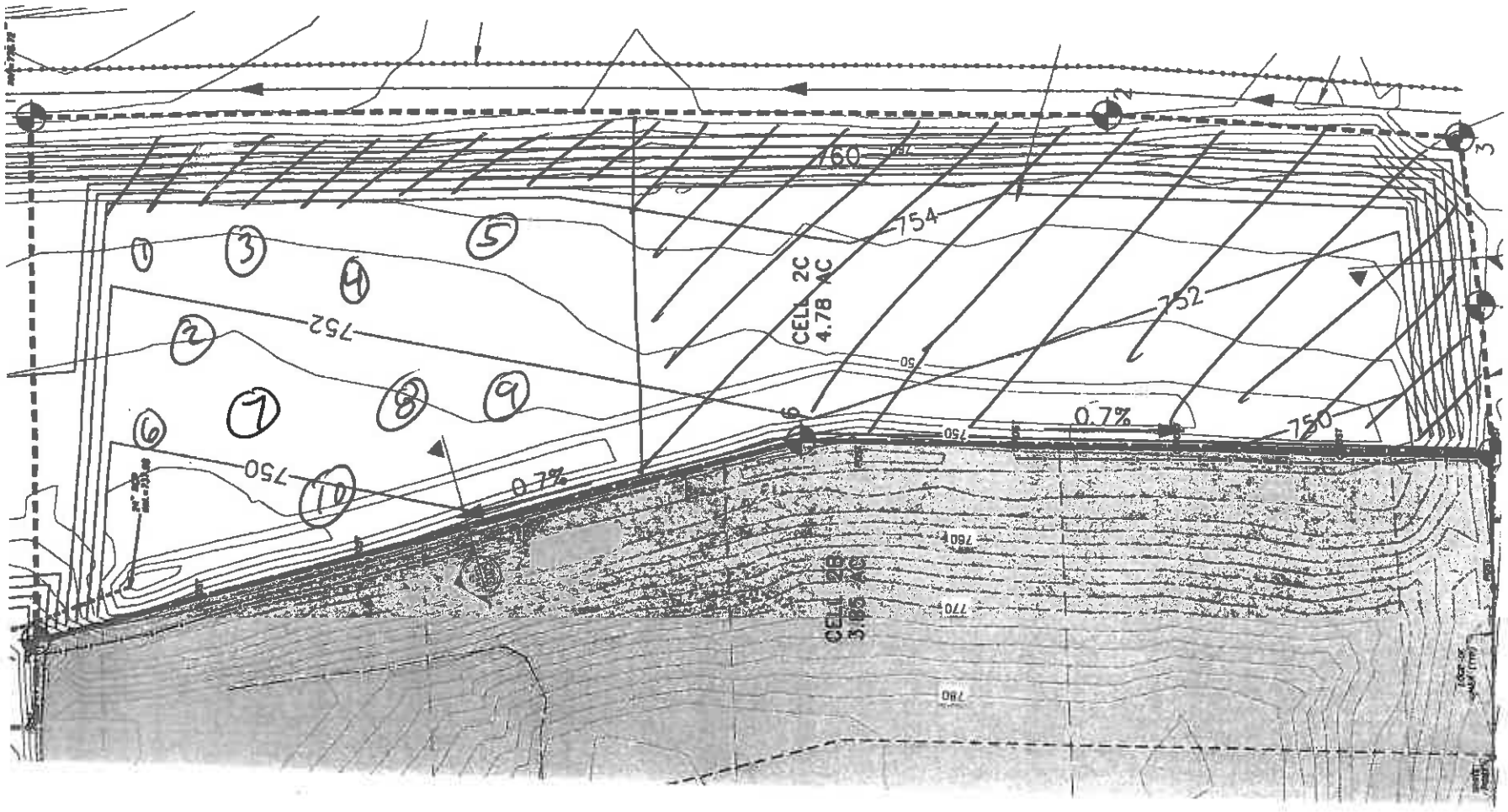
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/17/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
4	See	Map	3	1.32	5.48	124.9	374.5	506.7	483.0	21.8%	102.5	103.3	99.3%	19.8%	2.0%
10	See	Map	4	1.32	5.42	123.1	374.5	498.3	475.5	22.6%	100.4	103.3	97.2%	19.8%	2.8%
4	See	Map	4	1.32	5.43	123.4	374.5	476.8	455.5	26.3%	97.7	97.8	99.9%	23.1%	3.2%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Lift 3

Location Plan

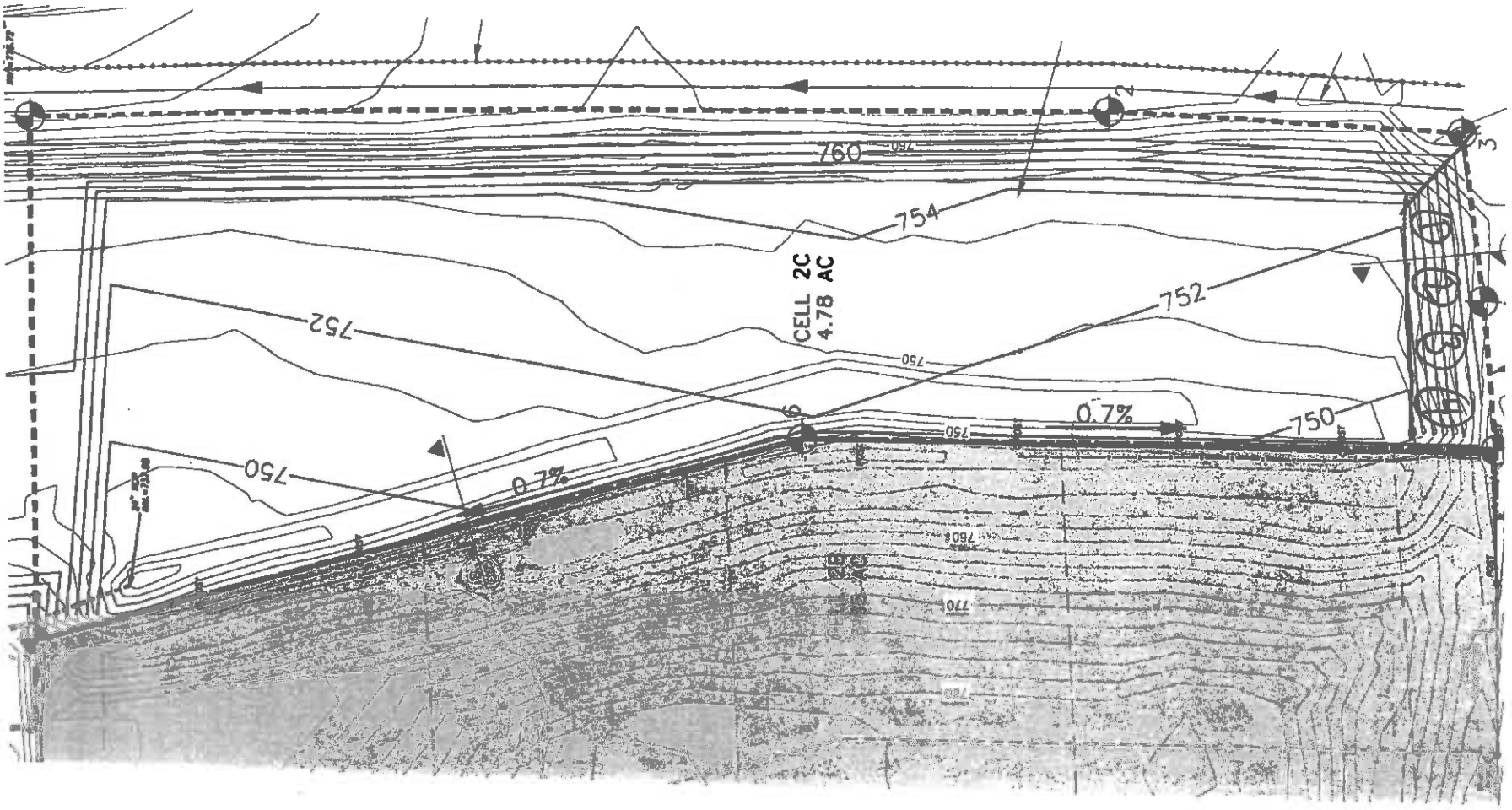
Date: 10/17/14

T&K - Gaston County LF Expansion
DALLAS, NC

DAA# R08281-05G

Draper Aden Associates
Engineering • Surveying • Environmental Services

Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA



Lift 4

Location Plan

Date: 10/17/14

T&K - Gaston County LF Expansion
DALLAS, NC

DAA# R08281-05G

Draper Aden Associates
Engineering • Surveying • Environmental Services
Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/18/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	4	120.6	95.4	26.4%	97.8	97.6%	23.1%	3.3%	DC	
2		See	Map	4	121.5	96.4	26.1%	97.8	98.5%	23.1%	3.0%		
3		See	Map	4	120.4	95.6	25.9%	97.8	97.8%	23.1%	2.8%		
4		See	Map	4	120.8	96.0	25.8%	97.8	98.2%	23.1%	2.7%		
5		See	Map	4	121.0	95.7	26.4%	97.8	97.9%	23.1%	3.3%		
6		See	Map	4	120.3	95.3	26.2%	97.8	97.5%	23.1%	3.1%	DC	P-3-4
7		See	Map	4	122.4	96.7	26.6%	97.8	98.9%	23.1%	3.5%		
8		See	Map	4	120.1	95.9	25.2%	97.8	98.1%	23.1%	2.1%		
9		See	Map	4	120.9	96.2	25.7%	97.8	98.3%	23.1%	2.6%		
10		See	Map	4	121.7	96.6	26.0%	97.8	98.8%	23.1%	2.9%		
11		See	Map	4	120.7	95.6	26.2%	97.8	97.8%	23.1%	3.1%		
12		See	Map	4	122.0	96.1	27.0%	97.8	98.2%	23.1%	3.9%	DC	P-2-4
13		See	Map	4	120.8	95.3	26.8%	97.8	97.4%	23.1%	3.7%		
14		See	Map	4	120.1	95.2	26.1%	97.8	97.4%	23.1%	3.0%		
15		See	Map	4	120.5	95.6	26.1%	97.8	97.7%	23.1%	3.0%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

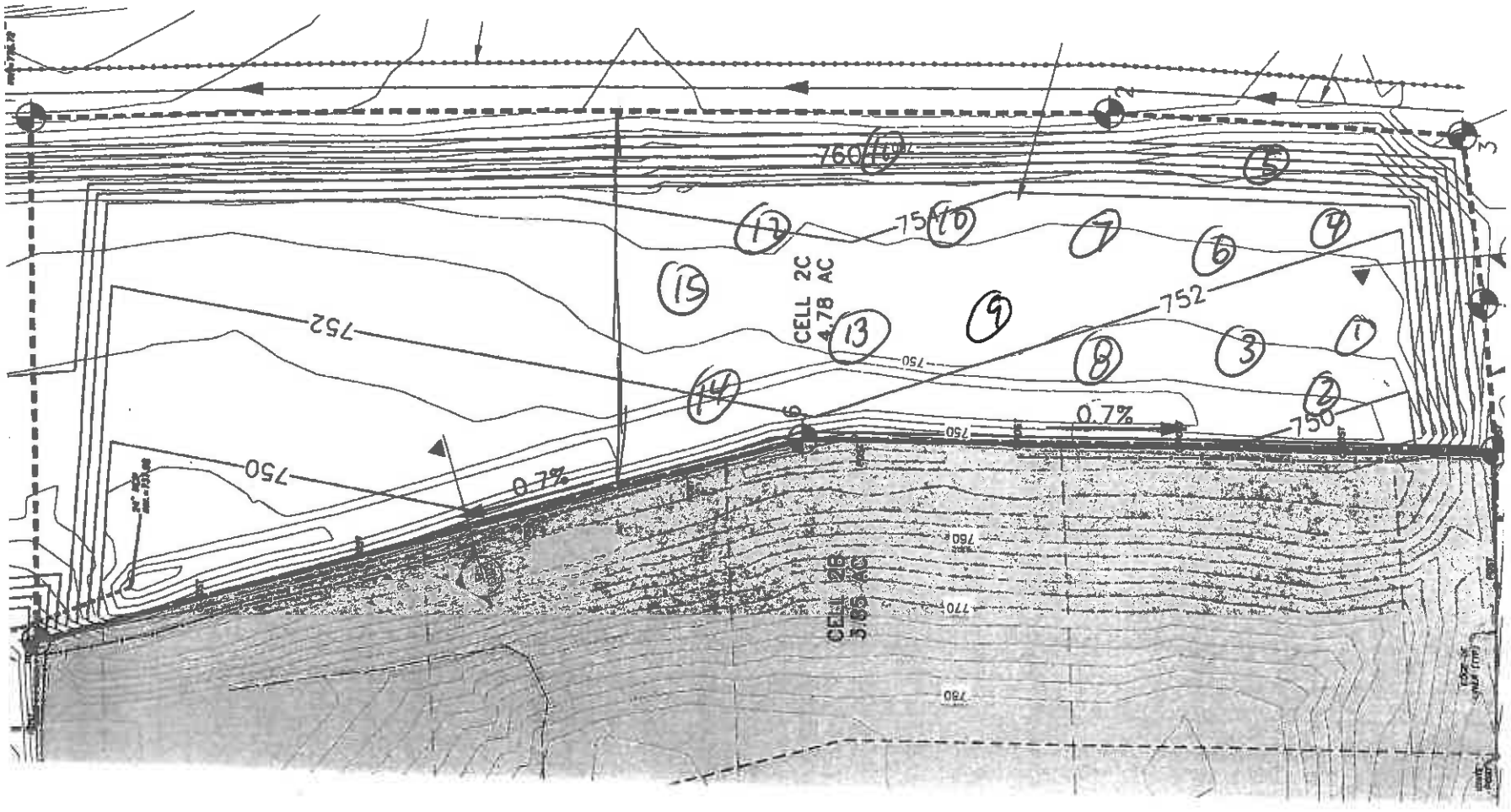
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/18/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
1	See	Map	4	1.32	5.32	120.1	374.5	490.2	466.8	25.4%	95.8	97.8	98.0%	23.1%	2.3%
6	See	Map	4	1.32	5.35	121.0	374.5	492.8	468.3	26.1%	96.0	97.8	98.1%	23.1%	3.0%
12	See	Map	4	1.32	5.37	121.6	374.5	506.8	478.6	27.1%	95.7	97.8	97.9%	23.1%	4.0%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Lift 4

Location Plan	T&K - Gaston County LF Expansion DALLAS, NC	Draper Aden Associates *Engineering • Surveying • Environmental Services*
Date: 10/18/14	DAA# R08281-05G	Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/20/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	4	121.4	96.2	26.2%	97.8	98.4%	23.1%	3.1%	DC	P-1-4
2		See	Map	4	120.4	95.6	25.9%	97.8	97.8%	23.1%	2.8%		
3		See	Map	4	120.8	95.5	26.5%	97.8	97.6%	23.1%	3.4%		
4		See	Map	4	121.5	96.6	25.8%	97.8	98.8%	23.1%	2.7%		
5		See	Map	4	120.7	95.0	27.0%	97.8	97.2%	23.1%	3.9%		
6		See	Map	4	120.8	96.2	25.6%	97.8	98.3%	23.1%	2.5%		
7		See	Map	4	121.2	95.6	26.8%	97.8	97.7%	23.1%	3.7%	DC	P-4-4
8		See	Map	4	119.8	95.8	25.1%	97.8	97.9%	23.1%	2.0%		
9		See	Map	4	120.2	95.4	26.0%	97.8	97.5%	23.1%	2.9%		
10		See	Map	4	121.3	96.9	25.2%	97.8	99.1%	23.1%	2.1%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

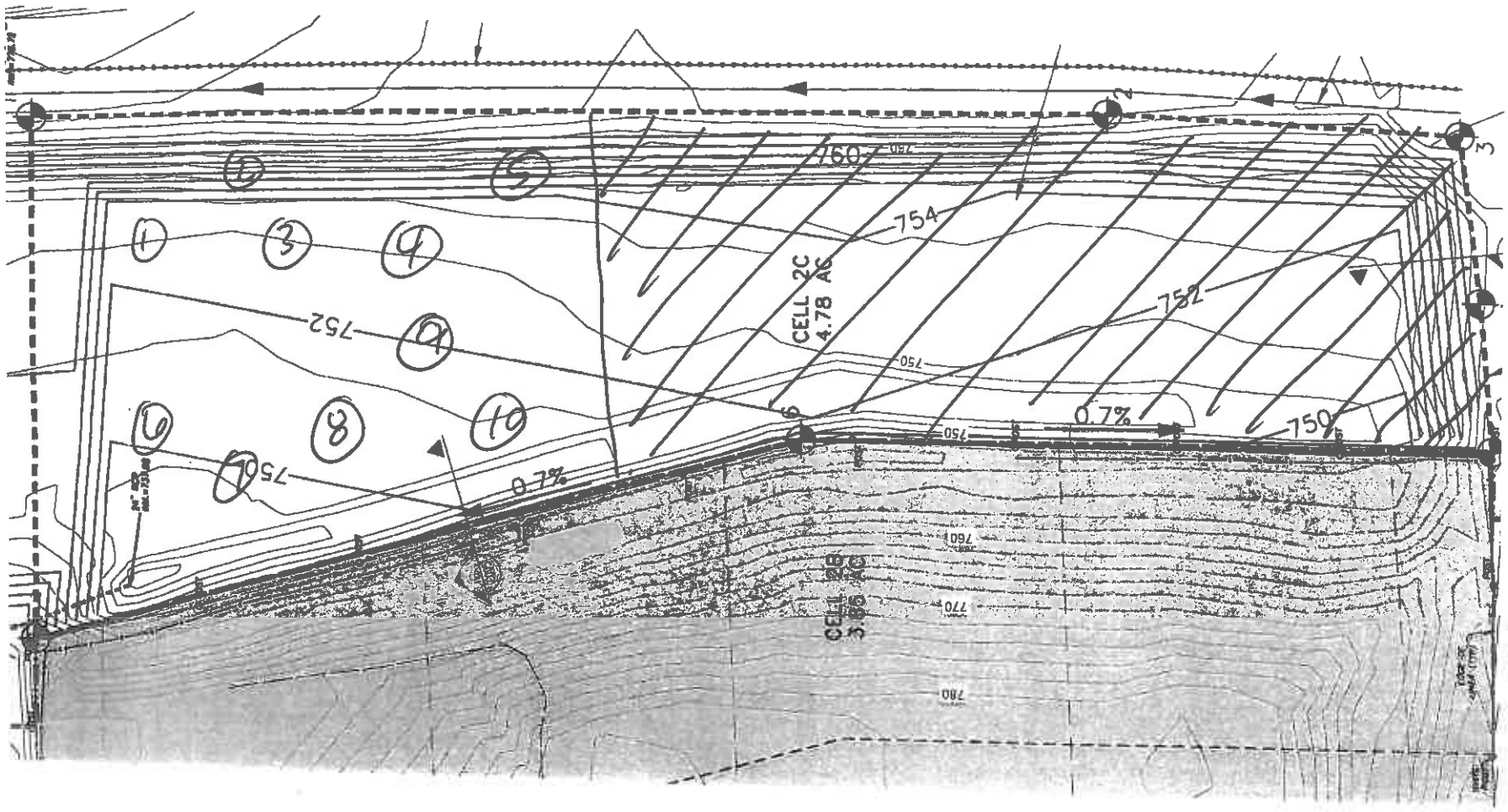
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/20/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
1	See	Map	4	1.32	5.39	122.2	374.5	512.4	483.6	26.4%	96.7	97.8	98.9%	23.1%	3.3%
7	See	Map	4	1.32	5.34	120.7	374.5	498.8	472.3	27.1%	95.0	97.8	97.1%	23.1%	4.0%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



Lift 4

Location Plan	T&K - Gaston County LF Expansion DALLAS, NC	Draper Aden Associates Engineering • Surveying • Environmental Services
Date: 10/20/14	DAA# R08281-05G	Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/22/2014
PAGE 1 of 3

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	1	118.8	99.2	19.8%	102.2	97.0%	18.5%	1.3%		
2		See	Map	1	117.6	99.9	17.7%	102.2	97.8%	18.5%	-0.8%		
3		See	Map	1	116.4	97.7	19.1%	102.2	95.6%	18.5%	0.6%		
4		See	Map	1	115.7	97.7	18.4%	102.2	95.6%	18.5%	-0.1%		
5		See	Map	1	114.9	97.2	18.2%	102.2	95.1%	18.5%	-0.3%		
1		See	Map	2	117.4	100.5	16.8%	102.2	98.3%	18.5%	-1.7%		
2		See	Map	2	115.0	98.4	16.9%	102.2	96.3%	18.5%	-1.6%		
3		See	Map	2	116.3	99.1	17.4%	102.2	96.9%	18.5%	-1.1%		
4		See	Map	2	114.8	97.9	17.3%	102.2	95.8%	18.5%	-1.2%		
5		See	Map	2	115.4	97.8	18.0%	102.2	95.7%	18.5%	-0.5%		
1		See	Map	3	118.9	100.3	18.5%	102.2	98.2%	18.5%	0.0%		
2		See	Map	3	119.2	100.0	19.2%	102.2	97.8%	18.5%	0.7%		
3		See	Map	3	122.0	101.6	20.1%	102.2	99.4%	18.5%	1.6%		
4		See	Map	3	116.3	98.3	18.3%	102.2	96.2%	18.5%	-0.2%		
5		See	Map	3	115.4	98.0	17.8%	102.2	95.9%	18.5%	-0.7%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/22/2014
PAGE 2 of 3

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	4	114.9	97.2	18.2%	102.2	95.1%	18.5%	-0.3%		
2		See	Map	4	116.3	99.2	17.2%	102.2	97.1%	18.5%	-1.3%		
3		See	Map	4	115.2	99.2	16.1%	102.2	97.1%	18.5%	-2.4%		
4		See	Map	4	117.3	98.3	19.3%	102.2	96.2%	18.5%	0.8%		
5		See	Map	4	115.8	97.8	18.4%	102.2	95.7%	18.5%	-0.1%		
1		See	Map	5	116.7	98.9	18.0%	102.2	96.8%	18.5%	-0.5%		
2		See	Map	5	118.2	99.7	18.6%	102.2	97.5%	18.5%	0.1%		
3		See	Map	5	117.5	100.2	17.3%	102.2	98.0%	18.5%	-1.2%		
4		See	Map	5	117.3	98.3	19.3%	102.2	96.2%	18.5%	0.8%		
5		See	Map	5	118.3	99.4	19.0%	102.2	97.3%	18.5%	0.5%		
1		See	Map	6	117.7	99.4	18.4%	102.2	97.3%	18.5%	-0.1%		
2		See	Map	6	116.1	99.8	16.3%	102.2	97.7%	18.5%	-2.2%		
3		See	Map	6	114.8	99.3	15.6%	102.2	97.2%	18.5%	-2.9%		
4		See	Map	6	115.2	99.3	16.0%	102.2	97.2%	18.5%	-2.5%		
5		See	Map	6	116.6	100.0	16.6%	102.2	97.8%	18.5%	-1.9%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

Draper Aden Associates

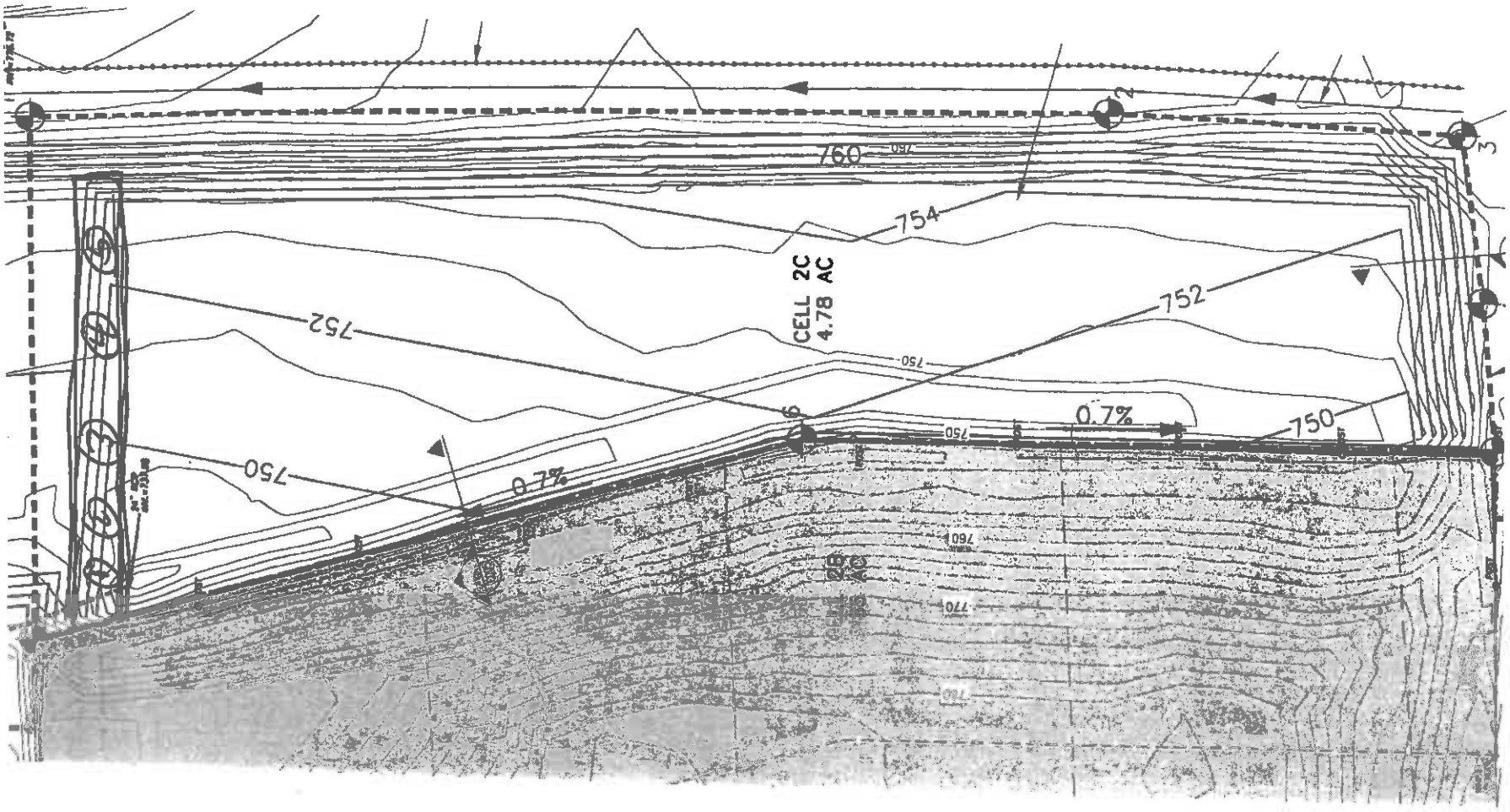
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/22/2014
PAGE 3 of 3

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	7	116.9	98.6	18.5%	102.2	96.5%	18.5%	0.0%		
2		See	Map	7	116.1	97.3	19.3%	102.2	95.2%	18.5%	0.8%		
3		See	Map	7	115.8	98.8	17.2%	102.2	96.7%	18.5%	-1.3%		
4		See	Map	7	116.3	100.2	16.1%	102.2	98.0%	18.5%	-2.4%		
5		See	Map	7	117.2	100.6	16.5%	102.2	98.4%	18.5%	-2.0%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST



Berm Fill

Location Plan

Date: 10/22/14

T&K - Gaston County LF Expansion
DALLAS, NC

DAA# R08281-05G

Draper Aden Associates
Engineering • Surveying • Environmental Services
Blacksburg, VA Charlottesville, VA Hampton Roads, VA Richmond, VA

Draper Aden Associates

Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/24/2014
PAGE 1 of 1

Test ID	Retest of	Station	Offset	Lift	Wet Density	Dry Density	Moisture (%)	Proctor (PCF)	Compaction (%)	Optimum Moisture	Deviation from Opt.	Comments DC / SC	Shelby Tube ID
1		See	Map	1	121.2	95.6	26.8%	97.8	97.7%	23.1%	3.7%		
2		See	Map	1	119.1	95.1	25.3%	97.8	97.2%	23.1%	2.2%		
3		See	Map	1	121.2	96.6	25.5%	97.8	98.7%	23.1%	2.4%		
1		See	Map	2	123.6	97.3	27.0%	97.8	99.5%	23.1%	3.9%	DC	
2		See	Map	2	122.3	96.8	26.3%	97.8	99.0%	23.1%	3.2%		
3		See	Map	2	121.4	96.3	26.1%	97.8	98.4%	23.1%	3.0%		
1		See	Map	3	121.7	96.7	25.9%	97.8	98.8%	23.1%	2.8%		
2		See	Map	3	122.0	96.0	27.1%	97.8	98.1%	23.1%	4.0%		
3		See	Map	3	120.7	95.9	25.8%	97.8	98.1%	23.1%	2.7%	DC	
1		See	Map	4	120.6	96.4	25.1%	97.8	98.6%	23.1%	2.0%		
2		See	Map	4	119.8	94.9	26.2%	97.8	97.1%	23.1%	3.1%		
3		See	Map	4	121.1	96.5	25.5%	97.8	98.7%	23.1%	2.4%		

DC = Drive Cylinder, SC = Sand Cone, Opt = Optimum Moisture, PCF = pounds per cubic foot

FIELD DENSITY TEST

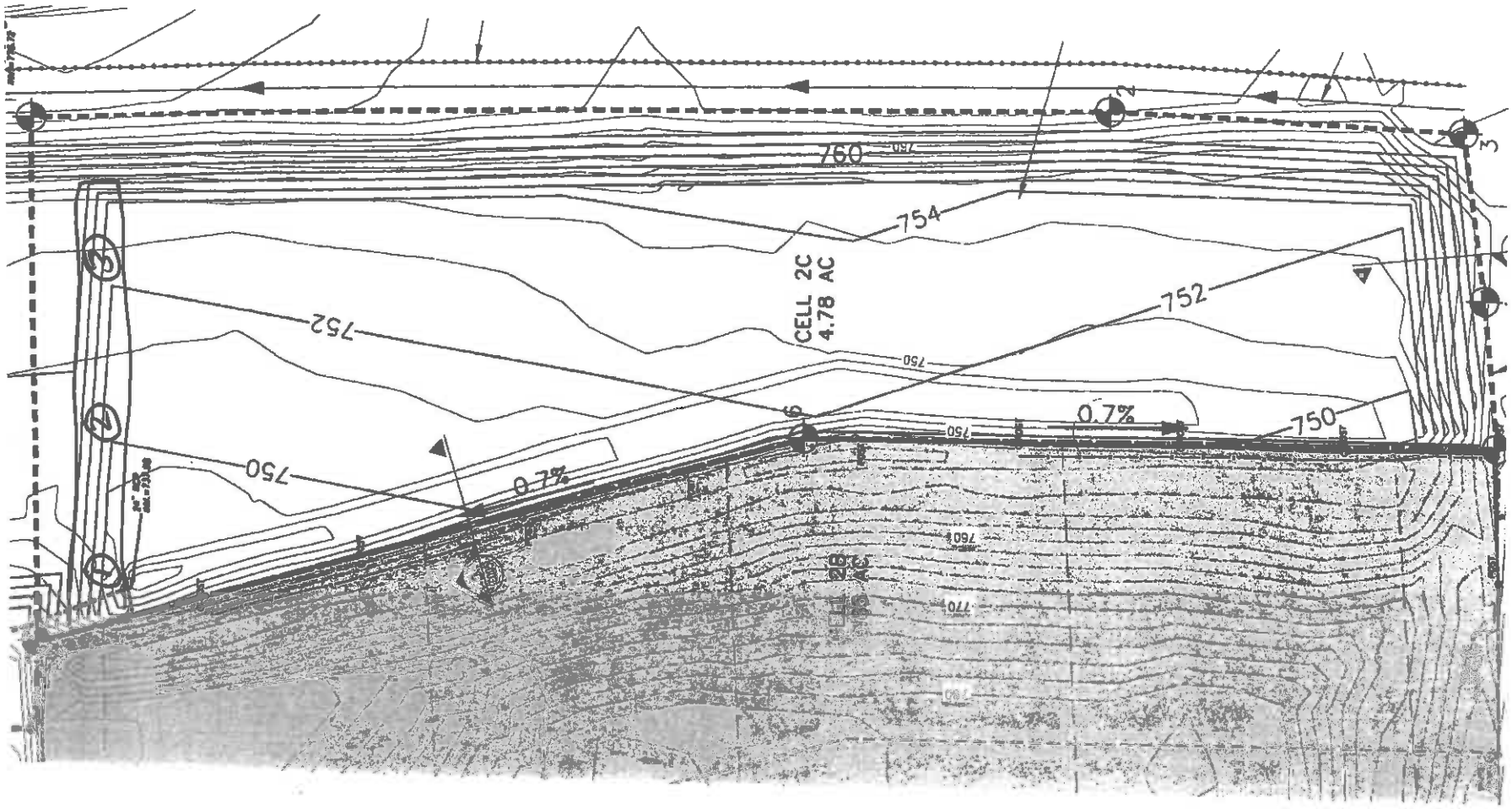
Draper Aden Associates
Engineering • Surveying • Environmental Services

PROJECT: Gaston County Landfill
PROJECT #: R08281N-05G
DATE: 10/24/2014
PAGE 1 of 1

				A	B	C	D	E	F	G	H	I	J	K	L
						(B-A)/0.0333				(E-F)/(F-D)	C/(1+G)		H/I		G-K
Test ID	Station	Offset	Lift	Weight M (lbs)	Weight M+WS (lbs)	Wet Density (PCF)	Weight P (g)	Weight P+WS (g)	Weight P+DS (g)	Moisture (%)	Dry Density (PCF)	Proctor	Compaction (%)	Optimum Moisture (%)	Deviation from Opt. (%)
1	See	Map	2	1.32	5.46	124.3	374.5	497.4	471.8	26.3%	98.4	97.8	100.6%	23.1%	3.2%
3	See	Map	3	1.32	5.37	121.6	374.5	480.8	458.0	27.3%	95.5	97.8	97.7%	23.1%	4.2%

M= Mold, P=Pan, WS= Wet Soil, DS= Dry Soil, lbs= pounds, g= grams, PCF = pounds per cubic foot

DRIVE CYLINDER



CLAY
Lifts 1-4

Location Plan

Date: 10/24/14

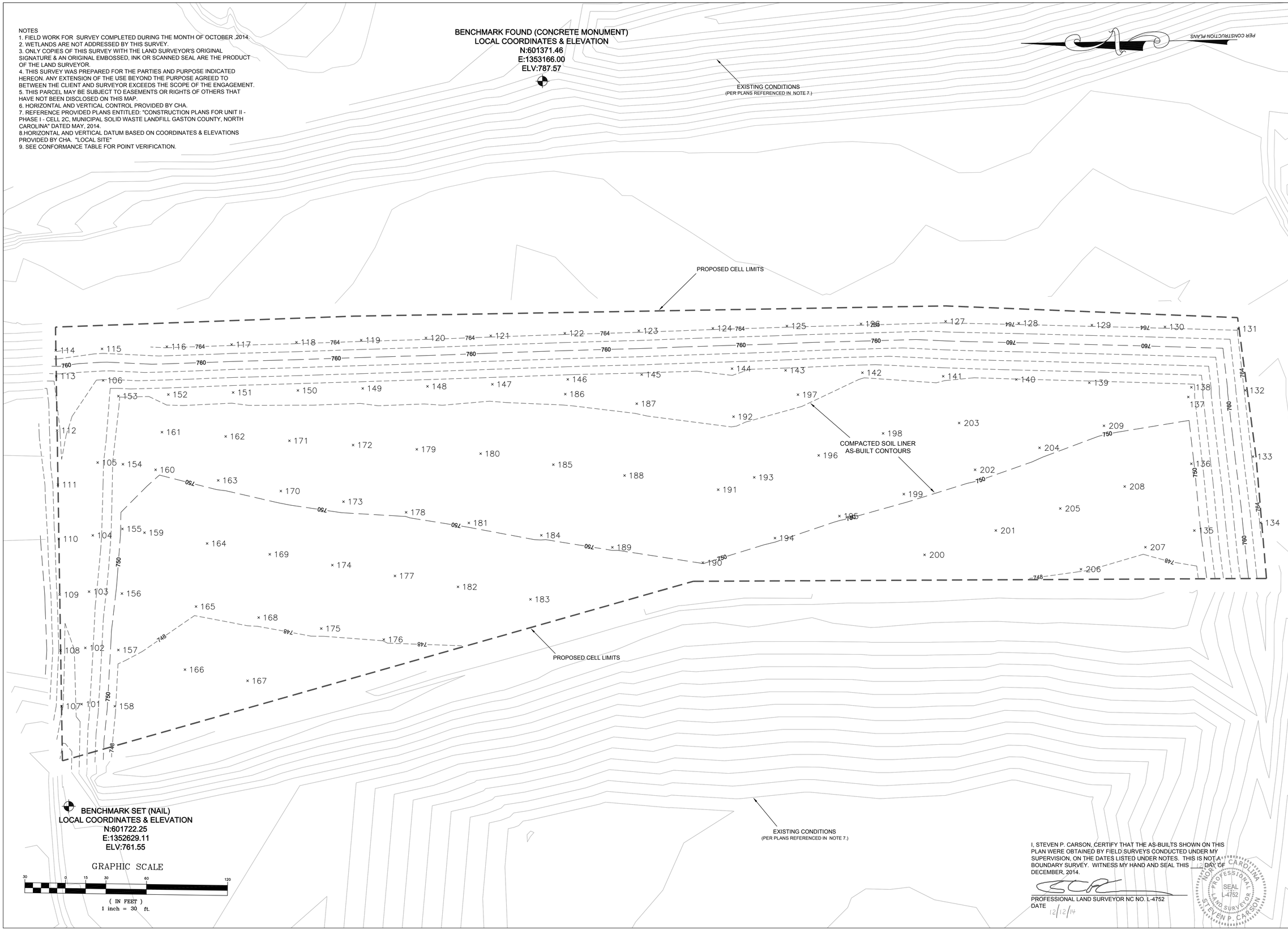
T&K - Gaston County LF Expansion
DALLAS, NC

DAA# R08281-05G

Draper Aden Associates
Engineering • Surveying • Environmental Services
BLACKSBURG, VA CHARLOTTESVILLE, VA HAMPTON ROADS, VA RICHMOND, VA

Clay Liner
As-Built Map

NOTES
1. FIELD WORK FOR SURVEY COMPLETED DURING THE MONTH OF OCTOBER ,2014.
2. WETLANDS ARE NOT ADDRESSED BY THIS SURVEY.
3. ONLY COPIES OF THIS SURVEY WITH THE LAND SURVEYOR'S ORIGINAL SIGNATURE & AN ORIGINAL EMBOSSED, INK OR SCANNED SEAL ARE THE PRODUCT OF THE LAND SURVEYOR.
4. THIS SURVEY WAS PREPARED FOR THE PARTIES AND PURPOSE INDICATED HEREON. ANY EXTENSION OF THE USE BEYOND THE PURPOSE AGREED TO BETWEEN THE CLIENT AND SURVEYOR EXCEEDS THE SCOPE OF THE ENGAGEMENT.
5. THIS PARCEL MAY BE SUBJECT TO EASEMENTS OR RIGHTS OF OTHERS THAT HAVE NOT BEEN DISCLOSED ON THIS MAP.
6. HORIZONTAL AND VERTICAL CONTROL PROVIDED BY CHA.
7. REFERENCE PROVIDED PLANS ENTITLED: "CONSTRUCTION PLANS FOR UNIT II - PHASE I - CELL 2C, MUNICIPAL SOLID WASTE LANDFILL GASTON COUNTY, NORTH CAROLINA" DATED MAY, 2014.
8.HORIZONTAL AND VERTICAL DATUM BASED ON COORDINATES & ELEVATIONS PROVIDED BY CHA. "LOCAL SITE"
9. SEE CONFORMANCE TABLE FOR POINT VERIFICATION.



I, STEVEN P. CARSON, CERTIFY THAT THE AS-BUILTS SHOWN ON THIS PLAN WERE OBTAINED BY FIELD SURVEYS CONDUCTED UNDER MY SUPERVISION, ON THE DATES LISTED UNDER NOTES. THIS IS NOT A BOUNDARY SURVEY. WITNESS MY HAND AND SEAL THIS 12 DAY OF DECEMBER, 2014.

PROFESSIONAL LAND SURVEYOR NC NO. L-4752
DATE 12/12/14

NORTH CAROLINA PROFESSIONAL LAND SURVEYOR SEAL L-4752 STEVEN P. CARSON

BATEMAN CIVIL SURVEY COMPANY
ENGINEERS ● SURVEYORS ● PLANNERS
200 NORTH MAIN STREET, HOLLY SPRING, NC 27540
PHONE: (919) 577-1080 FAX: (919) 577-1081
INFO@BATEMANCIVILSURVEY.COM
NCBELS FIRM# C-2378

Compacted Soil Liner
As-Built Survey
Municipal Solid Waste Landfill
Unit II - Phase I - Cell 2C
Gaston County, North Carolina

Revisions

Designed By:	
Drawn By:	JRD
Checked By:	SPC
Scale:	1" = 30'
Date:	10/24/14
Drawing Number:	140425

SHEET 2

POINT NUMBER	NORTHING	EASTING	PROPOSED SUBGRADE ELEVATION	AS-BUILT SUBGRADE ELEVATION	DEVIATION FROM PROPOSED TO AS-BUILT ELV.	COMPACTED SOIL LINER AS-BUILT ELV.	DEVIATION FROM SOIL LINER TO SUBGRADE ELV.	PROTECTIVE COVER AS-BUILT ELEVATION	DEVIATION FROM PROTECTIVE TO SOIL LINER ELV.
101	601712.77	1352704.70	754.00	753.50	-0.50	755.88	2.38	758.37	2.48
102	601710.00	1352746.35	754.00	753.37	-0.63	755.79	2.42	758.15	2.37
103	601707.23	1352788.00	754.00	753.22	-0.78	755.60	2.38	758.21	2.61
104	601704.46	1352829.65	754.00	753.32	-0.68	755.68	2.36	758.30	2.62
105	601700.86	1352883.59	754.00	752.91	-1.09	755.32	2.41	758.11	2.79
106	601696.81	1352944.43	754.00	753.48	-0.52	755.86	2.38	758.10	2.24
107	601727.65	1352703.16	754.00	752.61	-1.39	754.69	2.08	757.00	2.31
108	601728.31	1352744.45	754.00	752.53	-1.47	754.58	2.05	755.69	1.10
109	601728.97	1352785.75	754.00	752.81	-1.19	754.82	2.01	755.14	0.32
110	601729.64	1352827.03	754.00	753.01	-0.99	755.08	2.07	754.78	-0.30
111	601730.28	1352867.19	754.00	753.22	-0.78	755.27	2.05	754.47	-0.79
112	601730.92	1352907.34	754.00	753.39	-0.61	755.44	2.05	754.91	-0.53
113	601731.57	1352947.55	756.00	755.07	-0.93	757.36	2.29	757.69	0.33
114	601731.88	1352966.63	762.00	762.08	0.08	764.31	2.23	763.13	-1.18
115	601697.60	1352967.79	762.00	761.91	-0.09	763.05	1.14	766.06	3.01
116	601649.62	1352969.40	762.00	761.97	-0.03	764.33	2.36	766.35	2.02
117	601601.65	1352971.01	762.00	761.93	-0.07	764.29	2.36	766.31	2.02
118	601553.68	1352972.62	762.00	761.95	-0.05	764.30	2.35	766.30	2.00
119	601505.71	1352974.23	762.00	761.94	-0.06	764.29	2.35	766.32	2.03
120	601457.73	1352975.84	762.00	761.92	-0.08	764.28	2.36	766.31	2.03
121	601409.76	1352977.46	762.00	761.90	-0.10	764.31	2.41	766.43	2.12
122	601354.93	1352979.30	762.00	761.93	-0.07	764.30	2.37	766.50	2.20
123	601300.10	1352981.14	762.00	761.91	-0.09	764.33	2.42	766.35	2.02
124	601245.27	1352982.98	762.00	761.93	-0.07	764.32	2.39	766.34	2.02
125	601190.44	1352984.67	762.00	761.98	-0.02	764.35	2.37	766.38	2.03
126	601135.59	1352986.27	762.00	761.98	-0.02	764.33	2.35	766.33	2.00
127	601072.92	1352988.09	762.00	761.97	-0.03	764.37	2.40	766.37	2.00
128	601018.77	1352986.73	762.00	761.96	-0.04	764.34	2.38	766.39	2.05
129	600964.63	1352985.37	762.00	761.95	-0.05	764.35	2.40	766.38	2.03
130	600910.49	1352984.01	762.00	761.92	-0.08	764.30	2.38	766.31	2.01
131	600856.30	1352982.58	762.00	761.90	-0.10	764.25	2.35	766.25	2.00
132	600851.00	1352937.04	762.00	761.93	-0.07	764.29	2.36	766.32	2.03
133	600845.29	1352888.01	762.00	761.97	-0.03	764.32	2.35	766.34	2.02
134	600839.58	1352838.99	762.00	761.93	-0.07	764.31	2.38	766.33	2.02
135	600888.74	1352833.27	746.00	745.95	-0.05	748.39	2.44	750.92	2.52
136	600890.98	1352882.69	747.00	746.90	-0.10	749.29	2.39	751.38	2.09
137	600893.22	1352932.12	748.00	747.95	-0.05	750.38	2.43	752.68	2.30
138	600890.94	1352939.32	749.00	748.92	-0.08	751.31	2.39	754.05	2.74
139	600966.53	1352942.67	749.31	749.25	-0.06	751.66	2.41	753.69	2.03
140	601020.62	1352945.07	749.53	749.49	-0.04	751.85	2.36	753.89	2.04
141	601074.72	1352947.48	749.75	749.72	-0.03	752.11	2.39	754.13	2.02
142	601134.54	1352950.13	750.00	749.99	-0.01	752.35	2.36	754.35	2.00
143	601191.44	1352951.88	751.18	751.15	-0.03	753.53	2.38	755.56	2.03
144	601231.09	1352953.10	752.00	751.95	-0.05	754.30	2.35	756.39	2.09
145	601297.98	1352948.73	751.25	751.17	-0.08	753.53	2.36	755.58	2.05
146	601352.70	1352945.15	750.63	750.55	-0.08	752.92	2.37	754.95	2.03
147	601408.55	1352941.51	750.00	749.91	-0.09	752.27	2.36	754.31	2.04
148	601456.60	1352939.99	750.00	749.95	-0.05	752.33	2.38	754.36	2.03
149	601504.58	1352938.48	750.00	749.97	-0.03	752.34	2.37	754.37	2.03
150	601552.56	1352936.97	750.00	749.96	-0.04	752.35	2.39	754.35	2.00
151	601600.53	1352935.46	750.00	749.92	-0.08	752.31	2.39	754.31	2.00
152	601648.51	1352933.95	750.00	749.93	-0.07	752.33	2.40	754.37	2.04
153	601685.53	1352932.78	750.00	749.91	-0.09	752.27	2.36	754.36	2.09
154	601682.14	1352882.34	748.00	747.93	-0.07	750.38	2.45	752.59	2.21
155	601682.51	1352834.46	747.00	746.95	-0.05	749.85	2.90	751.91	2.06
156	601682.88	1352786.59	746.00	745.92	-0.08	749.12	3.20	751.16	2.04
157	601685.53	1352744.80	746.00	745.90	-0.10	748.32	2.42	750.53	2.20
158	601688.17	1352703.14	746.00	745.91	-0.09	748.31	2.40	750.44	2.13
159	601666.16	1352831.66	747.00	746.94	-0.06	749.67	2.73	751.72	2.05
160	601657.97	1352878.23	748.00	747.94	-0.06	750.06	2.12	752.34	2.27
161	601653.24	1352906.09	749.00	748.92	-0.08	751.14	2.22	753.19	2.05
162	601606.06	1352902.91	749.00	748.93	-0.07	751.06	2.12	753.28	2.22
163	601611.59	1352870.36	748.00	747.97	-0.03	750.14	2.17	752.21	2.07
164	601619.80	1352823.66	747.00	746.99	-0.01	749.19	2.20	751.19	2.00
165	601628.01	1352776.94	746.00	745.95	-0.05	748.14	2.19	750.19	2.06
166	601636.22	1352730.25	745.00	744.95	-0.05	747.18	2.23	749.22	2.04
167	601589.84	1352721.98	745.00	744.95	-0.05	747.05	2.10	749.18	2.13
168	601581.63	1352768.81	746.00	746.00	0.00	748.15	2.15	750.15	2.00
169	601573.41	1352815.65	747.00	746.99	-0.01	749.14	2.15	751.17	2.03
170	601565.20	1352862.49	748.00	747.96	-0.04	750.20	2.24	752.24	2.04
171	601558.88	1352899.73	749.00	748.92	-0.08	751.17	2.25	753.21	2.04
172	601511.70	1352896.55	749.00	748.96	-0.04	751.06	2.10	753.06	2.00
173	601518.82	1352854.61	748.00	747.95	-0.05	750.18	2.23	752.19	2.01
174	601527.05	1352807.64	747.00	746.99	-0.01	749.15	2.16	751.17	2.01
175	601535.29	1352760.68	746.00	745.96	-0.04	748.16	2.20	750.38	2.22
176	601488.95	1352752.54	746.00	745.94	-0.06	748.03	2.09	750.25	2.22
177	601480.70	1352799.63	747.00	746.96	-0.04	749.03	2.07	751.18	2.15
178	601472.44	1352846.74	748.00	747.99	-0.01	750.06	2.08	752.08	2.02
179	601464.52	1352893.36	749.00	748.92	-0.08	751.15	2.22	753.26	2.11
180	601417.27	1352890.18	749.00	748.93	-0.07	751.15	2.22	753.30	2.15
181	601425.98	1352838.85	748.00	747.94	-0.06	750.06	2.12	752.35	2.29
182	601434.01	1352791.57	747.00	746.99	-0.01	749.19	2.20	751.36	2.16
183	601380.35	1352782.31	747.00	746.96	-0.04	749.05	2.09	751.34	2.28
184	601372.30	1352829.73	748.00	747.98	-0.02	750.08	2.09	752.13	2.06
185	601363.42	1352882.00	749.00	748.97	-0.03	751.08	2.11	753.14	2.06
186	601354.55	1352934.26	750.00	749.92	-0.08	752.17	2.25	754.18	2.01
187	601301.64	1352927.17	750.00	749.97	-0.03	752.15	2.17	754.20	2.05
188	601310.67	1352873.99	749.00	748.94	-0.06	751.02	2.08	753.18	2.16
189	601319.70	1352820.80	748.00	747.99	-0.01	750.06	2.07	752.10	2.03
190	601252.69	1352809.43	748.00	747.94	-0.06	750.02	2.08	752.08	2.05
191	601241.33	1352863.49	749.00	748.98	-0.02	751.11	2.14	753.14	2.02
192	601229.97	1352917.56	750.00	749.94	-0.06	752.15	2.20	754.15	2.00
193	601214.63	1352872.61	749.00	748.99	-0.01	751.20	2.21	753.21	2.01
194	601199.29	1352827.65	748.00	747.91	-0.09	750.09	2.18	752.23	2.14
195	601151.57	1352843.94	748.00	747.92	-0.08	750.08	2.15	752.09	2.01
196	601166.91	1352888.89	749.00	748.99	-0.01	751.12	2.13	753.23	2.12
197	601182.26	1352933.85	750.00	749.99	-0.01	752.21	2.22	754.23	2.02
198	601119.20	1352905.18	749.00	749.00	0.00	751.15	2.15	753.18	2.03
199	601103.86	1352860.23	748.00	747.95	-0.05	750.15	2.19	752.16	2.01
200	601088.51	1352815.27	747.00	746.95	-0.05	749.04	2.09	751.13	2.09
201	601035.74	1352833.28	747.00	746.95	-0.05	749.16	2.20	751.17	2.01
202	601051.09	1352878.24	748.00	747.99	-0.01	750.18	2.19	752.19	2.00
203	601062.90	1352912.86	748.88	748.79	-0.09	750.93	2.13	752.98	2.06
204	601003.37	1352894.52	748.00	747.91	-0.09	750.17	2.26	752.19	2.01
205	600988.03	1352849.57	747.00	746.93	-0.07	749.04	2.11	751.07	2.02
206	600972.68	1352804.61	746.00	745.96	-0.04	748.06	2.10	750.21	2.15
207	600924.96	1352820.90	746.00	745.92	-0.08	748.12	2.19	750.27	2.15
208	600940.31	1352865.86	747.00	746.91	-0.09	749.12	2.20	751.23	2.11
209	600955.65	1352910.81	748.00	747.91	-0.09	750.14	2.22	752.35	2.22

NOTE:
POINTS 108 - 114 FALL OUTSIDE THE AS-BUILT LINER LIMIT.

I, STEVEN P. CARSON, CERTIFY THAT THE AS-BUILTS SHOWN ON THIS PLAN WERE OBTAINED BY FIELD SURVEYS CONDUCTED UNDER MY SUPERVISION, ON THE DATES LISTED UNDER NOTES. THIS IS NOT A BOUNDARY SURVEY. WITNESS MY HAND AND SEAL THIS 12 DAY OF DECEMBER, 2014.

PROFESSIONAL LAND SURVEYOR NC NO. L-4752
DATE 12/12/14

NORTH CAROLINA PROFESSIONAL SEAL L-4752 LAND SURVEYOR STEVEN P. CARSON

BATEMAN CIVIL SURVEY COMPANY
ENGINEERS ● SURVEYORS ● PLANNERS
200 NORTH MAIN STREET, HOLLY SPRING, NC 27540
PHONE: (919) 577-1080 FAX: (919) 577-1081
INFO@BATEMANCIVILSURVEY.COM
NCBELS FIRM# C-2378

Conformance Table
Municipal Solid Waste Landfill
Unit II - Phase I - Cell 2C
Gaston County, North Carolina

Revisions

Designed By:
Drawn By: JRD
Checked By: SPC
Scale: N / A
Date: 11/25/14
Drawing Number: 140425

SHEET 4

APPENDIX I

CQA Reports

Laboratory Test Results

SHIELD ENGINEERING, INC.

September 18, 2014

Mr. Dan Zakary

Subject: **Laboratory Test Results**
Gaston County LF
Shield Job Number 1140152-01
LRF # 14-129

Dear Mr. Zakary:

As requested Shield Engineering Inc., has completed the laboratory testing on the above reference project. The test results for Grain Size Analysis, Atterberg Limits, Hydraulic Conductivity (Flex Wall Perm), and Moisture Density Relationship are attached to this letter. These testing results can also be found in the Shield Project folder located on the company server.

The laboratory tests were provided in accordance with the applicable ASTM Standards. The test samples were obtained by a representative of Shield Engineering, and then delivered to Shield's Charlotte, North Carolina laboratory for testing.

If you have any questions concerning our test results, please do not hesitate to call our office at (704) 394-6913.

Sincerely,

Shield Engineering, Inc.

Josh Slusarczyk
Laboratory Manager

4301 Taggart Creek Road
Charlotte, NC 28208

www.shieldengineering.com

Telephone 704.394.6913
Fax 704.394.6968

SHIELD ENGINEERING, INC.

Flexible Wall Permeability Test
ASTM D 5084

Project Name: Gaston County LF
Project No: 1140152-01
Date: 9/17/2014

Sample ID: 14-129/Clay 2
Location: Borrow Study
Sample Condition: Remolded

Test Data:

Initial Dry Density (pcf) :	91.2
Initial Moisture Content (%) :	28.2
Sample Length (cm) :	11.8
Sample Area (cm^2) :	81.2
Hydraulic Conductivity K (cm/sec) :	**7.99E-08**
Saturated:	100%

SHIELD ENGINEERING, INC.

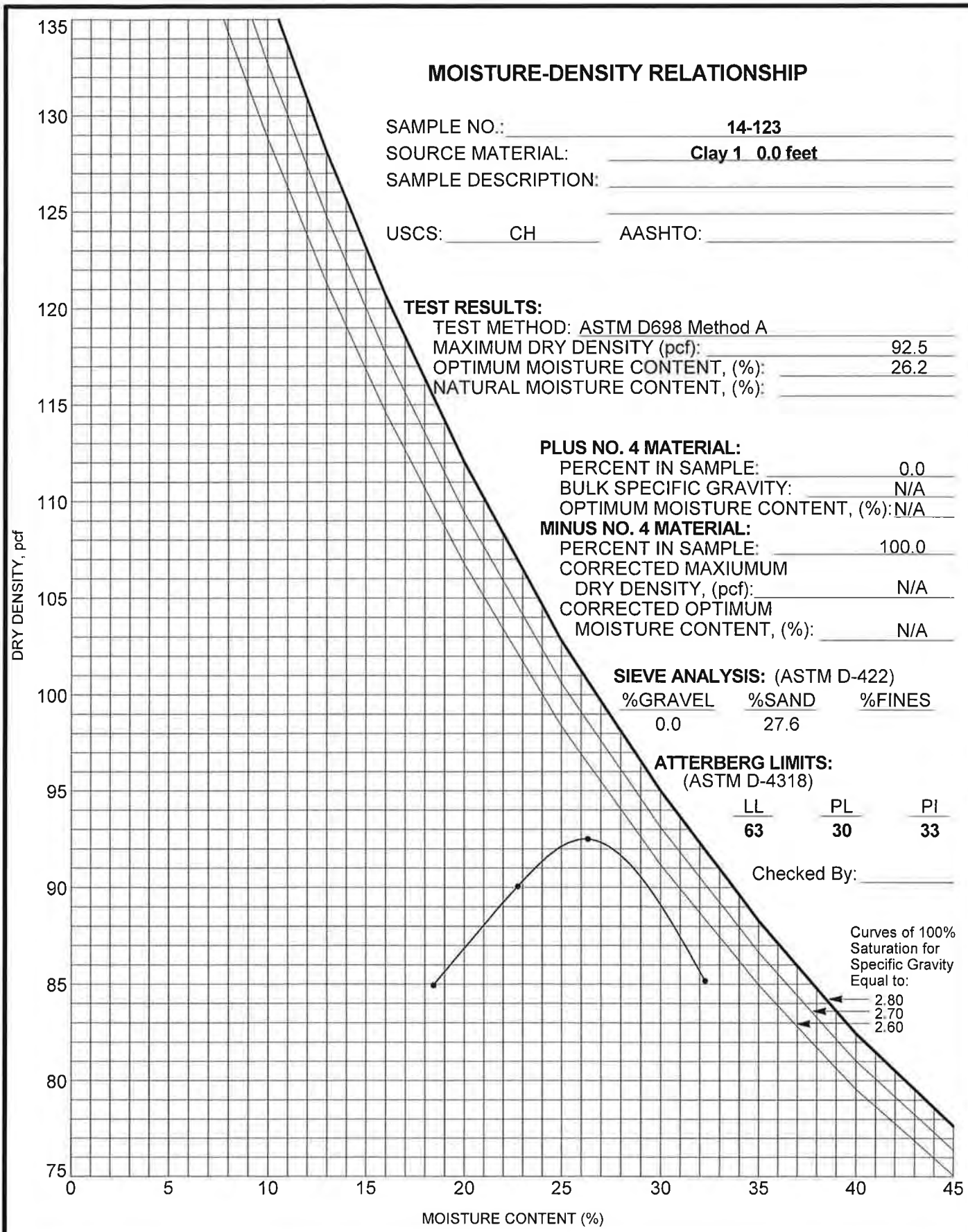
Flexible Wall Permeability Test
ASTM D 5084

Project Name: Gaston County LF
Project No: 1140152-01
Date: 9/17/2014

Sample ID: 14-129/Clay 1
Location: Borrow Study
Sample Condition: Remolded

Test Data:

Initial Dry Density (pcf) :	90.0
Initial Moisture Content (%) :	26.9
Sample Length (cm) :	11.8
Sample Area (cm^2) :	81.2
Hydraulic Conductivity K (cm/sec) :	**2.01E-08**
Saturated:	98%



MOISTURE-DENSITY RELATIONSHIP

SAMPLE NO.: **14-123**

SOURCE MATERIAL: **Clay 1 0.0 feet**

SAMPLE DESCRIPTION:

USCS: CH AASHTO:

TEST RESULTS:

TEST METHOD: ASTM D698 Method A

MAXIMUM DRY DENSITY (pcf): 92.5

OPTIMUM MOISTURE CONTENT, (%): 26.2

NATURAL MOISTURE CONTENT, (%):

PLUS NO. 4 MATERIAL:

PERCENT IN SAMPLE: 0.0

BULK SPECIFIC GRAVITY: N/A

OPTIMUM MOISTURE CONTENT, (%): N/A

MINUS NO. 4 MATERIAL:

PERCENT IN SAMPLE: 100.0

CORRECTED MAXIUMUM DRY DENSITY, (pcf): N/A

CORRECTED OPTIMUM MOISTURE CONTENT, (%): N/A

SIEVE ANALYSIS: (ASTM D-422)

%GRAVEL	%SAND	%FINES
0.0	27.6	

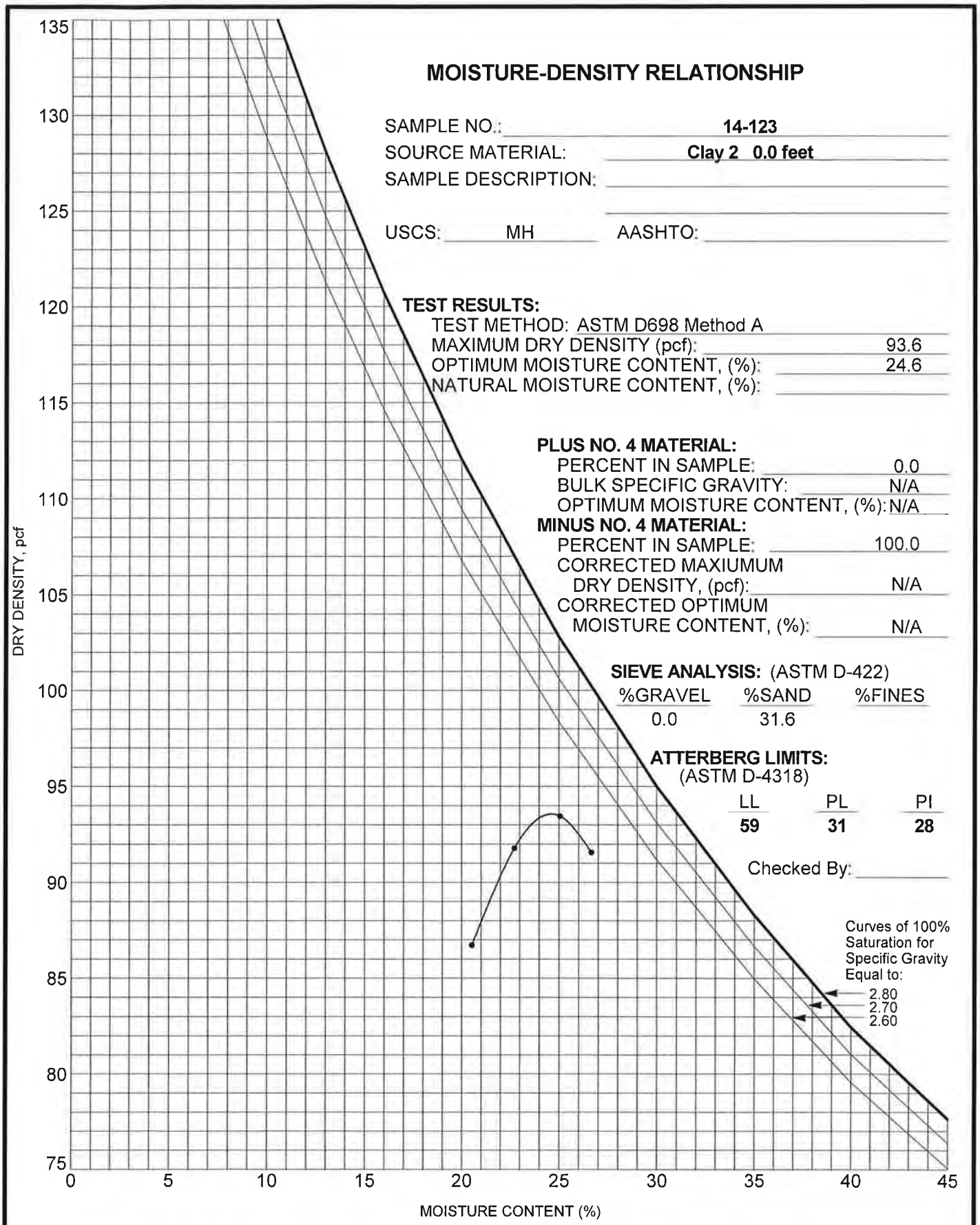
ATTERBERG LIMITS:
(ASTM D-4318)

LL	PL	PI
63	**30**	**33**

Checked By:

SHIELD ENGINEERING, INC.
4301 Taggart Creek Road
Charlotte, NC 28208
Telephone: 704-394-6913
Toll Free: 800-395-5220
Fax: 704-394-6968

CQA Gaston Co LF
(CHA)
Gaston County, North Carolina
Shield Project No.: 1140152-01



MOISTURE-DENSITY RELATIONSHIP

SAMPLE NO.: **14-123**

SOURCE MATERIAL: **Clay 2 0.0 feet**

SAMPLE DESCRIPTION:

USCS: MH AASHTO:

TEST RESULTS:

TEST METHOD: ASTM D698 Method A

MAXIMUM DRY DENSITY (pcf): 93.6

OPTIMUM MOISTURE CONTENT, (%): 24.6

NATURAL MOISTURE CONTENT, (%):

PLUS NO. 4 MATERIAL:

PERCENT IN SAMPLE: 0.0

BULK SPECIFIC GRAVITY: N/A

OPTIMUM MOISTURE CONTENT, (%): N/A

MINUS NO. 4 MATERIAL:

PERCENT IN SAMPLE: 100.0

CORRECTED MAXIUMUM DRY DENSITY, (pcf): N/A

CORRECTED OPTIMUM MOISTURE CONTENT, (%): N/A

SIEVE ANALYSIS: (ASTM D-422)

%GRAVEL	%SAND	%FINES
0.0	31.6	

ATTERBERG LIMITS:
(ASTM D-4318)

LL	PL	PI
59	**31**	**28**

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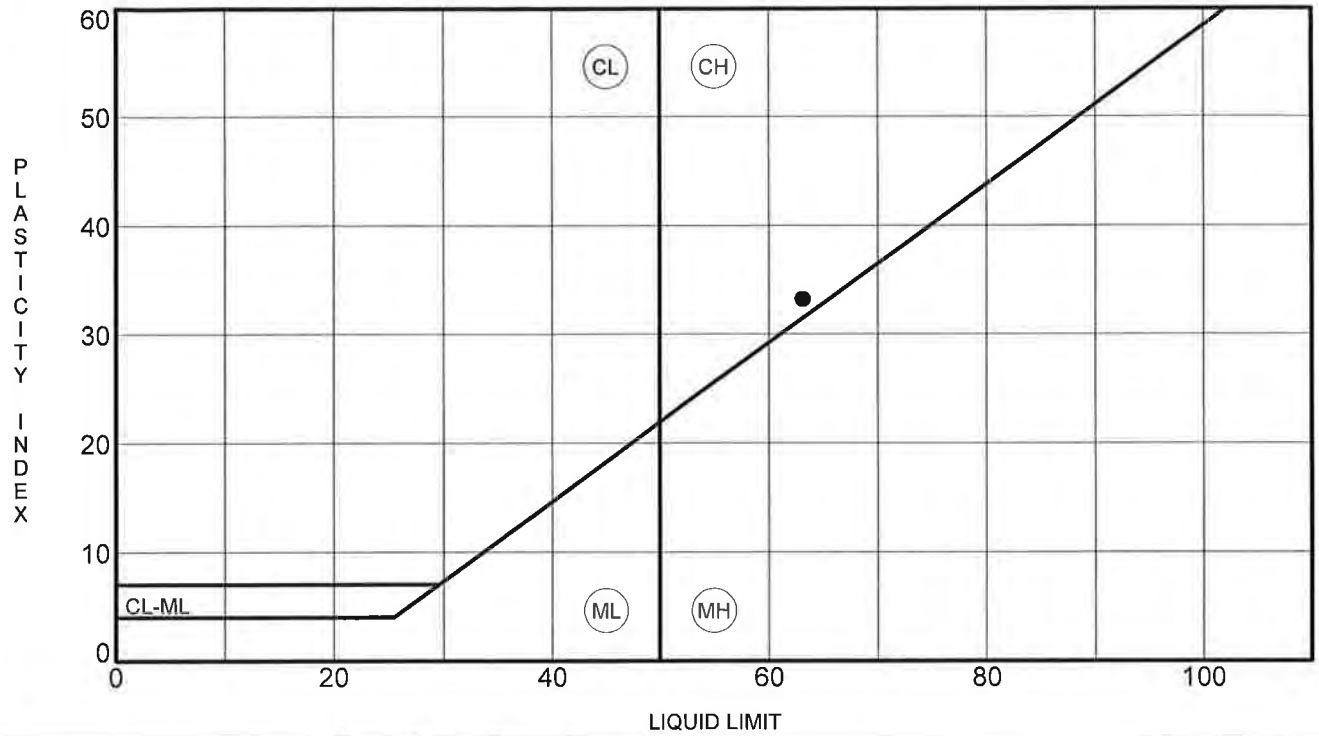
ATTERBERG LIMITS' RESULTS



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**Clay 1**	**0.0**	**63**	**30**	**33**	**72**	**FAT CLAY with SAND(CH)**

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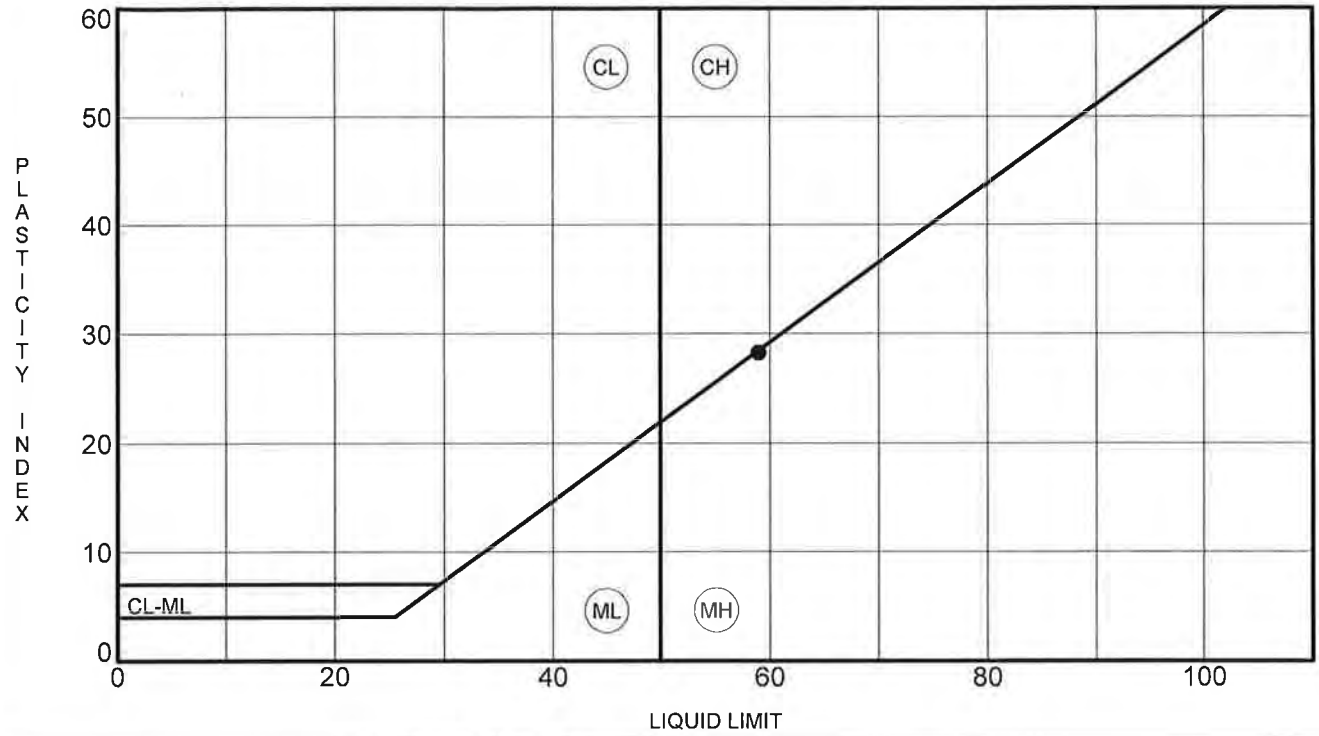
ATTERBERG LIMITS' RESULTS



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**Clay 2**	**0.0**	**59**	**31**	**28**	**68**	**SANDY ELASTIC SILT(MH)**

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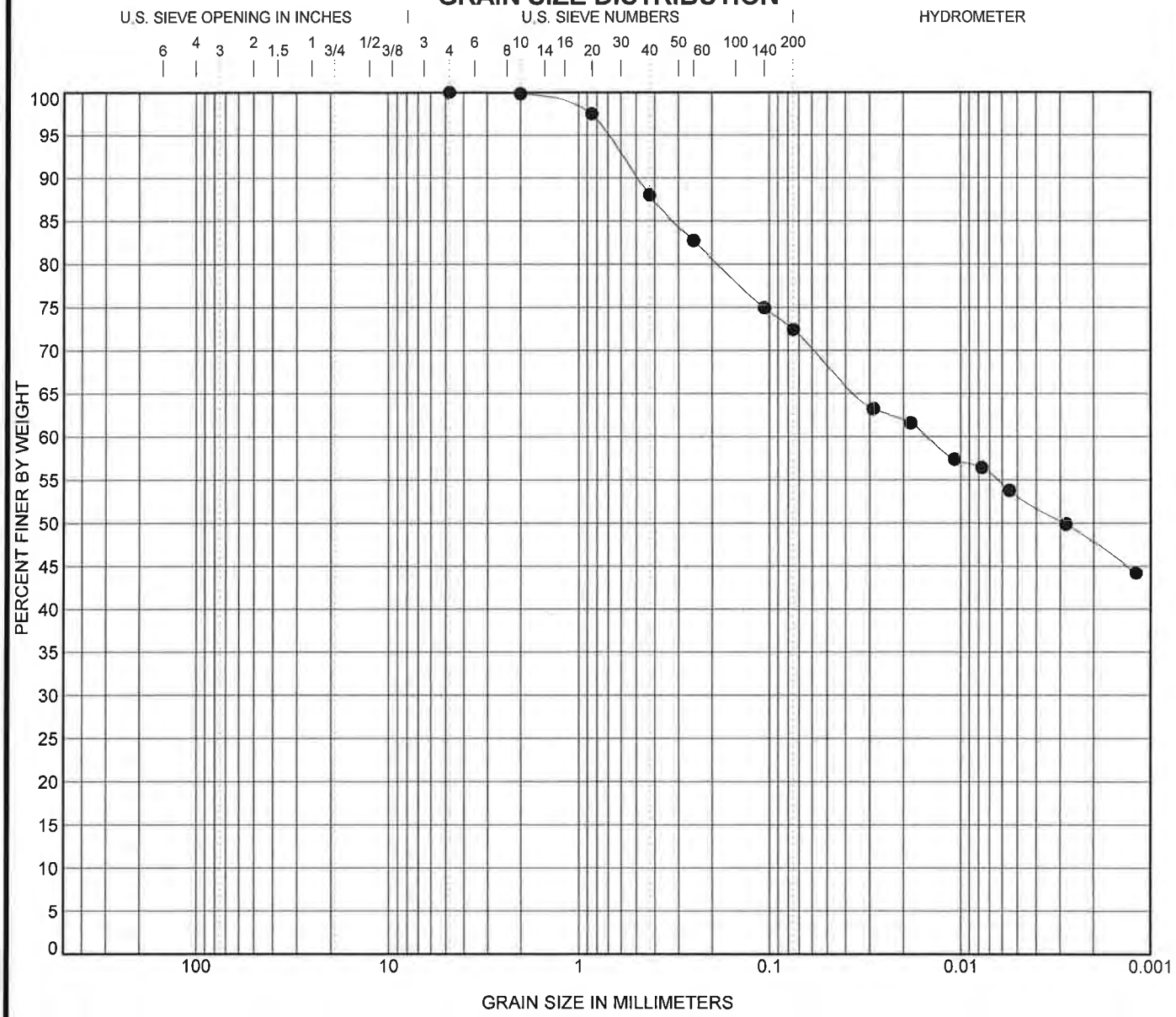
GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**Clay 1**	**0.0**	**FAT CLAY with SAND(CH)**	**63**	**30**	**33**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**Clay 1**	**0.0**	**4.75**	**0.015**			**0.0**	**27.6**	**19.2**	**53.2**

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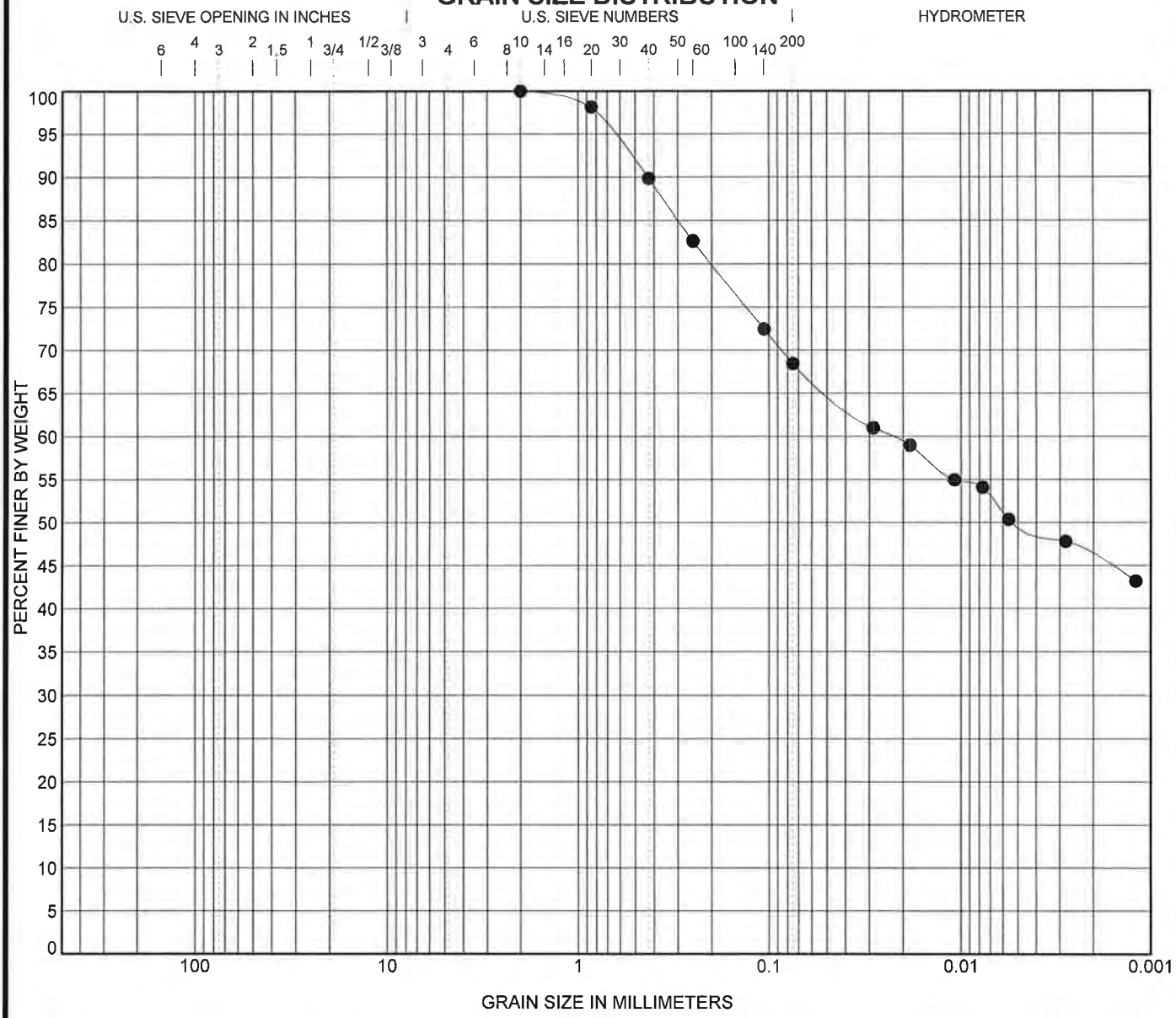
GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**Clay 2**	**0.0**	**SANDY ELASTIC SILT(MH)**	**59**	**31**	**28**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**Clay 2**	**0.0**	**2**	**0.023**			**0.0**	**31.6**	**18.5**	**49.9**

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(CHA)
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Shield Project No.: 1140152-01

Soil Liner

Construction Quality Assurance Report for the Soil Liner
Gaston County Landfill
Unit II, Phase 1 - Cell 2C
Gaston County, North Carolina

December 11, 2014

Prepared by

Shield Engineering, Inc.
Charlotte, North Carolina
4301 Taggart Creek Road
Charlotte, NC 28208

Shield Project No. 1140152-01

Prepared for

CHA Companies
8720 Red Oak Boulevard, Suite 505
Charlotte, NC 28217

SHIELD ENGINEERING, INC.

December 11, 2014

Mr. Bob Sallach, P.E.
Olver Incorporated
8720 Red Oak Boulevard, Suite 505
Charlotte, North Carolina 28217

RE: Construction Quality Assurance Summary Report
Soil Liner – Unit II, Phase 1 - Cell 2C
Gaston County, North Carolina
Shield Project Number 1140152-01

Dear Mr. Sallach:

Shield Engineering, Inc. (Shield) has completed the requested Construction Quality Assurance (CQA) field and laboratory testing required of the soil liner for Gaston County Landfill Cell 2C in Gaston County, North Carolina. This report provides a presentation of the test results and an opinion of conformity with the performance requirements.

The soil liner was constructed with material obtained from an off-site borrow source. A Komatsu 61PX Dozer was used to place and spread soil liner material while a Hamm's sheep's-foot roller was used to achieve compaction. The soil liner was constructed in approximately four (4) 6-inch lifts. Once all 4 lifts were installed, a Caterpillar 663-E smooth drum roller with vibration was used to seal off the area from moisture loss.

Shield performed compaction testing of the clay liner as required by the specifications between the dates of October 2, 2014 and October 24, 2014. Shield was again required to perform testing at approximately ten percent (10%) of the frequency required by the CQC Consultant. The project specifications for the soil liner required the CQC Consultant to perform one (1) field moisture/density compaction tests per 10,000 square feet of material placed per lift. Following the CQA requirement of 10% for five (5) acres of four (4) 6-inch lifts of soil liner construction, approximately 20 field moisture density/compaction tests would be required at minimum (not including the test pad). Again, it should be noted that the specifications required a minimum of ninety-seven percent (97%) compaction and a moisture content 2% wet of optimum or higher. Shield performed a total of 23 field moisture/density compaction tests during the placement of the clay liner within the Cell 2C. Compaction testing was performed using the drive cylinder method (ASTM D2937). Shield also collected an undisturbed sample for laboratory hydraulic conductivity testing (ASTM D5084, maximum permeability of $1x10^{-7}$ cm/s) at the required 10% frequency of one sample per acre per lift. The undisturbed samples collected for laboratory hydraulic conductivity testing were collected using a Shelby sampler tube. Percent fines (ASTM D1140) and Atterberg limits (ASTM D4318) testing was performed on grab samples which were collected at the required 10% frequency of one test per acre per lift. CQA field compaction data for the soil liner is summarized in Table 1. Approximate locations of field compaction tests are

illustrated on Figure 1. The results of the CQA laboratory testing are attached in Appendix A for review and the Draper Aden Proctors are attached in Appendix B.

CQA Summary Statement

This CQA summary report of the soil liner for Gaston County Landfill Cell 2C has been prepared for the exclusive use of CHA Companies and/or clients. Services were performed using generally accepted geotechnical engineering practices. Our conclusions and opinions are based upon our site observations, the project documents, and the CQA field and laboratory testing performed during the course of the project. Based on the results of our site observations and the CQA field testing performed, it is Shield's professional opinion that the soil liner placed within Cell 2C was constructed in accordance with the project specifications.

Shield appreciates the opportunity to be of service to CHA Companies. If there are any questions regarding the information provided in this report, please do not hesitate to contact us.

Sincerely,
SHIELD ENGINEERING, INC.

Karen J. Clark, E.I.
Staff Professional

Daniel F. Zakary, P.E.
Senior Project Engineer

Samson K. Abudu, P.E.
Principal Engineer

Attachments:

- Table 1: Field Test Results – Soil Liner
- Figure 1: Density Test Location Plan
- Appendix A: Soil Liner CQA Laboratory Test Results
- Appendix B: Draper Aden Proctors

H:\Projects\2014\1140152-01 CQA Gaston Co LF P1-2C\CQA Summary Report - Soil Liner.doc

Shield Engineering Inc.
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TABLE 1: SUMMARY OF CQA FIELD COMPACTION TESTING RESULTS - SOIL LINER
GASTON COUNTY LANDFILL - UNIT II, PHASE I, CELL 2C
GASTON COUNTY, NORTH CAROLINA
JOB #1140152-01

TEST NO.	TEST TYPE	DATE	AREA[1]	LIFT	WET DENSITY (pcf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	PROCTOR NUMBER[2]	PERCENT COMPACTION (%)	MEETS CRITERIA[3]	
												YES	NO
SL-1	DT	10/02/14	Area 1	1	120.3	34.1	89.7	92.1	25.5	DA-#5	97.4	X	
SL-2-P	DT	10/03/14	Area 2	1	123.6	28.5	96.2	97.8	23.1	DA-#10	98.4	X	
SL-3	DT	10/06/14	Area 3	1	120.3	29.9	92.6	92.5	25.8	DA-#8	100+	X	
SL-4	DT	10/06/14	Area 4	1	118.1	30.8	90.3	92.5	25.8	DA-#8	97.6	X	
SL-5	DT	10/07/14	Area 3	2	120.6	29.4	93.2	92.5	25.8	DA-#8	100+	X	
SL-6	DT	10/08/14	Area 2	2	123.1	28.5	95.8	97.8	23.1	DA-#10	98.0	X	
SL-7	DT	10/08/14	Area 5	1	116.9	31.2	89.1	91.5	28.0	DA-#2	97.4	X	
SL-8-P	DT	10/09/14	Area 1	2	119.9	26.3	94.9	95.6	23.9	DA-#1	99.3	X	
SL-9	DT	10/10/14	Area 4	2	116.9	27.6	91.6	92.1	25.5	DA-#5	99.5	X	
SL-10	DT	10/13/14	Area 3	3	120.9	28.6	94.0	92.5	25.8	DA-#8	100+	X	
SL-11	DT	10/13/14	Area 5	2	120.3	28.7	93.5	92.5	25.8	DA-#8	100+	X	
SL-12	DT	10/13/14	Area 2	3	120.9	29.3	93.5	92.5	25.8	DA-#8	100+	X	
SL-13	DT	10/16/14	Area 5	3	123.0	28.8	95.5	96.4	25.2	DA-#6	99.1	X	
SL-14-P	DT	10/17/14	Area 4	3	124.2	28.1	97.0	97.8	23.1	DA-#10	99.1	X	
SL-15	DT	10/17/14	Area 1	3	123.0	28.2	95.9	97.8	23.1	DA-#10	98.1	X	
SL-16-P	DT	10/17/14	Area 5	4	123.6	28.8	96.0	97.8	23.1	DA-#10	98.1	X	
SL-17	DT	10/20/14	Area 3	4	122.1	29.6	94.2	95.6	23.9	DA-#1	98.5	X	
SL-18	DT	10/20/14	Area 2	4	121.5	27.2	95.5	95.6	23.9	DA-#1	99.9	X	
SL-19	DT	10/20/14	Area 1	4	121.5	27.6	95.2	95.6	23.9	DA-#1	99.6	X	
SL-20	DT	10/20/14	Area 4	4	122.1	30.7	93.4	95.6	23.9	DA-#1	97.7	X	
SL-21	DT	10/23/14	Berm	1	122.1	28.0	95.4	96.4	25.2	DA-#6	99.0	X	
SL-22	DT	10/24/14	Berm	2	121.8	29.9	93.8	96.4	25.2	DA-#6	97.3	X	

DT-Drive Tube Density Test
P-Perm Sample Collected

FINAL REVIEW COMPLETED: KJC

Shield Engineering Inc.
4301 Taggart Creek Road, Charlotte, NC 28208
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TABLE 1: SUMMARY OF CQA FIELD COMPACTION TESTING RESULTS - SOIL LINER
GASTON COUNTY LANDFILL - UNIT II, PHASE I, CELL 2C
GASTON COUNTY, NORTH CAROLINA
JOB #1140152-01

TEST NO.	TEST TYPE	DATE	AREA[1]	LIFT	WET DENSITY (pcf)	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	PROCTOR NUMBER[2]	PERCENT COMPACTION (%)	MEETS CRITERIA[3]	
												YES	NO
SL-23	DT	10/24/14	Berm	3	121.5	27.6	95.2	96.4	25.2	DA-#6	98.8	X	

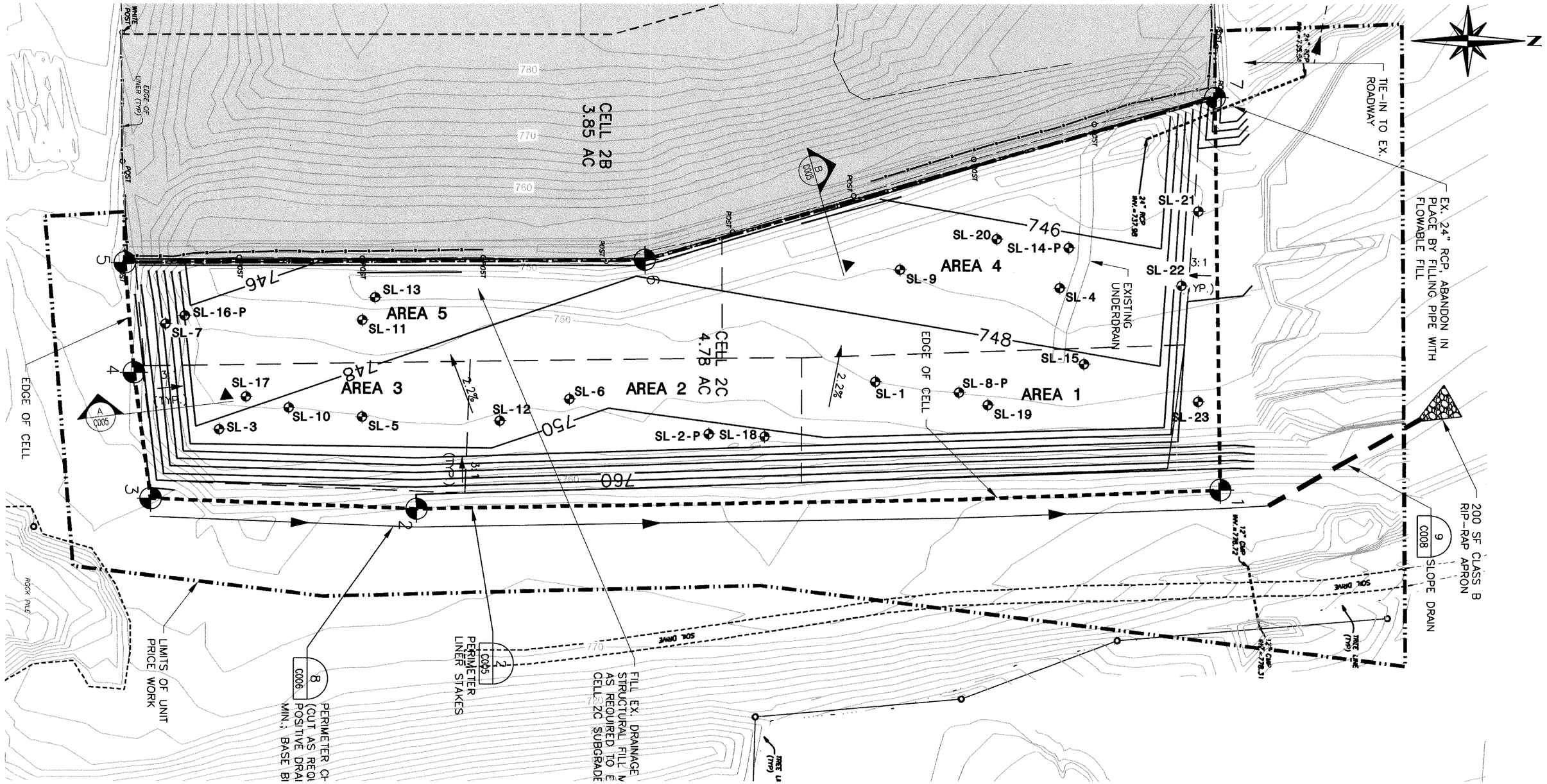
[1] all locations are approximate.

[2] 1-point performed by Contractor's CQC Firm (Draper Aden) in general accordance with ASTM D698 to aid in proctor selection.

[3] density test plots inside the acceptance window.

DT-Drive Tube Density Test
P-Perm Sample Collected

FINAL REVIEW COMPLETED: NC



LEGEND:

SL-#	APPROXIMATE LOCATION OF SOIL LINER DENSITY TEST
-P	PERM SAMPLE COLLECTED
— — — —	INDICATES APPROXIMATE 1 ACRE AREA LIMITS (USED BY DRAPER ADEN ASSOCIATES)

NOTES: 1. BASE MAP PROVIDED BY CLIENT.
2. ALL LOCATIONS ARE APPROXIMATE.

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4301 TAGGART CREEK ROAD
CHARLOTTE, NC 28208
704-394-6913
704-394-0008 fax
www.shieldengineering.com

DENSITY TEST LOCATION PLAN - SOIL LINER

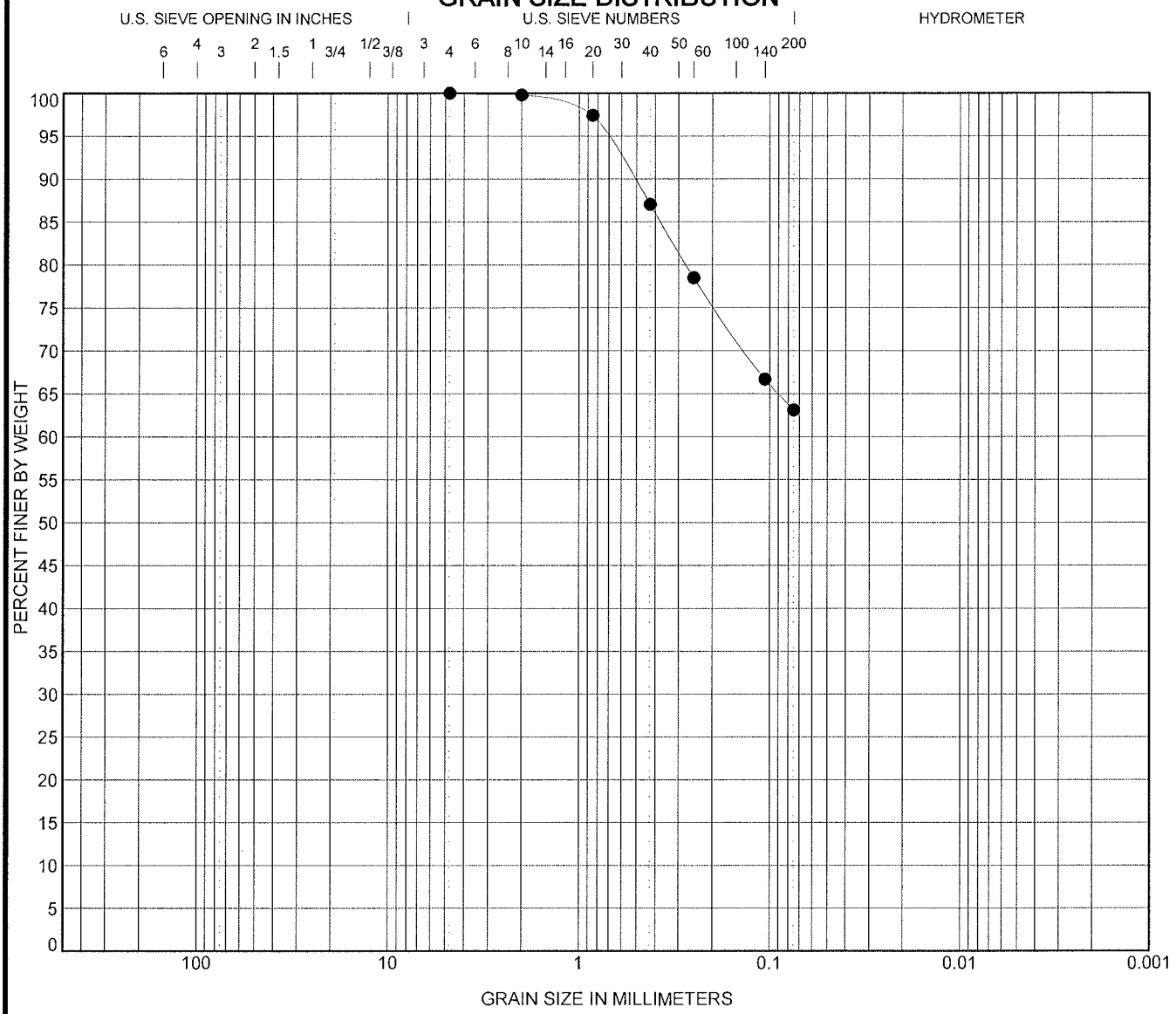
GASTON COUNTY LANDFILL
CELL 2C
GASTON COUNTY, NORTH CAROLINA
SHIELD # 1140152-01

DATE : 10/24/14	DRAWN BY : KJC
SCALE : 1:80	FIGURE : 1

H:\PROJECTS\2014\1140152-01 CQA GASTON CO LF P1-2C\DRAWINGS\TEST LOCATION PLAN.DWG

APPENDIX A

GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**SL-L1**	**0.0**	**SANDY FAT CLAY(CH)**	**55**	**29**	**26**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**SL-L1**	**0.0**	**4.75**				**0.0**	**36.9**	**63.1**	

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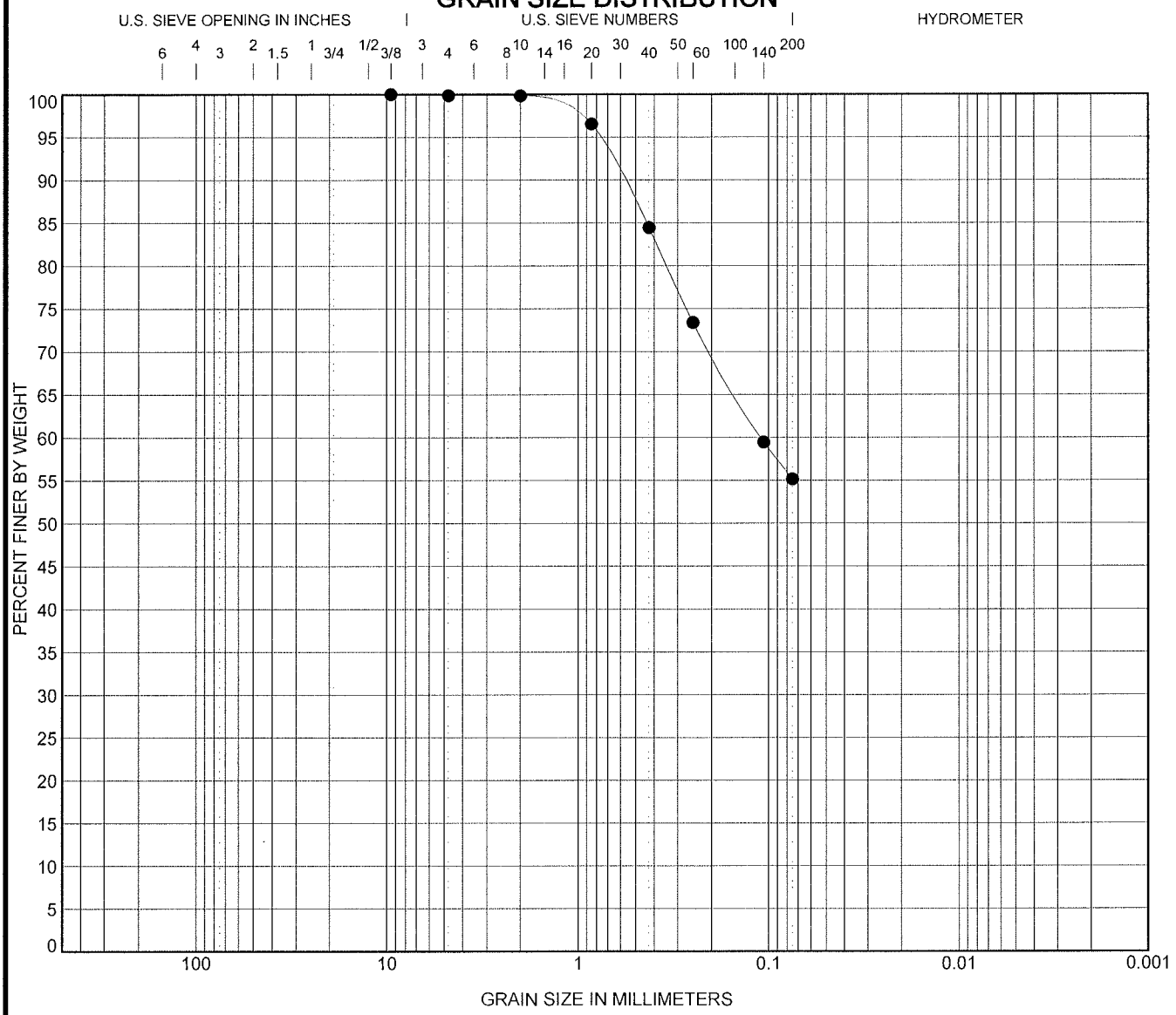
GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	SL-L2	0.0	SANDY SILT(ML)	41	27	14		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	SL-L2	0.0	9.525	0.109			0.1	44.7	55.2	

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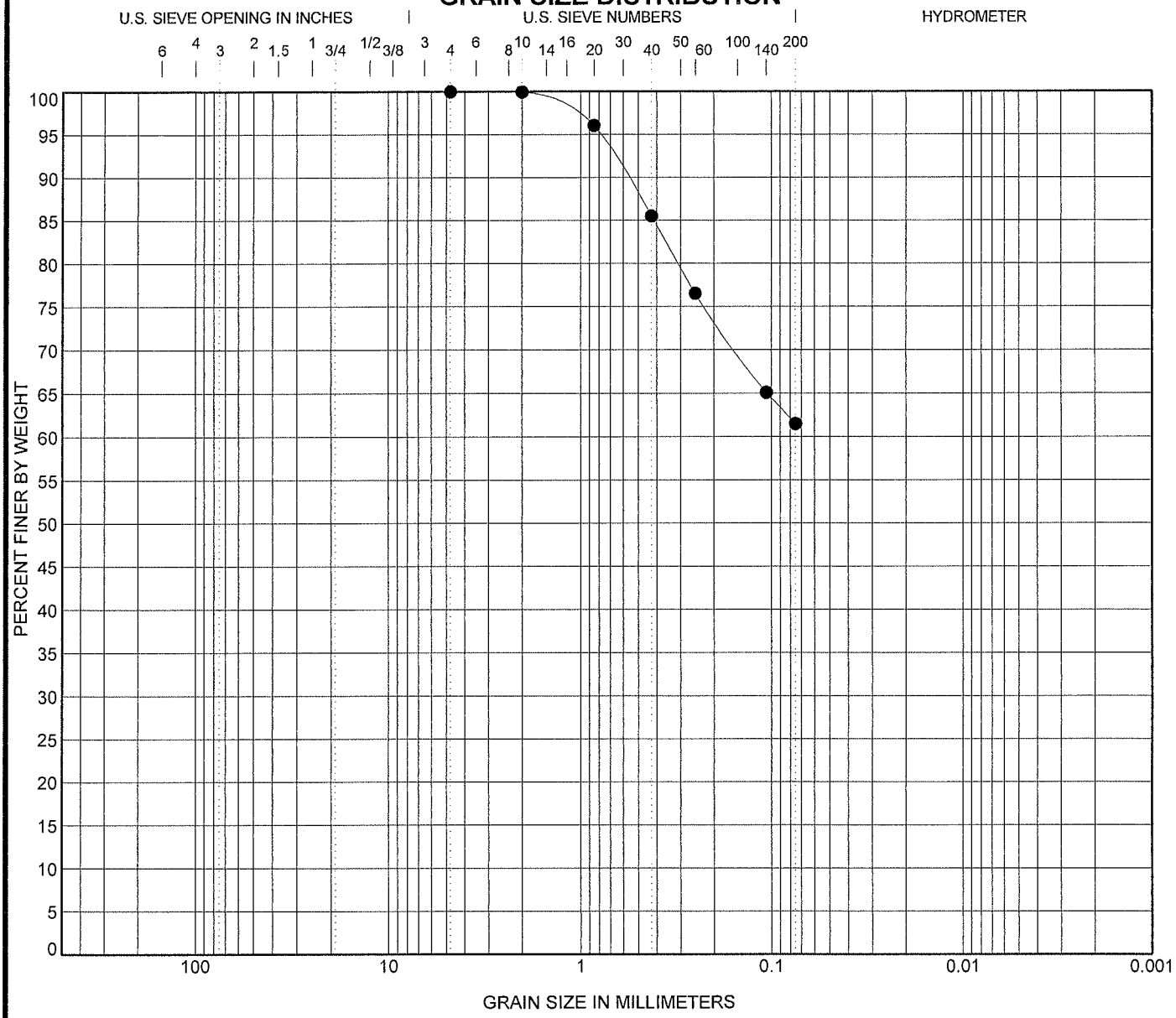
GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**SL-L3**	**0.0**	**SANDY LEAN CLAY(CL)**	**48**	**27**	**21**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**SL-L3**	**0.0**	**4.75**				**0.0**	**38.5**	**61.5**	

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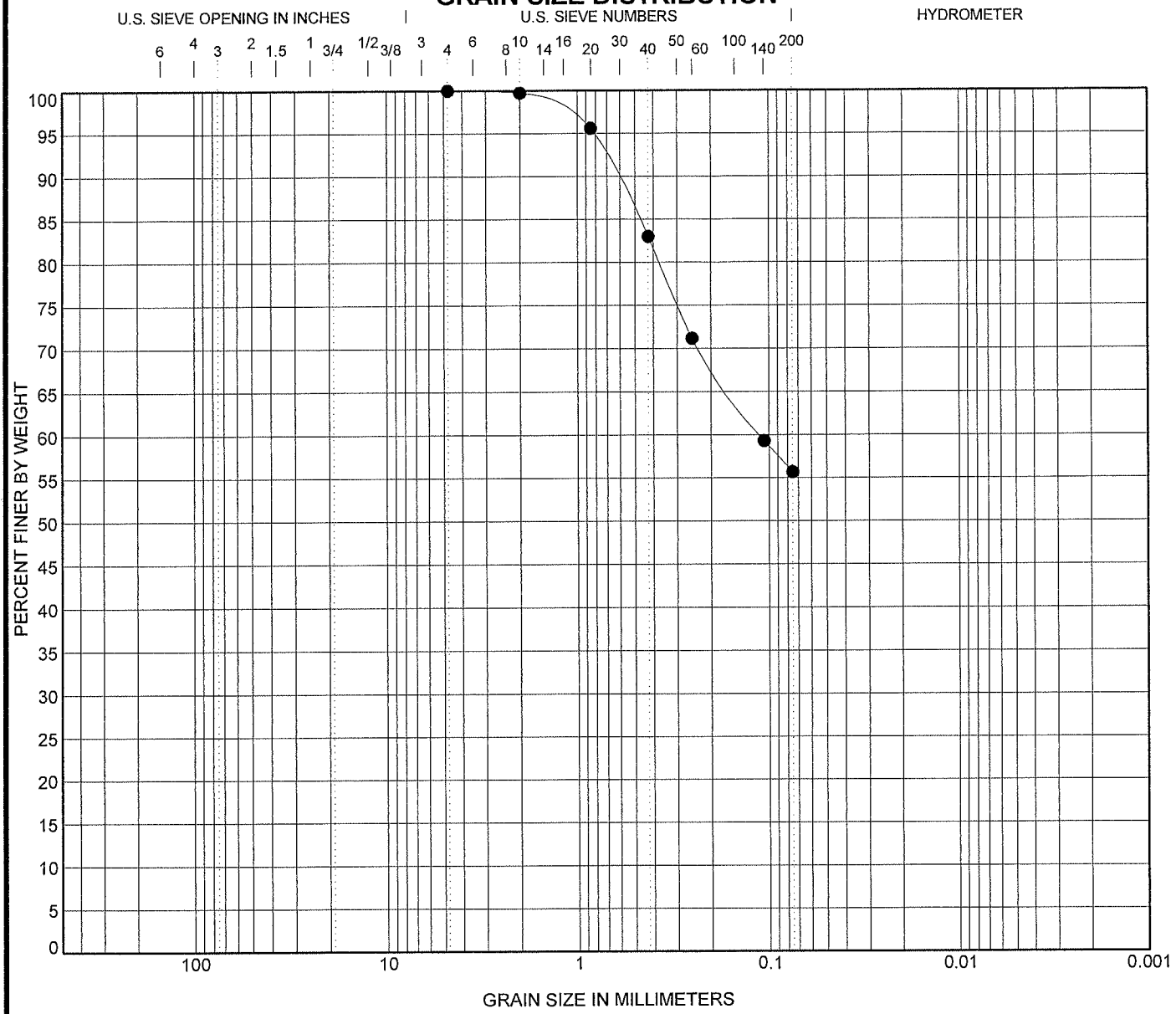
GRAIN SIZE DISTRIBUTION



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**SL-L4**	**0.0**	**SANDY FAT CLAY(CH)**	**53**	**27**	**26**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**SL-L4**	**0.0**	**4.75**	**0.112**			**0.0**	**44.3**	**55.7**	

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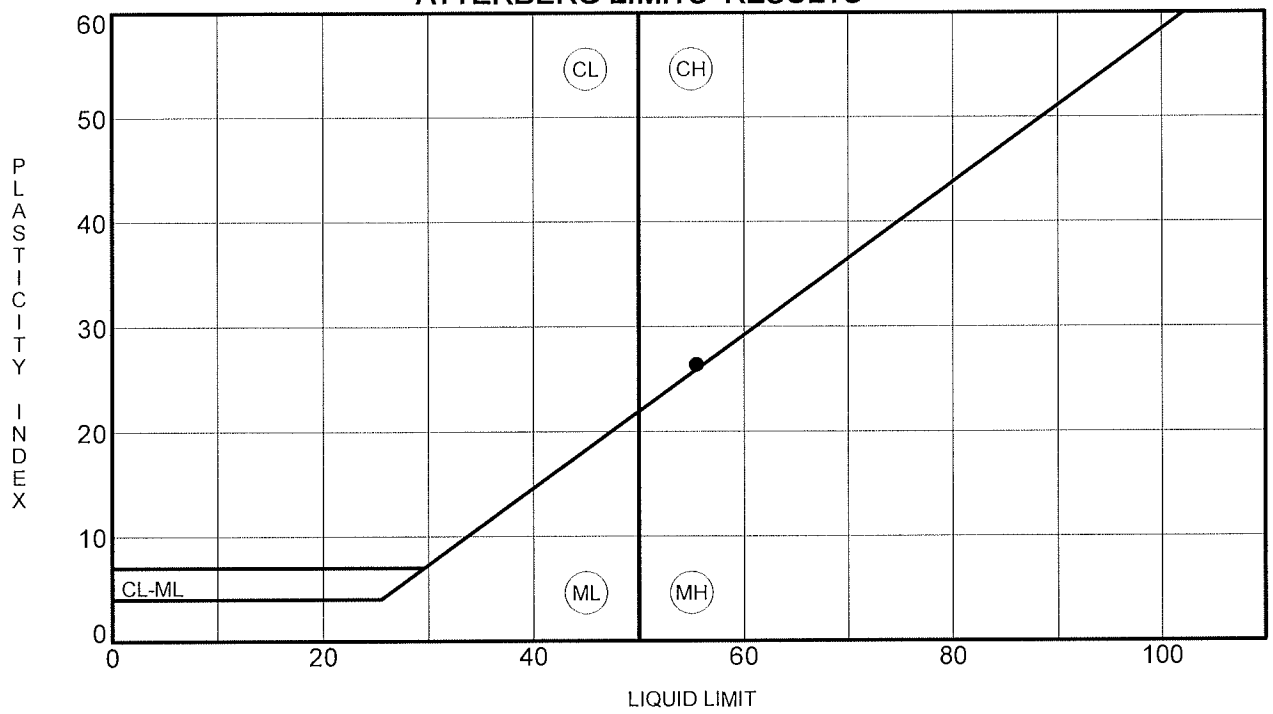
ATTERBERG LIMITS' RESULTS



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**SL-L1**	**0.0**	**55**	**29**	**26**	**63**	**SANDY FAT CLAY(CH)**

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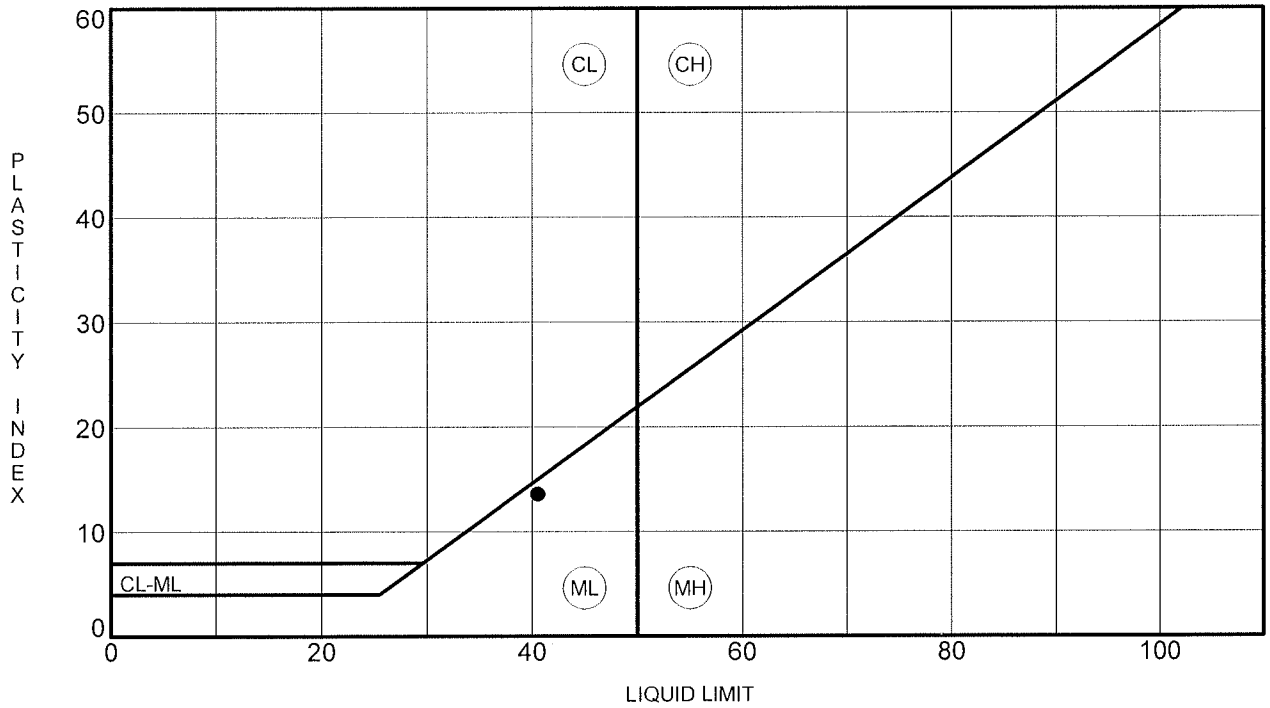
ATTERBERG LIMITS' RESULTS



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**SL-L2**	**0.0**	**41**	**27**	**14**	**55**	**SANDY SILT(ML)**

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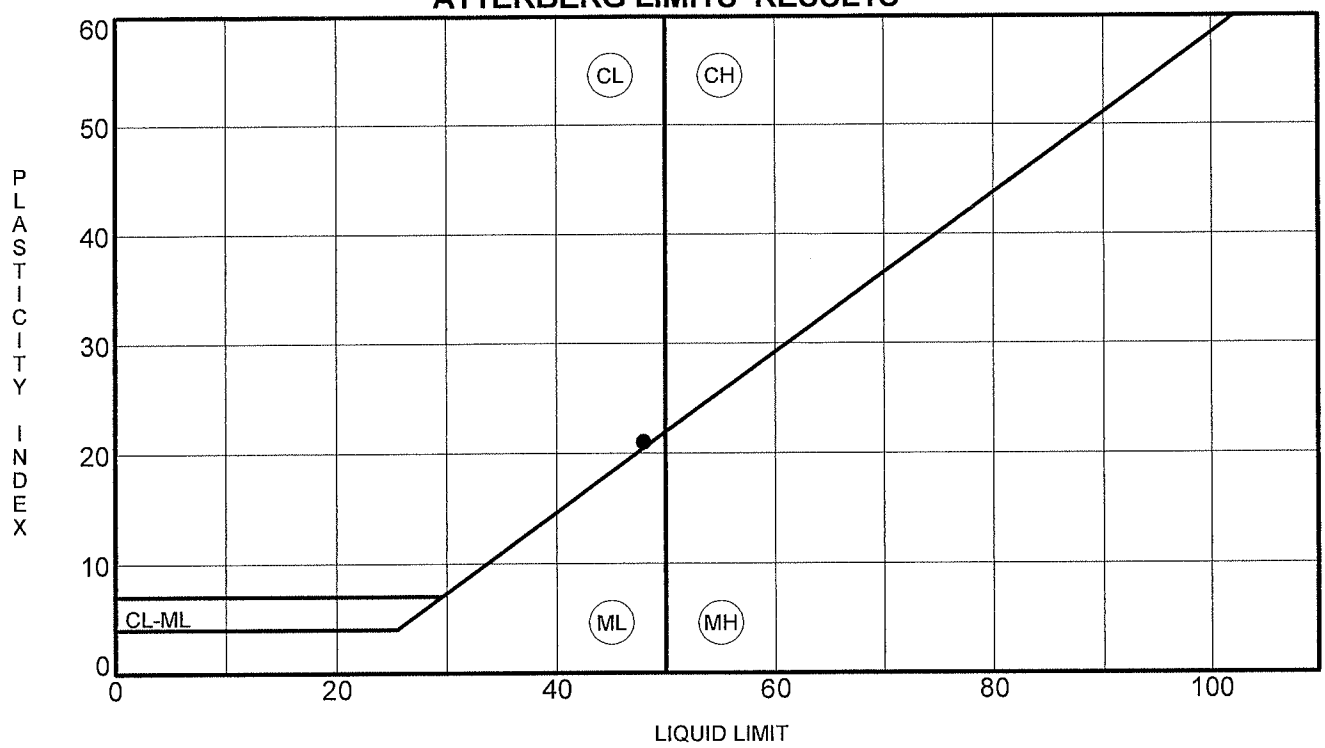

	Specimen Identification		LL	PL	PI	Fines	Classification
●	**SL-L3**	**0.0**	**48**	**27**	**21**	**62**	**SANDY LEAN CLAY(CL)**

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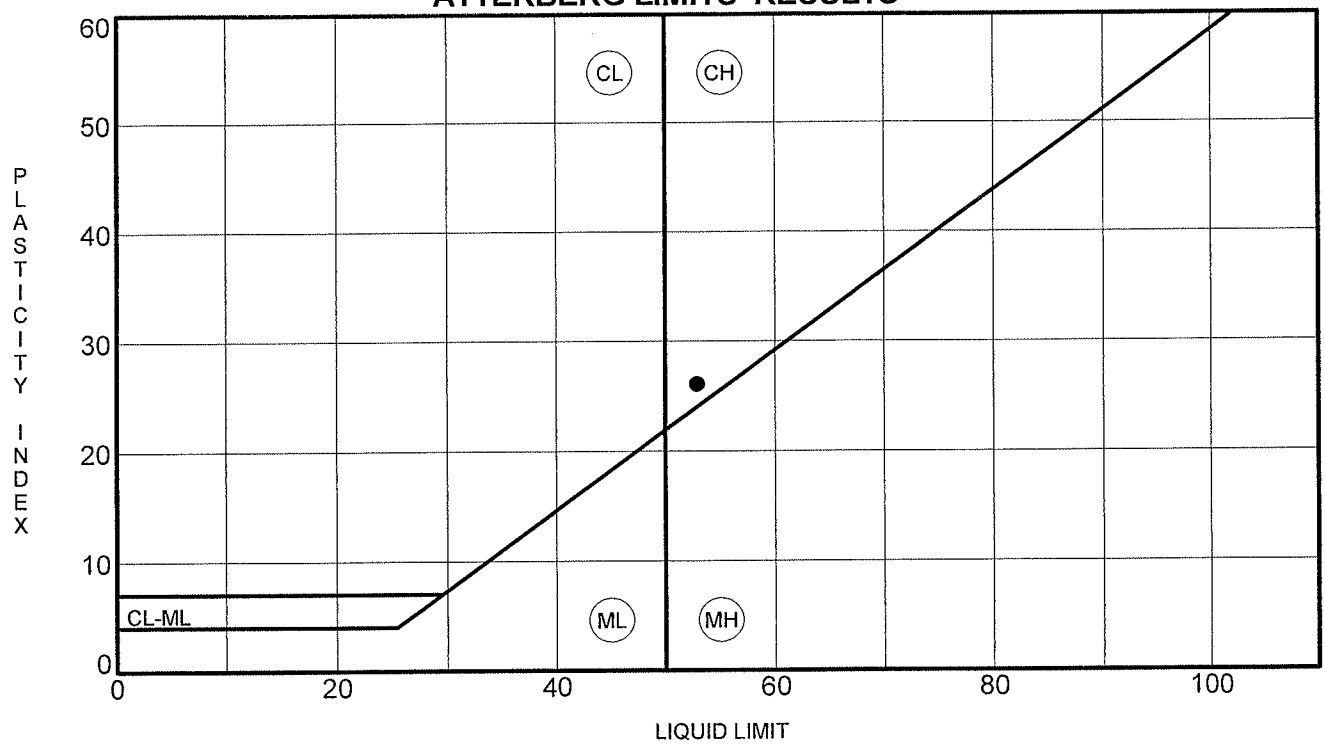
ATTERBERG LIMITS' RESULTS



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**SL-L4**	**0.0**	**53**	**27**	**26**	**56**	**SANDY FAT CLAY(CH)**

SHIELD ENGINEERING, INC.
4301 Taggart Creek Road
Charlotte, NC 28208
Telephone: 704-394-6913
Toll Free: 800-395-5220
Fax: 704-394-6968

CQA Gaston Co LF
(CHA)
Gaston County, North Carolina
Shield Project No.: 1140152-01

SHIELD ENGINEERING, INC.

Flexible Wall Permeability Test
ASTM D 5084

Project Name: Gaston County LF
Project No: 1140152-01
Date: 10/7/2014

Sample ID: SL-L1
Location: Lift 1
Sample Condition: Shelby Tube

Test Data:

Initial Dry Density (pcf) :	94.9
Initial Moisture Content (%) :	28.5
Sample Length (cm) :	9.5
Sample Area (cm^2) :	39.7
Hydraulic Conductivity K (cm/sec) :	**6.44E-08**
Saturated:	95%

SHIELD ENGINEERING, INC.

Flexible Wall Permeability Test
ASTM D 5084

Project Name: Gaston County LF
Project No: 1140152-01
Date: 10/13/2014

Sample ID: 14-150/SL-L2
Location: Lift 2
Sample Condition: Shelby Tube

Test Data:

Initial Dry Density (pcf) :	99.4
Initial Moisture Content (%) :	22.2
Sample Length (cm) :	8.0
Sample Area (cm^2) :	40.9
Hydraulic Conductivity K (cm/sec) :	**3.90E-08**
Saturated:	98%

SHIELD ENGINEERING, INC.

Flexible Wall Permeability Test
ASTM D 5084

Project Name: Gaston County LF
Project No: 1140152-01
Date: 10/24/2014

Sample ID: 14-154/SL-L3
Location: Lift 3
Sample Condition: Shelby Tube

Test Data:

Initial Dry Density (pcf) :	106.5
Initial Moisture Content (%) :	22.2
Sample Length (cm) :	7.0
Sample Area (cm^2) :	40.7
Hydraulic Conductivity K (cm/sec) :	**3.21E-08**
Saturated:	99%

SHIELD ENGINEERING, INC.

Flexible Wall Permeability Test
ASTM D 5084

Project Name: Gaston County LF
Project No: 1140152-01
Date: 10/24/2014

Sample ID: 14-154/SL-L4
Location: Lift 4
Sample Condition: Shelby Tube

Test Data:

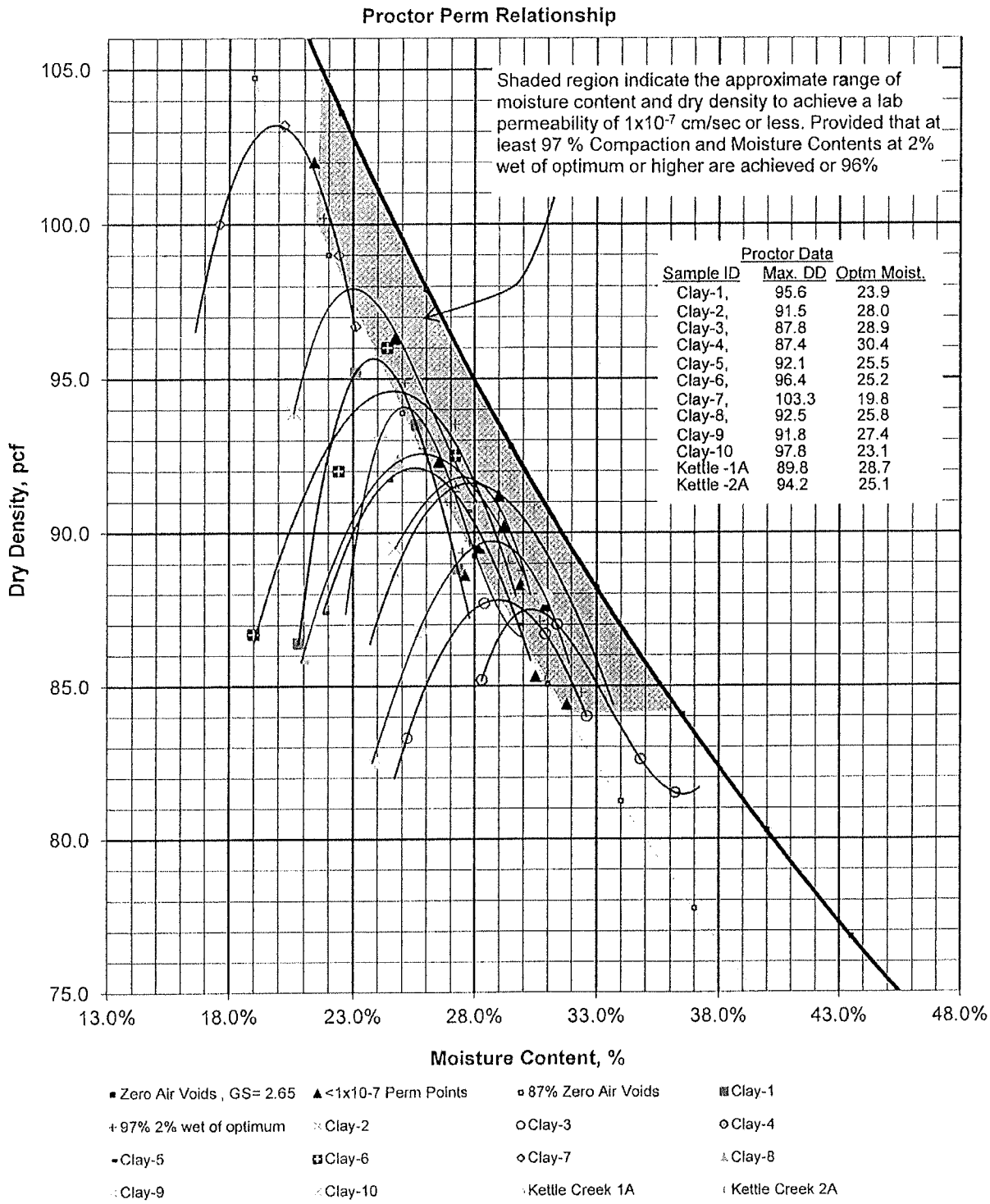
Initial Dry Density (pcf) :	95.9
Initial Moisture Content (%) :	24.2
Sample Length (cm) :	11.1
Sample Area (cm^2) :	40.2
Hydraulic Conductivity K (cm/sec) :	**7.43E-08**
Saturated:	98%

APPENDIX B

Proctor/ Perm Summary

Gaston Co. LF Unit II, Ph 1-Cell 2C CQC

DAA # R08281-05G

Prepared By: JAC

Draper Aden Associates
Blacksburg • Richmond, Virginia
Engineering • Surveying • Environmental Services