Coastal Protection and Restoration Authority of Louisiana
Office of Coastal Protection and Restoration

2008 Operations, Maintenance and Monitoring Report

for

North Lake Mechant Landbridge Restoration – Construction Unit 1

State Project Number TE-44
Priority Project List 9

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Terrebonne Parish

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Operations, Maintenance, and Monitoring Report
For
North Lake Mechant Landbridge Restoration
(TE-44) – Construction Unit 1

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I. Introduction

The North Lake Mechant Landbridge Restoration (TE-44) project, Construction Unit 1 (CU1), is located in Terrebonne Parish, south of Bayou Decade and north of Lake Mechant (figure 1). The project area encompasses approximately 7,572 ac (3,064 ha) of predominantly open water (>70%) and marsh, of which most is classified as intermediate (Belhadjali, 2002).

The land bridge, consisting of the Small Bayou la Pointe natural levees and the north shore of Lake Mechant, helps to protect the low-salinity marshes north of Lake Mechant from marine processes of the lake. The steep salinity gradient in the project area and the Penchant Basin area to the north demonstrates the important hydrologic function performed by this land bridge. The Brady Canal Hydrologic Restoration Project (TE-28) in the Penchant Basin, was implemented in 1999 to restore and maintain the salinity gradient of freshwater, intermediate and brackish marshes.

Continued deterioration of the marsh within the project area, both from interior marsh loss and shoreline erosion along Lakes Mechant and Pagie, threatens the integrity of the landbridge. The landbridge separates the intermediate and fresh marshes to the north, from the marine and tidally dominated system of the lake. At the present shoreline erosion rate of 7.5 ft/year (2.29 m/yr) (Paille and Segura 2000), it is projected that a 500 -1,000 ft (152-305 m) section of Lake Mechant shoreline will be breached, thus compromising the hydrologic and ecologic integrity of the area. Additionally, the east Lake Pagie shoreline is eroding at a rate of 3.3 to 3.8 ft/year (1.00 - 1.16 m/yr; Paille and Segura 2000).

The project features for Construction Unit 1 (completed in the spring of 2003) include:

1. Vegetative plantings consisting of *Spartina alterniflora* Loisel cv. Vermilion, (smooth cordgrass) grown in trade gallons.
2. Vegetative plantings consisting of *Spartina alterniflora* Loisel cv. Vermilion, (smooth cordgrass) grown as plugs.

The *S. alterniflora* plants grown in trade gallons had a minimum of six (6) live and growing stems per gallon. The *S. alterniflora* plants grown as plugs were multi-stemmed with bare roots. The planting scheme consisted of a row of trade gallon plants closest to the existing shoreline, then two rows of plugs. Rows and plants were spaced five (5) feet apart, unless water depth was not conducive to plant growth (figure 2). Approximately 10,000 trade gallons and 20,000 plugs were planted along 44,307 ft (13,505 m) of the northern shoreline of Lake Mechant and the eastern shoreline of Lake Pagie. No nutria exclusion devices were used for this project.

Construction Unit 2 (CU2) consists of dredged material placed on the interior marsh, earthen plugs, armored earthen plugs, and weir repairs. Construction started in fall 2008.

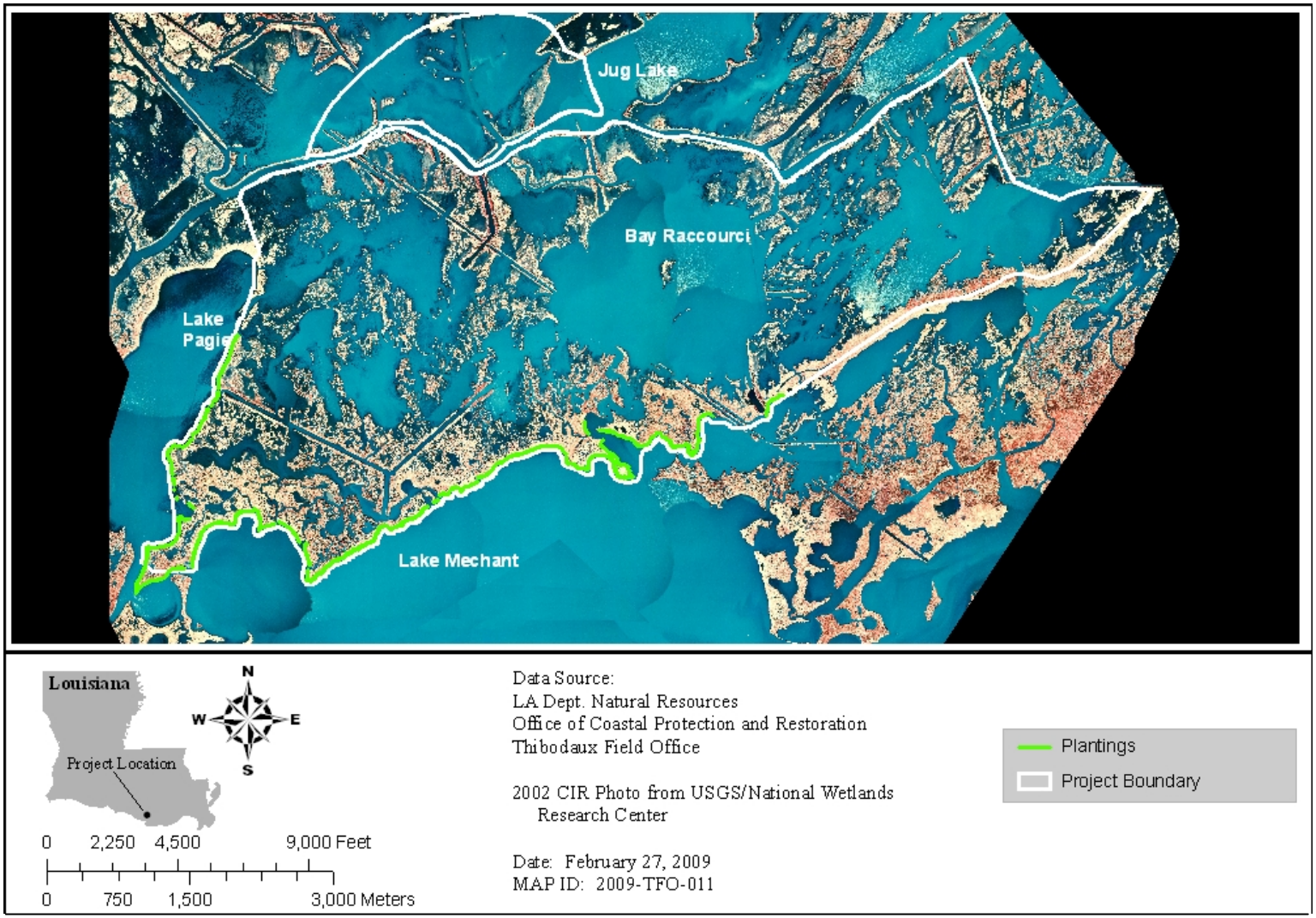

Figure 1. Project location and boundary along with the location of the vegetative plantings for the North Lake Mechant Landbridge Restoration (TE-44) project, Construction Unit 1.

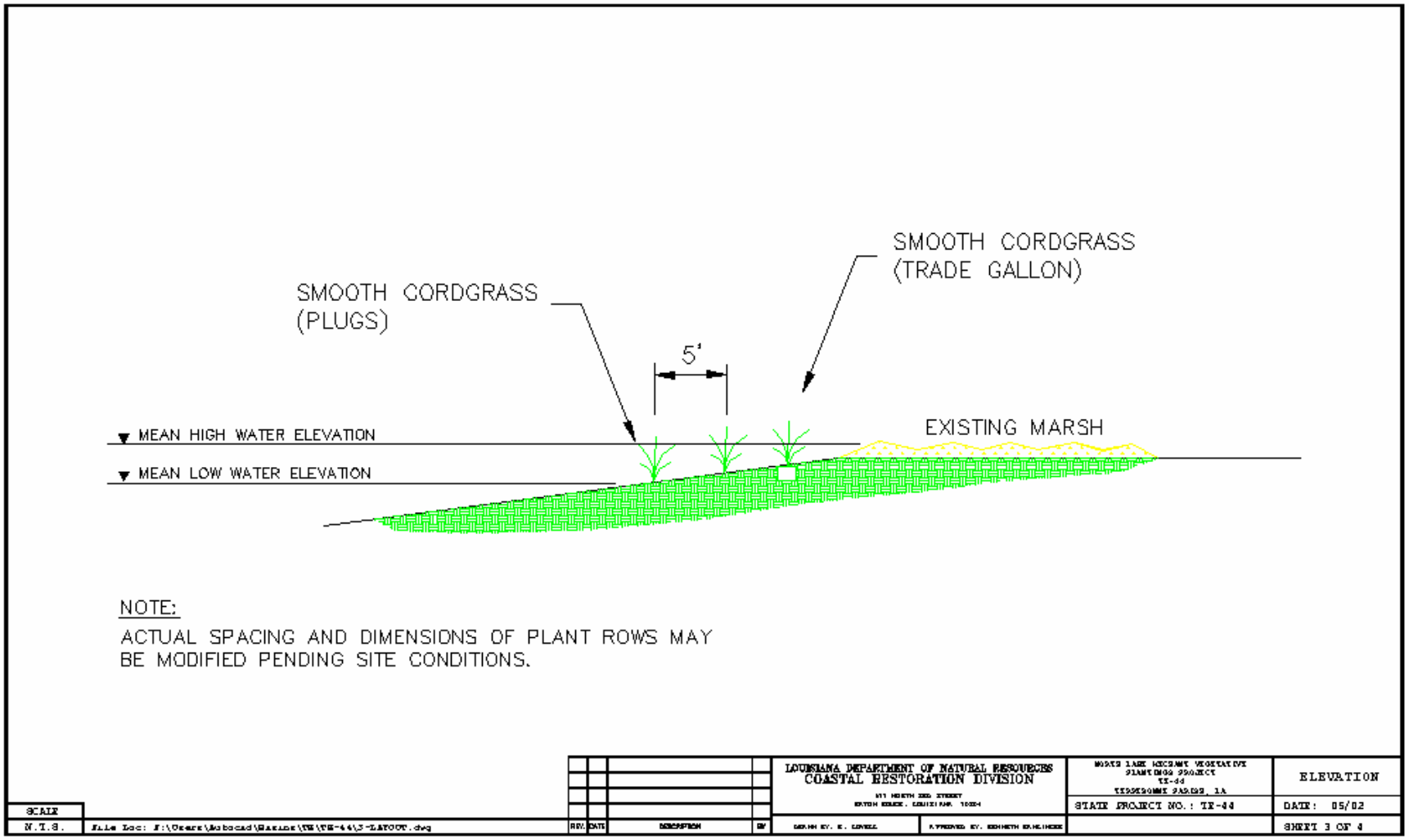

Figure 2. Typical planting schematic at the North Lake Mechant Landbridge Restoration (TE-44) project, Construction Unit 1.

II. Maintenance Activity

No maintenance activities have occurred on Construction Unit 1.

III. Operation Activity

No operation activities are necessary on Construction Unit 1.

IV. Monitoring Activity

a. Monitoring Goals

The vegetative plantings are evaluated based upon the following goals:

1. Determine the effectiveness of vegetative plantings in reducing the rate of erosion as compared to historical rates of erosion.
2. Determine the survival success of the vegetation plantings.

b. Monitoring Elements

The following monitoring elements will provide the information necessary to evaluate the specific goals listed above:

Shoreline Change

The shoreline of Lakes Mechant and Pagie were divided into 400 ft (122 m) segments, and ten (10) segments were randomly selected for sampling. Lake Pagie had four (4) 400 ft segments while Lake Mechant had six (6) 400 ft segments. Two (2) reference areas were selected and sampled for each lake (figure 3). Shoreline position was defined as the edge of the living emergent vegetation (Steyer et al. 1995). However, for this project, the 'actual' shoreline was defined as opposed to the outside or bayward row of Spartina alterniflora that was planted. It was intended that as the S. alterniflora plantings grew and expanded future data collection efforts would have followed the plantings or expansion of the vegetation.

As-built (immediate post-construction), 1-year post-planting (2004), and 4-year post-planting (2007) shoreline positions were determined by Office of Coastal Protection and Restoration (OCPR) (former Louisiana Department of Natural Resources/Coastal Restoration Division, LDNR/CRD) personnel using a differential global positioning system (DGPS) to achieve sub-meter horizontal accuracy for each reading.

Shoreline position was measured by walking the shoreline and stopping at approximately 5 ft (1.5 m) intervals along the shoreline, averaging 10 to 20 DGPS readings. A best fit line was drawn to connect the points, thereby establishing the shoreline position for the total area. All DGPS shoreline position measurements were

conducted in the Universal Transverse Mercator Projection, Zone 15 South, in the North American Datum of 1983 (UTM NAD 83).

Vegetation

Species composition and relative abundance were evaluated on the vegetative plantings using techniques described in Folse and West (2005). A modified Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974) was utilized. Vegetation was sampled in ten randomly selected plots within each of the ten randomly selected 400 ft (122 m) segments referenced in the previous section (figure 3) for a total of 100 plots.

Vegetation species composition and relative abundance were evaluated in the fall following construction in 2003 (as-built), years one (1) (2004) and four (4) (2007). Each sampling station was marked with a corner pole to allow revisiting over time. DGPS will also be used to document each sampling station.

c. Preliminary Monitoring Results and Discussion

Shoreline Change

Shoreline position data for the North Lake Mechant Landbridge Restoration (TE-44) project was collected pre-construction (2003) and post-construction (2004 and 2007) by OCPR personnel. Sub-meter accurate DGPS equipment was used to collect the shoreline points along ten (10) randomly selected 400 ft (122 m) segments and four (4) randomly selected reference areas along the shorelines of Lake Mechant and Lake Pagie (figure 3). The same segments were revisited for each subsequent survey. OCPR personnel utilized a Trimble GeoXT for collection of all shoreline data.

Data Analysis Methods for Shoreline Change

Georectified DGPS shoreline segments from each survey year were entered into ESRI® ArcMap™ Version 9.2 and converted to shapefiles. Polygons were created from these segments in order to have a pre-existing standardized area from which to calculate area and linear changes with polygons created from each data collection year. Shoreline segments for each year were also entered into ESRI® ArcMap™ Version 9.2 as shapefiles. Area and distance calculations were made between the polygons and segments for each year using the area command function in ESRI® ArcMap™ Version 9.2. Data generated from these calculations were entered into a Microsoft® Excel 2002, Version 10.6841 worksheet and additional calculations were performed to determine the change rate per year for each shoreline segment.

In order to calculate the change rate per year for a given span of years, the land area inside the standardized polygon created for each shoreline segment was first determined for each survey year. The difference between the areas inside the polygon for a given span of years represented the change in the area.

Year 2003 Area (m^2) - Year 2004 Area (m^2) = Area Change (m^2)

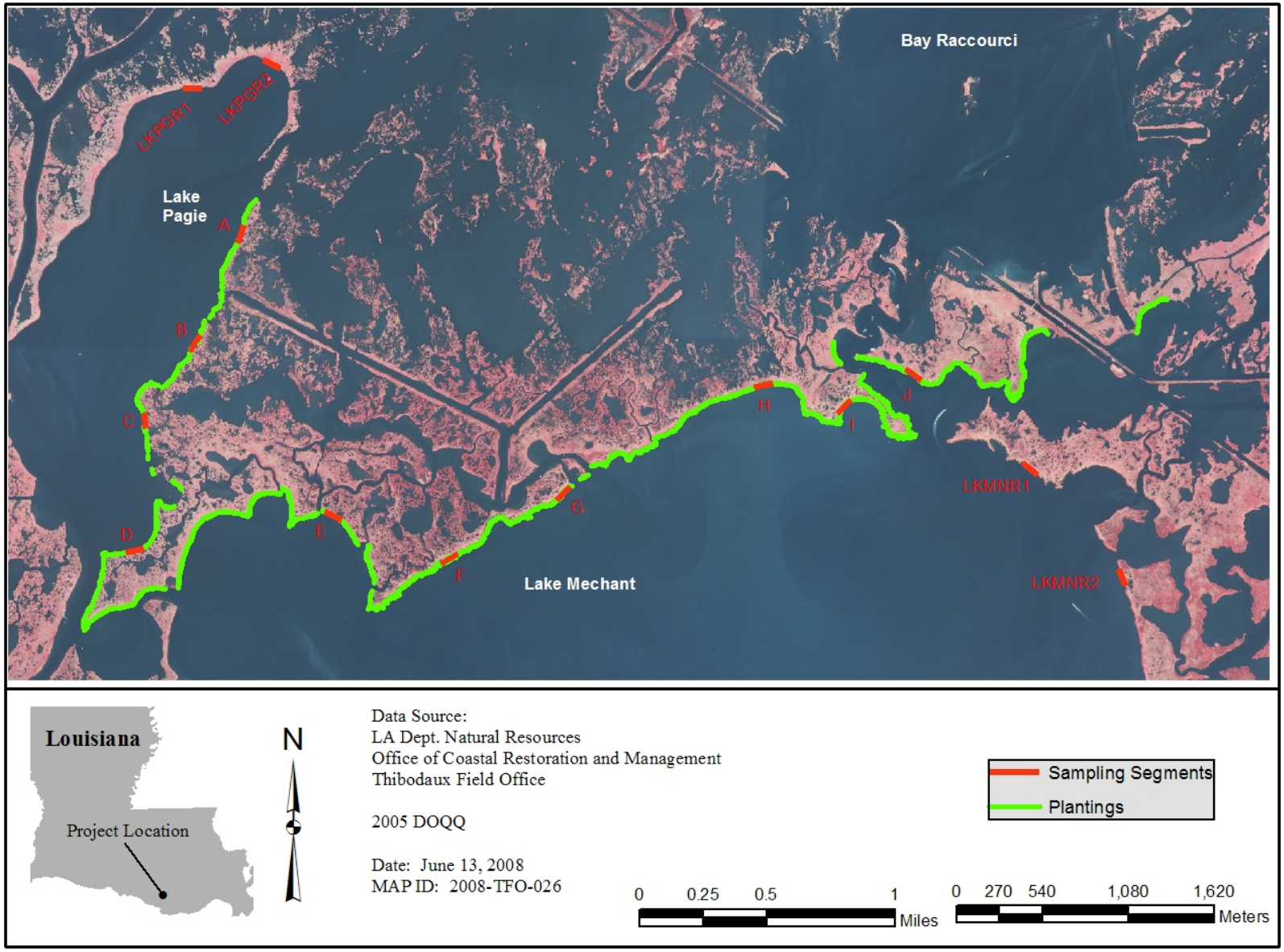

Figure 3. Shoreline segments sampled and vegetative planting along Lake Paige and Lake Mechant.

Next, an average change rate was calculated by taking the area change inside the shoreline segment polygon and dividing it by the shoreline segment length.

$$\text{Area Change } (m^2) \div \text{Shoreline Segment Length (m)} = \text{Avg. Change Rate (m)}$$

Finally, the average change rate was divided by the number of days within the span of the two surveys being compared, and then multiplied by 365.25 days to determine the change rate per year.

$$(\text{Avg. Change Rate (m)} \div \text{\# of Days between surveys}) \times 365 \text{ days} = \text{Change Rate/Year } (m/yr^{-1})$$

Although the data results for both lake rims are similar, the results will be presented separately because the shoreline areas for each lake differ in size, orientation, water / marsh interface, and number of segments sampled.

- The average shoreline change rate in the Lake Pagie segments between 2003 and 2007 was calculated at -0.15 ft/yr for the planted areas, while the reference areas averaged -2.53 ft/yr. Figure 4 illustrates the shoreline change for each segment over the 4-year period along with the average of the planted and reference areas. All segments are within the range of error of the equipment used (represented by the line in figure 4 at -3.28 and 3.28); therefore, the shoreline during this period was relatively stable with little to no change. Figures for shorter time periods, 2003 to 2004 and 2004 to 2007, are provided in Appendix A.
- The Lake Mechant shoreline plantings had an average shoreline change rate of -1.08 ft/yr between 2003 and 2007 while the reference areas averaged 1.09 ft/yr. Figure 5 illustrates the shoreline change for each segment over the 4 year period. These averages fall within the range of error of the instrumentation used to collect the data. Examining shorter term intervals (2003 – 2004 and 2004 – 2007; Appendix A), the shoreline expanded an average of 5.74 feet for the 2003/2004 time period while the reference area expanded an average of 6.21 ft for the same time frame. The reverse occurred for the 2004/2007 time period when the average shoreline change was -5.05 ft/yr for the planted area while the reference was -1.88 ft/yr.

The average values for the project and reference shorelines are presented as actual rates of shoreline change between 2003 and 2007. The rates are within the error of the instrumentation used to gather the data; consequently, there was no significant shoreline change for this time period along these areas.

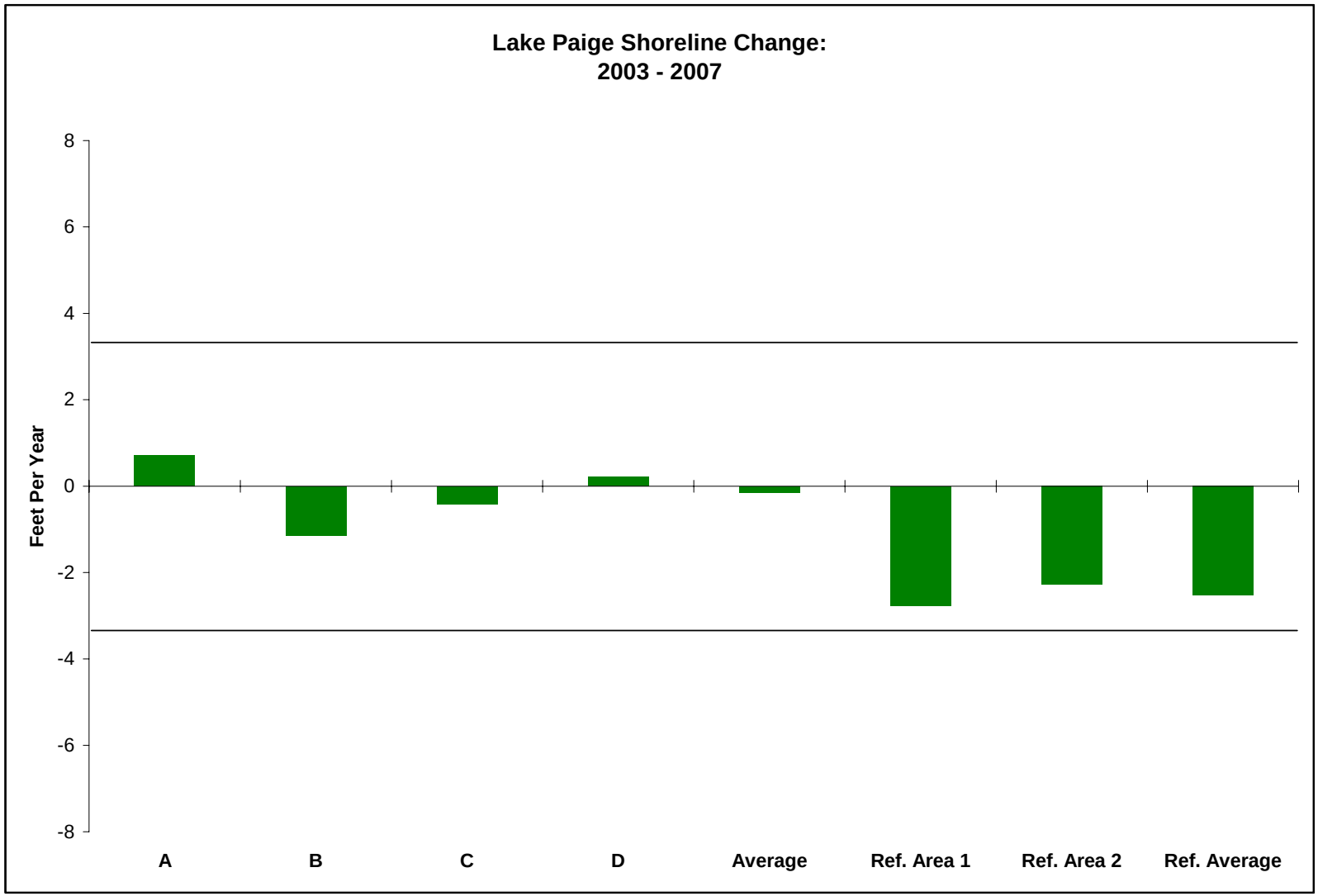

Figure 4. Shoreline change rate per year for the eastern shore of Lake Paige.

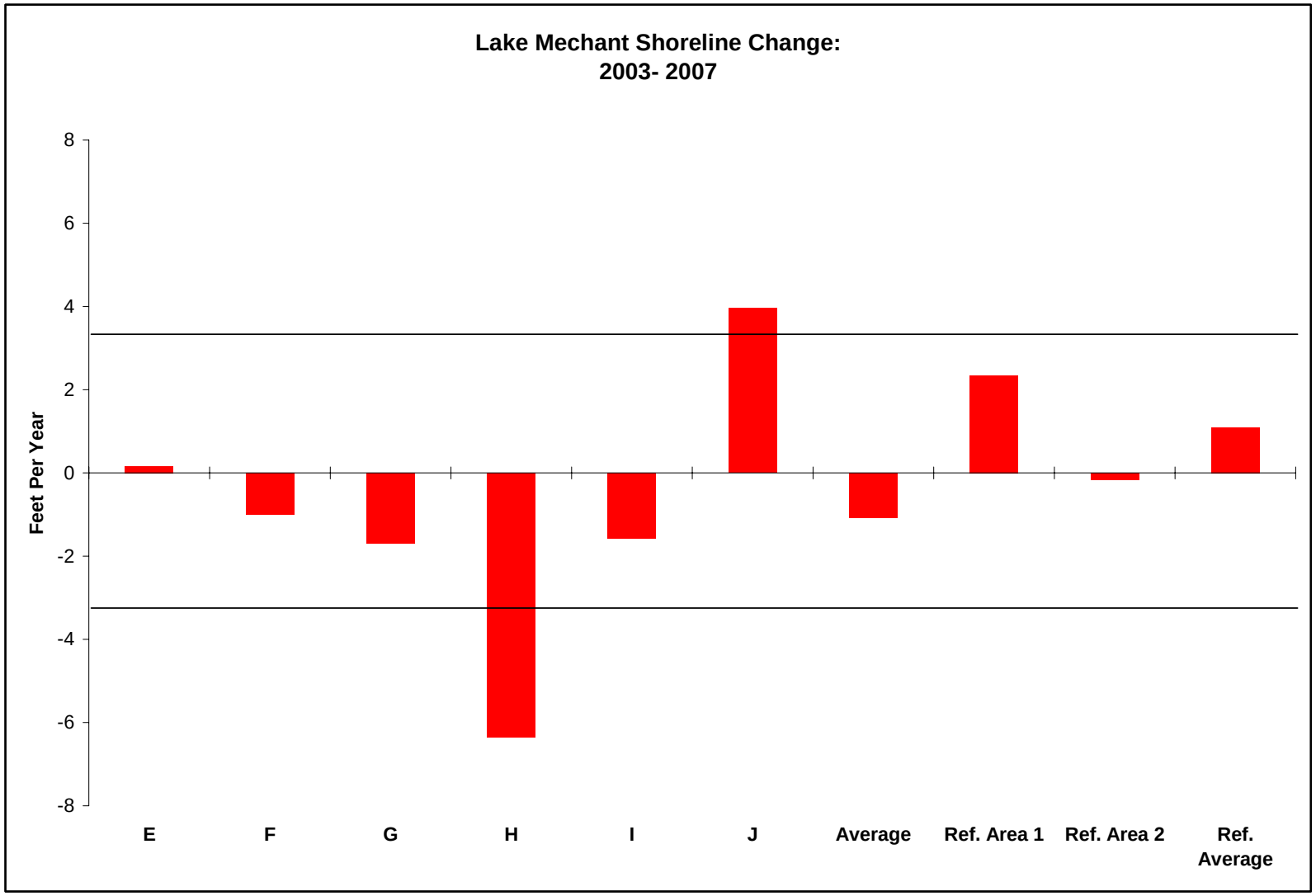

Figure 5. Shoreline change rate per year for the eastern shore of Lake Mechant.

Vegetation

Vegetation stations were established and surveys were conducted in June of 2003 (N=100 plots) immediately post-construction (as-built). In October of 2004 (N=95) and September of 2007 (N=100) the surveys were repeated. During the 2004 sampling, 95 of the 100 markers were present and the 5 remaining stations were in open water. OCPR personnel re-established all 100 stations using a Trimble GeoXT sub-meter GPS unit prior to the September 2007 field sampling. Coastal Estuary Services Inc., a contractor of OCPR, conducted the sampling.

Vegetative plantings were sampled for survival in 2003 and sampling was attempted in 2004. The 2003 data results showed an overall survival of 61.3% with survival highest along Lake Paige (76.9%, n=346). The survival rate along Lake Mechant was 52% (n=572). The results of the 2004 sampling are not as definitive because many stations had indistinguishable plantings. Plants may have grown together or died and there were no remnants to accurately document. Forty-two (42) of fifty-three (53) stations had plants that were classified as indistinguishable.

The mean cover for all plots in 2003, 2004, and 2007 was 5.57%, 24.21%, and 12.19%. As expected, the lowest percentage was immediately after the plantings. The reduced cover in 2007 is a result of erosion that is still occurring along the shorelines of both Lakes Mechant and Paige.

Figure 6 graphically displays a comparison of the relative mean percent vegetative cover for the 4 segments along Lake Paige as well as the average of the segments for years 2003 (as-built) and 2007 (4-years post-construction). All segments had an increase in bare ground (bare ground data was collected as an individual species; a percent cover value was assigned to the area where there was no vegetative cover present in the 4 square meter plot). Segments A and D no longer had any vegetative components within any of the plots in the reach in 2007. The three most common species found during the sampling periods were *Spartina patens* (Ait.) Muhl., *Spartina alterniflora* Loisel., and *Schoenoplectus americanus* (Pers.) Volk. Ex Schinz & R. Keller. Any other species that was observed was lumped into the 'Sum of Other Species' category. Appendix B provides the data results for 2004.

The Lake Mechant shoreline segments averaged a higher vegetative cover during the 2007 sampling as compared to the 2003 sampling (figure 7). There was approximately 13% more vegetative cover in 2007. The 3 segments that contributed to the increase were segments E, I, and J which increased 14%, 17%, and 59% respectively. On the other side of the spectrum, segments F and H remained the same while segment G had a reduction of 12%. Appendix B provides the data results for 2004.

When examining the mean percent cover for the plots and the shoreline change data, 1-year post-plantings the mean cover along the Lake Mechant was 35.8% up from 7.03% during the as-built survey. The shoreline showed an average expansion of 5.74 ft. Unfortunately, the Lake Paige shoreline did not experience the same vegetative growth

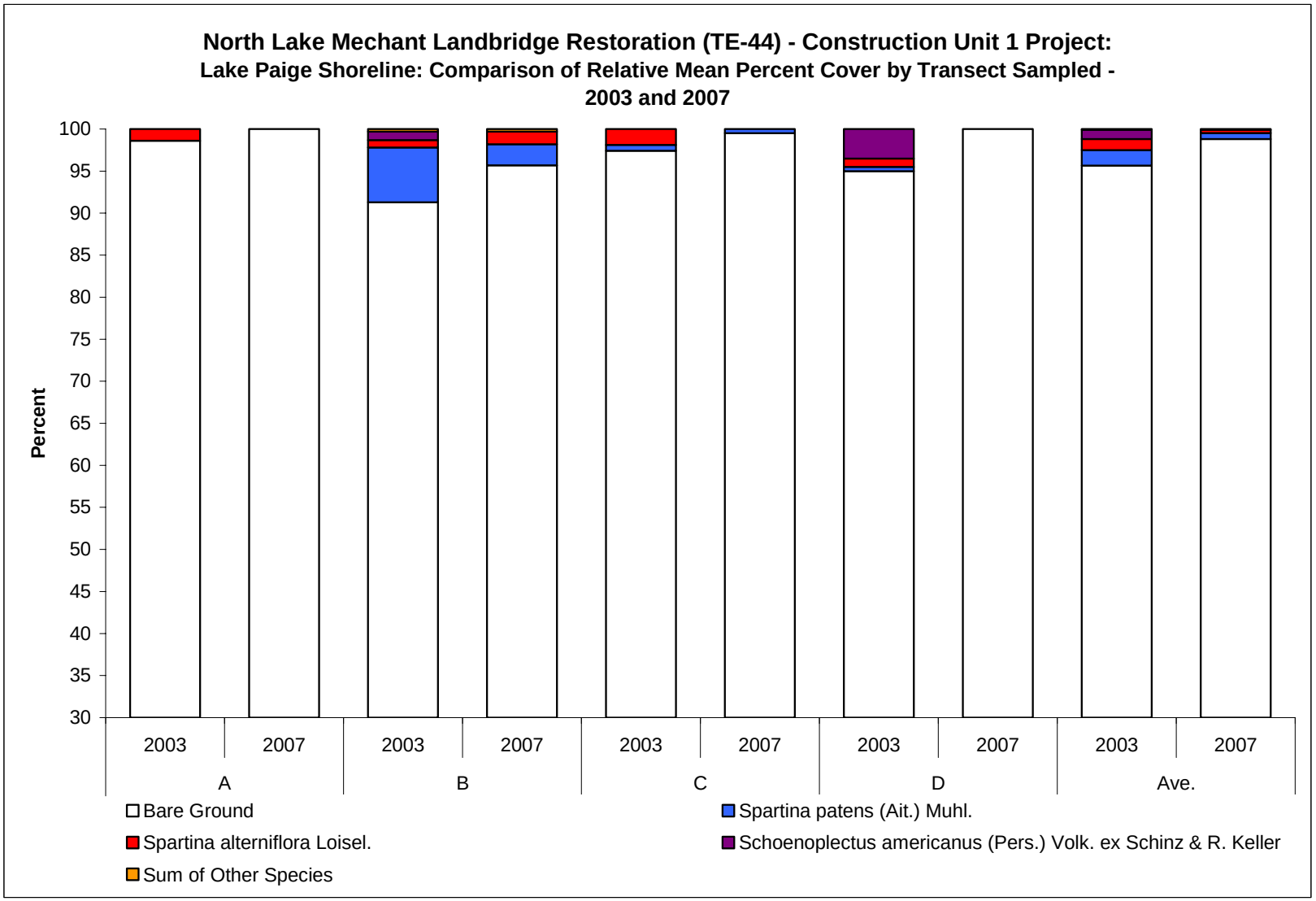

Figure 6. 2003 and 2007 comparison of the relative mean percent cover by transect for the Lake Paige shoreline.

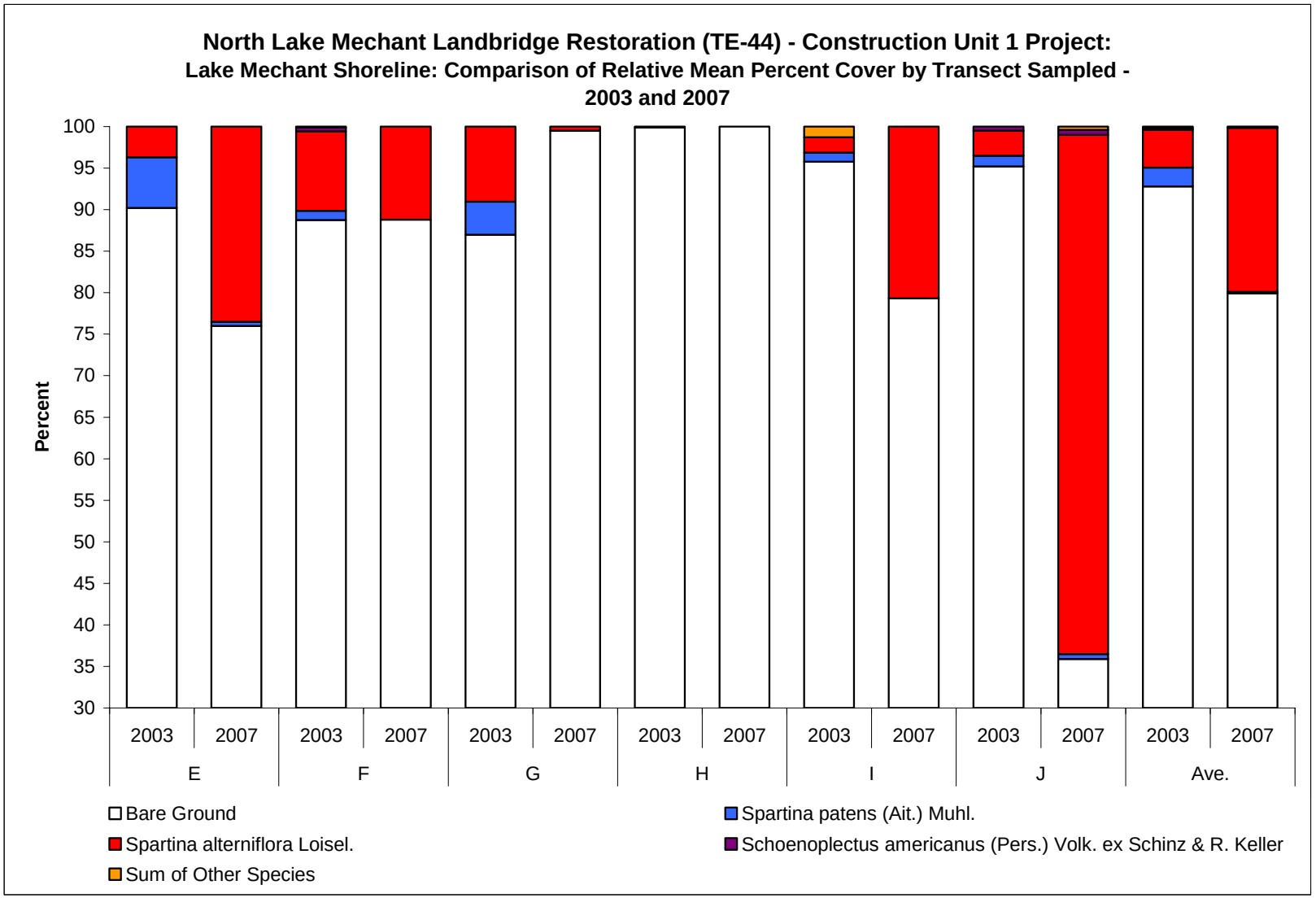

Figure 7. 2003 and 2007 comparison of the relative mean percent cover by transect for the Lake Mechant shoreline.

and shoreline expansion. The vegetation showed a reduction in the overall mean percent cover by 1.96 meaning the average percent cover 1-year post-plant was 1.41 percent while the shoreline growth averaged 1.56 ft. Appendix C contains photos from the 2003 and 2007 sampling trips.

As noted in the 2004 Operations, Maintenance, and Monitoring Report for the North Lake Mechant Landbridge Restoration (TE-44) project (Gray 2004), the shoreline along Lake Pagie in the project area is not a gradual slope from supratidal to subtidal. There is a two to three foot drop off along the marsh edge. The vegetation was planted in the water where depths were observed from two to three feet (in 2003). The soils of the Lake Pagie shoreline are loose, unconsolidated and highly organic. Vegetation mortality along the north shore of Lake Mechant, seemed to have suffered from vigorous wave action. Some planting rows were completely missing. The north shoreline of Lake Mechant consists of a wide tidal mudflat of consolidated soils. Prevailing winds during the summer are from the south. Lake Mechant is a very shallow lake and rough conditions can be generated by moderate wind speeds of 15 - 20 miles per hour.

V. Conclusions

a. Project Effectiveness

The Lake Paige vegetative plantings exhibited a 77% survival one month after planting occurred in 2003; however, subsequent sampling (1 and 4 years post-planting) have yielded much less success. Calculations of percent survival post-planting were not conducted because data could not be obtained due to the inability to sample the exact same plants. This problem was due to the death of plants and the remnants being missing or in some occasions the plants had grown together making it difficult to determine the exact plants that were counted in the original sampling. Based on the mean percent cover of the plots sampled, the vegetative component of the plots was reduced in 2004 from 2003 and was farther reduced in 2007 from year 2003. This indicates that the planting effort was not successful along the Lake Paige shoreline. Field observations indicate that the plantings occurred along a cut bank where the existing marsh elevation was 2 -3 feet higher than the surface where the plants were planted. This elevation difference may have hindered plant growth and ultimately prevented the growth and spread of the plants.

In the four years of monitoring after the *Spartina alterniflora* plantings occurred along Lake Paige, the shoreline change rate averaged -0.15 ft/yr which is less than the 3.3 – 3.8 ft /yr cited by Paille and Segura (2000). The types of data collected does not provide any definitive conclusions with respect to the reduced shoreline erosion obtained post-planting.

The Lake Mechant vegetative plantings exhibited a 52% survival one month after planting occurred in 2003 and a mean percent cover of 7%. In 2004, the mean cover

increased to 35%. In 2007, the mean cover decreased to 16.5%. The shoreline of Lake Mechant is much different than Lake Paige. The shoreline is a gradual sloping shoreline along the northern rim of the lake. This gradual sloping area allowed for some of the plantings to flourish immediately post-planting; however, the hurricanes of 2005 may have affected the survival and cover of the plantings for the 2007 sampling period.

Since there are no longer any evidence of plant survival along Lake Paige and there is limited spread of the plantings along Lake Mechant, it is recommended that all monitoring associated with vegetative cover, species richness, and shoreline positioning be halted. The data that would be collected in subsequent years would not provide any beneficial information to the project nor is it likely that the shoreline will prograte unless more plantings are established or there is a marsh creation constructed along the shorelines.

b. Recommended Improvements

Projects that contain vegetative plantings as a project feature should have money allocated for multiple supplemental plantings during the first 5-years of the project's life. Along with the budget, a detailed plan of action on when to initiate these plantings should be outlined either in the operations and maintenance plan or the monitoring plan.

Communication of data collection results need to be provide back to the project team in a more timely manner (within 3 months of data collection) so decision about supplemental plantings can be decided. Waiting for data to be published in a formal report takes to long. The data should be analyzed and summarized for the project team to make decision prior to the formal presentation of the data and results in a report.

c. Lessons Learned

Shorelines where there is a cut bank of 2-3 feet or the elevation between the marsh surface and the water bottom is greater than one foot should not be planted with *Spartina alterniflora* or any other plant species that can not tolerate continuous flooding. As the data illustrates for the Lake Paige shoreline, the plantings never flourished.

A new method for sampling success/survival of vegetative plantings needs to be developed that is flexible for many applications, but also repeatable after one or more years of planting. Being able to repeat a data collection method would strengthen the conclusions being derived from the data collection efforts.

Shoreline position data collection efforts need to be collected more infrequently when the area has low rates of erosion. When erosion rates are less than the accuracy of the equipment being utilized, it is difficult to derive conclusions.

VI. REFERENCES

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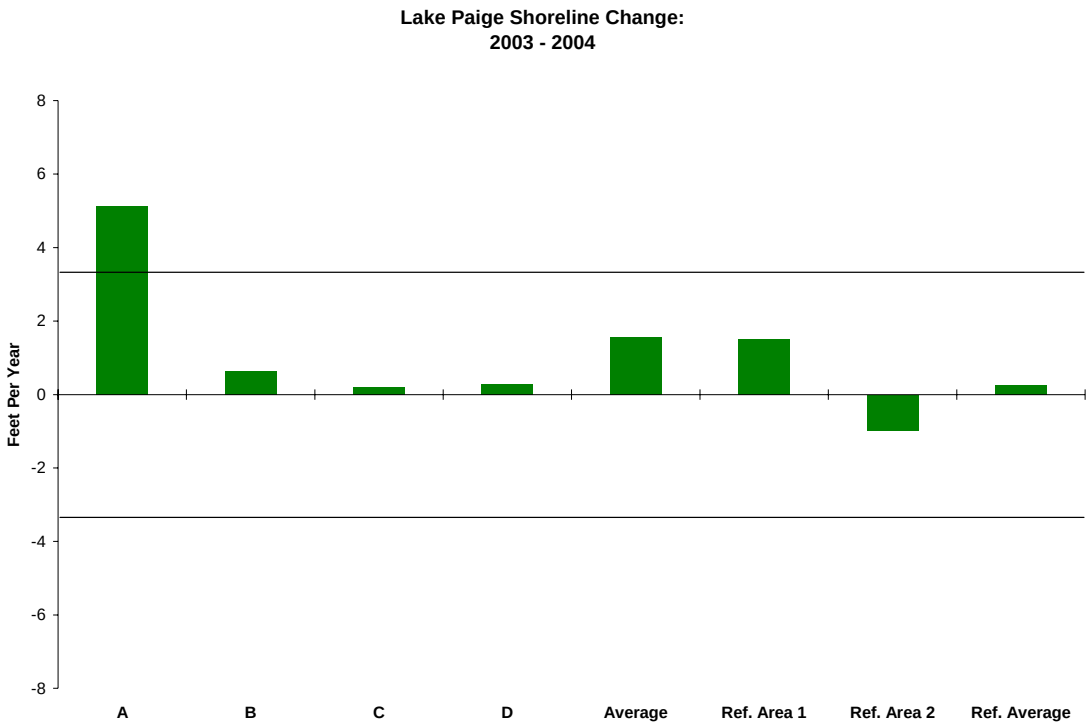
Gray, K. 2007. 2004 Operations, Maintenance and Monitoring Report for North Lake Mechant Landbridge Restoration (TE-44), Louisiana Department of Natural Resources, Coastal Restoration Division, Thibodaux, Louisiana. 14pp.

Mueller-Dombois, D. and Ellenberg, H. 1974. Aims and methods of vegetation ecology. John Wiley and Sons. New York. 547 pp.

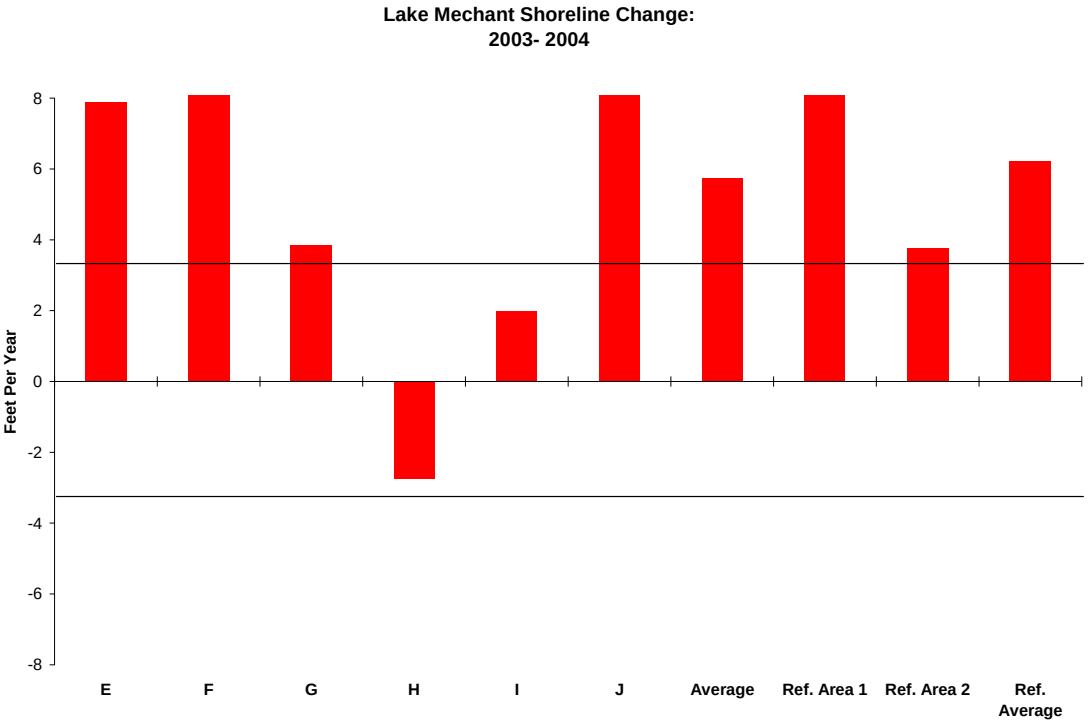
Paille, R. and Segura, M. 2000. North Lake Mechant Landbridge Restoration Project. Project Information Sheet Format for Wetland Value Assessment, September 19, 2000. 8pp.

Appendix A

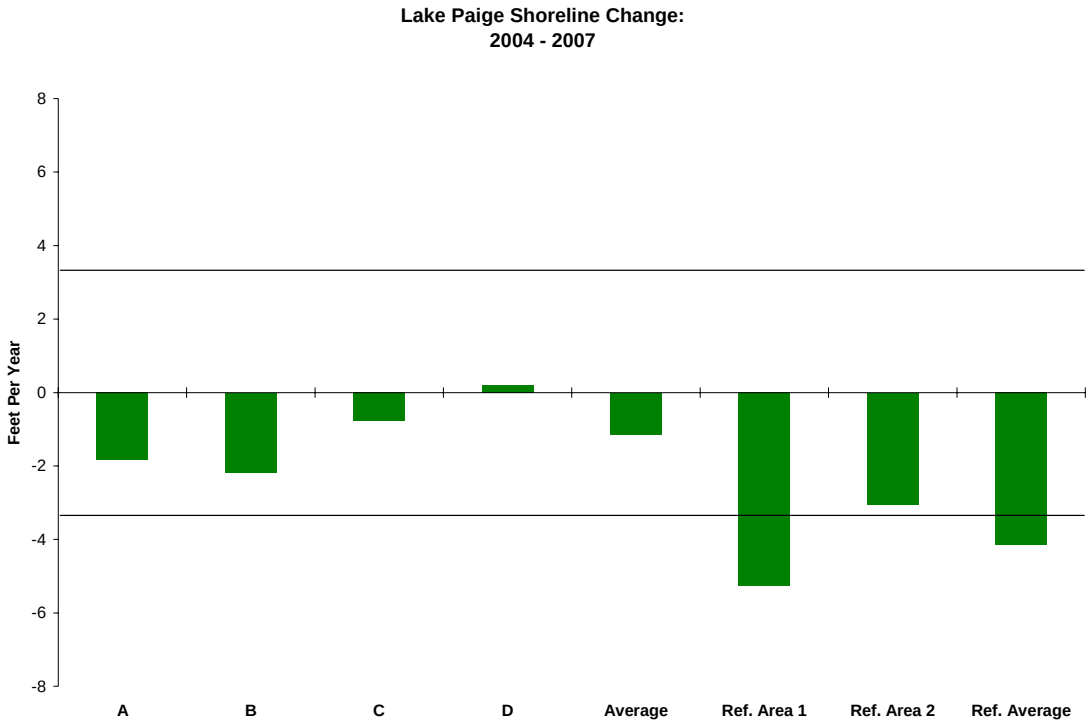
Shoreline Change Data For Lakes Paige and Mechant: 2003 – 2004 and 2004 - 2007



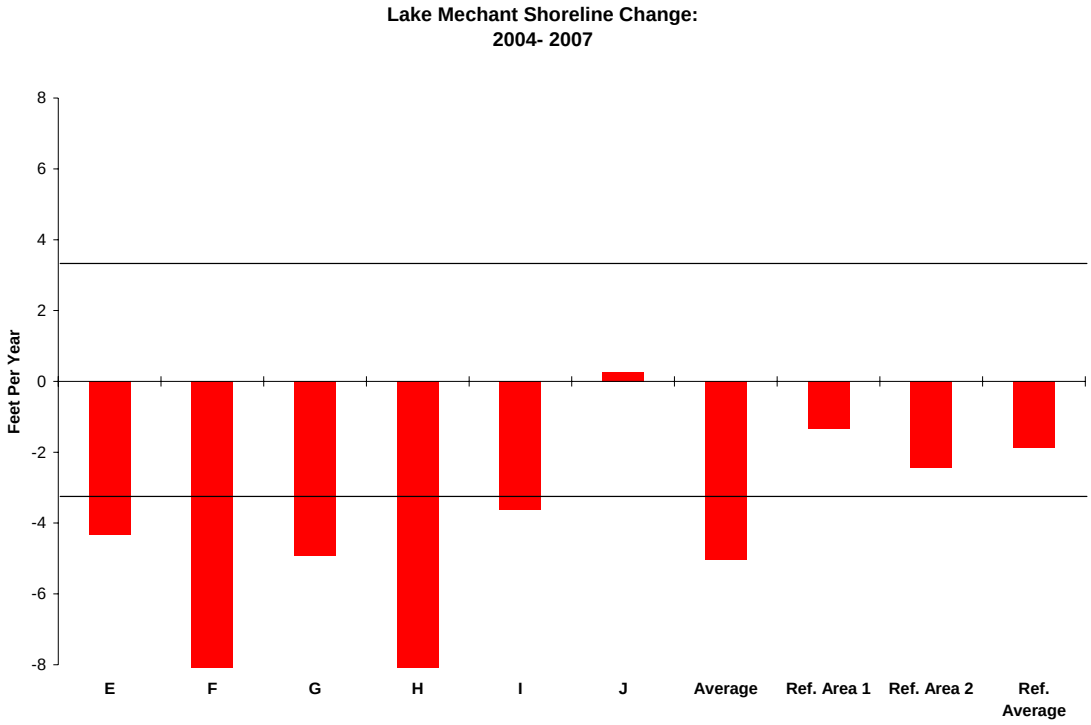
Graph 1. Lake Paige Shoreline Change data between 2003 and 2004.



Graph 2. Lake Mechant Shoreline Change data between 2003 and 2004.



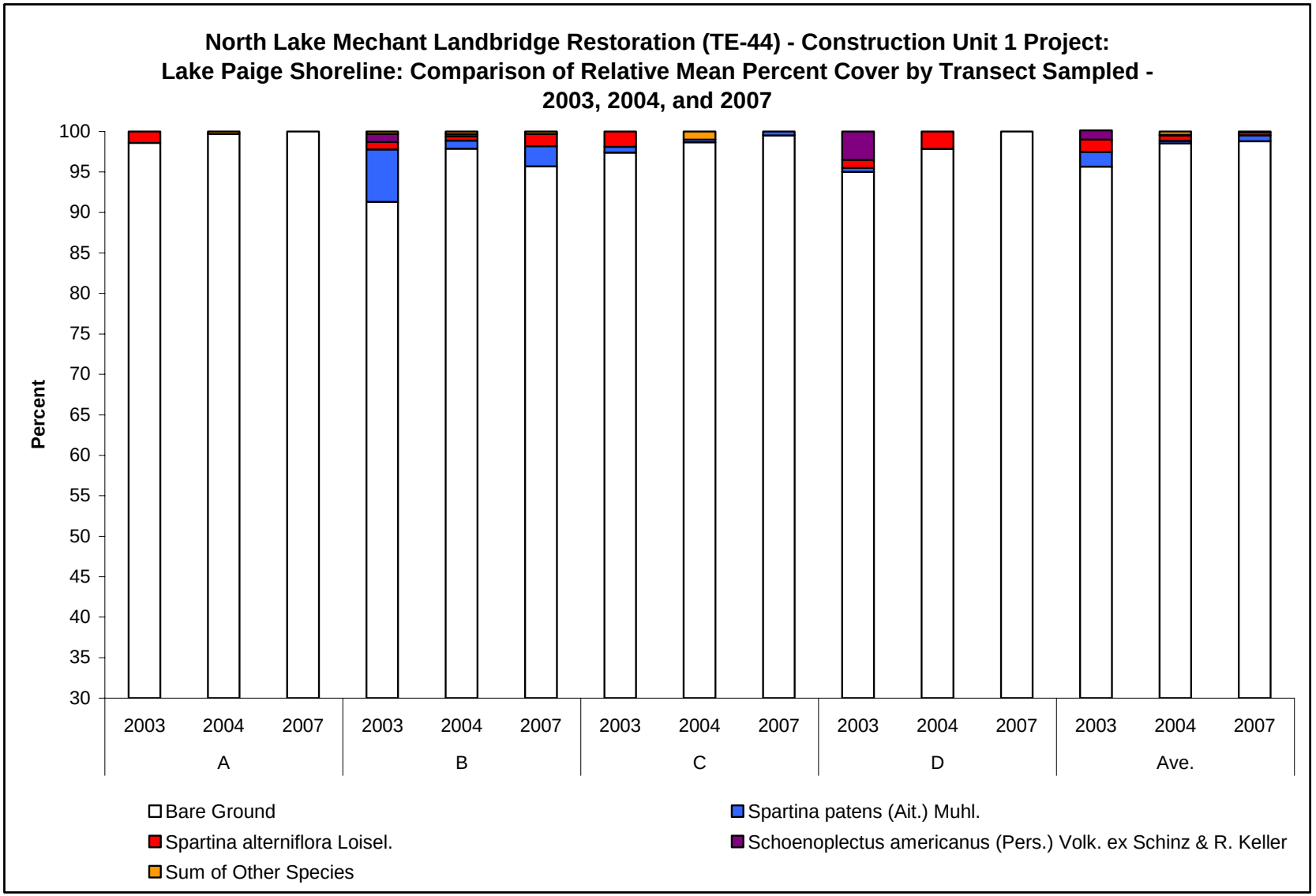
Graph 3. Lake Paige Shoreline Change data between 2004 and 2007.



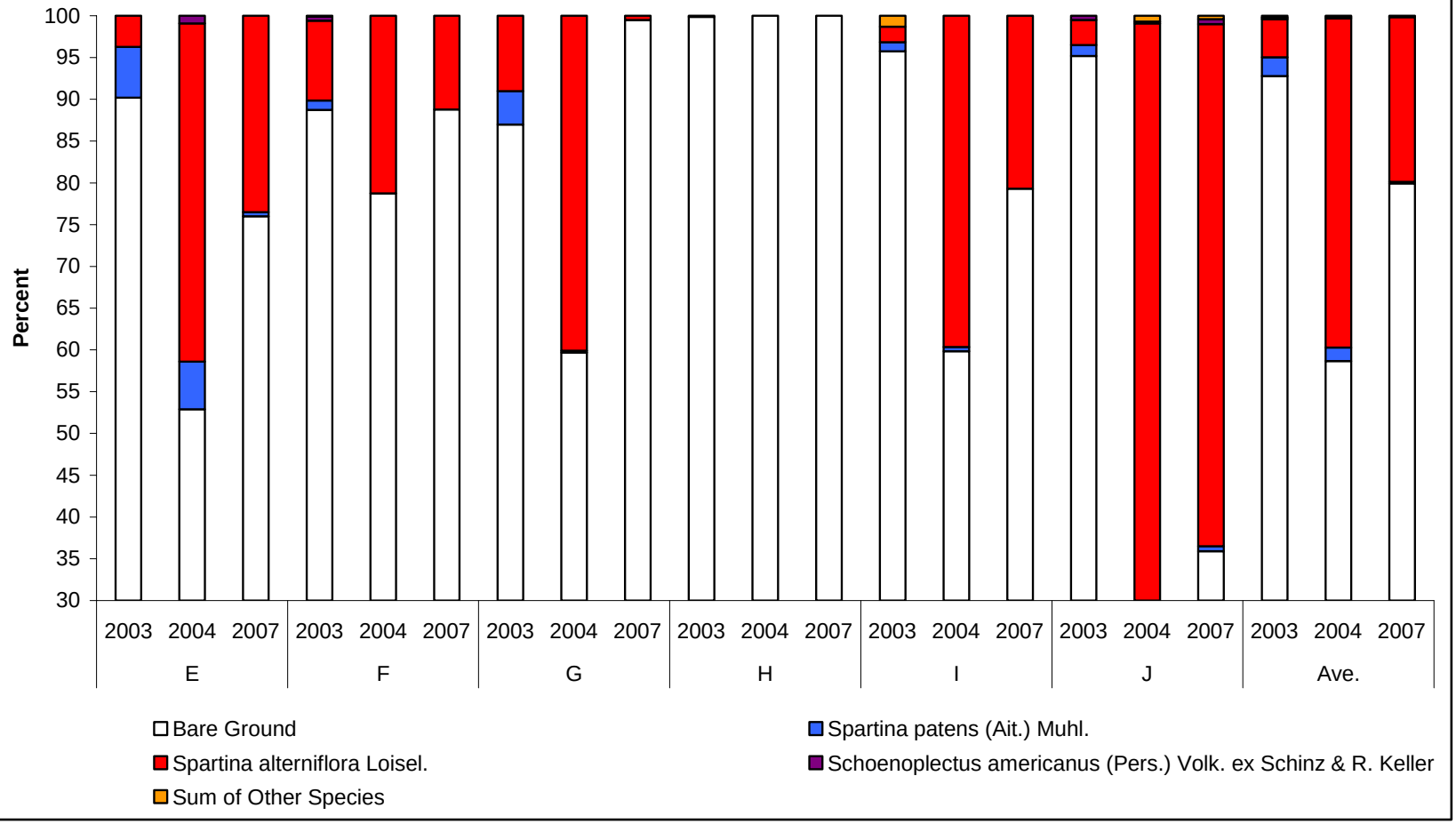
Graph 4. Lake Mechant Shoreline Change data between 2004 and 2007.

Appendix B

2003, 2004, 2007 Relative Mean Percent Vegetative Cover: Comparative Results


North Lake Mechant Landbridge Restoration (TE-44) - Construction Unit 1 Project:
Lake Paige Shoreline: Comparison of Relative Mean Percent Cover by Transect Sampled -
2003, 2004, and 2007
Percent
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
2003
2004
2007
A
B
C
D
Ave.
Bare Ground
Spartina alterniflora Loisel.
Sum of Other Species
Spartina patens (Ait.) Muhl.
Schoenoplectus americanus (Pers.) Volk. ex Schinz & R. Keller

North Lake Mechant Landbridge Restoration (TE-44) - Construction Unit 1 Project:
Lake Mechant Shoreline: Comparison of Relative Mean Percent Cover by Transect Sampled - 2003, 2004, and 2007



Appendix C

Data Collection Photos

Photo 1. Lake Paige shoreline plantings.

Photo 2. Lake Mechant shoreline plantings.

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NOTE: Due to a camera malfunction, there are no photos from the October 2004 data collection efforts.

NOTE: Below are photos of each reach that was sampled in September 2007.

Photo 3. Lake Paige, Section A shoreline looking northward.

Photo 4. Lake Paige, Section B shoreline looking northward, existing vegetation plot in water.

Photo 5. Lake Paige, Section C shoreline looking north, existing vegetation plots in water.

Photo 6. Lake Paige, Section D shoreline looking northeast.

Photo 7. Lake Mechant, Section E shoreline.

Photo 8. Lake Mechant, Section F eastern portion of section looking toward section F. Finger of marsh extending from bank line.

Photo 9. Lake Mechant, Section G shoreline facing northeast.

Photo 10. Lake Mechant, Section H, shoreline from eastern end looking westward

Photo 11. Lake Mechant, Section I, looking along shoreline.

Photo 12. Lake Mechant, Section J, vegetation plot showing vegetation distribution along shoreline.