State of Louisiana
Department of Natural Resources
Coastal Restoration Division

Monitoring Plan

for

GIWW (Gulf Intracoastal Waterway) to Clovelly Hydrologic Restoration

State Project Number BA-02
Priority Project List 1

August 2003
Lafourche Parish

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MONITORING PLAN

PROJECT NO. BA-02 GIWW (Gulf Intracoastal Waterway) TO CLOVELLY HYDROLOGIC RESTORATION

ORIGINAL DATE: February 28, 1997
REVISED DATES: June 23, 1997; July 23, 1998; August 14, 2003

Preface

The original plan was updated to reflect no monitoring on the reference area because landrights could not be obtained.

Pursuant to a CWPPRA Task Force decision on April 14, 1998, the updated monitoring plan was reduced in scope due to budgetary constraints. Specifically, shoreline monitoring will occur every three years rather than every two years.

Pursuant to a CWPPRA Task Force decision on August 14, 2003 to adopt the Coastwide Reference Monitoring System (CRMS-*Wetlands*) for CWPPRA, this Monitoring Plan was reviewed to facilitate merging it with CRMS to provide more useful information for modeling efforts and future project planning while maintaining the monitoring mandates of the Breaux Act. CRMS parameters which may serve as reference include Surface Elevation Table (SET) data, accretion (measured with feldspar), hourly water level and salinity, and vegetation sampling. A number of CRMS stations are available for each habitat type within each hydrologic basin to supplement project-specific reference area limitations. The recommendations for modifying this Monitoring Plan are the result of a joint meeting with DNR, USGS, and the federal sponsor.

Specifically, SAV sampling and discrete hydrologic data collection will be discontinued, sondes will be reduced from 7 to 4, and after 2005, reduced to 2 sondes (maintain 1 in the northern project area and 1 in the south), the CRMS station in the middle of the project area will be utilized, habitat mapping will be replaced with land:water analyses and the number of vegetation stations and soil samples will be reduced to 12. These recommendations have been incorporated into this revised Monitoring Plan in the Monitoring Elements section.

Project Description

The GIWW to Clovelly Hydrologic Restoration project is located in Lafourche Parish, Louisiana, southeast of the Gulf Intracoastal Waterway (GIWW), east of Bayou Lafourche, and north of the Superior Canal (figure 1). The proposed project area totals 14,948 ac (6,049 ha) of wetlands (86% land/marsh, 14% water) and is part of the last contiguous marsh tracts in the Barataria Basin. Of the 14,948 ac in the project area, 209 ac (85 ha) are classified as freshwater marsh, 14,006 ac (5,668 ha) are classified as intermediate marsh, 254 ac (103 ha) are classified as brackish marsh, and 478 ac (193 ha) are classified as scrub/shrub and forest (Barras et al. 1993).

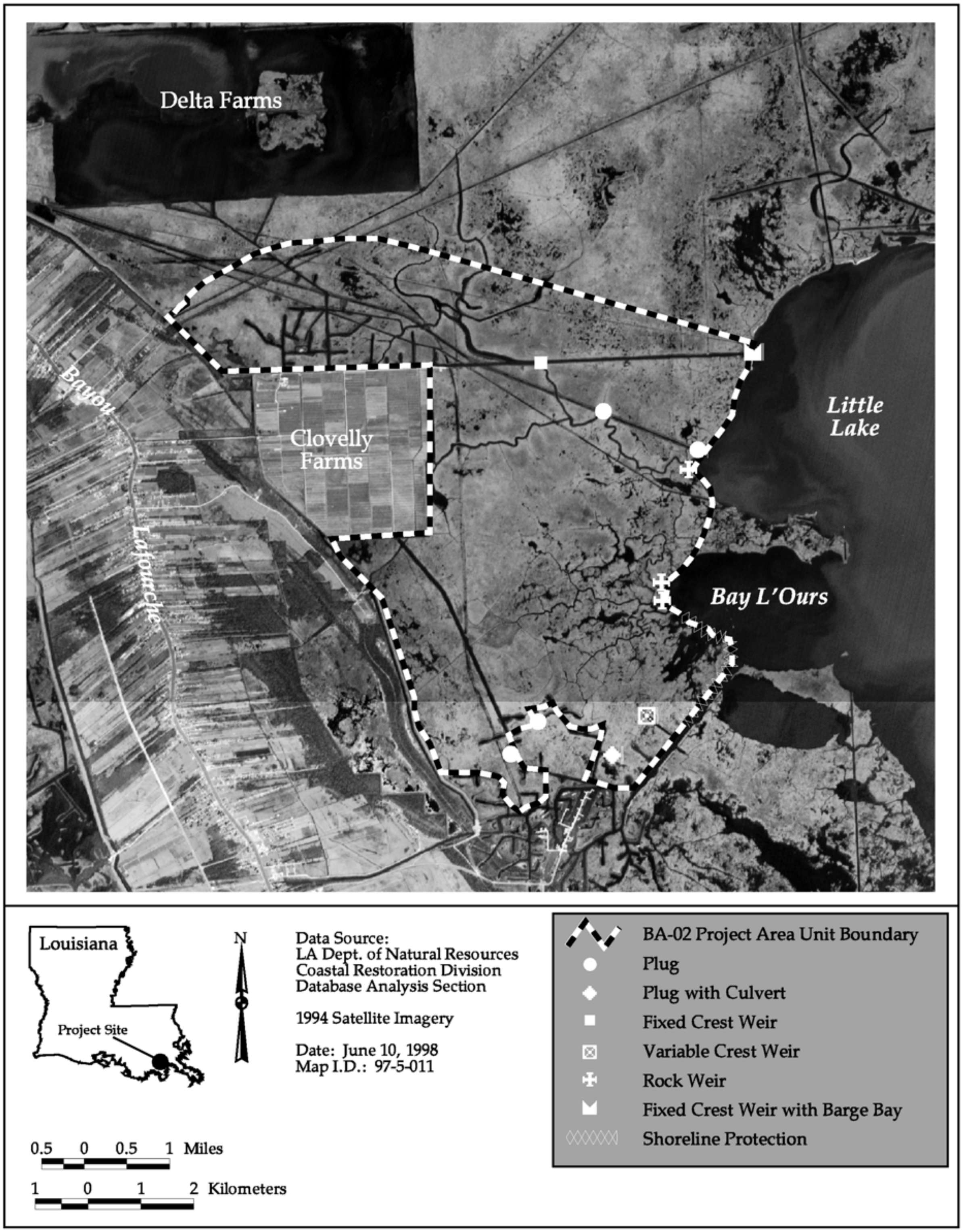

Figure 1. Location of GIWW to Clovelly Hydrologic Restoration (BA-02) project area and project elements.

Within the GIWW to Clovelly Hydrologic Restoration project the average rate of change from marsh habitat to non-marsh habitat (including wetland loss to both open water and commercial development) has been increasing since the 1950's. The mean wetland loss rates were 0.36%/year between 1945 and 1956, 1.03%/year between 1956 and 1969; and 1.96%/year between 1969 and 1980 (Sasser et al. 1986). The main reasons for wetland deterioration in the project area as reported by NRCS in the Wetlands Value Assessment (WVA) are saltwater intrusion, oil field activities, subsidence, lack of sedimentation, and reduced freshwater influx. It has been shown that the highest marsh loss rates occur where freshwater marshes have been subject to saltwater intrusion (Sasser et al. 1986). Sasser et al. (1986) reported that net sediment accretion rates of interior marshes in the Barataria Basin are too low to offset net subsidence. Net vertical accretion ranges from 0.65 cm/yr to 0.75 cm/yr for interior marshes. However, mean subsidence rates have increased from 0.27 cm/yr between 1948-1959 to 1.29 cm/yr between 1959-1971 (Sasser et al. 1986). Saltwater intrusion and increased soil waterlogging can occur when marsh subsidence out paces vertical accretion, such as within the GIWW to Clovelly Hydrologic Restoration project, promoting the development of sulfides (Gambrell and Patrick 1978; Mendelssohn and McKee 1988). Sulfides are known to be toxic to many wetland plant species (Pearson and Havill 1987; Koch and Mendelssohn 1989; Koch et al. 1990; Havill et al. 1995; Webb et al. 1995).

The construction of canals has produced negative impacts on coastal marshes of Louisiana. These impacts include changes in hydrology, increased marsh subsidence, marsh impoundments, reduction in sediment accretion, and saltwater intrusion (Turner et al. 1984; Swenson and Turner 1987;Wang 1988; Turner 1990). Numerous canals are present in the GIWW to Clovelly Hydrologic Restoration project area. The Clovelly Canal is connected to Little Lake on the eastern end and likely facilitates the transport of more saline waters from Little Lake to western regions of the project area. Since 1949, marsh types have changed throughout the project, especially in the southern area. The entire project area was characterized as freshwater marsh by O'Neil in 1949 (Coastal Environments, Inc. 1989). Since 1968, areas of intermediate and brackish marsh have encroached into the eastern reaches of the area around Bayou Perot and Little Lake. In 1988, none of the project area was characterized as freshwater marsh (Chabreck et al. 1968, 1988). It is unclear whether the changes in these areas have been due to an increase in salinity, a change in the water level regime, or a combination of the two. Increasing land loss rates for the Cut Off area (1932-1985: 0.10%, 1983-1990: 0.25%) (Dunbar et al. 1992), along with the changes in marsh types, are raising concerns that the quality of the marsh is declining and marsh will be converted to open water.

Vegetation and soils within the project area are widely mixed. Vegetation in the project is dominated by *Spartina patens* (marshhay cordgrass). *Sagittaria lancifolia* (bulltongue), *Scirpus americanus* (olney threesquare), *Lythrum lineare* (saltmarsh loosestrife), and *Setaria sp.* (bristlegrass) are also present in various amounts (U.S. Soil Conservation Service [SCS] 1991a). The project area consists of a variety of soil types including Lafitte-Clovelly, Timbalier-Belle Pass, and Sharkey soils. The dominant soil types are the Lafitte-Clovelly and Timbalier-Belle Pass associations which are characterized by level, poorly drained organic and semifluid soils. The Sharkey soils are located along the Bayou Lafourche ridge and are characterized by level, poorly drained loamy or clayey soils which are occasionally flooded (SCS 1984). Although organic matter typically makes up a greater percent of the volume of soils in less saline marshes of coastal

Louisiana (Nyman et al. 1990), active freshwater marshes have higher organic matter content and higher mineral matter content than inactive freshwater marshes. Because of this, soil bulk densities are typically higher in active freshwater marshes than in inactive freshwater marshes (Nyman et al. 1990).

The project will protect intermediate marsh in the project area by restoring natural hydrologic conditions that promote greater use of available freshwater and nutrients. This will be accomplished by limiting rapid water level changes, slowing water exchange through over-bank flow, reducing rapid salinity increases, and reducing saltwater intrusion. Measures utilized for this purpose are composed of several structures (locations can be seen in figure 1).

Structures:

- five water control structures (four fixed crest weirs, one variable crest weir)
- four canal plugs, including one plug with a culvert
- 6,000 ft (1,829 m) of lake rim re-establishment
- 5,000 ft (1,525 m) of bankline re-establishment

Project Objectives

1. Protect and maintain approximately 14,948 ac (6,049 ha) of intermediate marsh. This will be achieved by restoring natural hydrologic conditions that promote greater freshwater retention and utilization, prevent rapid salinity increases, and reduce the rate of tidal exchange.
2. Reduce shoreline erosion through shoreline stabilization.

Specific Goals

The following measurable goals were established to evaluate project effectiveness:

1. Increase or maintain marsh to open water ratios.
2. Decrease salinity variability in the project area.
3. Decrease the water level variability in the project area.
4. Increase or maintain the relative abundance of intermediate marsh plants.
5. Promote greater freshwater retention and utilization in the project area.

6. Reduce shoreline erosion through shoreline stabilization.

7. Increase or maintain the relative abundance of submerged aquatic vegetation (SAV).

<u>Reference Area</u>

The importance of using appropriate reference areas cannot be overemphasized. Monitoring on both project and reference areas provides a means to achieve statistically valid comparisons, and is therefore the most effective means of assessing project effectiveness. Various locations were evaluated for their potential use as a reference area that best mimics the preconstruction conditions of the project area. The evaluation of sites was based on the criteria that both project and reference areas have similar vegetational community, soil, hydrology, and salinity characteristics. Areas east of the project were eliminated from consideration due to inclusion in and impacts from future coastal restoration projects. Areas to the north, south, and west of the project were not suitable due to impacts by future coastal restoration projects and dissimilar vegetational community, soil, hydrology, and salinity characteristics. A small, 3,987 ac (1,614 ha) area to the northeast of the project was found to contain similar vegetation, hydrology, soil, and salinity characteristics, however, land rights for monitoring could not be obtained. Because of these factors, no suitable reference area could be located for the project.

CRMS will provide a pool of reference sites within the same basin and across the coast to evaluate project effects. At a minimum, every project will benefit from basin-level satellite imagery and land:water analysis every 3 years, and supplemental vegetation data collected through the periodic Chabreck and Linscombe surveys. Other CRMS parameters which may serve as reference include Surface Elevation Table (SET) data, accretion (measured with feldspar), hourly water level and salinity, and vegetation sampling. A number of CRMS stations are available for each habitat type within each hydrologic basin to supplement project-specific reference area limitations. The CRMS will be utilized for reference comparisons for the project area. All instances where "reference area" is used are to be interpreted as referring to the CRMS.

<u>Monitoring Limitations</u>

Due to the lack of an ecologically similar area to be used as a reference, data interpretation will be difficult. Monitoring prior to construction focused on a larger project area while monitoring during and post-construction are concentrated within a smaller project area. Data comparisons will be difficult due to changes in spatial scale as well as the lack of post-construction reference data. Without comparisons between the project area and a reference area, proper assessment of whether or not changes are the result of the project are not possible.

Monitoring Elements

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

1. Habitat Mapping — To document vegetated and non-vegetated areas and marsh loss rates, color-infrared aerial photography (1:24,000 scale, with ground control markers) will be obtained by NWRC for the project area. The photography will be geo-rectified, photo-interpreted, mapped, ground-truthed, and analyzed with GIS by NWRC personnel using techniques described in Steyer et al. (1995). The photography will be obtained prior to construction in 1993 and 1996, and after construction in 2002. Based on the CRMS review, land:water analysis will be done on photography collected in 2008 and 2015.

2. Salinity — To monitor salinity variability, seven continuous recorder stations will be located within the project area (figure 2). Salinity variability prior to construction will be statistically compared to salinity variability after construction within the project area. Salinity variability post-construction will be statistically compared between the project and reference areas. Discrete salinity will be measured monthly at 25 stations inside the project area (figure 3) using techniques described in Steyer et al. (1995). Discrete data will be used to characterize the spatial and temporal variation in salinity throughout the project area and to model the system. The number of sampling stations may be adjusted by DNR/CRD based on interpretation of preliminary data acquired from the area. Salinity data will be collected every year from 1996-2003.

   Based on the CRMS review, discrete stations and continuous recorders at stations 54, 55, and 59 will be discontinued after 2003 . Recorders at stations 53 and 58 will be discontinued after 2005. Recorders at stations 56 and 57 will be maintained and CRMS0190 in the center of the project area will be utilized.

3. Water Level — To monitor water level variability, seven continuous recorder stations will be located within the project area (figure 2). Mean daily water level variability prior to construction will be compared statistically to mean daily water level variability after construction inside the project area. Mean daily water level variability post-construction will be compared statistically between the project and CRMS reference sites. Discrete water levels will be measured monthly at 5 stations inside the project area using techniques described in Steyer et al. (1995). Discrete data will be used to characterize the spatial

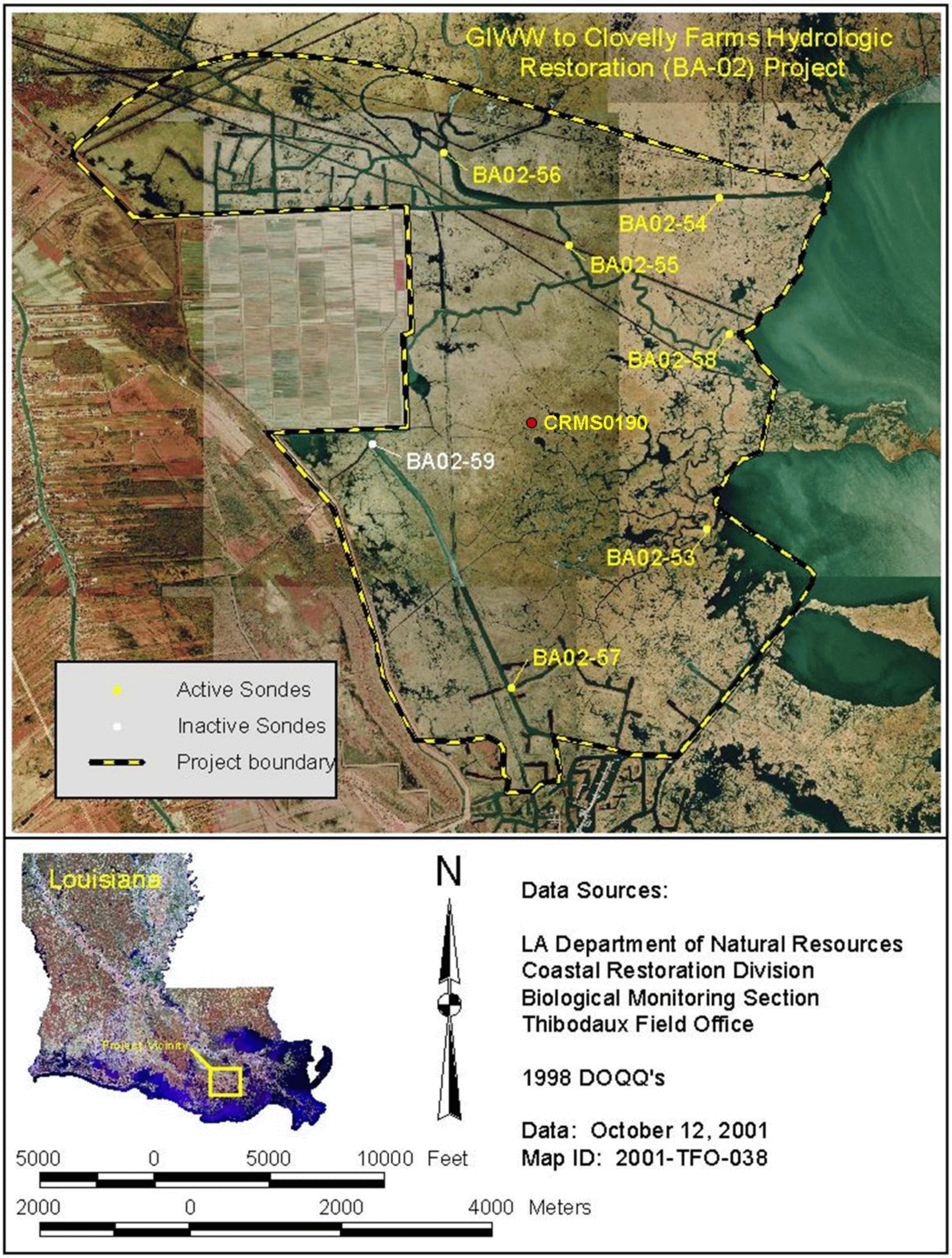

Figure 2. Location of GIWW to Clovelly Hydrologic Restoration (BA-02) project area constant recorder sampling stations.

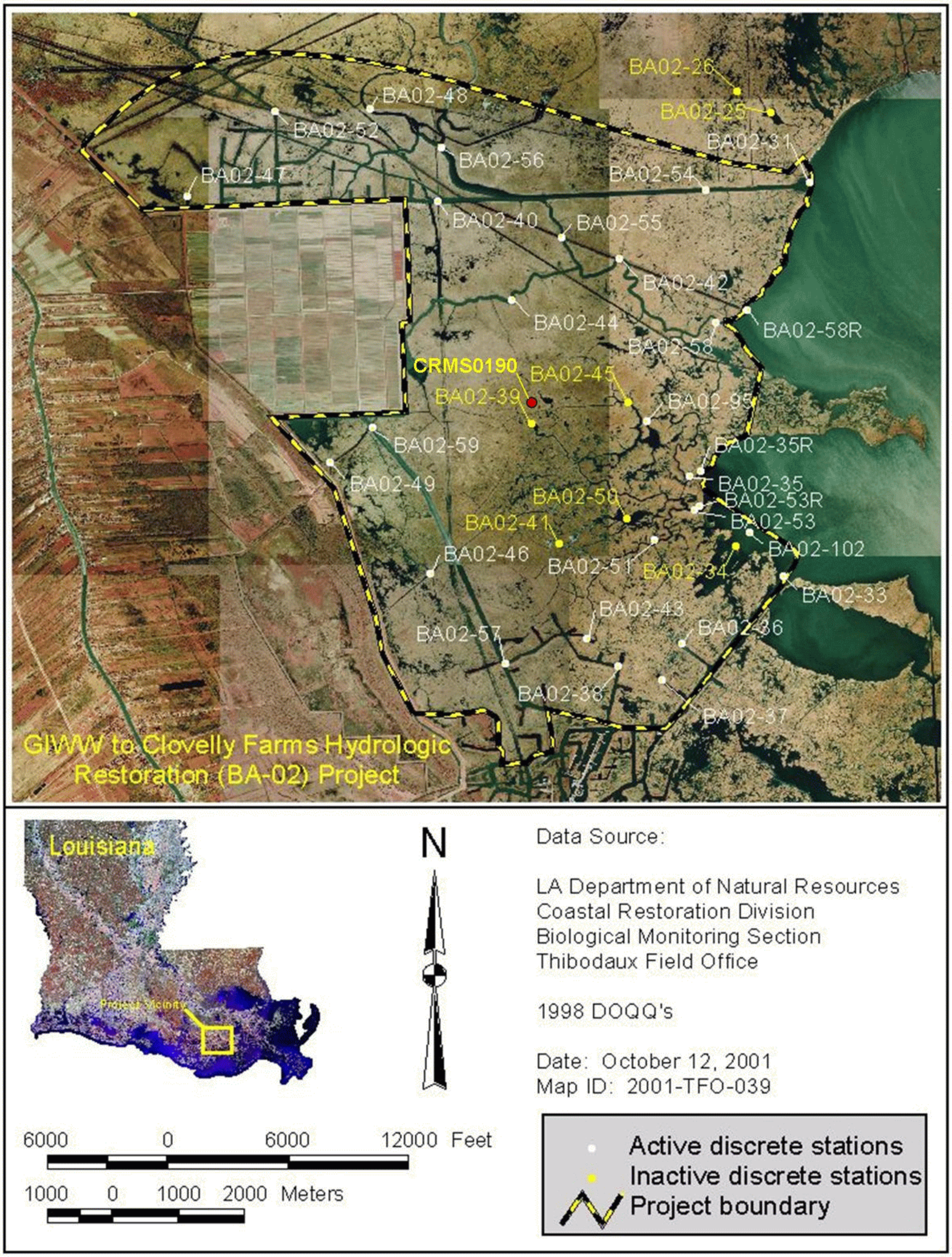

Figure 3. Location of GIWW to Clovelly Hydrologic Restoration (BA-02) project area discrete sampling stations.

and temporal variation in water level throughout the project area and to model the system. Staff gauges will be surveyed to NAVD88 adjacent to the continuous recorders in order to tie recorder water levels to a known datum (figure 2). Additionally, the marsh elevation will be surveyed in order to determine water levels relative to the marsh surface. Marsh elevation will be surveyed and used in conjunction with continuous recorders to determine duration and frequency of flooding. This information will be utilized for estimating sheet flow across the marsh using methods outlined in Swenson and Turner (1987). The number of sampling stations may be adjusted by DNR/CRD based on interpretation of preliminary data acquired from the area. Water level data will be collected every year from 1996-2003.

Based on the CRMS review, discrete stations and continuous recorders at stations 54, 55, and 59 will be discontinued after 2003. Recorders at stations 53 and 58 will be discontinued after 2005. Recorders at stations 56 and 57 will be maintained and CRMS0190 in the center of the project area will be utilized.

4. Vegetation

Species composition and relative abundance will be evaluated inside the project area using techniques described in Steyer et al. (1995). More specifically, a modification of the Braun-Blanquet method (Mueller-Dombois and Ellenberg 1974) will be utilized. Twenty-five plots will be located in the project area (figure 4). Vegetation species composition and relative abundance will be evaluated once prior to construction and then at years 1999, 2000, 2002, 2005, 2008, 2012, and 2016. The number of sampling stations may be adjusted by DNR/CRD based on interpretation of preliminary data acquired from the area.

Based on the CRMS review, the number of vegetation stations after 2002 will be reduced to 12, and will be allocated to maintain representation of soil types (figure 5). Additionally, the vegetation data collected at CRMS0190 and Chabreck and Linscombe vegetation data will be used to track vegetative changes.

5. Soil Samples

To evaluate effects of freshwater retention and saltwater intrusion, soil samples (30 cm cores) will be taken to determine percent organic matter, bulk density, and soil porewater salinity using techniques described in Steyer et al. (1995). Twenty-five plots will be located in the project area (figure 4). Soil samples will be evaluated once prior to construction and then at years 1999, 2000, 2002, 2005, 2008,

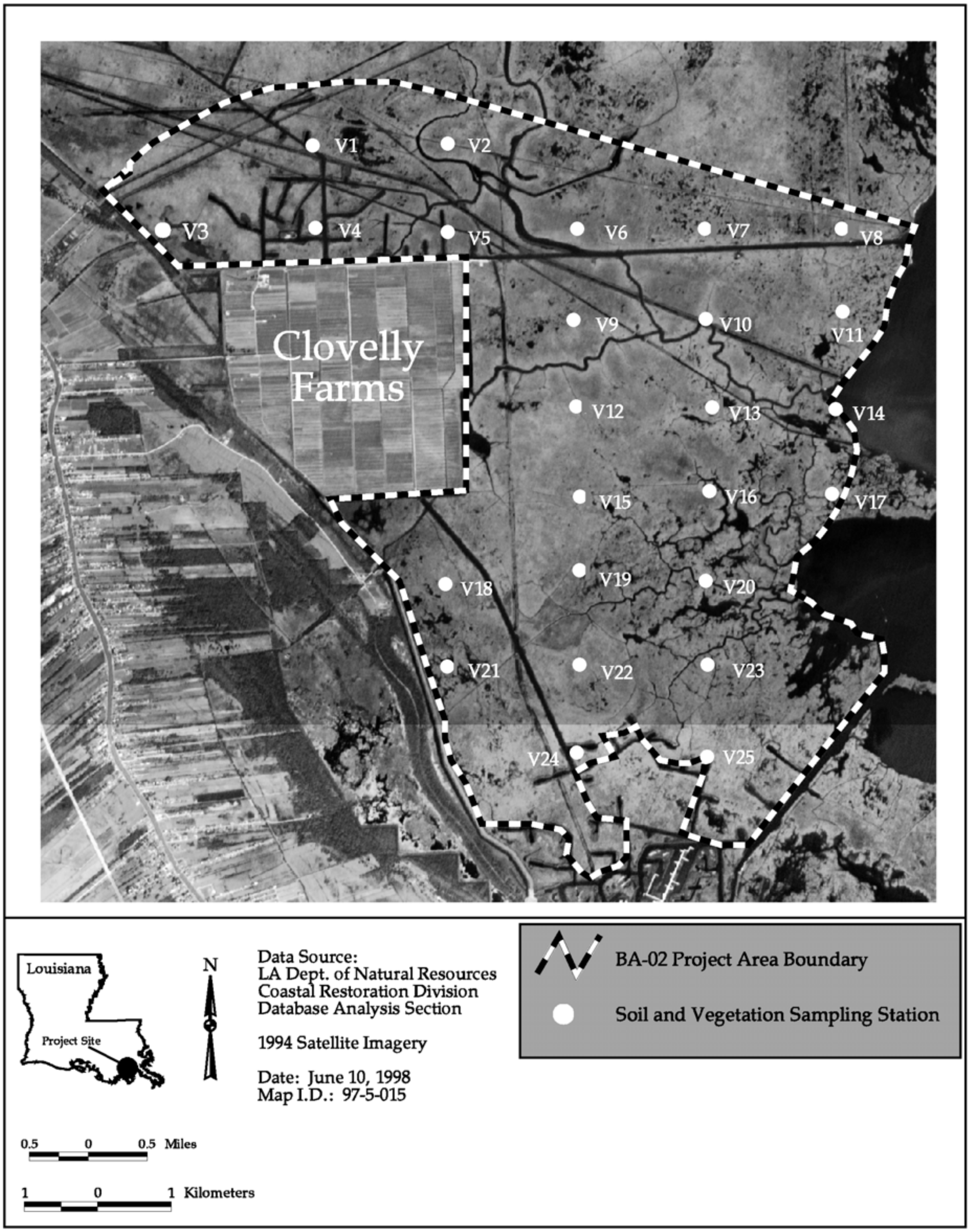

Figure 4. Location of GIWW to Clovelly Hydrologic Restoration (BA-02) project area soil and vegetation sampling stations.

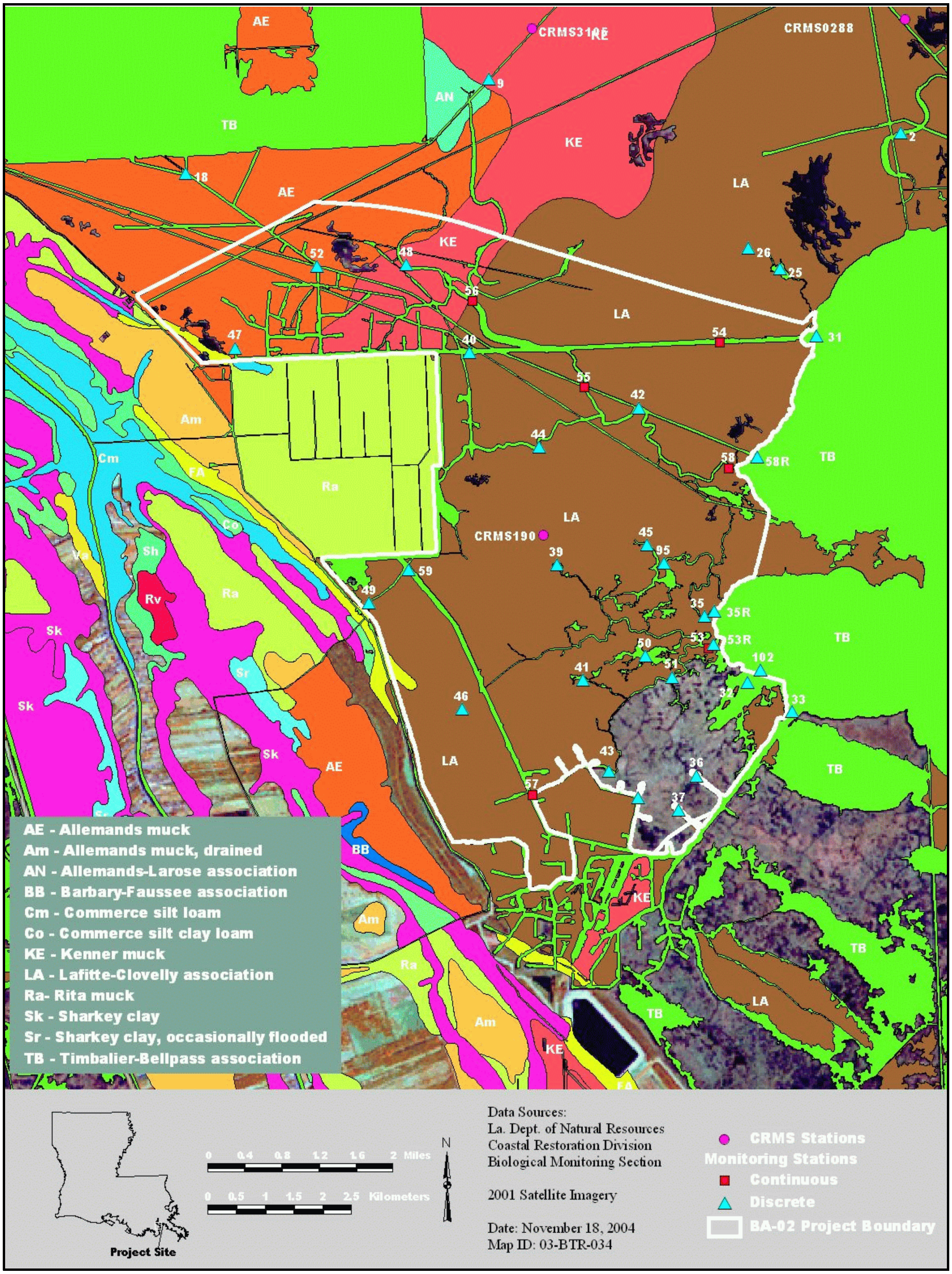

Figure 5. Classification of soils in the BA-02 GIWW to Clovelly Hydrologic Restoration project area and vicinity.

2012, and 2016. Soil porewater salinity samples will be collected and analyzed in conjunction with the soil cores. These data will be collected adjacent to the vegetation plots at a time that will correspond with the vegetation sampling.

Based on the CRMS review, the number of soil stations after 2002 will be reduced to 12 (corresponding to the vegetation stations). Additionally, the soils data collected at CRMS0190 will be used to track changes in soil conditions.

6. Shoreline Change

To evaluate marsh edge movement along the shoreline protection structures placed in Bay L'Ours and along the pipeline canal at the southern border of the project area (see figure 1), controlled DGPS will be used to document marsh edge position using techniques described in Steyer et al. (1995). DGPS measurements will be taken immediately after construction and then at years 2002, 2005, 2008, 2012, and 2016. In addition, historical rates (as m/yr loss) of erosion will be obtained (e.g. Dunbar et al. 1992) and compared to erosion rates after project implementation. The amount of sampling may be adjusted by DNR/CRD based on interpretation of preliminary data acquired from the area.

7. Submerged Aquatic Vegetation (SAV)

The frequency of occurrence of SAV will be analyzed for the project and area. Ten ponds inside the project area (figure 6) will be sampled once in the fall of 1996 (October or November) and spring (April or May) of 1997 (depending on the construction schedule) pre-construction and once during spring (April or May) and once duringfall (October or November) growing seasons at years 1999, 2000, 2002. Methods described in Nyman and Chabreck (1996) will be used to determine the frequency of occurrence of SAV. Each pond will be sampled at random points along transects. The number of random points and transects will be adjusted to appropriately characterize each pond according to pond size and configuration. Within each pond sampled, the presence/absence of SAV will be determined. When SAV occurs at a point, the species occurring will be listed. Frequency of occurrence will be determined for each pond from the number of points at which SAV occurred and the total number of points sampled.

Based on the CRMS review, SAV samples in 2005, 2008, 2012, and 2016 were discontinued.

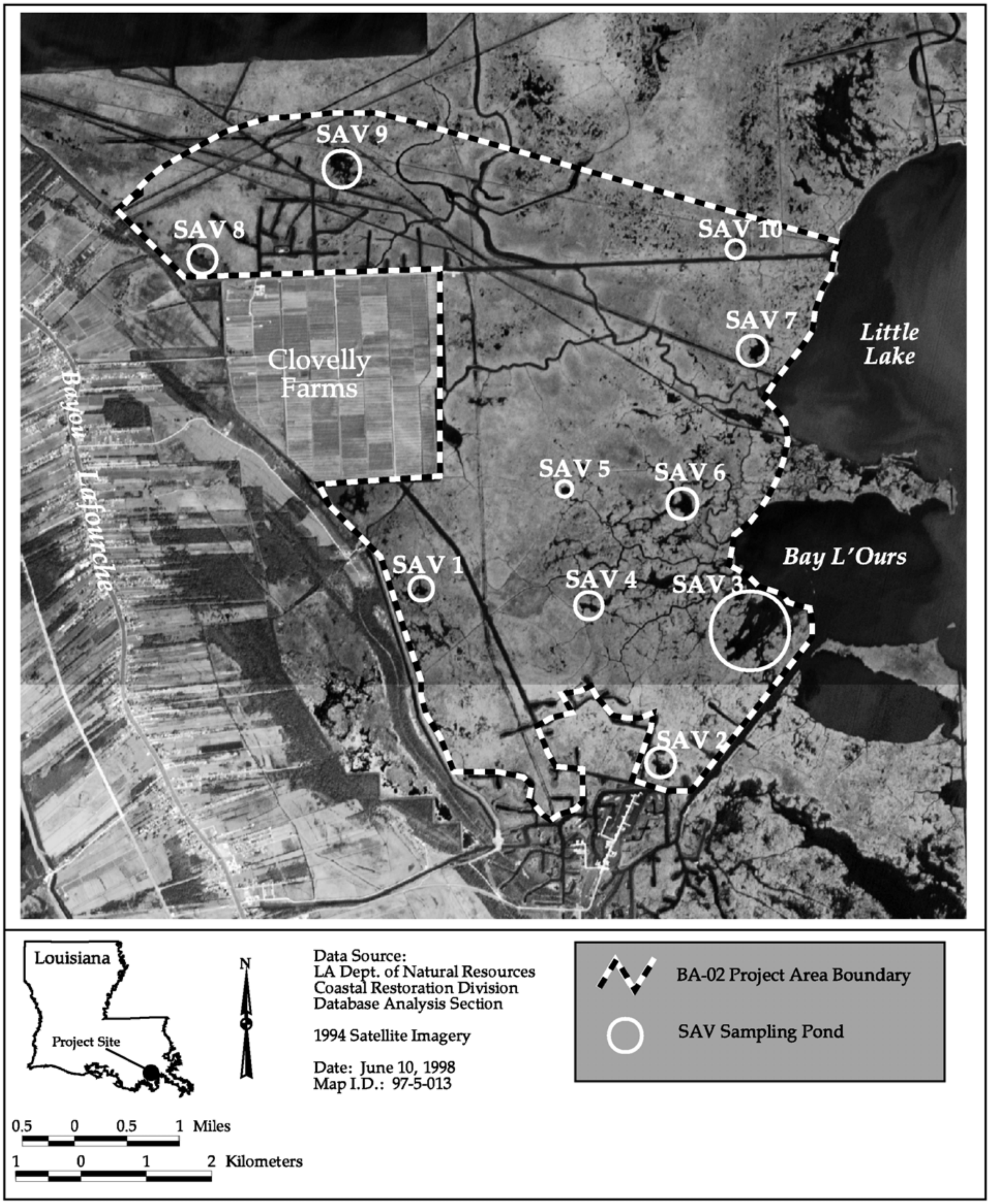

Figure 6. Location of GIWW to Clovelly Hydrologic Restoration (BA-02) project area SAV sampling ponds.

Anticipated Statistical Tests and Hypotheses

All instances where "reference area" is used are to be interpreted as referring to the coastwide reference system upon implementation. The following hypotheses correspond with the monitoring elements and will be used to evaluate the accomplishment of the project goals:

1. Descriptive and summary statistics on historical data (1956, 1978, 1988) and data from aerial photography and GIS interpretation collected during post-project implementation will be used to evaluate marsh to open water ratios and marsh loss rates. If sufficient historical information is available, regression analyses will be done to examine changes in slope between pre- and post-conditions.

   Goal: Increase or maintain existing marsh to open water ratios.

2. The primary method of analysis for differences in salinity and freshwater retention inside the project and reference areas will be to determine differences in salinity variability (Sal) as evaluated by an analysis of variance (ANOVA) that will consider both spatial and temporal variation and interaction. The basic model of ANOVA will be the BACI type model (Before-After-Control-Impact). This model will determine if there is detectable impact (for example, decrease in salinity variability) in the project area after construction. Multiple comparisons will be used to compare individual means across different treatment levels. All original data will be analyzed and transformed (if necessary) to meet the assumption of ANOVA (e.g. normality, equality of variances). When the H_0 is not rejected, the possibility of negative effects will be examined.

   Goal: Decrease salinity variability inside the project area.

   Goal: Promote greater freshwater retention and utilization inside the project area.

   Hypothesis A:

   H_0: Mean salinity variability inside the project area post-construction at time *I* will not be lower than mean salinity variability inside the project area pre-construction.

   H_a: Mean salinity variability inside the project area post-construction at time *I* will be lower than mean salinity variability inside the project area pre-construction.

   Hypothesis B:

   H_0: Mean salinity variability inside the project area post-construction at time *I* will not be lower than mean salinity variability inside the reference area post-construction at time *I*.

H_a: Mean salinity variability inside the project area post-construction at time *I* will be lower than mean salinity variability inside the reference area post-construction at time *I*.

3. The primary method of analysis for water level variability inside the project and reference areas will be to determine differences in mean daily water level variability (WLV) as evaluated by an analysis of variance (ANOVA) that will consider both spatial and temporal variation and interaction. The basic model of ANOVA will be the BACI type model (Before-After-Control-Impact). This model will determine if there is detectable impact (for example, decrease in mean daily water level variability) in the project area after construction. Multiple comparisons will be used to compare individual means across different treatment levels. All original data will be analyzed and transformed (if necessary) to meet the assumption of ANOVA (e.g. normality, equality of variances). When the H_0 is not rejected, the possibility of negative effects will be examined. These analyses will allow for the evaluation of goal 3 (above).

Goal: Decrease water level variability inside the project area.

Hypothesis A:

H_0: Mean daily water level variability inside the project area post-construction at time *I* will not be lower than pre-construction mean daily water level variability.

H_a: Mean daily water level variability inside the project area post-construction at time *I* will be lower than pre-construction mean daily water level variability.

Hypothesis B:

H_0: Mean daily water level variability inside the project area post-construction at time *I* will not be lower than mean daily water level variability inside the reference area post-construction at time *I*.

H_a: Mean daily water level variability inside the project area post-construction at time *I* will be lower than mean daily water level variability inside the reference area post-construction at time *I*.

4. The primary method of analysis for the relative abundance of vegetation inside the project and reference areas will be to determine differences in the relative abundance of vegetation (V) as evaluated by an analysis of variance (ANOVA) that will consider both spatial and temporal variation and interaction. The basic model of ANOVA will be the BACI type model (Before-After-Control-Impact). This model will determine if there is detectable impact (for example, increase in the relative abundance of vegetation) in the project area

after construction. Multiple comparisons will be used to compare individual means across different treatment levels. All original data will be analyzed and transformed (if necessary) to meet the assumption of ANOVA (e.g. normality, equality of variances). When the H_0 is not rejected, the possibility of negative effects will be examined.

Goal: Increase the relative abundance of intermediate marsh plants.

Hypothesis A:

H_0: Mean relative abundance of vegetation inside the project area post-construction at time *I* will not be greater than mean relative abundance of vegetation inside the project area pre-construction.

H_a: Mean relative abundance of vegetation inside the project area post-construction at time *I* will be greater than mean relative abundance of vegetation inside the project area pre-construction.

Hypothesis B:

H_0: Mean relative abundance of vegetation inside the project area post-construction at time *I* will not be greater than mean relative abundance of vegetation inside the reference area post-construction.

H_a: Mean relative abundance of vegetation inside the project area post-construction at time *I* will be greater than mean relative abundance of vegetation inside the reference area post-construction.

5. The primary method of analysis to evaluate the effects of freshwater retention and saltwater intrusion inside the project and reference areas will be to determine differences in soil samples, (percent organic matter [OM], bulk density [BD], porewater salinity [PWS], and porewater sulfides [Sulf]) as evaluated by an analysis of variance (ANOVA) that will consider both spatial and temporal variation and interaction. The basic model of ANOVA will be the BACI type model (Before-After-Control-Impact). This model will determine if there is detectable impact (for example, increase in soil bulk density) in the project area after construction. Multiple comparisons will be used to compare individual means across different treatment levels. All original data will be analyzed and transformed (if necessary) to meet the assumption of ANOVA (e.g. normality, equality of variances). When the H_o is not rejected, the possibility of negative effects will be examined.

Goal: Promote greater freshwater retention and utilization in the project area.

Goal: Decrease salinity variability in the project area.

Hypothesis A:

H_0: Mean percent soil organic matter within the project area post-construction at time *I* will not be higher than pre-construction mean percent soil organic matter.

H_a: Mean percent soil organic matter within the project area post-construction at time *I* will be higher than pre-construction mean percent soil organic matter.

Hypothesis B:

H_0: Mean percent soil organic matter inside the project area post-construction at time *I* will not be higher than mean percent soil organic matter inside the reference area post-construction at time *I*.

H_a: Mean percent soil organic matter inside the project area post-construction at time *I* will be higher than mean percent soil organic matter inside the reference area post-construction at time *I*.

Hypothesis C:

H_0: Mean soil bulk density within the project area post-construction at time *I* will not be higher than pre-construction mean soil bulk density.

H_a: Mean soil bulk density within the project area post-construction at time *I* will be higher than pre-construction mean soil bulk density.

Hypothesis D:

H_0: Mean soil bulk density inside the project area post-construction at time *I* will not be higher than mean soil bulk density inside the reference area post-construction at time *I*.

H_a: Mean soil bulk density inside the project area post-construction at time *I* will be higher than mean soil bulk density inside the reference area post-construction at time *I*.

Hypothesis E:

H_0: Mean soil porewater salinity within the project area post-construction at time *I* will not be lower than pre-construction mean soil porewater salinity.

H_a: Mean soil porewater salinity within the project area post-construction at time *I* will be lower than pre-construction mean soil porewater salinity.

Hypothesis F:

H_0: Mean soil porewater salinity inside the project area post-construction at time *I* will not be lower than mean soil porewater salinity inside the reference area post-construction at time *I*.

H_a: Mean soil porewater salinity inside the project area post-construction at time *I* will be lower than mean soil porewater salinity inside the reference area post-construction at time *I*.

7. The primary method of analysis for SAV occurrence inside the project area will be to determine the mean frequency of SAV in the project area as evaluated by a repeated measures analysis of variance (ANOVA) that will consider both spatial and temporal variation and interaction. The basic model of ANOVA will be the BACI type model (Before-After-Control-Impact). This model will determine if there is detectable impact (for example, an increase in SAV occurrence) in the project area after construction. Multiple comparisons will be used to compare individual means across different treatment levels. All original data will be analyzed and transformed (if necessary) to meet the assumption of ANOVA (e.g. normality, equality of variances). When the H_o is not rejected, the possibility of negative effects will be examined. These analyses will allow for the evaluation of goal 7 (above).

Goal: Increase or maintain the relative abundance of SAV's.

Hypothesis A:

H_0: Mean SAV occurrence inside the project area post-construction at time *I* will not be greater than mean SAV occurrence inside the project area pre-construction.

H_a: Mean SAV occurrence inside the project area post-construction at time *I* will be greater than mean SAV occurrence inside the project area pre-construction.

<u>Notes</u>

1.	Implementation:	Start Construction:	April 21, 1997
		End Construction:	October 31, 2000
2.	NRCS Point of Contact:	Marty Floyd	(318) 473-7690
3.	DNR Project Manager:	Hilary Thibodaux	(985) 449-5105
	DNR Monitoring Manager:	Elaine Lear	(985) 447-0974

4. The twenty year monitoring plan development and implementation budget for this project is $1,236,624. Pursuant to the CRMS review, it was authorized by the Task Force to maintain $1,160,476 with the project, and utilize $76,148 to support CRMS. A progress report will be available in 1999 and 2000. Periodic comprehensive reports on coastal restoration efforts in the Barataria hydrologic basin will describe the status and effectiveness of the project as well as cumulative effects of restoration projects in the basin.

5. Evaluating sheet flow will be done by comparison of water levels and existing marsh levels and calculating duration and frequency of flooding (MSL marsh level elevation and NAVD88 will be established).

6. Pre-construction monitoring (i.e. discrete monthly salinity, water temperature, and depth) was started in January 1993, suspended in August 1993, reinstated in July 1994, and suspended in June 1995.

7. The northern reference area monitoring was dropped because of landrights issues, but landrights are secured for the remainder of the project area.

8. The project area was initially flown using color infrared aerial photography (1:24,000) in November 1993. A second pre-construction flight was conducted in December 1996 because of project construction delays. Post construction photography was obtained on December 16, 2002.

9. Available ecological data, both descriptive and quantitative, will be evaluated in concert with all of the above data and statistical analysis to aid in determination of the overall project success.

10. Historical data dating back to 1978 is available for salinity and water levels from Louisiana Department of Wildlife and Fisheries. LDWF has stations located in GIWW, Bay L'Ours, Little Lake, and just south of Superior Canal.

11. Should LDNR/CRD monitoring reveal that a waterlogging or impoundment problem exists as a result of structures installed due to this plan, LDNR and NRCS in conjunction with Lafourche parish shall determine corrective actions to be taken.

12. Additional aerial photography may be flown to augment that flown as requirements for Habitat Mapping monitoring element. This intermittent photography will aid in evaluation of marsh to open water ratios.

13. References:

Barras, J. A., L. R. Handley, and P. E. Bourgeois 1993. 1990 Landcover/use data for coastal Louisiana. Open-file report 94-02. Lafayette, La.: National Wetlands Research Center.

Boon, J. D., III 1978. Suspended solids transport in a salt marsh creek - an analysis of error. in Estuarine Transport Processes (Kjerfve, B.J., ed.). The Belle W. Baruch Library in Marine Science, Number 7. University of South Carolina Press. Columbia, South Carolina. 331 pp.

Chabreck, R. H., and J. Linscombe 1988. Vegetative type map of the Louisiana coastal marshes. Louisiana Department of Wildlife and Fisheries, New Orleans.

Chabreck, R. H., T. Joanen, and A. W. Palmisano 1968. Vegetative type map of the Louisiana coastal marshes. Louisiana Department of Wildlife and Fisheries, New Orleans.

Coastal Environments, Inc. 1989. Wetland Protection and Maintenance Between U.S. Highway 90 and the Clovelly Oil and Gas Field in Lafourche Parish. Prepared by Coastal Environments, Inc. for the Lafourche Parish Council.

Dunbar, J. B., L. D. Britsch, and E. B. Kemp III 1992. Land loss rates: report 3, Louisiana coastal plain. Technical Report GL-90-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Gambrell, R. P., and W. H. Patrick, Jr. 1978. Chemical and microbiological characteristics of wetland soils and sediments. In: D.D. Hook and R.M. Crowford (Eds.), Plant Life in Anaerobic Environments. Ann Arbor Science Publishers, Ann Arbor, MI, pp. 375-423.

Havill, D. C., A. Ingold, and J. Pearson 1985. Sulfide tolerance in coastal halophytes. Vegetatio, 62:279-285.

Kjerfve, B. J., L. H. Stevenson, J. A. Prohel, T. H. Chzranowski, and W. M. Kitchens 1981. Estimation of material fluxes in an estuarine cross-section: a critical analysis of spatial measurement density and errors. Limnology and Oceanography 26:325-335.

Koch, M. S., and I. A. Mendelssohn 1989. Sulfide as a soil phytotoxin: Differential responses in two salt marsh species. J. Ecol., 77:565-578.

Koch, M. S., I. A. Mendelssohn, and K. L. McKee 1990. Mechanisms for the hydrogen sulfide-induced growth limitation in wetland macrophytes. Limnol. Oceanogr., 35:399-408.

Mendelssohn, I. A., and K. L. McKee 1988. Spartina alterniflora die-back in Louisiana: Time-course investigation of soil waterlogging effects. J. Ecol., 76:509-521.

Natural Resources Conservation Service 1996. GIWW to Clovelly wetland project (BA-2) - Description of revised project: two options. Wetlands Value Assessment for Project BA-2, GIWW to Clovelly Wetland Restoration.

Nyman, J. A., and R. H. Chabreck 1996. Some effects of 30 years of weir management on coastal marsh aquatic vegetation implications to waterfowl management. Gulf of Mexico Science. 1:16-25.

Nyman, J. A., R. D. DeLaune, and W. H. Patrick, Jr. 1990. Wetland soil formation in the rapidly subsiding Mississippi River Deltaic Plain: Mineral and organic matter relationships. Estuarine, Coastal and Shelf Science, 31:57-69.

Pearson, J., and D. C. Havill 1987. The effect of hypoxia and sulphide on culture-grown wetland and non-wetland plants. Journal of Experimental Botany, 39(200):363-374.

Sasser, C. E., M. D. Dozier, J. G. Gosselink, and J. M. Hill 1986. Spatial and temporal changes in Louisiana's Barataria Basin marshes, 1945-1980. Environmental Management, 10(5):671-680.

Steyer, G. D., R. C. Raynie, D. L. Steller, D. Fuller, and E. Swenson 1995. Quality management plan for Coastal Wetlands Planning, Protection, and Restoration Act monitoring program. Open-file series no. 95-01. Baton Rouge: Louisiana Department of Natural Resources, Coastal Restoration Division.

Swenson, E. M., and R. E. Turner 1987. Spoil banks: effects on a coastal marsh water-level regime. Estuarine, Coastal and Shelf Science, 24:599-609.

Turner, R. E. 1990. Landscape development and coastal wetland losses in the northern Gulf of Mexico. Amer. Zool., 30:89-105.

Turner, R. E., K. L. McKee, W. B. Sikora, J. P. Sikora, I. A. Mendelssohn, E. Swenson, C. Neill, S. G. Leibowitz, and F. Pedrazini. 1984. The impact and mitigation of man-made canals in coastal Louisiana. Wat. Sci. Tech., 16:497-504.

U. S. Soil Conservation Service (SCS) 1984. Soil survey of Lafourche Parish, Louisiana. 228 pp.

_________1991a. Feasibility Report for Project BA-2, GIWW to Clovelly Wetlands. Completed by USDA-Soil Conservation Service for LA. DNR - Coastal Restoration Division.

_____ 1991b. Wetlands Value Assessment for Project BA-2, GIWW to Clovelly Wetland Restoration. Completed by USDA-Soil Conservation Service for LA. DNR - Coastal Restoration Division.

Wang, F. C. 1988. Dynamics of saltwater intrusion in coastal channels. Journal of Geophysical Research, 93(C6)6937-6946.

Webb, E. C., I. A. Mendelssohn, and B. J. Wilsey 1995. Causes for vegetation dieback in a Louisiana salt marsh: A bioassay approach. Aquatic Botany, 51:281-289.

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