APPENDIX I

SUBROUTINE DESCRIPTIONS FOR THE SFWMM V5.5

A brief description of all subroutines and functions used by the SFWMM v5.5 is given below:

accum_estuar_dmnds.F

This subroutine accumulates estuarine demands and calculates supplemental releases from Lake Okeechobee to meet the demands for Caloosahatchee and St. Lucie estuaries for every month of current year in simulation. Maximum available volumes of water for backflow into Lake Okeechobee from Caloosahatchee/St Lucie basins are also calculated here for every month of current year.

agarea.F

This routine simulates the water table management practices in the ag area by forcing the soil moisture to reside within a very narrow range. Excess water is removed from the soil and routed though the outlet structures or to a reservoir. Supplemental irrigation requirements are met from appropriate sources (Lake Okeechobee or reservoir or both) and added to the soil column.

alloc_to_eaa.F

This routine routes the volume of water determined by supply-side management plan that is in excess of the demand in LOSA to cells where the soil moisture is less than the moisture level that triggers supplemental releases from outside source.

annual_init.F

This routine initializes variables at the beginning of each year of simulation.

asr.F

This subroutine performs water budget accounting for the particular aquifer storage and recovery (ASR) system.

asr_input.F

In this subroutine, read in basic parameters for each ASR facility.
Each ASR has an efficiency factor defined as eta = (volume recoverable)/(vol injected), and a capacity (separate for injection and recovery). Any ASR can have multiple sources in the injection phase (e.g. canals, reservoirs, eaa ro, etc), and during the recovery phase, multiple destinations. Thus, for each ASR, the foll. have to be defined:

1. number of canal sources, IF any, FROM which the asr takes water for injection(ncnl_src_to_asr)
2. number of reservoirs srcs, IF any, FROM which the asr takes water for injection(nres_src_to_asr)
3. number of eaa ro sources, IF any, FROM which the asr takes water for injection(neaa_src_to_asr)

Also needed, for each ASR, are the following:

1. number of canal destination, IF any, TO which the asr delivers during recovery(ncnl_dest_from_asr)

2. number of reservoirs dest, IF any, TO which the asr delivers during recovery(nres_dest_from_asr)
3. number of eaa dmd dest, IF any, TO which the asr delivers during recovery(neaa_dest_from_asr)

asr_to_lec_ws.F

This subroutine calculates volumes of recovery from aquifer storage and retrieval systems to maintain canals in LEC service areas during dry periods. Sources of water for recovery from ASR wells can be excess water from reservoirs or canal systems.

avail_res_stor_adjust.F

This subroutine computes adjustment in available storage in reservoirs that are not separate entities within grid network. The adjustment is due to the difference between the actual area of reservoir and area of the grid cells containing reservoir.

bpts.F

inputs: iday, month, stage, rvoir
outputs: mzone, stgref
- OR -
inputs: iday, month, rvoir, mzone
outputs: stgref, iregjul(res, zone, brkpt)

caloos.F

This subroutine determines the interaction (inflows/outflows) between Lake Okeechobee, Caloosahatchee basin, and Caloosahatchee estuary.

canl_dep_struc_capac_setup.F

This subroutine determines the available capacity of outlet structures from canal, taking into account open/close criteria, available volume of water upstream of structures, and tailwater constraints.

canl_dep_struc_param_setup.F

This subroutine sets up the basic parameters, such as headwater, tailwater, downstream constraints, and volume of downstream water supply needs, for computation of discharge through structure.

chnlf.F

This subroutine calculates downstream stage, seepage along canal, downstream outflow, and overland inflow given upstream inflows and downstream stage at the end of the previous day. Head drops for the major project canals (names and pertinent information are input) in east coast service areas are calculated on a daily basis.

cnldata.F

This subroutine opens and reads canal data files. Files opened:

Cndta22: physical parameters for each canal

Canal22: node locations to define path of each canal
Kflpts2: known flow specifications

daily_output.F

daily_ovlnf_out.F

This subroutine prints out the desired arrays when called by main program. Printing occurs when LP index is true.

daily_variables_init.F

This subroutine initializes appropriate variables on a daily basis.

dstring.F

This subroutine formats the date string from the month, day, and year values.

eaa_flow_distrib_capac_setup.F

This subroutine sets up the parameters necessary to compute flow distribution to or from everglades agricultural area.

eaa_neutral_caps.F

This subroutine calculates conveyance capacities for the major EAA Canals with and without STAs for the neutral case (no EAA runoff/no EAA demand).

eaacor.F

This subroutine assures mass balance in everglades agricultural area (EAA) by appropriately adjusting water levels in EAA when excess runoff and irrigation requirements in excess of what can be delivered occur.

etcomp.F

This subroutine calculates evapotranspiration from the saturated zone for each grid cell.

excadjfresstg.F

This subroutine calculates depth of excess water used to adjust estimate of reservoir stage for reservoirs whose actual area is different from grid cell(s); reservoir passes through and not treated as separate entity from grid cell(s)

final_output.F

This subroutine outputs 1) mean number of days per year the limit for overland flow from each grid cell is reached to an ASCII file, and 2) cell water levels, canal stages, and Lake Okeechobee stage to restart file. This is done at end of last day of simulation.

flow_to_stas.F

This subroutine routes runoff and environmental water supply volumes from appropriate areas to corresponding stormwater treatment area (STA) as part of Everglades Construction Project (ECP).

funcs.F

This subroutine gives the operation schedule for s340 and s339 based on gage 3a-2.

gen_canl_dep_struc_flw.F

This subroutine calculates flow through outlet structures from a canal, using generic code.

gen_model_def_param.F

This subroutine retrieves general definition data for model domain. File opened: model_definition_data.info.dat.

gen_model_run_def_param.F

This subroutine retrieves model run definition data required by model. File opened: gen_model_def_param.dat

grid_cell_based_data.F

This subroutine retrieves grid-cell-based physical data required by model.

gw_rchg_update.F

This subroutine updates recharge term (RCHG) of groundwater equation due to municipal and industrial wellfield pumpage and irrigation for appropriate grid cells.

gwf.F

This subroutine solves the two-dimensional groundwater equation using a finite difference approach for head at each node.

hist_flow_adjust.F

This subroutine adjusts flows provided by data base when necessary. Only done during calibration/verification.

hist_lok_bndry_input_data.F

This subroutine retrieves historical boundary flow data and modified delta storage for Lake Okeechobee.

holeyland_inflow_managmt.F

This subroutine calculates inflow into Holeyland based upon options for management of the inflow (rain-driven operations, calendar-based operations, source of water).

init.F

This subroutine initializes appropriate variables in the model. These variables need to be initialized once.

knflows.F

This subroutine distributes measured or simulated (prior to chnlf subroutine) flows to the appropriate canal or surface ponding location.

lake_nonreg_wca.F

This subroutine calculates the water supply releases from Lake Okeechobee to the WCAS to meet environmental (primarily Everglades) and urban needs during appropriate times

lake_reg_wca.F

This subroutine calculates excess water from Lake Okeechobee to appropriate destination(s). Destinations can include reservoirs, ASRs, and water conservation areas (WCAs).

larger_reserv_stor.F

lec_et_comp.F

This subroutine computes the ET in nodes that are in the LEC developed area. This option is used when the variable USE_LEC_ET > 0.

lec_et_initial_read.F

Subroutine opens files used for the LEC ET routine and initializes other grid_io calls.

lec_et_set_cutbacks.F

When LEC ET is used, this subroutine is called each day for each cell in the LEC developed area. The subroutine computes values for daily net irrigation supply (per irrigation use type), daily shortages per irrigation use type, daily total net irrigation demand, daily total net irrigation supply, and daily total shortages. Daily adjusted ET in the unsaturated zone for irrigated areas—et_unsat_irr_adj—also computed. (the daily values are summed monthly later in subroutine lec_et_sum_monthlies)

lec_et_sum_monthlies.F

This subroutine sums monthly values

lec_et_time_series_read.F

This subroutine reads daily values for the LEC ET input grid files

lec_pws_irrig.F

This subroutine computes public water supplies and shortages as well as net irrigation and shortages in developed areas if trigger module is used and water restrictions are in effect for current month

lineout.F

This subroutine writes out groundwater head data in fixed format; this output data is used as an input boundary condition for the 1-mile by 1-mile version of SFWMM.

locate.F

Given an array xx of length n, and given a value of x, this subroutine returns a value of j such that x is between xx(j) and xx(j+1). xx must be monotonic, either increasing or decreasing. j = 0 or j = n is returned to indicate that x is out of range.

locwslwdd.F

This subroutine determines water deliveries into Lake Worth Drainage District (LWDD) from local sources such as c-51 basin and excess water from LWDD canals.

lok_bndry_input_data.F

This subroutine opens i/o files and retrieves physical data required by model.

lok_o_wca_in_struc_dta.F

This subroutine opens i/o files and retrieves physical data required by model.

lok_ws_to_larger_res.F

This subroutine computes water supply deliveries from lake okeechobee to maintain minimum depths of water in the stormwater treatment areas (STAs) and other appropriate larger reservoirs (area of reservoir approaching at least one grid cell).

lok_ws_to_small_res.F

This subroutine computes water supply releases from Lake Okeechobee to maintain smaller reservoirs that are separate entities within model domain at desired minimum depths.

lvseep.F

This subroutine calculates seepage beneath protective levees into borrow canals.

main.F

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map_lec_array_to_model.F

This subroutine writes an LEC array to a model array, and converts the units from inches to feet.

map_lec_node_to_model.F

This subroutine checks to see if a model node is in the LEC developed area. If so, the model node number is mapped to the LEC node. Array model_node_in_lec contains the model node number associated with each LEC node. Array lec_node_in_model contains the LEC node number for each model node.

mthly_unsat_et_irr_comp.F

This subroutine computes monthly sums for the net irrigation demands and for the unsaturated zone ET from irrigated areas in developed areas.

mthly_variables_init.F

This subroutine initializes appropriate variables at the beginning of each month of simulation.

munic_well_pump_setup.F

This subroutine reads municipal wellfield pumpages, which include residential and industrial areas, and sets up parameters for determination of the contribution of pumpages to recharge (RCHG) term of groundwater equation at appropriate grid cells.

northlok_res.F

This subroutine performs the water budget for proposed North LOK Reservoir. Preliminary specs are: 10kac @ 10ft max depth Initial inflow&outflow pump capacity = 4800cfs (to be resized as necessary) Location TBD, but not necessary to specifically define for SFWMM simulation operations:

- Inflows from Lake Okeechobee to be pumped into reservoir when lake stage is rising >0.25ft below the bottom pulse zone of the current (aka Run25) regulation schedule.
- Releases back to lake when lake stage is falling > 0.5ft below the bottom pulse zone.

Source: 6/26/97 email from Cal, Subject: Restudy "Starting Point" Components. Note: Above operating conditions have to be defined in main program.

open_ascii_output_files.F

This subroutine opens the required ascii files and writes the appropriate headers identifying the data written to files.

open_binary_output_files.F

This subroutine opens necessary binary output files and writes headers to files. The files are set up so that time-dependent data in binary format can be output to files.

open_input_data_files.F

This subroutine opens the input data files. The paths are input in altwmm file.

oper_sched_data.F

This subroutine retrieves data defining operational schedules for Lake Okeechobee, WCAs, Holeyland, and Rotenberger tract.

ovlnf.F

This subroutine computes overland flow, infiltration, and evapotranspiration for each grid cell. This subroutine also computes flow over passive wiers across protective levees.

printlp.F

This subroutine prints out the desired arrays when called by main program. Printing occurs when LP index is true

qmax_one_reach.F

This subroutine calculates the conveyance capacity for a spillway-canal-spillway reach within the EAA.

qmax_two_reaches.F

This subroutine calculates the conveyance capacity for a spillway-canal-spillway reach within the EAA.

qpulse.F

This subroutine determines the pulse release from Lake Okeechobee to tidewater called for by operational schedule.

rain_driven_flow_stage_targ.F

This subroutine determines 1) the non-regulatory component of target flow to ENP shark river slough based on current rainfall plan, if target flow in not pre-processed, and 2) status of everglades system relative to stage targets for rain driven operations.

rain_pet_setup.F

This subroutine sets up rainfall and potential evapotranspiration for model domain.

readtk.F

This subroutine reads mid-month crop coefficients for each land use type and converts coefficients to actual day value depending on the relative position of the current day to two mid-month values.

remov_comm_inp_files.F

The main purpose of this subroutine is to remove comment lines from SFWMM input files. This subroutine determines if an input file is non-local. If this is the case, then it opens the input file and returns control to the calling program. Otherwise, it removes comment lines from the original input file and writes a cleaned version file in the unit number specified in the ALTWMM file, so that the file can be read again in the calling subroutine of the SFWMM code.

resasr_sim.F

This subroutine simulates the proposed reservoir/ASR systems in the Caloosahatchee and St. Lucie basins.

reserv_cell_equil_stg.F

This subroutine computes the weighted mean water surface elevation for a grid cell containing small reservoir(s) which are treated independently. This mean elev. is needed for calculating maximum limit to seepage loss from reservoir to cell so that no reversal of gradient between head in grid cell and head in reservoir occurs.

reserv_input_data.F

This subroutine reads data for reservoirs/STAs.

reservoir_init.F

This subroutine initializes parameters necessary for simulation of reservoirs.

resout.F

This subroutine calculates structural outflow and seepage from leveed systems (mainly reservoirs). Outflow can be routed to grid cell(s), canal, or to another reservoir.

reusenores.F

This subroutine routes reuse water to appropriate location(s). Reuse water can be routed to a canal or to grid cells which may contain reservoir(s).

simcstg2dss.F

This subroutine dumps daily flows from simulated structure into the dss file 'strflows.dss'; if pathnames already exist, it writes over them; if not, it appends these simulated flows at the end of the dss file. This subroutine appends to file str2x2.dss simulated flows from the SFWMM.

simq2dss.F

This subroutine dumps daily flows from simulated structure into the dss file 'strflows.dss'; if pathnames already exist, it writes over them; if not, it appends these simulated flows at the end of the dss file. This subroutine appends to file str2x2.dss simulated flows from the SFWMM.

sl.F

This subroutine determines inflows/outflows between Lake Okeechobee, St. Lucie basin, and St. Lucie estuary. This requires daily time series of basin demand/runoff and a daily time series of estuarine demands.

small_res_gw_flow.F

This subroutine solves the groundwater equation within small reservoirs passing through more than one grid cell and treated as separate entities.

small_res_stor.F

This subroutine computes available storage for reservoirs treated as separate entities within model domain.

small_reserv_ovlnf.F

This subroutine calculates overland flow within smaller reservoirs treated independently.

spec_canl_dep_struc_flw.F

This subroutine computes discharges through canal outlet structures that require unique code.

specsetupfdss.F

This subroutine sets up special flow components that are not automatically captured in model to be written to dss file (daily_str_flw.dss).

ssm.F

Given Lake Okeechobee stage, storage, and date, this function computes water supply releases to the lake service area. This plan takes effect when the lake stage is projected to fall below 11' nvgd during the dry season. The function is based on the documentation on the Lake Okeechobee Supply-Side Management Plan (Alan Hall, 1991). The code was written by Paul Trimble and Lehar Brion.

ssm_cutback.F

This subroutine computes water supply releases to Lake Okeechobee service area according to the Lake Okeechobee Supply-Side Management Plan (Hall,1991). The source of water is Lake Okeechobee.

struc_lok_in_wca_flw.F

This subroutine computes discharges for structures dependent on basin demand/runoff computation or dependent on operational criteria primarily as a function of grid cell stage. Structures simulated in this routine are EAA structures and others north of everglades. Routine will return the kflo array containing discharges to knflows.

taycrnbs_res.F

This subroutine performs water budget for proposed Taylor Creek/Nubbin Slough Res. Preliminary specs are: 5kac @ 10ft max depth Initial inflow pump capacity = 2500cfs (to be resized as necessary). Location TBD, but not necessary to specifically define for SFWMM simulation operations:

- Sources of inflow are outflows from S191 and S133 (Taylor Creek and Nubbin Slough)
- Releases to lake when lake stage is > 0.4ft below the bottom pulse zone.(max capacity is 1000 cfs)

Note: Above operating conditions have to be defined in main program.

trg.F

The trigger package allows the user to set minimum limits on heads at selected nodes. If these limits are exceeded during a run, the pumpage at certain wells is cutback according to an input cutback schedule. The routine is completely data-driven, except that zones must be rectangular.

val2val_w_lok.F

This program creates an array containing active SFWMM cell stage-lsel values plus lake_stage-bathymetry values. No. of SFWMM active cells = 1746; no. of LOK cells = 176.

wca_avail_stor_dmnd_setup.F

This subroutine computes available storage in the Conservation areas, which include Lake Okeechobee releases, for flood control purposes and for meeting demands in Lower East Coast Service Areas and Everglades National Park.

wcaout.F

This subroutine is a management module that determines the discharges at the outflow structures of the WCAs. Discharges are put in kflo array.

wcas_input_data.F

This subroutine inputs data to simulate the outlet structures flows from the water conservation areas. Structure names are set up for dss output.

ws_from_res.F

This subroutine computes water supply discharges from reservoir to appropriate destination(s).

wsneeds.F

This subroutine determines the total surface water requirements for water supply in the lower east coast. The need is defined as the volume of water required to maintain the canals at desired minimum levels during dry periods. The water, if available, is delivered from the appropriate WCA or Lake Okeechobee. The needs are determined for every canal reach to be maintained by the storage areas.

xy.F

This subroutine gets x,y position of grid cell based on linearized array of cell indices.