Effectiveness of Mitigation Techniques at the Alafia River Crossing

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Mitigation activities are frequently required on highway construction projects. Explored in this paper is the effectiveness of revegetating a black rush *(Juncus roemerianus)* marsh in Florida. The results of a 6-yr monitoring effort are reported. Based on the results, it is concluded that elevation was the critical factor in the success or failure of this marsh revegetation effort.

The extension of I-75 by the Florida Department of Transportation (FDOT) from north of Tampa to Naples and on to Miami began in the mid-1970s. A portion of this Interstate crossed the Alafia River just west of Riverview (see Figure 1). Located in central Hillsborough County, this 31-mi-long river originates in the western part of Polk County and empties into Hillsborough Bay near Gibsonton. The Interstate crosses this tidally influenced river approximately 3.5 mi east of its mouth. At this location the Interstate is a six-lane rural design. Twin concrete bridges 1,552 ft long cross the river at about 34 ft above mean high water. The floodplain was bridged to an elevation of +6 ft or more to minimize potential adverse impacts on this sensitive ecological area.

PRECONSTRUCTION ACTIVITIES

During the development of the final design for the Interstate, environmental permits were required from a number of permitting agencies. These included the U.S. Army Corps of Engineers, the U.S. Coast Guard, the Florida Department of Environmental Regulation (FDER), and the Tampa Port Authority. These permits were obtained in 1978 before construction took place and, among other things, specified

1. No fill (temporary or permanent) to be placed in the wetlands;
2. No dredging for access of work barges;
3. The use of temporary timber work mats; and
4. An on-site, post-construction inspection to determine if restoration measures would be necessary in the tidal marsh.

In cross section, the bridge and approaches showed a transition from a pine-palmetto flatwood north of the bridge at an elevation of +12 ft through a natural marsh edge habitat of palmetto (*Serona repens*) and cabbage palm (*Sabal palmetto*) (*1*) at +5 ft. Crossing a black rush (*Juncus roemerianus*) marsh approximately 425 ft wide at an elevation of +1 ft, the bridge finally reached a natural berm (approximately 3 ft high) of

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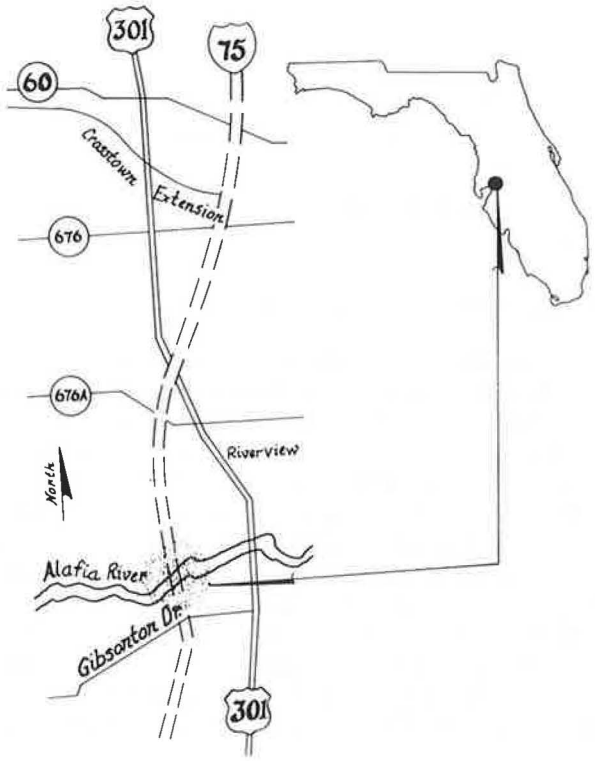


FIGURE 1 Project location map.

alluvial deposition. The berm is vegetated with palmetto, cabbage palm, and grasses for about 50 ft to the edge of the Alafia River. Two small tidal creeks cross the black rush marsh under the bridges. On the south side of the river, the bank climbs rapidly to an elevation of +6 ft within 60 ft of the river's edge (see Figure 2). This rapid transition into a pine-palmetto flatwoods condition minimized any adverse impact on the aquatic environment south of the river. Because of this, all mitigation activities required by the permits focused on the north side of the river, specifically the black rush marsh.

As noted earlier, the original permits received in 1978 provided for temporary timber mats to be placed over the black rush marsh. The black rush was to be burned before the placement of the mats and the mats were to be removed after construction was complete. Any areas where culverts were to be placed had to be restored to original contour and vegetative cover. The FDOT was required to arrange an on-site postconstruction meeting with FDER to determine if restoration measures would be necessary in the tidal black rush marsh. If restoration was deemed necessary after the meeting, the

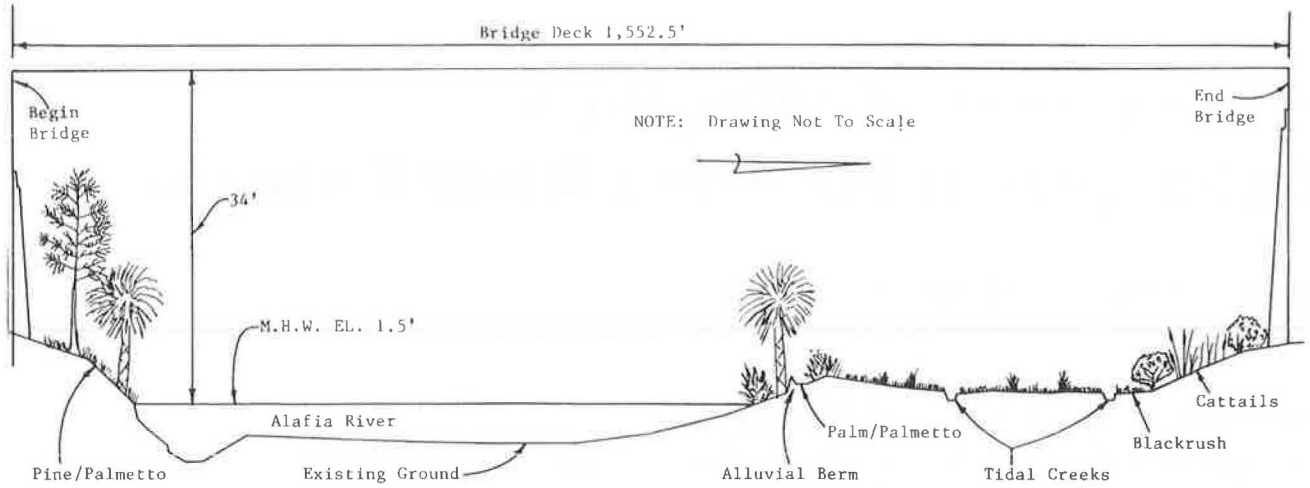


FIGURE 2 Alafia River floodplain cross section.

FDOT was responsible for the development of a restoration plan that would be approved by the FDER.

CONSTRUCTION ACTIVITIES

The construction contract was awarded in September 1979 to the Wiley N. Jackson Company. Work began in January 1980 and the contractor quickly proposed several permit modifications to allow for easier, lower cost construction techniques. However, these construction methods would result in greater impacts to the river's floodplain environment. The proposed modifications requested in the spring of 1980 featured a timber loading platform on the north bank of the Alafia River and a 425-ft-long, 60-ft-wide temporary access road across the black rush marsh, also on the north side of the river (see Figure 3). Two temporary 18-in. culvert pipes were to be installed in the two tidal creeks to maintain the tidal flushing these creeks provided. Additional finger fills were provided east and west of the temporary access road.

The access road was to be placed on Mirafi filter fabric after the area of black rush to be covered was burned to ground level. Because of the wet conditions encountered during construction, this was not possible. As an alternative, the black rush was cut off near ground level and covered with the fabric. Approximately 4 ft of fill material was placed on top of the fabric and the edges of the fabric were rolled back to minimize soil erosion into the marsh.

Adjacent to the main access road, 11 finger fills were constructed to allow access for the bridge construction equipment and materials. These finger fills employed the same techniques for fill placement that the contractor used on the main access road. The permit modification required that all disturbed areas were to be restored to original contour and revegetated with black rush clumps a minimum of 6 in. square. The revegetation plan was to be coordinated with the FDER before its implementation.

REVEGETATION ACTIVITIES

As construction of the bridge was nearing completion, the FDOT developed a revegetation plan that was approved by the permitting agencies. The details of the plan can be found in Figure 4. Although the FDOT did not guarantee any success rate, it did agree to monitor the site for at least 2 yr and report the results to the FDER. The results of the monitoring program will be discussed later in this paper and are summarized in Figure 5.

The contractor began the revegetation plan in September 1981 by first removing the fill material and the filter fabric from the finger fills as required. The contractor used a back hoe with a modified bucket to avoid tearing the fabric. The overlay of fill material was carefully removed until the filter fabric was reached. Before uncovering the filter fabric, a test hole was created on one fill pad to determine the condition of the fabric and the black rush under it. It was noteworthy to find that the fabric under the fill was in nearly original condition, whereas the edges of the fabric exposed to the sun were brittle and easily torn. The black rush and supporting muck soil were compressed as much as 12 to 18 in. in some locations. As the fabric was uncovered, the edges were rolled toward the center to minimize the loss of the fill material.

Following specific criteria for the removal of the fill and filter fabric at each individual location, the fingers were replanted as required by the revegetation plan. The first step in this process involved the restoration of the fill site in accordance with the plan. This involved various techniques including backfilling with a variety of materials (see Figure 4) and matching contours as specified in the plan.

The next step was to identify a donor site for the replacement black rush. Because undisturbed areas of black rush marsh were available within existing rights-of-way, this did not pose a serious problem. To minimize the potential impact on these undisturbed areas, the contractor was required to restrict the width of his clearing for donor plants. The contractor also used random patterns and spread the collection of donor plants over a fairly large area. To collect the plants, workers first cut a path 2 to 3 ft wide through an area of black rush up to 75 ft long. A gasoline-powered weed cutter with a saw-toothed blade was used to cut off the upper portion of the plants, leaving about 12 to 18 in. of stem. Using a hand shovel, random 6-in. squares of black rush were dug and transported to the revegetation areas. Here, operating from planks to avoid sinking into the

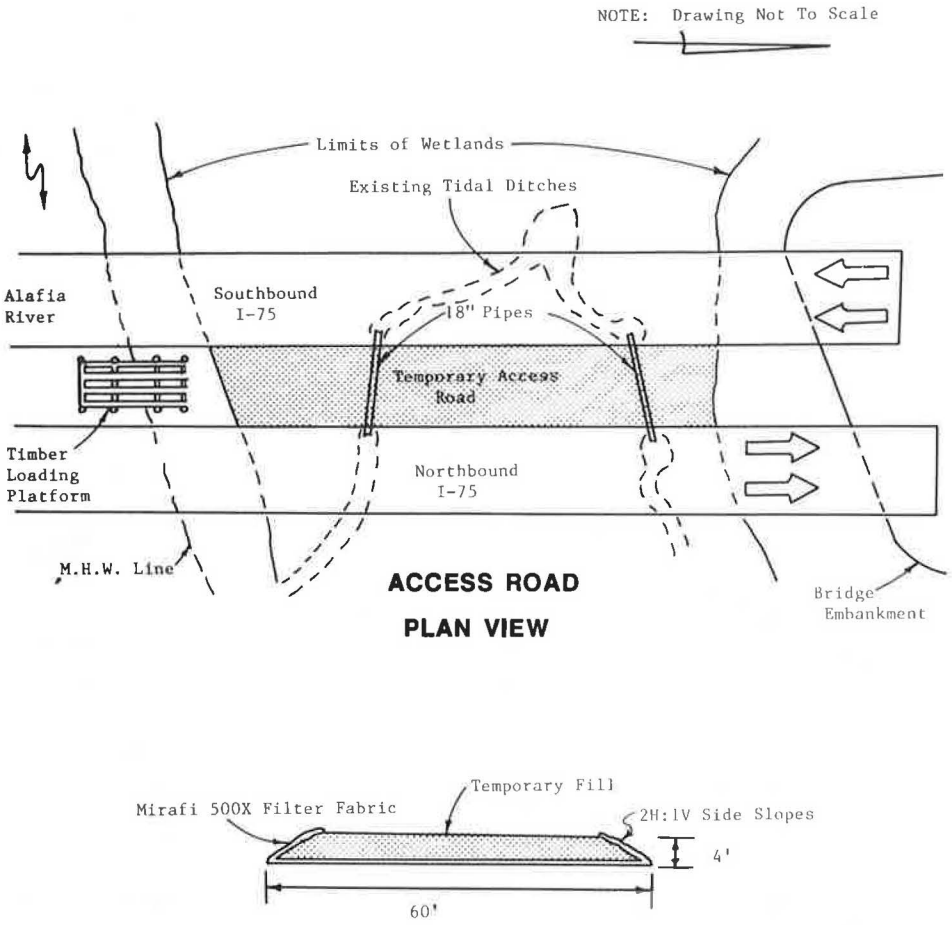


FIGURE 3 Modified permit sketch.

muck, the workers placed the plugs of black rush into holes created by the use of post-hole diggers. The plants were generally placed on 3-ft centers within the areas called for in the revegetation plan.

After the revegetation of the finger fills was completed, the main access road was removed and replanted. The process followed was the same as for the finger fills, with removal starting near the river and working northward. The revegetation work was completed by November 1981.

Based on field reviews conducted in 1981, 1982, 1983, 1986, and 1987, the relative success of the revegetation plan can be evaluated. As seen in Figure 5, Area 1 shows generally good recovery. This area was restored to original contours but was not revegetated. A diversity of plant species covers the area transitions from north to south. On the northern edge are found grasses, dog fennel (*Eupatorium capillifolium*), wax myrtle (*Myrica cerifera*), and brazilian pepper (*Schinus terebinthifolius*). As the area becomes wetter, cattail (*Typha domingenis*) and black rush dominate (2). Total vegetative coverage is better than 60 percent and would probably be better if it were not for livestock creating paths and trampling vegetation.

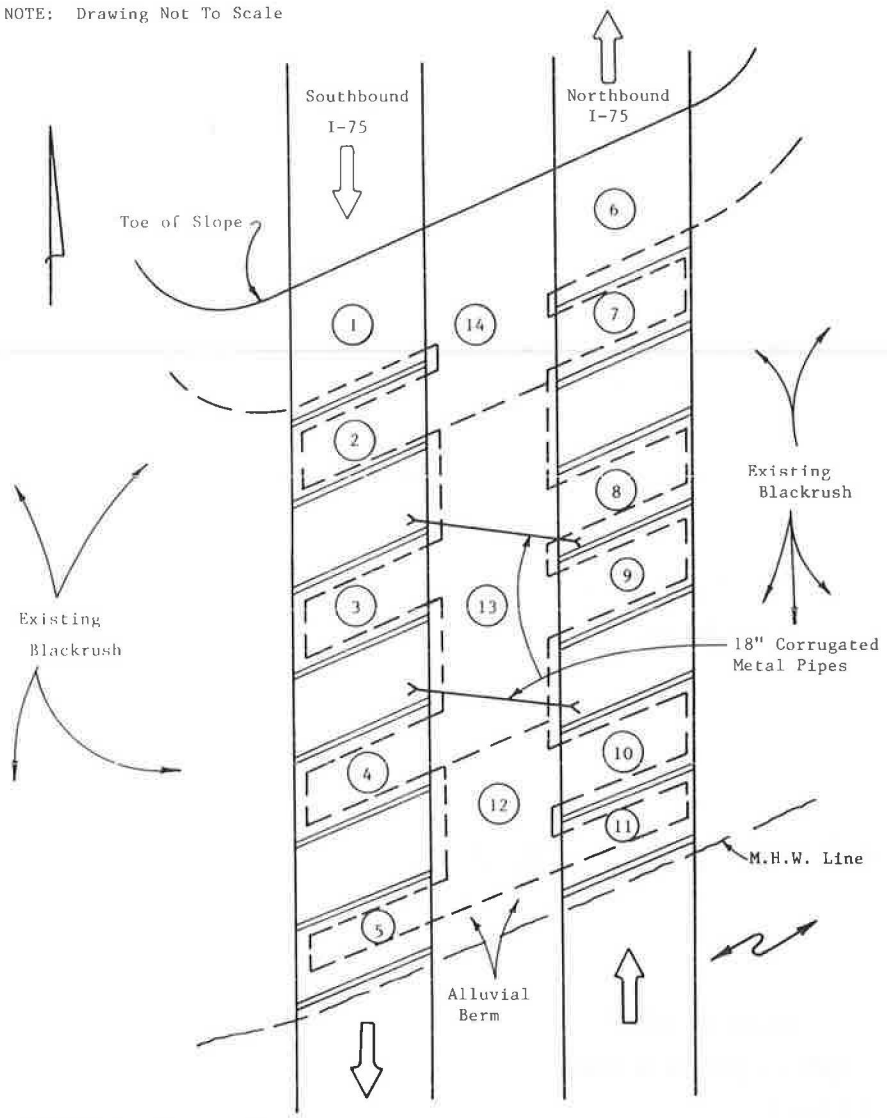
Area 2 contains one of the two tidal creeks with cattails, alligator weed (*Alternanthera Philloxeroides*), willows (*Salix* spp.) (*3*), and ferns present along with black rush. This area was not backfilled but was planted with black rush, which covers about 30 percent of the area.

Like Area 2, Area 3 also contains one of the tidal creeks and was not backfilled, nor was it replanted. Less than 10 percent of black rush establishment has occurred. Some fern and alligator weed are present but little other vegetation is found. Open water, even at low tide, occupies 80 to 85 percent of the area.

Black rush, 4 to 5 ft tall, covers more than 90 percent of Area 4. After backfilling to natural contours, the area was replanted with black rush.

Approaching the alluvial berm separating the marsh from the Alafia River, less than 15 percent coverage by black rush is seen in Area 5. This area has approximately 6 in. of the original fill left on top of the filter fabric. No revegetation was attempted in this area. The black rush that does exist is shorter (typically 3 ft high) than the surrounding plants.

Viewed from the toe of the slope southward on the northbound bridge (east side), Area 6 is very similar to Area 1. Edge



Area	Proposed Activity	Revegetation
1	Remove filter blanket and backfill with mixture of organic material and topsoil to match natural surrounding contours	None
2	Leave as presently excavated	Black rush on 3 ft centers
3	Leave as presently excavated	None
4	Backfill with sand (low organic content) to match natural surrounding contours	Black rush on 3 ft centers
5	Leave filter blanket with approximately 6 in. of existing fill remaining on top of it	None
6	Remove filter blanket and backfill with mixture of organic material and topsoil to match natural surrounding contours	Black rush on 3 ft centers
7	Backfill with topsoil to match natural surrounding contours	None
8	Backfill with topsoil to match natural surrounding contours	Black rush on 3 ft centers
9	Remove fill from filter blanket and roll back blanket without damaging existing root system	None
10	Remove fill from filter blanket and roll back blanket without damaging existing root system	Black rush on 3 ft centers
11	Leave filter blanket with approximately 6 in. of existing fill remaining on top of it	Black rush on 3 ft centers
12	Remove filter blanket and backfill with sand (low organic content) to match natural surrounding contours	Black rush on 3 ft centers
13	Remove filter blanket and backfill with topsoil to match natural surrounding contours	Black rush on 3 ft centers
14	Remove filter blanket and backfill with mixture of organic material and topsoil to match natural surrounding contours	Black rush on 3 ft centers

FIGURE 4 Revegetation plan.

plants such as dog fennel, brazilian pepper, wax myrtle, and palmetto are dominant. Livestock paths crisscross the area. After the backfilling and contouring of this area were completed, black rush was planted. No surviving black rush could be found.

Area 7 was backfilled and contoured but not replanted. Revegetation is slow, with less than 30 percent coverage in black rush. Alligator weed and some cattail was found.

After backfilling and contouring were completed, Area 8 was replanted with black rush. About 70 to 80 percent of the area is now covered with black rush 3 to 5 ft tall.

Following removal of the fill, the filter fabric was carefully removed from Area 9 so that existing black rush root stock was not damaged. No additional plants were introduced. The results show less than 10 percent revegetation in this area although some young plants (1 to 2 ft high) are in evidence.

After the fill and filter fabric were removed, Area 10 was replanted with black rush. No backfilling or contouring took place before the planting. Less than 20 percent coverage of 4- to 5-ft tall black rush has taken place.

Approaching the alluvial berm on the east side of the project, better than 80 percent revegetation with 3.5- to 4-ft tall black rush can be seen in Area 11. Like its western counterpart (Area 5), this area was left with about 6 in. of fill material on the filter fabric. The difference appears to be because Area 11 was replanted, whereas Area 5 was not.

Area 12 is one of three segments of the main access road. This area nearest to the river was backfilled and contoured before being replanted with black rush. Today, a dense coverage of black rush 4 to 5 ft tall exists.

Like Area 12, Area 13 was backfilled and contoured before replanting. Approximately 80 percent of the area is covered with 4- to 5-ft tall black rush and bisected by the two tidal creeks.

The last area to be revegetated was Area 14. This transition area from marsh to upland at the northern end of the bridge was backfilled and contoured. Black rush was replanted and shows a vegetative gradation. Black rush marsh gives way to cattail, dog fennel, brazilian pepper, and wax myrtle. The area adjacent to the toe of the slope is disturbed by livestock paths and contains vines and grasses.

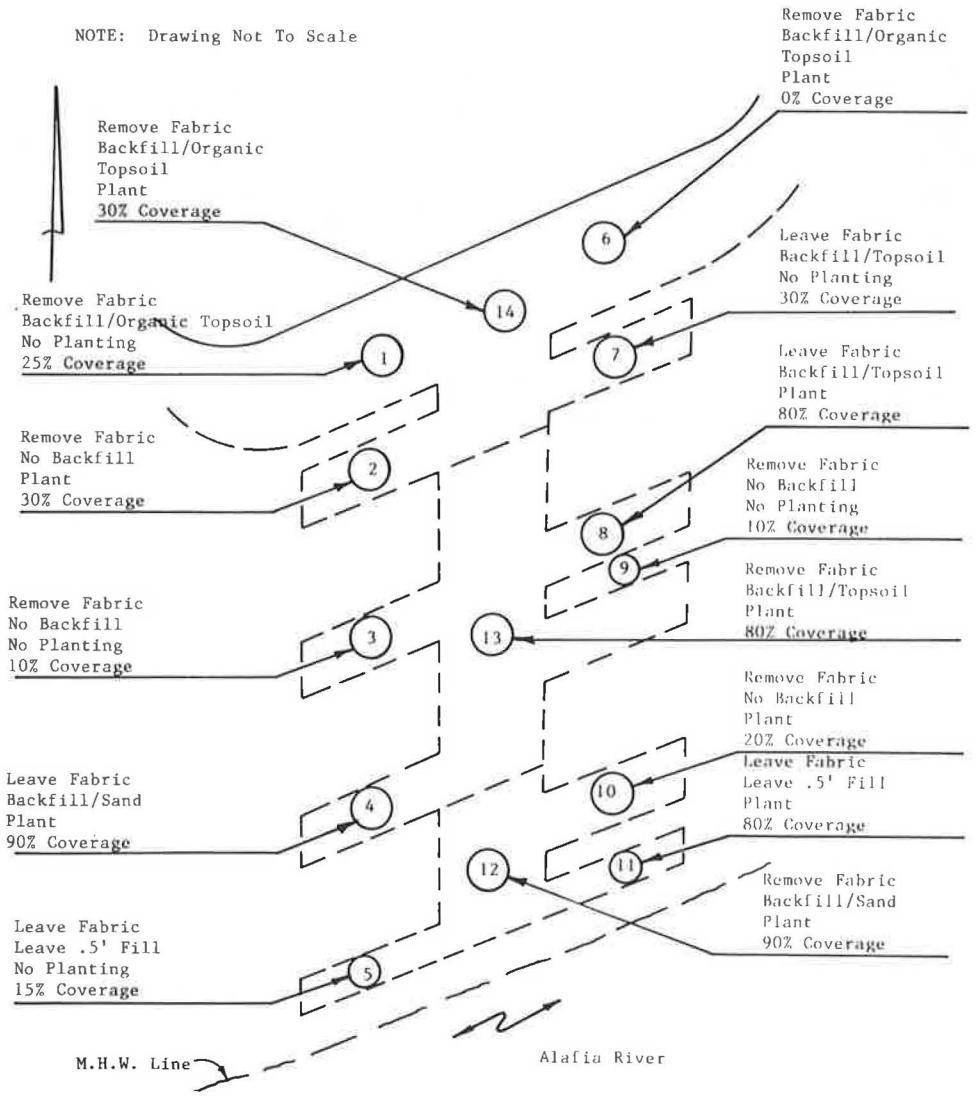


FIGURE 5 1987 summary of activities and results.

As a final point, the donor sites were monitored to determine if any adverse impacts would result. After 6 yr of growth, it is nearly impossible to distinguish the donor areas from the adjacent growth.

CONCLUSIONS

Based on the results of 6 yr of monitoring this mitigation effort in a tidal marsh, several conclusions can be drawn.

1. Reestablishment of the preconstruction contours is critical to the success of revegetation of a tidal black rush marsh. Backfilling (independent of soil type) and contouring before replanting seemed to be the controlling factors in a successful effort. Those areas where backfilling of some type did not take place generally resulted in less than 20 percent black rush coverage. The transition areas (1, 5, 6, and 11) also showed the effects of elevation changes. The black rush does not appear to survive as well when the elevation increases by 12 in. over the preconstruction level of the marsh.

2. Supplemental planting will increase the rate of coverage significantly when combined with backfilling and contouring. A comparison of Areas 2 and 3, 5 and 11, 7 and 8, and 9 and 10 illustrates this conclusion. Whether planting on 3 ft centers is necessary for coverage could not be determined, although it is the accepted norm.

3. Removal of the filter fabric does not appear critical to the successful reestablishment of a black rush marsh if the area is contoured and revegetated. This principle is well illustrated by examining Area 11.

4. The use of areas next to the project for donor sites did not have any adverse impact on the viability of the marsh. No evidence of the removal of these donor plants is evident if care is taken in their selection and removal.

5. After 6 yr, the replanted black rush is generally as tall and full as those specimens found in the undisturbed areas.

6. Finally, it appears that replanting will generally be required in this type of marsh setting to ensure reasonable coverage. Areas 7 and 8 illustrate this concept, although temperature and rainfall may play an important part.

SUMMARY

The use of revegetation by using plugging is an acceptable method to aid in the reestablishment of a black rush marsh. Before replanting, backfilling and contouring to preconstruction conditions is critical. The use of available topsoil or fill material is adequate to provide for plant growth in this type of marsh environment. Donor sites near the project site, if selected at random, will not be adversely affected.

ACKNOWLEDGMENT

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