AGNPS Project and Input Data Preparation Documentation

Version 5.50
September 2018

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OVERVIEW

This document presents the procedures used to develop a watershed project using AGNPS technology. The components in this technology are designed to aid in the preparation of input files used to execute the AnnAGNPS watershed planning tool for evaluation of watershed systems. While these components greatly facilitate the preparation of the AnnAGNPS input files, users can choose to create or modify any input parameter independently from these tools. Users are encouraged to consult with any individual or source of information to determine or confirm any of the parameters produced from these components that may be required for their simulations.

This document assumes that all of the 64-bit versions of the AGNPS components have been successfully installed onto a personal computer, including the 32-bit version of the AnnAGNPS Input Editor and MAPWinGIS. All of the 32-bit versions of the components can be used on a 64-bit operating system, but the 32-bit versions will likely execute slower and will not execute as large of a simulation dataset as the 64-bit version. The use of the MAPWinGIS tools is provided to facilitate the development of TOPAGNPS and AnnAGNPS datasets, including the AnnAGNPS Cell, Reach, Ephemeral Gully, Riparian Buffer and Wetland data sections. Users may find features within other GIS software (i.e. ArcGIS, Erdas, ENVI) better suited for their purposes and are encouraged to substitute other procedures for the MAPWinGIS procedures used with AGNPS.

Any watershed simulation project requires the definition of objectives describing the goal or purpose for the project. Once the objectives are established, all the necessary information can be assembled describing the watershed and conditions needed. For all watershed simulations, basic knowledge is needed concerning the characteristics describing the watershed, such as topographic, climatic, management, and soil data. Fortunately, most of this data is available for use with AGNPS that relies on GIS information without much user effort. While many input parameters utilize default values that are predetermined within the model, users should evaluate how relevant these default parameters are to their project. In addition, evaluating alternative management practices requires users to select the appropriate practices from the available databases or create new input data parameters appropriate for their conditions.

This document describes the procedures to execute most of the AGNPS components and to define the necessary input files required to execute AnnAGNPS. A description of the use of the simulation results for calibration, validation and planning is provided in associated documents (Bingner et al., 2010; French et al., 2010; Frees et al., 2010; Theurer et al., 2010). An example watershed simulation project developed for the Grand Lake St. Marys watershed in west-central Ohio is used to illustrate the application of the AGNPS components and eventual AnnAGNPS simulations and alternative practice analyses. The data for this example is part of the AGNPS downloadable files as described later.

INPUT DATA PREPARATION

The development of the AnnAGNPS input file(s) will be described based on starting from a DEM and applying the procedures used to execute TOPAGNPS needed to determine the spatial characteristics of the watershed. Procedures to populate databases associated with soil properties, management, climate, and other associated parameters will be described that are necessary to perform a successful AnnAGNPS simulation.

TOPAGNPS

The optional use of the AGNPS component comprising the TOPAGNPS program can be used to generate the topographic characteristics required to link the AnnAGNPS cell, reach, ephemeral gully, riparian buffer, and wetland data sections associated with AnnAGNPS for a watershed project. All previous individual subcomponents of TOPAGNPS (DEDNM, RASPRO, RASFOR, AGFLOW, PEG, AGBUF, AGWET, POTHOLE, CONCEPTS) are now integrated together into a single TOPAGNPS program and can be executed from a single control file and DEM ASCII grid file or from individual component control files. The TOPAGNPS files produced for the AnnAGNPS cell and reach data sections are required for an AnnAGNPS simulation, while the ephemeral gully, riparian buffer, and wetland data sections are only required if needed. Detailed documentation for the TOPAGNPS component is provided elsewhere in files located in the folder 'AGNPS\DataPrep\Document\TOPAGNPS_Users_Guide'. The AnnAGNPS Input Editor can be used to easily apply TOPAGNPS when using a digital elevation model (DEM) that describes the project watershed. From the use of TOPAGNPS, files can be created that subdivides the watershed into multiple subareas described as AnnAGNPS cells and then routes flow through channel reaches. Files produced from TOPAGNPS, '*AnnAGNPS_Cell_Data_Section.csv*' and '*AnnAGNPS_Reach_Data_Section.csv*' can then be imported into the AnnAGNPS Input Editor for the Cell and Reach data sections, respectively, as part of or used directly as csv input files with AnnAGNPS. Detailed information describing the procedures for use of the TOPAGNPS Potential Ephemeral Gully (PEG) component is contained in the document file 'PEG_User_Manual.pdf'. Detailed information describing the AGNPS Buffer Utility Feature (AGBUF) component of TOPAGNPS is contained in the document file 'AGBUF_User_Manual.pdf'. Detailed information describing the AGNPS WETland (AGWET) component of TOPAGNPS is contained in the document file 'AGBUF_User_Manual.pdf'.

New to TOPAGNPS in version 5.50 is the capability to identify pothole locations in the landscape and determine the characteristics of a pothole for use in AnnAGNPS as a wetland. Detailed information describing the AGNPS POTHOLE component of TOPAGNPS is contained in the document file 'POTHOLE_User_Manual.pdf'. The other new feature within TOPAGNPS involves the production of files for use as input files for CONCEPTS when linking an AnnAGNPS and CONCEPTS simulation via a watershed simulation. The upstream and downstream most points associated with a CONCEPTS corridor are defined for use with TOPAGNPS and the corresponding cell and reach identifiers are produced populating the output options data section files for cell

and reach locations that AnnAGNPS produces output for. The AnnAGNPS output files are then used as input to the CONCEPTS simulation. Detailed information describing the AGNPS CONCEPTS component of TOPAGNPS is contained in the document file 'CONCEPTS_User_Manual.pdf'.

The AnnAGNPS Input Editor – AGNPS GIS Tools – AGNPS Data Preparation – TOPAGNPS component uses information automatically obtained from an ASCII Grid formatted DEM associated with the cell size, the UTM Easting and Northing values, the number of rows and columns, minimum and maximum elevations, combined with user selected outlet row and column values to generate the TOPAGNPS control file. Users have the option to manually modify the TOPAGNPS csv control file (TOPAGNPS.csv) or to use the DNMCNT.inp alternate TOPAGNPS control file to define the information generated by the program. Users are referred to the TOPAGNPS User's Manual (TOPAGNPS_User_Manual.pdf) for a description of the TOPAGNPS control file or the contents of the DNMCNT.inp file. Users may also want to refer to the 'General Steps in Executing AGNPS Components' at the end of this document for a quick guide to running the TOPAGNPS modules.

AnnAGNPS

An example of the procedures used to develop an AnnAGNPS simulation project is provided using the Grand Lake St. Mary's (GLSM) Watershed, Ohio example distributed as part of the complete AGNPS installation file (AGNPS\Example_AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed.exe). This example demonstrates how to execute TOPAGNPS for use in developing AnnAGNPS input files and illustrates the functionality of the procedures necessary to produce the cell, reach, ephemeral gully, riparian buffer data, and wetland data sections. A description is also provided to populate all other necessary data sections required to execute AnnAGNPS for this project. The AGNPS GIS Tools procedure requires that the open source software MapWinGIS be installed on the computer (provided as '\AGNPS\DataPrep\Editor\Execute\Setup\MapWinGIS-only-v4.9.3.6-Win32.exe'), as well as the AnnAGNPS 32-bit Version of the Input Editor. The procedures work best with computers that have a fast CPU and memory above 8 GB. For watersheds described by very large DEMs (>5000 rows by >5000 columns) and more than 8GB of memory, the use of the 64-bit version of TOPAGNPS is recommended.

AGNPS PROJECT DEVELOPMENT

Installation and Directory structure for AGNPS Projects

The first step in developing an AGNPS Simulation Project is to obtain the latest version of AGNPS by downloading AGNPS_Complete_64.exe or AGNPS_Complete_32.exe from the AGNPS web site:

http://ars.usda.gov/Business/docs.htm?docid=5199

Or directly via the AGNPS download Page:

https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/?cid=stelprdb1043591

Unzip the 'AGNPS_Complete_64.exe' file for 64-bit computer operating systems using the 'Unzip to folder' option defined as C:\ or D:\ or other drives where files will be placed into the folder C:\AGNPS or D:\AGNPS or other drives.   Unzip the 'AGNPS_Complete_32.exe' file for 32-bit computer operating systems only. For the purposes of this discussion all files are shown to be extracted using the C:\ drive and the 'AGNPS_Complete_64.exe' file, but the files can be placed in any other drive other than C:\ as well.

As part of this installation, the self-extracting zip file 'AGNPS_Project_Structure.exe' located in the folder 'C:\AGNPS\Utility\AGNPS_Project_Structure' is used to develop the folder structure to start the process of creating project simulation files using the AGNPS components.
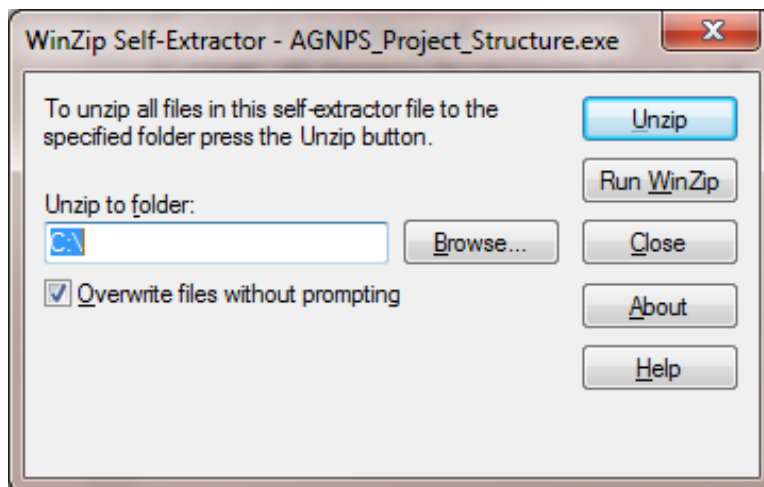
The extracted folder will be unzipped in
'C:\AGNPS_Watershed_Studies\AGNPS_Project_Structure' when selecting 'C:\' in the
'Unzip to folder' box resulting in the subfolder structure:

```
├──────0_Batch_files
├──────1_TopAGNPS_DataSets
├──────2_GIS_DataSets
├──────3_Weather_DataSets
├──────4_Editor_DataSets
├──────5_AnnAGNPS_DataSets
├──────6_Output_DataSets
└──────7_Presentation_Material
```

Users are advised to rename the folder
'C:\AGNPS_Watershed_Studies\AGNPS_Project_Structure' to something more relevant
to their project such as
'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed' used for the
AGNPS example project. Although, the AGNPS GIS Tools will function properly with
any folder project name defined. This recommended project structure provides a
framework for developing and organizing AnnAGNPS simulation datasets.

For illustration, a watershed in Ohio named Grand Lake St. Mary's watershed will be
used to illustrate the procedures for the development of project files. The information
and data for this watershed is located in the self-extracting zip file contained in the folder
'C:\AGNPS\Example_AGNPS_Watershed_Studies' by extracting the files from the self-
extracting zip file 'OH_AGNPS_Example_Watershed.exe'. After opening this file,
select '**Unzip**' after changing the 'Unzip to folder' to 'C:\' or 'D:\'or any drive selected
as shown in the following figure using 'C:\':
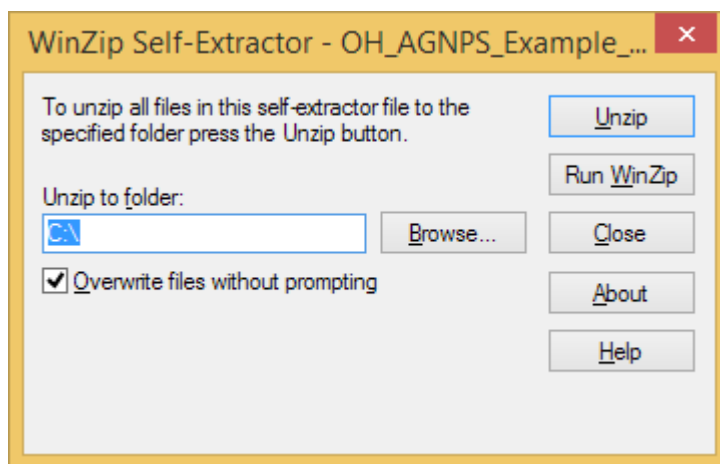
The extracted files can also be placed in the C:\ or D:\ or any other drive, but for this
example the files will be extracted into the C:\ drive.

The directory structure for the extracted files in the C:\ drive will result in the following:
C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed
+---0_Batch_files
+---1_TopAGNPS_DataSets
| |---Original
+---2_GIS_Datasets
| \---buffer
| +---elevation
| | \---dem_03m
| | \---info
| \---general
| \---hydrology
| \---imagery
| \---info
| +---landuse
| | \---Management
| \---Scenario_91_Cells
| \---soils
+---3_Weather_DataSets
| \---Generated_Climate_Data
| \---Observed_Climate_Data
+---4_Editor_DataSets
| +---CSV_Input_Files
| | \---climate
| | \---general
| | \---simulation
| | \---watershed
| \---Fixed_Format
| +---Management
| | +---CMZ 16
| | | \---Base
| | \---Field
| | \---Schedule
| \---Reference_Data
| | \---Runoff_Curve_Number
| | +---Soil_Data
| | | \---NASIS
| \---Scenario_91_Cells_AnnAGNPS_Data_Sections
\---5_AnnAGNPS_DataSets
\---6_Output_DataSets
\---7_Presentation_Material
This structure provides a way to organize the input, output and information files used by
the AGNPS components for the project. A description of the purpose of each
recommended project folder follows.

- '**0_Batch_files**': This folder contains batch files that can help execute the AGNPS components of TOPAGNPS, agGEM, AnnAGNPS, or STEAD when files are organized in the recommended project structure.
- '**1_TopAGNPS_DataSets**': This folder can be used to create and temporarily store the input files for TOPAGNPS and the associated output files. The batch file '1_Save_Files_to_a_GIS_Datasets_Project_Folder.bat' can be used to copy the files from this folder to a folder named by the user under '2_GIS_Datasets'. This provides a means to save TOPAGNPS project files for later use. The batch file '1_execute_TopAGNPS.bat' located in '0_Batch_files' can be used to execute TOPAGNPS if the required TOPAGNPS input files are present in the '1_TopAGNPS_DataSets' folder. The batch file '2_Save_AnnAGNPS_Data_Section_Files_to_an_Editor_Datasets_Project_Folder.bat' is copied to the '2_GIS_Datasets' folder designated by the user to be used in that location to copy only the AnnAGNPS data section files used to prepare the AnnAGNPS watershed simulation dataset to a separate folder for inclusion in the AnnAGNPS input file structure.
- '**2_GIS_Datasets**': This folder can serve as a repository for any relevant GIS information associated with the project or generated TOPAGNPS files.
- '**3_Weather_DataSets**': This folder can be used as a repository of historical or generated climate files for the project. If the batch file '0_Batch_files\2_execute_Weather.bat' is executed with the associated agGEM files present, then the resulting generated climate files will be created in this folder.
- '**4_Editor_DataSets**': This folder can serve as a repository for any AnnAGNPS input files created by the user. The batch file '0_Batch_files\3_execute_AnnAGNPS.bat' will read in the comma-delimited formatted AnnAGNPS input files based on the AnnAGNPS control file 'AnnAGNPS.fil' located in the folder '\4_Editor_DataSets\CSV_Input_Files'.
- '**5_AnnAGNPS_DataSets**': This folder can serve as a repository for AnnAGNPS simulation output files resulting from an AnnAGNPS execution. The output files resulting from executing the batch file '0_Batch_files\3_execute_AnnAGNPS.bat' will be written to this folder.
- '**6_Output_DataSets**': This folder can serve as a repository of files created for further analysis from AnnAGNPS output files. Output files generated from the AnnAGNPS output processor program 'STEAD' can be stored in this folder. The batch file '0_Batch_files\4_execute_Output_Tables.bat' will execute STEAD by reading in the STEAD control file, if present, and either the AnnAGNPS output file 'AnnAGNPS_TBL_Gaging_Station_Data_Hyd.txt' or 'AnnAGNPS_TBL_Gaging_Station_Data_Hyd.txt' are present. If both files are present, then the user can designate the file for processing by STEAD.
- '**7_Presentation_Material**': This folder can serve as a repository for any files used to present information concerning the project or any other document the user designates.

Using the Input Editor to Populate AnnAGNPS Input Data Sections

The AnnAGNPS Input Editor 32-bit version contains both the TOPAGNPS and AGNPS GIS Tool components, while the 64-bit version contains only the TOPAGNPS component. The AGNPS GIS Tool is located only in the 32-bit version of the AnnAGNPS Input Editor and is a result of the limitations of MapWinGIS to provide all of the necessary functions in a 64-bit operating system environment. The 64-bit and 32-bit versions of the Input Editor are both contained in the 64-bit version download package of AnnAGNPS. This document will assume the 32-bit version of the Input Editor is installed successfully on a 64-bit personal computer operating system. Both the 64-bit and 32-bit versions of the AnnAGNPS Input Editor can be installed at the same time on a computer and the appropriate version used when needed.

1. Open the AnnAGNPS Input Editor

Open the 32-bit version of the AnnAGNPS Input Editor either via clicking on the AnnAGNPS Input Editor desktop icon or via the program located in the Windows Start button on Windows 7 or by searching for the 'AnnAGNPS 32-bit Input Editor' in the Windows 8 or 10 search procedure. Within Windows 8 or 10, the AnnAGNPS Input Editor can be pinned to the taskbar as an icon by right-clicking the mouse on the resulting search line displaying the Input Editor opened in a new window.

In order to prepare TOPAGNPS input data files and to execute TOPAGNPS, begin by selecting the 'AGNPS GIS Tools' menu item shown below after opening the AnnAGNPS Input Editor.
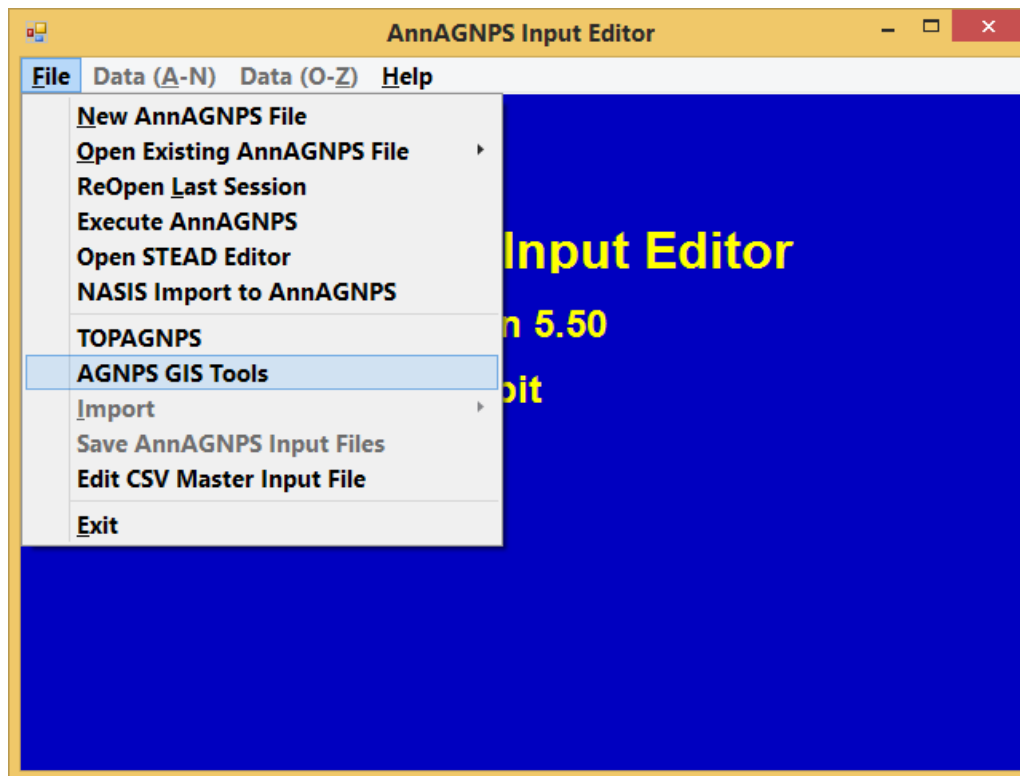
The AGNPS GIS Tools window then appears,
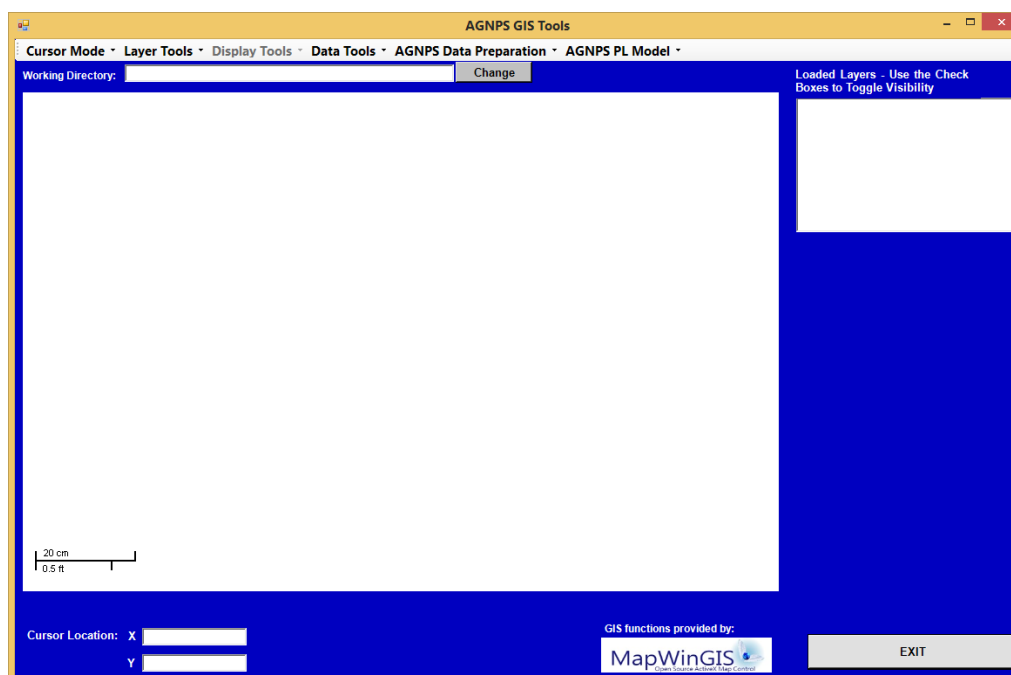
The 'Layer Tools' menu option allows grid and shape files to be added to the view, as well as converting grid to shape file format or ESRI grid to ASCII raster format. The 'Display Tools' menu option is greyed until a layer is displayed and provides option for displaying each layer. The 'Data Tools' menu option provides procedures to convert an AnnAGNPS csv output file to a dbf formatted file used to join with the AnnAGNPS cell shape file. The 'AGNPS Data Preparation' menu option provides a means to clip a DEM, select a watershed outlet, delineate the watershed into AnnAGNPS cells via TOPAGNPS, and assign management field, soils, or climate layer information to each AnnAGNPS cell. The 'AGNPS PL Model' menu option provides a way to execute completed AnnAGNPS input files.

2. Creation of AnnAGNPS Cell, Reach, Gully, and Riparian Buffer Data Sections

To create an AnnAGNPS cell, reach, gully, riparian buffer, or wetland data section, the first step is to divide the watershed into AnnAGNPS cells connected to AnnAGNPS reaches. This is performed by selecting in the 32-bit version of the Input Editor the 'File – AGNPS GIS Tools – AGNPS Data Preparation – TOPAGNPS' menu option.
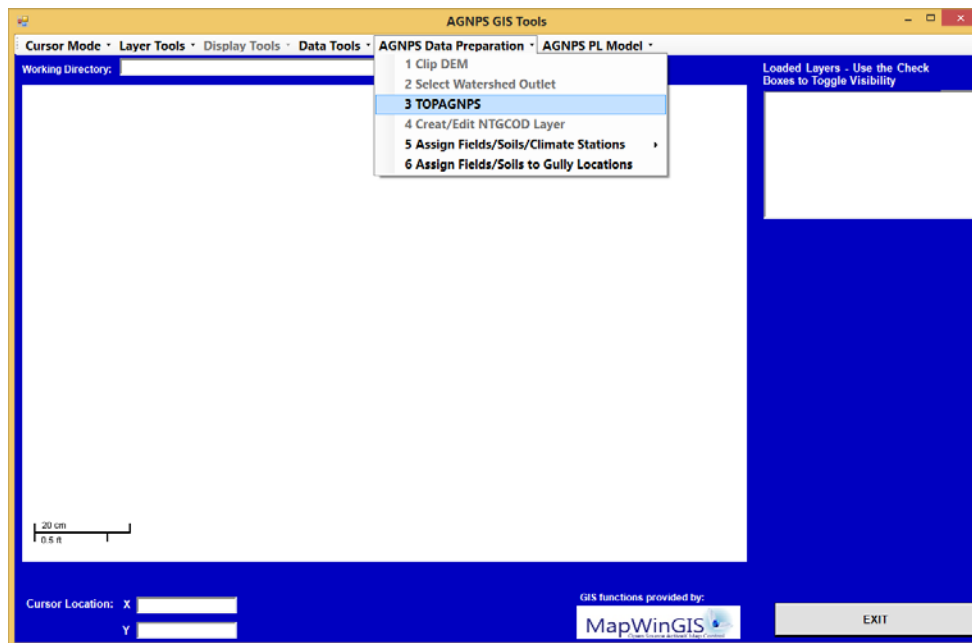
Or in the 64-bit version of the Input Editor select the 'File – TOPAGNPS' menu option.
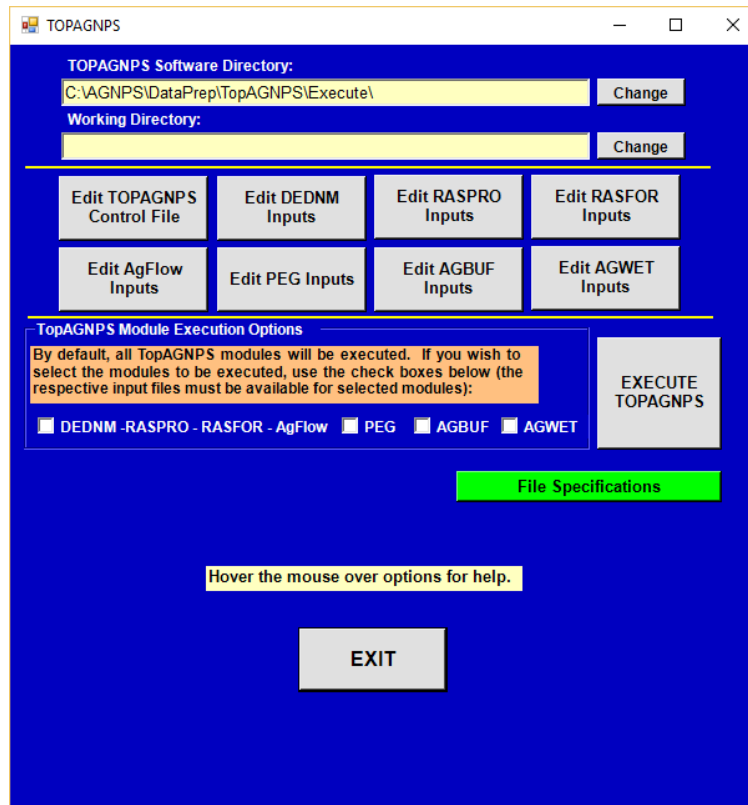
For this example the Topographic Programs Software Directory will be the same as the default 'C:\AGNPS\DataPrep\TopAGNPS\Execute' and the Working Directory will be selected as 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\1_TopAGNPS_Data Sets' with the working directory and software folder paths selected as shown:
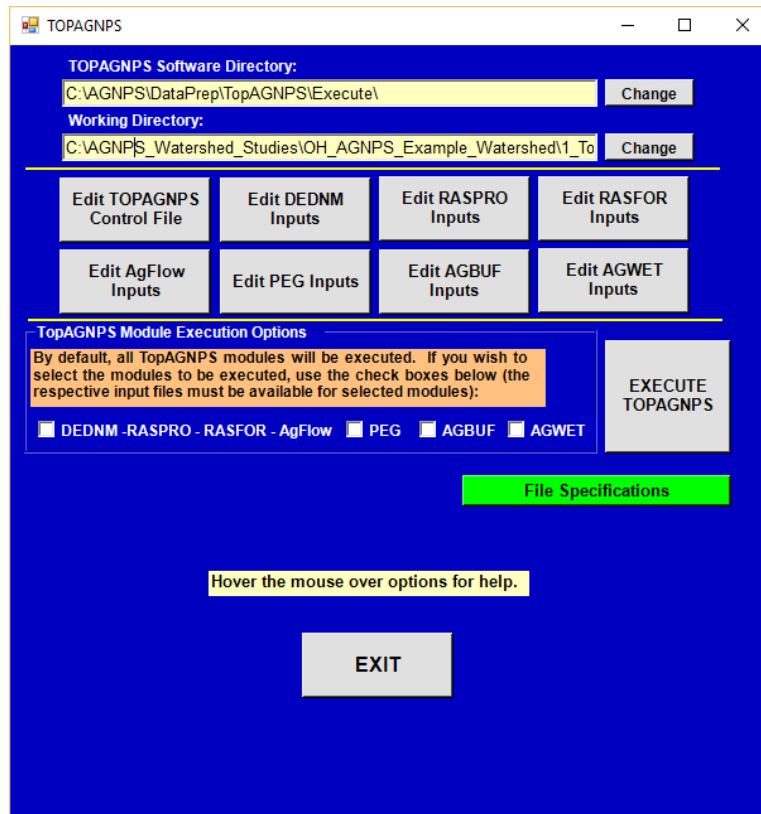
3. Edit TOPAGNPS Inputs

To create or edit an existing TOPAGNPS control file (TOPAGNPS.csv), select the 'Edit TOPAGNPS Control File' button to open the following window:

Users can create a new 'TOPAGNPS.csv' control file by entering the associated information for the TOPAGNPS Input Parameters and saving, or users can edit a preexisting file, such as by selecting the 'Import Values from Existing File' button and select the file 'TOPAGNPS.csv' located in 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\1_TopAGNPS_Data Sets'.

Any blank parameter fields will default to the information contained in the header of the ASCII grid DEM file, such as the cell size. The DEM file name of the DEM for this example is 'DEDNM.asc', but can be any file name defined by the user.   Note that if an accompanying projection file, 'DEDNM.prj' is produced with the 'DEDNM.asc' file, then all of the subsequent ASCII grid output files will also have an accompanying projection file. Such as with the TOPAGNPS output file 'NETW.asc' the file 'NETW.prj' would be created for use in GIS software. For this example the values should remain as shown, but if values are modified then the user should save the information into the 'TOPAGNPS.csv' file. For a complete description of the TOPAGNPS Input Parameters, please refer to the file' TopAGNPS_User_Manual.pdf' in the folder 'C:\AGNPS\DataPrep\Document\TOPAGNPS_Users_Guide'.

If an ASCII Grid DEM file is used then the parameters 'UTM Easting ULC', 'UTM Northing ULC', 'Rows', 'Columns', 'Cell Size', and 'No Data Value' can be left blank as the default for these parameters will be populated directly from the DEM ASCII Grid header. If the 'Outlet Row' and 'Outlet Column' are defined, but do not align directly on a channel raster, then the TOPAGNPS program will utilize the 'Outlet Snapping' value to search for the nearest acceptable outlet raster, with a default value of '2' rasters from the user-defined outlet to search for an acceptable outlet location. The 'Optimization' parameters allow users the option of using the slower, but backward compatible 'Row-Major' option or the faster 'Column-Major' option that produces slightly different stream network and subsequent subdivision of the watershed into AnnAGNPS cells than the 'Row-Major' option. If continuing from a version pre-5.45, then users may want to use the 'Row-Major' option. If starting new projects then users may choose the 'Column-Major' option. Either version will produce acceptable results, but may produce slightly different stream networks between them based on the row and column order of processing the DEM.

If users do not know the outlet location, then they can either select a best guess and set a large value for the outlet snapping to locate an acceptable outlet, or leave the 'Outlet Row' and 'Outlet Column' parameters blank and set the 'DEM Processing' parameter to 'Preprocessing and Network Generation'. This option will produce the files 'NETFUL.asc' and UPAREA.asc' that can be helpful in identifying the channel rasters within the DEM that can be used to define the watershed outlet. Note that the 'NETFUL.asc' defined channels will be based on the values selected for the parameters 'CSA' and 'MSCL' or defaults values of 10 ha and 100 m, respectively, will be used if the parameters are blank. Users have the option to define the outlet location as a row (Y) and column (X) within the DEM or as UTM coordinates within the DEM.

The user also has the option of using separate control files for each individual TOPAGNPS component, DEDNM, RASPRO, RASFOR, AGFLOW, PEG, and AGBUF. If the 'TOPAGNPS.csv' file is not present or the 'Control File Options' TOPAGNPS input parameter is set to 'Use', then the DEDNM control file 'DNMCNT.inp' is required. If the 'TOPAGNPS.csv' file is also not present or the TOPAGNPS input parameter 'Format' is set to 'One Value per Record', then the DEM file 'DEDNM.inp' described using one elevation value per record is required as described in the TOPAZ User Manual.

If the control file for any other component is present when executing TOPAGNPS, then the program will utilize those individual control files for that component. If the 'DNMCNT.inp' control file for DEDNM is not present, then the 'TOPAGNPS.csv' file will be used with defaults defined internally for the parameters defined in 'DNMCNT.inp', but not utilized in the 'TOPAGNPS.csv' file. If the 'RASPRO.inp', 'RASFOR.inp', or 'AgFCnt.inp' control files for the RASPRO, RASFOR, and AGFLOW components, respectively are not present, then internal defaults for each component will be used by TOPAGNPS. For TOPAGNPS, most users will not need to utilize the RASPRO, RASFOR or AGFLOW control files, as the associated default values are sufficient to execute TOPAGNPS. If values other than the associated default values are needed then the 'DNMCNT.inp' file is required.

The PEG, AGBUF, and AGWET components will only execute if the 'PEG.csv', 'AGBUF.csv', or AGWET.csv' control files are present. Users can choose to execute only the combined DEDNM-RASPRO-RASFOR-Agflow component, or the individual PEG, AGBUF, or AGWET components of TOPAGNPS by selecting the associated check boxes. The output files from the DEDNM-RASPRO-RASFOR-Agflow components are required to execute the PEG, AGBUF, or AGWET components. This provides an approach to iteratively produce alternative PEG, AGBUF, or AGWET scenarios without having to execute the DEDNM-RASPRO-RASFOR-Agflow component again for each alternative.

The development of each individual TOPAGNPS component DEDNM-RASPRO-RASFOR-Agflow-PEG-AGBUF-AGWET control file is described below if needed. Although, the use of the TOPAGNPS csv control file 'TOPAGNPS.csv' is highly recommended and can be used to replace the use of the individual DEDNM-RASPRO-RASFOR-Agflow ASCII-formatted control files.

If only the TOPAGNPS csv control file 'TOPAGNPS.csv' is used and the individual DEDNM-RASPRO-RASFOR-Agflow ASCII-formatted control files are not to be used, then users should skip to the section entitled '8. Selecting an Outlet.'

4. Edit DEDNM Inputs

The DEDNM component of TOPAGNPS can have a separate individual control file called from the TOPAGNPS control file 'TOPAGNPS.csv' or separately as described above that can be used to execute the DEDNM component of TOPAGNPS. Both the single line per record DEM 'DEDNM.inp' and the DEDNM control file 'DNMCNT.inp' can be created by selecting the 'Edit DEDNM Inputs' button of the TOPAGNPS window to open the following window:

Select the "Import a DEM into 'dednm.inp'" and select the file 'DEDNM.asc' located in C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\2_GIS_Datasets\elevation
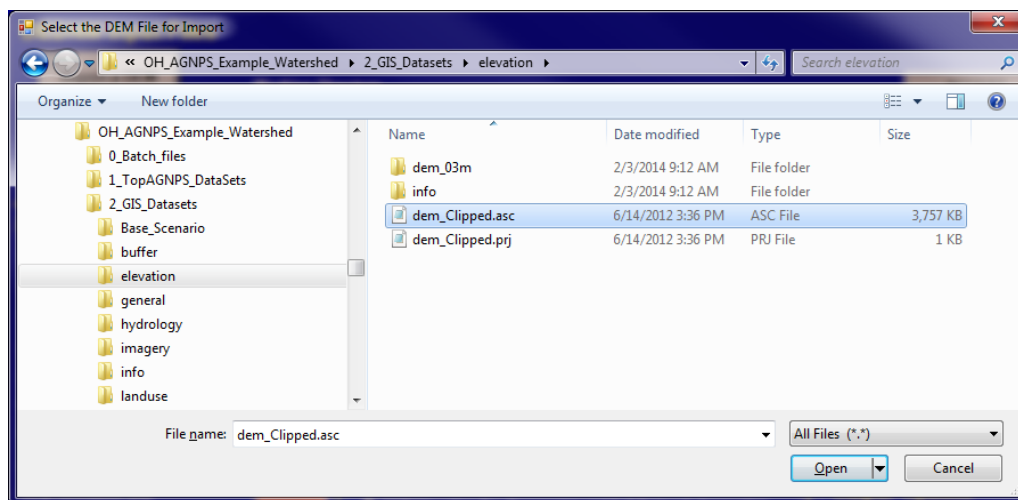
Select the destination file as 'DEDNM.inp' into the working directory 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\1_TopAGNPS_Data Sets'. The working directory should appear by default as this was set in an earlier step.
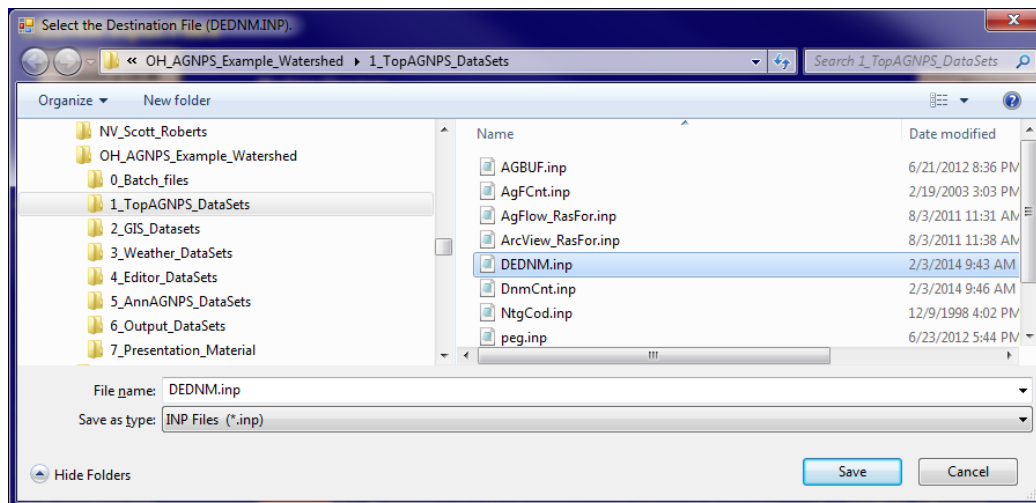
Select Save and the dialog box appears to 'Confirm Save As' and select 'Yes', to replace the existing file if present. DEDNM.inp is the default name for use with TOPAGNPS.
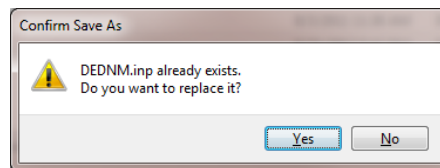
The DEM Properties section is then populated that describes the DEM, except for the outlet row and column to be provided by the user:

5. *CSA and MSCL Values*

The CSA and MSCL values are critical to determining the extent of the stream network and resulting AnnAGNPS cells. This is described in more detail in the TOPAGNPS documentation.

For this example the initial CSA and MSCL values are 2 ha and 30 meters, respectively.

With all of the other parameters left 'as is', select the 'ACCEPT' button and enter the file name
'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\1_TopAGNPS_Data Sets\DnmCnt.inp'. Typically the program will display the last file name entered as C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\1_TopAGNPS_Data Sets\DEDNM.inp, which needs to be updated to Dnmcnt.inp.
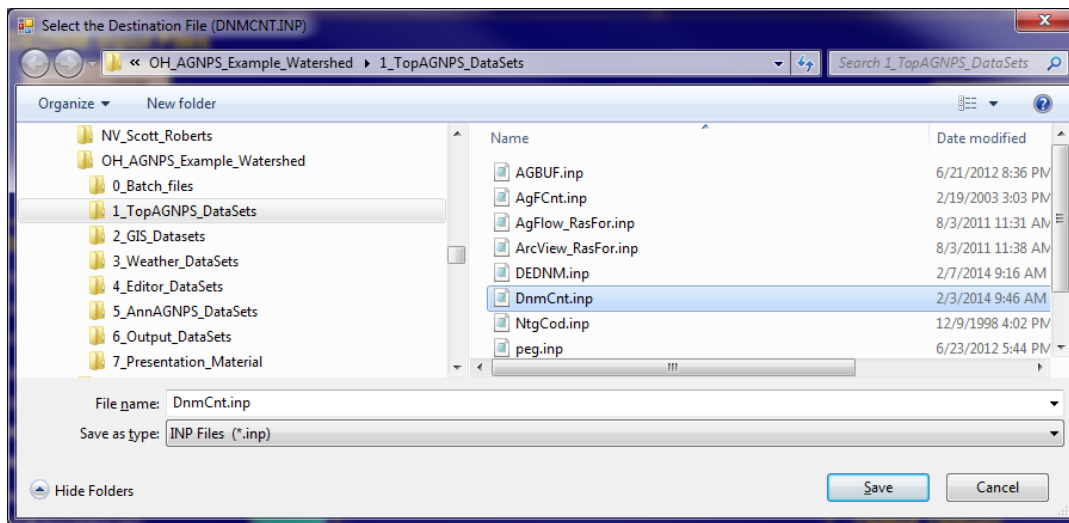
Click the 'Save' button and if a Dnmcnt.inp file already exists then a dialog box will appear and click 'Yes'.
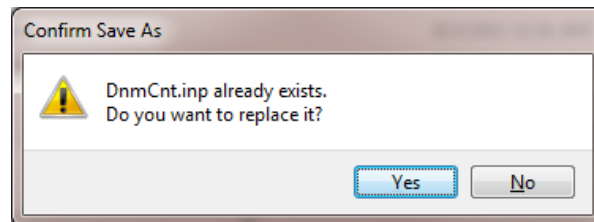
The user will be returned to the Watershed Topographic Parameters window where additional TOPAGNPS input files can be edited.

6. Editing an Existing 'DNMCNT.inp' file

The 'Import Values from an existing 'dnmcnt.inp' file' button allows users to repopulate the parameters from that file, revise any parameters and save the file for later use.

To import all of the 'dnmcnt.inp' file, uncheck the 'Ignore DEM Properties' checkbox and select the 'dnmcnt.inp' file.

By leaving the 'Ignore DEM Properties" checked, then the DEM properties portion of the 'dnmcnt.inp' file will not be imported. The 'Ignore DEM Properties' option is useful when the DEM properties have been entered from importing a DEM and only the other information from a previous 'dnmcnt.inp' file is needed, such as the CSA and MSCL values.

The 'dnmcnt.inp' file can also be directly modified with any ASCII editor, if the user is knowledgeable making those revisions in that manner.

7. Editing RASPRO, RASFOR and AGFLOW Input Files

The recommendation for AGNPS projects is to use the internal input parameter defaults for the Raspro, Rasfor, and Agflow components. Users can select input parameters associated with these components through the TOPAGNPS 'Edit RASPRO Inputs', 'Edit RASFOR Inputs', or Edit AgFlow Inputs' sections. If any of the individual component input files are present when executing TOPAGNPS, then those parameters will be used instead of the internal default values. The TOPAGNPS documentation can be used to review the format and parameter definitions.

8. Selecting an Outlet

An outlet location for the watershed is required to specify where the channel network downstream location begins. Users can obtain this information many different ways including using the GIS Tools of the AnnAGNPS Input Editor as described later. Other techniques can be used including locating the outlet from photogrammetric imagery or from GPS data. Note that the generated stream network may not be the same as expected from photogrammetric imagery or GPS means as a result of topographic processing of the DEM by TOPAGNPS. Thus, the designated outlet location may not fall on a TOPAGNPS stream network as expected.

The outlet can be determined via any number of methods or using the 'AGNPS GIS Tools–AGNPS Data Preparation–Select Watershed Outlet' menu item. For example if TOPAGNPS is executed with the Partial DEM Processing Option of 'DEM Elevation Pr-Processing Only', then the 'UPAREA.asc' and 'AnnAGNPS_Reach_IDs.asc' files are among the files produced that can be used to designate the outlet location. If the 'AnnAGNPS_Reach_IDs.asc' grid file is converted to a shape file for better visual representation via the 'Layer Tools–Convert Grid to Shape' menu option, with a shape file name of 'AnnAGNPS_Reach_IDs_sh' and add to the AGNPS GIS Tools view window with the 'UPAREA' grid file, then the view will appear as the following figure.
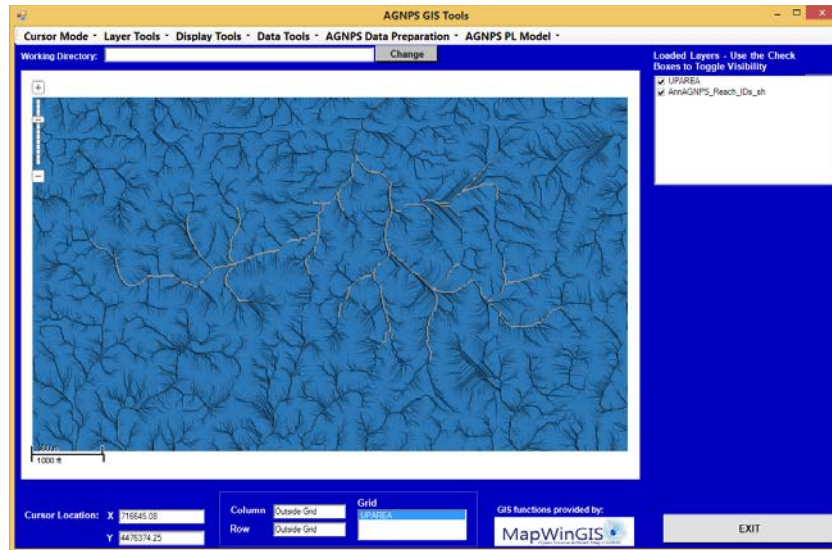
Users can then select the 'AGNPS Data Preparation–Select Watershed Outlet' menu item to begin the selection of a channel raster that defines the outlet of the watershed.
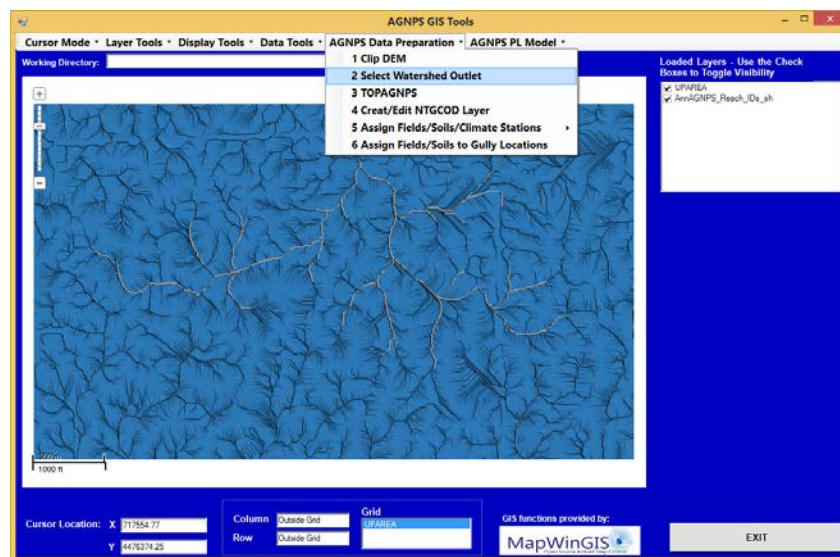
Once the 'UPAREA' grid file is highlighted in the 'Grid Coordinates' box, users can select the 'Select on Map' button and move the cursor into the view window to display the row and column that the cursor is located. When the outlet location is determined then select the location where the row and column parameter fields will be populated.

The outlet location can be recorded and manually placed into the TOPAGNPS.csv control file as 83 and 464, respectively for 'OUTROW' and 'OUTCOL'. The outlet location can also be placed automatically into the TopAGNPS.csv or DNMCNT.inp files by selecting the 'Save Location as TOPAGNPS Outlet ('TopAGNPS.csv' and/or 'DNMCNT.INP')' button. The file selection window will open where the 'TopAGNPS.csv' file can be selected where the program will write the outlet location to the file.

If the outlet location is to be placed into the 'DNMCNT.inp' file instead then select 'Cancel' to select the 'DNMCNT.inp' file to place the outlet location parameters into.

For this example the outlet will be used as row 83 and column 464.

9. Editing PEG, AGBUF and AGWET Input Files

The PEG, AGBUF and AGWET control input files can be edited as described in each programs documentation or using the TOPAGNPS 'Edit PEG Inputs', 'Edit AGBUF Inputs', or 'Edit AGWET Inputs' sections of the TOPAGNPS window of the Input Editor. For the example used in this document those input files have already been prepared as part of the files in 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\1_TopAGNPS_Data

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Sets'. The GIS grid files, 'buffer.asc' and 'vegetation.asc' were previously developed describing the buffer location and type of vegetation and for this example should be copied from 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\2_GIS_Datasets\buffer' to 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\1_TopAGNPS_Data Sets'. The format of these files is also described in the AGBUF document, but for this example the files are assumed to have been previously created based on known or planned buffer locations in the example watershed. For use within AGWET, four barrier points were defined in the file 'AgWet_Barrier_Points.csv' and referred to in the AGWET control file 'AgWet.csv'.

10. Executing TOPAGNPS

After the preparation of all of the input files are completed, the user can select the 'EXECUTE TOPAGNPS' button.
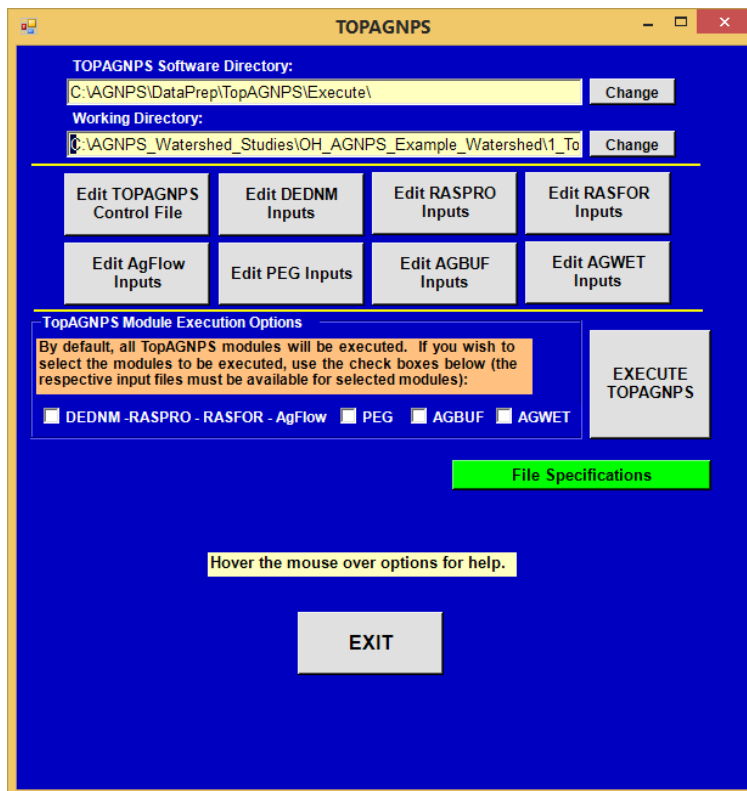
The TOPAGNPS program execution will begin. A dialog box will appear while executing TOPAGNPS with statements describing the progress of the program and will disappear on completion of TOPAGNPS.   All of the statements are written to the TOPAGNPS log file 'TOPAGNPS_log.CSV'. A description of the definitions of the information produced in the log file is described in the file 'C:\AGNPS\DataPrep\TopAGNPS\Document\TopAGNPS_Message_Codes.xlsx.' The

'TOPAGNPS Module Execution Options' check boxes can be left blank when executing all of the TOPAGNPS modules, as the default is to use all of the modules, including the PEG and AGBUF components if their individual input files are present.
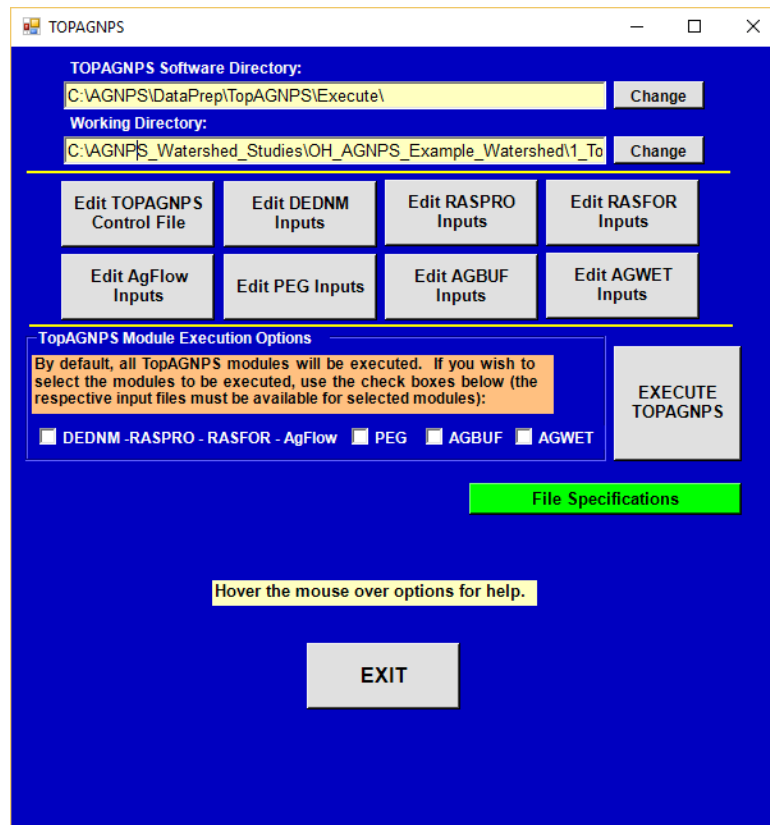
This can be useful if the DEDNM-RASPRO-RASFOR-AGFLOW components have already been created and iterations of the PEG component is only needed, then only the PEG checkbox would be selected. If only the AGBUF component is to be executed then the same procedure for this as described for PEG would be followed.

The information in this log file can be used to confirm the selection of the outlet location. A non-zero raster in this box indicates the number of upstream rasters at that point and thus, the location of the channel network. The outlet selected is required to be in a channel network in order to proceed. The parameter 'OUTSNAP' in the TOPAGNPS control can be used to automatically find a suitable outlet near the user defined outlet if the channel raster row and column is not known. TOPAGNPS will search for the outlet using a search grid defined by the 'OUTSNAP' parameter, such as a value of 2 will search two rasters from the user defined outlet location. If a 'CSA' and 'MSCL' values are not provided then defaults of 10 ha for CSA and 100 m for MSCL will be used.

Users may use the 'DEMPROC' parameter set to '2' when the outlet is not known to create the resulting channel network from the entire DEM produced as the file 'NETFUL.ASC', as well as the 'UPAREA.ASC' file describing the accumulated upstream area. These files can be useful in locating the outlet row and column location. Then an outlet raster row and column location can be determined from the derived channel network and 'DEMPROC' set to '0'.

If the program terminates with an error than an error message is written to the log file and summarized in the error file 'TOPAGNPS_err.CSV'.

When all of the programs have successfully executed the user can exit the 'TOPAGNPS' window.

11. TOPAGNPS Files Generated for use with AnnAGNPS

All of the files in the folder 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\1_TopAGNPS_Data Sets' containing input and output files produced from the TOPAGNPS execution should then be copied to another folder location to save the information generated in this step. For this document the files will be copied to the '2_GIS_Datasets' folder as 'Trial_1'

located as
'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\2_GIS_Datasets\Tri
al_1'. The batch file '1_Save_Files_to_a_GIS_Datasets_Project_Folder.bat' is available
to use when copying the files from
'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\1_TopAGNPS_Data
Sets' to another folder. This batch file will create the folder defined by the user and copy
all of the critical files needed for use later with AnnAGNPS or used to re-execute
TOPAGNPS.

The main files generated by TOPAGNPS for use later within AnnAGNPS are:

AnnAGNPS_Cell_IDs.asc – The AnnAGNPS cell boundary ASCII raster grid file.
AnnAGNPS_Reach_IDs.asc – The AnnAGNPS reach ID ASCII raster grid file.
AnnAGNPS_Cell_Data_Section.csv – The AnnAGNPS cell data section file without
           Soils, Management Field or Climate IDs defined.
AnnAGNPS_Reach_Data_Section.csv – The AnnAGNPS reach data section file.
AnnAGNPS_Ephemeral_Gully_Data_Section.csv – The Ephemeral Gully Data section
            file.
AnnAGNPS_Ephemeral_Gully_Data_Section_Revised_by_AgBuf.csv – Revised
                                        Ephemeral Gully Data section file if
                                        riparian buffers influence ephemeral gully
                                        erosion.
AnnAGNPS_Ephemeral_Gully_Data_Section_Revised_by_AgWet.csv – Revised
                                        Ephemeral Gully Data section file if
                                        wetlands influence ephemeral gully
                                        erosion.
AnnAGNPS_Riparian_Buffer_Data_Section_AgBuf.csv – The Riparian Buffer Data
                                            section file produced by AGBUF.
AnnAGNPS_Riparian_Buffer_Data_Section_AgWet.csv – The Riparian Buffer Data
                                            section file produced by
                                            AGWET.
AnnAGNPS_Wetland_Data_Section.csv – The Wetland Data section file produced by
                                        AGWET.

There are additional files produced that are also useful for visualizing the watershed
characteristics generated, such as:

Netful.asc – Stream network generated for the entire DEM
Netw.asc – Strahler stream order of the watershed selected ASCII Raster grid file.
Relief.asc – Modified DEM from the TOPAGNPS ASCII Raster grid file.
Uparea.asc – The number of contributing upstream raster to any raster location as am
           ASCII Raster grid file.
FLOVEC.asc – Used to display the flow direction of each raster.
PEG_cti_grid_table.asc – CTI Values for every raster as an ASCII Raster grid file.
PEG_summary.txt – X and Y and row and column coordinates for each potential
                     ephemeral gully identified from the PEG program with Gully

characteristics.

PEG_points.asc – X and Y points for each potential ephemeral gully identified from the PEG program with Gully characteristics.

AgWet_AnnAGNPS_Wetland_IDs.asc – The wetland extent generated for each wetland from AGWET.

AgWet_AnnAGNPS_Wetland_Buffer_IDs.asc – The riparian buffer extent generated for each wetland from AGWET.

AgWet_AnnAGNPS_Wetland_Barrier_Points.asc – The wetland and reach intersection point generated for each wetland from AGWET.

AgFlow_LS_Factor.asc – The RUSLE LS factor for each raster within the watershed boundary as an ASCII Raster grid file.

AgFlow_Cell_Longest_Flow_Path.asc – The longest flow path designated for each AnnAGNPS cell within the watershed boundary as an ASCII Raster grid file.

12. Soils, Management Field or Climate Identifiers assigned to Cell Data

The AGNPS GIS Tools can be used to populate the Soils ID, Management Field ID, and Climate File ID in the Cell Data section in order to complete the spatial description of each AnnAGNPS cell. To add the soils, management field, or climate ID to the AnnAGNPS cell data section file, AnnAGNPS_Cell.csv, the user has to have available the associated GIS layers for each. The user has to first add the AnnAGNPS cell layer as an ASCII grid or shape file, a soils shape layer, a management field shape layer, and/or a climate shape layer to the AGNPS GIS tools view window, and then assign the categories to overlay with each layer. Climate ID's are optional as the program will assume use of the 'climate_station.csv' and 'climate_daily.csv' when csv format is used if this ID is left blank in the Cell Data section.

This process is begun after the application of the TOPAGNPS tools has been completed and the AnnAGNPS_Cell_Data_Section.csv and AnnAGNPS_Cell_IDs.asc files have been successfully generated. Begin by adding GIS grid or shape layers as 'Loaded Layers' into the AGNPS GIS Tools using the 'Layer Tools–Add Grid Layer' or 'Add Shape Layer' menu items as shown below. When selecting 'Add Grid Layer', the user can select any ASCII raster or grid file to load into AGNPS GIS Tools.

The Layer Tools also provides the option to convert any grid file to a shape file format or an ESRI Grid file to an ASCII Raster file format.
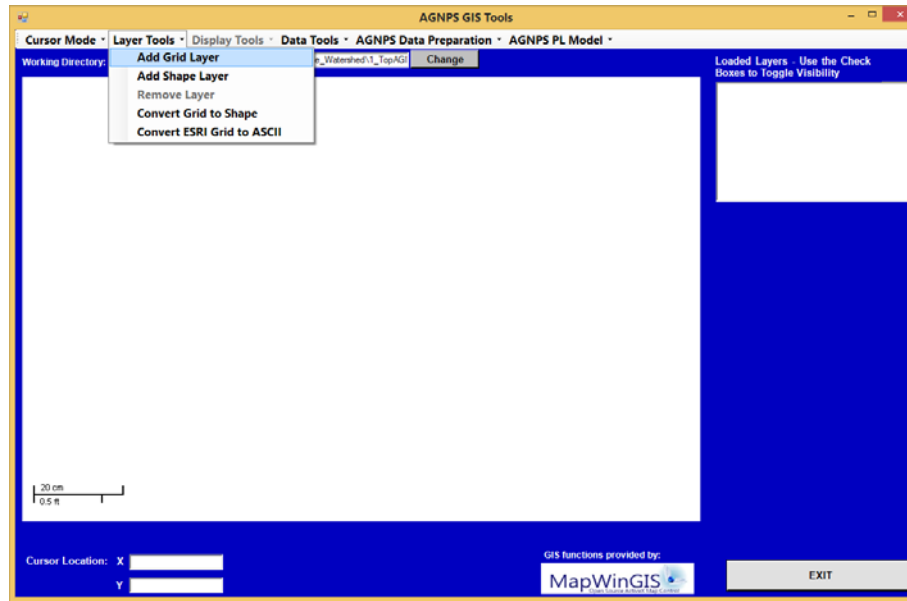
For illustration purposes, the files produced from the TOPAGNPS components of the OH_AGNPS_Example_Watershed example will be used to generate the soils and management field ID in the AnnAGNPS_Cell_Data_Section.csv file previously produced using TOPAGNPS. This assumes that the Soils and Management Field shape files have been previously created. A detailed discussion on the creation of these layers is provided in the document 'AGNPS_GIS_Database_Development_Overview.pdf'. The user has the option of intersecting the Management Field (Fields), Soils, or Climate Stations layers using either the AnnAGNPS cell boundary file defined either as a grid (AnnAGNPS_Cell_IDs.asc) or converted to a shape file. The results will be identical using either method, but the grid file approach is somewhat faster. Creating an AnnAGNPS cell boundary shape file can be useful later when creating output files to join to this shape file to visualize the output results.

To begin, select the working folder location that the TOPAGNPS files to be used are stored, where in this example this is located at 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\2_GIS_Datasets\trial_1'.
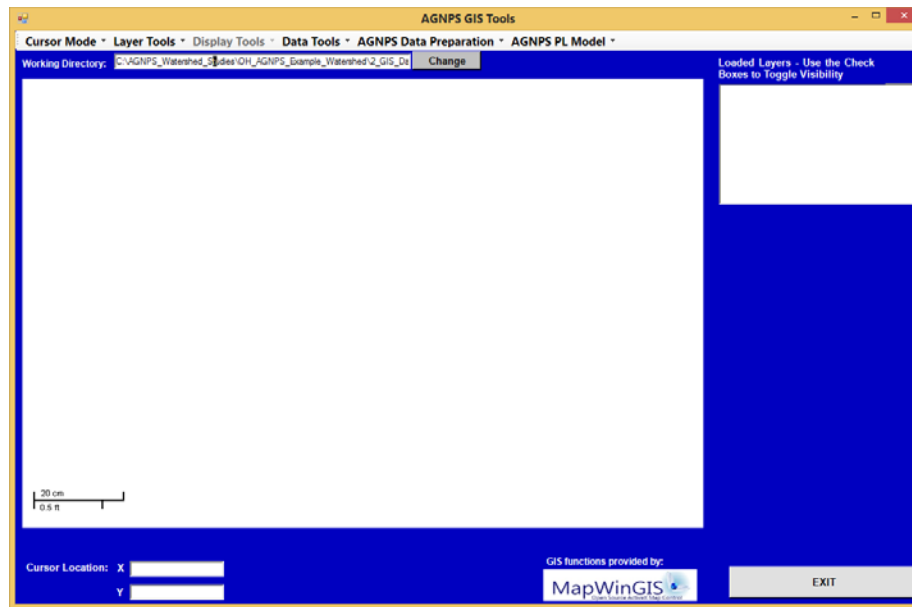
For this example, start by selecting the menu item 'Layer Tools–Add Grid Layer' and select the 'AnnAGNPS_Cell_IDs.ASC' file in the Trial_1 folder to load the grid file and enter the name for the new layer or use the default name of 'AnnAGNPS_Cell_IDs' and select 'CONTINUE' where the layer will be added to the list of loaded layers and the spatial view of the AnnAGNPS cell layer will also appear in the view window. Although, each layer will need to be in the same projection as the DEM for these procedures to function successfully. If the landuse and soils layers are not in the same projection as the DEM, simply reproject the layers using a GIS program like ESRI's ArcMap.
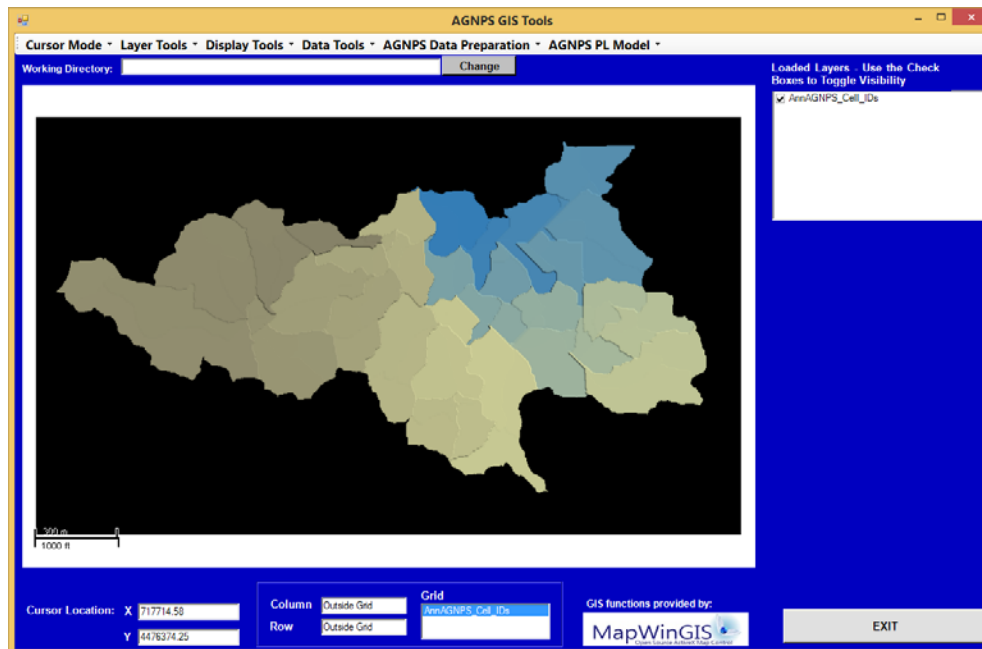
Assign the landuse layer by selecting the menu item 'Layer Tools–Add Shape Layer' and select the landuse shape file
'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\2_GIS_Datasets\landuse\OH_Example_Watershed_Landuse' and designate this as the default name
'OH_Example_Watershed_Landuse'. Assign the soils layer by selecting the menu item
'Layer Tools–Add Shape Layer' and select the soils shape file
'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\2_GIS_Datasets\soils\OH_Example_Watershed_Soils' shape file and designate this as the default file name
'OH_Example_Watershed_Soils'. If a climate shape file indicating polygons assigned to a climate station is available, then the process would be the same in assigning a climate station identifier to an AnnAGNPS cell, but for this example there is not a climate station shape file since there is only a single climate station applied to the entire watershed.
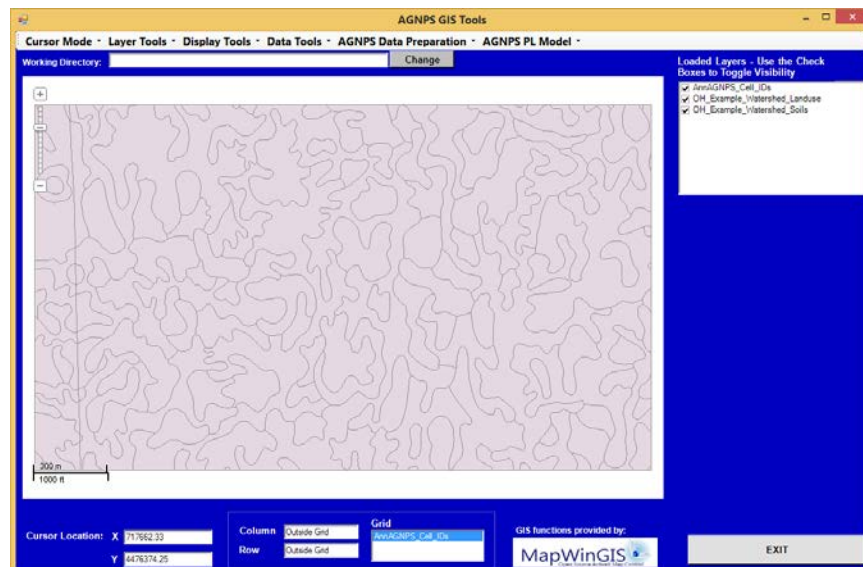
Select the menu item 'AGNPS Data Preparation–Assign Fields/Soils/Climate Stations–Assign Fields'.
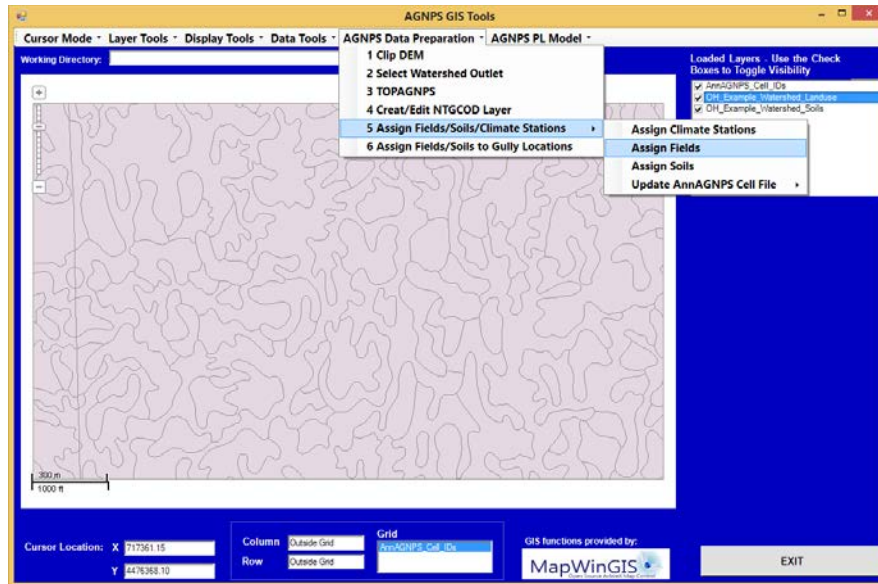
In the 'Layer Selection' window select the Cell Layer as 'AnnAGNPS_Cell_IDs' and the
Management Field Layer as 'OH_Example_Watershed_Landuse' and click on the
'SELECT' button.
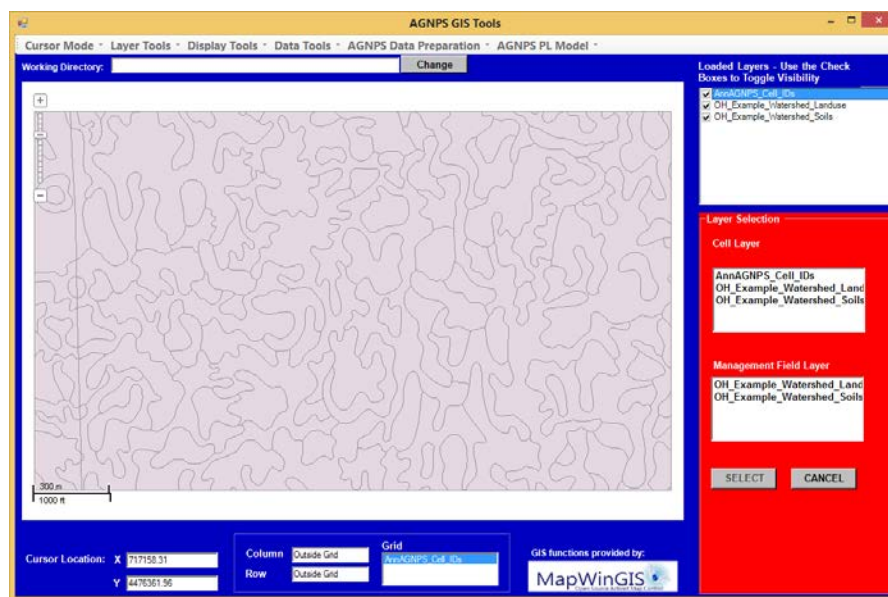
Three Management Field categories in the landuse shape file will appear where the
Landuse_ID is associated with the Management Field data base previously created within
the AnnAGNPS Input Editor and should be selected where then AGNPS GIS Tools
processing will occur to assign a Landuse_ID to each AnnAGNPS cell.
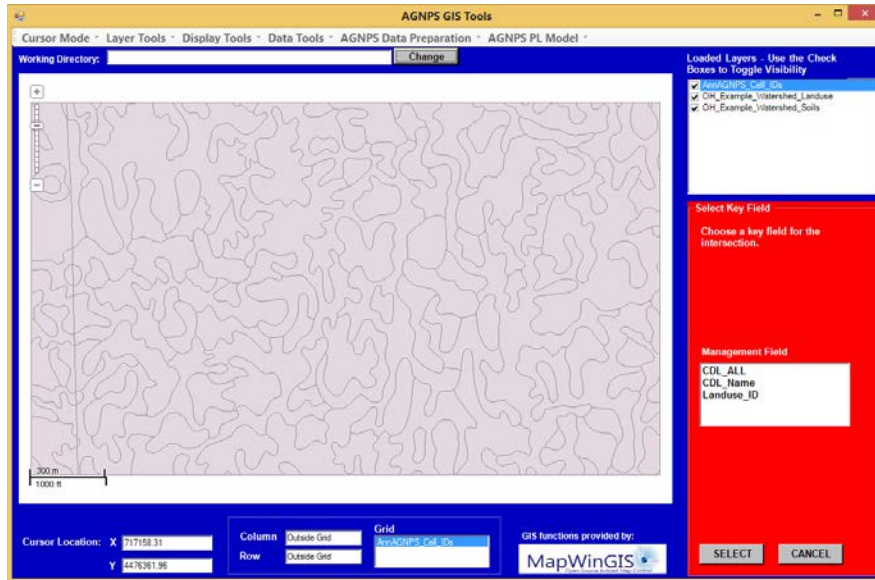
To intersect soils layer information onto the subwatershed layer, select the menu item 'AGNPS Data Preparation–Assign Fields/Soils/Climate Stations–Assign Soils'. Then in the 'Layer Selection' window select the Cell Layer as 'AnnAGNPS_Cell_IDs' and the Soils Layer as 'OH_Example_Watershed_Soils' and click on the 'SELECT' button. Several soil categories in the soils shape file will appear where MUSYM is associated with the Soils data base previously created within the AnnAGNPS Input Editor and should be selected where AGNPS GIS Tools processing will occur to assign a Soils identifier to each AnnAGNPS cell.

To complete the steps of assigning the management field and soils identifier to the AnnAGNPS cell data section select the menu item 'AGNPS Data Preparation–Assign Fields/Soils/Climate Stations–Update AnnAGNPS Cell File–All'.
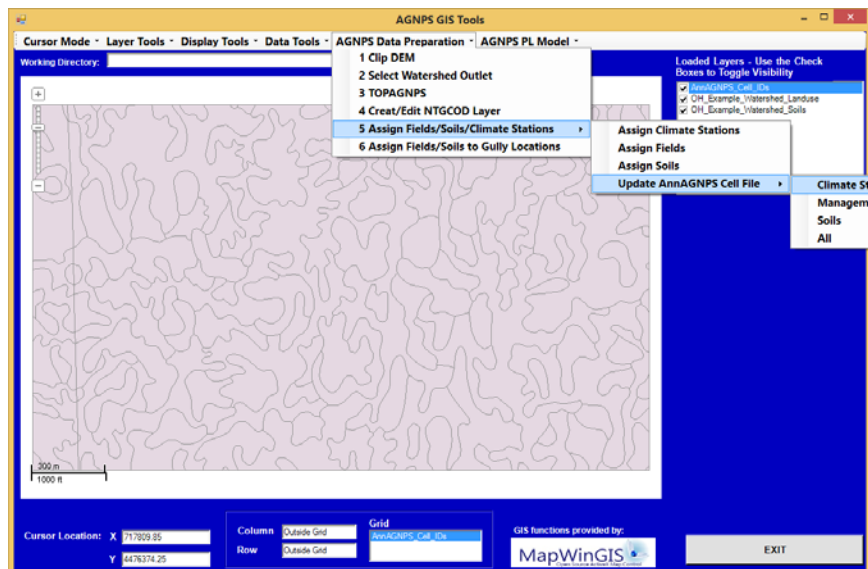
Then select the AnnAGNPS cell data section file created using TOPAGNPS as 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\2_GIS_Datasets\trial_1\ AnnAGNPS_Cell_Data_Section.csv' where the Soil_ID and Management_Field_ID parameters will be populated.
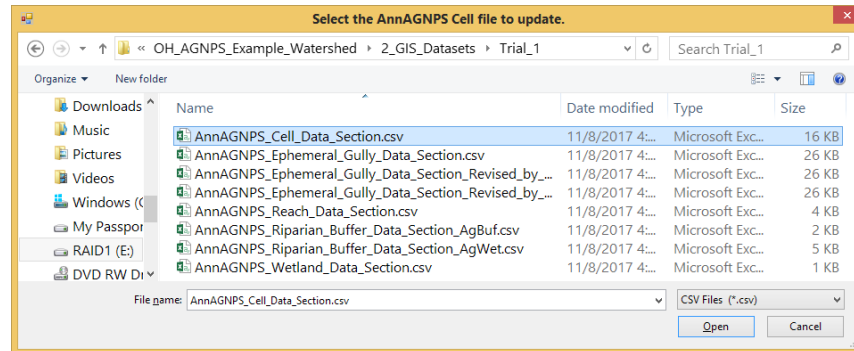
If only the Management Field or Soils or Climate parameter is to be changed without affecting any other parameter, then the user has the option to only change those by selecting the specific menu item.

Once the overlay procedures are completed, then the 'AnnAGNPS_Cell_Data_Section.csv' and 'AnnAGNPS_Reach_Data_Section.csv' files, plus any of the gully, wetland, or buffer input csv files created, can be imported into an existing fixed format AnnAGNPS input file or directly used within the comma-delimited input file format to execute AnnAGNPS, as described in the following section. The Soils ID or the Management Field ID can be assigned to each ephemeral gully defined in the Ephemeral Gully data section using a similar procedure as for defining these in the Cell data section using the menu item 'AGNPS Data Preparation–Assign Fields/Soils to Gully Locations'.

Import Data Section Files into the AnnAGNPS Input Editor

The files created from the AGNPS GIS Tools can be imported into a new or existing AnnAGNPS fixed format input file or comma-delimited data section input files for use in simulating the watershed with AnnAGNPS. These files can also be directly copied to the csv data section input files used to execute AnnAGNPS. Either these imported files can be the starting point for creating other input data sections or can be used with existing AnnAGNPS input files with all of the necessary input data sections populated.

For this example all other input data sections have been created for those data sections that describe the required data, including soils data from USDA-NRCS NASIS database and those based on the management data sections from the RUSLE2 databases. Information on how to populate these data sections is provided later in this document.

Open an existing AnnAGNPS watershed input file using the AnnAGNPS Input Editor menu item 'File–Open Existing AnnAGNPS File–Comma-Delimited (*.csv)', in this case from the watershed example 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\4_Editor_DataSets\ CSV_Input_Files\annagnps_master.csv'. Then import all of the relevant previously

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created csv files using the file import options of the AnnAGNPS Input Editor.

Select the menu item 'File–Import–From Comma-delimited files–Cell Data' and select the AnnAGNPS cell data file 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\2_GIS_Datasets\trial_1\AnnAGNPS_Cell_Data_Section.csv' to import into the editor.
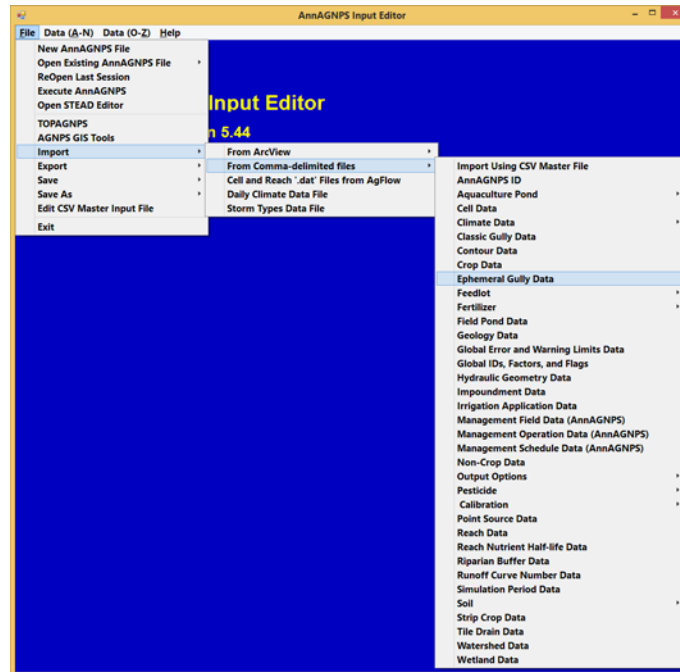
Continue importing the comma-delimited files 'AnnAGNPS_Reach_Data_Section.csv' for Reach Data, 'AnnAGNPS_Ephemeral_Gully_Data_Section.csv' for the Ephemeral Gully Data (for this example), 'AnnAGNPS_Wetland_Data_Section.csv' for the Wetland Data and 'AnnAGNPS_Riparian_Buffer_Data_Section_AgBuf.csv' for the Riparian Buffer Data sections.

When the importing process of the data section files is complete, save the AnnAGNPS file as comma-delimited files by selecting 'File–Save–Save AnnAGNPS Input Files as Comma Delimited files (*.csv).
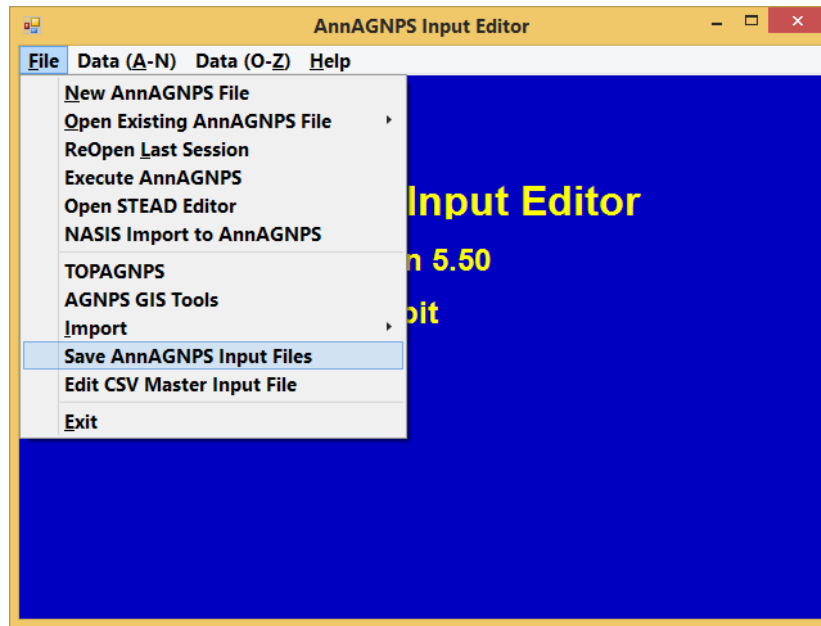
A csv export window will appear where users can change the location of the csv files to be saved. For this example, the Master File Path and file name will remain the same as when the file was opened and the 'Save/Export Files' button can be selected.
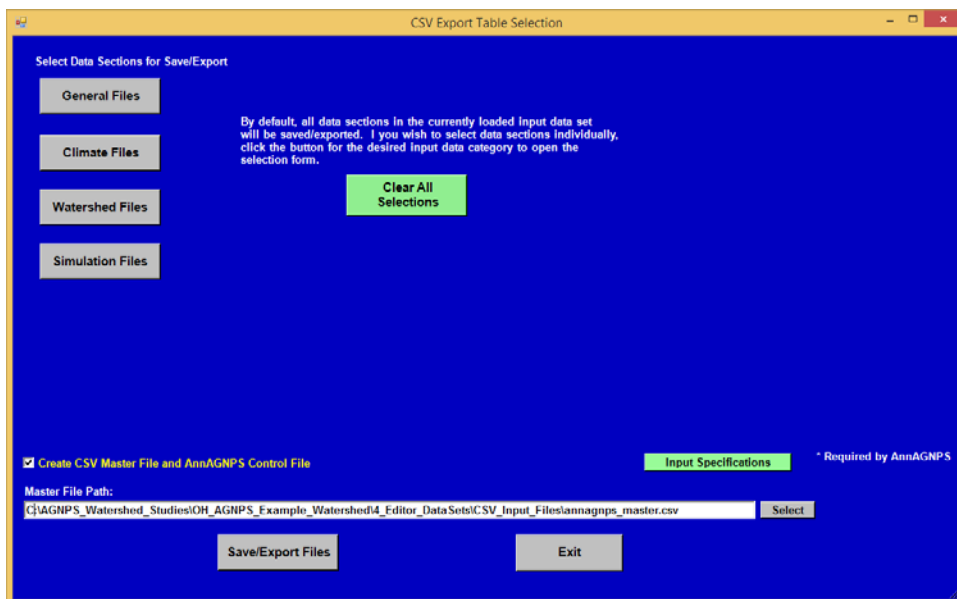
Alternately, the user can choose to save the input files to a working folder that will be used to execute AnnAGNPS and store output files as well. For this example the original input files will be stored as

C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\4_Editor_DataSets\C
SV_Input_Files\annagnps_master.csv' and the same files used as working input will be
saved as
'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\5_TOPAGNPS_Dat
aSets\annagnps_master.csv'.

Execute the AnnAGNPS model by selecting the 'File-Execute AnnAGNPS' menu item
where the AnnAGNPS Executable Directory and the AnnAGNPS Input Directory will be
populated with the AnnAGNPS executable folder when located in the C-drive and the
saved folder of the input files.
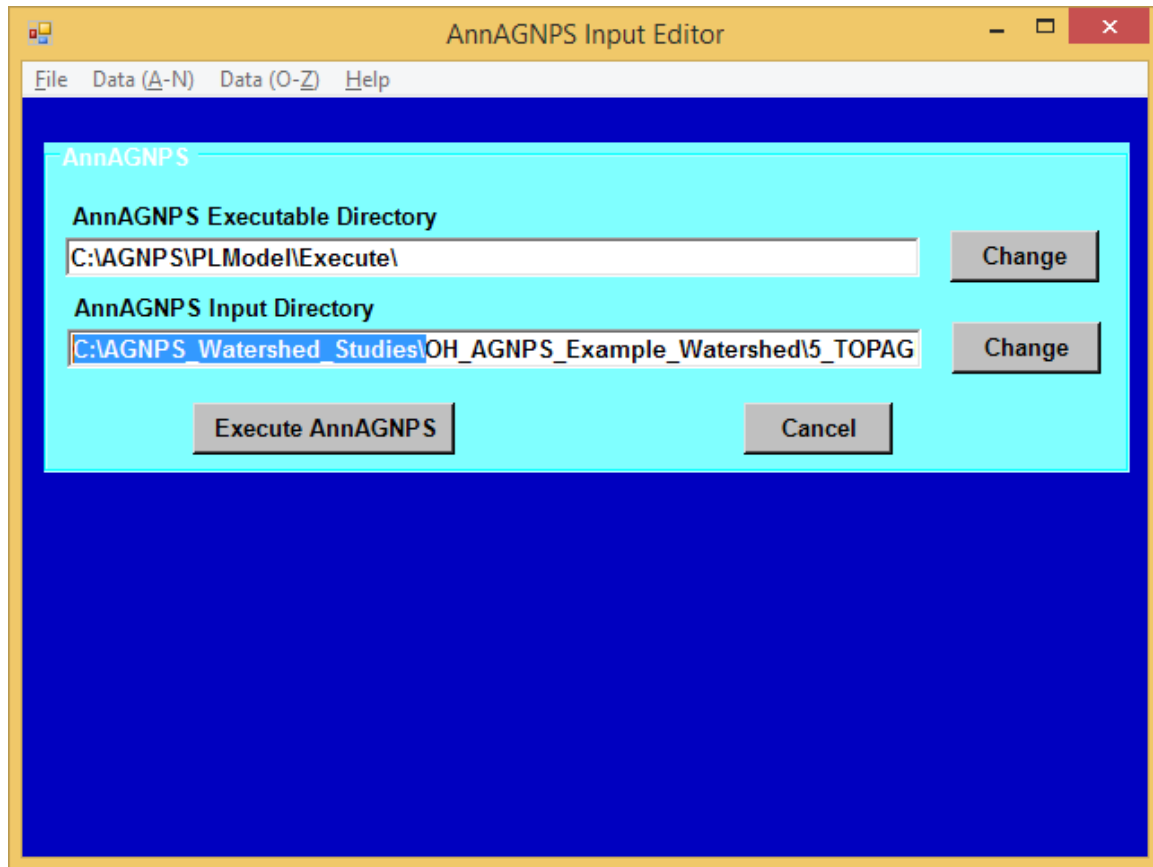
Users can also execute AnnAGNPS from the shortcut batch file
'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\0_Batch_files\5_exe
cute_AnnAGNPS.bat'. This will execute the AnnAGNPS input files and produce the
results in the folder
'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\5_AnnAGNPS_Dat
aSets'.

Alternately, the AnnAGNPS model can be executed from within the AGNPS GIS
TOOLS by selecting the menu items 'AGNPS PL Model–Execute AnnAGNPS'. The
user then can select the folder where the AnnAGNPS.exe exists (typically at

'C:\AGNPS\PLModel\Execute\') and the AnnAGNPS Data folder where the AnnAGNPS input files exist where this example the AnnAGNPS csv input files are recommended to be copied to the folder 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\5_AnnAGNPS_Dat aSets'.
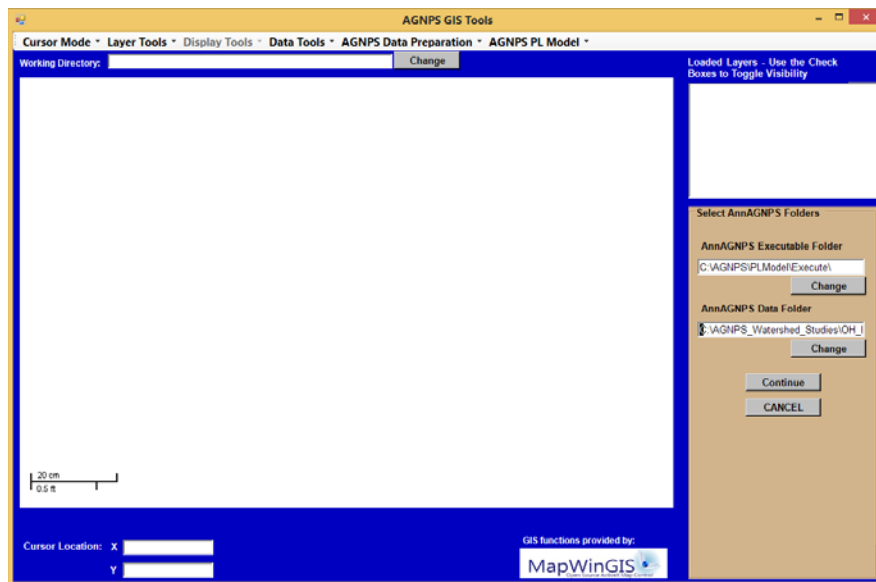
Alternatively, the AnnAGNPS model can be executed using the batch file '' located within the folder 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\5_AnnAGNPS_Dat aSets\1_execute_AnnAGNPS.bat' if all of the AnnAGNPS input files are also located in the folder, 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\4_Editor_DataSets\ CSV_Input_Files'.

Also contained in this '5_AnnAGNPS_DataSets' folder is an Microsoft excel macro file (Source_Load_Contributing_Area_Graph.xlsm) that has been developed to process load data into a predefined graph. The 'Output Options–Standard Text Output Files–Average Annual Values' section parameters should be selected to produce output files for use with this feature. Each 'unit_area' option selected will produce a file that can be utilized in this macro, such as selecting the 'AA_Water_load_(unit_area)' parameter will produce the output file 'AnnAGNPS_AA_Water_load_UA_RR_Total_OUTLET.csv' in the folder 'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\5_AnnAGNPS_Dat aSets\CSV_Output_Files\UA_RR_Output'.

Utilization of the macro is accomplished by opening the 'Source_Load_Contributing_Area_Graph.xlsm' file using Microsoft Excel.
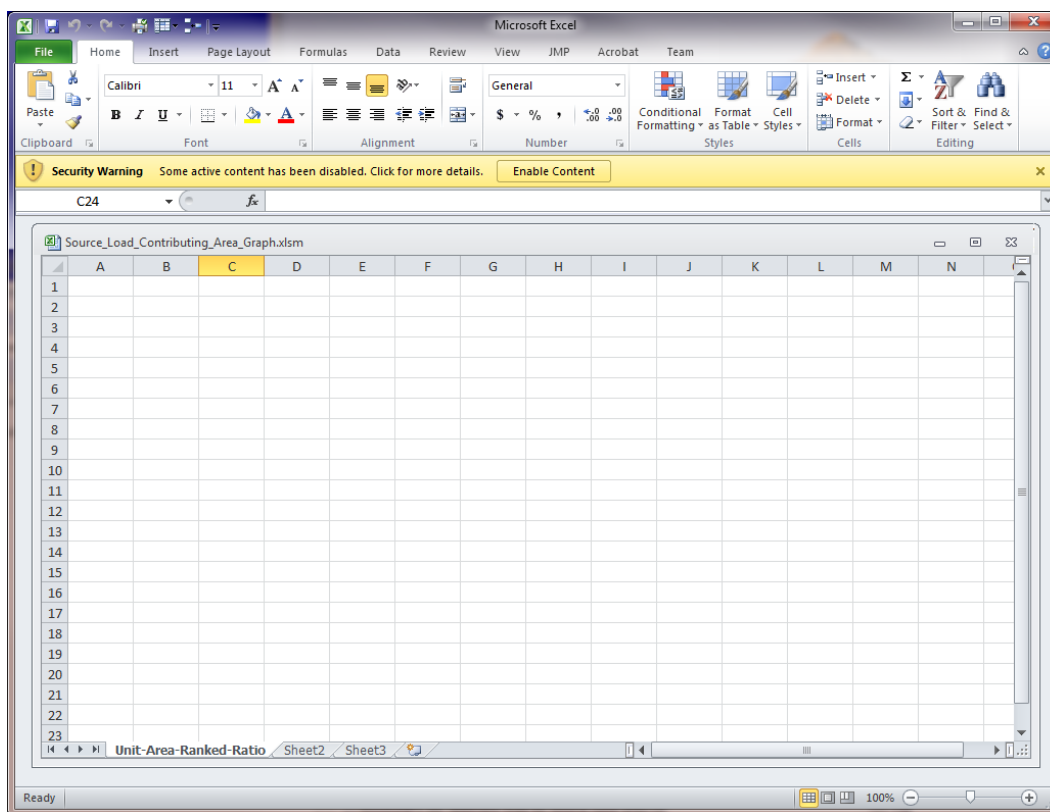
Select the 'Enable Content' button and locate the file of interest. In this example the Nitrogen Load file
'C:\AGNPS_Watershed_Studies\OH_AGNPS_Example_Watershed\5_AnnAGNPS_Dat aSets\CSV_Output_Files\UA_RR_OutputAnnAGNPS_AA_Nitrogen_load_UA_RR_Tot al_OUTLET.csv' will be used as produced by selecting the
'AA_Nitrogen_load_(unit_area)' output option in the Output Options data section of the AnnAGNPS Input Editor and executing AnnAGNPS. The scaling factor dialog box appears and provides a means to compare various scenarios with a base condition by entering a base load to the current scenario. In this case there is no base scenario defined yet so no value is modified and OK is selected with the default value shown.
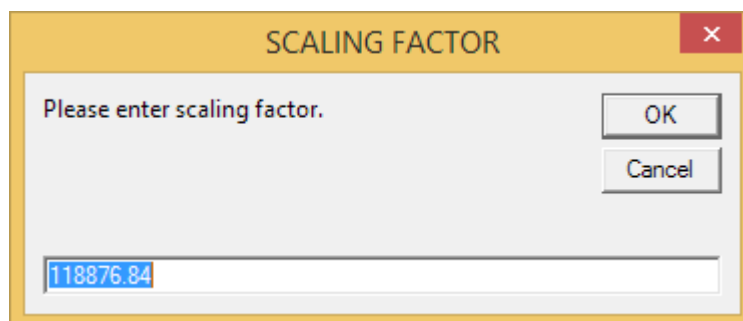
A window will appear to save the results into a separate file and in this case was named 'Nitrogen_Total_Source_Load_Contributing_Area_Graph.xlsx'. Select 'Yes' or 'OK' to any boxes that may appear. A contributed load to contributed drainage graph will be produced displaying the loads from all AnnAGNPS cells accumulated by highest load.

This is often helpful in understanding where the most pollutant loads originate from within the watershed simulation.
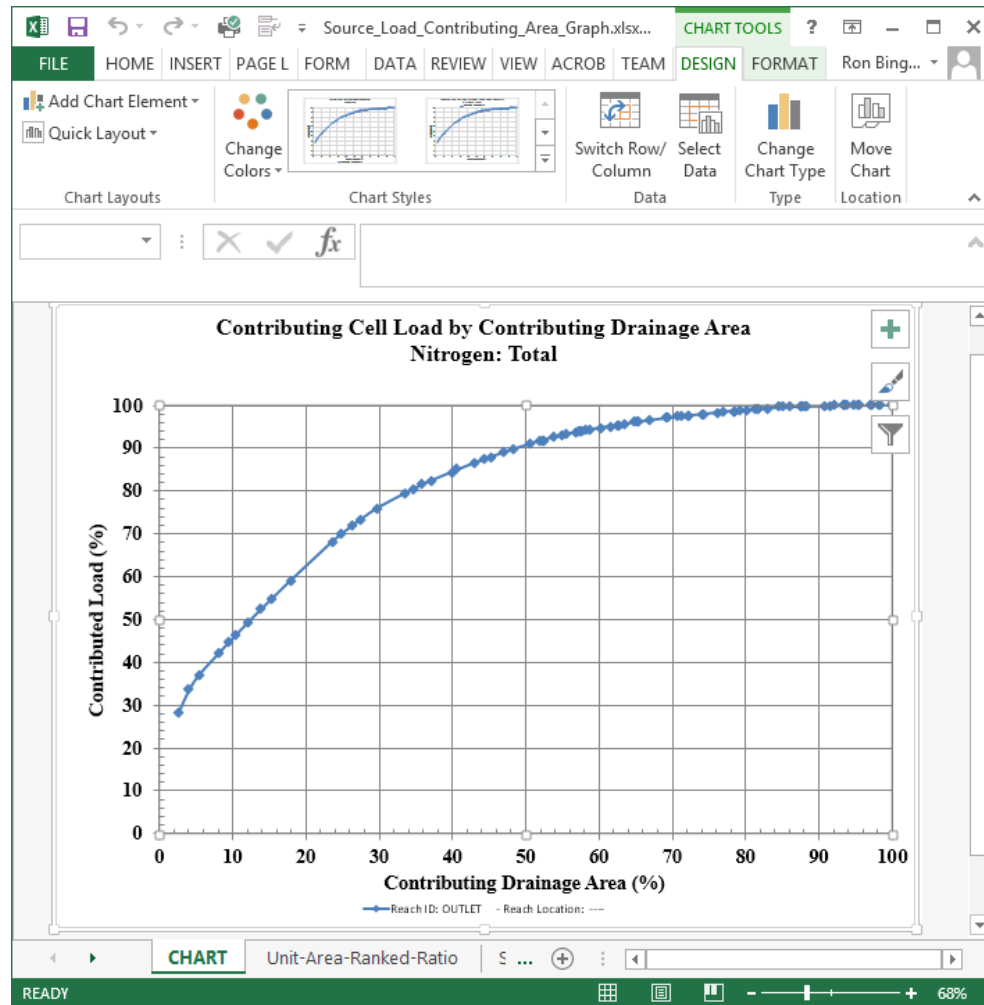
This procedure can be continued for all similar unit-area_ranked_ratio files.

The 'unit_area' files can also be used to spatially display the simulation pollutant loading results by joining the 'unit area' file with the shape file produced from the AnnAGNPS_subwta.asc file. The join is produced using the 'Gridcode' parameter of the shape file and the 'Cell_ID' of the 'unit_area' file.

Populating the Other AnnAGNPS Data Sections

The TOPAGNPS tools is used to create the Cell, Reach, Ephemeral Gully, and Riparian Buffer data sections from spatial data that describe the watershed. Other relational data sections that are referred to in these data sections, such as the soils and management field data sections, requires the user to prepare the input parameters in these data sections from many sources. A brief review will be provided on techniques to populate the required

data sections necessary to execute AnnAGNPS from existing databases. Data sections populated within the AnnAGNPS Input Editor can be exported into a comma-delimited format for easy use in spreadsheet programs, such as Microsoft Excel. The AnnAGNPS program can also be executed directly from comma-delimited files instead of the fixed format AnnAGNPS input files.
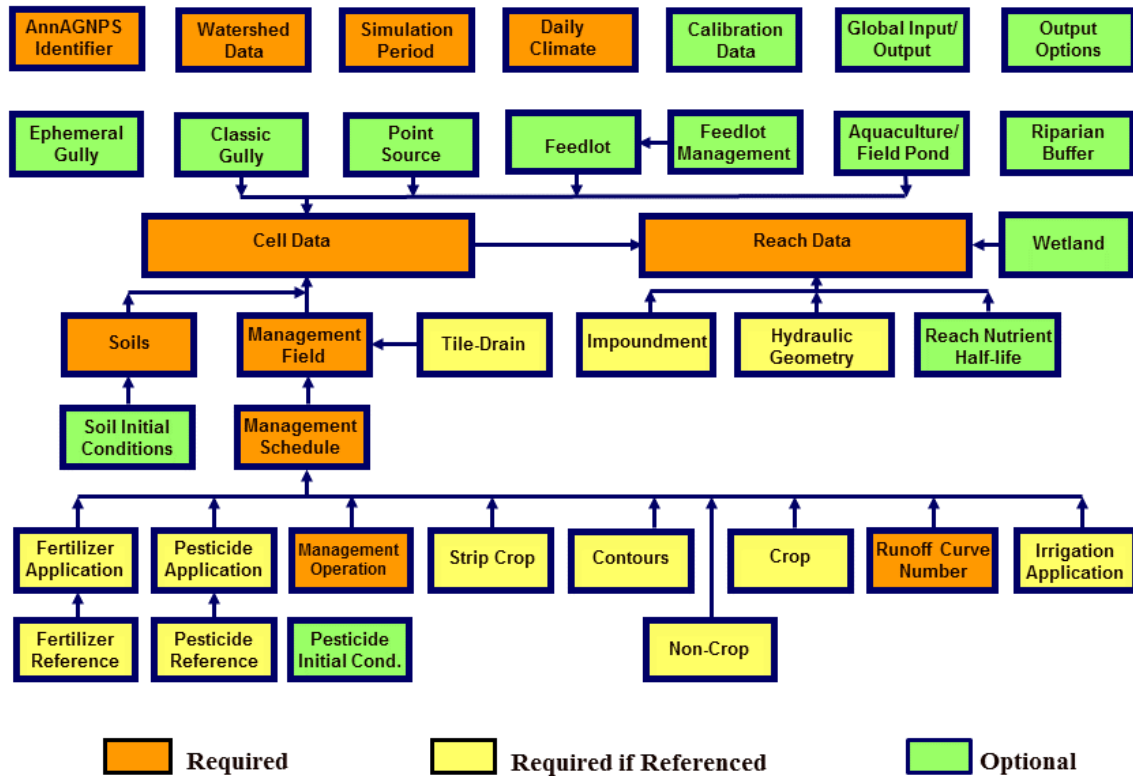
AnnAGNPS input data sections.

AnnAGNPS Identifier/Watershed Data Section

The AnnAGNPS Identifier data section requires basic information about whether English or SI units are to be used in the input or output parameters. If left blank, then all unit options will utilize English units. The 'Screen Output Units Code' provide the user an option to display output on the screen as AnnAGNPS is running.

The Watershed Data Section requires a 'Watershed Name' and 'Watershed Description' to be provided that is used as header information in many of the output files to distinguish from other watershed simulations the user may perform. These can be any 80 characters the user wants to utilize.

The Latitude and Longitude are often defined based on the centroid of the watershed, but can be defined as any point in or near the watershed. This information is not currently used and can be left blank.

Simulation Period Data Section

The Simulation Period data section defines mostly time varying parameters. The 'Simulation Begin Date' and 'Simulation End Date' will define the time that the simulation will start and end and requires that the climate data also contain at least this period in order to execute AnnAGNPS. The year can be any year from year 1 to 9999 and is referenced based on Gregorian years. The typical starting year generated from the GEM6 Climate Generator is year 1. Historical years are often associated with validation datasets and can be utilized as well.

The 'Rainfall Factor' can be determined from Chapter 2 of the RUSLE Handbook 703, pages 47-51. An electronic copy of the handbook is available as part of the AGNPS downloads located at 'C:\AGNPS\DataPrep\Document\RUSLE_Users_Guide\AH_703.pdf'.

The '10 Year EI' can be determined from Chapter 2 of the RUSLE Handbook 703, pages 55-58.

The 'EI Number' can be determined from Chapter 2 of the RUSLE Handbook 703, page 53.

The 'Annual K-factor code' indicates whether the K-factor is to be calculated based on input parameters or used based on the K-factor provided in the soil data section. If this is left blank then the default is to calculate the K-factor.

The 'Variable-K-factor code' is used to determine whether the K-factor varies throughout the year as described in AH-703, Chapter 3.

The 'Number Initialization Years' defines the number of years to execute prior to performing the watershed simulation. From 0 to 100 years can be selected, with a default of 2 years.

The 'Initialization Method Code' is used to determine whether a typical weather year is used for initialization where all of the climate years are evaluated and the year closest to a normal year is utilized. The other option is whether the climate data is reused. The default is to use typical weather.

Global IDs, Factors & Flag Data Section

There are many parameters that are defined as defaults in this section, but one critical parameter that should be examined is the 'Watershed Storm Type ID' defined in the 'Global IDs' section. While the default is 'Std. SCS Type II' and describes most of the US, there are areas of differences that should be examined using the NRCS rainfall distribution map provided on page B-2 of the NRCS TR-55 'Urban Hydrology for Small Watershed' document provided as part of the AGNPS downloads at 'C:\AGNPS\Utility\TR55\tr55.pdf'.

Other parameters that utilize defaults that the user may want to consider occur in the 'Global Flags' section with the 'FAO ET Enhancement' and 'Basal Crop Coefficient Climatic Adjustment Code' parameters. While the default is to use these parameters, the user can turn off the FAO ET functionality with these parameters.

There are many options the user may want to examine with ephemeral gullies and the 'Ephemeral Gully Factors and Flags' section describe many parameters that can be selected as global defaults for all ephemeral gullies. Individual gully parameters can also be defined in the Ephemeral Gully data section.

Soil Data Section

The Soil data section can be directly populated from NRCS Soil Survey Center's NASIS data using procedures provided in the 'NASIS Download Instructions' button. The spatial data associated with SSURGO can also be obtained for each county in the US as described in these instructions. The spatial data is helpful in assigning a Soil ID to each AnnAGNPS cell as described earlier using the AGNPS GIS TOOLS.

Instructions for Obtaining NASIS Soil Data for AGNPS

The AnnAGNPS soils data section can be populated using the following instructions to access the NRCS Soil Survey NASIS data. In addition, the SSURGO spatial data associated with the NASIS data can be downloaded for any county in the US where the data is available. The 'musym' parameter is the key to linking the spatial data to the soil data section. If issues with the same soil defined with different musym parameters is an issue than the user may want to consider replacing the 'mu.musym' parameter in the following script with 'mu.mukey'. The mukey is unique to any soil and would follow the same mukey across county boundaries, unlike some musym identifiers. The downside of the mukey is that the numeric value used is not a parameter that has any descriptive meaning in of itself that the musym value may provide.

1. Copy the following script into a text editor (Notepad, etc.)

```
select
sa.saverest,
l.areasymbol,
l.areaname,
mu.musym,
hydgrp,
kwfact,
albedodry_r,
(SELECT CASE when min(resdept_r) is null then '>200' else cast(min(resdept_r)
as varchar) END
```

from component left outer join corestrictions on component.cokey =
corestrictions.cokey where component.cokey = c.cokey and reskind is not null) as
restrictiondepthr,
partdensity,
c.compname,
texdesc,
hzdepb_r,
dbovendry_r,
claytotal_r,
silttotal_r,
sandtotal_r,
 (select sum(cf.fragvol_r) as fragvol FROM chfrags cf WHERE cf.chkey =
ch.chkey) as fragvol,
sandvf_r,
caco3_r,
ksat_r,
wthirdbar_r,
wfifteenbar_r,
om_r,
ph1to1h2o_r,
c.comppct_r

FROM
legend l INNER JOIN mapunit mu ON mu.lkey = l.lkey
LEFT OUTER JOIN sacatalog sa ON sa.areasymbol = l.areasymbol
LEFT OUTER JOIN component c ON c.mukey = mu.mukey
LEFT OUTER JOIN chorizon ch ON ch.cokey = c.cokey
LEFT OUTER JOIN chtexturegrp ct ON ch.chkey=ct.chkey

WHERE l.areasymbol = 'IL011' and ct.rvindicator = 'yes'

Order by l.areasymbol, musym, hzdepb_r

2. Edit the next to last line in the script, replacing the area symbol 'IL011' with the
   area symbol of the area for which data is desired. The county area symbol and
   SSURGO spatial data can be obtained via the website:
   http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

    a. Open this link by right clicking on the link and selecting the option 'Open
        Hyperlink'. A web browser window will open at this site.

b. Expand the links, if needed, in the 'Quick Navigation' tab.
c. Select the 'Soil Survey Area' tab. Enter the state and county information associated for your watershed or select the county. For the AGNPS example, the county is Mercer County, OH associated with Area Symbol 'OH107'. The Area Symbol will be used in Step 3 below to obtain the AnnAGNPS soil parameters.
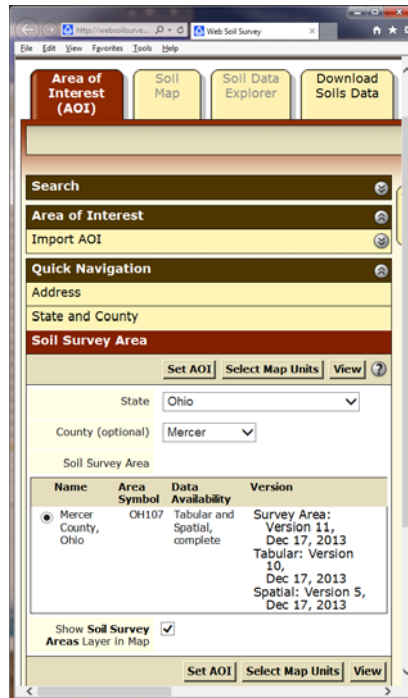
d. The spatial soil data (SSURGO) for this area can be obtained by selecting a county and selecting the 'Set AOI' button.

e. Once the AOI has been created then select the 'Download Soils Data' tab at the top of the page.

f. Select the 'Soil Survey Area (SSURGO)' menu item.

g. Select the associated 'Download Link' to obtain the files (ex. 'wss_SSA_OH107_soildb_OH_2003_[2013-12-17].zip' for Mercer County, Ohio). The SSURGO ESRI shape file is located in the extracted 'spatial' folder as 'soilmu_a_oh107', with the associated soil table key as 'musym' (Mapping Unit Symbol). Note that this soil shape file should be reprojected into the projection used for the DEM of the watershed for application with the AGNPS GIS Tools features.

This procedure can be repeated for other counties to obtain the area symbol for the soil databases and SSURGO shape files for the entire watershed."

3. The process to obtain the associate soil database that corresponds to the SSURGO soil shape file involves opening the link below in a new browser window:
   http://sdmdataaccess.nrcs.usda.gov/Query.aspx

4. Copy and paste the script from step 1 and modified by the county area symbol into the query window on the 'Soil Data Access – Query' web page.

5. Below the query window, select 'Queued / Text' for the results format. Check the box marked 'First row contains column names'. Set the options as vertical bar '|' for the Field Delimiter, and double quote "" for the text delimiter.

6. Enter the e-mail address to which the data is to be sent.

7. Submit the query.

8. A link to the data file will be sent to the specified e-mail address from NRCS. Please make sure your email program will allow the NRCS email address of 'SoilDataAccess@nrcs.usda.gov' to deliver their email to your system. The file may then be downloaded from the data link. The downloaded file will be in '.zip' format with a name such as 'SDMQuery674.zip'. The number '674' within the filename will vary based on each individual query. The zip file contains a file that is always named 'Table.txt', which must be unzipped before it can be imported into the Input Editor. It is recommended that the 'Table.txt' file name be changed to something that relates to the content of the file such as 'NASIS_Table_OH-107_Mercer_County_Accessed_2011.11.30.txt'. For this example, Auglaize County, Ohio was also obtained to produce a file 'NASIS_Table_OH-011_Auglaize_County_Accessed_2011.11.30.txt'

9. There are two options to produce the AnnAGNPS soil data inputs. The recommended option is to execute the NITA program located in the folder '\AGNPS\Utility\NITA\Execute' with the NASIS downloaded files. The use of NITA will correct and combine all associated soil files into a combined set of

AnnAGNPS soil and soil layer AnnAGNPS input files that can then be used to import soil data into the Input Editor via the 'Import' menu option.

The other option is to use the files 'NASIS_Table_OH-107_Mercer_County_Accessed_2011.11.30.txt' and 'NASIS_Table_OH-011_Auglaize_County_Accessed_2011.11.30.txt' that can be imported into the AnnAGNPS Input Editor one at a time using the Soil Data section 'Import NASIS Soil Data' button.
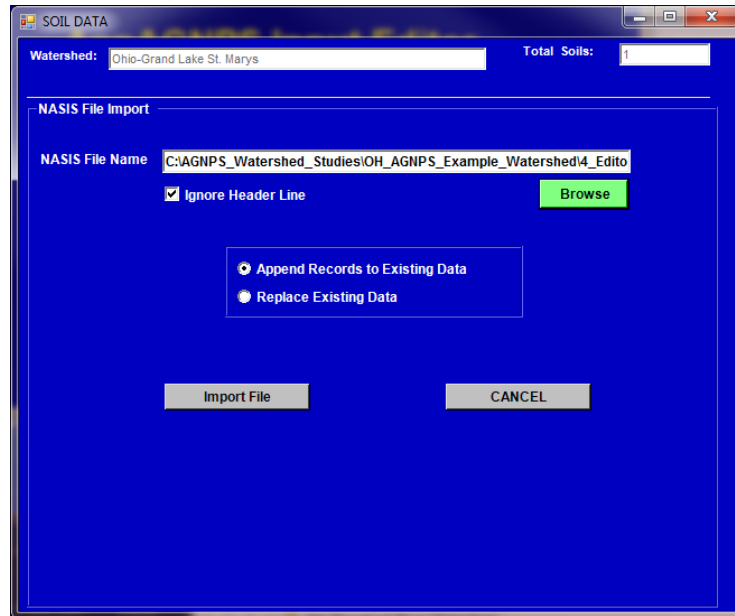
After selecting the associated NASIS File Name, with the 'Ignore Header Line' parameter checked, the information can be appended to an existing file or replace an existing soil data set by selecting the 'Import File' button.

A window will open that allows users to select individual soils or to add all of the soils. After clicking 'Finished' all of the NASIS soil parameters pertaining to AnnAGNPS will be populated within the Soil data section of the AnnAGNPS Input Editor where the data section can be accepted and saved into an AnnAGNPS input file.
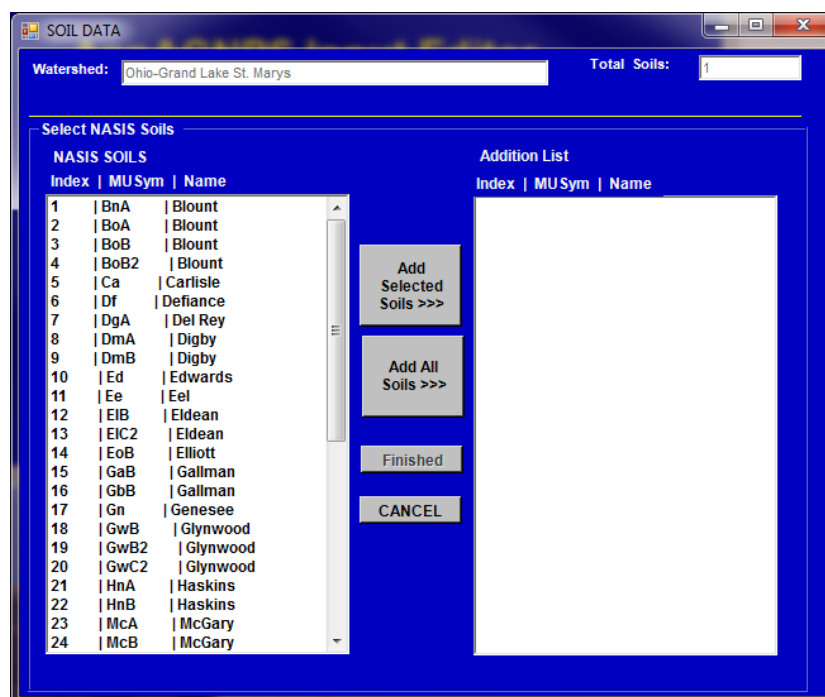
The user should inspect the data to evaluate if there is missing data. The user should also consider values for the Organic and Inorganic N and P ratios if nutrient results will be produced. Since these parameters are not part of the NASIS database, the users can either use the defaults or enter in site specific data for these nutrient parameters.

The soil data produced from NITA can also be exported into a comma-delimited format using the 'File-Export-Comma-Separated Value Files (*.csv)' menu item. This will produce two files 'soildat.csv' and 'soil_layers.csv' that can be edited and imported back into the Input Editor or used directly when applying AnnAGNPS. Note that some Soil IDs obtained from the NASIS MUSYM field will contain characters that can also be interpreted as numeric values when opening the file directly within Microsoft Excel. An example is when the Soil ID has an 'E' in the ID followed by a number such as '120E2' where this is read as '12000' when converted by default using Microsoft Excel. If needed and to prevent Excel from changing by default the Soil ID to a number and leaving this as a text field follow the following steps: 1. open a new blank worksheet within Excel; 2. On the **Data** tab, in the **Get External Data** group, click **From Text**; 3. locate and double-click the text file that you want to import; 4. In the **Text Import Wizard – Step 1 of 3** dialog box check the **Delimited** file type and select **Next**; 5. In the **Text Import Wizard – Step 2 of 3** dialog box check the 'Comma' **Delimiters** option and select **Next;** 6. In the **Text Import Wizard – Step 3 of 3** dialog box check **Text** as the Column data format and select **Finish**; 7. Finally, select **OK** in the **Import Data** window. Then save the file to the same file name as the file using the **CSV (Comma-delimited) (*csv)** type format that was imported or as a revised name if needed after completing any revisions to the data as necessary.

Runoff Curve Number Data Section

The NRCS runoff curve number is very important in the determination of water loads. The Curve Number ID is associated with the soil hydrologic groups A, B, C, and D. The Curve Number ID is assigned within a Management Schedule created within the Management Schedule data section by the user. If a Curve Number ID is not assigned then default values assigned within the 'Global IDs, Factors, and Flags Data section for crop or non-crop events will be used.

Typical curve numbers are provided in Table 2-2a-d on pages 2-5 through 2-8 of the NRCS TR-55 'Urban Hydrology for Small Watershed' document and available as part of the AGNPS downloads at 'C:\AGNPS\Utility\TR55\tr55.pdf'. The information in these tables has also been prepared in a comma-delimited file for import into the editor or directly used in the execution of AnnAGNPS as a comma-delimited and is located in the AGNPS downloads as 'C:\AGNPS\Ref_Data\Runoff_Curve_Number_Data_Input_Editor_v5.0_Format.csv'.

If a Curve Number ID is left blank in the Management Schedule then the previous Curve Number ID in the Management Schedule would be applied to subsequent events until a new Curve Number ID is defined. If there are no Curve Number IDs defined for any event within a Management Schedule then the 'Default Crop RCN ID' or 'Default Non-Crop RCN ID', defined in the GLOBAL IDS section of the Global IDS, FACTORS, AND FLAGS data section, is used depending on if the Management Schedule is a crop or non-crop schedule.

Non-Crop Data Section

Information for the Non-Crop data section can be derived from the RUSLE 1 dataset by importing the file 'C:\AGNPS\DataPrep\Editor\DataSets\RUSLE1_Data_Files\non_crop_RUSLE1.csv' into the Input Editor or directly using the csv file when applying AnnAGNPS.

Crop Data Section

Information for the Crop Data section can be obtained using the RUSLE2 datasets that correspond to the crop management zone (CMZ) that the watershed is in.

Crop Management Zones
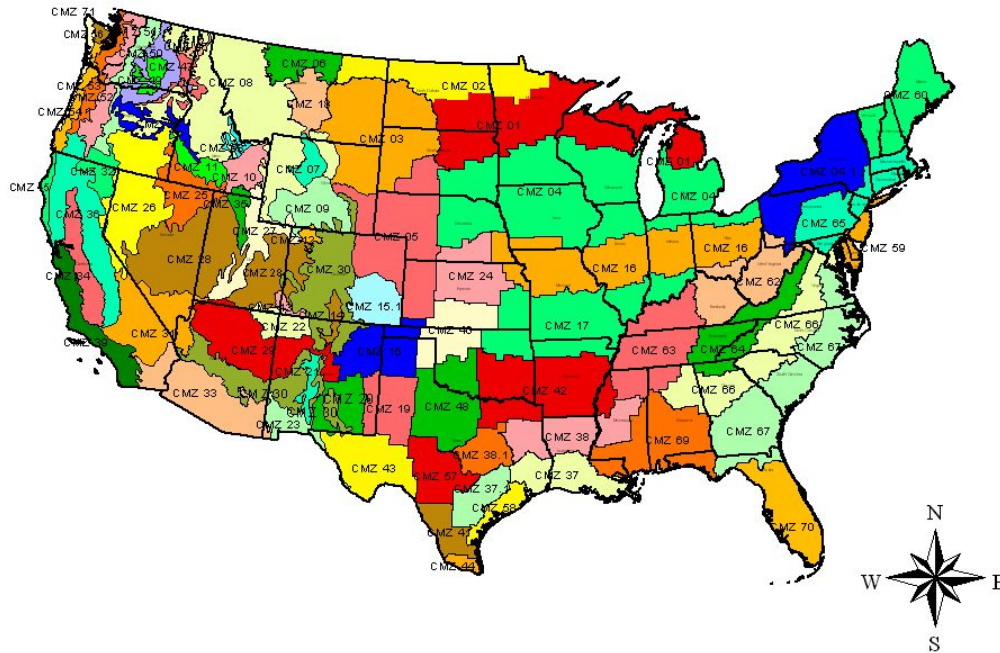
Each CMZ corresponds to RUSLE2 datasets that have been converted to AnnAGNPS format and are available in the AGNPS program structure associated by each CMZ, such as CMZ 16 crop data is in 'C:\AGNPS\DataPrep\Editor\DataSets\RUSLE2_Data_Files\CMZ\CMZ 16' described the 'cropdata.csv' and 'crop_growth.csv' files. The crop data csv file can be imported into the AnnAGNPS Input Editor or directly used when applying AnnAGNPS.

In addition, RUSLE1 crop database files for AnnAGNPS are available in the folder 'C:\AGNPS\DataPrep\Editor\DataSets\RUSLE1_Data_Files' associated with the files 'cropdata_RUSLE1.csv' and 'crop_growth_RUSLE1.csv'.

Crop coefficient parameters for the initial, mature and senescence growth stages are used to improve the evapotranspiration ET estimates and follow FAO ET guidelines. Information needed to select appropriate crop coefficients by growth stage for many crops is provided in the file 'C:\AGNPS\Ref_Data\FAO_Length_of_Growing_Season_and_Basal_Crop_Coefficients .pdf'. If the crop coefficients are left blank then default values are assigned to each growth stage.

Management Operation Data Section

Information for the Management Operation Data section can be obtained using the

RUSLE2 datasets that correspond to the crop management zone (CMZ) that the watershed is in.

For example the CMZ 16 Management Operation data is in the file 'C:\AGNPS\DataPrep\Editor\DataSets\RUSLE2_Data_Files\CMZ\CMZ 16\AnnAGNPS_Management_Operation_Data.csv'. The Management Operation data csv file can be imported into the AnnAGNPS Input Editor or directly used when applying AnnAGNPS.

In addition, RUSLE1 a management operation database file for AnnAGNPS is available in the folder 'C:\AGNPS\DataPrep\Editor\DataSets\RUSLE1_Data_Files' associated with the file 'manoper_RUSLE1.csv'.

Management Schedule Data Section

Information for the Management Schedule Data section can be obtained using the RUSLE2 datasets that correspond to the crop management zone (CMZ) that the watershed is in.

For example the CMZ 16 Management Operation data is in the file 'C:\AGNPS\DataPrep\Editor\DataSets\RUSLE2_Data_Files\CMZ\CMZ 16\AnnAGNPS_Management_Schedule_Data.csv'. The Management Schedule data csv file can be imported into the AnnAGNPS Input Editor or directly used when applying AnnAGNPS. The Crop Data and Crop Growth Data files, AnnAGNPS_Crop_Data.csv and AnnAGNPS_Crop_Growth_Data.csv, respectively, are also available for each CMZ.

For each RUSLE2 CMZ set of files, the Management Schedule, Management Operation and Crop data files are linked via the IDs assigned within the Management Schedule data section when associating the Management Operation ID and the Crop ID.

Management Field Data Section

The Management Field data section is associated with the Management Field ID assigned with each AnnAGNPS cell in the Cell data section and provides the link to the appropriate sequence of events within the Management Schedule assigned to each AnnAGNPS cell. Since there is not a standard naming convention or database for this data section, users will need to develop this data section manually. Although, this can be accomplished fairly easily by assigning a Management Field ID of CORN to a Management Schedule associated with corn, assigning a Management Field ID of SOYBEANS to a Management Schedule associated with soybeans, and so on.

The other key aspect of this data section is associated with assigning a 'Field Landuse Type' to each Management Field.

Other aspects of this data section provide an assignment of tile drains to the Management Field and the 'Gregorian Year for a 1ˢᵗ Year of Rotation'. Assigning a Gregorian year to the first year of a Management Schedule rotation will ensure that the simulation year that

the user would like a rotation year to correspond to actually occurs in the simulation.

Daily Climate Data Section

The development of the daily climate file can be from historical or generated data. A typical procedure to begin is to generate a climate dataset for as many years needed for either historical or synthetic purposes. The generation of climate data is described in the document 'C:\AGNPS\DataPrep\Weather\agGEM\Document\agGEM-preGEM_Documentation'. Then use the climate file generated to either use directly with an AnnAGNPS watershed input file or as a template to populate the historical data into.

General Steps in Executing AGNPS Components

There are general steps that can be followed for most projects and these are listed below. More detail is also provided later in the document. Steps that do not meet the objectives of the project can be skipped, such as the step used to define buffers can be skipped when buffers are not part of the project.

1. Convert the DEM from DEM.tif or other format to ascii raster format using the preferred GIS software like ArcGIS. Users may refer to a python script 'dlw_Convert_TIF_Raster_to_ASCII.PY' located in the folder '\AGNPS\Utility\Helpful_files_for_GIS-AnnAGNPS\Convert_TIF_to_ASCII' for use in converting DEMs to ASCII format. The AGNPS GIS Tools interface may also be used for the conversion from ESRI grid format into ASCII grid format. Note that a projection file is also created and used by TOPAGNPS to provide projection information for subsequent grid and shape files created by the program. For editing DEMs, users may refer to the python script 'DEM_Editing.py' located in '\AGNPS\Utility\Helpful_files_for_GIS-AnnAGNPS\DEM_Editing' for help in modifying a DEM using vector graphics.
2. Create the TOPAGNPS.csv file for execution with TOPAGNPS using the 'Edit TOPAGNPS Input File' button of the 32-bit version of the AnnAGNPS Input Editor's 'AGNPS GIS Tools–AGNPS Data Preparation–TOPAGNPS' menu option.
    a. Define the ASCII raster DEM file name (DEDNM.asc used as a default),
    b. Select the 'ASCII Grid' option,
    c. If the outlet is not known select the DEM Processing option 'Preprocessing and Network Generation' to generate the stream network in the DEM, as well as uparea and other grid file. If the outlet is known select the DEM Processing option 'Full' and enter the outlet row and column raster coordinates.
    d. Define the CSA and MSCL values. These will default to 10 ha and 100 meters, respectively if left blank.
    e. All other parameters are optional when the DEM is in ASCII Grid format as they will be read from the header in the DEM file.
3. Execute TOPAGNPS with the working directory defined that has the TOPAGNPS.csv and ASCII raster DEM file defined.

4. Select the 'EXECUTE TOPAGNPS' button of the 'TOPAGNPS' window.
    a. If the outlet is not defined and DEMPROC is set to 2, convert the 'netful.asc' grid to a shape file using the AGNPS GIS Tools–Layer Tools–Convert Grid to Shape' menu option or any other GIS Software procedure and display in the AGNPS GIS Tools view window. This conversion to a shape file is done so the resulting stream network of the DEM is easily visible in the view window. Then add the 'uparea.asc' grid layer file to the AGNPS GIS Tools display window.
    b. Select the 'AGNPS GIS Tools–AGNPS Data Preparation–Watershed Delineation–Select Watershed Outlet' menu option used to identify the location of the watershed outlet associated with a channel raster.
    c. Select the layer defined as the 'uparea' grid and click on the button 'Select on Map'.
    d. Move the cursor to the view window and select exactly on or as close as possible to within a few rasters of a channel identified as the watershed outlet. If the exact channel raster is not selected, but is within a few rasters then when executing TOPAGNPS the model can snap to the nearest channel raster. If the outlet selected is farther than two rasters from a channel, the TOPAGNPS 'Outlet Snapping' parameter can be increased to the necessary size to automatically locate an acceptable outlet nearest to user defined outlet.
    e. Users can either note the outlet location or save the location in the TOPAGNPS control file 'TOPAGNPS.csv' or the older 'DNMCNT.inp' format using the included button.
5. Once the outlet is determined or after completing the procedures in Step 4 above, edit the 'TOPAGNPS.csv' file by resetting DEMPROC to 0 in TOPAGNPS.csv and define the outlet outrow and outcol parameters. Users may need to refer to the TOPAGNPS csv documentation or example for help in knowing what parameters to utilize.
6. Reselect 'Execute TOPAGNPS' and display the AnnAGNPS_Cell_IDs.asc grid file for inspection until an acceptable outlet location is defined and the watershed is subdivided sufficiently. Users may want to convert this grid file to a shape file as well for better definition of the AnnAGNPS cells in the view window.
7. Iterate through steps 5-7 until the outlet location and subdivision level of the watershed is finalized.
8. Use the available landuse, soils and climate shape files to overlay onto the AnnAGNPS cells defined in the AnnAGNPS_Cell_IDs file using the 'AGNPS GIS Tools–AGNPS Data Preparation–Assign Fields/Soils/Climate Stations–Assign Fields/Soils/Climate Stations' menu options.
When all assignments are complete then select the 'Update AnnAGNPS Cell File–All' menu option.
9. Import the AnnAGNPS_Cell_Data_Section.csv and AnnAGNPS_Reach_Data_Section.csv files into either a new or existing set of csv files.
10. Using the SSURGO soil shape file a soil ID of W may be assigned to an AnnAGNPS cell that would require the user to delete the soil ID of W for this cell

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in the Cell data section and revise the Management Field Id for this cell to 'Water'. It is also recommended that either the user revise the soil layer so there is not a W soil defined or add a W soil to the soil data section with the appropriate soil parameters. What may also happen is that any ephemeral gullies created in the cell designated as 'water' will produce an error message saying no soil ID found for that gully located in that water cell. For these ephemeral gullies the user may want to use the menu option 'AGNPS Data Preparation–Assign Fields/Soils to Gully Locations' to directly assign these IDs to each individual gully.

11. If the PEG program was not executed, rerun TOPAGNPS with PEG.csv parameters defined and the PEG box checked in the TOPAGNPS window with the AnnAGNPS Input Editor and import the related AnnAGNPS peg csv file (AnnAGNPS_Ephemeral_Gully_Data_Section.csv) into the editor. A recommendation of PEG.csv input control file parameters of around 'Accum_pct 99.9' or higher even may be used to reduce the number of PEG points to a reasonable number.

12. If buffers are digitized, then create the grid files needed for the TOPAGNPS– AGBUF component plus create the AGBUF.csv control file.

13. Import the resulting AGBUF csv file (AnnAGNPS_Riparian_Buffer_Data_Section_AgBuf.csv) into the AnnAGNPS Input Editor, save and execute AnnAGNPS assuming the climate and other associated AnnAGNPS data sections have been populated.

14. If ephemeral gullies are also present with the buffers then the information in the 'AnnAGNPS_Ephemeral_Gully_Data_Section.csv' file will be revised to account for the effect of the buffers on the gullies as written to the 'AnnAGNPS_Ephemeral_Gully_Data_Section_Revised_by_AgBuf.csv' file. This revised file can also be imported into the AnnAGNPS Input Editor as a replacement for the Ephemeral Gully data section.

15. Execute AnnAGNPS by selecting from a number of options, one being from within the AnnAGNPS Input Editor 'File-Execute AnnAGNPS' menu option and defining the input file location.

16. Import all other required data sections for the project, like soils data, management data, and climate data.

17. Use output files like that selected via 'Output Options-Local Output File Options-Standard Text Output Files—Average Annual-AA_Sediment_Load_(unit_area)' that produces the file 'AnnAGNPS_AA_Sediment_load_UA_RR_Total_OUTLET.csv' for GIS visualization and via 'Output Options-Local Output File Options-Standard Text Output Files—Table-Gaging Station Data-Hydrograph' that produces the file 'AnnAGNPS_TBL_Gaging_Station_Data_Hyd.txt' used by STEAD to create the STEAD output file 'AnnAGNPS_Gaging_Station_Data_Hyd_csv_Summary.csv' to help when analyzing the results on a daily, monthly, annual, or average annual basis.

REFERENCES

Bingner, R. L., Theurer, F. D., Frees, L. D. and French, L. Cheney Lake CEAP Project Validation/Calibration: Sediment. Proceedings of the 2010 Federal Interagency Sedimentation Conference, Las Vegas, Nevada. June 27-July 1, 2010. CD-ROM.

Frees, L. D., Theurer, F. D., Bingner R. L. and French, L. Cheney Lake CEAP Project: Validation/Calibration, Nutrients. Proceedings of the 2010 Federal Interagency Sedimentation Conference, Las Vegas, Nevada. June 27-July 1, 2010. CD-ROM.

French, L., Frees, L. D., Theurer, F. D. and Bingner R. L. Cheney Lake CEAP Project: Conservation Practice Effects Assessment. Proceedings of the 2010 Federal Interagency Sedimentation Conference, Las Vegas, Nevada. June 27-July 1, 2010. CD-ROM.

Theurer, F. D., Bingner R. L., Frees, L. D. and French, L. Cheney Lake CEAP Project Validation/Calibration: Streamflow. Proceedings of the 2010 Federal Interagency Sedimentation Conference, Las Vegas, Nevada. June 27-July 1, 2010. CD-ROM.