RES 17-06

M E M O R A N D U M

TO: Jayantha Obeysekera, Director, HSM

FROM: Jenifer Barnes, Staff Hydrologic Modeler, HSM

DATE: September 24, 2003

SUBJECT: Update of 2050 Land Use and Vegetation Cover for SFWMM v5.0

This document is an update of the 2050 land use map for the SFWMM v5.0. The SFWMD recently acquired land use updates for Martin County which changed the projections for six of the SFWMM cells:

R64C32, R64C33, R64C34, R64C36, R65C32, and R65C36 were all changed from Forested Upland to Irrigated Pasture.

The August 4, 2003 and August 29, 2003 memoranda are attached.

JB

cc: Luis Cadavid
Randy Van Zee
Ray Santee
Carl Fitz
Chris McVoy
Sharika Senarath
Ken Rutchey
Winifred Said
Ken Tarboton

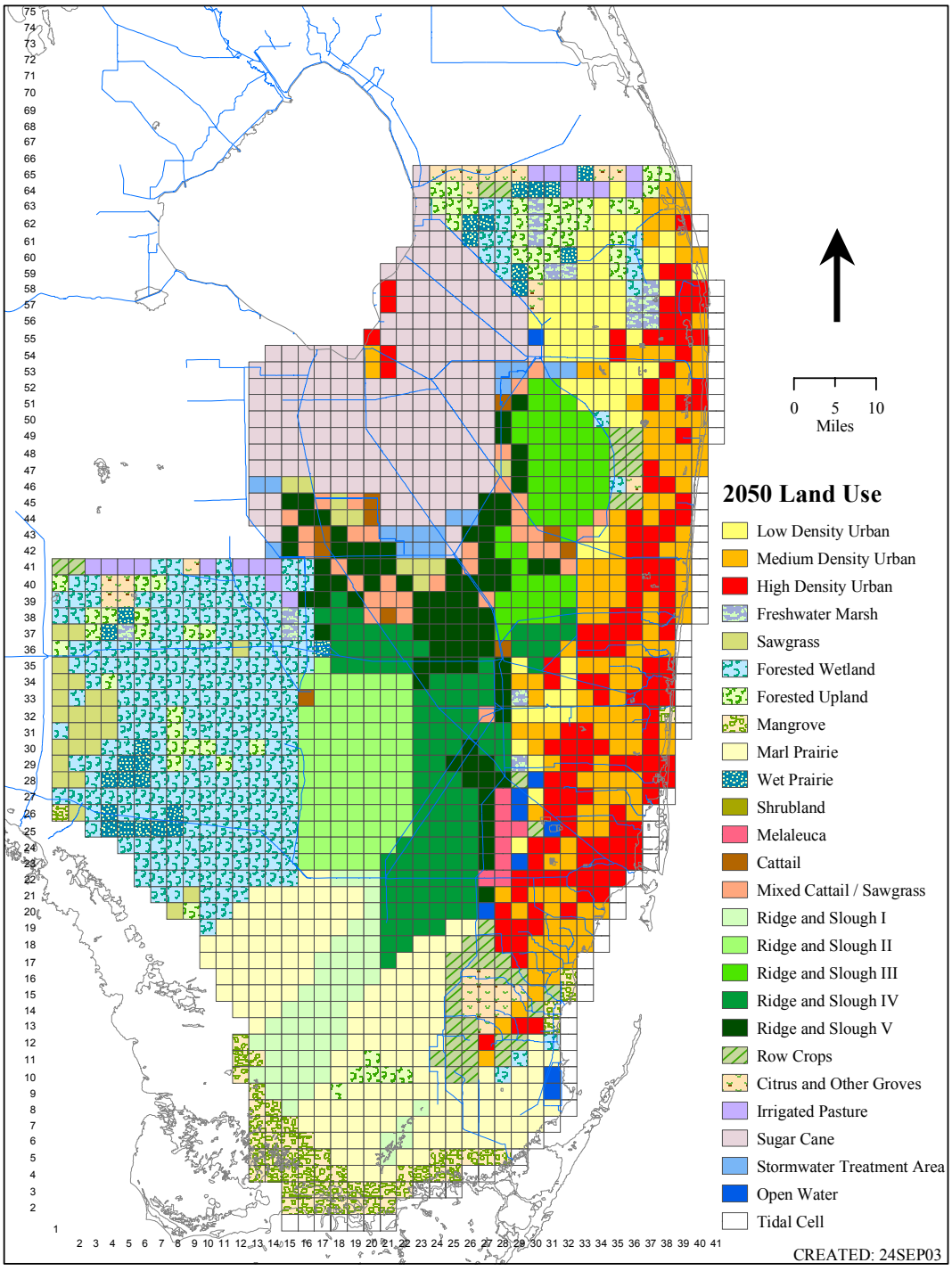

Figure 3. South Florida Water Management Model 2050 Land Use

RES 17-06

M E M O R A N D U M

TO: Jayantha Obeysekera, Director, HSM

FROM: Jenifer Barnes, Staff Hydrologic Modeler, HSM

DATE: August 29, 2003

SUBJECT: Update of 1988, 2000, and 2050 Land Use and Vegetation Cover for SFWMM v5.0

This document is an update of the land use maps for the SFWMM v5.0. The only change present in all maps is the land use of R52 C32. This cell was considered part of Water Conservation Area 1 in the August 4, 2003 memorandum and now it is part of the Lower East Coast region.

The August 4, 2003 memorandum is attached to this update.

JB

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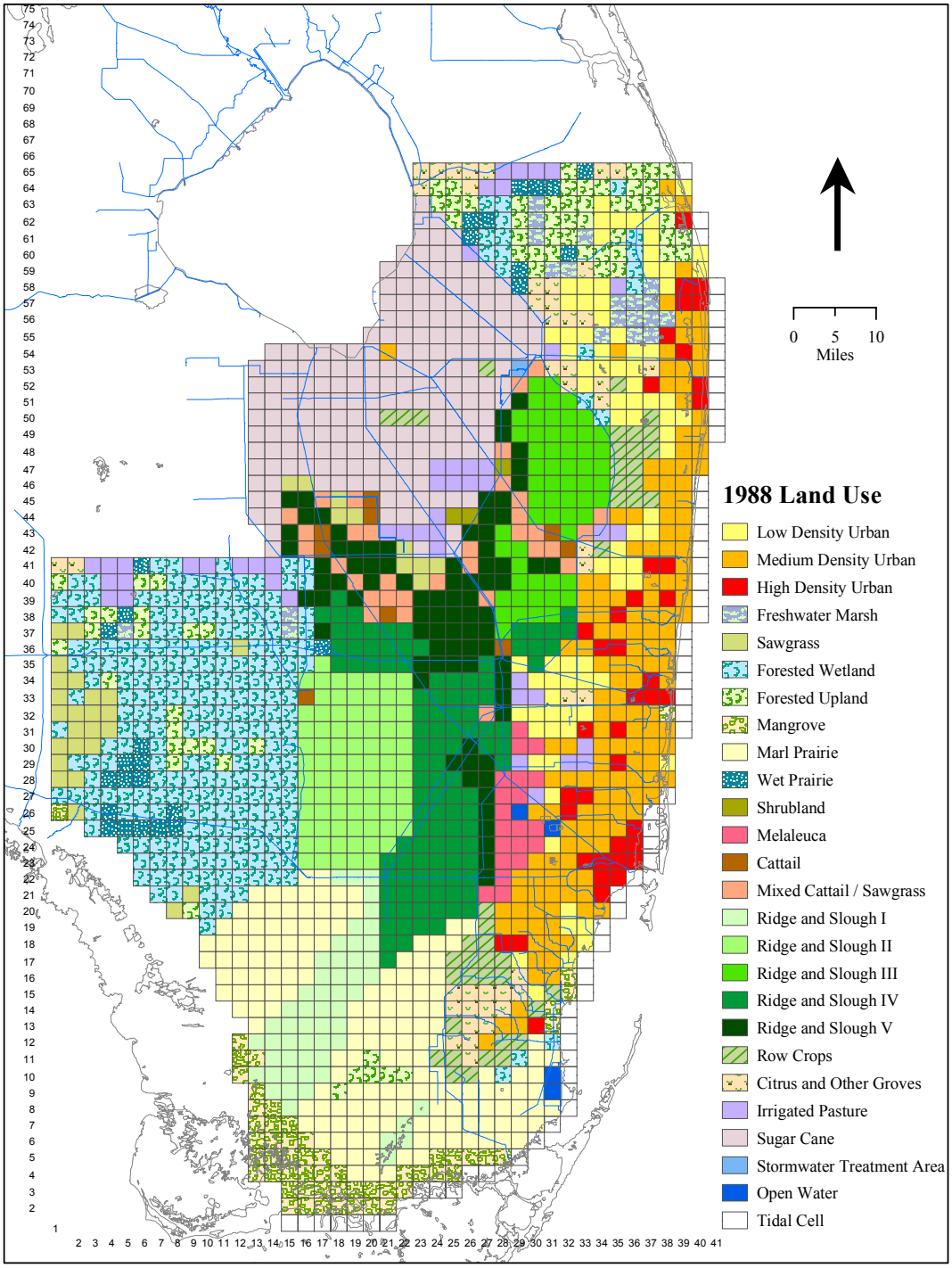

Figure 1. South Florida Water Management Model 1988 Land Use

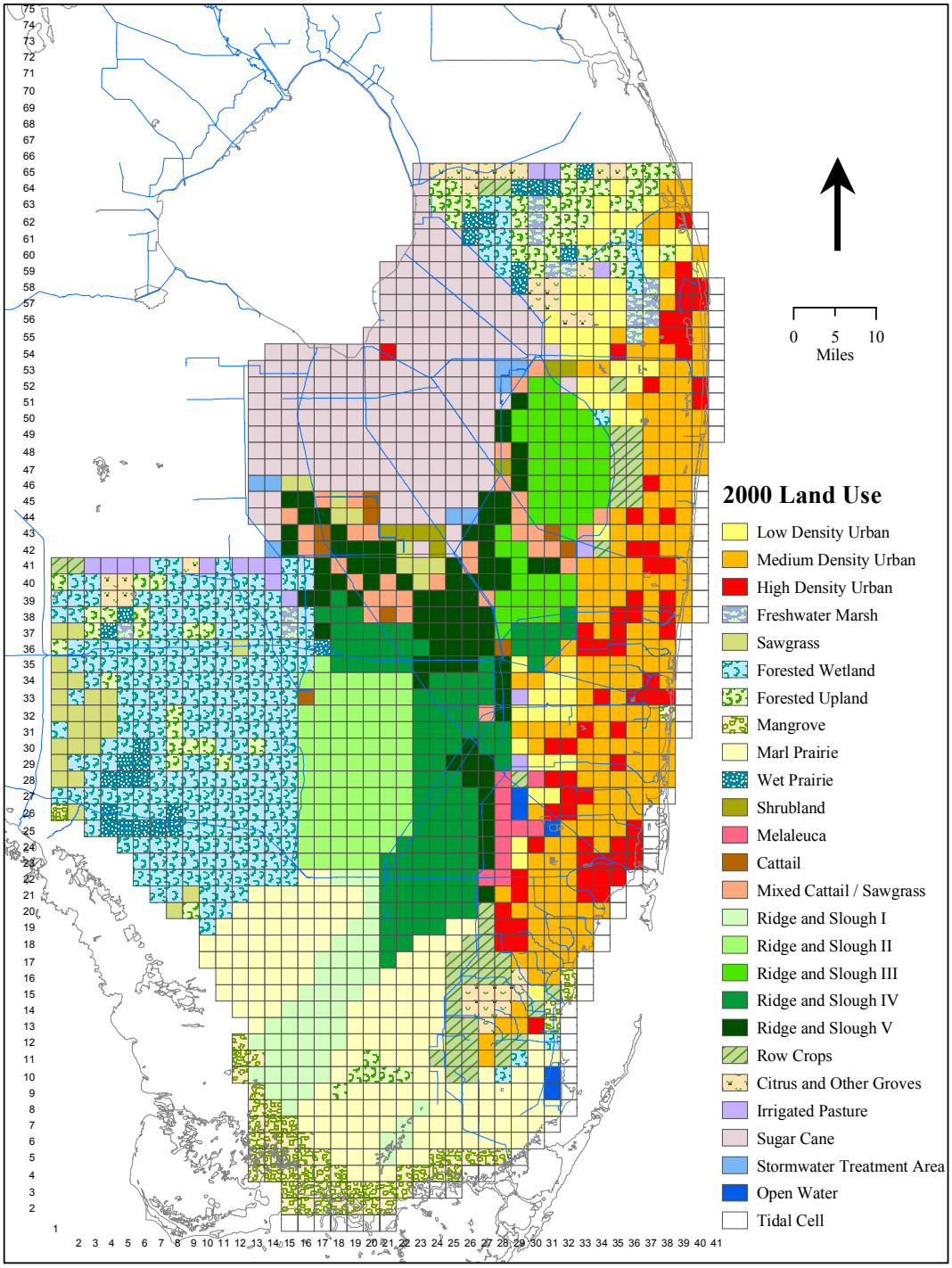

Figure 2. South Florida Water Management Model 2000 Land Use

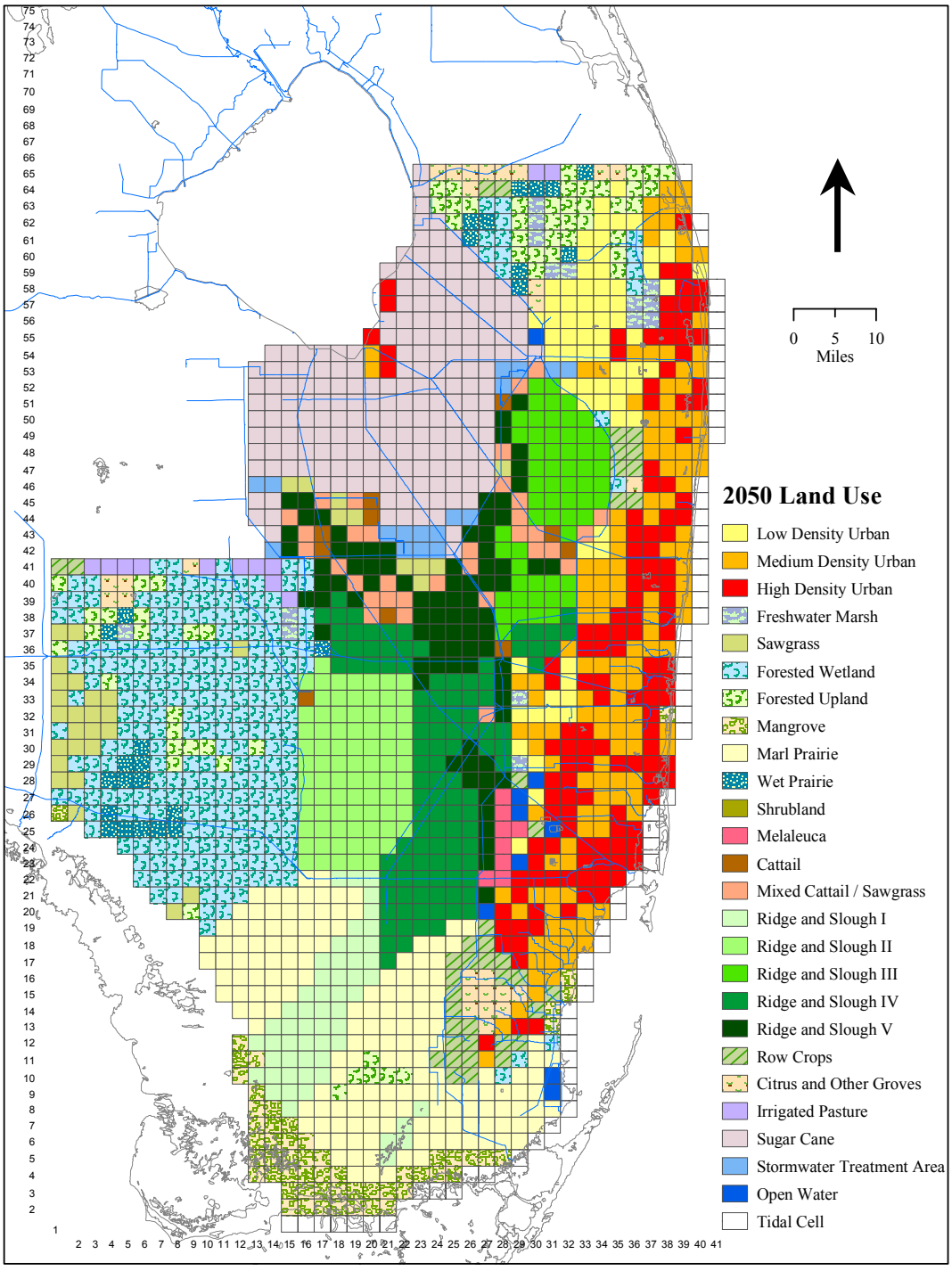

Figure 3. South Florida Water Management Model 2050 Land Use

RES 17-06

M E M O R A N D U M

TO: Jayantha Obeysekera, Director, HSM

FROM: Jenifer Barnes, Staff Hydrologic Modeler, HSM
Ken Tarboton, Sr. Supervising Engineer, HSM

DATE: August 4, 2003

SUBJECT: 1988, 2000, and 2050 Land Use and Vegetation Cover for SFWMM v5.0

This document describes the update of the South Florida Water Management Model (SFWMM) land use or vegetation to represent the years 1988, 2000 and 2050 for each 2-mile by 2-mile model grid cell. The final maps are shown in Figures 1, 2 and 3.

An effort was made to use the most recent or most accurate data. Since no detailed, uniform map of vegetation exists for the entire SFWMM area several data sources were used to create a composite high resolution Geographic Information System (GIS) dataset to represent the year 2000. The data sources and location of the dataset are shown in Figure 4.

After completion of the 2000 land use map, the 1988 land use previously used for SFWMM calibration (1979-1989 period) was remapped applying the same classes as the 2000 land use map. Remapping of the 1988 land use with updates classes was necessary since the 1988 land use was still needed for SFWMM runs. The revised 1988 land use map is shown in Figure 1. A comparison of the new and the old classes can be found in Tables 1 and 2. Helicopter flights were taken to do a visual check of the natural areas and photographs are included to illustrate the new classification scheme.

This document also describes the sources of data and the correspondence between the former land use classes used in SFWMM v3.5 and the new classes used in SFWMM v5.0. A description of each land use class is provided with emphasis on their hydrological differences. Values for overland flow resistance coefficients and evapotranspiration (ET) parameters from the calibrated version of the SFWMM v5.0 are provided in Table 3.

JB/KT

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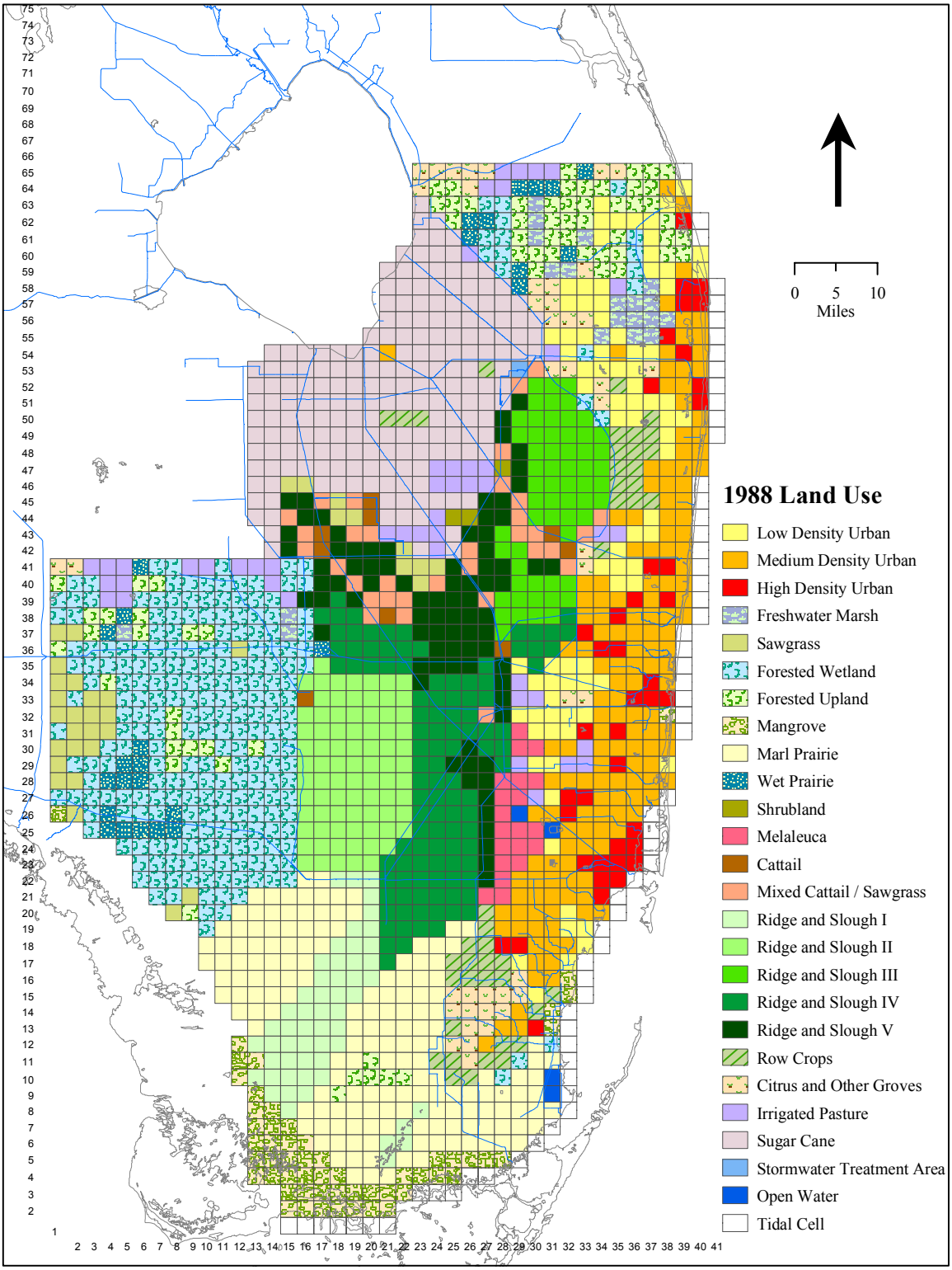

Figure 1. South Florida Water Management Model 1988 Land Use

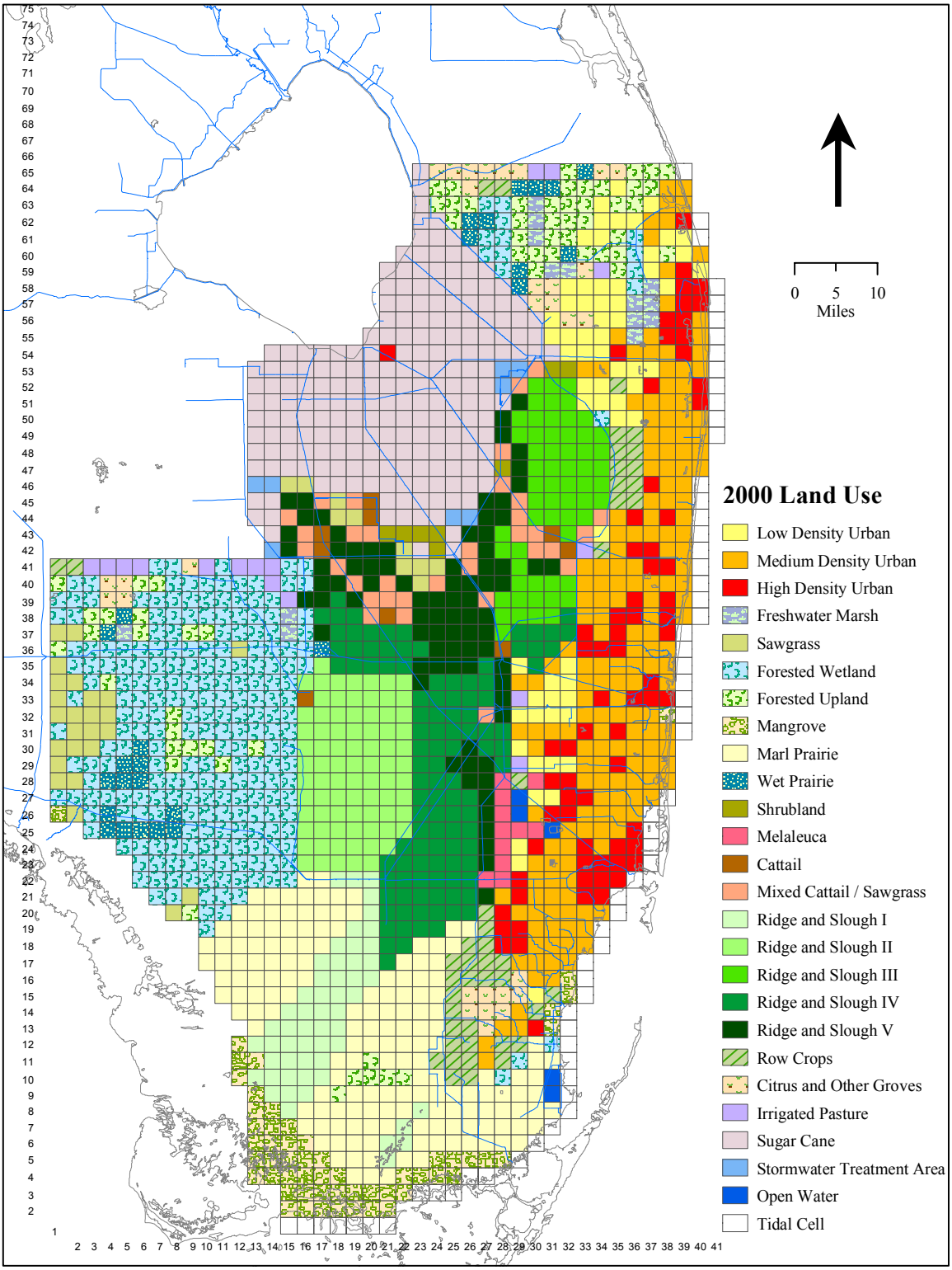

Figure 2. South Florida Water Management Model 2000 Land Use

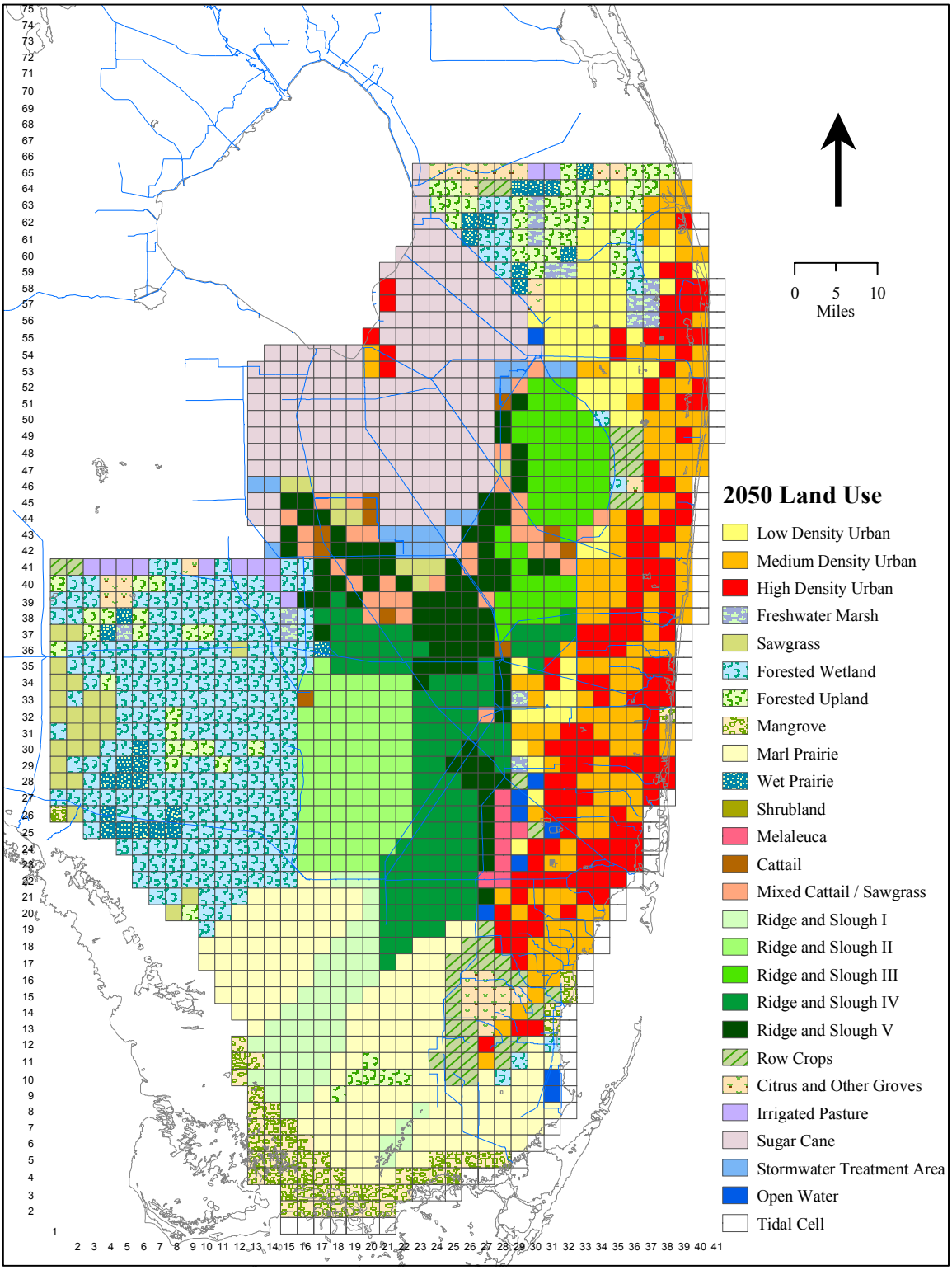

Figure 3. South Florida Water Management Model 2050 Land Use

Sources and Classification Method

2000 Land Use

The Florida Land Use and Cover Classification System (FLUCCS) is the primary source for land use/land cover input to the SFWMM. Since FLUCCS does not include detailed vegetation information, the best available alternative data sources (Pers. Comm. Carl Fitz, Ken Rutchey, Les Vilchek) were used for vegetation classification within the Water Conservation Areas and Everglades National Park (Figure 4). A composite GIS coverage of these sources was developed and intersected with the SFWMM grid in order to produce a majority land use type for each cell.

Checks were performed including a visual check against 2000 satellite imagery to evaluate each grid cell's former and new land use class. In areas where the majority from the land use data did not match the satellite image, the satellite image took precedence. A draft SFWMM 2000 land use map was verified by aerial survey resulting in adjustments to several classifications in the natural areas and parts of the Everglades Agricultural Area.

1988 Land Use

The SFWMM 2000 land use map was used as a base for revision of the 1988 land use map. It was assumed that natural areas in 2000 were also natural areas with the same land use type as in 1988. Urban and agricultural cells in the SFWMM v3.5 1988 land use map and the SFWMM v5.0 2000 land use map were cross checked. Cells designated as agricultural in the original 1988 map, and as urban in the 2000 map, reverted to agricultural in the revised 1988 map. A check of urban cells was also performed. In this check the SFWMM v3.5 1988 land use was used as a guide in determining the SFWMM v5.0 1988 land use values. Since the SFWMM v3.5 did not include the Medium Density Urban category, cells that fit this category were derived from the 1988 land use and the 2000 land use with the following table:

Table 1. Crosswalk for urban values from SFWMM v3.5 to SFWMM v5.0

SFWMM v3.5 1988 Land Use	SFWMM v5.0 2000 Land Use	SFWMM v5.0 1988 Land Use
High Density Urban	Low Density Urban	Low Density Urban
High Density Urban	Medium Density Urban	Medium Density Urban
High Density Urban	High Density Urban	High Density Urban
Low Density Urban	Low Density Urban	Low Density Urban
Low Density Urban	Medium Density Urban	Low Density Urban
Low Density Urban	High Density Urban	Medium Density Urban

2050 Land Use

The 2000 land use coverage was used as a starting point for the 2050 land use projections. All polygons with the potential to be developed were extracted from the 2000 land use coverage. These polygons were then updated with Comprehensive Plan projections from Palm Beach, Broward and Miami-Dade counties. The 2050 land use coverage was then intersected with the SFWMM grid and the majority land use was assigned to each grid cell. The natural areas were assumed to be the same as 2000 except in areas of urban development.

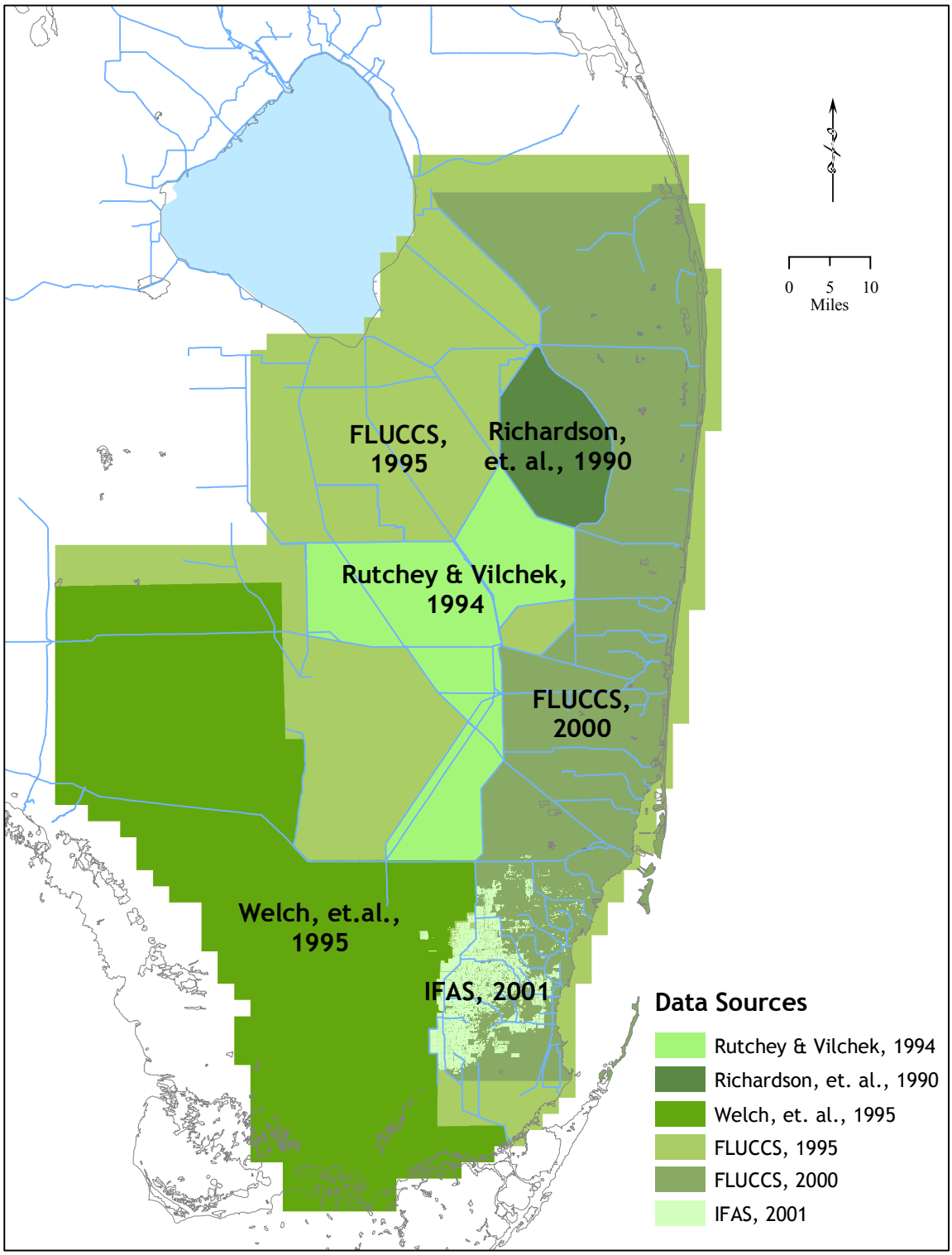

Figure 4. Data Sources for the 2000 Land Use Coverage

Landscape Classification Crosswalk

The correspondence between the SFWMM v3.5 land use classes and those for the SFWMM v5.0 are shown in Table 2. Where possible the Basic Land Unit (BLU) numbers were kept the same as in SFWMM v3.5 to minimize changes and possible confusion. Urban areas were further subdivided to include a Medium Density Urban class which now has BLU number 25. The Ridge & Slough landscape is divided into 5 subclasses. Basic Land Unit 17 is used for Ridge & Slough I to be consistent with SFWMM v3.5, while Ridge & Slough II through Ridge & Slough V were given new BLU numbers 21 through 24. Cypress Prairie is now included in the Forested Wetland category.

Table 2. Land Use Crosswalk from SFWMM v3.5 to SFWMM v5.0

	SFWMM v3.5		SFWMM v5.0	
Land Use	BLU	Type/Description	BLU	Type/Description
Urban	1	Low density	1	Low Density
	11	High Density	25	Medium Density
			11	High Density
Agriculture	2	Citrus	2	Citrus & Other Groves
	7	Row (or truck) Crops	7	Row (or truck) Crops
	8	Sugar Cane	8	Sugar Cane
	9	Irrigated Pasture	9	Irrigated Pasture
Rangeland	6	Shrubland	6	Shrubland
Wetland	18	Marl Prairie	18	Marl Prairie
	17	Modified Ridge & Slough I	17	Ridge & Slough I
	21	Modified Ridge & Slough II	21	Ridge & Slough II
			22	Ridge & Slough III
			23	Ridge & Slough IV
			24	Ridge & Slough V
	4	Sawgrass Plains	4	Sawgrass
	15	Cattail	15	Cattail
	19	Mixed Cattail / Sawgrass	19	Mixed Cattail / Sawgrass
	5	Wet Prairie	5	Wet Prairie
	3	Marsh	3	Marsh
	10	Stormwater Treatment Area	10	Stormwater Treatment Area
Forest	12	Forested Wetland	12	Forested Wetland
	22	Cypress Prairie		
	16	Forested Uplands	16	Forested Uplands
	13	Mangroves	13	Mangroves
	14	Melaleuca	14	Melaleuca
Water	20	Open Water	20	Open Water

Land Use/Landscape Description

Urban

High Density Urban
Model grid cells with greater than 50 percent impervious cover. Areas comprised of industrial sites, shopping centers with large paved areas, and high density residential areas are designated as high density urban.

Figure 5. Example of High Density Urban Land Use.

Medium Density Urban
Model grid cells with 25 to 50 percent impervious cover. Medium density residential areas or mixtures of low density and high density within the same grid cell are classified as medium density urban.

Figure 6. Example of Medium Density Urban Land Use.

Low Density Urban
Model grid cells with less than 25 percent impervious cover. This category includes golf courses, small holdings and low density residential areas, it may also contain agricultural or natural areas within urban land uses.

Figure 7. Example of Low Density Urban Land Use.

Wetlands

Ridge & Slough
The most extensive landscape in the remnant Everglades, Ridge & Slough, can be characterized as a mosaic of sawgrass ridges interspersed with open water sloughs and dotted with tree islands. Ridges vary from consisting only of sawgrass, to ridges with shrub cover or tree islands. Slough conditions range from open water to dense aquatic vegetation cover (e.g. water lilies). Periphyton communities are established to varying degrees in some areas. Due to shortened hydroperiods, sawgrass and other macrophyte encroachment into sloughs has resulted in an increase in resistance to flow. The ridge and slough landscape is highly directional in places (Central WCA-3A), and has non-directional characteristics in other places (WCA-1).

Due to water management practices, the current Ridge & Slough landscape is a modified form of the pre-drainage Everglades landscape. It is reduced in spatial extent as well as modified in terms of vegetation community composition. For the purpose of SFWMM land cover classification, current vegetation occurring within the boundary of Ridge and Slough landscape as defined in the Natural System Model, was classified as (modified) Ridge and Slough, and divided into five categories representing different resistances to flow.

Ridge & Slough I
Ridge & Slough I consists of linear directional sawgrass ridges interspersed with predominantly open water sloughs. This subclass of Ridge & Slough has lower resistance to flow than other Ridge & Slough subclasses because it has more open water with fewer water lilies, little to no invasion of the sloughs with sawgrass and other species and little periphyton. The Ridge & Slough I landscape is found in Shark River Slough and Taylor Slough in Everglades National Park.

Ridge & Slough II
Ridge & Slough II is comprised of directional sawgrass with open water sloughs that have been slightly filled in with sparse sawgrass and other species, increasing resistance to flow. Periphyton growth on submerged stems of the emergent vegetation in the sloughs increases flow resistance. The Ridge & Slough II landscape is found in WCA-3A south of Alligator Alley and west of the Miami Canal (Figure 8).

Ridge & Slough III
Ridge & Slough III is predominantly non-directional consisting of circular and irregular shaped sawgrass ridges interspersed with open water sloughs. Shrubs and trees are present on many of the ridges. In places, water lilies are present in the sloughs. Ridge & Slough III is found in WCA-1 and WCA-2A (Figure 9). Resistance to flow is expected to be higher than Rideg and Slough II due to lack of directionality.

Ridge & Slough IV
Ridge & Slough IV consists of non-directional to slightly directional sawgrass ridges with little evidence of shrubs or tree islands. Sloughs often have water lilies or periphyton in them. Areas of Ridge & Slough IV include WCA-2B, parts of WCA-3A north of Alligator Alley and southeast of the Miami Canal / Alligator Alley intersection, WCA-3B and Northeast Shark River Slough (Figure 10).

Ridge & Slough V
Ridge & Slough V consists of Ridge & Slough vegetation that has been considerably modified by in-filling of sloughs with sawgrass and other wet prairie species. Resistance to flow is higher than the other Ridge & Slough subclasses and slightly less than that of the sawgrass landscape. Areas of Ridge and Slough V include parts of northwest and northeast WCA-3A, parts of the Rotenberger and Holey Land Wildlife Management Areas, northern WCA-3B and the Pennsuco wetlands (Figure 11).

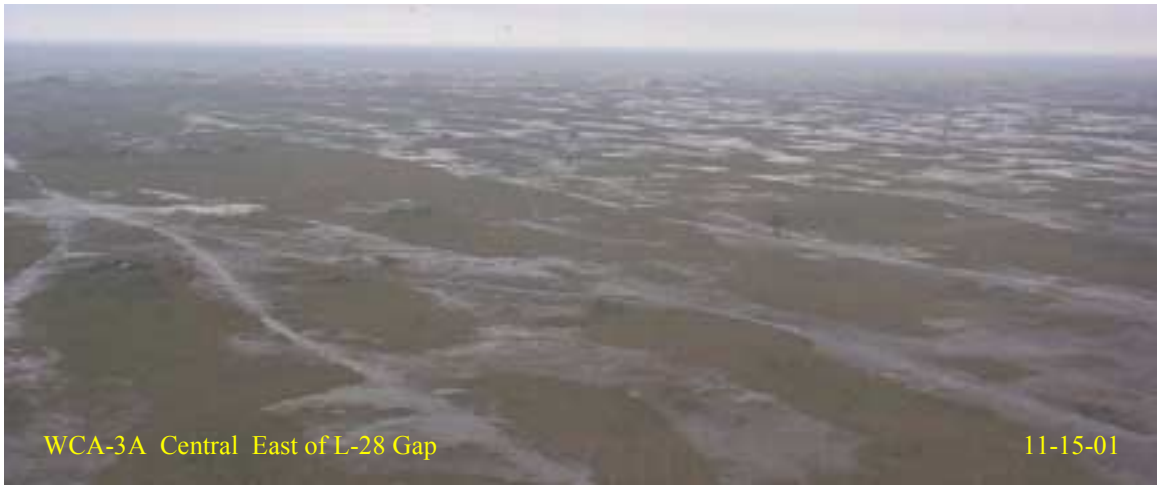

Figure 8. Examples of Ridge & Slough II Landscape.

Figure 9. Examples of Ridge & Slough III Landscape.

Figure 10. Examples of Ridge & Slough IV Landscape.

Figure 11. Examples of Ridge & Slough V Landscape.

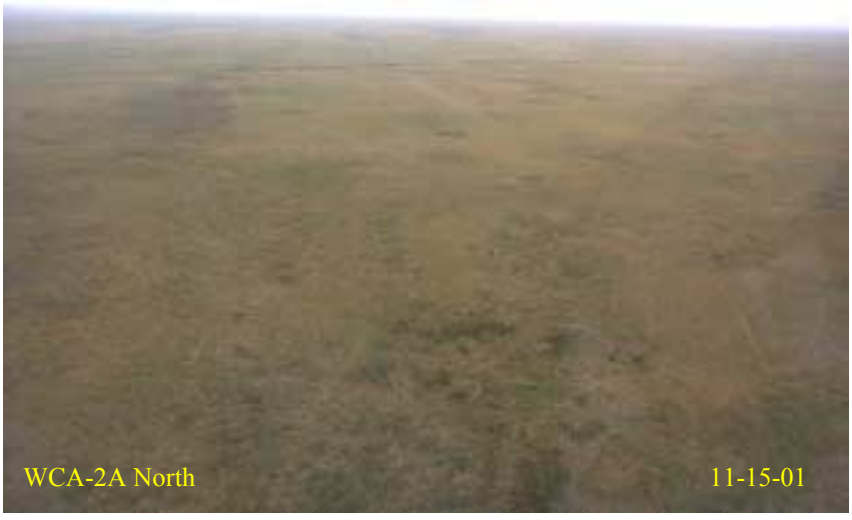

Figure 12. Example of Mixed Cattail / Sawgrass Landscape.

Freshwater Marsh
Freshwater marshes are inundated areas outside of the Ridge & Slough boundary. Marshes are dominated by emergent and floating vegetation. Freshwater marshes occur in deeper depressions than prairies and have longer hydroperiods.

Wet Prairie
This landscape is found in shallow depressions among flatwoods, in pastures, and at the edges of cypress domes and marshes. In this classification, wet prairie is a grassy landscape mixed with open water. The dominant vegetation of wet prairies include wiregrass, spike rush, muhly grass, beak rush, cordgrass, maidencane, and St. John's wort.

Marl Prairie
Marl Prairies are comprised of relatively (compared to Ridge & Slough landscapes) sparse, low stature sawgrass on marl soils. Open water sloughs with no prominent directional pattern occur in marl prairies. The Marl Prairie landscape was defined by intersecting model grid cells with predominantly sawgrass vegetation and marl soils. The resulting Marl Prairies correspond closely with those identified in several studies (Davis 1943, Davis et al, 1994, McVoy and Park 1997) as having a distinct boundary with the Ridge & Slough landscape. Resistance to flow in the Marl Prairies is lower than in the Ridge & Slough landscapes because of the relatively sparse sawgrass.

Sawgrass
This classification is applied to areas outside of the Ridge & Slough boundary that are dominated by contiguous areas of medium to dense sawgrass. In some places there are breaks in the sawgrass due to open water where periphyton and bladderwort may be found.

Cattail
Cattail *(Typha spp.)* is a marsh species that thrives under high-nutrient conditions. It occurs naturally in disturbed areas or around gator holes and can be found downstream of the Everglades Agricultural Area in areas where nutrient enrichment has occurred.

Mixed Cattail / Sawgrass
This landscape is a mixture of cattail patches and sawgrass and is used to represent SFWMM grid cells that contain greater than 20 percent cattail and greater than 20 percent sawgrass. It is found in areas where cattails have invaded sawgrass, such as parts of northern WCA-3A and along parts of the edges of WCA-2A and the Loxahatchee National Wildlife Reserve.

Stormwater Treatment Area (STA)
Stormwater Treatment Areas include large, constructed, treatment wetlands designed to serve as biological filters to reduce the phosphorous concentration in agricultural runoff entering the Everglades Protection Area. Vegetation varies by STA, and consists mainly of cattail, mixed marsh and submerged aquatic vegetation communities.

Forest

Forested Wetlands
Forested wetlands include cypress swamps, hardwood and wetter species forming a mosaic of pine flatwoods and depressed wetlands.

Forested Uplands
Forested uplands are pinelands on higher sands or areas of former mosaic of pine flatwoods and depressed wetlands that have been dehydrated by artificial drainage.

Mangrove
Mangrove forests are coastal landscapes containing red, white or black mangrove that may extend inland such as in the southern and southwestern Everglades. Mangroves are permanently to regularly flooded by tidal waters.

Melaleuca
Melaleuca is an exotic species (*Melaleuca quinquenervia*) forming monotypic stands that dominate the landscape. Melaleuca exists in both upland habitats, and lower areas which have experienced prolonged inundation.

Shrubland

Shrubland includes areas where trees are not present but shrubs are the dominant vegetation. Shrubs may include: Brazilian pepper, wax myrtle and saw palmetto. Shrubland is an upland community which rarely experiences inundation.

Open Water

Open water bodies such as lakes, canals or deep excavated reservoirs are included in the open water category.

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Table 3. Overland Flow Coefficients and ET Parameters for SFWMM v5.0.

BLU	Land Use Type	Manning's n		OWPOND	DSRZ	DDRZ	DETEN	Vegetation/Crop Coefficient (KVEG)											
		A	b	(ft)	(ft)	(ft)	(ft)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Low Density Urban	0.200	0.00	1.0	4.0	1.5	0.60	.546	.512	.534	.542	.552	.572	.638	.706	.705	.676	.604	.562
25	Medium Density Urban	0.140	0.00	1.0	2.5	1.0	0.55	.500	.450	.475	.490	.510	.530	.560	.600	.600	.570	.540	.510
11	High Density Urban	0.080	0.00	1.0	1.5	1.0	0.50	.413	.381	.392	.401	.412	.422	.435	.455	.480	.483	.442	.415
2	Citrus & Other Groves	0.230	0.00	3.0	4.0	2.0	0.30	.701	.693	.610	.542	.661	.710	.744	.810	.822	.772	.723	.700
7	Row (or truck) Crops	0.230	0.00	1.0	3.0	1.5	0.30	.640	.690	.870	.950	.860	.660	.610	.660	.710	.870	.930	.880
8	Sugar Cane	0.230	0.00	1.0	3.8	1.5	0.10	.800	.600	.550	.800	.950	1.00	1.05	1.05	1.05	1.00	.950	.900
9	Irrigated Pasture	0.230	0.00	1.0	2.0	1.0	0.25	.650	.700	.750	.950	.950	.980	.980	.980	.940	.800	.870	.650
6	Shrubland	1.050	-0.77	3.5	7.0	0.0	0.10	.820	.790	.830	.840	.850	.860	.870	.880	.880	.850	.835	.820
18	Marl Prairie	0.615	-0.77	3.0	6.5	0.0	0.10	.780	.750	.790	.820	.850	.890	.960	.995	.995	.950	.860	.800
17	Ridge & Slough I	0.765	-0.77	4.5	2.8	0.0	0.10	.760	.740	.770	.790	.810	.850	.920	.980	.980	.910	.810	.770
21	Ridge & Slough II	0.765	-0.77	6.5	3.0	0.0	0.11	.610	.600	.630	.650	.670	.690	.720	.740	.740	.720	.675	.620
22	Ridge & Slough III	0.825	-0.77	3.0	1.5	0.0	0.11	.780	.750	.790	.800	.820	.850	.870	.880	.880	.870	.840	.820
23	Ridge & Slough IV	0.895	-0.77	6.8	3.0	0.0	0.12	.770	.750	.780	.800	.830	.860	.910	.960	.960	.910	.840	.780
24	Ridge & Slough V	1.150	-0.77	6.9	4.0	0.0	0.12	.830	.800	.840	.870	.890	.900	.910	.960	.960	.880	.860	.840
4	Sawgrass	1.250	-0.77	7.0	4.5	0.0	0.10	.830	.800	.840	.870	.890	.900	.910	.960	.960	.880	.860	.840
15	Cattail	1.200	-0.77	6.0	3.0	0.0	0.11	.805	.780	.810	.820	.832	.848	.862	.890	.890	.840	.815	.807
19	Mixed Cattail/Sawgrass	1.250	-0.77	7.0	4.0	0.0	0.11	.815	.790	.825	.835	.850	.870	.882	.930	.930	.860	.835	.820
3	Freshwater Marsh	1.100	-0.77	4.0	1.2	0.0	0.10	.780	.750	.800	.830	.850	.900	.940	.970	.970	.902	.840	.800
5	Wet Prairie	0.750	-0.77	3.5	2.0	0.0	0.10	.780	.750	.790	.800	.810	.830	.850	.880	.880	.835	.810	.790
10	STA	1.150	-0.77	4.0	5.0	0.5	0.10	.830	.782	.810	.835	.848	.860	.880	.920	.920	.872	.844	.830
12	Forested Wetland	0.350	-0.77	10.0	9.0	0.0	0.10	.700	.670	.710	.720	.740	.750	.770	.780	.780	.760	.730	.710
16	Forested Uplands	0.850	0.00	10.0	11.0	4.8	0.10	.730	.700	.740	.760	.800	.870	.940	.980	.980	.950	.870	.750
13	Mangroves	0.550	-0.77	7.0	0.7	0.0	0.15	.710	.700	.730	.750	.790	.830	.890	.950	.950	.870	.790	.730
14	Melaleuca	0.450	-0.77	10.0	7.0	1.5	0.12	.770	.740	.790	.820	.850	.880	.900	.930	.930	.850	.810	.780
20	Water	0.010	0.00	0.0	0.0	0.0	0.10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Notes: Manning's $n=A(h)^b$ where h is ponded depth
KMAX = 1.0 ft for all Land Use Types
OWPOND is the minimum ponding depth above which ET for open-water is assumed.
DSRZ is the depth from the land surface to the bottom of the shallow root zone.
DDRZ is the depth from the land surface to the bottom of the deep root zone.
DETEN is the ponding depth below which no overland flow can occur.