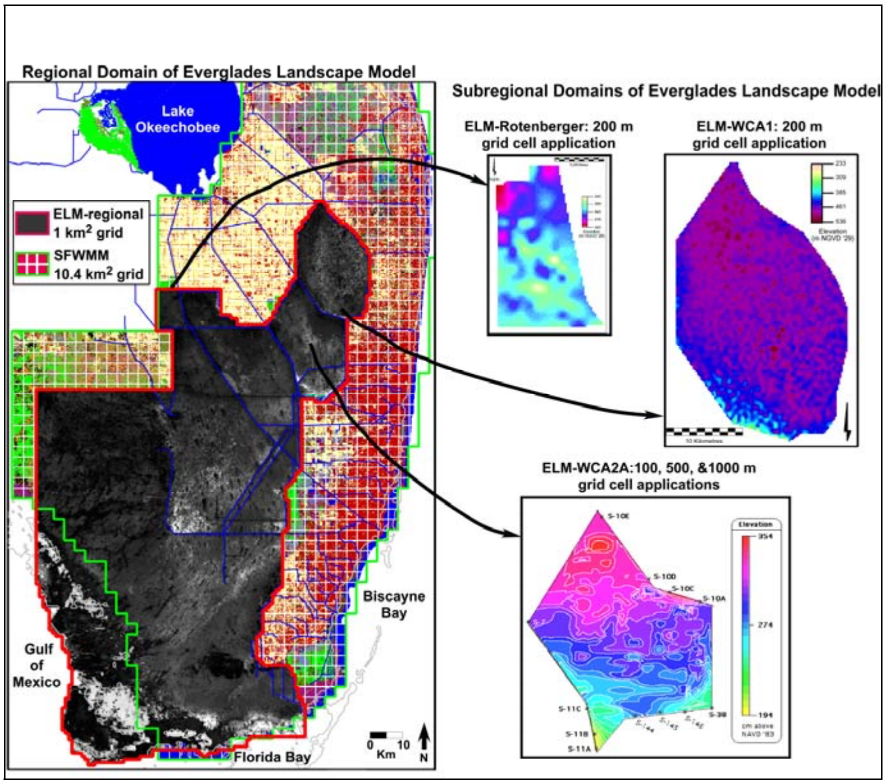
Documentation of the Everglades Landscape Model: ELM v2.5

Chapter 4: Data



http://my.sfwmd.gov/elm

July 10, 2006

Chapter 4: Data

4.1 Overview

There are three primary types of data used in modeling projects: observed input data, observed "target" data, and simulated (output) data. The principal focus of this Chapter is on documenting the observed data that were used in the project, fully describing the input data that affect the model dynamics. Additionally, at the end of this Chapter are summaries of the observed "target" data that were used to assess model performance.

The simulated data that are output by the model are described in the User's Guide Chapter, in which output selection and interpretation are covered. The Chapter on Model Performance Assessment compares simulated data to observed data, while the Chapter on Uncertainty describes some of the important uncertainties associated with both simulated and observed data. *The Uncertainty Chapter is an essential component of understanding the model, data, and concomitant performance expectations of the ELM.*

Domain & static attributes

The spatial domain (grain and extent) of ELM is defined by an input map, and the vectors and points (grid cells) of the water management infrastructure are superimposed on this raster map via inputs from two databases. Two other databases contain the model parameters: one documents the parameters that are global across the domain, while the other contains parameters that are specific to the habitats distributed across the domain.

Initial conditions

These habitats (defined by macrophyte communities) are initialized by an input map, as are other dynamic spatial variables that involve water depths, soil nutrients, land surface elevation, and macrophyte biomass. In the current version, variables such as periphyton biomass and nutrient content are initialized by calculations involving global and/or habitat-specific parameters (i.e., without specific input maps).

Boundary conditions

The dynamic drivers of the model include spatially explicit, historical time series of rainfall, potential evapotranspiration, stage along the periphery of the domain, water flows through all managed water control structures, and nutrient concentrations associated with inflows into the model domain.

Data usage

The model was designed to provide the flexibility of modifying the scenario(s) of simulation entirely through Open Source database files, without need to modify the source code of the model. While we necessarily provide details on the derivation of some of the data in this documentation Chapter, the metadata associated with all data sources should impart a sufficient degree of understanding for their usage. An overview of the input methods for these data is provided in the Model Structure Chapter of this documentation, while the User's Guide Chapter describes the relatively simple steps necessary to run model applications.

4.1.1 Metadata

All of the input data files used in the model have metadata directly associated with them in the project data directories. Those metadata provide the information necessary to use and interpret the input data files in model applications, while this documentation Chapter serves to expand on the metadata by further detailing the sources and derivation of the data themselves. The following table lists all of the files that are input to the ELM and described in this Chapter[1].

Type	Input filename	Description
Model domains		
	ModArea	Define spatial domain
	gridmapping.txt	Link coarse-fine grids
Initial condition maps		
	icSfWt	Initial surface water
	icUnsat	Initial unsaturated water
	Elevation	Initial land elevation
	Bathymetry	Initial (and constant) creek bathymetry
	soilBD	Initial (and constant) soil bulk density
	soil_orgBD	Initial (and constant) soil organic bulk density
	soilTP	Initial soil phosphorus
	HAB	Initial habitat type
	icMacBio	Initial total macrophyte biomass
Boundary conditions		
	BoundCond	Grid cells allowing boundary flows
	BoundCond_stage.BIN	Boundary stage/depth time series
	rain.BIN	Rainfall time series
	ETp.BIN	Potential ET time series
	CanalData.struct_wat	Structure: water flow time series
	CanalData.struct_TP	Structure: phosphorus conc. time series
	CanalData.struct_TS	Structure: salt (chloride) conc. time series
	CanalData.graph	Recurring annual time series of tide height
Static attributes		
	CanalData.chan	Canal/levee parameters/locations
	CanalData.struct	Water control structure attributes
	basins	Basin/Indicator Region locations
	basinIR	Basin/Indicator Region hierarchy
	GlobalParms_NOM	Parameters: global
	HabParms_NOM	Parameters: habitat-specific
	HydrCond	Parameters: hydraulic conductivity

[1] Two other files, outside of the Project's "Data" directory in the "RunTime" directory, are input to the model and serve to configure the model at runtime. See the User Guide Chapter for information on the "Driver.parm" and "Model.outList" configuration files.

4.2 Model domains

4.2.1 Spatial domain

The ELM can be applied at a variety of grid scale resolutions and extents without changing any source code. For an application at a particular spatial grain and/or extent, the following data files are used to define the model at the desired scale: 1) the appropriate grid resolution/extent of each of the map input files; 2) the grid resolution and geographic (upper left) origin in the two databases that define the canal/levee locations and water control structure attributes; and 3) the linked-list text file that maps coarser-grid data to the selected model application. The User Manual Chapter explains these steps needed to develop an application at a new spatial resolution/extent.

All spatial data are referenced to zone 17 of the Universal Transverse Mercator (UTM) geographic coordinate system, relative to the 1927 North American Datum (NAD).

4.2.1.1 Regional domain (infile = "ModArea")

The focus of this review is on the regional application of ELM to the greater Everglades region, from the northern Everglades marshes along the Everglades Agricultural Area to the mangroves along Florida Bay and the Gulf of Mexico. This region is generally restricted to the "natural" areas of the greater Everglades, including all of the Water Conservation Areas, Holey Land, Rotenberger Tract, most of Everglades National Park, and most of Big Cypress National Preserve (Figure 4.1). This regional application uses 1 km^2 square grid cells that encompass an area of 10,394 km^2 (4,013 mi^2). All of the maps of the regional application are bounded by the following rectangle of UTM coordinates in zone 17 (NAD 1927):

northing:	2,953,489 m
southing:	2,769,489 m
easting:	580,711 m
westing:	472,711 m

4.2.1.2 Subregional domains (infile = "ModArea")

The domains of existing sub-regional applications of the ELM are displayed in Figure 4.1. The grain of these subregional applications in the Rotenberger Tract and WCA-2A includes square grid dimensions of 100 m, 200 m, 500 m, and 1 km.

4.2.1.3 Multi-scale grid-mapping (input = "gridmapping.txt")

A variety of dynamic boundary condition data may be input from coarser model grids. The ELM v2.5 uses some dynamic boundary condition data (described in later sections) that are at the scale of the 2x2 mile (10.4 km^2) grid of the SFWMM. For regional or subregional applications of ELM, a "linked list" is generated to map boundary condition data from a coarse grid (usually that from the SFWMM) to the ELM grid. These data are generated from the pre-processor GridMap tool, and input to the ELM via the "gridmapping.txt" file.

4.2.1.4 Basins & Indicator Regions (input = "basins", "basinIR")

The map of the Basins and Indicator Regions (Figure 4.2) defines the spatial distribution of hydrologic Basins and Indicator Regions (BIR). These BIR spatial distinctions do not affect any model dynamics, but are used in summarizing nutrient & water budgets and selected ecological Performance Measures. Budgets and preset Performance Measure variables are output at the different spatial scales defined by the BIR. The Indicator Regions are particularly useful for summarizing model dynamics along ecological gradients.

The largest spatial unit is Basin 0, the "basin" of the entire domain. Hydrologic basins within the domain are regions with either complete restrictions on overland flows (such as Water Conservation Area 1 surrounded by levees) or partial restrictions of overland flows (i.e., Water Conservation Area 3A is bounded by levees except along part of its western boundary). Hydrologic basins are "parent" regions that (may) contain "child" Indicator Regions. Indicator Regions are drawn within a hydrologic basin boundary (but an Indicator Region may not belong to two parent basins). In reporting BIR output data, parent basins' data include (e.g., sum) the data on all child Indicator Regions contained within them. When re-drawing the BIR ("basins") map, the user must edit the "basinIR" text file that defines the inheritance characteristics and allowable surface flows of the BIRs (such as the flow allowed to/from Water Conservation Area 3A through the gap mentioned above).

4.2.2 Temporal domain

The ELM can be applied at a variety of time scales, depending on the objective and the availability of boundary condition data. The temporal extent of the historical period used in evaluating model performance (calibration/validation) is 1981 – 2000. The temporal extent of the available meteorological record (used in other CERP modeling efforts) is 1965 – 2000. As detailed later in this Chapter for each boundary condition data file, the temporal grain of these input data is 1-day. As described in the Model Structure chapter, the time step (dt) of the vertical solutions is 1-day, while the time step for horizontal solutions varies with the model grid resolution.

4.3 Initial condition maps

There are a number of map data files that are necessary to implement this spatially explicit landscape model. Those that are used in defining the initial conditions of the simulation were developed using the methods described below for each specific data set. Note that the initial conditions for some variables do not have individual input map files (see the descriptions of the Global and the Habitat-specific parameter databases).

4.3.1 Water depths

4.3.1.1 Surface water depth (input = "icSfWt")

Output from the ELMv2.1 calibrated hydrology (initialized Jan 1, 1979) provided a snapshot of Jan 1, 1981 for initial ponded surface water depth input to ELMv2.5 (Figure 4.3).

4.3.1.2 Unsaturated water depth (input = "icUnsat")

Output from the ELMv2.1 calibrated hydrology (initialized Jan 1, 1979) provided a snapshot of Jan 1, 1981 for initial unsaturated storage water depth input to ELMv2.5 (Figure 4.4).

4.3.2 Land surface elevation

We compiled a comprehensive topographic database that included the most up-to-date topographic point data from surveys distributed throughout the greater Everglades. The most extensive surveys, covering most of the greater Everglades, were conducted by the US Geological Survey (USGS) as part of their High Accuracy Elevation Data (HAED) Collection project (Desmond 2004). We used CORPSCON for Windows (v5.11.08) for conversion of horizontal and vertical datums where necessary. For each survey/basin, the ArcGIS (v8.3) TOPOGRID function (without drainage enforcement) was used to generate a Digital Elevation Model (DEM) at a 30 meter grid resolution. For the regional application of ELM, the individual DEMs for each basin were aggregated and mosaiced into a regional coverage (described below).

4.3.2.1 WCA1

Elevations data points were collected in 2004 under the USGS HAED project at 400-meter spacing using a variety of GPS-related techniques. Data were reported using the vertical datum NAVD88 and horizontal datum NAD83. Stated vertical accuracy of the original data was 15 cm overall. Figure 4.5 shows the 30 m DEM for the region.

4.3.2.2 WCA2A

From Oct 1992 to Feb 1993 fifteen iron pipe benchmarks were established throughout WCA2A for vertical and horizontal control by Keith and Schnars Surveyors. Hydrographic survey soundings were taken from the closest surveyed benchmark at 1/2 minute latitude/longitude grid locations. Vertical heights were based on sounding pole measurements ground referenced to water surface. The water surface elevation was determined based on the closest above-mentioned benchmark. Both peat and hard rock ground elevation were calculated. Data were reported using the NAVD88/NAD83 datums. Figure 4.6 shows the 30 m DEM for the region.

4.3.2.3 WCA2B

Because no updated fine-scale data were available, the elevation data used in the South Florida Water Management Model (SFWMM v5.4, 10.4 km^2 grids) were interpolated into 1 km^2 grids.

4.3.2.4 WCA3 North of I-75

LIDAR data was collected in 2000 by Earthdata Aviation Corporation under a USGS contract associated with their HAED project. During the time frame the area was experiencing drought conditions and had recently completely burned, which provided optimum conditions for collecting this type of data. Data was collected over a 5-meter grid system. Initial quality assurance checks using 153 data verification points resulted in an root mean square error of 0.19 m. Data were reported using the NAVD88/NAD83 datums. We removed artifacts in the proximity of roads/levees. Figure 4.7 shows the 30 m DEM for the region.

Recently (December 2005), the LIDAR data have been confirmed to have a bias, the magnitude of which may influence hydrologic modeling. The USGS anticipates that funding will become available during the summer of 2006 to acquire an improved elevation data set for this region using HAED methods.

4.3.2.5 Big Cypress National Preserve

This dataset was assembled by South Florida Water Management District staff for the Southwest Florida Feasibility Study project, using an existing District coverage and available toposheets. Data were reported using the NGVD29/NAD83 datums. Figure 4.8 shows the 30 m DEM for the region.

These elevation data are different from those used in the SFWMM v5.4, and this difference may be reflected in different model performance characteristics in the region. During the summer of 2006, the USGS may be funded to acquire HAED elevation data in parts of this region.

4.3.2.6 WCA3 South of I-75 and Everglades National Park

Elevations data points were collected from 2001 – 2003 as part of the USGS HAED project, with 400-meter sample point spacing using a variety of GPS-related techniques. Data were reported using the vertical datum NAVD88 and horizontal datum NAD83. Stated vertical accuracy of the original data was 15 cm overall. We removed artifacts in the proximity of roads/levees. Figure 4.8 shows the 30 m DEM for the region.

4.3.2.7 Holey Land

Water depth measurements were taken by the Florida Game and Fish Commission during a flat pool stage in 1992. Water depths were measured on a 0.5 minute latitude/longitude grid. Vertical distances were based on sounding pole measurements ground referenced to water surface. A total of 196 measurements were taken. Data were reported using the NGVD29/NAD27 datums. Figure 4.9 shows the 30 m DEM for the region.

4.3.2.8 Rotenberger Tract

Water depth measurements were taken by the Florida Game and Fish Commission during a flat pool stage in 1992. Water depths were measured on a 0.5 minute latitude/longitude grid. Vertical distances were based on sounding pole measurements ground referenced to water surface. A total of 136 measurements were taken. Data were reported in the NGVD29/NAD27 datums. Figure 4.10 shows the 30 m DEM for the region.

4.3.2.9 Regional map (input = "Elevation", "Bathymetry")

To generate the land surface elevation map for input to the regional ELM application, the fine-scale DEM in each basin was converted to a 1 km^2 grid resolution. In each basin, the 30 meter resolution DEM was filtered by averaging elevations in neighboring cells in a moving window of 1 km radius from the 30 meter cell. The filtered DEM was then aggregated into 1 km^2 ELM grid cells for the regional map (Figure 4.11). Because the ELM is set up to read positive values of input maps, negative values of elevation (i.e., approximately below sea level in NGVD 1929) were converted to positive values of creek/estuarine bathymetry as a separate map product.

4.3.3 Soils

Spatial maps of soil initial conditions were generated using standard Kriging, with a Spherical model, to interpolate spatial point observations on local variability within eight subregions. These subregions/basins were generally defined by levees: WCA-1, WCA-2, WCA-2B, WCA-3, WCA-3B, Rotenberger Tract, Holey Land, and the combined regions of Everglades National Park (ENP) and Big Cypress National Preserve (BCNP). Figure 4.12.shows locations of the spatial data points used to develop the maps of the soil variables. The following are the sources of the original data:

- WCA-1, 1991 survey, 94 points. (Reddy et al. 1993) (Newman et al. 1997)
- WCA-2A, 1990 survey, 74 points. (Reddy et al. 1991) (DeBusk et al. 1994)
- WCA-3A & WCA-3B, 1992 survey, 115 & 28 points, respectively. (Reddy et al. 1994a)
- Holey Land, 1993 survey, 36 points. (Reddy et al. 1994b, Newman et al. 1998)
- Rotenberger Tract, 1994 survey, 28 points. (Newman et al. 1998)
- Big Cypress National Preserve, Everglades National Park, and WCA-2B, 1995-1996 survey, 201 points. (Stober et al. 1998)

The initial condition of soils used in the model was within a homogenous zone from the soil/water interface down to 30 cm depth, or to the maximum depth of the peat layer. Interpolations were done by basin according to the following treatments:

- Aggregate 0 – 10 cm, 10-20 cm, and 20 – 30 cm layers of soil by arithmetic averaging
  - Vertical profile constraint: None
  - Basin: WCA-2
- Aggregate 0 – 10 cm with 10 – 20 cm layers of soil by double-weighting the 10-20 cm layer's mass, and arithmetic averaging
  - Vertical profile constraint: absence of 20 – 30 cm layer observations
  - Basins: WCA-1, WCA-3, WCA-3B, and Holey Land.
- Aggregate 0 – 10 cm layer of soil with estimated background levels for deeper layers, using 40 – 80 ug TP • cm^{-3} for layers down to a 30 cm depth, or to the greatest depth of the peat soil.
  - Vertical profile constraint: absence of 10 – 20 cm and 20 – 30 cm layer observations
  - Basins: WCA-2B, Rotenberger Tract, and Big Cypress/Everglades National Park.

4.3.3.1 Bulk density (input = "soilBD")

Soil bulk density was assumed constant for the simulation. Figure 4.13 shows the resulting map of the interpolated soil layer, with the following table containing the parameters in the kriging model.

Region	Number of Samples	Range	Nugget	Partial Sill	Sill
WCA1	85	14232	0.000260	0.000247	0.000506
WCA2A	74	17720	0.000277	0.000825	0.001102
WCA2B	11	9925	0.000245	0.004645	0.004891
ROTEN	31	2100	0.003905	0.005208	0.009113
HOLEY	36	11853	0.024584	0.022585	0.047169
WCA3	155	27893	0.012846	0.029237	0.042083
WCA3B	28	17720	0.000785	0.001280	0.002065
ENP/BCY	204	27893	0.024848	0.028166	0.053014

4.3.3.2 Organic bulk density (input = "soil_orgBD")

The organic bulk density is the bulk density of only the organic (ash-free) mass of the soil layer[2]. Figure 4.14 shows the resulting map of the interpolated soil layer, with the following table containing the parameters in the kriging model.

Region	Number of Samples	Range	Nugget	Partial Sill	Sill
WCA1	85	20590	0.000123	0.000111	0.000234
WCA2A	74	23707	0.000041	0.000111	0.000152
WCA2B	11	11359	0.000765	0.000495	0.001260
ROTEN	31	2091	0.000872	0.001875	0.002746
HOLEY	36	4962	0.000000	0.000200	0.000200
WCA3	155	39925	0.000158	0.000588	0.000745
WCA3B	28	9251	0.000288	0.000211	0.000500
ENP/BCY	204	17546	0.000603	0.000248	0.000852

4.3.3.3 Total phosphorus concentration (input = "soilTP")

The initial concentration of soil total phosphorus was estimated from observations of Davis (1989) in WCA-2A from the late 1970's[3], and data on the current concentration in deep soil layers (that are relatively un-impacted by recent anthropogenic inputs). Figure 4.15 shows the resulting map of the interpolated soil layer, with the following table containing the parameters in the kriging model.

[2] (1-(percent_ash/100))*soilBD, where percent_ash is the percent of ash weight relative to entire core weight

[3] Maximum in northern WCA-2A was approximately 300 mg TP kg^{-1}

Region	Number of Samples	Range	Nugget	Partial Sill	Sill
WCA1	85	19849	24196	8508	32704
WCA2A	74	9917	19385	52156	71541
WCA2B	10	9925	1114	1902	3015
ROTEN	31	5431	1001	1725	2726
HOLEY	36	3910	18676	7462	26138
WCA3	155	11849	9420	2720	12140
WCA3B	28	23707	5224	3822	9045
ENP/BCY	204	14508	14802	7374	22176

4.3.4 Vegetation

4.3.4.1 Habitat type (input = "HAB")

To create a regional habitat map, data from six major vegetation classification efforts were used (Figure 4.16):

- WCA-1, 1987 satellite interpretation. (Richardson et al. 1990)
- WCA-2A, 1995 photo interpretation. (Rutchey and Vilchek 1999)
- WCA-3, 1995 photo interpretation. (Rutchey et al. *in review*)
- Everglades National Park & Big Cypress National Preserve (ENP & BCNP), 1995 photo interpretation. (Welch et al. 1999)
- Rotenberger Tract, 1992 photo interpretation. SFWMD, unpublished data.
- Other subregions, 1995 FLUCCS photo interpretation. Unpublished update of FLUCCS (1985)

These photo-interpreted vegetation classes were aligned ("cross-walked") among the projects, and mosaiced into a fine scaled regional map. In this process, the more detailed vegetation classes from these studies were aggregated into more general classes. The map was then spatially aggregated to a 1 km^2 grid scale using majority-rules, producing a regional habitat map of 28 classes for the ELM domain (Figure 4.17).

Moreover, several map features were developed beyond those in the original observations. The distinct Ridge and Slough (RS) habitat in Shark River Slough of Everglades National Park was delineated by satellite-based habitat classes from the Florida Gap Analysis Project (GAP[4]). The landscape characteristics of the finer-scale RS heterogeneity in some of the more pristine RS habitats was captured at the 1-km^2 model scale by spatial pattern analyses. A moving window scanned across fine-scale (100 m) habitat data, and calculated an index of relative heterogeneity. This index was used to define the degraded vs. more pristine RS habitats. In the current ELM v2.5[5], the habitat succession module is not executed, and thus the habitat types remain constant during the simulation.

[4] **http://www.wec.ufl.edu/coop/GAP/lcmapping.htm**

[5] See Fitz and Sklar (1999) for ELM v1.0 habitat succession dynamics in WCA-2A.

4.3.4.2 Macrophyte biomass (input = "icMacBio")

The initial total carbon biomass (of photosynthetic and non-photosynthetic components) of macrophytes was estimated at approximately 25-35% of the habitat-specific maximum biomass (parameter in HabParms database), with the within-habitat variation based on the estimated soil nutrient gradient in 1981 (described above for soils). This coarse adjustment was made by running the model for one year (1981) under all of the other imposed initial and boundary conditions described above, and then using the resulting biomass for subsequent initial biomass conditions (Figure 4.18). An refined spatial map of initial biomass may be produced for future model versions, using an approach based on NDVI (Normalized Difference Vegetation Index) from available remote sensing products.

4.4 Static attributes

4.4.1 Water management infrastructure

4.4.1.1 Canal and levee network (input = "CanalData.chan")

The canals and associated levees are defined in a text data file (CanalData.chan) that is input to the model. This data file provides attributes of precise geographic canal-reach vector locations and the multiple attributes of these canal reaches. The file is created/maintained using a vector-capable GIS (GRASS). Scripts are used to input the data into the GRASS GIS for any desired pre-processing, including visualization.

All geographic coordinates use (the metric units of) UTM zone 17, North American Datum of 1927. In ELMv2.5, there are over 90 individual canal reaches, each identified by a numeric ID. Figure 4.19 displays the canal reach topology for the entire domain of the regional implementation. In the southern Everglades, tidal creeks (and open water tidal boundaries) are represented with these vector hydrologic attributes (with tidal inputs described in a later section). Increased detail in Water Conservation Areas 1 and 2 is shown in Figure 4.20, and Figure 4.21 shows the increased detail needed in northern Water Conservation Area 3A.

The format of the file is detailed in its associated metadata file, "CanalData.chan.info". A canal reach is defined as a continuous vector object, usually (but not necessarily) associated with an upstream and a downstream water control structure. A reach is comprised of one or more line segments using geographic (UTM) coordinates for each beginning and ending point of a segment. Thus, a canal reach may be as simple as a straight line, or have the complexity of rounded curves or angular bends. The attributes defined for each canal reach are assumed to be homogenous along its entire length.

- Levee location: proceeding from first coordinate in the reach coordinate list to the last in the list, the levee location attributes are integers as follows:
    - 1 = levee is to left of canal
    - 0 = levee is not present (no levee)
    - -1 = levee is to right of canal
    - 2 = levees are on both sides of canal
- Depth (m) of the canal reach, from canal bottom to rim of canal

- Width (m) of the canal reach (square cross-sections only); a NEGATIVE width indicates that the canal reach is inoperative (ignored)
- Seepage coefficient, or hydraulic conductivity of levee (m/d)
- Initial salt/tracer concentration (g/L)
- Initial total phosphorus (TP) concentration (mg/L)
- Initial water depth (m)
- Surface roughness associated with any lip/berm along a reach (d/(m^(1/3)))
- Identifier of the hydrologic basin with which the reach has overland flow interactions (does not effect flux calculations, used only in budget summaries)
- Comments on the canal reach, including brief description of location and usage

4.4.1.2 Water control structures (input = "CanalData.struct")

The attributes of all water control structures are maintained in a relational database using "FilemakerPro" software. This FilemakerPro database, "Structs_attr_v2.5.fmp", is found in the ./SME/Projects/Dbases directory. The database allows the user to select the scenario/alternative that is to be simulated, such as a historical calibration run or an Alternative to be evaluated for projects such as CERP. The functionality of the database greatly simplifies the development of new water management alternatives for Project evaluations, and includes capabilities such as the calculation of grid cell locations for any model scale (grain and extent) using geographic coordinates.

After making the simple query to select the water control structures for the desired simulation, the data are exported into a plain text file for input to the model. Figure 4.22 displays a database snapshot of the attributes for all of the water control structures used in the historical (calibration/validation) runs of ELM v2.5.

The text input file, CanalData.struct, provides attributes of all water control structures used in the model. This text input file is created/maintained using the relational database. Significantly more details on the attributes are found in the relational database; the text metadata CanalData.struct.info file provides basic descriptions of the data fields for each water control structure (record) that is input to the model.

The following are field descriptors for this input file:

- *Driver*: integer attribute indicating how model uses the structure:
    - -1 = structure is inoperative, ignored in the model
    - 0 = structure is a calculated virtual structure (rule-based, not driven by input data time series)
    - 1 = structure is driven by a time series of data, either observed data or data from another model
    - >1 = structure is an aggregated (total, summed) flow generally for a group of structures (e.g., S11=sum of S11A, S11B, S11C), and that flow is disaggregated into equal partitions: integer 2-9 (e.g., "2" for S11 total flow) denotes a structure holding the aggregated flow, while 10x that single-digit integer (e.g., "20" for each of S11A, S11B, S11C) denotes one of multiple structures that will have equal-partitions of the total flow (e.g., S11A, S11B, S11C flow will each be 1/3 of the total S11 flow, and applied in the correct spatial location)

- *aaName*: name of structure as used in model
- *TP*: Total Phosphorus concentration (ug/L) associated with water flows at this structure; a number denotes the constant concentration to apply to all flows, while the string "tser" denotes that the structure is expected to have time-series data (in "CanalData.struct_TP") for each daily flow value
- *TN*: Total Nitrogen concentration (ignored/unused)
- *TS*: Total Salt/tracer concentration (g/L) associated with water flows at this structure; a number denotes the constant concentration to apply to all flows, while the string "tser" denotes that the structure is expected to have time-series data (in "CanalData.struct_TS") for each daily flow value
- *St_N*: Structure location, the Northing (row) grid cell number (used only to obtain land surface elevation for virtual structure calculations)
- *St_E*: structure location, the Easting (column) grid cell number (used only to obtain land surface elevation for virtual structure calculations)
- *C-fr*: Canal from (i.e., source) which water flows through this structure (or blank)
- *C-to*: Canal to (i.e., destination) which water flows through this structure (or blank)
- *ClNfr*: Northing grid Cell number (row) from (i.e., source) which water flows through this structure (or blank)
- *ClEfr*: Easting grid Cell number (column) from (i.e., source) which water flows through this structure (or blank)
- *ClNto*: Northing grid Cell number (row) to (i.e., destination) which water flows through this structure (or blank)
- *ClEto*: Easting grid Cell number (column) to (i.e., destination) which water flows through this structure (or blank)
- *HW*: HeadWater (source) stage (numeric values unused/obsolete); only use is in tide-based virtual structures, containing text string which identifies the CanalData.graph headwater time series of stage
- *TW*: TailWater (destination) stage (numeric values unused/obsolete); only use is in tide-based virtual structures, containing text string which identifies the CanalData.graph headwater time series of stage
- *ClHWN*: Unused
- *ClHWE*: Unused
- *ClTWN*: Northing grid cell row number to check for tailwater depth in boundary condition virtual structures
- *ClTWE*: Easting grid cell column number to check for tailwater depth in boundary condition virtual structures
- *Flow_c*: Flow coefficient (m^3/d), used only in virtual structure flow calculations; originally a weir-flow calculation, value is currently just a large number to accommodate nearly-instantaneous flow of the volumetric flow potential

4.4.2 Model parameters

Because the ELM is a spatially distributed model of the fundamental properties of ecosystems, it necessarily uses a relatively large number of parameters to define rates, initial conditions, and various other system attributes. The parameters are not "hard-coded" into the model source code, but organized within user-friendly databases. To accurately communicate the data requirements of the model, the parameters should first be classified according to their spatial distributions, their importance in influencing model results, and according to the degree to which they can be supported by available research.

Their spatial distribution, if any, is a fundamental component of these data. There are no more than approximately 40 individual parameters that are important to model results and that impose data acquisition needs. Some of these parameters are distributed in some spatial context. The spatial distributions range from those that are spatially-constant, those that are distributed among habitat types across the landscape, and parameters that are distributed among individual grid cells across the landscape. A previous section (describing the water management network) documented the parameter attributes of the water control structures and canal/levee vectors. The remaining ecological parameters in the three spatial classes are documented in the following sections.

While there are decades of monitoring and research activities in the greater Everglades, the past 5-10 years has dramatically increased our knowledge of system properties. Many of the parameters in use in the current ELM v2.5 have not been updated from ELM v2.1, and we anticipate that the next version of ELM will significantly advance our synthesis of this base of knowledge of the Everglades.

4.4.2.1 Global parameters (input = "GlobalParms_NOM")

Global parameters are those that apply uniformly throughout the spatial domain of the model. These parameters are documented and maintained within the OpenOffice (= MS Excel) database/workbook "GlobalParms_v2.5.xls". This parameter database contains the following fields for each parameter:

- *Rank*: a ranking of the relative importance (sensitivity) of each parameter
- *Parameter name*: the name of the parameter as used in model code
- *Nominal Value:* the value of the parameter that was selected by the user
- *Units:* the units used in the numeric value of the parameter
- *Default Value*: the default value used in calibrating/validating the current ELM
- *diff?:* A warning flag to denote the selected value of differs from the default value
- *Brief documentation:* brief description of the parameter definition
- *Extended documentation:* extended description of the parameter, including applicable literature sources.

Figure 4.23 shows a snapshot of the primary worksheet used in this database, including all of the global parameters. The GlobalParms_v2.5.xls database also contains worksheets (not displayed here) that automate the selection of high and low values of the parameters that are used in the automated sensitivity analysis (whose results are described in the Uncertainty Chapter, with instructions on user-implementation in the User's Guide Chapter). Of the 70 global parameters, 30 are unused or not intended to be modified except in model sensitivity experiments. A total of 23 of the 70 global parameters have the potential to affect, to at least a very small but observable extent, the hydrologic and water quality Performance Measures being considered[6] (see Uncertainty Chapter). Six of those 23 potentially- important parameters have significant effects on multiple Performance Measures.

4.4.2.2 Habitat-specific parameters (input = "HabParms_NOM")

Habitat-specific parameters are those that apply only to the specified habitat type within spatial domain of the model. These parameters are documented and maintained within the OpenOffice (= MS Excel) database/workbook "HabParms_v2.5.xls". This database is somewhat more complex than that of the GlobalParms, with multiple parameters per record (a record with multiple parameter fields for each habitat) compared to one parameter per record in the former. This parameter database contains the following fields for each parameter:

- *Rank*: a ranking of the relative importance (sensitivity) of each parameter
- *Parameter name*: the name of the parameter as used in model code
- *Nominal Value:* the value of the parameter that was selected by the user
- *Units:* the units used in the numeric value of the parameter
- *Documentation:* description of the parameter, including applicable literature sources.

Figure 4.24 shows a snapshot of the primary documentation (definitions) worksheet used in this database, with all of the parameters listed. The OpenOffice/Excel (HabParms_v2.5.xls) database can be used to view the parameter values and their associated documentation. The database also contains worksheets that automate the selection of high and low values of the parameters, used in the automated sensitivity analysis (whose results are described in the Uncertainty Chapter, with instructions on user-implementation in the User's Guide Chapter). Of the 40 habitat-specific parameters, 5 are unused in this version of the model. A total of 13 of the 40 habitat-specific parameters have the potential to affect, to at least a very small but observable extent, the hydrologic and water quality Performance Measures being considered[7]. Of those 13 "important" parameters, one (1) has significant effects on multiple Performance Measures.

While each of the 40 habitat-specific parameters may have unique values for each of 28 habitats considered in the model (i.e., 1120 potentially unique values), such unique-by-each-habitat distributions do not exist for any of the parameters. The actual number of unique parameter values in the entire matrix is less than 140 (calculated in HabParms_v2.5.xls), with the most complex distribution of a single parameter across habitats having unique values for less than half of the habitats. When considering only the 13 "important" parameters, the actual number of unique values is 64, across all 28 habitats. Finally, only half (14) of the total number of habitats comprise >90% of the region of the ELM domain. Thus, in general, *there is, in total, on the order of several dozen unique-by-habitat values that may be important to quantify for model application*.

[6] Those performance measures are water depth, and TP concentration in surface and in pore water. For details on the analyses, see the Sensitivity Analysis section of the Uncertainty chapter of this documentation.
[7] Ibid.

Of those parameters that we do assign unique values, basic field observations are used to support the parameter values. Generally, habitat-distributions of parameters are limited to differences among broadly defined ecosystem types involving *sedge*, *forest, savannah, and scrub* type habitats. Within an ecosystem type, any (usually limited) variation employs simple field-supported modifications of parameters according to the following: 1) slight modifications of maximum macrophyte biomass and related parameters along a gradient (e.g., the 3 cattail habitats of high, medium, and low density), 2) replication of data from one habitat type to values for a similar habitat, differing in one or two primary attributes (e.g., from a simplistic perspective, *Juncus* and *Cladium* could differ primarily in salt tolerance, with some limited structural parameter differences), and 3) specific field research and monitoring data that supports the use of distinctions among the attributes of different habitats.

Instead of supporting a parameter database that includes such a large number (28) of habitat types for 40 parameters (in a 2D array of parameters), we could obtain the same or similar model results in the current water-quality oriented version by simply not including all of the fundamental habitat types. This is attractive in terms of reducing the apparent complexity of the ELM via a smaller 2D array of parameters, but would do little to decrease the actual complexity in terms of the data that currently populates the 2D array of parameters. As discussed, the large majority of parameter values are the same for multiple habitat types, and thus the numerical complexity of such a large array is never realized. Moreover, a reduction of the number of habitat types would require increased maintenance of spatial and parameter databases, as future model updates include increased levels of differentiation among ecological dynamics of soils, periphyton, macrophytes, and habitat succession. Whereas we can currently simply improve the parameter values as data become available, the alternative is to incrementally modify both the habitat type map and the number of records supported in the database. The bottom line: from a model development and refinement perspective, it is attractive to maintain the two-dozen habitat types currently defined as the minimum (that only begins) to represent the regional heterogeneity across the greater Everglades.

We have taken a *simple approach that generally assumes a high degree of similarity among most habitats, while providing a database mechanism to recognize differences in attributes where they are important,* either currently or in the future. Regardless of the database implementation of habitat-specific parameters, that assumption of broadly-based habitat-similarity will remain until increased knowledge supports more refined distinctions in the heterogeneity of the greater Everglades.

4.4.2.3 Aquifer hydraulic conductivity (input = "HydrCond")

The map of hydraulic conductivity (Figure 4.25) used in the groundwater flux calculations is a static, spatially distributed parameter (i.e., can potentially have unique values for each of 10,394 grid cells). The hydraulic conductivity (permeability) and aquifer depth data are the same input data used in the (10.4 km^2 grid of) SFWMM v5.4, interpolated to the 1 km^2 ELM grid. Because the base datum (below 0 m NGVD 1929 sea level) used in ELM is chosen to be 6.0 meters (changeable in the GlobalParms database), the hydraulic conductivity was modified to account for the extent to which surficial aquifer depth exceeds the ELM base datum depth: the hydraulic conductivity was multiplied by the ratio of the aquifer depth to the ELM base datum depth.

4.5 Boundary conditions

4.5.1 Meteorological

4.5.1.1 Rain (input = “rain.BIN”)

Rainfall input to the model is the spatial time series data developed by SFWMD staff for use in regional models such as the South Florida Water Management Model (SFWMM) and Regional Simulation Model. The data file used in ELM v2.5 was “rain_v2.0_nsm_wmm.bin”, identical to the data used in the SFWMM v5.4 (but renamed for ELM input). The 2 dimensional grid data has a ~10.4 km2 grid cell resolution (2 miles by 2 miles). The spatial extent encompasses most of the ELM domain; in the southwest Everglades (mangrove region), missing data were filled in with the nearest grid cell to the easterly direction that contained data. The temporal resolution is daily summed rainfall. The temporal extent spans the period 1965-2000 (inclusive). A variety of techniques were used to accommodate missing data and to spatially interpolate (using a Triangular Irregular Network method) observations at point rainfall monitoring locations. Details on methods used to generate the data are available in the SFWMM v.5.4 documentation.

4.5.1.2 Evapotranspiration (input = “ETp.BIN”)

Potential evapotranspiration (ETp) input to the model is the spatial time series data developed by SFWMD staff for use in regional models such as the South Florida Water Management Model (SFWMM) and Regional Simulation Model. The “grid_io” format data file used in ELM v2.5 was “ETp_recomputed_tin_wmmgrid.bin”, identical to the data used in the SFWMM v5.4 (but renamed for ELM input). The 2 dimensional grid data has a ~10.4 km2 grid cell resolution (2 miles by 2 miles). The spatial extent encompasses most of the ELM domain; in the southwest Everglades (mangrove region), missing data were filled in with the nearest grid cell to the easterly direction that contained data. The temporal resolution is daily summed potential evapotranspiration. The temporal extent spans the period 1965-2000 (inclusive). A variety of techniques were used to accommodate missing data and to spatially interpolate (using a Triangular Irregular Network method) observations at point ETp monitoring locations. Details on methods used to generate the data are available in the SFWMM v.5.4 documentation.

4.5.2 Hydrologic

4.5.2.1 Flow constraints (input =”BoundCond”)

Figure 4.26 shows the input map that defines the type of boundary flow calculations (groundwater and/or surface water) that were allowed along the ELM domain border.

4.5.2.2 Stage/depth (input = “BoundCond_stage.BIN”)

Using output from the SFWMM v5.4 calibration and verification runs (1981-2000), we obtained daily water depths from SFWMM grid cells that were adjacent to the ELM boundary grid cells. The positive (above land surface) or negative (below land surface) water depths were used (Model Structure Chapter) in head-based flow calculations along this domain boundary. These calculated cell-to-cell flows are in addition to the (imposed) flows through managed water control structures that are described in a subsequent section of this Chapter.

4.5.2.3 Tidal height (input = "CanalData.graph")

In the southern and southwestern region bordering Florida Bay and the Gulf of Mexico Figure 4.26, boundary flows were mediated by tidal exchanges with major rivers/creeks and estuaries. For ELM v2.5, the tide (stage) heights were simply annually-repeating, monthly mean tide heights (using the same concept as input data to the SFWMM v5.4). We used a development version (April 2006) of the data used in the South Florida Regional Simulation Model (SFRSM) development. Daily (NOAA predictions of) tidal amplitudes were summarized into monthly mean values at three locations: Everglades City (northern mangrove region), Flamingo (central/western Florida Bay), and Manatee Bay (extreme-eastern Florida Bay[8]). The tidal fluctuations were input to "virtual structures" (see Model Structure Chapter) to impose tide heights onto the boundary vectors. (Monthly data points were interpolated to daily values within the model). The model boundary vectors along the Florida Bay and Gulf of Mexico exchanged flows with interior river/creek vectors via inter-reach virtual structures.

The spatial distribution of tide observations may be input to any discretizaton of the vectors and virtual structures, and longer periods of observation may also be incorporated. However, the freshwater stage gages that we current target for evaluating model performance were at significant distances from tidal sources (see Performance Assessment Chapter), and the model results at the currently targeted gage locations were relatively insensitive to increases or decreases in tidal amplitude. As indicated in the Chapter on Model Refinements, we anticipate extending the formal evaluation of the model into the mangrove-dominated regions, acquiring enhanced data sets to drive the tidal dynamics.

4.5.2.4 Managed flows (input = "CanalData.struct_wat")

All water flows through managed water control structures within the model domain were "imposed" as data-derived, daily forgings. Historical flows through managed water control structures for the 1981 – 2000 period of record were obtained from the SFWMD "DBHYDRO" database (SFWMD 2005). As described elsewhere (Akpoji et al. 2003) (Damisse and Raymond 2000), these flows were derived from either direct flow estimates through pump structures, or calibrated flow estimates based on head and tail waters at structures such as weirs. With the exceptions noted below, all data were extracted[9] using a database field identifier ("dbkey") that denoted data that had undergone extensive quality assurance/control for use in regional modeling, and especially for the SFWMM.

There were two types of exceptions to the direct use of historical data found in that regional modeling dbkey of DBHYDRO: 1) cases where (flows through) multiple water control structures were aggregated into a single "structure" flow for regional modeling; and 2) cases where observed data were either unavailable in the database or known to be unreliable/inaccurate.

[8] this station is east of US Highway 1, and its direct application to ELM boundary conditions in Florida Bay may need further refinement.
[9] all data with database revision date on or before 09/05/2003

There were two cases in which it was necessary to disaggregate a single combined flow into multiple flows through separate structures. This was considered important because the actual structures were separated by distances on the order of 5-10 km, and the nutrient flows associated with individual (disaggregated) structures had concomitant spatial distinctions that were important to ecological dynamics. One such combined flow was that of the S10 structures (S10A + S10C + S10D), and the other combined flow was that of the S11 structures (S11A + S11B + S11C). We partitioned the S10 total flow into separate S10A, S10C, and S10D flows according to the daily flow ratios found in another database field identifier ("preferred" dbkey) for each individual structure. Similar calculations were done for the S11 combined flow, partitioning that into separate S11A, S11B, and S11C flows. Thus, the sum of the disaggregated flows for each set of structures remained consistent with the flow data that was quality-assured for regional modeling purposes, while maintaining the actual relative differences among individual structures.

The other type of exception to use of historical flows from the DBHYDRO database involved structures with either extensive missing data, or data that was found to be inaccurate after extensive checking by data users and/or other regional modeling efforts (Santee *pers. comm.*). For the ELM v2.5 historical simulation, we used water control structure flows from the SFWMM v5.4 in a number of cases. In some cases such as S-339 and S-340 (in WCA-3A), the data are known to have extensive missing data and/or erroneous flow estimate calculations (likely due, for example, to difficulties in site access). For ELM v2.5, any water control structure flow that was available as output from the SFWMM v5.4 was used in place of the data from DBHYDRO.

Table 4.1 provides the names of all of the managed water control structure flows that were used in ELM v2.5 simulations, and denotes whether the data source was that of DBHYDRO or SFWMM calculations (including the "dbkey").

4.5.3 Nutrient/constituent inflows

4.5.3.1 Atmospheric nutrient deposition

To estimate atmospheric deposition of total phosphorus (TP) into the model domain, we applied a spatially- and temporally- constant concentration of total phosphorus to all rainfall events. With the rainfall distributed heterogeneously across time and space, the concentration was selected[10] that resulted in a long-term mean deposition rate of approximately 25 mg-TP m^{-2} yr^{-1}. This rate is consistent with that used by Walker (1993), and is intermediate between low values (ca. 10-15 mg-TP m^{-2} yr^{-1}) reported in the interior of the Everglades (Ahn and James 2001) (Walker 1999), and higher values (ca. 30-50 mg-TP m^{-2} yr^{-1}) reported outside of the periphery of the Everglades (Ahn and James 2001).

For use in versions subsequent to ELM v2.5, we further analyzed the Everglades data (Walker 1999) (Ahn and James 2001) to develop a spatially distributed model of the long-term daily mean total (wet plus dry) deposition. This deposition rate will be applied

[10] GlobalParms database parameter "TP_IN_RAIN" = 0.20 mg/L

as a single map of the daily deposition rate that is distributed relative to the apparent local sources.

4.5.3.2 Phosphorus in structure inflows (input = "CanalData.struct_TP")

The concentration of nutrients and other constituents (i.e., chloride) must be known for the water volumes associated with all flows through water control structures. Total phosphorus (TP) concentration in the source water is always known (via internal model calculations) for all structure flows whose source waters are within the active domain of the model. For flows whose source water was external to the model domain, the concentration associated with each daily flow volume was imposed through input time series data.

For these inflow structures, we obtained estimates of the TP concentrations for all daily inflow volumes. A major constraint on developing this ~continuous time series of concentration was the (generally) very low frequency of water quality sampling relative to the much more continuous characteristic of water flow. Some sites in this region were monitored for water quality strictly through the use of "grab" samples that were intended to be made at the regular intervals of bi-weekly, monthly, or even longer periods. Very frequently, however, the sampling intervals varied widely among the years and among monitoring sites. Some of the more "important" sites also had automatic composite (over multiple days) sampling devices for water quality, but these autosamplers also had discontinuous records. Thus, regardless of the sampling methods, there were significant temporal gaps in the data records during the historical period of record. These gaps in the time series of concentrations were filled in using the best available method, as described below.

The SFWMD "Load Program" (Mo et al. 2003) was used (Germain pers. comm.) to develop a daily concentration time series for each inflow structure. In deriving daily concentration estimates for any given monitoring site, the "Load Program" 1) preferentially used the daily automated composite samples, if available; and 2) when temporal gaps were encountered in the targeted daily time series, linear interpolations of concentration were made between the two nearest points of autosampler data or grab sample data, depending on availability. In the (relatively limited number of) cases where no concentration estimate was available for an earlier date, the long-term mean concentration was applied uniformly across the initial time gap. In one instance (at the structure G155_W), there was no water quality monitoring associated directly with the flow monitoring site. In this case, the concentration from the upstream L3 (1/1/1981–10/29/1984) and L3BRS (10/30/1984 – 12/31/2000) sites were used in the "Load Program" to estimate the concentration associated with G155_W flows.

The time series of daily concentrations that were obtained with these methods were the best available for this modeling effort, or for any other project that requires estimates of ~continuous nutrient loading to the Everglades. However, *it is critical that users understand the significant uncertainties that these data impart to models or other projects*, particularly at time scales shorter than seasonal or annual. In the Uncertainty Chapter of this documentation, we analyze and discuss how to best understand and make use of these data.

4.5.3.3 Chloride in structure inflows (input = "CanalData.struct_TS")

Another water quality constituent in the ELM is chloride, which is used as a conservative tracer that is input to the model domain solely via water control structures. The concentration of chloride must be known for the water volumes associated with all flows through water control structures. Chloride (CL) concentration in the source water is always known (via internal model calculations) for all structure flows whose source waters are within the active domain of the model. For flows whose source water was external to the model domain, the concentration associated with each daily flow volume was imposed through input time series data.

For these inflow structures, we obtained estimates of the CL concentrations for all daily inflow volumes. A major constraint on developing this ~continuous time series of concentration was the (generally) very low frequency of water quality sampling relative to the much more continuous characteristic of water flow. To obtain daily estimates of CL concentrations, we used the same interpolation methods described above for the phosphorus inputs.

The time series of daily concentrations that were obtained with these methods were the best available for this modeling effort, or for any other project that requires estimates of ~continuous constituent loading to the Everglades. However, <u>*it is critical that users understand the significant uncertainties that these data impart to models or other projects*</u>, particularly at time scales shorter than seasonal or annual. In the Uncertainty Chapter of this documentation, we analyze and discuss how to best understand and make use of these data.

4.6 Performance assessment targets

4.6.1 Hydrologic

4.6.1.1 Stage

Daily observations of stage height (water surface elevation) in marsh monitoring sites were retrieved from the SFWMD DBHYDRO database (SFWMD 2005). These target stage data are the same as those used in assessing the performance of the SFWMM v5.4. The locations of these stage monitoring sites are shown in the Model Performance Chapter, in which we compare model predictions to the observed data.

4.6.2 Water quality

4.6.2.1 Surface water quality constituents

Observations of the water quality constituent concentrations in the water column at water control structure, marsh, and canal monitoring sites were retrieved for total phosphorus (TP) (Hill pers. comm.) and chloride (CL) from the water quality database associated with the SFWMD DBHYDRO database (SFWMD 2005). A summary of these phosphorus data is in Table 4.6.2.1. The locations of these water quality monitoring sites are shown in the Model Performance Chapter, in which we compare model predictions to the observed data.

4.6.3 Ecological

4.6.3.1 Other ecological targets

A variety of other ecological data were acquired from the SFWMD Everglades Division ERDP database. For ELM v2.5, these primarily included additional water column constituent concentration data at the research transects in Water Conservation Area 2A. As noted in the Model Performance Chapter, other specific ecological attributes were summarized from published literature sources.

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4.8 Tables

Three tables (4.1 – 4.3) follow.

Table 4.1. Water control structure names as used in the ELM/SFWMM, with the name & database code used in the DBHYDRO database. The source of daily flow data used in ELM v2.2 - v2.5 simulations is indicated in the last column: "SFWMMv5" indicates use of simulated flows output from the SFWMM v5.4, while "ELMv2.2" indicates the use of the observed data.

Flows updated in the database				Flows used in ELM v2.4 Model Run	
Name	**Sources**			ELMv2.4	sources
ELM dataset	DBKeys	DBHYDRO	Note		
ACME1	PI317	ACME1		ACME12	SFWMMv5
ACME2	PI318	ACME2			
ACMWS	PI321	ACME12WS		ACMWS	SFWMMv5
G155	P1039	G155_W		G155	ELMv22
G204	P1042	G204		G204	SFWMMv5
G205	P1043	G205		G205	SFWMMv5
G206	P1044	G206		G206	SFWMMv5
G250_P	P1046	G250_P		G250_P	ELMv22
G251	P1047	G251_P		G251	ELMv22
G310	M2901	G310		G310	ELMv22
HLYQIN	P1040	G200A_P		HLYQIN	ELMv22
L28WQ	P0974	S190		L28WQ	SFWMMv5
LWDD	P1064	LWDDSUMQ		LWDD	ELMv22
				NSIMP2	SFWMMv5
				NSIMP3	SFWMMv5
				RTECV1	SFWMMv5
				RTECV2	SFWMMv5
S10A	P0795_15261	S10	S10 total(P0795) were distributed according to the ratios of S10 ACD (DBKeys15261,15262,15263)	S10A	ELMv22
S10C	P0795_15262	S10		S10C	ELMv22
S10D	P0795_15263	S10		S10D	ELMv22
S10E	P1066	S10E		S10E	ELMv22
S11A	P1067_15258_JJ856	S11_T	S11 total(P1067) were distributed according to the ratios of S11ABC (DBKeys 1558, 15259, 15260)	S11A	ELMv22
S11B	P1067_15259	S11_T		S11B	ELMv22
S11C	P1067_15260	S11_T		S11C	ELMv22
S-12A	P0796	S12A		S-12A	ELMv22
S-12B	P0950	S12B		S-12B	ELMv22
S-12C	P0951	S12C		S-12C	ELMv22
S-12D	P0952	S12D_S		S-12D	ELMv22
S140A	P0956	S140		S140A	SFWMMv5
				S142E	SFWMMv5
				S142W	SFWMMv5
S143	P0957	S143		S143	ELMv22
S144	P0958	S144_C		S144	ELMv22
S145	P0959	S145_C		S145	ELMv22
S146	P0960	S146		S146	ELMv22
S150	P0961	S150		S150	ELMv22
S151	P0962	S151		S151	ELMv22
S175	P0969	S175		S175	SFWMMv5
S18C	P0973	S18C		S18C	SFWMMv5
S197	P0978	S197_C		S197	SFWMMv5
S31	P0991	S31		S31	SFWMMv5
S332	P0994	S332		S332	SFWMMv5
S333	P0997	S333		S333	ELMv22
S334	P0998	S334		S334	ELMv22
S337	P1001	S337_C		S337	SFWMMv5
	P1003	S339_S		S339	SFWMMv5
S34	P1004	S34	DBHYDRO rev .2003/09	S34	ELMv22
	P1005	S340_S		S340	SFWMMv5
S343	P1006	S343_T		S343	SFWMMv5
S344	P1007	S344		S344	SFWMMv5
S38	P1011	S38		S38	SFWMMv5
S39	P1012	S39		S39	ELMv22
S5A2NO	P1016	S5A+S5AS_T	Negtive (S5A+S5AS_T)	S5A2NO	SFWMMv5
S5A2SO	P1016	S5A+S5AS_T	Positive (S5A+S5AS_T)	S5A2SO	SFWMMv5
S6in	P1019	S6	Positive S6	S6in	ELMv22

Table 4.2. Summary of total phosphorus concentration data at boundary inflow sites.

Station	Sample Date		Number of Days Sampled	Mean Sample Frequency (Day)	TP (ug/l)				
	Start	End			Mean	Median	Min	Max	Std Dev
ACME1DS	2/5/1997	12/18/2000	48	29	87	71	35	348	52
ENR012	12/16/1993	12/28/2000	393	7	26	21	8.5	630	32
G200	7/26/1989	12/27/2000	285	15	62	49	5	423	47
G310	6/1/2000	12/28/2000	30	7	32	26	14	84.5	18
G94D	2/5/1997	12/18/2000	54	26	105	98	21	263	54
L28I	1/3/1979	10/16/2000	277	29	61	45	12	666	58
L3BRS	10/30/1984	12/27/2000	217	27	119	94	20	514	85
S140	1/3/1979	12/28/2000	431	19	62	43	4	688	68
S150	1/2/1979	12/26/2000	359	22	57	49	8	679	47
S175	5/2/1995	12/20/2000	150	14	7	6	4	18	3
S18C	10/5/1983	12/20/2000	368	17	8	7	1	59	6
S332	10/5/1983	12/20/2000	454	14	9	7	4	57	7
S332D	6/16/1999	12/28/2000	94	6	7	6	2	33	4
S5A	1/2/1979	12/28/2000	682	12	155	141	4	550.5	83
S6	1/2/1979	12/28/2000	729	11	89	72	12	872	78
S7	1/2/1979	12/26/2000	674	12	75	61	10	1030	63
S8	1/2/1979	12/27/2000	782	10	95	69	4	1286	94
S9	1/3/1979	12/26/2000	518	15	17	14	3	172	14

Table 4.3. Summary of observed data on total phosphorus concentrations

Station	Sample Date		Number of Days Sampled	Mean Sample Frequency (Day)	TP (ug/l)				
	Start	End			Mean	Median	Min	Max	Std Dev
217	1/10/1979	8/27/1986	47	59	11	8	2	52	9
B-2	1/10/1979	5/14/1991	35	129	197	134	17	719	181
B-5	1/10/1979	8/26/1986	43	65	41	20	5	232	46
C123SR84	1/27/1988	12/12/2000	159	30	47	38	7	262	34
CA210	3/28/1979	2/21/1984	30	60	12	10	2	48	11
CA211	3/28/1979	2/21/1984	31	58	23	14	2	138	28
CA212	3/28/1979	2/21/1984	31	58	74	34	5	989	173
CA213	3/28/1979	2/21/1984	30	60	13	10	5	40	8
CA214	3/28/1979	2/21/1984	30	60	20	8	4	199	41
CA215	8/9/1994	12/19/2000	125	19	6	6	1	48	4
CA216	3/28/1979	11/30/1983	25	68	23	12	2	144	34
CA217	3/28/1979	2/21/1984	28	64	13	10	3	92	17
CA218	3/28/1979	2/21/1984	30	60	11	8	2	43	10
CA219	3/28/1979	2/21/1984	30	60	19	6	2	307	55
CA220	3/28/1979	2/21/1984	31	58	14	9	2	122	21
CA221	3/28/1979	2/21/1984	32	56	13	7	3	100	18
CA23	3/28/1979	2/21/1984	30	60	103	89	46	216	47
CA24	3/28/1979	2/21/1984	29	62	169	133	40	771	152
CA25	3/28/1979	2/21/1984	26	69	166	130	23	646	144
CA26	3/28/1979	11/30/1983	26	66	17	11	5	73	15
CA27	6/28/1994	11/20/2000	121	19	11	9	4	83	9
CA28	6/28/1994	10/23/2000	103	22	105	79	22	509	81
CA29	8/9/1994	11/20/2000	122	19	8	7	2	90	8
CA311	6/16/1994	12/19/2000	140	17	6	5	1	36	4
CA315	6/16/1994	12/19/2000	147	16	6	6	1	17	3
CA32	6/29/1994	12/4/2000	110	21	9	8	4	94	9
CA33	5/20/1994	12/19/2000	105	23	13	10	5	62	8
CA34	6/16/1994	11/21/2000	118	20	10	9	3	70	8
CA35	6/29/1994	11/8/2000	81	29	12	10	3	55	8
CA36	6/16/1994	9/14/2000	111	21	31	24	9	192	25
CA38	6/16/1994	12/5/2000	120	20	8	7	1	103	11
COOPERTI	5/9/1991	12/19/2000	228	15	11	11	4	41	5
ENR002	12/16/1993	12/28/2000	378	7	100	93	8	677	64
EP	10/27/1986	12/19/2000	121	43	6	4	2	34	5
G123	12/14/1982	12/27/2000	115	57	18	15	4	80	11
G204	7/26/1989	10/16/2000	93	44	56	38	9	325	55
G205	7/26/1989	10/16/2000	94	44	52	34	10	394	63
G206	7/26/1989	10/16/2000	94	44	24	16	4	199	30
L3	1/2/1979	6/29/2000	335	23	114	83	12	860	103
L40-1	1/2/1979	1/4/1999	164	45	65	50	17	410	53
L40-2	1/2/1979	1/4/1999	164	45	86	78	9	383	53
L7	1/2/1979	3/29/1993	77	68	105	65	6	1415	175

4.9 Figure legends

Figure 4.1 The spatial domains of the regional application and subregional applications of ELM.

Figure 4.2 Hydrologic Basins and Indicator Regions for the regional implementation of ELM.

Figure 4.3 Initial depth of ponded surface water, January 1, 1981.

Figure 4.4 Initial depth of water in unsaturated storage, January 1, 1981.

Figure 4.5 Initial land surface elevation for WCA-1.

Figure 4.6 Initial land surface elevation for WCA-2A.

Figure 4.7 Initial land surface elevation for WCA-3A north of Alligator Alley (I-75).

Figure 4.8 Initial land surface elevation for central and southern Everglades and Big Cypress National Preserve.

Figure 4.9 Initial land surface elevation for Holey Land.

Figure 4.10 Initial land surface elevation for Rotenberger Tract.

Figure 4.11 Initial land surface elevation for the regional ELM domain, January 1, 1981.

Figure 4.12 Locations of soil core samples from different surveys.

Figure 4.13 Initial (and constant) bulk density of soil.

Figure 4.14 Initial (and constant) bulk density of only the organic fraction of soil, January 1, 1981.

Figure 4.15 Initial total phosphorus concentration of soil, January 1, 1981.

Figure 4.16 Vegetation classification efforts that were used in developing the habitat map for the model.

Figure 4.17 Habitat types, ca. 1995; cattail were replaced with adjacent habitat types (usually sawgrass) for initial habitat types, January 1, 1981.

Figure 4.18 Initial total biomass of macrophytes, January 1, 1981.

Figure 4.19 Canal reach identities, water control structure locations, and generalized flow diagram for the regional implementation of ELM, displayed for entire domain.

Figure 4.20 Canal reach identities and water control structure locations in the regional implementation of ELM, displayed for WCA-1 and WCA-2.

Figure 4.21 Canal reach identities and water control structure locations in the regional implementation of ELM, displayed for northern WCA-3A.

Figure 4.22 Water control structure attributes for all of the structures operating in the ELM v2.5 historical simulation (continued through 18 pages).

Figure 4.23 The GlobalParms database, documenting the parameters that are global to the model domain (continued through 3 pages).

Figure 4.24 The HabParms data base, documenting the parameters that are specific to each habitat defined in the model domain (continued through 2 pages).

Figure 4.25 Hydraulic conductivity of the surficial aquifer simulated in ELM.

Figure 4.26 The stage-based grid-cell and vector allowable-flow conditions along the borders of the regional ELM domain.

4.10 Figures

Twenty six figures follow this page (46 pages).

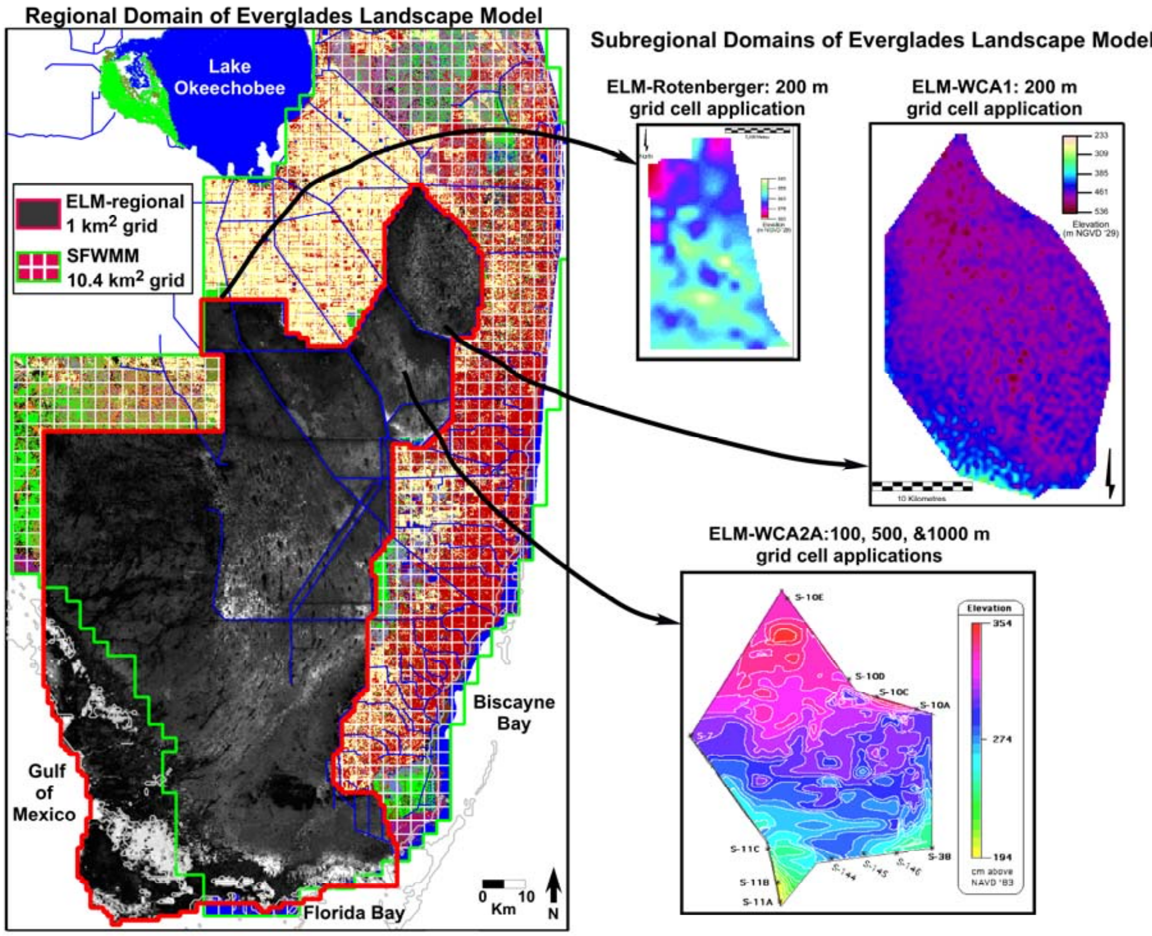

Regional Domain of Everglades Landscape Model
Lake Okeechobee
ELM-regional 1 km2 grid
SFWMM 10.4 km2 grid
Gulf of Mexico
Biscayne Bay
Florida Bay
0 10 Km
N
Subregional Domains of Everglades Landscape Model
ELM-Rotenberger: 200 m grid cell application
ELM-WCA1: 200 m grid cell application
Elevation (m NGVD '29)
10 Kilometres
ELM-WCA2A:100, 500, &1000 m grid cell applications
Elevation
354
274
194
cm above NAVD '83
S-10E
S-10D
S-10C
S-10A
S-7
S-11C
S-11B
S-11A
S-144
S-145
S-146
S-38

Figure 4.1.

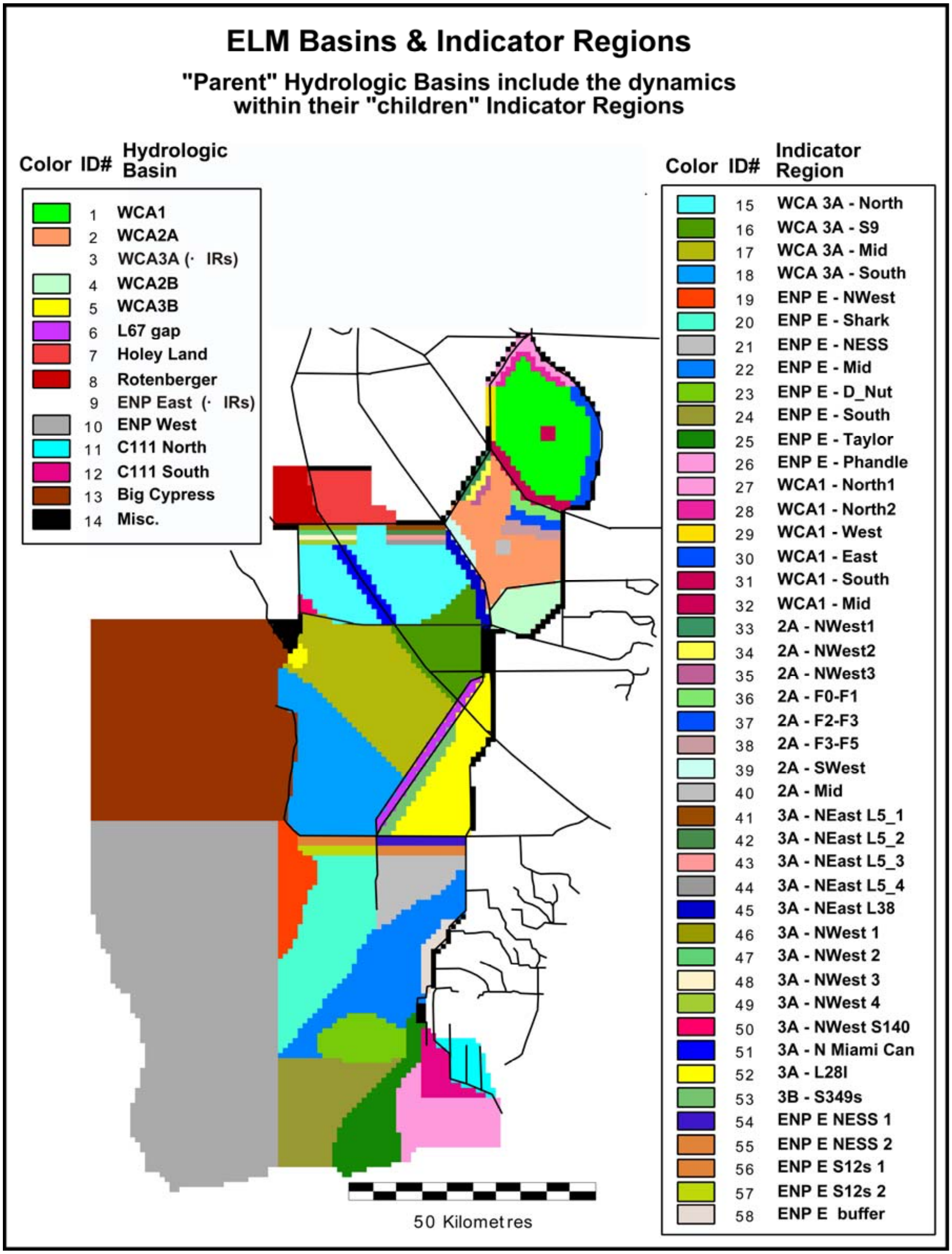

ELM Basins & Indicator Regions
"Parent" Hydrologic Basins include the dynamics within their "children" Indicator Regions
Color ID# Hydrologic Basin
1 WCA1
2 WCA2A
3 WCA3A (· IRs)
4 WCA2B
5 WCA3B
6 L67 gap
7 Holey Land
8 Rotenberger
9 ENP East (· IRs)
10 ENP West
11 C111 North
12 C111 South
13 Big Cypress
14 Misc.
Color ID# Indicator Region
15 WCA 3A - North
16 WCA 3A - S9
17 WCA 3A - Mid
18 WCA 3A - South
19 ENP E - NWest
20 ENP E - Shark
21 ENP E - NESS
22 ENP E - Mid
23 ENP E - D_Nut
24 ENP E - South
25 ENP E - Taylor
26 ENP E - Phandle
27 WCA1 - North1
28 WCA1 - North2
29 WCA1 - West
30 WCA1 - East
31 WCA1 - South
32 WCA1 - Mid
33 2A - NWest1
34 2A - NWest2
35 2A - NWest3
36 2A - F0-F1
37 2A - F2-F3
38 2A - F3-F5
39 2A - SWest
40 2A - Mid
41 3A - NEast L5_1
42 3A - NEast L5_2
43 3A - NEast L5_3
44 3A - NEast L5_4
45 3A - NEast L38
46 3A - NWest 1
47 3A - NWest 2
48 3A - NWest 3
49 3A - NWest 4
50 3A - NWest S140
51 3A - N Miami Can
52 3A - L28I
53 3B - S349s
54 ENP E NESS 1
55 ENP E NESS 2
56 ENP E S12s 1
57 ENP E S12s 2
58 ENP E buffer
50 Kilometres

Figure 4.2.

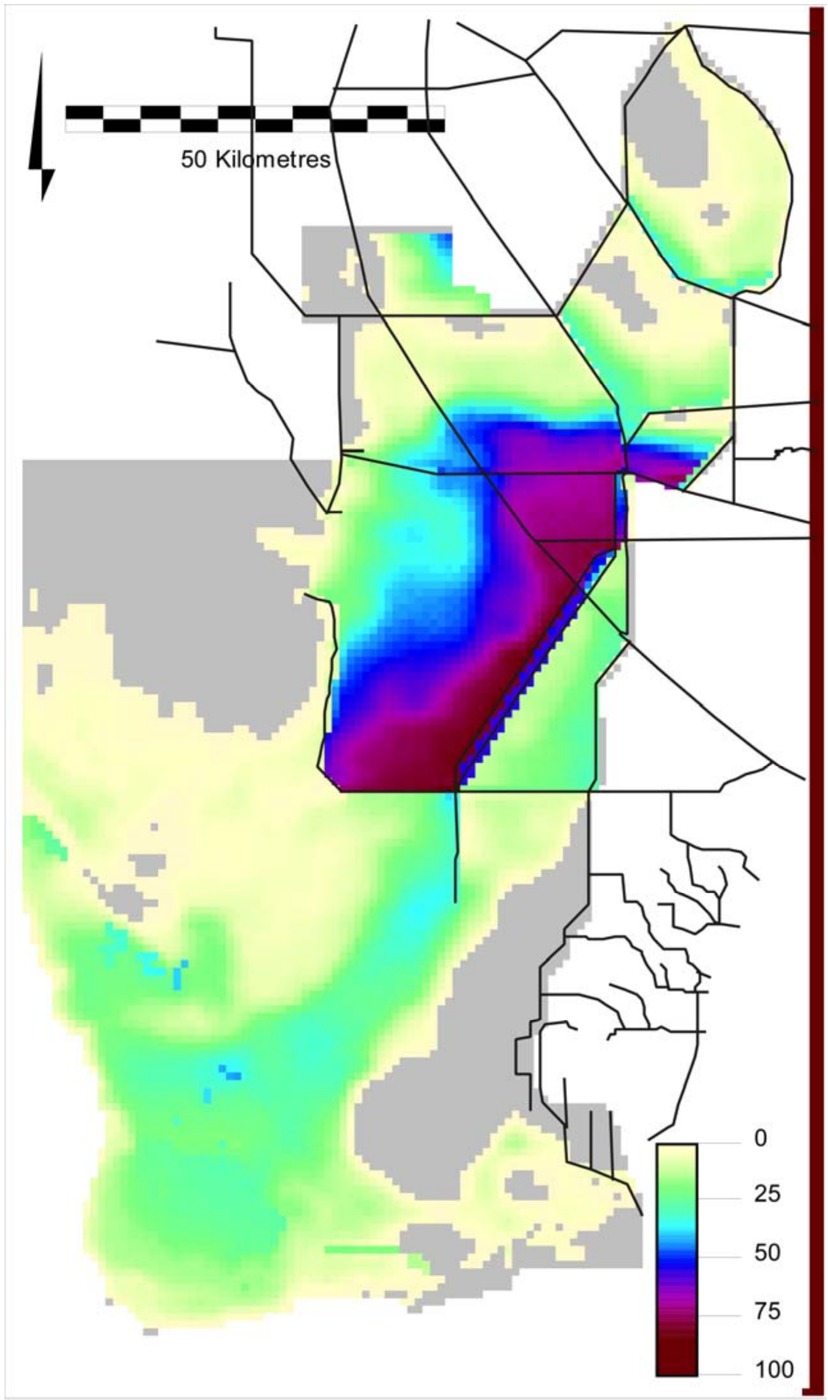


Figure 4.3.

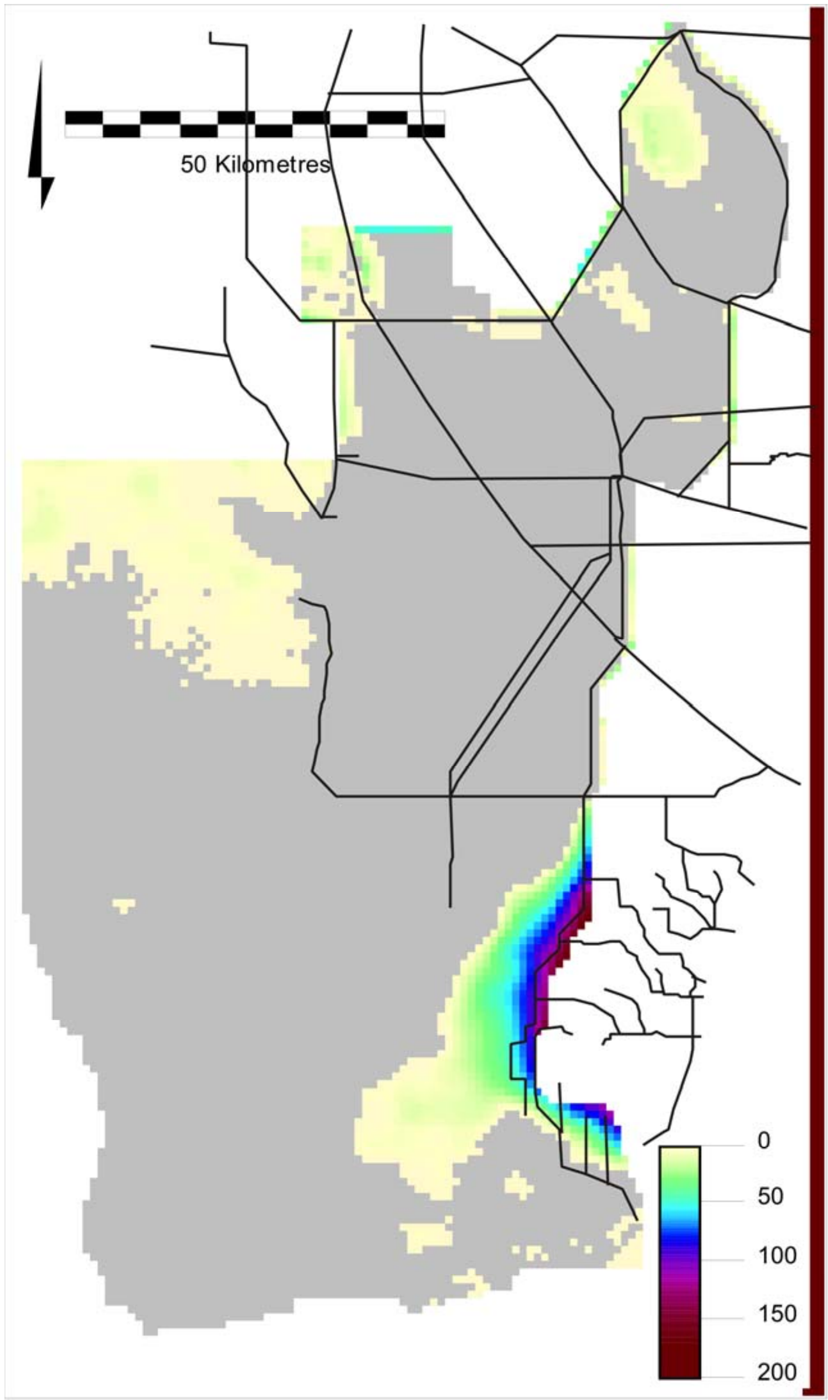


Figure 4.4.

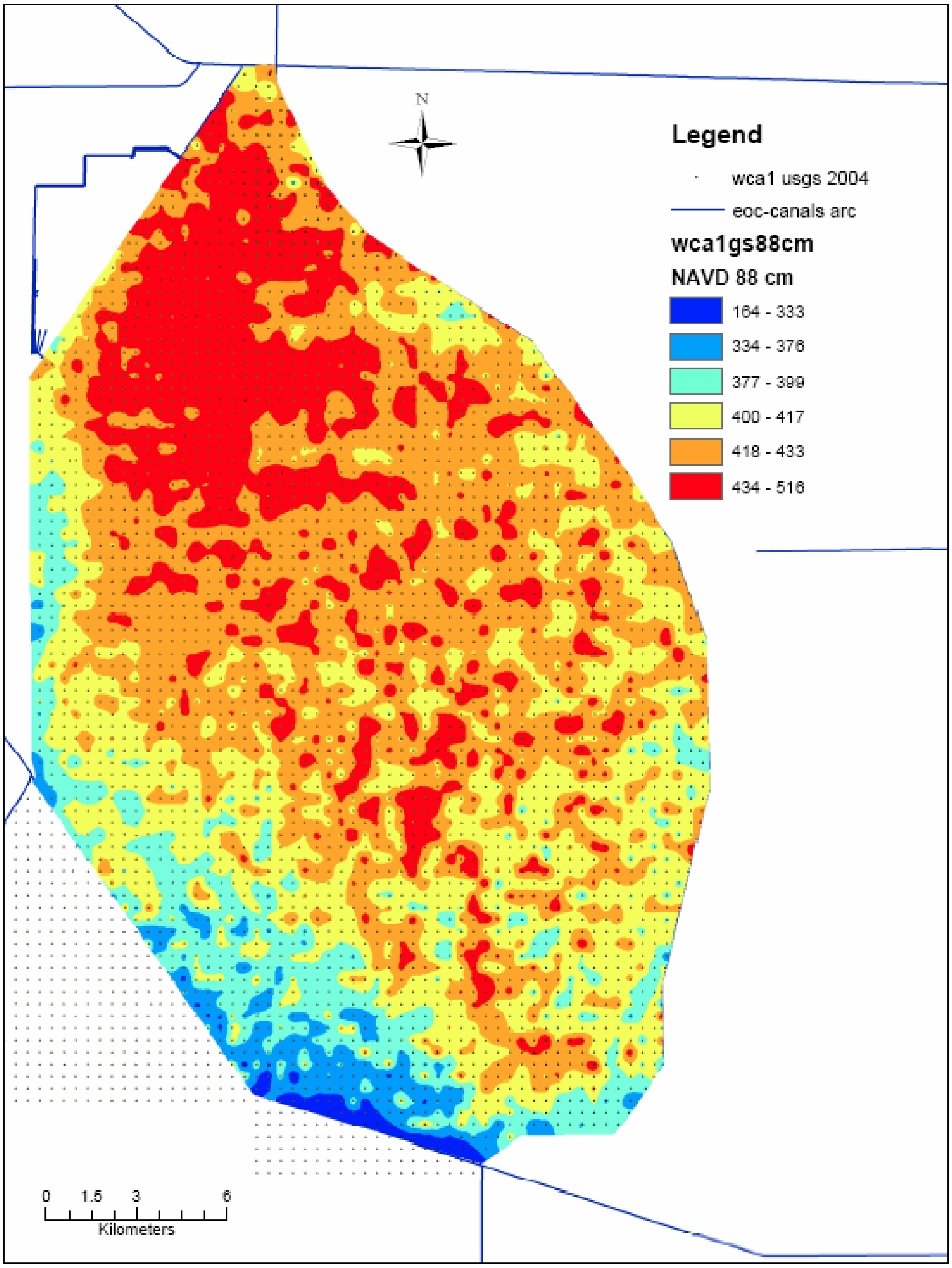

N
Legend
wca1 usgs 2004
eoc-canals arc
wca1gs88cm
NAVD 88 cm
164 - 333
334 - 376
377 - 399
400 - 417
418 - 433
434 - 516
0 1.5 3 6
Kilometers

Figure 4.5.

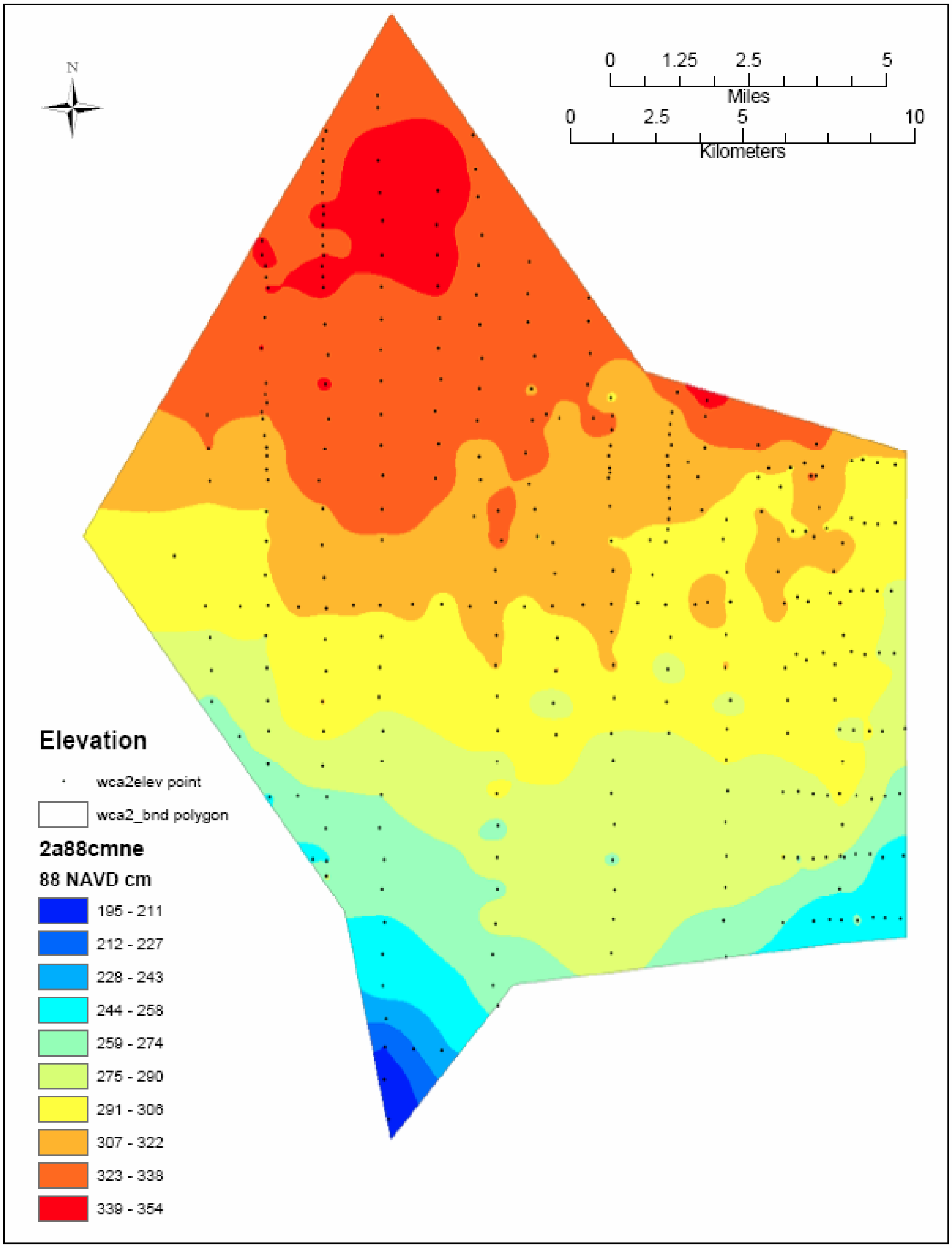

N
0 1.25 2.5 5
Miles
0 2.5 5 10
Kilometers
Elevation
wca2elev point
wca2_bnd polygon
2a88cmne
88 NAVD cm
195 - 211
212 - 227
228 - 243
244 - 258
259 - 274
275 - 290
291 - 306
307 - 322
323 - 338
339 - 354

Figure 4.6.

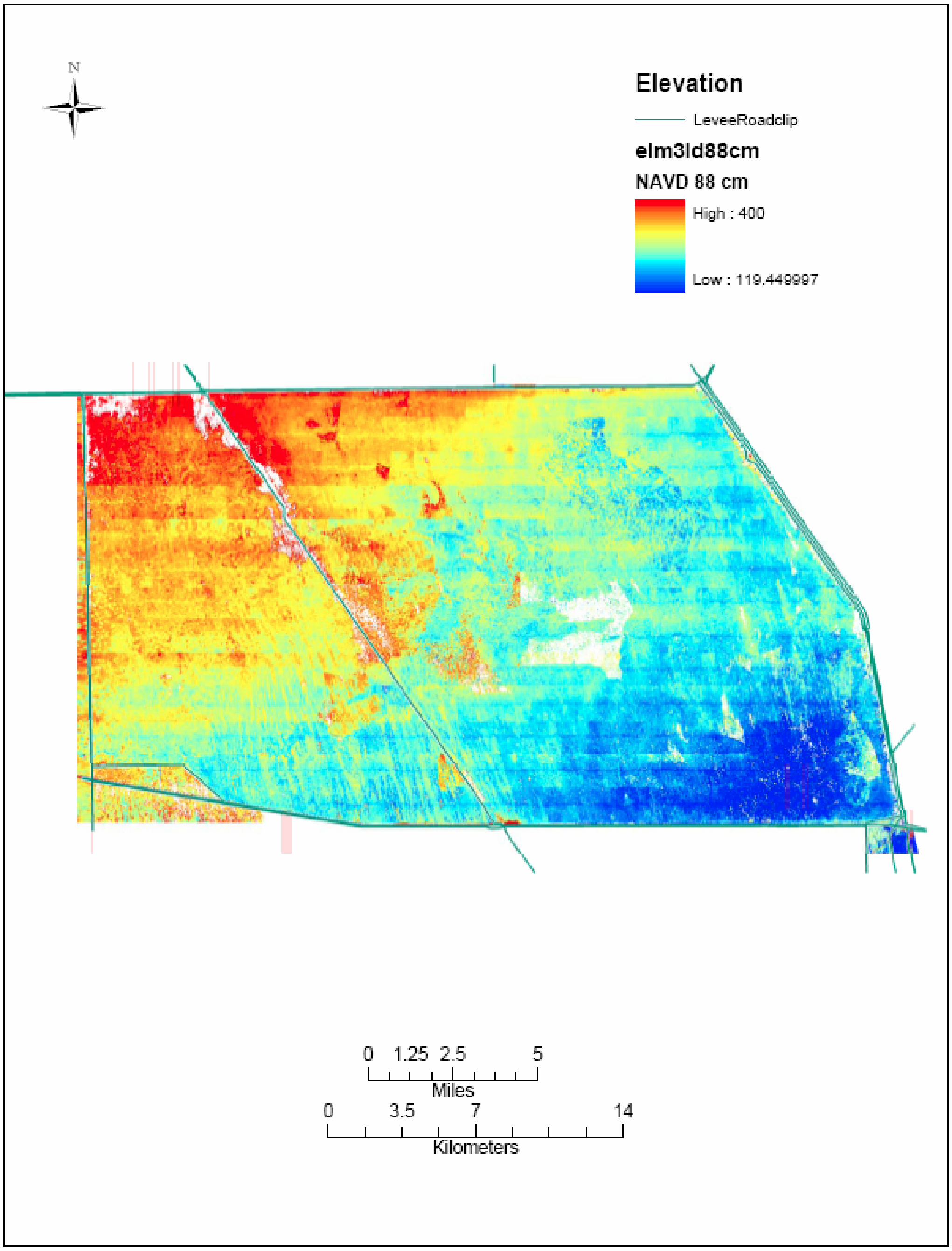

N
Elevation
LeveeRoadclip
elm3ld88cm
NAVD 88 cm
High : 400
Low : 119.449997
0 1.25 2.5 5
Miles
0 3.5 7 14
Kilometers

Figure 4.7.

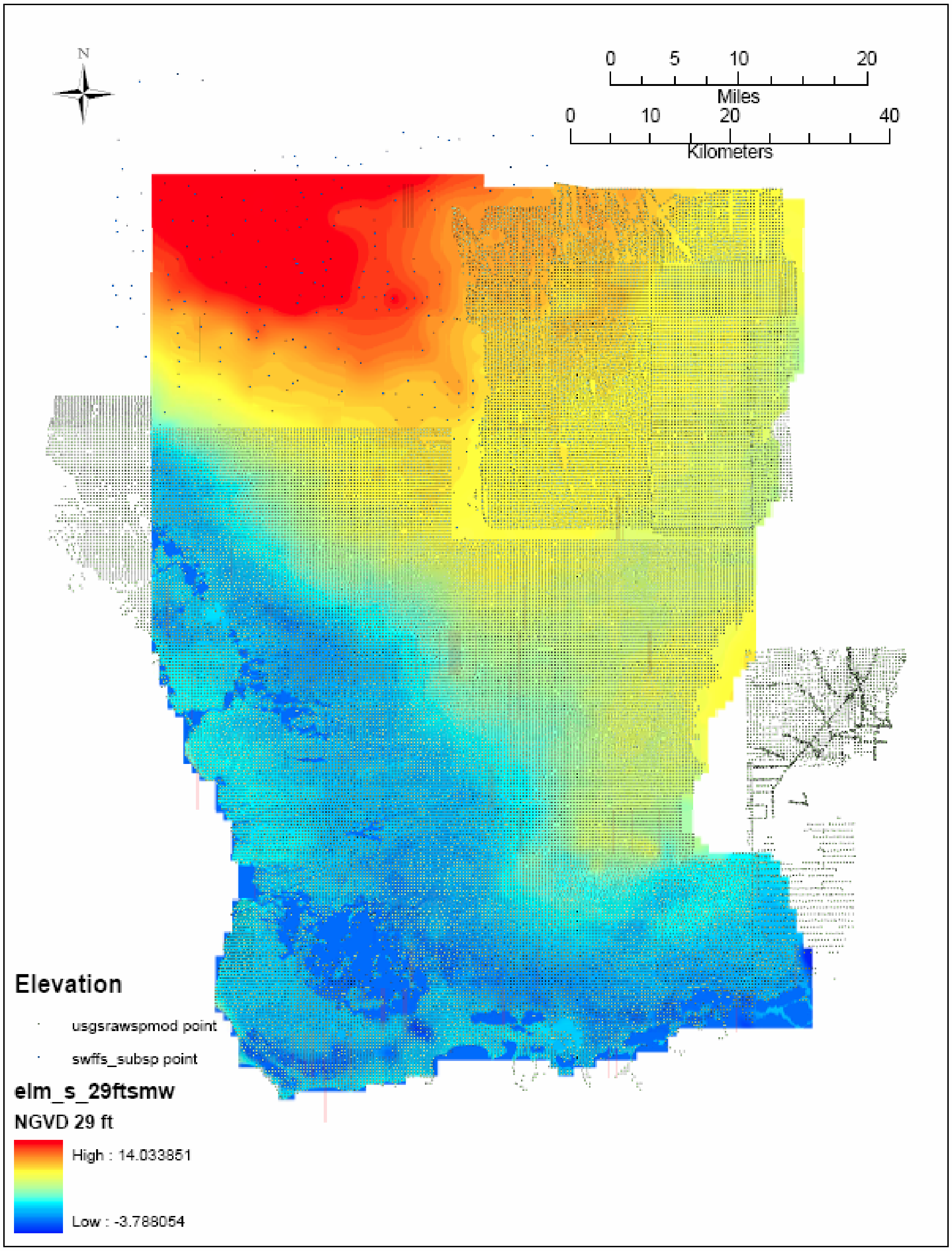

N
0 5 10 20
Miles
0 10 20 40
Kilometers
Elevation
usgsrawspmod point
swffs_subsp point
elm_s_29ftsmw
NGVD 29 ft
High : 14.033851
Low : -3.788054

Figure 4.8.

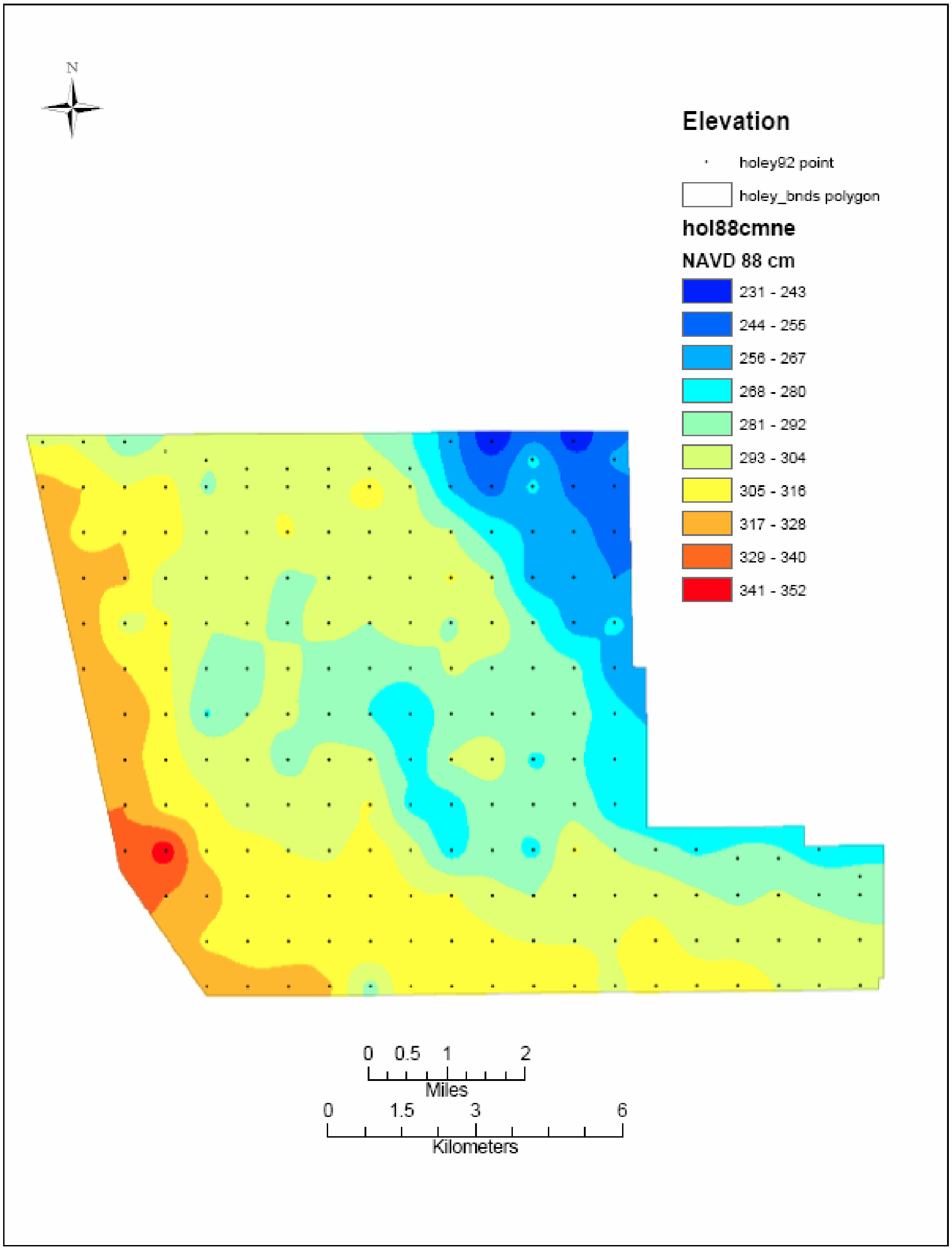

N
Elevation
holey92 point
holey_bnds polygon
hol88cmne
NAVD 88 cm
231 - 243
244 - 255
256 - 267
268 - 280
281 - 292
293 - 304
305 - 316
317 - 328
329 - 340
341 - 352
0 0.5 1 2
Miles
0 1.5 3 6
Kilometers

Figure 4.9.

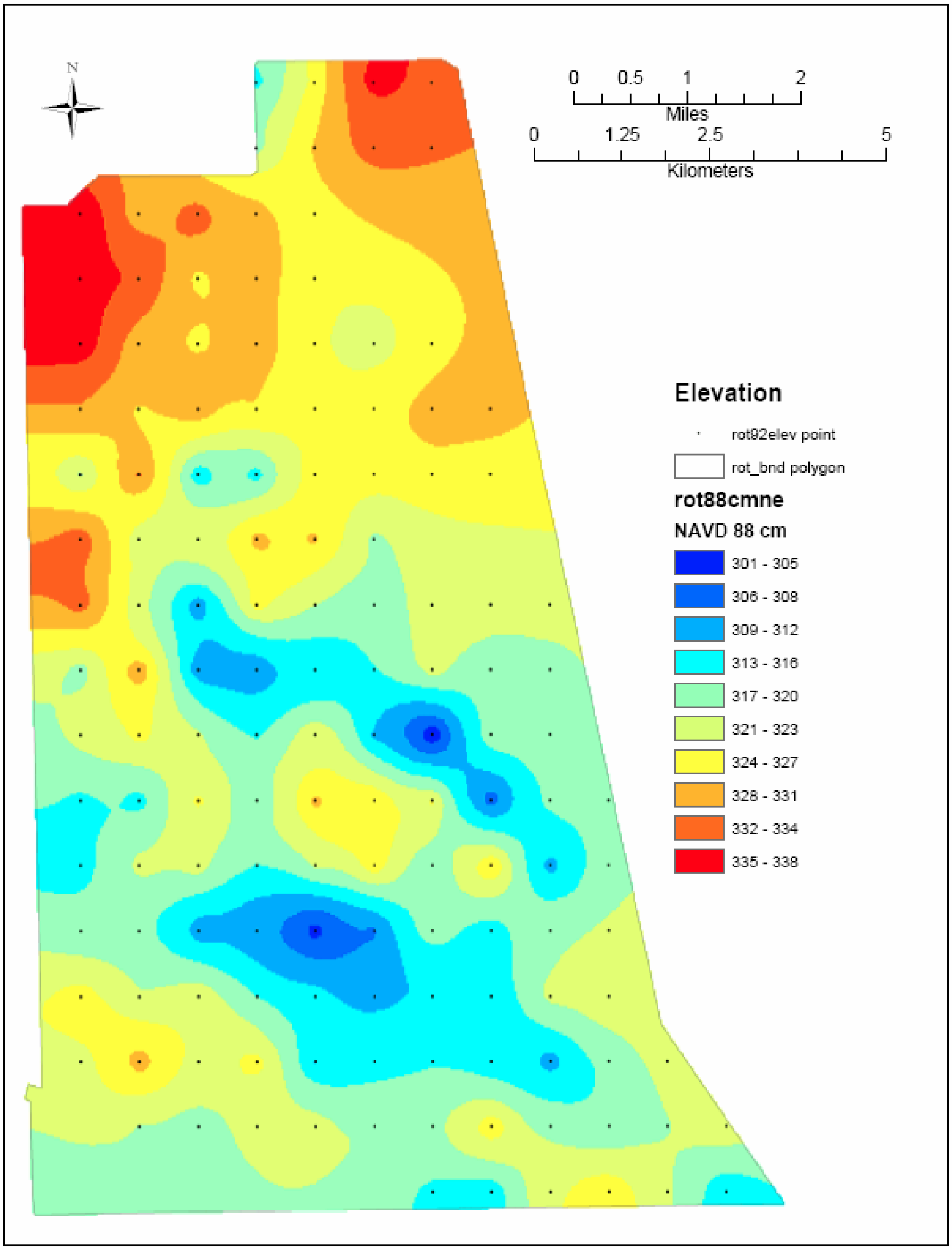

N
0 0.5 1 2
Miles
0 1.25 2.5 5
Kilometers
Elevation
rot92elev point
rot_bnd polygon
rot88cmne
NAVD 88 cm
301 - 305
306 - 308
309 - 312
313 - 316
317 - 320
321 - 323
324 - 327
328 - 331
332 - 334
335 - 338

Figure 4.10.

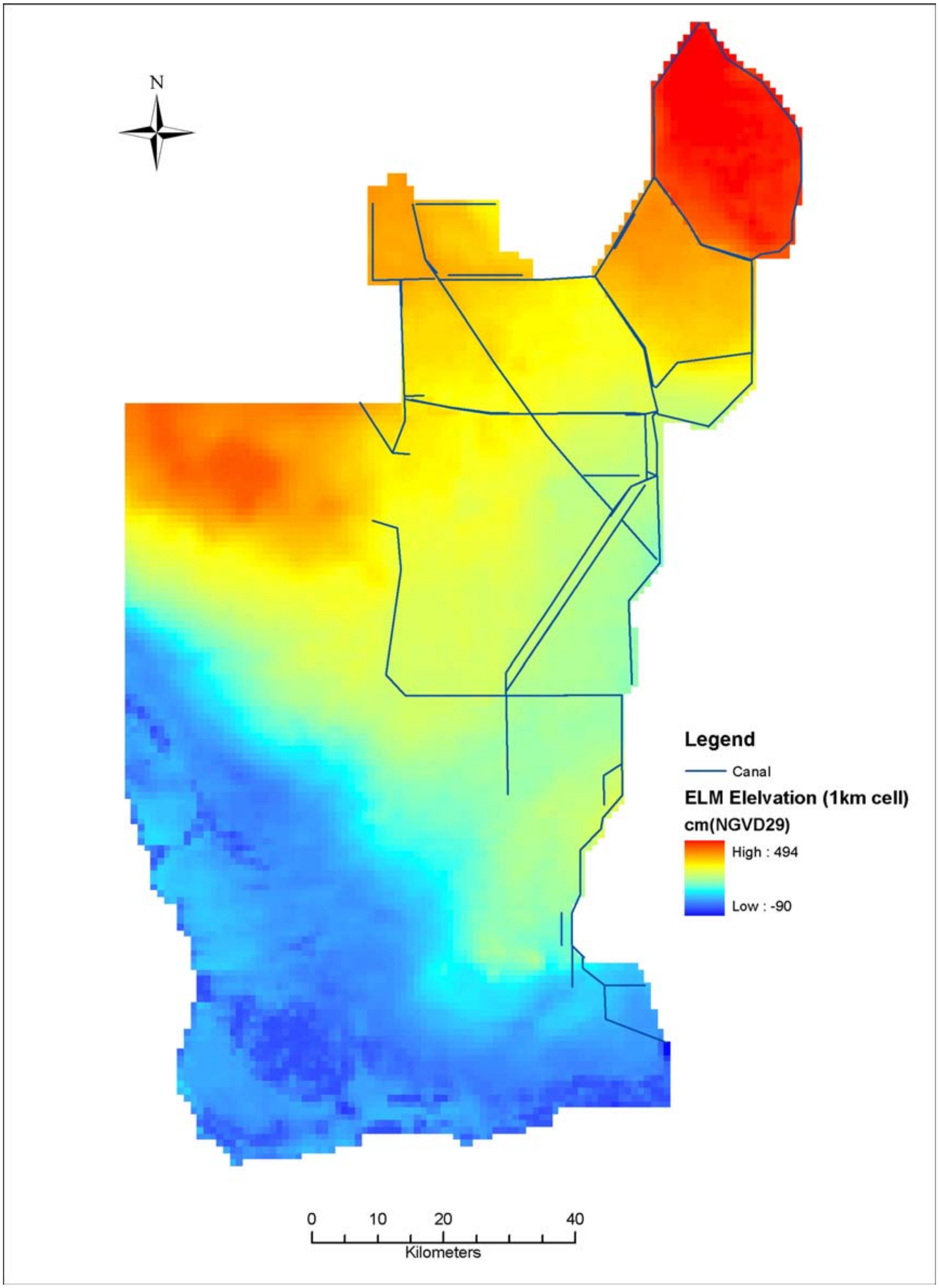

N
Legend
Canal
ELM Elelvation (1km cell)
cm(NGVD29)
High : 494
Low : -90
0
10
20
40
Kilometers

Figure 4.11.

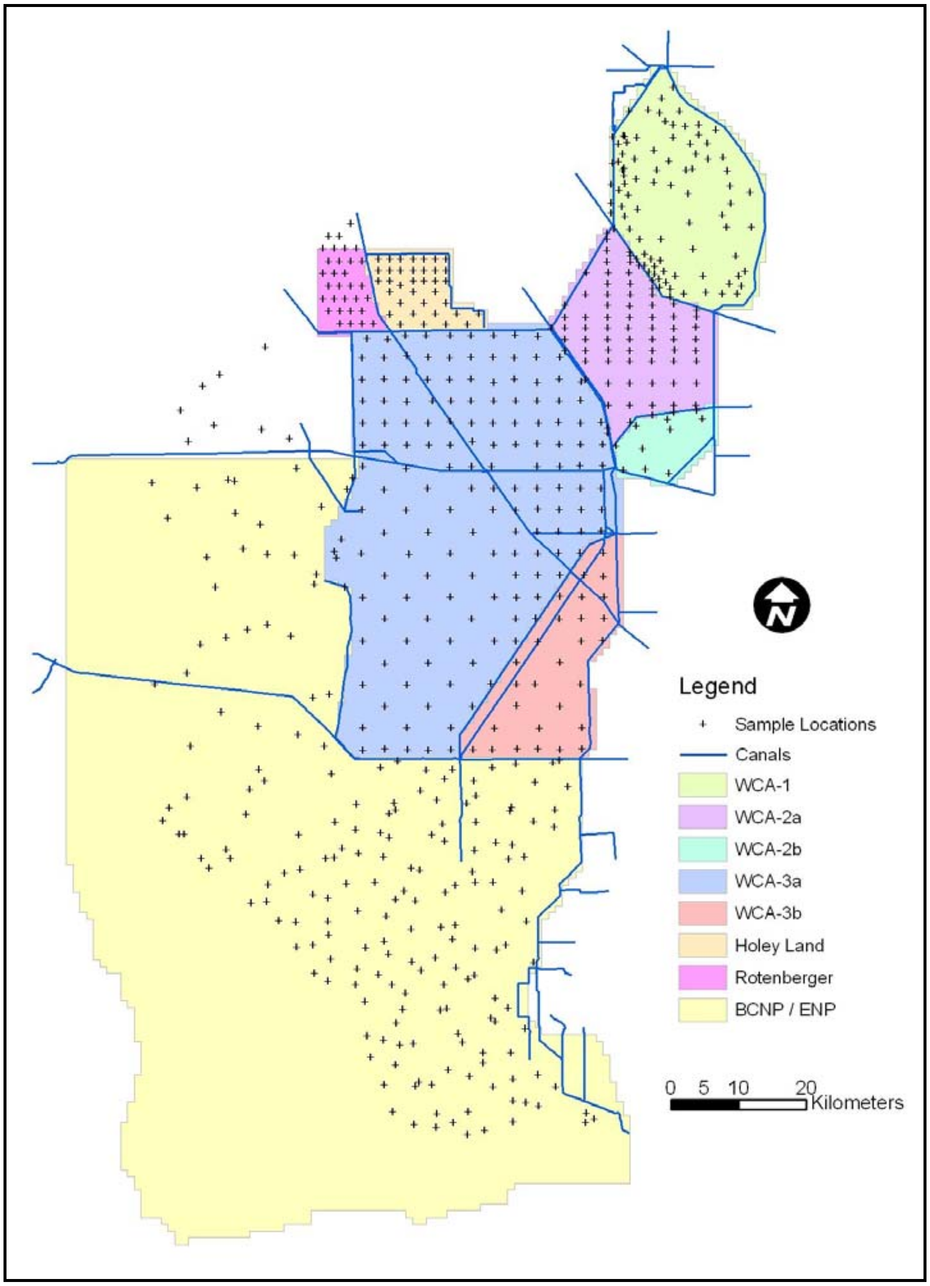

Legend
Sample Locations
Canals
WCA-1
WCA-2a
WCA-2b
WCA-3a
WCA-3b
Holey Land
Rotenberger
BCNP / ENP
N
0 5 10 20 Kilometers

Figure 4.12.

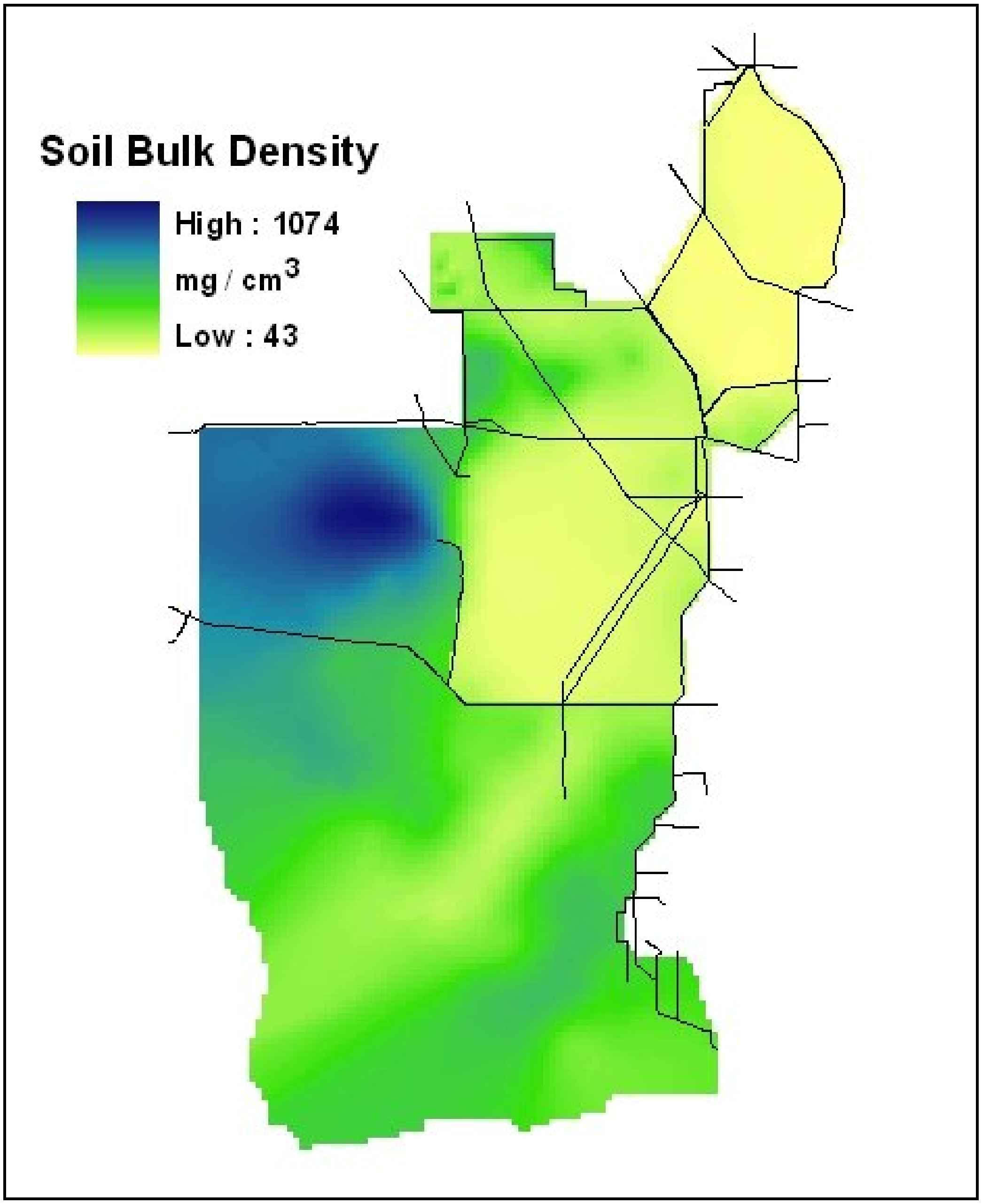


Figure 4.13.

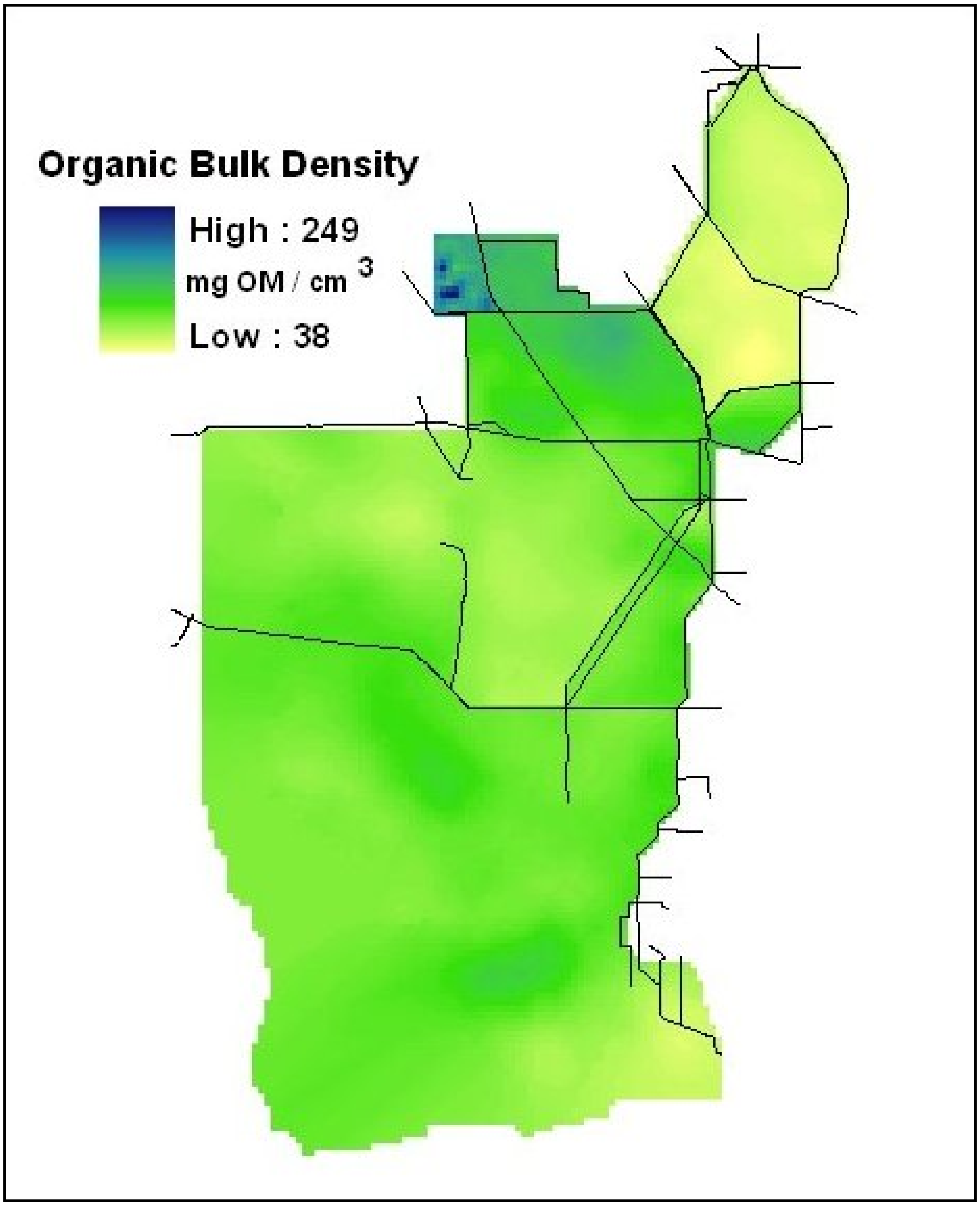


Figure 4.14.

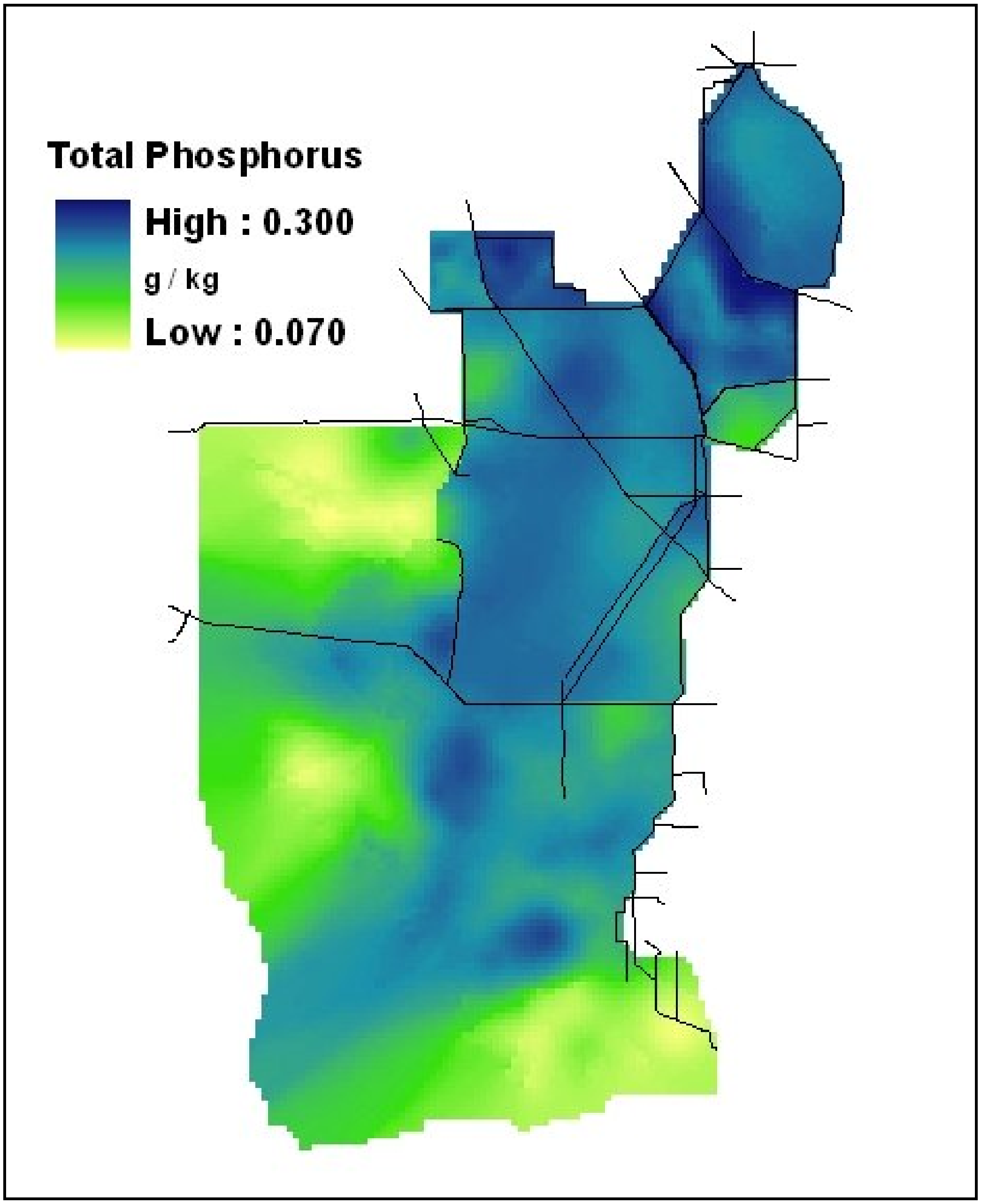


Figure 4.15.

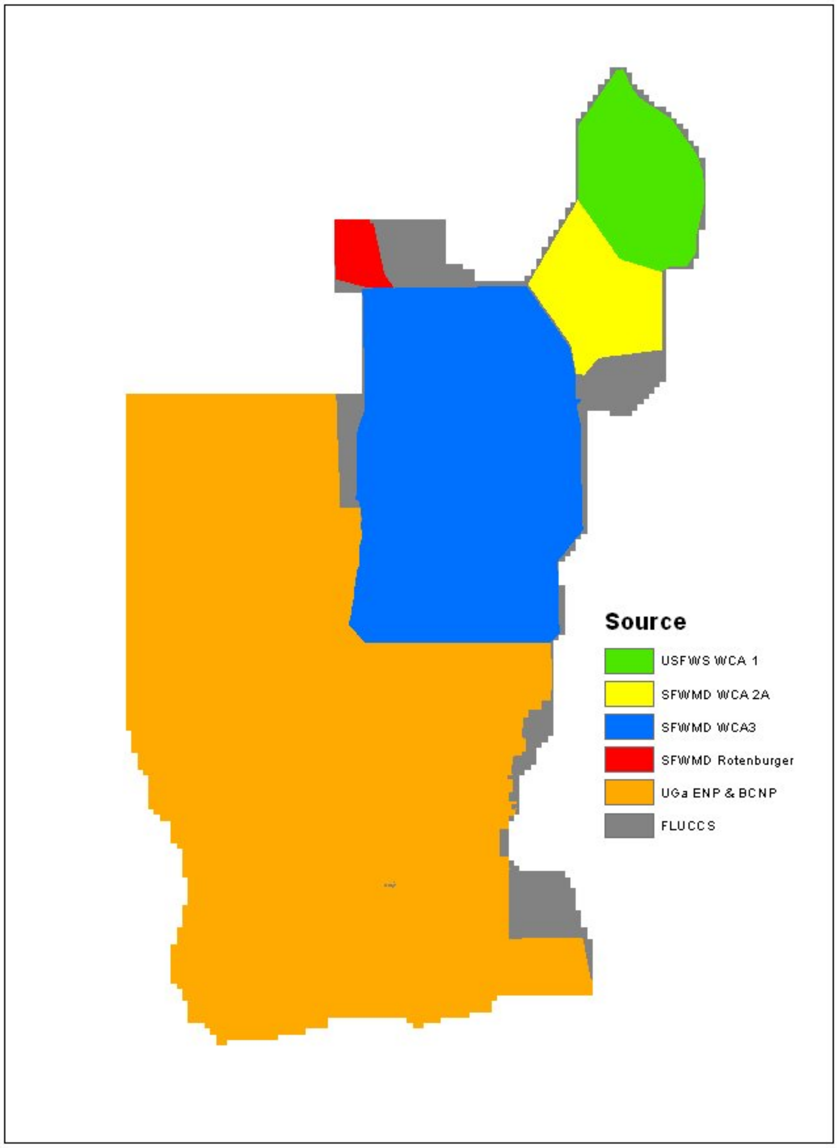

Source
USFWS WCA 1
SFWMD WCA 2A
SFWMD WCA3
SFWMD Rotenburger
UGa ENP & BCNP
FLUCCS

Figure 4.16.

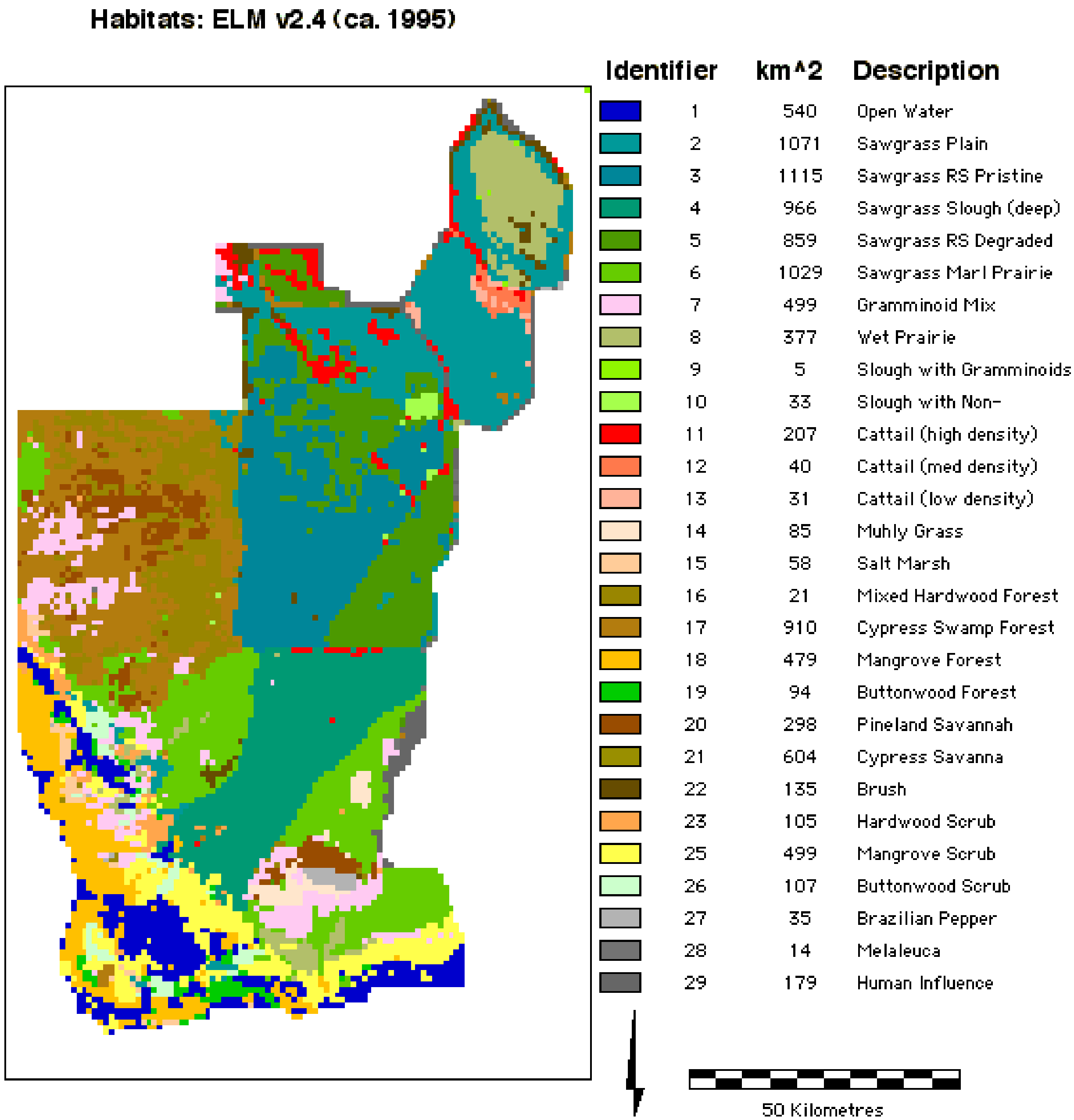


Figure 4.17. Note: Habitats initialized in 1981 without any cattail habitat types.

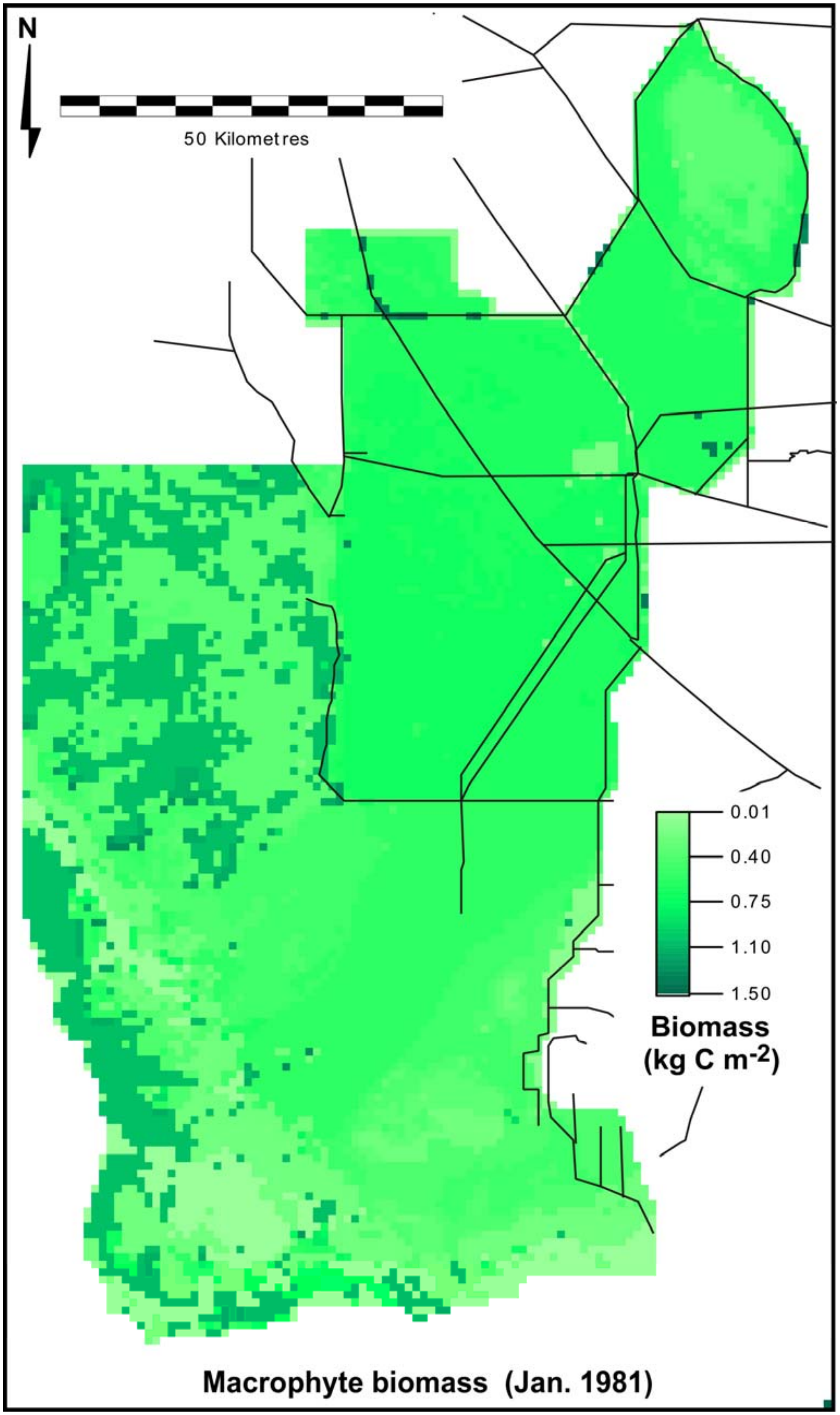

N
50 Kilometres
0.01
0.40
0.75
1.10
1.50
Biomass
(kg C m-2)
Macrophyte biomass (Jan. 1981)

Figure 4.18.

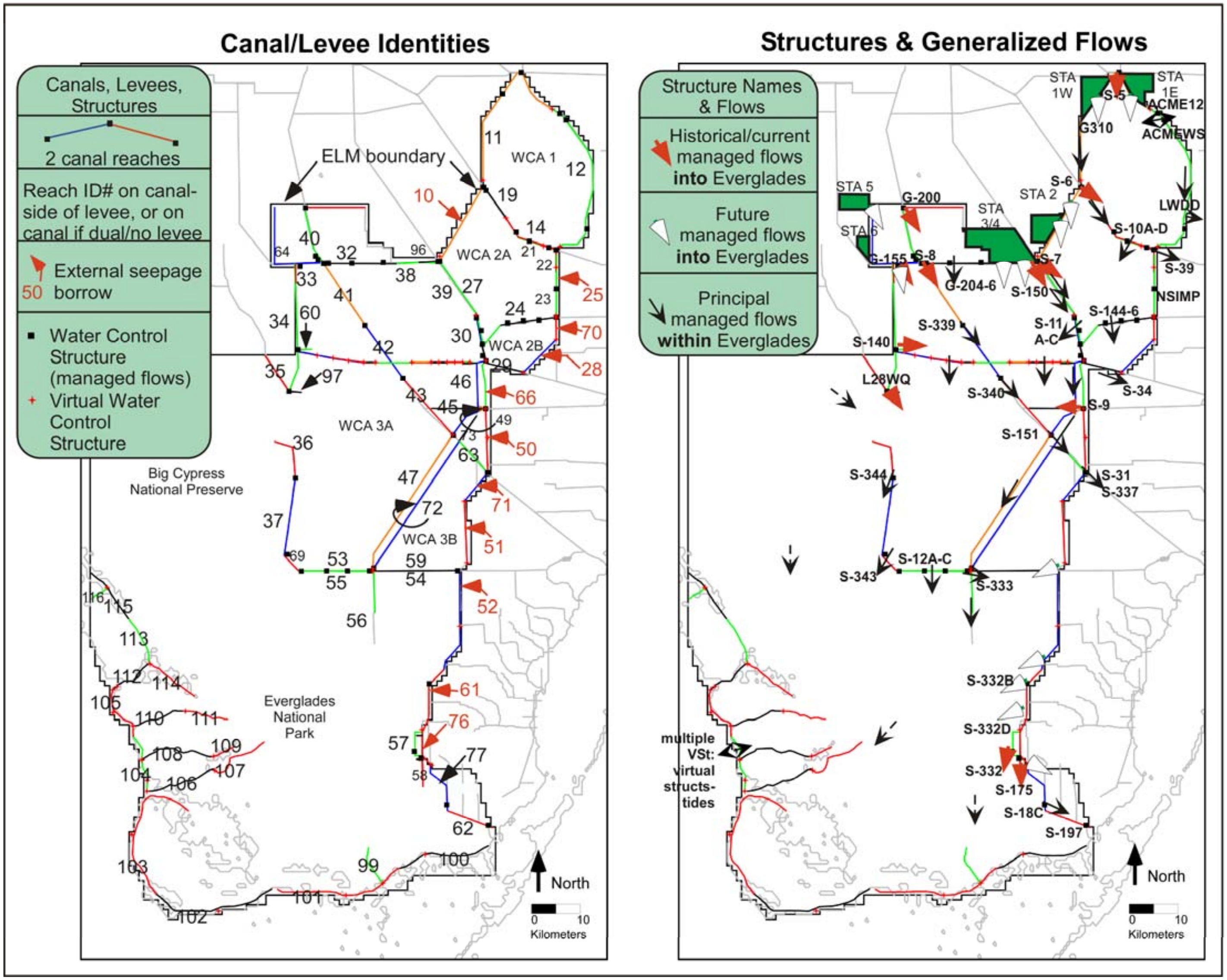
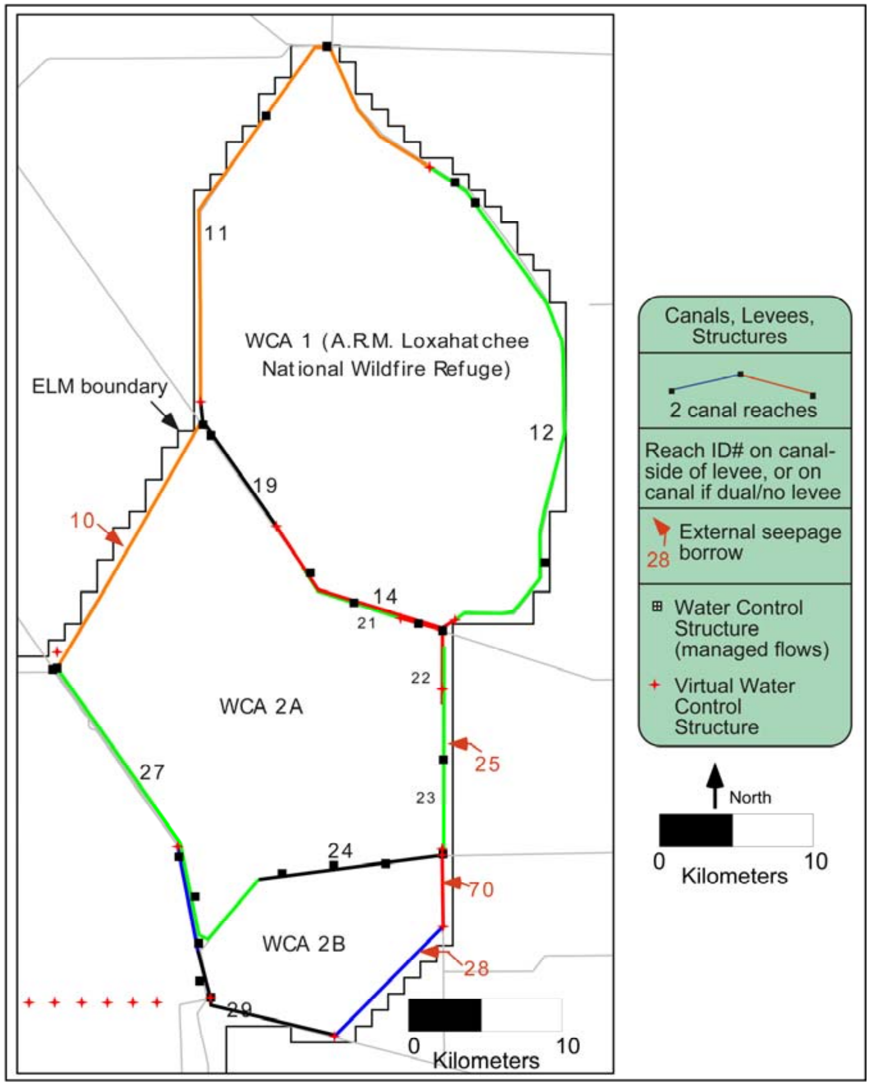

Canal/Levee Identities
Canals, Levees, Structures
2 canal reaches
Reach ID# on canal-side of levee, or on canal if dual/no levee
External seepage borrow
50
Water Control Structure (managed flows)
Virtual Water Control Structure
ELM boundary
WCA 1
WCA 2A
WCA 2B
WCA 3A
WCA 3B
Big Cypress National Preserve
Everglades National Park
North
0
10
Kilometers
Structures & Generalized Flows
Structure Names & Flows
Historical/current managed flows into Everglades
Future managed flows into Everglades
Principal managed flows within Everglades
STA 5
STA 6
STA 3/4
STA 2
STA 1W
STA 1E
G-200
G-155
S-8
G-204-6
S-150
S-7
S-5
G310
ACME12
ACMEWS
S-6
LWDD
S-10A-D
S-39
NSIMP
S-144-6
S-11 A-C
S-339
S-140
L28WQ
S-340
S-34
S-9
S-151
S-31
S-337
S-344
S-343
S-12A-C
S-333
S-332B
S-332D
S-332
S-175
S-18C
S-197
multiple VSt: virtual structs-tides
North
0
10
Kilometers

Figure 4.19



11
WCA 1 (A.R.M. Loxahatchee National Wildfire Refuge)
ELM boundary
12
19
10
14
21
22
WCA 2A
25
27
23
24
70
WCA 2B
28
29
0
10
Kilometers
Canals, Levees, Structures
2 canal reaches
Reach ID# on canal-side of levee, or on canal if dual/no levee
External seepage borrow
28
Water Control Structure (managed flows)
Virtual Water Control Structure
North
0
10
Kilometers

Figure 4.20.

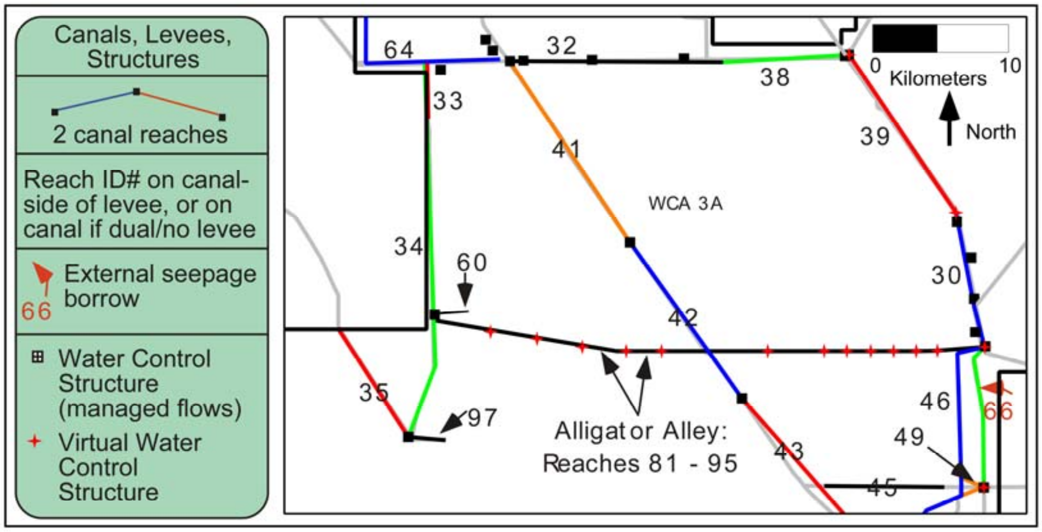

Canals, Levees, Structures
2 canal reaches
Reach ID# on canal-side of levee, or on canal if dual/no levee
External seepage borrow
66
Water Control Structure (managed flows)
Virtual Water Control Structure
64
32
38
33
41
39
WCA 3A
34
60
30
42
35
97
Alligator Alley: Reaches 81 - 95
43
46
66
49
45
0
10
Kilometers
North

Figure 4.21.

ELM Water Control Structure Attributes

Click Alt button for structure list

GO TO: Details

Model WMM ID	Model ELM ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X	Fr: Cell_Y	Fr: CanalID	To: Cell_X	To: Cell_Y	To: CanalID	Calib	Calib 2.2+	95 Bas	Bas RR2R	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Description
ACME12	ACME12	ACME1, ACME2,	tser	tser	LEC	WCA1	1	1				11		x								Runoff from ACME basin into L-40 canal in eastern WCA-1 via ACME Pump#1 (ACME1DS) plus Pump#2 (G-94D) (SFWMM names can be: ACME1=ACME1DS=ACME12=ACMERO=ACMERF). (ACMERF,
ACMEWS	ACMEWS	ACME12WS,			WCA1	LEC			12	1	1			x								Water supply releases from L-40 canal in eastern WCA-1 to ACME basinPump#2 (G-94D), (plus Pump#1?). SFWMM names: ACME12WS=ACME2=ACMEWS (ACMEWS for ALTs). Near L40-2 WQ
G155	G155	G-155	tser	tser	EAA	WCA3A	1	1		45	42		x	x								From L-3 canal split at Confusion Corner, input into cell of NW WCA-3A
G200	G200	G-200, HLYQIN	tser	tser	LOK	Holey L	1	1		47	30			x								From Miami Canal into NW tip of Holey Land. Assume water from LOK in ALTS? (always 0 flow in Restudy ALT3) ELMv2.1name = HLYQIN (HLYQIN ZERO IN V5.4 SFWMM calib)
G204	G204	G-204			Holey L	WCA3A			32	50	41		x	x	X							One of 3 outflows from southern Holey Land into north WCA-3A (G-204, G-205, G-206). Historical flows are bad-use SFWMM v5.4 simulated flows in calibration.
G205	G205	G-205			Holey L	WCA3A			32	55	41		x	x	X							One of 3 outflows from southern Holey Land into north WCA-3A (G-204, G-205, G-206) Historical flows bad-use SFWMM v5.4 simulated flows in calibration.
G206	G206	G-206			Holey L	WCA3A			32	61	41		x	x	X							One of 3 outflows from southern Holey Land into north WCA-3A (G-204, G-205, G-206) Historical flows are bad-use SFWMM v5.4 simulated flows in calibration.
G251	G251	G-251, ENR012	tser	tser	STA	WCA1	1	1				11	x	x								Originally the outflow from Everglades Nutrient Removal (ENR) Project into L-7 in NW WCA-1; now outflow from STA1-W into WCA-1 (G-251 also known as ENR012). G251 not in SFWMMv5.0 glossary. SFWMMv5.4

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Model ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr:/To: Cell_X	Cell_Y	CanalID	Calib	Calib 2.2+	95 Bas	Bas RR2R	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Description
WMM G310 ELM G310	G-310	tser	tser	STA	WCA1	Fr: 1 To:	1 	 11		x								Outflow from STA-1W into L-7 canal in NW WCA-1. DEVELOP (location just same as G251 here) G310 not in SFWMMv5.0 glossary
WMM L28WQ ELM L28WQ	L28-Int	tser	tser	BC	WCA3A	Fr: 1 To:	1 	 97		x								Flow from L28Interceptor canal into western WCA-3A. Removed from Restudy ALTD+, with flows coming from S-190, no levee along SW L-28I. SFWMM name is L28WQ (ELMv2.1 name=L28WQ)
WMM LWDD ELM LWDD	LWDD, G-94A,	—	—	WCA1	LEC	Fr: To: 1	 1	12 	x	x	X	x	X	X	x		x	Water supply releases from L-40 canal in eastern WCA-1 into Lake Worth Drainage District (LWDD) via G-94A plus G-94B, which are well-separated (but usually in same ELM reach). SFWMMv5.0HistFlow
WMM NSIMP2 ELM NSIMP2	S-38B	38	0.05	LEC	WCA2A	Fr: 1 To: 96	1 46			x		x						One of two pump flows from North Springs Improvement District (NSIMP) into east WCA-2A. Other NSIMP pumps, but ELM only models these 2 inflows. ALSO a gated culvert in L-36 borrow, acts as divide between
WMM NSIMP3 ELM NSIMP3	S-38B	38	0.05	LEC	WCA2A	Fr: 1 To: 96	1 46			x		x						One of two pump flows from North Springs Improvement District (NSIMP) into east WCA-2A. Other NSIMP pumps, but ELM only models these 2 inflows. ALSO a gated culvert in L-36 borrow, acts as divide between
WMM RTECV1 ELM RTECV1	S-8	—	—	Rot	WCA3A	Fr: To: 1	 1	64 	x	x								One of 2 unregulated flows thru existing culverts into Miami canal above S8, considered to go out of system because S8 flow is from out of system (95base this is part of S8 flow). Historical flows bad-use
WMM RTECV2 ELM RTECV2	S-8	—	—	Rot	WCA3A	Fr: To: 1	 1	64 	x	x								One of 2 unregulated flows thru existing culverts into Miami canal above S8, considered to go out of system because S8 inflow is from out of system (95base this is part of S8 flow). Historical flows bad-use
WMM S10A ELM S10A	S-10A	—	—	WCA1	WCA2A	Fr: To:		14 22		x								From Hillsboro Canal in WCA-1 to NE region of WCA-2A. S10-A,C,D similar. SFWWM aggregates A,C,&D into 1 flow. For ALTS, ELM partitions the SFWMM flow among structs. ELM calib uses indiv. flows.

ELM Water Control Structure Attributes

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Model ID WMM	Model ID ELM	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X	Fr: Cell_Y	Fr: CanalID	To: Cell_X	To: Cell_Y	To: CanalID	Calib	Calib 2.2+	95 Bas	Bas RR2R	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Description
S10C	S10C	S-10C			WCA1	WCA2A			14			21		x								From Hillsboro Canal in WCA-1 to NE region of WCA-2A. S10-A,C,D similar. SFWWM aggregates A,C,&D into 1 flow. For ALTS, ELM partitions the SFWMM flow among structs. ELM calib uses indiv. flows.
S10D	S10D	S-10D			WCA1	WCA2A			14			21		x								From Hillsboro Canal in WCA-1 to NE region of WCA-2A. S10-A,C,D similar. SFWWM aggregates A,C,&D into 1 flow. For ALTS, ELM partitions the SFWMM flow among structs. ELM calib uses indiv. flows.
S10E	S10E	S-10E			WCA1	WCA2A			19	82	26		x	x	X	x	X	X	x	x	x	From Hillsboro Canal in WCA-1 to northern tip of WCA-2A. Much smaller structure than other S-10s (A,C,D).
	S11	S11			WCA2A	WCA3A			27			30		x								From North New River Canal in SW WCA-2A into L-38W canal in NE WCA-3A. S-11-A,B,C similar. SFWWM aggregates A,B,&C into 1 flow. For ALTS, ELM partitions the flow among structs. ELM calib uses indiv.
S11A	S11A	S-11A			WCA2A	WCA3A			27			30		x								From North New River Canal in SW WCA-2A into L-38W canal in NE WCA-3A. S-11-A,B,C similar. SFWWM aggregates A,B,&C into 1 flow. For ALTS, ELM partitions the flow among structs. ELM calib uses indiv.
S11B	S11B	S-11B			WCA2A	WCA3A			27			30		x								From North New River Canal in SW WCA-2A into L-38W canal in NE WCA-3A. S-11-A,B,C similar. SFWWM aggregates A,B,&C into 1 flow. For ALTS, ELM partitions the flow among structs. ELM calib uses indiv.
S11C	S11C	S-11C			WCA2A	WCA3A			27			30		x								From North New River Canal in SW WCA-2A into L-38W canal in NE WCA-3A. S-11-A,B,C similar. SFWWM aggregates A,B,&C into 1 flow. For ALTS, ELM partitions the flow among structs. ELM calib uses indiv.
S12A	S12A	S-12A			WCA3A	ENP			53	45	104		x	x								From L-29 borrow in southern WCA-3A into northern Everglades National Park (ENP). S-12 A,B,C,D similar.

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Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr/To	Cell_X	Cell_Y	CanalID	Calib	Calib 2.2+	95 Bas	Bas RR2B	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Description
WMM	S12B	S-12B			WCA3A	ENP	Fr:			53	x	x								From L-29 borrow in southern WCA-3A into northern Everglades National Park (ENP). S-12 A,B,C,D similar.
ELM	S12B						To:	50	104											
WMM	S12C	S-12C			WCA3A	ENP	Fr:			53	x	x								From L-29 borrow in southern WCA-3A into northern Everglades National Park (ENP). S-12 A,B,C,D similar.
ELM	S12C						To:	54	104											
WMM	S12D	S-12D			WCA3A	ENP	Fr:			53	x	x								SFrom L-29 borrow in southern WCA-3A into northern Everglades National Park (ENP). S-12 A,B,C,D similar.
ELM	S12D						To:	58	104											
WMM		S140in	tser	tser	BC	WCA3A	Fr:	1	1			x								From L-28 canal into short C-60 canal in NW WCA-3A (v2.1=S140A) In ALTS, S140A = (ROTOL4+HLYL4+ST3TL4+ST6TL4+S140FC). In many ALTS, partitioned into other structs, thus this not always used.
ELM	S140in						To:			60										
WMM		S140out			WCA3A	BC	Fr:			60		x								From short C-60 canal in NW WCA-3A to L-28 canal.
ELM	S140out						To:	1	1											
WMM	S142E	S-142E S-34			WCA3A	WCA2B	Fr:			30		x	X	x	X	X			x	From WCA-3A into NNRiver canal reach between S143 & S34; sources of this NNR reach are G-123 (south NNR), S-141 (2B), S-142E (3A), and S-143 (2A); outflows are S-34 (to south) and S-142W (to WCA-3A).
ELM	S142E						To:			29										
WMM	S142W	S-142W G-123			WCA2B	WCA3A	Fr:			29		x	X	x	X	X			x	From NNRiver canal reach between S143 & S34, into WCA-3A; sources of this NNR reach are G-123 (south NNR), S-141 (2B), S-142E (3A), and S-143 (2A); outflows are S-34 (to south) and S-142W (to WCA-3A).
ELM	S142W						To:			30										
WMM	S143	S-143			WCA2A	WCA2B	Fr:			27	x	x	X	x	X	X	x	x	x	From south WCA-2A into NNRiver canal reach above S-34 (which controls further down-canal flows); G-123 pumps north across S-34; S-141 is release from 2B above S-34); S-142 is in/out of 3A above S-34.
ELM	S143						To:			29										

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Calib | Calib 2.2+ | 95 Bas | Bas RR2P | 50 Bas | Alt A | Alt D13R | 2050 wProj | MWD 12

Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X	Fr: Cell_Y	Fr: CanalID	To: Cell_X	To: Cell_Y	To: CanalID	Alt	Description
WMM ELM	S144neg	S144neg	—	—	WCA2B	WCA2A	87	54				24	x (Calib 2.2+)	From WCA2B into L35B borrow in south WCA-2A (three identical structs, 144,145,146)
WMM ELM	S144pos	S144pos	—	—	WCA2A	WCA2B			24	87	54		x (Calib 2.2+)	From L35B borrow in south WCA-2A into WCA2B (three identical structs, 144,145,146)
WMM ELM	S145neg	S145neg	—	—	WCA2B	WCA2A	90	53				24	x (Calib 2.2+)	From WCA2B into L35B borrow in south WCA-2A (three identical structs, 144,145,146)
WMM ELM	S145pos	S145pos	—	—	WCA2A	WCA2B			24	90	53		x (Calib 2.2+)	From L35B borrow in south WCA-2A into WCA2B (three identical structs, 144,145,146)
WMM ELM	S146neg	S146neg	—	—	WCA2B	WCA2A	93	53				24	x (Calib 2.2+)	From WCA2B into L35B borrow in south WCA-2A (three identical structs, 144,145,146)
WMM ELM	S146pos	S146pos	—	—	WCA2A	WCA2B			24	93	53		x (Calib 2.2+)	From L35B borrow in south WCA-2A into WCA2B (three identical structs, 144,145,146)
WMM ELM	S150in	S150in	tser	tser	LOK	WCA3A	1	1				39	x (Calib 2.2+)	From EAA (NNRiver/Hillsb basin) to L-38W canal in NE WCA-3A. 95Base = discharge from EAA NNR/HLSB basin to conveyance canal in NE WCA-3A; in 50Base onward, is water supply from LOK's S-351
WMM ELM	S150out	S150out	—	—	WCA3A	LOK			39	1	1		x (Calib 2.2+)	From EAA (NNRiver/Hillsb basin) to L-38W canal in NE WCA-3A. 95Base = discharge from EAA NNR/HLSB basin to conveyance canal in NE WCA-3A; in 50Base onward, is water supply from LOK's S-351

ELM Water Control Structure Attributes

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Model ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X	Fr: Cell_Y	Fr: CanalID	To: Cell_X	To: Cell_Y	To: CanalID	Calib	Calib 2.2+	95 Bas	Bas RR2P	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Description
WMM S151 ELM S151	S-151	—	—	WCA3A	WCA3B			47			63	x	x								From Miami Canal in WCA-3A (at juncture of L-67A), into Miami Canal (C304) in WCA-3B. S-151 is not split into two flows (WS and Reg.) for calibration
WMM S175 ELM S175	S-175	tser	tser	LEC	ENP	1	1				58	x	x								From L-31W south of Frog Pond into continuation of L-31W (S175D canal) and into marsh region just upstream of Everglades National Park east panhandle. Check calib SFWMM v5.4 vs observed data flows
WMM S18C ELM S18C	S-18C	tser	tser	LEC	ENP	1	1				62	x	x								From northern C-111E canal into lower C-111 canal (upstream of culverts/newly-degraded levee). S-197 downstream of the latter area historically controlled how much of this water flowed south into marsh
WMM S197 ELM S197	S-197	—	—	ENP	LEC			62	1	1		x	x	x	x	x	x			x	From C-111 canal (reach containing culverts/newly-degraded levee, downstream of S-18C) to Barnes Sound.
WMM S31 ELM S31	S-31	—	—	WCA3B	LEC			63	1	1		x	x	X	x	X	X			x	From C304 (Miami Canal) in WCA-3B to C-6 (Miami Canal) in urban LEC. For ALTS, S-31 split into 3 structs, plus S-337
WMM S332 ELM S332	S-332	tser	tser	LEC	ENP	1	1		67	141		x	x								From L-31W into marshes of Taylor Slough (in Everglades National Park).
WMM S332B ELM S332B	S-332B	7	0.04	LEC	ENP	1	1		69	127			x								From L-31N (between S-176 & S-331) into detention areas north of Taylor Slough, intended to recycle seepage from the Park. A plan had set of S-332A,B,C,D of similar config. (LOCATION? and historical
WMM S332D ELM S332D	S-332D	tser	tser	LEC	ENP	1	1		67	141			x								From L-31N (between S-176 & S-331) into detention areas north of Taylor Slough, intended to recycle seepage from the Park. A plan had set of S-332A,B,C,D of similar config. (LOCATION?)

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Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X	Fr: Cell_Y	Fr: CanalID	To: Cell_X	To: Cell_Y	To: CanalID	Calib	Calib 2.2+	95 Bas	Bas RR2R	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Notes
WMM ELM	S333 S333	S-333	—	—	WCA3A	ENP			47			54	x	x	X	x	X	X			x	From L-29/L-67 in WCA-3-A to L-29 canal in NE ENP (below WCA-3B), no levee on south side L-29 below WCA-3B See also S-334, S-337
WMM ELM	S334 S334	S-334 S-336	—	—	ENP	LEC			54	1	1		x	x	X	x	X	X			x	From L-29 borrow in NE ENP to L-31N borrow of LEC upstream of G-211 (but there is some recycling, see S-356A&B)
WMM ELM	S337 S337	S-337	—	—	WCA3B	LEC			63	1	1		x	x	X	x	X	X			x	From Miami Canal (C304) in WCA-3B into L-30 canal of LEC. See also S-31 - we've put both structures in same phys location, but S-337 is more south actually. This is moved in Restudy ALTD (also==S337_C)
WMM ELM	S339 S339	S-339	—	—	WCA3A	WCA3A			41			42	x	x								From L-23E to C123 (both are reaches of Miami Canal), all within WCA-3A. NOT using historical data, just virtual weir. Historical flows bad-use SFWMM v5.4 simulated flows in calibration.
WMM ELM	S34 S34	S-34	—	—	WCA2B	LEC			29	1	1		x	x	X	x	X	X	x	x	x	From NNRiver reach segment between S143 and S34, to LEC; sources of this segment of NNR are G-123 (pumps from S to N of S-34), S-141 (2B), S-142E (3A), and S-143 (2A); other outflow is S-142W
WMM ELM	S340 S340	S-340	—	—	WCA3A	WCA3A			42			43	x	x								From C123 to CA-3 canal (both are reaches of Miami Canal), all within WCA-3A. NOT using historical data, just virtual weir. Historical flows bad-use SFWMM v5.4 simulated flows in calibration.
WMM ELM	S343 S343	S-343A&B	—	—	WCA3A	ENP			53	41	101		x	x	X	x	X	X			x	From SW corner of WCA-3A into Tamiami Canal in loop road area of ENP, via sum of S-343A and S-343B (S343T name ==v2.1 name S343, but flow is diff). Historical flows bad-use SFWMM v5.4 simulated flows in
WMM ELM	S344 S344	S-344	—	—	WCA3A	BC_			36			37	x	x	X	x	X	X			x	From borrow in L28 that is on east of levee in SW WCA-3A to borrow of that levee on west side in Big Cypress (i.e., borrow switches sides) See also S-343A&B. Historical flows bad-use SFWMM v5.4 simulated flows

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Model ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X	Fr: Cell_Y	Fr: CanalID	To: Cell_X	To: Cell_Y	To: CanalID	Calib	Calib 2.2+	95 Bas	Bas RR2P	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Description
WMM S38 ELM S38	S-38 S-38A	—	—	WCA2A	LEC			24	1	1		x	x	X	x	X	X	x	x	x	From L-38 canal in SE WCA-2A into C-14 canal of LEC (see also S-38A,B)
WMM S39 ELM S39	S-39 S-39A	—	—	WCA1	LEC			14	1	1		x	x	X	x	X	X	x	x	x	From Hillsboro Canal (actually, perimeter canal in general) in SE WCA-1 into Hillsboro Canal reach in LEC. Flow partitioned into 3 equal contributions.
WMM S39_L39 ELM S39_L39	S-39 S-39A	—	—	WCA1	LEC			14	1	1		x	x	X	x	X	X	x	x	x	From Hillsboro Canal (actually, perimeter canal in general) in SE WCA-1 into Hillsboro Canal reach in LEC. Contribution from L39 segment of perimeter canal.
WMM S39_L39b ELM S39_L39b	S-39 S-39A	—	—	WCA1	LEC			14	1	1		x	x	X	x	X	X	x	x	x	From Hillsboro Canal (actually, perimeter canal in general) in SE WCA-1 into Hillsboro Canal reach in LEC. Contribution from L39 segment of perimeter canal.
WMM S39_L40 ELM S39_L40	S-39 S-39A	—	—	WCA1	LEC			12	1	1		x	x	X	x	X	X	x	x	x	From Hillsboro Canal (actually, perimeter canal in general) in SE WCA-1 into Hillsboro Canal reach in LEC. Contribution from L40 segment of perimeter canal.
WMM S5A2NO ELM S5A2NO	S-5S	—	—	WCA1	EAA			11	1	1		x	x	X							From north tip of WCA1 into L8/C51/LWDD (water supply), partitioned into contribution from west (L-7) and east (L-40) segments of the rim canal.
WMM S5A2NO1 ELM S5A2NO1	S-5S	—	—	WCA1	EAA			11	1	1		x	x	X							From north tip of WCA1 into L8/C51/LWDD (water supply), partitioned into contribution from west (L-7) and east (L-40) segments of the rim canal. This is the L-7 flow.
WMM S5A2NO2 ELM S5A2NO2	S-5S	—	—	WCA1	EAA			11	1	1		x	x	X							From north tip of WCA1 into L8/C51/LWDD (water supply), partitioned into contribution from west (L-7) and east (L-40) segments of the rim canal. This is the L-40 flow.

ELM Water Control Structure Attributes

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Calib | Calib 2.2+ | 95 Bas | Bas RR2P | 50 Bas | Alt A | Alt D13R | 2050 wProj | MWD 12

Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X	Fr: Cell_Y	Fr: CanalID	To: Cell_X	To: Cell_Y	To: CanalID	Description
WMM ELM	S5A2SO S5A2SO	S-5			EAA	WCA1	1	1				11	From L-8 basin (and elsewhere) to north tip of WCA1, partitioned into contribution to west (L-7) and to east (L-40) segments of the rim canal.
WMM ELM	S5A2SO1 S5A2SO1	S-5	tser	tser	EAA	WCA1	1	1				11	From L-8 basin (and elsewhere) to north tip of WCA1, partitioned into contribution to west (L-7) and to east (L-40) segments of the rim canal. This is the L-7 flow.
WMM ELM	S5A2SO2 S5A2SO2	S-5	tser	tser	EAA	WCA1	1	1				11	From L-8 basin (and elsewhere) to north tip of WCA1, partitioned into contribution to west (L-7) and to east (L-40) segments of the rim canal. This is the L-40 flow.
WMM ELM	S6in S6in	S-6	tser	tser	EAA	WCA1	1	1				19	From EAA_NNR/HLSB basin to Hillsboro Canal in SW WCA-1. This structure is bi-directional, and this is a positive flow in this direction.
WMM ELM	S6out S6out	S-6			WCA1	EAA			19	1	1		From Hillsboro Canal in SW WCA-1 to EAA_NNR/HLSB basin. This structure is bi-directional, and this is a positive flow in this direction.
WMM ELM	S7in S7in	S-7	tser	tser	EAA	WCA2A	1	1				27	From EAA_NNR/HLSB basin to North New River Canal in western WCA-2A. This structure is bi-directional, and this is a positive flow in this direction.
WMM ELM	S7out S7out	S-7			WCA2A	EAA			27	1	1		From North New River Canal in western WCA-2A to EAA_NNR/HLSB basin. This structure is bi-directional, and this is a positive flow in this direction.
WMM ELM	S8in S8in	S-8	tser	tser	EAA	WCA3A	1	1				41	From EAA Miami basin (Miami Canal reach) to Miami Canal (C-123) reach in northern WCA-3A. This structure is bi-directional, and this is a positive flow in this direction. (Note that Miami Canal north of S-8 is

ELM Water Control Structure Attributes

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Alt buttons: Calib | Calib 2.2+ | 95 Bas | Bas RR2P | 50 Bas | Alt A | Alt D13R | 2050 wProj | MWD 12

Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X	Fr: Cell_Y	Fr: CanalID	To: Cell_X	To: Cell_Y	To: CanalID	Calib	Calib 2.2+	95 Bas	Bas RR2P	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Description
WMM / ELM	S8out / S8out	S-8	—	—	WCA3A	EAA			41	1	1		x	x								From Miami Canal (C-123) reach in northern WCA-3A to EAA Miami basin (Miami Canal reach). This structure is bi-directional, and this is a positive flow in this direction. (Note that Miami Canal north of S-8 is
WMM / ELM	S9 / S9	S-9	tser	tser	LEC	WCA3A	1	1				45	x	x	X							From C-11W canal of LEC to C-304 canal reach in eastern WCA-3A.
WMM / ELM	/ VS_H1	VS_H1	—	—	Holey L	EAA			31	1	1		x	x	X	x	X	X	x	x	x	A variation on use of virtual structures for seepage control outside Holey Land , via northern borrow
WMM / ELM	/ VS1_06	VS1_06	—	—	WCA1	WCA1			11			19	x	x	X	x	X	X	x	x	x	A virtual structure linking a reach of the rim canal of west WCA1 to the western reach segment of Hillsboro (in rim of WCA1)
WMM / ELM	/ VS1_07	VS1_07	—	—	WCA1	WCA1			19			14	x	x	X	x	X	X	x	x	x	A virtual structure linking two reaches of Hillsboro canal
WMM / ELM	/ VS1_07b	VS1_07b	—	—	WCA1	WCA1			11			12	x	x	X	x	X	X	x	x	x	A virtual structure linking two reaches of L-40 canal
WMM / ELM	/ VS1_09	VS1_09	—	—	WCA1	WCA1			12			14	x	x	x	x	x	x	x	x	x	A virtual structure linking the L-40 rim canal of east WCA1, southern reach with eastern reach of Hillsboro
WMM / ELM	/ VS2A1	VS2A1	—	—	WCA2A	LEC			25	1	1		x	x	X	x	X	X	x	x	x	A variation on use of virtual structures for seepage control across L36 of eastern WCA-2A boundary

ELM Water Control Structure Attributes

Click Alt button for structure list — GO TO: Details

Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr/To	Cell_X	Cell_Y	CanalID	Calib	Calib 2.2+	95 Bas	Bas RR2R	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Description
WMM		VS2A2	—	—	WCA2A	LEC	Fr:			10	x	x	X	x	X	X	x	x	x	A variation on use of virtual structures for seepage control across L6 of western WCA-2A boundary
ELM	VS2A2						To:	1	1											
WMM		VS2A4	—	—	WCA2A	WCA2A	Fr:			21	x	x	x	x	x	x	x	x	x	A virtual structure linking borrow along northeast corner of WCA2A
ELM	VS2A4						To:			22										
WMM		VS2A5	—	—	WCA2A	WCA2A	Fr:			22	x	x	x	x	x	x	x	x	x	A virtual structure linking borrow along eastern WCA2A to south
ELM	VS2A5						To:			23										
WMM		VS2A6	—	—	WCA2A	WCA2A	Fr:			23	x	x	x	x	x	x	x	x	x	A virtual structure linking borrow along SE WCA2A to L-35B
ELM	VS2A6						To:			24										
WMM		VS2B1	—	—	WCA2B	LEC	Fr:			28	x	x	X	x	X	X	x	x	x	A variation on use of virtual structures for seepage control outside WCA2B , via L35A borrow
ELM	VS2B1						To:	1	1											
WMM		VS2B2	—	—	WCA2B	LEC	Fr:			70	x	x	X	x	X	X	x	x	x	A variation on use of virtual structures for seepage control outside WCA2B , via L35A borrow
ELM	VS2B2						To:	1	1											
WMM		VS3A1	—	—	WCA3A	WCA3A	Fr:			39	x	x	X	x	X	X	x	x	x	A virtual structure linking reaches of L38 borrow along NE 3A
ELM	VS3A1						To:			30										
WMM		VS3A2	—	—	WCA3A	WCA3A	Fr:			30	x	x	X	x	X	X	x	x	x	A virtual structure linking reaches of L38 borrow and L-68A borrow along NE 3A
ELM	VS3A2						To:			46										

ELM Water Control Structure Attributes

GO TO: Details

Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr/To	Cell_X	Cell_Y	CanalID
WMM / ELM	VS3A3	VS3A3	—	—	WCA3A	WCA3A	Fr:			46
							To:			47
WMM / ELM	VS3A6	VS3A6	—	—	WCA3A	WCA3A	Fr:			47
							To:			53
WMM / ELM	VS3A7	VS3A7	—	—	WCA3A	WCA3A	Fr:			43
							To:			47
WMM / ELM	VS3B1	VS3B1	—	—	WCA3B	LEC	Fr:			66
							To:	1	1	
WMM / ELM	VS3B2	VS3B2	—	—	WCA3B	LEC	Fr:			50
							To:	1	1	
WMM / ELM	VS3B3	VS3B3	—	—	WCA3B	LEC	Fr:			51
							To:	1	1	
WMM / ELM	VS3B4	VS3B4	—	—	WCA3B	LEC	Fr:			71
							To:	1	1	
WMM / ELM	VSbr01	VSbr01	—	—	WCA3A	WCA3A	Fr:	48	59	
							To:	48	60	

Click Alt button for structure list

Name	Calib	Calib 2.2+	95 Bas	Bas RR2R	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Description
VS3A3	x	x	x	x	X	X	x	x	x	A virtual structure linking reaches of L-68A & L-67A borrows.
VS3A6	x	x	X	x	X	X			x	A virtual structure linking reaches of L-67A and L-29 borrow.
VS3A7	x	x	x	x	X	X			x	A virtual structure linking reaches of Miami canal and L-67A borrow.
VS3B1	x	x	X	x	X	X	x	x	x	A variation on use of virtual structures for seepage control outside WCA3B , via L37
VS3B2	x	x	X	x	X	X	x	x	x	A variation on use of virtual structures for seepage control outside WCA3B , via L33
VS3B3	x	x	X	x	X	X	x	x	x	A variation on use of virtual structures for seepage control outside WCA3B , via L30
VS3B4	x	x	X	x	X	X	x	x	x	A variation on use of virtual structures for seepage control outside WCA3B , via L30
VSbr01	x	x	X	x	X	X	x	x	x	A virtual structure allowing (Manning's) flow under bridge of Alligator Alley

ELM Water Control Structure Attributes

Click Alt button for structure list

GO TO: Details

Calib | Calib 2.2+ | 95 Bas | Bas RR2R | 50 Bas | Alt A | Alt D13R | 2050 wProj | MWD 12

Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To		Cell_X	Cell_Y	CanalID	Description
WMM		VSbr02	—	—	WCA3A	WCA3A	Fr:	51	59		A virtual structure allowing (Manning's) flow under bridge of Alligator Alley
ELM	VSbr02						To:	51	61		
WMM		VSbr03	—	—	WCA3A	WCA3A	Fr:	54	60		A virtual structure allowing (Manning's) flow under bridge of Alligator Alley
ELM	VSbr03						To:	54	61		
WMM		VSbr04	—	—	WCA3A	WCA3A	Fr:	57	60		A virtual structure allowing (Manning's) flow under bridge of Alligator Alley
ELM	VSbr04						To:	57	62		
WMM		VSbr05	—	—	WCA3A	WCA3A	Fr:	60	61		A virtual structure allowing (Manning's) flow under bridge of Alligator Alley
ELM	VSbr05						To:	60	62		
WMM		VSbr06	—	—	WCA3A	WCA3A	Fr:	67	61		A virtual structure allowing (Manning's) flow under bridge of Alligator Alley
ELM	VSbr06						To:	67	62		
WMM		VSbr07	—	—	WCA3A	WCA3A	Fr:	71	61		A virtual structure allowing (Manning's) flow under bridge of Alligator Alley
ELM	VSbr07						To:	71	62		
WMM		VSbr08	—	—	WCA3A	WCA3A	Fr:	73	61		A virtual structure allowing (Manning's) flow under bridge of Alligator Alley
ELM	VSbr08						To:	73	62		
WMM		VSbr09	—	—	WCA3A	WCA3A	Fr:	75	61		A virtual structure allowing (Manning's) flow under bridge of Alligator Alley
ELM	VSbr09						To:	75	62		

Each structure row is marked x in all nine scenario columns (Calib, Calib 2.2+, 95 Bas, Bas RR2R, 50 Bas, Alt A, Alt D13R, 2050 wProj, MWD 12).

ELM Water Control Structure Attributes

GO TO: Details

Click Alt button for structure list: Calib | Calib 2.2+ | 95 Bas | Bas RR2R | 50 Bas | Alt A | Alt D13R | 2050 wProj | MWD 12

Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X	Fr: Cell_Y	Fr: CanalID	To: Cell_X	To: Cell_Y	To: CanalID	Calib	Calib 2.2+	95 Bas	Bas RR2R	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Description
WMM / ELM	VSbr10	VSbr10	—	—	WCA3A	WCA3A	76	61		76	62		x	x	X	x	X	X	x	x	x	A virtual structure allowing (Manning's) flow under bridge of Alligator Alley
WMM / ELM	VSbr11	VSbr11	—	—	WCA3A	WCA3A	78	61		78	62		x	x	X	x	X	X	x	x	x	A virtual structure allowing (Manning's) flow under bridge of Alligator Alley
WMM / ELM	VSbr12	VSbr12	—	—	WCA3A	WCA3A	79	61		79	62		x	x	X	x	X	X	x	x	x	A virtual structure allowing (Manning's) flow under bridge of Alligator Alley
WMM / ELM	VSENP1	VSENP1	—	—	ENP	LEC			52	1	1		x	x	x	x	x	x	x	x	x	A variation on use of virtual structures for seepage control outside north ENP, via L31N
WMM / ELM	VSENP2	VSENP2	—	—	ENP	LEC			61	1	1		x	x	x	x	x	x	x	x	x	A variation on use of virtual structures for seepage control outside north ENP, via southern part of L31N
WMM / ELM	VSENP4	VSENP4	—	—	ENP	LEC			76	1	1		x	x	x	x	x	x	x	x	x	A variation on use of virtual structures for seepage control outside south ENP near Frog Pond, via upper part of ELM's C-111
WMM / ELM	VSENP5	VSENP5	—	—	ENP	ENP			55			56	x	x	x							A virtual structure providing physical connection between Tamiami canal and L67extension borrow.
WMM / ELM	VSt_ABC Ri1	VSt_ABC Ri1	—	—	ENP	TIDE			115	1	1			x								Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions, Gulf of Mexico via Alligator Bay (AB) & Chatham River (CRi); 1 of 2 uni-directional flows at this virtual structure (outflow)

ELM Water Control Structure Attributes

GO TO: Details

Click Alt button for structure list: Calib | Calib 2.2+ | 95 Bas | Bas RR2R | 50 Bas | Alt A | Alt D13R | 2050 wProj | MWD 12

Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X / To: Cell_X	Fr: Cell_Y / To: Cell_Y	Fr: CanalID / To: CanalID	Description
WMM / ELM	VSt_ABCRi2	VSt_ABCRi2	___	15	TIDE	ENP	Fr: 1	Fr: 1	To: 115	Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions, Gulf of Mexico via Alligator Bay (AB) & Chatham River (CRi); 1 of 2 uni-directional flows at this virtual structure (inflow)
WMM / ELM	VSt_ABLRi	VSt_ABLRi	___	___	ENP	ENP			Fr: 113 / To: 112	Virtual structure, tidal influence (VSt). A virtual structure providing physical connection between the estuarine bays south of Alligator Bay (AB) and the Lostmans River (LRi)
WMM / ELM	VSt_BRi	VSt_BRi	___	___	ENP	ENP			Fr: 111 / To: 110	Virtual structure, tidal influence (VSt). A virtual structure providing physical connection between the eastern portion of the Broad River (BRi) and western portion of the Broad River (BRi)
WMM / ELM	VSt_BRiGM	VSt_BRiGM	___	___	ENP	ENP			Fr: 110 / To: 105	Virtual structure, tidal influence (VSt). A virtual structure providing physical connection between the western portion of the Broad River (BRi) and the Gulf of Mexico (GM) boundary reach in vicinity of the
WMM / ELM	VSt_HRi	VSt_HRi	___	___	ENP	ENP			Fr: 109 / To: 108	Virtual structure, tidal influence (VSt). A virtual structure providing physical connection between the eastern portion of the Harney River (HRi) and the western portion of the Harney River (HRi)
WMM / ELM	VSt_HRiGM	VSt_HRiGM	___	___	ENP	ENP			Fr: 108 / To: 104	Virtual structure, tidal influence (VSt). A virtual structure providing physical connection between the western portion of the Harney River (HRi) and the Gulf of Mexico (GM) boundary reach in the vicinity of the
WMM / ELM	VSt_LBLRi	VSt_LBLRi	___	___	ENP	ENP			Fr: 114 / To: 112	Virtual structure, tidal influence (VSt). A virtual structure providing physical connection between the estuarine bays near Big Lostmans Bay (LB) and the Lostmans River (LRi)
WMM / ELM	VSt_LRiGM	VSt_LRiGM	___	___	ENP	ENP			Fr: 112 / To: 105	Virtual structure, tidal influence (VSt). A virtual structure providing physical connection between the western portion of the Lostmans River (LRi) and the Gulf of Mexico (GM) boundary reach in vicinity of the Broad

ELM Water Control Structure Attributes

Click Alt button for structure list — Calib | Calib 2.2+ | 95 Bas | Bas RR2P | 50 Bas | Alt A | Alt D13R | 2050 wProj | MWD 12

GO TO: Details

Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X	Fr: Cell_Y	Fr: CanalID	To: Cell_X	To: Cell_Y	To: CanalID	Calib	Calib 2.2+	95 Bas	Bas RR2P	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Description
WMM / ELM	VSt_SRi	VSt_SRi	—	—	ENP	ENP			106			107		x								Virtual structure, tidal influence (VSt). A virtual structure providing physical connection between the eastern portion of the Shark River (SRi) and the western portion of the Shark River (SRi)
WMM / ELM	VSt_SRi GM	VSt_SRiG M	—	—	ENP	ENP			107			104		x								Virtual structure, tidal influence (VSt). A virtual structure providing physical connection between the western portion of the Shark River (SRi) and the Gulf of Mexico (GM) boundary reach in the vicinity of the
WMM / ELM	VSt_TRiF B	VSt_TRiF B	—	—	ENP	ENP			99			100		x								Virtual structure, tidal influence (VSt). A virtual structure providing physical connection between the Taylor River (TRi) and the eastern Florida Bay boundary reach
WMM / ELM	VStFB_C 1	VStFB_C1	—	—	ENP	TIDE			101	1	1			x								Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions in Florida Bay (FB), central (C) section; 1 of 2 uni-directional flows at this virtual structure (outflow)
WMM / ELM	VStFB_C 2	VStFB_C2	—	30	TIDE	ENP	1	1				101		x								Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions in Florida Bay (FB), central (C) section; 1 of 2 uni-directional flows at this virtual structure (inflow)
WMM / ELM	VStFB_E 1	VStFB_E1	—	—	ENP	TIDE			100	1	1			x								Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions in Florida Bay (FB), eastern (E) section; 1 of 2 uni-directional flows at this virtual structure (outflow)
WMM / ELM	VStFB_E 2	VStFB_E2	—	30	TIDE	ENP	1	1				100		x								Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions in Florida Bay (FB), eastern (E) section; 1 of 2 uni-directional flows at this virtual structure (inflow)
WMM / ELM	VStFB_W 1	VStFB_W 1	—	—	ENP	TIDE			102	1	1			x								Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions in Florida Bay (FB), west (W) section; 1 of 2 uni-directional flows at this virtual structure (outflow)

ELM Water Control Structure Attributes

Click Alt button for structure list — GO TO: Details

Calib | Calib 2.2+ | 95 Bas | Bas RR2P | 50 Bas | Alt A | Alt D13R | 2050 wProj | MWD 12

Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X	Fr: Cell_Y	Fr: CanalID	To: Cell_X	To: Cell_Y	To: CanalID	Alternatives	Description
WMM / ELM	VStFB_W2	VStFB_W2		30	TIDE	ENP	1	1				102	x	Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions in Florida Bay (FB), west (W) section; 1 of 2 uni-directional flows at this virtual structure (inflow)
WMM / ELM	VStGM_BL1	VStGM_BL1			ENP	TIDE			105	1	1		x	Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions along the Gulf of Mexico region adjacent to the Broad and Lostmans Rivers (BL); 1 of 2 uni-directional flows at this
WMM / ELM	VStGM_BL2	VStGM_BL2		30	TIDE	ENP	1	1				105	x	Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions along the Gulf of Mexico region adjacent to the Broad and Lostmans Rivers (BL); 1 of 2 uni-directional flows at this
WMM / ELM	VStGM_CRi1	VStGM_CRi1			ENP	TIDE			116	1	1		x	Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions along the Chatham River (CRi); 1 of 2 uni-directional flows at this virtual structure (outflow)
WMM / ELM	VStGM_CRi2	VStGM_CRi2		15	TIDE	ENP	1	1				116	x	Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions along the Chatham River (CRi); 1 of 2 uni-directional flows at this virtual structure (inflow)
WMM / ELM	VStGM_LRi1	VStGM_LRi1			ENP	TIDE			112	1	1		x	Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions along the Lostmans River (LRi); 1 of 2 uni-directional flows at this virtual structure (outflow)
WMM / ELM	VStGM_LRi2	VStGM_LRi2		15	TIDE	ENP	1	1				112	x	Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions along the Lostmans River (LRi); 1 of 2 uni-directional flows at this virtual structure (inflow)
WMM / ELM	VStGM_SH1	VStGM_SH1			ENP	TIDE			104	1	1		x	Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions along the Gulf of Mexico region adjacent to the Shark and Harney Rivers (SH); 1 of 2 uni-directional flows at this virtual

ELM Water Control Structure Attributes

GO TO: Details

Click Alt button for structure list

Model	ID	Name	TP (ppb)	TS (ppt)	Basin From	Basin To	Fr: Cell_X	Fr: Cell_Y	Fr: CanalID	To: Cell_X	To: Cell_Y	To: CanalID	Calib	Calib 2.2+	95 Bas	Bas RR2P	50 Bas	Alt A	Alt D13R	2050 wProj	MWD 12	Description
WMM / ELM	VStGM_SH2	VStGM_SH2		30	TIDE	ENP	1	1				104		x								Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions along the Gulf of Mexico region adjacent to the Shark and Harney Rivers (SH); 1 of 2 uni-directional flows at this virtual
WMM / ELM	VStGM_WB1	VStGM_WB1			ENP	TIDE			103	1	1			x								Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions along Cape Sable-Whitewater Bay (WB); 1 of 2 uni-directional flows at this virtual structure (outflow)
WMM / ELM	VStGM_WB2	VStGM_WB2		30	TIDE	ENP	1	1				103		x								Virtual structure, tidal influence (VSt). A virtual structure providing tidal boundary conditions along Cape Sable-Whitewater Bay (WB); 1 of 2 uni-directional flows at this virtual structure (inflow)

Global parameters for input to ELM v2.5.1 15-Jun-06

Modifications to the "Nominal" numeric values may be made in this worksheet - as long as you document it!!;
Those values and the brief supporting documentation column are mirrored in the "GlobalParms_NOM" worksheet for model input.
The GlobalParms_LO and GlobalParms_HI sheets are only used in the automated Sensitivity Analysis - modify those parameters as desired.

Ranks are based upon subregional sensitivity analyses on water depth and on surface and porewater phosphorus. See those results for more detailed documentation.

Rank:
5= unused - there are 3 such parameters;
4= not intended for modification beyond sensitivity tests - there are 27 such parameters;
3= has little to no effect on current model Performance Measures - there are 17 such parameters;
2= has observable effect on a Performance Measure - there are 17 such parameters;
1= a sensitive variable affecting multiple Performance Measures - there are 6 such parameters;

Rank	Parameter name	Nominal Value	Units	Default Value	diff?	Brief documentation	Extended documentation
4	GP_SOLOMEGA=	0.03259	dimless	0.03259		***empirical constant used in solar radiation, don't change from 0.03259	fixed value from Nikolov and Zeller (1992) solar radiation algorithm which was tested in multiple global locations
4	GP_ALTIT=	1	m	1		***regional altitude of land surface	pertinent only to applying model to other region
4	GP_LATDEG=	26.00	deg.min	26.00		***regional latitude (degrees.minutes, don't convert min to decimal deg)	pertinent only to applying model to other region
4	GP_mannDepthPow=	1.667	dimless	1.667		***power used in manning's equation water depth	for "true" manning's, use 1.667
4	GP_mannHeadPow=	0.50	dimless	0.50		***power used in manning's equation head difference	for "true" manning's, use 0.5
1	GP_calibGWat=	1.25	dimless	1.25		***calibration parameter, multiply by aquifer hydraulic conductivity, levee seepage	coarse calibration knob, used in calibrating budget to approximate SFWMM budget
5	GP_IDW_pow=	2.00	dimless	2.00		***power for (all) inverse distance^parm interpolations	have always used IDW^2 (parm=2.0) when running meteorological interpolations; no ELM-calculated interpolations in ELM v2.2 - v2.4
1	GP_calibET=	0.90	dimless	0.90		***calibration parameter, multiply potential ET input data	coarse calibration knob, used in calibrating ET budget to Abtew's (1996) rates for specific flooded habitats, and approximate SFWMM budget
4	GP_DATUM_DISTANCE=	6.00	m	6.00		***distance below NGVD'29 to base datum	not simulating deep aquifer (below 6 meters beneath NGVD '29)
4	GP_HYD_IC_SFWAT_ADD=	0.00	m	0.00		***surf water depth added to Initial Condition ponded surface water depth map (+/- m)	only used in exploratory model experiments
4	GP_HYD_IC_UNSAT_ADD=	0.00	m	0.00		***depth of unsat zone added to Initial Condition unsaturated water storage depth map (+/-m)	only used in exploratory model experiments
5	GP_HYD_RCRECHG=	0.00	m/d	0.00		***Rate of recharging of the aquifer below the base datum (loss from model system).	***should always=0.0, deep recharge effectively not implemented
4	GP_HYD_ICUNSATMOIST=	1.00	dimless	1.00		***Initial condition of the moisture proportion in the unsaturated zone.	limited spatial data; non-critical initial condition
3	GP_DetentZ=	0.01	m	0.01		***detention depth in a grid cell, below which surface flows do not occur	scale-dependent relative to topographic heterogeneity
4	GP_MinCheck=	0.0001	m	0.0001		***small threshold number, for relative error-checking (not a multiplier etc)	only used in constraining fluxes at extremely mimimal conditions
2	GP_dispLenRef=	500	m	500		***reference length for which numerical dispersion (of finite difference sol'n) approximates actual turbulent diffusion, or dispersion	code not truly established for input of actual dispersion estimates - at this point, dispersion is poorly quantified in these wetlands
2	GP_dispParm=	1.00	dimless	1.00		***calibration parameter, can be ~representative of Dispersion Number estimates; a value of 0 removes any dispersion adjustments (leaving only the numerical dispersion of model scale)	code not truly established for input of actual dispersion estimates - at this point, dispersion is poorly quantified in these wetlands
3	GP_SLRise=	0.0024	m/yr	0.0024		***rate of Sea Level Rise	based on CERP Guidance Memo 016.00
4	GP_ALG_IC_MULT=	1.0	dimless	1.0		***algal init-cond multiplier (0-1 proportion, relative to maximum attainable biomass)	intended only for use in exploratory model experiments
4	GP_alg_uptake_coef=	3.0	dimless	3.0		***parameter for exp function describing uptake kinetics	not intended for adjustment, only used to define (fixed) function behavior; set at 3.0
3	GP_ALG_SHADE_FACTOR=	1.0	dimless	1.0		***calibration parm to modify LAI in shading fcn	regulate magnitude of macrophyte shading; CALIBRATE to achieve observed periphyton biomass in dense/moderate vegetation
3	GP_algMortDepth=	0.05	m	0.05		***depth of the unsat zone below which accelerated "drydown" alg mort occurs	limited field observations
3	GP_ALG_RC_MORT_DRY=	0.0002	1/d	0.0002		***Specific mortality rate of benthic algae (periphyton) in "drydown" conditions.	limited field observations; preliminary lab experiments
2	GP_ALG_RC_MORT=	0.0001	1/d	0.0001		***Baseline specific rate of algal (periphyton) mortality. Note that this is in the presence of water.	liimited field observations relating to biomass changes
2	GP_ALG_RC_PROD=	0.05	1/d	0.05		***Maximum specific rate observed/attainable of algal (periphyton) gross primary production.	field experiments (and O2->Carbon conversion); CALIBRATE to achieve observed periphyton production rates
3	GP_ALG_RC_RESP=	0.0001	1/d	0.0001		***Max specific rate of algal respiration.	field experiments (and O2->Carbon conversion)
2	GP_alg_R_accel=	1.0	dimless	1.0		***acceleration of mortality (via assumed loss of calcareous sheath) of oligotrophic community under high phosphorus conditions	due to uncertainty of mechanism for mat loss, increase loss at elevated P concentrations; CALIBRATE to achieve biomass observations
3	GP_AlgComp=	2.0	dimless	2.0		***algal density-dep competition, with parameter >1.0 increasing competitive "ability" of oligotrophic periphyton	CALIBRATE to achieve relative biomass estimates of the two communities under low nutrient conditions
4	GP_ALG_REF_MULT=	0.01	dimless	0.01		***proportion of max attainable periphyton biomass, defining a refuge density (from losses)	this parameter multiplied by HP_ALG_MAX habitat-specific parameter to obtain refuge density; proxy for maintaining senescent stocks under severe drydown conditions
1	GP_NC_ALG_KS_P=	0.10	mg/L	0.10		***half-saturation conc of avail phosphorus for uptake kinetics, eutrophic (was non-calcareous)	Lab study; CALIBRATE to achieve plant growth rates along nutrient gradients

Figure 4.23 (3 pages)

3	GP_alg_alkP_min=	0.10	dimless	0.10		***minimum possible constraint level (0-1) on phosphorus uptake and growth; value>0 indicative of non-zero nutrient limitation due to APActivity	a proportion >0 is indicative of the observed continued (low) uptake and growth by periphyton at very low ambient P concentrations, due to alkaline phosphotase activity increasing bioavailability in low P conditions
2	GP_C_ALG_KS_P=	0.05	mg/L	0.05		***half-saturation conc of avail phosphorus for uptake kinetics, oligotrophic (was calcareous) periph	Lab study; CALIBRATE to achieve plant growth rates along nutrient gradients
4	GP_ALG_TEMP_OPT=	33	deg C	33		***Optimal temperature for algal primary production (degrees C). Also used in respiration control.	General literature estimates relative to plant type/family. Water temperature is constant across space and time in ELM v2.4, so temperature relationships are not effectively simulated.
1	GP_C_ALG_threshTP=	0.02	mg/L	0.02		***TP conc above which oligotrophic (was calcareous) periphyton have elevated mortality (via asmed loss of calcareous sheath)	due to uncertainty of mechanism for periphyton mat loss, increase respiration loss at elevated P concentrations; note that 10 ppb is estimate supported by multiple research efforts
2	GP_ALG_C_TO_OM=	0.48	gC/gOM	0.48		***Mass ratio of organic carbon to total organic material in algae (ash free dry weight).	multiple glades field and lab observations
4	GP_alg_light_ext_coef=	0.005	1/m	0.005		***light extinction parameter, currently used to fully define (statically) extinction	fixed extinction coef for clear water
3	GP_ALG_LIGHT_SAT=	550	cal/cm^2/d	550		***Saturating light intensity for algal photosyn (langley/d = cal/cm^2 per day)	assume max normal radiation is saturation
2	GP_ALG_PC=	0.003	gP/gC	0.003		***Initial phophorus:carbon ratio in all algae/periphyton	multiple glades field and lab observations
1	GP_DOM_RCDECOMP=	0.001	1/d	0.001		***Maximum observed/attainable specific rate of organic matter decomposition (w/o limitations)	field and lab studies, glades peat-systems
2	GP_DOM_DECOMPRED=	0.30	dimless	0.30		***under anaerobic conditions, proportional reduction of the maximum rate of aerobic decomposition	glades lab experiments
4	GP_calibDecomp=	0.60	dimless	0.60		***calibration parameter, multiply soil/floc decomposition flux calculation	Sensitive parameter, but duplicative of another: This is directly correlated to (multiplies) the GP_DOM_RCDECOMP; maintained from older model configuration
4	GP_DOM_decomp_coef=	3.0	dimless	3.0		***parameter for exp function describing decomposition kinetics with respect to phosphorus availability/quality	not intended for adjustment, only used to define (fixed) function behavior; set at 3.0
1	GP_DOM_DECOMP_POPT=	0.45	mg/L	0.45		***Optimal phosphorus concentration in water for maximal decomposition of organic matter	generalized from glades lab experiments
4	GP_DOM_DECOMP_TOPT=	33	deg C	33		***Optimal temperature for maximal decomposition of organic matter	assume max normal temperature is optimum. Water temperature is constant across space and time in ELM v2.4, so temperature relationships are not effectively simulated.
2	GP_sorbToTP=	0.01	dimless	0.01		***initial condition only, the ratio of sorbed phosphorus to total phosphorus in soil	generalization of soilTP conc initial condition
4	GP_IC_BATHY_MULT=	1.0	dimless	1.0		***Bathymetry initial condition multiplier, mutiply by the bathymetry initial condition (actually static) map	intended only for use in exploratory model experiments
4	GP_IC_TPtoSOIL_MULT=	1.0	dimless	1.0		***Soil TP concentration initial condition multiplier, mutiply by the TPsoil initial condition map	at least one Performance Measure is sensitive to this parameter; this global multiplier is intended only for use in exploratory model experiments
4	GP_IC_DOM_BD_MULT=	1.0	dimless	1.0		Organic bulk density initial condition multiplier, mutiply by the Organic Bulk Density initial condition map	intended only for use in exploratory model experiments
4	GP_IC_BulkD_MULT=	1.0	dimless	1.0		***Soil bulk density initial condition multiplier, mutiply by the soil bulk density initial condition (actually static) map	several Performance Measures have some sensitivity to this parameter; this global multiplier is intended only for use in exploratory model experiments
4	GP_IC_ELEV_MULT=	1.0	dimless	1.0		***Land elevation initial condition multiplier, mutiply by the elevation initial condition map	multiple Performance Measures are sensitive to this parameter; this global multiplier is intended only for use in exploratory model experiments
4	GP_MAC_IC_MULT=	1.0	dimless	1.0		***macrophyte initial condition multiplier (0-1 proportion, relative to maximum attainable (photo, non-photo) biomass)	several Performance Measures show some sensitivity; parameter intended only for use in exploratory model experiments
4	GP_MAC_REFUG_MULT=	0.01	dimless	0.01		***proportion of max attainable macrophyte biomass, defining a refuge density (from losses)	not sensitive; this parameter multiplied by HP_PH{NPH}BIO_MAX to obtain refuge density; proxy for maintaining a seed source
4	GP_mac_uptake_coef=	3.0	dimless	3.0		***parameter for exp function describing nutrient uptake kinetics	only used to define (fixed) function behavior
4	GP_mann_height_coef=	0.15	dimless	0.15		***proportion of height at which macrophyte starts to bend over in flowing systems	used in determining appropriate breakpoint in manning's n; use other parameters for adjusting/calibrating Manning's N
2	GP_Floc_BD=	20	mg/cm3	20		***bulk density of floc layer (mg/cm3 == kg/m3)	generalized from multiple soil cores
3	GP_FlocMax=	0.1	m	0.1		***max floc depth observed/attainable	generalized from multiple soil cores
3	GP_TP_P_OM=	0.012	gP/gOM	0.012		***phosphorus to organic matter ratio of particulate phosphorus (ash-free masses)	standard redfield ratios
2	GP_Floc_rcSoil=	0.01	1/d	0.01		***baseline rate of floc layer consolidation into the soil matrix (under flooded conditions)	CALIBRATE to achieve spatial and temporal distribution in floc depth
3	GP_TP_DIFFCOEF=	0.0000088	cm^2/sec	0.0000088		***Phosphorus molecular (surface-soil water) diffusion coefficient.	general literature value
2	GP_TP_K_INTER=	40	mg/L	40		***intercept for Freundlich soil sorption eqn	porewater P responds to this parameter; value from lab study (Richardsonet al. 1994)
3	GP_TP_K_SLOPE=	-50	dimless	-50		***slope for Freundlich soil sorption eqn	lab study (Richardsonet al. 1994)
5	GP_WQMthresh=	0.15	m	0.15		***UNUSED in ELM - EWQM implementation ONLY: water depth threshold below which settling stops (EWQM used 0.15m)	ONLY used to emulate Everglades Water Quallity Model, in ELM cell_dyn13

Figure 4.23 (3 pages)

2	GP_PO4toTP=	0.54	dimless	0.54		***slope of empirical linear regression of predicting PO4 from TP from long-term historical data, northern Everglades locations	synoptic (northern) glades monitoring; data more variable than a constant slope
2	GP_TP_IN_RAIN=	0.02	mg/L	0.02		***TP concentration in rainfall (will be switching to new data for versions > ELMv2.4)	glades literature estimates; to incorporate recent reviews of data; concentration of 0.02 mg/L results in ~25 mg TP/m2/yr loading
3	GP_PO4toTPint=	-0.003	mg/l	-0.003		***intercept of empirical regression of predicting PO4 from TP from long-term historical data, northern Everglades locations	synoptic (northern) glades monitoring
3	GP_TP_ICSFWAT=	0.01	mg/L	0.01		***initial TP concentration, surface water	global estimate
3	GP_TP_ICSEDWAT=	0.001	mg/L	0.001		***initial TP concentration, soil pore water	global estimate
2	GP_TPpart_thresh=	0.1	mg/L	0.1		***TP conc used in predicting relative proportion of particulate P in Total Phosphorus	used to estimate particulate P for potential physical settling loss from water column; generalized estimate from (relatively limited) POC and TP observations
3	GP_TP_DIFFDEPTH=	0.1	m	0.10		***depth of surface-soil water diffusion zone	large depth due to poorly defined soil-water interface (w/ floc)
2	GP_settlVel=	0.4	m/d	0.40		***ELM (NOT EWQM emulation) mean settling velocity of particulate phosphorus (NOT of Total Phosphorus)	Calibrated parameter: "Black-box" to incorporate particulate settling and microbial uptake at high concentrations/particulate levels
Count:	70						

Figure 4.23 (3 pages)

Habitat-specific parameters for input to ELM

v2.5.2 23-May-06

Modifications to the parameter values may be made in each Modules' worksheet - as long as you document it!!
Parameter values (but not other documentation) are mirrored in the "Parms_NOM" worksheet that is input to model.
The Parms_LO and Parms_HI sheets are only used in the automated Sensitivity Analysis - modify those parameters as desired.

Note: Succession module not invoked in regional ELMv2.4, thus the associated parameters are unranked.

Ranks are based upon subregional sensitivity analyses on water depth and on surface and porewater phosphorus. See those results for more detailed documentation.

Rank: 5= unused - there are 4 such parameters;
4= not intended for modification beyond sensitivity tests - there are 1 such parameters;
3= has little to no effect on current model Performance Measures - there are 22 such parameters;
2= has observable effect on a Performance Measure - there are 12 such parameters;
1= a sensitive variable affecting multiple Performance Measures - there are 1 such parameters;

Rank	Parameter Name	Type	VarType	Units	Parameter Definition
	Periphyton				
2	HP_ALG_MAX	hab-spec	float	gC/m^2	Maximum attainable (observed) algal biomass density.
	Floc				
3	HP_FLOC_IC	hab-spec	float	kgOM/m^2	Initial mass of floc organic material (ash free dry weight).
3	HP_FLOC_IC_CTOOM	hab-spec	float	dimless	Initial mass ratio of organic carbon to total organic material in floc (ash free dry weight).
3	HP_FLOC_IC_PC	hab-spec	float	dimless	Initial mass ratio of phosphorus to carbon in floc organic matter (ash free dry weight).
	Soils				
3	HP_DOM_MAXDEPTH	hab-spec	float	m	Maximum depth (positive, from sediment surface) of Deposited Organic Matter to consider in model. This determines the depth of the active DOM zone for all model dynamics via: 1) decomposition, 2) sorption/desorption of nutrients, and 3) nutrient uptake by macrophytes. This generally should be <= the max root depth parm (less than root depth in case of trees).
3	HP_DOM_AEROBTHIN	hab-spec	float	m	The thin aerobic zone in a flooded wetland. Note that aerobic total depth is defined to include any zone of soil/sediment that is unsaturated or devoid of water.
	Hydrology				
3	HP_HYD_RCINFILT	hab-spec	float	m/d	Rate of infiltration into the unsaturated water storage zone.
2	HP_HYD_SPEC_YIELD	hab-spec	float	dimless	Proportion of total sediment/soil volume, for a given soil type, that represents water able to be drained by gravity. Field capacity = porosity - specific yield; ensure that alterations to porosity and specific yield are consistent in your parameterization.
2	HP_HYD_POROSITY	hab-spec	float	dimless	Porosity of the aquifer, average from the sediment to base datum. Field capacity = porosity - specific yield; ensure that alterations to porosity and specific yield are consistent in your parameterization. Must be non-zero.
	Phosphorus				
3	HP_TP_CONC_GRAD	hab-spec	float	dimless	For concentration gradient, provide the ratio of this nutrient in the inactive DOM zone to that in the active DOM zone. Used in partioning the mass of sediment nutrients to different concentrations in the shallow active DOM zone and the deeper inactive zone.
	Salt/tracer				
3	HP_SALT_ICSEDWAT	hab-spec	float	g/L	Initial salt concentration in the sediment water.
3	HP_SALT_ICSFWAT	hab-spec	float	g/L	Initial salt concentration in the surface water.
	Macrophytes				
2	HP_PHBIO_MAX	hab-spec	float	kgC/m^2	Maximum attainable (observed) biomass density of photosynthetic tissue.
3	HP_NPHBIO_MAX	hab-spec	float	kgC/m^2	Maximum attainable (observed) biomass density of nonphotosynthetic tissue.
2	HP_MAC_MAXHT	hab-spec	float	m	Maximum observed/attainable height of mature plant community (associated with a unit plant density at maturity).

Figure 4.24 (2 pages)

2	HP_NPHBIO_ROOTDEPTH	hab-spec	float	m	Depth of roots below the sediment/soil zone (positive value) for the community.
2	HP_MAC_MAXROUGH	hab-spec	float	d/(m^(1/3))	The maximum Manning's n roughness associated with present vegetation when fully inundated by water. The relation of the total manning's n to water depth ranges along the continuum from the roughness due to sediment only and roughness imparted by inundation of plants by water depth. Be sure this max value > the minimum roughness coeff.
2	HP_MAC_MINROUGH	hab-spec	float	d/(m^(1/3))	The minimum Manning's roughness coefficient for minimal/no vegetation. Be sure this value is less than the roughness coeff for the vegetation.
2	HP_MAC_MAXLAI	hab-spec	float	dimless	Maximum observed/attainable Leaf Area Index for a mature community (= area of leaves/area of ground).
5	HP_MAC_MAXCANOPCOND	hab-spec	float	mol/m^2/sec	UNUSED (v2.2+)Maximum canopy conductance (units mol LEAFm-2 sec-1) for plant that is NOT water stressed. For simplicitly, assume canopy conductance = unweighted mean of all leaves in canopy, using lit. values for leaf conductance. See Jarvis & McNaughton 1986.
5	HP_MAC_CANOPDECOUP	hab-spec	float	dimless	UNUSED (v2.2+)Canopy couple/decouple factor desciribing how closely the saturation deficit at the canopy surface is linked to the saturation deficit outside the Planetary Boundary Layer. SCALE dependent; this algorithm assumes model is geared towards large field, scale of hundreds to several thousand meters size. See Jarvis 1986. Values near 0 (perfectly coupled) for many tree canopies, near 1 for grassland-type canopies.
4	HP_MAC_TEMPOPT	hab-spec	float	deg C	Optimal temperature for maximum primary production growth rate. Air temperature is constant across space and time in ELM v2.4, so temperature relationships are not effectively simulated.
3	HP_MAC_LIGHTSAT	hab-spec	float	cal/cm^2/d	Saturating light intensity (langleys/d = cal/cm^2 per day) for macrophyte growth kinetics.
2	HP_MAC_KSP	hab-spec	float	mgP/L	Half saturation coeff of phosphorus for the nutrient uptake kinetics of macrophytes.
1	HP_PHBIO_RCNPP	hab-spec	float	1/d	Maximum observed/attainable specific rate of net primary production.
2	HP_PHBIO_RCMORT	hab-spec	float	1/d	Baseline specific rate of photobiomass mortality.
3	HP_MAC_WAT_TOLER	hab-spec	float	m	Depth of ponded surface water above which plant growth becomes restricted. Used in growth control function. Should be at least a very small positive number: A value of zero will be reset to 5mm in code.
5	HP_MAC_SALIN_THRESH	hab-spec	float	g/L	UNUSED (v2.2, v2.3)Salinity threshold, above which plant growth decreases linearly with increasing salinity.
3	HP_PHBIO_IC_CTOOM	hab-spec	float	gC/gOM	Initial ratio of organic carbon to total organic material in PhotoBiomass (ash free dry weight).
3	HP_NPHBIO_IC_CTOOM	hab-spec	float	gC/gOM	Initial ratio of organic carbon to total organic material in NonPhotoBiomass (ash free dry weight).
2	HP_PHBIO_IC_PC	hab-spec	float	gP/gC	Initial phosphorus:carbon ratio in PhotoBiomass (ash free dry weight).
3	HP_NPHBIO_IC_PC	hab-spec	float	gP/gC	Initial phosphorus:carbon ratio in NonPhotoBiomass (ash free dry weight).
3	HP_MAC_TRANSLOC_RC	hab-spec	float	1/d	Simple, bi-directional baseline translocation rate between Non-photo and Photo biomass; consider this gradual equilibrium as placeholder for a more process-based algorithm
	Succession				
3	HP_SfDepthLo	hab-spec	float	m	Lower Depth tolerance for Surface Water Depth
3	HP_SfDepthHi	hab-spec	float	m	Higher Depth tolerance for Surface Water Depth
3	HP_SfDepthInt	hab-spec	float	days	Time Interval for staying within Surface Water Depth range
3	HP_PhosLo	hab-spec	float	mgP/kg soil	Lower concentration tolerance for soil total Phosphorus
3	HP_PhosHi	hab-spec	float	mgP/kg soil	Higher concentration tolerance for soil total Phosphorus
3	HP_PhosInt	hab-spec	float	days	Time Interval for staying within soil total Phosphorus range
5	HP_FireInt	hab-spec	float	days	UNUSED. Time Interval since last Fire

40	Parameters	
28	Habitats (shown in other worksheets)	
1120	Potentially-unique parameter values	
138	Actually-unique pararmeter values (shown in other worksheets)	(64 unique values of 13 "important" parameters across 28 habitats)

Figure 4.24 (2 pages)

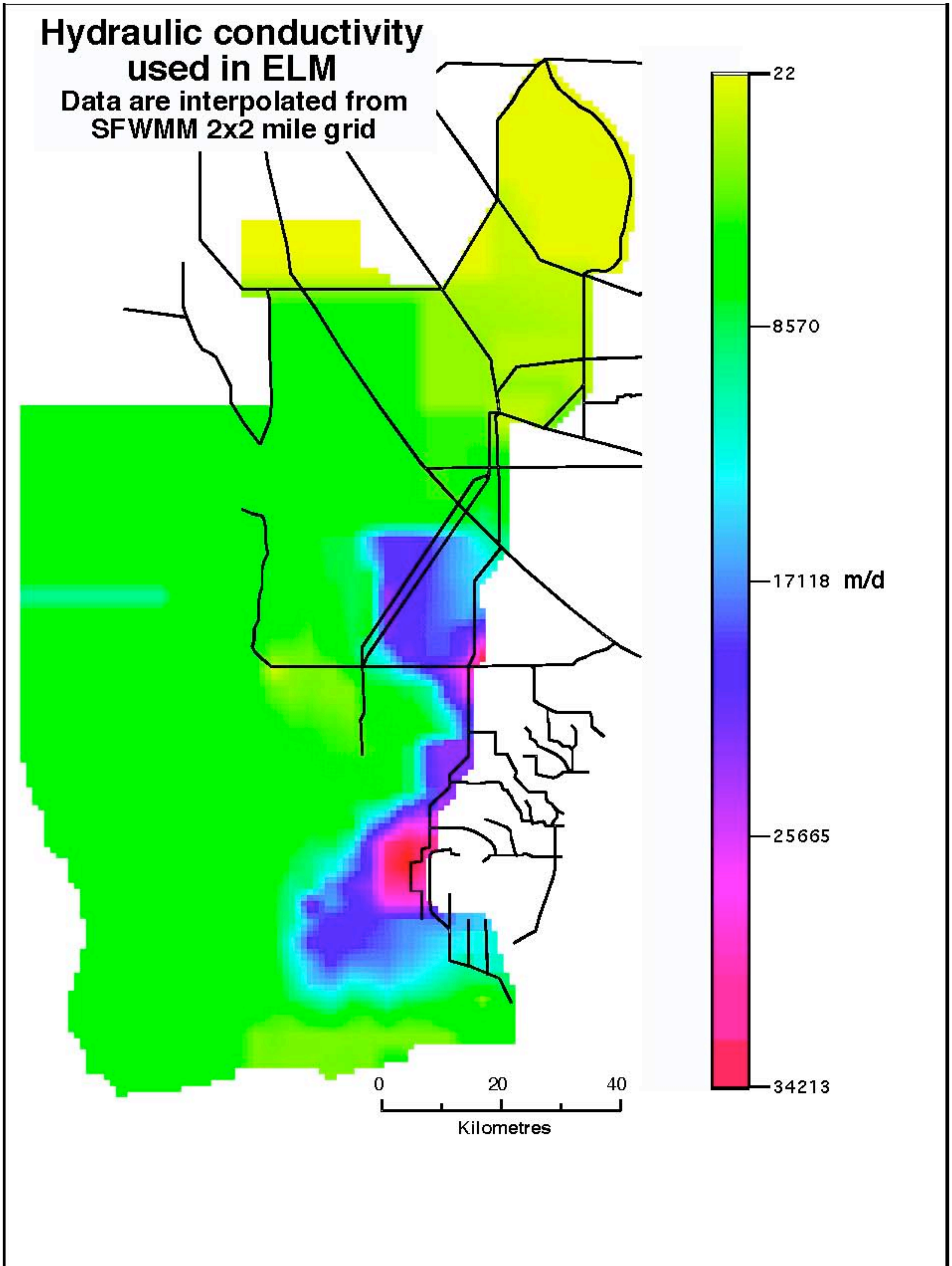
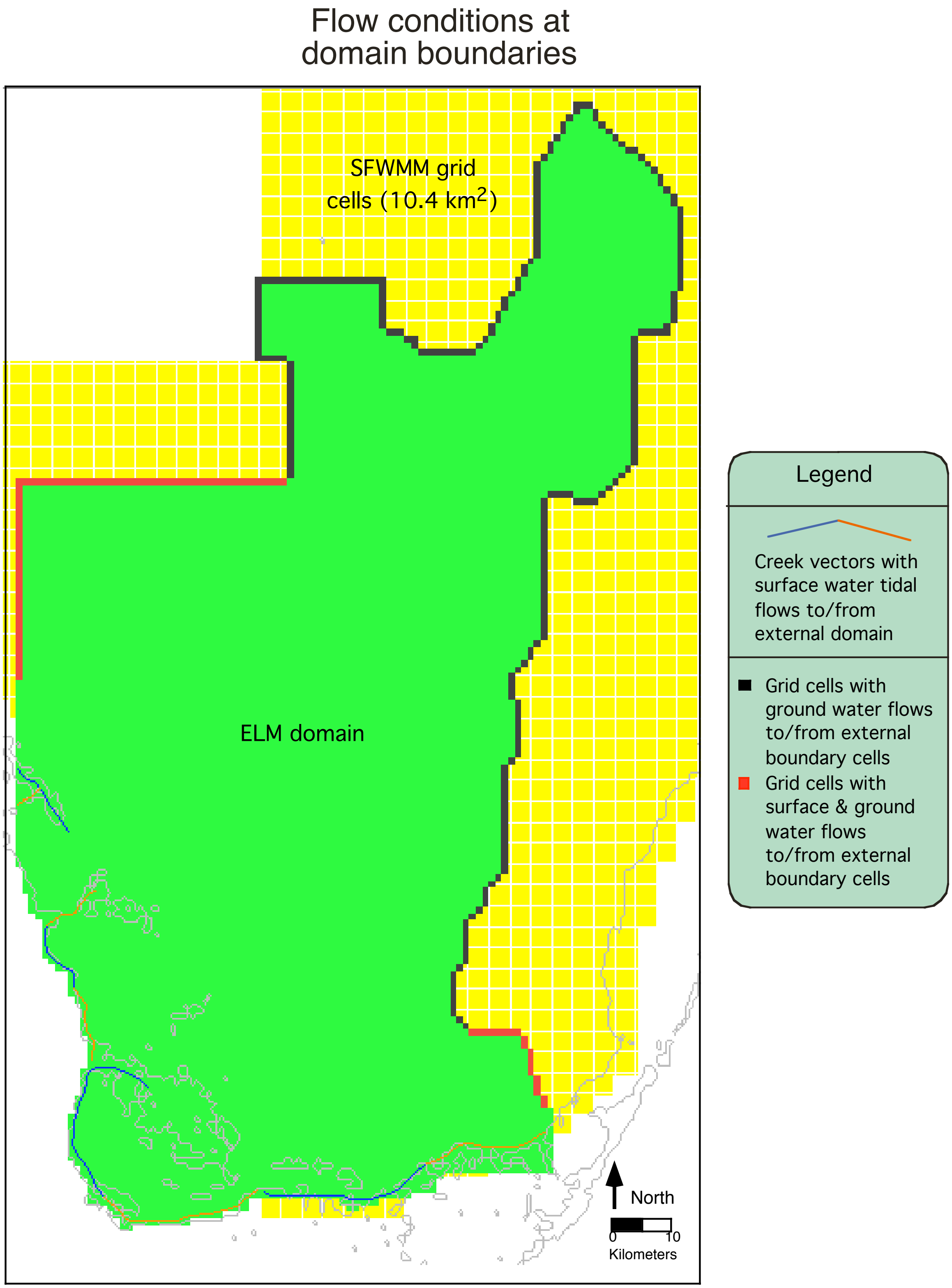

Hydraulic conductivity
used in ELM
Data are interpolated from
SFWMM 2x2 mile grid
22
8570
17118
m/d
25665
34213
0
20
40
Kilometres

Figure 4.25.



Flow conditions at domain boundaries
SFWMM grid cells (10.4 km2)
ELM domain
North
0
10
Kilometers
Legend
Creek vectors with surface water tidal flows to/from external domain
Grid cells with ground water flows to/from external boundary cells
Grid cells with surface & ground water flows to/from external boundary cells

Figure 4.26.