State of Louisiana
Department of Natural Resources
Coastal Restoration Division and
Coastal Engineering Division

2004 Operations, Maintenance, and Monitoring Report

for

Replace Sabine Refuge Water Control Structures at Headquarters Canal, West Cove Canal, and Hog Island Gully

State Project Number CS-23
Priority Project List 3

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Cameron Parish

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2004 Operations, Maintenance, and Monitoring Report
for
Sabine Structure Replacement (CS-23)

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I. Introduction

The Replace Hog Island Gully, West Cove and Headquarters Canal Structures (CS-23) project area is located within the Sabine National Wildlife Refuge, approximately 9 mi (14.5 km) south of the town of Hackberry in Cameron Parish, Louisiana (figure 1). Established on December 6, 1937, the Sabine Refuge is bound on the east by Calcasieu Lake, on the west by Sabine Lake, on the north by broken marsh, and on the south by pasture land and coastal ridges.

The project area wetlands are characterized as fresh to intermediate marshes dominated by *Cladium mariscus* (Jamaica sawgrass). The Black Lake area, located north of the project, experienced an 81% reduction in the acreage of emergent wetlands between 1952 and 1974. By 1972, the Black Lake area was characterized as brackish marsh. A number of factors such as salinity stress, erosion, subsidence, burning and hydrologic modification influenced this habitat change.

Since there are primarily three avenues for water passage (Hog Island Gully, West Cove Canal, and Headquarters Canal) in the area, water management by weirs was initiated in the 1970's. By the 1990's, these structures had corroded with the continuous exposure to saline water to the extent that they were inoperable or almost inoperable.

Due to the detrimental impacts of excessive salinity on brackish and intermediate marshes, the ability to occasionally reduce or halt the inflow of saline water is critical. This level of control was not available with the original structures. The inability to manipulate gate structures jeopardized the integrity of thousands of acres of interior brackish and intermediate marshes which are lower in elevation and often occur in highly organic semifloating soils. The estimated subsidence rate in the project marshes ranges between 0.12 in/yr and 0.16 in/yr (0.32 and 0.42 cm/yr).

Because of the restricted cross-sectional area of the pre-existing structures and culverts, the lower elevation interior marshes experienced longer periods of vegetative water logging stress than the marshes located east of Highway 27. The pre-existing structures afforded the primary avenues for drainage and were inadequate to provide sufficient discharge to evacuate excess water. Due to the project area not being fully enclosed, secondary drainage for the area could occur to the west through Sabine Lake via North, Central and South line canals.

In May 1999, the US Fish and Wildlife Service (USFWS) completed the environmental assessment (EA) plan addressing the Replacement of Water Control Structures at Hog Island Gully, West Cove Canal, and Headquarters Canal (CS-23). The plan called for the complete removal of the Hog Island Gully

Structure, West Cove Canal Structure, and Headquarters Canal Structure and replacement with additional structures and culverts to provide larger cross sections for water removal and to minimize saltwater intrusion.

The replacement structures are operated to more effectively discharge excess water, increase cross sectional area for ingress and egress of estuarine dependent species and more effectively curtail saltwater intrusion into the interior marshes. Since completion of the new structures, high saline waters could be precisely controlled, water discharge capacities have been increased, and vegetative stress through water logging has been minimized, thus enhancing emergent and submergent vegetative growth.

Construction began in November 1999 and was completed on the Hog Island Gully, West Cove, and Headquarters Canal structures in August 2000, June 2001, and February 2000, respectively. However, the Hog Island Gully and West Cove structures are not fully operational due to an electrical service problem.

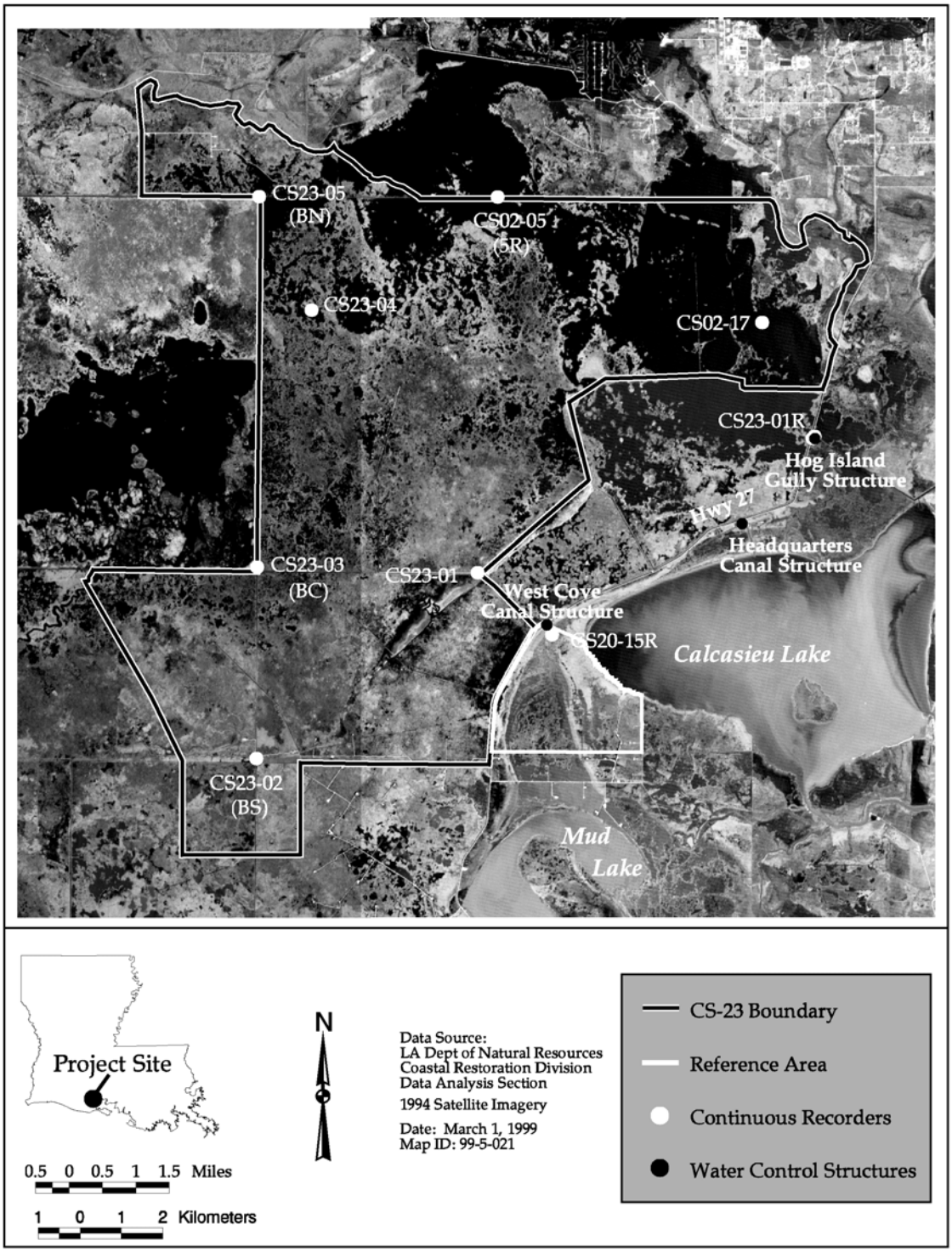

Figure 1. Replace Hog Island Gully, West Cove and Headquarters Canal Structures (CS-23) project features, project area boundaries and reference area boundaries.

II. Maintenance Activity

a. Project Feature Inspection Procedures

The purpose of the annual inspection is to evaluate the constructed project features to identify any deficiencies and prepare a report detailing the condition of project features and recommended corrective actions needed.
There was no O & M Inspection performed in 2003/2004 since the project is still under construction.

b. Inspection Results

N/A

II. Maintenance Activity (continued)

c. Maintenance Recommendations

i. Immediate/ Emergency Repairs

1. Install operating nut in gate 6A, Hog Island Gully.
2. Free gate 6b that is jammed, Hog Island Gully.
3. Replace operation nut in gate 3A, West Cove.
4. Replace batteries in all Rotork Actuators.

ii. Programmatic/ Routine Repairs

None.

III. Operation Activity

a. Operation Plan

Structure A-Hog Island Gully Canal
This structure has four 7.5 foot wide gates (HG1, HG2, HG5, and HG6) and two 3.0 foot wide gates (HG3 and HG 4) [306 ft^2 total area]. Each gate is 8 foot deep, assuming that water level is at marsh elevation (1.0' NGVD). Each gate is equipped with stop logs on slide gates that may be used to preclude all water flow. Of the four 7.5 foot wide gates, three have exterior flap gates, (HG1, HG2, and HG6).
Structure B- Headquarters Canal
This structure has three 5 foot wide diameter culverts (HQ1, HQ2, and HQ3) [59ft^2 total area]. The top of each culvert is at marsh level (1.0' NGVD). Each gate is equipped with an exterior flap gate that may be raised and locked closed to serve as an adjustable sluicegate.
Structure C – West Cove Canal
This structure has three 7.5 foot wide gates (WC1, WC3, and WC5) and two 3.0 foot wide gates (WC2 and WC4) [242 ft^2 total area]. Each gate is 8 foot deep,

assuming that water level is at marsh elevation (1.0' NGVD). Each is equipped with stop logs in slide gates that may be used to preclude all water flow. Two of the four 7.5 foot gates have exterior flap gates (WC1 and WC5).

Normal Operation: Water exchange will be provided through open bays having approximately the same cross-sectional area as that provided by the old structures' fully open gates [182 ft^2 total area]. The slide/sluice gates of the flapgated bays may be adjusted by the refuge manager at his discretion, except for the middle Headquarters' Canal Structure culvert (HQ2) which will remain 50 percent open. All flapgates will remain down in the operating position, except for HQ2 in which the flapgate will be locked closed to serve as the sluice gate.

Hog Island Gully Canal - Structure A: Normal management of this structure would provide a cross-sectional area of 112 ft^2 compared with 93.5 ft^2 of gated opening in the old structure.

HG1	HG1	HG2	HG2	HG3	HG3	HG4	HG4	HG5	HG5	HG6	HG6
Stop Logs	Flap Gate	Stop Logs	Flap Gate	Stop Logs	Flap Gate	Stop Logs	Flap Gate	Stop Logs	Flap Gate	Stop Logs	Flap Gate
MD	Down	MD	Down	-7'	None	-7'	None	-7'	None	MD	Down

MD=Manger's discretion

Headquarter's Canal – Structure B. Normal management provides a cross-sectional area of approximately 10 ft^2 compared with 0 to 12.6 ft^2 of gated opening maintained through operation of the old structure.

HQ1 Sluice	HQ2 Sluice	HQ3 Sluice
Sluice Open	Sluice ½ Open	Sluice Open

West Cove Canal - Structure C. Normal management would provide a cross-sectional area of 60 ft^2 compared to 59.5 ft^2 of gated opening in the old structure.

WC1 Stop Logs	WC1 Flap Gate	WC 2 Stop Logs	WC2 Flap Gate	WC3 Stop Logs	WC3 Flap Gate	WC 4 Stop Logs	WC4 Flap Gate	WC 5 Stop Logs	WC5 Flap Gate
MD	Down	+2'	None	-7'	None	+2'	None	MD	Down

Deviations from normal operation will be short-term and conducted for the reason identified below.

Increased Exchange Operation:

Additional gates may be temporarily opened to the degree necessary as determined by the refuge manager for any of the following reasons.

1) To discharge excess water
2) To facilitate inflow of freshwater, or water of lower salinity
3) To enhance ingress and egress of estuarine-dependent fishes and shellfishes
4) To discharge anoxic waters

High Water Provisions: When water levels in interior marshes exceed four inches above average marsh level for four days or more, the discharge capacity of structures A, B, and or C will be increased with flap fates or by opening stop logs or sluice gates to permit outflows. Normal operation will be restored when the water conditions have receded.

Storm provisions: Prior to a storm's approach, flapgated bays may be readied in advance for later discharge of excess water by raising and thereby opening the sluice gates of those bays equipped with flapgates. Prior to a storm's approach, refuge personnel may restrict or close non-flapgated bays to reduce exposure or interior marshes to saltwater tidal surges. Following a storm, normal or restricted water exchange operations shall be resumed on non-flapgated bays in accordance with the established salinity and water level provisions and criteria. In an attempt to reduce the exposure of interior marshes to saltwater because of tropical depression tidal surges, the fates will be closed precluding any surges. Following the inundation of high tides and rainfall, the gates will be opened to alleviate interior marsh flooding.

Monitoring Activities: Baseline salinity and water level monitoring, using continuous recorders, began in April 1998 using the standard Coastal Wetlands, Planning, Protection, and Restoration Act monitoring protocol. The Louisiana Department of Natural Resources Coastal Restoration Division has deployed six continuous monitoring recorders (sondes) within the project area. The U.S. Fish and Wildlife Service has been collecting salinity, water temperature, dissolved oxygen, pH, and specific conductivity parameters at area stations approximately every two weeks for over 15 years and will continue to do so after project completion.

b. Actual Operations

Project was still under construction. Therefore structures were not operated.

IV. Monitoring Activity

a. Project Objectives and Goals:

The objective of the Hog Island Gully, West Cove & Headquarters Canal Structure Replacement Project is to increase the cross-sectional area of the project features to improve hydrologic conditions that control high saline waters, increase water discharge capacities, and maintain emergent vegetation.

The following goals will contribute to the evaluation of the above objectives:

1. Reduce the occurrence of salinities that exceed target levels during the growing and non-growing seasons at stations CS23-02 (BS), CS23-03 (BC), CS23-05 (BN) and CS02-05 (5R). Target levels range from 2 – 8 ppt during the growing season and 3 – 10 ppt during the non-growing season (table1).

2. Minimize frequency and duration of marsh flooding events.

3. Maintain existing intermediate and brackish vegetation communities.

4. Increase occurrence of submerged aquatic vegetation (SAV).

b. Monitoring Elements

Aerial Photography

Near-vertical color-infrared aerial photography (1:24,000 scale) was used to measure land to water ratios for the project and reference areas (figure 2). The photography was obtained in November 2000 prior to project construction. The original photography was checked for flight accuracy, color correctness, and clarity and was subsequently archived. Aerial photography was scanned, mosaicked, and georectified by USGS/NWRC personnel according to standard operating procedures (figure 3). The photography will be obtained after construction in 2004, 2009, and 2018.

Salinity

Salinities are monitored hourly utilizing eight continuous recorders (figure 4). Six are located in the project area, one in the reference area and one outside of the project area within Hog Island Gully Canal. Five recorders are associated with this project, two associated with Rycade Canal (CS02-05, CS02-17) and one from East Mud Lake (CS20-15R). Discrete salinities are collected bi-weekly at 15 stations in the project and reference areas by USFWS and data are provided to DNR each month. Both discrete and continuous data will be used to characterize frequency and duration of average annual salinities throughout the project and reference area. Salinity data will also be used to identify occurrences of salinities that exceed target levels at stations CS23-02 (BS), CS23-03 (BC), CS23-05 (BN) and CS02-05 (5R). Salinity was monitored in 1998-1999 (pre-construction) and will be monitored from 2000-2018 (post-construction).

Water Level

Water levels are monitored hourly utilizing eight continuous recorders (figure 4). Six are located in the project area, one in the reference area and one outside of the project area within Hog Island Gully Canal. Five recorders are associated with this project, two associated with Rycade Canal (CS02-05, CS02-17) and one from East Mud Lake (CS20-15R). To document annual duration and frequency of flooding, water levels were analyzed at 5 of the continuous recorder stations which were referenced to marsh elevations. A staff gauge has been surveyed adjacent to each continuous recorder to correlate water levels to a known datum. Marsh elevations have been established at stations (CS23-02, CS23-03, CS23-05, CS02-05, CS02-17) and will be used to evaluate 1998-1999 (pre-construction) and 2000-2018 (post-construction) data sets.

Vegetation

Species composition, richness and relative abundance will be evaluated in the project and reference areas using the Braun-Blanquet method. Fifty $4m^2$ sample areas (replicate 2m x 2m plots) are used to monitor percent cover, species composition, and height of dominant plants. Forty plots are located in the project area and ten existing plots are in the reference area. The plots were established along a North/South transect line and are marked by GPS points and PVC poles to allow revisiting over time. Vegetation was monitored in 1999 (pre-construction) and will be re-sampled in 2004, 2009, 2014, and 2018.

Submerged Aquatic Vegetation

To determine the occurrence of submerged aquatic vegetation (SAV) within the project and reference area, eight ponds are randomly sampled for presence or absence of SAV using the modified rake method. Five ponds are located in the project area and three in the reference area. Transect lines are set up within each pond and a minimum of 25 samples are taken along each transect line, not to exceed 100 samples per line. Depending on pond configuration and wind direction, the number of transect lines within each pond varies. SAV's were monitored in 1999 (pre-construction) and will be sampled in 2004, 2009, 2014, and 2018.

c. Preliminary Monitoring Results and Discussion

Aerial Photography

Land / Water analysis was acquired in November 2000 (figure 2). Results indicate that the project area had a ratio of 67.5% land to 32.5% water while the reference area was comprised of 57.9% land to 42.1% water. Post-construction photography will be collected in 2004, 2009 and 2018.

Salinity:

Salinity data was collected hourly at seven stations (figure 4) associated within the CS-23 project and reference areas (Figures 5a-b to 11a-b).

Station	Data collection period
CS23-01	3/18/98 - present

CS23-02	3/18/98 - present
CS23-03	3/18/98 - present
CS23-04*	3/18/98 – 8/25/99
CS23-05	3/18/98 - present
CS23-01R	3/17/98 - present
CS02-05**	7/14/94 - present
CS02-17**	6/14/94 - present

*The continuous recorder at CS23-04 was removed due to low water conditions and station to station analysis that concluded no significant differences P<.005 were found when compared to station CS23-05.
**Vented water level data were not collected at stations CS02-05 and CS02-17 from 6/14/94 until 4/8/97.

Hourly data were combined at each station to derive a daily means value. Weekly means were then calculated from the daily means. Yearly means were derived from the weekly means associated with each station (figure 12). Salinity was not significantly different (P<0.001) at stations CS23-01 and CS02-05. However significant differences did occur (P<0.005) at stations CS23-02, CS23-03, CS23-05 (p=<.001) and CS02-17 (p=0.0010).

Salinity relative to target levels which were set forth in the *Environmental Assessment (EA) for the Replacement of Water Control Structures at the Hog Island Gully, West Cove and Headquarters Canal project (XCS/CS-23;* 1999), were calculated using hourly salinity (ppt) data from 1/1/03 – 12/31/03. Stations CS02-05, CS23-02, CS23-03 and CS23-05 which had salinity target levels for the growing (March – August) and non-growing (September – February) seasons were calculated (table 1). The percentage of total time target levels were maintained during the growing season at stations CS02-05, CS23-02, CS23-03 and CS23-05 were 32.52, 69.28, 80.09 and 63.42 percent respectively. The percentage of total time target levels were maintained during the non-growing season was 94.28, 97.89, 96.75 and 97.32 percent respectively (table 2).

Water level:

Water level NAVD 88 (ft) data were collected hourly at five stations associated within the CS-23 project and reference areas. Water circulation patterns relative to incoming tidal flows are depicted in figure 13. Hourly data were combined at each station to derive daily mean values. Weekly means were then calculated from the daily means. Yearly means were then calculated from the weekly means associated with each station. Water levels relative to marsh elevations were calculated to determine yearly marsh inundation rates for the sampling period. The reference station CS23-01R was compared to the project stations for yearly marsh inundation. Water levels were not significantly different (P<0.0001) at stations CS02-17 and CS23-05. However, significant differences did occur (P<0.005) at stations CS23-02 and CS23-03, (figure 14). Water levels remained well below the average marsh elevation of 1.41 ft for the 1/1/03 -12/31/03 period.

IV. Monitoring Activity (continued)

Vegetation:

Vegetation surveys were conducted in June 1999 (N= 49 plots) during the pre-construction period (figure 15). During this sampling period, the area was dominated by *Spartina patens*, which had the highest cover value of 76.62 %. The five co-dominant emergent vegetation species *Distichlis spicata, Schoenoplectus americanus, Typha latifolia, Schoenoplectus californicus* and *Eleocharis radicans*, with percent covers of 7.89 %, 6.36 %, 5.35%, 3.06% and 1.20% respectively (table 3).

Submerged aquatic vegetation (SAV):

SAV surveys were conducted in October 1999 (N= 14 transects) during the pre-construction period. Results indicate that three species, *Ruppia maritima, Nelumbo lutea* and an *unidentified Alga spp* represented the total number of occurrences among all sampling plots inside and outside the project area (table 4). .

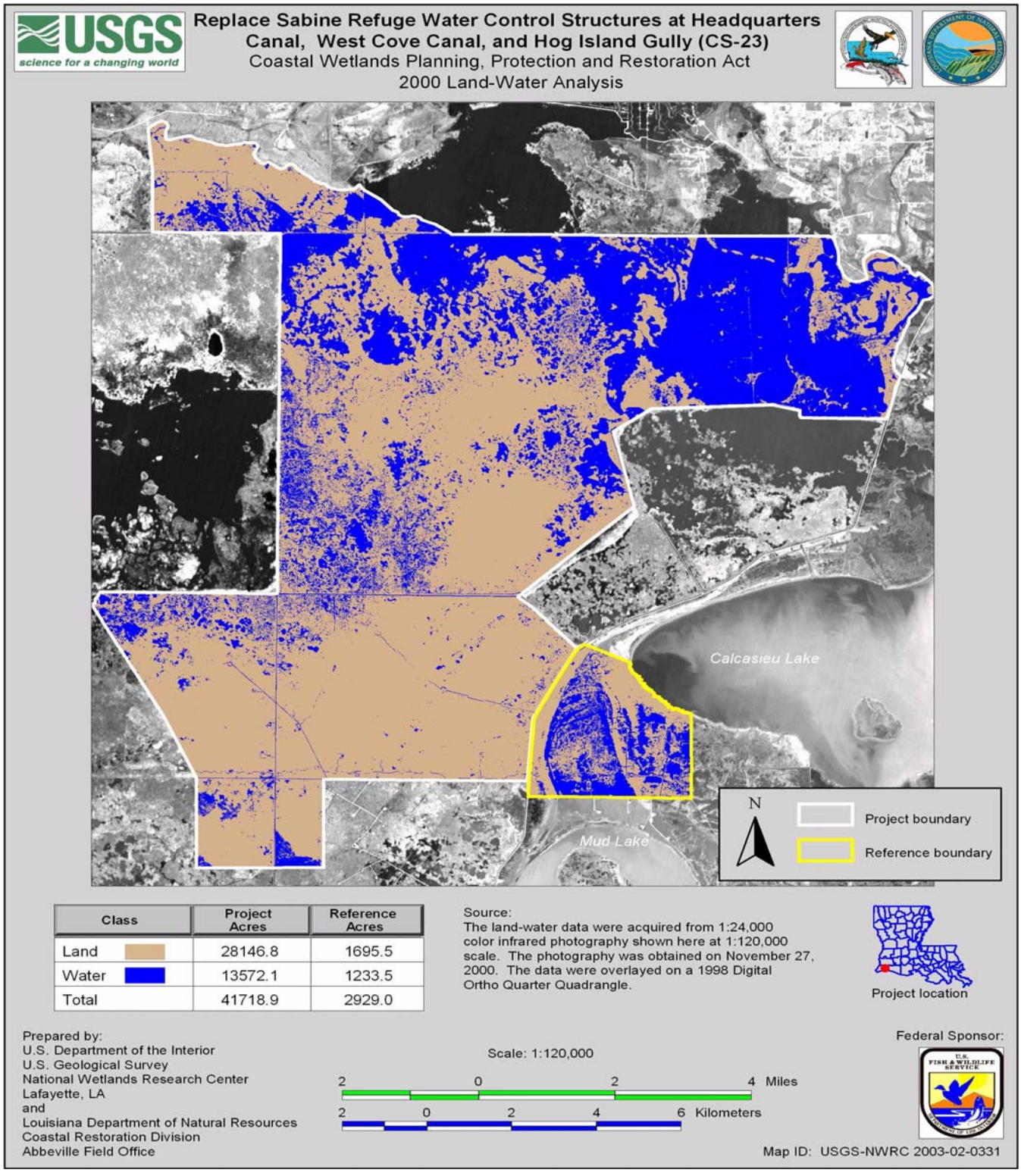

Figure 2. Land/water analysis of the Sabine Structure Replacement (CS-23) for the project and reference areas from photography obtained November 27, 2000.

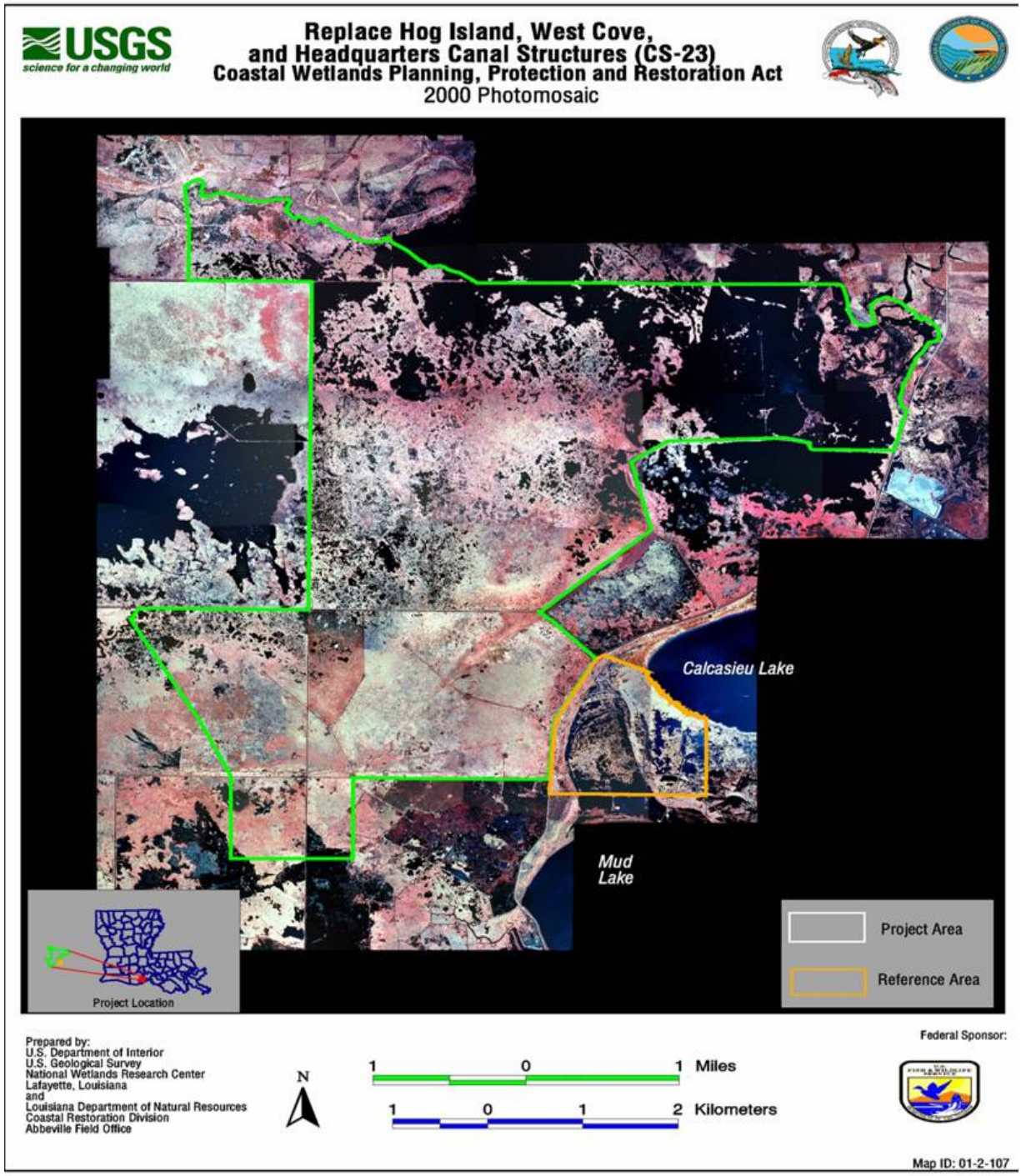

Figure 3. Photo-mosaic of the Hog Island Gully, West Cove and Headquarters Canal Structure Replacement project area from photography obtained November 27, 2000**.**

Table 1. Salinity criteria for restricting and halting saltwater inflows, which were set forth in the *Environmental Assessment (EA) for the Replacement of Water Control Structures at the Hog Island Gully, West Cove and Headquarters Canal project (XCS/CS-23;* 1999)

		Monitoring Station			
Season	***Months***	***CS23-03***	***CS23-02***	***CS02-05***	***CS23-05***
Growing	Mar - Aug	4	4	5	2
Non-Growing	Sept - Feb	8	8	7	4

Salinity criteria (ppt) for restricting saltwater inflows.

		Monitoring Station			
Season	***Months***	***CS23-03***	***CS23-02***	***CS02-05***	***CS23-05***
Growing	Mar - Aug	6	6	-	3
Non-Growing	Sept - Feb	10	10	-	5

Salinity criteria (ppt) for halting all saltwater inflows.

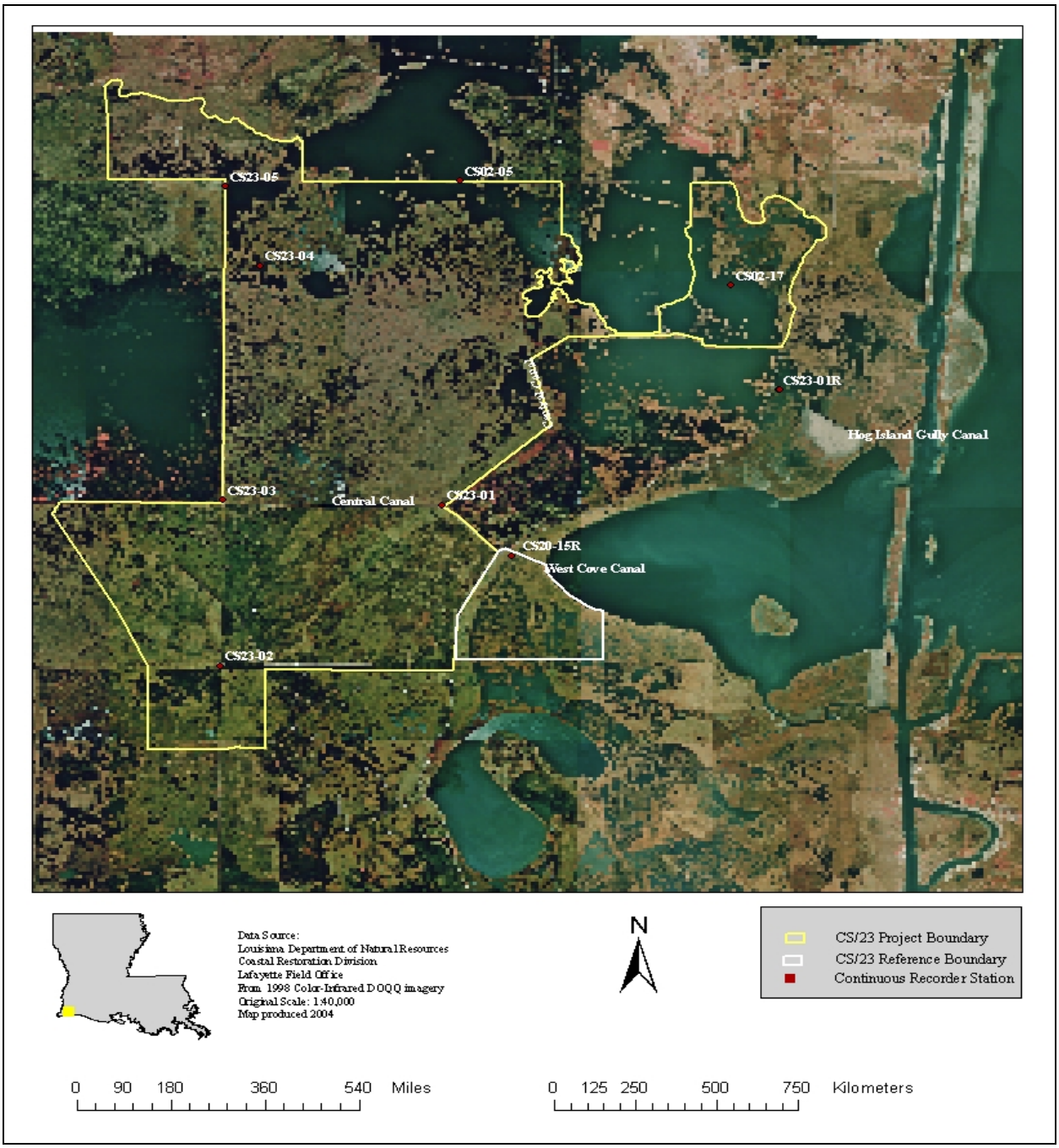

Figure 4. 1998 DOQQ imagery of continuous recorder monitoring stations in the Hog Island Gully, West Cove and Headquarters Canal Structure Replacement project and reference areas.

Station CS23-01 (1/1/03 – 12/31/03)
Salinity and Water Level Data

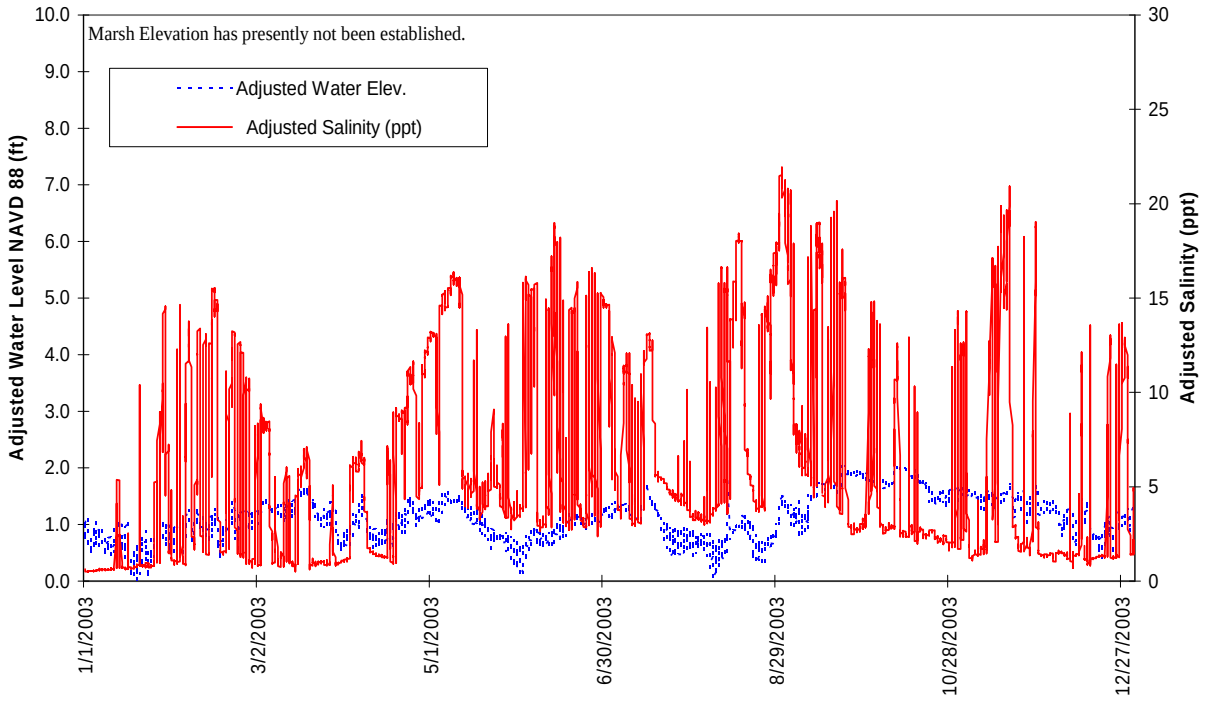

Figure 5a-b. Hourly salinity and water level at station CS23-01 in the Sabine Structure Replacement (CS-23) project area. No marsh elevation was established due to the close proximity of a ridge and shell road.

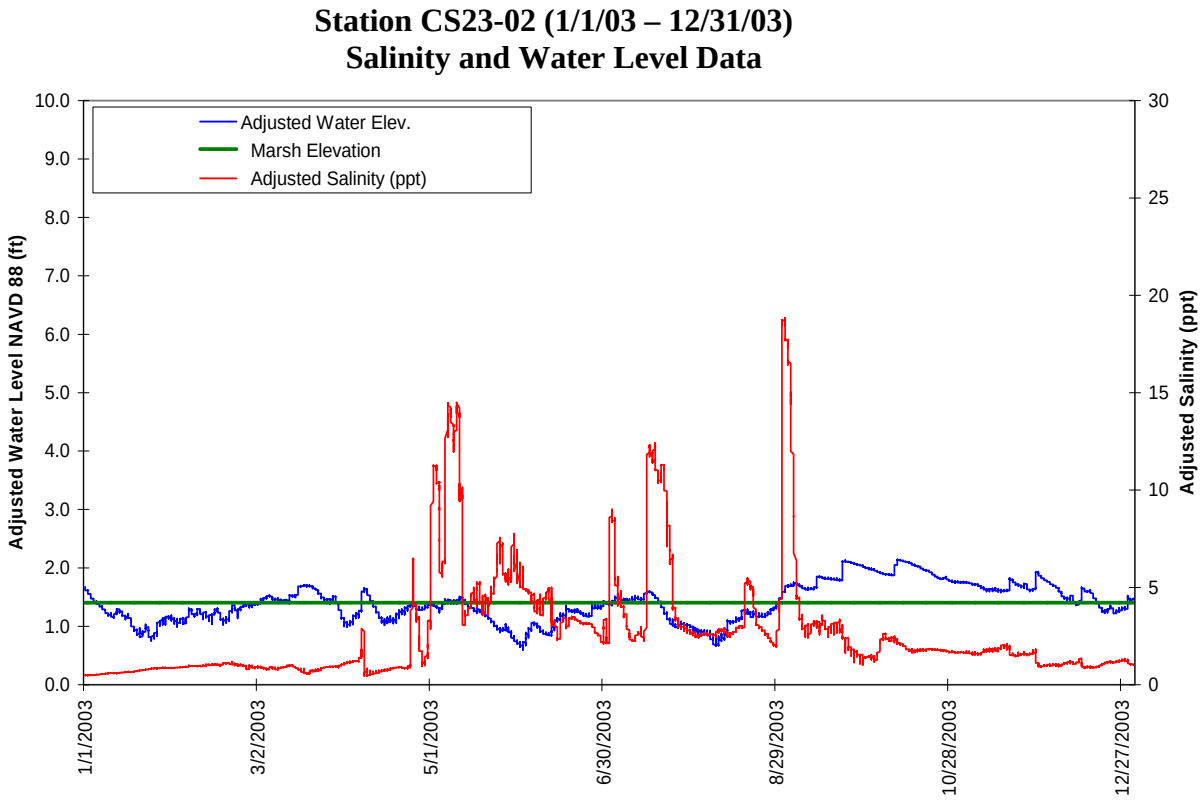

Figure 6a-b. Hourly salinity and water level at station CS23-02 in the Sabine Structure Replacement (CS-23) project area. A water level reading above marsh elevation indicates that the marsh is flooded.

Station CS23-03 (1/1/03 – 12/31/03)
Salinity and Water Level Data

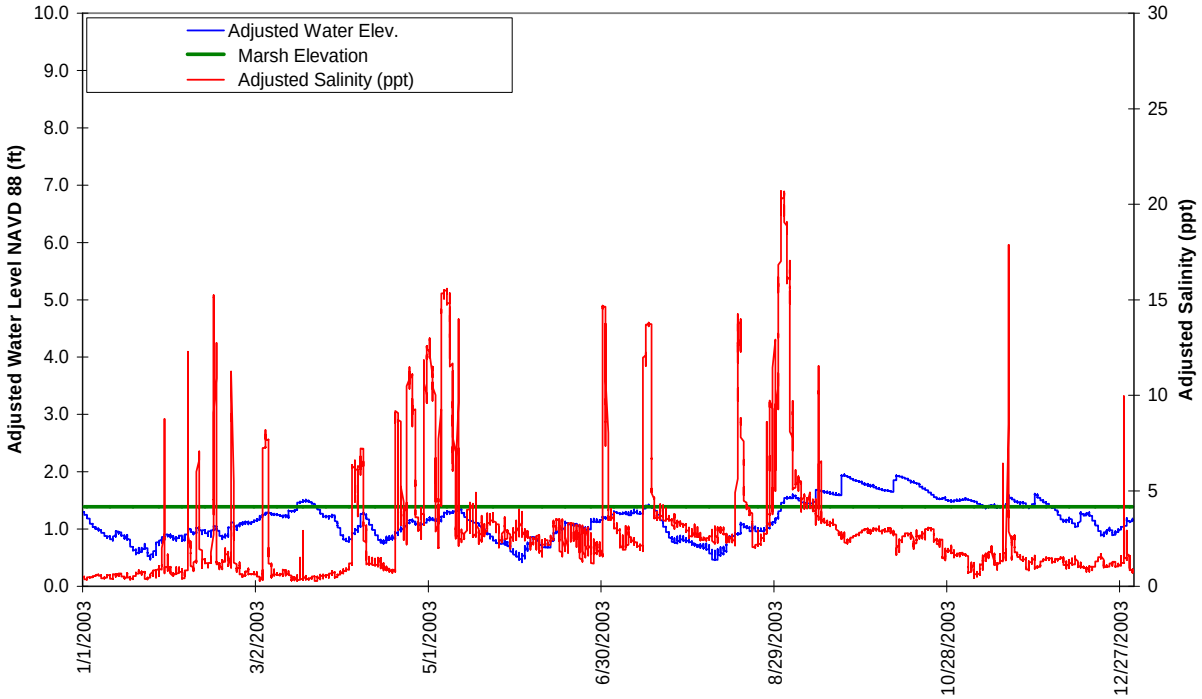

Figure 7a-b. Hourly salinity and water level at station CS23-03 in the Sabine Structure Replacement (CS-23) project area. A water level reading above marsh elevation indicates that the marsh is flooded.

Station CS23-05 (1/1/03 – 12/31/03)
Salinity and Water Level Data

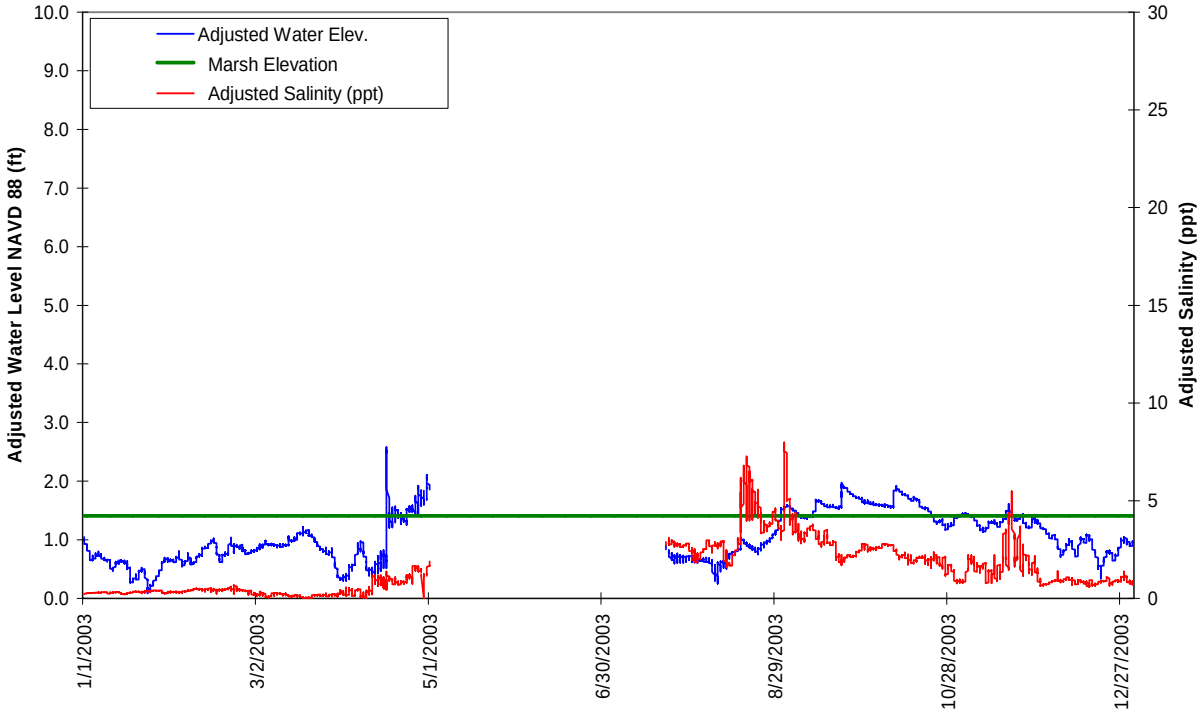

Figure 8a-b. Hourly salinity and water level at station CS23-05 in the Sabine Structure Replacement (CS-23) project area. A water level reading above marsh elevation indicates that the marsh is flooded.

Station CS23-01R (1/1/03 – 12/31/03)
Salinity and Water Level Data

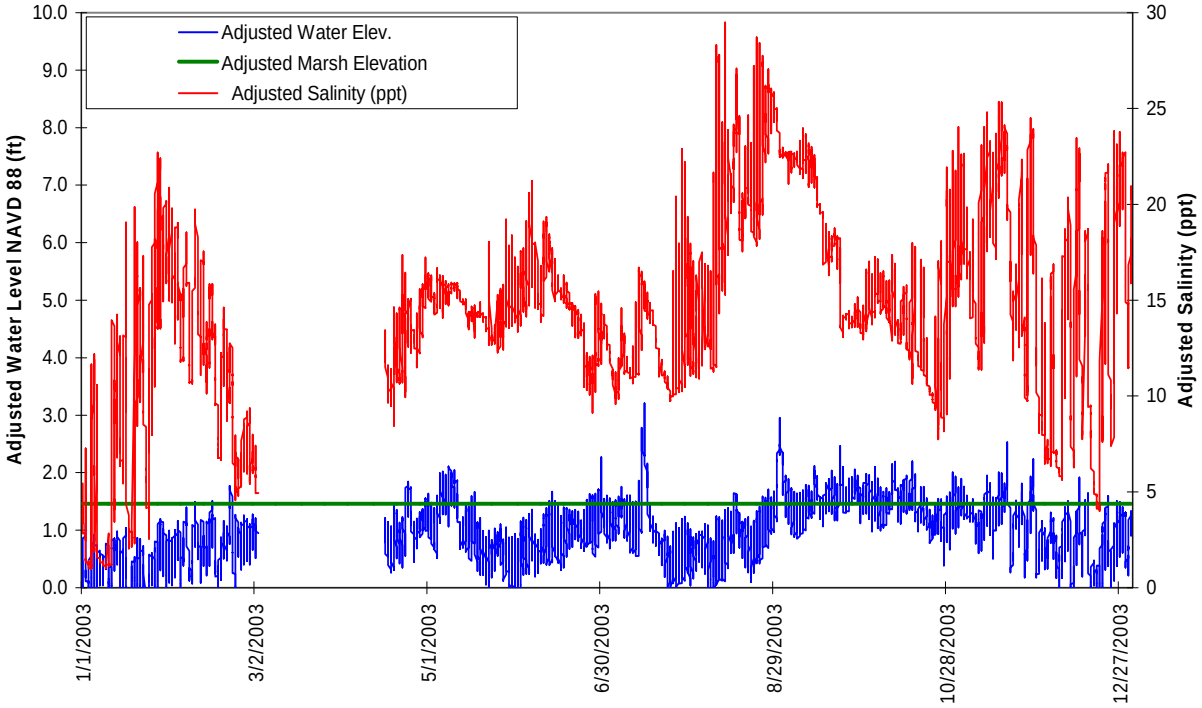

Figure 9a-b. Hourly salinity and water level at station CS23-01R in the Sabine Structure Replacement (CS-23) project area. A water level reading above marsh elevation indicates that the marsh is flooded.

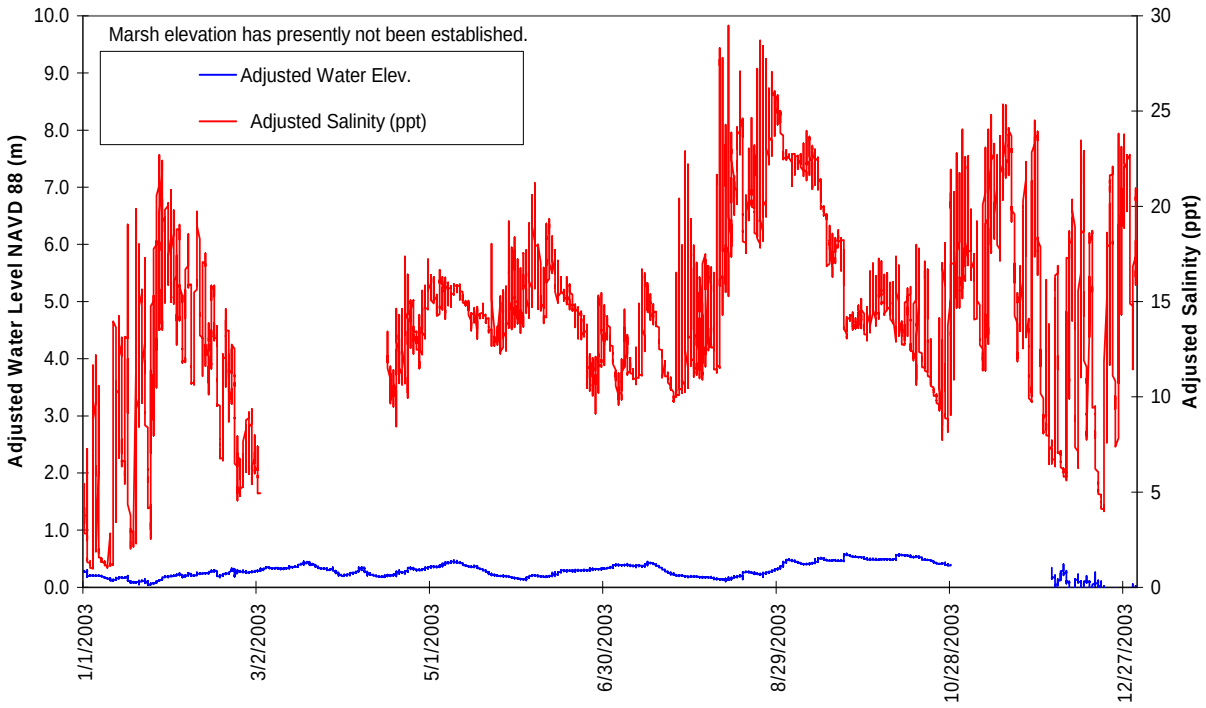

Figure 10a-b. Hourly salinity and water level at station CS02-17 in the Sabine Structure Replacement (CS-23) project area. A water level reading above marsh elevation indicates that the marsh is flooded.

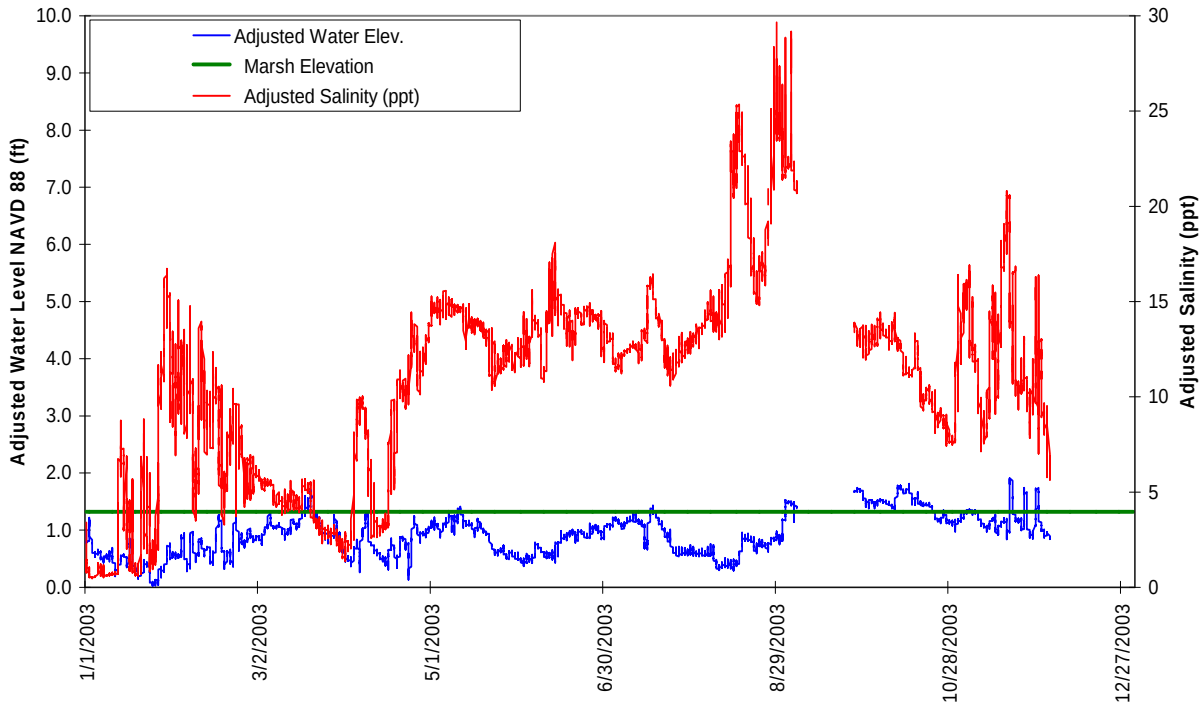

Figure 11a-b. Hourly salinity and water level at station CS02-17 in the Sabine Structure Replacement (CS-23) project area. A water level reading above marsh elevation indicates that the marsh is flooded.

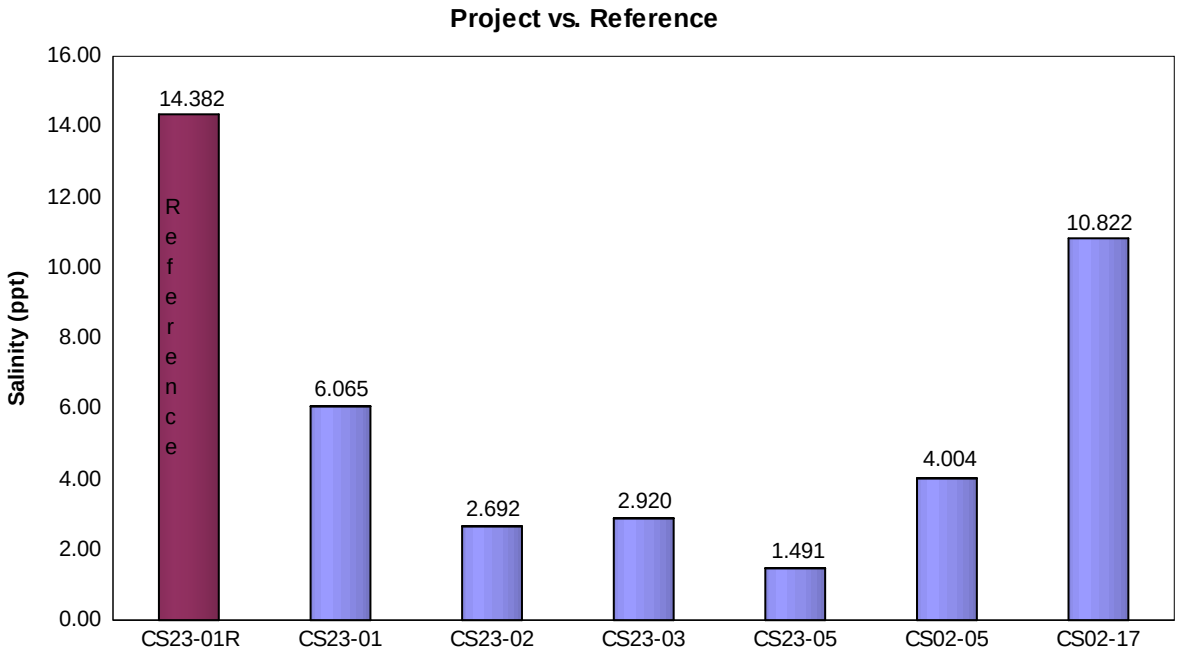

Figure 12. Yearly means derived from weekly means of salinity (ppt) at 7 continuous recorder stations located in the Sabine Structure Replacement (CS-23) project and reference areas from period 1/1/03 – 12/31/03.

Table 2. Frequency distribution of salinities during the growing and non growing seasons in the project and reference areas from 1/1/03 to 12/31/03.

*Red indicates target levels during the growing season.

**Blue indicates target levels during the Non-growing season.

(CS02-05) Replace Sabine Refuge Structures
Frequency Distrubution of salinities (ppt) (01/01/03 -12/31/03)

Salinity (ppt)		"Growing" Duration of Salinity events (hours)	Percent of Total Time	"Non-Growing" Duration of Salinity events (hours)	Percent of Total Time
>20.0 ppt		0	0	0	0
10.0 - 20.0 ppt		90	2.038505096	51	1.45631068
7.0 - 10.0 ppt		447	10.12457531	149	4.254711593
4.0 - 7.0 ppt		2442	55.31143828	1022	29.18332381
2.0 - 4.0 ppt		213	4.824462061	906	25.8709309
0.0 - 2.0 ppt		1223	27.70101925	1374	39.23472302
total hours		**4415**	**100**	**3502**	**100**

(CS23-02) Replace Sabine Refuge Structures
Frequency Distrubution of salinities (ppt) (01/01/03 -12/31/03)

Salinity (ppt)		"Growing" Duration of Salinity events (hours)	Percent of Total Time	"Non-Growing" Duration of Salinity events (hours)	Percent of Total Time
>20.0 ppt		0	0	0	0
8.0 - 20.0 ppt		453	10.25815217	91	2.095325812
6.0 - 8.0 ppt		188	4.257246377	6	0.13815335
4.0 - 6.0 ppt		715	16.19112319	29	0.667741193
2.0 - 4.0 ppt		1671	37.83967391	638	14.69030624
0.0 - 2.0 ppt		1389	31.45380435	3579	82.40847341
total hours		**4416**	**100**	**4343**	**100**

(CS23-03) Replace Sabine Refuge Structures
Frequency Distrubution of salinities (ppt) (01/01/03 -12/31/03)

Salinity (ppt)		"Growing" Duration of Salinity events (hours)	Percent of Total Time	"Non-Growing" Duration of Salinity events (hours)	Percent of Total Time
>20.0 ppt		0	0	0	0
8.0 - 20.0 ppt		470	10.67454009	140	3.234750462
6.0 - 8.0 ppt		169	3.838292074	34	0.785582255
4.0 - 6.0 ppt		237	5.382693618	219	5.060073937
2.0 - 4.0 ppt		2323	52.75948217	1157	26.73290203
0.0 - 2.0 ppt		1204	27.34499205	2778	64.18669131
total hours		**4403**	**100**	**4328**	**100**

(CS23-05) Replace Sabine Refuge Structures Frequency Distrubution of salinities (ppt) (01/01/03 -12/31/03)					
Salinity (ppt)		"Growing" Duration of Salinity events (hours)	Percent of Total Time	"Non-Growing" Duration of Salinity events (hours)	Percent of Total Time
>20.0 ppt		0	0	0	0
10.0 - 20.0 ppt		0	0	0	0
6.0 - 10.0 ppt		55	2.2755482	23	0.52946593
4.0 - 6.0 ppt		150	6.206040546	93	2.140883978
2.0 - 4.0 ppt		679	28.09267687	1225	28.19981584
0.0 - 2.0 ppt		1533	63.42573438	3003	69.12983425
total hours		**2417**	**100**	**4344**	**100**

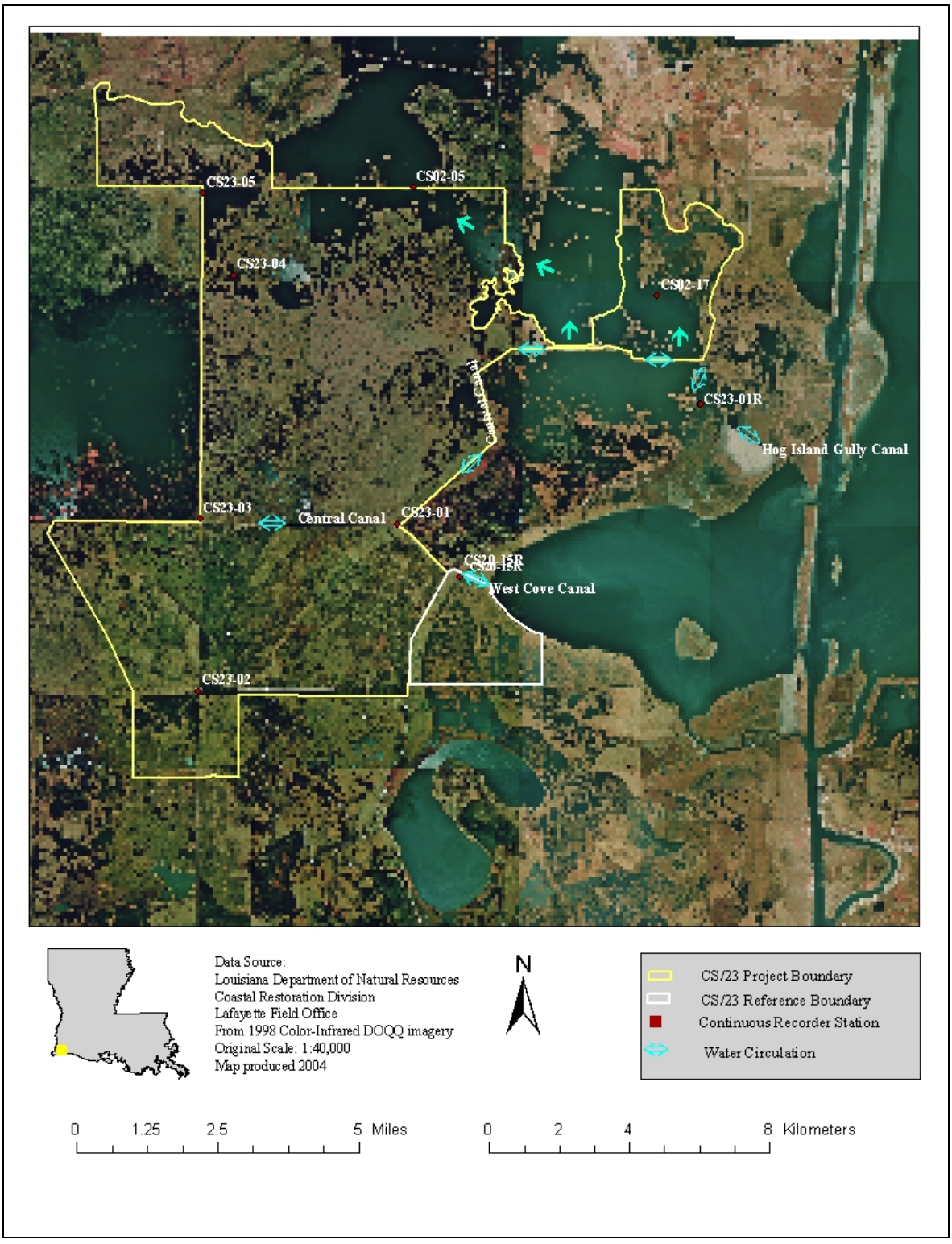

Figure 13. 1998 DOQQ imagery of continuous recorder monitoring stations and water circulation patterns in the Hog Island Gully, West Cove and Headquarters Canal Structure Replacement project and reference areas.

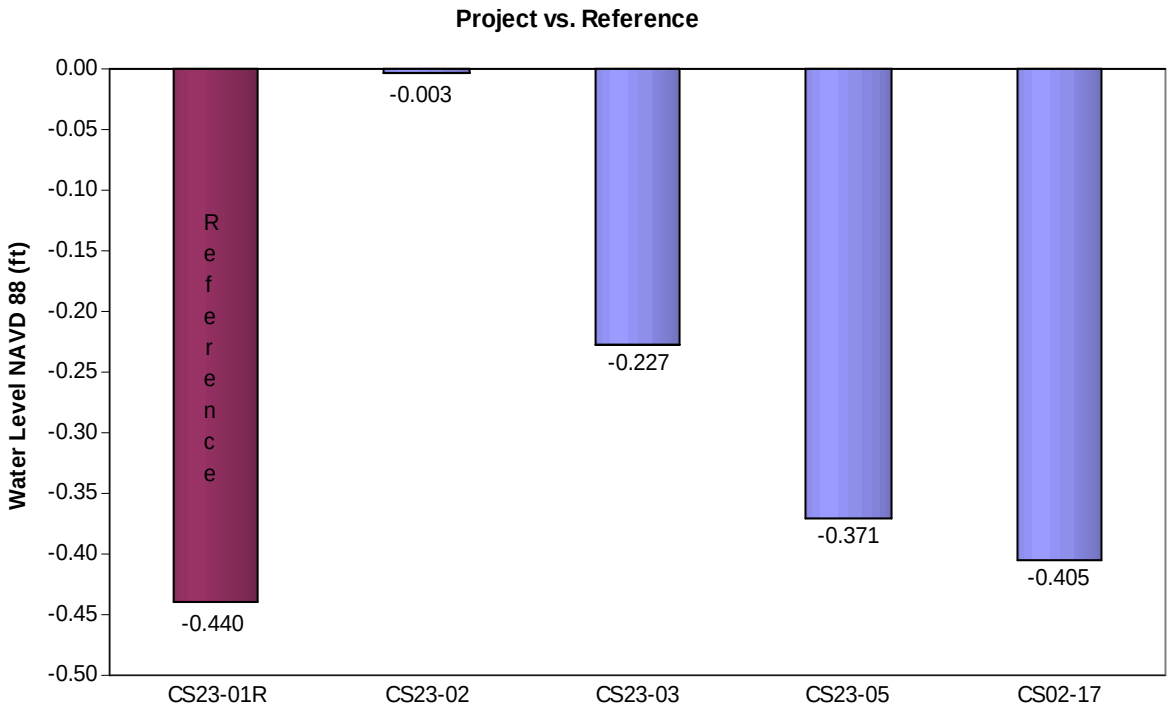

Figure 14. Yearly means derived from weekly means of water levels NAVD 88 (ft) at 5 continuous recorder stations located in the Sabine Structure Replacement (CS-23) project and reference areas for period 1/1/03 – 12/31/03.

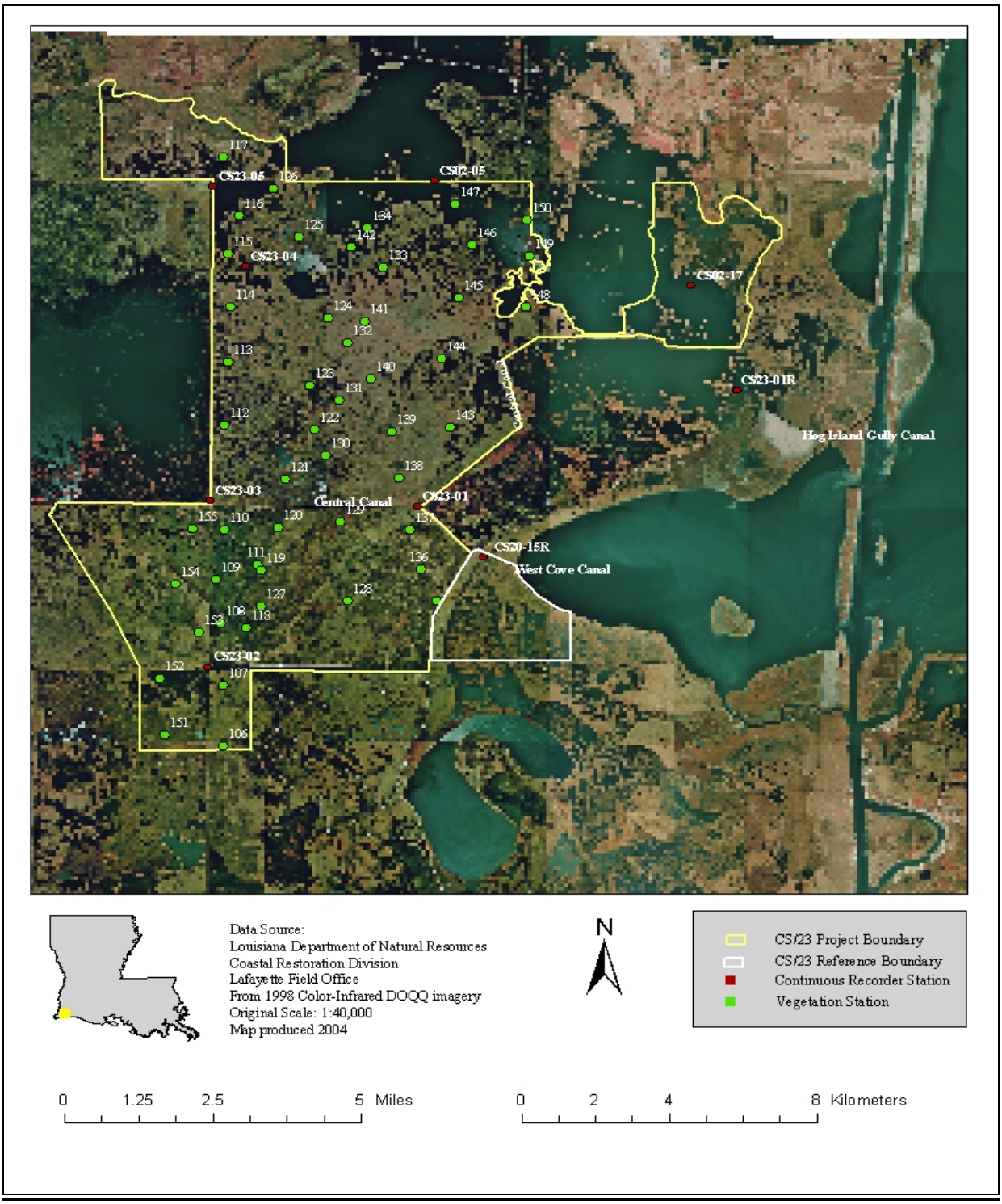

Figure 15. Location of vegetation stations within the Hog Island Gully, West Cove and Headquarters Canal Structure Replacement project area.

Table 3. Mean percent cover and number of occurrences of highest ranking emergent vegetation species in the Hog Island Gully (CS-23) project area as recorded in June 1999.

Species	Common Name	Mean % Cover	# Occurrences
Spartina patens	Marshhay cordgrass	76.62	90
Distichlis spicata	seashore saltgrass	7.89	17
Schoenoplectus americanus	Olney bulrush	6.36	14
Typha latifolia	broadleaf cattail	5.35	25
Schoenoplectus californicus	California bulrush	3.06	15
Eleocharis radicans	rooted spikerush	1.2	2

Table 4. Number of occurrences and percent occurrences of SAV species within the Hog Island Gully, West Cove and Headquarters Canal Structure Replacement (CS/23) project area.

Species	Common Name	# Occurrences Project	# Occurrences Reference	% Occurrences Project	% Occurrences Reference
Ruppia maritima	widgeongrass	65	34	20	14
Unidentified Alga	alga spp.	2	0	1	0
Unvegetated		249	209	78	86
Nelumbo lutea	american lotus	4	0	1	0
Total		**320**	**243**	**100**	**100**

V. Conclusions

a. Project Effectiveness

Preconstruction land to water analysis from aerial photography taken in 2000 indicates that the Sabine Refuge Structure Replacement project area is 67.5 percent land and the reference area is 57.9 percent land.

Electrical problems caused the electric motors to overheat on the Hog Island Gully and West Cove structures after the initial installation, and the structures are not fully operational at this time. Due to the inability to operate the structures correctly, salinity and water level spikes have occurred, although less frequently than preconstruction. Yearly mean salinities derived from the weekly means were also lower within the project area when compared to the reference area (figure 12).

Water levels remained well below the average marsh elevation of 1.41 ft for the 1/1/03 -12/31/03 period.

Once the Hog Island Gully and West Cove Canal structures become fully operational, their ability to halt saltwater inflows and reduce water level fluctuations within the project area and surrounding areas will become evident.

b. Recommended Improvements

Timely identification and repair of structural problems will likely improve project performance.

The Refuge should contract with a local contractor to operate the gates manually in the event that an actuator is inoperable

c. Lessons Learned

Require the supplier of new equipment to train people to operate and maintain the equipment.