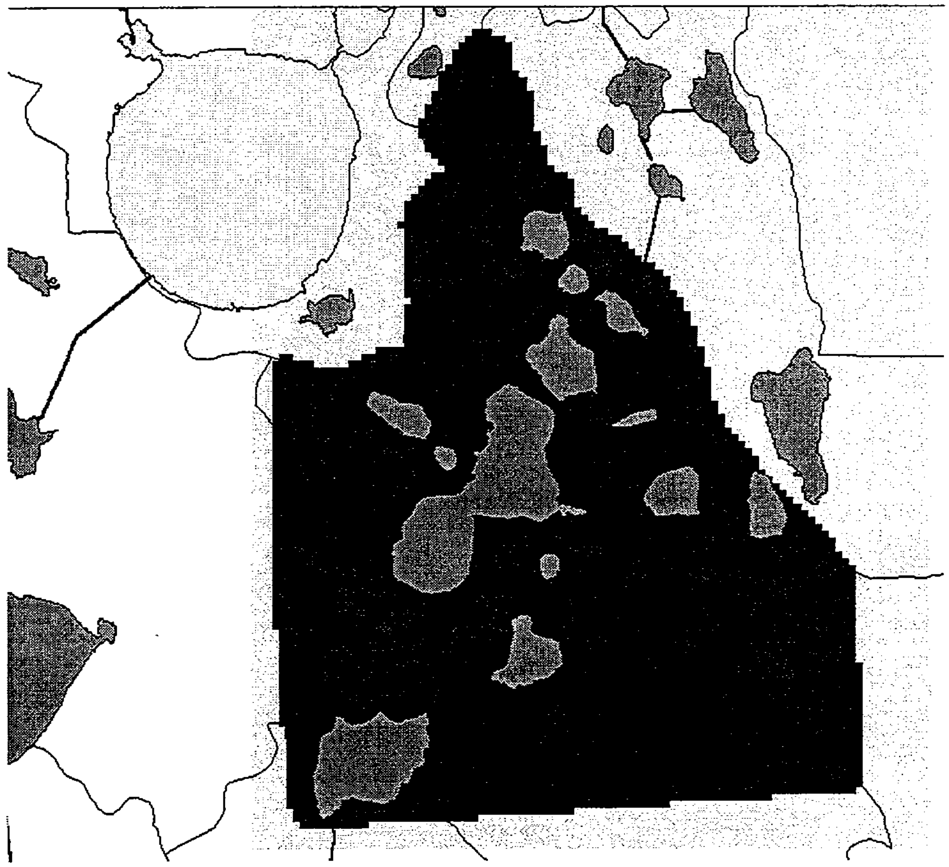

Figure 1 Model area, sub-basins, lakes and canals

2.2 The Saturated Zone Component (SZ)

2.2.1 Vertical Discretization

At present the model includes three geologic layers. The upper layer contains the entire Surficial Aquifer System (SAS). The second layer contains the Hawthorn group and the bottom layer contains the upper Floridan Aquifer. Hydrogeologic information within the model domain is sparse, with only a few wells from which to define the extents of each layer. Figure 3 on page H-7, Figure 4 on page H-7, and Figure 5 on page H-8 show the layering (referenced in feet NGVD) used in the model, as generated by MIKE SHE's built in interpolation program.

In MIKE SHE the vertical discretization is very flexible and may be chosen independent of the geological layers. However, in this study the vertical discretization follows the geological layers. Thus the model operates with 3 computational layers.

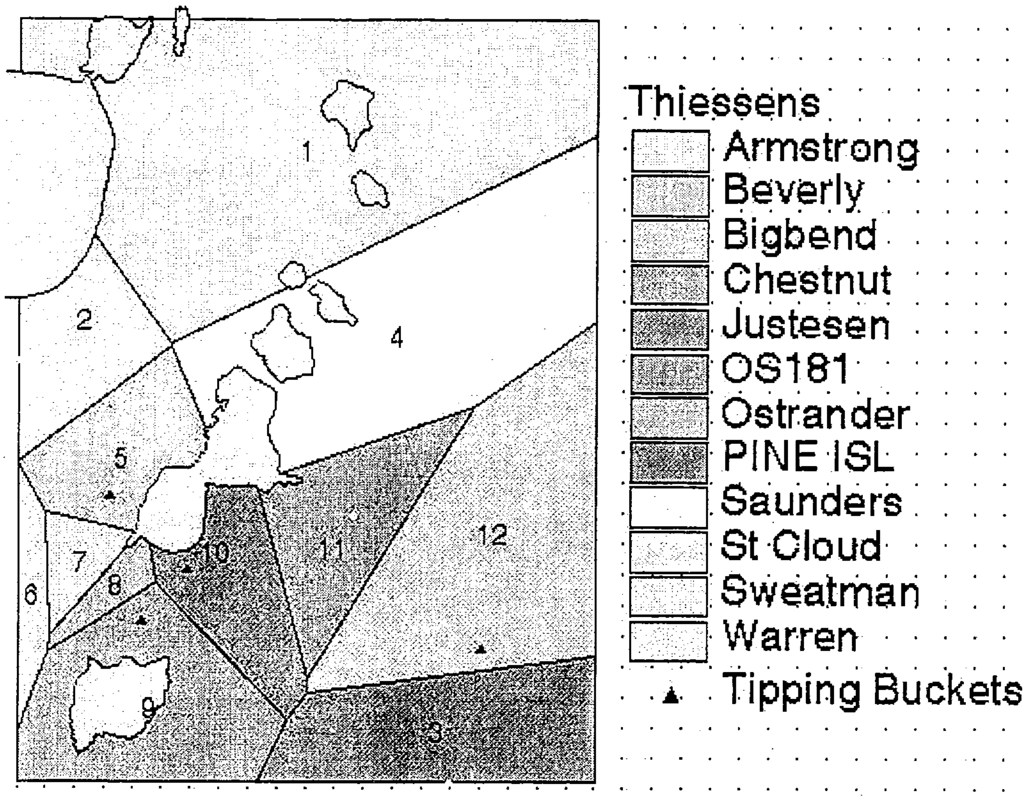

Figure 2 Rainfall Station distribution

2.2.2 Hydraulic Characteristics

At the beginning of this study, there were no field measurements of horizontal or vertical hydraulic conductivity within the model domain. In support of this modeling effort, 8 slug tests were performed by SFWMD staff, on the Surficial Aquifer System (Table 1: on page H-6).

Table 1: Results of Aquifer Slug Tests

X-Coordinate	Y-Coordinate	K [ft./day]	Site Name
429256	1398978	15.48	Beekman
421407	1406333	2.50	Blackwater
456331	1395373	9.93	Castelli
424160	1393122	5.69	Chestnut

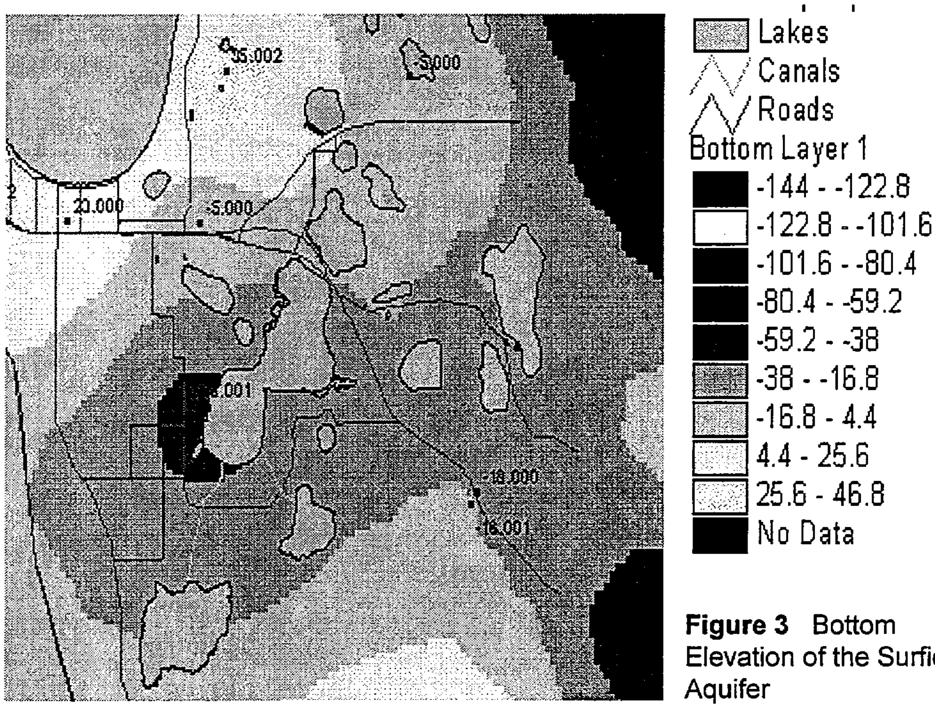

Figure 3 Bottom Elevation of the Surficial Aquifer

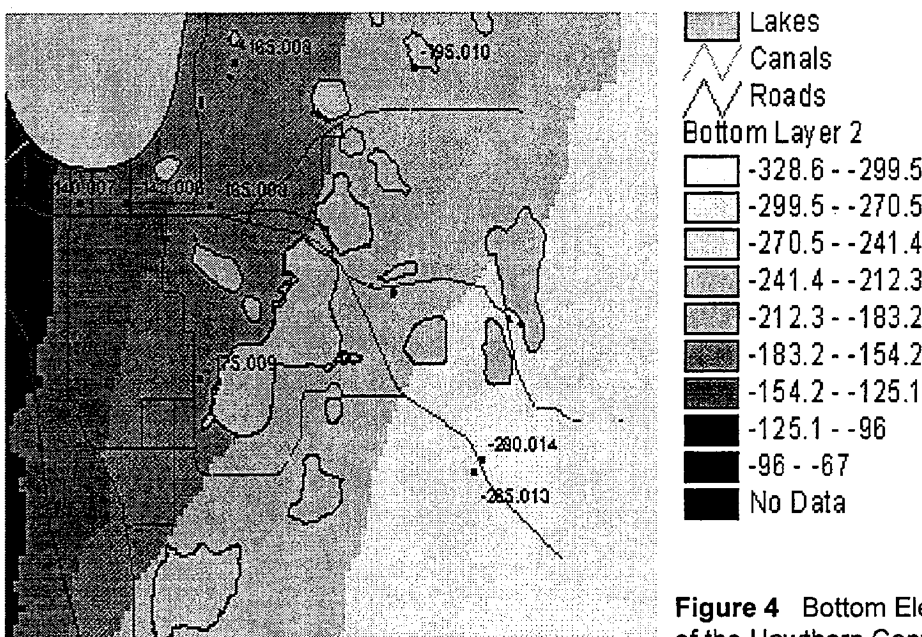

Figure 4 Bottom Elevation of the Hawthorn Confining Unit

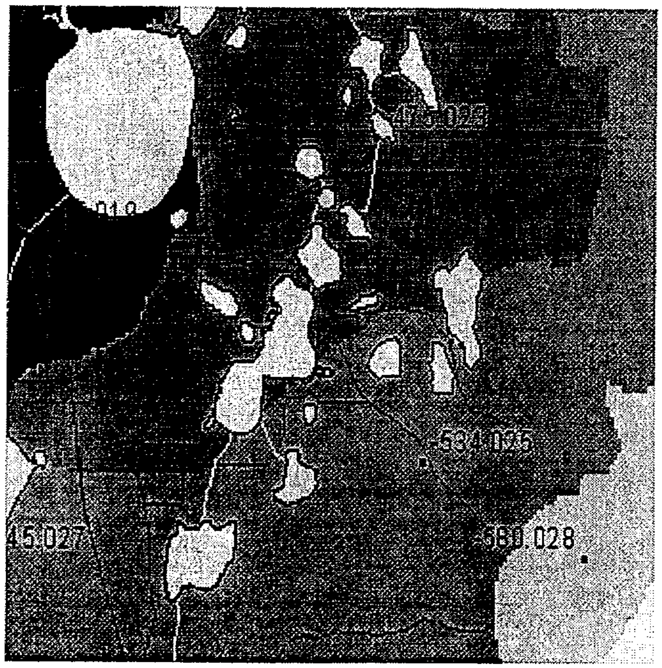

Figure 5 Bottom Elevation of the Upper Floridan Aquifer

Table 1: Results of Aquifer Slug Tests

426170	1394478	3.47	Moonlight1
426173	1393482	4.09	Moonlight2
421500	1404901	5.58	Simmons1
422674	1404906	2.19	Simmons2

The wells on which the slug tests were performed penetrated only a small portion of the Surficial aquifer. Given this partial penetration, and the fact that slug tests do not represent the actual aquifer conductivity as well as a full pumping test, the slug test results were used simply as a starting point from which to begin calibration. Final values for hydraulic conductivity of layer one of the model are shown in Figure 6 on page H-9.

Vertical conductivity in layer one was taken to be one-tenth the original interpolated values for horizontal hydraulic conductivity. There were no measured hydraulic parameters within

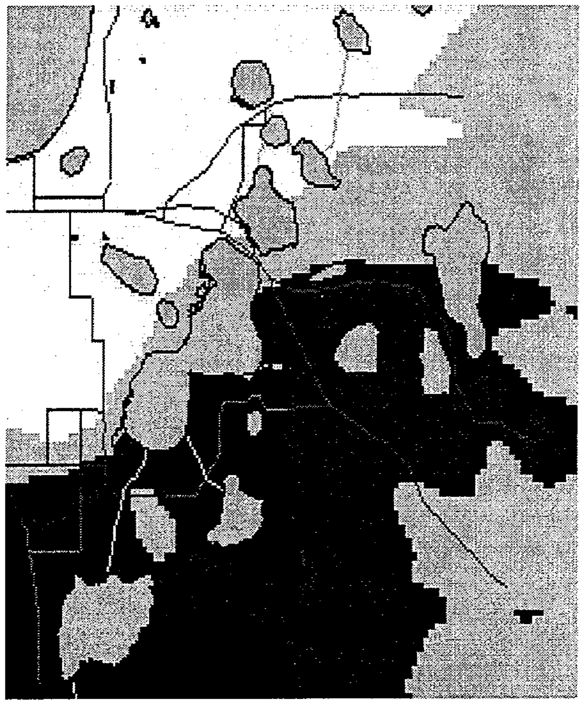

Figure 6 Horizontal Hydraulic Conductivity in Layer One

the model domain for the lower layers. Consequently, a single typical regional value was used for each layer (Table 2: on page H-9)

Table 2: Regional Conductivity Values

Model Layer	Horizontal K [ft./day]	Vertical K [ft./day]
Layer 2	.028	.0028
Layer 3	250	20

2.2.3 Initial Conditions

Initial (ground water level) head must be specified for each of the three computational layers. Water level observations began in November 1997. Prior to that time, there were only two observation wells within the model boundaries, OS-181 and a temporary well at Castelli fish farm (1992 – 1994), both located in the central part of the model east of Alligator Lake (layer 1). Consequently, it was not possible to interpolate a starting head for the model layers. Initial conditions arrays were created in the following manner. Model layers one and two were assigned an initial head of four feet below land-surface and forty-five feet NGVD in layer 3. A test simulation was run with the model. A stress period was found in the test run in which the simulated water level in the cell containing OS-181 was close to the observed level in the well at the beginning of the simulation period. The simulated heads for that stress period were extracted and used as initial conditions for the calibration.

2.2.4 Boundary Conditions

Boundary conditions are defined for each computational layer by an integer code. For instance code 0 is a zero-flux boundary and code 2 is a constant head boundary. If a code value is specified instead of a T2 filename the boundary type will automatically be assigned to all model boundary points (defined by code value 2 in the model grid file). Different types of boundary conditions can be applied using a T2 grid code file.

In the SAS the present model applies no-flux boundaries along the sub-basin boundaries in the eastern part of the model area. Along the southern and western boundaries a constant head is applied. Very little ground water table data is available. However, all available data indicate that the phreatic surface typically is about 2-4 feet below ground surface. Hence, for all cells using constant head boundary condition the ground water table is kept constant at 2 feet below ground surface.

Local adjustments were made to this during the course of calibration. Lake Gentry, and the Alligator Chain of Lakes were defined as variable head boundaries, where the head value was the mean daily stages at the headwater of S-63 and S-60 respectively (see Figure 7 on page H-11). For the Hawthorn confining beds (layer 2) a zero flux boundary was been applied. For the Upper Florida aquifer a constant head boundary condition is applied. Very little information is available regarding the potentiometric surface of the Upper Floridan aquifer within the model area. A representative local value of 14.5 meters, 47.57 feet was applied along the entire model boundary. Suitability of boundary conditions was tested during sensitivity analysis.

2.2.5 Drainage

Typically the major canals, rivers, and lakes, etc., are described in MIKE SHE's river module. However, most agricultural and urban areas are efficiently drained either naturally or artificially. On larger scale model the MIKE SHE drainage option accounts for small canals, ditches etc. that are not included in details in MIKE SHE's river module. A drainage level and a time constant describe drained areas. Whenever the ground water level in a cell is above the drainage level, drain flow is produced. Drainage water is routed to a river or a lake. The time-scale of the water routing is described using a linear reservoir approach. The time-constant is the mean retention time in a linear reservoir. The receiving body (typically a river or a lake) may be defined in different ways. In the present model drainage flows are routed using the slope of the drains. The notation #-0.3048 indicates that the drainage level is 0.3048 meters (1 foot) below ground surface (see Figure 8 on page H-11).

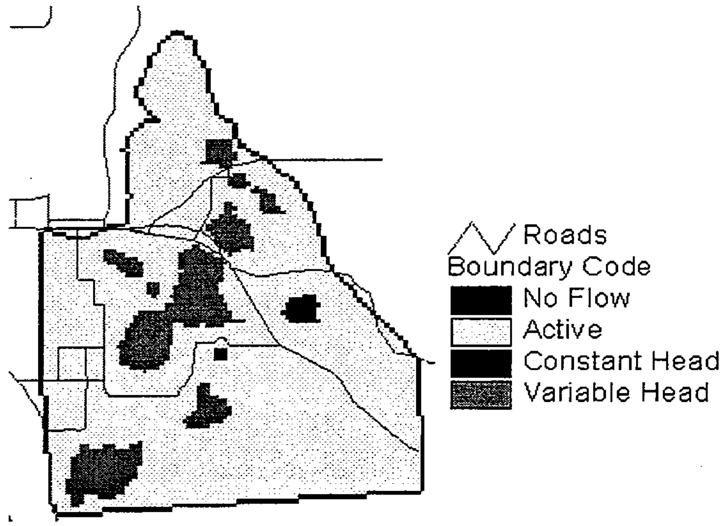

Figure 7 Layer 1 Boundary Conditions

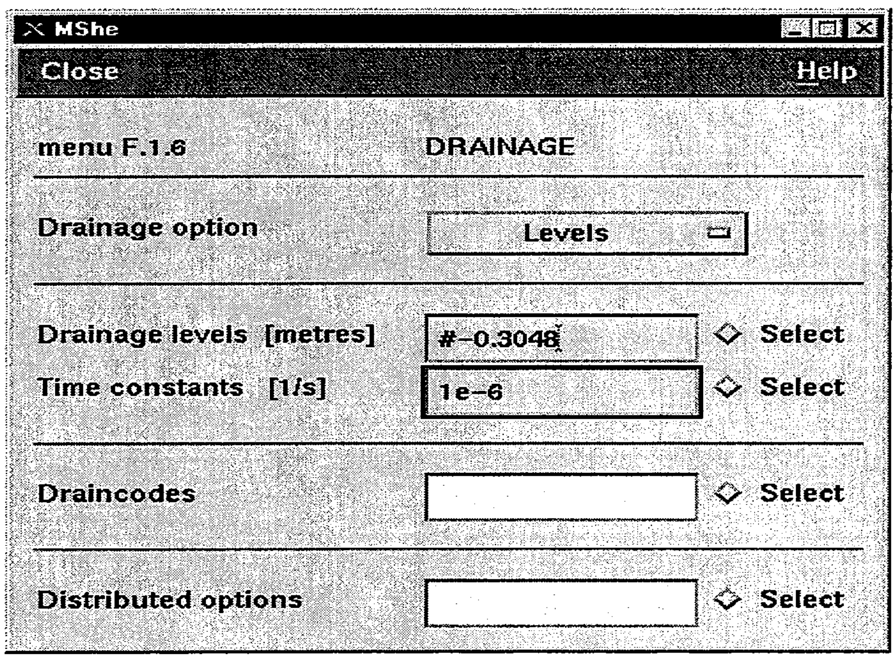

Figure 8 Drainage Menu

2.3 Unsaturated Zone Component

An unsaturated zone setup includes the definition of one or more soil profiles and the spatial distribution of the soil profiles. Soil profiles define soil horizons with different properties. Soil properties are described for individual soil types and stored in the MIKESHE soil database (Figure 9 on page H-12).

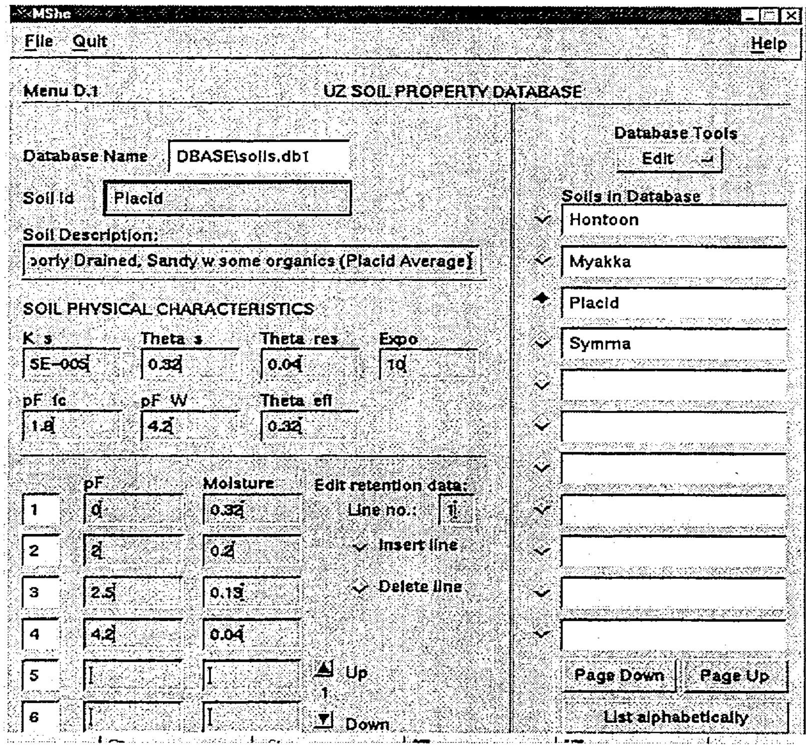

Figure 9 Soils Database for the Alligator Model

The distribution of soil classes used in the model is shown in Figure 10 on page H-13, from the Osceola County Soil Survey. The survey describes the soil groupings in the following manner:

- *Myakka-Tavares-Immokalee* – Nearly level to gently sloping, moderately well drained and poorly drained soils that are sandy throughout; some have weakly cemented sandy subsoil. Represented in the model by the average hydraulic properties of the Myakka soil.
- *Symrna-Myakka-Immokalee* – Nearly level, poorly drained soils that are sandy throughout and have a weakly cemented subsoil. Represented in the model by the average hydraulic properties of the Symrna soil.

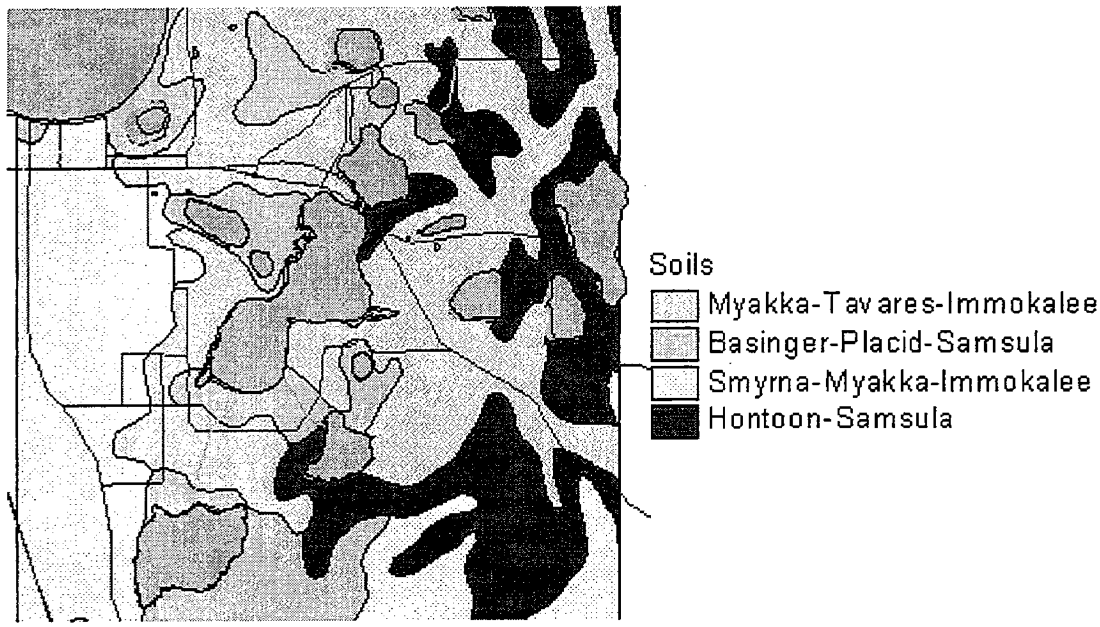

Figure 10 Generalized Soils Map

- *Bassinger-Placid-Samsula* – Nearly level, poorly drained and very poorly drained soils; most are sandy throughout and some have organic layers underlain by sandy layers. Represented in the model by the average hydraulic properties of the Placid soil.
- *Hontoon-Samsula* – Nearly level, very poorly drained organic soils; some are organic throughout, and some are sandy within a depth of 51 inches. Represented in the model by the average hydraulic properties of the Hontoon soil.

With the exception of the organic soils of the Hontoon-Samsula series, all of the soils in the area are fairly similar in their hydraulic properties. A 10-meter deep soil profile was defined for the four soil horizons. The profiles were vertically discretized into cells of 0.1 and 0.25 meter thickness, where the first 10 cells are each 0.10-meter thick and the last 36 cells are each 0.25-m thick. The soils are defined to well below their actual depth so that the model can easily switch to unsaturated zone equations as the water table drops. This prevents the problem of cells going dry within layer 1 of the saturated zone.

In order to keep computational speed at a reasonable level MIKE SHE enables lumped UZ computations. This implies that an unsaturated zone simulation is done in a few vertical profiles. Subsequently results are transferred to other profiles with similar characteristics. This "classification" may be done in a number of ways in MIKE SHE. Automatic classification identifies model grids with the same properties in terms of depth to the ground water, soil and vegetation type, rainfall rate etc. At present unsaturated zone calculations are carried out in approximately 244 columns out of the 6042 active cells.

2.4 Overland and Channel Flow Component

The overland and channel flow component contains specification of a few properties for the overland flow component and specification of the name of the river data file (rdf-file). The main work in this respect is to create the rdf file. This is done using the graphical river editor. The overland flow parameters are illustrated in Figure 11 on page H-14. Two surface water features, Russell Ditch, and Blackwater Creek are currently represented in the model. The major surface water features of the area, the lakes, were represented as boundary conditions. Centerline and cross-section data for Blackwater Creek were obtained from the Osceola County Engineering Department. Representative cross-sections (Figure 12 on page H-15) for the Russell Ditch were acquired by SFWMD surveying crews in June of 1998. Figure 13 on page H-15 shows the location of the two channels.

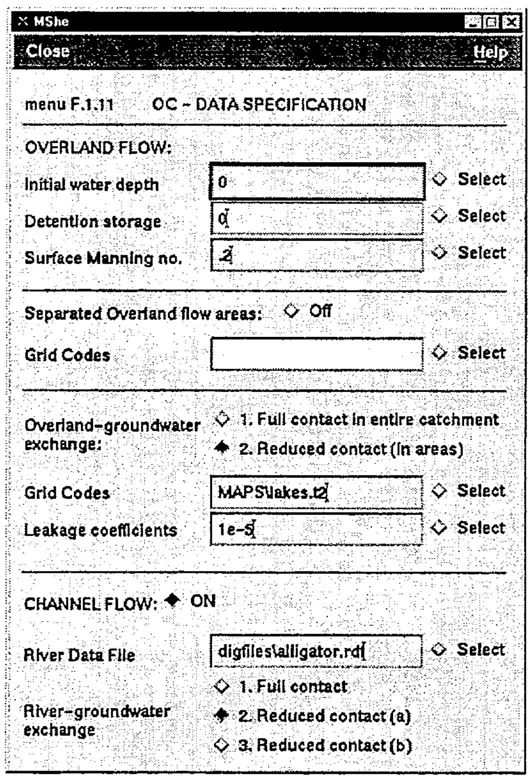

Figure 11 OC - Data Specification

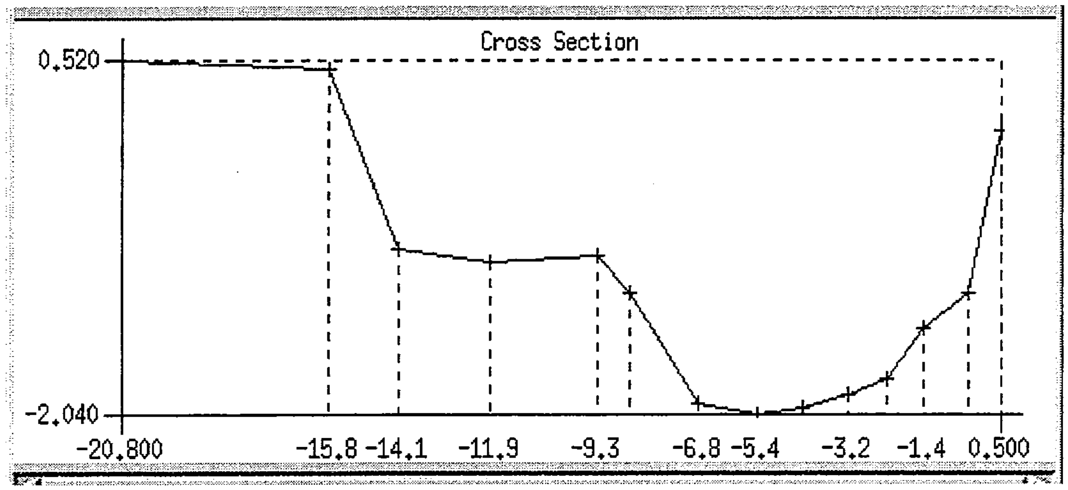

Figure 12 Model Representation of Channel Cross-sections (example from the Russel Ditch)

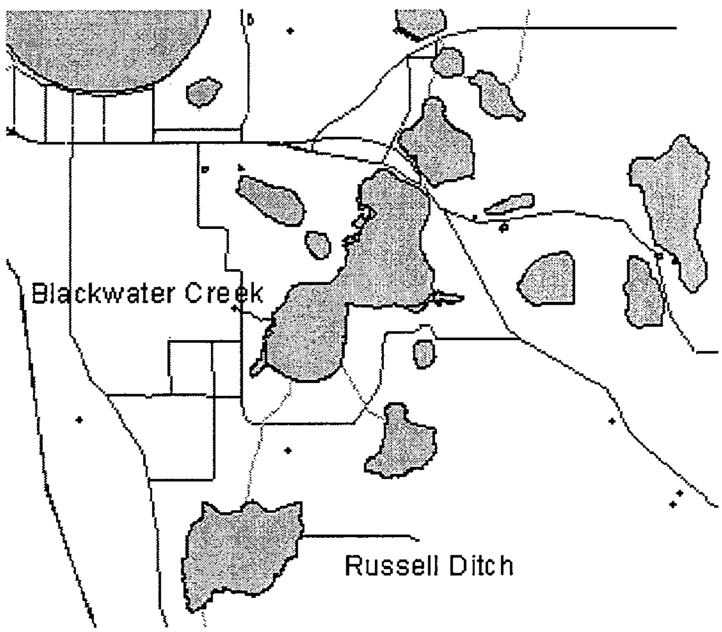

Figure 13 Location of represented Channels

2.5 Evapotranspiration Component

As part of the Small Scale Integrated Model Development project a new evapotranspiration (ET) and infiltration component is being developed for MIKE SHE. This has been tailored specifically for SFWMD use. However, this module has not yet been finalized. Hence, at present the standard MIKE SHE ET module is used. This module calculates the ET based on a specified potential rate, leaf area index (LAI) and root depth and finally based on the available water in the root zone (Figure 14 on page H-16).

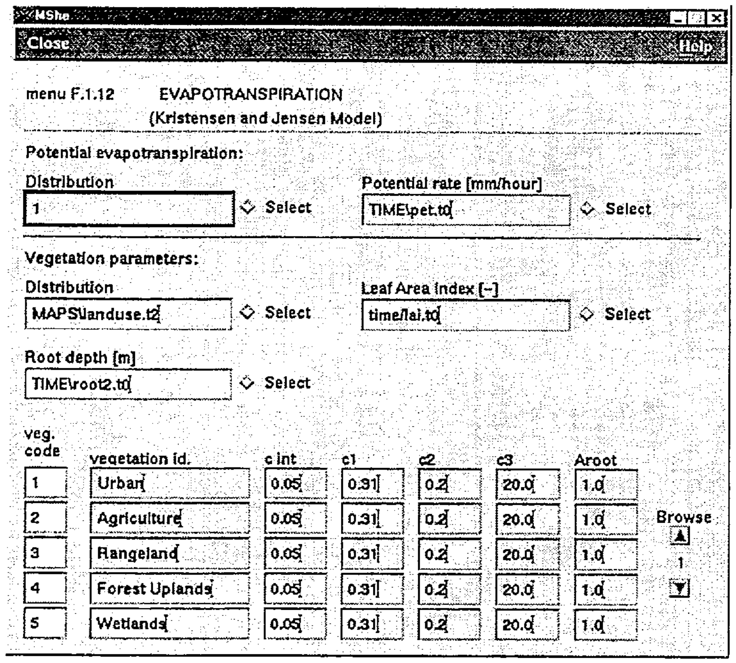

Figure 14 Evapotranpiration Menu

The potential ET rate was estimated by the Priestly-Taylor equation using solar radiation and temperature measurements at SFWMD weather station S61W.

Assuming soil heat flux can be neglected, ET or Latent Heat is described by:

$$LH = 1.18 (Del * Rn) / (Del + p)$$

Del = slope of the saturation vapor pressure curve [kPa/C]

Rn = net Radiation [MJ/m2 day]

P = psychometric constant

1.18 = empirical constant alpha, recommended value from (Abtew & Obeysekera, 1995[1]).

1. Abtew & Obeysekera

At present the model accounts for 6 different land use types. For each land use type a time-series of LAI and root depth has been defined (Table 3: on page H-17). The land use (vegetation) distribution codes are generated based on the level 1 land use (Figure 15 on page H-17).

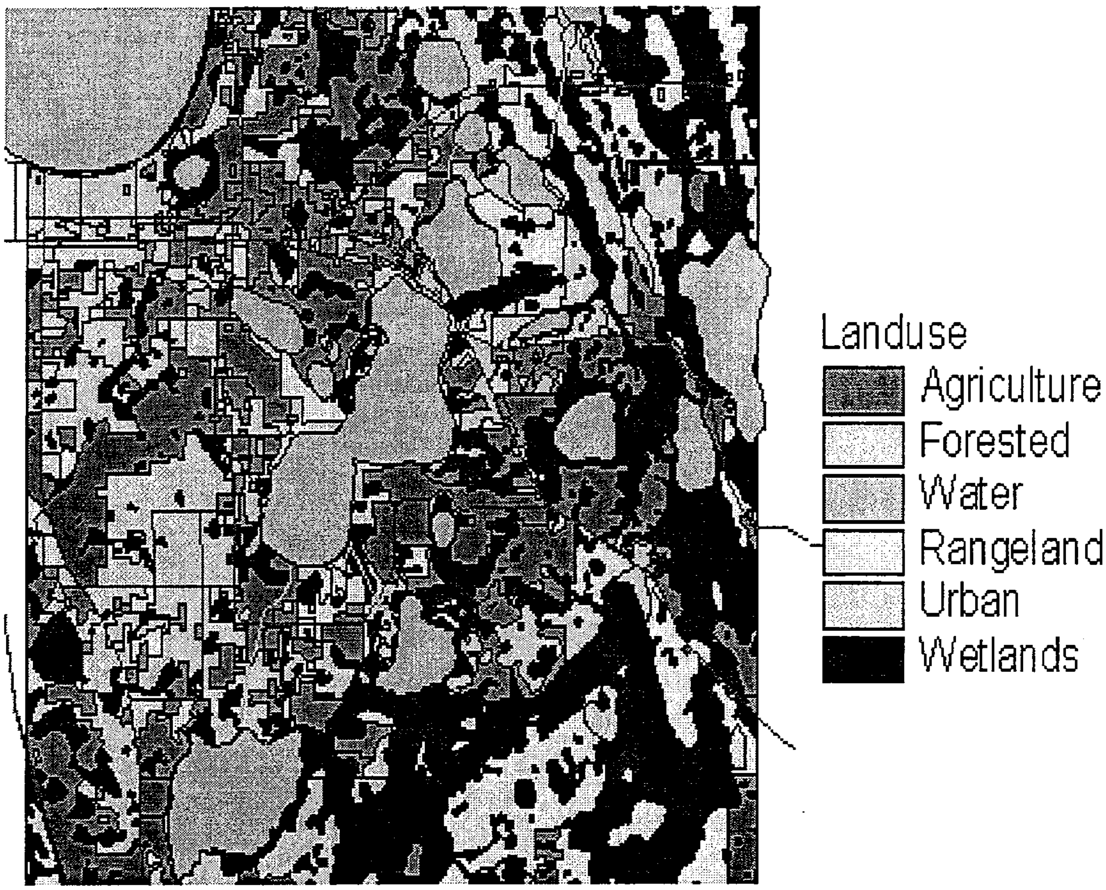

Figure 15 Level I Landuse

Table 3: LAI and Root Depths for Land Uses

Land use	Agriculture	Rangeland	Forested	Wetland	Urban	Water
LAI	1.0	1.2	4.0	2.0	0.0	0.0
Root Depth [meters]	0.76	.61	.81	1.0	0.0	0.0