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**MODELING PROCEDURES FOR USING
ANNAGNPS ARCVIEW EXTENSION**

by

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Abstract

The AnnAGNPS-ArcView interface, Spatial AnnAGNPS Extension (SAE), is being developed at the University of Kansas. This extension with ArcView is an integrated and interactive modeling environment to facilitate the use of the AnnAGNPS for watershed water-quality analysis. A step-by-step walk-through of an example, using this newly implemented GIS interface, is provided. At last, the structure and function of the interface are depicted with a detailed presentation of implementation and future development tasks.

1. Introduction

Annualized Agricultural Nonpoint Source (AnnAGNPS, <http://www.sedlab.olemiss.edu/agnps.html>) is a continuous-simulation, watershed-scale computer model for use in evaluating agricultural nonpoint-source pollution. The model can be used as a screening tool or a management application (e.g., evaluation of best management practices (BMP) or changes in land use) to address many of total-maximum-daily-load (TMDL) and nutrient-criteria developments related to the identification and management of natural and/or anthropogenic nutrient levels and on the receiving water bodies. The earlier version of this model, Agricultural Non-Point Source (AGNPS), is a single-event model. Because of its flexibility and relative accuracy, AGNPS has been widely used by many state/federal agencies and research institutions in the United States.

AnnAGNPS (version 2.0) uses up-to-date technology (e.g., RUSLE, winter routines) to expand the original capabilities of AGNPS to simulate monthly or annual transport of surface runoff, sediment, nutrients, and pesticides from an agriculturally dominated watershed. The model operates on a cell basis. Cells are irregular basins, with uniformly physical characteristics, that subdivide the watershed up to 10,000 acres in size and allow analyses at any point within the watershed. The main capabilities of AnnAGNPS are

- ❖ Evaluates the effect of various BMPs on the downstream sediment, nutrient, and pesticide load.
- ❖ Simulates the amount of soluble nutrients and chemical oxygen demand present in feedlot runoff.
- ❖ Predicts erosion for five particle sizes (sand, silt, clay, small aggregates and large aggregates).
- ❖ Predicts water quality and erosion on a cell, reach, and watershed basis.
- ❖ Incorporates the spatial variation of hydrologic, nutrient, and sediment processes when the watershed is divided into cells.
- ❖ Divides pollutant transport into soluble pollutants and sediment-attached pollutants.
- ❖ Source accounting feature creates the ability to rank individual cells based on impact to receiving water at watershed outlet.
- ❖ Determines soil erosion is determined using the Revised Universal Soil Loss Equation.
- ❖ Simulates snowmelt.
- ❖ Simulates changes in runoff pollutant concentrations due to conservation tillage, nutrient management, contour farming, and strip cropping on agricultural fields.

The limitations of AnnAGNPS are

- ❖ AnnAGNPS is a comprehensive watershed model and as such the amount of input data required can become quite demanding with increasing watershed size and/or resolution.
- ❖ The development of topographic input data utilizing the flownet generator with DEMs is cumbersome.
- ❖ Wetland- and lake-nutrient processes are not simulated.
- ❖ Agricultural-field-tile drainage is not simulated.
- ❖ Documentation is not completed.

Future improvement of AnnAGNPS listed by AnnAGNPS developers are

- ❖ The interface of AnnAGNPS with Geographical Information Systems is being enhanced.
- ❖ Incorporation of a lake and a wetland model is under development.
- ❖ Completion of a one-dimensional, unsteady, advanced channel-dynamics component that simulates streambank stability, bank erosion, and channel evolution is underway.
- ❖ Integration of Next Generation Weather Radar (NEXRAD) technology is under development.

Because the required input data for AnnAGNPS are complex and time-consuming, and reviewing the numerical outcome of AnnAGNPS is tedious in the decision-making process, a new graphical user interface (ArcView extension) was developed to assist organizing input files, running the model, and visualizing modeling and management results. The development of this interface was based on the previous interface and tools designed by the U.S. Department of Agriculture. A step-by-step walk-through of an example, using this newly implemented GIS interface, is provided in Section 3. The structure and function of the interface is depicted in Section 4, with a detailed presentation of implementation and future development tasks.

2. Data Preparation or Input Requirements

The input data requirements depend upon the size of a watershed and complexity of watershed features. AnnAGNPS input consists of 34 categories of data, including land use, topography, hydrology, soil types, field conditions and management, feedlot operation, chemical characteristics, and climate, although the model can be run for a single-storm event (24 variables)/AGNPS. In total, there are over 400 separate input parameters needed for model execution. For example, field data include tillage, planting, harvest, rotation, chemical operation, and irrigation schedules. Land-characterization data include soil characterization, curve number, RUSLE parameters, and watershed-drainage characterization. Feedlot operation includes daily manure-production rate, times of manure removal, and residual amount from previous operation. Detailed input data are listed as the following:

AnnAGNPS input data categories

File identifier

- AnnAGNPS Identifier
- Watershed Data

Simulation Period Data

- Simulation Period Data

Cell Related Data

- Cell Data
- Cell Profile Data (**AnnAGNPS** only)

Field Related Data

- Field Data
- Field Management Data
- Operations Data
- Operations Reference Data (**AnnAGNPS** only)
- Contour Data (**AnnAGNPS** only)
- Irrigation Application Data (**AnnAGNPS** only)
- Fertilizer Application Data
- Pesticide Application Data
- Strip Crop Data (**AnnAGNPS** only)

Reach Related Data

- Reach Data
- Reach Geometry Coefficients
- Reach Nutrient Half-life
- Impoundment Data

Other Component Data

- Feedlot Data
- Feedlot Management Data (**AnnAGNPS** only)
- Gully Data
- Point Source Data

Reference Data

- Crop Data (**AnnAGNPS** only)
- Fertilizer Reference Data
- Land Use Reference Data
- Pesticide Reference Data
- Runoff Curve Number Data
- Soil Data

Output Related Data

- Global Output Specification
- Reach Output Specification
- Source Accounting Output Specification
- Verification Data

Climate Data

Precipitation
Maximum Air Temperature
Minimum Air Temperature
Relative Humidity
Sky Cover
Wind Speed

Eight basic input GIS layers are required for extracting the input parameters for AGNPS:

1. Soils
2. Elevation
3. Land use and field
4. Management practice
5. Fertilizer or nutrient inputs
6. Type of machinery used for land preparation
7. Channel slope
8. Slope-length factor

Five types of data are required for the total watershed:

1. Watershed identification/description
2. Precipitation (inches)
3. Erosion Index (EI-value) for that storm/rainfall event
4. Area of each cell (acres)
5. Outlet-cell number

For each watershed element, AGNPS requires the following 22 input data values (its distributed parameter information):

1. Cell number
2. Number of the cell into which it drains
3. SCS curve number
4. Average land slope (%)
5. Slope-shape factor (uniform, convex or concave)
6. Average field-slope length (feet)
7. Average channel slope (%)
8. Average channel-side slope (%)
9. Mannings roughness coefficient for the channel
10. Soil-erodibility factor (K) for USLE
11. Cropping factor (C) for USLE
12. Practice factor (P) for USLE
13. Surface-condition constant (factor based on land use)
14. Aspect (one of eight possible directions indicating the principal drainage direction from the cell)
15. Soil texture (sand, silt, clay, peat)
16. Fertilization level (zero, low, medium, high)
17. Incorporation factor (% fertilizer left in top 1 cm of soil)
18. Point-source indicator (indicates existence of a point-source input within a cell)
19. Gully-source level (estimate of amount, tons, of gully erosion in a cell)
20. Chemical-oxygen demand factor

21. Impoundment factor (indicating the presence of an impoundment-terrace system within the cell)
22. Channel indicator (indicating existence of a defined channel within a cell)

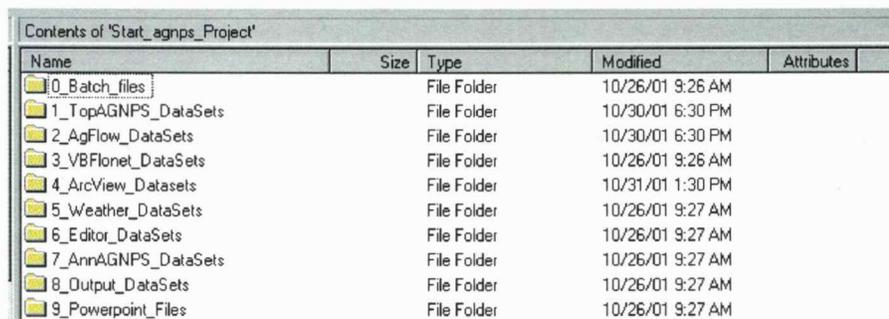
The development of topographic input data can be assisted by the use of a Flownet generator which automates the task of developing stream-reach and cell physical characteristics. The Flownet generator, TopAGNPS, is based on the U. S. Department of Agriculture (USDA) – Agricultural Research Service Topographic Parameterization (TOPAZ) model, and allows the user to utilize existing Digital Elevation Models (DEMs) for the development of topographic parameters. The program can also utilize a synthetic weather generator, Generation of weather Elements for Multiple applications (GEM), to develop a portion of the climatological input. The input of soil information from SSURGO (Soil Survey Geographic), land-use information, and topographic information from U. S. Geographical Survey topographic maps and DEMs can be obtained from DASC at the Kansas Geological Survey (<http://mapster.kgs.ukans.edu/dasc/catalog/coredata.html>).

3. Procedures for Using AnnAGNPS ArcView Extension

The AnnAGNPS-ArcView interface, Spatial AnnAGNPS Extension (SAE), is being developed at the University of Kansas. This extension with ArcView is an integrated and interactive modeling environment to facilitate the use of the AnnAGNPS for watershed water-quality analysis. The interface consists of three major components: TopAGNPS, Import Soil and Field Data, and AnnAGNPS. The first component is designed to assist in delineation of watershed boundary, outlet selection, TOPAZ (AnnAGNPS's physical parameters generation utility) input-data preparation, and execution of TopAGNPS. The second component serves as an operating tool to organize and/or control soil data and land-use (field-) information in appropriate formats. The last component initiates the AnnAGNPS, process output files, and display results in ArcView. The following sections depict the detailed procedures of operating Spatial AnnAGNPS, using a small portion of the Hillsdale Lake watershed as a demonstration case.

3.1 Directory Structure

Install the AnnAGNPS package into C:\ directory as C:\AGNPS and copy the following folders under C:\AGNPS_Watershed_Studies\OR_Mission_Creek (Figure 1) into a new folder under C:\AGNPS_Watershed_Studies for a new study case. Keep the files in the folder \OR_Mission_Creek intact, because the interface copies batch files from it.



Name	Size	Type	Modified	Attributes
0_Batch_files		File Folder	10/26/01 9:26 AM	
1_TopAGNPS_DataSets		File Folder	10/30/01 6:30 PM	
2_AgFlow_DataSets		File Folder	10/30/01 6:30 PM	
3_VBFInet_DataSets		File Folder	10/26/01 9:26 AM	
4_ArcView_DataSets		File Folder	10/31/01 1:30 PM	
5_Weather_DataSets		File Folder	10/26/01 9:27 AM	
6_Editor_DataSets		File Folder	10/26/01 9:27 AM	
7_AnnAGNPS_DataSets		File Folder	10/26/01 9:27 AM	
8_Output_DataSets		File Folder	10/26/01 9:27 AM	
9_Powerpoint_Files		File Folder	10/26/01 9:27 AM	

Figure 1. Folders under C:\AGNPS_Watershed_Studies\OR_Mission_Creek.

3.2 Loading Spatial AnnAGNPS Extension

Open an ArcView project and load extensions of Spatial Analyst and Spatial AnnAGNPS (Figure 2). It is recommended to unload the AnnAGNPS extension before closing the project. You may receive an error message when you open this project next time if you let ArcView bring in the AnnAGNPS extension by itself. This is because AnnAGNPS extension requires certain functions from Spatial Analyst. Therefore, the Spatial Analyst should be loaded before the AnnAGNPS extension. To remove the error message, unload the AnnAGNPS extension and save the project. Then, close and re-open the project.

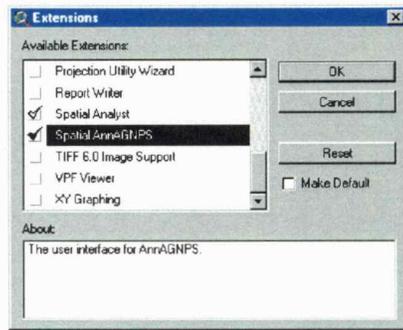


Figure 2. Dialog for ArcView Extensions.

3.3 Pre-processing DEM

Add a DEM into a view (Figure 3) and start **TopAGNPS** from the menu **AnnAGNPS** (Figures 4-5).

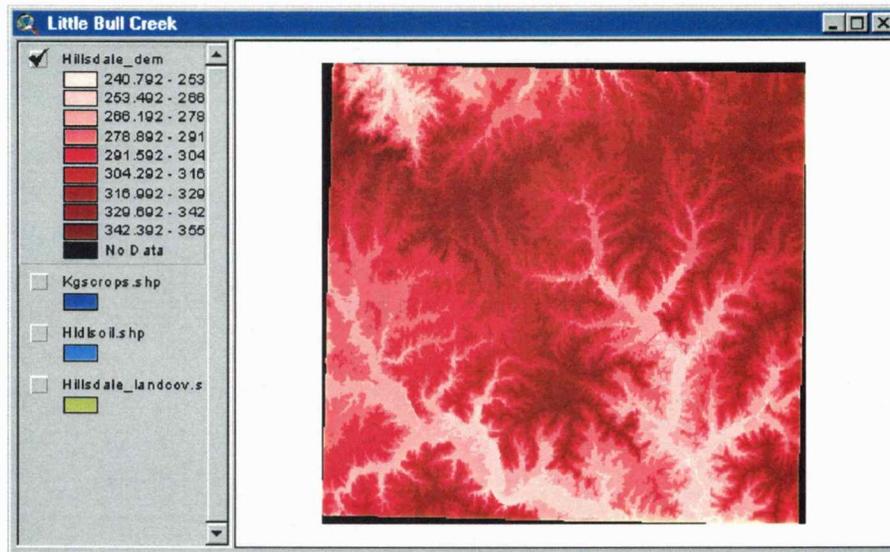


Figure 3. DEM for the study area.

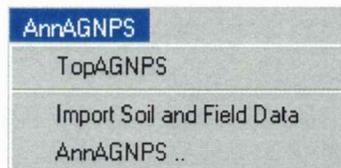


Figure 4. Items under the menu “AnnAGNPS.”

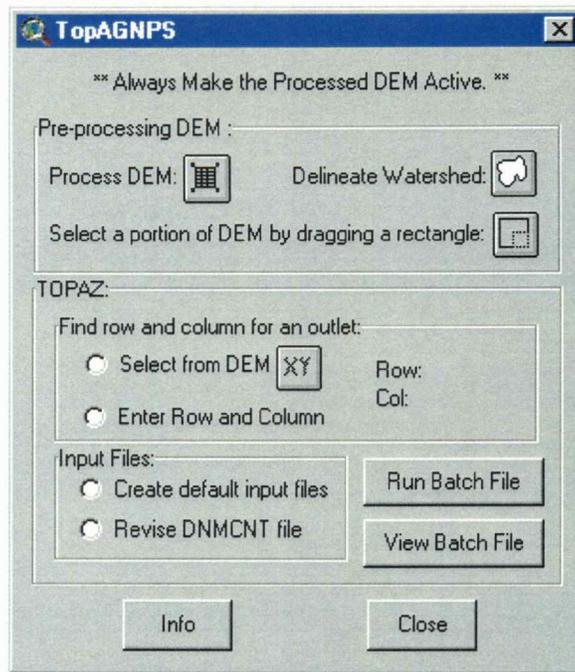


Figure 5. Dialog for TopAGNPS.

The added DEM can be trimmed to a smaller size if the area of interest is a portion of the DEM (Figure 6). This would save time in processing DEM to generate shapefiles that are required in delineating watershed boundary in GIS. Make the DEM active and select the button after **Select a portion of DEM by dragging a rectangle** in the **TopAGNPS** dialog to trim a portion of the DEM.

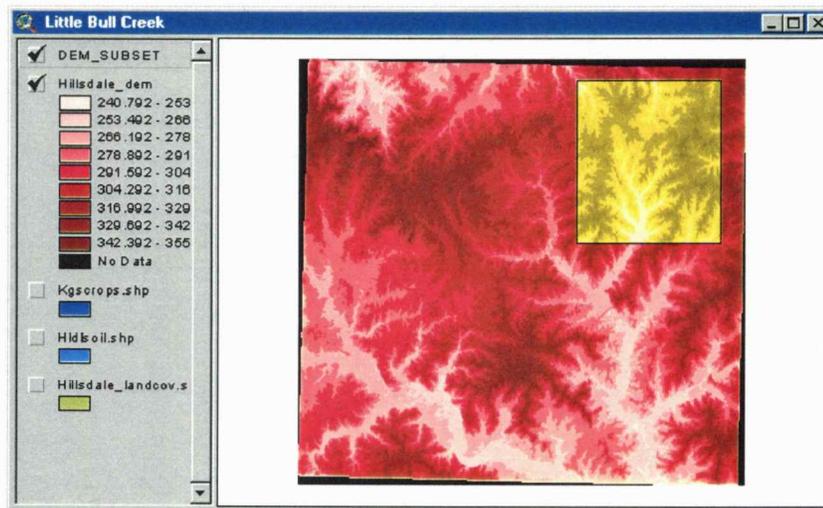


Figure 6. Trimming a DEM.

Make the **DEM_SUBSET** active and then click the **Process DEM** button in the above dialog to generate shapefiles that are used for delineating a watershed boundary. A

dialog box will appear while the program is processing (Figure 7). One can accept a default number or enter a new one.

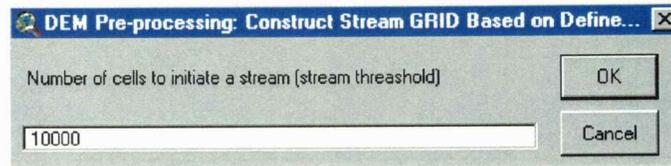


Figure 7. Dialog for entering number of cells to initiate a stream.

When the work is done, the **Outlets**, **fillDem**, **FlowDir**, **FlowAcc**, **StreamGrd**, **LinkGrd**, and **WatshdGrd** themes will be added into the View (Figure 8).



Figure 8. Adding new generated themes.

3.4 Watershed Delineation

The watershed boundary is delineated based on the location of the outlet. The tool **Delineate Watershed** in the **TopAGNPS** dialog is to assist delineating the boundary based on a user-defined point on a DEM. It is important to note that the outlet point needs to be placed directly on the raster channel network (Stream Grid) as shown in Figure 9. Otherwise, the target watershed may not be delineated properly. Thus, it is recommended to zoom into the desired outlet point prior to initiating watershed delineation.

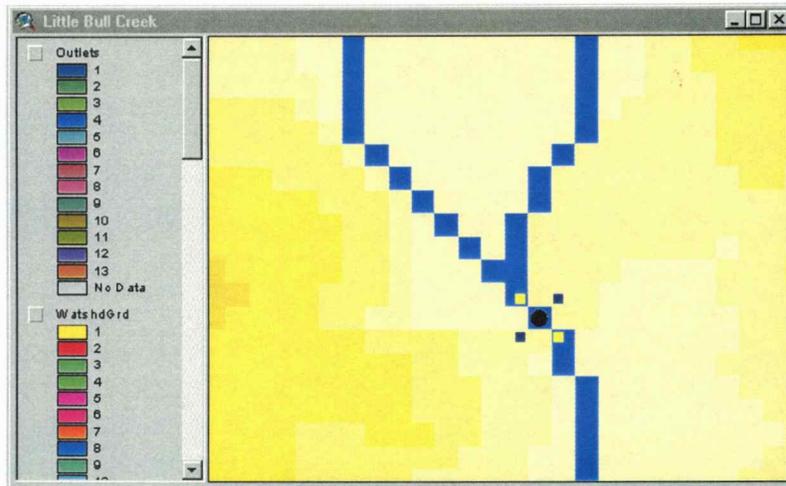


Figure 9. Locate an outlet of a watershed.

Accept the default name in the dialog box or change the default name in the output theme (Figure 10). Leave the name of the input theme as it is. When the process is accomplished, the **OutWat** theme, a watershed boundary delineated through GIS, will be added to the View (Figure 11).

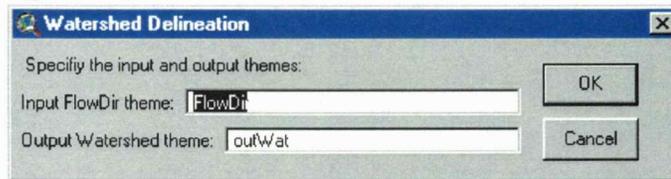


Figure 10. Enter names for the themes.

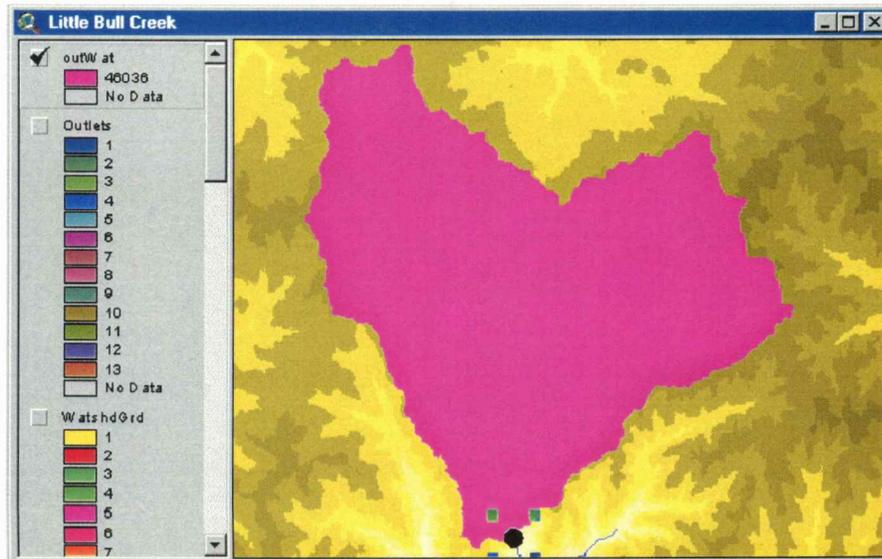


Figure 11. A new theme for a watershed boundary is added.

3.5 Clipping DEM

It is recommended to clip the DEM again so that the size of the DEM is closer to the watershed boundary. Doing this would also avoid possible errors in running the following steps through the interface. Make the DEM **DEM_SUBSET** active and repeat the steps in **3.3 Pre-processing DEM** for trimming a portion of DEM from the entire DEM (Figure 12). A new DEM with the same name **DEM_SUBSET** will be added to the View after the execution.

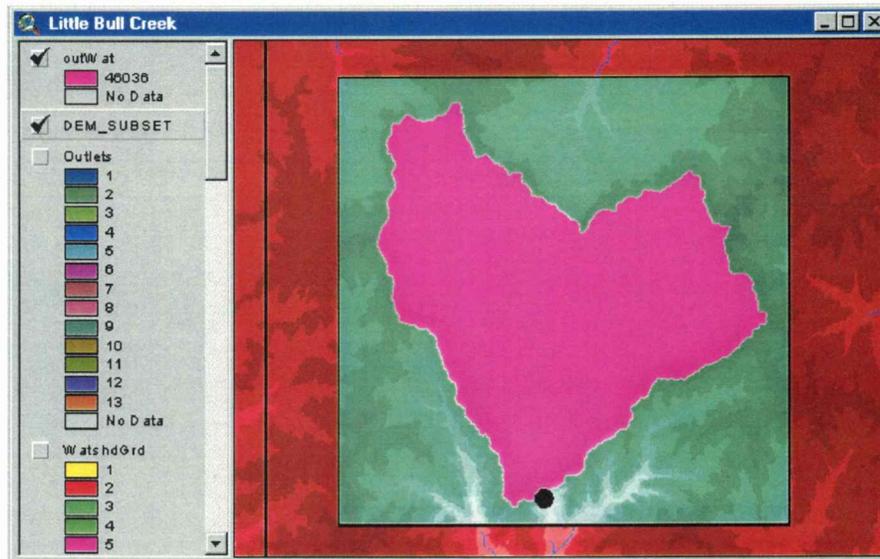


Figure 12. Re-clip DEM.

3.6 TopAGNPS Operations

Prior to running **TopAGNPS**, three input files: **DEDNM.inp**, **DNMCNT.inp**, and **NTGCOD.inp**, need to be prepared based on the information extracted from the DEM. Adding the location of an outlet is the only input point entered by a user. After the outlet is selected, the functions in the **TOPAZ** section of the **AnnAGNPS** dialog will then automatically generate the required files (i.e., **DEDNM.inp**, **DNMCNT.inp**, and **NTGCOD.inp**) plus three additional files named **RASPRO.inp**, **AgFlow_RasFor.inp**, and **ArcView_RasFor.inp** copied from the folder **\OR_Mission_Creek\1_TopAGNPS_DataSets**. It is important to note here that the selected DEM needs to be kept active before preceding to the following operations.

3.6.1 Find Row and Column Coordinates for an Outlet

The function **Select from DEM** is for assigning row and column identification numbers from a **DEM** according to the location that the user has selected. One can select a point on a **DEM** by pressing down the button **XY**. The exact coordinates will then display in the **TopAGNPS** dialog (Figure 13). Another way to assign row and column values is to directly enter the coordinates from the function **Enter Row and Column**.

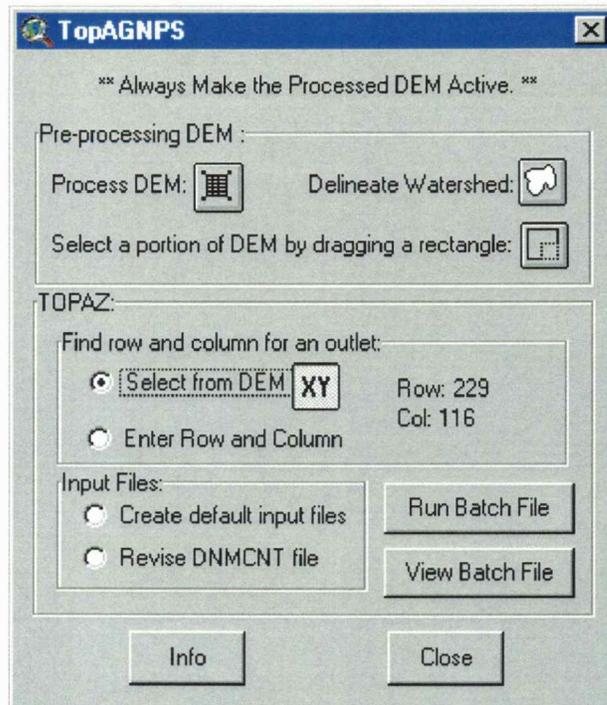


Figure 13. Location of a selected outlet on a DEM.

3.6.2 Create TopAGNPS Input Files

Select the function **Create default input files** and an input file dialog will appear. Change the directory to **1_TopAGNPS_DataSets** and then click **OK** (Figure 14). Six input files will be generated in this directory.

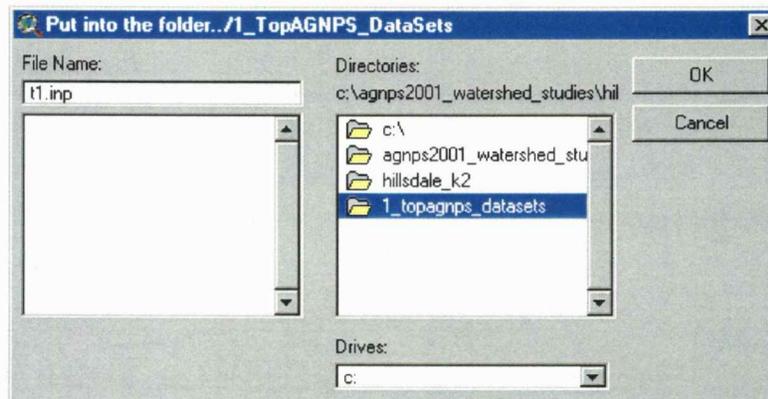


Figure 14. Directory for storing TopAGNPS input files.

The parameters in the **DNMCNT** file may be revised through the **DNMCNT PARAMETERS** dialog (Figure 15). This dialog appears promptly by clicking the **Revise DNMCNT file** button in the **TopAGNPS** dialog. After making changes, the user needs to click the **Create** button and the previous **DNMCNT** file will be updated. One can access the updated file by pressing the **View** button.

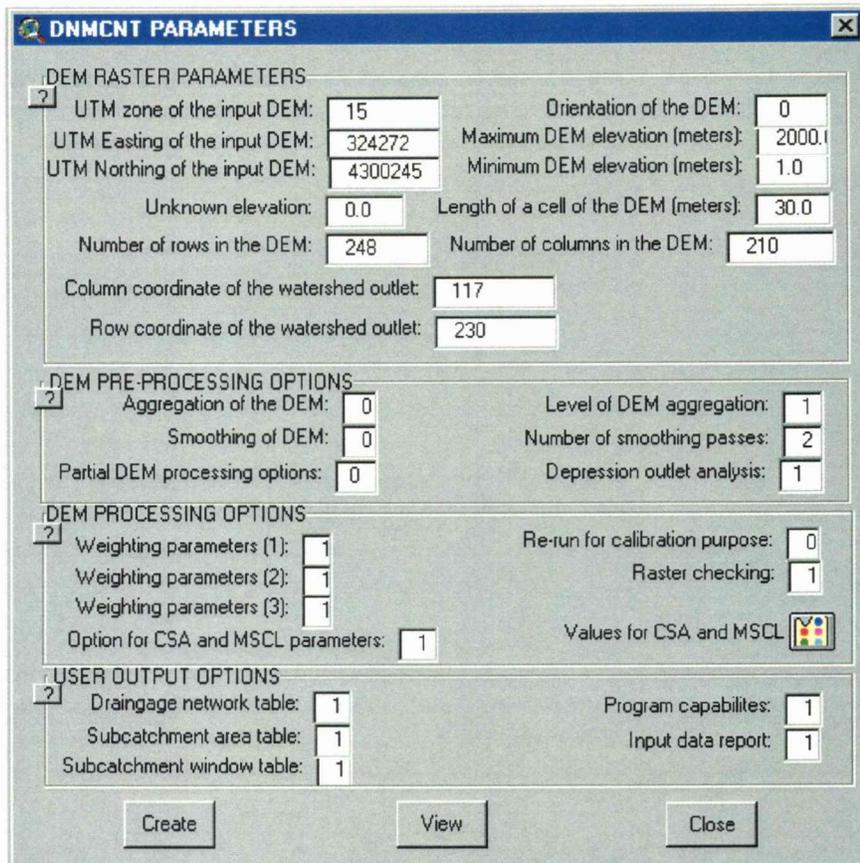


Figure 15. Dialog for DNMCNT parameters.

3.6.3 Run TopAGNPS

The first step in running **TopAGNPS** is to create a program directory -- change the directory to **0_vatch_files** and select the batch file **1_execute_topagnps.bat** (Figure 16) and then click the **Run Batch File** button. The program will automatically re-write the batch file based on the current patch, and run the batch file. One can always examine the batch files by clicking the **View Batch File** button to make sure the batch file executing the correct files. Remember that the batch file can be updated anytime by clicking **Run Batch File**. The file **FlowGen.inp** will be generated in the directory **2_AgFlow_Datasets**. Run **AGFLOW** after selecting the batch file **2_execute_Agflow.bat**. After running **AGFLOW**, cell and reach data are generated in the directory **2_AgFlow_Datasets**.

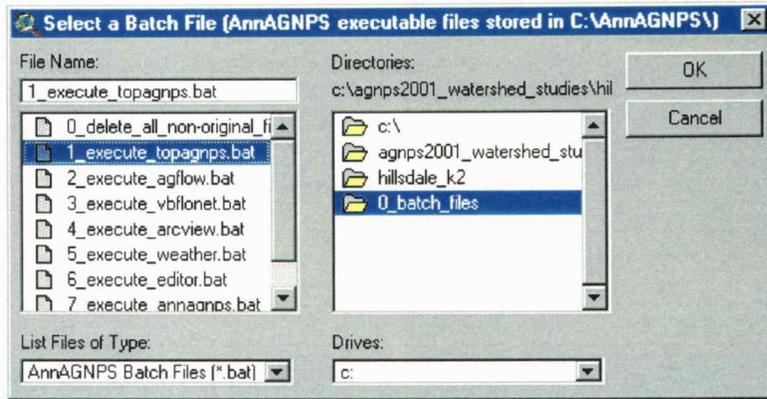


Figure 16. Select a batch file to run.

3.7 Generate the Dominant Soil and Field ID on Each Cell

Import **Subwat.arc** from **1_TopAGNPS_DataSet** as ASCII Raster into a view using the option **Import Data Source** under **File** in ArcView menu. Convert **Subwat.arc** into a shape file (a polygon of the watershed boundary). Use this polygon to clip soil and land cover coverages by using the **Geoprocessing** in ArcView extension (Figures 17-18).

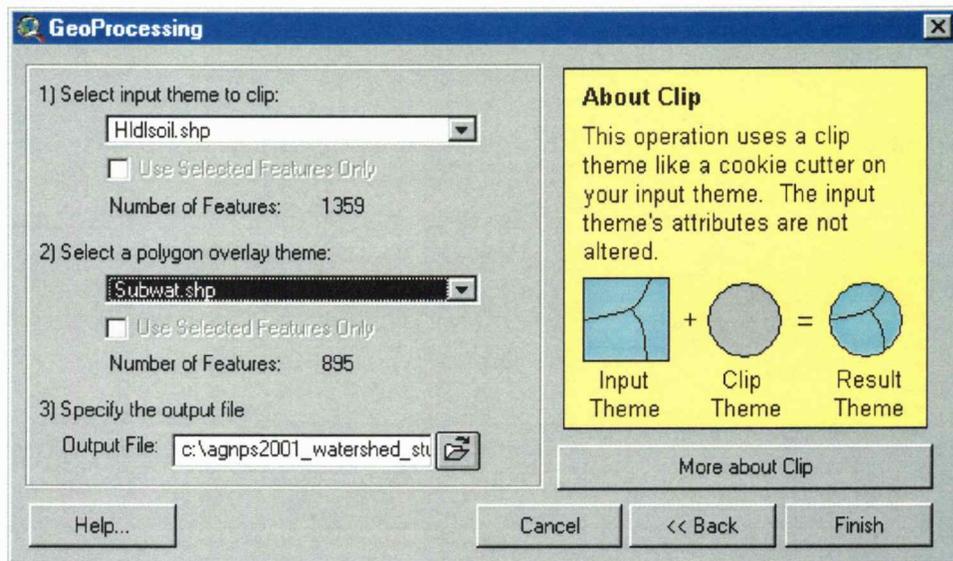


Figure 17. Wizard for the Geoprocessing.

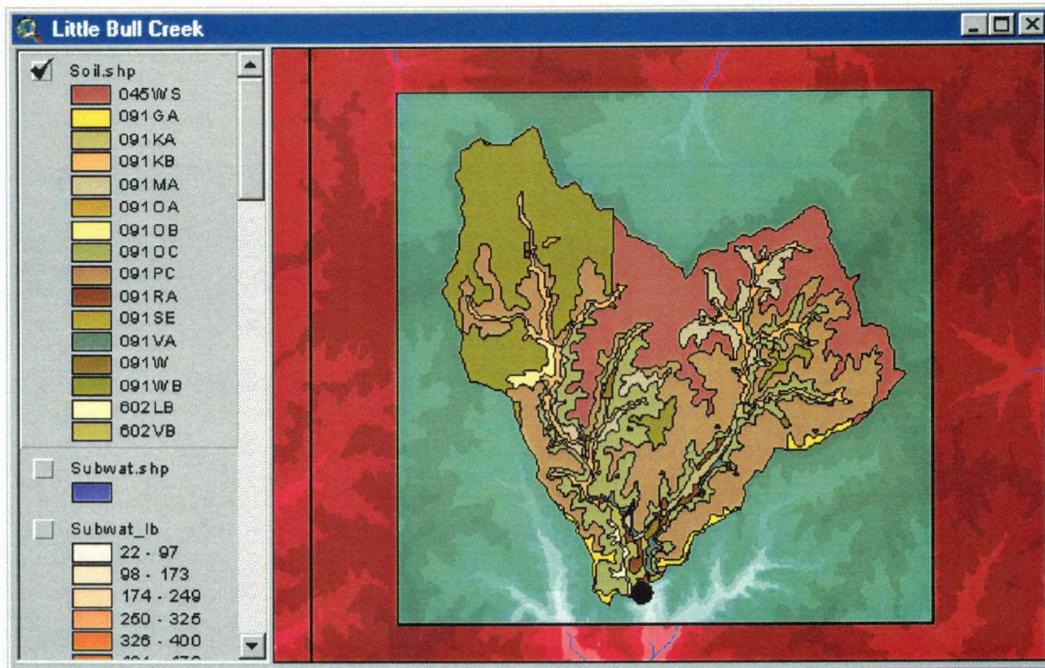


Figure 18. A clipped soil coverage.

Click on **Import Soil and Field Data** in the **AnnAGNPS** menu and start the dialog **Import_Soil** (Figure 19).

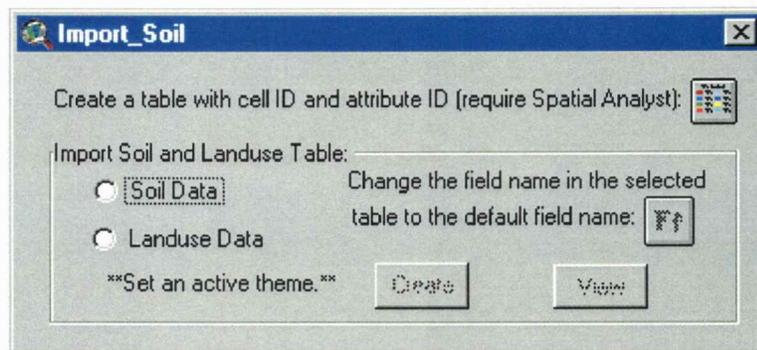


Figure 19. Dialog of Import_Soil.

Click on the button next to **Create a table with cell ID and attribute ID** and the dialog **Tabulate Areas** will appear. Select **Row Theme** as **subwat**, **Row Field** as **Value**, **Column Theme** as **soil.shp**, and **Column Field** as **Muid** (soil ID) as shown in Figure 20. A table will be generated with the dominant soil ID on each cell (Figure 21). A similar table for land use can be generated through repeating the same procedures.

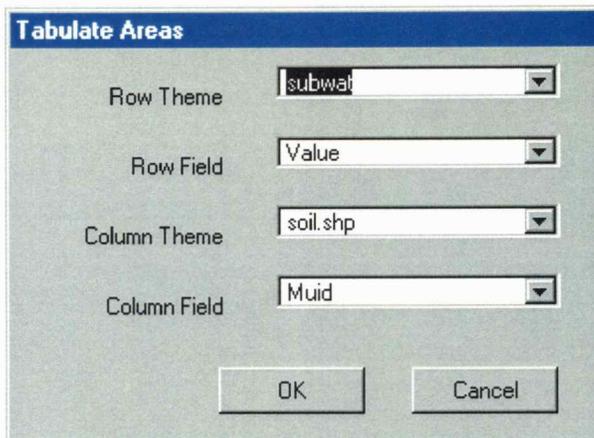


Figure 20. Dialog for selecting dominant soil (or field) ID on a cell.

id	Maximum
22	Ob
24	Va
31	Ws
32	Ws
33	Ws
34	Sc
42	Ma
43	Ma
44	Kb
52	Sc
53	Sc

Figure 21. A table with the dominant soil ID on each cell.

Export the soil and land-use tables as comma delimited files and remove the headers id and Maximum in the file as shown in Figure 22. These two text files will be needed when the user starts operating the input editor of **AnnAGNPS**.

```
22,Ob
24,Va
31,Ws
32,Ws
33,Ws
```

Figure 22. A comma-delimited file without header.

3.8 Soil Parameters

The soil parameters required for **AnnAGNPS** are extracted from SURGO soil database and stored in the soil coverage. The procedures displayed here are only for a one-layer soil. Click on the button **Ff** (Figure 23) to change the field names of soil parameters to the default field names such as C1, C2,..., and C30 in the program. Select a field name in the list box to match the description in the dialog **Change_FieldName** (Figure 24) and click **OK** to accept the changes.

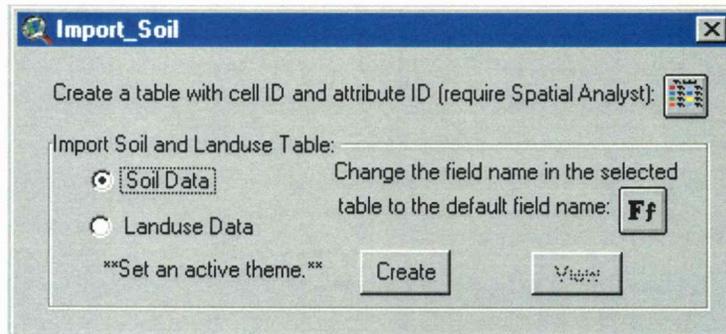


Figure 23. Click on the button **Ff** to start the dialog **Change_FieldName**

After changing the field names to the default names, these parameters with soil ID can be exported into a text file with the **AnnAGNPS** input format by clicking the button **Create** in the "**Import_Soil**" dialog.

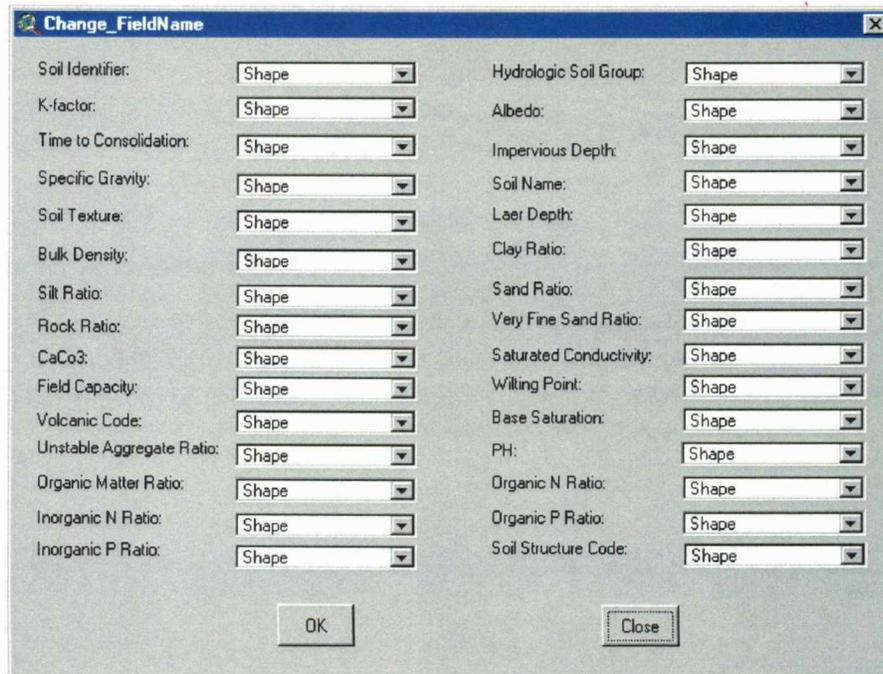


Figure 24. The dialog of **Change_FieldName**

3.9 Generate Climate Data

A file containing daily climatic data is required for AnnAGNPS simulation. Climate data can be historical records, synthetic data, or a combination of the two, and are of great importance in running AnnAGNPS. Daily precipitation, maximum and minimum temperature, dew-point temperature, sky cover, and wind speed are required to run AnnAGNPS (wind direction is currently not used) because daily precipitation is the prime force of the hydrologic cycle and temperature data are used to define frozen conditions, while the remaining climate elements are used to compute potential evapotranspiration. Great consideration should be given to the source of climate data and how many years are analyzed. The following programs should be used to generate synthetic climate data for use in AnnAGNPS.

Climate Generator (**GEM**) is a program that generates synthetic climatic data for locations in the United States. **GEM** generates daily precipitation, maximum and minimum temperature, and solar radiation. AnnAGNPS requires six climatic elements for each day, which are precipitation, maximum and minimum temperature, sky cover, average daily dew-point temperature, and average daily wind speed. The operation of **GEM** is suggested whether or not historic records are available.

Complete Climate is the program that generates the daily dew-point temperature, sky cover, and wind speed, and formats the six daily climatic elements to be read by AnnAGNPS. The input files to this program should be named **GEM output.inp** (GEM generated precipitation and temperatures) and **MonClim.inp** (monthly average dew points, sky cover, and wind speed) because they are the interim data in the final climatic data preparation for AnnAGNPS.

3.10 Prepare AnnAGNPS Input File

Start the AnnAGNPS input editor from the **AnnAGNPS** dialog and select **New AnnAGNPS File** under the option **File** in the input editor. Enter basic information such as unit code and watershed name, and click the button **Accept**. Import cell and reach data generated in Section 2.6 through **Flownet Generator Reach File** and **Flownet Generator Cell File** under the option **Import**. Import soil and field IDs generated in Section 2.7 through **Field IDs from ArcView** and **Soil IDs from ArcView**. The user can evaluate these imported data in the menu **Data (A-N)** and **Data (O-Z)**. Save all of the data as an AnnAGNPS input file. Other related data can then be entered through the editor or organized directly in the input text file.

3.11 Run AnnAGNPS and Display Results

With the AnnAGNPS input and climate files ready, execute AnnAGNPS by clicking the button **Run AnnAGNPS** (Figure 25). Two files **AnnAGNPS.evn** and **AnnAGNPS.src** are generated in the directory **7_AnnAGNPS_DataSets**. The two output files can be processed through the same button to extract the data such as runoff and nutrient at outlet or in each cell. The comma-delimited text files **GIS_SA_nutrient.out**, **GIS_SA_Pest.out**, **GIS_SA_Sed_Class.out**, **GIS_SA_Sed_Src.out**, and **GIS_SA_water.out** for source accounting and

Ev_Output_Table.out for event output at outlet are generated in 8_Output_DataSets after output processing.

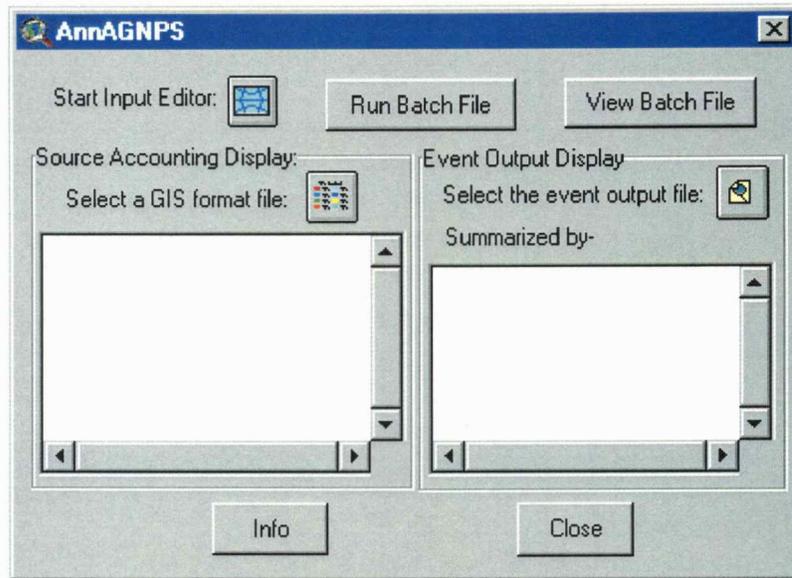


Figure 25. The Dialog of AnnAGNPS.

For the display of source accounting, select the button after **Select a GIS format file** in the dialog **AnnAGNPS** and select a file storing the item that is of interest for display (Figure 26). Items stored in the selected file are listed in the list box after the selection (Figure 27). After selecting an item in the list box of the dialog **AnnAGNPS** and the base coverage (**Subwat.shp**), a new coverage for the selected item will be generated and added into the active **View** (Figure 28).

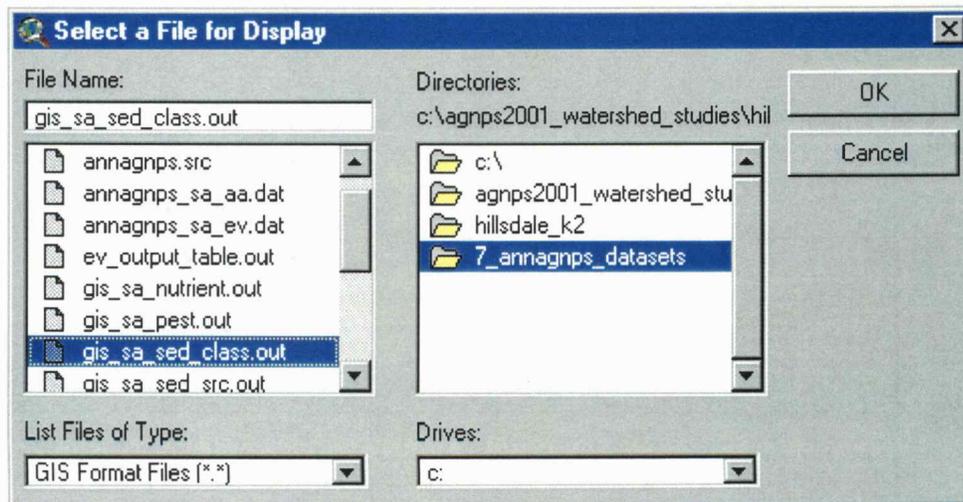


Figure 26. Select a file for display.

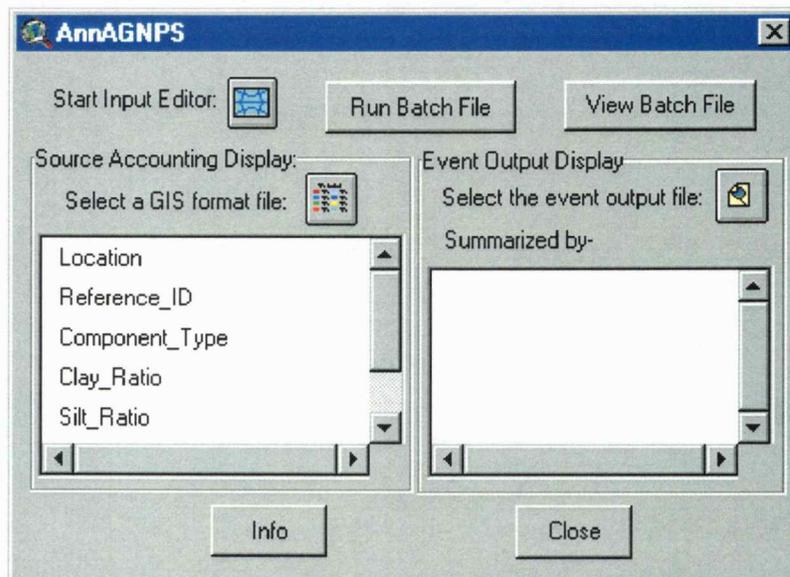


Figure 27. Items of interest are listed in the list box.

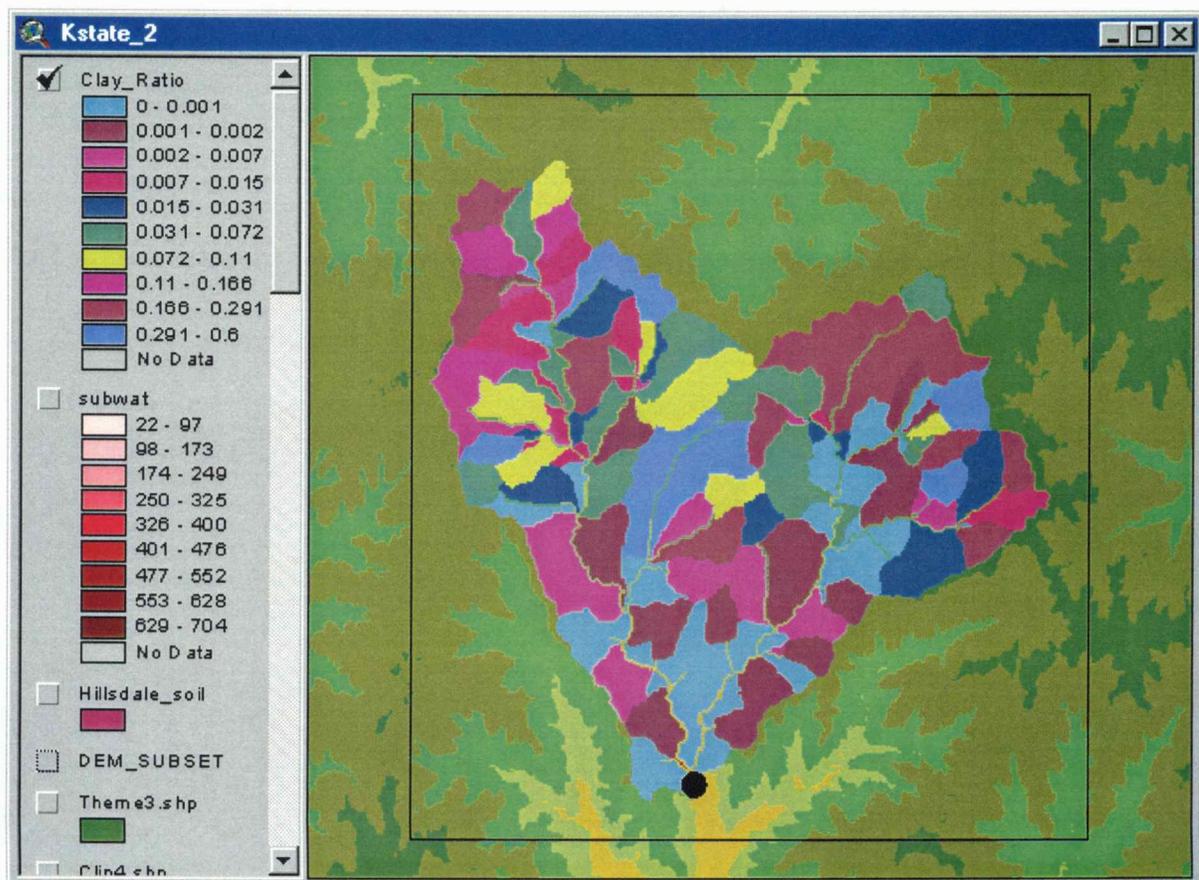


Figure 28. A new coverage generated for the display of source accounting.

For the display of an event output, select the button after **Select the event output file** in the dialog **AnnAGNPS** and select the file **Ev_Output_Table.out**. Items for event-output display are listed in the list box after selection (Figure 29). A table of values for the selected item (Figure 30) and another dialog for graphing (Figure 31) will appear after selecting an item in the list box of the dialog **AnnAGNPS**. Select **Graph type**, **Graph style**, and **X-Y Fields** in the second dialog and press buttons **Calculate Graph Properties** and **Graph** in the same dialog, and a plot for the selected fields will be displayed (Figure 32).

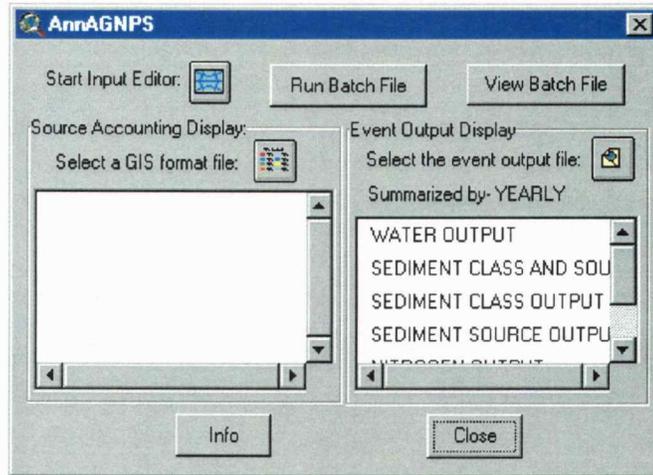


Figure 29. Items for event-output display are listed in the list box.

Year	Up/down	Rainfall	Other water	Runoff	Peak flow
1		19.920	4.630	6.801	
2		32.660	0.900	8.463	
3		13.810	0.930	3.250	
4		11.010	0.000	2.458	
5		23.850	2.760	6.493	
6		18.300	3.100	5.269	
7		19.570	6.790	7.373	
8		29.400	2.240	8.768	
9		17.020	3.390	6.056	
10		23.590	0.880	6.071	

Figure 30. A table of values for the selected item.

Graph type: XY XYX

Graph style: Scatter Scatter and Trend Line Line (sorted)

Page Properties

Width: 11.0 X margin: 2.0 X length: 6.5

Height: 8.5 Y margin: 2.0 Y length: 5

X:Y Fields

XY pairs: 2

X1: Yearly Y1: Rainfall

Y2: Runoff

Calculate Graph Properties

X min: 1 X max: 10 X inc: 0.9

Y min: 2.458 Y max: 32.66 Y inc: 3.0202

X axis title: X-axis

Y axis title: Y-axis

Graph title: wa.txt

Select another Info Graph Cancel

Figure 31. The dialog for graphing.

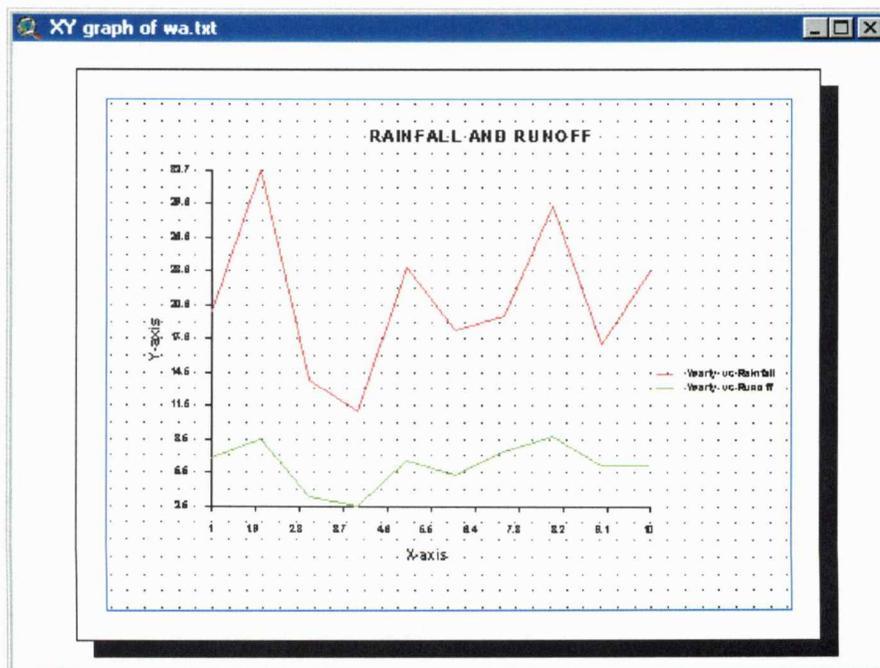


Figure 32. A plot for the selected fields.

4. Concluding Remarks and Future Plan

AnnAGNPS is a very effective tool for watershed management. However, the complex modeling procedures and data preparation keep it from being an efficient modeling tool. Our main thrust in building the GIS tools and the interface has been to minimize the user interaction in running model simulations and preparing the input data for the model and to reduce the number of user-supplied GIS database layers. The structure diagram in Figure 33 depicts our implemented and in-progress GIS tool components superimposed over the existing model structure of flow of data inputs and outputs and the interaction of the various loosely coupled AnnAGNPS modules in the system.

Accordingly the following list itemizes implemented, in progress, and planned tasks to improve the overall ease and usability of the AnnAGNPS model.

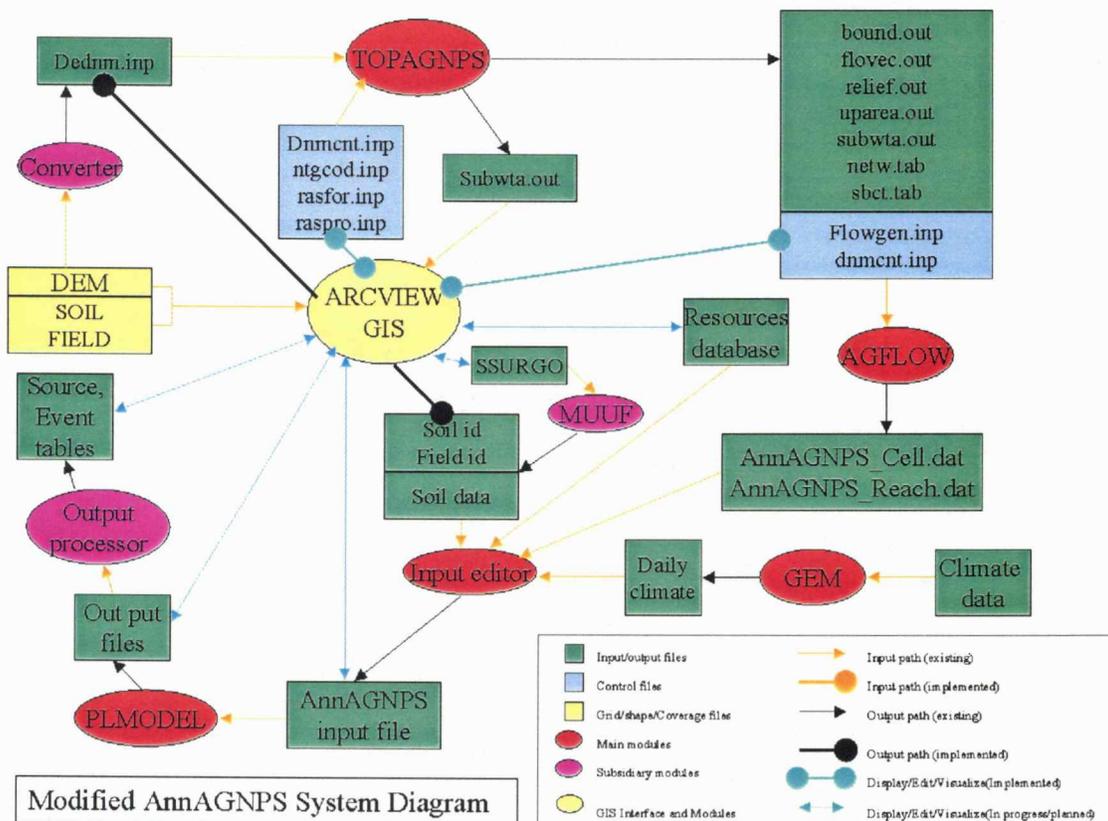


Figure 33. A schematic diagram for the tasks.

4.1 Implemented Tasks:

- Created tool to link soil id and field/land use id to their corresponding subwatershed (cell) id's in Arcview GIS.
- Built control file for generating/editing, and DEM input preprocessing and reformatting tools for TOPAGNPS in Arcview.

- c) Modified and considerably improved the overall mechanism of intermediate input/output file interaction that facilitates the loose coupling of the TOPAGNPS and AGFLOW modules (collectively called Flonet or Flow net generator). This removes the involved manual copying of files and creation of new project folders for every run of model simulation under varying scenarios.
- d) Created tools to import, reformat, and visualize the various model-output results in GIS. AnnAGNPS has very limited graphics capability for visualizing and analyzing the model output. The lack of this capability impairs the user's ability to make effective use of the various detailed outputs from the model.

4.2 Future Planned Tasks:

- a) Complete processing and reformatting to AnnAGNPS input format requirement of SSURGO soil database in Arcview. The process includes derivation of required soil parameters not directly available in the SSURGO.
- b) Totally import all the functionality of the current Input editor module into the GIS interface.