

Quick Users Guide to the NFSEG Automated Water-Use Permit Simulation Tool: Step-by-Step Procedures

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Please report any errors to Paul Bremner (pbremner@sjrwmd.com) or Lanie Meridith (imeridith@sjrwmd.com) at the St Johns River Water Management District, Douglas Durden (Douglas.Durden@srwmd.org) at the Suwannee River Water Management.

Software Requirements:

ArcGIS Desktop, version 10.0 or later, installed on your local machine (or a computer that you connect with remotely that has ArcGIS installed on it).

Overview of Steps:

Note to the User: If this is the first time running the tool or an update, please read the more detailed instructions (below) first.

1. Navigate to the top-level tool directory
2. Create a formatted User input csv file. Name is flexible, but no spaces are allowed in the name. The "user_input_files" folder is provided with example input files and is the recommended location for new input files.
3. Double-click on the batch file "sim_cup_initiate.bat" to open the tool console
4. Fill-in the User input filename, select whether to replace an existing results directory which possesses the same name as the User input file, and select a projection as prompted.
5. Monitor the output in the console to ensure no errors occur, process takes about 10-20 minutes for each well depending on the size of withdrawal/injection.

6. A completion message appears at the end of a run. The console pauses to allow inspection of the output. If no errors occurred (signified by an error statement on the console) then the User has the option to either enter another User input file to run, or type **exit** to close the console. There is no limit to the number of times new input files may be processed before exiting the console. Each run is processed in its own results directory with its own logfile.
7. Each successful run generates a results directory containing an mxd map of the change in head water levels, two output csv files, and the logfile.

NOTE: Before clicking on the batch file to start the tool, close all related Excel and ArcMap files that are used to setup the Permitting Tool. Any open files could cause program errors. Also, it is sometimes necessary to save Excel csv files in MSDOS csv format.

NOTE: This tool is setup to run the NFSEG v1.1 groundwater model. Using a different model will cause unpredictable errors.

NOTE: The Suwannee River Water Management District (SRWMD) and St Johns River Water Management District (SJRWMD) utilize two different map projections in GIS. X,Y coordinates must correspond to the correct projection. Input the selection when prompted at the command line.

1 = SRWMD is used for State Plane North

2 = SJRWMD is used for UTM Zone 17N meters

Detailed Instructions:

[Initial Setup / Installation of the Tool](#)

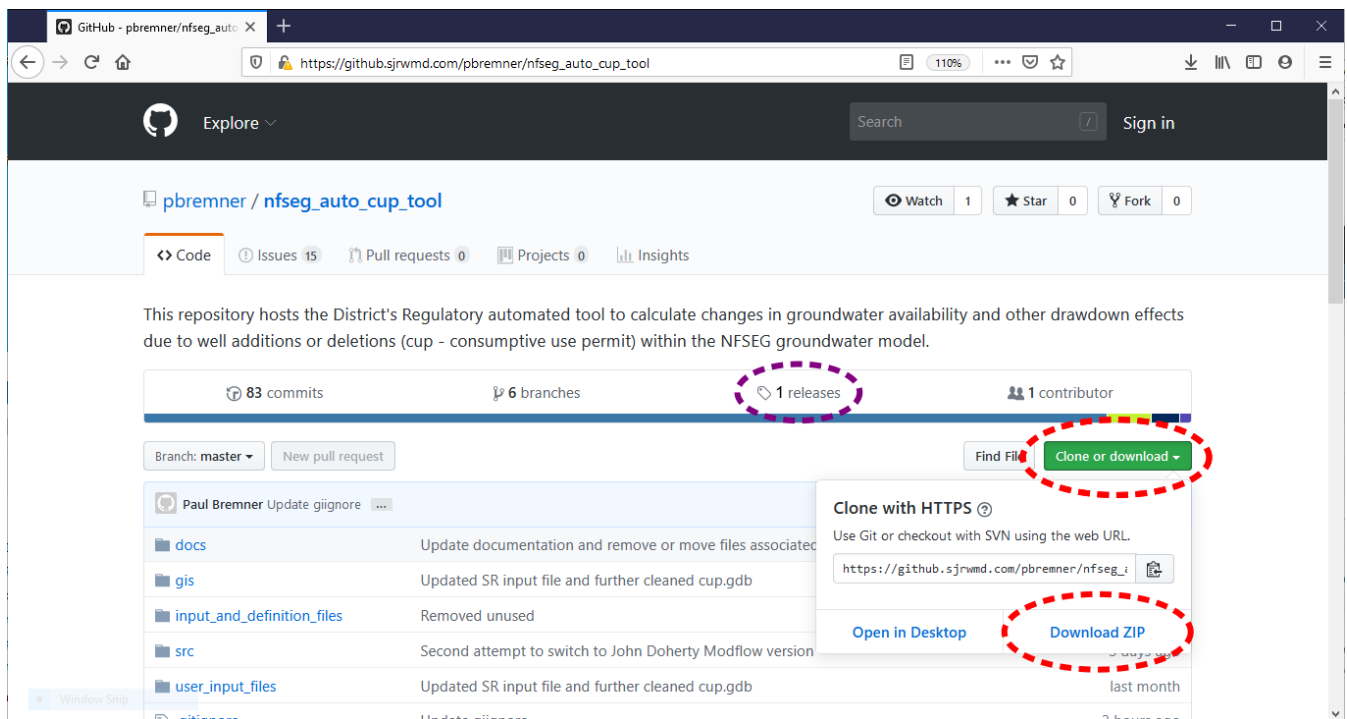
NOTE: This process only needs to be done once per tool update.

NOTE: This tool uses the Python that is bundled with ArcMap 10.0 or newer. The tool automatically searches for the location of this Python. If that is unsuccessful, then ERRORS will occur. Ensure that ArcMap's Python can be found before running the tool (see steps below).

NOTE: The tool should be downloaded to the local machine's hard drive, such as the local C:\ drive, where ArcMap is generally installed. The tool does not currently support running from a server location (i.e. poseidon or beohome).

1. There are two types of download versions: the development and release versions, each of which can be downloaded as zip files. Navigate to the Tool's GitHub repository (https://github.sjrwmd.com/pbremner/nfseg_auto_cup_tool) and download the zip file. The development version is found by clicking on the green colored "Clone or download" icon (see figure, dashed red circle). The

release version is found by clicking on the “release” icon and downloading the zip file from the desired release version (see figure, dashed purple circle). After the download is complete, unzip the tool to a directory on the local machine’s hard drive. The tool unzips into its own directory, referred to as the *top-level tool directory*. The portion of the default Windows PATH when unzipping is usually not necessary. Unzip the tool and enter the top-level tool directory. **NOTE:** Microsoft Edge or Firefox are the preferred browsers to use to access the District’s GitHub webpage. You may receive a security warning when visiting the page, please proceed to the webpage. If you are using Microsoft Edge, click ‘Details’ and ‘Go on to webpage’ to visit the webpage.



2. Check that the top-level tool directory includes (at a minimum) the following:

- docs (folder) containing this Quick Users Guide
- gis (folder)
- input_and_definition_files (folder)
- model_update.zip (zip file)
- src (folder)
- user_input_files (folder)
- sim_cup_initiate.bat
- setup.bat

NOTE: Additional files will appear in the top-level tool directory following download that are not accessed directly by the tool. This includes a file named ‘README.md’. ‘README.md’ is a markdown file containing a general description of the tool which

appears in its formatted form on the GitHub repository page where the tool is accessed.

3. Setup the tool for use by double-clicking the *setup.bat* script in the top-level directory. A message may appear warning you about running the script. Click the **Run-Anyway** option (sometimes this option only appears after clicking **More**).

The setup script does the following:

- a. Search for the Python bundled with ArcGIS.
- b. Automatically generate a file called *PY_PATH_autogen.txt* to store the PATH. Though the simulation tool does not require the auto-generated file (the tool auto searches for Python when the file is not present), having this file available will decrease the tool runtime significantly. If Python could not be found, then a **Failure** message will appear. If this occurs, or if the version is not the one desired by the User, it will be necessary to manually set Python in the tool to resolve the issue. Please contact the tool maintainers for help.
- c. Unzip the model data directory.

NOTE: It may take several minutes for the Python version on your computer to be located. To verify that the setup was successful, the *PY_PATH_autogen.txt* text file should be created and when opened should contain the file path to python on your computer. The *model_update.zip* should be unzipped into a folder named "model_update". In the event that "model_update" is chosen to be unzipped manually, remove the final directory name that appears in the default Windows chosen PATH, which inserts the model_update directory into another directory called model_update.

[How to setup the User Input File](#)

The User input file is a comma-separated-value (.csv) file created in MS Excel, or equivalent, that lists all the wells needing to be processed for a permit. Table 1 shows an example of the Excel file format, and example csv files are also provided in the *user_input_files* folder included in the tool download. The name given to the file is not important, but the name must NOT contain spaces. Instead, use underscores in place of spaces. A descriptive filename of the permit simulation is recommended. The name assigned to the User input file is used to create a new results directory one directory level above the top-level tool directory. Results directories are created outside of the top-level directory to prevent results from being overwritten whenever new release versions of the tool are downloaded and installed by users. The results directory name appends "_results" to the base User input file name. Within the results directory, two csv files are output summarizing the results of the simulation, both of which will be prepended with the base of the User input filename. A logfile with all output from the console is written to the results directory and named with the base User input filename. An mxd map (dh.mxd) showing the change in head in model layers 1 and 3 from the

simulation is output to the results gis folder. The User input file used for the simulation is also copied to the output results directory.

For example, if the input filename is:

“sim_cup_input_example_srwmd.csv”

then the results directory will be named:

“sim_cup_input_example_srwmd_results”

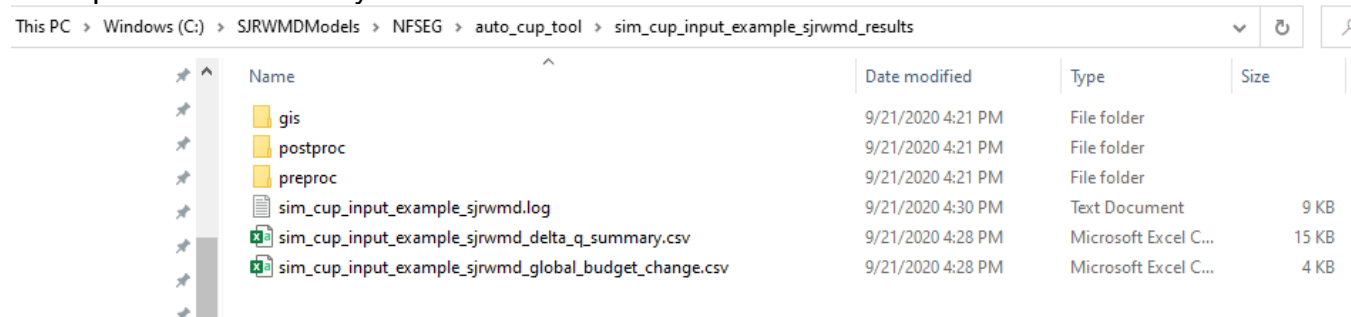
and the two output csv files and log file will be named:

“sim_cup_input_example_srwmd_delta_q_summary.csv”

“sim_cup_input_example_srwmd_global_budget_change.csv”

“sim_cup_input_example_srwmd.log”

Example results directory:



Name	Date modified	Type	Size
gis	9/21/2020 4:21 PM	File folder	
postproc	9/21/2020 4:21 PM	File folder	
preproc	9/21/2020 4:21 PM	File folder	
sim_cup_input_example_srwmd.log	9/21/2020 4:30 PM	Text Document	9 KB
sim_cup_input_example_srwmd_delta_q_summary.csv	9/21/2020 4:28 PM	Microsoft Excel C...	15 KB
sim_cup_input_example_srwmd_global_budget_change.csv	9/21/2020 4:28 PM	Microsoft Excel C...	4 KB

The Rows of the User input file are as follows:

- *Row 1* contains the Permit ID and Name.
- *Row 2* contains a set of header field names describing what information needs to be filled out by the User. The field names **MUST** be in the order and spelling shown in the example.
- *Rows 3+* contain all the need-to-be-processed wells, one well per row.

The Columns of the well data portion (rows 3+) of the User input file are as follows:

- *Col A – WellKey* – an integer counter for each well
- *Col B – WellId* – an identifier for each well
- *Col C/D – Xcoord/Ycoord* – Cartesian coordinate representation of the Lon/Lat well coordinates. For each well, use a GIS program such as ArcMap, to obtain the X,Y coordinates within the NFSEG model. **IMPORTANT:** Reference the NFSEG grid to confirm that any added wells are within the model domain. Including a well in the user input file that is outside of the model domain will result in errors and failure of the tool, with an error message such as “division by zero”.
- *Col E – layer* – model layer the well will interact with

- *Col F – Q_mgd* – amount of water flowing through the well [units = million-gallons-per-day].

IMPORTANT: The Suwannee River Water Management District (SRWMD) and St Johns River Water Management District (SJRWMD) utilize two different map projections in GIS. Make note of which projection was used in GIS and input the selection when prompted at the command line.

1 = SRWMD is used for State Plane North

2 = SJRWMD is used for UTM Zone 17N meters

NOTE: Use a positive Q_mgd value for withdrawal, and a negative value for injection.

Table 1 User input file example. File should be created in MS Excel, or equivalent, and be saved as a .csv file.

	A	B	C	D	E	F
1	2_345_123456_1	Testing123				
2	WellKey	WellId	XCoord	YCoord	layer	Q_mgd
3	987654	w00160	436759.1709	3284314.454	3	1.2345
4						
5						
6						
7						
8						
9						
10						
11						
12						

More

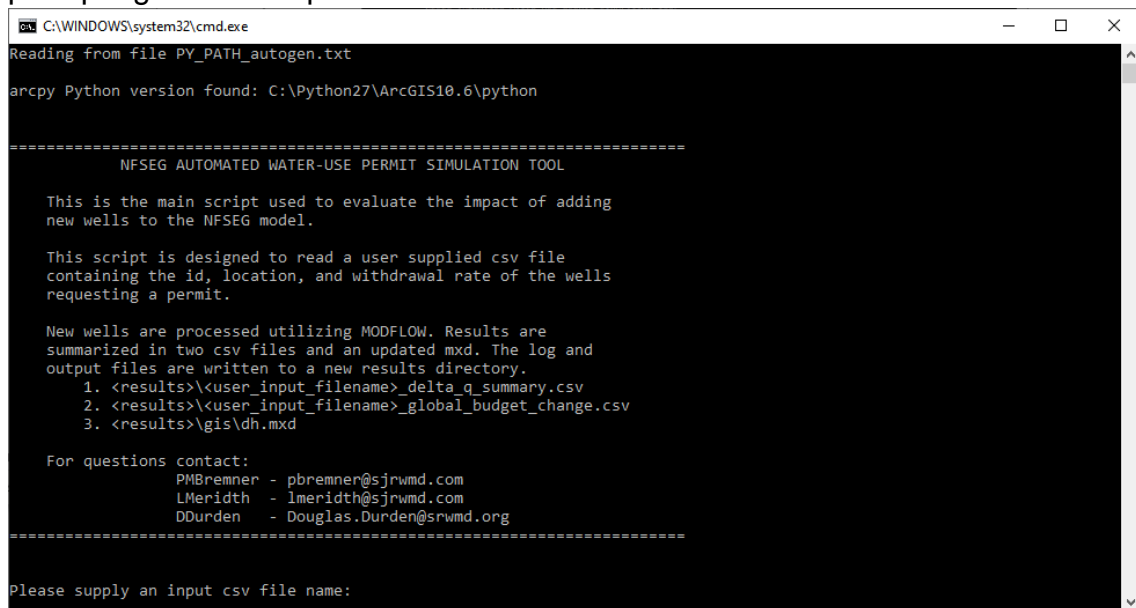


[Running the Water-Use Simulation Permit Simulation](#)

The Automated Water-Use Permit Simulation Tool runs a batch script within a Windows Command Prompt console. In the background, the batch script runs a Python script that controls the processing workflow and manages output. Successive input files may be processed without limit, where each new User input file is able to be entered once the current process is completed. The following are the steps to activate and run the tool:

1. Navigate to the top-level directory of the tool

2. Double click on the batch file *sim_cup_initiate.bat*. A console will pop-up on the screen. When first opened, the tool may take a few moments to initialize before prompting for User input.



```
C:\WINDOWS\system32\cmd.exe
Reading from file PY_PATH_autogen.txt
arcpy Python version found: C:\Python27\ArcGIS10.6\python

=====
NFSEG AUTOMATED WATER-USE PERMIT SIMULATION TOOL

This is the main script used to evaluate the impact of adding
new wells to the NFSEG model.

This script is designed to read a user supplied csv file
containing the id, location, and withdrawal rate of the wells
requesting a permit.

New wells are processed utilizing MODFLOW. Results are
summarized in two csv files and an updated mxd. The log and
output files are written to a new results directory.
1. <results>\<user_input_filename>_delta_q_summary.csv
2. <results>\<user_input_filename>_global_budget_change.csv
3. <results>\gis\dh.mxd

For questions contact:
PMBremner - pbremner@sjrwmd.com
LMeridth - lmeridth@sjrwmd.com
DDurden - Douglas.Durden@srwmd.org
=====

Please supply an input csv file name:
```

3. Follow the prompts to input both the User input csv filename, whether to proceed with overwriting an existing results directory possessing the same name (overwrite is currently the only option), as well as the map projection that corresponds to what was used in GIS to obtain the X,Y coordinates of each well. Push Enter after each prompted input.

NOTE: While a User created input csv file may be located anywhere convenient to the User, a directory called “*user_input_files*” that is included with the tool download may be used. When prompted to supply an input csv file name after initiating the tool, type the path to the file in the command line, such as: *input_user_files\User input csv filename* as highlighted in the screenshot below:

```
Select C:\WINDOWS\system32\cmd.exe

C:\MY_CODES\RegTools\nfseg_auto_cup_tool-master>echo off

Reading from file PY_PATH_autogen.txt

arcpy Python version found: C:\Python27\ArcGIS10.6\python

=====
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    DDurden - Douglas.Durden@srwmd.org
=====

Please supply an input csv file name: user_input_files\sim_cup_input_example_sjrwmd.csv

=====
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  2. <results>\<user_input_filename>_global_budget_change.csv
  3. <results>\gis\dh.mxd

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    PMBremner - pbremner@sjrwmd.com
    LMeridth - lmeridth@sjrwmd.com
    DDurden - Douglas.Durden@srwmd.org
=====

Please supply an input csv file name: user_input_files\sim_cup_input_example_sjrwmd.csv

Preexisting results with the jobname C:\MY_CODES\RegTools\sim_cup_input_example_sjrwmd_results will be overwritten. Proceed?
( Y = yes , N = no )
Y
```



```
Select C:\WINDOWS\system32\cmd.exe

C:\MY_CODES\RegTools\nfseg_auto_cup_tool-master>echo off

Reading from file PY_PATH_autogen.txt

arcpy Python version found: C:\Python27\ArcGIS10.6\python

=====
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New wells are processed utilizing MODFLOW. Results are
summarized in two csv files and an updated mxd. The log and
output files are written to a new results directory.
  1. <results>\<user_input_filename>_delta_q_summary.csv
  2. <results>\<user_input_filename>_global_budget_change.csv
  3. <results>\gis\dh.mxd

For questions contact:
    PMBremner - pbramner@sjrwmd.com
    LMeridith - lmeridth@sjrwmd.com
    DDurden - Douglas.Durden@srwmd.org
=====

Please supply an input csv file name: user_input_files\sim_cup_input_example_sjrwmd.csv

Preexisting results with the jobname C:\MY_CODES\RegTools\sim_cup_input_example_sjrwmd_results will be overwritten. Proceed?
( Y = yes , N = no )
y

Creating or replacing C:\MY_CODES\RegTools\sim_cup_input_example_sjrwmd_results

Please input the map projection type used - in all caps - or the associated number
(options are 1=SRWMD or 2=SJRWMD. Different names result in a poetic exit): 2
```

4. The simulation proceeds to run. Monitor the output to ensure no error messages appear. If the simulation was successful, then the output files will be written to the new results folder one level above the top-level tool directory, and a completion message will appear in the console. The output files will be prepended with the User input filename. The user will then be prompted to supply another User input file for processing. If there is no additional user input file to

process, type **exit** in the command prompt or close the command terminal to exit.

```

Results directory location and name:
    C:\SJRWMDModels\NFSEG\auto_cup_tool\sim_cup_input_example_srwm_results

CSV filenames output to results directory:
    sim_cup_input_example_srwm_delta_q_summary.csv
    sim_cup_input_example_srwm_global_budget_change.csv

Log output written to:
    C:\SJRWMDModels\NFSEG\auto_cup_tool\sim_cup_input_example_srwm_results\sim_cup_input_example_srwm.log

    xoxoxoxoxoxoxoxoxoxoxox
    -- PROCESSING COMPLETE --
    xoxoxoxoxoxoxoxoxoxoxox

If no Error or Warning messages appeared then the simulation was successful!

More? Please supply another input csv file name (input "exit" if done): user_input_files/sim_cup_input_example_srwm.csv

```

Water-Use Simulation Permit Simulation Log File

Output from the console, including any error messages, is written to a log file in the results directory that is named with the base User input filename. Error messages and warning messages usually start with one of the following terms: “ERROR”, “Warning”, or “Traceback”. If an error occurs during execution of the tool, and it is not obvious why the error occurred, then the logfile should be examined for additional information. If errors persist, the log file and a description of the issue should be emailed to the tool maintainers.

Example log file:



```
sim_cup_input_example_srwm.log - Notepad
File Edit Format View Help
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
-- NFSEG AUTOMATED WATER-USE PERMIT SIMULATION TOOL --
-- LOG OUTPUT --
Run datetime: Tue Sep 22 16:06:08 2020
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

User supplied input file: user_input_files/sim_cup_input_example_srwm.csv
Projection type: SRWMD

Results directory location and name:
C:\SJRWMModels\NFSEG\auto_cup_tool\sim_cup_input_example_srwm_results

CSV filenames output to results directory:
sim_cup_input_example_srwm_delta_q_summary.csv
sim_cup_input_example_srwm_global_budget_change.csv
Nothing to delete: C:\SJRWMModels\NFSEG\auto_cup_tool\sim_cup_input_example_srwm_results\sim_cup_input_example_srwm_delta_q_
Nothing to delete: C:\SJRWMModels\NFSEG\auto_cup_tool\sim_cup_input_example_srwm_results\sim_cup_input_example_srwm_global_b
Ln 1, Col 1 100% Windows (CRLF) UTF-8
```

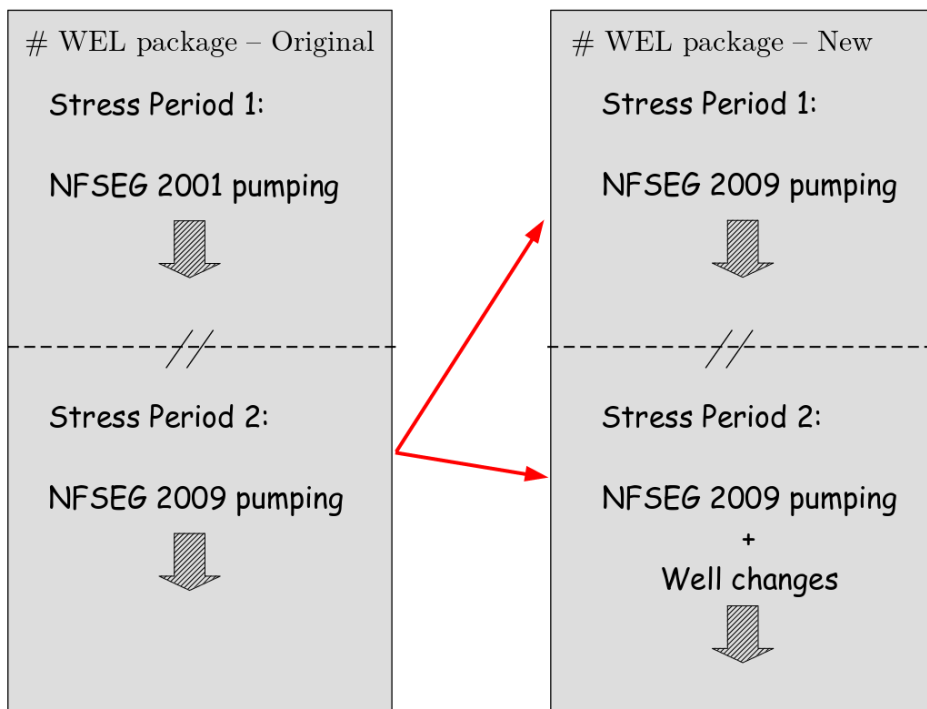
Tool Operations and Results

The NFSEG Automated Water-Use Simulation Tool uses MODFLOW to calculate changes in groundwater availability and other drawdown effects due to well additions or deletions (CUP - consumptive use permit) within the NFSEG groundwater model domain. The tool calculates the cumulative effects of adding one or more new CUP wells within the NFSEG model area, and summarizes results in the following outputs:

- Change in Water Budget
- Change in flow at river and spring flow gages
- Change in head water levels in model layers 1 and 3

The tool can be split into three stages:

1. **Preprocessing** – Processing the input CUP wells in order to setup a new MODFLOW WEL Package. The new WEL Package starts with the calibrated NFSEG 2nd Stress Period (2009), which becomes the new Stress Period 1. The new 2nd Stress Period repeats Calibrated NFSEG 2nd Stress Period plus all the CUP well modifications:



2. **Execute MODFLOW** – Utilize the new WEL Package, but all other packages are unchanged.

3. **Postprocess the results** – Extract and process the global water budget and flow changes from the *.lst* and *.hds* files.

a. The global water budget is summarized in the *<user input filename> global budget change.csv* (see example):

J	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	bc_flux_type	flux_units	timeStep_1	stressPeriod_1	timeStep_2	stressPeriod_2	in_rate_1	in_rate_2	in_rate_1_minus_1	in_rate_2_minus_1	out_rate_1	out_rate_2	net_rate_1	net_rate_2	net_rate_1_minus_1	net_rate_2_minus_1
2	CONSTANT HEAD	cfm	1	1	1	2	58922484	58922604	120	140176128	140172416	-3712	-81253644	-81249812	3832	-0.02
3	DRAINS	cfm	1	1	1	2	0	0	0	986734720	986689792	-44928	-986734720	-986689792	44928	-0.27
4	ET	cfm	1	1	1	2	0	0	0	2611415808	2611369984	-45824	-2611415808	-2611369984	45824	-0.28
5	HEAD DEP BOUNDS	cfm	1	1	1	2	174854640	174857904	3264	674153728	674134976	-18752	-499299088	-499277072	22016	-0.13
6	MINW2	cfm	1	1	1	2	3644703.75	3644517.5	-186.25	19595294	19595108	-186	-15950590.25	-15950590.5	-0.25	0
7	RECHARGE	cfm	1	1	1	2	5298147328	5298147328	0	0	0	0	5298147328	5298147328	0	0
8	RIVER LEAKAGE	cfm	1	1	1	2	217602304	217606160	3856	1165426688	1165385344	-41344	-947824384	-947791184	45200	-0.27
9	STORAGE	cfm	1	1	1	2	0	0	0	0	0	0	0	0	0	0
10	WELLS	cfm	1	1	1	2	54044196	54044196	0	209716688	209881712	165024	-155672492	-155837516	-165024	1

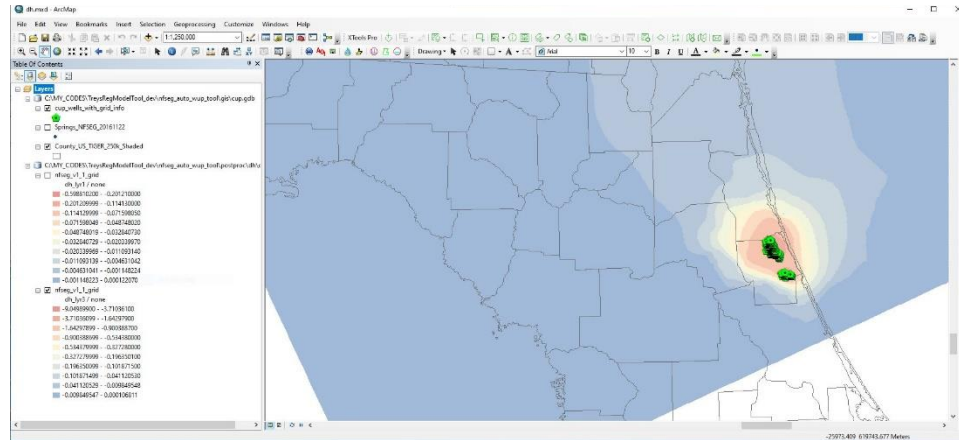
b. The change in flow is summarized in

<user input filename> delta q summary.csv (see example):

J	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	station_number	station_name	simulated_flux_base_condition_cfs	simulated_flux_with_cup_cfs	simulated_change_in_flow_cfs	simulated_change_in_flow_as_fraction_of_flow	simulated_change_in_flow_as_a_fraction_of_cup									
2	2315000	savannah river near benton	-10844063.83	-10844055.12	8.71	-0.000001	4.560081									
3	2315500	savannah river at white springs	-14057591.11	-14057563.86	27.25	-0.000002	14.266815									
4	2317600	alapaha river near jennings fla	-70118800.49	-70118777.36	23.13	0	12.214817									
5	2319000	withlacoochee river near pinetta fla	-7263267.35	-72634928.86	338.49	-0.000005	177.214919									
6	2319394	withlacoochee river nr lee	-110119308.1	-110118303.8	1004.29	-0.000001	551.968792									
7	2319500	savannah river at ellaville	-260075507.4	-260072360.3	3207.07	-0.000012	1679.047888									
8	2319800	savannah river at downing park	-270122613.4	-270115339.4	6273.97	-0.000012	1714.072283									
9	2320000	savannah river at turaville	-285509495.7	-285506189.3	3306.37	-0.000012	1751.035157									
10	2320500	savannah river at brantford	-338422933.9	-338419497.7	3436.17	-0.00001	1788.529404									
11	2320700	santa fe river near graham	-329526.635	-329526.788	0.153	-0.000004	97.091929									
12	2321000	new river near lake butler	-1437561.57	-1437532.06	29.51	-0.000021	15.449828									
13	2322700	chuckawnee river at us hwy27 near hildreth	-23341434.1	-23341201.6	232.5	-0.00001	121.72403									
14	2323500	santa fe river near worthington springs	-3752650.45	-3752425.368	225.087	-0.000042	81.268242									
15	2323750	santa fe river at us hwy 443 near high springs	-12640148.06	-12647062.51	1085.547	-0.000086	568.331254									
16	2325500	santa fe river near fort white	-62517471.06	-62515986.31	1484.747	-0.000024	777.33262									
17	2322800	santa fe river near hildreth	-96587560.66	-96585003.61	1757.047	-0.000018	919.894962									
18	2323000	savannah river near wilcox	-471961137.4	-471958917.3	220.117	-0.000011	2722.491789									
19	2323592	savannah river ab gosper river nr suwannee	-514120004.3	-51411340.2	5264.117	-0.00001	2756.004802									
20	2313700	waccasassa river nr gulf hammock	-10891330	-10890833.6	496.4	-0.000046	259.888799									
21	2324000	steelewhatchee river near cross city	-5377135.34	-5377135.34	0	0	0									

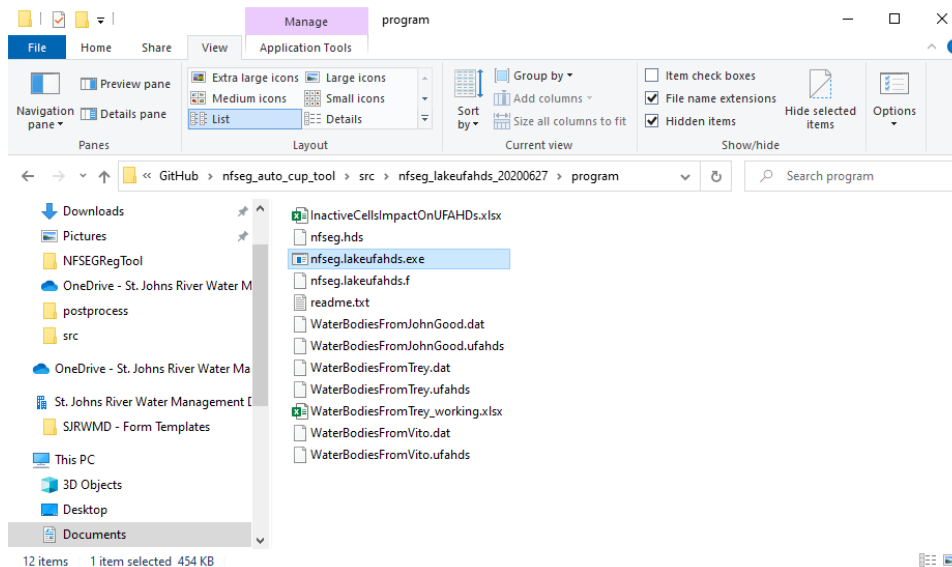
c. The change in head levels of layers 1 or 3 are viewable from the *dh.mxd* (see example below). **NOTE:** The change in head feature layers generated during post-processing (*dh_layerX*, where *X* represents the model layer number) may need to be rescaled in the *dh.mxd* file. This can

happen if calculated changes in head are outside of the range of values in the legend, resulting in some cells showing as blank or unclassified in the map. This should be verified in the symbology classification tab for the feature layer. Also note that the *dh_layerX* feature layer is semi-transparent to enable the user to add base maps or reference layers.



Lake-UFA Head Extraction

A separate, standalone tool that extracts the Lake-UFA head levels is bundled with this Tool. To navigate to the extraction tool, start from the top-level tool directory and enter into the subdirectory *src\nfseg_lakeufahds\program*:



To use the extraction tool:

- Copy the heads file produced by the MODFLOW run into the extraction tool program directory:
 - From the results directory, copy *postproc\dh\nfseg_auto.hds* to the tool program directory
 - Rename as *nfseg.hds*.

- Double click the Fortran executable file, *nfseg.lakeufahds.exe*, to run the extraction tool.
- Once the process is complete, the output may be moved back to the results directory.

Currently, the tool processes from three lists of lakes, and creates an output file for each of them. Each output filename has the suffix *.ufahds*. Below is an example of the input and output files.

- The input file (left) lists the NFSEG grid rows and columns, as well as the area that make up each lake. Each lake has a unique ID.
- The output file (right) lists the average UFA head levels for each Stress Period beneath each LakeID

LakeID	row	col	AreaRatio
1	667	346	0.410721207
1	667	347	0.589278793
2	600	326	0.053270891
2	600	327	0.006602863
2	600	328	0.003736122
2	601	326	0.039475764
2	601	327	0.356996443
2	601	328	0.176070058
2	602	327	0.140998759
2	602	328	0.165612569
2	603	327	0.035219784
2	603	328	0.022016745
3	675	350	0.509295915
3	676	350	0.490704085
4	589	319	6.70597E-05
4	589	320	0.132416504
4	590	319	0.006522296
4	590	320	0.546793444
4	590	321	0.260882152
4	591	320	0.018746438
4	591	321	0.034572106
5	701	278	6.28791E-05
5	701	279	0.019981238
5	702	279	0.106869094

LakeID	UFA_Head_SP1	UFA_Head_SP2
1	23.8704357	24.7402954
2	69.9009933	74.5878448
3	21.2288990	24.4777107
4	69.6874466	74.3994217
5	48.1977463	48.5087814
6	22.2289505	24.7310505
7	22.8607140	22.3173275
8	15.7438049	23.0309467
9	72.7342072	75.3918839
10	11.4555864	23.4530048
11	24.3875427	25.1051426
12	17.7533169	23.3330002
13	24.1949825	25.7409439
14	24.3068466	24.9916973
15	68.5091934	73.8273163
16	12.6061964	10.3338537
17	43.3857880	43.3238335
18	23.6748753	22.5554409
19	19.7126598	20.0445385
20	21.3537884	20.9330502
21	19.1483555	23.1949768
22	20.8523998	24.2726402
23	75.4661865	79.8236313
24	25.9441757	26.3947144