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Construction Documentation Report For The New Landfill No. 3 - Phase 1A Module 1 - Sections 1 through 8 Module 2 - Sections 9 and 10

Weyerhaeuser Company
Plymouth, North Carolina

Prepared By RMT North Carolina, Inc.

November 2000

APPROVED
DIVISION OF SOLID WASTE MANAGEMENT
DATE 12/14/2000 BY

Volume I

Weyerhaeuser

RED'C 11/13/2000

Construction Documentation Report For The New Landfill No. 3 - Phase 1A Appendices A - U

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Plymouth, North Carolina

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CONSTRUCTION DOCUMENTATION REPORT FOR THE NEW LANDFILL NO. 3 - PHASE 1A MODULE 1 - SECTIONS 1 THROUGH 8 MODULE 2 - SECTIONS 9 AND 10

WEYERHAEUSER COMPANY
PLYMOUTH, NORTH CAROLINA

PREPARED BY RMT NORTH CAROLINA, INC.

November 2000

NORTH CAROLINA PROFESSIONAL SEAL No. 17543 ENGINEER R. KENT NILSSON
11/6/00

Bruce Urban
Resident Project Representative

R Kent Nilsson, P.E.
Project Manager, CQA Officer

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Project Summary

The purpose of this document is to describe the construction activities performed by Ryan Consolidated Central of Madison, Wisconsin, for Weyerhaeuser Company (Weyerhaeuser). This document describes the key activities, tests, and performance standards for construction of the landfill cell in conformance with the Technical Specifications (RMT, March 2000), and the Construction Quality Assurance Plan (CQAP) (RMT, March 2000).

Project name:	Weyerhaeuser Company Landfill #3 Phase 1A Construction
Contractor:	Ryan Consolidated Central
Subcontractors:	McKim and Creed - Surveying GeoSynthetics Construction, Inc. (GSI)- Geosynthetics Landsaver - Silt Fence, Erosion Control Phillips and Jordan – Clearing and Grubbing
Design engineer:	RMT North Carolina, Inc. (RMT)
Construction quality assurance (CQA):	RMT
Geosynthetics testing laboratories:	RMT and Geotesting Express, Inc
Soil testing laboratories:	RMT and S&ME, Inc
Construction start:	May 2000
Construction completion:	November 2000
Area constructed:	Approximately 9 acres
General fill, prepared subgrade, and low permeability clay	
Placement dates:	June 15, 2000, through August 15, 2000
Quantity:	107,000 cubic yards (cy), loose
Geomembrane (geosynthetic clay liner (GCL) and high density polyethylene (HDPE))	
Placement dates:	August 20, 2000, through October 4, 2000
Quantity:	453,760 square feet (sf)
Geotextile	
Placement dates:	September 15, 2000, through October 4, 2000
Quantity:	453,760 (sf)

RMT

Section 1
Certifications

1.1 Report and Plan Set Certification

I, R. Kent Nilsson, hereby certify that I am a registered professional engineer in the State of North Carolina; that the construction related to Phase 1A at the Weyerhaeuser Landfill #3 was performed in substantial compliance with the approved plans and specifications; and that, to the best of my knowledge, all information contained in this document was prepared in compliance with all applicable North Carolina Department of Environment and Natural Resources (NC DENR) requirements.

Signature — R. Kent Nilsson
Print Name

1.2 Prepared Subgrade and Low Permeability Soil Certification

I, R. Kent Nilsson, certify that, to the best of my knowledge, information, and belief, the prepared subgrade and low permeability soil components of the liner was constructed in conformance with the approved plans and all applicable solid waste administrative code requirements. This certification shall not be construed to be either an implied or expressed guarantee or warranty regarding the performance of the construction documented in this report. This certification applies to each of the following components of construction:

- The quality of clay material used and the methods utilized in its placement
- Preparation of anchor trenches
- Preparation of the upper portions of the prepared subgrade and low permeability components of the composite liner

The details of construction for each of these components are further described in Section 5, Prepared Subgrade and Low Permeability Soil Construction of Phase 1A section of this report. This certification is based on personal observations, communications with the full-time RMT site representative, field and laboratory test results, record surveys, photographs, and the daily construction reports.

Signature — R. Kent Nilsson
Print Name

1.3 Geosynthetic Liner Certification

I, R. Kent Nilsson, certify that, to the best of my knowledge, information, and belief, the geosynthetic liner was constructed in conformance with the approved plans and all applicable solid waste administrative code requirements. Any observed deviations are as noted in Section 2.

This certification shall not be construed to be either an implied or expressed guarantee or warranty regarding the performance of the construction documented in this report. This certification applies to each of the following components of construction:

- Placement of geomembrane in anchor trenches, and other irregularly shaped areas
- Removal of geomembrane wrinkles

The details of construction for each of these components are further described in Section 6. This certification is based on personal observations, communications with the full-time RMT site representative, field and laboratory test results, manufacturer's information, photographs, and the daily construction reports.

Signature: ______________________ R. Kent Nilsson (Print Name)

Section 2
Introduction

2.1 Background

The Weyerhaeuser facility in Plymouth, North Carolina, consists of an integrated kraft process pulp and paper mill and a wood products plant. Solid wastes generated by facility operations are disposed of in a state-permitted, on-site landfill (Landfill No. 2). The existing landfill is nearing its design capacity, and is expected to be closed by the end of 2003.

Landfill No. 2 occupies approximately 40 acres of a 300-acre tract of land that has been approved for use as a landfill by NC DENR. A 9-acre asbestos landfill area is located east of Landfill No. 2, the northerly portion that has already received asbestos waste. In 1993, Weyerhaeuser retained RMT North Carolina, Inc. (RMT) to prepare a construction plan application and CQAP for Weyerhaeuser to permit a new landfill (Landfill No. 3) to be constructed on a portion of the 300-acre tract. However, as a result of recent property acquisitions and site drainage improvements, Weyerhaeuser retained RMT in 1998, to redesign the proposed landfill, and the 1993 application was withdrawn. The new design included a revised landfill footprint, grading modifications, and an alternate composite liner and cap. A permit-to-construct Phase 1A was issued by NC DENR on May 16, 2000

Weyerhaeuser Company retained RMT to provide construction management and quality assurance (QA) during construction. Table 1 provides a listing of project QA personnel.

Table 1
Quality Assurance Personnel

NAME	PROJECT ROLE
RMT	
R. Kent Nilsson, P.E.	Project Manager, CQA Officer
Bruce Urban	Resident Project Representative
Joe Combs	Resident Project Representative

2.2 Purpose and Scope

This report and its accompanying record drawings present the results of RMT's construction observations and field surveys that were conducted for Phase 1A construction. This module only addresses construction of the earthen perimeter berms, prepared subgrade, low permeability soil, and geosynthetic liner system. Documentation regarding the construction of the leachate collection system, pumps, and force main will be provided as part of the final document. This report and the record drawings also document RMT's findings and conformance to the technical specifications and the CQAP. Table 2 lists the project construction specifications, which are included in this report as Appendix A. The project CQAP is included as Appendix B. Project photographs are included in Appendix C. Record drawings are included under Drawings at the end of this document.

On the basis of RMT's documentation assessment, which included construction observation, soil sampling and testing, geomembrane testing, and review of construction surveys, the Phase 1A construction activities have been substantially completed in conformance with the technical specifications and the CQAP prepared by RMT. Observed deviations from the plans have been noted in this report (Subsection 2.4) and on the record drawings.

2.3 Construction Schedule

A chronological listing of the dates for the major components of construction follows:

CONSTRUCTION TASK	START DATE	COMPLETION DATE
Mobilization	05/29/00	06/14/00
Rough Grading and General Fill	06/11/97	07/16/00
Construct Sedimentation Pond	06/26/00	07/17/00
Construct 1-Foot Prepared Subgrade	07/16/00	08/02/00
Low Permeability Soil Installation	08/15/00	08/15/00
GCL and Geomembrane Installation	08/20/00	10/04/00

2.4 Design Modifications

Modifications to the design made during construction consisted of the following bulleted items.

- **GCL Installation at Sump Areas:** During installation of the GCL, GSI installed two layers of GCL with a layer of sodium bentonite between layers in both sump areas. Only one layer was required by design. During installation of the HDPE membrane, stormwater had accumulated under the HDPE at the east sump. The HDPE and wet GCL was removed, the subgrade reworked, and 3 layers of GCL were placed back in the sump. Sodium bentonite was placed between each layer. The HDPE was then replaced and rewelded.

Table 2
Approved Construction Specification List

SECTION NUMBER	SPECIFICATION TITLE
Section 01010	Summary of Work
Section 01330	Submittals
Section 01410	Regulatory Requirements
Section 01420	Reference Standards
Section 01450	Quality Control
Section 01452	Testing Laboratory Services
Section 01520	Construction Facilities and Temporary Controls
Section 01570	Temporary Controls
Section 01574	Temporary Water Control
Section 01600	Material and Equipment
Section 01720	Field Engineering
Section 01770	Contract Closeout
Section 02070	HDPE Geomembrane
Section 02075	GCL
Section 02076	Geotextiles
Section 02232	Clearing and Grubbing
Section 02250	Soil Compaction Control and Test
Section 02325	Excavation
Section 02317	Trenching, Backfilling, and Compaction
Section 02320	Fill
Section 02372	Riprap
Section 02374	Sediment Control Fence
Section 02376	Erosion Control and Re-vegetation Mat
Section 02618	HDPE Pipe and Fittings
Section 02720	Aggregate Base Course
Section 02911	Topsoil
Section 02921	Seeding
Section 02923	Fertilizing

2.5 Permits/Approvals

A "Permit-to-Construct" (Facility Permit No. 94-01) was issued by NC DENR, Division of Waste Management, Solid Waste Section on May 16, 2000. The "Erosion and Sedimentation Control Plan" for the site was approved by the Division of Land Resources, Land Quality Section on May 3, 2000. A Construction Activities General NPDES Permit (NCG010000) was also issued for the project.

Section 3
Site Survey and Construction Control

The initial construction survey layout was performed by McKim and Creed, a registered land surveyor, of New Bern, North Carolina, under subcontract to Ryan Consolidated Central. This survey layout included control points for Ryan Consolidated Central's use during construction. McKim and Creed staked initial locations of the berms, piping, manholes, and selected points for the base of Phase 1A. Ryan Consolidated Central proceeded with construction and periodically surveyed in select locations using in-house personnel to verify correspondence with the plans. McKim and Creed then finalized construction locations. McKim and Creed also performed surveying activities during geomembrane installation.

Section 4
Site Preparation

4.1 Construction Material Sampling

RMT obtained representative samples of soil materials prior to construction for laboratory proctor and sieve analysis; including on-site soil (general fill material), prepared subgrade and low permeability soil (sump liner). Laboratory analyses were performed by S&ME, Inc. at their laboratory located in Raleigh, North Carolina. Results are summarized in Table 3. Proctor and sieve analysis results for representative samples are included as Appendix D.

4.2 Sediment Control Facilities

Prior to commencing construction activities of Phase 1A, silt fencing was installed to minimize the transport of sediment off-site. The location of the silt fencing is shown on Drawing 510108-C03, and details are shown on Drawing 510108 - C11. Silt fencing was installed at appropriate locations along the perimeter of the landfill construction limits. Other erosion control devices, including check dams and hay bales, were also utilized. Ryan Consolidated Central inspected the silt fencing throughout construction and made repairs to it as needed. RMT also inspected silt fencing and related erosion control as part of the approved Erosion and Sedimentation Control Plan dated April 2000.

Ryan Consolidated Central constructed a sediment pond for settlement of suspended solids in storm water runoff. The location of the sediment pond is shown on Drawing No. 510108 - C03. Details of the sediment pond construction are shown on Drawing No. 5101008 - C10. The sediment pond was mainly constructed by excavating existing soil to obtain proper grade in the bottom of the pond. The southern berm of the pond was constructed as part of the north berm of Phase 1A of Landfill No. 3. The compaction of the structural fill was tested using a Troxler nuclear density gauge (NDG), which measured dry and wet densities and moisture contents. Sample results from field analysis are found in Appendix F.

4.3 Clearing and Grubbing

A minimal amount of clearing and grubbing was performed during construction as the majority of the site was free of any significant vegetation. The majority of the clearing was performed at the northern most area at the site of Sedimentation Pond No. 3. All clearing debris was collected and burned on site. Ryan Consolidated Central received daily permits for all on-site burning activity.

Table 3
Summary of Proctor Sample Results

DESCRIPTION	ATTERBERG LIMITS			PERMEABILITY	PROCTOR TESTS		GRAIN SIZE DISTRIBUTION TEST PERCENT PASSING SIEVE NUMBERS				
	LL (%)	PL (%)	PI (%)	Kv (cm/sec)	OMC (%)	DDmax (%)	10	40	60	100	200
General/Select Fill- PS-1	25	17	8	-	14.0	117.8	100.0	76.0	65.0	50.0	32.0
General Fill - PS-2	34	17	17	-	13.5	117.9	100.0	98.0	95.0	84.0	67.5
General/Select Fill - PS-3	37	21	16	-	16.2	112.8	100.0	97.5	90.0	62.5	33.0
General Fill - PS-4	NP	NP	NP	-	14.5	108.3	100.0	100.0	97.5	47.5	19.0
General Fill - PS-5	41	24	17	-	18.0	108.2	100.0	100.0	98.0	40.0	27.5
General Fill - PS-6	58	22	36	1.60E-07	22.5	102.2	100.0	100.0	97.5	70.0	61.0
General/Select Fill - PS-7	45	21	24	2.18E-06	19.0	104.9	100.0	100.0	98.0	77.5	54.0
General/Select Fill - PS-8	44	20	24	4.87E-06	15.6	109.7	100.0	99.5	92.5	55.0	46.0
General/Select Fill - PS-9	24	19	5	8.37E-05	16.5	108.6	100.0	100.0	93.5	32.0	22.0
General/Select Fill - PS-10	-	-	-	6.65E-08	16.3	112.9	100.0	99.0	95.0	65.0	56.2
Low Permeability Soil - PS-13*	56	26	30	2.9EE-8	21.0	102.2	99.7	94.7		85.1	76.0

NP Non plastic
* Index properties derived from borrow investigation, see "Borrow Investigation Report of the Former Snell and Beasley Properties," January 1999.

4.4 General Fill

Placement of General Fill proceeded from mid-Mid June to mid-July and included excavating to the bottom of Phase 1A at the southern end of the landfill and constructing the north, south, east, and west berms of Phase 1A with fill material from the on-site borrow area shown on Drawing 510108-C05. The exposed subgrade was inspected by a North Carolina registered geologist prior to preparation or placement of fill. The soils exposed were consistent with those assumed in the design, and this was communicated to NC DENR in a memorandum to Sheryl Marks dated July 26, 2000. A copy of this memorandum is enclosed as Appendix E.

The perimeter berms were constructed by placing fill material in 8-inch lifts to obtain the necessary 6-inch thick compacted layer. The dry densities and moisture contents of the general fill were documented using a Troxler nuclear density gauge by American Society for Testing and Materials (ASTM) Method D2922. The NDG used during the project was calibrated daily against a standardized block supplied by Troxler.

Field moisture content and dry densities of the general fill were documented using the calibrated NDG on an approximate 100-foot by 100-foot (10,000 square feet) grid pattern for each lift. This ensured that the number of tests for the general fill exceeded the frequency of 1 per 500 cubic yards as required in the Quality Assurance Plan (QAP).

A summary of borrow material proctor sample results for general is located on Table 3. Sample results from field and laboratory analysis for general fill are found in Appendix F. Soil test locations for general fill are shown on Figure 1. A total of 316 locations of general fill were tested for compaction, including 14 re-tests. Of the 316 locations, 302 samples passed on initial testing. Areas of failing tests were re-worked and retested. All retests are shown in Appendix F.

The subgrade was surveyed prior to the construction of the prepared subgrade layer or low permeability layers within the leachate collection sumps. Since the lower 6-inch lift of the prepared subgrade layer in the initial cut areas was prepared in-place, these survey elevations represent the top of the first lift of the prepared subgrade.

Section 4

Drawings Under Seperate Cover

Section 5

Section 5
Phase 1A Prepared Subgrade and Low Permeability Soil

The Phase 1A liner included a 1-foot prepared subgrade, a 2 -foot low permeability soil layer in the collection sumps, a GCL, a smooth 60-mil HDPE geomembrane on the bottom, and a textured 60-mil HDPE geomembrane on the side-slopes. The installation of GCL and HDPE are discussed in Section 6 and 7 of this report. Placement of the prepared subgrade began on July 17, 2000, and continued until August 3, 2000. The low permeability soil consisted of a two foot layer in the bottom of each collection sump. The total quantity of low permeability soil used was approximately 30 yards. Placement of the low permeability soil took place on August 15, 2000.

The majority of the prepared subgrade material and low permeability soil was obtained from the on-site borrow area. Excavation at the borrow site was performed with a backhoe, and the excavated material was loaded onto 35 ton haul trucks for hauling to the landfill. Representative samples were obtained once for every 4,000 cubic yards delivered hauled to the landfill. Permeability, Standard Proctor, Atterberg limits, and grain size analysis results are summarized in Table 3.

5.1 Prepared Subgrade Placement

In fill areas in the northern half of the cell, the first lift of prepared subgrade material was spread in loose lifts of approximately 8 inches to obtain the necessary 6-inch-thick compacted over the majority of the cell. Dump trucks were used to haul and place the prepared subgrade material. Dozers were used to level the material into a uniform lift before moisture-conditioning and compacting.

The southern half of the landfill is located in an area that required significant cut to bring the area to proper grade. In the cut areas, the first lift of the prepared subgrade in this area of the landfill consisted of *in-situ* material that was disked to a 6-inch depth, re-worked, moisture conditioned, and compacted to 95 percent of Standard Procter density. Bottom of subgrade elevations are shown on Figure 3.

After the first lift was moisture-conditioned, compacted, and tested for dry density and moisture content, and permeability, the remaining 6-inch lift was placed. The total thickness of the prepared subgrade layer was 1 foot. Observations and testing found that this construction method was adequate for achieving the required compaction and permeability.

To ensure a good bond between lifts, the upper 2 to 3 inches of the preceding lift was mechanically scarified prior to placing the next lift. In addition, water was added if the surface of the prepared subgrade became too dry.

Prepared subgrade material was placed directly on the 3H:1V slopes and leveled with dozers to approximately 8-inch vertical loose lifts, and compacted to 6 inches.

The prepared subgrade was extended along the outer slope of Phase 1A's southern delineation berm to facilitate the future construction of Phase 1B. The limits of the prepared subgrade construction are shown on Drawing No. 510108 - C06.

The top of the prepared subgrade was finish-graded and rolled with a smooth drum roller. Final top of prepared subgrade elevations were documented by a level survey. The toe and top of the slide slopes were also documented with a level survey. The survey indicated that the 1-foot-thick prepared subgrade layer was constructed in conformance with plans and specifications. The top of subgrade elevations are shown on Figure 4.

5.2 Moisture-Conditioning

Since the fill material from the borrow area was at or slightly above the optimum moisture content, it did not require extensive moisture conditioning or drying. The natural moisture content of the material in the borrow area ranged from 15 to 23 percent. The material, once compacted and rolled, was then tested as discussed in later sections.

5.3 Compaction

A Cat 815 Compactor with approximately 7-inch-deep pads was used for primary compaction of the prepared subgrade. Also, a smooth drum roller was used to seal the material, which helped to control desiccation from drying and to keep the material from becoming saturated after a rainstorm. Material on the 3H:1V sidewalls was compacted with the smooth drum roller.

5.4 Nuclear Density Testing

The dry densities and moisture contents of the prepared subgrade were documented using a Troxler nuclear density gauge by method ASTM D2922. The NDG used during the project was calibrated daily against a standardized block supplied by Troxler.

Field moisture content and dry densities of the prepared subgrade were documented using the calibrated NDG on an approximate 100-foot by 100-foot (10,000 square feet) grid pattern for each lift. This corresponded to a frequency of approximately 46 tests per lift. Test locations were offset between subsequent lifts. Several of these tests were performed in the south phase delineation berm as well. Field moisture contents and dry densities of the clay were required to be within 95 percent of the maximum dry density and within 2 percent of optimum moisture as determined by ASTM D 698.

The results of the field densities and moisture contents for each lift of the prepared subgrade are shown in Appendix G. Figure 2 shows the locations of field and laboratory sample locations for the prepared subgrade. A total of 94 samples were tested for compaction.

5.5 Laboratory Testing of the Prepared Subgrade

The following testing program presents the minimum testing performed on the prepared subgrade:

5.5.1 Prepared Subgrade Quality Control Testing

- Initially, representative soil samples were collected from the borrow source and analyzed to determine if the soil met the requirement of a prepared subgrade borrow source. Additional representative soil samples were collected if a visually identifiable material changed occurred. Each sample was analyzed for Atterberg Limits, grain-size analyses (sieve and hydrometer), moisture-density relationship using Standard Proctor Compaction, moisture content, and hydraulic conductivity remolded to 95 percent of its Standard Proctor maximum dry density at 2 percent over its optimum moisture content.
- A representative soil sample was collected for every 4,000 cubic yards of the select clay borrow source to determine if a material change had occurred. These samples were analyzed for Atterberg Limits, grain-size analyses (sieve and hydrometer), moisture-density relationship using Standard Proctor Compaction, and moisture content.
- If a material change had occurred based on these test results, a hydraulic conductivity test was performed on the sample remolded to 95 percent of its Standard Proctor maximum dry density at 2 percent over its optimum moisture content to confirm that the soil still met the requirements of a prepared subgrade source.
- Samples were also obtained and the prescribed testing performed when noticeable material change occurred in the soil borrow source.

5.5.2 Prepared Subgrade Quality Assurance Testing

Testing of the "as-placed" characteristics of the prepared subgrade layer included the following:

- Field density tests were performed on an approximate 100-foot by 100-foot (10,000 square feet) grid pattern for each lift in place.
- One permeability test was performed on an undisturbed Shelby tube sample obtained from each acre per lift of select clay placed. In addition, one grain size (P200 content), one Atterberg Limits test, and one moisture-dry density determinations were performed on a sample obtained from each acre per lift of prepared subgrade.

The frequency and results of soil property and NDG tests for the prepared subgrade meet or exceed these minimum requirements of the approved specifications. A summary of results for laboratory testing of prepared subgrade material is shown in Table 4.

Table 4
Prepared Subgrade Soil Laboratory Test Results

SAMPLE NO.	LOCATION	LIFT NO.	LL	PL	PI	%-200	Kv cm/sec
PT-1	1292N, 792E	1	35	24	11	42.5	1.1×10^{-6}
PT-2	1250N, 1051E	1	24	18	6	29.3	2.3×10^{-4}
PT-3	1053N, 795E	1	26	20	6	38.2	3.7×10^{-5}
PT-4	1050N, 1050E	1	24	17	7	56.0	3.4×10^{-7}
PT-5	905N, 750E	1	35	24	11	48.4	2.9×10^{-8}
PT-6	895N, 1009E	1	24	23	1	27.8	7.1×10^{-5}
PT-7	750N, 755E	1	23	21	2	21.9	8.0×10^{-5}
PT-8	700N, 1000E	1	23	21	2	29.7	3.9×10^{-4}
PT-9	1460N, 900E	1	29	22	7	33.6	9.9×10^{-6}
PT-10	670N, 900E	2	22	21	1	21.0	6.2×10^{-5}
PT-11	800N, 705E	2	27	20	7	37.4	2.8×10^{-6}
PT-12	800N, 1045E	2	32	20	12	43.7	9.5×10^{-8}
PT-13	1000N, 750E	2	28	21	7	45.2	2.2×10^{-8}
PT-14	1000N, 1015E	2	27	20	7	35.2	1.7×10^{-5}
PT-15	1200N, 775E	2	NP	NP	NP	23.4	8.4×10^{-6}
PT-16	1200N, 1010E	2	21	17	4	28.7	1.3×10^{-4}
PT-17	1400N, 775E	2	17	16	1	22.9	8.4×10^{-4}
PT-17A	1400N, 775E	2	NP	NP	NP	21.6	4.5×10^{-4}
PT-17B	1393N, 715E	2	19	17	2	26.5	6.6×10^{-7}
PT-18	1400N, 1050E	2	23	19	4	30.8	1.1×10^{-7}

NP Non-plastic

NP Non-plastic

Figure 2 shows the locations where prepared subgrade samples were obtained for soil property and hydraulic conductivity tests. "Undisturbed" (*i.e.*, Shelby tube) samples were collected at 18 locations and submitted to laboratory testing. Holes in the subgrade created from the sample retrieval were backfilled with bentonite. Hydraulic conductivities ranged from 3.9×10^{-4} to 2.2×10^{-8} cm/s. One sample initially failed the requirement for hydraulic conductivity of 4.2×10^{-4} cm/s (PT-17). The testing laboratory had reported possible sample disturbance during extraction of the sample from the Shelby tube. A second test was taken from the same location (PT-17A). This sample also failed the minimum requirement for hydraulic conductivity; therefore, the affected 1-acre area was disked, re-worked, re-compacted, and retested for hydraulic conductivity (PT-17B). This sample passed the requirement for hydraulic conductivity. Results for soil property and hydraulic conductivity tests are shown in Table 4.

5.6 Low Permeability Soil Placement

The design for Phase 1A includes leachate collection sumps at the northeast and northwest corners of the landfill. The location and details of these sumps are shown on Drawing No. 510108-C04 and 510108-07. These leachate collection sumps require a 2-foot layer of low permeability soil with a hydraulic conductivity of less than 1.0×10^{-7} cm/s.

A source of low permeability soil was identified in the borrow area. Proctor analysis, Atterberg Limit, sieve analysis, hydrometer, and hydraulic conductivity were performed on this source to ensure that the material was capable of achieving the required permeability. The results of this testing are located in Table 3 (Low Permeability Soil P-13).

The total amount of soil used to construct the 2-foot layer in both sumps was approximately 30 cubic yards. Although the total amount of soil used is minimal, the same requirements for placement and for QA testing still applied. The soil was placed in 6-inch lifts and tested for density and moisture using the nuclear density gauge. Each lift was also tested for hydraulic conductivity, Atterberg limit, and P-200. A summary of results for laboratory testing of prepared subgrade material is shown in Table 5. A total of 8 tests were performed on the low permeability soil. All tests exceeded the minimum requirement of less than 1.0×10^{-7} cm/s. The results of these tests are shown in Appendix H.

Table 5
Low Permeability Soil Laboratory Test Results

SAMPLE NO.	LOCATION	LIFT NO.	ATTERBERG LIMIT			%-200	Kv cm/sec	
			LL	PL	PI			
LPT-1	1420N, 1120E	1	38	20	18	49.1	2.8×10^{-8}	$.3 \times 10^{-7}$
LPT-2	1422N, 1118E	2	39	20	19	55.9	1.6×10^{-8}	.2
LPT-3	1420N, 1123E	3	31	18	13	47.2	2.6×10^{-8}	.3
LPT-4	1420N, 1120E	4	37	21	16	53.6	1.6×10^{-8}	.2
LPT-5	1421N, 681E	1	38	20	18	55.3	1.2×10^{-8}	.1
LPT-6	1420N, 683E	2	35	19	16	50.0	1.8×10^{-8}	.2
LPT-7	1422N, 680E	3	36	20	16	53.4	3.3×10^{-8}	.3
LPT-8	1420N, 684E	4	39	20	19	57.9	2.5×10^{-8}	.2

$K_{AVG} = .2 \times 10^{-7}$ ✓

Drawings Under Seperate Cover

RMT

Section 6
Geosynthetic Clay Liner Installation

6.1 Base Surface (Top of Prepared Subgrade) Preparation

Prior to deploying GCL panels, the prepared subgrade was graded smooth and examined for slope uniformity and general appearance. The subgrade was continually conditioned as deployment took place to repair areas affected by equipment traffic and precipitation. A Certificate of Acceptance of Subgrade was prepared by the geosynthetic installer, GSI, for each day on which the geomembrane was deployed, indicating that the surface on which the geomembrane panels were deployed was acceptable. Subgrade acceptance forms are included as Appendix I.

6.2 Geomembrane Deployment

6.2.1 Geosynthetic Clay Liner Unloading, Storage, and Transport

Two hundred and three rolls of GCL were delivered to the job site. The GCL rolls were delivered to the site on flat-bed semi-trailer trucks. Rolls were removed from the trucks by attaching two nylon straps, which were placed around each roll at the factory, to a wheel loader. The geomembrane rolls were lifted off the trucks and temporarily placed in a material storage area located south of Phase 1A. The storage area kept the geomembrane clean and accessible. All GCL rolls were covered with visqueen for protection from moisture infiltration during rain events.

After the geomembrane rolls were unloaded, an inventory of the rolls was taken. This inventory is presented in Appendix J. Quality control (QC) data was submitted from the manufacturer and is presented in Appendix J. The GCL rolls were 15 feet wide and 150 feet long. The total surface area of GCL delivered to the site was 456,750 square feet. GCL rolls were transported from the storage area to the construction area using a wheel loader and spreader bar with Z-bar attachments.

6.2.2 Deployment Method and Panel Locations

The GCL was installed using a spreader bar assembly, which was fastened to the bucket of a wheel loader using a spreader bar with Z-bar attachments. This set-up allowed the loader to pick up and position the roll for deployment. The GCL was then pulled into place by hand. An RMT representative was on-site at all times during GCL deployment.

GCL membrane deployment began on the south slope of the landfill in conjunction with the geomembrane, which is discussed in Section 7. Any GCL deployed during a given work day was immediately covered with geomembrane. No GCL was left open to the elements at the end of each day. The GCL panels were positioned manually to provide the required 6-inch overlap. After the panels were manually positioned, a layer of sodium bentonite was placed between the layers of each seam at a rate of ¼ lb per linear foot of seam as recommended by the manufacturer. The overlaps were made with the upslope panel above the down-slope panel to create a shingle effect. The panel layout for the GCL is shown on Figure 5.

The installation of GCL began on August 20, 2000 and was completed on October 4, 2000. On the first day of GCL and HDPE installation, the GCL installer failed to place the sodium bentonite between the first 11 seams. On October 4, 2000, the installer cut the HDPE at each GCL seam and placed the sodium bentonite between the layers of GCL. The HDPE was then capped and repaired.

6.2.3 Anchor Trenches

The GCL panels were anchored in trenches along the east, west, and north berms of Phase 1A. The trenches were a minimum of 2 feet deep by 2 feet wide, and were excavated 4 feet from the inside top of slope of the east, west, and north berms. A backhoe was used to excavate the trenches.

Drawing Under Seperate Cover

Section 7

Section 7 Geomembrane Installation

7.1 Base Surface (Top of Prepared Subgrade) Preparation

Prior to deploying geomembrane panels, the prepared subgrade was graded smooth and examined for slope uniformity and general appearance. The subgrade was continually conditioned as deployment took place to repair areas affected by equipment traffic and precipitation. A Certificate of Acceptance of Subgrade was prepared by the geosynthetic installer, GSI for each day on which the geomembrane was deployed, indicating that the surface on which the geomembrane panels were deployed was acceptable. Subgrade acceptance forms are included as Appendix I.

7.2 Geomembrane Deployment

7.2.1 Geomembrane Unloading, Storage, and Transport

Forty two rolls (31 smooth and 11 textured) of 60-mil HDPE were delivered to the job site. The geomembrane rolls were delivered to the site on flatbed semi-trailer trucks. Rolls were removed from the trucks by attaching two nylon straps, which were placed around each roll at the factory, to a wheel loader. The geomembrane rolls were lifted off the trucks and temporarily placed in a material storage area located south of Phase 1A. The storage area kept the geomembrane clean and accessible.

After the geomembrane rolls were unloaded, an inventory of the rolls was taken. This inventory is presented in Appendix K. Textured and smooth rolls were both 23.5 feet wide and 480 feet long. The total surface area of geomembrane delivered to the site was 473,760 square feet. Geomembrane rolls were transported from the storage area to the construction area using a wheel loader and spreader bar with Z-bar attachments.

7.2.2 Deployment Method and Panel Locations

The 60-mil HDPE geomembrane was installed using a spreader bar assembly, which was fastened to the bucket of either a track or wheel loader using a spreader bar with Z-bar attachments. This set-up allowed the loader to pick up and position the roll for deployment. The 60-mil HDPE was then pulled into place using two balloon tired four wheelers. During deployment, the four wheelers were not permitted travel over previously deployed geomembrane. An RMT representative was on site at all times during geomembrane deployment, seaming, and testing.

Geomembrane deployment began on the south slope of the landfill, with textured panels deployed in a north-south direction parallel to the slope, progressing east. Deployment then moved to the east and west slopes, approximately halfway toward the north slope. Next, deployment moved to the bottom of the cell, where smooth panels were deployed south to north. When deployment on the bottom reached the previously deployed sidewalls, the side walls and bottom were deployed in unison until the liner reached the north slope. Deployment ended with the north slope of Phase 1A. Panel numbers indicate the order in which the panels were deployed, with panel P-1 being the first panel deployed and panel P-150 being the last panel deployed (see Figure 6). Prior to seaming the panels, the geomembrane panels were positioned manually to provide the required 4-inch overlap. After the panels were manually positioned, they were sandbagged to prevent the panels from being lifted and possibly damaged by the wind. The overlaps were made with the upslope panel above the down-slope panel to create a shingle effect.

As the panels were deployed, the panel number, roll number, length of panel, and date of deployment were written on each panel using a marking pen. Each panel was examined for damage and defects after deployment. Damaged or defective areas were marked and repaired. Geomembrane placement forms are included as Appendix L.

7.2.3 Anchor Trenches

The geomembrane panels were anchored in trenches along the east, west, and north berms of Phase 1A. The trenches were a minimum of 2 feet deep by 2 feet wide, and were excavated 4 feet from the inside top of slope of the east, west, and north berms. A backhoe was used to excavate the trenches.

The geomembrane panels were placed down along the inside sidewall of the trenches. Due to the potential for storm water to accumulate within the anchor trenches and potentially seep beneath the GCL, the trenches were backfilled shortly after geomembrane and the protective Geocushion™ were deployed. The trenches were backfilled with the clay, which was excavated from the trenches, in two lifts with each lift being compacted. The anchor trenches were typically backfilled early in the morning when the geomembrane was cool. This limited bridging at the toe-of-slope caused by the geomembrane contracting due to cooler overnight temperatures.

7.3 Geomembrane Seaming

7.3.1 Seaming Methods

Two methods of seaming/welding were used during geomembrane installation (the terms *seaming* and *welding* are used interchangeably throughout this report). The two seaming methods were the dual hot wedge process and the extrusion fillet process. The dual hot wedge process was used only for production welding of typically long straight seams. The extrusion fillet process was used for nonproduction welds (*i.e.*, repairs), and production seaming of the side slope panels to the bottom liner.

The dual hot wedge welders used by GSI consisted of a self-propelled unit containing a high-temperature dual wedge used to melt the geomembrane surfaces in contact with the wedge along the overlapped panels. The liner panels were then squeezed together by pressure rollers so that the two sheets fused together. The dual wedge produced two fusion weld lines called "tracks" that were separated by an unwelded channel. This unwelded channel was used to nondestructively test this type of seam.

The extrusion fillet welder consisted of a hand-held "gun" that melted the geomembrane panels along the overlap and extruded molten HDPE from the barrel of the gun to create a single homogeneous bond. This type of weld was nondestructively tested using the vacuum box method. Prior to making an extrusion fillet weld, the weld line along the overlap was bonded together by heat using a hot air gun called a leister, and the geomembrane surface was roughened using a grinder. The overlapped area was roughened approximately 0.5 to 0.75 inch on both sides of the seam centerline with a hand grinder to improve adhesion qualities of the extrusion weld.

7.3.2 Trial Seams

*Prior to performing seaming, production or nonproduction trial seams were made on scrap pieces of geomembrane to document that seaming conditions were adequate. Trial seams were made for each piece of welding equipment in use at the beginning of each seaming period and once for every 4 hours of use. The trial seam samples were typically 6-feet-long by 1-foot-wide, with the seam centered length-wise. The seam overlap was typically 4 inches wide. The trial seams were examined for squeeze out, foot pressure, and general appearance. Squeeze out refers to the amount of resin being pushed out of the seam, and foot pressure refers to the shape of the seam. Both are indications of excessive pressure being placed on the weld or of excessive welding temperatures.

Four 1-inch-wide specimens were cut from each end of the trial seam and subjected to field-testing. Field-testing included film-tear bond (FTB) tests in both peel and shear using a field tensiometer that qualitatively and quantitatively determines whether a seam passes or fails the test. Minimum acceptance specifications for shear strength and peel strength are as follows:

CHARACTERISTIC	SMOOTH	TEXTURED
Shear strength (ppi)	126	113 *
Shear elongation (%)	50	50
Peel strength - fusion (ppi)	90	82 *
Peel strength - extrusion (ppi)	78	70 *
Peel separation (%)	10	10

A test specimen passed or failed depending on the strength, failure location, and mode of failure. If a specimen broke or yielded beyond the test weld on either side, then the test was considered passing (*i.e.*, this indicated that the seam was stronger than the geomembrane panel itself). If a specimen failed by seam separation (seam peeling of greater than 10 percent) or breakage within the seam, then the specimen was considered a failure, and a new (second) trial seam was made using the same welding equipment and subjected to the same testing until passing tests were recorded.

A total of ~~68 trial~~ seam samples were prepared and field-tested. Of the 68 samples field tested, 68 samples passed testing. Appendix M contains trial seam information forms. After each trial seam test, the date, temperature ~~setting(s), gun~~ or welder number, name of operator, and trial seam identification number were written on the remaining portion of the sample.

7.3.3 Seaming Sequence

The first production seam, welded on August 20, 2000, was seam 1/2 between panels 1 and 2. The dual hot wedge process was used for this seam. Most of the production seams were produced with the dual hot wedge process. Appendix N summarizes the panels seamed, the seaming method, the seam length, the seamer's initials, the machine number, and the machine settings used to produce the seam.

As successive panels were deployed, seaming of the adjoining panels commenced immediately. Sandbags were used to hold the newly deployed panels in place so that the panels would not move and the proper overlap was maintained.

7.3.4 Seam Repairs

Non-production welds are those welds made for the repair of seams or the repair of geomembrane panels themselves. Most of the repair work was performed on the seams. Repair work on the seams normally was performed in conjunction with the nondestructive seam testing, cross seams, and destructive seam sampling. Repair work consisted typically of either a geomembrane patch placed over a section of defective seam, panel area, or destructive seam sample location, or the addition of a bead of extrudate to reconstruct a portion of an existing weld, repair a wrinkle, or reinforce an area of geomembrane that may have been creased during geomembrane handling and placement. RMT observed all repairs made on the geomembrane.

A patch or cap consisted of a piece of geomembrane with rounded corners that extended a minimum of 6 inches beyond the edge of the defect. The patches and caps were welded to the underlying geomembrane panels after leistering and grinding.

Occasionally, overlapping panels would not lie flat on top of one another. Under these circumstances, small wrinkles termed "fish mouths" would occur as the seam was welded, causing the seam to be discontinuous over a short distance, typically 6 to 12 inches. In these cases, the wrinkles were removed by cutting the geomembrane along the ridge of the wrinkle, overlapping the cut portion, placing patches at each end of the wrinkle where the overlap was insufficient, and extrusion-welding the patches and the wrinkle overlap.

A total of 276 repairs were required, including the repairs for the 42 destructive samples. Seam and panel repairs were logged, and this documentation can be found in Appendix O.

7.4 Field Seam Testing

7.4.1 Nondestructive Seam Testing Methods

Production and non-production field seams were tested nondestructively using either air pressure testing and vacuum box testing to determine the continuity of the seams. A total of 317 air pressure tests and vacuum tests were performed. All of these tests passed.

Nondestructive testing does not provide information on the strength of the seams. Seam strengths were determined by laboratory destructive testing methods on destructive seam samples. The air pressure testing method was used for dual hot wedge seams, while the vacuum box method was used for extrusion fillet weld seams.

Appendix P contains nondestructive air testing logs for production seams, while Appendix O contains vacuum test logs for geomembrane repairs.

Prior to performing air pressure testing on a given dual hot wedge seam, the seam was examined visually for obvious defects that would result in a failing air pressure test. The defective seam areas were marked with a paint-based marker to indicate that a repair was required. Air pressure testing was then performed on shortened seam sections between two defective seam areas or between the end of a seam and a defective seam area.

The air pressure test procedure used by GSI, in accordance with the specifications, was as follows:

1. Seal both ends of the air channel of the test seam.
2. Insert the pressure gauge/needle assembly at one end of the test seam.
3. Apply air pressure generally between 25 to 30 pounds per square inch gauge (psig) into the air channel with an air pump.
4. Allow 2 or more minutes for the air pressure to stabilize before testing.
5. Sustain the pressure for an additional 5 minutes.
6. After the 5 minutes, if pressure loss exceeds 2 psig, then the seam fails and the leak must be located, repaired, and vacuum tested. The remaining portion(s) of the original seam is retested until passing results are obtained over the entire seam length.
7. If pressure loss does not exceed 2 psig, then the seam passes.

At the conclusion of a passing test, the end of the tested seam opposite the pressure gauge was cut to observe an immediate drop in pressure. This was performed to demonstrate that the entire tested seam length was under pressure and that there were no blockages.

If several defects were located relatively close together, or if a difficulty was encountered in pinpointing the leak, then the installer often chose to cap, patch, or extrusion weld the seam. The repair was then vacuum tested.

The vacuum box consisted of a five-sided box with a clear glass top and an open bottom. A pliable gasket was attached around the bottom of the box. The vacuum box was attached to a portable vacuum pump from which the vacuum was drawn.

To perform the test, a solution of soapy water was applied incrementally on the section of seam to be tested. The vacuum box was then placed over the wetted area, and a tight seal was created by turning on the vacuum pump and pressing down on the top of the vacuum box. The seam was examined through the clear top for the presence of soap bubbles for a minimum of 10 seconds. If no bubbles appeared, then the box was moved to the next adjoining area with a minimum overlap of 3 inches. If bubbles did appear, then the location was marked and the area was repaired and retested.

7.4.2 Destructive Seam Testing Methods

Field destructive seam testing was performed to determine the strength of the seam in both shear and peel failure methods. The specifications required that destructive seam samples be collected on an average frequency of one test location per 500 linear feet of production seam.

The total length of production fusion seam was approximately 21,890 feet. The seam lengths were measured to an intersecting seam or to the end of the panel. There were also approximately 2,180 of production extrusion seams for the primary liner.

For this installation, 42 destructive seam samples were collected. Sampling locations were determined by RMT personnel after a seam had been welded. Typically, the location of a destructive seam sample was selected because the location prompted suspicion of excess crystallinity, contamination, offset welds, or other potential causes of a defective seam.

The size of the destructive seam samples was typically 24 inches wide by 48 inches long. The destructive samples were cut from the liner by the geomembrane installer.

A specimen approximately 18 inches long by 12 inches wide was cut from each original sample and sent to RMT's laboratory for testing. A 12 inch wide by 12 inch long sample was submitted to Weyerhaeuser for archive purposes. The remaining sample was kept by the installer for QC testing. Three 1-inch samples were cut from each end of the original sample and subjected in the field to film tear bond tests in both peel and shear using a field tensiometer as described for trial seam testing above.

All of the 42 destructive samples passed laboratory testing. Appendix Q contains laboratory destructive seam test logs.

FUSION 21,890 / 500 = 43.78 = (44)

(1) ?

EXTRUSION 2180 / 500 = 4.36 = 4 TOTAL: 48 42 X

7.5 Laboratory Testing Results

Two laboratory testing programs were conducted on the geomembrane described in this report. The two testing programs were performed in accordance with the geomembrane specifications as follows:

- Resin and roll testing (conformance testing)
- Destructive seam testing

7.5.1 Conformance Testing

Resin tests were performed by Chevron/Phillips Chemical Company (Phillips), the resin manufacturer, for each of the material batches, and were forwarded to GSE for submittal. Each of the test results submitted by Phillips met the testing requirements outlined in the geomembrane specifications. Copies of the submittals can be found in Appendix S.

Conformance roll testing was performed by GSE on every roll of geomembrane delivered to the site. Conformance testing included testing for carbon black content, carbon black dispersion, and density was conducted at a frequency of one test per 2,100 square feet of geomembrane material delivered to the site. In addition, testing for tear resistance, puncture resistance, dimensional stability, and tensile properties was conducted on every roll of geomembrane delivered to the site. Testing for environmental stress cracking was conducted at a minimum frequency of one test per truckload of geomembrane material delivered to the site. The frequency of conformance testing and the test results met the frequencies and minimum values specified in the geomembrane specifications. Conformance testing of the 60-mil smooth and textured geomembrane was also performed by Geotesting Express, Inc., an independent laboratory. Results are summarized in Table 6, and data are provided in Appendix R.

7.5.2 Destructive Seam Testing and Trial Seam Testing

Laboratory destructive seam testing was performed by RMT in accordance with the technical specifications and the CQAP. The results of laboratory destructive seam tests are included as Appendix S. Minimum acceptance specifications for shear strength and peel strength are shown in Subsection 6.3.2. All destructive seam samples exceeded the minimum acceptance requirements.

Table 6
Geomembrane Conformance Test Results

PROPERTY	UNITS	TYPE OF CRITERION	ACCEPTABLE VALUE[1]	ROLL #114107538 TEXTURED	ROLL #115116285 SMOOTH
Carbon Black Content	% by weight	Range	2 - 3	2.52 - 2.64	2.41 - 2.45
Carbon Black Dispersion	NA	Range	Category 1, 2, or 3[2]	Category 1	Category 1
Density	g/cc	Minimum	0.940	0.942	0.944
Tear Resistance[3]	lb	Minimum	42	54.4	55.1
Puncture Resistance	lb	Minimum	90	139.3	133.9
Tensile Properties[4]					
Yield Stress	ppi	Minimum	126	126.2	130.8
Yield Elongation	%	Minimum	12	17.7	17.4
Break Stress	ppi	Minimum	228 (90)[4]	253.9	230.4
Break Elongation	%	Minimum	700 (100)	743.8	735.9
SP-NCTL	hours	Minimum	200		
Thickness (lowest individual) [5]	mils	Minimum	54 (51) [6]	61.0	65.0
Thickness (minimum average)	mils	Average	60	65.1	67.2

(1) Values from Tables 1a and 2a of GRI-GM 13 Standards.
(2) Eight of 10 views Category 1 or 2, and 10 of 10 views Category 1, 2, or 3.
(3) Test performed in both machine and cross direction.
(4) Parenthetical values are for textured geomembrane.
(5) For smooth geomembrane, lowest individual value of 10 values; for textured geomembrane, lowest individual value for 8 of 10 values.
(6) For textured geomembrane, lowest individual value for any of the 10 values.

Drawing Under Seperate Cover

Section 8

RMT

Section 8
Geotextile Installation

8.1 Geotextile Unloading, Storage, and Transport

Rolls of 32 oz. geotextile were delivered to the job site on enclosed trailers manufactured and supplied by GSE. The rolls were removed from the trailer with a wheel loader and placed in a flat well drained area south of Phase 1A. The rolls were delivered wrapped in a plastic covering to keep them clean and dry.

All of the rolls delivered to the site were 14.0 feet in width and 150 feet in length, and were transferred to the deployment area using a wheel loader. All geotextile rolls were visually inspected for damage as they were brought to the deployment area.

Appendix T includes geotextile submittals as provided by GSE.

8.2 Deployment Method and Panel Locations

GSI was retained by Ryan Consolidated Central as the installation contractor for the geotextile. The geotextile was deployed by manually pulling the material down the slope and rolling the material out along the bottom of the landfill.

Deployment of the geotextile began on September 8, 1997, and was completed October 4, 2000. Panel deployment began on the south slope and progressed along the east slope, west slope, and bottom to the north end of the landfill. Approximately 456,750 square feet of geotextile were installed. Deployment ended with the north slope of Phase 1A.

8.3 Geotextile Seaming

Geotextile panels were bonded together by heat using a duel wedge welding machine. As indicated in the specifications, there were no testing requirements for geotextile seaming. RMT visually inspected the panels and seams and identified no problems during seaming.

RMT

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Transmittal Letter

To:	Mr. Jim Barber NC DENR - Division of Waste Management; Solid Waste Section 1646 Mail Service Center Raleigh, NC 27699-1649	**Date:**	12/01/00
		Project No.:	00-05101.18
		Subject:	Weyerhaeuser Landfill No. 3 Plymouth, North Carolina
Prepared By:	Kent Nilsson, P.E.	**Title**	Project Manager
Signature:	[signature]		

We are sending you:

☒Report and Drawings

COPIES	DATE	NO.	DESCRIPTION
1	11/30/00	Module 2	Construction Documentation Report for the New Landfill No. 3 - Phase 1A, Volumes I and II – Module 2
1	11/30/00	Rev. 1	Record Drawings

These items are transmitted as checked below:

☒For approval

Remarks

Jim-

Attached for your review and approval is Module 2 of the above referenced report which documents construction of the leachate collection system and other remaining elements [Sections 9 and 10, Photographs 23 – 34 to be inserted into Appendix C (pages 16 – 24), and Appendix U].

Also included with this submittal (being sent under separate cover) is a complete set of Record Drawings.

We are also enclosing replacement pages, as follows, for Module 1 of the report:

- Table of Contents (Volume I, pages i through iv)
- Certification pages (Section 1, pages 1 and 2)
- Figure 4 - Top of Prepared Subgrade Elevations (Section 5, page 20)

As we have discussed on the telephone, Weyerhaeuser would like to have a Permit to Operate in hand by December 4th, so anything you can do to expedite your review would be greatly appreciated. Please call me with any comments (864/281-0030). Thanks.

Rec'D 4 DEC. 2000

MODULE 2 BEGINS

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Section 1 Certifications

1.1 Report and Plan Set Certification

I, R. Kent Nilsson, hereby certify that I am a registered professional engineer in the State of North Carolina; that the construction related to Phase 1A at the Weyerhaeuser Landfill #3 was completed in substantial conformance to the approved Construction Plan Application (CPA), dated September 1999, the Construction Quality Assurance Plan (CQAP) contained in that document, the requirements of Subchapter 13B of the North Carolina Administrative Code (15 NCAC), and generally accepted engineering practices. To the best of my knowledge, all information contained in this document was prepared in compliance with all applicable North Carolina Department of Environment and Natural Resources (NC DENR) requirements.

Signature ____________ R. Kent Nilsson, P.E.
Print Name

1.2 Prepared Subgrade and Low Permeability Soil Certification

I, R. Kent Nilsson, certify that, to the best of my knowledge, information, and belief, the prepared subgrade and low permeability soil components of the liner was constructed in conformance with the approved plans and all applicable solid waste administrative code requirements. This certification shall not be construed to be either an implied or expressed guarantee or warranty regarding the performance of the construction documented in this report. This certification applies to each of the following components of construction:

- The quality of clay material used and the methods utilized in its placement
- Preparation of anchor trenches
- Preparation of the upper portions of the prepared subgrade and low permeability components of the composite liner

The details of construction for each of these components are further described in Section 5, Prepared Subgrade and Low Permeability Soil Construction of Phase 1A section of this report. This certification is based on personal observations, communications with the full-time RMT site representative, field and laboratory test results, record surveys, photographs, and the daily construction reports.

Signature ____________ R. Kent Nilsson, P.E.
Print Name

1.3 Geosynthetic Liner Certification

I, R. Kent Nilsson, certify that, to the best of my knowledge, information, and belief, the geosynthetic liner was constructed in conformance with the approved plans and all applicable solid waste administrative code requirements. Any observed deviations are as noted in Section 2.

This certification shall not be construed to be either an implied or expressed guarantee or warranty regarding the performance of the construction documented in this report. This certification applies to each of the following components of construction:

- Placement of geomembrane in anchor trenches, and other irregularly shaped areas
- Removal of geomembrane wrinkles

The details of construction for each of these components are further described in Section 6. This certification is based on personal observations, communications with the full-time RMT site representative, field and laboratory test results, manufacturer's information, photographs, and the daily construction reports.

Signature	R. Kent Nilsson, P.E. Print Name

Drawing Under Seperate Cover

RMT

Section 9
Leachate Collection System Construction

9.1 Granular Drainage Blanket

The select granular drainage blanket consists of two components: a 1-foot aggregate layer of North Carolina Department of Transportation (DOT) No. 67 stone having a minimum permeability of 1 cm/sec, and a 6-inch granular layer having a minimum permeability of 1.0 x 10^{-3} cm/sec. Both materials consist of clean, debris-free natural materials obtained from the Wakestone Corporation-Nash County Quarry located in Knightsdale, North Carolina. Approximately 18,000 cubic yards of No. 67 stone and 9,000 cubic yards of sand were placed during construction.

The aggregate fill (gravel) material was placed on the floor and side-slopes of Phase 1A. Temporary marking posts with one-foot and 18-inch increments were located on an approximate 50-foot by 50-foot grid within the footprint of the cell. The No. 67 Stone (aggregate) was then placed by dumping the material in bulk to create a 4-foot thick access road within the landfill. This 4-foot thick access road allowed heavy equipment to haul the stone inside the landfill without putting unacceptable stress on the geomembrane. The stone was then spread to a uniform thickness of 12 inches on the floor, sidewalls, and over the south interim levee using CAT D-6 and D-3 low ground pressure (LGP) bulldozers. The granular fill (sand) was placed on the floor and 5 foot up the side walls on the north, east, and west sides using the same placement techniques and the No. 67 stone. As waste levels in the cell rise, the sand will be further extended up the slopes as a part of landfill operations.

On a site visit during placement of the No. 67 stone, Mr. Jim Barber of NC DENR expressed concerns about some minor trampolining of the geomembrane at the toe of slope on the west berm of the landfill. In one area, this problem was sufficiently addressed by waiting for warmer ambient temperatures to expand the geomembrane until it again conformed to the subgrade prior to placement of stone. In another area, it was necessary to re-excavate the anchor trench in this area to allow the geomembrane to relax to conform the slope contours.

Laboratory testing was performed on the No. 67 stone and the sand at a frequency of one sieve analysis for every 1,000 cubic yards. A constant head permeability was performed on the No. 67 stone and the sand at a rate of one test for every 2,500 cubic yards. Results of these tests are shown on Tables 7 through 10. Appendix U contains laboratory results for the drainage layer materials. Although the grain-size analyses indicated that some samples of the No. 67 stone and sand were slightly finer than specified in the No. 4 and No. 8 sieve size, permeability test data indicate the material has suitable hydraulic conductivity properties. Gradations are still acceptable for providing drainage media filtration.

McKim and Creed surveyed top-of-gravel elevations and top-of-sand elevations on a 50-foot by 50-foot grid within the footprint of Phase 1A. This grid matches the grid used for verifying the subgrade and prepared subgrade thickness. Allowing for some imprecision in locating the top and toe of slopes for each layer, these surveys indicate that the appropriate sand and gravel thickness had been achieved. Results of these surveys are shown on Figure 7 and Figure 8.

9.2 Collection Piping

The leachate collection system consists of perforated 6-inch–diameter HDPE pipe, perforated 18-inch-diameter, and solid 18-inch diameter SDR 17 - HDPE pipe. The 6-inch perforated pipe runs along the toe-of-slope at the north, east, and west berms of the landfill. The 18-inch perforated and solid pipe runs from the collection sumps to the collection manholes. Clean-outs are located at the ends of all 6-inch perforated HDPE pipe runs and extend 2 to 3 feet above the tope of slope (see Drawing 510108-C04).

The perforations in the collection pipe are in two rows, 0.5 inch in diameter, spaced at 6 inches on center. The rows are parallel to the axis of the pipe and 90 degrees apart. The pipe was placed 3 inches above the floor of the landfill with the holes facing down (see Drawing 510108-C07). Pipe joints were made by a certified HDPE welder using butt-fusion techniques for HDPE pipe. The connection between the 18-inch solid pipe and the leachate collection manholes are made with bolted flange connections.

9.3 Leachate Pumping and Force Main System

The leachate force main system consists of the following:

- Four 3-inch pumps supplied and installed by Leachator Pumps, Inc. (see Drawing 7055202-C15) (The pump assemblies included flexible discharge hoses, retrieval cables, pressure gases, transducers and instrumentation panels.)
- Two 48-inch diameter HDPE manholes
- 3-inch HDPE transfer pipe in a 6-inch HDPE carrier pipe
- 6-inch HDPE force main pipe in a 10-inch HDPE carrier pipe

Installation of the double-walled 6-inch HDPE force main began at the leachate collection sump located at the sludge processing building and progressed toward Phase 1A along the edge of the landfill access road toward the leachate collection manhole on the west berm. The force main installation then proceeded along the north berm to the second leachate collection manhole on the east berm and terminated at the southern end of the east berm (see Drawing

510108-C04). A blind flange connection was put at the end of the line for future connection to Phase 1B. The force main pipe was installed a minimum of 3 feet below final grade. The leachate force main line was placed on a minimum 4-inch bed of granular fill and connected to the manholes. These features were installed as shown on Drawing 510108-C07.

As discussed in Subsection 2.4 Design Modifications, the manufacturer of the HDPE pipe did not recommend using 45 degree "Y" connections between the leachate connection manholes and the double-walled 6-inch force main due to the high pressure testing requirements for the HDPE force main. A "T" connection was used instead.

The leachate main line was tested for leaks using the following method:

- The manholes and leachate sump outfall were plugged.
- The leachate force main pipe was filled with water.
- Air was removed from the pipe.
- The pipe was then pressurized to 90 psi and held.
- RMT personnel monitored the pressure for 3 hours for any loss of pressure in the pipe.
- The pressure was then dropped to 80 psi and monitored for an additional hour.

No leaks were detected in the leachate main line using this procedure.

Table 7
Grain Size Analysis of NC DOT No. 67 Aggregate in the Leachate Collection Layer

SAMPLE NO.	PERCENTAGE PASSING					
SIEVE SIZE	1 INCH	¾ INCH	⅜ INCH	NO. 4	NO. 8	NO. 200
NC DOT SPECIFICATION	100	90 TO 100	20 TO 55	0 TO 10	0 TO 5	0 TO 0.6
RS-1	100	92	28.5	7	0.3	0.1
RS-4	100	94.6	41.8	17.4	8.5	0.3
RS-5	100	92.7	36.1	14.1	7.8	0.6
RS-6	100	93.8	30.2	10.2	3.9	0.4
RS-7	100	94.5	33.4	12.2	6.7	0.5
RS-8	100	96.3	40.6	13.1	5.5	0.3
RS-9	100	94.1	40.1	14.0	7.0	0.5
RS-10	100	94.3	38.5	14.4	9.0	0.6
RS-11	100	93.1	35.3	16.6	6.7	0.6
RS-12	100	96.6	44.1	6.4	3.0	0.6
RS-13	100	94.5	23.8	2.6	1.0	0.3
RS-14	100	92.3	38.7	12.2	4.0	0.5
RS-15	100	95.8	44.2	15.4	5.2	0.3
RS-16	100	90.1	36.0	12.3	7.6	1.0
RS-17	100	94.0	55.2	15.0	4.9	0.4
RS-18	100	94.0	55.2	15.0	4.9	0.4

Shading indicates deviation from specification.

Table 8
Grain Size Analysis of Sand in the Leachate Collection Layer

SAMPLE NO.	PERCENTAGE PASSING					
SIEVE SIZE	NO. 4	NO. 10	NO. 20	NO. 40	NO. 60	NO. 200
SAND SPECIFICATION	85-100	62 TO 90	0 TO 70	0 TO 32	0 TO 23	0 TO 5
1	98.0	94.0	76.0	46.0	22.0	1.4
3	98.9	92.6	64.1	37.2	14.9	2.0
4	98.3	92.3	68.0	42.9	19.7	1.2
5	98.5	93.0	68.6	42.3	17.8	2.0
6	99.7	95.5	70.4	42.2	18.1	2.3
10	99.5	95.6	65.3	35.3	14.0	1.4
11	99.9	97.0	71.2	40.6	16.5	1.5
12	99.0	94.8	73.1	47.7	22.7	1.6

Shading indicates deviation from specification.

Table 9
Permeability Results of NC DOT No. 67 Aggregate in the Leachate Collection Layer

SAMPLE NO.	MINIMUM ACCEPTABLE PERMEABILITY (cm/sec)	PERMEABILITY RESULTS (cm/sec)
RS-19	1	2.2
RS-20	1	2.2
RS-21	1	2.1
RS-22	1	2.1
RS-23	1	2.1
RS-24	1	2.1
RS-25	1	2.1
RS-26	1	2.1

Table 10
Permeability Results of Sand in the Leachate Collection Layer

SAMPLE NO.	MINIMUM ACCEPTABLE PERMEABILITY (cm/sec)	PERMEABILITY RESULTS (cm/sec)
SS-1	1×10^{-3}	3.1×10^{-3}
SS-2	1×10^{-3}	3.2×10^{-3}
SS-3	1×10^{-3}	3.3×10^{-3}
SS-10	1×10^{-3}	3.4×10^{-3}
SS-11	1×10^{-3}	2.9×10^{-3}
SS-12	1×10^{-3}	2.5×10^{-3}

Drawing Under Seperate Cover

RMT

Section 10
Miscellaneous Site Construction

10.1 Erosion Control

Erosion and sedimentation control measures were implemented in accordance with the approved *Erosion and Sedimentation Control Plan for On-site Industrial Waste Landfill No. 3,* dated April 2000. Erosion control during construction included the placement of silt fence around most of the perimeter of the construction site. Silt fence was also installed north of the topsoil stockpile (at the northeast corner of the site), at the inlet to the cross-culvert, and south of the access road to protect the wetlands south of the site. Various other locations were protected with silt fence when construction practices were warranted.

During the construction period, rock check dams, erosion mat, and silt fence were used to control erosion during topsoil fine grading, seeding, and construction of the drainage swale.

10.2 Drainage Swales

Earthen drainage swales were installed on the south , west, and north sides of Phase 1A and along the landfill access road. The swales were constructed as shown on Drawing 510108-C03. The swales collect runoff from the southern portion of the landfill area.

10.3 Level Spreader and Emergency Spillway

A level spreader was constructed at the outfall of Sedimentation Pond #3. This level spreader controls the velocity of storm water leaving the site. An Enkamat Type 7010 was installed on the bottom and sidewall of the level spreader to control erosion. An emergency spillway was also constructed at the northeast corner of the sedimentation pond. The level spreader and emergency spillway were constructed as shown on Drawing 510108-C11.

10.4 Riprap Installation

Riprap was installed in various drainage areas along the outside of the perimeter berms and along the access road. These riprap areas were installed in locations that expect large volumes of water during rainstorm events. The riprap was installed as shown on Drawing 510108-C11.

10.5 Access Road Construction

A gravel access road was constructed between the sludge processing building and around Phase 1. The road was constructed using a geotextile overlain by 8 inches of aggregate base course as shown on Drawing 510108-C06.

10.6 Reinforced Concrete and Corrugated Metal Pipe

Reinforced concrete and corrugated metal pipe was installed at locations shown on Drawing 510108-C03. Concrete headwalls were installed at the inlet and outfall of the pipes as shown on Drawing 510108-C09.

10.7 Electrical Installation

A three phase electrical line was installed along the same route as the leachate force main to each leachate collection manhole. A licensed electrical contractor installed the electrical portion of the project in accordance with Drawing 510108-E01.

Photograph 21. Butt fuse welding of 18-inch diameter riser pipe.

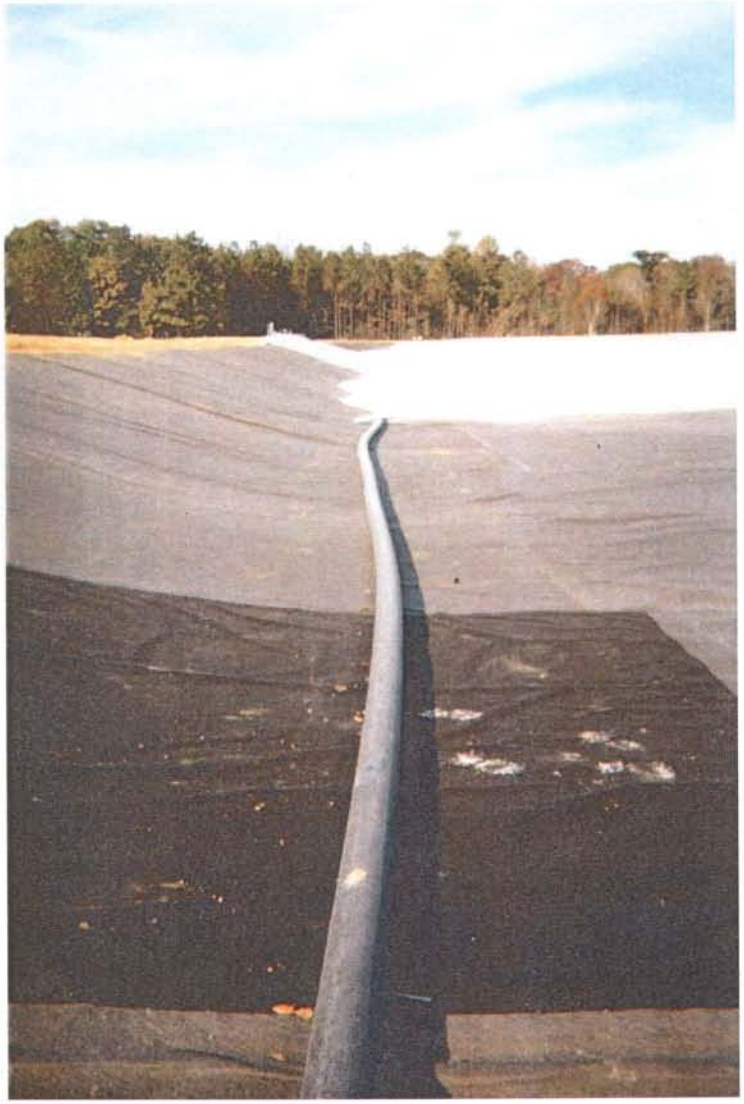
Photograph 22. Leachate force main installation along east perimeter berm.

Photograph 23. Tee connection from leachate force main to HDPE manhole.

Photograph 24. Leachate collection system manhole with 18-inch riser pipes from sump.

Photograph 25. Fittings within the leachate collection system manhole.

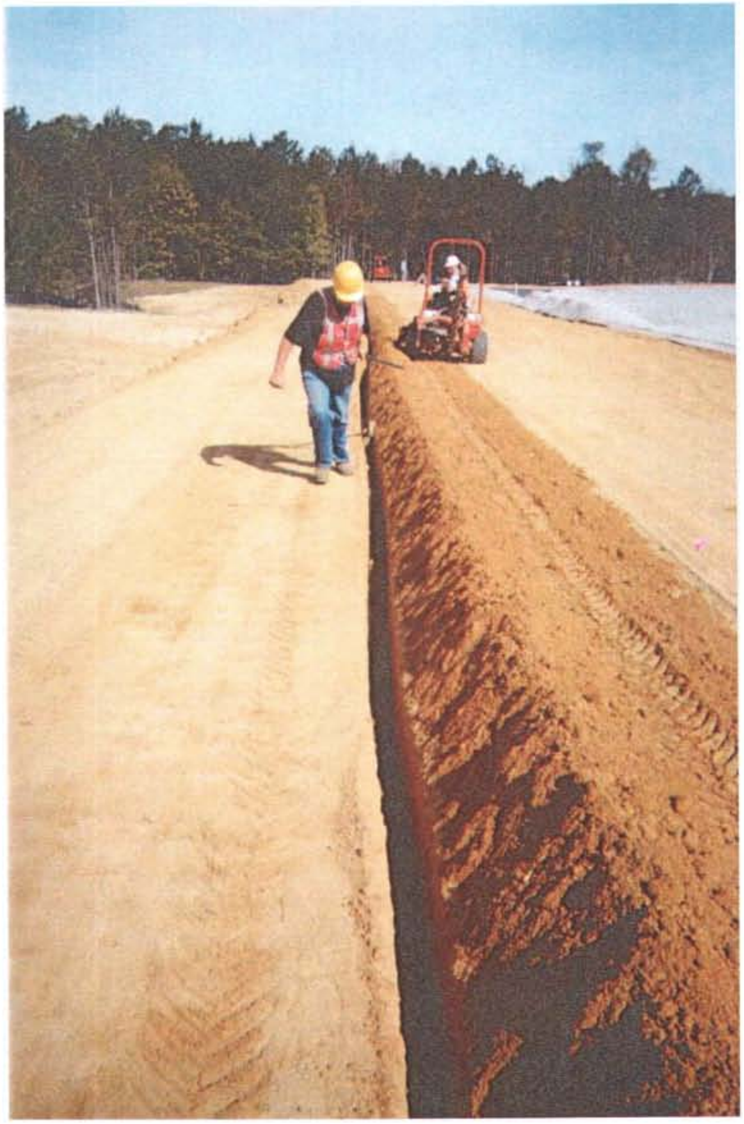
Photograph 26. Placement of gravel drainage layer over the completed liner system and Geocushion™.



Photograph 27. Perforated HDPE leachate collection pipe along west side of cell.

Photograph 28. Bedding of leachate collection. Protective layer of plywood visible on top of slope at future cap splice location.

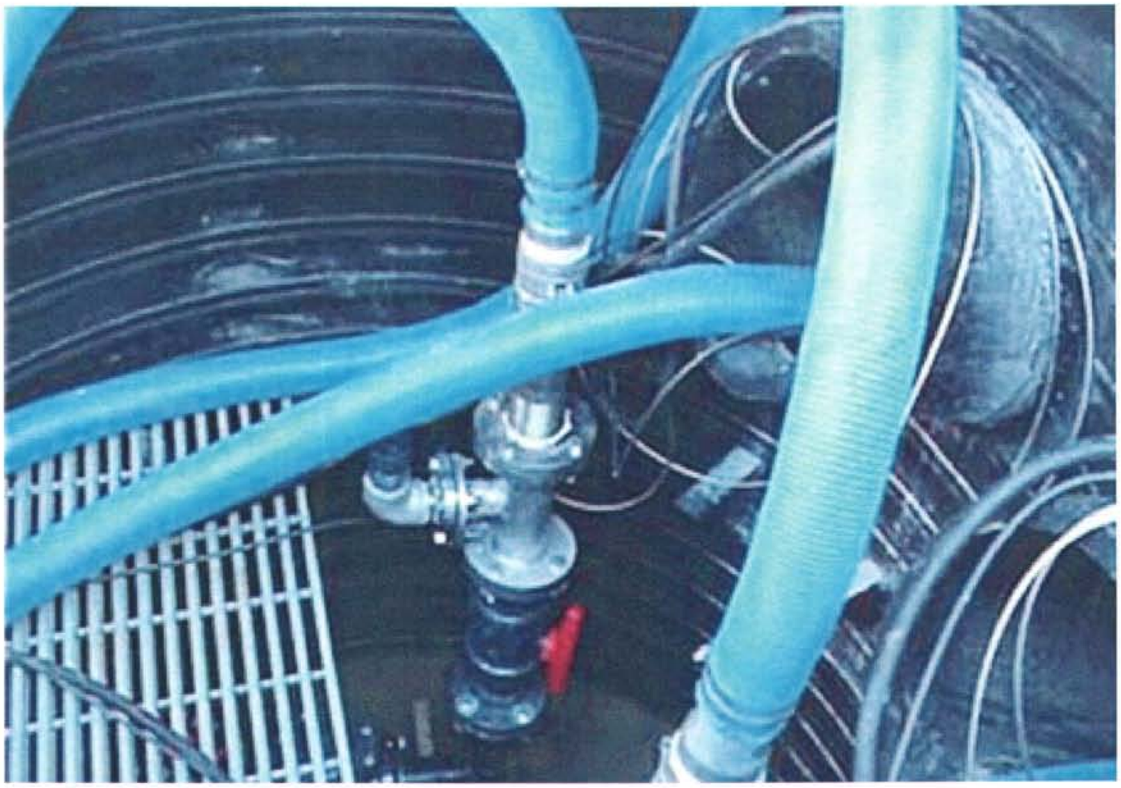
Photograph 29. Survey marker for placement of stone and sand layers in the leachate collection system.



Photograph 30. Placement of electrical cable feed to leachate pumps.

Photograph 31. Haul road for sand placement into cell interior. Conveyer visible in the background.

Photograph 32. HDPE leachate pump manhole with riser pipes and electrical box.



Photograph 33. Flexible hose, cables, and fittings for leachate pump.

Photograph 34. Overview of completed cell with sand and gravel layers in place. Top soil has been placed on slope surfaces that will be seeded.

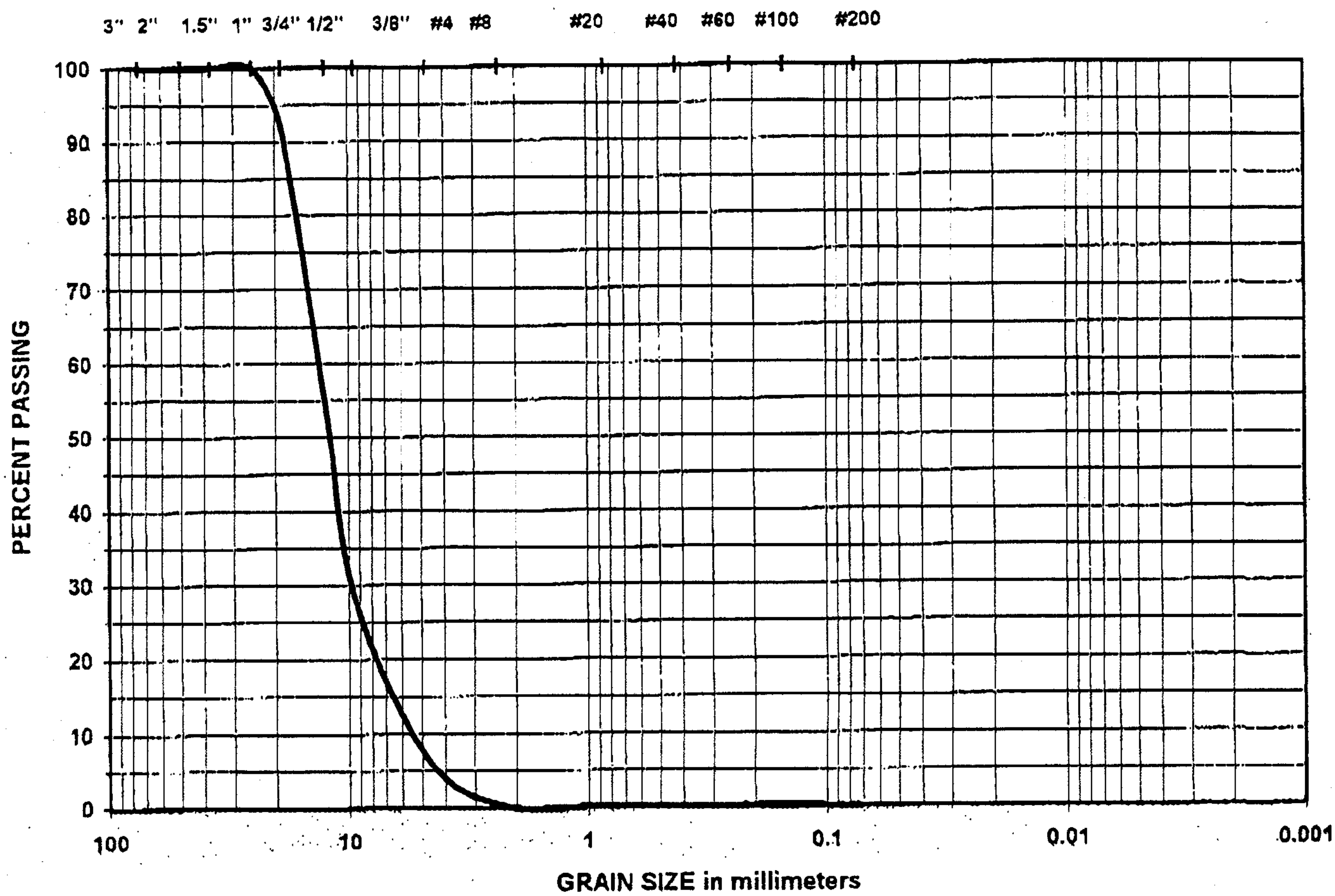
Appendix U
Drainage Layer Materials Laboratory Results

GRAIN SIZE DATA SHEET

Project Name: RTM Lab Service

S&ME Project Number: 1053-00-211

GRAIN SIZE DISTRIBUTION CURVE



Sample No.: 1
Type Material: #67
Station No.: N/A

Date Tested. 7/17/00
Tested By: B. Thompson
Checked By: M. Krajan

SIEVE ANALYSIS DATA: ASTM C-136/117

Sieve #	Percent Passing	Spec. Limit NCDOT 1005-1
2"	100	100
1 1/2"	100	100
1"	100	100
3/4"	92.0	90-100
3/8"	28.5	20-55
#4	7	0-10
#8	0.3	0-5
#200	0.1	0-.6

S&ME, Inc., 3100 Spring Forest Road, Raleigh, North Carolina 27604, (919) 872-2660, Fax (919) 790-9827

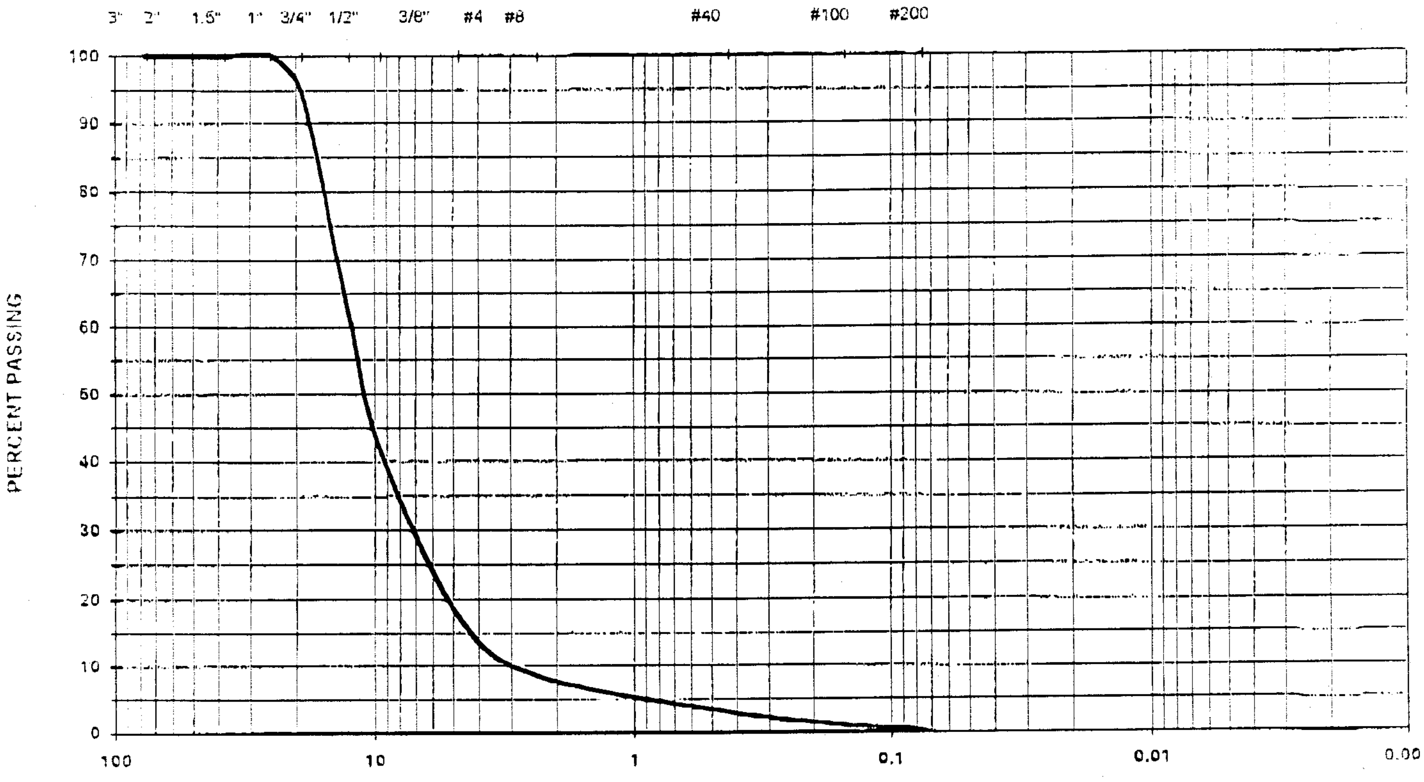
S&ME

GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211

GRAIN SIZE DISTRIBUTION CURVE



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #67

Quarry:

Field Samle No: RS-4

S&ME Sample No: 4

Source:

SIEVE ANALYSIS: ASTM C-136							
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200
Wt. Retained (grs):	0	218.1	2354.1	3343.7	3704.7	4000.0	4035
Percent Retained	0.0	5.4	58.2	82.6	91.5	98.8	99.7
Percent Passing	100.0	94.6	41.8	17.4	8.5	1.2	0.3
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6

Materials Finer Than 0.075 mm ASTM C-117	
Percent Loss	0.3

Tested By: BT | Drawn By: MK | Checked By: MK | Date Tested: 10/2/00

3109 Srping Forest Road Raleigh, North Carolina 27658 Tel 919-872-2660 Fax 919-876-3958

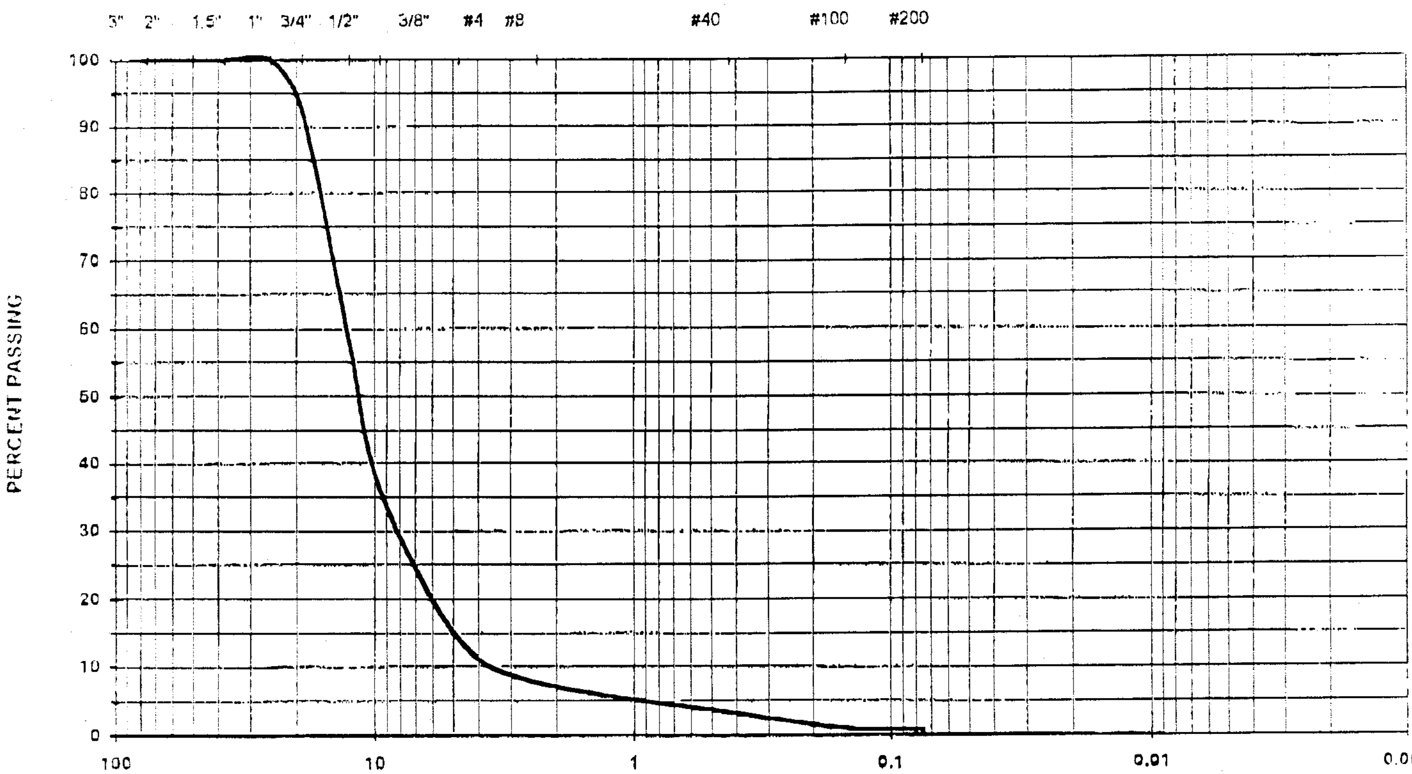
S&ME

GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211

GRAIN SIZE DISTRIBUTION CURVE



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #67

Quarry:

Field Samle No.: RS-5

S&ME Sample No. 5

Source.

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm ASTM C-117	
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200		
Wt. Retained (grs):	0	299.7	2635.5	3542.2	3803.6	4092.0	4100.5	Percent	
Percent Retained	0.0	7.3	63.9	85.9	92.2	99.2	99.4	Loss	0.5
Percent Passing	100.0	92.7	36.1	14.1	7.8	0.8	0.6		
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6		

Tested By: BT | Drawn By: MK | Checked By: MK | Date Tested: 10/2/00

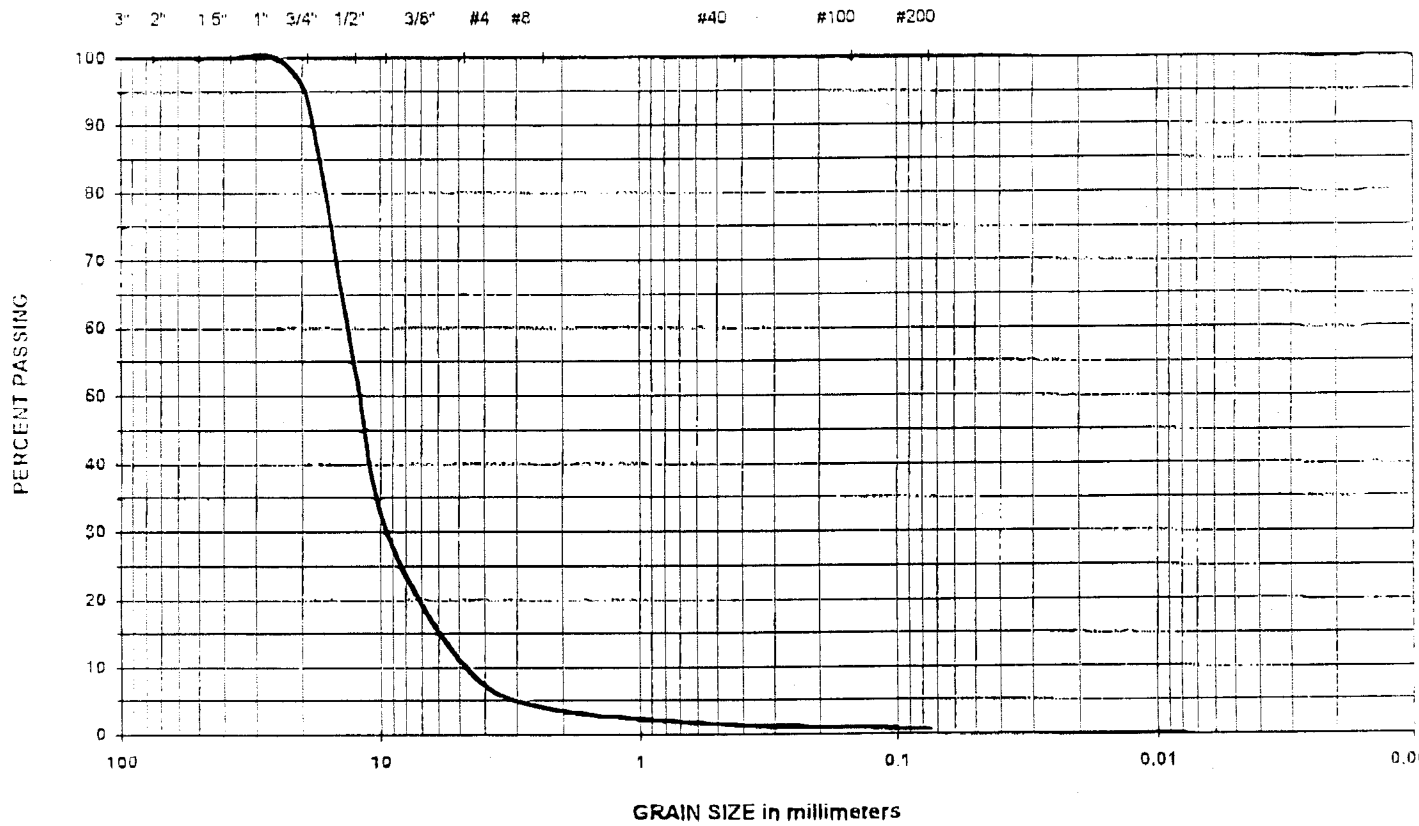
S&ME

GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211

GRAIN SIZE DISTRIBUTION CURVE



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #57

Quarry:

Field Samle No.: RS-6

S&ME Sample No: 6

Source:

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm	
Sieve No: (In)	1	3/4	3/8	#4	#8	#100	#200	ASTM C-117	
Wt. Retained (grs):	0	360.9	4058.9	5225.3	5592.1	5777.7	5797.7	Percent	
Percent Retained	0.0	6.2	69.8	89.8	96.1	99.3	99.6	Loss	0.4
Percent Passing	100.0	93.8	30.2	10.2	3.9	0.7	0.4		
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6		

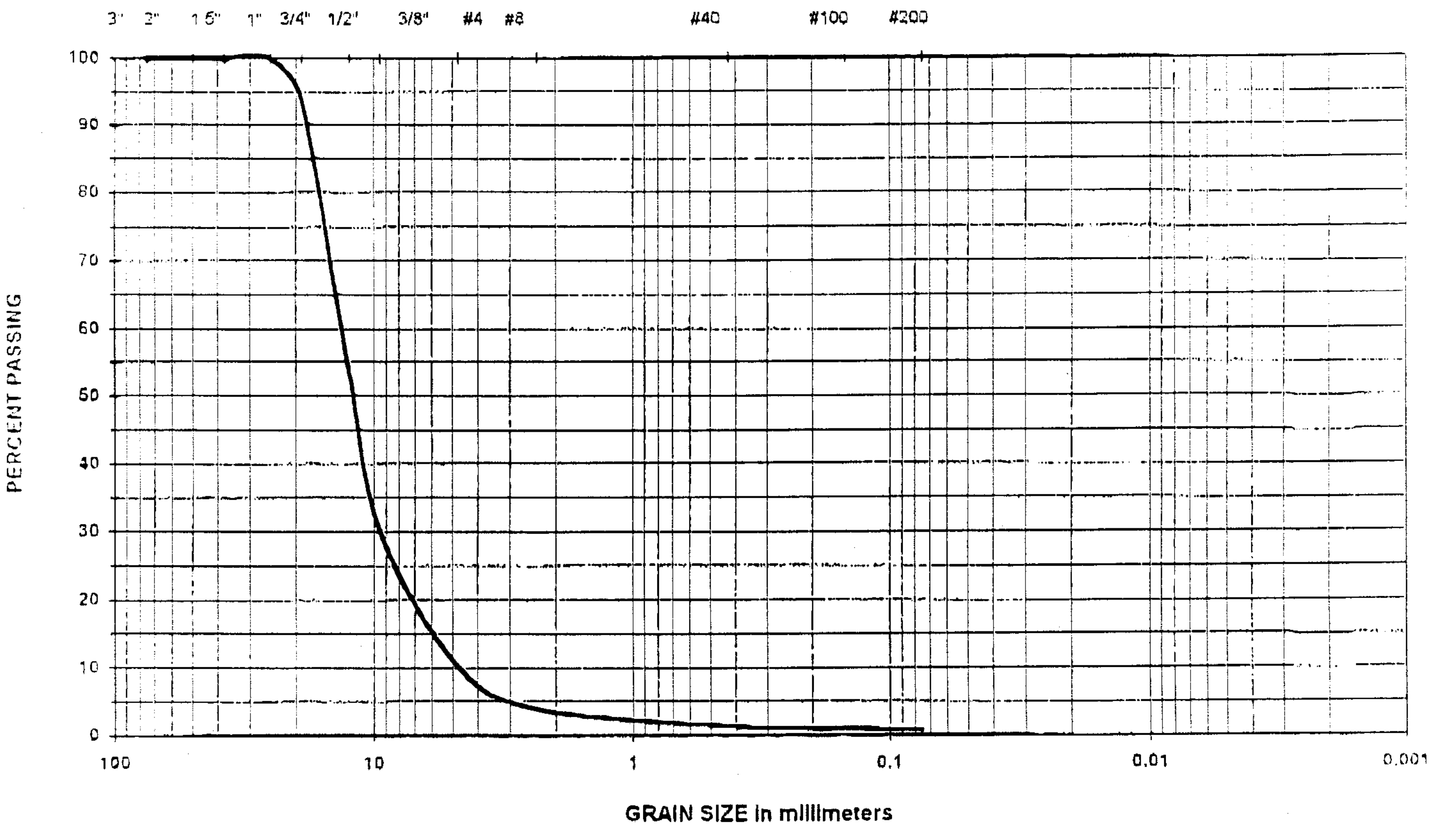
Tested By: BT | Drawn By: MK | Checked By: MK | Date Tested: 10/2/00

S&ME

GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #57 Field Samle No.: RS-7 Source:

Quarry: S&ME Sample No.: 7

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm	
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200	ASTM C-117	
Wt. Retained (grs):	0	219.3	2656.4	3502.2	3723.6	3937.5	3970.2	Percent	
Percent Retained	0.0	5.5	66.6	87.8	93.3	98.7	99.5	Loss	0.4
Percent Passing	100.0	94.5	33.4	12.2	6.7	1.3	0.5		
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6		

Tested By: BT	Drawn By: MK	Checked By: MK	Date Tested: 10/2/00

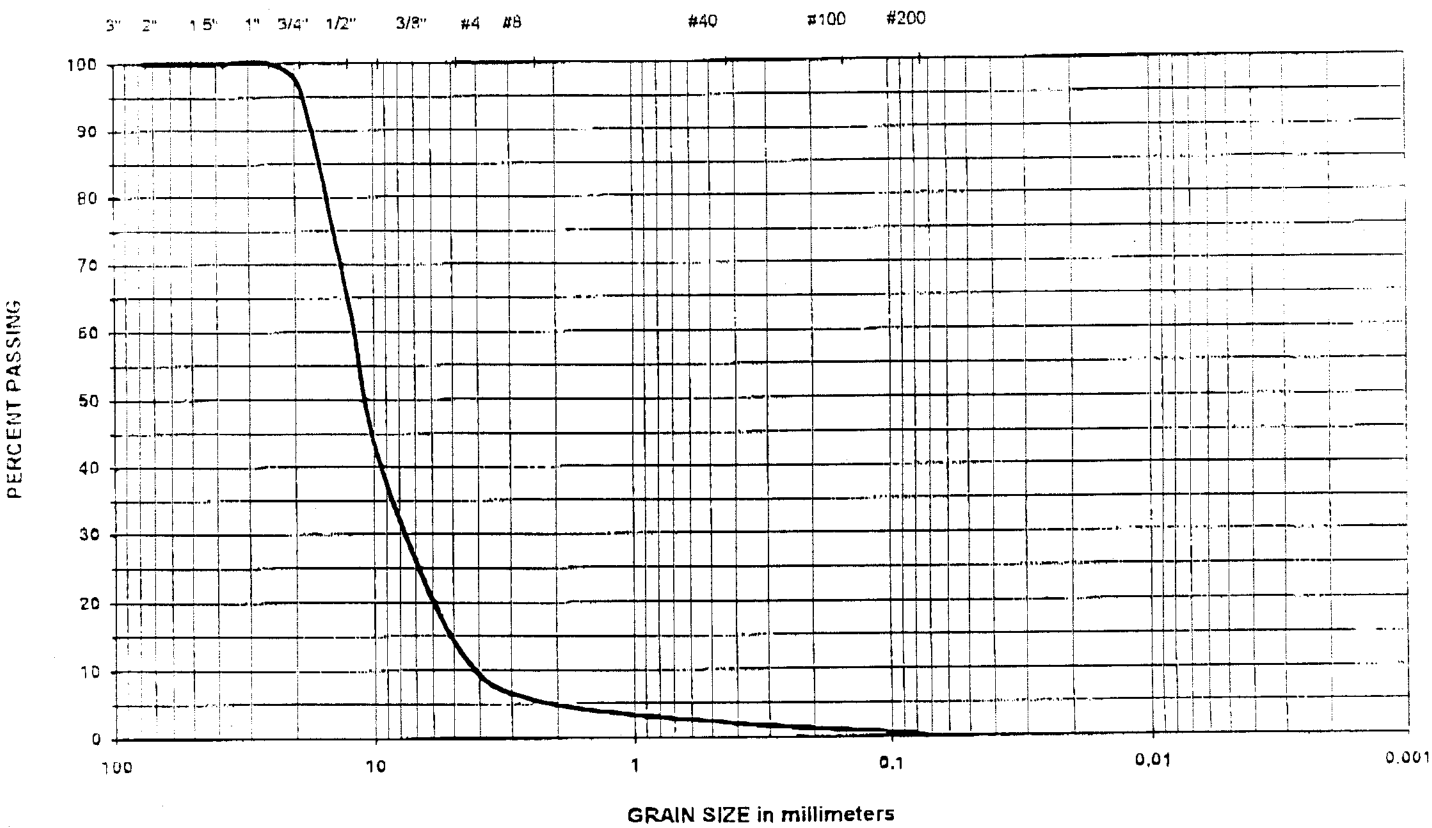
3109 Srping Forest Road Raleigh, North Carolina 27658 Tel 919-872-2660 Fax 919-876-3958

S&ME

GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services
Project Number: 1053-00-211

GRAIN SIZE DISTRIBUTION CURVE



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #67 Field Samle No.: RS-8 Source:
Quarry: S&ME Sample No: 6

SIEVE ANALYSIS: ASTM C-136							
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200
Wt. Retained (grs):	0	148.8	2379.4	3484.3	3787.8	3977.3	3997.2
Percent Retained	0.0	3.7	59.4	86.9	94.5	99.2	99.7
Percent Passing	100.0	96.3	40.6	13.1	5.5	0.8	0.3
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6

Materials Finer Than 0.075 mm ASTM C-117	
Percent Loss	0.3

Tested By: BT Drawn By: MK Checked By: MK Date Tested: 10/2/00

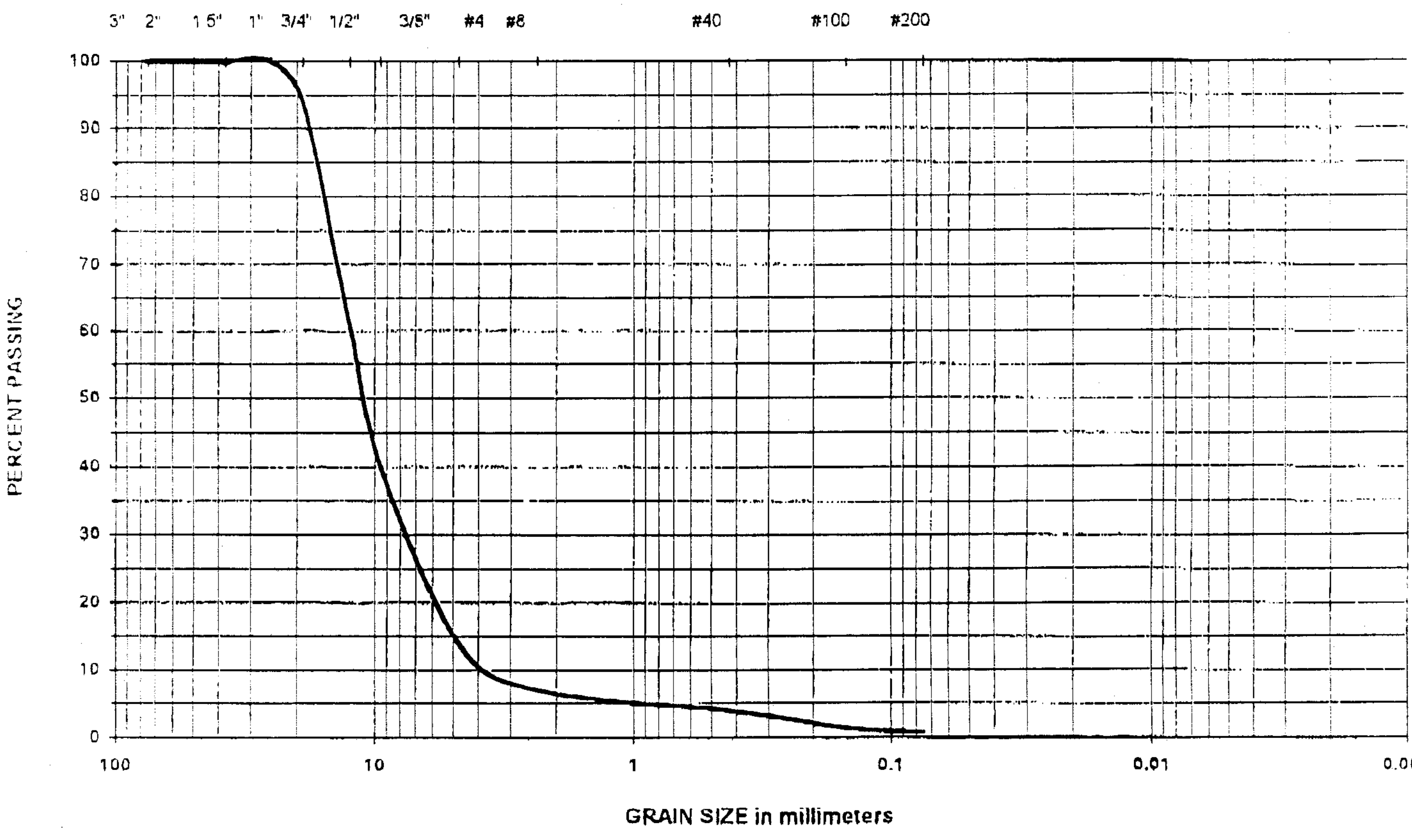
S&ME

GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211

GRAIN SIZE DISTRIBUTION CURVE



Gravel	< 75 mm and > 4.75 mm
Course Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #67

Quarry:

Field Samle No: RS-9

S&ME Sample No.: 9

Source:

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm	
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200	ASTM C-117	
Wt. Retained (grs):	0	396	4033	5790.3	6262.0	6646.6	6701	Percent	
Percent Retained	0.0	5.9	59.9	86.0	93.0	98.7	99.5	Loss	0.4
Percent Passing	100.0	94.1	40.1	14.0	7.0	1.3	0.5		
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6		

Tested By: BT | Drawn By: MK | Checked By: MK | Date Tested: 10/2/00

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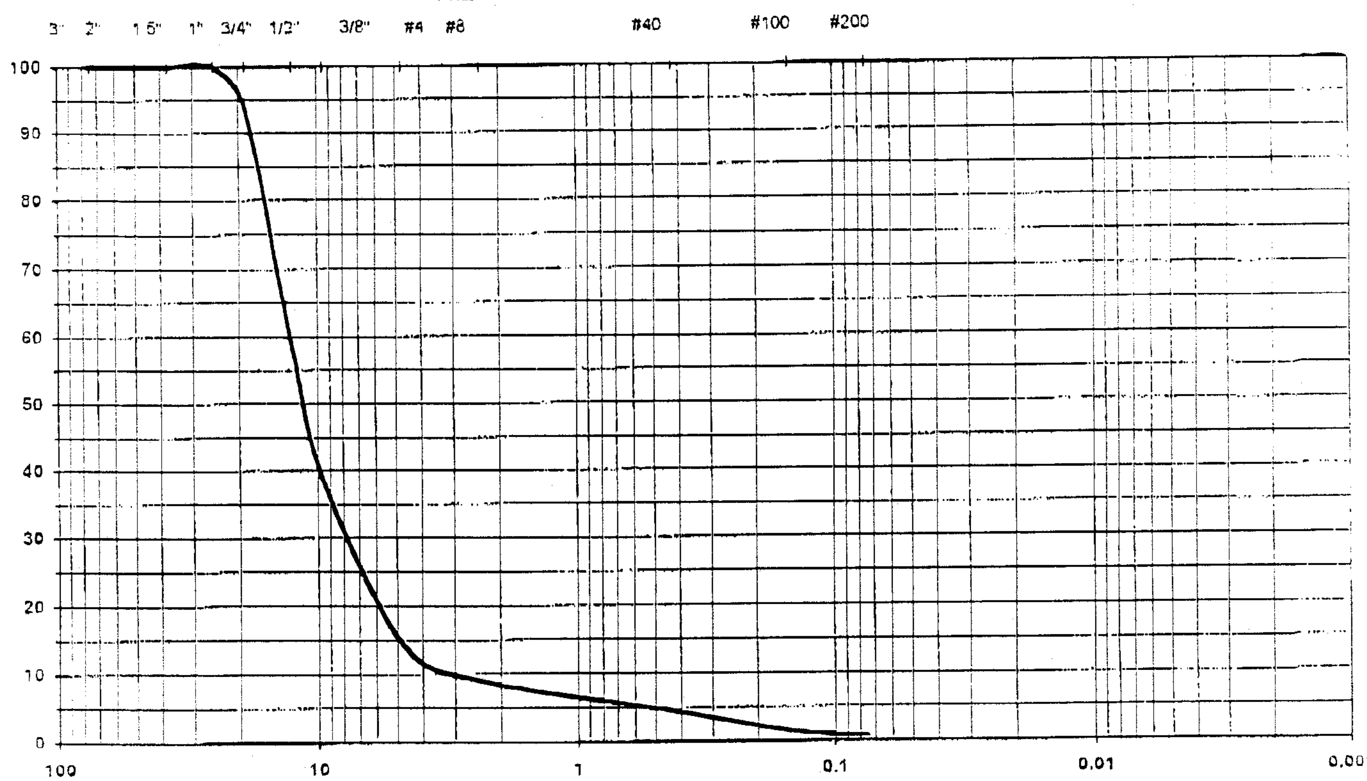
GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211

GRAIN SIZE DISTRIBUTION CURVE



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #67 Field Samle No: RS-10 Source:

Quarry: S&ME Sample No.: 10

SIEVE ANALYSIS: ASTM C-136							
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200
Wt. Retained (grs):	0	204.3	2208.5	3072.7	3267.7	3535.6	3571
Percent Retained	0.0	5.7	61.5	85.6	91.0	98.5	99.4
Percent Passing	100.0	94.3	38.5	14.4	9.0	1.5	0.6
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6

Materials Finer Than 0.075 mm	
ASTM C-117	
Percent Loss	0.4

Tested By: BT | Drawn By: MK | Checked By: MK | Date Tested: 10/2/00

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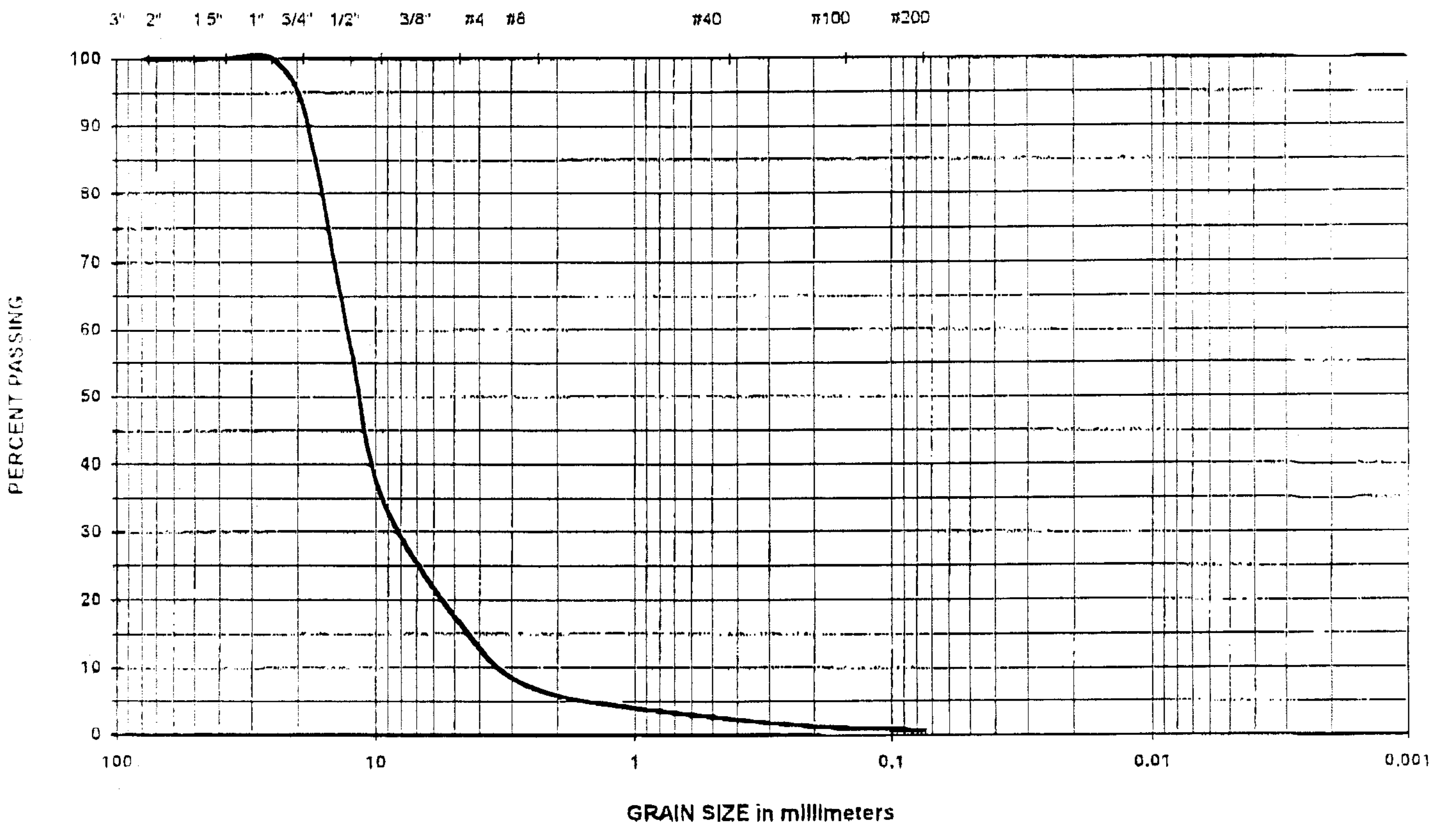
GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211

GRAIN SIZE DISTRIBUTION CURVE



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #67 Field Samle No.: RS-11 Source:

Quarry: S&ME Sample No: 11

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm ASTM C-117	
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200		
Wt. Retained (grs):	0	360.6	3405.5	4387.9	4908.8	5218.5	5228.7	Percent Loss	0.5
Percent Retained	0.0	6.9	64.7	83.4	93.3	99.2	99.4		
Percent Passing	100.0	93.1	35.3	16.6	6.7	0.8	0.6		
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6		

Tested By: BT Drawn By: MK Checked By: MK Date Tested: 10/11/00

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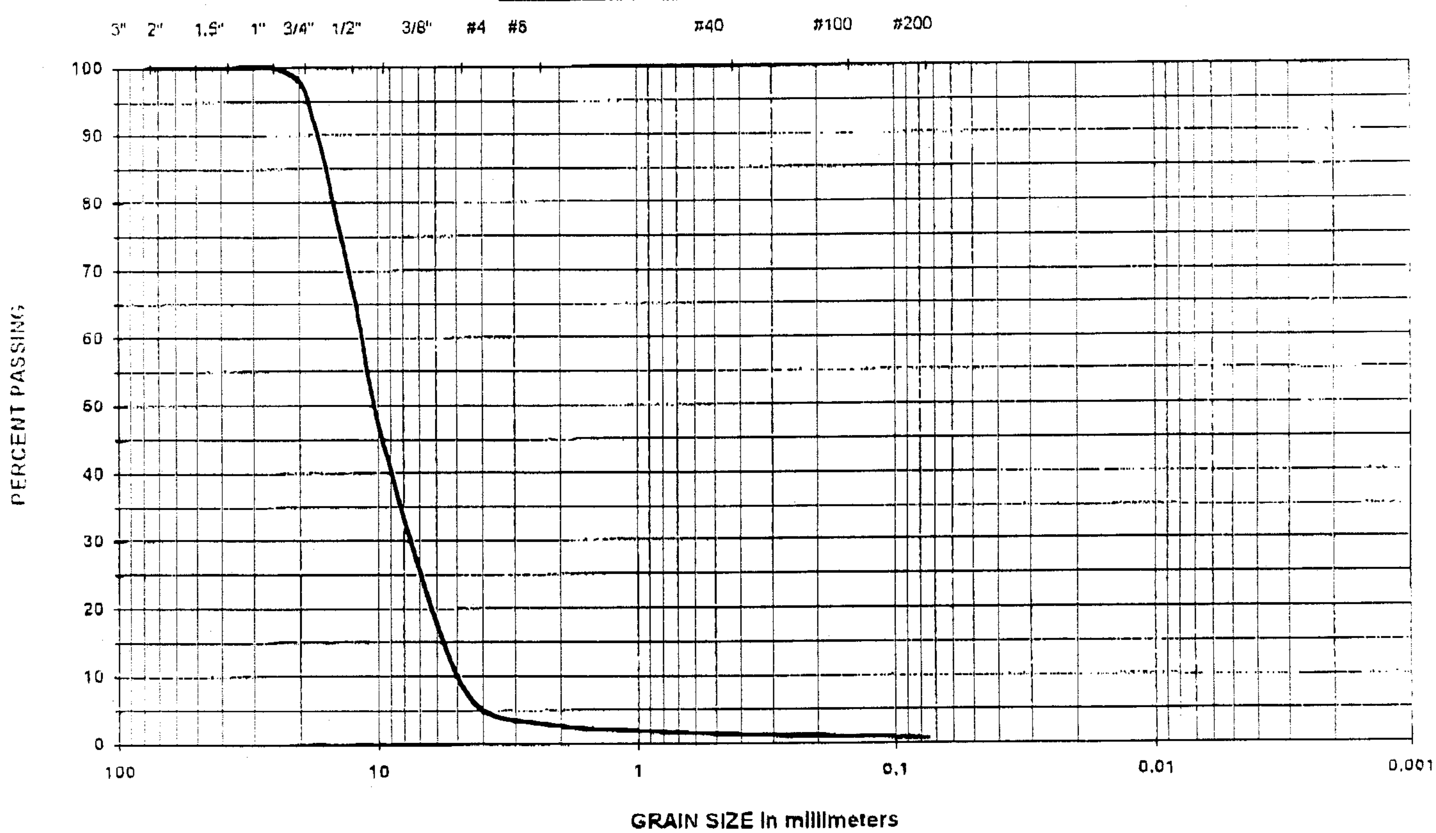

Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #57 Field Sample No. RS-12 Source: ______

Quarry: ______ S&ME Sample No: 12

SIEVE ANALYSIS: ASTM C-136							
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200
Wt. Retained (grs):	0	167.6	2740.7	4488.1	4749.9	4860.0	4867.5
Percent Retained	0.0	3.4	55.9	91.6	97.0	99.2	99.4
Percent Passing	100.0	96.6	44.1	8.4	3.0	0.8	0.6
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6

Materials Finer Than 0.075 mm ASTM C-117	
Percent Loss	0.5

Tested By: BT | Drawn By: MK | Checked By: MK | Date Tested: 10/11/00

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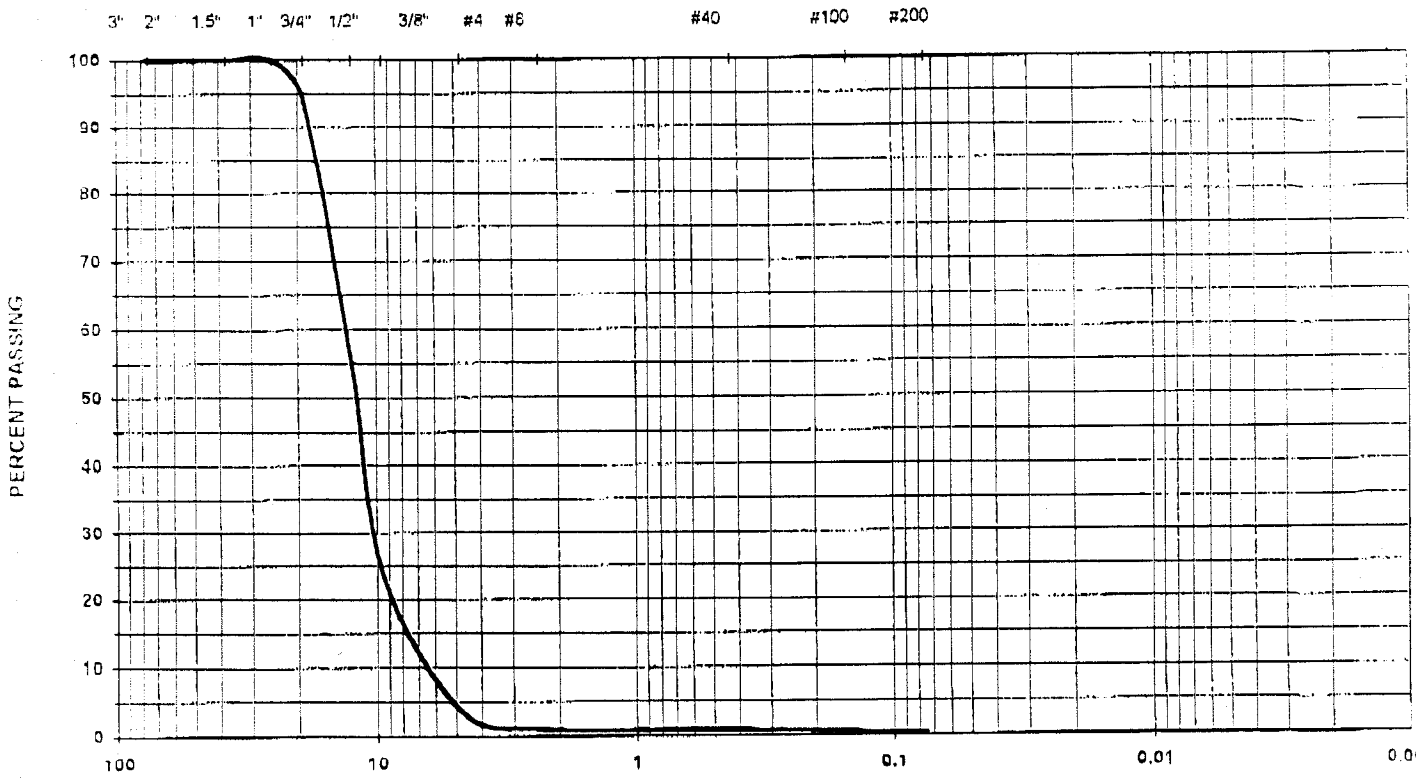
Project Number: 1053-00-211

GRAIN SIZE DISTRIBUTION CURVE



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #57 Field Samle No: RS-13 Source:

Quarry: S&ME Sample No.: 13

SIEVE ANALYSIS: ASTM C-136							
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200
Wt. Retained (grs):	0	263.4	3655.7	4675.9	4754.0	4782.0	4786.2
Percent Retained	0.0	5.5	76.2	97.4	99.0	99.6	99.7
Percent Passing	100.0	94.5	23.8	2.6	1.0	0.4	0.3
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6

Materials Finer Than 0.075 mm ASTM C-117	
Percent Loss	0.3

Tested By: BT | Drawn By: MK | Checked By: MK | Date Tested: 10/23/00

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GRAIN SIZE DATA SHEET

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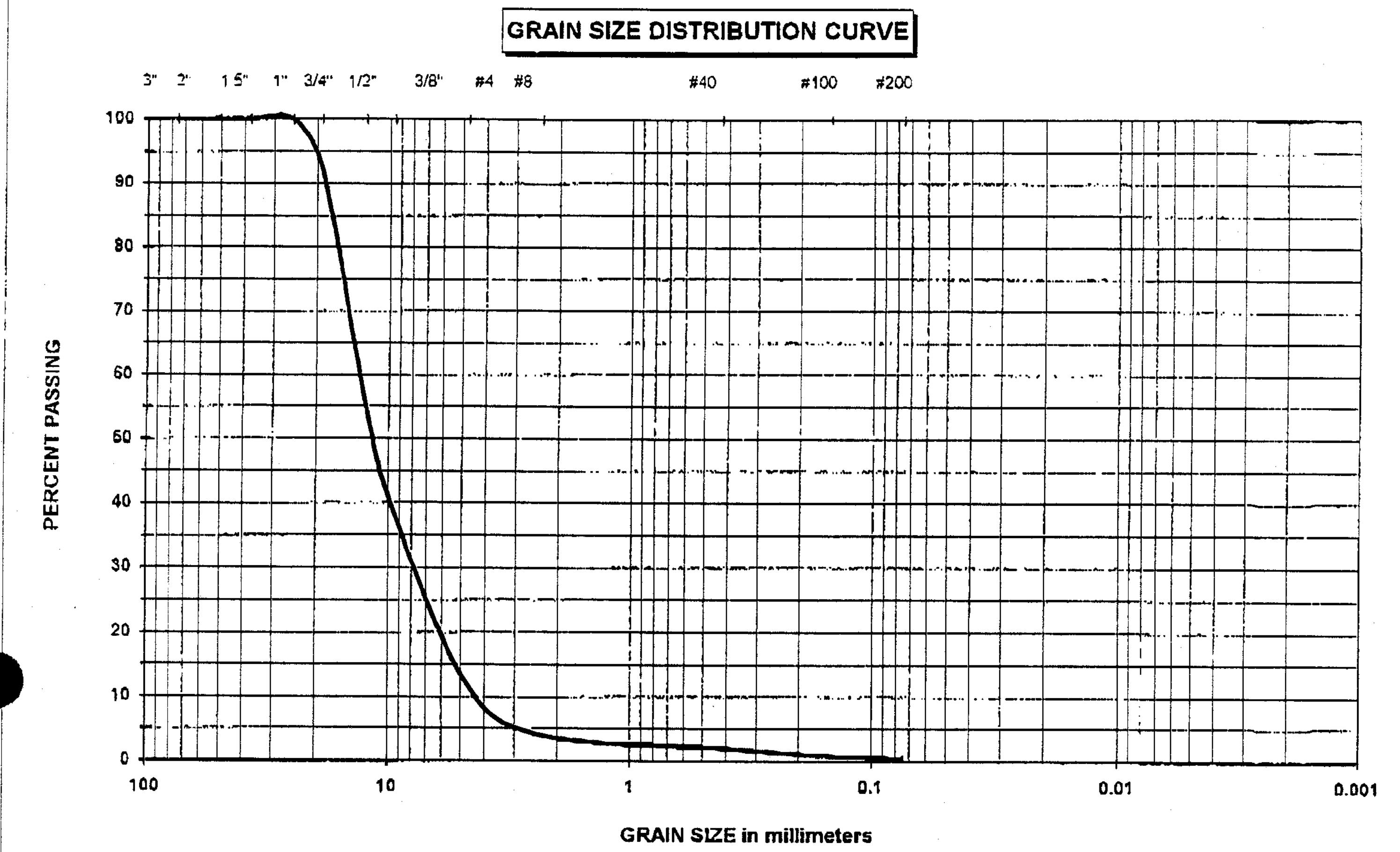
Project Number: 1053-00-211



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #67

Quarry:

Field Samle No.: RS-14

S&ME Sample No.: 14

Source:

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm ASTM C-117	
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200		
Wt. Retained (grs):	0	471.6	3772.8	5399.5	5905.3	6102.1	6118.2	Percent Loss	0.3
Percent Retained	0.0	7.7	61.3	87.8	96.0	99.2	99.5		
Percent Passing	100.0	92.3	38.7	12.2	4.0	0.8	0.5		
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6		

Tested By: BT	Drawn By: MK	Checked By: MK

Date Tested: 10/30/00

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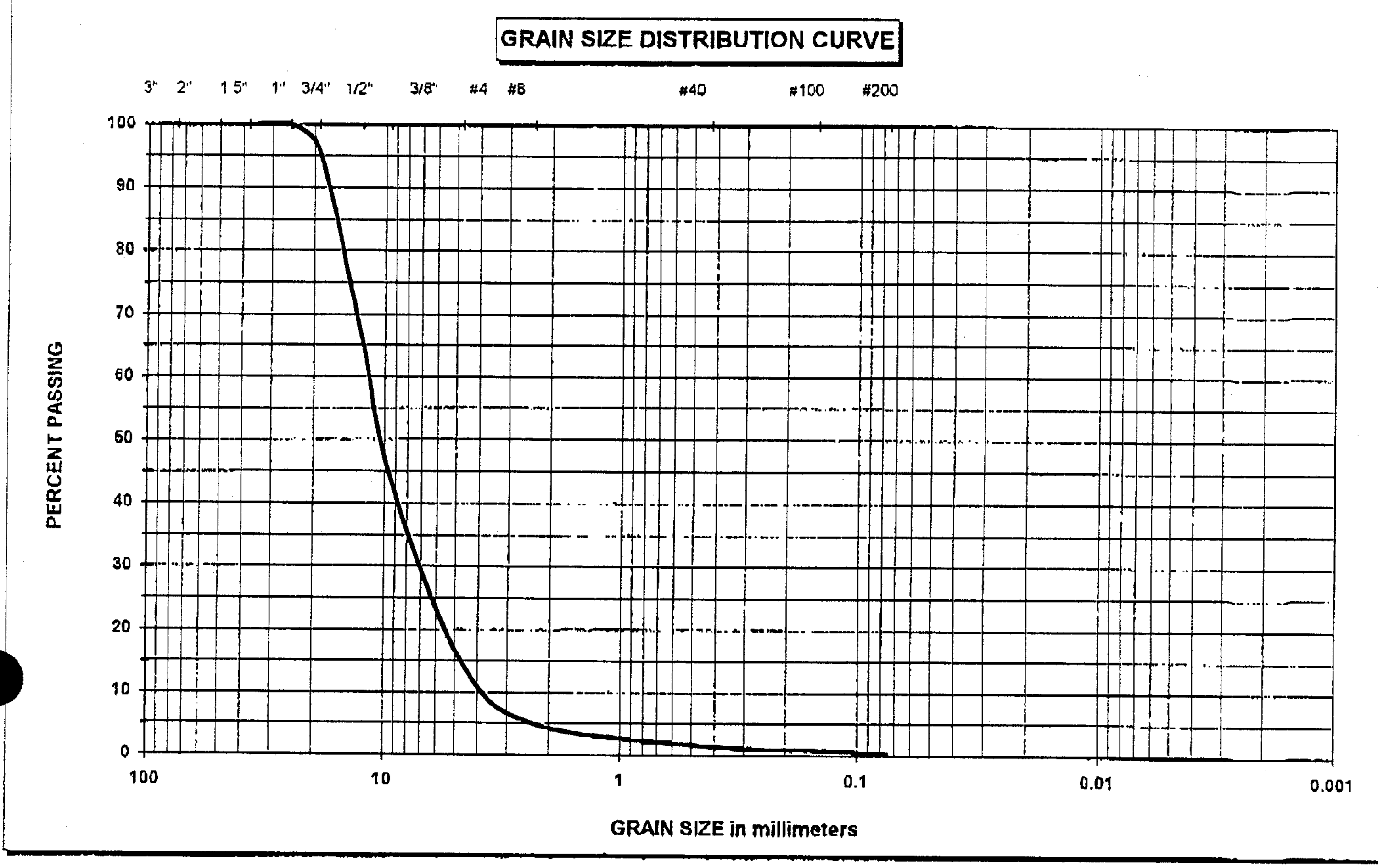
GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #67

Quarry:

Field Samle No.: RS-15

S&ME Sample No.: 15

Source:

SIEVE ANALYSIS: ASTM C-136							
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200
Wt. Retained (grs):	0	230.1	3071.1	4654.3	5215.4	5465.0	5485
Percent Retained	0.0	4.2	55.8	84.6	94.8	99.3	99.7
Percent Passing	100.0	95.8	44.2	15.4	5.2	0.7	0.3
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6

Materials Finer Than 0.075 mm ASTM C-117	
Percent Loss	0.3

Tested By: BT	Drawn By: MK	Checked By: MK	Date Tested: 10/30/00

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GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

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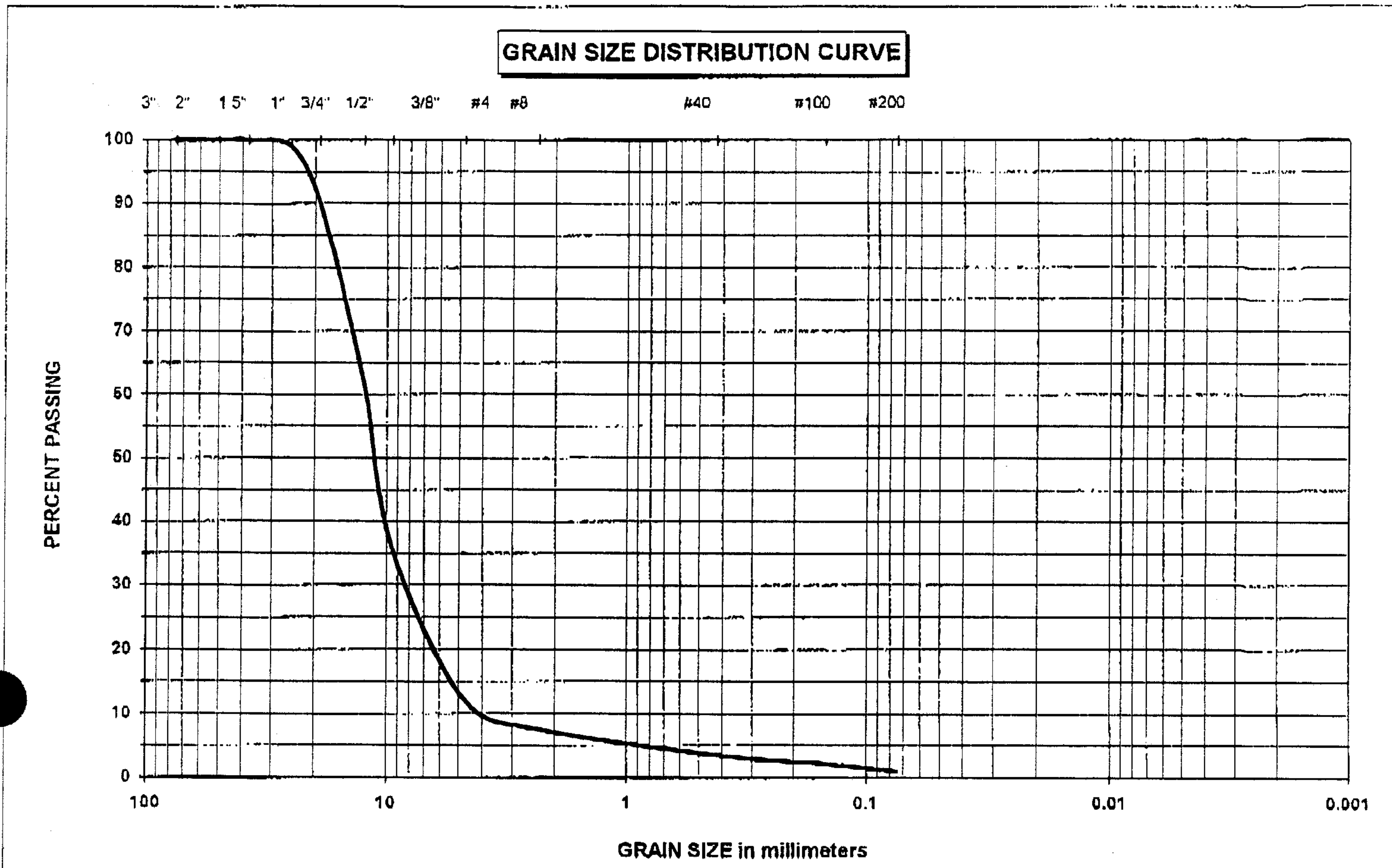

Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #67 Field Samle No.: RS-16 Source:

Quarry: S&ME Sample No: 16

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm ASTM C-117	
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200		
Wt. Retained (grs):	0	529.6	3421.2	4688.0	4939.2	5240.6	5292.1	Percent	
Percent Retained	0.0	9.9	64.0	87.7	92.4	98.0	99.0	Loss	0.8
Percent Passing	100.0	90.1	36.0	12.3	7.6	2.0	1.0		
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6		

Tested By: BT	Drawn By: MK	Checked By: MK	Date Tested: 10/30/00

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GRAIN SIZE DATA SHEET

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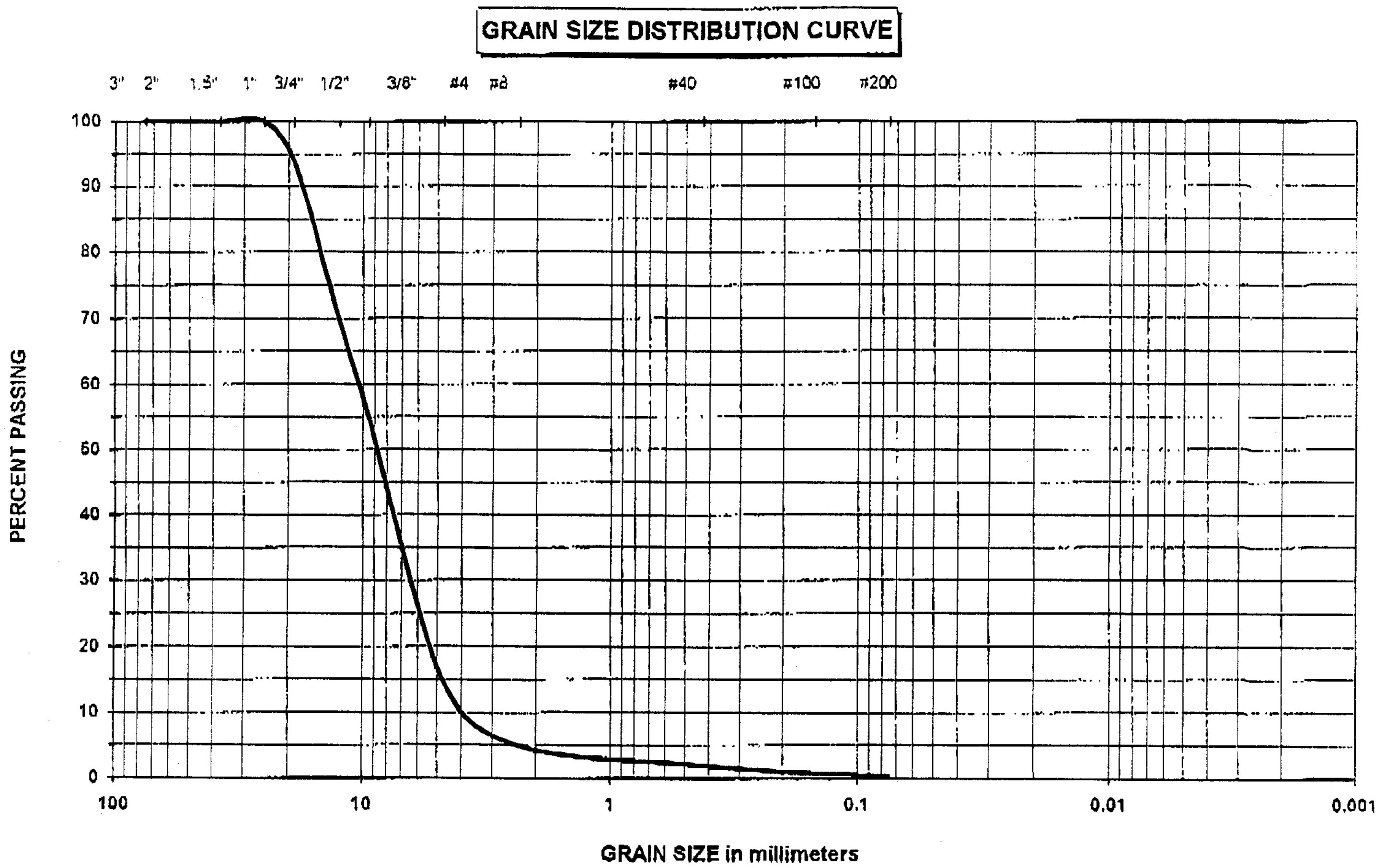
Project Number: 1053-00-211



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #57　　Field Samle No.: RS-17　　Source:

Quarry:　　S&ME Sample No.: 17

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm ASTM C-117	
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200		
Wt. Retained (grs):	0	322.5	2408.7	4569.9	5111.4	5301.0	5353.3	Percent	
Percent Retained	0.0	6.0	44.8	85.0	95.1	98.6	99.6	Loss	0.3
Percent Passing	100.0	94.0	55.2	15.0	4.9	1.4	0.4		
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6		
Tested By: BT		Drawn By: MK		Checked By: MK				Date Tested:	10/30/00

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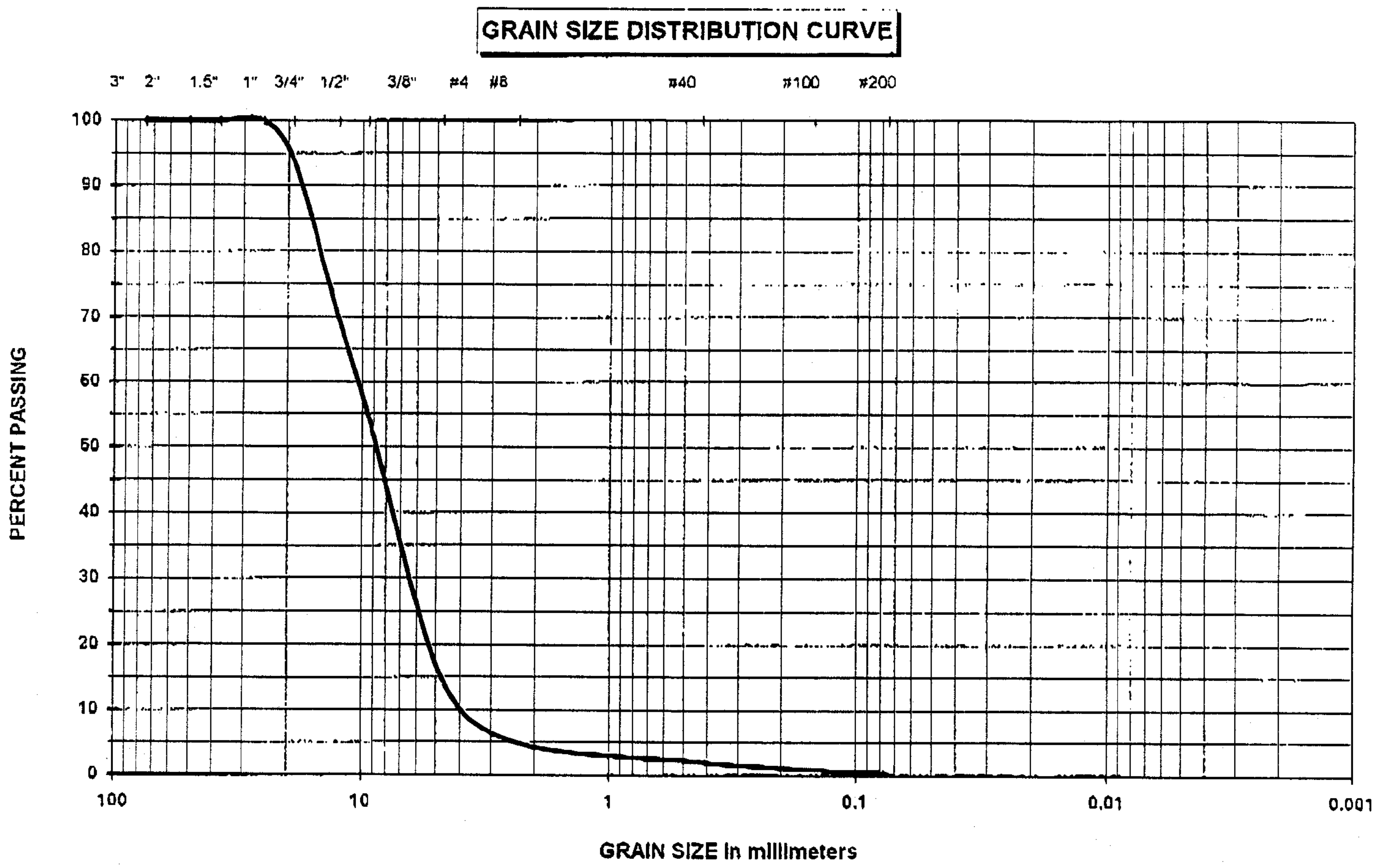
GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Type Material: #67

Quarry:

Field Sample No.: RS-18

S&ME Sample No.: 18

Source:

SIEVE ANALYSIS: ASTM C-136							
Sieve No: (in)	1	3/4	3/8	#4	#8	#100	#200
Wt. Retained (grs):	0	322.5	2408.7	4569.9	5111.4	5301.0	5353.3
Percent Retained	0.0	6.0	44.8	85.0	95.1	98.6	99.6
Percent Passing	100.0	94.0	55.2	15.0	4.9	1.4	0.4
NCDOT Spec. Limits	100	90-100	20-55	0-10	0-5		0.0-0.6

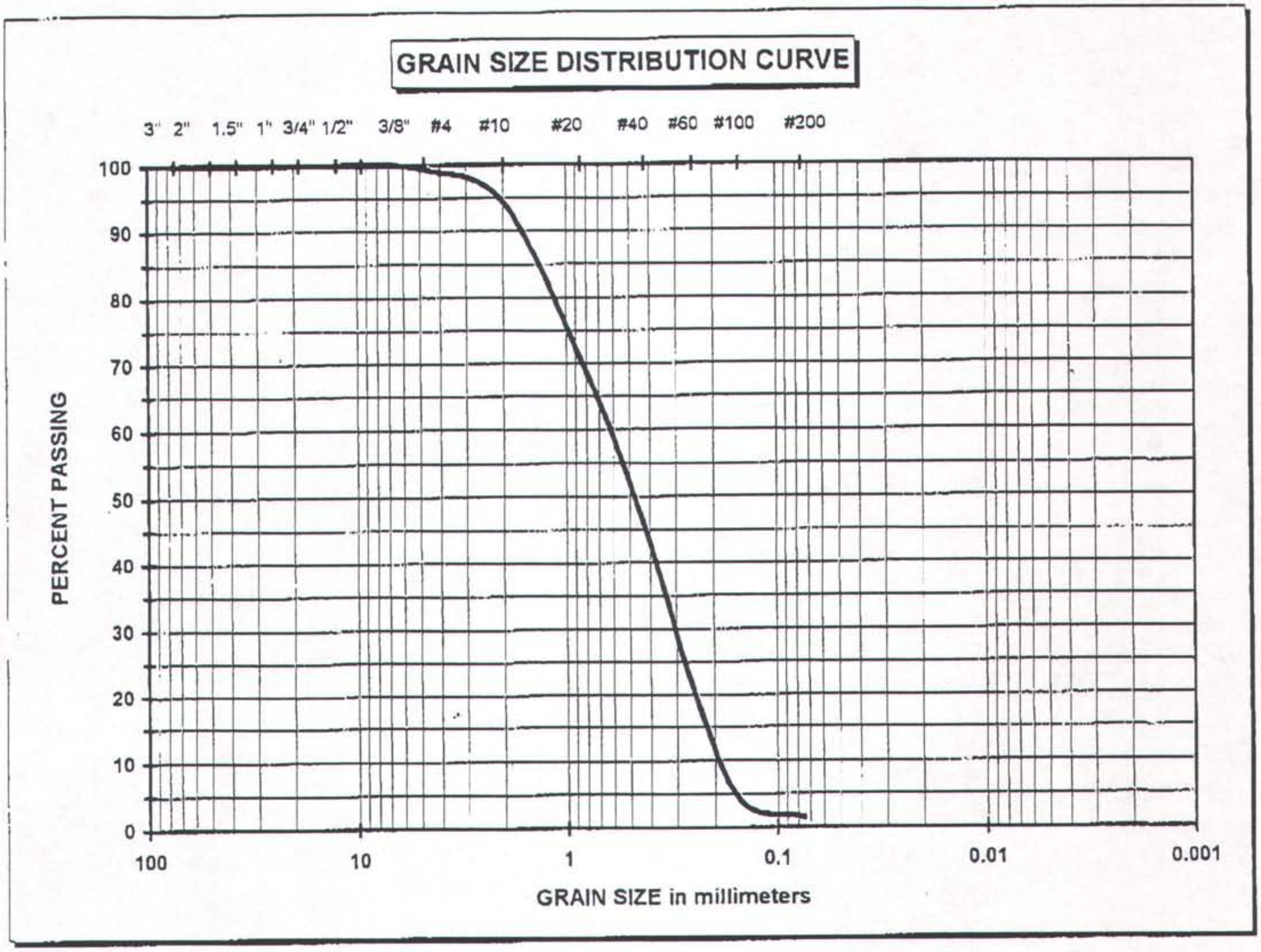
Materials Finer Than 0.075 mm ASTM C-117	
Percent Loss	0.3

Tested By: BT | Drawn By: MK | Checked By: MK | Date Tested: 10/30/00

GRAIN SIZE DATA SHEET

Project Description: RMT Lab Service

Project Number: 1053-00-211



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Boring No.: Bag Sample No.: 1 Depth (ft): N/A

Soil Description: Tan SAND

ATTERBERG LIMIT (-#40 MATERIAL)	
LIQUID LIMIT	--
PLASTIC LIMIT	--
PLASTICITY INDEX	--
NATURAL MOISTURE (%)	--

GRAIN SIZE DATA	
SAND (%)	98.6
SILT & CLAY (%)	1.4

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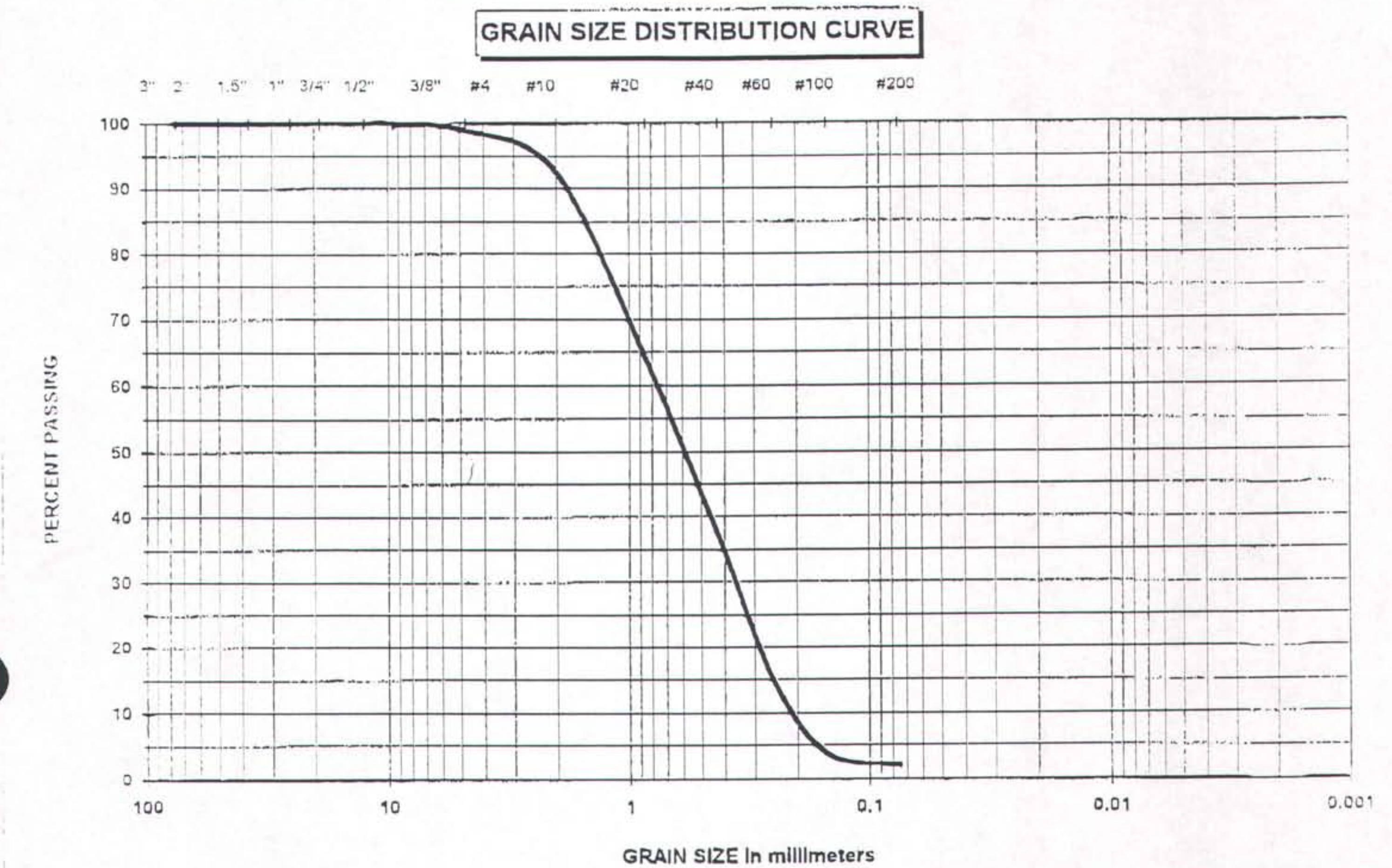
GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Boring No.: Sample No.: 3 Depth (ft): NA

Soil Description: SAND

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm	
Sieve No. (in)	#4	#10	#20	#40	#60	#100	#200	ASTM C-117	
Cum. Retained (grs)	7.9	52.1	252.1	440.5	597.0	675.2	687.8	Total Dry Wt (grs)	701.54
Percent Retained	1.1	7.4	35.9	62.8	85.1	96.2	98.0	Percent Loss	1.9
Percent Passing	98.9	92.6	64.1	37.2	14.9	3.8	2.0	% Nat. Moisture	
Tested By: BT		Drawn By: MK		Checked By: MK				Date Tested	10/2/00

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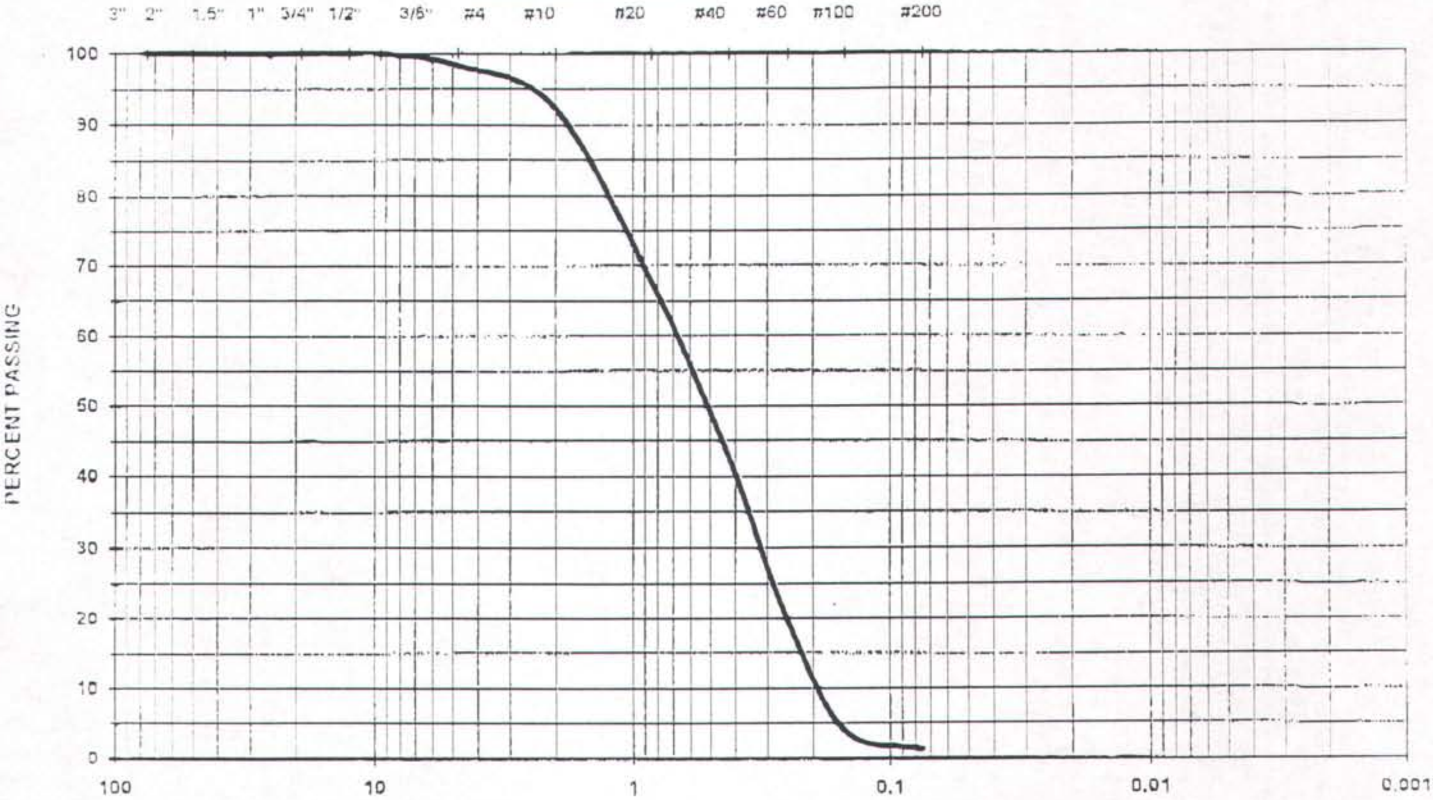
GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211

GRAIN SIZE DISTRIBUTION CURVE



GRAIN SIZE in millimeters

Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Boring No.: Sample No.: 4 Depth (ft): NA

Soil Description: SAND

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm ASTM C-117	
Sieve No: (in)	#4	#10	#20	#40	#60	#100	#200		
Wt. Retained (grs):	14.7	66.7	276.6	494.2	695.2	832.3	854.9	Total Dry Wt (grs)	865.72
Percent Retained	1.7	7.7	32.0	57.1	80.3	96.1	98.8	Percent Loss	1.1
Percent Passing	98.3	92.3	68.0	42.9	19.7	3.9	1.2	% Nat. Moisture	
Tested By: BT		Drawn By: MK		Checked By: MK				Date Tested	10/2/00

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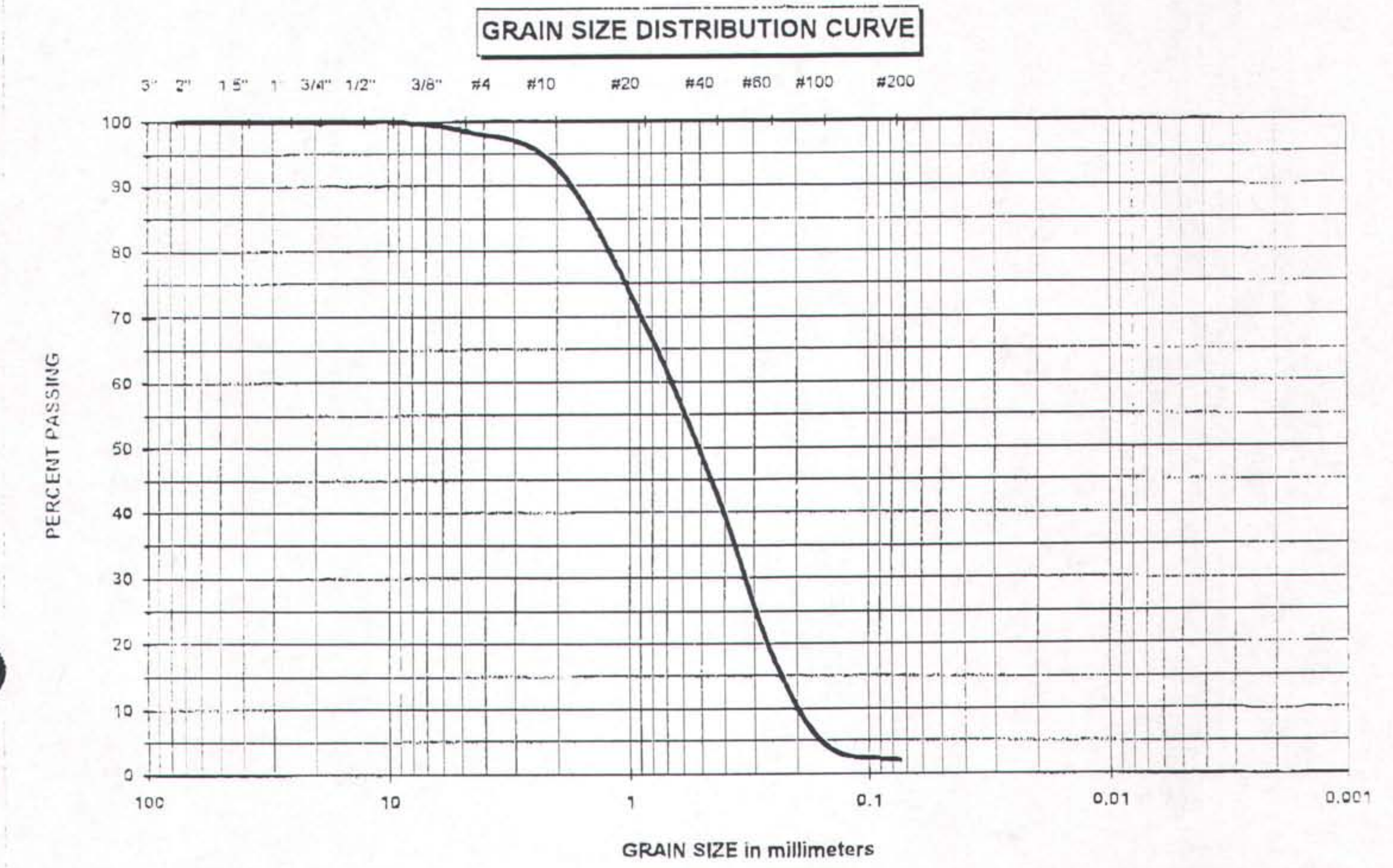
Project Number: 1053-00-211



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Boring No.: Sample No.: 5 Depth (ft): NA

Soil Description: SAND

SIEVE ANALYSIS: ASTM C-136							
Sieve No. (in)	#4	#10	#20	#40	#60	#100	#200
Wt. Retained (grs)	11.3	53.4	238.8	438.9	625.7	729.1	745.7
Percent Retained	1.5	7.0	31.4	57.7	82.2	95.6	98.0
Percent Passing	98.5	93.0	68.6	42.3	17.8	4.2	2.0

Materials Finer Than 0.075 mm ASTM C-117	
Total Dry Wt (grs)	761.28
Percent Loss	1.8
% Nat. Moisture	
Date Tested	10/2/00

Tested By: BT Drawn By: MK Checked By: MK

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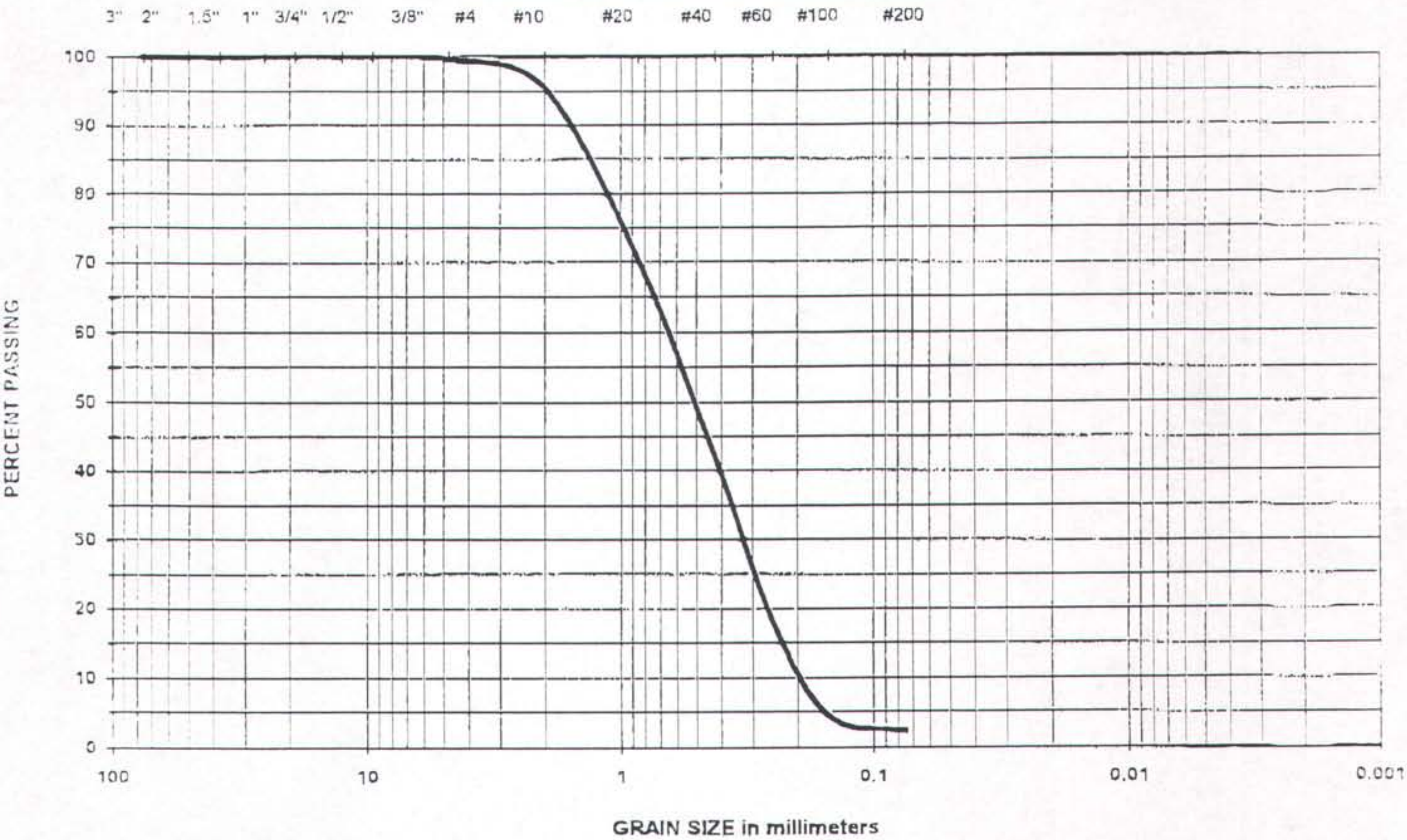
Project Description: RMT Lab Services

Project Number: 1053-00-211

GRAIN SIZE DISTRIBUTION CURVE



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Boring No.: Sample No.: 6 Depth (ft): NA

Soil Description: SAND

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm	
Sieve No. (in)	#4	#10	#20	#40	#60	#100	#200	ASTM C-117	
Wt. Retained (grs):	1.1	16.88	110.6	216.12	306.2	357.3	365.26	Total Dry Wt (grs)	373.75
Percent Retained	0.3	4.5	29.6	57.8	81.9	95.6	97.7	Percent Loss	2.1
Percent Passing	99.7	95.5	70.4	42.2	18.1	4.4	2.3	% Nat. Moisture	
Tested By: BT		Drawn By: MK		Checked By: MK				Date Tested:	10/16/00

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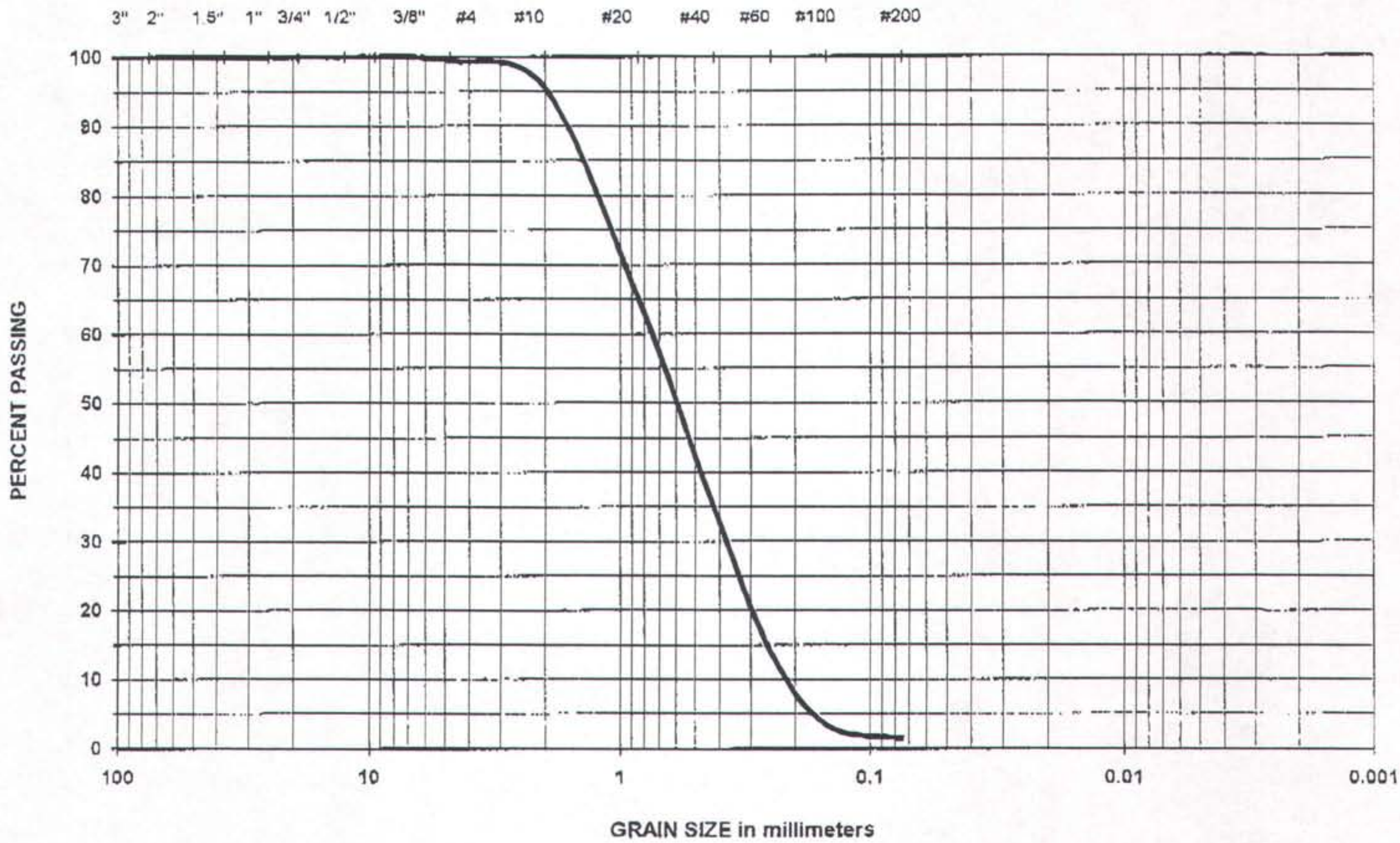
GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm
Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Boring No.: Sample No.: 10 Depth (ft): NA

Soil Description: Brown SAND

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm ASTM C-117	
Sieve No: (in)	#4	#10	#20	#40	#60	#100	#200		
Wt. Retained (grs):	3.25	27.36	213.68	398.72	530.2	595.8	608.2	Total Dry Wt (grs)	616.58
Percent Retained	0.5	4.4	34.7	64.7	86.0	96.6	98.6	Percent Loss	1.3
Percent Passing	99.5	95.6	65.3	35.3	14.0	3.4	1.4	% Nat. Moisture	
Tested By: BT		Drawn By: MK		Checked By: MK				Date Tested:	10/30/00

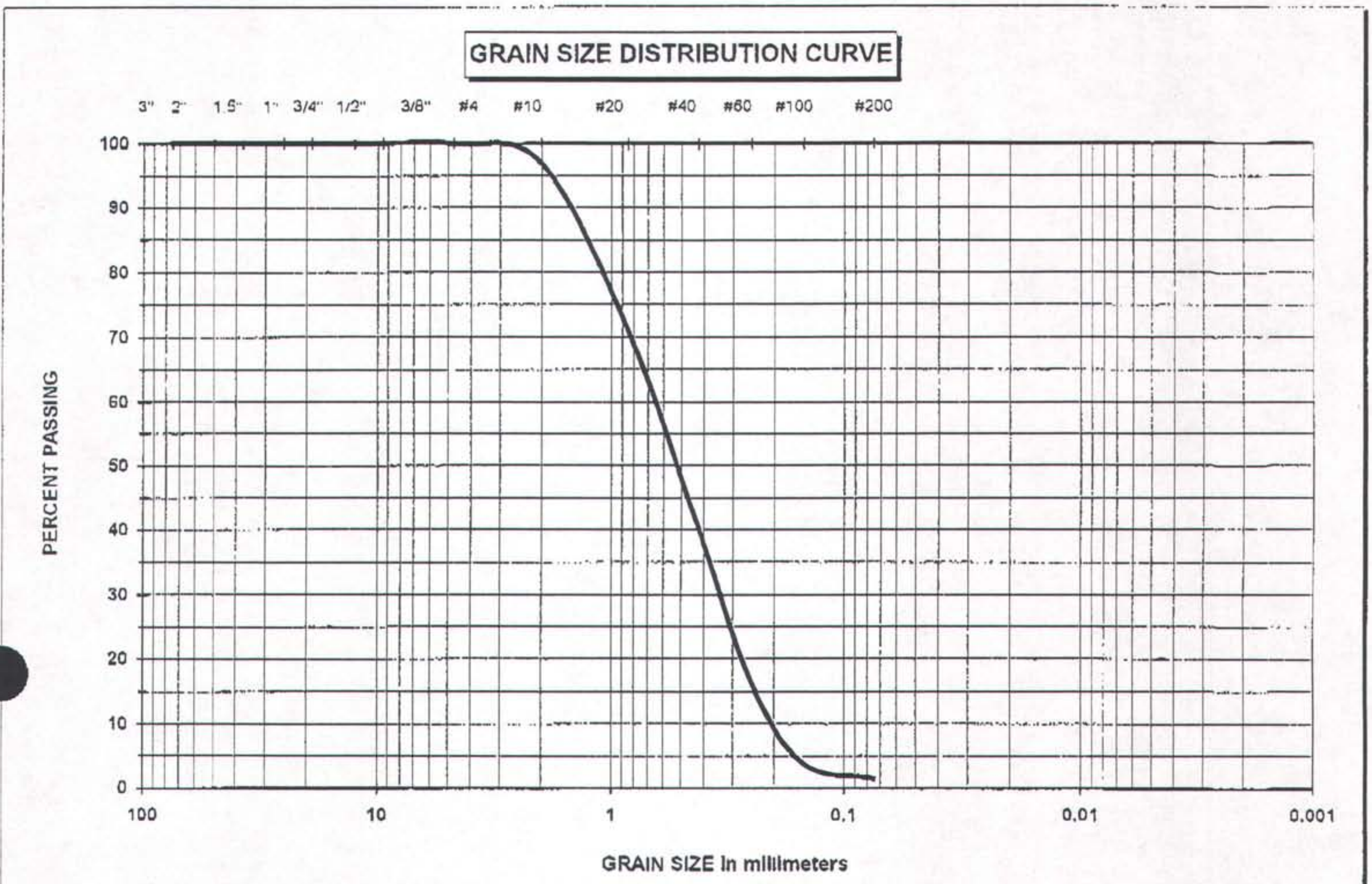
3109 Srping Forest Road Raleigh, North Carolina 27658 Tel 919-872-2660 Fax 919-876-3958

S&ME

GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Boring No.: Sample No.: 11 Depth (ft): NA

Soil Description: Brown SAND

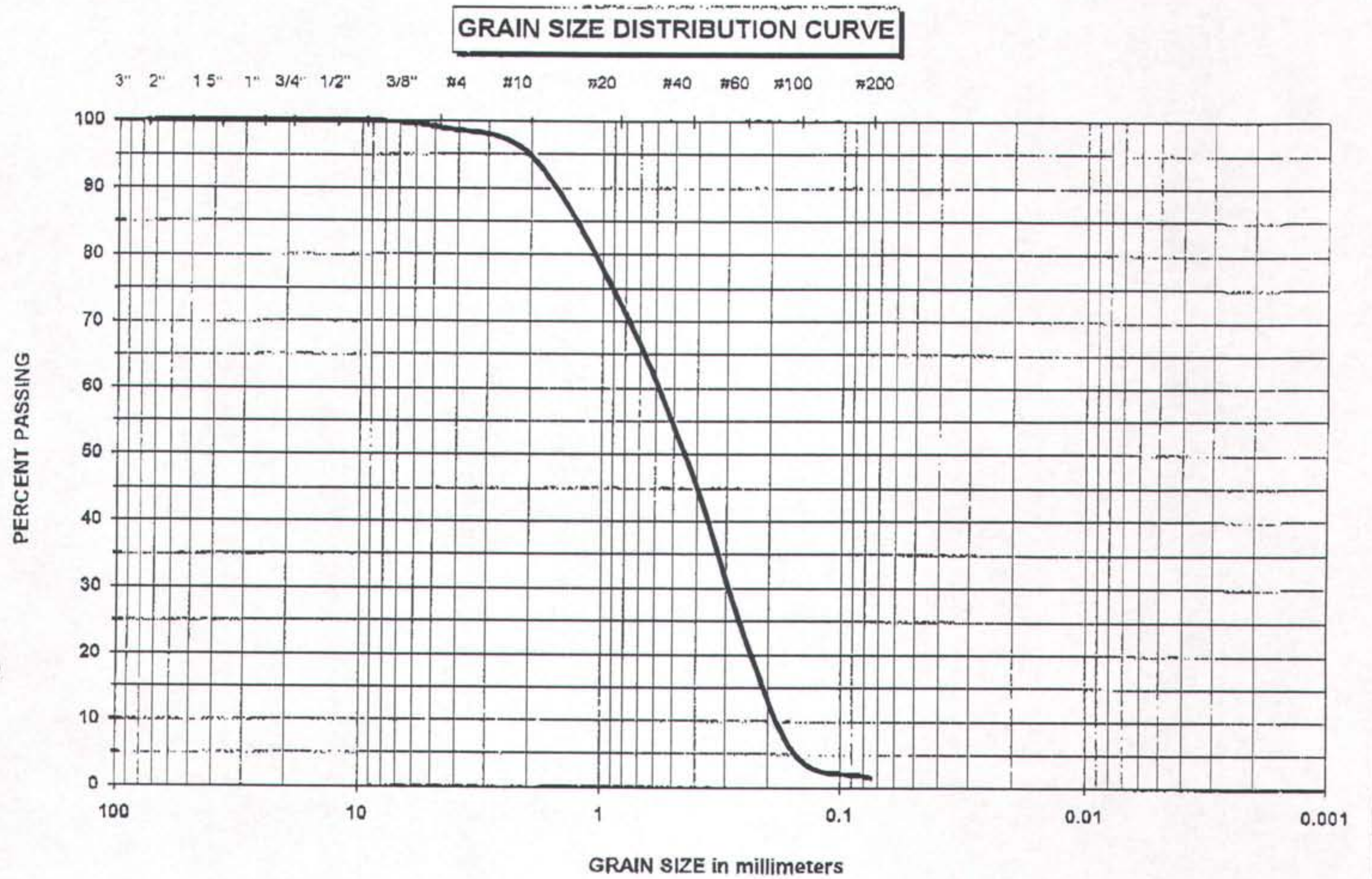
SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm	
Sieve No: (in)	#4	#10	#20	#40	#60	#100	#200	ASTM C-117	
Wt. Retained (grs):	0.7	17.83	170.88	352.53	496.1	570.8	585.12	Total Dry Wt (grs)	593.87
Percent Retained	0.1	3.0	28.8	59.4	83.5	96.1	98.5	Percent Loss	1.3
Percent Passing	99.9	97.0	71.2	40.6	16.5	3.9	1.5	% Nat. Moisture	
Tested By: BT		Drawn By: MK		Checked By: MK				Date Tested:	10/30/00

S&ME

GRAIN SIZE DATA SHEET

Project Description: RMT Lab Services

Project Number: 1053-00-211



Gravel	< 75 mm and > 4.75 mm
Coarse Sand	< 4.75 mm and >2.00 mm
Medium Sand	< 2.00 mm and > 0.425 mm

Fine Sand	< 0.425 mm and > 0.075 mm
Silt	< 0.075 and > 0.005 mm
Clay	> 0.005 mm

Boring No.: Sample No.: 12 Depth (ft): NA

Soil Description: Brown SAND

SIEVE ANALYSIS: ASTM C-136								Materials Finer Than 0.075 mm ASTM C-117	
Sieve No: (in)	#4	#10	#20	#40	#60	#100	#200		
Wt. Retained (grs):	6.04	31.69	164.77	320.28	473.1	584.0	602.2	Total Dry Wt (grs)	611.98
Percent Retained	1.0	5.2	26.9	52.3	77.3	95.4	98.4	Percent Loss	1.4
Percent Passing	99.0	94.8	73.1	47.7	22.7	4.6	1.6	% Nat. Moisture	
Tested By: BT		Drawn By: MK		Checked By: MK				Date Tested:	10/30/00

RMT, Inc.

Constant Head Permeability Test (ASTM D2434)

QC: [signature]
QA: [signature]

Project Name:	WEYERHAEUSER		
Project #:	5101.08	USCS Description:	N/A
Sample Name:	#67 Stone, RS-19	USCS Classification:	N/A
Visual Descript:	Poorly graded gravel	Average k_v =	2.2E+00 cm./sec.

Sample Diameter (in):	4.00		
Sample Height (in):	4.63		
Specific Gravity:	2.70		
Tare & Wet Soil (g):	664.40		
Tare & Dry Soil (g):	664.20		
Tare (g):	261.80	Beaker Tare Wt. (g):	392.32

	Initial Values		Final Values
Mold & Wet Soil (g):	4804.00	Mold & Wet Soil (g):	4846.00
Mold & Dry Soil (g):	4803.28	Mold & Dry Soil (g):	4803.28
Tare of Mold (g):	3363.00	Tare of Mold (g):	3363.00
Wet Density (pcf):	94.45	Wet Density (pcf):	97.21
Dry Density (pcf):	94.41	Dry Density (pcf):	94.41
% Saturation:	0.17%	% Saturation:	10.21%
% Moisture:	0.05%	% Moisture:	2.97%

Date YY	MM	DD	Time Sec.	Temp.	Flow Vol Readings	Flow Vol.	Head Bottom	Top	h	k_v* cm/sec
2000	11	2	60	25	532.6	140.28	109.9	110.0	0.1	2.2E+00
2000	11	2	60	25	532.6	140.28	109.9	110.0	0.1	2.2E+00
2000	11	2	60	25	532.8	140.48	109.9	110.0	0.1	2.2E+00
2000	11	2	60	25	532.8	140.48	109.9	110.0	0.1	2.2E+00

k_v = QL/Aht cm./sec.

Q = 140.38 ml. (ave. measured flow volume)

L = 3.313 in. (flow length)

A = 12.57 sq. cm. (area of sample)

h = 0.10 cm. (ave. head)

t = 60.00 sec. (average run time)

i = 0.03 (average gradient)

k_v = 2.2E+00 cm/sec (ave. k value)

* k_v adjusted for temperature

RMT, Inc.

Constant Head Permeability Test (ASTM D2434)

QC: [handwritten initials]
QA: [handwritten initials]

Project Name:	WEYERHAEUSER		
Project #:	5101.08	USCS Description:	N/A
Sample Name:	#67 Stone, RS-20	USCS Classification:	N/A
Visual Descript:	Poorly graded gravel	Average k_v =	2.2E+00 cm./sec.

Sample Diameter (in):	4.00		
Sample Height (in):	4.63		
Specific Gravity:	2.70		
Tare & Wet Soil (g):	519.90		
Tare & Dry Soil (g):	519.60		
Tare (g):	262.85	Beaker Tare Wt. (g):	392.32

	Initial Values		Final Values
Mold & Wet Soil (g):	4847.00	Mold & Wet Soil (g):	4886.00
Mold & Dry Soil (g):	4845.27	Mold & Dry Soil (g):	4845.27
Tare of Mold (g):	3363.00	Tare of Mold (g):	3363.00
Wet Density (pcf):	97.27	Wet Density (pcf):	99.83
Dry Density (pcf):	97.16	Dry Density (pcf):	97.16
% Saturation:	0.43%	% Saturation:	10.11%
% Moisture:	0.12%	% Moisture:	2.75%

Date YY	MM	DD	Time Sec.	Temp.	Flow Vol Readings	Flow Vol.	Head Bottom	Top	h	k_v* cm/sec
2000	11	2	60	25	532.5	140.18	110.3	110.4	0.1	2.2E+00
2000	11	2	60	25	532.5	140.18	110.3	110.4	0.1	2.2E+00
2000	11	2	60	25	532.5	140.18	110.3	110.4	0.1	2.2E+00
2000	11	2	60	25	532.4	140.08	110.3	110.4	0.1	2.2E+00

k_v = QL/Aht cm./sec.

Q = 140.16 ml. (ave. measured flow volume)

L = 3.313 in. (flow length)

A = 12.57 sq. cm. (area of sample)

h = 0.10 cm. (ave. head)

t = 60.00 sec. (average run time)

i = 0.03 (average gradient)

k_v = 2.2E+00 cm/sec (ave. k value)

* k_v adjusted for temperature

RMT, Inc.
Constant Head Permeability Test (ASTM D2434)

QC: H/W
QA: [illegible]

Project Name:	WEYERHAEUSER	USCS Description:	N/A
Project #:	5101.08	USCS Classification:	N/A
Sample Name:	#67 Stone, RS-21	Average k_v =	2.1E+00 cm./sec.
Visual Descript:	Poorly graded gravel		

Sample Diameter (in):	4.00		
Sample Height (in):	4.63		
Specific Gravity:	2.70		
Tare & Wet Soil (g):	621.70		
Tare & Dry Soil (g):	621.30		
Tare (g):	264.30	Beaker Tare Wt. (g):	392.32
	Initial Values		Final Values
Mold & Wet Soil (g):	4825.00	Mold & Wet Soil (g):	4862.00
Mold & Dry Soil (g):	4823.36	Mold & Dry Soil (g):	4823.36
Tare of Mold (g):	3363.00	Tare of Mold (g):	3363.00
Wet Density (pcf):	95.83	Wet Density (pcf):	98.25
Dry Density (pcf):	95.72	Dry Density (pcf):	95.72
% Saturation:	0.40%	% Saturation:	9.40%
% Moisture:	0.11%	% Moisture:	2.65%

Date			Time		Flow Vol	Flow	Head			k_v *
YY	MM	DD	Sec.	Temp.	Readings	Vol.	Bottom	Top	h	cm/sec
2000	11	2	60	25	531.1	138.78	110.2	110.3	0.1	2.1E+00
2000	11	2	60	25	531.1	138.78	110.2	110.3	0.1	2.1E+00
2000	11	2	60	25	531.5	139.18	110.2	110.3	0.1	2.1E+00
2000	11	2	60	25	531.2	138.88	110.2	110.3	0.1	2.1E+00

k_v = QL/Aht cm./sec.

Q = 138.91 ml. (ave. measured flow volume)

L = 3.313 in. (flow length)

A = 12.57 sq. cm. (area of sample)

h = 0.10 cm. (ave. head)

t = 60.00 sec. (average run time)

i = 0.03 (average gradient)

k_v = 2.1E+00 cm/sec (ave. k value)

* k_v adjusted for temperature

RMT, Inc.

Constant Head Permeability Test (ASTM D2434)

QC: HJW
QA: [illegible]

Project Name:	WEYERHAEUSER	USCS Description:	N/A
Project #:	5101.08	USCS Classification:	N/A
Sample Name:	#67 Stone, RS-22		
Visual Descript:	Poorly graded gravel	Average k_v =	2.1E+00 cm./sec.

Sample Diameter (in):	4.00		
Sample Height (in):	4.63		
Specific Gravity:	2.70		
Tare & Wet Soil (g):	566.50		
Tare & Dry Soil (g):	565.80		
Tare (g):	263.44	Beaker Tare Wt. (g):	392.32

	Initial Values		Final Values
Mold & Wet Soil (g):	4846.00	Mold & Wet Soil (g):	4885.00
Mold & Dry Soil (g):	4842.57	Mold & Dry Soil (g):	4842.57
Tare of Mold (g):	3363.00	Tare of Mold (g):	3363.00
Wet Density (pcf):	97.21	Wet Density (pcf):	99.76
Dry Density (pcf):	96.98	Dry Density (pcf):	96.98
% Saturation:	0.85%	% Saturation:	10.50%
% Moisture:	0.23%	% Moisture:	2.87%

Date YY	MM	DD	Time Sec.	Temp.	Flow Vol Readings	Flow Vol.	Head Bottom	Head Top	h	k_v* cm/sec
2000	11	2	60	25	531.9	139.58	110.1	110.2	0.1	2.1E+00
2000	11	2	60	25	532.1	139.78	110.1	110.2	0.1	2.1E+00
2000	11	2	60	25	532.1	139.78	110.1	110.2	0.1	2.1E+00
2000	11	2	60	25	532.3	139.98	110.1	110.2	0.1	2.2E+00

k_v = QL/Aht cm./sec.

Q = 139.78 ml. (ave. measured flow volume)

L = 3.313 in. (flow length)

A = 12.57 sq. cm. (area of sample)

h = 0.10 cm. (ave. head)

t = 60.00 sec. (average run time)

i = 0.03 (average gradient)

k_v = 2.1E+00 cm/sec (ave. k value)

* k_v adjusted for temperature

RMT, Inc.

Constant Head Permeability Test (ASTM D2434)

QC: [handwritten initials]
QA: [handwritten initials]

Project Name:	WEYERHAEUSER		
Project #:	5101.08	USCS Description:	N/A
Sample Name:	#67 Stone, RS-23	USCS Classification:	N/A
Visual Descript:	Poorly graded gravel	Average k_v =	2.1E+00 cm./sec.

Sample Diameter (in):	4.00		
Sample Height (in):	4.63		
Specific Gravity:	2.70		
Tare & Wet Soil (g):	532.50		
Tare & Dry Soil (g):	531.00		
Tare (g):	263.07	Beaker Tare Wt. (g):	392.32

	Initial Values		Final Values
Mold & Wet Soil (g):	4890.00	Mold & Wet Soil (g):	4930.00
Mold & Dry Soil (g):	4881.50	Mold & Dry Soil (g):	4881.50
Tare of Mold (g):	3363.00	Tare of Mold (g):	3363.00
Wet Density (pcf):	100.09	Wet Density (pcf):	102.71
Dry Density (pcf):	99.53	Dry Density (pcf):	99.53
% Saturation:	2.18%	% Saturation:	12.45%
% Moisture:	0.56%	% Moisture:	3.19%

Date			Time		Flow Vol	Flow	Head			k_v*
YY	MM	DD	Sec.	Temp.	Readings	Vol.	Bottom	Top	h	cm/sec
2000	11	2	60	25	530.8	138.48	110.0	110.1	0.1	2.1E+00
2000	11	2	60	25	531.2	138.88	110.0	110.1	0.1	2.1E+00
2000	11	2	60	25	531.4	139.08	110.0	110.1	0.1	2.1E+00
2000	11	2	60	25	531.2	138.88	110.0	110.1	0.1	2.1E+00

k_v = QL/Aht cm./sec.

Q = 138.83 ml. (ave. measured flow volume)

L = 3.313 in. (flow length)

A = 12.57 sq. cm. (area of sample)

h = 0.10 cm. (ave. head)

t = 60.00 sec. (average run time)

i = 0.03 (average gradient)

k_v = 2.1E+00 cm/sec (ave. k value)

* k_v adjusted for temperature

RMT, Inc.
Constant Head Permeability Test (ASTM D2434)

QC: JRS
QA: [illegible]

Project Name:	WEYERHAEUSER		
Project #:	5101.08	USCS Description:	N/A
Sample Name:	#67 Stone, RS-24	USCS Classification:	N/A
Visual Descript:	Poorly graded gravel	Average k_v =	2.1E+00 cm./sec.

Sample Diameter (in):	4.00		
Sample Height (in):	4.63		
Specific Gravity:	2.70		
Tare & Wet Soil (g):	606.00		
Tare & Dry Soil (g):	605.60		
Tare (g):	257.75	Beaker Tare Wt. (g):	392.32

	Initial Values		Final Values
Mold & Wet Soil (g):	4812.00	Mold & Wet Soil (g):	4849.00
Mold & Dry Soil (g):	4810.34	Mold & Dry Soil (g):	4810.34
Tare of Mold (g):	3363.00	Tare of Mold (g):	3363.00
Wet Density (pcf):	94.98	Wet Density (pcf):	97.40
Dry Density (pcf):	94.87	Dry Density (pcf):	94.87
% Saturation:	0.40%	% Saturation:	9.30%
% Moisture:	0.11%	% Moisture:	2.67%

Date YY	MM	DD	Time Sec.	Temp.	Flow Vol Readings	Flow Vol.	Head Bottom	Top	h	k_v* cm/sec
2000	11	2	60	25	530.8	138.48	110.5	110.6	0.1	2.1E+00
2000	11	2	60	25	531.4	139.08	110.5	110.6	0.1	2.1E+00
2000	11	2	60	25	530.9	138.58	110.5	110.6	0.1	2.1E+00
2000	11	2	60	25	531.3	138.98	110.5	110.6	0.1	2.1E+00

k_v = QL/Aht cm./sec.

Q = 138.78 ml. (ave. measured flow volume)

L = 3.313 in. (flow length)

A = 12.57 sq. cm. (area of sample)

h = 0.10 cm. (ave. head)

t = 60.00 sec. (average run time)

i = 0.03 (average gradient)

k_v = 2.1E+00 cm/sec (ave. k value)

* k_v adjusted for temperature

RMT, Inc.

Constant Head Permeability Test (ASTM D2434)

QC: JRS
QA: [illegible]

Project Name:	WEYERHAEUSER		
Project #:	5101.08	USCS Description:	N/A
Sample Name:	#67 Stone, RS-25	USCS Classification:	N/A
Visual Descript:	Poorly graded gravel	Average k_v =	2.1E+00 cm./sec.

Sample Diameter (in):	4.00		
Sample Height (in):	4.63		
Specific Gravity:	2.70		
Tare & Wet Soil (g):	560.30		
Tare & Dry Soil (g):	559.60		
Tare (g):	264.10	Beaker Tare Wt. (g):	392.32
	Initial Values		Final Values
Mold & Wet Soil (g):	4819.00	Mold & Wet Soil (g):	4859.00
Mold & Dry Soil (g):	4815.56	Mold & Dry Soil (g):	4815.56
Tare of Mold (g):	3363.00	Tare of Mold (g):	3363.00
Wet Density (pcf):	95.44	Wet Density (pcf):	98.06
Dry Density (pcf):	95.21	Dry Density (pcf):	95.21
% Saturation:	0.83%	% Saturation:	10.49%
% Moisture:	0.24%	% Moisture:	2.99%

Date YY	MM	DD	Time Sec.	Temp.	Flow Vol Readings	Flow Vol.	Head Bottom	Top	h	k_v* cm/sec
2000	11	2	60	25	529.4	137.08	110.1	110.2	0.1	2.1E+00
2000	11	2	60	25	531.0	138.68	110.1	110.2	0.1	2.1E+00
2000	11	2	60	25	531.1	138.78	110.1	110.2	0.1	2.1E+00
2000	11	2	60	25	531.2	138.88	110.1	110.2	0.1	2.1E+00

k_v = QL/Aht cm./sec.

Q = 138.36 ml. (ave. measured flow volume)

L = 3.313 in. (flow length)

A = 12.57 sq. cm. (area of sample)

h = 0.10 cm. (ave. head)

t = 60.00 sec. (average run time)

i = 0.03 (average gradient)

k_v = 2.1E+00 cm/sec (ave. k value)

* k_v adjusted for temperature

RMT, Inc.
Constant Head Permeability Test (ASTM D2434)

QC: JRS
QA: JBA

Project Name:	WEYERHAEUSER		
Project #:	5101.08	USCS Description:	N/A
Sample Name:	#67 Stone, RS-26	USCS Classification:	N/A
Visual Descript:	Poorly graded gravel	Average k_v =	2.1E+00 cm./sec.

Sample Diameter (in):	4.00		
Sample Height (in):	4.63		
Specific Gravity:	2.70		
Tare & Wet Soil (g):	549.50		
Tare & Dry Soil (g):	548.80		
Tare (g):	257.80	Beaker Tare Wt. (g):	392.32

	Initial Values		Final Values
Mold & Wet Soil (g):	4844.00	Mold & Wet Soil (g):	4887.00
Mold & Dry Soil (g):	4840.45	Mold & Dry Soil (g):	4840.45
Tare of Mold (g):	3363.00	Tare of Mold (g):	3363.00
Wet Density (pcf):	97.07	Wet Density (pcf):	99.89
Dry Density (pcf):	96.84	Dry Density (pcf):	96.84
% Saturation:	0.88%	% Saturation:	11.50%
% Moisture:	0.24%	% Moisture:	3.15%

Date YY	MM	DD	Time Sec.	Temp.	Flow Vol Readings	Flow Vol.	Head Bottom	Top	h	k_v * cm/sec
2000	11	2	60	25	531.5	139.18	110.1	110.2	0.1	2.1E+00
2000	11	2	60	25	531.4	139.08	110.1	110.2	0.1	2.1E+00
2000	11	2	60	25	531.5	139.18	110.1	110.2	0.1	2.1E+00
2000	11	2	60	25	531.6	139.28	110.1	110.2	0.1	2.1E+00

k_v = QL/Aht cm./sec.

Q = 139.18 ml. (ave. measured flow volume)

L = 3.313 in. (flow length)

A = 12.57 sq. cm. (area of sample)

h = 0.10 cm. (ave. head)

t = 60.00 sec. (average run time)

i = 0.03 (average gradient)

k_v = 2.1E+00 cm/sec (ave. k value)

* k_v adjusted for temperature

Perme[illegible] [illegible] Soils
(Constant Head)

Job No.:	1053-00-211	Spec. I.D:	SS-1	ASTM:	D2434
Job Name:	RMT Lab Services	Depth:		Tech:	JWA
Client:		Received:	11/3/00	Date:	11/6/00

Description of Soil: Brown Sand

Moisture Content:		Specimen Parameters:					
Tare:	H21	Dia. (in):	3.085	Area (in^2)	7.475	Avg. "K" (cm/sec)	3.1E-03
Tare wt.	8.51	Lgth. 1 (in):	5.156	Area (cm^2)	48.23		
Wet + tare	149.84	Lgth. 2 (in):	5.166	Vol. (cf)	0.0223		
Dry + tare	141.87	Lgth. 3 (in):	5.149	Weight (lb)	2.329		
Solids wt.	133.36	Avg. Lgth.(in):	5.157	Wet Dens.(pcf)	104.4		
Water wt.	7.97	Weight (g)	1056.25	% Moisture	6.0		
		Flow Lgth. (cm):	7.62	Dry Dens. (pcf)	98.5		

Test No.	Time, seconds			Manometer, (cm)		Head	Effluent	Effluent	Effluent +	Quantity	Q/A t	h/L	K
	Start	Stop	Elapsed, t	H_1	H_2	h, cm	cont. #	cont. wt.	cont. wt.	Q, cm^3			cm/s
1			120	16.9	80.9	64.0	4	77.67	245.21	167.54	0.028948	8.398950	3.447E-03
2			120	16.7	79.1	62.4	4	77.67	225.93	148.26	0.025617	8.188976	3.128E-03
3			120	16.7	77.2	60.5	4	77.67	214.50	136.83	0.023642	7.939633	2.978E-03
4			120	16.9	77.2	60.3	4	77.67	212.59	134.92	0.023312	7.913386	2.946E-03

Perme[illegible] Soils
(Constant Head)

Job No.:	1053-00-211	Spec. I.D:	SS-2	ASTM:	D2434
Job Name:	RMT Lab Services	Depth:		Tech:	JWA
Client:		Received:	11/3/00	Date:	11/7/00

Description of Soil: Brown Sand

Moisture Content:		Specimen Parameters:					
Tare:	H11	Dia. (in):	3.085	Area (in^2)	7.475	Avg. "K"	
Tare wt.	8.17	Lgth. 1 (in):	5.175	Area (cm^2)	48.23	(cm/sec)	3.2E-03
Wet + tare	185.73	Lgth. 2 (in):	5.167	Vol. (cf)	0.0223		
Dry + tare	174.75	Lgth. 3 (in):	5.110	Weight (lb)	2.34		
Solids wt.	166.58	Avg. Lgth.(in):	5.151	Wet Dens.(pcf)	104.9		
Water wt.	10.983	Weight (g)	1061.28	% Moisture	6.6		
		Flow Lgth. (cm):	7.62	Dry Dens. (pcf)	98.4		

Test No.	Time, seconds			Manometer, (cm)		Head	Effluent	Effluent	Effluent +	Quantity	Q/At	h/L	K
	Start	Stop	Elapsed, t	H_1	H_2	h, cm	cont. #	cont. wt.	cont. wt.	Q, cm^3			cm/s
1			120	18.9	88.7	69.8	4	77.67	235.38	157.71	0.027250	9.160105	2.975E-03
2			120	18.5	86.8	68.3	4	77.67	253.25	175.58	0.030337	8.963255	3.385E-03
3			120	18.0	83.7	65.7	4	77.67	238.27	160.6	0.027749	8.622047	3.218E-03
4			120	18.4	82.6	64.2	4	77.67	237.53	159.86	0.027621	8.425197	3.278E-03

Perm Soils
(Constant Head)

Job No.: 1053-00-211
Job Name: RMT Lab Services
Client:
Description of Soil: Brown Sand

Spec. I D: SS-3
Depth:
Received: 11/3/00

ASTM: D2434
Tech: JWA
Date: 11/7/00

Moisture Content:

Tare:	HD6
Tare wt.	8.31
Wet + tare	215.46
Dry + tare	203.37
Solids wt.	195.06
Water wt.	12.09

Specimen Parameters:

Dia. (in):	3.085	Area (in^2)	7.475
Lgth. 1 (in):	5.136	Area (cm^2)	48.23
Lgth. 2 (in):	5.145	Vol. (cf)	0.0223
Lgth. 3 (in):	5.160	Weight (lb)	2.307
Avg. Lgth.(in):	5.147	Wet Dens.(pcf)	103.5
Weight (g)	1046.29	% Moisture	6.2
Flow Lgth. (cm):	7.62	Dry Dens. (pcf)	97.5

Avg. "K" (cm/sec) 3.3E-03

Test No.	Time, seconds			Manometer, (cm)		Head h, cm	Effluent cont. #	Effluent cont. wt.	Effluent + cont. wt.	Quantity Q, cm^3	Q/A t	h/L	K cm/s
	Start	Stop	Elapsed, t	H_1	H_2								
1			120	18.2	76.8	58.6	4	77.65	232.67	155.02	0.026785	7.690289	3.483E-03
2			120	18.7	76.9	58.2	4	77.65	231.8	154.15	0.026635	7.637795	3.487E-03
3			120	18.2	78.4	60.2	4	77.65	220.42	142.77	0.024668	7.900262	3.122E-03
4			120	18.3	78.2	59.9	4	77.65	222.25	144.6	0.024984	7.860892	3.178E-03

Perm ... lar Soils
(Constant Head)

Job No.: 1053-00-211
Job Name: RMT Lab Services
Client:
Description of Soil: Brown Sand

Spec. I D: SS-10
Depth:
Received: 11/3/00

ASTM: D2434
Tech: JWA
Date: 11/8/00

Moisture Content:

Tag:	H6
Tare wt.	8.22
Wet + tare	236.78
Dry + tare	223.23
Solids wt.	215.01
Water wt.	13.55

Specimen Parameters:

Dia. (in):	3.085	Area (in^2)	7.475
Lgth. 1 (in):	5.118	Area (cm^2)	48.23
Lgth. 2 (in):	5.118	Vol. (cf)	0.0222
Lgth. 3 (in):	5.157	Weight (lb)	2.32
Avg. Lgth.(in):	5.131	Wet Dens.(pcf)	104.5
Weight (g)	1052.32	% Moisture	6.3
Flow Lgth. (cm):	7.62	Dry Dens. (pcf)	98.3

Avg. "K" (cm/sec) 3.4E-03

Test No.	Time, seconds			Manometer, (cm)		Head h, cm	Effluent cont. #	Effluent cont. wt.	Effluent + cont. wt.	Quantity Q, cm^3	Q/At	h/L	K cm/s
	Start	Stop	Elapsed, t	H_1	H_2								
1			120	19.9	82.7	62.8	4	77.65	242.02	164.37	0.028400	8.241470	3.446E-03
2			120	20.3	83.0	62.7	4	77.65	240.73	163.08	0.028177	8.228346	3.424E-03
3			120	20.3	83.4	63.1	4	77.65	239.39	161.74	0.027946	8.280840	3.375E-03
4			120	20.7	84.4	63.7	4	77.65	238.59	160.94	0.027808	8.359580	3.327E-03

SME

Pern [illegible] ular Soil
(Constant Head)

Job No.: 1053-00-211
Job Name: RMT Lab Services
Client:
Description of Soil: Brown Sand

Spec. I.D: SS-11
Depth:
Received: 11/3/00

ASTM: D2434
Tech: JWA
Date: 11/8/00

Moisture Content:

Tare:	H11
Tare wt.	8.16
Wet + tare	179.37
Dry + tare	169.04
Solids wt.	160.88
Water wt.	10.33

Specimen Parameters:

Dia. (in):	3.085	Area (in^2)	7.475
Lgth. 1 (in):	5.000	Area (cm^2)	48.23
Lgth. 2 (in):	5.000	Vol. (cf)	0.0216
Lgth. 3 (in):	5.000	Weight (lb)	2.261
Avg. Lgth (in):	5.000	Wet Dens. (pcf)	104.7
Weight (g)	1025.61	% Moisture	6.4
Flow Lgth. (cm):	7.62	Dry Dens. (pcf)	98.4

Avg. "K" (cm/sec) 2.9E-03

Test No.	Time, seconds			Manometer, (cm)		Head h, cm	Effluent cont. #	Effluent cont. wt.	Effluent + cont. wt.	Quantity Q, cm^3	Q/A t	h/L	K cm/s
	Start	Stop	Elapsed, t	H_1	H_2								
1			120	39.3	99.9	60.6	6	78.86	222.74	143.88	0.024860	7.952756	3.126E-03
2			120	39.3	100.0	60.7	6	78.86	221.29	142.43	0.024610	7.965879	3.089E-03
3			120	36.0	98.2	62.2	6	78.86	204.40	125.54	0.021691	8.162730	2.657E-03
4			120	35.9	98.1	62.2	6	78.86	204.42	125.56	0.021695	8.162730	2.658E-03