E C O L O G I C A L R E V I E W

South Lake De Cade Freshwater Introduction - Construction Unit 1
CWPPRA Priority Project List 9
State No. TE-39
Federal No. PTE-28

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This document reflects the project design as of the 95% Design Review meeting, incorporates all comments and recommendations received following the meeting, and is current as of August 18, 2005.

95% ECOLOGICAL REVIEW
South Lake De Cade Freshwater Introduction - Construction Unit 1

In August 2000, the Louisiana Department of Natural Resources (LDNR) initiated the Ecological Review to improve the likelihood of restoration project success. This is a process whereby each restoration project's biotic benefits, goals, and strategies are evaluated prior to granting construction authorization. This evaluation utilizes monitoring and engineering information, as well as applicable scientific literature, to assess whether or not, and to what degree, the proposed project features will cause the desired ecological response.

I. Introduction

The South Lake De Cade Freshwater Introduction project is located in Terrebonne Parish, Louisiana, and is delimited to the north by the southern bank of Lake De Cade and the Small Bayou La Pointe Ridge, to the east and southeast by an unnamed oilfield location canal, to the southwest by an imaginary line through the marsh, and to the west by an unnamed oilfield canal and Bayou De Cade (Figure 1). The southwestern boundary of the project was determined by approximating the area to be benefited by the project's physical features. The 7,343 acre project area is classified predominantly as intermediate marsh with fresh marsh fringing the southern rim of Lake De Cade and brackish marsh identified along the western and southern edges of the project boundary (Chabreck and Linscombe 1997).

It has been estimated that 2,120 acres of marsh were lost within the project area from 1956 through 1990 (United States Department of Agriculture – Natural Resources Conservation Service [USDA-NRCS] 1999). Coast 2050 identified high subsidence rates (0.25–0.42 inches per year) as the primary cause of land loss within the Mechant/De Cade Mapping Unit, of which the proposed project is a part (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority [LCWCRTF & WCRA] 1999). Continued subsidence has subjected interior marshes to increased tidal scour, making them more susceptible to soil erosion and the effects of saltwater intrusion.

The proposed hydrologic restoration project, which is intended to enhance, maintain, and protect existing marshes within the project area (USDA-NRCS 2001), has been separated into two Construction Units (CU) to expedite construction of those project features requiring less engineering and design effort. Construction Unit 1, the subject of this Ecological Review, will proceed toward construction authorization in advance of CU 2, which requires additional engineering and scientific evaluation to adequately quantify the project's ecological benefits. Construction Unit 1 includes the construction of approximately 8,700 linear feet of rock armor shoreline protection along a southern section of Lake De Cade (Figure 2).

The proposed strategy of armoring the southern rim of Lake De Cade is supported by the Coast 2050 Region 3 Ecosystem Strategies which promote the protection of bay, lake, and gulf shorelines for the preservation of interior wetlands and the maintenance of favorable hydrologic conditions (LCWCRTF & WCRA 2001).

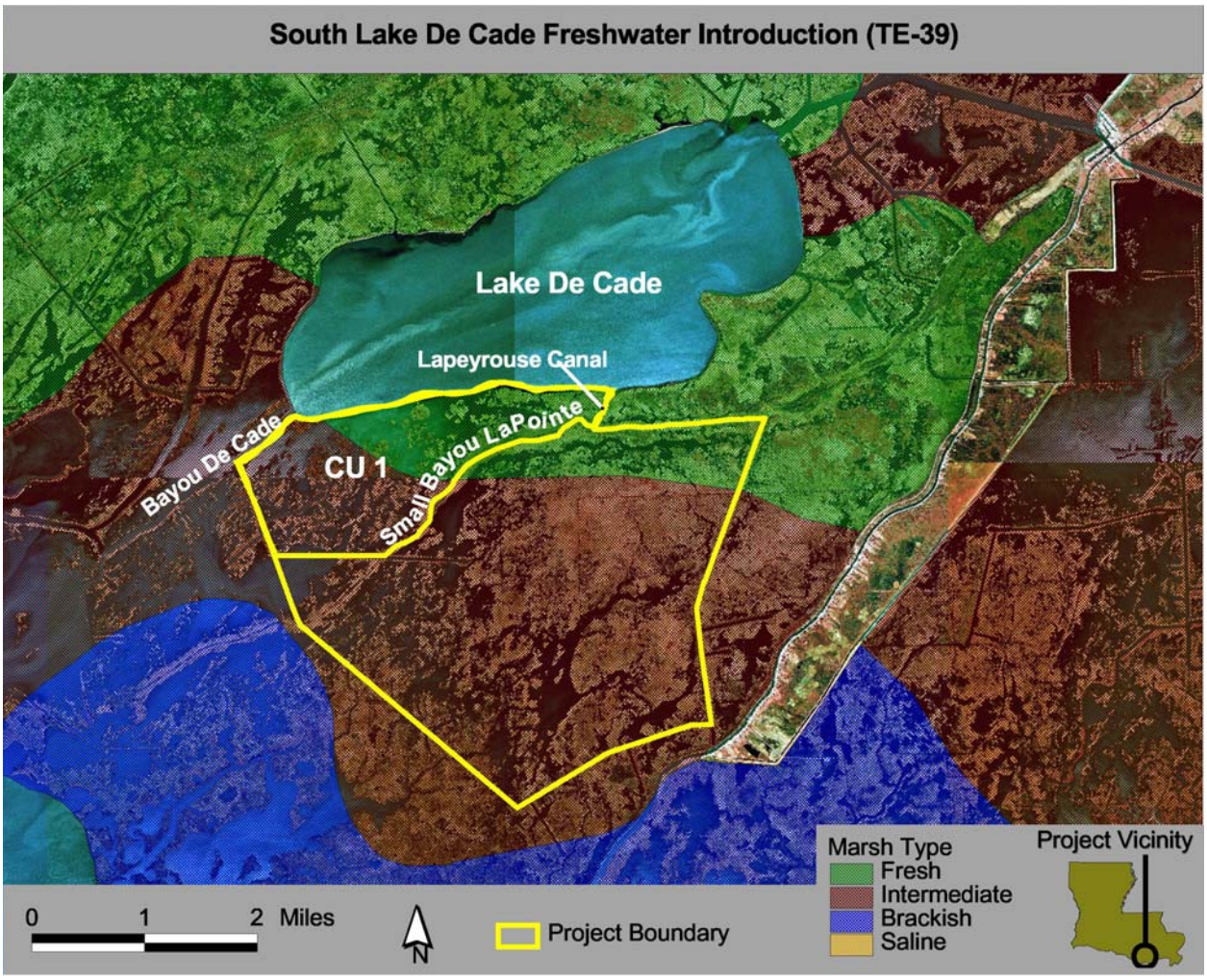

Figure 1. South Lake De Cade Freshwater Introduction (TE-39) project boundary and marsh types (Chabreck and Linscombe 1997).

II. Goal Statement

- Stop erosion along approximately 8,700 linear feet of the southern Lake De Cade shoreline (USDA-NRCS 2001).

III. Strategy Statement

- Stop Lake De Cade shoreline erosion through the construction of rock armor shoreline protection.

IV. Strategy-Goal Relationship

The construction of armor shoreline protection is intended to stop erosion along the 8,700 linear foot section of southern Lake De Cade by dissipating wave energies. By halting shoreline erosion, the narrow band of marsh separating Lake De Cade from the marine and tidally dominated system to the south will likely be maintained.

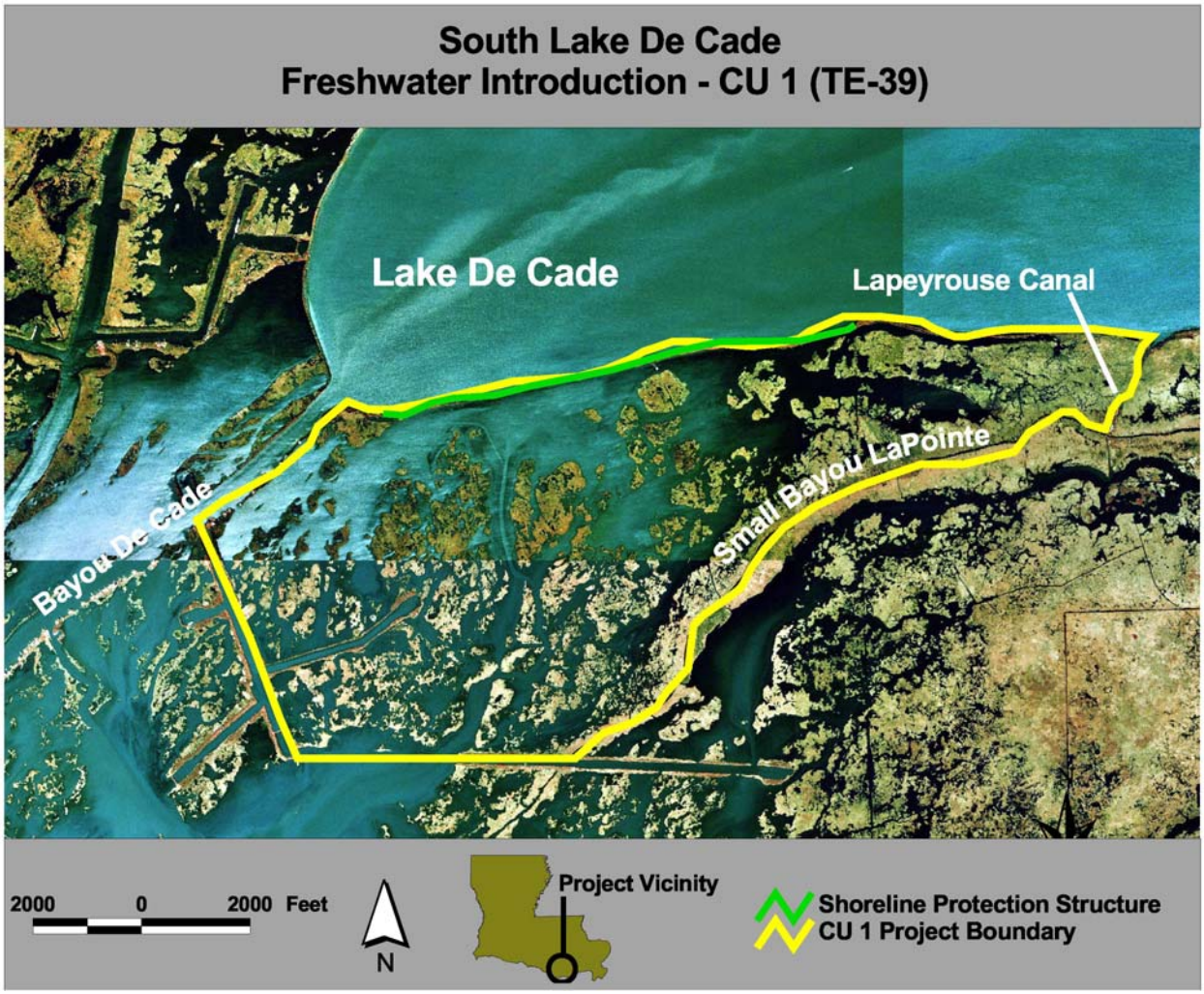

Figure 2. South Lake De Cade Freshwater Introduction – Construction Unit 1 (TE-39) project feature and boundary.

V. Project Feature Evaluation

Soil Testing Engineers, Inc. (2001) characterized the near surface soils within the project area as "extremely soft to very soft organic clays followed by very soft to soft clays with occasional sand layers." Below is a summary of the geotechnical investigation results describing the settlement and slope stability associated with each of the proposed project features. The accepted measure of a slope's stability is its "safety factor" which is the ratio of the forces or moments tending to prevent failure (primarily soil strength) to those that cause failure (primarily soil and surcharge weights plus seepage forces) (Soil Testing Engineers, Inc. 2001). For the extremely soft soil conditions found within the CU 1 project area, Soil Testing Engineers, Inc. established a minimum acceptable safety factor of 1.2 for slope stability (Soil Testing Engineers, Inc. 2001).

A supplemental geotechnical investigation was performed by Burns Cooley Dennis, Inc. (2004) to provide additional foundation analyses of the same soils information evaluated by Soil Testing Engineers, Inc. Settlement and slope stability predictions were described for alternative project feature designs. Burns Cooley Dennis, Inc. (2004) established a minimum acceptable safety factor of 1.3 for slope stability.

Armor Shoreline Protection

Soil Testing Engineers, Inc. (2001) determined that the initially proposed foreshore rock dike structure, built to an elevation of +4.0 feet NAVD 88 and at a side slope of 3(H):1(V), would settle approximately 1 foot at four of the five boring locations adjacent to the Lake De Cade shoreline. At these four boring locations, a silty sand surficial layer was encountered to an approximate depth of 10 feet. An acceptable safety factor of 1.7 was reported. At location B-4 (the remaining boring on the Lake De Cade shoreline), results indicated that the foreshore rock dike structure would settle approximately 3.5 feet due to the absence of the silty sand surficial layer (Soil Testing Engineers, Inc. 2001). An acceptable safety factor of 1.9 was assigned at this boring location.

Due to the settlement projections and high wave energies which develop in Lake De Cade, engineers with LDNR and the Natural Resources Conservation Service (NRCS) agreed to modify the shoreline protection structure from a foreshore rock dike to a rock revetment (Figure 3). Soil conditions along the Lake De Cade shoreline are expected to be better than the foreshore soil borings analyzed in the two prior geotechnical investigations because periodic re-building of the lake shoreline, previously undertaken by landowners, has pre-consolidated the underlying soil layers. The rock revetment will be built to an elevation of +3.5 feet NAVD 88 and at a side slope of 2(H):1(V). Geotextile material will be used as a separator and reinforcement for the rock riprap material and the native soils. NRCS engineers determined that a design wave height of 1.05 feet would not overtop the shoreline revetment height of +3.5 feet NAVD 88 (USDA-NRCS 2004a). It was also assumed, based on the soil conditions and the revised design, that the side slope would be adequate and that the structure would settle approximately 0.5 feet (Ronnie Faulkner, NRCS, Personal Communications, June 15, 2004). A maintenance lift was approved at target years 7 and 14 post-construction (TY7 and TY14) to recap the rock structure and maintain the target elevation. Spoil excavated from the access channel will be permanently placed on the south-facing slope of the existing embankment (Figure 3).

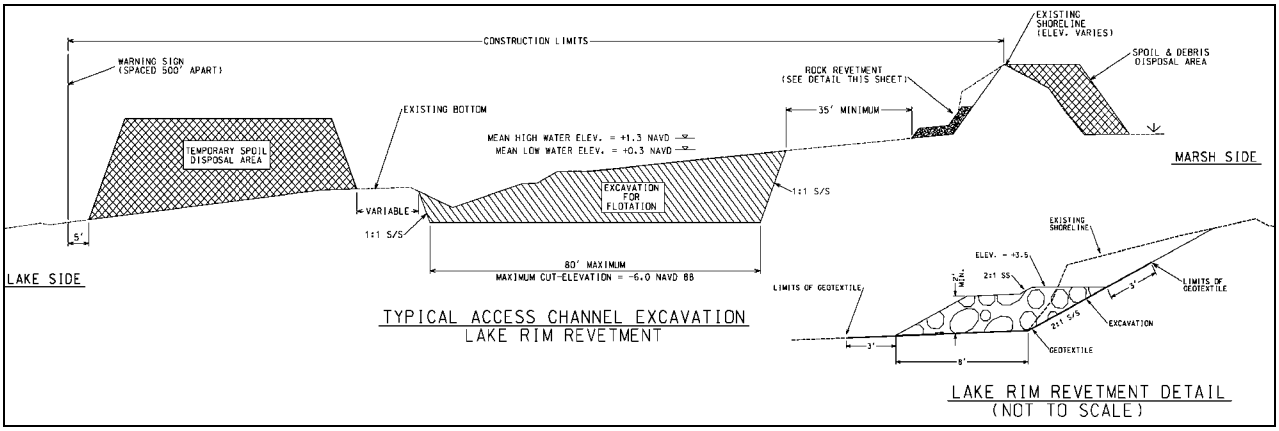

Figure 3. Preliminary Lake Rim Revetment (USDA-NRCS 2004b).

VI. Assessment of Goal Attainability

Environmental data and scientific literature documenting the effects of the proposed project features in field application are evaluated below to assess whether or not, and to what degree, the project features will cause the desired ecological response in CU 1.

A number of projects using traditional shoreline protection structures have been implemented in Louisiana coastal areas to protect lake, bay, and navigation canal shorelines. Published results of projects funded under the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) and by the State of Louisiana that have used armor shoreline protection features constructed in environments similar to the South Lake De Cade Freshwater Introduction project are discussed below.

- The Boston Canal/Vermilion Bay Shoreline Protection (TV-09) project was designed to abate wind-driven wave erosion along Vermilion Bay and at the mouth of Boston Canal (Thibodeaux 1998). To accomplish that goal, a 1,405 foot foreshore rock dike with a top elevation of +3.8 feet NGVD 29 was installed in 1995 along the bank of Boston Canal extending into Vermilion Bay. In 1997, two years after construction, the project was estimated to have protected 57.4 acres of marsh and 1.4 to 4.5 feet of sediment was deposited behind the breakwater while the reference area continued to erode. The rock breakwater at the mouth of Boston Canal was successful in stabilizing the shoreline (Thibodeaux 1998).

- Lake Salvador Shoreline Protection Demonstration (BA-15) project evaluated a series of shoreline protection measures at Lake Salvador, St. Charles Parish, Louisiana. Phase 2 of this project was conducted in 1998 and evaluated the effectiveness of an 8,000 foot rock berm in protecting the highly organic soil foundation along the lake shoreline from high-energy wave erosion. Shoreline surveys conducted behind the berm five months after construction indicated that the shoreline was still eroding. Subsequent surveys were not conducted due to poor weather conditions (Lee et al. 2000). The rock structure itself appears to be holding up well, showing little sign of deterioration and subsidence. The structure was designed to be constructed with a crest elevation of +4.0 feet NAVD 88. However, a 2002 survey of the rock dike determined that the average height of the structure was +2.51 feet NAVD 88. The average settlement of the structure, measured from 1998 to 2002, was approximately 0.29 feet or 0.07 feet per year (Raynie and Visser 2002). It was concluded that the rock dike was built to an inadequate crest elevation of +2.75 feet NAVD 88 (Darin Lee, LDNR, Personal Communications, July 19, 2002).

- The Turtle Cove Shoreline Protection (PO-10) was initiated in 1993 to protect a narrow strip of land in the Manchac Wildlife Management Area that separates Lake Pontchartrain from an area known as "the Prairie" (O'Neil and Snedden 1999). Wind induced waves contributed to a shoreline erosion rate of 12.5 feet per year. A 1,642 foot rock-filled gabion structure was constructed 300 feet from shore at an elevation of 3 feet above mean water level with the goal of reducing erosion and increasing sediment accretion behind the structure. Post-construction surveys conducted during the period of October 1994 to December 1997 revealed that the shoreline had prograded at a rate of 3.47 feet in the project area. The rate of sediment accretion, as determined from elevation surveys conducted in January 1996 and January 1997, was 0.26 feet per year.

  The soils in The Prairie and Turtle Cove area consist of Allemands-Carlin peat, which is described as highly erodible organic peat and muck soils (USDA 1972). Due to the weak and compressible nature of the subsurface soils, the gabions settled 0.59 feet in just over two years (October 1994 to January 1997) (O'Neil and Snedden 1999). Also, five years

after construction, the rock-filled gabion structure exhibited numerous breaches and required extensive maintenance (O'Neil and Snedden 1999).

- Intracoastal Waterway Bank Stabilization and Cutgrass Planting project at Blind Lake was a state-funded project constructed to prevent the Intracoastal Waterway and Sweet Lake from coalescing with Blind Lake (LDNR 1992). A limestone foreshore rock dike built at an elevation of +4.0 feet NGVD 29 was placed 70 feet from the edge of the main channel along 2,339 feet of bank on a six-inch layer of shell and filter cloth. Large stones were used to prevent movement of rocks and to allow sediment and organism passage. In 1991, two years after project completion, an average increase in elevation of 0.32 feet was observed along transects due to the deposition of suspended sediments. Data indicate that the project has been successful in protecting the shoreline at Blind Lake and maintaining the hydrology of the Cameron-Creole watershed.

These CWPPRA and State of Louisiana funded shoreline protection projects are similar in scope to the proposed armor shoreline protection component of CU 1. Results from these projects support the contention that the proposed shoreline protection measures will be successful in reducing erosion, assuming that the structures are designed correctly for the extremely soft soil conditions.

Summary/Conclusions

Stability and settlement analyses of the armor shoreline protection were conducted by Soil Testing Engineers, Inc. and Burns Cooley Dennis, Inc. However, the reported settlement estimates, although satisfactorily addressed in the geotechnical analyses, do not factor in relative sea level rise (subsidence + eustasy), which according to *Coast 2050* and Penland and Ramsey (1990) ranges between 0.25–0.43 inches per year or 5.0–8.6 inches over twenty years. Both settlement and subsidence estimates should be considered before finalizing project features and in the development of operations, maintenance, and rehabilitation plans.

In areas with good soil foundations, the aforementioned shoreline protection projects were successful in reducing erosion. Additional shoreline protection projects including Yellow Bayou (TV-02b) and Sabine National Wildlife Refuge Erosion Protection (CS-18) had similar success in reducing erosion in critical marsh areas. The "no action" alternative would result in the continued deterioration of the southern Lake De Cade shoreline and the eventual breaching of the lake rim which now protects interior marsh from wave-induced erosion

VII. Recommendations

Since the 95% Design Review meeting, two project features, a weir and an earthen embankment, were dropped from the current project design. However, based on information gathered from similar restoration projects, engineering designs and computations, and related literature, the current proposed shoreline protection structure will likely achieve the desired ecological goals. At this time, the level of design of the project's physical effects and confidence in goal attainability warrant continued progress toward construction authorization.

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