

**KENNEDY SPACE CENTER  
PROPOSED ADVANCED ECOLOGICAL WETLANDS MITIGATION PLAN**

*Prepared for:*



**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

Mail Code: TA-B3B  
Kennedy Space Center, Florida 32899

*Submitted to:*

**DEPARTMENT OF THE ARMY**  
Jacksonville District Corps of Engineers  
400 High Point Drive, Suite 600  
Cocoa, Florida 32926

*Prepared by:*

**JONES EDMUNDS & ASSOCIATES, INC.**  
730 NE Waldo Road  
Gainesville, FL 32641  
Jones Edmunds Project No.: 14000-196-03

And

**INOMEDIC HEALTH APPLICATIONS, INC.**  
Medical and Environmental Support Contract (MESC)  
CLIN10 Environmental Projects  
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TABLE OF CONTENTS

1.0 BACKGROUND ..... 1

2.0 PROPOSED WETLAND MITIGATION PLAN OVERVIEW..... 3

3.0 SHILOH IMPOUNDMENT ..... 4

    3.1 OBJECTIVES .....4

    3.2 SITE SELECTION .....4

    3.3 SITE PROTECTION INSTRUMENT .....4

    3.4 BASELINE INFORMATION .....4

    3.5 MITIGATION CREDITS .....6

    3.6 MITIGATION WORK PLAN .....6

    3.7 SEQUENCING .....6

    3.8 MAINTENANCE PLAN .....6

    3.9 PERFORMANCE STANDARDS .....6

    3.10 MONITORING REQUIREMENTS .....6

        3.10.1 Reporting.....7

    3.11 LONG TERM MANAGEMENT PLAN .....7

    3.12 ADAPTIVE MANAGEMENT PLAN .....7

    3.13 FINANCIAL ASSURANCES .....7

4.0 NASA CAUSEWAY MITIGATION SITE..... 7

    4.1 OBJECTIVES .....7

    4.2 SITE SELECTION .....7

    4.3 SITE PROTECTION INSTRUMENT .....8

    4.4 BASELINE INFORMATION .....8

    4.5 MITIGATION CREDITS .....8

4.6	MITIGATION WORK PLAN .....	10
4.7	SEQUENCING .....	10
4.8	MAINTENANCE PLAN .....	10
4.9	PERFORMANCE STANDARDS .....	10
4.10	MONITORING REQUIREMENTS .....	12
	4.10.1 Reporting.....	12
4.11	LONG TERM MANAGEMENT PLAN .....	12
4.12	ADAPTIVE MANAGEMENT PLAN .....	12
4.13	FINANCIAL ASSURANCES .....	12
5.0	IMPOUNDMENT T-17 ENHANCEMENT .....	12
5.1	OBJECTIVES .....	12
5.2	SITE SELECTION .....	13
5.3	SITE PROTECTION INSTRUMENT .....	13
5.4	BASELINE INFORMATION .....	13
5.5	MITIGATION CREDITS .....	14
5.6	MITIGATION WORK PLAN .....	21
	5.6.1 Wetland Enhancement Area 1 (Culvert and Ditch Plug Installation).....	21
	5.6.2 Wetland Enhancement Area 2 (Brazilian Pepper Treatment).....	26
5.7	SEQUENCING .....	26
5.8	MAINTENANCE PLAN .....	27
5.9	PERFORMANCE STANDARDS .....	28
5.10	MONITORING REQUIREMENTS .....	28
	5.10.1 Pre-Mitigation Construction Baseline Monitoring .....	28
	5.10.2 Post-Mitigation Construction Compliance Monitoring .....	30
	5.10.3 Reporting.....	30

5.11	LONG TERM MANAGEMENT PLAN .....	30
5.12	ADAPTIVE MANAGEMENT PLAN .....	30
5.13	FINANCIAL ASSURANCES .....	30
6.0	IMPOUNDMENT C-15E RESTORATION (LEVEE AND CANAL REMOVAL).....	31
6.1	OBJECTIVES .....	31
6.2	SITE SELECTION .....	31
6.3	SITE PROTECTION INSTRUMENT .....	31
6.4	BASELINE INFORMATION .....	32
6.5	MITIGATION CREDITS .....	32
6.6	MITIGATION WORK PLAN .....	39
6.6.1	Wetland Creation .....	39
6.6.2	Wetland Restoration.....	41
6.6.3	Wetland Enhancement Area 1 .....	41
6.6.4	Wetland Enhancement Area 2 .....	42
6.6.5	Wetland Enhancement Area 3 .....	42
6.6.6	Wetland Buffer Enhancement.....	42
6.7	SEQUENCING .....	42
6.8	MAINTENANCE PLAN .....	43
6.9	PERFORMANCE STANDARDS .....	44
6.10	MONITORING REQUIREMENTS .....	45
6.10.1	Pre-Mitigation Construction Baseline Monitoring .....	45
6.10.2	Post-Mitigation Construction Compliance Monitoring .....	45
6.10.3	Reporting.....	46
6.11	LONG-TERM MANAGEMENT PLAN.....	46
6.12	ADAPTIVE MANAGEMENT PLAN .....	46

6.13	FINANCIAL ASSURANCES .....	46
7.0	STANDARD KSC WETLAND MITIGATION SITE PROTECTION AND MANAGEMENT .....	47
7.1	SITE PROTECTION INSTRUMENT .....	47
7.2	LONG TERM MANAGEMENT PLAN .....	47
7.3	ADAPTIVE MANAGEMENT PLAN .....	48
7.4	FINANCIAL ASSURANCES .....	48
8.0	REFERENCES .....	48

LIST OF TABLES

Table A.1 USACE UMAM Analysis Summary Table for Proposed Wetland Mitigation Sites.....50

LIST OF FIGURES

Figure 1.1 KSC AEM Site Location Map .....2

Figure 3.1. Shiloh 1 North, Shiloh 3 and Shiloh 5 Impoundment Mitigation Sites (Shiloh Impoundment Mitigation Site).....5

Figure 4.1 NASA Causeway Wetland Mitigation Site.....9

Figure 4.2 NASA Causeway Wetland Mitigation Site land cover.....11

Figure 5.1 Impoundment T-17 Location Map.....15

Figure 5.2 Impoundment T-17 2012 Aerial Map.....16

Figure 5.3 Impoundment T-17 Existing Conditions .....17

Figure 5.4 Impoundment T-17 Existing Land Cover Map.....19

Figure 5.5 Impoundment T-17 Enhancement Areas .....20

Figure 5.6 Impoundment T-17 Restoration Plan.....22

Figure 5.7 Impoundment T-17 Topographic Map.....23

Figure 5.8 Impoundment T-17 Construction Details .....24

Figure 5.9 Impoundment T-17 Construction Details .....25

Figure 6.1 Impoundment C-15E Location Map .....34

Figure 6.2 Impoundment C-15E Existing Conditions.....35

Figure 6.3 Impoundment C-15E Proposed Wetland Mitigation Activities Map .....36

Figure 6.4 Impoundment C-15E Restoration Plan .....37

Figure 6.5 Impoundment C-15E Site Sections.....38

Figure 6.6 Impoundment C-15E planting plan.....40

LIST OF PHOTOGRAPHS

Photograph 5.1 Existing Canal .....18  
Photograph 5.2 Downstream Wetlands and Impoundment .....18  
Photograph 5.3 Existing Levee .....18  
Photograph 5.4 Standard MINWR Culvert.....18  
Photograph 6.1 C-15E Levee.....33  
Photograph 6.2 C-15E Canal .....33  
Photograph 6.3 C-15E-Herbaceous Wetlands .....33  
Photograph 6.4 C-15E Shrub Wetlands.....33

LIST OF APPENDICES

APPENDIX A UMAM SUMMARY FOR IMPOUNDMENT T-17, AND  
IMPOUNDMENT C-15E WETLAND MITIGATION SITES  
APPENDIX B SHILOH ADVANCED MITIGATION EFFORT CREDIT LEDGER  
(FEBRUARY 2013)  
APPENDIX C UMAM SUMMARY FOR NASA CAUSEWAY MITIGATION SITE  
APPENDIX D KSC CONSERVATION LANDS LAYER PRESENTATION  
APPENDIX E MINWR LONG TERM MANAGEMENT COMMITMENT LETTER  
APPENDIX F REPORT AMMENDMENT LOG

## 1.0 BACKGROUND

Historically, with no private wetland mitigation banks serving the area, Kennedy Space Center (KSC) has designed and permitted small wetland mitigation sites throughout the Center to offset wetland impacts on a project-by-project basis. This results in an often lengthy permitting process, delayed construction schedules, increased costs, and multiple small mitigation sites spread throughout KSC, making compliance and long term management more onerous. KSC has its own suite of future projects, such as repurposing the Shuttle Landing Facility (SLF), serves other federal agency projects such as the US Army, and is now facilitating private commercial aerospace development at existing facilities and other areas of KSC. Many of these future projects have the potential to impact wetlands. As a result, KSC is proposing this Advanced Ecological Mitigation (AEM) project to provide mitigation prior to future impacts at KSC.

This plan consolidates two previously permitted advanced wetland mitigation sites and three additional proposed wetland mitigation sites into one US Army Corps of Engineers (USACE) permit. This permit can then be referenced as the source of wetland mitigation for future impacts from KSC projects. The two previously permitted sites, the Shiloh Impoundment Mitigation Site (Shiloh, Permit No. SAJ-2002-05046) and NASA Causeway Mitigation Site (NASA Causeway, Permit No. SAJ-2009-01696[NW]) have both demonstrated success. The Shiloh mitigation site has an existing positive mitigation balance for estuarine wetland and surface water Wetland Rapid Assessment Procedure (WRAP) credits with the USACE. The NASA Causeway mitigation area was reviewed by USACE in January 2015 and also has a positive credit balance for estuarine wetlands and surface water as determined under the Uniform Mitigation Assessment Method (UMAM). In addition, two new freshwater mitigation sites are proposed for construction: The T-17 Impoundment enhancement mitigation site, and the C-15E Impoundment restoration mitigation site. The general locations of existing and proposed mitigation sites included in this plan are shown in Figure 1.1. The following provides information for each of these two new sites and the two previously permitted mitigation sites.

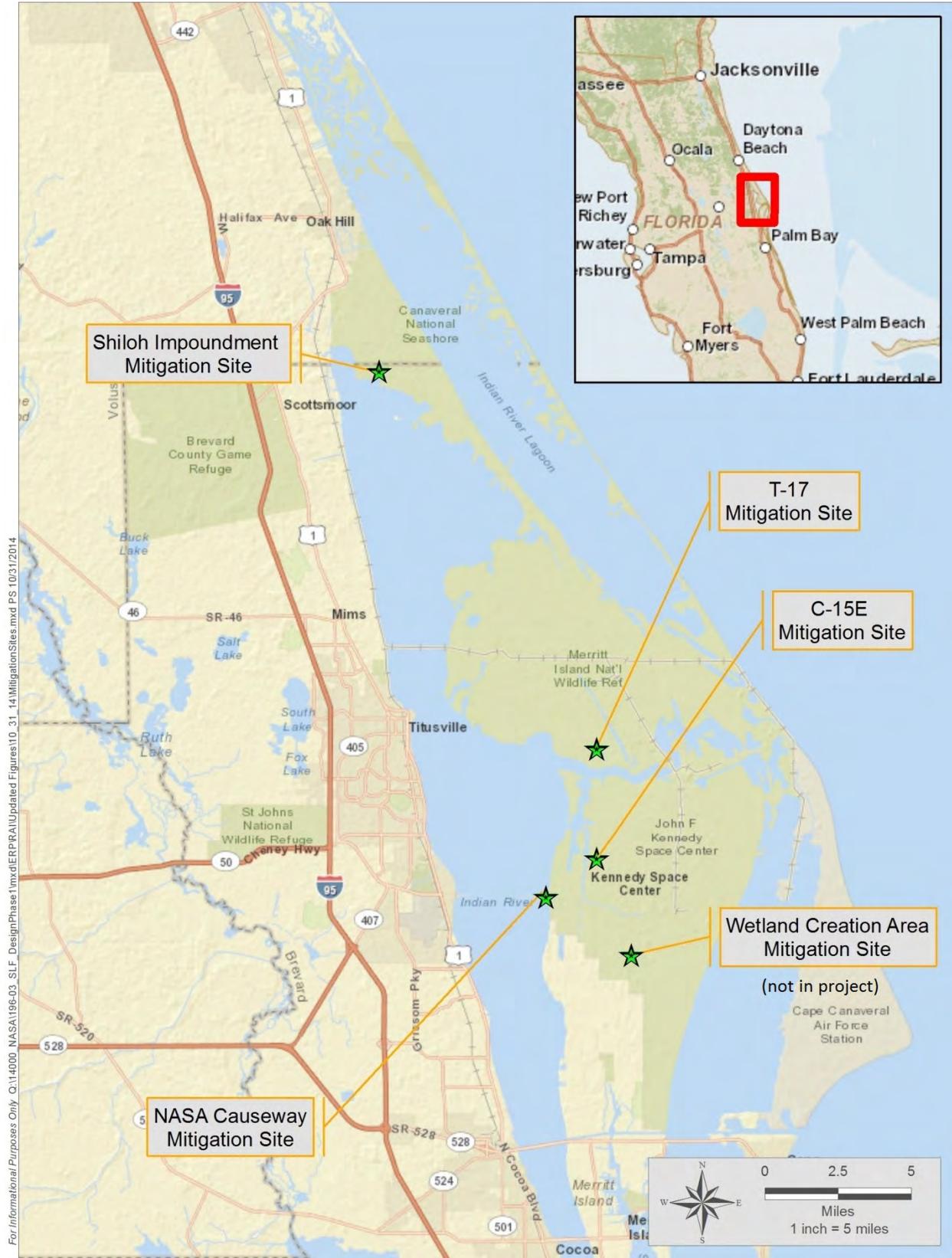


Figure 1.1 KSC AEM Site Location Map

## 2.0 PROPOSED WETLAND MITIGATION PLAN OVERVIEW

The AEM project was developed to offset the proposed primary and secondary wetland impacts associated with future KSC projects. The compensatory mitigation proposed in this plan consists of freshwater herbaceous, shrub, and forested wetland mitigation and estuarine herbaceous and forested (mangrove) wetland mitigation. The AEM project is comprised of the following four KSC sites (Figure 1.1):

1. Shiloh Impoundment Mitigation Site (Shiloh)
2. NASA Causeway Mitigation Site (NASA Causeway)
3. Impoundment T-17
4. Impoundment C-15E

The Shiloh and NASA Causeway sites were previously constructed on KSC and have already demonstrated success. The Shiloh and NASA Causeway mitigation areas both have a positive mitigation balance for estuarine wetland and surface water credits. UMAM assessments for Impoundment T-17 and Impoundment C-15E were completed to determine the maximum Functional Gain (FG) credits the sites would generate once mitigation is constructed and deemed successful. A total of 11.6 FG freshwater wetland credits were approved by USACE for these two projects (Appendix A, Table A-1). Release of some of the mitigation credits associated with these sites will occur as work is completed at each location, and all potential credits will be realized once sites have demonstrated success by meeting permit criteria.

Sections 3.0 through 6.0 of the KSC Advanced Ecological Wetlands Mitigation Plan (Plan) describes the objectives, site-selection process, baseline information, determination of wetland credits, mitigation work plan, maintenance activities, performance criteria, and monitoring requirement details for each of the above sites. Section 7.0 describes the site protection instrument, long term management strategy, adaptive management plan, and financial backing that apply to all KSC wetland mitigation sites to provide reasonable assurances that they will remain productive, high-quality wetland communities in perpetuity.

### 3.0 SHILOH IMPOUNDMENT

#### 3.1 OBJECTIVES

Restoration and enhancement of the Shiloh impoundments is an important aspect of restoring water quality of the Indian River Lagoon (IRL), an estuary of national significance managed under the National Estuary Program (NEP). This activity is consistent with the Merritt Island National Wildlife Refuge (MINWR) Comprehensive Conservation Plan (MINWR 2008) long term strategy for wetland protection and management. Impoundment restoration reestablishes the natural hydrologic flow patterns in the landscape and eliminates large pulses of freshwater entering the IRL from excavated impoundment canals.

#### 3.2 SITE SELECTION

MINWR is actively engaged in identifying and restoring large wetland/upland habitat mosaics. The main focus is on mosquito impoundment restoration. The Shiloh impoundments are ideal candidates for restoration based on their immediate proximity to the IRL and the expected practicability for establishment of an ecologically self-sustaining estuarine wetland habitat.

#### 3.3 SITE PROTECTION INSTRUMENT

The site protection assurance for Shiloh and all other wetland mitigation sites covered under this Plan is accomplished through NASA Environmental Management Branch (EMB) coordination and planning with the KSC Master Planning Office. This effort starts with mitigation site selection and Master Planning concurrence, followed by identification/tracking of constructed or sited mitigation sites using the KSC Conservation Lands Geographic Information System (GIS) Layer. This ensures siting of new facilities will not impact or displace existing or proposed wetland mitigation sites. A description of this process is provided in Section 7.1.

#### 3.4 BASELINE INFORMATION

The Shiloh Mitigation Site includes approximately 34.5 acres of enhanced tidal marsh from removal of approximately 7200 linear feet of upland dike and restoration of approximately 9.8 acres of saltmarsh by removal of 10,877 linear feet of upland dike within Shiloh 1 North, Shiloh 3 and Shiloh 5 impoundments located at the northwestern terminus of Merritt Island (Figure 3.1). The enhanced tidal marsh area is an herbaceous dominated marsh primarily consisting of saltgrass (*Distichlis spicata*), seashore paspalum (*Paspalum vaginatum*), and saltmarsh cordgrass (*Spartina alterniflora*) with black mangrove (*Avicennia germinans*), and white mangrove (*Laguncularia racemosa*) along low shoreline berms and interspersed within the interior. The restored dike saltmarsh is a mix of grass-dominated habitat similar to the tidal marsh above, and areas dominated by mostly small black and white mangroves, saltwort (*Batis maritima*) and glasswort (*Salicornia ambigua*). Percent cover by nuisance and exotic species, primarily Brazilian pepper (*Schinus terebinthifolius*) and Guinea grass (*Panicum maximum*) located along adjacent upland dikes, is below 5 %.



Figure 3.1. Shiloh 1 North, Shiloh 3 and Shiloh 5 Impoundment Mitigation Sites (Shiloh Impoundment Mitigation Site)

### 3.5 MITIGATION CREDITS

This restoration project was completed in 2004 by NASA to provide advanced ecological credits. The project wetlands were evaluated using WRAP to determine anticipated functional gain, and the site currently maintains a balance of 4.55 functional units of credit. The release of an additional 4.65 functional units of credit is anticipated based on the successful revegetation of dike removal areas with native estuarine wetland vegetation comprising saltmarsh and mangrove plant communities. The current Shiloh mitigation area ledger is provided in Appendix B.

### 3.6 MITIGATION WORK PLAN

Mitigation work was completed at this site in 2004. Beyond site maintenance required to maintain the required plant community in perpetuity, no additional mitigation construction activities are planned for this location at this time.

### 3.7 SEQUENCING

Annual (through FY-2019) and biennial (beginning FY-2020) qualitative site monitoring will continue to ensure the Shiloh site meets performance standards.

### 3.8 MAINTENANCE PLAN

The Shiloh site is currently monitored and managed for control of non-desirable plants. KSC staff will conduct annual inspections and MINWR staff or subcontractors will perform maintenance as needed to ensure that treatment areas remain dominated by desirable native estuarine wetland vegetation and are not encroached on by Brazilian pepper. The latest inspection was completed for Fiscal Year (FY) -2015 in January 2015 and no treatment of exotic plants is deemed necessary at this time. The next scheduled inspection for FY-2016 will occur in October/November 2015.

### 3.9 PERFORMANCE STANDARDS

To document the maintenance of wetland FG units, KSC will ensure the following success criteria are maintained:

1. In Shiloh restoration areas maintain at least 80 percent cover by appropriate (i.e., Facultative Wet [FACW] or Obligate [OBL]) native estuarine wetland species.
2. In Shiloh restoration areas, cover of Category I and II invasive exotic plant species, pursuant to the most current list established by the Florida Exotic Pest Plant Council at <http://www.flpeppc.org>, will total less than 5 percent.

### 3.10 MONITORING REQUIREMENTS

Annual qualitative mitigation site inspections will be conducted for the first 5 years (through FY-2019) and then completed biennially thereafter. Brazilian pepper and other exotic/invasive species will be identified, location(s) recorded, and treated. The hydrologic and

vegetation improvements were documented during three annual monitoring events conducted from 2005 to 2007. Post site acceptance compliance monitoring was completed in FY-2013 and FY-2014 and the site continues to meet performance standards.

### *3.10.1 Reporting*

KSC will prepare an annual report of monitoring activities and pertinent management activities completed to update the USACE regarding the project status. The report will be submitted each January, on or before the 31<sup>st</sup>.

## 3.11 LONG TERM MANAGEMENT PLAN

See Section 7.2 of the Plan for NASA's approach to long term management of all mitigation sites included in this Plan.

## 3.12 ADAPTIVE MANAGEMENT PLAN

See Section 7.3 of this Plan for the KSC Adaptive Management strategy to be implemented at all mitigation sites included in this Plan.

## 3.13 FINANCIAL ASSURANCES

See Section 7.4 of the Plan for financial assurance of implementing the KSC Advanced Ecological Wetlands Mitigation Plan.

## 4.0 NASA CAUSEWAY MITIGATION SITE

### 4.1 OBJECTIVES

The objective of this mitigation project was to eliminate dense stands of Brazilian pepper that comprised the dominant cover on this section of the NASA Causeway, and establish a self-sustaining, functional estuarine wetland to preclude reestablishment of pepper trees. The project was implemented to reduce long term ground maintenance for the NASA Causeway, restore wetland habitats, and provide mitigation credits for anticipated wetland impacts associated with the Constellation program which was later cancelled and replaced by the current Space Launch System (SLS) program.

### 4.2 SITE SELECTION

The NASA Causeway Mitigation Site was chosen primarily due to the degraded condition of the landscape from invasive exotic plant cover, and the site's proximity to the Indian River Lagoon. The site is an ideal location for restoration based on its immediate proximity to the IRL, adjacent mangrove and saltmarsh habitats, and the practicability for establishment of an ecologically self-sustaining estuarine wetland. The NASA Causeway site is also adjacent to a wetland mitigation area established for a previously permitted/completed shoreline revetment project constructed immediately west of this site.

#### 4.3 SITE PROTECTION INSTRUMENT

The site protection assurance for the NASA Causeway Wetland Mitigation Site and all other wetland mitigation sites covered under this Plan is accomplished through NASA EMB coordination and planning with the KSC Master Planning Office. This effort starts with mitigation site selection and Master Planning concurrence, followed by identification/tracking of constructed or sited mitigation sites using the KSC Conservation Lands GIS Layer. This ensures siting of new facilities will not impact or displace existing or proposed wetland mitigation sites. A description of this process is provided in Section 7.1.

#### 4.4 BASELINE INFORMATION

The NASA Causeway Wetland Mitigation Site includes approximately 9 acres of created/restored and enhanced estuarine habitats including saltmarsh, mangrove, wetland scrub-shrub, mud flat and open water located within a man-made impoundment along the southeastern edge of the NASA Causeway (Figures 4.1 and 4.2). Prior to mitigation site construction the area consisted of a series of landlocked freshwater ditches and dikes with an approximate 80% cover of Brazilian pepper.

The area consists of a contiguous southeast shoreline berm dominated by black mangrove (*Avicennia germinans*), a constructed inlet connecting the site's interior to the Indian River, and a nearly contiguous southwest shoreline berm vegetated primarily with marsh elder (*Iva frutescens*), white mangrove (*Laguncularia racemosa*), buttonwood (*Conocarpus erectus*) and various herbaceous saltmarsh species. The site's interior includes a system of small perimeter ditches connected to the inlet that remains flooded, in part, for the majority of the year providing some persistent open water habitat within the site. Mud flat, saltmarsh, and a few areas of dense white and black mangrove recruits comprise the remaining area. Common species found within the site's interior include: saltgrass (*Distichlis spicata*), seashore paspalum (*Paspalum vaginatum*), saltmarsh bulrush (*Schoenoplectus robustus*), marsh elder and white mangrove. Percent cover by nuisance and exotic species, primarily cattail (*Typha domingensis*), Brazilian pepper and Guineagrass is below 5% and the site is currently monitored and managed for control of non-desirable plants. This mitigation site will provide 3.74 functional units of credit once incorporated into the KSC AEM Permit.

#### 4.5 MITIGATION CREDITS

This restoration project was completed in 2010 by NASA to provide advanced ecological credits. The project wetlands were evaluated using UMAM to determine anticipated functional gain and the site will be assigned a balance of 3.74 functional units of estuarine wetland credit under the proposed USACE AEM Permit (Appendix C). Two assessed mitigation activities are described below:

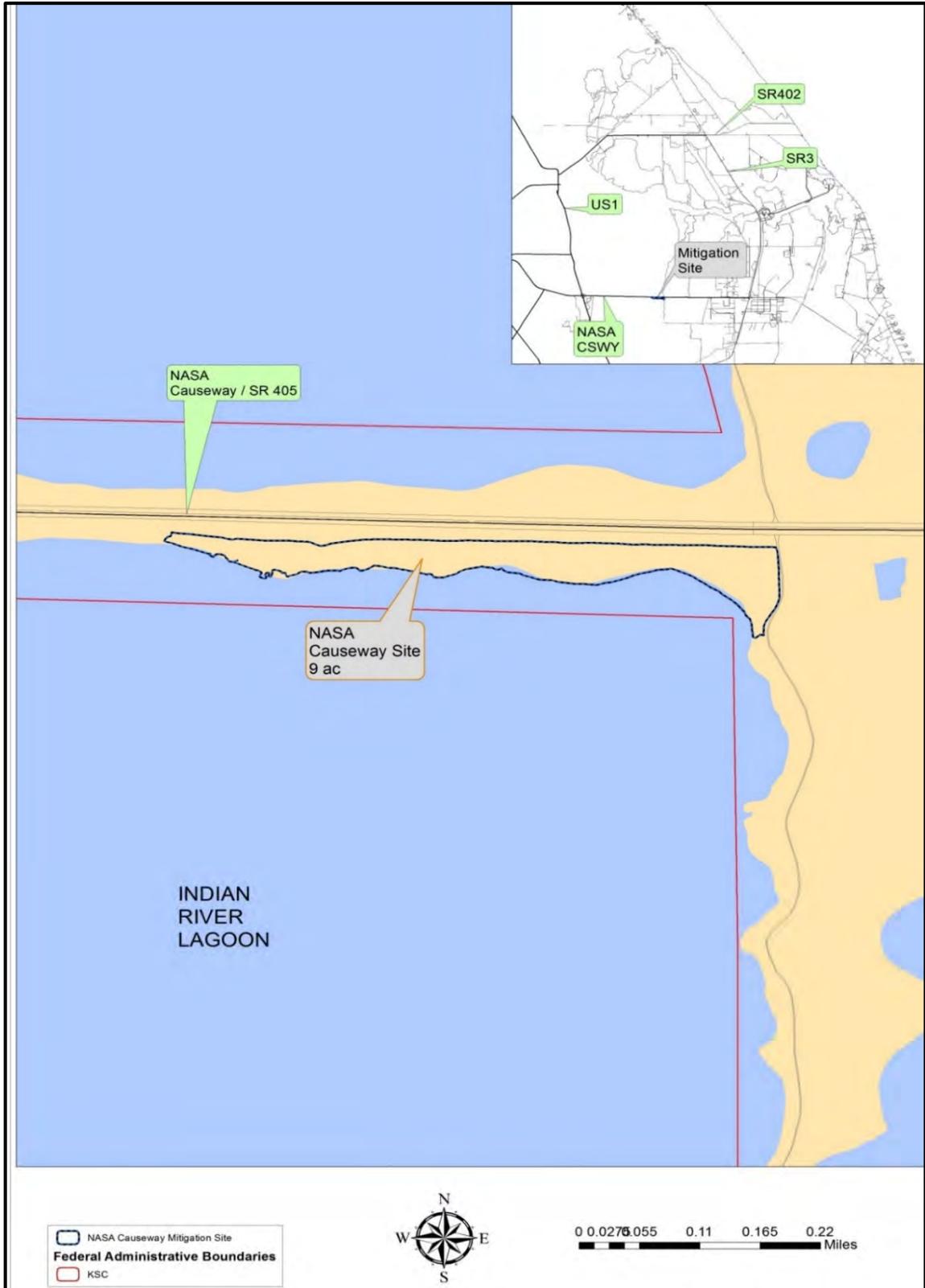


Figure 4.1 NASA Causeway Wetland Mitigation Site

a) Wetland Creation/Restoration (7.7 acres):

This area corresponds to the backfilled and graded marsh interior, and includes saltmarsh, mudflat and open water wetland communities established by natural recruitment and site development. This area is directly connected to the Indian River (Figure 4.2 and Appendix C).

b) Wetland Enhancement Area (1.3 acres):

This area corresponds to the outer (southern) berm along the Indian River shoreline that includes mangrove and estuarine scrub-shrub wetland communities. These areas were impacted by high density cover of Brazilian pepper and enhanced by removal of exotic plants and establishment of adjacent wetland communities (Figure 4.2 and Appendix C).

#### 4.6 MITIGATION WORK PLAN

Mitigation work was completed at this site in 2010. Beyond site maintenance required to maintain the required plant community in perpetuity, no additional mitigation construction activities are planned for this location at this time.

#### 4.7 SEQUENCING

The final annual quantitative site monitoring will be completed in FY-2015 (August 2015). Annual qualitative site monitoring will be conducted through FY-2020, and biennially thereafter to ensure the Shiloh site continues to meet performance standards.

#### 4.8 MAINTENANCE PLAN

The NASA Causeway site is currently monitored and managed for control of non-desirable plants. KSC staff will conduct periodic site inspections and MINWR will perform maintenance as required to ensure that treatment areas remain dominated by desirable native vegetation and are not compromised by invasive species. The latest inspection was completed August 2015 and only minimal cover of exotic plants, primarily Brazilian pepper, was noted. The next scheduled monitoring event/site inspection would occur in August 2016. The last control for exotic plant species was completed between March and July of 2015.

#### 4.9 PERFORMANCE STANDARDS

To document the maintenance of wetland FG units, KSC will ensure the following success criteria are maintained:

1. In NASA Causeway saltmarsh, mangrove, and scrub-shrub wetland communities maintain at least 80-percent cover by appropriate (i.e., Facultative Wet [FACW] or Obligate [OBL]) native estuarine wetland species.
2. In entire NASA Causeway mitigation area, cover of Category I and II invasive exotic plant species, pursuant to the most current list established by the Florida Exotic Pest Plant Council at <http://www.floridapeppc.org>, will total less than 5 percent.



Figure 4.2 NASA Causeway Wetland Mitigation Site land cover.

#### 4.10 MONITORING REQUIREMENTS

The final annual quantitative site monitoring will be completed in FY-2015 (August 2015). Annual qualitative site monitoring will be conducted from FY-2016 through FY-2020, and biennially thereafter. Brazilian pepper and other exotic/invasive species will be identified, location(s) recorded, and treated.

##### 4.10.1 *Reporting*

KSC will prepare an annual report of monitoring activities and pertinent management activities completed to update the USACE regarding the project status. The report will be submitted in January, on or before the 31<sup>st</sup>.

#### 4.11 LONG TERM MANAGEMENT PLAN

See Section 7.2 of the Plan for NASA's approach to long term management of all mitigation sites included in this Plan.

#### 4.12 ADAPTIVE MANAGEMENT PLAN

See Section 7.3 of this Plan for the KSC Adaptive Management strategy to be implemented at all mitigation sites included in this Plan.

#### 4.13 FINANCIAL ASSURANCES

See Section 7.4 of the Plan for financial assurance of implementing the KSC Advanced Ecological Wetlands Mitigation Plan.

### 5.0 IMPOUNDMENT T-17 ENHANCEMENT

#### 5.1 OBJECTIVES

MINWR is actively engaged in identifying and restoring large wetland/upland habitat mosaics. The main focus is on mosquito impoundment restoration. Impoundment restoration restores the natural hydrologic flow patterns in the landscape. Impoundments do not allow freshwater from rain to sheet flow across a mosaic of herbaceous wetlands. Instead, the canals associated with impoundments convey large pulses of freshwater directly into the creeks of the Indian River Lagoon. The goal of the T-17 Impoundment restoration project is to restore hydrologic connectivity between the impoundment and the adjacent estuary lost due to levee construction for mosquito control in the 1960s. The restoration project will facilitate the establishment of native plant, invertebrate, fish, and wildlife species while creating unsuitable conditions for exotics. Furthermore, restoring this impoundment will reduce the large freshwater pulses and instead direct water across the mosaic of wetlands. Previous impoundment restoration projects by MINWR and KSC have shown promising results with minimal re-infestation by exotic plant species.

## 5.2 SITE SELECTION

MINWR recently completed the restoration of Impoundments T-18a and 18b, which are immediately east of T-17. As a result, the restoration of Impoundment T-17 will build on regional restoration efforts already completed by restoring the hydrology of approximately 700 acres of wetlands that discharge into the north side of Banana Creek (Figure 5.1). In addition to building on regional wetland restoration efforts, the proposed restoration and exotic vegetation treatments at Impoundment T-17 can be accomplished with minimal direct impacts to existing wetlands and surface waters, and are anticipated to have an almost immediate benefit to wetlands up and downstream of the existing dike.

## 5.3 SITE PROTECTION INSTRUMENT

The site protection assurance for the T-17 Impoundment Mitigation Site and all other wetland mitigation sites covered under this Plan is accomplished through NASA EMB coordination and planning with the KSC Master Planning Office. This effort starts with mitigation site selection and Master Planning concurrence, followed by identification/tracking of constructed or sited mitigation sites using the KSC Conservation Lands GIS Layer. This ensures siting of new facilities will not impact or displace existing or proposed wetland mitigation sites. A description of this process is provided in Section 7.1.

## 5.4 BASELINE INFORMATION

The T-17 Impoundment wetland mitigation area is located within approximately 350 acres of impounded former saltmarsh southwest of the SLF. The impoundment is delineated by a dredged canal approximately 25 feet wide and an adjacent, similar width upland dike constructed from the canal spoil along the impoundment north/eastern boundary, and by the Banana Creek and T-16 Impoundment on the south and west boundaries, respectively. The area involving restoration/enhancement mitigation activities includes approximately 53 acres of fresh to brackish marsh, wetland scrub-shrub (fresh and estuarine), and sabal palm hydric hammocks located within 250 feet upstream (north) and downstream (south) of the constructed levee/canal. The invasive Brazilian pepper tree is common within the sabal hammocks and wetland scrub-shrub/marsh edges wherever slightly higher elevations persist. Percent cover of this invasive species ranges from 30-40% in wetlands along the north side of the levee to more than 80% within hydric sabal hammocks along the south side of the levee. Dominant native plant species within the T-17 wetland mitigation area include sabal palms (*Sabal palmetto*), cordgrasses (*Spartina* spp.), coastal plain willow (*Salix caroliniana*), sea-oxeye daisy (*Borrichia frutescens*) and sawgrass (*Cladium jamaicense*). Historically, water sheet-flowed from north to south via wetlands, which regulated freshwater flows into Banana Creek and maintained water quality. Freshwater also likely backed up across the existing levee during extreme high tide/river stage events. However, this historical flow regime no longer occurs due to the levee. Presently, no hydrologic connections between the T-17 impoundment and wetlands located upstream of the levee are present, and freshwater flows from

the extensive wetland complex north of the impoundment are directed into the levee canal and ultimately into Banana Creek to the south (Figures 5.2 and 5.3 and Photographs 5.1 through 5.4). These unnatural flows and pulses of freshwater into Banana Creek have negative effects on salinity and phytoplankton composition.

The mitigation site project area consists of the east levee and adjacent canal. No culverts are found along the entire length of the east levee. The levee consists primarily of bahia grass and ruderal herbaceous species. The areas on the north side of the ditch are dominated by a mosaic of live oak hammock uplands and herbaceous wetlands. Brazilian pepper is fairly common in the wetlands and is typically found in clumps. Brazilian pepper comprises approximately 30 to 40 percent of the overall wetland vegetation cover. Areas on the south side of the levee, which form the T-17 impoundment, are primarily herbaceous marsh dominated by sand cordgrass with numerous fingers or small islands of sabal palm hydric hammock (Figure 5.4). Brazilian pepper dominates the mid and understory of the sabal palm hammocks and is also found as scattered islands throughout the wetlands.

## 5.5 MITIGATION CREDITS

Using UMAM, the Impoundment T-17 mitigation project will generate a proposed 4.8 (herbaceous, scrub-shrub and cabbage palm hammock freshwater wetland) credits from the USACE. Two UMAM assessment areas are described below and summarized in Table A.1 (Appendix A).

a) Wetland Enhancement Area 1 (39.3 acres):

This UMAM assessment area consists of primarily herbaceous and scrub-shrub freshwater wetland areas that will be hydrologically and vegetatively enhanced due to the installation of 16 culverts (Figures 5.4-5.7). This area comprises approximately 39.3 acres that was determined by digitizing wetland areas using historical aerial imagery 250 feet upstream and downstream of the levee.

b) Wetland Enhancement Area 2 (14 acres):

The second UMAM assessment area consists of approximately 14 acres (north [50-foot-wide area] and south [50- to up to 250-foot-wide area] of the levee) of primarily cabbage palm hydric hammock in which Brazilian pepper will be treated (Figures 5.4 and 5.5).

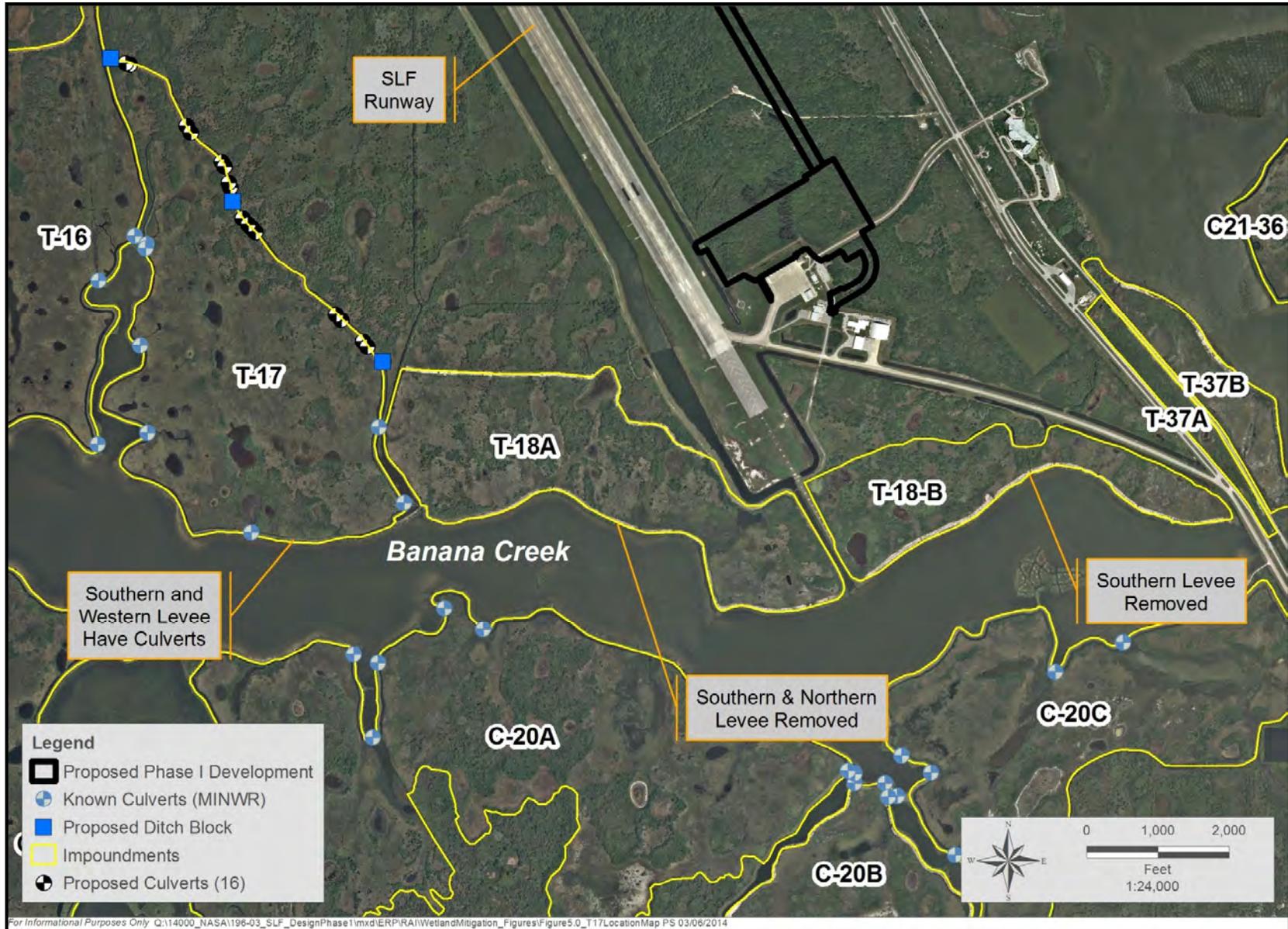


Figure 5.1 Impoundment T-17 Location Map



Figure 5.2 Impoundment T-17 2012 Aerial Map

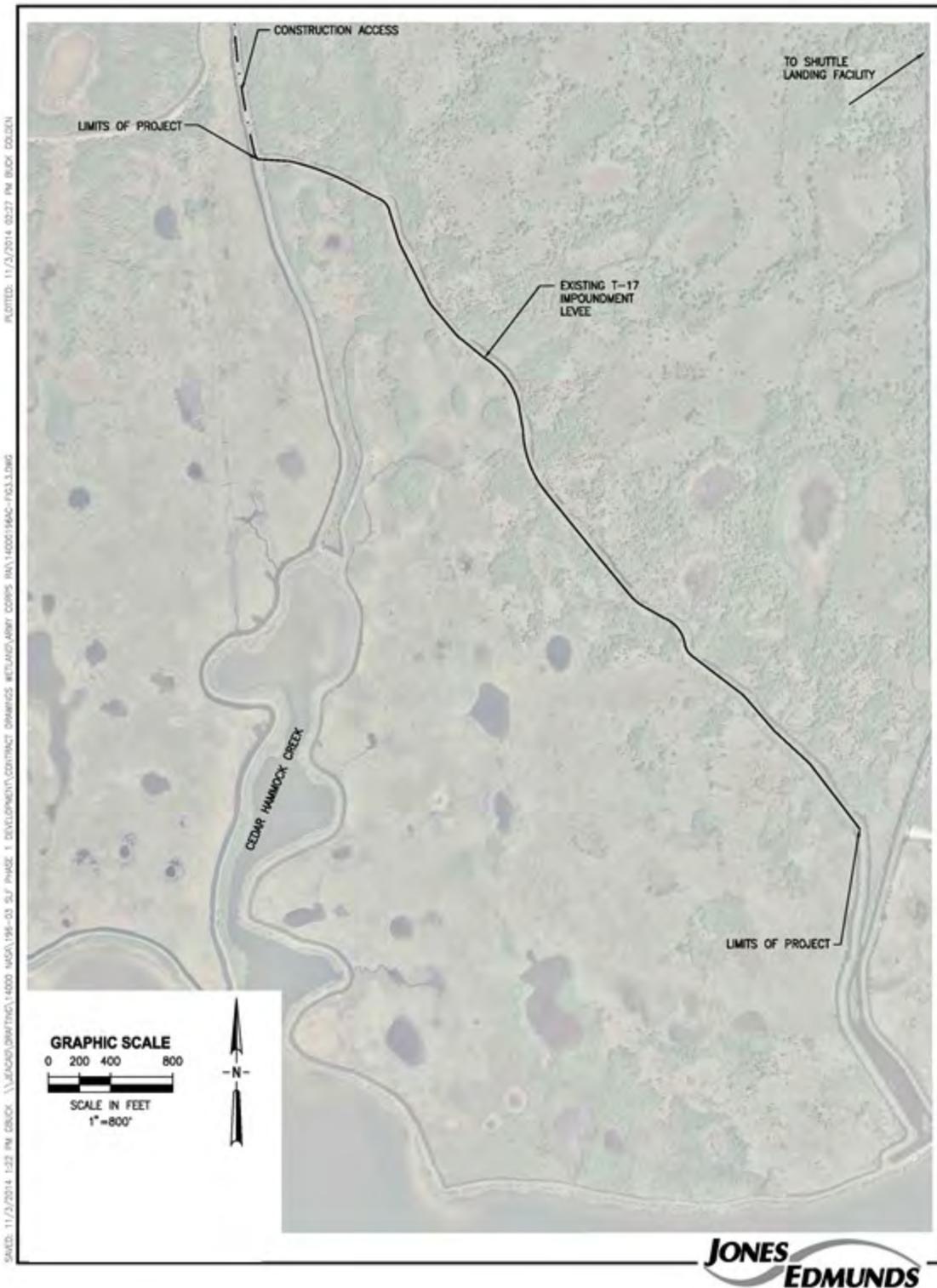


Figure 5.3 Impoundment T-17 Existing Conditions



Photograph 5.1 Existing Canal



Photograph 5.2 Downstream Wetlands and Impoundment



Photograph 5.3 Existing Levee



Photograph 5.4 Standard MINWR Culvert

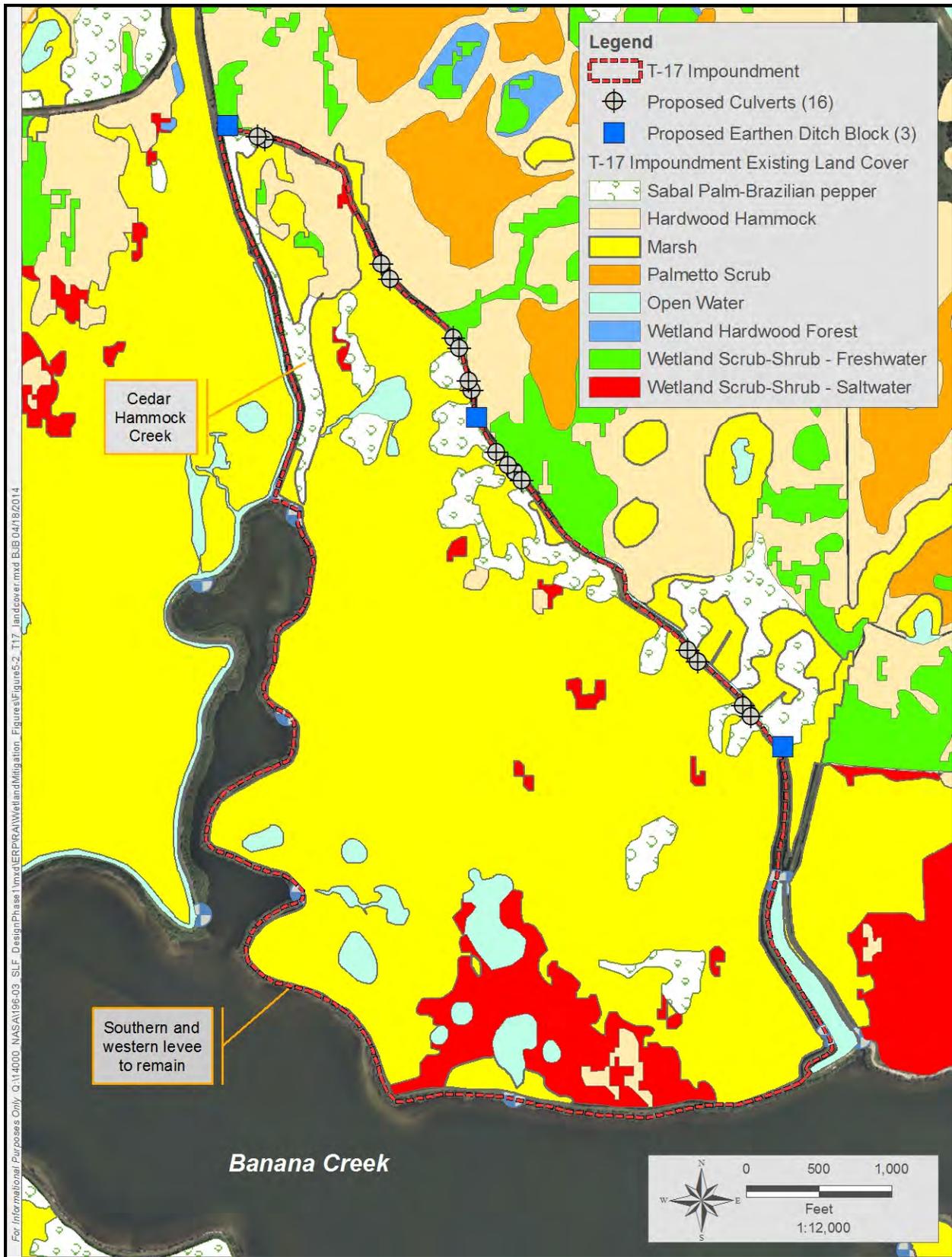


Figure 5.4 Impoundment T-17 Existing Land Cover Map

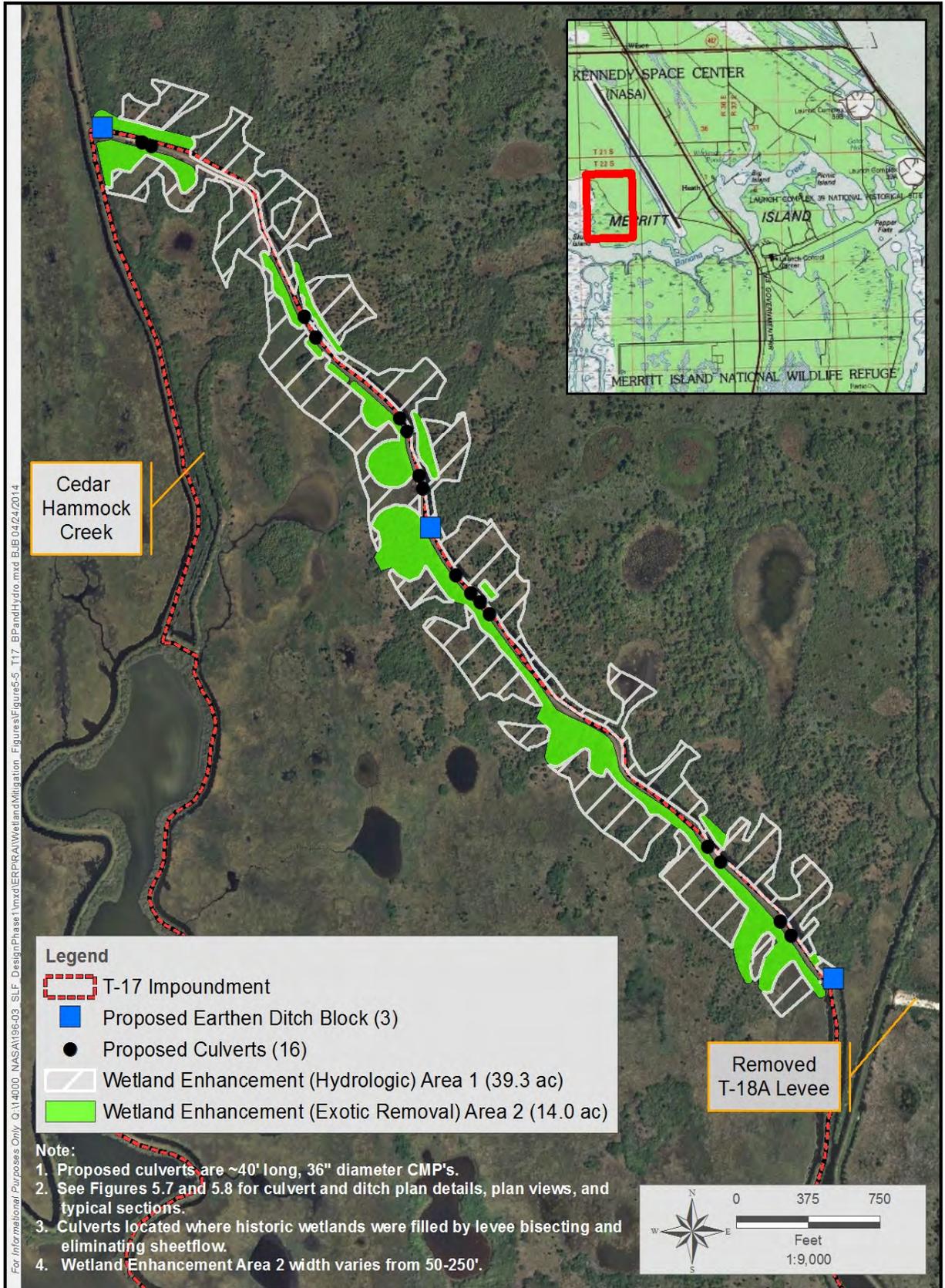


Figure 5.5 Impoundment T-17 Enhancement Areas

## 5.6 MITIGATION WORK PLAN

### 5.6.1 Wetland Enhancement Area 1 (Culvert and Ditch Plug Installation)

This project is southwest of the existing SLF and entails installing a pair of culverts at eight locations and three ditch plugs (Figures 5.5 and 5.6) along a 1.5-mile portion of the impoundment. The approximately 45-foot-x-64-foot earthen ditch plugs will be located at the two opposite ends of the impoundment with one in the middle. This will eliminate the ability of water to bypass the impoundment and flow directly into Banana Creek. The ditch plug in the center will force water to flow north or south toward the installed culverts. The 16 culverts are located where wetlands were bisected by the levee. Many of these locations already have depressions on the south side possibly dug by alligators.

Installing the culverts would restore historical hydrologic connectivity between wetlands on either side of the levee and significantly reduce freshwater discharges into the Banana Creek. The ditch plugs will redirect freshwater flows, which currently bypass the impoundment via large canals that discharge directly into Banana Creek, into over 300 acres of existing wetlands. This restored connectivity and the ditch plugs will force freshwater flow from the north into the impoundment wetlands and allow freshwater exchange north and south of the levee. The restoration of these historical flows will provide considerable benefits to the wetlands within the impoundment and improve water quality in Banana Creek. Installing the culverts is expected to hydrologically and vegetatively enhance an approximately 250-foot area (39.3 acres) upstream and downstream of the levee (Figure 5.5). This acreage does not include Wetland Enhancement Area 2 acreage. The proposed enhancement will occur due to the restoration of freshwater flows across the levee into downstream wetlands and the hydroperiod of upstream wetlands that were dewatered by the canal. The acreage was estimated based on literature that estimates wetland setback distances from ditches or quantifies the horizontal distance at which ditches negatively influence the surficial water table. These distances are supported by the flat topography of the area and the slope of the landscape from northeast to southwest (Figure 5.7).

The proposed culverts are the same design as those installed throughout MINWR and were chosen based on comments from MINWR staff. Plan section view details of the culvert and ditch plug installation are provided in Figures 5.8 and 5.9. Silt fence will be installed around the south side of each culvert installation location, and a floating turbidity curtain will be installed on the north side in the canal. Culverts will be installed using open trenching methods. Approximately 2 feet of clean fill will be placed on top of the culvert followed by 6 inches of limerock.

The ditch plug design is similar to other ditch plugs that have been installed at several other impoundments. Silt fence and turbidity curtains will be installed at each ditch plug. The earthen ditch plugs will tie into existing natural grade on the east side and the levee on the west side. The top of the ditch plugs will be at an elevation 1 to 1.5 feet below the crown of the levee (~2.0 feet NAVD88). Excess cut material from culvert installation will be stored on the levee, and suitable portions of this material will be used to construct the ditch plugs.

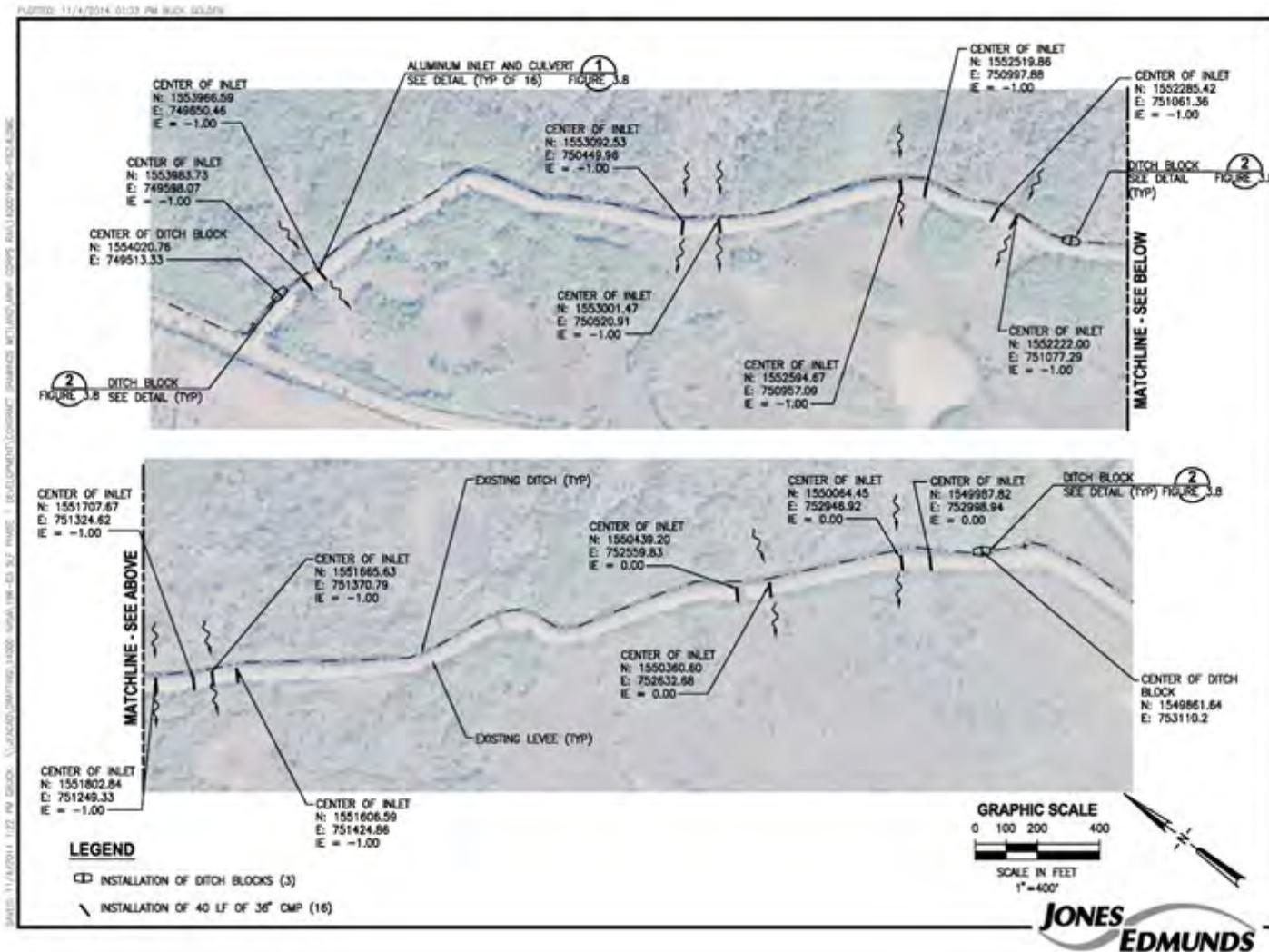


Figure 5.6 Impoundment T-17 Restoration Plan

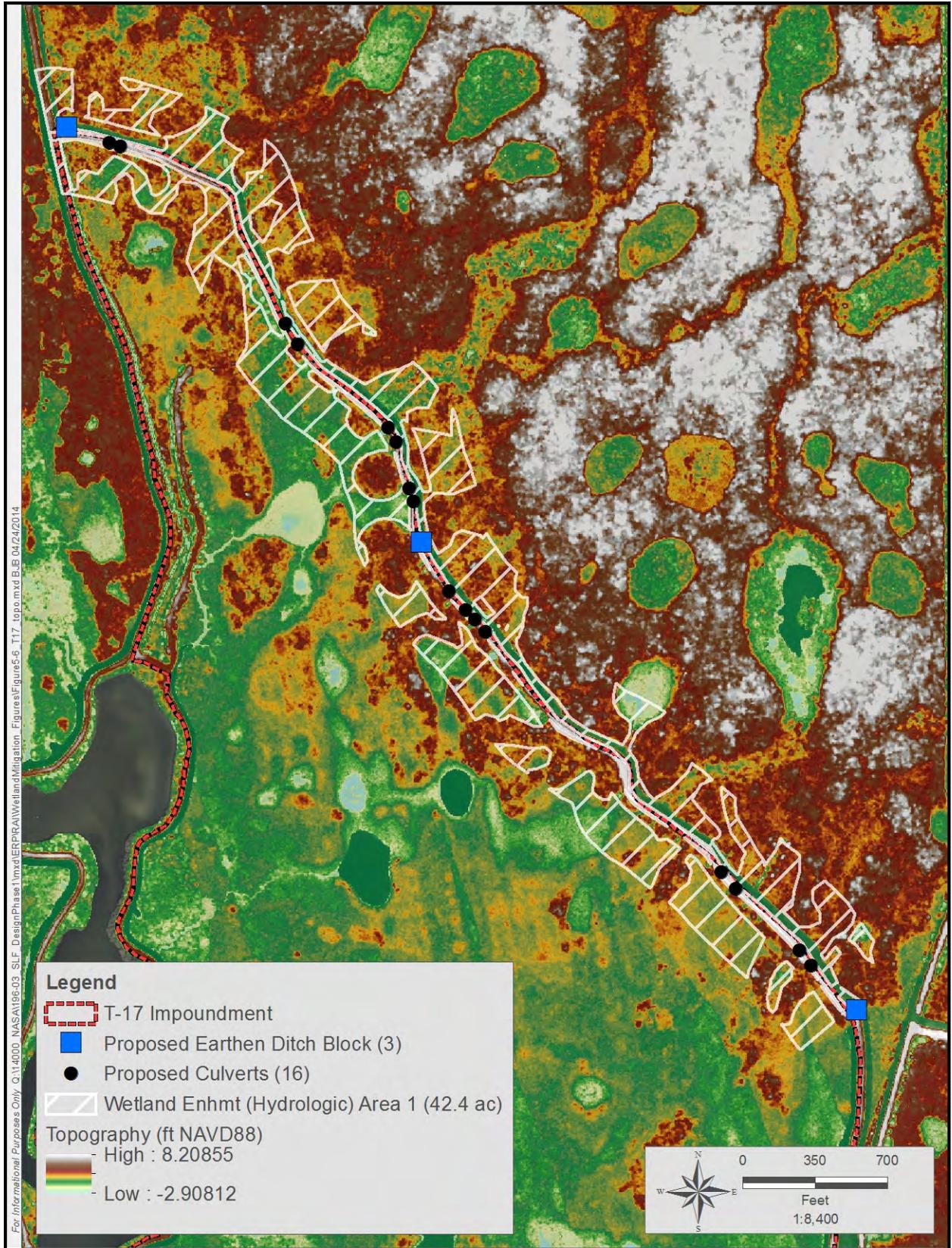


Figure 5.7 Impoundment T-17 Topographic Map

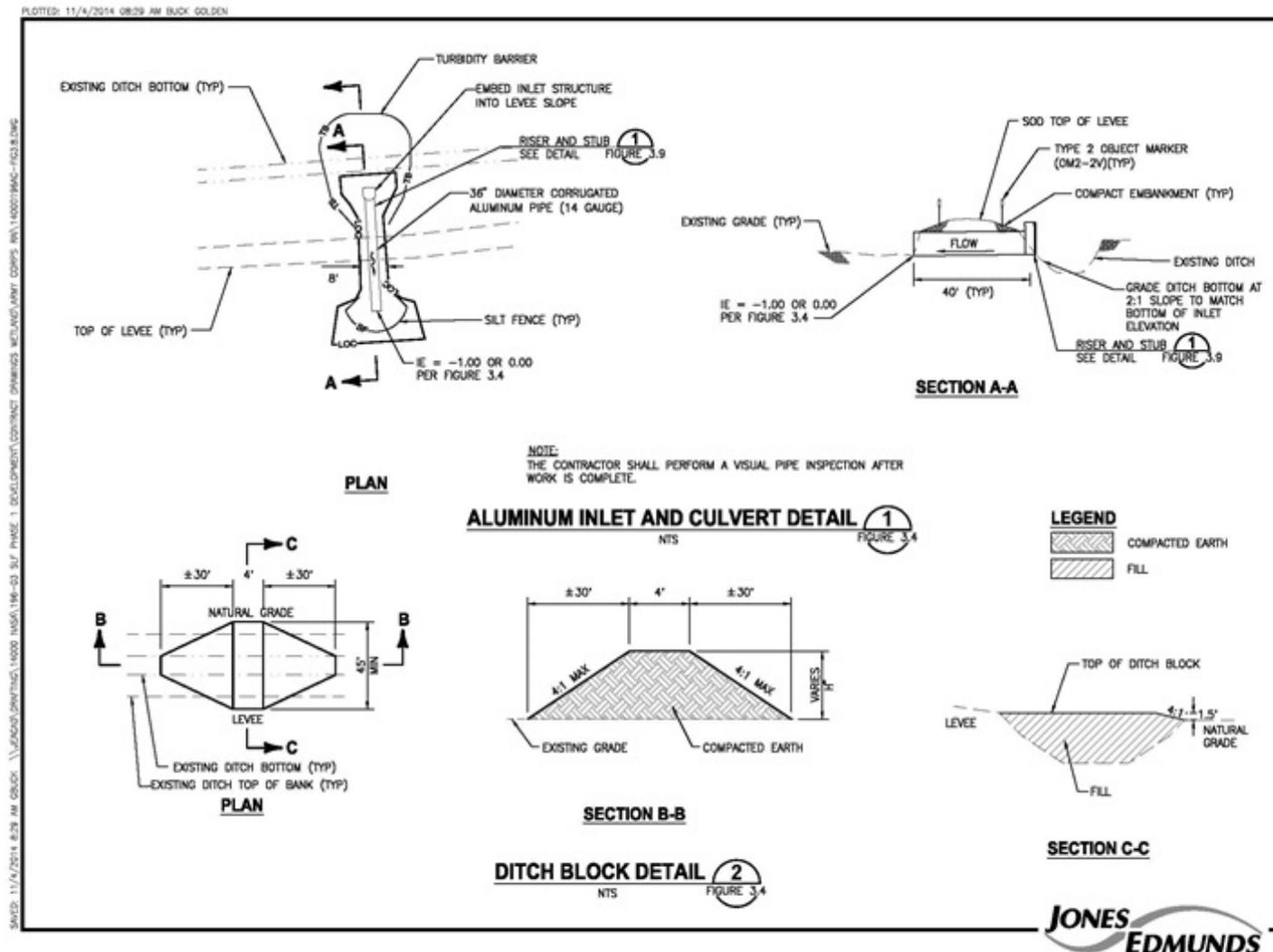


Figure 5.8 Impoundment T-17 Construction Details

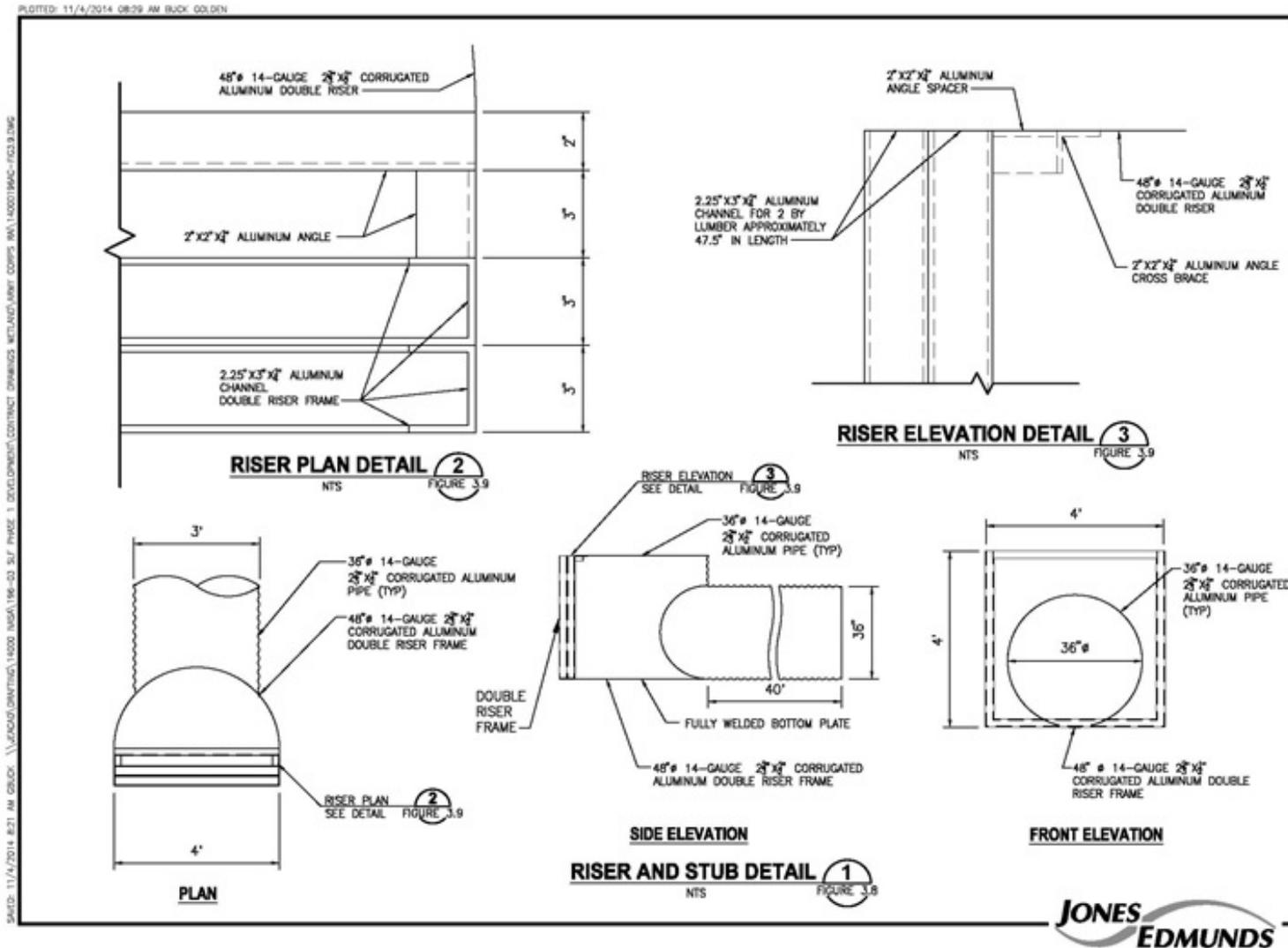


Figure 5.9 Impoundment T-17 Construction Details

Excess cut material will be hauled off site to an approved upland disposal site. Clean fill will be used to complete the construction of the ditch plugs. Ditch plugs will be compacted and then seeded with an annual grass such as millet or rye grass. Installation of the ditch plugs and culverts is expected to take approximately 4 to 6 weeks.

#### *5.6.2 Wetland Enhancement Area 2 (Brazilian Pepper Treatment)*

Brazilian pepper will be treated within an approximately 50-foot-wide area on the north side of the levee and 50 to 250 feet on the south side of the levee. This enhancement area comprises approximately 14.0 acres and is intended to reduce competition with native species as well as the seed source of this species along the levee in hydrologically restored areas and in several small hydric palm hammocks (Figure 5.5). The limit of treatment areas will be flagged in the field and monumented with rebar covered by 2-inch PVC poles so that maintenance crews can see the limits of the treatment area and treatment success can be evaluated. Brazilian pepper shrubs will be girdled, herbicided, and left in place. Large limbs will be cut manually to facilitate the collapse of large specimens. Saplings will be treated with a foliar herbicide. Once the Brazilian pepper is treated, rapid colonization is expected to occur via seed and vegetatively by desirable native herbaceous wetland species because of the abundant and dense desirable vegetation adjacent to the treatment areas.

Within the approximately 50-foot-wide area north of the levee, Brazilian pepper cover is approximately 20 to 30 percent. Within the proposed treatment area south of the levee, Brazilian pepper cover is approximately 80 to 100 percent. These areas are depicted on Figure 5.5 and make up approximately 14 acres of treatment area.

### 5.7 SEQUENCING

The following is the expected sequencing plan for implementing mitigation activities at the Impoundment T-17 site:

1. Vegetation transects and piezometers will be installed initially to provide baseline site assessment of vegetation communities and hydrologic conditions within the hydrologic enhancement areas prior to mitigation construction activities. This will occur in FY-2015.
2. Following setup, the existing condition site assessment to document vegetation and hydrology in Wetland Enhancement Area 1 will occur.
3. Annual reporting of baseline monitoring activities and proposed mitigation construction schedules will be provided to the USACE each January until mitigation construction is initiated.
4. Initiation of mitigation site construction is expected to occur during late FY-2017 to FY-2018 and include the following:

- a. Manually cut and treat Brazilian pepper and other exotics in Wetland Enhancement Area 2.
- b. Install silt fence and turbidity curtains.
- c. Install culverts and ditch blocks.
- d. Complete as-built drawings of culverts and ditch blocks to verify locations and elevations.
- e. After the culvert and ditch blocks are installed, the limits of Brazilian pepper treatment areas depicted on Figure 5.5 will be flagged and monumented at approximately 50- to 100-foot spacing with rebar covered by 2-inch PVC poles. Brazilian pepper trees will be manually cut and left in place. Stumps and saplings will be treated with the appropriate herbicide.
- f. Conduct a controlled burn of dead Brazilian pepper biomass to release understory.
- g. After the as-built drawing is approved, initiate post-construction vegetation and hydrologic compliance monitoring and submit an annual report to USACE.
- h. Conduct additional Brazilian pepper herbicide treatments semi-annually or as required to maintain required success criteria.

## 5.8 MAINTENANCE PLAN

The primary maintenance activities expected at this mitigation area will be to:

1. Identify and maintain (remove) Category I and II invasive exotic plant species, pursuant to the most current list established by the Florida Exotic Pest Plant Council at <http://www.flpeppc.org> to less than 5-percent cover.
2. Inspect and confirm ditch blocks are not eroding and are performing as designed.
3. Inspect and confirm integrity of installed culverts and that they are open and functioning as designed.

Exotic vegetation treatment activities will occur twice per year for the first 3 years followed by annual treatments if necessary for Years 4 and 5 for a total of no less than 5 years with a goal of reducing invasive exotic coverage to 5 percent or less. Brazilian pepper and other invasive exotic percent cover will also be maintained at 5 percent or less in treatment areas beyond the compliance monitoring period.

Once compliance monitoring is no longer required, KSC staff will conduct periodic inspections and MINWR staff or subcontractors will perform maintenance as needed to ensure that treatment areas remain dominated by desirable native vegetation and are not encroached on by

Brazilian pepper and other exotic plant species, and hydrologic enhancements at the T-17 mitigation area continue to function properly.

## 5.9 PERFORMANCE STANDARDS

To document the attainment of wetland FG units, KSC will submit comprehensive narratives and functional assessment analyses that document the generation of wetland functional lift after the culvert installations and Brazilian pepper treatment. To meet the objectives of the project, KSC will achieve the following performance standards:

1. In Wetland Enhancement Areas 1 and 2, at least 80-percent cover by appropriate (i.e., Facultative Wet [FACW] or Obligate [OBL]) native wetland species.
2. In Wetland Enhancement Areas 1 and 2, cover of Category I and II invasive exotic plant species, pursuant to the most current list established by the Florida Exotic Pest Plant Council at <http://www.tleppc.org>, and the nuisance species primrose willow (*Ludwigia peruviana*), dog fennel (*Eupatorium capillifolium*), Bermuda grass (*Cynodon* spp.), Bahia grass (*Paspalum notatum*), and cattail (*Typha* spp.) will total less than 5 percent in Brazilian pepper treatment areas.
3. The wetland impoundment areas within the 250-foot enhancement area will be measured for overall wetland quality by vegetative composition and hydrological indicators (e.g., water marks, adventitious roots, standing water). We expect that this enhancement area will experience increased percent cover or transition (loss of cattail) of FACW and OBL plant species and/or increased abundance of hydrologic indicators such as crayfish burrows and adventitious rooting.

The hydrologic and vegetation improvements will be documented by conducting pre-mitigation construction baseline biotic, vegetation, hydrologic, and wading bird monitoring. This will be accomplished before the culverts and ditch blocks are installed to document current conditions. Compliance monitoring data collected after the mitigation activities are complete will be used in conjunction with the pre-construction baseline data to determine mitigation success. Please see Section 5.10 for additional details on the proposed monitoring design.

## 5.10 MONITORING REQUIREMENTS

### 5.10.1 *Pre-Mitigation Construction Baseline Monitoring*

The following data will be collected in FY-2015, before construction of the mitigation activities:

#### a) *Biotic Indicators*

Biotic indicators such as crayfish burrow abundance, stain lines, moss lines and other hydrologic indicators will be identified and documented in the field. These biotic indicators, in conjunction with vegetation, will be monitored to document changes that

occur in response to the hydrologic enhancements. Additionally, baseline monthly pre-mitigation construction wading bird surveys commenced in March 2015 and will continue after construction to provide a pre and post mitigation dataset to evaluate wildlife utilization.

*b) Vegetation*

Vegetation sampling at approximately twenty 25-meter transects will be completed using the point-intercept methods (Mueller-Dombois and Ellenberg, 1974). Endpoints of transects will be located by differentially-corrected GPS. Transects will be 25 meters long with sample points every 2.5 meters unless modifications are required for the site. Ten transects will be installed on each side of the levee. On each side of the existing levee, six transects will be placed in the area of hydrologic enhancement area and four transects in the area of Brazilian Pepper removal. The transects will be established in both upstream and downstream enhancement areas based on site area (acreage), habitat uniformity, and type of enhancement or restoration activity completed to encompass all community types within the extent (250 feet) of the proposed enhancement area. Transect end points will be monumented with rebar and PVC and located using a real time kinematic Trimble GPS with centimeter accuracy. Vegetation sampling will be initiated in March 2015 and repeated in July/August 2015.

*c) Water Quality*

Salinity, conductivity, pH and temperature will be measured weekly in the associated ditches and in Banana Creek using a YSI model 600XL. A single wet and dry season pre-mitigation construction surface water sampling/lab analysis will occur to provide baseline measurements of total suspended solids (TSS) and total dissolved solids (TDS) in the levee canal and adjacent surface waters within the projects area of influence. Surface water sampling sites will be located along the levee canal approximately every 500 feet adjacent to installed piezometers and future culvert locations. One surface water sampling site within the Banana Creek will also be established. All data will be stored in the Ecological Program Oracle Environmental Data Management System (EDMS). Statistical analyses, models, and graphics will be developed using R Models that assess relationships between water levels, rainfall, evapotranspiration, lagoon level, and sea level.

*d) Hydrology*

KSC will be installing five piezometers to monitor water levels, conductivity, and salinity. One piezometer will be installed near the south terminus of the canal at its outfall to Banana Creek, and two paired piezometers (one upstream of the canal and one downstream of the levee) will be installed between the proposed ditch plug locations along the canal, north of the Banana Creek sampling location.

### 5.10.2 *Post-Mitigation Construction Compliance Monitoring*

For post-mitigation construction compliance monitoring, the same monitoring transects described above will be used to quantify vegetation species and coverage, and document vegetation changes upstream and downstream of the dike within hydrologic enhancement areas as well as in the Brazilian pepper treatment areas. These transects will use the point intercept methodology, which will include photographic stations and vegetation monitoring at 2.5-meter intervals. The vegetation monitoring will include a detailed quantitative assessment of each vegetative community with respect to dominant species, approximate range of cover of each dominant species, overall condition of the community, presence of nuisance or exotic species, presence of mesic or upland-encroaching vegetation, and any signs of disturbance. A photo station will also be established to document site vegetation. These data will be used in conjunction with baseline monitoring data to assess success. Annual monitoring for a minimum of 5 years is proposed. Inspections and required maintenance of Brazilian pepper will be conducted semi-annually for the first 2 years and annually for an additional 3 years for a total of no less than 5 years. Brazilian pepper and other exotic/invasive species will be treated. Annual qualitative mitigation site inspections will be conducted for the first 5 years post-compliance monitoring and then completed biennially thereafter. Brazilian pepper and other exotic/invasive species will be identified, location(s) recorded, and treated.

### 5.10.3 *Reporting*

KSC will perform a time-zero (baseline) monitoring event of the project sites within 60 days of the authorized work being completed. A time-zero report will be submitted to the USACE within 90 days of the monitoring event completion. The report will include a paragraph describing baseline vegetative, hydrologic, wildlife utilization, and water quality conditions of the project areas before the work is initiated and a detailed plan view drawing of all enhanced areas and monitoring locations. KSC will prepare an annual report of monitoring activities and pertinent management activities completed to update the USACE regarding the Plan status. The report will be submitted each January, on or before the 31<sup>st</sup>.

## 5.11 LONG TERM MANAGEMENT PLAN

See Section 7.2 of the Plan for NASA's approach to long term management of all mitigation sites included in this Plan.

## 5.12 ADAPTIVE MANAGEMENT PLAN

See Section 7.3 of this Plan for the KSC Adaptive Management strategy to be implemented at all mitigation sites included in this Plan.

## 5.13 FINANCIAL ASSURANCES

See Section 7.4 of the Plan for financial assurance of implementing the KSC Advanced Ecological Wetlands Mitigation Plan.

## 6.0 IMPOUNDMENT C-15E RESTORATION (LEVEE AND CANAL REMOVAL)

### 6.1 OBJECTIVES

MINWR is actively engaged in identifying and restoring large wetland/upland habitat mosaics. The main focus is on mosquito impoundment restoration. Impoundment restoration restores the natural hydrologic flow patterns in the landscape. Impoundments do not allow freshwater from rain to sheet flow across a mosaic of herbaceous wetlands. Instead, the canals associated with impoundments convey large pulses of freshwater directly into the creeks of the Indian River Lagoon. The goal of the C-15E Impoundment restoration project is to restore hydrologic connectivity between the impoundment and the adjacent estuary lost due to the construction of a levee. This entails removing approximately 4,800 linear feet of the east portion of an approximately 4-mile-long mosquito impoundment levee and backfilling the adjacent canal which will restore natural sheet flow to wetlands upstream and downstream of the mitigation area. The restoration project will facilitate the establishment of native plant, invertebrate, fish, and wildlife species while creating unsuitable conditions for exotics. Furthermore, restoring this impoundment reduces the large pulses of freshwater and instead directs this water across a mosaic of wetlands. MINWR's as well as KSC's previous impoundment restoration projects have shown promising results with minimal re-infestation by exotic plant species.

### 6.2 SITE SELECTION

The C-15E Impoundment wetland mitigation area is located within 275 acres of previously impounded estuarine marsh wetlands south of Schwartz road and east of Moore Creek/Oyster Prong in the west central vicinity of Kennedy Space Center. The area involving creation, restoration and enhancement mitigation activities comprises approximately 54 acres; including herbaceous freshwater marsh, freshwater scrub-shrub wetlands, and sabal palm hydric hammocks located within approximately 300 feet upstream (east) and downstream (west) of the constructed levee/canal. A Brazilian pepper (*Schinus terebinthifolius*)/coastal plain willow (*Salix caroliniana*) overstory with a sparse to 50% cover of swamp fern (*Blechnum serrulatum*), royal fern (*Osmunda regalis*) and sand cordgrass (*Spartina Bakeri*) understory dominates the area west of the levee/canal. Brazilian pepper (40-50% cover) and sabal palm hydric hammock comprise the dominant community east of the levee/canal. Currently, no hydrologic connections between the C-15E impoundment and wetlands located upstream of the levee are present, and freshwater flows from the extensive wetland complex east of the impoundment are directed into the C-15E levee canal and ultimately into the Indian River via Moore Creek to the north.

### 6.3 SITE PROTECTION INSTRUMENT

The site protection assurance for the C-15E Impoundment Mitigation Site and all other wetland mitigation sites covered under this Plan is accomplished through NASA Environmental Management Branch (EMB) coordination and planning with the KSC Master Planning Office. This effort starts with mitigation site selection and Master Planning concurrence, followed by

identification/tracking of constructed or sited mitigation sites using the KSC Conservation Lands GIS Layer. This ensures siting of new facilities will not impact or displace existing or proposed wetland mitigation sites. A description of this process is provided in Section 7.1.

#### 6.4 BASELINE INFORMATION

The Impoundment C-15E Restoration mitigation site is at the west end of Schwartz Road and consists of work proposed on the south half of the east levee (Figures 6.1 and 6.2). The mitigation site is comprised of the levee and adjacent canal. The levee is a maintained access road with a large adjacent canal and no observed culverts under the levee (Photographs 6.1 and 6.2). The existing canal is 4 to 6 feet deep, has no littoral shelf, and has little or no submergent aquatic vegetation. As a result, this surface water provides little or no community structure. The interior portions of the impoundment are dominated by herbaceous, shrub, and forested (hydric sabal palm hammocks) wetland vegetation communities that are routinely burned by MINWR land managers. (Photographs 6.3 and 6.4). Brazilian pepper and Carolina willow dominate the west side of the levee, and herbaceous wetlands and temperate hammock uplands dominate the east side of the canal. Brazilian pepper comprises approximately 40 to 50 percent of the midstory on the east side of the canal.

#### 6.5 MITIGATION CREDITS

Using UMAM, the C-15E mitigation project will generate a proposed 6.8 UMAM credits from USACE. Five UMAM assessment areas are described below and summarized in Appendix A.

a) Wetland Creation (5.0 acres):

This area corresponds to the levee that will be removed and excavated to wetland grade and planted with native vegetation (Figure 6.3).

b) Wetland Restoration (5.0 acres):

This area corresponds to the canal that will be backfilled to wetland grade and planted with native vegetation (Figure 6.3).

c) Wetland Enhancement Area 1 (8.3 acres):

This area corresponds to an approximately 70- to 100-foot-wide area on the west side of C-15E levee dominated by Brazilian pepper and Carolina willow (Figure 6.3) that will be treated by a combination of mulching, hand clearing, selective herbicide application, and controlled burns. An average treatment area width of 85 feet was used to calculate the UMAM assessment area.

d) Wetland Enhancement Area 2 (1.2 acres):

This mitigation activity consists of vegetative enhancement of wetlands within an approximately 50-foot-wide area (1.2 acres) east of the canal backfill (Figure 6.3).

e) Wetland Enhancement Area 3 (34.3 acres):

This area corresponds to wetlands approximately 150-foot-wide that are located 250 feet upstream and 200 feet downstream of Wetland Enhancement Area 1 area that will experience hydrologic enhancement due to the restored hydrology (Figure 6.3).

Ecological lift for exotic treatment activities associated with Wetland Buffer Enhancement Area are incorporated into the UMAM analysis of mitigation activities a) through e) above.



Photograph 6.1 C-15E Levee



Photograph 6.2 C-15E Canal



Photograph 6.3 C-15E-Herbaceous Wetlands



Photograph 6.4 C-15E Shrub Wetlands

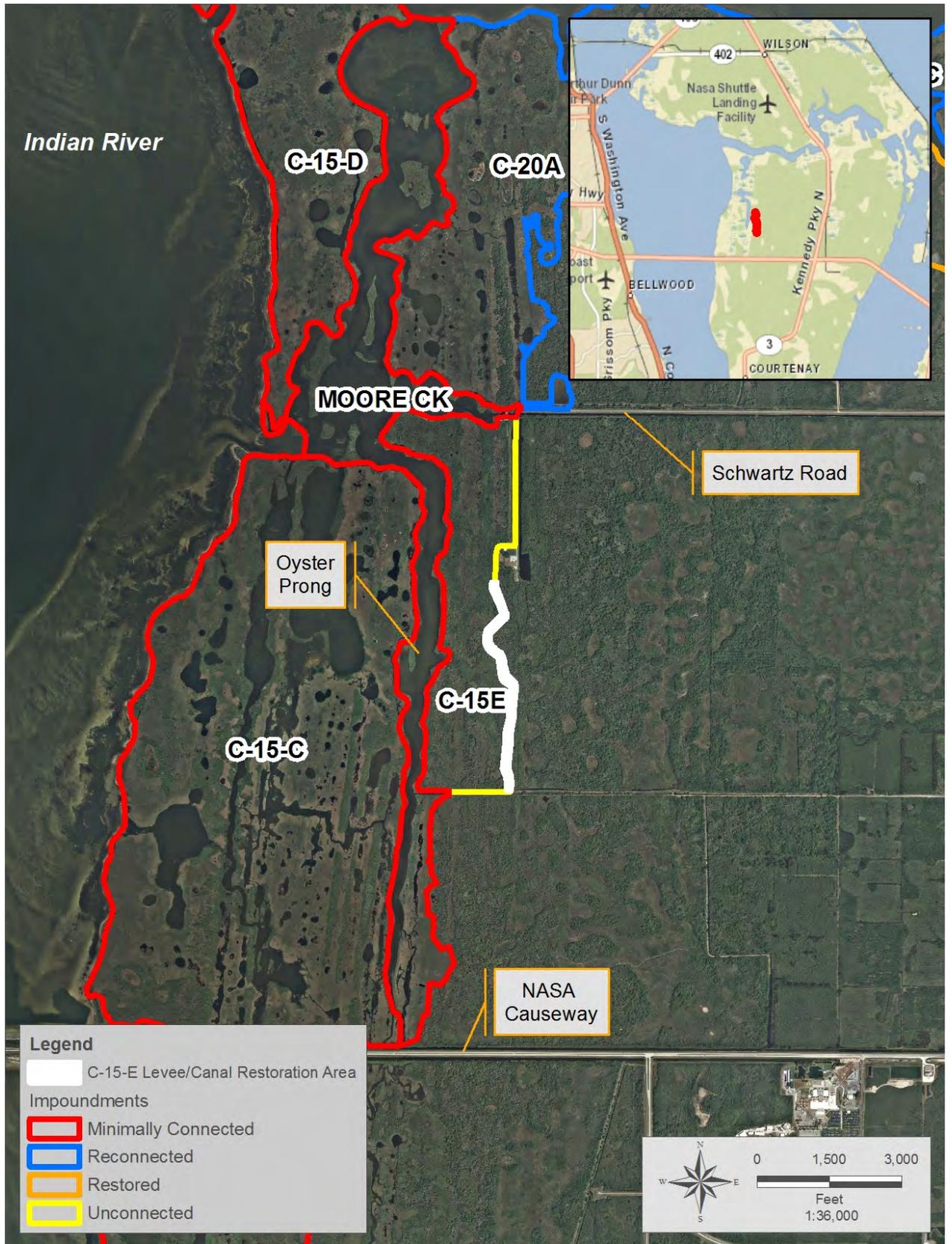


Figure 6.1 Impoundment C-15E Location Map

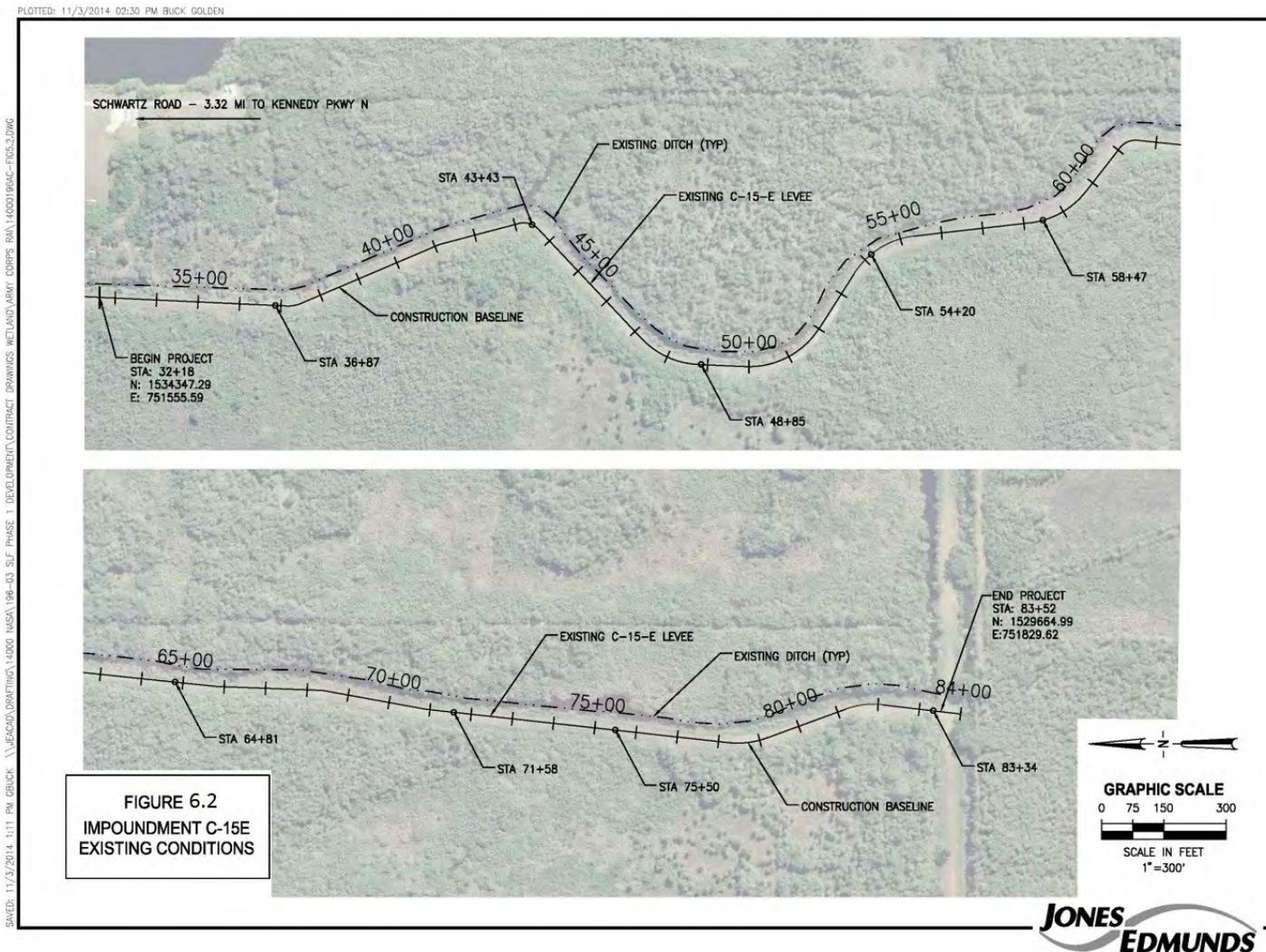


Figure 6.2 Impoundment C-15E Existing Conditions

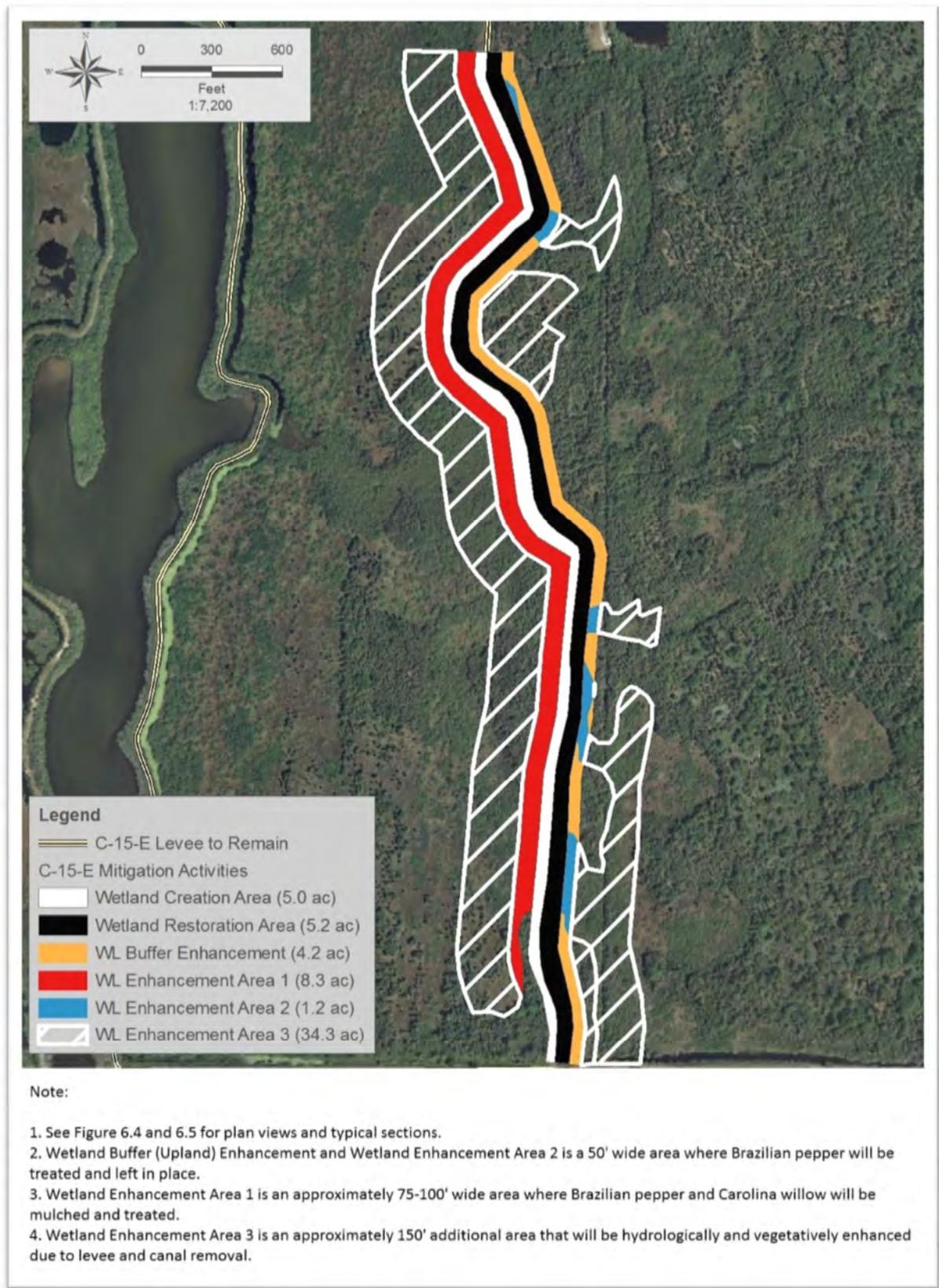


Figure 6.3 Impoundment C-15E Proposed Wetland Mitigation Activities Map

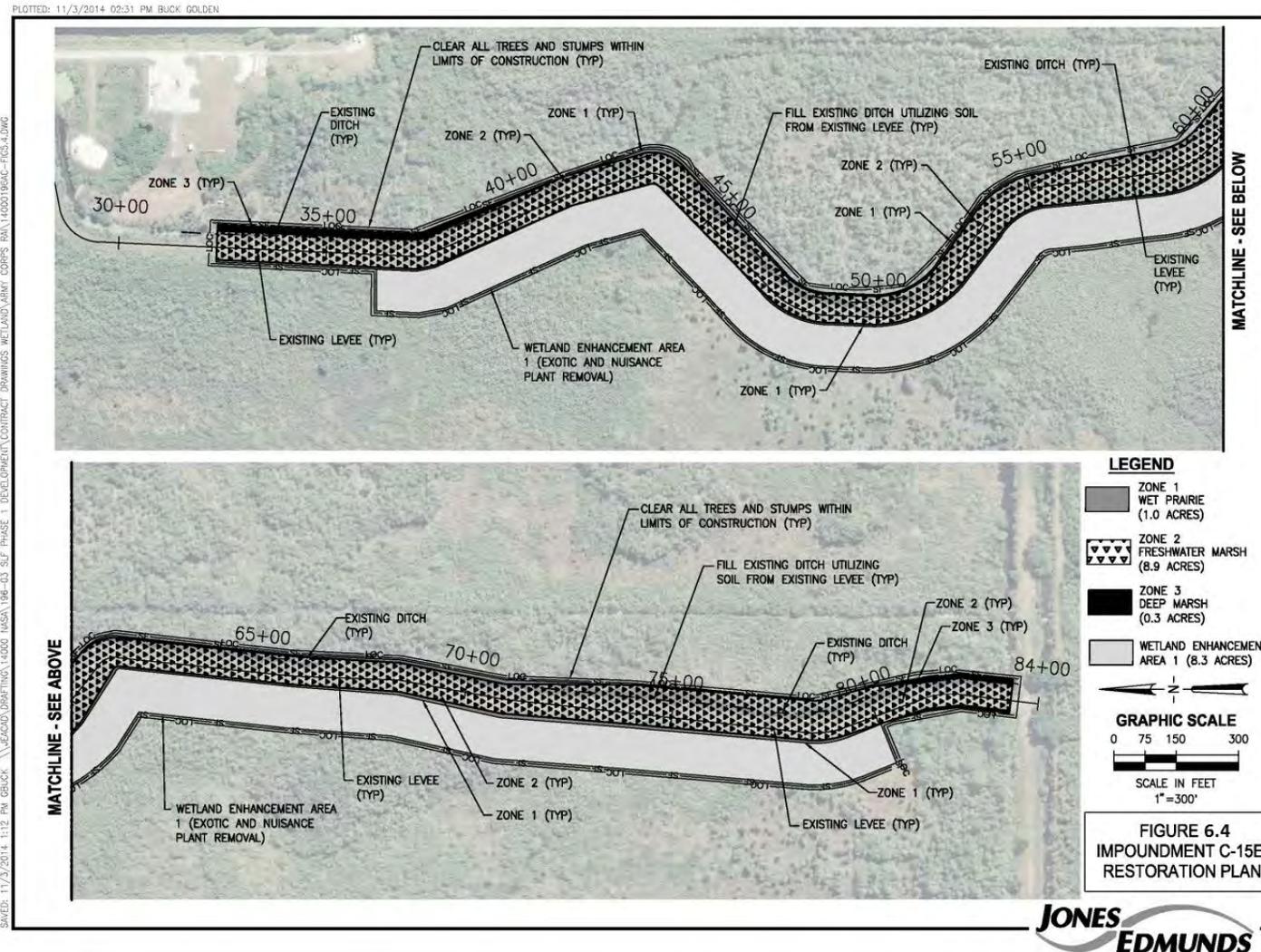


Figure 6.4 Impoundment C-15E Restoration Plan

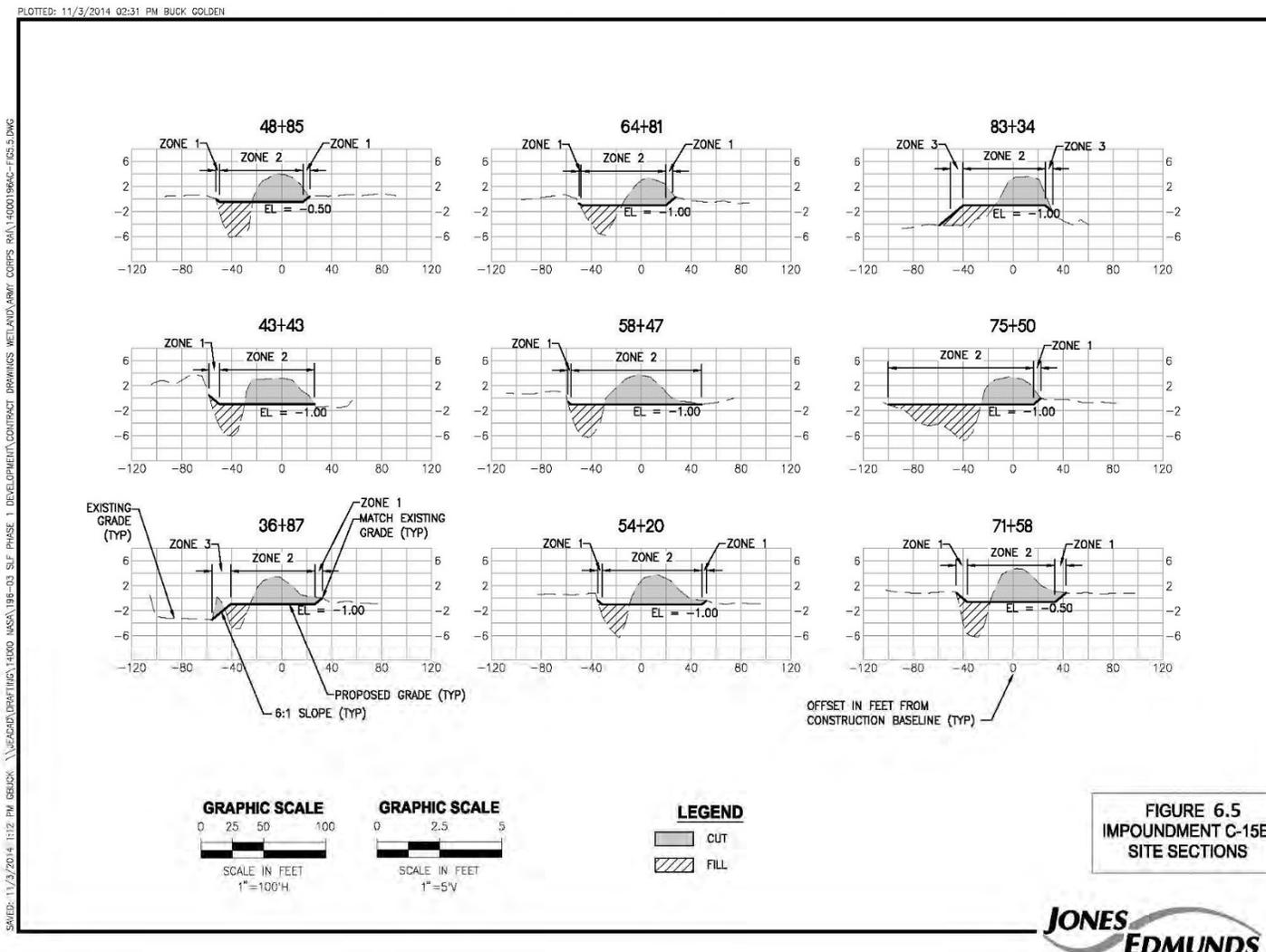


Figure 6.5 Impoundment C-15E Site Sections

## 6.6 MITIGATION WORK PLAN

This project entails removing approximately 4,800 linear feet of the east portion of an approximately 4-mile-long mosquito impoundment levee and backfilling the adjacent canal (Figures 6.2 through 6.5). As a result of removing the levee and backfilling the adjacent canal, natural sheet flow will be restored to wetlands upstream and downstream of the mitigation area.

### *6.6.1 Wetland Creation*

This area (5.0 acres) corresponds to the levee that will be removed and excavated to wetland grade and planted with native vegetation. The creation area will consist of three zones (Figure 6.4). Zone 1 represents the side slopes of the creation area as it ties to natural grade. Zone 2 represents the proposed freshwater marsh and the majority of the creation area. Zone 3 represents a small deep marsh in the southwest region of the mitigation area as it ties to one of the existing canals.

A Florida-licensed surveyor will stake/flag the limits of the work area and set design elevation stakes. Silt fence and turbidity barriers will then be installed around the site. All staked silt fence and turbidity barriers will be inspected and maintained in accordance with the project's Erosion Control Plan. Next, the levee will be cleared and grubbed. All woody debris will be burned on site or hauled away to an approved off-site disposal site. Heavy equipment will be used to then push the levee into the adjacent canal and grade the footprint of the levee and the adjacent filled canal to the design elevations. Clean fill will be used to meet design elevations if the levee does not provide sufficient fill material. The soil specification in the construction documents requires fill to be clean of debris and other organic materials. This fill is expected to come from a borrow pit and thus will not be a topsoil that has the potential to contain exotic invasive vegetation seeds.

Once the restoration grades have been established, the area will be disked or aerated (to approximately 6 inches) to undo any soil compaction that may have occurred during the earthwork process. Once site construction has been completed, an as-built survey will be completed that will include spot elevations on a pre-determined grid within the restoration area and cross sections into adjacent existing wetlands. The as-built will be forwarded to USACE for review and approval before planting begins.

After the as-built survey confirms that restoration grades have been achieved, plant material will be installed within 60 days of acceptance of final grade by the USACE according to the planting plan identified in Figure 6.6. Herbaceous species will be bare root, 2-inch, or 4-inch liners depending on availability. Herbaceous species will be planted in large groupings in their designated areas.



### *6.6.2 Wetland Restoration*

This area (5.2 acres) corresponds to the canal that will be backfilled to wetland grade and planted with native vegetation. A temporary berm will likely be constructed on the north and south sides of the restoration area to allow for dewatering and backfilling to design grade. Turbidity curtains will be installed north and south of this mitigation area as well as silt fence on the east side.

The restoration area will consist of three zones (Figures 6.4 and 6.6). Zone 1 represents the side slopes of the creation area as it ties to natural grade. Zone 2 represents the proposed freshwater marsh and the majority of the creation area. Zone 3 represents a small deep marsh in the southwest region of the mitigation area as it ties to one of the existing canals. Once site construction has been completed, an as-built survey will be completed that will include spot elevations on a pre-determined grid within the restoration area and cross sections into adjacent existing wetlands. The as-built will be forwarded to USACE for review and approval before planting begins.

After the as-built survey confirms that restoration grades have been achieved, plant material will be installed within 60 days of acceptance of final grade by the USACE according to the planting plan identified in Figure 6.6. Herbaceous species will be bare root, 2-inch, or 4-inch liners depending on availability. Herbaceous species will be planted in large groupings in their designated areas.

### *6.6.3 Wetland Enhancement Area 1*

This area (8.3 acres) corresponds to an approximately 70- to 100-foot-wide area on the west side of C-15E levee that is dominated by Brazilian pepper and Carolina willow and forms a closed canopy along much of the this side of the levee (Figures 6.3 and 6.3). An average treatment area width of 85 feet was used to calculate the UMAM assessment area. Sparse to 20- to 50-percent coverage of desirable native understory species such as swamp fern, royal fern, and sand cordgrass is in these areas. Removing these invasive exotic and nuisance shrub species will release the native understory species and allow rapid recruitment and expansion.

Due to the density of these species, manual treatment will be too labor-intensive, too costly, and leave too much above ground biomass that would result in shading and create structure for vines. Therefore, a combination of mulching, hand clearing, and controlled burning is proposed in this 70- to 100-foot-wide section to remove above ground Brazilian pepper and Carolina willow. The mulcher will consist of a Bobcat or similar tracked vehicle with a large drum mulching head on the front. Mulching will be conducted in a manner to widely distribute the resulting mulch so that remaining mulch does not impede vegetation recruitment. In very dense areas, not all the shrubs will be mulched and some will remain that will be manually treated with the appropriate herbicide. A crew will follow the mulcher and herbicide the remaining stumps and saplings/seedlings of these shrub species. To minimize soil disturbance, mulching activities will be completed during the dry season.

#### *6.6.4 Wetland Enhancement Area 2*

This mitigation activity consists of vegetative enhancement of wetlands within an approximately 50-foot-wide area (1.2 acres) east of the canal backfill (Figure 6.3). Brazilian pepper is common in this area along the existing canal and currently comprises approximately 40 to 50 percent of the vegetation cover. This species will be cut and stumps/stems will be treated with the appropriate herbicide.

#### *6.6.5 Wetland Enhancement Area 3*

This area (34.3 acres) corresponds to wetlands approximately 200 to 230 feet upstream and downstream of the Wetland Enhancement Area 1 area that will experience hydrologic enhancement due to the restored hydrology (Figure 6.3). The assumption is that adjacent wetlands within this 300-foot area will now experience the historical hydroperiod due to water sheet flowing across the former footprint of the levee as well as longer hydroperiods in upstream wetlands due to the backfilling of the canal that dewateres the upstream wetlands. The assessment area acreage was determined by digitizing wetland areas using historical aerial imagery.

#### *6.6.6 Wetland Buffer Enhancement*

This mitigation activity consists of vegetative enhancement of wetland buffer within an approximately 50-foot-wide area (4.2 acres) east of the canal backfill (Figure 6.3). Brazilian pepper is common in this area along the existing canal and currently comprises approximately 40 to 50 percent of the vegetation cover. This species will be cut and stumps/stems will be treated with the appropriate herbicide. Shrub material will be left in place.

### 6.7 SEQUENCING

The following is the expected sequencing plan for implementing mitigation activities at the Impoundment C-15E site:

1. Vegetation transects and piezometers will be installed initially to provide baseline site assessment of vegetation communities and hydrologic conditions within the hydrologic enhancement areas before mitigation construction activities. This will occur in FY 2015 before any mitigation construction commences.
2. Following establishment of monitoring proposed above in Item 1, the existing condition site assessment and data collection will occur to document vegetation and hydrology in Wetland Enhancement Area 1.
3. Initiation of mitigation site construction will occur as necessary to support future KSC construction or other activities requiring wetland mitigation occurring during the KSC AEM permit period, to include the following:
  - a. Stake and flag limits of work areas and design elevations.

- b. Install perimeter silt fence and turbidity curtains.
- c. Mulch and manually cut and treat Brazilian pepper and other exotics in Wetland Enhancement Area 1.
- d. Manually cut and treat Brazilian pepper and other exotics in Wetland Enhancement Area 2 and Wetland Buffer Enhancement Area.
- e. Conduct a controlled burn of Wetland Enhancement Areas 1 and 2 and Wetland Buffer Enhancement Area.
- f. Clear and grub the levee.
- g. Excavate and grade the levee and push the soil into adjacent canal.
- h. Complete as-built survey to verify acreages and that design elevations are met.
- i. After the as-built drawing is approved, disk or rake creation area to aerate soil.
- j. Install plant material.
- k. Install monitoring transects and conduct the baseline monitoring event.

#### 6.8 MAINTENANCE PLAN

The primary maintenance activities expected at this mitigation area will be to:

1. Identify and maintain (remove) Category I and II invasive exotic plant species, pursuant to the most current list established by the Florida Exotic Pest Plant Council at <http://www.flpeppc.org>, and the nuisance species primrose willow (*Ludwigia peruviana*), dog fennel (*Eupatorium capillijolium*), Bermuda grass (*Cynodon* spp.), Bahia grass (*Paspalum notatum*), and cattail (*Typha* spp.), to less than 5-percent cover.
2. Determine if supplemental plantings are necessary during the compliance monitoring period planting to achieve the performance standards described in Section 6.9.

Treatment activities will occur twice per year for the first 3 years followed by annual treatments if necessary for Years 4 and 5 for a total of no less than 5 years with a goal of reducing invasive exotic coverage to 5 percent or less. Brazilian pepper and other invasive exotic percent cover will also be maintained at 5 percent or less in treatment areas beyond the compliance monitoring period.

Feral hogs have been observed in the vicinity of the Impoundment C-15E Mitigation Site. MINWR has licensed feral hog trappers under contract. MINWR will implement a feral hog removal program as necessary to ensure that wetland mitigation areas will not be disturbed during establishment and compliance monitoring. Periodic feral hogs monitoring and control will continue beyond the required compliance monitoring.

Once compliance monitoring is no longer required, KSC staff will conduct periodic inspections and MINWR staff or subcontractors will perform maintenance as needed of this mitigation site to ensure that treatment areas remain dominated by desirable native vegetation and are not encroached on by invasive exotic species.

## 6.9 PERFORMANCE STANDARDS

To document the attainment of wetland functional units of lift at the C-15E mitigation site, KSC will submit comprehensive narratives and functional assessment analyses that document the generation of wetland functional lift at this site. To meet the objectives of this wetland mitigation area, KSC will achieve the following performance standards:

1. At least 80-percent cover by appropriate planted or naturally recruited wetland plant species (i.e., FACW or OBL) in the wetland creation and restoration areas.
2. Less than 25-percent mortality of planted wetland species unless desirable/similar native wetland species sufficiently recruit allowing a positive trajectory toward meeting Performance Standard 1.
3. Cover of Category I and II invasive exotic plant species, pursuant to the most current list established by the Florida Exotic Pest Plant Council at <http://www.floridapeppc.org>, and the nuisance species primrose willow (*Ludwigia peruviana*), dog fennel (*Eupatorium capillifolium*), Bermuda grass (*Cynodon* spp.), Bahia grass (*Paspalum notatum*), and cattail (*Typha* spp.) will total less than 5 percent in the C-15E wetland creation and restoration areas, Wetland Enhancement Areas 1–3, and upland Wetland Buffer Enhancement Area.
4. The hydrologic and vegetative improvements will be documented by establishing a pre-construction baseline biotic, vegetation, hydrologic, and wading bird dataset. This will be accomplished before the levee is removed/canal backfilled to document current conditions. Compliance monitoring data collected after the mitigation activities are complete will be used in conjunction with the pre-construction baseline data to determine mitigation success. Please see Section 6.10 for additional details on the proposed monitoring design.
5. The hydrologic and vegetation improvements will be documented by conducting pre-mitigation construction baseline biotic, vegetation, hydrologic, and wading bird monitoring. This will be accomplished before the levee is removed and the canal backfilled to document current conditions. Compliance monitoring data collected after the mitigation activities are complete will be used in conjunction with the pre-construction baseline data to determine mitigation success. Please see Section 6.10 for additional details on the proposed monitoring design.
6. Mitigation site creation and restoration areas meet the USACE standard definition of a wetland.

## 6.10 MONITORING REQUIREMENTS

### 6.10.1 *Pre-Mitigation Construction Baseline Monitoring*

The following data will be collected before construction of the mitigation activities in FY 2015:

#### a) *Biotic Indicators*

Biotic indicators such as crayfish burrow abundance, stain lines, moss lines and other hydrologic indicators will be identified and documented in the field. These biotic indicators, in conjunction with vegetation, will be monitored to document changes that occur in response to the hydrologic enhancements. Additionally, baseline monthly pre-mitigation construction wading bird survey commenced in March 2014 and will continue after construction to provide a pre-post mitigation dataset to evaluate wildlife utilization.

#### b) *Vegetation*

Vegetation sampling using approximately twenty 25-meter transects will be completed using the point-intercept methods (Mueller-Dombois and Ellenberg, 1974). Endpoints of transects will be located by differentially-corrected GPS. Transects will be 25 meters long with sample points every 2.5 meters unless modifications are required for the site. On each side of the existing levee, four transects will be placed in the area of hydrologic enhancement area and four transects in the area of Brazilian pepper/willow removal. The transects will be established based on site area (acreage), habitat uniformity, and type of enhancement or restoration activity completed to encompass all community types within the extent (250 feet) of the proposed enhancement area. Transect end points will be monumented with rebar and PVC and located using a real time kinematic Trimble GPS with centimeter accuracy. Vegetation sampling was completed in March/April 2015, repeated in July 2015, and will be replicated once the mitigation project is started.

#### c) *Hydrology*

KSC has installed two piezometers to monitor water levels. One piezometer was installed east of the canal and one west of the levee. Nearly continuous water level monitoring is stored on a data logger and downloaded monthly for analysis/archiving.

### 6.10.2 *Post-Mitigation Construction Compliance Monitoring*

For post-mitigation construction compliance monitoring, the previously established monitoring transects and new transects established within the creation/restoration areas will be used to quantify vegetation species and coverage, and document vegetation changes upstream and downstream of the levee removal/canal backfill area and the Brazilian pepper/willow treatment areas east and west of the levee. These transects will use the point intercept methodology, which will include photographic stations and vegetation monitoring at 2.5-meter intervals. The vegetation monitoring will include a detailed quantitative assessment of each vegetative

community with respect to dominant species, approximate range of cover of each dominant species, overall condition of the community, presence of nuisance or exotic species, presence of mesic or upland-encroaching vegetation, and any signs of disturbance. Photo stations will also be established to document site vegetation. These data will be used in conjunction with data collected in Section 6.10.1 to assess success. Annual monitoring for a minimum of 5 years is proposed.

Inspections and required maintenance of Brazilian pepper will be conducted semi-annually for the first 2 years and annually for an additional 3 years for a total of no less than 5 years. Annual qualitative mitigation site inspections will be conducted for the first 5 years post compliance monitoring and then completed biennially thereafter. Brazilian pepper and other exotic/invasive species will be identified, location(s) recorded and treated if observed.

### 6.10.3 *Reporting*

KSC will perform a time-zero (baseline) monitoring event of the project sites within 60 days of the work authorized being completed. A time-zero report will be submitted to SJRWMD and USACE within 90 days of the monitoring event completion. The report will include a paragraph describing baseline vegetative, hydrologic, wildlife utilization, and water quality conditions of the project areas before the work is initiated and a detailed plan view drawing of all enhanced areas and monitoring locations. KSC will prepare an annual report of monitoring activities and pertinent management activities completed to update the USACE regarding the mitigation site status. The report will be submitted on or before January 31<sup>st</sup>.

## 6.11 LONG-TERM MANAGEMENT PLAN

See Section 7.2 of the Plan for NASA's approach to long term management of all mitigation sites included in this Plan.

## 6.12 ADAPTIVE MANAGEMENT PLAN

See section 7.3 of this plan for the KSC adaptive management strategy to be implemented at all mitigation sites included in this Plan.

## 6.13 FINANCIAL ASSURANCES

See Section 7.4 of the Plan for financial assurance of implementing the KSC Advanced Ecological Wetlands Mitigation Plan.

## 7.0 STANDARD KSC WETLAND MITIGATION SITE PROTECTION AND MANAGEMENT

### 7.1 SITE PROTECTION INSTRUMENT

KSC provides reasonable assurance that mitigation areas will be preserved in perpetuity by the establishment of a conservation area layer in the KSC Master Planning Institutional GIS (Appendix D). This layer, referred to as the KSC Conservation Lands Layer, is now incorporated into the Site Plan Review Process (ENG-I-MP01), which is the process by which all projects are reviewed for consistency with the KSC Master Plan, including operational uses of land and long-range planning. This process ensures review and concurrence from all directorates and programs to avoid any overlap or interference with existing land uses by proposed actions. It includes a comprehensive review of existing known conditions including but not limited to physical locations of buildings and infrastructure, historical and archaeological sites, land cover, and proposed future

In addition to the Site Plan Review Process, KSC also has an Environmental Checklist Process (KDP-P-1727) for which all projects, from painting a door to developing a new launch pad, must comply. Project proponents are required to complete a checklist and submit to EP for review and determination of potential environmental issues. EP in turn provides the project proponent with a Record of Environmental Consideration (REC) that outlines environmental issues associated with the project and actions that must be taken to proceed. This would include the requirement for an Environmental Resource Permit and Federal Dredge and Fill Permit if wetland impacts are expected, and a formal siting for projects involving new or expanded land use and would specifically identify any potential conflicts with KSC conservation areas.

KSC Environmental Planning (EP) is responsible for quality assurance by providing oversight of the new conservation area GIS data layer which has the same level of importance as the Historic and Archaeological Layer identifying specific areas for which the boundary is permanent, and no change in use or overlap of activities will be permitted. This is a standard operational procedure for KSC, and the addition of the Conservation Lands Layer has been readily incorporated into the environmental impact review and siting processes. The KSC Conservation Lands Layer will be updated as required and reviewed annually. Updates to the layer mitigation site shapefiles will be provided to the USACE Cocoa Permitting Office each January for their records. NASA will maintain ownership and control of all wetland mitigation sites in perpetuity.

### 7.2 LONG TERM MANAGEMENT PLAN

Upon successful completion of the mitigation requirements set forth in the permit conditions, the project proponent (KSC or its Customer or Partner) has the responsibility for long term monitoring. Site management and maintenance will become the responsibility of the KSC Environmental Management Branch Ecological Program and KSC's land manager, the USFWS at Merritt Island National Wildlife Refuge. KSC and MINWR have a long-standing Memorandum of Agreement outlining the responsibilities of each agency and identifying the latter as the land

manager (KCA-1647). Additionally, the Refuge Manager has provided a letter of assurance to specifically address the mitigation areas identified in this permit application (Appendix E).

### 7.3 ADAPTIVE MANAGEMENT PLAN

The long term management of all advanced ecological mitigation sites will follow the long term management strategy and actions as described in the Comprehensive Conservation Plan (MINWR 2008) and the KSC Ecological Program Plan, which are based on adaptive management practices. As demonstrated by the Adaptive Resource Management Plan developed by KSC and MINWR, the plans monitor habitat function and management techniques, and are updated annually to ensure the best management of resources at KSC.

### 7.4 FINANCIAL ASSURANCES

The project site and adjacent lands are owned by NASA KSC. KSC has funding through FY-2015 for pre-mitigation construction baseline monitoring activities. Funding for additional baseline monitoring, mitigation site construction and compliance monitoring will be provided by the project proponent tenant organization(s) or other responsible parties before permitted wetland impact construction activities begin. After the minimum 5-year compliance monitoring period is satisfied and when the areas have met the success criteria, MINWR will incur full financial responsibility for the long term maintenance of all wetland mitigation sites identified in this plan.

## 8.0 REFERENCES

Mueller-Dombois, D.; Ellenberg, H. 1974. *Aims and Methods of Vegetation Ecology*. New York: John Wiley and Sons, Inc. 547 p.

## **APPENDIX A**

# **UMAM SUMMARY FOR IMPOUNDMENT T-17 AND IMPOUNDMENT C-15E MITIGATION SITES**

Table A.1 USACE UMAM Analysis Summary Table for Proposed Wetland Mitigation Sites															
Activity	Assessment Area Acreage	Current Habitat Type (FLUCCS)	Proposed Habitat Type (FLUCCS)	Location/Landscape Support (With Mitigation?)		Water Environment (With Mitigation?)		Community Structure (With Mitigation?)		Time Lag	Risk Factor	Relative Functional Gain	Functional Gain Units		
				Yes	No	Yes	No	Yes	No						
<b>T-17 Impoundment Enhancement/Culvert Install</b>															
<b>Wetland Enhancement Area 1 (Installation of Ditch Plugs and Culverts)*</b>	39.3	6400/6300	6400/6300	9	9	7	9	8	9	1.02	1.25	0.078	3.1		
<i>Comment:</i> The assessment area represents areas 5.6.1250 feet upstream and downstream of the levee and comprises 39.3 acres out of the 350 acres that comprise T-17. Location and Landscape Support score increases due to downstream benefit to water quality and wetland vegetation. Wetlands north of the canal are dewatered by the canal, which rapidly conveys freshwater to Banana Creek rather than sheet flowing it south across the wetlands within the impoundment. A slight shift in vegetation on both sides of levee is expected due to the increased freshwater input downstream and increased hydrology on north side of levee due to ditch blocks restoring hydrology upstream. The assessment area does not include acreage of Wetland Enhancement Area 2.															
<b>Wetland Enhancement Area 2 (Brazilian Pepper Treatment)</b>	14	6400/6300	6400/6300	9	9	7	9	4	7	1.07	1.25	0.125	1.7		
<i>Comment:</i> Water Environment score will increase due to restoration of freshwater inflows into the assessment area. Brazilian pepper is currently 80 to 110% of the cover on south side and 20 to 30% on north side. Brazilian pepper will be cut and treated with herbicide.															
<b>SUBTOTAL</b>	<b>53.3</b>												<b>4.8</b>		
<b>C-15E Impoundment Restoration/Canal Backfill</b>															
<b>Wetland Creation (Levee Removal)</b>	5.0	8000	6400/6300	0	9	0	9	0	9	1.07	1.50	0.561	2.8		
<i>Comment:</i> Risk is set at 1.5 due to KSC's record with the wetland creation at Space Commerce Way and other sites. KSC is financially committed to ensuring this as well as the other mitigation sites are successful. Location and Landscape Support will increase because of the restoration of the hydroperiod to upstream and downstream areas. Additionally, considerable water quality benefits should be realized in Oyster Prong due to the reduction in frequency and duration of freshwater pulses into Oyster Prong from the canals.															
<b>Wetland Restoration (Backfill Canal)</b>	5.2	5000	6400/6300	7	9	5	8	2	8	1.07	1.50	0.291	1.0		
<i>Comment:</i> Risk is set at 1.5 due to KSC's record with the wetland creation at Space Commerce Way and other sites. KSC is financially committed to ensuring this as well as the other mitigation sites are successful. Location and Landscape Support will increase because of the restoration of the hydroperiod to upstream and downstream areas. Additionally, considerable water quality benefits should be realized in Oyster Prong due to the reduction in frequency and duration of freshwater pulses into Oyster Prong from the canals.															
<b>Wetland Enhancement Area 1 (85-foot-wide West Side Shrub Treatment Area)</b>	8.2	6400	6400	8	9	9	9	4	8	1.07	1.25	0.150	1.0		

Table A.1 USACE UMAM Analysis Summary Table for Proposed Wetland Mitigation Sites															
Activity	Assessment Area Acreage	Current Habitat Type (FLUCCS)	Proposed Habitat Type (FLUCCS)	Location/Landscape Support (With Mitigation?)		Water Environment (With Mitigation?)		Community Structure (With Mitigation?)		Time Lag	Risk Factor	Relative Functional Gain	Functional Gain Units		
				Yes	No	Yes	No	Yes	No						
<p><b>Comment:</b> Brazilian pepper and Carolina willow comprise 50 to 100% of the shrub and canopy strata within the assessment area. Mulching and subsequent herbicide follow-up treatments will remove these species and allow desirable native understory species to flourish. This will in turn reduce the seed source of these species to areas to the west. The assessment area is expected to also experience an increase in hydroperiod due to the filling of the adjacent canal, which dewateres the assessment area.</p>															
<b>C-15E Impoundment Restoration/Canal Backfill (cont.)</b>															
<b>Wetland Enhancement Area 2 (50-foot-wide East Side Brazilian Pepper Treatment)</b>	1.2	6400	6400	8	9	9	9	4	8	1.07	1.25	0.150	0.1		
<p><b>Comment:</b> Brazilian pepper comprises 40 to 60% of the shrub and canopy strata within the assessment area. Herbicide follow-up treatments will remove these species and allow desirable native understory species to flourish. The assessment area is expected to also experience an increase in hydroperiod due to the filling of the adjacent canal, which dewateres the assessment area.</p>															
<b>Wetland Enhancement Area 3 (Upstream/Downstream Wetlands)**</b>	34.3	6400/6300	6400/6300	8	9	7	8	7	8	1.02	1.25	0.105	1.8		
<p><b>Comment:</b> The assessment area represents areas 250 feet upstream and downstream of the levee and comprises 34 acres out of the 277 acres that comprise Impoundment C-15E. Location and Landscape Support score increases due to downstream benefit to water quality and wetland vegetation. Wetlands east of the canal are dewatered by the canal, which rapidly conveys freshwater to Oyster Prong rather than sheet flowing it west into and across the wetlands within the impoundment. A slight shift in vegetation on both sides of levee is expected due to the increased freshwater input downstream and increased hydrology on the east side of levee due to backfilling the canal. The assessment area does not include acreage of Wetland Enhancement Areas 1 or 2.</p>															
<b>SUBTOTAL</b>	<b>53.9</b>												<b>6.8</b>		
<b>TOTAL</b>	<b>107.2</b>												<b>11.6</b>		

\* Area 250 feet wide upstream/downstream in which hydrologic/minor vegetative enhancement is expected. Wetland Enhancement Area 2 acreage is not included in Assessment Area acreage.

**APPENDIX B**

**SHILOH ADVANCED MITIGATION  
EFFORT CREDIT LEDGER  
(FEBRUARY 2013)**



DEPARTMENT OF THE ARMY  
JACKSONVILLE DISTRICT CORPS OF ENGINEERS  
400 HIGH POINT DRIVE, SUITE 600  
COCOA, FL 32926

REPLY TO  
ATTENTION OF

North Permits Branch  
Cocoa Section  
SAJ-2002-05046 (NW-IS)

SHILOH ADVANCED MITIGATION EFFORT (SAME)  
CREDIT LEDGER  
U.S. ARMY CORPS OF ENGINEERS  
INSTRUMENT #: SAJ-2002-05046

Transaction Number	U.S. Corps File Number	Project Name	Date of Transaction	Credits Available	Credit change Plus/minus	Balance after transaction
A	SAJ-2002-05046	Mitigation Effort	3 Sep 2003	0.00	9.40	9.40
1	SAJ-2002-05046	NASA dike	3 Sep 2003	9.40	-1.00	8.40
2	SAJ-2008-00934	NASA Mobile Launcher	4 Sep 2008	8.40	-0.11	8.29
3	SAJ-2007-05574	NASA Causeway stabilization	5 Sep 2008	8.29	-3.60	4.69
4	SAJ-2011-03035	NASA Orbiter Display facility	13 Feb 2013`	4.69	-.014	4.55

Key for Transaction Numbers:  
Credit Release = Letters (A-Z)  
Credit Withdrawal = Numbers

Date of Transaction: 20 February 2013

Authorized by: Tamara

## **APPENDIX C**

### **UMAM SUMMARY FOR NASA CAUSEWAY MITIGATION SITE**

Project: SAJ-2014-03686 NASA Advanced Ecological Mitigation		date: 1/13/2015														
Impacts :	Habitat type	Location and Landscape Support			Water Environment		Community Structure			Acres	Functional units lost	Total Impact Acres	Total Creation Acres	wetland preserve Provided	Upland preserve Provided	
		before		after	before	after	before		after							
											0	0	9.02	0		
X1											0.0000	<b>Total Functional Units lost</b>	<b>Total Functional Units gained</b>	<b>3.746</b>		
X2											0.0000					
X3											0.0000					
X4											0.0000					
X5											0.0000					
X6											0.0000					
X7											0.0000					
X8											0.0000					
X9											0.0000					
X10											0.0000					
Mitigation :	Habitat Type	Location and Landscape Support			Water Environment		Community Structure			time lag	risk factor	Preservation Adjustment Factor	Relative Functional Gain	Acres Provided	Functional Units gained	
wetland preservation		w/o CE		w/ CE	w/o CE		w/ CE	w/o CE								w/ CE
WA	saltmarsh(u)	0		7	0		9	0		9	1	1.25	1	0.6667	1.17	0.7800
WA	saltmarsh(sw)	6		7	4		9	3		9	1	1.25	1	0.3200	2.87	0.9184
WA	mudflat(u)	0		7	0		9	0		9	1	1.25	1	0.6667	0.58	0.3867
WA	mudflat(sw)	6		7	4		9	3		9	1	1.25	1	0.3200	0.88	0.2816
WA	open water(u)	0		7	0		9	0		9	1	1.25	1	0.6667	0.6	0.4000
WA	open water(sw)	6		7	4		9	3		7	1	1.25	1	0.2667	0.91	0.2427
WB	Mangrove	6		7	7		9	6		9	1	1.25	1	0.1600	0.52	0.0832
WB	saltmarsh(u)	0		7	0		9	0		9	1	1.25	1	0.6667	0.59	0.3933
WC	scrub-shrub	6		7	7		9	4		9	1	1.25	1	0.2133	0.75	0.1600
WC	saltmarsh(u)	0		7	0		9	0		9	1	1.25	1	0.6667	0.15	0.1000

## **APPENDIX D**

# **KSC CONSERVATION LANDS LAYER PRESENTATION**



# KSC Conservation Lands GIS Layer

Kennedy Space Center  
Center Operations Directorate

*Medical & Environmental Management Division*

Planning for the Next Generation  
of Space Flight at KSC



# KSC Conservation Lands GIS Layer

Kennedy Space Center  
Center Operations Directorate

Medical & Environmental Management Division

Of the 140,000 acres that make up KSC, approximately 50,000 acres are wetlands



# KSC Conservation Lands GIS Layer

Kennedy Space Center  
Center Operations Directorate

*Medical & Environmental Management Division*

- ◆ The purpose of the Conservation Lands (CL) GIS Layer is to provide a mechanism to identify and track conservation lands established to mitigate impacts from NASA, other governmental and commercial spaceflight programs at KSC.
- ◆ The CL GIS Layer Identifies KSC's long term preservation and management mitigation sites established to offset impacts to wetlands and Florida scrub jay habitat on Center.
- ◆ The layer will be integrated with the KSC Site Plan review process and KSC Environmental Checklist (NEPA) process ensuring that mitigation sites are not impacted by future development or activities.

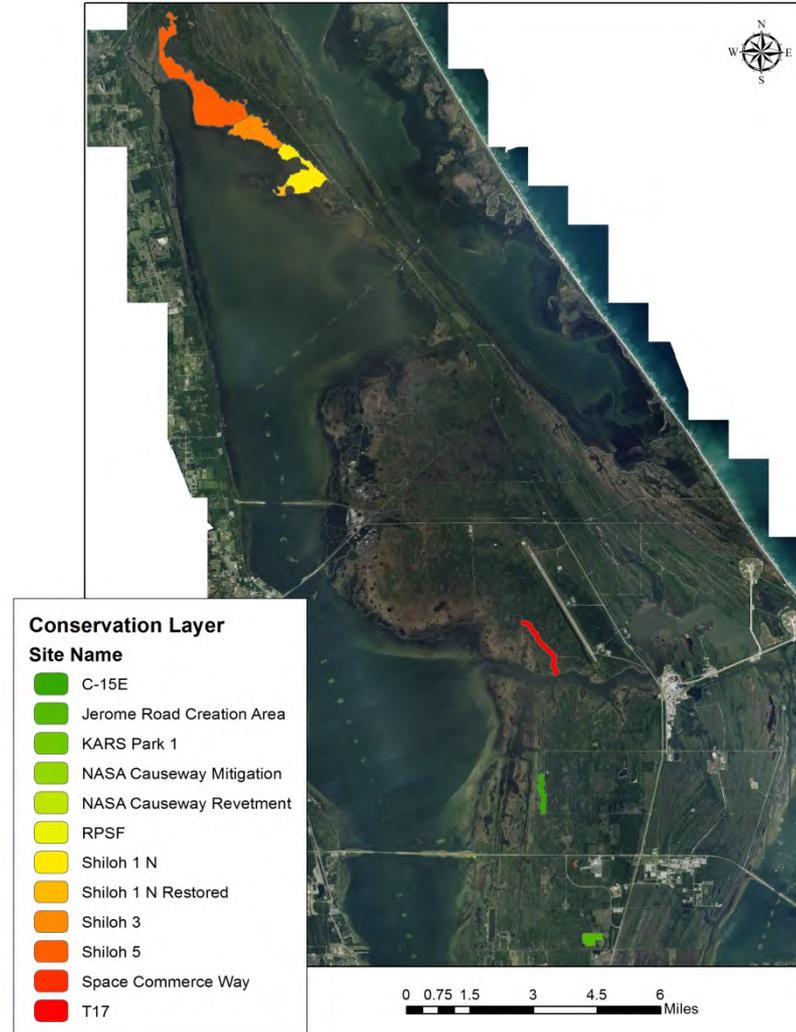


# KSC Conservation Lands GIS Layer

Kennedy Space Center  
Center Operations Directorate

◆ Expanded view showing  
All KSC wetland mitigation  
sites.

7



## **APPENDIX E**

# **MINWR LONG TERM MANAGEMENT COMMITMENT LETTER**



**United States Department of the Interior**  
**FISH AND WILDLIFE SERVICE**

Merritt Island National Wildlife Refuge  
P. O. Box 2683  
Titusville, Florida 32781  
(321) 861-0667, (321) 861-1276 FAX



October 28, 2014

In Reply Refer to:  
FWS/R4/RF/MINWR

TA-A4C

Harold Williams, Acting Division Chief  
Medical & Environmental Management Division  
John F. Kennedy Space Center  
Kennedy Space Center, FL 32899

Subject: KSC Advanced Ecological Mitigation Sites  
on the John F. Kennedy Space Center, Florida

The U.S. Fish and Wildlife Service (Service), Merritt Island National Wildlife Refuge (MINWR) recognizes the efforts of the Kennedy Space Center (KSC) Environmental Management Branch (EMB) to establish advanced ecological mitigation sites on KSC in conjunction with current and future development plans aligned with the NASA KSC vision for the next generation of space flight. We are aware that the effort will be permitted by the U.S. Army Corps of Engineers (USACE) and will require a long term management commitment once the mitigation areas are deemed successful. At that time these areas will be incorporated into the annual habitat maintenance plans as described in the MINWR Comprehensive Conservation Plan (2008). We have a long standing, robust program to manage habitats free of exotic vegetation and in an optimal state for the benefit of the animals that rely on them.

This commitment is ratified not only in the Service's mission statements and requirements but also in our Interagency Agreement, KCA-1649, Rev B. The agreement clearly identifies that MINWR has primary administration over real property at KSC that is not developed and is within our official boundary. Further, our commitment to assisting KSC with habitat management activities including control of exotic vegetation and insuring compliance with environmental permitting are described in paragraphs 3 and 15 of that document.

This letter is intended to provide assurance that long term management of the KSC, MINWR lands associated with the Advanced Ecological Mitigation project will be conducted to maintain an optimal habitat condition in perpetuity. If you have any questions or concerns, please do not hesitate to contact

me at 321-861-2278 ([layne\\_hamilton@fws.gov](mailto:layne_hamilton@fws.gov)) or Supervisory Wildlife Biologist Mike Legare at 321-861-2369 ([mike\\_legare@fws.gov](mailto:mike_legare@fws.gov)).

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Sincerely,

A handwritten signature in blue ink, appearing to read "Layne L. Hamilton", with a long horizontal flourish extending to the right.

Layne L. Hamilton  
Refuge Manager

cc: Mike Legare, Supervisory Wildlife Biologist, MINWR  
John Shaffer, Environmental Planning Lead, KSC

Enclosures

## **APPENDIX F**

### **REPORT AMMENDMENT LOG**







