SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Pre-Development Vegetation Communities of Southern Florida

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sfwmd.gov

South Florida Water Management District

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The cover photo is from the South Florida Photographic Collection provided through the courtesy of the Historical Museum of Southern Florida.

Executive Summary

A geospatial database of pre-development vegetation within the boundaries of the South Florida Water Management District was created to provide a reliable and comprehensive data source for pre-development ecological conditions of the region. This geo-spatial database offers an improvement over previous efforts in its extent (16 counties), its reliability (verification with historic field descriptions) and detail.

As a first step, a literature search was conducted to identify all previous studies that examined or created maps of historical vegetation within the central and south Florida region. Source data and maps varied in their formats and usability. More recent efforts were available in an electronic format, such as a Geographical Information System (GIS) spatial database. Older sources were available only as paper maps. In these cases, the maps were scanned and geospatially rectified using ArcGIS® tools.

A vegetation classification scheme was then developed to define major natural community types that would also meet anticipated data requirements of hydrological models and restoration projects.

The study area of this project is the full geographical extent of all 16 counties contained within the South Florida Water Management District. To facilitate analysis and verification, the project area was divided into subregions having unique or similar vegetation patterns. Each subregion map of historic vegetation was created from existing pre-development vegetation map sources obtained from the literature review. A base map was compiled by using a default historic map (usually, the earliest source with the highest resolution) and filling data gaps or areas of questionable accuracy with other historic information. Vegetation communities and descriptions in this base map were converted to the vegetation community classes developed by this project.

The resulting map and geospatial database were "verified" by comparing vegetation descriptions in the base map with General Land Office (GLO) survey field note descriptions and maps from the mid- to late-1800s. Typically, GLO field descriptions followed the township-range-section line grid laid out by the original survey staff. Where agreement was found between the base map and the GLO description, the polygon attributes were considered verified. Base map attributes were changed to reflect the GLO conditions when disagreement between the GLO data and base map occurred.

As a final step in database development, additional data fields were added to provide information considered useful to hydrologic models and other target users. These fields

included transpiration coefficients and hydrologic characteristics associated with central and south Florida vegetation community types.

The geospatial database will be completed in two phases; the first phase will map and document the region between the Atlantic and Gulf coasts from Lake Okeechobee to Florida Bay. The second phase, which is anticipated to be released within 6 months of the first, will map and document the region from the Kissimmee Chain of Lakes to Lake Okeechobee, as well as the Fisheating Creek and St. Lucie watersheds.

This database will have application to a number of projects that require a reliable estimate of the pre-development ecological and hydrological landscape. The pre-development condition can be used as a baseline to measure alteration of the landscape that has occurred within an area and provides another source of information from which a restoration target can be developed. Some projects that may benefit from use of this database include the development of a Regional Simulation Natural Systems Model, the Comprehensive Everglades Restoration Plan and local restoration plans.

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Acronyms and Abbreviations

CERP	Comprehensive Everglades Restoration Plan
District	South Florida Water Management District
GIS	Geographical Information System
GLO	General Land Office
NRCS	Natural Resources Conservation Service
SFWMD	South Florida Water Management District
SSURGO	Soil Survey Geographic Database

Project Overview

OBJECTIVES

The purpose of this project is to construct a reliable regional Pre-Development Landscape Database (PDLD) of southern Florida encompassing the 16 county area within the boundaries of the South Florida Water Management District (SFWMD or District). Vegetation community characterizations, spatially-related soil information (from county soil surveys) and hydrologic modeling parameters will be included. A key product of this study will be a "field" verified" pre-development vegetation map based on vegetation classifications. The geodatabase and map will be viewable in a Geographic Information System (GIS)

Florida's regional pre-development condition serves as a baseline from which to measure alterations to the area's landscape and it is a valuable source of information for ecological and hydrological restoration target development. The PDLD will have application to a number of projects including the Natural System Regional Simulation Model (NSRSM) implementation, the Comprehensive Everglades Restoration Plan (CERP) evaluation, and local restoration plan formulation.

The PDLD project will be completed by subregion and documented in two publications. Part I encompasses the area south of Lake Okeechobee (see map insert inside of cover jacket). Subregions in this area include Southwest Florida, the historical Everglades-Okeechobee area and the Lower East Coast. Part II will include the area north of Lake Okeechobee (shaded area on map insert). Documentation for the PDLD Part II is expected to be completed within six months. To facilitate use of the database and maps, a data CD is included with this report document. The CD contains the PDLD database, an atlas of maps corresponding to the study area discussed in this document, and an electronic copy of this report. This material is also available from the District's Web site at: http://www.sfwmd.gov.

APPROACH

Completion of this geodatabase project required development of a vegetation classification system designed to meet anticipated data requirements of hydrological models and restoration projects. Using an ecological community classification approach, we consolidated and then refined existing classification systems of major plant assemblages found in southern Florida (current and historical), resulting in a system that met our objectives (**Appendix A**).

Initially, baseline information was compiled based on ecological community attributes of the Soils Classification Database (Zahina *et al.*, 2001) and available pre-development vegetation studies of the region, including Austin *et al.* (1977), Richardson (1977), Steinberg (1980), Hohner (1994), Duever (2004) and McVoy *et al.* (In Press). The data sources were then cross walked to the project classification system.

Using GIS, vegetation community attributes in the database and map were refined and verified with the U.S. Government's General Land Office (GLO) and U.S. Coast and Geodetic Survey information from the mid-to-late 1800s.

Background

PREVIOUS EFFORTS TO CHARACTERIZE PRE-DEVELOPMENT VEGETATION

General Land Office Surveys of Central and South Florida (1800s)

The United States Government General Land Office (GLO) sponsored a survey of lands in Florida in response to the Land Ordinance of 1785 requiring Public Lands be surveyed prior to settlement. The resulting survey effort established the township-range-section lines still in use today. Surveys of Florida's public lands began in the mid 1800s and continued through the latter part of the 19th century. As part of this historic effort, field notes describing significant natural features observed along section lines (including plant community types) were recorded and maps of townships were created based on the descriptions provided in the survey field notes. The Florida Department of Environmental Protection (FDEP) provides electronic copies of original survey field notes and map documents on its Web site, http://data.labins.org.

The GLO survey field notes contain measured lengths between landscape features along section lines. However, the detail of vegetation descriptions varied by surveyor, so caution must be exercised to properly interpret the vegetation community types. Additionally, the terminology used by the surveyors may require scrutiny by the reader. For example, a "prairie," the term used to describe a treeless expanse of grass-like plants, may indicate a dry prairie (a level upland), wet prairie (a short-hydroperiod wetland) or an expanse of sawgrass (marsh). Typically, additional descriptions contained within the field notes allow the reader to make a determination of which modern definition is best applied.

The GLO's initial survey effort represents the earliest and most comprehensive field descriptions and documentation of vegetation across the south and central Florida region. The survey field note descriptions are of sufficient quality to be used as a "field verification" of the region's pre-development vegetation as it existed at the time of the survey effort. But, a notable limitation of the documentation is that landscape features are only recorded along section lines. Descriptions and map features of areas not along these transects (i.e. within the center of a section block) are inferred and not reliable as measured or observed data.

Davis (1943a) Vegetation Map of Southern Florida

John Henry Davis is credited with producing the first comprehensive vegetation map of central and south Florida. The familiar "Davis Map" accompanied the Florida Geological Survey report entitled, *The Natural Features of Southern Florida Especially the Vegetation, and the Everglades* (Davis 1943a). Based on 1940 surveys and photographs, this vegetation map generally reflects the landcover present at the time of the survey.

It is important to note the Davis Map represents the post-drainage condition of the Kissimmee-Okeechobee-Everglades Region, which had been subject to drainage activity and associated development for 50 years before the area was surveyed. Existing urban and agricultural areas in the Everglades and adjacent coastal regions were classified based on an estimated natural (but not necessarily "pre-drainage") condition. Also, while landscape level features are well represented spatially in this study, vegetation communities, such as bay heads, tree islands and scattered isolated marshes were "roughly estimated" due to limited mapping capabilities. The Davis Map was of a generally low resolution (by modern standards) and useful only as a landscape-level view of plant community distribution. It was not intended to provide site-specific information.

Although the Davis Map cannot be considered representative of south Florida vegetation prior to impacts from drainage, it is a valuable source of surveyed data. It provided a reference condition from which to estimate "pre-canal drainage" landcover in the Everglades Basin for subsequent studies (i.e., Davis *et al.* 1994, [no relation to J.H. Davis]; McVoy *et al.* In Press).

Richardson (1977) Vegetation of the Atlantic Coastal Ridge of Palm Beach County

Pre-drainage vegetation patterns of the Atlantic Coastal Ridge of Palm Beach County were mapped using survey information from 1845 to 1870; 1940 aerial photographs; and, 1913–1973 soil surveys and qualitative ground truth studies. Eleven community types were defined in this study.

One limitation of Richardson's map is that its reliability is based on the author's interpretation of pre-development written accounts, post-development aerial photography and maps. Additionally, the map was not systematically verified with pre-development field data (i.e., GLO field notes and maps), and the agreement between pre-development vegetation descriptions and GIS map polygons was not tested.

Steinberg (1980) Vegetation of the Atlantic Coastal Ridge of Broward County

A vegetation map of the Atlantic Coastal Ridge of Broward County was produced from 1940s aerial photography, for the purpose of aiding in the assessment of human interference and non-native species spread into natural habitats. Ten vegetation types were recognized in this effort.

Steinberg's vegetation map was produced using standard stereoscopic techniques with aerial photography from the years 1940, 1947, 1948 and 1949. Changes in the area's vegetation occurring before 1940 are not shown on the map. The reliability of Steinberg's map is limited due to its reliance on the author's interpretation of post-development (1940s) aerial photography. It is also important to note that some of the author's interpretations were based on qualitative, not quantitative, sources. The map was not systematically verified with pre-development field data (i.e., GLO field notes and maps) and the agreement between pre-development vegetation descriptions and GIS map polygons was not tested.

Zahina *et al.* (2001) Vegetation Map of 19 Counties in South and Central Florida.

A large geospatial soil database of 19 counties in south Florida was developed as part of the Comprehensive Conservation, Permitting and Mitigation Strategy (Wetland Conservation Strategy). Development of the database was a multi-agency cooperative effort between the South Florida Water Management District, the U.S. Environmental Protection Agency (USEPA), the U.S. Army Corps of Engineers (USACE) and the Florida Department of Environmental Protection. The corresponding GIS map polygons follow the Soil Survey Geographical Database (SSURGO), developed by the Natural Resources Conservation Service (NRCS). As part of this effort, soil survey data were used to infer historic vegetation, as represented within each polygon, by examining hydrogeographic patterns. Additionally, soil survey staff related an ecological community type with a soil type, using a guidebook of 26 ecological communities commonly found in Florida (Soil Conservation Service 1989). This study's analysis of the distribution of ecological communities and their associated soils resulted in a classification scheme based on 10 ecological community types.

An advantage of the Zahina *et al.* map is its large coverage area (19 counties), which is viewable at a resolution of at least 5 acres. It should be noted that the accuracy of the community types represented in the map has only been verified in a few areas of the SFWMD using GLO field notes and maps. Areas verified for this effort include the

Loxahatchee Watershed (Taylor Engineering 2005), Loxahatchee Slough Natural Area (Zahina and Kramp 2004), Upper Kissimmee Basin (unpublished data) and Lake Istokpoga area (SFWMD 2005). In each of these areas, at least 90 percent agreement exists between the soil pre-development data and GLO field notes and maps.

One limitation of the Zahina *et al.* map's reliability relates to the paucity of soil data available in parts of the study area. Unfortunately, several large land tracts were never surveyed by the NRCS, creating data gaps in the soil and pre-development vegetation maps. Most of the resulting data gaps occur where permission to survey was denied on private lands; in national parks; and, in metropolitan areas, where significant disturbance occurred before the soil survey was initiated.

For some applications, another limitation of the Zahina *et al.* map is its generalized definitions of some vegetation classes. For example, some wetland (i.e. sawgrass or bald cypress) or flatwood (pine flatwoods or dry prairie) communities cannot be resolved based on soils alone. Also, the map's historic reliability may not be consistent over its entire study boundary because the map was based upon an association between a soil taxon and a vegetation community type. In areas where the soil type was not significantly altered by the time the soil survey was conducted, the reliability of the inferred vegetation community is high. In areas where the soil type was largely altered from its historic form, the ability to predict the historic vegetation community is reduced.

Duever (2004) Southwest Florida Pre-Development Vegetation Map

The Natural Systems Group of the Southwest Florida Feasibility Study (SWFFS) Team developed a map of pre-development vegetation communities as part of the Comprehensive Everglades Restoration Plan (CERP) effort. The study area spans from the western edge of the Everglades to the Gulf Coast, and from the Fisheating Creek Watershed to Florida Bay. Counties included in the study area are Charlotte, Collier, Glades, Hendry, Lee and Monroe. The Big Cypress National Preserve and adjacent Everglades National Park lands were not included in the soil surveys. For these areas, more recent vegetation maps were reclassified into the same plant community classes as the rest of the study area. Determinations of pre-development communities were based upon soil survey information and best professional judgment. The latest version of this document is provided as **Appendix B**.

The Duever pre-development vegetation map offers a fairly high resolution of 15 major community types across the region. The map, which has undergone extensive scrutiny, offers the advantage of a seamless geospatial database across five counties. Additionally, the historical extent of plant communities in the region (as depicted in the map), reflects a general consensus of the CERP team members. The CERP team's collective field experience in the region, which is extensive, also provided guidance for the GIS polygon definition development.

The limitation of this database is its reliability, which is based on the subjective interpretation of soil information and team members' experience. Also, the map has not been systematically verified with pre-development field data, and the agreement between observed pre-development vegetation and map polygons has not been quantified.

McVoy *et al.* (In Press) Pre-Drainage Everglades Landscapes and Hydrology

This project was originally designed to independently verify the SFWMD Natural System Model (NSM) output. The NSM is designed to simulate the hydrologic response of an Everglades watershed in its pre-drainage condition. Scientific studies, historical narratives and surveyed data were integrated to characterize mid-19^{th} century pre-development Everglades landscapes and hydrology. Primary source material, included: quantitative information from prior studies, surveys, profiles, major expeditions, early maps and narrative accounts. Anecdotal information was also considered in context.

An important finding that emerged from this research was the realization that a significant amount of historical pre-development information exists, is accessible, and could potentially be usable to produce a verifiable representation of Everglades landscapes and hydrology prior to the region's development.

Methods

VEGETATION DATABASE DEVELOPMENT

The process used to create the Pre-Development Vegetation (PDV) database and map is depicted in **Figure 1**. In the first step, the authors defined the study area and its subregions of similar hydro-geomorphic characteristics. The study area is the entire geographical extent of all 16 counties within the South Florida Water Management District, which has been divided into subregions based on their unique or similar patterns of vegetation (**Figure 2**).

A literature search was conducted to identify all previous studies that examined or created maps of historical vegetation within the central and south Florida region. Available source data and maps varied in format and usability. While recent efforts were available in an electronic format, such as a GIS cover or layer file, older sources were available only as paper maps. In such cases, the maps were scanned and geospatially rectified using Arc GIS tools.

A vegetation classification scheme (summarized in **Table 1)** was developed to group similar vegetation community types together and to meet the anticipated data requirements of hydrological models and restoration projects. A detailed description of the vegetation classes identified by this effort is presented in **Appendix A**.

Within each subregion, a base map was created by compiling existing pre-development vegetation map sources. Typically, one map source was identified as the primary source (usually, the source with the highest resolution). The remaining sources were used to fill in where questions of accuracy or gaps existed in the original source. Ecological community descriptors and classes provided by the original map sources were converted to the vegetation community descriptors developed for this project (**Table 1**). The resulting map was then checked for accuracy and modified with GLO field notes and maps and other additional sources (where noted).

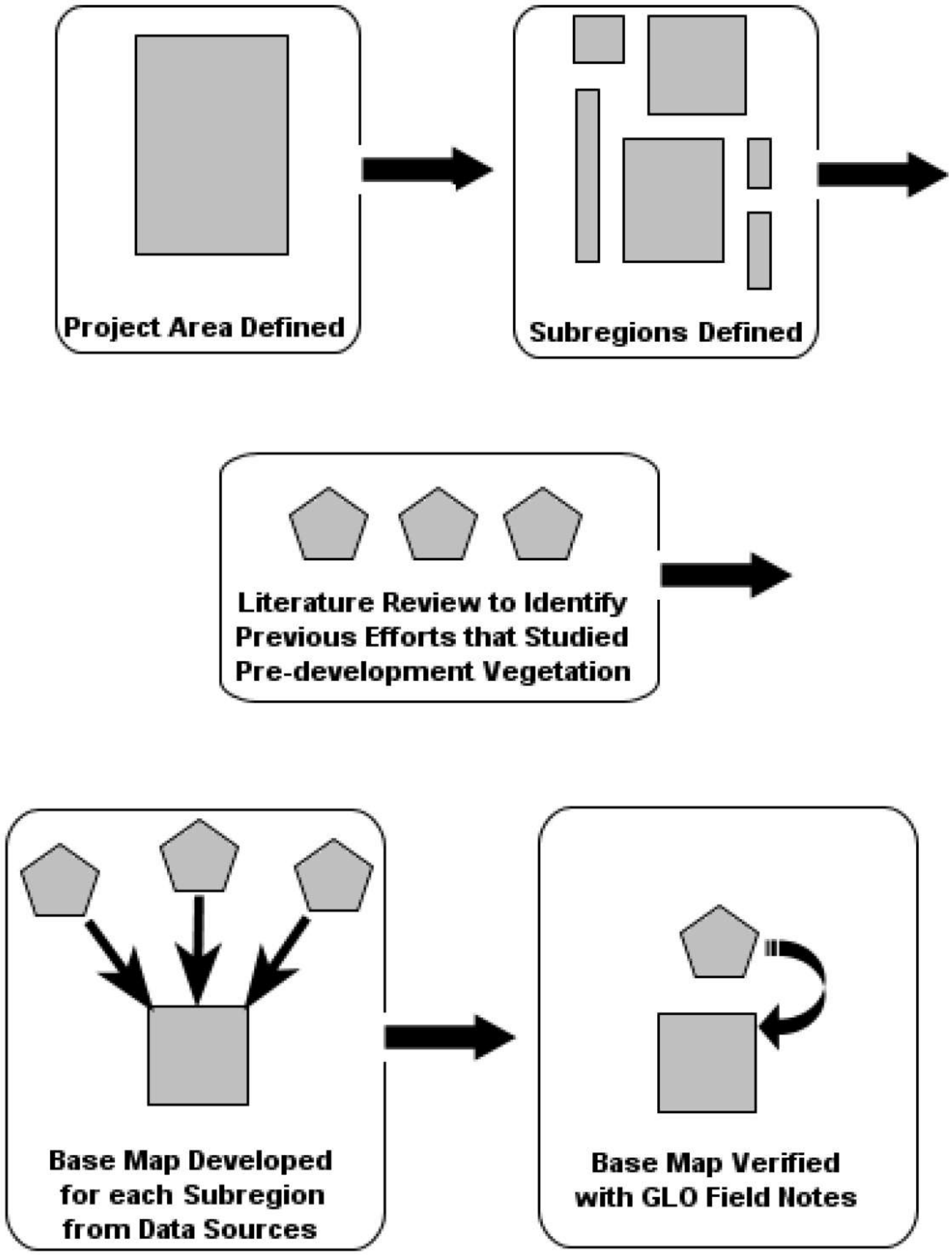


Figure 1. Process Diagram of the Method Used to Create a Pre-Development Map of Central and South Florida.

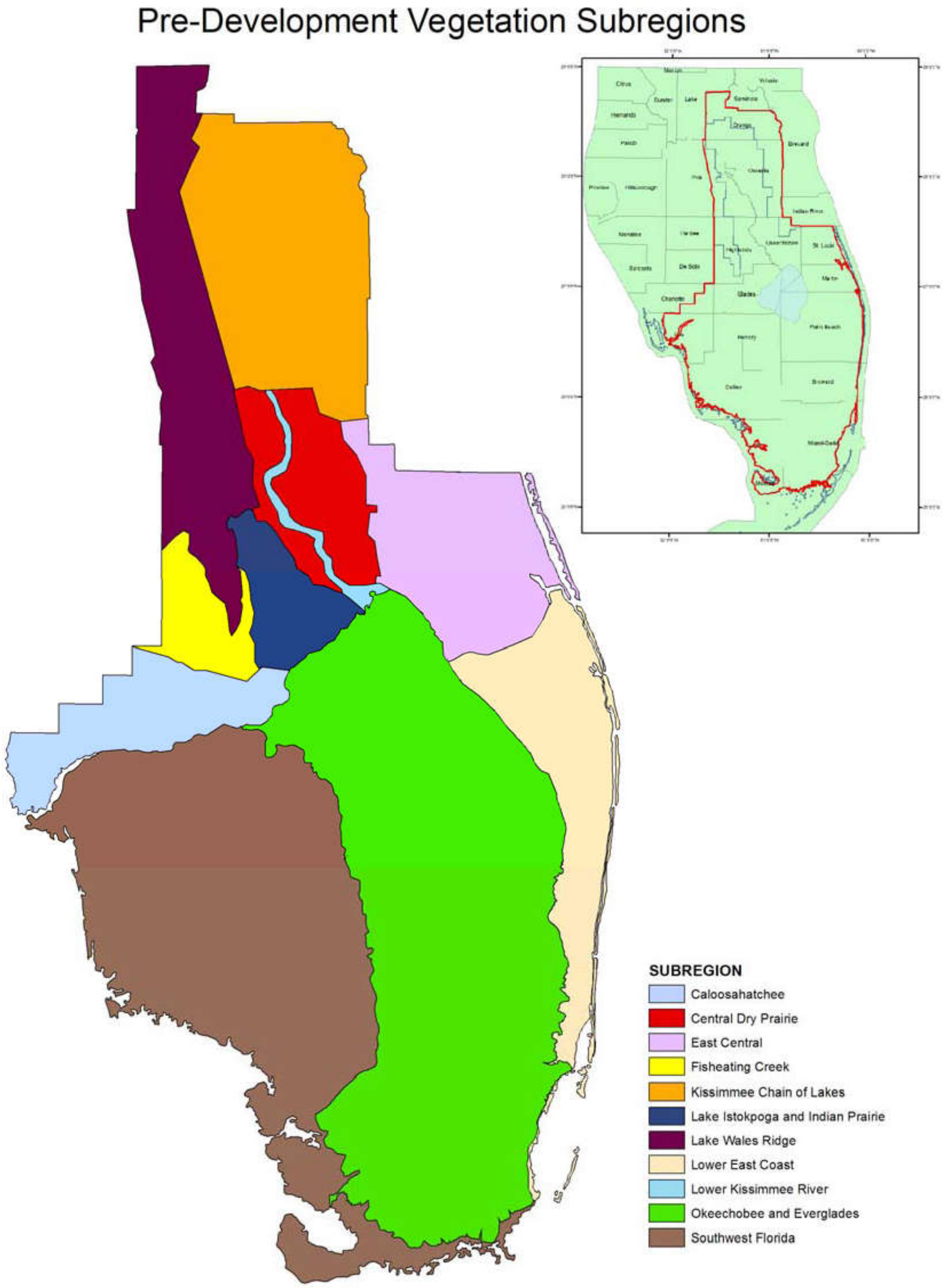


Figure 2. Map of Project Area and Subregions.

Table 1. Vegetation Classifications Used to Develop the Pre-Development Landscape Map and Database

Vegetation Type	Description[a]	*Classification Code*
Water	Permanently inundated site; includes freshwater, estuary and marine systems.	*1*
Intra-tidal Wetland	Tidally inundated sites; vegetation community is influenced by magnitude of daily flooding regime and saltwater exposure.	*2*
Shore	Consolidated substrate (e.g., rock) or unconsolidated deposits (e.g., sands) on shorelines influenced by moving water.	*3*
Forested Freshwater Wetland	Forested freshwater wetlands (swamps).	*4*
Cypress Swamp	Freshwater swamp dominated by cypress.	*4.1*
Hardwood Swamp	Freshwater swamp dominated by broadleaf trees.	*4.2*
Non-Forested Freshwater Wetland	Freshwater wetland dominated by herbaceous vegetation; non-forested.	*5*
Long-hydroperiod Marsh	Freshwater marsh with hydroperiods extending from 11 to 12 months on average.	*5.1*
Ridge and Slough Marsh	Everglades-specific community mosaic of alternating open water sloughs and sawgrass ridges interspersed with tree islands.	*5.11*
Sawgrass Plain	Northern Everglades-specific community consisting of a generally unbroken expanse of sawgrass across a large spatial extent.	*5.12*
Medium-hydroperiod Marsh	*Freshwater marsh with hydroperiods extending from 6 to 10 months on average.*	*5.2*

a. Additional description detail is included in **Appendix A**.

Table 1. Vegetation Classifications Used to Develop the Pre-Development Landscape Map and Database (Continued).

Vegetation Type	Description	Classification Code
Marsh with Scattered Cypress	Freshwater marsh with hydroperiods (from 6 to 10 months on average) that contain scattered stunted cypress.	5.21
Everglades Marl Marsh	Everglades-specific community consisting of a medium-hydroperiod marsh with marl soils derived from calcareous algae; most extensive in the southern Everglades.	5.22
Wet Prairie	Short-hydroperiod treeless wetlands that have hydric soils, hydroperiods extending from 2 to 6 months, and inundation to 1 foot on average.	5.3
Wet Prairie with Scattered Trees	Wet prairie with scattered trees, including pine, cypress and bay.	5.31
Wet Prairie with Cypress	Wet prairie with scattered cypress.	5.32
Hydric Upland	Moist woodlands on non-hydric soils in level, low landscapes than may have some short-duration flooding each year. Fire frequency is the primary factor in shaping dominant vegetation type.	6
Hydric Flatwood	Hydric flatwoods typically are dominated by slash pine.	6.1
Hydric Hammock	Hydric hammocks typically are dominated by hardwood species.	6.2
Mesic Upland	Mesic communities are found on upland (non-hydric) soils; short-duration flooding may occur only during high-rainfall events. Fire frequency is the primary factor shaping dominant vegetation type.	7
Dry Prairie	Non-forested upland community composed primarily of grasses and palms; high fire frequency.	7.1

Table 1. Vegetation Classifications Used to Develop the Pre-Development Landscape Map and Database (Continued).

Vegetation Type	Description	Classification Code
Mesic Pine Flatwood	Forested upland community composed primarily of pines; moderate fire frequency.	7.2
Mesic Hammock	Forested upland community composed primarily of broadleaf trees; low fire frequency.	7.3
Xeric Upland	Xeric communities are found on highest elevation sites with the water table well below (more than 3 feet) the soil surface all year. Xeric plant communities are dominated by species that have special adaptations for survival in dry conditions. Fire frequency is the primary factor shaping dominant vegetation type.	8
High Pine (Sandhill)	Dry pine communities on undulating sandy soils that are dominated by longleaf pines and wiregrass; these communities are typically found in central Florida.	8.1
Scrub	Scrub communities are dominated by sand pine or oak scrub species and are typically found on pure, deep sands of relic dune systems.	8.2
Coastal Strand	Coastal strand communities are typically found on excessively drained elevated sites, such as coastal dunes, ridges, rocky outcrops or shell mounds. Vegetation species are primarily of tropical and Caribbean origin.	8.3

IDENTIFICATION AND MANAGEMENT OF POTENTIAL SOURCES OF ERROR

Potential sources of error and uncertainties were identified while the PDV Database and Map were being created and verified. the, a number of discovered. The project team responded by developing quality control guidelines, designed to manage potential error sources. These quality control measures were designed to: 1) increase the reliability of the product to the greatest extent possible; 2) track and maintain the "minimum reliable mapping unit" a user should expect within a subregion; and 3) identify, compile and present a description of data application limitations along with guidelines for proper interpretation of the data to the user. It is anticipated that this process created a more reliable product, as well as clearly-identified limitations to use of the database. Following are descriptions of the types of potential sources of error identified during this effort.

Variations in General Land Office Source Information and Maps

During the verification process, a number of variations in the U.S. Government's General Land Office's (GLO) field note descriptions and maps were identified and found to be potential sources of error. Variations arose from three general sources: 1) differences in what and how different surveyors recorded their observations, 2) interpretation of what was recorded relative to the context of the era, and 3) cartographic quality of maps produced in the mid-to-late 1800s.

Variations in Field Note Descriptions by Different Surveyors

After reading numerous field notes from across the region, it was apparent that not all surveyors interpreted the landscape in exactly the same way; each individual had a unique style for recording major features along survey lines. Typically, all surveyors recorded significant timber or agriculture-related resources, such as descriptions of the forest (pineland, hardwood or cypress stand) observed along a survey line; but, not all surveyors included descriptions of the forest quality (1^{st}, 2^{nd} or 3^{rd} rate), site wetness (inundated, boggy or impracticable) or soil quality (barren, sandy or boggy). A few surveyors provided little or no vegetation descriptors in the field notes; this was especially striking when comparing site notes for the same area with other map sources (e.g., soils) that indicated a more heterogeneous landscape. In these situations, it was assumed the surveyor had omitted some details of natural features along the survey line that were considered incidental. In areas where the surveyor typically provided only brief descriptions (a few words or less) and the general description along a survey line was in agreement with the base map, additional details in the base map were retained (e.g., small inclusions of other vegetation community types). It was assumed these small features were likely present in the pre-development landscape, but not of interest to the GLO team; and, therefore not recorded.

The amount of detail provided in field note descriptions also varied according to the types of natural features encountered; most surveyors provided the greatest detail when encountering a wetland, stream or water body. A few surveyors provided a description of nearby features that did not lie exactly on the section line being surveyed. Within the context of the variety of detail encountered in GLO field notes, descriptions of dominant landscape features, such as “pines with saw palmetto,” were taken literally. However, if the word “pines” appeared alone, the description was not interpreted to include or exclude “saw palmettos” (an indicator of a mesic rather than hydric flatwood community), or any other species associated with pine flatwoods, except if other descriptors or sources indicated otherwise.

Interpretation of GLO Field Notes within their Historical Context

The GLO surveys were conducted well before most modern plant taxonomy and ecological community classifications were established for Florida’s natural systems. Typically, surveyors were not trained biologists, so they would not interpret or describe the natural vegetation communities as modern-day botanists would record the same ecological systems.

In many instances, the context of the field note descriptions (from the same surveyor) became clear only after examination of numerous entries across the landscape. And, because surveyors across the region applied a term such as “prairie” to any number of communities that may be described differently today, its meaning as implied by one surveyor in a specific subregion was not necessarily carried into another area. In the context of that era, a “prairie” meant a “treeless expanse”. Hence, some surveyors have applied the term “prairie” to an expanse of sawgrass (sawgrass prairie), to a large (medium-hydroperiod, mixed species) marsh, as well as to communities that modern classification conventions call wet prairie and dry prairie communities. In cases when the exact meaning of the descriptor was not explicit, the question was usually resolved by examining additional field note descriptions, surrounding landscape features, or consulting other sources (such as soil data).

GLO Mapping Precision and Quality

Maps created by GLO survey staff were hand-drawn and based on field note descriptions and measurements. Occasionally, translation errors arose during the process of creating paper maps from field notes and information. Often, these errors were minor; however, in a few cases the geographical representation of some maps has been found to be skewed or mis-drawn. Another potential source of translation errors can occur when a paper map is converted to an electronic image format. Usually, both of these types of distortions can be corrected when geo-rectifying the image in a GIS program.

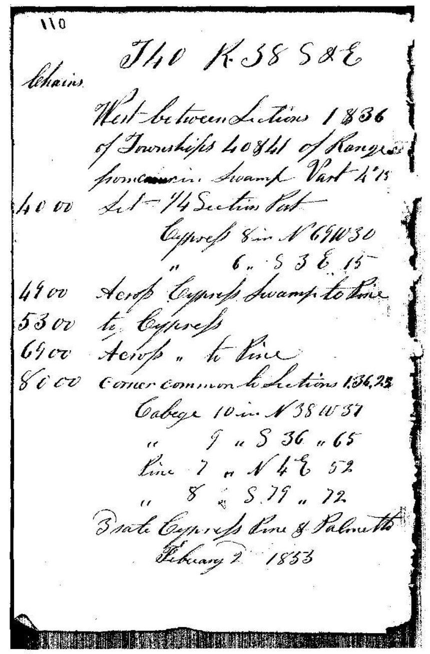
Mapping a Complex Landscape Mosaic

One of the most challenging sources of potential error was the interpretation of complex landscape mosaics. Usually, these areas are low, flat landscapes that contain a mix of forested and non-forested wetland types with inclusions of uplands. The difficulty arises from one, or all, of the following circumstances: 1) polygons for each community type are typically small with poorly-defined ecotones between communities; 2) polygons defining different vegetation communities may be close to, or less than, the minimum mapping unit of the base map; 3) the landscape lacks a clear directionality, such as flowways, which could be used to define vegetation patterns.

Throughout the verification process, it became evident that when differences between the base map and GLO descriptions occurred, these differences were not always consistent across the landscape, even on smaller scales. One example of this was found with pine flatwood soils in areas dominated by shallow wetlands. In areas where a polygon of mesic pine flatwood community was relatively large, the GLO descriptions and base map were typically in agreement. In areas where there were small polygons of mesic pine flatwoods which were surrounded by wetlands, GLO field note descriptions usually indicated that these polygons were better described as "hydric flatwoods" or "wet prairie with pine." One likely explanation for the difference in what was indicated by the base map and the actual GLO field observation is the influence of the surrounding wetland hydrology on the small isolated stand of pines. In cases such as these, every effort was made to change the base map to agree with the GLO descriptions. However, it is impossible to analyze and verify every polygon within the base map for accuracy; indeed, insufficient historic data exists to conduct such an effort. It is important for the user of the Pre-Development Vegetation database and map to understand the map is most reliable when applied at a landscape (rather than a localized) scale, in areas where a mosaic of wetland and non-wetland community types exists.

VERIFICATION OF PRE-DEVELOPMENT VEGETATION MAPS BY SUBREGION

Areas of each subregion base map were compared with the GLO field notes as a means to verify the accuracy of the Pre-Development Vegetation map. Vegetation descriptions from GLO field notes (**Figure 3**) and maps (**Figure 4**) along section lines in townships were examined and compared with polygon attributes in the base map. Where agreement was found between the GLO field note descriptions and vegetation community classes on the base map, the base map and was assumed to be correct or "verified" at that location. Where disagreement between the GLO descriptions and pre-development map was found, attributes of the base map were changed to the vegetation class (**Table 1**) that most closely matched GLO vegetation descriptions. A closer examination of the discrepancy between the base map and GLO descriptions for that community type was also conducted to determine to what extent the base map classes should be changed throughout the subregion. More detail of how this method was applied in different subregions is provided next.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T40 R38 S&E
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Cypress 8 in N 69 W 30
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44 00 Across Cypress Swamp to Pine
53 00 to Cypress
69 00 Across " to Pine
80 00 Corner common to Sections 1, 36, 2, 35
Cabbage 10 in N 38 W 57
" 9 " S 36 " 65
Pine 7 " N 4 E 52
" 8 " S 79 " 72
3rd rate Cypress Pine & Palmetto
February 2 1853

Figure 3. Sample General Land Office (GLO) Field Note Page

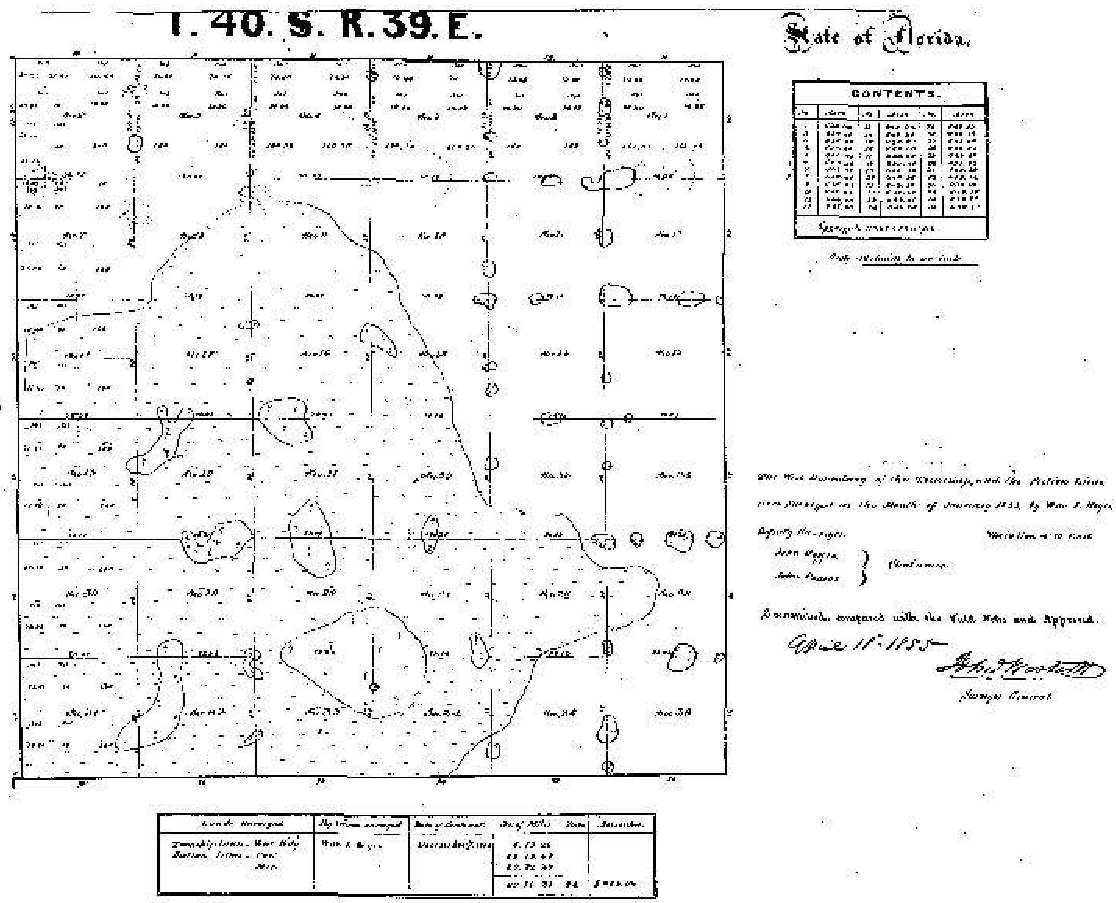

Figure 4. Sample General Land Office (GLO) Township-Range Map

Lower East Coast

This subregion encompasses portions of Miami-Dade, Broward, Palm Beach and Martin counties along the southeast peninsula of Florida, including the lower St. Lucie Watershed south of the present-day C-44 Canal (which contains the South Fork of the St. Lucie River), the Loxahatchee Watershed, and portions of the present-day southeast Florida metropolitan complex along the Atlantic coastline (**Figure 5**). Data sources used to create a base map in this subregion included vegetation maps derived from interpretation of early aerial photography (Richardson 1977, Steinberg 1980), soils by the Wetlands Conservation Strategy (Zahina *et al.* 2001) and surveys of relict areas (Austin 1977, Austin *et al.* 1977) (**Figure 6**). Detailed descriptions of distinct areas within the subregion are outlined next.

Martin and Palm Beach Counties

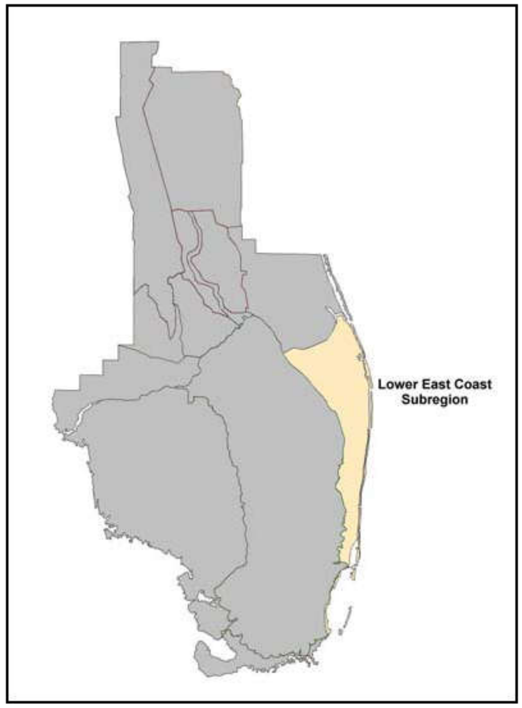

Figure 5. Lower East Coast Subregion

The portion of the Lower East Coast Subregion within Martin and Palm Beach counties is generally defined as the area between the Atlantic coastline and the historical Everglades, south of the St. Lucie River (including the South Fork) to the Broward County line. In the northern portion of this area, significant tracts of land are currently in public ownership as parks and preserves; some of these natural areas remain fairly unchanged from their pre-development condition. The base map used in this area was compiled from three map sources: 1) ecological classifications developed by the Wetlands Conservation Strategy (Zahina *et al*. 2001) were used for the area between the Everglades and the coastal zone where soils survey information was no longer available; 2) Richardson's (1977) photo-interpretative map of historical vegetation was used along the coastal zone and, 3) the U.S. Coast and Geodetic Survey of the coastal waterways from 1884 were used to define the extent of natural waterways. The soil maps were available in electronic format; however, the Geodetic Survey and Richardson's maps were only in paper format, and digitized to create an electronic geospatial version for this project. **Figure 6** shows the source data used to create the base map in the Lower East Coast Subregion.

Vegetation descriptions from the Wetlands Conservation Strategy database (Zahina *et al*. 2001) and Richardson (1977) were converted to classifications used by this project (**Table 1**); the methods used are shown in **Table 2** and **Table 3**. This resulting base map was compared to GLO field notes and maps to determine its accuracy. Additional changes to the base map were made to more closely approximate vegetation community distribution recorded in GLO field notes and plat maps; these changes are shown in **Table 4**.

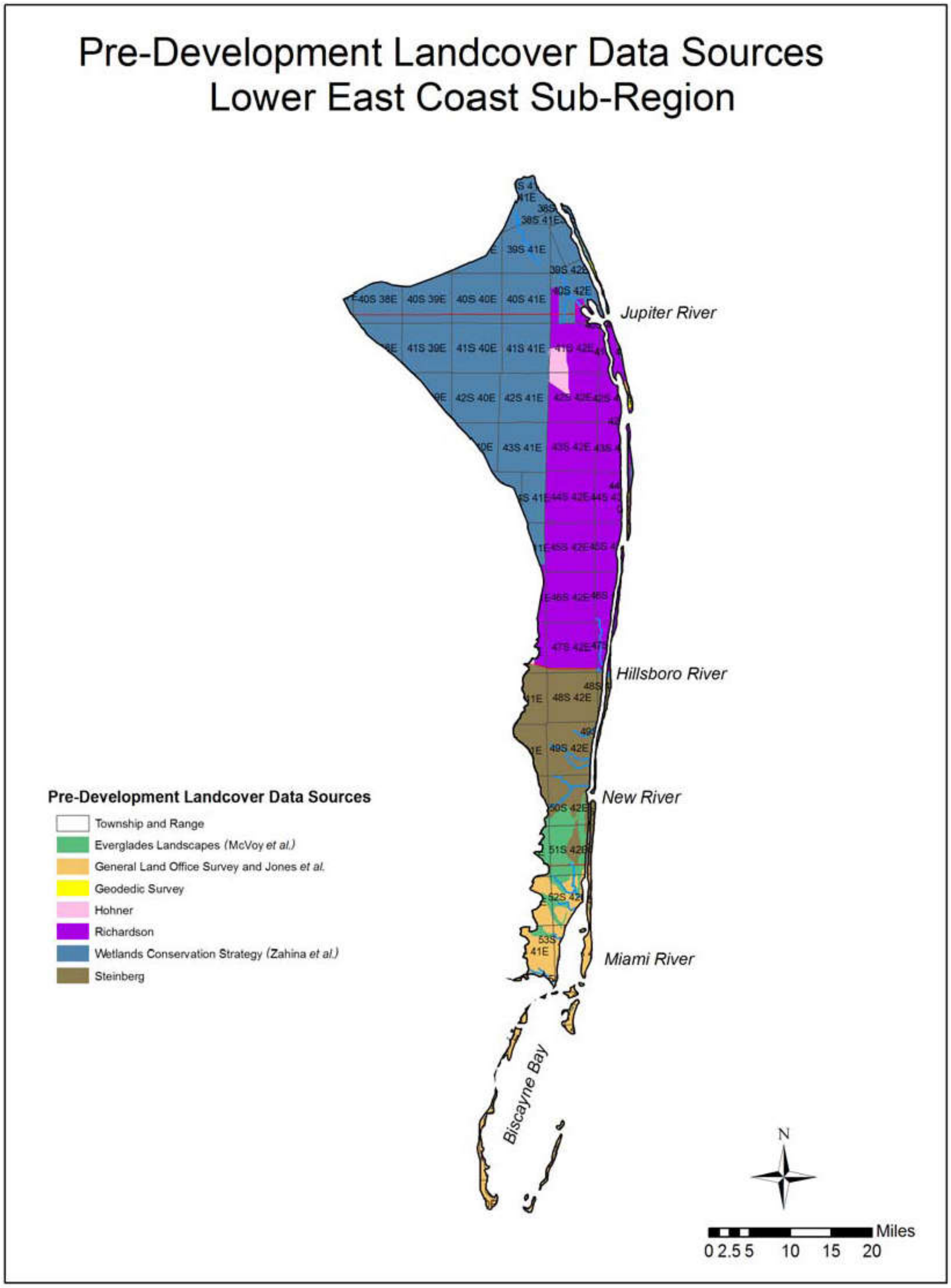

Figure 6. Source Data Used to Create the Base Map for the Lower East Coast Subregion.

Table 2. Wetland Conservation Strategy Database Vegetation Classification Crosswalk (Zahina *et al.* 2001).

Wetlands Conservation Strategy Vegetation Class	Pre-Development Vegetation Class	
	Description	***Classification Code***
Water	Water	1
Intra-Tidal Wetlands	Intra-Tidal Wetland	2
Beaches	Beach	3
Freshwater Wetlands	Non-Forested Freshwater Wetland	5
Wet Prairie	Wet Prairie	5.3
Swamp Hammock	Hydric Upland	6
Uplands	Mesic Upland	7
Flatwoods	Mesic Pine Flatwood	7.2
Highlands	Xeric Upland	8

Table 3. Richardson (1977) Vegetation Classifications Crosswalk.

Richardson's Vegetation Class	Pre-Development Vegetation Class	
	Description	***Classification Code***
Mangrove	Intra-tidal Wetland	2
Beach and Strand	Beach	3
Swamp	Hardwood Swamp	4.2
Marsh	Medium-Hydroperiod Marsh	5.2
Wet Prairie	Wet Prairie	5.3
Ponded Wet Prairie	Wet Prairie with Cypress	5.32
Low Hammock	Wet Prairie with Scattered Trees	5.31
Tropical Hammock	Mesic Hammock	7.3
Pine Flatwoods	Mesic Pine Flatwood	7.2
Dry Prairie	Dry Prairie	7.1
Scrub	Scrub	8.2

Table 4. Additional Modifications During Verification of Base Map in the Martin and Palm Beach County Area.

Township-Range	Modifications to Vegetation Classification based on GLO Observations
Township 40 – Range 40 Township 40 – Range 41 Township 41 – Range 41 Township 42 – Range 41	Wet Prairie (# 5.3) in the base map derived from soil data was changed to Hydric Flatwood (# 6.1). Non-Forested Freshwater Wetland (# 5) in the base map derived from soil data was changed to Medium-Hydroperiod Marsh (# 5.2). Mesic Upland (# 7) in the base map derived from soil data was changed to Mesic Pine Flatwood (# 7.2); in Township 41 – Range 41 only, Mesic Upland was changed to Hydric Flatwood (# 6.1). Wet Prairie with Scattered Trees (# 5.31) in the base map derived from Richardson (1977) was changed to Hydric Flatwoods (# 6.1).
Township 41 – Range 38	Non-Forested Freshwater Wetland (# 5) in the base map derived from soil data was changed to Cypress Swamp (# 4.1). Wet Prairie (# 5.3) in the base map derived from soil data was changed to Wet Prairie with Cypress (# 5.32). Mesic Upland (# 7) in the base map derived from soil data was changed to Mesic Pine Flatwood (# 7.2).
Township 41 – Range 39	Non-Forested Freshwater Wetland (# 5) in the base map derived from soil data was changed to Cypress Swamp (# 4.1) in the western half of the township. Wet Prairie (# 5.3) in the base map derived from soil data was changed to Wet Prairie with Cypress (# 5.32) in the western half of the township and to Hydric Flatwoods (# 6.1) in the eastern half. Mesic Upland (# 7) in the base map derived from soil data was changed to Mesic Pine Flatwood (# 7.2) in the western half of the township. Small, isolated wetland polygons designated as Non-Forested Freshwater Wetlands (# 5) were changed to Medium Hydroperiod Marsh (# 5.2) in the northern half of the township.

Table 4. Additional Modifications During Verification of Base Map in the Martin and Palm Beach County Area (Continued).

Township-Range	Modifications to Vegetation Classification based on GLO Observations
Township 41 – Range 40	Wet Prairie (# 5.3) in the base map was changed to Hydric Flatwoods (# 6.1). Mesic Pine Flatwood (# 7.2) in the base map was changed to Hydric Flatwoods (# 6.1) in the southern half of the township. Wet Prairie with Scattered Trees (# 5.31) in the base map derived from Richardson (1977) was changed to Hydric Hammock (# 6.2) in the southern half of the township. Non-Forested Freshwater Wetland (# 5) was changed to Marsh with Scattered Cypress (# 5.21); small, isolated wetland polygons designated as “Non-Forested Freshwater Wetlands” (# 5) were changed to Medium Hydroperiod Marsh (# 5.2) in the northern half of the township.
Township 41 – Range 42	Wet Prairie (# 5.3) in the base map derived from Richardson (1977) was changed to Mesic Pine Flatwood (# 7.2) in the southern half of the township and to Hydric Flatwoods (# 6.1) in the northern half of the township. Wet Prairie with Scattered Trees (# 5.31) in the base map derived from Richardson (1977) was changed to Hydric Flatwoods (# 6.1). Medium Hydroperiod Marsh (# 5.2) in the base map derived from Richardson (1977) was changed to Marsh with Scattered Cypress (# 5.21). Non-Forested Freshwater Wetland (# 5) in the base map derived from Richardson (1977) was changed to Hydric Hammock (# 6.2). Hardwood Swamp (# 4.2) in the base map derived from Richardson (1977) was changed to Cypress Swamp (# 4.1).
Township 42 – Range 42 Sections 6, 7, 17, 18, 19, 20 (western half only), 30 and 31 ------------------------------------- Sections 8, 16, 21, 28 and 33	Wet Prairie (# 5.3) in the base map derived from Richardson (1977) was changed to Hydric Flatwoods (# 6.1). -- Medium-Hydroperiod Marsh (# 5.2) in the base map derived from Richardson (1977) was changed to Marsh with Scattered Cypress (# 5.21). Hardwood Swamp (# 4.2) in the base map derived from Richardson (1977) was changed to Cypress Swamp (# 4.1).

Table 4. Additional Modifications During Verification of Base Map in the Martin and Palm Beach County Area (Continued).

Township-Range	Modifications to Vegetation Classification based on GLO Observations
Township 41 – Range 43 Township 42 – Range 43 Township 43 – Range 43	Hardwood Swamp (# 4.2) in the base map derived from Richardson (1977) was changed to Cypress Swamp (# 4.1).
Township 43 – Range 42 Sections 2, 11, 14, 23, 26 and 35	GLO field survey information defines a transition from mesic to hydric community types. Wet Prairie (# 5.3) in the base map derived from Richardson (1977) was changed to Mesic Pine Flatwoods (# 7.2) along the east side of the transition zone and to Wet Prairie with Scattered Trees (# 5.31) along the west side of the transition zone.
Sections 1, 12, 13, 24 and 25	Hardwood Swamp (# 4.2) in the base map derived from Richardson (1977) was changed to Cypress Swamp (# 4.1).

Broward County Area

The base map for eastern Broward County up to the historic edge of the Everglades was developed from 1940s aerial photography (U.S. Department of Agriculture 1940) as interpreted by Steinberg (1980). The District staff digitized and generated polygons from the paper map published as part of that study. Additional polygons outlining xeric communities, which were not well defined by Steinberg, were taken from the 1948 soils map (Jones 1948). **Figure 6** shows the source data used to create the base map in Broward County.

Steinberg's (1980) vegetation descriptions were converted to the vegetation classes defined for this study (**Table 1**), following the method outlined in **Table 5**. Soils designated as St. Lucie Fine Sand were selected from the 1948 soil map and delineated as isolated scrub communities[1]. Examination of GLO field notes indicated the descriptions of these areas include not only the xeric (scrub) areas, but transitional zones between pine flatwoods. This resulting base map was compared to GLO field notes and maps to determine its accuracy. Additional changes to vegetation classifications were made to the base map vegetation community types according to GLO field note descriptions and plat maps (**Table 6**).

[1] St. Lucie Fine Sand is an excessively drained soil that is associated with relic dune systems; typically these sites support xeric and scrub vegetation, and have a seasonal high water table at least six feet below the soil surface (Zahina *et al.* 2001). Other soils of this type include Archbold and Pomello.

Table 5. Steinberg (1980) Vegetation Classification Crosswalk

Steinberg Vegetation Class	Pre-Development Vegetation Class	
	Description	***Classification Code***
Mangrove	Intra-tidal Wetland	2
Beach and Strand	Beach	3
Swamp	Hardwood Swamp	4.2
Marsh	Medium-Hydroperiod Marsh	5.2
Wet Prairie	Wet Prairie	5.3
Low Hammock	Wet Prairie with Scattered Trees	5.31
Tropical Hammock	Mesic Hammock	7.3
Pine Flatwoods	Mesic Pine Flatwood	7.2
Dry Prairie	Dry Prairie	7.1
Scrub	Scrub	8.2

Table 6. Additional Modifications During Verification of the Base Map for the Eastern Broward County Area.

Township-Range	**Modifications to Vegetation Classification based on GLO Observations**
Township 48 – Range 42	Hardwood Swamp (# 4.2) in the base map derived from Steinberg (1980) was changed to Hydric Flatwood (# 6.1). Wet Prairie with Scattered Trees (# 5.31) in the base map derived from Steinberg (1980) was changed to Mesic Hammock (# 7.3). Scrub (# 8.2) in the base map derived from Steinberg (1980) was changed to Mesic Pine Flatwood (# 7.2) in only the central and western sections of the township. Isolated scrub areas in central township were defined by soils map (Jones 1948).
Township 49 – Range 42	Hardwood Swamp (# 4.2) in the base map derived from Steinberg (1980) was changed to Cypress Swamp (# 4.1). Scrub (# 8.2) in the base map derived from Steinberg (1980) was changed to Mesic Pine Flatwoods (# 7.2) in only the central and western sections of the township. Isolated scrub areas in central township defined by soils map (Jones 1948).

Table 6. Additional Modifications During Verification of the Base Map for the Eastern Broward County Area (Continued).

Township-Range	Modifications to Vegetation Classification based on GLO Observations
Township 50 – Range 42	Hardwood Swamp (# 4.2) in the base map derived from Steinberg (1980) was changed to Cypress Swamp (Classification Code # 4.1) only in non-riverine wetlands. In areas adjacent to rivers (e.g., floodplains), Hardwood Swamp was changed to Hydric Hammock (# 6.2). Wet Prairie with Scattered Trees (# 5.31) in the base map derived from Steinberg (1980) was changed to Non-Forested Freshwater Wetland (# 5). Intra-Tidal Wetlands (# 2) in the base map derived from Steinberg (1980) were changed to Non-Forested Freshwater Wetland (# 5) for inland lakes that later became part of the Intracoastal Waterway; the water body that is now the inlet was not changed. Scrub (# 8.2) in the base map derived from Steinberg (1980) was changed to Mesic Pine Flatwoods (# 7.2) in only the central and western sections of the township. Isolated scrub areas in central township defined by soils map (Jones 1948).

Miami-Dade County Area

Although much of Miami-Dade County was part of the historical Everglades (covered in another section), certain coastal areas were not. Along the coast, the base map was created primarily from the GLO maps with additional guidance from the soil map compiled by Jones (1948) (**Figure 6**). Vegetation classifications aggregated from Jones (1948) in McVoy *et al.* (In Press) were converted to the vegetation classes defined for this study according to the method shown in **Table 7.** Since the base map was derived primarily from GLO maps and descriptions, the resulting base map was considered verified.

Table 7. Jones *et al.* (1948) Soil-Vegetation Classification Crosswalk

Soil-Vegetation Class (adapted from Jones)	Pre-Development Vegetation Class	
	Description	***Classification Code***
1 ,2 Custard Apple Swamp	Hardwood Swamp	4.2
6, 11, 12, 13, 8	Medium-Hydroperiod Marsh	5.2
10	Mesic Pine Flatwood	7.2
14	Xeric Upland	8

Southwest Florida

The Southwest Florida Subregion is generally defined as the area between the Caloosahatchee River and Florida Bay, bounded by the Gulf of Mexico to the west and merging with the Everglades in the east (**Figure 7**). This subregion includes the Big Cypress Swamp, the Fakahatchee Strand, Picayune Strand and lowlands that gradually decline in elevation to the southwest to form the Ten Thousand Islands. The base map for this subregion is the pre-development vegetation developed for the Southwest Florida Feasibility Study (Duever 2002, **Appendix B**). Duever's vegetation descriptions were crosswalked to the vegetation classes defined for this study (**Table 1**), following the method outlined in **Table 8**.

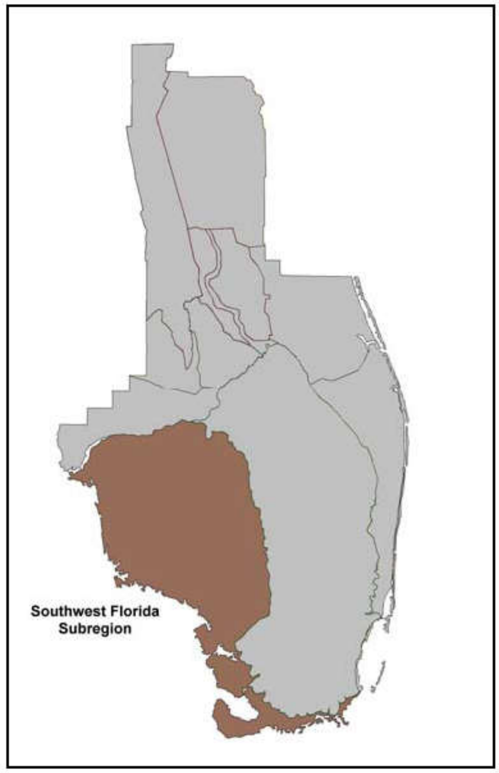

Figure 7. Southwest Florida Subregion

Table 8. Duever (2004) Vegetation Classification Crosswalk*.

Duever Vegetation Class	Pre-Development Vegetation Class	
	Description	***Classification Code***
Open Water	Water	1
Tidal Marsh, Mangrove	Intra-tidal Wetland	2
Beach	Beach	3
Cypress	Cypress Swamp	4.1
Swamp Forest	Hardwood Swamp	4.2
Marsh	Medium-Hydroperiod Marsh	5.2
Wet Prairie	Wet Prairie	5.3
Dwarf Cypress	Wet Prairie with Cypress	5.32
Hydric Hammock, Hydric Flatwood	Hydric Uplands	6
Mesic Hammock	Mesic Hammock	7.3
Mesic Flatwoods	Mesic Pine Flatwood	7.2
Xeric Hammock, Xeric Flatwood	Xeric Upland	8

* See Appendix B.

Okeechobee and Everglades

The Okeechobee and Everglades Subregion includes waters of pre-diked Lake Okeechobee (excluding the streams and wetlands to the north and northwest of the lake, which are included in other subregions) and the historical extent of the Everglades Basin, extending from the south rim of Lake Okeechobee to Florida Bay, and from the Big Cypress Swamp to the eastern fringing bald cypress swamps and flatwoods (**Figure 8**). The base map source was derived from McVoy *et.al.* (In Press), which was converted to the pre-development vegetation classes used by this project according to the method outlined in **Table 9**. Since this map and associated descriptions were based upon GLO maps, field observations and survey information, this subregion map was not further verified.

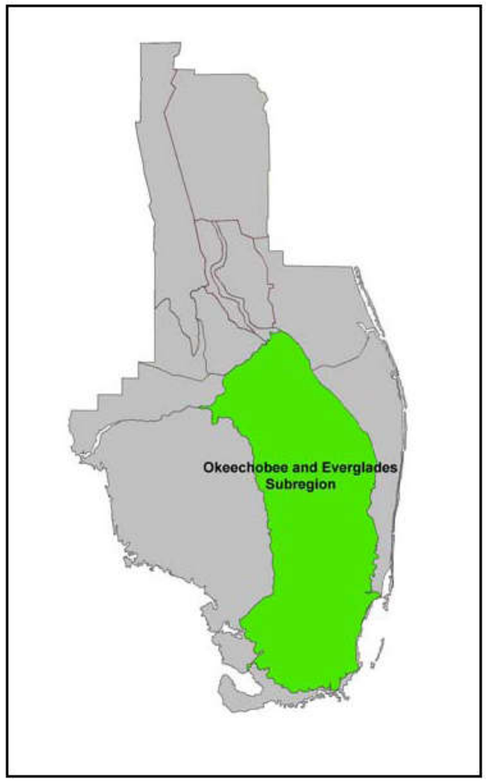

Figure 8. Okeechobee and Everglades Subregion

Tree Islands

Tree islands are significant features within the Everglades ridge and slough landscape. They vary in size, origin and vegetative composition, but are generally recognized as forming on a bedrock high or peat mound within the surrounding marsh, and having a tear drop shape with the tapered end oriented down stream of the surface water flow. Historical accounting of tree island size ranges from 0.1 acres (.04 hectares) to 100 acres (40.5 hectares) (McVoy *et al*. In Press). For the purpose of this project, we adopt the definition from the Avineon (2002) report.

> "Characteristically, tree islands are tear-shaped, their orientation follows the flow of surface water (NW to SE), the tallest trees and shrubs are at the upstream end of the island called the 'head', and behind the head there is an elongated v-shaped area called the 'tail'. While the head is typically dominated by trees and taller shrubs, the tail is dominated by shrubs and/or marsh species, such as sawgrass…"

Source data for tree island features in the pre-development database came from four sources:

1. The 1948 soil survey (Jones *et al*., 1948) was a key source as it remains the only comprehensive soil survey done in the Everglades. This survey is available as a GIS coverage. Polygons were reselected for the bay and myrtle landcover and gandy peat soil.

2. A tree island trend analysis conducted for the SFWMD by Avineon (2002) that documented changes in tree island vegetative communities in Water Conservation Area 3 (WCA) from the 1940s to 1995. In this study, tree islands were mapped from 1940s aerial photography. The minimum mapping unit was 1 hectare (2.8 acres).

3. The J.H. Davis Vegetation Map (1943) provided an estimate of tree island distribution in areas where these features have disappeared due to development or were not included in the soil surveys. Although many of Davis' tree island delineations correspond to actual locations, many were estimated based on his interpretation of this feature in the historical system. We included a subset of these islands where they seemed reasonably distributed and to scale.

4. Current satellite imagery. Significant tree island signatures interpreted from a 1994 Landsat mosaic were compared to the other three data sources. Features were added, if not accounted for in the other sources.

Although tree islands are numerous, georeferenced historical data are scarce. The GLO surveys did not extend into the Everglades beyond the fringes so we cannot "field verify" the tree island features in this project using our standard method. We are assuming the 1940s and satellite data can be considered to spatially represent tree islands accurately, whereas the islands derived from Davis' mapping are reasonable, but not spatially verifiable. A project to consider may be to map tree islands from the entire set of 1940s aerials.

Table 9. Pre-Drainage Everglades Database (McVoy *et al.* In Press) Vegetation Classification Crosswalk

Pre-Drainage Everglades Database Vegetation Class	Pre-Development Vegetation Class	
	Description	***Classification Code***
Water, Lake	Water	1
Cypress	Cypress Swamp	4.1
Custard Apple Swamp, Willow and Elderberry	Hardwood Swamp	4.2
Eastern Marshes	Long-Hydroperiod Marsh	5.1
Ridge and Slough, Taylor Slough	Ridge and Slough Marsh	5.11
Sawgrass Plains	Sawgrass Plain	5.12
Peat Transverse Glades	Medium-Hydroperiod Marsh	5.2
Marl Marsh	Everglades Marl Marsh	5.22
Everglades Keys	Xeric Uplands	8

Results

SUMMARY OF PRODUCTS

A geospatial database was compiled from existing base map sources and additional data fields were added to reflect values for hydrological parameters associated with each vegetation community type. The database was developed to display the extent of historical vegetation communities across the southern Florida landscape (see insert map in front cover). To facilitate use of this large database, the study area was divided into subregions, each of which contains a unique group of communities that are distributed in a particular spatial pattern. Generally, these patterns are determined by hydrological characteristics primarily influenced by local topography. A description of vegetation characteristics from each subregion is provided next.

Pre-Development Lower East Coast Subregion

The pre-development vegetation of the Lower East Coast Subregion is highly varied and distinctly arranged along elevation gradients and surface water flow patterns (**Figure 9** and **Figure 10**). This is in contrast to the fact that relief in southeastern Florida is low and any significant elevation gradients occur only along stream embankments and coastal ridges. Much of the landscape tends to be flat and low, supporting flatwoods and expansive wetland systems. The highest elevations are found along the coast in Martin, Palm Beach and Miami-Dade counties on relic dune systems, coral ridges and oolitic rock outcrops. These sites supported xeric communities, dominated by sand pine or oak scrub at more inland areas, and tropical hammocks or coastal strand along the coast and on barrier islands.

Most of the inland wetlands of Martin and Palm Beach counties that are part of the Loxahatchee and lower St. Lucie River watersheds exhibit only weak flow patterns because of the very poorly drained landscape. The potholes and swales in these low flatlands give rise to a complex of marsh, wet prairie and hydric flatwoods in the slightly undulating land surface. Wetlands adjacent to the historical Everglades in this region exhibit a more articulated pattern of flow, indicating drainage towards the southwest. Cypress swamps tend to be associated with the transitional ecotone at the eastern edge of the Everglades marsh.

In contrast to vegetation in Martin and Palm Beach counties, wetland vegetation in Broward and Miami-Dade counties tends to exhibit a strong directionality associated with the flowways of the New River, the Miami River and the peat transverse glades.

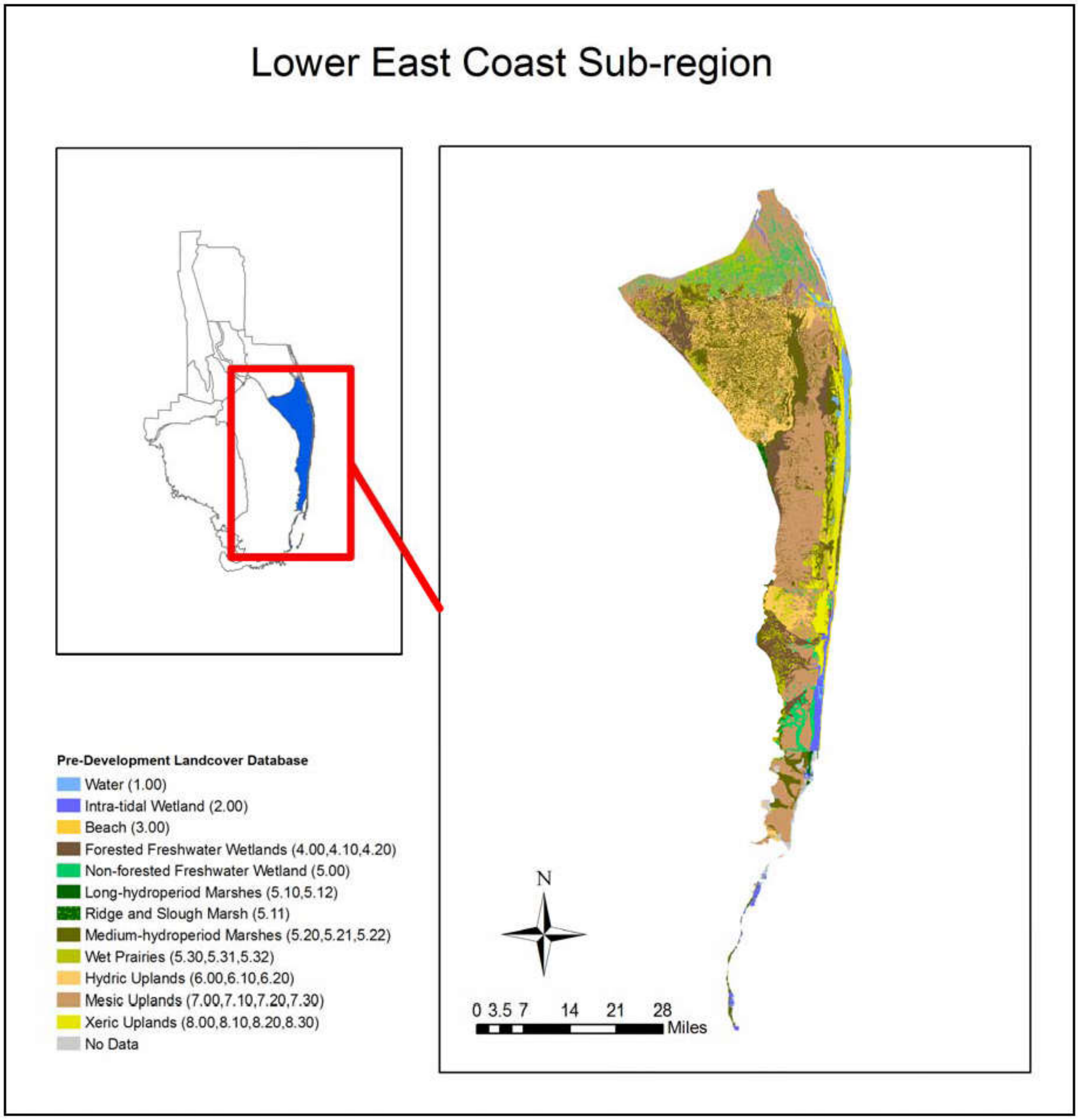

Figure 9. Generalized Map of the Pre-Development Vegetation Communities in the Lower East Coast Subregion.

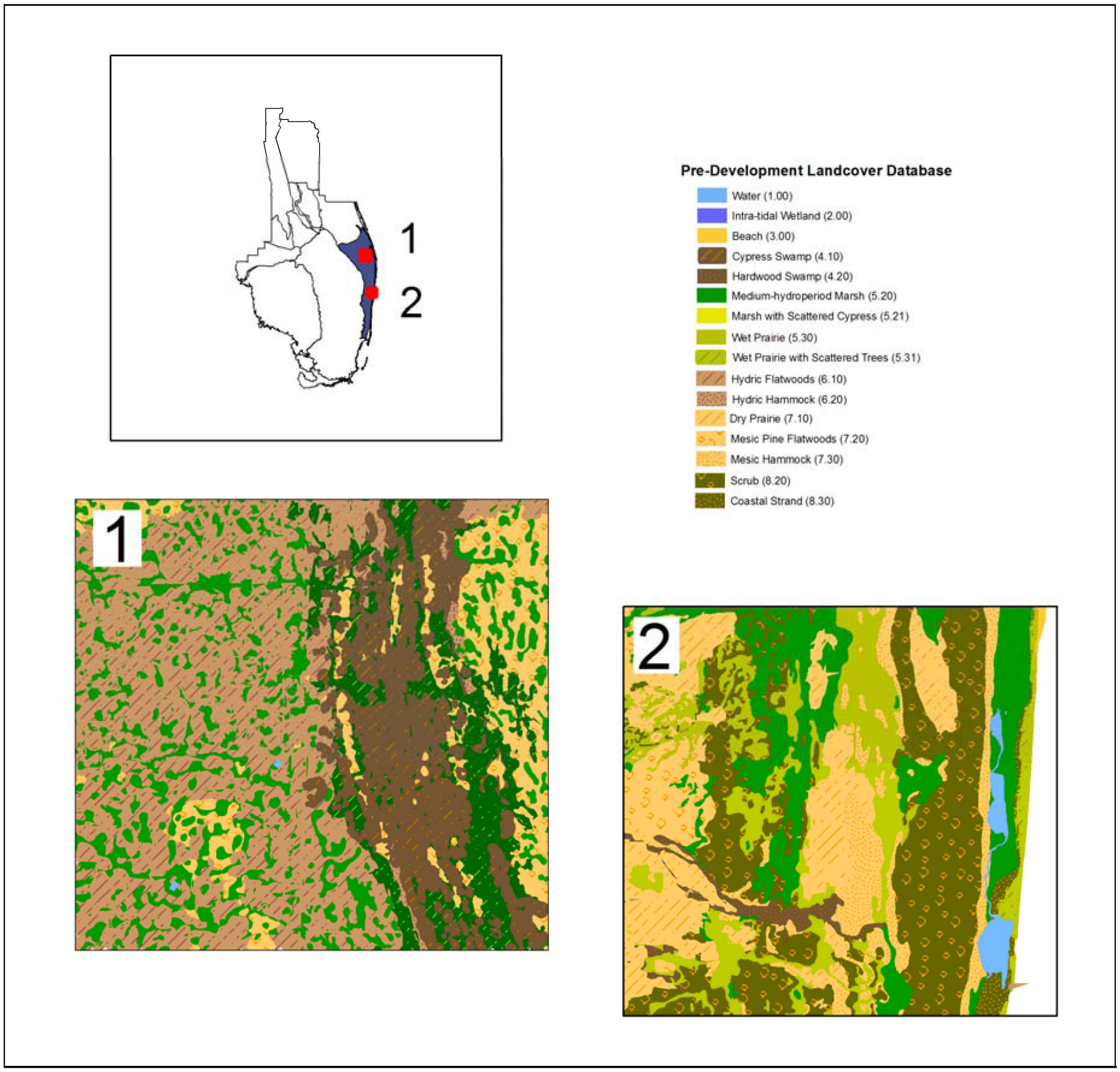

Figure 10. Detailed Maps of the Pre-Development Vegetation Communities in the Lower East Coast Subregion.

One notable natural feature along the peninsular coastline of southeastern Florida is a series of freshwater lakes and wetlands running parallel to the coast (excluding areas near inlets). This chain of freshwater wetland systems occupy a lowland area between natural ridges formed during earlier geological periods. These wetlands were often dominated by sawgrass or grassy vegetation (i.e., sedges). A representational map of this feature from the GLO survey is shown in **Figure 11**; section lines and numbers were removed from this map so that landscape features are more easily visible. Most of the coastal freshwater wetlands, lakes and streams became the primary channel route for the Intracoastal Waterway.

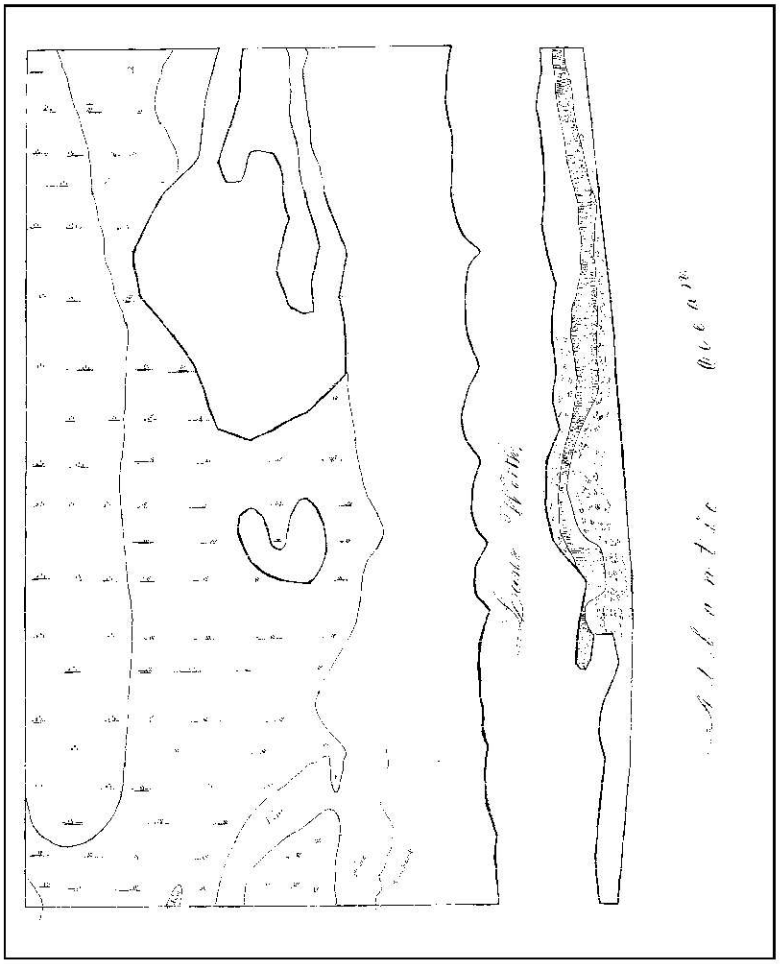

Figure 11. GLO Map of Coastal Freshwater Lakes and Wetlands at Present-Day Downtown West Palm Beach (Township 43 South, Range 43 East; originally surveyed 1845, 1870); Section Lines have been Removed.

The extent of coastal mangrove swamp in the GLO maps and field notes may be useful as an indicator of the historic extent of saltwater-tolerant communities. In the Loxahatchee River, there are recorded accounts of mangrove fringing the central embayment where the three forks of the river converge. The next natural inlet to the south is at the outflow of the Hillsboro River where mangroves are recorded up to approximately one mile upstream. Mangroves are not recorded along the New River or its outlet, with the next significant population found in Biscayne Bay. There, mangroves are recorded from Dumfundling Bay south to Big Snake Creek and Arch Creek (**Figure 12**).

Figure 12. Map of Northern Biscayne Bay Area (Township 52 South, Range 42 East; originally surveyed 1845, 1870) from the GLO Surveys; Section Lines have been Removed.

Pre-Development Southwest Florida Subregion

The pre-development vegetation of the Southwest Florida Subregion contains a mosaic of wetlands and flatwoods that gradually slope downward in elevation from the

Big Cypress Swamp to the Ten Thousand Islands and the Everglades. The slightly sloping landscape plays a key role in shaping the vegetation communities, which tend to be arranged along interconnecting channels and flowways that carry water from the interior wetlands to the coastal estuaries (**Figure 13**).

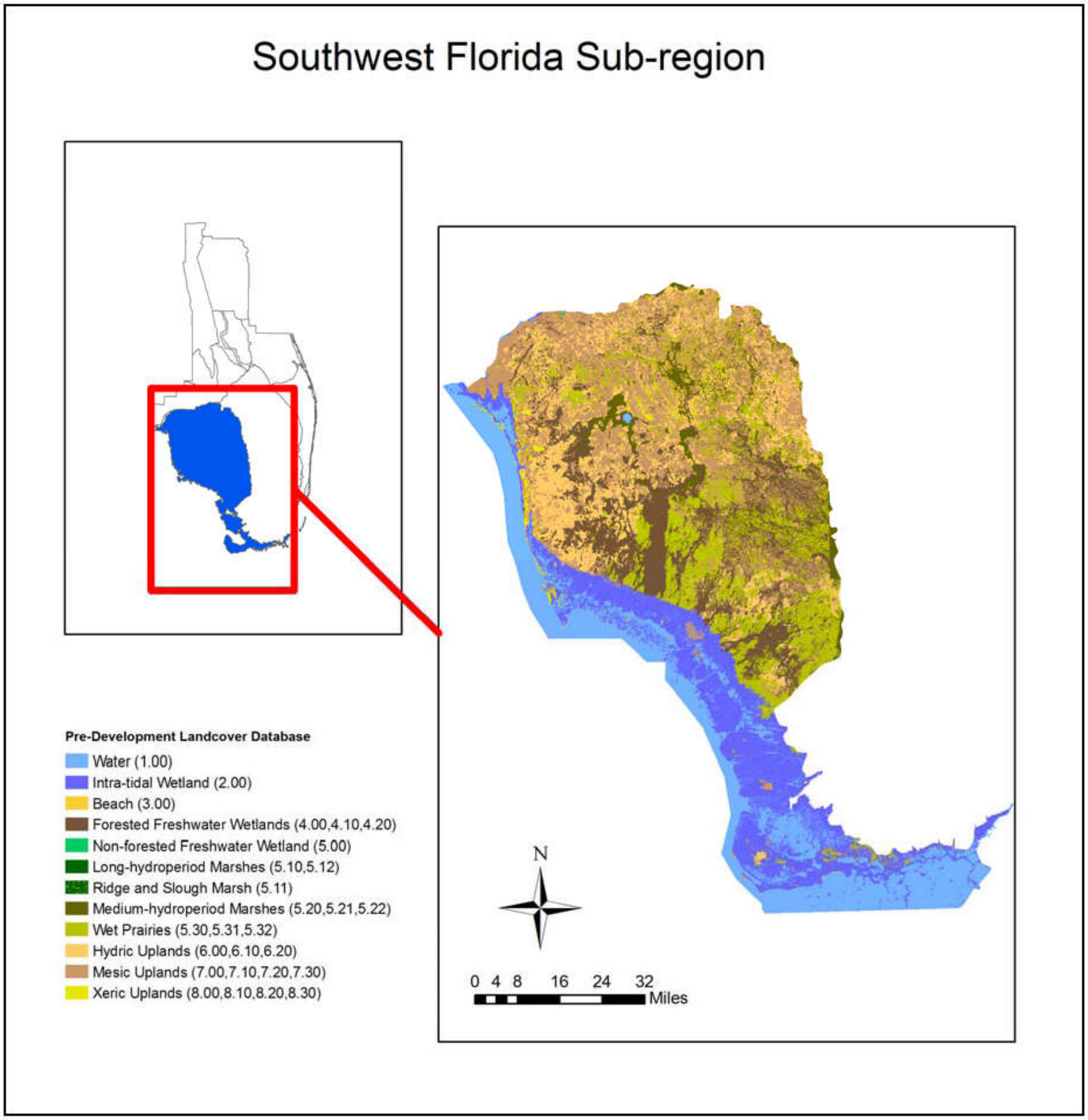

Figure 13. Generalized Map of the Pre-Development Vegetation Communities in the Southwest Florida Subregion.

Vegetation communities in this subregion range from the extensive mangrove forests located on the hundreds of islands along the Gulf of Mexico to the interior cypress swamps that contain trees of formidable age and stature: Big Cypress, Corkscrew, Fakahatchee Strand and Picayune Strand. Some portions of the Big Cypress Swamp contain diminutive dwarf cypress forests of scattered, stunted trees crowded in wet prairies. These swamps form major drainage flowways to the Gulf of Mexico (**Figure 14**).

Detailed descriptions of pre-development vegetation in Southwest Florida were prepared for the SFWMD Southwest Florida Feasibility Study by M. Duever (2002) and are included as (**Appendix B**).

Pre-Development Okeechobee and Everglades Subregion

Pre-development vegetation patterns in the Okeechobee and Everglades Subregion were influenced by seasonally pulsing water flows through an extremely flat wetland system that sloped slightly southward. The length of this great flowway was approximately 100 miles (160 kilometers), the distance from Lake Okeechobee to Florida Bay. Lake Okeechobee and the Everglades were intrinsically interconnected water bodies that sustained several major landscapes within a vast wetland system (**Figure 15**).

Lake Okeechobee is a broad, shallow open water body with an indeterminate shoreline in many areas where lake levels were even with the surrounding landscape for most of the year. Overflow from the lake sustained an expansive sawgrass marsh along the northwest shoreline and provided substantial inflow to the Everglades from its southern shores.

An elongated pond apple (or custard apple) swamp extended southward approximately 2 miles from the south and southeastern shore of Lake Okeechobee before giving way to an immense expanse of sawgrass marsh ("sawgrass plains") in the northern Everglades (**Figure 15**). Further downstream, the sawgrass plains transitioned into a "ridge and slough" mosaic of interconnected, undulating sawgrass ridges and water lily sloughs interspersed with hammock-bearing tree islands (**Figure 16**). Shallow soil marl marshes flanked the ridge and slough landscape in the southern Everglades. Other community types present include upland mesic and xeric communities associated with the relatively elevated Miami Rock Ridge in the southeastern area of this subregion.

Detailed descriptions of the pre-drainage Everglades landscapes and associated hydrology were developed for the SFWMD (McVoy *et al.* In Press).

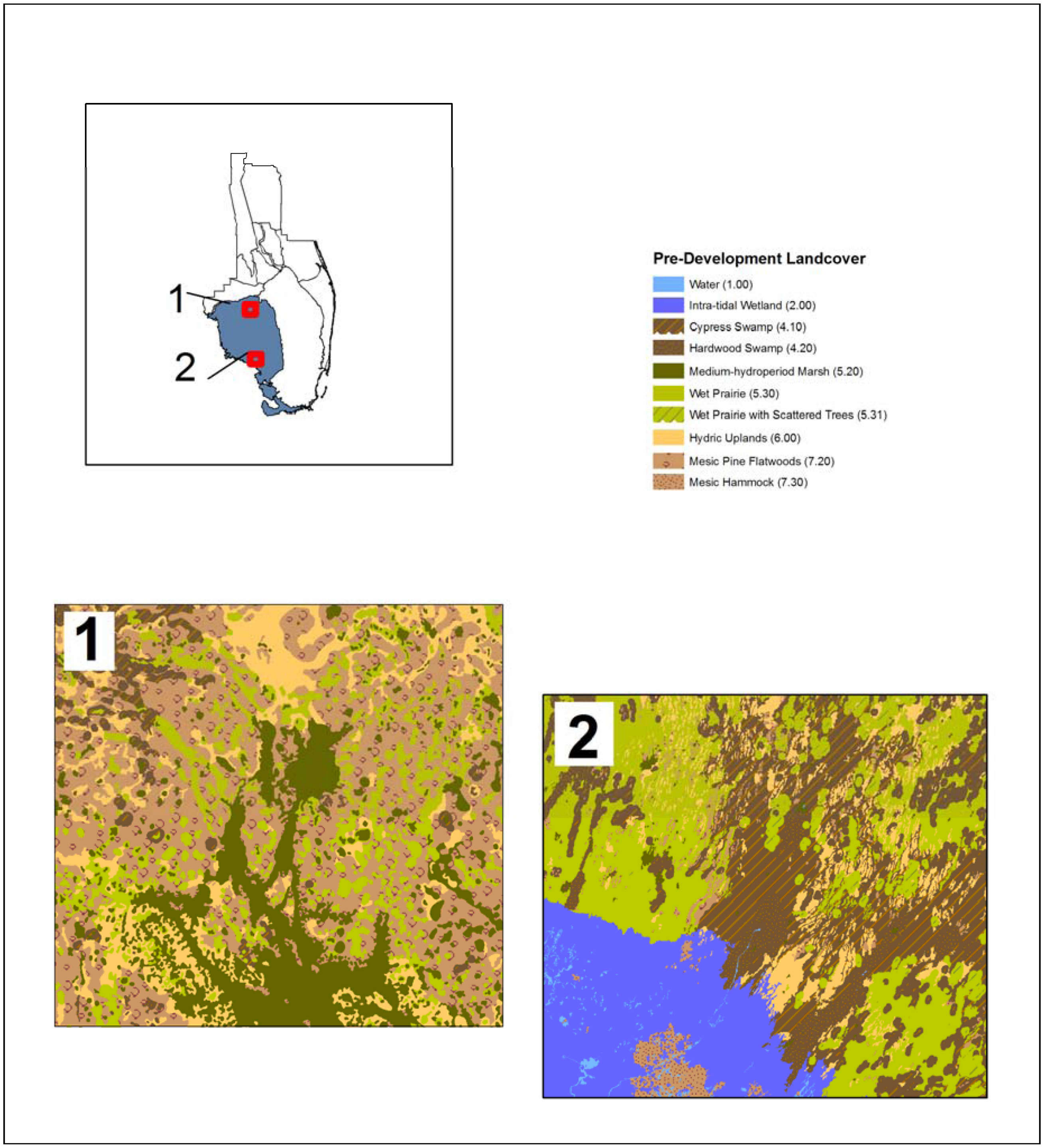

Figure 14. Detailed Maps of the Pre-Development Vegetation Communities in the Southwest Florida Subregion, Big Cypress Area (1) and Gulf of Mexico Inflows (2).

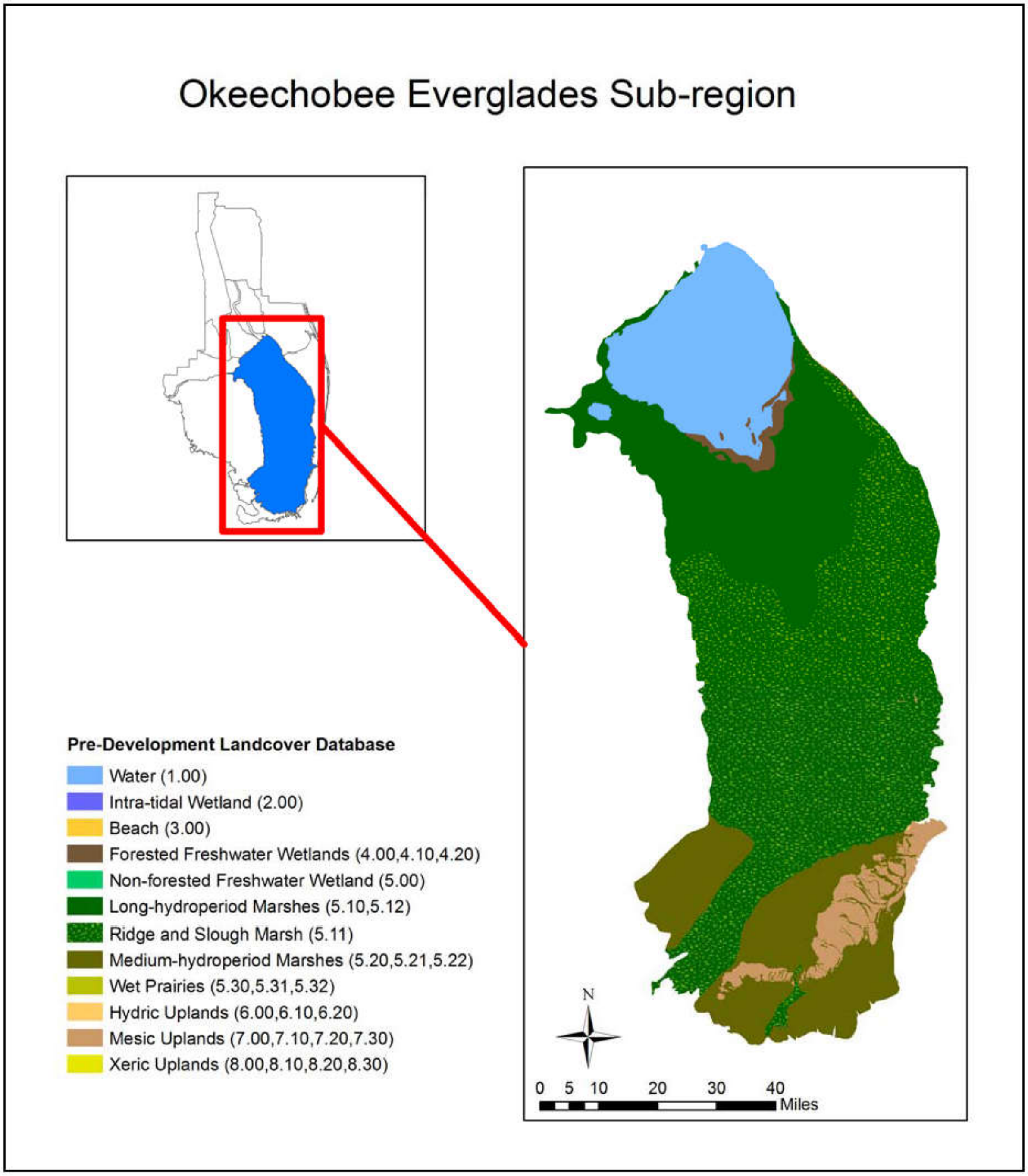

Figure 15. Generalized Map of the Pre-Development Vegetation Communities in the Okeechobee-Everglades Subregion Adapted from McVoy *et al.* (In Press).

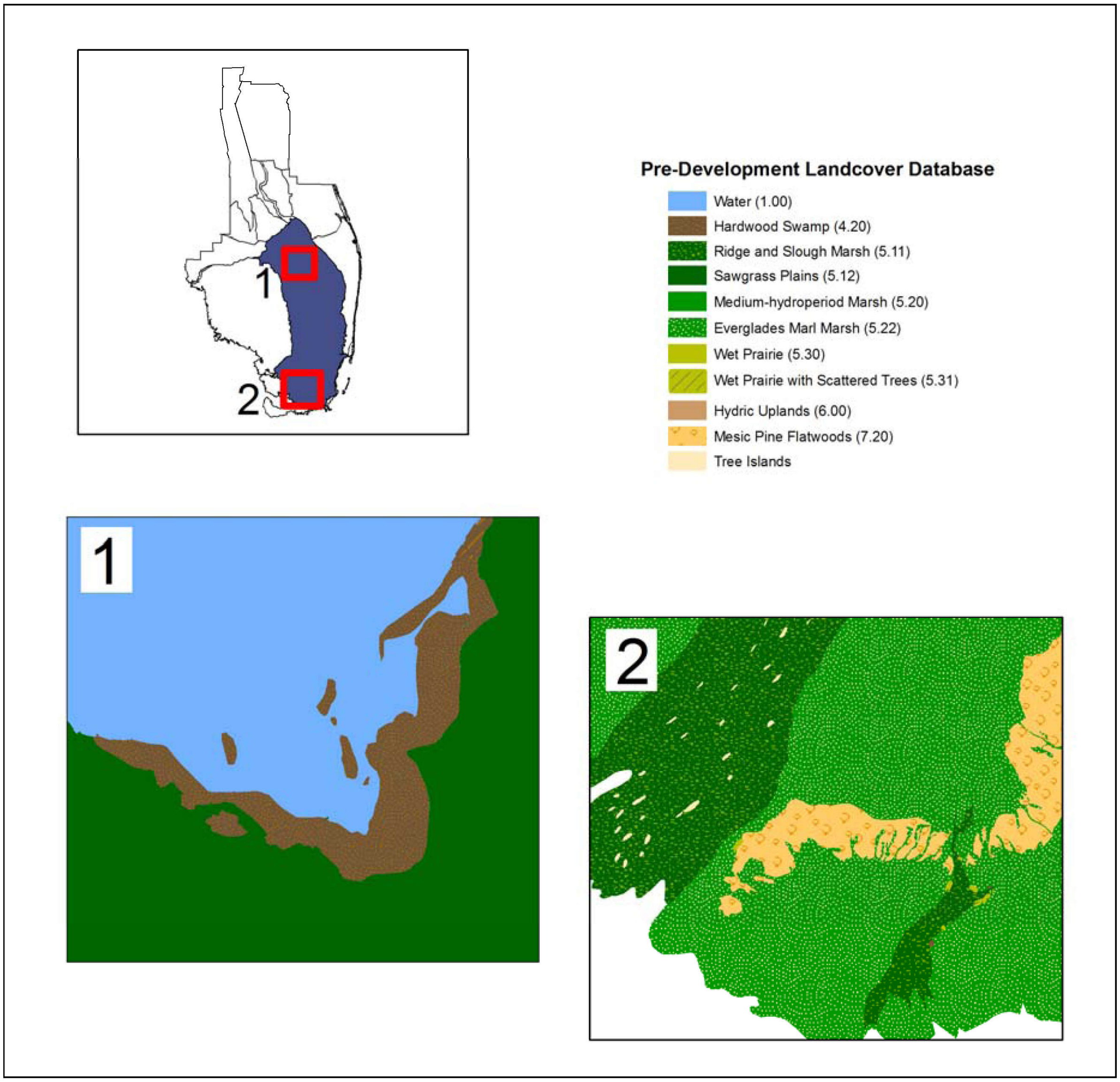

Figure 16. Detailed Maps of the Pre-Development Vegetation Communities in the Okeechobee-Everglades Subregion; South Shore of Lake Okeechobee (1) and Shark River Slough Inflow to Florida Bay (2).

LIMITATIONS OF DATA AND MAP PRODUCTS

As with any data set and map product, there are limitations to the application and interpretation of the information that can affect the reliability of any analysis upon which they are based. When using data from the Pre-Development Vegetation Database or any map produced from the database, there are several limitations that should be recognized and considered. These include:

- Minimum Mapping Unit
- Landscape versus Local Application
- Extent of Verification
- Landscape Heterogeneity

When conducting an analysis based upon this database, the scale that is used in the analysis can affect the reliability or confidence of the result. As a general rule with maps, accuracy increases as one zooms out. Polygons defined in the database are representations of the distribution of vegetation communities across the landscape. Some sources for vegetation community polygons used in the database were derived from interpretation of aerial photography, which is an approximation of the extent of an area of similar character. Verification of these polygons was conducted along section lines in representative and special areas of interest; however, GLO field surveys usually did not measure within the section area. At times, the surveyors estimated the extent of a community type there. Given these limitations, the database and resulting maps are most reliable at the landscape level. When the reliability of a specific polygon or relatively small area of the Pre-Development Vegetation Map is important to an analysis, it is suggested additional confirmation is sought.

In some areas, the earliest available map contained some artifacts of development or landscape alteration. These features were filtered or corrected to give good correspondence to the GLO land surveys. However, the influence of these features on adjacent polygons may still persist at the local level, particularly near the coastline and major drainage canals.

Landscape heterogeneity should also be considered when reliability of the database on smaller scales is important. Generally, the more homogeneous a landscape is, the more reliable its representation is at a smaller scale.

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Appendix A

Vegetation Classifications Used to Develop the Pre-Development Landscape Map and Database

VEGETATION CLASSES USED IN DEVELOPMENT OF A PRE-DEVELOPMENT MAP FOR CENTRAL AND SOUTH FLORIDA

As part of the effort to create a pre-development vegetation map for the Central and South Florida region, a classification scheme was developed to define the major plant community assemblages historically found within the study area. While compiling different studies and surveys of historical vegetation, it became clear that no two studies defined the same vegetation classes; this presented the challenge of discerning the intent of the original source material to properly interpret the species and hydrological characteristics associated with a particular vegetation category. It was determined that the vegetation classification scheme used by any one of the contributing studies was insufficiently inclusive and detailed to be applied across the extent of our study region. For this reason, a classification system that is unique to this study, but also contains elements of previous published works, was compiled.

Challenges are encountered when developing any vegetation classification system. Many natural communities do not occur as discrete entities, but instead are often arranged in the landscape along gradients so that mixtures and intermediate forms can be identified. One example of this is two types of communities that occupy the same landscape position and have similar hydrological characteristics but have markedly different tree densities based on fire frequency: dry prairies and mesic pine flatwoods. In places where there is a nearly treeless expanse of saw palmetto, a determination of the dry prairie community is easy to discern. However, at what density of pines does one definitively categorize the community as mesic pine flatwood rather than dry prairie? A similar challenge exists along some hydrological gradients; for example the change from a mesic to hydric flatwood in the natural landscape is often indeterminable in flat, low landscapes and the decision to categorize a site as one or the other is sometimes a factor of human decision rather than absolute certainty. In reality, the categories we have defined rely on describing the usual species and hydropattern found in a clearly-defined or pure example of the class type. Areas that contain intermediate and variant forms of a vegetation community occur in the natural world and how these features were classified was, out of necessity, based on professional judgment.

The identification and classification of sub-region specific landscapes was considered necessary for the application of this database to hydrologic modeling. Whereas most of the features in Southwest Florida and other regions adjacent to the Everglades tend to be relatively small and scattered, the Everglades landscapes (ridge and slough, sawgrass plains, and marl marshes) are large physiographic areas of uniform characteristics and were classified accordingly as sub-region specific landscapes.

Broad categories of community types were created: 1) water, or permanently flooded sites; 2) intra-tidal wetlands; 3) shores; 4) forested freshwater wetlands; 5) non-forested wetlands; 6) hydric uplands; 7) mesic uplands; and 8) xeric uplands. Where it was considered necessary, subclasses and variant forms of these community types were included in the vegetation classification scheme. This classification scheme is primarily based on the relationships between plant communities and hydrological conditions. This classification addresses natural community types unaffected by human influences.

Descriptions of each community type are presented in **Table A-1**; these include plant species that may be found in the community, hydroperiod characteristics and location of major examples of the community (either historically or current). Hydrological characteristics can be defined in two different ways and the reader is encouraged to be aware that different studies and authors may not use comparable methods. Inundation duration is the period of time that a community has surface water inundation. This may range from perhaps 8 weeks for some short-hydroperiod wetlands during dry years to 13 or more months for long-hydroperiod wetlands during wet years. Some authors may define "average hydroperiod" as a mean of the inundation duration for a wetland type. In contrast, the "average annual hydroperiod" is defined as the average amount of time within a calendar year that a wetland is inundated. For this latter definition, no wetland has a hydroperiod exceeding 12 months. Hydroperiods and depth of flooding ranges presented in the classification descriptions for this database represent average annual hydroperiods from published sources for the community type.

It is important for the user of this database to remember that the classifications presented below describe a historic and not the present-day condition for the community. Although some remnant communities may persist in a pre-development condition, many present-day communities in the study area have been altered.

Table A-1. Vegetation Classes for the Pre-Development Landscape.

Vegetation Type (Classification Code)	Description	Hydrology
Water (1.0)	Open water areas that generally lack emergent vegetation; includes freshwater, estuary and marine systems	Permanently inundated all year
Intra-tidal Wetland (2.0)	Tidally inundated sites; vegetation community is influenced by magnitude of daily flooding regime and salinity concentration	Tidally-influenced hydrology
Shore (3.0)	Consolidated substrate (e.g., rock) or unconsolidated deposits (e.g., sands) on shorelines influenced by moving water	Hydrology a function of associated water body
Forested Freshwater Wetland (4.0)	Forested freshwater wetlands (swamps)	Annual average depth range from 1.5 ft. below the soil surface to 2.0 ft. above; annual average duration of flooding ranges from 5 to 10 months
Cypress Swamp (4.1)	Freshwater swamp dominated by cypress with few large hardwood trees	Annual average depth range from 1.5 ft. below the soil surface to 1.5 ft. above; annual average duration of flooding ranges from 5 to 9 months
Hardwood Swamp (4.2)	Freshwater swamp dominated by broadleaf trees; may also contain some cypress	Annual average depth range from 1.0 ft. below the soil surface to 2.0 ft. above; annual average duration of flooding ranges from 6 to 10 months

Table A-1. Vegetation Classes for the Pre-Development Landscape (Continued).

Vegetation Type	Description	Hydrology
Non-Forested Freshwater Wetland (5.0)	Freshwater wetland dominated by herbaceous vegetation; may also contain scattered shrubs or trees	Annual average depth range from -2.0 ft. below the soil surface to 2.5 ft. above; annual average duration of flooding ranged from 2 to 12 months
Long-hydroperiod Marsh (5.1)	Freshwater marsh with hydroperiods extending from 9-12 months on average	Annual average depth range from -0.5 ft. below the soil surface to 3.0 ft. above; annual average duration of flooding ranged from 9 to 12 months
Ridge and Slough Marsh (5.11)	Everglades-specific community mosaic of alternating open water sloughs and sawgrass ridges interspersed with tree islands	Annual average depth in ridges were from 0.5 ft. below the soil surface to 1.5 ft. above and in sloughs were from 1.0 to 3.0 ft deep; annual average duration of flooding in ridges were from 9 to 10 months and were 12 months in sloughs
Sawgrass Plain (5.12)	Historical northern Everglades community generally consisting of a unbroken expanse of sawgrass across a large spatial extent	Annual average depth range from -0.5 ft. below the soil surface to 1.5 ft. above; annual average duration of flooding ranged from 9 to 10 months
Medium-hydroperiod Marsh (5.2)	Freshwater marsh; may also include mixed shrubs	Annual average depth range from -0.6 ft. below the soil surface to 1.5 ft. above; annual average duration of flooding ranged from 6 to 10 months
Marsh with Scattered Cypress (5.21)	Freshwater marsh that contains scattered stunted cypress	Annual average depth range from -0.6 ft. below the soil surface to 1.5 ft. above; annual average duration of flooding ranged from 6 to 10 months

Table A-1. Vegetation Classes for the Pre-Development Landscape (Continued).

Vegetation Type	Description	Hydrology
Everglades Marl Marsh (5.22)	Historical Everglades community consisting of a medium-hydroperiod marsh with marl soils derived from calcareous algae; most extensive in the southern Everglades	Annual average depth range from -1.0 ft. below the soil surface to 1.5 ft. above; annual average duration of flooding ranged from 6 to 9 months
Wet Prairie (5.3)	Short-hydroperiod treeless wetlands that have hydric soils	Annual average depth range from -2.0 ft. below the soil surface to 1.0 ft. above; annual average duration of flooding ranged from 2 to 6 months
Wet Prairie with Scattered Trees (5.31)	Wet prairie with scattered trees and shrubs, including pine, cypress and bay	Annual average depth range from -2.0 ft. below the soil surface to 1.0 ft. above; annual average duration of flooding ranged from 2 to 6 months
Wet Prairie with Cypress (5.32)	Wet prairie with scattered cypress	Annual average depth range from -2.0 ft. below the soil surface to 1.0 ft. above; annual average duration of flooding ranged from 2 to 6 months
Hydric Upland (6.0)	Moist woodlands on soils that are not hydric in level, low landscapes; fire frequency is the primary factor in shaping dominant vegetation type	Annual average depth range from -2.5 ft. below the soil surface to 0.5 ft. above; annual average duration of flooding ranged from 1 to 2 months
Hydric Flatwood (6.1)	Hydric flatwoods typically are dominated by open pine forest with a herbaceous ground cover	Annual average depth range from -2.5 ft. below the soil surface to 0.5 ft. above; annual average duration of flooding ranged from 1 to 2 months

Table A-1. Vegetation Classes for the Pre-Development Landscape (Continued).

Vegetation Type	Description	Hydrology
Hydric Hammock (6.2)	Hydric hammocks typically are dense forests dominated by hardwood species	Annual average depth range from -2.5 ft. below the soil surface to 0.5 ft. above; annual average duration of flooding ranged from 1 to 2 months
Mesic Upland (7.0)	Mesic communities are found on upland (non-hydric) soils; short-duration flooding may occur only during high-rainfall events. Fire frequency is the primary factor shaping dominant vegetation type	None
Dry Prairie (7.1)	Non-forested upland community typically including grasses and saw palmettos; high fire frequency	None
Mesic Pine Flatwood (7.2)	Forested upland community with an open pine canopy and denser herbaceous ground cover; moderate fire frequency	None
Mesic Hammock (7.3)	Forested upland community composed primarily of broadleaf trees; develop in the absence of fire	None
Xeric Upland (8.0)	Xeric communities are found on sites where the water table is well below (more than 3 feet) the soil surface all year. Xeric plant communities are dominated by species that have special adaptations for survival in dry conditions. Fire frequency is the primary factor shaping dominant vegetation type	None

Table A-1. Vegetation Classes for the Pre-Development Landscape (Continued).

Vegetation Type	Description	Hydrology
High Pine (Sandhill) (8.1)	Dry pine communities on undulating sandy soils that are dominated by longleaf pines and wiregrass; these communities are typically found in central Florida.	None
Scrub (8.2)	Scrub communities are dominated by sand pine or oak scrub species and are typically found on pure, deep sands of relic dune systems.	None
Coastal Strand (8.3)	Coastal strand communities are typically found on excessively drained elevated sites, such as coastal dunes, ridges, rocky outcrops or shell mounds. Vegetation species are primarily of tropical and Caribbean origin.	None

Water (Classification Code #1)

These are permanently inundated sites of open-water areas. Hydroperiods are typically 12 months per year on average. Some ponds or very shallow lakes may have exposed substrate during droughts. Water areas typically have little, if any, emergent vegetation (vegetated areas are typically classified as wetlands). This class includes freshwater, estuary and marine water bodies.

The greatest expanses of water in Florida occur along the tidally-influenced coastline, estuaries and lagoons. The highest concentration of freshwater lakes occurs in the sandy ridge of central Florida. Most of Florida's water bodies are shallow and have a maximum depth of less than 16 feet (5 meters) (Brenner *et al.* 1990).

In marine environments a variety of organisms may be found along the coast, including beds of sessile invertebrates (e.g. hard and soft corals, sponges and oysters), marine animals (e.g., chitons, urchins, octopus), fish and seagrasses such as manateegrass (*Syringodium filiforme*), shoalweed (*Halodule wrightii*), seagrass (*Halophila* spp.) and turtlegrass (*Thalassia testudinum*). Many of these organisms need a stable substrate for colonization or depend on sessile communities for habitat or foraging.

Freshwater communities vary according to water quality, substrate, water flow and depth of water. In flowing water (lotic) systems, flow magnitude and substrate type can significantly influence the benthic vegetation and invertebrate communities. Examples of lotic systems include rivers, streams, creeks and springs. In freshwater non-flowing (lentic) systems, trophic status may play a dominant role in determining the types of vegetation present (e.g., emergent, floating, submersed). Typically shallow water bodies support varied submersed and benthic communities; but deep water areas do not, as anoxic conditions prevail and light penetration is dampened at greater depths. Examples of lentic systems include sloughs, ponds and lakes.

Freshwater vegetation that can be found in these water bodies include tapegrass (*Vallisneria americana*), lemon bacopa (*Bacopa caroliniana*), waternymph (*Najas* spp.) floatingheart (*Nymphoides cristata*), water lettuce (*Pistia stratiotes*), Carolina mosquito fern (*Azolla caroliniana*), duckweed (*Lemna* spp.), and macroalgae such as *Chara* spp.

Intra-tidal Wetlands (Classification Code #2)

These areas are tidally inundated with daily variable water levels and salinity concentrations. These communities are not permanently flooded (permanently flooded sites are classified as "Water"), but are inundated as often as twice a day, including extreme monthly or seasonal tides. The vegetation community composition is shaped by climate, magnitude of flooding, salinity concentrations and degree of wave energy exposure. The frequency and magnitude of tidal inundation may vary between the Atlantic and Gulf coasts; however, the highest daily tidal magnitude of approximately 2.5 to 3.0 feet is typical along the Atlantic coast. Types of intra-tidal wetlands include tidal flats, salt marshes and mangroves, the latter being the most dominant community type in the more frost-free areas of south Florida peninsula.

Salt marshes are communities with nonwoody, salt-tolerant plants occupying sites that are occasionally inundated with salt water. These communities are found where the inter-tidal zone is sufficiently large and wave energy is sufficiently low to allow their development and where mangroves are restricted (Montague and Wiegert 1990). The rate of primary production in salt marshes is among the highest measured in natural systems (MacDonald Environmental Sciences 1994). The principal plants of salt marshes are needle rush (*Juncus roemerianus*) and saltmarsh cordgrass (*Spartina alterniflora*), which usually occur in monotypic stands (Kurz and Wagner 1957). High marsh plants are succulents or species that are adapted to soils of high salinity, such as glasswort (*Salicornia bigelovii*), saltwort (*Batis maritima*), saltgrass (*Distichlis spicata*), shoreline seapurslane (*Sesuvium portulacastrum*) and Carolina sealavender (*Limonium carolinianum*) (Kurz and Wagner 1957; Carlton 1975, 1977).

Three tree species are associated with the mangrove community, these are: red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*) and white mangrove (*Laguncularia racemosa*). Buttonwood (*Conocarpus erecta*) is classified as a "mangrove associate" and often constitutes an important upland fringe of many Florida mangrove communities (Tomlinson 1980). All of these species have physiological and morphological adaptations that allow them to thrive in unstable, anaerobic sediments, fluctuating water levels and high salinity concentrations (Odum and McIvor 1990). Mangrove species may cohabit and are often arranged along an elevation gradient with red mangrove situated lower and white mangrove situated higher in the landscape.

Shore (Classification Code #3)

Shores consist of consolidated substrate (e.g., rock) or unconsolidated deposits (e.g., beaches of sands or shells) along shorelines that are influenced by moving water or fluctuating water levels. Beaches can be found along high-energy ocean shorelines, lake shores and can also form from alluvial deposits along rivers. Most beaches in Florida are associated with the Atlantic and Gulf of Mexico coastlines; some significant beach formations form along the Kissimmee River and some lake shores.

Atlantic and Gulf coast beaches in Florida consist of fine, well sorted silica sands mixed with organically-derived calcium carbonate (shell) components. Along Florida's Atlantic coastline, grain size increases from north to south (Benedet *et al*. 2004). Along the Gulf Coast, the contribution of shells to beach formation is particularly important; some beaches in the Ten Thousand Islands and Cape Sable areas consist of significant shell deposits.

Vegetation along Florida's Atlantic and Gulf coast beaches varies by site, being shaped by elevation, substrate, exposure and other factors. Along beaches that have a developed dune system, vegetation has been characterized by zones that contain species with similar characteristics and are generally arranged along an elevation gradient. These four zones are the: 1) open beach zone, 2) vine zone, and the 3) grass zone. All of these plants play important roles in stabilizing the dunes and may help to reduce beach erosion during normal conditions.

The open beach zone is influenced by the sweep of daily tides, plus extreme astronomical tides and surf runup during storms, and is characterized by a lack of rooted vegetation. A well-defined wrack line of debris carried in by waves contains marine animals, plants, algae, shells, driftwood and drift seeds. The vine zone contains species of mostly tropical origin such as railroad vine (*Ipomoea pes-caprae* subsp. *brasiliensis*) and baybean (*Canavalia rosea*) that often crisscross the slope to the wrack line. These species rapidly recolonize following a disturbance event. The grass zone contains a number of grass and herbaceous species that represent a more or less permanent community; species include sea oats (*Uniola paniculata*), shoreline seapurslane (*Sesuvium portulacastrum*) and seacoast marshelder (*Iva imbricata*). The extensive and fibrous roots of the grasses provide an important dune stabilization and first-line defense against storm surge.

Forested Freshwater Wetland (Classification Code #4)

Forested freshwater wetlands, or swamps, are widely distributed throughout Florida. They can be found along rivers and surface flowways, or in isolated depressions. Swamps may also be found in a landscape mosaic that may include uplands, hydric hammocks and hydric flatwoods. Many different types of swamp have been described from Florida, including heads, galls, domes, bogs, sogs, bays, strands and hammock (Ewel 1990). Many of the different forms of swamps that have been described reflect the landscape variability that influences hydrological conditions, species composition and community form.

At least four major environmental factors influence the range of structural and functional diversity within and among Florida swamps; these are: 1) hydroperiod, 2) fire frequency, 3) organic matter accumulation, and 4) water source (Ewel 1990). The duration of saturated soils or standing water throughout the year is the primary environmental factor influencing ecological characteristics of swamps, affecting soil aeration, plant survival and plant reproduction. When flooding persists, oxygen in the soil is gradually depleted and only a few species can tolerate the anoxic conditions and high concentrations of soluble iron, manganese and even hydrogen sulfide that develop in the root zone under such conditions (Ewel 1990). Annual average hydroperiods for swamps range from approximately 3 to 10 months and average seasonal water levels can range from 1.5 foot below to 2 feet above the soil surface (see Brown and Starnes 1983, Ewel 1990, Environmental Science and Engineering 1992, CH2M Hill 1996, Duever 2004).

Fire frequency can shape several characteristics of swamps. Fire may be important in reducing the amount of organic matter accumulation in both leaf litter and soils. It can also exclude the establishment of some species that are intolerant of fire, thereby influencing species dominance and species richness.

Common swamp species include cypress (*Taxodium* spp.), red maple (*Acer rubrum*), tupelo (*Nyssa*), pop ash (*Fraxinus caroliniana*), laurel oak (*Quercus laurifolia*), water hickory (*Carya aquatica*), coastal plain willow (*Salix caroliniana*), pond apple (*Annona glabra*), bays (genera *Gordonia*, *Magnolia*, *Persea* and *Ilex*), wax myrtle (*Myrica cerifera*), cabbage palm (*Sabal palmetto*), buttonbush (*Cephalanthus occidentalis*), Virginia willow (*Itea virginica*), wild coffee (*Psychotria* spp.), vines (*Vitis* spp. and *Smilax* spp.) and ferns.

As part of this study, we have defined two major types of forested wetlands: cypress swamps (Classification Code # 4.1) and hardwood swamps (Classification Code # 4.2).

Cypress Swamps (Classification Code #4.1)

Cypress swamps are dominated by cypress; some authors distinguish between two forms – the pond cypress (*Taxodium ascedens.*) and bald cypress (*Taxodium distichum.*). Cypress is among the most common wetland trees in Florida and is usually the dominant species in swamps with fluctuating water levels (Ewel 1990). Cypress swamps can take several forms and are often classified as strands, heads or domes. Hydroperiods may range from 5 to 9 months of the year and average seasonal water levels can range from 1.5 feet below to 1.5 feet above the soil surface (see CH2M Hill 1996, Duever 2004).

Cypress strands are often shallow flowways without a distinctive channel. Two outstanding examples of cypress strands are the Fakahatchee Strand and Corkscrew Swamp; other examples can be found along the southwestern area of the Big Cypress Swamp. Cypress heads or domes are more-or-less round in shape and are isolated depressions within a landscape. Taller trees are concentrated in the center of the dome where deeper water and organic soils are found. Domes typically formed within a depression in the limestone bedrock.

Cypress swamps contain a number of other species such as bays (genera *Magnolia*, *Persea* and *Ilex*), wax myrtle (*Myrica cerifera*), cocoplum (*Chrysobalanus icaco*), cabbage palm (*Sabal palmetto*) and ferns (genera *Thelypteris*, *Blechnum* and *Osmunda*). Besides these primary forest species, an abundance of air plants and orchids are found in cypress swamps including bromeliads, epiphytic ferns and epiphytic orchids.

Hardwood Swamp (Classification Code #4.2)

Hardwood swamps are a type of freshwater wetland dominated by broadleaf trees and represent a late successional cypress forest. Species may include laurel oak (*Quercus laurifolia*), willow (*Salix caroliniana*), red maple (*Acer rubrum*), pop ash (*Fraxinus caroliniana*), water hickory (*Carya aquatica*), sweetgum (*Liquidambar styraciflua*), pond apple (*Annona glabra*), cabbage palm (*Sabal palmetto*) and bays (e.g., *Gordonia lasiathus*, *Persea* spp., *Magnolia virginiana*). Cypress may also be found in hardwood swamps, but they are not present in high numbers. Hydroperiods may range from 6 to 10 months of the year and average seasonal water levels can range from 1 foot below to 2 feet above the soil surface (see Ewel 1990, Duever 2004). Forested swamps with hydroperiods shorter than 6 months are included in the Forested Freshwater Wetland (Classification Code #4)

Many forms of hardwood swamps have been described from Florida including riparian swamps and mixed swamps. Those types of swamps usually have a mix of species. However some hardwood swamps are dominated by a single tree species and are referred to as galls or heads; these may be monospecific stands (or nearly so) of pond apple, bay, hackberry (*Celtis laevigata*), maple, willow, elderberry (*Sambucus nigra*) or ash. Species composition of hardwood swamps is influenced by hydrological characteristics and fire frequency. Bay heads occur in stable water areas and floodplain forests occur on sites with flowing water and rapid water level fluctuations. Some single-species hardwood swamps are seral stages induced by fire.

As with cypress swamps, mixed swamps generally contain a number of herbaceous and epiphytic species such as mosses, terrestrial ferns (e.g., *Thelypteris* spp.) epiphytic ferns (genera *Pleopeltis*, *Campyloneurum* and *Ophioglossum*), bromeliads (genera *Tillandsia*, *Guzmania* and *Catopsis*) and epiphytic orchids (genera *Epidendrum*, *Encyclia* and *Vanilla*).

Non-Forested Freshwater Wetland (Classification Code #5)

Non-forested freshwater wetlands are dominated by herbaceous vegetation of a variety of forms: rooted, non-rooted, submersed, benthic, emersed, floating-leaved, emergent, etc. These wetlands may also contain some shrubs. Trees are absent or may be widely scattered (Kushlan 1990). These communities are highly variable in species composition, which is influenced by topography, geology, soil composition, fire frequency, nutrient status, rainfall, evaporation and hydrological regime. Surface water is seasonally present (annual inundation or hydroperiod of 2 to 12 months) and average seasonal water levels can range from 2 feet below to 2.5 feet above the soil surface (see Ewel 1990, CH2M Hill 1996, Duever 2004). Numerous marsh types have been described from Florida including bogs, fens, mires, sloughs, flats, prairies, wet prairies, savannas, wet savannas and single species marshes (e.g., sawgrass, reed, cattail, spikerush, pickerelweed, water lily). The Florida Natural Areas Inventory (1988) lists nine marsh types: basin marsh, bog, depression marsh, floodplain marsh, marl prairie, seepage slope, slough, swale and wet prairie (Kushlan 1990).

As part of this study, we have defined three marsh types that are assembled along a hydroperiod gradient (long-hydroperiod, medium-hydroperiod and wet prairie), each with variants that result from different fire frequency regimes. Long hydroperiod marshes have annual average hydroperiods that range from 9 to 12 months; these wetlands typically have sparse emergent vegetation and may dry only during extreme drought conditions. Medium-hydroperiod marshes have average annual hydroperiods of 6 to 10 months and experience drying nearly every year. Wet prairies are short-hydroperiod wetlands (annual average hydroperiods of 2 to 6 months) that are only shallowly covered with water and have a relatively high fire frequency. Some wetland soils may have significant accumulations of organic matter, depending on local conditions.

The most notable non-forest freshwater wetland in Florida is the Everglades, which once extended from Lake Okeechobee to Florida Bay between the Big Cypress Swamp and the Atlantic Coastal Ridge. Other large marshes are associated with the Kissimmee River floodplain and adjacent to the southeastern coastal ridge. In addition, significant areas of relatively small herbaceous wetlands are found as seasonal marshes in flatwoods and lake floodplains.

Long Hydroperiod Marsh (Classification Code #5.1)

Long hydroperiod freshwater marshes have hydroperiods extending from 9-12 months and seasonal water levels can range from 0.5 feet below to 3 feet above the soil surface. Dominant vegetation includes water lily (*Nymphaea* spp.), spatterdock (*Nuphar adventa*), spikerush (*Eleocharis* spp.), bladderworts (*Utricularia* spp.) and other submersed, emersed or floating-leafed vegetation. Two unique variants of this community type are the *ridge and slough marsh* and *sawgrass plains* found chiefly in the Everglades.

Long hydroperiod marsh soils range from highly organic, resulting from prolonged inundation that retards decomposition of dead plant material, to mixed soils containing mineral components. Organic soils are important for retaining soil moisture in times of prolonged drought and in maintaining marsh habitats.

The Everglades marsh, which was the largest in Florida, encompassed over 3,861 mi^2 (10,000 km^2) in an elongated basin spanning 62 miles (100 km) from Lake Okeechobee to Florida Bay (Kushlan 1990). Several other significant marshes were linked to the Everglades through flowways, including the Hicpochee marsh, the Loxahatchee Slough and the Hungryland Slough.

Ridge and Slough Marsh (Classification Code #5.11)

The ridge and slough marsh is an Everglades-specific community that is comprised of a mosaic of interspersed open water sloughs and sawgrass (*Cladium jamaicense*) in elongated formations. Ridge hydroperiods were 9 to 10 months and sloughs were inundated approximately 12 months (McVoy *et al*., 2005 Draft). Seasonal water levels in sawgrass ridges were 0.5 feet below to 1.5 feet above the soil surface and within the slough ranged from 1.0 feet to 3.0 feet above the soil surface (McVoy *et al*., 2005 Draft). Slough vegetation is typically composed of white water lily (*Nymphaea odorata*), bladderworts (*Utricularia* spp.) and spikerush (*Eleocharis* spp.).

Sawgrass Plains (Classification Code #5.12)

This historical Everglades-specific community consisted of a generally unbroken monotypic expanse of sawgrass across a large spatial extent and was found generally south of Lake Okeechobee in the northern Everglades. Soils are deep peats that are derived from partially-decomposed sawgrass. These are oligotrophic hard water systems, which are a significant factor in determining the species inhabiting this community. Surface water flows in a continuous sheet rather than in distinct channels or flowways. Average historical annual hydroperiods ranged from 9 to 10 months and average seasonal water levels ranged from 0.5 foot below to 1.5 feet above the soil surface (McVoy *et al*., 2005 Draft). Soils may dry only during the most prolonged droughts. Fire is believed to play an important role in maintaining this community as a herbaceous marsh.

Relatively few other vascular plant species are associated with this habitat type. Where breaks do occur, some emergent marsh species may be present such as arrowhead (*Sagittaria lancifolia*), pickerelweed (*Pontederia cordata*), bladderworts (*Utricularia* spp.) and spikerush (*Eleocharis* spp.).

Medium Hydroperiod Marsh (Classification Code #5.2)

Medium hydroperiod freshwater marshes have hydroperiods extending from 6-10 months on average (Kushlan 1990, CH2M Hill 1996) and average seasonal water levels can range from 0.6 feet below the soil surface to 1.5 feet above the soil surface (Zahina et al. 2001). Species composition is influenced by many different factors such as fire frequency, soil type, geology and hydrological conditions; however all marshes are composed of characteristic types of vegetation such as tall herbaceous sedges, reeds, rushes, grasses and broad-leafed herbs. Common species include sawgrass (*Cladium jamaicense*), cattail (*Typha* spp.), spikerush (*Eleocharis* spp.), St. John's-Wort (*Hypericum* spp.), arrow arum (*Peltandra* spp.), arrowhead (*Sagittaria* spp.), pickerelweed (*Pontederia cordata*) and bladderworts (*Utricularia* spp.).

These marshes may occupy isolated depressions within flatwood communities (flatwood marshes), occur as part of larger wetland systems, or may be associated with river floodplains or shallow lake littoral zones. Flatwood marshes are seasonally flooded wetlands that occur throughout Florida's extensive pine flatwoods (Kushlan 1990). These marshes occur in shallow depressions within flatwoods and are usually small, although collectively they may cover a significant area within the landscape (Laessle 1943, Abrahamson *et al*. 1984, Winchester *et al*. 1985, Abrahamson and Hartnett 1990). Vegetation in these seasonal ponds includes beaksedges (*Rhynchospora* spp.), St. John's-Wort (*Hypericum fasciculatum*), maidencane (*Panicum hemitomon*) and bladderworts (*Utricularia* spp.).

Soils within these marshes may vary considerably. In flatwood marshes, soils are usually deep or shallow sands with a thin surface layer of organic matter. In other places, soils are deep peats, such as in the Everglades or along the south rim of Lake Istokpoga. The amount of sand or organic matter in the substrate is a function of local geology and hydrology.

Medium hydroperiod marshes vary considerably in vegetation, landscape position, geology, surface water and water quality. Two marshes may contain similar species assemblages, yet may not be hydrologically or geologically comparable. For example, a sphagnum bog can be found: 1) in a flatwood marsh, 2) on a seepage slope as a "hanging bog", and 3) in a perched wetland on top of a confining soil or rock stratum. Although these bogs may contain comparable species, the hydrogeological characteristics of the sites are entirely different.

Two unique variants of medium hydroperiod marsh are the *marsh with scattered cypress* and *Everglades marl marsh*, the latter of which is found chiefly in the southern Everglades.

Marsh with Scattered Cypress (Classification Code #5.21)

Marsh with scattered cypress is a variant of the medium hydroperiod marsh. These communities may be found along broad shallow lake littoral zone wetlands or in isolated wetlands, often adjacent to cypress swamps. Average historical annual hydroperiods ranged from 6 to 9 months and average seasonal water levels ranged from 1 foot below to 1.5 feet above the soil surface (McVoy *et al*., 2005 Draft). Usually the cypress are scrubby, widely spaced and never attain the stature typical of a cypress swamp.

Everglades Marl Marsh (Classification Code #5.22)

The Everglades marl marsh was found predominantly in the southern Everglades. Marl marsh is found in areas of thin calcitic soil with a limestone bedrock base. Average historical annual hydroperiods ranged from 6 to 9 months and average seasonal water levels ranged from 1 foot below to 1.5 feet above the soil surface (McVoy *et al*., 2005 Draft). Species typically encountered in marl marsh include sawgrass (*Cladium jamaicense*), Tracy's beaksedge (*Rhynchospora tracyi*), spikerush (*Eleocharis* spp.), star rush whitetop (*Rhynchospora colorata*) and muhly grass (*Muhlenbergia capillaris*). Seasonal periphyton covers inundated portions of plants and submerged substrate, and is found in floating mats. Calcium precipitate from the algae is the primary constituent of marl soils.

Marsh areas included the Rockland Marl Marsh and Perrine Marl Marsh along the southeastern Everglades, and the Ochopee Marl Marsh along the southwestern Everglades.

Wet Prairie (Classification Code #5.3)

Wet prairie communities are short-hydroperiod treeless wetlands that have hydric soils, average annual hydroperiods extending from 2-6 months, and average seasonal water levels that range from 2 feet below the soil surface to 1 foot above the soil surface (Kushlan 1990, CH2M Hill 1996, Duever 2004). Wet prairies are distinguished from marsh by the shorter hydroperiod and prevalence of grass species; whereas dry prairies have no annual hydroperiod, upland species and non-hydric soils. Wet prairie soils are predominantly sandy to marl, if any, organic matter deposition.

Typical plant species of wet prairies include grasses (e.g., *Muhlenbergia capillaris, Panicum hemitomon* and *Spartina bakeri*), sedges (e.g., *Cladium jamaicense, Rynchospora spp.*), St. John's-Wort (*Hypericum fasciculatum*), tenangle pipewort (*Eriocaulon decangulare*), sundews (*Drosera* spp.), yellow-eyed grass (*Xyris* spp.), marsh pinks (*Sabatia* spp.) and terrestrial orchids (*Spiranthes* spp., *Calopogon* spp. and *Pogonia ophioglossoides*). Occasional scattered trees may also be found in wet prairies, but the total coverage is small; species include wax myrtle (*Myrica cerifera*), cypress (*Taxodium* spp.), coastal plain willow (*Salix caroliniana*), bays and cabbage palm (*Sabal palmetto*). As part of this study, we have defined two unique variants of wet prairie: *wet prairie with scattered trees* and *wet prairie with cypress*, the latter of which is found most commonly in the Big Cypress Swamp.

The largest extent of wet prairies lies to the east, northeast and west of the Everglades; these are transitional zones between the Everglades and coastal flatwoods or cypress swamps. Other significant areas of wet prairie are within the Indian Prairie, and Kissimmee River and St. Johns River valleys.

Wet Prairie with Scattered Trees (Classification Code #5.31)

This variant of the wet prairie community contains scattered and sometimes scrubby trees that cover less than approximately 30 percent of the total area of the community (Kushlan 1990). Annual hydroperiods extending from 2-6 months, and average seasonal water levels that range from 2 feet below the soil surface to 1 foot above the soil surface (Kushlan 1990, CH2M Hill 1996, Duever 2004). Typical tree species include wax myrtle (*Myrica cerifera*), bays (e.g., *Persea* spp.), coastal plain willow (*Salix caroliniana*), cabbage palm (*Sabal palmetto*) and slash pine (*Pinus elliottii*). The tree species present is often determined by nearby forest type; for example, scattered pines occur in wet prairies that are adjacent to pine flatwoods. Some less fire-tolerant species, such as bays, may be found within small (wetter) depressions in the prairie where they are protected from fire. Soils may be thin and rock may be close to the surface.

Wet Prairie with Scattered Cypress (Classification Code #5.32)

This variant of the wet prairie community contains scattered and sometimes scrubby cypress; cypress knees and vegetation associated with cypress swamps are absent. Often, this community type is adjacent to cypress forests. Trees that are only 5 to 10 feet tall may be as much as 50 to 100 years old, limited in growth by shallow soils and limited nutrients. Annual hydroperiods extending from 2-6 months, and average seasonal water levels that range from 2 feet below the soil surface to 1 foot above the soil surface (Kushlan 1990, CH2M Hill 1996, Duever 2004). The most extensive area of wet prairie with scattered cypress is within the Big Cypress Swamp and the transitional zone between the Everglades and east coast cypress and flatwood communities.

Hydric Uplands (Classification Code #6)

Hydric uplands are moist woodlands on hydric soils in level, low landscapes; fire frequency is the primary factor in shaping dominant vegetation type. Annual average hydroperiods are from 1 to 2 months and average seasonal water levels can range from 2.5 feet below to 0.5 feet above the soil surface (Duever 2004). Soils are sandy with little surface organic matter.

One extreme variant of hydric uplands that occurs on somewhat alkaline sands is the cabbage palm savanna (Abrahamson and Hartnett 1990), which is common on the Indian Prairie northwest of Lake Okeechobee. Two variants of the hydric upland community that are most commonly encountered, *hydric flatwoods* and *hydric hammocks*, are the result of different fire frequencies; these are further described below.

Hydric Flatwoods (Classification Code #6.1)

Hydric flatwoods are fire-maintained moist pinelands in level, low landscapes. These communities often reside adjacent to marshes or wet prairies, or are situated in shallow depressions in mesic flatwoods. The water table may be at or near the soil surface during the summer rainy season. Average annual duration of flooding can range from 1 to 2 months and average seasonal water levels can range from 2.5 feet below to 0.5 feet above the soil surface. Soils may resemble mesic flatwood soils and may have a hardpan or spodic layer that is impervious or partially confining; this confining layer contributes to the poorly drained conditions of the site.

Dominant vegetation in hydric flatwoods can be superficially similar to mesic pine flatwoods; a canopy of slash pine (*Pinus elliottii*) and a diverse understory that is determined by fire frequency. The pines often are of lower density or are smaller in stature than in mesic pinelands, likely a response to prolonged saturated soil conditions for significant durations throughout the year. Other species that may be common include bald cypress (*Taxodium distichum*), saw palmetto (*Serenoa repens*), myrsine (*Rapanea punctata*), swamp fern (*Blechnum serrulatum*), wax myrtle (*Myrica cerifera*), coco plum (*Chrysobalanus icaco*), gallberry (*Ilex glabra*), groundsel tree (*Baccharis* spp.), American beautyberry (*Callicarpa americana*), St. Johns-Wort (*Hypericum* spp.), candyroot (*Polygala nana*), sundews (*Drosera* spp.), sedges and yellow-eyed grass (*Xyris elliottii*).

Hydric Hammock (Classification Code #6.2)

Hydric hammocks are moist broadleaf woodlands in level, low landscapes. These communities develop in areas of low fire frequency and, as a result, are dominated by hardwood species. Pines are rare or absent. These communities often reside adjacent to marshes or wet prairies, or are situated in shallow, fire protected depressions in mesic flatwoods.

Average annual duration of flooding is from 1 to 2 months and average seasonal water levels can range from 2.5 feet below to 0.5 feet above the soil surface. Soils may resemble mesic flatwood soils and may have a hardpan or spodic layer that is impervious or partially confining; this confining layer contributes to the poorly drained conditions of the site.

Dominant canopy species include laurel oak (*Quercus laurifolia*), sugarberry (*Celtis laevigata*), red mulberry (*Morus rubra*), red bay (*Persea borbonia*). cabbage palm (*Sabal palmetto*), wild coffee (*Psychotria* spp.), American beautyberry (*Callicarpa americana*), myrsine (*Rapanea punctata*), wax myrtle (*Myrica cerifera*), marl berry (*Ardisia escallioniodes*), stoppers (*Eugenia* spp.), poison ivy (*Toxicodendron radicans*) and catbriar (*Smilax* spp.).

Mesic Uplands (Classification Code #7)

Mesic uplands are one of the most extensive types of terrestrial ecosystems in Florida (Abrahamson and Hartnett 1990), especially north of Lake Okeechobee. On this landscape position, three different types of communities may be encountered: mesic hammock, mesic pine flatwoods and dry prairie; these communities represent a gradient from low to high fire frequency. Some factors that influence fire frequency include local topography, proximity to wetlands, elevation and geography.

Mesic communities are found on upland (non-hydric) soils; the water table is below the soil surface most of the year and may be up to 3 ft. below ground surface during the spring dry season. However, short-duration flooding may occur following high rainfall events; wetland species are absent or of low abundance, mostly a function of site-specific conditions. Soils are sandy or rocky substrates with little organic matter accumulation, except in hammocks where a layer of decaying leaf litter may be substantial. The presence of a confining or spodic layer is common in flatwood soils, which affect local drainage and hydrologic conditions. Mesic uplands are often dotted with marshes or isolated ponds (flatwood marshes), which occur in shallow depressions and collectively they may cover a significant area within the landscape (Laessle 1942, Abrahamson *et al.* 1984, Winchester *et al.* 1985, Abrahamson and Hartnett 1990, Kushlan 1990).

Dry Prairie (Classification Code #7.1)

Florida dry prairie is a natural landscape that is endemic to the state (Fitzgerald and Tanner 1992, Bridges 1997), with no similar communities found in adjacent states (U.S. Fish and Wildlife Service 1999). It is geographically restricted to the interior of central, south-central and west-central peninsular Florida. Soils are usually poorly drained, nutrient-poor, acidic and sandy. Dry prairie is often found on the same soils, landscape positions and moisture regimes as mesic pine flatwoods, with dry prairie being the essentially treeless endpoint of a continuum of variation in canopy cover across pine flatwoods landscapes in central Florida (Abrahamson and Hartnett 1990, U.S. Fish and Wildlife Service 1999). Fire frequency is high compared to other community types, with fire occurring at least once every one to four years.

Vegetation of dry prairies is dominated by saw palmetto (*Serenoa repens*), wiregrass (*Aristida stricta*) and dwarf live oak (*Quercus minima*). Other common species include a variety of grasses (*Andropogon ternarius, Andropogon virginicus, Schizachyrium scoparium* and *Sorghastrum secundum*), gallberry (*Ilex glabra*), lyonias (*Lyonia ferruginea* and *Lyonia lucida*), tarflower (*Bejaria racemosa*) and shiny blueberry (*Vaccinium myrsinites.*). Notable variation in this community type can be found associated with latitude. In south Florida rocklands, switch grass (*Panicum virgatum*) and short grasses are generally common, whereas on acidic sands wiregrass is often most abundant (Abrahamson and Hartnett 1990). Other factors that influence species composition and density are seasonal precipitation, temperature, topography, elevation, drainage pattern, soil type and fire regime.

Extensive areas of dry prairie vegetation occurred north and west of Lake Okeechobee (excluding the Istokpoga and Kissimmee lowlands) and in western St. Lucie, Indian River, Brevard and Volusia counties. In each of these Florida physiographic regions, dry prairie occurs on nearly level, poorly to somewhat poorly drained, interdrainage flatlands above major river/stream floodplain valleys. As with mesic pine flatwoods, dry prairies are often dotted with numerous isolated small shallow depressions (ephemeral ponds and marshes), but have very few surface drainage features.

Mesic Pine Flatwoods (Classification Code #7.2)

Pine flatwoods are an open forested mesic upland community composed primarily of open pineland (typically *Pinus elliottii*) and usually with an understory of saw palmetto (*Serenoa repens*). The density of the canopy and understory is related to fire and hurricane frequency with fewer trees and shrubs in more frequently-burned sites. Seasonal precipitation, temperature, topography, elevation, drainage pattern, soil type, latitude and fire regime all play a role in shaping species composition and density.

This community is often characterized by low, flat topography and relatively poorly drained, acidic, sandy soil sometimes with an underlying organic horizon (Abrahamson and Hartnett 1990) or confining spodic zone. Mesic pine flatwoods are often dotted with numerous isolated small shallow depressions (ephemeral ponds and marshes), but have very few surface drainage features.

Characteristic vegetation, in addition to the pine overstory and palmetto understory, includes gallberry (*Ilex glabra*), lyonias (*Lyonia ferruginea* and *Lyonia lucida*), wax myrtle (*Myrica cerifera*), blueberries (*Vaccinium* spp.), tarflower (*Bejaria racemosa*), sumac (*Rhus copallinum*), wiregrass (*Aristia stricta*), catbriar (*Smilax* spp.), poison ivy (*Toxicodendron radicans*) and wild grapes (*Vitis* spp.). Considerable variation exists in understory species throughout Florida. For example, in southern Florida, the dominant pine is *Pinus elliottii* var. *densa*; in central and north Florida, this south Florida slash pine variety may be replaced by *Pinus elliottii* var. *elliottii* or *Pinus palustris* (longleaf pine).

Mesic Hammock (Classification Code #7.3)

Mesic hammock communities are a type of forested mesic upland community composed primarily of broadleaf trees. Mesic hammocks are believed to develop from the same landscape types as dry prairie and mesic pine flatwoods, however fire is naturally suppressed or excluded, allowing development of a hardwood forest.

Hammocks are generally defined as an island of trees in another vegetation type. Mesic hammocks may be found within a fire shadow of a pine flatwood or dry prairie. They may also develop on an elevated site that is surrounded by wetlands where fire is excluded.

The microclimate within a hammock is strikingly different from the surrounding prairie or flatwood. Typically, the canopy is closed and the amount of sunlight reaching the forest floor limits shrub and groundcover species to those that are shade tolerant. Temperatures within the hammock are more moderate than in the surrounding landscape, humidity is higher and evaporation is reduced as sunlight and air movement is dampened. As a result, species found within hammocks are strikingly different than those in areas outside of the hammock.

Species common to mesic hammocks vary considerably between sites and are especially influenced by latitude. In central Florida, live oak (*Quercus virginiana*) and cabbage palm (*Sabal palmetto*) dominate the canopies of most mesic hammocks. In the southernmost reaches of the peninsula tropical species dominate, including West Indies mahogany (*Swietenia mahagoni*), lancewood (*Ocotea coriacea*), nettletree (*Trema micranthum*), wild tamarind (*Lysiloma latisiliquum*), paradise tree (*Simarouba glauca*) and pigeon plum (*Coccoloba diversifolia*). This latter forest type is also referred to as a "tropical hammock."

Xeric Uplands (Classification Code #8)

Xeric communities are found on elevated sites with the water table well below the soil surface (more than 3 feet) throughout the year. Xeric plant communities are dominated by species that have special adaptations for survival in dry soil conditions. Many such communities have leaves that have been reduced to needle-like forms, some plants have thick waxy cuticles and others have underground stems or specialized root structures to maximize water storage and retention—all are adaptations to an environment somewhat, but not entirely, desert-like. Soils are excessively drained sterile sands. Fire frequency, location and climate are the primary factors influencing dominant vegetation types.

Xeric communities, in contrast to pine flatwoods, are often found on rolling hills sand dunes or ridges. The primary aggregations of xeric uplands are along the Atlantic Coastal Ridge, on barrier islands and on central Florida's sand hills and ridges. Three unique variants of the xeric community are the *high pine* or *sandhill*, *scrub* and *coastal strand*. High pine communities are found primarily in central and north Florida on rolling sand hills. These open canopy communities are dominated by longleaf pine (*Pinus palustris*) and wire grass (*Aristida stricta*). Scrub occurs on interior relic sand dunes and ridges (e.g., Lake Wales Ridge), as well as along the Gulf and Atlantic coasts. This community is dominated by sand pine (*Pinus clausa*) or scrub oaks (*Quercus* spp.). Coastal strand is usually restricted to coastal dunes and slopes adjacent to shorelines or beaches. Vegetation in coastal strand is dominated by tropical hardwood species and is sometimes referred to as maritime hammock.

High Pine (Sandhills) (Classification Code #8.1)

High pine or sandhill communities are open pinelands characterized by longleaf pine (*Pinus palustris*) and wiregrass (*Aristida stricta*) on rolling or undulating sand in central and north Florida. High pine once stretched from Texas to Virginia and was one of the most extensive forest types in the southeastern United States. Fires in high pine occur with a frequency of approximately once every one to ten years (Myers 1990).

In addition to longleaf pine and wiregrass, other species common in high pine communities include deciduous clonal oaks such as turkey oak (*Quercus laevis*), bluejack oak (*Quercus incana*), southern red oak (*Quercus falcata*), sand post oak (*Quercus margaretta*) and blackjack oak (*Quercus marilandica*). Hardwoods in high pine are deciduous, in contrast to scrub that has evergreen or nearly-evergreen species. Herbaceous vegetation, grasses and forbs are abundant (Myers 1990). The forest is usually stratified into a pine overstory, deciduous oak sub-canopy and a grass/herbaceous groundcover. At the southern extent of its range on the Lake Wales Ridge, longleaf pine is replaced by south Florida slash pine (*Pinus elliottii* var. *densa*) (Abrahamson *et al.* 1984).

Soils in high pine communities are yellow or gray in color, and can vary considerably in texture, drainage and fertility.

Scrub (Classification Code #8.2)

Scrub communities are typically found on excessively drained, infertile, pure, deep sands on elevated sites, relic dunes and ridges. Scrub communities are characterized by sand pine (*Pinus clausa*) and scrub oaks (*Quercus spp.*) and variations in this community are often attributed to fire frequency, which occur at intervals of approximately 15 to 100 years (Myers 1990).

In addition to sand pine (which may or may not be present), scrub oaks are a dominant and defining species of scrub habitat, including myrtle oak (*Quercus myrtifolia*), sand live oak (*Quercus geminata*), scrub oak (*Quercus inopina*) and Chapman's oak (*Quercus chapmanii*). Other representative species include rosemary (*Ceratiola ericoides*), saw palmetto (*Serenoa repens*), silk bay (*Persea humilis*) and rusty lyonia (*Lyonia ferruginea*). Many species found in scrub are highly adapted to life in xeric conditions; as a result they are of very limited distribution. Some species are endemic to scrub and occur nowhere else; some scrub endemic species include scrub holly (*Ilex opaca* var. *arenicola*), silk bay, scrub hickory (*Carya floridana*), scrub plum (*Prunus geniculata*), garberia (*Garberia heterophylla*), palafoxia (*Palafoxia feayi*), wild olive (*Osmanthus megacarpus*) and Curtiss' milkweed (*Asclepias curtissii*).

The largest extent of scrub occurs in Florida's central peninsula situated on the high sands of the Lake Wales Ridge. Other coastal scrubs are found along the Atlantic and Gulf coasts associated with more recent dunes from the Pleistocene shoreline (Myers 1990).

Coastal Strand (Classification Code #8.3)

Coastal strand communities are found on excessively drained elevated coastal sites along the Gulf and Atlantic shorelines and estuaries. These communities may be situated on coastal dunes, sand ridges, rocky outcrops or shell mounds. Soils are usually sandy; however rocky, shelly or shallow soils over bedrock may also be present in some sites. This community is strongly impacted by wind and salt spray, especially during storm events.

Vegetation may vary considerably between sites along Atlantic coast beaches, vines, shrubs, seagrape (*Coccoloba uvifera*), saw palmetto (*Serenoa repens*) and cocoplum (*Chrysobalanus icaco*) may be common. In southern Florida, species are primarily of tropical and Caribbean origin and may include inkwood (*Exothea paniculata*), gumbo-limbo (*Bursera simaruba*), paradise tree (*Simarouba glauca*), West Indies mahogany (*Swietenia mahagoni*), Jamaica caper (*Capparis cynophallophora*), nickerbean (*Caesalpinea bonduc*) and coin vine (*Dalbergia ecastaphyllum*). Coastal strand may take several different forms, each of which are points along a continuum of fire frequency, storm surge disturbance and other factors. In fire-exposed, storm surge protected sites, the strand is a treeless community composed of mostly saw palmetto interspersed with a few shrubby species. In fire-protected sites with periodic storm surge disturbance, seagrape, nickerbean and seashore shrubs such as bay cedar (*Suriana maritima*) and buttonsage (*Lantana involucrata*) dominate. In sites relatively free from fire and storm surge disturbance, coastal strand is dominated by tropical hardwood trees and may have a hammock-like form; this community is also referred to as a maritime hammock.

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APPENDIX B

Southwest Florida Pre-Development Vegetation Map

By Michael Duever

2004

SOUTHWEST FLORIDA PRE-DEVELOPMENT VEGETATION MAP

Development of a natural system hydrologic model (NSM) will be based on the distribution of pre-development southwest Florida plant communities, whose classification is directly related to the hydrologic regime of the sites where each community is located (Table 1). Pre-development is defined as the condition of the landscape prior to the arrival of Europeans in southwest Florida, when hydrology and fire regimes were the primary determinants of plant community distributions.

The Natural Systems Group (NSG) of the Southwest Florida Feasibility Study (SWFFS) Team began work on the Pre-Development Vegetation Map (PDVP) in September 2001. At our first meeting we reviewed the known maps that were available to see if something might already exist that could meet our needs. The most important features of an appropriate map would be that it described the pre-development vegetation on a scale comparable to the mesh (cell size) of the proposed NSM, that the plant community classification be clearly related to their hydrologic regimes, and that it be available in electronic format because of time constraints. At this meeting, it was agreed that the University of Florida Center for Wetlands 1900 maps for Collier, Hendry, and Lee Counties, and for South Florida by Lehman (no date), DeBellevue (no date), Brown (no date), and Browder et al. (no date), respectively, which were published in the late 1970s, would be the best choice, if the digitized versions of the maps could be located. After several months of searching, the two known copies of the digitized maps were presumed lost.

At subsequent meetings in October and November, we considered several other maps in case we were unable to locate the Center for Wetlands digitized maps. One was based on the Florida Gap Analysis conducted by the Florida Game and Freshwater Fish Commission (Cox et al. 1994). This was a detailed digitized map created from 1985-89 Landsat Satellite Thematic Mapper data. While the map proved useful in describing current plant communities, the vegetation in many areas had been so altered that it would have been a major task, that was beyond our time constraints, to correct these back to their pre-development condition. The 30 m pixel size was also much more detailed than the approximate 20 ac size of the NSM cell mesh. While this level of detail might be desirable, it was beyond the needs of our project, particularly considering the amount of work and the uncertainty that would have been involved in converting the map to pre-development conditions. We also looked at several other maps that were even less suitable for our needs.

In October we had looked at the Natural Soils Landscape Positions (NSLP) map that had recently been created by the South Florida Water Management District (Zahina et al. 2001). However, its plant community classification, which was developed to apply to the whole area of the District, contained only ten natural plant community classes and these classes were not related to specific hydrologic regimes. This did not provide enough detail to adequately sort out the communities in southwest Florida in a way that was relevant to hydrology, so we decided not to use this map. However, later discussions among the PDVM subteam of the NSG led us to reevaluate this map because of the relationship between plant communities and the detailed soil unit coverage that was also included in the NSLP. Between November and January, the PDVM subteam met periodically, and reclassified the NSLP soil types into hydrology-related plant community maps, using best professional judgment and the information in the most recent soil surveys for each of five southwest Florida counties, including Charlotte (Henderson 1984a), Collier (Liudahl et al. 1998), Glades (Carter et al. 2000), Hendry (Belz et al. 1990), and Lee (Henderson 1984b) (Table 2).

While the NSLP does include tidal and barrier island plant communities along the coast, the NSM does not adequately deal with tidal water flows, which are a major component of the hydrologic regime in these coastal areas. Portions of the NSM mesh do extend into tidal areas, but the primary reason for this is to have the peripheral NSM cells beyond the area where we can expect the model to make reasonably accurate hydrologic predictions. Cells along model boundaries are characteristically less accurate in their predictions, largely because of the lack of an appropriate representation of flows across their edges. In situations where there are tidal boundaries, daily flow reversals rather than generally one-way downstream flows, greatly increase the complexity of modeling hydrology. This in combination with the convoluted flow paths through a maze of islands, shallowly submerged bars, and as sheetflow across broad areas requires vast amounts of site specific data, that are generally not available, if we are going to accurately represent water flows within the coastal portion of a southwest Florida hydrologic model.

The Big Cypress National Preserve (BCNP) and the adjacent Everglades National Park (ENP) lands were not included in the NSLP coverage. However, a recent plant community classification and vegetation map of these areas was available (Doren et al. 1999, Madden et al. 1999, Welch et al. 1999), and was reclassified into the same plant community classes as was done for the five county areas (Table 3). We felt this was a reasonable approximation, since only small portions of BCNP have been altered from their pre-development condition. In a few areas, we utilized McPherson's (1973) map of the eastern Big Cypress and Leighty et al.'s (1954) Collier County soil map to help bridge the gap between the National Park Service's (NPS) current plant community classification boundaries and those we ultimately used in our PDVM.

After the soil units (counties) or plant communities (NPS lands) were reclassified according to our hydrology-related plant community classification, I printed them as separate ARCVIEW maps for each county, the BCNP, and the ENP. The PDVM subteam then reviewed them and made suggestions concerning how and where their accuracy might be improved. General types of changes that applied throughout the area are described below and are listed in Table 4. Descriptions of detailed changes for each of the seven land units are found in Attachment.

The most obvious needed changes were to convert areas where the substrates had been sufficiently disturbed at the time the county soil surveys were done so that information on the pre-development soil characteristics was not available. Examples included canals, excavations, filled wetlands, dredge spoil, and developments where the landscape had been severely recontoured. We needed to map the original plant communities on these sites and reconnect them across the boundaries of these disturbances as best we could. In some locations there were documents, primarily those developed in the process of permitting site alterations, which assisted us in deciding how to map the original plant communities. There was an early soil survey in Collier County (Leighty et al. (1954) (Table 5), which was very helpful in mapping the original plant communities in developed portions of the county. Where this information was not available, but the sites were small or elongate, it was not difficult to reconnect plant communities. As they increased in size, unless I had historical information, I attempted to recreate plant community distribution patterns that matched those in nearby areas. In very large disturbed areas, such as Cape Coral and Fort Myers, we had little useful information on pre-development vegetation patterns, so I simply tried to recreate vegetation patterns that resembled those in the region and that made sense given their location on the landscape.

Less obvious needed changes were based primarily on the knowledge of individuals with long term experience in southwest Florida, a 1940s soil survey of Collier County (Leighty et al. 1954), 1940s and early 1950s aerial photography, and aerial photos contained in the county soil surveys. The subteam's original county-wide estimate of the plant communities present on certain soil types did not always agree with what communities we felt were likely to have been present prior to development on these soil types at specific sites we were familiar with in the area. In yet other cases, a certain soil type was known to support one plant community on some sites and another on other sites within a county. Sometimes two very different communities were found on two sides of a canal or road, particularly in the Big Cypress National Preserve. These were more than simply differences in successional status associated with fire. They often involved significant differences in hydrologic regime, which needed to be rectified if we were going to be able to convert the PDVM to a Pre-Development Hydrologic Map that would form the basis for the NSM.

When we had completed all of the corrections to the individual five county and two NPS lands maps, we had to merge them so that the plant community distributions were seamless along the borders of the seven land units. For the county boundaries, the polygons had already been aligned in the NSLP project (Zahina 2001). Unfortunately, there were often large differences in the soil classifications when they were compared between most of the counties (Table 6). Only Lee and Charlotte counties had essentially the same soil classifications, since they were done by the same person and were published simultaneously. Comparisons among the other counties indicated that they invariably had less than half of their soil types in common and normally had less than a third in common, even where the counties were adjacent to one another. As a result, there were sometimes major differences in soil characteristics, and thus in our estimated plant communities, in polygons that extended across these boundaries. I generally used aerial photos in the county soil surveys and my professional knowledge of some areas to help me make decisions about how to correct these discrepancies.

The boundaries between the BCNP and ENP lands matched very well since they were done simultaneously by the same group (Doren et al. 1999, Madden et al. 1999, Welch et al. 1999). However, the boundaries between the soil-based polygons in the adjacent counties and the current vegetation polygons in the NPS lands, required major adjustments immediately along these boundaries and to some extent further into the adjacent county or NPS lands. These decisions were again based on aerial photos in the county soil surveys and my professional knowledge of some areas. There is an obvious difference in the grain between the county and NPS lands portions of the map, which was impossible to adjust for, without taking what I felt would be excessive liberties in the manipulation of the maps.

The model mesh for the SWFFS area extended into small areas of southern DeSoto, northwestern Palm Beach, and western Broward counties. We had comparable NSLP data for DeSoto County, which merged easily with the adjacent Charlotte County coverage. However, we had only a very coarse 1948 soils coverage for the other two areas (Jones et al. 1948). We reclassed the Palm Beach County area as Marsh because most of the adjacent Hendry County lands were Marsh, and this small area was even closer to the vast Everglades marshes. The Broward coverage was more problematical because both the adjacent Hendry soil-based polygons and particularly the adjacent BCNP vegetation-based polygons had a much finer resolution of plant communities than did the old Broward County soils data. It was impossible to resolve all of the discrepancies across these boundaries, so I just tried to make the dominant plant community types as compatible as possible. I used the Hendry County and BCNP coverage to make adjustments across the boundary with Broward County because their data were both more recent and detailed.

Southwest Florida Plant Communities

We have classified the pre-development plant communities in southwest Florida into 15 major types, based on characteristics relevant to their relationship to hydrology of the region. All "disturbed areas" on our original plant community maps, which were within or close to the area to be included within the SWFFS hydrologic model, have been reclassified to what represents our best estimate of the pre-disturbance communities on these sites. The highest level of the pre-development classification hierarchy was whether a community was tidal or non-tidal, since the hydrologic models we will be using in the Southwest Florida Feasibility Study do not apply to tidal areas. The second level divides the communities on the basis of their hydrologic regimes, in terms of hydroperiod, average wet season water depth, and minimum dry season water depth during an average year and during a 10-year drought. Lastly, we divide them according to their successional stage in terms of whether they are predominantly an early successional herbaceous wetland community or pine flatwoods community or a later successional community dominated by cypress and/or hardwoods. The hydrologic significance of distinguishing successional stages is that herbaceous communities have different rooting depths, leaf areas, and roughness coefficients based on their structural characteristics, which factors are important to defining model parameters for these communities. The shrub stages of these successional sequences were not included in our classification. They were considered to be transitional communities, which could be included with earlier or later successional stages depending on their degree of development. We characterized each major pre-development plant community according to its topographic setting and soils, dominant vegetation, hydrology, and fire regime (Tables 7 and 8).

Upland areas are dominated by a pine flatwoods complex with numerous small-to-large wetland depressions and flowways. Pine flatwoods are most extensive on the higher elevation, more northern portions of southwest Florida. Xeric pinelands are typically found on the most well-drained sites, which are usually located on deep sands. These types of sites are typically found on the highest topographic elevations in an area, or close to the Gulf coast and along streams where there are relatively steep slopes. They rarely have water standing above ground, and then only for very short periods. At the other extreme, hydric pinelands are more common in the southern portions of southwest Florida in poorly-drained areas with little relief, where they can be shallowly inundated for several months each year. Mesic flatwoods occur on sites with moderate drainage, where the water table is located close to the ground surface for much of the summer wet season, but is only above ground for short periods during most years. Mesic and hydric flatwoods can occur on a variety of soil types, including sand, marl, and rock.

Flatwoods can best be described as low-relief savannas that burn frequently. They are typically dominated by an open canopy of slash pine (Pinus elliottii var. densa) over a low open cover of scrub oak (Quercus spp.) on the driest sites, palmetto (Serenoa repens) on moist sites, and a dense and very diverse herbaceous community on the wettest sites (Table 1). With a reduced fire frequency, shrubs gradually increase their dominance on mesic and hydric sites, until the more slowly invading trees overtop them and establish either a mesic or hydric hammock forest of mixed hardwoods with a reduced, shade-tolerant groundcover. On the driest sites, the scrub oaks merely increase in size and density until they develop into a low xeric hammock forest, again with a reduced, shade-tolerant groundcover.

Herbaceous wetlands in southwest Florida vary greatly in size, from small shallow depressions on the order of only 30 ft across up to some as large as hundreds or thousands of acres. We have divided them into two major types, those with and without organic soils (Table 1), although both types can be present in larger wetlands where organic soils develop in the deeper parts of mineral soil depressions. Mineral soil herbaceous wetlands, which we call wet prairies, typically are a very diverse plant community, and can be found on sand, marl, or rock substrates. Structurally, the vegetation is relatively short and open, so that sunlight reaches the water surface over much of the wetland. Light reaching the water surface results in the development of a substantial submerged aquatic vegetation and algal periphyton community, the latter growing on the many surfaces present in the shallow water, including live plant stems, litter, logs, and the ground surface. Wet prairies typically have shorter hydroperiods, are more shallowly inundated during the wet season, and have a greater annual water table fluctuation than do organic soil marshes. While marshes support a less diverse community, they are more structurally developed. The vegetation is typically taller and denser, so that little sunlight gets to the water surface, resulting in little submerged vegetation or periphyton. They have longer hydroperiods, are inundated more deeply during the wet season, and do not have as great an annual water table fluctuation as wet prairies. In the absence of fire, woody shrubs invade herbaceous wetlands with wax myrtle (Myrica cerifera) dominating in wet prairies and willow (Salix caroliniana) in marshes. Eventually trees will colonize these sites, with pine flatwoods dominating in drier areas and cypress forests in wetter areas. The shade produced by the forest canopy typically results in a reduced ground cover with a very different species composition from that present in the herbaceous wetlands.

Dwarf cypress communities are dominated by cypress (Taxodium distichum), but are functionally more similar to wet prairies. They typically occur on marl soils with a very shallow depth to bedrock. As a result, the cypress are stunted because of limited root development and low nutrient availability on the rock substrate. The hydrology is more characteristic of a wet prairie, whose fire regime is normally too frequent for cypress. However, the low productivity of this community results in little fuel accumulation in the form of either vegetation or litter, and a fire frequency and severity more similar to that of cypress.

Forested wetlands are dominated by cypress and/or mixed hardwoods. They occur in topographic depressions or on stream floodplains where there are long hydroperiods and moderate annual water table fluctuations (Table 1). Cypress dominate on sites that burn relatively frequently, while mixed hardwood swamps, usually with a significant cypress component in the pre-development landscape, dominate sites that burn infrequently. Those on stream floodplains usually have a somewhat flashier range of water level fluctuation associated with major rainfall events and the subsequent rapid watershed runoff.

In southwest Florida, water as a habitat is most common in the form of small, shallow depressions located in wetlands. They are typically no more than about an acre in size and about 3 - 5 ft in depth during the wet season, and support either floating or submerged vegetation (Table 1). All surface water is lost from even the deepest of these water bodies on an average of about once every ten years during severe droughts. They typically have sand, organic or sometimes rock substrates. Some of those with organic soils have even been created by fire during particularly severe droughts. The largest bodies of open water in southwest Florida include Lake Okeechobee, Lake Trafford, and Lake Hicpochee. They are all permanently inundated, although they may have extensive exposed shorelines during dry periods. Wetlands along their shores regularly burn during dry periods. Substrates are generally sandy, with varying amounts of organic accumulation. They tend be relatively shallow for their size, usually less than 20 ft deep. They may have floating vegetation around their edges, and may be dominated by either submerged vegetation or plankton in their deeper areas. The proportions of these communities can also vary seasonally and from year-to-year, largely because of varying climatic conditions. There are numerous streams and rivers in the more northern and coastal portions of the area. The largest are the Caloosahatchee River and Fisheating Creek, and their tributaries. Most of the others are small creeks draining into coastal estuaries. The smaller creeks may be greatly reduced in size during dry periods, but they virtually always have some flow, particularly in their lower reaches. Both herbaceous and forested wetlands are found at various locations along the stream and creek floodplains.

The tidal ecosystems of southwest Florida include herbaceous and forested wetlands and beaches. The wetlands can be either freshwater or saline as long as they are influenced by tidal water movements. The tidal marshes range from short, sparse herbaceous communities to tall, dense communities, and they can occur on organic, sand, marl, and rock substrates. As in the wet prairies and marshes, they can be invaded by wax myrtle or willow on freshwater sites. On more saline sites, red mangrove (Rhizophora mangle), black mangrove (Avicennia germinans), white mangrove (Laguncularia racemosa), and buttonwood (Conocarpus erectus) dominate the tidal forested wetlands on a similar range of substrates. They can occur as dense shrubby communities or well developed forests, but both have a sparse groundcover. The Bay-Hardwood Scrub community in the Everglades National Park Stairsteps was also included with the tidal forested wetlands. Beaches occur on high-energy coastal shorelines. They include the bare or sparsely vegetated sandy flats along the shore and the dunes behind the shore. The dunes are not normally inundated, but their water table is tidally influenced because of their proximity to the coast and the porosity of their sand substrate.

Use of the Pre-Development Vegetation Map

Several things are important to remember about the southwest Florida Pre-Development Vegetation Map when thinking about ways to use it.

The map is designed to show "pre-development" vegetation. Many areas currently have very different land covers from what are depicted on the map, and not just because of past or current agricultural or residential development. Changes in plant community type or characteristics could also be explained by altered hydrologic and/or fire regimes, as well as the presence of invasive exotic plants.

The map is designed to be used as a basis for reconstructing hydrology in pre-development southwest Florida for a hydrologic model with a mesh of about 20 acres. We did try to make the map as accurate as possible in terms of the type of plant community present on any particular site. However, this was significantly influenced by the degree of familiarity of those working on the map with different geographic areas in southwest Florida. In addition, while the use of soil - plant community relationships provided the best opportunity to create a pre-development vegetation map with the level of detail we needed, it was still a relatively coarse approach to mapping. Where there were extensive areas of disturbed soils, such as near the Gulf coast from Marco Island north, it is primarily a representation of the types of vegetation patterns likely to have been present prior to development. The same can be said for the use of current plant community (and disturbed land) distributions in the NPS lands, although it could be expected to be less of leap in arriving at their pre-development plant community distributions. While these approaches were adequate for our purposes of showing hydrologic patterns in southwest Florida, they would likely be very inadequate for many other purposes, particularly where accurate pre-development plant community type information is needed at exact geographic locations.

When portions of the map in the BCNP are highly magnified, it is possible to find relatively long, very thin polygons that can appear to extend as tails off of other polygons or that can exist as very narrow fringes along other polygons or as thread-like polygons floating in other polygons. These "slivers" appeared in the BCNP while we were editing this area of the map. We have eliminated over 20,000 of these "slivers", but some unknown number still remain. In any future editions of this map, we will try to further reduce their numbers. Given the small size of the "slivers", we do not feel they will adversely affect our intended uses of the map. They are small enough so that they can only be seen under extremely high magnification, and thus do not alter the visual appearance of the map for most uses. The small size should mean that they will not significantly affect the use of the map as the basis for the southwest Florida NSM. The size of the individual model cells are planned to be 20 acres or larger in size, and any remaining "slivers" should make up only a very small fraction of this area, and thus should not significantly affect the "average" attributes of any cell. Examples of situations where the "slivers" might present a problem would be if someone wanted a count or an average area of all polygons or of a certain class of polygons in a portion of the map that included the BCNP. Even without the "slivers", it would be inappropriate to make these kinds of summaries for the map as a whole or for areas that included a mix of one or more soil-based county maps and the plant-community based NPS lands map because of the differences in polygon sizes that existed in the original source maps.

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ATTACHMENT

EDITS TO INDIVIDUAL COUNTY AND NATIONAL PARK SERVICE LAND UNITS

Changes to Charlotte County (Partial) Vegetation Map

Changed numerous soil types/plant communities:

- Cypress to wet prairie (to correct problems on Cecil Webb WMA); soil types involved in change included:
  - Copeland Sandy Loam, Depressional
  - Felda Fine Sand, Depressional
  - Floridana Sand, Depressional
  - Malabar Fine Sand, Depressional
  - Pineda Fine Sand, Depressional
  - Winder Sand, Depressional
- Wet prairie to cypress (mostly around Telegraph Swamp); soil types involved in change included:
  - Copeland Sandy Loam, Depressional
  - Felda Fine Sand, Depressional
  - Floridana Sand, Depressional
  - Malabar Fine Sand, Depressional
  - Pineda Fine Sand, Depressional
  - Pompano Fine Sand, Depressional
  - Valkaria Fine Sand, Depressional
  - Winder Sand, Depressional

- Converted water in excavations and cattle water holes, which usually appeared angular in shape, to plant communities they were located in.

- Converted water in the center of a wet prairie to marsh

- Changed a few individual polygons to more correct plant communities, based normally on aerial photos

- Converted wet prairie above "lake" in upper Peace River estuary to tidal marsh

- Converted disturbed areas, mostly near coast to plant communities based largely on Jim Beever's experience in area. Many of these were located in Mangroves or Tidal marshes along the coast, which is what we converted them back to. An area along Alligator Creek was a band of Xeric Hammock down to where the creek splits.

- Adjusted straight lines along plant community boundaries to resemble more natural configurations.

Matched plant community types for polygons along Charlotte County boundary with Lee and Glades Counties to provide reasonable transitions. I tended to favor the larger of the two polygons and the more common plant community type in the area.

Changes to Western Collier County Vegetation Map

- Changed two soil types/plant communities that were located mostly in SGGE
    - Hallandale and Boca Fine Sands from hydric flatwood to cypress
    - Hallandale Fine Sand from mesic flatwood to hydric flatwood
- Changed Canaveral- Beaches Complex from Xeric Hammock to Beach
- Changed Tuscawilla Fine Sand from Hydric Hammock to Mesic Hammock?*
- Converted water in excavations and cattle water holes to plant communities they were located in.
- Eliminated canals and reconnected plant communities
- Changed a few individual polygons to more correct plant communities, usually of the basis of aerial photography. Also changed some around Corkscrew Swamp based on my familiarity with the area.
- Used Leighty et al. (1954) soils maps to correct developed areas in and around Immokalee, Marco Island, and Naples. See Table C for the crosswalk between Leighty's and our plant community classifications.
- Adjusted straight lines along plant community boundaries to resemble more natural configurations

Matched plant community types for polygons along Collier County boundary with Lee and Hendry Counties to provide reasonable transitions. I tended to favor the larger of the two polygons and the more common plant community type in the area. Matching the polygons between Collier County and the BCNP and ENP required the same process, but since the polygons had not previously been matched in the NSLP process, I needed to adjust both plant community types and polygon shapes to be able to match them across the boundaries. I used aerial photography in the Collier County soil survey (Liudahl et al.1998), McPherson's 1973 eastern Big Cypress Map and Leighty's 1954 soil maps to help make these decisions.

Changes to Glades County (Partial) Vegetation Map

- Changed Floridana Fine Sand, Depressional from cypress to marsh; then changed three of these polygons back to cypress based on aerials
- Replaced Caloosahatchee Canal with 1929 Caloosahatchee River and reconnected plant communities, including islands, which were set to match an adjacent plant community
- Replaced Lake Okeechobee levee with 1929 shoreline and estimated shoreline plant communities based on adjacent communities
- Converted water in excavations and cattle water holes to plant communities they were located in
- Eliminated levees and canals (mostly along lower Fisheating Creek) and reconnected plant communities
- Changed a few individual polygons to more correct plant communities, based normally on aerials
- Estimated plant community distributions at Caloosahatchee River spoil sites
- Adjusted straight lines along plant community boundaries to resemble more natural configurations

Matched plant community types for polygons along Glades County boundary with Charlotte and Hendry Counties to provide reasonable transitions. I tended to favor the larger of the two polygons and the more common plant community type in the area.

Changes to Hendry County Vegetation Map

- Changed plant communities from Wet Prairie to Hydric Flatwood on two soil types to match the soil type/plant community relationship in Collier County
  - Basinger Sand
  - Holopaw Sand, Limestone Substratum
- Changed two soil types/plant communities (just south of LaBelle) from marsh to cypress
  - Malabar Sand, Depressional
  - Pineda Sand, Depressional
- Changed Oldsmar Sand from Xeric Hammock to Mesic Flatwood
- Replaced Caloosahatchee Canal with 1929 Caloosahatchee River and reconnected plant communities, including islands, which were set to match an adjacent plant community
- Replaced Lake Okeechobee levee with 1929 shoreline and estimated shoreline plant communities based on adjacent plant communities
- Converted water in excavations and cattle water holes to plant communities they were in
- Eliminated canals and reconnected plant communities
- Changed a few individual polygons to more correct plant communities, based normally on aerials
- Estimated plant community distributions at Caloosahatchee River spoil sites
- Checked for cypress in southern Okaloacoochee Slough and decided the appropriate sites were a mix of cypress, willow, and marsh communities, and it would take too long to try to sort each individual polygon at this time. Regardless, it does not affect the resulting hydrology because all of these communities have the same hydrology.
- Adjusted straight lines along plant community boundaries to resemble more natural configurations

Matched plant community types for polygons along Hendry County boundary with Lee and Collier Counties to provide reasonable transitions. I tended to favor the larger of the two polygons and the more common plant community type in the area. Matching the polygons between Hendry County and the BCNP required the same process, but since the polygons had not previously been matched in the NSLP process, I needed to adjust both plant community types and polygon shapes to be able to match them across the boundaries. I used aerial photography in the Hendry County soil survey (Belz et al.1990), McPherson's 1973 eastern Big Cypress Map and Leighty's 1954 soil maps to help make these decisions.

Changes to Lee County Vegetation Map

- Converted disturbed areas, mostly near coast to plant communities based largely on Jim Beever's experience in area. Many of these were located in Mangroves or Tidal marshes along the coast, which is what we converted them back to

- Replaced Caloosahatchee Canal with 1929 Caloosahatchee River and reconnected plant communities, including islands, which were set to match an adjacent plant community

- Converted water in excavations and cattle water holes to plant communities they were located in

- Eliminated canals and reconnected plant communities

- Changed a few individual polygons to more correct plant communities, based normally on aerials

- Estimated plant community distributions at Caloosahatchee River spoil sites

- Adjusted straight lines along plant community boundaries to resemble more natural configurations

Matched plant community types for polygons along Lee County boundary with Charlotte and Collier Counties to provide reasonable transitions. I tended to favor the larger of the two polygons and the more common plant community type in the area.

Changes to University of Georgia's Big Cypress National Preserve Vegetation Map

We started with the current (199?) plant community map created by the University of Georgia (UGA) under contract with the National Park Service. Jim Burch reclassed most of the UGA classes to match those used in this study, and Mike Duever completed the reclassification. This map had 73 different classes, of which 65 were natural communities. The remaining classes, defined as Disturbed Areas, included four classes dominated by exotic vegetation, and one each of canals, human landscapes, roads, and spoil areas. All of the Disturbed Areas were converted to natural communities.

- I converted melaleuca (*Melaleuca quinquenervia*) to Flatwoods, usually Hydric, occasionally Mesic, depending on which was more common in an area.

- I converted the few Brazilian pepper (*Schinus terebinthifolius*) to the habitat they were located within.

- I did not retain straight lines associated with roads or other disturbances. Typically I merely connected similar habitats across the artificial boundary. In some cases I configured plant community boundaries so they had a more "natural" shape. This was most frequent along roads, which often had associated parallel canals, since the roads and canals were part of the GIS land cover theme and needed to be removed to recreate the pre-development landscape.

- I converted some areas where different communities were on the two sides of a line, usually a road, into a single community. This difference could be associated with several recent changes in the ecosystem. One situation was a probable difference in successional stage due to an altered fire regime, with the assumption that the earlier successional stage was the pre-development condition. Another situation could be an altered hydrologic regime. I assumed that I-75 (and Alligator Alley before it), the Turner River Road complex, and SR 29 significantly interfere with overland water flows, but Tamiami Trail (US 41) and the Loop Road do not. Where there are significant effects on water flows, I would expect wetter than natural conditions upstream and/or drier conditions downstream. Drier conditions could also increase the frequency and severity of fires. I also used McPherson's (1973) map of the Big Cypress and Leighty et al.'s (1954) soil map to help make decisions about these changes.

- I had classed Cypress (*Taxodium distichum* and *T. ascendens*) Savanna as Cypress, but later changed it back to agree with Jim Burch's decision to classify it as Scrub Cypress.

- I converted all Hydric Hammock (Bay Hardwood Scrub) south of Ochopee to Mangrove.

- I converted Wet Prairie and Marsh that occurred south of line I drew in disturbed coastal areas or along selected UGA coastal plant community polygons to Tidal Marsh. This line was based on McPherson (1973) and partially on Leighty et al. (1954). For Tidal Marsh, I am specifically referring to tidally-influenced, not saline plant communities, which is why I specifically did not say "saline" or "saltwater" marshes.

- I eliminated airboat trails in Tidal Marsh south of Ochopee.

- Spoil and landscaped areas and excavations were converted (divided as necessary) to surrounding plant communities.

- Adjusted straight lines along plant community boundaries to resemble more natural configurations.

There already was a good match between the plant community polygons for the BCNP and ENP. However, since the Hendry and Collier County polygons had not previously been matched with those of the BCNP in the NSLP process, I needed to adjust both plant community types and polygon shapes in both of the counties and the BCNP to be able to match them across the boundaries. I tended to favor the larger polygons and the more common plant community types in the area. I also had to make changes for short distances beyond the edges of the counties and BCNP to create reasonable patterns across the area. I used aerial photography in the Hendry and Collier County soil surveys (Belz et al.1990), McPherson's 1973 eastern Big Cypress Map and Leighty's 1954 soil maps to help make these decisions.

Changes to University of Georgia's Everglades Stairsteps Vegetation Map

- I made the following global changes to my original classification in the vegetation coverage. These communities were exclusively found in the tidal areas. I am specifically referring to tidal, not saline plant communities.

  - Bay Hardwood Scrub: I originally classed as Hydric Hammock, but changed it to Mangrove

  - Swamp Forest: I originally classed as Swamp Forest, but changed it to Mangrove

  - Black Rush (*Juncus roemerianus*): I originally classed as Wet Prairie, but changed it to Tidal Marsh

  - Cordgrass (*Spartina spp.*): I originally classed as Wet Prairie, but changed it to Tidal Marsh

- I changed the following communities to Tidal Marsh within what I defined as the tidal area, based on McPherson (1973), and the portions of Leighty et al. (1954) that were in the Stairstep area. These communities occurred in both tidal and non-tidal areas, so the changes had to be made polygon by polygon. (* not in NPS classification?)

  - Cattail (*Typha spp.*) Marsh

  - Common reed (*Phragmites spp.*)

  - *Freshwater Marsh

  - Graminoid Prairie/Marsh

  - Mixed Graminoids

  - *Non-vegetated (Mud?)

  - Prairies and Marshes

  - Sawgrass (*Cladium jamaicense*)

  - Seconary Canals

  - Shrublands

- Spike Rush (*Eleocharis cellulosa*)
- Tall Sawgrass (*Cladium jamaicense*)
- Willow (*Salix caroliniana*)

- Adjusted straight lines along plant community boundaries to resemble more natural configurations.

There already was a good match between the plant community polygons for the ENP and BCNP. However, since the Collier County polygons had not previously been matched with those of the ENP in the NSLP process, I needed to adjust both plant community types and polygon shapes in Collier County and the ENP to be able to match them across the boundaries. I tended to favor the larger polygons and the more common plant community types in the area. I also had to make changes for short distances beyond the edge of the county and ENP to create reasonable patterns across the area. I used aerial photography in the Collier County soil survey (Belz et al.1990), McPherson's 1973 eastern Big Cypress Map and Leighty's 1954 soil maps to help make these decisions.

Comparisons of Different Counties and NPS Lands

Xeric Flatwood and Xeric Hammock were only present in certain counties, while only Xeric Hammock was present in other counties.

More Marsh in Glades County, while more Wet Prairie in Charlotte County.

Also more Mesic Hammock and more xeric in Glades

Table 1. Hydrologic Regimes of Major Southwest Florida Plant Communities

SW Florida Plant Communities	Hydroperiod (mon)	Seasonal Water Level (in)	
		Wet	Dry (1,10)*
Xeric Flatwood	0	<u><</u>-24	-60, -90
Xeric Hammock	0		
Mesic Flatwood	<u><</u>1	<u><</u>2	-46, -76
Mesic Hammock			
Hydric Flatwood	1 - 2	2 - 6	-30, -60
Hydric Hammock			
Wet Prairie	2 - 6	6 - 12	-24, -54
Dwarf Cypress			
Marsh	6 - 10	12 - 24	-6, -46
Cypress	6 - 8	12 - 18	-16, -46
Swamp Forest	8 - 10	18 - 24	-6, -36
Open Water	>10	<u>></u>24	< 24, -6
Tidal Marsh	Tidal	Tidal	Tidal
Mangrove			
Beach			

* 1 = average year low water
10 = 1 in 10 year drought

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Table 2. Soil Types and Associated Plant Communities for the Southwest Florida Counties

Soil Type	Collier	Hendry	Lee	Glades	Char	Plant Community	Notes #Changed to
Adamsville Fine Sand		1				Mesic Flatwood	
Adamsville Variant Sand		1				Hydric Hammock	
Anclote Sand, Depressional			1		1	Cypress	
Aquents, Organic Substratum		1				Marsh	
Arents, Very Steep				1		Disturbed	
Astor Fine Sand, Depressional				1		Marsh	
Basinger Sand		#1				Wet Prairie	#Hydric Flatwood
Basinger Fine Sand	1			1		Hydric Flatwood	
Basinger Fine Sand, Occasionally Flooded	1					Mesic Hammock	
Basinger Fine Sand, Depressional				1		Wet Prairie	
Beaches			1		1	Beach	
Boca Sand		1				Mesic Flatwood	
Boca Fine Sand	1		1	1	1	Mesic Flatwood	
Boca Sand, Depressional		1				Cypress Forest	
Boca Fine Sand, Slough			1		1	Hydric Flatwood	
Boca Fine Sand, Tidal			1		1	Tidal Marsh	
Boca, Riviera, Limestone Substratum and Copeland FS, Depressional	1					Swamp Forest	
Bradenton Fine Sand			1		1	Hydric Hammock	
Caloosa Fine Sand			1		1	Disturbed	
Canaveral Fine Sand			1		1	Xeric Hammock	
Canaveral-Urban Land Complex			1		1	Disturbed	
Canaveral - Beaches Association	#1					Xeric Hammock	#Beach?
Captiva Fine Sand			1		1	Wet Prairie	
Chobee Muck					1	Swamp Forest	
Chobee Fine Sandy Loam, Depressional		1				Marsh	
Chobee Loamy Fine Sand, Depressional				1		Marsh	

Chobee Fine Sandy Loam, Limestone Substratum, Depressional		1				Swamp Forest	
Chobee, Limestone Substratum and Dania Mucks, Depressional	1					Swamp Forest	
Chobee, Winder and Gator Soils, Depressional	1					Wet Prairie	
Cocoa Fine Sand			1		1	Xeric Flatwood	
Copeland Sandy Loam, Depressional			1		1	Cypress	
Dania Muck		1		1		Marsh	
Daytona Sand			1**		1*	Xeric Flatwood*	Mesic Flatwood**(NO)
Delray Sand, Depressional		1				Swamp Forest	
Denaud Muck		1				Cypress Forest	
Denaud-Gator Mucks		1				Marsh	
Durbin and Wilfert Mucks, Frequently Flooded	1					Mangrove	
Eaugallie Sand			1		1	Mesic Flatwood	
Eaugallie Fine Sand				1		Mesic Flatwood	
Electra Fine Sand			1		1	Xeric Hammock	
Estero Muck			1		1	Tidal Marsh	
Estero and Peckish Soils, Frequently Flooded	#1					Salt Flats	#Tidal Marsh
Farmton Fine Sand					1	Mesic Flatwood	
Felda Fine Sand			1	1	1	Hydric Flatwood	
Felda Fine Sand, Depressional			1		1	Cypress	
Floridana Sand, Depressional			1		1	Cypress	
Floridana Fine Sand, Depressional				1		Cypress	
Floridana, Astor,and Felda Soils, Frequently Flooded				#1		Swamp Forest	#Floodplain Forest
Ft. Drum Fine Sand				1		Mesic Hammock	
Ft. Drum and Malabar, High, Fine Sands	1					Mesic Hammock	
Gator Muck		1	1	1	1	Marsh	
Gentry Fine Sand, Depressional		1				Marsh	
Hallandale Sand		1				Mesic Flatwood	
Hallandale Fine Sand	#1		1	1	1	Mesic Flatwood	#Hydric Flatwood
Hallandale Sand, Depressional		1				Wet Prairie	
Hallandale Fine Sand, Slough			1		1	Hydric Flatwood	
Hallandale Fine Sand, Tidal			1		1	Mangrove	

Hallandale - Pople Complex				1		Mesic Hammock	
Hallandale-Urban Land Complex			1		1	Disturbed	Mesic Flatwood
Hallandale and Boca Fine Sands	#1					Hydric Flatwood	#Cypress
Heights Fine Sand			1		1	Mesic Flatwood	
Hilolo Limestone Substratum, Jupiter and Margate Soils	1					Mesic Flatwood	
Holopaw and Okeelanta Soils, Depressional	1					Marsh	
Holopaw Sand		1				Hydric Flatwood	
Holopaw Fine Sand	1					Hydric Flatwood	
Holopaw Fine Sand, Limestone Substratum	1					Hydric Flatwood	
Holopaw Sand, Limestone Substratum		#1				Wet Prairie	#Hydric Flatwood
Holopaw Sand, Depressional		1				Marsh	
Immokalee Sand		1*	1**	1*	1*	Mesic Flatwood*	Hydric Flatwood** (NO)
Immokalee Fine Sand	1					Mesic Flatwood	
Immokalee-Urban Land Complex			1		1	Disturbed	Mesic Flatwood?
Isles Fine Sand, Depressional			1		1	Cypress	
Isles Fine Sand, Slough			1		1	Hydric Hammock	
Isles Muck			1		1	Mangrove	
Jupiter Fine Sand		1				Mesic Hammock	
Jupiter - Boca Complex	1					Swamp Forest	
Jupiter-Ochopee-Rock Outcrop Complex		1				Hydric Flatwood	
Kesson Muck, Frequently Flooded	#1					Salt Marsh	#Tidal Marsh
Kesson Fine Sand			1		1	Mangrove	
Lauderhill Muck		1		1		Marsh	
Malabar Sand		1				Hydric Flatwood	
Malabar Fine Sand	1		1	1	1	Hydric Flatwood	
Malabar Fine Sand, Depressional			1		1	Cypress	
Malabar Sand, Depressional		1				Marsh	
Malabar Fine Sand, High		1	1	1	1	Mesic Flatwood	
Margate Sand		1				Marsh	MM
Matlacha Gravelly Fine Sand			1		1	Disturbed	?

Matlacha Gravelly Fine Sand, Limestone Substratum			1		1	Disturbed	Mesic Flatwood?
Matlacha, Urban Land Complex			1		1	Disturbed	Mesic Flatwood?
Myakka Sand		1				Mesic Flatwood	
Myakka Fine Sand	1		1	1	1	Mesic Flatwood	
Myakka Fine Sand, Depressional			1		1	Wet Prairie	
Myakka Sand, Depressional		1				Marsh	MM
Ochopee Fine Sandy Loam	1					Scrub Cypress	
Ochopee Fine Sandy Loam, Low	1					Wet Prairie	
Okeelanta Muck		1				Marsh	
Okeelanta Muck, Depressional				1		Marsh	
Okeelanta and Dania Mucks, Depressional				1		Marsh	
Oldsmar Fine Sand	1			1		Mesic Flatwood	
Oldsmar Sand		1	1		1	Mesic Flatwood	
Oldsmar Sand, Depressional		1				Wet Prairie	MM
Oldsmar Sand, Limestone Substratum		1				Mesic Flatwood	
Oldsmar Fine Sand, Limestone Substratum	1*		1**		1*	Mesic Flatwood*	Hydric Flatwood** (NO)
Orsino Fine Sand			1		1	Xeric Flatwood	
Pahokee Muck		1		1		Marsh	MM
Paola Fine Sand, 1 to 8 PCT Slopes	1					Xeric Hammock	
Peckish Mucky Fine Sand			1		1	Mangrove	
Pennsucco Silt Loam	1					Wet Prairie	
Pineda Sand, Depressional		1				Wet Prairie	
Pineda Fine Sand, Depressional			1		1	Cypress	
Pineda Fine Sand, Limestone Substratum	1		1		1	Hydric Flatwood	
Pineda Sand, Limestone Substratum		1				Hydric Flatwood	
Pineda Fine Sand		1	1	1	1	Hydric Flatwood	
Pineda and Riviera Fine Sands	1					Hydric Flatwood	
Plantation Muck		1		1		Marsh	
Pomello Fine Sand	1			1		Xeric Hammock	
Pomello Fine Sand, 0 to 5 PCT Slopes		1				Xeric Hammock	
Pompano Sand		1				Wet Prairie	
Pompano Fine Sand			1		1	Wet Prairie	

Pompano Fine Sand, Depressional			1		1	Wet Prairie	
Pople Fine Sand				1		Mesic Hammock	
Punta Fine Sand			1		1	Mesic Flatwood	
Riviera Fine Sand		1				Hydric Flatwood	
Riviera Sand, Depressional		1				Wet Prairie	
Riviera Fine Sand, Limestone Substratum	1					Cypress Forest	
Riviera Sand, Limestone Substratum		1				Wet Prairie	
Riviera Sand, Limestone Substratum Depressional		1				Marsh	
Riviera, Limestone Substratum - Copeland Fine Sand	1					Swamp Forest	
Sanibel Muck				1		Marsh	
Sanibel Muck, Depressional				1		Marsh	
Satellite Fine Sand	1		1		1	Xeric Hammock	
Smyrna Fine Sand			1	1	1	Mesic Flatwood	
Smyrna-Urban Land Complex			1		1	Disturbed	Mesic Flatwood?
St. Augustine Sand			1		1	Disturbed	?
St. Augustine Sand, Organic Substratum-Urban Land Complex			1		1	Disturbed	Mangrove?
Tequesta Muck				1		Marsh	
Terra Ceia Muck		1	1	1	1	Marsh	
Tuscawilla Fine Sand	1*	1**				Hydric Hammock*	Mesic Hammock**
Udifluvents		1				Disturbed	
Udorthents		1				Disturbed	
Udorthents Shaped	1					Disturbed	
Urban Land	1		1		1	Disturbed	
Urban Land - Aquents Complex, Organic Substratum	1					Disturbed	
Urban Land - Holopaw - Basinger Complex	1					Disturbed	
Urban Land - Immokalee -Oldsmar, Limestone Substratum, Complex	1					Disturbed	
Urban Land - Matlacha - Boca Complex	1					Disturbed	
Urban Land - Satellite Complex	1					Disturbed	
Valkaria Sand		1				Wet Prairie	
Valkaria Fine Sand			1	1	1	Hydric Flatwood	
Valkaria Fine Sand, Depressional			1		1	Wet Prairie	

Wabasso Sand		1*	1**		1*	Mesic Flatwood*	Hydric Flatwood** (NO)
Wabasso Fine Sand	1				1	Mesic Flatwood	
Wabasso Sand, Limestone Substratum		1	1		1	Mesic Flatwood	
Water	1	1	1	1	1	Water	
Winder Fine Sand		1				Wet Prairie	
Winder Fine Sand, Depressional		1				Wet Prairie	
Winder Sand, Depressional			1		1	Cypress	
Winder, Riviera, Limestone Substratum, and Chobee Soils Depressional	1					Marsh	
Wulfert Muck			1		1	Mangrove	
	37	49	59	33	62		

Table 3. National Park Service Lands and Southwest Florida Feasibility Study Plant Community Crosswalk.

Jones et al. Plant Community (South Florida NPS Lands)	Jones Abbrev.*	Duever ENP Comm.	Duever BCNP Comm.
Australian Pine (Casuarina spp.)	EC	Disturbed Areas	
Bay Hardwood Scrub	SS	Mangrove	Mangrove
Bayhead	FSb	Hydric Hammock	Hydric Hammock
Beaches	BCH	Beach	Beach
Black (Avicennia germinans) Mangrove	FMa	Mangrove	
Black (Avicennia germinans) scrub	SMa	Mangrove	Mangrove
Black rush (Juncus roemerianus)	PGj	Tidal Marsh	Tidal Marsh
Brazilian Pepper (Schinus terebinthifolius)	ES	Disturbed Areas	Disturbed Areas
Broadleaf Emergents	PEb	Marsh	Marsh
Buttonbush (Cephalanthus occidentalis)	SBc	Marsh	
Buttonwood (Conocarpus erectus) Forest	FB	Mangrove	
Buttonwood (Conocarpus erectus) scrub	SC	Mangrove	
Cabbage Palm (Sabal palmetto) Forest	FC	Mesic Hammock	Mesic Hammock
Cajeput (Melaleuca quinquenervia)	EM	Disturbed Areas	Disturbed Areas
Cattail (Typha spp.) Marsh	PC	Marsh	Marsh
Cocoplum (Chrysobalanus icaco)	SBy	Mesic Hammock	Mesic Hammock
Common reed (Phragmites spp.)	PGp	Wet Prairie	Wet Prairie
Cordgrass (Spartina spp.)	PGs	Tidal Marsh	Tidal Marsh
Cypress (Taxodium distichum and T. ascendens) Savanna	SVC	Scrub Cypress	Scrub Cypress
Cypress Domes	FSd	Cypress	Cypress
Cypress Mixed Hardwoods	FSx	Cypress	Cypress
Cypress Pines	FSCpi	Hydric Flatwood	Hydric Flatwood
Cypress Strands	FSc	Cypress	Cypress
Cypress with pine	SVCpi	Hydric Flatwood	Hydric Flatwood
Dwarf Cypress	SVCd	Scrub Cypress	Scrub Cypress
Exotics	E	Disturbed Areas	Disturbed Areas
Floating/Floating Attached Emergents	PEf	Marsh	

Graminoid	PHg	Tidal Marsh	
Graminoid Prairie/Marsh	PG	Wet Prairie	Wet Prairie
Groundsel bush (Baccharis spp.)	SBb	Mesic Flatwood	
Halophytic Herbaceous Prairie	PH	Tidal Marsh	
Hardwood Scrub	SH	Mesic Hammock	Mesic Hammock
Java Plum (Syzygium cumini)	EJ	Disturbed Areas	Disturbed Areas
Lather Leaf (Colubrina asiatica)	EO	Disturbed Areas	
Maidencane (Panicum hemitomon)	PGa	Wet Prairie	Wet Prairie
Maidencane Spike rush	PGw	Wet Prairie	Wet Prairie
Major Canals (>30m wide)	C		Water
Major Roads (> 30m wide)	RD	Disturbed Areas	Disturbed Areas
Mangrove Forest	FM	Mangrove	
Mangrove Scrub	SM	Mangrove	Mangrove
Mixed Graminoids	PGx	Wet Prairie	Wet Prairie
Mixed Hardwood Swamp Forest	FSh	Swamp Forest	Swamp Forest
Mixed Hardwoods	FSa	Swamp Forest	Swamp Forest
Mixed Mangrove	FMx	Mangrove	Mangrove
Mixed Scrub	SMx	Mangrove	Mangrove
Mud	M	Tidal Marsh	
Muhly grass (Muhlenbergia filipes)	PGm	Wet Prairie	Wet Prairie
Non graminoid Emergent Marsh	PE	Wet Prairie	Marsh
Oak Sabal Forest	FO	Mesic Hammock	Mesic Hammock
Open Water	W	Water	Water
Palm (Sabal palmetto) Savanna	SVPM	Mesic Hammock	Hydric Flatwood
Paurotis Palm (Acoelorrhaphe wrightii) Forest	FP	Mesic Hammock	Mesic Hammock
Pine (Pinus elliottii var. densa) Savanna	SVPI	Hydric Flatwood	Hydric Flatwood
Pond Apple	SBa	Swamp Forest	
Pop Ash (Faxinus caroliniana)	SBf	Marsh	Marsh
Prairies and Marshes	P	Wet Prairie	Wet Prairie
Primrose (Ludwigia spp.)	SBl	Wet Prairie	
Red (Rhizophora mangle) Mangrove	FMr	Mangrove	
Red (Rhizophora mangle) scrub	SMr	Mangrove	Mangrove
Savanna	SV	Hydric Flatwood	Hydric Flatwood

Saw Palmetto (Serenoa repens) scrub	SP	Mesic Flatwood	Mesic Flatwood
Sawgrass (Cladium jamaicense)	PGc	Wet Prairie	Wet Prairie
Seconday canals (< 30m wide)	Cs?	Water	
Shrublands	SB	Marsh	Marsh
Slash pine mixed with palms	SVx	Mesic Flatwood	Mesic Flatwood
Slash pine with cypress	SVPIc	Hydric Flatwood	Hydric Flatwood
Slash pine with hardwoods	SVPIh	Mesic Flatwood	Mesic Flatwood
Spike rush (Eleocharis cellulosa)	PGe	Wet Prairie	Wet Prairie
Spoil Areas	SA	Disturbed Areas	Disturbed Areas
Structures and Cultivated Lawns	HI	Disturbed Areas	Disturbed Areas
Subtropical Hardwood Forest	FT	Mesic Hammock	Mesic Hammock
Succulent	PHs	Tidal Marsh	
Swamp Forest	FS	Mangrove	Mangrove
Tall Sawgrass (Cladium jamaicense)	PGct	Marsh	Marsh
Tropical Soda Apple (Solanum viarum)	EL	Disturbed Areas	
Wax myrtle (Myrica cerifera)	SBm	Wet Prairie	
White (Laguncularia racemosa) Mangrove	FMI	Mangrove	
White (Laguncularia racemosa) scrub	SMI	Mangrove	
Willow (Salix caroliniana)	SBs	Marsh	Marsh
	FSbc		Hydric Hammock
	PCI		Marsh
	PR		Wet Prairie
	SBt		Mesic Hammock
	SPVI		Mesic Flatwood
	SPVIc		Mesic Flatwood
	SVMP		Hydric Flatwood

* Some of the 2nd or later letters can be caps or lower case but they indicate the same community.

Table 4. General Corrections to Initial Soil/Plant Community Relationships

Type of Correction	Charlotte	Collier	Glades	Hendry	Lee	BCNP	ENP
Eliminated canals and reconnected plant communities	X	X	X	X	X	X	X
Converted water in excavations and cattle water holes, as well as filled sites, all of which often appeared angular in shape, to surrounding plant community (s)	X	X	X	X	X	X	X
Changed individual polygons to more correct plant communities, based normally on aerial photos, personal experience in some areas, and available references	X	X	X	X	X	X	X
Adjust plant community type across county and/or NPS lands boundaries	X	X	X	X	X	X	X
Adjusted straight lines along plant community boundaries to more natural configurations.	X	X	X	X	X	X	
Changed plant communities on selected soil types	X	X	X	X			
Replaced Caloosahatchee Canal with 1929 Caloosahatchee River and reconnected plant communities, including islands, which were set to match an adjacent plant community			X	X	X		
Estimated plant community distributions at Caloosahatchee River spoil sites			X	X	X		

Replaced Lake Okeechobee levee with 1929 shoreline and estimated shoreline plant communities based on adjacent plant communities		X	X	
Converted large disturbed areas, mostly near coast to plant communities based largely on Jim Beever's experience in area.	X			X

Table 5. Collier County 1954 Soil Survey and Vegetation

Map Unit Symbol	Soil Name or Position - 1954 Collier Cty	SCS Vegetation Types	SWFFS Veg Types
Aa	Arzell Fine Sand	Slash Pines	Hydric Flatwood
Aa3	Arzell Fine Sand	Prairie	Wet Prairie
Ba	Blanton Fine Sand	Slash Pine	Xeric Flatwood
Bb	Broward Fine Sand	Slash Pines	Mesic Flatwood
Bc	Broward Fine Sand, heavy substratum	Slash Pines	Mesic Flatwood
Bc4	Broward Fine Sand	Palmetto	Mesic Flatwood
Bd	Broward Fine Sand, shallow	Slash Pines	Mesic Flatwood
Bd4	Broward Shallow	Palmetto	Mesic Flatwood
Be	Broward/Ochopee Complex	Slash Pines	Hydric Flatwood
Be7	Broward/Ochopee Complex	Mixed Palmetto and Prairie	Wet Prairie
Be8	Broward/Ochopee Complex	Mixed Pine and Cypress	Hydric Flatwood
Ca	Charlotte Fine Sand	Slash Pine	Hydric Flatwood
Cb	Coastal Beach	Cabbage Palmetto	Beach
Cc	Copeland Fine Sand	Subtropical Hammock/Flatwood	Mesic Hammock
Cd	Copeland Fine Sand, low	Cabbage Palmetto	Mesic Hammock
Ce	Copeland Fine Sand, shallow	Cabbage Palmetto	Mesic Hammock
Cf	Cypress Swamp	Cypress and other trees	Cypress
Fa	Felda Fine Sand	Grasses	Wet Prairie
Fb	Freshwater Marsh	Marsh Plants	Marsh
Ia	Immokalee Fine Sand	Slash Pines	Mesic Flatwood
Ka	Keri-Copeland Complex	Cabbage Palmetto & Slash Pines	Mesic Flatwood
Kb	Keri Fine Sand	Slash Pines	Mesic Flatwood
La	Lakewood Fine Sand	Scrub	Xeric Hammock
Ma	Made Land	Made Land	Disturbed
Mb	Mangrove Swamp	Mangrove	Mangrove
Mc	Matmon Loamy Fine Sand	Slash Pines	Mesic Flatwood

Oa	Ochopee Fine Sandy Marl	Grasses	Wet Prairie
Ob	Ochopee Fine Sandy Marl, shallow	Grasses	Wet Prairie
Ob2	Ochopee Fine Sandy Marl, shallow	Slash Pine	Hydric Flatwood
Ob5	Ochopee Fine Sandy Marl, shallow	Cypress	Cypress
Oc	Ochopee Fine Sandy Marl, tidal	Salt Tolerant Grasses	Tidal Marsh
Od	Ochopee Marl	Grasses	Wet Prairie
Oe	Ochopee Marl, deep	Grasses	Wet Prairie
Of	Ochopee Marl, shallow	Grasses	Wet Prairie
Pa5	Pompano Fine Sand	Cypress	Hydric Flatwood
Ra	Rockland	Slash Pine	Hydric Flatwood
Ra2	Rockland	Slash Pine	Hydric Flatwood
Ra3	Rockland	Prairie	Hydric Flatwood
Ra9	Rockland	Mixed Pine, Cypress, and Prairie	Hydric Flatwood
Sa	St. Lucie Fine Sand	Scrub	Xeric Hammock
Sb	Shell Mounds	Cabbage Palmetto	Xeric Hammock
Sc	Sunniland Fine Sand	Slash Pine	Mesic Flatwood
Ta	Tidal Marsh	Salt Tolerant Marsh Grasses & Shrubs	Tidal Marsh
Tb	Tucker Marl	Grasses	Wet Prairie

Table 6. Soils Common to Different Combinations of Counties

Without Disturbed Soil Types and Water (%)*					
	Charlotte	Collier	Glades	Hendry	Lee
Charlotte	100	19	26	28	94
Collier	28	100	22	28	28
Glades	42	24	100	48	45
Hendry	29	20	31	100	27
Lee	98	19	29	27	100

* Percentage comparisons of number of soil types each pair of counties has in commom divided by total number of soil types in a county are horizontal, not vertical.

Without Disturbed Soil Types and Water					
	Charlotte	Collier	Glades	Hendry	Lee
Charlotte	54	10	14	15	51
Collier	10	36	8	10	10
Glades	14	8	33	16	15
Hendry	15	10	16	51	14
Lee	51	10	15	14	52

With Disturbed Soil Types and Water					
	Charlotte	Collier	Glades	Hendry	Lee
Charlotte	66	12	15	15	63
Collier	12	44	9	11	12
Glades	15	9	35	17	16
Hendry	15	11	17	54	15
Lee	63	12	16	15	63

Table 7. Major Plant Communities and Their Characteristics in Southwest Florida

Plant Community	Topographic Setting and Soils	Dominant Vegetation*	Hydrology	Fire
Xeric Flatwood	White well-drained sands on locally higher elevations or at the top of steep slopes.	Dense thickets of low (<10 ft high) shrubs and xeric oaks, including myrtle oak, live oak, and sand live oak, with scattered patches of mostly bare white sand and a very scattered overstory of slash pine.	Wet season water table usually more than 2 ft below ground.	Maintained by intense crown fires every 10-15 years. Because of little groundcover, occasional surface fires are light and patchy.
Xeric Hammock	White well-drained sands on locally higher elevations or at the top of steep slopes.	Dense, tall (10-20 ft) closed canopy forest of xeric oaks, including myrtle oak, live oak, and sand live oak, with a scattered overstory of slash or sand pine and little groundcover.	Wet season water table usually more than 2 ft below ground.	Develops in the absence of fire for 50 years.
Mesic Flatwood	Light-to-dark brown, sandy soils on sites with little topographic relief.	Open canopy of slash pine, with understory dominated by dense palmetto.	Inundated 0-1 month per year. Normal wet season water depths from 2 ft below ground to 0.2 ft above ground. Annual water table fluctuation of 4 ft.	Maintained by light-moderate intensity, growing season fires every 2-5 years.
Mesic Hammock	Sandy or rocky soils on elevated sites within or adjacent to larger wetlands.	Dense canopy of live oak and/or tropical hardwoods, with open-to-dense shrub and sapling subcanopy and a sparse groundcover.	Inundated 0-1 month per year. Normal wet season water depths from 2 ft below ground to 0.2 ft above ground. Annual water table fluctuation of 4 ft.	Found on sites that have not experienced a growing season burn for more than 80 years.

Hydric Flatwood	Light-to-dark brown, sandy soils on sites with little topographic relief.	Open canopy of slash pine, with diverse, primarily herbaceous groundcover, e.g. little bue maidencane, and other grasses, sedges, forbs, and some palmetto.	Inundated 1-2 months per year. Normal wet season water depths from 1 ft below ground to 0.50 ft above ground. Annual water table fluctuation of 4 ft.	Maintained by light-moderate intensity, growing season fires every 2-5 years.
Hydric Hammock	Loamy, rocky or sandy soils on elevated sites within or adjacent to larger wetlands.	Closed canopy forest, with laurel oak, sabal palm, red maple, swamp bay, slash pine, an open-to-dense shrub and sapling subcanopy, and a sparse groundcover.	Inundated 1-2 months per year. Normal wet season water depths from 1 ft below ground to 0.5 ft above ground. Annual water table fluctuation of 4 ft.	Found on sites that have not experienced a growing season burn for more than 80 years.
Wet Prairie	Depression and flowway wetlands on sand or marl soils.	Short (2-5 ft), open-to-dense, diverse primarily herbaceous community with many grasses, sedges, and forbs, e.g. sand cordgrass, beaksedges, milkworts, St. Johns-wort, and wax myrtle.	Inundated 2-6 months per year. Normal wet season water depths 0.5-1.3 ft. Annual water table fluctuation of 3.5 ft.	Maintained by moderately intense, growing season fires about every 2-5 years.
Dwarf Cypress	Depression and flowway wetlands on limestone bedrock.	Open stands of stunted cypress with a sparse herbaceous groundcover	Inundated 2-6 months per year. Normal wet season water depths 0.5-1.3 ft. Annual water table fluctuation of 3.5 ft.	Maintained by low intensity fires about every 20-50 years.
Marsh	Depression and flowway wetlands and fringes of lakes and streams on organic soils.	Tall (4-10 ft), dense, primarily herbaceous community, often with only a few species, e.g. pickerelweed, arrowhead, sawgrass, maidencane, and willow.	Inundated 6-10 months per year. Normal wet season water depths of 1-2 ft. Annual water table fluctuation of 2-3 ft.	Maintained by moderately intense, growing season fires about every 2-5 years.
Cypress	Depression or flowway wetlands and fringes of lakes and streams with sandy or shallow (<1 ft) organic soils.	Canopy dominated by cypress, with open-to-dense understory of shrubs and herbaceous vegetation.	Inundated 6-8 months per year. Normal wet season water depths of 1-1.5 ft. Annual water table fluctuation of 3 ft.	Maintained by light-moderate intensity, growing season fires every 20-50 years.

Swamp Forest	Depression or flowway wetlands with deep (>1 ft) organic soils.	Closed canopy of cypress and mixed hardwoods, e.g. red maple, sweetbay, pond apple, pop ash, and dahoon holly with occasional palms, and an open-to-dense understory of shrubs and herbaceous vegetation, e.g., buttonbush, fire flag, and ferns.	Inundated 8-10 months per year. Normal wet season water depths of 1.5-2 ft. Annual water table fluctuation of 2 ft.	Found on sites infrequently reached by fire.
Water	Basins or channels with water too deep for emergent vegetation.	Open water with submerged or floating aquatic plants, e.g., water lettuce.	Normally have water above ground. Edges or all (depending on size and depth) could dry down in extreme (>25year) droughts.	During extreme (>25 years) droughts, exposed dry organics on bottom can burn. Ponds can be created by organic soil fires.
Tidal Marsh	Coastal tidal sites with sand, rock or organic substrates.	Open-to-dense low diversity herbaceous communities.	Inundated by salt or fresh water and drained on regular daily-to-monthly schedule.	Maintained by moderately intense, growing season fires about every 1-4 years.
Mangrove Swamp	Coastal tidal sites with sand, rock or organic substrates.	Canopy dominated by red, black, or white mangroves or buttonwood, and little or no groundcover.	Inundated by salt or fresh water and drained on regular daily-to-monthly schedule.	Developed and maintained by absence of fire.
Beach	Sandy flat and dune substrates along and behind high energy shoreline	Bare sand along shoreline or in adjacent dunes.	Water depth underlying sand variable depending on tides and location on beach slope and dunes.	No fuels to support fire.

* The scientific names for these species are listed in Table 7.

Table 8. Scientific names for species listed in Table 7.

Common Name	Scientific Name	Common Name	Scientific Name
arrowheads	*Sagittaria sp.*	pickerelweed	*Pontederia cordata*
beaksedges	*Rhynchospora sp.*	pond apple	*Annona glabra*
black mangrove	*Avicennia germinans*	pop ash	*Fraxinus caroliniana*
blueberries	*Vaccinium sp.*	red mangrove	*Rhizophora mangle*
bluestems	*Andropogon sp.*	red maple	*Acer rubrum*
buttonbush	*Cephalanthus occidentalis*	sabal palm	*Sabal palmetto*
buttonwood	*Conocarpus erectus*	sand cordgrass	*Spartina bakeri*
cypress	*Taxodium distichum*	sand live oak	*Quercus geminata*
dahoon holly	*Ilex cassine*	sawgrass	*Cladium jamaicense*
fireflag	*Thalia geniculata*	silkgrass	*Pityopsis graminifolia*
gallberry	*Ilex glabra*	slash pine	*Pinus elliottii*
greenbriars	*Smilax sp.*	St. John's-wort	*Hypericum fasciculatum*
groundsel tree	*Baccharis halimifolia*	staggerbush	*Lyonia fruticosa*
laurel oak	*Quercus laurifolia*	swamp bay	*Persea palustris*
little blue maidencane	*Amphicarpum muhlenbergianum*	sweetbay	*Magnolia virginiana*
live oak	*Quercus virginiana*	water lettuce	*Pistia stratoites*
maidencane	*Panicum hemitomon*	wax myrtle	*Myrica cerifera*
milkworts	*Polygala sp.*	white mangrove	*Laguncularia racemosa*
myrtle oak	*Quercus myrtifolia*	white waterlily	*Nymphaea odorata*
palmetto	*Serenoa repens*	willow	*Salix caroliniana*