S	Interpretation
0	Species absent from quadrat
0.1	Species represented by a solitary short shoot, <5% cover
0.5	Species represented by a few (<5%) short shoots, <5% cover
1	Species represented by many (>5%) short shoots, <5% cover
2	Species represented by many (>5%) short shoots, 5%-25% cover
3	Species represented by many (>5) short shoots, 25%-50% cover
4	Species represented by many (>5) short shoots, 50%-75% cover
5	Species represented by many (>5%) short shoots, 75%-100% cover

The data for each quadrat was recorded and data was analyzed to determine density, abundance and frequency by species for the seagrass bed (Fourqurean J.W., A. Willsie, C.D. Rose, and L.M. Rutten. 2001. Spatial and Temporal Patterns in Seagrass Community Composition and Productivity in South Florida. Marine Biology Journal 138:341-354.). Seagrass root systems were not removed or disturbed during the performance of the rapid visual assessment. At each sample quadrat, BEI characterized the soil type as sand, dredge material, mud, silt, oyster shell or rock. At each sample quadrat, BEI also probed for depth of soft sediment with a 1-1/2 –inch pvc sounding rod.

Once in the field the visibility allowed the Braun-Blanquet method to be utilized at every 10-meter sample location (rather than 20-meters) with minimal extra effort since personnel stopped at 10-meter intervals to collect, observe, and record post-hole digger samples. A post-hole digger was also used every 10 meters to determine the absence or presence of buried seagrass at areas evident of recent dredge material placement.

The seafloor sampling plan was comprised of two components: (a) mapping elevations of the 383-acre area to establish 0.5 Ft contours; and (b) collecting 52 sediment samples to characterize soils. To estimate the site elevations on 0.5 Ft contours, BEI obtained elevations on a 100 Ft grid throughout the sampling area shown in Appendix A, Figure 3. The 1,872 elevation points were interpolated using Arc GIS 9.2. BEI used RTK GPS (subcentimeter RTK GPS receiver with TRSC 2 & 3 data loggers) receiving corrections from the VRS network for this elevation work. Elevations were measured and recorded in the North America Vertical Datum 1988 (NAVD 88). BEI collected four evenly spaced sediment samples per transect (52 sediment samples) throughout the survey area. The sample stations are shown in Appendix A, Figure 4. The samples were taken to a depth of two feet. Each sample location was logged and visually classified in accordance with ASTM D 2487 (Unified Soil Classification System) and the location was recorded by sub-meter GPS. A 1-1/2 inch diameter PVC core sampler with a core catcher was used to collect each sediment sample. The core samples were sized to minimize the impacts to the bay bottom. The entire sample was placed in a container approved by the testing laboratory. All samples were obtained, preserved and transported in accordance with ASTM D 1452 and ASTM D 4220. The samples were tested for mechanical Sieve/Hydrometer analysis ASTM D 422, Atterberg limits ASTM D 4318, and Moisture Content ASTM D 2216. The testing will be completed within approximately 45 days of taking the samples in an Engineer Research and Development Center (ERDC) validated laboratory. BEI used The Professional Services Industries, Inc. (PSI) laboratory in Corpus Christi, Texas to conduct the testing. Sampling was completed January 15, 2012 and ASTM classification testing was completed by February 8, 2012.

4.0 PROJECT RESULTS:

The sample results from the seagrass survey are illustrated in Appendix A, Figure 4. Appendix C, Table 1 includes the seagrass survey data analysis for density, abundance and frequency for each species. Appendix A, Figure 5 shows the elevation point data for the 100 Ft grid as well as 0.5 Ft contours within the survey area. Appendix D provides test results for for soil samples collected at the 52 sample points indicated in Appendix A, Figures 4.

As indicated in Appendix A, Figure 4, and Appendix C, only two seagrass species (Shoalgrass, *Halodule wrightii*, and clovergrass grass, *Halophila englemannii*) were found in the 417 quadrats sampled. Shoalgrass was present in 310 of the 417 quadrats, or 74% of the samples. Clover grass was observed in 53 of the 417 quadrats, or 13% of the samples. In Appendix C, Table 1, density, abundance and frequency of each of these species are presented. Post-hole samples at each sample location matched the corresponding results of the Braun-Blanquet visual assessment. These data are shown for each transect and for transects 1-9 and 12-13 combined.

Previously placed dredge material was observed from west of transect 9 to west of transect 11 (Appendix A, Figure 4). This area was sampled with post-hole samples only and analyzed for presence or absence of seagrass roots and rhizomes, depth of dredge material and sediment type. These findings are presented separately in Appendix C, Table 2. An average depth of 0.75 ft of previously placed dredge material was observed within an approximate 57-acre area (Appendix A, Figure 4 and Appendix C, Table 2). In

this 57-acre area impacted by dredge material 74% (165 of 222 samples on Transect 10 & 11) of the samples contained seagrass roots and rhizomes.

BEI identified the landward and bayward edge of seagrass on each transect. Based on the edge of seagrass approximately 251.4 acres of seagrass beds including the 57-acre impacted area are currently present within the survey area. See Appendix A, Figure 4.

At the request of the USACE, readily available aerial imagery from 2005 to present was analyzed to estimate seagrass distribution within the boundaries of PA 62 and PA 63. Where possible, BEI utilized aerial images from late summer/early fall for the analysis. After an extensive search BEI was not able to locate a 2007 aerial image. The highest quality available image was selected for each respective year. In an effort to approximate seagrass distribution for a respective year, BEI identified different habitat signatures within the image. These signatures included the open water, shallow water bottom sediment, sandflats, mudflats, upland communities, marsh communities and seagrass. By comparing the signatures of the habitat types present within the boundaries of PA 62 and PA 63, BEI was able to estimate the shallow edge and deep edge of seagrass. BEI's elevation data obtained during the January 2012 survey was added to each map as reference to ensure estimated seagrass boundaries were within a reasonable depth range suitable for seagrass growth. During BEI's January 2012 survey, a significant amount of seagrass wrack and debris was noted immediately adjacent to the shoreline. BEI suspects these dark signature areas were wrack and/or debris pushed along the shoreline as a result of prevailing winds and currents. However, to account for any uncertainty, BEI has included these areas as potential seagrass. The total potential seagrass distribution range is included in Appendix E and in the table below. It should be noted that haze, clouds,

water depth, water clarity, surface disturbances, and sun angle at the time of the photography can affect these habitat signatures unintentionally resulting in inclusion/exclusion of particular habitat signatures.

Image Date	PA 62 (Ac)	PA 63 (Ac)
August 2005	68.2-71.6	13.1-23.8
January 2006	30.0-100.7	2.4-4.6
April 2008	108.8-121.5	101.0-128.7
January 2009	123.5-133.8	155.5
January 2010	111.3-114.4	164.4

As Appendix A, Figure 4 shows, elevations in the survey area ranged from -5.1 Ft NAVD 88 to +5.6 Ft NAVD 88. Shoalgrass elevations ranged from -3.23 Ft NAVD 88 to -0.20 Ft NAVD 88. Elevations of clover grass ranged from -3.10 Ft NAVD 88 to -1.15 Ft NAVD 88. The elevations at the shoalgrass sample stations with the greatest coverage (scores 4 and 5) ranged from -2.48 Ft NAVD 88 to -0.33 Ft NAVD 88.

Soil test results are provided in Appendix D. Each of the 52 samples were classified as lean clay (CL) with sand, fat clay (CH) with sand, clayey sand (SC) and poorly graded sand (SP). Shell fragments were present in some of the poorly graded sand (SP) samples. Transects 1 through transect 5 were classified primarily as gray lean and fat clays with sand. Whereas transects 6 through 13 were classified as gray poorly graded sand or gray clayey sand. Transects 10 and 11 were predominantly covered by dredge material. The void ratio for all 52 samples ranged from 0.554 to 1.271.

5.0 CONCLUSIONS:

BEI's survey found seagrass in 75% (363 of 417) of the quadrat samples outside of the area previously impacted by dredge material. Shoalgrass was present in 74% of these quadrats and clover grass was observed in 13% of these quadrats. In the area previously impacted by dredge material (Transects 10 & 11) 74% of post-hole digger samples had seagrass present. An average depth of 0.75 ft of previously placed dredge material was observed on transects 10 and 11. Elevations in the survey areas ranged from -5.1 Ft NAVD 88 to +5.6 Ft NAVD 88. Seagrass growth was found from elevation -3.23 Ft NAVD 88 to -0.20 Ft NAVD 88. Fat and lean clays with sand and gray sand were the predominant substrate type in the survey area.

Based on the results of this survey, BEI concludes:

- Approximately 194.4 acres of seagrass beds currently exist within the survey area and are subject to potential burial impacts from the placement of dredge material.
- An area of approximately 57 acres on and in the vicinity of transects 10 and 11 was observed to have an average of 0.75 ft of previously placed dredge material. Seagrass roots and rhizomes were found in 74% of the post-hole digger samples in this area.

The results of this survey suggest that seagrass may be at least temporarily impacted by the placement of dredge material. Historically, some seagrass beds have recovered to varying degrees over time (Sheridan, 1999).

6.0 REFERENCES CITED:

Braun-Blanquet rapid visual assessment technique (Braun-Blanquet, 1972. Plant Sociology: The Study of Plant Communities. Hafner Publishing Company).

Fourqurean, J. W., A. Willsie, C.D. Rose, and L.M. Rutten. 2001. "Spatial and Temporal Patterns in Seagrass Community Composition and Productivity in South Florida." Marine Biology Journal 138:341-354.

Leatherwood, Art (May 30, 2010). "West Bay". *Handbook of Texas Online*. Texas State Historical Association. http://www.tshaonline.org/handbook/online/articles/WW/rrw1.html. Retrieved 10 February 2012.

Lester, Jim, Ph.D. and Gonzalez, Lisa. 2002. The State of the Bay: A Characterization of the Galveston Bay Ecosystem, 2nd edition Editors GBEP T-7.

Pulich, W., Jr., and White, W.A., 1991, Decline of submerged vegetation in the Galveston Bay system: chronology and relationship to physical processes: Journal of Coastal Research, v. 7, no. 4, p. 1125–1138.

Pulich, et al (Pulich, Warren Jr., Hardegree, Beau, Kopecky, Andrea, Schwelling, Steve, Onuf, Christopher, Dunton, Kenneth. 2000. Texas Seagrass Monitoring Program: 2000 Strategic Plan. TPWD).

Pulich, W., Jr., Hardegree, B., Kopecky, A., Schwelling, S., Onuf, C.P., and Dunton, K., 2003, Strategic plan for a Texas seagrass monitoring program: Austin, Texas Parks and Wildlife Department, Resource Protection Division, 36 p.

Sheridan, Pete. 1999. "Temporal and Spatial Effects of Open Water Dredged Material Disposal of Habitat Utilitization by Fishery and Forage Organisms in Laguna Madre, Texas." Final Report to the Laguna Madre Interagency Coordination Team. NOAA, National Marine Fisheries Service.

Texas Commission on Environmental Quality (TCEQ). 2002. Draft 305(b) Water Quality Inventory for 2002. Accessed at http://www.tnrcc.state.tx.us/water/quality/02_twqmar/02_305b/index.html.