



## INTRODUCTION

Starting with the 1993 edition of the Texas Department of Transportation (TxDOT) *Standard Specifications for Construction of Highways, Streets and Bridges*, TxDOT shifted from a material-type specification into an “approved product”-type specification for two classifications of erosion control and revegetation products. These two product classifications included rolled and spray-on products promoted by industry for either slope protection or flexible channel liner applications, (termed “Soil Retention Blankets within TxDOT’s Standard Specification Item 169), and standard hydraulic mulches (termed “cellulose fiber mulch” within TxDOT’s Standard Construction Item 164).

TxDOT’s current specifications for soil retention blankets and for cellulose fiber mulches are included as attachments to this document, and do not include any of the typical ASTM-type material requirements such as mass per unit area, water holding capacity, tensile strength, elongation, pH, etc. TxDOT has elected to base their approved product list (APL) upon the documented field performance of the products through a formal evaluation program conducted by the Environmental and Planning Program of the Texas Transportation Institute (TTI).

TxDOT has defined the critical performance factors for the products and has established minimum performance standards which must be met for any product seeking to be approved for use within any of TxDOT’s construction or maintenance activities.

With respect to the rolled and spray on products being promoted by industry for slope protection and flexible channel liner protection, TxDOT adopted the following critical performance factors:

- How well the product protected the seedbed of an embankment or a drainage channel from the loss of sediment during simulated rainfall or channel flow events; and
- How well the product promoted the establishment of warm-season, perennial vegetation.

Furthermore, TxDOT recognized that the above rolled and spray-on products are promoted by industry within two general use classifications including:

- Products designed for overland flows associated with typical slope or embankment protection applications (termed “Class 1” applications within TxDOT’s Standard Specification Item 169), and
- Products designed for concentrated water flows associated with typical highway drainage channels (termed “Class 2” applications within TxDOT’s Standard Specification Item 169).

By statistically analyzing the performance data produced through controlled performance tests, TxDOT is able to maintain minimum performance standards for each classification of products evaluated at the TTI Sediment and Erosion Control Laboratory (SEC Lab). TxDOT reserves the right to revise the minimum performance standards as it deems necessary. For a product to be placed upon TxDOT’s APL, the product must meet (or exceed) all adopted minimum performance standards for that application. Failure to meet any of the adopted minimum performance standards will automatically reject the product from being placed on the APL.

In 2014, TxDOT decided to change the minimum performance standards on erosion products to guarantee better performing products on construction and maintenance projects. With recent and potential upcoming changes in the regulatory environment, dealing with erosion and sediment control on construction and maintenance projects, TxDOT’s Maintenance Division was and continues to be committed to maintaining the Approved Products List with the highest quality best management practices (BMPs) available. With increased environmental regulations, TxDOT must ensure the best products are being implemented on projects to minimize environmental concerns and reduce the risk for product failure. The new performance standards have been developed from years of product evaluation and ongoing changes to environmental regulations.

Effective February 2015, all “Class 1” products were required to meet (or exceed) new performance thresholds to remain or be placed on the Approved Products List (APL). Products previously approved, that failed to meet the new performance standards were removed from the APL. If a product was removed from the list, the product representative was provided the opportunity of retesting the identical product with the TTI SEC Lab. If a re-tested product met or exceeded the new 2015 minimum performance standards the product was added back to the list. All “Class 2” products continue to be required to meet all minimum performance standards adopted by TxDOT in 2015.

Also, starting with the 2014 edition of the Texas Department of Transportation (TxDOT) *Standard Specifications for Construction of Highways, Streets and Bridges*, erosion and sediment control devices must be selected from the *Erosion Control Approved Products list*. *Sedimentation* and environmental control measures must be installed and maintained to prevent or reduce the discharge of pollutants in accordance with the Storm Water Pollution Prevention Plan (SWP3) on the plans and the Texas Pollutant Discharge Elimination System (TPDES) General Permit TXR150000.

A review of the TxDOT testing program was conducted in 2000 to reduce the annual operating costs of the facility. Likewise, there was a desire to make the testing program more flexible so that the program could provide better service to other agencies and participate in cooperative testing and research.

## THE TESTING FACILITY

### About the SEC Lab

Since 1990, the TTI SEC Lab provides the transportation industry with a research and performance evaluation program for roadside environmental management. The program includes storm water quality improvement, erosion and sediment control, and vegetation establishment and management.

TTI’s Environment and Planning Program operates a 19-acre, full scale, indoor/outdoor facility. Demand for the facility has steadily grown since opening the lab in 1990, necessitating frequent expansion to meet industry needs. With funding from the TxDOT, TTI produces and maintains the **TxDOT Approved Products List (APL)** for all erosion control products used by TxDOT on Texas roadsides. Three major aspects of the lab are the indoor rain simulators, sediment retention device flume, and variable slope channel flume. The TTI SEC Lab also houses a 2,800-square-foot climate-controlled greenhouse, small footprint stormwater quality structure, index testing laboratory, bench-scale testing capabilities, 65-foot concrete flume, and a 1,000 linear ft x 25 ft tall soil embankment built with both a 2:1 and 3:1 side slope per TxDOT standard construction specifications.

Slope protection product evaluations were first conducted outdoors utilizing test plots on the soil embankment. However, in 2002 an indoor rainfall simulator test facility was constructed which replaced the outdoor testing embankment. Due to high demand, in 2013 the indoor testing facility was expanded to accommodate more bays and testing capabilities. The current facility includes two buildings with multiple runoff beds and five available test bays. The facility is capable of testing erosion control products using multiple test protocols, including ASTM D6459, ASTM D8297 and custom R&D test methods, and has been in continual use since it was constructed.

Adjacent to the new rainfall simulator building is a 1,500-foot covered sediment bed preparation area. This area creates a dry workspace for storage of test beds during inclement weather. The expansion also included a 40-foot by 60-foot soil storage building that allows for test bed preparation during rain events without affecting antecedent soil moisture, a critical factor in the indoor testing procedure. The original rainfall building has also been modified to expedite testing. The building was originally designed for manual sediment collection however, it was retrofitted in 2013 to allow bulk handling and collection of sediment.

A flume is currently used to evaluate channel liner products. Prior to 2002, all channel products were tested using in ground at grade channels located at the facility, however in 2002; a metal flume with vertical plywood and plexiglass side walls was constructed to evaluate channel liner products and turf reinforcement mats. The

flume was designed so that soil filled trays installed with channel liner materials, could be installed and could then be evaluated by running concentrated flows of water at different flow rates, over the surface of the test trays. The flume utilizes a high-capacity pump capable of 42,000 gallons per minute, and can evaluate channel products based on categories that utilize increasing shear stress values of 2-12 pounds per square ft. In 2021 the flume pump was modified to allow easier access and a roof was built over the structure.

A greenhouse is also located on site and is used to establish vegetation in trays and flumes before and during test cycles. The greenhouse at the facility is climate controlled and allows vegetation to be grown and evaluated on a year-round basis.



**Figure 1 SEC Lab Greenhouse**



**Figure 2 Rainfall Simulation Buildings**

### **INITIAL EVALUATION FEES**

Effective with all products evaluated starting with the 2001 evaluation cycle and beyond, evaluation fees are required of each product evaluated at the TTI SEC Lab:

Current testing fees for evaluation of new products are as follows:

- Class 1 “Slope Protection” Applications: \$10,500 per evaluation
- Class 2 “Flexible Channel Liner” Applications: \$10,500 per evaluation
- “Hydraulic Mulch” Applications: \$10,500 per evaluation
- Sediment Retention Device \$10,500 per evaluation

An “evaluation” is defined as one product and one complete test evaluation for each test category selected.

An evaluation also includes index properties tests for each material received. These tests are performed, and the data results are kept on file, so that the physical properties and characteristics of the product are measured and documented. The physical properties tests are not used to determine pass/failure of a product but are used to ensure that the physical characteristics and properties of a material are consistent. This data is also used when a product is recertified, to ensure that specific products approved for use have not been significantly altered or changed. When recertifying a specific product, index physical properties tests are repeated and compared to the original index test results. Common physical properties tests include mass per unit area, tensile strength, flexibility, water absorption capacity, swell, light penetration etc. TTI reserves the right to add or modify properties testing as needed.

Should evaluation fees not be paid in full to TTI by the deadline established, the product will be removed from the evaluation waiting list schedule, and the evaluation slot offered to the next product in accordance with the existing procedures relating to the waiting list. The product must then submit a new “Request for Performance Evaluation” packet in order to place the product back on the waiting list for evaluation.

### **Services Request**

The form for “Request for Testing Services” can be found here:

<https://static.tti.tamu.edu/tti.tamu.edu/documents/SECL/application-for-testing.pdf>

## **EVALUATION WAITING LIST**

Because of high demand for testing at the laboratory, it was necessary to implement a waiting-list procedure to provide the greatest degree of access to the facility to the greatest number of participants.

In order to be placed on the waiting list a completed “Request for Performance Evaluation (RPE) must be received by TTI Lab Manager, and a 10% deposit of the overall testing fee must be received. Once these are both received the product is immediately placed on the waiting list in the order received in preparation for testing. Personal memoranda, telephone calls, fax transmissions or individual letters to the Lab Manager will not be utilized to determine a product(s) position on the waiting list. Timing of testing is based upon the order of the postmarked date on the completed RPE and the receipt of the testing deposit. In the event a participant fails to commit to testing by the deadline established by TTI, the product will be removed or rolled to the bottom of the waiting list and the current evaluation slot offered to the next participant on the list.

Management reserves the right to limit the number of products any single company, manufacturer or distributor may evaluate during any given evaluation cycle, and will treat requests for different gradients, soil types and/or channel gradients as separate requests.

## **INSTALLATION & EVALUATION PROCEDURES**

With respect to products being evaluated for “Slope Protection” applications, participants must select the steepness of slope on which their product is to be evaluated.

With respect to products being tested for “Flexible Channel Liner” applications, participants have the option of specifying the shear-stress range most appropriate for their products, however products that break at a peak force less than 50 lbs. during tensile properties testing are considered “temporary” products and are not eligible for the higher flow 6 & 8 pounds per square ft. test categories.

All products, whether submitted for “Slope Protection” or for “Flexible Channel Liners” applications, are installed in strict accordance with the manufacturer’s published installation literature, as determined by the Laboratory Manager. Particular attention will be paid to edge and junction overlaps, staple size, and staple

pattern. Installation techniques which, in the Laboratory Manager's opinion, are not supported by the product's published installation literature will not be permitted. The adopted installation techniques, as taken from the product's published installation literature and as agreed on between the participant and Laboratory Manager, may be utilized by TxDOT to produce "Standard Installation Sheets" for the approved products as may be appropriate.

To be approved for use by TxDOT, a material must meet minimum acceptable vegetation cover and meet soil loss thresholds at an acceptable level compared to an unprotected surface.

## **CLASS I – SLOPE PROTECTION**

The procedure for testing Class 1 slope protection materials utilizes two slopes, 3:1 and 2:1 and two soil types, sand, and clay. At the participants' option, a material may be tested on 3:1, 2:1 or both. Selection of both slopes is allowed but is regarded as two separate evaluations and will require two separate applications and test fees per evaluation. Regardless of slope selected, the material is tested on both sand and clay soils. Materials are evaluated using three different identically installed test beds for each soil type and by using identical and repeatable rainfall rates, storm intensities and test durations as outlined in the test protocol. Vegetation cover is determined by taking video samples which are processed to determine the average surface cover of vegetation. Class 1 slope protection products are tested without vegetation. Testing in an unvegetated condition, provides a better measure of a materials ability to protect the soil surface and prevent migration of sediment and seed.

### **Test Beds**

Test beds for sediment control tests are 30 ft. x 6 ft. x 9 inches for ASTM D8297 testing and are 40 ft. x 8 ft x 12 inches for ASTM D6459 testing.

Frames are steel and plywood with expanded metal bottoms. A layer of filter fabric is placed over the bottom grid to allow water to flow out of the bottom of the test bed, once it has reached the bottom of the test soil layer

Soils used in the tests are of two types, a loamy sand, and a plastic clay. The soils are collected from on-site and/or regional sources, graded for texture, composition and organic content to insure uniformity. Soil moisture and compaction is controlled for all tests.

Once the soils have been stabilized in the test beds the slope protection material is applied according to manufacturer's published literature.

### **Sediment Collection and Processing**





All water and sediment are collected at the base of the sediment beds. The sediment is allowed to settle for a minimum of 12 hours. At that point the clear water is decanted. The remaining sediment and water are weighed. Weight is taken to the nearest 0.1 lb. Sediment is then agitated for two minutes, and 10 samples are taken. Agitation continues until all samples are taken. Samples are transferred to a desiccating oven and dried at 130°F (58°) for 24 hours. Samples are then weighed on a scientific balance to the nearest 0.0004 oz.

Sediment loss is calculated by determining the water ( $w$ ) to sediment ( $s$ ) ratio ( $w/s$ ) of the sediment samples by dividing the dry sample weight by the original sample weight. This ratio is applied to the full sediment sample to determine total sediment loss.

## Rainfall Simulation

Rainfall simulation is done using a simulator that closely reproduces the more damaging precipitation drop sizes found in more intense storms. Uniformity of the coverage and precipitation rate is carefully controlled. For the ASTM D8297 test, required for TXDOT approval, each test consists of three (3), repetitions of three, 30-minute storms of 3.5 in/hr. After each set of 3 rainfall events, the test bed is completely rebuilt with new soil and new Class 1 material.

## Vegetation Cover

Vegetation cover is based on the average percent of surface cover achieved in three standard nursery flats (12 in x 18 in) covered with the selected Class 1 material. The same soil for the sediment test is used for the vegetation cover test. Flats are seeded with the seeding mixture and are allowed to grow for 30 days. Each nursery flat and channel flume receive the identical rate of the standard, rural area, warm season, permanent, perennial seed mix as specified for TxDOT's Bryan District 17. Further, each flat and channel flume receive the same amount of fertilizer and simulated rainfall.



Percent vegetation covered is determined using a digital camera and processed using the current VCAP technology.

## CLASS II – FLEXIBLE CHANNEL LINERS

The procedure for testing Class II flexible channel liner material utilizes vegetated trays 15 ft long x 1.5 ft wide x 9 inches deep which are placed in a flume prior to the simulated flow event. Shear stress flows beginning at the 96 pascal (2 lb./sq. ft.) level and continue with evaluations at 4 lb./sf. and 6lb./sq. ft. increments up to 383 pascal (8 lbs./sq. ft.) maximum.

## Test Channel

Three test trays are prepared for each material to be tested. Trays are lined with a filter fabric and then filled with sterile soil. They are seeded manually, when seeding is required in the test protocol; and the channel liner is installed. Materials are installed in accordance with the manufacturer's published literature. Once prepared, the trays are either installed directly in the flume or are placed in the greenhouse for a vegetative growth period, depending on the test protocol being used.

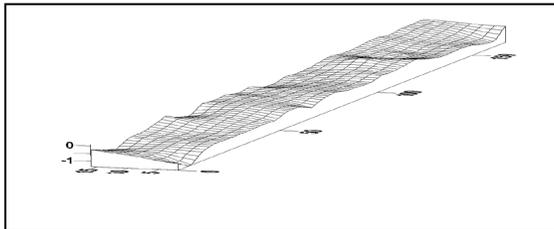


## Flow Simulation

Flow simulation begins when the tray is installed. Test flow intensity, duration and frequency all vary based on the test protocol being used. Test flows start at the lowest test flows allowed and continue until the material fails or survives a stress of >8 psf.

## Sediment Data Collection

Before and after each run, profiles are taken longitudinally. Two profiles 2 inches from each side of the flume and the third along the centerline on 6-inch increments are taken down the flume. This is accomplished with a computer operated instrument that measures the change in soil depth and the data is automatically recorded in a computer.



Sediment movement is taken as a gross measure of sediment deposited and lost. Sediment loss is calculated using a standard and uniform mass per unit soil loss equation for each product.

## Vegetation Cover

Vegetation cover remains a consideration in channel liner performance. In a channel the material relies to some degree on having some vegetation to help stabilize the blanket. Therefore, it is important that the material protect the seed bed and protect the young plants until the channel is stabilized.

For the vegetation cover test, at the end of the 30-day growing period, the product installed and bare soil control vegetation nursery trays are checked for any foreign vegetation that could indicate that the product was contaminated with weed seed. If no weeds are present, trays are placed on a camera stand and photographed. The photographs are processed using the VCAP program to determine the percent of cover achieved. The data reported are the arithmetic average of surface cover for the three sample trays for each soil type compared to the same arithmetic average for the control trays.

## HYDRAULIC MULCHES

Cellulose and Bonded Fiber Mulches can be tested for sediment loss and vegetation growth at the 3:1 and 2:1 slope categories using the same criteria as other Class I products and will be approved for use, as long as they meet the same exact performance thresholds required for all products evaluated.

Hydraulic mulches also have the option to be tested in the “Mulches 4:1 or Flatter Slopes” category and can be approved for use, as long as they pass the minimum performance thresholds required. This lower slope 4:1 category is primarily for basic paper and wood fiber hydraulic mulches and generally is not designed for BFM’s and other high-end hydraulically applied products

Currently, all hydraulic mulches in the 4:1 slope category are applied at the following rates only:

- \* Sandy Soils - 2.8 Mg/ha (2,500 lbs./acre); or
- \* Clay Soils - 2.3 Mg/ha (2,000 lbs./acre).

## Testing Soil

Soils used in the tests are collected from on site or regional sources, graded for texture composition and organic content to insure uniformity. Soil moisture and compaction is controlled for all tests and meets specific density and compaction requirements as outlined in the specific test protocol being used.

## SEDIMENT RETENTION DEVICES

The Sediment Retention Device (SRD) testing facility is designed to measure the filtering and sediment retention characteristics of sediment retention devices. The sediment retention device test procedure is designed to effectively monitor & compare characteristics and performance of various sediment control devices. A polypropylene tank with a capacity of 1600 gallons, an 18-foot X 15-foot concrete testing channel with a 4-foot natural soil installation zone, Two Hach SOLITAX model TS-line turbidity sensors, Hach model sc100 controller, and two ISCO model 4230 Bubble flow meters are used to complete this test.

Water combined with ground silica and ball clay is mixed in the poly tank and sediment laden water is introduced into the system. Turbidity probes and bubbler tubes are connected to their appropriate locations at the sediment delivery system on the bottom of the mixing tank and the outlet tube of the collection zone. The flow meters and turbidity meters are then turned on and evaluated to ensure that the data is being collected and recorded correctly at each location. Overall performance of the SRD is measured by comparing the change in turbidity and change in flow rate when comparing the inflow and outflow data after all water has passed through the device.

Suspended solid concentration (mg/L), mass loading (lbs.), and removal efficiency (%) can be determined. The data currently used by TXDOT for performance evaluation is Percent change in velocity and percent change in turbidity

## APPROVAL BY EXTENSION

Within TxDOT, “Approved by Extension” shall apply for “Slope Protection” applications only. Approval by Extension shall not apply to “Flexible Channel Liner” applications or to Hydraulic Mulch applications. For Slope Protection applications products, if the participant elects to evaluate a product on the severe slope conditions (2:1) only, and the product successfully meets the current minimum performance established by TxDOT, the product will also be included as an approved product on the less severe (3:1) slope within the same soil texture group. For example, if a product is evaluated on the 2:1 clay, and successfully meets the adopted sediment and vegetation density standards for 2:1 clay the product will also be listed as an approved product for 3:1 clay slope.

If a product elects to test at the 3:1 slope, the product will not be added to the steeper (2:1) slope as an approved product regardless of the performance of the material. If a product elects to be tested at both 3:1 and 2:1 slopes, the product’s individual performance, as documented within each application, shall determine placement upon TxDOT’s Approved Product List (APL) and approval by extension shall not apply.

## **RELEASE OF PRODUCT PERFORMANCE DATA**

All performance data will be released by TxDOT only. Performance data shall be published on all products by individual trade or brand name.

The Approved Product List for all products evaluated to date is available through TxDOT Internet Home Page without charge.

## **REVISION OF MINIMUM PERFORMANCE STANDARDS**

Based upon statistical analysis of performance data as produced through the SEC Lab, TxDOT reserves the right to revise the minimum performance standards. If an individual product's performance data fails to meet any of the revised performance standards, the product will be removed from the APL during the next scheduled revision of the APL, and the product representative is provided the opportunity of retesting the identical product within the next available evaluation cycle as determined by the Lab Manager. If the product's performance meets the newly adopted minimum performance standards, the product will remain on the APL.

## **CONTRACTOR'S OPTION**

The APL will be maintained by TxDOT according to the classes and types as may be appropriate for the given products. It will be the Contractor's option of using any approved product included on the current APL for the class and type specified within the plans. Installation of the product will be in strict accordance with any product installation sheets as may be issued by TxDOT.

## **PRIVATE LABELING**

Within TxDOT, private labeling shall apply, and private labels will be added to the APL if the original manufacturer of the product evaluated at the SEC Lab certifies, to TxDOT's satisfaction, that the private label brand is identical to the product tested and only distributed under other (private labels) brand names. Additions or revisions to the APL due to private label name changes will be made individually and at the timing and discretion of TXDOT personnel.

## **REQUIRED MANUFACTURER LITERATURE**

A product will not be accepted for evaluation at the SEC Lab, nor placed on the waiting list for future evaluation at the Lab unless the participant furnishes evidence that the product is currently being marketed under a discrete trade or brand name, and unless the product can demonstrate published installation literature.

All "Request for Performance Analysis" packets for products which do not include complete manufacturer's literature, or for products which are under development only, shall not be accepted for evaluation through the SEC Lab.

R&D contracts and product development non applicable to the TXDOT approved products list is handled directly with product manufacturers and the Texas A&M Transportation Institute. A R&D product tested at the Texas A&M Transportation Institute Sediment & Erosion Control (SEC) Lab, will not be include on the TXDOT approved list until it has been evaluated and met all minimum TXDOT performance criteria.

## **APPROVED PRODUCT LIST**

Based upon the performance data collected through the SEC Lab, TxDOT will establish and maintain a current Approved Product List (APL). A revised APL will be issued only after data analysis has been completed.

## PRODUCT BRAND OR TRADE NAME REVISIONS

The manufacturer of a product evaluated at the SEC Lab shall notify TxDOT should any revisions to the trade or brand name for the product be made. The manufacturer must provide the revised trade or brand name for the product and must further certify, to TxDOT's satisfaction, that the action reflects a revision to the trade or brand name only, and that no material properties were revised. The manufacturer must also notify TxDOT if any brand or trade name revisions are made to any of the product's private labels.

## SUMMARY

The TxDOT/TTI Sediment and Erosion Control (SEC) Laboratory is a unique facility which provides TxDOT and the specifying community data on the performance of a product's ability to protect the natural environment through controlled, formal performance evaluations.

The SEC Lab provides industry with a timely, uniform, and fair method through which their products are evaluated for possible usage within TxDOT's construction and maintenance activities. The evaluation program seeks to establish and maintain the greatest number of individual products on the APL possible, provided those products have demonstrated their ability to meet adopted minimum performance standards for the appropriate use applications.

## FUTURE DIRECTIONS

As the new protocols are installed and refined, TxDOT and TTI are planning to expand the research program to include analysis of runoff samples to test for contaminants, and laboratory methods to determine product longevity as well as additional research identified.

## PROGRAM CONTACT PERSONNEL

To discuss or request information on TxDOT's overall evaluation program for erosion control products contact:

Travis Jez, Natural Resources Specialist IV  
Texas Dept. of Transportation  
Maintenance Division  
Vegetation Management Section  
(512) 913-7240  
[Travis.Jez@txdot.gov](mailto:Travis.Jez@txdot.gov)

To secure a "Application for Testing" packet, inquire about waiting list or evaluation schedules, or to arrange a visit to the evaluation facility, contact the following:

Jett McFalls, Project Supervisor  
Texas A&M Transportation Institute  
Environment and Planning Program  
(979) 317-2801  
[j-mcfalls@tti.tamu.edu](mailto:j-mcfalls@tti.tamu.edu)

Derrold Foster, Lab Manager  
Texas A&M Transportation Institute  
Environment and Planning Program  
(979) 317-2242  
[d-foster@tti.tamu.edu](mailto:d-foster@tti.tamu.edu)

