Large-Scale Sediment Retention Device Testing (ASTM D 7351)

of a

Heavyweight™ Wattle on Sandy Loam

October 2007

Submitted to:
World Textile and Bag, Inc
2319 thistle Down Drive
Roseville, CA 95661

Attn: Mr. Richard Quinley

Submitted by:
TRI/Environmental, Inc.
9063 Bee Caves Road
Austin, TX 78733

C. Joel Sprague
Project Manager

October 20, 2007

Mr. Richard Quinley
World Textile and Bag, Inc
2319 thistle Down Drive
Roseville, CA 95661

E-mail: rich@wtbinc.net

Subject: Sediment Retention Device Testing of Heavyweight™ Wattle on Sandy Loam (Log # 2278-01-17)

Dear Mr. Quinley:

This letter report presents the results for large-scale sediment retention device tests performed on a synthetic wattle on sandy loam. Included are data developed for simulated sediment-laden runoff from a 100-ft long, 3:1 slope. All testing work was performed in general accordance with the ASTM D 7351, *Standard Test Method For Determination Of Sediment Retention Device Effectiveness In Sheet Flow Applications*. Generated results were used to develop the following effectiveness percentages for the tested materials:

Heavyweight™ Wattle = 96.60% Soil Retention Effectiveness

Heavyweight™ Wattle = 18.75% Water Retention Effectiveness

TRI is pleased to present this final report. The data presented herein appears to be consistent with commonly reported values. Please feel free to call if we can answer any questions or provide any additional information.

Sincerely,

C. Joel Sprague

C. Joel Sprague, P.E.
Senior Engineer
Geosynthetics Services Division

Cc: Sam Allen, Jarrett Nelson - TRI

SEDIMENT RETENTION DEVICE (SRD) TESTING REPORT

Heavyweight™ Wattles on Sandy Loam

TESTING EQUIPMENT AND PROCEDURES

Overview of Test and Apparatus

TRI/Environmental, Inc.'s (TRI's) large-scale sediment retention device testing facility is located at the Denver Downs Research Farm in Anderson, SC. Testing oversight is provided by C. Joel Sprague, P.E. The large-scale testing is performed in accordance with ASTM D 7351. Sediment-laden water is allowed to "sheet flow" up to and seep through, over, and/or under an installed sediment retention device (SRD). At a minimum, the amount (via water and soil weight) of sediment-laden flow is measured both upstream and downstream of the SRD. The measurement of sediment that passes through, over, and/or under the SRD compared to the amount in the upstream flow is used to quantify the effectiveness of the SRD in retaining sediments.

The effectiveness of SRDs is installation dependent. Thus, replicating field installation techniques is an important aspect of this test method. This test method is full-scale and therefore, appropriate as an indication of product performance, for general comparison of product capabilities, and for assessment of product installation techniques.

A single replicate test was performed. The test apparatus is shown in Figures 1 thru 4.

Sediment Retention Device (SRD)

The following properties describe the tested SRD.

Table 1. Tested SRD Properties: Heavyweight™ Wattle

Index Property	Units	Test 1
Roll Dimensions (reported)	in	5" high with geotextile "tail"
Roll Length	ft	20
Fill Composition	-	Synthetic fully rebound foam
Envelope Composition	-	Monofilament filter fabric (#40 US Sieve; 100 gal/sf flow)

Test Soil

The test soil used in the test plots had the following characteristics.

Table 2. TRI-Loam Characteristics

Soil Characteristic	Test Method	Value
% Gravel	ASTM D 422	2
% Sand		60
% Silt		24
% Clay		14
Liquid Limit, %	ASTM D 4318	34
Plasticity Index, %		9
Soil Classification	USDA	Sandy Loam
Soil Classification	USCS	Silty Sand (SM)

Test Setup

SRD Installation – The Sediment Retention Device (SRD) is installed in the installation zone which is comprised of the same soil to be used as sediment. The soil depth is in excess of the depth of SRD installation and compacted to 90±3% of Standard Proctor maximum dry density, at a soil moisture within ±3% of optimum moisture content per ASTM D-698. The SRD length exposed to flow between end abutments was 16 ft.

Mixing Sediment-Laden Runoff - Sediment-laden runoff was created by combining water and soil in the mixing tank and agitated during the test. 4000 lb of water and 240 lb of soil were combined to create the sediment-laden runoff. This amount of water and sediment simulates sheet flow from a slope measuring 16 ft (4.8 m) wide by 100 ft (30 m) long during the peak 30 minutes of a 4 in (100 mm) per hour rainfall hydrograph. The following calculation (which is outlined in the standard) was modified for the narrower slope (i.e. 16 ft vs. 20 ft) . . .

"For this testing, a standard 10-year, 6-hour storm event (mid-Atlantic region of US) was selected. This return frequency is commonly used for sizing sediment control ponds and, thus, was deemed appropriate for the testing of other SRDs. Using this criterion, a 100 mm (4 in) rainfall was selected. It was also assumed that approximately 25% of the storm would occur during the peak 30 minutes, and that 50% of the rainfall would infiltrate into the ground. (Goldman, et al, 1986) A theoretical contributory area of 30 m (100 ft) slope length by 6 m (20 ft) wide was selected to limit runoff to sheet flow conditions. (Richardson, 1990). Runoff and associated sediment were calculated using the Modified Universal Soil Loss Equation (MUSLE) which allows for calculating a storm-specific quantity of sediment. Following is the MUSLE (SI formula):

$$T = 89.6\ (V \times Q_p)^{0.56}\ K\ LS\ C\ P$$

Where: T = sediment yield (tonnes); V = runoff (m^3) = (Rainfall – Infiltration) x Area; Q_p = peak flow (m^3/s); and K, LS, C, P are from RUSLE charts

The following calculations provided the runoff and sediment load used in the testing:

$V = (0.5)^* \times (0.1\ m) \times (180\ m^2) = 9\ m^3$

$Q_p = (0.1m) \times (0.25)^* \times (0.5)^{**} \times (180m^2) = 2.25\ m^3/\ 30min = 0.00125\ m^3/s$

(= 25% of storm during 30-min peak; ** = 50% infiltration)*

K, sandy-silt = 0.041; LS, 2-10%/30m = 0.46 (approx); C, P = 1.0

$T = 89.6\ (9 \times 0.00125)^{0.56}\ (0.041)\ (0.46)\ (1.0)\ (1.0) = 0.136$ *Tonnes = 136 kg of soil*

(assume most sediment is generated during the peak flow period)

Std. Test Quantities: 30-Minute Runoff: $2.25\ m^3 \times 1000\ kg/m^3 = 2250$ *kg (approx. 5000 lb)*

Sediment Load: 136 kg (approx. 300 lb)"

***[References:** Goldman, S.J., Jackson, K., and Bursztynsky, T.A., 1986, Erosion and Sediment Control Handbook, McGraw-Hill, p. 8.17.; Richardson, G.N. and Middlebrooks, P., 1991, "A Simplified Design Method for Silt Fences", Proceedings of Geosynthetics '91, Atlanta, GA, IFAI, pp. 879-888.]"*

Actual Test Quantities adjusted for 16 ft wide slope:

30-Minute Runoff: 5000 lb x (16 ft / 20 ft) = 4000 lb
Sediment Load: 300 lb x (16 ft / 20 ft) = 240 lb

Installation of Sediment Retention Device

As noted, the submitted SRD is installed as directed by the client. For the tests reported herein, the SRD was placed on a 4 x 4 "curb" adjacent to a 4 inch deep trench. The product "tail" was anchored in the trench using 6-inch nails with washers every 3 ft along the length of the product, then backfilling with 2 inches of compacted soil.

Figure 1. Installing Wattle on Curb with "tail" in 4-inch Trench; Backfilled with 2 inches of Soil

Test Procedure

Releasing, and Collecting Sediment-Laden Runoff - The sediment-laden water was discharged evenly for 30 minutes. The quantity of released runoff was measured at 5-minute intervals by noting the reduction in weight in the mixing tank, adjusting the valve on the tank outlet to increase/decrease flow to stay as close as possible to the target (4240 lb / 30 min = 140 lb / min). The discharge flow is spread out to impact the full length of the SRD. Retention observations and ponding depths, and associated times, are recorded during the test.

As runoff passing the SRD enters the collection tank, the weight of the collection tank is recorded and grab samples are taken, at 5 minute intervals. Cutoff time is the earlier of 90 minutes or when there is low-volume ponding and minimal discharge.

Collecting and Measuring Sediments - All sediments passing the SRD are collected, dried, and measured. Grab samples are evaluated in a lab to determine turbidity using a Hach 2100 AN Turbidimeter and to determine percent dry solids content. Drying of collected sediments is accomplished in a forced air oven at 110°C for a minimum of 24 hours or until all moisture is driven off, whichever is greater. All weighing of sediments is done with laboratory scales accurate to ± 0.01 lbs.

Figure 2. Typical Runoff Condition

Figure 3. Location of Downstream Sampling and Collection

Figure 4. Seepage (left) and Ponding (right) as Wattle Intercepts Runoff

Figure 5. End of Test

TEST RESULTS

Total sediment and associated runoff measured during the testing are the principle data used to determine the performance of the product tested. This data is entered into a spreadsheet (see appendix) that transforms the sediment concentration and collected runoff into the retention effectiveness values shown in Table 3. Graphs showing upstream and downstream gradations, runoff/seepage, and sediment load/loss are shown in Figures 6, 7 and 8.

Table 3. Overall Efficiency Factor

Product	Percent Retention Effectiveness
Heavyweight™ Wattle	Soil: 96.60%
Heavyweight™ Wattle	Water: 18.75%

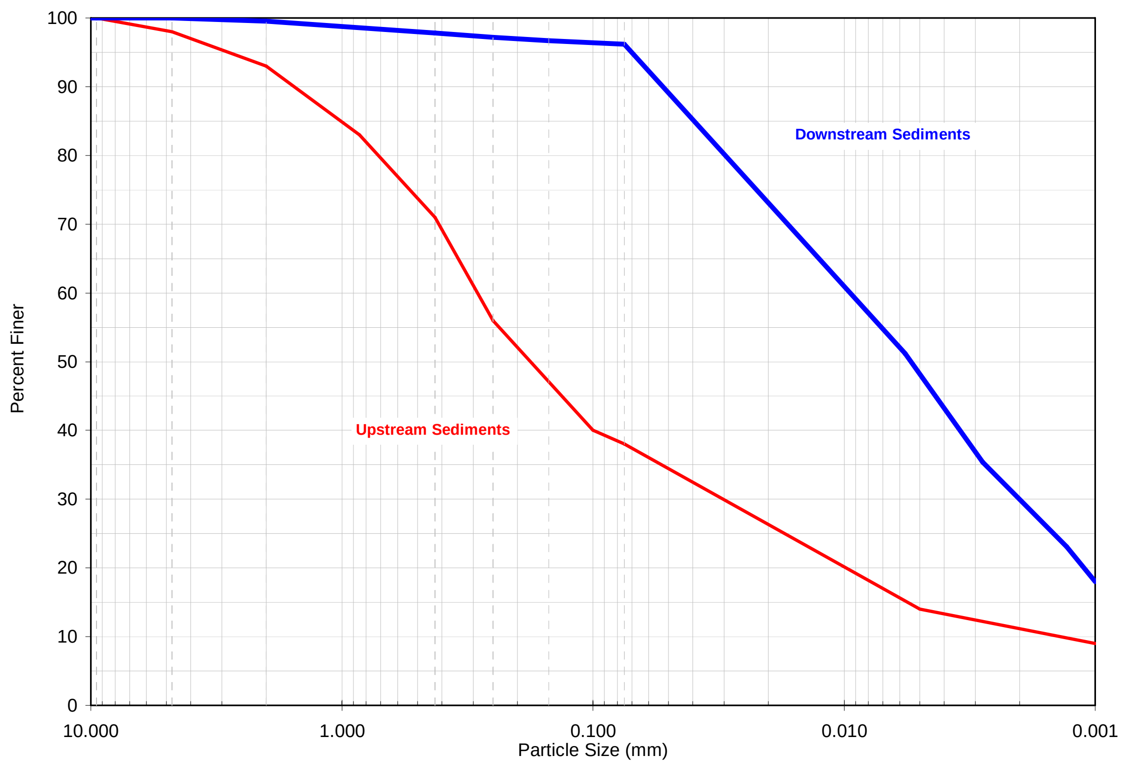


Figure 6. Upstream / Downstream Sediment Gradations

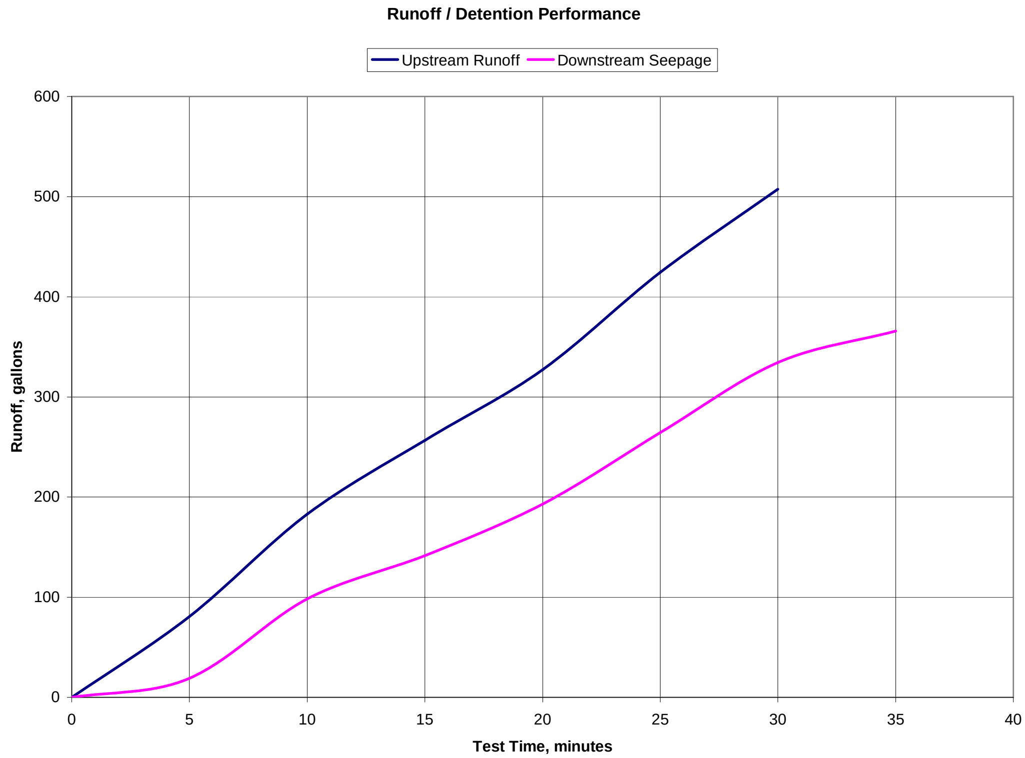


Figure 7. Runoff / Seepage vs. Time

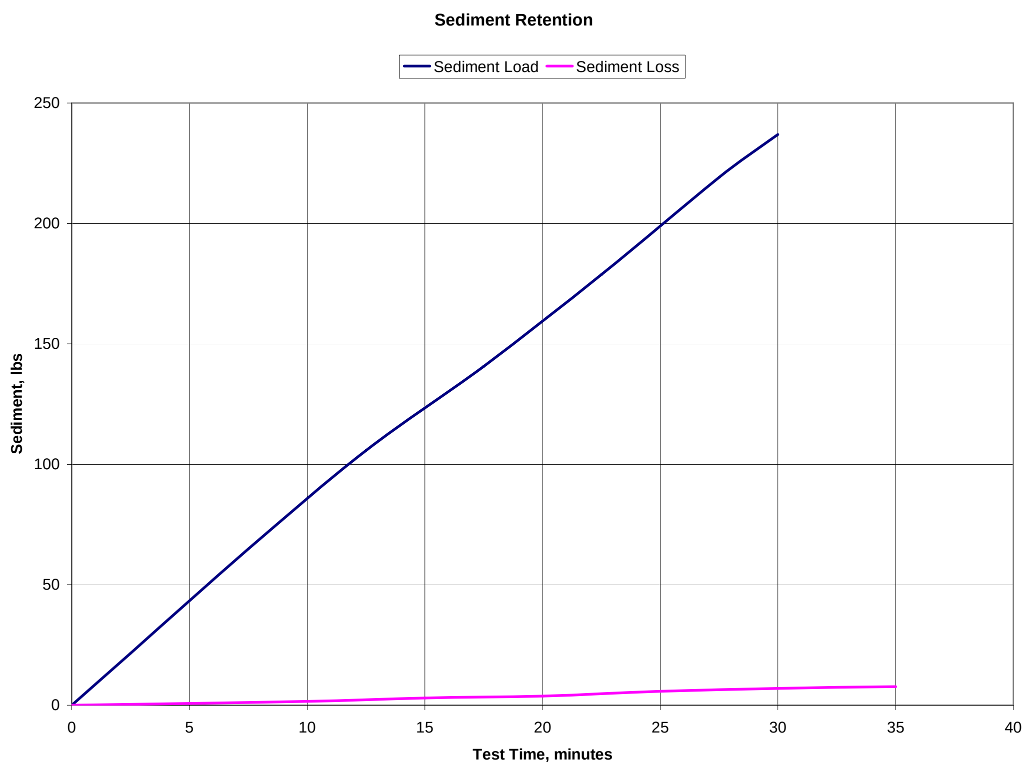


Figure 8. Sediment Load / Loss vs. Time

APPENDIX A – RECORDED DATA

Test Record Sheet

ASTM D 7351 - SEDIMENT RETENTION DEVICE (SRD) TESTING

TEST I.D.: WTB-SRD-HvyWtWattle DATE: 10/9/07

SRD Device & Installation Details, including Product Description and Width of Installation:

Heavy Weight Wattle – 5" high synthetic fully rebound foam wrapped with filter fabric; 20-ft long;

(filter fabric specification: #40 US sieve AOS; 100 gal/sf flow; monofilament)

Initial Weight = Final Weight

Installed in 4-inch trench with pins at 3' centers; backfilled 2" compacted

Soil Subgrade Type: Loam **Sediment Type:** Loam

Sediment Weight: 240 lbs **Runoff Weight**: 4000 lbs

Runoff Discharge- Start Time:1:00pm **Finish Time**:1:30pm

Upstream Runoff			Downstream Runoff				SRD		
Time	Sample #	Reservior Weight (lbs)	Time	Sample #	Collected Weight (lbs)	Collected Height (in)	Time	Ponding Height (in)	Observation #
0	U1	4240	0				2:20	2"	1
5	U2	3568	5	D-1	160	1.5	5	3	
10	U3	2712	10	D-2	822	3	10	3	
15	U4	2100	15	D-3	1180	4	15	4	
20	U5	1510	20	D-4	1610	4.75	20	4.5	
25	U6	700	25	D-5	2206	6	25	4.75	
30	U7	8	30	D-6	2790	7	30	4.75	
35			35	D-7	3050	7.5	35		
40			40	D-8	3168	8	40		
45			45	D-9	3220	8.25	45		
60			60	D-10	3250	8.5	60		
75			75	D-11	3258	8.5	75		
90			90	D-12			90		

OBSERVATIONS:

1. Initial breakthrough

2.

3.

APPENDIX B – CALCULATIONS

Effectiveness Calculation Spreadsheet

Retention Effectiveness Calculations
10/9/2007

Sample Number	Test Time, minutes	Turbidity	Total Weight, g	Decanted Weight, g	Dry Weight, g	Bottle Weight, g	Dry Sediment Weight, mg	Total Collected Water Wt., g	Total Collected Volume of Water, l	Sediment Concentration, mg/l	% Solids	Reservoir Weight, lb	Associated Discharge, gal	Cumm Discharge, gal	Associated Solids Loss, lbs	Soil Retention Effectiveness, %	Water Retention Effectiveness, %
Upstream																	
U-1	0	> 10000	307.4	58.7	49.5	32.90	16600	257.90	0.26	64366	6.44%	4240	40	0	21.63		
U-2	5	> 10000	311.2	55.1	47.8	32.90	14900	263.40	0.26	56568	5.66%	3568	92	81	43.22		
U-3	10	> 10000	308.0	56.2	47.4	32.90	14500	260.60	0.26	55641	5.56%	2712	88	183	40.85		
U-4	15	> 10000	305.2	56.9	47.9	32.90	15000	257.30	0.26	58298	5.83%	2100	72	257	35.04		
U-5	20	> 10000	302.6	54.1	46.8	32.90	13900	255.80	0.26	54339	5.43%	1510	84	327	38.04		
U-6	25	> 10000	303.6	54.9	46.7	32.90	13800	256.90	0.26	53717	5.37%	700	90	424	40.35		
U-7	30	> 10000	303.0	54.2	46.1	32.90	13200	256.90	0.26	51382	5.14%	8	41	507	17.78		
Water Added To Mixer (lbs): 4000					Soil Added To Mixer (lbs): 240				AVGS:	56330	5.63%	TOTALS:	507		236.91		
Downstre	0													0			
D-1	5	1737	293.2	37.9	33.5	32.90	600	259.70	0.26	2310	0.23%	160	40	19	0.76		
D-2	10	1574	292.8	37.4	33.3	32.90	400	259.50	0.26	1541	0.15%	822	61	99	0.79		
D-3	15	2725	300.5	39.6	33.8	32.90	900	266.70	0.27	3375	0.34%	1180	47	141	1.33		
D-4	20	2445	306.5	39.1	33.4	32.90	500	273.10	0.27	1831	0.18%	1610	61	193	0.94		
D-5	25	9002	314.5	40.3	33.8	32.90	900	280.70	0.28	3206	0.32%	2206	71	264	1.89		
D-6	30	10000	293.2	40.1	33.7	32.90	800	259.50	0.26	3083	0.31%	2790	51	334	1.30		
D-7	35	5491	304.4	39.2	33.6	32.90	700	270.80	0.27	2585	0.26%	3050	30	366	0.64	**96.60%**	**18.75%**
D-8	40	4225	315.1	40.4	33.5	32.90	600	281.60	0.28	2131	0.21%	3168	13	380	0.24		
D-9	45	3626	316.1	40.1	33.3	32.90	400	282.80	0.28	1414	0.14%	3220	7	386	0.08		
D-10	60	2942	317.0	38.8	33.3	32.90	400	283.70	0.28	1410	0.14%	3250	3	390	0.03		
D-11	75	2606	314.1	38.3	33.0	32.90	100	281.10	0.28	356	0.04%	3258	0	391	0.00		
D-12	90																
Soil Collected from Apron (lbs): 0.95					**Soil Remaining in Mixer 3.20**					2289	0.21%	3258	383		8.00		
Soil Collected from Tank & Apron 8.04										(avg)	(avg)	(total)	(total)		(approx.)		
Dirty Wattle Weight (after test): n/a					**Clean Wattle Weight (before test): n/a**												

APPENDIX C – TEST SOIL

Test Soil Grain Size Distribution Curve

QORE PROPERTY SCIENCES

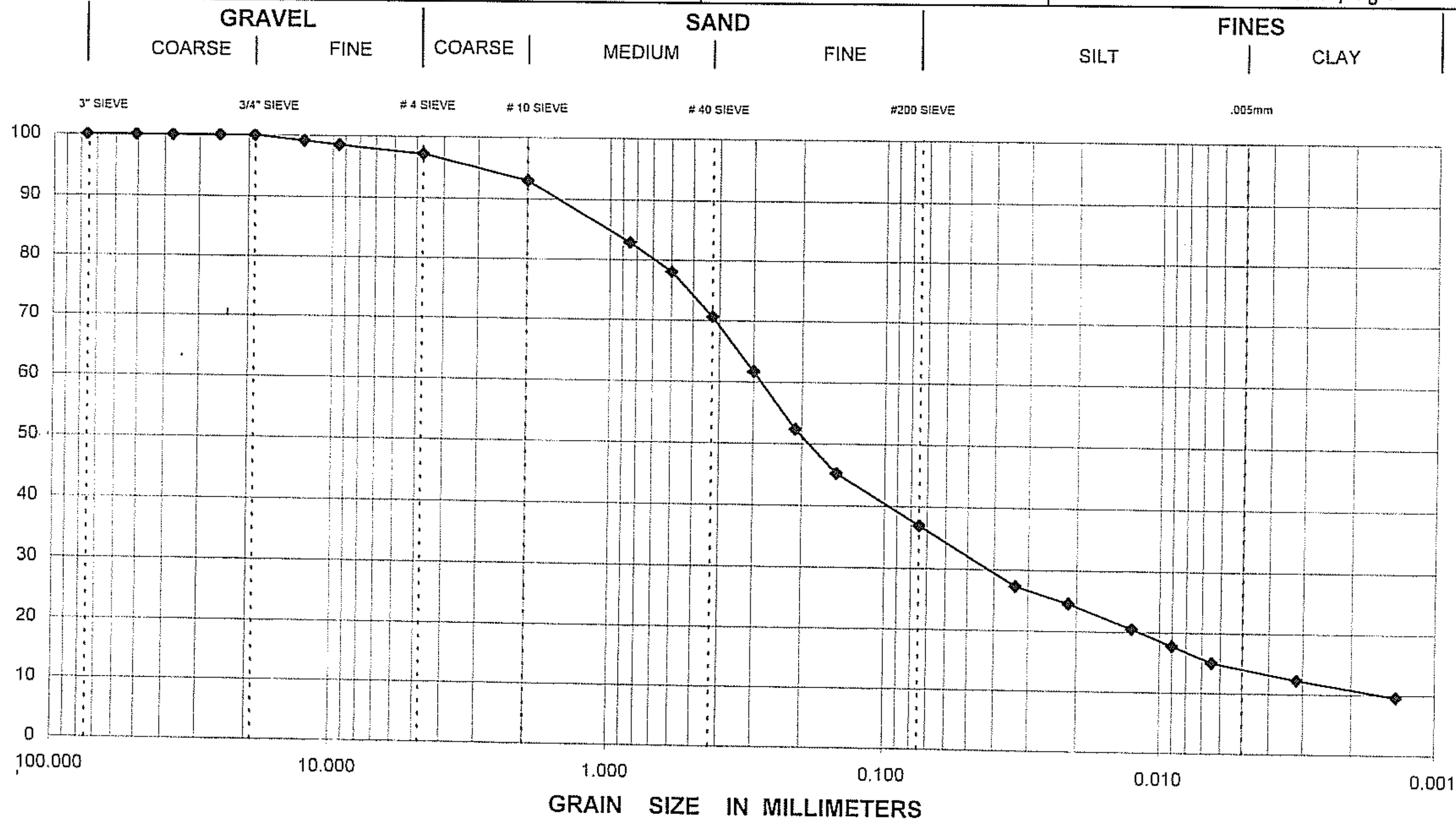
PARTICLE- SIZE DISTRIBUTION TEST REPORT

SIEVE AND HYDROMETER ASTM D422

REV1,9/17/03

AASHTO R18

JOB NAME :	Sprague & Sprague - General Laboratory Testing						
JOB NO. :	7752	REPORT NO. :	118471	DATE :	8/6/07	REVIEWED BY :	EWW
BORING / PIT NO. :	-	DEPTH / ELEV. :	-	SAMPLE NO. :	1	SAMPLE TYPE :	Bulk
SAMPLE LOCATION :							
SOIL DESCRIPTION :	Brown Silty Fine to Medium Sand					SP. GRAVITY, Gs :	2.63
LIQUID LIMIT, % :	34	PLASTICITY INDEX , % :	9	MOISTURE , % :	-	FINES , % :	36.9
D10 , MM :	0.0015	D30 , MM :	0.042	D60 , MM :	0.28	COEFF. OF CURVATURE , C_C :	4.2
CLASSIFICATION		UNIFIED :	SM	AASHTO :	-	COEFF. OF UNIFORMITY , C_U :	186.7



APPENDIX D – LABORATORY QUALIFICATIONS

Testing Expertise

TRI/Environmental (TRI) is a leading, accredited geosynthetic, plastic pipe, and erosion and sediment control product testing laboratory. TRI's large-scale erosion and sediment control testing facility in the upstate of South Carolina at the Denver Downs Research Farm (DDRF) is initially focused on the following full-scale erosion and sediment control performance tests:

- ASTM D 6459: Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion;
- ASTM D 6460: Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Earthen Channels from Stormwater-Induced Erosion;
- ASTM D 7208: Determination of Temporary Ditch Check Performance in Protecting Earthen Channels from Stormwater-Induced Erosion.
- ASTM D 7351: Determination of Sediment Retention Device Effectiveness In Sheet Flow Applications.

Technical Oversight

Joel Sprague, P.E., TRI's Senior Engineer provides technical oversight of all of TRI's erosion and sediment control testing and can be contacted at:

Mr. C. Joel Sprague, Senior Engineer
PO Box 9192, Greenville, SC 29604
Ph: 864/242-2220; Fax 864/242-3107; jsprague@tri-env.com

Mr. Sprague has been involved with the design of erosion and sediment control systems and the research, development, and application of erosion and sediment control products/materials for many years. He was the lead consultant in the development of bench-scale testing procedures for the Erosion Control Technology Council. Mr. Sprague has authored numerous technical papers on his research and is readily available to assist clients with their research and testing needs.

Operations Management

Sam Allen, TRI's Division Vice President provides operational management of all TRI laboratories and can be contacted at:

Mr. Sam Allen, Vice President & Program Manager
9063 Bee Caves Road
Austin, TX 78733
Ph: 512/263-2101; Fax: 512/263-2558; sallen@tri-env.com

Mr. Allen pioneered the laboratory index testing of rolled erosion control products (RECPs) and has been actively involved in the development and standardization of testing protocol and apparatus for more than 10 years. He set up and oversees TRI's erosion and sediment control testing laboratories. His oversight responsibilities include test coordination, reporting, and failure resolution associated with the National Transportation Product Evaluation Program (NTPEP) for RECPs.