Appendix 2-4: Annual Permit Report for the Allapattah Restoration Project - Phase 1, Parcel A

Permit Report (May 1, 2005–April 30, 2010)
Permit Number: 0232946-001
Permit Mod: 0232946-002-EM

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SUMMARY

Based on Florida Department of Environmental Protection (FDEP) permit reporting guidelines, **Table 1** shows cross-reference information for permit-specific conditions in the permit and the specific reference pages. **Table 2** lists key permit-related information. Table A-1 in **Attachment A** shows specific pages, tables, and graphs where project status and annual reporting requirements are addressed. **Table 3** lists the attachments included with this report. This annual report satisfies the reporting requirements specified in the permit, and is the final report required by the permit.

Table 1. Permit-specific conditions referenced in the permit.

Permit Conditions	Permit Reference 0232946-001 (Mod: 0232946-002-EM)
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Table 2. Key permit-related information.

Project Name	**Allapattah Restoration**
Permit Number	0232946-001 (Mod: 0232946-002-EM)
Issue and Expiration Date	Issue: December 30, 2004 Expiration: December 30, 2009
Project Phase	Completed
Relevant Period of Record	May 1, 2005–April 30, 2010
Report Generator	Christopher King cking@sfwmd.gov 561-682-2723
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Date	November 5, 2010

Table 3. Attachments included with this report.

Attachment	Title
A	Specific Conditions and Cross-References
B	Raw Data for Nutrients, Mercury, Pesticides, and Hydrological Analyses
C	Justification for Reducing Pesticide Monitoring for Allapattah
D	Allapattah Wetland Evaluation (WRAP) Parcel A
E	Listed Species Assessment & Habitat Mapping
F	Allapattah Flats Project Burrowing Owl and Gopher Tortoise Species Survey

BACKGROUND

PROJECT DESCRIPTION

The Allapattah Restoration, Phase 1 (Parcel A) is a component of the Indian River Lagoon South (IRL-S) Project. The IRL-S is a Comprehensive Everglades Restoration Plan (CERP) Project, which was authorized by Congress under Section 601 of the Water Resources Development Act of 2000. The CERP is a framework for modifications to the Central and Southern Florida Flood Control Project necessary to restore the South Florida ecosystem. The recommended IRL-S plan, further authorized under the 2007 Water Resources Development Act, consists of five features and/or operational modifications that, working together, would: restore a more natural volume and location of freshwater deliveries; store more water on land; reduce excessive nutrient loads contributing to muck formation, plankton blooms, and fish kills; restore natural water storage functions to terrestrial wetlands in the watershed; and restore water quality and more natural estuarine bottom communities.

The first portion of the IRL-S Project, the Allapattah Restoration, Phase I project component, is a natural storage and treatment area designed to provide additional freshwater storage through retention in on-site wetland areas that will reduce phosphorus and nitrogen loads to the estuaries, provide increased spatial extent of natural wetlands and upland habitat for wildlife, and provide recharge to the surficial aquifer. The Allapattah Restoration, Phase 1 project component consists of filling and/or plugging existing agricultural drainage ditches, constructing a perimeter berm, replacing one and constructing one new water control structure, and replacing a culvert structure under one of the site's main access and management roads. During this project component, previously drained wetland areas will be returned to a sheetflow character and the land elevations will be restored as much as possible to a pre-drainage character. Four new hydrologic monitoring stations will be constructed in addition to the existing stations to monitor the water levels within the area of the project component. Approximately 33 acres of wetlands will be directly and indirectly impacted during construction through the filling of ditches and berm construction; however, approximately 1,500 acres of predominantly emergent wetlands will be restored as a result of this project component. All the surface waters and wetlands to be directly impacted by construction of this project component are Class III Waters.

The South Florida Water Management District (SFWMD or District) is the local sponsor of this project component and is responsible for operation, maintenance, repair, replacement, and rehabilitation.

PROJECT LOCATION

The Allapattah Restoration, Phase 1 project component is bounded on the north by the C-23 canal, on the west by County Road 609, and on the south by State Road 714 and is located in Sections 5-9 and 16-18, Township 38 South, Range 39 East.

PROJECT OBJECTIVE

The Allapattah Restoration, Phase 1 (Parcel A) is a component of the IRL-S Project. The Final Feasibility Study for the IRL-S Project recommends a plan in Martin, St. Lucie, and Okeechobee counties that will improve water quality within the St. Lucie Estuary and the Indian River Lagoon by reducing the damaging effects of watershed runoff, reducing high peak freshwater discharges to control salinity levels, and reducing nutrient loads, pesticides and other pollutants. The project will also provide water supply for agriculture to reduce reliance on the Floridan aquifer.

PROJECT HISTORY

The IRL-S Project Implementation Report (PIR) Recommended Plan, authorized under WRDA 2007, proposed the acquisition and restoration of approximately 92,000 acres of natural land within Martin and St. Lucie counties, including 42,348 acres within what is known as the Allapattah Complex. The SFWMD has acquired approximately 50 percent of the proposed lands, consisting of the majority of the former Allapattah Ranch as well as several smaller out parcels. The subject of this permit report includes approximately 5,120 acres of the area of the former ranch that are located north of CR714 and east of CR609, and is noted as Parcel A (**Figure 1**). The property drains from south to north through three primary agricultural ditches that intercept drainage from wetland-to-wetland ditches. These primary ditches ultimately discharge through existing culvert connections to the C-23 canal. It is important to note that these primary agricultural drainage ditches also extend onto, and provide drainage for, Parcel B, via culverts that extend under CR 714.

Long-term drainage of the property has reduced the quality and quantity of the property's wetlands, which were historically comprised primarily of freshwater marshes, wet and dry prairie, and hydric flatwoods, along with some areas of maple and bay swamp.

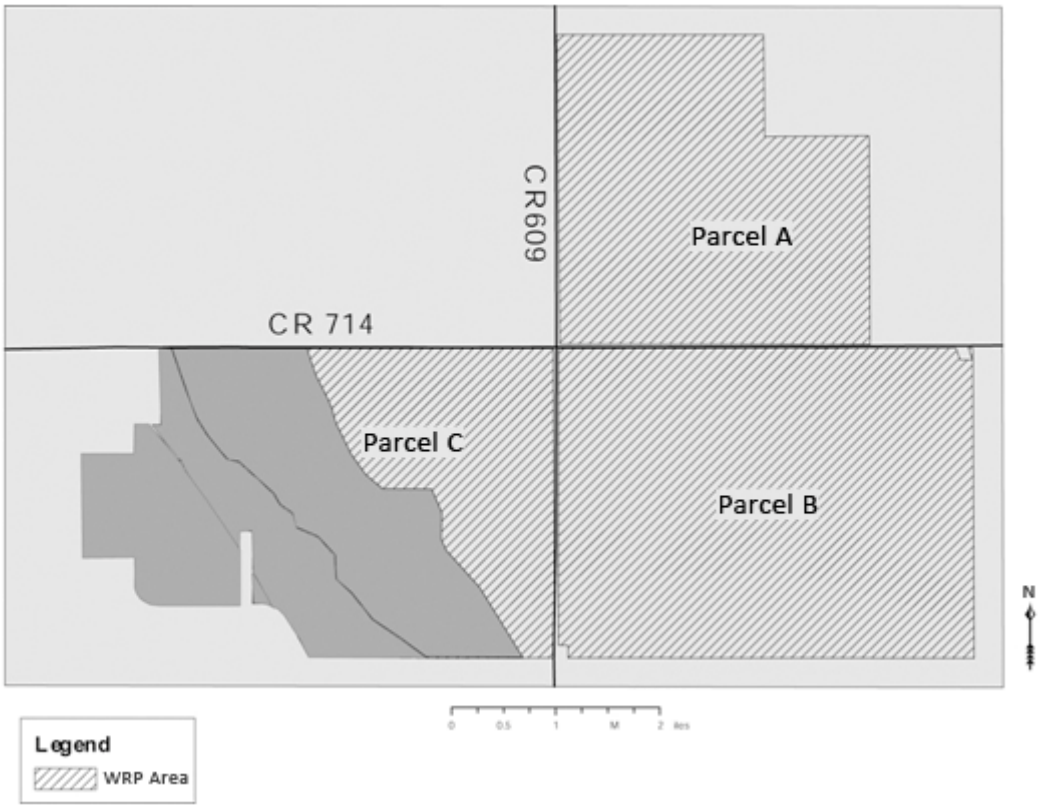

Figure 1. Allapattah East, Parcels A, B, and C, including the boundary of the Wetland Reserve Program (WRP area) easement.

The permit-allowed construction activities associated with Parcel A included filling or plugging wetland-to-wetland connector ditches while maintaining the existing primary north/south agricultural ditches. New culverts and control structures were proposed at two locations and berms were proposed at strategic locations along the property perimeter to protect adjacent property and roadways, as indicated in **Figure 2**. These activities were intended to address a number of goals, including, but not limited to: increasing the spatial extent of wetlands to a state as close to the pre-drainage conditions as possible; improving the habitat value for threatened and endangered species and other wildlife; and improving water quality through retention of rainfall in on-site wetlands, thereby decreasing runoff, which contributes to excessive, ecologically harmful freshwater flows to the St. Lucie Estuary.

A Wetland Reserve Program easement exists over 15,371 acres of the entire Allapattah property (**Figure 1**), which includes all of Parcel A (the subject of the permit), with the exception of several small outparcels totaling about 50 to 55 acres to allow for accommodating the public. The easement is consistent with the wetland restoration activities outlined in the PIR.

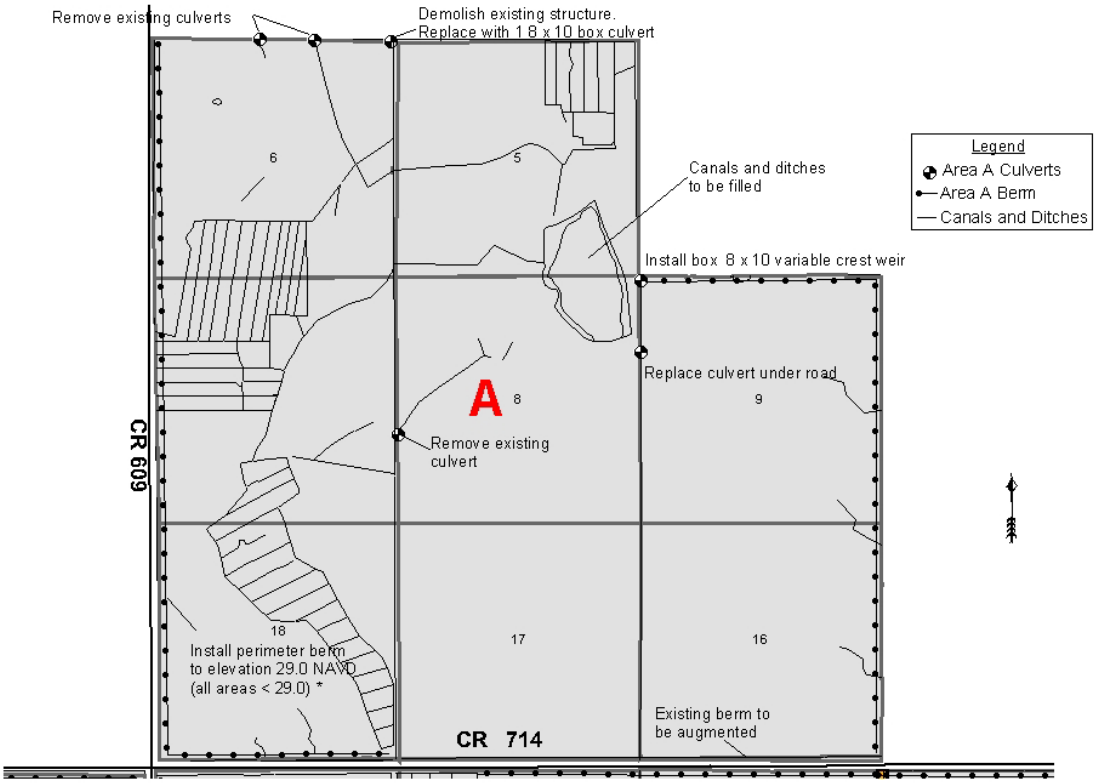

Figure 2. Schematic of Parcel A drainage ditches and proposed berm locations.

PROJECT STATUS

Construction Activities

With respect to the permitted construction, approximately 15 miles of ditches within sections 6, 7, and 18 (TWP38E, Range 39S) and 2 miles of ditches within section 5 (TWP 38E, Range 39S) have been filled. Additionally, one of the two proposed water control structures was completed (G-450 at ACRA1 at the terminus of the primary agricultural north/south drainage ditch between sections 5 and 6) and a berm to elevation 29 feet was constructed along the west side of the parcel. These activities were completed between 2005 and 2006.

Exotic and Undesirable Plant Species Treatment

An assessment of the exotic plant species present on the property was conducted and a number of problematic species were identified and targeted through an aggressive program to achieve a maintenance-level control of the site's exotics. Large stands of Brazilian pepper (*Schinus terebinthifolius*) were located along the spoil mounds adjacent to drainage ditches, along fence lines, and within and adjacent to pastures and natural areas. Melaleuca (*Melaleuca* sp.) heads have been noted in several locations. Old World climbing fern (*Lygodium microphyllum*) is located throughout the property, though primarily within the remaining bayheads and swamp maple forested areas. Additional problematic species observed include cogongrass (*Imperata cylindrica*), non-native lantana (*Lantana* sp.), torpedograss (*Panicum repens*), balsam apple (*Momordica charantia*), Chinese tallow (*Sapium sebiferum*), guava (*Psidium guajava),* and tropical soda apple (*Solanum viarum*). Frequent maintenance of the primary north–south ditches is needed since there are infestations of water hyacinth (*Eichornia crassipes*) and water lettuce (*Pistia stratiotes*). The main ditches that run north–south will remain to provide water control to prevent off-site impacts.

Over the past 5 years, ground crews have conducted broad land-based sweeps of the property to assess and treat these exotic plant populations, particularly cogongrass and torpedograss, along with the non-extensive populations of Brazilian pepper, guava, and melaleuca. Large infestations of Brazilian pepper that were located along the drainage ditches that are to remain have been treated either mechanically or with herbicide, primarily via ground treatment. In those areas where infestation was particularly heavy, the trees were physically removed. Brazilian pepper located along fence lines was treated with land-based application of the appropriate herbicide. In some extensively infested areas, aerial treatments of Brazilian pepper and lygodium were conducted. Additionally, coordination with Martin County has resulted in treatment of Brazilian pepper adjacent to the property along the road rights-of-way to limit seed sources. Treatment of exotic species on the property will continue to the extent that budgets allow, to provide for the basic level of maintenance control.

Prescribed Burning

A prescribed burning management plan has been developed for the entire Allapattah property. The appropriate timing and frequency of prescribed burning will contribute to the wetland restoration and enhancement objectives, augment ecological succession, and enhance the health of the ecological communities. Fire is an important management tool that will aid in increasing plant diversity and in maintaining feeding habitat for waterfowl and wading birds.

Prescribed fire activities have been conducted over approximately 1,200 acres of pine flatwoods area within Parcel A in 2005 and again in 2008. **Figure 3** shows a prescribed fire event.

Figure 3. A prescribed fire event in the Allapattah flats.

PROBLEMS ENCOUNTERED

Subsequent to the construction work being completed, economic conditions were such that agency priorities were readjusted and additional work planned under the permit was not completed due to budgetary constraints. Additional ditch filling, water control structures, and protective berms will be necessary in a future phase, when budget conditions improve.

A more holistic approach to the restoration will be necessary to ensure that roadways and adjacent areas are not impacted. Since one of the goals of the holistic IRL-S Project is to reduce or eliminate flows from the C-23 canal to the St. Lucie Estuary, and since the C-44 reservoir and Stormwater Treatment Area, located immediately south of Allapattah Parcel B, is expected to be constructed in the near future, it will be important to assess the potential for sending Allapattah water southward (in keeping with natural drainage patterns) to be captured by the C-44 project. This could minimize flows to the C-23 canal, while maximizing historic sheetflow patterns for the entire property.

OPERATIONS AND MAINTENANCE PLAN

The restoration of the Allapattah Complex is rainfall-driven. It is not anticipated that water will be pumped onto or off the property. A gravity water control structure, G-450, was installed within the main north-south drainage ditch at the point where it exits the property's perimeter. This is a passive structure that is operated only under emergency conditions or to provide land managers with the ability to draw down water levels, if necessary, to effect management activities such as prescribed burning, roadway maintenance, and tree planting. The G-450 structure includes a broad-crested top-discharging weir with the top elevation of the weir set at 27.43 ft relative to the National Geodetic Vertical Datum (NGVD) (26 ft relative to the North American Vertical Datum [NAVD]). Stage recorders were installed immediately upstream of this water control structure, near the upstream end of the main north–south drainage ditches, and within select wetland systems on the property. Review of stage data and wetland responses allow adaptive management decisions in the operation of the structure to effect appropriate wetland elevations throughout the property. It was expected initially that the weir elevations would be increased 6 inches per year, beginning at 27.43 ft NGVD (26 ft NAVD) (the point at which approximately 20 percent of the property is indicated to be wetland – which is the current condition), over a period of 3 years, to a maximum of 28.73 ft NGVD (27.3 ft NAVD). However, the weirs cannot be set at the full restoration elevation until remaining berms have been constructed to protect adjacent properties and roadways. Berms would allow water levels during high rainfall seasons to approach 30.43 ft NGVD (29 ft NAVD). During such events, the weir elevation would be lowered to prevent overtopping of the berms, if necessary. Once water levels have receded to the point where there is no longer a risk of overtopping the berms, elevation would be set back to the appropriate height.

Regular maintenance (removal of nuisance plants and shoal areas) has been performed for the main north-south drainage ditches.

Operational Protocol for Allapattah Weir Structure G-450

The G-450 structure is designed to achieve wet season target elevations within the Allapattah wetlands at 28.93 ft NGVD (27.5 ft NAVD). The weir elevation (notch) is to be set at elevation 27.43 ft NGVD (26 ft NAVD) during the dry season and through the early wet season. Operation of the weir should be limited, particularly early in the wet season as the internal wetland elevations are increasing. As the water levels rise throughout the property they will flow into the north/south ditch, filling the ditch to the point where the water will begin to flow over the weir. Once the wet season target has been reached, it is important to remain aware of storms and storm systems on a daily basis to adjust the weir stage to accommodate increasing water levels on the property and within the ditch to avoid any roadway impacts. The structure is designed to prevent 'flashy' management of water levels across the property, so the first defense against increasing water levels is to drop the weir incrementally to reduce stages back to the target elevation. At times, however, it will be necessary to drop water levels quickly due to impending storms with predicted heavy rainfall, particularly if the interior wetlands are at the target stage. This is an intuitive process, but decisions will need to be made relatively quickly to avoid impacting adjacent roadways. If the gate is operated (i.e., opened from the bottom) it is important to be aware that the bottom gate will not seat properly into the closed position unless the top gate is first lowered to be flush with the bottom gate (that is, the top gate must be used to seat the bottom gate). Once the bottom gate is seated, the top gate should be raised back to the control elevation.

The structure has been operated by the SFWMD. An operational log that includes the date, time, and method (weir lowered or raised, elevation, or gate opened/closed) has been maintained for all structure operations.

Stage recorders are located throughout the Allapattah property. Though telemetry is not available for this site, the data are downloaded every day at midnight. The stage recorder designated as ACRA1 is located immediately upstream of G-450. ACRA4 is located in the same ditch, at the southern end of the property (just north of Coca Cola Road). Wetland stage recorders ACRA5 and ACRA8 are most appropriate to monitor interior wetland stages with respect to this structure.

WATER QUALITY MONITORING

Water at Allapattah Parcel A was monitored for nutrients, mercury, and pesticides, as required in the permit (see **Attachment A** for cross-reference information). The following sections provide summaries of monitoring results for each of these constituents.

NUTRIENT DATA SUMMARY

Water quality monitoring for nutrients was conducted at four sites (ACRA1, ACRA1A, ACRA2, and ACRA5A) for total phosphorus, total Kjeldahl nitrogen, total nitrate and nitrite, and total ammonia. The compliance sites required by the permit are ACRA1 as the water quality (WQ) site and ACRA1A as the interior marsh site.

Summaries of analytical results for these parameters are shown for each site, for Water Year 2006 (WY2006) through WY2010 (each water year begins May 1 and ends April 30 of the following year) in **Table 4** through **Table 7**. Data used for these summaries is included in **Attachment B**.

Table 4. Water quality data summary for station ACRA1 by water year (WY) for WY2006 through WY2010. ACRA1 is the water quality site required by the permit.

Parameter (Sampling Method)	Water Year	Number of Samples	Concentration (mg/L)			Standard Deviation
			Minimum	Maximum	Mean	
Total Phosphorus (Grab)	WY2006	24	0.212	2.73	0.946	0.59
	WY2007	15	0.044	1.65	0.398	0.536
	WY2008	22	0.103	2.226	1.029	0.684
	WY2009	24	0.052	2.126	0.595	0.667
	WY2010	25	0.094	2.088	0.881	0.552
Total Phosphorus (Autosampler)	WY2006	42	0.203	2.52	0.884	0.52
	WY2007	26	0.018	2.06	0.442	0.591
	WY2008	45	0.068	3.637	0.911	0.806
	WY2009	51	0.059	2.443	0.586	0.684
	WY2010	50	0.087	2.22	0.889	0.552
Total Kjeldahl Nitrogen (Grab)	WY2006	23	0.8	2.15	1.49	0.377
	WY2007	15	1.04	5.21	1.783	1.121
	WY2008	21	1.17	5.23	2.111	0.934
	WY2009	24	1.03	2.43	1.718	0.428
	WY2010	25	1.16	10.32	2.437	2.357
Nitrate/Nitrite (as N) (Grab)	WY2006	23	<0.006	0.206	0.038	0.048
	WY2007	14	<0.006	0.117	0.021	0.034
	WY2008	20	<0.005	0.129	0.023	0.029
	WY2009	22	<0.005	0.101	0.017	0.023
	WY2010	22	<0.005	0.009	<0.005	0.002
Ammonia (as N) (Grab)	WY2006	23	<0.009	0.345	0.122	0.101
	WY2007	15	<0.009	0.523	0.074	0.144
	WY2008	22	0.016	0.261	0.065	0.068
	WY2009	22	0.014	0.376	0.07	0.085
	WY2010	17	0.019	3.329	0.259	0.795

Table 5. Water quality data summary for station ACRA1A by water year for WY2006 through WY2010. ACRA1A is the interior marsh site required by the permit.

Parameter (Sampling Method)	Water Year	Number of Samples	Concentration (mg/L)			Standard Deviation
			Minimum	Maximum	Mean	
Total Phosphorus (Grab)	WY2006	13	0.03	0.19	0.078	0.055
	WY2007	7	0.325	8.64	3.161	3.199
	WY2008	10	0.023	5.681	0.726	1.754
	WY2009	11	0.026	4.995	0.675	1.477
	WY2010	13	0.028	4.108	0.526	1.202
Total Kjeldahl Nitrogen (Grab)	WY2006	13	0.83	3.56	1.572	0.793
	WY2007	7	2.68	34.75	12.399	12.706
	WY2008	9	1.35	7.62	2.832	2.073
	WY2009	11	1.1	32.54	5.355	9.105
	WY2010	13	1.34	10.72	2.959	2.492
Nitrate/Nitrite (as N) (Grab)	WY2006	13	0.008	0.038	0.013	0.008
	WY2007	6	<0.006	0.02	0.011	0.006
	WY2008	9	<0.005	0.053	0.016	0.015
	WY2009	11	<0.005	0.015	0.008	0.004
	WY2010	13	<0.005	0.017	<0.005	0.004
Ammonia (as N) (Grab)	WY2006	13	<0.009	0.079	0.024	0.019
	WY2007	7	0.038	9.108	2.252	3.553
	WY2008	10	0.027	2.546	0.296	0.791
	WY2009	11	0.026	12.41	1.21	3.717
	WY2010	8	0.034	7.132	0.944	2.5

Table 6. Water quality data summary for station ACRA2 by water year for WY2006 through WY2010. ACRA2 is not a permit-required site for water quality.

Parameter (Sampling Method)	Water Year	Number of Samples	Concentration (mg/L)			Standard Deviation
			Minimum	Maximum	Mean	
Total Phosphorus (Grab)	WY2006	26	0.087	2.86	0.958	0.731
	WY2007	21	0.072	5.395	0.726	1.225
	WY2008	16	0.236	1.907	1.013	0.612
	WY2009	19	0.111	2.361	0.819	0.691
	WY2010	20	0.095	2.36	0.917	0.694
Total Phosphorus (Autosampler)	WY2006	48	0.091	3.22	0.925	0.709
	WY2007	42	0.06	2.37	0.362	0.562
	WY2008	38	0.094	1.962	1.012	0.556
	WY2009	35	0.135	2.647	0.779	0.67
	WY2010	43	0.05	2.994	1.038	0.78
Total Kjeldahl Nitrogen (Grab)	WY2006	26	0.77	7.08	1.666	1.233
	WY2007	21	1.04	9.71	2.148	1.804
	WY2008	16	1.23	4.71	1.792	0.84
	WY2009	19	1.07	2.15	1.5	0.414
	WY2010	20	1.03	4.09	1.891	0.786
Nitrate/Nitrite (as N) (Grab)	WY2006	25	<0.006	0.104	0.019	0.022
	WY2007	20	<0.006	0.022	0.008	0.006
	WY2008	15	<0.005	0.058	0.022	0.019
	WY2009	17	<0.005	0.054	0.017	0.018
	WY2010	18	<0.005	0.023	0.008	0.006
Ammonia (as N) (Grab)	WY2006	26	<0.009	2.12	0.192	0.45
	WY2007	21	<0.009	0.158	0.028	0.036
	WY2008	16	0.02	0.085	0.047	0.02
	WY2009	17	0.021	0.361	0.069	0.08
	WY2010	12	0.018	1.316	0.199	0.387

Table 7. Water quality data summary for station ACRA5A by water year for WY2006 through WY2010. ACRA5A is not a permit-required site for water quality.

Parameter (Sampling Method)	Water Year	Number of Samples	Concentration (mg/L)			Standard Deviation
			Minimum	Maximum	Mean	
Total Phosphorus (Grab)	WY2006	8	0.097	3.06	0.632	1.005
	WY2007	0	---	---	---	---
	WY2008	2	0.566	1.3	0.933	---
	WY2009	6	0.019	3.271	2.101	1.229
	WY2010	8	0.824	2.053	1.516	0.503
Total Kjeldahl Nitrogen (Grab)	WY2006	8	1.08	2.36	1.654	0.407
	WY2007	0	---	---	---	---
	WY2008	2	1.34	6.48	3.91	---
	WY2009	6	1.36	3.32	2.507	0.814
	WY2010	7	2.49	3.57	3.056	0.373
Total Nitrate/Nitrite (as N) (Grab)	WY2006	8	<0.006	0.014	0.008	0.004
	WY2007	0	---	---	---	---
	WY2008	2	0.014	0.069	0.041	---
	WY2009	6	<0.005	0.007	0.005	0.001
	WY2010	4	<0.005	0.006	<0.005	0.002
Total Ammonia (as N) (Grab)	WY2006	8	<0.009	0.07	0.022	0.021
	WY2007	0	---	---	---	---
	WY2008	2	0.045	0.048	0.047	---
	WY2009	6	0.022	0.037	0.03	0.006
	WY2010	2	0.052	0.069	0.06	---

MERCURY DATA SUMMARY

Routine fish mercury (Hg) monitoring has been conducted for the Allapattah Project since 2005. Summary information follows in **Table 8** through **Table 11**. Data used for these analyses are included in **Attachment B**.

Mosquitofish Evaluation

Since basin-specific data are lacking, all mosquitofish total mercury (THg) concentrations, including THg concentrations for sunfish and largemouth bass, have been compared to the 75th percentile concentration for the period of record for all basins. From 2005 to 2010, two mosquitofish composites exceeded the 75th percentile for the 1999 to 2008 period over all basins (97.2 ng/g, Gabriel et al., 2010). The aliquots that exceeded the 75th percentile were collected from station ACRA1B in 2008 and 2009. These composite concentrations were 98 and 117 ng/g, respectively.

Table 8. Data summary for THg (ng/g) in mosquitofish for the Allapattah Project (stations ACRA1B, ACRA1, ACRA1A, ACRA7, and ACRA8) (2005 to 2010).

Size (n)	Mean	Std. Dev.	90% C.I. (about the mean)	
58	35.5	40.5	8.7	
Max	**Min**	**Median**	**10th Percentile**	**90th Percentile**
145	1.70	17.5	3.0	95.2

Between 2005 and 2010, average THg concentrations in mosquitofish composites did not exceed the 75th percentile for the period of record (97.2 ng/g). Average annual mosquitofish THg concentrations for the Allapattah Project are summarized in **Table 9**. From 2005 to 2010, mosquitofish THg concentrations do not show a statistically significant increase (Pearson r = 0.66; p = 0.16) (**Table 9**).

Table 9. Average annual mosquitofish THg concentrations for the Allapattah Project (2005 to 2010).

Year	Average annual mosquitofish THg concentration (ng/g)
2005	14.0
2006	37.7
2007	27.0
2008	34.7
2009	45.7
2010	34.1

Large-Bodied Fish Evaluation

From 2005 to 2009, the average annual THg concentration in largemouth bass and sunfish did not exceed their respective 75th percentiles (230 ng/g [sunfish] and 670 ng/g [largemouth bass], Gabriel et al., 2010) for the 1999 to 2008 period over all basins. Average annual THg concentrations for sunfish and largemouth bass for the Allapattah Project are summarized in **Table 10**.

Table 10. THg concentration in large-bodied fish for the Allapattah Project (2005 to 2009).

Year	Sunfish (includes all species and ages) (ng/g)	Largemouth bass (includes all ages) (ng/g)
2005	N/A	N/A
2006	89.6	212
2007	41.6	146
2008	124	158
2009	149	170

N/A indicates at least three samples were not available

Between 2006 and 2009 sunfish (bluegill [*Lepomis macrochirus*]) demonstrate a temporal increase; however, the trend was not statistically significant (Pearson r = 0.80, p = 0.21) (**Table 11**). There is no time during the period of record where largemouth bass show an apparent increase in THg concentration that would warrant statistical evaluation (**Table 11**).

Table 11. Standardized THg concentrations for large-bodied fish for the Allapattah project (2005 to 2009); averages presented.

Year	Sunfish[#] THg (length standardized, species *Lepomis macrochirus* [ng/g/mm])	Largemouth bass* THg (length standardized [ng/g/mm])
2005	NA	NA
2006	0.54	NA
2007	0.29	NA
2008	0.83	0.49
2009	1.00	0.49

NA indicates at least three samples were not available

[#] All sunfish were between lengths 102 and 178 mm (*CERP Guidance Memorandum 42: Toxic Substances Screening Process – Mercury and Pesticides*)

* All largemouth bass were between lengths 307 and 385 mm (*CERP Guidance Memorandum 42: Toxic Substances Screening Process – Mercury and Pesticides*), which largely encompasses age 2 to 3 year old largemouth bass

PESTICIDE DATA SUMMARY

In September 2008, a modification (0232946-002-EM) was granted, eliminating the requirement to monitor for pesticides in fish tissue in Allapattah Parcel A. To justify the modification, an analysis was conducted in September 2008, using data through April 2008 (**Attachment C**). Additional data was collected between April 2008 and September 2008, and is included in **Attachment B**.

RELATED MONITORING AND ANALYSIS

In addition to monitoring activities required in the permit, additional monitoring activities and studies were required in accordance with the document entitled, "Draft Ecological and Water Quality Monitoring Plan for the Indian River Lagoon South Project," which was submitted as Appendix A of the SFWMD's permit application. The following sections describe monitoring and studies conducted in accordance with this plan, including hydrological monitoring and ecological monitoring and surveys.

HYDROLOGICAL DATA SUMMARY

This section presents hydrologic monitoring data summary for the Allapattah Project. Rainfall data is available from two sites. Evapotranspiration was computed on daily basis using a model used by the District to derive wetland evapotranspiration from solar radiation (Abtew, 1996). Solar radiation from the weather station at the project site was used to derive evapotranspiration. Stage recorders were installed at nine locations throughout the Allapattah property in 2004, and were fully operational and collecting data by January 2005. The stage recorders were installed and calibrated to NGVD elevations. The NAVD elevation conversion for this area is -1.43 ft. The stage recorders associated with Parcel A are ACRA1, ACRA3 (within drainage ditches), and ACRA 5 and ACRA 6 (wetland recorders). Summary of the hydrologic monitoring sites and dbkeys in DBHYDRO (a District database) are shown in **Table 12**. Daily rainfall over the project site is depicted in **Figure 4**.

Table 12. Hydrologic monitoring stations and database dbkeys.

Site Name	Dbkey	Parameter	Comment
ACCRA2_R	SX445	Rainfall	Gaps filled from ACRAWX (UA568)
ACRAWX	UA576	Evapotranspiration	Derived from solar radiation; gaps filled from SVWX (16024), S65DWX (OH511) L001 (OH509)
ACRA1	SX441	Stage	North/south drainage ditch
ACRA2	SX443	Stage	North/south drainage ditch
ACRA3	SX447	Stage	North/south drainage ditch
ACRA4	SX449	Stage	North/south drainage ditch
ACRA5	SX451	Stage	Parcel A wetland stages
ACRA6	SX453	Stage	Parcel A wetland stages
ACRA7	SY978	Stage	
ACRA8	SY980	Stage	
ACRA9	SY982	Stage	

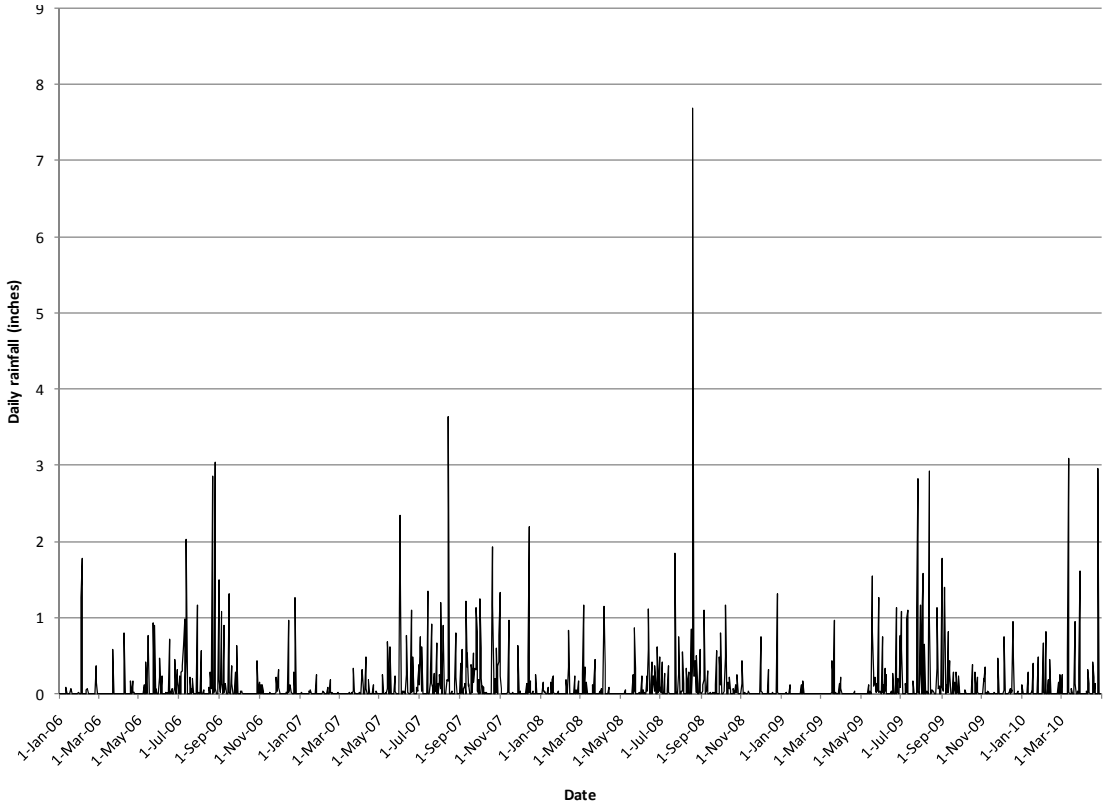

Figure 4. Daily rainfall at the Allapattah Project.

The period from 2006 to 2009 was generally dry and that is reflected in the rainfall over the project area. Daily wetland evapotranspiration over the project area is shown in **Figure 5**. Further comparison of monthly rainfall and monthly evapotranspiration (**Table 13**) shows that on an annual basis evapotranspiration was higher than rainfall. Most of the months showed rainfall less than evapotranspiration. Water level (stage) in the wetlands reflects the drought condition where aboveground ponding was limited to the wet months. **Figure 6** depicts stages in the wetland and ground elevation at the sites where stage is monitored. Stages in the Allapattah main north/south drainage ditches also show the seasonal pattern of water levels (**Figure 7**).

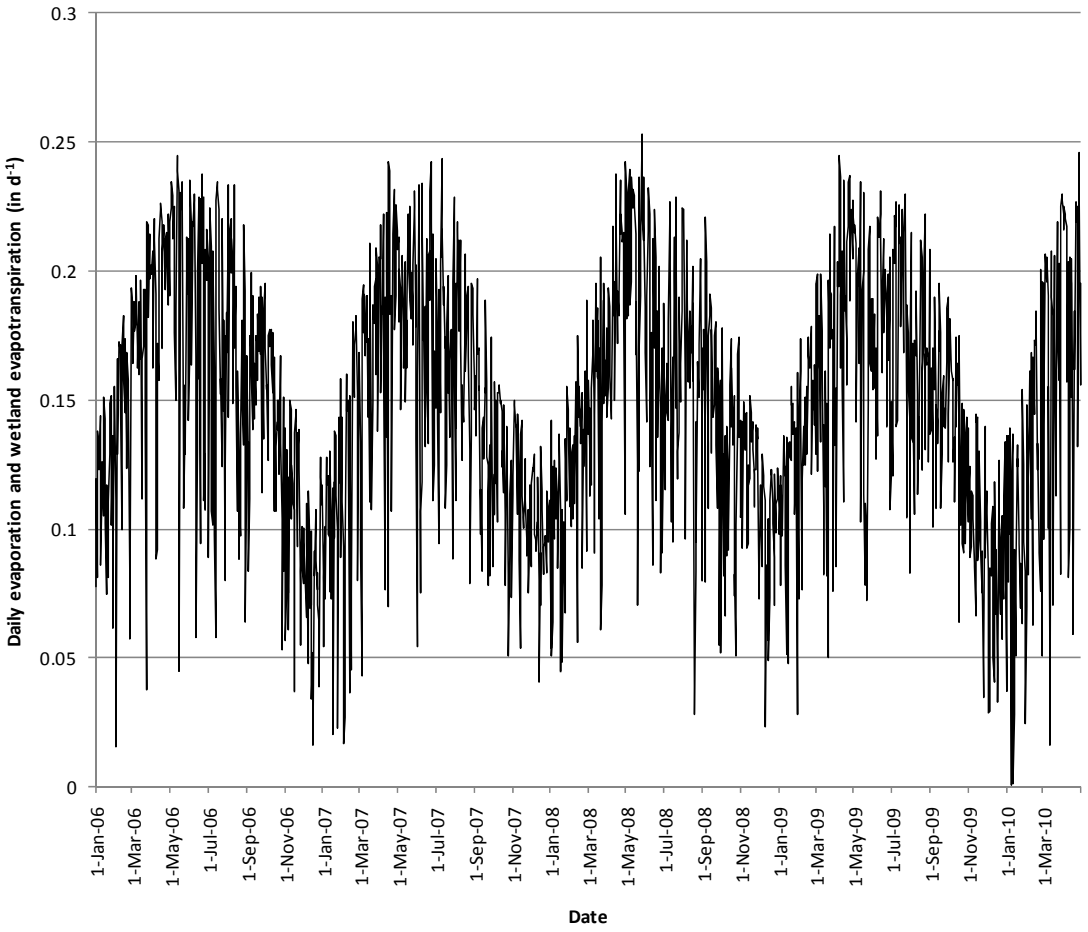

Figure 5. Daily wetland evapotranspiration at the Allapattah Project.

Table 13. Monthly rainfall and evapotranspiration (January 1, 2006–April 30, 2010). Months when rainfall was higher than evapotranspiration are shown in bold.

Month	2006		2007		2008		2009		2010	
	Rain	ET	Rain	ET	Rain	ET	Rain	ET	Rain	ET
Jan	0.17	3.57	0.35	3.17	0.96	3.24	0.25	3.59	1.35	2.82
Feb	3.68	3.86	0.38	3.43	1.82	3.77	0.17	4.01	2.55	3.62
Mar	0.59	5.52	0.42	5.11	2.66	4.60	2	4.75	**6.99**	5.05
Apr	1.17	5.78	1.27	5.71	1.66	5.71	0.09	5.77	4.23	5.47
May	3.92	5.93	2.21	5.92	1.55	6.26	4.89	5.25		
Jun	2.91	5.50	**7.74**	5.14	4.82	4.92	4.01	5.42		
Jul	**7.27**	5.20	**6.38**	5.32	4.19	5.20	**9.57**	5.62		
Aug	**9.06**	5.19	**7.77**	5.27	**13.06**	4.76	**9.06**	5.07		
Sep	**5.16**	4.85	**7.82**	4.16	4	4.46	**6.14**	4.52		
Oct	0.68	4.50	**9.31**	3.69	2.76	3.96	0.95	4.19		
Nov	1.03	3.21	2	3.45	1.39	3.80	1.25	3.06		
Dec	**2.86**	2.61	**3.32**	3.13	1.73	3.08	**2.61**	2.58		
Total	38.50	55.72	48.97	53.50	40.60	53.74	40.99	53.83	15.12	16.97
Rain-ET	-17.22		-4.53		-13.14		-12.84		-1.85	

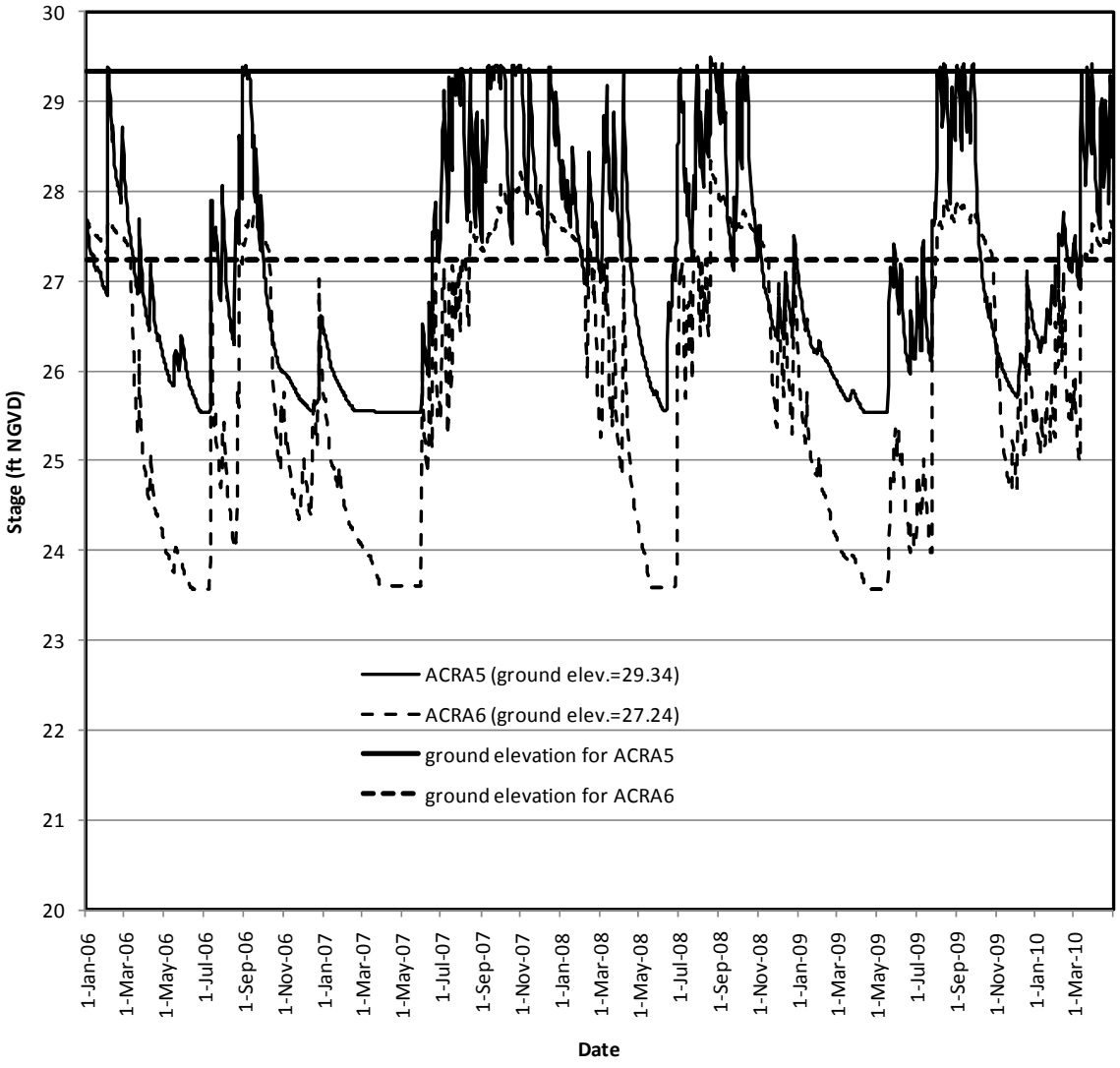

Figure 6. Allapattah wetland stage and ground elevation.

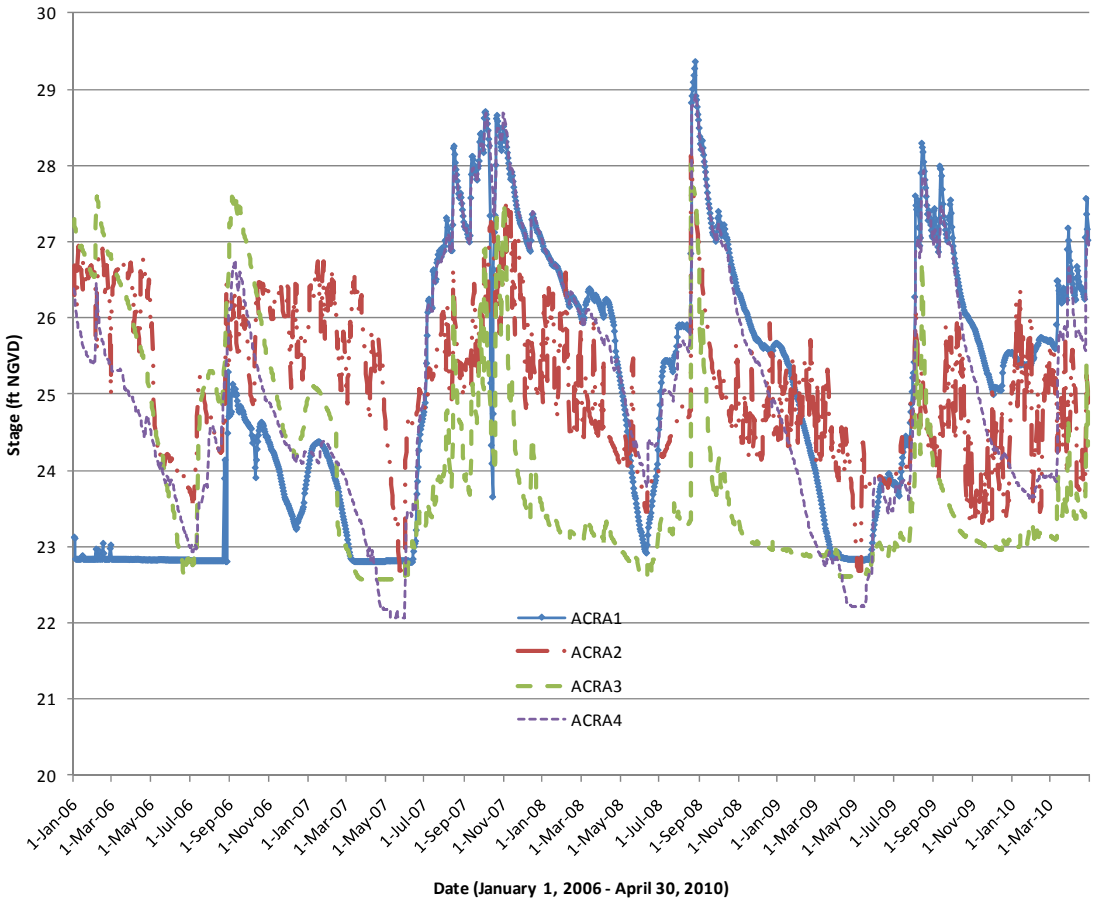

Figure 7. Stages within Allapattah main north–south ditches.

ECOLOGICAL MONITORING AND SURVEY RESULTS

Between January 2003 and January 2004, a pre-construction wetland rapid assessment procedure (WRAP) was conducted for the Allapattah Project, Parcel A. WRAP results are included in **Attachment D**. A post-construction WRAP assessment is planned for early 2011. Baseline wildlife monitoring was conducted through a listed species assessment and habitat mapping in 2006 (**Attachment E**). A follow-up burrowing owl and gopher tortoise species survey was conducted post-construction, in 2009 (**Attachment F**).

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Attachment A: Specific Conditions and Cross-References

Table A-1. Specific conditions and cross-references presented in this report.

Condition	Table	Narrative (pages)	Figure	Attachment
16. Operations Phase	---	App. 2-4-3 – 2-4-9	2, 3	---
17. Monitoring Requirements	4–7	App. 2-4-9 – 2-4-13	---	B
18. Related Monitoring and Analysis	12, 13	App. 2-4-16 – 2-4-23	4–7	B, D, E, & F
19. Mercury and Pesticide Monitoring	8–11	App. 2-4-14 – 2-4-16	---	B, C
20. Quality Assurance and Quality Control	---	---	---	B
21. Method Detection Limits (MDLs)	---	---	---	B
23. Annual Water Quality Monitoring Reports	All tables	Entire report	All figures	All attachments
25. Removal of Parameters	---	App. 2-4-16	---	C
28. Permit Modifications	---	App. 2-4-16	---	C

Attachment B: Raw Data for Nutrients, Mercury, Pesticides and Hydrological Analyses

In accordance with Specific Condition 23 of the Allapattah Restoration, Phase 1 (Parcel A) permit (FDEP Permit Number 0232946-001, Permit Modification 0232946-002-EM), this supporting information is available upon request.

Attachment C: Justification for Reducing Pesticide Monitoring for Allapattah

September 2008

Justification for Reducing Pesticide Monitoring for Allapattah

A Protocol for Monitoring Mercury and Other Toxicants (*Protocol*) dated February 13, 2006 makes the following recommendation for reducing toxicant monitoring if the following action levels are not exceeded:

- the critical tissue benchmark used to establish Sediment Quality Assessment Guidelines or developed during site-specific risk assessments; or
- the annual average toxicant level in a given fish species become elevated to the point of exceeding the 90% upper confidence level of the annual basin-wide average, or if basin specific data are lacking, exceeding the 75th percentile concentration for the period of record for all basins; or
- the annual average levels of a residue in a given fish species increase progressively over time (i.e., two or more years).

Samples were collected from six different sites from November 2005 to April 2008. Fish species collected included mosquito fish, bluegill, and largemouth bass. Initially, the analysis consisted of organochlorine pesticides. For subsequent samples, the analytes were reduced to just the compounds of potential concern based on the project site assessment. All of the fish tissue pesticide concentrations were below critical tissue benchmarks (Tables 1, 3, and 4) (Newfields 2006, Newell et al. 1987, Environment Canada 1999, U.S. Environmental Protection Agency 2000).

Additionally, the Allapattah project has not exceeded any of these criteria:

Mosquitofish Evaluation

For all years no annual mosquitofish composite exceeded the 90th percentile for the period of record for the basins monitoring stations. Table 1 provides the mosquitofish pesticide concentrations for each year.

Table 1. Summary of mosquitofish pesticide analysis for Allapattah Project.

Site	Date Collected	p,p'-DDE µg/Kg wet weight	Analytes	Criteria								
				Newfields 2006 (1) p,p'-DDE µg/Kg wet weight					Newell, et. al 1987 (2)	Environment Canada 1999 (3) whole fish total DDTr µg/Kg dry weight		U.S. EPA 2000 (4) total DDTr µg/Kg dry weight
				Bald eagle	Great blue heron	Little blue heron	White pelican	Wood stork	Whole fish total DDTr µg/Kg wet weight	Protection fish consuming birds	Protection human health	Screening value for recreational fishers
ACRA1C	11/8/2005	1.7 I	Organochlorine pesticides	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	11/22/2005	10	Organochlorine pesticides	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	3/23/2006	6.3 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	6/26/2006	9.7	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	8/17/2006	3.7 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	8/17/2006	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA8	8/17/2006	-	Site dry, no sample	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA7	8/17/2006	-	Site dry, no sample	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	11/14/2006	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	11/14/2006	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	2/7/2007	7.6 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	2/7/2007	5	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	6/5/2007	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA8	6/5/2007	-	Site dry, no sample	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA7	6/5/2007	-	Site dry, no sample	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117

I: value reported is less than the practical quantification limit, and greater than or equal to the method detection limit.

BDL: below the method detection limit

Table 1 cont. Summary of mosquitofish pesticide analysis for Allapattah Project.

Site	Date Collected	p,p'-DDE µg/Kg wet weight	Analytes	Criteria								
				Newfields 2006 (1) p,p'-DDE µg/Kg wet weight					Newell, et. al 1987 (2)	Environment Canada 1999 (3) whole fish total DDTr µg/Kg dry weight		U.S. EPA 2000 (4) total DDTr µg/Kg dry weight
				Bald eagle	Great blue heron	Little blue heron	White pelican	Wood stork	Whole fish total DDTr µg/Kg wet weight	Protection fish consuming birds	Protection human health	Screening value for recreational fishers
ACRA1B	6/5/2007	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	8/29/2007	*	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA8	8/29/2007	-	Site dry, no sample	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA7	8/29/2007	*	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	8/29/2007	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA8	12/3/2007	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA7	12/3/2007	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	12/3/2007	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	12/3/2007	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA8	2/6/2008	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA7	2/6/2008	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	2/6/2008	4.4 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	2/6/2008	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA8	4/22/2008	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA7	4/22/2008	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117

I: value reported is less than the practical quantification limit, and greater than or equal to the method detection limit.
BDL: below the method detection limit
*: values did not meet appropriate quality assurance criteria

Table 1 cont. Summary of mosquitofish pesticide analysis for Allapattah Project.

Site	Date Collected	p,p'-DDE µg/Kg wet weight	Analytes	Criteria								
				Newfields 2006 (1) p,p'-DDE µg/Kg wet weight					Newell, et. al 1987 (2)	Environment Canada 1999 (3) whole fish total DDTr µg/Kg dry weight		U.S. EPA 2000 (4) total DDTr µg/Kg dry weight
				Bald eagle	Great blue heron	Little blue heron	White pelican	Wood stork	Whole fish total DDTr µg/Kg wet weight	Protection fish consuming birds	Protection human health	Screening value for recreational fishers
ACRA1B	4/22/2008	4 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	4/22/2008	2.4 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117

I: value reported is less than the practical quantification limit, and greater than or equal to the method detection limit.

Table 2 provides the mosquitofish toxicant data summaries where the mean annual concentration does not exceed the 90th percentile of the basin wide average. Additionally the mean annual concentration has been decreasing for each subsequent year (linear regression [date = independent variable; fish concentration = dependent variable], DF = 1, F = 3, p = 0.33).

Table 2. Data summary for toxicants (µg/Kg) in mosquitofish.

Year	Sample Size (n)	Mean	Standard Deviation	95% Confidence Interval	90th Percentile
2005	2	6	5.9	0.26	9.17
2006	6	4.2	3.2	0.08	8
2007	9	4.2	1.5	0.03	5.5
2008	8	2.7	1.3	0.03	4.1

Large-Bodied Fish Evaluation

For all years no annual large-bodied fish (bluegill, largemouth bass) composite exceeded the 90th percentile for the period of record for the basins monitoring stations. Tables 3 and 4 provide the bluegill and largemouth bass, respectively, pesticide concentrations for each year.

Table 3. Summary of bluegill pesticide analysis for Allapattah Project.

Site	Date Collected	p,p'-DDE µg/Kg wet weight	Analytes	Criteria								
				Newfields 2006 (1) p,p'-DDE µg/Kg wet weight					Newell, et. al 1987 (2)	Environment Canada 1999 (3) whole fish total DDTr, µg/Kg dry weight		U.S. EPA 2000 (4) total DDTr µg/Kg dry weight
				Bald eagle	Great blue heron	Little blue heron	White pelican	Wood stork	Whole fish total DDTr µg/Kg wet weight	Protection fish consuming birds	Protection human health	Screening value for recreational fishers
ACRA1A	3/23/2006	1.5 I	DDE, DDD, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	8/17/2006	47.6	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	8/17/2006	23.6	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	8/17/2006	30	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	8/17/2006	23.8	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	8/17/2006	21.8	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	8/17/2006	4.3 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	8/17/2006	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	8/17/2006	3.6 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	8/17/2006	5.2 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	8/17/2006	13	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	11/28/2007	6.7	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	11/28/2007	5 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	11/28/2007	7.9	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	11/28/2007	11	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117

I: value reported is less than the practical quantification limit, and greater than or equal to the method detection limit.
BDL: below the method detection limit

Table 3 cont. Summary of bluegill pesticide analysis for Allapattah Project.

Site	Date Collected	p,p'-DDE µg/Kg wet weight	Analytes	Criteria								
				Newfields, 2006 (1) p,p'-DDE µg/Kg wet weight					Newell, et. al 1987 (2)	Environment Canada 1999 (3) whole fish total DDTr µg/Kg dry weight		U.S. EPA 2000 (4) total DDTr µg/Kg dry weight
				Bald eagle	Great blue heron	Little blue heron	White pelican	Wood stork	Whole fish total DDTr µg/Kg wet weight	Protection fish consuming birds	Protection human health	Screening value for recreational fishers
ACRA1	11/28/2007	6.7	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	1/24/2008	2 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	1/24/2008	2.4 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	1/24/2008	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	1/24/2008	6.1	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1B	1/24/2008	4.1	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117

I: value reported is less than the practical quantification limit, and greater than or equal to the method detection limit.
BDL: below the method detection limit

Table 4. Summary of largemouth bass pesticide analysis for Allapattah Project.

Site	Date Collected	p,p’-DDE µg/Kg wet weight	Analytes	Criteria								
				Newfields, 2006 (1) p,p’-DDE µg/Kg wet weight					Newell, et. al 1987 (2)	Environment Canada 1999 (3) whole fish total DDTr µg/Kg dry weight		U.S. EPA 2000 (4) total DDTr µg/Kg dry weight
				Bald eagle	Great blue heron	Little blue heron	White pelican	Wood stork	Whole fish total DDTr µg/Kg dry weight	Protection fish consuming birds	Protection human health	Screening value for recreational fishers
ACRA1	8/17/2006	2.2 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	8/17/2006	4.5 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	8/17/2006	2.1 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	8/17/2006	2.5 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	8/17/2006	2.4 I	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	11/28/2007	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	11/28/2007	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	11/28/2007	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	11/28/2007	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117
ACRA1	11/28/2007	BDL	DDE, DDD, DDT, Dieldrin	14,700	10,000	5,200	12,200	10,100	200	1,000	320	117

I: value reported is less than the practical quantification limit, and greater than or equal to the method detection limit.
BDL: below the method detection limit

Table 5 provides the large-bodied fish toxicant data summaries where the mean annual concentration does not exceed the 90th percentile of the basin wide average. Additionally the mean annual concentration has been decreasing for each subsequent year. However, the small sample size precludes appropriate statistical analysis i.e. linear regression.

Table 5. Data summary for toxicants (µg/Kg) in large-bodied fish.

	Year	Sample Size (n)	Mean	Standard Deviation	95% Confidence Interval	90th Percentile
Bluegill	2006	11	16	14.7	0.28	30
	2007	5	7	2.2	0.06	9.8
	2008	5	3	2.1	0.06	5.3
Largemouth bass	2006	5	3	1.0	0.03	3.7
	2007	Values all BDL	-	-	-	-

Final Recommendation

All action criteria for toxicant monitoring in fish were met for the Allapattah Project, therefore it is recommended fish tissue monitoring be terminated.

References

1) Newfields, 2006. Risk Based Screening Levels for Select Organochlorine Pesticides in Sediment and Fish Tissue. Prepared for South Florida Water Management Distict.

Screening levels correspond to exposure equal to No-observed-adverse-effects Levels (NOAELS), wet weight basis, for overall receptor diet.

2) Newell, A.J., Johnson, D.W., and Allen, L.K., 1987. Niagara River biota contamination project-fish flesh criteria for piscivorous wildlife: New York State Department of Environmental Conservation, Division of Fish and Wildlife, Bureau of Environmental Protection Technical Report 87-3, 182 p.

Whole fish benchmark for protection of fish eating wildlife: total DDTr - 200 µg/Kg

3) Environment Canada 1999. A Compendium of Environmental Quality Benchmarks, Environment Canada, Vancouver, B.C.

Protection of fish consuming birds, whole fish: DDTr - 1,000 µg/Kg

Maximum tissue residue for the protection of wildlife consumers of aquatic biota: total DDTr - 14 µg/Kg

Available tissue reside quality criteria for protection of human health: DDTr - 320 µg/Kg

4) U.S. Environmental Protection Agency 2000. Guidance for assessing chemical contaminant data for use in fish advisories, Vol. 1, fish sampling and analysis, (3rd ed.): U. S. Environmental Protection Agency, Office of Water, EPA 823-B-00-007.

Recommended screening value for recreational fishers: total DDTr - 117 µg/Kg

Attachment D: Allapattah Wetland Evaluation (WRAP) Parcel A

Allapattah Wetland Evaluation (WRAP) Parcel A

WL I.D.	Photo ID	WL type	DATE	Evaluator	WU	O/S	GC	BUFF	HYD	WQ	WRAP	WL ACRE	Typical vegegation	Soil type	WRAP/WT.
Q1WL1	15WL1	Depression/pickerel marsh	2/12/2003	BG team	1.0 (1.5)	0 (.5)	1.00	1.75	1.5 (1.0)	1.00	0.35 (0.40)	2.88	Wax myrtle inv., pickerel, juncus, smartweed	54/19	0.01
Q1WL2	13WL1	fw marsh	2/12/2003	BG team	1.50	NA	1.50	2.00	2.00	1.00	0.53	7.25	smartweed dominant	56/54	0.03
Q1WL3	17WL1	fw marsh	2/12/2003	BG team	2.00	2.00	2.50	2.00	2.00	1.00	0.64	20.11	dahoon, maple, myrtle, maidencane,sawgrass, pickerel	58/49	0.10
Q1WL4	18WL1	fw marsh	2/12/2003	BG team	2.00	NA	2.00	2.00	2.00	1.00	0.60	22.3	maidencane, pickerel, bladderwort, eleocharis	54	0.11
Q1WL5	12WL1	fw marsh	2/12/2003	BG team	2.00	NA	1.50	2.00	2.00	1.00	0.57		smartweed dominant, w/ melaleuca	54	0.00
Q1WL6	21WL1	fw marsh	2/12/2003	BG team	2.00	NA	2.00	2.00	2.00	1.00	0.60	39.43	maidencane, pickerel,azolla, pithophora(?), smartweed, willow	58/49	0.19
Q1WL7	2WL1	wet prairie	2/12/2003	Miller team	1.00	NA	1.00	2.00	1.50	1.00	0.43	6.32	Juncus, smartweed, maidencane, fennel	58/56	0.02
Q1WL8	2WL2	wet prairie	2/12/2003	Miller team	1.00	NA	0.50	2.00	1.00	1.00	0.37	4.45	fennel, panicum, smarweed, climbing hemp	58	0.01
Q1WL9	5WL1	wet prairie/ shallow marsh	2/12/2003	Miller team	1.50	NA	1.50	2.00	2.00	1.00	0.53		pennywort, pickerel, smartweed, maidencane, juncus, torpedo grass	54	0.00
Q1WL10	1WL1	shallow marsh	2/12/2003	Miller team	1.5 (2.0)	NA	1.50	2.00	2.00	1.00	0.53 (0.57)	1.91	juncus dominant, smarteed, eleocharis, sedge	49?	0.01
Q1WL11	7WL2	shallow marsh	2/12/2003	Miller team	2.50	NA	2.00	2.00	2.00	1.25	0.65	0.61	day flower, swamp fern, eleocharis (hair grass), pickerel, juncus	54	0.00
Q1WL12	7WL1	shallow marsh	2/12/2003	Miller team	2.00	NA	2.00	2.00	2.00	1.25	0.62	0.14	Juncus, ludwigia repens, pickerel, maidencane, smartweed, (periphyton eve.)	54	0.00
Q1, WL13	25WL1	deep marsh	2/13/2003	Miller team	2.50	NA	2.50	2.00	2.50	1.00	0.70	4.52	pennywort, pickerelweed, maidencane, smartweed, bladderword, duckweed, azolla, sag.	54	0.03
Q1, WL14	24WL1	deep marsh	2/13/2003	Miller team	2.50	NA	2.50	2.00	2.50	1.00	0.70	1.39	pennywort, pickerelweed, maidencane, smartweed, bladderword, duckweed, azolla, sag.	54	0.01
Q1, WL13	25WL2	shallow marsh	2/13/2003	Miller team	1.0 (1.5)	NA	1.50	2.00	1.50	1.00	0.47 (0.50)	2.22	smartweed, maidencane, pickerel, pennywort, juncus	54	0.01
Q1, WL14	24WL2	shallow marsh	37665	Miller team	0.50	NA	1.00	2.00	1.00	1.00	0.37	1.13	Juncus, smartweed, maidencane, sagitaria	54	0.00
Q1, WL15	23WL1	shallow marsh	37665	Miller team	0.50	NA	1.00	2.00	1.00	1.00	0.37	3.95	Juncus, smartweed, maidencane, sagitaria		0.01
Q1, WL16	26WL1	shallow marsh	2/13/2003	Miller team	0.50	NA	0.50	2.00	1.00	1.00	0.33	0.52	Juncus, pennywort, dayflower, smarweed, pickerel	54	0.00
Q1, WL17	26WL2	shallow marsh	2/13/2003	Miller team	0.50	NA	0.50	2.00	1.00	1.00	0.33	0.47	Juncus, pennywort, dayflower, smarweed, pickerel	54	0.00
Q1, WL18	26WL3	shallow marsh	2/13/2003	Miller team	0.50	NA	0.50	2.00	1.00	1.00	0.33	1.85	Juncus, pennywort, dayflower, smarweed, pickerel	54	0.00
Q1, WL19	26WL4	shallow marsh	2/13/2003	Miller team	0.50	NA	0.50	2.00	1.00	1.00	0.33	1.12	Juncus, pennywort, dayflower, smarweed, pickerel	54	0.00
Q1, WL20	27WL1	shallow marsh	2/13/2003	Miller team	0.50	NA	0.50	2.00	0.50	1.00	0.30	0.97	Pennywort, smartweed	58	0.00
												123.54			0.56
Q2, WL1	7WL1	wet prairie	2/13/2003	BG team	2.50	NA	3.00	2.50	2.50	2.67 (2.25)	0.88 (0.85)	68.06	Amphicarpa, bog buttons, hypericum, bladderwort, drosera, aristida (edge)	49/56/19	0.20
Q2, WL2	4WL1	sawgrass marsh	4/23/2003	Schubert/Argo/Harnden	1.50	NA	2.00	1.50	2.00	1.00	0.53	1.62	Lygodium/tallow, Sebatia, lachnanthes, rhynchospora	49	0.00
Q2, WL3	5WL1	deep marsh	4/23/2003	Schubert/Argo/Harnden	1.50	NA	2.00	1.50	2.00	1.00	0.53	5.95	Smartweed/maidencane, with pickerel, juncus, hydrocotyl, cyperus, oxydendrun(?)	54	0.01
Q2, WL4	4WL2	deep marsh/wet prairie	4/23/2003	Schubert/Argo/Harnden	1.00	NA	2.50	1.75	2.00	2.25	0.63	2.65	Sacciolepis(?), sundews, hatpins, redroot	49	0.01
Q2, WL5	4WL3	sawgrass marsh	4/23/2003	Schubert/Argo/Harnden	1.00	NA	1.50	2.00	1.50	1.75	0.52	5.72	lachnanthes, hypericum, stillingia, hatpins, pickerel, sag., fennel, buttonwillow, smartweed	49	0.01
Q2, WL6	4WL4	remnant bayhead	4/23/2003	Schubert/Argo/Harnden	2.50	1.50	1.00	1.15	2.00	1.75	0.52	11.12	dahoon, persea palustris, salix, ludwigia	49/65	0.02
Q2, WL7	5WL2	sawgrass marsh w/drier fringe	4/23/2003	Schubert/Argo/Harnden	1.00	NA	1.50	1.50	1.50	1.00	0.43	4.65	sawgrass, slillingia, scirpus, ludwigia, maindencane fringe, elecharis, lachnanthes	49	0.01
Q2, WL8	5WL3	deep marsh w/prairie fringe	4/23/2003	Schubert/Argo/Harnden	2.00	NA	3.00	2.00	2.00	2.25	0.75	9.19	amphycarpum, sag., furiena, phyla, centella, stillingia, pickerel, persea, button willow	58	0.02
Q2, WL9	14WL1	wet prairie	2/13/2003	Miller team	3.00	2.50	2.50	2.50	2.50	2.50	0.86	34.38	wiregrass, hatpins, lemon bacopa, stillingia, pickerel, waxmyrtle fringe	49	0.10
Q2, WL10	16WL1	deep marsh	2/13/2003	Miller team	2.50	2.50	2.50	2.50	2.50	2.75	0.85	47.02	redbay, wax myrtle, hatpins, hyperium, pickerelweed, stillingia, sundews, wiregras, gallberry	49	0.13
Q2, WL11	16WL2	deep marsh	2/13/2003	Miller team	2.50	2.50	2.50	2.50	2.50	2.75	0.85	27.31	redbay, wax myrtle, hatpins, hyperium, pickerelweed, stillingia, sundews, wiregras, gallberry	38/56	0.08
Q2, WL12	15WL1	wet prairie	2/13/2003	Miller team	2.50	NA	2.50	2.50	2.50	2.75	0.85	40.38	St. Johnswort, hatpins, xyris, eleocharis, bladderwort, maidencane	49	0.12
Q2, WL15	2WL2	dp marsh with bay head and prairie fringe	4/23/2003	JT,SS,BK	2.00	1.50	1.50	1.75	1.50	1.25	0.53	1.07	maidencane, stillengia, buttonbush, pickerel, sag, bacopa with bay/myrtle tree island (subsidence) and broomsedge fringe	58/19	0.00
Q2, WL16	2WL1											16.47			0.03
Q2, WL17	29WL1	sawgrass marsh	4/23/2003	JT,SS,BK	1.50	NA	1.75	1.50	2.00	1.25	0.53	5.18	Salix, sawgrass, pickerel, Phyla, smartweed, royal fern	19	0.01
Q2, WL18	29WL2	sawgrass marsh	4/23/2003	JT,SS,BK	1.50	0.50	0.50	1.00	0.00	1.25	0.26	2.91	sawgrass, smartweed, juncus, some fern, wax myrtle, pepper, distichylis	19	0.00
Q2, WL19	1WL2	Deepmarsh	4/23/2003	JT,SS,BK	2.00	NA	2.00	1.50	1.50	1.25	0.55	6.22	maidencane, sag, smartweed, pennywort, stillingia, mallow, bacopa, waxmyrtle	38	0.01

Allapattah Wetland Evaluation (WRAP) Parcel A

WL I.D.	Photo ID	WL type	DATE	Evaluator	WU	O/S	GC	BUFF	HYD	WQ	WRAP	WL ACRE	Typical vegegation	Soil type	WRAP/WT.
Q2, WL20	3WL1	dryprairie with marsh depression	4/23/2003	JT,SS,BK	1.50	NA	0.50	1.75	0.50	1.25	0.37	4.69	mostly fennel, pasture grass with smartweed, alligator weed, stillingia, sag., cyperus	19	0.01
Q2, WL21	1WL1	depression marsh	4/23/2003	JT,SS,BK	1.25	NA	1.50	1.00	1.00	1.00	0.38	0.71	buttonbush, sag., pickerel, maidencane, stillingia, millfoil, juncus, much dead lygodium	19	0.00
												295.3			0.77
Q3, WL1	7WL1	marsh	4/24/2003	Argo, Pitts, Harnden	2.50	NA	3.00	1.63	2.00	2.50	0.78	2.82	pickerel, panicum, stillingia, button willow, rhynchospora spp., hypericum, sag., redroot	19/57	0.01
Q3, WL2	7WL2	wet prairie	4/24/2003	Argo, Pitts, Harnden	2.50	NA	3.00	2.50	2.00	2.00	0.80	4.27	sawgrass, proserpinaca, stillingia, hypericum, xyris, drosera, with bayhead in center*	19/57	0.01
Q3, WL3	7WL2*	remnant bay head	4/24/2003	Argo, Pitts, Harnden	2.50	2.00	0.50	3.00	2.00	2.50	0.69	inc. above	dahoon holly, sweetbay, persea, gordonia, lygodium infested	57	
Q3, WL4	6WL1	wet prairie	4/24/2003	Argo, Pitts, Harnden	2.50	NA	3.00	1.35	2.50	1.90	0.75	8.84	Xyris, Rhync. tracyi,. Hypericum, eriocaulon, maidencane, elecocharis, bladderwort	38	0.02
Q3, WL5	6WL2	hydric flatwoods	4/24/2003	Argo, Pitts, Harnden	1.50	0.50	1.50	1.38	1.00	2.00	0.44	51.13	amphicarpus, sag, furiena, rhync., pickerel, l. repens, xyris, rhexia, redroot, centella, proserpinaca	17/56	0.08
Q3, WL6	2WL1	depression marsh	4/24/2003	SS, BG, JT, BK	1.50	NA	1.50	1.00	1.00	1.00	0.40	1.75	maidencane, smartweed, eleocharis, sag, pickerel, sawgrass, fennel, wax myrtle	17	0.00
Q3, WL7	2WL-2	depression marsh	4/24/2003	SS, BG, JT, BK	1.50	1.00	1.00	1.00	0.50	1.00	0.33	1.72	juncus, sawgrass, ludwigia, salix, smartweed, l. repens, thalia, oxypolis	19	0.00
Q3, WL8	4WL1	depression marsh/hd of slough	4/24/2003	SS, BG, JT, BK	1.50	NA	1.00	1.50	1.50	1.00	0.43	0.88	sag., pickerel, duckweed, smartweed, juncus	47/19	0.00
Q3, WL9	5WL1	dep. Marsh, wet prairie trans.	4/24/2003	SS, BG, JT, BK	2.50	NA	2.50	2.50	2.50	2.00	0.80	16.36	bluestem, stillingia, redroot, fennel, sag. Hypericum, bacopa, hatpins	19	0.05
Q3, WL10	18WL1	marsh	4/24/2003	SS, BG, JT	1.50	NA	1.50	2.00	1.00	1.25	0.48	20.66	Sagitaria, centella, fennel, pickerel, smartweed, sawgrass, juncus	19	0.04
Q3, WL11	18WL2	marsh	4/24/2003	SS, BG, JT	1.50	NA	1.00	2.00	0.50	1.50	0.43	3.05	sawgrass, juncus, pickerel, saliz, ceasarwwed, fennel, wx myrtle	38	0.00
Q3, WL12	18WL3	sawgrass/willow with marsh	4/24/2003	SS, BG. JT,BK	1.50	1.00	1.50	1.50	1.00	1.50	0.42	2.16	sawgrass, juncus, thalia, fennel, smartweed, phyla, ceasar	19	0.00
Q3, WL13	17WL1	deepmarsh in slough	4/25/2003	SS,BG,JT,BK	1.50	NA	1.50	1.00	2.00	1.00	0.47	120.17	pickerel, sagitaria, phyla, juncus, smartweed, andropogon fringe, pennywort, fennel	19/38	0.20
Q3, WL14	10WL1	wet prairie	4/25/2003	SS,BG,JT,BK	2.50	NA	2.50	2.00	2.50	2.50	0.80	20.37	hatpins, fureina, stillingia, sundews, xyrus, rhynchospora, bacopa, bladderwort	65/38/19	0.06
Q3, WL15	3WL1	bayhead w/ sawgrass	4/25/2003	SS,BG,JT,BK	2.00	1.50	0.50	1.50	1.50	1.50	0.47	1.87	pickerel, redbay, sawgrass, juncus, buttonbush, sweetbay, swampfern	19/57	0.00
Q3, WL16	2WL3	sawgrass/ dw marsh	4/25/2003	SS,BG,JT,BK	1.50	1.00	1.50	1.50	1.50	1.50	0.47	9.16	bluestem, fennel, sawgrass, wxmyrtle, sweetbay	19/47	0.02
Q3, WL17	3WL2	deep marsh	4/25/2003	SS,BG,JT,BK	1.50	1.00	1.50	1.50	1.50	1.50	0.47	14.1	sagitaria, juncus, smartweed, wax myrtle, broomsedge, lygodium, pickerel, swamp fern	38	0.02
Q3, WL18	1WL1	flag marsh	4/25/2003	SS,BG,JT,BK	2.00	0.50	1.50	1.50	1.00	1.25	0.43	3.39	juncus, azolla, maidencane, smartweed, pickerl, buttonbush, baccharis, dayflower, marsh fern	19	0.01
												282.7			0.52

Soil Type:	Expected 'Ponding' Duration:
54 - Oldsmar Fine Sand, depressional	
19 - Winder Sand	6 to 9 months
56 - Wabasso Sand, depressional	6 to 9 months or more
58 - Gator muck	Inundated, except during extreme dry periods
49 - Riviera fine sand, depressional	6 to 9 months
38 - Floridana fine sand, depressional	More than 6 months
57 - Chobee loamy sand	6 to 9 months
17 - Wabasso Sand	*-10 to 40" and <-10" for 2 months or more; surface flooding following extreme events
65 - Tuscawilla Sand	<-10" for 2-4 months; <-40" for remainder; surface flooding following extreme events

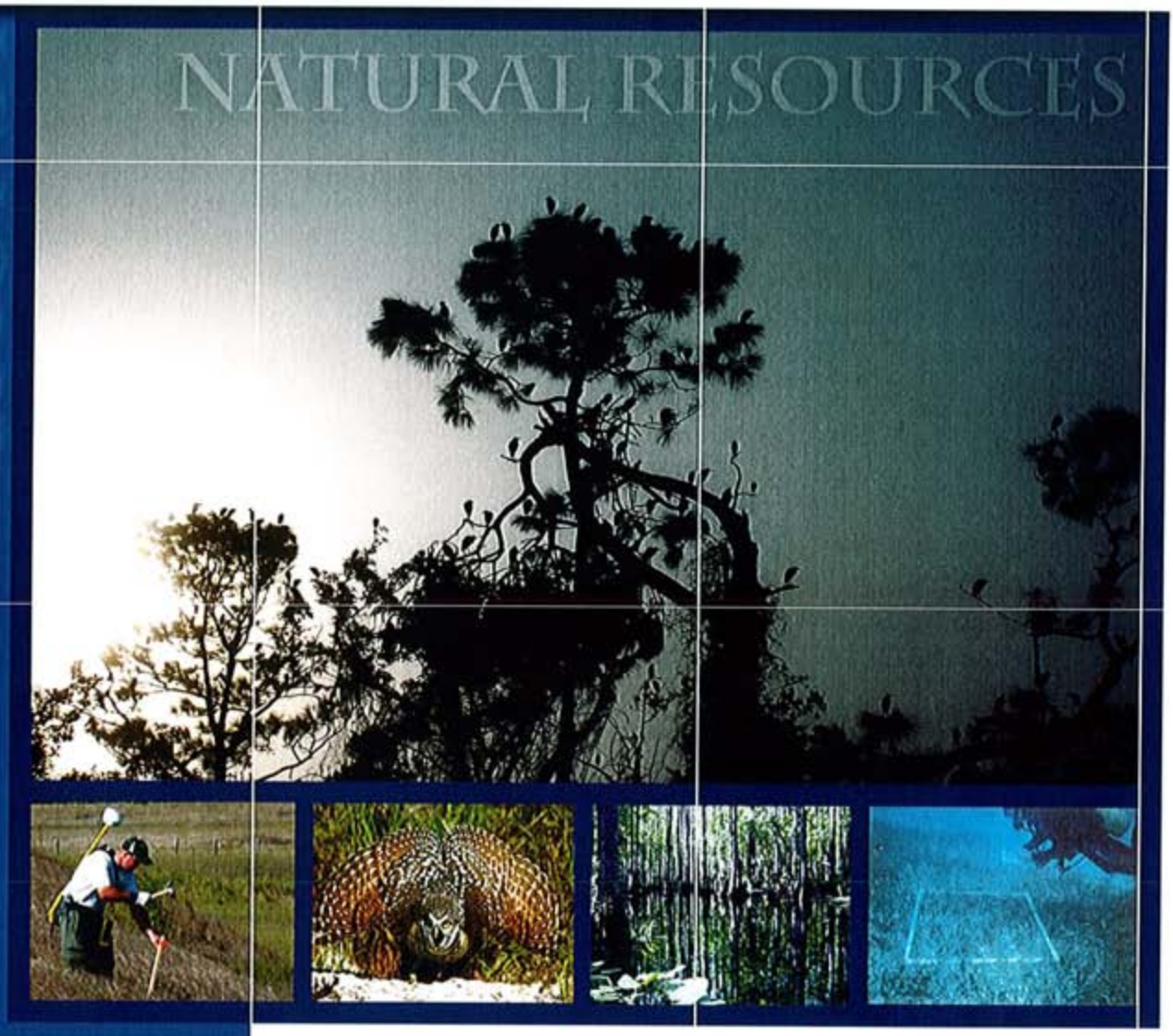
Attachment E: Listed Species Assessment & Habitat Mapping

Note: This document, dated July 2006, was provided to the South Florida Water Management District by Miller Legg/Quest Ecology, under ML Project No. 06-00115.

QUEST ecology

MILLER LEGG

LISTED SPECIES ASSESSMENT & HABITAT MAPPING



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... Creating Environments"

ALLAPATTAH FLATS

For
South Florida Water Management District
ML Project No. 06-00115

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ALLAPATTAH FLATS
LISTED SPECIES ASSESSMENT & HABITAT MAPPING
ML Project No: 06-00115

1.0 INTRODUCTION

The Miller Legg (ML) / Quest Ecology Inc. (Quest) team was contracted to conduct an assessment of Allapattah Flats for the presence or potential for use by listed plant and wildlife species. The scope was later adjusted to include preparation of land use maps to reflect current site conditions and habitat types. These land use maps will serve as a baseline for future comparisons following ongoing restoration activities and will provide a more accurate representation of true site conditions versus that shown on South Florida Water Management District (SFWMD) land use maps, which were found to contain many discrepancies.

The project site consists of three separate parcels, Parcel A, Parcel B and Parcel C, totaling 21,168.8 acres, and located in all or portions of Sections 5 - 9, 16 -22, 27 - 34, Township 38S, Range 39E and in all or portions of Sections 21 - 29, and 32 - 36, Township 38S, Range 38E in Martin County, Florida (Figure 1, Table 1). CR 714 separates Parcel A on the north from Parcel B on the south side of the road; CR 609 separates Parcel C on the west from Parcel B on the east. Privately owned, primarily undeveloped and agricultural lands are found on adjacent lands (Figure 2).

Table 1. Allapattah Flats Parcel Information.

Parcel Number	Acres	Sections	Township	Range
A	5217.5	5,6,7,8,9,16,17 & 18	38 South	39 East
B	7701.2	19,20,21,22,27,28,29,30,31,32,33 & 34	38 South	39 East
C	8250.1	21,22,23,24,25,26,27,28,29,32,33,34,35, 36	38 South	38 East

2.0 METHODS

A project kick-off meeting was conducted with Beth Kacvinsky of the South Florida Water Management District to review aerial photographs and discuss previous observations and potential locations of target species. Additional data sources, including the Florida Fish and Wildlife Conservation Commission (FFWCC) databases, were reviewed for documentation of listed species utilization on or in the vicinity of the site. Soil assessments were reviewed to identify those soil types likely to support gopher tortoise and the habitats associated with these soil types. These, as well as areas with a high likelihood of supporting tortoises, were identified for the field assessments.

ALLAPATTAH FLATS
LISTED SPECIES ASSESSMENT & HABITAT MAPPING
ML Project No: 06-00115

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Three field events took place in March, April and June 2006 using vehicular, pedestrian, ATV, point observations, and helicopter flyovers on Parcels A, B, and C. Field assessments were conducted such that representative habitat types were evaluated, and all parcels were visited. The level of detail and time spent in each habitat type or area was dependent upon the uniqueness or diversity of the area, and the potential to support listed species.

Although all listed species observations were documented, field assessments were conducted to specifically target gopher tortoise (*Gopherus polyphemus*), burrowing owl (*Speotyto cunicularia*), and Audubon's crested caracara (*Polyborus plancus audubonii*).

Pastures and open areas were assessed for the potential to support species such as burrowing owl and gopher tortoise. Herbaceous wetlands, canals, and ditches were scanned for use by wading bird species and shrub and forested systems assessed for potential rookery sites. Pine flatwoods supporting mature pine trees were assessed for potential red-cockaded woodpeckers (*Picoides borealis*) and cavity trees. Areas with scattered cabbage palms (*Sabal palmetto*) and pastures were noted for potential use by Audubon's crested caracara.

Helicopter flyovers were conducted on March 22, April 18, and June 20, 2006. The purpose of these flyovers was to assess habitat types and conditions for listed species and habitat likely to support listed species and update land use maps. In addition, any sandhill crane nests (*Grus canadensis pratensis*), wading bird rookeries, and caracaras observed were documented. The aerial assessments conducted in March and April were primarily for the purpose of habitat and listed species observations, whereas the June helicopter flyover was conducted for verification of land use and habitat types for updating the land use maps.

Vehicular, pedestrian and ATV transects occurred on Parcels A and B to document previously known burrowing owl locations and to GPS the current locations of burrowing owls. Active burrows observed were mapped on aerial photographs and GPS points were taken.

Potential caracara nesting habitat previously identified by others or observed during ground and helicopter assessments were verified using vehicular and point observations in all three parcels. Observations of adult and juvenile caracaras, and their nest sites if identified, were mapped on aerial photos, and a GPS point of each nest site was taken after the nesting season.

Semi-improved pine flatwoods located in Section 33 on Parcel C were assessed using parallel ATV and pedestrian transects to search for red-cockaded woodpeckers (RCW) nest cavities within pine trees. This area was considered the only potentially suitable area where RCW's may occur.

3.0 RESULTS

3.1 Database and Literature Search

Database searches revealed that listed species including Audubon's crested caracara, bald eagle (*Haliaeetus leucocephalus*) and eastern indigo snake (*Dymarchon corais couperi*) have been documented in the vicinity. Bald eagle nest sites were searched using the FFWCC eagle nest

locator and five nests were found to be within a 5 mile radius of the project (Figure 3). In addition, three woodstork (*Mycteria americana*) rookeries are documented within an 18.6 mile radius of the project site (Figure 4) which means that onsite wetlands are within Core Foraging Areas (CFA) for woodstork.

3.2 Listed Species Observations

3.2.1 Wading Bird Species

During the helicopter flyovers, numerous sandhill crane nests were observed in all three parcels, and sandhill cranes were frequently observed foraging within wetland and wet pasture habitats (Photos 1-4).

Two wading bird rookeries were observed: one in the northeast portion of Parcel A in Section 5 (Figure 5A); and another in the northeastern portion of Parcel B in Section 19 (Figure 5B). The Parcel A rookery was later confirmed on the ground, with approximately 25 actively nesting great egrets (*Ardea alba*) and five nesting anhingas (*Anhinga anhinga*) observed. This rookery was located in a herbaceous wetland with numerous dead Brazilian pepper (*Schinus terebinthifolius*) snags (Photos 5 and 6). The nests were located primarily on and within the dead trees. The Parcel B rookery consisted of 5 to 10 actively nesting anhingas. This rookery was located within a Carolina willow (*Salix caroliniana*) dominated shrub component of a herbaceous marsh.

Listed and non-listed wading bird species were also observed foraging in a variety of wetlands throughout all three parcels. Of particular note was the use by a diverse assemblage of wading birds in restored wetlands on Parcel A (Photo 7). The filling of ditches on Parcel A has resulted in the restoration of hydrology and wetland vegetation to several historically drained herbaceous wetlands. These restored areas coincide with the faint signatures apparent on aerial photos that indicate the previous wetland signature. Observed birds foraging in one such wetland include: tri-color heron (*Egretta tricolor*), little blue heron (*Egretta caerulea*), white ibis (*Eudocimus albus*), snowy egret (*Egretta thula*), glossy ibis (*Plegadis falcinellus*), great blue heron (*Ardea herodias*), Great egret, cattle egret (*Bubulcus ibis*), mottled duck (*Anas fulvigula*), purple gallinule (*Porphyrula martinica*), common grackle (*Colaptes auratus*), red-winged black bird (*Agelaius phoeniceus*), lesser yellowlegs (*Tringa flavipes*), least sandpiper (*Calidris minutilla*), and northern harrier (*Circus cyaneus*).

3.2.2 Burrowing Owl

Active burrowing owl burrows, both primary and satellite burrows, were identified on Parcel A in Section 7 (Figure 5A) and Parcel B in Sections 19 and 20 (Figure 5B). These included areas previously mapped as burrowing owl locations, as well as new nest locations not previously documented. All of the areas previously marked in the field with PVC poles prior to construction in Parcel A were assessed, however, owls were identified in only two of the areas marked with the PVC (Photos 8 and 9). Photos 10 and 11 depict a typical nesting location on berms within Parcel B.

3.2.3 Gopher Tortoise

Gopher tortoise burrows were observed only within Parcel C (Figure 5C). Eleven active and inactive gopher tortoise burrows were located in Sections 28 and 29. The burrows were found in palmetto prairie and dry pasture habitats with scattered pines (Photo 12).

3.2.4 Crested Caracara

Adult caracaras were observed in various locations in all three parcels. Assessments for nest locations concentrated on those areas where adults were most frequently observed, or reported as suspect nest areas by SFWMD personnel. A total of three active nest sites were documented: one in Parcel A and two in Parcel C.

During point observations conducted in the northeastern area of Parcel A, one adult caracara was observed perched in a dead pine. An area within a 100 meter radius of this observation was thoroughly assessed on foot until a very obscure nest was found containing one nestling (March 24, 2006) (Figure 5A). Using the same method, two additional caracara nests were located on Parcel C, both of which had already fledged juveniles (Figure 5C). The only previously confirmed caracara nest site, located in Parcel B, was investigated. An old or inactive nest was observed, however no caracaras were observed in the vicinity (Figure 5B). Photo 13 depicts the Parcel A nest site; Photo 14 is of the Parcel B inactive nest site; and Photos 15 and 16 are juveniles and adults observed within Parcel C. All active and inactive caracara nest sites were mapped on aerial photographs in the field and GPS points were collected at the nest site following the conclusion of nesting season.

3.2.5 Listed Plant Species

Three listed plant species, giant wild pine (*Tillandsia utriculata*), common wild pine (*T. fasiculata*), and inflated wild pine (*T. balbisiana*) were located on Parcel C. The giant wild pine was located in a live oak on the edge of a shrub swamp, and inflated wild pine was located in an overgrown scrub habitat. Common wild pine was also observed in a cabbage palm hammock on the east side of Parcel A.

3.3 Land Use Types and Habitat Descriptions

Updated land use maps were prepared to depict current site conditions and habitat types (Figures 6A, 6B, 6C). These maps were prepared using 2004 aerial photographs and the Florida Land Use Cover and Forms Classification System (FLUCFCS) (1999). Representative signatures and habitat types were field verified via ground-truthing and aerial assessments as described above. Tables 2 provides the land use types and total acreage of each for Parcels A, B, and C. Descriptions of each of the dominant habitat types mapped are provided below.

Table 2. FLUCFCS delineation of Allapattah Flats by parcel.

FLUCFCS Code	Description	Size (Acres) Parcel A	Parcel B	Parcel C
110	Residential, Low Density	5.8	-	1.6
120	Residential, Medium Density	-	-	8.3
211	Improved Pastures	2825.4	5956.2	-
213	Woodland Pastures	177.6	167.2	713.9
321	Palmetto Prairies	-	-	50.8
411	Pine Flatwoods	86.4	45.1	58.0
414	Pine Mesic Oak	92.4	-	
421	Xeric Oak	-	-	18.5
428	Cabbage Palm	21.1	7.0	146.1
429	Wax Myrtle - Willow	37.7	28.4	87.3
611	Bay Swamps	-	-	60.6
618	Willow and Elderberry	4.3	89.3	55.6
619	Exotic Wetland Hardwoods	.	.	105.8
620	Wetland Coniferous Forests	-	-	20.8
625	Hydric Pine Flatwoods	673.4	180.1	291.0
641	Freshwater Marshes	1118.5	1178.7	1316.6
643	Wet Prairies	172.5	2.1	8.4
740	Disturbed Lands	-	-	27.1
742	Borrow Areas	2.4	1.9	4.1
	Total	**5217.5**	**7701.2**	**8250.1**

3.3.1 Oak Scrub (421 FLUCFCS)

Existing, remnant oak scrub habitat is limited to areas along the western side of Fox Brown Road in Parcel C, and comprises less than 20 acres. The bulk of this is located in the 23-acre "triangle" parcel located on the west side of Fox Brown Road, along the east side of the powerline. These areas are dominated by sand live oak (*Quercus geminata*) with saw palmetto (*Serenoa repens*) as the dominant understory. The triangle parcel is dense and overgrown, with scrub oak species reaching heights of 30+ feet. The remaining portions of the scrub habitats to the north of the triangle parcel have been partially converted with bahia grass (*Paspalum notatum*) the dominant groundcover and scattered oaks. Soil and vegetation impacts are evident from cattle. The potential exists for these areas to be restored to functioning xeric habitats through mechanical clearing of overgrowth, controlled burning, control of bahia, and planting of native scrub species.

3.3.2 Pine Flatwoods (411 FLUCFCS)

Upland pine flatwoods habitats are found infrequently scattered across the site. Most of these areas support slash pine (*Pinus elliottii*), but some include a mixture of slash pine and longleaf pine (*Pinus palustris*). Saw palmetto dominates the understory in the less-disturbed areas. It is likely that these areas may have been wet pine flatwoods, but due to ditching, draining and fire exclusion these areas have become overgrown with palmetto and vine species, and have lost the

wet grasses and historic hydroperiod. These areas will likely benefit from controlled burns and rehydration activities.

3.3.3 Hardwood Hammock/Cabbage Palm (428 FLUCFCS)

Relatively small hardwood hammocks are scattered throughout the site, most commonly found in the central portion of Parcel C, within the improved pasture areas. These small upland hammocks support a dominant mature canopy of live oak (*Quercus virginiana*) and cabbage palm (*Sabal palmetto*) with occasional laurel oak (*Quercus laurifolia*) and slash pine on the edges. Brazilian pepper has infested many of these hammocks, particularly along the fringes, although they have been treated with herbicide in many areas. The herbaceous assemblage, due to the dense canopy, tends to be low and sparse. Common vine and herbaceous species observed include greenbriar (*Smilax* spp.), paspalum (*Paspalum* spp.), bahia grass, and low panicums (*Dichanthelium* spp.).

3.3.4 Palmetto Prairie (321 FLUCFCS)

Palmetto-dominated rangelands are limited to relatively small patches in Parcel C, west of Fox Brown Road (Photo 4-18, 20). These areas border marshes, flatwoods and open pastures. Dominant vegetation is saw palmetto, with frequent wax myrtle (*Myrica cerifera*), gallberry (*Ilex glabra*) and scattered slash pine in some areas. Ground cover includes bachelor buttons (*Polygala* sp.) and bluestem (*Andropogon virginicus*). These habitats are in fairly good condition, although some areas are overgrown and should be burned to maintain high quality wildlife habitat and control of nuisance and invasive species, especially vines.

3.3.5 Mixed Wetland Hardwood Forests (617 FLUCFCS)

Mixed wetland hardwood forested systems were mapped on Parcels B and C and include the slough just east of Fox Brown Road, as well as a number of isolated and ditched mixed wetland hardwood forests scattered throughout improved pasture areas in Parcels B and C. Within the slough system, red maple (*Acer rubrum*) and water hickory (*Carya aquatic*) are dominant through the central portion, with frequent sweet bay (*Magnolia virginiana*), and species such as laurel oak, loblolly bay (*Gordonia lasianthus*), cabbage palm, American elm (*Ulmus* americanus), and sugarberry (*Celtis laevigata*) more frequent along the outer fringes. Black gum (*Nyssa sylvatica*) was observed in some of the deeper wetland systems, including the slough. In the remaining forested wetland systems, red maple tends to be the dominant species, with wax myrtle, laurel oak and cabbage palm frequent. For the most, part these forested wetland systems are of fairly good quality, with the exception of nuisance and exotic species encroaching along transitional and upland borders and in severely drained systems. Construction of roads and berms has resulted in impounded areas within the slough and a few other areas.

3.3.6 Freshwater Marshes (641 FLUCFCS)

The dominant native habitat type throughout the site is herbaceous wetlands, comprising an estimated 3,600 acres. These include isolated and connected systems and range from well hydrated to significantly drained. Many of these marshes were at one time much larger, but following extensive ditching, have been substantially reduced. Dominant vegetation varies, but includes sawgrass (*Cladium jamaicense*), pickerelweed (*Pontederia cordata*), fire-flag (*Thalia*

geniculata), arrowhead (*Sagittaria* spp.), and soft-rush (*Juncus effuses*). Additional species commonly observed in these areas include torpedo grass (*Panicum repens*), smartweed (*Polygonum* spp.), beakrushes (*Rhynchospora* spp.), maidencane (*Panicum hemitomon*), bulrush (*Scirpus* spp.) and spikerushes (*Eleocharis* spp.). The marshes on the southeasternmost portion of Parcel C are likely the most impacted wetland systems, as most have been drained to some extent by the network of ditch systems. The highest quality, most intact herbaceous wetlands tend to be found on Parcel C in Sections 32 and 33, where large sawgrass marshes dominate. Although ditching has occurred in this area, it is considerably less extensive than the eastern portions of Parcel C, and on Parcels A and B. Of note, however, is the rapid response of previously drained herbaceous wetlands on Parcel A in areas where ditches have recently been filled. As discussed above, these areas coincide with the faint signatures apparent on aerial photos that indicate the historic wetland signature. The reestablishment of wetland vegetation and hydrology was observed in several of these areas, and early indication of the effectiveness of the ditch filling.

3.3.7 Willow and Elderberry/Shrub Marsh (618 FLUCFCS)

Shrub wetlands are scattered frequently throughout the improved pasture portions of the easternmost parcel, and interspersed within herbaceous marshes. These areas are dominated by or consist of an assemblage of Carolina willow, buttonbush (*Cephalanthus occidentalis*), and primrose willow (*Ludwigia peruviana*). In many of these systems, the sub-canopy cover of shrub species is quite dense, somewhat limiting the herbaceous ground cover to more open areas and edges. Herbaceous species observed consist primarily of those found in the herbaceous marsh systems described above. Primrose willow is the most common nuisance species, with coverages ranging from below 5% to up to 100%. Other shrub species found within these systems include salt bush (*Baccharis halimifolia*), elderberry (*Sambucus nigra* sub. *canadensis*), and wax myrtle. Brazilian pepper has invaded many of these systems, particularly those in Parcel B, with disturbed hydroperiods. The highest quality, most intact shrub wetlands are found in Parcel A in Sections 8 and 17.

3.3.8 Ditches/Canals (FLUCFCS 510)

Each parcel supports an extensive network of agricultural ditches, swales, and other drainage conveyances of varying widths and depths. Some of these are large drainage canals that serve the regional system, however most were historically constructed for the purpose of draining for agricultural conversion. These range from small grass swales that are temporarily inundated, to deep permanently inundated ditches. They vary in size from a few feet to thirty feet wide, and support a variety of primarily exotic species. Brazilian pepper is prevalent on the banks, although herbicide treatments have been effective in many areas. Water hyacinth (*Eichhornia crassipes*) and water lettuce (*Pistia stratiotes*), primrose willow, Carolina willow, and cattail (*Typha* sp.) are common in the canals and larger ditches. The exotic burhead rush (*Scirpus cubensis*) was noted occasionally growing in floating monoculture clumps within inundated ditches. In addition to the nuisance and exotics listed above, many areas also support native wetland species including soft rush, pickerelweed and arrowhead.

Because of the very large number of ditches, swales and canals, the large areas involved, and the limited scale with which to work, only the larger, major canals were included on the land use

maps. In addition, several ditches have been filled since the date of the aerial photography, which will continue as restoration proceeds. The signature of the existing and previously filled ditches are easily identifiable on historic and recent aerial photographs which should suffice for future comparisons.

3.3.9 Borrow Areas/Cattle Ponds (742 FLUCFCS)

Cattle ponds are scattered infrequently over all three parcels, and generally are steep sided ponds with little to no fringing vegetation. Spoil is typically piled to one or both sides of the excavated pond. Nuisance, exotic, and pioneer shrub species are present on the fringes of some cattle ponds.

3.3.10 Wet Prairie (643 FLUCFCS)

Wet prairie habitats of high quality are found on Parcel A in conjunction with the hydric pine flatwoods, and on the Steele Property in Parcel C interspersed among wetlands and pine flatwood habitats. Vegetation consists of beak rush, broomsedge (*Andropogon* spp.), coinwort (*Centella asiatica*), maidencane, beaked panicum (*Panicum anceps*), rushes (*Juncus marginatus* and *J. effusus*), yellow-eyed grasses (*Xyris* spp.), redroot (*Lachnanthes caroliniana*), and goldenrod (*Solidago* spp.). Scattered through these areas are introduced turf grasses, primrose willow and wax myrtle.

3.3.11 Improved Pasture (211 FLUCFCS)

Improved pasture is found throughout the site and exhibits dominant cover by one or more exotic turf grass species such as bahia grass, Bermuda grass, and tropical signalgrass (*Urochloa distachya*). Dog fennel (*Eupatorium* spp.), smut grass (*Sporobolis indicus*), thistle (*Cirsium* sp.), and tropical soda apple (*Solanum capsicoides*) are commonly found scattered through most of these pasture areas. Many pasture areas also support scattered occurrences of Brazilian pepper, wax myrtle, cabbage palm and slash pine.

Historically, many of these areas were wetlands; although extensive ditching and draining occurred, some areas of improved pasture continue to support wetland vegetation and hydrology. Within these wet pasture areas, turf grasses such as bahia and Bermuda grass (*Cynodon dactylon*) tend to be dominant, however, several wetland species are subdominant and/or frequent. These include smartweed, pennywort (*Hydrocotyle* sp.), frog fruit (*Phyla nodiflora*), flat sedge (*Cyperus polystachyos*), sour paspalum (*Paspalum conjugatum*), paragrass (*Brachiaria purpurascens*), sword grass (*Scirpus pungens*), and soft rush. In many of these areas, shallow drainage swales have been constructed. The swales are dominated by wetland species such as red ludwigia (*Ludwigia repens*), torpedo grass, smartweed and pickerelweed. Although these areas provide foraging habitat for a variety of wading bird species, because of the degree of disturbance and dominance by exotic turf species, overall habitat value is limited and could be enhanced through restoration.

3.3.12 Woodland Pastures (213 FLUCFCS)

Woodland pastures are scattered in each of the three parcels and typically consist of hydric and mesic pine flatwoods, oak and/or cabbage palm hammocks. Typically, these are areas where the understory has been converted to improved pasture, but the canopy/forested species have been left in place.

3.3.13 Wax Myrtle - Willow (429 FLUCFCS)

These shrub-dominated areas are infrequently scattered in all three parcels. These areas typically occur adjacent to wetland shrub and herbaceous marshes. They tend to be dominated by wax myrtle with associate shrub species including saltbush (*Baccharis halimifolia*), elderberry (*Sambucus nigra* sub. *canadensis*), and Carolina willow (*Salix caroliniana*). Previous conversion of the native herbaceous strata is evident due to the presence of introduced turf grass. The overstory is generally lacking, however, scattered individuals of pine, oak, palm, and dahoon holly were observed.

3.3.14 Bay Swamps (611 FLUCFCS)

Bay swamps were identified in Parcel C located as isolated bay heads within freshwater marshes in Sections 32 and 33, and a forested system at the south end of the linear mixed wetland hardwoods east of Fox Brown Road (Section 34). These systems are dominated by mature sweet bay (*Magnolia virginica*).

3.3.15 Exotic Wetland Hardwoods (619 FLUCFCS)

These areas are infrequent and typically are dominated by Brazilian pepper. Many of these areas have been treated with herbicide and now consist of herbaceous wetland vegetation with an overstory of dead pepper.

3.3.16 Wetland Coniferous Forests (620 FLUCFCS)

Bald cypress (*Taxodium distichum*) and pond cypress (*T. ascendens*) are dominant in a few isolated systems, primarily in the southeast and southwest portion of Parcel C. Cypress fringes and islands occur in the large marsh system in Section 32 and 33 to the west of Fox Brown Road, and as small isolated systems just west of CR 609/Allapattah Road.

3.3.17 Hydric Pine Flatwoods (625 FLUCFCS)

Hydric pine flatwoods are present on each of the three parcels. This habitat on Parcels B and C has been significantly impacted by one or a combination of cattle grazing, fire suppression, and ditching. A large high quality hydric pine flatwood habitat is present on Parcel A. This habitat consists of varying low densities of slash pine, scattered saw palmetto and wiregrass, and a dominance of hydric grasses, sedges, and rushes. Additionally, islands of hydric pine flatwoods are present within freshwater marshes and wet prairies/ephemeral wetlands.

3.3.18 Wetland Forested Mixed (630 FLUCFCS)

One small area of mixed forested wetland is found within a freshwater marsh in Parcel B. This system does not, however, meet the 60% canopy cover defined by FLUCFCS for this category. This forested "island" consists of red maple, sweet bay, blackgum, and dahoon holly.

3.3.19 Residential (110 and 120 FLUCFCS)

Three residential areas are found on the project: one in the southwest portion of Parcel A in Section 18, and two on Parcel C in Section 23. All three consist of single family homes.

4.0 RECOMMENDATIONS

4.1 Wildlife Assessments

Future wildlife assessments recommended for the site include annual inventories to assess continued or increased wading bird nesting activity, sandhill crane nesting, and Audubon's crested caracara nesting. These assessments will serve to determine whether restoration activities have a significant impact on such species and whether a benefit may be derived. It is recommended that caracara nest assessments begin in December of each year, using aerial and ground assessments in areas where caracara activity has been observed and where suitable habitat occurs. Sandhill crane and wading bird assessments may be conducted aerially, beginning in March of each year.

Burrowing owl activity should be monitored annually in those portions of Parcels A and B where the owls have been documented and/or are being managed. This will allow for identification of new or revised management areas, adjustment of management activities, and will determine what impact restoration activities may have on this species.

In areas slated for restoration where gopher tortoise burrows may be using berms or spoil, it is recommended that field assessments take place six months or less prior to construction to identify and relocate tortoises that would be affected.

4.2 Management Plans / Restoration

Preparation of a detailed habitat management plan is recommended so that management goals and objectives can be set forth, target species identified, and a plan to achieve the objective and goals can be created that will serve to manage intact native systems and restore native habitats for optimum wildlife utilization.

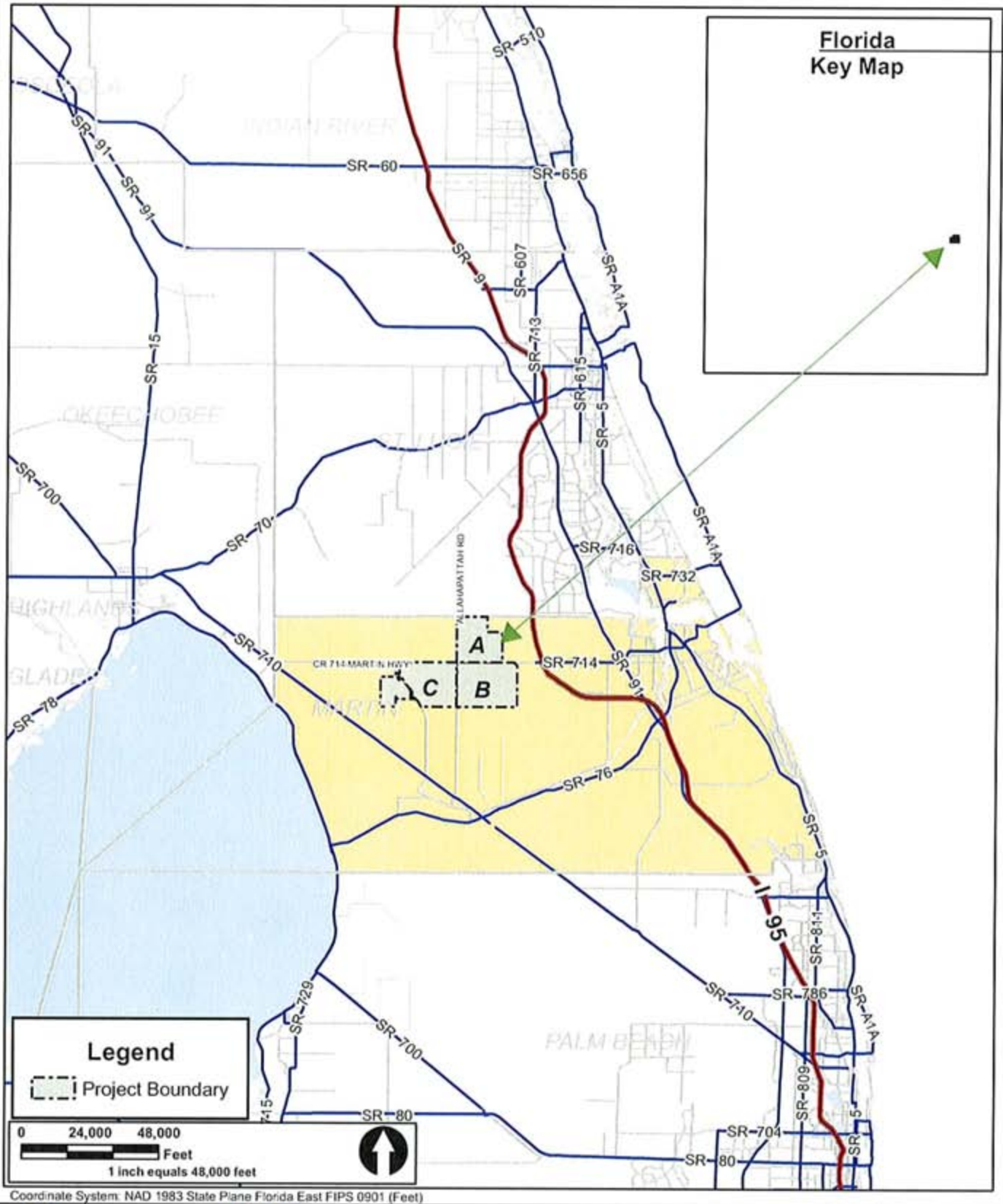
Continued and regular maintenance of nuisance and exotic species is highly recommended. Due to the extensive cover of nuisance and exotic species within the three parcels and the long duration of viable seeds from these species, continued infestation is likely to occur, making a continued nuisance and exotic vegetation management program imperative.

Continued and increased use by gopher tortoise and other xeric habitat dependent species could be encouraged in those portions of Parcel C that support remnant xeric oak and palmetto prairie habitats. This could be accomplished through prescribed fire and the restoration of the existing improved pasture habitats to pine flatwood/palmetto prairie.

In those areas of Parcel C that support xeric soil types, scrubby pine flatwoods or xeric oak scrub habitats could be reestablished. Due to the overgrown nature of the sand live oak trees in the existing xeric oak habitat, fire will no longer be effective on these fire resistant mature trees. Mechanical cutting of the overgrown scrub trees is the only means of decreasing the forested structure. This can be completed inexpensively by using crews with chainsaws to cut down all trees taller than 10 feet. This should be accomplished by cutting the trees at ground level. Cutting of the oaks will not kill them, but will transfer vegetative growth to the network of root systems thus stimulating shrub growth while increasing the shrub cover.

A management plan to reduce the population of feral pigs should be implemented, as extensive hog rooting was found in scattered locations in all three parcels. Feral pig rooting will not only affect surficial water flow, but may negatively impact restored habitats, and provides a disturbed substrate for colonization by exotic vegetation. Feral pig populations should be significantly reduced prior to any habitat restoration. Portable solar powered electric fencing has been proven to be effective in similar situations when erected around newly restored habitats.

FIGURES



Coordinate System: NAD 1983 State Plane Florida East FIPS 0901 (Feet)

QUEST ecology

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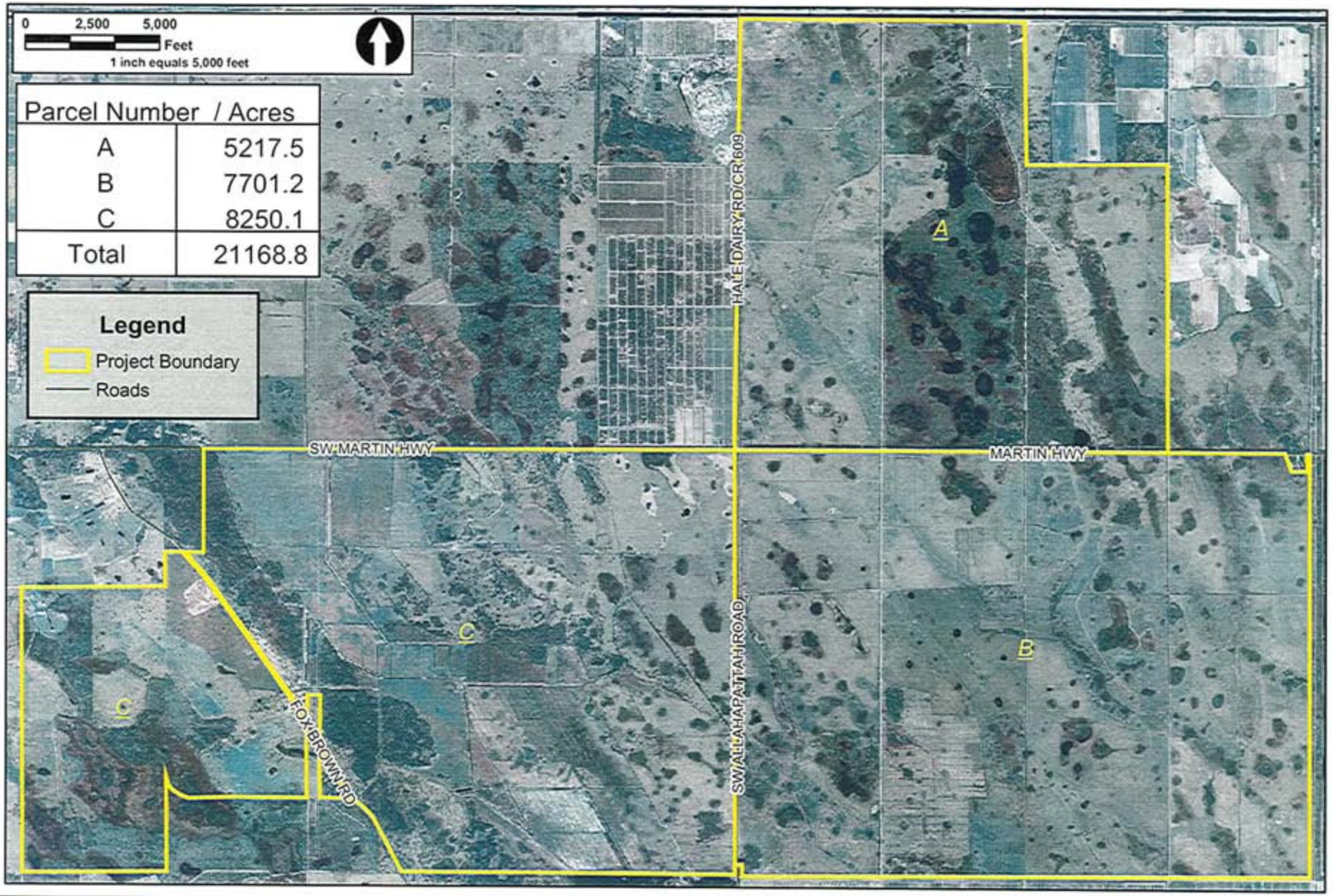
ALLAPATTAH FLATS

FOR: South Florida Water Management District

FIGURE 1
Location Map

Path: (C:\GIS\Projects\Allapattah Flats\Arcmap\location.mxd) By: MAR Date: 5/26/2006



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ALLAPATTAH FLATS

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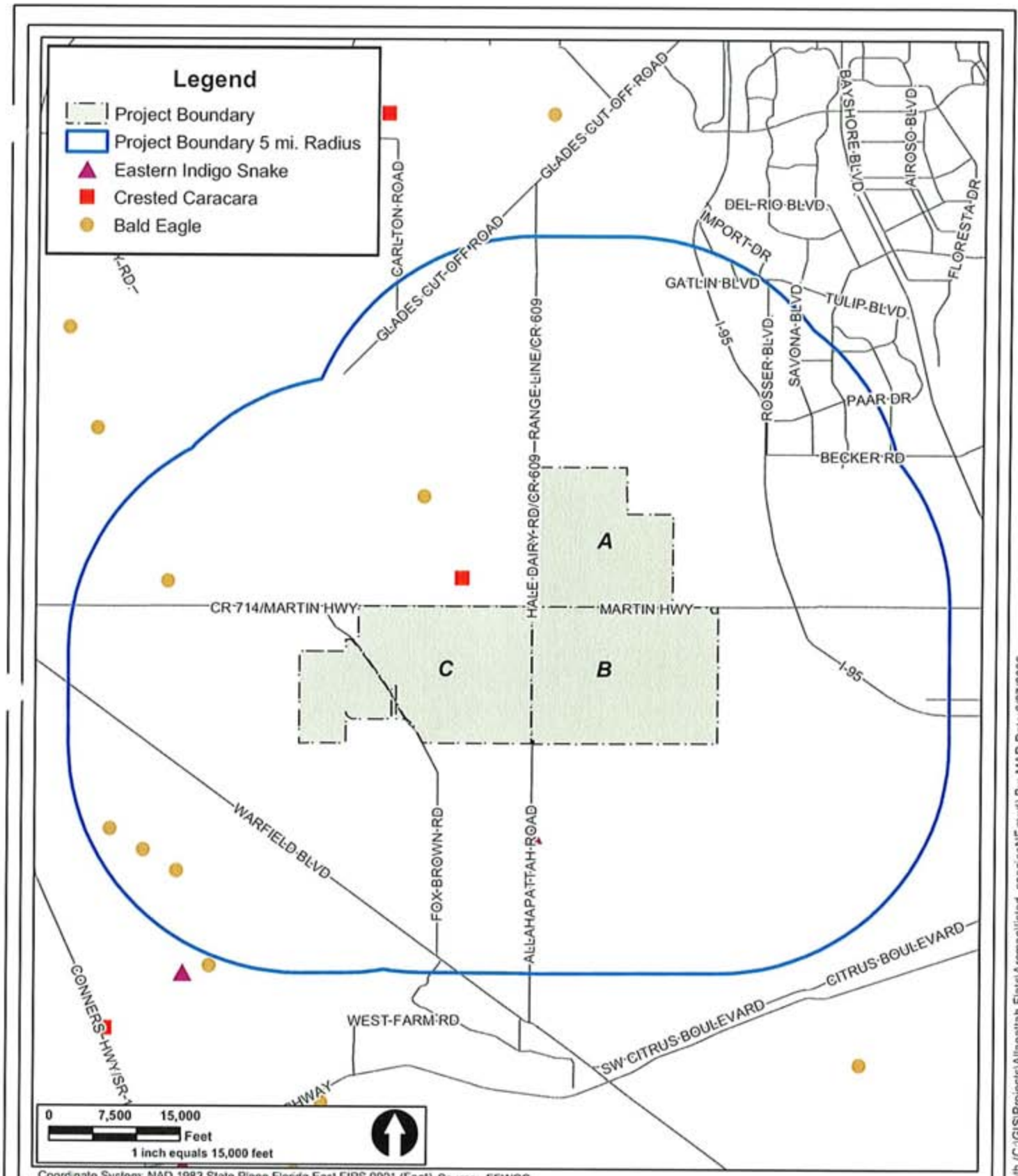
FIGURE 2
Parcel Boundaries

Path (C:\GIS\Projects\Allapattah Flats\Arcmap\project boundary.mxd) By: MAR Date 6/26/2006



Coordinate System: NAD 1983 State Plane Florida East FIPS 0901 (Feet) Source: FFWCC

Path (C:\GIS\Projects\Allapattah Flats\Arcmap\listed_speciesNF.mxd) By: MAR Date:6/27/2006

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FIGURE 3
Documented Listed Species

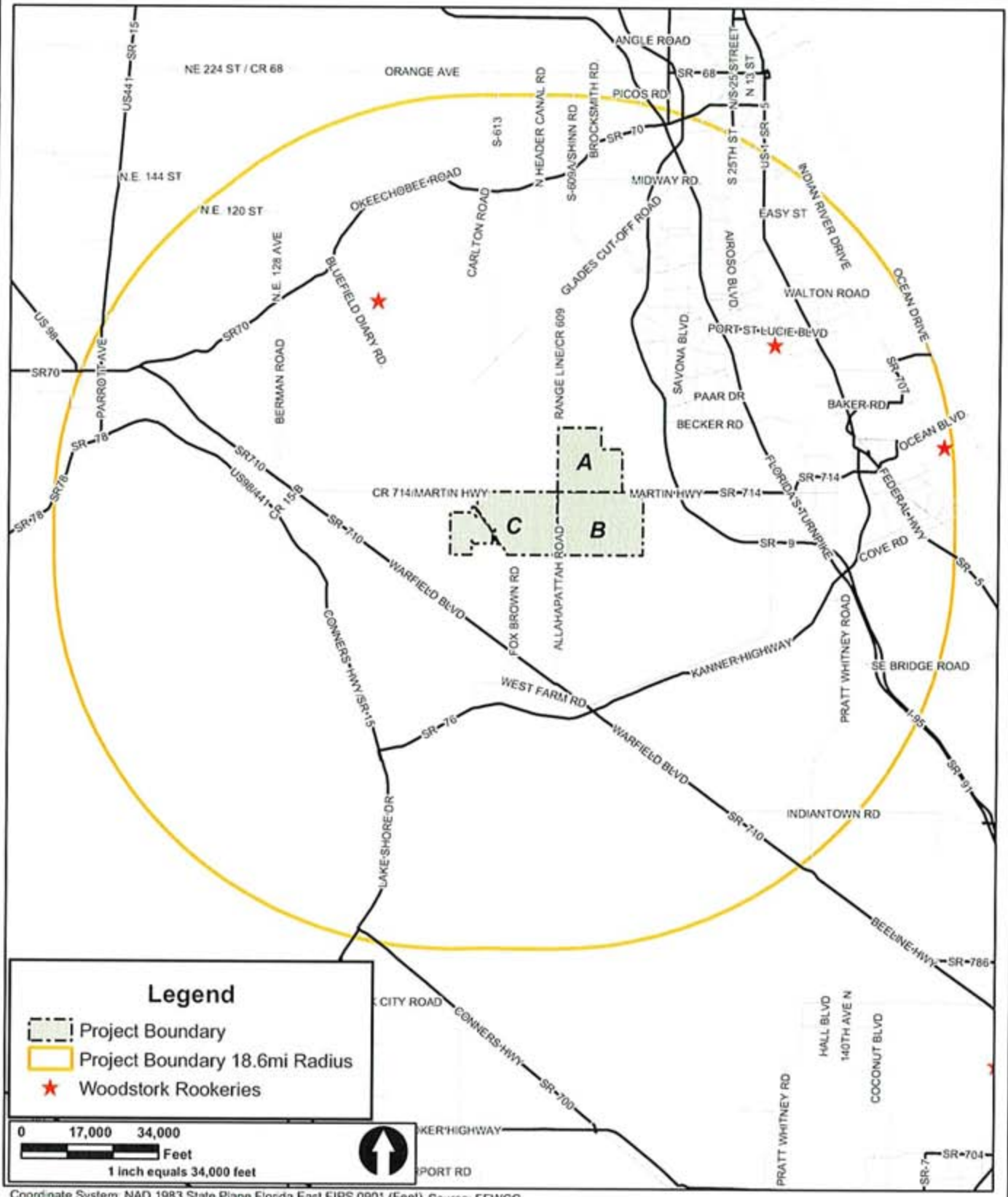

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FIGURE 4
Woodstork Rookeries

Path (C:\GIS\Projects\Allapattah Flats\Arcmap\woodstorksNF.mxd) By: MAR Date:6/27/2006

APPENDIX
REPRESENTATIVE PHOTOS

Photo 1. Parcel A marsh with sandhill crane nests (March 2006)

Photo 2. Sandhill crane nest in Parcel A marsh (March 2006)

Photo 3. Parcel C marsh with sandhill crane nest (March 2006)

Photo 4. Sandhill crane nest in Parcel B Marsh (March 2006)

Photo 5. Parcel A marsh with wading bird rookery (March 2006)

Photo 6. Nesting great egrets in marsh on Parcel A (March 2006)

Photo 7. Wading birds using restored wetland on Parcel A (March 2006)

Photo 8. Active owl burrow at previously marked burrow on Parcel A (March 2006.

Photo 9. Burrowing Owl at PVC marked location on Parcel A (March 2006)

Photo 10. Typical berm used by burrowing owls on Parcel B (March 2006)

Photo 11. Owl at burrow on Parcel C (March 2006)

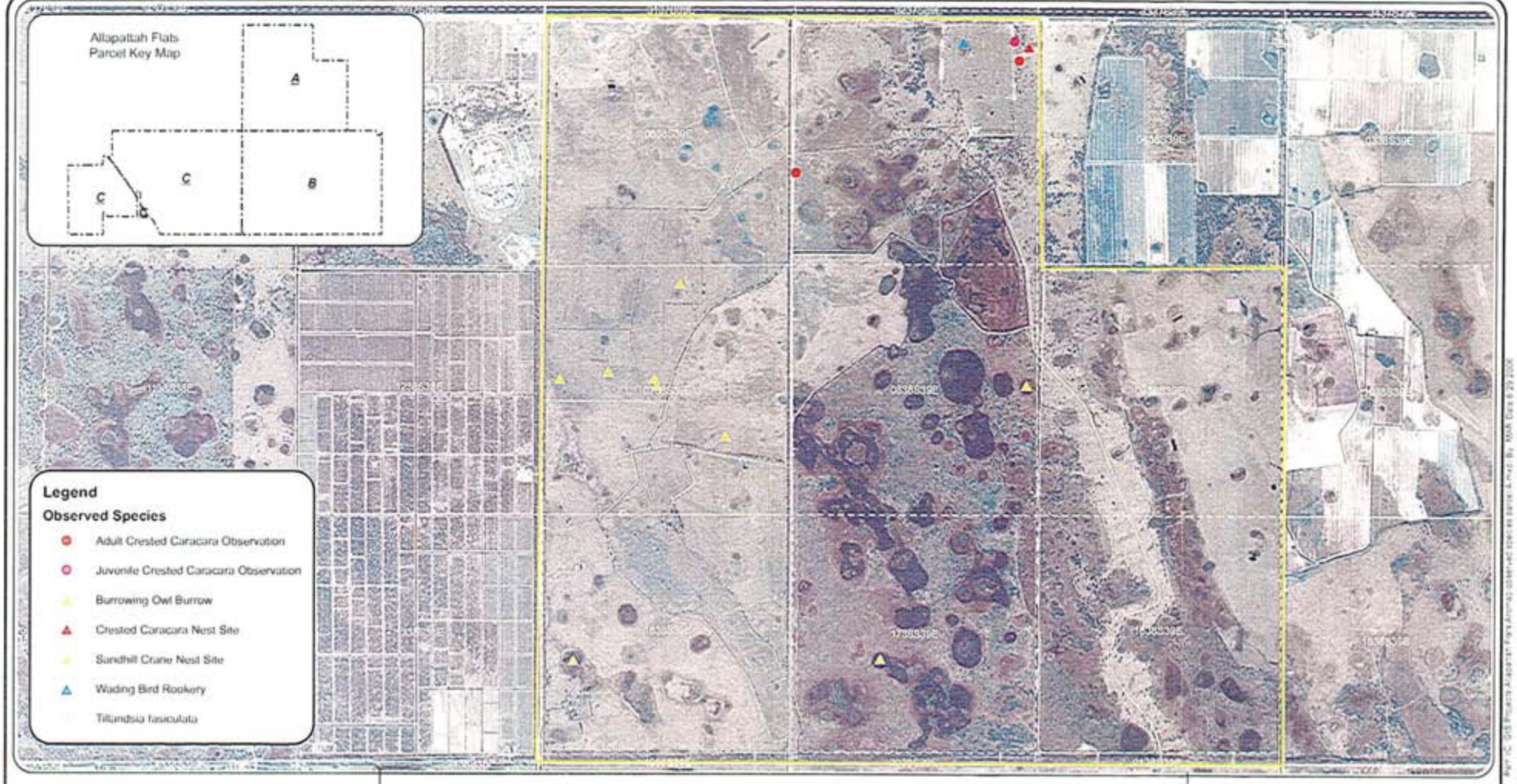
Photo 12. Palmetto prairie in Parcel C with gopher tortoise burrows (March 2006)

Photo 13. Caracara nest site on Parcel A (March 2006)

Photo 14. Inactive caracara nest site on Parcel B (March 2006)

Photo 15. Adult and juvenile caracaras observed on Parcel C (April 2006)

Photo 16. Juvenile caracaras observed on Parcel C (April 2006)



QUEST ecology

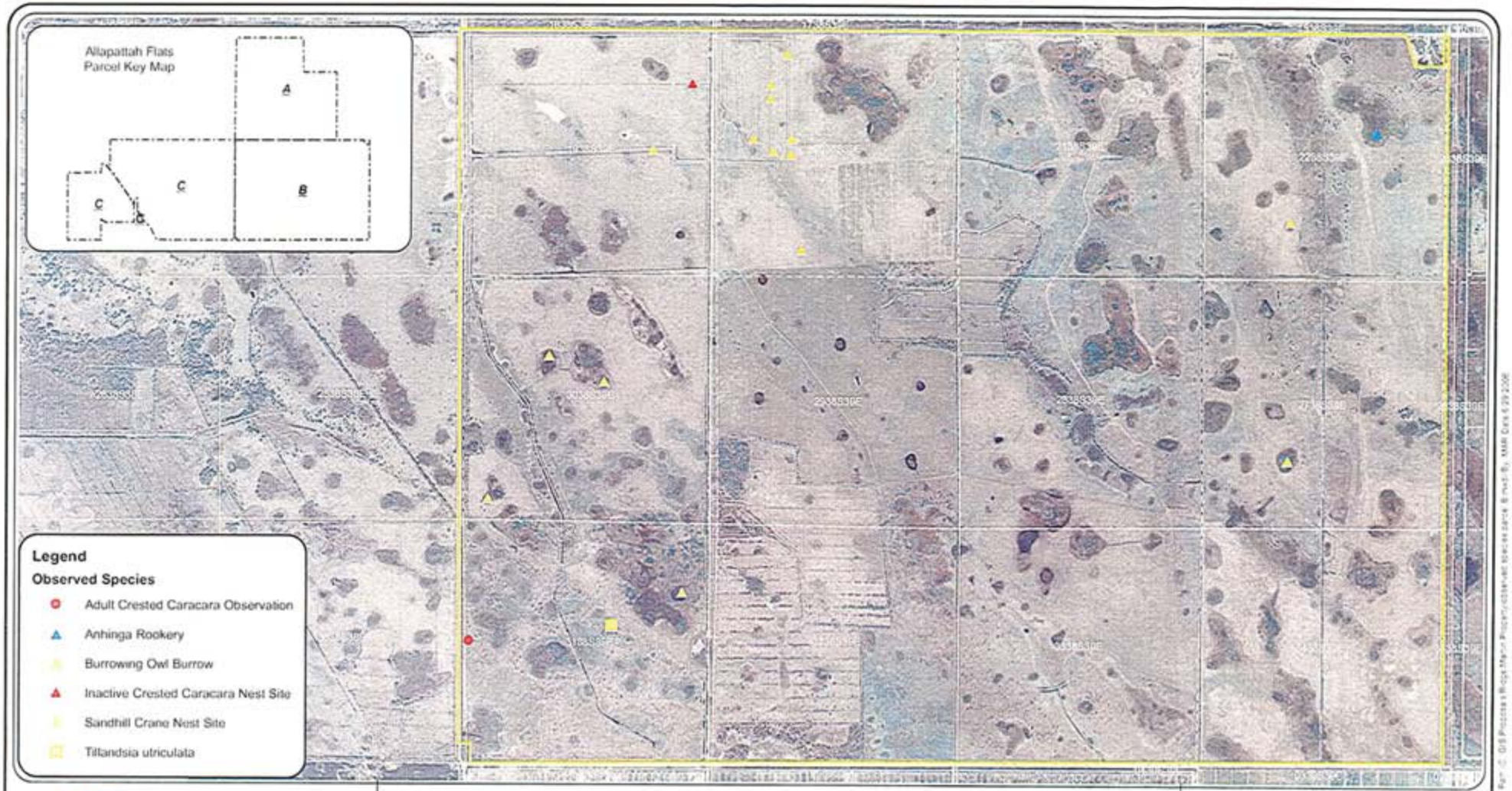
MILLER LEGG

0 2,000
Feet

ALLAPATTAH FLATS
PARCEL A
SPRING 2006 SURVEYS

FOR: South Florida Water Management District

FIGURE 5A
LISTED SPECIES OBSERVATIONS



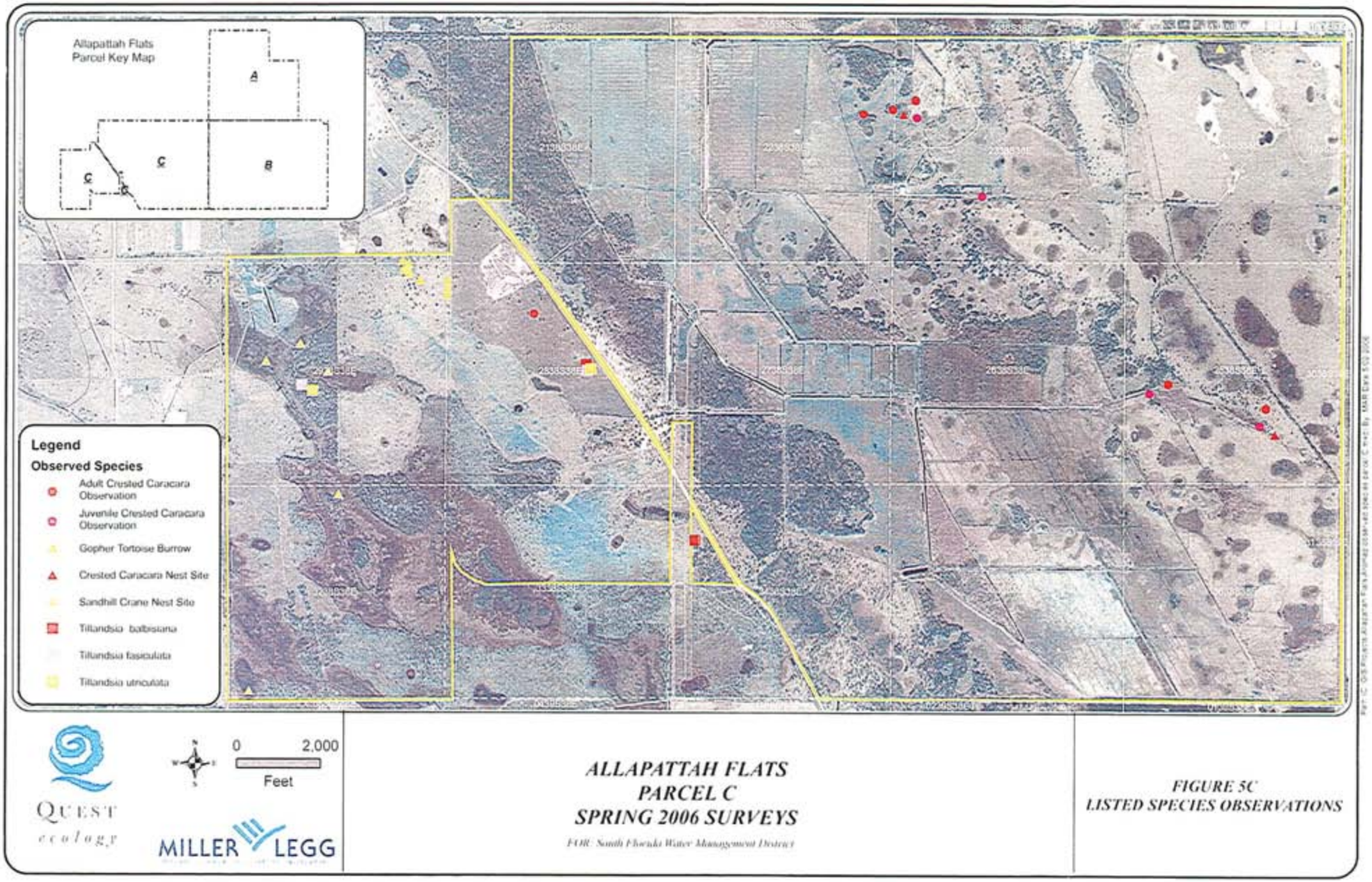
QUEST ecology

MILLER LEGG

ALLAPATTAH FLATS
PARCEL B
SPRING 2006 SURVEYS

FOR South Florida Water Management District

FIGURE 5B
LISTED SPECIES OBSERVATIONS



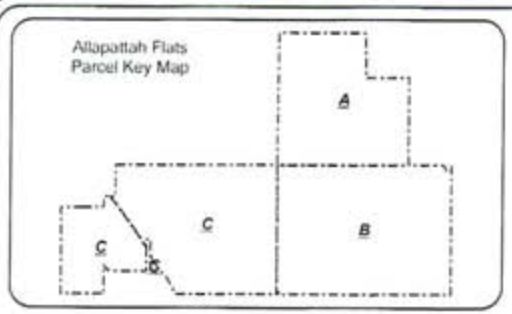
QUEST ecology

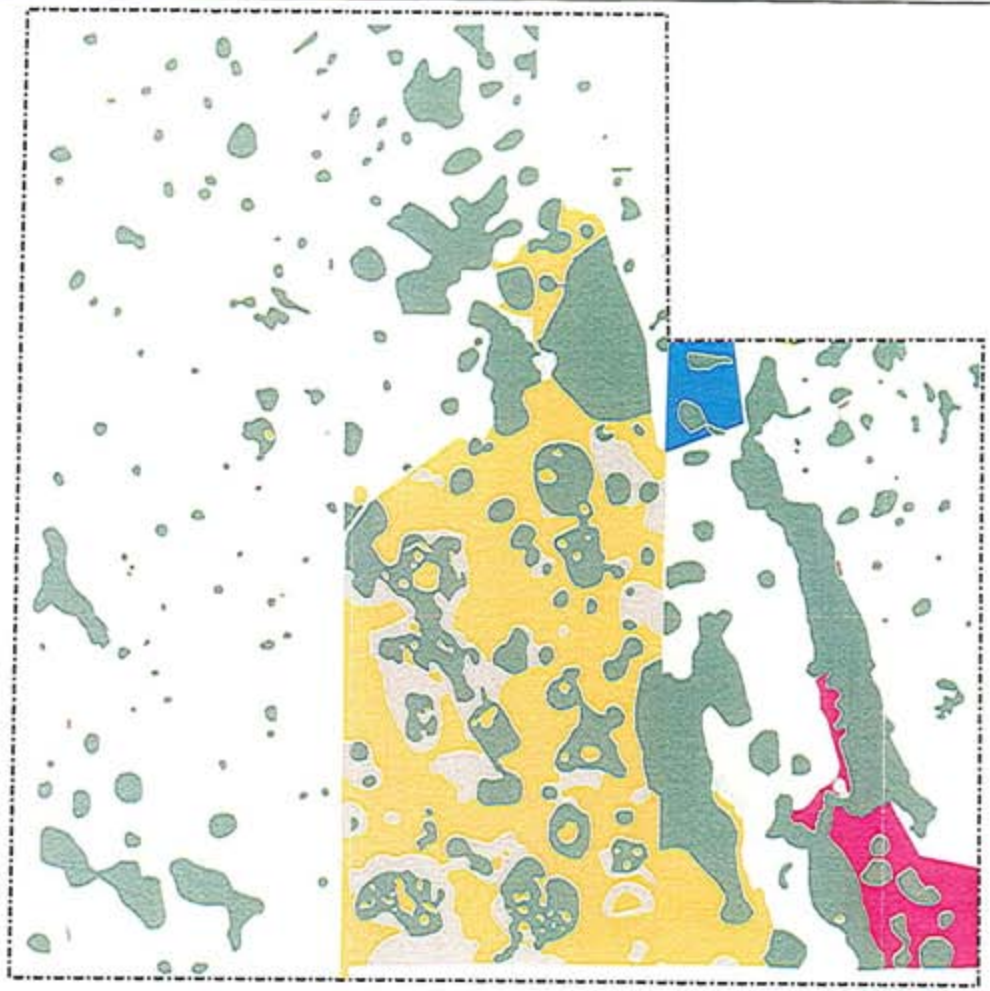
MILLER LEGG

ALLAPATTAH FLATS
PARCEL C
SPRING 2006 SURVEYS

FOR: South Florida Water Management District

FIGURE 5C
LISTED SPECIES OBSERVATIONS





Legend

Parcel A Boundary

Description / Acres	
110 Residential, Low Density	5.8
211 Improved Pastures	2825.4
213 Woodland Pastures	177.6
411 Pine Flatwoods	86.4
414 Pine Mesic Oak	92.4
428 Cabbage Palm	21.1
429 Wax Mirtle - Willow	37.7
618 Willow and Elderberry	4.3
625 Hydric Pine Flatwoods	673.4
641 Freswater Marshes	1118.5
643 Wet Prairies	172.5
742 Borrow Areas	2.4

QUEST ecology

0 2,000 Feet

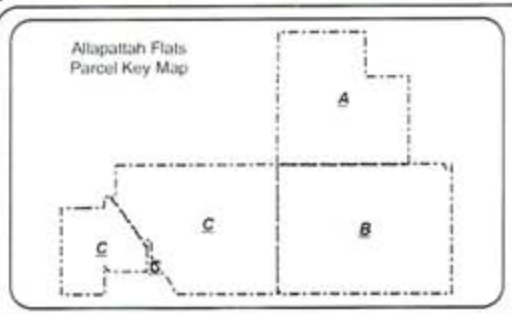
MILLER LEGG

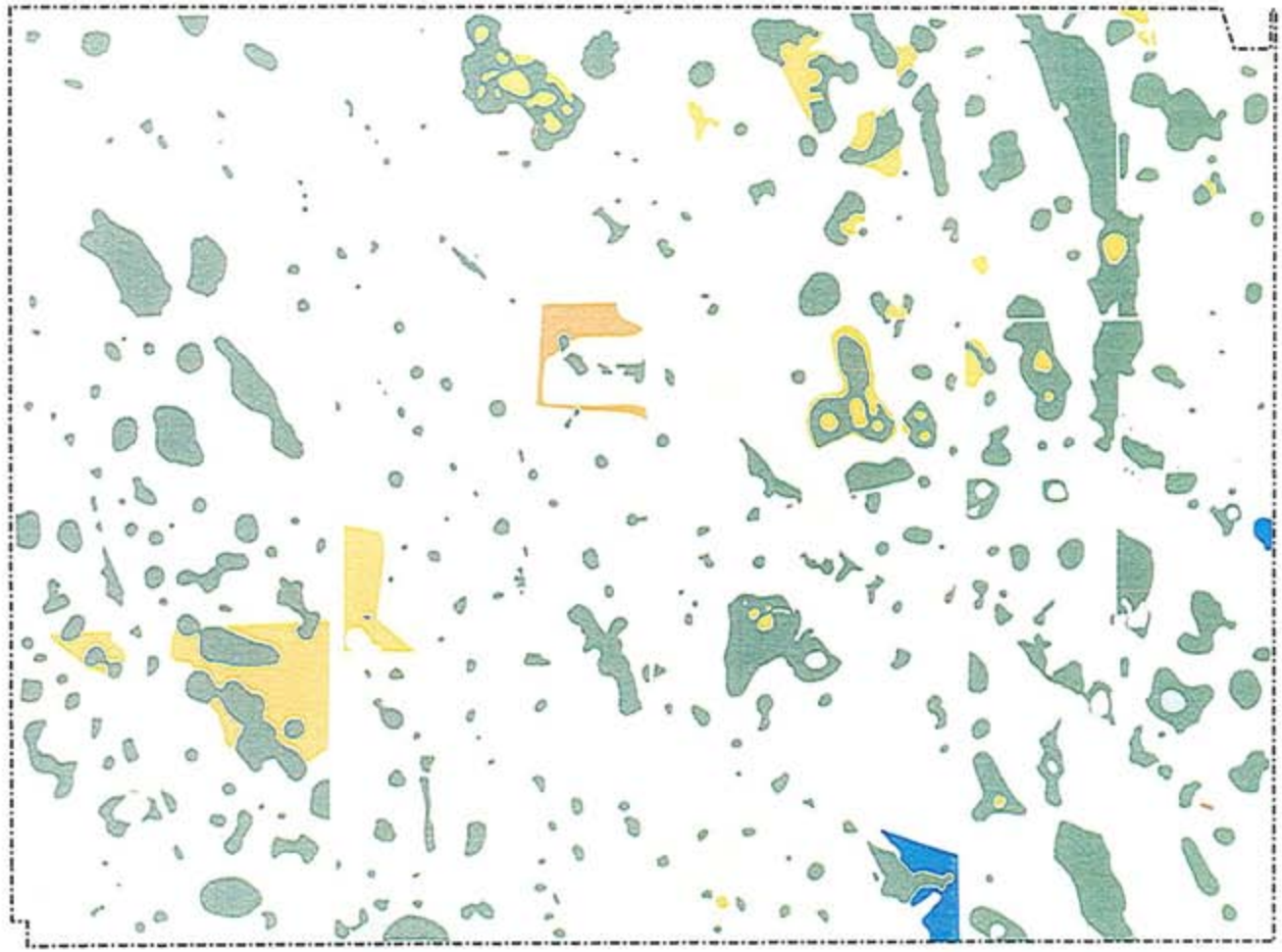
ALLAPATTAH FLATS PARCEL A

FOR: South Florida Water Management Water District

FIGURE 6A
2006 EXISTING LAND USE
(FLUCFCS 1999)

Source: Land Use Delineation by Quest Ecology, June 2006





Legend

Parcel B Boundary

Description / Acres	
211 Improved Pastures	5956.2
213 Woodland Pastures	167.2
320 Shrub and Brushland	29.3
411 Pine Flatwoods	45.1
428 Cabbage Palm	7.0
429 Wax Mirtle - Willow	28.4
617 Mixed Wetland Hardwoods	13.3
618 Willow and Elderberry	89.3
625 Hydric Pine Flatwoods	180.1
630 Wetland Forested Mixed	2.6
641 Freswater Marshes	1178.7
643 Wet Prairies	2.1
742 Borrow Areas	1.9

QUEST ecology

0 2,000 Feet

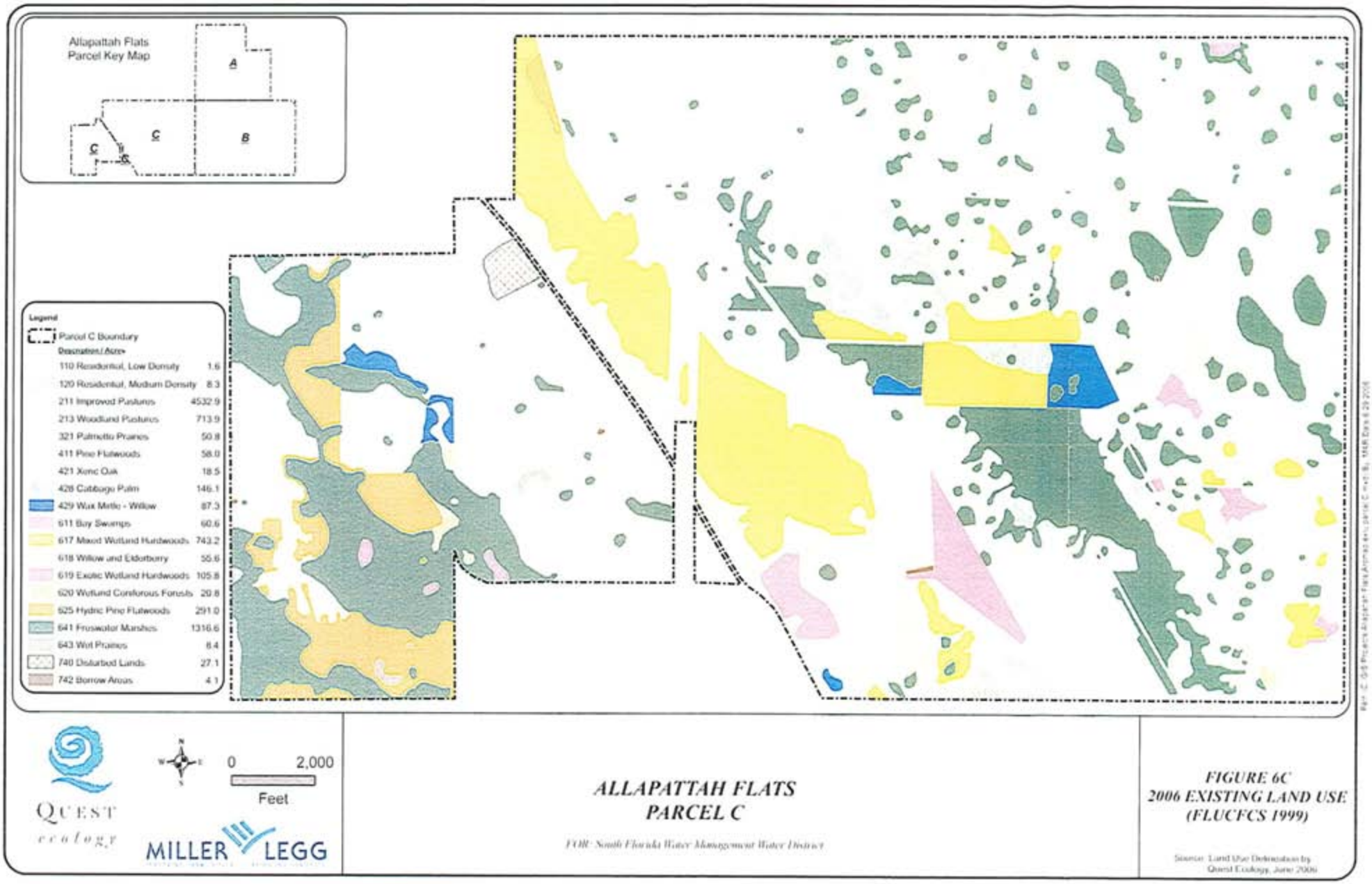
MILLER LEGG

ALLAPATTAH FLATS PARCEL B

FOR: South Florida Water Management Water District

FIGURE 6B 2006 EXISTING LAND USE (FLUCFCS 1999)

Source: Land Use Delineation by Quest Ecology, June 2006


Allapattah Flats
Parcel Key Map
A
B
C
C
C
Legend
Parcel C Boundary
Description / Acres
110 Residential, Low Density 1.6
120 Residential, Medium Density 8.3
211 Improved Pastures 4532.9
213 Woodland Pastures 713.9
321 Palmetto Prairies 50.8
411 Pine Flatwoods 58.0
421 Xeric Oak 18.5
428 Cabbage Palm 146.1
429 Wax Myrtle - Willow 87.3
611 Bay Swamps 60.6
617 Mixed Wetland Hardwoods 743.2
618 Willow and Elderberry 55.6
619 Exotic Wetland Hardwoods 105.8
620 Wetland Coniferous Forests 20.8
625 Hydric Pine Flatwoods 291.0
641 Freshwater Marshes 1316.6
643 Wet Prairies 8.4
740 Disturbed Lands 27.1
742 Borrow Areas 4.1
N
W
E
S
0
2,000
Feet
QUEST ecology
MILLER LEGG
ALLAPATTAH FLATS
PARCEL C
FOR: South Florida Water Management Water District
FIGURE 6C
2006 EXISTING LAND USE
(FLUCFCS 1999)
Source: Land Use Delineation by
Quest Ecology, June 2006

Attachment F: Allapattah Flats Project Burrowing Owl and Gopher Tortoise Species Survey

Note: This document, dated September 2009, was provided to the South Florida Water Management District by Jones Edmunds & Associates, Inc. and Entrix, Inc., under contract.

ALLAPATTAH FLATS PROJECT
BURROWING OWL AND GOPHER TORTOISE SPECIES SURVEY

Prepared for:

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Prepared By:

JONES EDMUNDS & ASSOCIATES, INC.
730 NE Waldo Road
Gainesville, Florida 32641

Certificate of Authorization #1841

and

ENTRIX, INC.
22 Sarasota Center Boulevard
Sarasota, Florida 34240

September 2009

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1.0 INTRODUCTION

The South Florida Water Management District (District) Allapattah Flats property is an approximately 21,000-acre, irregularly shaped parcel of land in northwestern Martin County, Florida (Figure 1). Martin County and the District jointly own Allapattah Flats while the Florida Fish and Wildlife Conservation Commission partners with the District and Martin County to manage public use and wildlife in the area.

Previous landowners constructed swales and ditches to drain the site's wetlands and channel the water to the C-23 Canal, which eventually flows into the St. Lucie River. Allapattah Flats was acquired as a component of the Indian River Lagoon Restoration. Planned restoration of this property entails filling and/or plugging approximately 600,000 linear feet of ditches, constructing water control structures in the primary north south canals, and constructing low berms along the perimeter of the property to prevent water from flooding roadways or adjacent private properties.

Gopher tortoises and burrowing owls are known to inhabit the Allapattah Flats property. A previous report by Quest Ecology and Miller Legg (2006) documented these species as well as others, such as Audubon's crested caracara (*Caracara cheriway audubonii*) and sandhill crane (*Grus canadensis pratensis*). Due to the proposed construction activities that will occur on-site to restore the hydrology of Allapattah Flats, it is important for the District to know where these species reside. Jones Edmunds and ENTRIX (Team) performed a preliminary gopher tortoise (*Gopherus polyphemus*) and burrowing owl (*Athene cunicularia*) species survey and habitat assessment to determine the location and approximate density of the species in a portion of the Allapattah Flats property referred to as Parcel A and Parcel B (Figure 1). The following presents the results of this survey.

2.0 SITE DESCRIPTION

Parcels A and B lie within Sections 5-9, 16-22 and 27-34 of Township 38 South and Range 39 East (Figure 2). Parcel A represents the northeast portion of Allapattah Flats property that is bound to the west by CR 609, to the south by CR 714, to the north by the C-23 Canal. Parcel B is immediately south of Parcel A and is bound by CR 714 to the north, CR 609 to the west, and private citrus groves to the south.

Parcels A and B are predominantly comprised of improved pasture and herbaceous wetlands (wet prairies and emergent marsh) (Figure 3). However, the eastern portions of Parcel A do contain large areas of sparsely canopied pine flatwoods. The District has also planted pine in some

portions of Parcel A. There are currently cattle leases on the property and Parcels A and B are grazed on a rotational basis based on the lessee's desire. Approximately 13 soil series comprise Parcels A and B based on the National Resource Conservation Service Martin County Soil Survey with Oldsmar, Wabasso, and Windsor being the dominant soil series (Figure 4). Both Wabasso and Windsor series are hydric soils that dominate the herbaceous wetland habitats while the Oldsmar soils series dominates much of the improved pasture areas.

3.0 METHODS

On May 27, 2009 the Team met with Beth Kacvinsky of the District to discuss site history, previous owl and gopher tortoise observations, proposed restoration activities, and the goals of this project. The Team and the District then drove around the project area to observe access points and the field conditions. Within Parcel A and B, intensive field surveys for burrowing owls and gopher tortoises were performed in specific areas (referred to as Parcel A West and Parcel B) specified by the District. Boundaries were based on the presence of these species as reported by previous surveys. The Team completed a less-intensive field survey for these species in the eastern portion of Parcel A (Parcel A East) (Figure 2). A general burrowing owl habitat suitability assessment was completed in the remaining portions of Parcel A and B using field survey points, soils, land use data, and aerial imagery.

3.1 BURROWING OWL AND GOPHER TORTOISE SURVEY

The Team of two field biologists conducted ATV and pedestrian transect surveys from July 7 – 10, 2009 for gopher tortoises and burrowing owls. On July 21, 2009 a single biologist completed an ATV survey of the proposed berm construction areas. Parallel transect surveys were conducted in an east/west or north/south orientation on both parcels.

Field ecologists completed an approximately 100% census within the designated detailed survey areas for Parcel A West and B (Figure 2). A more general survey of the eastern portion of Parcel A (Parcel A East) was also conducted using an ATV. All observed gopher tortoise and burrowing owl burrows were documented on hardcopy data sheets and located using a hand-held global positioning system (GPS) with an accuracy of 3 to 5 meters. Each burrow was classified by species and activity status (e.g., active, inactive, or abandoned). Other observed listed wildlife and animal signs were also noted and located with the GPS. In total, the Team spent approximately 198 man hours on-site completing the surveys.

3.2 BURROWING OWL HABITAT SUITABILITY ASSESSMENT

A burrowing owl habitat suitability assessment was completed during the field census for burrowing owls. The goal of this assessment was to create a simple classification scheme that could be used to characterize the upland habitat vegetation structure in Parcel A and B and to associate habitat characteristics with the presence/absence of

burrowing owls. At Allapattah Flats, a number of land management practices, including cattle grazing, use of prescribed fire, mowing, and the control of nuisance plants, have a direct effect on vegetation community composition and physical structure, which in turn influence the distribution and abundance of burrowing owls. Studies of burrowing owl habitat have identified certain characteristics that influence suitability for nesting. Of particular importance are the extent of areal cover and height of herbaceous ground vegetation, and shrub and tree strata (Uhmann et al. 2001).

The Team collected data to document structural habitat characteristics in the immediate areas around observed burrows and at representative unoccupied reference area sampling points. Average areal percent cover of vegetation height classes was calculated for burrow activity classes, i.e., active, inactive, and abandoned, by parcel. Habitat structure was characterized in a 50-foot-radius area around each burrow observed. Data were also collected at a number of arbitrary, representative points within the parcels to characterize baseline vegetation characteristics in areas of Parcel A and B of Allapattah Flats that did not exhibit burrowing owl burrows. The following data were collected at each sampling point:

- Percent areal cover of herbaceous vegetation less than 10 cm high
- Percent areal cover of herbaceous vegetation 10 to 45 cm high
- Percent areal cover of herbaceous vegetation greater than 45 cm high
- Percent areal cover of woody shrub vegetation (1 to 3 m high)
- Percent areal cover of tree canopy (>3 m high)
- Presence of potential perches, e.g., fence posts, trees, or shrubs
- Affects of topography/drainage that may influence groundwater table levels
- Presence/absence of cattle
- Qualitative descriptions of habitat, species present, etc.

Pie charts were then produced as a simple way to illustrate graphically vegetation characteristics associated with burrowing owl habitat suitability. In addition, the Team digitized suitable, potentially suitable, and not suitable owl habitat polygons within Parcel A and B using a combination of soils data, 2004 and 2006 aerial imagery, and survey data.

4.0 RESULTS AND DISCUSSION

4.1 GOPHER TORTOISE

4.1.1 Parcel A

In Parcel A West, three active, one inactive, and ten abandoned gopher tortoise burrows were observed and located in the detailed survey area. No tortoises or their burrows were located in the general survey area in Parcel A East (Figure 5).

Several burrows were located in fill material from adjacent ditches or swales, but a majority was located within flat pasture areas (Figure 5). No gopher tortoises were actually observed during

the survey. Soils in the detailed survey area of Parcel A are dominated by Oldsmar and Wabasso soil series (Figure 4). Oldsmar soil series has a depth to water table of 0.5 feet to 1.5 feet while the water table for Wabasso is at the ground surface or up to 2 feet above the ground surface. All tortoise burrows, with the exception of one abandoned burrow, were found in areas of Oldsmar soil (Figure 4).

4.1.2 Parcel B

No gopher tortoise burrows were observed in Parcel B. Soils in the detailed survey area of Parcel B are dominated by Oldsmar and Wabasso soil series (Figure 4). Oldsmar soil series has a depth to water table of 0.5 feet to 1.5 feet while the water table for Wabasso is at the ground surface or up to 2 feet above the ground surface. Soils in Parcel B outside the detailed survey area are dominated by Wabasso, Riviera, and Winder soil series that also have a water table 1 foot below ground surface up to 2 feet above ground during the wet season. As a result, soils in Parcel B do not provide suitable habitat for gopher tortoises unless there are spoil piles that provide greater distance to the wet season water table elevation.

4.2 BURROWING OWL

4.2.1 Parcel A

The Team observed 20 active, 19 inactive, and 9 abandoned burrowing owl burrows in the detailed survey area of Parcel A. The highest density of burrows was in the south central region of the detailed survey area (Figure 5). Twenty adults and one juvenile were observed in the survey area. These observations occurred in the northwest region of the detailed survey area. In Parcel A West, a minimum of 30% of the vegetation had a height of 45 cm or less.

No burrows were observed in the general survey area polygon in the northeast region of Parcel A. However, based on several vegetation characterization sampling points taken by the team in this polygon, the southern half of this polygon appears to contain suitable habitat. This is based on the fact that 70 to 90% of the herbaceous vegetation in the vicinity of the sampling points had a height less than 45 cm (Figure 6).

4.2.2 Parcel B

The Team observed 22 active, 6 inactive, and 13 abandoned burrowing owl burrows in the detailed survey area of Parcel B. The highest density of burrows was along a road and canal system in the center of the western half of the detailed survey area of Parcel B (Figure 5). Twenty-seven adults and five juveniles were observed in the detailed survey area. A majority of the bird observations occurred in the eastern half of the detailed survey area. In the Parcel B detailed area where burrows were observed, vegetation was predominantly 45 cm high or less.

A single inactive burrow was located outside the de tailed Parcel B survey area. This burrow was located right next to an entrance gate and fence line (Figure 5).

4.3 BURROWING OWL HABITAT SUITABILITY

To investigate potential habita t characteristics that promote burrowing owl presence, the Team characterized vegetation where burrows were observed and in other areas of Parcel A and B. As previously mentioned, data on a suite of qualita tive vegetation and ha bitat characteristics were collected during the survey:

- Percent areal cover of herbaceous vegetation less than 10 cm high
- Percent areal cover of herbaceous vegetation 10 to 45 cm high
- Percent areal cover of herbaceous vegetation greater than 45 cm high
- Percent areal cover of woody shrub vegetation (1 to 3 m in height)
- Percent areal cover of tree canopy (>3 m in height)
- Presence of potential perches, e.g., fence posts, trees, or shrubs
- Effects of topography/drainage that may influence groundwater table levels
- Presence/absence of cattle
- Qualitative descriptions of habitat, species present, etc.

Vegetation assessm ent points take n out side t he Pa rcel A and B surv ey areas w ere us ed to generate a generic burrowing owl habitat suitab ility m ap f or all of Parc el A and B (Figure 7). Habitats were clas sified as suitab le, potentially suitable, a nd not suitable. In ge neral, a reas supporting activ e and inactiv e burr owing owl bu rrows h ad plant co mmunities dom inated by herbaceous vegetation l ess than 45 cm in height and lacked t ree a nd s hrub c over. U noccupied reference areas and areas supporting abandoned burrows had on average a higher areal cover by herbaceous vegetation greater than 45 cm in height and/or sparse tree and shrub cover when compared to active and inactive burrow locations. The following provides m ore detailed results of this habitat assessm ent. Suitable habitats ei ther had active or inactive owl burrows or had desirable v egetation c haracteristics. Poten tially su itable habitat ar eas wer e d ominated b y herbaceous v egetation b ut t his v egetation w as d enser a nd a less d esirable h eight t han s uitable areas. However, these areas cou ld becom e suitabl e because of m anagement activities such as increased grazing or m owing. Jones Edm unds did not consider potential co sts or the financial feasibility of this sort of management. Such expenditures might be prohibitive unless they can be linked to other land m anagement goals. Unsuitable areas are predominately wetlands and upland areas with greater than 30 percent shrub or tree component.

4.3.1 Parcel A West

An extensive survey of Parcel A West indicated that portions of the parcel supported burrowing owls, while other portions of the parcel ar e n ot s uitable b urrowing o wl h abitat. A reas immediately adjacent to observed active and inactive burrowing owl burrows had on average a high areal cover of herbaceous ve getation less than 45 cm in height. For these burrow classes, herbaceous vegetation less than 10 cm averaged 21% and 25% for active and inactive burrows,

respectively. Herbaceous vegetation from 10 to 45 cm in height averaged 46% and 47%, respectively, for active and inactive burrows. Coverage by herbaceous vegetation taller than 45 cm was approximately 30% for both active and inactive burrows. Areas around abandoned burrows averaged 46% areal cover by vegetation over 45 cm in height and also supported a sparse (3%) shrub cover. Areas around unoccupied reference vegetation sampling points had herbaceous vegetation conditions similar to areas supporting burrowing owl burrows but had an average shrub cover of 9%. Figure 8 provides a pie chart of percentages of vegetation characteristics observed at Parcel A West.

4.3.2 Parcel A East

The Team did not observe any burrowing owls or burrows in Parcel A East even though the average vegetation conditions from 10 unoccupied reference vegetation sampling points were similar to those in areas where burrowing owls were observed. Based on our observations, the southern portion of Parcel A appeared suitable for use by burrowing owls. On the southern half of Parcel A East, the areal extent of herbaceous vegetation less than or equal to 45 cm in height was 70% or more and shrub and tree coverage was generally absent. The northern portion of Parcel A East supported a high areal cover of herbaceous vegetation greater than 45 cm in height. In this area tall smutgrass comprised 60% or more of the areal cover, and sparse shrub cover was also present, which are conditions unsuitable for use by burrowing owls (Photo 1). Figure 9 provides a pie chart of percentages of vegetation characteristics observed at Parcel A East.

4.3.3 Parcel B

The Team also conducted an extensive survey of Parcel B and observed burrowing owls and burrows on portions of the parcel. Areas around active burrows supported a high (averaging 55%) areal coverage of herbaceous vegetation less than 10 cm high. Areas around inactive and abandoned burrows averaged 31% and 45% areal cover, respectively, for vegetation less than 10 cm high. Areal coverage of herbaceous vegetation from 10 to 45 cm in height averaged between 16% and 22% for the three burrow classes. The areal coverage of herbaceous vegetation taller than 45 cm averaged 25% around active burrows. Around inactive burrows, herbaceous vegetation taller than 45 cm averaged 45% areal coverage. Around abandoned burrows, herbaceous vegetation taller than 45 cm averaged 38% areal coverage. Unoccupied reference vegetation sampling points supported on average a lesser areal cover of herbaceous vegetation less than 10 cm, 19%, and higher areal cover of herbaceous vegetation taller than 45 cm, 52%, than areas supporting burrowing owl burrows. Figure 10 provides a pie chart of percentages of vegetation characteristics observed at Parcel B.

4.3.4 Other Habitat Characteristics

In addition to characterizing vegetation characteristics, the Team scored each observed burrow relative to three other potential habitat characteristics. Topographic characteristics at the location of each burrow were classified as flat or having an altered topography that might affect burrow

locations, e.g., a mound, berm, or ditching that might contribute to a lowered water table compared to adjacent flat ground. Each burrow was classified as occurring within 50 feet of potential artificial perches, most typically fence posts. Each burrow was classified as to the presence of grazing cattle. Table 1 summarizes the distribution of 48 burrowing owl burrows on Parcel A West and 41 burrowing owl burrows on Parcel B.

Approximately one third of observed burrows were associated with features that modified the flat topography of the parcels. Most typically, the feature was a raised roadway or berm. On Parcel B, the occurrence of burrows on or near raised roadways also created proximity with fence posts, which may serve as artificial perches for burrowing owls. Some 80% of all observed burrows were not close to an artificial perch. On Parcel A West, approximately 60% of the observed burrows were in fields where cattle were currently grazing. Cattle were grazing throughout Parcel B at the time of the surveys.

Table 1 Summary of Various Habitat Characteristics at Burrowing Owl Burrows

Parcel	Burrowing Owl Status	Topographic Characteristics		Artificial Perches Present		Cows Present	
		Flat	Altered Topography	Yes	No	Yes	No
A West	Active (20)	12	8	5	15	13	7
	Inactive (19)	11	8	0	19	9	10
	Abandoned (9)	9	0	0	9	7	2
B	Active (22)	16	6	7	15	22	0
	Inactive (6)	1	5	5	1	6	0
	Abandoned (13)	12	1	1	12	13	0
Subtotals		61	28	18	71	70	19

Bahia grass was the dominant species in pastures supporting vegetation shorter than 10 cm in height (Photo 2). Species contributing to the vegetation taller than 45 cm included smutgrass, dog fennel, and *Andropogon* spp (Photo 1 and 3). Control of smutgrass would likely a significant challenge for the District. However, based on results of this survey, its control will increase open rangeland preferred by burrowing owls at this site. Salt bush (*Baccharis halimifolia*) and wax myrtle (*Myrica cerifera*) are common shrubs in unmanaged and semi-improved pastures that appear to limit significantly habitat suitability for burrowing owls.

5.0 BURROWING OWL HABITAT MANAGEMENT RECOMMENDATIONS

Survey work at the Allapattah Flats property confirms that burrowing owls prefer open habitats vegetated by low-growing herbaceous vegetation. Open pastures with a mixture of herbaceous vegetation less than 45 cm in height supported the greatest number of active and inactive burrowing owl burrows. Habitat management to maintain or increase potentially suitable habitat for burrowing owls should target the control of herbaceous vegetation greater than 45 cm in height to levels below 35% areal cover and attempt to preclude shrub and tree cover. Smutgrass,

a weedy, exotic bunchgrass native to tropical Asia, appears to be a major contributor to the unsuitability of certain portions of the Preserve for burrowing owls. We recognize that smutgrass control is difficult and expensive. Mowing and burning may provide a short term reduction in vegetation height but may actually contribute to the spread of the grass. Control of smutgrass through the application of Velpar® can be effective but is expensive (Ferrell et al. 2006).

There was a positive association between active and inactive burrowing owl burrows and the presence of grazing cattle. Nearly four times the number of burrowing owls burrows were documented in pastures being grazed by cattle than in pastures without cattle. As appropriate with other land management goals of the District, cattle grazing should be managed as a means to help control herbaceous vegetation height.

6.0 REFERENCES

Ferrell, J.A., Adjei, M.B., Mullahey, J.J., & Mislevy, P. 2006. Smutgrass Control in Perennial Grass Pastures. Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences. Publication Number SS-AGR-18.

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Uhmann, T.V., Kenkel, N.C., & Baydack, R.K. 2001. Development of a Habitat Suitability Index Model for Burrowing Owls in the Eastern Canadian Prairies. *Journal of Raptor Research* 35(4): 378-384.

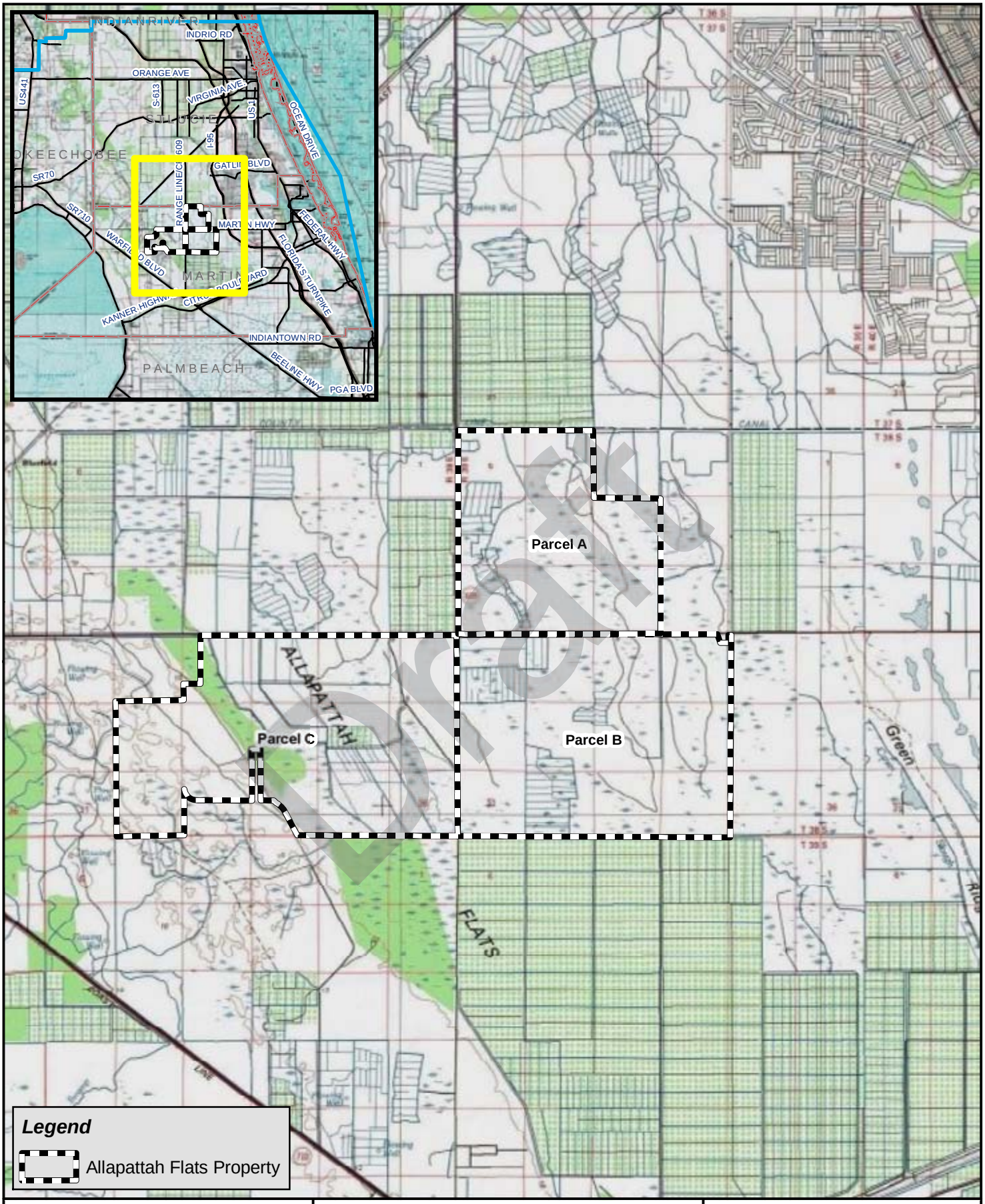
PHOTOS

Photo 1 Typical Area Dominated by Dense and Tall Smutgrass

Photo 2 Typical Area Dominated by Grazed Bahia Grass

Photo 3 Typical Area Dominated by Dog Fennel

FIGURES



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JONES EDMUNDS
ENGINEERS | ARCHITECTS | SCIENTISTS

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Figure 1

Burrowing Owl and Gopher Tortoise Survey Map

Allapattah Flats Wildlife Survey

0 5,000 10,000

Feet

1:120,000

N

For Informational Purposes Only

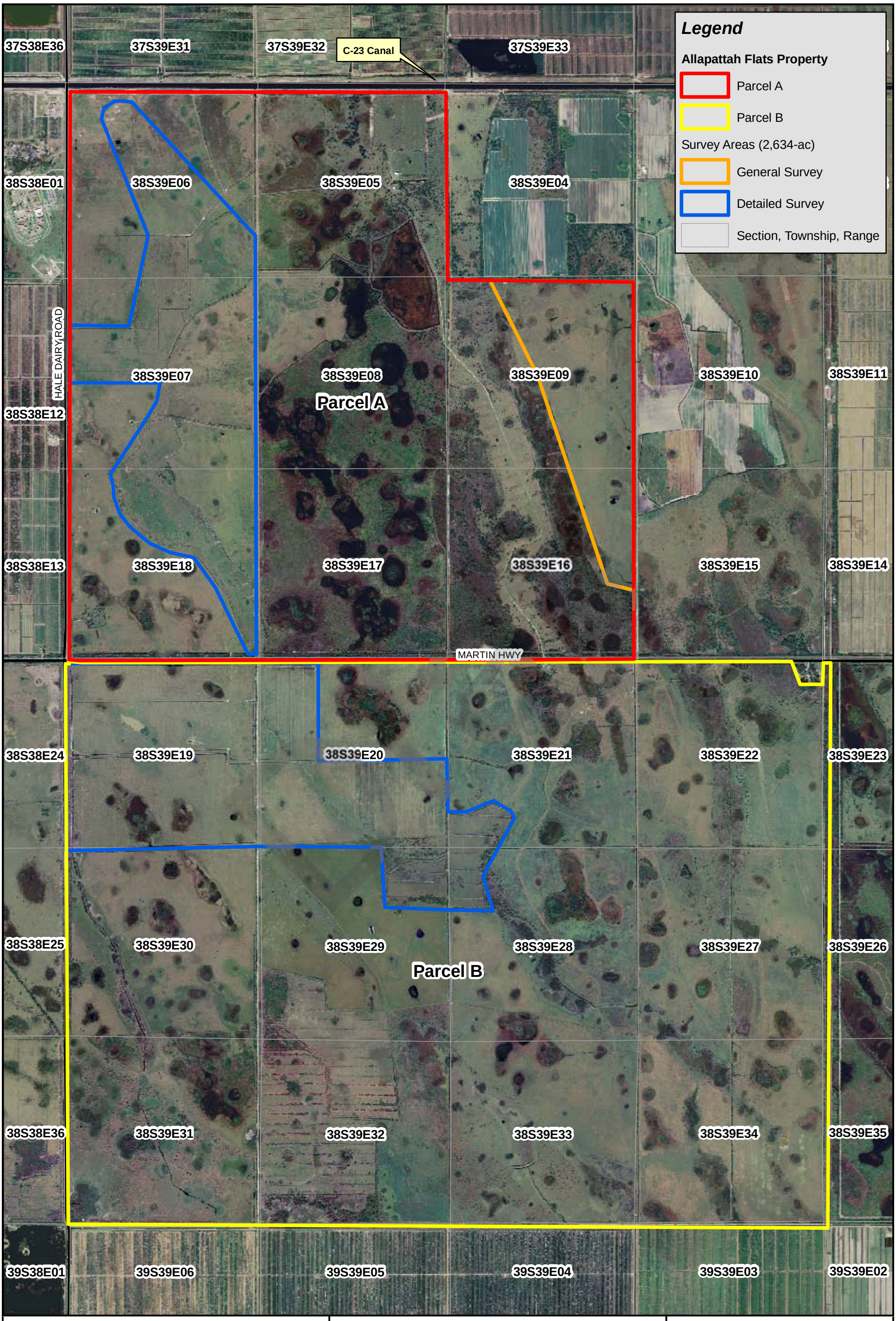

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Figure 2

Survey Location Map

Allapattah Flats Wildlife Survey

0 1,250 2,500
Feet
1:30,000

N

Q:\19999-011-01\mxd\report_figures\figure2_site_map.mxd BJB 08-18-09

For Informational Purposes Only

C-23 Canal

HALE DAIRY ROAD

Parcel A

MARTIN HWY

Parcel B

Legend

Allapattah Flats Property

- Parcel A
- Parcel B

Survey Areas (2,634-ac)

- General Survey
- Detailed Survey

2004 SFWMD Land Use (FLUCFCS)

- Improved Pastures (2110)
- Unimproved Pastures (2120)
- Woodland Pastures (2130)
- Citrus Groves (2210)
- Shrub and Brushland (3200)
- Upland Hardwood Forests (4220)
- Water (5000)
- Mixed Wetland Hardwoods (6170)
- Emergent Marsh (6410)
- Wet Prairies (6430)
- Utilities (8300)

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Figure 3

Land Use Map

Allapattah Flats Wildlife Survey

0 1,250 2,500
Feet
1:30,000

N

Aerial Photography: 2004 DOQQ

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For Informational Purposes Only

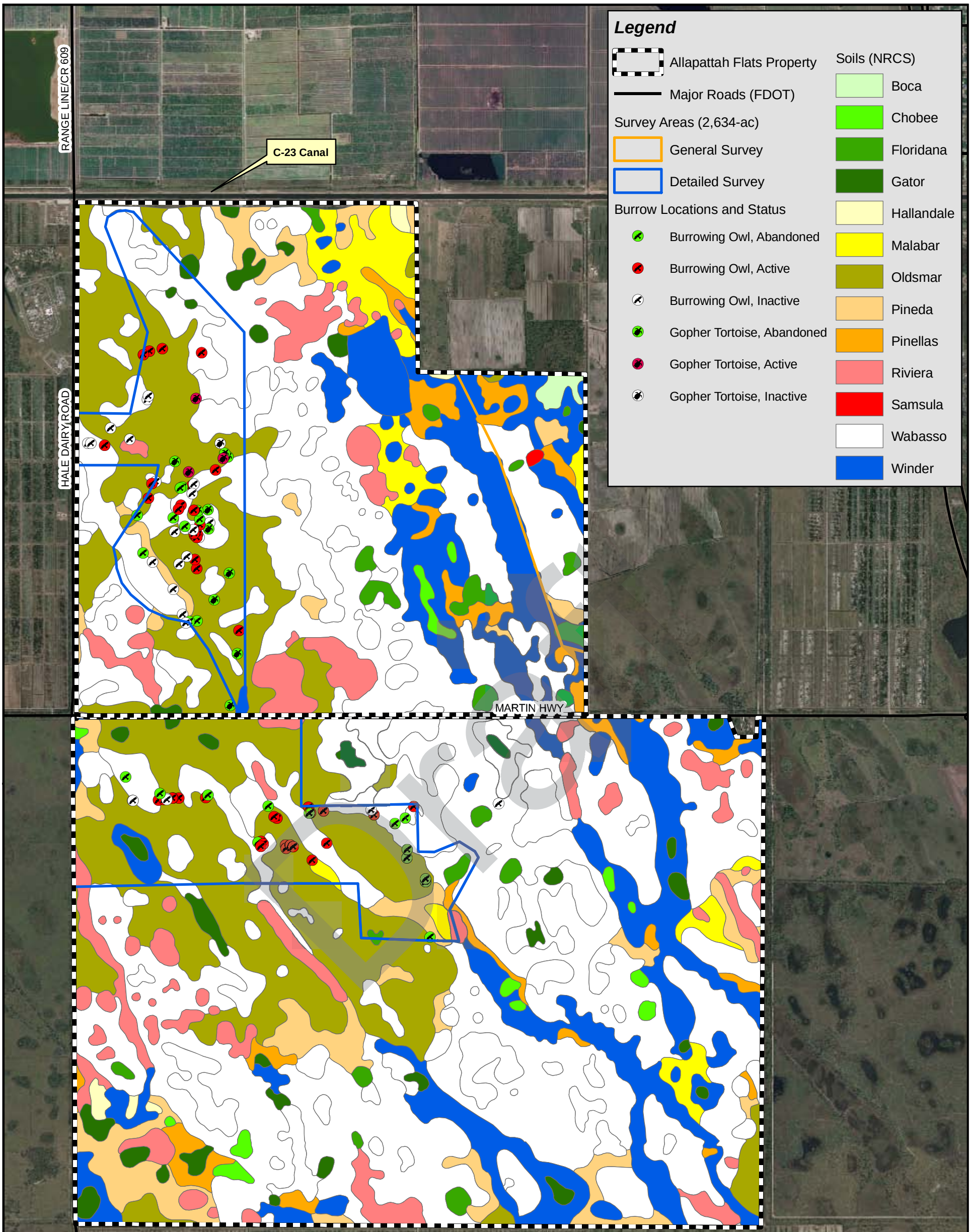

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Figure 4

Soils Map

Allapattah Flats Wildlife Survey

0 1,500 3,000
Feet
1:36,000

N

Aerial Photography: 2004 DOQQ

Q:\19999_SFWMD\011-01_Allapattah_Flats_survey\mxd\report_figures\figure4_soils_map.mxd MCL 8/20/2009

For Informational Purposes Only

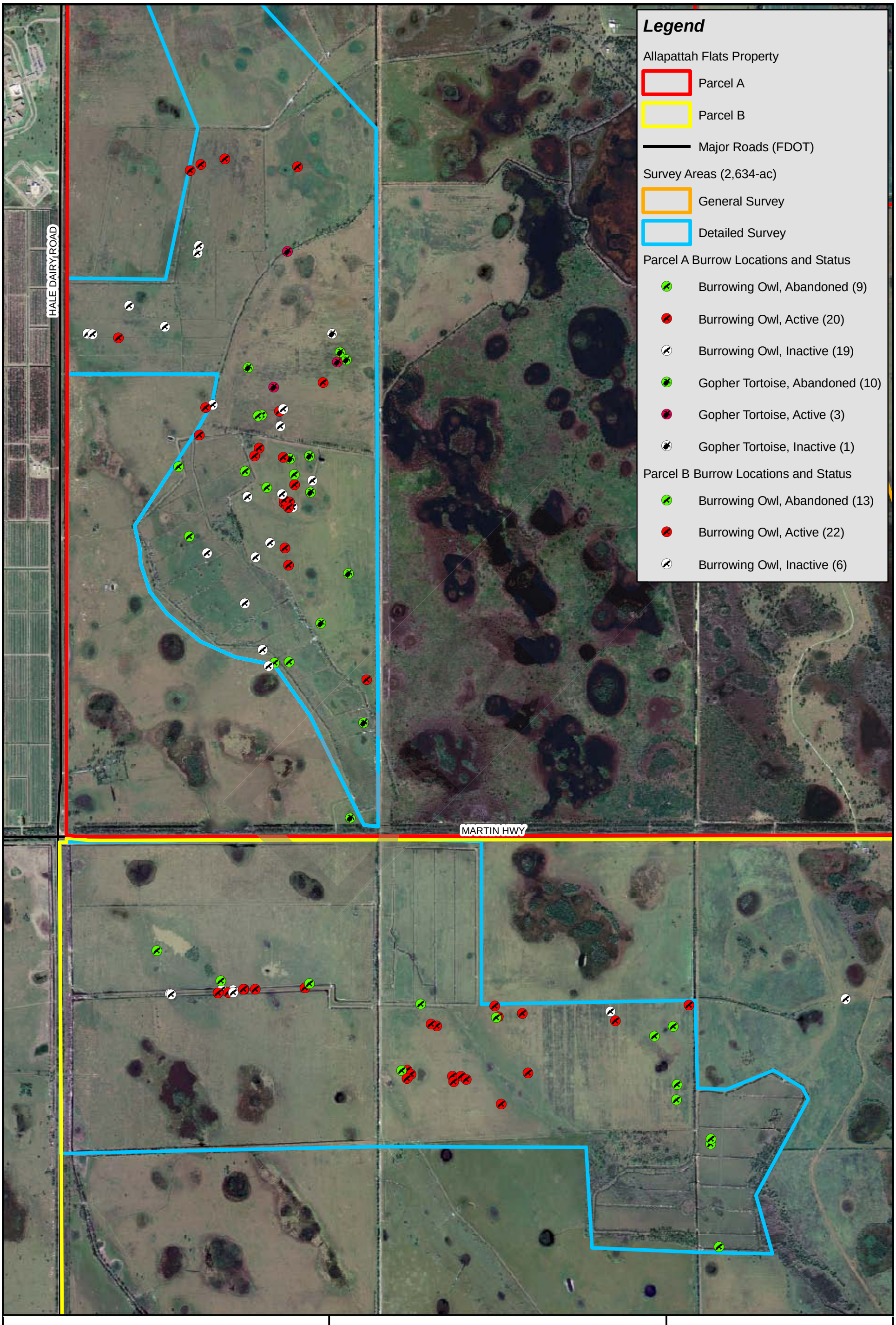

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Figure 5

Burrow Map

Allapattah Flats Wildlife Survey

0 750 1,500
Feet
1:18,000

N

Aerial Photography: 2004 DOQQ

Q:\19999_SFWMD\011-01_Allapattah_Flats_survey\mxd\report_figures\figure5_burrow_map.mxd MCL 8/19/2009

For Informational Purposes Only

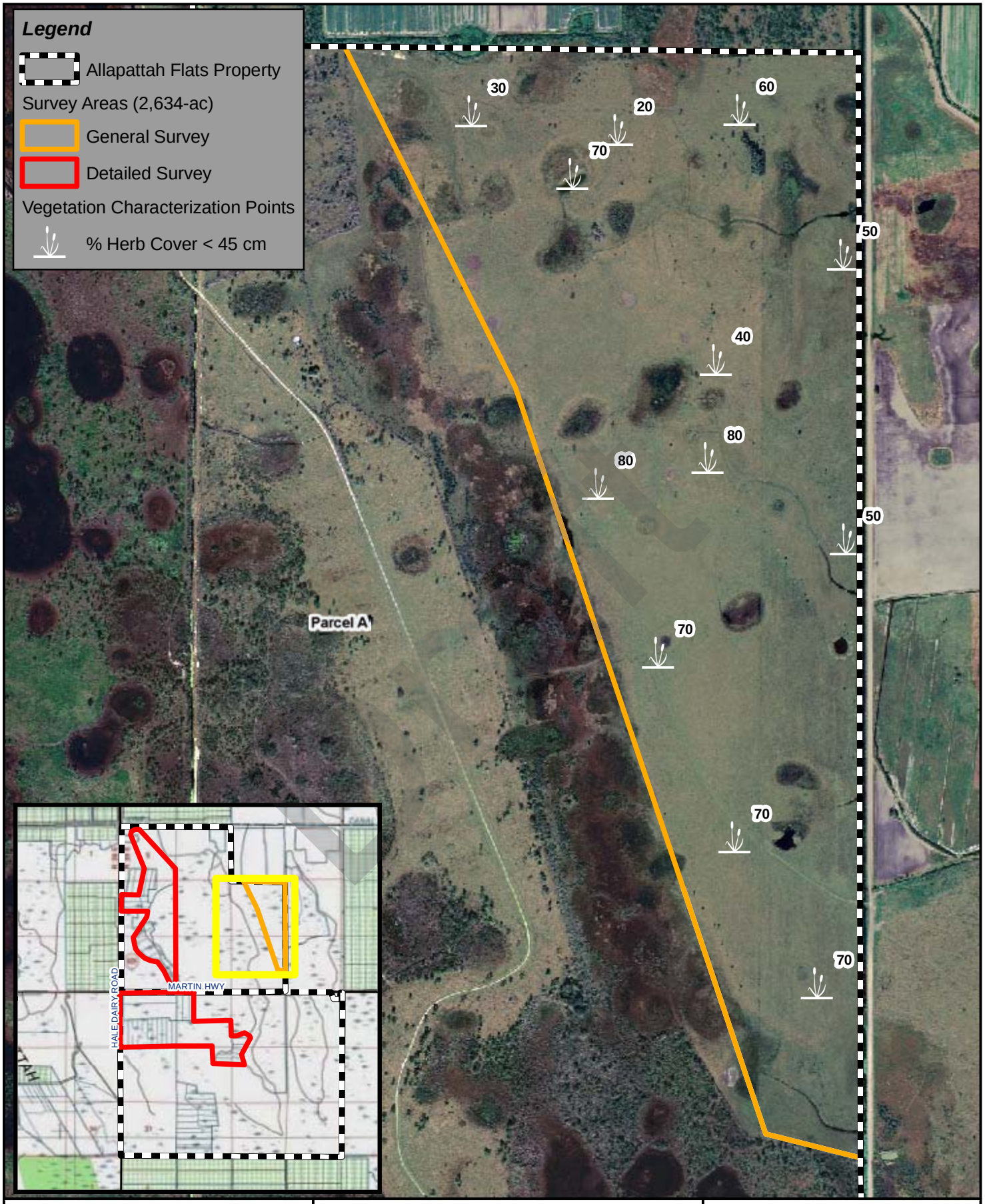

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Figure 6

Parcel A East General Survey Area
Habitat Suitability Map

0 500 1,000
Feet
1:12,000

N

Aerial Photography: 2004 DOQQ

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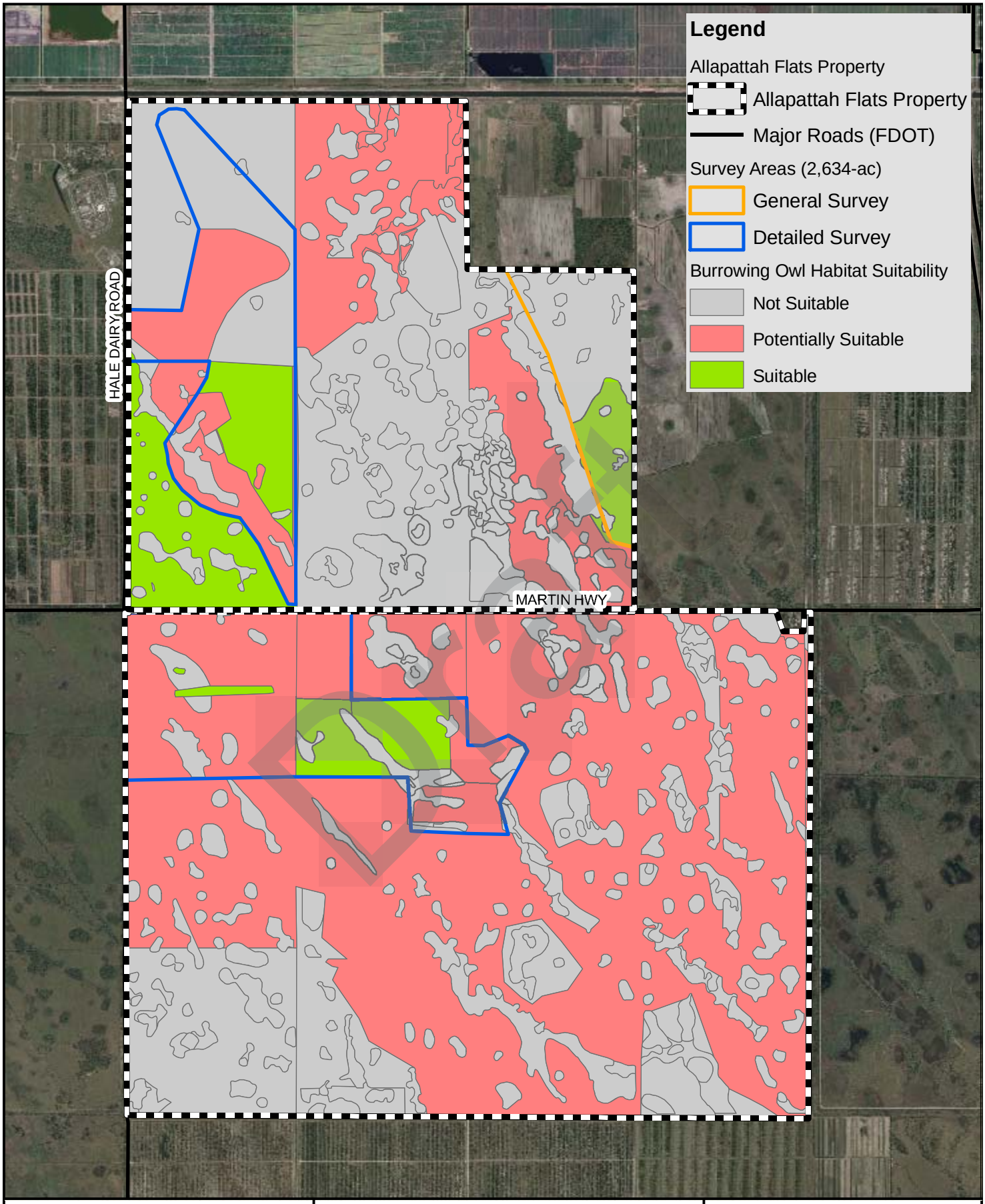

Figure 7

Burrowing Owl Suitability Map

Allapattah Flats Wildlife Survey

0 2,000 4,000

Feet

1:48,000

Aerial Photography: 2004 DOQQ

N

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Q:\19999-011-01\mxd\report_figures\figure7_owl_suitability_map.mxd BJB 08/18/2009

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Figure 8. Vegetation Percent Areal Cover by Burrowing Owl Burrow Status and Vegetation Type for Parcel A West

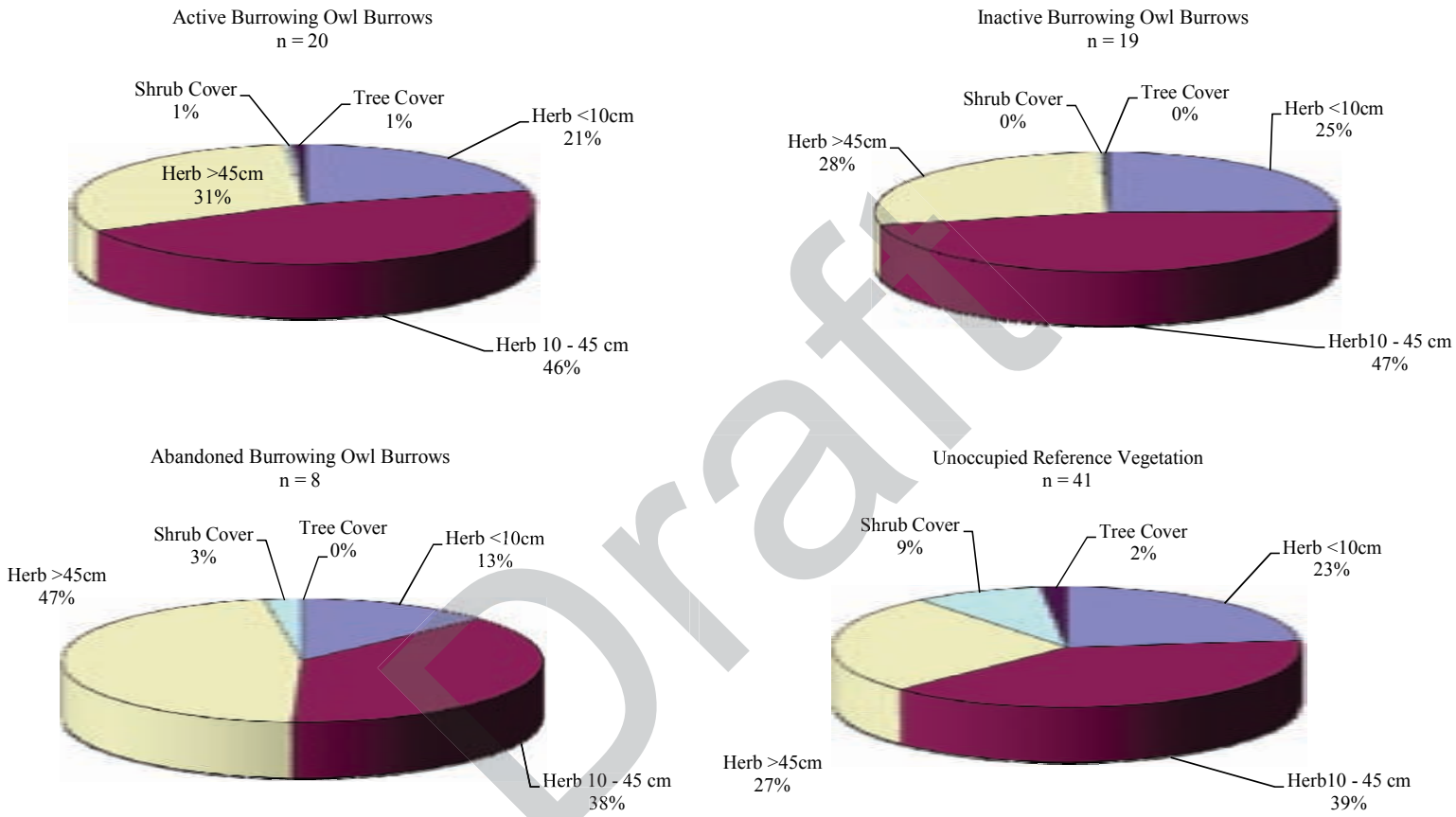

Figure 9. Vegetation Percent Areal Cover by Vegetation Type for Parcel A East

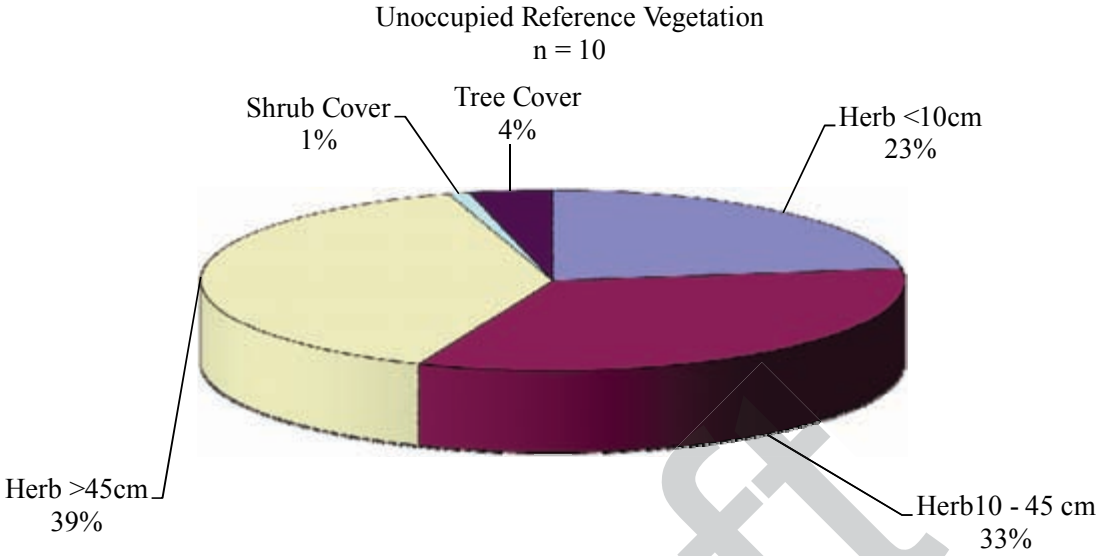

Figure 10. Vegetation Percent Areal Cover by Burrowing Owl Burrow Status and Vegetation Type for Parcel B