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

# of

# GeoHay Sediment Retention Devices

**October 2008**

Submitted to:
GeoHay, LLC
PO Box 160040
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Attn: Ms. Kellyn Hargett

Submitted by:
TRI/Environmental, Inc.
9063 Bee Caves Road
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C. Joel Sprague
Project Manager

TRI/ENVIRONMENTAL, INC.
A Texas Research International Company

October 14, 2008

**Ms. Kellyn Hargett**
GeoHay, LLC
PO Box 160040
Spartanburg, SC 29316

E-mail: kellyn@geohay.com

**Subject: GeoHay** Sediment Retention Device Testing (Log # 2278-01-29)

Dear Ms. Hargett:

This letter report presents the results for large-scale sediment retention device tests performed on GeoHay products. A variety of products were tested. 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:

| Property | GeoHay Product | | | |
|---|---|---|---|---|
| | 15-inch Roll | 12-inch Roll | 15-inch Square Bale | 9-inch Tube |
| Soil Retention Effectiveness | 98.17% | 94.62% | 99.43% | 94.86% |
| Water Retention Effectiveness | 24.61% | 9.32% | 81.28% | 9.06% |

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, P.E.
Senior Engineer
Geosynthetics Services Division

Cc: Sam Allen, Jarrett Nelson - TRI

# SEDIMENT RETENTION DEVICE (SRD) TESTING REPORT

## GeoHay Sediment Retention Devices

### 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.

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. *For this testing, a simulated trench installation comprised of a wooden "box" section and wood insert was used to simulate the slight depression frequently used beneath SRDs. This eliminated soil surface irregularities as a variable in the testing and facilitated multiple test repetitions during a single day of testing.*

A single replicate test was performed for each SRD type. The test apparatus is shown in Figures 1 and 2.

### Sediment Retention Device (SRD)

The following table describes the tested SRDs.

**Table 1. Tested SRD Descriptions**

| All Products Consist of Recycled Carpet Fibers | | | |
|---|---|---|---|
| 15-inch Roll | 12-inch Roll | 15-inch Square Bale | 9-inch Tube |

### Test Soil

The test soil used as sediment 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 typically 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. *For this testing the soil was covered with a moisture-proof covering to facilitate repeated testing on the same day*.

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 this testing, a simulated trench installation comprised of a wooden "box" section and wood insert was used to simulate the slight depression frequently used beneath SRDs. This eliminated soil surface irregularities as a variable in the testing and facilitated multiple test repetitions during a single day of testing.*

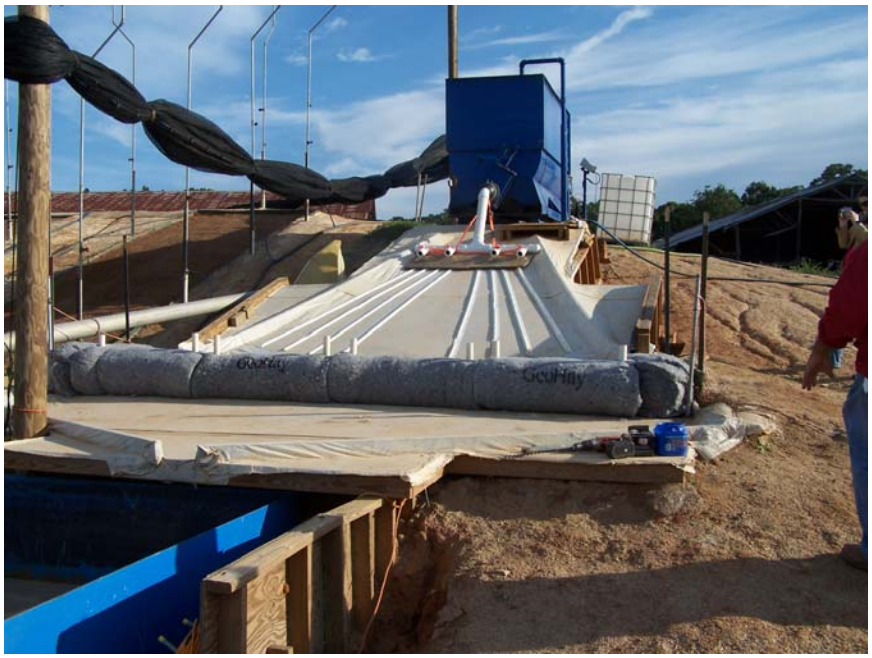


Figure 1. SRD Installed Along and Above Wooden Box Trench

## 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 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. 15-inch Roll Test**

**Figure 4. 12-inch Roll Test**

**Figure 5. 15-inch Square Bale Test**

**Figure 6. 9-inch Tube 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 summarizing test data are shown in Figures 7 thru 9. Turbidity samples were not taken to determine if any change in turbidity resulted from the measured short-term silt fence performance. In previous testing, no significant difference in upstream (runoff) and downstream (short-term seepage) turbidity was found. This is likely the result of the inadequate time afforded for settlement of fine-grained suspended soil particles during the test.

**Table 3. Measures of Effectiveness**

| Property | Control | All Products Consist of Recycled Carpet Fibers | | | |
|---|---|---|---|---|---|
| | | 15-inch Roll | 12-inch Roll | 15-inch Square Bale | 9-inch Tube |
| Soil Retention Effectiveness | 79.98% | 98.17% | 94.62% | 99.43% | 94.86% |
| Water Retention Effectiveness | 1.05% | 24.61% | 9.32% | 81.28% | 9.06% |

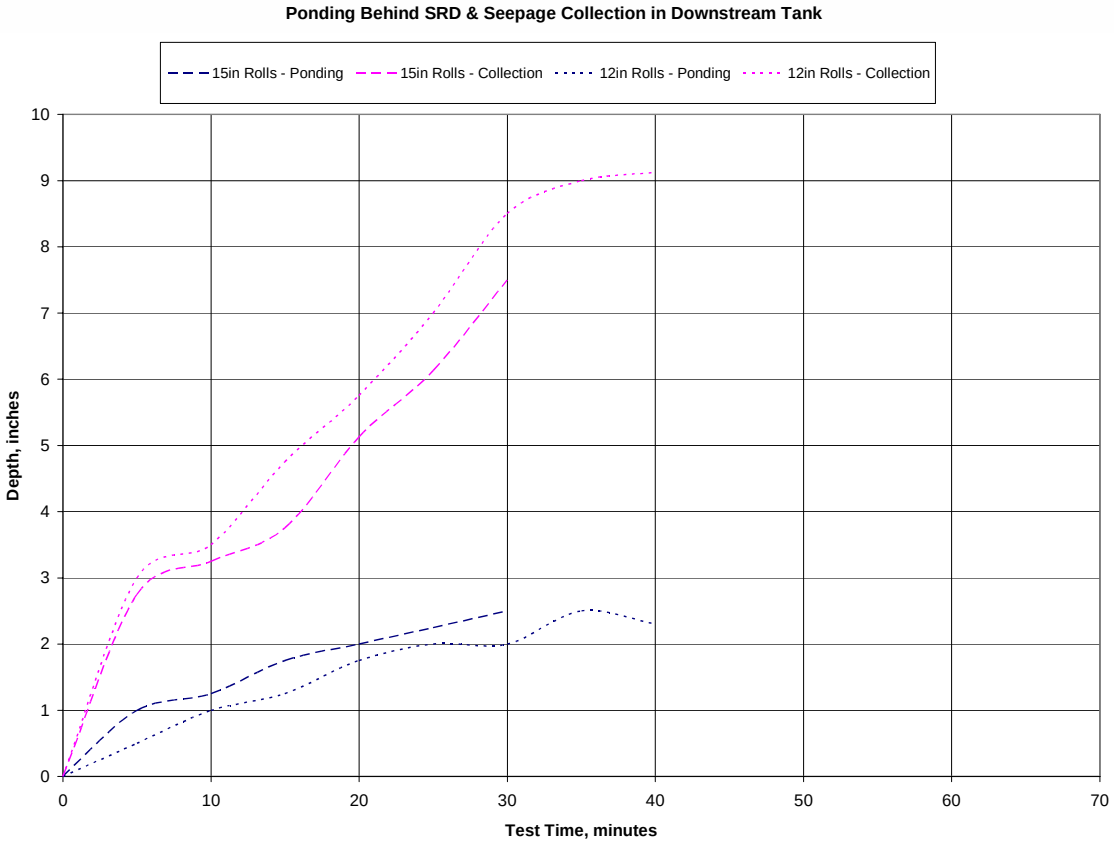



**Figure 7. Ponding Behind SRDs and Depth of Seepage Collected in Downstream Tank**

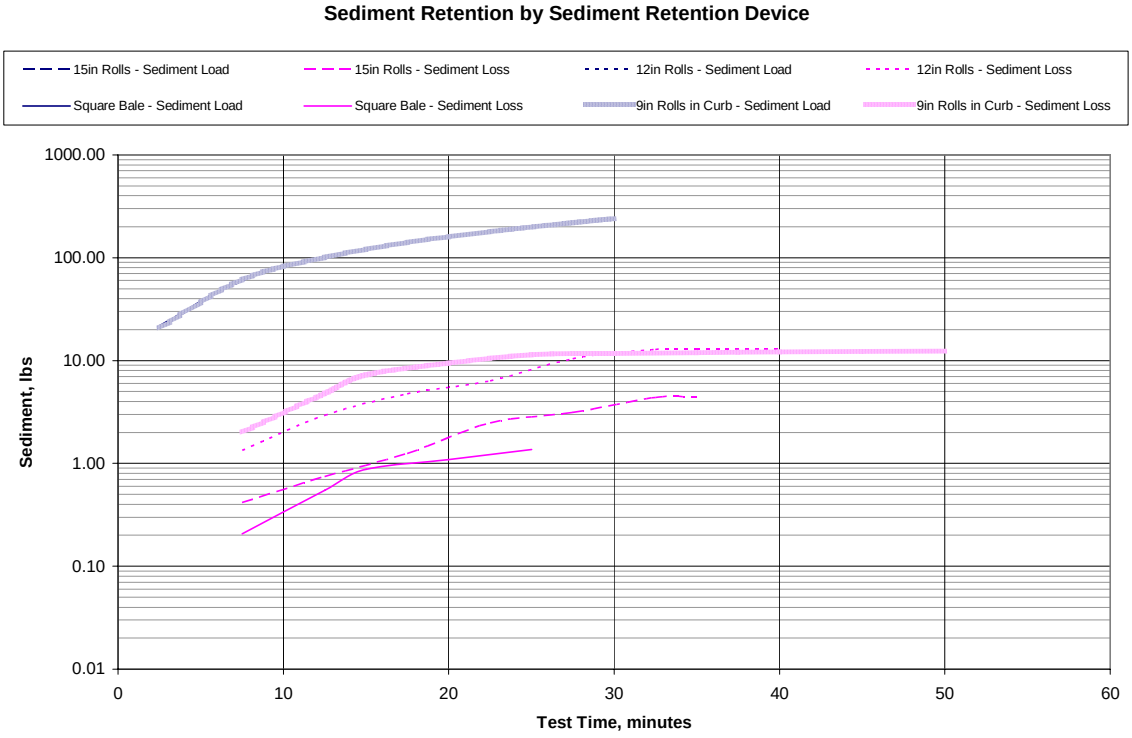



**Figure 8. Sediment Load in Runoff and Sediment Loss thru SRD**

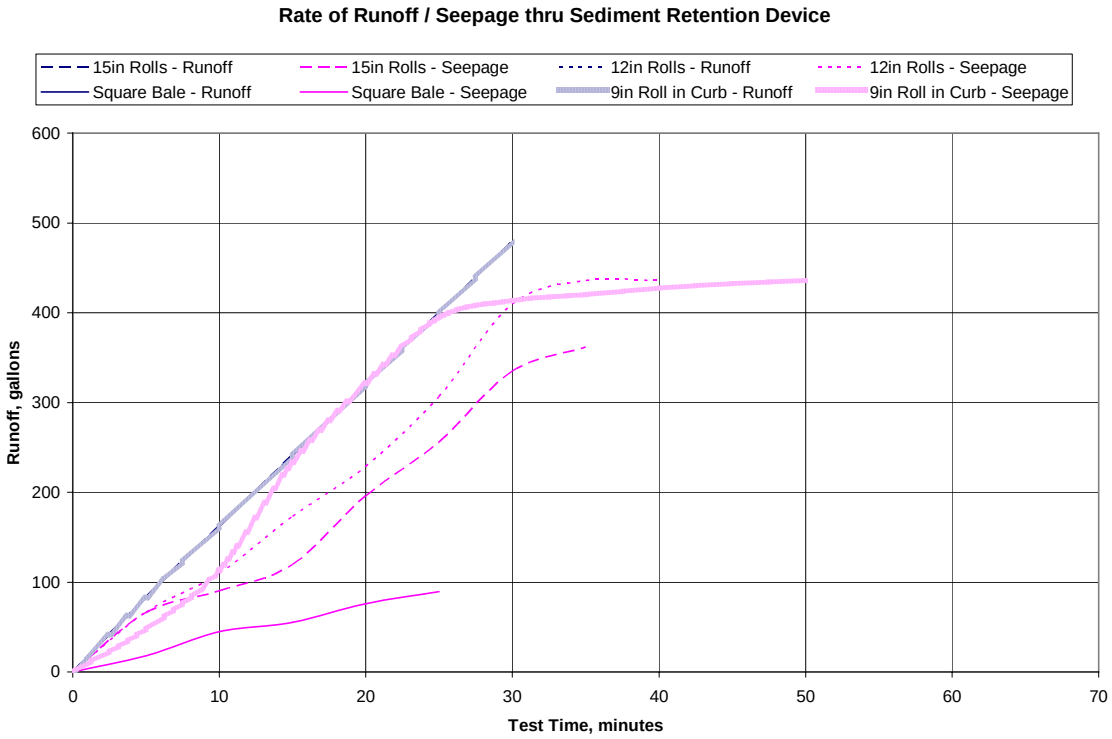



**Figure 9. Rate of Runoff and Rate of Seepage thru SRD**

# APPENDIX A – RECORDED DATA

## Test Record Sheets

**ASTM D 7351 - SEDIMENT RETENTION DEVICE (SRD) TESTING**

TEST I.D.:GeoHay DATE: 9/25/08

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

GeoHay Sediment Retention Rolls – 15 inch Diameter; Staked 2 per Roll;

Installation width = 16 ft.

Initial Weight = Final Weight

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

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

**Runoff Discharge- Start Time**: 9:35 am **Finish Time**: 10:10 am

| 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 | | | | | | |
| 5 | U2 | 3510 | 5 | D-1 | 550 | 2.8 | 5 | 1.0 | |
| 10 | U3 | 2810 | 10 | D-2 | 754 | 3.3 | 10 | 1.3 | |
| 15 | U4 | 2110 | 15 | D-3 | 1000 | 3.8 | 15 | 1.8 | |
| 20 | U5 | 1410 | 20 | D-4 | 1640 | 5.1 | 20 | 2.0 | |
| 25 | U6 | 710 | 25 | D-5 | 2136 | 6.1 | 25 | 2.3 | |
| 30 | U7 | 0 | 30 | D-6 | 2800 | 7.5 | 30 | 2.5 | |
| 35 | | | 35 | D-7 | 3020 | 7.7 | 35 | 2.3 | |
| 40 | | | 40 | D-8 | | | 40 | | |
| 45 | | | 45 | D-9 | | | 45 | | |
| 60 | | | 60 | D-10 | | | 60 | | |
| 75 | | | 75 | D-11 | | | 75 | | |
| 90 | | | 90 | D-12 | | | 90 | | |

OBSERVATIONS:

# 1.

# 2.

# 3.

**ASTM D 7351 - SEDIMENT RETENTION DEVICE (SRD) TESTING**

TEST I.D.:GeoHay DATE: 9/25/08

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

GeoHay Sediment Retention Rolls – 12 inch Diameter; Staked 2 per Roll;

Installation width = 16 ft.

Initial Weight = Final Weight

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

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

**Runoff Discharge- Start Time**: 11:45 am **Finish Time**: 12:25 pm

| 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 | | | | | | |
| 5 | U2 | 3510 | 5 | D-1 | 558 | 3.0 | 5 | 0.5 | |
| 10 | U3 | 2810 | 10 | D-2 | 918 | 3.5 | 10 | 1.0 | |
| 15 | U4 | 2110 | 15 | D-3 | 1450 | 4.8 | 15 | 1.3 | |
| 20 | U5 | 1410 | 20 | D-4 | 1915 | 5.8 | 20 | 1.8 | |
| 25 | U6 | 710 | 25 | D-5 | 2570 | 7.0 | 25 | 2.0 | |
| 30 | U7 | 0 | 30 | D-6 | 3430 | 8.5 | 30 | 2.0 | |
| 35 | | | 35 | D-7 | 3638 | 9.0 | 35 | 2.5 | |
| 40 | | | 40 | D-8 | 3640 | 9.1 | 40 | 2.3 | |
| 45 | | | 45 | D-9 | | | 45 | | |
| 60 | | | 60 | D-10 | | | 60 | | |
| 75 | | | 75 | D-11 | | | 75 | | |
| 90 | | | 90 | D-12 | | | 90 | | |

OBSERVATIONS:

# 1.

# 2.

# 3.

**ASTM D 7351 - SEDIMENT RETENTION DEVICE (SRD) TESTING**

TEST I.D.:GeoHay DATE: 9/25/08

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

GeoHay Sediment Retention Bale – Square Bale; Staked 2 per Bale (only 1 bale tested)

Installation width = 16 ft.

Initial Weight = Final Weight

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

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

**Runoff Discharge- Start Time**: 12:30 pm **Finish Time**: 12:55 pm

| 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 | | | | | | |
| 5 | U2 | 3510 | 5 | D-1 | 150 | | 5 | | |
| 10 | U3 | 2810 | 10 | D-2 | 376 | | 10 | | |
| 15 | U4 | 2110 | 15 | D-3 | 462 | | 15 | | |
| 20 | U5 | 1410 | 20 | D-4 | 636 | | 20 | | |
| 25 | U6 | | 25 | D-5 | 750 | | 25 | | |
| 30 | U7 | | 30 | D-6 | | | 30 | | |
| 35 | | | 35 | D-7 | | | 35 | | |
| 40 | | | 40 | D-8 | | | 40 | | |
| 45 | | | 45 | D-9 | | | 45 | | |
| 60 | | | 60 | D-10 | | | 60 | | |
| 75 | | | 75 | D-11 | | | 75 | | |
| 90 | | | 90 | D-12 | | | 90 | | |

OBSERVATIONS:

# 1. Runoff stopped at 20 minutes as requested by client. Seepage collected for 25 minutes. Note, 1 square bale was inserted among rolled bales and exposed to isolated flow/ponding.

# 2.

# 3.

**ASTM D 7351 - SEDIMENT RETENTION DEVICE (SRD) TESTING**

TEST I.D.:GeoHay DATE: 9/25/08

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

GeoHay Sediment Retention Roll – 9 inch diameter; "Tucked" into 4-ft Curb Inlet with ponding

Installation width = 16 ft.

Initial Weight = Final Weight

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

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

**Runoff Discharge- Start Time**: 3:30 pm **Finish Time**: 4:30 pm

| 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 | | | | | | |
| 5 | U2 | 3510 | 5 | D-1 | 400 | | 5 | | |
| 10 | U3 | 2810 | 10 | D-2 | 950 | | 10 | | |
| 15 | U4 | 2110 | 15 | D-3 | 1950 | | 15 | | |
| 20 | U5 | 1410 | 20 | D-4 | 2690 | | 20 | | |
| 25 | U6 | 710 | 25 | D-5 | 3310 | | 25 | | |
| 30 | U7 | 0 | 30 | D-6 | 3460 | | 30 | | |
| 35 | | | 35 | D-7 | 3520 | | 35 | | |
| 40 | | | 40 | D-8 | 3580 | | 40 | | |
| 45 | | | 45 | D-9 | 3620 | | 45 | | |
| 60 | | | 50 | D-10 | 3650 | | 60 | | |
| 75 | | | 75 | D-11 | | | 75 | | |
| 90 | | | 90 | D-12 | | | 90 | | |

OBSERVATIONS:

# 1. This is a retest. During the first test, the roll was pushed into the inlet causing loss of ponding at 14 minutes..

# 2.

# 3.

# APPENDIX B – CALCULATIONS

## Effectiveness Calculation Spreadsheets

**Retention Effectiveness Calculations**
**15-inch Diameter Rolls of Recycled Carpet Fibers**
**9/25/2008**

| 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 Conc., mg/l | % Solids | Reservoir Weight, lb | Assoc. Discharge, gal | Cumm Discharge, gal | Coll. Tank Depth, in | plot time | SRD Ponding Height, in | Cumm Soil Loss, lbs | Assoc. Solids Loss, lbs | Soil Retention Effectiveness, % | Water Retention Effectiveness, % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upstream | | | | | | | | | | | | | | | | 0 | | 0 | | | |
| B0 | 0 | N/A | 290.4 | 59.9 | 48.0 | 32.90 | 15100 | 242.40 | 0.24 | 62294 | 6.23% | 4240 | 42 | 0 | | 2.5 | | 21.7 | 21.7 | | |
| B5 | 5 | N/A | 286.4 | 55.9 | 47.0 | 32.90 | 14100 | 239.40 | 0.24 | 58897 | 5.89% | 3500 | 82 | 84 | | 7.5 | | 61.8 | 40.1 | | |
| B10 | 10 | N/A | 300.9 | 51.3 | 47.8 | 32.90 | 14900 | 253.10 | 0.25 | 58870 | 5.89% | 2800 | 79 | 163 | | 12.5 | | 100.7 | 38.9 | | |
| B15 | 15 | N/A | 286.6 | 58.4 | 47.3 | 32.90 | 14400 | 239.30 | 0.24 | 60176 | 6.02% | 2100 | 79 | 242 | | 17.5 | | 140.4 | 39.7 | | |
| B20 | 20 | N/A | 287.6 | 57.9 | 47.4 | 32.90 | 14500 | 240.20 | 0.24 | 60366 | 6.04% | 1400 | 79 | 321 | | 22.5 | | 180.3 | 39.9 | | |
| B25 | 25 | N/A | 285.6 | 53.8 | 47.8 | 32.90 | 14900 | 237.80 | 0.24 | 62658 | 6.27% | 700 | 79 | 400 | | 27.5 | | 221.5 | 41.3 | | |
| B30 | 30 | N/A | 280.6 | 53.3 | 46.8 | 32.90 | 13900 | 233.80 | 0.23 | 59453 | 5.95% | 0 | 40 | 479 | | 30.0 | | 241.2 | 19.6 | | |
| Water Added To Mixer (lbs): 4000 | | | | | Soil Added To Mixer (lbs): 240 | | | | AVGS: | 60388 | 6.04% | TOTALS: | 479 | | | | | | 241.2 | | |
| Downstre | 0 | | | | | | | | | | | 0 | 33 | 0 | 0 | 0 | 0 | 0 | | | |
| A5 | 5 | N/A | 304.0 | 35.9 | 33.2 | 32.90 | 300 | 270.80 | 0.27 | 1108 | 0.11% | 550 | 45 | 66 | 2.8 | 7.5 | 1.0 | 0.4 | 0.4 | | |
| A10 | 10 | N/A | 305.0 | 36.1 | 33.3 | 32.90 | 400 | 271.70 | 0.27 | 1472 | 0.15% | 754 | 27 | 90 | 3.3 | 12.5 | 1.3 | 0.7 | 0.3 | | |
| A15 | 15 | N/A | 300.0 | 36.4 | 33.2 | 32.90 | 300 | 266.80 | 0.27 | 1124 | 0.11% | 1000 | 53 | 120 | 3.8 | 17.5 | 1.8 | 1.2 | 0.5 | | |
| A20 | 20 | N/A | 310.0 | 37.7 | 33.5 | 32.90 | 600 | 276.50 | 0.28 | 2170 | 0.22% | 1640 | 68 | 196 | 5.1 | 22.5 | 2.0 | 2.5 | 1.2 | | |
| A25 | 25 | N/A | 301.0 | 36.8 | 33.2 | 32.90 | 300 | 267.80 | 0.27 | 1120 | 0.11% | 2136 | 69 | 256 | 6.1 | 27.5 | 2.3 | 3.1 | 0.6 | | |
| A30 | 30 | N/A | 319.0 | 38.2 | 33.7 | 32.90 | 800 | 285.30 | 0.29 | 2804 | 0.28% | 2800 | 53 | 335 | 7.5 | 32.5 | 2.5 | 4.4 | 1.2 | | |
| A35 | 35 | N/A | 307.0 | 36.1 | 33.0 | 32.90 | 100 | 274.00 | 0.27 | 365 | 0.04% | 3020 | 13 | 362 | | 35.0 | | 4.4 | 0.0 | **98.17%** | **24.61%** |
| A40 | 40 | | | | | | | | | | | | | | | | | | | | |
| A45 | 45 | | | | | | | | | | | | | | | | | | | | |
| A60 | 60 | | | | | | | | | | | | | | | | | | | | |
| | 75 | | | | | | | | | | | | | | | | | | | | |
| | 90 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | 1452 | 0.15% | 3020 | 361 | | | | | | 4.4 | | |
| | | | | | | | | | | (avg) | (avg) | (total) | (total) | | | | | | (approx.) | | |
| **Soil Collected from Tank (lbs): N/A** | | | | | | | | | | | | | | | | | | | | | |

**Retention Effectiveness Calculations**
**12-inch Diameter Rolls of Recycled Carpet Fibers**
**9/25/2008**

| 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 Conc., mg/l | % Solids | Reservoir Weight, lb | Assoc. Discharge, gal | Cumm Discharge, gal | Coll. Tank Depth, in | plot time | SRD Ponding Height, in | Cumm Soil Loss, lbs | Assoc. Solids Loss, lbs | Soil Retention Effectiveness, % | Water Retention Effectiveness, % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upstream | | | | | | | | | | | | | | | | 0 | | 0 | | | |
| B0 | 0 | N/A | 302.2 | 59.9 | 48.2 | 32.90 | 15300 | 254.00 | 0.25 | 60236 | 6.02% | 4240 | 41 | 0 | | 2.5 | | 20.7 | 20.7 | | |
| B5 | 5 | N/A | 310.3 | 57.9 | 48.0 | 32.90 | 15100 | 262.30 | 0.26 | 57568 | 5.76% | 3510 | 81 | 83 | | 7.5 | | 59.7 | 38.9 | | |
| B10 | 10 | N/A | 289.0 | 58.2 | 47.9 | 32.90 | 15000 | 241.10 | 0.24 | 62215 | 6.22% | 2810 | 79 | 162 | | 12.5 | | 100.7 | 41.0 | | |
| B15 | 15 | N/A | 304.6 | 56.9 | 47.9 | 32.90 | 15000 | 256.70 | 0.26 | 58434 | 5.84% | 2110 | 79 | 241 | | 17.5 | | 139.3 | 38.7 | | |
| B20 | 20 | N/A | 294.4 | 56.5 | 47.5 | 32.90 | 14600 | 246.90 | 0.25 | 59133 | 5.91% | 1410 | 79 | 320 | | 22.5 | | 178.4 | 39.1 | | |
| B25 | 25 | N/A | 288.6 | 58.6 | 47.9 | 32.90 | 15000 | 240.70 | 0.24 | 62318 | 6.23% | 710 | 80 | 399 | | 27.5 | | 219.8 | 41.4 | | |
| B30 | 30 | N/A | 299.9 | 59.0 | 48.1 | 32.90 | 15200 | 251.80 | 0.25 | 60365 | 6.04% | 0 | 40 | 479 | | 30.0 | | 240.0 | 20.2 | | |
| Water Added To Mixer (lbs): 4000 | | | | | Soil Added To Mixer (lbs): 240 | | | | AVGS: | 60039 | 6.00% | TOTALS: | 479 | | | | | | 240.0 | | |
| Downstre | 0 | | | | | | | | | | | 0 | 33 | 0 | 0 | 0 | 0 | 0 | | | |
| A5 | 5 | N/A | 307.0 | 37.0 | 33.7 | 32.90 | 800 | 273.30 | 0.27 | 2927 | 0.29% | 558 | 55 | 67 | 3.0 | 7.5 | 0.5 | 1.3 | 1.3 | | |
| A10 | 10 | N/A | 310.4 | 47.5 | 33.9 | 32.90 | 1000 | 276.50 | 0.28 | 3617 | 0.36% | 918 | 53 | 110 | 3.5 | 12.5 | 1.0 | 2.9 | 1.6 | | |
| A15 | 15 | N/A | 310.5 | 45.1 | 33.9 | 32.90 | 1000 | 276.60 | 0.28 | 3615 | 0.36% | 1450 | 60 | 173 | 4.8 | 17.5 | 1.3 | 4.7 | 1.8 | | |
| A20 | 20 | N/A | 310.6 | 37.5 | 33.7 | 32.90 | 800 | 276.90 | 0.28 | 2889 | 0.29% | 1915 | 67 | 229 | 5.8 | 22.5 | 1.8 | 6.4 | 1.6 | | |
| A25 | 25 | N/A | 315.0 | 39.2 | 34.4 | 32.90 | 1500 | 280.60 | 0.28 | 5346 | 0.53% | 2570 | 90 | 306 | 7.0 | 27.5 | 2.0 | 10.4 | 4.0 | | |
| A30 | 30 | N/A | 311.3 | 39.0 | 34.2 | 32.90 | 1300 | 277.10 | 0.28 | 4691 | 0.47% | 3430 | 64 | 409 | 8.5 | 32.5 | 2.0 | 12.9 | 2.5 | | |
| A35 | 35 | N/A | 303.7 | 36.3 | 33.0 | 32.90 | 100 | 270.70 | 0.27 | 369 | 0.04% | 3638 | 13 | 436 | 9.0 | 35.0 | 2.5 | 12.9 | 0.0 | **94.62%** | **9.32%** |
| A40 | 40 | N/A | 300.3 | 34.6 | 33.0 | 32.90 | 100 | 267.30 | 0.27 | 374 | 0.04% | 3640 | 0 | 436 | 9.1 | 40.0 | 2.3 | 12.9 | 0.0 | | |
| A45 | 45 | | | | | | | | | | | | | | | | | | | | |
| A60 | 60 | | | | | | | | | | | | | | | | | | | | |
| | 75 | | | | | | | | | | | | | | | | | | | | |
| | 90 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | 2979 | 0.30% | 3640 | 435 | | | | | | 12.9 | | |
| | | | | | | | | | | (avg) | (avg) | (total) | (total) | | | | | | (approx.) | | |
| **Soil Collected from Tank (lbs): N/A** | | | | | | | | | | | | | | | | | | | | | |

**Retention Effectiveness Calculations**
**Square Bale of Recycled Carpet Fibers**
**9/25/2008**

| 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 Conc., mg/l | % Solids | Reservoir Weight, lb | Assoc. Discharge, gal | Cumm Discharge, gal | Coll. Tank Depth, in | plot time | SRD Ponding Height, in | Cumm Soil Loss, lbs | Assoc. Solids Loss, lbs | Soil Retention Effectiveness, % | Water Retention Effectiveness, % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upstream | | | | | | | | | | | | | | | | 0 | | 0 | | | |
| B0 | 0 | N/A | 302.2 | 59.9 | 48.2 | 32.90 | 15300 | 254.00 | 0.25 | 60236 | 6.02% | 4240 | 41 | 0 | | 2.5 | | 20.7 | 20.7 | | |
| B5 | 5 | N/A | 300.3 | 57.9 | 48.0 | 32.90 | 15100 | 252.30 | 0.25 | 59849 | 5.98% | 3510 | 81 | 83 | | 7.5 | | 61.1 | 40.4 | | |
| B10 | 10 | N/A | 289.0 | 58.2 | 47.9 | 32.90 | 15000 | 241.10 | 0.24 | 62215 | 6.22% | 2810 | 79 | 162 | | 12.5 | | 102.1 | 41.0 | | |
| B15 | 15 | N/A | 304.6 | 56.9 | 47.9 | 32.90 | 15000 | 256.70 | 0.26 | 58434 | 5.84% | 2110 | 79 | 241 | | 17.5 | | 140.8 | 38.7 | | |
| B20 | 20 | N/A | 294.4 | 56.5 | 48.0 | 32.90 | 15100 | 246.40 | 0.25 | 61282 | 6.13% | 1410 | 40 | 320 | | 20.0 | | 161.0 | 20.2 | | |
| B25 | 25 | | | | | | | | | | | | | | | | | | | | |
| B30 | 30 | | | | | | | | | | | | | | | | | | | | |
| Water Added To Mixer (lbs): 4000 | | | | | Soil Added To Mixer (lbs): 240 | | | | AVGS: | 60403 | 6.04% | TOTALS: | 320 | | | | | | 161.0 | | |
| Downstre | 0 | | | | | | | | | | | 0 | 9 | 0 | 0 | 0 | 0 | 0 | | | |
| A5 | 5 | N/A | 307.0 | 37.2 | 33.2 | 32.90 | 300 | 273.80 | 0.27 | 1096 | 0.11% | 150 | 23 | 18 | | 7.5 | | 0.2 | 0.2 | | |
| A10 | 10 | N/A | 305.8 | 37.0 | 33.5 | 32.90 | 600 | 272.30 | 0.27 | 2203 | 0.22% | 376 | 19 | 45 | | 12.5 | | 0.5 | 0.3 | | |
| A15 | 15 | N/A | 308.7 | 35.9 | 33.6 | 32.90 | 700 | 275.10 | 0.28 | 2545 | 0.25% | 462 | 16 | 55 | | 15.0 | | 0.9 | 0.3 | | |
| A20 | 20 | N/A | 313.6 | 36.1 | 33.3 | 32.90 | 400 | 280.30 | 0.28 | 1427 | 0.14% | 636 | 17 | 76 | | 20.0 | | 1.1 | 0.2 | | |
| A25 | 25 | N/A | 313.2 | 38.6 | 34.3 | 32.90 | 1400 | 278.90 | 0.28 | 5020 | 0.50% | 750 | 7 | 89 | | 25.0 | | 1.4 | 0.3 | | |
| A30 | 30 | | | | | | | | | | | | | | | | | | | | |
| A35 | 35 | | | | | | | | | | | | | | | | | | | **99.43%** | **81.28%** |
| A40 | 40 | | | | | | | | | | | | | | | | | | | | |
| A45 | 45 | | | | | | | | | | | | | | | | | | | | |
| A60 | 60 | | | | | | | | | | | | | | | | | | | | |
| | 75 | | | | | | | | | | | | | | | | | | | | |
| | 90 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | 2458 | 0.25% | 750 | 90 | | | | | | 1.4 | | |
| | | | | | | | | | | (avg) | (avg) | (total) | (total) | | | | | | (approx.) | | |
| **Soil Collected from Tank (lbs): N/A** | | | | | | | | | | | | | | | | | | | | | |

**Retention Effectiveness Calculations**
**Square Bale of Recycled Carpet Fibers**
**9/25/2008**

| 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 Conc., mg/l | % Solids | Reservoir Weight, lb | Assoc. Discharge, gal | Cumm Discharge, gal | Coll. Tank Depth, in | plot time | SRD Ponding Height, in | Cumm Soil Loss, lbs | Assoc. Solids Loss, lbs | Soil Retention Effectiveness, % | Water Retention Effectiveness, % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upstream | | | | | | | | | | | | | | | | 0 | | 0 | | | |
| B0 | 0 | N/A | 302.2 | 59.9 | 48.2 | 32.90 | 15300 | 254.00 | 0.25 | 60236 | 6.02% | 4240 | 41 | 0 | | 2.5 | | 20.7 | 20.7 | | |
| B5 | 5 | N/A | 300.3 | 57.9 | 48.0 | 32.90 | 15100 | 252.30 | 0.25 | 59849 | 5.98% | 3510 | 81 | 83 | | 7.5 | | 61.1 | 40.4 | | |
| B10 | 10 | N/A | 289.0 | 58.2 | 47.9 | 32.90 | 15000 | 241.10 | 0.24 | 62215 | 6.22% | 2810 | 79 | 162 | | 12.5 | | 102.1 | 41.0 | | |
| B15 | 15 | N/A | 304.6 | 56.9 | 47.9 | 32.90 | 15000 | 256.70 | 0.26 | 58434 | 5.84% | 2110 | 79 | 241 | | 17.5 | | 140.8 | 38.7 | | |
| B20 | 20 | N/A | 294.4 | 56.5 | 48.0 | 32.90 | 15100 | 246.40 | 0.25 | 61282 | 6.13% | 1410 | 40 | 320 | | 20.0 | | 161.0 | 20.2 | | |
| B25 | 25 | | | | | | | | | | | | | | | | | | | | |
| B30 | 30 | | | | | | | | | | | | | | | | | | | | |
| Water Added To Mixer (lbs): 4000 | | | | | Soil Added To Mixer (lbs): 240 | | | | AVGS: | 60403 | 6.04% | TOTALS: | 320 | | | | | | 161.0 | | |
| Downstre | 0 | | | | | | | | | | | 0 | 9 | 0 | 0 | 0 | 0 | 0 | | | |
| A5 | 5 | N/A | 307.0 | 37.2 | 33.2 | 32.90 | 300 | 273.80 | 0.27 | 1096 | 0.11% | 150 | 23 | 18 | | 7.5 | | 0.2 | 0.2 | | |
| A10 | 10 | N/A | 305.8 | 37.0 | 33.5 | 32.90 | 600 | 272.30 | 0.27 | 2203 | 0.22% | 376 | 19 | 45 | | 12.5 | | 0.5 | 0.3 | | |
| A15 | 15 | N/A | 308.7 | 35.9 | 33.6 | 32.90 | 700 | 275.10 | 0.28 | 2545 | 0.25% | 462 | 16 | 55 | | 15.0 | | 0.9 | 0.3 | | |
| A20 | 20 | N/A | 313.6 | 36.1 | 33.3 | 32.90 | 400 | 280.30 | 0.28 | 1427 | 0.14% | 636 | 17 | 76 | | 20.0 | | 1.1 | 0.2 | | |
| A25 | 25 | N/A | 313.2 | 38.6 | 34.3 | 32.90 | 1400 | 278.90 | 0.28 | 5020 | 0.50% | 750 | 7 | 89 | | 25.0 | | 1.4 | 0.3 | | |
| A30 | 30 | | | | | | | | | | | | | | | | | | | | |
| A35 | 35 | | | | | | | | | | | | | | | | | | | **99.43%** | **81.28%** |
| A40 | 40 | | | | | | | | | | | | | | | | | | | | |
| A45 | 45 | | | | | | | | | | | | | | | | | | | | |
| A60 | 60 | | | | | | | | | | | | | | | | | | | | |
| | 75 | | | | | | | | | | | | | | | | | | | | |
| | 90 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | 2458 | 0.25% | 750 | 90 | | | | | | 1.4 | | |
| | | | | | | | | | | (avg) | (avg) | (total) | (total) | | | | | | (approx.) | | |
| **Soil Collected from Tank (lbs): N/A** | | | | | | | | | | | | | | | | | | | | | |

**Retention Effectiveness Calculations**
**CONTROL - No SRD**
**11/23/2007**

| 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 Conc., mg/l | % Solids | Reservoir Weight, lb | Assoc. Discharge, gal | Cumm Discharge, gal | Coll. Tank Depth, in | plot time | SRD Ponding Height, in | Cumm Soil Loss, lbs | Assoc. Solids Loss, lbs | Soil Retention Effectiveness, % | Water Retention Effectiveness, % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upstream | | | | | | | | | | | | | | | | 0 | | 0 | | | |
| B0 | 0 | N/A | 311.0 | 62.6 | 49.0 | 32.90 | 16100 | 262.00 | 0.26 | 61450 | 6.15% | 4240 | 42 | 0 | | 2.5 | | 21.4 | 21.4 | | |
| B5 | 5 | N/A | 310.1 | 56.5 | 48.2 | 32.90 | 15300 | 261.90 | 0.26 | 58419 | 5.84% | 3500 | 82 | 84 | | 7.5 | | 61.2 | 39.7 | | |
| B10 | 10 | N/A | 290.8 | 52.0 | 48.5 | 32.90 | 15600 | 242.30 | 0.24 | 64383 | 6.44% | 2800 | 79 | 163 | | 12.5 | | 103.5 | 42.3 | | |
| B15 | 15 | N/A | 306.9 | 60.0 | 47.6 | 32.90 | 14700 | 259.30 | 0.26 | 56691 | 5.67% | 2100 | 79 | 242 | | 17.5 | | 141.1 | 37.6 | | |
| B20 | 20 | N/A | 297.1 | 56.3 | 48.2 | 32.90 | 15300 | 248.90 | 0.25 | 61470 | 6.15% | 1400 | 79 | 321 | | 22.5 | | 181.6 | 40.5 | | |
| B25 | 25 | N/A | 304.6 | 56.7 | 47.7 | 32.90 | 14800 | 256.90 | 0.26 | 57610 | 5.76% | 700 | 79 | 400 | | 27.5 | | 219.8 | 38.1 | | |
| B30 | 30 | N/A | 304.9 | 55.1 | 48.7 | 32.90 | 15800 | 256.20 | 0.26 | 61671 | 6.17% | 0 | 40 | 479 | | 30.0 | | 240.1 | 20.3 | | |
| Water Added To Mixer (lbs): 4000 | | | | | Soil Added To Mixer (lbs): 240 | | | | AVGS: | 60242 | 6.02% | TOTALS: | 479 | | | | | | 240.1 | | |
| Downstre | 0 | | | | | | | | | | | 0 | 12 | 0 | 0 | 0 | 0 | 0 | | | |
| A5 | 1 | N/A | 308.7 | 51.0 | 36.5 | 32.90 | 3600 | 272.20 | 0.27 | 13226 | 1.32% | 200 | 42 | 24 | 1.8 | 3.0 | 0.0 | 4.6 | 4.6 | | |
| A10 | 5 | N/A | 311.5 | 50.2 | 36.3 | 32.90 | 3400 | 275.20 | 0.28 | 12355 | 1.24% | 710 | 86 | 84 | 3.3 | 7.5 | 0.0 | 13.5 | 8.9 | | |
| A15 | 10 | N/A | 315.2 | 51.7 | 36.5 | 32.90 | 3600 | 278.70 | 0.28 | 12917 | 1.29% | 1656 | 120 | 196 | 5.0 | 12.5 | 0.0 | 26.4 | 12.9 | | |
| A20 | 15 | N/A | 315.1 | 50.7 | 36.3 | 32.90 | 3400 | 278.80 | 0.28 | 12195 | 1.22% | 2736 | 82 | 324 | 7.0 | 17.5 | 0.0 | 34.8 | 8.4 | | |
| A25 | 20 | N/A | 313.8 | 61.9 | 36.5 | 32.90 | 3600 | 277.30 | 0.28 | 12982 | 1.30% | 3042 | 52 | 360 | 7.8 | 22.5 | 0.0 | 40.4 | 5.6 | | |
| A30 | 25 | N/A | 315.2 | 50.9 | 36.3 | 32.90 | 3400 | 278.90 | 0.28 | 12191 | 1.22% | 3614 | 52 | 428 | 9.0 | 27.5 | 0.0 | 45.7 | 5.2 | | |
| A35 | 30 | N/A | 312.1 | 50.3 | 36.3 | 32.90 | 3400 | 275.80 | 0.28 | 12328 | 1.23% | 3912 | 23 | 463 | 9.5 | 32.5 | 0.0 | 48.0 | 2.4 | **79.98%** | **1.05%** |
| A40 | 35 | | | | | | | | | | | 4006 | 6 | 474 | 9.8 | 35.0 | | 48.0 | 0.0 | | |
| A45 | 45 | | | | | | | | | | | | | | | | | | | | |
| A60 | 60 | | | | | | | | | | | | | | | | | | | | |
| | 75 | | | | | | | | | | | | | | | | | | | | |
| | 90 | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | 12599 | 1.26% | 4006 | 474 | | | | | | 48.0 | | |
| **Soil Collected from Tank (lbs): N/A** | | | | | | | | | | (avg) | (avg) | (total) | (total) | | | | | | (approx.) | | |

# APPENDIX C – TEST SOIL

## Test Soil Grain Size Distribution Curve

QORE
PROPERTY SCIENCES

# PARTICLE- SIZE DISTRIBUTION TEST REPORT

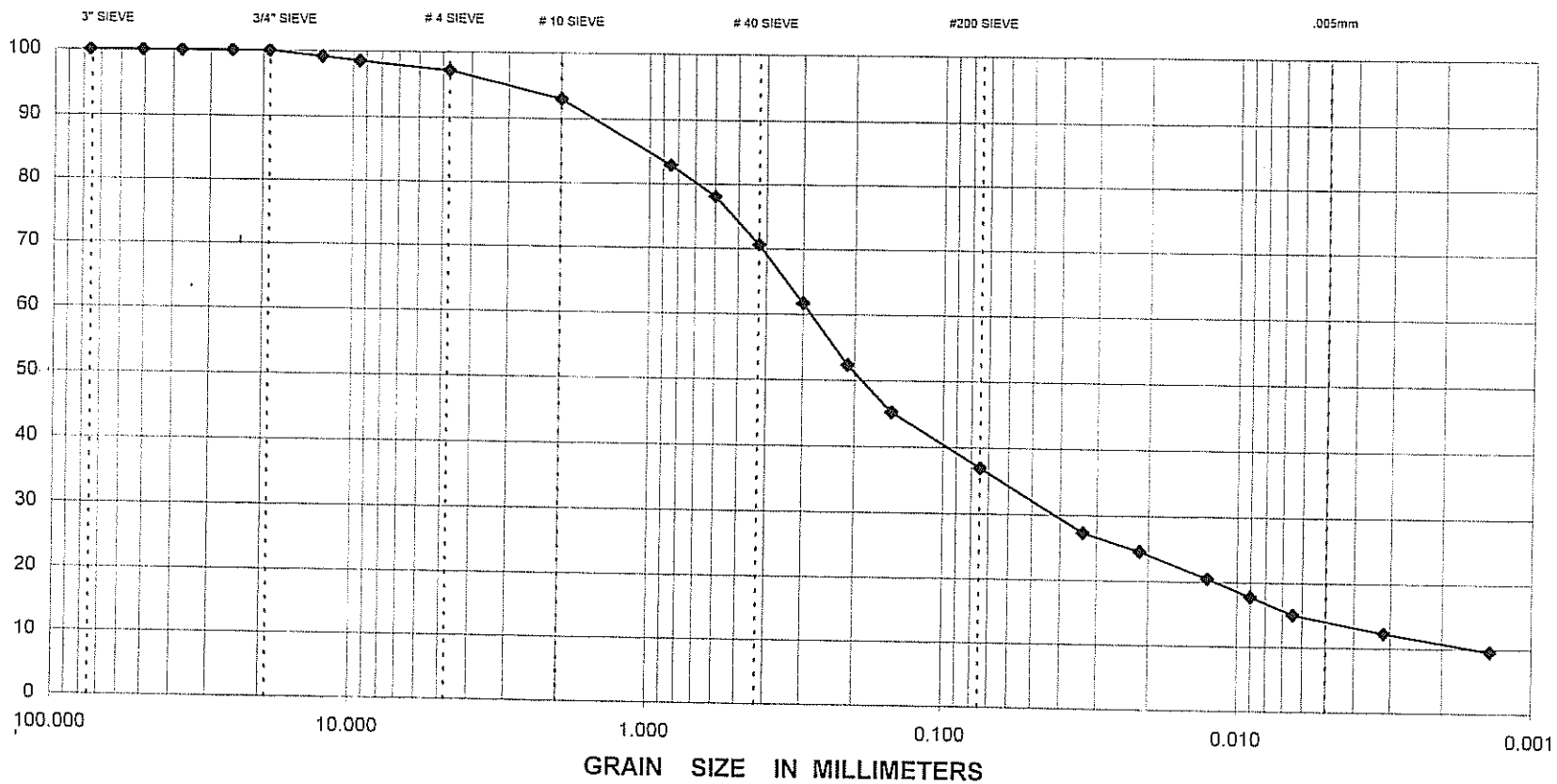
## SIEVE AND HYDROMETER ASTM D422

REV1,9/17/03

AAR GAI 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 |

| GRAVEL | | SAND | | | FINES | |
|---|---|---|---|---|---|---|
| COARSE | FINE | COARSE | MEDIUM | FINE | SILT | CLAY |



# 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.