A BIOENGINEERING SYSTEM FOR COASTAL SHORELINE STABILIZATION

By George Farek and John Lloyd-Reilley

For many years, the Shoreline Erosion Committee of the Texas State Association of Soil and Water Conservation Districts has implemented shoreline erosion control projects with smooth cordgrass (Spartina alterniflora). However, many of these projects, where bluffs were encountered, failed to completely solve the shoreline erosion problem. Either the planting would not become established, or in some cases the bluff just continued to erode. With the development of geotextiles, there is the potential to implement low-cost shoreline projects that address these highly eroding bluff sites.

Geosynthetic turf reinforcement mats (TRM) provide a low-cost alternative to hard armor on eroding critical areas. The mats along with the root reinforcement of seeded or planted vegetation resist damage from wave energy and high velocity surface flows. On high-energy wave sites, cellular concrete blocks are an alternative to concrete and rip-rap. Both of these erosion control materials provide for the opportunity to install native salt tolerant plant species. These plants are not only aesthetically appealing but their roots and stems are a critical component of an effective long-term erosion control system.

In partnership with the San Patricio Soil and Water Conservation District we implemented a shoreline project in October, 1997, under a grant from the Texas Coastal Management Program. We evaluated turf reinforcement matting and cellular blocks while testing several plants such as marshhay cordgrass (Spartina patens) gulf cordgrass (Spartina spartinae) and marsh elder (Iva frutescens) for adaptation and added environmental and engineering enhancement.

The location of the project is near the city of Portland, Texas along the Nueces Bay. The shoreline had a bluff that ranged in vertical height from 0 to 8 feet. The soil of the site was a Monteola clay. The slope of the tidal area was approximately 5% and had an open fetch of roughly 3 miles. The water salinity in July of 1997 was 25 parts per thousand.

On July 1, 1997, we installed "Tensar" fence with three-inch diameter size posts every ten feet as a wave barrier at approximately the mean tide level. It was secured to the post with 1" x 2" lathing and nailed at the top and bottom. "Vermilon" smooth cordgrass that was 18-24" tall, 1-2 stems and with 6" bare roots was planted as 4 rows 2' apart at 2" below to 12" above mean tide, ten feet toward shore from the Tensar wave barrier.

From August 25-28, 1997, we installed "PROTEC 420" cellular blocks and "North American Green C-350" TRM. We shaped the slope with an excavator at a 2.5:1 grade. We dug 1' below ground level for the toe and installed 3 blocks at 4:1 grade and then backfilled. We also dug 3' into the bank and installed three blocks at a 4:1 grade and then backfilled. All blocks were underlain with a nonwoven filter fabric. The blocks extended 48 feet in length and 3' in vertical height. The TRM was placed on the bank and extended for 152 feet in length and ranged from 0 feet to 8 feet in vertical height. The toe and the top of the bank was trenched to a 1 1/2 foot depth and the TRM was secured with either 8" staples or 6" (60d) nails with tin caps and buried. The TRM was secured every 18" with a 6" overlap of the mats.

On October 27, 1997, we planted an alternating sequence of a grass and a shrub. The grasses were gulf cordgrass (Spartina spartinae) and marshhay cordgrass (Spartina patens). The shrubs were marsh elder (Iva frutescens), armed saltbush (Atriplex acanthocarpa) and wax myrtle (Myrica pusilla). The grass and shrub sequence was chosen to provide a root network of fibrous and tap roots to secure the bank slope. The plants were also chosen for abundant top growth to cushion the bank against wave energy. All plants were chosen to grow no taller than 2 meters so as not to restrict shoreline views.

The TRM was easy to install and has stayed stable since planting in late October 1997. The estimated wave energy for material stability at this site based on our experienced conditions is at two feet above mean tide when protected with a secure offshore wave barrier or a mature cordgrass stand. Without wave barrier protection, we would only recommend using the TRM at three feet or more above mean tide. The cost of the material was relatively inexpensive making this erosion material very attractive.

The cellular blocks have stayed stable under all wave conditions. However, the corner where the blocks made a transition to TRM did not stay stable. Therefore, we made repairs and used a "Terracell" cellular confinement system, and it has stayed stable at this transition from the cellular block to the TRM. The cost of cellular blocks is expensive making this material desirable only where other material is inadequate.

The four-inch "Terracell" cellular confinement system was a flexible material, making it easy to install. It has provided better stability then the TRM at low tide elevations and is less expensive than cellular blocks. Furthermore, on high shrink-swell clay soils, the cellular confinement system may give added protection against rilling and gullying of the bluff slope. It appears to be adapted based on our experience to 1 foot above mean tide and higher.

In February 1998, we surveyed the transplants for survival and found 40 dead plants out of 1400. No grasses were dead and most of the dead plants were at the shoreline of the cellular blocks, smothered by shoalgrass (Halodule wrightii). By April of 1998, the shoalgrass was 1-2 feet thick along the shoreline smothering the shoreline plants, especially at the deep corner of the blocks.

On July 9, 1998, and again in February 5, 1999, we surveyed the plants for survival and growth. The grasses performed exceedingly well with all having survival rates over 90%. Both gulf cordgrass and marshhay cordgrass have grown well at this site and appear to be adapted to 11/2 to 2 feet above mean tide and higher. Marshhay cordgrass not only survived well but it extended runners from its rhizomes on 44% of the plants.

The shrubs did not perform as well as the grasses. Wax myrtle performed especially bad. It only had an 11% survival rate. This collection of wax myrtle came from a sandy site and apparently was not adapted to the clay soils of this site. Where the bluff was a little bit sandy the wax myrtle performed better, with a 43% survival rate. Marsh elder had overall a 72% survival rate. However, at those sites that were 2' above mean tide it had a 93% survival rate. The majority of its mortality occured where we planted it at the shoreline. Shoalgrass, which built-up to a 2 foot layer smothered many of these plants.

It is recommended that smooth cordgrass be planted on sites where little shoalgrass is encountered and tidal slopes are less than 5%. Once the cordgrass is well established, bluffs less than 8' in elevation can be shaped and planted to adapted plant material. With the added toe protection, the bluff treatment has improved chances of success.

Where a smooth cordgrass stand is established, a combination of TRM and cellular confinement system with selected plant material should provide good shoreline stabilization. If smooth cordgrass cannot be established, then a bluff treatment that includes cellular concrete blocks for toe protection will be needed.

If the total length of a bluff site can not be treated, we would discourage any attempts at bluff shaping. However, on high value commercial or residential property where adjacent landowners are protecting their shoreline, we believe this system has promising value. We also think this system may have particular value for soil stabilization and wildlife habitat enhancement on man-made spoil islands along the Texas Gulf Coast.

For more information, contact the Kika de la Garza Plant Materials Center, 3409 N FM 1355, Kingsville, TX 78363-2704, 361-595-1313.