# Alternative Formulation Evaluation Tool
# Model Documentation / Calibration Report

(Deliverable No. 2.1.3.2.5.1)

# Kissimmee Basin Modeling and Operations Study

(Contract No. 4600000933-WO02)


Prepared for:

South Florida Water Management District
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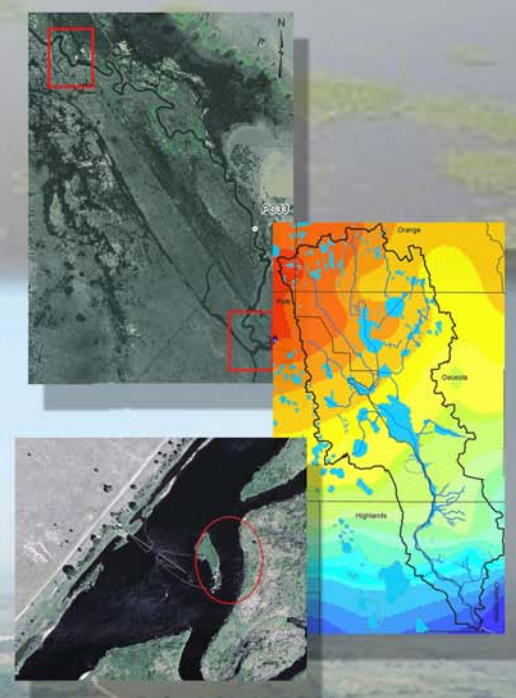


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September, 2009


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# 1 INTRODUCTION

## 1.1 Objectives of the AFET Model Documentation / Calibration Report

The goal of KBMOS is to assess whether existing operating criteria for the water control structures in the Kissimmee Basin can be modified to achieve a more acceptable balance among flood control, water supply, aquatic plant management, and natural resource water management objectives. Natural resource objectives are outlined in the Kissimmee River Restoration Project (KRRP) and the Kissimmee Chain of Lakes Long Term Management Plan (KCOL LTMP). The river restoration project is intended to restore ecological integrity to a significant portion of the Kissimmee River floodplain. The KCOL LTMP is intended to improve, enhance, and/or sustain the lake ecosystem while balancing downstream impacts to other ecosystems.

Activities performed during Phase I of KBMOS identified the need to develop a suite of modeling tools to use in the evaluation of possible operating criteria that would help to achieve the project objectives. The modeling strategy developed as part of Task 1.7 established that "*the Earth Tech team will develop an integrated surface and groundwater model for the evaluation of existing and proposed operating criteria to improve system hydrologic and hydraulic performance relative to selected performance targets. Operating criteria will be constrained to floodplain and lake inundation extents that do not exceed the acquired land interests of the State of Florida or the South Florida Water Management District (SFWMD) and existing structure conveyance capacities.*" Subsequently, the MIKE SHE/MIKE 11 model was selected as the Alternative Formulation / Evaluation Tool (AFET) for the KBMOS. A Technical Design Document (Earth Tech, 2006a) and the AFET Acceptance Test Plan (Earth Tech, 2006b) were prepared to fit the objectives of the study. The AFET was then constructed and calibrated following the guidelines established in these documents, which are focused in obtaining an accurate representation of flow and stage in the canals and lakes that make up the Central and Southern Florida (C&SF) Flood Control Project in the Kissimmee Basin and their sensitivity to alternate structure operations. Statistical criteria used to define the acceptance of the model were defined under these bases. The use of this model outside of the KBMOS will require a case-specific analysis of the acceptance criteria in view of the requirement of the intended use. A more detailed description of the project background and objectives is given in the AFET Technical Design Document (Earth Tech, 2006a).

The purpose of this AFET Model Documentation / Calibration Report (MDCR) is to document the process used to develop and calibrate the KBMOS MIKE SHE/MIKE 11 model.

During the KBMOS alternative plan selection process, AFET-W replaced AFET. AFET-W was calibrated under Pre-Phase I conditions and was used to represent the fully restored conditions of the KRR Project. This report documents the development of the original model (AFET). The development and calibration of AFET-W is documented in a supplement to this report (Earth Tech | AECOM, 2008).

## 1.2 Overview of MIKE SHE/MIKE 11

MIKE SHE is a grid based dynamic modeling system that can be used to simulate integrated surface water and groundwater systems. It can simulate all the major land phase hydrological processes and is comprised of several independent modules that represent each hydrological process. A number of numerical approaches and/or conceptualizations are available within each module and allow users to tailor the model to meet the objectives and data constraints of a given project. The basic hydrologic flow processes incorporated into MIKE SHE are shown graphically in Figure 1-1.

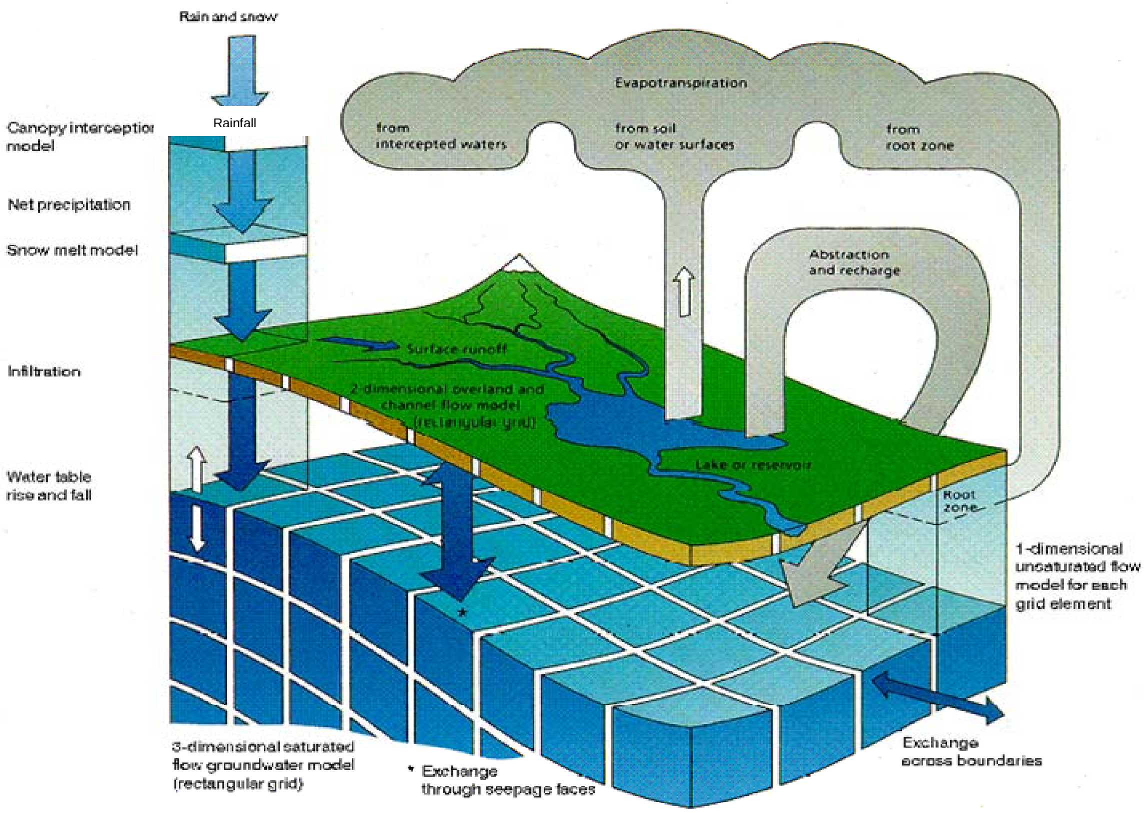


**Figure 1-1: Hydrologic processes that can be represented in MIKE SHE/MIKE 11.**

The Kissimmee Basin MIKE SHE Model includes the following modules: overland flow, unsaturated zone, saturated zone, evapotranspiration processes, groundwater withdrawals, and irrigation. Channel flow is represented within the MIKE 11 portion of the model. The MIKE SHE and MIKE 11 models have been merged to create the integrated surface/groundwater AFET. As specified by the AFET Technical Design Document (TDD) (Earth Tech, 2006a), the overland flow component used a two-dimensional finite difference diffusive wave approximation of the Saint Venant equations and includes conceptual components to deal with runoff from urban areas, detention storage, and physical obstructions to flow. The unsaturated zone utilizes a simple conceptual two-layer approach water balance method that also accounts for evapotranspiration from: the canopy, ponded water, the unsaturated zone, and the saturated zone. Moisture contents or actual evapotranspiration rates simulated by the unsaturated zone module are used to determine irrigation demand. The saturated zone is solved using a three-dimensional finite difference form of the Darcy flow equation. The saturated zone module also accounts for groundwater withdrawals.

MIKE 11 simulates channel flow using a one-dimensional hydrodynamic calculation method and can be dynamically coupled to MIKE SHE (Alternative Evaluation Tool) or used in a stand-alone mode (Alternative Formulation Tool). Fixed and operable hydraulic control structures can be simulated with MIKE 11 model. When MIKE 11 is coupled with MIKE SHE, dynamic exchanges between the overland flow plain, groundwater system, and the river system are simulated.

### 1.3 Model Development

The AFET is an essential tool in the Kissimmee Basin Modeling and Operations Study (KBMOS) Phase II. Its role in the study was defined in Task 1.9 Kissimmee Basin Model Development Work Plan (Earth Tech, June 2005). The AFET is comprised of MIKE SHE and MIKE 11, which have been coupled as described in the AFET. Therefore, the development of the MIKE 11 model is part of the AFET TDD (Earth Tech 2006a). The MIKE 11 portion of AFET was initially developed by integrating information from existing models. This information was refined by the addition of available cross sections and bathymetry from Lake Tohopekaliga to S-65. The MIKE SHE portion of the model was developed using information collected during the first part of the KBMOS Phase II. The KBMOS MIKE SHE also builds on the results of similar modeling efforts developed and calibrated for large basins in South Florida. A complete description of the model development is included in Section 2.

### 1.4 Model Calibration

As specified in the AFET Acceptance Test Plan – ATP (Earth Tech, 2006b), the calibration of the KBMOS MIKE SHE/MIKE 11 model included calibration of the model for the period from November 1, 2001 through December 31, 2004. The calibrated model was then validated for the period from January 1, 1994 through December 31, 1998 using daily rainfall data and the period from August 1, 2004 through October 15, 2004 using 15-minute rainfall data.

Calibration of the model is discussed in detail in Section 4, but included:

- Adjustment of control structure operations to improve their representation in the model and the surface water calibration.
- Modification of key surface water and groundwater parameters to improve model calibration at defined calibration locations.
- Modification of key model parameters to improve simulated seasonal water budgets.

Adjustment of model parameters was guided by sensitivity analyses performed with the model. The sensitivity analyses are also discussed in Section 3 of this document.

# 2 MODEL DEVELOPMENT

The following subsections describe the model development process. They are organized to follow the process required to build a MIKE SHE/MIKE 11 model, documenting the source of the information used to populate the model. Table 2-1 and Table 2-2 identify the calibration criteria defined for the model and how they will be used to assess the ability of the model to address primary issues in the Kissimmee Basin.

**Table 2-1: Statistical and additional criteria that have been applied to the KBMOS MIKE SHE/MIKE 11 model during the calibration and verification periods.**

| | | | | 1 Continuous Simulation | | | | 2 Event Simulation | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Calibration/Verification Criteria | daily | monthly | annual | cumulative | hourly | daily | event |
| Structures | Stage | Headwater | Mean Error | ✓ | | | | | ✓ | |
| | | | Root Mean Square Error | ✓ | | | | | ✓ | |
| | | | Correlation Coefficient | ✓ | | | | | ✓ | |
| | | | Stage Duration | | | ✓ | | | | ✓ |
| | | Tailwater | Mean Error | ✓ | | | | | ✓ | |
| | | | Root Mean Square Error | ✓ | | | | | ✓ | |
| | | | Correlation Coefficient | ✓ | | | | | ✓[1] | |
| | | | Stage Duration | | | ✓ | | | | ✓ |
| | Flow | | Correlation Coefficient | ✓ | ✓ | | | ✓ | | |
| | | | Cumulative Error | | ✓ | ✓ | ✓ | | | ✓ |
| | | | Peak Error | | | | | | | ✓ |
| | | | Peak Time Error | | | | | | | ✓ |
| | | | Flow Duration | | | ✓ | ✓ | | | ✓ |
| GW Wells | Groundwater levels | | Mean Error | ✓ | | | | | | |
| | | | Root Mean Square Error | ✓ | | | | | | |
| | | | Correlation Coefficient | ✓ | | | | | | |
| Water budget | Quantitative | | Upper Kissimmee River Basin – Lake Budgets | ✓ | | | | | ✓ | |
| | Qualitative | | Upper Kissimmee River Basin | | ✓[2] | ✓ | | | | ✓ |
| | | | Lower Kissimmee River Basin | | ✓[2] | ✓ | | | | ✓ |

[1] Daily stage data will be used where hourly data is not available
[2] Seasonal water budget

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**Table 2-2: Relationship of statistical and additional criteria applied to the KBMOS MIKE SHE/MIKE 11 model during the calibration and verification periods to issues in the Kissimmee Basin.**

| KB Issues | Primary Location | Primary Model Capabilities Needed | Temporal Scale (A) | Level First Simulated | Variable | Calibration Criteria Column |
|---|---|---|---|---|---|---|
| Seasonal Flooding | KB | Operations | Daily | Screening | OCSE* | Continuous Simulation |
| | KB | Water surface profiles | Daily | Screening | Stage | |
| | KB | Channel and structure hydraulics | Daily | Formulation | Flow | |
| | KB | Lake levels | Daily | Screening | Stage | |
| Hurricane or Storm Event Flooding | KB | Operations | Hourly | Formulation | Stage/Flow | Event Simulation |
| | KB | Flow Routing | Hourly | Formulation | Flow | |
| | KB | Lake levels | Hourly | Formulation | Stage | |
| | KB | Channel and structure hydraulics | Hourly | Formulation | Flow | |
| Improve range and duration of lake level fluctuations | KUB | Channel and structure hydraulics | Hourly | Formulation | Stage(D) / Water Budget | Continuous Simulation |
| | KUB | Groundwater-SAS | Daily | Evaluation | Groundwater Levels | |
| | KUB | Surface water levels | Daily | Screening | Stage | |
| | KUB | Operations | Daily | Screening | OCSE* | |
| Water Supply – Surface Water | KB | Water budget | Daily | Screening | Stage(D) / Water Budget | Continuous Simulation |
| | KB | Channel and structure hydraulics | Daily | Formulation | Stage/Flow | |
| | KB | Operations | Daily | Screening | OCSE* | |
| Hydrilla Management | KUB | Lake level fluctuations | Daily | Screening | Stage | Continuous Simulation |
| | KUB | Operations | Daily | Screening | OCSE* | |

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| KB Issues | Primary Location | Primary Model Capabilities Needed | Temporal Scale (A) | Level First Simulated | Variable | Calibration Criteria Column |
|---|---|---|---|---|---|---|
| Water Supply – Groundwater | KB | Groundwater flow | Daily | Evaluation | Groundwater Levels | Continuous Simulation |
| | KB | Operations | Daily | Screening | OCSE* | |
| Increased Stormwater Volumes | KUB | Flow Routing | Hourly | Formulation | Flow | Event Simulation |
| | KUB | Channel and structure hydraulics | Hourly | Formulation | Stage/Flow | |
| | KUB | Operations | Hourly | Formulation | Stage/Flow | |
| | KUB | Effects of land use change | Hourly | Evaluation | Stage/Flow/ Groundwater Levels | |
| Improve Stage Recession Rate | KB | Water surface profiles | Daily | Screening | Stage | Continuous Simulation |
| | KB | Channel and Structure hydraulics | Daily | Formulation | Stage / Water Budget | |
| | KB | Operations | Daily | Screening | OCSE* | |
| Attain Pre-channelization Floodplain Inundation Frequency and Hydroperiod | LKB | Surface water hydrology | Daily | Screening | Flow / Lake Stages | Continuous Simulation |
| | LKB | Groundwater (SAS,FAS) hydrology | Daily | Evaluation | Groundwater Levels | |
| | LKB | Water surface profiles | Daily | Screening | Stage | |
| | LKB | Channel and structure hydraulics | Daily | Formulation | Stage(D) / Water Budget | |
| | LKB | Operations | Daily | Screening | OCSE* | |
| Balance runoff impacts between upstream and downstream ecosystems | KB | Surface water hydrology | Daily | Screening | Flow / Lake Stages | Continuous Simulation |
| | KB | Groundwater (SAS,FAS) hydrology | Daily | Evaluation | Groundwater Levels | |
| | KB | Surface water levels | Daily | Formulation | Stage | |
| | KB | Operations | Daily | Screening | OCSE* | |

OCSE* : Operation rules being evaluated through the Operation Criteria Simulation Engine (MIKE 11 control logics "POC")

(A) **Note:** Maximum model output time step will not exceed temporal scale.

(B) Stage Duration

## 2.1 Simulation Components

A number of different options for the hydrologic processes simulated in a model setup and the numerical methods used are possible with MIKE SHE. The possible hydrologic processes and numerical approaches include:

- Overland Flow (OL) Processes
  - Simplified Overland Flow Routing Method
  - *Finite Difference Method*
- Rivers and Lakes (OC) (MIKE 11 Model)
- Unsaturated Flow (UZ) Processes
  - *Two-Layer Water Balance Method*
  - 1D Richards Equation Solution
  - 1D Simplified Gravity Flow Equation
- Evapotranspiration (ET) Processes
- Saturated Flow (SZ) Processes
  - Linear Reservoir Method
  - *3D Finite Difference Method*

MIKE SHE permits processes not essential for a particular project to be excluded from the simulation, provided the process is not used by an essential component of the project (i.e., evapotranspiration cannot be simulated without some representation of the unsaturated zone).

The KBMOS MIKE SHE/MIKE 11 integrated model utilizes all of the major components. The overland flow module is solved using the 2D finite difference diffusive wave approximation of the St. Venant equations. The unsaturated zone module is solved with the two-layer water balance method. The saturated zone is solved with the 3D finite difference Darcy flow equation. Each process is discussed in further detail within the appropriate sections of this report.

Model datasets have been constructed such that any time within the period from January 1, 1994 to January 1, 2004 can be simulated (including the calibration and verification periods). An initial MIKE SHE calculation time step of 15-minutes was used to permit the model to stabilize at the beginning of the simulation. The maximum allowed time step of the UZ and ET components was set to 12 hours and the maximum allowed SZ time step was set to 12 hours. A maximum UZ time step of 12 hours is possible because the two-layer water balance method is being used in the KBMOS MIKE SHE model. In order to permit the overland component to capture runoff processes and accurately simulate exchanges between the overland and channel components a maximum overland time step of 30-minutes has been used. A constant MIKE 11 time step of 2 minutes has been used.

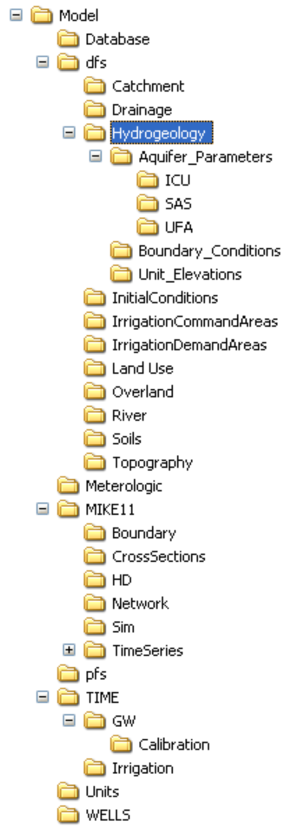
## 2.2 Model Domain and Grid

The model domain and grid have been defined based on the defined extent of the Kissimmee Basin. This was defined during Phase I of the KBMOS project. This boundary is defined primarily by topography. The domain of the KBMOS model encompasses parts of five South Florida Counties (Orange, Polk, Highlands, Osceola, and Okeechobee) and three water management districts (South Florida Water Management District, South West Florida Water Management District, and St Johns River Water Management District). The domain covers an area approximately 1.65 million acres. This area is divided into square grids that are 1,000 × 1,000 ft or approximately 23 acres in area. The entire domain therefore consists of nearly 72,000 square grid cells. An alternate grid has also been developed that consists of approximately 7,520 cells with a cell size equal to 3,000 × 3,000 ft (~205 acre cells) and will be used for the MIKE SHE model that includes the Surficial Aquifer System (SAS), Intermediate Aquifer System (IAS), and Upper Floridan Aquifer System (UFAS), this coarser grid model is also referred as the Regional KB Model.

All of the surface water in the defined model domain drains to the Kissimmee Chain of Lakes and the Kissimmee River or its tributaries. The Kissimmee River discharges into the northern end of Lake Okeechobee. The highest elevations in the model domain are found along the Lake Wales Ridge located at the western portions of the area. The topography is not as high along the northern and eastern boundaries of the model domain as along the Lake Wales Ridge but the basin divide is well defined. The extent of the KBMOS model domain is shown in Figure 2-1 along with other pertinent geographic features.

## 2.3 Model Characteristics and Model Run-Times

AFET was run on MIKE SHE version 2007. The complete set of input files has a folder size of 1.25 Gigabytes. Output from the 4-year run may reach several Gigabytes in size depending of how frequent is the model output being stored, currently the output from the calibration and verification runs occupies 2 DVDs. The folder structure used to run the AFET calibration model is included below




Run-times for the calibrated KBMOS model range from 2.31 hours per year for the three-layer regional KBMOS model to 3.79 hours per year for the one-layer, higher-resolution surficial aquifer KBMOS model. These run-times meet the run-time goals (4 to 5 hours per year) defined in the TDD (Earth Tech, 2006a).

## 2.4 Topography

The topography used in the pre- and post-Phase 1 models was developed from composite datasets that included data from the basin wide digital elevation model (DEM) available from the United States Geological Survey's National Elevation Dataset (NED) and site specific topographic and bathymetric data developed for previous projects (*e.g.*, USACE HEC-RAS modeling of the LKB, USACE Kissimmee River Restoration Project, KRRP). The pre- and post-Phase 1 DEM developed by the Earth Tech team have a 32.8 × 32.8 ft (10 m) raster resolution and are identical except where the Kissimmee River was backfilled between S-65A and S-65C as part of Phase 1 restoration activities.

The pre- and post-Phase 1 DEMs developed by Earth Tech were used to develop the resampled to a 1,000 × 1,000 ft topographic data used in the KBMOS model. The pre- and post-Phase 1 topographic data being used in the KBMOS model are shown in Figure 2-2 and Figure 2-3.

The topography in the model domain area ranges from approximately 20 to 289 feet NVGD29. The highest elevations are found along the Lake Wales Ridge to the west and in isolated areas along the northern portion of the model domain. The lowest areas lie in the interior of the basin and towards the southern tip of the model domain. In general, the topography slopes from the ridge towards the Atlantic and towards Lake Okeechobee and is composed of large connected depressions (Upper Kissimmee Basin) in the north central area of the model, which ultimately converges into a central linear feature to the south (Lower Kissimmee Basin).

## 2.5 Precipitation

Precipitation is the primary input to the model. MIKE SHE has the ability to distribute precipitation spatially and temporally in several ways depending on the available data. The spatial distribution can be uniform, station based (*i.e.*, Thiessen polygons), or fully distributed (i.e., NEXRAD data).

A fully distributed daily precipitation dataset is used in the KBMOS MIKE SHE model during the calibration and verification period. The precipitation data set was developed using discrete rainfall station data and interpolated to a 3,000 × 3,000 ft grid that coincides with the coarse model domain grid defined for the project. The rainfall datasets were developed by the project team as part of the KBMOS Phase II wave 2 activities and documented in a technical memorandum titled Interpolated Rainfall Grids (Earth Tech, 2006c). The rainfall datasets development process used an interpolation method that minimizes artificial spatial spreading of gage data and better reflects the isolated nature of rainfall storms was used to develop the fully distributed dataset. The rainfall grids were initially provided as ASCII raster files. These files were used to develop binary data files that could be used directly by MIKE SHE.

A fully distributed 15-minute precipitation dataset was developed from NEXRAD data provided by the South Florida Water Management District (SFWMD) for the Kissimmee Basin. The 15-minute NEXRAD dataset is used for the 2004 hurricane season storm verification simulation.

A seasonal analysis of the fully distributed daily precipitation dataset for the Kissimmee basin is shown in Figure 2-4. For the KBMOS model, the wet and dry seasons have been defined as the period from May 1 to October 31 and November 1 to April 30, respectively. This analysis was used identify extreme climatic conditions (*i.e.*, a wet dry season, a dry wet season, *etc.*) during the calibration and verification periods. Extreme periods include the 1996 wet season, the 1996 to 1997 dry season, the 1997 wet season, the 1997 to 1998 dry season, the 2001 to 2002 dry season, the 2002 to 2003 dry season, the 2003 wet season, and the 2004 wet season. Upper Floridan Aquifer potentiometric surface, maximum overland depths, and average overland depths are presented for these extreme periods to evaluate the ability of the model to simulate conditions during these periods.

## 2.6 Potential Evapotranspiration

The reference evapotranspiration (RET) is the rate of evapotranspiration from a reference vegetation type (i.e., grass) surface that is not short of water. It is independent of all variables except climate. The SFWMD provided an Excel spreadsheet file of a single time series of RET values over the model domain. The Earth Tech team developed the RET model dataset directly from data provided by SFWMD staff.

The RET file is the basis from which the simulated ET evapotranspiration values are calculated on a cell-by-cell basis. The two-layer water balance evapotranspiration method is used to calculate the simulated ET. In this method, the actual evapotranspiration and the actual soil moisture status in the root zone are calculated from the reference evaporation rate, along with maximum root depth, leaf area index, and the simulated moisture content in the root zone.

## 2.7 Land Use

The land use component defines parameters that are associated with land use classifications and affect hydrologic processes. The land use component includes vegetation classifications which are used to define land use based evapotranspiration parameters, irrigated areas, paved area runoff parameters (i.e., directly connected impervious areas), and detention storage. Vegetation/Land Use grid code(s) are used to define uniform or time varying leaf area index (LAI), root depths (RD), and crop coefficients ($K_c$). Vegetation/Land Use grid codes are also used to define irrigation parameters for a demand driven scheme with priorities. Demand can be defined in a number of ways but the most common in Florida are the maximum allowed deficit (MAD) and crop stress factor approach ($E_{act}/E_{potential}$). The irrigation option requires that the evapotranspiration and unsaturated zone processes be explicitly simulated in the model. The paved area option allows runoff from urban areas to be represented in a conceptual sense and requires that a fractional portion of rainfall that is directly routed by urban surface water management features be defined.

The following section details the procedure that has been used to develop the land use classification scheme, associated physically based initial estimate coefficient parameters, demand driven irrigation command areas, and irrigation demand criteria for the KBMOS MIKE SHE model.

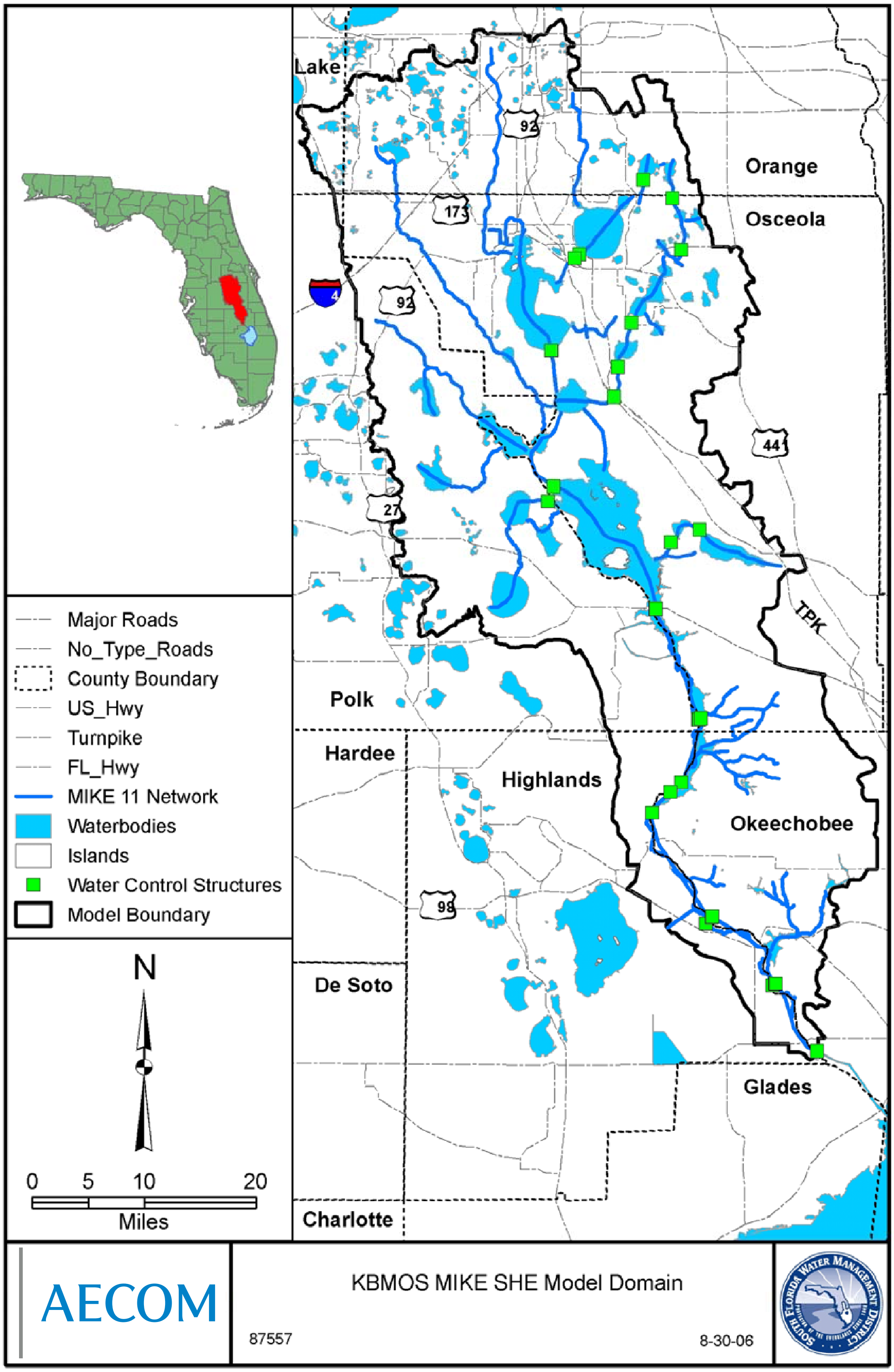



**Figure 2-1: KBMOS MIKE SHE Model Domain.**

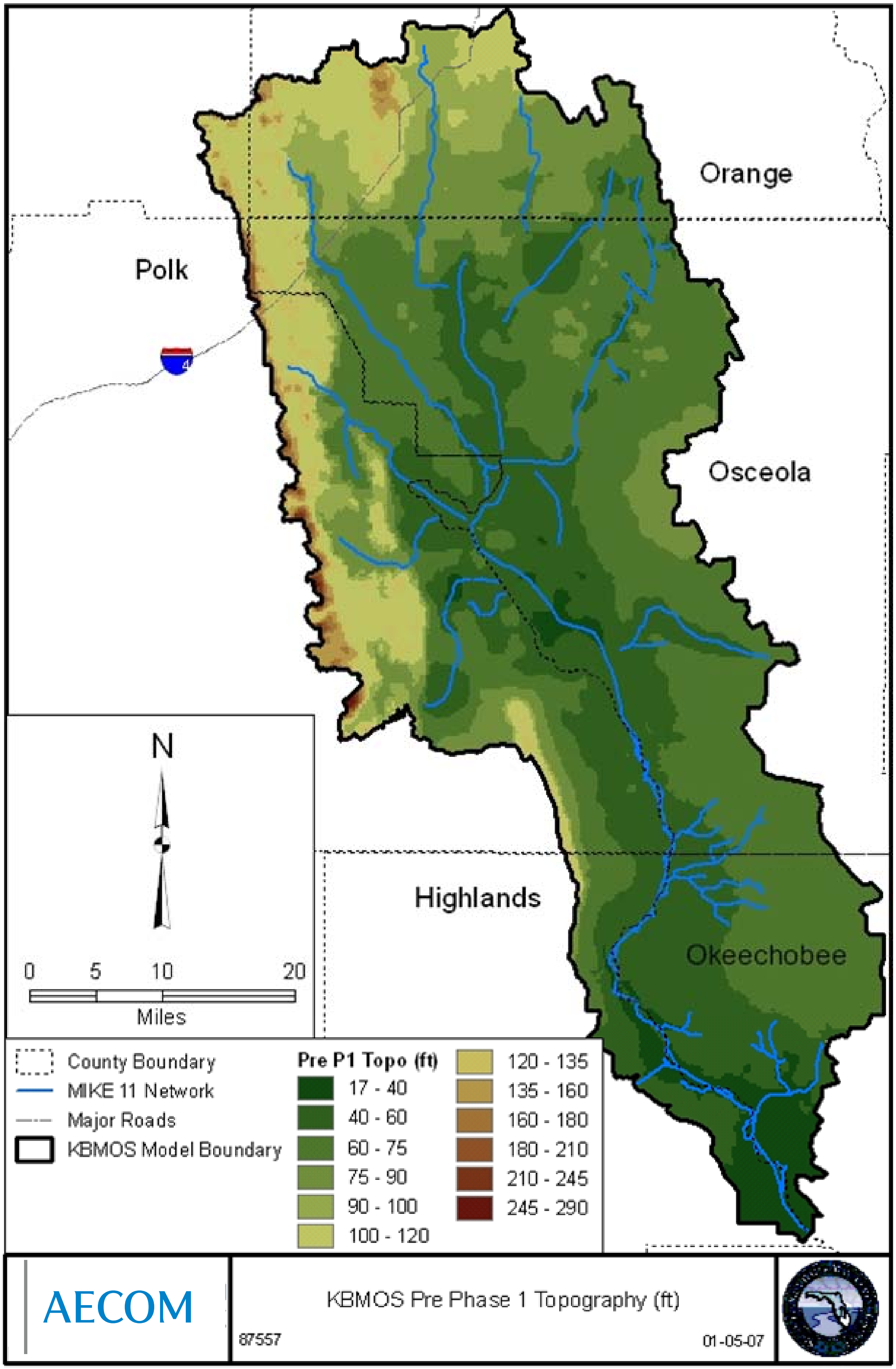



**Figure 2-2: Generalized Pre-Phase 1 topography (ft NVGD29) in the model.**

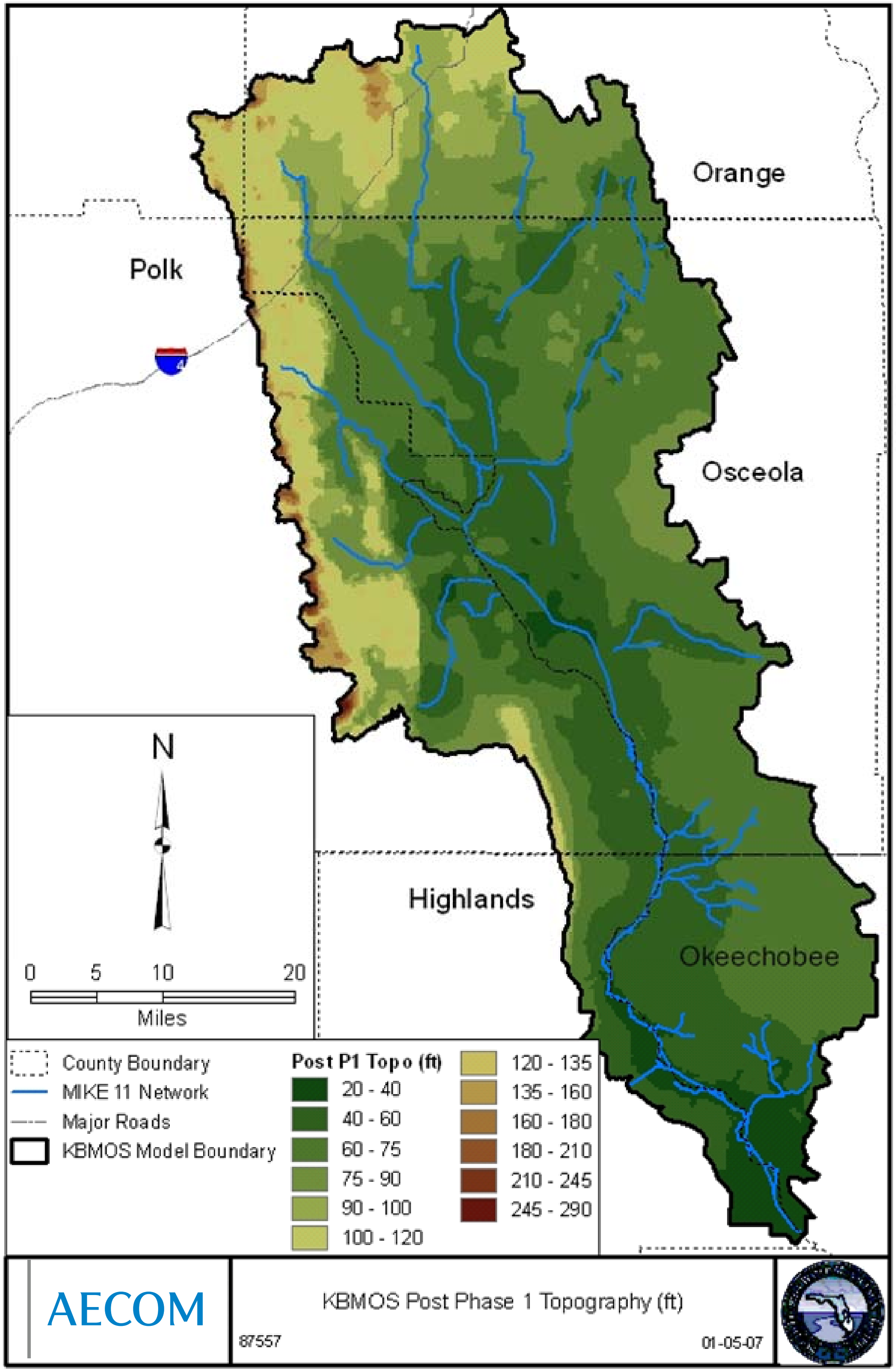



**Figure 2-3: Generalized Post-Phase 1 topography (ft NVGD29) in the model.**

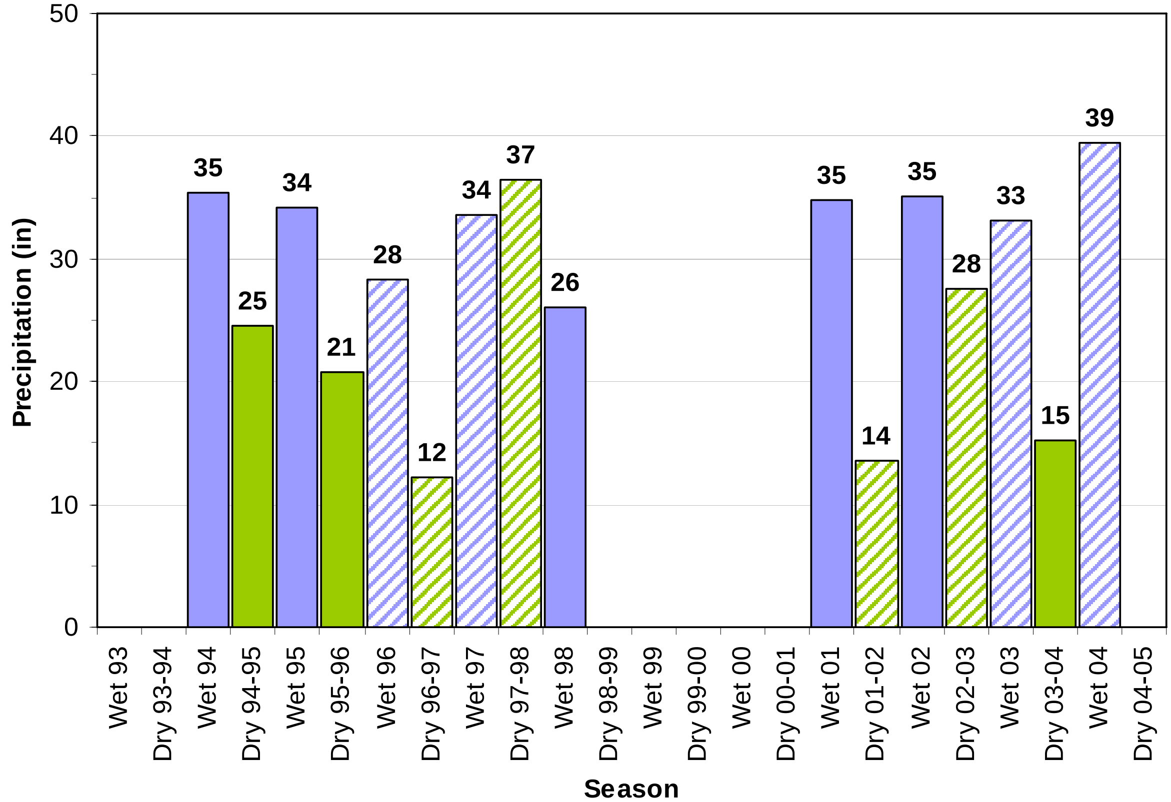



**Figure 2-4: Seasonal precipitation totals for the calibration and verification periods. Results represent areal average precipitation totals for the Kissimmee Basin. Dry and wet season totals are indicated in green and blue, respectively. Seasons representing extreme conditions in the calibration and verification periods are indicated with hatching.**

### 2.7.1 Vegetation/Land Use Classification Scheme

Florida Land Use Cover and Forms Classification System (FLUCCS) data for 2000, provided by the SFWMD, was used to develop the land-use classification used in the KBMOS model. FLUCCS codes were grouped into 15 categories based on similarity of land-use and summarized in Table 2-3 and shown graphically in Figure 2-5. The total area of each Kissimmee Basin land use classification is summarized in Table 2-4. A detailed discussion of the approach used to develop the land-use classification implemented in the KBMOS model is given in Appendix A.

**Table 2-3: Land Use Classification Scheme**

| Land Use Type | MIKE SHE Code | FLUCCS Code |
|---|---|---|
| Citrus | 1 | 220[2] |
| Pasture | 2 | 160[2], 161[3], 162[3], 163[3], 182[3], 210[3], 230[3], 242[3], 261[3], 740[3], 742[3], 744[3], 835[3] |
| Truck Crops | 5 | 214[3], 215[3] |
| Golf Courses | 6 | 1820[3] |
| Hydric-Mesic-Xeric Flatwood | 8 | 190[3], 191[3], 194[3], 260[3], 310[2], 321[3], 330[2], 410[3], 411[3], 412[3], 413[3], 414[3], 419[3], 41194, 429[3], 435[3], 440[3], 441[3], 443[3], 624[3], 710[2], 720[2], 741[3] |
| Mesic-Xeric Hammock | 9 | 322[3], 420[3], 421[3], 422[3], 423[3], 426[3], 427[3], 432[3] 434[3], 437[3], 438[3], 439[3] |
| Cypress | 17 | 620[3], 621[3], 6218[4], 745[3], 6219[4] |
| Hydric Hammock | 13 | 329[3], 424[3], 425[3], 428[3], 433[3], 610[3], 611[3], 743[3] |
| Wet Prairie | 14 | 643[3], 6439[4] |
| Marsh | 16 | 6171[4], 6172[4], 640[3], 641[3], 6411[4], 6412[4], 644[3] |
| Swamp Forest | 18 | 613[3], 614[3], 615[3], 616[3], 617[3], 630[2] |
| Water | 20 | 166[3], 500[1], 612[3], 642[3] |
| Urban Low Density | 41 | 110[2], 180[2], 192[3], 193[3], 240[2], 241[3], 243[3], 245[3], 246[3], 250[2] |
| Urban Medium Density | 42 | 1009[3], 120[2], 144[3], 833[3], 834[3] |
| Urban High Density | 43 | 130[2], 140[2], 150[3], 151[3], 155[3], 170[3], 810[3], 820[3], 830[3], 152[3], 153[3], 154[3], 159[3] |
| Note: | | |

[1] FLUCCS level

**Table 2-4: Area of Each Land Use Classification**

| Land Use Type | MIKE SHE Code | Area (acres) | Percent of Total (%) |
|---|---|---|---|
| Citrus | 1 | 109,706 | 5.66 |
| Pasture | 2 | 538,403 | 27.79 |
| Truck Crops | 5 | 17,614 | 0.91 |
| Golf Courses | 6 | 8,043 | 0.42 |
| Hydric-Mesic-Xeric Flatwood | 8 | 351,343 | 18.14 |
| Mesic-Xeric Hammock | 9 | 61,811 | 3.19 |
| Hydric Hammock | 13 | 66,443 | 3.43 |
| Wet Prairie | 14 | 178,476 | 9.21 |
| Marsh | 16 | 57,892 | 2.99 |
| Cypress | 17 | 46,747 | 2.41 |
| Swamp Forest | 18 | 126,405 | 6.52 |
| Water | 20 | 150,874 | 7.79 |
| Urban Low Density | 41 | 88,220 | 4.55 |
| Urban Medium Density | 42 | 54,534 | 2.81 |
| Urban High Density | 43 | 80,844 | 4.17 |
| | | | |
| Total | | 1,937,353 | 100.00 |

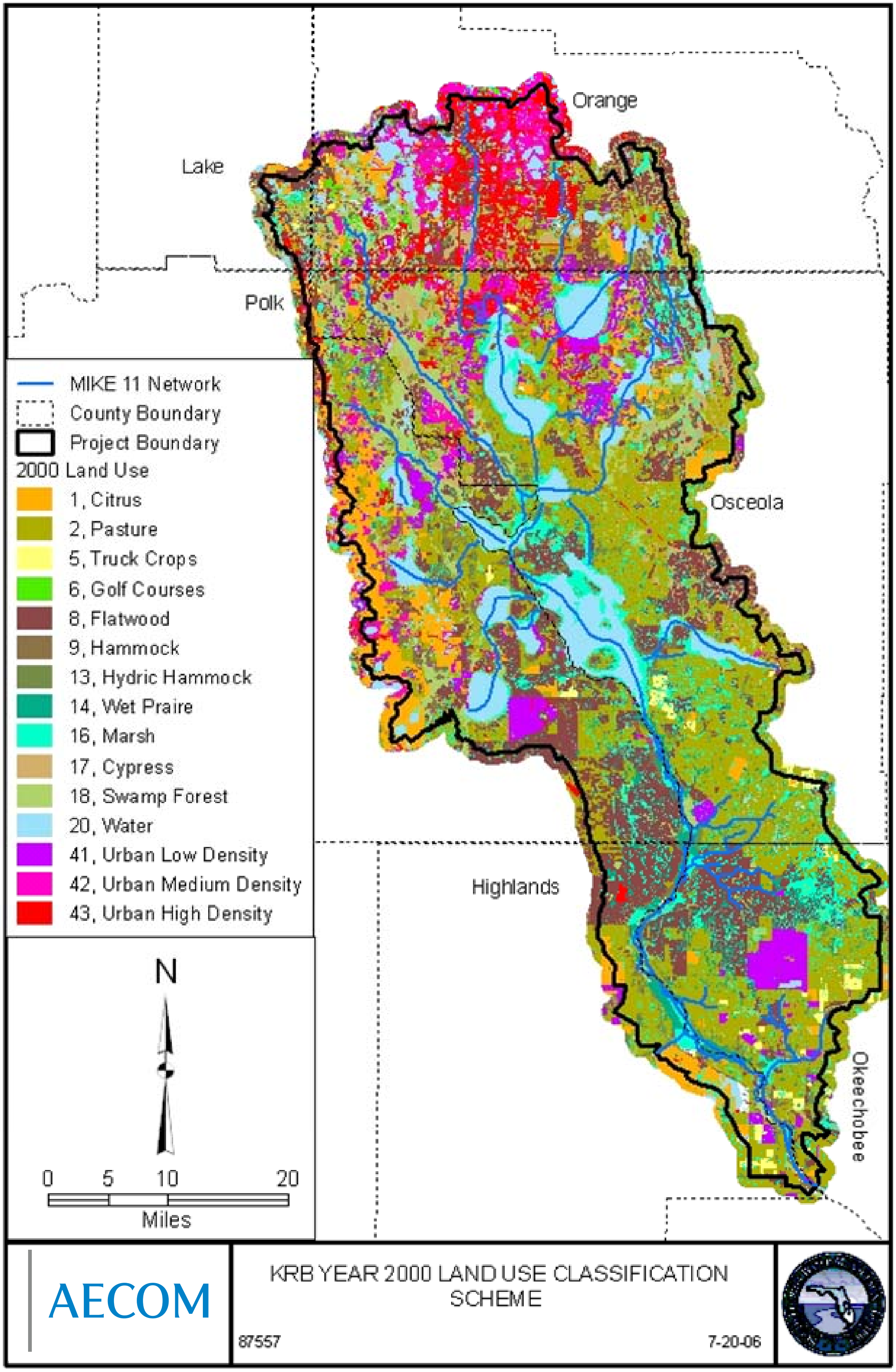



**Figure 2-5: KBMOS 2000 Land Use Classification Scheme.**

### 2.7.2 Vegetation Based Evapotranspiration Parameters

Initial estimates of the physically based parameters related to MIKE SHE for vegetation-based evapotranspiration (ET) were primarily developed from the Picayune Strand Restoration Project (PSRP) and LT MIKE SHE models. These parameters were adjusted during model calibration to reflect values specific to the KBMOS, as described in Sections 4 and 5.

The spatially and temporally distributed ET parameters used by MIKE SHE are typically based on land use classifications. These parameters include the Leaf Area Index (LAI), the Root Depth (RD), and the crop coefficient ($K_{c)}$. The LAI relates the ratio of total leaf area to total area for a particular type of vegetation category during the growing cycle. It is one of the primary variables used by MIKE SHE to calculate ET fluxes. RD defines the depth of the root system for a specific vegetation category and determines the vertical extent of ET in the soil profile. $K_c$ is used to scale specified potential ET rates to individual vegetation types and growth stage. Monthly, land-use based LAI, RD, and $K_c$ parameters values for the KBMOS are given in Table 2-5, through 2.7, respectively. Because the Penmann-Montieth equation was used to calculate the reference evapotranspiration (RET) values used in the KBMOS MIKE SHE model, $K_c$ values were developed using the guidelines outlined in FAO (1998).

The Kissimmee River Restoration Project will have an effect on the vegetative cover of the Lower Kissimmee Basin. The future condition model (see Base Conditions Report, Earth Tech 2006c) will incorporate the expected changes to the vegetation based on recommendations made by the Kissimmee Division.

### 2.7.3 Irrigation Command Areas - ICA

Irrigation Command Areas (ICA) define unique areas where irrigation is applied to meet crop water demands. Irrigation sources and rates are defined for each ICA. Furthermore, multiple prioritized sources can be defined for each ICA.

The ICAs for the model are based on water use permit areas from SFWMD, South West Florida Water Management District (SWFWMD), and St. Johns River Water Management District (SJRWMD). Only existing permits with corresponding permit areas were included in the irrigation setup. The ICAs correspond to Citrus, Truck Crops, Golf Courses, Low Urban Density, Medium Urban Density, and High Urban Density land use classifications defined in the model. Permit areas that were defined as ranches were omitted from consideration since they correspond to pasture areas and the Earth Tech team has made the assumption that ranches in the Kissimmee Basin do not rely extensively on active irrigation. The total irrigated area from within the model domain is approximately 126,500 acres divided into approximately 800 individual ICAs. Individual ICAs range in area from less than 1 acre to more than 15,000 acres.

To simplify the setup of the KBMOS model, multiple sources were condensed to a single irrigation source pulling from the Floridan Aquifer System (FAS). The combined maximum irrigation rate for individual sources associated with an ICA were used to define the total irrigation capacity. Shallow wells are used in the 3,000 ft regional model and external sources have been used for the 1,000 × 1,000 ft SAS model. Assumed withdrawal capacities were used for some of the ICAs because data was not available for these areas.

Screen depths were developed using hydrostratigraphic data and/or data from neighboring withdrawal locations. Hydrostratigraphic data is discussed in detail in Section 2.10. Surface water withdrawals corresponding to on-site ponds have been implemented as shallow wells sourced in the SAS because these small scale surface water features are not included in the MIKE 11 network. Most of these on-site ponds communicate effectively with the SAS so simulating them as shallow wells is appropriate. Others ICAs that withdrawal irrigation water from minor tributaries not included in MIKE 11 are also represented as shallow wells using the SAS as a source of water. ICAs in the KBMOS model domain are shown in Figure 2-6.

**Table 2-5: KMBOS Monthly Leaf Area Index ()**

| Land Use Type | MIKE SHE Code | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Citrus | 1 | 3.38 | 3.38 | 3.75 | 4.12 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 3.38 | 3.38 | 3.38 |
| Pasture | 2 | 3 | 3.5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3.5 | 3 |
| Truck Crops | 5 | 3.75 | 4.5 | 3 | 3.75 | 4.5 | 3 | 3 | 3 | 3 | 3 | 3.75 | 4.5 |
| Golf Courses | 6 | 2 | 2.5 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2.5 | 2 |
| Flatwood | 8 | 1.5 | 2.25 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2.25 | 1.5 |
| Hammock | 9 | 2.5 | 3.25 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3.25 | 2.5 |
| Hydric Hammock | 13 | 2.5 | 3.25 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3.25 | 2.5 |
| Wet Prairie | 14 | 1.5 | 2.25 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2.25 | 1.5 |
| Marsh | 16 | 2 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 2 |
| Cypress | 17 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 |
| Swamp Forest | 18 | 3 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 4 | 3 |
| Water | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Low Density | 41 | 0.9 | 1.25 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.6 | 1.25 | 0.9 |
| Urban Medium Density | 42 | 0.8 | 1.13 | 1.45 | 1.45 | 1.45 | 1.45 | 1.45 | 1.45 | 1.45 | 1.45 | 1.13 | 0.8 |
| Urban High Density | 43 | 0.7 | 0.98 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 0.98 | 0.7 |

**Table 2-6: KBMOS Monthly Distribution of Root Depths (inches)**

| Land Use Type | MIKE SHE Code | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Citrus | 1 | 49.2 | 49.2 | 49.2 | 49.2 | 49.2 | 49.2 | 49.2 | 49.2 | 49.2 | 49.2 | 49.2 | 49.2 |
| Pasture | 2 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 |
| Truck Crops | 5 | 17.7 | 29.5 | 5.98 | 17.7 | 29.5 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 17.7 | 29.5 |
| Golf Courses | 6 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 |
| Flatwood | 8 | 47.9 | 47.9 | 47.9 | 47.9 | 47.9 | 47.9 | 47.9 | 47.9 | 47.9 | 47.9 | 47.9 | 47.9 |
| Hammock | 9 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Hydric Hammock | 13 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Wet Prairie | 14 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 |
| Marsh | 16 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 | 5.98 |
| Cypress | 17 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| Swamp Forest | 18 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| Water | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Urban Low Density | 41 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 |
| Urban Medium Density | 42 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 |
| Urban High Density | 43 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 | 7.9 |

**Table 2-7: KBMOS Monthly Distribution of Crop Coefficients**

| Land Use Type | MIKE SHE Code | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Citrus | 1 | 0.52 | 0..52 | 0.54 | 0..55 | 0.57 | 0.57 | 0.57 | 0.57 | 0.57 | 0.55 | 0.54 | 0.52 |
| Pasture | 2 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 |
| Truck Crops | 5 | 0.8 | 0.98 | 0.63 | 0.8 | 0.98 | 0.63 | 0.63 | 0.63 | 0.63 | 0.63 | 0.8 | 0.98 |
| Golf Courses | 6 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 |
| Flatwood | 8 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 |
| Hammock | 9 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 |
| Hydric Hammock | 13 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 | 0.64 |
| Wet Prairie | 14 | 0.64 | 0.74 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.74 | 0.64 |
| Marsh | 16 | 0.64 | 0.74 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.84 | 0.74 | 0.64 |
| Cypress | 17 | 0.76 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.76 |
| Swamp Forest | 18 | 0.75 | 0.79 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.83 | 0.79 | 0.75 |
| Water | 20 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 |
| Urban Low Density | 41 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 |
| Urban Medium Density | 42 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 |
| Urban High Density | 43 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 | 0.62 |

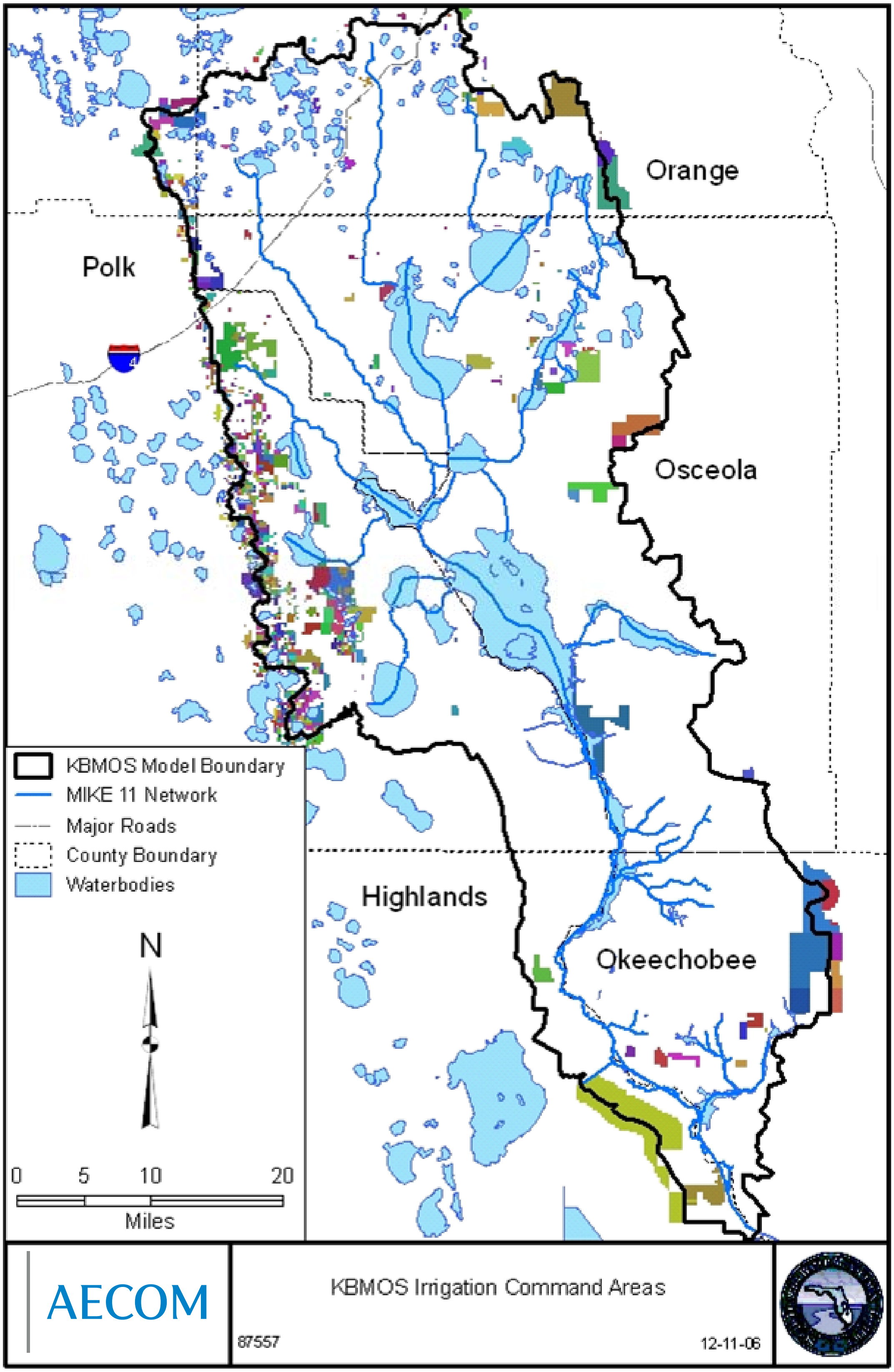



**Figure 2-6: KBMOS Irrigation Command Areas.**

### 2.7.4 Irrigation Demand

Irrigation demand is used to describe the conditions when irrigation water will be applied in the model. Definition of irrigation demand requires specification of the spatial distribution of irrigation demand areas within the model domain, demand type, and the temporal distribution of irrigation demands.

The crop stress factor irrigation demand strategy is used in the KBMOS model and is defined in the MIKE SHE vegetation property file (*.etv). The vegetation property file specifies the types of vegetation/land use to be irrigated. For the KBMOS model, the following land use types have been designated as needing irrigation water: Citrus, Golf Courses, Truck Crops, Low Density Urban, Medium Density Urban, and High Density Urban. The crop stress factor of one (1) has been specified for irrigated areas. A crop stress factor of one (1) has been used because it has been assumed that irrigation will be applied if the potential evapotranspiration for an irrigated area has not been met.

### 2.7.5 Water Reuse

Application of reuse water was represented in the KBMOS model using the irrigation module. Water reuse application areas within the KBMOS model domain are shown in Figure 2-7. Water reuse application areas larger than or equal to one 1,000 foot model grid cell were simulated using the specified irrigation demand option to apply reported application quantities. The SFWMD provided monthly application rates for each water reuse area in the KBMOS model domain. Annual application rates for water reuse areas in the KBMOS model domain are summarized in Table 2-8.

### 2.7.6 Paved Runoff

Within MIKE SHE, the paved area option is a conceptual method for representing surface water management in urban areas and requires that a paved area runoff coefficient be defined for each grid cell. The paved area runoff coefficient specifies the percentage of paved area in a grid cell and has been defined based on land use classifications in the KBMOS model. When precipitation is applied to a cell the paved area runoff coefficient, a value between 0 and 1, specifies how much of the rainfall is routed directly to the stream network. The remainder is allowed to pond, infiltrate into the unsaturated zone, and or flow via overland flow to adjacent cells. Paved area runoff is not simulated for cells with a paved area coefficient of zero or where a value is not defined (missing values = $-1\times10^{-35}$).

Initial estimates of the physically based paved area runoff coefficients were developed from the Picayune Strand Restoration Project (PSRP) and LT MIKE SHE models. The paved area runoff coefficient has been directly related to the land use type and was not adjusted from initial values defined in Earth Tech (2006e). Table 2-8 summarizes the paved area runoff coefficients used in the KBMOS model. The spatial distribution of paved area runoff coefficients used in the KBMOS model, are shown in Figure 2-8.

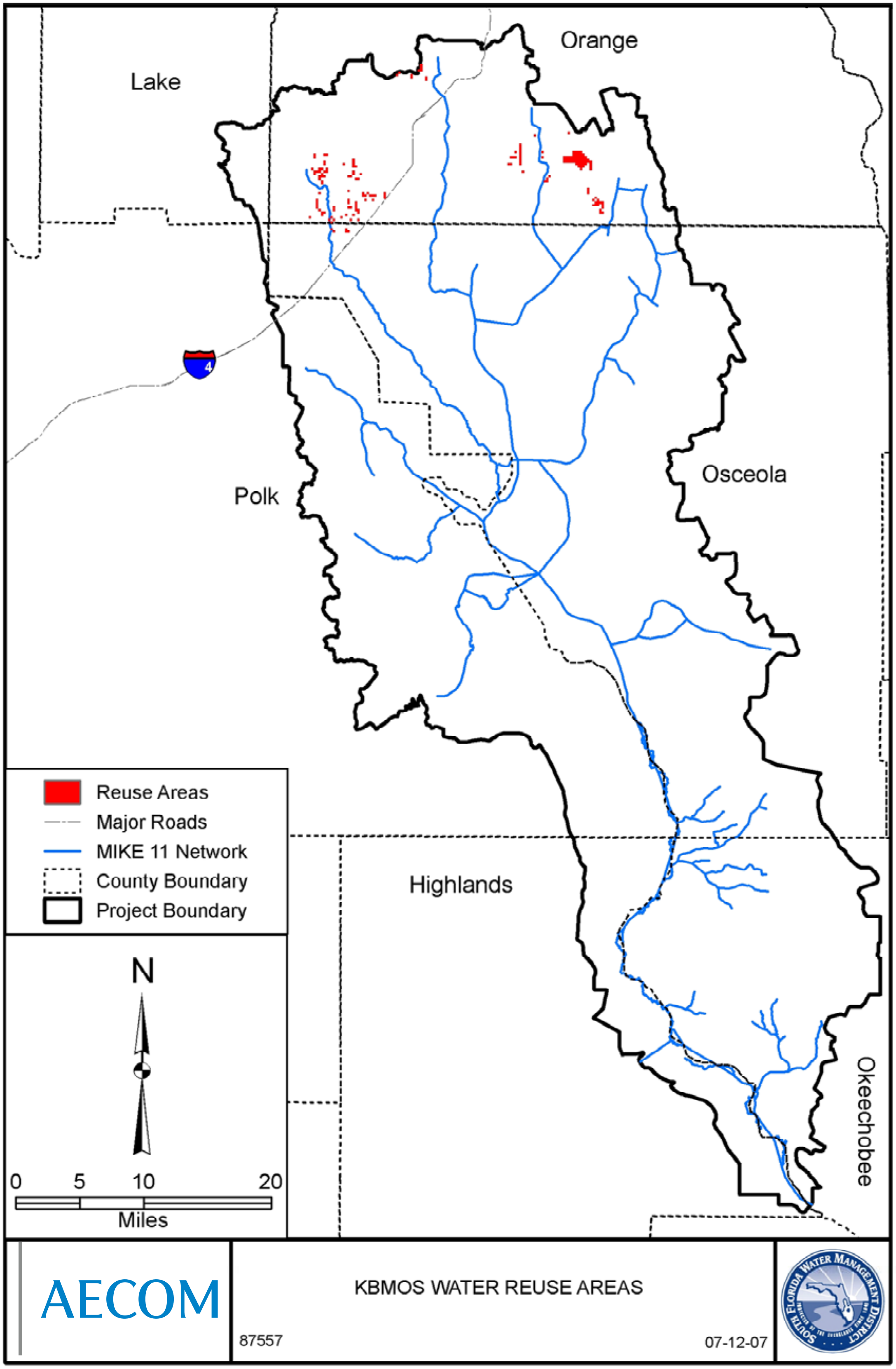



**Figure 2-7: KBMOS Water Reuse Areas.**

**Table 2-8: Annual water reuse application rates (in/year)**

| Name | ID | Application Rate (in/year) | | | |
|---|---|---|---|---|---|
| | | 2001 | 2002 | 2003 | 2004 |
| Reedy Creek Improvement District | 745 | 132.7 | 67.2 | 68.3 | 76.8 |
| Metrowest Country | 750 | 72.2 | 0.0 | 54.2 | 0.0 |
| Valencia Community College | 753 | 6.6 | 0.0 | 7.3 | 0.0 |
| Grand Reserve Apartments at Kirk. | 756 | 1.3 | 0.0 | 2.1 | 0.0 |
| Lake Nona Northlake Park School | 777 | 33.5 | 8.9 | 32.2 | 23.3 |
| Boggy Creek Golf Club | 778 | 28.1 | 3.5 | 10.0 | 9.1 |
| GOAA Authority Blue Parking Lot | 781 | 15.7 | 6.9 | 6.7 | 6.9 |
| Federal Express | 784 | 10.4 | 3.7 | 2.6 | 3.3 |
| Lake Nona Golf Course | 786 | 26.1 | 18.8 | 17.6 | 28.3 |
| Lakeshore Tree Farm Incorporated | 794 | 8.7 | 8.6 | 0.0 | 0.0 |
| Alamo Rental Car | 923 | 8.2 | 3.9 | 1.6 | 0.7 |
| Rapid Infiltration Basin | 937 | 34.7 | 6.0 | 10.7 | 11.4 |
| Tradeport Drive Meridian and Row Irrigation | 1035 | 26.2 | 6.0 | 5.2 | 7.7 |
| SR 436 Extension Roadway Irrigation | 1036 | 73.6 | 21.8 | 26.7 | 74.3 |
| Industrial Park Authority | 3147 | 74.1 | 50.2 | 18.5 | 17.0 |
| Eagle Creek Golf Course | 3149 | 2.7 | 1.0 | 8.4 | 6.1 |
| Eastside of 5A-5B Irrigation Control Boxes | 3155 | 0.0 | 0.0 | 10.3 | 23.4 |

**Table 2-9: Land Use Based Paved Runoff Coefficients ()**

| Land Use Type | MIKE SHE Code | Paved Runoff Coefficient () |
|---|---|---|
| Citrus | 1 | 0 |
| Pasture | 2 | 0 |
| Truck Crops | 5 | 0 |
| Golf Courses | 6 | 0.05 |
| Flatwoods | 8 | 0 |
| Hammock | 9 | 0 |
| Cypress | 17 | 0 |
| Hydric Hammock | 13 | 0 |
| Wet Prairie | 14 | 0 |
| Marsh | 16 | 0 |
| Swamp Forest | 18 | 0 |
| Water | 20 | 0 |
| Urban Low Density | 41 | 0.07 |
| Urban Medium Density | 42 | 0.22 |
| Urban High Density | 43 | 0.62 |

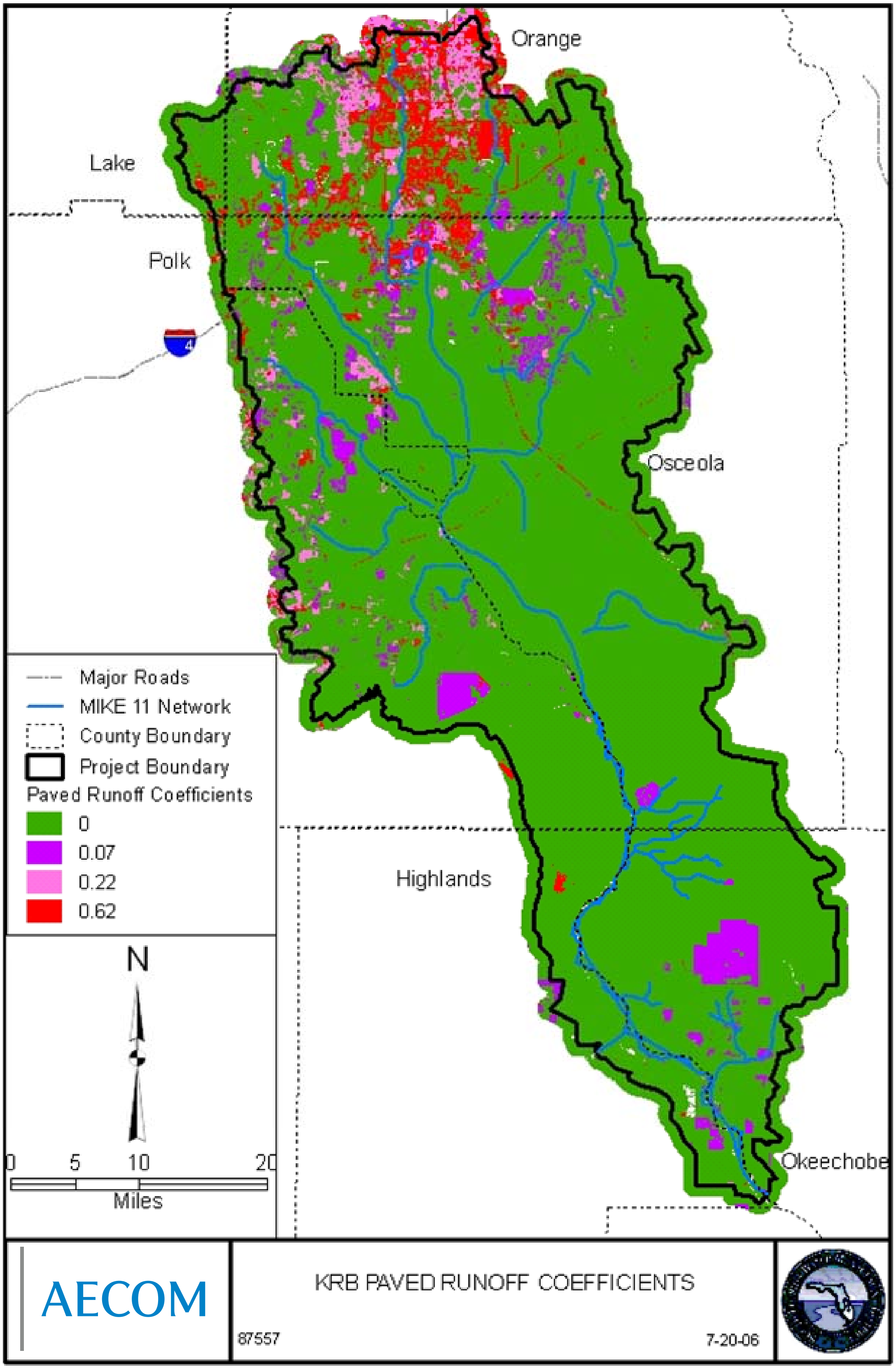



**Figure 2-8: KBMOS Land Use Based Paved Area Runoff Coefficients.**

## 2.8 Hydraulic Network

This KBMOS MIKE 11 model was developed from a number of existing hydraulic models developed for portions of the Kissimmee Basin. Development of the KBMOS MIKE 11 model included the following tasks:

1. Compiling available cross sections from other models
2. Finalizing model network
3. Importing cross section files into MIKE 11
4. Providing information on cross section location, dimensions, separations, and length of reaches represented, and location of structures
5. Checking and revising water control structure details
6. Establishing boundary conditions
7. Establishing Manning's *n* values for channel and over-bank areas
8. Coupling of MIKE 11 and MIKE SHE

The tasks initially executed to develop the KBMOS MIKE 11 model are described in the following subsections. The hydraulic network was refined during the calibration process. These refinements are described in Section 4 of this report.

### 2.8.1 Compiling Available Cross Sections

The available hydraulic models were compiled and reviewed to determine their utility for the Kissimmee River Basin model. The review was presented in a May 16 Technical Memorandum "Summary of Available Information to Construct the MIKE 11 model for the KB" (Earth Tech, 2006d). The sources of hydraulic model data used to develop cross sections for the KBMOS model are summarized in Table 2-10.

**Table 2-10: Available Models with Cross Section Data**

| Model Name | Source | Model | Comments |
|---|---|---|---|
| Csect.cs | SFWMD | UNET | • Model developed for 2004 hurricanes. Does not include the KUB.<br>• Modification of USACE UNET model.<br>• Phase I included.<br>• Will be used to model current conditions. |
| KRR_PredictionModel | USACE | HEC-RAS | • Model developed for 2004 hurricanes. Does not include the KUB.<br>• Modification of USACE UNET model.<br>• Phase I included. |

| Model Name | Source | Model | Comments |
|---|---|---|---|
| KRR_UBLBnc.cs | USACE | UNET | • Model of KUB and LKB. Does not include channels and lakes to the north of S-61, S-63, Lake Marion Canal, and Catfish Creek.<br>• Represents conditions similar to Post-Phase I of KRR<br>• T2 cards state with Proj.<br>• Will be used to supplement SFWMD UNET model for s condition. |
| LBEXRUSa.cs | USACE | UNET | • Errors in file. Two 7R cards instead of GR. Changed to GR by ADA Engineering (part of the Earth Tech Team) The extent of this model is the same as KRR_UBLBnc.cs<br>• Represents conditions equivalent to Pre-Phase I of KRR<br>• Includes S-65B which was demolished in Phase I.<br>• Will be used to represent the calibration period (pre-Phase I) |
| russN10a.cs | USACE | UNET | • Represents conditions equivalent to Future Conditions<br>• Does NOT contain S-65C which will be demolished. The extent of this model is the same as KRR_UBLBnc.cs<br>• Phase I, II/II channels backfilled from just south of Weir I to just north of S-65D.<br>• Will be used for the fully restored condition model. |
| Oak_2000_wp.x3.cs | USACE | UNET | • Restored condition for Oak Creek. Includes backfilling. Will be used for the current and restored condition. |
| Oak_2000_ex_x3.cs | USACE | UNET | • Existing (Pre-Phase I) condition for Oak Creek. Will be used for the calibration period (pre-Phase I) |
| Chan_hec2.cs | USACE | UNET | • Existing (Pre-Phase I) condition for Chandler Slough. Will be used for the calibration period (pre-Phase I) and restored condition. |
| C-31 | ADA | HEC-RAS | • Existing condition of the C-31 canal including S-59 and a weir just downstream of S-59. Will be used for calibration, current, and restored condition. |
| Catfish_R1.g01 | Stanley Consultants | HEC-RAS | • Existing condition for the Lower 4.8 mile of Catfish Creek |

### 2.8.2 Model Network

The KBMOS MIKE 11 network was developed in coordination with the SFWMD and includes the upper and lower basin consisting of the following canals and tributaries as well as the natural Kissimmee meanders, and the backfilled Phase-I restoration. Two surface water networks have been developed for use in the model calibration (Post-Phase 1) and verification (Pre-Phase 1);

1. The Pre-Phase-I network consists of the C-38 canal, the natural meanders of the Kissimmee River, and the Upper basin. Figure 2-9 (solid gray line) shows a cross

section that traverses the C-38 and a meander. Two channels are present in the pre-Phase 1 cross section, with the C-38 being much deeper than the meander.

2. The Post-Phase 1 network consists of the Phase-I backfilled portion of C-38, the restored river, the C-38 canal, and the upper basin. Figure 2-10 (solid gray line) also shows a cross section that traverses the backfilled portion of C-38 and a meander.

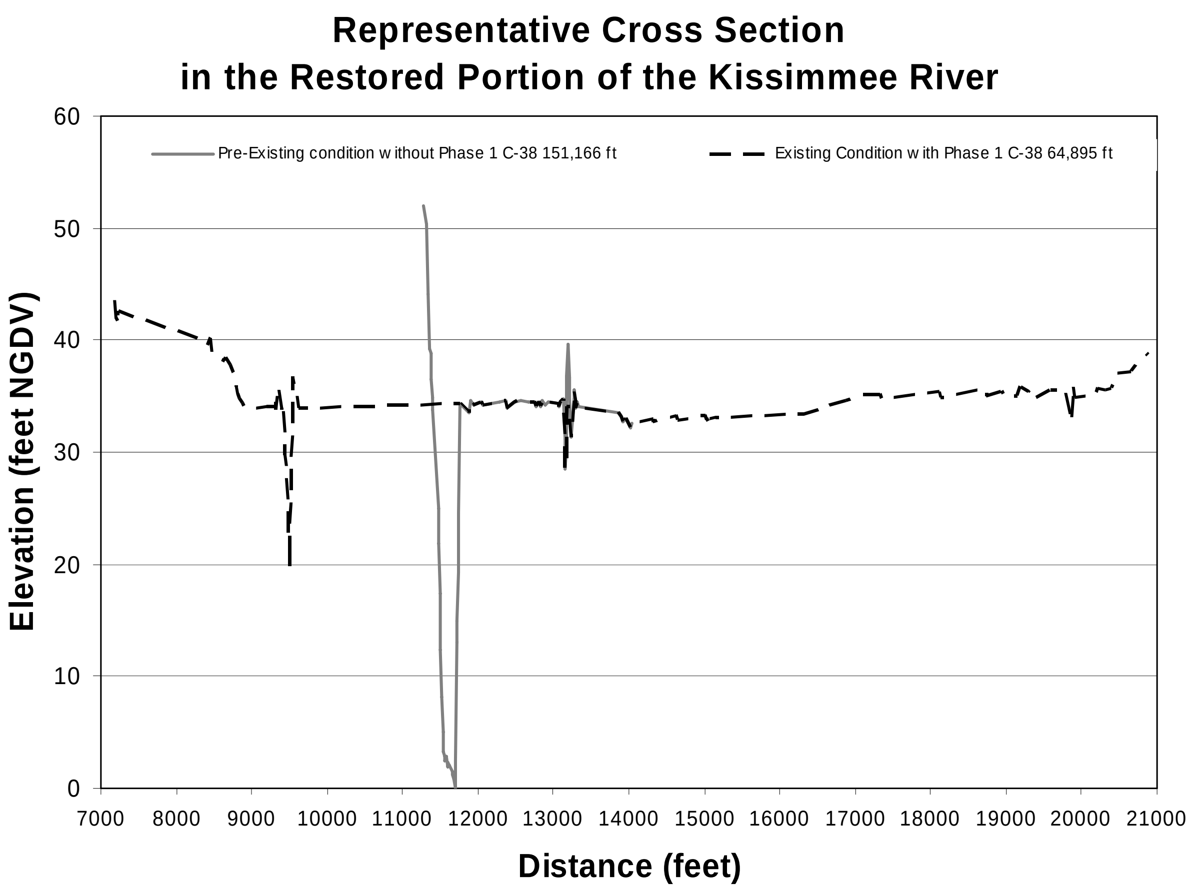



**Figure 2-9: Example of differences between the Pre- and Post-Phase 1 cross sections backfilled portions of the C-38.**

The network included the network of the DHI LT MIKE SHE/MIKE 11 model (DHI and GeoModel, 2001). The original LT MIKE 11 model was modified slightly during KBMOS MIKE 11 model development. The modifications to the LT MIKE 11 model included:

- A channel representing Dead Creek was added to link Reedy Creek to Lake Hatchineha as shown in the various USACE models and aerial photographs.
- The simple conceptual cross sections for Reedy Creek in the LT model were replaced with cross sections from a USACE model.

- A branch was added to link Lake Marion Creek to Lake Marion.
- The simplistic cross sections for C-31 were replaced with the A.D.A. HEC-RAS cross sections.
- S-63A was added to the network.
- Additional cross sections from a USACE model were added to C-34.

The complete model Post-Phase 1 network is shown in Figure 2-10. The post-Phase 1 network for the upper and lower Kissimmee Basin is shown in more detail in Figure 2-11 through Figure 2-17**.**

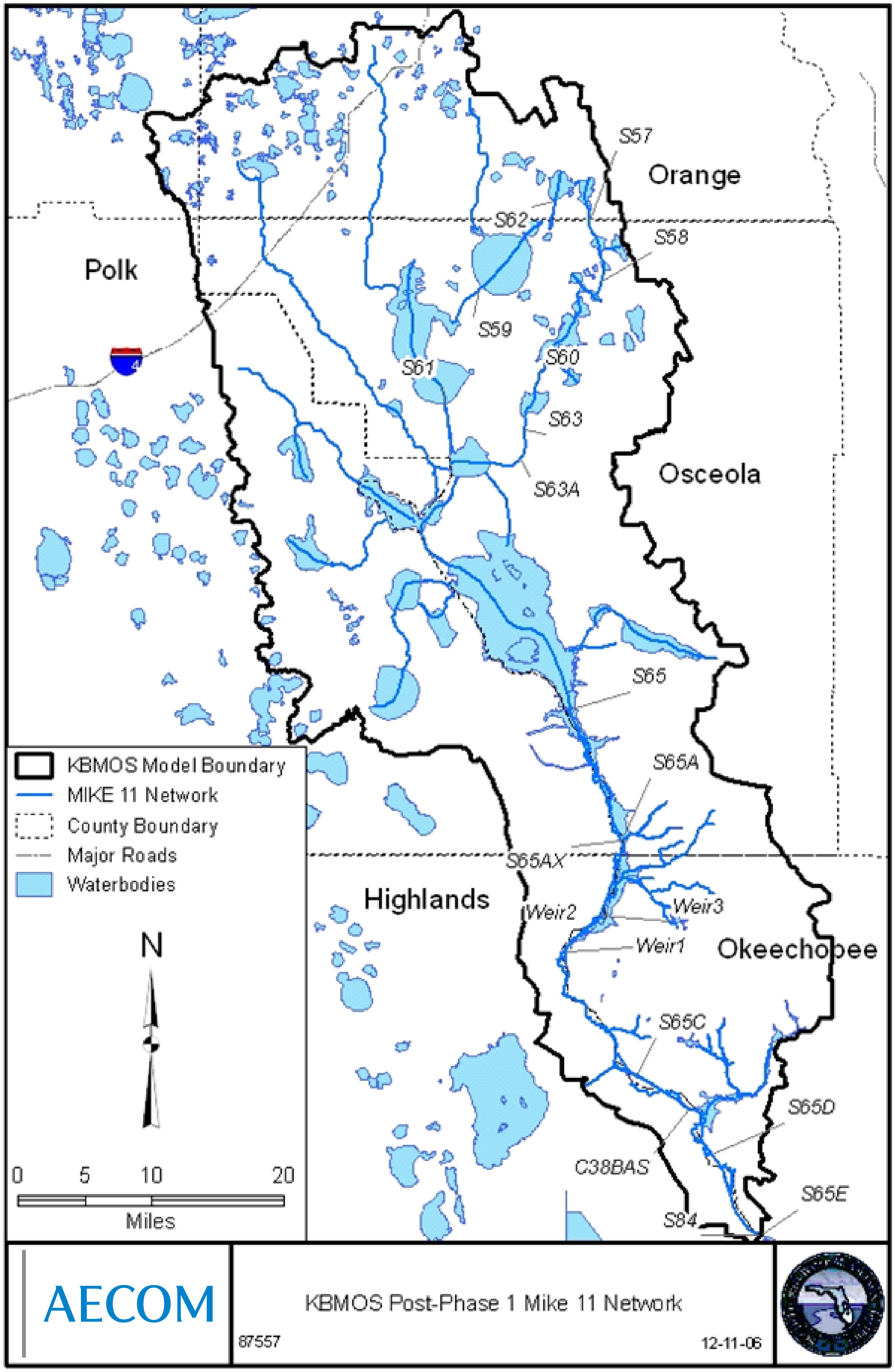



**Figure 2-10: Post-Phase 1 KBMOS MIKE 11 Network.**

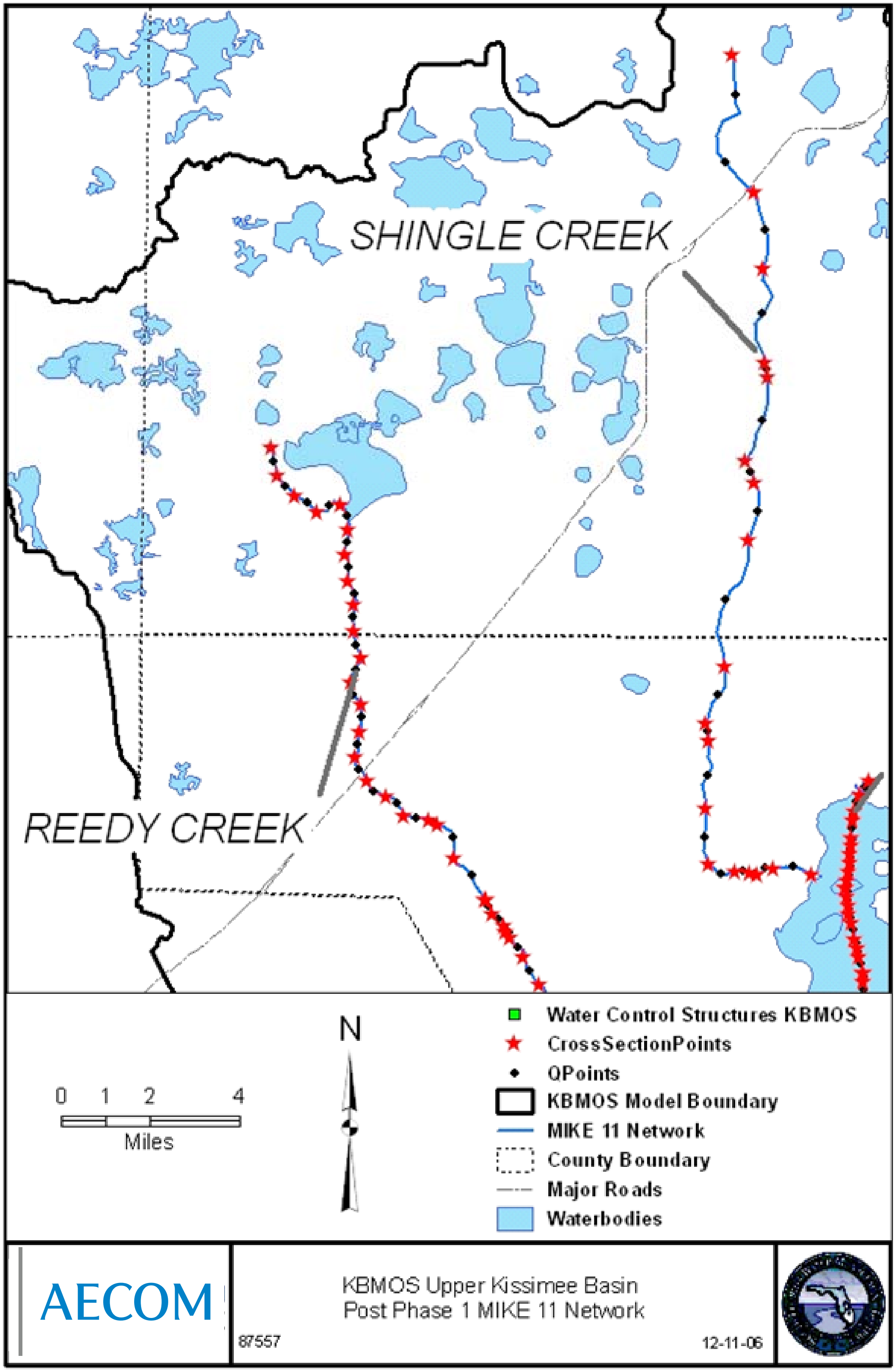



**Figure 2-11: MIKE 11 Network in the Upper Kissimmee Basin in the vicinity of Reedy and Shingle Creek.**

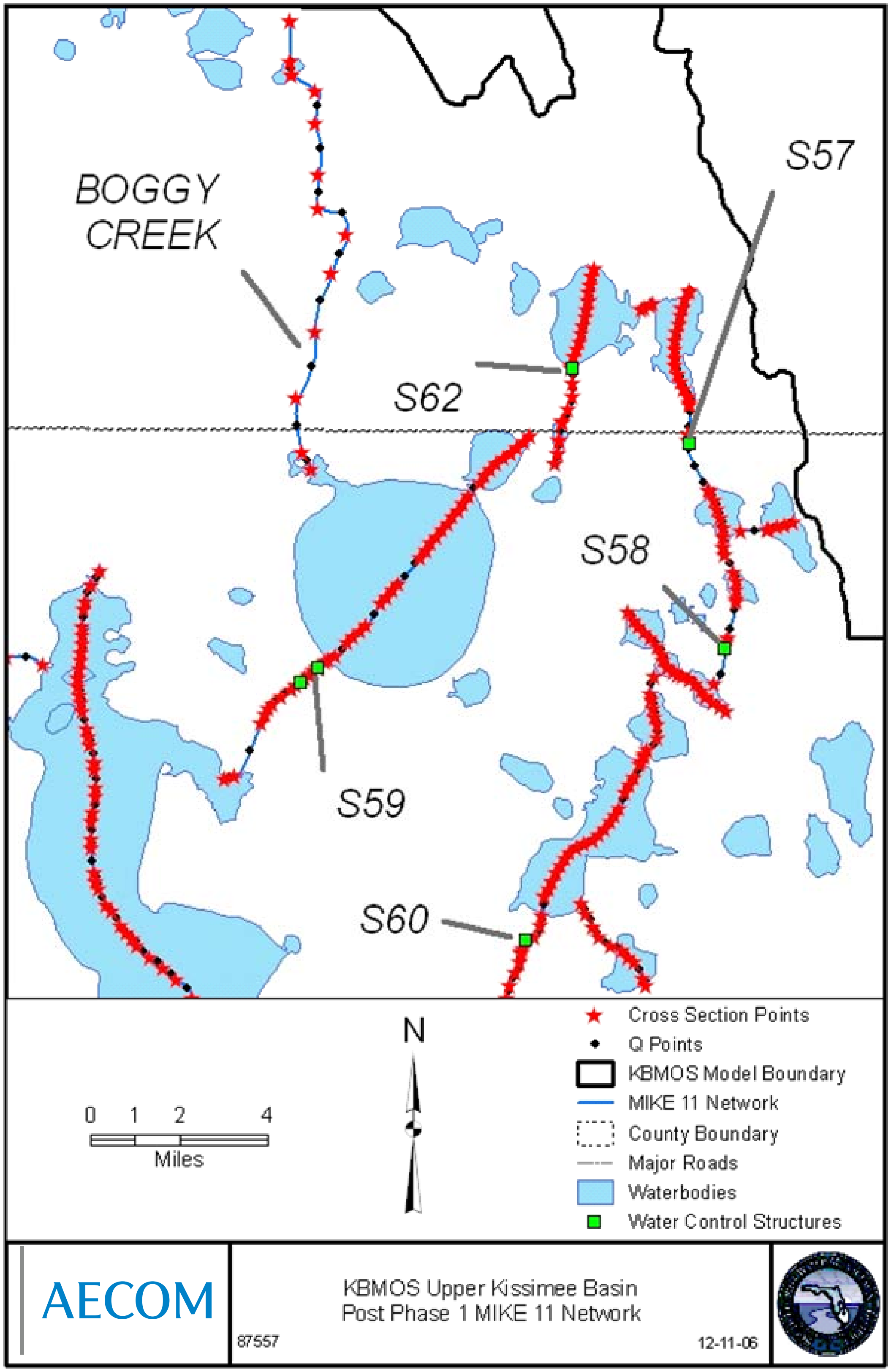



**Figure 2-12: MIKE 11 Network in the Upper Kissimmee Basin in the vicinity of Lake Toho, East Lake Toho, Alligator Lake, and Boggy Creek.**

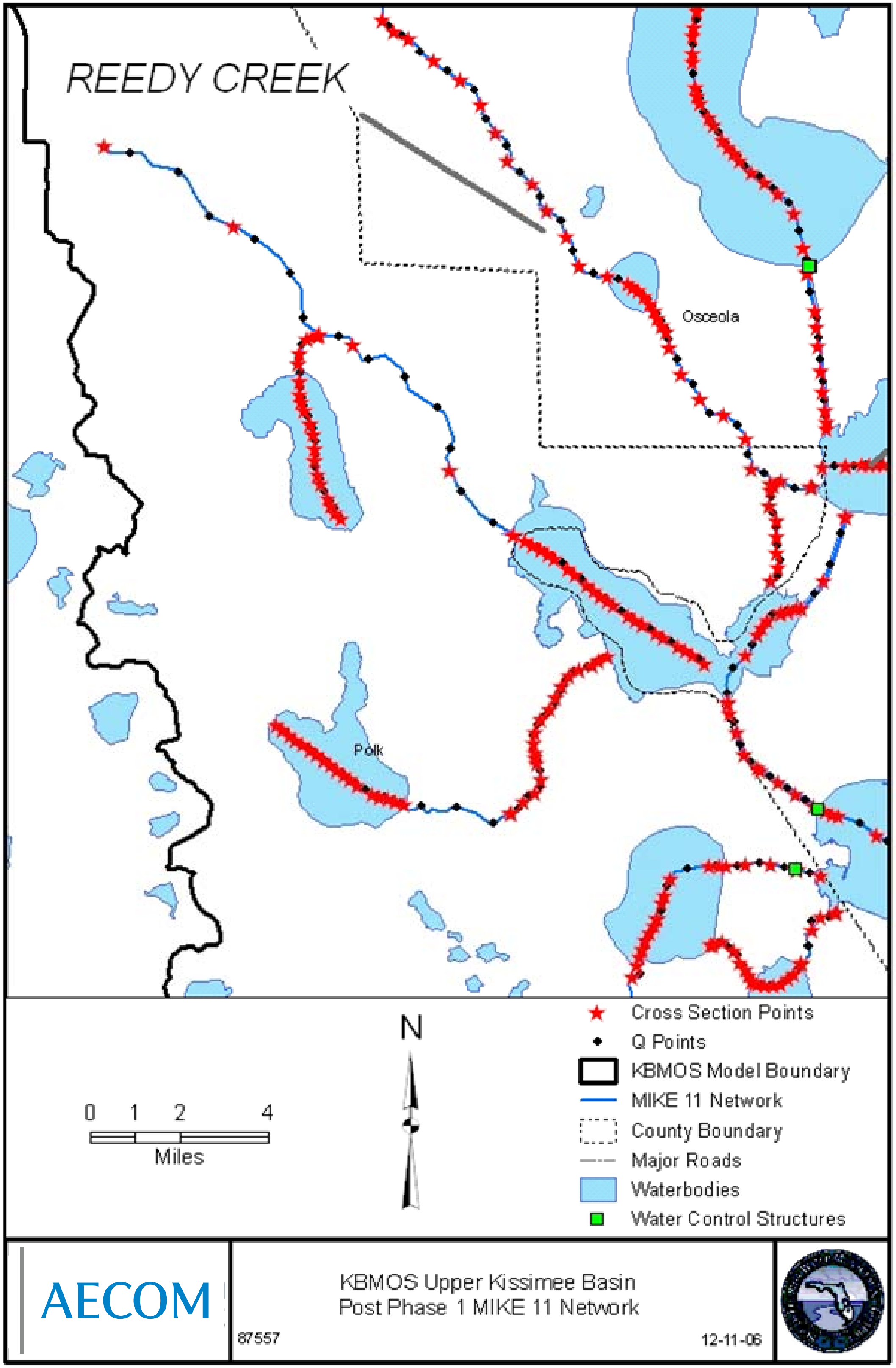



**Figure 2-13: MIKE 11 Network in the southwest portion of the Upper Kissimmee Basin near Lake Catfish, Lake Marion, and Lake Hatchineha.**

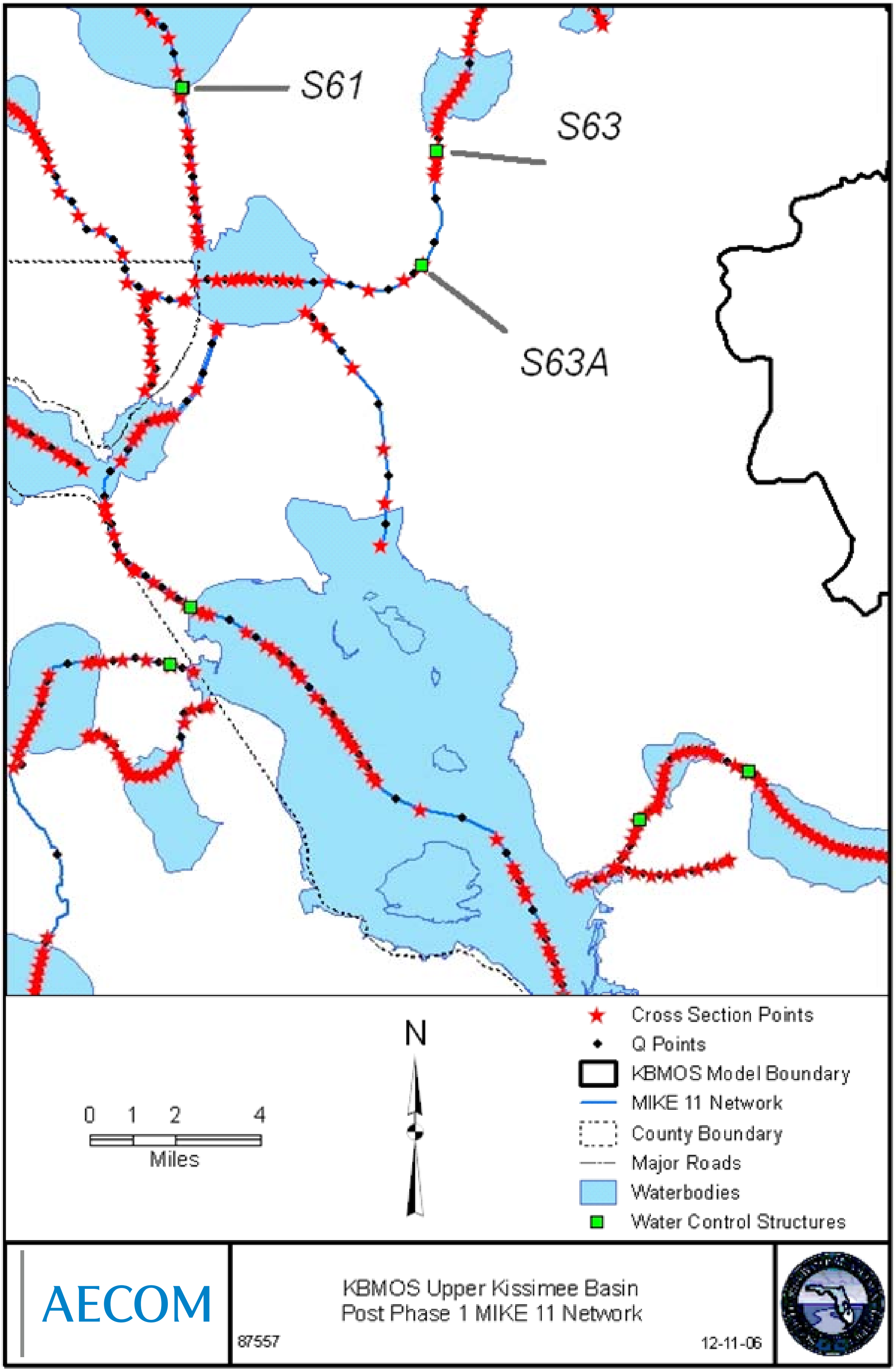



**Figure 2-14: MIKE 11 Network in the Upper Kissimmee Basin from S-63 to Lake Kissimmee.**

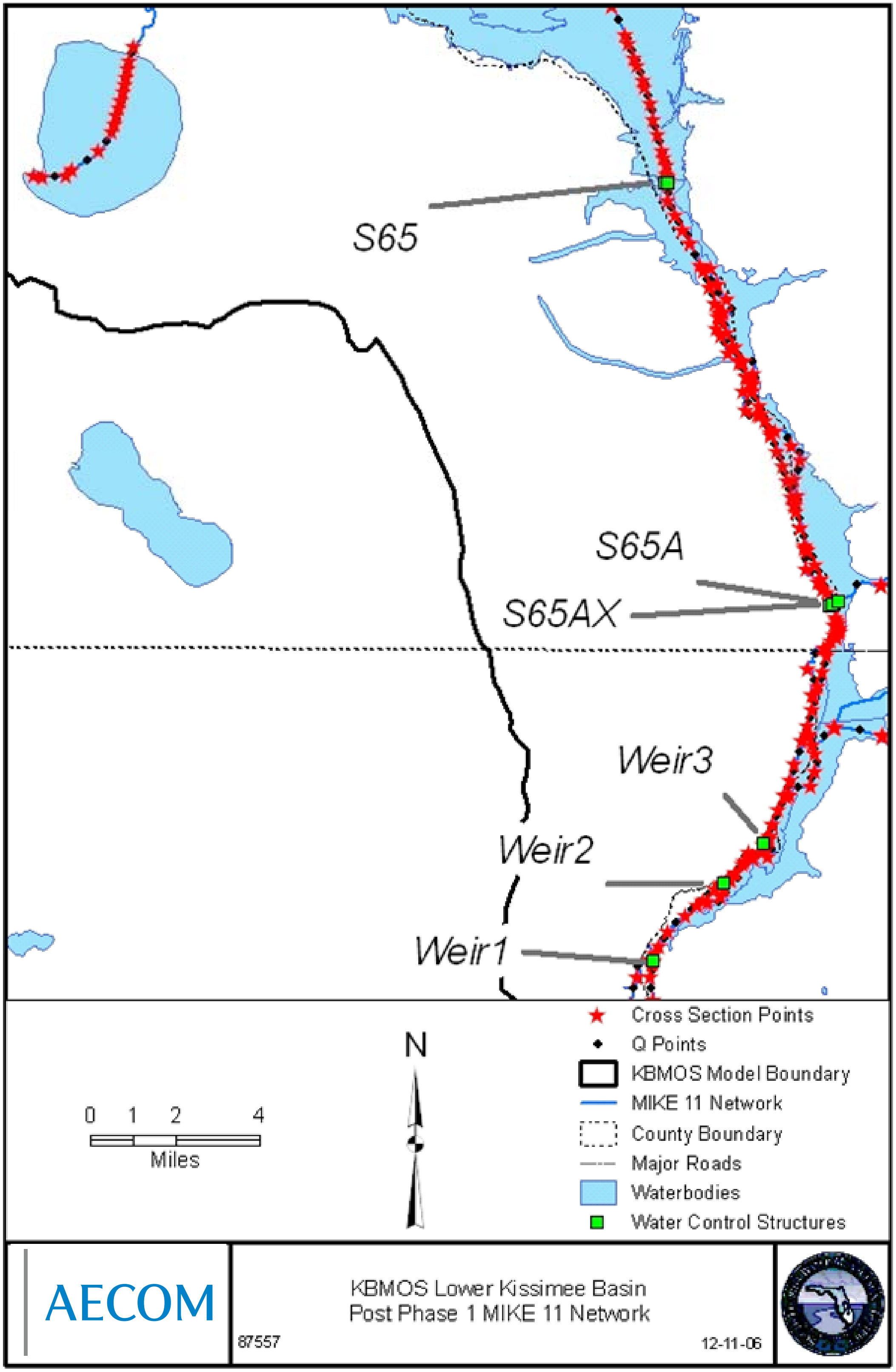



**Figure 2-15: MIKE 11 Network in the Lower Kissimmee Basin from S-65 to Weir 1.**

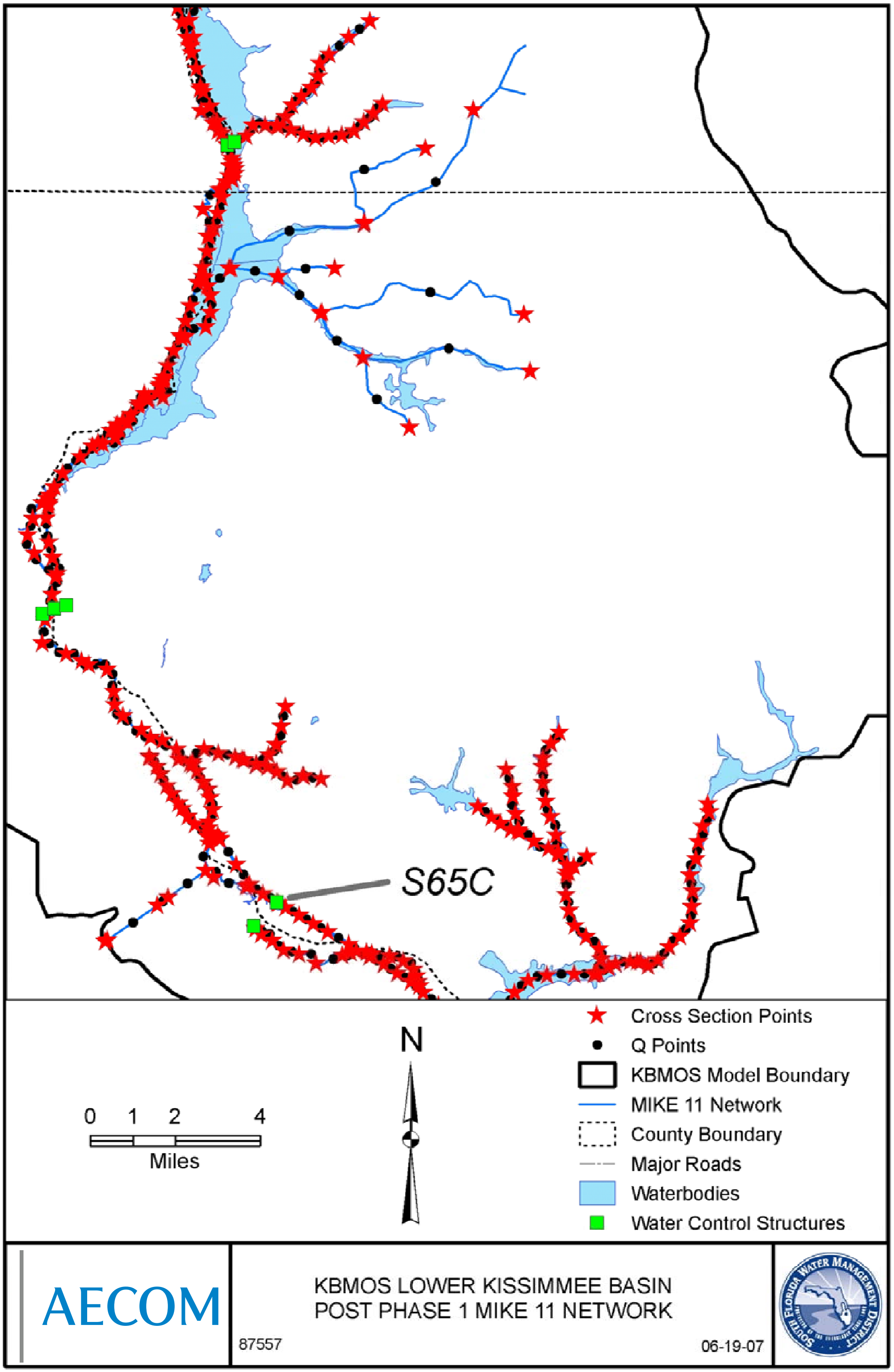



**Figure 2-16: MIKE 11 Network in the Lower Kissimmee Basin from Weir 1 to S-65C.**

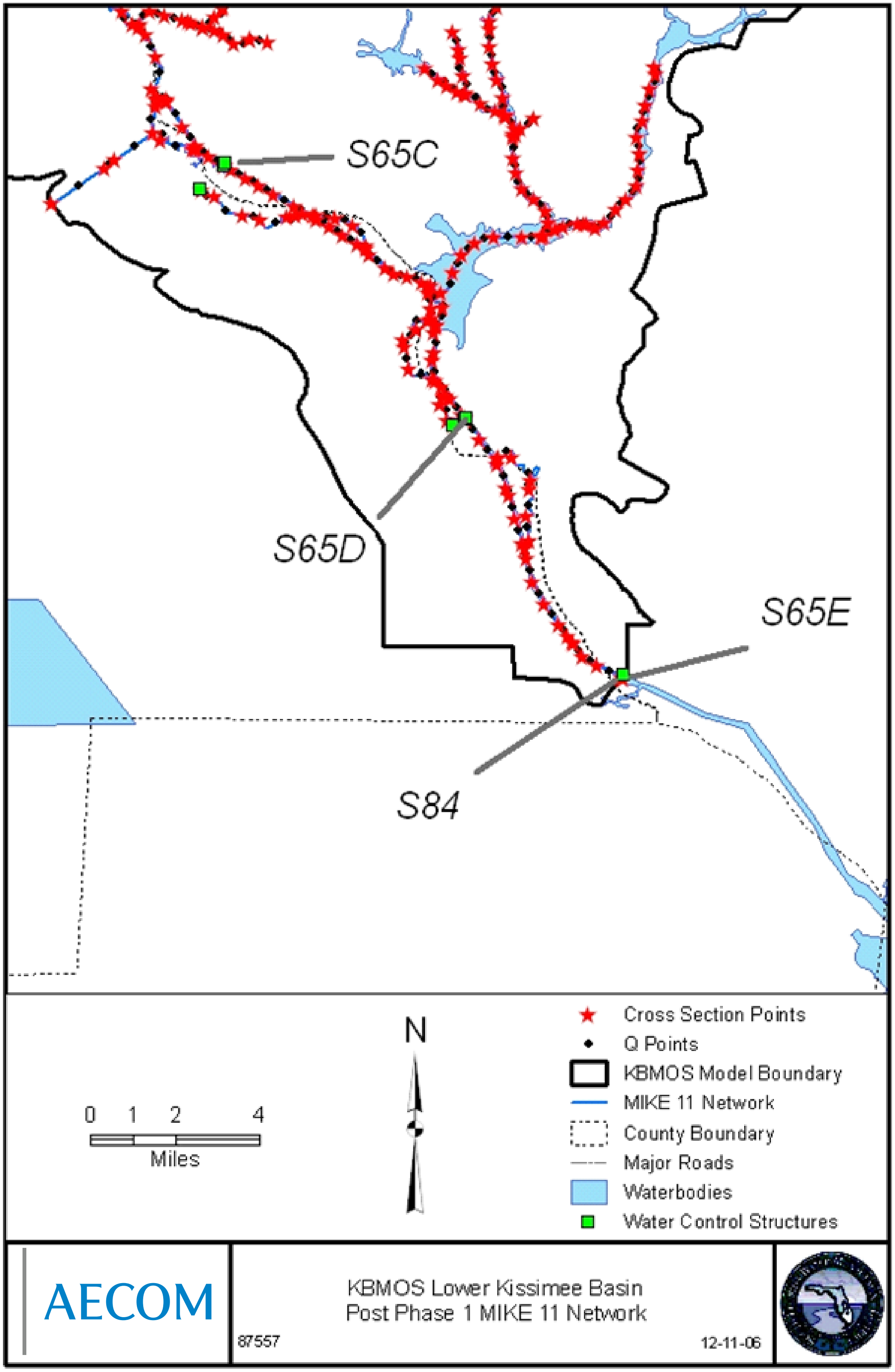



**Figure 2-17: MIKE 11 Network in the Lower Kissimmee Basin from S-65C to S-65E.**

### 2.8.3 Importing Cross Section Files into MIKE 11

Cross sections from the models shown in Table 2-10 were imported into MIKE 11 from existing UNET, and HEC-RAS models. Cross sections that traversed the C-38 as well as natural meanders were used to construct separate cross sections for C-38 and meanders represented in the model. The LT model was a MIKE SHE/MIKE 11 model and cross sections from the MIKE 11 model were included in the KBMOS MIKE 11 network as-is, except for the modifications described in Section 2.7.8.

### 2.8.4 Information on Cross Sections

The cross section data available in the existing hydraulic models is extensive. In an effort to develop a MIKE 11 model that was numerically stable, able to simulated surface water stages and discharges with sufficient accuracy, and with reasonable run times for the multi-year continuous simulations necessary to meet model objectives, the number of cross sections used in the KBMOS MIKE 11 model was reduced from the total number available. The cross sections included in the model were based on an analysis of the available cross section data to identify the cross sections necessary to provide adequate spatially representative variation in cross section for man-made channels as well as natural meanders. A total of 1042 cross sections over a total channel length of approximately 392 miles have been included in the KBMOS MIKE 11 model. A total of 115 cross sections are included for the 19 meanders included in the Post-Phase 1 MIKE 11 model. The MIKE 11 cross sections markers (1 and 3 markers) were set to minimize overlap and double accounting of storage in adjacent branches of the model. The modifications included trimming of long cross sections to prevent overlap. The locations of cross sections included in the model are shown in Figure 2-11 to Figure 2-17. It is noted that the red stars in Figure 2-11 through Figure 2-17 represent the center point of each cross section. The cross section width extends to cover the width of the branch at that point. Appendix B contains detailed information on the network including the lenght of each MIKE 11 branch, and the number of cross sections within each branch.

### 2.8.5 Water Control Structures

Sixteen (16) major water control structures were included in the model. Details are shown from screen capture screens for the existing condition with Phase I KRR model in Table 2-11. Structure S-65B is included on Table 2-11 even though it was removed as a part of the Phase I KRR project. Therefore, S-65B is only included in the Pre-Phase 1 MIKE 11 model representing conditions before Phase I KRR was constructed (Pre-Phase I KRR).

Control Structures were modeled using the newly added feature of MIKE 11 (2007 version) which has the SFWMD structure flow equations built in the model Graphical Users Interface (GUI). This new feature was added as part of the KBMOS Wave 2 activities and is documented in the AFET Operating Criteria Simulation Engine OCSE Demonstration report (Earth Tech, 2006f)

**Table 2-11: Control Structure Details**

| Structure ID | Branch | Chainage (ft) | Structure Type | Number of Gates | Structure Invert (ft NGVD) | Gate Width (ft) | Gate Height (ft) | a[1] | b[1] |
|---|---|---|---|---|---|---|---|---|---|
| G103 | Zipper Canal | 8418 | Overflow | 1 | 48 | 23.5 | 7.5 | NA | NA |
| G111 | Jackson Canal | 2782 | Overflow | 5 | 51.5 | 9 | 4.5 | NA | NA |
| G113 | Marian | 1981 | Overflow | 3 | 52 | 8 | 8.5 | NA | NA |
| S-57 | Upper Alligator | 31198 | Underflow | 2 | 52.5 | 3.53 | 4.5 | NA | NA |
| S-58 | Upper Alligator | 5735 | Underflow | 2 | 54.5 | 3.53 | 4.5 | NA | NA |
| S-59 | Lower – E-Toho | 36417 | SFWMD | 1 | 49.1 | 18 | 8.9 | 1.12/0.86/0.89/0.77 | 0.21/0.38/0.17/NA |
| S-60 | Alligator Chain | 38622 | SFWMD | 1 | 54.9 | 12.8 | 9.1 | 1.12/0.86/0.89/0.77 | 0.21/0.38/0.17/NA |
| S-61 | Toho-Main | 62254 | SFWMD | 1 | 36.9 | 27.8 | 18.1 | 1.00/0.86/0.89/0.77 | 0.27/0.38/0.17/NA |
| S-62 | Lk-Hart | 12303 | SFWMD | 1 | 55.2 | 14.8 | 6.8 | 1.12/0.86/0.89/0.77 | 0.21/0.38/0.17/NA |
| S-63 | Alligator Chain | 61857 | SFWMD | 1 | 53.9 | 15.8 | 8.1 | 1.12/0.86/0.89/0.77 | 0.21/0.38/0.17/NA |
| S-63A | Alligator Chain | 74186 | SFWMD | 2 | 49.3 | 15.8 | 7.7 | 1.12/0.86/0.89/0.77 | 0.21/0.38/0.17/NA |
| S-65 | C-38 | 210 | SFWMD | 3/5[2] | 39.2 | 27.8 | 14.2 | 1.04/0.838/0.86/0.7 | 0.3/0.167/0.35/NA |
| S-65A | C-38 | 56788 | SFWMD | 3 | 34.4 | 27.8 | 13.8 | 1.04/0.838/0.86/0.7 | 0.3/0.167/0.35/NA |
| S-65C | Lower C-38 | 167270 | SFWMD | 4 | 22.2 | 27.8 | 13.8 | 1.04/0.838/0.86/0.7 | 0.3/0.167/0.35/NA |
| S-65D | Lower | 214423 | SFWMD | 4 | 15 | 27.8 | 13.8 | 1.04/0.8 | 0.3/0.16 |

AECOM

| Structure ID | Branch | Chainage (ft) | Structure Type | Number of Gates | Structure Invert (ft NGVD) | Gate Width (ft) | Gate Height (ft) | a[1] | b[1] |
|---|---|---|---|---|---|---|---|---|---|
| | C-38 | | | | | | | 38/0.86/0.7 | 7/0.35/NA |
| S-65E | Lower C-38 | 252805 | SFWMD | 6 | 9.6 | 27.8 | 13.8 | 1.04/0.838/0.86/0.7 | 0.3/0.167/0.35/NA |
| S-65B | C-38 | 121810 | SFWMD | 3 | 26.3 | 27.8 | 13.8 | 1.04/0.838/0.86/0.7 | 0.3/0.167/0.35/NA |

[1] SFWMD structure coefficients for the CS/US/CF/UF flow conditions
[2] 3 gates prior to January 24, 2002; 5 gates after January 24, 2002
NA Not Applicable

For calibration purposes only, the control structures in the Pre- and Post-Phase 1 models are dynamically operated using the observed headwater stage data to open and close the gates and dynamically simulate structure discharges. The gates begin to open when the simulated headwater stage is at least 0.1 feet above the observed stage and begin to close when simulated stages are within 0.1 feet of the observed stage. During the course of the project the modeling team evaluated using reported gate opening data provided by the SFWMD. It was decided to not use the reported gate opening data because 1) it varied on a 15-minute frequency which is contrary to the modeling team's understanding that all structures except S-63A are operated on a daily basis and 2) it was unclear how the 15-minute gate opening data was developed and the original observed gate opening information was not available.

Under-prediction of headwater stages during high-flow events was a result of the combined use of 15-minute gate opening data and SFWMD structure equations which essentially fixed structure discharge at calculated values. The modeling team and SFWMD staff decided to use headwater stages to operate the structures. Cumulative discharge errors were used to confirm that model errors were within the expected uncertainty range for structure discharge, The methodology used to operate the gates will be modified during the alternative evaluation process where the details of each operating criteria being evaluated will be included in the structure control logic.

In addition to the control structure, lock and leakage structures were represented in the model to simulate additional unregulated discharge in the Kissimmee Basin. Lock structures were simulated as discharge structures at S-60, S-65, S-65A, S-65B (in the Pre Phase 1 model), S-65C, S-65D, and S-65E. The SFWMD reviewed lock opening data and determined that on average S-60, S-65, S-65A, S-65B, S-65C, S-65D, and S-65E were operated 19, 8, 10, 10, 10, 10, and 13 times a day, respectively, during the calibration period. Simulated lock discharges were calculated using the lock geometry and simulated head difference between the headwater and tailwater side of the structure.

Structure leakage was simulated at S-57 through S-65E using a 4 inch × 2 foot rectangular culvert for each gate and lock at a given location. The invert for the leakage structures were set at the invert elevation of the gates at each structure location. The structure leakage structures were included to account for discharge resulting from debris and poor seals which prevent complete closure of structure and lock gates.

### 2.8.6 Pool B's Weirs 1, 2, and 3

Weir 1, 2 and 3 in Pool B were installed in the main channel of the river in the mid-1980s as part of a demonstration project designed to determine whether Kissimmee River restoration would be effective. Each weir was originally designed with a notch in it to allow navigation but these notches became hazardous when water levels in the river were low. To alleviate this problem, the notches in the weirs were lowered in May of 2003 by 10 feet at Weir 1 and 3, and by 8.75 feet at Weir 2.

Design drawings were used to represent Weir 1, 2, and 3 in the Pre-Phase 1 model as a broad-crested weir. The weirs were modified in the Post-Phase 1 model based on the modifications made in 2003. Weir 2 was further modified to reflect the degradation (collapse/washout) of the left bank of the weir (Figure 2-18). Twenty-five percent of the left bank of Weir 2 was degraded and set equal to the channel bottom geometry.

**Figure 2-18: Aerial view of Weir 2 showing the collapse/washout of the left bank of the structure that occurred in 1998.**

### 2.8.7 Boundary Conditions

Closed (zero flow) boundaries were specified on all upstream ends of branches represented in MIKE 11. Observed tailwater stage at S-65E is specified at the downstream end of the Lower C-38. No other boundary conditions are specified in the KBMOS MIKE 11 model. A discussion of the headwater stages used to drive the MIKE11 control logic during calibration that might be regarded as internal boundary conditions is included in Section 2.8.5.

### 2.8.8 Manning's n

As discussed previously, cross sections were imported to MIKE 11 from the various UNET, HEC-RAS files or constructed from bathymetric data. Horizontally varying Manning's *n* values were applied in the MIKE 11 cross sections if such data were available in the original cross section data. Where horizontally varying values were applied, in-channel values are less than overbank areas. Examples of horizontally-varying Manning's *n* values are shown in Fgigure 2.19 and Figure 2-20.

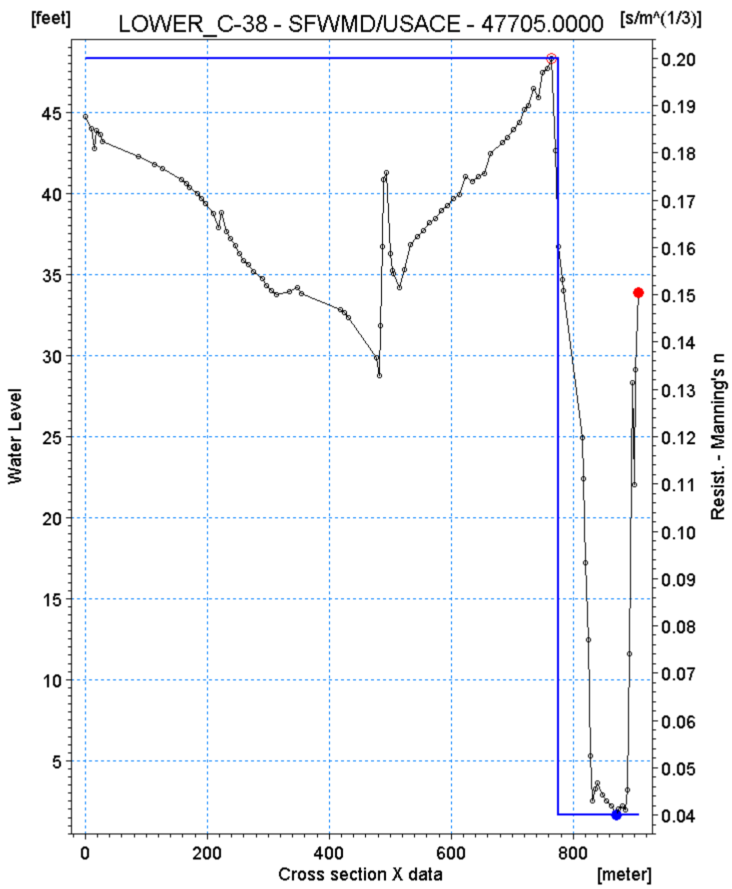



**Figure 2-19: Example of a cross section with horizontally varying Manning's *n* values in the Lower C-38 canal in the KBMOS MIKE 11 model.**

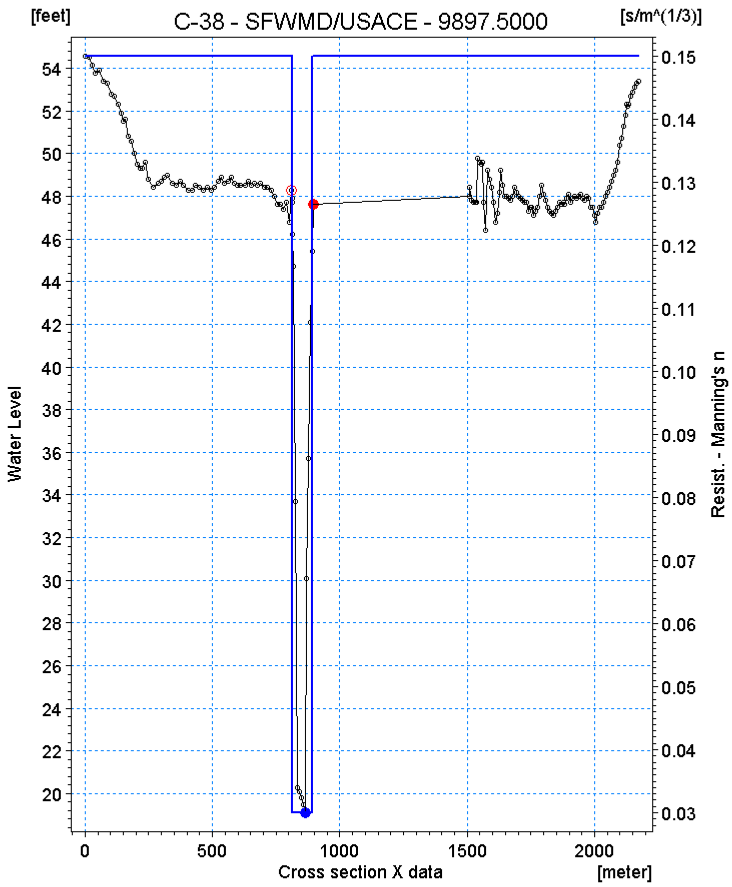



**Figure 2-20: Example of a cross section with horizontally varying Manning's *n* values in the C-38 canal in the KBMOS MIKE 11 model.**

### 2.8.9 Cross Sections and Bathymetry from Lake Tohopekaliga to S-65

Cross section data for the lakes were constructed from USACE bathymetric maps provided by the SFMWD with the exception of Lakes Pierce and Marion, where data were not available. A major flow line was drawn on each bathymetric map and cross sections drawn at right angles to the flow lines. Information was then extracted for each cross section and input into MIKE 11. Cross Section data originally included in the Lake Tohopekaliga model were also replaced with new cross sections obtained from the latest basinwide DEM. Lakes Pierce and Marion cross sections were estimated with the following procedures:

1. Extract data on elevation vs. area from USACE HEC-1 models.
2. Develop regression equations (University of Central Florida, 1998, SMADA software, downloaded from internet at http://www.cee.ucf.edu/software) relating elevation as a function of area
3. Outline the lake areas in GIS and calculate the areas for each. Outline smaller within-lake areas that are parallel to the shoreline and calculate areas.
4. Use the regression equations to estimate elevation based on the areas in "3" above.
5. Subsequently, follow the procedures for the bathymetric maps.

Additional information on the process used to develop cross sections for Lakes Pierce and Marion is given in Earth Tech (2006d).

### 2.8.10 Coupling MIKE 11 to MIKE SHE

All branches included in MIKE 11 were coupled to the MIKE SHE model. The MIKE SHE river links for the Post Phase 1 MIKE 11 model are shown in Figure 2-21. The MIKE SHE river links defines the location where the overland, drainage, and baseflow components interact with MIKE 11. The area-inundation approach was used to allow bi-directional exchange of water between MIKE 11 and the overland component of MIKE SHE for all lakes explicitly included in the MIKE 11 network in the KUB. Bi-directional exchange of water was also allowed for the C-38 canal below S-65 in Pools A, C, and D of the Kissimmee River between S-65A and S-65C in the Post Phase 1 model. Areas where bi-directional flow is allowed between MIKE 11 and the overland component of MIKE SHE are shown on Figure 2-21.

In the KUB, the area-inundation approach and associated flood codes were defined for all of the major lakes defined in MIKE 11 (Figure 2-21). This approach was used to ensure that lake volumes were consistent in MIKE SHE and MIKE 11 and that the same water level elevation was simulated in all MIKE SHE cells in the defined area of the lakes. This approach also allows exchange of water from MIKE 11 to the overland flow plain adjacent to the defined area of the lake during high flow conditions. Flood codes shown in Figure 2-21 are used to identify geographic areas so that all area within the same code was assigned the same lake level.

In the LKB, the area-inundation approach was used in Pool A, C, and D in the Post-Phase 1 model but associated flood codes were restricted to the grid cells immediately adjacent to the MIKE SHE river links (Figure 2-21). The flood codes were limited to the cells adjacent to the river links because the cross sections used in the C-38 in the MIKE 11 portion of the model were restricted to the main channel and the area-inundation approach is only used to allow exchange of water from MIKE 11 to the overland flow plain during high flow conditions. The cross section markers were set based on the 1,000 × 1,000 foot topography data in the cells adjacent to the cross section to ensure accurate representation of over-bank flooding during high flow conditions. The same approach was also used in Pool B in the Pre-Phase 1 model. The area-inundation approach was not used in the restored portion of the Kissimmee River in the Post-Phase 1 model because the MIKE 11 cross sections extend across the entire floodplain and a better representation of floodplain conveyance features was added to the model. This approach proved to be better than what could be achieved with a combination of the area-inundation approach and the MIKE SHE topography.

The full contact river-aquifer option was specified for all MIKE 11 branches except KUB lakes where the area-inundation is specified. The full contact river-aquifer option was used because it resulted in the best calibration of river leakage in the LKB. The calibration of river leakage in the LKB is discussed in more detail in Section 4. In KUB lakes using the area-inundation approach the river bed leakage option and a baseflow leakage coefficient of 0.0 day$^{-1}$ were specified because aquifer-lake exchanges are accounted for by direct overland-saturated zone exchange calculations in areas where groundwater levels exceed land surface (*i.e.*, lakes).

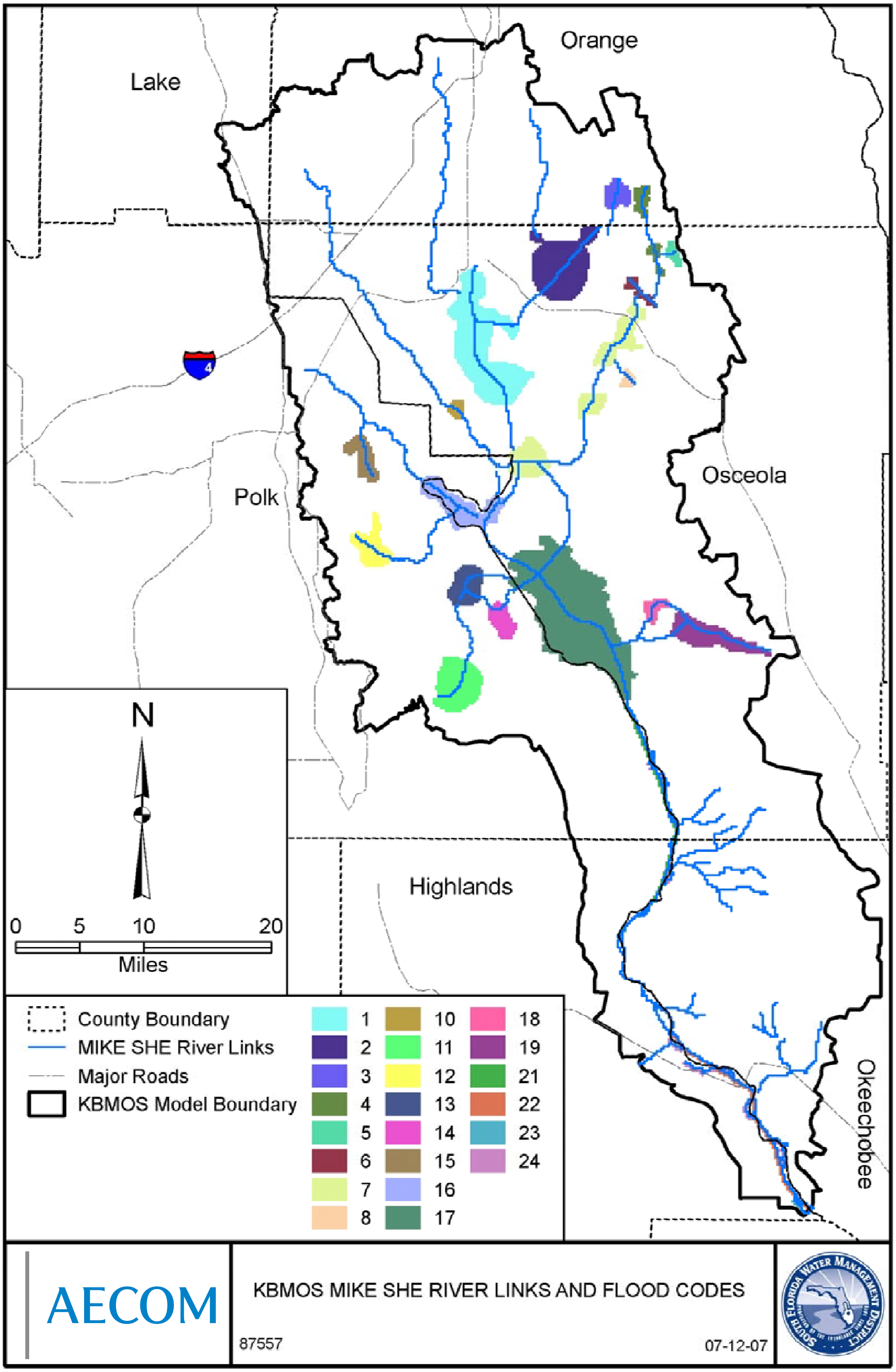



**Figure 2-21: MIKE SHE River Links and Floodcodes used in the KBMOS model.**

## 2.9 Overland Flow

The overland flow module used in the KBMOS model is a grid cell based finite difference method that is driven by the discretized model topography. The finite difference overland method utilizes a two-dimensional finite difference diffusive wave approximation of the St. Venant equations. This approximation ignores momentum losses due to convective acceleration and lateral inflows perpendicular to the flow direction. The approximation is then further simplified by substituting Manning's equation into the diffusive wave approximation momentum equations. The resulting solutions in the x- and y-directions reduce to:

$$uh = M_x(-\partial z/\partial x)^{1/2}\, h^{5/3}$$

$$vh = M_y(-\partial z/\partial y)^{1/2}\, h^{5/3}$$

where:

$h$ = depth of flow
$u$ = velocity in the x direction
$v$ = velocity in the y direction
$z$ = total potential head
$x$ = x direction unit length
$y$ = y direction unit length
$M$ = Manning's M friction coefficient = 1 / $n$

An explicit or iterative linear matrix modified Gauss Seidel method is then used to solve the numerical solution for the entire grid simultaneously. The five parameters associated with calculating overland flow are:

- Initial Water Depth – This is the initial water depth in the model domain. This initial condition has been developed from previous model runs and represents conditions at the start of the calibration, verification, and storm verification runs.
- Manning's *M* values – Manning's *M* values lump the friction effects due to bedding and vegetation and directly impact the velocity of overland flow. These values are constant over the entire flow regime and spatially distributed based on the specified land-use types. Manning's *M* values are equal to the inverse of Manning's *n* values and are equivalent to the Stickler roughness coefficient.
- Detention Storage – These values are storage depths that must be exceeded in a grid cell before overland flow can occur. This depth accounts for water detained in micro-topographic features that are not visible within the topographic resolution and grid extent. These values have been developed using land use relationships. Water in detention storage is not available for overland flow but is available for infiltration to the unsaturated zone and evapotranspiration.
- Overland – Saturated Zone Leakage Coefficient – When the soil profile becomes completely saturated the overland flow and saturated zone modules exchange water directly. The overland – saturated zone leakage coefficient reduces the exchange of water if it is less than the equivalent vertical hydraulic properties defined for the water table aquifer (*i.e.*, model layer 1). The overland – saturated zone leakage coefficient is typically used to represent the

effect of lower permeability sediments in areas that are inundated (*e.g.,* lakes) and where the hydraulic properties of the water table aquifer do not adequately reflect the presence of low permeability sediment.

- Separated overland flow areas – This allows physical divides (*i.e.*, levees, roads, basin divides, *etc.*) that are not present in the model topography to be represented in the model.

Table 2-12 documents the Manning *M* (1/ n) roughness coefficients and detention storage depths used in the KBMOS model. These values are closely linked to land use type.

**Table 2-12: Land Use Based Overland Flow Parameters**

| KBMOS Land Use Type | KBMOS MIKE SHE Land Use Code | Detention Storage (in) | Manning's *M* () |
|---|---|---|---|
| Citrus | 1 | 1.15 | 5.88 |
| Pasture | 2 | 1 | 7.14 |
| Truck Crops | 5 | 1.25 | 5.88 |
| Golf Courses | 6 | 1 | 7.14 |
| Flatwoods | 8 | 1.2 | 5.00 |
| Hammock | 9 | 1.2 | 3.33 |
| Cypress | 17 | 1.25 | 2.50 |
| Hydric Hammock | 13 | 1.2 | 2.50 |
| Wet Prairie | 14 | 1.25 | 3.33 |
| Marsh | 16 | 1.25 | 1.67 |
| Swamp Forest | 18 | 1.25 | 2.50 |
| Water | 20 | 0 | 0.00 |
| Urban Low Density | 41 | 2.5 | 7.14 |
| Urban Medium Density | 42 | 2.5 | 8.33 |
| Urban High Density | 43 | 2.5 | 9.01 |

It should be noted that overland flow parameters are effective parameters that are a function of both the grid sizes used in the model and conditions under which sheet-flow begins to occur in the watershed.

Initial estimates of physically based overland Manning's *M* values were developed from the Picayune Strand Restoration Project (PSRP) and LT MIKE SHE models and were not adjusted during model calibration. Figure 2-22 shows the area distribution of the Manning M values used in the KBMOS model.

The detention storage depths from the PSRP model for agriculture and urban areas were further evaluated for the KBMOS to develop initial estimates (Earth Tech, 2006e). The PSRP model detention storage depths for agricultural areas are considered reasonable for the KBMOS model because:

- It is assumed that agricultural areas have internally managed drainage facilities and are isolated from surrounding lands,

- It is assumed that topography features such as swales between crop beds and other significant depression storage exist, and
- Drainage features within the farms typically have available storage capacity that collects surface water during storm events and is used to convey water off-site in a controlled fashion.

Urban detention storage depths were developed based on surface water management practices in the area. Detention storage in urban areas has been set to 2.5 in based on current design criteria, which require that on-site storage in developed areas should be capable of retaining 2.5 in of runoff from a single event. This represents a maximum value for medium-density urban areas because it assumes that these areas were developed using the current design criteria. Older developments may not currently meet these criteria as a result of being developed when design criteria were less stringent. It is also likely that sediment accumulation within storage facilities has reduced available detention storage capacity. Low density urban areas might detain more than 2.5 inches because of features that exist within undisturbed areas of the development. High-density urban areas may have detention storage values less than 2.5 in due to greater percentages of impervious areas. Although up to 2.5 inches of water is retained on the overland flow plain in urban areas this water is available for evapotranspiration and groundwater seepage to adjacent areas. Furthermore, paved areas runoff coefficients automatically route a specified fraction of the precipitation to defined outlet points.

The detention storage depths were modified during model calibration to better represent the effective detention storage values in the Kissimmee Basin. Initial detention storage depths used in the KBMOS model are summarized in Earth Tech (2006e). Figure 2-23 shows the distribution of detention storage values used in the KBMOS model.

Overland – saturated zone leakage coefficients are shown in Figure 2-24. The smallest overland – saturated zone leakage coefficients are defined for the large lakes in the KUB. Separated overland flow areas are shown in Figure 2-25 and are based on the sub-watershed coverage provided by District staff. The correspondence of separated overland flow area codes and sub-watershed names is summarized in Table 2-13.

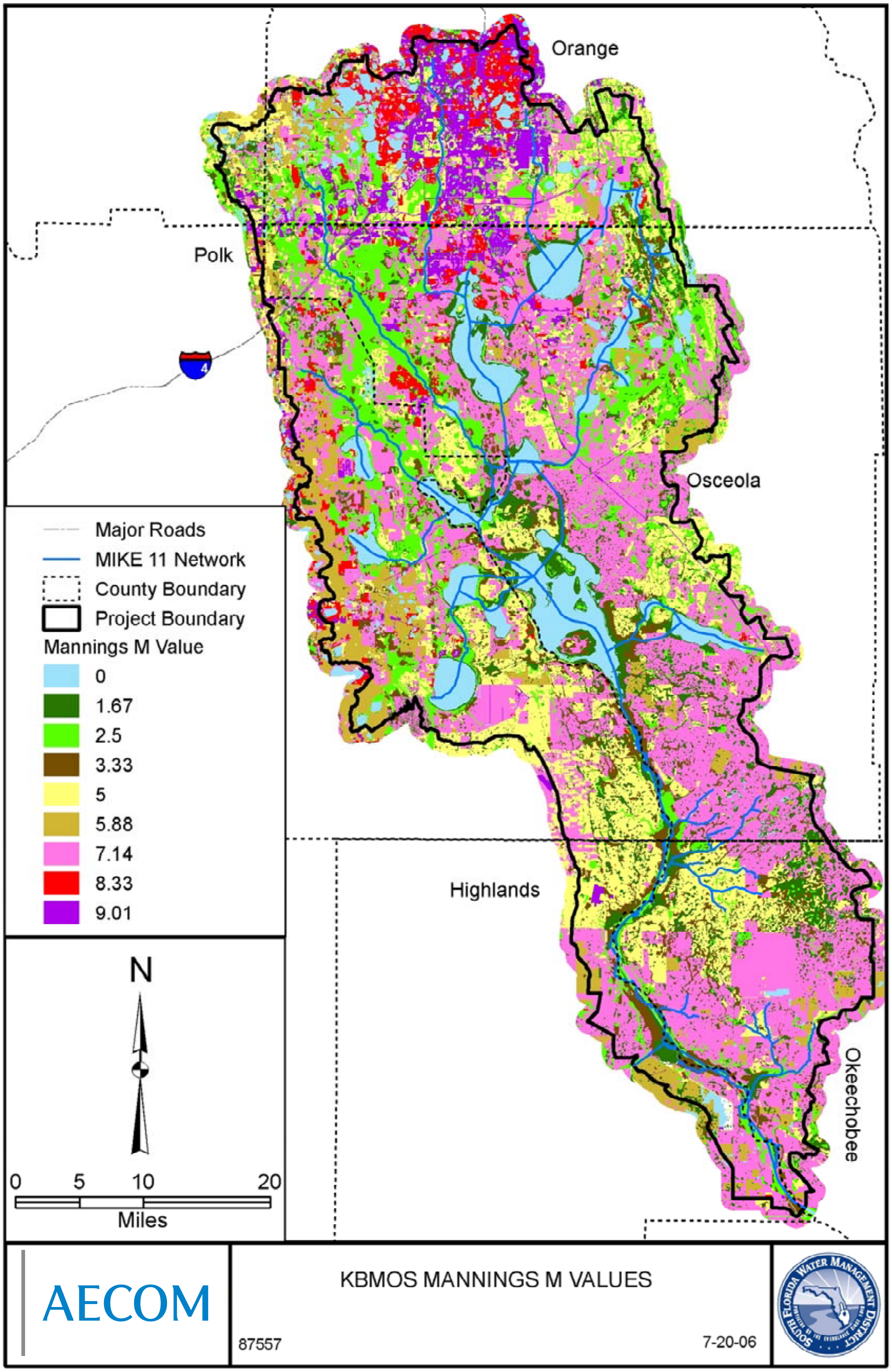



**Figure 2-22: KBMOS Land Use Based Manning's M Values.**

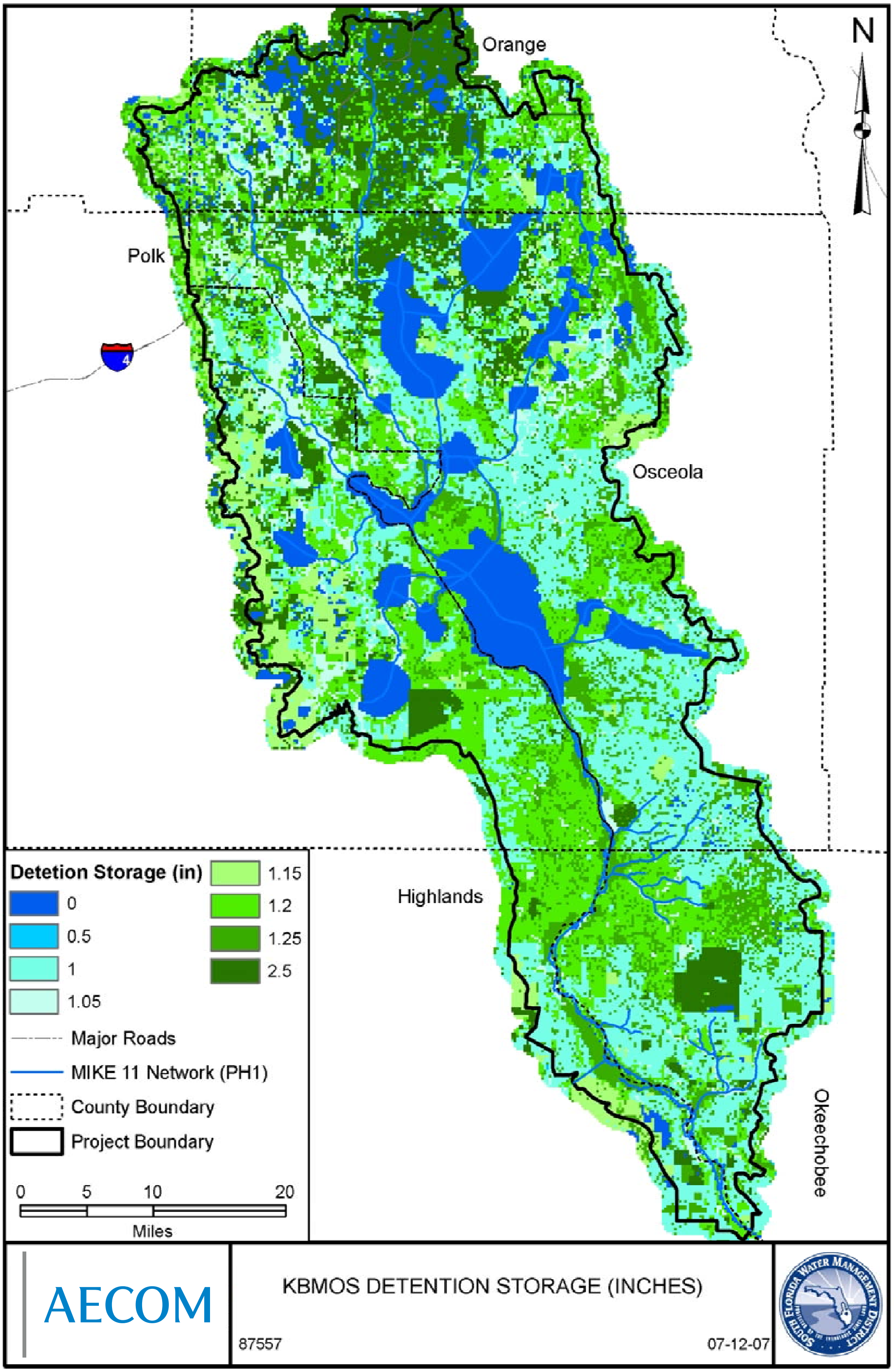



**Figure 2-23 KBMOS Land Use Based Detention Storage Depths (ft).**

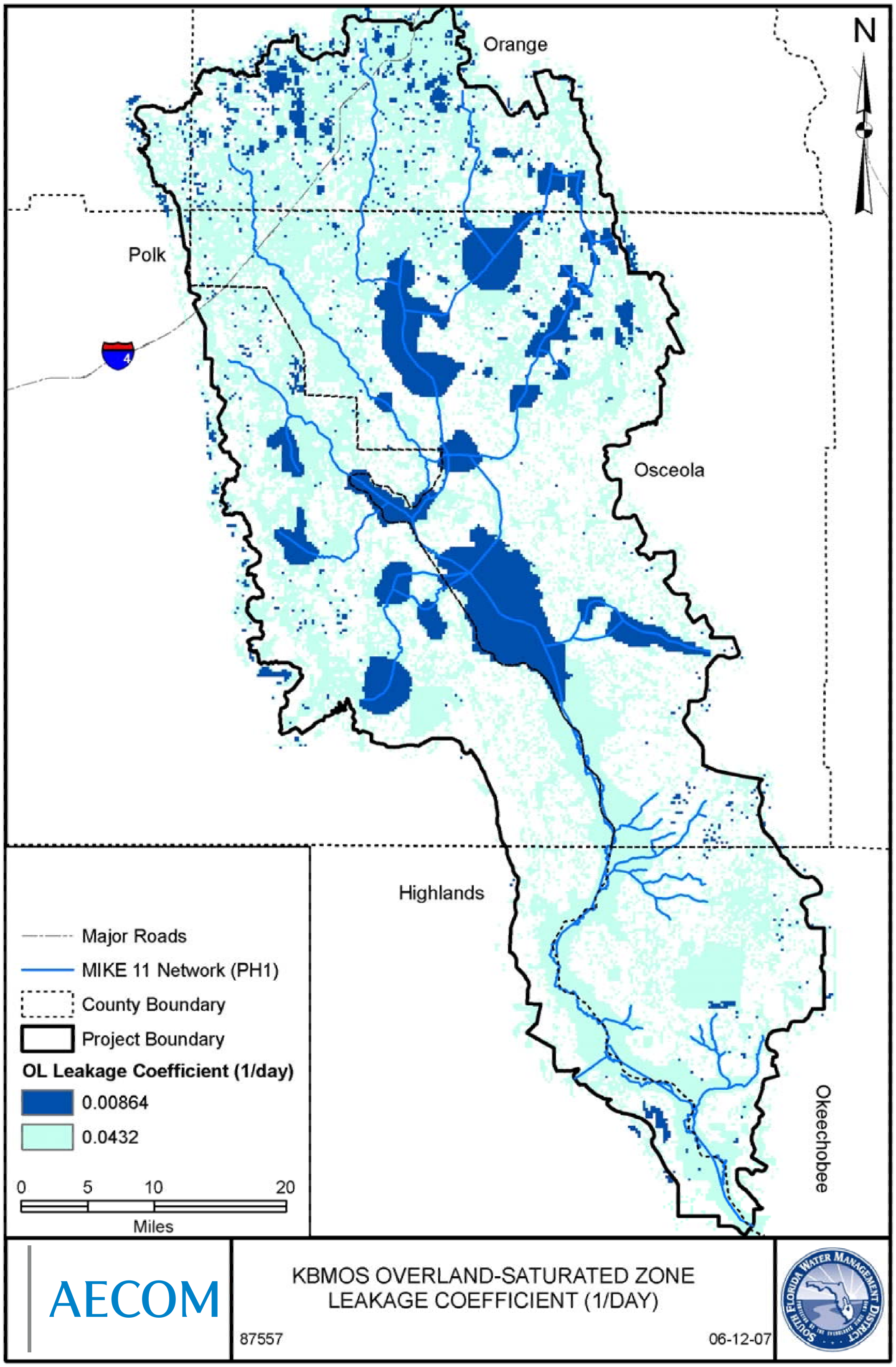



**Figure 2-24: KBMOS Overland – Saturated Zone Leakage Coefficients (day$^{-1}$).**

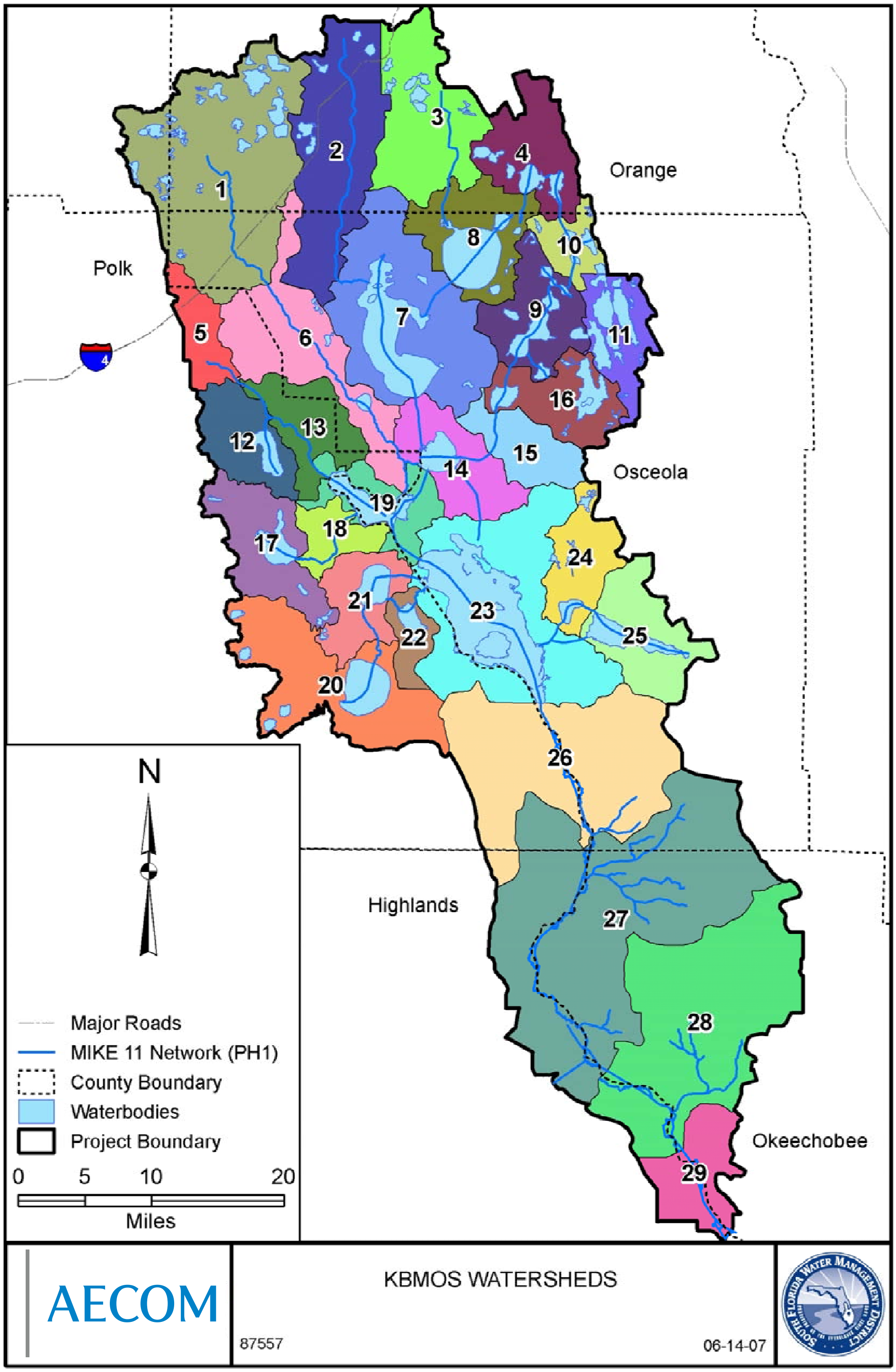



**Figure 2-25: KBMOS Separated Overland Flow Areas.**

**Table 2-13: Sub-watershed names for defined separated overland flow areas.**

| Sub-Watershed | Separated Overland Flow Area Grid Code |
|---|---|
| Upper Reedy Creek | 1 |
| Shingle Creek | 2 |
| Boggy Creek | 3 |
| Lake Hart | 4 |
| Horse Creek (Closed Basin) | 5 |
| Lower Reedy Creek | 6 |
| Lake Tohopekaliga | 7 |
| East Lake Tohopekaliga | 8 |
| Alligator Lake | 9 |
| Lake Mrytle | 10 |
| Lake Conlin (Closed Basin) | 11 |
| Lake Marion | 12 |
| Marion Creek | 13 |
| Lake Cypress | 14 |
| S-63A | 15 |
| Lake Gentry | 16 |
| Lake Pierce | 17 |
| Catfish Creek | 18 |
| Lake Hatchineha | 19 |
| Lake Weohyakapaka | 20 |
| Lake Rosalie | 21 |
| Tiger Lake | 22 |
| Lake Kissimmee | 23 |
| Lake Jackson | 24 |
| Lake Marian | 25 |
| S-65A | 26 |
| S-65BC | 27 |
| S-65D | 28 |
| S-65E | 29 |

## 2.10 Unsaturated Flow

The KBMOS model utilizes the Two-Layer Water Balance Method to represent unsaturated zone flow. It assumes a uniform soil profile for the entire depth and an evapotranspiration surface (extinction) depth. The four principal parameters related to each soil type are saturated water content, field capacity, wilting point, and saturated hydraulic conductivity. The ET surface depth defines the amount of capillary rise in a given soil and is used to define the minimum water table depth where capillary fringe reaches the ground surface or the maximum water table depth where plants still have access to moisture when the water table is below the root zone. A distributed soil classification map and a uniform ET surface depth of 0.4 ft has been defined for the KBMOS model. Soil parameters associated with the soil classifications were developed using county soil survey data (National Resource Conservation Service, 2003; Soil Conservation Survey, 1975, 1979, 1989a, 1989b, 1990).

The soil classification for the KBMOS model was developed using available soil GIS coverages provided by the SFWMD. 186 individual soil series were simplified into 21 unique classes for the KBMOS model. The methodology used to develop the soil classification used in the KBMOS model is detailed in Appendix A. The soil grid codes used in the KBMOS model is summarized in Table 2-14 along with the total area for each code and the percent of the total area. The physical parameters associated with each soil class are summarized in Table 2-15. The spatial distribution of soils within the model domain is shown in Figure 2-26.

**Table 2-14: Area of Defined Soil Classes in the Model Domain**

| KBMOS MIKE SHE Soils Grid Codes | KBMOS Soil Class Names | Soil Area Contribution Acres | Percent of Total |
|---|---|---|---|
| 1 | Astatula | 34,873 | 2.1 |
| 2 | Basinger | 147,723 | 9.0 |
| 3 | Candler | 93,616 | 5.7 |
| 4 | Eaugallie | 39,656 | 2.4 |
| 5 | Floridana | 33,268 | 2.0 |
| 6 | Hontoon | 37,799 | 2.3 |
| 7 | Immokalee | 10,5876 | 6.4 |
| 8 | Malabar | 38,534 | 2.3 |
| 9 | Miscellaneous Moderately Drained | 14,887 | 0.9 |
| 10/22 | Miscellaneous Poorly Drained | 219,315 | 13.3 |
| 11 | Miscellaneous Well Drained | 35,002 | 2.1 |
| 12 | Placid | 26,710 | 1.6 |
| 13 | Pomello | 27,730 | 1.7 |
| 14 | Pompano | 27,113 | 1.6 |
| 15 | Riviera | 19,421 | 1.2 |
| 16 | Samsula | 59,591 | 3.6 |
| 17/23 | Smyrna-Myakka | 428,866 | 26.0 |
| 18 | Tavares | 41,974 | 2.5 |
| 19 | Unknown | 31,009 | 1.9 |
| 20 | Valkaria | 38,768 | 2.4 |
| 21 | Water | 145,093 | 8.8 |
| | | | |
| | **Totals** | **1,646,824** | **100.0** |

**Table 2-15: Effective Physical Soil Properties**

| KBMOS Soils Grid Codes | KBMOS Soil Names | Drain Class | Effective Harmonic Saturated Hydraulic Conductivity (cm\hr) | Effective Saturation Moisture Content | Effective Field Capacity Moisture Content | Effective Wilting Point Moisture Content |
|---|---|---|---|---|---|---|
| 1 | Astatula | Well | 12.40 | 0.043 | 0.029 | 0.005 |
| 2 | Basinger | Poor | 1.80 | 0.146 | 0.106 | 0.028 |
| 3 | Candler | Well | 16.98 | 0.043 | 0.030 | 0.011 |
| 4 | Eaugallie | Poor | 0.06 | 0.233 | 0.206 | 0.073 |
| 5 | Floridana | Poor | 0.34 | 0.272 | 0.237 | 0.156 |
| 6 | Hontoon | Poor | 5.36 | 0.718 | 0.552 | 0.079 |
| 7 | Immokalee | Poor | 0.52 | 0.130 | 0.095 | 0.018 |
| 8 | Malabar | Poor | 0.33 | 0.210 | 0.159 | 0.048 |
| 9 | Miscellaneous Moderately Drained | Moderate | 3.16 | 0.065 | 0.045 | 0.011 |
| 10 | Miscellaneous Poorly Drained | Poor | 1.06 | 0.249 | 0.190 | 0.050 |
| 11 | Miscellaneous Well Drained | Well | 14.69 | 0.043 | 0.030 | 0.008 |
| 12 | Placid | Poor | 1.18 | 0.175 | 0.115 | 0.027 |
| 13 | Pomello | Moderate | 2.81 | 0.061 | 0.048 | 0.009 |
| 14 | Pompano | Poor | 1.02 | 0.234 | 0.191 | 0.113 |
| 15 | Riviera | Poor | 0.06 | 0.183 | 0.125 | 0.048 |
| 16 | Samsula | Poor | 2.40 | 0.537 | 0.448 | 0.030 |
| 17 | Smyrna-Myakka 01 | Poor | 1.20 | 0.140 | 0.094 | 0.023 |
| 18 | Tavares | Moderate | 3.51 | 0.069 | 0.042 | 0.012 |
| 19 | Unknown | Moderate | 3.16 | 0.065 | 0.045 | 0.011 |
| 20 | Valkaria | Poor | 1.90 | 0.121 | 0.053 | 0.010 |
| 21 | Water | Poor | 3.88 | 0.628 | 0.500 | 0.055 |
| 22 | LKB Floodplain Poorly Drained | Poor | 1.06 | 0.249 | 0.190 | 0.050 |
| 23 | Smyrna-Myakka 02 | Poor | 1.20 | 0.140 | 0.094 | 0.023 |

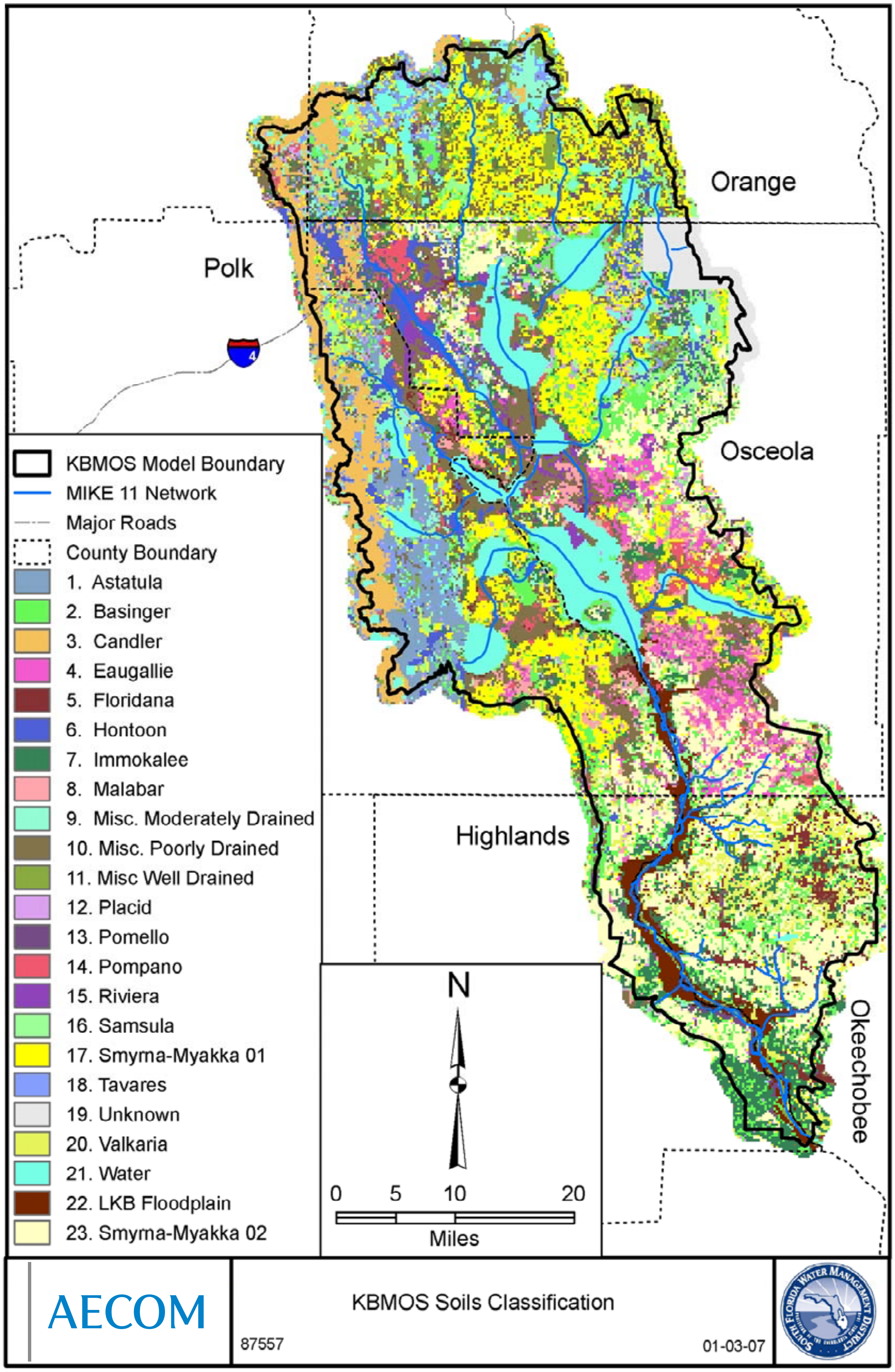



**Figure 2-26: KBMOS Soil Classification.**

## 2.11 Saturated Zone

The KBMOS model represents the saturated zone using the three-dimensional finite difference option. The three-dimensional finite difference option implemented in the KBMOS model requires specification of data for the following components:

- Geological Layers
- Computational Layers
- Subsurface Drainage
- Pumping Wells

Hydrogeologic parameters may be distributed by geological layers or by geological units within layers. When applying the geological layer distribution, the lower level, horizontal hydraulic conductivities, vertical hydraulic conductivities, specific yield, and specific storage coefficients are assigned for each specified geologic layer (i.e., aquifer). Computational layers are used to discretize the geologic layers into numerical layers and require definition of initial heads, outer boundaries, and internal boundary conditions. Pumping wells are specified in a database that defined the locations, screen intervals, and reported pumping rates for each well. Drainage is a special boundary condition used to conceptually define drainage features that are not explicitly represented in the model. This water is routed to surface water bodies using a head-dependent flux boundary condition formulation that requires a specification of a drainage time constant (leakance value) and drainage level.

Aquifer parameters for each layer have been developed from shapefiles provide by Earth Tech.

Initial estimates of physically based parameters related to MIKE SHE for the drainage levels and drainage time constants have been developed from the PSRP and LT MIKE SHE models. These parameters may need to be adjusted during model calibration to reflect values specific to the KBMOS. However, it is expected that the initial parameter values will be similar to final calibrated values. Pumping well locations were determined using water use permits data contained in shapefiles developed by the SFWMD, SWFWMD, and SJRWMD.

### 2.11.1 Geological Layers

In the KBMOS model geological layers correspond to the Surficial Aquifer, Intermediate Confining Unit, and the Upper Floridan Aquifer hydrostratigraphic units. A coarse and fine KBMOS groundwater model with one and three hydrostratigraphic units have been developed. The one layer model is used to look at dynamic groundwater flow in the Surficial Aquifer (SAS) using the higher resolution 1,000 × 1,000 foot grid. The three layer model simulates groundwater flow in the SAS, the Intermediate Confining Unit (ICU), and the Upper Floridan Aquifer (UFA) using a coarser 3,000 × 3,000 foot grid. The three layer model has be developed primarily to provide dynamic UFA boundary conditions for the one layer SAS model. A conceptual model of the hydrostratigraphy in the KBMOS model domain is shown in Figure 2-27.

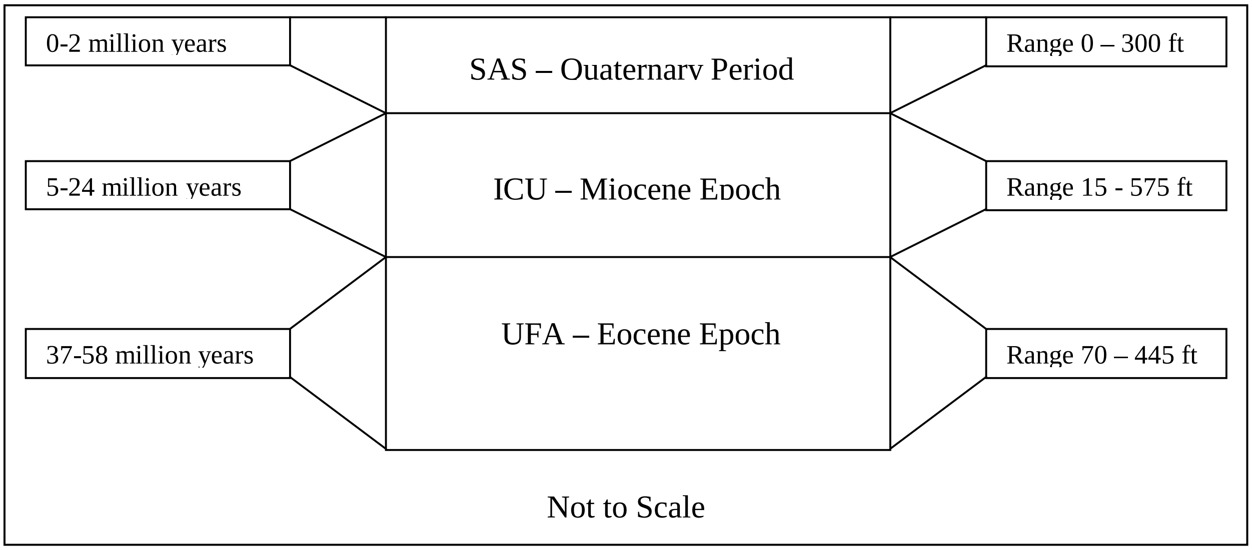



**Figure 2-27: Conceptual Geological Model.**

The three-layer geological model and related aquifer properties have been developed from GIS coveraged provided by the SFWMD. Each geologic layer contains a lower level, horizontal hydraulic conductivity, vertical hydraulic conductivity, specific yield, and specific storage dialogs. The lower level represents a surface dividing one geologic layer from another. The horizontal and vertical hydraulic conductivities represent the hydraulic properties of the geologic layer. The specific yield is the unit volume fraction of water that drains from the geologic layer under the influence of gravity alone. The specific storage is the unit volume fraction of water released from storage in a confined aquifer per unit change in hydraulic head and is related to aquifer and water compressibility. Specific yield and specific storage values are defined for each calculation regardless of the hydraulic characteristics of the layer (i.e., confined or unconfined).

#### 2.11.1.1 Surficial Aquifer System (SAS)

The SAS in the KBMOS area is modeled as one continuous unconfined system. The water table fluctuates seasonally with direct response to rainfall and pumping. This system extends from ground surface to the top of the ICU that in general slopes to the southeast. The SAS is composed primarily of unconsolidated clayey-sands.

A spatially distributed dataset has been developed for the bottom of the SAS, the horizontal hydraulic conductivity, the vertical hydraulic conductivity, and the specific yield. The raw SAS parameters were provided by the SFWMD and were based on the physiographic zones of White (1970). The physiographic shapefile used to develop a 1,000 × 1,000 foot raster dataset for the KBMOS model.

The initial horizontal hydraulic conductivity ($K_h$) (ft/day) of the model was developed using SAS transmissivity values (ft$^2$/day) and the SAS thickness. The horizontal to vertical hydraulic conductivity ratio of 10 was used to develop the initial vertical hydraulic conductivity ($K_v$) used in the model. The vertical hydraulic conductivity of the SAS was modified from initial values summarized in Earth Tech (2006e) during model calibration. The top of the ICU, the thickness of the SAS, the horizontal hydraulic conductivity of the SAS, the vertical hydraulic conductivity of the SAS, and the specific yield of the SAS is shown in Figure 2-28 through Figure 2-32. A default specific storage ($S_s$) coefficient of $3.048 \times 10^{-6}$ 1/ft was assigned to the SAS but is not a significant parameter because the Surficial Aquifer remains unconfined at all times.

#### 2.11.1.2 Intermediate Aquifer System (IAS) and Intermediate Confining Unit (ICU)

The ICU in the KBMOS is modeled as a continuous semi-confined leaky layer separating the SAS from the UFA. In general, the top surface of the ICU and the UFA gradually slope towards the southeast. The IAS exists in the southwest portion of the KBMOS model area and is modeled as an area of relatively high horizontal hydraulic conductivity within the ICU. The thickness of the combined IAS and ICU gradually increases to the southeast. The ICU is primarily composed of low permeability interbedded marine sand, silt, and clays, but can contain zones of more permeable limestone. The top of the UFA and the thickness of the ICU are shown in Figure 2-33 and Figure 2-34.

Data from the USGS Mega Model (Sepulveda, 2002), provided by the SFWMD, was used to develop the datasets for the ICU. The initial $K_h$ of the ICU was calculated using the Mega Model ICU transmissivity and the ICU thickness. The initial $K_v$ of the ICU was calculated using the Mega Model leakance (1/T) and the ICU thickness datasets. Default ICU specific yield and specific storage values of 0.1 and $3.048 \times 10^{-6}$, respectively, have been assigned. The vertical hydraulic conductivity of the ICU was modified from initial values summarized in Earth Tech (2006e) during model calibration. The horizontal hydraulic conductivity of the IAS is shown in Figure 2-35. The vertical hydraulic conductivity of the ICU is shown in Figure 2-36. Areas in the southwest portion of the model where the ratio of horizontal to vertical hydraulic conductivity exceeds one (1) represent areas where the IAS is present. ICU vertical conductivity values were used as horizontal conductivity values in areas where the IAS is not present.

#### 2.11.1.3 Upper Floridan Aquifer (UFA)

The UFA in the KBMOS is defined as continuous aquifer layer confined by the ICU on top and MCU on the bottom. It is the predominant source of groundwater for potable, irrigation, and industrial water used in the model domain. In generally, the top of the UFA and the Middle Confining Unit (MCU) gradually slope towards the southeast. Furthermore, the UFA generally increases in thickness to the southeast in the model domain. The UFA is composed of high permeability consolidated limestone. The top of the MCU and the thickness of the UFA are shown in Figure 2-37 and Figure 2-38.

Data from provided by the SFWMD, was used to develop the UFA aquifer parameter data for the KBMOS model. The initial $K_h$ of the UFA was developed using UFA transmissivity and thickness data. A horizontal to vertical hydraulic conductivity ratio of 10 was assumed for the UFA. The UFA has been assigned default specific yield and specific storage values of 0.1 and $1.0 \times 10^{-3}$ 1/ft. A specific yield value is required for each geologic layer by MIKE SHE but is not a significant parameter for the UFA since the aquifer is always confined in the KBMOS area. The specific storage value specified for the UFA is a representative value for the UFA and was not adjusted during calibration. The horizontal and vertical hydraulic conductivity of the UFA are shown in Figure 2-39 and Figure 2-40, respectively.

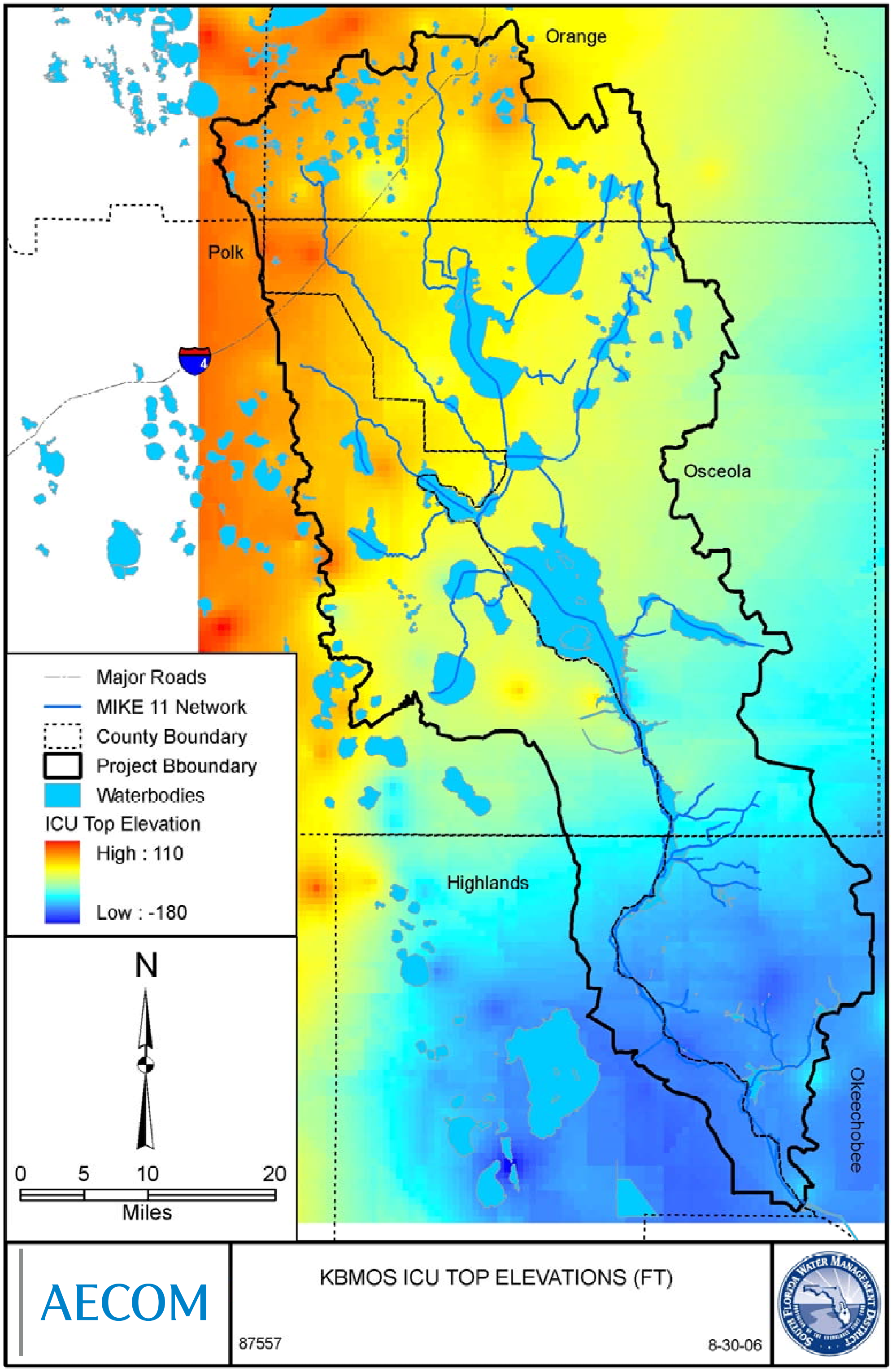



**Figure 2-28: KBMOS Top of the Intermediate Confining Unit (ft NVGD).**

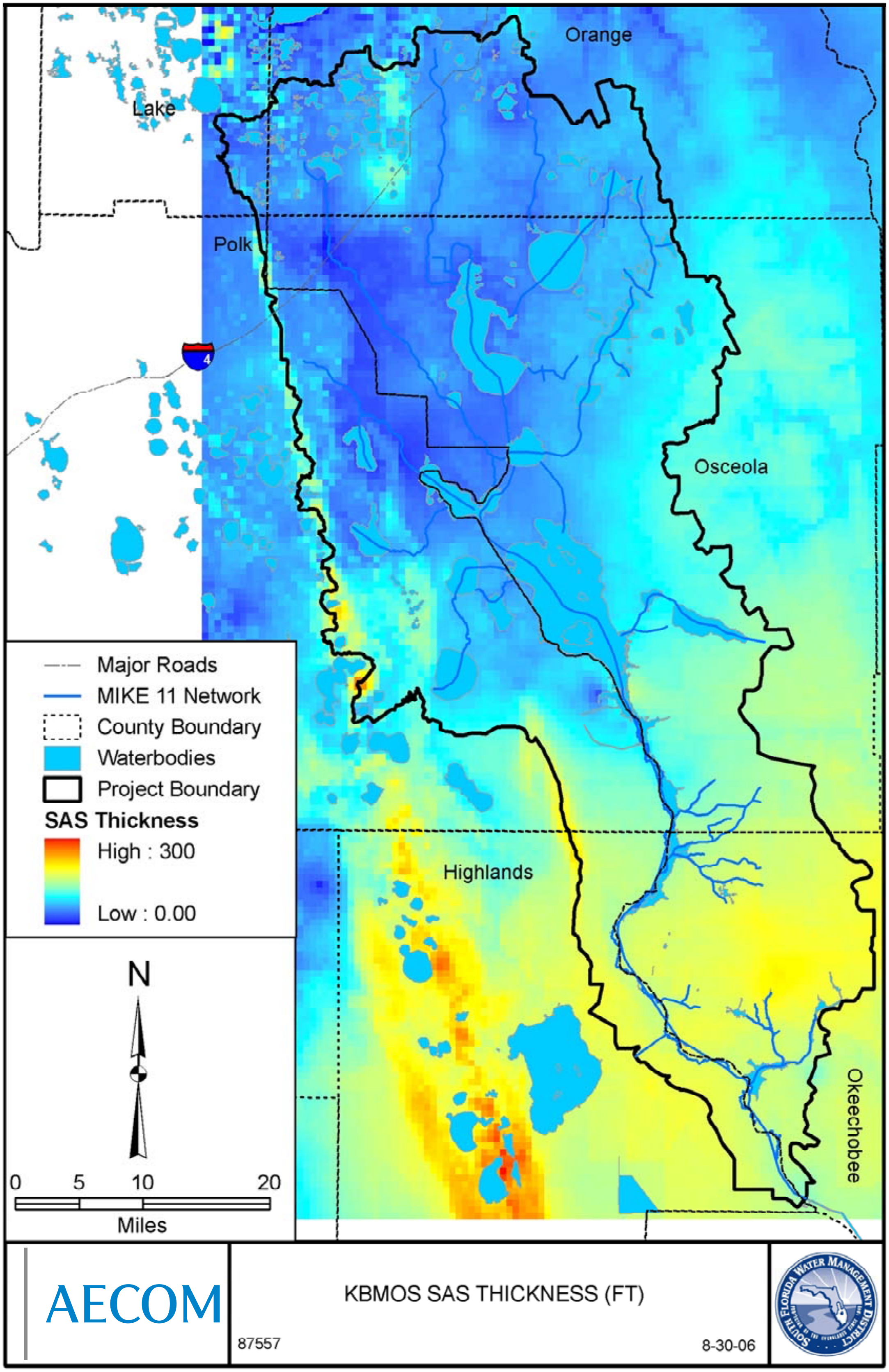



**Figure 2-29: KBMOS Thickness of the Surficial Aquifer.**

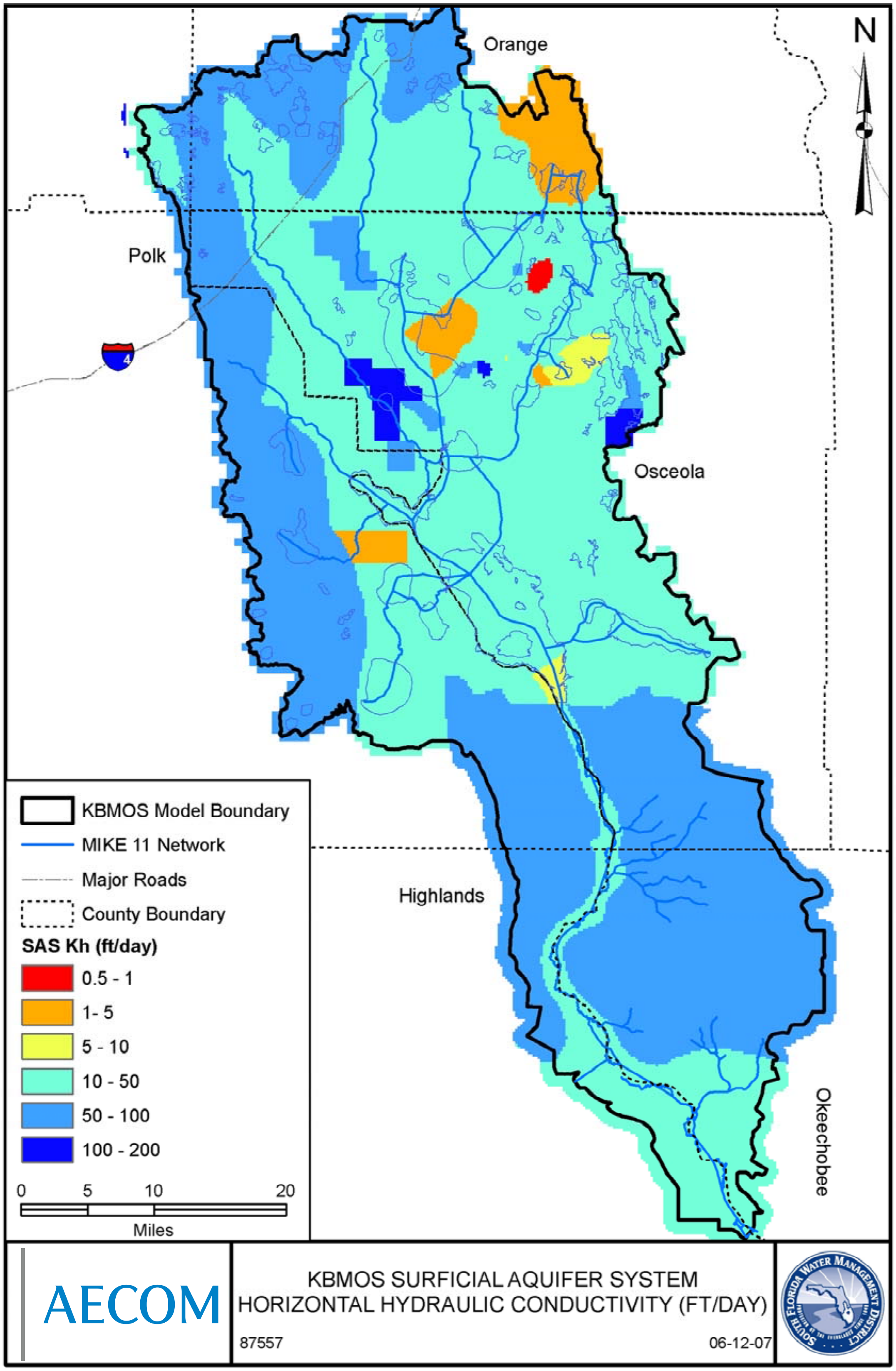



**Figure 2-30: KBMOS Horizontal Hydraulic Conductivity of the Surficial Aquifer.**

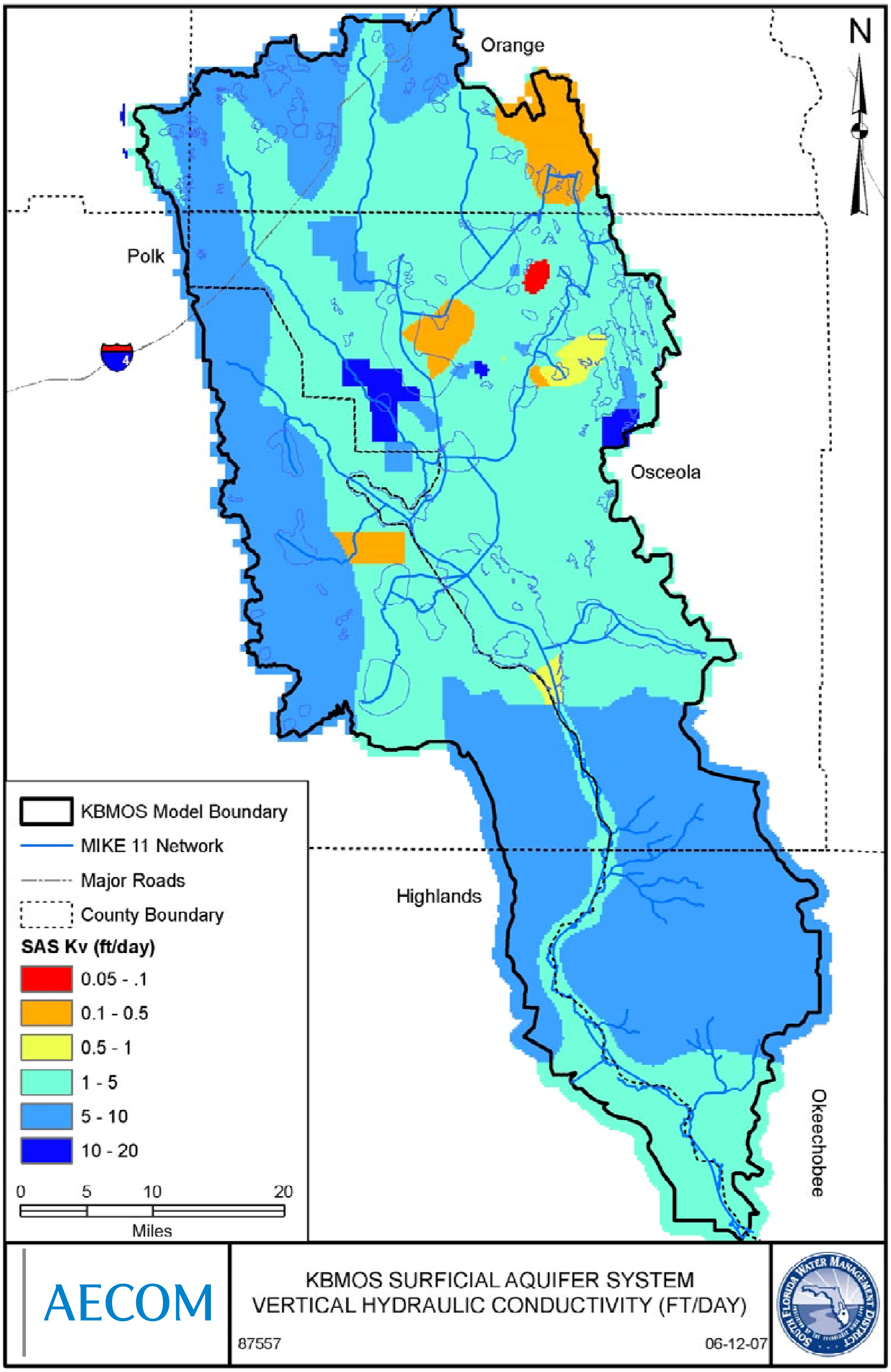



**Figure 2-31: KBMOS Vertical Hydraulic Conductivity of the Surficial Aquifer.**

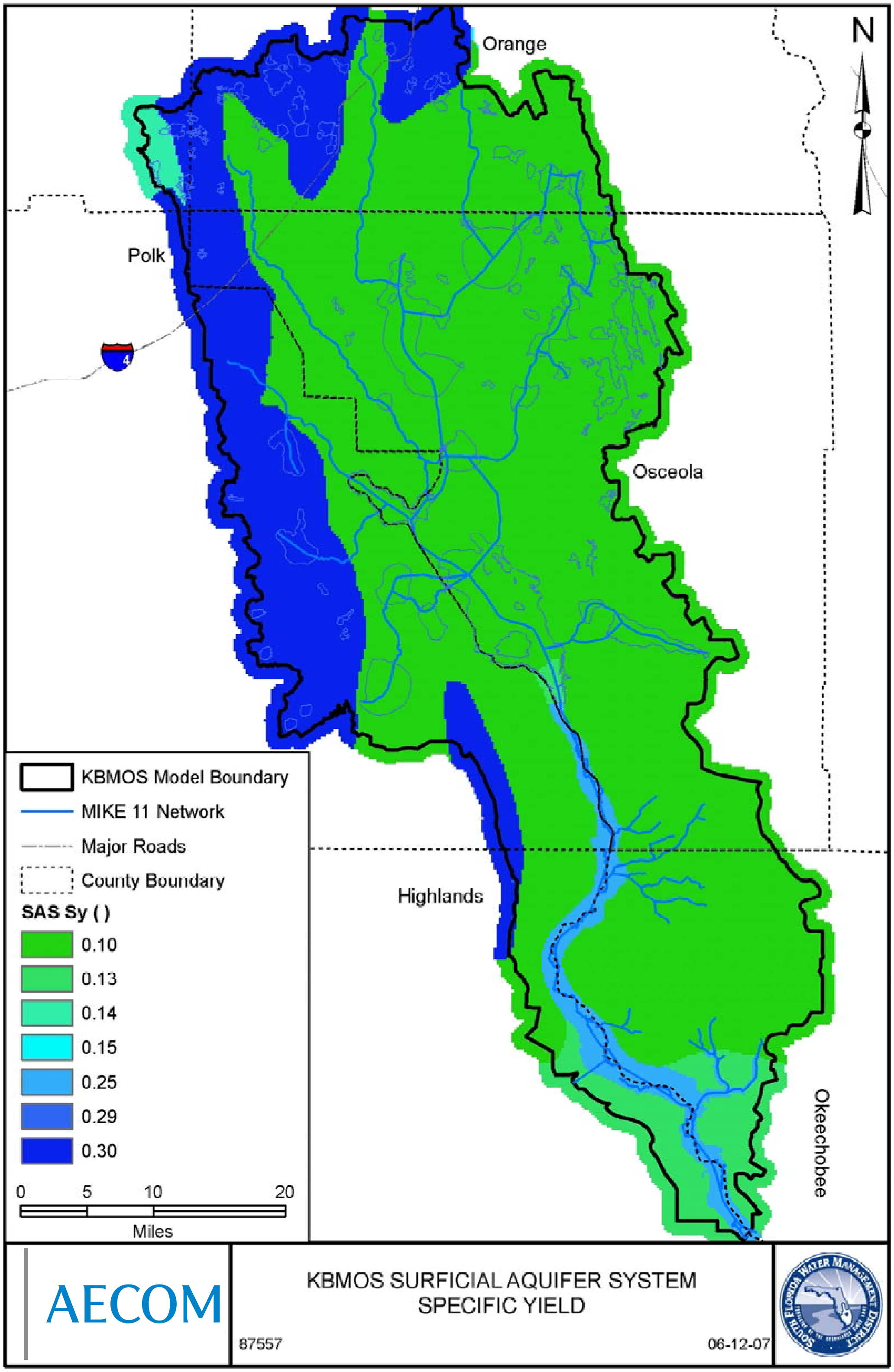



Figure 2-32: KBMOS Specific Yield of the Surficial Aquifer.

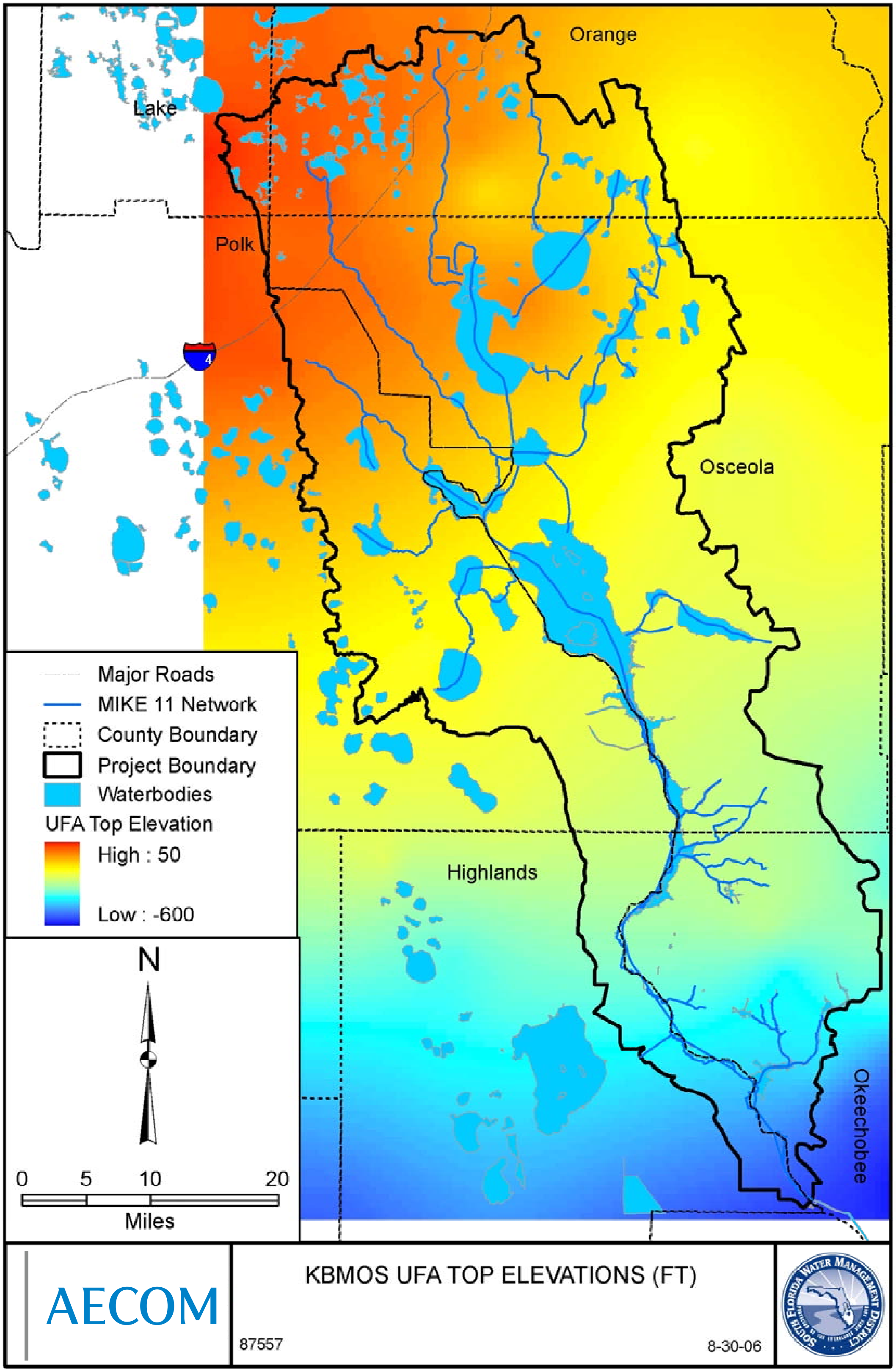



**Figure 2-33: KBMOS Top of the Upper Floridan Aquifer (NVGD 29).**

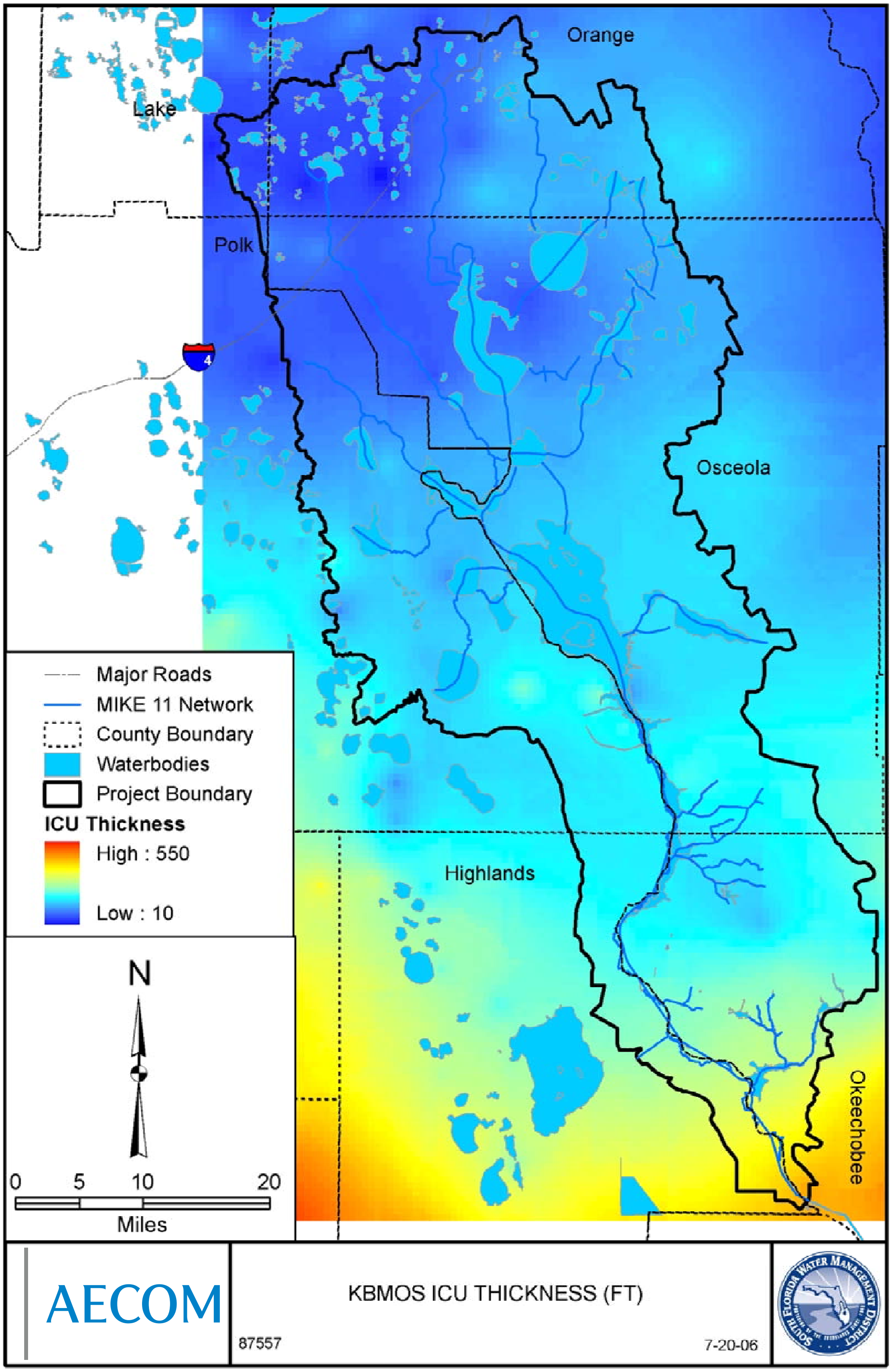



**Figure 2-34: KBMOS Thickness of the Intermediate Confining Unit (ft).**

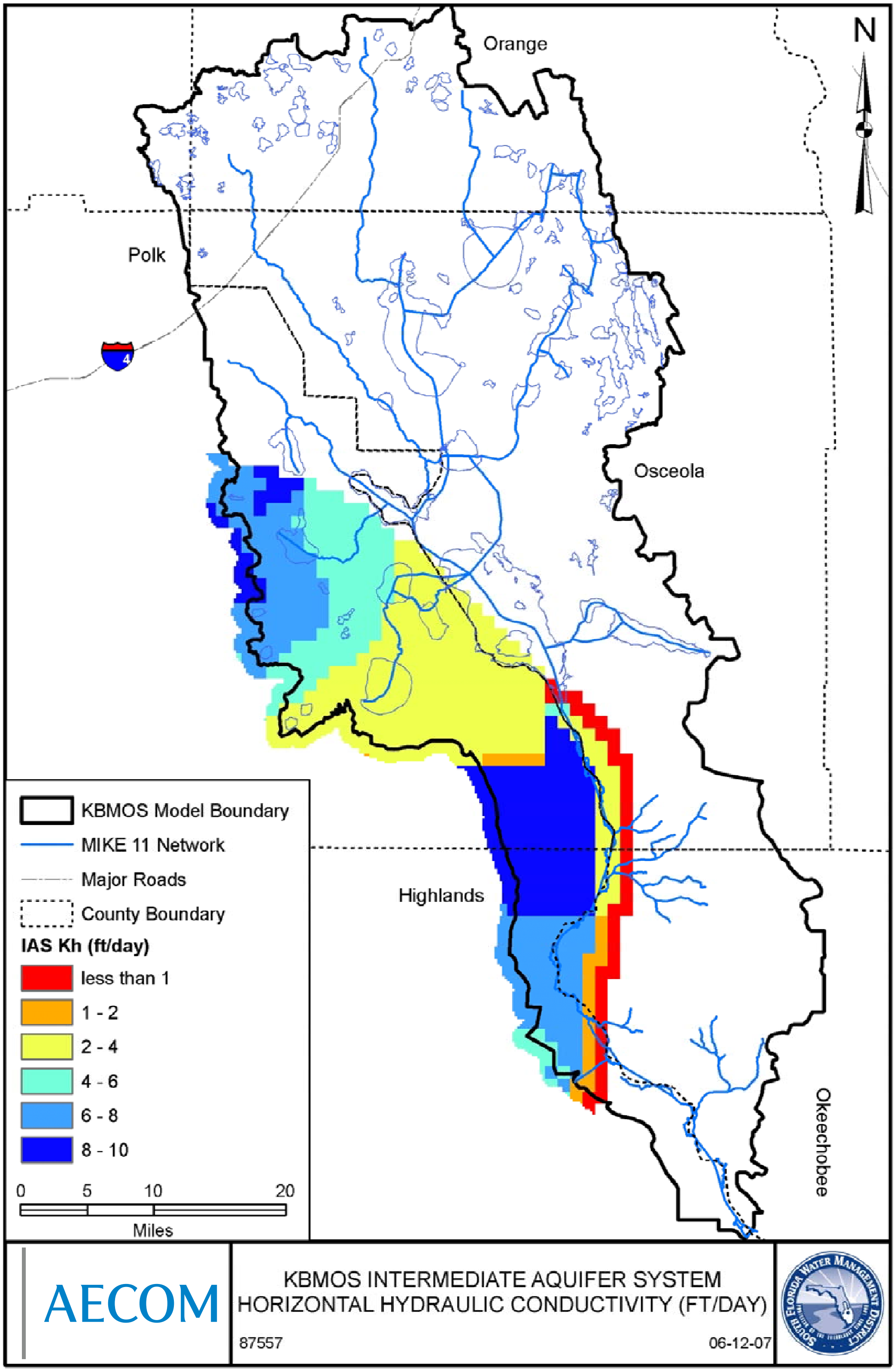



**Figure 2-35: KBMOS Horizontal Hydraulic Conductivity of the Intermediate Aquifer System.**

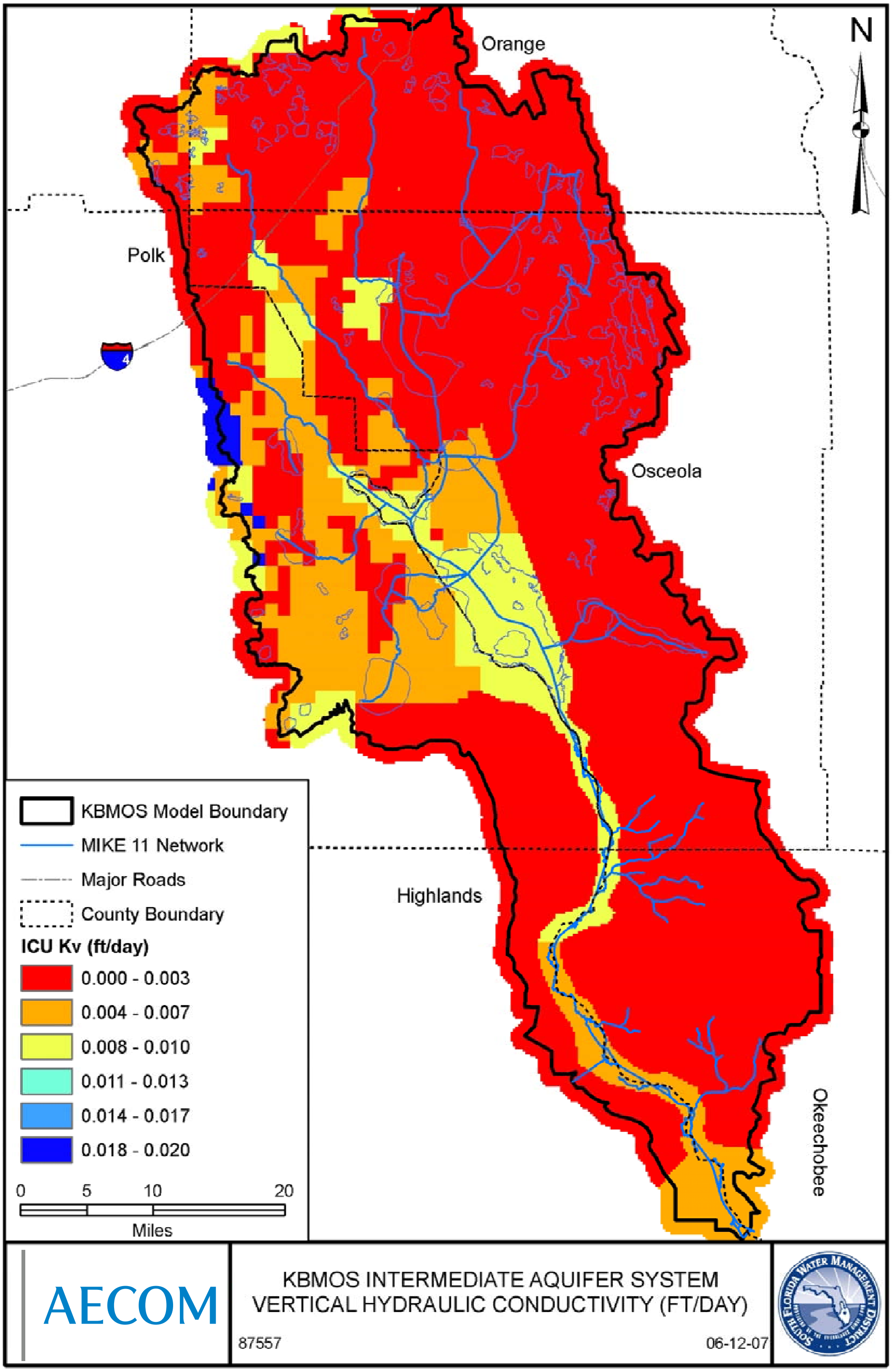



**Figure 2-36: KBMOS Vertical Hydraulic Conductivity of the Intermediate Confining Unit.**

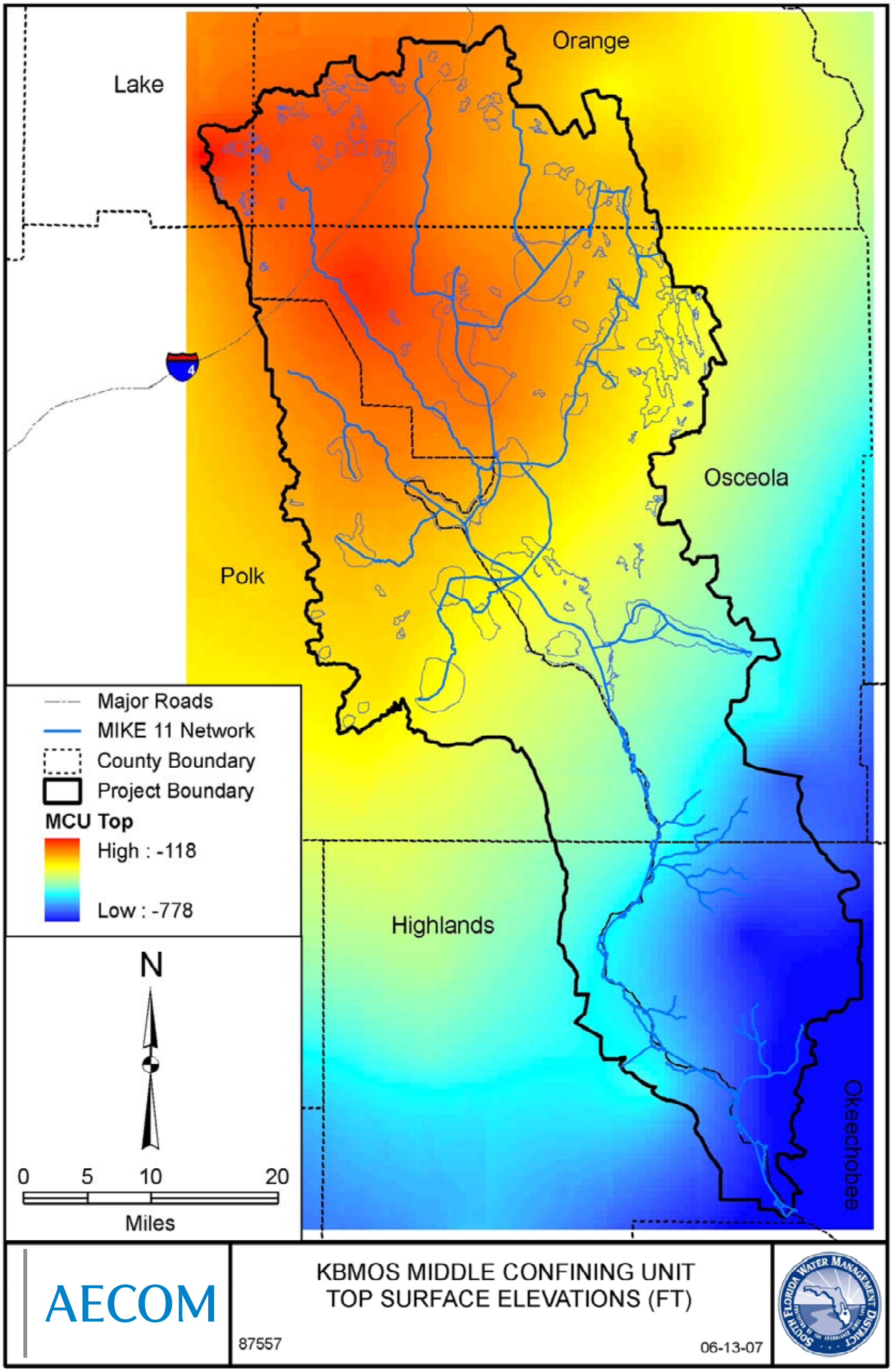



**Figure 2-37: KBMOS Top of the Middle Confining Unit (NVGD 29).**

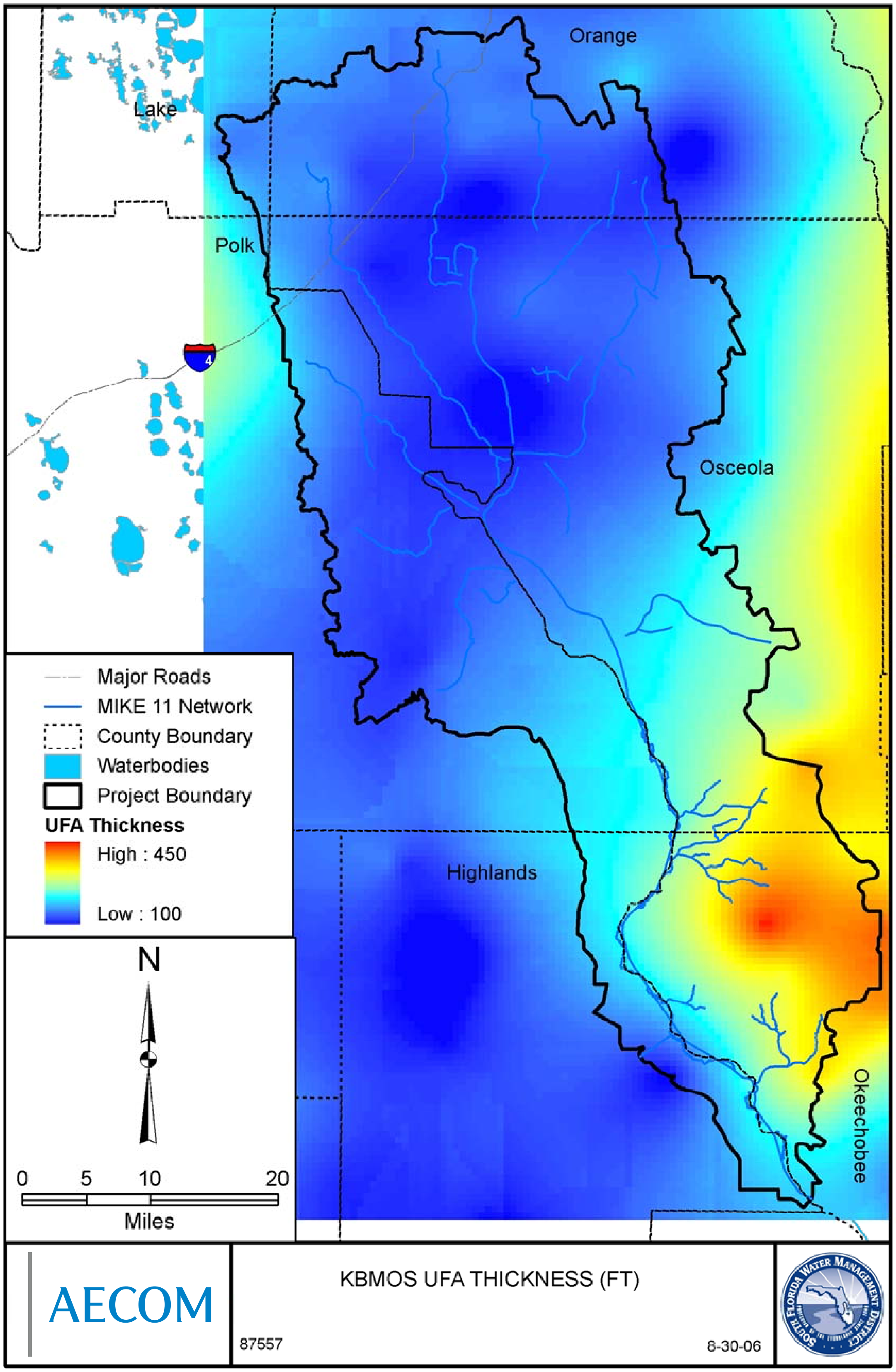



**Figure 2-38: KBMOS Thickness of the Upper Floridan Aquifer (ft).**

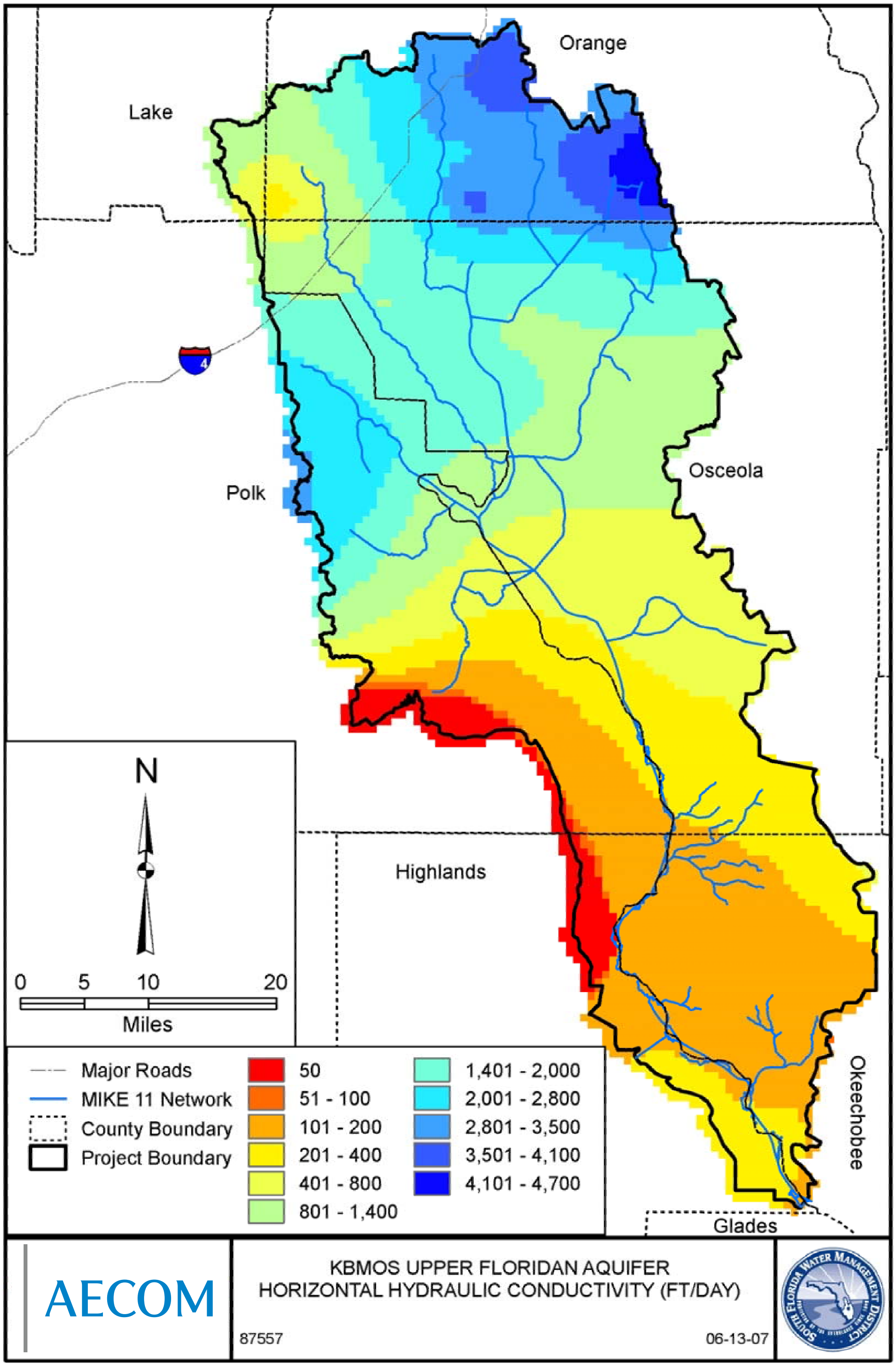



**Figure 2-39: KBMOS Horizontal Hydraulic Conductivity of the Upper Floridan Aquifer.**

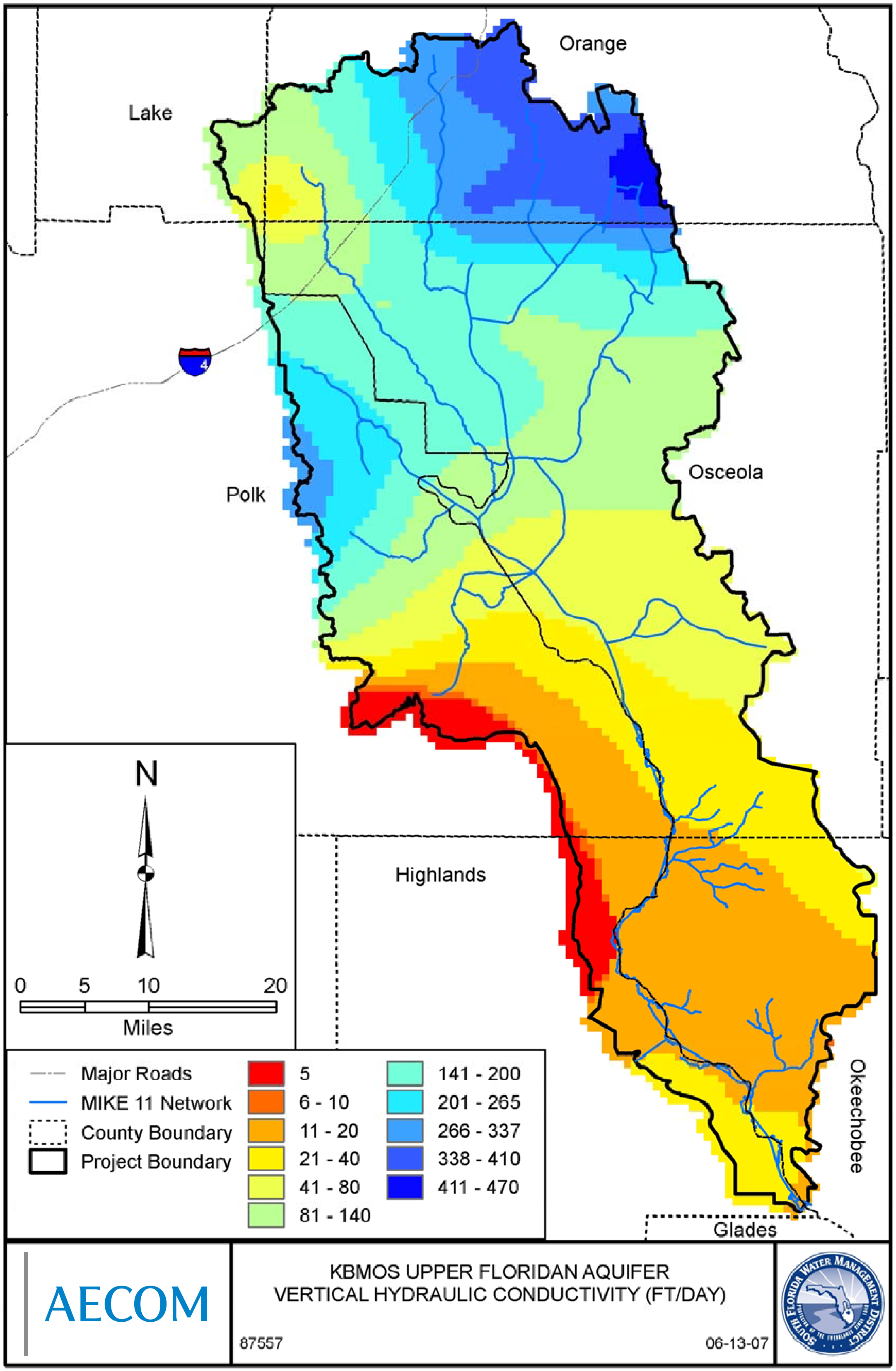



**Figure 2-40: KBMOS Horizontal Vertical Conductivity of the Upper Floridan Aquifer.**

### 2.11.2 Computational Layers

geologic layers described in Section 2.11.1 were converted to calculation layers which are solved using a transient form of the three-dimension finite difference form of Darcy's equation. The governing flow equation for three-dimensional groundwater flow is:

$$\partial/\partial x(K_{xx}\partial h/\partial x) + \partial/\partial y(K_{yy}\partial h/\partial y) + \partial/\partial z(K_{zz}\partial h/\partial z) - Q = S\partial h/\partial t$$

where:

$K_{xx}$ is the horizontal hydraulic conductivity in the x-direction
$K_{yy}$ is the horizontal hydraulic conductivity in the y-direction
$K_{zz}$ is the vertical hydraulic conductivity
$Q$ represents source/sink terms
$S$ represents storage changes

The three-dimensional groundwater flow equation is formulated using finite difference numerical methods and solved using an iterative solver. Two numerical solver options are available for the finite difference groundwater approach and include a successive over-relaxation (SOR) and preconditioned conjugant gradient (PCG) solver. Details of these solvers are explained in detail in the MIKE SHE user manual.

The vertical discretization of the computational layers in MIKE SHE can be expressed in two ways.

- Geological Layers – directly corresponds to the geologic layer thickness
- Explicit Definition - user defined layers

Defining the layer thickness only requires a lower level surface since the upper level is the lower level of the preceding geological layer. The KBMOS model utilizes the geological layer approach.

The geological computational layers in the 3,000 × 3,000 ft regional KBMOS MIKE SHE model correspond directly to the conceptual geological layers described in Section 2.11.1. In the 1,000 × 1,000 ft SAS model a single calculation layer representing the SAS was simulated and the bottom of the layer was explicitly defined by the elevation of the top of the ICU (Figure 2-28).

#### 2.11.2.1 Saturated Zone Boundary Conditions

Initial potential heads for the SAS and ICU have been developed from previous model runs and are representative of conditions at the start of the calibration and verification periods. Initial conditions for the UFA were developed from potentiometric surface contours developed by the USGS for the calibration and verification periods from May 2001 and May 1994, respectively. Initial conditions for the 2004 hurricane season storm verification simulation were extracted from the calibration simulation.

A no-flow boundary conditions is defined for the outer boundary of the KBMOS model. A constant head boundary condition was evaluated during model calibration based on initial comments by SFWMD staff regarding potential lateral exchange of water into and out of the model domain in the surficial aquifer. Surficial aquifer heads from the MegaModel developed by Sepulveda (2002) were used to define constant head values at the outer boundary of the KBMOS model. It was decided to use a no-flow outer boundary condition in the surficial aquifer because simulated lateral exchanges were excessive. Because the surface water boundary of the Kissimmee Basin was used to define the extent of the KBMOS model it is expected that lateral exchanges in the surficial aquifer would be relatively small since the basin boundary represents the highest point in the domain in most cases. Excessive lateral flows resulting from use of a constant head boundary were caused by use of a single surficial aquifer head representing average conditions during 1993-1994 and differences between the grid resolution (5,000 foot) of the topographic data used by Sepulveda (2002) to calculate surficial aquifer water levels.

The UFA outer boundary is a time-varying constant head boundary with potentiometric head values developed from seasonal (May and September) potentiometric surface maps developed by the USGS.

In the 1,000 × 1,000 ft SAS model a general head boundary (GHB) is defined for each saturated zone cell in the model in order to simulate the exchange of groundwater between the SAS and ICU. Use of a GHB requires specification of a leakance coefficient for the GHB and head boundary condition. The GHB leakance coefficient was calculated as the harmonic mean of the calibrated vertical hydraulic properties of the SAS and ICU and half the thickness of the SAS and ICU from the 3,000 × 3,000 ft regional model. Simulated ICU heads from the 3,000 × 3,000 ft regional model were extracted from the model results and are used as time-varying GHB heads.

### 2.11.3 Drainage

The drainage option allows conceptual drainage water to be routed using four possible methods that include:

- Drainage routed downhill based on adjacent drain levels
- Drainage routed to boundaries based on grid codes
- Distributed drainage options
- Drainage remove from the model

The distributed drainage option that routes drainage water to boundaries based on grid codes and to specified MIKE 11 reaches has been used in the KBMOS model. The grid code option routes drainage water from areas with general drainage features (*i.e.*, agricultural areas, *etc.*) to the closest MIKE 11 reach. The drainage to specified MIKE 11 reaches option was defined for grid cells that have specific drainage features (*e.g.*, canals and ditches) in them but are not explicitly defined as reaches in MIKE 11. The specific drainage features were developed using the National Hydrography Dataset (NHD) for the Kissimmee Basin. The sub-watershed definitions provided by district staff were used to identify MIKE 11 branches that would receive drainage water from specific drainage features being represented with the drainage module.

Land use/process based drainage time constants and levels (below land surface) are summarized in Table 2-16 and as stated above are used to conceptually represent surface water features not explicitly included in the KBMOS model. The land use based drainage time constants and levels assigned in the KBMOS model are shown in Figure 2-42 and Figure 2-43, respectively. Land use types with a drainage time constant equal to zero are not drained. The initial drainage time constants and levels were derived from previous MIKE SHE models developed for the SFWMD.

The drainage levels are based on the Earth Tech team's understanding of typical control elevations for the indicated land use types. The drainage time constant values were modified during calibration to adjust simulated recession rates in the surface water network. Initial land-use based drainage time constant values are summarized in Earth Tech (2006e).

Land-use based drainage parameters were adjusted during model calibration to improve model calibration. Drainage levels were modified from land-use based values during calibration in the Lake Conlin (Watershed 11) and Lake Gentry (Watershed 16) to improve model performance in Alligator Lake. Drainage was added to this area after reviewing aerial photographs which suggested wetland features in these watersheds drained to Alligator Lake through Lake Gentry.

**Table 2-16: KBMOS Drainage Parameters**

| Land Use Type | MIKE SHE Code | Time Constant (1/day) | Drain Level (ft) |
|---|---|---|---|
| Citrus | 1 | 0.06 | 2 |
| Pasture | 2 | 0 | 0 |
| Truck Crops | 5 | 0.05 | 1.5 |
| Golf Courses | 6 | 0.05 | 2.5 |
| Flatwoods | 8 | 0 | 0 |
| Hammock | 9 | 0 | 0 |
| Cypress | 17 | 0 | 0 |
| Hydric Hammock | 13 | 0 | 0 |
| Wet Prairie | 14 | 0 | 0 |
| Marsh | 16 | 0 | 0 |
| Swamp Forest | 18 | 0 | 0 |
| Water | 20 | 0 | 0 |
| Urban Low Density | 41 | 0.06 | 2.5 |
| Urban Medium Density | 42 | 0.06 | 2.5 |
| Urban High Density | 43 | 0.06 | 2.5 |
| Ditched Areas | | 0.04 | 1.0 |

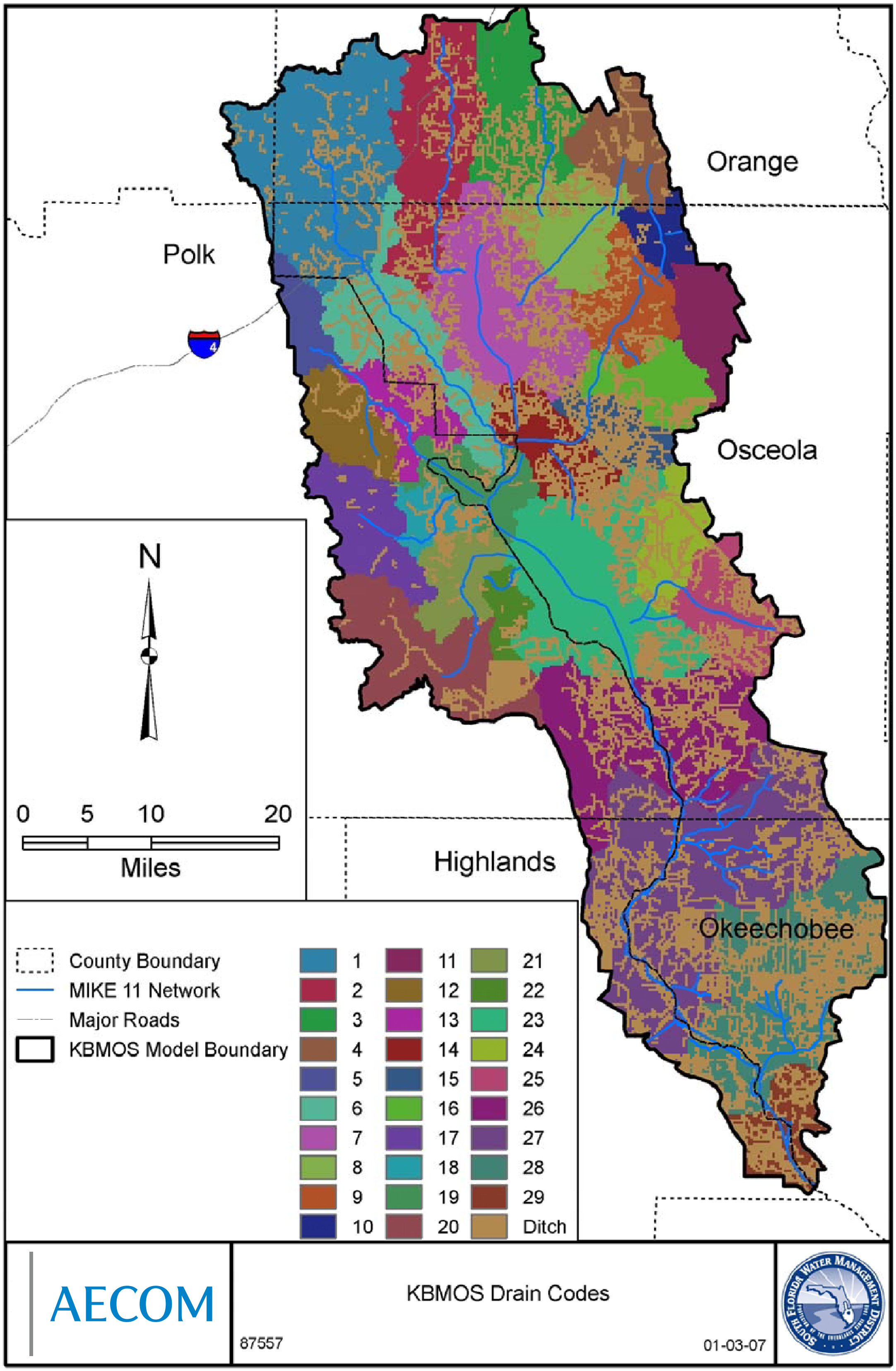



**Figure 2-41: KBMOS Drain Codes.**

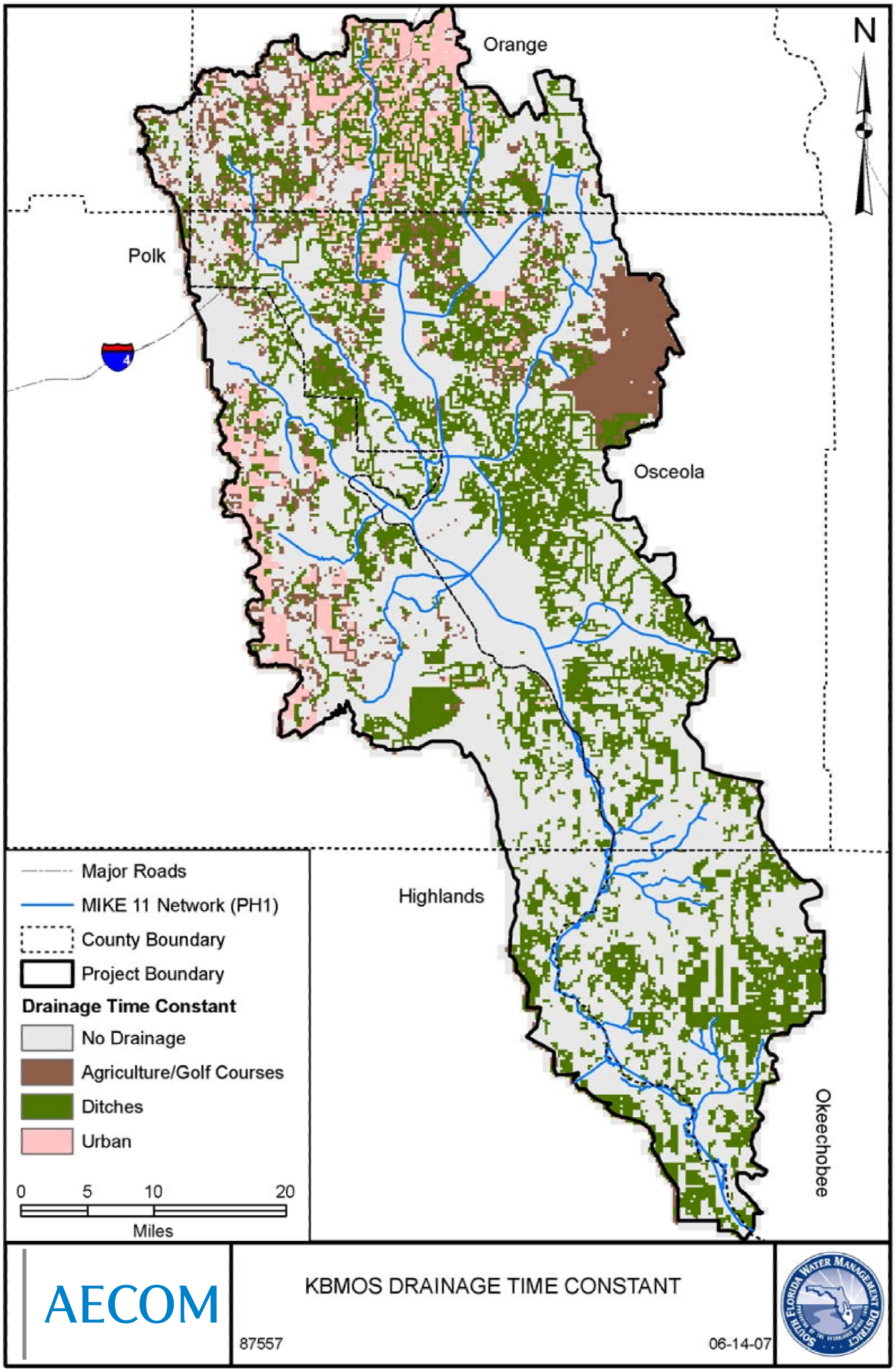



**Figure 2-42: KBMOS Drainage Time Constants. Refer to Table 2-15 for specific land-use based drainage time constant values.**

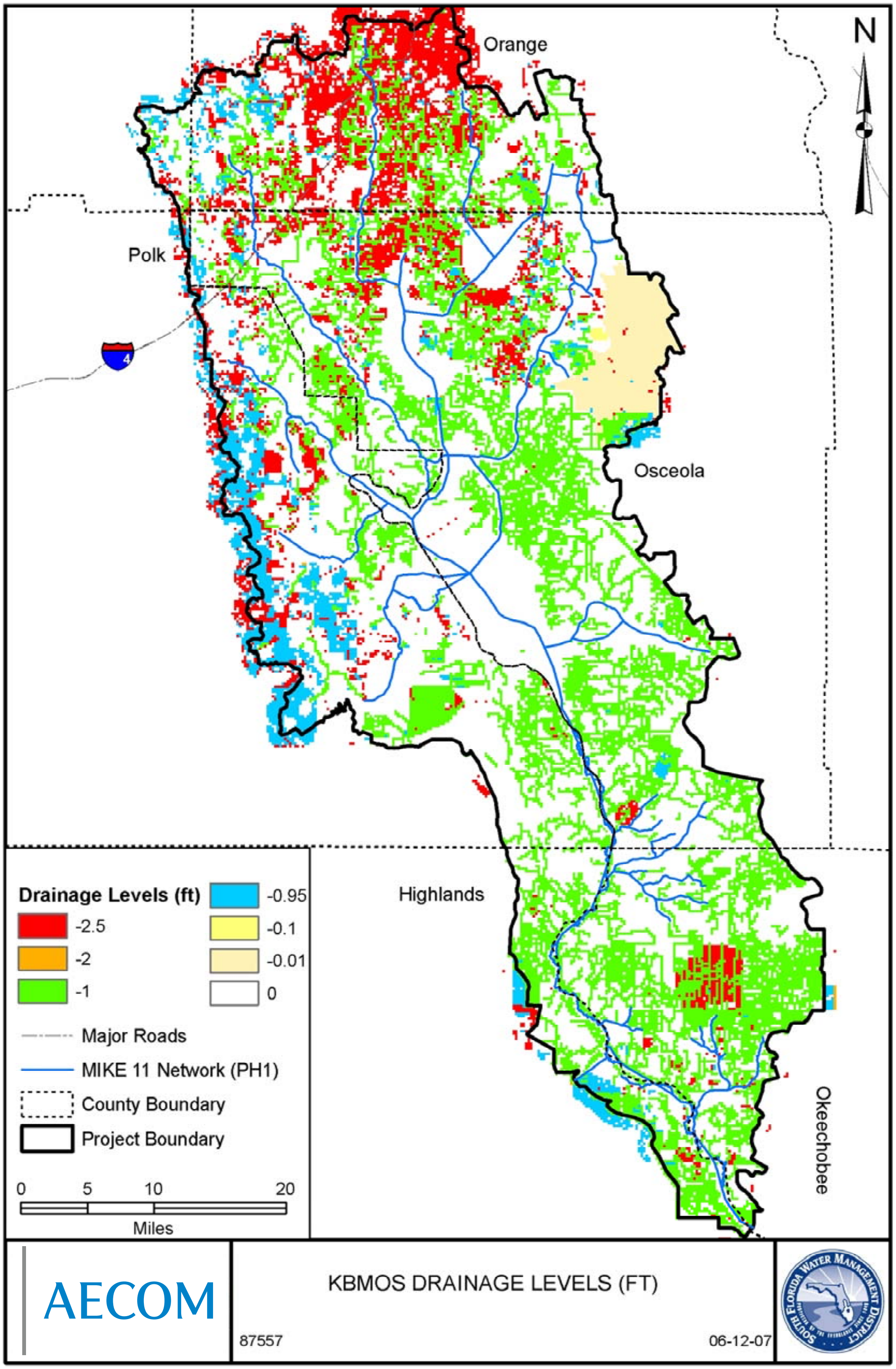



**Figure 2-43: KBMOS Drain Levels (ft above land surface).**

### 2.11.4 Potable Groundwater Withdrawals

Groundwater wells included in the KBMOS model represent potable water supply (PWS) wells in the model domain. As implemented, the PWS wells do not include irrigation wells which have been included in the irrigation setup. Water pumped from the PWS wells is extracted from the specified screen interval and removed from the model. The data required in the potable groundwater well database includes:

- Well locations – requires a well id, x-coordinate, and y-coordinate
- Well characteristics – identifies the screen interval within the geologic framework and a time series of pumping withdrawal rates

Potable groundwater well data was developed using data provided by District staff for the ECFT MODFLOW (A.K.A. KBECF model) model currently being developed by the District. Screen depths were developed for UFA wells in the KBMOS model area from hydrostratigraphy data used in the model and have been constrained to the UFA. The ECFT pumping well dataset had withdrawal data from 1995 through 1999. Based on discussions with District staff monthly withdrawal rates for 1995 were used in 1994 and pumping rates for 1999 were used in 2001 through 2004. The locations of the potable water supply groundwater wells in the KBMOS model domain are shown Figure 2-44. Potable groundwater wells are not included in the 1,000 × 1,000 SAS model.

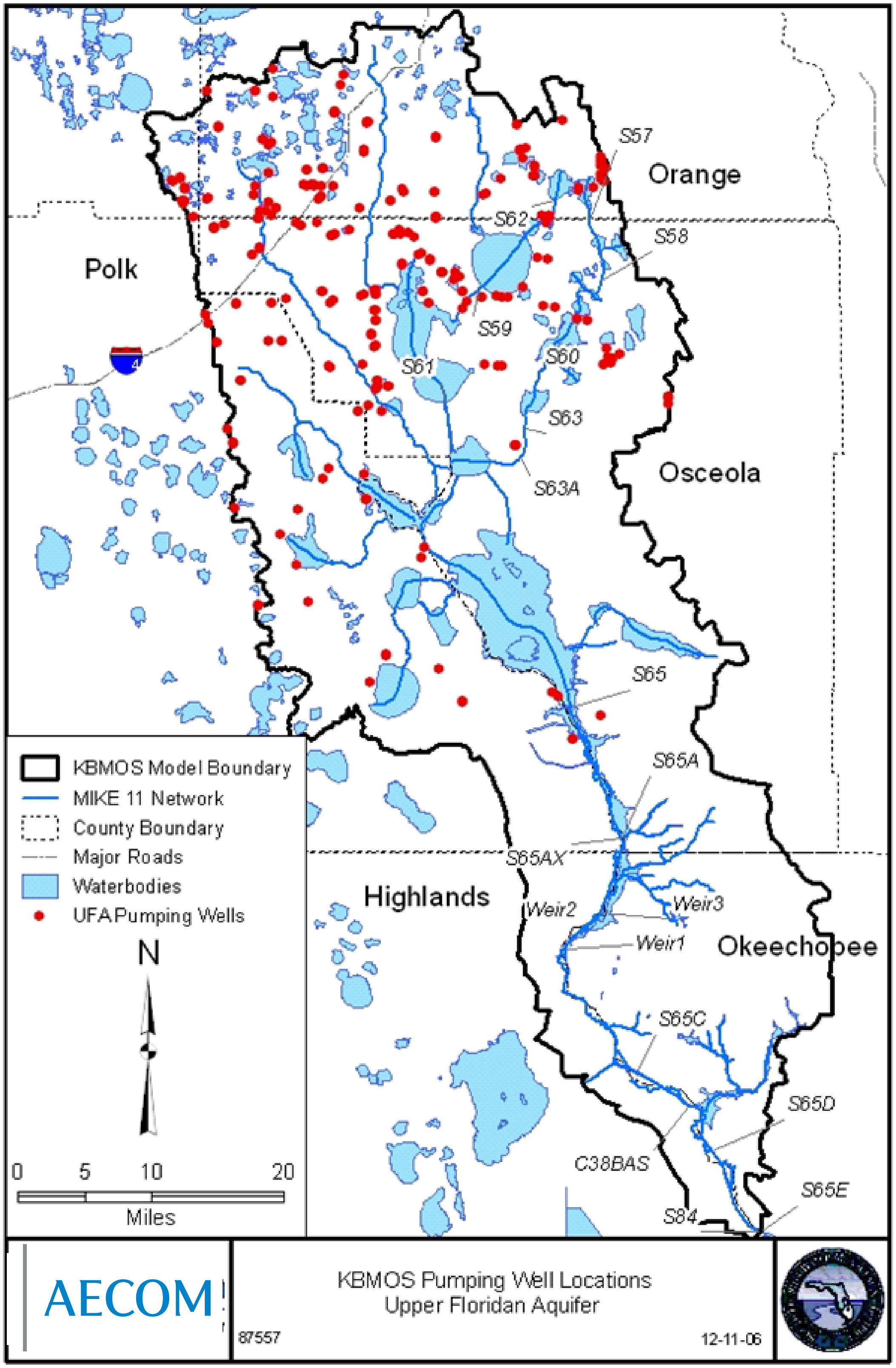



**Figure 2-44: KBMOS Location of Potable Well Supply Groundwater Wells.**

# 3 SENSITIVITY ANALYSIS

A sensitivity analysis of a select number of parameters was performed prior to beginning of the KBMOS model calibration process. The selected parameters evaluated in the sensitivity analysis was based on the modeling team's understanding of parameter sensitivities developed in previous integrated surface and groundwater projects conducted for the SFWMD in south Florida. The intent of the analysis was to identify the most sensitive parameters in the KBMOS MIKE SHE/MIKE 11 model and guide the calibration process. Although the sensitivity analysis was performed on an early version of the KBMOS model, the analysis was beneficial to the model calibration process. Model calibration and verification are discussed in Section 4 and Section 5.

## 3.1 Objectives of the Initial MIKE SHE/MIKE 11 Sensitivity Analysis Report

The purpose of the MIKE SHE/MIKE 11 Sensitivity Analysis is to evaluate the sensitivity of several key parameters. The sensitivity analyses were used to identify the parameters that have a significant effect model results and guide the calibration process. The results of the sensitivity analyses are discussed below and a calibration process diagram developed using the results of the sensitivity analysis is presented. These analyses do not evaluate model sensitivity. A model Sensitivity Analysis is to be performed after the model had been calibrated and verified.

## 3.2 Approach to Setup of Sensitivity Analyses

The ten parameters evaluated as part of the sensitivity analysis and how each parameter typically affects simulated results are described in detail below. Furthermore, the approach used to perturb each parameter is also explained. The sensitivity of each of the parameters is evaluated by comparing the simulated values with a base sensitivity simulation. The base sensitivity simulation represents the version of the regional model that uses the initial parameter values defined in the MIKE 11 Model Documentation Report (Earth Tech, 2006d) and the MIKE SHE Model Development Report (Earth Tech, 2006e).

The base sensitivity simulation and all sensitivity runs were run on the coarse grid, 3-layer model for the period from September 1, 1994 to December 31, 1995. Comparisons were completed for the period January 1, 1995 to December 31, 1995. This year included above average rainfall conditions (Figure 2-4). The initial pre-Phase 1 MIKE 11 model was used in all sensitivity simulations.

The pre-Phase 1 model configuration was used because the coupling of the post-Phase 1 MIKE 11 model and MIKE SHE was not completed when the sensitivity analysis phase of the project was begun. Results from sensitivity analyses using the pre-Phase 1 model should be directly applicable to the post-Phase 1 model because simulated data is being compared in this sensitivity analysis and sensitivities are developed by evaluating relative differences in results between the base sensitivity simulation and subsequent sensitivity simulations.

Historical rainfall and reference evapotranspiration rates for 1995 were used in all simulations. No flow boundaries were specified for all upstream ends of branches represented in the MIKE 11 model and historical tailwater stages for S-65E were used at the downstream end of the model. MIKE 11 structures are being operated using observed gate level data or observed stage data (as was done in the original Lake Toho model). Outer boundaries of the groundwater portion of the model used time-varying constant head values developed by the USGS for the dry and wet-season of 1995. Historical groundwater withdrawal data from 1995 was used in all simulations.

### 3.2.1 Selection of Sensitivity Parameters

The scope of work for this task required that a sensitivity analyses be completed for ten different parameters of the KBMOS MIKE SHE model. Each parameter was evaluated separately by using initial values for the other nine parameters. The following is a list of the selected parameters:

1. Crop Coefficient (*Kc*) Value
2. River Manning's *n* Value
3. Overland Manning's *M* Value
4. Drainage Time Constant ($TC_d$)
5. Hydraulic Conductivity of the Surfical Aquifer
6. Hydraulic Conductivity of the Intermediate Confining Unit
7. Hydraulic Conductivity of the Upper Floridan aquifer
8. Two-layer UZ Approach Soil Infiltration Parameter
9. Two-layer UZ approach Field Capacity Parameter
10. Range of Two-layer UZ approach Moisture Content Parameters

Specific information regarding each individual parameter and how it was modified during the sensitivity analysis simulations is described in detail in the following sections. In general, all the parameters are adjusted by 20 percent, exceptions are made for the parameters where a 20 percent change would make the parameters, or model results unrealistic. A 10 percent change has been used for the crop coefficients, river Manning's *n* values, the overland Manning's *M* values, and the drain time constants.

#### 3.2.1.1 Crop Coefficient (Kc) Value

Crop coefficient is a vegetation specific physical parameter in a MIKE SHE model that adjusts reference evapotranspiration rates to vegetation specific rates. The crop coefficient is specified in the MIKE SHE vegetation database on a monthly basis for most vegetation types. The crop coefficient directly affects simulated evapotranspiration rates because it is multiplied by the reference evapotranspiration rate to define the maximum evapotranspiration rate for each vegetation type ($ET_{max} = ET_{ref} \times K_c$). The crop coefficient is typically one of the most sensitive parameters because it directly affects maximum evapotranspiration rates and evapotranspiration is usually the largest water budget item after rainfall in most watersheds.

The crop coefficient also indirectly impacts the amount of irrigation water applied because evapotranspiration affects the soil moisture content in the root zone and calculated irrigation demands when the Maximum Allowed Deficit approach is used. Similarly, the crop coefficient can affect irrigation demand calculations when the crop stress factor irrigation approach is used.

The sensitivity of the crop coefficient was evaluated by increasing and decreasing monthly vegetation based values used in the base sensitivity model by 10 percent. The range of crop coefficient values used for each vegetation type in the base sensitivity model is summarized in Table 3-1.

**Table 3-1: Range of vegetation based monthly crop coefficients ($K_c$) used in the base sensitivity simulation.**

| Vegetation Classification | Base Sensitivity Model Maximum Monthly Kc | Maximum Monthly Kc 10% Increase | Maximum Monthly Kc 10% Decrease | Base Sensitivity Model Minimum Monthly Kc | Minimum Monthly Kc 10% Increase | Minimum Monthly Kc 10% Decrease |
|---|---|---|---|---|---|---|
| Citrus | 0.90 | 0.99 | 0.81 | 0.66 | 0.73 | 0.59 |
| Pasture | 0.77 | 0.85 | 0.69 | 0.77 | 0.85 | 0.69 |
| Truck crops | 1.00 | 1.10 | 0.90 | 0.62 | 0.68 | 0.56 |
| Golf course | 0.85 | 0.94 | 0.77 | 0.61 | 0.67 | 0.55 |
| Hydric - mesic - xeric - flatwood | 0.90 | 0.99 | 0.81 | 0.28 | 0.31 | 0.25 |
| Mesic - xeric - hammock | 0.87 | 0.96 | 0.78 | 0.26 | 0.29 | 0.23 |
| Wet prairie | 1.00 | 1.10 | 0.90 | 1.00 | 1.10 | 0.90 |
| Marsh | 1.00 | 1.10 | 0.90 | 0.38 | 0.42 | 0.34 |
| Cypress | 0.96 | 1.06 | 0.86 | 0.29 | 0.32 | 0.26 |
| Swamp forest | 1.00 | 1.10 | 0.90 | 1.00 | 1.10 | 0.90 |
| Water | 1.00 | 1.10 | 0.90 | 1.00 | 1.10 | 0.90 |
| Urban low density | 0.86 | 0.95 | 0.77 | 0.61 | 0.67 | 0.55 |
| Urban medium density | 0.85 | 0.94 | 0.77 | 0.61 | 0.67 | 0.55 |
| Urban high density | 0.85 | 0.94 | 0.77 | 0.65 | 0.72 | 0.59 |

#### 3.2.1.2 River Manning’s n Value

Manning’s *n* roughness values are specified in the MIKE 11 river network model setup and are used to describe the roughness of the streambed for rivers and canals represented in the model. Roughness coefficients directly affect simulated stages, discharge, and velocities in each branch represented in the MIKE 11 model.

Manning’s *n* roughness values are variable in each branch in the model and are based on previous models developed for the Kissimmee basin. The ranges of Manning’s *n* values used in each branch represented in MIKE 11 in the base sensitivity simulation are summarized in Table 3-2. The sensitivity of the River Manning’s *n* value was evaluated by increasing and decreasing values used in the base sensitivity model by 10 percent.

**Table 3-2: Manning's *n* values used in the base sensitivity simulation[1]**

| River Name | Manning *n* | | River Name | Manning *n* | |
|---|---|---|---|---|---|
| | Maximum | Minimum | | Maximum | Minimum |
| Alligator-chain | 0.033 | 0.033 | Meander12 | 0.140 | 0.120 |
| Armstrong_Slough | 0.035 | 0.035 | Meander13 | 0.187 | 0.150 |
| Armstrong_Trib1 | 0.035 | 0.035 | Meander14 | 0.050 | 0.050 |
| Armstrong_Trib2 | 0.035 | 0.035 | Meander15 | 0.130 | 0.050 |
| Ash_Slough1 | 0.300 | 0.125 | Meander16 | 0.128 | 0.050 |
| Ash_Slough2 | 0.300 | 0.125 | Meander17 | 0.200 | 0.200 |
| Ash_Slough3 | 0.300 | 0.125 | Meander18 | 0.200 | 0.050 |
| Boggy-creek | 0.033 | 0.033 | Meander19 | 0.083 | 0.050 |
| C-29 | 0.033 | 0.033 | Meander2 | 0.150 | 0.150 |
| C-31 | 0.030 | 0.030 | Meander20 | 0.150 | 0.150 |
| C-36 | 0.033 | 0.033 | Meander21 | 0.150 | 0.150 |
| C-37 | 0.035 | 0.035 | Meander22 | 0.150 | 0.150 |
| C-38 | 0.078 | 0.030 | Meander23 | 0.150 | 0.150 |
| Catfish_Creek | 0.067 | 0.040 | Meander3 | 0.030 | 0.030 |
| Chandler_Outlet | 0.300 | 0.125 | Meander4 | 0.150 | 0.150 |
| Chandler_Slough1 | 0.300 | 0.125 | Meander5 | 0.150 | 0.150 |
| Chandler_Slough2 | 0.300 | 0.125 | Meander6 | 0.150 | 0.150 |
| Cypress_Slough | 0.300 | 0.125 | Meander7 | 0.150 | 0.150 |
| DEAD_CREEK | 0.134 | 0.070 | Meander8 | 0.150 | 0.150 |
| East_Lk_Hatchineha | 0.039 | 0.033 | Meander9 | 0.150 | 0.150 |
| Fanny-bass | 0.033 | 0.033 | Nash_Slough | 0.300 | 0.125 |
| FODDERSTACK_SLOUGH | 0.072 | 0.070 | Oak_Creek | 0.137 | 0.035 |
| Gore_Slough | 0.300 | 0.125 | Oak_Creek_NBranch | 0.117 | 0.040 |
| Istokpoga_Canal | 0.035 | 0.035 | Oak_Creek_SBranch | 0.126 | 0.040 |
| JACKSON_CANAL | 0.093 | 0.035 | Pine_Island_Slough | 0.035 | 0.035 |
| Kiss-airport-canal | 0.033 | 0.033 | Pine_Island_Trib1 | 0.035 | 0.035 |
| Kiss-city-ditch | 0.033 | 0.033 | Reedy-Creek | 0.033 | 0.033 |
| KISSIMMEE | 0.033 | 0.033 | ROSALIE_CREEK | 0.095 | 0.033 |
| Lake_Marian | 0.033 | 0.033 | Sevenmile_Slough | 0.035 | 0.035 |
| Lake_Marion | 0.033 | 0.033 | Sevenmile_Trib1 | 0.035 | 0.035 |
| Lake_Pierce | 0.033 | 0.033 | Sevenmile_Trib2 | 0.035 | 0.035 |
| Lake_Rosalie | 0.033 | 0.033 | Sevenmile_Trib3 | 0.035 | 0.035 |
| Lk_Jackson | 0.033 | 0.033 | Shingle-creek | 0.033 | 0.033 |
| Lk_Marion_Creek | 0.033 | 0.033 | SHORT_CANAL | 0.035 | 0.035 |
| Lk-Brick | 0.033 | 0.033 | TIGER_CREEK | 0.095 | 0.035 |
| Lk-Hart | 0.033 | 0.033 | Tiger_Lake | 0.033 | 0.033 |
| Lk-Lizzie | 0.033 | 0.033 | Toho-main | 0.033 | 0.033 |
| Lk-Preston | 0.033 | 0.033 | Turnpike_N | 0.033 | 0.033 |
| LOWER_C-38 | 0.061 | 0.040 | Turnpike_S | 0.033 | 0.033 |
| Lower_RC | 0.300 | 0.150 | UPPER_RC | 0.090 | 0.070 |
| Lower-E-Toho | 0.033 | 0.033 | Upper-Alligator | 0.033 | 0.033 |
| MARIAN | 0.120 | 0.060 | Weohyakapka_Creek | 0.033 | 0.033 |
| Meander1 | 0.150 | 0.150 | West_Lk_Hatchineha | 0.033 | 0.033 |
| Meander10 | 0.200 | 0.150 | ZIPPER_CANAL | 0.098 | 0.035 |
| Meander11 | 0.200 | 0.150 | | | |

[1]Values presented are the ones included in the model, variations correspond to Manning's *n* for different roughness areas within the specific stream

#### 3.2.1.3 Overland Manning's M Value

Overland Manning's *M* values are analogous to Manning's *n* values defined for the MIKE 11 model and define the roughness of the overland flow plain. Manning's M values are defined as the reciprocal of Manning's *n* ($M = 1 / n$). Manning's *M* values directly affect overland flow rates and indirectly affect infiltration to the unsaturated zone. Overland flow roughness decreases with higher values of Manning's *M*. Values used in the calibrated model varied by land use. Land-use based Manning's *M* values used in the base sensitivity model are summarized in Table 3-3. The sensitivity of the Overland Manning's *M* value was evaluated by increasing and decreasing values used in the base sensitivity model by 10 percent.

**Table 3-3: Manning's *M* values used in the base sensitivity simulation.**

| Vegetation Classification | MIKE SHE Land Use Code | Base Sensitivity Model Manning M | Manning M 10% Increase | Manning M 10% Decrease |
|---|---|---|---|---|
| Citrus | 1 | 5.88 | 6.47 | 5.29 |
| Pasture | 2 | 7.14 | 7.85 | 6.43 |
| Truck Crops | 5 | 5.88 | 6.47 | 5.29 |
| Golf Courses | 6 | 7.14 | 7.85 | 6.43 |
| Flatwoods | 8 | 5 | 5.50 | 4.50 |
| Hammock | 9 | 3.33 | 3.66 | 3.00 |
| Cypress | 17 | 2.5 | 2.75 | 2.25 |
| Hydric Hammock | 13 | 2.5 | 2.75 | 2.25 |
| Wet Prairie | 14 | 3.33 | 3.66 | 3.00 |
| Marsh | 16 | 1.67 | 1.84 | 1.50 |
| Swamp Forest | 18 | 2.5 | 2.75 | 2.25 |
| Water | 20 | 0 | 0.00 | 0.00 |
| Urban Low Density | 41 | 7.14 | 7.85 | 6.43 |
| Urban Medium Density | 42 | 8.33 | 9.16 | 7.50 |
| Urban High Density | 43 | 9.01 | 9.91 | 8.11 |

#### 3.2.1.4 Drainage Time Constant ($TC_d$) Value

The drainage time constant is a parameter that is used control the discharge rate of water routed using the drainage module in MIKE SHE. The drainage module is a head dependent flux boundary condition that is used to represent natural and artificial drainage features that are not explicitly represented in the open channel component of the model (MIKE 11). The drainage module is typically used to represent flow from small creeks or streams or "interflow" in a watershed. The flow through the drainage system is calculated as the product of the head difference between user defined drainage levels and simulated groundwater level, the cell area, and the defined time constant. Large time constant values result in faster responses to rainfall events and associated water level changes, while a small time constant values result in slower responses.

Land-use based drainage time constants used in the base sensitivity model are summarized in Table 3-4. The sensitivity of the drainage time constant was evaluated by increasing and decreasing values used in the base sensitivity model by 10 percent.

**Table 3-4: Drainage time constant values used in the base sensitivity simulation.**

| Vegetation Classification | MIKE SHE Land Use Code | Base Sensitivity Model Drainage Time Constant (1/day) | Drainage Time Constant 10% Increase | Drainage Time Constant 10% Decrease |
|---|---|---|---|---|
| Citrus | 1 | 0.06 | 0.07 | 0.05 |
| Pasture | 2 | 0 | 0.00 | 0.00 |
| Truck Crops | 5 | 0.05 | 0.06 | 0.05 |
| Golf Courses | 6 | 0.05 | 0.06 | 0.05 |
| Flatwoods | 8 | 0 | 0.00 | 0.00 |
| Hammock | 9 | 0 | 0.00 | 0.00 |
| Cypress | 17 | 0 | 0.00 | 0.00 |
| Hydric Hammock | 13 | 0 | 0.00 | 0.00 |
| Wet Prairie | 14 | 0 | 0.00 | 0.00 |
| Marsh | 16 | 0 | 0.00 | 0.00 |
| Swamp Forest | 18 | 0 | 0.00 | 0.00 |
| Water | 20 | 0 | 0.00 | 0.00 |
| Urban Low Density | 41 | 0.06 | 0.07 | 0.05 |
| Urban Medium Density | 42 | 0.06 | 0.07 | 0.05 |
| Urban High Density | 43 | 0.06 | 0.07 | 0.05 |

#### 3.2.1.5 Hydraulic Conductivity of the Surficial Aquifer

The horizontal and vertical hydraulic conductivity of the surficial aquifer (SAS) are used to determine horizontal flow within the SAS and vertical flow to the Intermediate Confining Unit (ICU) and ultimately affect simulated groundwater levels. The sensitivity of the hydraulic conductivity of the SAS was evaluated by increasing and decreasing horizontal hydraulic conductivity values used in the base sensitivity model by 20 percent. The ratio of horizontal to vertical hydraulic conductivity used in the base sensitivity model was maintained during the sensitivity analyses.

#### 3.2.1.6 Hydraulic Conductivity of the Intermediate Confining Unit

The horizontal and vertical hydraulic conductivity of the ICU are used to determine horizontal flow within the ICU and vertical flow to the SAS and the Upper Floridan Aquifer (UFA) and ultimately affect simulated groundwater levels. Groundwater flow is primarily vertical in the ICU. The sensitivity of the hydraulic conductivity of the ICU was evaluated by increasing and decreasing horizontal hydraulic conductivity values used in the base sensitivity model by 20 percent. The ratio of horizontal to vertical hydraulic conductivity used in the base sensitivity model was maintained during the sensitivity analyses.

#### 3.2.1.7 Hydraulic Conductivity of the Floridan Aquifer

The horizontal and vertical hydraulic conductivity of the UFA are used to determine horizontal flow within the UFA and vertical flow to the ICU and ultimately affect simulated groundwater levels. Groundwater flow is primarily horizontal in the UFA. The sensitivity of the hydraulic conductivity of the UFA was evaluated by increasing and decreasing horizontal hydraulic conductivity values used in the base sensitivity model by 20 percent. The ratio of horizontal to vertical hydraulic conductivity used in the base sensitivity model was maintained during the sensitivity analyses.

#### 3.2.1.8 Two-layer UZ Approach Soil Infiltration Parameter

The soil infiltration parameter of the two-layer unsaturated approach is used to calculate infiltration to the unsaturated zone. The infiltration parameter is one of the soil characteristics defined in the MIKE SHE setup. It is a constant value and represents the maximum infiltration rate for each soil classification. The infiltration rate primarily affects infiltration to the unsaturated zone but also affects overland flow rates.

The sensitivity of the infiltration parameter was evaluated by increasing and decreasing infiltration rates defined in the base sensitivity model by 20 percent. Infiltration rates used in the base sensitivity simulation and adjusted infiltration rates for each soil classification defined in the model are summarized in Table 3-5.

**Table 3-5: Infiltration rates (in/hr) specified in the base sensitivity simulation adjusted values used in the base sensitivity case and each sensitivity analysis run.**

| Soil Classification | Base Sensitivity Model Maximum Infiltration Rate [in/hr] | Maximum Infiltration Rate [in/hr] 20% Increase | Maximum Infiltration Rate [in/hr] 20% Decrease |
|---|---|---|---|
| Astatula | 4.88 | 5.85 | 3.90 |
| Basinger | 0.71 | 0.85 | 0.57 |
| Candler | 6.69 | 8.03 | 5.35 |
| Eaugallie | 0.02 | 0.03 | 0.02 |
| Floridana | 0.13 | 0.16 | 0.11 |
| Hontoon | 2.11 | 2.53 | 1.69 |
| Immokalee | 0.20 | 0.24 | 0.16 |
| malabar | 0.13 | 0.16 | 0.10 |
| Minor moderately drained | 1.24 | 1.49 | 1.00 |
| Minor poorly drained | 0.42 | 0.50 | 0.33 |
| Minor well drained | 5.78 | 6.94 | 4.63 |
| Placid | 0.46 | 0.56 | 0.37 |
| Pomello | 1.11 | 1.33 | 0.89 |
| Pompano | 0.40 | 0.48 | 0.32 |
| Riviera | 0.02 | 0.03 | 0.02 |
| Samsula | 0.95 | 1.13 | 0.76 |
| Smyrna - Myakka | 0.47 | 0.57 | 0.38 |
| Tavares | 1.38 | 1.66 | 1.11 |
| Unknown | 1.24 | 1.49 | 1.00 |
| Valkaria | 0.75 | 0.90 | 0.60 |
| Water | 1.53 | 1.84 | 1.22 |

#### 3.2.1.9 Two-Layer UZ Approach Moisture Content at Field Capacity ( $_{fc}$) Parameter

Field capacity is defined as the moisture content of a soil that has been fully drained by gravity where the remaining soil moisture held by surface tension is in equilibrium with gravitational potential. Soil moisture can be further reduced by evapotranspiration processes until the wilting point is reached. A unique value defining the moisture content at field capacity is defined for each soil type defined in the MIKE SHE setup. Changing the moisture content field capacity primarily affects groundwater recharge because as the amount of water available for recharge is defined as the difference between the moisture content at saturation and field capacity.

The sensitivity of the soil moisture content at field capacity was evaluated by increasing and decreasing the moisture content by 20 percent. Moisture contents at field capacity used in the base sensitivity simulation and adjusted moisture contents for each soil classification defined in the model are summarized in Table 3-6.

**Table 3-6: Soil Moisture at Field capacity values from the base sensitivity simulation and the values used in the sensitivity analysis.**

| Soil Classification | Base Sensitivity Model $_{FC}$ () | $_{FC}$ () 20% Increase | $_{FC}$ () 20% Decrease |
|---|---|---|---|
| Astatula | 0.029 | 0.035 | 0.023 |
| Basinger | 0.106 | 0.127 | 0.085 |
| Candler | 0.030 | 0.036 | 0.024 |
| Eaugallie | 0.206 | 0.247 | 0.165 |
| Floridana | 0.237 | 0.284 | 0.190 |
| Hontoon | 0.552 | 0.662 | 0.442 |
| Immokalee | 0.095 | 0.114 | 0.076 |
| Malabar | 0.159 | 0.191 | 0.127 |
| Minor moderately drained | 0.045 | 0.054 | 0.036 |
| Minor poorly drained | 0.190 | 0.228 | 0.152 |
| Minor well drained | 0.030 | 0.036 | 0.024 |
| Placid | 0.115 | 0.138 | 0.092 |
| Pomello | 0.048 | 0.058 | 0.038 |
| Pompano | 0.191 | 0.229 | 0.153 |
| Riviera | 0.125 | 0.150 | 0.100 |
| Samsula | 0.448 | 0.538 | 0.358 |
| Smyrna - Myakka | 0.094 | 0.113 | 0.075 |
| Tavares | 0.042 | 0.050 | 0.034 |
| Unknown | 0.045 | 0.054 | 0.036 |
| Valkaria | 0.053 | 0.064 | 0.042 |
| Water | 0.500 | 0.600 | 0.400 |

#### 3.2.1.10 Range of Two-layer UZ Approach Moisture Content at Saturation ( $_{sat}$) Parameters

The maximum moisture content of the unsaturated zone is adjusted by modifying the moisture content at saturation. The moisture content at saturation is defined for each soil and is specified in the soil parameters defined in the MIKE SHE setup. Changing the soil saturation affects infiltration to the unsaturated zone, as saturation defines the maximum moisture content of the soil and limits infiltration under saturated conditions. This parameter also defines the amount of amount of water available for recharge and indirectly affects overland flow rates because of its effect on infiltration rates.

The sensitivity of this parameter was evaluated by increasing and decreasing the defined moisture content at saturation by 20 percent. The moisture content at saturation used for the defined soil classifications and adjusted moisture contents are summarized in Table 3-7.

**Table 3-7: Soil Moisture at saturation values used in the base sensitivity simulation and the values used in the sensitivity analysis.**

| Soil Classification | Base Sensitivity Model $_{sat}$ () | $_{sat}$ 20% Increase | $_{sat}$ 20% Decrease |
|---|---|---|---|
| Astatula | 0.043 | 0.052 | 0.034 |
| Basinger | 0.146 | 0.175 | 0.117 |
| Candler | 0.043 | 0.052 | 0.034 |
| Eaugallie | 0.233 | 0.280 | 0.186 |
| Floridana | 0.272 | 0.326 | 0.218 |
| Hontoon | 0.718 | 0.862 | 0.574 |
| Immokalee | 0.130 | 0.156 | 0.104 |
| Malabar | 0.210 | 0.252 | 0.168 |
| Minor moderately drained | 0.065 | 0.078 | 0.052 |
| Minor poorly drained | 0.249 | 0.299 | 0.199 |
| Minor well drained | 0.043 | 0.052 | 0.034 |
| Placid | 0.175 | 0.210 | 0.140 |
| Pomello | 0.061 | 0.073 | 0.049 |
| Pompano | 0.234 | 0.281 | 0.187 |
| Riviera | 0.183 | 0.220 | 0.146 |
| Samsula | 0.537 | 0.644 | 0.430 |
| Smyrna - Myakka | 0.141 | 0.169 | 0.113 |
| Tavares | 0.069 | 0.083 | 0.055 |
| Unknown | 0.065 | 0.078 | 0.052 |
| Valkaria | 0.121 | 0.145 | 0.097 |
| Water | 0.628 | 0.754 | 0.502 |

## 3.3 Sensitivity Analyses Results

The results from the sensitivity analysis are presented below in terms of the relative impact on the simulated model-wide water budget and the difference in mean errors for select surface water and groundwater calibration locations. The sensitivity of each parameter perturbation is calculated based using the differences between a given sensitivity simulation and the base sensitivity simulation.

The impact of parameter perturbations on the model-wide water budget is described to identify those parameters that have the largest effect on the larger scale regional response of the model. A total of 108 observation locations (48 surface water and 60 groundwater locations) are used to determine how parameter perturbations affect the groundwater and surface water system. These results were used to develop the calibration process diagram discussed in Section 4.

### 3.3.1 Response of the Water Budget to Parameter Perturbations

The response of the simulated water budget to parameter perturbations is useful to determine how the model responds at the watershed scale. The following approach has been used:

1. Model-wide water budgets have been developed for the base sensitivity simulation and for each of the 20 sensitivity simulations (total water balance, with accumulated values).
2. Eight specific water budget components have been selected and the values from each sensitivity simulation are compared with corresponding values from the base sensitivity simulation.
3. Values for individual simulations have been normalized against rainfall and relative differences between individual sensitivity simulations and the base sensitivity simulation are presented. In the presented results a value of 0 percent indicates results for the sensitivity run are identical to the base sensitivity case whereas a value of five indicates the parameter perturbation results in a 5 percent increase.

The following eight water balance components are used in the sensitivity analysis:

Total evapotranspiration.

Overland storage change.

Overland flow to the river system.

Amount of water for irrigation.

Storage change in the saturated zone.

Drainage flow to the river system.

Baseflow to the river system.

Leakage from river into the groundwater.

The impact of parameter perturbation on each of the above components is briefly explained in the following section.

### 3.3.2 Water Budget Results

The normalized sensitivity of the water budget components based on the parameter perturbations (Sn) was calculated using the following equations (Ken Konyha, May 2005):

$$S = \frac{dR}{dP} \qquad \text{Eq. 1}$$

where:

*dR* = change in model results, and
*dP* = change in model parameter

Relative Sensitivity ($S_{rel}$) is defined as:

$$S_{rel} = \frac{dR}{dP} \times \frac{P}{R} \qquad \text{Eq. 2}$$

Rearranging the equation for relative sensitivity:

$$S_{rel} = \frac{\frac{dR}{R}}{\frac{dP}{P}} \qquad \text{Eq. 3}$$

Where $\frac{dR}{R}$ is the effect of the perturbation in the water budget component and $\frac{dP}{P}$ is the parameter perturbation which was 20% for most of the parameters with the exception of Kc, Manning's n, Manning's M and drain time where a 10% perturbation was used.

The relative sensitivity was normalized dividing it by the annual rainfall. Therefore the Relative Sensitivity is expressed in terms of fractions of annual rainfall.

A summary of the rainfall normalized relative Sensitivity on water budget components are summarized in Table 3-8. The average column in Table 3-8 represents the average change in the 20 sensitivity runs and the minimum and maximum values indicate extreme values. The response of each of the components to parameter perturbations for each of the 20 sensitivity simulations is shown graphically in Figure 3-1. In combination, Table 3-8 and Figure 3-1 show that the crop coefficient and the soil moisture content at saturation have the largest effect on simulated water budgets. The moisture content at field capacity, hydraulic conductivity of the SAS, and drainage time constant have a small effect on the water budget components. The other parameters (infiltration rates, Manning's *M* values, ICU hydraulic conductivity, UFA hydraulic conductivity, and Manning's n values) do not have a significant effect on simulated water budgets.

**Table 3-8: Average, minimum and maximum water budget changes resulting from parameter perturbations.**

| Simulation | Simulation Number | Average | Minimum | Maximum |
|---|---|---|---|---|
| **Base Sensitivity Model** | | 0.0 | 0.0 | 0.0 |
| **Surficial AQ (Decrease)** | 1 | 0.1 | -0.5 | 0.5 |
| **Surficial AQ (Increase)** | 2 | -0.1 | -0.5 | 0.0 |
| **Confining Unit (Decrease)** | 3 | 0.0 | -0.3 | 0.3 |
| **Confining Unit (Increase)** | 4 | 0.1 | -0.1 | 0.5 |
| **Floridan AQ (Decrease)** | 5 | -0.5 | -4.6 | 0.5 |
| **Floridan AQ (Increase)** | 6 | 0.5 | -0.5 | 4.0 |
| **Kc (Decrease)** | 7 | -1.6 | -57.2 | 23.0 |
| **Kc (Increase)** | 8 | 1.8 | -19.8 | 52.4 |
| **OL Manning (Decrease)** | 9 | 0.0 | -0.5 | 1.0 |
| **OL Manning (Increase)** | 10 | 0.0 | -0.7 | 0.5 |
| **River Manning (Decrease)** | 11 | 0.0 | -0.5 | 0.6 |
| **River Manning (Increase)** | 12 | 0.0 | -0.6 | 0.4 |
| **UZ inf. (Decrease)** | 13 | 0.0 | -0.1 | 0.1 |
| **UZ inf. (Increase)** | 14 | 0.0 | -0.5 | 0.4 |
| **Soil Moisture Content$_{sat}$ (Decrease)** | 15 | 0.4 | -5.5 | 4.4 |
| **Soil Moisture Content$_{sat}$ (Increase)** | 16 | -0.2 | -2.4 | 3.5 |
| **Soil Moisture Content$_{Fc}$ (Decrease)** | 17 | -0.3 | -1.0 | 0.1 |
| **Soil Moisture Content$_{Fc}$ (Increase)** | 18 | 0.5 | -0.6 | 2.1 |
| **Drain constant (Decrease)** | 19 | -0.2 | -5.5 | 3.1 |
| **Drain constant (Increase)** | 20 | 0.2 | -1.3 | 4.4 |

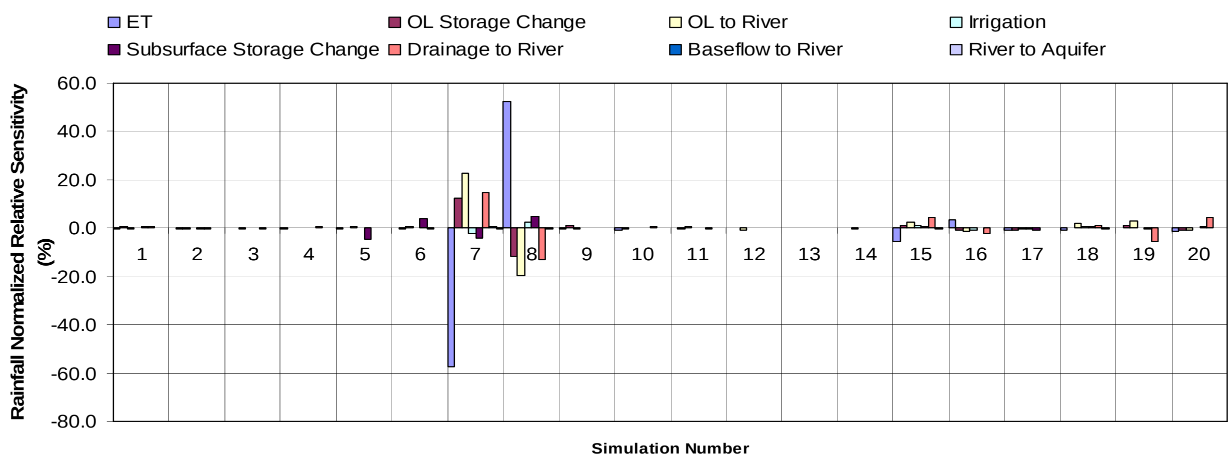



**Figure 3-1: Rainfall normalized relative sensitivity of water budget components on parameter perturbations. Simulation numbers are identified in Table 3-8.**

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The response of each water budget component to crop coefficient perturbations is summarized in Table 3-9. As shown in Table 3-9, the crop coefficient has the largest effect on simulated evapotranspiration rates but also has a significant effect on runoff (OL to River), overland storage changes, and drainage. The response of these components is a direct result of changes in evapotranspiration rates which changes the amount of water stored on the overland flow plain, infiltration, and groundwater recharge.

**Table 3-9: Effect of a 10 percent crop coefficient ($K_c$) perturbation on the simulated response of specific water budget components normalized with rainfall data.**

| Water Budget Component | Kc (Decrease) | Kc (Increase) |
|---|---|---|
| **ET** | -5.7 | 5.2 |
| **OL Storage Change** | 1.3 | -1.2 |
| **OL to River** | 2.3 | -2.0 |
| **Irrigation** | -0.2 | 0.2 |
| **Subsurface Storage Change** | -0.4 | 0.5 |
| **Drainage to River** | 1.5 | -1.3 |
| **Baseflow to River** | 0.1 | -0.1 |
| **River to Aquifer** | 0.0 | 0.0 |

The response of each water budget component to saturated moisture content perturbations is summarized in Table 3-10. As shown in Table 3-10, the moisture content at saturation has the largest effect on simulated evapotranspiration rates but also has a significant effect on runoff (OL to River), overland storage changes, and drainage. The response of these components is a direct result of changes in evapotranspiration rates which changes the amount of water stored on the overland flow plain, infiltration, and groundwater recharge.

**Table 3-10: Effect of a 10 percent moisture content at saturation ( $_{sat}$) perturbation on the simulated response of specific water budget components.**

| Water Budget Component | $_{sat}$ (Decrease) | $_{sat}$ (Increase) |
|---|---|---|
| **ET** | -1.1 | 0.7 |
| **OL Storage Change** | 0.2 | -0.2 |
| **OL to River** | 0.5 | -0.3 |
| **Irrigation** | 0.2 | -0.1 |
| **Subsurface Storage Change** | 0.1 | 0.0 |
| **Drainage to River** | 0.9 | -0.5 |
| **Baseflow to River** | 0.0 | 0.0 |
| **River to Aquifer** | 0.0 | 0.0 |

The complete results for each simulation and water budget component are given in Earth Tech (2006g).

### 3.3.3 Response of Model at Calibration Locations to Parameter Perturbations

To evaluate the response of the surface water and groundwater portions of the model to parameter perturbations the difference between the sensitivity simulation and the base sensitivity simulation at specified locations was used. A total of 108 observation locations (60 groundwater and 48 surface water locations) were used to evaluate parameter sensitivities. The mean error (ME) was used to quantify the difference between the base sensitivity model and the scenario simulation at each of the observation locations. For each observation the ME is calculated using:

$$ME = \frac{1}{N}\sum_{i=1}^{N} Sim_{base,i} - Sim_{sens,i} \qquad \text{Eq. 4}$$

where

$N$ is the number of observations at location j,

$Sim_{base,j}$ is the simulated value at location j in the base sensitivity run, and

$Sim_{sens,j}$ is the simulated value at location j in the sensitivity run.

Complete results for all of the surface water and groundwater observation locations evaluated are presented in Earth Tech (2006g). The composite effect of the parameter perturbations on simulated results are summarized below. It is important to emphasize that the sensitivity values included below have not been divided by the % of perturbation, therefore they do not correspond to the relative sensitivity presented in the previous section.

#### 3.3.3.1 Response of Surface Water System to Parameter Perturbations

The effect of parameter perturbations on sum of the mean errors at each surface water stage and flow observation location are summarized in Table 3-11 and Table 3-12. The normalized mean error is also summarized on Table 3-11 and shown graphically on Figure 3-2. The normalized mean error is calculated as the sum of the mean errors for sensitivity simulation divided by the maximum sum of the mean errors. Therefore, a normalized mean error with a value of 100 is assigned to the most sensitive parameter perturbation. Mean errors for each surface water observation location during each simulation is given in Earth Tech (2006g).

**Table 3-11: Composite surface water stage mean error for each parameter perturbation. The composite surface water mean error is based on results at 31 stage observation locations. Parameter perturbations with normalized mean errors exceeding ±15% are identified with shading.**

| Parameter | Simulation Number | Change | Sum of Stage ME | Normalized Sum of Stage ME |
|---|---|---|---|---|
| **Surficial AQ (Decrease)** | 1 | 20% | 0.77 | 25.52 |
| **Surficial AQ (Increase)** | 2 | 20% | -0.53 | -17.59 |
| **Confining Unit (Decrease)** | 3 | 20% | -0.23 | -7.51 |
| **Confining Unit (Increase)** | 4 | 20% | -0.62 | -20.49 |
| **Floridan AQ (Decrease)** | 5 | 20% | 0.37 | 12.17 |
| **Floridan AQ (Increase)** | 6 | 20% | 1.06 | 35.00 |
| **Kc (Decrease)** | 7 | 10% | -2.18 | -72.14 |
| **Kc (Increase)** | 8 | 10% | 3.02 | 100.00 |
| **OL Manning (Decrease)** | 9 | 10% | -0.24 | -7.88 |
| **OL Manning (Increase)** | 10 | 10% | -1.74 | -57.55 |
| **River Manning (Decrease)** | 11 | 10% | 2.08 | 68.91 |
| **River Manning (Increase)** | 12 | 10% | -0.67 | -22.23 |
| **UZ inf. (Decrease)** | 13 | 20% | 0.06 | 1.94 |
| **UZ inf. (Increase)** | 14 | 20% | -0.08 | -2.66 |
| $_{sat}$ **(Decrease)** | 15 | 20% | -1.33 | -43.92 |
| $_{sat}$ **(Increase)** | 16 | 20% | 1.25 | 41.46 |
| $_{Fc}$ **(Decrease)** | 17 | 20% | 0.81 | 26.92 |
| $_{Fc}$ **(Increase)** | 18 | 20% | -0.11 | -3.58 |
| **Drain constant (Decrease)** | 19 | 10% | 0.65 | 21.37 |
| **Drain constant (Increase)** | 20 | 10% | -0.05 | -1.67 |

**Table 3-12: Composite surface water flow mean error for each parameter perturbation. The composite surface water mean error is based on results at 17 flow observation locations. Parameter perturbations with normalized mean errors exceeding ±15% are identified with shading.**

| Parameter | Simulation Number | Change | Sum of Flow ME | Normalized Sum of Flow ME |
|---|---|---|---|---|
| **Surficial AQ (Decrease)** | 1 | 20% | 23.62 | -17.80 |
| **Surficial AQ (Increase)** | 2 | 20% | -29.41 | 22.17 |
| **Confining Unit (Decrease)** | 3 | 20% | -15.06 | 11.35 |
| **Confining Unit (Increase)** | 4 | 20% | -26.01 | 19.61 |
| **Floridan AQ (Decrease)** | 5 | 20% | -0.13 | 0.10 |
| **Floridan AQ (Increase)** | 6 | 20% | -19.44 | 14.65 |
| **Kc (Decrease)** | 7 | 10% | -98.99 | 74.62 |
| **Kc (Increase)** | 8 | 10% | 88.29 | -66.55 |
| **OL Manning (Decrease)** | 9 | 10% | -16.69 | 12.58 |
| **OL Manning (Increase)** | 10 | 10% | -132.66 | 100.00 |
| **River Manning (Decrease)** | 11 | 10% | 35.33 | -26.63 |
| **River Manning (Increase)** | 12 | 10% | -15.75 | 11.87 |
| **UZ inf. (Decrease)** | 13 | 20% | -2.36 | 1.78 |
| **UZ inf. (Increase)** | 14 | 20% | -8.07 | 6.08 |
| $_{sat}$ **(Decrease)** | 15 | 20% | -49.14 | 37.04 |
| $_{sat}$ **(Increase)** | 16 | 20% | 30.86 | -23.26 |
| $_{Fc}$ **(Decrease)** | 17 | 20% | 18.18 | -13.70 |
| $_{Fc}$ **(Increase)** | 18 | 20% | -20.44 | 15.41 |
| **Drain constant (Decrease)** | 19 | 10% | 9.83 | -7.41 |
| **Drain constant (Increase)** | 20 | 10% | -13.92 | 10.50 |

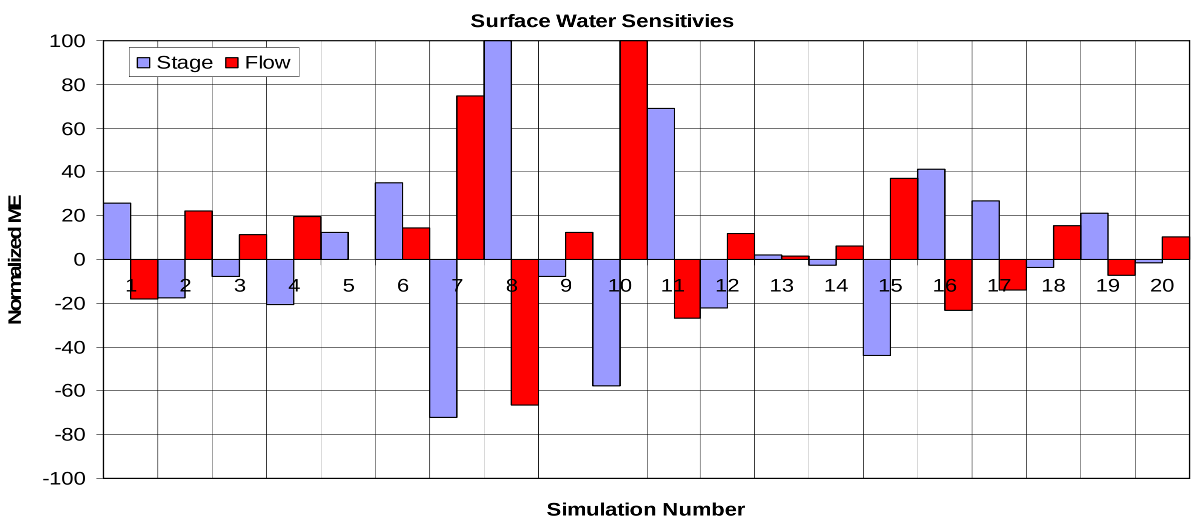


**Figure 3-2: Normalized mean error of the surface water system to parameter perturbations. Parameter perturbations applied in each simulation are identified in Table 3-12.**

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Table 3-11 and Figure 3-2 show that surface water stage is extremely sensitive to the crop coefficient and River Manning's *n* values. Surface water results are also very sensitive to increases in overland Manning's *M* values and somewhat sensitive (greater than ±15%) to changes in the hydraulic conductivity of the SAS, increases in the hydraulic conductivity of the ICU and UFA, changes in the moisture content at saturation, decreases in the moisture content at field capacity, and decreases in the drain time constant.

Table 3-12 and Figure 3-2 show that surface water flow is extremely sensitive to the crop coefficient, increases in overland Manning's *M* values, and decreases in River Manning's *n* values. Surface water results are also sensitive (greater than ±15%) to changes in the hydraulic conductivity of the SAS, increases in the hydraulic conductivity of the ICU, changes in the moisture content at saturation, and increases in the moisture content at field capacity.

Except for the sensitivity of stages and flows to hydraulic conductivity all of the other sensitive parameters that have a significant effect on surface water results have a direct effect on changing the ratio of evapotranspiration, infiltration, and runoff in the model. Stages and flows have some sensitivity to the hydraulic conductivity of the SAS, ICU, and UFA because these parameters affect water levels which affect infiltration and runoff processes. The response of simulated stages and flows to changes in Manning's *n* or *M* values is inversely related because stages generally increase with increased resistance while flows are decreased. The converse would be true for decreased resistance values.

The high degree of sensitivity of flow results to Overland Manning's *M* values is a result of the effect that this parameter has on overland flow rates and the timing and magnitude of water entering the surface water system. Increased Manning *M* values reduce the resistance of the overland flow plane and increases overland discharges to the river system and/or local depressions. Overland Manning's *M* values had a limited effect on the water budget (see Table 3-8 and Figure 3-2) but have a significant effect on the normalized mean error because of the effect it has on six surface water observation locations (see the S-65 gages in Earth Tech, 2006g). The sensitivity of the model to crop coefficients is consistent with the response of simulated water budgets to parameter perturbations.

#### 3.3.3.2 Response of Groundwater System to Parameter Perturbations

The effect of parameter perturbations on sum of the mean errors at each groundwater observation location in the SAS and the UFA are summarized in Table 3-13 and Table 3-14, respectively. The normalized mean errors are also summarized on Table 3-13 and Table 3-14 and shown graphically on Figure 3-3. Mean errors and normalized mean errors were calculated for 29 SAS and 31 UFA locations. The normalized mean error is calculated as the sum of the mean errors for sensitivity simulation divided by the maximum sum of the mean errors. Therefore, a normalized mean error with a value of 100 is assigned to the most sensitive parameter perturbation. Mean errors for each groundwater observation location during each simulation is given in Earth Tech 2006g.

**Table 3-13: Composite surficial aquifer mean error for each parameter perturbation. The composite groundwater mean error is based on results at 29 observation locations. Parameter perturbations with normalized mean errors exceeding ±15% are identified with shading.**

| Parameter | Simulation Number | Change | SAS Sum of ME | SAS Normalized Sum of ME |
|---|---|---|---|---|
| Surficial AQ (Decrease) | 1 | 20% | -0.46 | 27.42 |
| Surficial AQ (Increase) | 2 | 20% | 0.35 | -21.11 |
| Confining Unit (Decrease) | 3 | 20% | -0.05 | 3.01 |
| Confining Unit (Increase) | 4 | 20% | -0.01 | 0.57 |
| Floridan AQ (Decrease) | 5 | 20% | -0.09 | 5.36 |
| Floridan AQ (Increase) | 6 | 20% | 0.06 | -3.63 |
| Kc (Decrease) | 7 | 10% | 1.65 | -98.29 |
| Kc (Increase) | 8 | 10% | -1.68 | 100.00 |
| OL Manning (Decrease) | 9 | 10% | -0.01 | 0.80 |
| OL Manning (Increase) | 10 | 10% | -0.03 | 1.74 |
| River Manning (Decrease) | 11 | 10% | 0.00 | 0.08 |
| River Manning (Increase) | 12 | 10% | 0.02 | -1.23 |
| UZ inf. (Decrease) | 13 | 20% | 0.00 | 0.26 |
| UZ inf. (Increase) | 14 | 20% | -0.01 | 0.88 |
| $_{sat}$ (Decrease) | 15 | 20% | 1.41 | -83.80 |
| $_{sat}$ (Increase) | 16 | 20% | -0.41 | 24.15 |
| $_{Fc}$ (Decrease) | 17 | 20% | -0.40 | 23.84 |
| $_{Fc}$ (Increase) | 18 | 20% | 1.35 | -80.52 |
| Drain constant (Decrease) | 19 | 10% | -0.22 | 13.32 |
| Drain constant (Increase) | 20 | 10% | 0.15 | -8.74 |

**Table 3-14: Composite Upper Floridan aquifer mean error for each parameter perturbation. The composite groundwater mean error is based on results at 31 observation locations. Parameter perturbations with normalized mean errors exceeding ±15% are identified with shading.**

| Parameter | Simulation Number | Change | UFA Sum of ME | UFA Normalized Sum of ME |
|---|---|---|---|---|
| **Surficial AQ (Decrease)** | 1 | 20% | -1.11 | -19.62 |
| **Surficial AQ (Increase)** | 2 | 20% | 1.11 | 19.65 |
| **Confining Unit (Decrease)** | 3 | 20% | -1.07 | -19.05 |
| **Confining Unit (Increase)** | 4 | 20% | 1.01 | 17.95 |
| **Floridan AQ (Decrease)** | 5 | 20% | -0.90 | -15.93 |
| **Floridan AQ (Increase)** | 6 | 20% | 0.81 | 14.37 |
| **Kc (Decrease)** | 7 | 10% | 1.58 | 28.00 |
| **Kc (Increase)** | 8 | 10% | -1.54 | -27.34 |
| **OL Manning (Decrease)** | 9 | 10% | 0.03 | 0.61 |
| **OL Manning (Increase)** | 10 | 10% | 0.00 | 0.00 |
| **River Manning (Decrease)** | 11 | 10% | 0.02 | 0.36 |
| **River Manning (Increase)** | 12 | 10% | 0.03 | 0.61 |
| **UZ inf. (Decrease)** | 13 | 20% | -0.01 | -0.19 |
| **UZ inf. (Increase)** | 14 | 20% | -0.02 | -0.43 |
| **$_{sat}$ (Decrease)** | 15 | 20% | 5.64 | 100.00 |
| **$_{sat}$ (Increase)** | 16 | 20% | -1.85 | -32.74 |
| **$_{Fc}$ (Decrease)** | 17 | 20% | -2.28 | -40.47 |
| **$_{Fc}$ (Increase)** | 18 | 20% | 4.09 | 72.53 |
| **Drain constant (Decrease)** | 19 | 10% | -0.47 | -8.37 |
| **Drain constant (Increase)** | 20 | 10% | 0.36 | 6.47 |

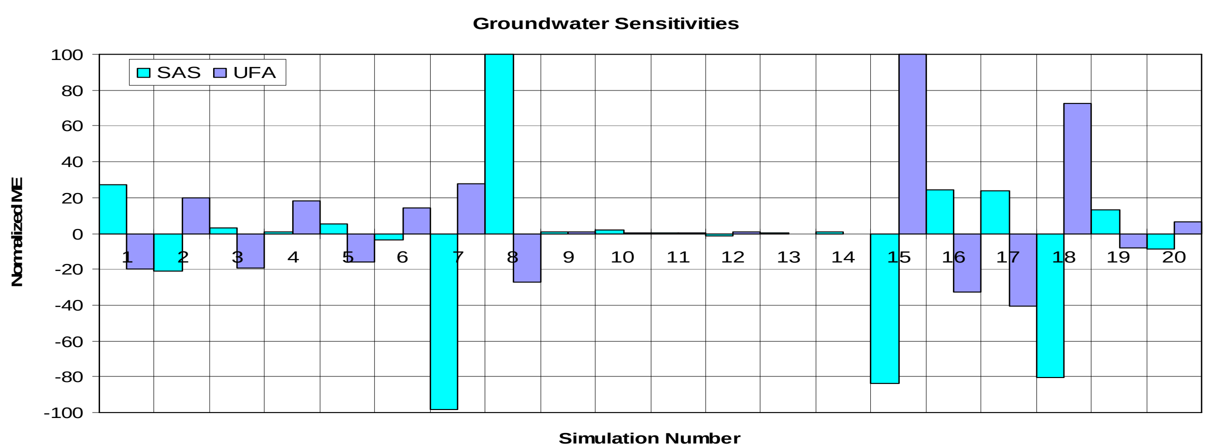


**Figure 3-3: Normalized mean error of the surficial aquifer and the Upper Floridan aquifer to parameter perturbations. Parameter perturbations applied in each simulation are identified in Table 3-14.**

Table 3-13 and Figure 3-3 show that show that SAS results are extremely sensitive to crop coefficient changes. The SAS is also sensitive to the moisture content at saturation and field capacity. The SAS is somewhat sensitive (greater than ±15%) to changes to the hydraulic conductivity of the SAS.

Table 3-14 and Figure 3-3 show that show that UFA results are extremely sensitive to the moisture content at saturation and field capacity. The UFA is also sensitive to the crop coefficient. The UFA is somewhat sensitive (greater than ±15%) to changes to the hydraulic conductivity of the SAS and the ICU and decreases in the hydraulic conductivity of the UFA.

As with the water budget and surface water sensitivities, the SAS and UFA are sensitive to crop coefficient changes because it affects the total volume of water available for runoff and infiltration. The SAS and UFA are also sensitive to the moisture content at saturation and field capacity because these parameters control the amount of water available for groundwater recharge. Also the SAS and UFA are sensitive to the hydraulic conductivities because they directly affect water levels.

## 3.4 Summary of Model Sensitivities

The sensitivity analysis has been performed by identifying 10 parameters that typically have an effect on simulated results and evaluating the impact from changing each parameter with 10 or 20 percent. The effect of perturbing each parameter was evaluated separately by using initial values for the other nine (9) parameters and comparing simulated results to results from a base sensitivity simulation that used initial values for all ten parameters.

The result of each parameter perturbations has been evaluated using select water budget components and quantitative differences at 108 observation locations (31 surface water stage, 17 surface water flow, 29 SAS, and 31 UFA observations). The analysis on water balance components gives an overall model-wide assessment of the effect of parameter perturbations, while the quantitative analysis of differences between the scenarios and the base sensitivity simulation at each observation locations isolates the effect of parameter perturbations at specific locations in the surface water and groundwater systems.

The crop coefficient had the largest impact on simulated water budgets. A 10 percent change in the crop coefficient affects the total simulated evapotranspiration by as much as 8.1 percent. Since evapotranspiration consumes approximately 70 percent of the rainfall in the watershed and an 8 percent change is significant. The moisture content at saturation was the second most sensitive parameter in the water budget analyses, though the impact was not as significant as the crop coefficient. This parameter primarily affects groundwater recharge, and indirectly affects overland flow and irrigation demand.

When evaluating the effect of parameter perturbations at 48 surface water and 60 groundwater observations locations the mean error for each sensitivity simulation was calculated. Calculated mean errors for each surface water and groundwater observation location are given in Earth Tech (2006g). The calculated mean errors summarized in Earth Tech (2006g) were used during model calibration to evaluate how a change in a parameter affects results at each of the observation locations. In order to evaluate the net effect of a parameter perturbation on model results and assess the relative sensitivity of a parameter the individual mean errors for all of the surface water and groundwater observation locations were summed. The summed surface water and groundwater mean error represents the impact of individual parameter perturbations.

Surface water and groundwater responses to parameter group (*i.e.*, crop coefficient, *etc.*) perturbations are summarized in Table 3-15. The crop coefficient and River Manning's n values were identified as the most sensitive parameters for the surface water stage observation locations evaluated. The crop coefficient and overland Manning's *M* values were identified as the most sensitive parameters for the surface water flow observation locations evaluated. SAS results were most sensitive to the crop coefficient and the moisture content at saturation. The UFA was most sensitive to the moisture content at saturation and field capacity.

**Table 3-15: Summary of model sensitivity to parameter perturbations at surface water and groundwater observation locations. The most sensitive parameter groups for surface water stage, surface water flow, SAS water levels, and UFA water levels are identified with shading.**

| Parameter | Simulation Number | Change | Surface Water | | | | Groundwater | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Average Stage ME | Normalized Stage ME | Average Flow ME | Normalized Flow ME | Average SAS ME | Normalized SAS ME | Average UFA ME | Normalized UFA ME |
| **Surficial AQ (Decrease)** | 1 | 20% | 0.025 | 25.5 | 1.389 | -17.8 | -0.016 | 27.4 | -0.036 | -19.6 |
| **Surficial AQ (Increase)** | 2 | 20% | -0.017 | -17.6 | -1.730 | 22.2 | 0.012 | -21.1 | 0.036 | 19.6 |
| **Confining Unit (Decrease)** | 3 | 20% | -0.007 | -7.5 | -0.886 | 11.4 | -0.002 | 3.0 | -0.035 | -19.0 |
| **Confining Unit (Increase)** | 4 | 20% | -0.020 | -20.5 | -1.530 | 19.6 | 0.000 | 0.6 | 0.033 | 17.9 |
| **Floridan AQ (Decrease)** | 5 | 20% | 0.012 | 12.2 | -0.007 | 0.1 | -0.003 | 5.4 | -0.029 | -15.9 |
| **Floridan AQ (Increase)** | 6 | 20% | 0.034 | 35.0 | -1.144 | 14.7 | 0.002 | -3.6 | 0.026 | 14.4 |
| **Kc (Decrease)** | 7 | 10% | -0.070 | -72.1 | -5.823 | 74.6 | 0.057 | -98.3 | 0.051 | 28.0 |
| **Kc (Increase)** | 8 | 10% | 0.098 | 100.0 | 5.194 | -66.6 | -0.058 | 100.0 | -0.050 | -27.3 |
| **OL Manning (Decrease)** | 9 | 10% | -0.008 | -7.9 | -0.982 | 12.6 | 0.000 | 0.8 | 0.001 | 0.6 |
| **OL Manning (Increase)** | 10 | 10% | -0.056 | -57.6 | -7.804 | 100.0 | -0.001 | 1.7 | 0.000 | 0.0 |
| **River Manning (Decrease)** | 11 | 10% | 0.067 | 68.9 | 2.078 | -26.6 | 0.000 | 0.1 | 0.001 | 0.4 |
| **River Manning (Increase)** | 12 | 10% | -0.022 | -22.2 | -0.926 | 11.9 | 0.001 | -1.2 | 0.001 | 0.6 |
| **UZ inf. (Decrease)** | 13 | 20% | 0.002 | 1.9 | -0.139 | 1.8 | 0.000 | 0.3 | 0.000 | -0.2 |
| **UZ inf. (Increase)** | 14 | 20% | -0.003 | -2.7 | -0.475 | 6.1 | -0.001 | 0.9 | -0.001 | -0.4 |
| $_{sat}$ **(Decrease)** | 15 | 20% | -0.043 | -43.9 | -2.891 | 37.0 | 0.049 | -83.8 | 0.182 | 100.0 |
| $_{sat}$ **(Increase)** | 16 | 20% | 0.040 | 41.5 | 1.815 | -23.3 | -0.014 | 24.1 | -0.060 | -32.7 |
| $_{Fc}$ **(Decrease)** | 17 | 20% | 0.026 | 26.9 | 1.069 | -13.7 | -0.014 | 23.8 | -0.074 | -40.5 |
| $_{Fc}$ **(Increase)** | 18 | 20% | -0.003 | -3.6 | -1.203 | 15.4 | 0.047 | -80.5 | 0.132 | 72.5 |
| **Drain constant (Decrease)** | 19 | 10% | 0.021 | 21.4 | 0.578 | -7.4 | -0.008 | 13.3 | -0.015 | -8.4 |
| **Drain constant (Increase)** | 20 | 10% | -0.002 | -1.7 | -0.819 | 10.5 | 0.005 | -8.7 | 0.012 | 6.5 |



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# 4 MODEL CALIBRATION

Calibration of the post-Phase 1 KBMOS model for the period from November 1, 2001 through December 31, 2004 is discussed below. The approach used to calibrate the model is defined along with the criteria that were used to evaluate model performance. The calibration criteria defined in the ATP were refined during the calibration process based on data limitations identified during the calibration process and discussions with SFWMD staff.

Calibration of the model was difficult because of the complexity of the Kissimmee Basin and the size of the KBMOS model. The calibrated model meets the criteria defined for the project and adequately representing hydrologic processes in the Kissimmee Basin and can be used to evaluate alternative operational criteria and restoration of the Kissimmee River. Surface water, groundwater, overland water, water budget, and surface water-groundwater interaction results are presented below.

A small-scale MIKE 11 model was developed for the restored portion of the Kissimmee model to refine the model conceptualization used in the KBMOS model. The objectives and results of the small-scale MIKE 11 model are also presented below. Development of this model was essential to adequately simulate the restored portion of the Kissimmee River and will be used to guide development of the restored Pool BC portion of the Kissimmee River in the future conditions model developed in later phases of the KBMOS. Analysis of calibration of the KUB is limited because this portion of the model was developed from the previously developed Lake Toho MIKE SHE/MIKE 11 model and was not included in the KBMOS scope of work.

## 4.1 Approach

The results of the sensitivity analysis and the KBMOS AFET Acceptance Test Plan (Earth Tech, 2006b) were used to develop a diagram that details the model calibration process that was used during calibration of the KBMOS MIKE SHE/MIKE 11 model. A regional model (RM) that uses a 3,000 × 3,000 ft grid spacing and includes the ICU and the UFA will be used to develop dynamic groundwater boundary conditions of the UFA for a higher resolution MIKE SHE/MIKE 11 model of the SAS. The higher resolution SAS model (SM) uses a 1,000 × 1,000 ft grid spacing and be used to optimize structure operations in the Kissimmee Basin in a later phase of the project.

A general figure showing the interaction between the RM and SM is shown in Figure 4-1. This Figure includes three basic processes:

1. MIKE SHE Water Budget Calibration
2. Surface Water Calibration
3. Groundwater Calibration

The first step towards achieving the MIKE SHE water budget calibration was to modify the crop coefficients (Kc) until the resulting values of actual evapotranspiration produced by the model fell within the range of expected values. Once the Kc values were tuned up, the next step included the modification of soil parameters (Field capacity, wilting point and saturation potential). The actual evapotranspiration results were checked again for reasonableness. A check for the SAS recharge was also added at this point. When necessary the infiltration parameters were also modified. Once the SAS recharge values were within the expected range, the UFA leakage was reviewed. The parameter used to achieve an accepted UFA leakage was the ICU hydraulic conductivity (K). The process described above can be summarized by a downward sweep where the upper layers of the model were tuned first before reviewing the results of the lower layers.

The surface water calibration focused first in evaluating the peak discharges. The overland flow roughness coefficient ($M_{OL}$) was the parameter used to adjust the peak. This parameter controls the time of concentration of the hydrologic units in the model. After the peak flows were matching the total cumulative error was evaluated. The drainage time was adjusted to reduce the cumulative error to acceptable values. After calibrating the "volumetric" portion of the surface water network, the stream's mannings' n was adjusted to achieved the correct stages in all branches of the model. At this point another check of the main parameters reviewed under the MIKE SHE water budget calibration were revisited to evaluate the need to another downward sweep.

The third process, the groundwater calibration, was divided in two parts. The first part dealt with the Regional Model (3-layer 3,000-foot-grid-cell). The heads in the upper floridan aquifer were evaluated. If necessary soil physical parameters and UFA K were adjusted. The second part of the groundwater calibration dealt with the SAS. Again, soil physical parameters and SAS K were adjusted to achieve the desired ranges in head.

The calibration, as shown in Figure 4-1**,** iterated between the three basic process until the pre-established calibration criteria was achieved. Calibration targets are discussed further in this document. The values for the adjusted parameters at the end of the calibration process correspond to the information presented in Section 2.

Early phases of model calibration followed the process identified in Figure 4-1 but as calibration progressed it was not uncommon for surface water and groundwater parameters to be modified concurrently. In fact, this approach was used exclusively in the last phases of model calibration after the modeling team had developed a good understanding of parameter sensitivities and the effect of concurrent modification of surface water and groundwater parameters. Furthermore, in later phases of the calibration process water budgets were routinely evaluated during each model simulation. This modification of the calibration process is not considered a deviation from the approach defined in the ATP but a natural evolution that occurred as the model team's understanding of the Kissimmee Basin evolved.

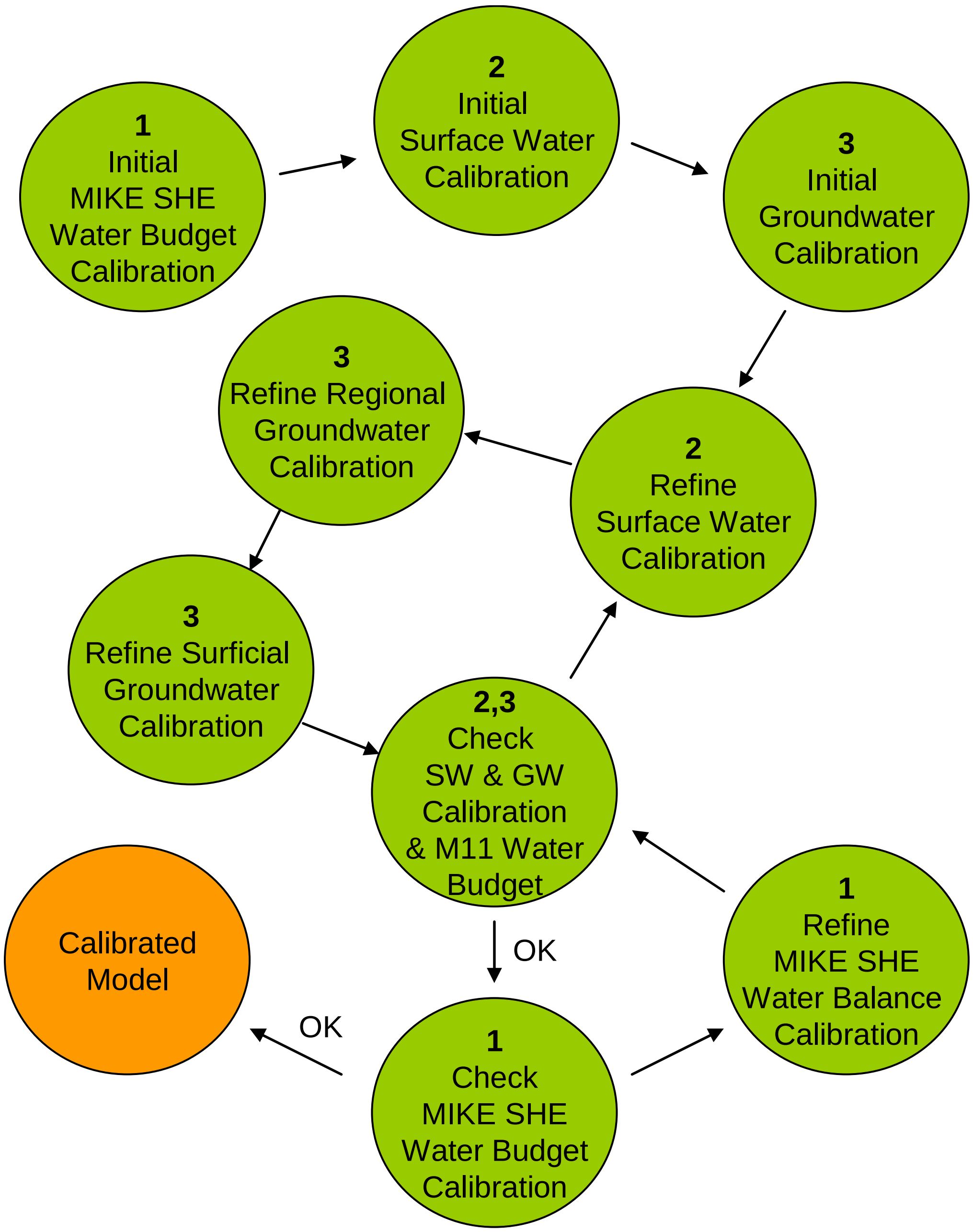


**Figure 4-1: General calibration process used in the KBMOS MIKE SHE/MIKE 11 model.**

For calibration purposes only, the control structures in the Pre- and Post-Phase 1 models are dynamically operated using the observed headwater stage data to open and close the gates and dynamically simulate structure discharges. The gates begin to open when the simulated headwater stage is at least 0.1 feet above the observed stage and begin to close when simulated stages are within 0.1 feet of the observed stage. During the course of the project the modeling team evaluated using reported gate opening data provided by the SFWMD. It was decided to not use the reported gate opening data for the reasons stated in Section 2.8.5.

## 4.2 Calibration Criteria

The calibration criteria set in the Acceptance Test Plan- ATP - (Earth Tech, 2006b) were revised during the calibration process. This revision was performed with the assistance of the District's Hydrological and Environmental Systems Modeling (HESM) Department and was justified by limitations in measured data, a large range of parameters to examine, and uncertainty in the significance of the various flow processes throughout the watershed, which are problems associated with all seminal models.

Modeling (HESM) and EarthTech reviewed the initial set of calibration metrics and identified a subset of metrics that appear critical to a successful calibration. The AFET calibration statistics were classified into three groups:

- Highly Useful (H)
- Moderately Useful (M) and
- Low Utility (L):

Those statistics defined as highly useful (H) will use targets defined for these stations similar to the targets defined in the final draft version of the ATP, the following features described the statistics under this group:

- Data quality = good
- Type-of-Data and Location are similar to data used to define KBMOS Performance Measures.

The statistics defined as moderately useful (M) will use targets that are lower than the H targets. Generally, these targets are equivalent to those described in the ATP as Fair to Good, the following features described the statistics under this group:

- Data quality = good
- Type-of-Data and Location are distant from data used to define KBMOS Performance Measures.

There are no targets defined for those statistics defined as low utility (L). Those metrics were not be part of the formal calibration documentation. However, if required by other potential users of the model, they would be presented in a separate table for information purposes only.

- Data quality = 'marginal' OR 'good but dominated by small-scale h&h processes not captured by regional model

# Table 4-1: Revised Targets for Stage Statistic

**Surface Water Flow Network: Stage Statistics**
Metrics are divided in 3 groups: Highly Useful (H), Moderately Useful (M) and Low Utility (L)

| MODEL AREA | Station | RMSE | R(correlation) | Comments | |
|---|---|---|---|---|---|
| **Stages in Upper Basin Lake Management Units** | | | | | |
| LMU K-H-C | S65H | H | H | Time-series of Observed Headwater Stage used as Operational Target Head | |
| LMU K-H-C | S61T | H | H | | |
| LMU K-H-C | S63AT | M | M | | |
| LMU K-H-C | LCYPR19 | L | L | datum issues (zhiming) | |
| LMU K-H-C | L Hatch3 H | L | L | datum issues (zhiming) | |
| LMU K-H-C | LKiss5B | L | L | | |
| LMU Toho | S61H | H | H | Time-series of Observed Headwater Stage used as Operational Target Head | |
| LMU Toho | TohoW_H | L | L | similar to S61 | |
| LMU Toho | S59T | H | H | Comments for structures S59, S62, S57, S58, S60, S63, S63A: #1. All Datums need inspection and recertification (zhiming). #2. Time-series of Observed Headwater Stage are used in model as an Operational Target Head #3 Hydrography in this area is uncertain. Investigation of the connection between the Alligator Chain and the Lake Conlon WCC is needed | |
| LMU Etoho | S59H | H | H | | |
| LMU Etoho | S62T | M | M | | |
| LMU Hart | S62H | M | M | | |
| LMU Hart | S57T | M | M | | |
| LMU Myrtle | S57H | M | M | | |
| LMU Myrtle | S58T | M | M | | |
| LMU Alligator | S58H | M | M | | |
| LMU Alligator | S60H | M | M | | |
| LMU Gentry | S60T | M | M | | |
| LMU Gentry | S63H | M | M | | |
| LMU s63a | S63T | M | M | | |
| LMU s63a | S63AH | M | M | | |
| **Stages in Upper Basin's unmanaged watersheds** | | | | | |
| ws_UpperReedy | REEDYLOU | M | M | long-period usgs station; managed system | No Performance Measures associated with these systems |
| ws_UpperReedy | REEDY-LO | L | L | long-period usgs station; managed system | |
| ws_UpperReedy | ReedyS46 | L | L | long-period usgs station; managed system | |
| ws_shingle | Shing.cp | L | L | long-period usgs station; unmanaged system | |
| ws_shingle | Shing.ap | L | L | long-period usgs station; unmanaged system | |
| ws_boggy | BoggyAFB | L | L | long-period usgs station; unmanaged system | |
| ws_boggy | Boggy.TA | L | L | long-period usgs station; unmanaged system | |
| ws_??? | Maric | L | L | | |
| ws_catfishcrk | Catfish | L | L | long-period usgs station near outlet to Lake Pierce | |
| ws_??? | L Maria2_H | L | L | | |
| ws_??? | L Maria2_T | L | L | | |
| ws_weihya | Weohya | L | L | incomplete por | |
| **Stages in Lower Basin Lake Management Units** | | | | | |
| Pool A | S65T | H | H | | |
| Pool A | RATHAM | L | L | This station was taken out of the calibration set. It is located in a unconnected branch of the river | |
| Pool A | S65AH | H | H | Time-series of Observed Headwater Stage used as Operational Target Head | |
| Pool BC | S65AT | H | H | | |
| Pool BC | weir3H | H | H | weirs dominate during low-flow conditions only, when floodplain flow is minor | |
| Pool BC | weir3T | H | H | | |
| Pool BC | weir2H | H | H | | |
| Pool BC | weir2T | H | H | | |
| Pool BC | weir1H | H | H | | |
| Pool BC | weir1T | H | H | | |
| Pool BC | avonP4 | L | L | This station was taken out of the calibration set. Influenced by local hydrography not represented in the model | |
| Pool BC | PC61 | M | M | PC61, PC52, PC45, PC21,PC31 are not in the KRR Channel and may be affected by micro-topography and hydrography not included in the model. For PC51, PC52, PC45, PC33, PC21, and PC31, post-processing generates floodplain statistics from both mike 11 and mike SHE | |
| Pool BC | PC52 | M | M | | |
| Pool BC | PC45 | M | M | | |
| Pool BC | PC33 | H | H | | |
| Pool BC | PC21 | M | M | | |
| Pool BC | PC31 | M | M | | |
| Pool BC | S65CH | H | H | Time-series of Observed Headwater Stage used as Operational Target Head | |
| Pool D | S65CT | H | H | | |
| Pool D | C38bas | L | L | | |
| Pool D | S65DH | H | H | Time-series of Observed Headwater Stage used as Operational Target Head | |
| Pool E | S65DT | L | H | datum issues (zhiming) | |
| Pool E | S65EH | H | H | Time-series of Observed Headwater Stage used as Operational Target Head | |
| **Stages in Lower Basin's unmanaged watersheds** | | | | | |
| D_Chandler | CYPRS | H | H | tests MIKE SHE in all of lower basin | |
| D_Chandler | CHAND1 | H | H | tests MIKE SHE in all of lower basin | |
| **Lake O** | S65ET | H | H | | |

Rationale for selection of statistics Targets:
Highly Useful (H):
RMSE ATP Statistic Target range 1.0 to 2.5-ft
R ATP Statistic Target range 0.50 to 0.75
Moderately Useful (M):
RMSE ATP Statistic Target low end of range plus 0.5-ft
R ATP Statistic Target low end of range minus 0.05

# Table 4-2: Revised Targets for Flow Statistics

**Surface Water Flow Network: Flow Statistics**

Metrics are divided in 3 groups: Highly Useful (H), Moderately Useful (M) and Low Utility (L)

| UPSTREAM WCU | DOWNSTREAM WCU | STATION | CE | R(correlation) | COMMENTS | |
|---|---|---|---|---|---|---|
| **Flows in Upper Basin Lake Management Units** | | | | | | |
| LMU Myrtle | LMU Hart | S57Q | M | M | moderate data quality | |
| LMU Hart | LMU Etoho | S62Q | M | M | moderate data quality | |
| LMU Etoho | LMU Toho | S59Q | M | M | known flooding issues, impacted by Boggy flows | |
| LMU Toho | LMU KHC | S61Q | H | H | large storage area | |
| LMU Alligator | LMU Myrtle | S58Q | M | M | It is a divide structure with little to no flow | |
| LMU Alligator | LMU Gentry | S60Q | M | M | leakage and bypass flow issues | |
| LMU Gentry | LMU s63a | S63Q | M | H | leakage and bypass flow issues | |
| LMU s63a | LMU KHC | S63AQ | M | M | leakage and bypass flow issues | |
| LMU KHC | PoolA | S65Q | H | H | very large storage area | |
| **Flows in Upper Basin's unmanaged watersheds** | | | | | | |
| ws_boggy | LMU EToho | boggy_ta | M | M | long-period USGS station; important to Etoho | No Performance Measures associated with these systems |
| ws_lake pierce | WS_catfish creek | catfish Q | M | M | long-period USGS station near outlet to Lake Pierce | |
| ws_upperreedy | ws_lowerreedy | reedy | M | M | long-period USGS station | |
| ws_shingle | LMU Toho | shingle | M | M | long-period USGS station; important to Toho | |
| **Flows in Lower Basin Lake Management Units** | | | | | | |
| PoolA | PoolBC | S65AQ | M | M | S65A flow Record does not include Overflow | |
| PoolBC | PoolBC | PC33Q | L | L | ET concerned about method and accuracy of the "observed" flow calculations | |
| PoolBC | PoolBC | weir3Q | L | L | weirs dominate only when floodplain flow is minor | |
| PoolBC | PoolBC | weir2Q | L | L | weirs dominate only when floodplain flow is minor | |
| PoolBC | PoolBC | weir1Q | L | L | weirs dominate only when floodplain flow is minor | |
| PoolBC | PoolD | S65CQ | H | H | | |
| PoolD | PoolE | S65DQ | H | H | | |
| PoolE | Lake O | S65EQ | H | H | | |
| **Flows in Lower Basin's unmanaged watersheds** | | | | | | |
| PoolD | PoolD | usgs2272676 | L | M | new USGS station: cypress slough in pool D | |

Rattionale for selection of statistics Targets:
Highly Useful (H):
CE ATP Statistic for 'Good' (<15%) plus average basinwide flow calcuation error of 7%
R ATP Statistic for 'Good' (>0.84)
Moderately Useful (M):
CE ATP Statistic for 'Fair' (<25%) plus average basinwide flow calcuation error of 7%
R Statistic set at 20% below minimum level for 'Fair'

## Table 4-3: Revised Targets for Groundwater Statistics

**Groundwater Stage Statistics**

Metrics are divided in 3 groups: Highly Useful (H), Moderately Useful (M) and Low Utility (L)

| MODEL AREA | Station | RMSE | R(correlation) | COMMENTS |
|---|---|---|---|---|
| **UKB SAS Calibration Wells for the 1000 x 1000 ft model** | | | | |
| UKB bc | BEELINE | M | M | This is a Boundary station, hardly influenced by model parameters |
| UKB north | TAFT | H | H | |
| UKB north | POINCI | L | L | Datum issue |
| UKB north | KISSFS | H | H | |
| UKB north | MAKO | L | L | Datum issue |
| UKB north | REEDGW 10 | H | H | |
| UKB alligator | ALL 1 | H | H | |
| UKB alligator | ALL 2 | L | L | Clustered with ALL2, only ALL1 to be used in this area |
| UKB east | CAST | H | H | |
| UKB east | EXOT | H | H | |
| UKB north | KIRCOF | L | L | unusual pattern (reversed chain?) in pre-2002 data. Data after Jul 2002 OK |
| UKB east | PINEISL | H | H | |
| UKB central | WR 6 | H | H | Only WR 6 and WR11 will be used in this area |
| UKB central | WR 9 | L | L | |
| UKB central | WR 11 | H | H | |
| UKB central | WR 15 | L | L | |
| UKB east | WR 16 | L | L | |
| UKB east | CHAPMAN | H | H | |
| UKB east | SNIVELY | L | L | Datum issue |
| UKB east | KENANS 1 | H | H | |
| UKB east | INDIAN_L | L | L | Datum issue |
| **LKB SAS Calibration Wells for the 1000 x 1000 ft model** | | | | |
| LKB west | AVONP4 | L | L | Not good for regional calibration - influenced by local hydrography not represented in the model |
| LKB west | PA1F | M | M | |
| LKB east | ELMAX | H | H | |
| LKB kr | TICKICL | H | H | |
| LKB east | MAXCEY-N | H | H | |
| LKB east | PEAVINE | H | H | |
| LKB east | MAXCEY-S | H | H | |
| LKB east | GRIFFITH | H | H | |
| **Kissimmee River Seepage Wells:** | | | | |
| LKB poolA | KRFNS | L | L | Do not use to calibrate regional-scale modeling - these wells show local drawdown near river - 'near&shallow' well |
| LKB poolA | KRENS | L | L | |
| LKB poolC | KRDRS | L | L | |
| LKB poolC | KRBNS | L | L | |
| **Floridan Wells for the 3000 x 3000 ft model** | | | | |
| The Acceptance Test Plan (ATP) also considers wells in the Floridan aquifer system (FAS). Calibration to the Floridan Aquifer System has two elements; the first is a qualitative calibration, comparing to USGS seasonal contour plots. The second is a comparison of 1000x1000 MIKE SHE modeled SAS lower-boundary flow against 3000x3000 MIKE SHE modeled flow through the confining layer. Flows are also compared to Aucott's estimated (1988) recharge of FAS. | | | | |

Rattionale for selection of statistics Targets:
Highly Useful (H):
RMSE ATP Statistic Target range 2.5 to 3.0-ft
R ATP Statistic Target range 0.50 to 0.75
Moderately Useful (M):
RMSE ATP Statistic Target low end of range plus 0.5-ft
R ATP Statistic Target low end of range minus 0.05

Statistics targets and classification are summarized in Table 4-1, Table 4-2 and Table 4-3. Revised targets and the reasons for assigning specific utility values are provided in the 'comment' columns of the above mentioned tables. Among those reasons are: poor datum referencing, proximity to a boundary condition (internal and external), sensitivity of critical Performance Measures to a specific statistic, significance of small-scale factors that cannot be captured by regional model.

The Acceptance Test Plan (ATP) also considers wells in the Floridan aquifer system (FAS). Calibration to the Floridan Aquifer System has two elements; the first is a qualitative calibration, comparing to USGS seasonal contour plots. The second is a comparison of 1000x1000 MIKE SHE modeled SAS lower-boundary flow against 3000x3000 MIKE SHE modeled flow through the confining layer. Flows are also compared to Aucott's estimated (1988) recharge of FAS.

The equations used to calculate the statistics indicated above are included in the ATP (Earth Tech, 2006b).

## 4.3 Calibration Data

The following sections will discuss the results of the completed calibration efforts. For all calibration plots, the results represent the selected calibration period of November 1, 2001 through December 31, 2004.

### 4.3.1 Surface Water Data

The discussion of surface water data is focused on those locations that were identified as Key Calibration Points for Performance Measures. The results will be presented by basin.

### 4.3.2 Groundwater Data

The discussion of groundwater data is focused on those locations that are in close proximity to the Kissimmee River. These locations are considered most important due to the interaction of the groundwater and surface water systems.

### 4.3.3 Water Budgets for the Upper Kissimmee Basin

The discussion of water budgets will focus primarily on sub-watersheds (see Figure 2-4). Water budgets will include elements obtained from MIKE SHE and MIKE 11, emphasizing in the volume of water stored in the Upper Basin Lakes and in the Kissimmee River Floodplain. Tables of seasonal water budgets are presented for the calibration, verification, and storm verification periods.

## 4.4 Restored Kissimmee River MIKE 11 Sub-Model

A stand-alone MIKE 11 was developed for the restored portion of the Kissimmee River. The purpose of this model was to improve the surface water calibration of the restored portion of the Kissimmee River, particularly the models ability to accurately predict high water levels during the 2004 storm period. Prior to this exercise, simulated stages in the KBMOS MIKE 11 model were 1-4 feet lower than observed in the restored portion of the River during the peak of the storm. This model deficiency was shown throughout the entire restored portion of the Kissimmee River and floodplain calibration locations: PC61, KRDRS, PC52, KRBNS, PC45, PC33, PC31, and PC21.

The sub-model provided an efficient method to concentrate calibration efforts on this particular portion of the Kissimmee Basin model. The approach used with the sub-model was to improve the representation of the hydraulic system by evaluating the storage, topography, and geometry of the hydraulic network using observed inflows and water levels at the upstream and downstream boundaries, respectively.

The model includes the hydraulic network from the S-65A structure to the S-65C structure (Figure 4-3). S-65A and S-65C were not explicitly included in the model, but, as explained below, the observed data from these structures were used to provide upstream and downstream boundary conditions for the model. The sub-model network includes the portion of the C-38 canal south of S-65A, meanders 7 through 12, the restored portion of the Kissimmee River, the portion of the C-38 canal north of S-65C, and meander 17. Oak Creek, Pine Island Slough, and Sevenmile Slough were excluded from the network, but were represented numerically using watershed inflows calculated from observed data as explained below.

Observed flow at S-65A was initially used as the upstream boundary condition in the sub-model. During the calibration of the sub-model, it was observed that the observed flows through S-65A were significantly lower than the observed flows through S-65, located upstream of S-65A, was significantly less during the storm period. The observed discharge data at S-65A only represents flow through the structure and does not take into account the flow through the adjacent floodplain weirs. Therefore, an adjusted time series based on the maximum flow at S-65 or S-65A was generate and used as the upstream boundary condition, instead of the S-65A observed flows. The composite flow used in the storm verification and calibration periods is shown in Figure 4-4 and Figure 4-5. Observed headwater levels at S-65C were used as the downstream boundary condition in the sub-model.

The Oak Creek, Pine Island Slough, and Sevenmile Slough tributary systems were represented as boundary conditions in the sub-model. The inflow at these locations were assumed to be the difference between flow at S-65C and the composite flow calculated from observed data from S-65 and S-65A. Inflows for Pine Island Slough and Sevenmile Slough were combined at a single location. The inflows for Oak Creek and the combined Pine Island and Sevenmile Sloughs are shown in Figure 4-4 and Figure 4-5.

The following improvements were made to the Kissimmee River hydraulic system during the calibration of the sub-model:

1. A branch (KR-M17_Canal) parallel to the Kissimmee River meander just upstream of S-65C was added.
2. Two cross sections were added to represent the constriction between Kissimmee River and the C-38 canal that exists where erosion reconnected the restored section to the C-38 after backfilling.
3. New Kissimmee River cross sections were extracted from the TIN dataset.
4. Head-loss coefficients for Weir 1, 2, and 3 were modified to improve model calibration.
5. Channel Manning’s values were modified to improve model calibration.

The branch west of the restored portion of the Kissimmee River (KR-M17_Canal) upstream of the S-65C structure was added to improve the downstream connection of the Kissimmee River to the C-38 and to capture the water level differences between the western site of the floodplain and the main channel of the restored portion of the Kissimmee River. Aerial photographs that illustrate how the KR-M17_Canal is connected to the Kissimmee River are shown in Figure 4-6 through Figure 4-8. The northern and southern connections of KR-M17_Canal to the main channel of the restored portion of the Kissimmee River are shown in Figure 4-7 and Figure 4-8, respectively. The parallel branch actually starts north of the location indicated in Figure 4-7**,** however, the conveyance of this feature is included in the cross sections representing the main branch, which cover the entire width of the floodplain. An example of water level differences between the western portion of the floodplain and the restored portion of the Kissimmee River at PC45 and KRBNS, located at the northern end of the new branch, is shown in Figure 4-9. In the western portion of the floodplain water levels during the dry season are lower than observed in the Kissimmee River and indicates these two areas are only connected during high flow conditions.

The creation of the MIKE 11 sub-model led to the identification of the main issue causing poor match between observed and calibration stages in the restored portion of the river. It was noted that a connection of the restored portion of the river and the downstream terminus of the C-38 backfill had developed after the completion of Phase I of the Restoration Project (Figure 4-6 and Figure 4-8**)**. A conceptual cross section was added at the downstream connection of the restored portion of the Kissimmee River and C-38 canal to add a constriction that would better represent the head loss between the PC33 gage and S-65C. The cross section geometry was developed in an iterative fashion in order to develop a rating curve capable of matching the observed data. Since the connection between the restored portion of the Kissimmee River and the C-38 developed after backfilling as a result of to scouring and sediment deposition, it is difficult to define a unique cross section that is valid for the entire post-Phase I period (2001 – 2004). The final cross section represents the geometry that best matched the data starting at the wet season of 2004 and thereafter.

A DEM with a 5-foot grid resolution was created from the Post Phase 1 TIN dataset and was used to develop a new set of cross sections for the restored portion of the Kissimmee River flood plain and KR-M17_Canal. Cross sections for the restored portion of the Kissimmee River were previously extracted from the 100-ft cell Post-NED DEM dataset. Cross sections were also extracted using a smaller spacing interval than used in previous extractions. As a result the horizontal and vertical resolution of cross sections in the restored portion of the Kissimmee River has been significantly improved between S-65A and S-65C.

Finally, head loss coefficient and channel Manning's values was modified to improve model calibration. Head loss coefficients were adjusted using observed headwater and tailwater stage data to guide modifications. Specific changes to Manning values in the restored portion of the Kissimmee River included refining distinct floodplain and channel values.

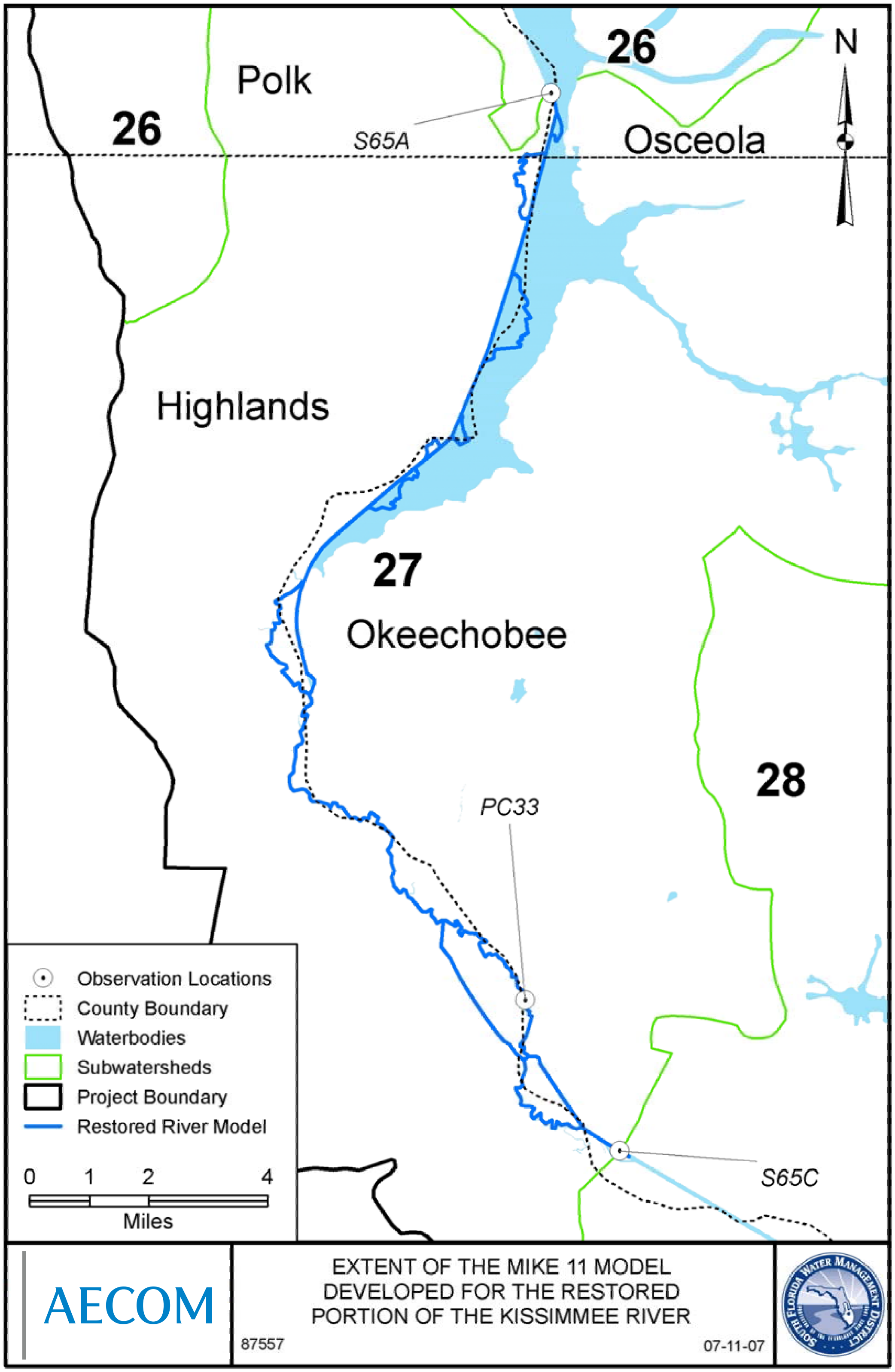


**Figure 4-2: Extent of the MIKE 11 model developed for the restored portion of the Kissimmee River.**

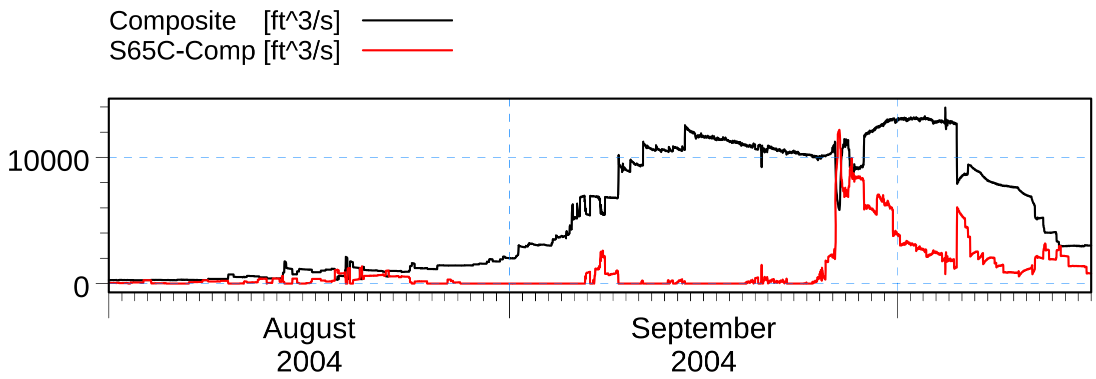


**Figure 4-3: Inflow conditions at S-65A (Composite) and lateral inflows (S-65C-Comp) to the restored Kissimmee River MIKE 11 sub-model during the storm verification period.**

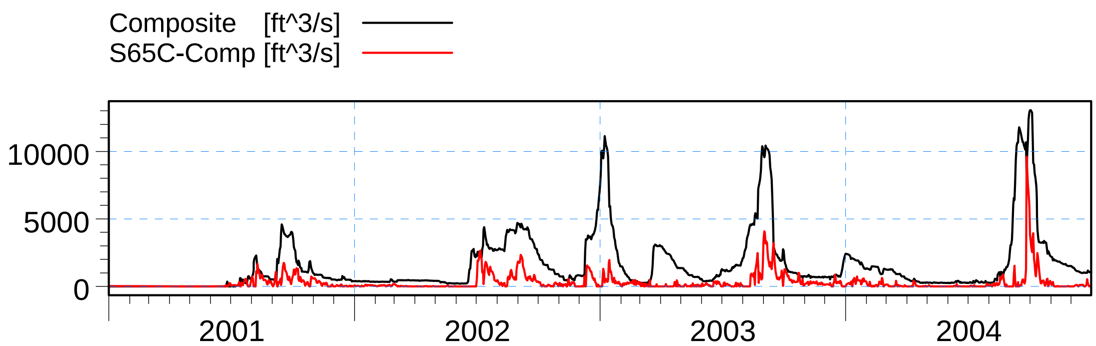


**Figure 4-4: Inflow conditions at S-65A (Composite) and lateral inflows (S-65C-Comp) to the restored Kissimmee River MIKE 11 sub-model during the calibration period.**

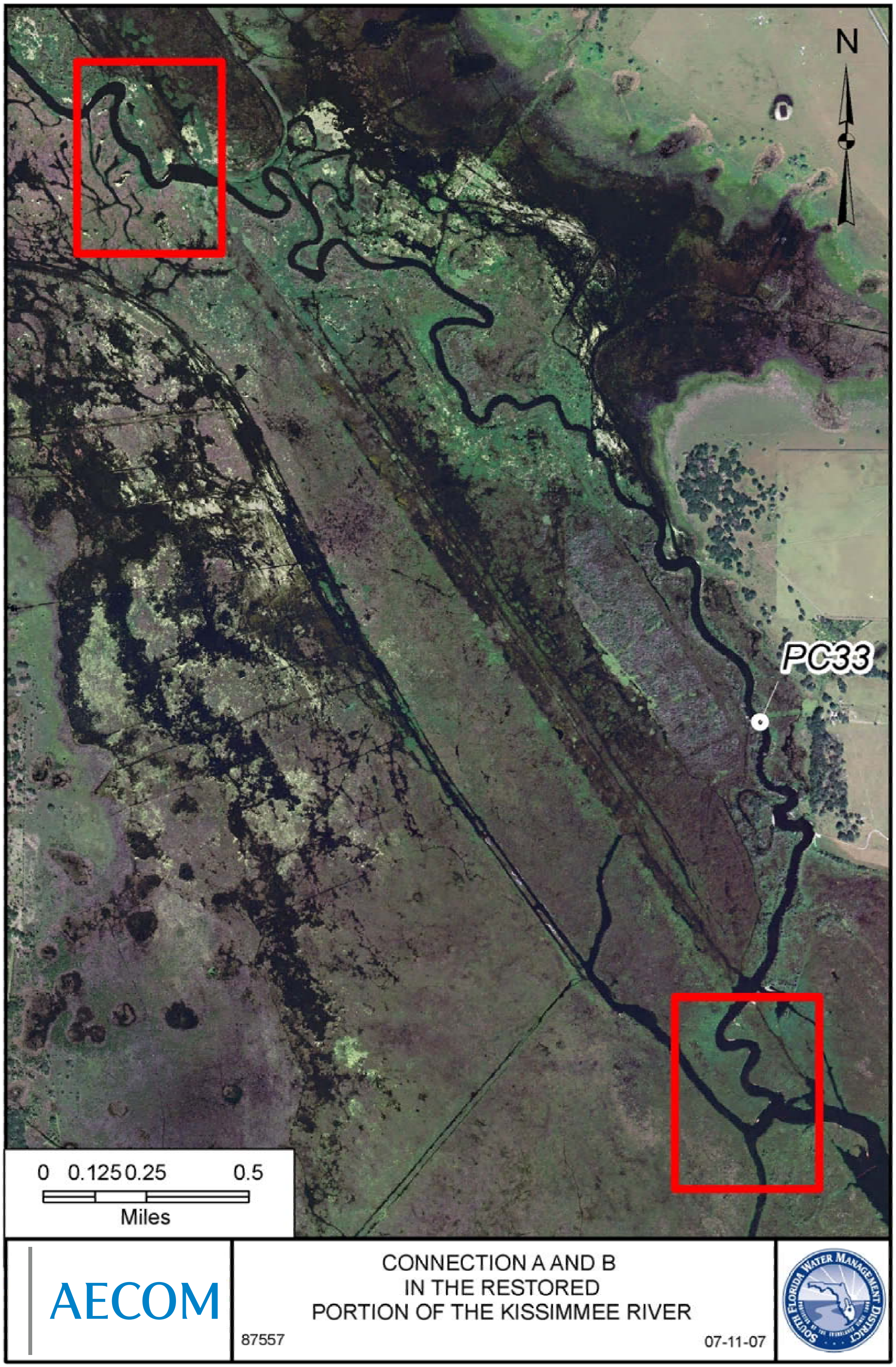


**Figure 4-5: 2004 Aerial photograph of the restored portion of the Kissimmee River in the vicinity of PC-33.**


**Figure 4-6: 2004 Aerial photograph of the northern portion of the high flow bypass of PC-33 (connection A) in the restored portion of the Kissimmee River.**


**Figure 4-7: 2004 Aerial photograph of the southern portion of the high flow bypass of PC-33 (connection B) and new connection between the restored portion of the Kissimmee River and the C-38 upstream of S-65C.**

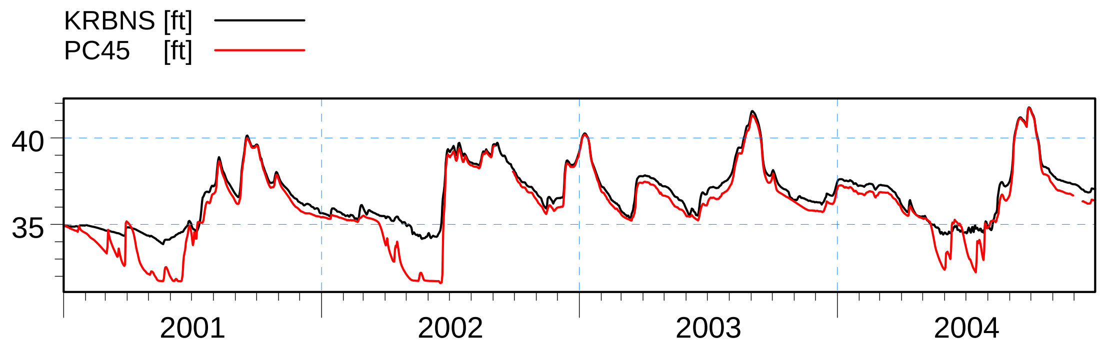


**Figure 4-8: Observed stage at KRBNS and PC45 in the restored portion of the Kissimmee River during the calibration period.**

#### 4.4.1 Results for the Restore Kissimmee River Model

The modifications made to the sub-model resulted in significantly model performance throughout the restored portion of the Kissimmee River during all flow regimes. The final set of cross sections and model parameters were used in the final AFET Post-Phase 1 MIKE 11 model.

##### 4.4.1.1 Storm Verification Period

Results for the storm verification period are shown in Figure 4-10 through Figure 4-21.

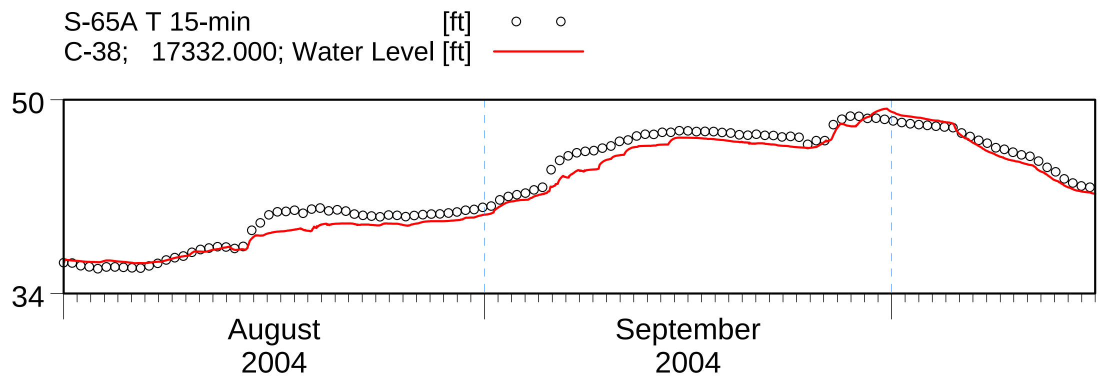


**Figure 4-9: Simulated and observed tailwater stage at S-65A during the storm verification period.**

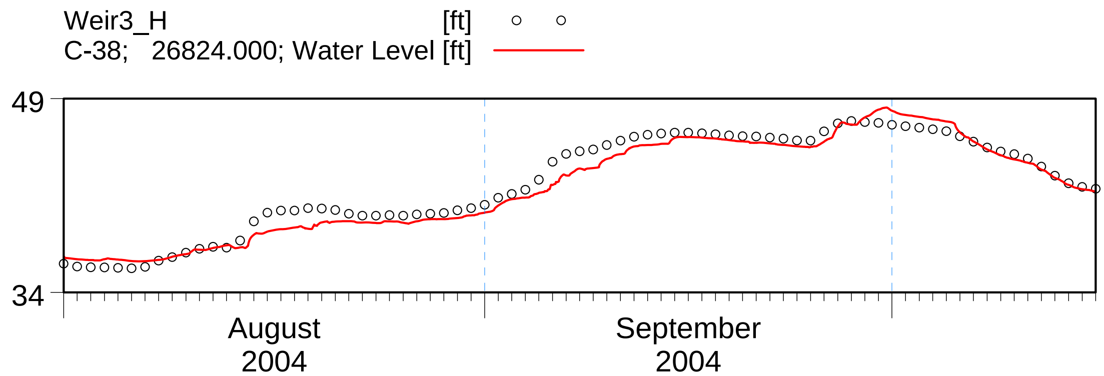


**Figure 4-10: Simulated and observed headwater stage at Weir 3 during the storm verification period.**

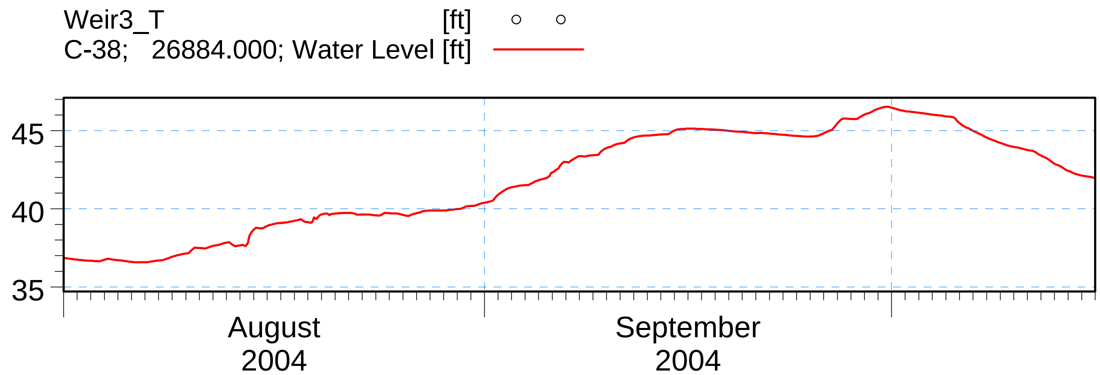


**Figure 4-11: Simulated and observed tailwater stage at Weir 3 during the storm verification period.**

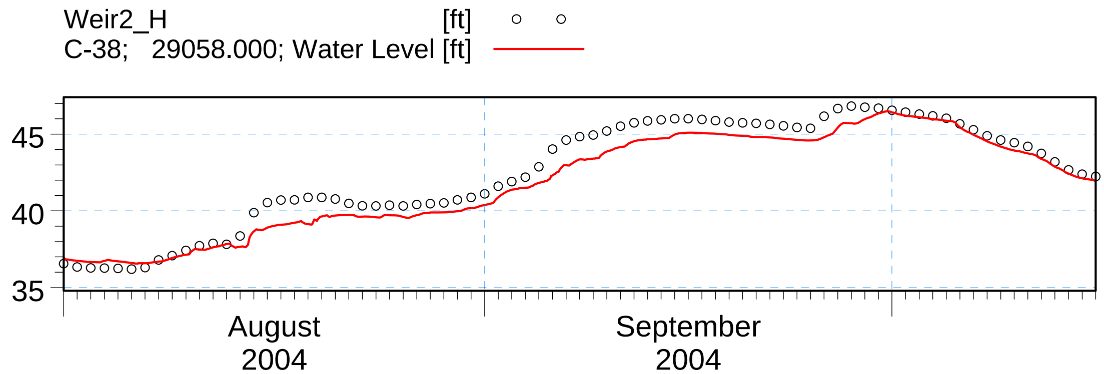


**Figure 4-12: Simulated and observed headwater stage at Weir 2 during the storm verification period.**

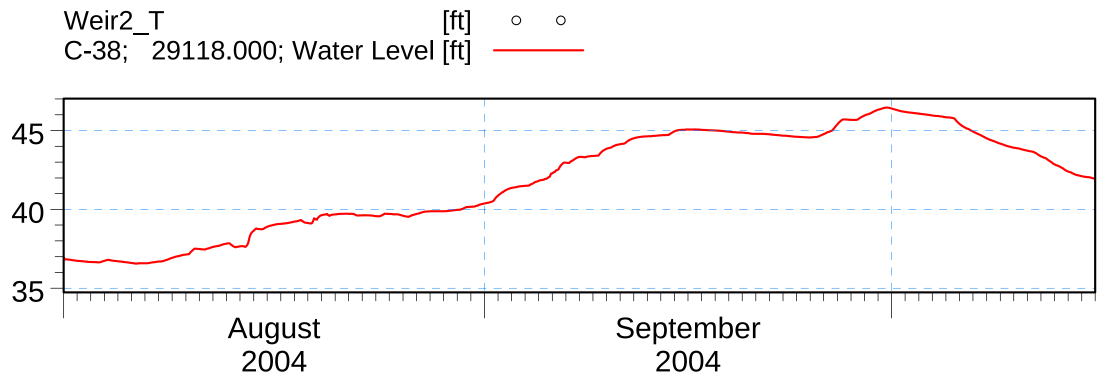


**Figure 4-13: Simulated and observed tailwater stage at Weir 2 during the storm verification period.**

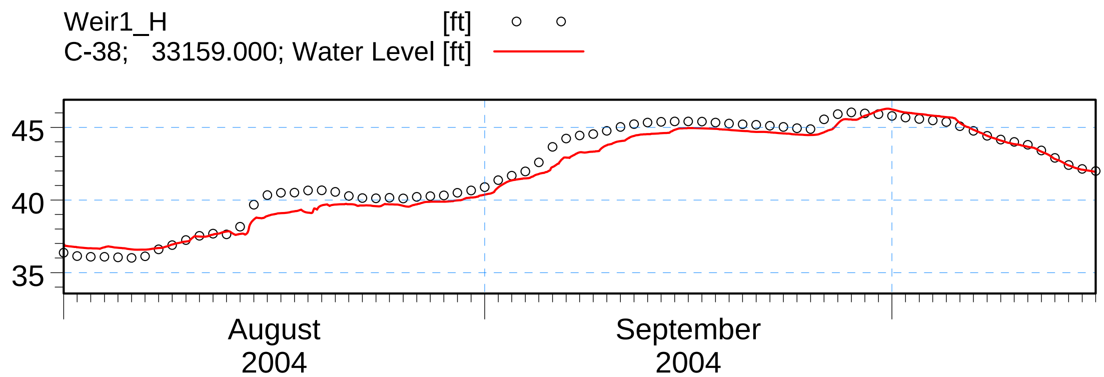


**Figure 4-14: Simulated and observed headwater stage at Weir 1 during the storm verification period.**

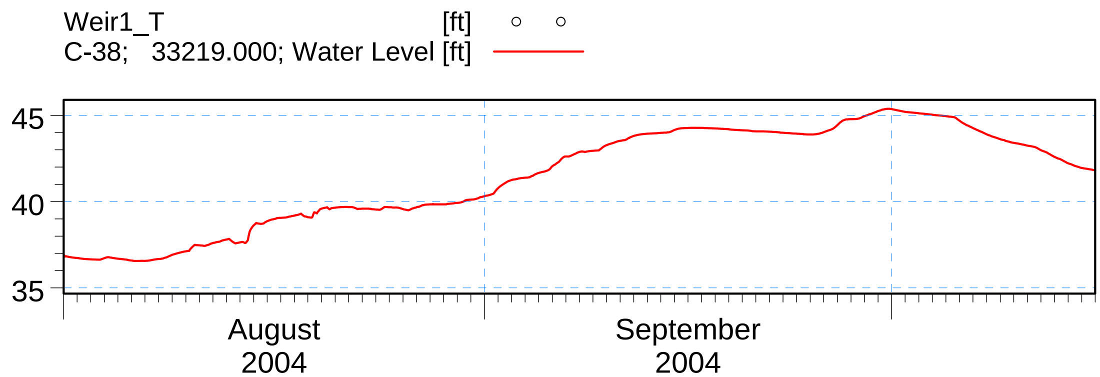


**Figure 4-15: Simulated and observed tailwater stage at Weir 1 during the storm verification period.**

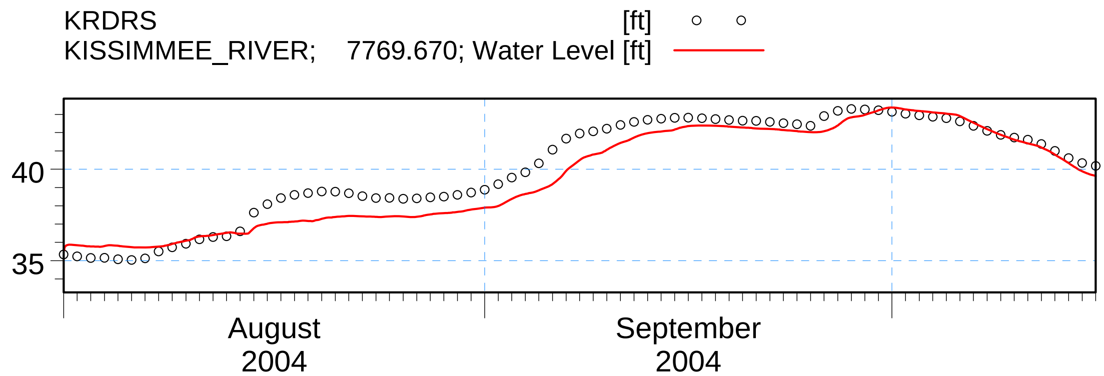


**Figure 4-16: Simulated and observed stage at KRDRS during the storm verification period.**

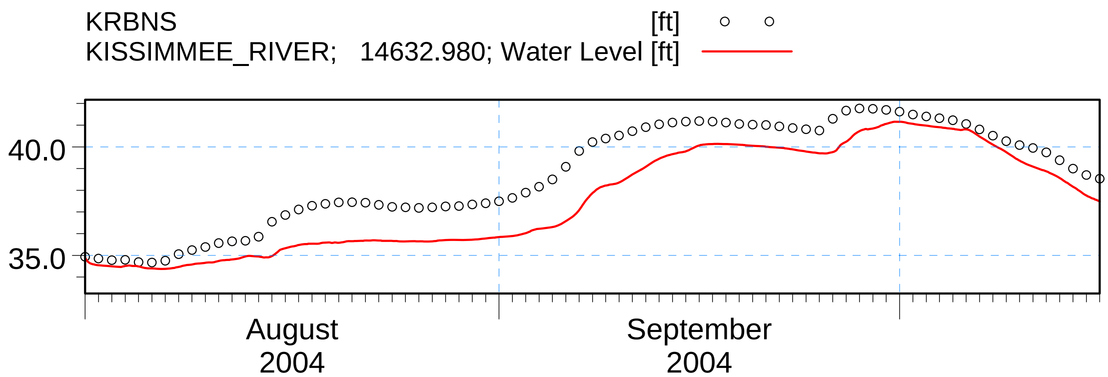


**Figure 4-17: Simulated and observed stage at KRBNS during the storm verification period.**

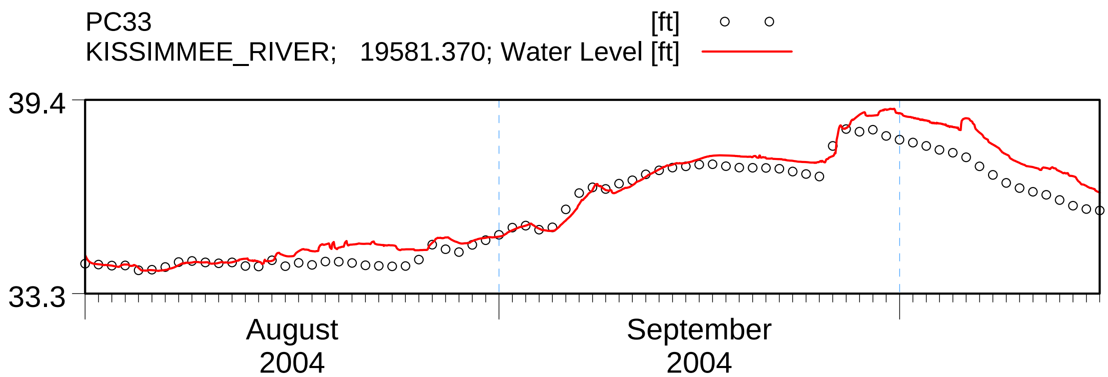


**Figure 4-18: Simulated and observed headwater stage at PC33 during the storm verification period.**

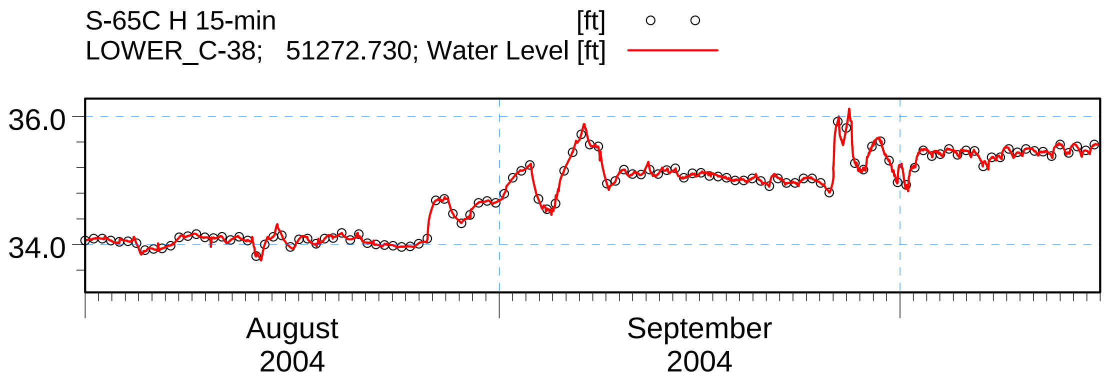


**Figure 4-19: Simulated and observed headwater stage at S-65C during the storm verification period.**

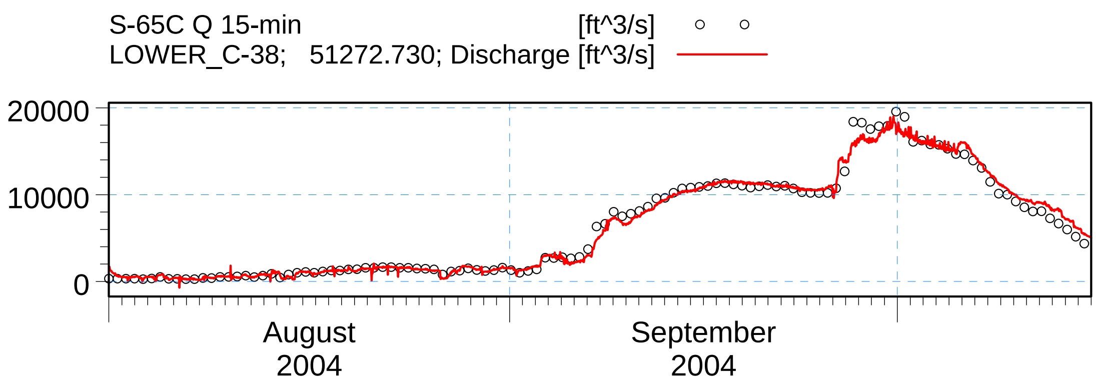


**Figure 4-20: Simulated and observed headwater flow at S-65C during the storm verification period.**

### 4.4.1.2 Calibration Period

Results for the calibration period are shown in Figure 4-22 through Figure 4-33.

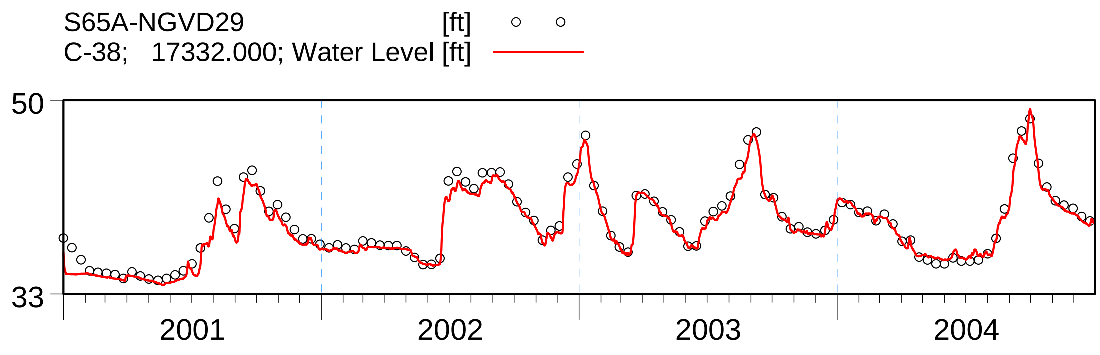


**Figure 4-21: Simulated and observed tailwater stage at S-65A during the calibration period.**

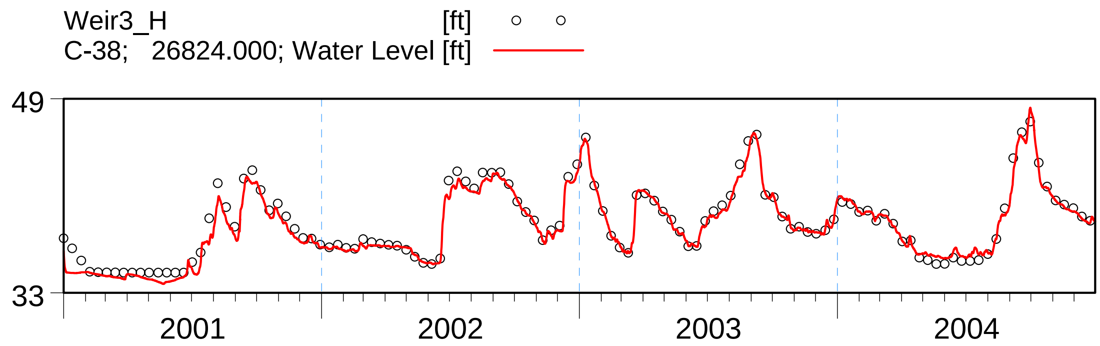


**Figure 4-22: Simulated and observed headwater stage at Weir 3 during the calibration period.**

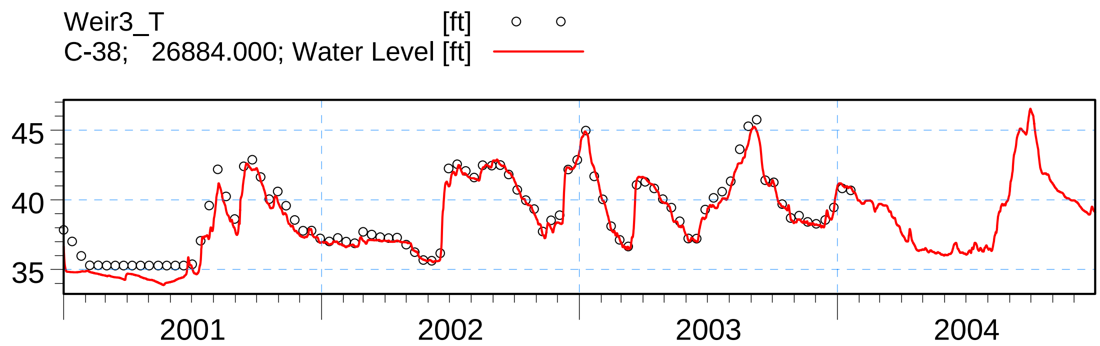


**Figure 4-23: Simulated and observed tailwater stage at Weir 3 during the calibration period.**

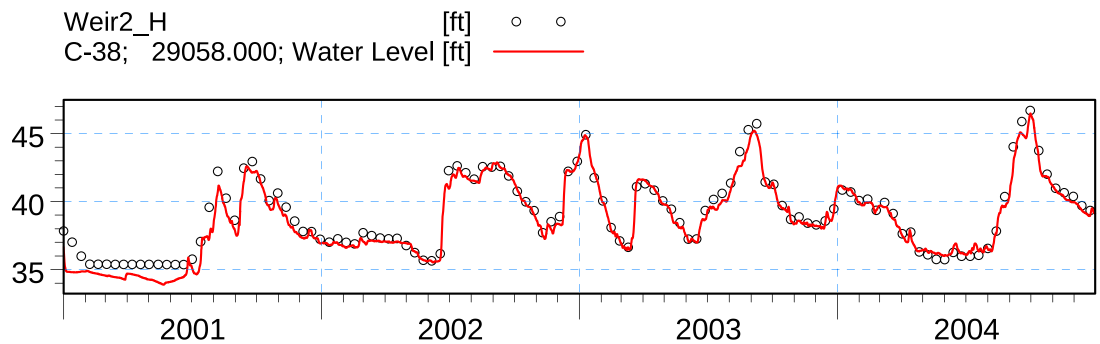


**Figure 4-24: Simulated and observed headwater stage at Weir 2 during the calibration period.**

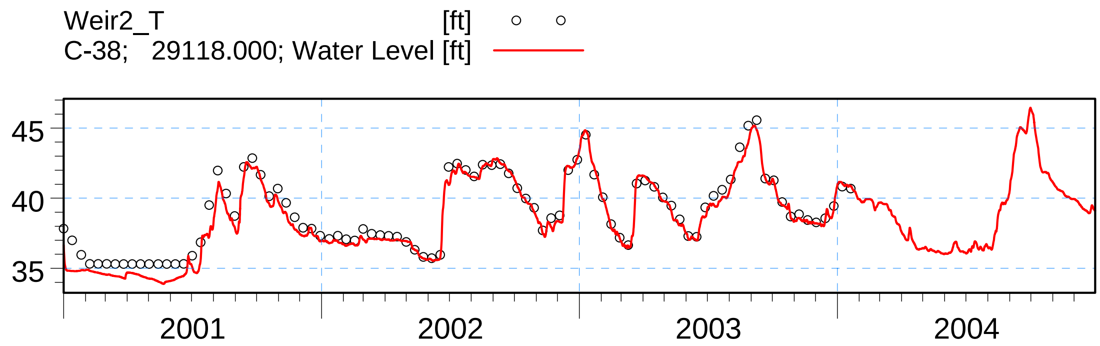


**Figure 4-25: Simulated and observed tailwater stage at Weir 2 during the calibration period.**

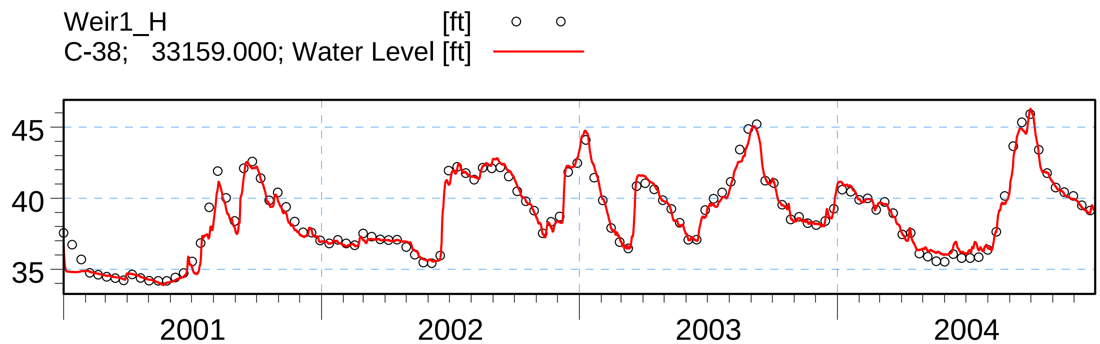


**Figure 4-26: Simulated and observed headwater stage at Weir 1 during the calibration period.**

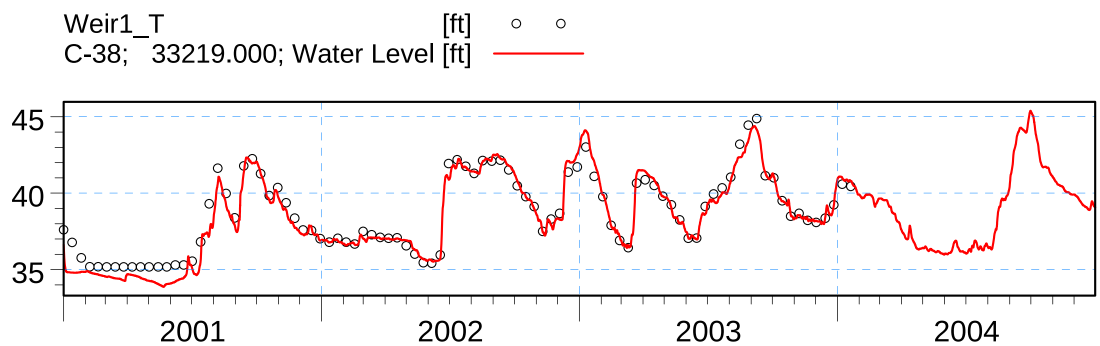


**Figure 4-27: Simulated and observed tailwater stage at Weir 1 during the calibration period.**

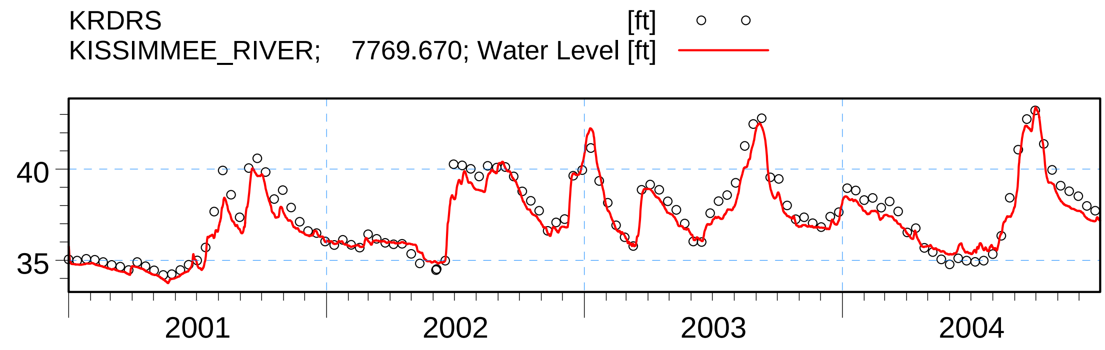


**Figure 4-28: Simulated and observed stage at KRDRS during the calibration period.**

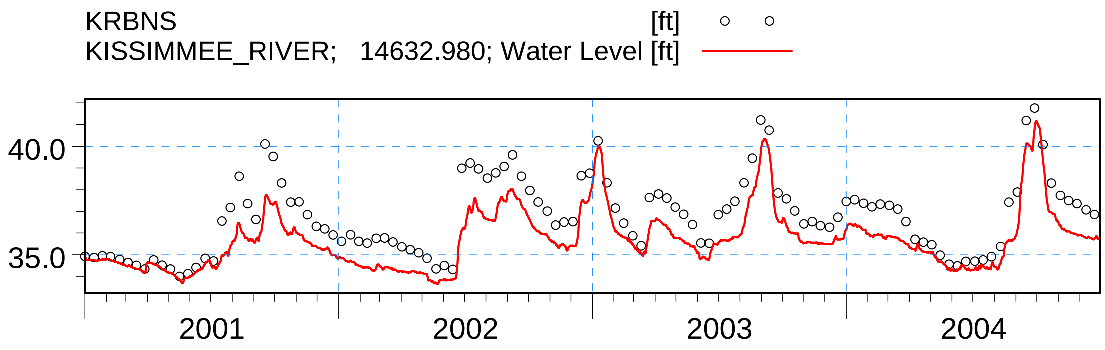


**Figure 4-29: Simulated and observed stage at KRBNS during the calibration period.**

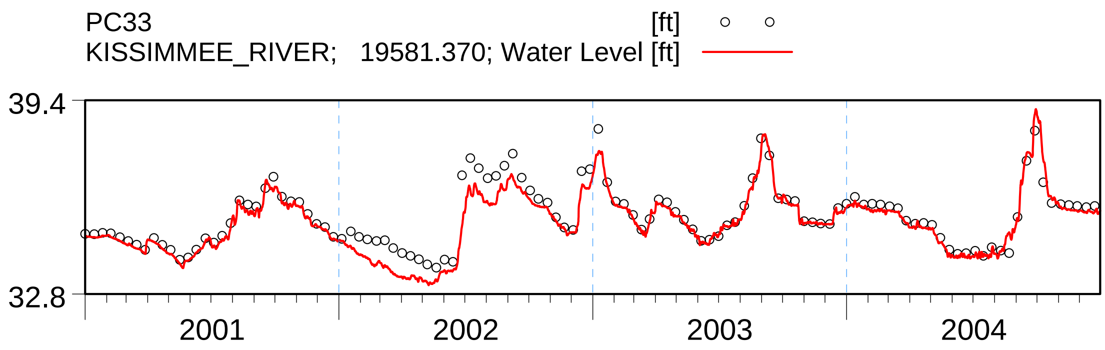


**Figure 4-30: Simulated and observed stage at PC33 during the calibration period.**

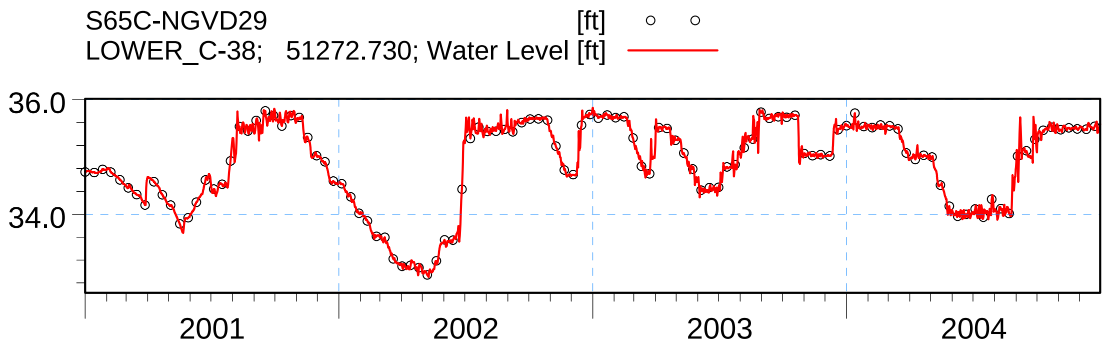


**Figure 4-31: Simulated and observed headwater stage at S-65C during the calibration period.**

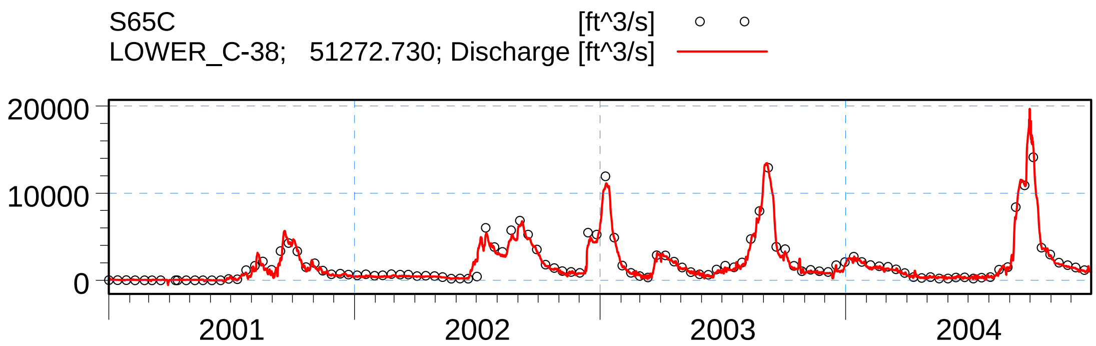


**Figure 4-32: Simulated and observed headwater flow at S-65C during the calibration period.**

## 4.5 Calibration Results

The results are discussed relative to locations of key performance measures that will be used as part of the alternatives analysis phase of the project. Results presented for the FAS correspond to the coarse grid RM model while results presented for the SAS and surface water correspond to the finer grid SM model.

The evaluation of all quantitative and qualitative calibration points identified in the ATP is included in the following sections.

### 4.5.1 Surface Water Calibration

Surface water results for the calibration period at key surface water calibration locations within the Kissimmee Basin are presented in Figure 4-34 to Figure 4-84. In general, the model does a very good job of simulating surface water system responses during the calibration period.

#### 4.5.1.1 Stage Variation Induced by Structure Operations

In some cases, simulated headwater and tailwater stages and discharge at control structures (*e.g.*, S-62, S-65, S-65E) show more variation than observed data. This additional variation is a result of use of observed headwater stages to dynamically operate control structures. Although it is understood that all control structures, except for S-63A, are operated on a daily basis, control structures during calibration were allowed to operate each MIKE 11 time step, sometimes creating variations in stages and flow greater than those observed in the historical record. This approach was considered appropriate for calibration purposes only since the original approach, where time series of historical gate openings were to be used, had to be modified due to issues with available gate opening data. Operation discretion was used during the calibration period to achieve the regulation schedule for the lake management areas and the LKB. A more complete analysis is included in the current KBMOS work plan to test the structure operations in AFET. Control structure operations will be modified for application of the KBMOS model to existing and future conditions to follow regulation schedules and operate on a daily basis.

#### 4.5.1.2 Upper Basin

The current results for the upper basin during the calibration period indicate that the model is adequately capturing surface water process and responses in the KUB. Surface water results for the upper basin are presented in Figure 4-34 to Figure 4-58.

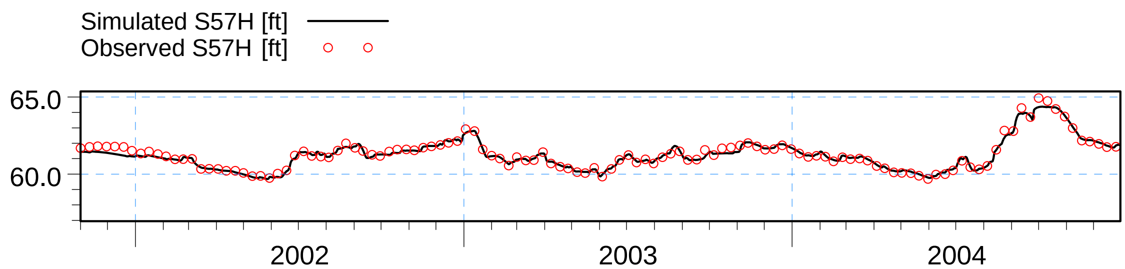


**Figure 4-33: Simulated and observed headwater stage at S-57 during the calibration period.**

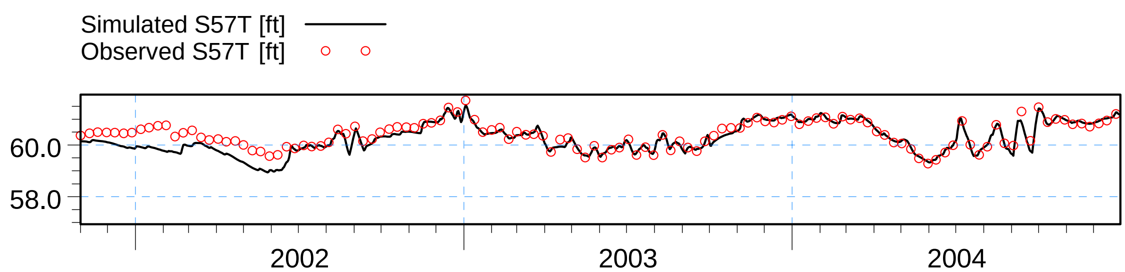


**Figure 4-34: Simulated and observed tailwater stages at S-57 during the calibration period.**

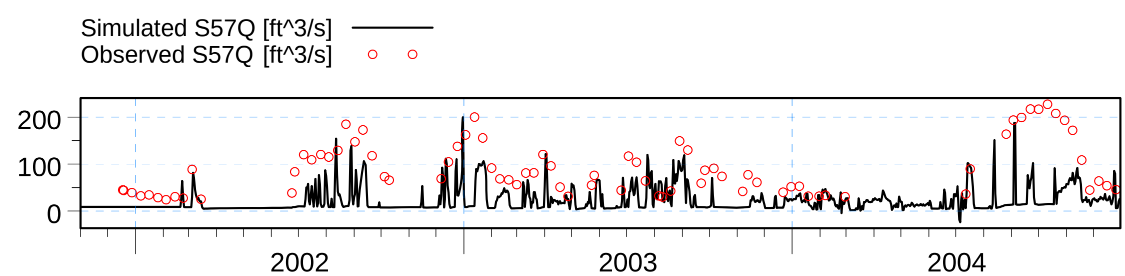


**Figure 4-35: Simulated and observed discharge at S-57 during the calibration period.**

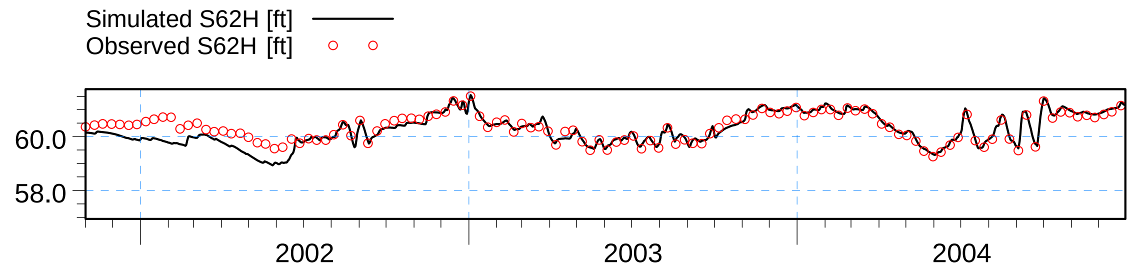


**Figure 4-36: Simulated and observed headwater stage at S-62 during the calibration period.**

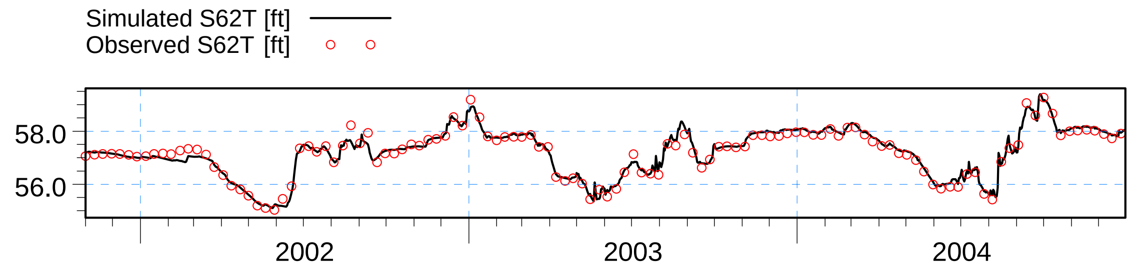


**Figure 4-37: Simulated and observed tailwater stage at S-62 during the calibration period.**

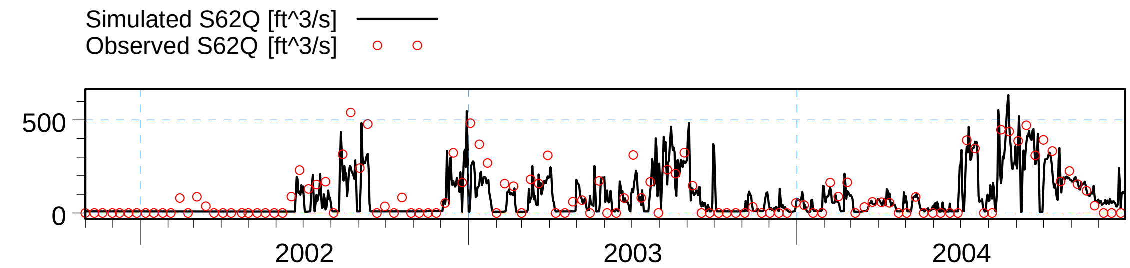


**Figure 4-38: Simulated and observed discharge at S-62 during the calibration period.**

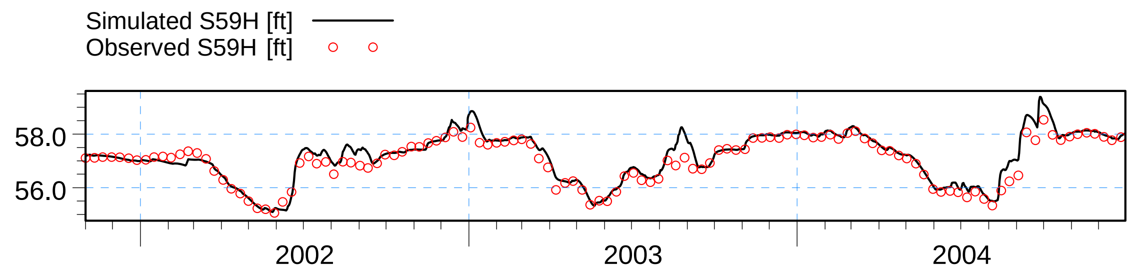


**Figure 4-39: Simulated and observed headwater stage at S-59 during the calibration period.**

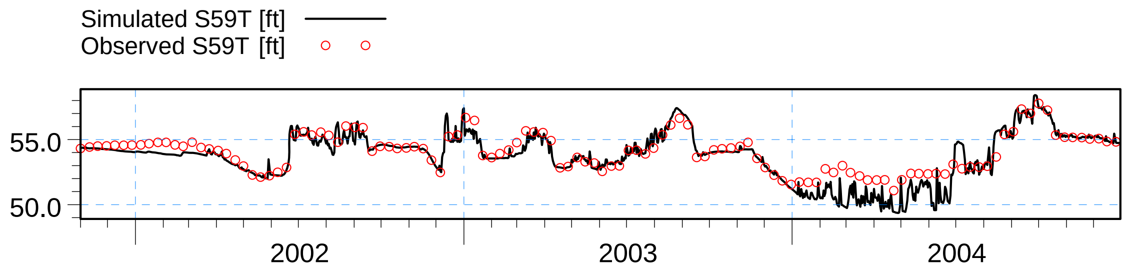


**Figure 4-40: Simulated and observed tailwater stage at S-59 during the calibration period.**

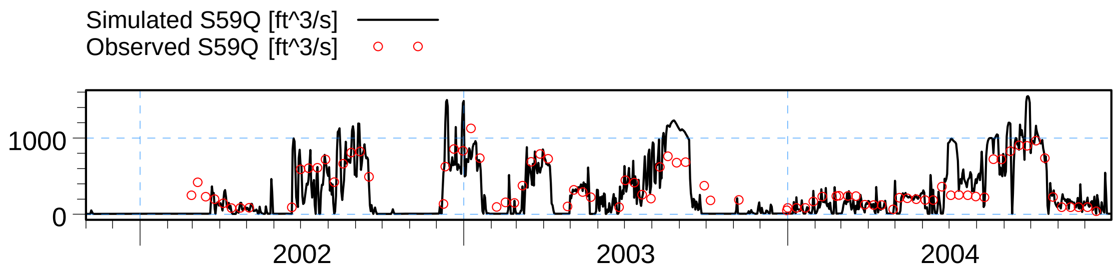


**Figure 4-41: Simulated and observed discharge at S-59 during the calibration period.**

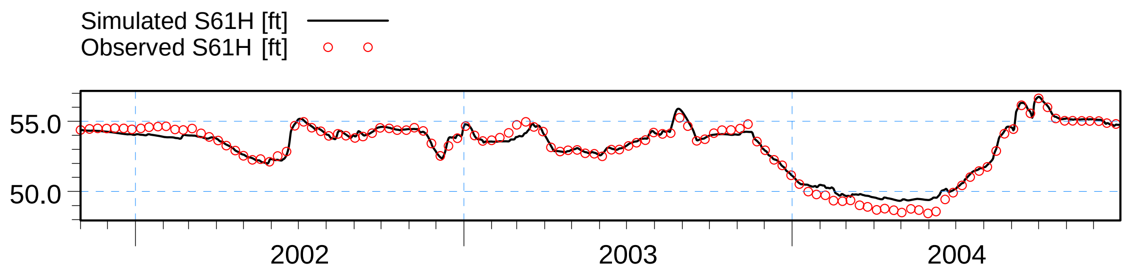


**Figure 4-42: Simulated and observed headwater stage at S-61 during the calibration period.**

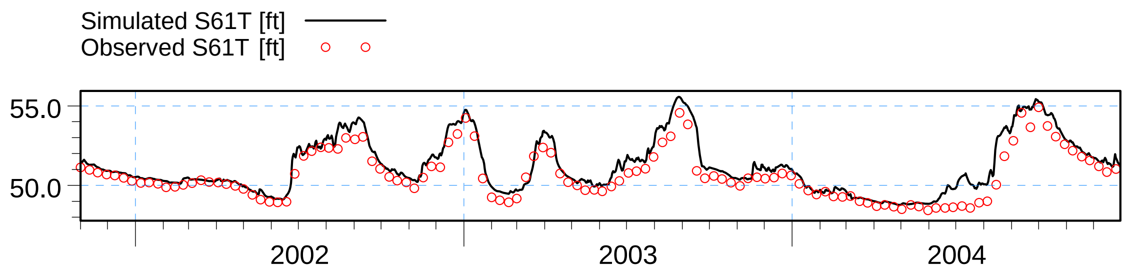


**Figure 4-43: Simulated and observed tailwater stage at S-61 during the calibration period.**

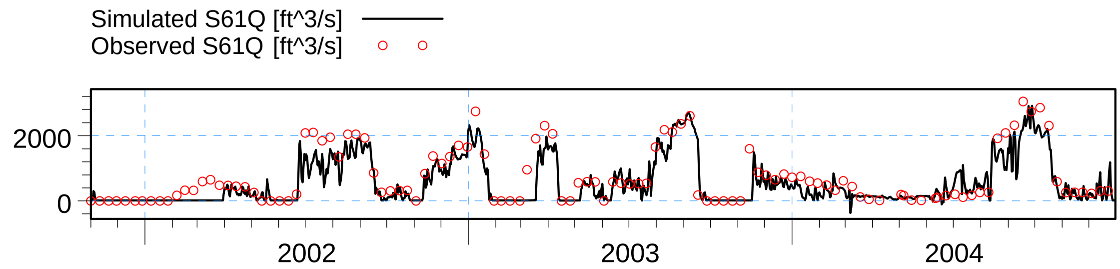


**Figure 4-44: Simulated and observed discharge at S-61 during the calibration period.**

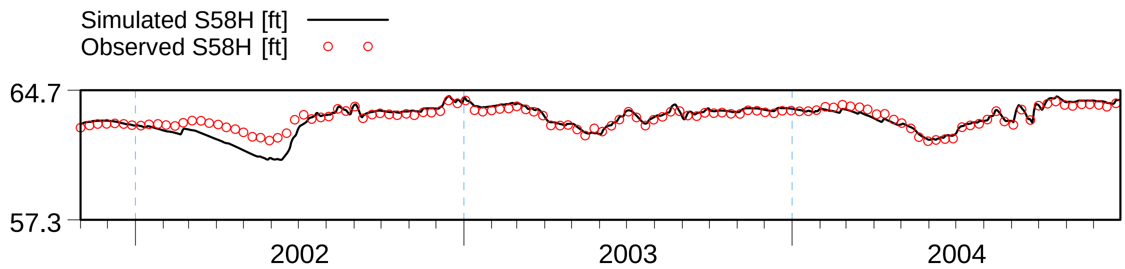


**Figure 4-45: Simulated and observed headwater stages at S-58 during the calibration period.**

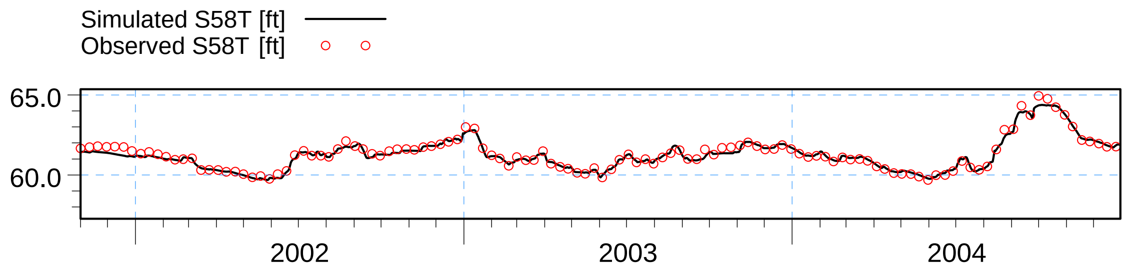


**Figure 4-46: Simulated and observed tailwater stages at S-58 during the calibration period.**

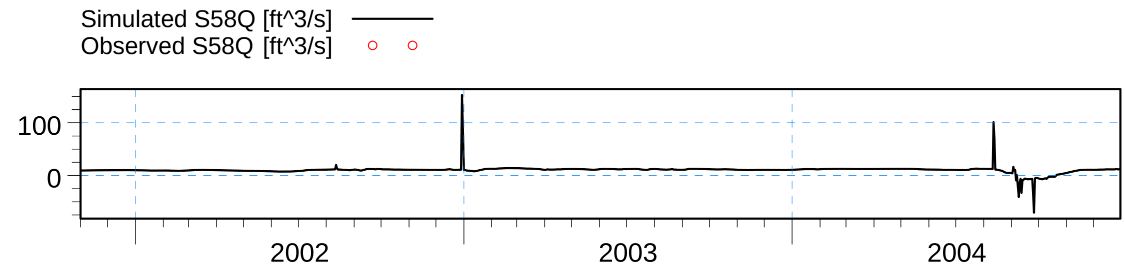


**Figure 4-47: Simulated and observed discharge at S-58 during the calibration period.**

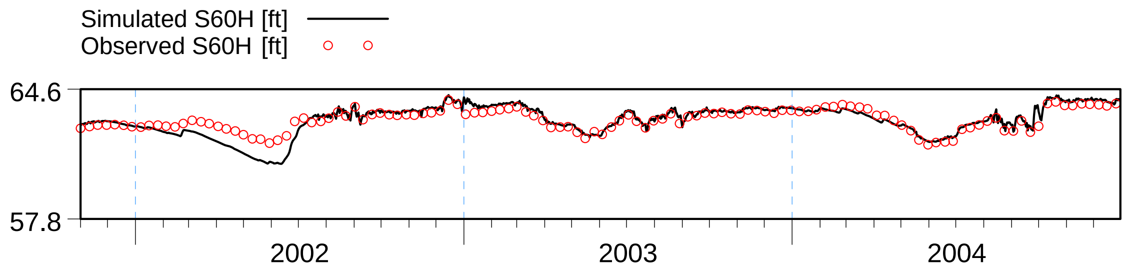


**Figure 4-48: Simulated and observed headwater stage at S-60 during the calibration period.**

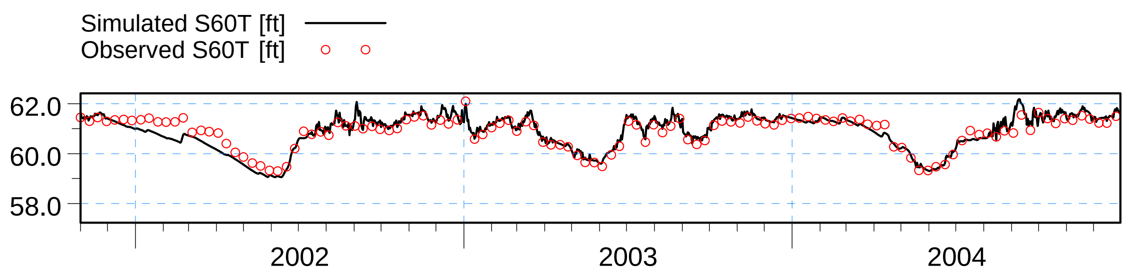


**Figure 4-49: Simulated and observed tailwater stage at S-60 during the calibration period.**

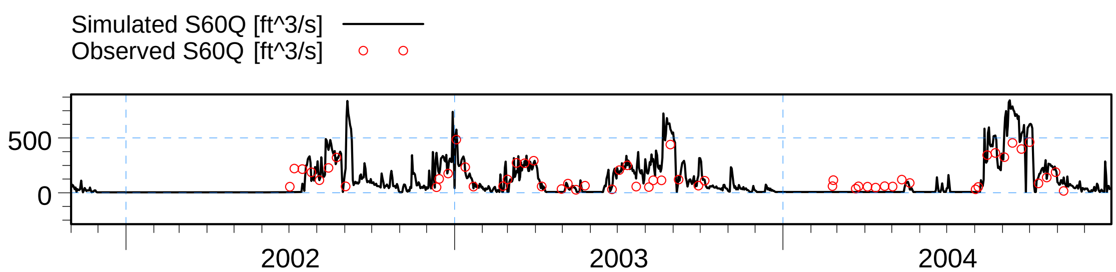


**Figure 4-50: Simulated and observed discharge at S-60 during the calibration period.**

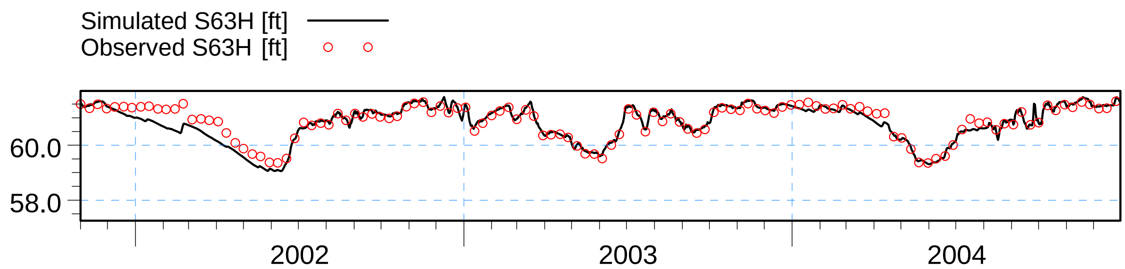


**Figure 4-51: Simulated and observed headwater stage at S-63 during the calibration period.**

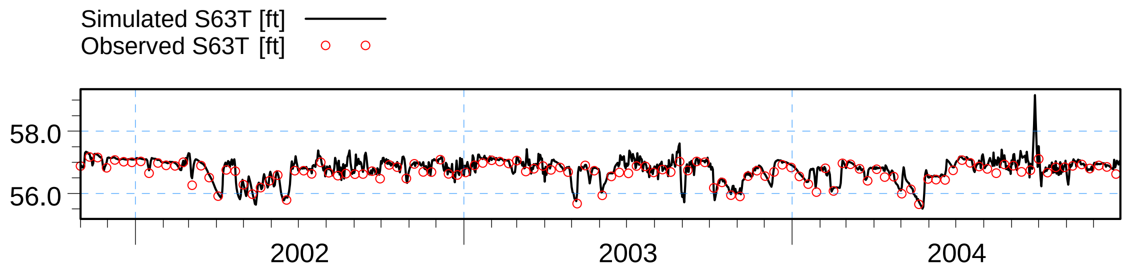


**Figure 4-52: Simulated and observed tailwater stage at S-63 during the calibration period.**

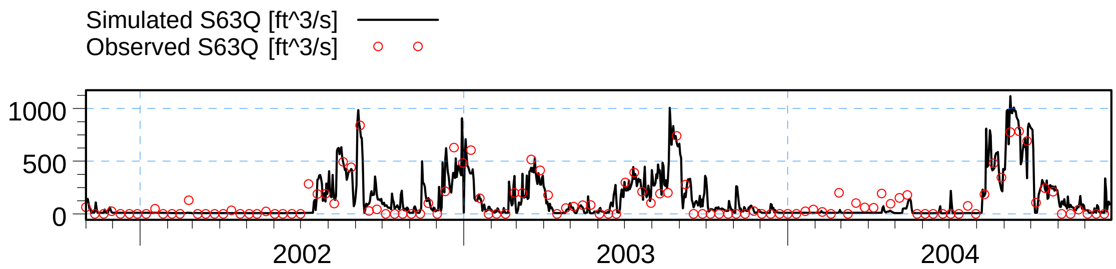


**Figure 4-53: Simulated and observed discharge at S-63 during the calibration period.**

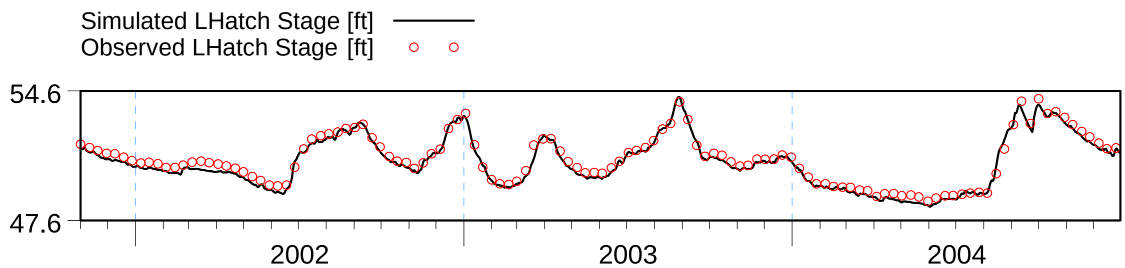


**Figure 4-54: Simulated and observed stage at LHATCH3H during the calibration period.**

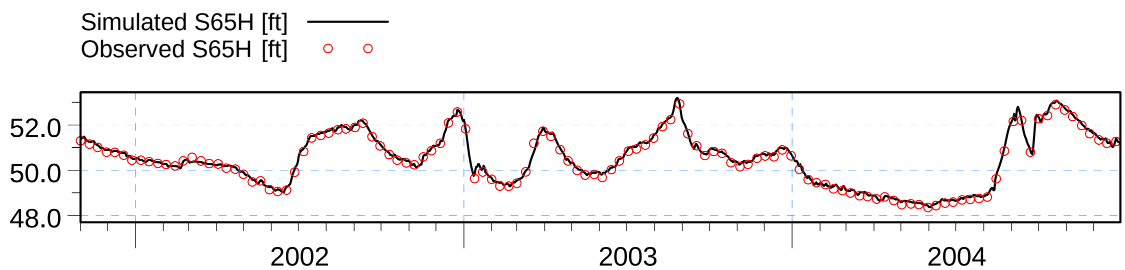


**Figure 4-55: Simulated and observed headwater stage at S-65 during the calibration period.**

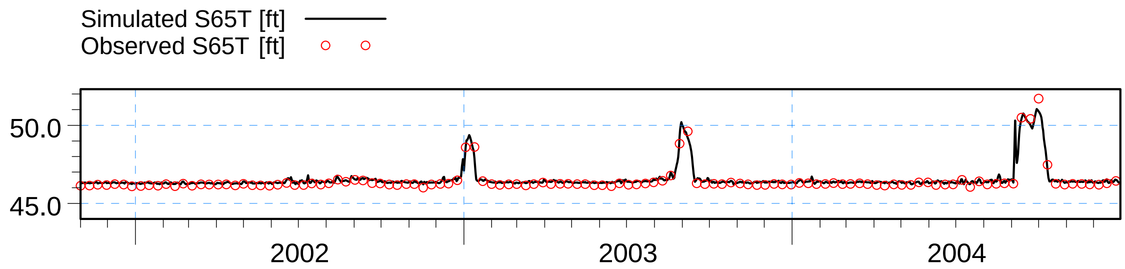


**Figure 4-56: Simulated and observed tailwater stage at S-65 during the calibration period.**

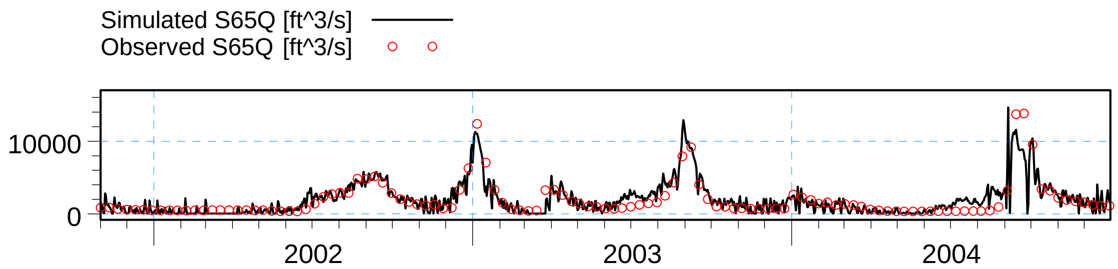


**Figure 4-57: Simulated and observed discharge at S-65 during the calibration period.**

### 4.5.1.3 Lower Basin

Results for the lower basin during the calibration period are presented in Figure 4-59 through Figure 4-84 and indicate that the model is adequately capturing surface water process and responses in the LKB. Relatively poor performance at the S-65D tailwater gage is a result of datum issues. Stages of the calibration locations located outside of the main channel of the restored portion of the river are often affected by local hydrography not represented in the sub-regional model.

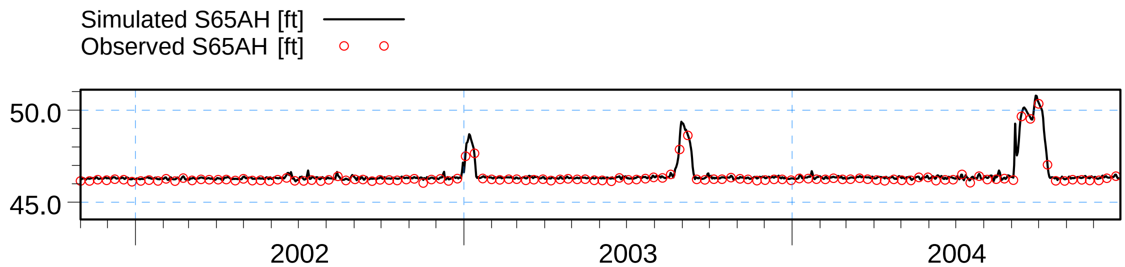


**Figure 4-58: Simulated and observed headwater stage at S-65A during the calibration period.**

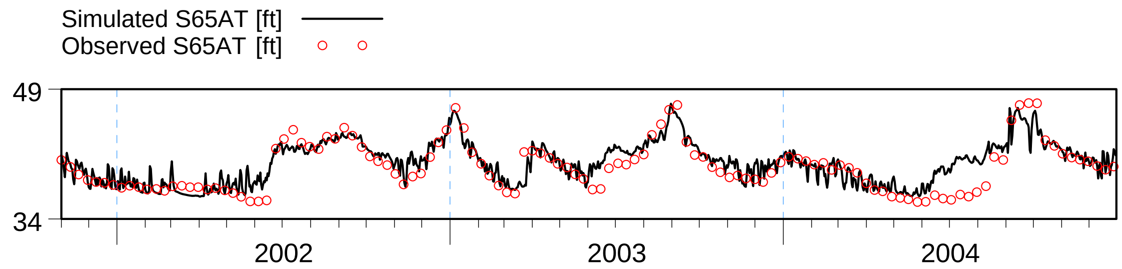


**Figure 4-59: Simulated and observed tailwater stage at S-65A during the calibration period.**

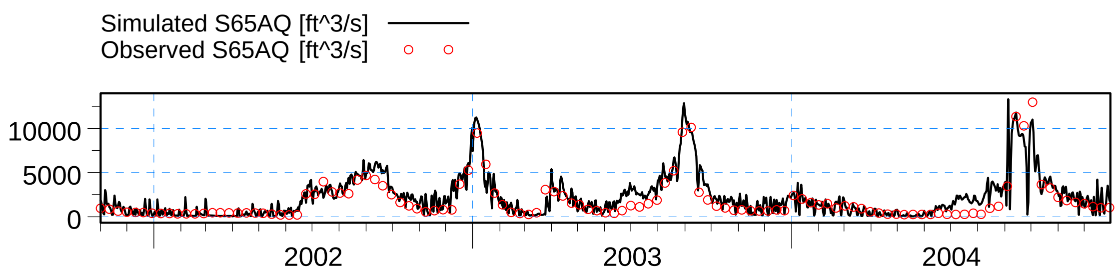


**Figure 4-60: Simulated and observed discharge at S-65A during the calibration period.**

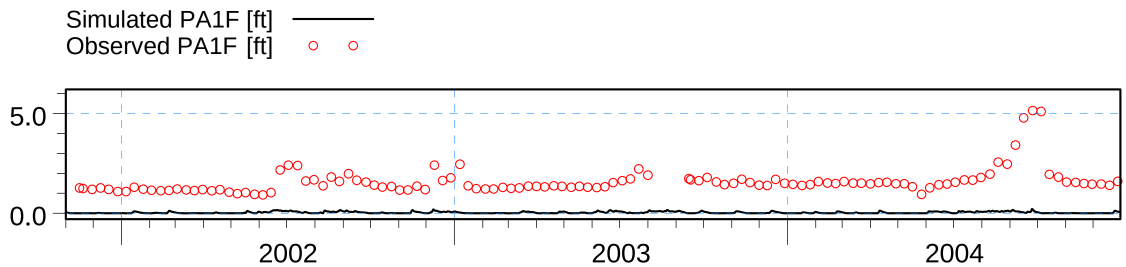


**Figure 4-61: Simulated and observed water depth at PA1F during the calibration period.**

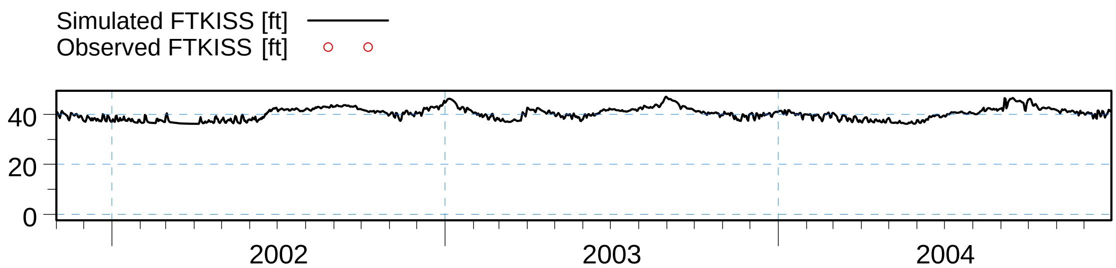


**Figure 4-62: Simulated stage at FTKISS during the calibration period.**

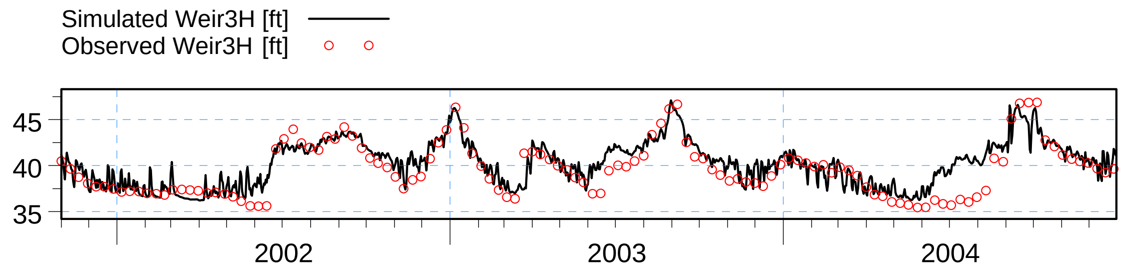


**Figure 4-63: Simulated and observed headwater stage at Weir 3 during the calibration period.**

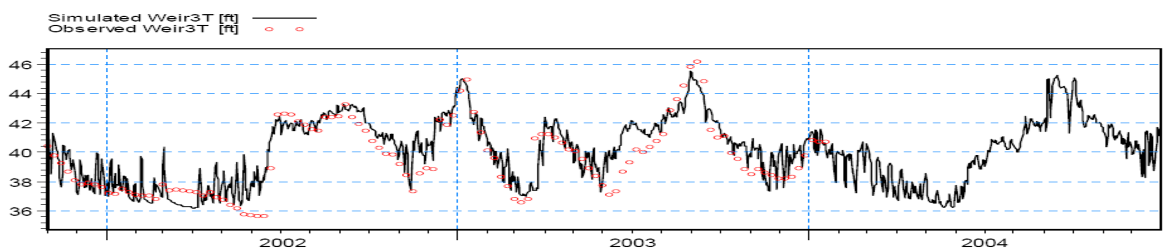


**Figure 4-64: Simulated and observed tailwater stage at Weir 3 during the calibration period.**

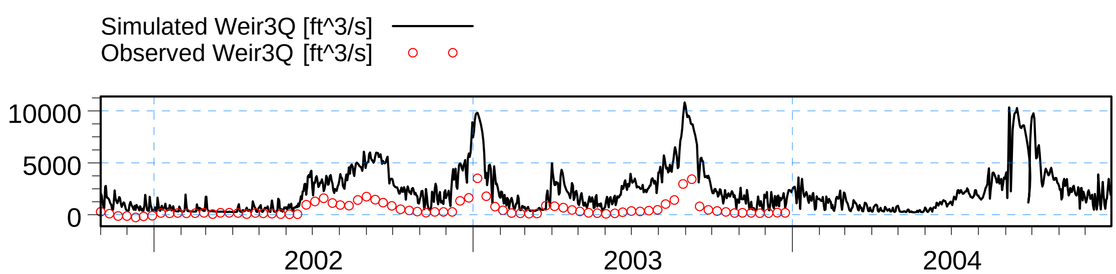


**Figure 4-65: Simulated and observed discharge at Weir 3 during the calibration period.**

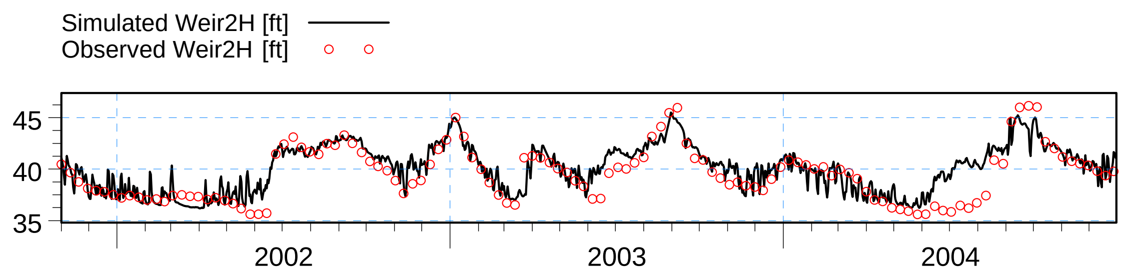


**Figure 4-66: Simulated and observed headwater stage at Weir 2 during the calibration period.**

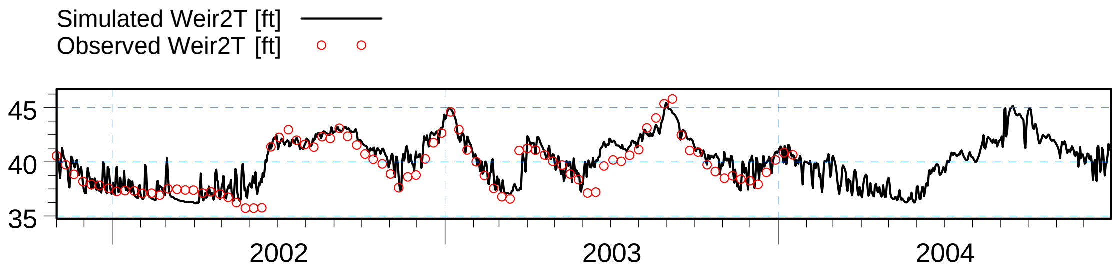


**Figure 4-67: Simulated and observed tailwater stage at Weir 2 during the calibration period.**

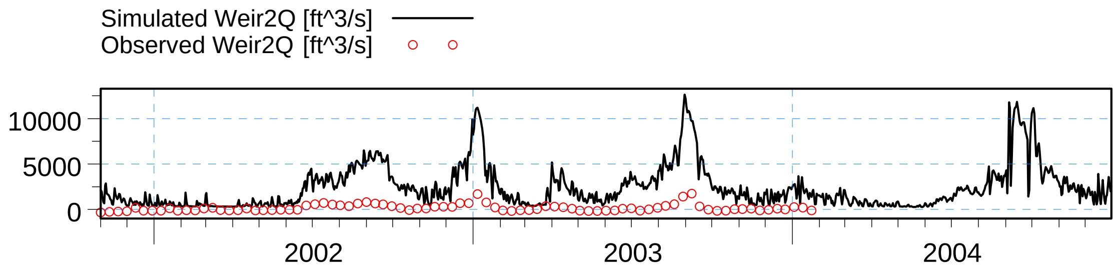


**Figure 4-68: Simulated and observed discharge at Weir 2 during the calibration period.**

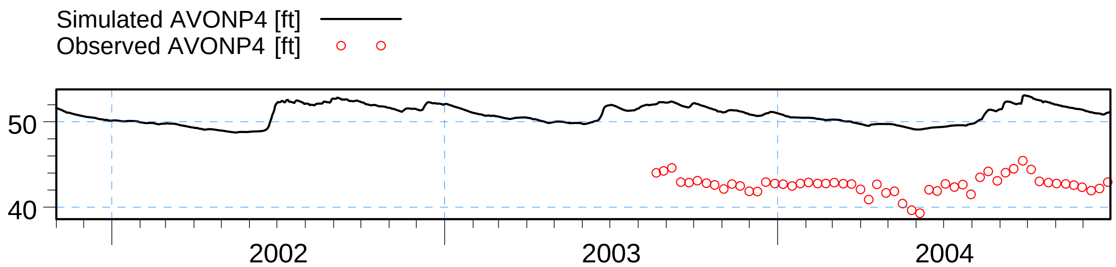


**Figure 4-69: Simulated and observed stage at AVONP4 during the calibration period.**

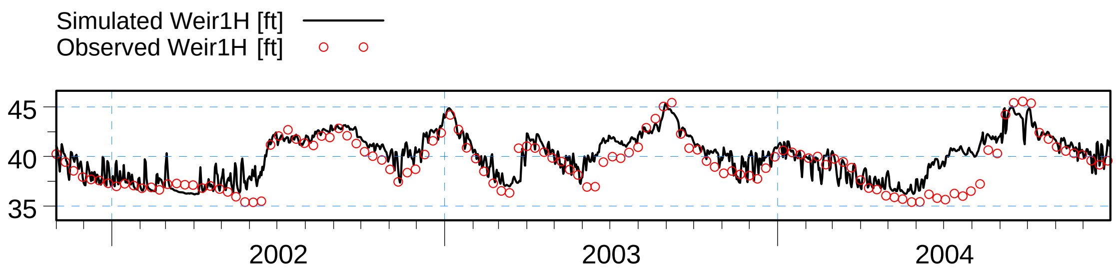


**Figure 4-70: Simulated and observed headwater stage at Weir 1 during the calibration period.**

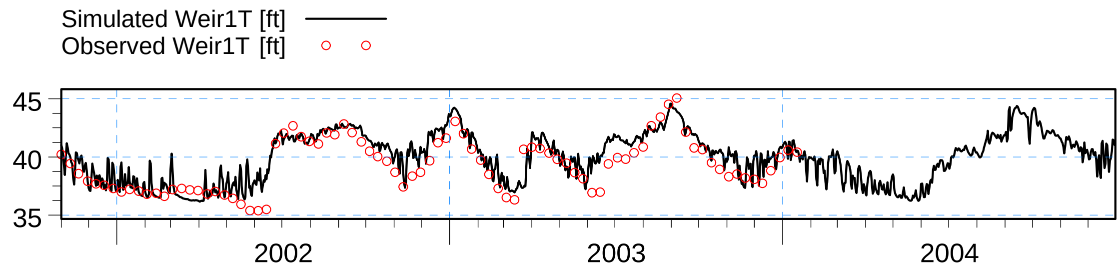


**Figure 4-71: Simulated and observed tailwater stage at Weir 1 during the calibration period.**

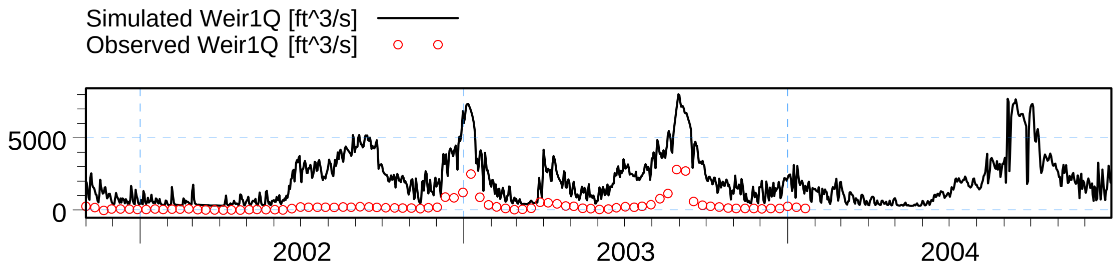


**Figure 4-72: Simulated and observed discharge at Weir 1 during the calibration period.**

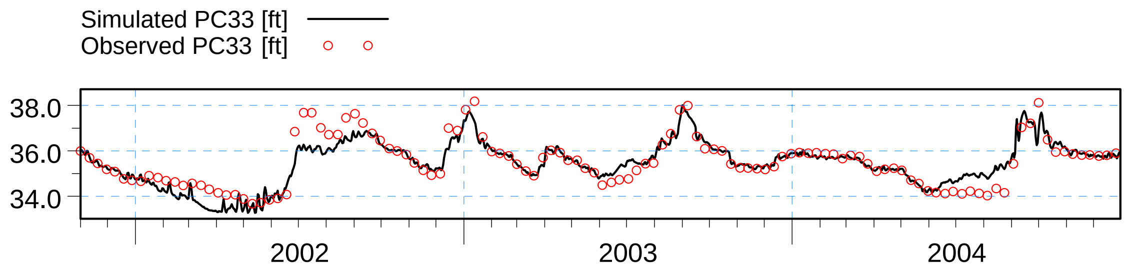


**Figure 4-73: Simulated and observed stage at PC33 during the calibration period.**

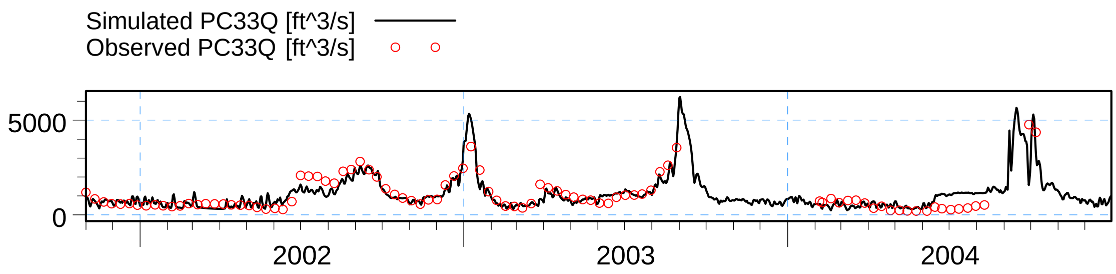


**Figure 4-74: Simulated and observed discharge at PC33 during the calibration period.**

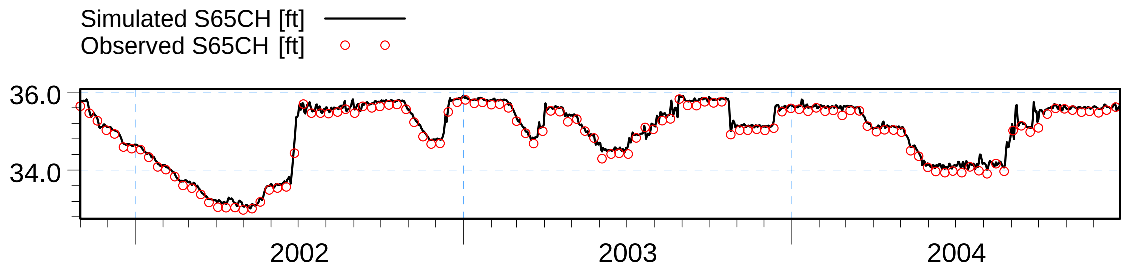


**Figure 4-75: Simulated and observed headwater stage at S-65C during the calibration period.**

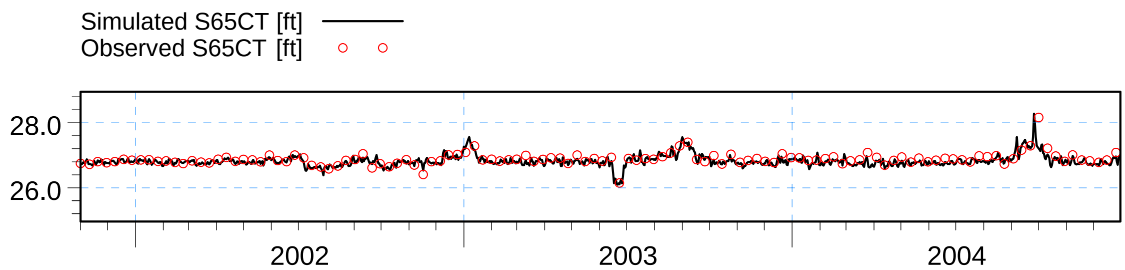


**Figure 4-76: Simulated and observed tailwater stage at S-65C during the calibration period.**

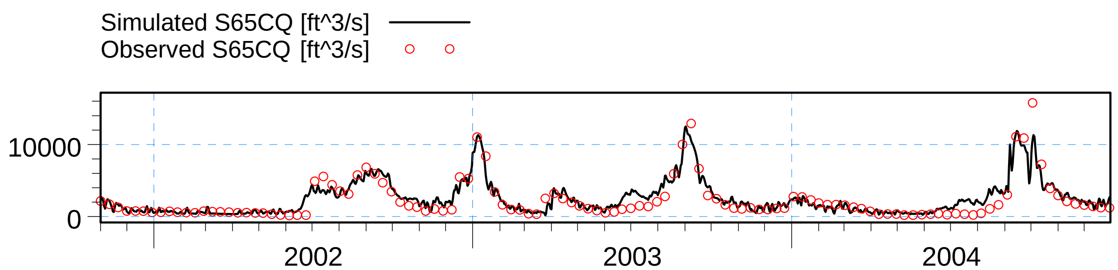


**Figure 4-77: Simulated and observed discharge at S-65C during the calibration period.**

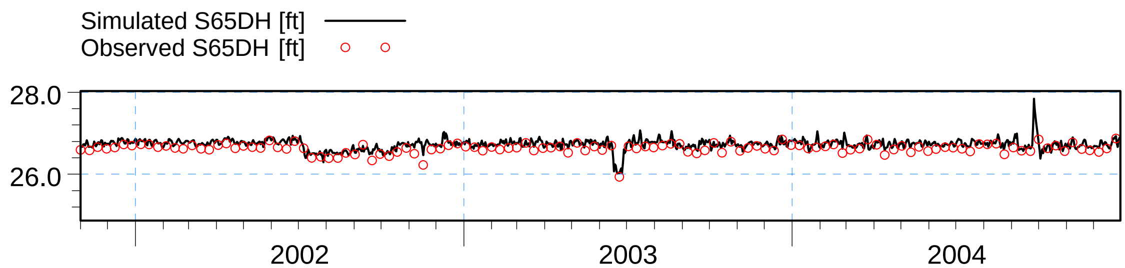


**Figure 4-78: Simulated and observed headwater stage at S-65D during the calibration period.**

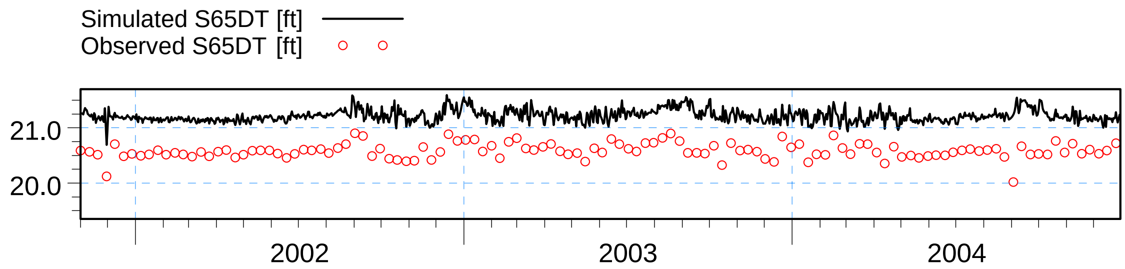


**Figure 4-79: Simulated and observed tailwater stage at S-65D during the calibration period.**

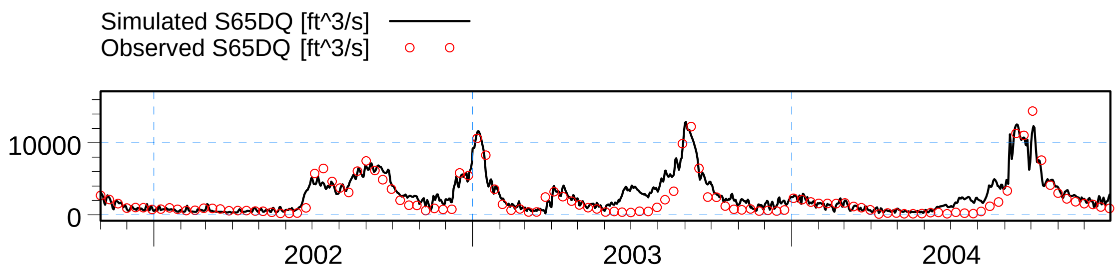


**Figure 4-80: Simulated and observed discharge at S-65D during the calibration period.**

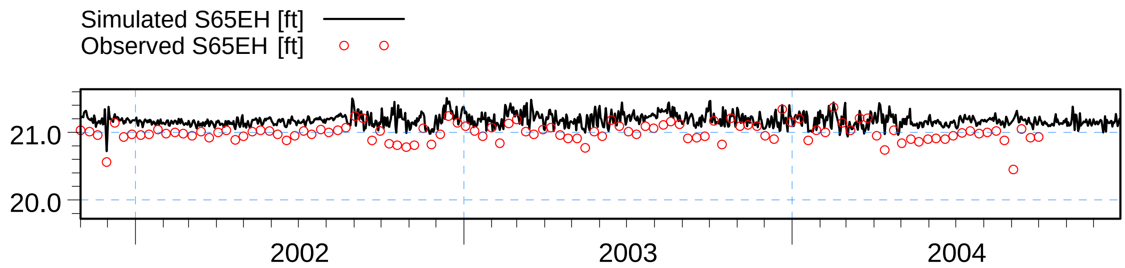


**Figure 4-81: Simulated and observed headwater stage at S-65E during the calibration period.**

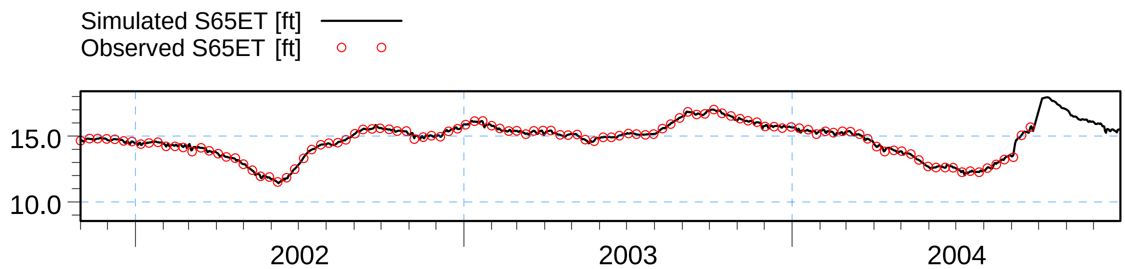


**Figure 4-82: Simulated and observed tailwater stage at S-65E during the calibration period.**

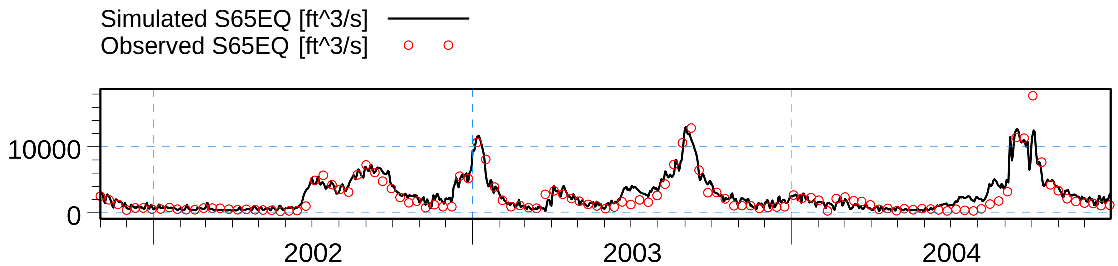


**Figure 4-83: Simulated and observed discharge at S-65E during the calibration period.**

#### 4.5.1.4 Surface Water Calibration Statistics

A table of calibration statistics for stage and flow in the Kissimmee are summarized in Table 4-4 and Table 4-5, respectively. Criteria that are not met at individual stations are indicated with red shading. In general, the surface water component of the AFET model does a very good job of meeting statistical criteria defined in the ATP (Earth Tech, 2006b) and later refined in consultation with SFWMD staff as described in Section 4.1.

The model meets the *RMSE* and *R* calibration criteria at all of the stage observation locations except PC45 which is classified as a low utility gage. The model meets the *CE* and *R* calibration criteria for flow except at S-57, S-61, Catfish Creek, and Reedy Creek. The model does not meet the *CE* or *R* criteria for flow at S-57 but this gage has been classified as a moderately useful gage. The model does not meet the *CE* criteria for flow at S-61 but does meet the *R* criteria. The model does not meet the *R* criteria for flow at Catfish Creek but does meet the *CE* criteria. The model does not the *CE* criteria for flow at Reedy Creek but does meet the *R* criteria.

A graphical presentation of the spatial distribution of model fit at stage and flow locations identified as quantitative gages in the ATP (Earth Tech, 2006b) relative to the mean error and correlation coefficient, respectively, are shown in Figure 4-85 and Figure 4-86.

**Table 4-4: Stage statistics for the calibration period. Shading is used to indicate locations that do not meet specified criteria.**

| MODEL AREA | Station | RMSE | R(correlation) | RMSE | R(correlation) | RMSE | R(correlation) |
|---|---|---|---|---|---|---|---|
| **Stages in Upper Basin Lake Management Units** | | | | | | | |
| LMU K-H-C | S65H | H | H | 0.10 | 1.00 | | |
| LMU K-H-C | S61T | H | H | 0.72 | 0.97 | | |
| LMU K-H-C | S63AT | M | M | 0.84 | 0.96 | | |
| LMU Toho | S61H | H | H | 0.37 | 0.99 | | |
| LMU Toho | S59T | H | H | 0.83 | 0.91 | | |
| LMU Etoho | S59H | H | H | 0.29 | 0.96 | | |
| LMU Etoho | S62T | M | M | 0.19 | 0.98 | | |
| LMU Hart | S62H | M | M | 0.27 | 0.88 | | |
| LMU Hart | S57T | M | M | 0.29 | 0.89 | | |
| LMU Myrtle | S57H | M | M | 0.18 | 0.98 | | |
| LMU Myrtle | S58T | M | M | 0.18 | 0.99 | | |
| LMU Alligator | S58H | M | M | 0.36 | 0.91 | | |
| LMU Alligator | S60H | M | M | 0.38 | 0.89 | | |
| LMU Gentry | S60T | M | M | 0.27 | 0.92 | | |
| LMU Gentry | S63H | M | M | 0.22 | 0.94 | | |
| LMU s63a | S63T | M | M | 0.16 | 0.94 | | |
| LMU s63a | S63AH | M | M | 0.12 | 0.97 | | |
| **Stages in Upper Basin's unmanaged watersheds** | | | | | | | |
| ws_UpperReedy | REEDYLOU | M | M | 1.80 | 0.76 | | |
| **Stages in Lower Basin Lake Management Units** | | | | | | | |
| Pool A | S65T | H | H | 0.22 | 0.98 | | |
| Pool A | S65AH | H | H | 0.15 | 0.99 | | |
| Pool BC | S65AT | H | H | 1.57 | 0.86 | | |
| Pool BC | PC52 | M | M | 2.88 | 0.80 | | |
| Pool BC | PC45 | M | M | 3.30 | 0.68 | | |
| Pool BC | PC33 | H | H | 0.45 | 0.90 | | |
| Pool BC | PC21 | M | M | 1.29 | 0.86 | | |
| Pool BC | S65CH | H | H | 0.11 | 1.00 | | |
| Pool D | S65CT | H | H | 0.12 | 0.88 | | |
| Pool D | S65DH | H | H | 0.11 | 0.94 | | |
| Pool E | S65DT | L | H | | 0.79 | 2 | |
| Pool E | S65EH | H | H | 0.19 | 0.82 | | |
| **Stages in Lower Basin's unmanaged watersheds** | | | | | | | |
| D_Chandler | CYPRS | H | H | 0.59 | 0.81 | | |
| D_Chandler | CHAND1 | H | H | 0.62 | 0.86 | | |
| Lake O | S65ET | H | H | 0.03 | 1.00 | | |

| | |
|---|---|
| (red) | "H" not meeting criteria |
| (green) | Does meet criteria |
| (pink) | "M" not meeting criteria |

NOTE: Calibration points with Low (L) utility have been omitted

Rationale for selection of statistics Targets:
Highly Useful (H):
RMSE ATP Statistic Target range 1.0 to 2.5-ft
R ATP Statistic Target range 0.50 to 0.75
Moderately Useful (M):
RMSE ATP Statistic Target low end of range plus 0.5-ft
R ATP Statistic Target low end of range minus 0.05

**Table 4-5: Flow statistics for the calibration period. Shading is used to indicate locations that do not meet specified criteria.**

| Upstream WCU | Downstream WCU | Station | CE | R(correlation) | CE % | R(correlation) | CE % | R(correlation) |
|---|---|---|---|---|---|---|---|---|
| **Flows in Upper Basin Lake Management Units** | | | | | | | | |
| LMU Myrtle | LMU Hart | S57Q | M | M | 68 | 0.26 | | |
| LMU Hart | LMU Etoho | S62Q | M | M | 20 | 0.78 | | |
| LMU Etoho | LMU Toho | S59Q | M | M | 2 | 0.73 | | |
| LMU Toho | LMU KHC | S61Q | H | H | 25 | 0.88 | | |
| LMU Alligator | LMU Gentry | S60Q | M | M | 11 | 0.81 | | |
| LMU Gentry | LMU s63a | S63Q | M | H | 6 | 0.86 | | |
| LMU s63a | LMU KHC | S63AQ | M | M | 8 | 0.86 | | |
| LMU KHC | PoolA | S65Q | H | H | 2 | 0.84 | | |
| **Flows in Upper Basin's unmanaged watersheds** | | | | | | | | |
| ws_boggy | LMU EToho | boggy_ta | M | M | 11 | 0.63 | | |
| ws_lake pierce | WS_catfish creek | catfish Q | M | M | 3 | 0.48 | | |
| ws_upperreedy | ws_lowerreedy | reedy | M | M | 60 | 0.65 | | |
| ws_shingle | LMU Toho | shingle | M | M | 19 | 0.63 | | |
| **Flows in Lower Basin Lake Management Units** | | | | | | | | |
| PoolA | PoolBC | S65AQ | M | M | 20 | 0.89 | | |
| PoolBC | PoolD | S65CQ | H | H | 9 | 0.91 | | |
| PoolD | PoolE | S65DQ | H | H | 20 | 0.91 | | |
| PoolE | Lake O | S65EQ | H | H | 11 | 0.92 | | |
| **Flows in Lower Basin's unmanaged watersheds** | | | | | | | | |
| PoolD | PoolD | usgs2272676 | L | M | 62 | 0.27 | | |

"H" not meeting criteria
Does meet criteria
"M" not meeting criteria
NOTE: Calibration points with Low (L) utility have been omitted

Rattionale for selection of statistics Targets:
Highly Useful (H):
CE ATP Statistic for 'Good' (<15%) plus average basinwide flow calcuation error of 7%
R ATP Statistic for 'Good' (>0.84)
Moderately Useful (M):
CE ATP Statistic for 'Fair' (<25%) plus average basinwide flow calcuation error of 7%
R Statistic set at 20% below minimum level for 'Fair'

AECOM

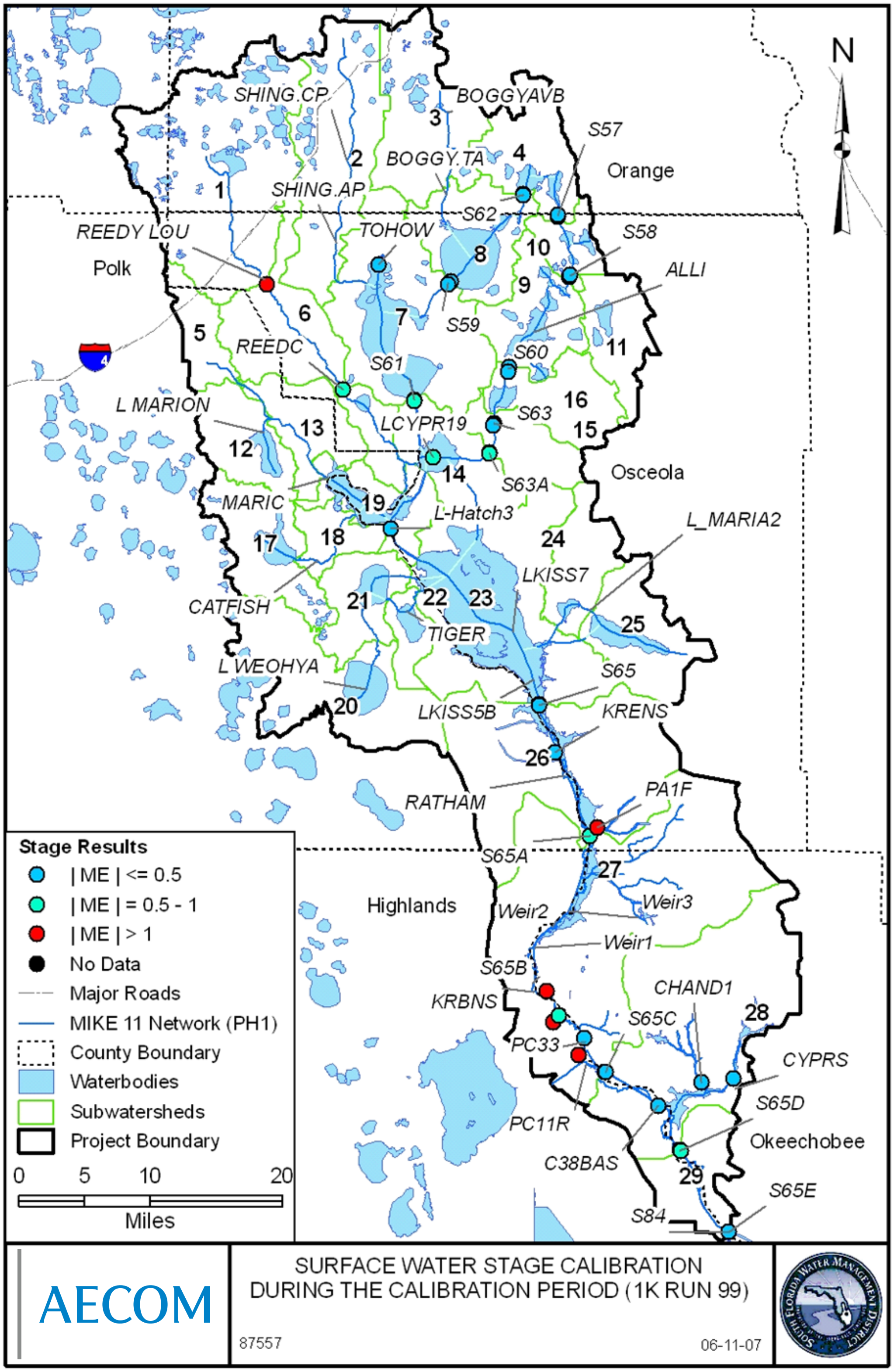


**Figure 4-84: Summary of statistical fit at quantitative surface water stage locations identified in the ATP during the calibration period.**

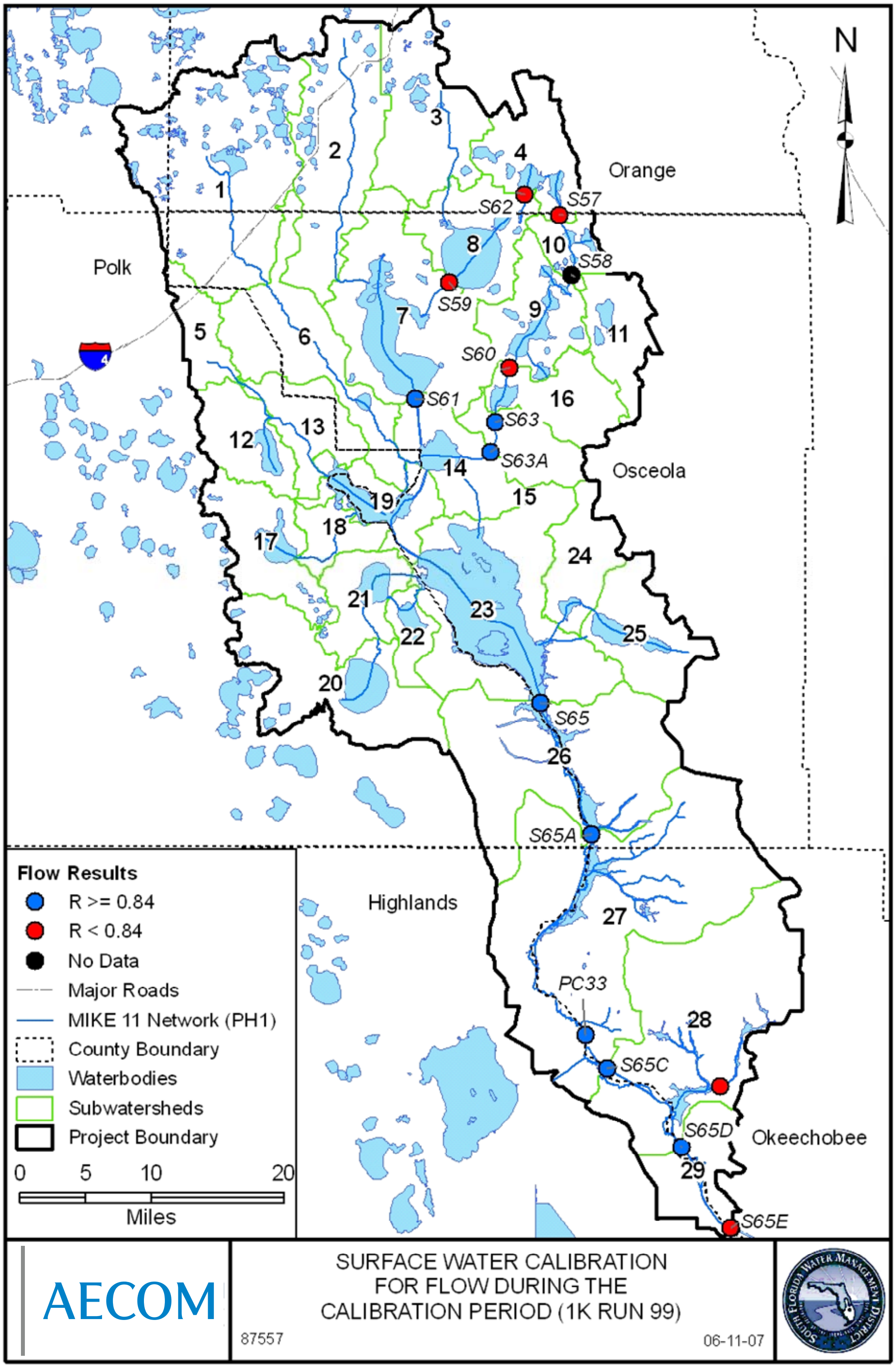


**Figure 4-85: Summary of statistical fit at quantitative surface water flow locations identified in the ATP during the calibration period.**

### 4.5.2 Groundwater Calibration

Model performance of the groundwater component during the calibration period is discussed in the following sections. Current results for the calibration period indicate that the current model is capable of simulating groundwater processes and levels at the level of accuracy according to the purpose of the study.

#### 4.5.2.1 Surficial Aquifer

The following graphs (Figure 4-87 through Figure 4-109) present a comparison of predicted groundwater head versus observed data sets. Results indicate that calibration is good, with a few exceptions, at all moderately and highly useful locations as identified in the ATP (Earth Tech, 2006b) and subsequent meetings with SFWMD staff.

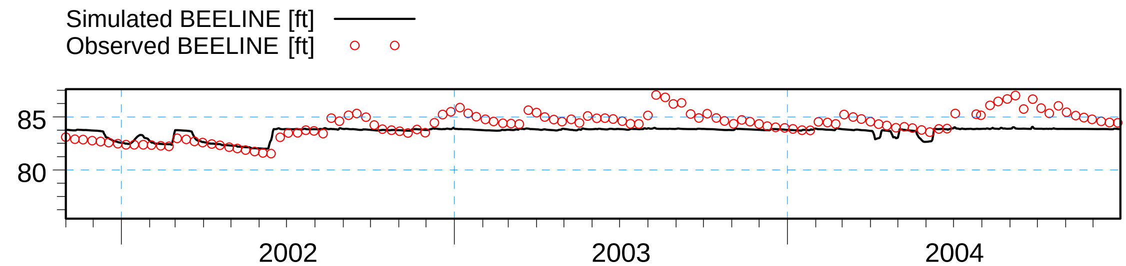


**Figure 4-86: Simulated and observed water level at SAS BEELINE during the calibration period.**

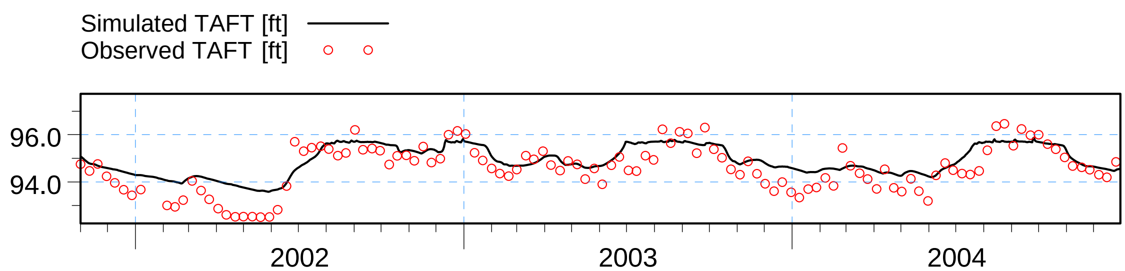


**Figure 4-87: Simulated and observed water level at SAS TAFT during the calibration period.**

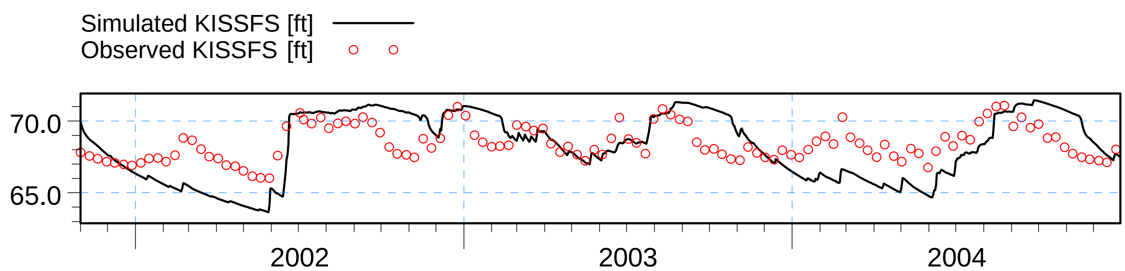


**Figure 4-88: Simulated and observed water level at KISSFS during the calibration period.**

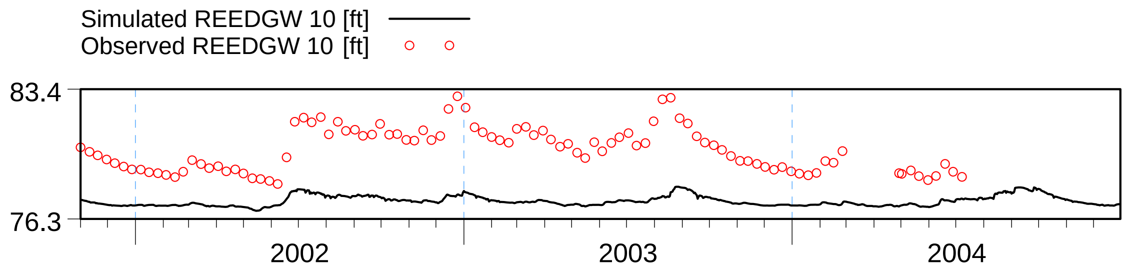


**Figure 4-89: Simulated and observed water level at SAS REEDGW 10 during the calibration period.**

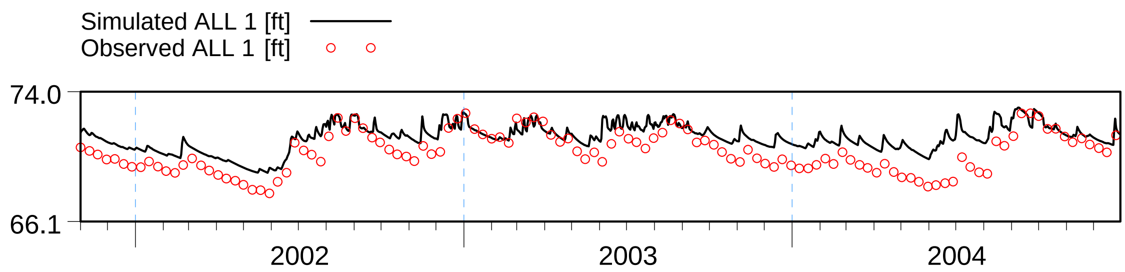


**Figure 4-90: Simulated and observed water level at SAS ALL 1 during the calibration period.**

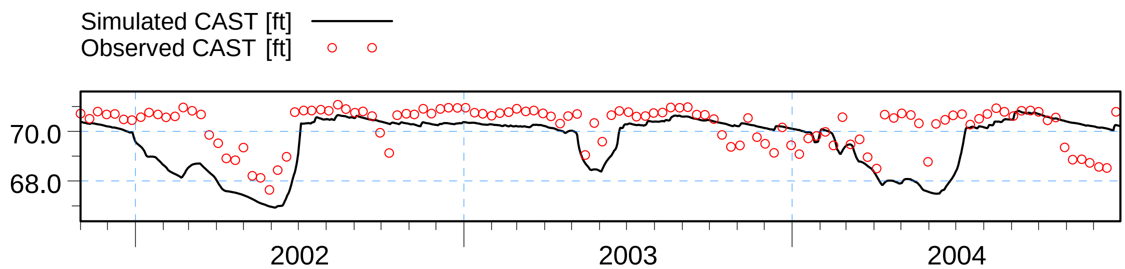


**Figure 4-91: Simulated and observed water level at SAS CAST during the calibration period.**

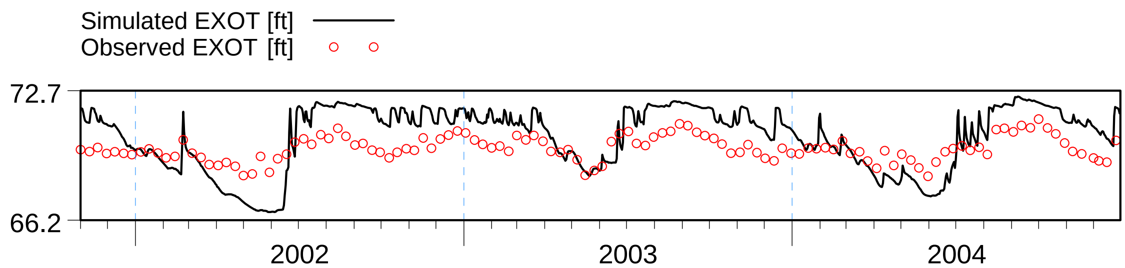


**Figure 4-92: Simulated and observed water level at SAS EXOT during the calibration period.**

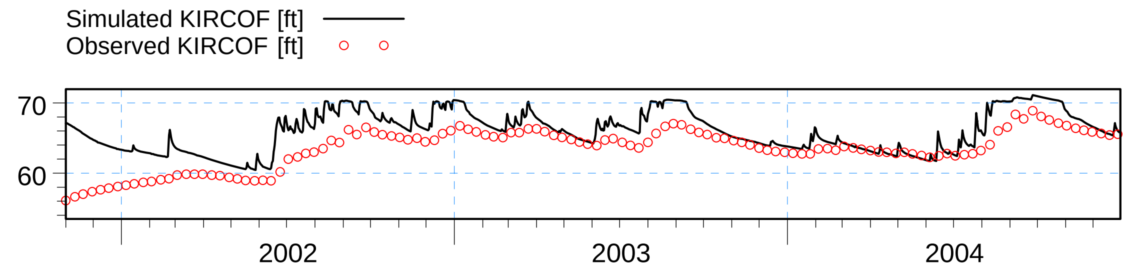


**Figure 4-93: Simulated and observed water level at SAS KIRCOF during the calibration period.**

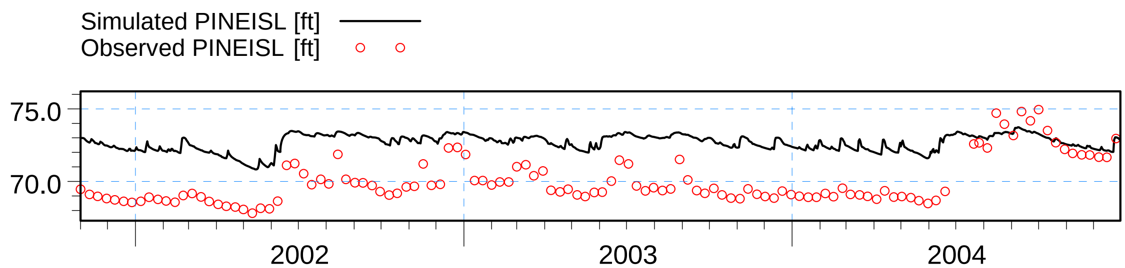


**Figure 4-94: Simulated and observed water level at SAS PINEISL during the calibration period.**

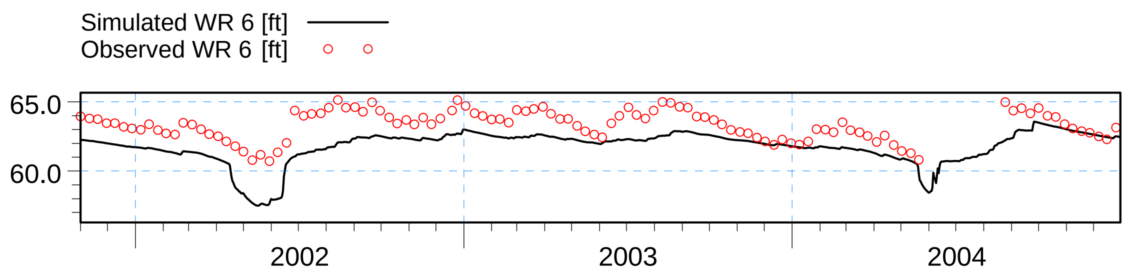


**Figure 4-95: Simulated and observed water level at SAS WR6 during the calibration period.**

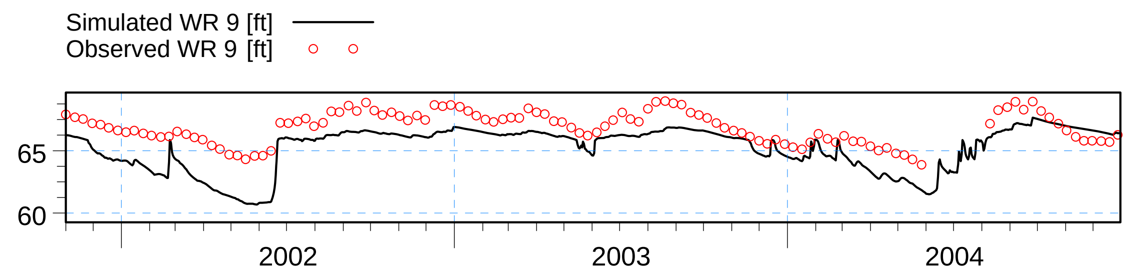


**Figure 4-96: Simulated and observed water level at SAS WR 9 during the calibration period.**

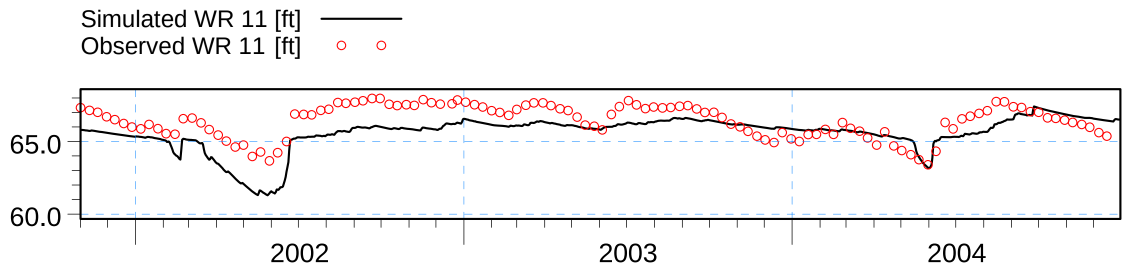


**Figure 4-97: Simulated and observed water level at SAS WR 11 during the calibration period.**

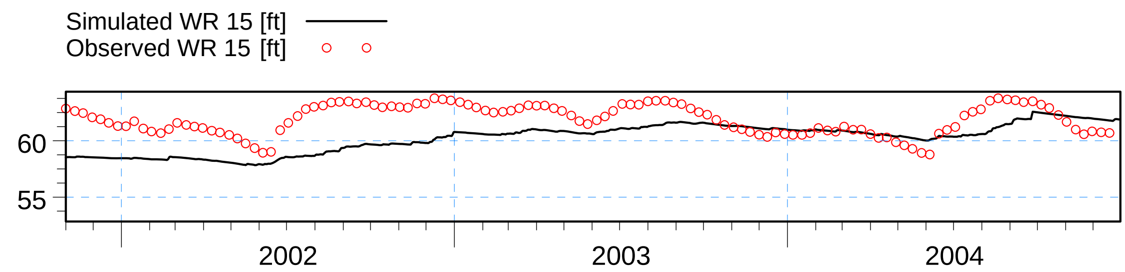


**Figure 4-98: Simulated and observed water level at SAS WR15 during the calibration period.**

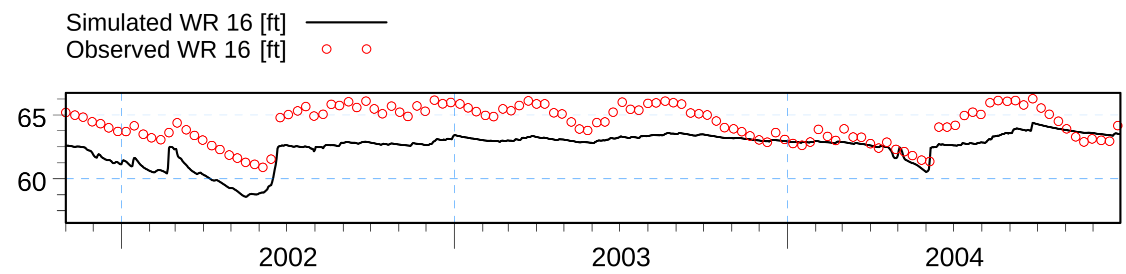


**Figure 4-99: Simulated and observed water level at SAS WR16 during the calibration period.**

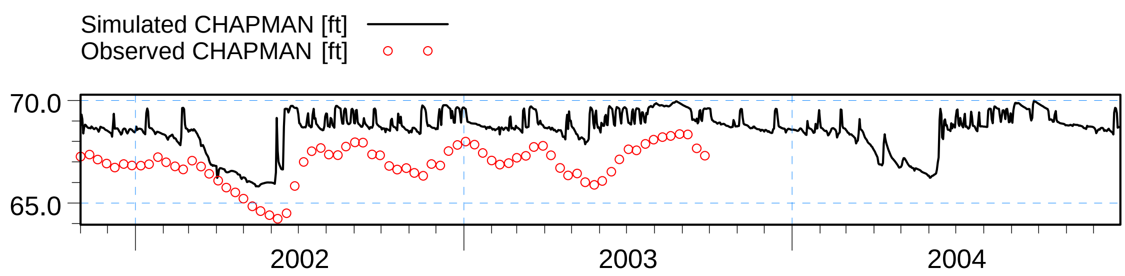


**Figure 4-100: Simulated and observed water level at SAS CHAPMAN during the calibration period.**

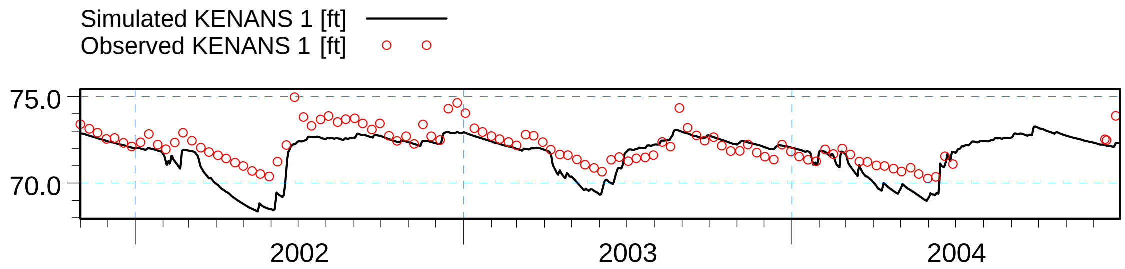


**Figure 4-101: Simulated and observed water level at SAS KENANS 1 during the calibration period.**

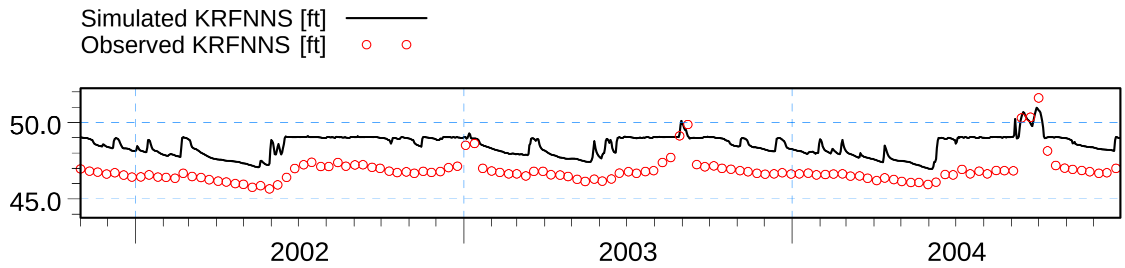


**Figure 4-102: Simulated and observed water level at SAS KRFNNS during the calibration period.**

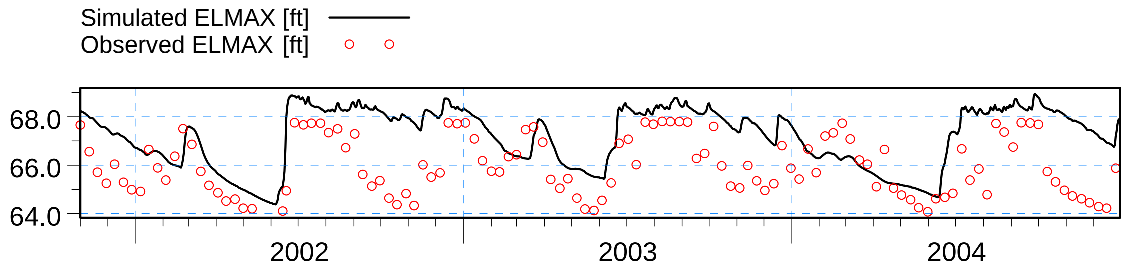


**Figure 4-103: Simulated and observed water level at SAS ELMAX during the calibration period.**

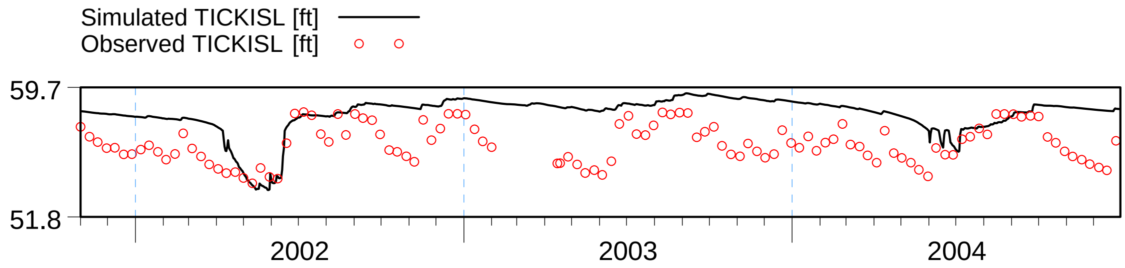


**Figure 4-104: Simulated and observed water level at SAS TICKISL during the calibration period.**

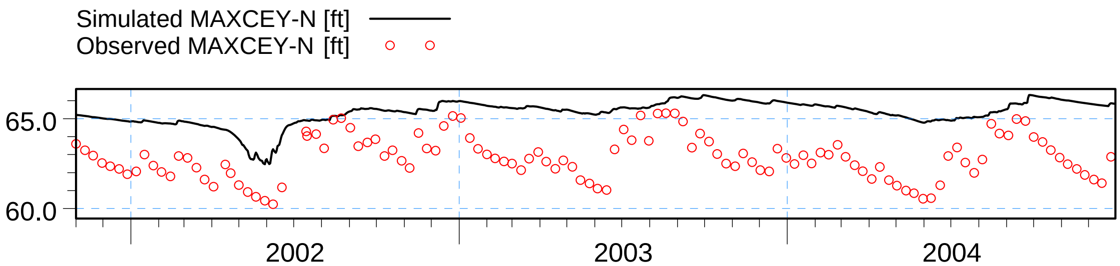


**Figure 4-105: Simulated and observed water level at SAS MAXCEY-N during the calibration period.**

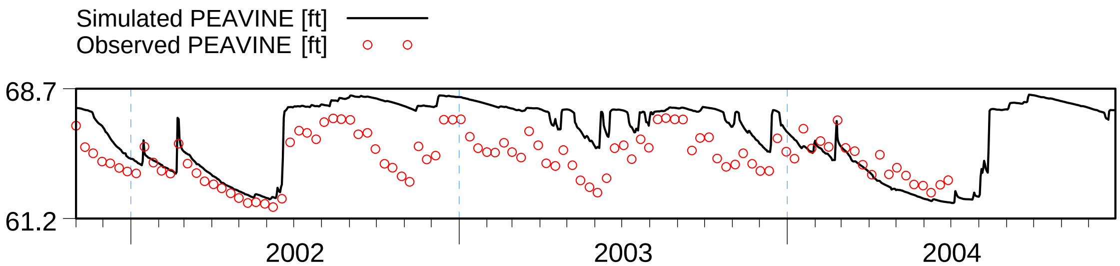


**Figure 4-106: Simulated and observed water level at SAS PEAVINE during the calibration period.**

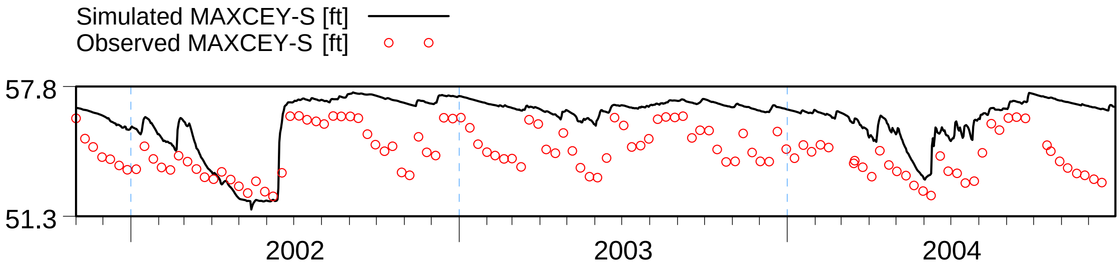


**Figure 4-107: Simulated and observed water level at SAS MAXCEY-S during the calibration period.**

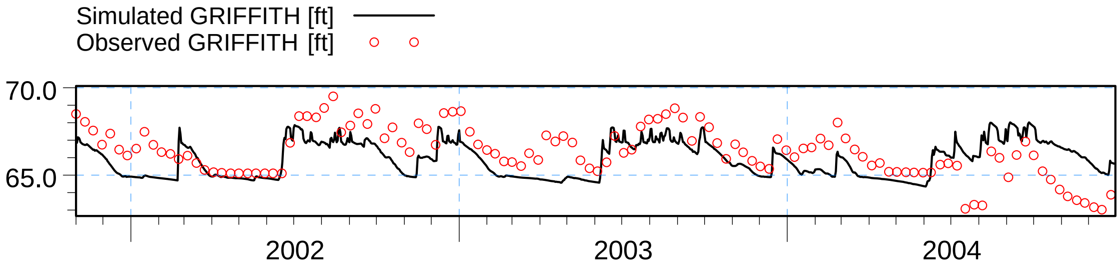


**Figure 4-108: Simulated and observed water level at SAS GRIFFITH during the calibration period.**

#### 4.5.2.2 Upper Floridan Aquifer

Simulated results at six qualitative UFA groundwater wells are shown in Figure 4-110 to Figure 4-115. The length of the observed record is limited at these groundwater wells but shown that the regional model is doing a reasonable job of simulating UFA groundwater levels.

Comparisons of potentiometric surface contours developed by the USGS and simulated UFA groundwater levels are shown in Figure 4-116 to Figure 4-119. UFA heads are shown for May 2002, May 2003, September 2003, and September 2004 and represent extreme conditions during the calibration period. The regional model is doing a reasonable job of simulating UFA heads in the KUB but there is a simulated depression in the LKB that is not present in the USGS potentiometric surface contours. The USGS potentiometric surface maps are generated based on a limited number of wells and may not include observation wells in the vicinity of the agricultural areas located within the simulated depression.

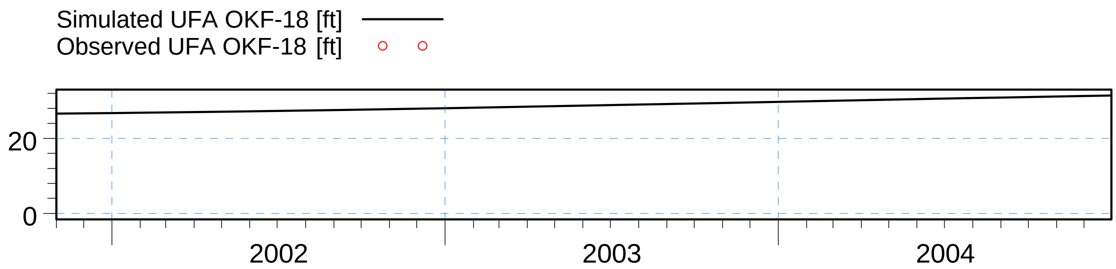


**Figure 4-109: Simulated water level at UFA OKF-18 during the calibration period.**

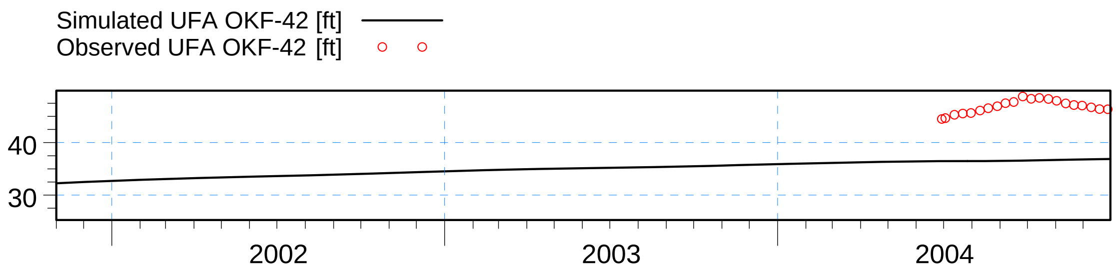


**Figure 4-110: Simulated and observed water level at UFA OKF-42 during the calibration period.**

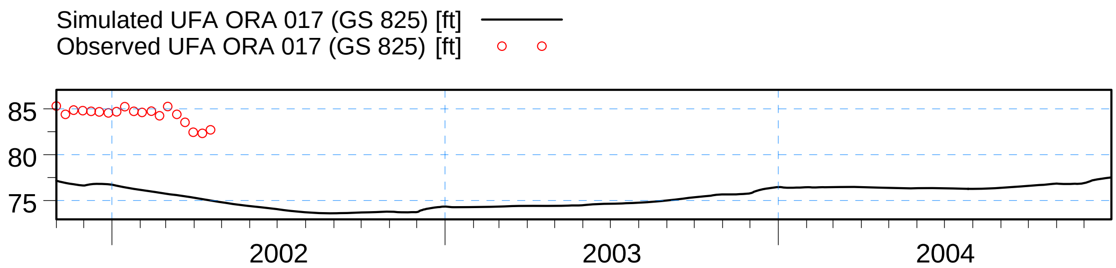


**Figure 4-111: Simulated and observed water level at UFA ORA 017/GS 825 during the calibration period.**

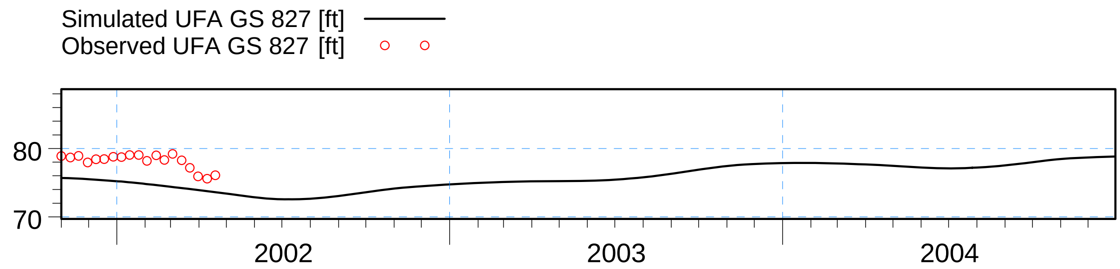


**Figure 4-112: Simulated and observed water level at UFA GS 827 during the calibration period.**

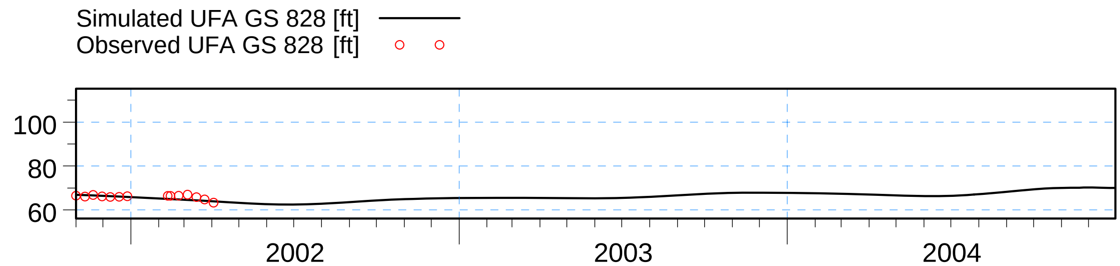


**Figure 4-113: Simulated and observed water level at UFA GS 828 during the calibration period.**

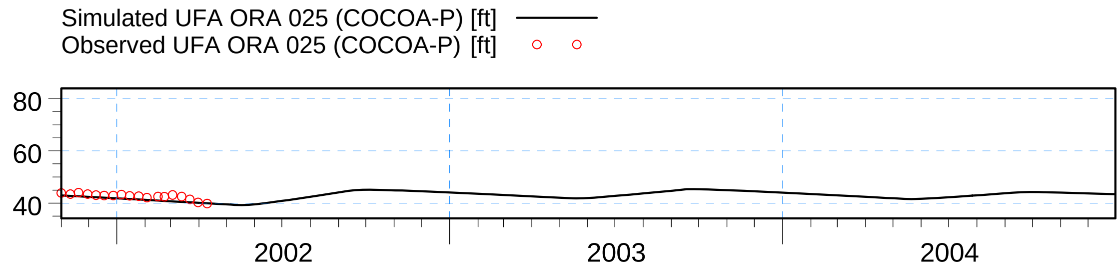


**Figure 4-114: Simulated and observed water level at UFA ORA 025/Cocoa-P during the calibration period.**

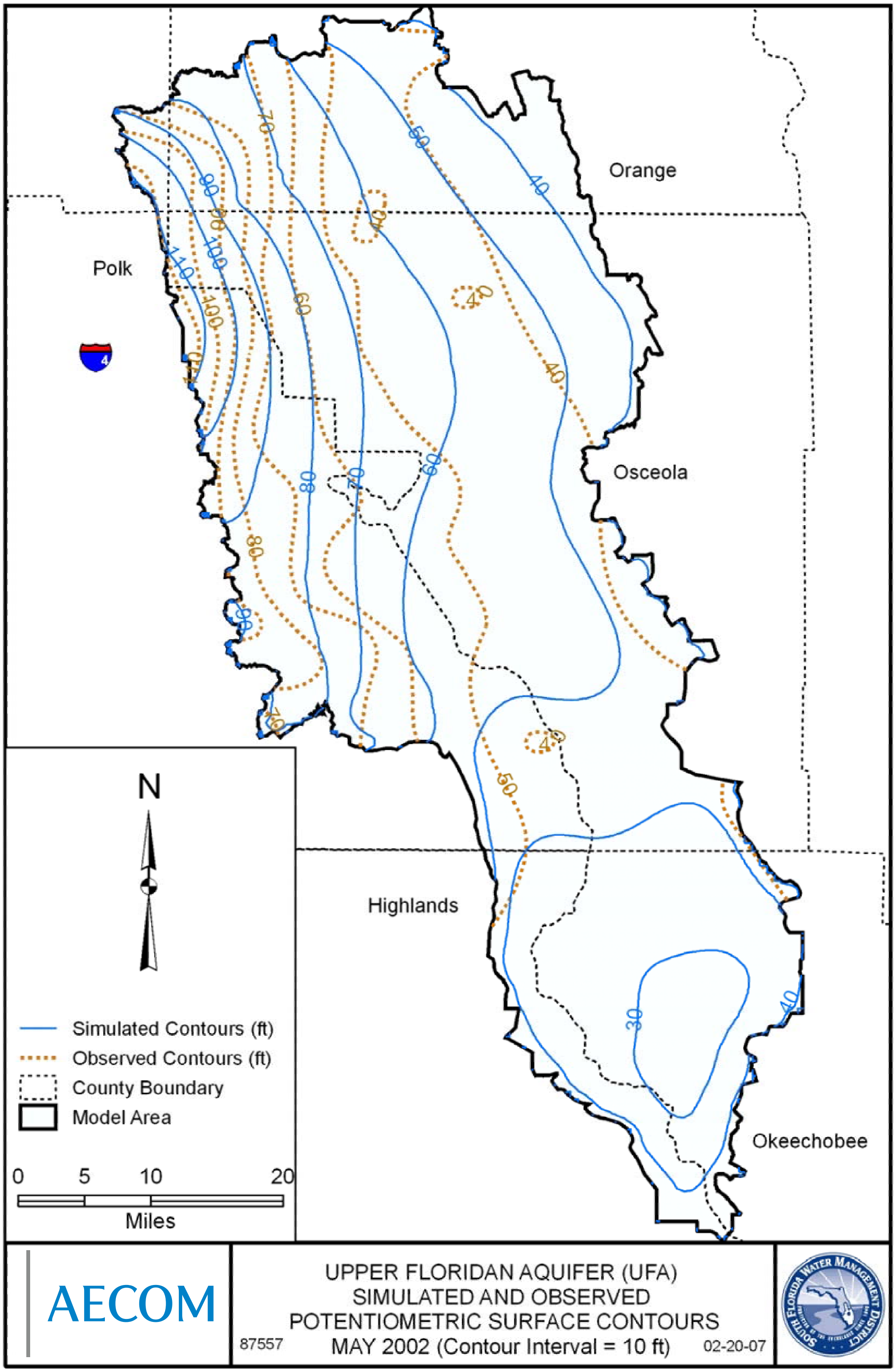


**Figure 4-115: Simulated and USGS contoured UFA potentiometric surface for May 2002.**

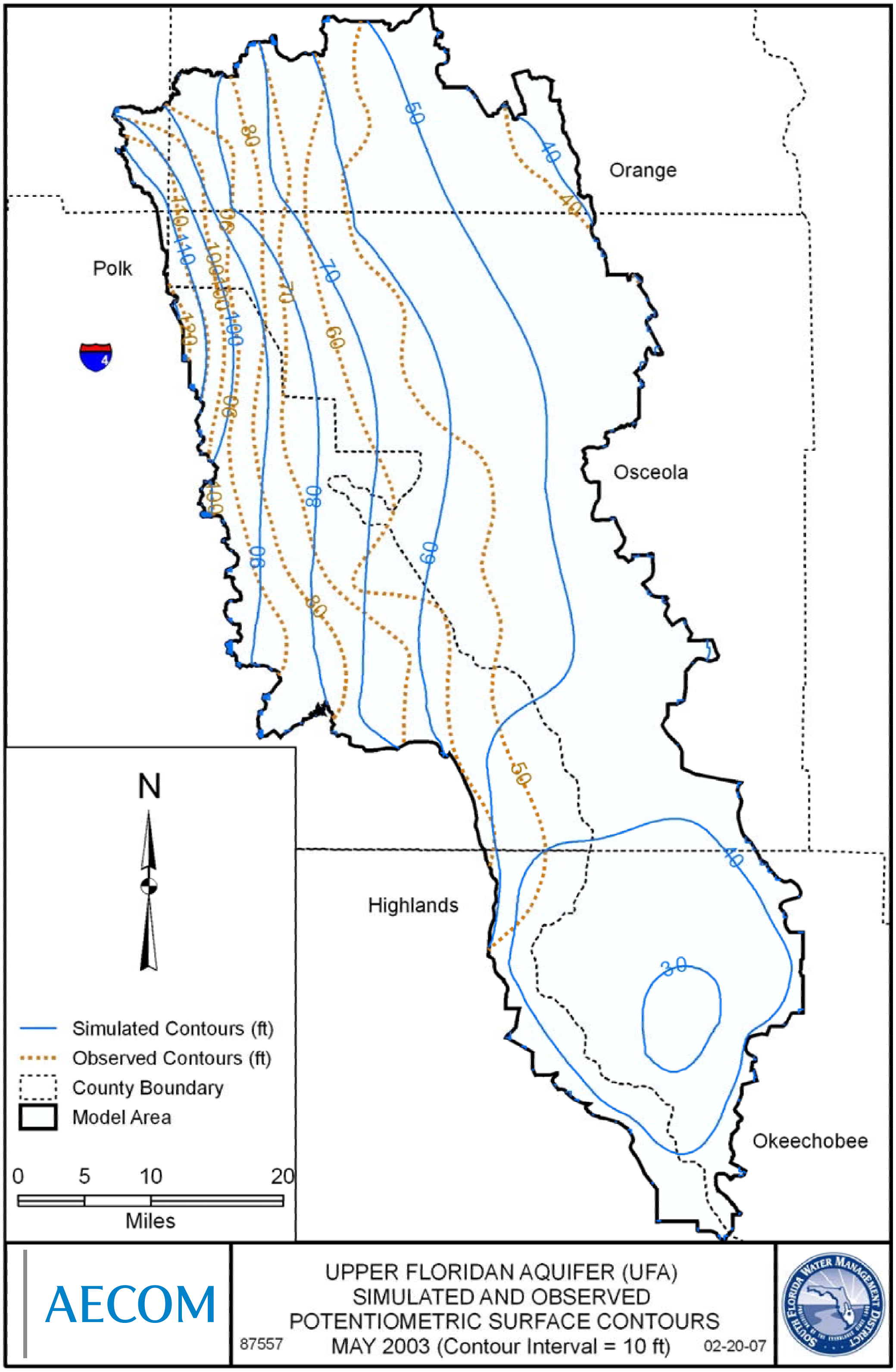


**Figure 4-116: Simulated and USGS contoured UFA potentiometric surface for May 2003.**

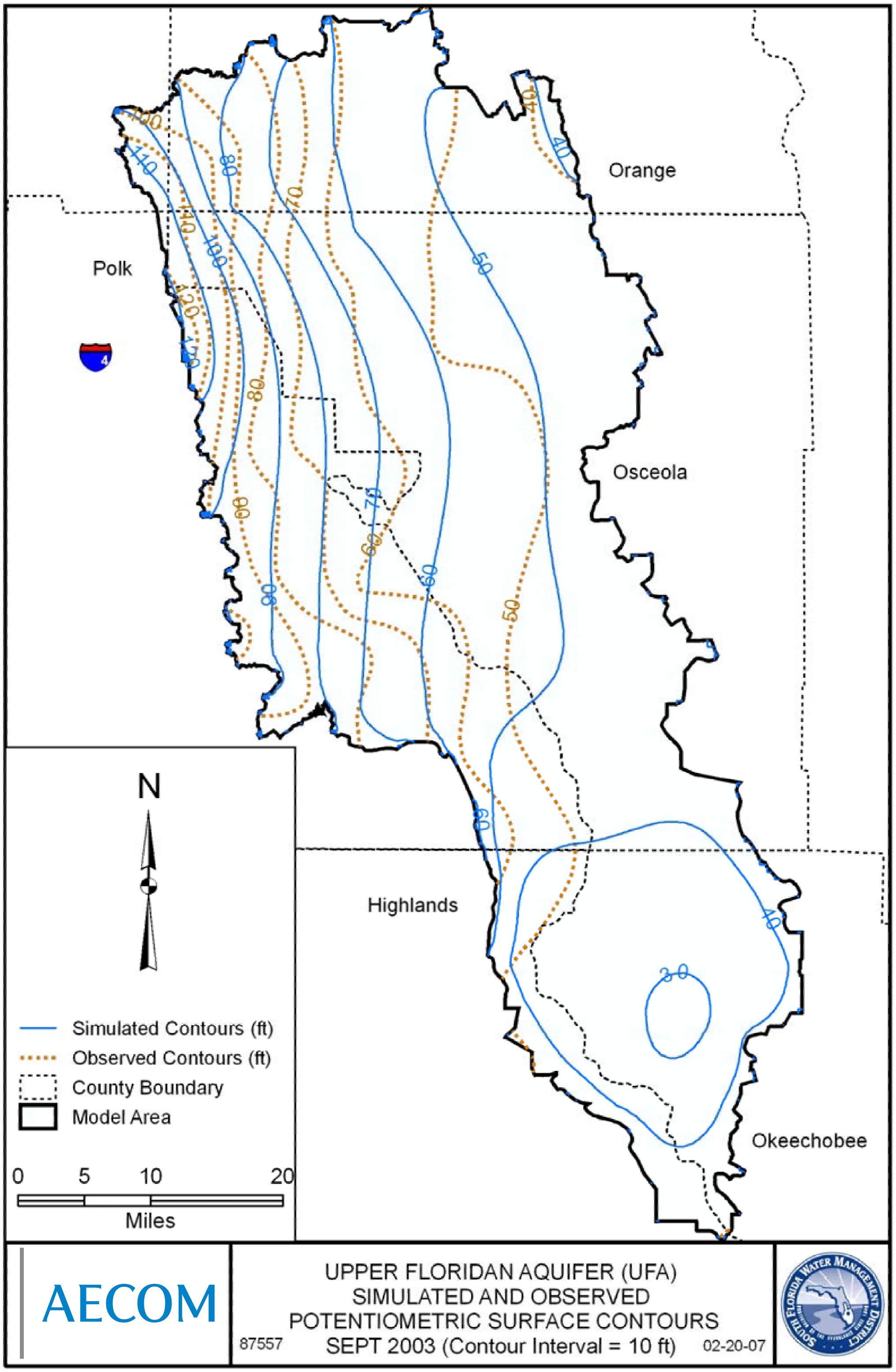


**Figure 4-117: Simulated and USGS contoured UFA potentiometric surface for September 2003.**

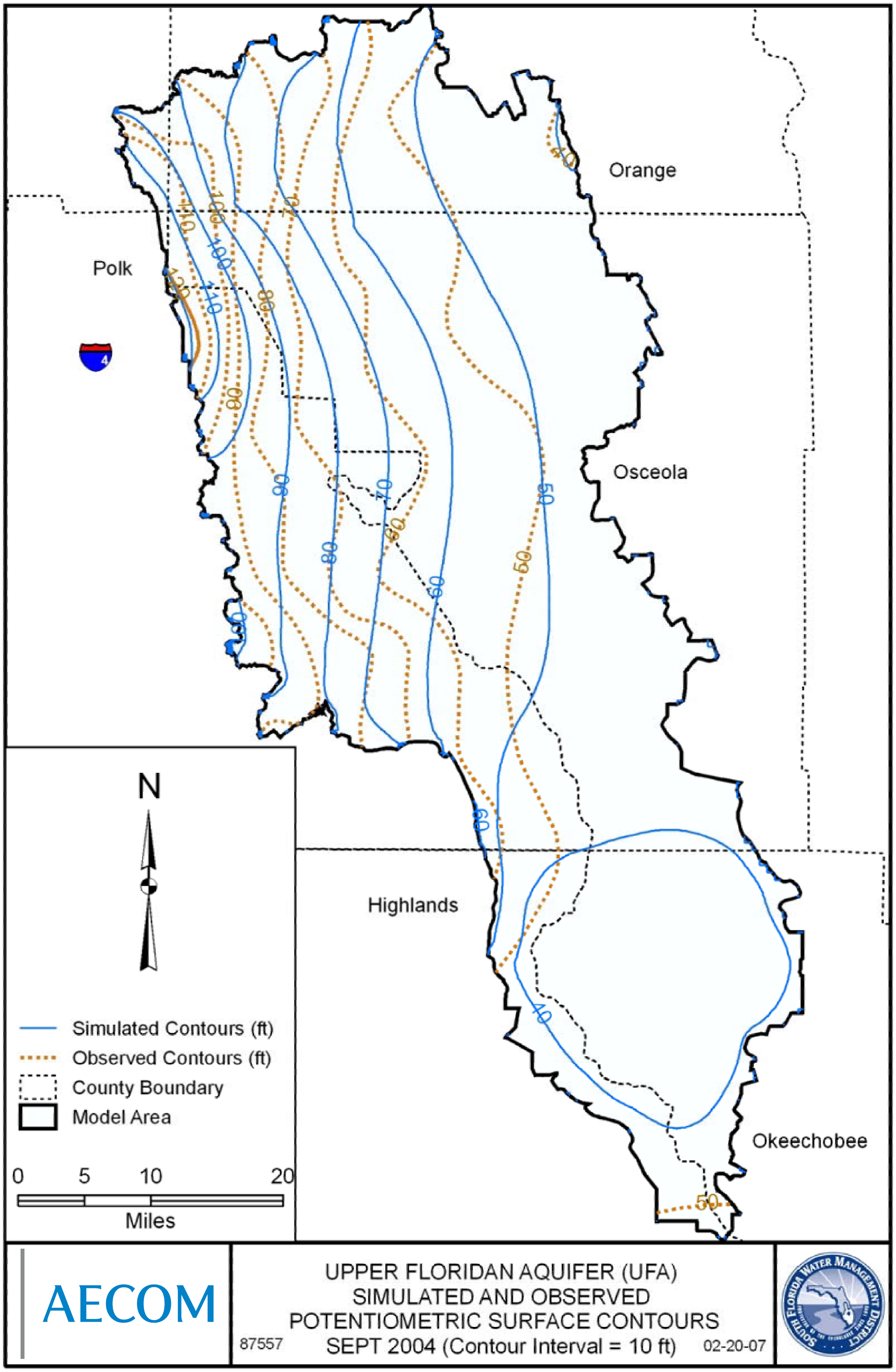


**Figure 4-118: Simulated and USGS contoured UFA potentiometric surface for September 2004.**

#### 4.5.2.3 Groundwater Calibration Statistics

Calibration statistics for the 33 selected SAS wells are summarized in Table 4-6. Criteria that are not met at individual stations are indicated with red shading. The model meets the *RMSE* and *R* calibration criteria at all wells identified as highly to moderately useful except for CAST, TICK, and GRIFFITH. The *R* criteria were not met at the CAST, TICK, and GRIFFITH wells but the *RMSE* criteria were met at all of these locations.

A graphical presentation of the fit of surficial aquifer groundwater levels at the 25 quantitative gages identified in the ATP (Earth Tech, 2006b) and refined in discussion with SFWMD staff relative to the mean error is shown in Figure 4-120.

**Table 4-6: Surficial Aquifer groundwater statistics for the calibration period. Red shading is used to indicate locations that do not meet specified criteria.**

| MODEL AREA | Station | RMSE | R(correlation) | RMSE | R(correlation) | RMSE | R(correlation) |
|---|---|---|---|---|---|---|---|
| **UKB SAS Calibration Wells for the 1000 x 1000 ft model** | | | | | | | |
| UKB bc | BEELINE | M | M | 1.14 | 0.71 | | |
| UKB north | TAFT | H | H | 0.63 | 0.86 | | |
| UKB north | KISSFS | H | H | 1.80 | 0.62 | | |
| UKB north | REEDGW 10 | H | H | 3.00 | 0.83 | | |
| UKB alligator | ALL 1 | H | H | 1.11 | 0.84 | | |
| UKB east | CAST | H | H | 1.11 | 0.49 | | |
| UKB east | EXOT | H | H | 1.27 | 0.80 | | |
| UKB east | PINEISL | H | H | 2.97 | 0.64 | | |
| UKB central | WR 6 | H | H | 1.65 | 0.72 | | |
| UKB central | WR 11 | H | H | 1.22 | 0.67 | | |
| UKB east | CHAPMAN | H | H | 1.86 | 0.72 | | |
| UKB east | KENANS 1 | H | H | 0.96 | 0.81 | | |
| **LKB SAS Calibration Wells for the 1000 x 1000 ft model** | | | | | | | |
| LKB east | ELMAX | H | H | 1.71 | 0.55 | | |
| LKB kr | TICKICL | H | H | 2.16 | 0.50 | | |
| LKB east | MAXCEY-N | H | H | 2.76 | 0.56 | | |
| LKB east | PEAVINE | H | H | 1.88 | 0.72 | | |
| LKB east | MAXCEY-S | H | H | 1.93 | 0.69 | | |
| LKB east | GRIFFITH | H | H | 1.42 | 0.40 | | |

"H" not meeting criteria
"M" not meeting criteria
Does meet criteria

NOTE: Calibration points with Low (L) utility have been omitted

Rattionale for selection of statistics Targets:
Highly Useful (H):
RMSE ATP Statistic Target range 2.5 to 3.0-ft
R ATP Statistic Target range 0.50 to 0.75
Moderately Useful (M):
RMSE ATP Statistic Target low end of range plus 0.5-ft
R ATP Statistic Target low end of range minus 0.05

AECOM

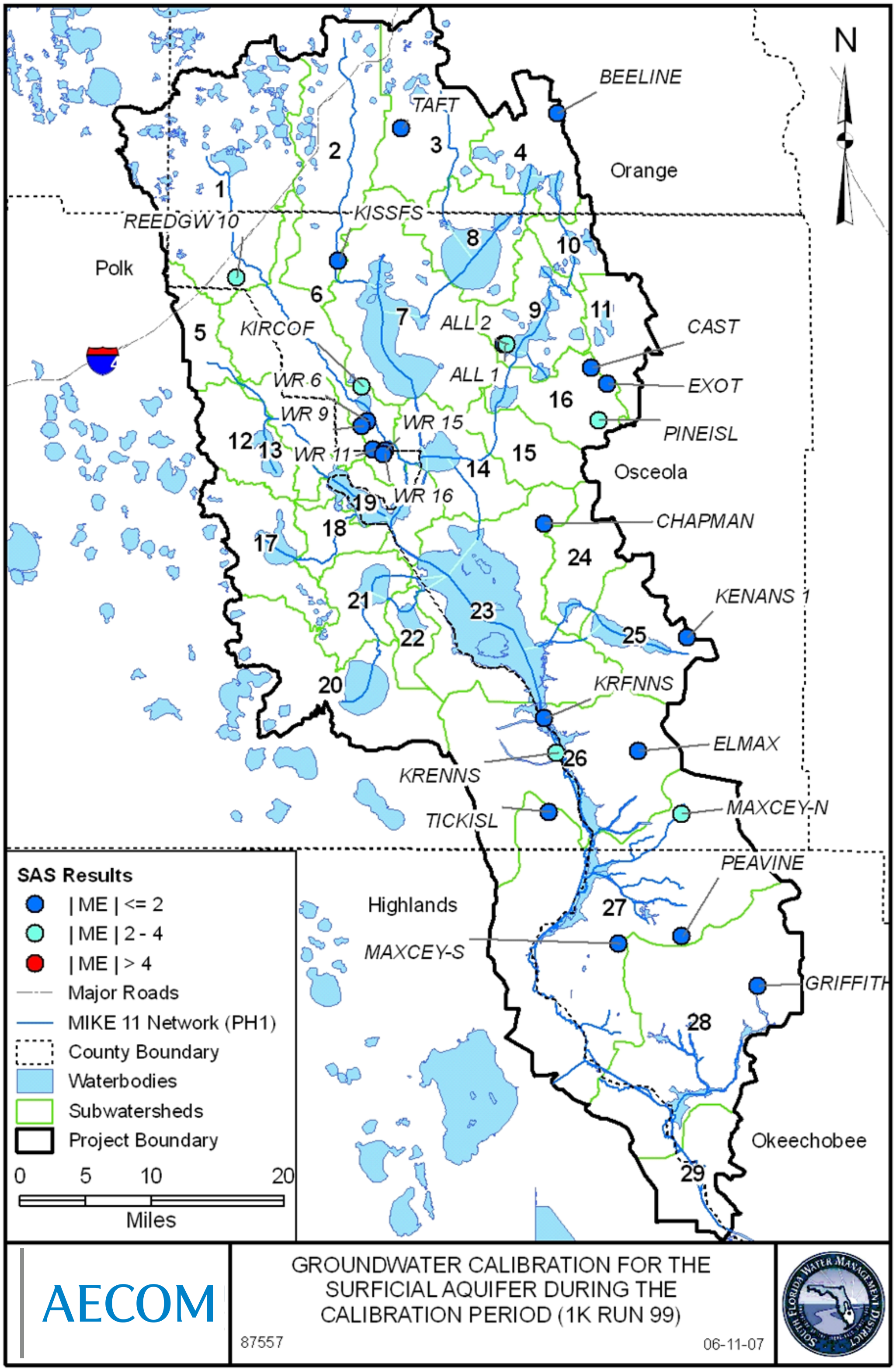


**Figure 4-119: Summary of statistical fit at surficial aquifer groundwater wells during the calibration period.**

### 4.5.3 Additional Qualitative Groundwater Calibration Criteria

In addition to use of observation data and potentiometric surfaces, model results were also evaluated relative to available groundwater recharge data from Aucott (1988) and river leakage data from Belanger et al. (2001). The comparison of the calibrated model to these additional qualitative data was very good.

#### 4.5.3.1 Upper Floridan Aquifer Recharge

The average annual recharge to the UFA developed by Aucott (1988) in the Kissimmee River Basin is shown in Figure 4-121. In general, the UFA receives recharge the KUB except in the vicinity of Lake Tohopekaliga, Cypress, Lake, Lake Hatchineha, Lake Marion, Lake Pierce, Lake Rosalie, Lake Weohyakapaka, Tiger Lake and Lake Kissimmee. UFA recharge rates are highest on the western side of the KUB in the ridge areas. Discharge from the UFA occurs in the LKB in the vicinity of the Kissimmee River and at the southern end of the watershed near Lake Okeechobee. UFA recharge rates are generally low in the LKB.

Simulated UFA recharge rates for the 3,000 ft regional model are shown in Figure 4-122 and correspond very well to the data of Aucott (1988). Simulated discharge rates in the KUB are higher than Aucott (1988) in some isolated areas locations but average rates for discharge areas are comparable. The model under-predicts UFA discharge in Pool A but does a good job simulating discharge in Pool B, C, and D. Simulated UFA recharge rates for the 1,000 ft surficial aquifer model are shown in Figure 4-123. Results for the 3,000 ft regional and 1,000 ft surficial aquifer models are nearly identical and indicate both models are accurately simulating exchanges between the surficial aquifer and UFA.

#### 4.5.3.2 River Leakage

Simulated groundwater leakage rates in the LKB were calibrated using the data of Belanger et al. (2001). The full contact river-aquifer exchange option was used in the KBMOS model except in the KUB lakes represented in MIKE 11. As a result, the horizontal hydraulic conductivity of the surficial aquifer is the model parameter that was used to calibrate river leakage in the LKB.

Simulated and observed river leakage rates in Pool A and C in the LKB are summarized in Table 4.7. Simulated river leakage rates summarized Table 4-7 represent average leakage values for the C-38 in Pool A and C. Observed river leakage rates summarized in Table 4-7 represent the average of discrete measurements at two and four locations in Pool A and C, respectively. The simulated river leakage rates are comparable to the values summarized in Belanger et al. (2001) and the calibration of river leakage parameters are considered adequate given the uncertainties associated with comparisons of discrete measurements and average values for a relatively long section of the C-38 canal.

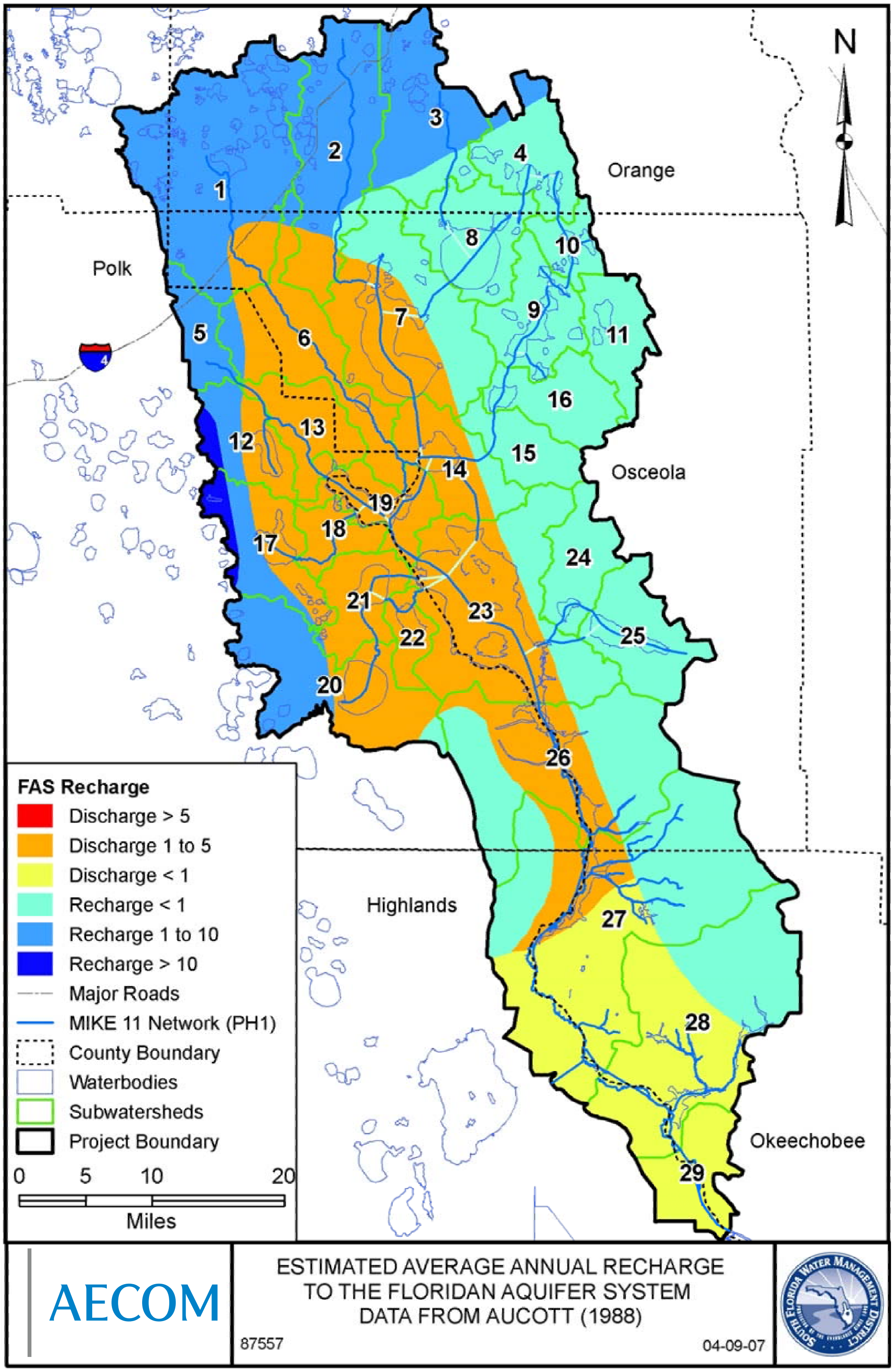


**Figure 4-120: Upper Floridan Aquifer recharge rates from Aucott (1988).**

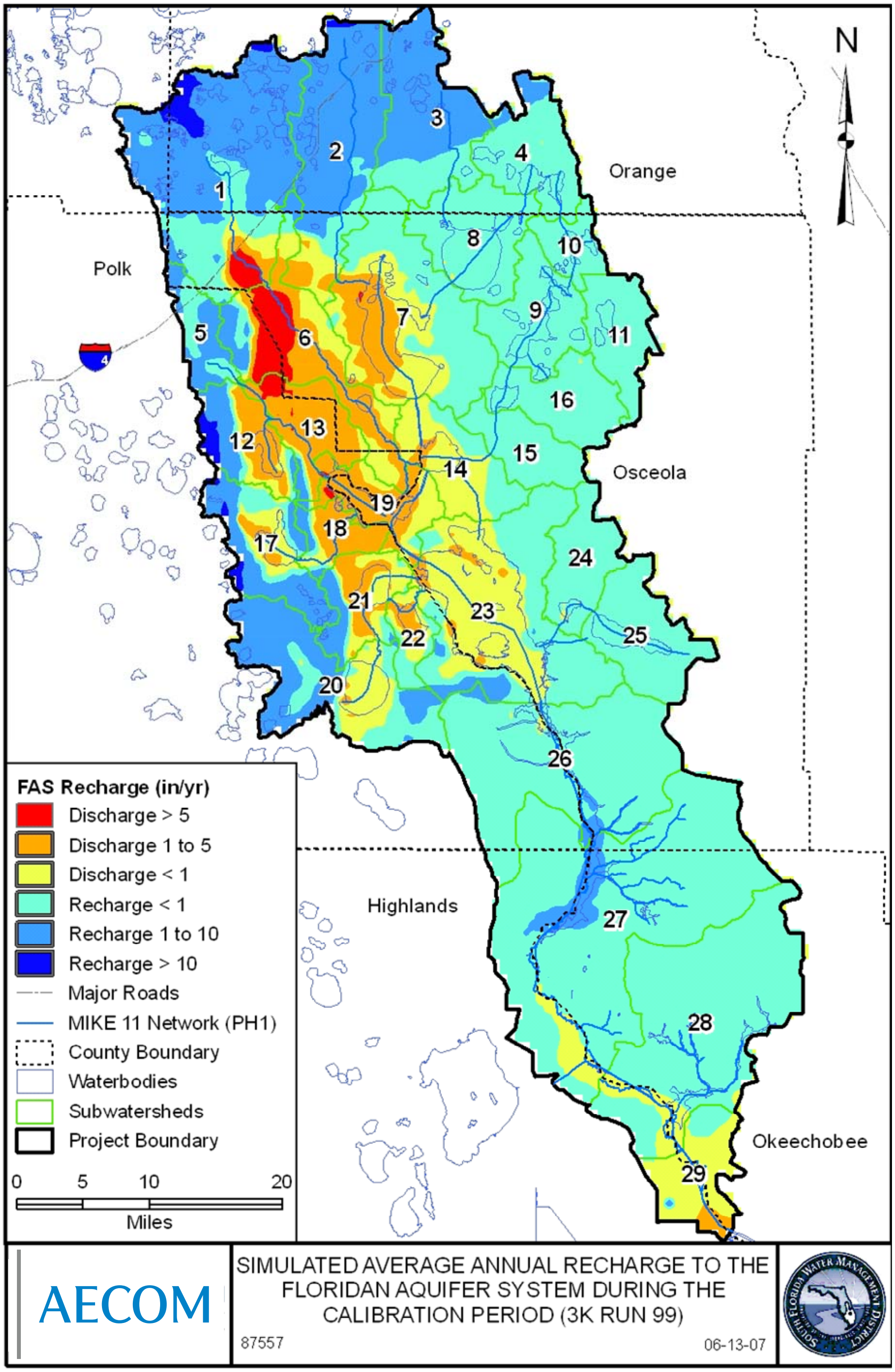


**Figure 4-121: Simulated Upper Floridan Aquifer recharge rates from the 3,000 ft regional model.**

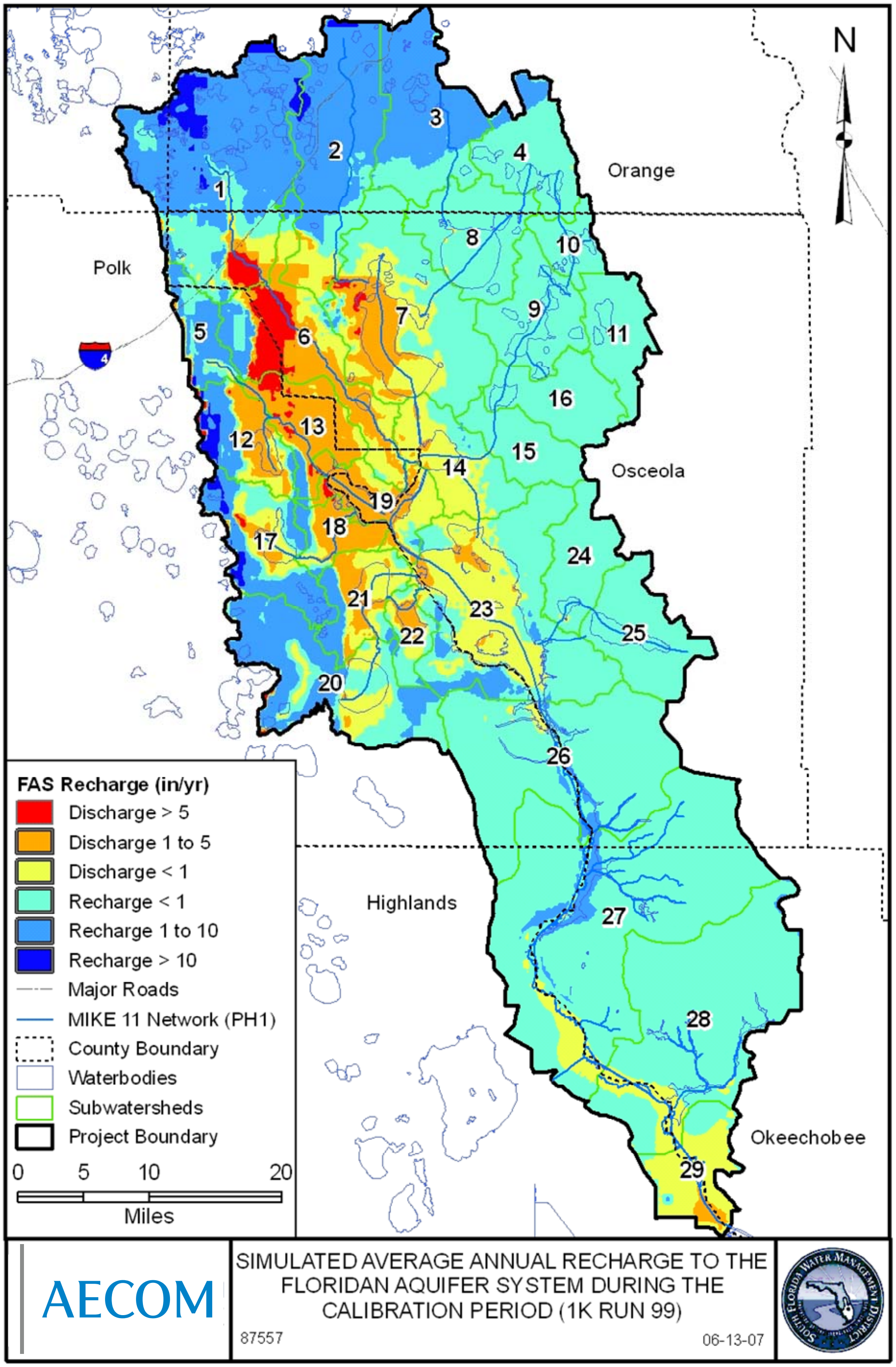


**Figure 4-122: Simulated Upper Floridan Aquifer recharge rates from the 1,000 ft surficial aquifer model.**

**Table 4-7: Simulated and observed river leakage for Pool A and C of the LKB.**

| Pool | Belanger et al. (2001) | | | KBMOS Results | | | | |
|---|---|---|---|---|---|---|---|---|
| | Minimum | Average | Maximum | 2001 | 2002 | 2003 | 2004 | Average |
| | (in/yr) | | | | | | | |
| A | -34 | 27 | 79 | 34 | 42 | 41 | 34 | 38 |
| C | -4 | 28 | 97 | 39 | 45 | 52 | 47 | 46 |

### 4.5.4 Qualitative Water Budgets for the Calibration Period

Seasonal MIKE SHE water budgets for 29 sub-watersheds are summarized in Appendix C. Seasonal MIKE SHE water budgets for the SAS for the 29 sub-watersheds are also summarized in Appendix C. MIKE SHE water budgets for the entire calibration period are included in Appendix C (see sub-watersheds delineation in Figure 2-25). The terms included in the water budgets and equations used to calculate the total model error (*Err*) are also defined in Appendix C. The Lake Management Unit Budget was also prepared. The results of this analysis are presented in a separate set of Excel spreadsheets (in digital format) and correspond to the water budget from the MIKE 11 perspective. The Excel spreadsheets summarize the lateral inflows (runoff + baseflow) for each Lake Management Unit.

Water budgets are presented for the 2001 to 2002 dry season, 2002 wet season, 2002 to 2003 dry season, 2003 wet season, 2003 to 2004 dry season, and the 2004 wet season. Water budgets are not presented for the 2001 wet season because this period is outside of the calibration period. Water budgets are not presented for the 2000-2001 dry season or the 2004 to 2005 dry season because the model was only run for a portion of these periods. In general, the water budgets appear to be reasonable based on review of available data (*e.g.*, McGurk and Presley, 2002).

### 4.5.5 Calibration Log

A separate document will be made available in the Study FTP site that summarizes the process followed during calibration. This document, named “KBMOS-AFET Calibration Log” describes the main components of each calibration run (from the initial runs to Run 99) and the changes introduced to the model configuration after every run.

## 4.6 Overland Flow Depth and Hydro-Period Maps

Maximum and average overland flow depths for the 2001 to 2002 dry season, 2002 to 2003 dry season, 2003 wet season, and 2004 wet season are shown in Figure 4-124 to Figure 4-131. These periods represent extreme conditions during the calibration period (see Figure 2-4). Overland depth hydro-period maps showing the percentage of time overland depths exceed 1 inch and 1 foot are shown in Figure 4-132, respectively.

Although a rigorous analysis of simulated hydro-periods for specific vegetation types was not performed, simulated overland depths and hydro-periods appear reasonable for the selected periods based on comparison with KBMOS land-use categories (see Figure 2-5). Areas with significant overland water depths generally correspond to land-use categories that are typically inundated for significant periods of time (water, swamp forest, *etc.*). Qualitative correspondence of simulated overland results to land-use suggests that overland parameters are adequate to meet the objectives of the KBMOS.

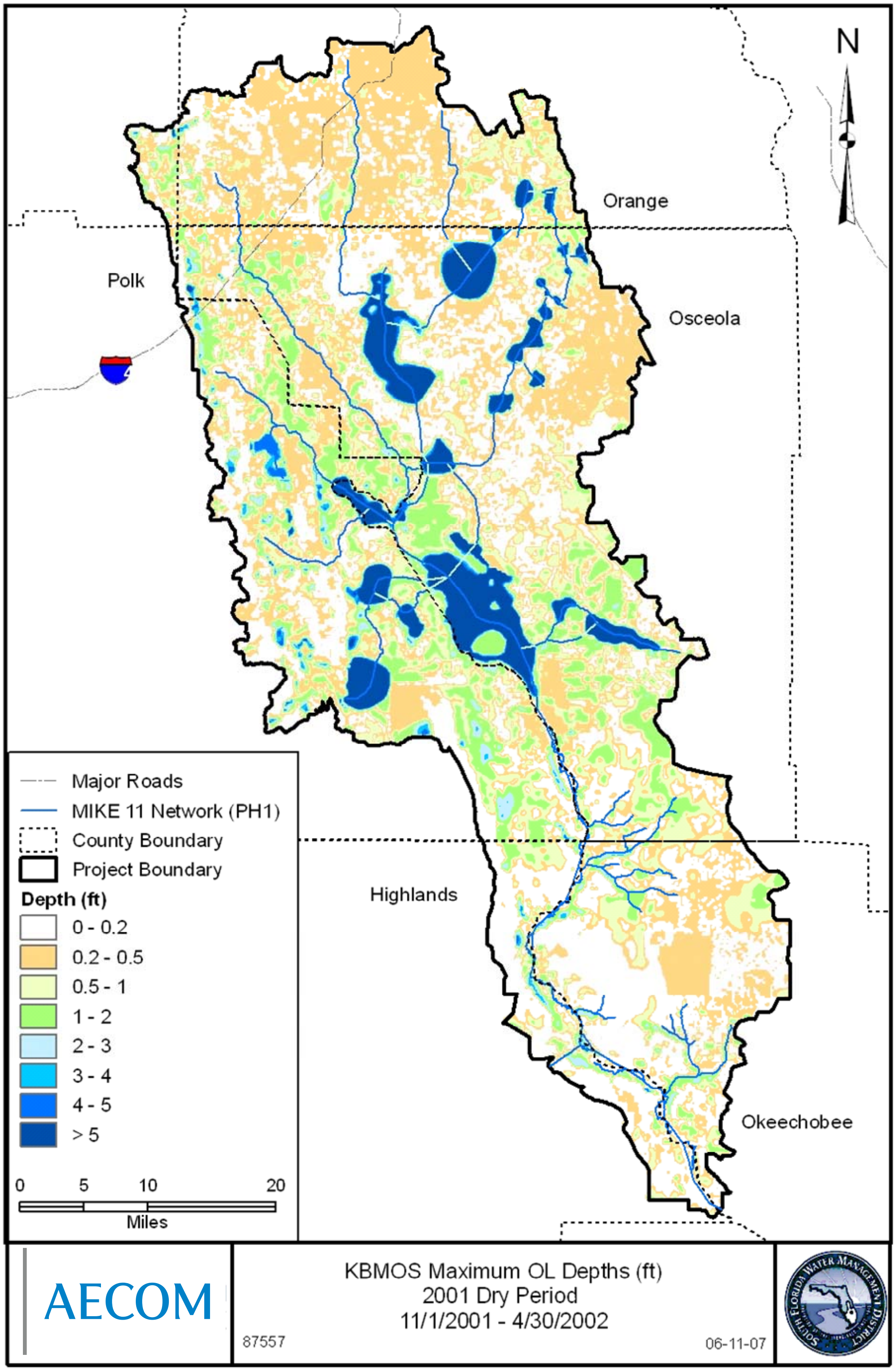


**Figure 4-123: Maximum overland flow depths for the 2001 to 2002 dry period.**

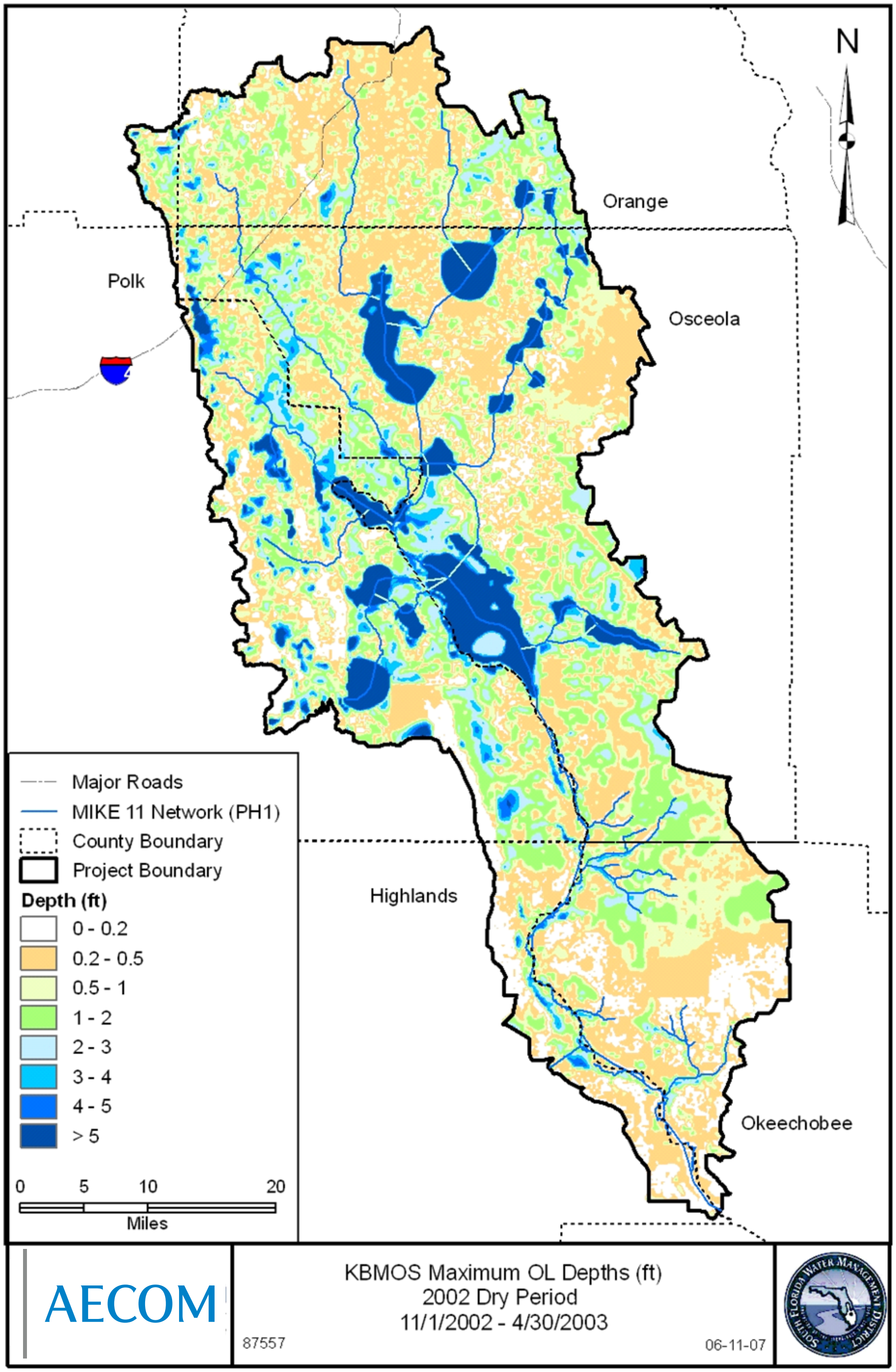


**Figure 4-124: Maximum overland flow depths for the 2002 to 2003 dry period.**

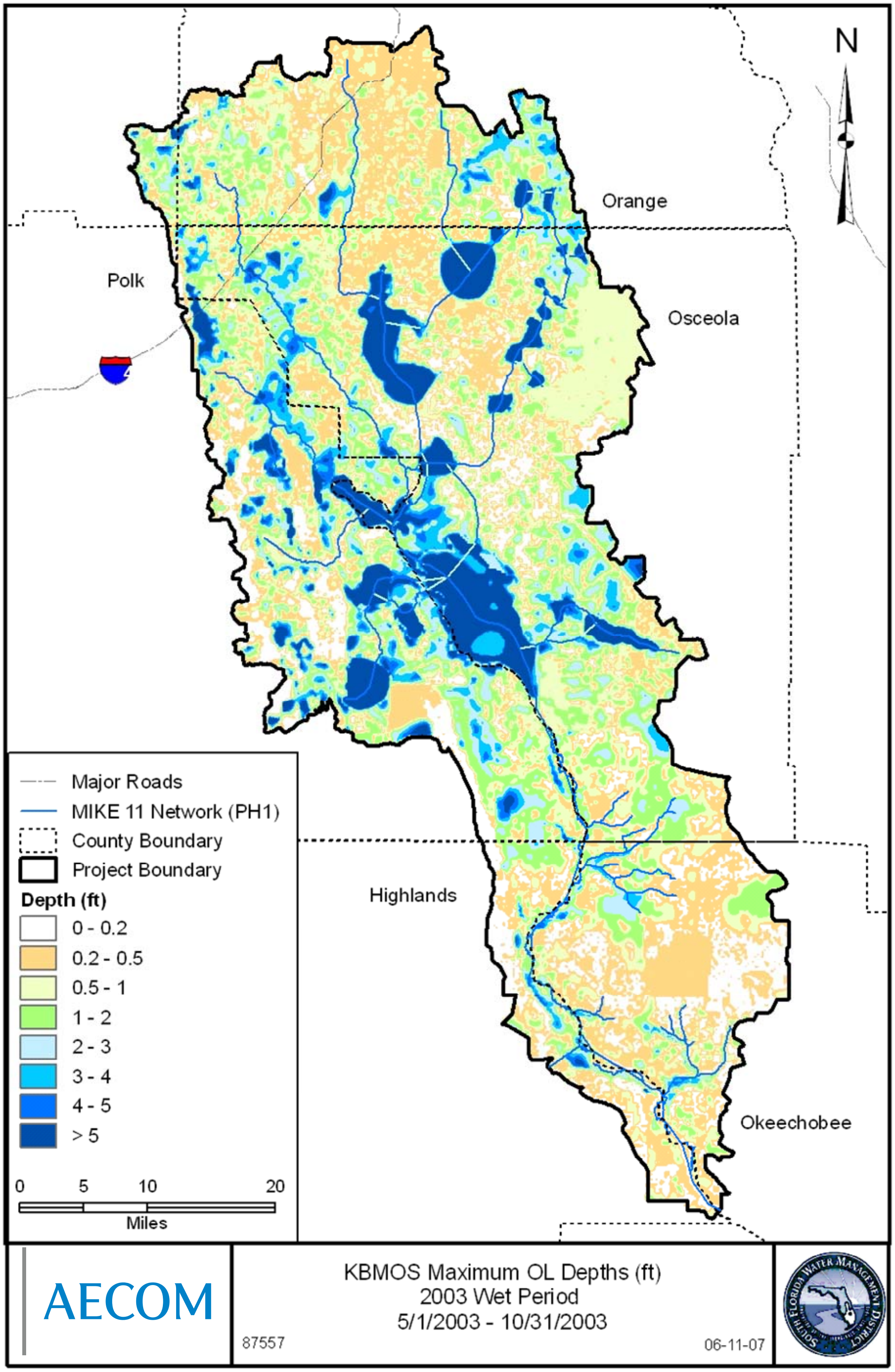


**Figure 4-125: Maximum overland flow depths for the 2003 wet period.**

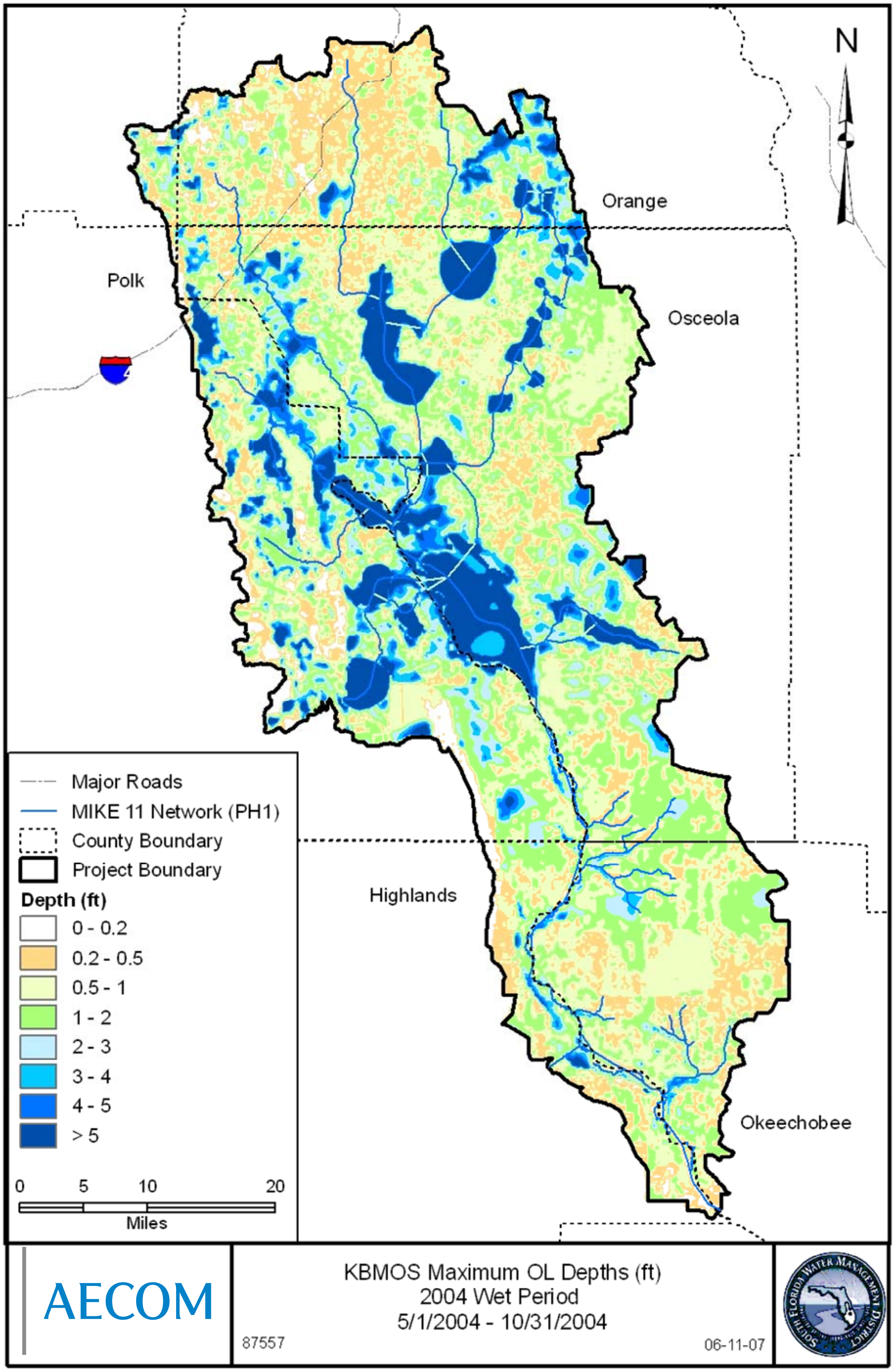


**Figure 4-126: Maximum overland flow depths for the 2004 wet period.**

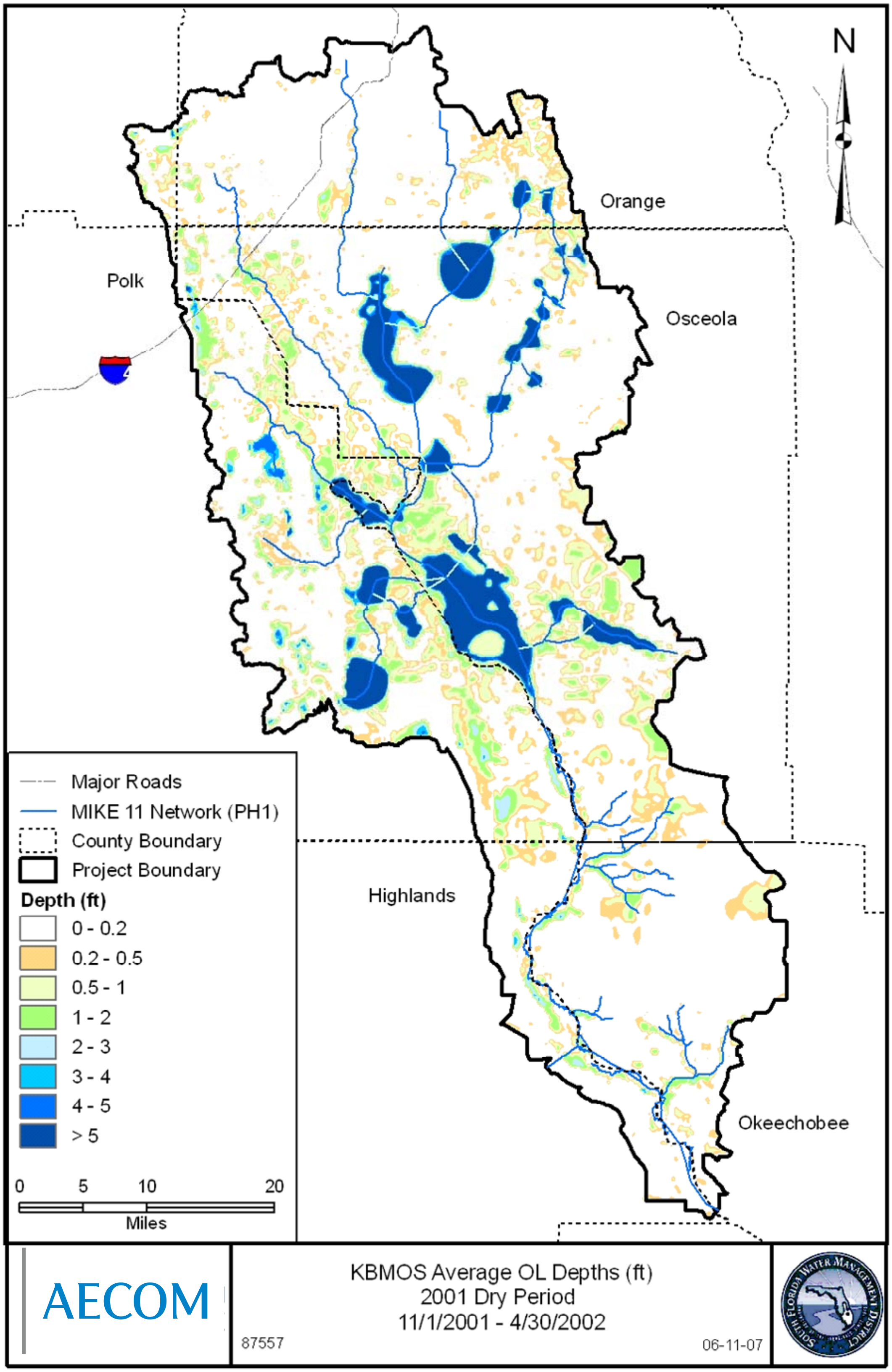


**Figure 4-127: Average overland flow depths for the 2001 to 2002 dry period.**

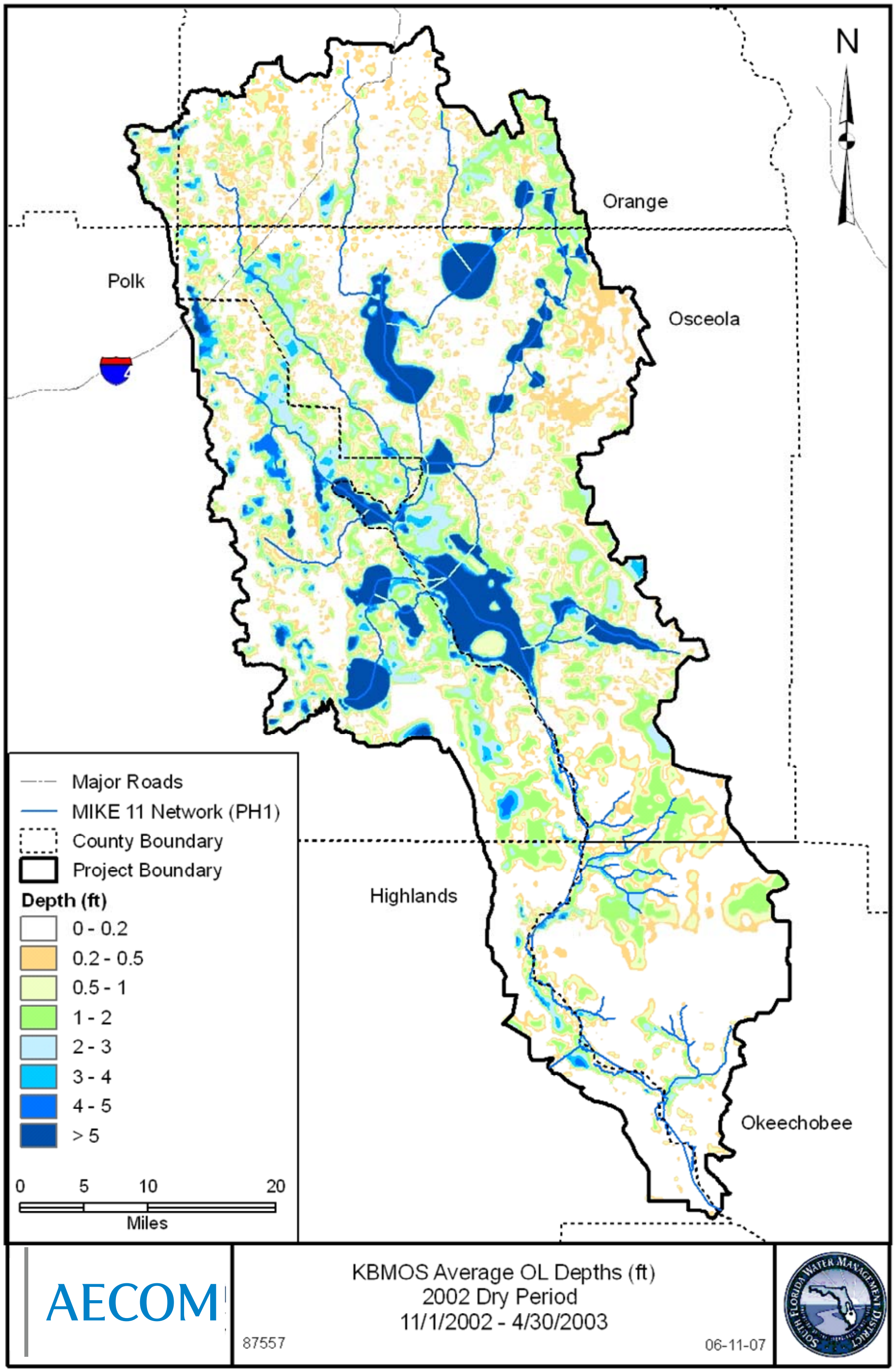


**Figure 4-128: Average overland flow depths for the 2002 to 2003 dry period.**

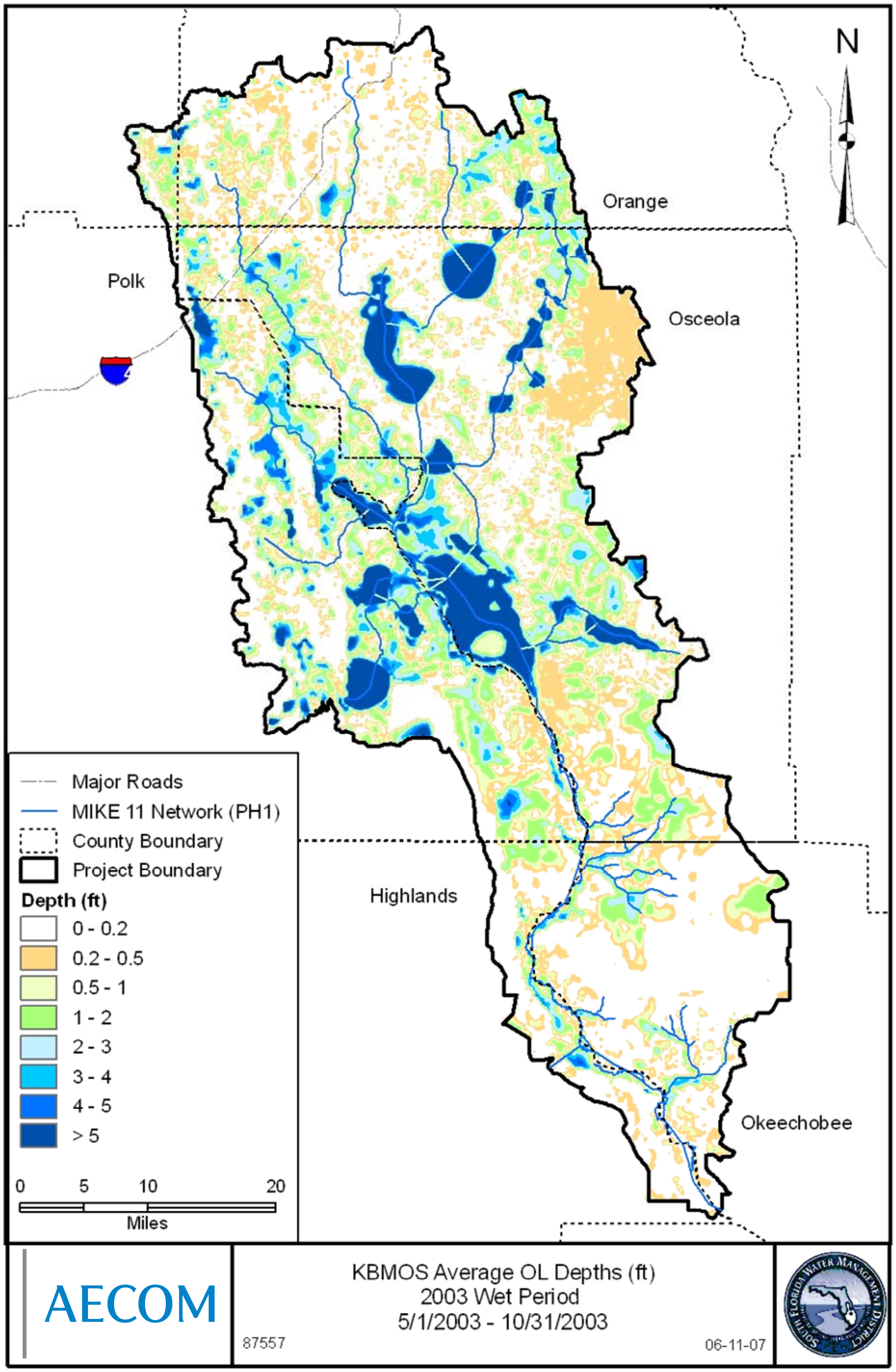


**Figure 4-129: Average overland flow depths for the 2003 wet period.**

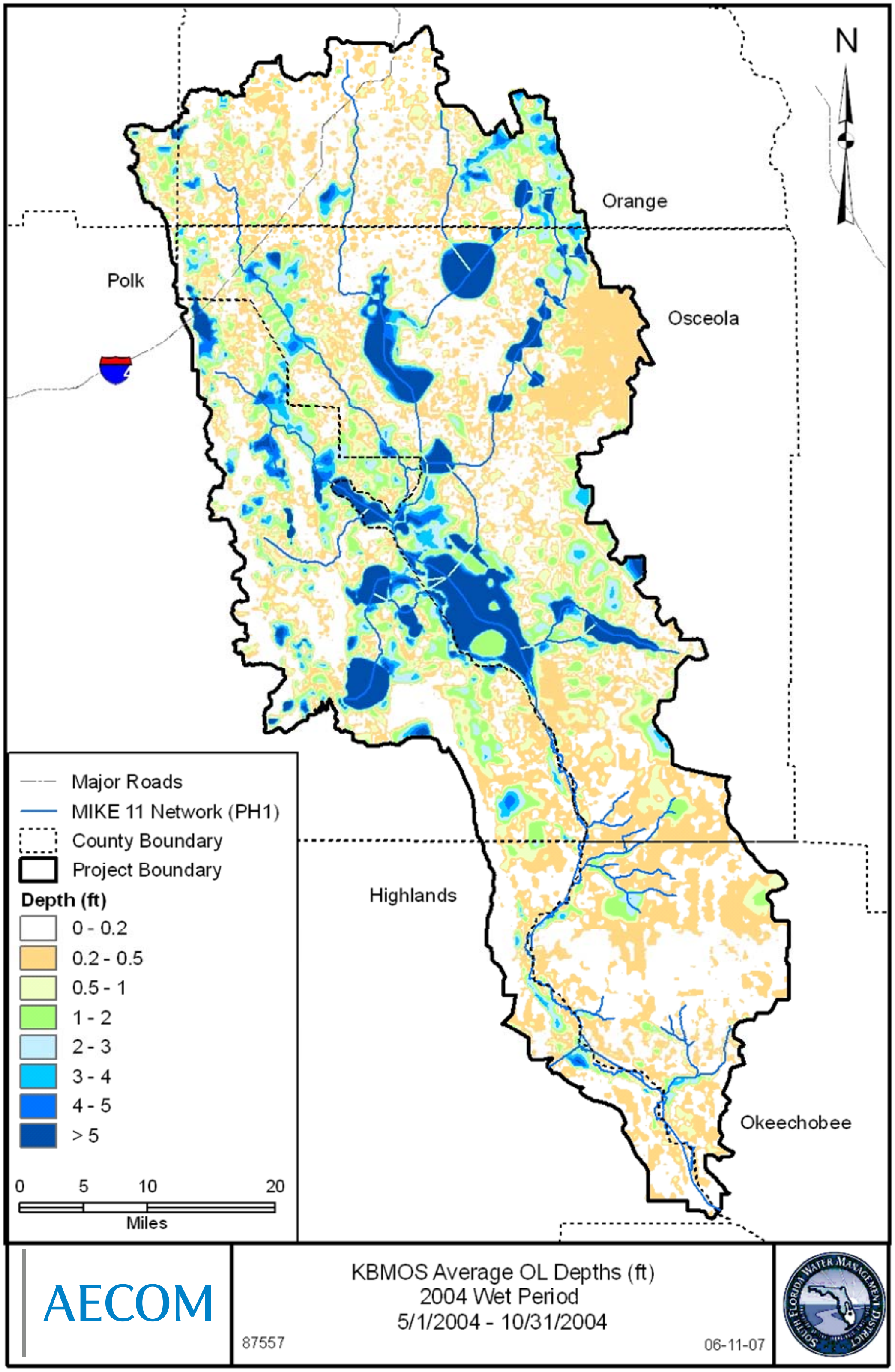


**Figure 4-130: Average overland flow depths for the 2004 wet period.**

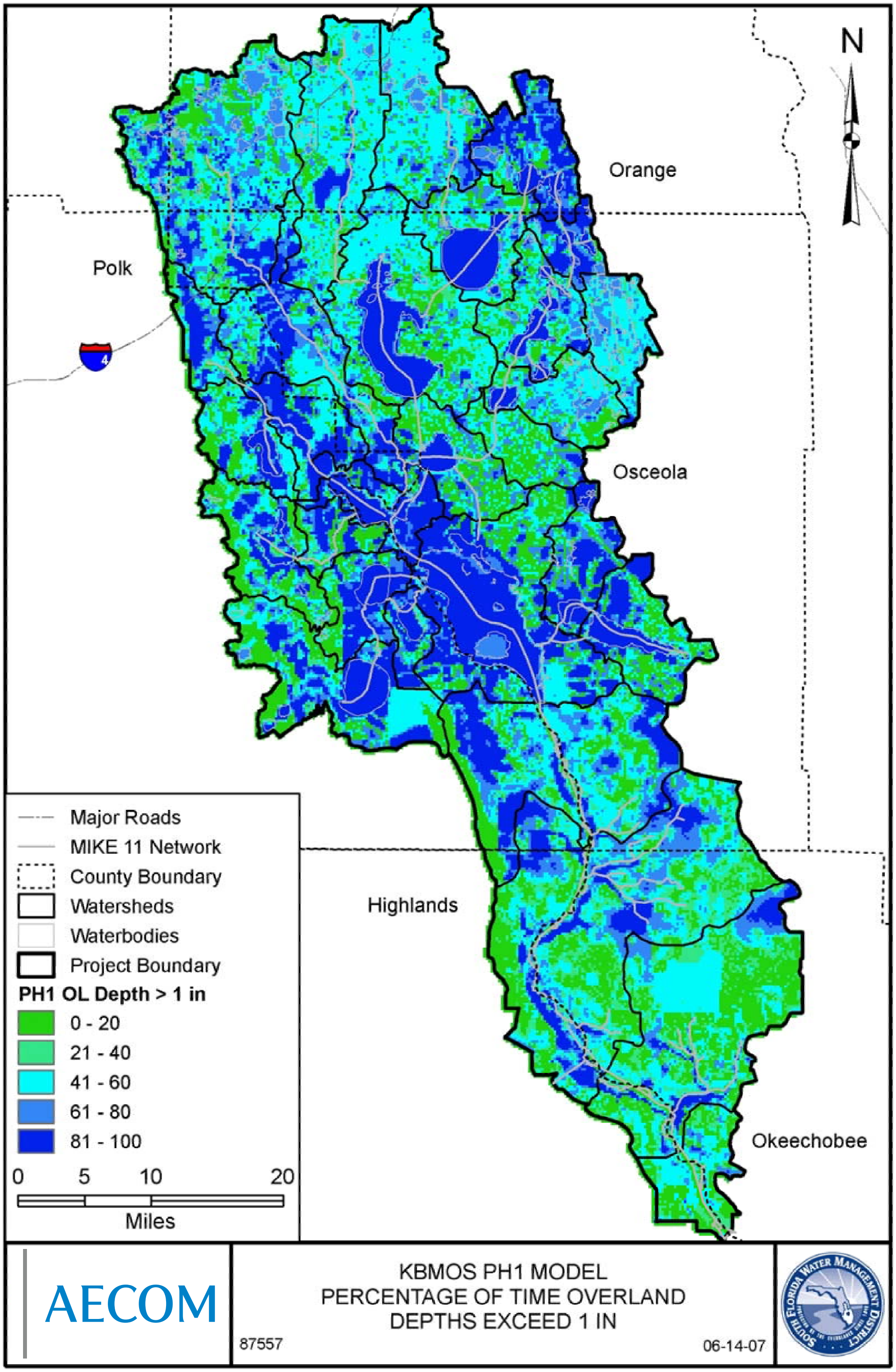


**Figure 4-131: Percentage of time overland flow depths exceed 1 inch during the period from 2001 to 2004.**

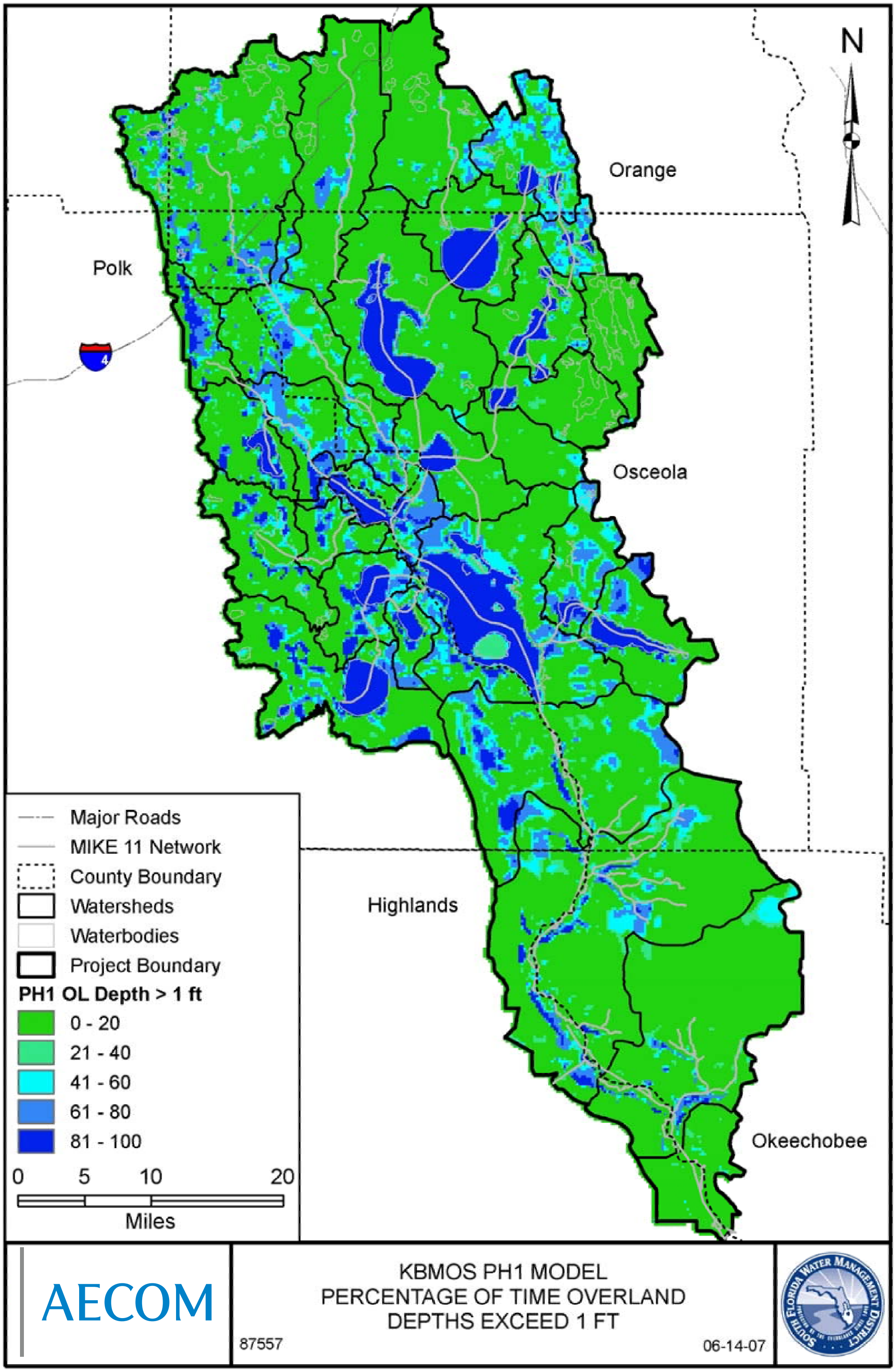


**Figure 4-132: Percentage of time overland flow depths exceed 1 foot during the period from 2001 to 2004.**

# 5 MODEL VERIFICATION

Verification of the pre-Phase 1 KBMOS model for the period from January 1, 1994 through December 31, 1998 is discussed below. Verification of the post-Phase 1 model for the 2004 hurricane season is also presented below. 15-minute NEXRAD rainfall and surface water verification data was used to verify the KBMOS model for the 2004 hurricane season.

For each verification run (1994-1998 and Storm event simulations) stage and flow hydrograph comparisons are presented. Additionally, tables and plots summarize the obtained goodness of fit in each veification run. Finally, qualitative comparisons of potentiometric maps are discussed. Water budget tables are also described in this section, detailed water budgets are presented in Appendix D.

The KBMOS model met the defined criteria in the verification periods and statistics were comparable to the verification period. Surface water, groundwater, overland water, and water budget results are presented below.

## 5.1 Daily Rainfall Data Verification Results

Surface water and groundwater results are presented for the verification period (January 1, 1994 to December 31, 1998) at the locations evaluated during the calibration period. The model was run for the verification period using daily precipitation data. The model setup for the verification period is identical to the model used in the calibration period except for the MIKE 11 model. The pre-Phase 1 MIKE 11 network was used in the verification period and is identical to the post-Phase 1 model except where the C-38 canal was backfilled as part of Phase 1 activities. The pre-Phase 1 model includes the S-65B and S-65BX structures and 3 gates at S-65.

### 5.1.1 Surface Water Verification

Current surface water results at key surface water calibration locations are presented in Figure 5-1 through Figure 5-52. In general, model performance is similar in the verification and calibration periods.

#### 5.1.1.1 Upper Basin

The current results for the upper basin during the verification period indicate that the model is adequately capturing surface water process and responses in the KUB. Simulated and observed surface water data for the upper basin is presented in Figure 5-1 to Figure 5-25.

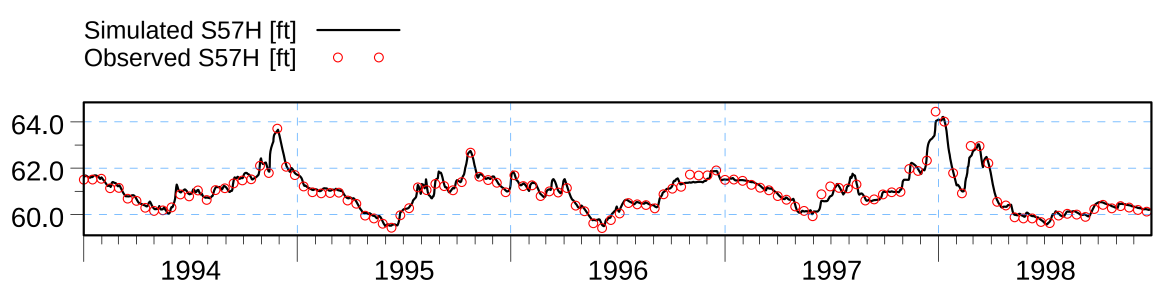


**Figure 5-1: Simulated and observed headwater stage at S-57 during the verification period.**

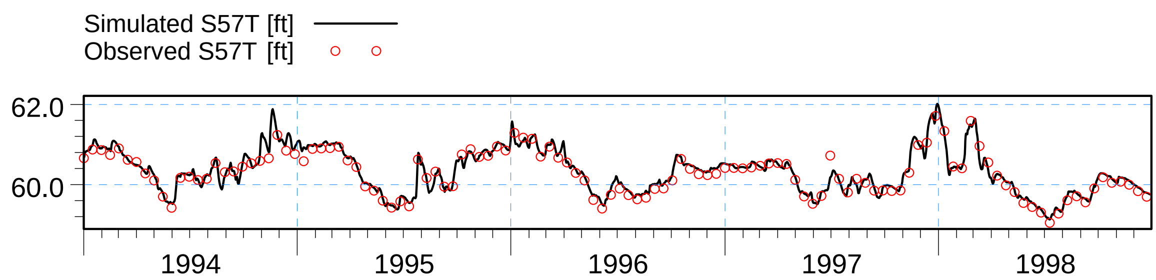


**Figure 5-2: Simulated and observed tailwater stages at S-57 during the verification period.**

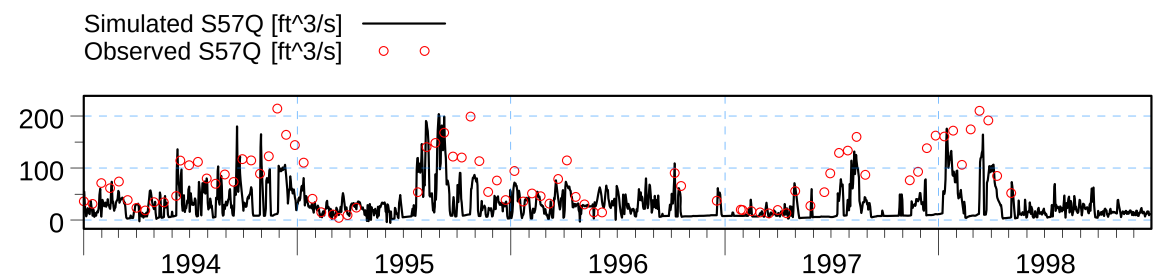


**Figure 5-3: Simulated and observed discharge at S-57 during the verification period.**

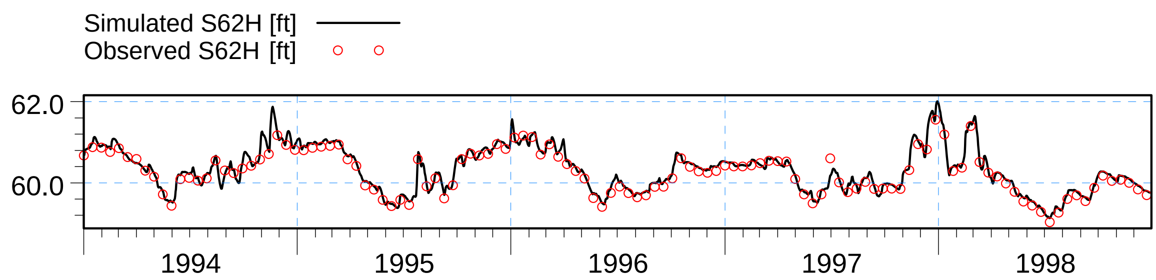


**Figure 5-4: Simulated and observed headwater stage at S-62 during the verification period.**

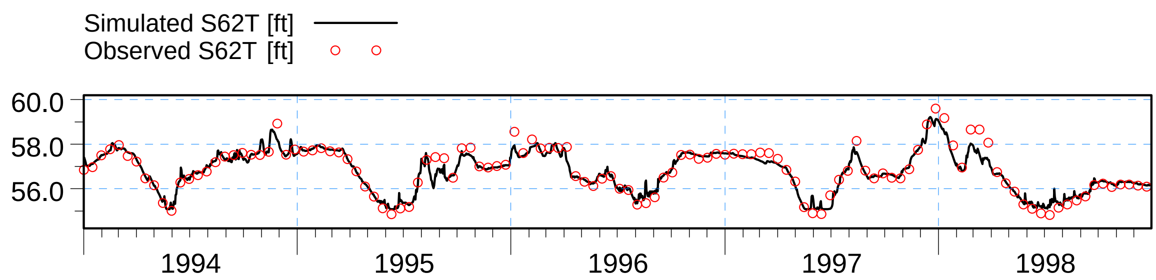


**Figure 5-5: Simulated and observed tailwater stage at S-62 during the verification period.**

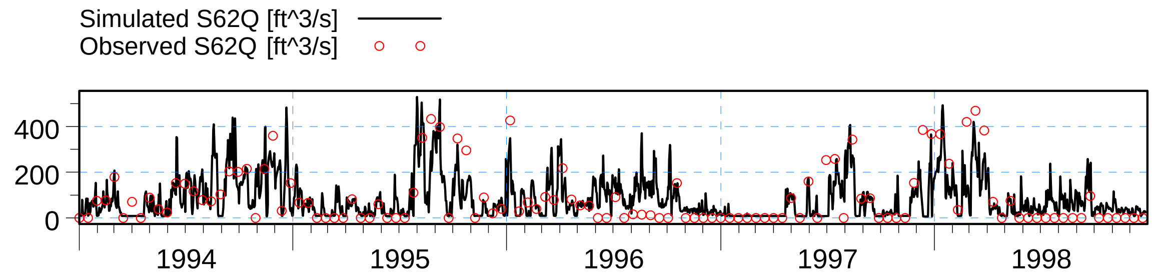


**Figure 5-6: Simulated and observed discharge at S-62 during the verification period.**

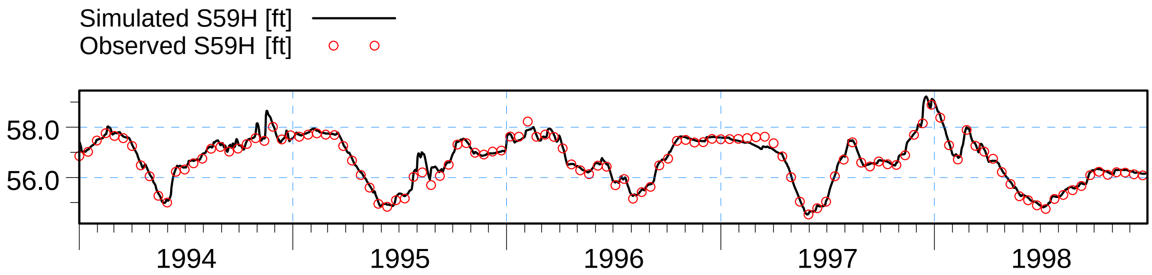


**Figure 5-7: Simulated and observed headwater stage at S-59 during the verification period.**

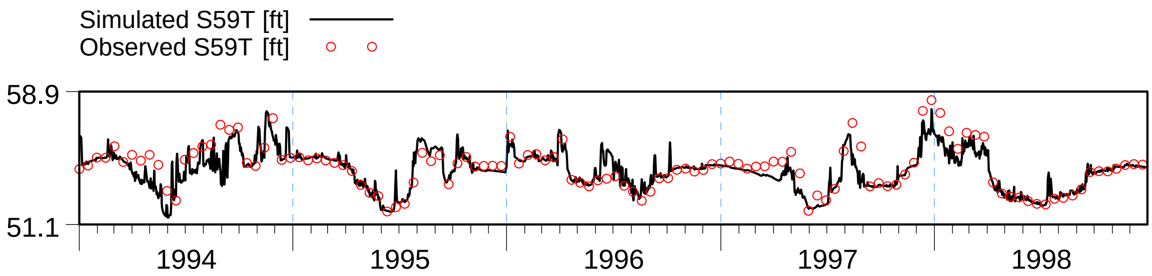


**Figure 5-8: Simulated and observed tailwater stage at S-59 during the verification period.**

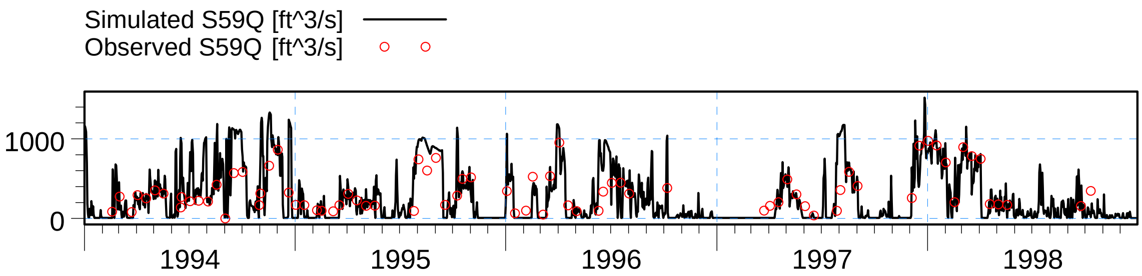


**Figure 5-9: Simulated and observed discharge at S-59 during the verification period.**

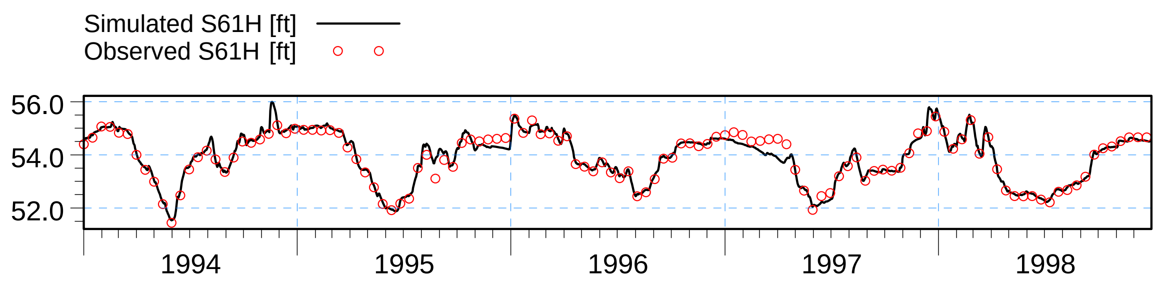


**Figure 5-10: Simulated and observed headwater stage at S-61 during the verification period.**

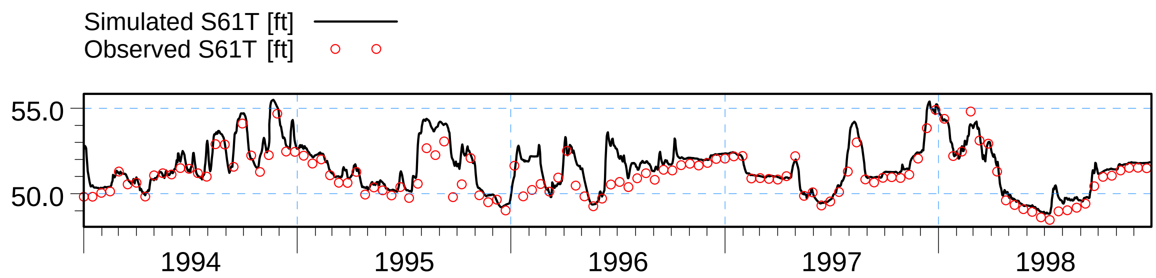


**Figure 5-11: Simulated and observed tailwater stage at S-61 during the verification period.**

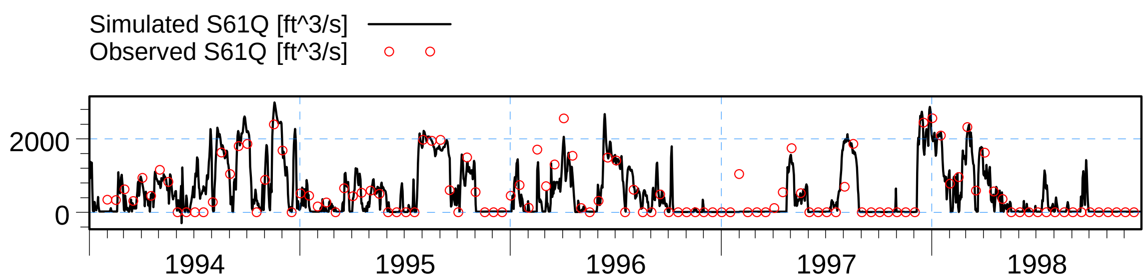


**Figure 5-12: Simulated and observed discharge at S-61 during the verification period.**

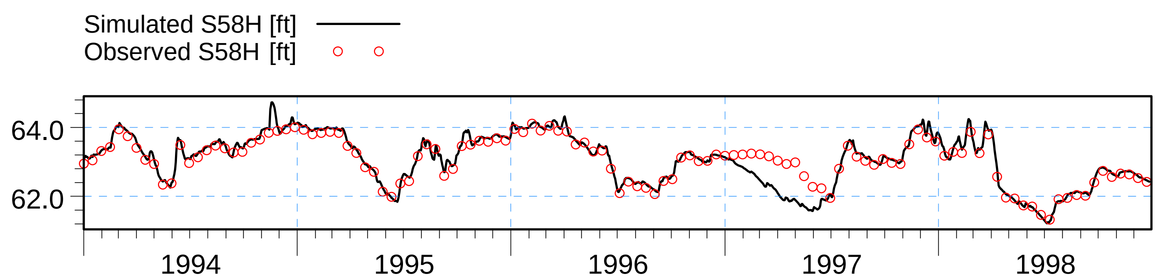


**Figure 5-13: Simulated and observed headwater stages at S-58 during the verification period.**

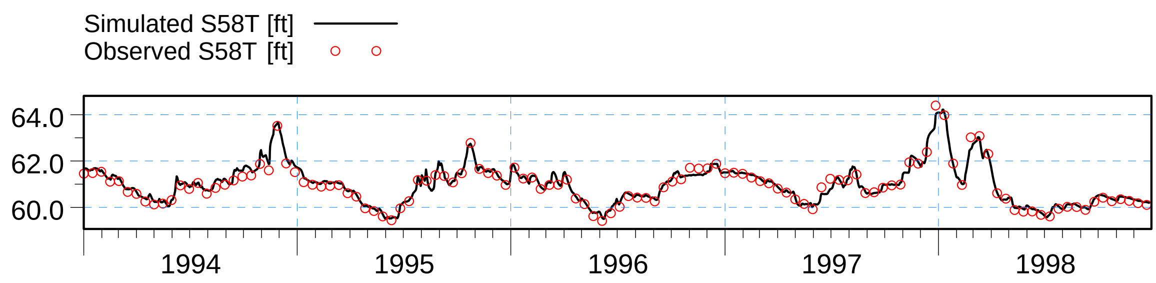


**Figure 5-14: Simulated and observed tailwater stages at S-58 during the verification period.**

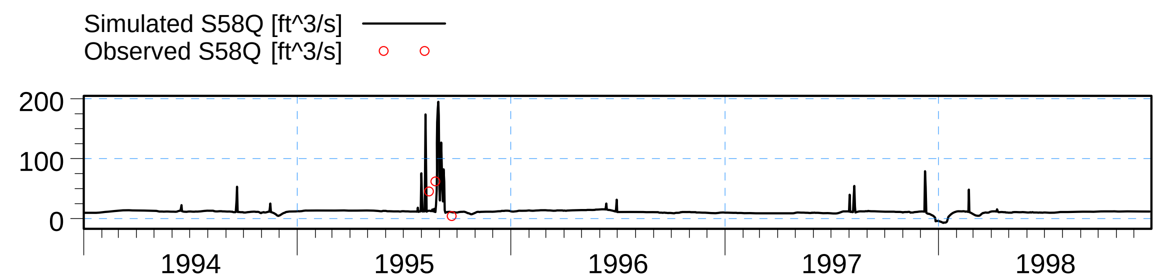


**Figure 5-15: Simulated and observed discharge at S-58 during the verification period.**

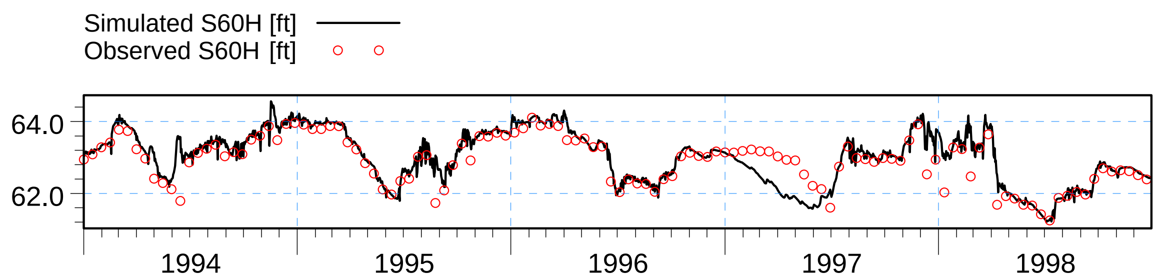


**Figure 5-16: Simulated and observed headwater stage at S-60 during the verification period.**

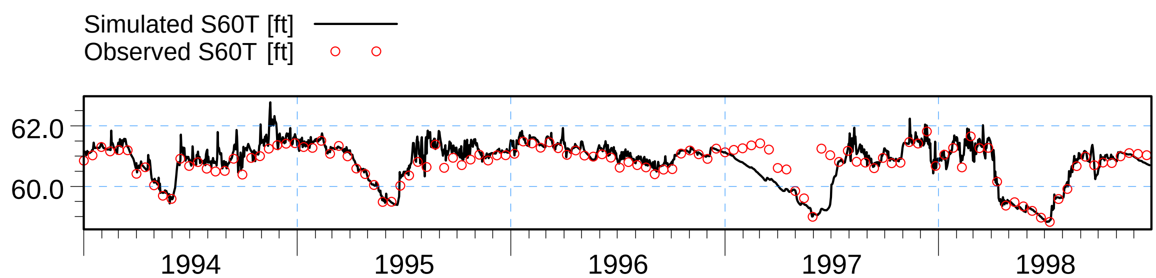


**Figure 5-17: Simulated and observed tailwater stage at S-60 during the verification period.**

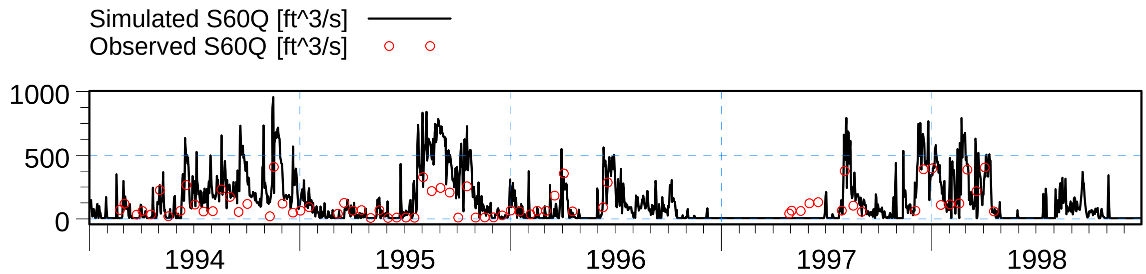


**Figure 5-18: Simulated and observed discharge at S-60 during the verification period.**

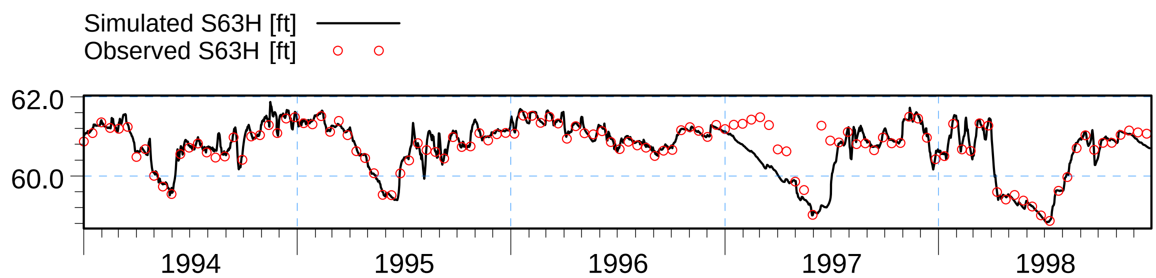


**Figure 5-19: Simulated and observed headwater stage at S-63 during the verification period.**

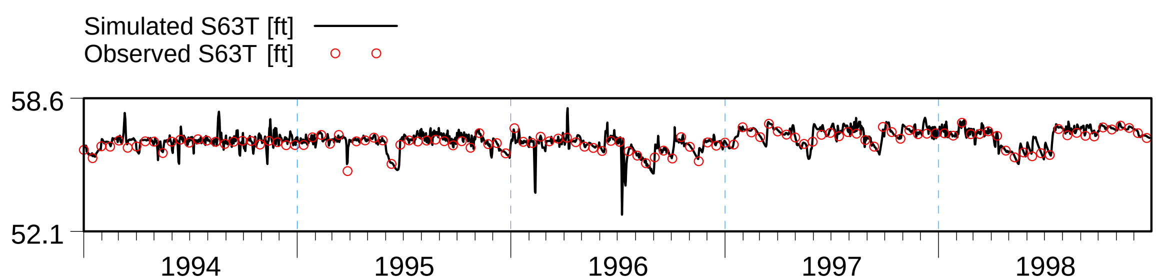


**Figure 5-20: Simulated and observed tailwater stage at S-63 during the verification period.**

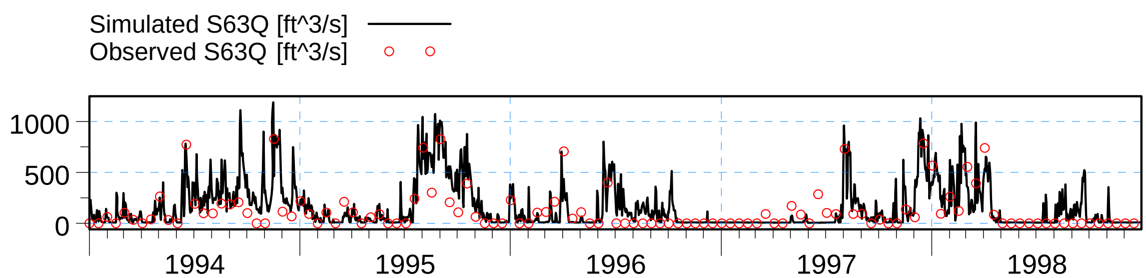


**Figure 5-21: Simulated and observed discharge at S-63 during the verification period.**

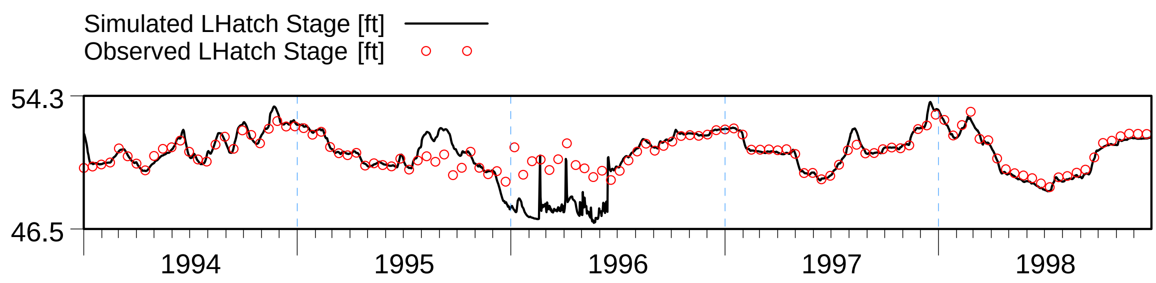


**Figure 5-22: Simulated and observed stage at LHATCH3H during the verification period.**

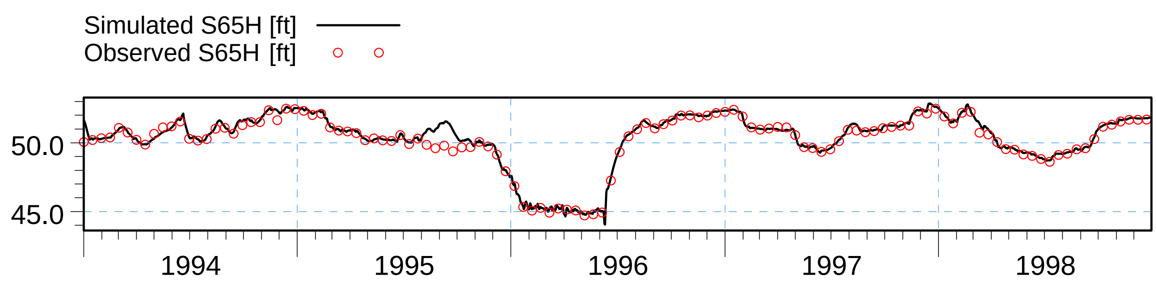


**Figure 5-23: Simulated and observed headwater stage at S-65 during the verification period.**

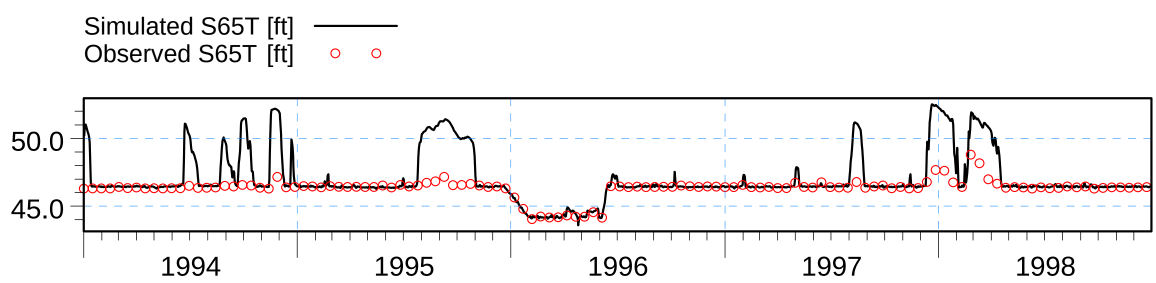


**Figure 5-24: Simulated and observed tailwater stage at S-65 during the verification period.**

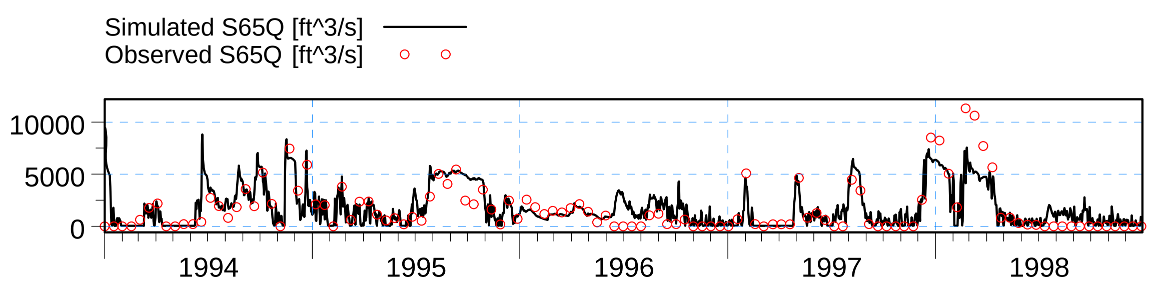


**Figure 5-25: Simulated and observed discharge at S-65 during the verification period.**

### 5.1.1.2 Lower Basin

Simulated and observed surface water data for the lower basin during the verification period are presented in Figure 5-26 to Figure 5-52 and indicate that the model is adequately capturing surface water process and responses in the LKB. Relatively poor performance at the S-65D tailwater gage is a result of datum issues.

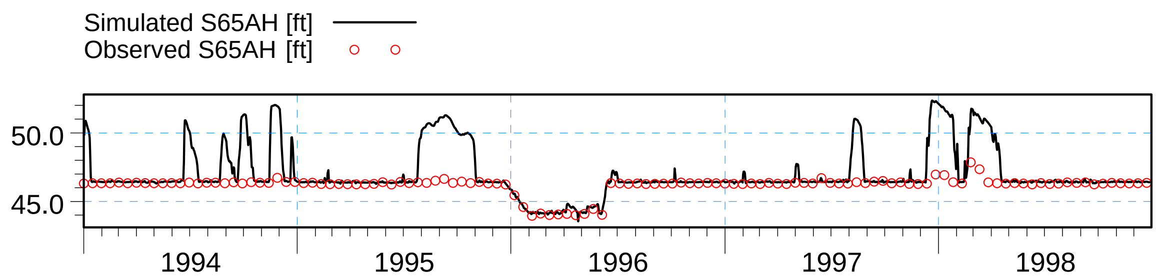


**Figure 5-26: Simulated and observed headwater stage at S-65A during the verification period.**

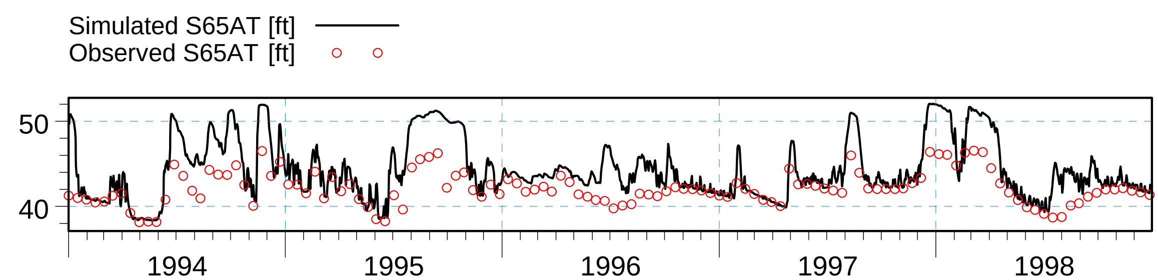


**Figure 5-27: Simulated and observed tailwater stage at S-65A during the verification period.**

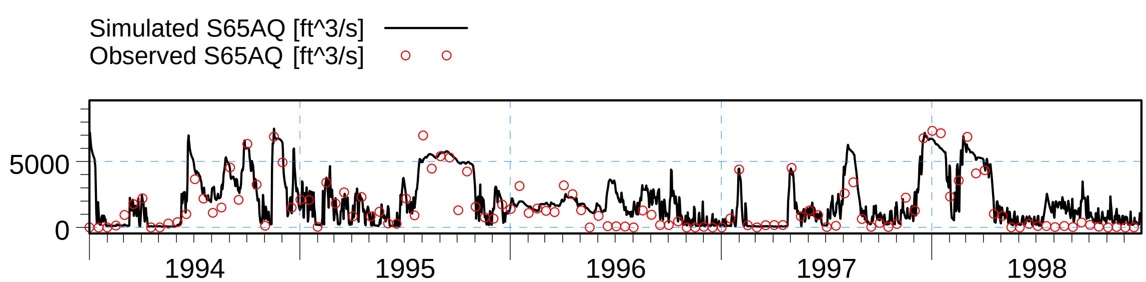


**Figure 5-28: Simulated and observed discharge at S-65A during the verification period.**

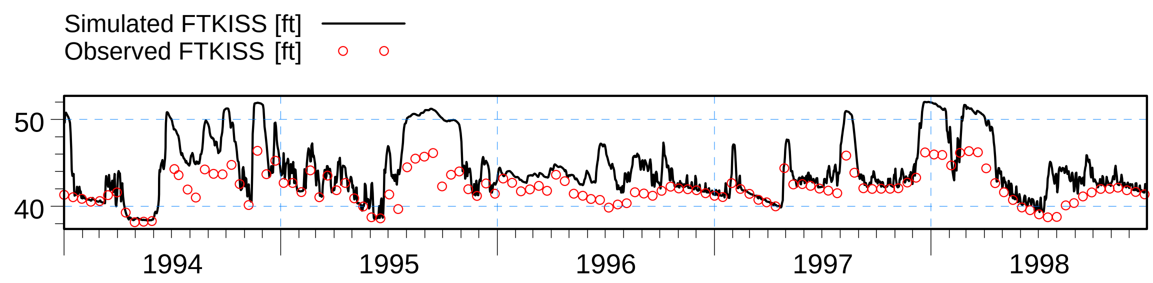


**Figure 5-29: Simulated stage at FTKISS during the verification period.**

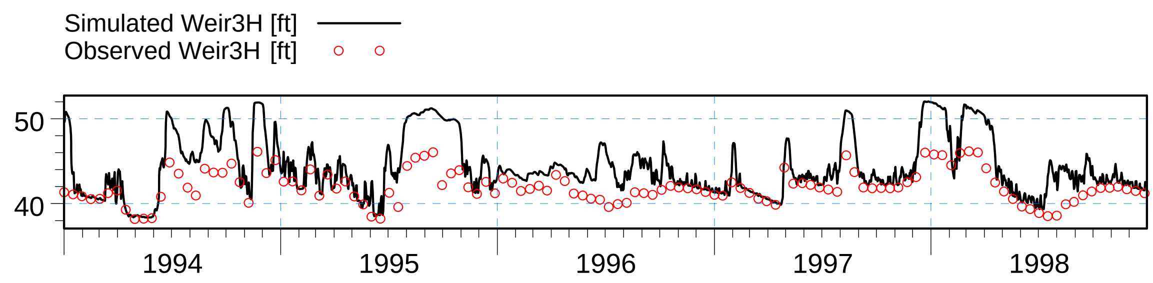


**Figure 5-30: Simulated and observed headwater stage at Weir 3 during the verification period.**

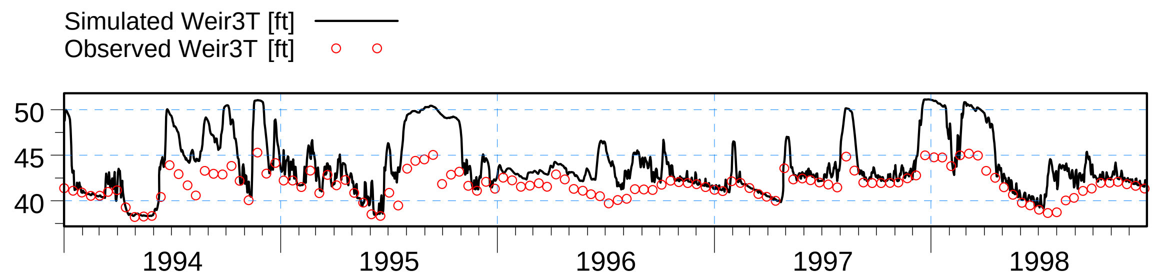


**Figure 5-31: Simulated and observed tailwater stage at Weir 3 during the verification period.**

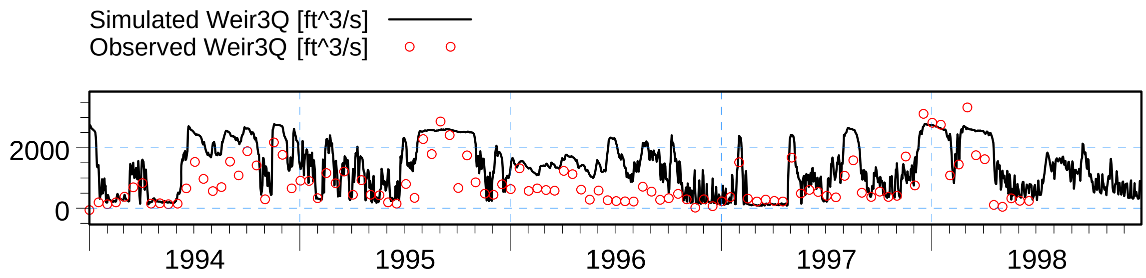


**Figure 5-32: Simulated and observed discharge at Weir 3 during the verification period.**

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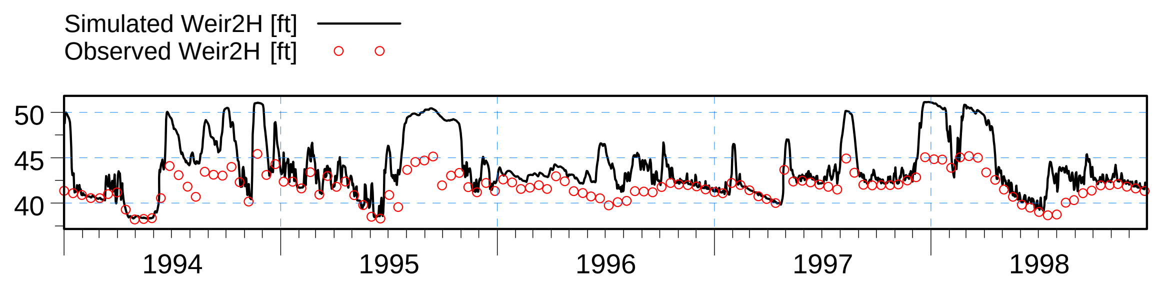


**Figure 5-33: Simulated and observed headwater stage at Weir 2 during the verification period.**

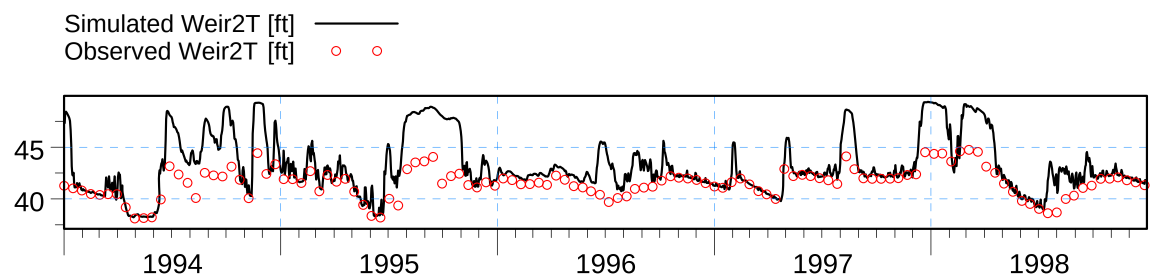


**Figure 5-34: Simulated and observed tailwater stage at Weir 2 during the verification period.**

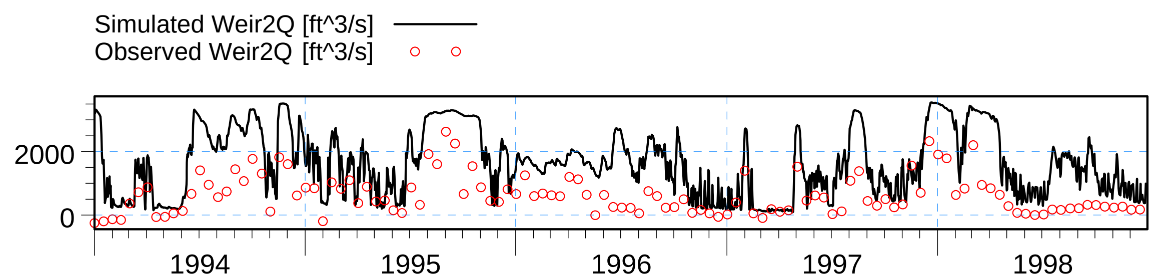


**Figure 5-35: Simulated and observed discharge at Weir 2 during the verification period.**

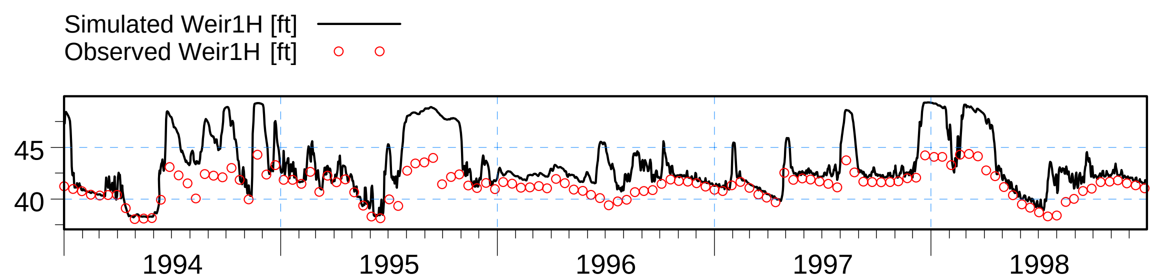


**Figure 5-36: Simulated and observed headwater stage at Weir 1 during the verification period.**

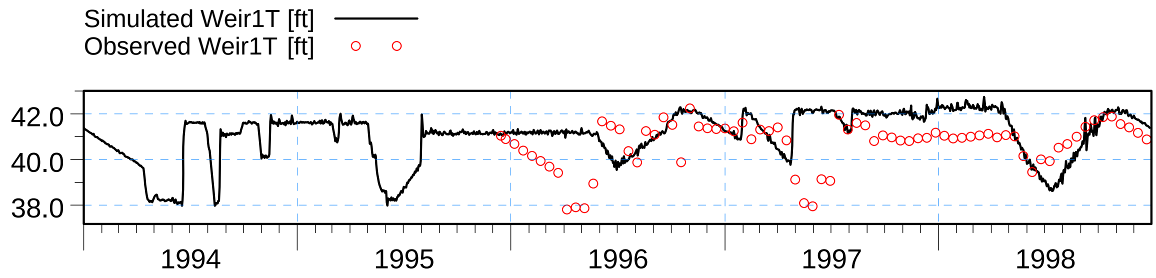


**Figure 5-37: Simulated and observed tailwater stage at Weir 1 during the verification period.**

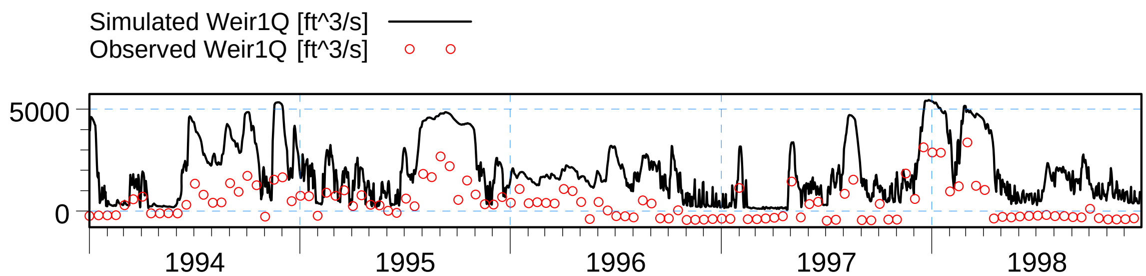


**Figure 5-38: Simulated and observed discharge at Weir 1 during the verification period.**

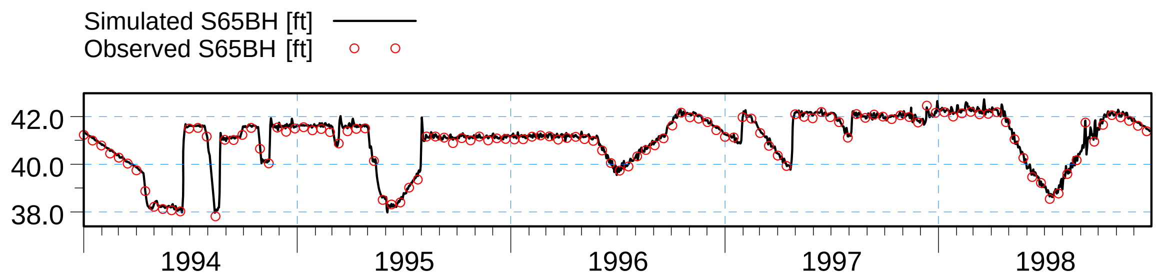


**Figure 5-39: Simulated and observed headwater stage at S-65B during the verification period.**

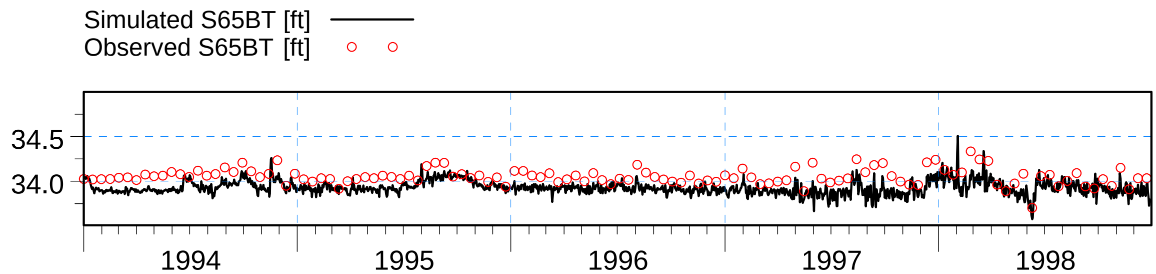


**Figure 5-40: Simulated and observed tailwater stage at S-65B during the verification period.**

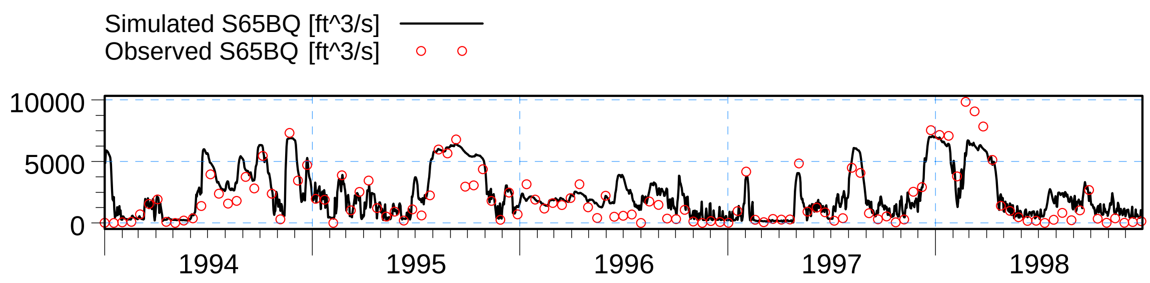


**Figure 5-41: Simulated and observed discharge at S-65B during the verification period.**

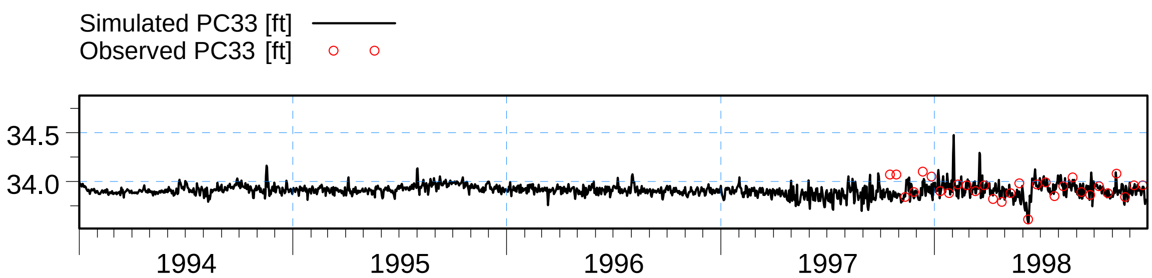


**Figure 5-42: Simulated and observed stage at PC33 during the verification period.**

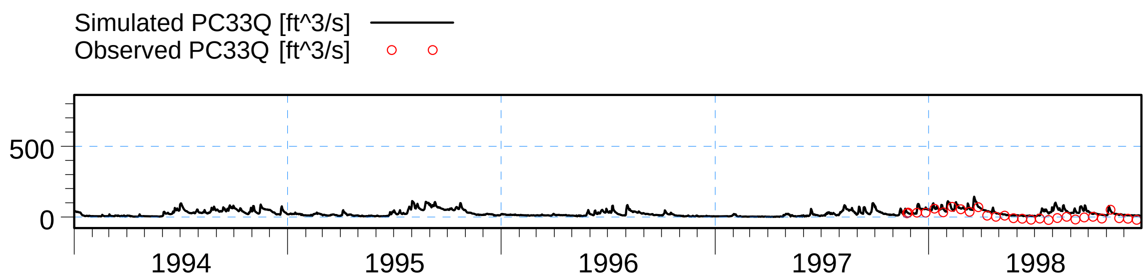


**Figure 5-43: Simulated and observed discharge at PC33 during the verification period.**

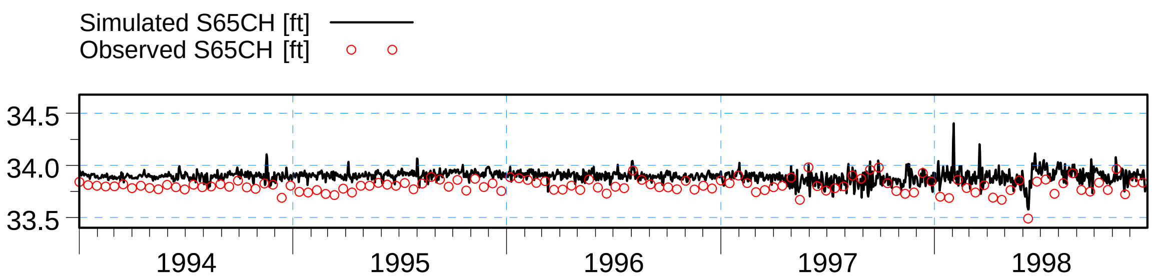


**Figure 5-44: Simulated and observed headwater stage at S-65C during the verification period.**

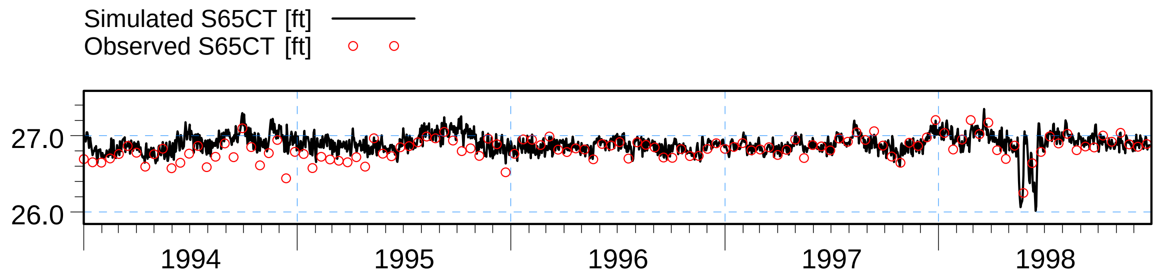


**Figure 5-45: Simulated and observed tailwater stage at S-65C during the verification period.**

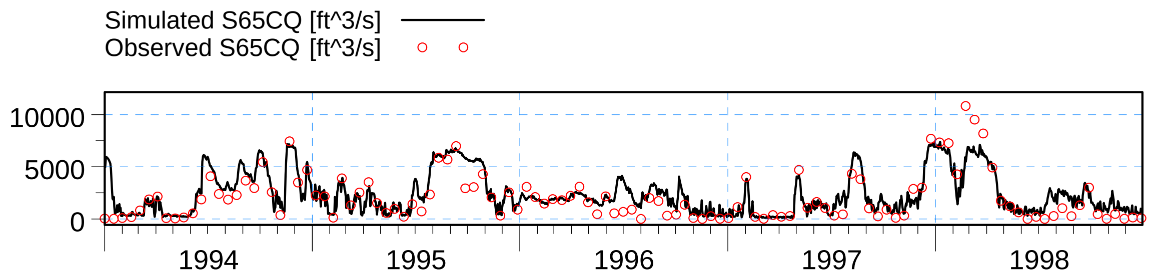


**Figure 5-46: Simulated and observed discharge at S-65C during the verification period.**

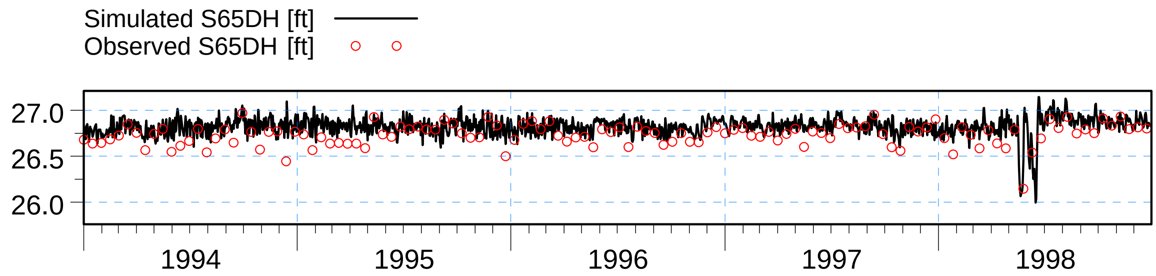


**Figure 5-47: Simulated and observed headwater stage at S-65D during the verification period.**

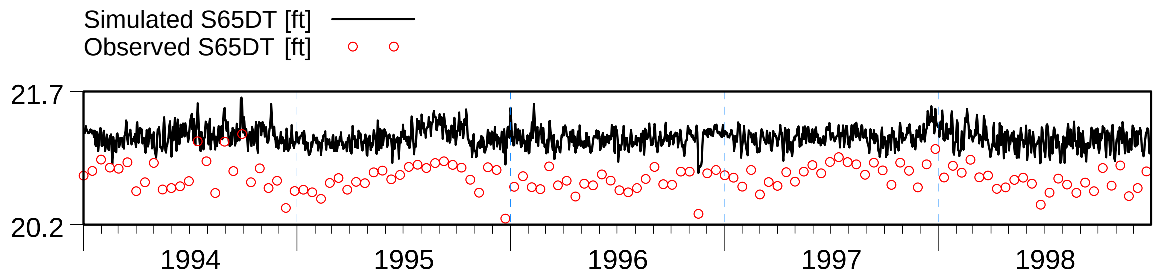


**Figure 5-48: Simulated and observed tailwater stage at S-65D during the verification period.**

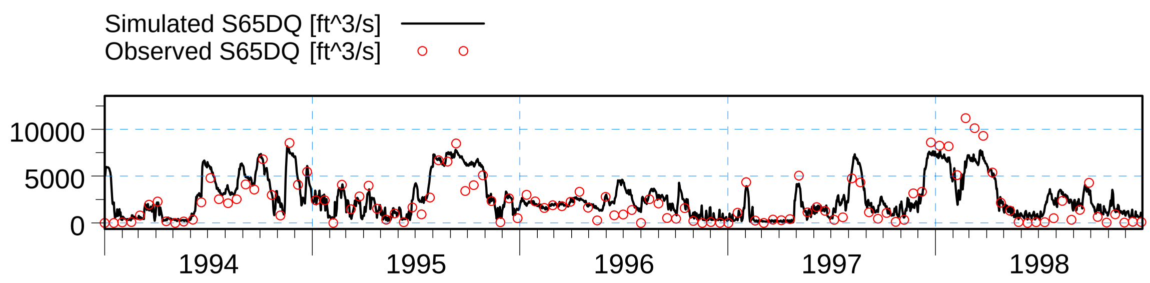


**Figure 5-49: Simulated and observed discharge at S-65D during the verification period.**

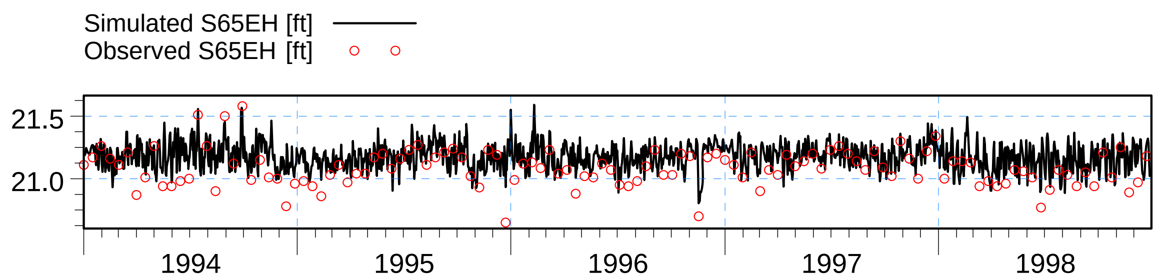


**Figure 5-50: Simulated and observed headwater stage at S-65E during the verification period.**

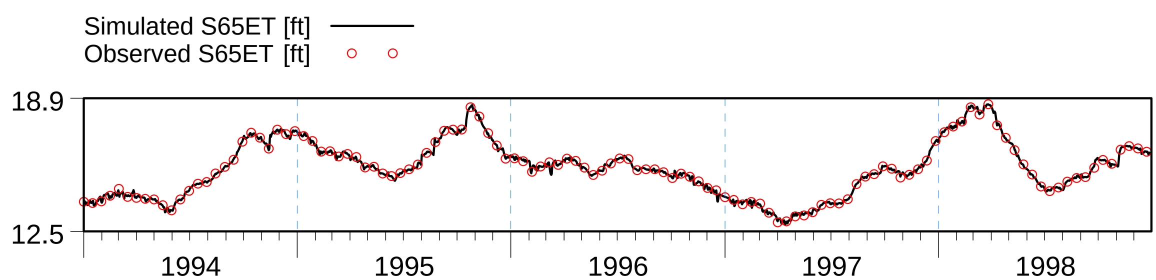


**Figure 5-51: Simulated and observed tailwater stage at S-65E during the verification period.**

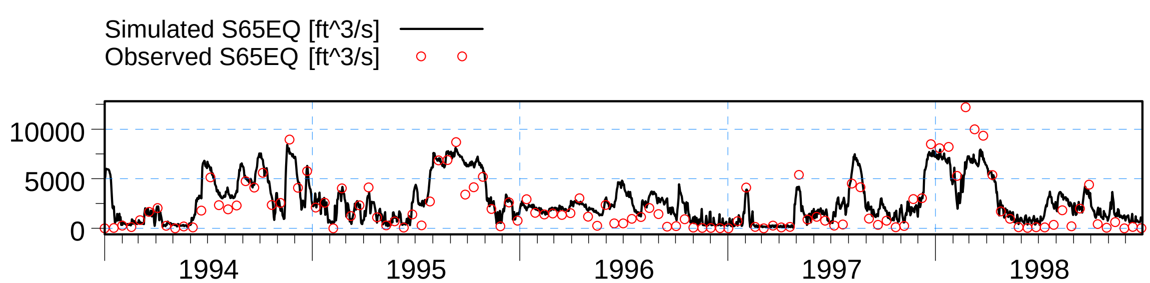


**Figure 5-52: Simulated and observed discharge at S-65E during the verification period.**

#### 5.1.1.3 Surface Water Verification Statistics

Verification statistics for stage and flow gages in the Kissimmee Basin are summarized in Table 5-1 and Table 5-2, respectively. Criteria that are not met at individual stations are indicated with red shading. In general, the surface water component of the AFET model does a very good job of meeting statistical criteria defined in the ATP (Earth Tech, 2006b) and later refined in consultation with SFWMD staff.

The model meets the *RMSE* and *R* calibration criteria at all of the stage observation locations during the verification period except at S-65AT and CYPRS. The model does meet the *RMSE* criteria for stage at S-65AT but does meet the *R* criteria. The model does not meet the *RMSE* or *R* criteria at the CYPRS gage.

The model meets the *CE* and *R* calibration criteria for flow except at S-57, S-58, S-60, S-63, S-65, Catfish Creek, Reedy Creek, Shingle Creek, or S-65E. The model does not meet the *CE* or *R* criteria for flow at the S-57, S-63, Catfish Creek, or Reedy Creek gages. The model does not meet the *CE* criteria for flow at the S-60 and S-65E gages. The model does not meet the *R* criteria for flow at the S-58, S-65, and Shingle Creek gages. The S-57, S-58, S-60, Catfish Creek, Reedy Creek, and Shingle Creek gages have been classified as moderately useful gages.

A graphical presentation of the spatial distribution of model fit at stage and flow locations identified as quantitative gages in the ATP (Earth Tech, 2006b) relative to the mean error and correlation coefficient, respectively, are shown in Figure 5-53 and Figure 5-54.

**Table 5-1: Surface water stage statistics for the verification period. Red shading is used to indicate locations that do not meet specified criteria.**

| MODEL AREA | Station | RMSE | R(correlation) | RMSE | R(correlation) | RMSE | R(correlation) |
|---|---|---|---|---|---|---|---|
| **Stages in Upper Basin Lake Management Units** | | | | | | | |
| LMU K-H-C | S65H | H | H | 0.32 | 0.99 | | |
| LMU K-H-C | S61T | H | H | 0.73 | 0.92 | | |
| LMU K-H-C | S63AT | M | M | 0.85 | 0.90 | | |
| LMU Toho | S61H | H | H | 0.17 | 0.98 | | |
| LMU Toho | S59T | H | H | 0.73 | 0.85 | | |
| LMU Etoho | S59H | H | H | 0.15 | 0.99 | | |
| LMU Etoho | S62T | M | M | 0.29 | 0.97 | | |
| LMU Hart | S62H | M | M | 0.10 | 0.99 | | |
| LMU Hart | S57T | M | M | 0.11 | 0.99 | | |
| LMU Myrtle | S57H | M | M | 0.15 | 0.99 | | |
| LMU Myrtle | S58T | M | M | 0.17 | 0.99 | | |
| LMU Alligator | S58H | M | M | 0.24 | 0.95 | | |
| LMU Alligator | S60H | M | M | 0.38 | 0.87 | | |
| LMU Gentry | S60T | M | M | 0.35 | 0.87 | | |
| LMU Gentry | S63H | M | M | 0.29 | 0.90 | | |
| LMU s63a | S63T | M | M | 0.18 | 0.94 | | |
| LMU s63a | S63AH | M | M | 0.14 | 0.97 | | |
| **Stages in Upper Basin's unmanaged watersheds** | | | | | | | |
| ws_UpperReedy | REEDYLOU | M | M | 1.50 | 0.68 | | |
| **Stages in Lower Basin Lake Management Units** | | | | | | | |
| Pool A | S65T | H | H | 1.58 | 0.70 | | |
| Pool A | S65AH | H | H | 1.68 | 0.59 | | |
| Pool BC | S65AT | H | H | 3.01 | 0.83 | | |
| Pool BC | PC52 | M | M | | | | |
| Pool BC | PC45 | M | M | | | | |
| Pool BC | PC33 | H | H | 0.07 | 0.79 | | |
| Pool BC | PC21 | M | M | | | | |
| Pool BC | S65CH | H | H | 0.11 | 0.84 | | |
| Pool D | S65CT | H | H | 0.11 | 0.82 | | |
| Pool D | S65DH | H | H | 0.11 | 0.89 | | |
| Pool E | S65DT | L | H | | 0.83 | | |
| Pool E | S65EH | H | H | 0.12 | 0.86 | | |
| **Stages in Lower Basin's unmanaged watersheds** | | | | | | | |
| D_Chandler | CYPRS | H | H | 10.54 | 0.06 | | |
| D_Chandler | CHAND1 | H | H | 0.73 | 0.70 | | |
| Lake O | S65ET | H | H | 0.04 | 1.00 | | |

Does not meet criteria
Low Utility
Does meet criteria
"M" not meeting criteria

Rationale for selection of statistics Targets:
Highly Useful (H):
RMSE ATP Statistic Target range 1.0 to 2.5-ft
R ATP Statistic Target range 0.50 to 0.75
Moderately Useful (M):
RMSE ATP Statistic Target low end of range plus 0.5-ft
R ATP Statistic Target low end of range minus 0.05

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**Table 5-2: Surface water flow statistics for the verification period. Red shading is used to indicate locations that do not meet specified criteria.**

| Upstream WCU | Downstream WCU | Station | CE | R(correlation) | CE% | R(correlation) | CE% | R(correlation) |
|---|---|---|---|---|---|---|---|---|
| **Flows in Upper Basin Lake Management Units** | | | | | | | | |
| LMU Myrtle | LMU Hart | S57Q | M | M | 55 | 0.50 | | |
| LMU Hart | LMU Etoho | S62Q | M | M | 8 | 0.71 | | |
| LMU Etoho | LMU Toho | S59Q | M | M | 6 | 0.69 | | |
| LMU Toho | LMU KHC | S61Q | H | H | 9 | 0.86 | | |
| LMU Alligator | LMU Myrtle | S58Q | M | M | 6 | -0.23 | | |
| LMU Alligator | LMU Gentry | S60Q | M | M | 53 | 0.66 | | |
| LMU Gentry | LMU s63a | S63Q | M | H | 39 | 0.76 | | |
| LMU s63a | LMU KHC | S63AQ | M | M | 30 | 0.76 | | |
| LMU KHC | PoolA | S65Q | H | H | 10 | 0.82 | | |
| **Flows in Upper Basin's unmanaged watersheds** | | | | | | | | |
| ws_boggy | LMU Etoho | boggy_ta | M | M | 26 | 0.66 | | |
| ws_lake pierce | WS_catfish creek | catfish Q | M | M | 61 | 0.52 | | |
| ws_upperreedy | ws_lowerreedy | reedy | M | M | 85 | 0.59 | | |
| ws_shingle | LMU Toho | shingle | M | M | 9 | 0.56 | | |
| **Flows in Lower Basin Lake Management Units** | | | | | | | | |
| PoolA | PoolBC | S65AQ | M | M | 26 | 0.85 | | |
| PoolBC | PoolD | S65CQ | H | H | 20 | 0.86 | | |
| PoolD | PoolE | S65DQ | H | H | 18 | 0.87 | | |
| PoolE | Lake O | S65EQ | H | H | 28 | 0.86 | | |

"H" not meeting criteria
Does meet criteria
"M" not meeting criteria
NA - Not Applicable
NOTE: Calibration points with Low (L) utility have been omitted

Rationale for selection of statistics Targets:
Highly Useful (H):
CE ATP Statistic for "Good" (<15%) plus average basinwide flow calculation error of 7%
R ATP Statistic for "Good" (>0.84)
Moderately Useful (M):
CE ATP Statistic for "Fair" (<25%) plus average basinwide flow calculation error of 7%
R Statistic set at 20% below minimum level for "Fair"

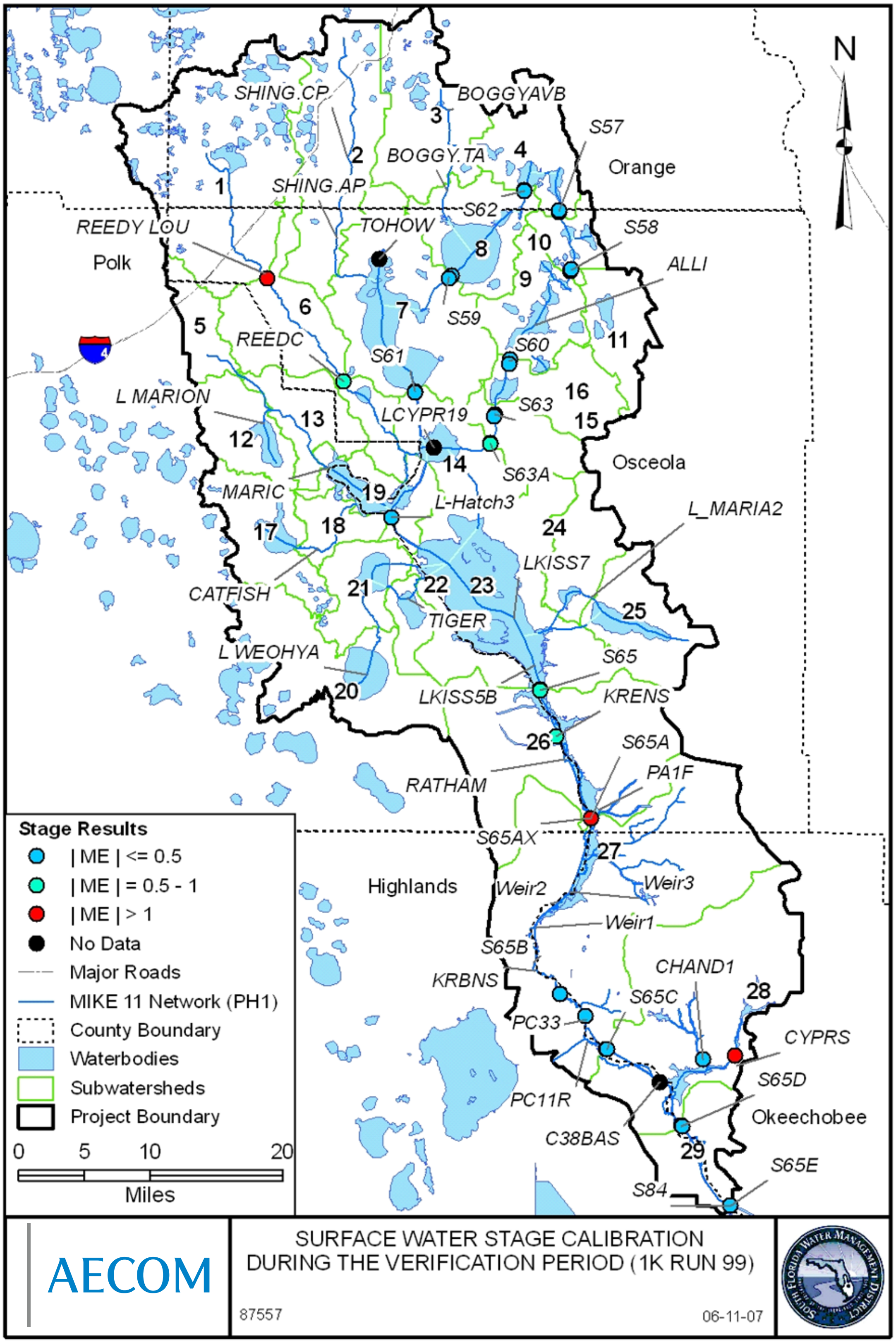


**Figure 5-53: Summary of statistical fit at surface water stage locations during the verification period.**

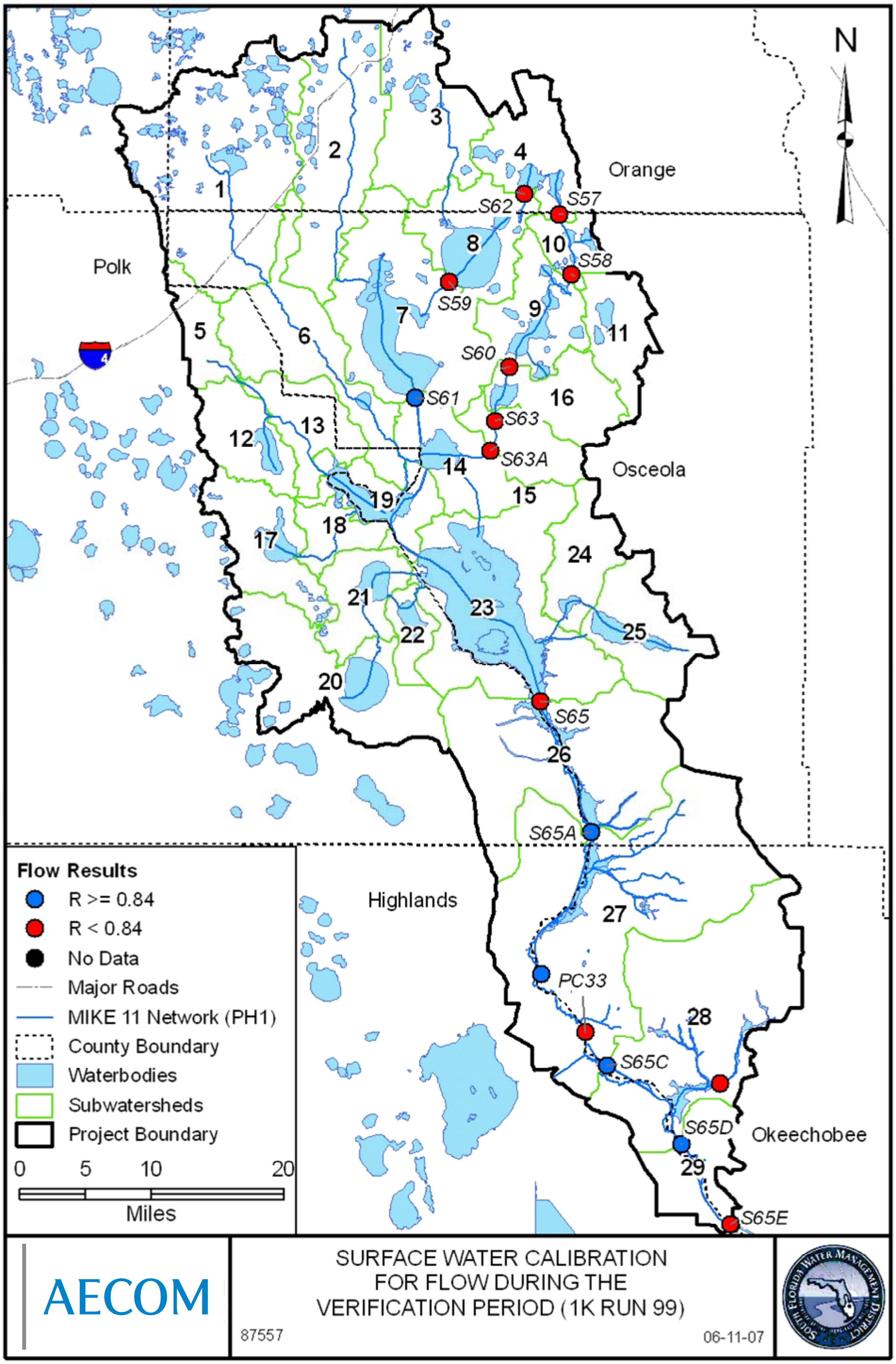


**Figure 5-54: Summary of statistical fit at surface water flow locations during the verification period.**

### 5.1.2 Groundwater Verification

Model performance of the groundwater component during the verification period is discussed in the following sections. Current results during the verification period indicate that the current model is capable of simulating groundwater processes and levels at the desired level of accuracy.

#### 5.1.2.1 Surficial Aquifer

Simulated and observed groundwater levels at the selected SAS wells are shown in Figure 5-55 through Figure 5-77. Results indicate that calibration is good, with a few exceptions, at all moderately and highly useful locations as identified in the ATP (Earth Tech, 2006b) and subsequent meetings with SFWMD staff.

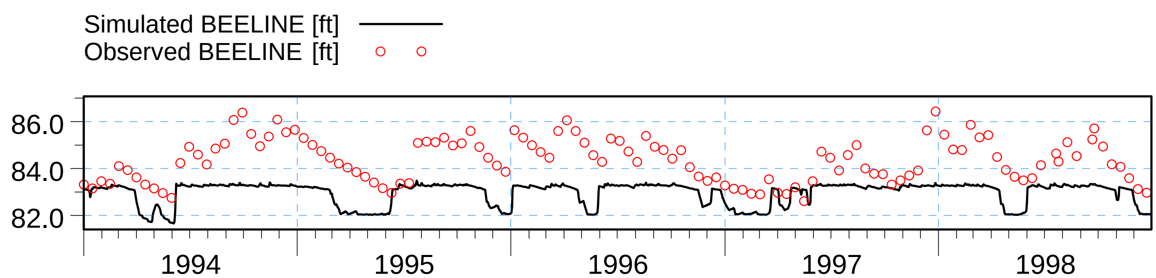


**Figure 5-55: Simulated and observed water level at SAS BEELINE during the verification period.**

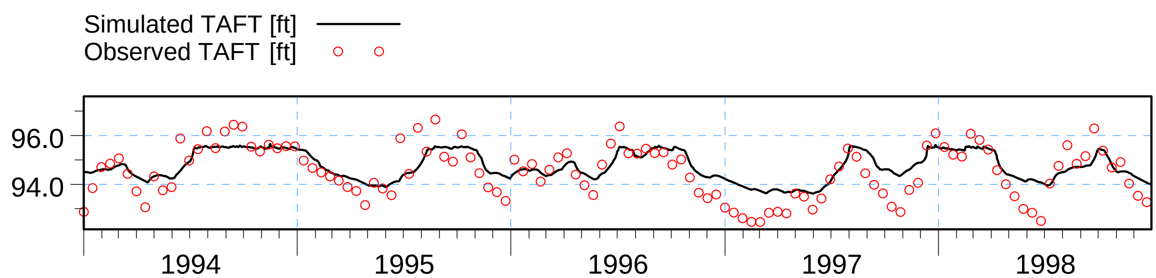


**Figure 5-56: Simulated and observed water level at SAS TAFT during the verification period.**

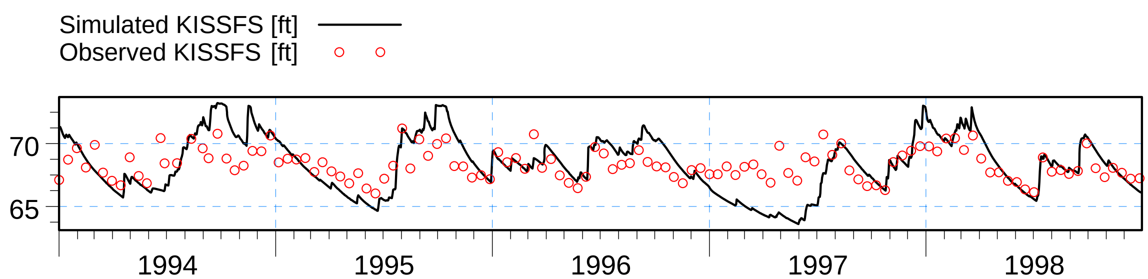


**Figure 5-57: Simulated and observed water level at KISSFS during the verification period.**

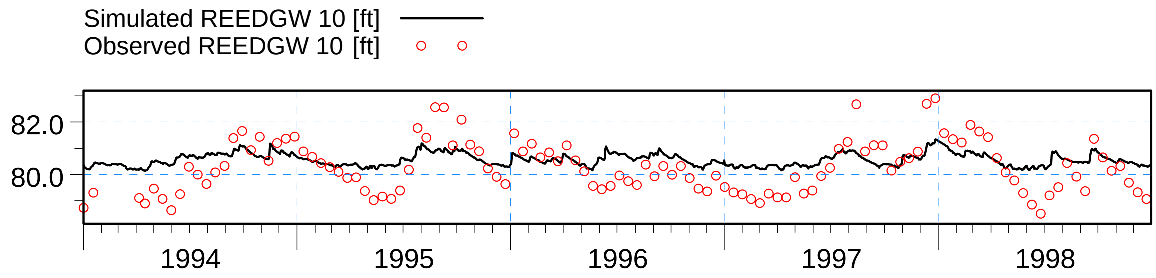


**Figure 5-58: Simulated and observed water level at SAS REEDGW 10 during the verification period.**

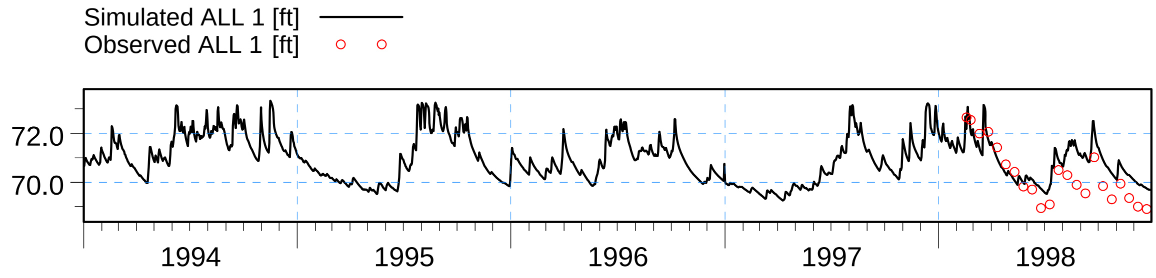


**Figure 5-59: Simulated and observed water level at SAS ALL 1 during the verification period.**

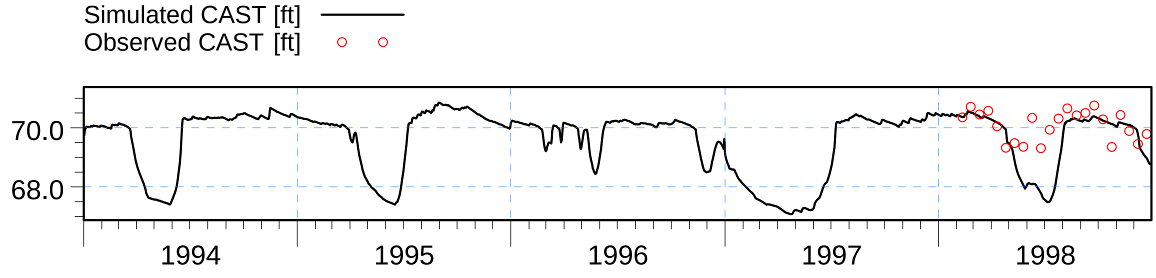


**Figure 5-60: Simulated and observed water level at SAS CAST during the verification period.**

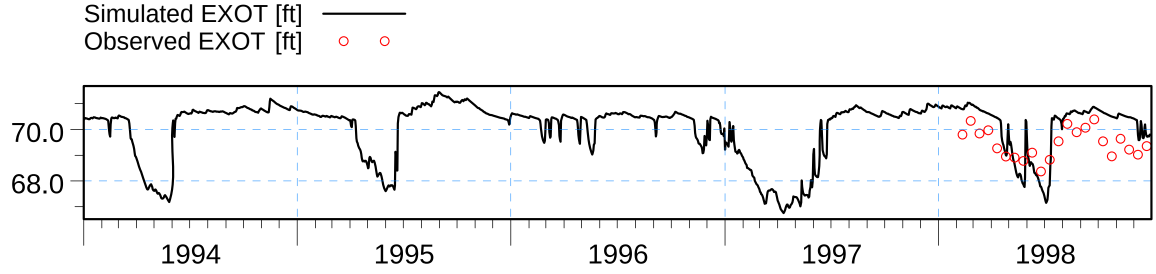


**Figure 5-61: Simulated and observed water level at SAS EXOT during the verification period.**

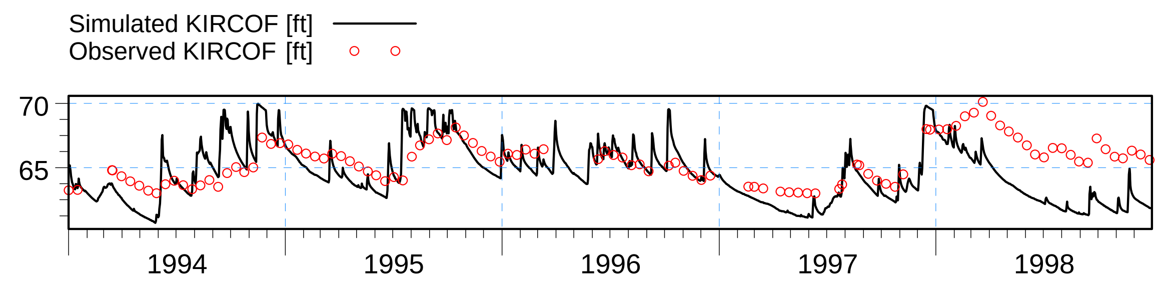


**Figure 5-62: Simulated and observed water level at SAS KIRCOF during the verification period.**

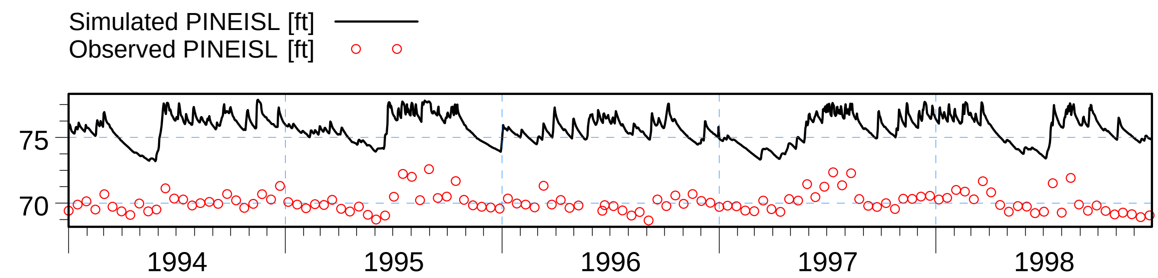


**Figure 5-63: Simulated and observed water level at SAS PINEISL during the verification period.**

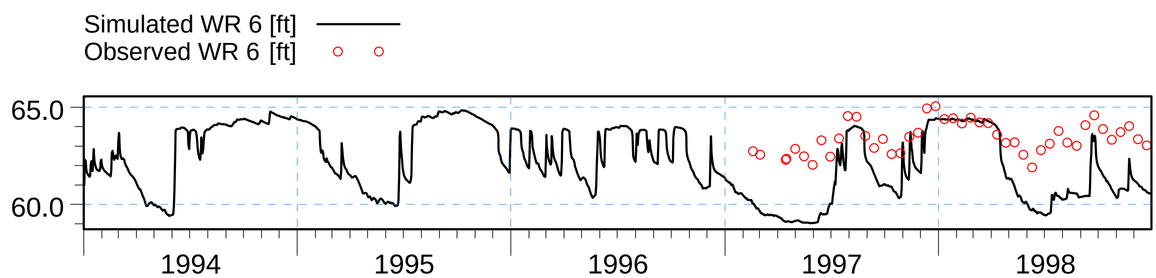


**Figure 5-64: Simulated and observed water level at SAS WR6 during the verification period.**

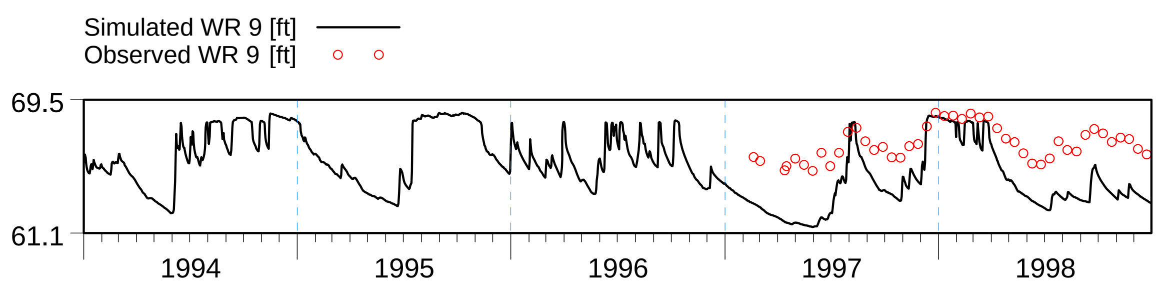


**Figure 5-65: Simulated and observed water level at SAS WR 9 during the verification period.**

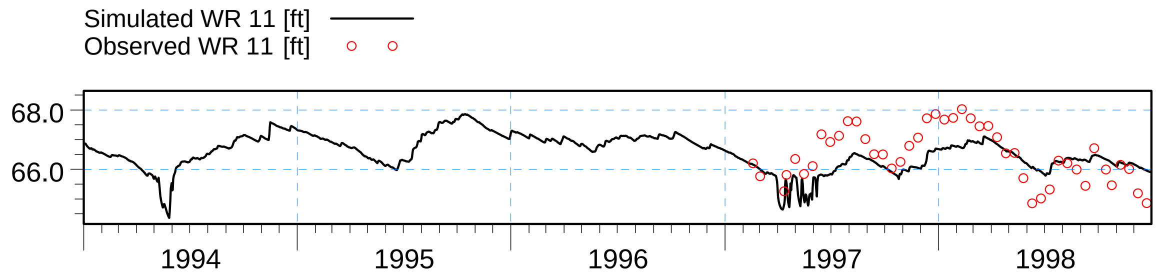


**Figure 5-66: Simulated and observed water level at SAS WR 11 during the verification period.**

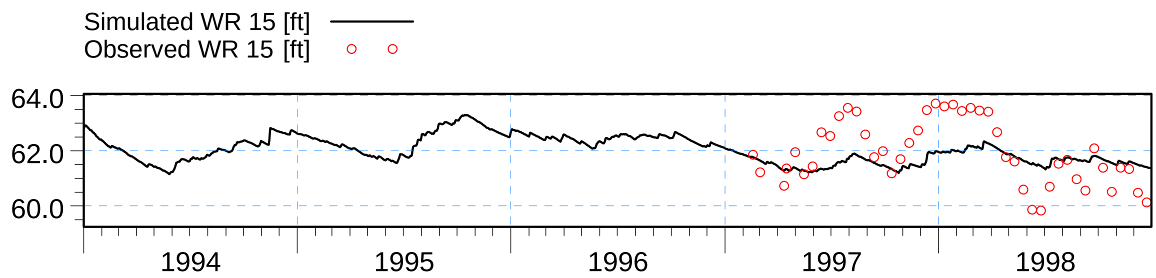


**Figure 5-67: Simulated and observed water level at SAS WR15 during the verification period.**

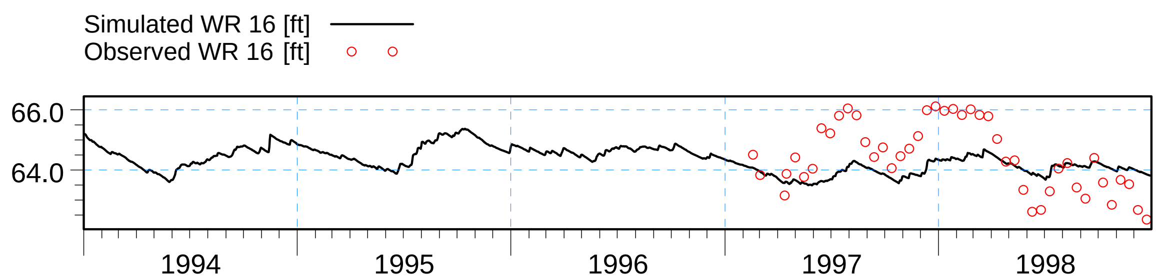


**Figure 5-68: Simulated and observed water level at SAS WR16 during the verification period.**

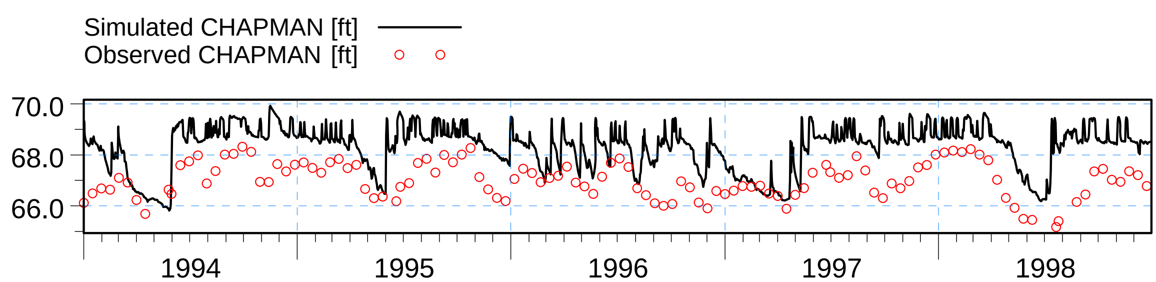


**Figure 5-69: Simulated and observed water level at SAS CHAPMAN during the verification period.**

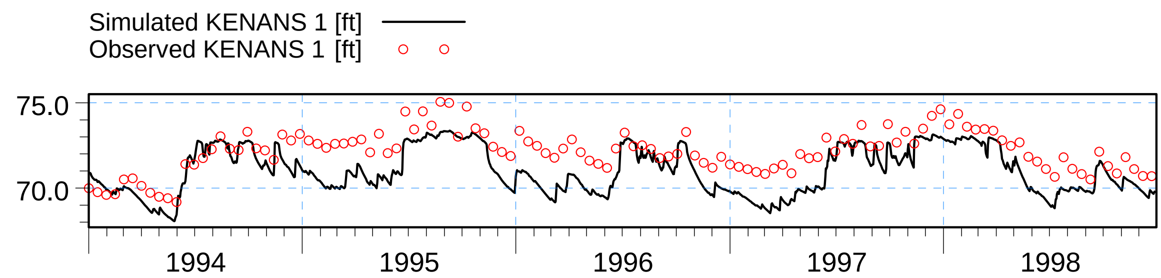


**Figure 5-70: Simulated and observed water level at SAS KENANS 1 during the verification period.**

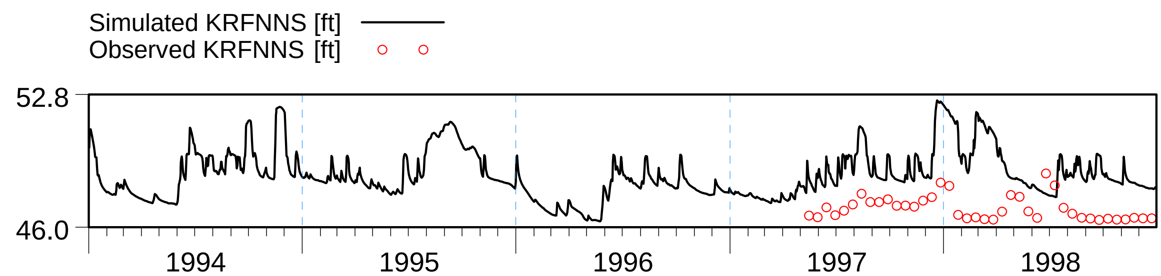


**Figure 5-71: Simulated and observed water level at SAS KRFNNS during the verification period.**

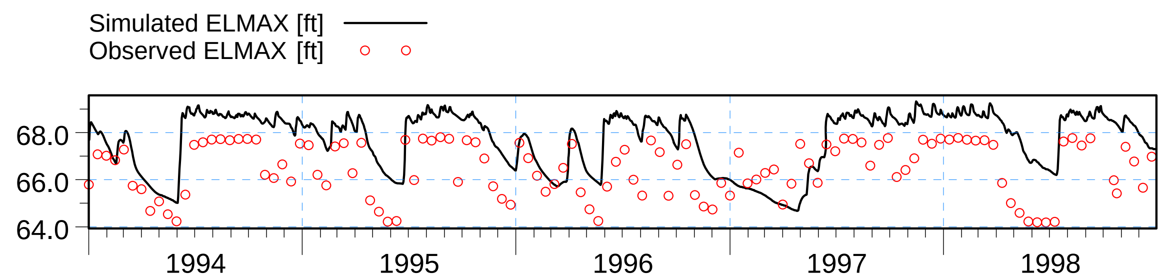


**Figure 5-72: Simulated and observed water level at SAS ELMAX during the verification period.**

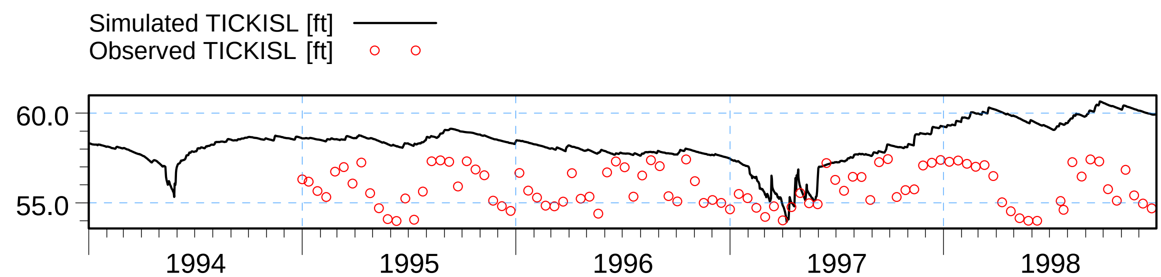


**Figure 5-73: Simulated and observed water level at SAS TICKISL during the verification period.**

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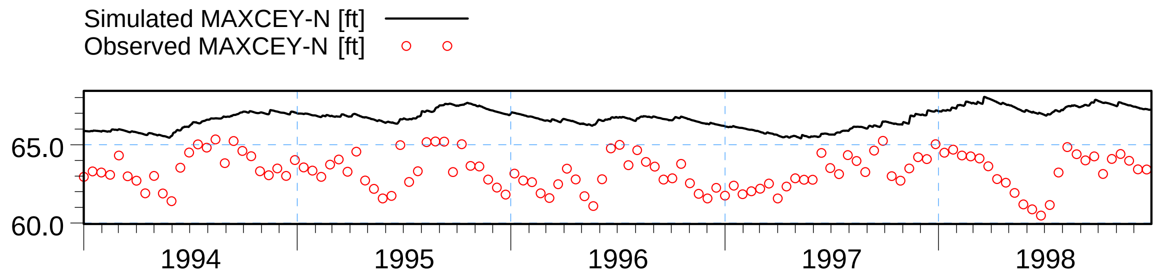


**Figure 5-74: Simulated and observed water level at SAS MAXCEY-N during the verification period.**

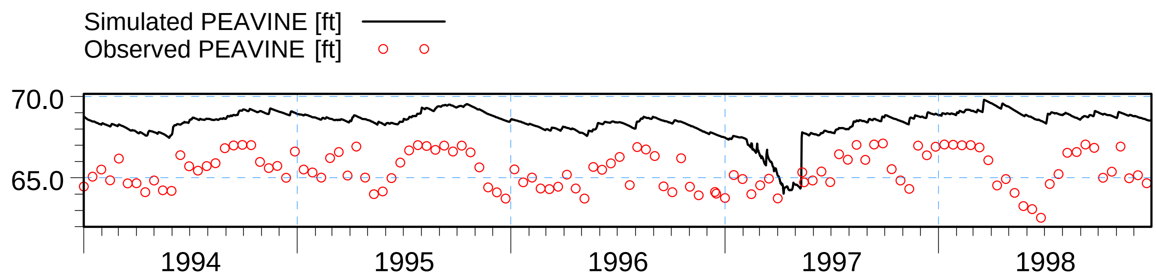


**Figure 5-75: Simulated and observed water level at SAS PEAVINE during the verification period.**

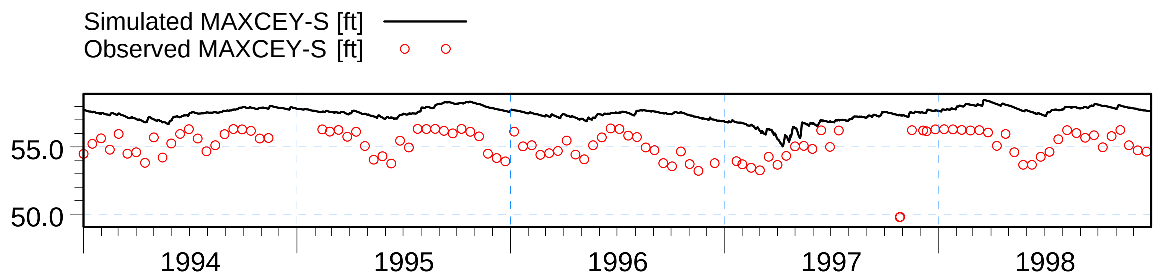


**Figure 5-76: Simulated and observed water level at SAS MAXCEY-S during the verification period.**

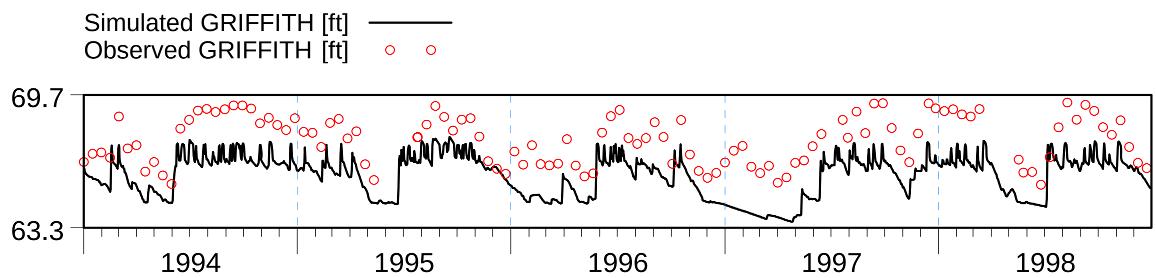


**Figure 5-77: Simulated and observed water level at SAS GRIFFITH during the verification period.**

#### 5.1.2.2 Floridan Aquifer

Simulated results at six qualitative UFA groundwater wells are shown in Figure 5-78 to Figure 5-83. The length of the observed record is limited at these groundwater wells but results indicate the regional model is doing a reasonable job of simulating UFA groundwater levels during the verification period.

Comparisons of potentiometric surface contours developed by the USGS and simulated UFA groundwater levels are shown in Figure 5-84 to Figure 5-87. UFA heads are shown for September 1996, May 1997, September 1997, and May 1998 and represent extreme conditions during the verification period (See Figure 2-4). The regional model is doing a reasonable job of simulating UFA heads in the KUB but similar to simulated UFA results for the calibration period, there is a simulated high in the LKB that is not present in the USGS potentiometric surface contours. The discrepancy between the USGS potentiometric surface maps and simulated results is a result of agricultural withdrawals in this area.

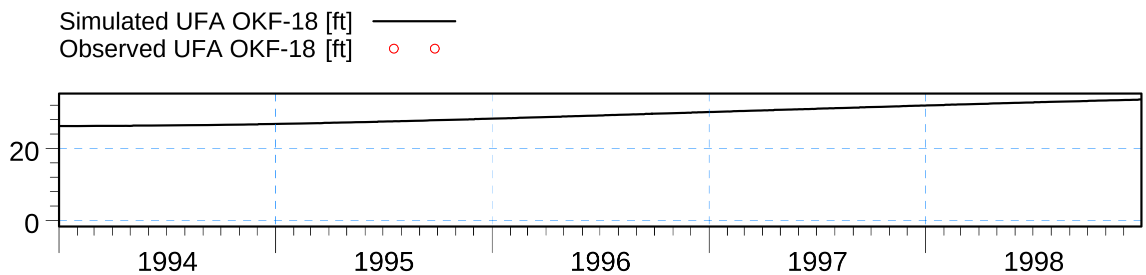


**Figure 5-78: Simulated water level at UFA OKF-18 during the verification period.**

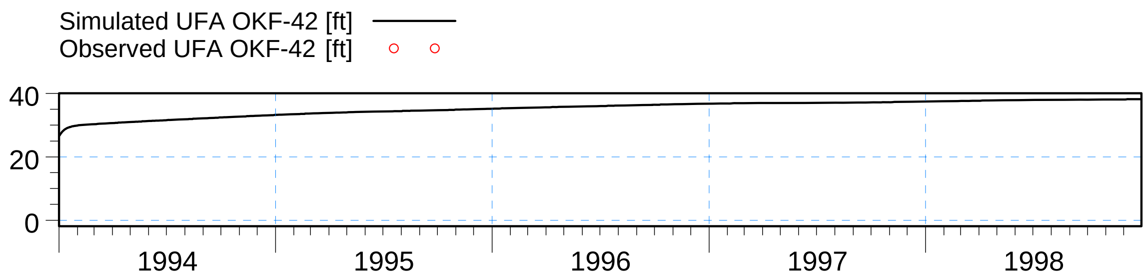


**Figure 5-79: Simulated water level at UFA OKF-42 during the verification period.**

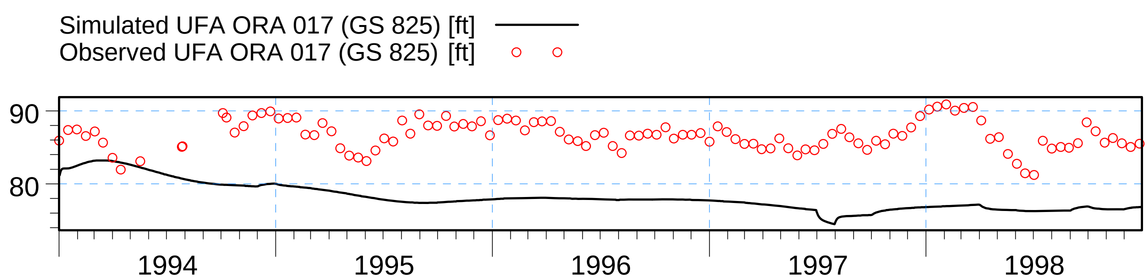


**Figure 5-80: Simulated and observed water level at UFA ORA 017/GS 825 during the verification period.**

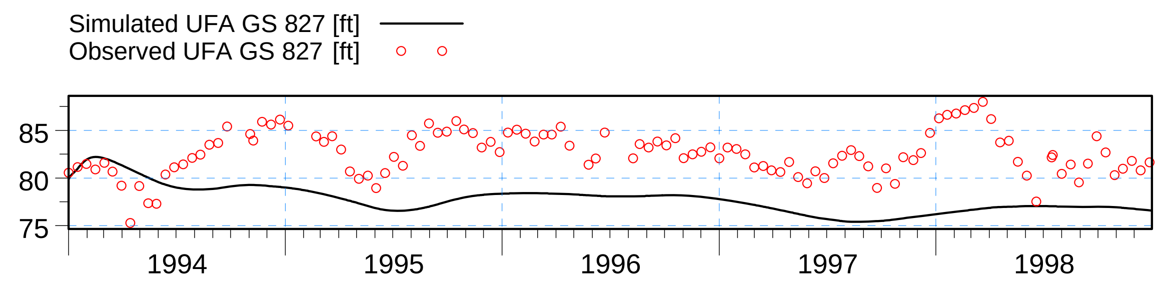


**Figure 5-81: Simulated and observed water level at UFA GS 827 during the verification period.**

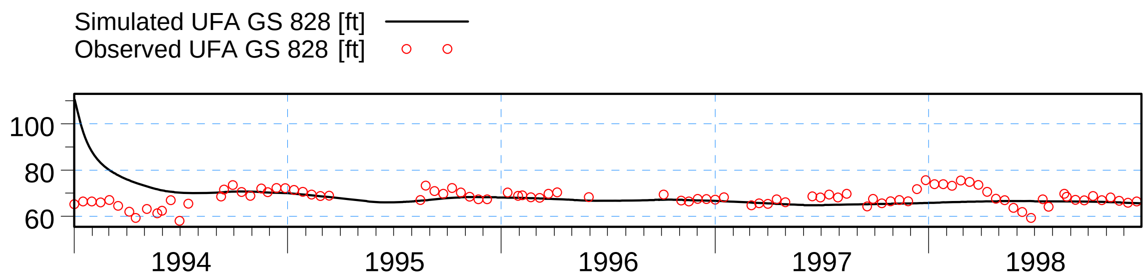


**Figure 5-82: Simulated and observed water level at UFA GS 828 during the verification period.**

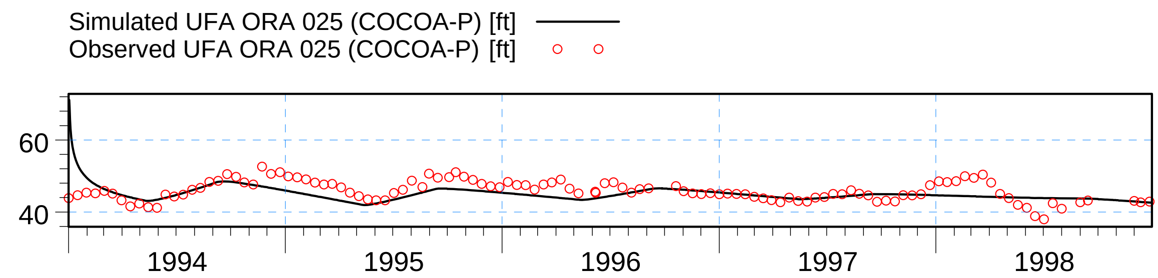


**Figure 5-83: Simulated and observed water level at UFA ORA 025/Cocoa-P during the verification period.**

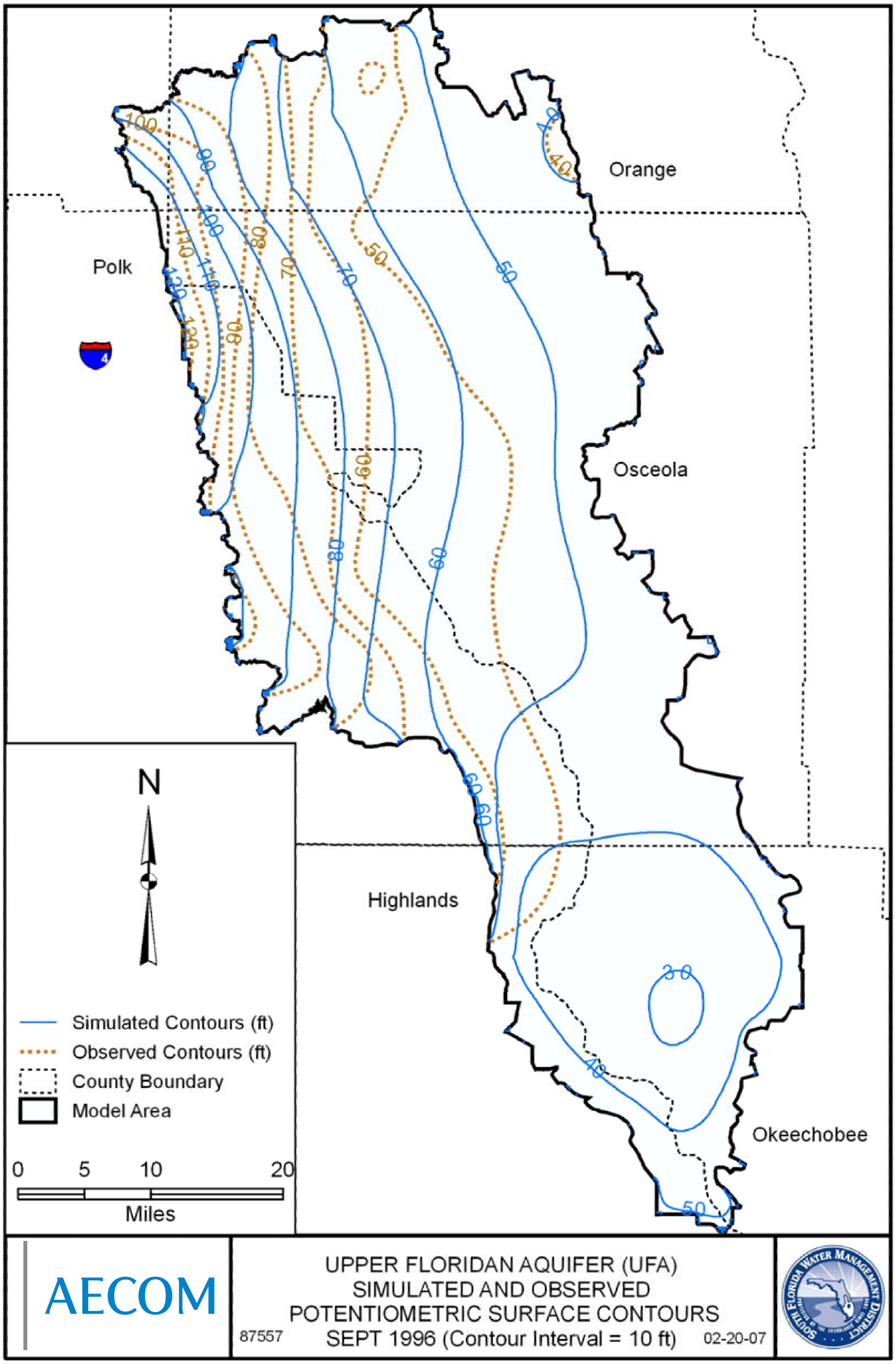


**Figure 5-84: Simulated and USGS contoured UFA potentiometric surface for September 1996.**

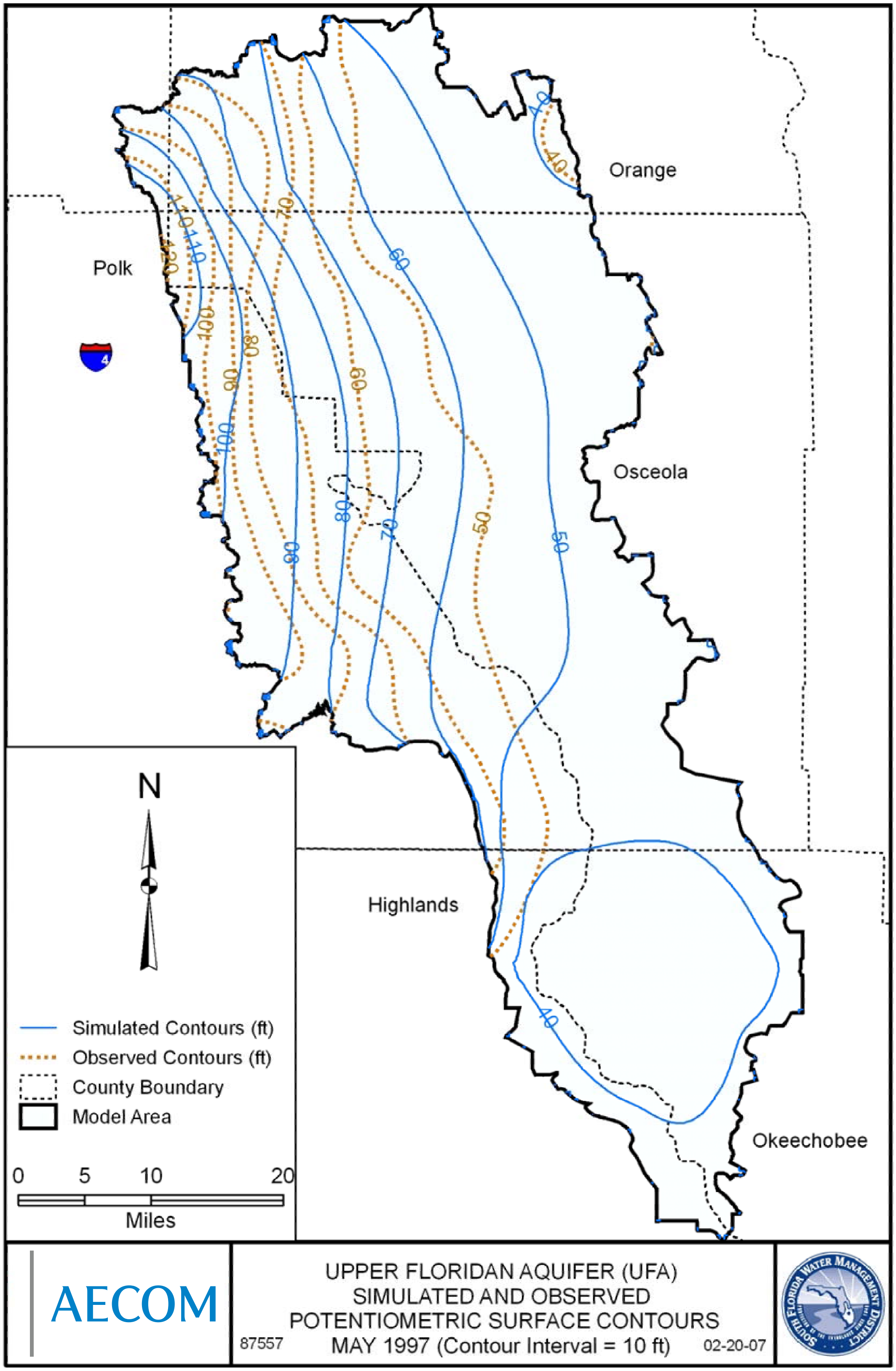


**Figure 5-85: Simulated and USGS contoured UFA potentiometric surface for May 1997.**

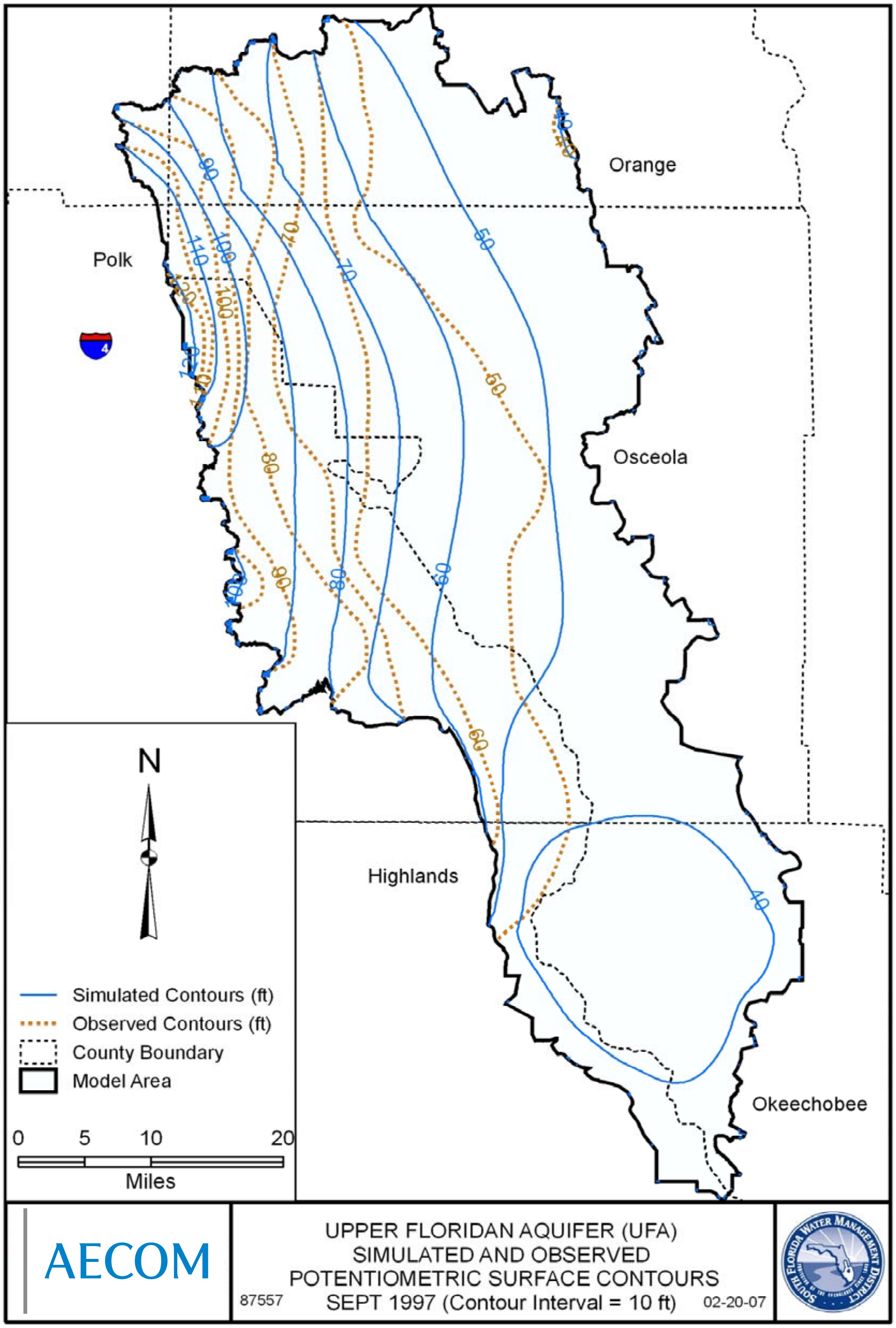


**Figure 5-86: Simulated and USGS contoured UFA potentiometric surface for September 1997.**

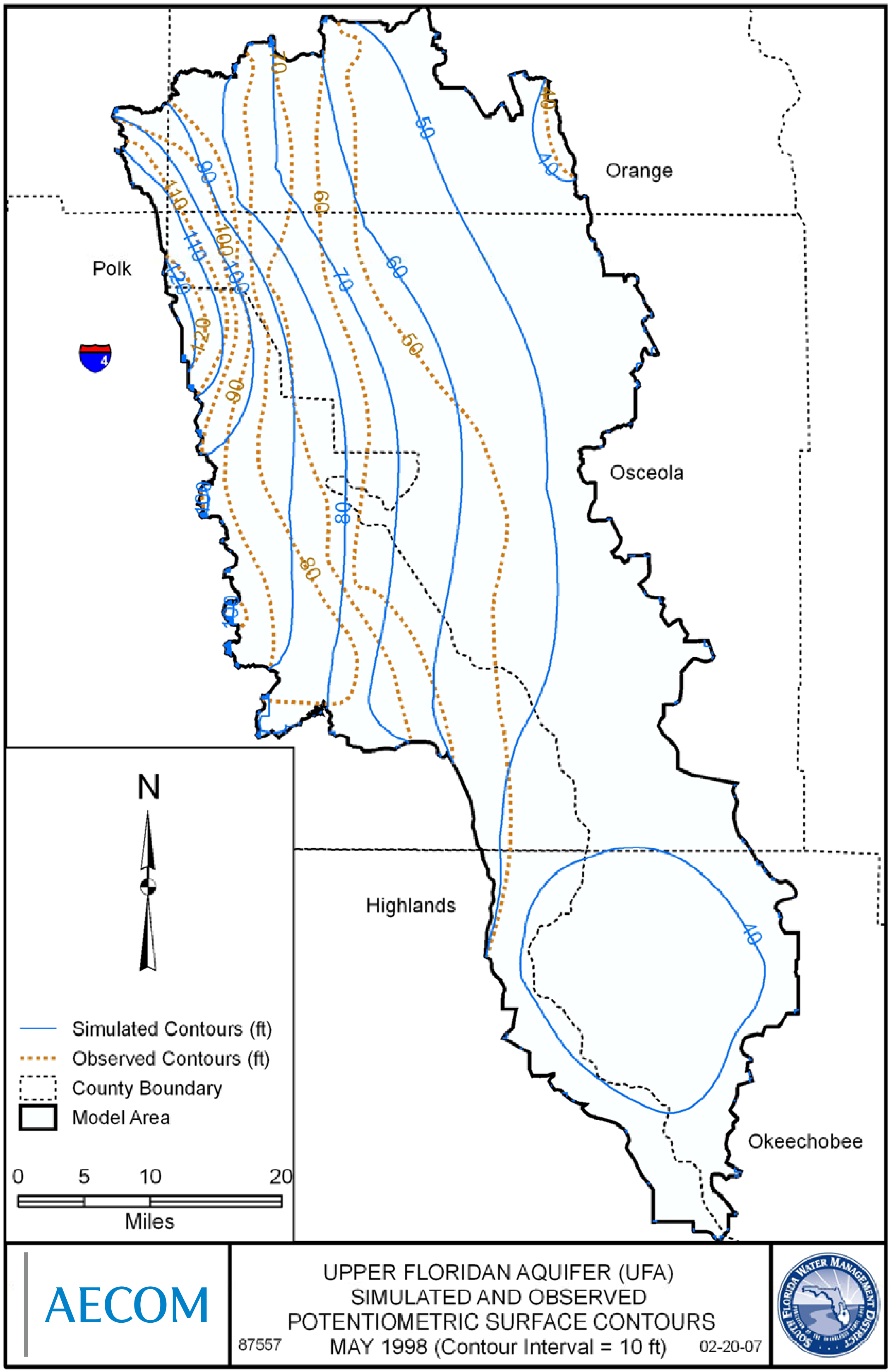


**Figure 5-87: Simulated and USGS contoured UFA potentiometric surface for May 1998.**

### 5.1.2.3 Groundwater Verification Statistics

Calibration statistics for the 33 selected SAS wells are summarized in Table 5-3. Criteria that are not met at individual stations are indicated with red shading. The model meets the *RMSE* and *R* calibration criteria at all wells identified as highly to moderately useful except for PINE ISLAND, TICK, MAXCEY-N, and PEAVINE. The *RMSE* and *R* were not met at the MAXCEY-N and PEAVINE wells. The *RMSE* criteria were not met at the PINE ISLAND well but the *R* criteria were met at all of these locations. The *R* criteria were not met at the TICK ISLAND well but the *RMSE* criteria were met.

A graphical presentation of the fit of surficial aquifer groundwater levels at the 25 quantitative gages identified in the ATP (Earth Tech, 2006b) and refined in discussions with SFWMD staff relative to the mean error is shown in Figure 5-88.

**Table 5-3: Surficial Aquifer groundwater statistics for the verification period. Red shading is used to indicate locations that do not meet specified criteria.**

| MODEL AREA | Station | RMSE | R(correlation) | RMSE | R(correlation) | RMSE | R(correlation) |
|---|---|---|---|---|---|---|---|
| **UKB SAS Calibration Wells for the 1000 x 1000 ft model** | | | | | | | |
| UKB bc | BEELINE | M | M | 1.57 | 0.57 | | |
| UKB north | TAFT | H | H | 0.70 | 0.81 | | |
| UKB north | KISSFS | H | H | 1.70 | 0.65 | | |
| UKB north | REEDGW 10 | H | H | 0.85 | 0.78 | | |
| UKB alligator | ALL 1 | H | H | 0.92 | 0.78 | | |
| UKB east | CAST | H | H | 0.97 | 0.50 | | |
| UKB east | EXOT | H | H | 0.87 | 0.79 | | |
| UKB east | PINEISL | H | H | 5.63 | 0.74 | | |
| UKB central | WR 6 | H | H | 2.22 | 0.86 | | |
| UKB central | WR 11 | H | H | 0.78 | 0.59 | | |
| UKB east | CHAPMAN | H | H | 1.49 | 0.57 | | |
| UKB east | KENANS 1 | H | H | 1.40 | 0.81 | | |
| **LKB SAS Calibration Wells for the 1000 x 1000 ft model** | | | | | | | |
| LKB east | ELMAX | H | H | 1.57 | 0.68 | | |
| LKB kr | TICKICL | H | H | 2.88 | 0.32 | | |
| LKB east | MAXCEY-N | H | H | 3.62 | 0.33 | | |
| LKB east | PEAVINE | H | H | 3.17 | 0.48 | | |
| LKB east | MAXCEY-S | H | H | 2.50 | 0.52 | | |
| LKB east | GRIFFITH | H | H | 1.80 | 0.85 | | |

"H" not meeting criteria
"M" not meeting criteria
Does meet criteria
NOTE: Calibration points with Low (L) utility have been omitted

Rationale for selection of statistics Targets:
Highly Useful (H):
RMSE ATP Statistic Target range 2.5 to 3.0-ft.
R ATP Statistic Target range 0.50 to 0.75
Moderately Useful (M):
RMSE ATP Statistic Target low end of range plus 0.5-ft.
R ATP Statistic Target low end of range minus 0.05

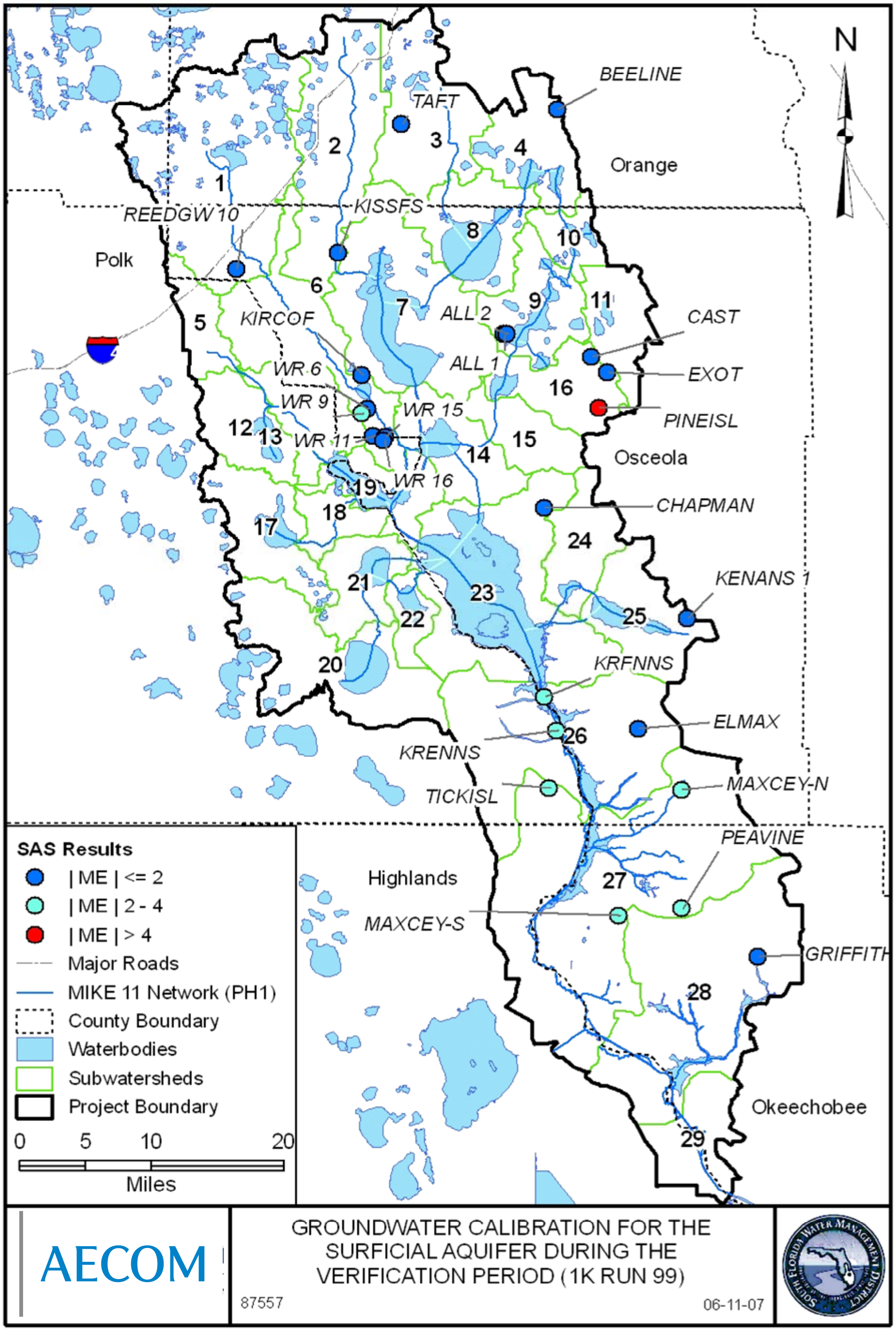


**Figure 5-88: Summary of statistical fit at surficial aquifer groundwater wells during the verification period.**

### 5.1.3 Qualitative Water Budget Verification

Seasonal MIKE SHE water budgets for 29 sub-watersheds are summarized in Appendix D (see sub-watershed delineation in Figure 2-25). Seasonal MIKE SHE water budgets for the SAS for the 29 sub-watersheds are also summarized in Appendix D. MIKE SHE water budgets for the entire verification period are included in Appendix D. The terms included in the water budgets and equations used to calculate the total model error (*Err*) are defined in Appendix C.

Water budgets are presented for the 1994 wet season, the 1994 to 1995 dry season, the 1995 wet season, the 1995 to 1996 dry season, the 1996 wet season, the 1996 to 1997 dry season, the 1997 wet season, the 1997-1998 dry season, and the 1998 wet season. Water budgets are not presented for the 1993-1994 dry season or the 1998 to 1999 dry season because the model was only run for a portion of these periods. In general, the water budgets appear to be reasonable based on review of available data (*e.g.*, McGurk and Presley, 2002).

### 5.1.4 Overland Flow Depth and Hydro-Period Maps

Maximum and average overland flow depths for the dry season of 1996 to 1997 and 1997 to 1998 and wet season of 1996 and 1997 are shown in Figure 5-89 to Figure 5-96. These periods represent extreme conditions during the calibration period (see Figure 2-4). Overland depth hydro-period maps showing the percentage of time overland depths exceed 1 inch and 1 foot are shown in Figure 5-97 and Figure 5-98, respectively.

These figures show that areas with significant overland water depths generally correspond to land-use categories that are typically inundated for significant periods of time (water, swamp forest, *etc*.). Correspondence of simulated overland results to land-use suggests that overland parameters are adequate to meet the objectives of the KBMOS.

However, since the KBMOS performance measures are not evaluated outside of the C&SF project canals and structures and the Kissimmee River floodplain, additional efforts were not placed on comparing or achieving a more rigorous criteria for regards to overland flow depths. Therefore, the use of the overland flow depths output by AFET will have to be done with caution.

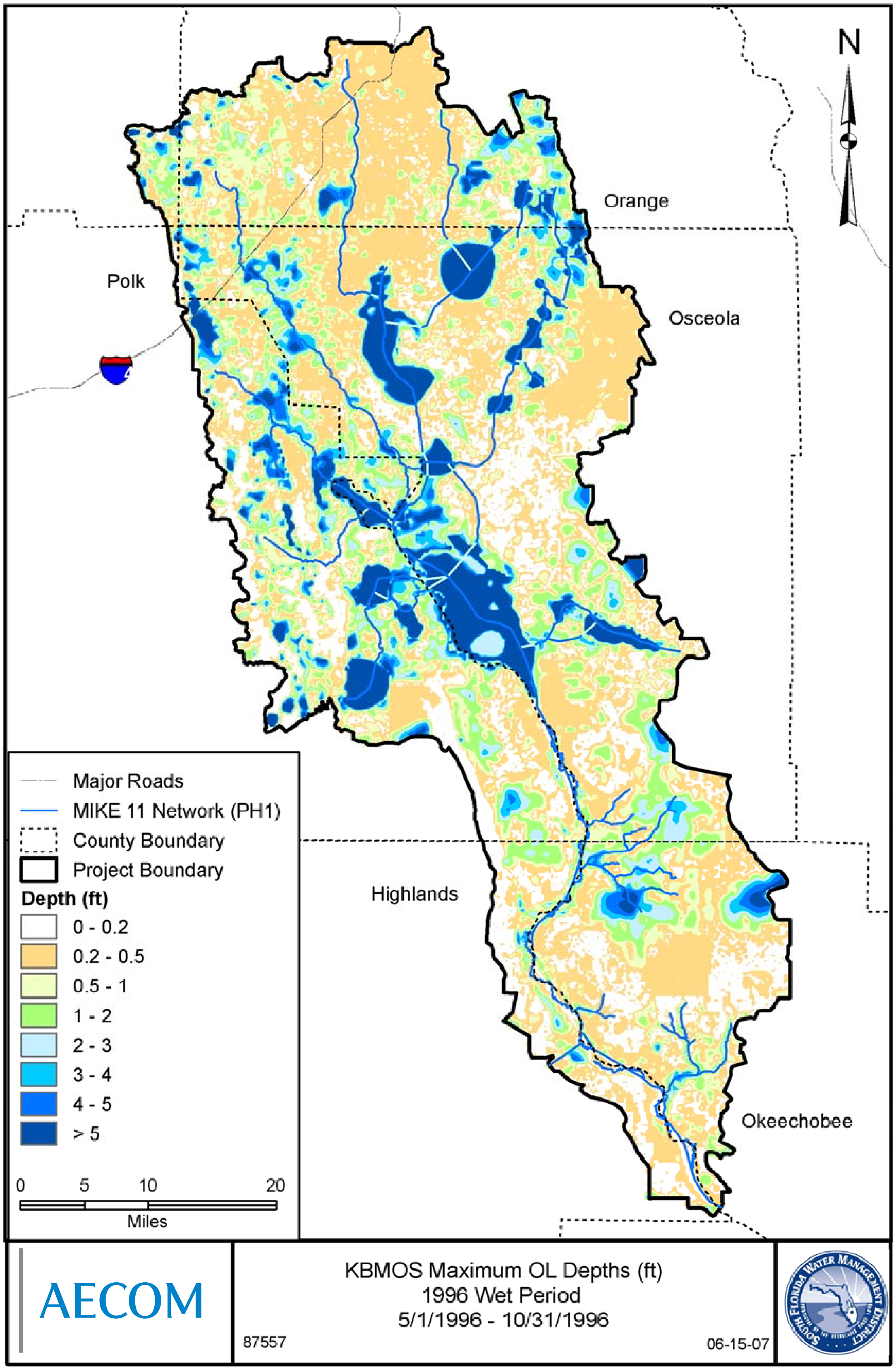


**Figure 5-89: Maximum overland flow depths for the 1996 wet period.**

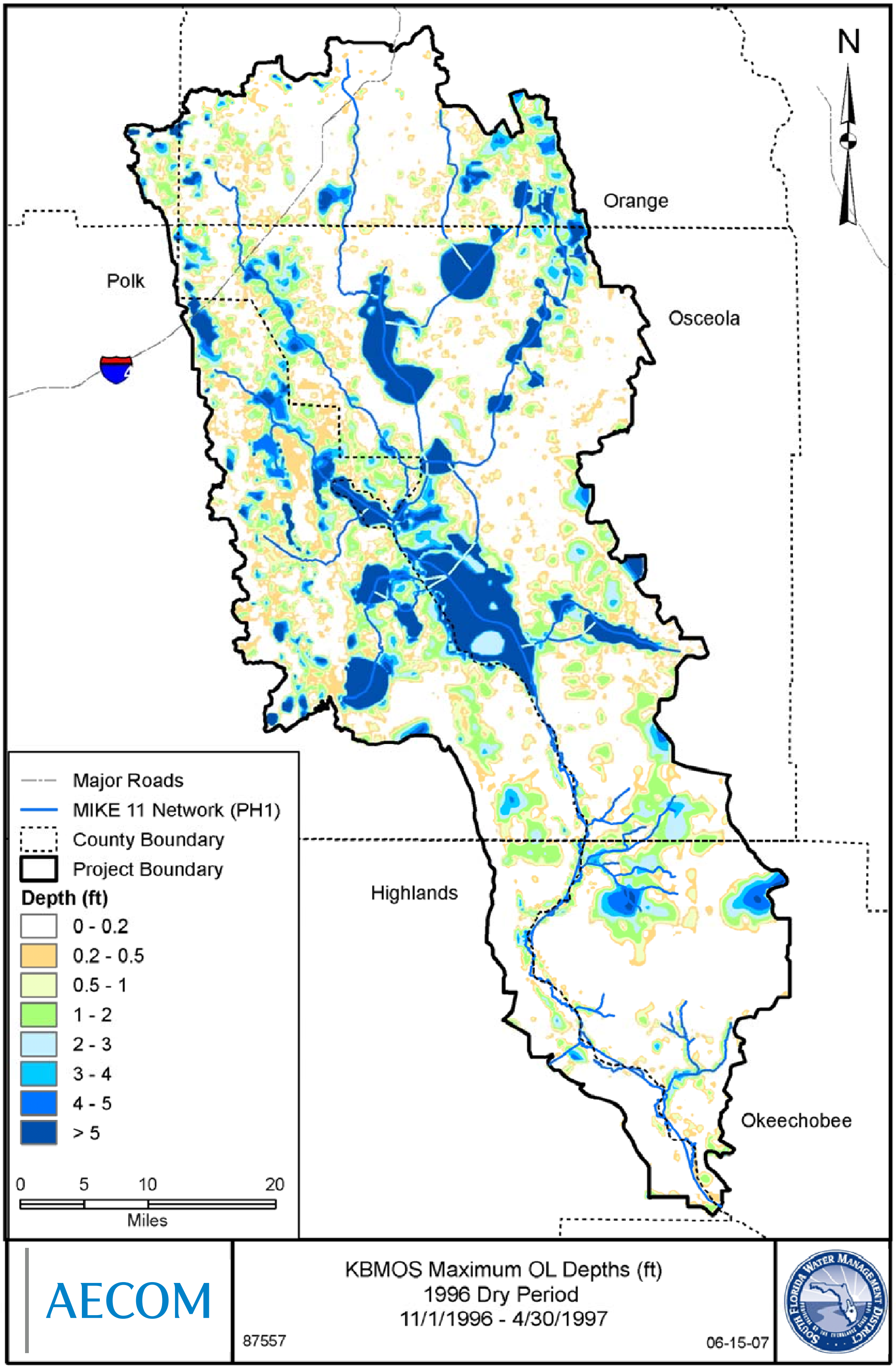


**Figure 5-90: Maximum overland flow depths for the 1996 to 1997 dry period.**

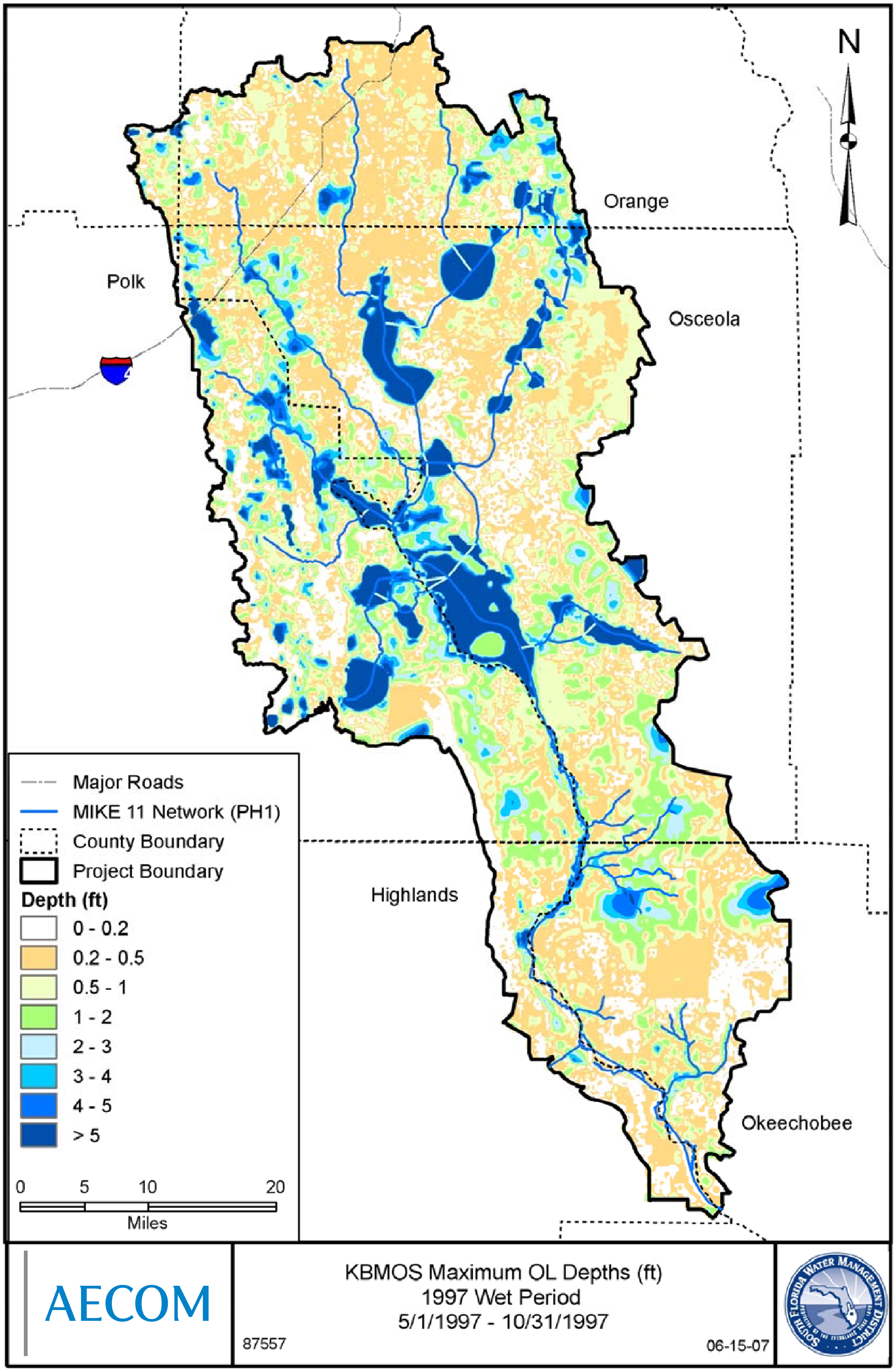


**Figure 5-91: Maximum overland flow depths for the 1997 wet period.**

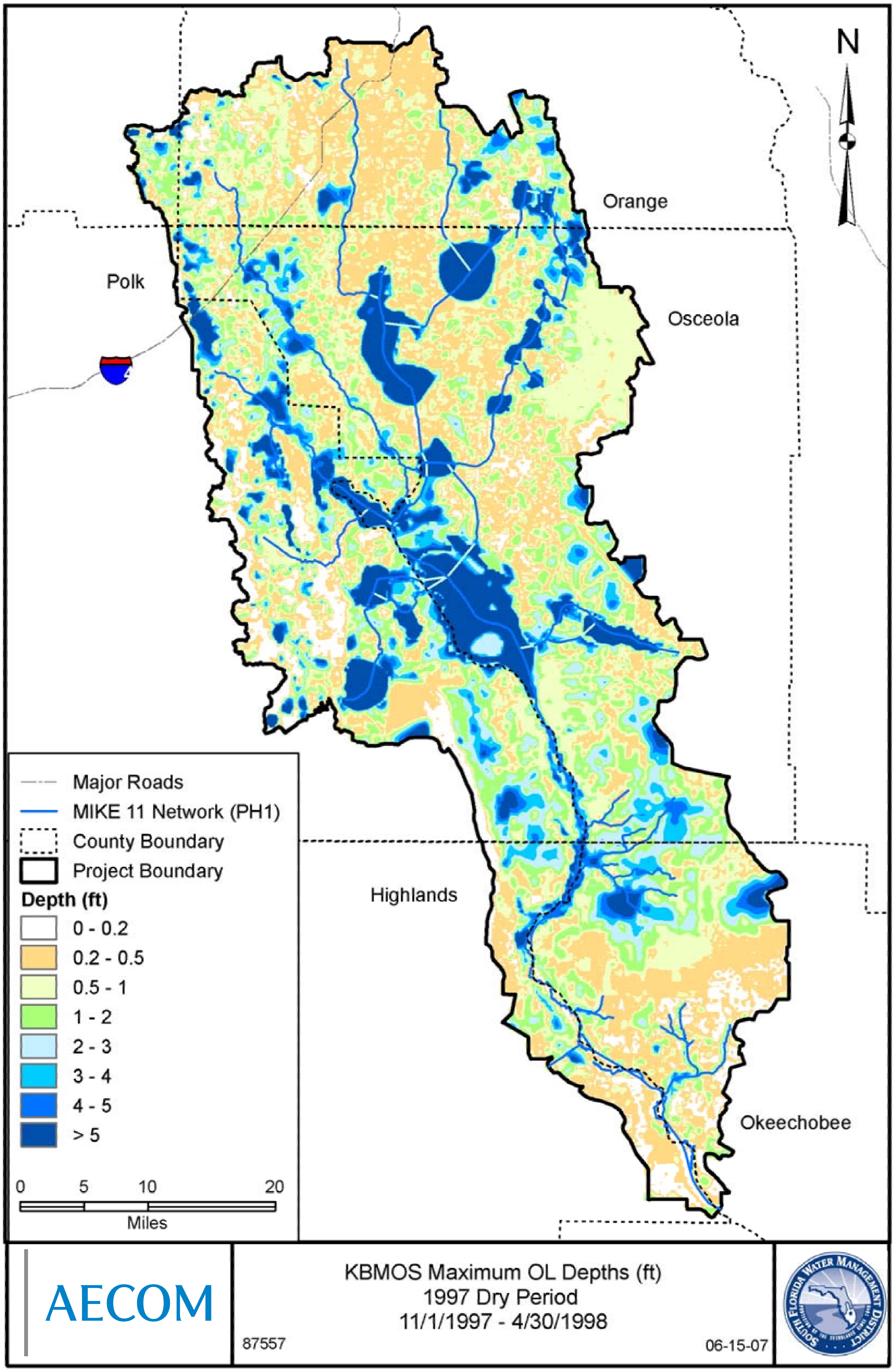


**Figure 5-92: Maximum overland flow depths for the 1997 to 1998 dry period.**

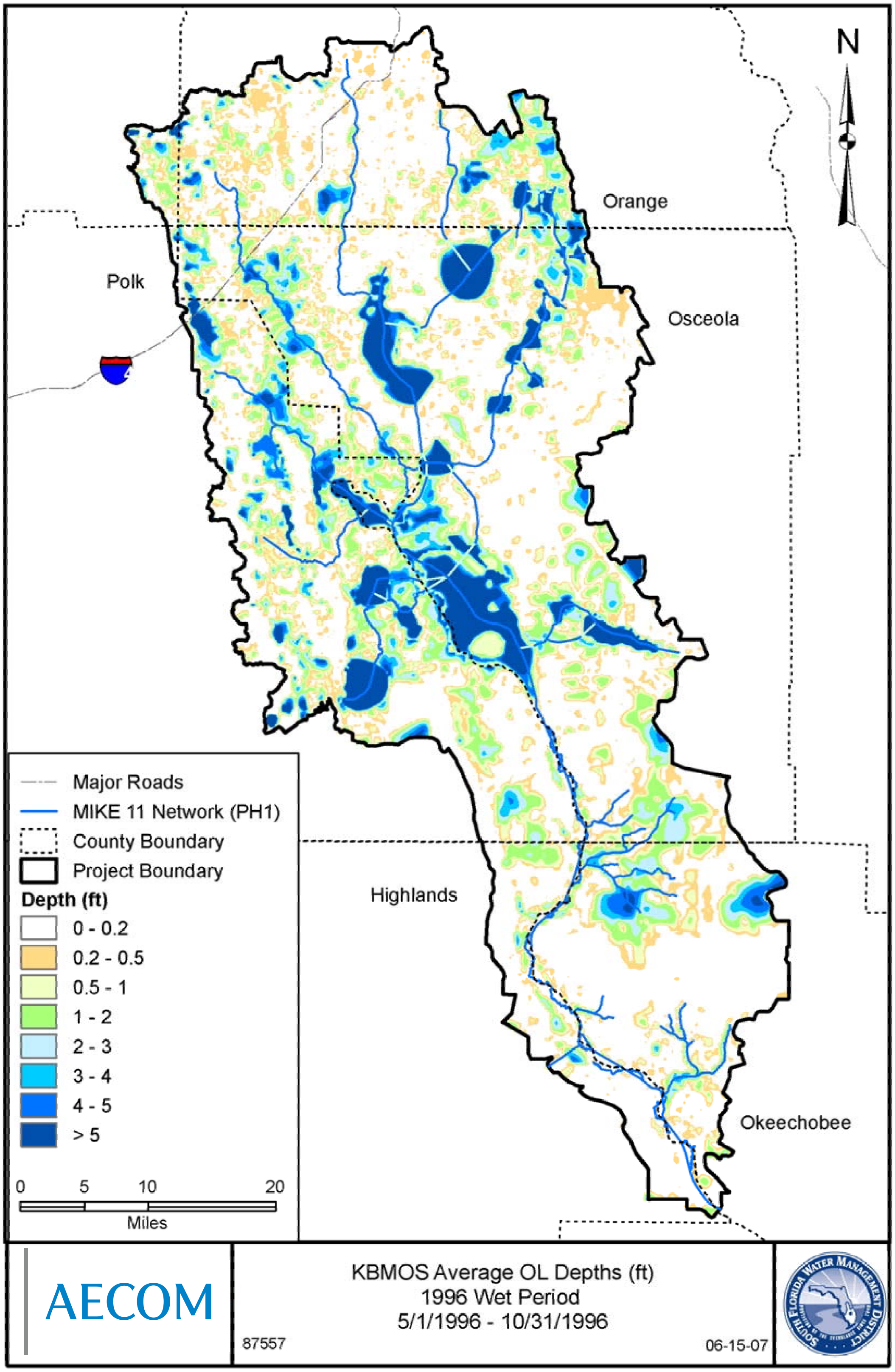


**Figure 5-93: Average overland flow depths for the 1996 wet period.**

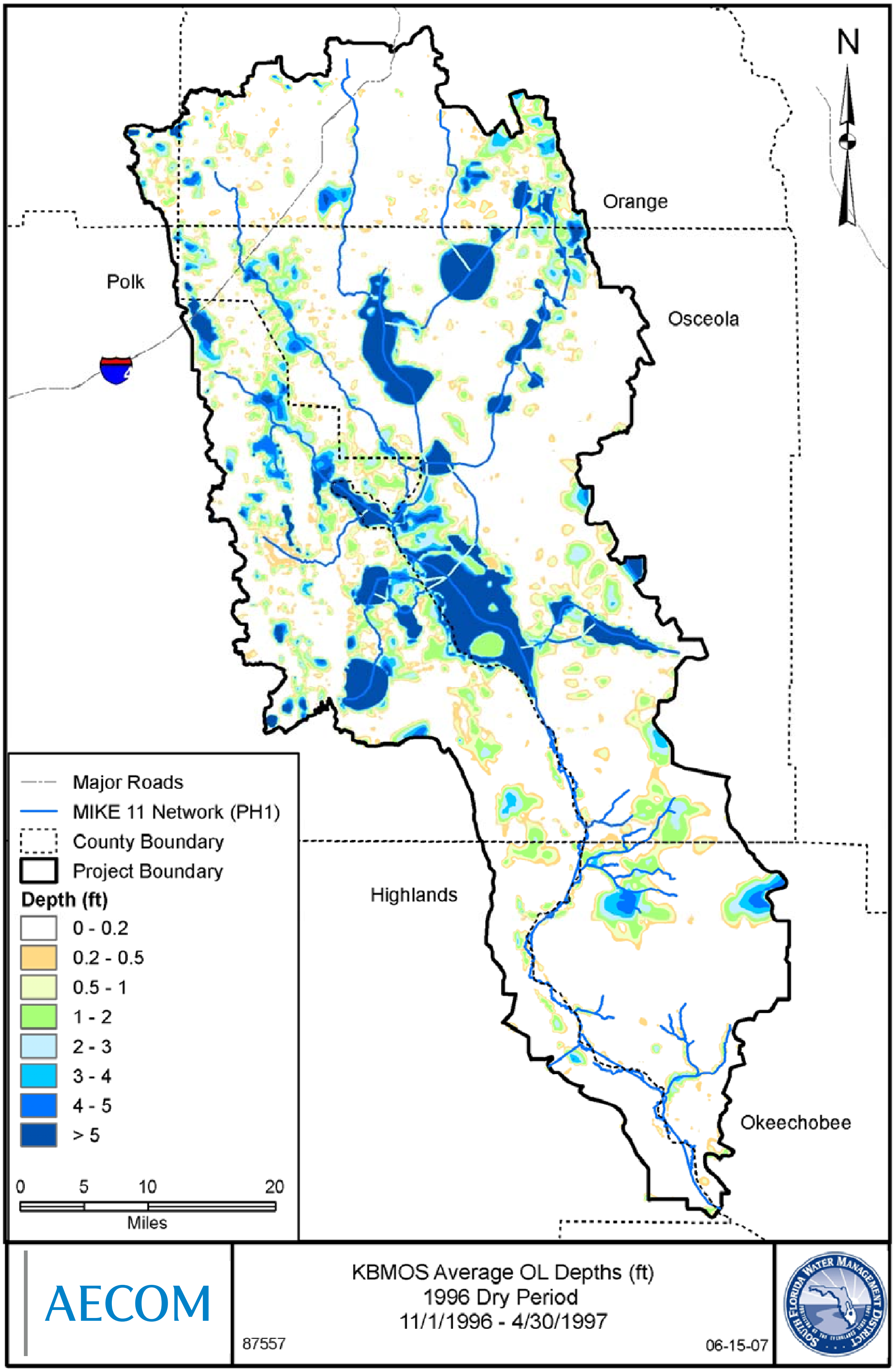


**Figure 5-94: Average overland flow depths for the 1996 to 1997 dry period.**

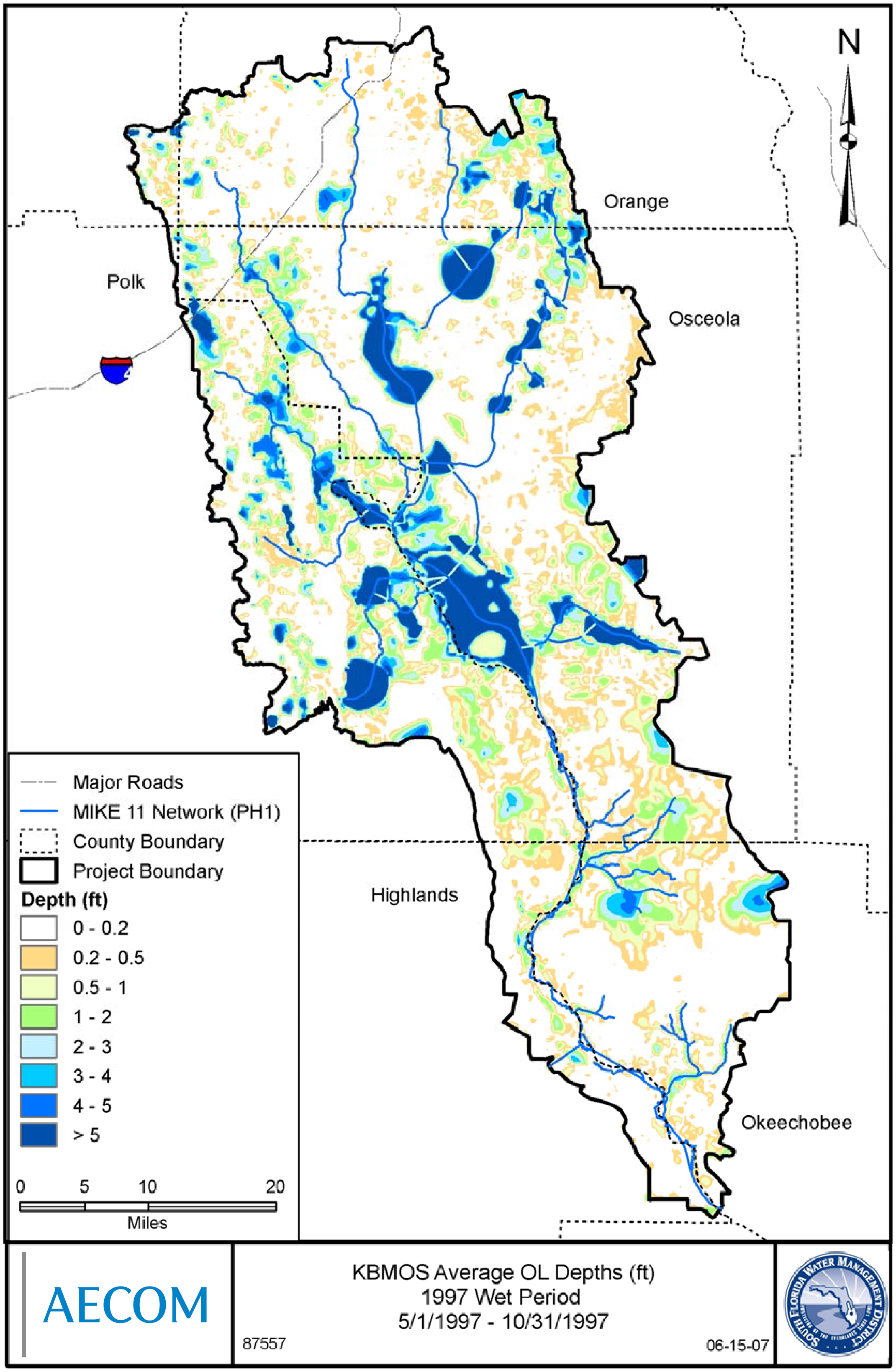


**Figure 5-95: Average overland flow depths for the 1997 wet period.**

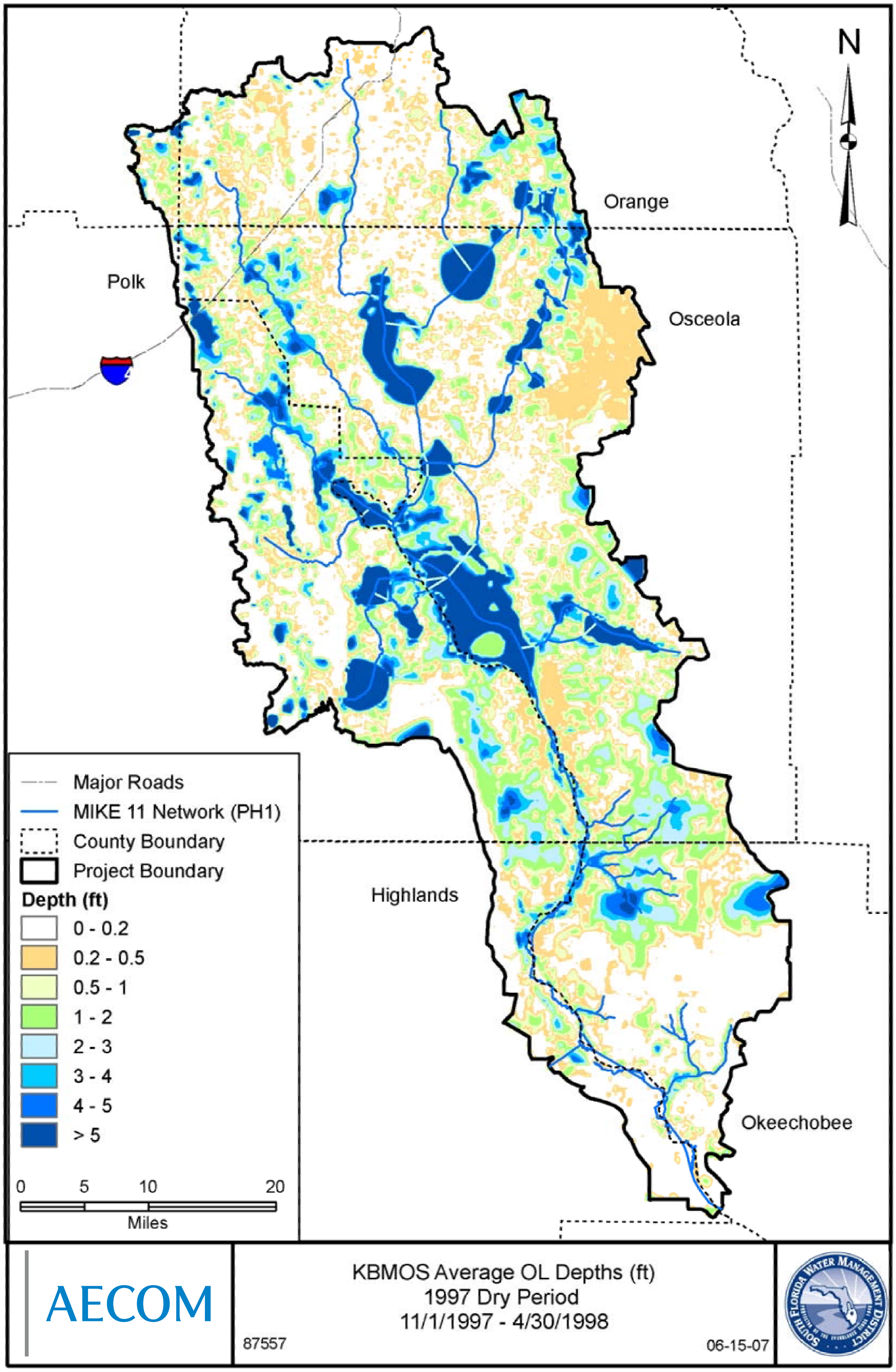


**Figure 5-96: Average overland flow depths for the 1997 to 1998 dry period.**

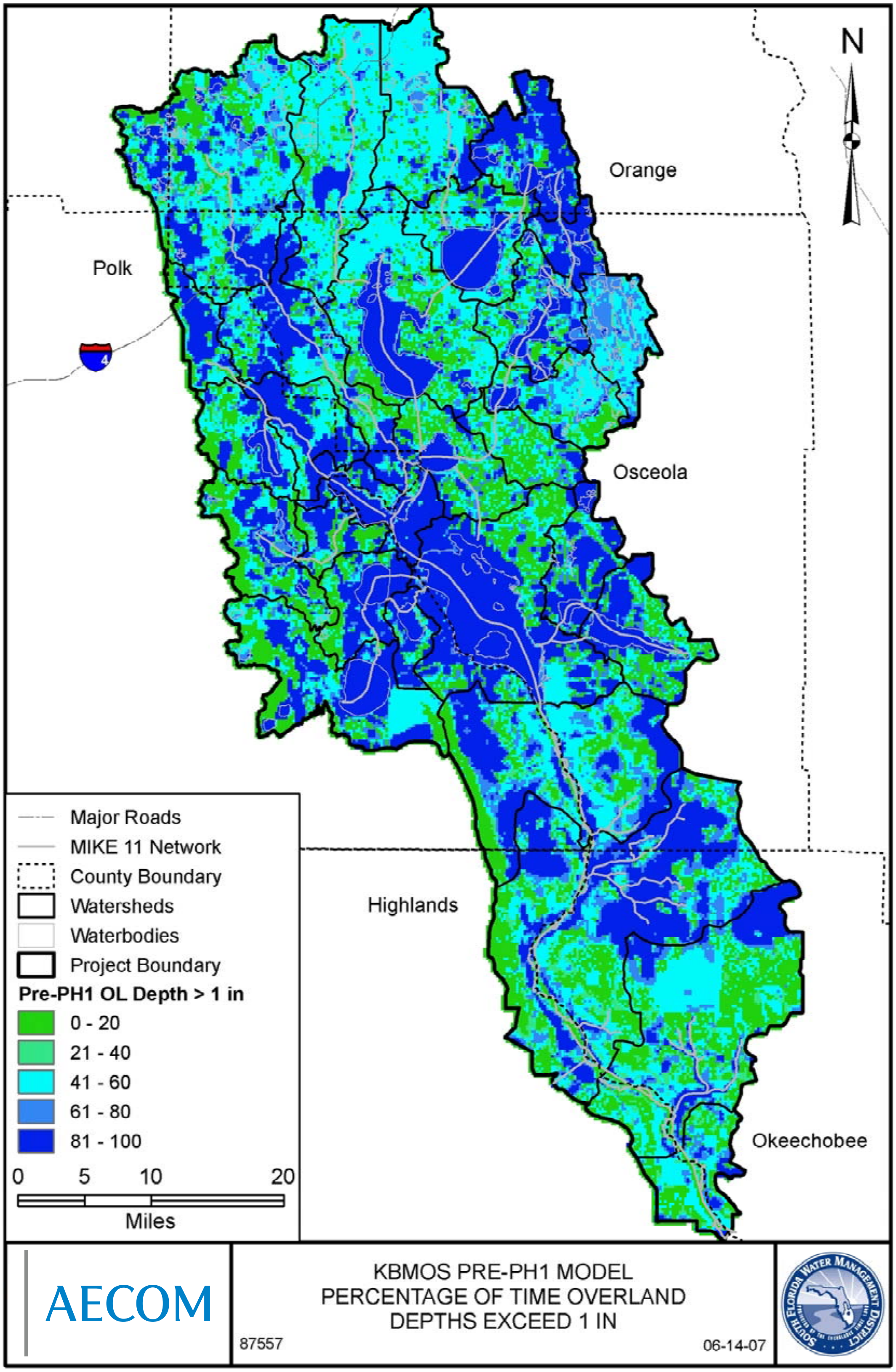


**Figure 5-97: Percentage of time overland flow depths exceed 1 inch during the verification period.**

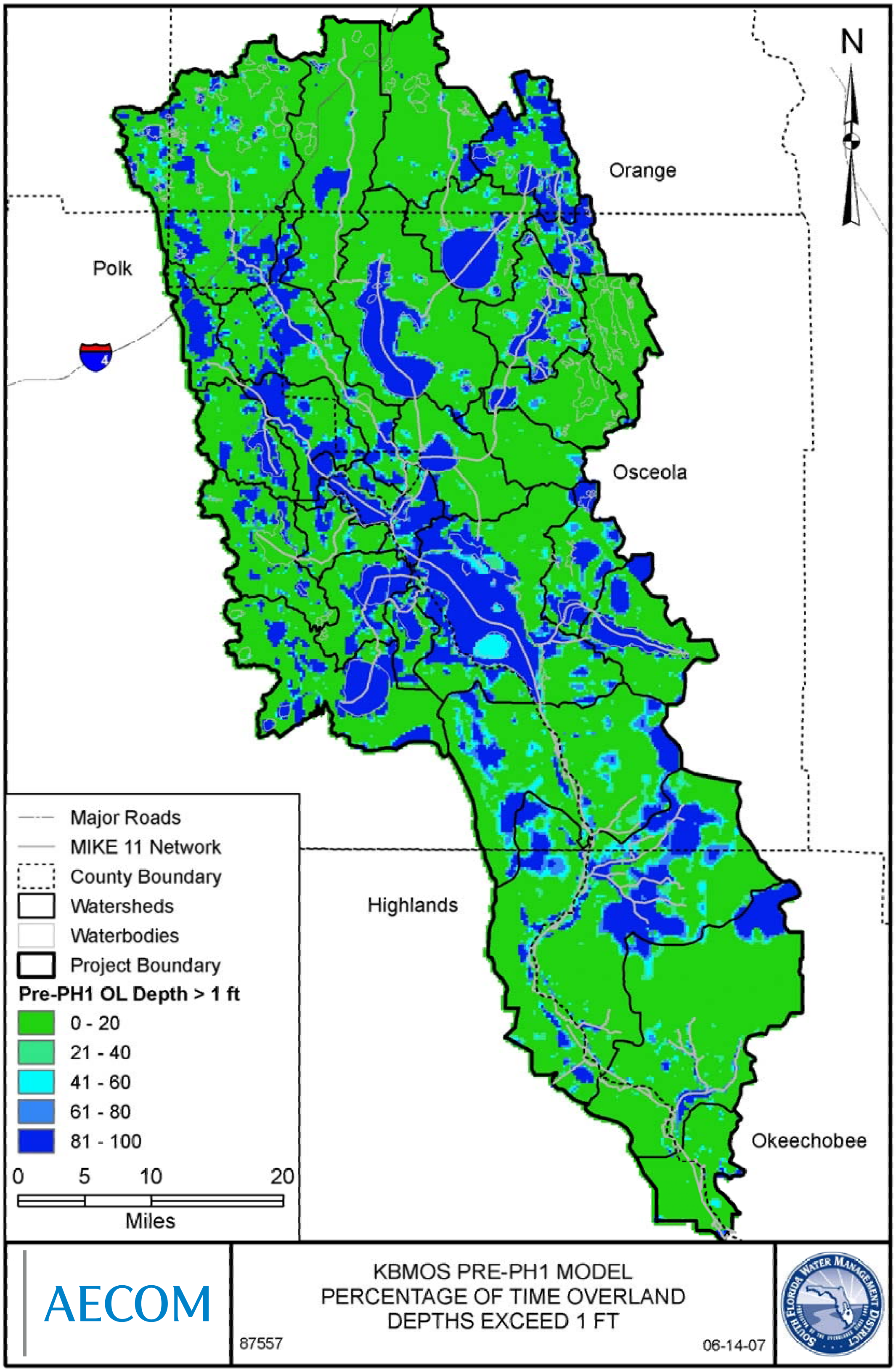


**Figure 5-98: Percentage of time overland flow depths exceed 1 foot during the verification period.**

## 5.2 2004 Hurricane Season Results

### 5.2.1 Surface Water Verification

Model performance during high-intensity storm events was evaluated by simulating the 2004 hurricane season with the calibrated model. The surface water storm verification period included the period from August 1, 2004 to October 15, 2004. Simulated and observed surface water stage and discharge for the upper and lower basin are shown in Figure 5-99 through Figure 5-147.

#### 5.2.1.1 Upper Basin

Results for the upper basin for the storm verification period are shown in Figure 5-99 through Figure 5-123 and indicate that the model is adequately capturing surface water process and responses in the KUB.

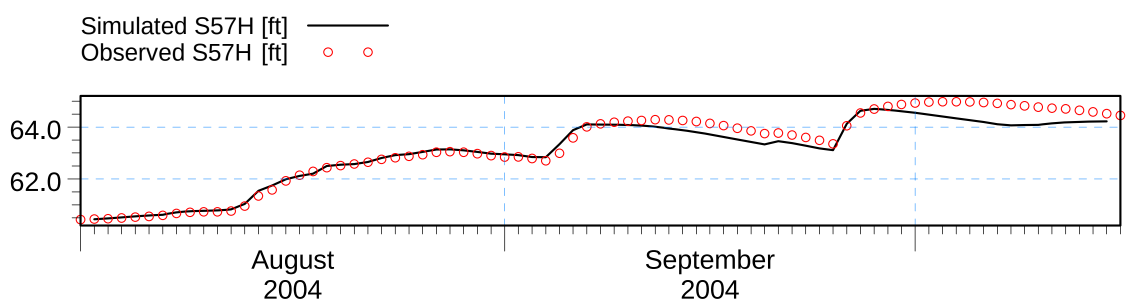


**Figure 5-99: Simulated and observed headwater stage at S-57 during the storm verification period.**

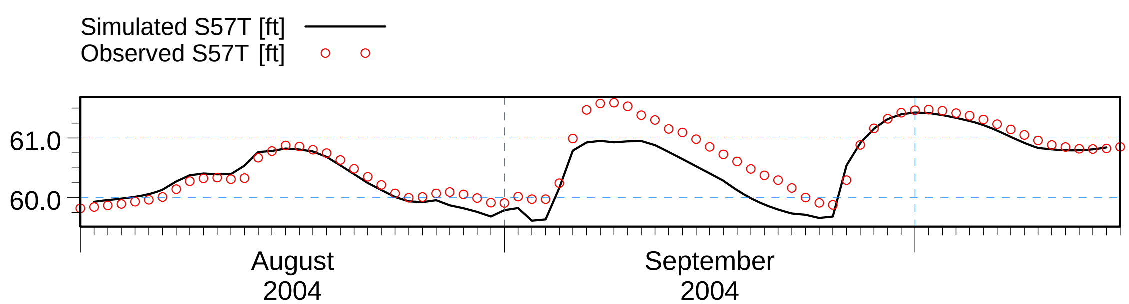


**Figure 5-100: Simulated and observed tailwater stage at S-57 during the storm verification period.**

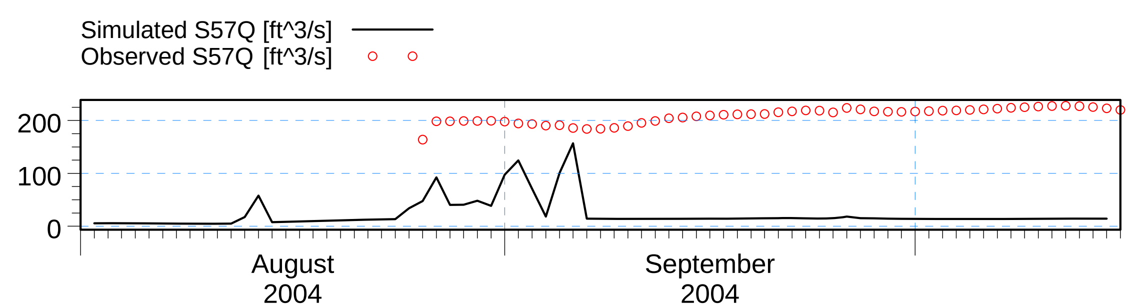


**Figure 5-101: Simulated and observed discharge at S-57 during the storm verification period.**

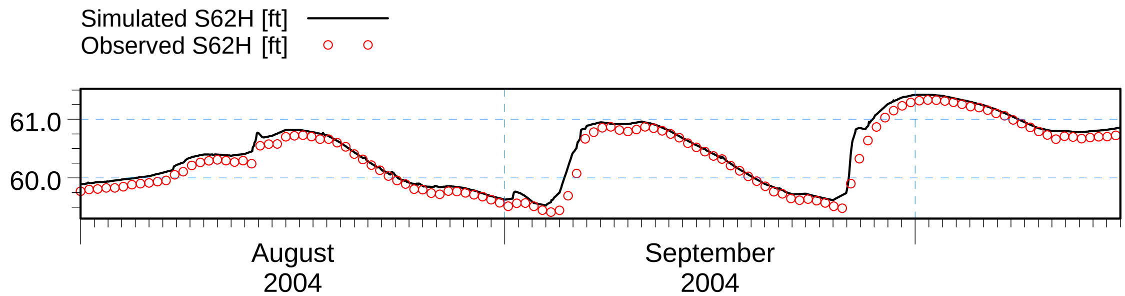


**Figure 5-102: Simulated and observed headwater stage at S-62 during the storm verification period.**

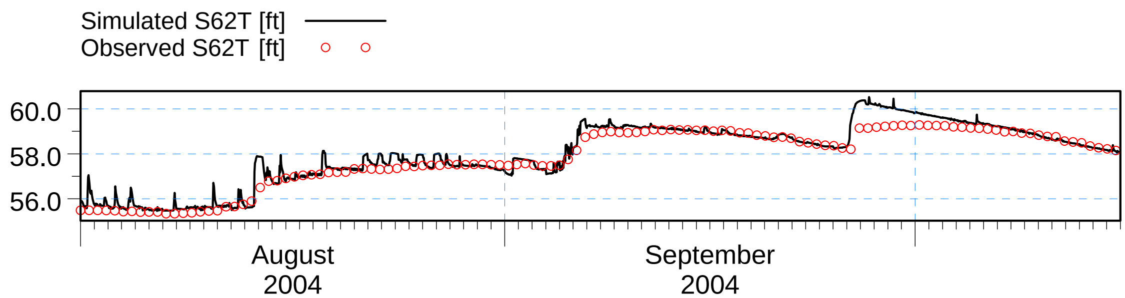


**Figure 5-103: Simulated and observed tailwater stage at S-62 during the storm verification period.**

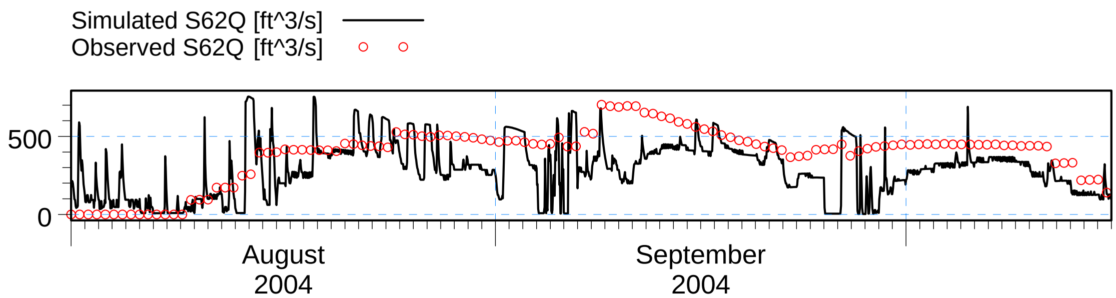


**Figure 5-104: Simulated and observed discharge at S-62 during the storm verification period.**

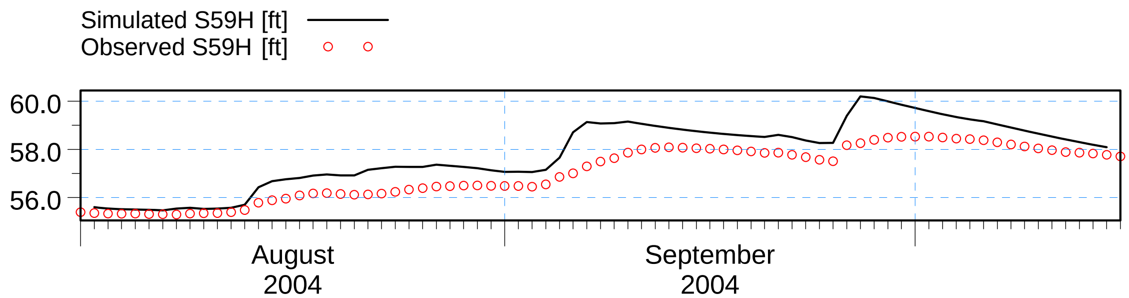


**Figure 5-105: Simulated and observed headwater stage at S-59 during the storm verification period.**

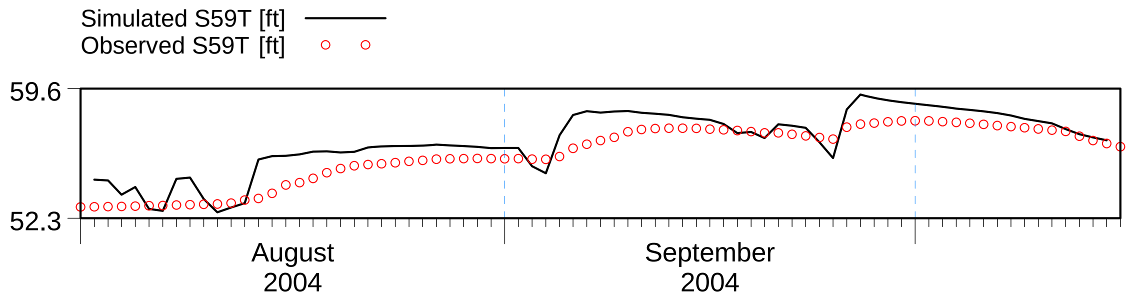


**Figure 5-106: Simulated and observed tailwater stage at S-59 during the storm verification period.**

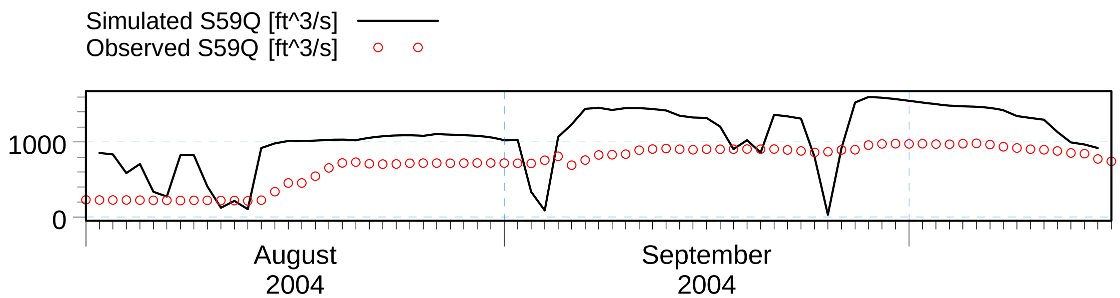


**Figure 5-107: Simulated and observed discharge at S-59 during the storm verification period.**

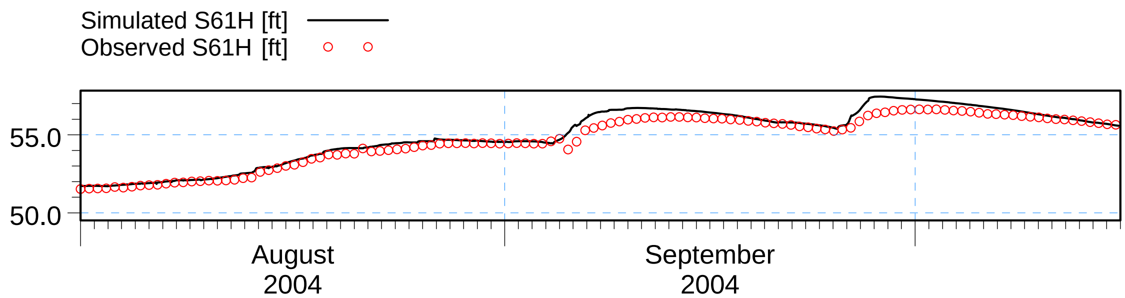


**Figure 5-108: Simulated and observed headwater stage at S-61 during the storm verification period.**

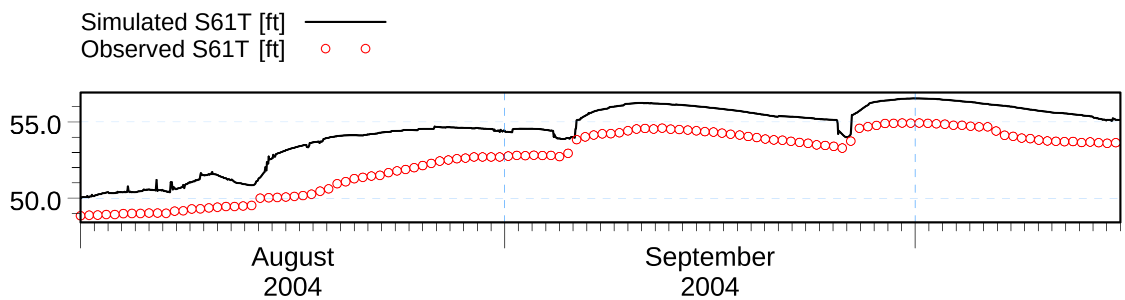


**Figure 5-109: Simulated and observed tailwater stage at S-61 during the storm verification period.**

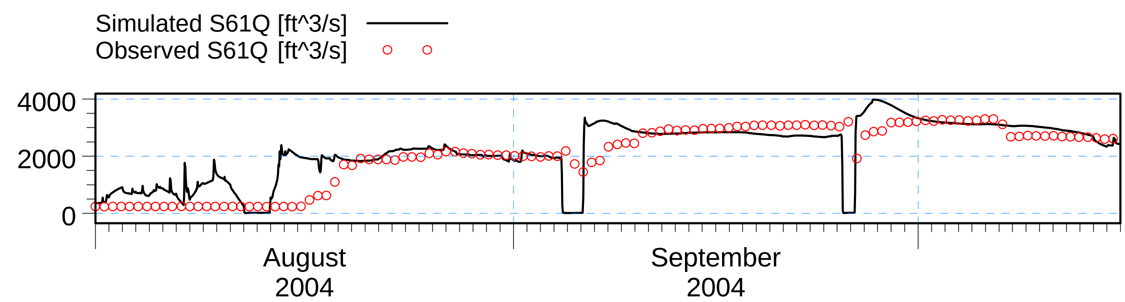


**Figure 5-110: Simulated and observed discharge at S-61 during the storm verification period.**

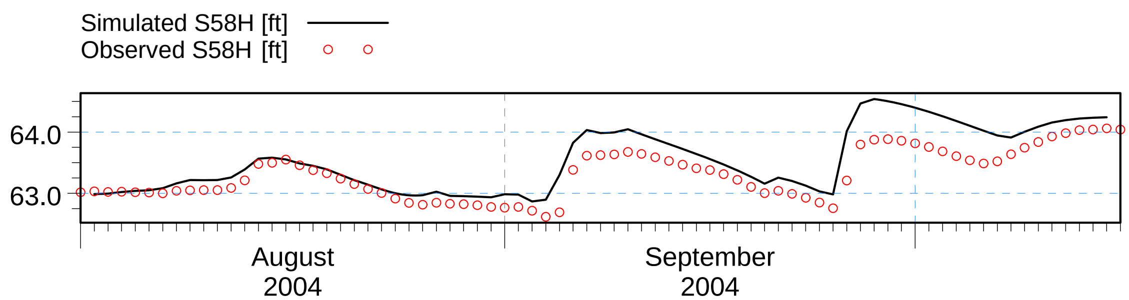


**Figure 5-111: Simulated and observed headwater stage at S-58 during the storm verification period.**

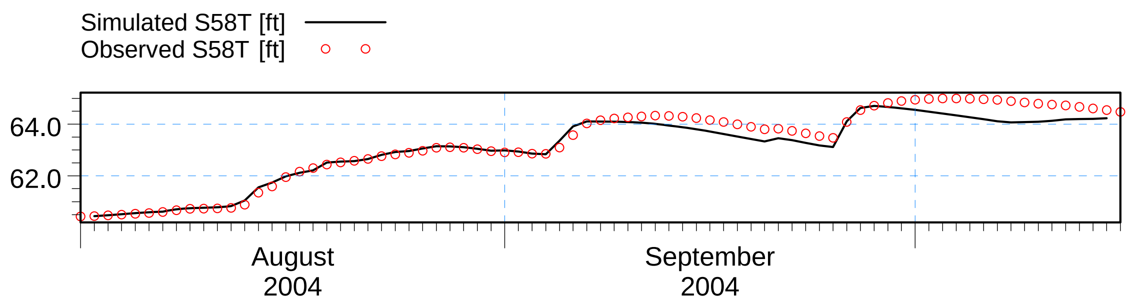


**Figure 5-112: Simulated and observed tailwater stage at S-58 during the storm verification period.**

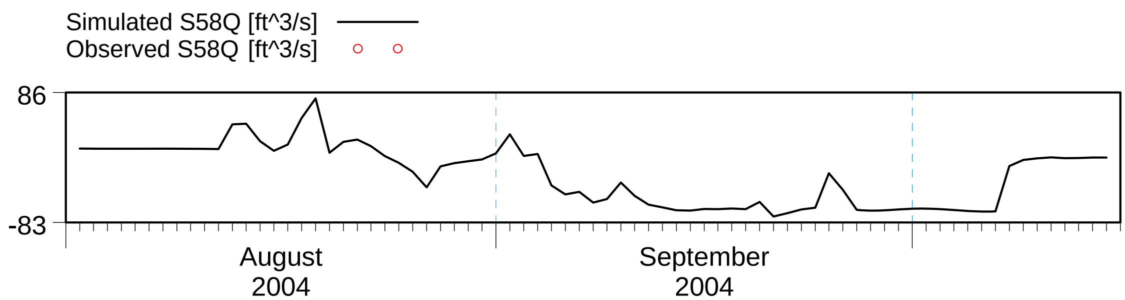


**Figure 5-113: Simulated and observed discharge at S-58 during the storm verification period.**

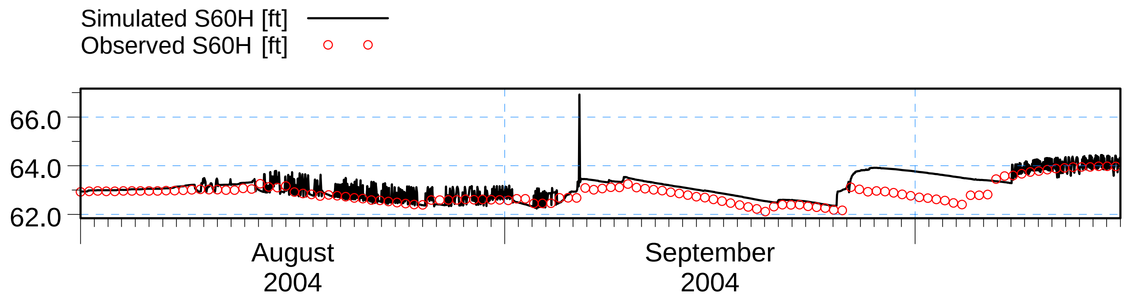


**Figure 5-114: Simulated and observed headwater stage at S-60 during the storm verification period.**

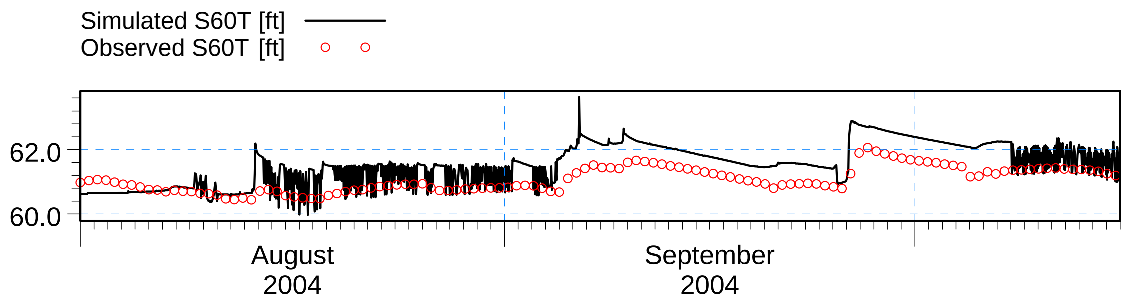


**Figure 5-115: Simulated and observed tailwater stage at S-60 during the storm verification period.**

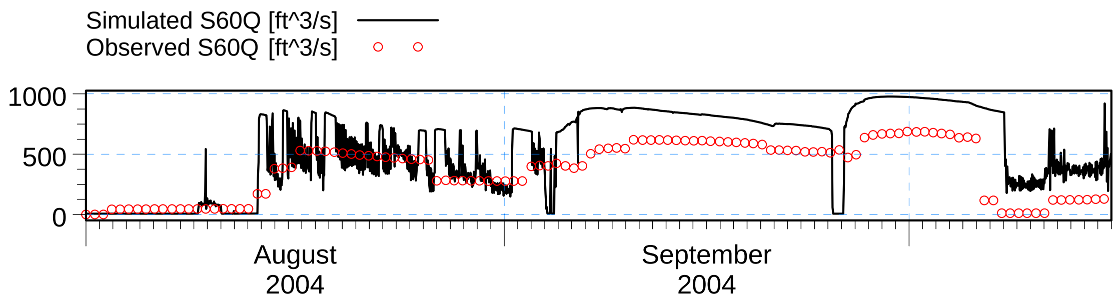


**Figure 5-116: Simulated and observed discharge at S-60 during the storm verification period.**

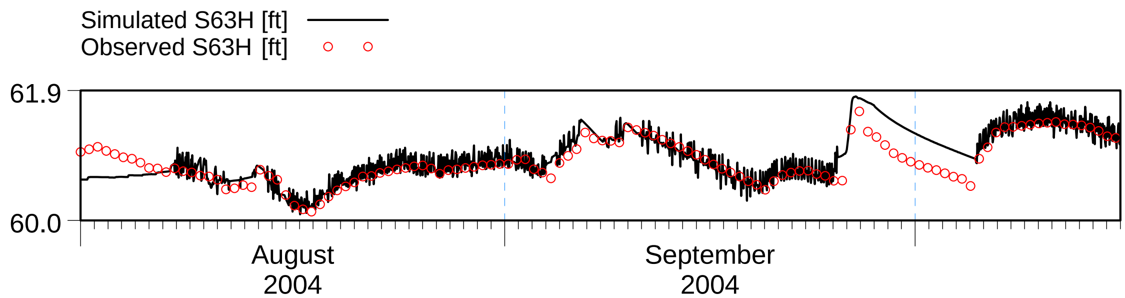


**Figure 5-117: Simulated and observed headwater stage at S-63 during the storm verification period.**

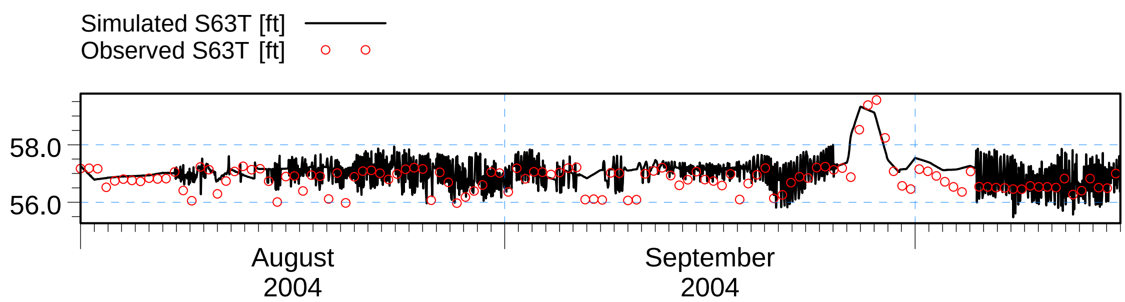


**Figure 5-118: Simulated and observed tailwater stage at S-63 during the storm verification period.**

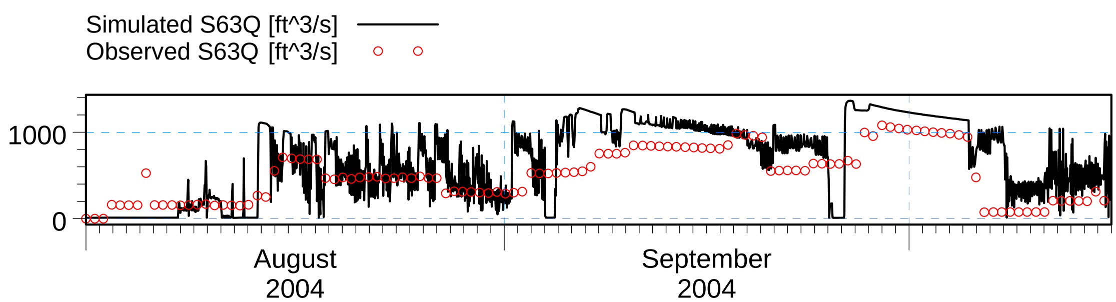


**Figure 5-119: Simulated and observed discharge at S-63 during the storm verification period.**

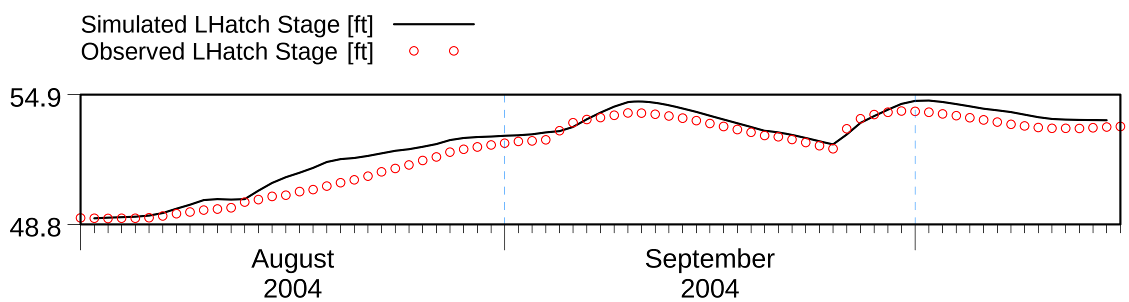


**Figure 5-120: Simulated and observed stage at LHATCH3H during the storm verification period.**

### 5.2.1.2 Lower Basin

Simulated and observed surface water data for the lower basin is presented in Figure 5-124 through Figure 5-147. The current results for the lower basin during the verification period indicate that the model is adequately capturing surface water process and responses in the LKB except during the last major event of the 2004 hurricane season. The model fit during the last major event is poorer than observed in the MIKE 11 sub-model developed for the restored portion of the Kissimmee River. Analytical water budget analyses of Pool B during the last major event (9/25/2004 – 10/10/2004) indicates the total rainfall (84,975 ac-ft) is less than the inflow to Pool B calculated from the observed discharge data (S-65C – S-65A composite flow = 117,859 ac-ft). The total rainfall and net rainfall (rainfall – evapotranspiration) for the entire storm verification period (348,468 and 236,497 ac-ft) are more consistent with the calculated inflow (155,869 ac-ft) and explains why the fit for the entire storm verification period is reasonable. This analysis suggests uncertainties in the magnitude of net rainfall in the LKB are responsible for the poor fit during the last major storm event.

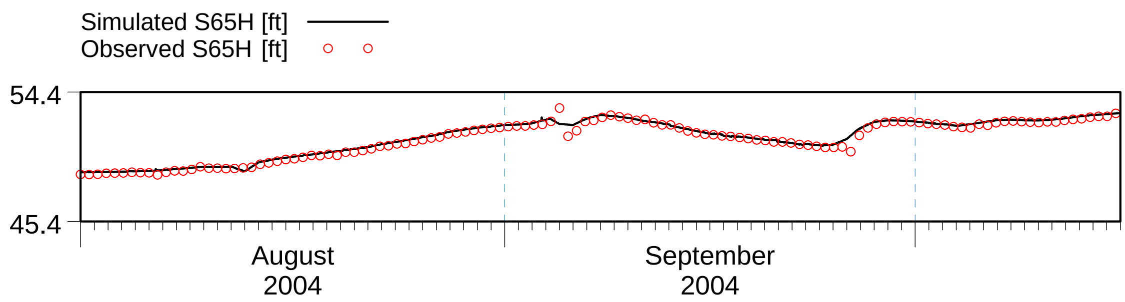


**Figure 5-121: Simulated and observed headwater stage at S-65 during the storm verification period.**

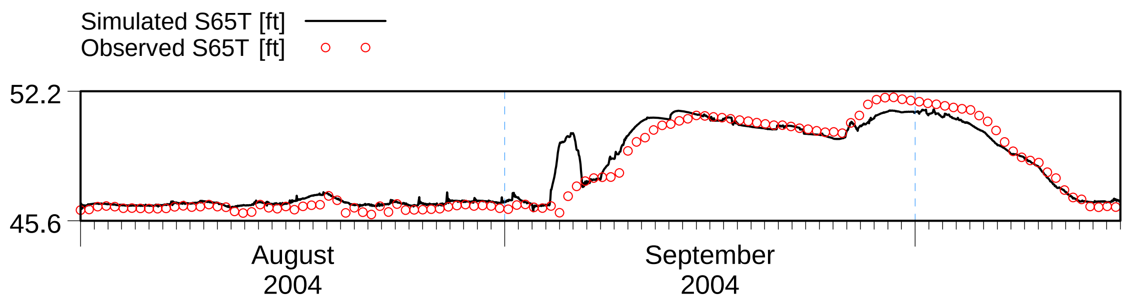


**Figure 5-122: Simulated and observed tailwater stage at S-65 during the storm verification period.**

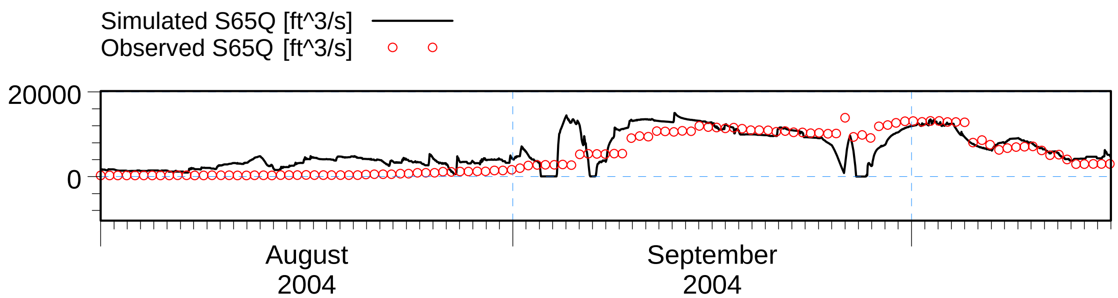


**Figure 5-123: Simulated and observed discharge at S-65 during the storm verification period.**

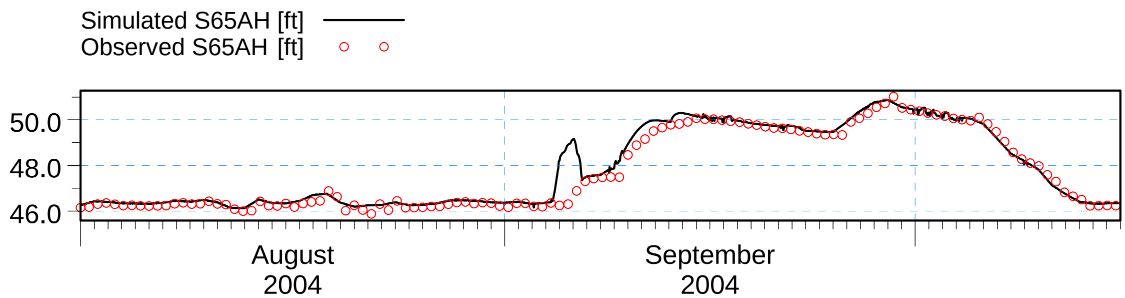


**Figure 5-124: Simulated and observed headwater stage at S-65A during the storm verification period.**

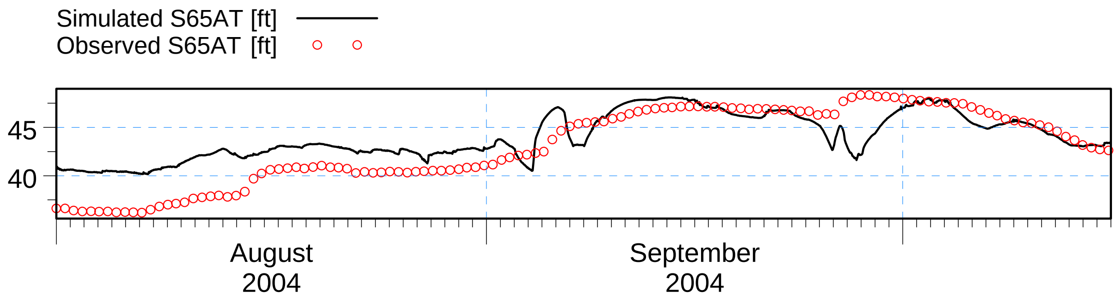


**Figure 5-125: Simulated and observed tailwater stage at S-65A during the storm verification period.**

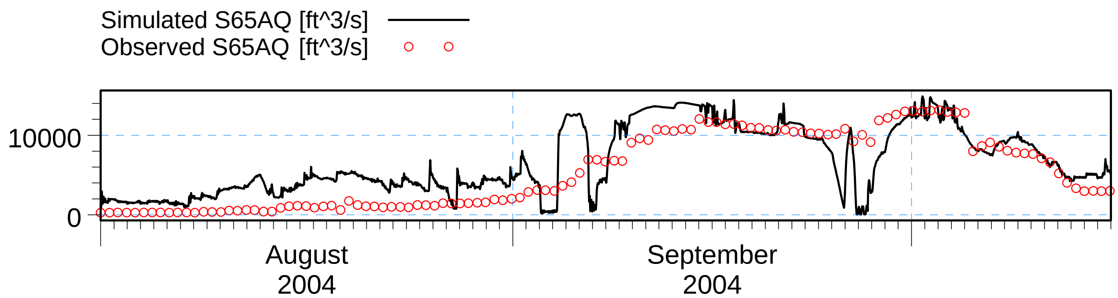


**Figure 5-126: Simulated and observed discharge at S-65A during the storm verification period.**

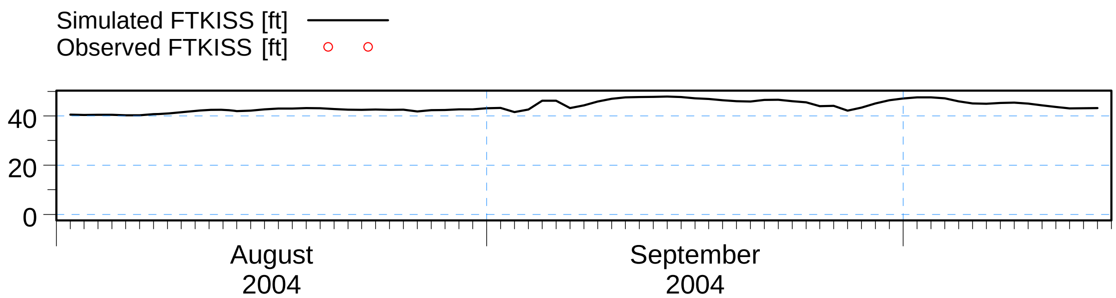


**Figure 5-127: Simulated stage at FTKISS during the storm verification period.**

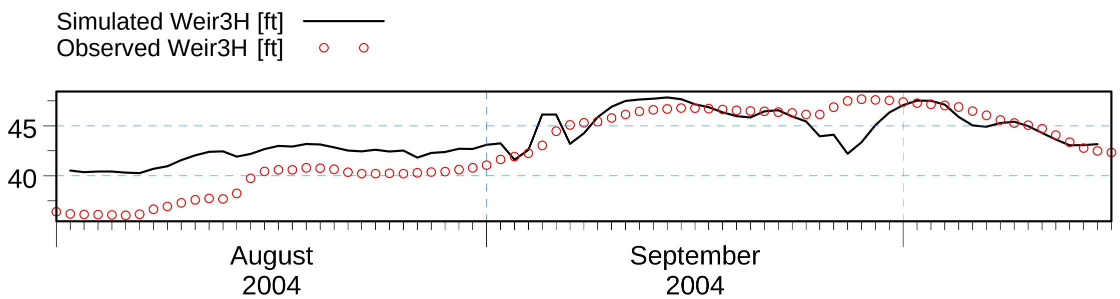


**Figure 5-128: Simulated and observed headwater stage at Weir 3 during the storm verification period.**

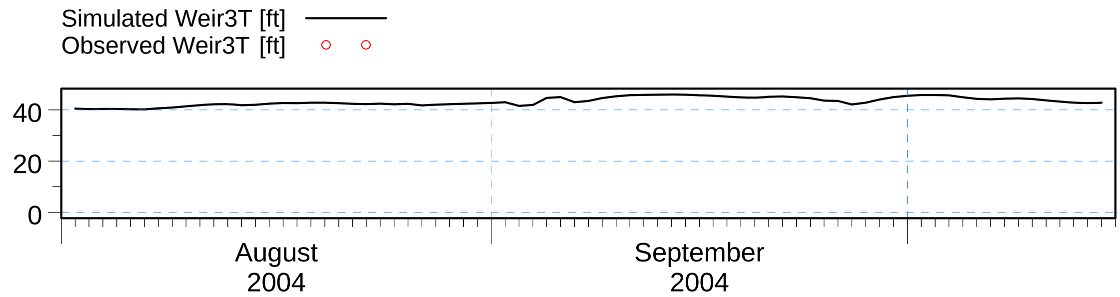


**Figure 5-129: Simulated tailwater stage at Weir 3 during the storm verification period.**

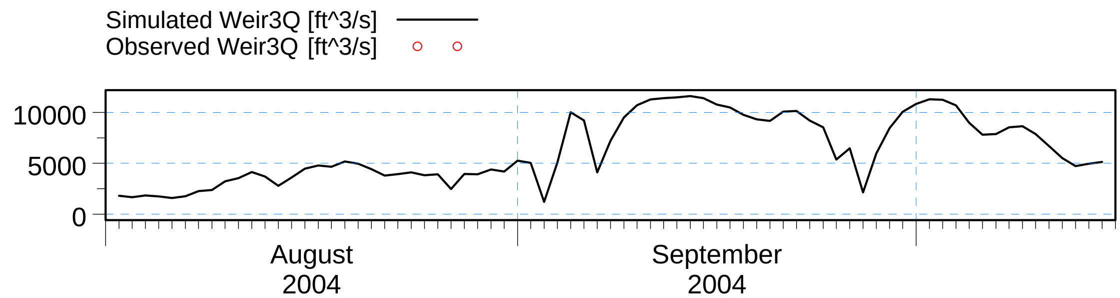


**Figure 5-130: Simulated discharge at Weir 3 during the storm verification period.**

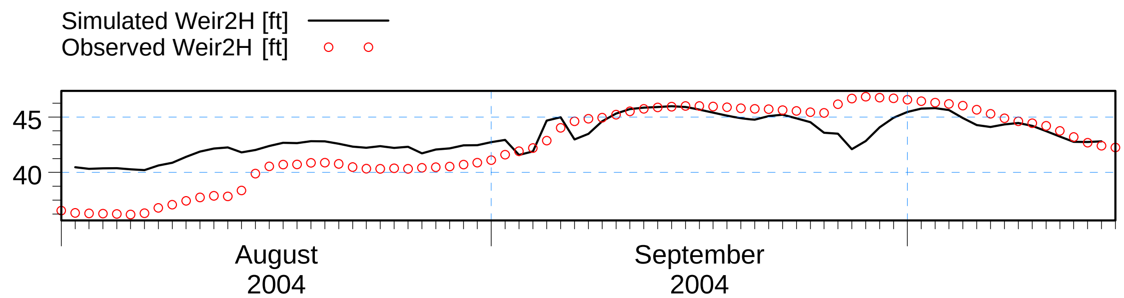


**Figure 5-131: Simulated and observed headwater stage at Weir 2 during the storm verification period.**

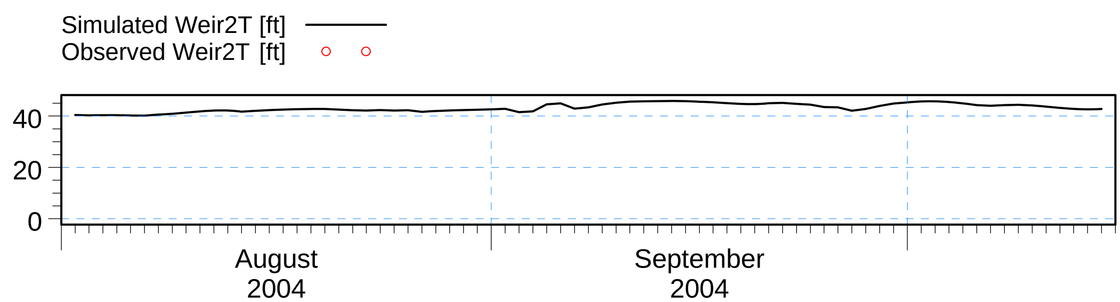


**Figure 5-132: Simulated tailwater stage at Weir 2 during the storm verification period.**

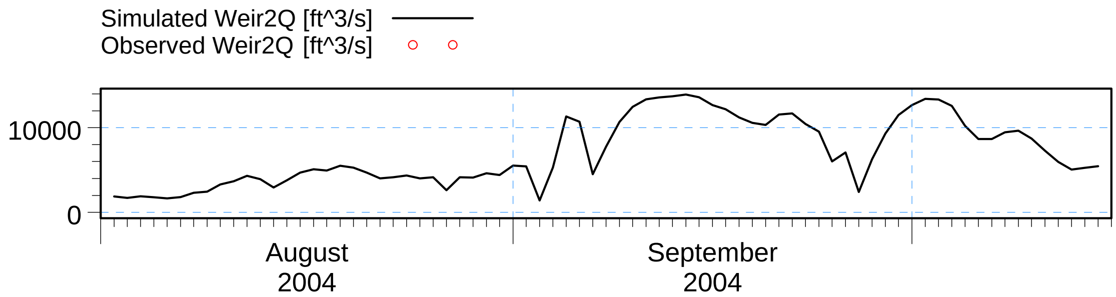


**Figure 5-133: Simulated discharge at Weir 2 during the storm verification period.**

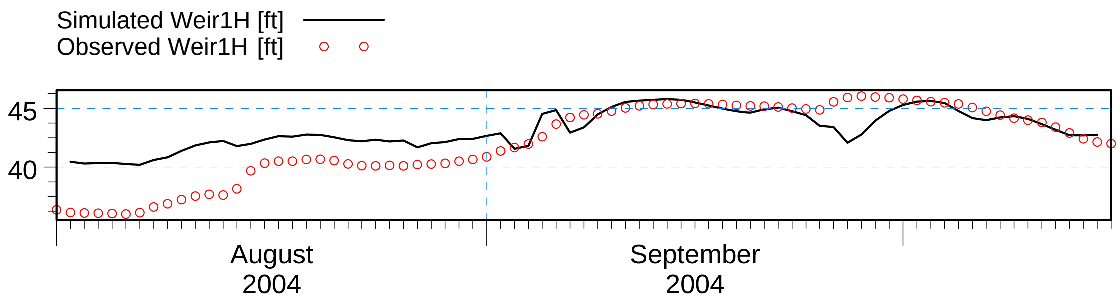


**Figure 5-134: Simulated and observed headwater stage at Weir 1 during the storm verification period.**

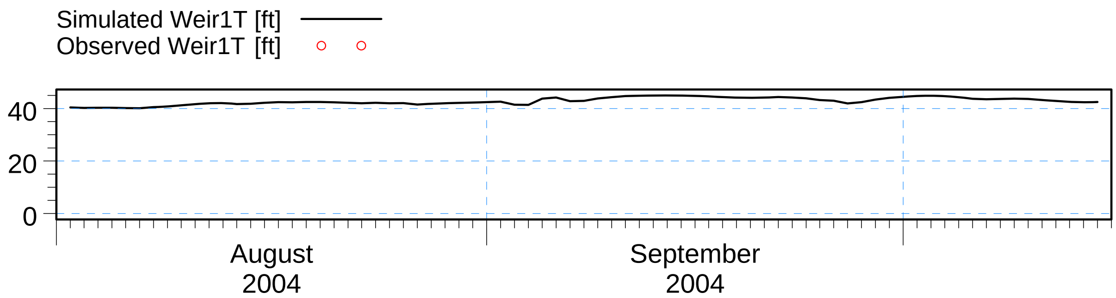


**Figure 5-135: Simulated tailwater stage at Weir 1 during the storm verification period.**

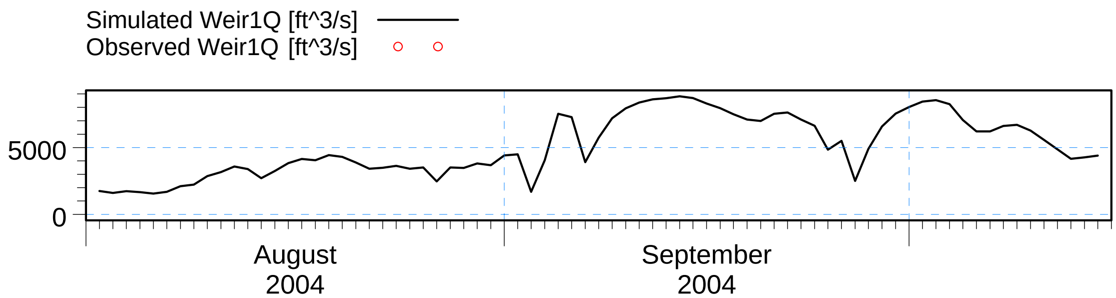


**Figure 5-136: Simulated discharge at Weir 1 during the storm verification period.**

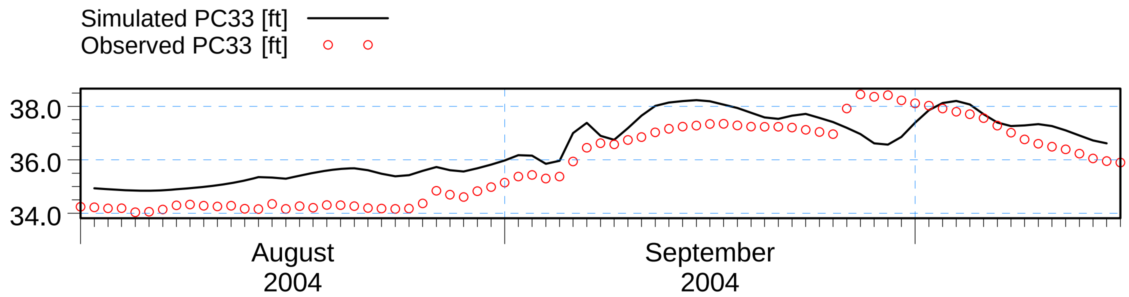


**Figure 5-137: Simulated and observed stage at PC33 during the storm verification period.**

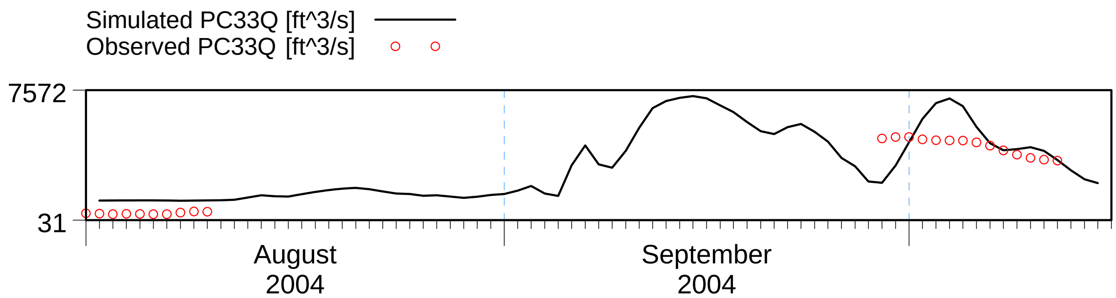


**Figure 5-138: Simulated and observed discharge at PC33 during the storm verification period.**

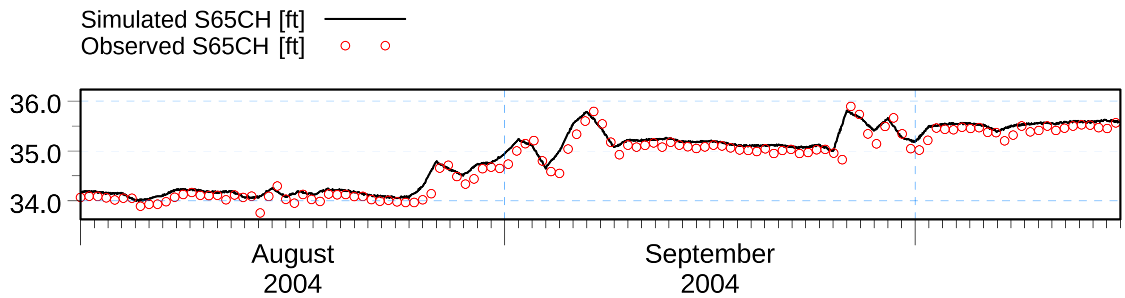


**Figure 5-139: Simulated and observed headwater stage at S-65C during the storm verification period.**

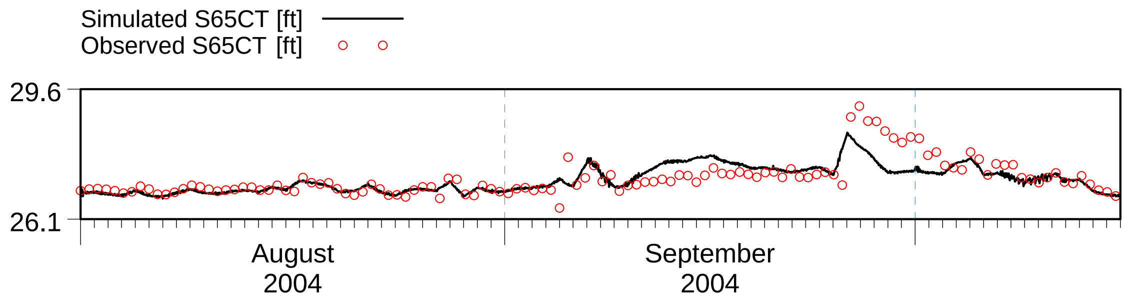


**Figure 5-140: Simulated and observed tailwater stage at S-65C during the storm verification period.**

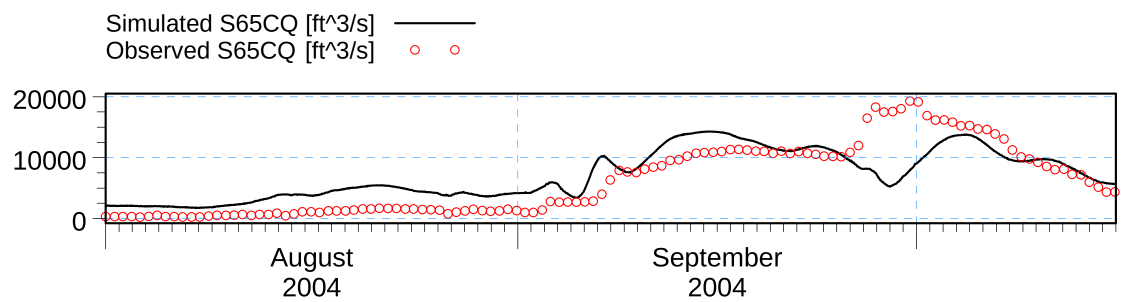


**Figure 5-141: Simulated and observed discharge at S-65C during the storm verification period.**

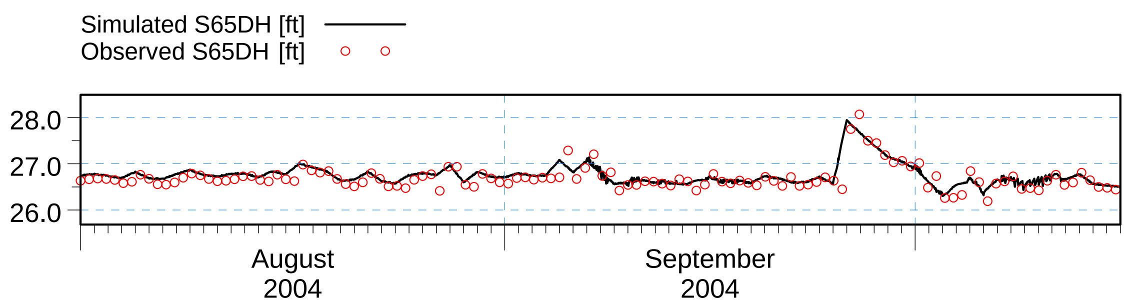


**Figure 5-142: Simulated and observed headwater stage at S-65D during the storm verification period.**

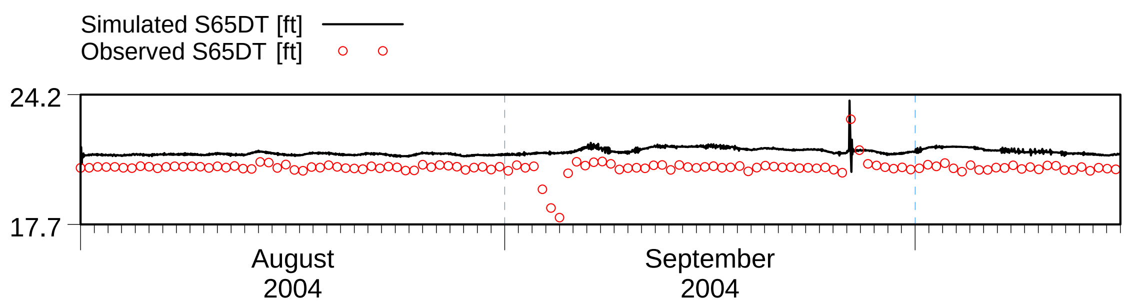


**Figure 5-143: Simulated and observed tailwater stage at S-65D during the storm verification period.**

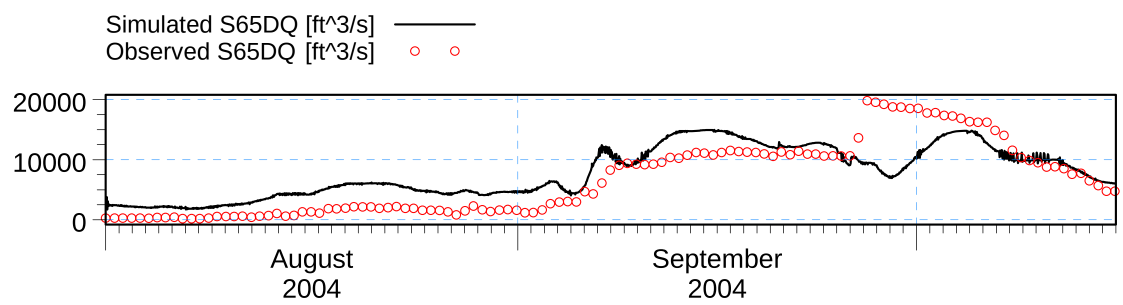


**Figure 5-144: Simulated and observed discharge at S-65D during the storm verification period.**

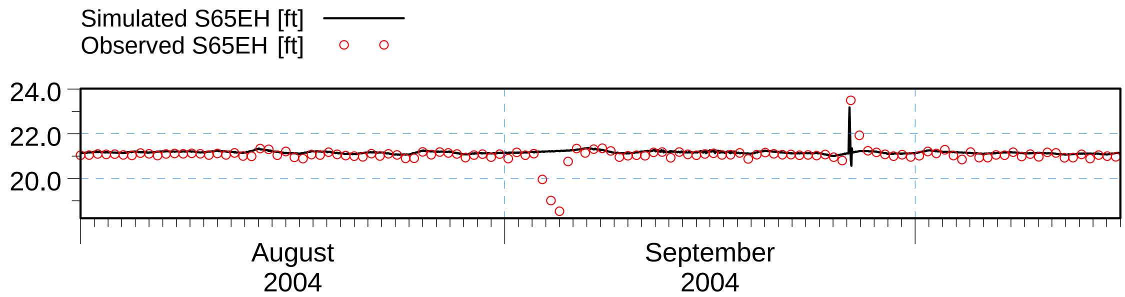


**Figure 5-145: Simulated and observed headwater stage at S-65E during the storm verification period.**

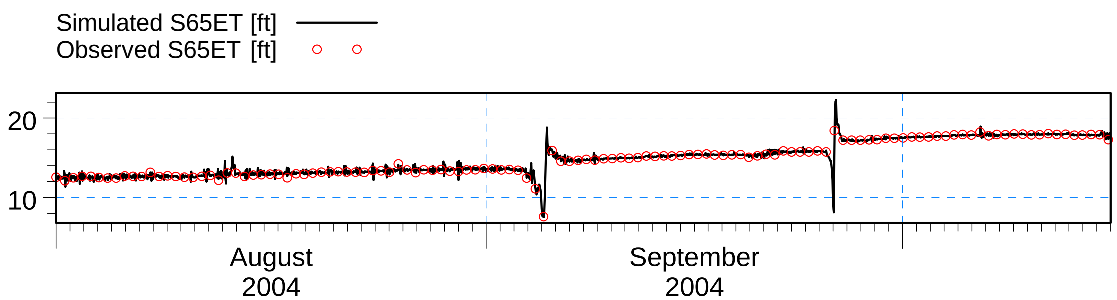


**Figure 5-146: Simulated and observed tailwater stage at S-65E during the storm verification period.**

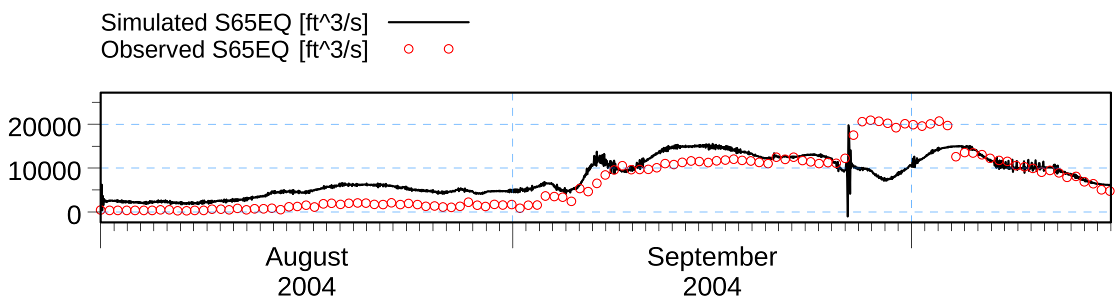


**Figure 5-147: Simulated and observed discharge at S-65E during the storm verification period.**

### 5.2.1.3 Surface Water Verification Statistics

Verification statistics for stage and flow gages in the Kissimmee Basin are summarized in Table 5-4 and Table 5-5, respectively. Criteria that are not met at individual stations are indicated with red shading. In general, the surface water component of the AFET storm verification model does a very good job of meeting statistical criteria defined for stage in the ATP (Earth Tech, 2006b) and later refined in consultation with SFWMD staff. The model does a poor job of meeting the flow criteria potentially as a result of uncertainties in the NEXRAD rainfall data during the 2004 hurricane season.

The model meets the *RMSE* and *R* calibration criteria at all of the stage observation locations during the verification period except at REEDY LOU, PC61, S-65DT, and S-65EH. The model meets the *R* criteria for stage at PC61 but does meet the *RMSE* criteria. The model meets the *RMSE* criteria for stage at S-65DT and S-65EH gages but does meet the *R* criteria. The model does not meet the *RMSE* or *R* criteria at the REEDY LOU gage but this gage has been classified as moderately useful.

The model does not meet the *CE* or *R* criteria for flow at the S-57, S-63A, Reedy Creek, or S-65A gages. The model does not meet the *CE* criteria for flow at the S-59, or S-60 gages. The model does not meet the *R* criteria for flow at the S-62, S-61, S-65, Boggy Creek, Shingle Creek, S-65C, S-65D, or S-65E gages. The S-57, S-62, S-59, S-60, S-63, Boggy Creek, Reedy Creek, and Shingle Creek gages have been classified as moderately useful gages.

**Table 5-4: Surface water stage statistics for the 2004 hurricane season validation period. Red shading is used to indicate locations that do not meet specified criteria.**

| MODEL AREA | Station | RMSE | R(correlation) | RMSE | R(correlation) | RMSE | R(correlation) |
|---|---|---|---|---|---|---|---|
| **Stages in Upper Basin Lake Management Units** | | | | | | | |
| LMU K-H-C | S65H | H | H | 0.27 | 0.98 | | |
| LMU K-H-C | S61T | H | H | 1.90 | 0.96 | | |
| LMU K-H-C | S63AT | M | M | 2.07 | 0.94 | | |
| LMU Toho | S61H | H | H | 0.44 | 0.99 | | |
| LMU Toho | S59T | H | H | 0.99 | 0.92 | | |
| LMU Etoho | S59H | H | H | 0.87 | 0.97 | | |
| LMU Etoho | S62T | M | M | 0.38 | 0.97 | | |
| LMU Hart | S62H | M | M | 0.14 | 0.99 | | |
| LMU Hart | S57T | M | M | 0.26 | 0.92 | | |
| LMU Myrtle | S57H | M | M | 0.33 | 0.99 | | |
| LMU Myrtle | S58T | M | M | 0.34 | 0.99 | | |
| LMU Alligator | S58H | M | M | 0.31 | 0.94 | | |
| LMU Alligator | S60H | M | M | 0.44 | 0.74 | | |
| LMU Gentry | S60T | M | M | 0.60 | 0.81 | | |
| LMU Gentry | S63H | M | M | 0.21 | 0.84 | | |
| LMU s63a | S63T | M | M | 0.58 | 0.51 | | |
| LMU s63a | S63AH | M | M | 0.43 | 0.61 | | |
| **Stages in Upper Basin's unmanaged watersheds** | | | | | | | |
| ws_UpperReedy | REEDYLOU | M | M | 3.14 | 0.29 | | |
| **Stages in Lower Basin Lake Management Units** | | | | | | | |
| Pool A | S65T | H | H | 0.60 | 0.96 | | |
| Pool A | S65AH | H | H | 0.40 | 0.98 | | |
| Pool BC | S65AT | H | H | 2.43 | 0.86 | | |
| Pool BC | weir3H | H | H | 2.38 | 0.87 | | |
| Pool BC | weir2H | H | H | 2.16 | 0.89 | | |
| Pool BC | weir1H | H | H | 2.17 | 0.89 | | |
| Pool BC | PC61 | H | H | 2.81 | 0.94 | | |
| Pool BC | PC52 | H | H | 2.19 | 0.94 | | |
| Pool BC | PC45 | H | H | 2.49 | 0.91 | | |
| Pool BC | PC33 | H | H | 0.89 | 0.90 | | |
| Pool BC | PC21 | H | H | 1.48 | 0.93 | | |
| Pool BC | PC31 | H | H | 1.09 | 0.84 | | |
| Pool BC | S65CH | H | H | 0.16 | 0.98 | | |
| Pool D | S65CT | H | H | 0.35 | 0.68 | | |
| Pool D | S65DH | H | H | 0.18 | 0.78 | | |
| Pool E | S65DT | L | H | | 0.16 | | |
| Pool E | S65EH | H | H | 0.43 | 0.12 | | |
| **Stages in Lower Basin's unmanaged watersheds** | | | | | | | |
| D_Chandler | CYPRS | H | H | 0.49 | 0.83 | | |
| D_Chandler | CHAND1 | H | H | 0.63 | 0.91 | | |
| Lake O | S65ET | H | H | 0.18 | 1.00 | | |

"H" not meeting criteria
Does meet criteria
"M" not meeting criteria

NOTE: Calibration points with Low (L) utility have been omitted

Rationale for selection of statistics Targets:
Highly Useful (H):
RMSE ATP Statistic Target range 1.0 to 2.5-ft
R ATP Statistic Target range 0.50 to 0.75
Moderately Useful (M):
RMSE ATP Statistic Target low end of range plus 0.5-ft
R ATP Statistic Target low end of range minus 0.05

**Table 5-5: Surface water flow statistics for the 2004 hurricane season validation period. Red shading is used to indicate locations that do not meet specified criteria.**

| upstream WCU | downstream WCU | Station | CE | R(correlation) | CE % | R(correlation) | CE % | R(correlation) |
|---|---|---|---|---|---|---|---|---|
| **Flows in Upper Basin Lake Management Units** | | | | | | | | |
| LMU Myrtle | LMU Hart | S57Q | M | M | 86 | -0.49 | | |
| LMU Hart | LMU Etoho | S62Q | M | M | 26 | 0.53 | | |
| LMU Etoho | LMU Toho | S59Q | M | M | 49 | 0.69 | | |
| LMU Toho | LMU KHC | S61Q | H | H | 8 | 0.77 | | |
| LMU Alligator | LMU Gentry | S60Q | M | M | 46 | 0.79 | | |
| LMU Gentry | LMU s63a | S63Q | M | H | 33 | 0.73 | | |
| LMU s63a | LMU KHC | S63AQ | M | M | 25 | 0.74 | | |
| LMU KHC | PoolA | S65Q | H | H | 21 | 0.77 | | |
| **Flows in Upper Basin's unmanaged watersheds** | | | | | | | | |
| ws_boggy | LMU EToho | boggy_ta | M | M | 12 | 0.20 | | |
| ws_lake pierce | WS_catfish creek | catfish Q | M | M | | | | |
| ws_upperreedy | ws_lowerreedy | reedy | M | M | 53 | 0.13 | | |
| ws_shingle | LMU Toho | shingle | M | M | 0 | 0.13 | | |
| **Flows in Lower Basin Lake Management Units** | | | | | | | | |
| PoolA | PoolBC | S65AQ | H | H | 28 | 0.81 | | |
| PoolBC | PoolD | S65CQ | H | H | 14 | 0.80 | | |
| PoolD | PoolE | S65DQ | H | H | 16 | 0.82 | | |
| PoolE | Lake O | S65EQ | H | H | 15 | 0.79 | | |
| **Flows in Lower Basin's unmanaged watersheds** | | | | | | | | |
| PoolD | PoolD | usgs2272676 | L | M | | 0.90 | | |

"H" not meeting criteria
Does meet criteria
"M" not meeting criteria

NOTE: Calibration points with Low (L) utility have been omitted

Rattionale for selection of statistics Targets:
Highly Useful (H):
CE ATP Statistic for 'Good' (<15%) plus average basinwide flow calcuation error of 7%
R ATP Statistic for 'Good' (>0.84)
Moderately Useful (M):
CE ATP Statistic for 'Fair' (<25%) plus average basinwide flow calcuation error of 7%
R Statistic set at 20% below minimum level for 'Fair'

### 5.2.2 Qualitative Water Budget Verification and Comparison to Daily Verification Results

Seasonal MIKE SHE water budgets for 29 sub-watersheds are summarized in Table 5-6. The terms included in the water budgets and equations used to calculate the total model error (*Err*) are defined in Appendix C. In general, the water budgets are consistent with the 2004 wet season water budgets calculated for the calibrated model and appear to be reasonable based on review of available data (*e.g.*, McGurk and Presley, 2002).

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**Table 5-6: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 2004 hurricane season.**

| Sub-Watershed | Sub-Watershed ID | Rainfall (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 30.36 | 7.13 | 7.58 | 6.24 | -0.01 | 0.06 | 7.28 | -0.08 | 0.30 | 0.00 | 0.00 | -1.54 | 0.89 | -0.01 |
| Shingle Creek | 2 | 30.39 | 6.82 | 4.10 | 10.52 | 0.00 | 0.13 | 6.94 | -0.11 | 0.01 | 0.00 | 0.00 | -0.79 | 1.18 | -0.03 |
| Boggy Creek | 3 | 29.79 | 6.86 | 3.60 | 10.52 | 0.00 | 0.05 | 7.90 | -0.09 | 0.04 | 0.00 | 0.00 | -0.71 | 0.25 | -0.02 |
| Lake Hart | 4 | 31.05 | 7.51 | 9.41 | 7.01 | -0.09 | 0.01 | 7.04 | -0.05 | 0.19 | 0.00 | 0.00 | -0.11 | 0.08 | -0.02 |
| Horse Creek (Closed Basin) | 5 | 28.50 | 6.64 | 7.80 | 9.85 | -0.07 | 0.90 | 0.04 | -0.07 | 0.24 | 0.00 | 0.00 | -3.50 | 0.01 | -0.01 |
| Lower Reedy Creek | 6 | 31.28 | 7.28 | 11.72 | 3.65 | 0.00 | 0.45 | 8.25 | -0.18 | 0.01 | 0.00 | 0.00 | 0.49 | 0.57 | -0.03 |
| Lake Tohopekaliga | 7 | 31.40 | 7.62 | 3.38 | 11.37 | -0.01 | 0.05 | 8.27 | -0.24 | 0.02 | 0.00 | 0.00 | 0.11 | 1.00 | -0.07 |
| East Lake Tohopekaliga | 8 | 30.21 | 7.86 | 3.69 | 12.08 | -0.03 | 0.09 | 6.00 | -0.15 | 0.01 | 0.00 | 0.00 | 0.05 | 0.63 | -0.04 |
| Alligator Lake | 9 | 30.25 | 7.68 | 7.14 | 7.53 | 0.00 | 0.03 | 6.87 | -0.33 | 0.04 | 0.00 | 0.00 | 0.01 | 1.29 | -0.09 |
| Lake Mrytle | 10 | 31.67 | 7.61 | 13.58 | 6.78 | -0.05 | 0.10 | 2.88 | -0.03 | 0.00 | 0.00 | 0.00 | -0.50 | 0.19 | -0.01 |
| Lake Conlin (Closed Basin) | 11 | 29.63 | 7.56 | 11.97 | 0.00 | -0.06 | 0.00 | 9.13 | -0.38 | 0.00 | 0.00 | 0.00 | -0.33 | 0.88 | -0.08 |
| Lake Marion | 12 | 29.15 | 6.97 | 4.48 | 7.63 | 0.03 | 0.01 | 9.31 | -0.10 | 0.39 | 0.00 | 0.00 | -0.98 | 0.30 | -0.01 |
| Marion Creek | 13 | 31.05 | 7.20 | 11.82 | 4.39 | -0.06 | 0.10 | 7.60 | -0.12 | 0.00 | 0.00 | 0.00 | 0.53 | 0.50 | -0.03 |
| Lake Cypress | 14 | 29.43 | 7.53 | 5.47 | 3.75 | -0.03 | 0.13 | 12.26 | -0.20 | 0.00 | 0.00 | 0.00 | 0.08 | 0.48 | -0.06 |
| S-63A | 15 | 29.18 | 7.03 | 6.51 | 0.58 | -0.01 | 0.09 | 14.25 | -0.43 | 0.01 | 0.00 | 0.00 | -0.16 | 0.93 | -0.06 |
| Lake Gentry | 16 | 30.19 | 7.25 | 8.47 | 2.04 | -0.01 | 0.07 | 11.58 | -0.45 | 0.18 | 0.00 | 0.00 | -0.25 | 1.09 | -0.06 |
| Lake Pierce | 17 | 29.04 | 6.84 | 5.59 | 5.86 | -0.02 | 0.00 | 7.75 | -0.09 | 0.67 | 0.00 | 0.00 | -2.89 | 0.85 | -0.01 |
| Catfish Creek | 18 | 28.60 | 6.79 | 7.98 | 2.33 | -0.24 | 0.84 | 10.05 | -0.18 | 0.09 | 0.00 | 0.00 | 0.91 | 1.53 | -0.03 |
| Lake Hatchineha | 19 | 29.83 | 8.07 | 9.48 | 7.56 | 0.00 | 0.21 | 4.86 | -0.03 | 0.00 | 0.00 | 0.00 | 0.42 | 0.09 | -0.01 |
| Lake Weohyakapaka | 20 | 27.02 | 6.96 | 5.67 | 5.44 | -0.01 | 0.01 | 5.80 | -0.12 | 0.43 | 0.00 | 0.00 | -2.67 | 1.00 | -0.02 |
| Lake Rosalie | 21 | 25.86 | 7.28 | 6.41 | 6.05 | -0.03 | 0.05 | 4.41 | -0.09 | 0.17 | 0.00 | 0.00 | -0.02 | 1.84 | -0.03 |
| Tiger Lake | 22 | 26.60 | 7.57 | 7.91 | 5.96 | -0.01 | 0.05 | 5.18 | -0.07 | 0.00 | 0.00 | 0.00 | 0.20 | 0.17 | -0.02 |
| Lake Kissimmee | 23 | 27.76 | 8.24 | 5.30 | 7.45 | 0.01 | 0.03 | 6.69 | -0.08 | 0.01 | 0.00 | 0.00 | 0.02 | 0.15 | -0.02 |
| Lake Jackson | 24 | 31.36 | 7.18 | 12.52 | 1.61 | 0.01 | 0.02 | 8.63 | -0.13 | 0.00 | 0.00 | 0.00 | -1.31 | 0.19 | -0.04 |
| Lake Marian | 25 | 29.05 | 7.63 | 5.95 | 3.75 | 0.00 | 0.00 | 10.49 | -0.14 | 0.00 | 0.00 | 0.00 | -1.13 | 0.21 | -0.03 |
| S-65A | 26 | 24.78 | 6.82 | 9.07 | 1.14 | -0.02 | 0.28 | 6.31 | -0.11 | 0.00 | 0.00 | 0.00 | 0.73 | 1.94 | -0.03 |
| S-65BC | 27 | 22.95 | 6.99 | 8.53 | 0.55 | 0.00 | 0.36 | 4.97 | -0.09 | 0.01 | 0.00 | 0.00 | -0.35 | 1.28 | -0.04 |
| S-65D | 28 | 25.04 | 6.97 | 5.78 | 2.95 | 0.00 | 0.41 | 7.24 | -0.09 | 0.11 | 0.00 | 0.00 | -0.71 | 1.16 | -0.03 |
| S-65E | 29 | 26.03 | 6.74 | 5.95 | 1.81 | -0.02 | 1.33 | 8.20 | -0.09 | 0.05 | 0.00 | 0.00 | -1.26 | 0.83 | -0.04 |

### 5.2.3 Overland Flow Depth Maps

Maximum and average overland flow depths for the 2004 hurricane are shown in Figure 5-148 to Figure 5-149. These periods were selected based on an analysis of rainfall data for the calibration period (see Figure 2-4)

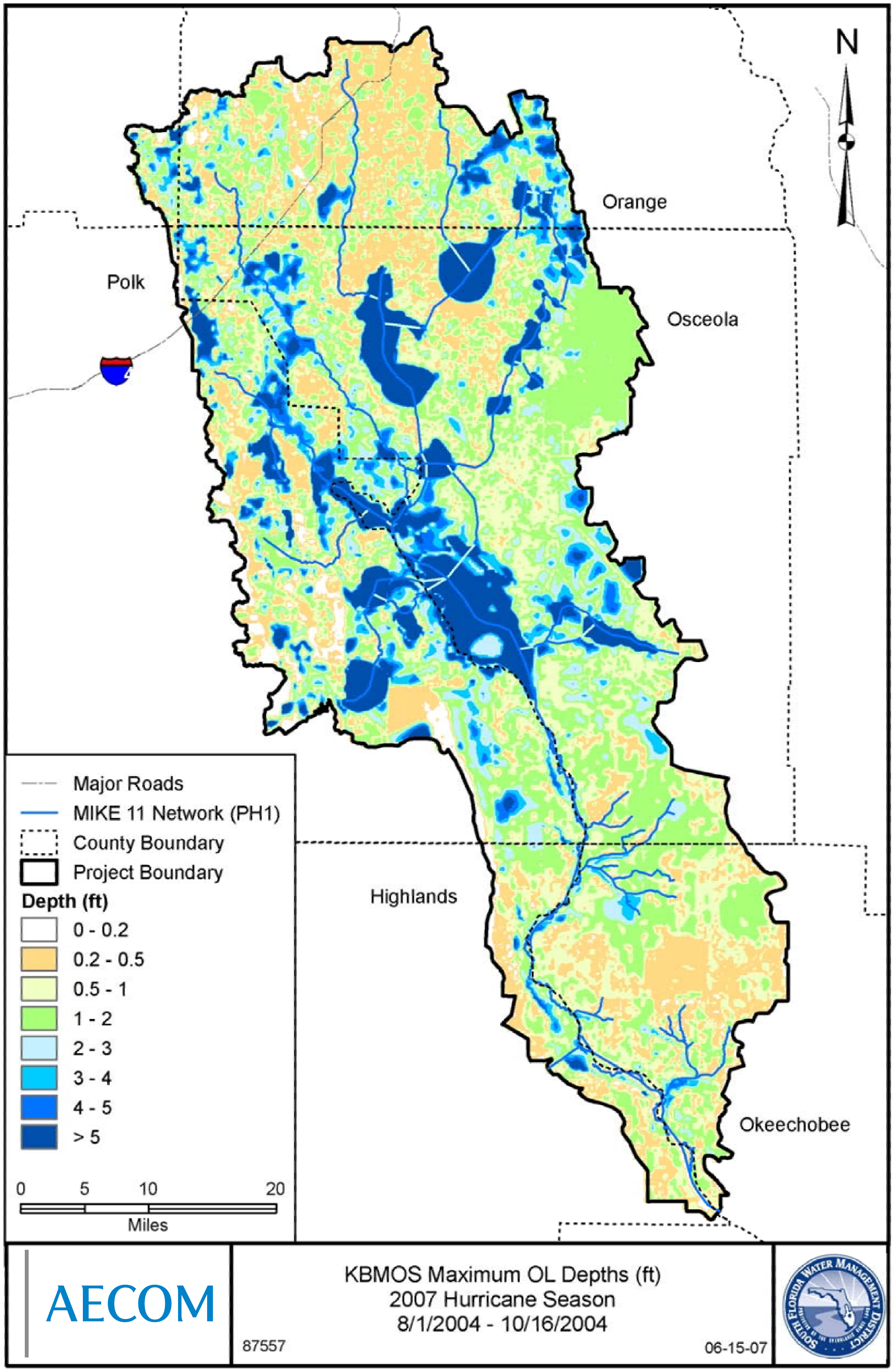


**Figure 5-148: Maximum overland flow depths for the 2004 hurricane season.**

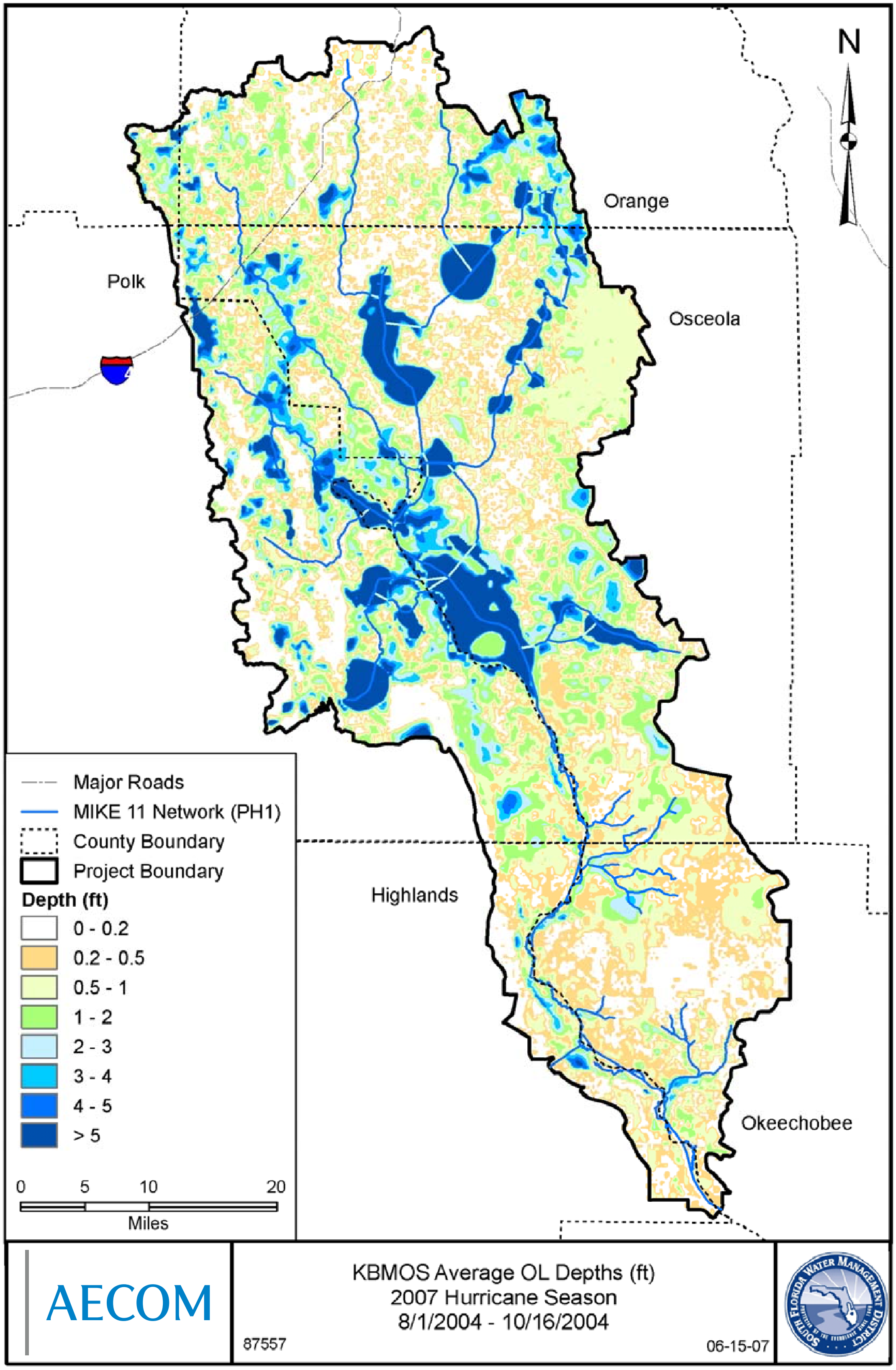


**Figure 5-149: Average overland flow depths for the 2004 hurricane season.**

### 5.3 Verification Using Current Regulation Schedules (Run 100)

After the calibration and verification process was finished, an additional model run was performed (a.k.a. Run 100). In this model run, instead of using the observed headwater stages to operate the gates, the structures were operated according to the current operating criteria. Calibration plots and statistics tables were prepared and included in Appendix E. These results show a good agreement between the model results and the observed data. Periods were this agreement is not that evident correspond to period were deviations from the operating rules were implemented. These deviations cause some of the calibration statistics, shown also in Appendix E, to fall outside of the target range. However, outside of the operational deviations periods both served and simulated time series track very closely.

# 6 MODEL LIMITATIONS

A formal uncertainty analysis is not included as part of the current model development and calibration activities. The following discussion has been prepared based on the results of the calibration process and the experience of the modeling team and should be be considered in the completion of the future model uncertainty analysis as specified in the KBMOS Work Plan.

## 6.1 Limitations of Current Model to Meet the Objectives of the Current Project and Non-KBMOS Studies

The AFET model was developed to meet specific objectives of the KBMOS. As a result, application of the KBMOS model to evaluate other issues in the Kissimmee Basin may not be appropriate in its current form. The objectives of the KBMOS AFET model are summarized below along with limitations relative to potential non-KBMOS studies.

### 6.1.1 Background

The goal of KBMOS is to assess whether existing operating criteria for the water control structures in the Kissimmee Basin can be modified to achieve a more acceptable balance among flood control, water supply, aquatic plant management, and natural resource water management objectives. Natural resource objectives are outlined in the Kissimmee River Restoration Project (KRRP) and the Kissimmee Chain of Lakes Long Term Management Plan (KCOL LTMP). The river restoration project is intended to restore ecological integrity to a significant portion of the Kissimmee River floodplain. The KCOL LTMP is intended to improve, enhance, and/or sustain the lake ecosystem while balancing downstream impacts to other ecosystems.

Activities performed during Phase I of KBMOS (Earth Tech, 2005) identified the need of using a modeling tool to achieve the project objectives. Task 1.7 report established that "*the Earth Tech team will develop an integrated surface and groundwater model for the evaluation of existing and proposed operating criteria to improve system hydrologic and hydraulic performance relative to selected performance targets. Operating criteria will be constrained to floodplain and lake inundation extents that do not exceed the acquired land interests of the State of Florida or the South Florida Water Management District (SFWMD) and existing structure conveyance capacities*" .Subsequently, the MIKE SHE/MIKE 11 model was selected as the Alternative Formulation / Evaluation Tool (AFET) for the KBMOS. A Technical Design Document (Earth Tech, 2006a) and the AFET Acceptance Test Plan (Earth Tech, 2006b) were prepared to fit the objectives of the study. AFET was then built and calibrated following the guidelines established in these documents, which are focused in obtaining an accurate representation of flow and stages of canals and lakes located within the extent of the Central and South Florida (C&SF) Flood Control Project within the Kissimmee Basin and their sensitivity to alternate structure operations. Statistical criteria used to define the acceptance of the model were defined under these bases. The use of this model outside of the KBMOS will require a case specific aanalysis of the acceptance criteria in view of the requirement of the intendend use. A more detailed description of the project background and objectives is given in the AFET Technical Design Document (Earth Tech, 2006a).

### 6.1.2 Changes in Local Drainage

The 1,000 foot grid size used to simulate the surficial aquifer and overland flow components in the KBMOS AFET model may be too coarse to study local-scale hydrologic changes in the restored section of the Kissimmee River. Development of a higher-resolution, local scale model of the LKB and refinement of the aquifer parameters used in the calibrated KBMOS AFET model may be required to evaluate local-scale drainage issues in more detail.

### 6.1.3 Groundwater Supply

The KBMOS AFET model was developed specifically to evaluate surface water issues in the Kissimmee Basin. The Phase 1 Basin Assessment indicated that the KBMOS AFET model was not envisioned to specifically simulate water demand from the FAS or the impact that those withdrawals may have on aquifer recharge and/or discharge but the capabilities of the model could be expanded to evaluate these processes in future projects.

### 6.1.4 Restoration of Fodderstack Slough and Surrounding Areas

Evaluation of the restoration of Fodderstack Slough and surrounding areas is not a component of the KBMOS. As a result, the ability of the model to simulate the effects of restoration was not evaluated using the KBMOS AFET model. Evaluation of the effect of restoration of Fodderstack Slough may require development of a higher-resolution, local-scale model and use of higher-resolution topographic data and/or additional ground survey information than used in the 1,000 foot KBMOS AFET model.

## 6.2 Data Limitations

In general, the data used to calibrate the model were sufficient to meet the objectives defined for the KBMOS AFET model. In several cases, the available data were sparse and this limited the precision of the AFET model for some processes. Data items that were limited are discussed below.

### 6.2.1 Reference Evapotranspiration Data

A single-station, composite-source RET dataset was used in the KBMOS AFET model. The single-station, composite-source RET dataset was used because it represents the best dataset available at this time. It is recognized that there are spatial differences in RET rates and it is suspected that the calibration of the AFET model could be improved with a spatially-varying RET dataset. It is recommended that the SFWMD consider the development of a spatially-variable, single-source RET dataset in order to refine the calibration of the AFET model for future applications.

### 6.2.2 Analytical Water Budget Data

A key component of the KBMOS AFET model is its ability to evaluate the effect of modifications of structure operating criteria and restoration of Pool C on the sub-watershed scale water budgets. Analytical lake water budgets developed by the SFWMD and water budget data from McGurk and Presley (2002) were used to evaluate model results. The current analytical water budget analyses are restricted by errors in the flow data and a limited understanding of the hydrology of Kissimmee Basin. It is recommended that the SFWMD continue to improve the analytical water budget data available for the Kissimmee Basin in order to refine the calibration of the AFET model for future applications.

### 6.2.3 Ungaged Structure Flows

During development of the AFET model it was determined that significant ungaged flows were occurring from lock structures and poorly seated gate structures. Very little data was available to quantify these flows but analysis of headwater and structure discharge data indicated that significant stage changes, that exceeded evaporation losses, occurred when structure gates were reported to be closed. These ungaged flows were conceptually represented in the AFET model. It is recommended that the SFWMD obtain additional information on lock operations and structre seepage from poorly seated gates to further refine the calibration of the AFET model for future applications.

### 6.2.4 Flow at S-65A

It was determined during development of the AFET model and the small MIKE 11 model developed of the restored portion of the Kissimmee River that flow through the floodplain weirs at S-65A was significant during high flow conditions. Currently the flow through the floodplain weirs at S-65A Structure is ungaged. A composite flow time series was used to evaluate the flow calibration at S-65A in the AFET model. The composite time series (S65A_W) was developed from flow data at S-65 and S-65A and was defined as the maximum flow at either gage on a given day. Because the composite flow time series used at S-65A may not accurately reflect storage changes and/or diversions it is suggested the the SFWMD continue to improve flow estimates at S-65A in order to improve the calibration of the AFET model for future applications.

## 6.3 Potential Benefits of Additional Calibration

Although the KBMOS AFET model met the calibration criteria defined for the project there are several parameters that could be refined to improve model results. Potential parameters that could be evaluated further are discussed below.

### 6.3.1 Groundwater

Although the confining unit properties and bed leakance were calibrated concurrently, the Floridan aquifer properties were not adjusted because it was assumed the parameters provide by SFWMD were sufficient to simulate UFA gradients and vertical exchanges between the SAS and Floridan aquifers. AFET uses FAS parameters from an interim ECFT MODFLOW model and may be updated in future projects with data sets from the fully calibrated ECFT MODFLOW model when they become available.

### 6.3.2 Drainage Parameters

The drainage parameters (drainage time constant and drainage level) used in the KBMOS AFET model were distributed using a land-use based approach except for the Lake Conlin sub-watershed where drainage parameters were used to conceptualize surface water conveyance in wetland features connected to Alligator and Brick Lakes. It is possible that adjustment of the land-use based drainage parameters on a sub-watershed basis could improve the calibration of the AFET model in some areas.

### 6.4 Recommended Analysis to Address AFET Uncertainty within the KBMOS Objectives

An AFET Uncertainty Analysis (UA) is part of the KBMOS work plan. The KBMOS US will provide a quantitative analysis of the impact of uncertainty in the AFET modeling tool predictions. This analysis should be conducted showing how the AFET model uncertainty is transferred to the predicted effectiveness of existing operating rules developed using the model, and how this uncertainty gets translated into the alternative evaluation scores. The analysis will be divided into three components: uncertainty characterization, uncertainty propagation and importance analysis. The uncertainty characterization will describe the key sources of uncertainty. The following list summarizes those parameters that may be regarded as the key sources of uncertainty. This list has been prepard taken into account the results of the calibration process:

1. Model parameters affecting runoff
    a. Overland Manning's coefficient
    b. RET and Crop coefficients
    c. Paved area runoff coefficient [1]
    d. Detention storage [2]
2. Model parmeters affecting surface water groundwater interactions
    a. MIKE 11 leakage parameters – the full contact leakage option is used in the AFET so the horizontal hydraulic conductivity is the parameter of interest.
    b. Drainage time constants
    c. OL-SZ Leakage coefficients
3. Model parameter affecting the impact of groundwater levels on surface water
    a. Drainage levels
    b. UZ infiltration parameter
    c. Vertical hydraulic conductivity of the ICU and to some degree the SAS
    d. Root depths[3]

[1] Expected to have limited sensitivity
[2] Expected to have limited sensitivity
[3] Expected to have limited sensitivity

# 7 CONCLUSIONS

The KBMOS model currently generally meets the calibration criteria defined in the ATP (Earth Tech, 2006b and refined in subsequent discussions and review by SFWMD staff. Gages or wells that do not meet defined calibration criteria have generally been classified as moderately useful gages or can be explained by uncertainties in meteorological data (*i.e.*, storm verification). Surface water stage and flow gages show a high degree of correlation with observed data in the calibration and verification period. Groundwater calibration meets the defined criteria and is sufficient to meet the objectives of the AFET.

Simulated potentiometric surface maps are comparable to potentiometric surface maps developed by the USGS. Simulated UFA recharge rates are consistent with the data of Aucott (1988). Simulated UFA recharge rates in the regional and surficial aquifer are nearly identical and indicate UFA fluxes are adequately characterized in the surficial aquifer model. Simulated river leakage rates in the LKB are consistent with data from Belanger et al. (2001) and indicate that simulated river leakage rates in the C-38 canal are reasonable and by inference river leakage rates are reasonable in the rest of the Kissimmee Basin.

Simulated water budgets for the calibration, verification, and storm verification periods are consistent with other studies (*i.e.*, McGurk and Presley 2002). Simulated overland depths during critical periods and, based on a qualitative comparison to land-use classifications, simulated hydro-periods appear reasonable and consistent with the presence of wetland and lakes in the watershed.

The AFET model is considered to be adequate to meet the objectives of the KBMOS based on the statistical fit at critical surface water and groundwater locations, graphical evaluation of the temporal response of the model at critical calibration locations, simulated UFA potentiometric surfaces, simulated UFA recharge rates, simulated river fluxes, water budgets, and simulated overland results. The modeling team believes the calibrated AFET model is ready to be used to evaluate base condition and alternative plan scenarios in future phases of the project. As it is the case with all seminal models, AFET calibration might be further refined to be able to expand its application to other water resource projects in the Kissimmee Basin.

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Alligator Chain of Lakes looking south from Structure S-58
Photographs provided by South Florida Water Management District

# APPENDIX A

# KBMOS AFET Land Use and Soil Classification Scheme

# KBMOS AFET Land Use and Soil Classification Scheme

## Land Use Classification

The Earth Tech team analyzed the year 2000 Florida Land Use Cover and Forms Classification System (FLUCCS) data, provided by the SFWMD. This analysis included evaluation of the land use categories developed for the Southwest Florida Feasibility Study (SWFFS) and the Lake Tohopekaliga (LT) MIKE SHE model (DHI and GeoModel, 2001). The team relied heavily on input from Mike Duever of the SFWMD to develop the land use categories for the SWFFS. The Lake Tohopekaliga classifications were developed by DHI during development of the LT model used to evaluate the effect of drawdown of Lake Tohopekaliga on surrounding areas.

The SWFFS land use classification scheme was modified in five ways to develop the land use classification scheme that will be used in the KBMOS. The adjustments are based on an evaluation of the total area of the SWFFS land use classifications and similarities in land use based parameters. Vegetation based ET parameters are discussed in detail in Section 2.7.2.
The land use classification scheme developed for the KBMOS is documented in this appendix.. An aerial image of the Land Use Classification Scheme is shown in Figure A-1. Adjustments to the SWFFS land use classification scheme are discussed below.

- The Bare Ground classification used in the SWFFS model was merged into a classification called Pasture in the KBMOS. Bare ground made up less than one (1) percent of the land use within the KBMOS model domain. If left undisturbed, vegetation consisting of grass and small shrubs will become established in a short period of time (month to years). As a result, the project team concluded that it is reasonable to consolidate the Bare Ground classification into the Pasture classification.

- The three distinct flatwood land use classifications used in the SWFFS model have been consolidated into a single classification, designated Hydric-Mesic-Xeric Flatwoods. The area of combined Xeric and Hydric Flatwoods accounted for approximately 0.5 percent of the total land use in the KBMOS model domain. Initial land use based parameter estimates for this new consolidated class is based on Mesic Flatwood characteristics since it accounts for the largest percentage of the three SWFFS Flatwood categories. The calibrated model overland flow characteristics will reflect the aggregation of these specific types of flatwood land use.

- The land use classification, Xeric Hammock, used in the SWFFS model accounts for only 0.37 percent of the total area of the KBMOS model. Thus it was merged with the land use classification, Mesic Hammock. Both types of hammocks exhibit similar overland flow characteristics. In the KBMOS model, the merged Hammock land use types have been designated Mesic-Xeric Hammock.

- Dwarf Cypress was grouped with Cypress since Dwarf Cypress comprises only 0.02 percent of the total area within the KBMOS model domain. Both land use types have similar hydrologic characteristics.

The land use type, Mangrove, used in the SWFFS comprises approximately 0.06 percent of the total area within the KBMOS. Therefore Mangrove was incorporated with Water. The only significant difference between these two land uses for a hydrological model would be the vegetation component of the mangrove classification. However, because mangroves only exist in areas that are perpetually flooded and have open water evaporation rates the contribution of mangroves to the total evapotranspiration for the area should be minor. Therefore, we believe it is appropriate to consolidate the Mangrove and Water categories.

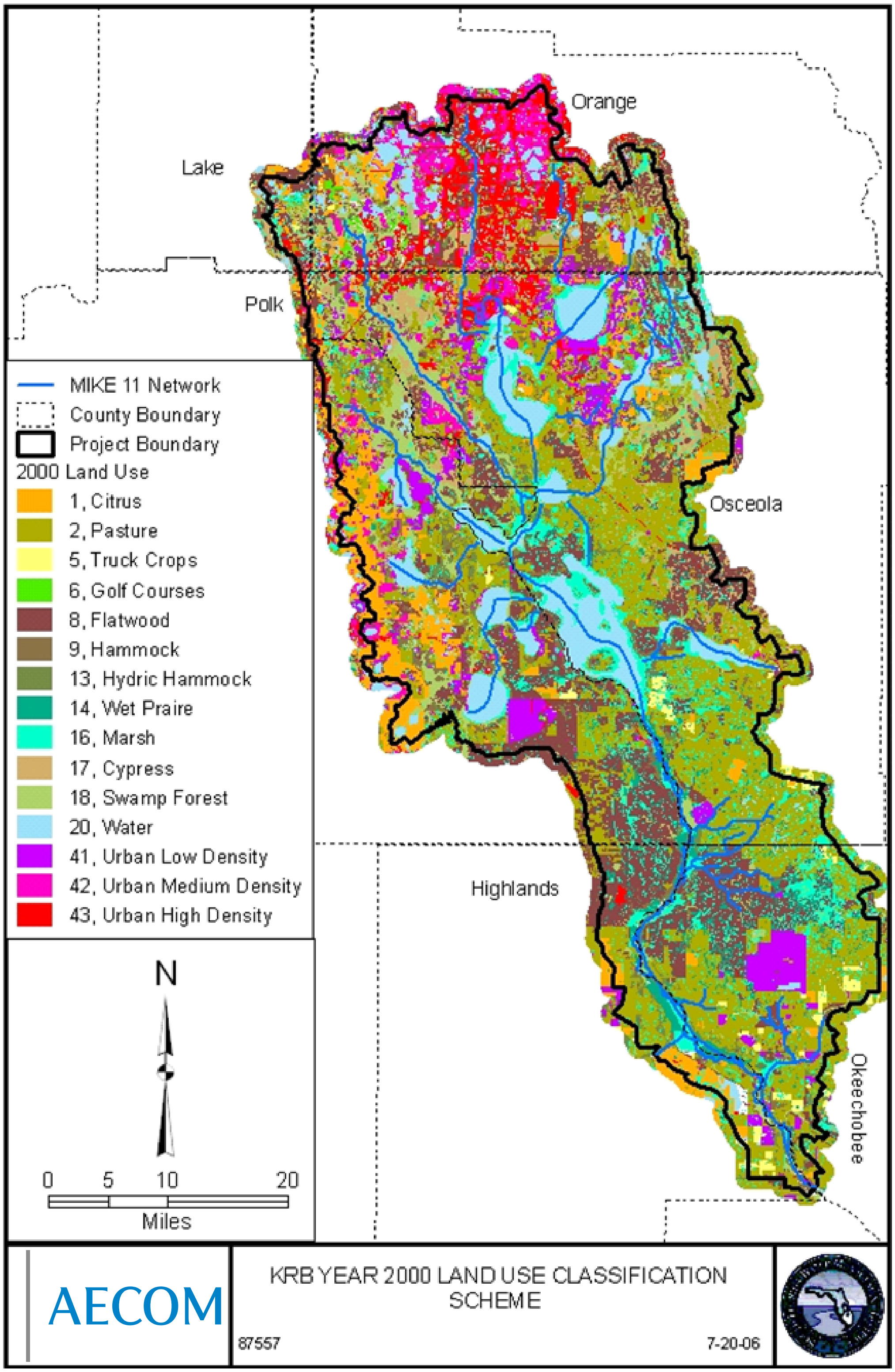


**Figure A-1 KBMOS 2000 Land Use Classification Scheme**

**Soil Classification**

The soil classification for the KBMOS model was developed using the sossrunt soils shapefile provided by the SFWMD and the Lake county soils shapefile. The 186 individual soil series from the sossrunt and Lake County soil shapefiles were simplified into 21 unique classes for the KBMOS model. The basic overall strategy involved consolidating the highly detailed and complex spatial distributions of individual soil polygons in a manner that retained the general physical hydrologic characteristics appropriate for the defined sub-regional model scale. The strategy for this simplification involved:

1. Merging the sossrunt and Lake county shapefiles together.
2. Clipping the merged shapefile to the model KBMOS domain with a 5,000 ft buffer zone.
3. Analyzing the area contribution of each soil series to the total area and defining a one percent limit for consolidation purposes
4. Consolidating individual soils series with the same primary name into one.
5. Grouped soil series were consolidated into a single class based on the predominant soil series.
6. Individual series that contributed less than one percent of the model were lumped into three separate classes based on drainage characteristics defined the USDA SCS Soil Survey. The three classes developed for the model are Minor Poorly Drained, Minor Moderately Drained, and Minor Well Drained soils.
7. The section of the model in northern Osceola County with the unknown soil series have been defined as a separate class; and the soil characteristics are assumed to be in the moderate drainage group.
8. The areas containing water also have their own class and are assumed to have mucky soil characteristics.

The simplification of the polygons is identifiable on a macro-scale by the Candler ridge soils along the western boundary of the model, water areas, Minor Poorly Drained alluvial soils, the Unknown soils block, the dendritic patterns of the Basinger, Floridana, Valkaria, Eaugallie and Malabar soils, clusters of Hontoon, Riviera, Astatula, Tavares, Minor Well Drained and Pompano soils, and the inter-dispersed Symrna and Myakka soils.

The physical hydrologic soil properties have been developed to represent the average response of the entire unsaturated zone and are based on data from all of the soil horizons. The saturated hydraulic conductivities were calculated using the harmonic mean of individual soil profiles using:

$$K_e = ns \,/\, \Sigma\, 1 \,/\, (K_i \times f_i)$$

where:

$K_e$ is effective saturated hydraulic conductivity
$ns$ is the total number of saturated hydraulic conductivities over the entire depth
$K_i$ is the individual saturated hydraulic conductivity for each horizon
$f_i$ is the ratio of the thickness of each horizon to the total thickness of the soil in the root zone

The harmonic mean weights the resultant value towards the minimum values and is considered appropriate because it emphasizes the contribution of soil horizons that inhibit the vertical flow of water. Use of the ratio of the depth of each soil horizon to the thickness of the soil in the root zone ensures that the thickness of individual soil horizons is considered in the calculation. Use of the two-layer water balance method and use of a thickness weighted harmonic mean saturated hydraulic conductivity allows a reasonable effective parameter to be used without having to explicitly discretize all of the soil horizons and dramatically reduces the numerical overhead of unsaturated zone calculation. The two-layer water balance method requires specification of a maximum infiltration rate which is dimensionally equivalent to hydraulic conductivity. Initially the effective saturated hydraulic conductivity will be used to define the maximum infiltration rate. It is expected that the maximum infiltration rates will need to be modified during calibration but it is expected that the relative differences in effective saturated hydraulic conductivities will be maintained.

The saturated moisture contents, field capacity moisture contents, and wilting point moisture contents were calculated based on the thickness weighted arithmetic average of all of the horizons in the root zone using:

$$\theta_e = \Sigma\, (SG_i \times w_i \times f_i) \,/\, 100$$

where:

$\theta_e$ is the effective moisture content by volume ($V_{water}$ / $V_{bulk\ soil}$)
$SG_i$ is the specific gravity (Horizontal Bulk Density / $\rho_{water}$)
$w_i$ is the percent moisture content by weight
$f_i$ is the ratio of the thickness of each horizon to the total thickness of the soil in the root zone

The 21 spatially distributed soil classes developed for the KBMOS MIKE SHE model provide a simplified aggregated representation of the more complex distribution contained in the sossrunt and Lake County soil databases. The soil classification developed for the KBMOS model groups the soils based on the overall distributed contribution of each soils series in the model domain and significant physical properties. Rational justifications for the simplification include:

1. Slopes for the individual soil series were neglected due to the fact that the runoff is calculated based on infiltration excess and topography.
2. Limited physical soil properties tables from the NRCS did not allow for explicit differences between sands and fine sands, therefore soils with the same primary name were lumped together.
3. The strategy developed is distributed in a fashion that can be feasibly represented using 1,000 by 1,000 foot square grid cells.
4. The Unknown soil class represented is assumed to have moderate physical properties.
5. The Water soil class for the area within the model has no bearing on the two-layer unsaturated zone calculations when the column is fully saturated.
6. The two-layer unsaturated zone method employs an infiltration rate which is dimensionally equivalent to the saturated hydraulic conductivity under a unit head gradient per unit area.

The initial soil classes that were initially developed were modified to create a separate soil class for the poorly drained soils in the floodplain of the LKB and to split the Smyrna-Myakka soil class into two separate soil classes to improve model calibration.

**Table A-1 KBMOS Detailed Effective Physical Soil Properties**

| KBMOS Soils Code | KBMOS Soil Name | Horizon Depth cm | Frac. Depth | K cm\hr | Eff. K cm\hr | Bulk Density g\cm^3 | SC 1\10 bar wt % | Frac SC 1\10 bar vol % | Avg SC | FC 1\3 bar wt % | Frac FC 1\3 bar vol % | Avg FC | WP 15 bar wt % | Frac WP 15 bar vol % | Avg WP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Astatula | 18 | 0.09 | 62.5 | **12.4** | 1.52 | 3.6 | 0.5 | **0.043** | 2.5 | 0.3 | **0.029** | 0.5 | 0.067 | **0.005** |
| | | 91 | 0.36 | 66.4 | | 1.55 | 3.2 | 1.8 | | 2.2 | 1.2 | | 0.4 | 0.223 | |
| | | 162 | 0.35 | 73 | | 1.49 | 2.7 | 1.4 | | 1.8 | 0.9 | | 0.3 | 0.156 | |
| | | 203 | 0.20 | 80.9 | | 1.51 | 2 | 0.6 | | 1.2 | 0.4 | | 0.2 | 0.061 | |
| 2 | Basinger | 15 | 0.07 | 24.5 | **1.8** | 1.44 | 7.2 | 0.8 | **0.146** | 4.6 | 0.5 | **0.106** | 2.3 | 0.245 | **0.028** |
| | | 41 | 0.13 | 23.7 | | 1.6 | 4.5 | 0.9 | | 2.5 | 0.5 | | 0.9 | 0.184 | |
| | | 53 | 0.06 | 20.4 | | 1.62 | 5 | 0.5 | | 2.6 | 0.2 | | 0.2 | 0.019 | |
| | | 76 | 0.11 | 12.1 | | 1.66 | 6.3 | 1.2 | | 3.6 | 0.7 | | 0.4 | 0.075 | |
| | | 132 | 0.28 | 6.4 | | 1.72 | 7.1 | 3.4 | | 4.2 | 2.0 | | 0.5 | 0.237 | |
| | | 157 | 0.12 | 9.3 | | 1.69 | 6 | 1.2 | | 3.7 | 0.8 | | 0.7 | 0.146 | |
| | | 203 | 0.23 | 0 | | 1.77 | 16.6 | 6.7 | | 14.8 | 5.9 | | 4.8 | 1.925 | |
| 3 | Candler | 15 | 0.07 | 127 | **17.0** | 1.46 | 5.1 | 0.6 | **0.043** | 3.2 | 0.3 | **0.030** | 1.1 | 0.119 | **0.011** |
| | | 107 | 0.45 | 82.2 | | 1.53 | 2.4 | 1.7 | | 1.6 | 1.1 | | 0.6 | 0.416 | |
| | | 160 | 0.26 | 89.4 | | 1.49 | 2.6 | 1.0 | | 1.9 | 0.7 | | 0.6 | 0.233 | |
| | | 203 | 0.21 | 79.5 | | 1.5 | 3.3 | 1.0 | | 2.6 | 0.8 | | 0.9 | 0.286 | |
| 4 | Eaugallie | 10 | 0.05 | 21 | **0.1** | 1.53 | 8.7 | 0.7 | **0.233** | 6.2 | 0.5 | **0.206** | 1.5 | 0.113 | **0.073** |
| | | 41 | 0.15 | 17.7 | | 1.58 | 3.9 | 0.9 | | 2.3 | 0.6 | | 0.4 | 0.097 | |
| | | 66 | 0.12 | 16.8 | | 1.6 | 3 | 0.6 | | 2.3 | 0.5 | | 0.3 | 0.059 | |
| | | 84 | 0.09 | 0.2 | | 1.79 | 15.8 | 2.5 | | 13.4 | 2.1 | | 2.2 | 0.349 | |
| | | 102 | 0.09 | 0.2 | | 1.63 | 20.4 | 2.9 | | 16.3 | 2.4 | | 2.2 | 0.318 | |
| | | 135 | 0.16 | 2.4 | | 1.66 | 20.4 | 5.5 | | 19.4 | 5.2 | | 9.2 | 2.483 | |
| | | 203 | 0.33 | 3.7 | | 1.77 | 17.2 | 10.2 | | 15.9 | 9.4 | | 6.5 | 3.854 | |
| 5 | Floridana | 5 | 0.02 | 16.4 | **0.3** | 1.5 | 10.8 | 0.4 | **0.272** | 7.3 | 0.3 | **0.237** | 2.7 | 0.100 | **0.156** |
| | | 10 | 0.02 | 11.8 | | 1.54 | 13.2 | 0.5 | | 9.6 | 0.4 | | 2.7 | 0.102 | |
| | | 25 | 0.07 | 7.9 | | 1.63 | 10 | 1.2 | | 7.8 | 0.9 | | 3 | 0.361 | |
| | | 51 | 0.13 | 9.2 | | 1.57 | 7.9 | 1.6 | | 5.8 | 1.2 | | 2.6 | 0.523 | |

| KBMOS Soils Code | KBMOS Soil Name | Horizon Depth cm | Frac. Depth | K cm\hr | Eff. K cm\hr | Bulk Density g\cm^3 | SC 1\10 bar wt % | Frac SC 1\10 bar vol % | Avg SC | FC 1\3 bar wt % | Frac FC 1\3 bar vol % | Avg FC | WP 15 bar wt % | Frac WP 15 bar vol % | Avg WP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 61 | 0.05 | 3.3 | | 1.63 | 16.8 | 1.3 | | 12.9 | 1.0 | | 4.8 | 0.385 | |
| | | 91 | 0.15 | 4.9 | | 1.76 | 17.9 | 4.7 | | 15.8 | 4.1 | | 6.5 | 1.691 | |
| | | 124 | 0.16 | 9.2 | | 1.75 | 17.9 | 5.1 | | 16.2 | 4.6 | | 9.9 | 2.816 | |
| | | 150 | 0.13 | 1.6 | | 1.81 | 16.5 | 3.8 | | 14.5 | 3.4 | | 10 | 2.318 | |
| | | 165 | 0.07 | 4.6 | | 1.67 | 21.8 | 2.7 | | 20.6 | 2.5 | | 19.4 | 2.394 | |
| | | 203 | 0.19 | 1 | | 1.83 | 17.2 | 5.9 | | 15.4 | 5.3 | | 14.3 | 4.899 | |
| 6 | Hontoon | 5 | 0.10 | 38.8 | **5.4** | 0.17 | 393.6 | 6.4 | **0.718** | 316 | 5.2 | **0.552** | 52.4 | 0.857 | **0.079** |
| | | 17 | 0.23 | 26.8 | | 0.14 | 497.9 | 16.1 | | 385.5 | 12.5 | | 51.1 | 1.651 | |
| | | 29 | 0.23 | 32.3 | | 0.14 | 525.7 | 17.0 | | 430.9 | 13.9 | | 62.5 | 2.019 | |
| | | 41 | 0.23 | 18.3 | | 0.11 | 704.6 | 17.9 | | 522.4 | 13.3 | | 66.9 | 1.698 | |
| | | 52 | 0.21 | 35.6 | | 0.13 | 524.4 | 14.4 | | 378.8 | 10.4 | | 61.3 | 1.686 | |
| 7 | Immokalee | 18 | 0.09 | 34.9 | **0.5** | 1.35 | 8.1 | 1.0 | **0.130** | 6.2 | 0.7 | **0.095** | 2 | 0.239 | **0.018** |
| | | 46 | 0.14 | 51.3 | | 1.58 | 3.2 | 0.7 | | 2.6 | 0.6 | | 0.6 | 0.131 | |
| | | 99 | 0.26 | 42.7 | | 1.62 | 2.5 | 1.1 | | 1.7 | 0.7 | | 0.3 | 0.127 | |
| | | 112 | 0.06 | 3.3 | | 1.35 | 27.9 | 2.4 | | 22.8 | 2.0 | | 2.8 | 0.242 | |
| | | 147 | 0.17 | 3.8 | | 1.57 | 15.7 | 4.2 | | 11.8 | 3.2 | | 2.6 | 0.704 | |
| | | 168 | 0.10 | 10.7 | | 1.64 | 5.5 | 0.9 | | 3 | 0.5 | | 0.3 | 0.051 | |
| | | 190 | 0.11 | 5.9 | | 1.67 | 7.1 | 1.3 | | 4.4 | 0.8 | | 0.7 | 0.127 | |
| | | 203 | 0.06 | 2.5 | | 1.56 | 13.8 | 1.4 | | 9.7 | 1.0 | | 1.9 | 0.190 | |
| 8 | Malabar | 10 | 0.05 | 30.6 | **0.3** | 1.23 | 13 | 0.8 | **0.210** | 9 | 0.5 | **0.159** | 3.3 | 0.200 | **0.048** |
| | | 36 | 0.13 | 21.4 | | 1.55 | 7.8 | 1.5 | | 4.5 | 0.9 | | 1.5 | 0.298 | |
| | | 76 | 0.20 | 16 | | 1.59 | 9.1 | 2.9 | | 6.1 | 1.9 | | 0.5 | 0.157 | |
| | | 94 | 0.09 | 1.7 | | 1.61 | 15.2 | 2.2 | | 10 | 1.4 | | 1.4 | 0.200 | |
| | | 112 | 0.09 | 7.1 | | 1.64 | 12.5 | 1.8 | | 9 | 1.3 | | 2.1 | 0.305 | |
| | | 122 | 0.05 | 2.6 | | 1.62 | 11.8 | 0.9 | | 7.1 | 0.6 | | 1.1 | 0.088 | |
| | | 165 | 0.21 | 0.7 | | 1.74 | 15.3 | 5.6 | | 12.5 | 4.6 | | 4 | 1.474 | |
| | | 203 | 0.19 | 0 | | 1.8 | 15.7 | 5.3 | | 13.8 | 4.6 | | 6.3 | 2.123 | |

| KBMOS Soils Code | KBMOS Soil Name | Horizon Depth cm | Frac. Depth | K cm\hr | Eff. K cm\hr | Bulk Density g\cm^3 | SC 1\10 bar wt % | Frac SC 1\10 bar vol % | Avg SC | FC 1\3 bar wt % | Frac FC 1\3 bar vol % | Avg FC | WP 15 bar wt % | Frac WP 15 bar vol % | Avg WP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | Myakka | 18 | 0.09 | 38.7 | **1.5** | 1.44 | 8.9 | 1.1 | **0.124** | 6 | 0.8 | **0.090** | 2 | 0.255 | **0.020** |
| | | 64 | 0.23 | 27.9 | | 1.53 | 4 | 1.4 | | 2.8 | 1.0 | | 0.2 | 0.069 | |
| | | 76 | 0.06 | 12.8 | | 1.37 | 19 | 1.5 | | 15.6 | 1.3 | | 4.2 | 0.340 | |
| | | 91 | 0.07 | 9 | | 1.52 | 11 | 1.2 | | 8.5 | 1.0 | | 2.5 | 0.281 | |
| | | 150 | 0.29 | 11.2 | | 1.58 | 8.4 | 3.9 | | 6.1 | 2.8 | | 1.3 | 0.597 | |
| | | 203 | 0.26 | 9.5 | | 1.6 | 7.7 | 3.2 | | 5.4 | 2.3 | | 1.2 | 0.501 | |
| 13 | Placid | 8 | 0.04 | 50 | **1.2** | 0.69 | 85.5 | 2.3 | **0.175** | 75.8 | 2.1 | **0.115** | 20.8 | 0.566 | **0.027** |
| | | 28 | 0.10 | 11.8 | | 1.56 | 15.9 | 2.4 | | 10.4 | 1.6 | | 2.2 | 0.338 | |
| | | 96 | 0.33 | 20.1 | | 1.67 | 6.6 | 3.7 | | 4 | 2.2 | | 0.6 | 0.336 | |
| | | 124 | 0.14 | 3.7 | | 1.75 | 12.9 | 3.1 | | 7.9 | 1.9 | | 1.7 | 0.410 | |
| | | 145 | 0.10 | 7.6 | | 1.74 | 8.7 | 1.6 | | 5.8 | 1.0 | | 1.4 | 0.252 | |
| | | 203 | 0.29 | 9.9 | | 1.7 | 9 | 4.4 | | 5.5 | 2.7 | | 1.7 | 0.826 | |
| 14 | Pomello | 10 | 0.05 | 61.8 | **2.8** | 1.57 | 3.3 | 0.3 | **0.061** | 2.7 | 0.2 | **0.048** | 0.8 | 0.062 | **0.009** |
| | | 76 | 0.33 | 55.2 | | 1.62 | 2.6 | 1.4 | | 2.3 | 1.2 | | 0.3 | 0.158 | |
| | | 142 | 0.33 | 57.9 | | 1.61 | 2.5 | 1.3 | | 2.1 | 1.1 | | 0.2 | 0.105 | |
| | | 157 | 0.07 | 10.8 | | 1.62 | 11.1 | 1.3 | | 8.6 | 1.0 | | 2 | 0.239 | |
| | | 203 | 0.23 | 49.6 | | 1.59 | 5.1 | 1.8 | | 3.6 | 1.3 | | 0.8 | 0.288 | |
| 15 | Pompano | 10 | 0.05 | 26.9 | **1.0** | 1.39 | 11.2 | 0.8 | **0.234** | 7.9 | 0.6 | **0.191** | 2.9 | 0.212 | **0.113** |
| | | 41 | 0.16 | 20.4 | | 1.49 | 6 | 1.5 | | 3 | 0.7 | | 1.5 | 0.365 | |
| | | 46 | 0.03 | 13.1 | | 1.51 | 9.6 | 0.4 | | 6.5 | 0.3 | | 1.4 | 0.056 | |
| | | 53 | 0.04 | 39.4 | | 1.16 | 22 | 0.9 | | 16.8 | 0.7 | | 3.9 | 0.167 | |
| | | 64 | 0.06 | 11.8 | | 1.47 | 13.3 | 1.1 | | 9.3 | 0.8 | | 3.7 | 0.315 | |
| | | 104 | 0.21 | 11.8 | | 1.57 | 10.7 | 3.5 | | 6.5 | 2.1 | | 1.8 | 0.595 | |
| | | 145 | 0.22 | 3.3 | | 1.72 | 17.1 | 6.3 | | 15.1 | 5.6 | | 7.7 | 2.858 | |
| | | 190 | 0.24 | 0 | | 1.61 | 23.1 | 8.8 | | 21.8 | 8.3 | | 17.7 | 6.749 | |
| 16 | Riviera | 10 | 0.07 | 28 | **0.1** | 1.36 | 7 | 0.7 | **0.183** | 4.1 | 0.4 | **0.125** | 2.6 | 0.249 | **0.048** |
| | | 43 | 0.23 | 19.9 | | 1.5 | 5.4 | 1.9 | | 2.7 | 0.9 | | 1.3 | 0.453 | |
| | | 79 | 0.25 | 28.3 | | 1.54 | 5.6 | 2.2 | | 3.1 | 1.2 | | 0.6 | 0.234 | |

| KBMOS Soils Code | KBMOS Soil Name | Horizon Depth cm | Frac. Depth | K cm\hr | Eff. K cm\hr | Bulk Density g\cm^3 | SC 1\10 bar wt % | Frac SC 1\10 bar vol % | Avg SC | FC 1\3 bar wt % | Frac FC 1\3 bar vol % | Avg FC | WP 15 bar wt % | Frac WP 15 bar vol % | Avg WP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 91 | 0.08 | 5.4 | | 1.59 | 9.7 | 1.3 | | 5.4 | 0.7 | | 1.1 | 0.148 | |
| | | 107 | 0.11 | 0.1 | | 1.6 | 23.5 | 4.2 | | 20.9 | 3.8 | | 9.3 | 1.677 | |
| | | 142 | 0.25 | 0.5 | | 1.62 | 20 | 8.0 | | 13.8 | 5.5 | | 5.2 | 2.076 | |
| 17 | Samsula | 18 | 0.14 | 18.4 | **2.4** | 0.24 | 224.9 | 7.4 | **0.537** | 193.6 | 6.3 | **0.448** | 33.6 | 1.100 | **0.030** |
| | | 68 | 0.38 | 19.1 | | 0.12 | 664.3 | 30.2 | | 588.6 | 26.8 | | 25.7 | 1.168 | |
| | | 79 | 0.08 | 13.1 | | 0.14 | 572.6 | 6.7 | | 468.6 | 5.5 | | 23.3 | 0.272 | |
| | | 132 | 0.40 | 11.5 | | 1.41 | 16.8 | 9.5 | | 11 | 6.2 | | 0.9 | 0.510 | |
| 18 | Smyrna | 13 | 0.06 | 18.4 | **0.9** | 1.23 | 26 | 2.0 | **0.157** | 19.7 | 1.6 | **0.097** | 6.2 | 0.488 | **0.025** |
| | | 38 | 0.12 | 14.8 | | 1.51 | 5.9 | 1.1 | | 2.7 | 0.5 | | 0.7 | 0.130 | |
| | | 46 | 0.04 | 11.2 | | 1.44 | 21.1 | 1.2 | | 17.4 | 1.0 | | 3.5 | 0.199 | |
| | | 56 | 0.05 | 34.2 | | 1.45 | 13.4 | 1.0 | | 9.5 | 0.7 | | 2.6 | 0.186 | |
| | | 89 | 0.16 | 18.4 | | 1.6 | 8.4 | 2.2 | | 4.2 | 1.1 | | 0.8 | 0.208 | |
| | | 114 | 0.12 | 10.6 | | 1.71 | 6.4 | 1.3 | | 2.9 | 0.6 | | 0.7 | 0.147 | |
| | | 142 | 0.14 | 7.6 | | 1.69 | 12.9 | 3.0 | | 7.9 | 1.8 | | 2 | 0.466 | |
| | | 203 | 0.30 | 1.3 | | 1.8 | 7.1 | 3.8 | | 4.5 | 2.4 | | 1.3 | 0.703 | |
| 19 | Tavares | 20 | 0.10 | 16.2 | **3.5** | 1.65 | 5.1 | 0.8 | **0.069** | 3.3 | 0.5 | **0.042** | 0.9 | 0.146 | **0.012** |
| | | 43 | 0.11 | 20.7 | | 1.57 | 5.6 | 1.0 | | 3.5 | 0.6 | | 0.9 | 0.160 | |
| | | 76 | 0.16 | 31.6 | | 1.47 | 4.6 | 1.1 | | 2.8 | 0.7 | | 0.9 | 0.215 | |
| | | 132 | 0.28 | 35.5 | | 1.51 | 4.7 | 2.0 | | 3.2 | 1.3 | | 0.8 | 0.333 | |
| | | 203 | 0.35 | 38.8 | | 1.55 | 3.7 | 2.0 | | 2 | 1.1 | | 0.6 | 0.325 | |
| 21 | Valkaria | 13 | 0.09 | 18.2 | **1.9** | 1.42 | 14.4 | 1.8 | **0.121** | 7.3 | 0.9 | **0.053** | 2.4 | 0.303 | **0.010** |
| | | 28 | 0.10 | 10.3 | | 1.57 | 7.6 | 1.2 | | 3.5 | 0.6 | | 1.2 | 0.193 | |
| | | 41 | 0.09 | 14.5 | | 1.59 | 5.9 | 0.8 | | 2.4 | 0.3 | | 0.5 | 0.071 | |
| | | 84 | 0.29 | 27.1 | | 1.51 | 6.9 | 3.1 | | 2.8 | 1.2 | | 0.3 | 0.133 | |
| | | 130 | 0.31 | 13.8 | | 1.57 | 8.7 | 4.3 | | 3.9 | 1.9 | | 0.3 | 0.148 | |
| | | 146.2 | 0.11 | 19.18 | | 1.604 | 5.07 | 0.9 | | 1.73 | 0.3 | | 0.59 | 0.105 | |

# APPENDIX B

# KBMOS AFET Summary of Cross Section Information

## KBMOS AFET Summary of Cross Section Information

**Table B-1 Cross-section details for the KBMOS MIKE 11 Model**

| Branch Name | Length (miles) | Number of Cross Sections | Cross Sections per mile |
|---|---|---|---|
| Alligator-Chain | 19.9 | 68 | 3.4 |
| Armstrong Slough | 4.1 | 14 | 3.4 |
| Armstrong_Trib1 | 3.4 | 10 | 2.9 |
| Ash_Slough1 | 0.5 | 3 | 6.0 |
| Ash_Slough2 | 1.1 | 4 | 3.6 |
| Ash_Slough3 | 1.1 | 5 | 4.5 |
| Boggy-Creek | 12.1 | 13 | 1.1 |
| C-29 | 0.3 | 4 | 13.3 |
| C-31 | 3.6 | 14 | 3.9 |
| C-36 | 2.4 | 4 | 1.7 |
| C-37 | 3.4 | 10 | 2.9 |
| C-38 | 21.5 | 78 | 3.6 |
| Catfish_Creek | 4.8 | 18 | 3.8 |
| Chandler_Outlet | 3 | 7 | 2.3 |
| Chandler_Slough1 | 2.5 | 8 | 3.2 |
| Chandler_Slough2 | 0.6 | 3 | 5.0 |
| Cypress_Slough | 5.8 | 19 | 3.3 |
| DEAD_CREEK | 2.3 | 7 | 3.0 |
| East_lk_Hatchineha | 2.9 | 9 | 3.1 |
| FODDERSTACK_SLOUGH | 2.7 | 9 | 3.3 |
| Gore_Slough | 3.3 | 9 | 2.7 |
| Istokpoga_Canal | 2.9 | 4 | 1.4 |
| JACKSON_CANAL | 2.8 | 11 | 3.9 |
| KISSIMMEE | 14.7 | 37 | 2.5 |
| Kissimmee_River | 13.7 | 33 | 2.4 |
| Lake_Marian | 7.9 | 41 | 5.2 |
| Lake_Marion | 4.6 | 18 | 3.9 |
| Lake_Pierce | 6.2 | 18 | 2.9 |
| Lake_Rosalie | 3.1 | 11 | 3.5 |
| Lk_Jackson | 2.3 | 13 | 5.7 |
| Lk_Marion_Creek | 14.2 | 6 | 0.4 |
| Lk-Brick | 2.4 | 9 | 3.8 |
| Lk-Hart | 4.6 | 21 | 4.6 |
| Lk-Lizzie | 3.2 | 28 | 8.8 |
| Lk-Preston | 1.2 | 6 | 5.0 |
| LOWER_C-38 | 18.3 | 47 | 2.6 |
| LOWER_RC | 0.9 | 4 | 4.4 |
| Lower-E-Toho | 6.6 | 31 | 4.7 |
| Lower_C38ToC41A | 2.8 | 21 | 7.5 |
| KR-M17_Canal | 2.4 | 11 | 4.6 |
| MARIAN | 1.1 | 6 | 5.5 |
| Meander1 | 1.9 | 6 | 3.2 |

| Branch Name | Length (miles) | Number of Cross Sections | Cross Sections per mile |
|---|---|---|---|
| Meander2 | 1.2 | 6 | 5.0 |
| Meander3 | 1 | 5 | 5.0 |
| Meander4 | 1.4 | 5 | 3.6 |
| Meander5 | 2.9 | 7 | 2.4 |
| Meander6 | 1.6 | 6 | 3.8 |
| Meander7 | 0.6 | 6 | 10.0 |
| Meander8 | 2 | 5 | 2.5 |
| Meander9 | 2.3 | 7 | 3.0 |
| Meander10 | 0.8 | 4 | 5.0 |
| Meander11 | 0.5 | 4 | 8.0 |
| Meander12 | 1.5 | 6 | 4.0 |
| Meander17 | 2.7 | 6 | 2.2 |
| Meander18 | 3.5 | 10 | 2.9 |
| Meander19 | 1.8 | 6 | 3.3 |
| Meander20 | 1.4 | 5 | 3.6 |
| Meander21 | 2.9 | 8 | 2.8 |
| Meander22 | 1.3 | 5 | 3.8 |
| Meander23 | 4 | 8 | 2.0 |
| Nash_Slough | 1.5 | 5 | 3.3 |
| Oak_Creek | 1.8 | 8 | 4.4 |
| Oak_Creek_Nbranch | 1.7 | 6 | 3.5 |
| Oak_Creek_Sbranch | 1.8 | 7 | 3.9 |
| Pine_Island_Slough | 8.4 | 4 | 0.5 |
| Pine_Island_Trib1 | 3.2 | 2 | 0.6 |
| Pine_Island_Slough_Trib2 | 1.1 | 2 | 1.8 |
| Pine_Island_Slough_US | 1.4 | 6 | 4.3 |
| Ready-Creek | 13.6 | 22 | 1.6 |
| ROSALIE_CREEK | 1.9 | 9 | 4.7 |
| S65E_HConnection | 0.4 | 7 | 17.5 |
| Sevenmile_Slough | 8.1 | 5 | 0.6 |
| Sevenmile_Trib1 | 1.4 | 2 | 1.4 |
| Sevenmile_Trib2 | 5.7 | 2 | 0.4 |
| Sevenmile_Trib3 | 2.2 | 2 | 0.9 |
| shingle-creek | 22.2 | 18 | 0.8 |
| SHORT_CANAL | 6.1 | 7 | 1.1 |
| TIGER_CREEK | 1.8 | 5 | 2.8 |
| Tiger_Lake | 1.2 | 7 | 5.8 |
| Toho_main | 15.5 | 49 | 3.2 |
| UPPER_RC | 18.2 | 36 | 2.0 |
| Upper-Alligator | 9.3 | 36 | 3.9 |
| Weohyakapka_Creek | 9.8 | 18 | 1.8 |
| West_Lk_Hatchineha | 4.9 | 21 | 4.3 |
| ZIPPER_CANAL | 2.1 | 6 | 2.9 |

# APPENDIX C

# Description of Parameters in the MIKE SHE Water Budget

# KBMOS AFET Water Budget Tables for the Calibration Run

# Description of Parameters in the MIKE SHE Water Budget

This Appendix will define the parameters, and relationship between the parameters, that are used to calculate the water budgets in MIKE SHE.

**Definitions:**
**<u>Inflows</u>** include all parameters that add water to the MIKE SHE model. These components include:

**Rainfall (*Rai*)–** This term represents an inflow to the model in the form of precipitation.

**Irrigation (Irr)** - This term represents an inflow to the model in the form of irrigation taken from river, groundwater, or external sources.

**Overland boundary flows (olbc) –** this term represents flow into and out of the overland flow module of the mike she model. Negative values represent flow out of the mike she model. Positive values represent flow into the mike she model**.**

**SZ Boundary Flow ($SZ_{BC}$) –** This term represents flow into and out of the saturated zone module of the MIKE SHE model. Negative values represent flow out of the MIKE SHE model. Positive values represent flow into the MIKE SHE model.

**<u>Outflows</u>** include all parameters that remove water from the MIKE SHE model. These components include:

**Actual Evapotranspiration (*AET*) –** This term represents an outflow from the model calculated as the sum of evaporation and transpiration.

**PWS Pumpage ($GW_p$)** - This term represents the volume of water removed from the groundwater component of the model for potable water supply. This volume is removed from the model.

**Runoff (*ro*) –** this term represents the volume of water moved to/from the mike 11 network from/to the overland flow component of mike she. Positive values represent contributions from the mike she overland flow module into the mike 11 model. Negative values represent contributions from mike 11 to the mike she overland flow module.

**Baseflow (*bf*)** - this term represents the volume of water moved between the mike she saturated zone and the mike 11 river network model. Positive values represent flow out of the saturated zone of the mike she model into the mike 11 model. Negative values represent flow from mike 11 in the saturated zone of the mike she model.

**Drainage to River (*D*) –** This term represented the volume of water moved between the MIKE SHE drainage module and the MIKE 11 river network model. Positive values represent flow from the MIKE SHE drainage module into the MIKE 11 model.

**Storage Changes** represent internal components of the model where water exchange occurs. These values represent the difference in volume of water stored within the module during the simulation.

**UZ Storage Change (*ΔUZ*) -** This is an internal computation within the MIKE SHE model used to represent change in volume stored within the unsaturated zone of the model. Negative values represent a loss in stored volume. Positive values represent an increase in stored volume.

**Canopy-Overland Storage Change (*ΔOL*)** – This is an internal computation within the MIKE SHE model used to represent change in volume stored within the vegetative canopy or in the overland flow plain. Negative values represent a loss in stored volume. Positive values represent an increase in stored volume.

**SZ Storage Change (*ΔSZ*) -** This is an internal computation within the MIKE SHE model used to represent change in volume stored within the saturated zone of the model. Negative values represent a loss in stored volume. Positive values represent an increase in stored volume.

**Other Parameters**

**Irrigation Pumpage ($Gw_i$)** - This term represents a volume of water removed from the groundwater component of the model and applied as irrigation. This component is not included in water budget calculations.

**Total Error (Err)** – This term represents the computation error that occurs during the simulation period.

## *CALCULATING THE WATER BUDGET*

In general, the balanced water budget is expressed in the following fashion:

$$\text{Total Error} = \text{Inflows} - \text{Outflows} - \text{Change in Storage}$$

Using the parameters described above, the MIKE SHE water budget would be written as:

$$ERR = (Rai + Irr + OL_{BC} + SZ_{BC}) - (AET + R_o + BF + D + GW_P) - (\Delta OL + \Delta UZ + \Delta SZ)$$

# KBMOS AFET Water Budget tables for the Calibration Run

**Table C-1: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the calibration period.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 164 | 102 | 4.67 | 13.06 | -0.04 | 1.03 | 37.63 | 0.02 | 5.03 | 0.00 | 0.00 | -9.07 | 1.73 | 0.03 |
| Shingle Creek | 2 | 164 | 95 | 2.35 | 21.14 | 0.00 | 2.34 | 33.03 | 0.10 | 0.42 | 0.00 | 0.00 | -9.42 | 1.04 | 0.02 |
| Boggy Creek | 3 | 172 | 97 | 3.61 | 24.56 | 0.00 | 0.90 | 42.21 | 0.01 | 1.06 | 0.00 | 0.00 | -3.74 | 0.61 | 0.01 |
| Lake Hart | 4 | 182 | 119 | 19.73 | 12.89 | -0.32 | 0.20 | 31.92 | -0.06 | 3.34 | 0.00 | 0.00 | -0.69 | 0.39 | 0.00 |
| Horse Creek | 5 | 174 | 98 | 14.99 | 42.77 | -0.48 | 10.60 | 0.27 | -0.14 | 6.50 | 0.00 | 0.00 | -12.40 | 0.54 | 0.02 |
| Lower Reedy Cr. | 6 | 171 | 112 | 11.27 | 7.40 | 0.09 | 4.41 | 44.25 | -0.11 | 0.68 | 0.00 | 0.00 | 7.70 | 0.34 | 0.03 |
| Lake Toho | 7 | 163 | 114 | 1.51 | 13.06 | -0.01 | 0.83 | 36.03 | -0.05 | 0.83 | 0.00 | 0.00 | 1.66 | 0.17 | 0.02 |
| East Lake Toho | 8 | 161 | 119 | 2.53 | 9.53 | -0.05 | 1.26 | 28.59 | -0.03 | 0.43 | 0.00 | 0.00 | 0.72 | 0.38 | 0.00 |
| Alligator Lake | 9 | 153 | 115 | 3.69 | 6.39 | 0.01 | 0.32 | 28.94 | -0.07 | 1.91 | 0.00 | 0.00 | 0.04 | 0.36 | -0.01 |
| Lake Mrytle | 10 | 160 | 117 | 14.27 | 9.91 | -0.17 | 1.73 | 14.91 | -0.01 | 0.06 | 0.00 | 0.00 | -2.29 | 0.14 | 0.05 |
| Lake Conlin | 11 | 151 | 113 | 2.52 | 0.00 | -0.18 | 0.00 | 35.56 | -0.03 | 0.25 | 0.00 | 0.00 | -0.20 | 0.11 | 0.04 |
| Lake Marion | 12 | 174 | 105 | 3.59 | 11.42 | 0.24 | 0.18 | 63.67 | -0.08 | 10.24 | 0.00 | 0.00 | -0.69 | 0.10 | 0.10 |
| Marion Creek | 13 | 173 | 111 | 16.40 | 8.53 | -0.29 | 1.86 | 41.39 | -0.07 | 0.05 | 0.00 | 0.00 | 6.95 | 0.19 | 0.02 |
| Lake Cypress | 14 | 169 | 114 | 2.55 | 4.40 | -0.07 | 2.78 | 47.08 | -0.08 | 0.00 | 0.00 | 0.00 | 1.20 | 0.04 | 0.06 |
| S63A | 15 | 164 | 106 | 2.87 | 1.36 | -0.07 | 0.91 | 53.88 | -0.11 | 0.64 | 0.00 | 0.00 | -0.16 | 0.03 | 0.08 |
| Lake Gentry | 16 | 155 | 112 | 2.45 | 0.66 | 0.01 | 0.85 | 45.48 | -0.07 | 6.61 | 0.00 | 0.00 | -0.27 | 0.16 | 0.09 |
| Lake Pierce | 17 | 174 | 103 | 5.20 | 15.58 | -0.21 | 0.00 | 53.32 | -0.10 | 15.96 | 0.00 | 0.00 | -12.75 | 0.26 | 0.09 |
| Catfish Creek | 18 | 173 | 105 | 4.05 | 8.18 | -0.48 | 10.28 | 59.99 | -0.14 | 2.46 | 0.00 | 0.00 | 11.93 | 0.39 | 0.06 |
| Lake Hatch | 19 | 172 | 128 | 14.62 | 7.31 | 0.25 | 3.14 | 25.64 | -0.03 | 0.03 | 0.00 | 0.00 | 6.16 | 0.04 | 0.03 |
| Lk Weohyakapaka | 20 | 174 | 106 | 5.49 | 11.26 | 0.00 | 0.09 | 52.95 | -0.07 | 8.82 | 0.00 | 0.00 | -6.58 | 0.33 | 0.04 |
| Lake Rosalie | 21 | 174 | 114 | 7.49 | 20.51 | -0.12 | 0.69 | 34.58 | -0.05 | 3.56 | 0.00 | 0.00 | -0.34 | 0.32 | 0.05 |
| Tiger Lake | 22 | 177 | 120 | 9.00 | 12.33 | -0.11 | 0.77 | 37.32 | -0.02 | 0.08 | 0.00 | 0.00 | 2.67 | 0.06 | 0.04 |
| Lake Kissimmee | 23 | 178 | 130 | 5.56 | 7.88 | 0.03 | 0.42 | 35.51 | 0.02 | 0.26 | 0.00 | 0.00 | 0.68 | 0.01 | 0.04 |
| Lake Jackson | 24 | 177 | 114 | 10.52 | 1.51 | -0.03 | 0.22 | 48.69 | -0.02 | 0.05 | 0.00 | 0.00 | -2.60 | 0.04 | 0.05 |
| Lake Marian | 25 | 175 | 120 | 4.51 | 3.63 | 0.00 | 0.04 | 47.85 | 0.04 | 0.00 | 0.00 | 0.00 | 0.67 | -0.05 | 0.03 |
| S-65A | 26 | 161 | 103 | 2.71 | 4.27 | -0.19 | 4.65 | 44.80 | -0.03 | 0.57 | 0.00 | 0.00 | -2.71 | 0.03 | 0.12 |
| S-65BC | 27 | 144 | 101 | 4.25 | 2.95 | 0.01 | 6.76 | 29.79 | -0.03 | 0.59 | 0.00 | 0.00 | 0.18 | 0.11 | 0.12 |
| S-65D | 28 | 140 | 97 | 1.84 | 7.53 | -0.03 | 4.45 | 31.65 | -0.08 | 3.54 | 0.00 | 0.00 | -0.89 | -0.02 | 0.12 |
| S-65E | 29 | 133 | 95 | 0.62 | 2.42 | -0.09 | 10.20 | 27.93 | -0.08 | 2.68 | 0.00 | 0.00 | 0.48 | -0.12 | 0.10 |

**Table C-2: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 2001-2002 dry season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 8.05 | 12.84 | -3.35 | 0.10 | 0.00 | 0.17 | 1.32 | -1.32 | 0.87 | 0.00 | 0.00 | -1.38 | -2.18 | 0.05 |
| Shingle Creek | 2 | 8.04 | 11.18 | -1.92 | 0.02 | 0.00 | 0.36 | 0.87 | -1.00 | 0.08 | 0.00 | 0.00 | -1.42 | -2.75 | 0.06 |
| Boggy Creek | 3 | 8.80 | 11.79 | -1.55 | 0.00 | 0.00 | 0.13 | 1.04 | -0.87 | 0.28 | 0.00 | 0.00 | -0.64 | -2.06 | 0.06 |
| Lake Hart | 4 | 9.90 | 17.61 | -4.07 | -1.63 | -0.01 | 0.03 | 0.57 | -0.78 | 0.64 | 0.00 | 0.00 | -0.10 | -1.21 | 0.07 |
| Horse Creek | 5 | 8.46 | 13.41 | -5.14 | 1.17 | -0.01 | 1.43 | 0.01 | -0.56 | 1.48 | 0.00 | 0.00 | -1.34 | -1.69 | 0.04 |
| Lower Reedy Cr. | 6 | 8.69 | 16.23 | -4.72 | 0.02 | 0.00 | 0.48 | 1.56 | -1.35 | 0.18 | 0.00 | 0.00 | 1.26 | -2.00 | 0.09 |
| Lake Toho | 7 | 8.40 | 16.11 | -1.34 | -3.99 | 0.00 | 0.09 | 0.81 | -0.97 | 0.17 | 0.00 | 0.00 | 0.25 | -1.86 | 0.05 |
| East Lake Toho | 8 | 8.30 | 16.73 | -1.08 | -5.27 | 0.01 | 0.17 | 0.66 | -0.79 | 0.08 | 0.00 | 0.00 | 0.11 | -1.88 | 0.06 |
| Alligator Lake | 9 | 7.84 | 15.73 | -1.68 | -2.77 | 0.00 | 0.04 | 0.76 | -1.35 | 0.43 | 0.00 | 0.00 | 0.00 | -2.40 | 0.05 |
| Lake Mrytle | 10 | 8.49 | 16.69 | -5.53 | -1.77 | 0.00 | 0.21 | 0.43 | -0.71 | 0.02 | 0.00 | 0.00 | -0.26 | -0.99 | 0.08 |
| Lake Conlin | 11 | 8.48 | 15.65 | -3.30 | 0.00 | -0.01 | 0.00 | 1.25 | -1.98 | 0.05 | 0.00 | 0.00 | -0.03 | -2.95 | 0.17 |
| Lake Marion | 12 | 9.10 | 14.91 | -3.30 | -2.06 | 0.02 | 0.02 | 4.15 | -0.62 | 1.98 | 0.00 | 0.00 | 0.22 | -1.76 | 0.02 |
| Marion Creek | 13 | 9.02 | 16.36 | -5.52 | 0.03 | 0.00 | 0.30 | 1.29 | -0.64 | 0.01 | 0.00 | 0.00 | 0.99 | -1.71 | 0.08 |
| Lake Cypress | 14 | 9.43 | 16.52 | -2.79 | -1.94 | 0.00 | 0.39 | 0.67 | -1.61 | 0.00 | 0.00 | 0.00 | 0.14 | -1.61 | 0.06 |
| S63A | 15 | 9.02 | 15.08 | -2.38 | 0.01 | 0.00 | 0.08 | 0.80 | -1.68 | 0.14 | 0.00 | 0.00 | -0.03 | -2.72 | 0.07 |
| Lake Gentry | 16 | 8.40 | 16.49 | -2.17 | -1.11 | 0.00 | 0.12 | 1.48 | -1.75 | 1.36 | 0.00 | 0.00 | -0.02 | -3.21 | 0.11 |
| Lake Pierce | 17 | 9.07 | 14.23 | -3.30 | -0.14 | -0.02 | 0.00 | 2.92 | -0.70 | 3.06 | 0.00 | 0.00 | -1.79 | -2.66 | 0.03 |
| Catfish Creek | 18 | 8.88 | 15.14 | -4.66 | 0.13 | 0.05 | 1.33 | 2.79 | -1.53 | 0.50 | 0.00 | 0.00 | 1.49 | -2.20 | 0.08 |
| Lake Hatch | 19 | 9.62 | 19.40 | -4.91 | -4.33 | 0.02 | 0.37 | 1.06 | -0.47 | 0.01 | 0.00 | 0.00 | 0.78 | -0.63 | 0.05 |
| Lk Weohyakapaka | 20 | 9.30 | 15.10 | -3.59 | -1.88 | 0.00 | 0.01 | 3.52 | -0.52 | 1.67 | 0.00 | 0.00 | -0.86 | -2.50 | 0.04 |
| Lake Rosalie | 21 | 8.91 | 16.75 | -3.79 | -2.40 | 0.00 | 0.09 | 2.19 | -0.38 | 0.63 | 0.00 | 0.00 | 0.01 | -2.80 | 0.10 |
| Tiger Lake | 22 | 9.97 | 18.08 | -4.78 | -2.94 | -0.01 | 0.10 | 1.72 | -0.61 | 0.02 | 0.00 | 0.00 | 0.27 | -1.24 | 0.08 |
| Lake Kissimmee | 23 | 10.88 | 19.86 | -3.52 | -5.31 | 0.00 | 0.05 | 1.32 | -0.55 | 0.06 | 0.00 | 0.00 | 0.08 | -0.79 | 0.04 |
| Lake Jackson | 24 | 10.64 | 17.38 | -6.11 | -0.93 | 0.01 | 0.03 | 2.14 | -0.58 | 0.01 | 0.00 | 0.00 | -0.32 | -1.50 | 0.09 |
| Lake Marian | 25 | 10.62 | 18.28 | -5.03 | -2.24 | 0.00 | 0.01 | 2.35 | -0.74 | 0.00 | 0.00 | 0.00 | 0.10 | -1.85 | 0.06 |
| S-65A | 26 | 9.83 | 15.06 | -6.39 | 0.07 | -0.01 | 0.67 | 3.48 | -1.07 | 0.13 | 0.00 | 0.00 | -0.42 | -2.20 | 0.09 |
| S-65BC | 27 | 8.00 | 13.58 | -4.41 | 0.06 | 0.00 | 1.13 | 1.39 | -1.46 | 0.14 | 0.00 | 0.00 | 0.06 | -2.01 | 0.07 |
| S-65D | 28 | 8.72 | 13.25 | -3.26 | 0.22 | 0.00 | 0.57 | 1.51 | -1.31 | 0.70 | 0.00 | 0.00 | -0.21 | -1.72 | 0.06 |
| S-65E | 29 | 7.13 | 12.98 | -3.84 | 0.01 | -0.01 | 1.29 | 1.38 | -1.80 | 0.55 | 0.00 | 0.00 | 0.08 | -2.20 | 0.08 |



AECOM

**Table C-3: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 2002 wet season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change $\Delta OL$ | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change ($\Delta UZ$) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 41.70 | 18.93 | 5.48 | 3.69 | -0.01 | 0.14 | 7.61 | 1.40 | 0.85 | 0.00 | 0.00 | -1.69 | 3.54 | -0.05 |
| Shingle Creek | 2 | 41.50 | 17.67 | 3.21 | 6.89 | 0.00 | 0.36 | 7.11 | 1.16 | 0.06 | 0.00 | 0.00 | -1.69 | 3.42 | -0.05 |
| Boggy Creek | 3 | 39.75 | 18.16 | 2.72 | 6.62 | 0.00 | 0.13 | 8.40 | 0.87 | 0.19 | 0.00 | 0.00 | -0.65 | 2.33 | -0.06 |
| Lake Hart | 4 | 37.53 | 21.64 | 7.79 | 1.77 | -0.04 | 0.03 | 4.56 | 0.75 | 0.58 | 0.00 | 0.00 | -0.10 | 1.38 | -0.06 |
| Horse Creek | 5 | 43.85 | 18.66 | 11.05 | 8.26 | -0.09 | 1.77 | 0.07 | 0.55 | 1.13 | 0.00 | 0.00 | -2.60 | 1.91 | -0.02 |
| Lower Reedy Cr. | 6 | 41.68 | 20.71 | 7.81 | 1.77 | 0.01 | 0.62 | 8.58 | 1.33 | 0.11 | 0.00 | 0.00 | 1.24 | 2.15 | -0.08 |
| Lake Toho | 7 | 38.36 | 21.07 | 1.50 | 5.12 | 0.00 | 0.15 | 8.15 | 0.96 | 0.14 | 0.00 | 0.00 | 0.29 | 1.80 | -0.04 |
| East Lake Toho | 8 | 36.58 | 21.87 | 1.71 | 4.35 | -0.01 | 0.21 | 5.81 | 0.77 | 0.07 | 0.00 | 0.00 | 0.11 | 1.98 | -0.05 |
| Alligator Lake | 9 | 34.48 | 20.74 | 2.19 | 2.46 | 0.00 | 0.06 | 5.59 | 1.32 | 0.32 | 0.00 | 0.00 | 0.03 | 2.42 | -0.05 |
| Lake Mrytle | 10 | 35.50 | 20.64 | 7.49 | 2.37 | -0.02 | 0.28 | 2.70 | 0.71 | 0.03 | 0.00 | 0.00 | -0.26 | 1.01 | -0.06 |
| Lake Conlin | 11 | 36.70 | 20.34 | 2.84 | 0.00 | -0.04 | 0.00 | 8.26 | 1.96 | 0.05 | 0.00 | 0.00 | -0.09 | 3.04 | -0.18 |
| Lake Marion | 12 | 41.20 | 19.92 | 4.07 | 3.48 | 0.03 | 0.02 | 12.14 | 0.64 | 1.68 | 0.00 | 0.00 | -0.96 | 1.69 | 0.01 |
| Marion Creek | 13 | 41.08 | 20.73 | 9.80 | 1.71 | -0.02 | 0.22 | 7.34 | 0.63 | 0.01 | 0.00 | 0.00 | 1.17 | 1.76 | -0.06 |
| Lake Cypress | 14 | 38.04 | 20.48 | 3.01 | 1.71 | -0.01 | 0.45 | 9.31 | 1.61 | 0.00 | 0.00 | 0.00 | 0.18 | 1.60 | -0.05 |
| S63A | 15 | 37.29 | 18.64 | 2.63 | 0.29 | -0.01 | 0.14 | 11.21 | 1.68 | 0.13 | 0.00 | 0.00 | -0.07 | 2.68 | -0.06 |
| Lake Gentry | 16 | 36.90 | 20.24 | 2.22 | 0.58 | 0.00 | 0.14 | 9.74 | 1.73 | 1.14 | 0.00 | 0.00 | -0.05 | 3.24 | -0.09 |
| Lake Pierce | 17 | 39.77 | 19.28 | 4.62 | 2.89 | -0.03 | 0.00 | 9.91 | 0.73 | 2.68 | 0.00 | 0.00 | -2.37 | 2.62 | 0.01 |
| Catfish Creek | 18 | 39.52 | 19.31 | 5.70 | 1.35 | -0.15 | 1.52 | 9.81 | 1.50 | 0.40 | 0.00 | 0.00 | 1.70 | 2.24 | -0.05 |
| Lake Hatch | 19 | 38.83 | 23.54 | 7.98 | 2.88 | 0.01 | 0.36 | 3.87 | 0.47 | 0.00 | 0.00 | 0.00 | 0.93 | 0.64 | -0.03 |
| Lk Weohyakapaka | 20 | 41.37 | 20.01 | 5.59 | 3.65 | 0.00 | 0.01 | 9.31 | 0.52 | 1.51 | 0.00 | 0.00 | -1.18 | 2.58 | -0.02 |
| Lake Rosalie | 21 | 39.74 | 21.13 | 6.45 | 4.04 | -0.01 | 0.08 | 5.38 | 0.38 | 0.62 | 0.00 | 0.00 | -0.03 | 2.80 | -0.06 |
| Tiger Lake | 22 | 41.64 | 22.02 | 8.20 | 3.26 | -0.01 | 0.08 | 6.49 | 0.60 | 0.01 | 0.00 | 0.00 | 0.32 | 1.24 | -0.06 |
| Lake Kissimmee | 23 | 42.53 | 23.66 | 5.08 | 4.83 | 0.01 | 0.05 | 7.67 | 0.60 | 0.05 | 0.00 | 0.00 | 0.11 | 0.78 | -0.03 |
| Lake Jackson | 24 | 39.38 | 20.55 | 7.84 | 0.85 | 0.00 | 0.03 | 7.67 | 0.59 | 0.03 | 0.00 | 0.00 | -0.35 | 1.46 | -0.08 |
| Lake Marian | 25 | 41.69 | 21.30 | 4.96 | 2.20 | 0.00 | 0.01 | 10.78 | 0.82 | 0.00 | 0.00 | 0.00 | 0.09 | 1.65 | -0.05 |
| S-65A | 26 | 43.63 | 19.10 | 7.87 | 1.36 | -0.03 | 0.90 | 10.82 | 1.03 | 0.07 | 0.00 | 0.00 | -0.45 | 2.08 | -0.06 |
| S-65BC | 27 | 38.34 | 18.78 | 5.97 | 0.98 | 0.00 | 1.06 | 8.42 | 1.31 | 0.08 | 0.00 | 0.00 | -0.01 | 1.87 | -0.03 |
| S-65D | 28 | 33.38 | 18.53 | 2.20 | 2.00 | 0.00 | 0.79 | 8.20 | 0.88 | 0.57 | 0.00 | 0.00 | -0.14 | 1.20 | 0.00 |
| S-65E | 29 | 27.77 | 17.25 | 0.57 | 0.41 | -0.01 | 1.81 | 5.56 | 1.31 | 0.49 | 0.00 | 0.00 | -0.02 | 1.33 | 0.00 |

**Table C-4: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 2002 to 2003 dry season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 25.64 | 15.97 | -0.57 | 2.13 | -0.01 | 0.20 | 7.61 | -0.16 | 0.74 | 0.00 | 0.00 | -1.71 | -0.51 | 0.01 |
| Shingle Creek | 2 | 25.50 | 15.10 | -0.59 | 3.24 | 0.00 | 0.46 | 6.54 | -0.23 | 0.04 | 0.00 | 0.00 | -1.64 | -0.61 | 0.02 |
| Boggy Creek | 3 | 25.66 | 15.33 | -0.44 | 3.26 | 0.00 | 0.18 | 7.25 | -0.10 | 0.11 | 0.00 | 0.00 | -0.63 | -0.32 | 0.01 |
| Lake Hart | 4 | 25.95 | 17.71 | 2.24 | 1.44 | -0.04 | 0.03 | 4.80 | -0.02 | 0.37 | 0.00 | 0.00 | -0.10 | -0.01 | 0.00 |
| Horse Creek | 5 | 27.43 | 14.90 | 1.07 | 7.96 | -0.12 | 2.02 | 0.05 | -0.06 | 0.83 | 0.00 | 0.00 | -2.53 | -0.34 | 0.01 |
| Lower Reedy Cr. | 6 | 27.91 | 16.93 | 0.90 | 1.19 | 0.03 | 0.97 | 9.44 | -0.11 | 0.06 | 0.00 | 0.00 | 1.03 | -0.28 | 0.01 |
| Lake Toho | 7 | 26.36 | 17.76 | -0.11 | 2.49 | 0.00 | 0.15 | 6.79 | -0.11 | 0.11 | 0.00 | 0.00 | 0.27 | -0.22 | 0.02 |
| East Lake Toho | 8 | 24.83 | 18.33 | -0.05 | 1.81 | -0.01 | 0.23 | 4.94 | -0.04 | 0.06 | 0.00 | 0.00 | 0.12 | -0.20 | 0.01 |
| Alligator Lake | 9 | 24.44 | 17.90 | -0.01 | 1.39 | 0.00 | 0.06 | 5.66 | -0.07 | 0.25 | 0.00 | 0.00 | -0.01 | -0.22 | 0.02 |
| Lake Mrytle | 10 | 24.05 | 17.73 | 1.59 | 1.51 | -0.02 | 0.31 | 2.63 | -0.03 | 0.01 | 0.00 | 0.00 | -0.37 | -0.07 | 0.01 |
| Lake Conlin | 11 | 21.68 | 17.74 | -2.01 | 0.00 | -0.03 | 0.00 | 6.60 | 0.04 | 0.03 | 0.00 | 0.00 | -0.05 | -0.61 | 0.13 |
| Lake Marion | 12 | 29.50 | 15.97 | -0.26 | 2.43 | 0.05 | 0.03 | 12.47 | -0.04 | 1.45 | 0.00 | 0.00 | -0.69 | -0.27 | 0.02 |
| Marion Creek | 13 | 29.23 | 16.81 | 2.88 | 1.39 | -0.07 | 0.33 | 8.93 | -0.05 | 0.00 | 0.00 | 0.00 | 0.93 | -0.18 | 0.00 |
| Lake Cypress | 14 | 28.25 | 17.65 | -0.15 | 1.20 | -0.01 | 0.55 | 9.54 | -0.15 | 0.00 | 0.00 | 0.00 | 0.15 | -0.23 | 0.02 |
| S63A | 15 | 26.34 | 16.57 | -0.37 | 0.20 | -0.01 | 0.22 | 10.28 | -0.02 | 0.07 | 0.00 | 0.00 | -0.04 | -0.47 | 0.03 |
| Lake Gentry | 16 | 24.31 | 16.99 | -0.84 | 0.31 | 0.00 | 0.16 | 9.06 | 0.10 | 0.90 | 0.00 | 0.00 | -0.03 | -0.52 | 0.08 |
| Lake Pierce | 17 | 29.71 | 15.61 | 0.63 | 3.32 | -0.04 | 0.00 | 10.42 | -0.04 | 2.29 | 0.00 | 0.00 | -2.36 | -0.35 | 0.01 |
| Catfish Creek | 18 | 29.35 | 15.78 | -0.40 | 1.58 | -0.11 | 1.99 | 12.94 | -0.04 | 0.35 | 0.00 | 0.00 | 1.98 | -0.27 | 0.01 |
| Lake Hatch | 19 | 30.18 | 19.03 | 3.47 | 2.49 | 0.06 | 0.55 | 5.74 | -0.02 | 0.00 | 0.00 | 0.00 | 0.99 | -0.02 | 0.01 |
| Lk Weohyakapaka | 20 | 26.59 | 15.94 | -0.01 | 1.49 | 0.00 | 0.02 | 9.85 | -0.07 | 1.28 | 0.00 | 0.00 | -1.21 | -0.57 | 0.00 |
| Lake Rosalie | 21 | 28.86 | 16.94 | 0.85 | 4.62 | -0.02 | 0.12 | 7.01 | -0.02 | 0.53 | 0.00 | 0.00 | -0.22 | -0.36 | 0.00 |
| Tiger Lake | 22 | 26.74 | 17.79 | 0.14 | 2.33 | -0.04 | 0.14 | 6.78 | 0.00 | 0.01 | 0.00 | 0.00 | 0.37 | -0.08 | 0.01 |
| Lake Kissimmee | 23 | 24.78 | 19.38 | -0.44 | 0.66 | 0.00 | 0.07 | 5.56 | -0.11 | 0.03 | 0.00 | 0.00 | 0.11 | -0.19 | 0.01 |
| Lake Jackson | 24 | 25.98 | 16.90 | 0.37 | 0.08 | 0.00 | 0.04 | 8.25 | -0.02 | 0.00 | 0.00 | 0.00 | -0.42 | -0.06 | 0.02 |
| Lake Marian | 25 | 23.29 | 17.87 | -1.36 | 0.22 | 0.00 | 0.01 | 7.47 | -0.08 | 0.00 | 0.00 | 0.00 | 0.13 | -0.68 | 0.03 |
| S-65A | 26 | 19.31 | 15.33 | -4.28 | 0.59 | -0.04 | 0.86 | 7.65 | -0.22 | 0.07 | 0.00 | 0.00 | -0.46 | -0.99 | 0.05 |
| S-65BC | 27 | 18.67 | 15.24 | -2.17 | 0.38 | 0.00 | 1.23 | 4.93 | -0.14 | 0.10 | 0.00 | 0.00 | 0.02 | -0.65 | 0.03 |
| S-65D | 28 | 18.57 | 14.25 | -0.28 | 0.82 | 0.00 | 0.77 | 3.91 | 0.07 | 0.57 | 0.00 | 0.00 | -0.15 | -0.52 | 0.02 |
| S-65E | 29 | 19.24 | 14.69 | 0.17 | 0.13 | -0.01 | 1.65 | 3.22 | 0.21 | 0.38 | 0.00 | 0.00 | 0.11 | -0.32 | 0.02 |

**Table C-5: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 2003 wet season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change $\Delta OL$ | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change ($\Delta UZ$) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 34.99 | 19.69 | 1.93 | 3.06 | -0.01 | 0.18 | 8.79 | 0.02 | 0.81 | 0.00 | 0.00 | -1.55 | 0.56 | 0.01 |
| Shingle Creek | 2 | 34.78 | 18.58 | 0.69 | 4.63 | 0.00 | 0.42 | 8.30 | 0.01 | 0.10 | 0.00 | 0.00 | -1.63 | 0.63 | 0.01 |
| Boggy Creek | 3 | 36.00 | 18.89 | 0.48 | 5.02 | 0.00 | 0.16 | 10.76 | -0.01 | 0.14 | 0.00 | 0.00 | -0.62 | 0.23 | 0.00 |
| Lake Hart | 4 | 36.57 | 21.41 | 4.25 | 3.38 | -0.07 | 0.04 | 7.83 | -0.02 | 0.51 | 0.00 | 0.00 | -0.12 | 0.01 | 0.00 |
| Horse Creek | 5 | 34.23 | 18.29 | 3.16 | 9.39 | -0.11 | 1.97 | 0.06 | -0.13 | 0.90 | 0.00 | 0.00 | -2.16 | 0.13 | 0.00 |
| Lower Reedy Cr. | 6 | 33.00 | 20.50 | 1.51 | 1.52 | 0.02 | 0.92 | 9.93 | -0.12 | 0.08 | 0.00 | 0.00 | 1.19 | 0.05 | 0.01 |
| Lake Toho | 7 | 33.25 | 21.21 | -0.12 | 3.60 | 0.00 | 0.16 | 8.98 | -0.15 | 0.12 | 0.00 | 0.00 | 0.24 | -0.06 | 0.00 |
| East Lake Toho | 8 | 34.38 | 22.00 | 0.45 | 4.34 | -0.01 | 0.24 | 7.49 | -0.05 | 0.07 | 0.00 | 0.00 | 0.14 | 0.11 | 0.00 |
| Alligator Lake | 9 | 31.45 | 21.49 | 0.61 | 2.23 | 0.00 | 0.08 | 7.31 | -0.03 | 0.27 | 0.00 | 0.00 | 0.00 | 0.02 | -0.01 |
| Lake Mrytle | 10 | 33.23 | 21.57 | 4.22 | 2.89 | -0.05 | 0.36 | 3.63 | 0.00 | 0.00 | 0.00 | 0.00 | -0.44 | 0.07 | 0.00 |
| Lake Conlin | 11 | 31.20 | 21.13 | 0.70 | 0.00 | -0.04 | 0.00 | 8.72 | -0.04 | 0.03 | 0.00 | 0.00 | -0.02 | 0.57 | -0.10 |
| Lake Marion | 12 | 32.85 | 19.17 | 0.00 | 2.45 | 0.06 | 0.04 | 13.29 | -0.19 | 1.64 | 0.00 | 0.00 | 0.06 | -0.15 | 0.01 |
| Marion Creek | 13 | 32.27 | 20.16 | 1.92 | 1.60 | -0.08 | 0.34 | 9.43 | -0.08 | 0.01 | 0.00 | 0.00 | 1.08 | -0.07 | 0.01 |
| Lake Cypress | 14 | 33.91 | 21.28 | -0.02 | 1.08 | -0.02 | 0.54 | 11.57 | -0.28 | 0.00 | 0.00 | 0.00 | 0.19 | -0.08 | 0.01 |
| S63A | 15 | 34.56 | 19.91 | 0.59 | 0.28 | -0.01 | 0.23 | 13.85 | -0.26 | 0.08 | 0.00 | 0.00 | -0.02 | 0.01 | 0.00 |
| Lake Gentry | 16 | 31.35 | 20.56 | 0.46 | 0.37 | 0.00 | 0.17 | 10.67 | -0.17 | 0.99 | 0.00 | 0.00 | -0.05 | 0.20 | -0.03 |
| Lake Pierce | 17 | 36.14 | 18.92 | 1.38 | 3.72 | -0.05 | 0.00 | 12.72 | -0.17 | 2.46 | 0.00 | 0.00 | -2.19 | -0.17 | 0.02 |
| Catfish Creek | 18 | 37.80 | 19.09 | 0.63 | 2.39 | -0.12 | 2.13 | 16.16 | -0.17 | 0.36 | 0.00 | 0.00 | 2.25 | 0.08 | 0.02 |
| Lake Hatch | 19 | 33.07 | 22.94 | 2.70 | 2.27 | 0.08 | 0.60 | 5.78 | -0.06 | 0.00 | 0.00 | 0.00 | 1.05 | -0.02 | 0.00 |
| Lk Weohyakapaka | 20 | 39.90 | 19.48 | 2.39 | 4.43 | 0.01 | 0.02 | 13.47 | -0.06 | 1.36 | 0.00 | 0.00 | -1.25 | 0.30 | 0.01 |
| Lake Rosalie | 21 | 39.38 | 20.56 | 2.04 | 7.67 | -0.04 | 0.12 | 9.29 | -0.09 | 0.56 | 0.00 | 0.00 | -0.21 | 0.10 | 0.01 |
| Tiger Lake | 22 | 39.92 | 21.54 | 3.37 | 5.28 | -0.04 | 0.16 | 10.05 | -0.05 | 0.01 | 0.00 | 0.00 | 0.48 | 0.03 | 0.00 |
| Lake Kissimmee | 23 | 40.99 | 23.42 | 2.70 | 4.81 | 0.01 | 0.08 | 9.98 | 0.02 | 0.03 | 0.00 | 0.00 | 0.09 | 0.11 | 0.00 |
| Lake Jackson | 24 | 41.28 | 20.48 | 5.50 | 0.98 | -0.02 | 0.04 | 13.71 | -0.01 | 0.00 | 0.00 | 0.00 | -0.51 | 0.05 | 0.00 |
| Lake Marian | 25 | 37.48 | 21.49 | 2.78 | 1.87 | 0.00 | 0.01 | 11.01 | -0.03 | 0.00 | 0.00 | 0.00 | 0.13 | 0.45 | -0.02 |
| S-65A | 26 | 36.54 | 19.10 | 4.07 | 1.09 | -0.04 | 0.88 | 9.97 | 0.10 | 0.05 | 0.00 | 0.00 | -0.47 | 0.87 | -0.01 |
| S-65BC | 27 | 29.94 | 19.46 | 1.82 | 0.65 | 0.00 | 1.17 | 6.42 | 0.03 | 0.07 | 0.00 | 0.00 | 0.02 | 0.51 | 0.02 |
| S-65D | 28 | 30.16 | 19.27 | 0.63 | 1.58 | 0.00 | 0.89 | 7.63 | -0.05 | 0.49 | 0.00 | 0.00 | -0.13 | 0.59 | 0.02 |
| S-65E | 29 | 30.42 | 18.76 | 0.92 | 0.58 | -0.02 | 2.20 | 7.57 | 0.01 | 0.33 | 0.00 | 0.00 | 0.03 | 0.72 | 0.00 |

AECOM

**Table C-6: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 2003 to 2004 dry season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 12.53 | 14.56 | -4.00 | 0.31 | 0.00 | 0.19 | 3.15 | -0.54 | 0.86 | 0.00 | 0.00 | -1.28 | -1.55 | 0.03 |
| Shingle Creek | 2 | 12.55 | 13.09 | -1.70 | 0.12 | 0.00 | 0.40 | 1.76 | -0.54 | 0.09 | 0.00 | 0.00 | -1.48 | -1.94 | 0.03 |
| Boggy Creek | 3 | 14.08 | 13.74 | -1.75 | 0.21 | 0.00 | 0.17 | 2.74 | -0.32 | 0.17 | 0.00 | 0.00 | -0.60 | -1.10 | 0.03 |
| Lake Hart | 4 | 15.87 | 18.09 | -4.25 | -0.20 | -0.03 | 0.03 | 2.96 | -0.11 | 0.54 | 0.00 | 0.00 | -0.13 | -0.26 | 0.01 |
| Horse Creek | 5 | 12.50 | 14.05 | -5.75 | 3.18 | -0.05 | 1.55 | 0.02 | -0.19 | 1.14 | 0.00 | 0.00 | -1.54 | -0.79 | 0.01 |
| Lower Reedy Cr. | 6 | 12.43 | 16.41 | -5.01 | 0.05 | 0.01 | 0.63 | 3.35 | -0.40 | 0.15 | 0.00 | 0.00 | 1.51 | -0.90 | 0.03 |
| Lake Toho | 7 | 12.48 | 16.43 | -1.02 | -2.21 | 0.00 | 0.15 | 1.15 | -0.44 | 0.15 | 0.00 | 0.00 | 0.29 | -1.09 | 0.03 |
| East Lake Toho | 8 | 13.44 | 17.86 | -1.49 | -3.49 | 0.01 | 0.19 | 1.67 | -0.21 | 0.08 | 0.00 | 0.00 | 0.12 | -0.88 | 0.03 |
| Alligator Lake | 9 | 13.24 | 17.34 | -2.02 | -1.84 | 0.00 | 0.04 | 1.63 | -0.40 | 0.35 | 0.00 | 0.00 | -0.02 | -1.13 | 0.04 |
| Lake Mrytle | 10 | 13.99 | 17.77 | -5.05 | -0.56 | -0.01 | 0.30 | 1.46 | -0.15 | 0.00 | 0.00 | 0.00 | -0.51 | -0.27 | 0.03 |
| Lake Conlin | 11 | 13.53 | 16.77 | -1.42 | 0.00 | 0.00 | 0.00 | 1.41 | -0.84 | 0.04 | 0.00 | 0.00 | 0.03 | -2.15 | 0.18 |
| Lake Marion | 12 | 13.08 | 15.24 | -2.49 | -1.50 | 0.03 | 0.03 | 5.29 | -0.17 | 1.81 | 0.00 | 0.00 | 0.75 | -0.71 | 0.02 |
| Marion Creek | 13 | 12.71 | 16.43 | -5.01 | 0.04 | -0.04 | 0.39 | 3.08 | -0.12 | 0.01 | 0.00 | 0.00 | 1.35 | -0.77 | 0.02 |
| Lake Cypress | 14 | 13.21 | 17.02 | -2.11 | -1.30 | 0.00 | 0.45 | 0.92 | -0.55 | 0.00 | 0.00 | 0.00 | 0.26 | -0.91 | 0.04 |
| S63A | 15 | 13.20 | 16.05 | -2.15 | 0.01 | -0.01 | 0.10 | 1.31 | -0.57 | 0.11 | 0.00 | 0.00 | 0.03 | -1.36 | 0.06 |
| Lake Gentry | 16 | 13.31 | 16.94 | -1.56 | -0.80 | 0.01 | 0.11 | 2.12 | -0.52 | 1.17 | 0.00 | 0.00 | -0.05 | -1.74 | 0.10 |
| Lake Pierce | 17 | 14.40 | 15.15 | -3.31 | 0.29 | -0.03 | 0.00 | 4.20 | -0.13 | 2.74 | 0.00 | 0.00 | -1.87 | -0.93 | 0.01 |
| Catfish Creek | 18 | 14.85 | 15.73 | -4.05 | 0.25 | 0.05 | 1.65 | 5.38 | -0.33 | 0.44 | 0.00 | 0.00 | 2.24 | -1.02 | 0.02 |
| Lake Hatch | 19 | 13.68 | 19.22 | -4.21 | -2.66 | 0.05 | 0.66 | 2.35 | -0.16 | 0.01 | 0.00 | 0.00 | 1.22 | -0.23 | 0.01 |
| Lk Weohyakapaka | 20 | 14.89 | 15.75 | -4.22 | -0.90 | 0.00 | 0.02 | 6.09 | -0.09 | 1.47 | 0.00 | 0.00 | -0.93 | -1.21 | 0.02 |
| Lake Rosalie | 21 | 15.18 | 16.95 | -3.78 | 0.17 | -0.01 | 0.15 | 3.64 | -0.05 | 0.60 | 0.00 | 0.00 | 0.06 | -1.24 | 0.02 |
| Tiger Lake | 22 | 14.75 | 18.09 | -5.48 | -0.96 | -0.02 | 0.15 | 4.09 | -0.06 | 0.02 | 0.00 | 0.00 | 0.62 | -0.43 | 0.03 |
| Lake Kissimmee | 23 | 14.32 | 19.52 | -3.42 | -3.18 | 0.00 | 0.09 | 2.14 | -0.24 | 0.05 | 0.00 | 0.00 | 0.15 | -0.37 | 0.02 |
| Lake Jackson | 24 | 14.75 | 17.28 | -7.02 | -0.63 | 0.00 | 0.04 | 5.12 | -0.07 | 0.00 | 0.00 | 0.00 | -0.52 | -0.44 | 0.04 |
| Lake Marian | 25 | 15.91 | 18.26 | -3.14 | -1.38 | 0.00 | 0.01 | 3.39 | -0.20 | 0.00 | 0.00 | 0.00 | 0.12 | -0.85 | 0.05 |
| S-65A | 26 | 13.02 | 15.12 | -5.84 | 0.17 | -0.03 | 0.70 | 4.47 | -0.38 | 0.12 | 0.00 | 0.00 | -0.46 | -1.52 | 0.07 |
| S-65BC | 27 | 13.31 | 14.76 | -3.53 | 0.19 | 0.00 | 1.25 | 2.32 | -0.47 | 0.10 | 0.00 | 0.00 | 0.07 | -1.00 | 0.05 |
| S-65D | 28 | 12.32 | 13.85 | -1.91 | 0.36 | 0.00 | 0.70 | 1.44 | -0.62 | 0.63 | 0.00 | 0.00 | -0.16 | -1.01 | 0.03 |
| S-65E | 29 | 11.92 | 13.93 | -1.62 | -0.02 | -0.01 | 1.30 | 1.36 | -0.92 | 0.46 | 0.00 | 0.00 | 0.24 | -1.36 | 0.04 |

**Table C-7: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 2004 wet season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change $\Delta OL$ | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change ($\Delta UZ$) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 41.44 | 20.16 | 5.17 | 3.76 | -0.01 | 0.16 | 9.14 | 0.61 | 0.90 | 0.00 | 0.00 | -1.45 | 1.87 | -0.02 |
| Shingle Creek | 2 | 41.17 | 18.95 | 2.66 | 6.24 | 0.00 | 0.35 | 8.45 | 0.70 | 0.05 | 0.00 | 0.00 | -1.56 | 2.29 | -0.03 |
| Boggy Creek | 3 | 47.33 | 19.14 | 4.15 | 9.46 | -0.01 | 0.13 | 12.02 | 0.44 | 0.18 | 0.00 | 0.00 | -0.60 | 1.53 | -0.04 |
| Lake Hart | 4 | 55.76 | 22.41 | 13.77 | 8.13 | -0.15 | 0.04 | 11.21 | 0.12 | 0.70 | 0.00 | 0.00 | -0.14 | 0.49 | -0.02 |
| Horse Creek | 5 | 47.23 | 18.98 | 10.59 | 12.82 | -0.11 | 1.86 | 0.07 | 0.25 | 1.02 | 0.00 | 0.00 | -2.23 | 1.32 | -0.01 |
| Lower Reedy Cr. | 6 | 47.34 | 21.22 | 10.77 | 2.84 | 0.02 | 0.79 | 11.39 | 0.54 | 0.10 | 0.00 | 0.00 | 1.47 | 1.33 | -0.04 |
| Lake Toho | 7 | 44.02 | 21.23 | 2.59 | 8.05 | 0.00 | 0.14 | 10.15 | 0.66 | 0.13 | 0.00 | 0.00 | 0.31 | 1.60 | -0.04 |
| East Lake Toho | 8 | 43.01 | 22.57 | 3.00 | 7.79 | -0.03 | 0.21 | 8.02 | 0.29 | 0.07 | 0.00 | 0.00 | 0.13 | 1.26 | -0.04 |
| Alligator Lake | 9 | 41.25 | 21.82 | 4.61 | 4.92 | 0.00 | 0.06 | 7.99 | 0.45 | 0.29 | 0.00 | 0.00 | 0.03 | 1.66 | -0.06 |
| Lake Mrytle | 10 | 44.76 | 22.33 | 11.54 | 5.46 | -0.07 | 0.28 | 4.06 | 0.18 | 0.00 | 0.00 | 0.00 | -0.44 | 0.39 | -0.01 |
| Lake Conlin | 11 | 39.62 | 21.33 | 5.72 | 0.00 | -0.06 | 0.00 | 9.33 | 0.82 | 0.04 | 0.00 | 0.00 | -0.04 | 2.21 | -0.16 |
| Lake Marion | 12 | 48.37 | 19.91 | 5.57 | 6.63 | 0.05 | 0.03 | 16.33 | 0.30 | 1.68 | 0.00 | 0.00 | -0.07 | 1.30 | 0.03 |
| Marion Creek | 13 | 48.75 | 20.99 | 12.33 | 3.77 | -0.08 | 0.30 | 11.32 | 0.20 | 0.01 | 0.00 | 0.00 | 1.43 | 1.17 | -0.03 |
| Lake Cypress | 14 | 46.62 | 20.94 | 4.61 | 3.65 | -0.04 | 0.40 | 15.08 | 0.90 | 0.00 | 0.00 | 0.00 | 0.29 | 1.27 | -0.02 |
| S63A | 15 | 44.07 | 19.77 | 4.56 | 0.56 | -0.02 | 0.14 | 16.43 | 0.75 | 0.11 | 0.00 | 0.00 | -0.04 | 1.89 | -0.02 |
| Lake Gentry | 16 | 41.21 | 21.16 | 4.34 | 1.31 | 0.00 | 0.15 | 12.42 | 0.55 | 1.04 | 0.00 | 0.00 | -0.07 | 2.19 | -0.07 |
| Lake Pierce | 17 | 44.61 | 19.34 | 5.18 | 5.50 | -0.04 | 0.00 | 13.15 | 0.21 | 2.72 | 0.00 | 0.00 | -2.18 | 1.76 | 0.02 |
| Catfish Creek | 18 | 42.94 | 19.52 | 6.84 | 2.48 | -0.20 | 1.66 | 12.91 | 0.44 | 0.41 | 0.00 | 0.00 | 2.27 | 1.56 | -0.02 |
| Lake Hatch | 19 | 46.74 | 23.74 | 9.59 | 6.66 | 0.02 | 0.60 | 6.84 | 0.21 | 0.00 | 0.00 | 0.00 | 1.19 | 0.31 | -0.01 |
| Lk Weohyakapaka | 20 | 41.79 | 19.80 | 5.32 | 4.47 | 0.00 | 0.01 | 10.71 | 0.15 | 1.55 | 0.00 | 0.00 | -1.15 | 1.72 | -0.01 |
| Lake Rosalie | 21 | 41.96 | 21.31 | 5.73 | 6.41 | -0.04 | 0.13 | 7.07 | 0.10 | 0.61 | 0.00 | 0.00 | 0.07 | 1.83 | -0.02 |
| Tiger Lake | 22 | 43.56 | 22.27 | 7.56 | 5.36 | 0.00 | 0.14 | 8.20 | 0.09 | 0.01 | 0.00 | 0.00 | 0.61 | 0.53 | -0.03 |
| Lake Kissimmee | 23 | 44.61 | 23.87 | 5.16 | 6.07 | 0.00 | 0.07 | 8.85 | 0.30 | 0.05 | 0.00 | 0.00 | 0.15 | 0.47 | -0.01 |
| Lake Jackson | 24 | 45.44 | 21.40 | 9.94 | 1.17 | -0.02 | 0.04 | 11.79 | 0.07 | 0.00 | 0.00 | 0.00 | -0.47 | 0.52 | -0.01 |
| Lake Marian | 25 | 45.96 | 22.42 | 6.30 | 2.94 | 0.00 | 0.01 | 12.85 | 0.27 | 0.00 | 0.00 | 0.00 | 0.10 | 1.23 | -0.04 |
| S-65A | 26 | 38.96 | 18.94 | 7.28 | 0.99 | -0.03 | 0.64 | 8.42 | 0.52 | 0.12 | 0.00 | 0.00 | -0.45 | 1.78 | -0.02 |
| S-65BC | 27 | 35.43 | 18.96 | 6.57 | 0.68 | 0.00 | 0.92 | 6.30 | 0.69 | 0.10 | 0.00 | 0.00 | 0.03 | 1.39 | -0.03 |
| S-65D | 28 | 36.87 | 18.25 | 4.46 | 2.56 | -0.01 | 0.73 | 8.96 | 0.94 | 0.58 | 0.00 | 0.00 | -0.09 | 1.43 | -0.01 |
| S-65E | 29 | 36.32 | 17.41 | 4.42 | 1.32 | -0.03 | 1.95 | 8.84 | 1.11 | 0.47 | 0.00 | 0.00 | 0.04 | 1.72 | -0.04 |

**Table C-8: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the calibration period**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 49.41 | 1.03 | 37.63 | 10.22 | 0.00 | 0.00 | 1.15 | -1.73 | 0.05 |
| Shingle Creek | 2 | 45.81 | 2.34 | 33.03 | 9.96 | 0.00 | 0.00 | 0.54 | -1.04 | 0.02 |
| Boggy Creek | 3 | 47.44 | 0.90 | 42.21 | 4.01 | 0.00 | 0.00 | 0.27 | -0.61 | 0.01 |
| Lake Hart | 4 | 33.18 | 0.20 | 31.92 | 0.60 | 0.00 | 0.00 | -0.09 | -0.39 | 0.01 |
| Horse Creek (Closed Basin) | 5 | 23.78 | 10.60 | 0.27 | 3.67 | 0.00 | 0.00 | -8.73 | -0.54 | 0.03 |
| Lower Reedy Creek | 6 | 41.24 | 4.41 | 44.25 | -7.49 | 0.00 | 0.00 | 0.21 | -0.34 | 0.05 |
| Lake Tohopekaliga | 7 | 35.33 | 0.83 | 36.03 | -1.75 | 0.00 | 0.00 | -0.09 | -0.17 | 0.04 |
| East Lake Tohopekaliga | 8 | 29.49 | 1.26 | 28.59 | 0.15 | 0.00 | 0.00 | 0.87 | -0.38 | 0.02 |
| Alligator Lake | 9 | 29.56 | 0.32 | 28.94 | 0.18 | 0.00 | 0.00 | 0.21 | -0.36 | 0.03 |
| Lake Mrytle | 10 | 19.02 | 1.73 | 14.91 | 0.09 | 0.00 | 0.00 | -2.19 | -0.14 | 0.05 |
| Lake Conlin (Closed Basin) | 11 | 35.82 | 0.00 | 35.56 | 0.14 | 0.00 | 0.00 | -0.06 | -0.11 | 0.05 |
| Lake Marion | 12 | 64.52 | 0.18 | 63.67 | 3.60 | 0.00 | 0.00 | 2.92 | -0.10 | 0.10 |
| Marion Creek | 13 | 36.47 | 1.86 | 41.39 | -7.85 | 0.00 | 0.00 | -0.90 | -0.19 | 0.02 |
| Lake Cypress | 14 | 48.64 | 2.78 | 47.08 | -0.99 | 0.00 | 0.00 | 0.21 | -0.04 | 0.07 |
| S63A | 15 | 54.88 | 0.91 | 53.88 | 0.51 | 0.00 | 0.00 | 0.36 | -0.03 | 0.09 |
| Lake Gentry | 16 | 46.66 | 0.85 | 45.48 | 0.35 | 0.00 | 0.00 | 0.08 | -0.16 | 0.11 |
| Lake Pierce | 17 | 66.24 | 0.00 | 53.32 | 6.90 | 0.00 | 0.00 | -5.85 | -0.26 | 0.10 |
| Catfish Creek | 18 | 58.67 | 10.28 | 59.99 | -4.64 | 0.00 | 0.00 | 7.30 | -0.39 | 0.06 |
| Lake Hatchineha | 19 | 22.62 | 3.14 | 25.64 | -5.52 | 0.00 | 0.00 | 0.64 | -0.04 | 0.03 |
| Lake Weohyakapaka | 20 | 59.90 | 0.09 | 52.95 | 4.36 | 0.00 | 0.00 | -2.22 | -0.33 | 0.04 |
| Lake Rosalie | 21 | 35.90 | 0.69 | 34.58 | 0.85 | 0.00 | 0.00 | 0.51 | -0.32 | 0.02 |
| Tiger Lake | 22 | 35.44 | 0.77 | 37.32 | -0.76 | 0.00 | 0.00 | 1.92 | -0.06 | 0.03 |
| Lake Kissimmee | 23 | 35.22 | 0.42 | 35.51 | 0.12 | 0.00 | 0.00 | 0.80 | -0.01 | 0.04 |
| Lake Jackson | 24 | 51.46 | 0.22 | 48.69 | 0.83 | 0.00 | 0.00 | -1.76 | -0.04 | 0.08 |
| Lake Marian | 25 | 47.12 | 0.04 | 47.85 | 0.18 | 0.00 | 0.00 | 0.85 | 0.05 | 0.06 |
| S-65A | 26 | 52.07 | 4.65 | 44.80 | 1.13 | 0.00 | 0.00 | -1.58 | -0.03 | 0.12 |
| S-65BC | 27 | 36.36 | 6.76 | 29.79 | 1.17 | 0.00 | 0.00 | 1.35 | -0.11 | 0.12 |
| S-65D | 28 | 36.85 | 4.45 | 31.65 | 0.63 | 0.00 | 0.00 | -0.26 | 0.02 | 0.11 |
| S-65E | 29 | 37.44 | 10.20 | 27.93 | -1.57 | 0.00 | 0.00 | -1.09 | 0.12 | 0.09 |

**Table C-9: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 2001 to 2002 dry season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 0.70 | 0.17 | 1.32 | 1.51 | 0.00 | 0.00 | 0.13 | 2.18 | 0.00 |
| Shingle Creek | 2 | -0.10 | 0.36 | 0.87 | 1.50 | 0.00 | 0.00 | 0.08 | 2.75 | 0.00 |
| Boggy Creek | 3 | -0.24 | 0.13 | 1.04 | 0.66 | 0.00 | 0.00 | 0.02 | 2.06 | 0.00 |
| Lake Hart | 4 | -0.52 | 0.03 | 0.57 | 0.10 | 0.00 | 0.00 | 0.00 | 1.21 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 1.08 | 1.43 | 0.01 | 0.23 | 0.00 | 0.00 | -1.11 | 1.69 | 0.00 |
| Lower Reedy Creek | 6 | -1.23 | 0.48 | 1.56 | -1.17 | 0.00 | 0.00 | 0.09 | 2.00 | 0.01 |
| Lake Tohopekaliga | 7 | -1.21 | 0.09 | 0.81 | -0.29 | 0.00 | 0.00 | -0.05 | 1.86 | 0.00 |
| East Lake Tohopekaliga | 8 | -1.16 | 0.17 | 0.66 | 0.02 | 0.00 | 0.00 | 0.13 | 1.88 | 0.00 |
| Alligator Lake | 9 | -1.61 | 0.04 | 0.76 | 0.02 | 0.00 | 0.00 | 0.02 | 2.40 | 0.00 |
| Lake Mrytle | 10 | -0.10 | 0.21 | 0.43 | 0.01 | 0.00 | 0.00 | -0.25 | 0.99 | 0.01 |
| Lake Conlin (Closed Basin) | 11 | -1.69 | 0.00 | 1.25 | 0.02 | 0.00 | 0.00 | -0.01 | 2.95 | 0.01 |
| Lake Marion | 12 | 2.19 | 0.02 | 4.15 | 0.26 | 0.00 | 0.00 | 0.48 | 1.76 | 0.01 |
| Marion Creek | 13 | -1.12 | 0.30 | 1.29 | -1.14 | 0.00 | 0.00 | -0.15 | 1.71 | 0.00 |
| Lake Cypress | 14 | -0.69 | 0.39 | 0.67 | -0.15 | 0.00 | 0.00 | -0.01 | 1.61 | 0.01 |
| S63A | 15 | -1.82 | 0.08 | 0.80 | 0.07 | 0.00 | 0.00 | 0.04 | 2.72 | 0.01 |
| Lake Gentry | 16 | -1.61 | 0.12 | 1.48 | 0.05 | 0.00 | 0.00 | 0.03 | 3.21 | 0.01 |
| Lake Pierce | 17 | 2.04 | 0.00 | 2.92 | 0.90 | 0.00 | 0.00 | -0.89 | 2.66 | 0.01 |
| Catfish Creek | 18 | 0.42 | 1.33 | 2.79 | -0.61 | 0.00 | 0.00 | 0.88 | 2.20 | 0.01 |
| Lake Hatchineha | 19 | 0.00 | 0.37 | 1.06 | -0.70 | 0.00 | 0.00 | 0.08 | 0.63 | 0.00 |
| Lake Weohyakapaka | 20 | 1.89 | 0.01 | 3.52 | 0.58 | 0.00 | 0.00 | -0.28 | 2.50 | 0.00 |
| Lake Rosalie | 21 | -0.53 | 0.09 | 2.19 | 0.15 | 0.00 | 0.00 | 0.15 | 2.80 | 0.00 |
| Tiger Lake | 22 | 0.30 | 0.10 | 1.72 | -0.06 | 0.00 | 0.00 | 0.22 | 1.24 | 0.01 |
| Lake Kissimmee | 23 | 0.50 | 0.05 | 1.32 | 0.03 | 0.00 | 0.00 | 0.10 | 0.79 | 0.00 |
| Lake Jackson | 24 | 0.97 | 0.03 | 2.14 | 0.12 | 0.00 | 0.00 | -0.21 | 1.50 | 0.01 |
| Lake Marian | 25 | 0.39 | 0.01 | 2.35 | 0.02 | 0.00 | 0.00 | 0.12 | 1.85 | 0.01 |
| S-65A | 26 | 2.35 | 0.67 | 3.48 | 0.18 | 0.00 | 0.00 | -0.24 | 2.20 | 0.02 |
| S-65BC | 27 | 0.44 | 1.13 | 1.39 | 0.19 | 0.00 | 0.00 | 0.24 | 2.01 | 0.02 |
| S-65D | 28 | 0.55 | 0.57 | 1.51 | 0.12 | 0.00 | 0.00 | -0.09 | 1.72 | 0.02 |
| S-65E | 29 | 0.38 | 1.29 | 1.38 | -0.20 | 0.00 | 0.00 | -0.12 | 2.20 | 0.01 |

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**Table C-10: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 2002 wet season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 12.98 | 0.14 | 7.61 | 1.92 | 0.00 | 0.00 | 0.23 | -3.54 | 0.01 |
| Shingle Creek | 2 | 12.57 | 0.36 | 7.11 | 1.73 | 0.00 | 0.00 | 0.04 | -3.42 | 0.00 |
| Boggy Creek | 3 | 11.51 | 0.13 | 8.40 | 0.70 | 0.00 | 0.00 | 0.04 | -2.33 | 0.00 |
| Lake Hart | 4 | 6.07 | 0.03 | 4.56 | 0.10 | 0.00 | 0.00 | 0.01 | -1.38 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 6.34 | 1.77 | 0.07 | 1.11 | 0.00 | 0.00 | -1.48 | -1.91 | 0.01 |
| Lower Reedy Creek | 6 | 10.10 | 0.62 | 8.58 | -1.22 | 0.00 | 0.00 | 0.03 | -2.15 | 0.01 |
| Lake Tohopekaliga | 7 | 9.80 | 0.15 | 8.15 | -0.29 | 0.00 | 0.00 | 0.00 | -1.80 | 0.01 |
| East Lake Tohopekaliga | 8 | 7.88 | 0.21 | 5.81 | 0.02 | 0.00 | 0.00 | 0.13 | -1.98 | 0.00 |
| Alligator Lake | 9 | 8.03 | 0.06 | 5.59 | 0.03 | 0.00 | 0.00 | 0.06 | -2.42 | 0.00 |
| Lake Mrytle | 10 | 4.24 | 0.28 | 2.70 | 0.01 | 0.00 | 0.00 | -0.24 | -1.01 | 0.01 |
| Lake Conlin (Closed Basin) | 11 | 11.39 | 0.00 | 8.26 | 0.02 | 0.00 | 0.00 | -0.06 | -3.04 | 0.00 |
| Lake Marion | 12 | 14.79 | 0.02 | 12.14 | 1.38 | 0.00 | 0.00 | 0.42 | -1.69 | 0.02 |
| Marion Creek | 13 | 8.14 | 0.22 | 7.34 | -1.26 | 0.00 | 0.00 | -0.09 | -1.76 | 0.00 |
| Lake Cypress | 14 | 11.18 | 0.45 | 9.31 | -0.16 | 0.00 | 0.00 | 0.02 | -1.60 | 0.01 |
| S63A | 15 | 14.10 | 0.14 | 11.21 | 0.08 | 0.00 | 0.00 | 0.02 | -2.68 | 0.01 |
| Lake Gentry | 16 | 13.15 | 0.14 | 9.74 | 0.06 | 0.00 | 0.00 | 0.01 | -3.24 | 0.02 |
| Lake Pierce | 17 | 14.89 | 0.00 | 9.91 | 1.48 | 0.00 | 0.00 | -0.90 | -2.62 | 0.02 |
| Catfish Creek | 18 | 11.87 | 1.52 | 9.81 | -0.66 | 0.00 | 0.00 | 1.04 | -2.24 | 0.01 |
| Lake Hatchineha | 19 | 3.93 | 0.36 | 3.87 | -0.85 | 0.00 | 0.00 | 0.08 | -0.64 | 0.01 |
| Lake Weohyakapaka | 20 | 13.07 | 0.01 | 9.31 | 0.80 | 0.00 | 0.00 | -0.38 | -2.58 | 0.01 |
| Lake Rosalie | 21 | 8.28 | 0.08 | 5.38 | 0.19 | 0.00 | 0.00 | 0.16 | -2.80 | 0.00 |
| Tiger Lake | 22 | 7.49 | 0.08 | 6.49 | -0.09 | 0.00 | 0.00 | 0.23 | -1.24 | 0.01 |
| Lake Kissimmee | 23 | 8.39 | 0.05 | 7.67 | 0.01 | 0.00 | 0.00 | 0.12 | -0.78 | 0.01 |
| Lake Jackson | 24 | 9.50 | 0.03 | 7.67 | 0.14 | 0.00 | 0.00 | -0.21 | -1.46 | 0.01 |
| Lake Marian | 25 | 12.33 | 0.01 | 10.78 | 0.03 | 0.00 | 0.00 | 0.12 | -1.65 | 0.01 |
| S-65A | 26 | 14.23 | 0.90 | 10.82 | 0.20 | 0.00 | 0.00 | -0.25 | -2.08 | 0.02 |
| S-65BC | 27 | 11.34 | 1.06 | 8.42 | 0.21 | 0.00 | 0.00 | 0.21 | -1.87 | 0.02 |
| S-65D | 28 | 10.31 | 0.79 | 8.20 | 0.12 | 0.00 | 0.00 | -0.02 | -1.20 | 0.02 |
| S-65E | 29 | 8.70 | 1.81 | 5.56 | -0.23 | 0.00 | 0.00 | -0.25 | -1.33 | 0.02 |

**Table C-11: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 2002 to 2003 dry season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 8.99 | 0.20 | 7.61 | 1.91 | 0.00 | 0.00 | 0.20 | 0.51 | 0.01 |
| Shingle Creek | 2 | 8.03 | 0.46 | 6.54 | 1.76 | 0.00 | 0.00 | 0.12 | 0.61 | 0.00 |
| Boggy Creek | 3 | 7.73 | 0.18 | 7.25 | 0.66 | 0.00 | 0.00 | 0.04 | 0.32 | 0.00 |
| Lake Hart | 4 | 4.92 | 0.03 | 4.80 | 0.10 | 0.00 | 0.00 | -0.01 | 0.01 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 4.25 | 2.02 | 0.05 | 1.04 | 0.00 | 0.00 | -1.49 | 0.34 | 0.01 |
| Lower Reedy Creek | 6 | 9.09 | 0.97 | 9.44 | -1.02 | 0.00 | 0.00 | 0.01 | 0.28 | 0.01 |
| Lake Tohopekaliga | 7 | 6.43 | 0.15 | 6.79 | -0.27 | 0.00 | 0.00 | 0.00 | 0.22 | 0.01 |
| East Lake Tohopekaliga | 8 | 4.85 | 0.23 | 4.94 | 0.03 | 0.00 | 0.00 | 0.15 | 0.20 | 0.00 |
| Alligator Lake | 9 | 5.50 | 0.06 | 5.66 | 0.03 | 0.00 | 0.00 | 0.03 | 0.22 | 0.01 |
| Lake Mrytle | 10 | 3.23 | 0.31 | 2.63 | 0.02 | 0.00 | 0.00 | -0.36 | 0.07 | 0.01 |
| Lake Conlin (Closed Basin) | 11 | 6.03 | 0.00 | 6.60 | 0.03 | 0.00 | 0.00 | -0.02 | 0.61 | 0.01 |
| Lake Marion | 12 | 12.90 | 0.03 | 12.47 | 1.20 | 0.00 | 0.00 | 0.51 | 0.27 | 0.02 |
| Marion Creek | 13 | 8.14 | 0.33 | 8.93 | -1.11 | 0.00 | 0.00 | -0.18 | 0.18 | 0.01 |
| Lake Cypress | 14 | 9.69 | 0.55 | 9.54 | -0.14 | 0.00 | 0.00 | 0.01 | 0.23 | 0.02 |
| S63A | 15 | 10.04 | 0.22 | 10.28 | 0.09 | 0.00 | 0.00 | 0.05 | 0.47 | 0.02 |
| Lake Gentry | 16 | 8.70 | 0.16 | 9.06 | 0.06 | 0.00 | 0.00 | 0.03 | 0.52 | 0.02 |
| Lake Pierce | 17 | 12.42 | 0.00 | 10.42 | 1.38 | 0.00 | 0.00 | -0.98 | 0.35 | 0.02 |
| Catfish Creek | 18 | 12.67 | 1.99 | 12.94 | -0.67 | 0.00 | 0.00 | 1.31 | 0.27 | 0.01 |
| Lake Hatchineha | 19 | 5.28 | 0.55 | 5.74 | -0.87 | 0.00 | 0.00 | 0.12 | 0.02 | 0.01 |
| Lake Weohyakapaka | 20 | 10.51 | 0.02 | 9.85 | 0.82 | 0.00 | 0.00 | -0.39 | 0.57 | 0.01 |
| Lake Rosalie | 21 | 6.98 | 0.12 | 7.01 | 0.22 | 0.00 | 0.00 | 0.00 | 0.36 | 0.00 |
| Tiger Lake | 22 | 6.47 | 0.14 | 6.78 | -0.10 | 0.00 | 0.00 | 0.27 | 0.08 | 0.01 |
| Lake Kissimmee | 23 | 5.33 | 0.07 | 5.56 | 0.03 | 0.00 | 0.00 | 0.14 | 0.19 | 0.01 |
| Lake Jackson | 24 | 8.65 | 0.04 | 8.25 | 0.14 | 0.00 | 0.00 | -0.28 | 0.06 | 0.01 |
| Lake Marian | 25 | 6.66 | 0.01 | 7.47 | 0.03 | 0.00 | 0.00 | 0.16 | 0.68 | 0.01 |
| S-65A | 26 | 7.97 | 0.86 | 7.65 | 0.19 | 0.00 | 0.00 | -0.27 | 0.99 | 0.02 |
| S-65BC | 27 | 5.47 | 1.23 | 4.93 | 0.21 | 0.00 | 0.00 | 0.23 | 0.65 | 0.02 |
| S-65D | 28 | 4.30 | 0.77 | 3.91 | 0.11 | 0.00 | 0.00 | -0.04 | 0.52 | 0.01 |
| S-65E | 29 | 4.42 | 1.65 | 3.22 | -0.28 | 0.00 | 0.00 | -0.16 | 0.32 | 0.01 |

**Table C-12: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 2003 wet season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 11.08 | 0.18 | 8.79 | 1.77 | 0.00 | 0.00 | 0.22 | -0.56 | 0.01 |
| Shingle Creek | 2 | 10.97 | 0.42 | 8.30 | 1.74 | 0.00 | 0.00 | 0.11 | -0.63 | 0.00 |
| Boggy Creek | 3 | 11.76 | 0.16 | 10.76 | 0.67 | 0.00 | 0.00 | 0.05 | -0.23 | 0.00 |
| Lake Hart | 4 | 7.99 | 0.04 | 7.83 | 0.10 | 0.00 | 0.00 | -0.02 | -0.01 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 4.31 | 1.97 | 0.06 | 0.55 | 0.00 | 0.00 | -1.61 | -0.13 | 0.00 |
| Lower Reedy Creek | 6 | 9.70 | 0.92 | 9.93 | -1.17 | 0.00 | 0.00 | 0.02 | -0.05 | 0.01 |
| Lake Tohopekaliga | 7 | 8.83 | 0.16 | 8.98 | -0.26 | 0.00 | 0.00 | -0.01 | 0.06 | 0.01 |
| East Lake Tohopekaliga | 8 | 7.70 | 0.24 | 7.49 | 0.03 | 0.00 | 0.00 | 0.17 | -0.11 | 0.00 |
| Alligator Lake | 9 | 7.40 | 0.08 | 7.31 | 0.03 | 0.00 | 0.00 | 0.03 | -0.02 | 0.01 |
| Lake Mrytle | 10 | 4.49 | 0.36 | 3.63 | 0.02 | 0.00 | 0.00 | -0.43 | -0.07 | 0.01 |
| Lake Conlin (Closed Basin) | 11 | 9.30 | 0.00 | 8.72 | 0.03 | 0.00 | 0.00 | 0.00 | -0.57 | 0.01 |
| Lake Marion | 12 | 13.11 | 0.04 | 13.29 | 0.47 | 0.00 | 0.00 | 0.53 | 0.15 | 0.01 |
| Marion Creek | 13 | 8.61 | 0.34 | 9.43 | -1.27 | 0.00 | 0.00 | -0.19 | 0.07 | 0.00 |
| Lake Cypress | 14 | 11.83 | 0.54 | 11.57 | -0.14 | 0.00 | 0.00 | 0.05 | 0.08 | 0.01 |
| S63A | 15 | 14.09 | 0.23 | 13.85 | 0.09 | 0.00 | 0.00 | 0.08 | -0.01 | 0.01 |
| Lake Gentry | 16 | 11.08 | 0.17 | 10.67 | 0.06 | 0.00 | 0.00 | 0.01 | -0.20 | 0.02 |
| Lake Pierce | 17 | 14.71 | 0.00 | 12.72 | 1.18 | 0.00 | 0.00 | -1.00 | 0.17 | 0.02 |
| Catfish Creek | 18 | 16.11 | 2.13 | 16.16 | -0.75 | 0.00 | 0.00 | 1.50 | -0.08 | 0.01 |
| Lake Hatchineha | 19 | 5.31 | 0.60 | 5.78 | -0.91 | 0.00 | 0.00 | 0.14 | 0.02 | 0.00 |
| Lake Weohyakapaka | 20 | 15.03 | 0.02 | 13.47 | 0.81 | 0.00 | 0.00 | -0.44 | -0.30 | 0.01 |
| Lake Rosalie | 21 | 9.72 | 0.12 | 9.29 | 0.21 | 0.00 | 0.00 | 0.00 | -0.10 | 0.01 |
| Tiger Lake | 22 | 9.75 | 0.16 | 10.05 | -0.12 | 0.00 | 0.00 | 0.36 | -0.03 | 0.00 |
| Lake Kissimmee | 23 | 10.08 | 0.08 | 9.98 | 0.06 | 0.00 | 0.00 | 0.15 | -0.11 | 0.01 |
| Lake Jackson | 24 | 14.30 | 0.04 | 13.71 | 0.15 | 0.00 | 0.00 | -0.36 | -0.05 | 0.01 |
| Lake Marian | 25 | 11.34 | 0.01 | 11.01 | 0.03 | 0.00 | 0.00 | 0.16 | -0.45 | 0.01 |
| S-65A | 26 | 12.17 | 0.88 | 9.97 | 0.20 | 0.00 | 0.00 | -0.27 | -0.87 | 0.02 |
| S-65BC | 27 | 8.06 | 1.17 | 6.42 | 0.20 | 0.00 | 0.00 | 0.22 | -0.51 | 0.02 |
| S-65D | 28 | 9.23 | 0.89 | 7.63 | 0.11 | 0.00 | 0.00 | -0.03 | -0.59 | 0.03 |
| S-65E | 29 | 10.45 | 2.20 | 7.57 | -0.27 | 0.00 | 0.00 | -0.24 | -0.72 | 0.02 |

**Table C-13: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 2003 to 2004 dry season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 3.07 | 0.19 | 3.15 | 1.44 | 0.00 | 0.00 | 0.16 | 1.55 | 0.01 |
| Shingle Creek | 2 | 1.70 | 0.40 | 1.76 | 1.59 | 0.00 | 0.00 | 0.11 | 1.94 | 0.00 |
| Boggy Creek | 3 | 2.40 | 0.17 | 2.74 | 0.65 | 0.00 | 0.00 | 0.05 | 1.10 | 0.00 |
| Lake Hart | 4 | 2.86 | 0.03 | 2.96 | 0.10 | 0.00 | 0.00 | -0.03 | 0.26 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 2.32 | 1.55 | 0.02 | 0.15 | 0.00 | 0.00 | -1.39 | 0.79 | 0.00 |
| Lower Reedy Creek | 6 | 1.57 | 0.63 | 3.35 | -1.45 | 0.00 | 0.00 | 0.06 | 0.90 | 0.01 |
| Lake Tohopekaliga | 7 | -0.09 | 0.15 | 1.15 | -0.33 | 0.00 | 0.00 | -0.04 | 1.09 | 0.00 |
| East Lake Tohopekaliga | 8 | 0.87 | 0.19 | 1.67 | 0.03 | 0.00 | 0.00 | 0.14 | 0.88 | 0.00 |
| Alligator Lake | 9 | 0.56 | 0.04 | 1.63 | 0.03 | 0.00 | 0.00 | 0.02 | 1.13 | 0.01 |
| Lake Mrytle | 10 | 1.99 | 0.30 | 1.46 | 0.02 | 0.00 | 0.00 | -0.49 | 0.27 | 0.01 |
| Lake Conlin (Closed Basin) | 11 | -0.78 | 0.00 | 1.41 | 0.02 | 0.00 | 0.00 | 0.05 | 2.15 | 0.02 |
| Lake Marion | 12 | 3.85 | 0.03 | 5.29 | -0.24 | 0.00 | 0.00 | 0.52 | 0.71 | 0.01 |
| Marion Creek | 13 | 1.35 | 0.39 | 3.08 | -1.52 | 0.00 | 0.00 | -0.17 | 0.77 | 0.00 |
| Lake Cypress | 14 | 0.19 | 0.45 | 0.92 | -0.21 | 0.00 | 0.00 | 0.05 | 0.91 | 0.01 |
| S63A | 15 | 0.01 | 0.10 | 1.31 | 0.09 | 0.00 | 0.00 | 0.12 | 1.36 | 0.01 |
| Lake Gentry | 16 | 0.53 | 0.11 | 2.12 | 0.06 | 0.00 | 0.00 | 0.01 | 1.74 | 0.02 |
| Lake Pierce | 17 | 5.12 | 0.00 | 4.20 | 0.78 | 0.00 | 0.00 | -1.09 | 0.93 | 0.01 |
| Catfish Creek | 18 | 3.76 | 1.65 | 5.38 | -0.96 | 0.00 | 0.00 | 1.28 | 1.02 | 0.01 |
| Lake Hatchineha | 19 | 1.56 | 0.66 | 2.35 | -1.10 | 0.00 | 0.00 | 0.12 | 0.23 | 0.00 |
| Lake Weohyakapaka | 20 | 5.82 | 0.02 | 6.09 | 0.63 | 0.00 | 0.00 | -0.30 | 1.21 | 0.00 |
| Lake Rosalie | 21 | 2.48 | 0.15 | 3.64 | 0.03 | 0.00 | 0.00 | 0.09 | 1.24 | 0.00 |
| Tiger Lake | 22 | 3.18 | 0.15 | 4.09 | -0.19 | 0.00 | 0.00 | 0.43 | 0.43 | 0.01 |
| Lake Kissimmee | 23 | 1.70 | 0.09 | 2.14 | 0.00 | 0.00 | 0.00 | 0.15 | 0.37 | 0.00 |
| Lake Jackson | 24 | 5.22 | 0.04 | 5.12 | 0.14 | 0.00 | 0.00 | -0.37 | 0.44 | 0.01 |
| Lake Marian | 25 | 2.41 | 0.01 | 3.39 | 0.03 | 0.00 | 0.00 | 0.16 | 0.85 | 0.01 |
| S-65A | 26 | 4.10 | 0.70 | 4.47 | 0.17 | 0.00 | 0.00 | -0.29 | 1.52 | 0.02 |
| S-65BC | 27 | 2.48 | 1.25 | 2.32 | 0.18 | 0.00 | 0.00 | 0.24 | 1.00 | 0.02 |
| S-65D | 28 | 1.28 | 0.70 | 1.44 | 0.09 | 0.00 | 0.00 | -0.08 | 1.01 | 0.02 |
| S-65E | 29 | 1.04 | 1.30 | 1.36 | -0.32 | 0.00 | 0.00 | -0.07 | 1.36 | 0.01 |

**Table C-14: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 2004 wet season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 12.60 | 0.16 | 9.14 | 1.67 | 0.00 | 0.00 | 0.22 | -1.87 | 0.01 |
| Shingle Creek | 2 | 12.64 | 0.35 | 8.45 | 1.65 | 0.00 | 0.00 | 0.08 | -2.29 | 0.01 |
| Boggy Creek | 3 | 14.28 | 0.13 | 12.02 | 0.67 | 0.00 | 0.00 | 0.07 | -1.53 | 0.00 |
| Lake Hart | 4 | 11.87 | 0.04 | 11.21 | 0.10 | 0.00 | 0.00 | -0.04 | -0.49 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 5.48 | 1.86 | 0.07 | 0.59 | 0.00 | 0.00 | -1.65 | -1.32 | 0.01 |
| Lower Reedy Creek | 6 | 12.02 | 0.79 | 11.39 | -1.46 | 0.00 | 0.00 | 0.00 | -1.33 | 0.01 |
| Lake Tohopekaliga | 7 | 11.56 | 0.14 | 10.15 | -0.30 | 0.00 | 0.00 | 0.01 | -1.60 | 0.01 |
| East Lake Tohopekaliga | 8 | 9.35 | 0.21 | 8.02 | 0.03 | 0.00 | 0.00 | 0.15 | -1.26 | 0.00 |
| Alligator Lake | 9 | 9.67 | 0.06 | 7.99 | 0.03 | 0.00 | 0.00 | 0.06 | -1.66 | 0.00 |
| Lake Mrytle | 10 | 5.16 | 0.28 | 4.06 | 0.02 | 0.00 | 0.00 | -0.42 | -0.39 | 0.01 |
| Lake Conlin (Closed Basin) | 11 | 11.57 | 0.00 | 9.33 | 0.03 | 0.00 | 0.00 | -0.01 | -2.21 | 0.01 |
| Lake Marion | 12 | 17.68 | 0.03 | 16.33 | 0.53 | 0.00 | 0.00 | 0.46 | -1.30 | 0.04 |
| Marion Creek | 13 | 11.34 | 0.30 | 11.32 | -1.55 | 0.00 | 0.00 | -0.11 | -1.17 | 0.01 |
| Lake Cypress | 14 | 16.44 | 0.40 | 15.08 | -0.19 | 0.00 | 0.00 | 0.09 | -1.27 | 0.02 |
| S63A | 15 | 18.47 | 0.14 | 16.43 | 0.09 | 0.00 | 0.00 | 0.06 | -1.89 | 0.02 |
| Lake Gentry | 16 | 14.80 | 0.15 | 12.42 | 0.06 | 0.00 | 0.00 | 0.00 | -2.19 | 0.03 |
| Lake Pierce | 17 | 17.06 | 0.00 | 13.15 | 1.19 | 0.00 | 0.00 | -0.99 | -1.76 | 0.03 |
| Catfish Creek | 18 | 13.85 | 1.66 | 12.91 | -0.97 | 0.00 | 0.00 | 1.29 | -1.56 | 0.01 |
| Lake Hatchineha | 19 | 6.54 | 0.60 | 6.84 | -1.09 | 0.00 | 0.00 | 0.10 | -0.31 | 0.01 |
| Lake Weohyakapaka | 20 | 13.58 | 0.01 | 10.71 | 0.72 | 0.00 | 0.00 | -0.43 | -1.72 | 0.01 |
| Lake Rosalie | 21 | 8.96 | 0.13 | 7.07 | 0.05 | 0.00 | 0.00 | 0.11 | -1.83 | 0.00 |
| Tiger Lake | 22 | 8.25 | 0.14 | 8.20 | -0.21 | 0.00 | 0.00 | 0.40 | -0.53 | 0.01 |
| Lake Kissimmee | 23 | 9.23 | 0.07 | 8.85 | -0.01 | 0.00 | 0.00 | 0.14 | -0.47 | 0.01 |
| Lake Jackson | 24 | 12.81 | 0.04 | 11.79 | 0.15 | 0.00 | 0.00 | -0.33 | -0.52 | 0.02 |
| Lake Marian | 25 | 13.98 | 0.01 | 12.85 | 0.03 | 0.00 | 0.00 | 0.13 | -1.23 | 0.02 |
| S-65A | 26 | 11.26 | 0.64 | 8.42 | 0.19 | 0.00 | 0.00 | -0.27 | -1.78 | 0.03 |
| S-65BC | 27 | 8.57 | 0.92 | 6.30 | 0.18 | 0.00 | 0.00 | 0.20 | -1.39 | 0.02 |
| S-65D | 28 | 11.19 | 0.73 | 8.96 | 0.09 | 0.00 | 0.00 | 0.00 | -1.43 | 0.02 |
| S-65E | 29 | 12.46 | 1.95 | 8.84 | -0.28 | 0.00 | 0.00 | -0.24 | -1.72 | 0.01 |

# APPENDIX D

# KBMOS AFET Water Budget tables for the Verification Runs

# KBMOS AFET Water Budget tables for the Verification Runs

**Table D-1: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the verification period.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 249 | 168 | 2.90 | 14.43 | 0.00 | 1.71 | 50.00 | 0.30 | 2.33 | 0.00 | 0.00 | -12.97 | 1.28 | 0.00 |
| Shingle Creek | 2 | 249 | 157 | 0.15 | 25.04 | -0.01 | 3.20 | 50.13 | 0.24 | 0.45 | 0.00 | 0.00 | -12.58 | 0.90 | 0.00 |
| Boggy Creek | 3 | 255 | 159 | -0.38 | 27.57 | -0.03 | 1.12 | 62.74 | 0.09 | 0.92 | 0.00 | 0.00 | -5.51 | 0.75 | -0.02 |
| Lake Hart | 4 | 265 | 190 | 8.45 | 16.84 | -0.49 | 0.43 | 48.72 | 0.13 | 1.17 | 0.00 | 0.00 | -1.26 | 0.51 | -0.01 |
| Horse Creek | 5 | 250 | 160 | 11.38 | 54.98 | -0.09 | 15.69 | 0.00 | -0.08 | 10.06 | 0.00 | 0.00 | -17.61 | 0.63 | 0.00 |
| Lower Reedy Cr. | 6 | 244 | 179 | 5.03 | 7.09 | -0.03 | 6.19 | 61.21 | 0.12 | 1.13 | 0.00 | 0.00 | 13.68 | 0.88 | -0.01 |
| Lake Toho | 7 | 252 | 185 | -0.59 | 14.37 | -0.01 | 0.96 | 55.73 | -0.13 | 1.25 | 0.00 | 0.00 | 2.15 | 0.35 | 0.01 |
| East Lake Toho | 8 | 258 | 193 | -0.36 | 15.94 | -0.06 | 1.92 | 48.20 | -0.09 | 0.60 | 0.00 | 0.00 | 0.97 | 0.37 | 0.00 |
| Alligator Lake | 9 | 265 | 189 | 0.75 | 19.05 | 0.02 | 0.78 | 58.27 | 0.00 | 2.64 | 0.00 | 0.00 | 0.47 | 0.19 | 0.01 |
| Lake Mrytle | 10 | 264 | 191 | 6.86 | 25.38 | -0.70 | 2.94 | 32.36 | -0.04 | 0.00 | 0.00 | 0.00 | -5.09 | 0.12 | 0.01 |
| Lake Conlin | 11 | 256 | 184 | -0.09 | 0.00 | -0.23 | 0.00 | 69.66 | 0.52 | 0.34 | 0.00 | 0.00 | 0.18 | 1.54 | -0.02 |
| Lake Marion | 12 | 248 | 167 | 1.97 | 11.85 | 0.48 | 0.34 | 86.53 | -0.01 | 16.59 | 0.00 | 0.00 | 3.03 | 0.69 | 0.03 |
| Marion Creek | 13 | 242 | 177 | 6.46 | 7.72 | -0.60 | 2.98 | 57.74 | 0.13 | 0.06 | 0.00 | 0.00 | 11.19 | 0.82 | -0.01 |
| Lake Cypress | 14 | 251 | 184 | 0.80 | 2.66 | -0.05 | 3.69 | 62.01 | 0.32 | 0.00 | 0.00 | 0.00 | 2.93 | 0.82 | 0.00 |
| S63A | 15 | 253 | 172 | 1.02 | 1.68 | -0.13 | 1.36 | 76.39 | 0.49 | 0.94 | 0.00 | 0.00 | 0.10 | 1.07 | 0.02 |
| Lake Gentry | 16 | 252 | 180 | 0.47 | 1.79 | 0.00 | 1.11 | 75.50 | 0.55 | 9.56 | 0.00 | 0.00 | -0.36 | 1.52 | 0.03 |
| Lake Pierce | 17 | 245 | 165 | 3.71 | 13.23 | -0.16 | 0.00 | 67.95 | 0.09 | 25.61 | 0.00 | 0.00 | -19.12 | 0.95 | 0.01 |
| Catfish Creek | 18 | 244 | 166 | 2.36 | 10.16 | -0.25 | 18.28 | 66.29 | 0.10 | 4.46 | 0.00 | 0.00 | 16.52 | 1.52 | -0.01 |
| Lake Hatch | 19 | 243 | 203 | 9.01 | -0.88 | 0.45 | 4.82 | 36.76 | 0.14 | 0.06 | 0.00 | 0.00 | 9.97 | 0.37 | -0.01 |
| Lk Weohyakapaka | 20 | 249 | 168 | 4.01 | 10.82 | -0.04 | 0.15 | 72.50 | 0.08 | 13.88 | 0.00 | 0.00 | -5.54 | 1.36 | 0.00 |
| Lake Rosalie | 21 | 245 | 180 | 4.90 | 21.38 | -0.17 | 1.21 | 39.94 | -0.02 | 5.60 | 0.00 | 0.00 | -1.81 | 1.33 | -0.02 |
| Tiger Lake | 22 | 250 | 190 | 7.48 | 7.45 | -0.04 | 0.81 | 45.74 | 0.31 | 0.10 | 0.00 | 0.00 | 3.19 | 1.36 | -0.04 |
| Lake Kissimmee | 23 | 259 | 206 | 5.26 | 1.90 | -0.03 | 0.52 | 44.60 | 0.37 | 0.38 | 0.00 | 0.00 | 0.46 | 1.02 | -0.02 |
| Lake Jackson | 24 | 264 | 181 | 8.78 | 1.35 | -0.11 | 0.25 | 66.21 | 0.25 | 0.01 | 0.00 | 0.00 | -4.10 | 1.46 | -0.05 |
| Lake Marian | 25 | 284 | 192 | 4.69 | 6.43 | 0.00 | 0.06 | 79.62 | 0.40 | 0.00 | 0.00 | 0.00 | 0.77 | 1.33 | -0.01 |
| S-65A | 26 | 266 | 167 | 8.24 | 8.04 | -0.32 | 6.00 | 71.73 | 0.31 | 0.69 | 0.00 | 0.00 | -3.10 | 2.17 | 0.03 |
| S-65BC | 27 | 261 | 170 | 6.52 | 3.92 | 0.05 | 10.95 | 70.59 | 0.05 | 0.80 | 0.00 | 0.00 | 0.05 | 0.62 | 0.06 |
| S-65D | 28 | 254 | 165 | 2.33 | 11.42 | -0.31 | 7.14 | 69.90 | 0.05 | 4.73 | 0.00 | 0.00 | -2.14 | 0.57 | 0.08 |
| S-65E | 29 | 243 | 164 | -0.59 | 1.51 | -2.73 | 17.32 | 63.77 | -0.18 | 3.40 | 0.00 | 0.00 | 2.61 | 0.16 | 0.07 |

See Appendix C for a description of each component of the Water Budget

**Table D-2: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 1994 wet season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change $\Delta OL$ | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change ($\Delta UZ$) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 39.28 | 20.82 | 4.71 | 2.12 | 0.00 | 0.16 | 7.34 | 0.56 | 0.22 | 0.00 | 0.00 | -1.83 | 1.94 | -0.02 |
| Shingle Creek | 2 | 41.02 | 19.84 | 2.48 | 5.15 | 0.00 | 0.33 | 9.40 | 0.46 | 0.04 | 0.00 | 0.00 | -1.33 | 2.05 | -0.02 |
| Boggy Creek | 3 | 44.14 | 19.58 | 3.35 | 6.54 | 0.00 | 0.11 | 12.08 | 0.27 | 0.09 | 0.00 | 0.00 | -0.59 | 1.67 | -0.04 |
| Lake Hart | 4 | 45.16 | 21.99 | 10.65 | 3.87 | -0.06 | 0.05 | 7.55 | 0.13 | 0.14 | 0.00 | 0.00 | -0.16 | 0.79 | -0.03 |
| Horse Creek | 5 | 39.48 | 19.27 | 9.94 | 5.74 | -0.04 | 1.80 | 0.00 | 0.19 | 1.04 | 0.00 | 0.00 | -2.39 | 1.15 | -0.01 |
| Lower Reedy Cr. | 6 | 38.24 | 21.10 | 6.57 | 1.13 | 0.00 | 0.65 | 7.65 | 0.43 | 0.12 | 0.00 | 0.00 | 0.68 | 1.48 | -0.04 |
| Lake Toho | 7 | 41.20 | 22.33 | 1.42 | 5.48 | 0.00 | 0.13 | 10.59 | 0.16 | 0.12 | 0.00 | 0.00 | 0.06 | 1.24 | -0.03 |
| East Lake Toho | 8 | 44.41 | 23.15 | 2.41 | 8.07 | -0.02 | 0.24 | 9.42 | 0.03 | 0.06 | 0.00 | 0.00 | 0.11 | 1.21 | -0.03 |
| Alligator Lake | 9 | 44.20 | 22.64 | 4.34 | 5.54 | 0.00 | 0.11 | 10.58 | 0.06 | 0.24 | 0.00 | 0.00 | 0.09 | 1.21 | -0.05 |
| Lake Mrytle | 10 | 44.82 | 22.44 | 11.07 | 5.45 | -0.08 | 0.36 | 4.63 | 0.04 | 0.00 | 0.00 | 0.00 | -0.41 | 0.33 | -0.02 |
| Lake Conlin | 11 | 40.32 | 21.92 | 4.79 | 0.00 | -0.04 | 0.00 | 11.03 | 0.49 | 0.05 | 0.00 | 0.00 | -0.04 | 1.92 | -0.14 |
| Lake Marion | 12 | 41.35 | 19.79 | 4.68 | 4.23 | 0.06 | 0.02 | 12.52 | 0.20 | 1.72 | 0.00 | 0.00 | -0.20 | 1.48 | -0.02 |
| Marion Creek | 13 | 39.13 | 20.73 | 8.24 | 1.40 | -0.03 | 0.28 | 7.23 | 0.21 | 0.01 | 0.00 | 0.00 | 0.46 | 1.43 | -0.04 |
| Lake Cypress | 14 | 40.43 | 21.34 | 3.08 | 2.10 | 0.00 | 0.44 | 11.48 | 0.69 | 0.00 | 0.00 | 0.00 | 0.15 | 1.39 | -0.05 |
| S63A | 15 | 39.96 | 19.99 | 3.10 | 0.33 | -0.01 | 0.20 | 13.68 | 0.71 | 0.11 | 0.00 | 0.00 | 0.01 | 2.01 | -0.05 |
| Lake Gentry | 16 | 38.15 | 20.99 | 3.13 | 1.05 | -0.01 | 0.16 | 10.88 | 0.51 | 1.00 | 0.00 | 0.00 | -0.04 | 2.29 | -0.09 |
| Lake Pierce | 17 | 36.42 | 19.26 | 4.38 | 2.60 | -0.03 | 0.00 | 8.58 | 0.26 | 2.77 | 0.00 | 0.00 | -2.39 | 1.67 | -0.02 |
| Catfish Creek | 18 | 33.39 | 19.34 | 3.42 | 1.11 | -0.09 | 1.84 | 6.62 | 0.47 | 0.46 | 0.00 | 0.00 | 0.99 | 1.91 | -0.04 |
| Lake Hatch | 19 | 35.86 | 23.42 | 6.11 | 1.86 | 0.02 | 0.34 | 3.86 | 0.23 | 0.01 | 0.00 | 0.00 | 0.42 | 0.46 | -0.02 |
| Lk Weohyakapaka | 20 | 34.73 | 19.78 | 3.43 | 2.39 | 0.00 | 0.01 | 8.21 | 0.23 | 1.52 | 0.00 | 0.00 | -0.59 | 1.58 | -0.02 |
| Lake Rosalie | 21 | 32.78 | 20.98 | 3.66 | 2.44 | -0.01 | 0.10 | 4.00 | 0.09 | 0.61 | 0.00 | 0.00 | -0.39 | 1.68 | -0.03 |
| Tiger Lake | 22 | 36.65 | 21.76 | 6.10 | 1.83 | -0.01 | 0.05 | 4.96 | 0.34 | 0.01 | 0.00 | 0.00 | -0.05 | 1.49 | -0.06 |
| Lake Kissimmee | 23 | 40.81 | 23.60 | 4.38 | 3.82 | 0.00 | 0.03 | 7.31 | 0.47 | 0.04 | 0.00 | 0.00 | -0.08 | 1.13 | -0.04 |
| Lake Jackson | 24 | 41.23 | 20.63 | 8.82 | 0.86 | -0.01 | 0.02 | 8.59 | 0.27 | 0.00 | 0.00 | 0.00 | -0.39 | 1.57 | -0.07 |
| Lake Marian | 25 | 40.69 | 21.52 | 4.53 | 2.08 | 0.00 | 0.00 | 10.36 | 0.49 | 0.00 | 0.00 | 0.00 | 0.09 | 1.75 | -0.05 |
| S-65A | 26 | 40.50 | 19.38 | 6.32 | 1.30 | -0.04 | 0.60 | 10.14 | 0.41 | 0.07 | 0.00 | 0.00 | -0.40 | 1.94 | -0.04 |
| S-65BC | 27 | 38.54 | 20.17 | 5.79 | 0.33 | 0.01 | 1.22 | 10.08 | 0.20 | 0.07 | 0.00 | 0.00 | -0.07 | 0.74 | -0.01 |
| S-65D | 28 | 38.76 | 19.96 | 3.93 | 1.82 | -0.03 | 0.80 | 11.29 | 0.21 | 0.48 | 0.00 | 0.00 | -0.23 | 0.93 | -0.02 |
| S-65E | 29 | 37.42 | 19.66 | 2.63 | 0.86 | -0.34 | 2.39 | 10.96 | 0.18 | 0.29 | 0.00 | 0.00 | -0.01 | 0.68 | 0.00 |

**Table D-3: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 1994 to 1995 dry season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 19.73 | 15.53 | -2.94 | 1.31 | 0.00 | 0.22 | 6.09 | -0.46 | 0.23 | 0.00 | 0.00 | -1.47 | -1.26 | 0.02 |
| Shingle Creek | 2 | 19.17 | 14.28 | -2.53 | 2.10 | 0.00 | 0.40 | 5.97 | -0.54 | 0.04 | 0.00 | 0.00 | -1.28 | -1.73 | 0.02 |
| Boggy Creek | 3 | 17.43 | 13.93 | -3.94 | 2.22 | 0.00 | 0.15 | 6.48 | -0.36 | 0.10 | 0.00 | 0.00 | -0.58 | -1.51 | 0.03 |
| Lake Hart | 4 | 17.58 | 17.40 | -5.96 | 1.29 | -0.05 | 0.04 | 5.54 | -0.18 | 0.13 | 0.00 | 0.00 | -0.14 | -0.60 | 0.02 |
| Horse Creek | 5 | 19.02 | 14.63 | -2.73 | 5.69 | 0.01 | 1.82 | 0.00 | -0.28 | 0.96 | 0.00 | 0.00 | -1.89 | -1.02 | 0.01 |
| Lower Reedy Cr. | 6 | 20.43 | 16.53 | -2.69 | 0.80 | 0.00 | 0.85 | 7.39 | -0.36 | 0.11 | 0.00 | 0.00 | 1.26 | -0.71 | 0.02 |
| Lake Toho | 7 | 20.63 | 17.23 | -1.84 | 0.83 | -0.01 | 0.09 | 6.12 | -0.39 | 0.12 | 0.00 | 0.00 | 0.17 | -1.09 | 0.03 |
| East Lake Toho | 8 | 19.28 | 17.77 | -2.67 | 0.45 | 0.00 | 0.23 | 5.01 | -0.19 | 0.06 | 0.00 | 0.00 | 0.12 | -1.10 | 0.03 |
| Alligator Lake | 9 | 19.68 | 17.42 | -3.64 | 1.21 | 0.00 | 0.07 | 6.37 | -0.19 | 0.27 | 0.00 | 0.00 | 0.04 | -1.21 | 0.05 |
| Lake Mrytle | 10 | 18.82 | 17.43 | -5.55 | 2.45 | -0.08 | 0.29 | 3.90 | -0.11 | 0.00 | 0.00 | 0.00 | -0.60 | -0.25 | 0.02 |
| Lake Conlin | 11 | 19.32 | 17.23 | -5.20 | 0.00 | -0.04 | 0.00 | 9.57 | -0.39 | 0.03 | 0.00 | 0.00 | 0.06 | -1.68 | 0.15 |
| Lake Marion | 12 | 16.73 | 15.25 | -3.18 | -0.11 | 0.04 | 0.04 | 8.73 | -0.25 | 1.64 | 0.00 | 0.00 | 0.84 | -1.20 | 0.02 |
| Marion Creek | 13 | 18.69 | 16.29 | -3.58 | 0.79 | -0.08 | 0.34 | 6.68 | -0.17 | 0.01 | 0.00 | 0.00 | 0.92 | -0.80 | 0.02 |
| Lake Cypress | 14 | 20.79 | 17.29 | -2.30 | -0.07 | -0.02 | 0.41 | 7.10 | -0.62 | 0.00 | 0.00 | 0.00 | 0.21 | -0.80 | 0.03 |
| S63A | 15 | 20.68 | 16.35 | -2.47 | 0.18 | -0.01 | 0.19 | 8.29 | -0.43 | 0.08 | 0.00 | 0.00 | 0.05 | -1.28 | 0.04 |
| Lake Gentry | 16 | 19.68 | 16.71 | -2.89 | -0.01 | 0.01 | 0.12 | 8.55 | -0.14 | 0.96 | 0.00 | 0.00 | -0.02 | -1.61 | 0.09 |
| Lake Pierce | 17 | 17.36 | 15.13 | -2.26 | 0.64 | -0.01 | 0.00 | 6.01 | -0.20 | 2.53 | 0.00 | 0.00 | -1.93 | -1.37 | 0.02 |
| Catfish Creek | 18 | 17.97 | 15.37 | -2.44 | 0.62 | 0.03 | 1.98 | 5.86 | -0.47 | 0.44 | 0.00 | 0.00 | 1.46 | -1.02 | 0.02 |
| Lake Hatch | 19 | 19.01 | 18.76 | -1.45 | -1.34 | 0.08 | 0.41 | 3.80 | -0.13 | 0.01 | 0.00 | 0.00 | 0.74 | -0.21 | 0.01 |
| Lk Weohyakapaka | 20 | 18.56 | 15.62 | -1.67 | -0.03 | 0.00 | 0.02 | 6.44 | -0.14 | 1.36 | 0.00 | 0.00 | -0.60 | -0.91 | 0.01 |
| Lake Rosalie | 21 | 17.98 | 16.60 | -1.51 | 0.85 | -0.01 | 0.13 | 3.42 | -0.13 | 0.54 | 0.00 | 0.00 | -0.34 | -1.18 | 0.02 |
| Tiger Lake | 22 | 19.46 | 17.67 | -1.67 | -0.63 | -0.01 | 0.07 | 4.56 | 0.00 | 0.01 | 0.00 | 0.00 | 0.09 | -0.41 | 0.03 |
| Lake Kissimmee | 23 | 21.24 | 19.42 | -1.07 | -1.17 | -0.01 | 0.04 | 4.30 | -0.12 | 0.03 | 0.00 | 0.00 | -0.04 | -0.18 | 0.01 |
| Lake Jackson | 24 | 22.39 | 16.76 | -2.27 | -0.05 | -0.02 | 0.03 | 7.67 | -0.02 | 0.00 | 0.00 | 0.00 | -0.47 | -0.22 | 0.01 |
| Lake Marian | 25 | 22.84 | 17.94 | -1.13 | -0.08 | 0.00 | 0.01 | 6.50 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | -0.29 | 0.01 |
| S-65A | 26 | 21.23 | 15.62 | -2.77 | 0.52 | -0.04 | 0.75 | 7.35 | -0.07 | 0.04 | 0.00 | 0.00 | -0.37 | -0.51 | 0.03 |
| S-65BC | 27 | 20.79 | 15.89 | -3.07 | 0.22 | 0.01 | 1.25 | 7.23 | -0.19 | 0.07 | 0.00 | 0.00 | 0.00 | -0.44 | 0.03 |
| S-65D | 28 | 20.91 | 15.92 | -3.08 | 0.98 | -0.04 | 0.84 | 7.47 | -0.36 | 0.43 | 0.00 | 0.00 | -0.27 | -0.70 | 0.04 |
| S-65E | 29 | 21.60 | 15.93 | -2.89 | 0.09 | -0.33 | 2.09 | 7.61 | -0.41 | 0.27 | 0.00 | 0.00 | 0.22 | -0.63 | 0.03 |

**Table D-4: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 1995 wet season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 36.20 | 19.83 | 4.31 | 2.22 | 0.00 | 0.18 | 6.74 | 0.39 | 0.23 | 0.00 | 0.00 | -1.48 | 1.26 | -0.01 |
| Shingle Creek | 2 | 35.56 | 18.92 | 2.49 | 3.35 | 0.00 | 0.34 | 6.99 | 0.53 | 0.04 | 0.00 | 0.00 | -1.42 | 1.55 | -0.02 |
| Boggy Creek | 3 | 35.89 | 19.18 | 2.68 | 2.82 | 0.00 | 0.12 | 8.77 | 0.41 | 0.08 | 0.00 | 0.00 | -0.61 | 1.35 | -0.02 |
| Lake Hart | 4 | 40.34 | 21.47 | 7.72 | 3.68 | -0.06 | 0.05 | 6.57 | 0.22 | 0.12 | 0.00 | 0.00 | -0.14 | 0.52 | -0.02 |
| Horse Creek | 5 | 37.88 | 18.57 | 7.50 | 7.58 | -0.03 | 1.79 | 0.00 | 0.22 | 1.03 | 0.00 | 0.00 | -2.08 | 1.12 | -0.01 |
| Lower Reedy Cr. | 6 | 40.23 | 20.51 | 7.85 | 1.69 | 0.00 | 0.81 | 9.73 | 0.32 | 0.10 | 0.00 | 0.00 | 1.41 | 0.81 | -0.03 |
| Lake Toho | 7 | 44.22 | 21.21 | 2.69 | 7.80 | 0.00 | 0.12 | 11.25 | 0.40 | 0.12 | 0.00 | 0.00 | 0.27 | 1.11 | -0.03 |
| East Lake Toho | 8 | 43.68 | 22.10 | 3.02 | 8.96 | -0.02 | 0.22 | 8.23 | 0.25 | 0.06 | 0.00 | 0.00 | 0.11 | 1.02 | -0.03 |
| Alligator Lake | 9 | 47.05 | 21.46 | 5.81 | 7.36 | 0.01 | 0.10 | 11.17 | 0.25 | 0.24 | 0.00 | 0.00 | 0.04 | 1.15 | -0.03 |
| Lake Mrytle | 10 | 45.02 | 21.66 | 10.21 | 6.69 | -0.11 | 0.34 | 5.06 | 0.11 | 0.00 | 0.00 | 0.00 | -0.57 | 0.25 | -0.01 |
| Lake Conlin | 11 | 46.52 | 20.53 | 8.64 | 0.00 | -0.08 | 0.00 | 15.12 | 0.39 | 0.03 | 0.00 | 0.00 | 0.04 | 1.68 | -0.15 |
| Lake Marion | 12 | 36.71 | 19.28 | 3.06 | 3.20 | 0.06 | 0.04 | 11.83 | 0.23 | 1.70 | 0.00 | 0.00 | 0.14 | 0.99 | -0.01 |
| Marion Creek | 13 | 38.76 | 20.27 | 7.17 | 1.92 | -0.08 | 0.31 | 9.22 | 0.18 | 0.01 | 0.00 | 0.00 | 1.25 | 0.84 | -0.02 |
| Lake Cypress | 14 | 44.79 | 20.94 | 3.89 | 3.32 | -0.03 | 0.45 | 14.98 | 0.61 | 0.00 | 0.00 | 0.00 | 0.27 | 0.81 | -0.03 |
| S63A | 15 | 44.27 | 19.54 | 4.55 | 0.50 | -0.03 | 0.18 | 17.94 | 0.39 | 0.09 | 0.00 | 0.00 | 0.02 | 1.24 | -0.02 |
| Lake Gentry | 16 | 46.23 | 20.46 | 5.95 | 1.65 | -0.01 | 0.14 | 17.09 | 0.16 | 0.90 | 0.00 | 0.00 | -0.04 | 1.55 | -0.07 |
| Lake Pierce | 17 | 39.02 | 18.92 | 5.43 | 3.17 | -0.03 | 0.00 | 10.04 | 0.17 | 2.66 | 0.00 | 0.00 | -2.25 | 1.64 | -0.01 |
| Catfish Creek | 18 | 41.15 | 18.97 | 5.95 | 2.32 | -0.16 | 2.11 | 11.52 | 0.48 | 0.46 | 0.00 | 0.00 | 1.54 | 1.62 | -0.02 |
| Lake Hatch | 19 | 41.61 | 23.01 | 8.14 | 4.53 | 0.02 | 0.48 | 6.10 | 0.12 | 0.01 | 0.00 | 0.00 | 0.99 | 0.23 | -0.01 |
| Lk Weohyakapaka | 20 | 39.36 | 19.35 | 5.35 | 3.46 | 0.00 | 0.02 | 10.31 | 0.10 | 1.44 | 0.00 | 0.00 | -0.65 | 1.55 | -0.01 |
| Lake Rosalie | 21 | 41.12 | 20.58 | 5.70 | 6.32 | -0.02 | 0.12 | 6.51 | 0.12 | 0.59 | 0.00 | 0.00 | -0.34 | 1.95 | -0.03 |
| Tiger Lake | 22 | 39.10 | 21.58 | 6.59 | 3.96 | -0.02 | 0.10 | 6.59 | -0.01 | 0.01 | 0.00 | 0.00 | 0.20 | 0.44 | -0.03 |
| Lake Kissimmee | 23 | 38.48 | 23.48 | 3.62 | 3.52 | -0.01 | 0.06 | 7.48 | 0.13 | 0.03 | 0.00 | 0.00 | -0.01 | 0.20 | -0.01 |
| Lake Jackson | 24 | 41.58 | 20.61 | 7.58 | 0.98 | -0.03 | 0.03 | 11.64 | 0.01 | 0.00 | 0.00 | 0.00 | -0.48 | 0.21 | -0.02 |
| Lake Marian | 25 | 47.84 | 21.95 | 5.71 | 3.44 | 0.00 | 0.01 | 16.50 | -0.07 | 0.00 | 0.00 | 0.00 | 0.10 | 0.40 | -0.02 |
| S-65A | 26 | 35.13 | 19.07 | 4.17 | 1.07 | -0.04 | 0.42 | 9.36 | 0.06 | 0.06 | 0.00 | 0.00 | -0.35 | 0.64 | -0.01 |
| S-65BC | 27 | 39.25 | 19.57 | 6.70 | 0.19 | 0.00 | 1.18 | 10.92 | 0.18 | 0.07 | 0.00 | 0.00 | -0.02 | 0.57 | -0.01 |
| S-65D | 28 | 42.08 | 18.98 | 5.23 | 2.66 | -0.05 | 0.88 | 13.47 | 0.35 | 0.47 | 0.00 | 0.00 | -0.26 | 0.67 | -0.01 |
| S-65E | 29 | 43.31 | 18.77 | 6.61 | 1.34 | -0.49 | 2.43 | 13.07 | 0.37 | 0.33 | 0.00 | 0.00 | 0.23 | 0.77 | -0.03 |

AECOM

**Table D-5: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 1995 to 1996 dry season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 19.49 | 16.97 | -3.19 | 0.94 | 0.00 | 0.21 | 4.59 | -0.30 | 0.25 | 0.00 | 0.00 | -1.32 | -0.79 | 0.01 |
| Shingle Creek | 2 | 19.09 | 15.75 | -2.12 | 1.39 | 0.00 | 0.40 | 3.68 | -0.29 | 0.05 | 0.00 | 0.00 | -1.34 | -1.01 | 0.02 |
| Boggy Creek | 3 | 19.20 | 15.74 | -2.26 | 1.58 | 0.00 | 0.14 | 4.38 | -0.19 | 0.10 | 0.00 | 0.00 | -0.59 | -0.67 | 0.01 |
| Lake Hart | 4 | 19.88 | 19.35 | -4.35 | 0.73 | -0.05 | 0.04 | 4.30 | -0.04 | 0.11 | 0.00 | 0.00 | -0.13 | -0.19 | 0.01 |
| Horse Creek | 5 | 18.04 | 15.88 | -4.19 | 4.93 | 0.01 | 1.70 | 0.00 | -0.20 | 1.11 | 0.00 | 0.00 | -1.67 | -0.64 | 0.01 |
| Lower Reedy Cr. | 6 | 17.75 | 18.24 | -5.33 | 0.31 | -0.01 | 0.80 | 6.15 | -0.13 | 0.13 | 0.00 | 0.00 | 1.66 | -0.50 | 0.02 |
| Lake Toho | 7 | 18.33 | 19.16 | -2.32 | -1.25 | 0.00 | 0.09 | 3.79 | -0.18 | 0.13 | 0.00 | 0.00 | 0.24 | -0.57 | 0.02 |
| East Lake Toho | 8 | 18.96 | 19.87 | -2.40 | -1.47 | 0.00 | 0.21 | 3.54 | -0.11 | 0.07 | 0.00 | 0.00 | 0.11 | -0.49 | 0.02 |
| Alligator Lake | 9 | 17.34 | 19.47 | -4.78 | -0.66 | 0.00 | 0.07 | 4.31 | -0.04 | 0.30 | 0.00 | 0.00 | 0.04 | -0.66 | 0.03 |
| Lake Mrytle | 10 | 18.48 | 19.43 | -6.35 | 1.12 | -0.07 | 0.31 | 3.47 | -0.05 | 0.00 | 0.00 | 0.00 | -0.64 | -0.15 | 0.01 |
| Lake Conlin | 11 | 15.67 | 19.46 | -8.45 | 0.00 | 0.00 | 0.00 | 5.50 | 0.04 | 0.03 | 0.00 | 0.00 | 0.03 | -0.69 | 0.13 |
| Lake Marion | 12 | 15.55 | 16.51 | -2.84 | -1.08 | 0.03 | 0.04 | 6.49 | -0.23 | 1.88 | 0.00 | 0.00 | 0.81 | -0.61 | 0.01 |
| Marion Creek | 13 | 15.82 | 17.84 | -5.46 | 0.21 | -0.07 | 0.36 | 4.81 | -0.08 | 0.01 | 0.00 | 0.00 | 1.33 | -0.57 | 0.02 |
| Lake Cypress | 14 | 16.22 | 18.86 | -3.55 | -1.11 | 0.00 | 0.46 | 2.87 | -0.39 | 0.00 | 0.00 | 0.00 | 0.35 | -0.54 | 0.03 |
| S63A | 15 | 15.63 | 17.66 | -4.26 | 0.07 | -0.01 | 0.17 | 3.29 | -0.25 | 0.10 | 0.00 | 0.00 | 0.04 | -0.87 | 0.03 |
| Lake Gentry | 16 | 15.02 | 18.43 | -5.59 | -0.57 | 0.02 | 0.10 | 4.68 | 0.06 | 1.09 | 0.00 | 0.00 | -0.02 | -0.92 | 0.08 |
| Lake Pierce | 17 | 14.74 | 16.38 | -4.35 | -0.01 | 0.00 | 0.00 | 5.10 | -0.22 | 2.88 | 0.00 | 0.00 | -1.84 | -1.11 | 0.02 |
| Catfish Creek | 18 | 14.43 | 16.65 | -5.36 | 0.44 | 0.04 | 2.01 | 4.98 | -0.48 | 0.52 | 0.00 | 0.00 | 1.94 | -1.28 | 0.02 |
| Lake Hatch | 19 | 15.04 | 20.66 | -5.16 | -2.99 | 0.07 | 0.67 | 3.34 | -0.07 | 0.01 | 0.00 | 0.00 | 1.17 | -0.15 | 0.01 |
| Lk Weohyakapaka | 20 | 14.19 | 16.57 | -4.89 | -0.98 | 0.00 | 0.02 | 6.06 | -0.17 | 1.56 | 0.00 | 0.00 | -0.61 | -1.44 | 0.02 |
| Lake Rosalie | 21 | 14.22 | 17.97 | -4.55 | -0.25 | -0.02 | 0.14 | 3.14 | -0.14 | 0.63 | 0.00 | 0.00 | -0.22 | -1.67 | 0.03 |
| Tiger Lake | 22 | 14.45 | 19.27 | -6.07 | -1.12 | -0.01 | 0.11 | 3.29 | -0.04 | 0.01 | 0.00 | 0.00 | 0.40 | -0.54 | 0.04 |
| Lake Kissimmee | 23 | 14.97 | 20.71 | -3.63 | -3.29 | -0.01 | 0.07 | 2.01 | -0.29 | 0.04 | 0.00 | 0.00 | 0.14 | -0.41 | 0.02 |
| Lake Jackson | 24 | 15.43 | 18.42 | -7.44 | -0.69 | -0.01 | 0.03 | 4.96 | -0.03 | 0.00 | 0.00 | 0.00 | -0.51 | -0.32 | 0.03 |
| Lake Marian | 25 | 15.86 | 19.48 | -5.51 | -1.54 | 0.00 | 0.01 | 4.39 | -0.10 | 0.00 | 0.00 | 0.00 | 0.11 | -0.72 | 0.04 |
| S-65A | 26 | 13.71 | 16.31 | -6.53 | 0.29 | -0.03 | 0.85 | 4.31 | -0.38 | 0.12 | 0.00 | 0.00 | -0.34 | -1.36 | 0.04 |
| S-65BC | 27 | 12.44 | 16.67 | -8.81 | 0.58 | 0.01 | 1.21 | 4.38 | -0.45 | 0.11 | 0.00 | 0.00 | 0.04 | -0.95 | 0.03 |
| S-65D | 28 | 12.27 | 15.87 | -5.72 | 0.27 | -0.04 | 0.70 | 3.00 | -0.55 | 0.58 | 0.00 | 0.00 | -0.28 | -1.02 | 0.03 |
| S-65E | 29 | 11.89 | 16.40 | -7.35 | -0.27 | -0.31 | 1.60 | 3.42 | -0.41 | 0.42 | 0.00 | 0.00 | 0.37 | -0.98 | 0.05 |

AECOM

**Table D-6: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 1996 wet season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 33.68 | 20.07 | 2.16 | 1.98 | 0.00 | 0.20 | 7.29 | 0.23 | 0.24 | 0.00 | 0.00 | -1.39 | 0.58 | -0.01 |
| Shingle Creek | 2 | 33.62 | 18.92 | 1.28 | 3.09 | 0.00 | 0.37 | 7.52 | 0.25 | 0.04 | 0.00 | 0.00 | -1.43 | 0.79 | -0.02 |
| Boggy Creek | 3 | 32.28 | 18.85 | 0.83 | 2.94 | 0.00 | 0.12 | 8.38 | 0.20 | 0.10 | 0.00 | 0.00 | -0.62 | 0.44 | -0.01 |
| Lake Hart | 4 | 35.91 | 22.07 | 3.63 | 2.97 | -0.07 | 0.05 | 6.90 | 0.05 | 0.11 | 0.00 | 0.00 | -0.13 | 0.14 | 0.00 |
| Horse Creek | 5 | 32.21 | 19.03 | 3.03 | 6.88 | -0.01 | 1.83 | 0.00 | 0.11 | 1.06 | 0.00 | 0.00 | -2.03 | 0.35 | 0.00 |
| Lower Reedy Cr. | 6 | 31.39 | 21.16 | 2.06 | 0.68 | -0.01 | 0.78 | 8.07 | 0.14 | 0.11 | 0.00 | 0.00 | 1.69 | 0.29 | 0.00 |
| Lake Toho | 7 | 31.34 | 21.91 | 0.48 | 1.82 | 0.00 | 0.13 | 6.94 | 0.16 | 0.14 | 0.00 | 0.00 | 0.27 | 0.31 | -0.01 |
| East Lake Toho | 8 | 32.37 | 22.67 | 0.73 | 2.21 | -0.01 | 0.23 | 6.33 | 0.11 | 0.07 | 0.00 | 0.00 | 0.12 | 0.27 | -0.01 |
| Alligator Lake | 9 | 31.88 | 22.35 | 0.83 | 2.03 | 0.00 | 0.10 | 6.50 | 0.09 | 0.29 | 0.00 | 0.00 | 0.06 | 0.34 | -0.01 |
| Lake Mrytle | 10 | 33.28 | 22.31 | 2.54 | 3.27 | -0.09 | 0.38 | 3.96 | 0.05 | 0.00 | 0.00 | 0.00 | -0.60 | 0.08 | 0.00 |
| Lake Conlin | 11 | 29.53 | 22.04 | 1.47 | 0.00 | 0.00 | 0.00 | 5.37 | -0.03 | 0.04 | 0.00 | 0.00 | 0.02 | 0.66 | -0.08 |
| Lake Marion | 12 | 32.71 | 19.96 | 1.78 | 1.64 | 0.06 | 0.04 | 10.76 | 0.13 | 1.79 | 0.00 | 0.00 | 0.20 | 0.45 | 0.00 |
| Marion Creek | 13 | 31.83 | 20.96 | 3.11 | 0.70 | -0.07 | 0.32 | 7.56 | 0.09 | 0.01 | 0.00 | 0.00 | 1.42 | 0.43 | -0.01 |
| Lake Cypress | 14 | 30.36 | 22.00 | 0.89 | 0.44 | 0.00 | 0.47 | 6.17 | 0.32 | 0.00 | 0.00 | 0.00 | 0.34 | 0.39 | -0.01 |
| S63A | 15 | 28.59 | 20.60 | 0.49 | 0.08 | -0.01 | 0.18 | 6.35 | 0.28 | 0.11 | 0.00 | 0.00 | 0.00 | 0.68 | -0.01 |
| Lake Gentry | 16 | 28.13 | 21.32 | 0.69 | 0.08 | 0.00 | 0.12 | 6.18 | -0.03 | 1.06 | 0.00 | 0.00 | -0.05 | 0.74 | -0.04 |
| Lake Pierce | 17 | 37.00 | 19.87 | 3.55 | 2.54 | -0.02 | 0.00 | 10.53 | 0.12 | 2.71 | 0.00 | 0.00 | -2.30 | 0.79 | 0.00 |
| Catfish Creek | 18 | 39.38 | 19.80 | 3.62 | 2.24 | -0.11 | 2.35 | 12.36 | 0.35 | 0.46 | 0.00 | 0.00 | 1.95 | 0.94 | -0.01 |
| Lake Hatch | 19 | 35.69 | 23.80 | 4.16 | 2.68 | 0.06 | 0.61 | 5.52 | 0.06 | 0.01 | 0.00 | 0.00 | 1.20 | 0.11 | 0.00 |
| Lk Weohyakapaka | 20 | 37.45 | 20.26 | 3.54 | 2.52 | -0.01 | 0.02 | 10.88 | 0.14 | 1.45 | 0.00 | 0.00 | -0.61 | 0.92 | -0.01 |
| Lake Rosalie | 21 | 39.79 | 21.40 | 3.51 | 6.27 | -0.03 | 0.14 | 7.32 | 0.10 | 0.60 | 0.00 | 0.00 | -0.35 | 1.26 | -0.02 |
| Tiger Lake | 22 | 35.30 | 22.32 | 3.78 | 2.79 | 0.00 | 0.10 | 6.10 | 0.04 | 0.01 | 0.00 | 0.00 | 0.36 | 0.50 | -0.03 |
| Lake Kissimmee | 23 | 30.92 | 24.15 | 1.60 | 0.86 | -0.01 | 0.06 | 3.77 | 0.25 | 0.04 | 0.00 | 0.00 | 0.09 | 0.35 | -0.01 |
| Lake Jackson | 24 | 28.98 | 21.18 | 1.36 | 0.06 | -0.01 | 0.03 | 5.60 | 0.04 | 0.00 | 0.00 | 0.00 | -0.43 | 0.27 | -0.01 |
| Lake Marian | 25 | 34.31 | 22.46 | 2.00 | 0.81 | 0.00 | 0.01 | 8.38 | 0.12 | 0.00 | 0.00 | 0.00 | 0.07 | 0.57 | -0.02 |
| S-65A | 26 | 30.46 | 19.69 | 1.93 | 0.49 | -0.03 | 0.80 | 6.05 | 0.39 | 0.06 | 0.00 | 0.00 | -0.31 | 0.82 | -0.01 |
| S-65BC | 27 | 31.44 | 20.16 | 1.97 | 0.55 | 0.00 | 1.23 | 6.69 | 0.40 | 0.08 | 0.00 | 0.00 | 0.01 | 0.54 | 0.00 |
| S-65D | 28 | 31.59 | 19.97 | 1.26 | 1.07 | -0.04 | 0.81 | 7.56 | 0.48 | 0.51 | 0.00 | 0.00 | -0.25 | 0.66 | 0.00 |
| S-65E | 29 | 31.07 | 19.54 | 1.49 | -0.05 | -0.29 | 1.98 | 7.41 | 0.41 | 0.37 | 0.00 | 0.00 | 0.35 | 0.71 | -0.01 |

**Table D-7: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 1996 to 1997 dry season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 12.06 | 15.09 | -3.77 | 0.15 | 0.00 | 0.20 | 1.75 | -0.45 | 0.33 | 0.00 | 0.00 | -1.22 | -1.77 | 0.02 |
| Shingle Creek | 2 | 12.22 | 13.70 | -1.29 | 0.03 | 0.00 | 0.32 | 1.06 | -0.45 | 0.07 | 0.00 | 0.00 | -1.34 | -2.40 | 0.02 |
| Boggy Creek | 3 | 12.43 | 13.80 | -1.15 | 0.02 | 0.00 | 0.12 | 1.11 | -0.36 | 0.15 | 0.00 | 0.00 | -0.59 | -1.53 | 0.03 |
| Lake Hart | 4 | 12.24 | 19.02 | -6.92 | -1.02 | -0.03 | 0.04 | 1.76 | -0.15 | 0.17 | 0.00 | 0.00 | -0.13 | -0.46 | 0.01 |
| Horse Creek | 5 | 12.09 | 15.05 | -6.47 | 2.78 | 0.02 | 1.47 | 0.00 | -0.05 | 1.32 | 0.00 | 0.00 | -1.59 | -0.94 | 0.01 |
| Lower Reedy Cr. | 6 | 11.17 | 16.99 | -5.22 | 0.02 | 0.00 | 0.55 | 2.44 | -0.53 | 0.17 | 0.00 | 0.00 | 1.79 | -1.10 | 0.02 |
| Lake Toho | 7 | 11.11 | 17.24 | -0.90 | -3.65 | 0.00 | 0.08 | 0.65 | -0.36 | 0.17 | 0.00 | 0.00 | 0.30 | -1.43 | 0.03 |
| East Lake Toho | 8 | 11.46 | 18.37 | -1.49 | -4.77 | 0.01 | 0.17 | 0.75 | -0.18 | 0.08 | 0.00 | 0.00 | 0.10 | -1.20 | 0.03 |
| Alligator Lake | 9 | 11.50 | 17.75 | -2.71 | -2.26 | 0.00 | 0.06 | 0.93 | -0.42 | 0.39 | 0.00 | 0.00 | 0.01 | -1.44 | 0.03 |
| Lake Mrytle | 10 | 11.66 | 18.73 | -7.90 | -1.09 | -0.05 | 0.27 | 1.33 | -0.04 | 0.00 | 0.00 | 0.00 | -0.59 | -0.25 | 0.01 |
| Lake Conlin | 11 | 11.35 | 16.36 | -1.44 | 0.00 | 0.00 | 0.00 | 0.43 | -1.00 | 0.06 | 0.00 | 0.00 | 0.07 | -2.75 | 0.11 |
| Lake Marion | 12 | 12.89 | 15.91 | -2.38 | -1.56 | 0.02 | 0.04 | 4.46 | -0.05 | 2.02 | 0.00 | 0.00 | 0.77 | -0.72 | 0.00 |
| Marion Creek | 13 | 11.77 | 17.04 | -5.40 | 0.04 | -0.05 | 0.36 | 2.57 | -0.25 | 0.01 | 0.00 | 0.00 | 1.49 | -1.11 | 0.02 |
| Lake Cypress | 14 | 12.05 | 17.29 | -1.72 | -2.00 | 0.01 | 0.23 | 0.43 | -0.40 | 0.00 | 0.00 | 0.00 | 0.43 | -1.31 | 0.04 |
| S63A | 15 | 12.21 | 15.57 | -1.26 | 0.00 | 0.00 | 0.05 | 0.42 | -0.33 | 0.14 | 0.00 | 0.00 | -0.03 | -2.10 | 0.03 |
| Lake Gentry | 16 | 11.31 | 17.22 | -1.25 | -0.97 | 0.00 | 0.09 | 0.83 | -0.68 | 1.32 | 0.00 | 0.00 | -0.02 | -2.55 | 0.07 |
| Lake Pierce | 17 | 13.03 | 15.77 | -4.06 | -0.19 | 0.00 | 0.00 | 3.65 | 0.00 | 3.04 | 0.00 | 0.00 | -1.74 | -0.84 | 0.00 |
| Catfish Creek | 18 | 13.09 | 16.25 | -3.91 | 0.22 | 0.12 | 1.86 | 3.22 | -0.25 | 0.54 | 0.00 | 0.00 | 2.28 | -1.36 | 0.01 |
| Lake Hatch | 19 | 12.58 | 20.43 | -4.92 | -4.08 | 0.07 | 0.53 | 2.26 | -0.05 | 0.01 | 0.00 | 0.00 | 1.28 | -0.22 | 0.00 |
| Lk Weohyakapaka | 20 | 13.27 | 16.07 | -3.62 | -1.37 | 0.00 | 0.01 | 4.38 | -0.04 | 1.64 | 0.00 | 0.00 | -0.58 | -1.11 | 0.01 |
| Lake Rosalie | 21 | 13.44 | 17.67 | -3.35 | -1.09 | -0.01 | 0.15 | 2.31 | -0.01 | 0.64 | 0.00 | 0.00 | 0.01 | -1.59 | 0.02 |
| Tiger Lake | 22 | 13.52 | 19.16 | -4.66 | -2.50 | 0.01 | 0.09 | 2.62 | 0.12 | 0.02 | 0.00 | 0.00 | 0.60 | -0.64 | 0.03 |
| Lake Kissimmee | 23 | 13.63 | 20.68 | -2.33 | -4.85 | 0.00 | 0.05 | 0.69 | -0.03 | 0.06 | 0.00 | 0.00 | 0.06 | -0.45 | 0.01 |
| Lake Jackson | 24 | 14.30 | 18.15 | -4.71 | -0.80 | 0.01 | 0.02 | 1.69 | 0.08 | 0.00 | 0.00 | 0.00 | -0.39 | -0.48 | 0.02 |
| Lake Marian | 25 | 15.17 | 19.12 | -2.98 | -1.72 | 0.00 | 0.00 | 1.38 | 0.09 | 0.00 | 0.00 | 0.00 | 0.05 | -0.65 | 0.02 |
| S-65A | 26 | 11.95 | 15.27 | -3.50 | 0.04 | -0.02 | 0.46 | 1.64 | -0.28 | 0.18 | 0.00 | 0.00 | -0.30 | -1.78 | 0.03 |
| S-65BC | 27 | 10.27 | 14.54 | -4.73 | -0.09 | 0.00 | 1.07 | 1.50 | -0.41 | 0.15 | 0.00 | 0.00 | 0.05 | -1.39 | 0.02 |
| S-65D | 28 | 9.37 | 13.12 | -2.56 | 0.06 | -0.02 | 0.50 | 0.79 | -0.53 | 0.71 | 0.00 | 0.00 | -0.22 | -1.53 | 0.01 |
| S-65E | 29 | 10.43 | 13.82 | -1.82 | -0.36 | -0.18 | 1.03 | 0.64 | -0.44 | 0.60 | 0.00 | 0.00 | 0.42 | -1.57 | 0.02 |

AECOM

**Table D-8: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 1997 wet season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change $\Delta OL$ | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change ($\Delta UZ$) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 27.90 | 21.30 | -0.34 | 1.31 | 0.00 | 0.16 | 3.82 | -0.01 | 0.29 | 0.00 | 0.00 | -1.42 | 0.55 | 0.00 |
| Shingle Creek | 2 | 29.65 | 20.23 | -0.51 | 3.30 | 0.00 | 0.29 | 3.89 | -0.01 | 0.06 | 0.00 | 0.00 | -1.46 | 1.05 | 0.00 |
| Boggy Creek | 3 | 33.70 | 20.85 | 0.08 | 4.77 | 0.00 | 0.11 | 6.25 | 0.13 | 0.10 | 0.00 | 0.00 | -0.64 | 0.94 | -0.02 |
| Lake Hart | 4 | 32.30 | 24.16 | 1.97 | 1.26 | -0.05 | 0.05 | 4.43 | 0.10 | 0.14 | 0.00 | 0.00 | -0.14 | 0.28 | 0.00 |
| Horse Creek | 5 | 29.79 | 20.54 | 1.67 | 4.93 | -0.01 | 1.61 | 0.00 | -0.09 | 1.23 | 0.00 | 0.00 | -2.07 | 0.28 | 0.00 |
| Lower Reedy Cr. | 6 | 27.08 | 22.79 | 0.00 | 0.50 | 0.00 | 0.44 | 4.54 | 0.19 | 0.14 | 0.00 | 0.00 | 1.66 | 0.41 | 0.00 |
| Lake Toho | 7 | 27.16 | 23.50 | -0.23 | -0.13 | 0.00 | 0.11 | 3.61 | 0.04 | 0.16 | 0.00 | 0.00 | 0.32 | 0.73 | 0.00 |
| East Lake Toho | 8 | 29.09 | 24.61 | 0.07 | -0.19 | 0.00 | 0.19 | 3.85 | 0.02 | 0.07 | 0.00 | 0.00 | 0.08 | 0.69 | -0.01 |
| Alligator Lake | 9 | 31.19 | 24.27 | 0.44 | 1.07 | 0.00 | 0.08 | 4.45 | 0.29 | 0.32 | 0.00 | 0.00 | 0.08 | 0.98 | -0.01 |
| Lake Mrytle | 10 | 31.31 | 24.40 | 1.71 | 1.68 | -0.07 | 0.33 | 2.52 | -0.01 | 0.00 | 0.00 | 0.00 | -0.49 | 0.14 | 0.00 |
| Lake Conlin | 11 | 32.39 | 23.84 | 0.12 | 0.00 | -0.02 | 0.00 | 5.03 | 1.00 | 0.04 | 0.00 | 0.00 | -0.02 | 2.33 | -0.06 |
| Lake Marion | 12 | 33.99 | 21.64 | 1.06 | 2.48 | 0.06 | 0.04 | 10.59 | -0.07 | 1.91 | 0.00 | 0.00 | -0.11 | 0.14 | 0.01 |
| Marion Creek | 13 | 30.26 | 22.70 | 1.69 | 0.93 | -0.05 | 0.32 | 5.37 | 0.10 | 0.01 | 0.00 | 0.00 | 1.45 | 0.55 | 0.00 |
| Lake Cypress | 14 | 28.60 | 23.80 | 0.12 | -0.53 | 0.01 | 0.37 | 4.44 | 0.04 | 0.00 | 0.00 | 0.00 | 0.40 | 0.74 | -0.01 |
| S63A | 15 | 31.36 | 22.40 | 0.55 | 0.12 | -0.01 | 0.08 | 6.72 | 0.21 | 0.10 | 0.00 | 0.00 | -0.02 | 1.36 | -0.01 |
| Lake Gentry | 16 | 32.20 | 23.20 | 0.11 | -0.08 | 0.00 | 0.11 | 7.18 | 0.72 | 1.09 | 0.00 | 0.00 | -0.08 | 1.95 | -0.02 |
| Lake Pierce | 17 | 30.16 | 21.36 | 0.49 | 1.46 | -0.03 | 0.00 | 7.97 | -0.14 | 3.03 | 0.00 | 0.00 | -2.26 | -0.23 | 0.01 |
| Catfish Creek | 18 | 27.98 | 21.31 | 0.21 | 0.91 | 0.00 | 1.92 | 6.32 | -0.38 | 0.54 | 0.00 | 0.00 | 2.06 | 0.29 | 0.01 |
| Lake Hatch | 19 | 26.68 | 25.87 | 0.18 | -1.65 | 0.05 | 0.56 | 3.25 | -0.12 | 0.01 | 0.00 | 0.00 | 1.35 | 0.00 | 0.01 |
| Lk Weohyakapaka | 20 | 30.66 | 21.84 | 0.56 | 1.17 | 0.00 | 0.02 | 7.91 | -0.09 | 1.67 | 0.00 | 0.00 | -0.59 | 0.32 | 0.00 |
| Lake Rosalie | 21 | 28.27 | 22.96 | 0.24 | 1.40 | -0.02 | 0.14 | 3.94 | -0.16 | 0.68 | 0.00 | 0.00 | -0.01 | 0.39 | 0.00 |
| Tiger Lake | 22 | 31.01 | 24.39 | 1.55 | 0.47 | 0.00 | 0.09 | 4.79 | -0.14 | 0.01 | 0.00 | 0.00 | 0.49 | 0.36 | -0.01 |
| Lake Kissimmee | 23 | 34.54 | 26.63 | 1.72 | 0.49 | 0.00 | 0.07 | 5.28 | 0.03 | 0.04 | 0.00 | 0.00 | 0.07 | 0.42 | -0.01 |
| Lake Jackson | 24 | 35.67 | 23.21 | 4.07 | 0.35 | -0.01 | 0.03 | 7.18 | -0.07 | 0.00 | 0.00 | 0.00 | -0.42 | 0.47 | -0.02 |
| Lake Marian | 25 | 38.69 | 24.67 | 2.88 | 1.11 | 0.00 | 0.01 | 9.34 | -0.07 | 0.00 | 0.00 | 0.00 | 0.05 | 0.77 | -0.02 |
| S-65A | 26 | 36.81 | 21.93 | 3.82 | 0.62 | -0.02 | 0.66 | 7.30 | 0.21 | 0.02 | 0.00 | 0.00 | -0.29 | 1.96 | -0.02 |
| S-65BC | 27 | 37.10 | 22.43 | 4.40 | 0.07 | 0.00 | 1.12 | 7.17 | 0.40 | 0.08 | 0.00 | 0.00 | -0.02 | 1.55 | -0.01 |
| S-65D | 28 | 35.75 | 22.33 | 1.98 | 1.28 | -0.02 | 0.80 | 7.79 | 0.40 | 0.52 | 0.00 | 0.00 | -0.18 | 1.48 | 0.00 |
| S-65E | 29 | 33.54 | 21.83 | 0.88 | 0.04 | -0.28 | 2.04 | 7.62 | 0.23 | 0.35 | 0.00 | 0.00 | 0.32 | 1.29 | -0.01 |

**Table D-9: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 1997 to 1998 dry season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 34.09 | 17.56 | 2.62 | 3.00 | 0.00 | 0.20 | 8.65 | 0.18 | 0.23 | 0.00 | 0.00 | -1.52 | 0.59 | -0.01 |
| Shingle Creek | 2 | 33.01 | 16.55 | 0.85 | 4.55 | 0.00 | 0.41 | 8.49 | 0.08 | 0.04 | 0.00 | 0.00 | -1.56 | 0.56 | -0.01 |
| Boggy Creek | 3 | 34.69 | 16.93 | 0.78 | 5.17 | -0.01 | 0.14 | 10.96 | -0.07 | 0.07 | 0.00 | 0.00 | -0.67 | 0.18 | -0.01 |
| Lake Hart | 4 | 32.40 | 19.53 | 2.05 | 3.31 | -0.07 | 0.04 | 7.46 | -0.06 | 0.09 | 0.00 | 0.00 | -0.15 | -0.05 | 0.00 |
| Horse Creek | 5 | 37.42 | 16.70 | 5.28 | 11.53 | -0.03 | 2.07 | 0.00 | 0.11 | 0.94 | 0.00 | 0.00 | -2.23 | 0.41 | -0.01 |
| Lower Reedy Cr. | 6 | 35.39 | 18.62 | 4.29 | 1.61 | 0.00 | 0.89 | 11.28 | 0.10 | 0.08 | 0.00 | 0.00 | 1.73 | 0.40 | -0.02 |
| Lake Toho | 7 | 36.55 | 19.67 | 0.79 | 5.45 | 0.00 | 0.11 | 10.53 | 0.01 | 0.11 | 0.00 | 0.00 | 0.25 | 0.33 | -0.01 |
| East Lake Toho | 8 | 36.47 | 20.36 | 0.83 | 6.30 | -0.02 | 0.23 | 8.71 | -0.01 | 0.05 | 0.00 | 0.00 | 0.11 | 0.19 | -0.01 |
| Alligator Lake | 9 | 37.98 | 19.89 | 2.18 | 5.10 | 0.00 | 0.10 | 10.80 | -0.02 | 0.22 | 0.00 | 0.00 | 0.06 | 0.21 | -0.01 |
| Lake Mrytle | 10 | 35.53 | 19.64 | 4.38 | 5.26 | -0.10 | 0.29 | 5.15 | 0.02 | 0.00 | 0.00 | 0.00 | -0.59 | 0.09 | 0.00 |
| Lake Conlin | 11 | 33.66 | 19.64 | 0.27 | 0.00 | -0.06 | 0.00 | 13.65 | 0.09 | 0.03 | 0.00 | 0.00 | -0.02 | -0.03 | 0.01 |
| Lake Marion | 12 | 35.42 | 17.48 | 1.39 | 3.62 | 0.10 | 0.04 | 14.31 | 0.10 | 1.67 | 0.00 | 0.00 | 0.01 | 0.24 | 0.00 |
| Marion Creek | 13 | 33.97 | 18.44 | 4.20 | 1.46 | -0.11 | 0.33 | 10.59 | 0.00 | 0.00 | 0.00 | 0.00 | 1.42 | 0.27 | -0.01 |
| Lake Cypress | 14 | 33.99 | 19.41 | 1.41 | 1.53 | -0.01 | 0.44 | 11.42 | -0.08 | 0.00 | 0.00 | 0.00 | 0.36 | 0.18 | -0.02 |
| S63A | 15 | 34.79 | 18.24 | 1.28 | 0.29 | -0.03 | 0.21 | 14.76 | -0.16 | 0.07 | 0.00 | 0.00 | 0.00 | 0.19 | -0.01 |
| Lake Gentry | 16 | 34.61 | 18.74 | 1.09 | 0.97 | -0.01 | 0.15 | 14.45 | -0.07 | 0.85 | 0.00 | 0.00 | -0.03 | 0.08 | -0.01 |
| Lake Pierce | 17 | 32.21 | 17.21 | 2.15 | 2.42 | -0.03 | 0.00 | 10.02 | 0.12 | 2.66 | 0.00 | 0.00 | -2.39 | 0.53 | 0.00 |
| Catfish Creek | 18 | 30.75 | 17.27 | 1.69 | 1.57 | -0.08 | 2.25 | 9.78 | 0.24 | 0.46 | 0.00 | 0.00 | 2.17 | 0.48 | -0.01 |
| Lake Hatch | 19 | 31.04 | 20.90 | 3.56 | 1.86 | 0.05 | 0.57 | 5.42 | 0.05 | 0.01 | 0.00 | 0.00 | 1.37 | 0.10 | -0.01 |
| Lk Weohyakapaka | 20 | 32.79 | 17.55 | 1.84 | 2.98 | -0.01 | 0.02 | 10.64 | 0.00 | 1.45 | 0.00 | 0.00 | -0.65 | 0.55 | 0.00 |
| Lake Rosalie | 21 | 30.61 | 18.66 | 1.64 | 4.39 | -0.03 | 0.15 | 5.56 | 0.06 | 0.59 | 0.00 | 0.00 | -0.10 | 0.60 | -0.01 |
| Tiger Lake | 22 | 32.92 | 19.67 | 2.83 | 2.59 | -0.01 | 0.09 | 8.18 | -0.03 | 0.00 | 0.00 | 0.00 | 0.49 | 0.09 | 0.00 |
| Lake Kissimmee | 23 | 36.12 | 21.55 | 1.70 | 3.75 | 0.00 | 0.07 | 9.45 | -0.17 | 0.03 | 0.00 | 0.00 | 0.06 | -0.12 | 0.00 |
| Lake Jackson | 24 | 36.50 | 18.66 | 3.53 | 0.97 | -0.02 | 0.04 | 12.84 | -0.03 | 0.00 | 0.00 | 0.00 | -0.52 | -0.04 | 0.00 |
| Lake Marian | 25 | 42.18 | 20.00 | 1.65 | 3.23 | 0.00 | 0.01 | 17.60 | -0.04 | 0.00 | 0.00 | 0.00 | 0.10 | -0.16 | 0.00 |
| S-65A | 26 | 42.15 | 17.52 | 5.31 | 2.36 | -0.06 | 0.56 | 15.62 | -0.07 | 0.02 | 0.00 | 0.00 | -0.35 | 0.45 | 0.00 |
| S-65BC | 27 | 39.51 | 17.88 | 5.77 | 0.83 | 0.01 | 1.17 | 13.81 | -0.01 | 0.06 | 0.00 | 0.00 | -0.01 | 0.12 | 0.00 |
| S-65D | 28 | 31.51 | 17.69 | 1.56 | 1.66 | -0.03 | 0.93 | 9.72 | 0.12 | 0.44 | 0.00 | 0.00 | -0.21 | 0.03 | 0.01 |
| S-65E | 29 | 25.23 | 17.46 | -0.23 | -0.12 | -0.30 | 2.01 | 6.94 | -0.17 | 0.33 | 0.00 | 0.00 | 0.36 | -0.27 | 0.01 |

**Table D-10: Seasonal MIKE SHE water budget (inches) for 29 defined sub-watersheds during the 1998 wet season.**

| Sub-Watershed | ID | Rain (*Rai*) | Actual ET (*AET*) | Canopy-OL Storage Change *ΔOL* | Runoff (*Ro*) | OL Boundary Flows ($OL_{BC}$) | Baseflow (*BF*) | Drainage To River (*D*) | UZ Storage Change (*ΔUZ*) | Irrigation (*Irr*) | PWS Pump ($GW_P$) | Irrigation Pump ($GW_I$) | SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change (*ΔSZ*) | Total Error (*Err*) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Cr. | 1 | 26.90 | 20.90 | -0.65 | 1.41 | 0.00 | 0.18 | 3.73 | 0.15 | 0.32 | 0.00 | 0.00 | -1.32 | 0.18 | 0.00 |
| Shingle Creek | 2 | 25.70 | 19.08 | -0.50 | 2.09 | 0.00 | 0.34 | 3.12 | 0.20 | 0.07 | 0.00 | 0.00 | -1.42 | 0.03 | 0.00 |
| Boggy Creek | 3 | 25.29 | 19.66 | -0.75 | 1.50 | 0.00 | 0.13 | 4.33 | 0.07 | 0.13 | 0.00 | 0.00 | -0.62 | -0.12 | 0.01 |
| Lake Hart | 4 | 29.45 | 24.58 | -0.34 | 0.75 | -0.05 | 0.05 | 4.21 | 0.07 | 0.14 | 0.00 | 0.00 | -0.15 | 0.08 | 0.00 |
| Horse Creek | 5 | 24.30 | 20.32 | -2.65 | 4.92 | 0.00 | 1.59 | 0.00 | -0.08 | 1.38 | 0.00 | 0.00 | -1.65 | -0.07 | 0.00 |
| Lower Reedy Cr. | 6 | 22.65 | 22.64 | -2.50 | 0.35 | 0.00 | 0.43 | 3.96 | -0.05 | 0.17 | 0.00 | 0.00 | 1.80 | -0.20 | 0.01 |
| Lake Toho | 7 | 21.74 | 22.77 | -0.68 | -1.99 | 0.00 | 0.11 | 2.25 | 0.04 | 0.18 | 0.00 | 0.00 | 0.28 | -0.29 | 0.01 |
| East Lake Toho | 8 | 21.96 | 24.31 | -0.86 | -3.61 | 0.00 | 0.20 | 2.37 | -0.01 | 0.08 | 0.00 | 0.00 | 0.10 | -0.24 | 0.01 |
| Alligator Lake | 9 | 24.39 | 24.06 | -1.71 | -0.35 | 0.00 | 0.09 | 3.16 | -0.03 | 0.37 | 0.00 | 0.00 | 0.05 | -0.40 | 0.02 |
| Lake Mrytle | 10 | 25.21 | 24.69 | -3.25 | 0.56 | -0.06 | 0.37 | 2.34 | -0.05 | 0.00 | 0.00 | 0.00 | -0.61 | -0.11 | 0.01 |
| Lake Conlin | 11 | 27.06 | 23.43 | -0.29 | 0.00 | -0.01 | 0.00 | 3.96 | -0.06 | 0.04 | 0.00 | 0.00 | 0.04 | 0.09 | 0.00 |
| Lake Marion | 12 | 22.71 | 20.99 | -1.60 | -0.56 | 0.04 | 0.04 | 6.84 | -0.06 | 2.25 | 0.00 | 0.00 | 0.57 | -0.08 | 0.01 |
| Marion Creek | 13 | 21.67 | 22.44 | -3.51 | 0.26 | -0.05 | 0.36 | 3.72 | 0.04 | 0.01 | 0.00 | 0.00 | 1.45 | -0.23 | 0.01 |
| Lake Cypress | 14 | 24.03 | 22.90 | -1.01 | -1.03 | 0.01 | 0.42 | 3.11 | 0.14 | 0.00 | 0.00 | 0.00 | 0.43 | -0.05 | 0.01 |
| S63A | 15 | 25.68 | 21.74 | -0.96 | 0.10 | -0.02 | 0.10 | 4.94 | 0.07 | 0.13 | 0.00 | 0.00 | 0.02 | -0.16 | 0.02 |
| Lake Gentry | 16 | 26.69 | 23.26 | -0.77 | -0.33 | 0.00 | 0.12 | 5.66 | 0.01 | 1.29 | 0.00 | 0.00 | -0.05 | 0.00 | 0.02 |
| Lake Pierce | 17 | 24.68 | 21.12 | -1.63 | 0.59 | -0.01 | 0.00 | 6.04 | -0.02 | 3.33 | 0.00 | 0.00 | -2.03 | -0.13 | 0.01 |
| Catfish Creek | 18 | 25.91 | 21.06 | -0.82 | 0.73 | 0.00 | 1.94 | 5.64 | 0.13 | 0.58 | 0.00 | 0.00 | 2.13 | -0.06 | 0.00 |
| Lake Hatch | 19 | 25.26 | 26.17 | -1.61 | -1.75 | 0.04 | 0.65 | 3.20 | 0.05 | 0.01 | 0.00 | 0.00 | 1.44 | 0.03 | 0.00 |
| Lk Weohyakapaka | 20 | 28.12 | 21.45 | -0.53 | 0.68 | 0.00 | 0.01 | 7.69 | 0.05 | 1.79 | 0.00 | 0.00 | -0.65 | -0.09 | 0.00 |
| Lake Rosalie | 21 | 26.93 | 23.15 | -0.45 | 1.04 | -0.02 | 0.14 | 3.75 | 0.05 | 0.71 | 0.00 | 0.00 | -0.06 | -0.12 | 0.00 |
| Tiger Lake | 22 | 27.93 | 24.57 | -0.95 | 0.06 | 0.00 | 0.10 | 4.65 | 0.05 | 0.02 | 0.00 | 0.00 | 0.62 | 0.08 | -0.01 |
| Lake Kissimmee | 23 | 28.41 | 26.01 | -0.73 | -1.22 | 0.00 | 0.07 | 4.32 | 0.11 | 0.06 | 0.00 | 0.00 | 0.18 | 0.09 | 0.00 |
| Lake Jackson | 24 | 27.63 | 23.54 | -2.16 | -0.33 | -0.01 | 0.03 | 6.05 | 0.01 | 0.00 | 0.00 | 0.00 | -0.49 | 0.00 | 0.02 |
| Lake Marian | 25 | 26.03 | 24.70 | -2.46 | -0.91 | 0.00 | 0.01 | 5.17 | -0.03 | 0.00 | 0.00 | 0.00 | 0.09 | -0.34 | 0.02 |
| S-65A | 26 | 33.85 | 21.80 | -0.51 | 1.35 | -0.05 | 0.89 | 9.97 | 0.04 | 0.12 | 0.00 | 0.00 | -0.39 | 0.00 | 0.02 |
| S-65BC | 27 | 31.86 | 22.20 | -1.51 | 1.24 | 0.01 | 1.50 | 8.83 | -0.08 | 0.10 | 0.00 | 0.00 | 0.06 | -0.12 | 0.02 |
| S-65D | 28 | 32.02 | 21.36 | -0.26 | 1.63 | -0.03 | 0.87 | 8.81 | -0.08 | 0.57 | 0.00 | 0.00 | -0.22 | 0.03 | 0.02 |
| S-65E | 29 | 28.55 | 20.98 | 0.10 | -0.01 | -0.21 | 1.75 | 6.10 | 0.06 | 0.46 | 0.00 | 0.00 | 0.34 | 0.17 | 0.01 |

AECOM

**Table D-11: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the verification period.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 65.94 | 1.71 | 50.00 | 13.97 | 0.00 | 0.00 | 1.00 | -1.28 | 0.02 |
| Shingle Creek | 2 | 66.80 | 3.20 | 50.13 | 13.43 | 0.00 | 0.00 | 0.85 | -0.90 | 0.01 |
| Boggy Creek | 3 | 70.10 | 1.12 | 62.74 | 5.64 | 0.00 | 0.00 | 0.14 | -0.75 | 0.01 |
| Lake Hart | 4 | 50.92 | 0.43 | 48.72 | 0.89 | 0.00 | 0.00 | -0.38 | -0.51 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 33.92 | 15.69 | 0.00 | 4.96 | 0.00 | 0.00 | -12.65 | -0.63 | 0.01 |
| Lower Reedy Creek | 6 | 54.59 | 6.19 | 61.21 | -13.06 | 0.00 | 0.00 | 0.62 | -0.88 | 0.02 |
| Lake Tohopekaliga | 7 | 54.87 | 0.96 | 55.73 | -2.85 | 0.00 | 0.00 | -0.70 | -0.35 | 0.01 |
| East Lake Tohopekaliga | 8 | 49.51 | 1.92 | 48.20 | 0.19 | 0.00 | 0.00 | 1.16 | -0.37 | 0.01 |
| Alligator Lake | 9 | 58.76 | 0.78 | 58.27 | 0.24 | 0.00 | 0.00 | 0.71 | -0.19 | 0.01 |
| Lake Mrytle | 10 | 40.50 | 2.94 | 32.36 | 0.14 | 0.00 | 0.00 | -4.95 | -0.12 | 0.02 |
| Lake Conlin (Closed Basin) | 11 | 70.98 | 0.00 | 69.66 | 0.21 | 0.00 | 0.00 | 0.39 | -1.54 | 0.04 |
| Lake Marion | 12 | 84.50 | 0.34 | 86.53 | 3.20 | 0.00 | 0.00 | 6.23 | -0.69 | 0.04 |
| Marion Creek | 13 | 50.33 | 2.98 | 57.74 | -13.14 | 0.00 | 0.00 | -1.95 | -0.82 | 0.01 |
| Lake Cypress | 14 | 63.56 | 3.69 | 62.01 | -2.05 | 0.00 | 0.00 | 0.89 | -0.82 | 0.02 |
| S63A | 15 | 78.67 | 1.36 | 76.39 | 0.73 | 0.00 | 0.00 | 0.83 | -1.07 | 0.05 |
| Lake Gentry | 16 | 78.42 | 1.11 | 75.50 | 0.53 | 0.00 | 0.00 | 0.17 | -1.52 | 0.07 |
| Lake Pierce | 17 | 87.99 | 0.00 | 67.95 | 9.48 | 0.00 | 0.00 | -9.64 | -0.95 | 0.03 |
| Catfish Creek | 18 | 69.56 | 18.28 | 66.29 | -7.66 | 0.00 | 0.00 | 8.85 | -1.52 | 0.02 |
| Lake Hatchineha | 19 | 31.98 | 4.82 | 36.76 | -9.00 | 0.00 | 0.00 | 0.97 | -0.37 | 0.01 |
| Lake Weohyakapaka | 20 | 79.54 | 0.15 | 72.50 | 5.39 | 0.00 | 0.00 | -0.15 | -1.36 | 0.01 |
| Lake Rosalie | 21 | 44.29 | 1.21 | 39.94 | 1.04 | 0.00 | 0.00 | -0.77 | -1.33 | 0.01 |
| Tiger Lake | 22 | 44.71 | 0.81 | 45.74 | -0.78 | 0.00 | 0.00 | 2.41 | -1.36 | 0.01 |
| Lake Kissimmee | 23 | 45.67 | 0.52 | 44.60 | 0.38 | 0.00 | 0.00 | 0.84 | -1.02 | 0.02 |
| Lake Jackson | 24 | 71.98 | 0.25 | 66.21 | 1.16 | 0.00 | 0.00 | -2.94 | -1.46 | 0.03 |
| Lake Marian | 25 | 80.21 | 0.06 | 79.62 | 0.25 | 0.00 | 0.00 | 1.02 | -1.33 | 0.03 |
| S-65A | 26 | 82.92 | 6.00 | 71.73 | 1.62 | 0.00 | 0.00 | -1.47 | -2.17 | 0.07 |
| S-65BC | 27 | 82.03 | 10.95 | 70.59 | 1.86 | 0.00 | 0.00 | 1.90 | -0.62 | 0.08 |
| S-65D | 28 | 79.66 | 7.14 | 69.90 | 0.90 | 0.00 | 0.00 | -1.24 | -0.57 | 0.09 |
| S-65E | 29 | 78.58 | 17.32 | 63.77 | -2.26 | 0.00 | 0.00 | 0.35 | -0.16 | 0.05 |

**Table D-12: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 1994 wet season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 11.27 | 0.16 | 7.34 | 1.95 | 0.00 | 0.00 | 0.12 | -1.94 | 0.00 |
| Shingle Creek | 2 | 13.12 | 0.33 | 9.40 | 1.39 | 0.00 | 0.00 | 0.06 | -2.05 | 0.00 |
| Boggy Creek | 3 | 14.45 | 0.11 | 12.08 | 0.60 | 0.00 | 0.00 | 0.01 | -1.67 | 0.00 |
| Lake Hart | 4 | 8.56 | 0.05 | 7.55 | 0.11 | 0.00 | 0.00 | -0.06 | -0.79 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 5.33 | 1.80 | 0.00 | 0.99 | 0.00 | 0.00 | -1.39 | -1.15 | 0.00 |
| Lower Reedy Creek | 6 | 9.09 | 0.65 | 7.65 | -0.59 | 0.00 | 0.00 | 0.10 | -1.48 | 0.00 |
| Lake Tohopekaliga | 7 | 11.90 | 0.13 | 10.59 | -0.15 | 0.00 | 0.00 | -0.09 | -1.24 | 0.00 |
| East Lake Tohopekaliga | 8 | 10.75 | 0.24 | 9.42 | 0.01 | 0.00 | 0.00 | 0.12 | -1.21 | 0.00 |
| Alligator Lake | 9 | 11.80 | 0.11 | 10.58 | 0.02 | 0.00 | 0.00 | 0.11 | -1.21 | 0.00 |
| Lake Mrytle | 10 | 5.73 | 0.36 | 4.63 | 0.01 | 0.00 | 0.00 | -0.40 | -0.33 | 0.00 |
| Lake Conlin (Closed Basin) | 11 | 12.99 | 0.00 | 11.03 | 0.02 | 0.00 | 0.00 | -0.02 | -1.92 | 0.00 |
| Lake Marion | 12 | 14.22 | 0.02 | 12.52 | 0.81 | 0.00 | 0.00 | 0.61 | -1.48 | 0.00 |
| Marion Creek | 13 | 8.48 | 0.28 | 7.23 | -0.64 | 0.00 | 0.00 | -0.18 | -1.43 | 0.00 |
| Lake Cypress | 14 | 13.16 | 0.44 | 11.48 | -0.06 | 0.00 | 0.00 | 0.08 | -1.39 | 0.00 |
| S63A | 15 | 15.87 | 0.20 | 13.68 | 0.07 | 0.00 | 0.00 | 0.08 | -2.01 | 0.00 |
| Lake Gentry | 16 | 13.36 | 0.16 | 10.88 | 0.05 | 0.00 | 0.00 | 0.02 | -2.29 | 0.00 |
| Lake Pierce | 17 | 12.64 | 0.00 | 8.58 | 1.36 | 0.00 | 0.00 | -1.03 | -1.67 | 0.00 |
| Catfish Creek | 18 | 9.38 | 1.84 | 6.62 | -0.27 | 0.00 | 0.00 | 0.71 | -1.91 | 0.00 |
| Lake Hatchineha | 19 | 4.25 | 0.34 | 3.86 | -0.27 | 0.00 | 0.00 | 0.14 | -0.46 | 0.00 |
| Lake Weohyakapaka | 20 | 10.39 | 0.01 | 8.21 | 0.63 | 0.00 | 0.00 | 0.04 | -1.58 | 0.00 |
| Lake Rosalie | 21 | 6.17 | 0.10 | 4.00 | 0.41 | 0.00 | 0.00 | 0.02 | -1.68 | 0.00 |
| Tiger Lake | 22 | 6.56 | 0.05 | 4.96 | 0.17 | 0.00 | 0.00 | 0.12 | -1.49 | 0.00 |
| Lake Kissimmee | 23 | 8.54 | 0.03 | 7.31 | 0.16 | 0.00 | 0.00 | 0.08 | -1.13 | 0.00 |
| Lake Jackson | 24 | 10.57 | 0.02 | 8.59 | 0.11 | 0.00 | 0.00 | -0.28 | -1.57 | 0.00 |
| Lake Marian | 25 | 12.03 | 0.00 | 10.36 | 0.02 | 0.00 | 0.00 | 0.11 | -1.75 | 0.00 |
| S-65A | 26 | 13.07 | 0.60 | 10.14 | 0.22 | 0.00 | 0.00 | -0.18 | -1.94 | 0.00 |
| S-65BC | 27 | 12.11 | 1.22 | 10.08 | 0.26 | 0.00 | 0.00 | 0.19 | -0.74 | 0.01 |
| S-65D | 28 | 13.26 | 0.80 | 11.29 | 0.16 | 0.00 | 0.00 | -0.08 | -0.93 | 0.01 |
| S-65E | 29 | 14.04 | 2.39 | 10.96 | -0.03 | 0.00 | 0.00 | -0.05 | -0.68 | 0.00 |

**Table D-13: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 1994 to 1995 dry season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 6.52 | 0.22 | 6.09 | 1.56 | 0.00 | 0.00 | 0.09 | 1.26 | 0.00 |
| Shingle Creek | 2 | 5.92 | 0.40 | 5.97 | 1.41 | 0.00 | 0.00 | 0.13 | 1.73 | 0.00 |
| Boggy Creek | 3 | 5.70 | 0.15 | 6.48 | 0.59 | 0.00 | 0.00 | 0.01 | 1.51 | 0.00 |
| Lake Hart | 4 | 5.12 | 0.04 | 5.54 | 0.10 | 0.00 | 0.00 | -0.04 | 0.60 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 2.69 | 1.82 | 0.00 | 0.50 | 0.00 | 0.00 | -1.40 | 1.02 | 0.00 |
| Lower Reedy Creek | 6 | 6.27 | 0.85 | 7.39 | -1.18 | 0.00 | 0.00 | 0.08 | 0.71 | 0.00 |
| Lake Tohopekaliga | 7 | 4.95 | 0.09 | 6.12 | -0.25 | 0.00 | 0.00 | -0.08 | 1.09 | 0.00 |
| East Lake Tohopekaliga | 8 | 4.02 | 0.23 | 5.01 | 0.02 | 0.00 | 0.00 | 0.13 | 1.10 | 0.00 |
| Alligator Lake | 9 | 5.20 | 0.07 | 6.37 | 0.02 | 0.00 | 0.00 | 0.06 | 1.21 | 0.00 |
| Lake Mrytle | 10 | 4.54 | 0.29 | 3.90 | 0.01 | 0.00 | 0.00 | -0.59 | 0.25 | 0.00 |
| Lake Conlin (Closed Basin) | 11 | 7.82 | 0.00 | 9.57 | 0.02 | 0.00 | 0.00 | 0.08 | 1.68 | 0.00 |
| Lake Marion | 12 | 6.72 | 0.04 | 8.73 | -0.10 | 0.00 | 0.00 | 0.75 | 1.20 | 0.00 |
| Marion Creek | 13 | 5.30 | 0.34 | 6.68 | -1.20 | 0.00 | 0.00 | -0.28 | 0.80 | 0.00 |
| Lake Cypress | 14 | 6.50 | 0.41 | 7.10 | -0.12 | 0.00 | 0.00 | 0.09 | 0.80 | 0.00 |
| S63A | 15 | 7.16 | 0.19 | 8.29 | 0.07 | 0.00 | 0.00 | 0.12 | 1.28 | 0.00 |
| Lake Gentry | 16 | 7.07 | 0.12 | 8.55 | 0.05 | 0.00 | 0.00 | 0.03 | 1.61 | 0.01 |
| Lake Pierce | 17 | 6.57 | 0.00 | 6.01 | 0.91 | 0.00 | 0.00 | -1.02 | 1.37 | 0.00 |
| Catfish Creek | 18 | 5.36 | 1.98 | 5.86 | -0.56 | 0.00 | 0.00 | 0.90 | 1.02 | 0.00 |
| Lake Hatchineha | 19 | 3.27 | 0.41 | 3.80 | -0.59 | 0.00 | 0.00 | 0.15 | 0.21 | 0.00 |
| Lake Weohyakapaka | 20 | 6.14 | 0.02 | 6.44 | 0.56 | 0.00 | 0.00 | -0.04 | 0.91 | 0.00 |
| Lake Rosalie | 21 | 2.71 | 0.13 | 3.42 | 0.27 | 0.00 | 0.00 | -0.07 | 1.18 | 0.00 |
| Tiger Lake | 22 | 4.12 | 0.07 | 4.56 | 0.08 | 0.00 | 0.00 | 0.17 | 0.41 | 0.00 |
| Lake Kissimmee | 23 | 4.20 | 0.04 | 4.30 | 0.14 | 0.00 | 0.00 | 0.09 | 0.18 | 0.00 |
| Lake Jackson | 24 | 7.95 | 0.03 | 7.67 | 0.12 | 0.00 | 0.00 | -0.35 | 0.22 | 0.00 |
| Lake Marian | 25 | 6.11 | 0.01 | 6.50 | 0.02 | 0.00 | 0.00 | 0.13 | 0.29 | 0.00 |
| S-65A | 26 | 7.95 | 0.75 | 7.35 | 0.19 | 0.00 | 0.00 | -0.18 | 0.51 | 0.01 |
| S-65BC | 27 | 8.04 | 1.25 | 7.23 | 0.23 | 0.00 | 0.00 | 0.23 | 0.44 | 0.01 |
| S-65D | 28 | 7.88 | 0.84 | 7.47 | 0.13 | 0.00 | 0.00 | -0.15 | 0.70 | 0.01 |
| S-65E | 29 | 8.84 | 2.09 | 7.61 | -0.18 | 0.00 | 0.00 | 0.04 | 0.63 | 0.01 |

**Table D-14: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 1995 wet season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 9.65 | 0.18 | 6.74 | 1.60 | 0.00 | 0.00 | 0.12 | -1.26 | 0.00 |
| Shingle Creek | 2 | 10.30 | 0.34 | 6.99 | 1.49 | 0.00 | 0.00 | 0.07 | -1.55 | 0.00 |
| Boggy Creek | 3 | 10.85 | 0.12 | 8.77 | 0.62 | 0.00 | 0.00 | 0.01 | -1.35 | 0.00 |
| Lake Hart | 4 | 7.28 | 0.05 | 6.57 | 0.10 | 0.00 | 0.00 | -0.04 | -0.52 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 4.99 | 1.79 | 0.00 | 0.69 | 0.00 | 0.00 | -1.40 | -1.12 | 0.00 |
| Lower Reedy Creek | 6 | 9.94 | 0.81 | 9.73 | -1.39 | 0.00 | 0.00 | 0.02 | -0.81 | 0.00 |
| Lake Tohopekaliga | 7 | 12.21 | 0.12 | 11.25 | -0.33 | 0.00 | 0.00 | -0.06 | -1.11 | 0.00 |
| East Lake Tohopekaliga | 8 | 9.36 | 0.22 | 8.23 | 0.02 | 0.00 | 0.00 | 0.13 | -1.02 | 0.00 |
| Alligator Lake | 9 | 12.38 | 0.10 | 11.17 | 0.03 | 0.00 | 0.00 | 0.07 | -1.15 | 0.00 |
| Lake Mrytle | 10 | 6.22 | 0.34 | 5.06 | 0.01 | 0.00 | 0.00 | -0.55 | -0.25 | 0.00 |
| Lake Conlin (Closed Basin) | 11 | 16.76 | 0.00 | 15.12 | 0.02 | 0.00 | 0.00 | 0.06 | -1.68 | 0.00 |
| Lake Marion | 12 | 12.70 | 0.04 | 11.83 | 0.50 | 0.00 | 0.00 | 0.64 | -0.99 | 0.01 |
| Marion Creek | 13 | 9.12 | 0.31 | 9.22 | -1.41 | 0.00 | 0.00 | -0.16 | -0.84 | 0.00 |
| Lake Cypress | 14 | 15.96 | 0.45 | 14.98 | -0.18 | 0.00 | 0.00 | 0.10 | -0.81 | 0.01 |
| S63A | 15 | 19.33 | 0.18 | 17.94 | 0.08 | 0.00 | 0.00 | 0.10 | -1.24 | 0.01 |
| Lake Gentry | 16 | 18.81 | 0.14 | 17.09 | 0.06 | 0.00 | 0.00 | 0.02 | -1.55 | 0.01 |
| Lake Pierce | 17 | 13.93 | 0.00 | 10.04 | 1.23 | 0.00 | 0.00 | -1.02 | -1.64 | 0.01 |
| Catfish Creek | 18 | 13.70 | 2.11 | 11.52 | -0.70 | 0.00 | 0.00 | 0.84 | -1.62 | 0.00 |
| Lake Hatchineha | 19 | 5.82 | 0.48 | 6.10 | -0.86 | 0.00 | 0.00 | 0.13 | -0.23 | 0.00 |
| Lake Weohyakapaka | 20 | 12.53 | 0.02 | 10.31 | 0.68 | 0.00 | 0.00 | 0.02 | -1.55 | 0.00 |
| Lake Rosalie | 21 | 8.93 | 0.12 | 6.51 | 0.25 | 0.00 | 0.00 | -0.09 | -1.95 | 0.00 |
| Tiger Lake | 22 | 6.93 | 0.10 | 6.59 | 0.00 | 0.00 | 0.00 | 0.20 | -0.44 | 0.00 |
| Lake Kissimmee | 23 | 7.76 | 0.06 | 7.48 | 0.10 | 0.00 | 0.00 | 0.09 | -0.20 | 0.00 |
| Lake Jackson | 24 | 12.36 | 0.03 | 11.64 | 0.13 | 0.00 | 0.00 | -0.36 | -0.21 | 0.01 |
| Lake Marian | 25 | 16.80 | 0.01 | 16.50 | 0.03 | 0.00 | 0.00 | 0.13 | -0.40 | 0.01 |
| S-65A | 26 | 10.76 | 0.42 | 9.36 | 0.19 | 0.00 | 0.00 | -0.16 | -0.64 | 0.01 |
| S-65BC | 27 | 12.67 | 1.18 | 10.92 | 0.23 | 0.00 | 0.00 | 0.21 | -0.57 | 0.01 |
| S-65D | 28 | 15.26 | 0.88 | 13.47 | 0.12 | 0.00 | 0.00 | -0.14 | -0.67 | 0.01 |
| S-65E | 29 | 16.03 | 2.43 | 13.07 | -0.21 | 0.00 | 0.00 | 0.02 | -0.77 | 0.01 |

**Table D-15: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 1995 to 1996 dry season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 5.34 | 0.21 | 4.59 | 1.43 | 0.00 | 0.00 | 0.10 | 0.79 | 0.00 |
| Shingle Creek | 2 | 4.42 | 0.40 | 3.68 | 1.46 | 0.00 | 0.00 | 0.11 | 1.01 | 0.00 |
| Boggy Creek | 3 | 4.44 | 0.14 | 4.38 | 0.61 | 0.00 | 0.00 | 0.01 | 0.67 | 0.00 |
| Lake Hart | 4 | 4.28 | 0.04 | 4.30 | 0.10 | 0.00 | 0.00 | -0.03 | 0.19 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 2.74 | 1.70 | 0.00 | 0.31 | 0.00 | 0.00 | -1.36 | 0.64 | 0.00 |
| Lower Reedy Creek | 6 | 4.79 | 0.80 | 6.15 | -1.59 | 0.00 | 0.00 | 0.07 | 0.50 | 0.00 |
| Lake Tohopekaliga | 7 | 3.07 | 0.09 | 3.79 | -0.33 | 0.00 | 0.00 | -0.09 | 0.57 | 0.00 |
| East Lake Tohopekaliga | 8 | 3.15 | 0.21 | 3.54 | 0.02 | 0.00 | 0.00 | 0.13 | 0.49 | 0.00 |
| Alligator Lake | 9 | 3.68 | 0.07 | 4.31 | 0.03 | 0.00 | 0.00 | 0.07 | 0.66 | 0.00 |
| Lake Mrytle | 10 | 4.27 | 0.31 | 3.47 | 0.02 | 0.00 | 0.00 | -0.62 | 0.15 | 0.00 |
| Lake Conlin (Closed Basin) | 11 | 4.77 | 0.00 | 5.50 | 0.02 | 0.00 | 0.00 | 0.06 | 0.69 | 0.01 |
| Lake Marion | 12 | 5.11 | 0.04 | 6.49 | -0.07 | 0.00 | 0.00 | 0.73 | 0.61 | 0.00 |
| Marion Creek | 13 | 3.26 | 0.36 | 4.81 | -1.59 | 0.00 | 0.00 | -0.26 | 0.57 | 0.00 |
| Lake Cypress | 14 | 2.44 | 0.46 | 2.87 | -0.23 | 0.00 | 0.00 | 0.11 | 0.54 | 0.00 |
| S63A | 15 | 2.53 | 0.17 | 3.29 | 0.08 | 0.00 | 0.00 | 0.12 | 0.87 | 0.00 |
| Lake Gentry | 16 | 3.87 | 0.10 | 4.68 | 0.06 | 0.00 | 0.00 | 0.03 | 0.92 | 0.00 |
| Lake Pierce | 17 | 5.83 | 0.00 | 5.10 | 0.77 | 0.00 | 0.00 | -1.07 | 1.11 | 0.00 |
| Catfish Creek | 18 | 3.76 | 2.01 | 4.98 | -0.89 | 0.00 | 0.00 | 1.05 | 1.28 | 0.00 |
| Lake Hatchineha | 19 | 2.69 | 0.67 | 3.34 | -1.06 | 0.00 | 0.00 | 0.11 | 0.15 | 0.00 |
| Lake Weohyakapaka | 20 | 5.24 | 0.02 | 6.06 | 0.55 | 0.00 | 0.00 | -0.06 | 1.44 | 0.00 |
| Lake Rosalie | 21 | 1.82 | 0.14 | 3.14 | 0.12 | 0.00 | 0.00 | -0.10 | 1.67 | 0.00 |
| Tiger Lake | 22 | 2.46 | 0.11 | 3.29 | -0.08 | 0.00 | 0.00 | 0.32 | 0.54 | 0.00 |
| Lake Kissimmee | 23 | 1.53 | 0.07 | 2.01 | -0.04 | 0.00 | 0.00 | 0.11 | 0.41 | 0.00 |
| Lake Jackson | 24 | 5.18 | 0.03 | 4.96 | 0.13 | 0.00 | 0.00 | -0.38 | 0.32 | 0.00 |
| Lake Marian | 25 | 3.56 | 0.01 | 4.39 | 0.03 | 0.00 | 0.00 | 0.14 | 0.72 | 0.00 |
| S-65A | 26 | 4.15 | 0.85 | 4.31 | 0.17 | 0.00 | 0.00 | -0.18 | 1.36 | 0.00 |
| S-65BC | 27 | 4.59 | 1.21 | 4.38 | 0.20 | 0.00 | 0.00 | 0.24 | 0.95 | 0.00 |
| S-65D | 28 | 2.96 | 0.70 | 3.00 | 0.10 | 0.00 | 0.00 | -0.18 | 1.02 | 0.00 |
| S-65E | 29 | 3.67 | 1.60 | 3.42 | -0.28 | 0.00 | 0.00 | 0.09 | 0.98 | 0.00 |

**Table D-16: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 1996 wet season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 9.46 | 0.20 | 7.29 | 1.51 | 0.00 | 0.00 | 0.12 | -0.58 | 0.00 |
| Shingle Creek | 2 | 10.11 | 0.37 | 7.52 | 1.52 | 0.00 | 0.00 | 0.10 | -0.79 | 0.00 |
| Boggy Creek | 3 | 9.55 | 0.12 | 8.38 | 0.63 | 0.00 | 0.00 | 0.01 | -0.44 | 0.00 |
| Lake Hart | 4 | 7.22 | 0.05 | 6.90 | 0.10 | 0.00 | 0.00 | -0.03 | -0.14 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 4.21 | 1.83 | 0.00 | 0.56 | 0.00 | 0.00 | -1.47 | -0.35 | 0.00 |
| Lower Reedy Creek | 6 | 7.45 | 0.78 | 8.07 | -1.63 | 0.00 | 0.00 | 0.06 | -0.29 | 0.00 |
| Lake Tohopekaliga | 7 | 7.11 | 0.13 | 6.94 | -0.35 | 0.00 | 0.00 | -0.08 | -0.31 | 0.00 |
| East Lake Tohopekaliga | 8 | 6.71 | 0.23 | 6.33 | 0.02 | 0.00 | 0.00 | 0.14 | -0.27 | 0.00 |
| Alligator Lake | 9 | 6.88 | 0.10 | 6.50 | 0.03 | 0.00 | 0.00 | 0.09 | -0.34 | 0.00 |
| Lake Mrytle | 10 | 5.02 | 0.38 | 3.96 | 0.02 | 0.00 | 0.00 | -0.58 | -0.08 | 0.00 |
| Lake Conlin (Closed Basin) | 11 | 6.00 | 0.00 | 5.37 | 0.02 | 0.00 | 0.00 | 0.05 | -0.66 | 0.01 |
| Lake Marion | 12 | 11.05 | 0.04 | 10.76 | 0.52 | 0.00 | 0.00 | 0.71 | -0.45 | 0.01 |
| Marion Creek | 13 | 6.89 | 0.32 | 7.56 | -1.63 | 0.00 | 0.00 | -0.21 | -0.43 | 0.00 |
| Lake Cypress | 14 | 6.70 | 0.47 | 6.17 | -0.24 | 0.00 | 0.00 | 0.09 | -0.39 | 0.00 |
| S63A | 15 | 7.21 | 0.18 | 6.35 | 0.09 | 0.00 | 0.00 | 0.08 | -0.68 | 0.01 |
| Lake Gentry | 16 | 7.08 | 0.12 | 6.18 | 0.06 | 0.00 | 0.00 | 0.01 | -0.74 | 0.01 |
| Lake Pierce | 17 | 13.61 | 0.00 | 10.53 | 1.19 | 0.00 | 0.00 | -1.11 | -0.79 | 0.01 |
| Catfish Creek | 18 | 13.70 | 2.35 | 12.36 | -0.92 | 0.00 | 0.00 | 1.03 | -0.94 | 0.00 |
| Lake Hatchineha | 19 | 5.04 | 0.61 | 5.52 | -1.09 | 0.00 | 0.00 | 0.11 | -0.11 | 0.00 |
| Lake Weohyakapaka | 20 | 12.42 | 0.02 | 10.88 | 0.67 | 0.00 | 0.00 | 0.06 | -0.92 | 0.00 |
| Lake Rosalie | 21 | 9.07 | 0.14 | 7.32 | 0.15 | 0.00 | 0.00 | -0.20 | -1.26 | 0.00 |
| Tiger Lake | 22 | 6.35 | 0.10 | 6.10 | -0.10 | 0.00 | 0.00 | 0.26 | -0.50 | 0.00 |
| Lake Kissimmee | 23 | 4.09 | 0.06 | 3.77 | 0.00 | 0.00 | 0.00 | 0.09 | -0.35 | 0.00 |
| Lake Jackson | 24 | 6.32 | 0.03 | 5.60 | 0.13 | 0.00 | 0.00 | -0.30 | -0.27 | 0.00 |
| Lake Marian | 25 | 8.89 | 0.01 | 8.38 | 0.03 | 0.00 | 0.00 | 0.10 | -0.57 | 0.00 |
| S-65A | 26 | 7.97 | 0.80 | 6.05 | 0.17 | 0.00 | 0.00 | -0.14 | -0.82 | 0.01 |
| S-65BC | 27 | 8.44 | 1.23 | 6.69 | 0.20 | 0.00 | 0.00 | 0.21 | -0.54 | 0.01 |
| S-65D | 28 | 9.28 | 0.81 | 7.56 | 0.10 | 0.00 | 0.00 | -0.16 | -0.66 | 0.01 |
| S-65E | 29 | 9.74 | 1.98 | 7.41 | -0.30 | 0.00 | 0.00 | 0.06 | -0.71 | 0.01 |

**Table D-17: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 1996 to 1997 dry season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 1.39 | 0.20 | 1.75 | 1.30 | 0.00 | 0.00 | 0.08 | 1.77 | 0.00 |
| Shingle Creek | 2 | 0.32 | 0.32 | 1.06 | 1.44 | 0.00 | 0.00 | 0.10 | 2.40 | 0.00 |
| Boggy Creek | 3 | 0.28 | 0.12 | 1.11 | 0.62 | 0.00 | 0.00 | 0.03 | 1.53 | 0.00 |
| Lake Hart | 4 | 1.48 | 0.04 | 1.76 | 0.09 | 0.00 | 0.00 | -0.04 | 0.46 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 2.13 | 1.47 | 0.00 | 0.35 | 0.00 | 0.00 | -1.24 | 0.94 | 0.00 |
| Lower Reedy Creek | 6 | 0.10 | 0.55 | 2.44 | -1.72 | 0.00 | 0.00 | 0.07 | 1.10 | 0.00 |
| Lake Tohopekaliga | 7 | -1.01 | 0.08 | 0.65 | -0.38 | 0.00 | 0.00 | -0.08 | 1.43 | 0.00 |
| East Lake Tohopekaliga | 8 | -0.37 | 0.17 | 0.75 | 0.02 | 0.00 | 0.00 | 0.12 | 1.20 | 0.00 |
| Alligator Lake | 9 | -0.46 | 0.06 | 0.93 | 0.03 | 0.00 | 0.00 | 0.04 | 1.44 | 0.00 |
| Lake Mrytle | 10 | 1.93 | 0.27 | 1.33 | 0.02 | 0.00 | 0.00 | -0.57 | 0.25 | 0.00 |
| Lake Conlin (Closed Basin) | 11 | -2.40 | 0.00 | 0.43 | 0.02 | 0.00 | 0.00 | 0.10 | 2.75 | 0.00 |
| Lake Marion | 12 | 3.01 | 0.04 | 4.46 | -0.11 | 0.00 | 0.00 | 0.67 | 0.72 | 0.00 |
| Marion Creek | 13 | 0.32 | 0.36 | 2.57 | -1.71 | 0.00 | 0.00 | -0.22 | 1.11 | 0.00 |
| Lake Cypress | 14 | -1.08 | 0.23 | 0.43 | -0.31 | 0.00 | 0.00 | 0.12 | 1.31 | 0.00 |
| S63A | 15 | -1.61 | 0.05 | 0.42 | 0.08 | 0.00 | 0.00 | 0.05 | 2.10 | 0.00 |
| Lake Gentry | 16 | -1.62 | 0.09 | 0.83 | 0.06 | 0.00 | 0.00 | 0.04 | 2.55 | 0.00 |
| Lake Pierce | 17 | 4.55 | 0.00 | 3.65 | 0.69 | 0.00 | 0.00 | -1.06 | 0.84 | 0.00 |
| Catfish Creek | 18 | 1.45 | 1.86 | 3.22 | -1.08 | 0.00 | 0.00 | 1.20 | 1.36 | 0.00 |
| Lake Hatchineha | 19 | 1.28 | 0.53 | 2.26 | -1.20 | 0.00 | 0.00 | 0.08 | 0.22 | 0.00 |
| Lake Weohyakapaka | 20 | 3.87 | 0.01 | 4.38 | 0.50 | 0.00 | 0.00 | -0.08 | 1.11 | 0.00 |
| Lake Rosalie | 21 | 0.85 | 0.15 | 2.31 | -0.05 | 0.00 | 0.00 | -0.04 | 1.59 | 0.00 |
| Tiger Lake | 22 | 1.46 | 0.09 | 2.62 | -0.18 | 0.00 | 0.00 | 0.42 | 0.64 | 0.00 |
| Lake Kissimmee | 23 | 0.23 | 0.05 | 0.69 | 0.02 | 0.00 | 0.00 | 0.07 | 0.45 | 0.00 |
| Lake Jackson | 24 | 1.60 | 0.02 | 1.69 | 0.13 | 0.00 | 0.00 | -0.26 | 0.48 | 0.01 |
| Lake Marian | 25 | 0.68 | 0.00 | 1.38 | 0.03 | 0.00 | 0.00 | 0.08 | 0.65 | 0.00 |
| S-65A | 26 | 0.61 | 0.46 | 1.64 | 0.14 | 0.00 | 0.00 | -0.15 | 1.78 | 0.00 |
| S-65BC | 27 | 1.12 | 1.07 | 1.50 | 0.16 | 0.00 | 0.00 | 0.21 | 1.39 | 0.01 |
| S-65D | 28 | -0.01 | 0.50 | 0.79 | 0.07 | 0.00 | 0.00 | -0.15 | 1.53 | 0.00 |
| S-65E | 29 | -0.32 | 1.03 | 0.64 | -0.35 | 0.00 | 0.00 | 0.07 | 1.57 | 0.00 |

**Table D-18: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 1997 wet season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 5.94 | 0.16 | 3.82 | 1.53 | 0.00 | 0.00 | 0.12 | -0.55 | 0.00 |
| Shingle Creek | 2 | 6.69 | 0.29 | 3.89 | 1.53 | 0.00 | 0.00 | 0.07 | -1.05 | 0.00 |
| Boggy Creek | 3 | 7.94 | 0.11 | 6.25 | 0.65 | 0.00 | 0.00 | 0.02 | -0.94 | 0.00 |
| Lake Hart | 4 | 4.90 | 0.05 | 4.43 | 0.10 | 0.00 | 0.00 | -0.04 | -0.28 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 3.96 | 1.61 | 0.00 | 0.72 | 0.00 | 0.00 | -1.35 | -0.28 | 0.00 |
| Lower Reedy Creek | 6 | 3.73 | 0.44 | 4.54 | -1.58 | 0.00 | 0.00 | 0.08 | -0.41 | 0.00 |
| Lake Tohopekaliga | 7 | 4.14 | 0.11 | 3.61 | -0.38 | 0.00 | 0.00 | -0.06 | -0.73 | 0.00 |
| East Lake Tohopekaliga | 8 | 4.64 | 0.19 | 3.85 | 0.02 | 0.00 | 0.00 | 0.11 | -0.69 | 0.00 |
| Alligator Lake | 9 | 5.43 | 0.08 | 4.45 | 0.03 | 0.00 | 0.00 | 0.11 | -0.98 | 0.00 |
| Lake Mrytle | 10 | 3.47 | 0.33 | 2.52 | 0.02 | 0.00 | 0.00 | -0.47 | -0.14 | 0.00 |
| Lake Conlin (Closed Basin) | 11 | 7.38 | 0.00 | 5.03 | 0.02 | 0.00 | 0.00 | 0.00 | -2.33 | 0.00 |
| Lake Marion | 12 | 10.87 | 0.04 | 10.59 | 0.75 | 0.00 | 0.00 | 0.65 | -0.14 | 0.01 |
| Marion Creek | 13 | 4.79 | 0.32 | 5.37 | -1.63 | 0.00 | 0.00 | -0.18 | -0.55 | 0.00 |
| Lake Cypress | 14 | 5.16 | 0.37 | 4.44 | -0.30 | 0.00 | 0.00 | 0.10 | -0.74 | 0.00 |
| S63A | 15 | 8.17 | 0.08 | 6.72 | 0.09 | 0.00 | 0.00 | 0.07 | -1.36 | 0.01 |
| Lake Gentry | 16 | 9.32 | 0.11 | 7.18 | 0.06 | 0.00 | 0.00 | -0.02 | -1.95 | 0.01 |
| Lake Pierce | 17 | 10.00 | 0.00 | 7.97 | 1.15 | 0.00 | 0.00 | -1.11 | 0.23 | 0.00 |
| Catfish Creek | 18 | 6.47 | 1.92 | 6.32 | -1.06 | 0.00 | 0.00 | 1.00 | -0.29 | 0.00 |
| Lake Hatchineha | 19 | 2.46 | 0.56 | 3.25 | -1.27 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 |
| Lake Weohyakapaka | 20 | 8.84 | 0.02 | 7.91 | 0.60 | 0.00 | 0.00 | 0.01 | -0.32 | 0.00 |
| Lake Rosalie | 21 | 4.49 | 0.14 | 3.94 | -0.02 | 0.00 | 0.00 | -0.04 | -0.39 | 0.00 |
| Tiger Lake | 22 | 4.75 | 0.09 | 4.79 | -0.20 | 0.00 | 0.00 | 0.28 | -0.36 | 0.00 |
| Lake Kissimmee | 23 | 5.69 | 0.07 | 5.28 | 0.01 | 0.00 | 0.00 | 0.08 | -0.42 | 0.00 |
| Lake Jackson | 24 | 8.08 | 0.03 | 7.18 | 0.14 | 0.00 | 0.00 | -0.28 | -0.47 | 0.01 |
| Lake Marian | 25 | 10.06 | 0.01 | 9.34 | 0.03 | 0.00 | 0.00 | 0.08 | -0.77 | 0.00 |
| S-65A | 26 | 10.20 | 0.66 | 7.30 | 0.17 | 0.00 | 0.00 | -0.12 | -1.96 | 0.01 |
| S-65BC | 27 | 9.84 | 1.12 | 7.17 | 0.19 | 0.00 | 0.00 | 0.16 | -1.55 | 0.02 |
| S-65D | 28 | 10.25 | 0.80 | 7.79 | 0.08 | 0.00 | 0.00 | -0.10 | -1.48 | 0.01 |
| S-65E | 29 | 10.61 | 2.04 | 7.62 | -0.30 | 0.00 | 0.00 | 0.02 | -1.29 | 0.01 |

**Table D-19: Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 1997 to 1998 dry season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 10.96 | 0.20 | 8.65 | 1.66 | 0.00 | 0.00 | 0.13 | -0.59 | 0.00 |
| Shingle Creek | 2 | 11.02 | 0.41 | 8.49 | 1.67 | 0.00 | 0.00 | 0.11 | -0.56 | 0.00 |
| Boggy Creek | 3 | 11.94 | 0.14 | 10.96 | 0.68 | 0.00 | 0.00 | 0.01 | -0.18 | 0.00 |
| Lake Hart | 4 | 7.61 | 0.04 | 7.46 | 0.10 | 0.00 | 0.00 | -0.04 | 0.05 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 4.70 | 2.07 | 0.00 | 0.56 | 0.00 | 0.00 | -1.67 | -0.41 | 0.00 |
| Lower Reedy Creek | 6 | 10.83 | 0.89 | 11.28 | -1.66 | 0.00 | 0.00 | 0.07 | -0.40 | 0.00 |
| Lake Tohopekaliga | 7 | 10.71 | 0.11 | 10.53 | -0.32 | 0.00 | 0.00 | -0.07 | -0.33 | 0.00 |
| East Lake Tohopekaliga | 8 | 9.02 | 0.23 | 8.71 | 0.03 | 0.00 | 0.00 | 0.14 | -0.19 | 0.00 |
| Alligator Lake | 9 | 11.05 | 0.10 | 10.80 | 0.03 | 0.00 | 0.00 | 0.10 | -0.21 | 0.00 |
| Lake Mrytle | 10 | 6.12 | 0.29 | 5.15 | 0.02 | 0.00 | 0.00 | -0.57 | -0.09 | 0.00 |
| Lake Conlin (Closed Basin) | 11 | 13.64 | 0.00 | 13.65 | 0.03 | 0.00 | 0.00 | 0.01 | 0.03 | 0.00 |
| Lake Marion | 12 | 14.59 | 0.04 | 14.31 | 0.78 | 0.00 | 0.00 | 0.78 | -0.24 | 0.00 |
| Marion Creek | 13 | 9.76 | 0.33 | 10.59 | -1.66 | 0.00 | 0.00 | -0.24 | -0.27 | 0.00 |
| Lake Cypress | 14 | 11.68 | 0.44 | 11.42 | -0.27 | 0.00 | 0.00 | 0.09 | -0.18 | 0.00 |
| S63A | 15 | 15.16 | 0.21 | 14.76 | 0.09 | 0.00 | 0.00 | 0.10 | -0.19 | 0.00 |
| Lake Gentry | 16 | 14.71 | 0.15 | 14.45 | 0.07 | 0.00 | 0.00 | 0.03 | -0.08 | 0.01 |
| Lake Pierce | 17 | 12.94 | 0.00 | 10.02 | 1.23 | 0.00 | 0.00 | -1.15 | -0.53 | 0.00 |
| Catfish Creek | 18 | 10.35 | 2.25 | 9.78 | -1.09 | 0.00 | 0.00 | 1.08 | -0.48 | 0.00 |
| Lake Hatchineha | 19 | 4.72 | 0.57 | 5.42 | -1.28 | 0.00 | 0.00 | 0.09 | -0.10 | 0.00 |
| Lake Weohyakapaka | 20 | 11.86 | 0.02 | 10.64 | 0.62 | 0.00 | 0.00 | -0.03 | -0.55 | 0.00 |
| Lake Rosalie | 21 | 6.42 | 0.15 | 5.56 | -0.03 | 0.00 | 0.00 | -0.13 | -0.60 | 0.00 |
| Tiger Lake | 22 | 7.87 | 0.09 | 8.18 | -0.21 | 0.00 | 0.00 | 0.28 | -0.09 | 0.00 |
| Lake Kissimmee | 23 | 9.33 | 0.07 | 9.45 | 0.05 | 0.00 | 0.00 | 0.12 | 0.12 | 0.00 |
| Lake Jackson | 24 | 13.35 | 0.04 | 12.84 | 0.14 | 0.00 | 0.00 | -0.37 | 0.04 | 0.00 |
| Lake Marian | 25 | 17.34 | 0.01 | 17.60 | 0.03 | 0.00 | 0.00 | 0.13 | 0.16 | 0.00 |
| S-65A | 26 | 16.98 | 0.56 | 15.62 | 0.20 | 0.00 | 0.00 | -0.15 | -0.45 | 0.01 |
| S-65BC | 27 | 15.10 | 1.17 | 13.81 | 0.21 | 0.00 | 0.00 | 0.20 | -0.12 | 0.01 |
| S-65D | 28 | 10.88 | 0.93 | 9.72 | 0.08 | 0.00 | 0.00 | -0.13 | -0.03 | 0.01 |
| S-65E | 29 | 8.32 | 2.01 | 6.94 | -0.31 | 0.00 | 0.00 | 0.04 | 0.27 | 0.01 |

**Table D-20 Seasonal MIKE SHE SAS water budget (inches) for 29 defined sub-watersheds during the 1998 wet season.**

| Sub-Watershed | Sub-Watershed ID | Net SAS Recharge (*NRch*) | Baseflow (*BF*) | Drainage To River (*D*) | SAS to ICU Flow ($GW_L$) | PWS Withdrawals ($GW_P$) | Irrigation Withdrawals ($GW_I$) | Lateral SZ Boundary Flow ($SZ_{BC}$) | SZ Storage Change ($\Delta SZ$) | SZ Error ($ERR_{SZ}$) |
|---|---|---|---|---|---|---|---|---|---|---|
| Upper Reedy Creek | 1 | 5.41 | 0.18 | 3.73 | 1.43 | 0.00 | 0.00 | 0.11 | -0.18 | 0.00 |
| Shingle Creek | 2 | 4.90 | 0.34 | 3.12 | 1.52 | 0.00 | 0.00 | 0.11 | -0.03 | 0.00 |
| Boggy Creek | 3 | 4.95 | 0.13 | 4.33 | 0.65 | 0.00 | 0.00 | 0.03 | 0.12 | 0.00 |
| Lake Hart | 4 | 4.49 | 0.05 | 4.21 | 0.10 | 0.00 | 0.00 | -0.05 | -0.08 | 0.00 |
| Horse Creek (Closed Basin) | 5 | 3.17 | 1.59 | 0.00 | 0.28 | 0.00 | 0.00 | -1.38 | 0.07 | 0.00 |
| Lower Reedy Creek | 6 | 2.38 | 0.43 | 3.96 | -1.72 | 0.00 | 0.00 | 0.08 | 0.20 | 0.00 |
| Lake Tohopekaliga | 7 | 1.80 | 0.11 | 2.25 | -0.36 | 0.00 | 0.00 | -0.09 | 0.29 | 0.00 |
| East Lake Tohopekaliga | 8 | 2.24 | 0.20 | 2.37 | 0.02 | 0.00 | 0.00 | 0.12 | 0.24 | 0.00 |
| Alligator Lake | 9 | 2.81 | 0.09 | 3.16 | 0.03 | 0.00 | 0.00 | 0.08 | 0.40 | 0.00 |
| Lake Mrytle | 10 | 3.20 | 0.37 | 2.34 | 0.02 | 0.00 | 0.00 | -0.59 | 0.11 | 0.00 |
| Lake Conlin (Closed Basin) | 11 | 4.01 | 0.00 | 3.96 | 0.02 | 0.00 | 0.00 | 0.06 | -0.09 | 0.00 |
| Lake Marion | 12 | 6.24 | 0.04 | 6.84 | 0.12 | 0.00 | 0.00 | 0.69 | 0.08 | 0.00 |
| Marion Creek | 13 | 2.41 | 0.36 | 3.72 | -1.67 | 0.00 | 0.00 | -0.22 | 0.23 | 0.00 |
| Lake Cypress | 14 | 3.05 | 0.42 | 3.11 | -0.33 | 0.00 | 0.00 | 0.11 | 0.05 | 0.00 |
| S63A | 15 | 4.86 | 0.10 | 4.94 | 0.09 | 0.00 | 0.00 | 0.11 | 0.16 | 0.00 |
| Lake Gentry | 16 | 5.82 | 0.12 | 5.66 | 0.06 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 |
| Lake Pierce | 17 | 7.93 | 0.00 | 6.04 | 0.96 | 0.00 | 0.00 | -1.07 | 0.13 | 0.00 |
| Catfish Creek | 18 | 5.38 | 1.94 | 5.64 | -1.09 | 0.00 | 0.00 | 1.04 | 0.06 | 0.00 |
| Lake Hatchineha | 19 | 2.45 | 0.65 | 3.20 | -1.36 | 0.00 | 0.00 | 0.08 | -0.03 | 0.00 |
| Lake Weohyakapaka | 20 | 8.26 | 0.01 | 7.69 | 0.58 | 0.00 | 0.00 | -0.07 | 0.09 | 0.00 |
| Lake Rosalie | 21 | 3.84 | 0.14 | 3.75 | -0.06 | 0.00 | 0.00 | -0.12 | 0.12 | 0.00 |
| Tiger Lake | 22 | 4.21 | 0.10 | 4.65 | -0.26 | 0.00 | 0.00 | 0.36 | -0.08 | 0.00 |
| Lake Kissimmee | 23 | 4.30 | 0.07 | 4.32 | -0.07 | 0.00 | 0.00 | 0.11 | -0.09 | 0.00 |
| Lake Jackson | 24 | 6.57 | 0.03 | 6.05 | 0.14 | 0.00 | 0.00 | -0.35 | 0.00 | 0.00 |
| Lake Marian | 25 | 4.74 | 0.01 | 5.17 | 0.03 | 0.00 | 0.00 | 0.12 | 0.34 | 0.00 |
| S-65A | 26 | 11.24 | 0.89 | 9.97 | 0.18 | 0.00 | 0.00 | -0.22 | 0.00 | 0.01 |
| S-65BC | 27 | 10.12 | 1.50 | 8.83 | 0.18 | 0.00 | 0.00 | 0.24 | 0.12 | 0.01 |
| S-65D | 28 | 9.91 | 0.87 | 8.81 | 0.07 | 0.00 | 0.00 | -0.15 | -0.03 | 0.02 |
| S-65E | 29 | 7.66 | 1.75 | 6.10 | -0.29 | 0.00 | 0.00 | 0.06 | -0.17 | 0.01 |

# APPENDIX E

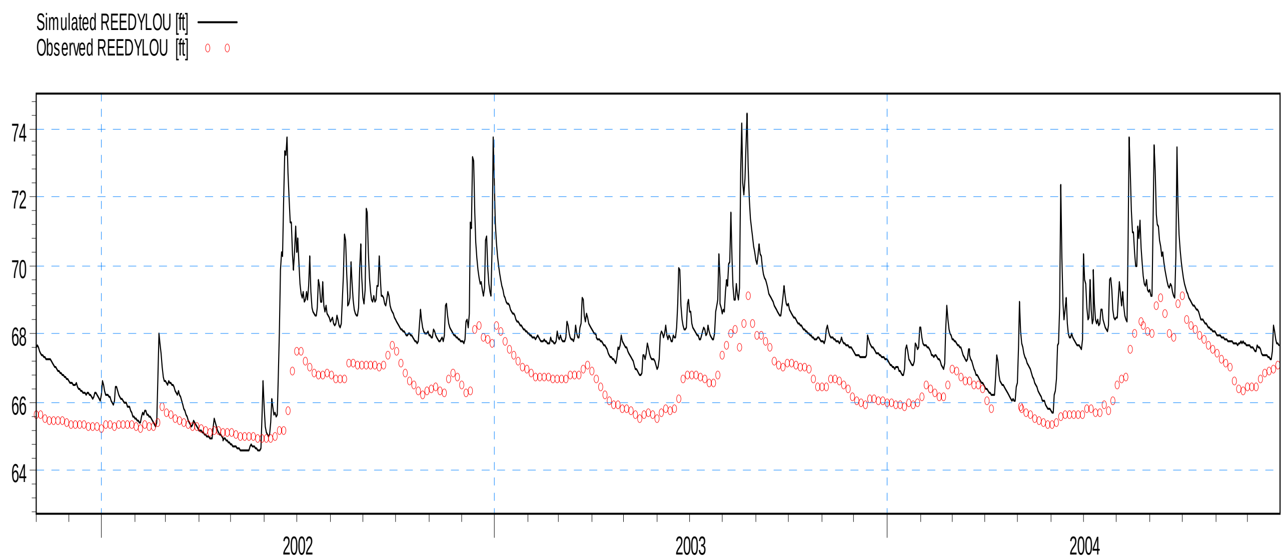
# Run 100 Calibration plots and statistics tables

HTML output from MSHECalPlot

12/19/2007 2:00:27 PM

Plot number 1 [Input Item No. 1]

REEDYLOU Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\REEDYLOUDaily.dfs0]

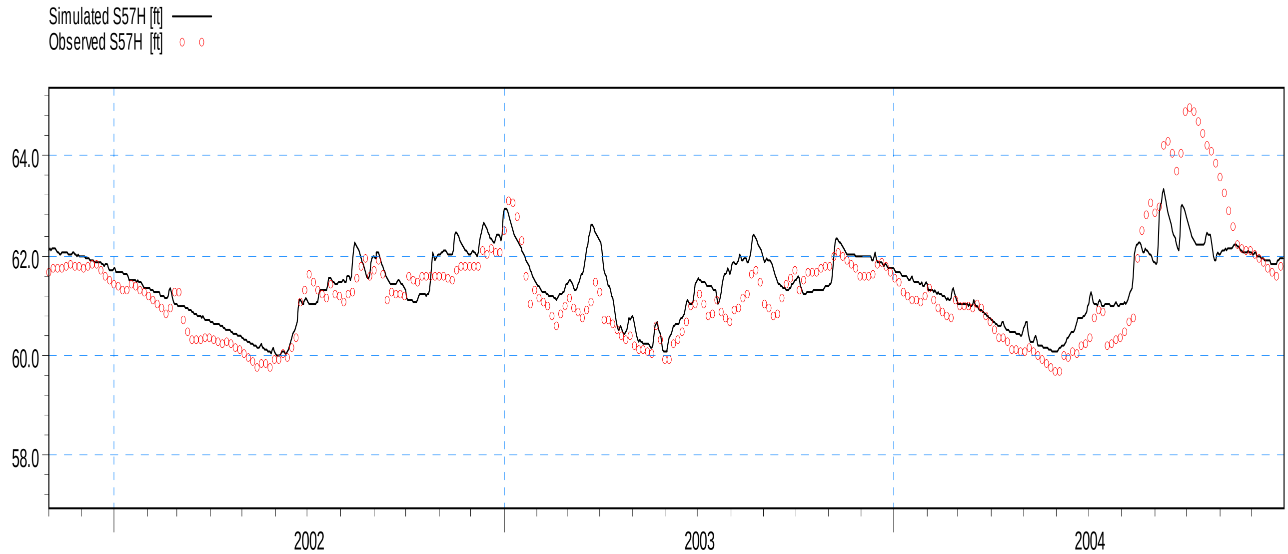



Plot number 2 [Input Item No. 2]

REEDC Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\REEDCDaily.dfs0]

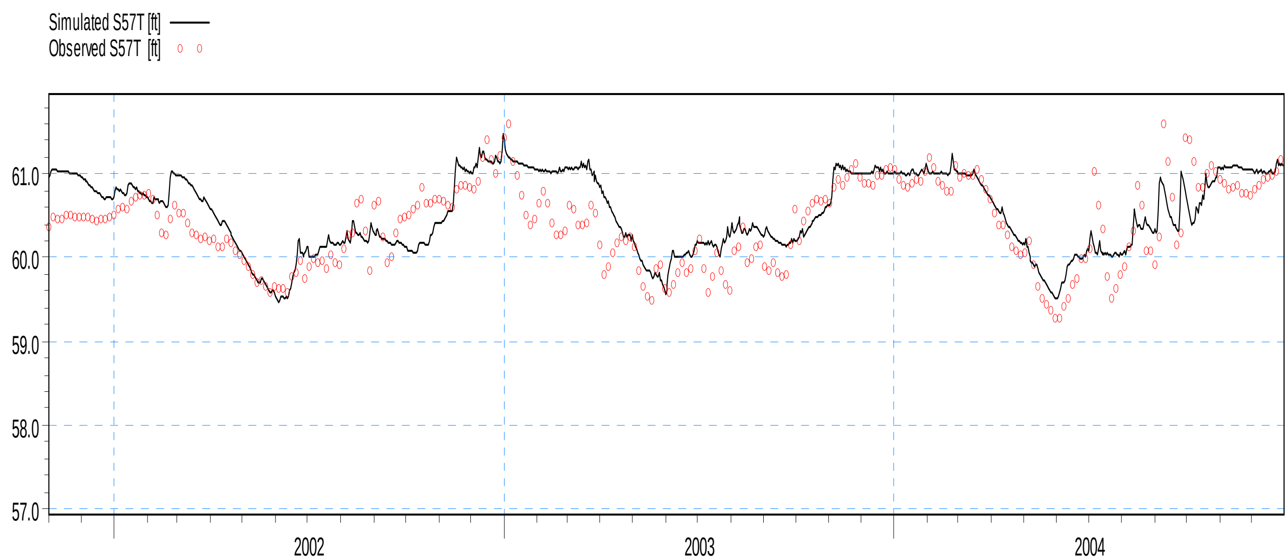
Plot number 3 [Input Item No. 3]

S57H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S57_headwater.dfs0]



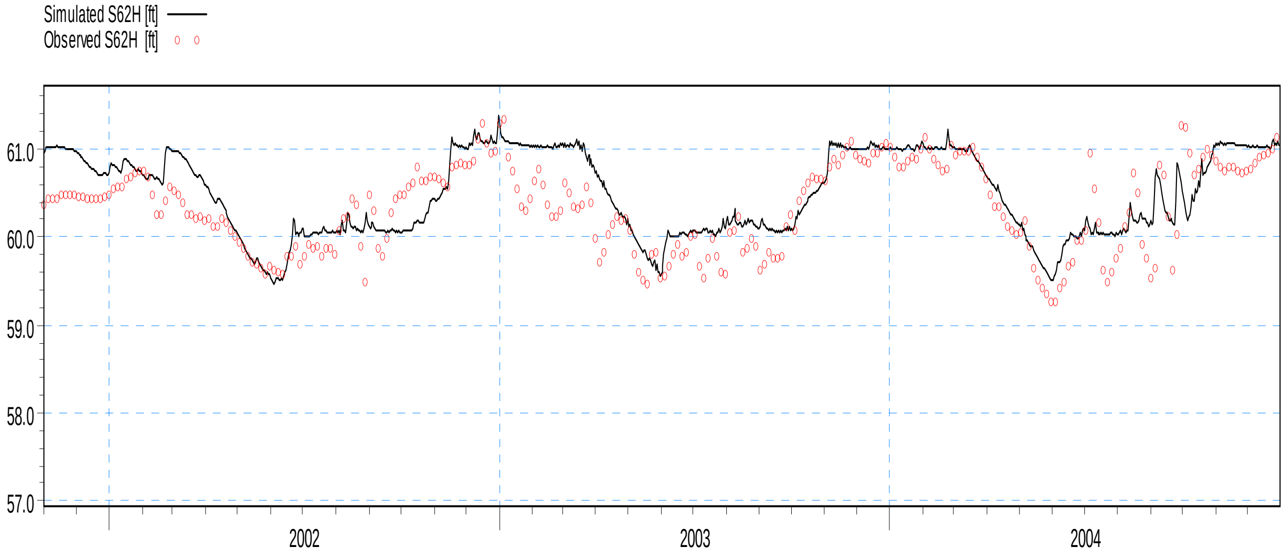

Plot number 4 [Input Item No. 4]

S57T Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S57_tailwater.dfs0]



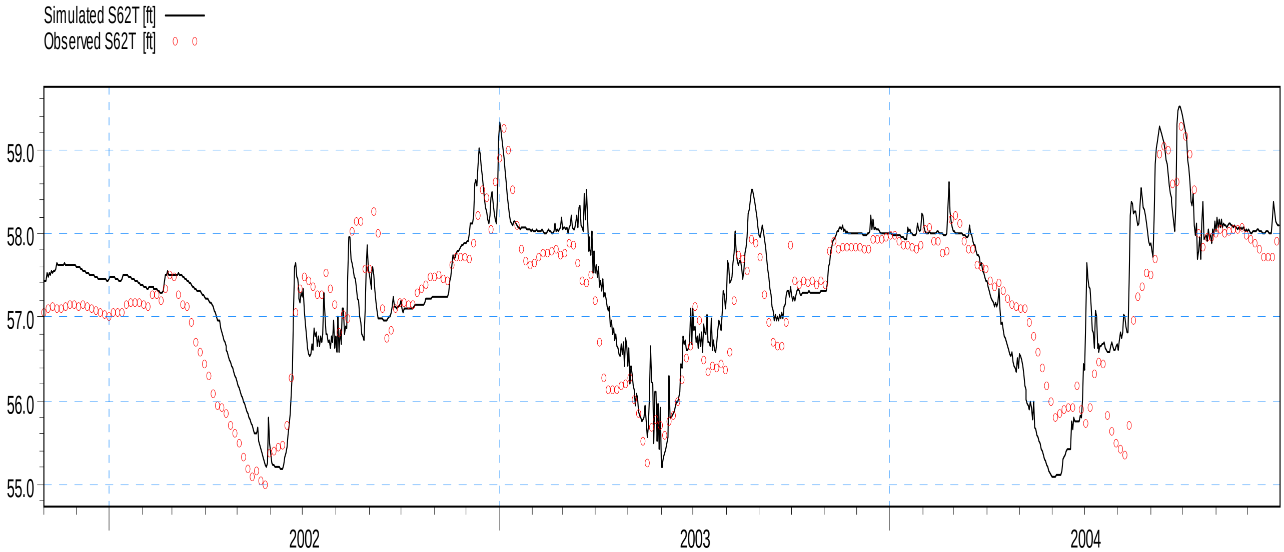

Plot number 5 [Input Item No. 5]

S62H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S62_headwater.dfs0]



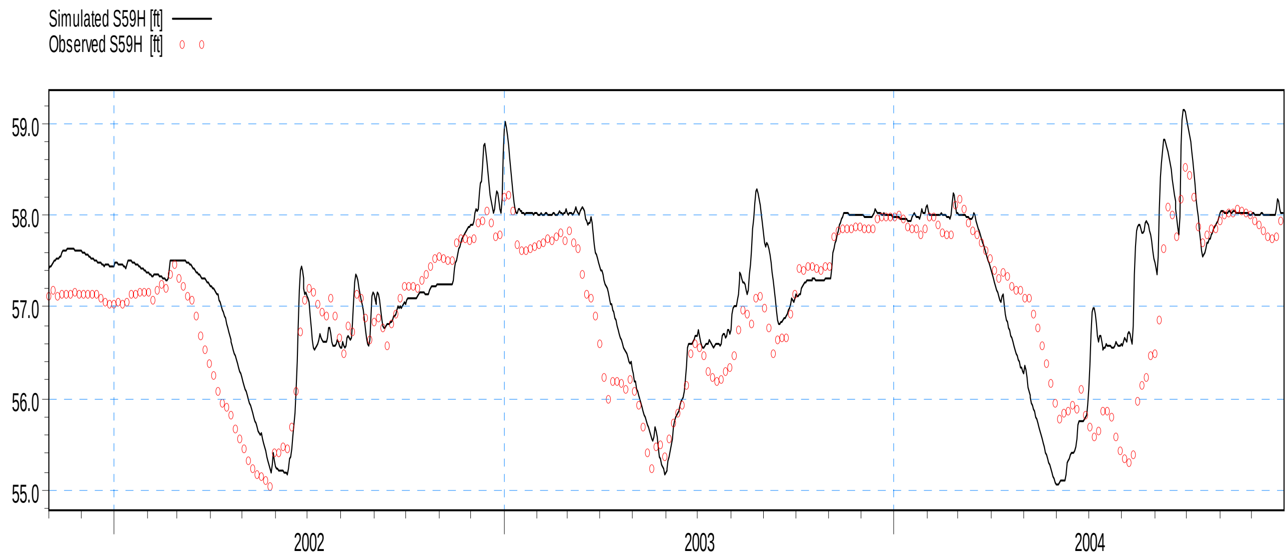

Plot number 6 [Input Item No. 6]

S62T Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S62_tailwater.dfs0]



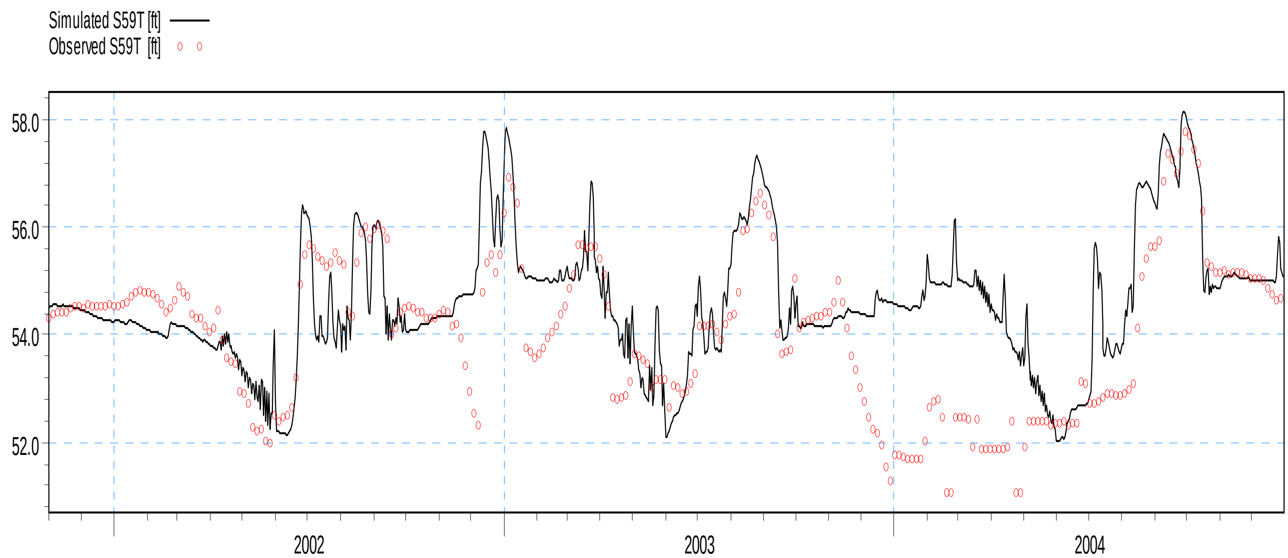

Plot number 7 [Input Item No. 7]

S59H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S59_headwater.dfs0]



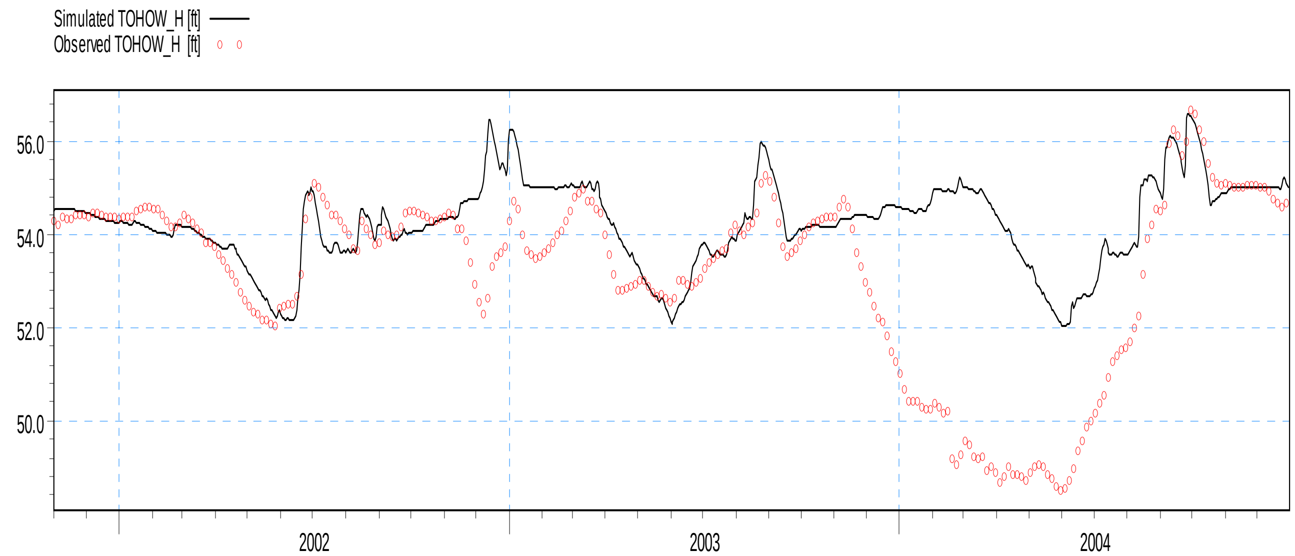

Plot number 8 [Input Item No. 8]

S59T Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S59_tailwater.dfs0]



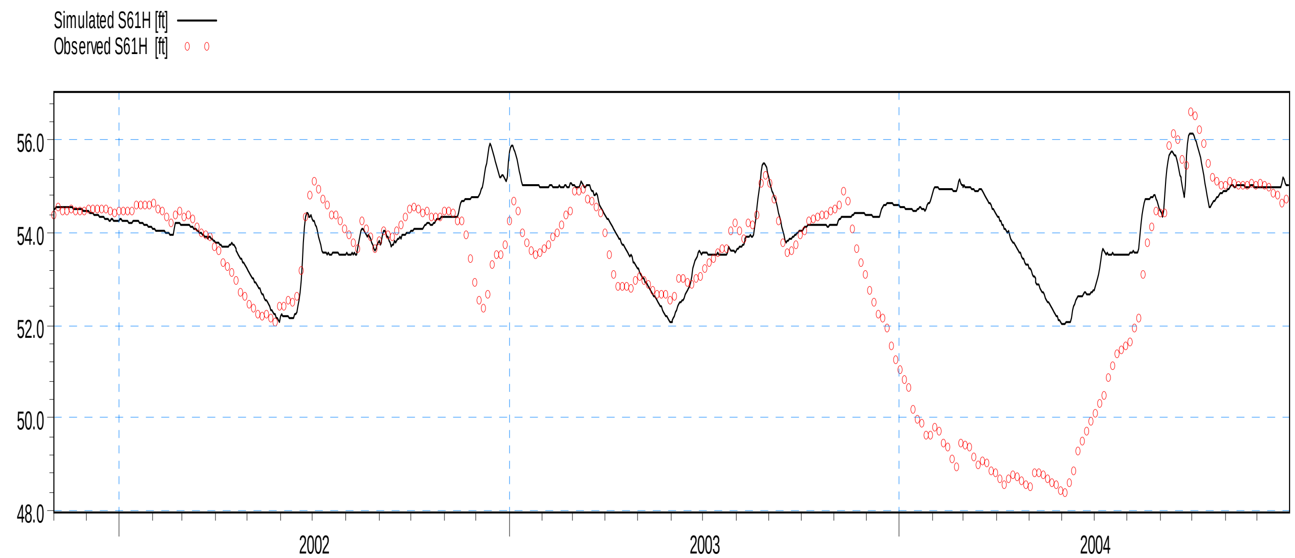

Plot number 9 [Input Item No. 9]

TOHOW_H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\TOHOW_headwaterDaily.dfs0]



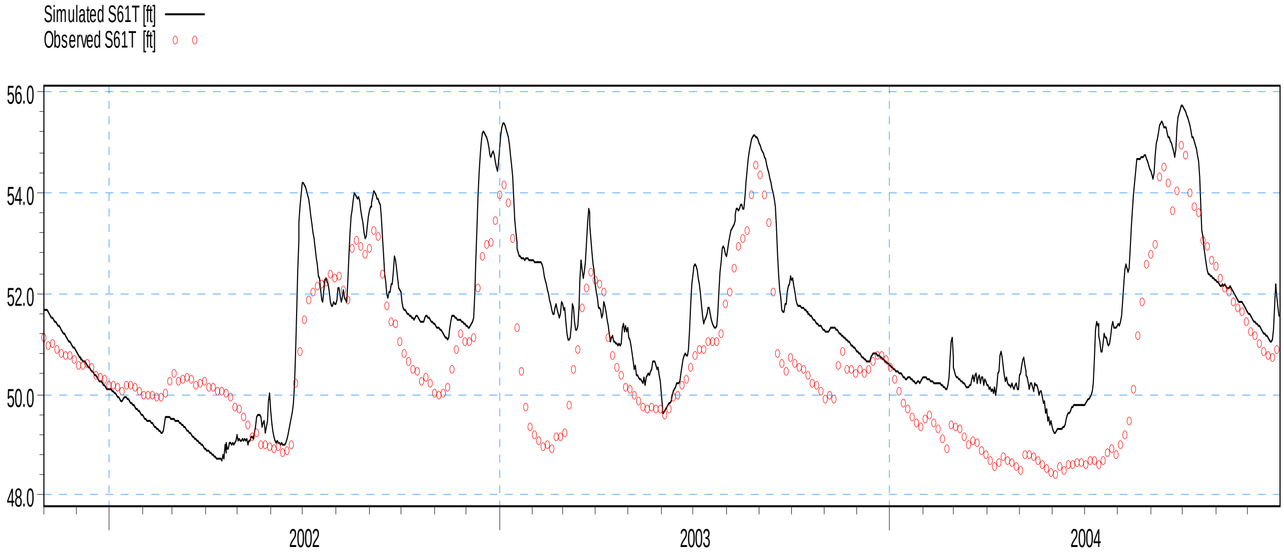

Plot number 10 [Input Item No. 10]

S61H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S61_headwater.dfs0]



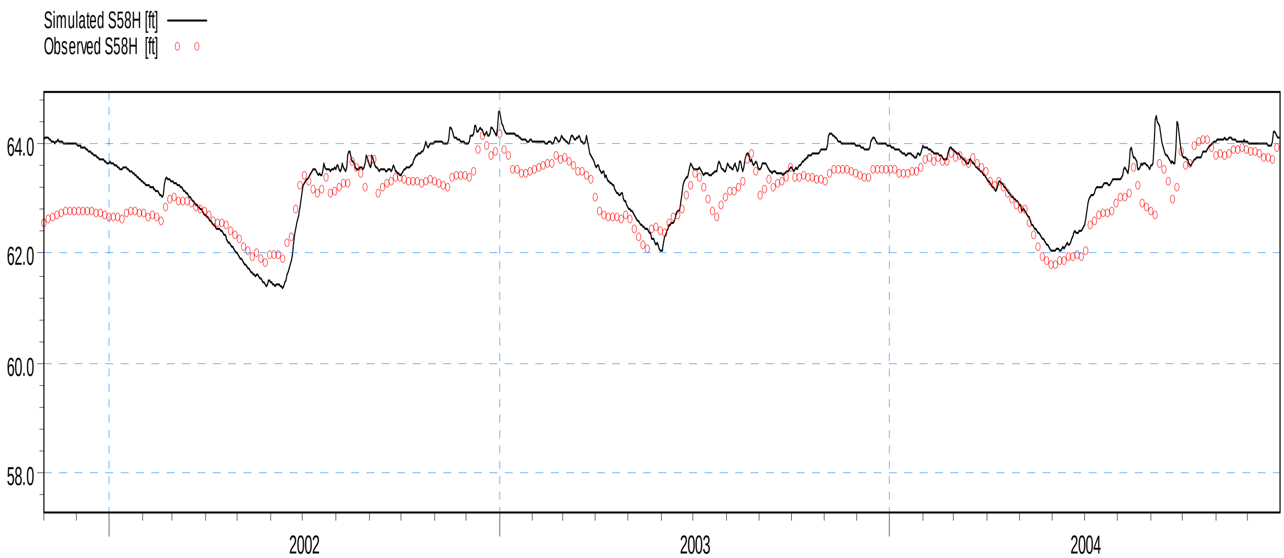

Plot number 11 [Input Item No. 11]

S61T Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S61_tailwater.dfs0]



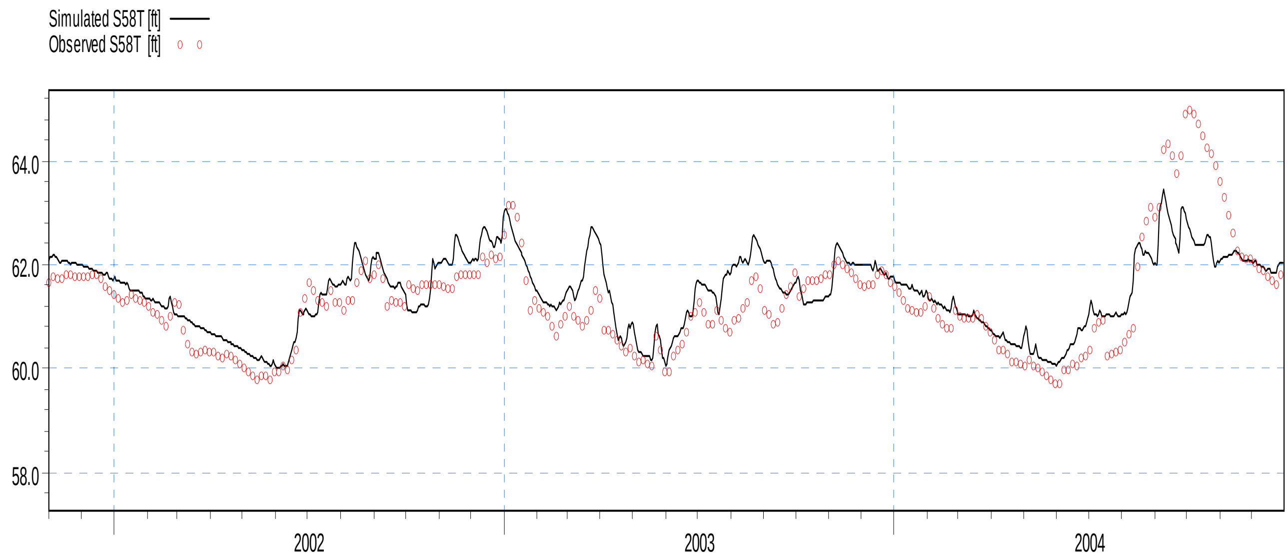

Plot number 12 [Input Item No. 12]

S58H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S58_headwater.dfs0]



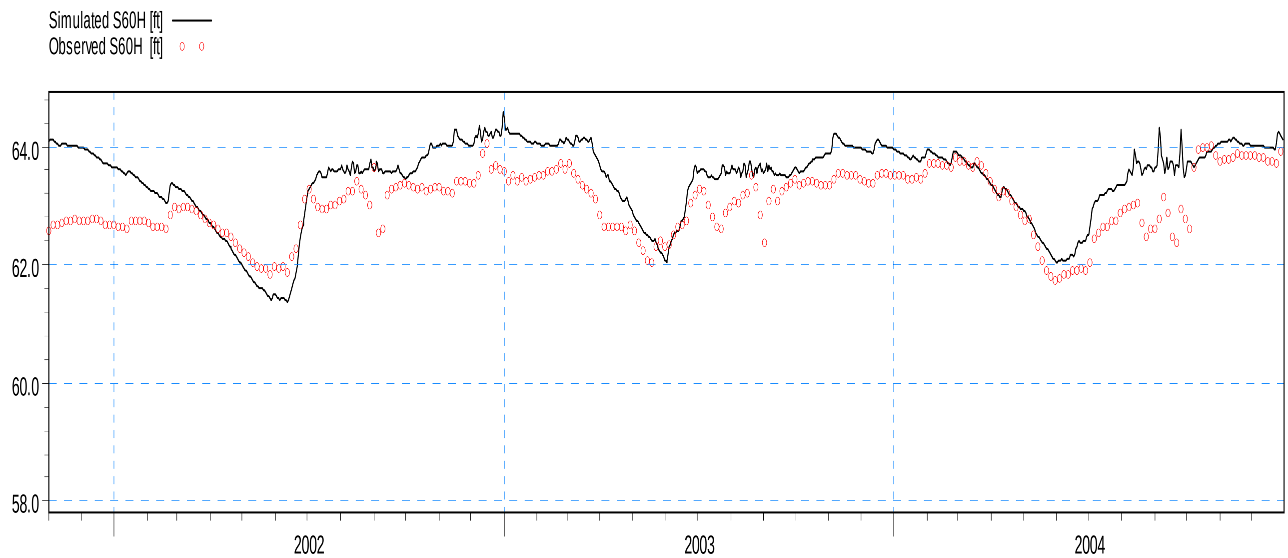

Plot number 13 [Input Item No. 13]

S58T Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S58_tailwater.dfs0]



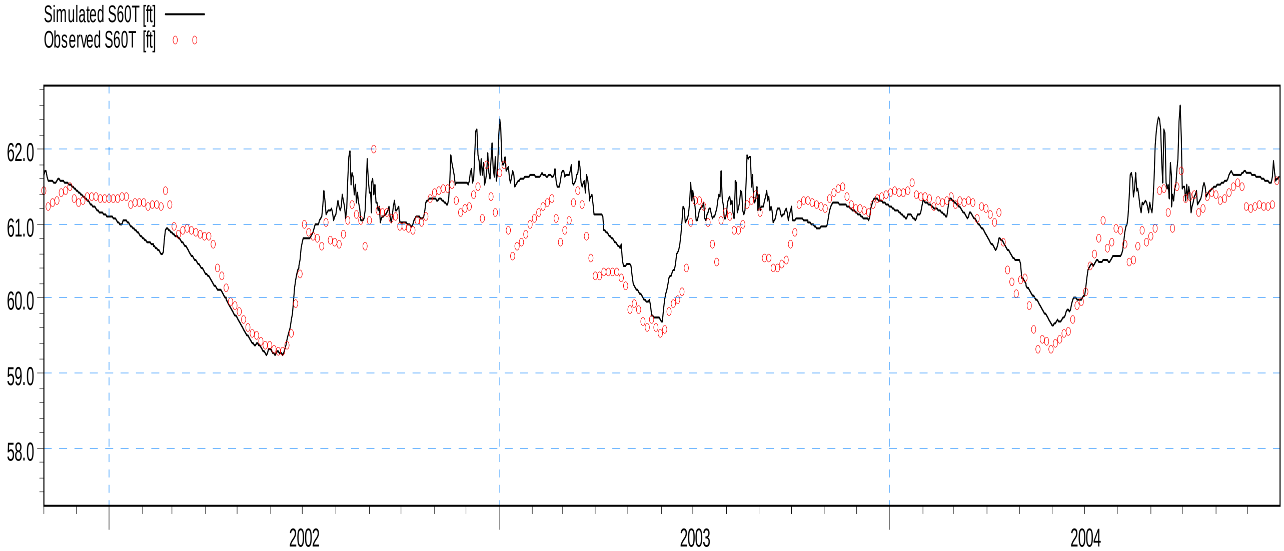

Plot number 14 [Input Item No. 14]

S60H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S60_headwater.dfs0]



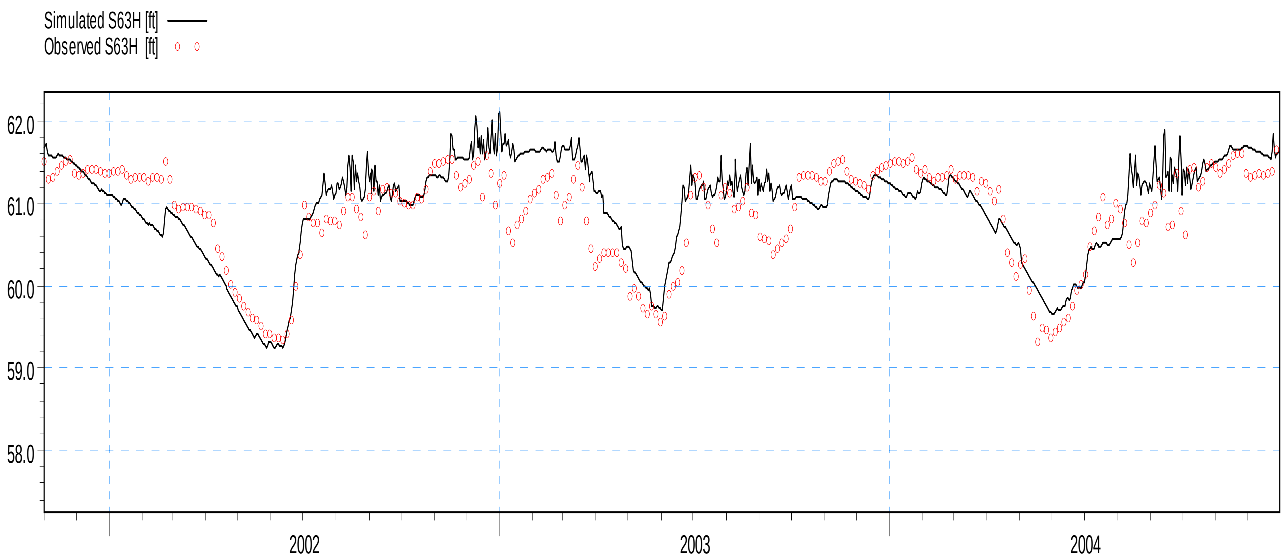

Plot number 15 [Input Item No. 15]

S60T Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S60_tailwater.dfs0]



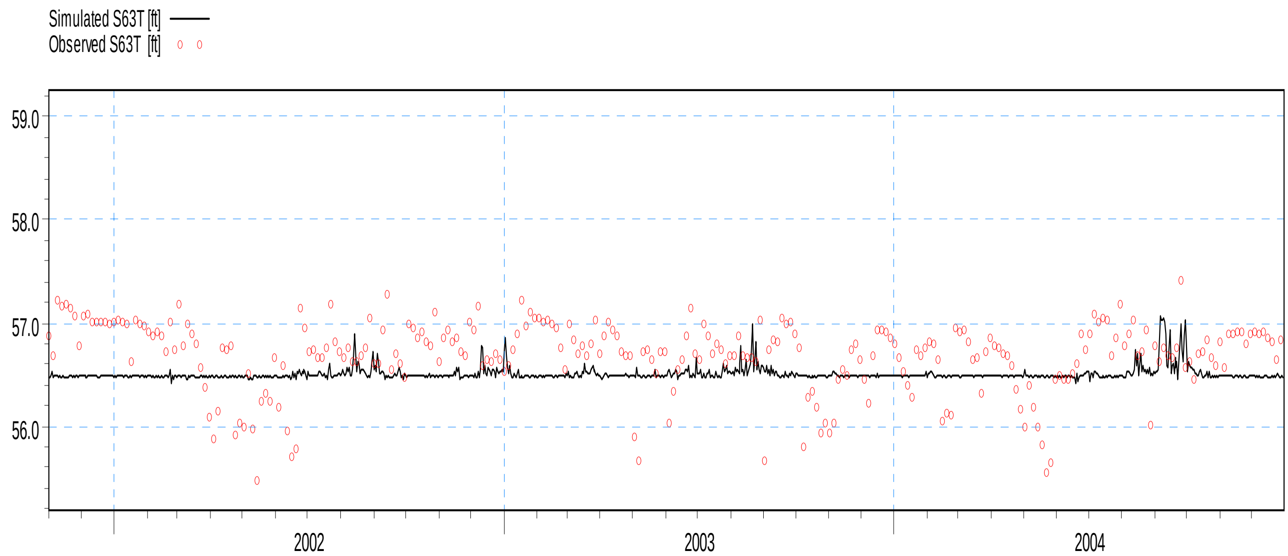

Plot number 16 [Input Item No. 16]

S63H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S63_headwater.dfs0]



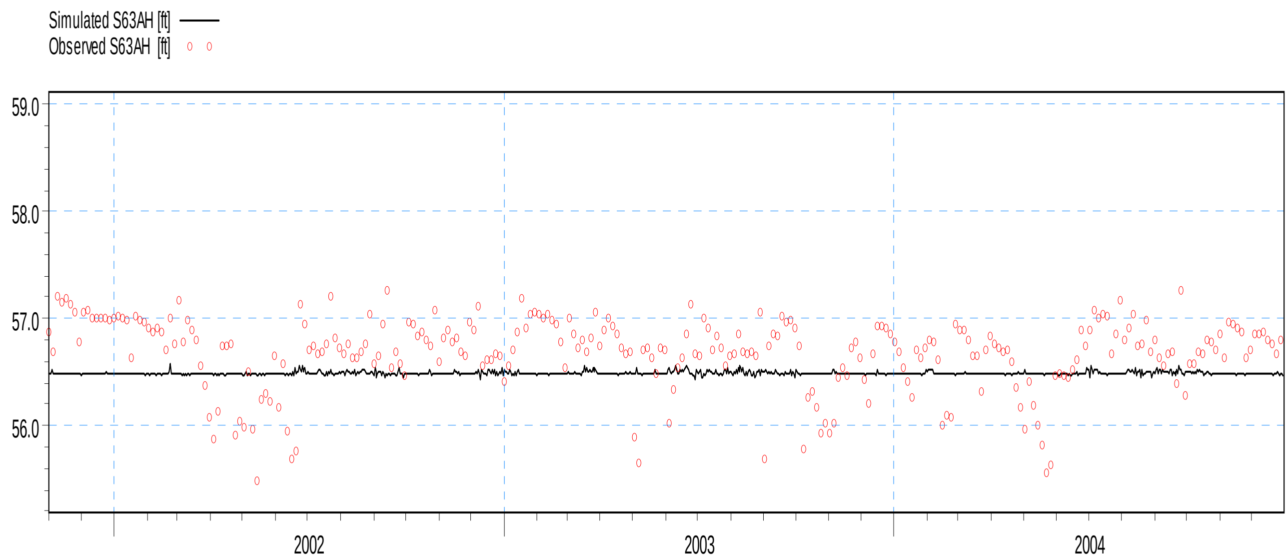

Plot number 17 [Input Item No. 17]

S63T Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S63_tailwater.dfs0]



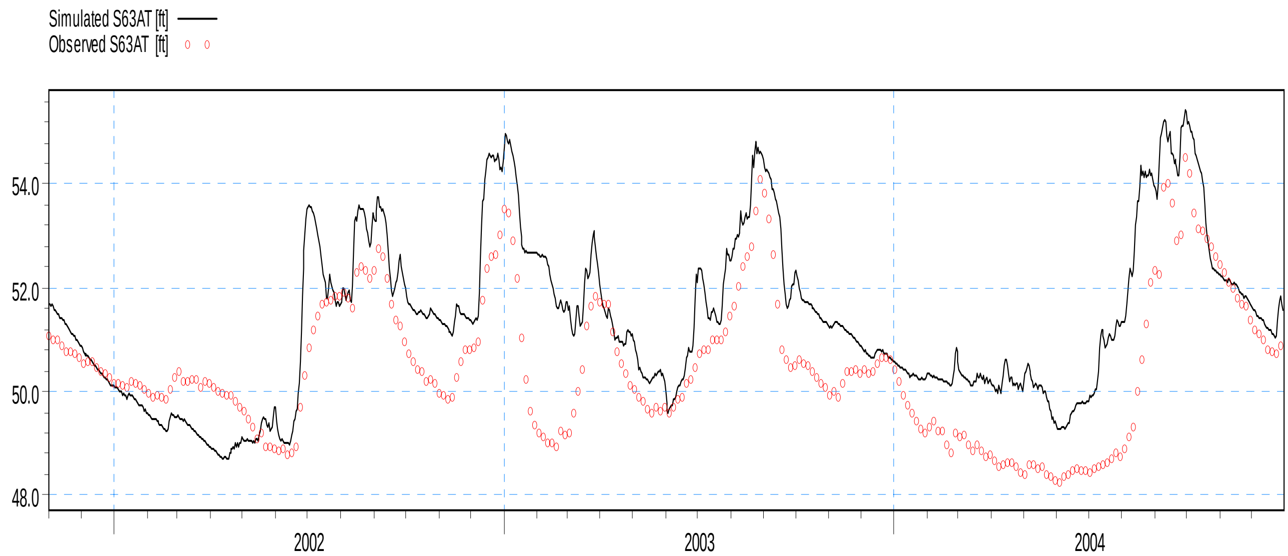

Plot number 18 [Input Item No. 18]

S63AH Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S63A_headwater.dfs0]



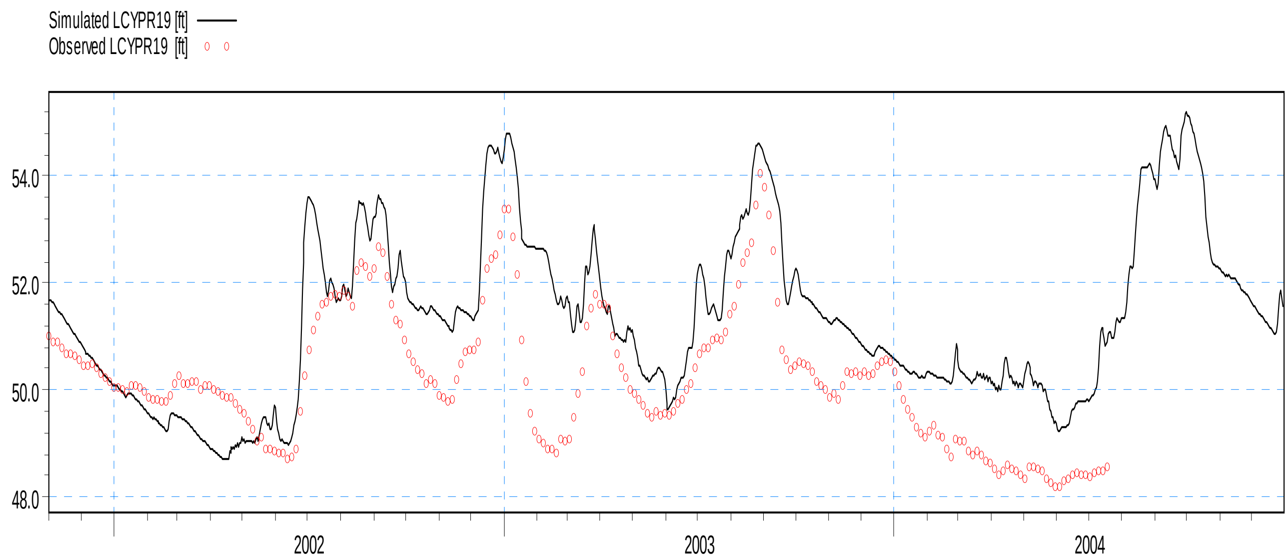

Plot number 19 [Input Item No. 19]

S63AT Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S63A_tailwater.dfs0]



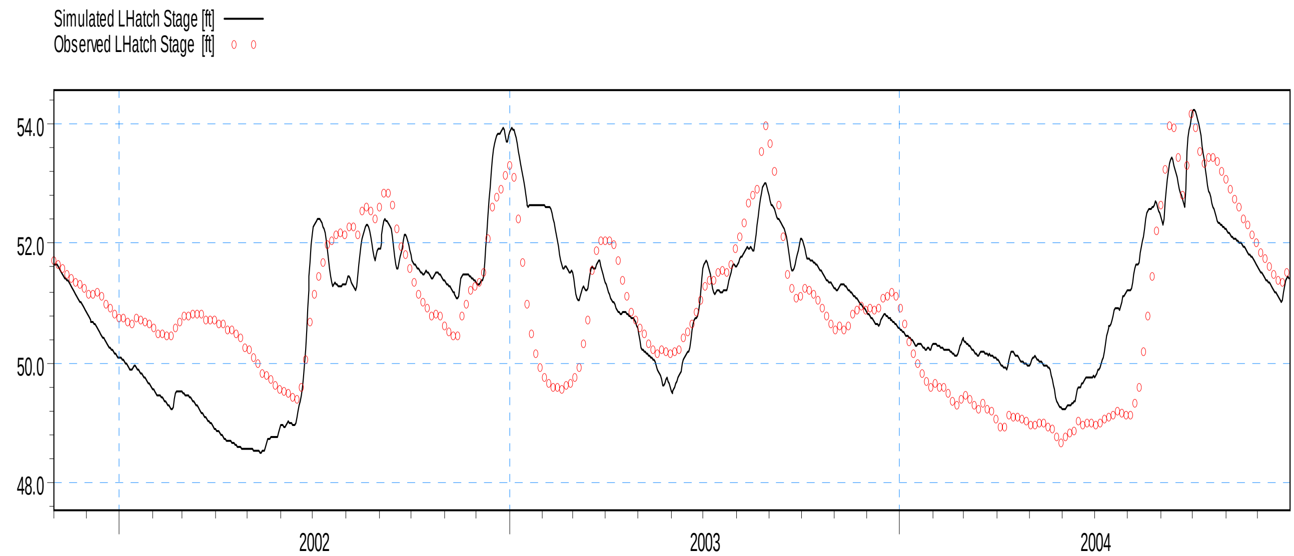

Plot number 20 [Input Item No. 20]

LCYPR19 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\LCYPR19_stage.dfs0]



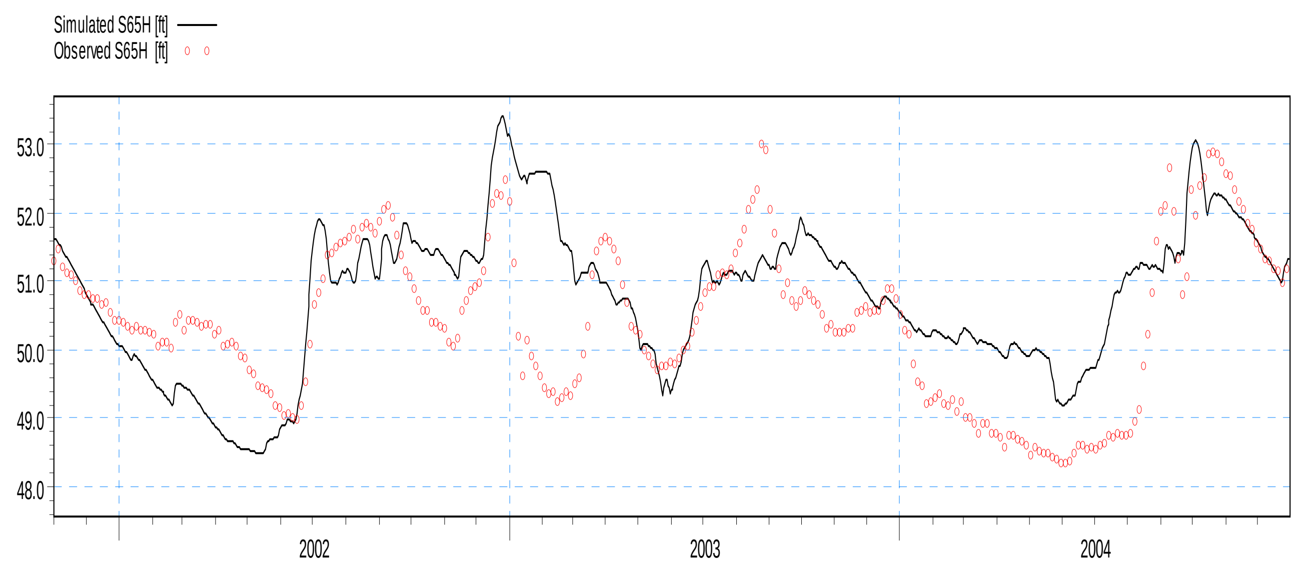

Plot number 21 [Input Item No. 21]

LHatch Stage Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\L-Hatch3_stage.dfs0]



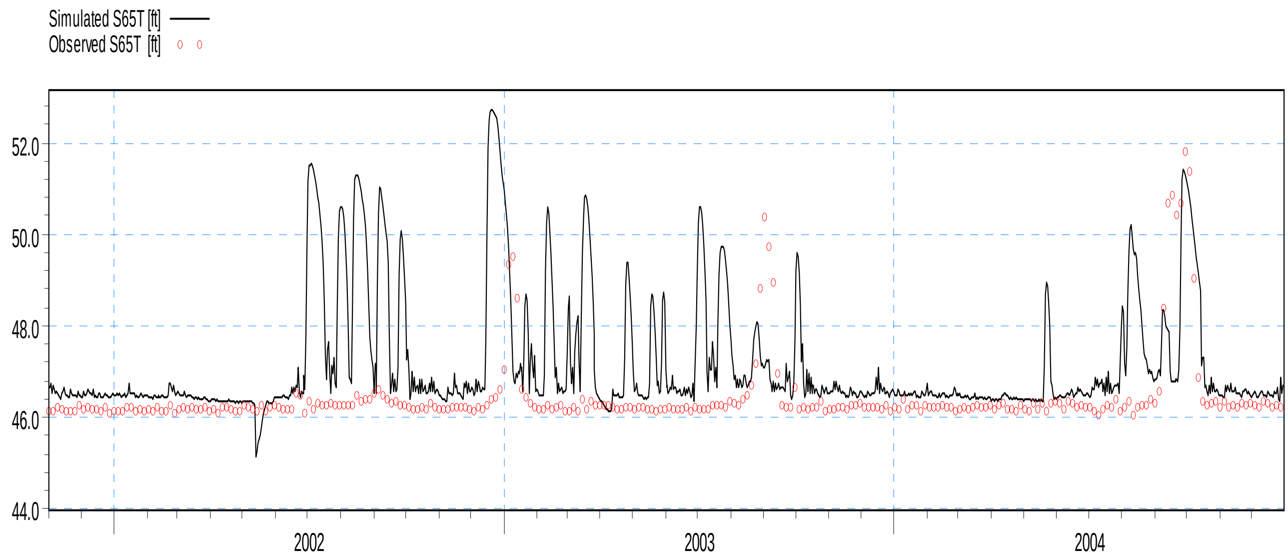

Plot number 22 [Input Item No. 22]

S65H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S65_headwater.dfs0]



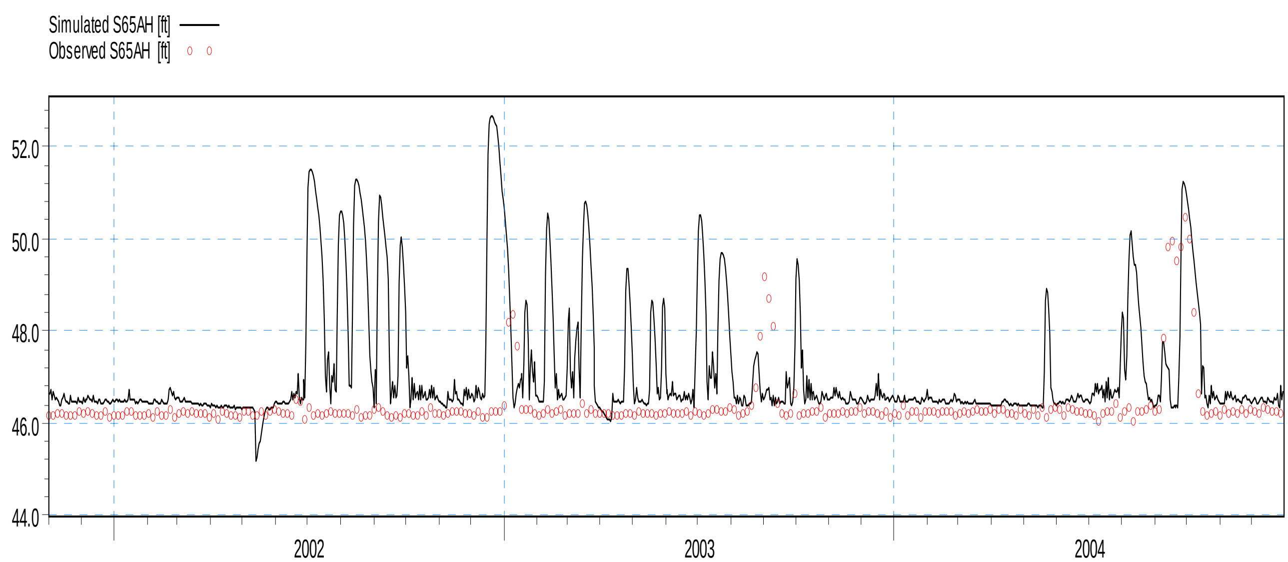

Plot number 23 [Input Item No. 23]

S65T Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S65_tailwater.dfs0]



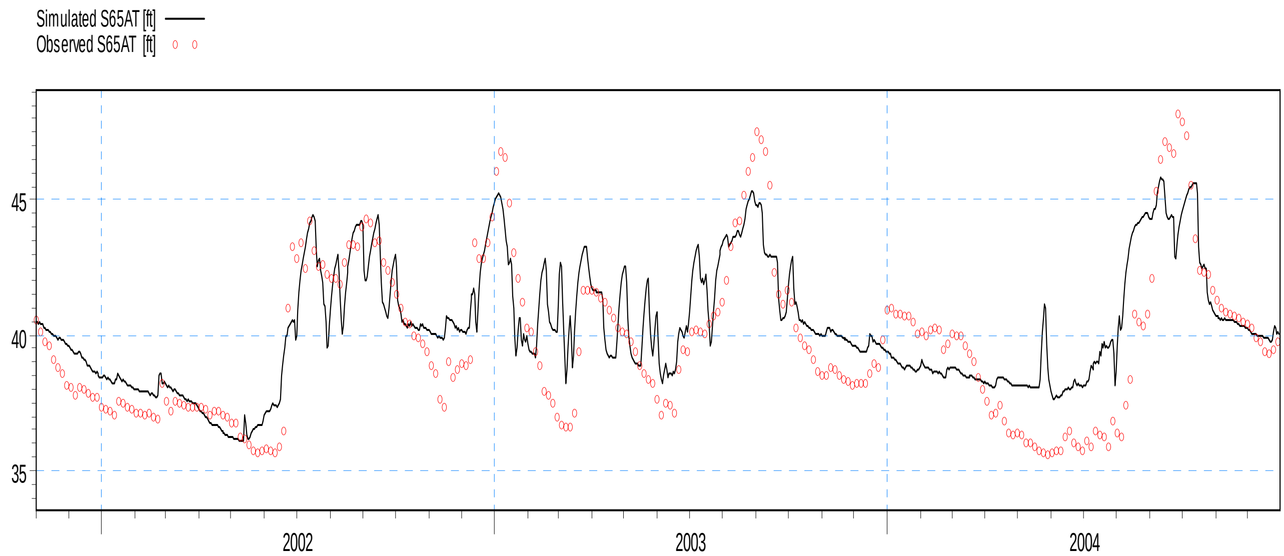

Plot number 24 [Input Item No. 24]

S65AH Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S65A_headwater.dfs0]



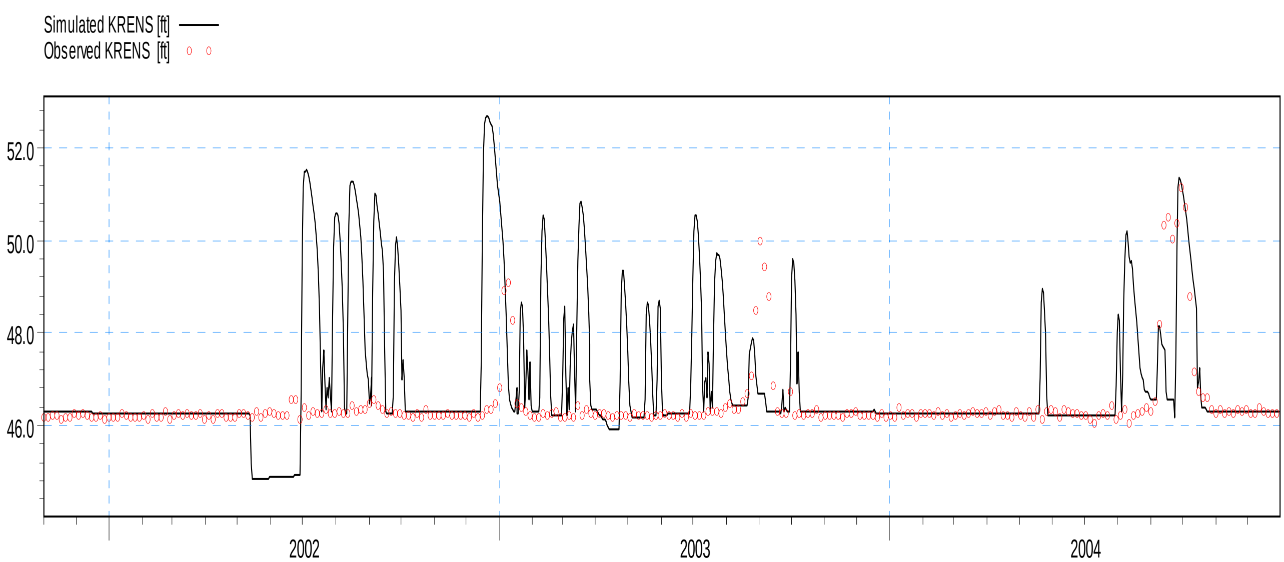

Plot number 25 [Input Item No. 25]

S65AT Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S65A_tailwater.dfs0]



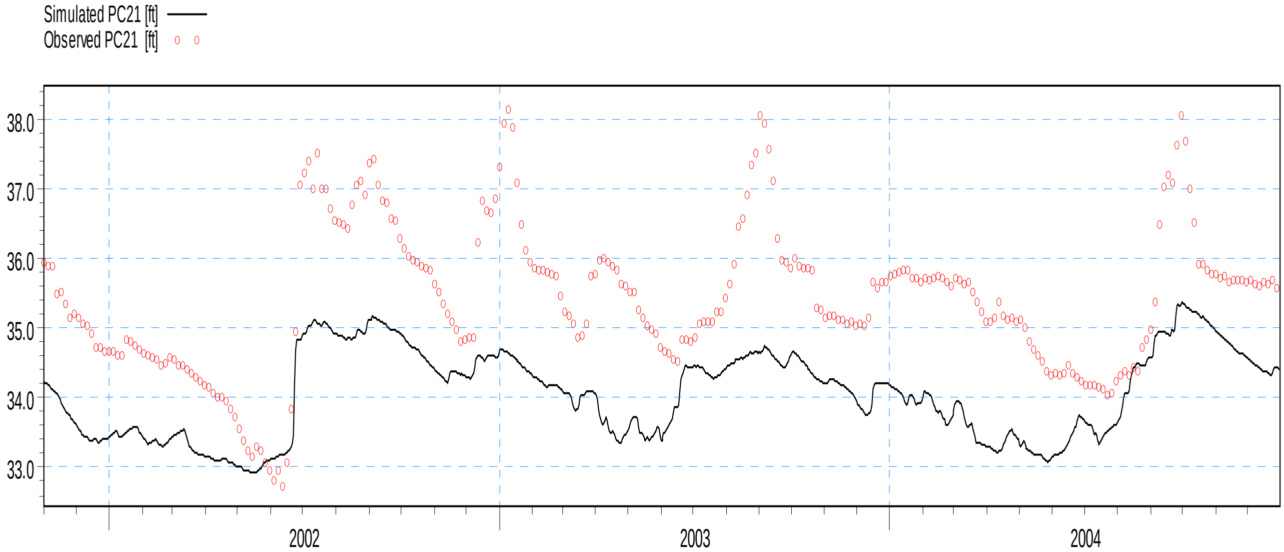

Plot number 26 [Input Item No. 26]

KRENS Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\KRENSDaily.dfs0]



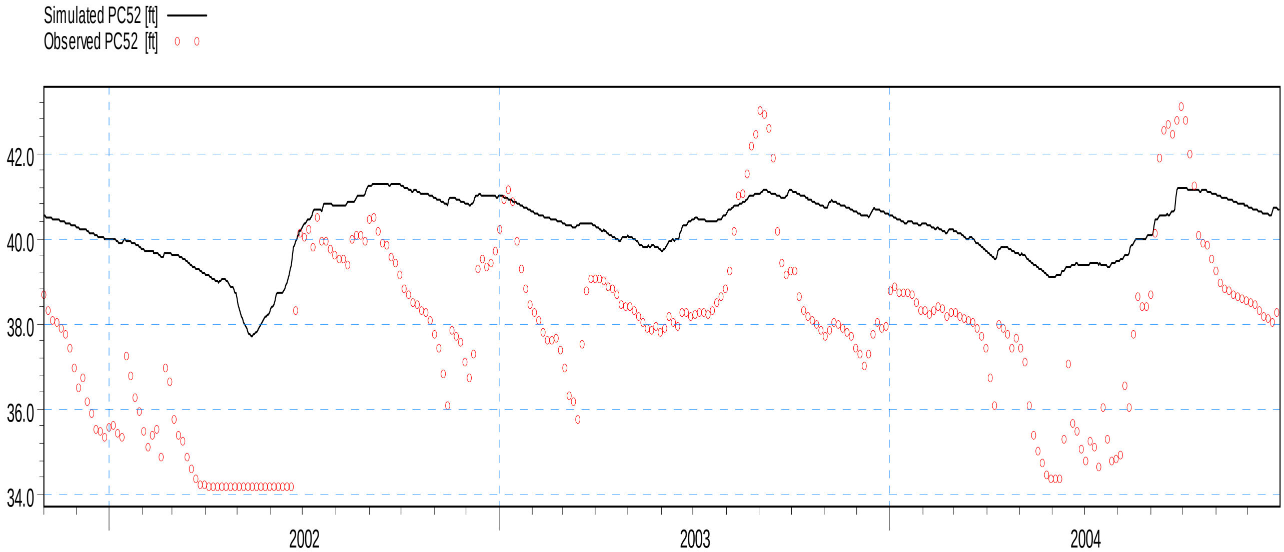

Plot number 27 [Input Item No. 27]

PC21 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\PC21Daily.dfs0]



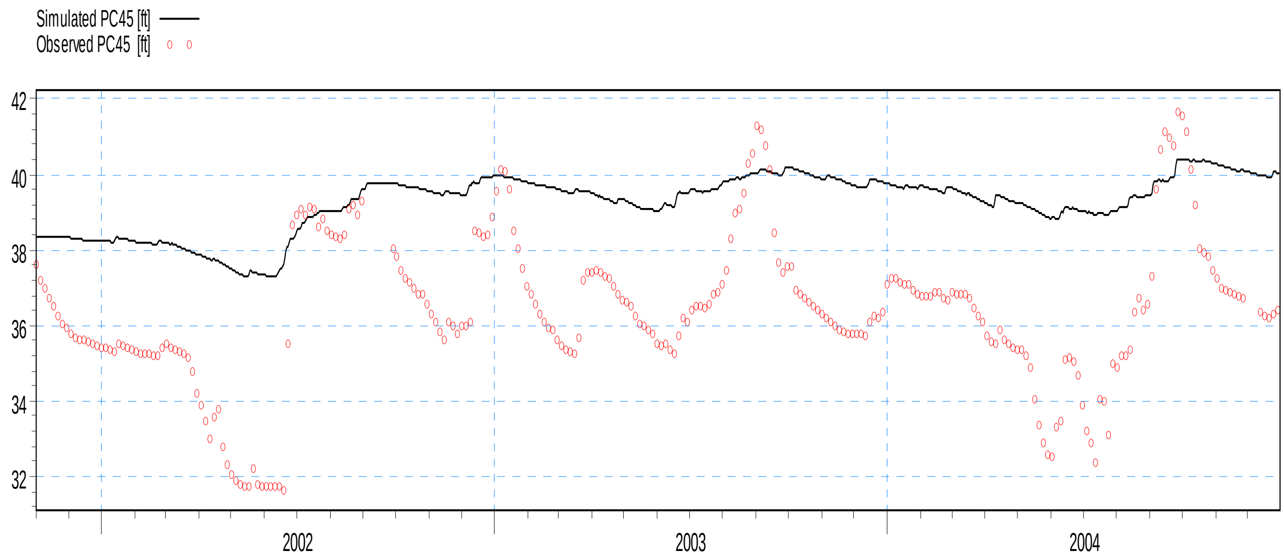

Plot number 28 [Input Item No. 28]

PC52 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\PC52Daily.dfs0]



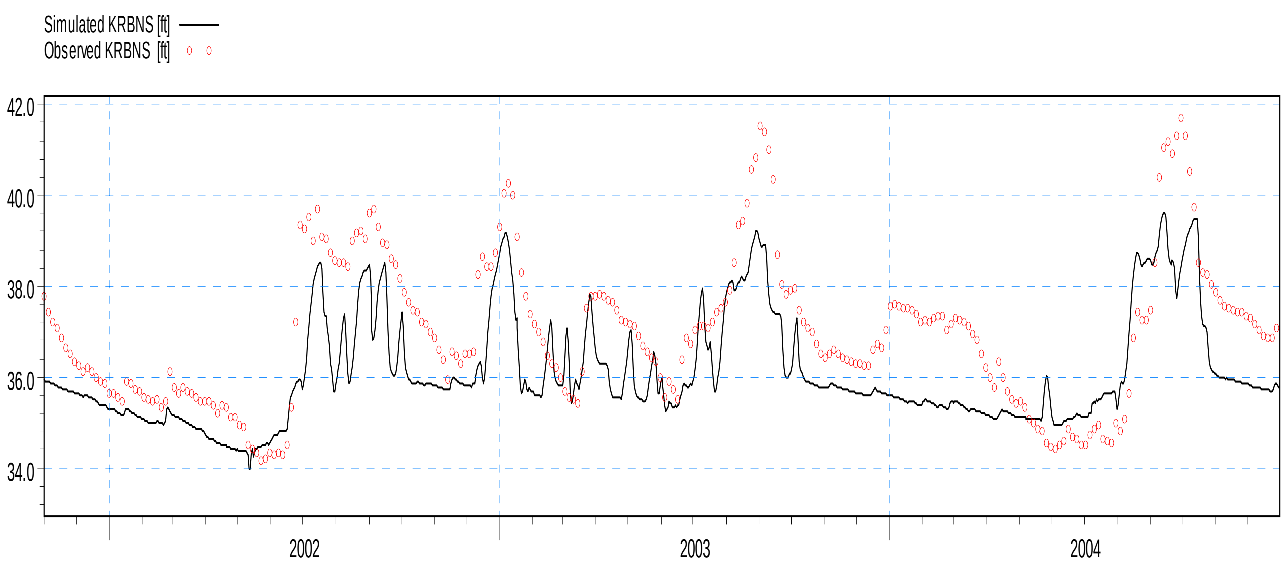

Plot number 29 [Input Item No. 29]

PC45 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\PC45.dfs0]



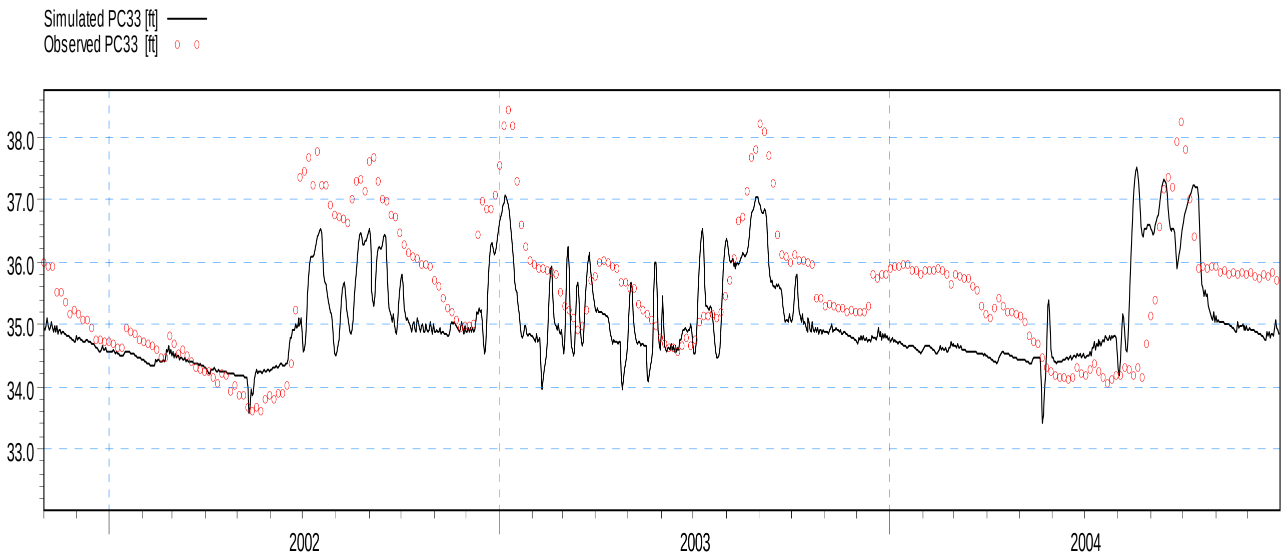

Plot number 30 [Input Item No. 30]

KRBNS Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\KRBNSDaily.dfs0]



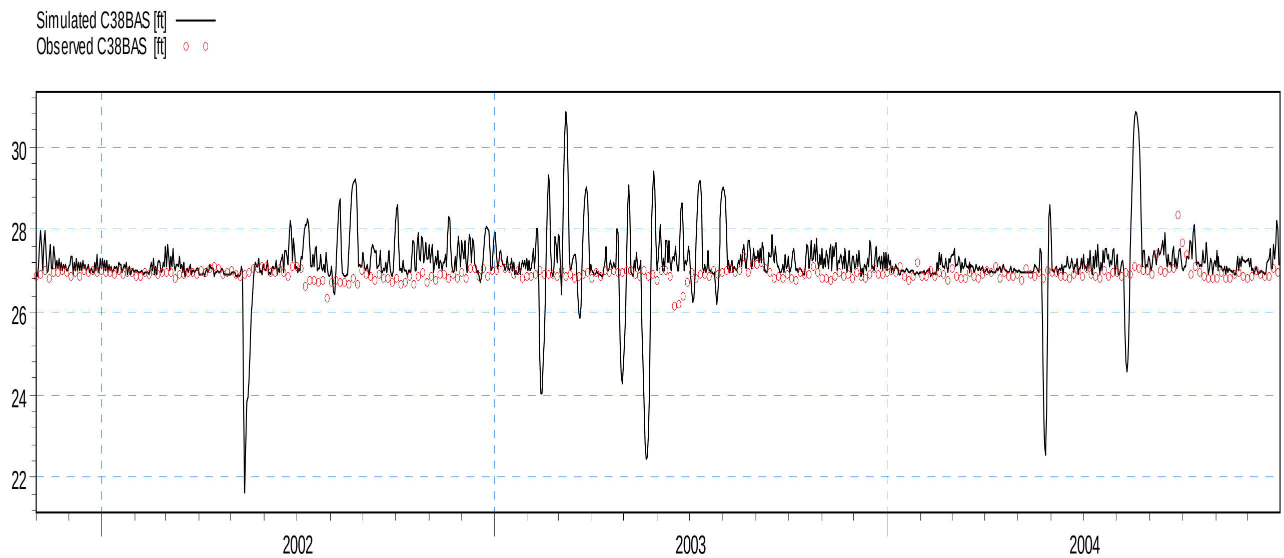

Plot number 31 [Input Item No. 31]

PC33 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\PC33Daily.dfs0]



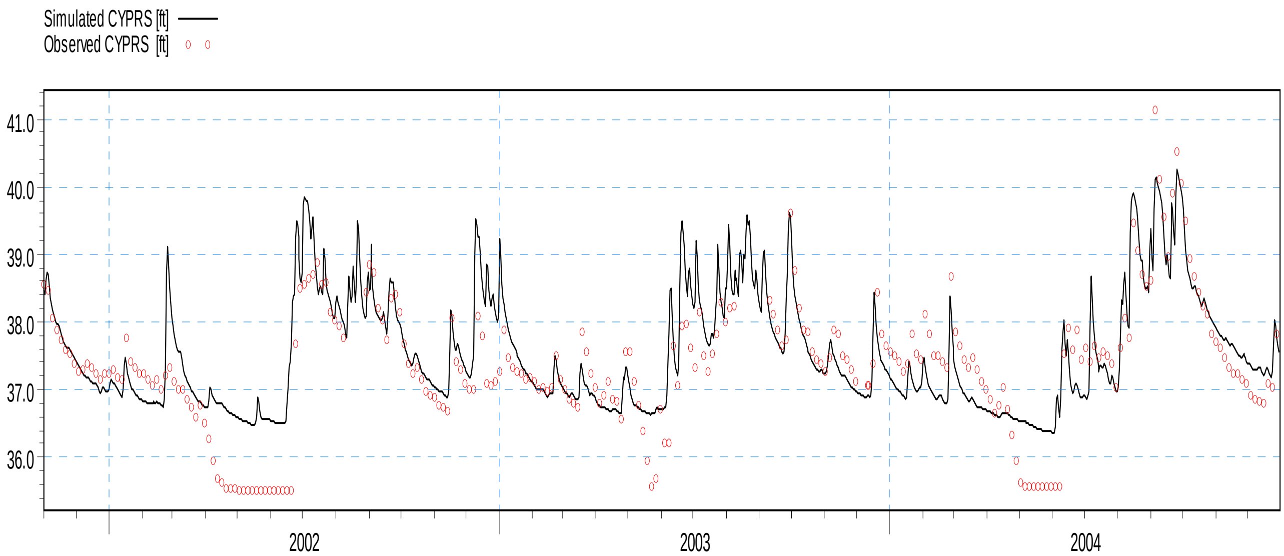

Plot number 32 [Input Item No. 32]

C38BAS Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\C38BASDaily.dfs0]



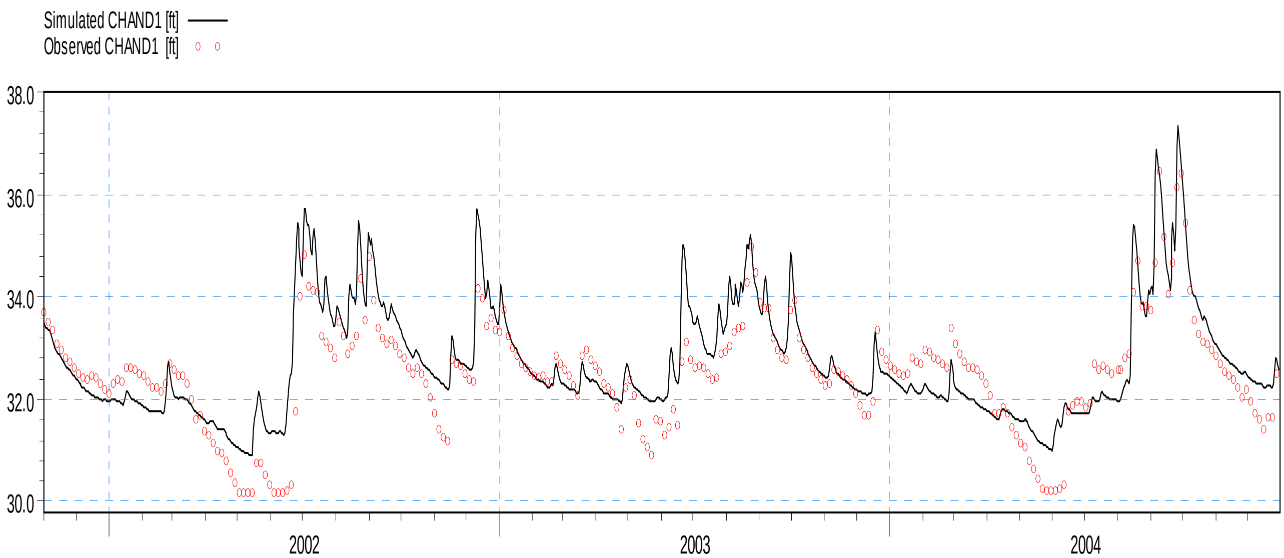

Plot number 33 [Input Item No. 33]

CYPRS Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\CYPRSDaily.dfs0]



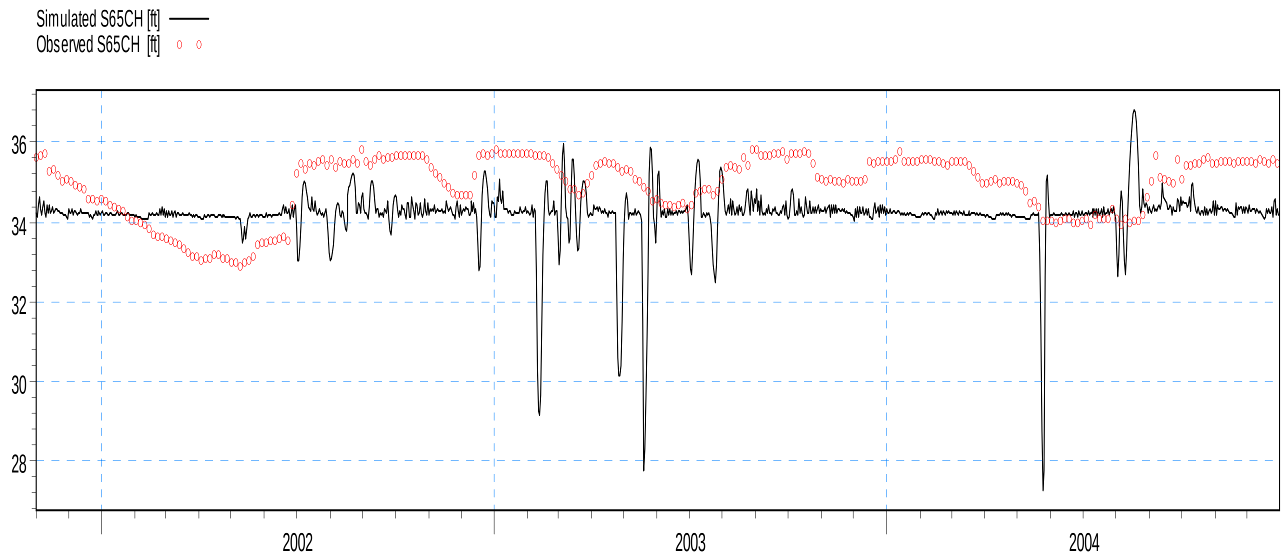

Plot number 34 [Input Item No. 34]

CHAND1 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\CHAND1Daily.dfs0]



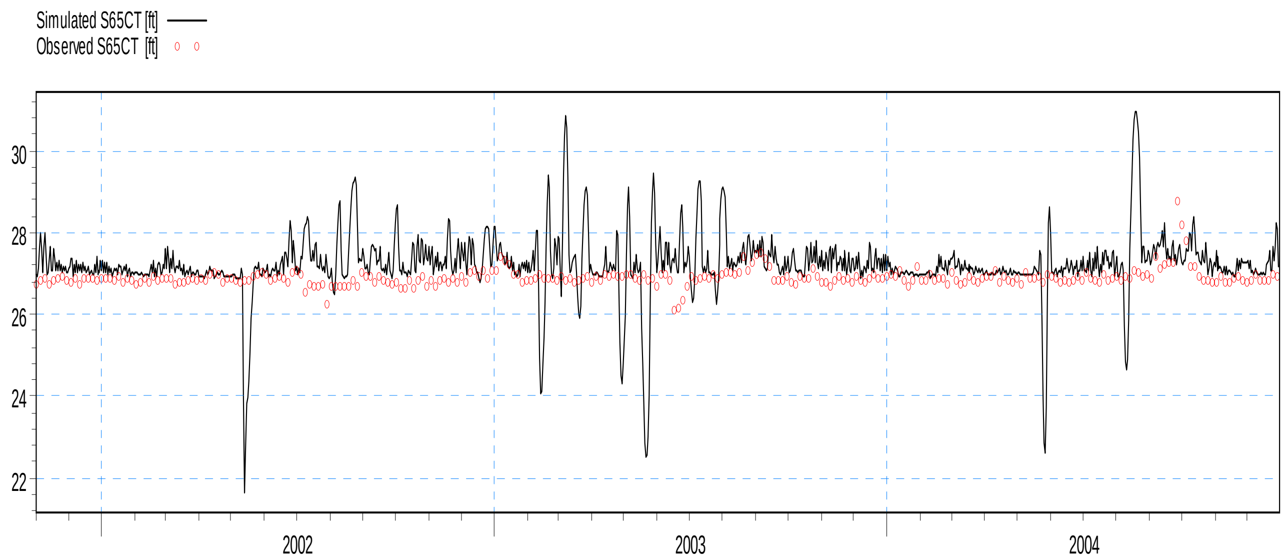

Plot number 35 [Input Item No. 35]

S65CH Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S65C_headwater.dfs0]



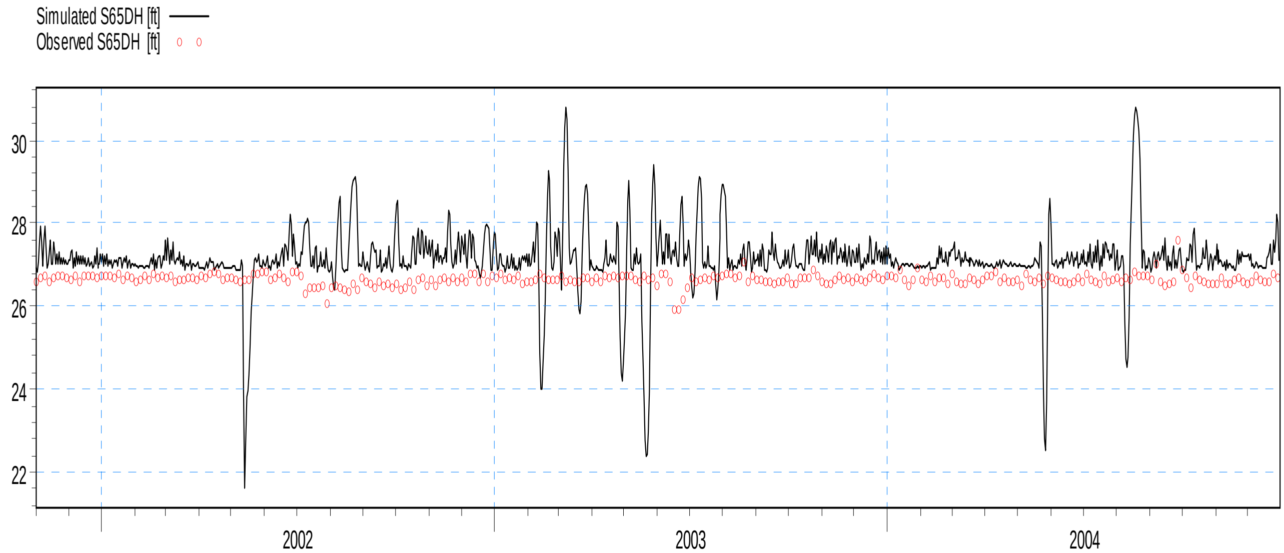

Plot number 36 [Input Item No. 36]

S65CT Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S65C_tailwater.dfs0]



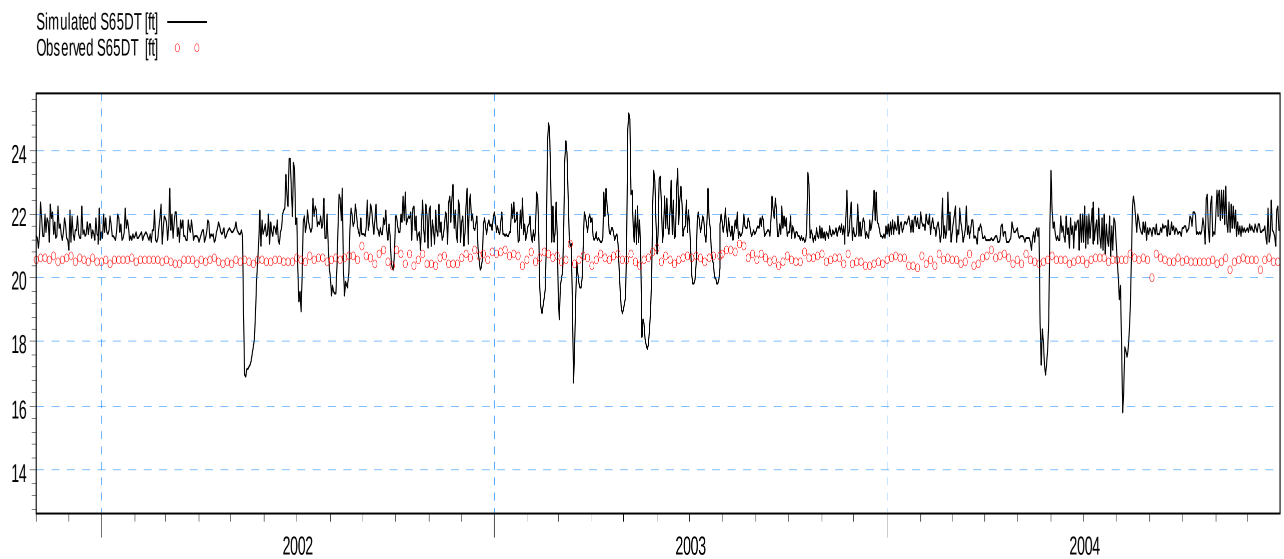

Plot number 37 [Input Item No. 37]

S65DH Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S65D_headwater.dfs0]



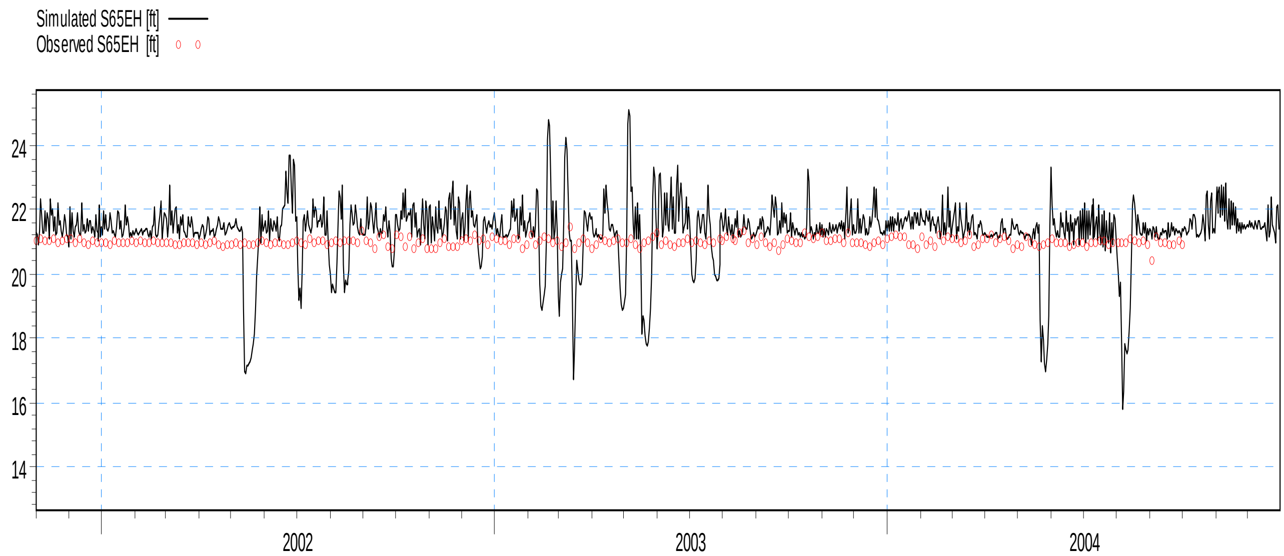

Plot number 38 [Input Item No. 38]

S65DT Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S65D_tailwater.dfs0]



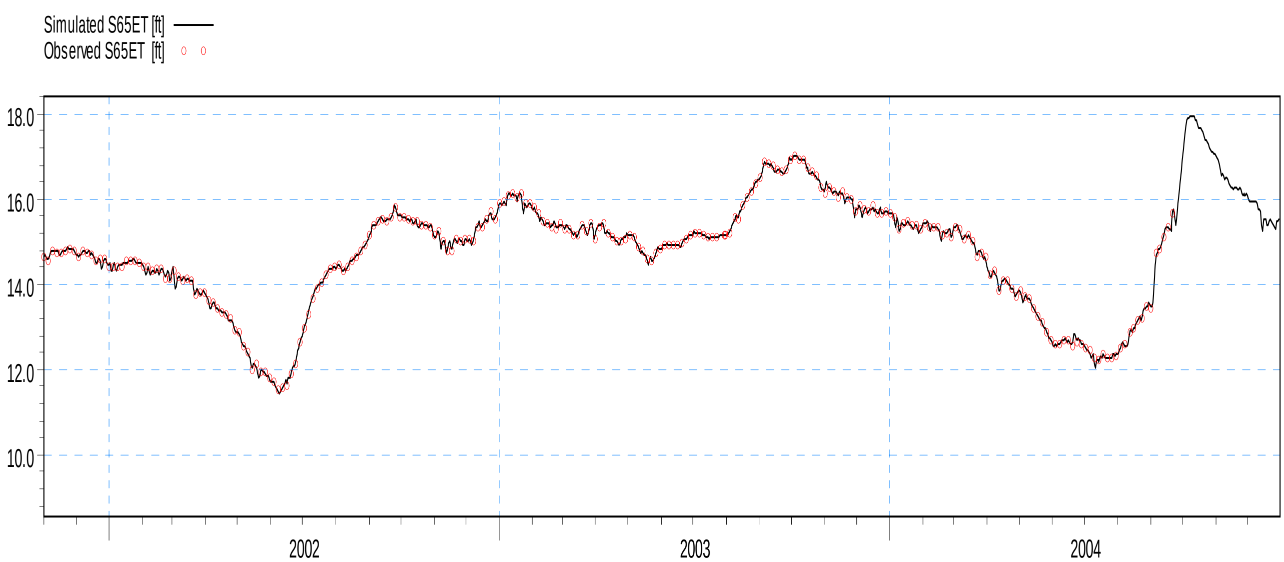

Plot number 39 [Input Item No. 39]

S65EH Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S65E_headwater.dfs0]



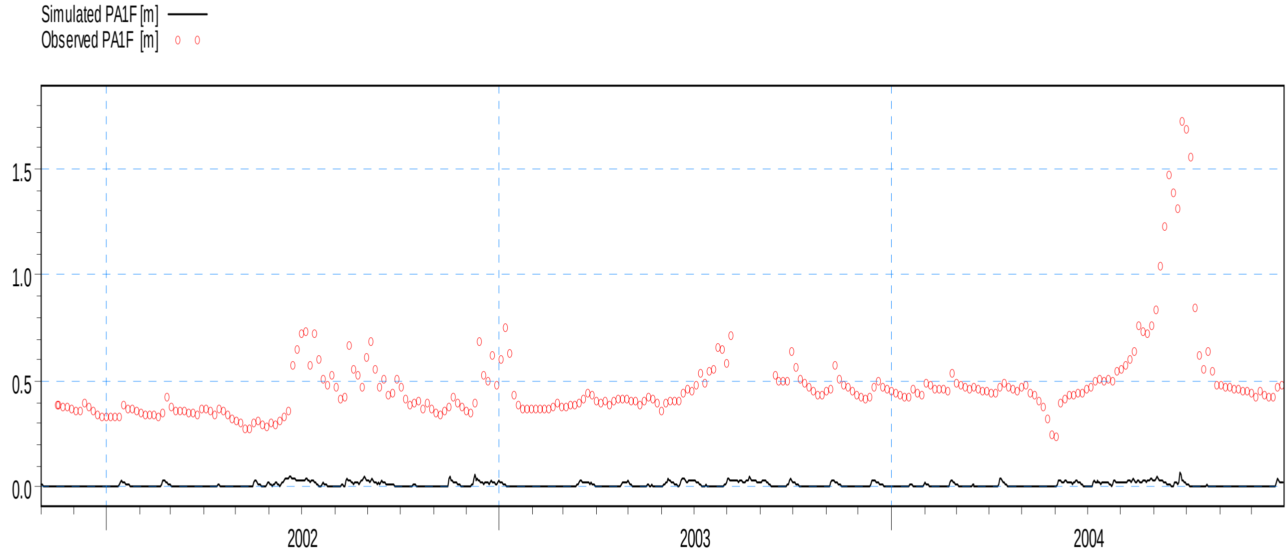

Plot number 40 [Input Item No. 40]

S65ET Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\S65E_tailwater.dfs0]




Plot number 41 [Input Item No. 41]

PA1F Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\Stage\PA1FDepth.dfs0]

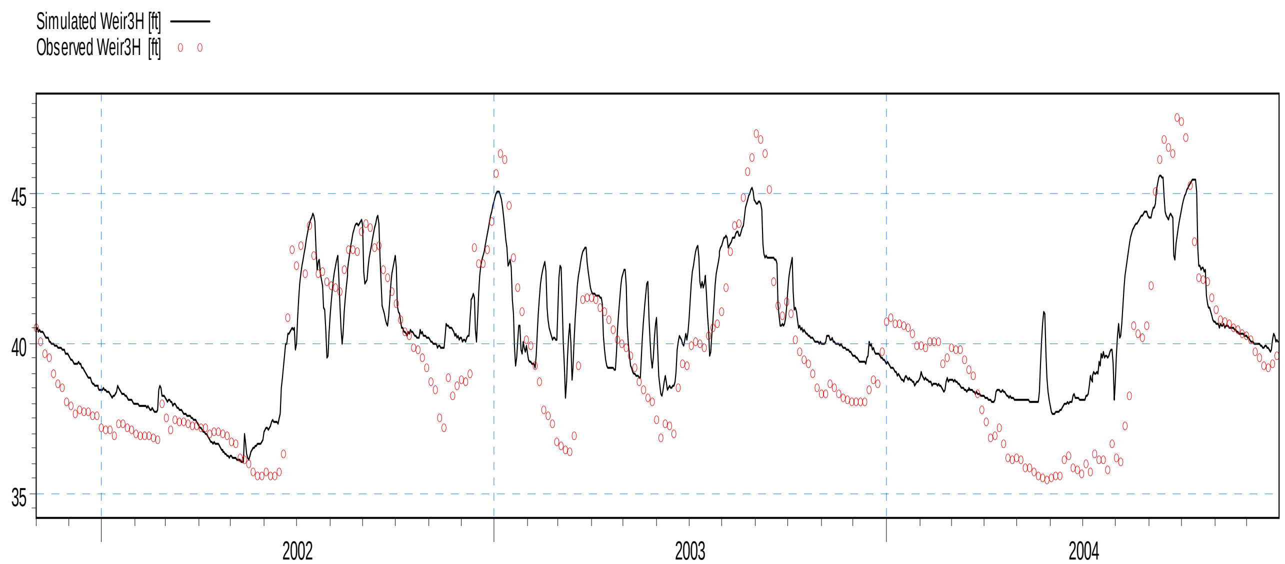

Simulated PA1F [m]
Observed PA1F [m]
1.5
1.0
0.5
0.0
2002
2003
2004

HTML output from MSHECalPlot

12/19/2007 2:01:48 PM

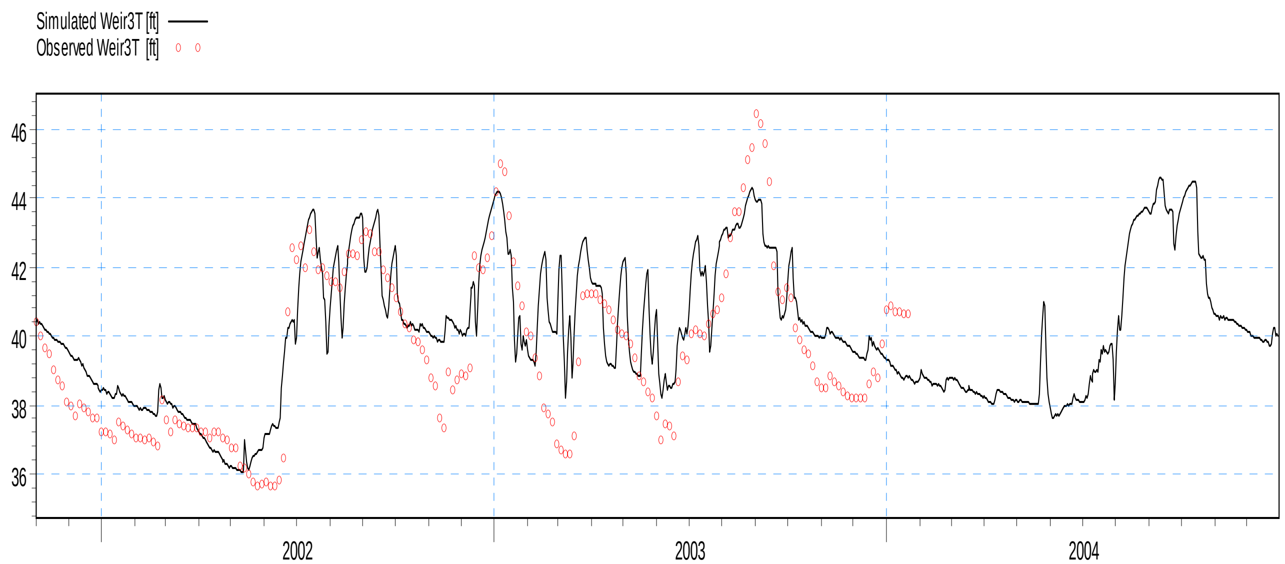
Plot number 1 [Input Item No. 1]

Weir3H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\Weir3HDaily.dfs0]



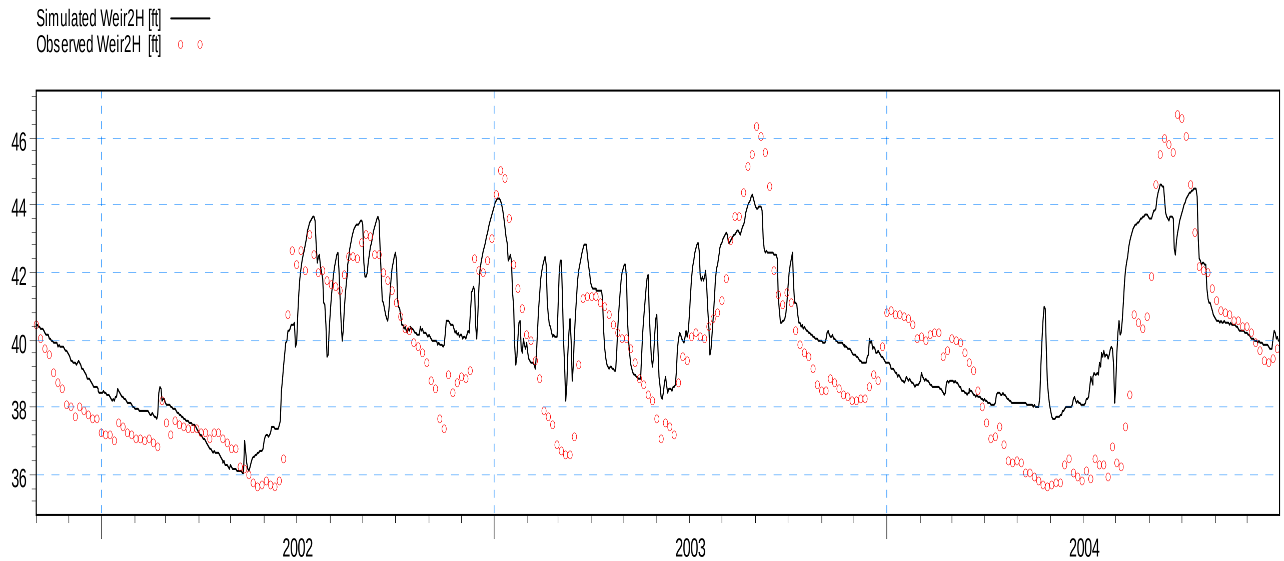

Plot number 2 [Input Item No. 2]

Weir3T Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\Weir3TDaily.dfs0]



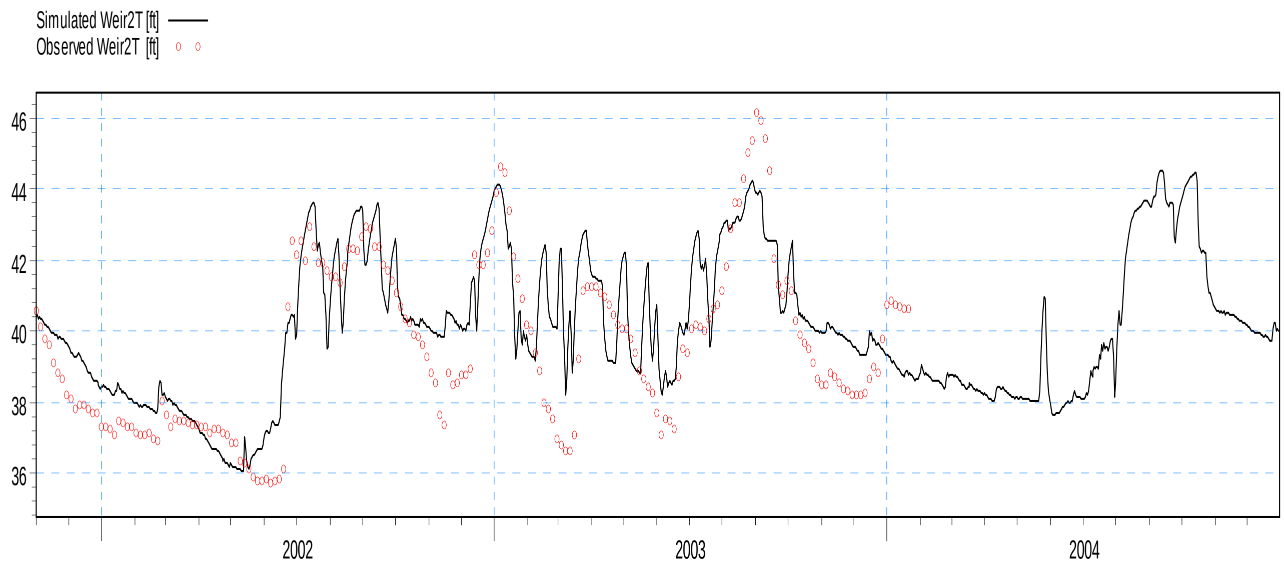
Plot number 3 [Input Item No. 3]

Weir2H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\Weir2HDaily.dfs0]




Plot number 4 [Input Item No. 4]

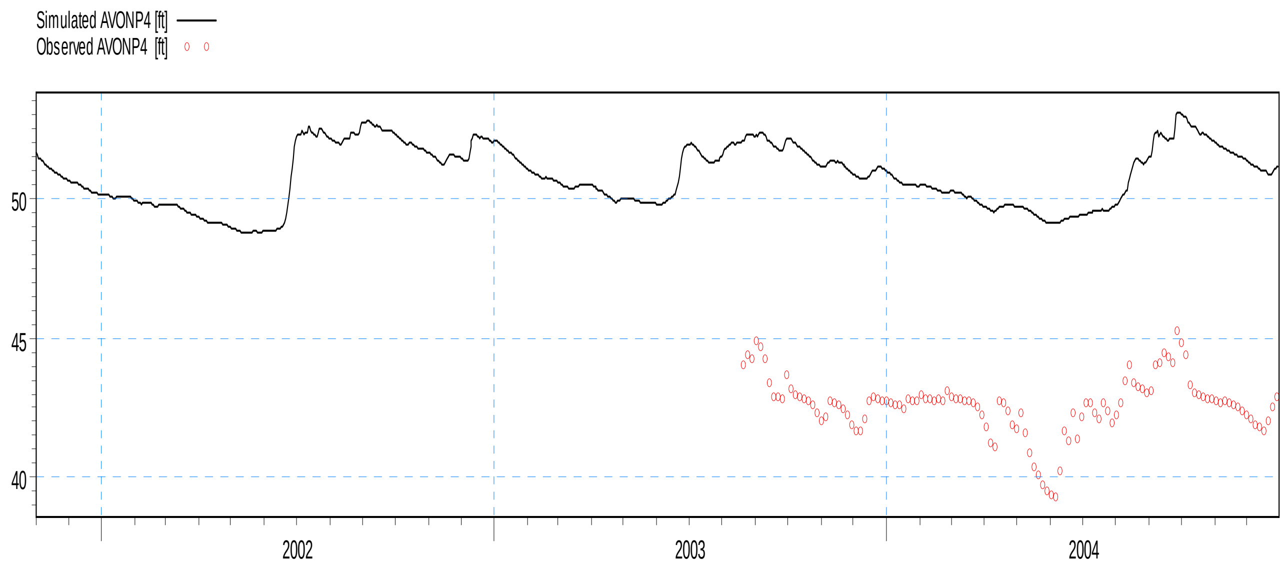
Weir2T Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\Weir2TDaily.dfs0]




Plot number 5 [Input Item No. 5]

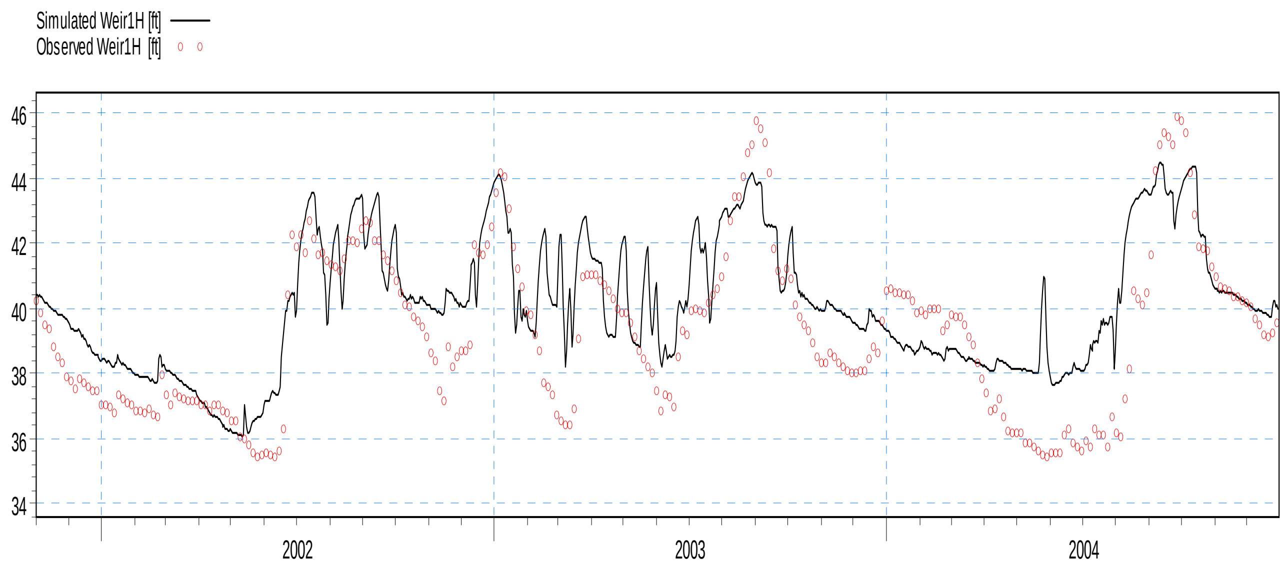
AVONP4 Simulated and Observed Data [File: C:\DHIModels\4021.477

KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\AvonP4Daily.dfs0]



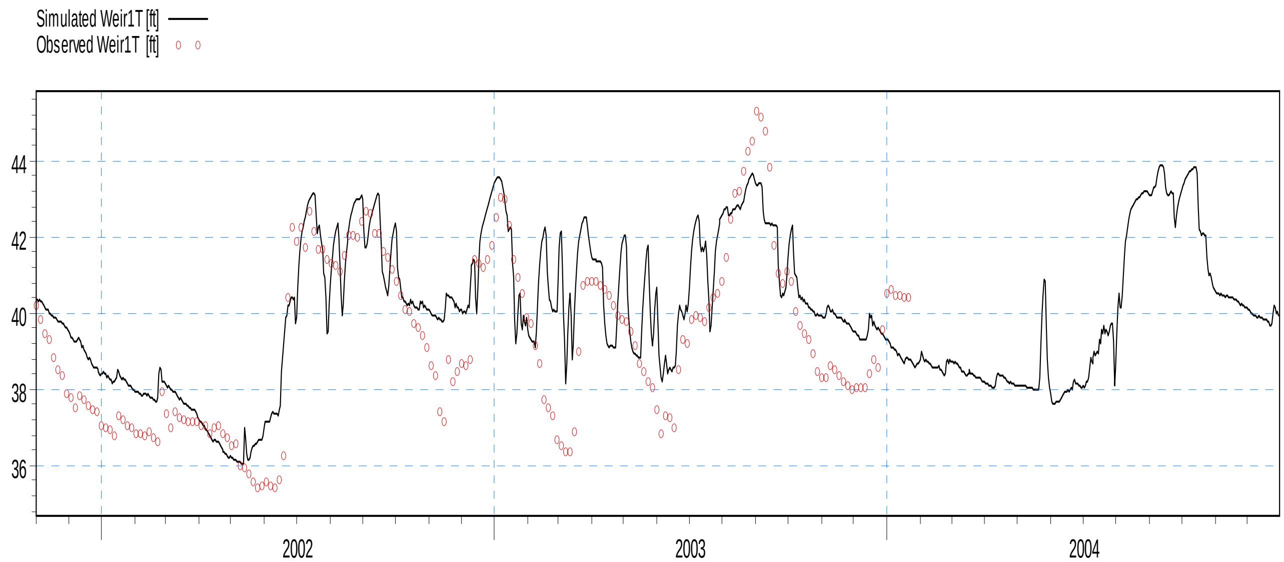

Plot number 6 [Input Item No. 6]

Weir1H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\Weir1HDaily.dfs0]



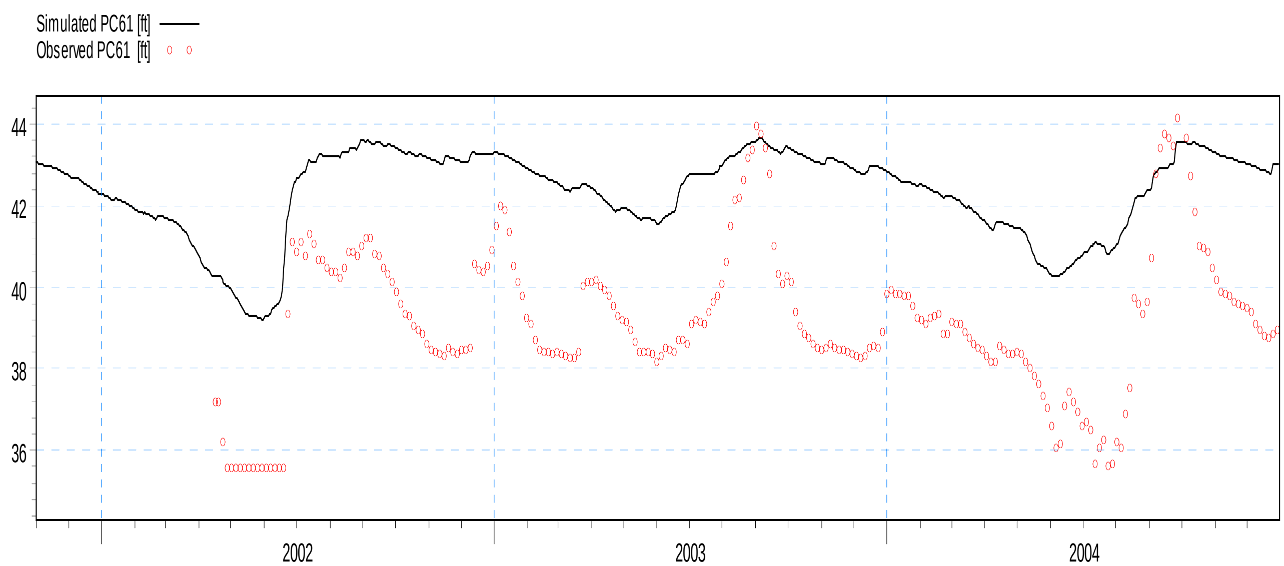

Plot number 7 [Input Item No. 7]

Weir1T Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\Weir1TDaily.dfs0]



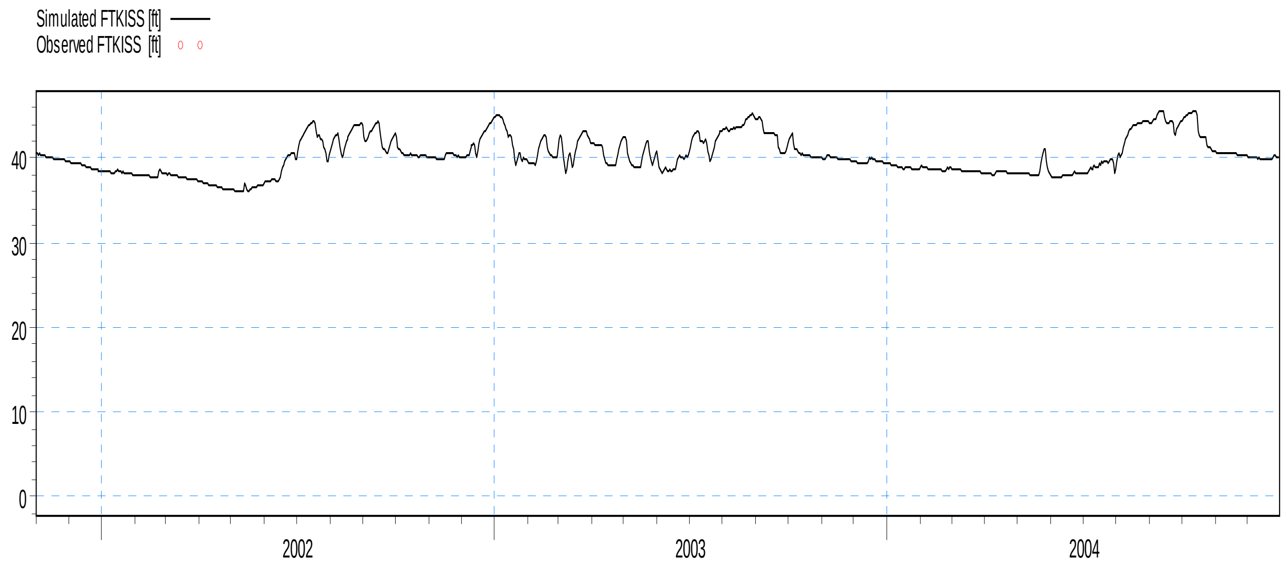

Plot number 8 [Input Item No. 8]

PC61 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\PC61_HDaily.dfs0]



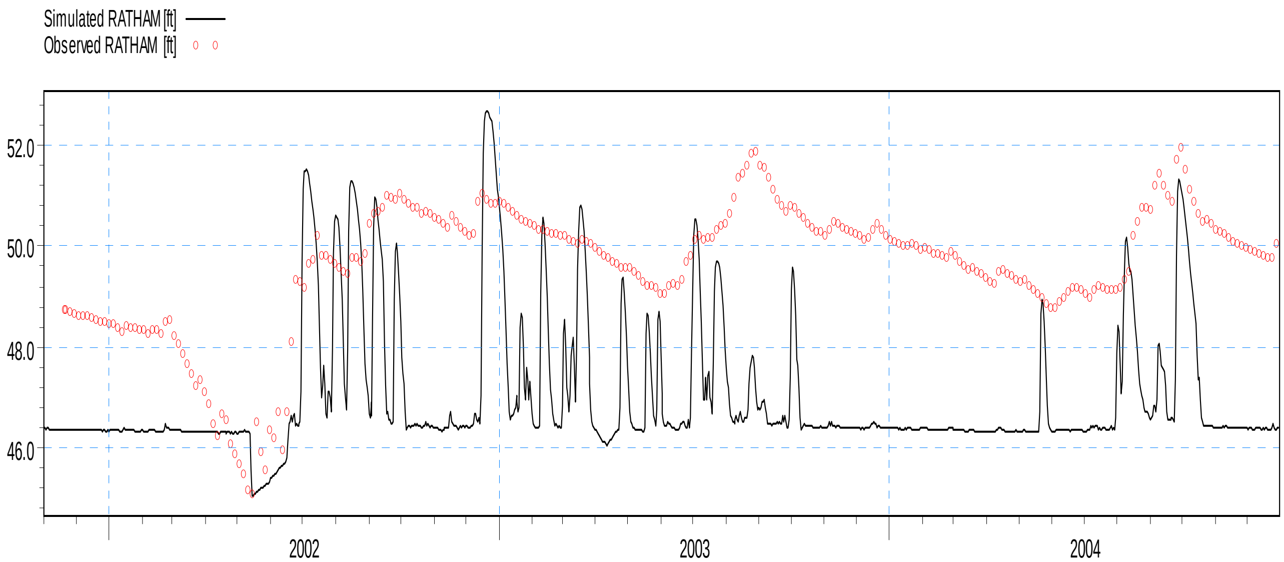

Plot number 9 [Input Item No. 9]

FTKISS Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\FTKISS_stage.dfs0]



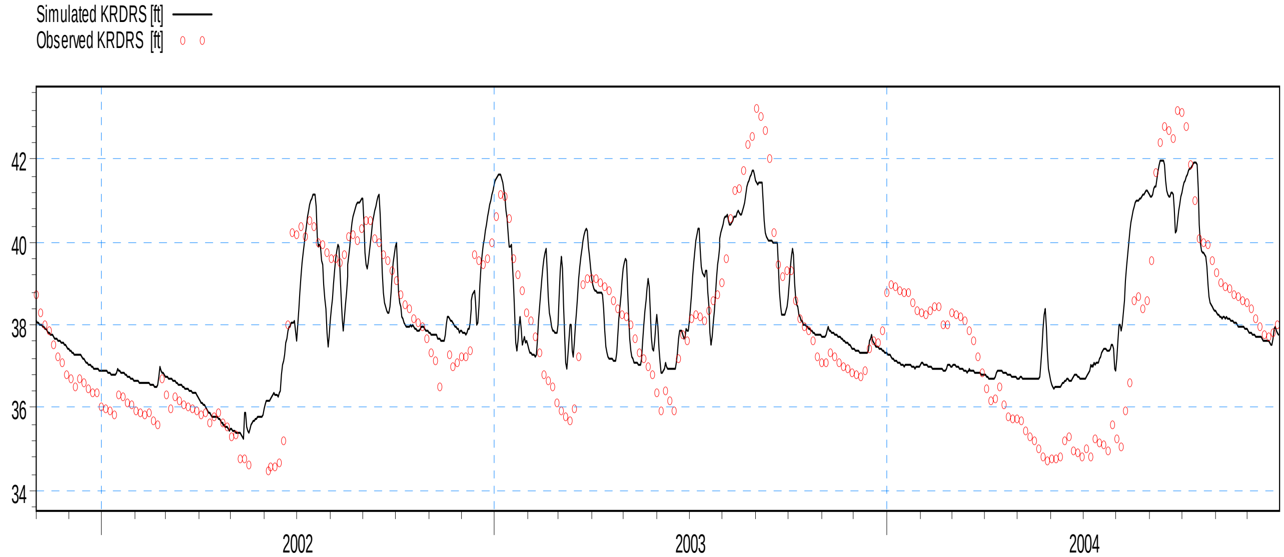

Plot number 10 [Input Item No. 10]

RATHAM Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\RathamDaily.dfs0]



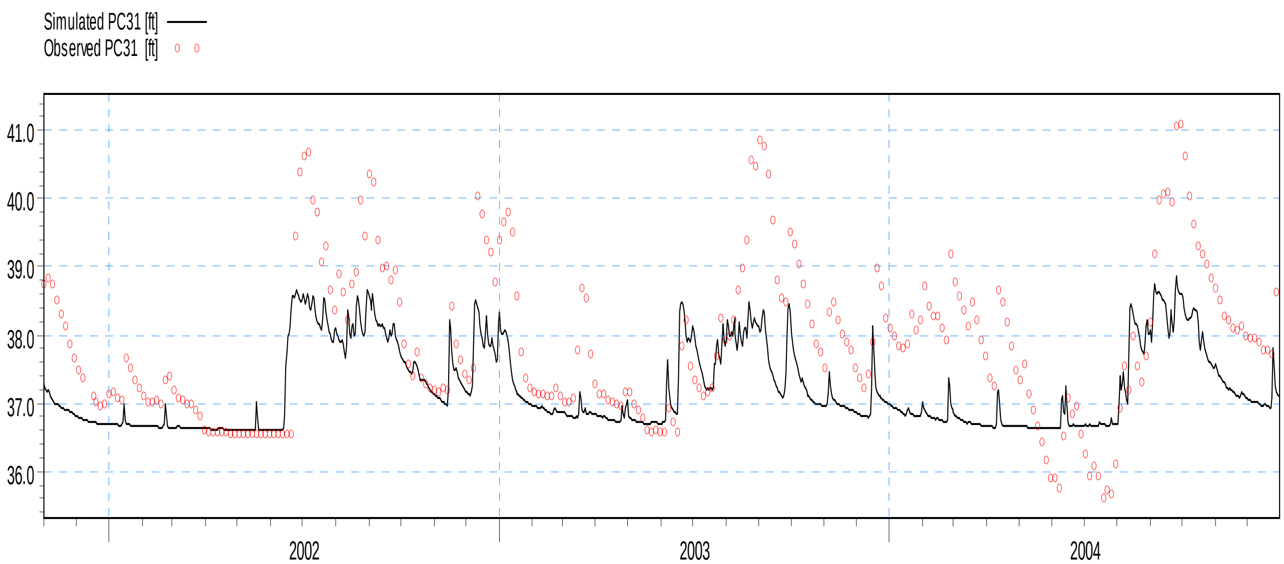

Plot number 11 [Input Item No. 11]

KRDRS Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\KRDRSDaily.dfs0]



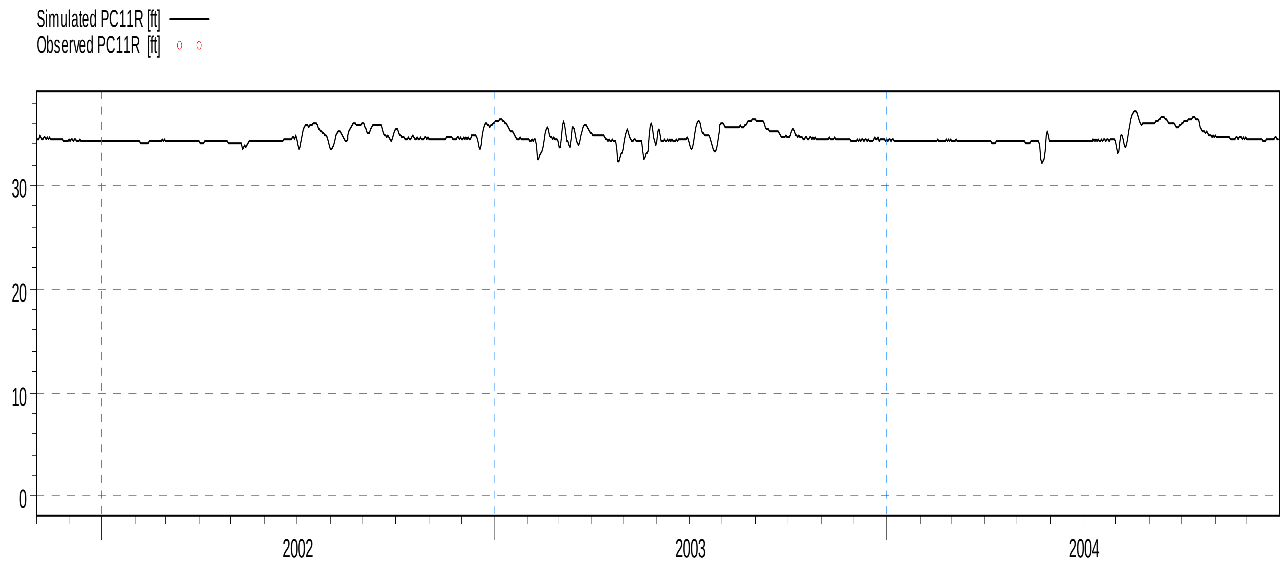

Plot number 12 [Input Item No. 12]

PC31 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\PC31Daily.dfs0]



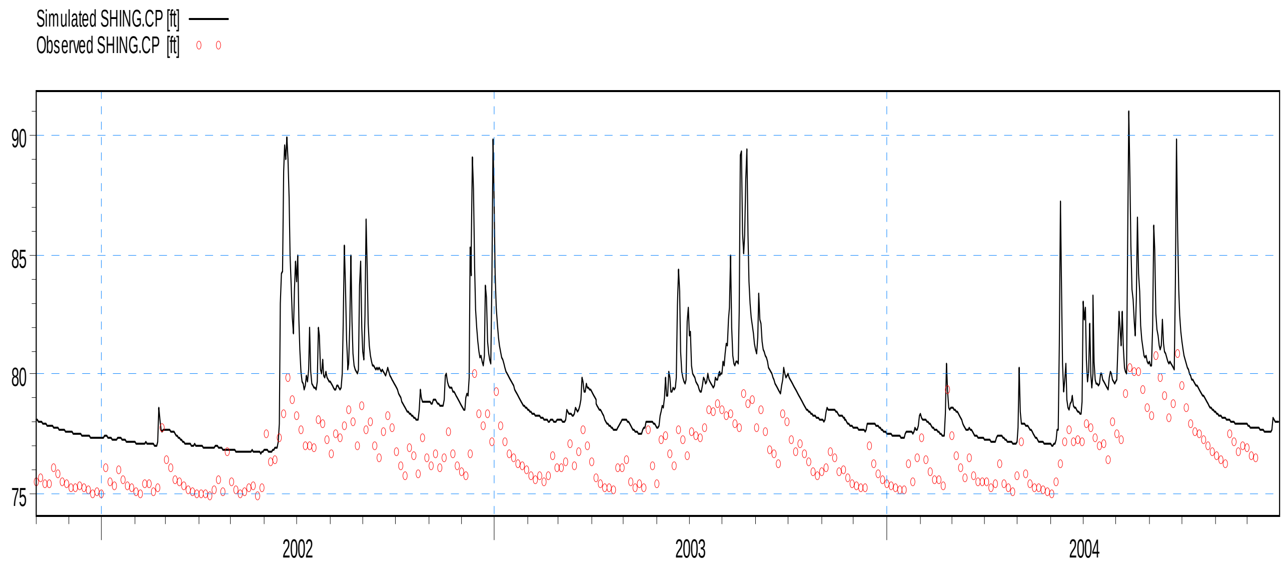

Plot number 13 [Input Item No. 13]

PC11R Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\PC11RDaily.dfs0]



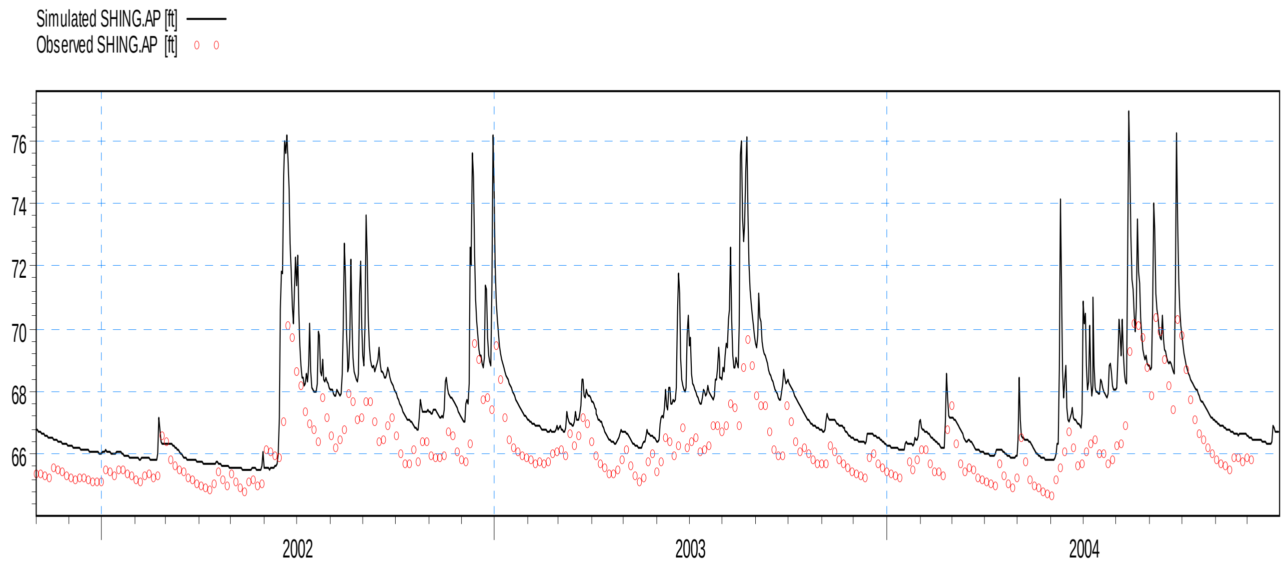

Plot number 14 [Input Item No. 14]

SHING.CP Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\SHING.CPDaily.dfs0]



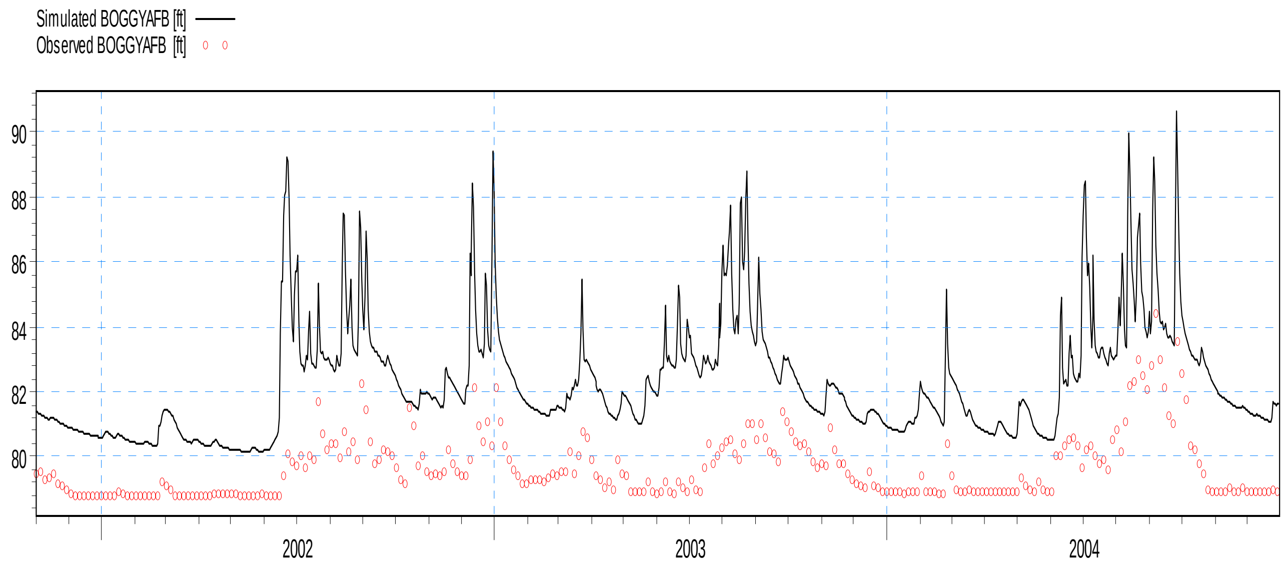

Plot number 15 [Input Item No. 15]

SHING.AP Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\SHING.APDaily.dfs0]



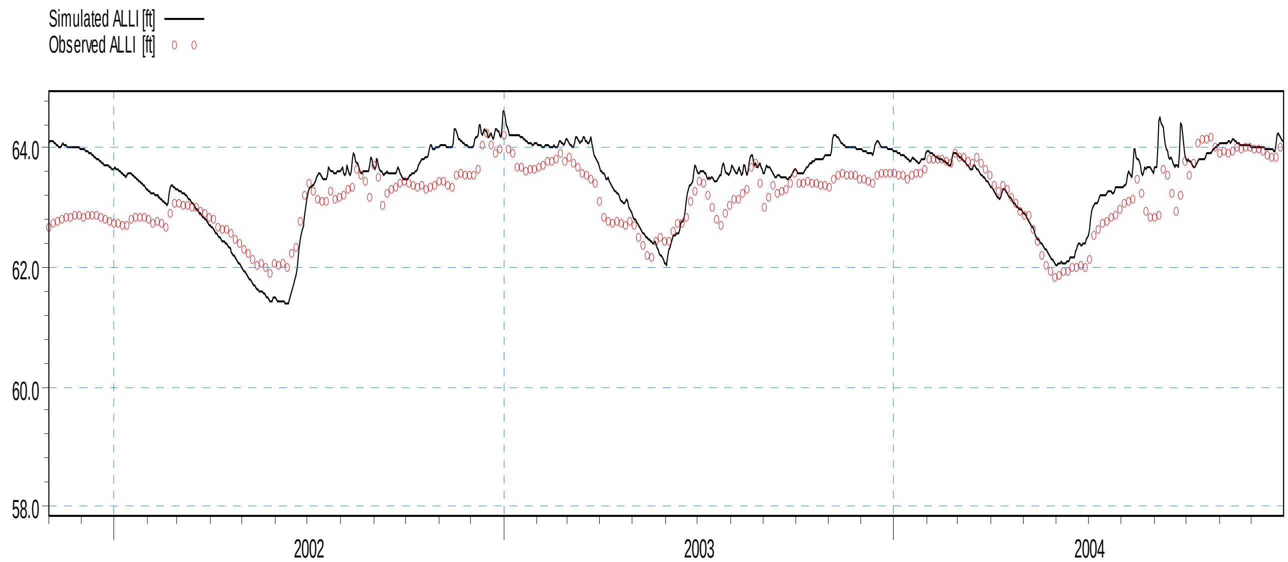

Plot number 16 [Input Item No. 16]

BOGGYAFB Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\BOGGYAFBDaily.dfs0]



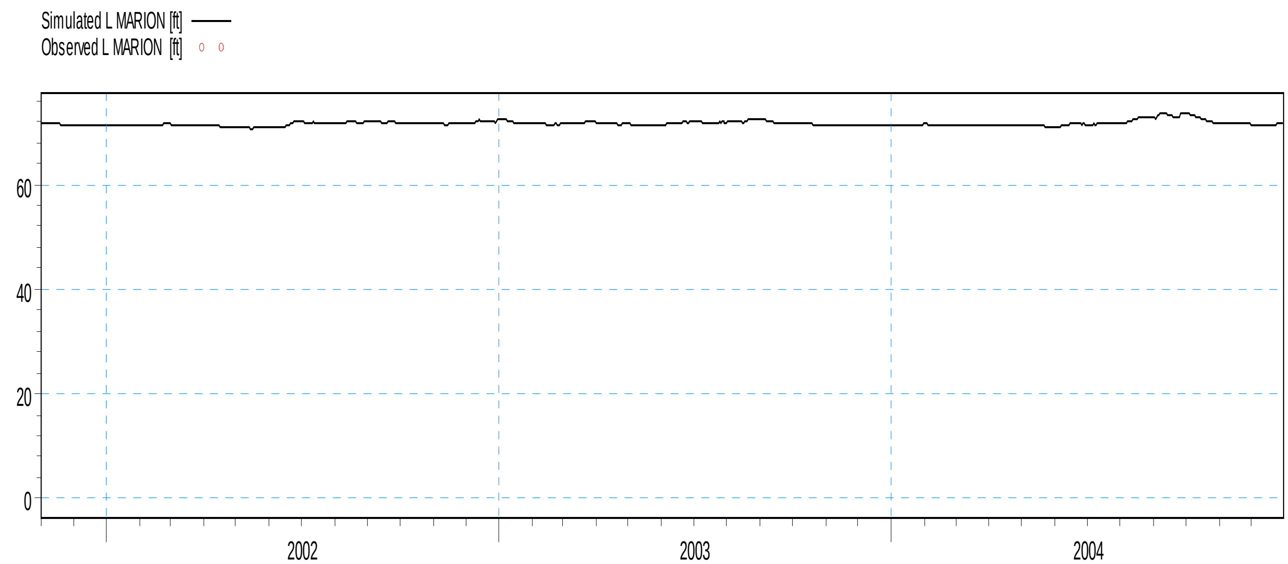

Plot number 17 [Input Item No. 17]

ALLI Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\ALL1Daily.dfs0]



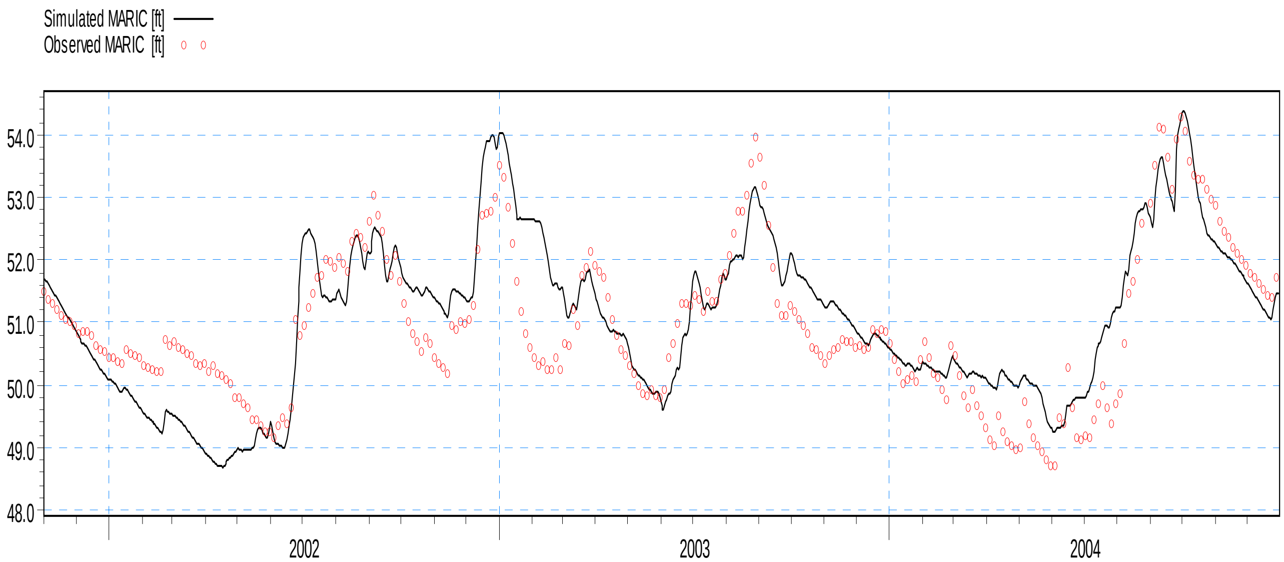

Plot number 18 [Input Item No. 18]

L MARION Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\LMARIONDaily.dfs0]



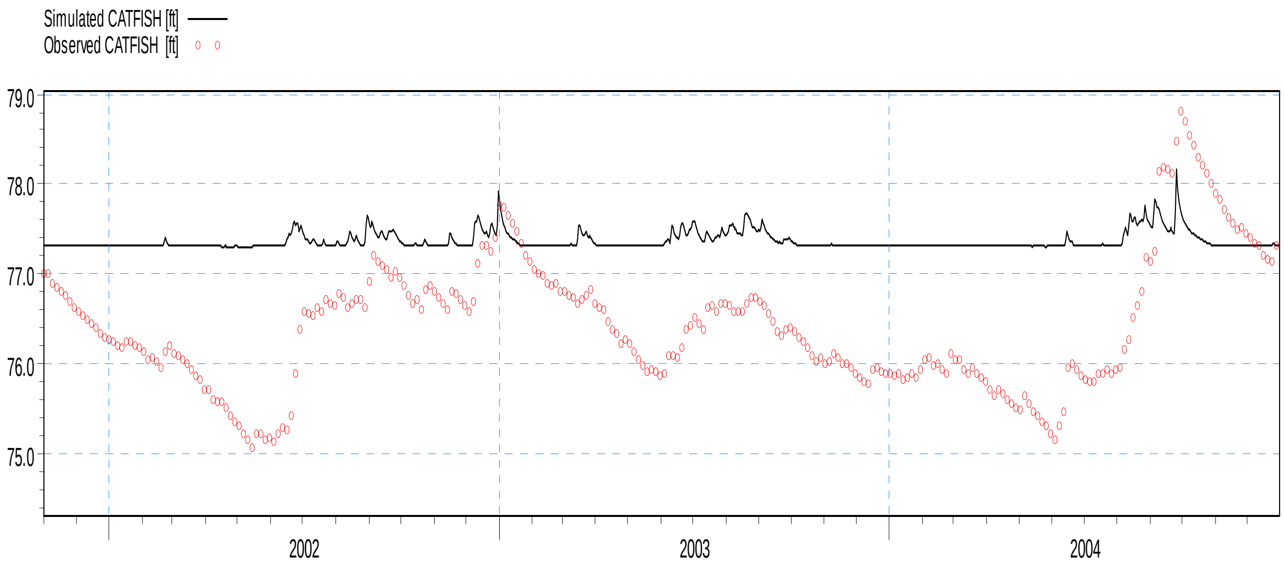

Plot number 19 [Input Item No. 19]

MARIC Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\MARICDaily.dfs0]



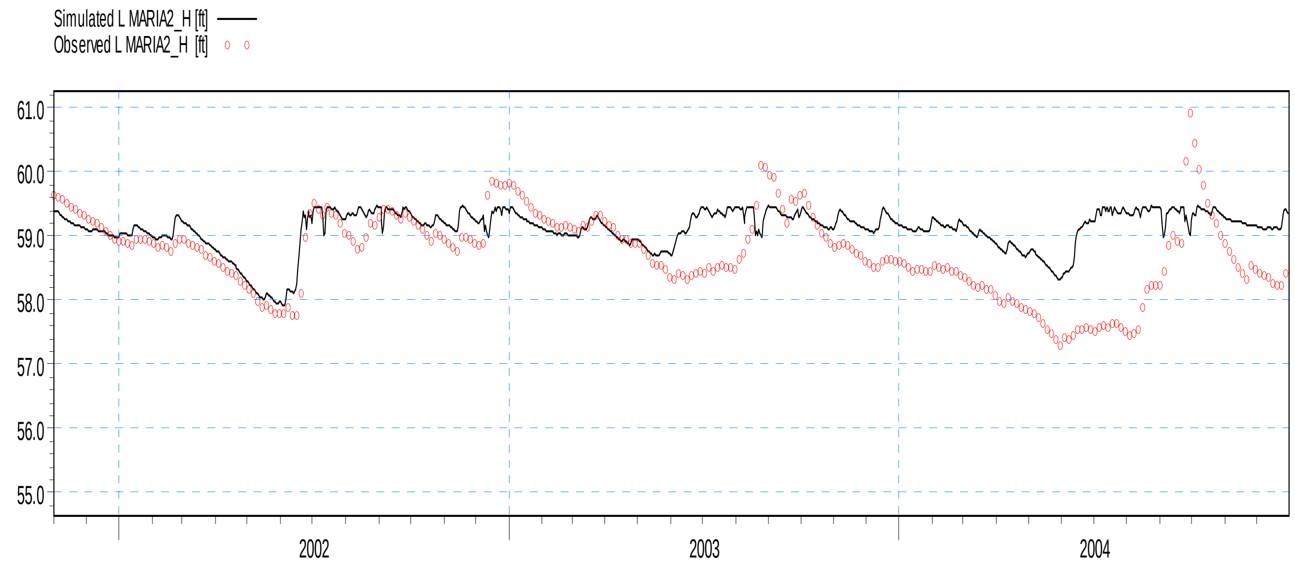

Plot number 20 [Input Item No. 20]

CATFISH Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\CATFISHDaily.dfs0]



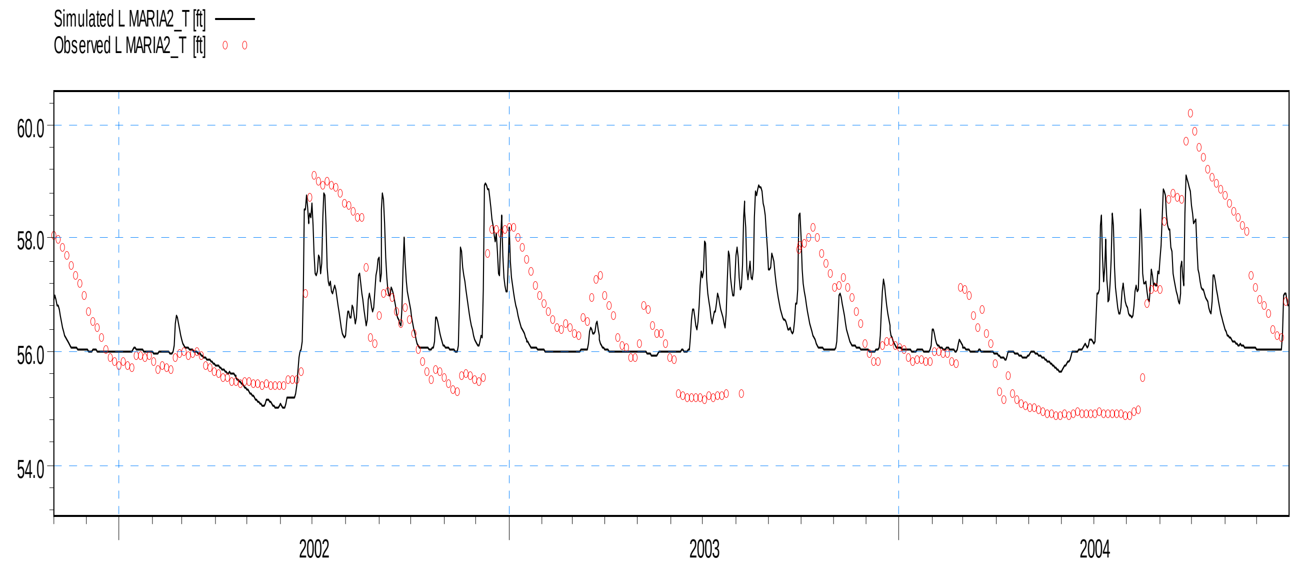

Plot number 21 [Input Item No. 21]

L MARIA2_H Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\LMARIA2 _headwater.dfs0]



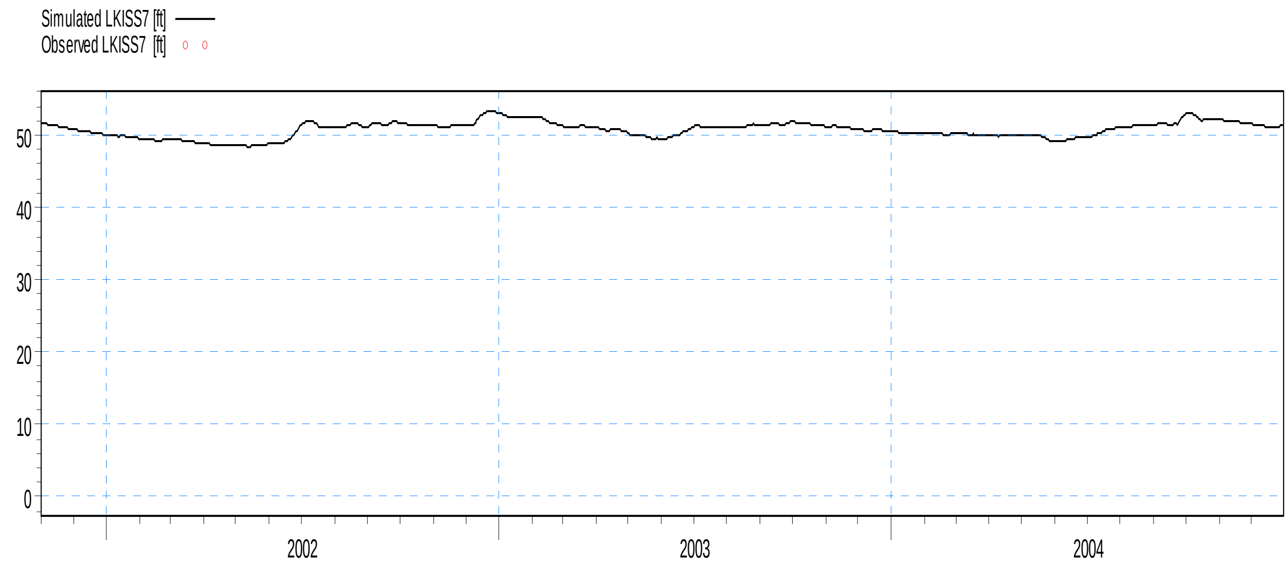

Plot number 22 [Input Item No. 22]

L MARIA2_T Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stageLMARIA2 _tailwater.dfs0]



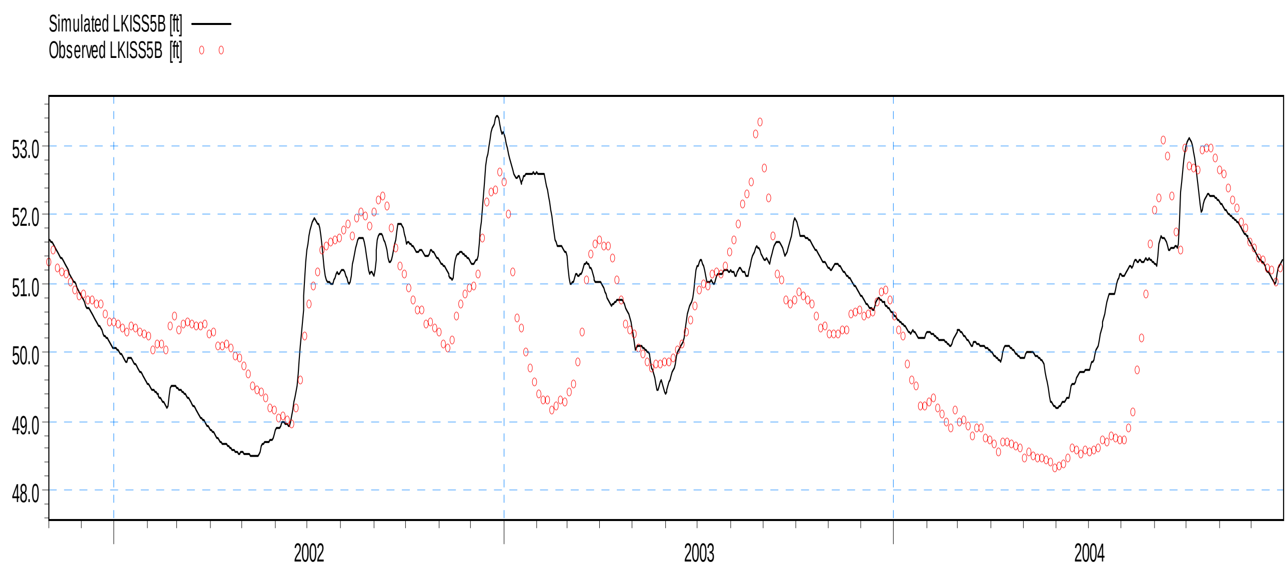

Plot number 23 [Input Item No. 23]

LKISS7 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\LKISS7Daily.dfs0]



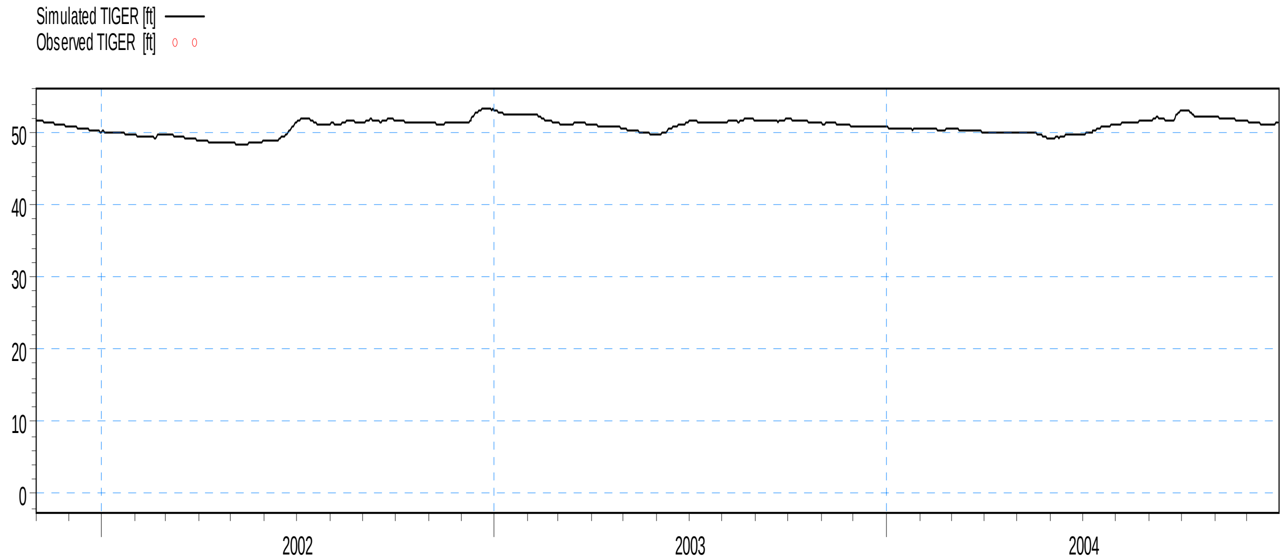

Plot number 24 [Input Item No. 24]

LKISS5B Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\LKISS5BDaily.dfs0]



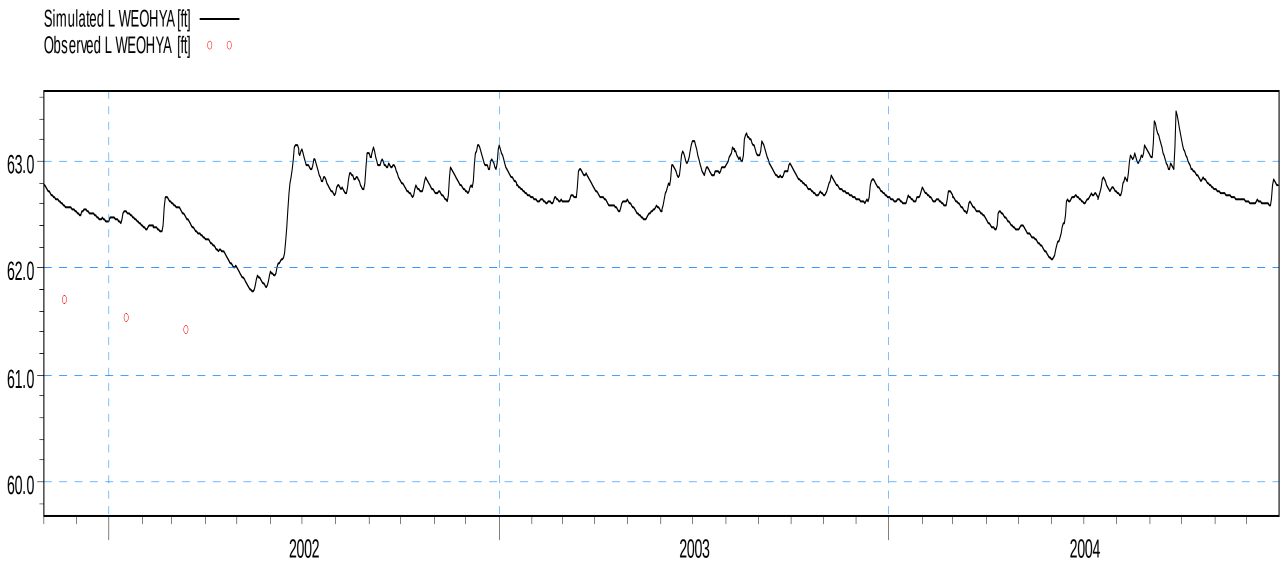

Plot number 25 [Input Item No. 25]

TIGER Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\TIGERDaily.dfs0]




Plot number 26 [Input Item No. 26]

L WEOHYA Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\stage\L WEOHYA_Weekly.dfs0]

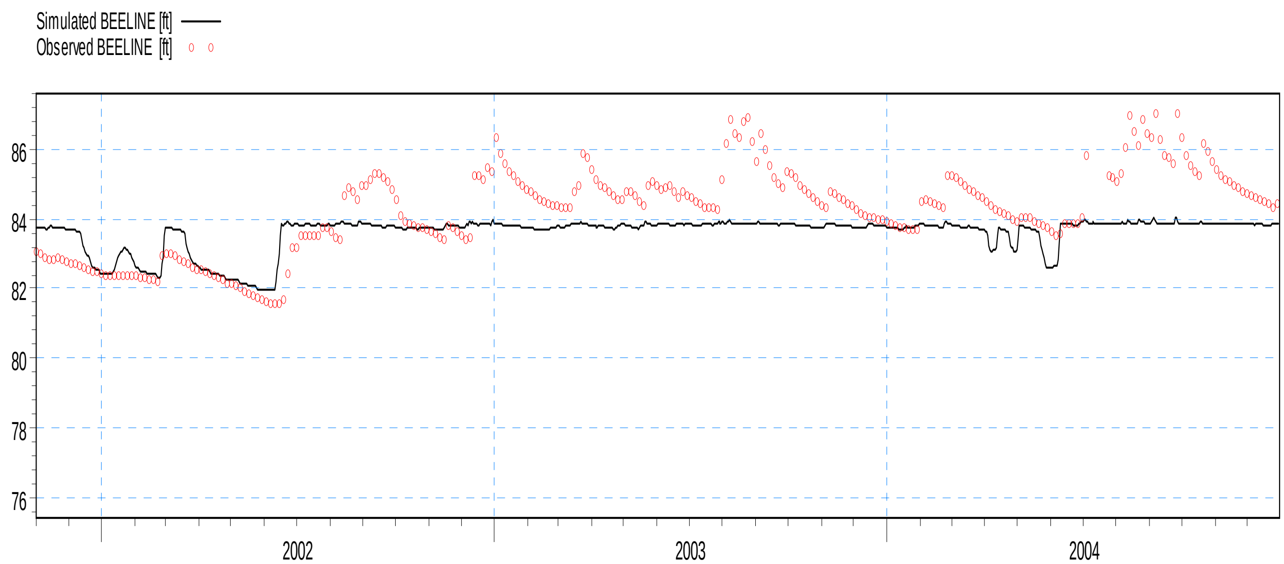


HTML output from MSHECalPlot

12/19/2007 2:05:27 PM

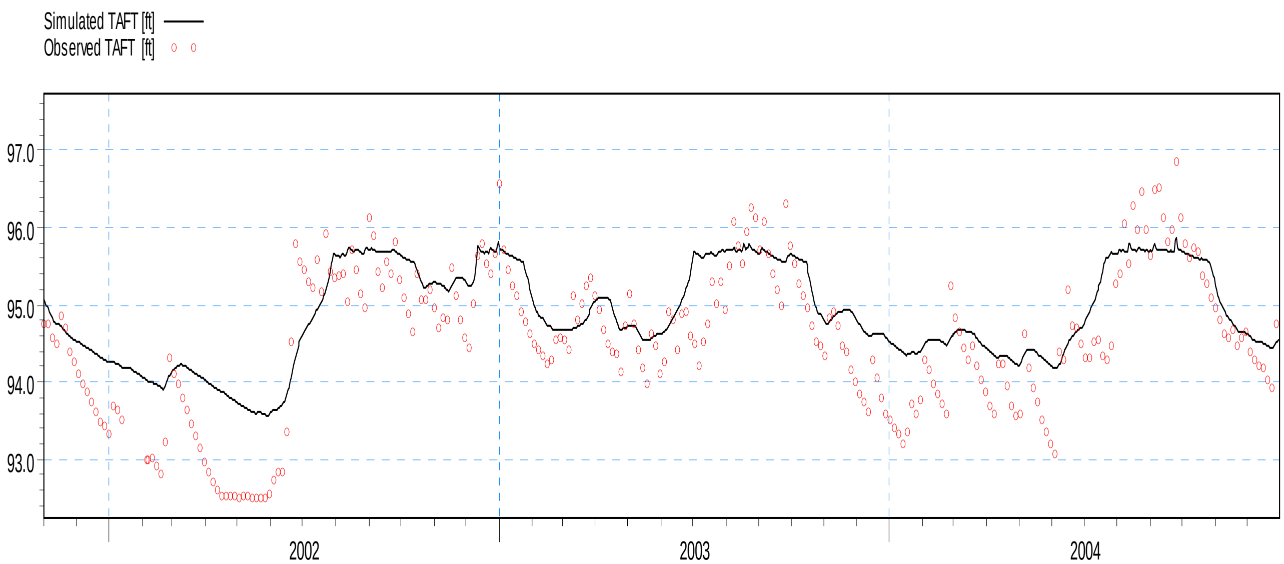
Plot number 1 [Input Item No. 1]

BEELINE Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\BEELINE.dfs0]



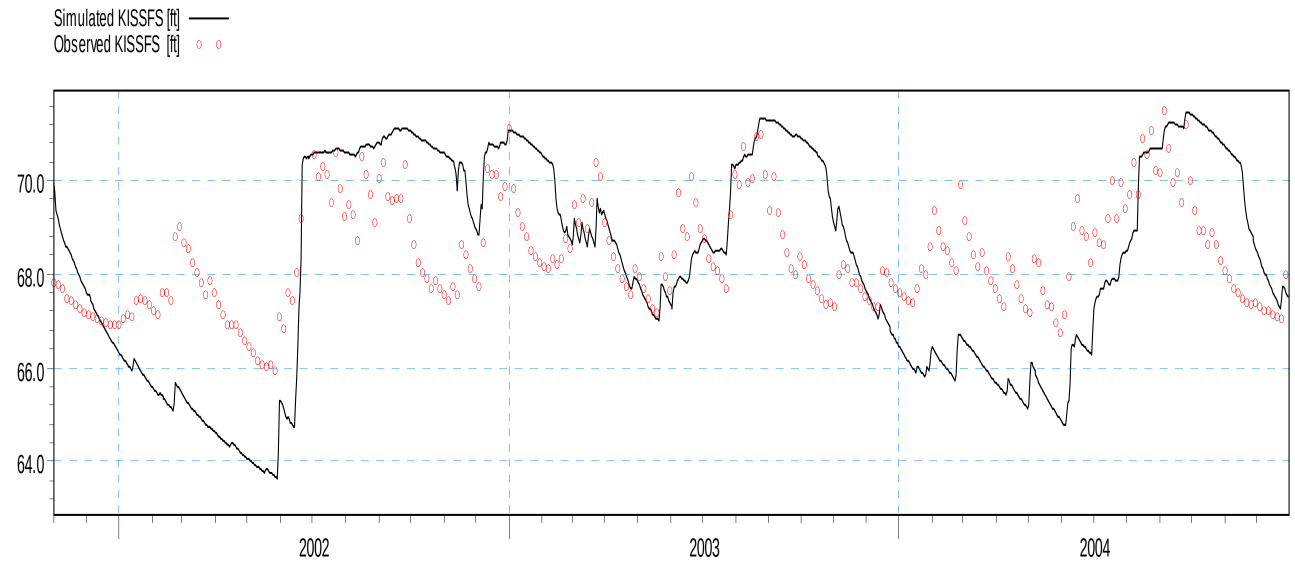

Plot number 2 [Input Item No. 2]

TAFT Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\TAFT.dfs0]



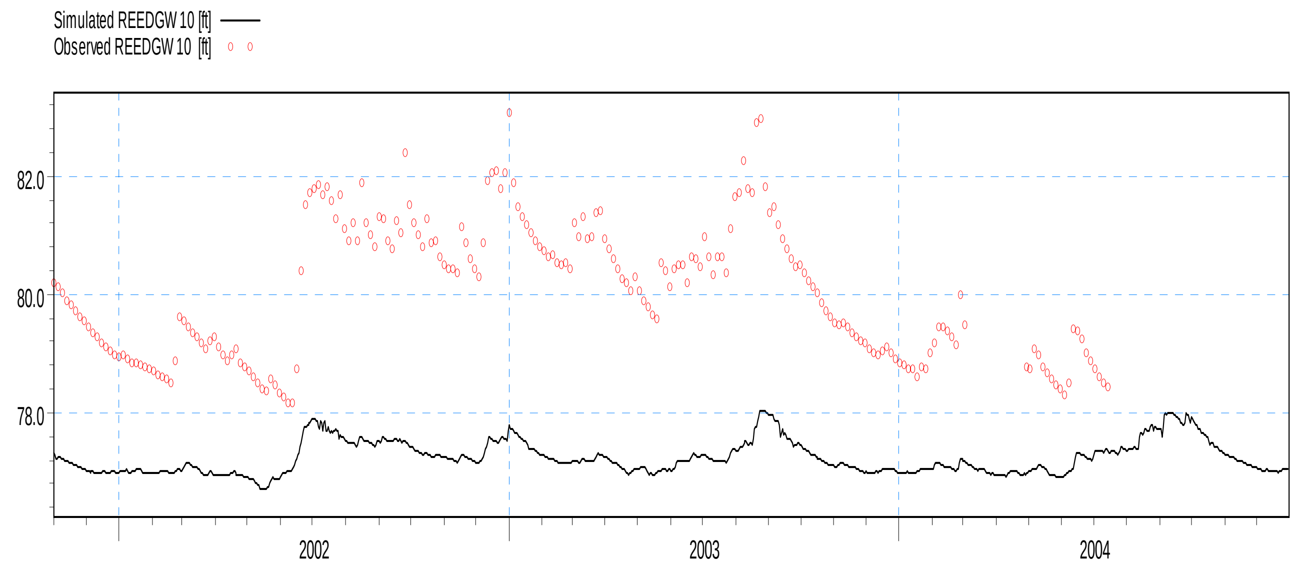
Plot number 3 [Input Item No. 3]

KISSFS Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\KISSFS.dfs0]




Plot number 4 [Input Item No. 4]

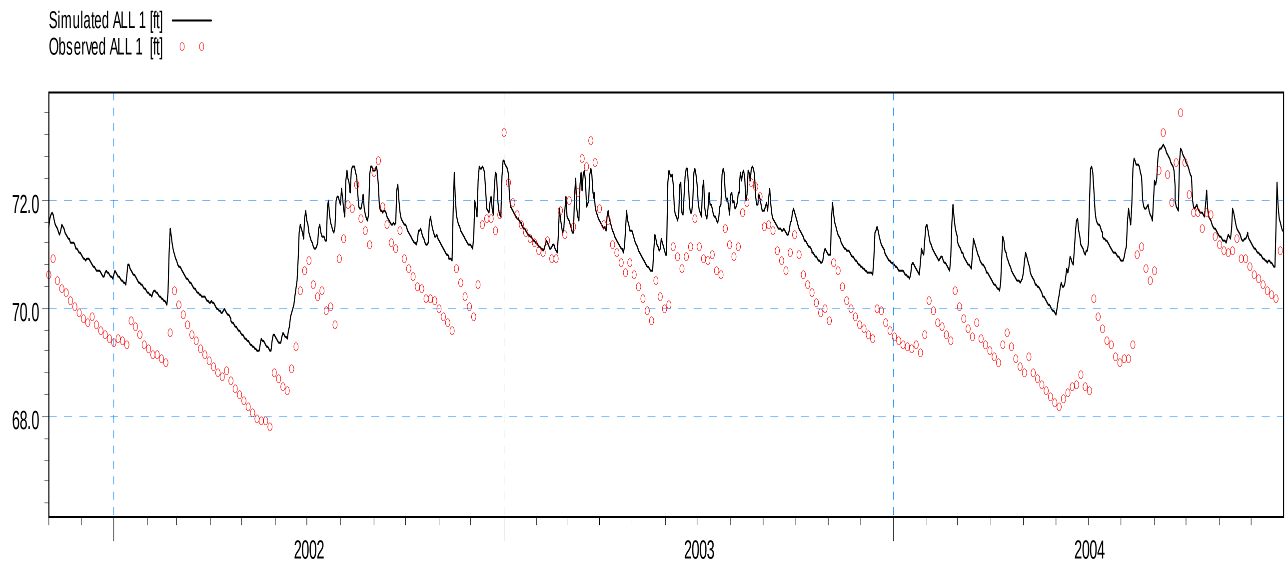
REEDGW 10 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\REEDGW10.dfs0]




Plot number 5 [Input Item No. 5]

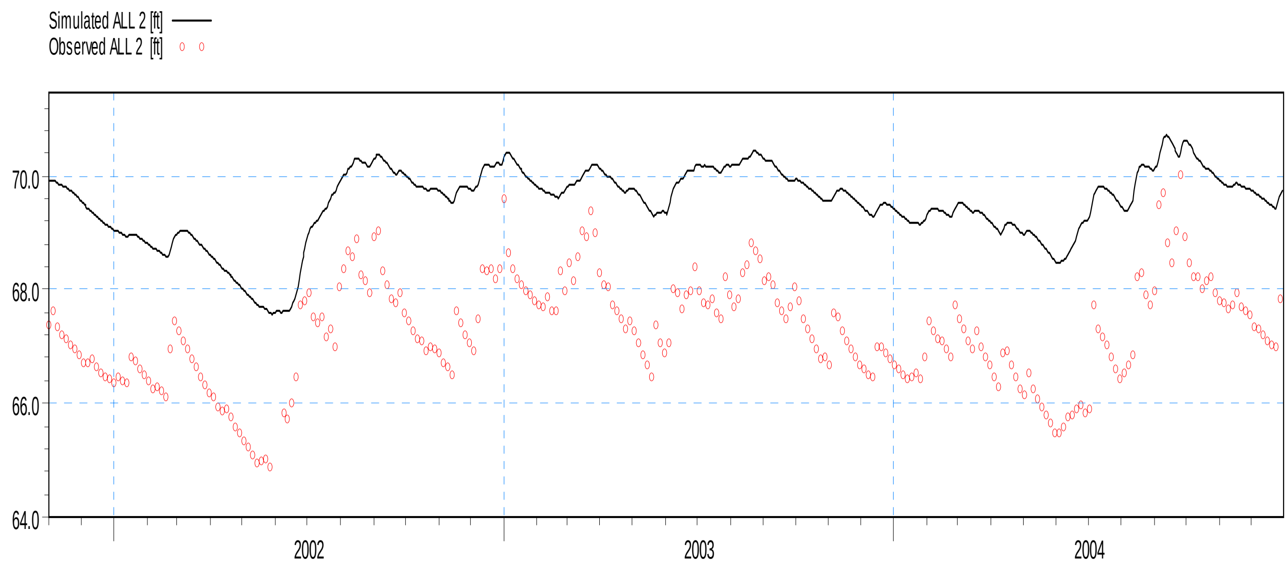
ALL 1 Simulated and Observed Data [File: C:\DHIModels\4021.477

KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\ALL1.dfs0]



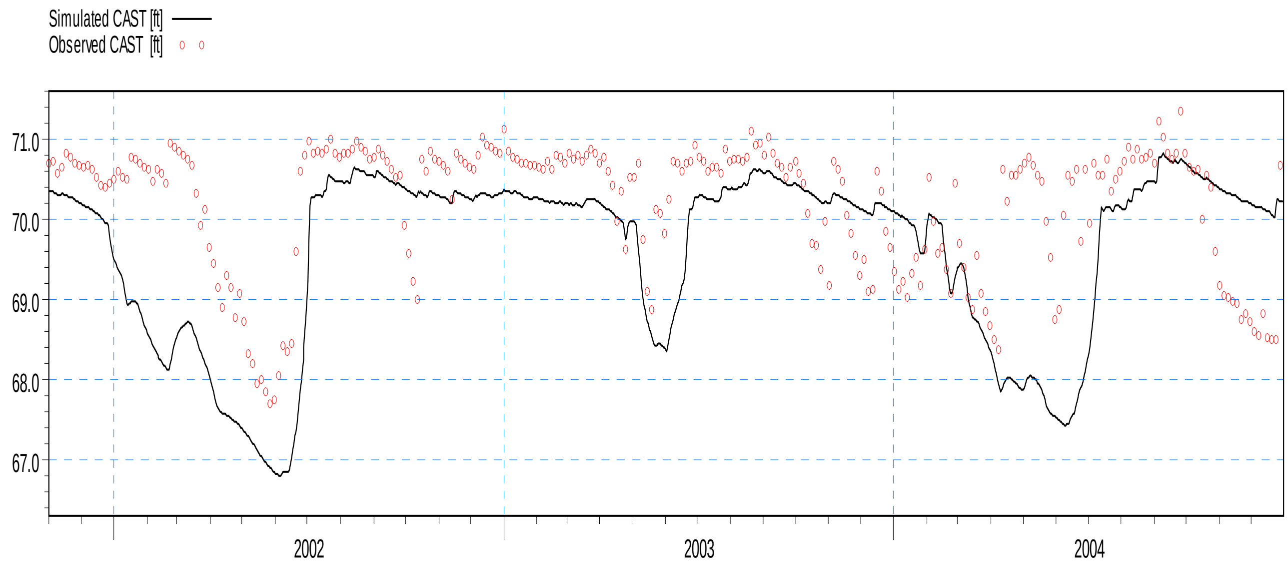

Plot number 6 [Input Item No. 6]

ALL 2 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\ALL2.dfs0]



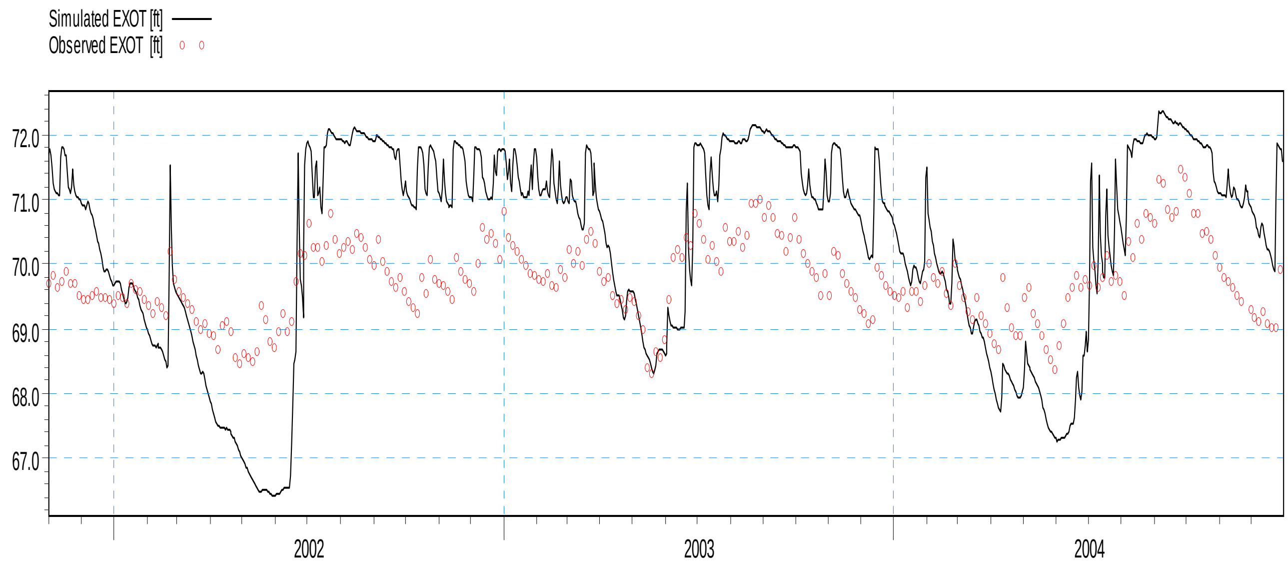

Plot number 7 [Input Item No. 7]

CAST Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\CAST.dfs0]



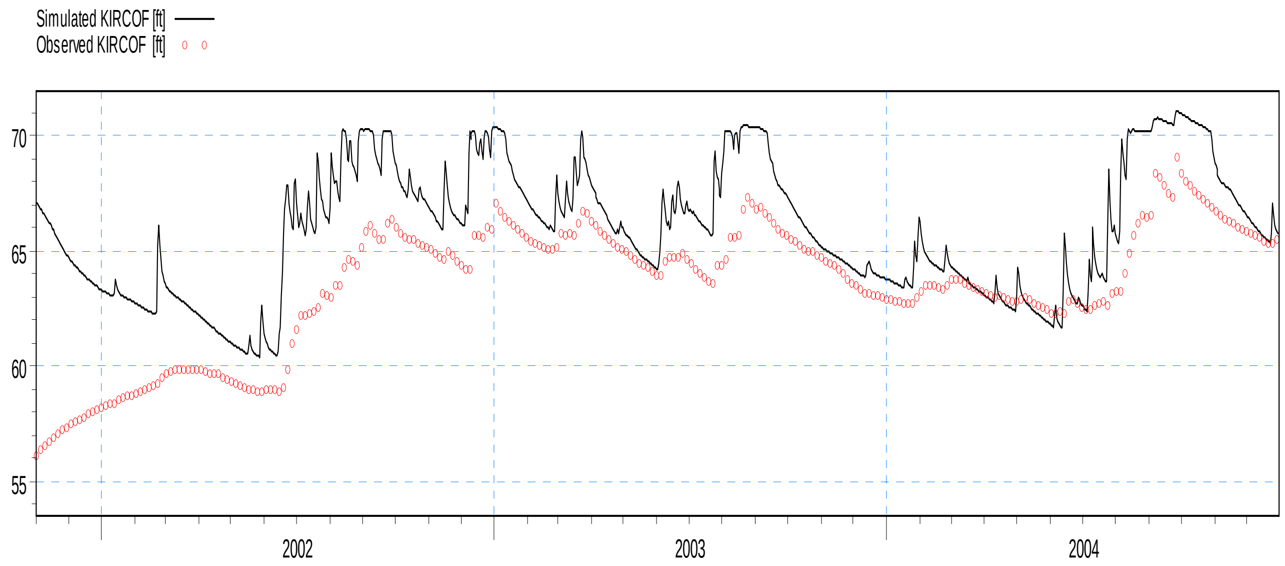

Plot number 8 [Input Item No. 8]

EXOT Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\EXOT.dfs0]



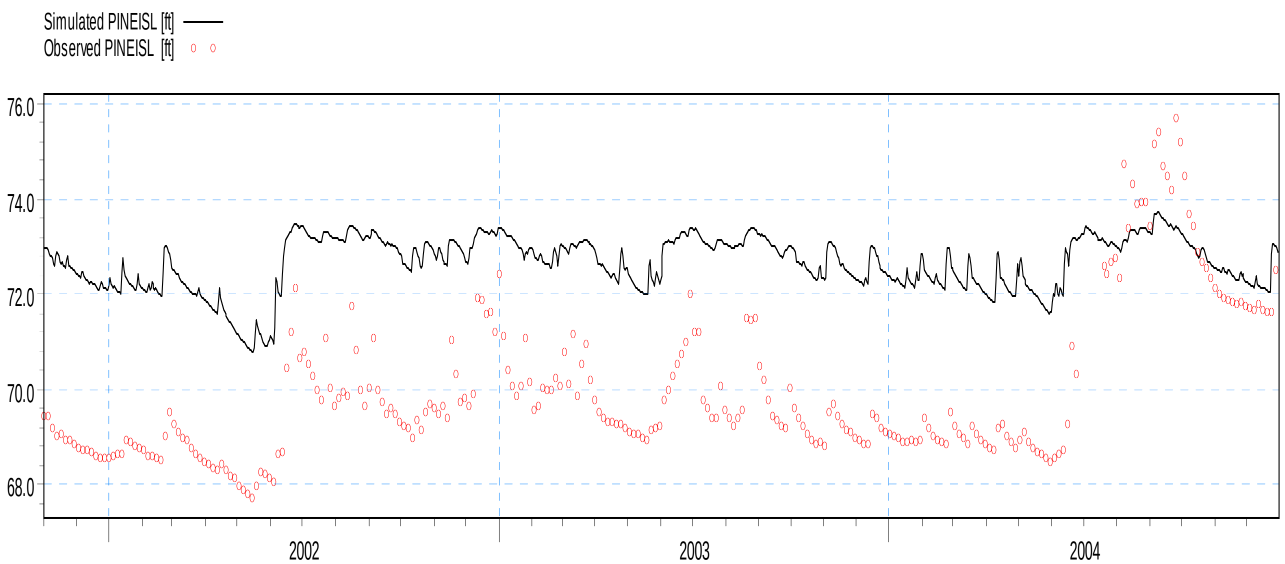

Plot number 9 [Input Item No. 9]

KIRCOF Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\KIRCOF.dfs0]



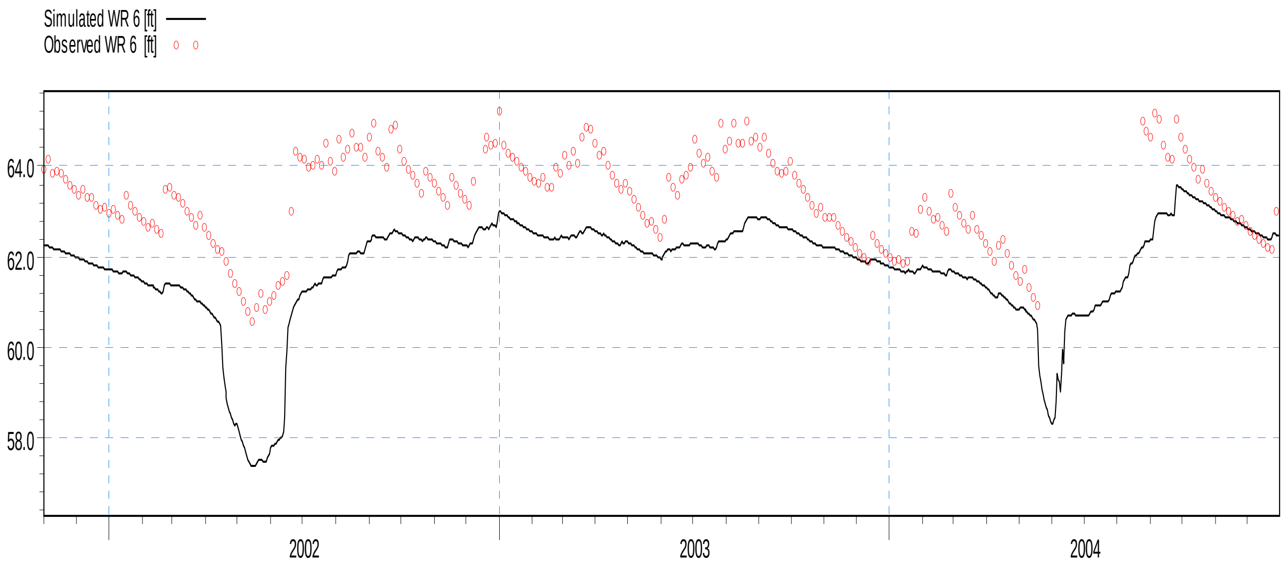

Plot number 10 [Input Item No. 10]

PINEISL Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\PINEISL.dfs0]



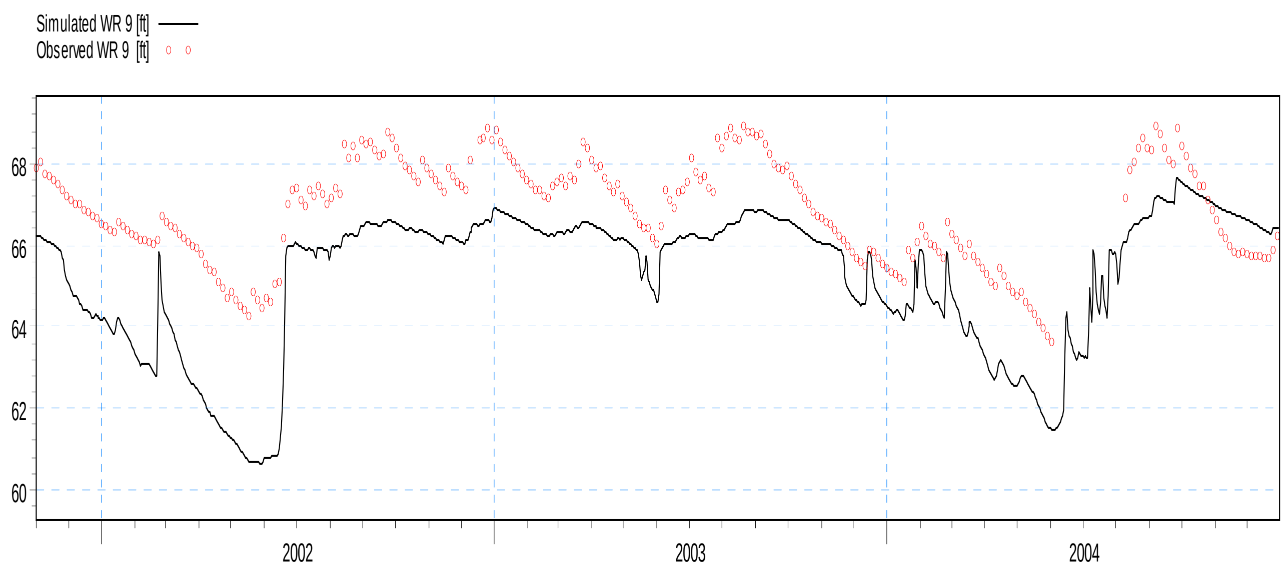

Plot number 11 [Input Item No. 11]

WR 6 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\WR6.dfs0]



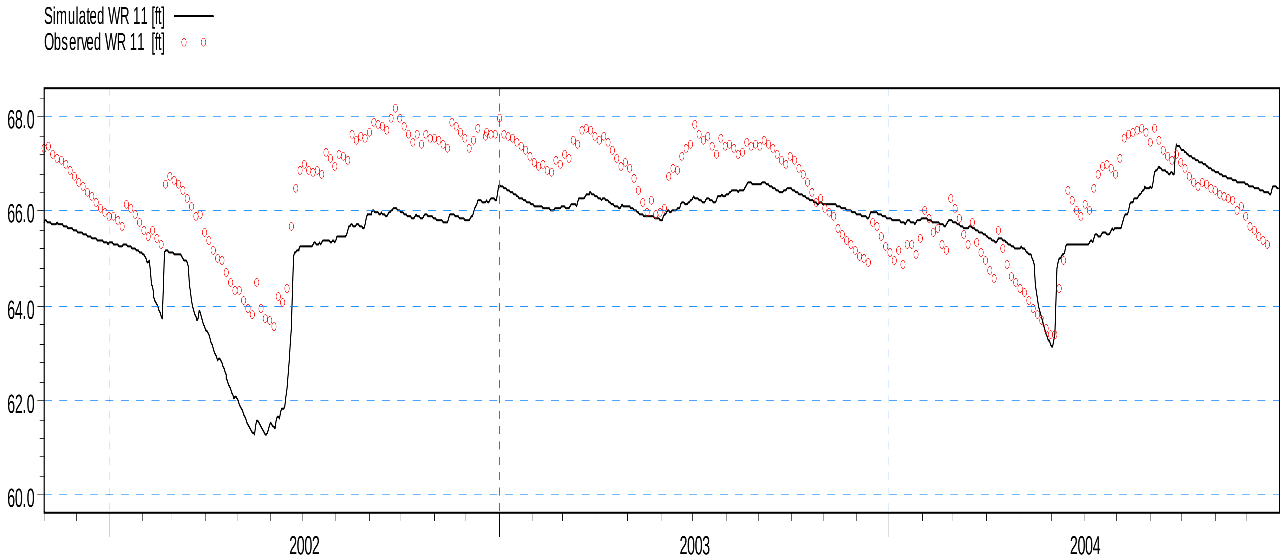

Plot number 12 [Input Item No. 12]

WR 9 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\WR9.dfs0]



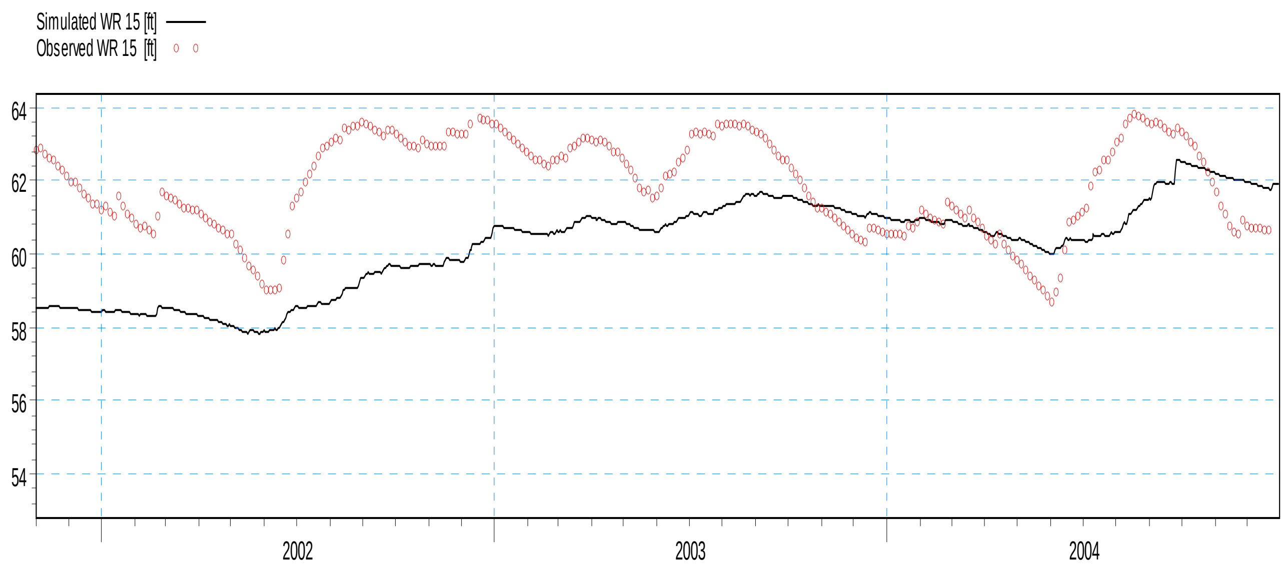

Plot number 13 [Input Item No. 13]

WR 11 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\WR11.dfs0]



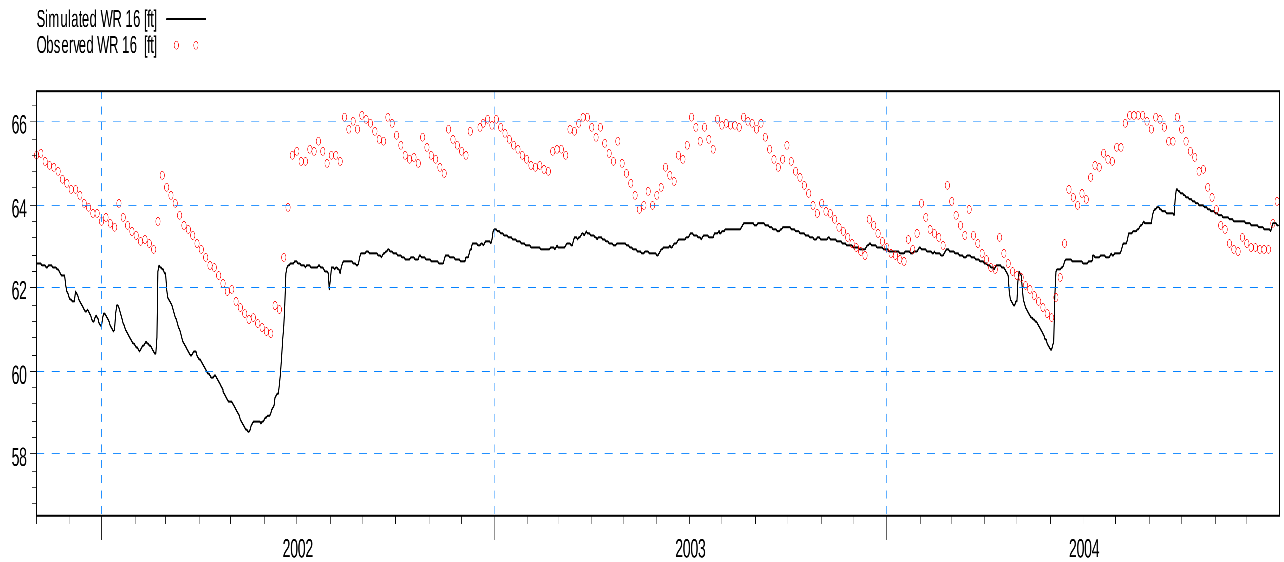

Plot number 14 [Input Item No. 14]

WR 15 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\WR15.dfs0]



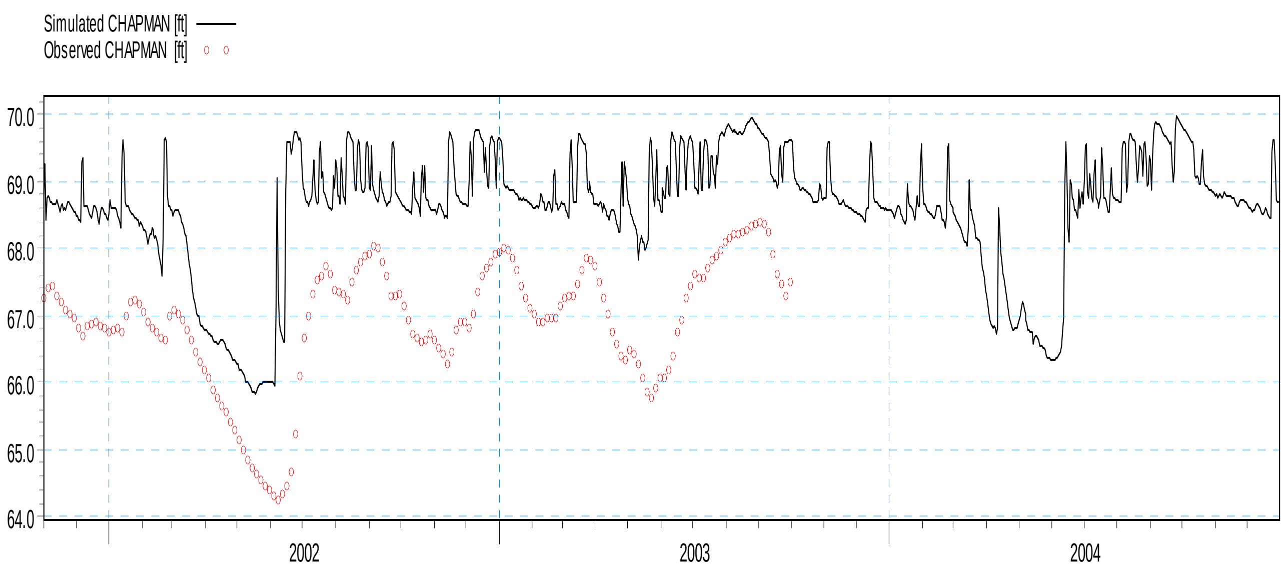

Plot number 15 [Input Item No. 15]

WR 16 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\WR16.dfs0]



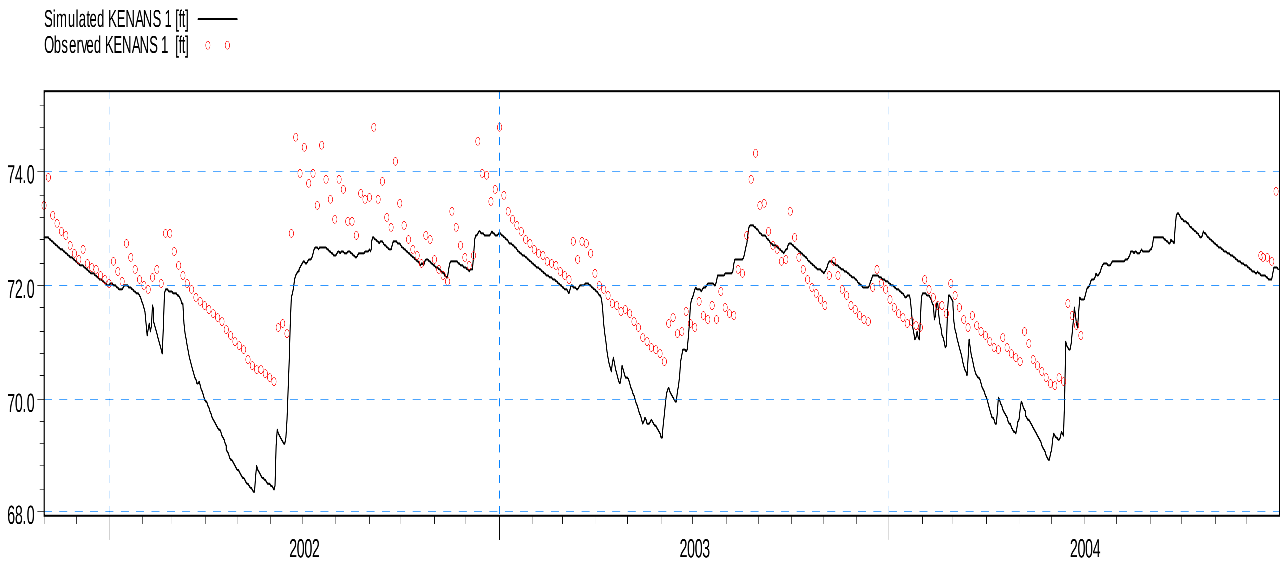

Plot number 16 [Input Item No. 16]

CHAPMAN Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\CHAPMAN.dfs0]



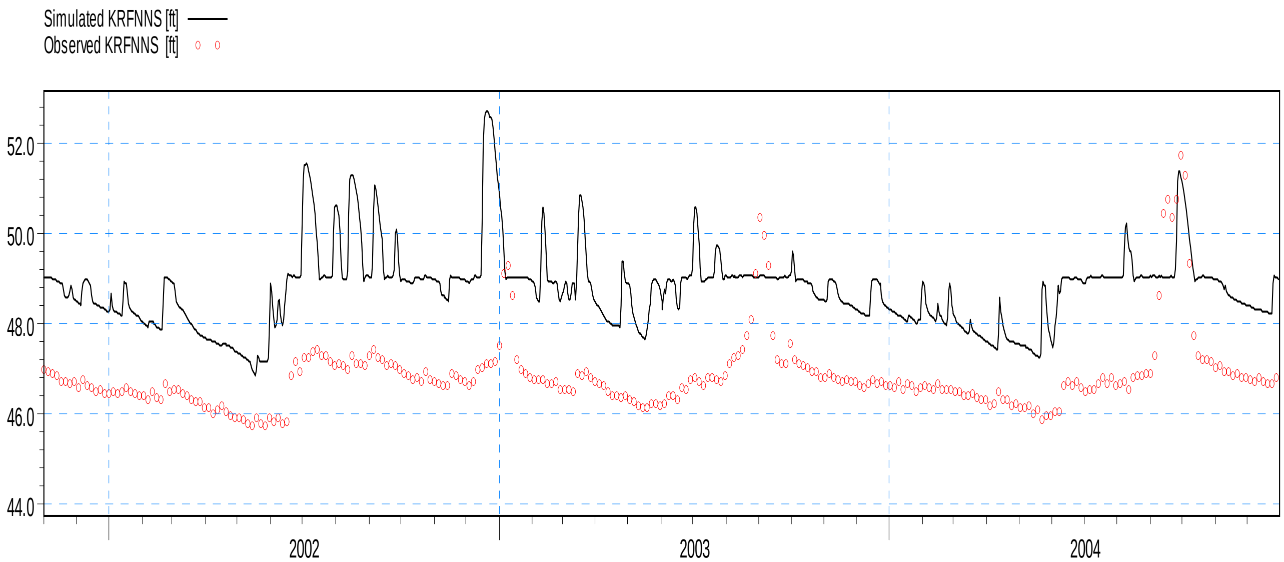

Plot number 17 [Input Item No. 17]

KENANS 1 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\KENANS1.dfs0]



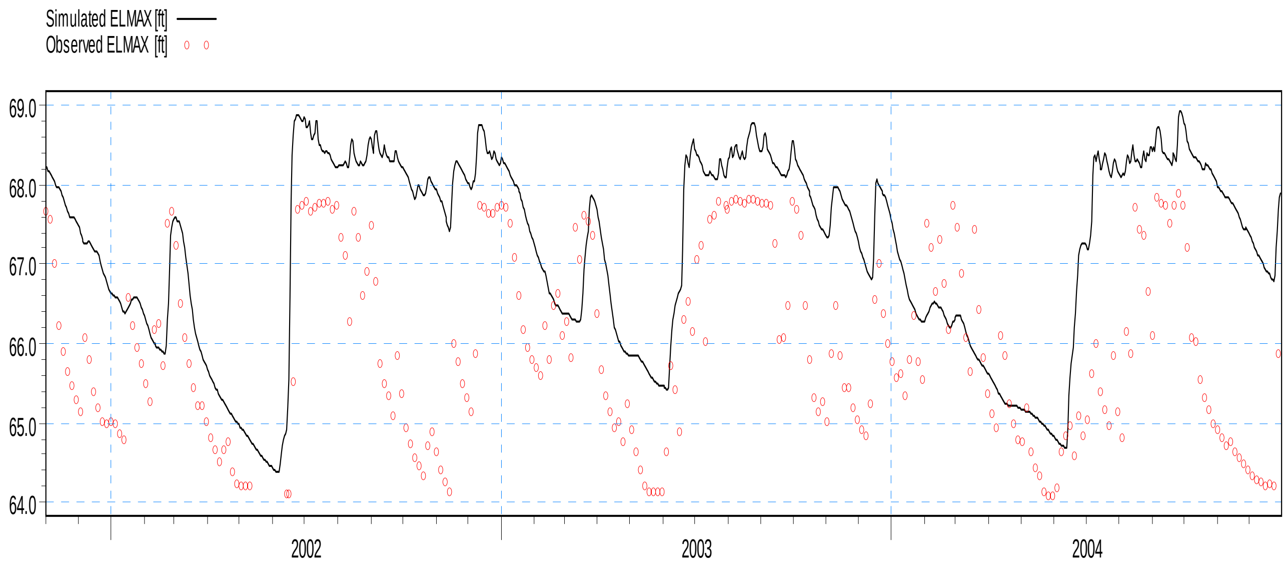

Plot number 18 [Input Item No. 18]

KRFNNS Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\KRFNNS.dfs0]



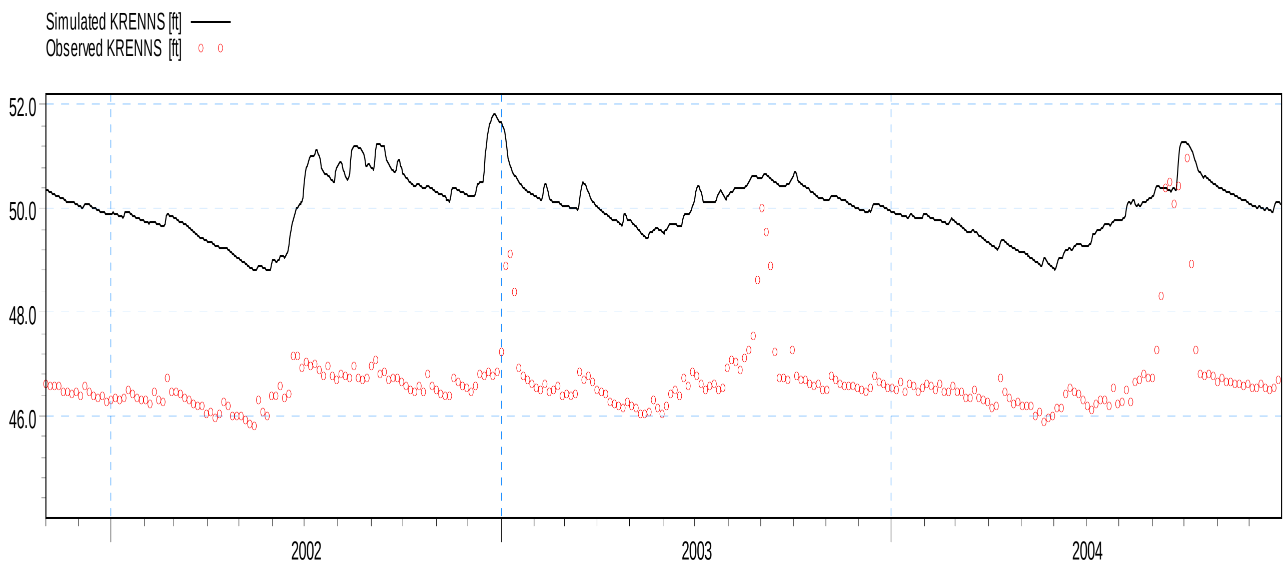

Plot number 19 [Input Item No. 19]

ELMAX Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\ELMAX.dfs0]



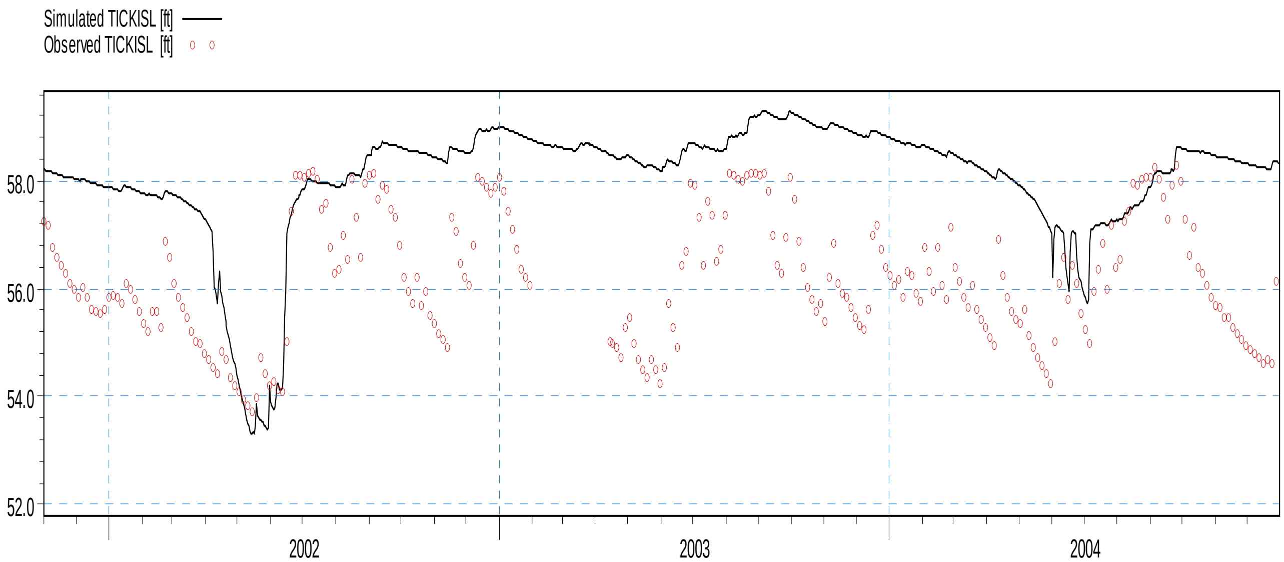

Plot number 20 [Input Item No. 20]

KRENNS Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\KRENNS.dfs0]



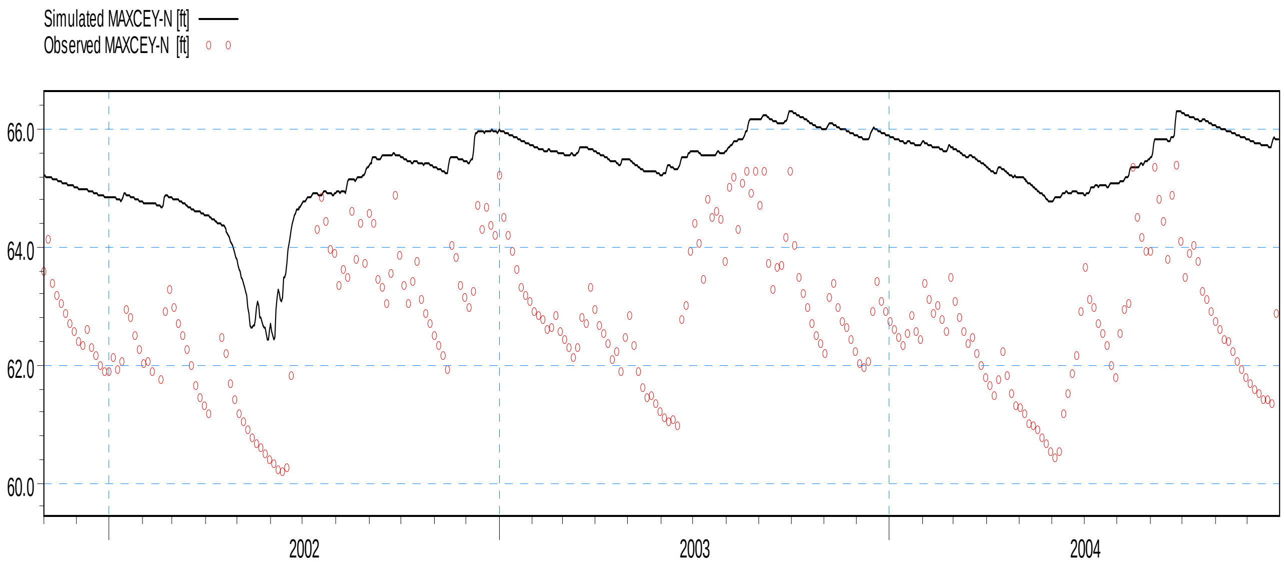

Plot number 21 [Input Item No. 21]

TICKISL Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\TICKISL.dfs0]



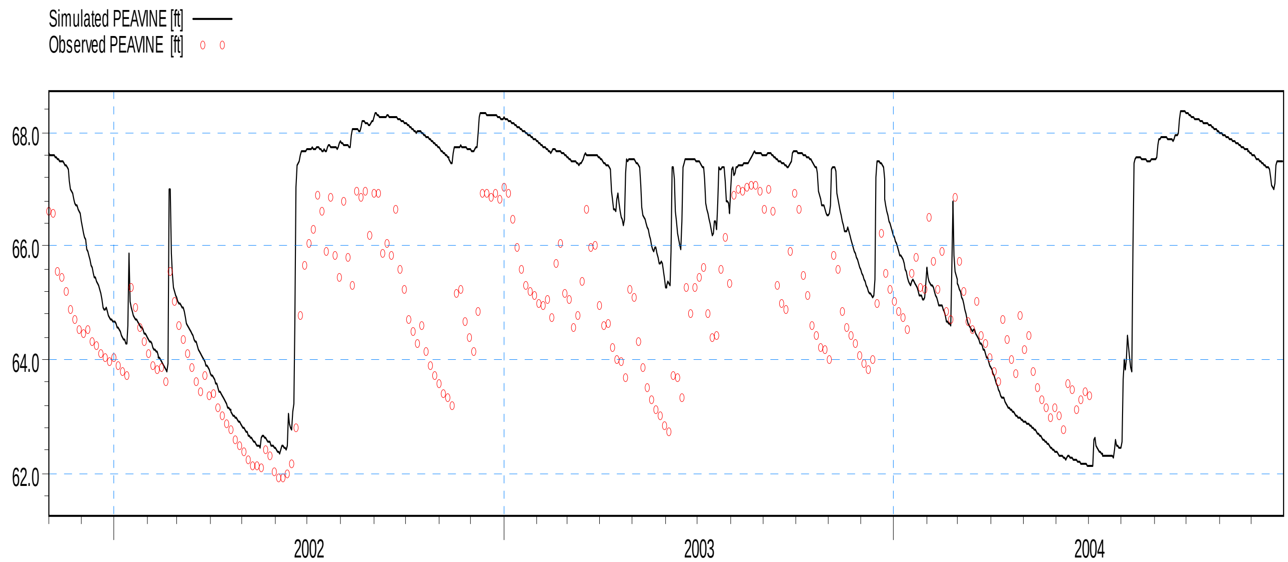

Plot number 22 [Input Item No. 22]

MAXCEY-N Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\MAXCEY-N.dfs0]



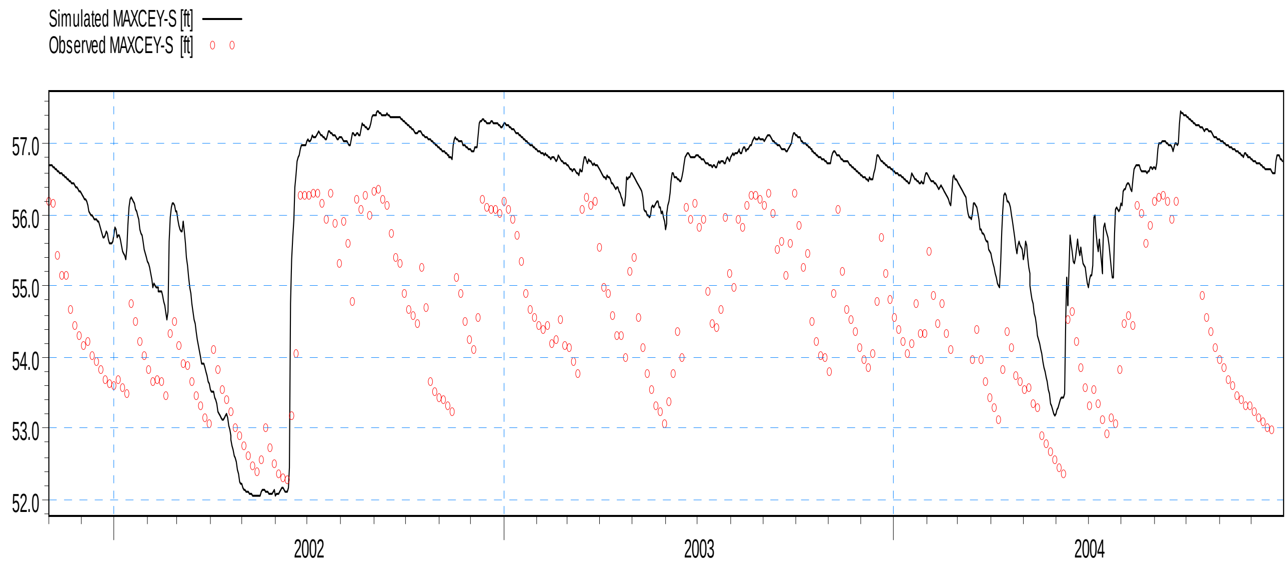

Plot number 23 [Input Item No. 23]

PEAVINE Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\PEAVINE.dfs0]



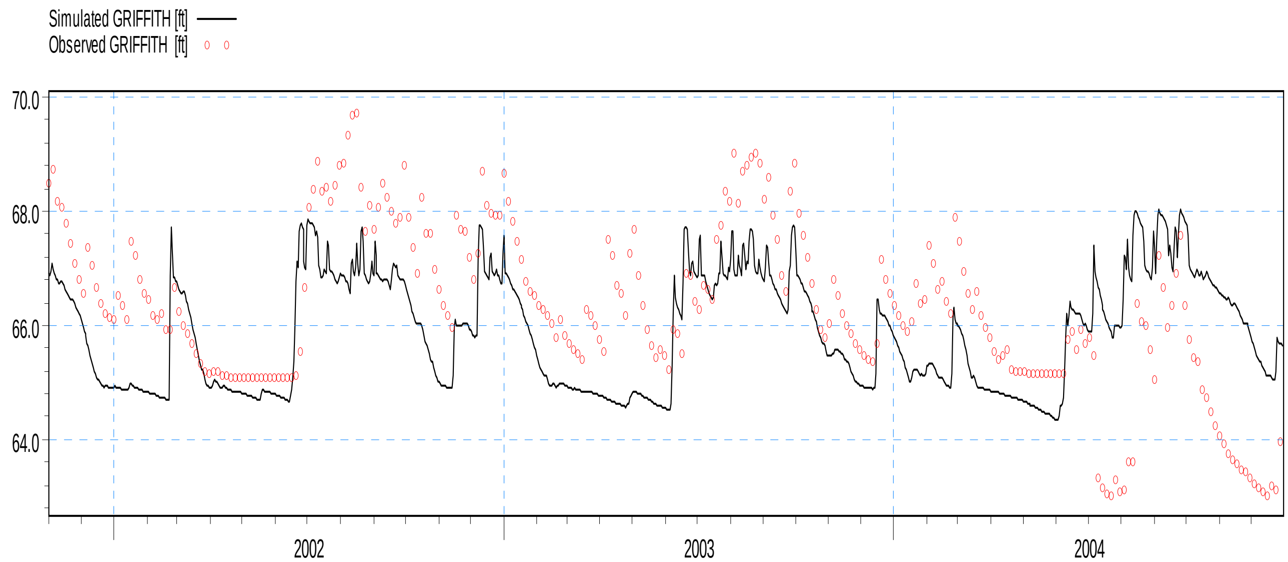

Plot number 24 [Input Item No. 24]

MAXCEY-S Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\MAXCEY-S.dfs0]




Plot number 25 [Input Item No. 25]

GRIFFITH Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SAS\GRIFFITH.dfs0]

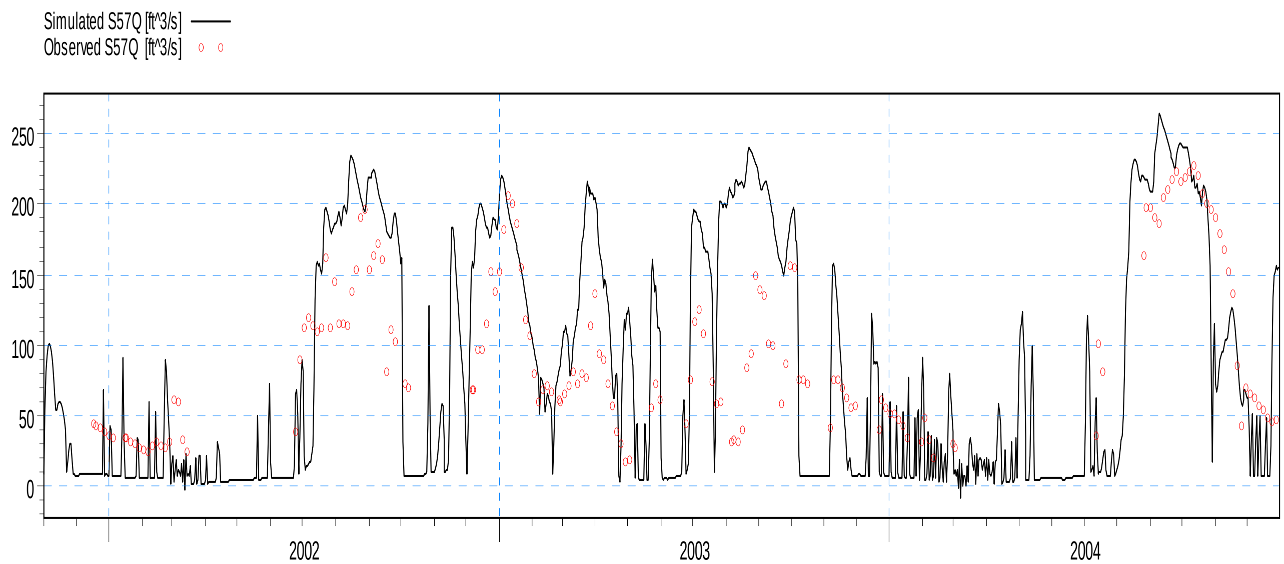

Simulated GRIFFITH [ft]
Observed GRIFFITH [ft]
70.0
68.0
66.0
64.0
2002
2003
2004

HTML output from MSHECalPlot

12/19/2007 2:02:34 PM

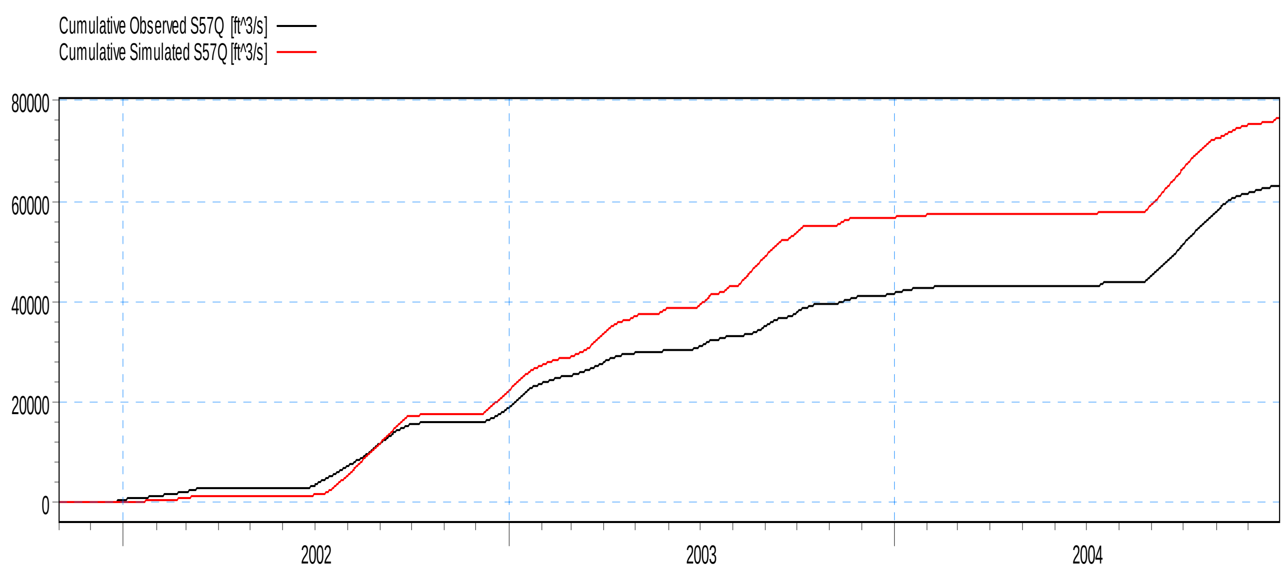
Plot number 1 [Input Item No. 1]

S57Q Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-57Discharge.dfs0]



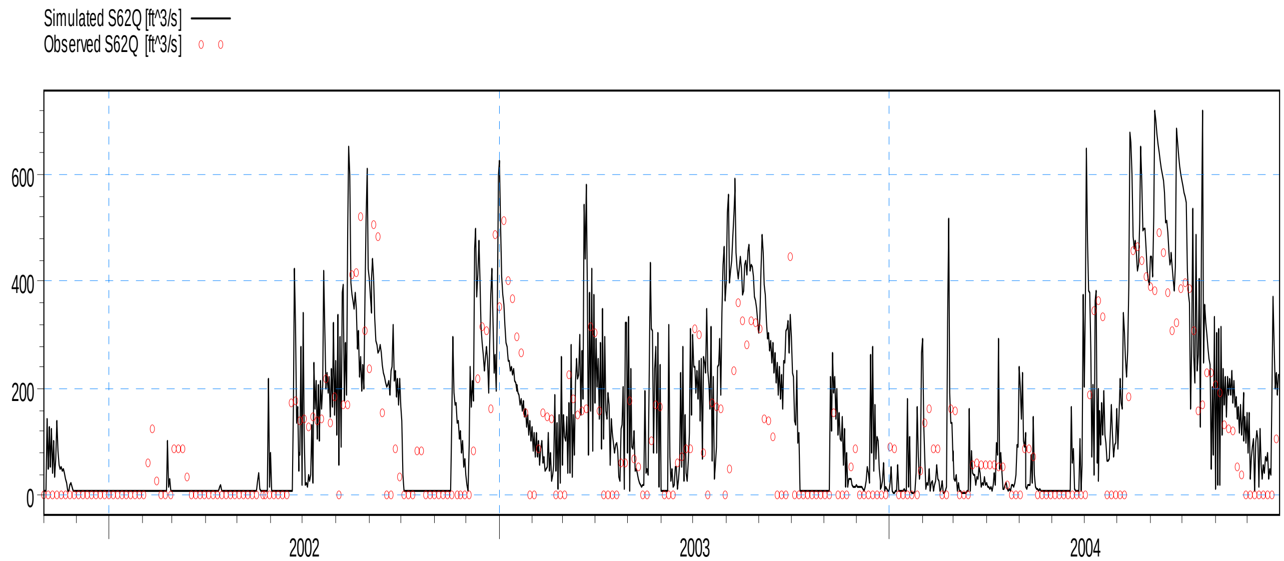

Plot number 2 [Input Item No. 1]

S57Q Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-57Discharge.dfs0]



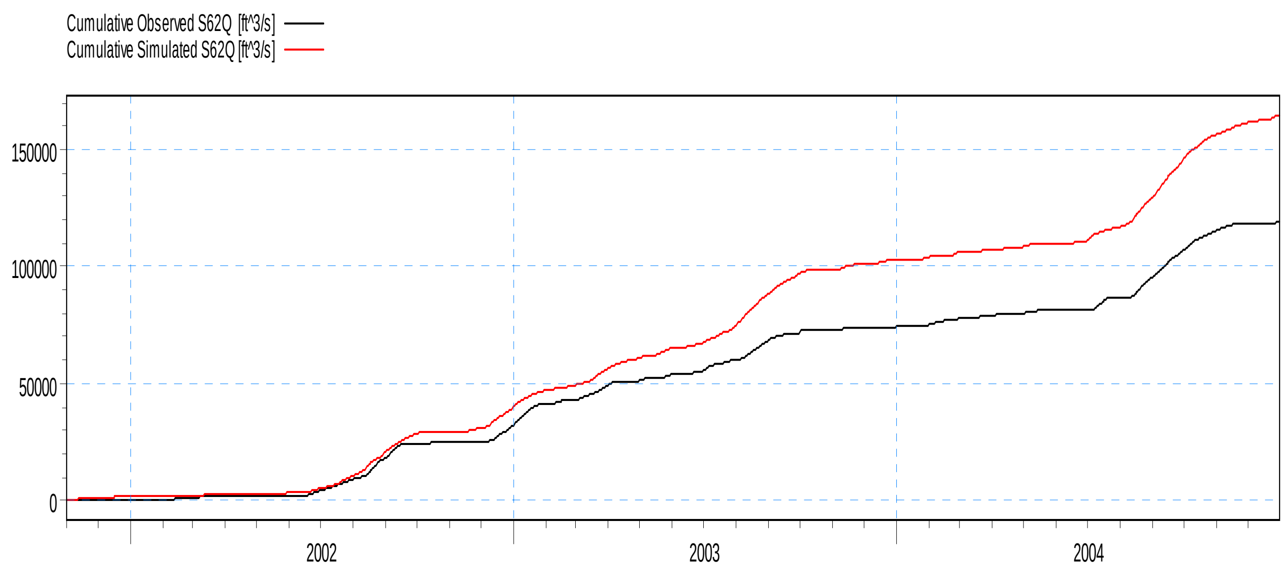
Plot number 3 [Input Item No. 2]

S62Q Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-52 Discharge.dfs0]




Plot number 4 [Input Item No. 2]

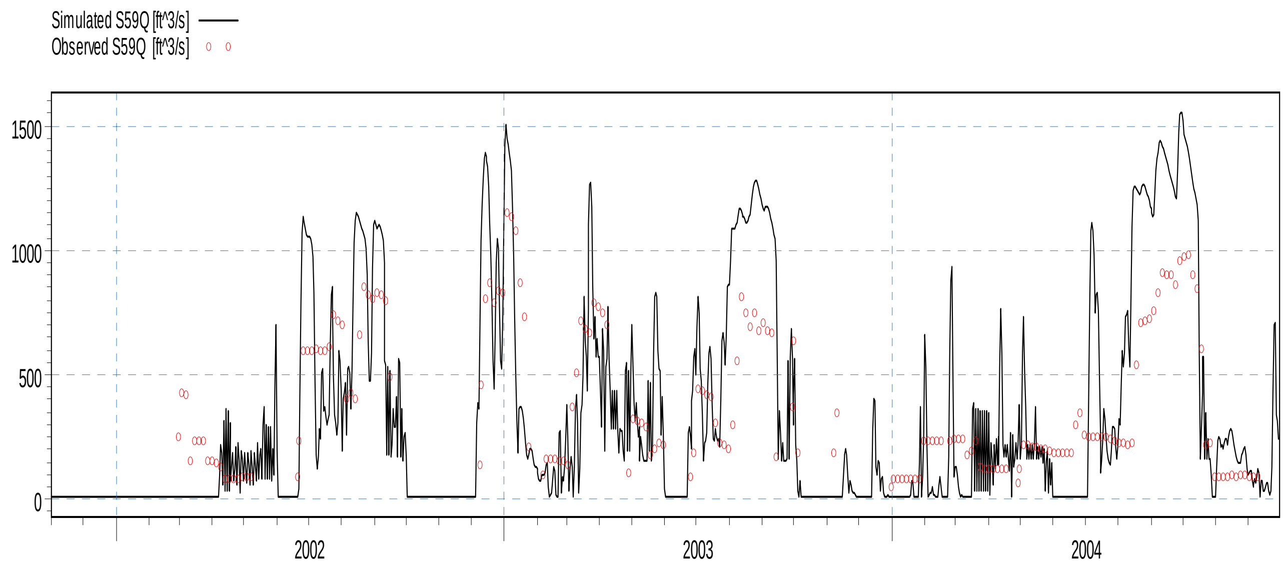
S62Q Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-52 Discharge.dfs0]




Plot number 5 [Input Item No. 3]

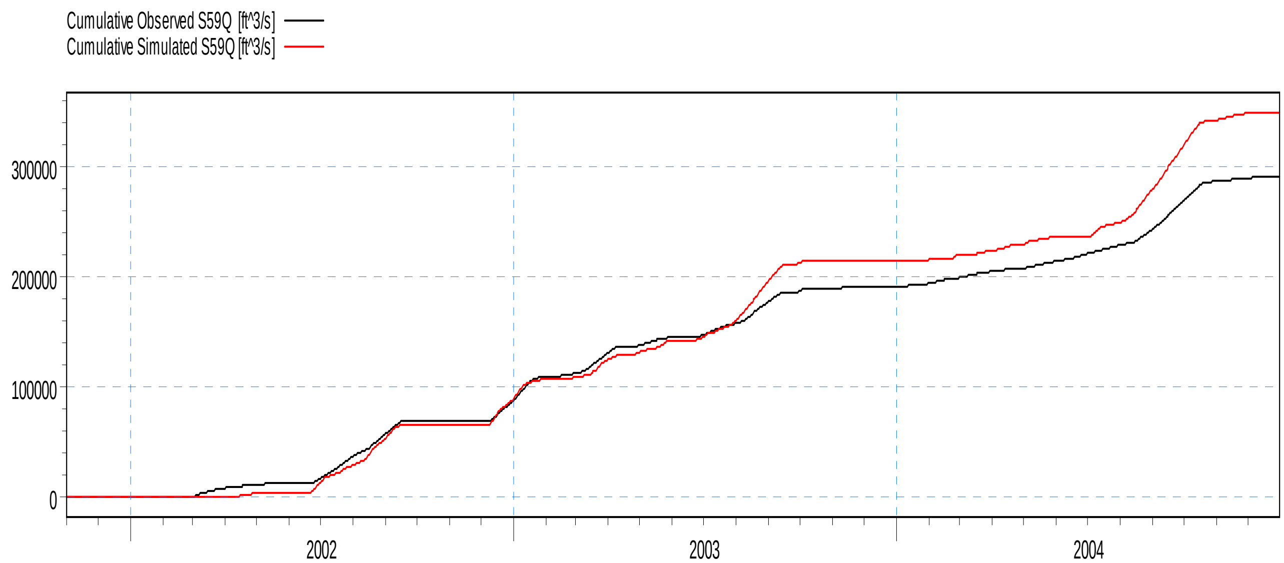
S59Q Simulated and Observed Data [File: C:\DHIModels\4021.477

KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-59 Discharge.dfs0]



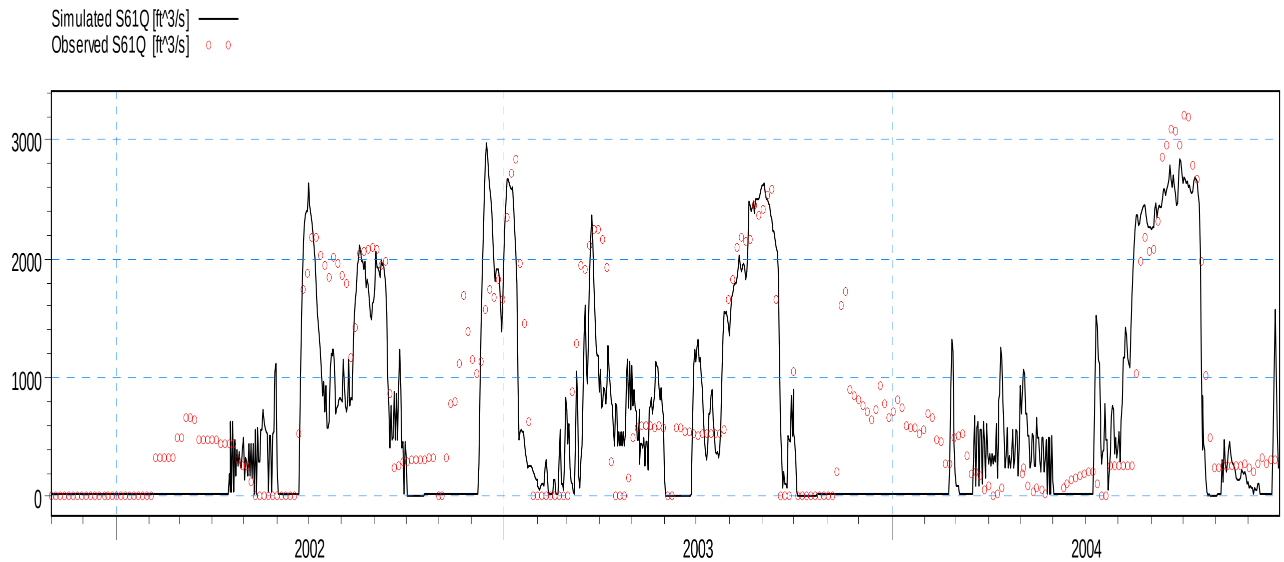

Plot number 6 [Input Item No. 3]

S59Q Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-59 Discharge.dfs0]



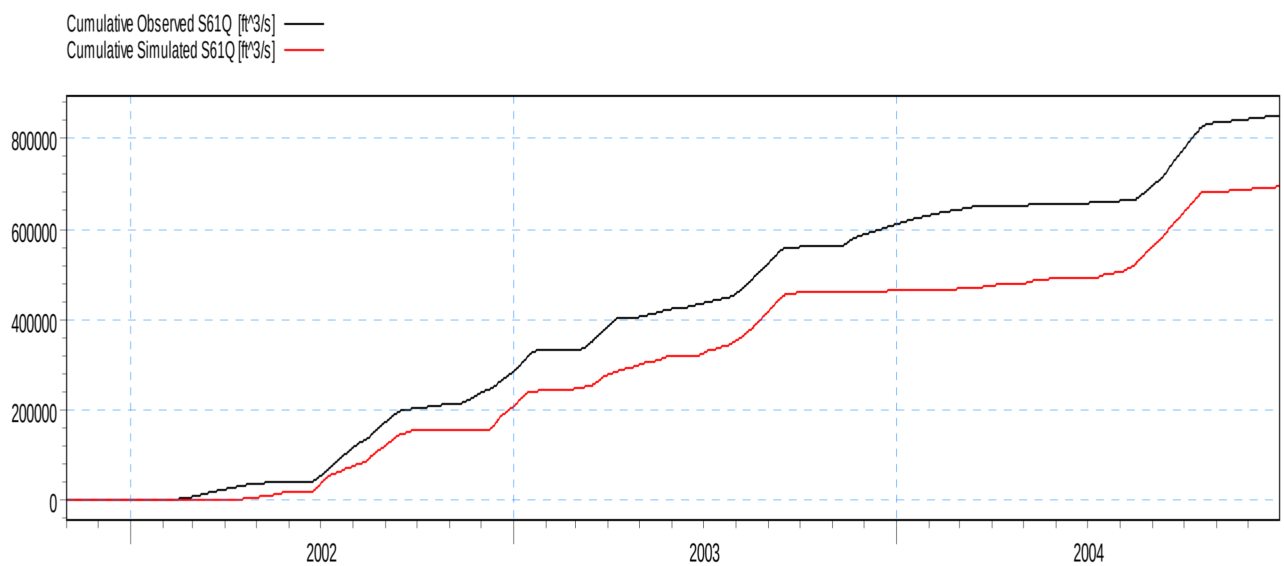

Plot number 7 [Input Item No. 4]

S61Q Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-61 Discharge.dfs0]



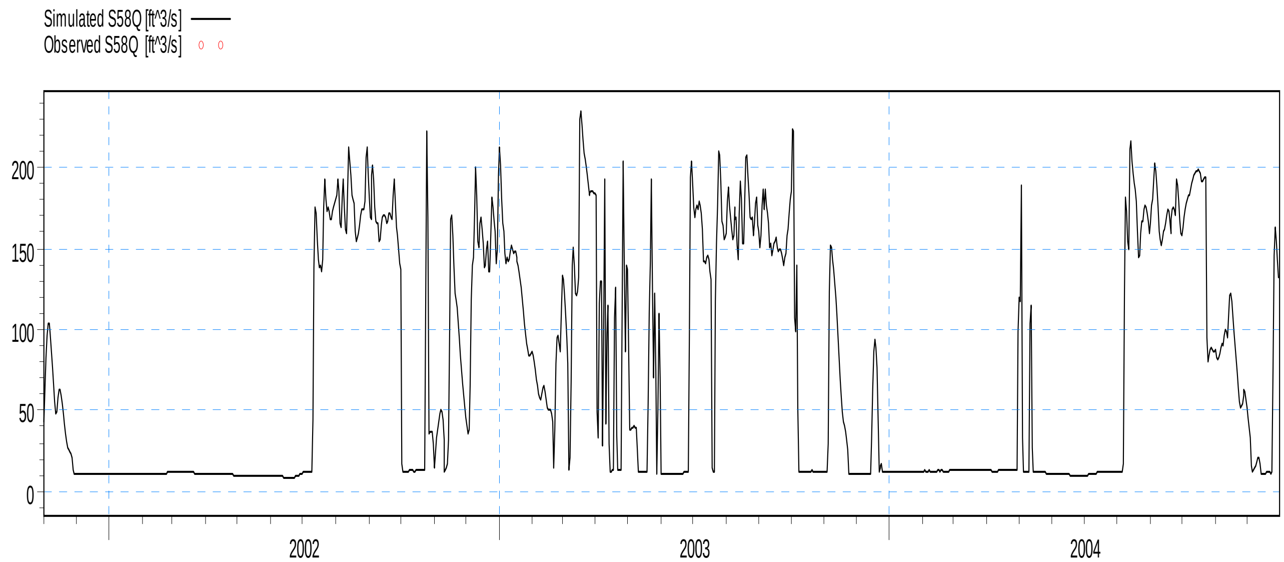

Plot number 8 [Input Item No. 4]

S61Q Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-61 Discharge.dfs0]



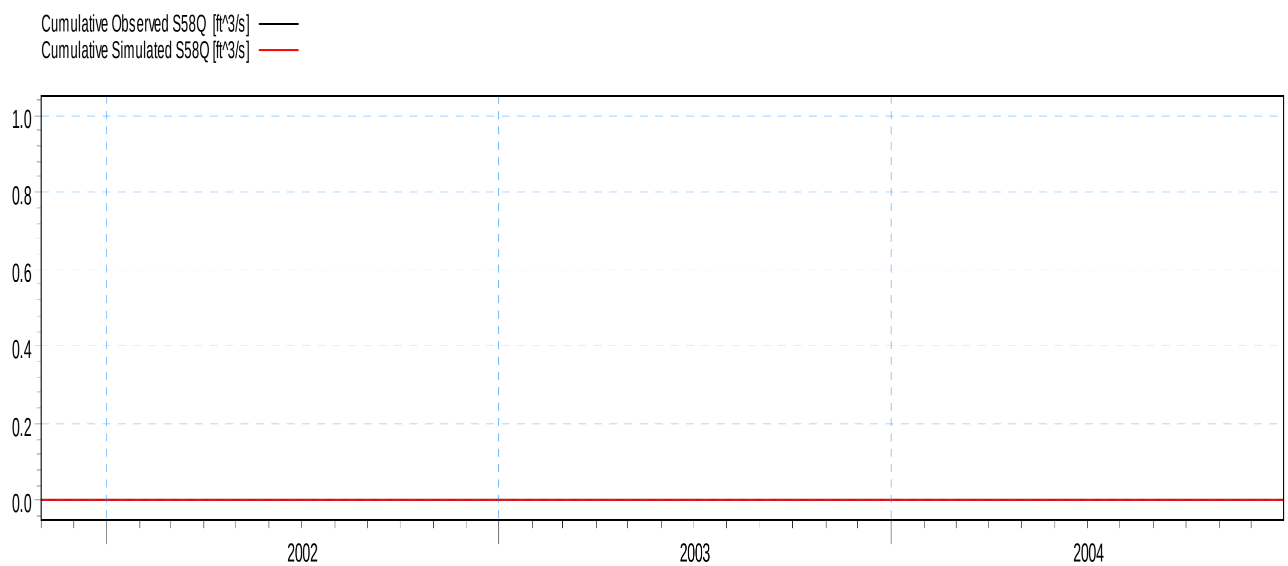

Plot number 9 [Input Item No. 5]

S58Q Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-58Discharge.dfs0]



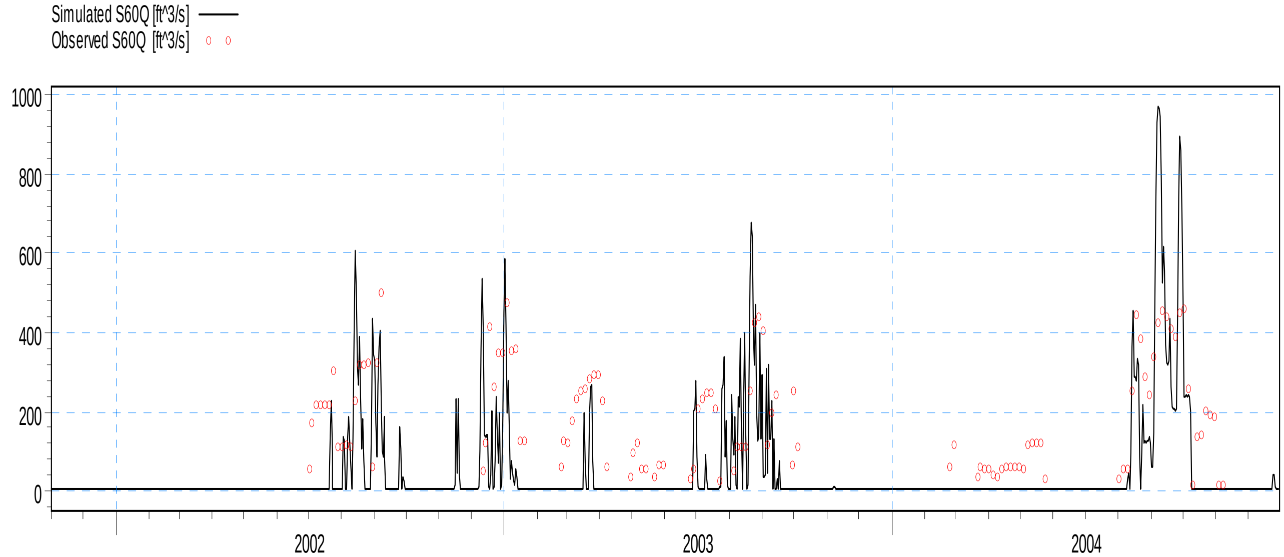

Plot number 10 [Input Item No. 5]

S58Q Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-58Discharge.dfs0]



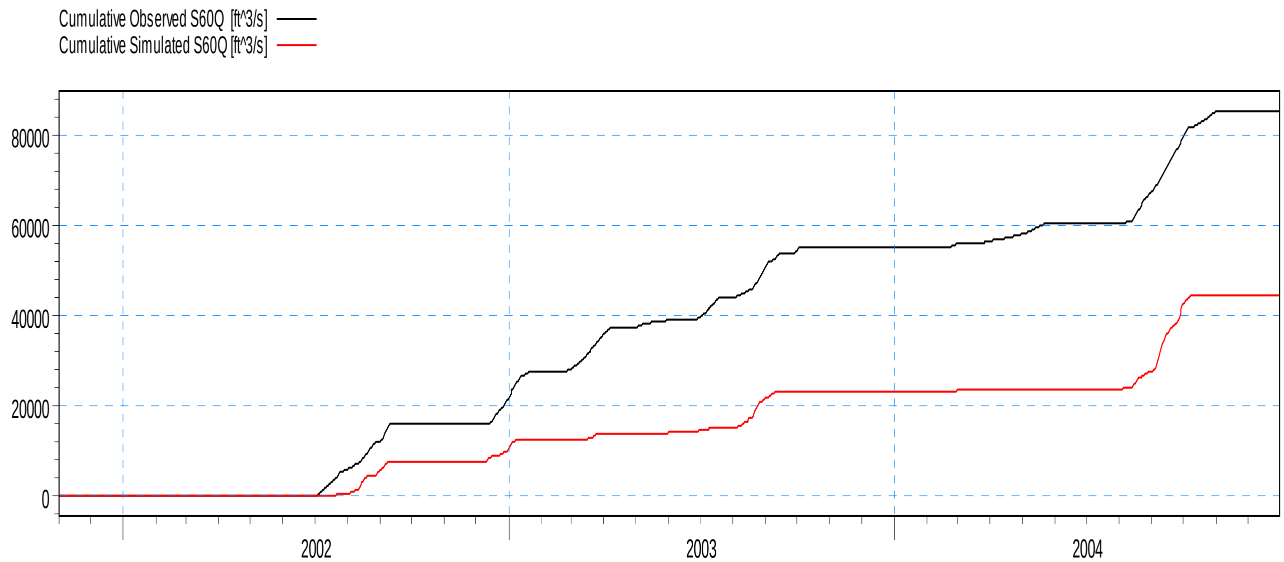

Plot number 11 [Input Item No. 6]

S60Q Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-60 Discharge.dfs0]



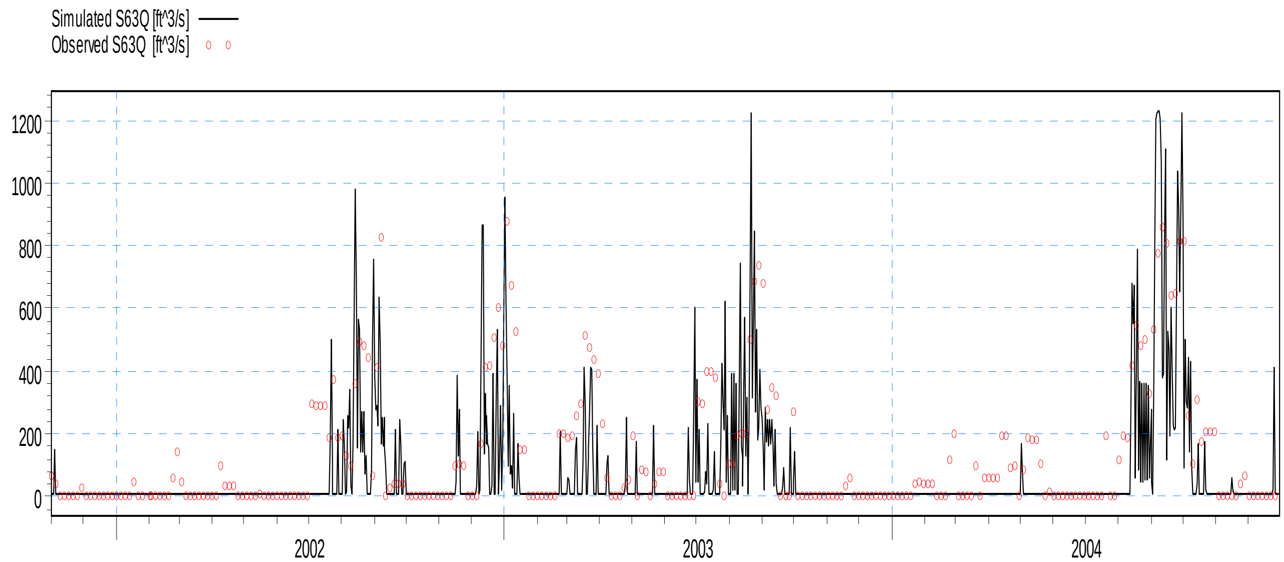

Plot number 12 [Input Item No. 6]

S60Q Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-60 Discharge.dfs0]



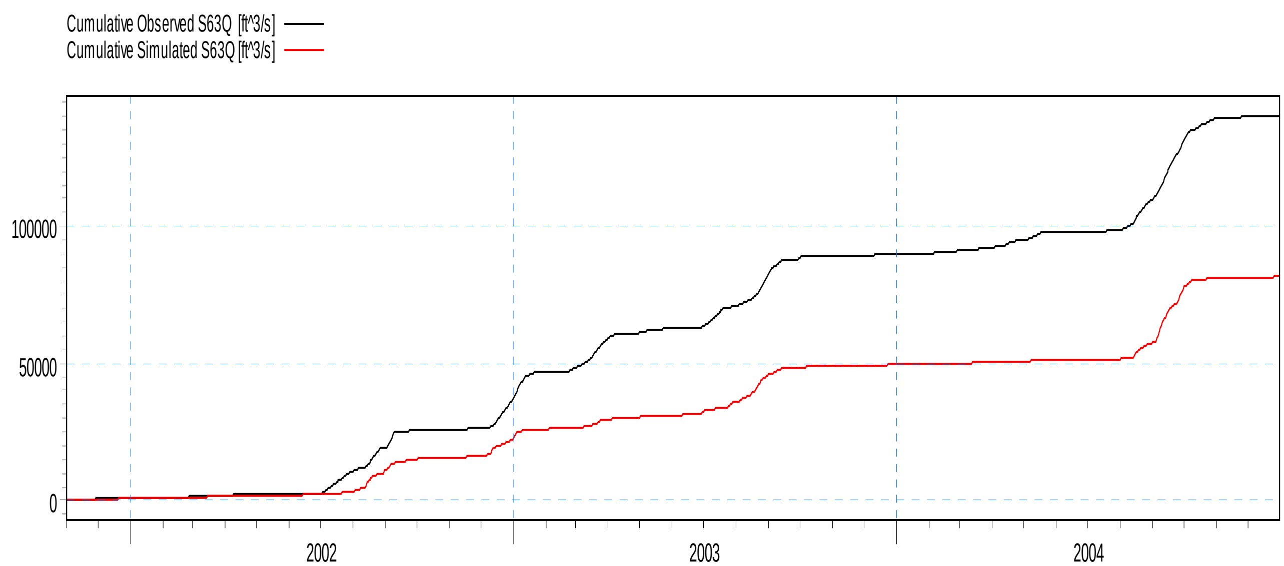

Plot number 13 [Input Item No. 7]

S63Q Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-63 Discharge.dfs0]



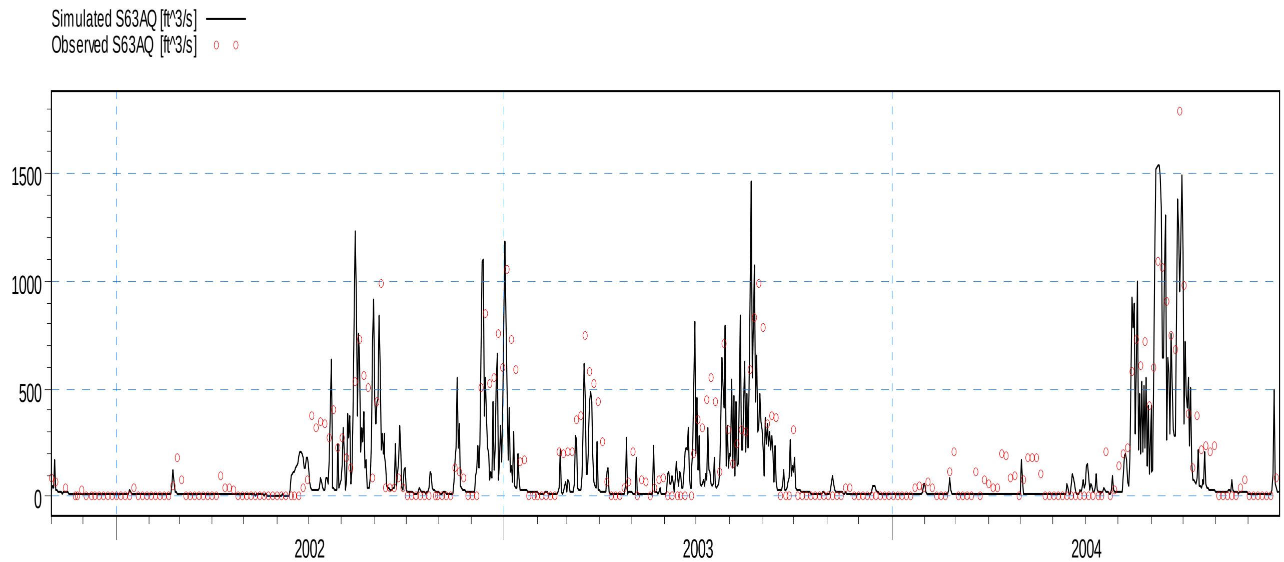

Plot number 14 [Input Item No. 7]

S63Q Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-63 Discharge.dfs0]



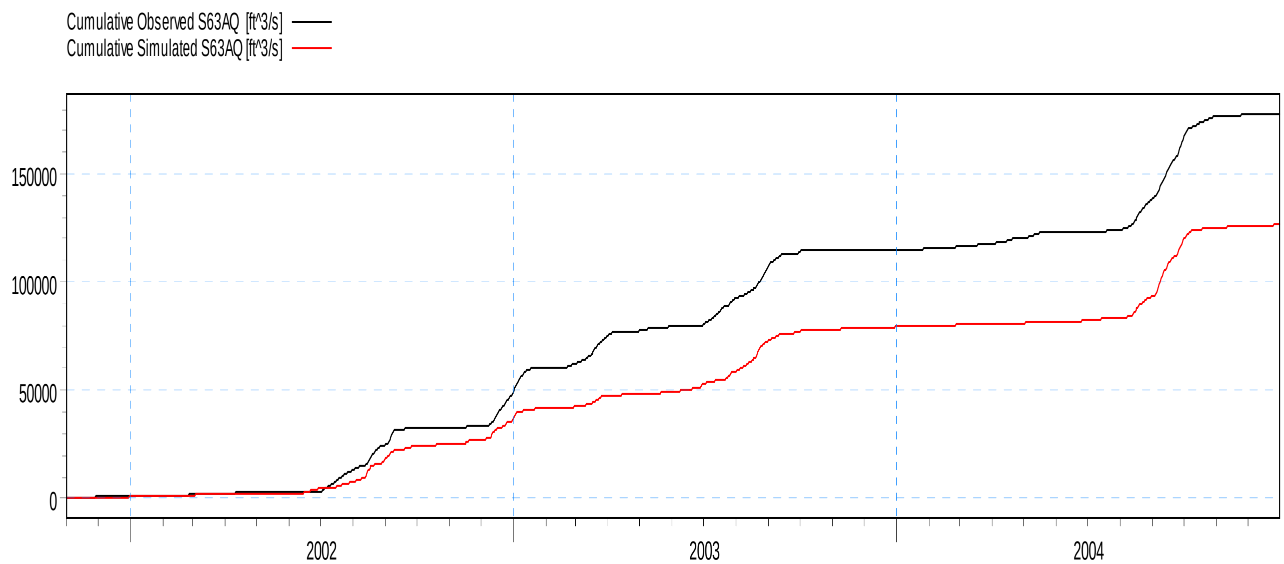

Plot number 15 [Input Item No. 8]

S63AQ Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-63A Discharge.dfs0]



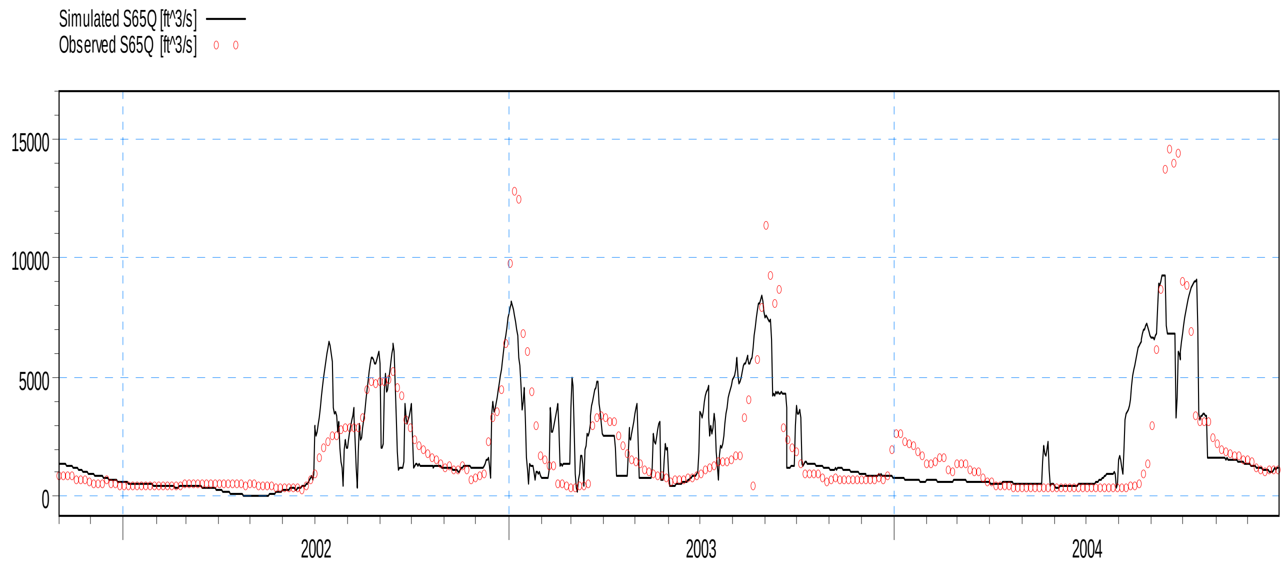

Plot number 16 [Input Item No. 8]

S63AQ Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-63A Discharge.dfs0]



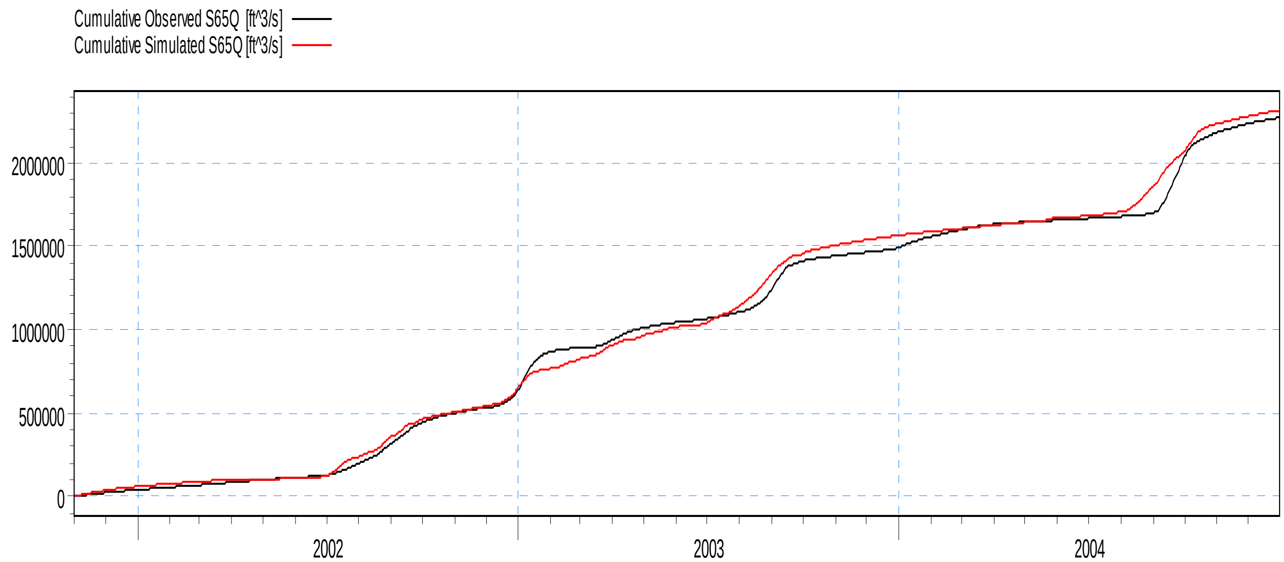

Plot number 17 [Input Item No. 9]

S65Q Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-65 Discharge.dfs0]



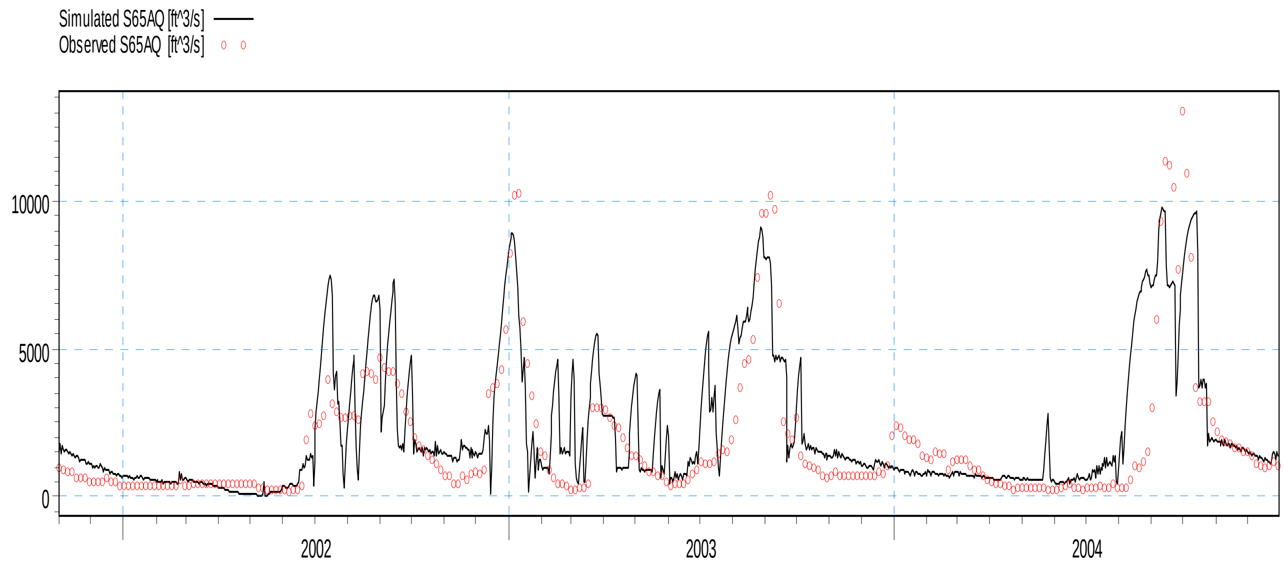

Plot number 18 [Input Item No. 9]

S65Q Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-65 Discharge.dfs0]



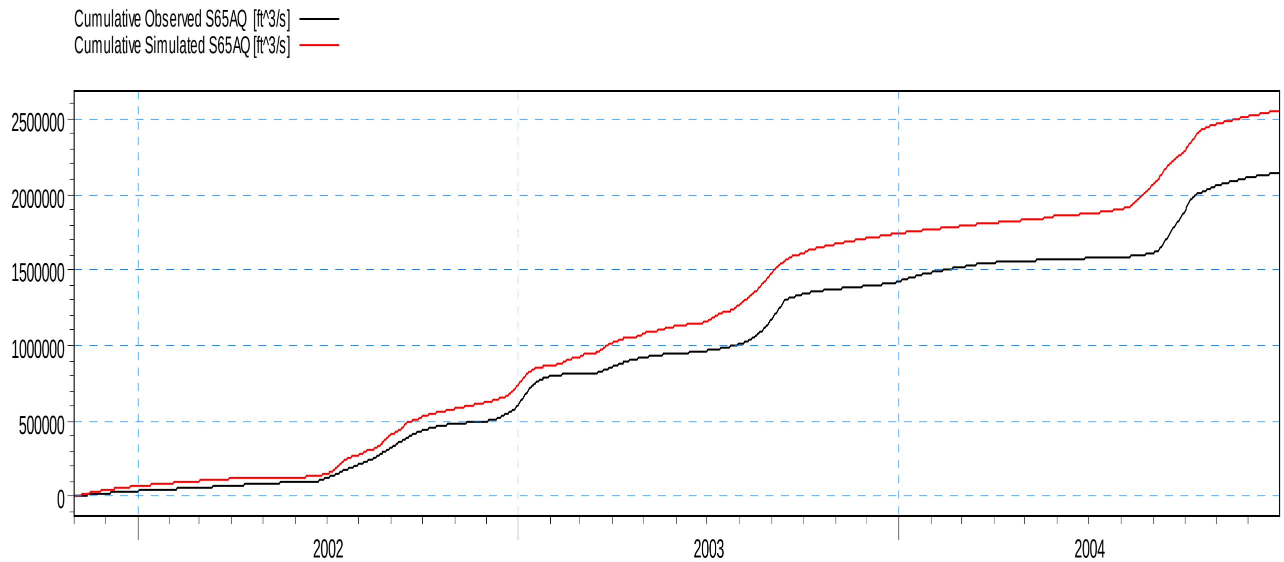

Plot number 19 [Input Item No. 10]

S65AQ Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-65A Discharge.dfs0]



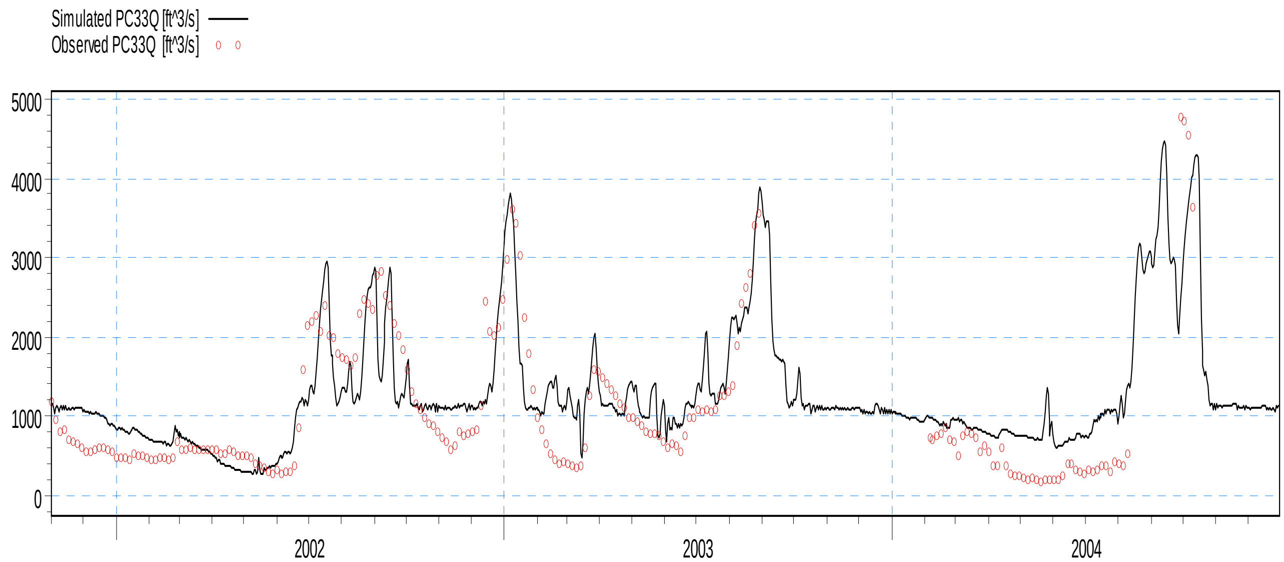

Plot number 20 [Input Item No. 10]

S65AQ Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-65A Discharge.dfs0]



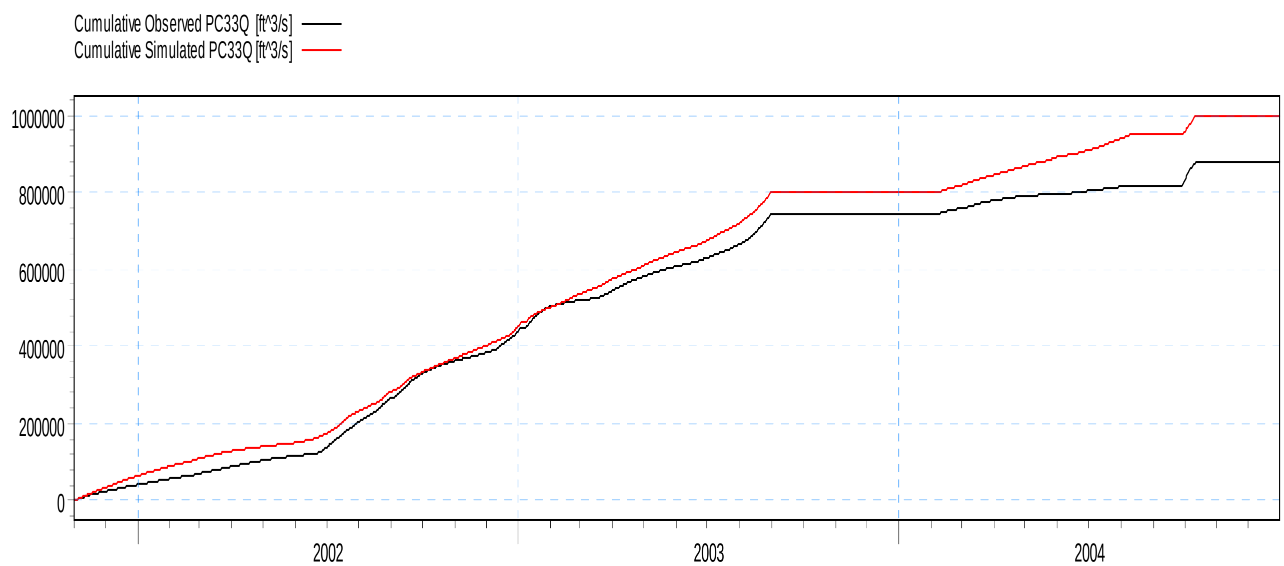

Plot number 21 [Input Item No. 11]

PC33Q Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\PC33 Discharge.dfs0]



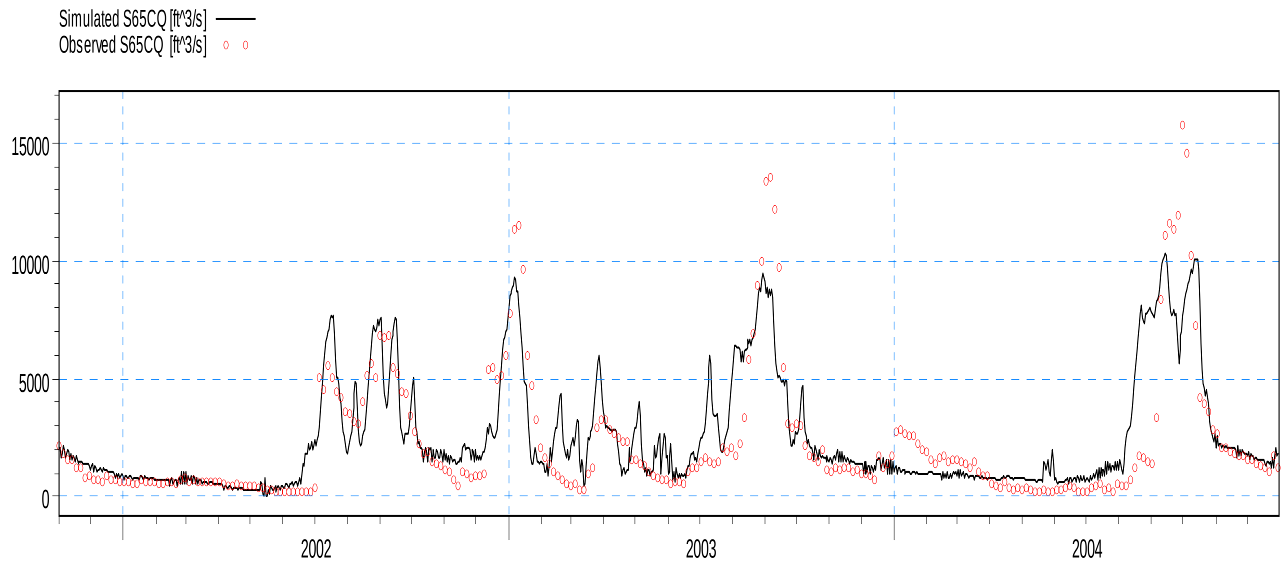

Plot number 22 [Input Item No. 11]

PC33Q Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\PC33 Discharge.dfs0]



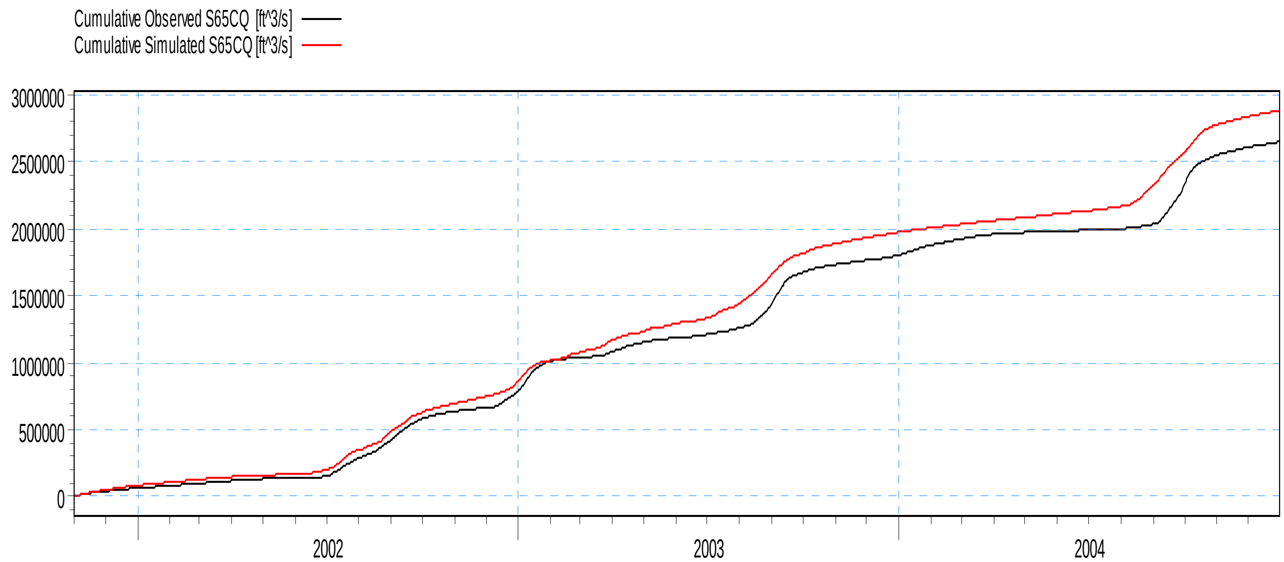

Plot number 23 [Input Item No. 12]

S65CQ Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-65C Discharge.dfs0]



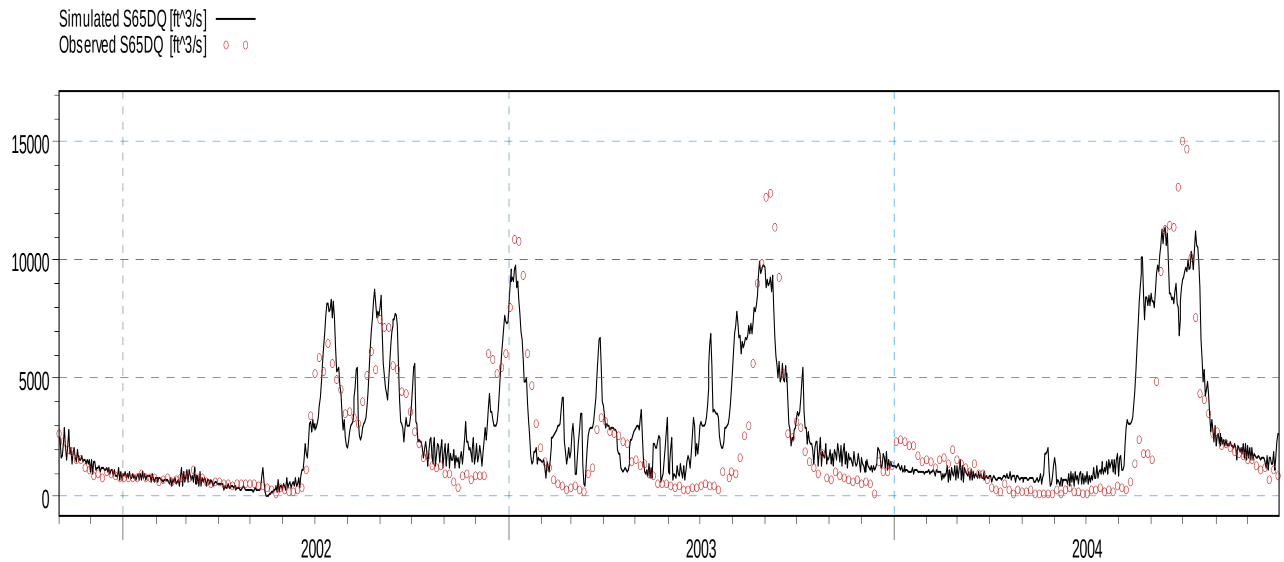

Plot number 24 [Input Item No. 12]

S65CQ Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-65C Discharge.dfs0]



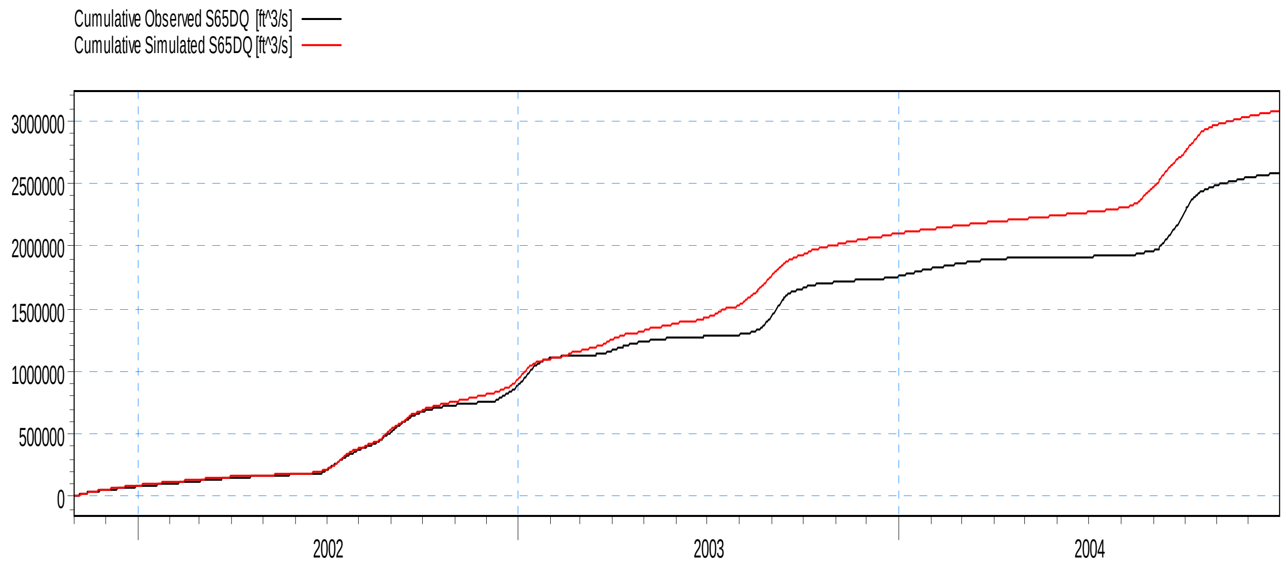

Plot number 25 [Input Item No. 13]

S65DQ Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-65D Discharge.dfs0]



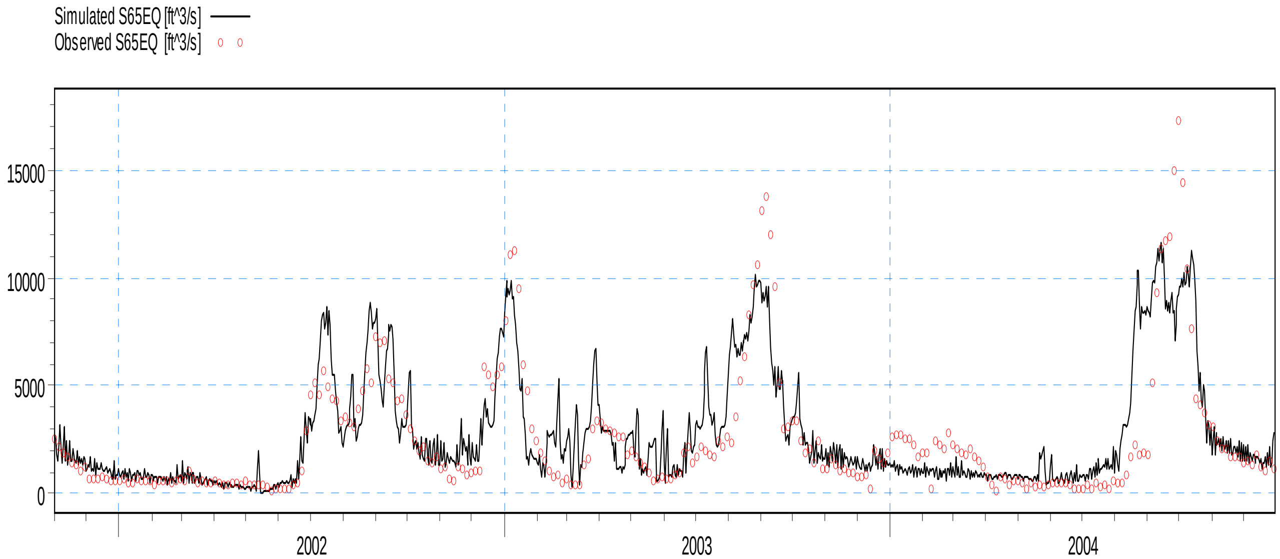

Plot number 26 [Input Item No. 13]

S65DQ Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-65D Discharge.dfs0]



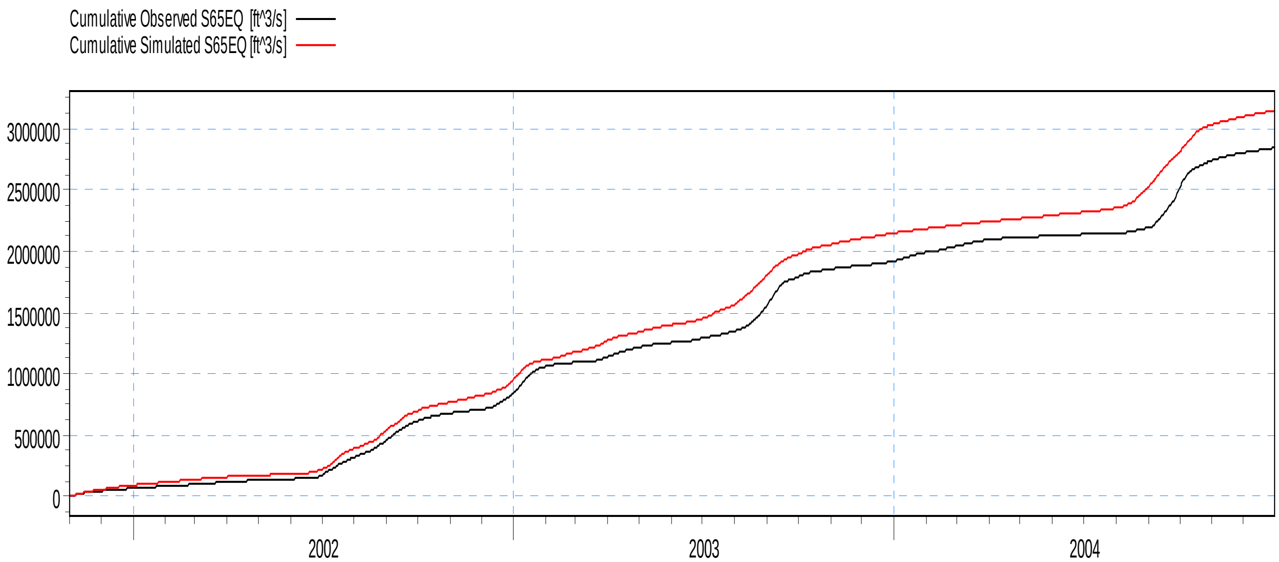

Plot number 27 [Input Item No. 14]

S65EQ Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-65E Discharge.dfs0]



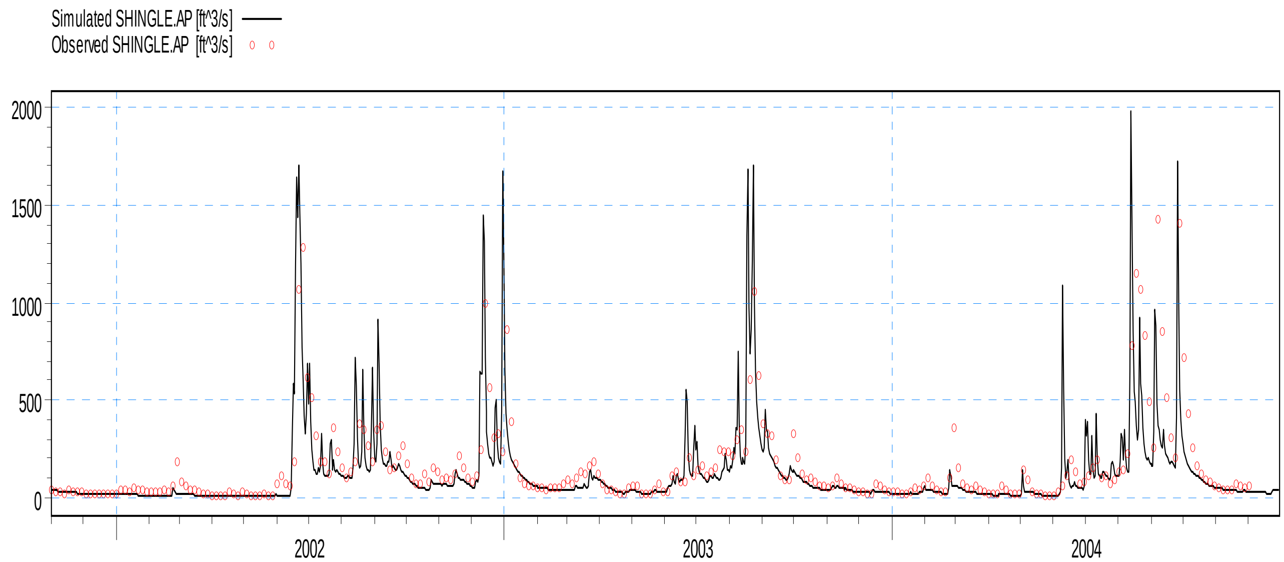

Plot number 28 [Input Item No. 14]

S65EQ Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\S-65E Discharge.dfs0]



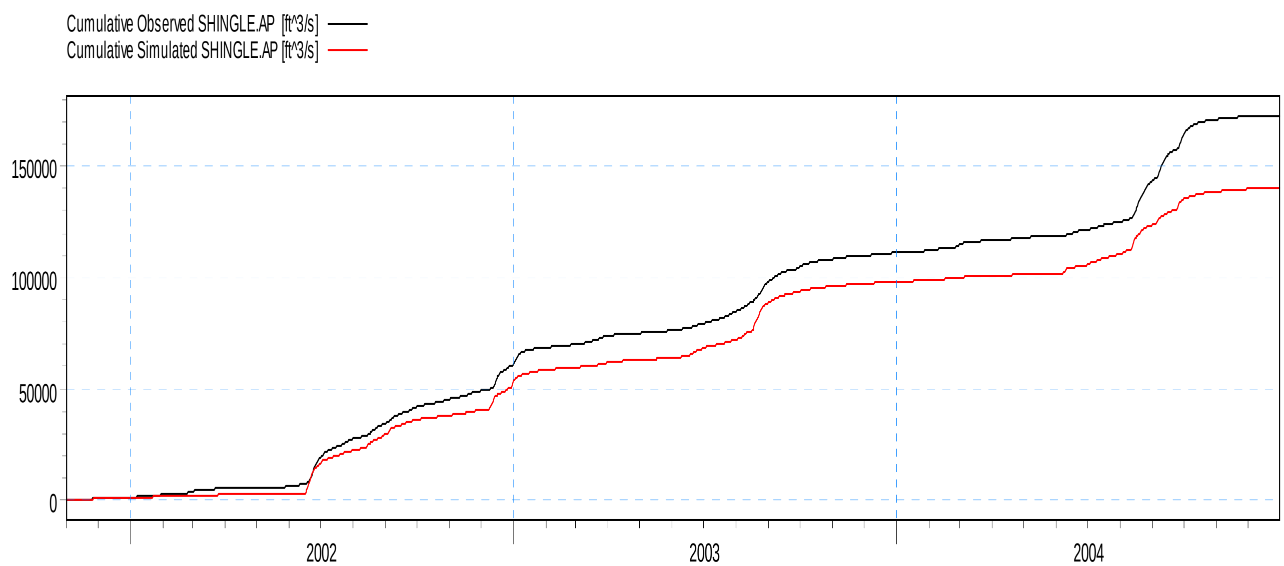

Plot number 29 [Input Item No. 15]

SHINGLE.AP Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SHINGLE.AP_Flow.dfs0]



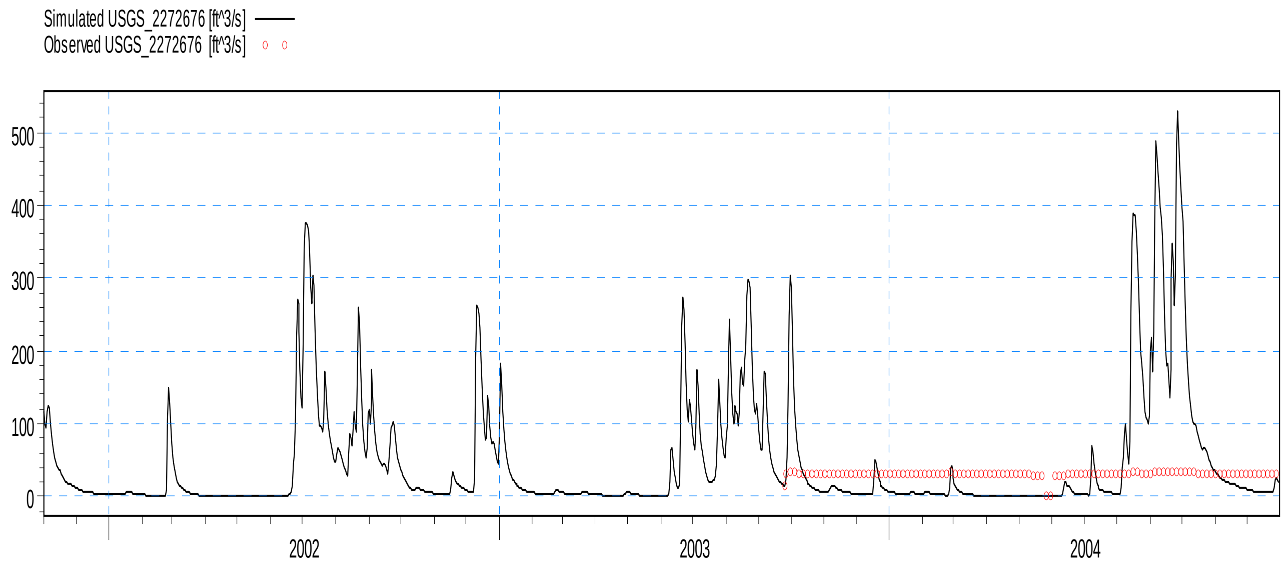

Plot number 30 [Input Item No. 15]

SHINGLE.AP Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\SHINGLE.AP_Flow.dfs0]



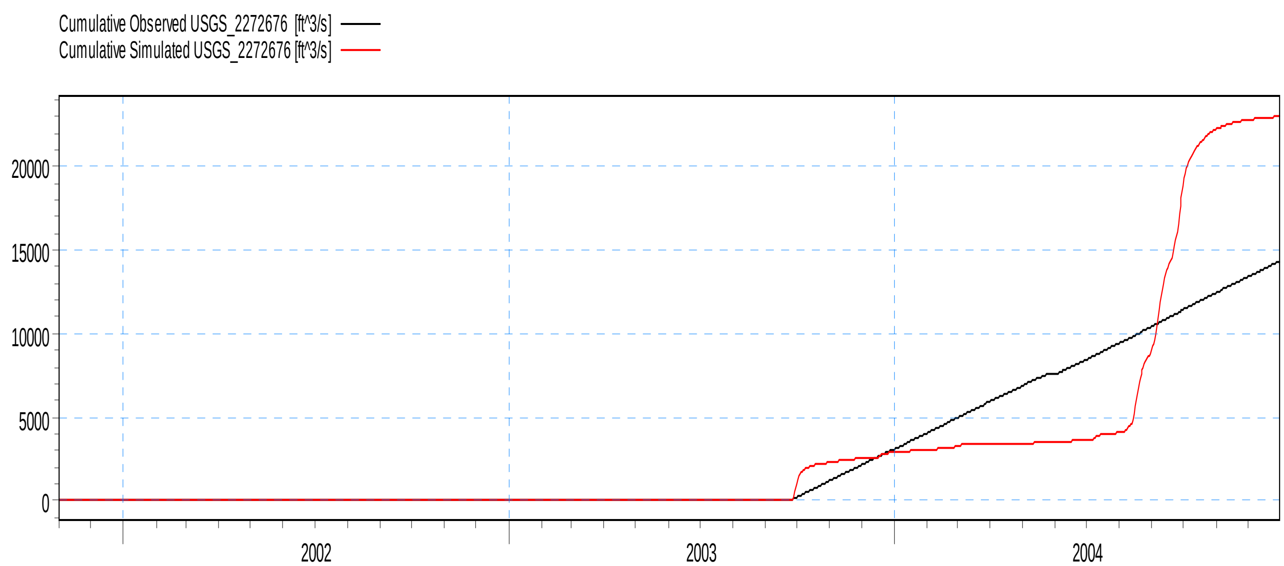

Plot number 31 [Input Item No. 16]

USGS_2272676 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\USGS_2272676_Flow.dfs0]




Plot number 32 [Input Item No. 16]

USGS_2272676 Cumulative Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\USGS_2272676_Flow.dfs0]

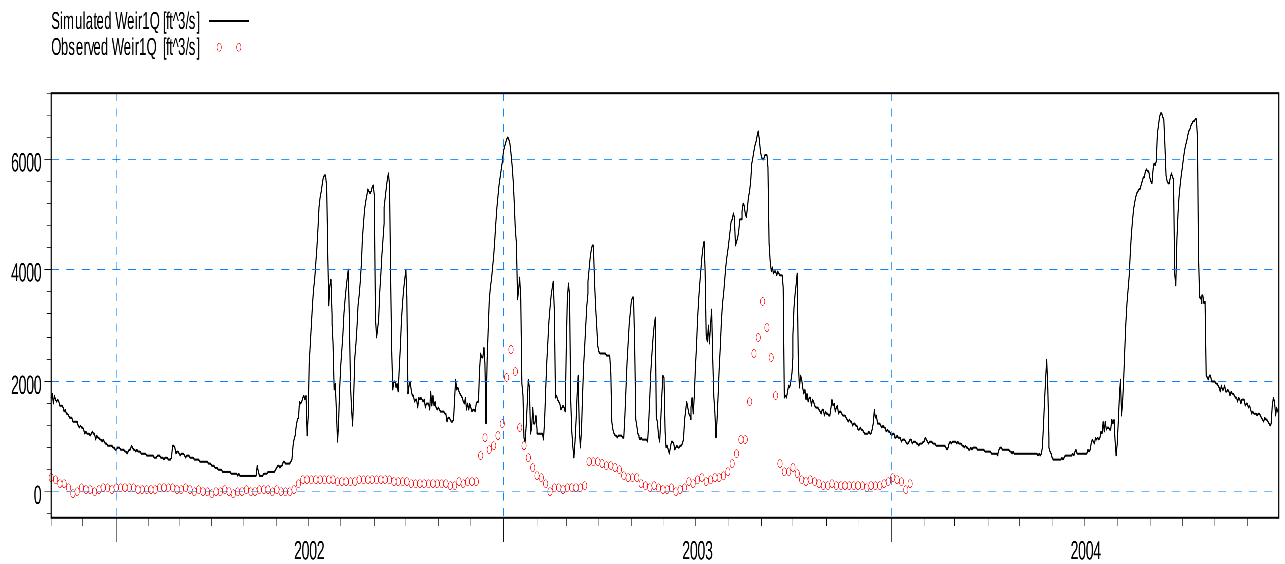


HTML output from MSHECalPlot

12/19/2007 2:02:55 PM

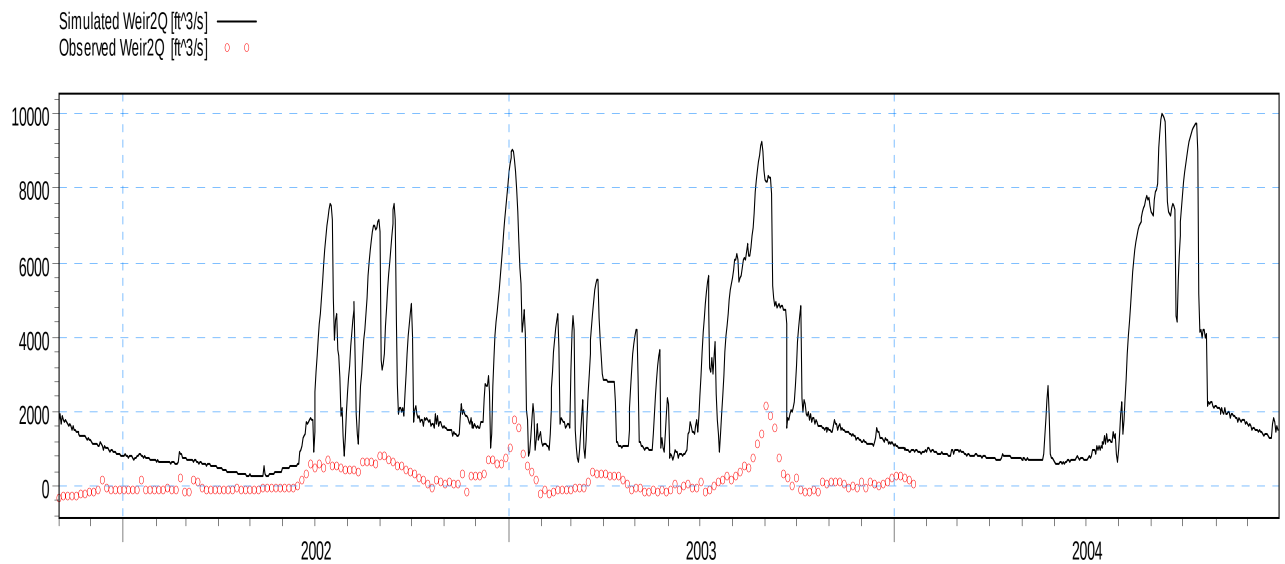
Plot number 1 [Input Item No. 1]

Weir1Q Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\Weir1 Discharge.dfs0]



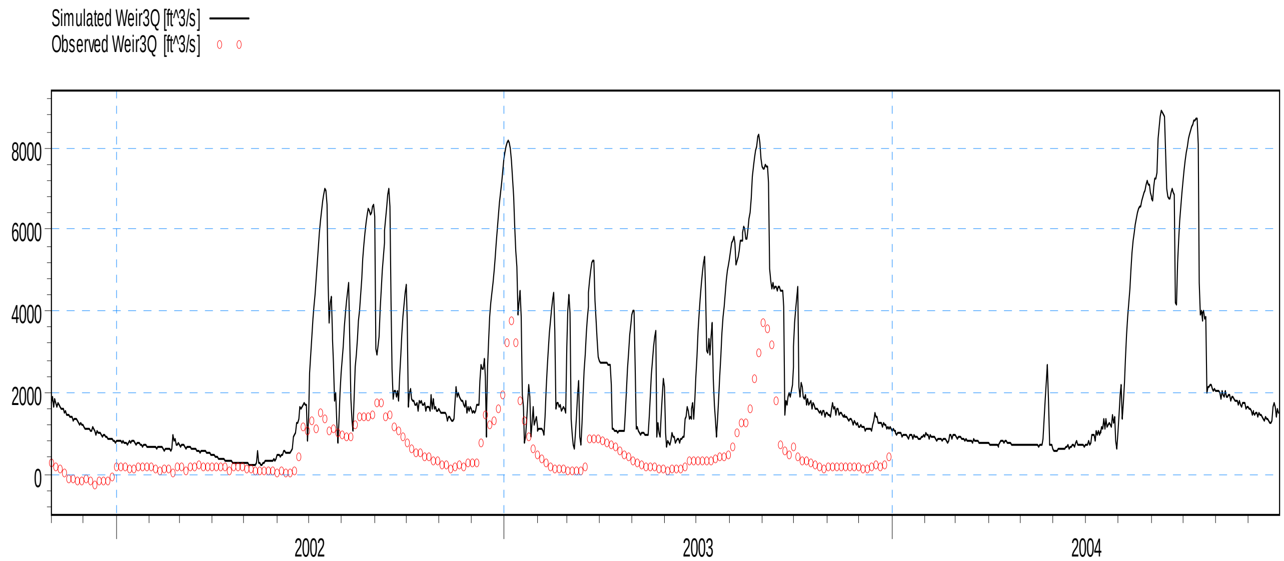

Plot number 2 [Input Item No. 2]

Weir2Q Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\Weir2 Discharge.dfs0]



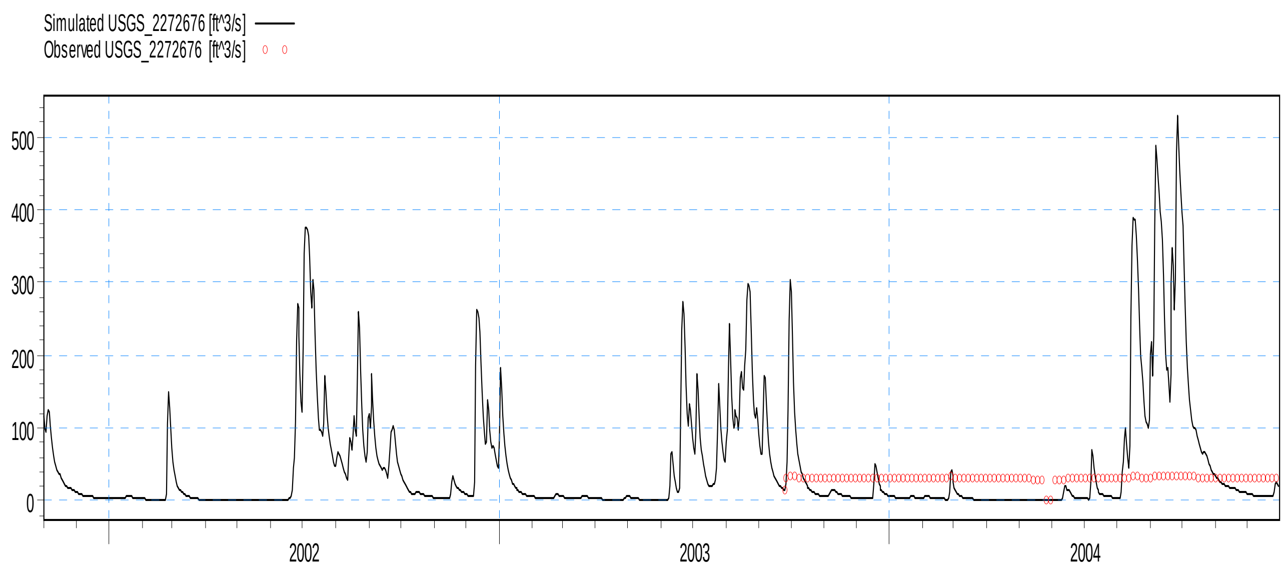
Plot number 3 [Input Item No. 3]

Weir3Q Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\Weir3 Discharge.dfs0]




Plot number 4 [Input Item No. 4]

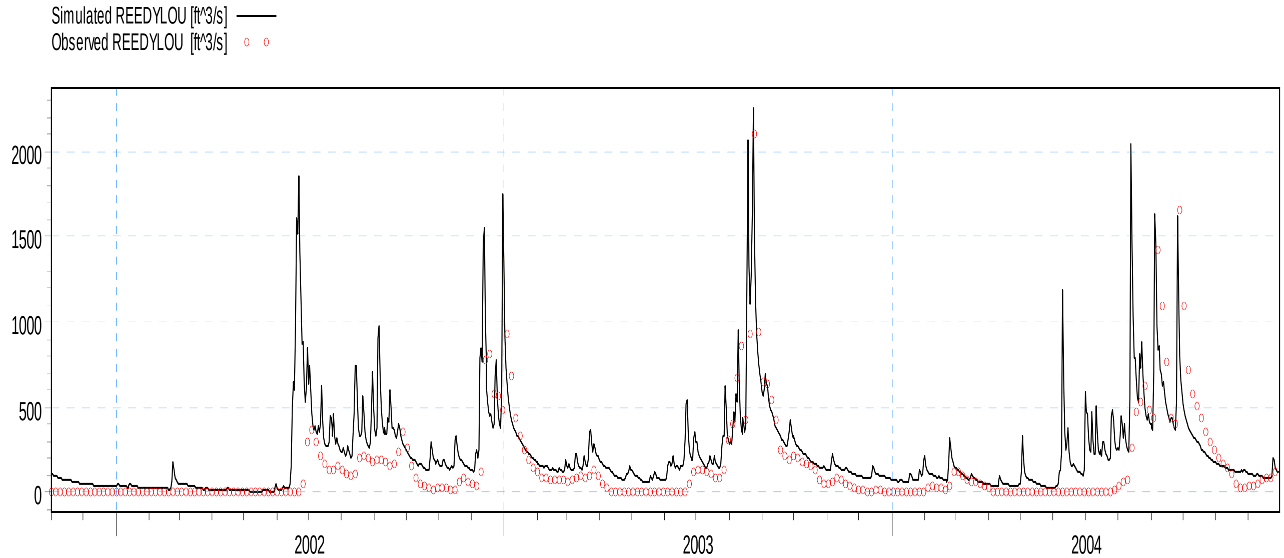
USGS_2272676 Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\USGS_2272676Discharge.dfs0]




Plot number 5 [Input Item No. 5]

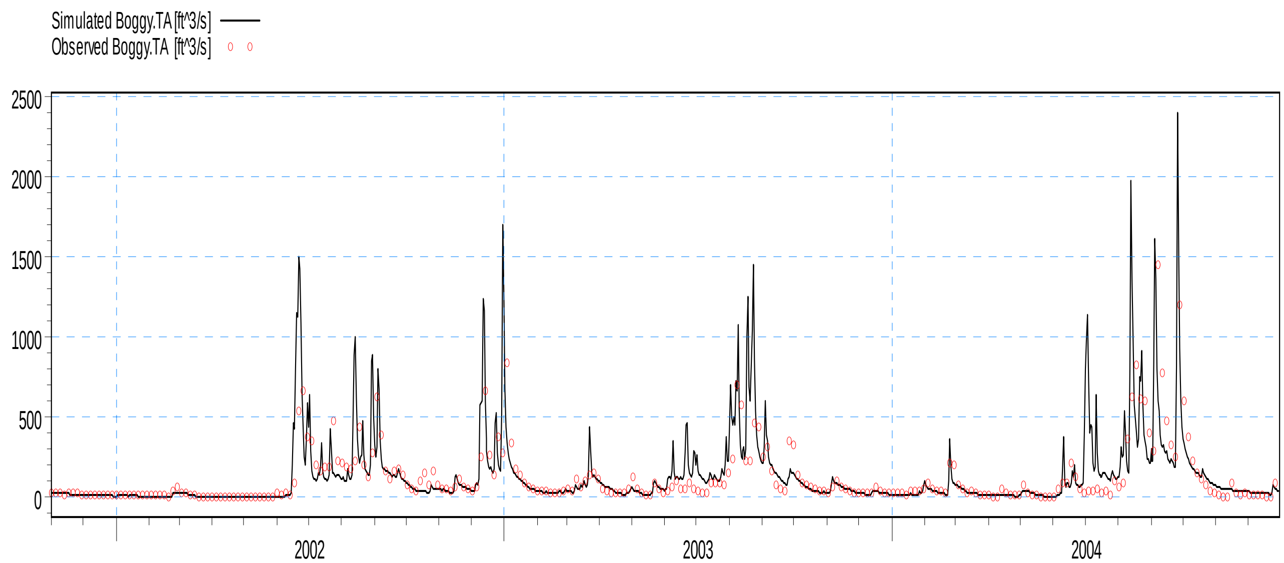
REEDYLOU Simulated and Observed Data [File: C:\DHIModels\4021.477

KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\REEDYLOUDischarge.dfs0]



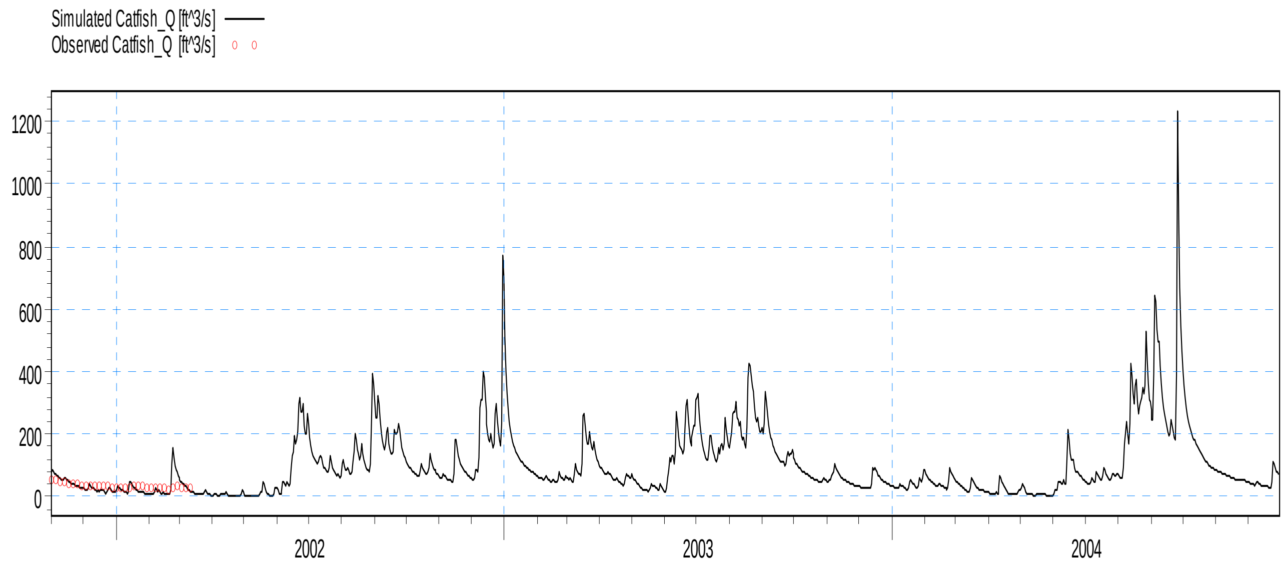

Plot number 6 [Input Item No. 6]

Boggy.TA Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\Boggy.TADischarge.dfs0]




Plot number 7 [Input Item No. 7]

Catfish_Q Simulated and Observed Data [File: C:\DHIModels\4021.477 KBMOS\Results\KBMOS_PH1_1K_99_ECOp\Report\CatfishDischarge.dfs0]



Simulated Catfish_Q [ft^3/s]
Observed Catfish_Q [ft^3/s]
1200
1000
800
600
400
200
0
2002
2003
2004

## Surface Water Flow Network: Flow Statistics

| | CE | R | |
|---|---|---|---|
| | 32.0 | 0.60 | M |
| | 22.0 | 0.84 | H |

| links | | | | | | | Run 99 | | Run 100 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| upstream WCI | downstream W | Station | CE | R(correlation) | CE Target (ft) | R Target | CE % | R(correlation) | Cum Obs (cfs) | Cum Sim (cfs) | CE % | R Simulated Criteria |
| **Flows in Upper Basin Lake Management Units** | | | | | | | | | | | | |
| LMU Myrtle | LMU Hart | S57Q | M | M | 32.0 | 0.60 | 68 | 0.26 | 63210 | 76698 | 21% | 0.69 |
| LMU Hart | LMU Etoho | S62Q | M | M | 32.0 | 0.60 | 20 | 0.78 | 118966 | 164788 | 39% | 0.69 |
| LMU Etoho | LMU Toho | S59Q | M | M | 32.0 | 0.60 | 2 | 0.73 | 291329 | 350177 | 20% | 0.76 |
| LMU Toho | LMU KHC | S61Q | H | H | 22.0 | 0.84 | 25 | 0.88 | 851198 | 693875 | -18% | 0.81 |
| LMU Alligator | LMU Myrtle | S58Q | M | M | 32.0 | 0.60 | NC | NC | NA | NA | | |
| LMU Alligator | LMU Gentry | S60Q | M | M | 32.0 | 0.60 | 11 | 0.81 | 85637 | 44637 | -48% | 0.54 |
| LMU Gentry | LMU s63a | S63Q | M | H | 22.0 | 0.84 | 6 | 0.86 | 140504 | 81957 | -42% | 0.64 |
| LMU s63a | LMU KHC | S63AQ | M | M | 32.0 | 0.60 | 8 | 0.86 | 178046 | 126921 | -29% | 0.75 |
| LMU KHC | PoolA | S65Q | H | H | 22.0 | 0.84 | 2 | 0.84 | 2271720 | 2314960 | 2% | 0.72 |
| **Flows in Upper Basin's unmanaged watersheds** | | | | | | | | | | | | |
| ws_boggy | LMU EToho | boggy_ta | M | M | 32.0 | 0.60 | 11 | 0.63 | 143268 | 158657 | 11% | 0.63 |
| ws_lake pierce | WS_catfish creek | catfish Q | M | M | 32.0 | 0.60 | 3 | 0.48 | 4539 | 4393 | -3% | 0.49 |
| ws_upperreedy | ws_lowerreedy | reedy | M | M | 32.0 | 0.60 | 60 | 0.65 | 166152 | 265048 | 60% | 0.65 |
| ws_shingle | LMU Toho | shingle | M | M | 32.0 | 0.60 | 19 | 0.63 | 172896 | 139985 | -19% | 0.63 |
| **Flows in Lower Basin Lake Management Units** | | | | | | | | | | | | |
| PoolA | PoolBC | S65AQ | M | M | 32.0 | 0.60 | 20 | 0.89 | 2142570 | 2556040 | 19% | 0.77 |
| PoolBC | PoolD | S65CQ | H | H | 22.0 | 0.84 | 9 | 0.91 | 2648950 | 2884950 | 9% | 0.80 |
| PoolD | PoolE | S65DQ | H | H | 22.0 | 0.84 | 20 | 0.91 | 2581330 | 3084540 | 19% | 0.80 |
| PoolE | Lake O | S65EQ | H | H | 22.0 | 0.84 | 11 | 0.92 | 2841170 | 3146980 | 11% | 0.81 |
| **Flows in Lower Basin's unmanaged watersheds** | | | | | | | | | | | | |
| PoolD | PoolD | usgs2272676 | L | M | | 0.60 | 62 | 0.27 | 14302 | 23071 | 61% | 0.27 |

- Does not meet ATP criteria
- Low Utility
- Value is (-) negative
- Does meet criteria
- "M" not meeting criteria

**Surface Water Flow Network: Stage Statistics**

| | RMSE | R | |
|---|---|---|---|
| | 3.0 | 0.45 | M |
| | 2.5 | 0.50 | H |

| MODEL AREA | Station | RMSE | R(correlation) | RMSE Target (ft) | R Target | Run 99 RMSE | Run 99 R (correlation) | Run 100 RMSE Simulated Criteria | Run 100 R Simulated Criteria |
|---|---|---|---|---|---|---|---|---|---|
| **Stages in Upper Basin Lake Management Units** | | | | | | | | | |
| LMU K-H-C | S65H | H | H | 2.50 | 0.50 | 0.10 | 1.00 | 1.03 | 0.60 |
| LMU K-H-C | S61T | H | H | 2.50 | 0.50 | 0.72 | 0.97 | 1.25 | 0.82 |
| LMU K-H-C | S63AT | M | M | 3.00 | 0.45 | 0.84 | 0.96 | 1.29 | 0.80 |
| LMU Toho | S61H | H | H | 2.50 | 0.50 | 0.37 | 0.99 | 2.07 | 0.40 |
| LMU Toho | S59T | H | H | 2.50 | 0.50 | 0.83 | 0.91 | 1.23 | 0.65 |
| LMU Etoho | S59H | H | H | 2.50 | 0.50 | 0.29 | 0.96 | 0.52 | 0.85 |
| LMU Etoho | S62T | M | M | 3.00 | 0.45 | 0.19 | 0.98 | 0.50 | 0.85 |
| LMU Hart | S62H | M | M | 3.00 | 0.45 | 0.27 | 0.88 | 0.34 | 0.81 |
| LMU Hart | S57T | M | M | 3.00 | 0.45 | 0.29 | 0.89 | 0.33 | 0.80 |
| LMU Myrtle | S57H | M | M | 3.00 | 0.45 | 0.18 | 0.98 | 0.59 | 0.83 |
| LMU Myrtle | S58T | M | M | 3.00 | 0.45 | 0.18 | 0.99 | 0.60 | 0.83 |
| LMU Alligator | S58H | M | M | 3.00 | 0.45 | 0.36 | 0.91 | 0.50 | 0.83 |
| LMU Alligator | S60H | M | M | 3.00 | 0.45 | 0.38 | 0.89 | 0.58 | 0.80 |
| LMU Gentry | S60T | M | M | 3.00 | 0.45 | 0.27 | 0.92 | 0.38 | 0.83 |
| LMU Gentry | S63H | M | M | 3.00 | 0.45 | 0.22 | 0.94 | 0.38 | 0.82 |
| LMU s63a | S63T | M | M | 3.00 | 0.45 | 0.16 | 0.94 | 0.40 | 0.03 |
| LMU s63a | S63AH | M | M | 3.00 | 0.45 | 0.12 | 0.97 | 0.40 | 0.003 |
| **Stages in Upper Basin's unmanaged watersheds** | | | | | | | | | |
| ws_UpperReedy | REEDYLOU | M | M | 3.00 | 0.45 | 1.80 | 0.76 | 1.80 | 0.76 |
| **Stages in Lower Basin Lake Management Units** | | | | | | | | | |
| Pool A | S65T | H | H | 2.50 | 0.50 | 0.22 | 0.98 | 1.58 | 0.25 |
| Pool A | S65AH | H | H | 2.50 | 0.50 | 0.15 | 0.99 | 1.55 | 0.16 |
| Pool BC | S65AT | H | H | 2.50 | 0.50 | 1.57 | 0.86 | 1.72 | 0.82 |
| Pool BC | PC52 | M | M | 3.00 | 0.45 | 2.88 | 0.80 | 2.86 | 0.80 |
| Pool BC | PC45 | M | M | 3.00 | 0.45 | 3.30 | 0.68 | 3.28 | 0.68 |
| Pool BC | PC33 | H | H | 2.50 | 0.50 | 0.45 | 0.90 | 0.94 | 0.65 |
| Pool BC | PC21 | M | M | 3.00 | 0.45 | 1.29 | 0.86 | 1.51 | 0.80 |
| Pool BC | S65CH | H | H | 2.50 | 0.50 | 0.11 | 1.00 | 1.25 | 0.05 |
| Pool D | S65CT | H | H | 2.50 | 0.50 | 0.12 | 0.88 | 0.87 | 0.05 |
| Pool D | S65DH | H | H | 2.50 | 0.50 | 0.11 | 0.94 | 0.93 | -0.05 |
| Pool E | S65DT | L | H | NA | 0.50 | | 0.79 | 1.27 | 0.01 |
| Pool E | S65EH | H | H | 2.50 | 0.50 | 0.19 | 0.82 | 1.05 | 0.03 |
| **Stages in Lower Basin's unmanaged watersheds** | | | | | | | | | |
| D_Chandler | CYPRS | H | H | 2.50 | 0.50 | 0.59 | 0.81 | 0.58 | 0.81 |
| D_Chandler | CHAND1 | H | H | 2.50 | 0.50 | 0.62 | 0.86 | 0.62 | 0.86 |
| Lake O | S65ET | H | H | 2.50 | 0.50 | 0.03 | 1.00 | 0.030 | 1.00 |

"H" Does not meet criteria

Low Utility

Does meet criteria

"M"  not meeting criteria

## Groundwater Stage Statistics

| | RMSE | R | |
|---|---|---|---|
| | 3.50 | 0.45 | M |
| | 3.00 | 0.50 | H |

| MODEL AREA | Station | RMSE | R(correlation) | RMSE Target (ft) | R Target | comments | Run 99 RMSE | Run 99 R(correlation) | Run 100 RMSE Simulated Criteria | Run 100 R Simulated Criteria |
|---|---|---|---|---|---|---|---|---|---|---|
| **UKB SAS Calibration Wells for the 1000 x 1000 ft model** | | | | | | | | | | |
| UKB bc | BEELINE | M | M | 3.50 | 0.45 | This is a Boundary station, hardly influenced by model parameters | 1.14 | 0.71 | 1.13 | 0.71 |
| UKB north | TAFT | H | H | 3.00 | 0.50 | | 0.63 | 0.86 | 0.61 | 0.86 |
| UKB north | KISSFS | H | H | 3.00 | 0.50 | | 1.80 | 0.62 | 1.78 | 0.63 |
| UKB north | REEDGW 10 | H | H | 3.00 | 0.50 | | 3.00 | 0.83 | 3.00 | 0.83 |
| UKB alligator | ALL 1 | H | H | 3.00 | 0.50 | | 1.11 | 0.84 | 1.13 | 0.84 |
| UKB east | CAST | H | H | 3.00 | 0.50 | | 1.11 | 0.49 | 1.13 | 0.49 |
| UKB east | EXOT | H | H | 3.00 | 0.50 | | 1.27 | 0.80 | 1.28 | 0.80 |
| UKB east | PINEISL | H | H | 3.00 | 0.50 | | 2.97 | 0.64 | 2.95 | 0.64 |
| UKB central | WR 6 | H | H | 3.00 | 0.50 | Only WR 6 and WR11 will be used in this area | 1.65 | 0.72 | 1.66 | 0.72 |
| UKB central | WR 11 | H | H | 3.00 | 0.50 | | 1.22 | 0.67 | 1.22 | 0.67 |
| UKB east | CHAPMAN | H | H | 3.00 | 0.50 | | 1.86 | 0.72 | 1.86 | 0.72 |
| UKB east | KENANS 1 | H | H | 3.00 | 0.50 | | 0.96 | 0.81 | 0.97 | 0.81 |
| **LKB SAS Calibration Wells for the 1000 x 1000 ft model** | | | | | | | | | | |
| LKB west | PA1F | M | M | 3.50 | 0.45 | | | | | |
| LKB east | ELMAX | H | H | 3.00 | 0.50 | | 1.71 | 0.55 | 1.70 | 0.55 |
| LKB kr | TICKICL | H | H | 3.00 | 0.50 | | 2.16 | 0.50 | 2.16 | 0.50 |
| LKB east | MAXCEY-N | H | H | 3.00 | 0.50 | | 2.76 | 0.56 | 2.75 | 0.56 |
| LKB east | PEAVINE | H | H | 3.00 | 0.50 | | 1.88 | 0.72 | 1.87 | 0.72 |
| LKB east | MAXCEY-S | H | H | 3.00 | 0.50 | | 1.93 | 0.69 | 1.92 | 0.69 |
| LKB east | GRIFFITH | H | H | 3.00 | 0.50 | | 1.42 | 0.40 | 1.43 | 0.40 |
| **Kissimmee River Seepage Wells:** | | | | | | | | | | |
| **Floridan Wells for the 3000 x 3000 ft model** | | | | | | | | | | |

The Acceptance Test Plan (ATP) also considers wells in the Floridan aquifer system (FAS). Calibration to the Floridan Aquifer System has two elements; the first is a qualitative calibration, comparing to USGS seasonal contour plots. The second is a comparison of 1000x1000 MIKE SHE modeled SAS lower-boundary flow against 3000x3000 MIKE SHE modeled flow through the confining layer. Flows are also compared to Aucott's estimated (1988) recharge of FAS.

Does not meet criteria

Low Utility

Does meet criteria