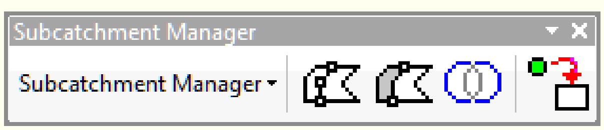
Introduction to The Subcatchment Manager

Teach Me More About the tools in the Innovyze Subcatchment Manager forInfoSWMM

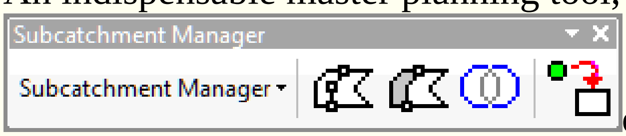
Watershed Delineation	Assigning Subcatchment Characteristics	Data Conversions and Modifications
DEM Sinks	Characteristic Width	Point Elevation to DEM
Create Flow Direction Grids	Slope	Contour Elevation to DEM
Create Flow Accumulation Grids	% Impervious	Raster to Subcatchment
Delineate Subcatchments	Landuse Coverage	Flow Path to Conduit
Define Flow Streams	Outlets	Cut Raster
Automated Hydrologic Models Watershed Delineation	Flow Direction  	**Methodology** Append and Merge Subcatchments Filling Sinks Clean Up Subcatchments

Introduction

Proper delineation of watersheds is critical for accurate stormwater modeling applications. Watersheds can be delineated from many sources of elevation models including contours, points, and digital elevation models (DEM). These data are analyzed to determine the direction of surface runoff. The size and shape of the delineated watershed influence the characteristics of the watershed such as area, width, slope, flow path length, and centroid. Inconsistent or inadequately defined methods of determining such attributes can lead to poor analysis and design/improvement recommendations of storm sewer systems.

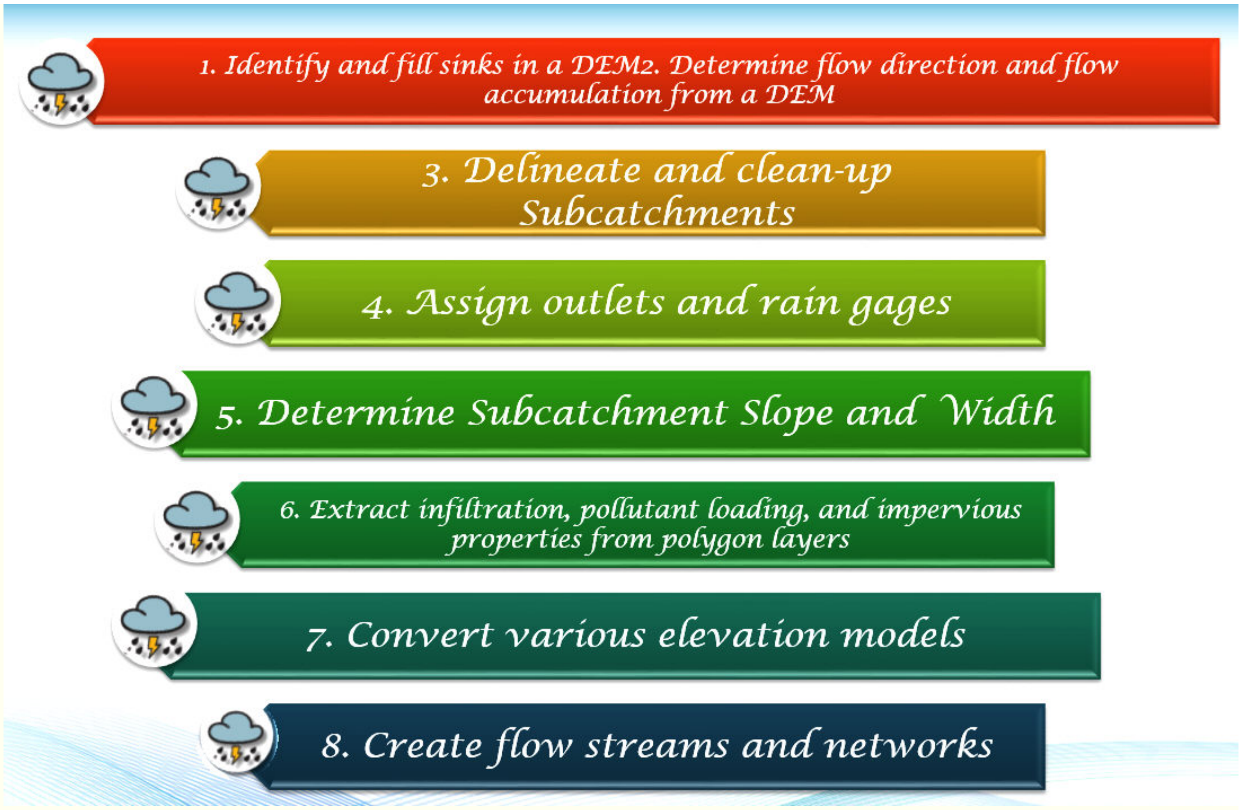
InfoSWMM Subcatchment Manager brings you unprecedented speed, accuracy, flexibility, and consistency for delineating watersheds and determining their properties. This important module fully automates the global population of subcatchment attributes to ensure the timely development of an unbiased rainfall / runoff model. It also aids in the development of a sewer network model.

An indispensable master planning tool, InfoSWMM Subcatchment Manager



offers you multiple highly advanced and efficient geospatial methods for defining Subcatchments and establishing their characteristics. You can:

- **Identify and fill sinks in a DEM**
- **Determine flow direction and flow accumulation from a DEM**
- **Delineate and clean-up Subcatchments**
- **Assign outlets and rain gages**
- **Determine subcatchment slope and width**
- **Extract infiltration, pollutant loading, and impervious properties from polygon layers**
- **Convert various elevation models**
- **Create flow streams and networks**

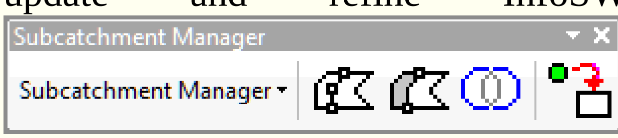


The first tool lets you identify local low areas in a DEM and remove them to ensure a continuous sloping surface that conveys water through each subcatchment. The second tool lets you determine the flow direction for each cell in the DEM. After the flow direction is computed, the total number of DEM pixels draining to every individual pixel is calculated in the flow accumulation raster. The flow direction and flow accumulation are used by the third tool to determine watershed boundaries and create clean polygon edges. A user defined threshold or any defined collection point layer is used to determine the boundary locations of each subcatchment. The fourth tool lets you link each subcatchment to the nearest rain gage. In addition, the "drains to" outlet for each subcatchment is assigned when a collection point layer was utilized in delineating the watersheds. The fifth tool lets you populate attributes for subcatchment slope and width. Two methods are provided for calculating the slope and four techniques are available for computing width, thus allowing the engineer to use judgment when determining these attributes. The sixth tool makes use of advanced polygon processing to extract information from soils, land use, and impervious percentage layers. The seventh tool enables you to convert point data or contours to a DEM for use with the other tools. The final function is used to create stream networks. Flow streams are defines from the flow accumulation grid and can then be converted to conduits in the sewer network.

Within a true GIS environment, InfoSWMM Subcatchment Manager lets you to edit, manipulate, and manage all your GIS polygons and their associated data with incredible ease and speed. Both existing sewer system and future system conditions such as build-out and phased land use and impervious percentage projections can be considered – a necessary feature for effectively staging capital improvement programs. These comprehensive capabilities will allow you to effectively utilize your engineering knowledge and judgment, leverage your existing GIS data investments, and strategically define Subcatchments and the network in your master planning effort.

You can now readily build and analyze more complete, representative, and reliable rainfall/runoff models than ever before and in record time. Without that credibility, the most complex and theoretically sound model that could be developed would not be effective in helping you plan and design a sound system. Sound methodology for subcatchment delineation and attribute population will not only result in more precise and comparable simulations, but will also greatly assist you in more effectively calibrating, operating, and managing your watersheds and in developing rigorous system performance improvement alternatives.

We are happy to bring you this practical and highly sophisticated geospatial subcatchment application tool to continue to effectively support your rainfall/runoff management activities.

Our high-level, state-of-the-art research and development effort in GIS-based network modeling is continuing at a rapid pace and we intend to update and refine InfoSWMM Subcatchment Manager 

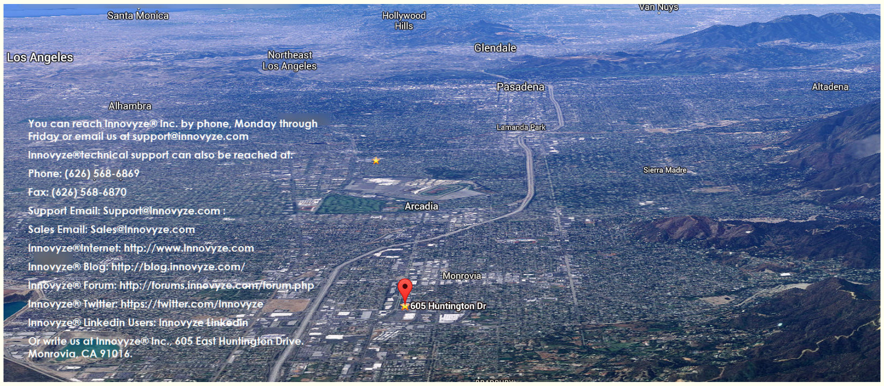
to reflect this progress. We are pleased to be at the forefront of this vital computer technology and to continue to advance it to an unprecedented level of comprehensiveness, reliability and performance.

Colby T. Manwaring, P.E.

Chief Executive Officer, Innovyze Inc.

Portland, Oregon USA January 30, 2019

Contact Us About Subcatchment Manager



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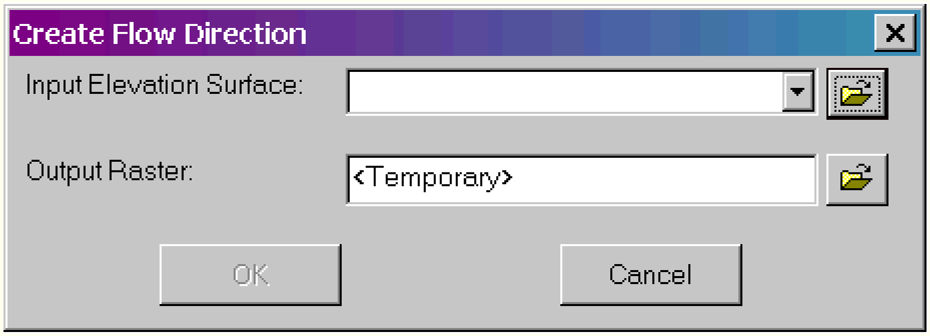
Create Flow Direction



* Please Leave the mouse cursor on the dialog box item to see its help string

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Content of the create flow direction dialog box are described below.

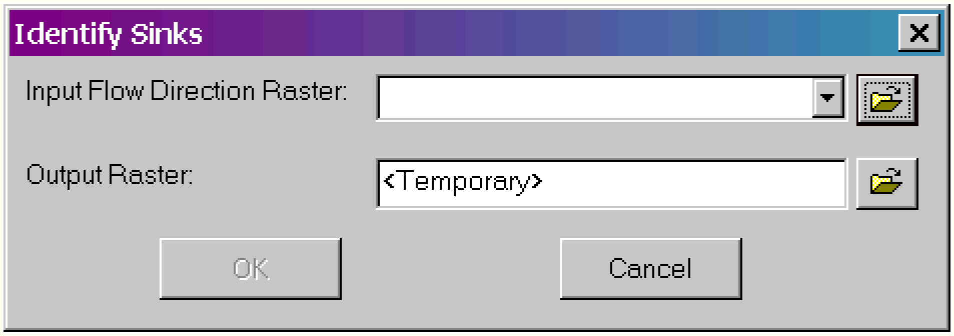
- **Input Elevation Surface** - Choose the DEM from which to create the flow direction grid. The DEM does not need to be filled for this process.
- **Output Raster** - Enter a name for the output flow direction raster and the location where the file will be stored.

  <Temporary> - If an output file name is not specified, the flow direction raster created will only remain in the map until the project is closed. Specify an output name to create a permanent file.
- **OK** – Creates the flow direction grid.
- **Close** – Closes the dialog box.

See Also

Description of Flow Direction

Identify Sinks



* Please Leave the mouse cursor on the dialog box item to see its help string

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Content of the identify sinks dialog box are described below.

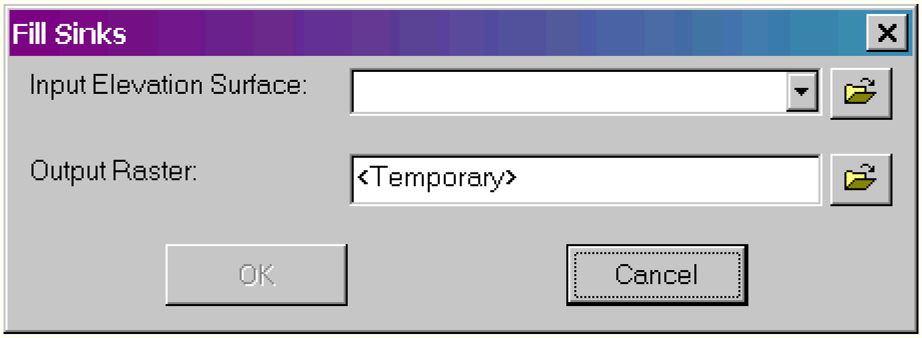
- **Input Flow Direction Raster** - Choose the flow direction raster created from the DEM with sinks.
- **Output Raster** - Enter a name for the output sink raster and the location where the file will be stored.
- **<Temporary>** - If an output file name is not specified, the sink raster created will only remain in the map until the project is closed. Specify an output name to create a permanent file.
- **OK** – Creates the sink raster.
- **Close** – Closes the dialog box.

See Also

Description of Sinks

Fill Sinks

Fill Sinks



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Content of the fill sinks dialog box are described below.

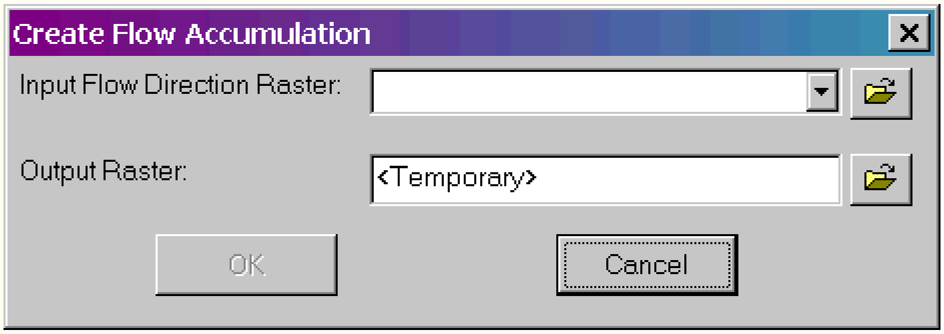
- **Input Elevation Layer** - Choose the DEM with sinks.
- **Output Raster** - Enter a name for the output DEM without sinks and the location where the file will be stored.
    - **<Temporary>** - If an output file name is not specified, the DEM created will only remain in the map until the project is closed. Specify an output name to create a permanent file.
- **OK** – Removes all sinks from the input DEM.
- **Cancel** – Cancels the operation and closes the dialog box.

See Also

Description of Sinks

Identify Sinks

Create Flow Accumulation



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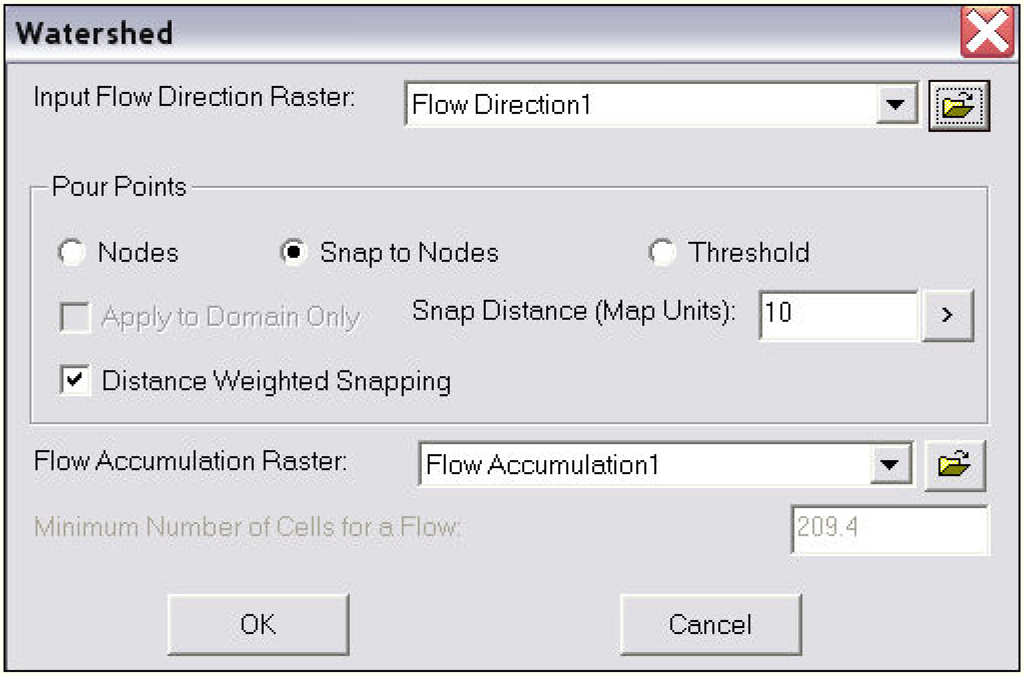
Content of the create flow accumulation dialog box are described below.

- **Input Flow Direction Raster** - Choose the flow direction raster created from the DEM with no sinks.
- **Output Raster** - Enter a name for the output flow accumulation raster and the location where the file will be stored.
- **<Temporary>** - If an output file name is not specified, the flow accumulation raster created will only remain in the map until the project is closed. Specify an output name to create a permanent file.
- **OK** – Creates the flow accumulation grid.
- **Close** – Closes the dialog box.

See Also

Description of Flow Accumulation

Create Watershed



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Content of the watershed dialog box are described below.

- **Input Flow Direction Raster** - Choose the flow direction raster created from the DEM with no Sinks.
- **Pour Points** - Specify the method used to delineate Subcatchments.
- **Flow Accumulation Raster** - Pick the flow accumulation grid created from the flow direction raster specified.
- **Minimum Number of Cells for a Flow**. Required for the threshold method
- **OK** – Delineates Subcatchments.
- **Cancel** – Cancels the operation and closes the dialog box.

Watersheds are delineated directly into the Subcatchment layer and assigned ID's in the InfoSWMM database.

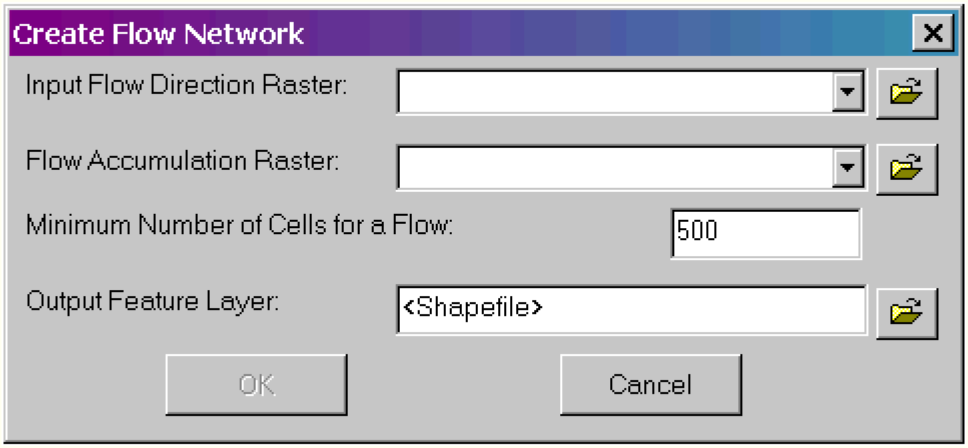
See Also

Watershed Delineation

Clean Up Subcatchment Edges

Append Subcatchment

Create Flow Network or Flow Stream



* Please Leave the mouse cursor on the dialog box item to see its help string

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Content of the create flow network dialog box are described below.

- **Input Flow Direction Raster** - Choose the flow direction raster created from the DEM with no sinks.
- **Flow Accumulation Raster** - Pick the flow accumulation grid created from the flow direction raster specified.
- **Minimum Number of Cells for a Flow**
- **Output Raster** - Enter a name for the output flow network and the location where the file will be stored.
- **<Shapefile>** - If an output file name is not specified, the flow network created will only remain in the map until the project is closed. Specify an output name to create a permanent file.
- **OK** – Creates a flow network.
- **Cancel** – Cancels the operation and closes the dialog box.

See Also

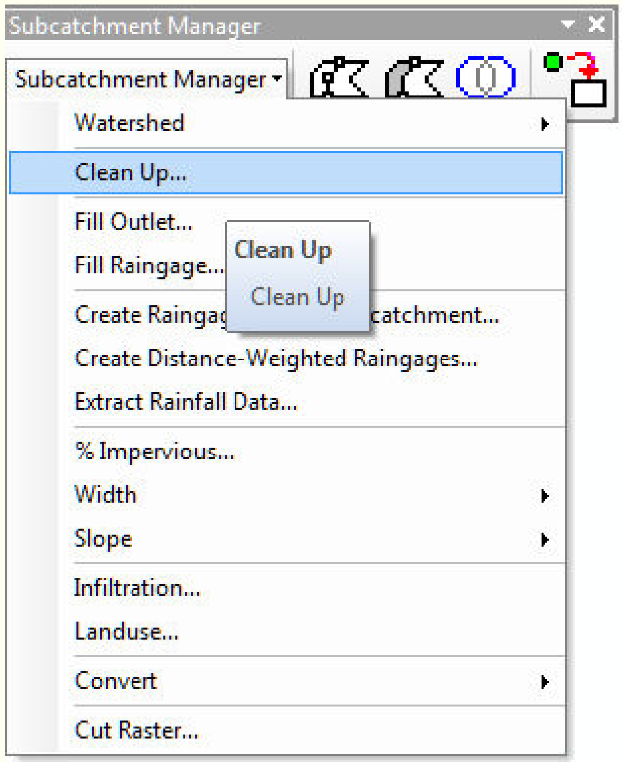
[Description of Flow Network]

[Convert Flow Path to Conduit]

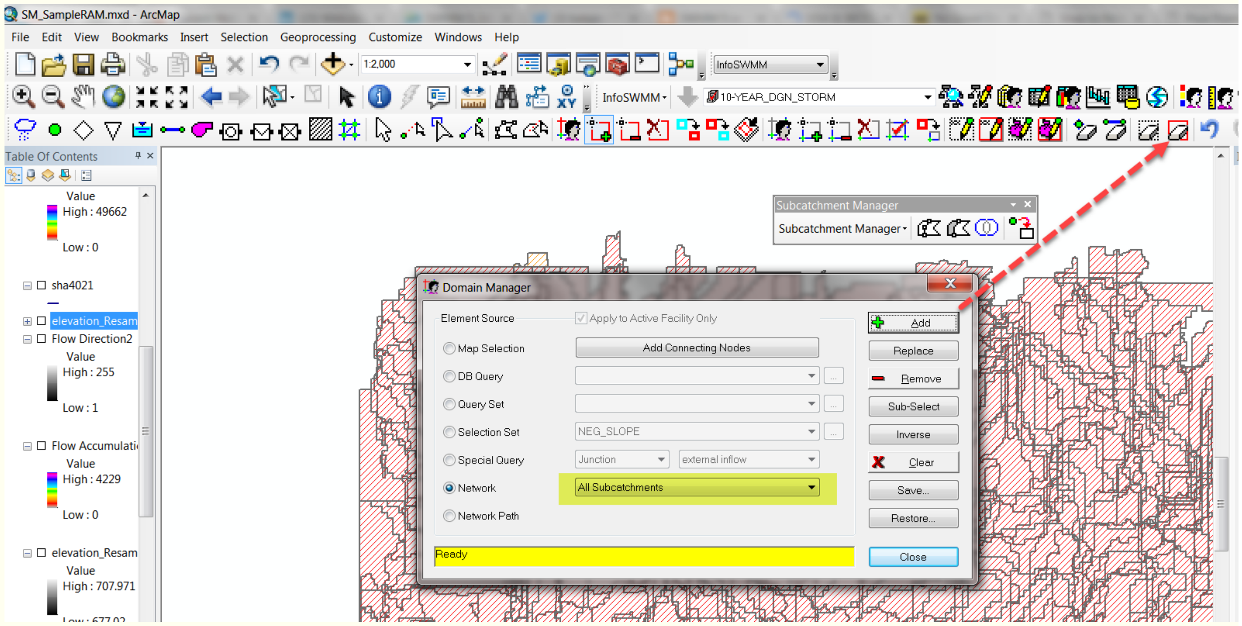
Clean Up

Clean Up

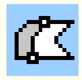
The clean up function removes all areas that contain overlapping Subcatchments.

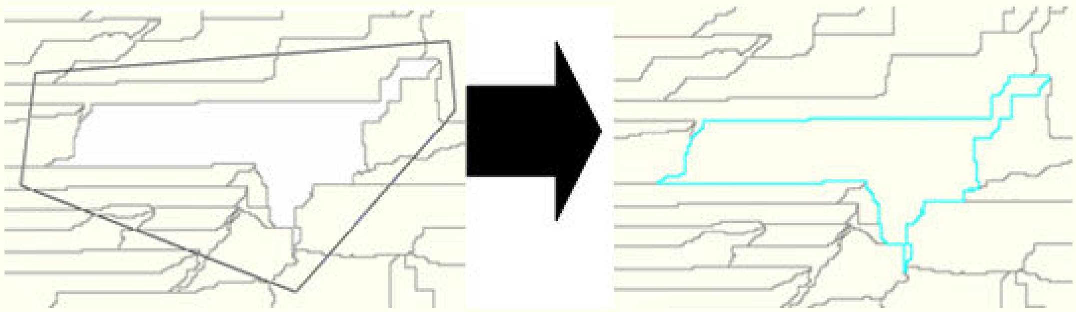


You can also use the InfoSWMM tools InfoSWMM Domain Manager and delete Domain to delete all of the created Subcatchments.


SM_SampleRAM.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
Subcatchment Manager
Domain Manager
Element Source
Apply to Active Facility Only
Map Selection
Add Connecting Nodes
DB Query
Query Set
Selection Set
NEG_SLOPE
Special Query
Junction
external inflow
Network
All Subcatchments
Network Path
Add
Replace
Remove
Sub-Select
Inverse
Clear
Save...
Restore...
Ready
Close

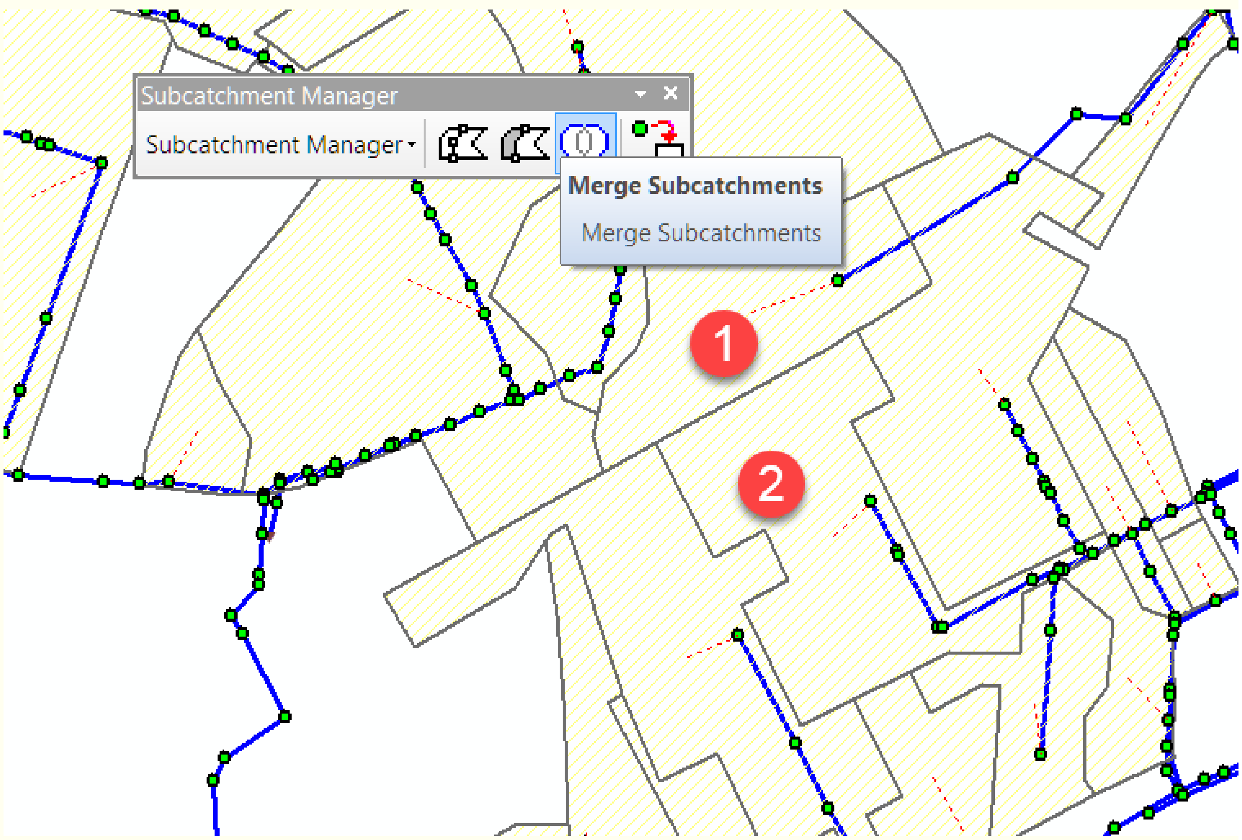
Append and Merge Subcatchment

The append Subcatchment tool  automatically snaps the edges of a newly created Subcatchment to those of existing Subcatchments.



Merge Subcatchments merge two Subcatchments together.

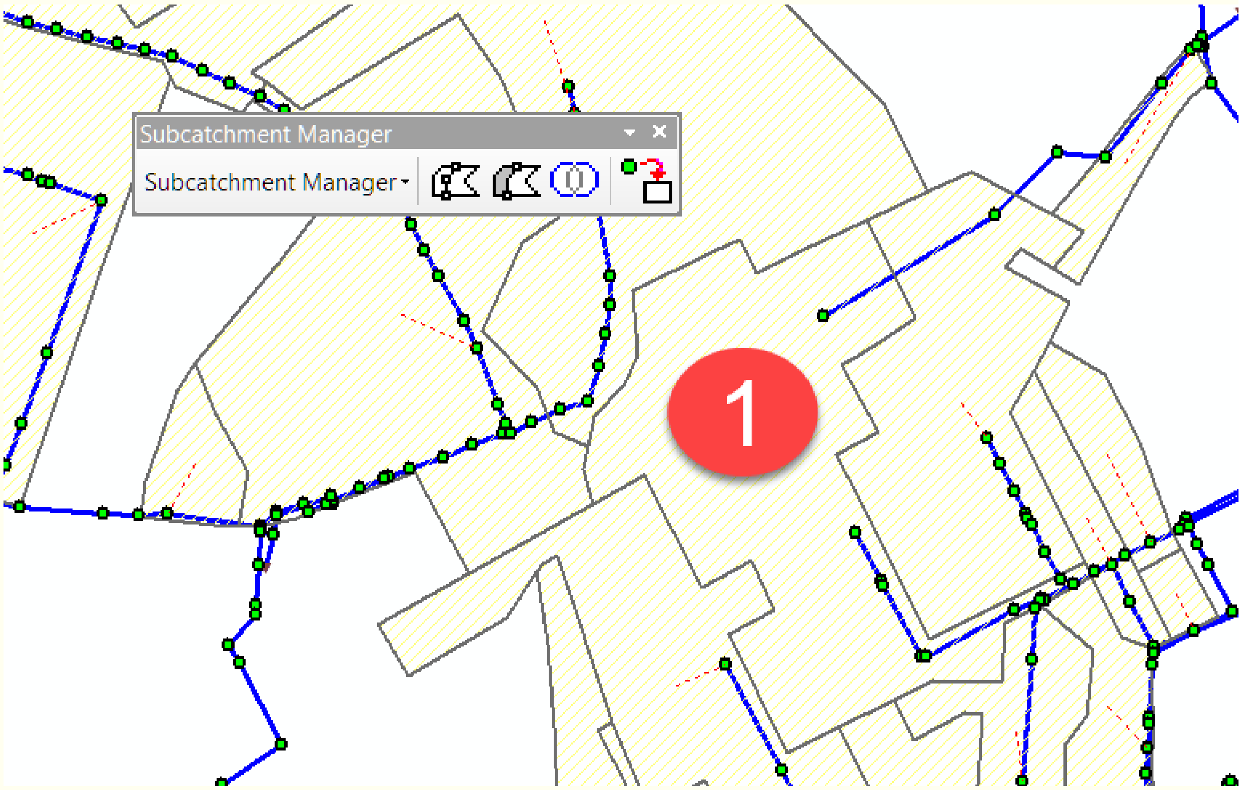
Use the Merge Tool



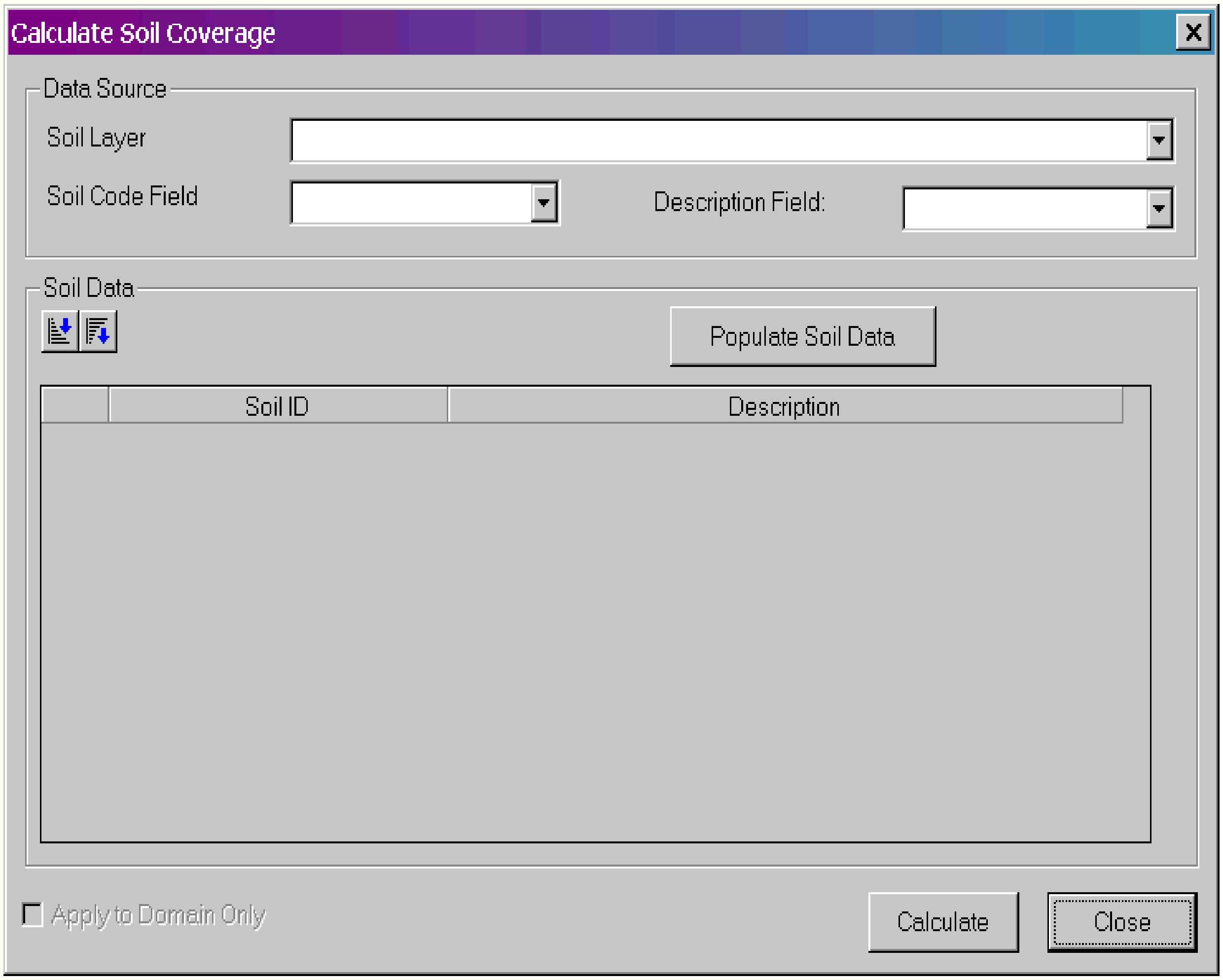
Please select a subcatchment to be merged with '18A'...

Subcatchment '16/17A' has been selected.

New Model - the two Subcatchments have been merged



Allocate Soils Coverage



* Please Leave the mouse cursor on the dialog box item to see its help string

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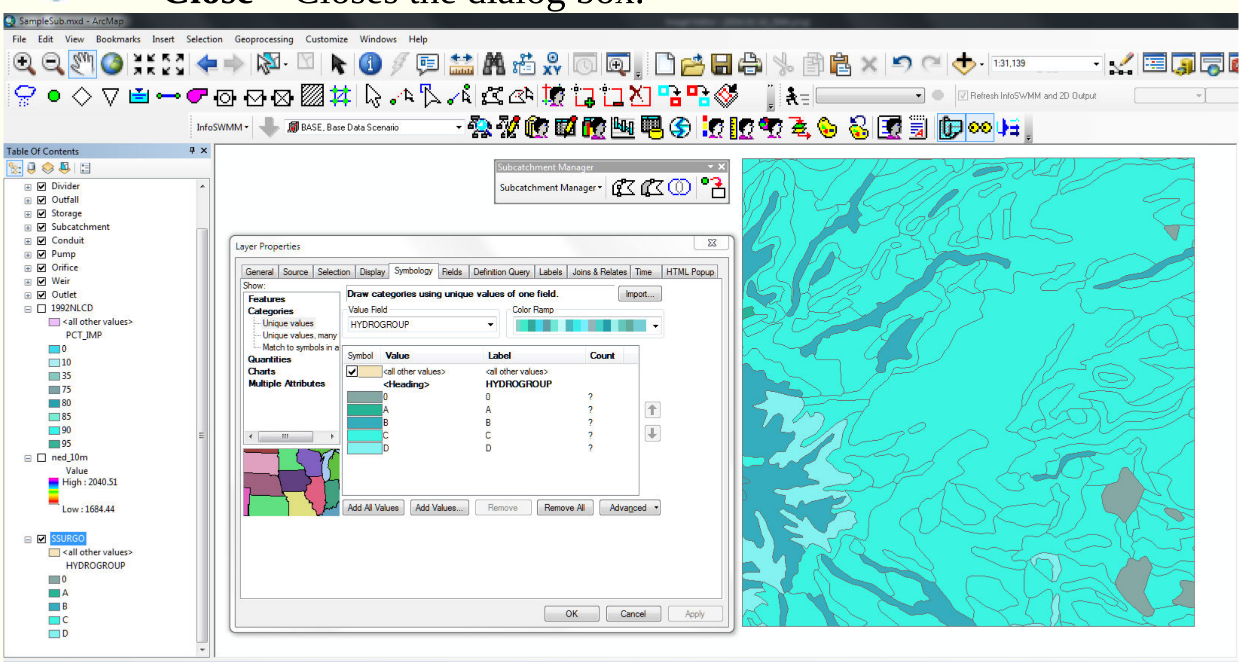
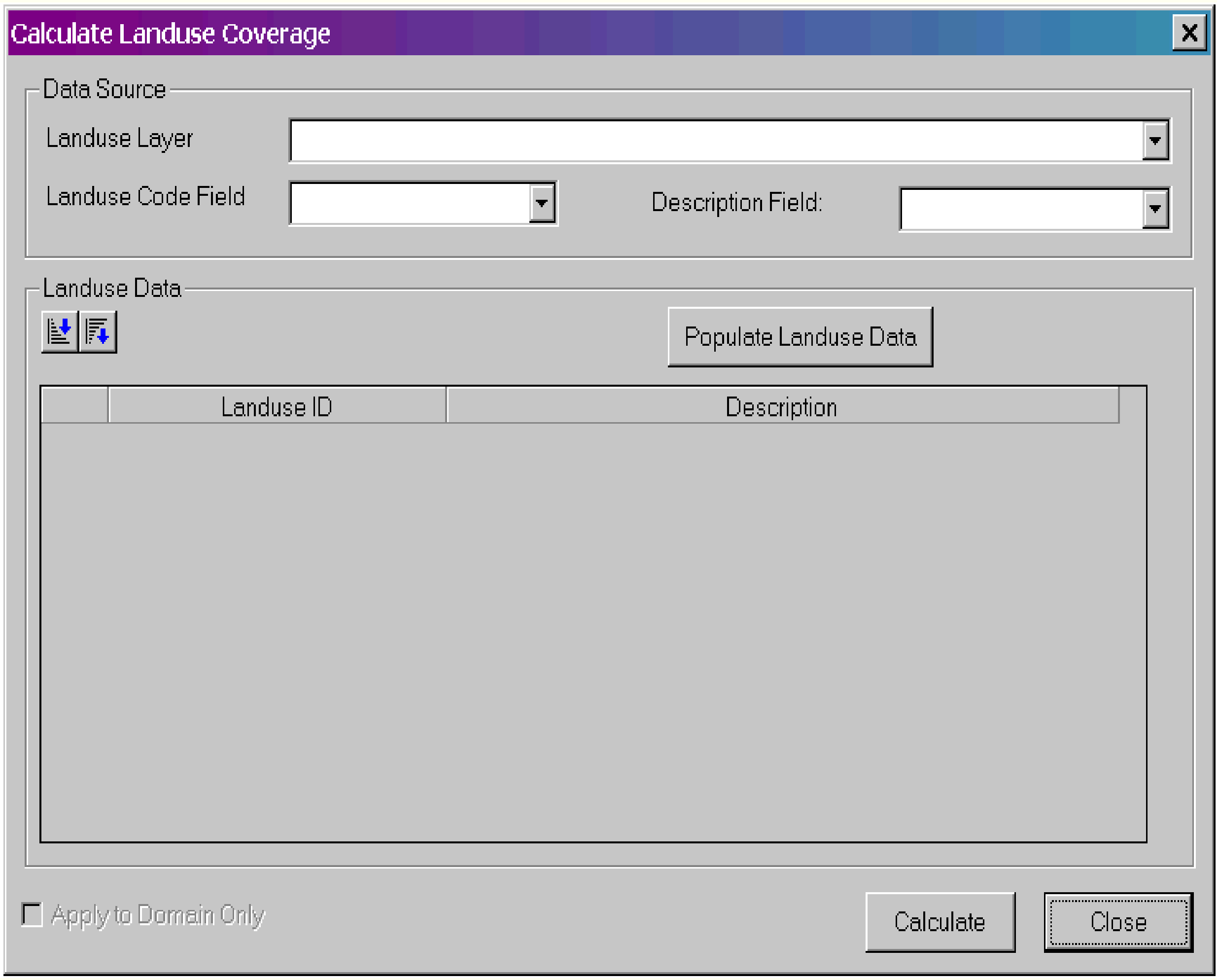
Content of the calculate soil coverage dialog box are described below.

- **Data Source** - Lets you specify or select the data elements to be included in the landuse allocation.
- **Soil Layer** - Pick the soil layer from which to extract infiltration information. The soil layer must be ESRI polygon format.
- **Soil Code Field** - Choose the field containing the code for unique soil types or hydrologic group

- **Description Field** – Choose the field that describes the soil type.
- **Soil Data** - Lets you review the information from the data source.
- **Populate Soil Data** – Adds all unique values from the data source to the soil data table.
- **Soil ID**– The unique values retrieved from the soil code field
- **Description** - The descriptions of the soil code field values from the description field.
  - Sort Ascending: This command is used to sort data in ascending order.
  - Sort Descending: This command is used to sort data in descending order.
- **Apply to Domain Only** – Checking this box will reduce the soil attribute population to Subcatchments in the current domain.
- **Calculate** – Processes the landuse polygons and assigns soil coverage to Subcatchments.
- **Close** – Closes the dialog box.



Allocate LandUse Coverage



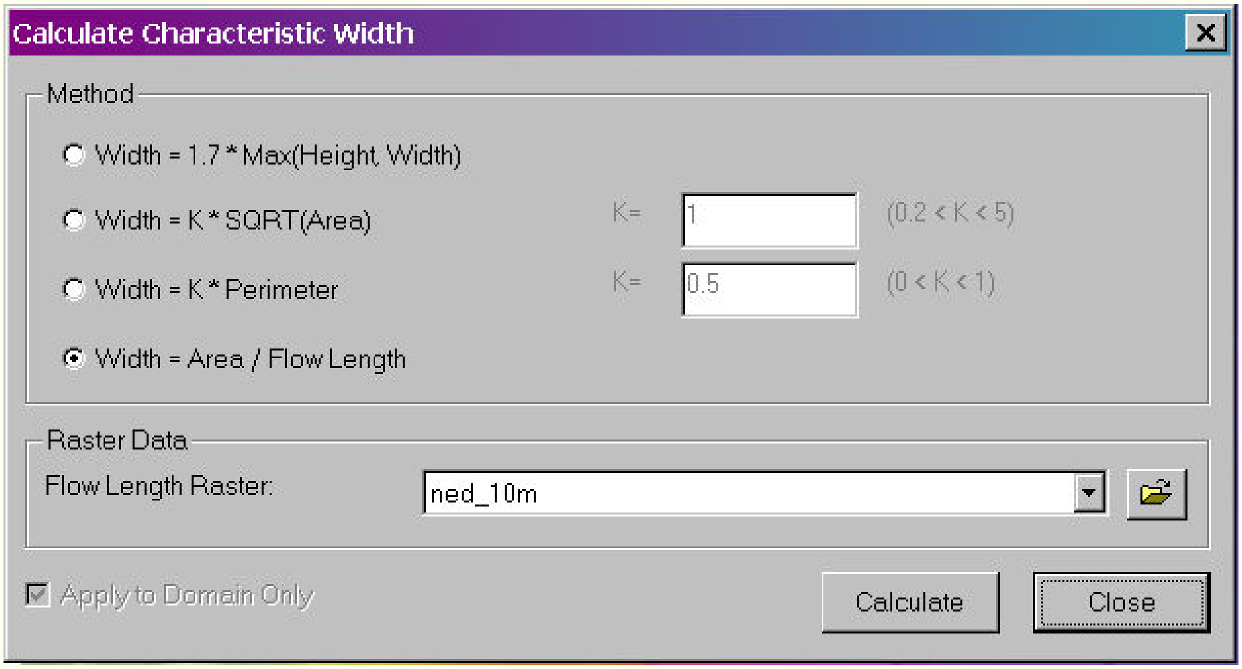
* Please Leave the mouse cursor on the dialog box item to see its help string

Content of the calculate landuse coverage dialog box are described below.

- **Data Source** - Lets you specify or select the data elements to be included in the landuse allocation.
- **Landuse Layer** - Pick the landuse layer from which to extract landuse information. The landuse layer must be ESRI polygon format.

- **Landuse Code Field** - Choose the field containing values for unique landuse types.
- **Description Field** – Choose the field that describes the landuse type.
- **Landuse Data** - Lets you review the information from the data source.
- **Populate Landuse Data** – Adds all unique values from the data source to the landuse data table.
- **Landuse ID**– The unique values retrieved from the landuse code field
- **Description** - The descriptions of the landuse code field values from the description field.
- Sort Ascending : This command is used to sort data in ascending order.
- Sort Descending : This command is used to sort data in descending order.
- **Apply to Domain Only** – Checking this box will reduce the landuse attribute population to Subcatchments in the current domain.
- **Calculate** – Processes the landuse polygons and assigns landuse coverage to Subcatchments.
- **Close** – Closes the dialog box.

Calculate Subcatchment Width



* Please Leave the mouse cursor on the dialog box item to see its help string

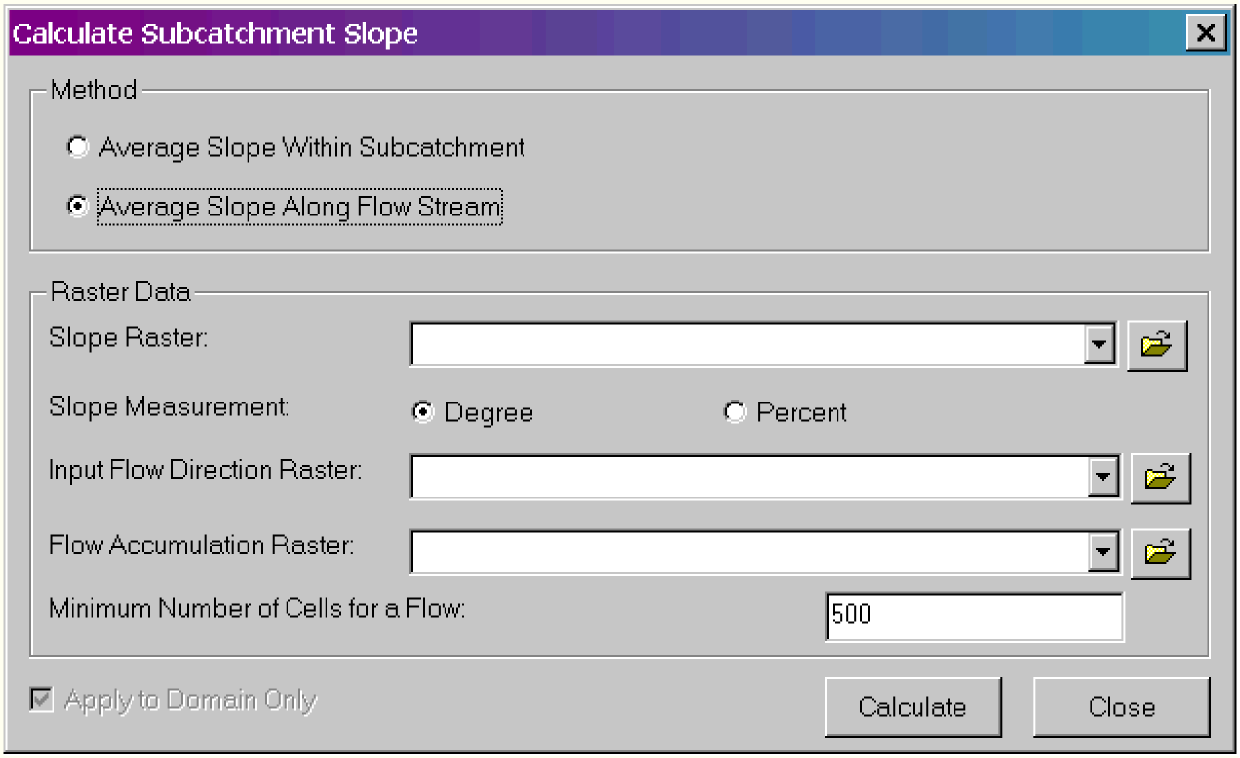
Content of the calculate characteristic width dialog box are described below.

- **Method** - Lets you specify the method to be used when calculating Subcatchment width.
  - **Width = 1.7*Max(Height, Width)** - Computes width as 1.7 times the maximum of the Subcatchment height or width.
  - **Width = K*SQRT(Area)** - Computes width as a user defined constant between 0.2 and 5.0 times the square root of the Subcatchment area.
  - **Width = K*Perimeter** - Computes width as a user defined constant between 0.0 and 1.0 times the perimeter of the Subcatchment.

- **Width = Area/Flow Length** - Computes width as the Subcatchment area divided by the flow length. This method requires a flow length raster.

- **Raster Data** - Lets you choose the flow length raster when using the Width = Area/Flow Length method.
- **Flow Length Raster** - Choose the flow length raster from which to obtain flow lengths.
- **Apply to Domain Only** – Checking this box will reduce the width attribute population to Subcatchments in the current domain.
- **Calculate** – Assigns width to Subcatchments using the chosen method.
- **Close** – Closes the dialog box.

Calculate Subcatchment Slope



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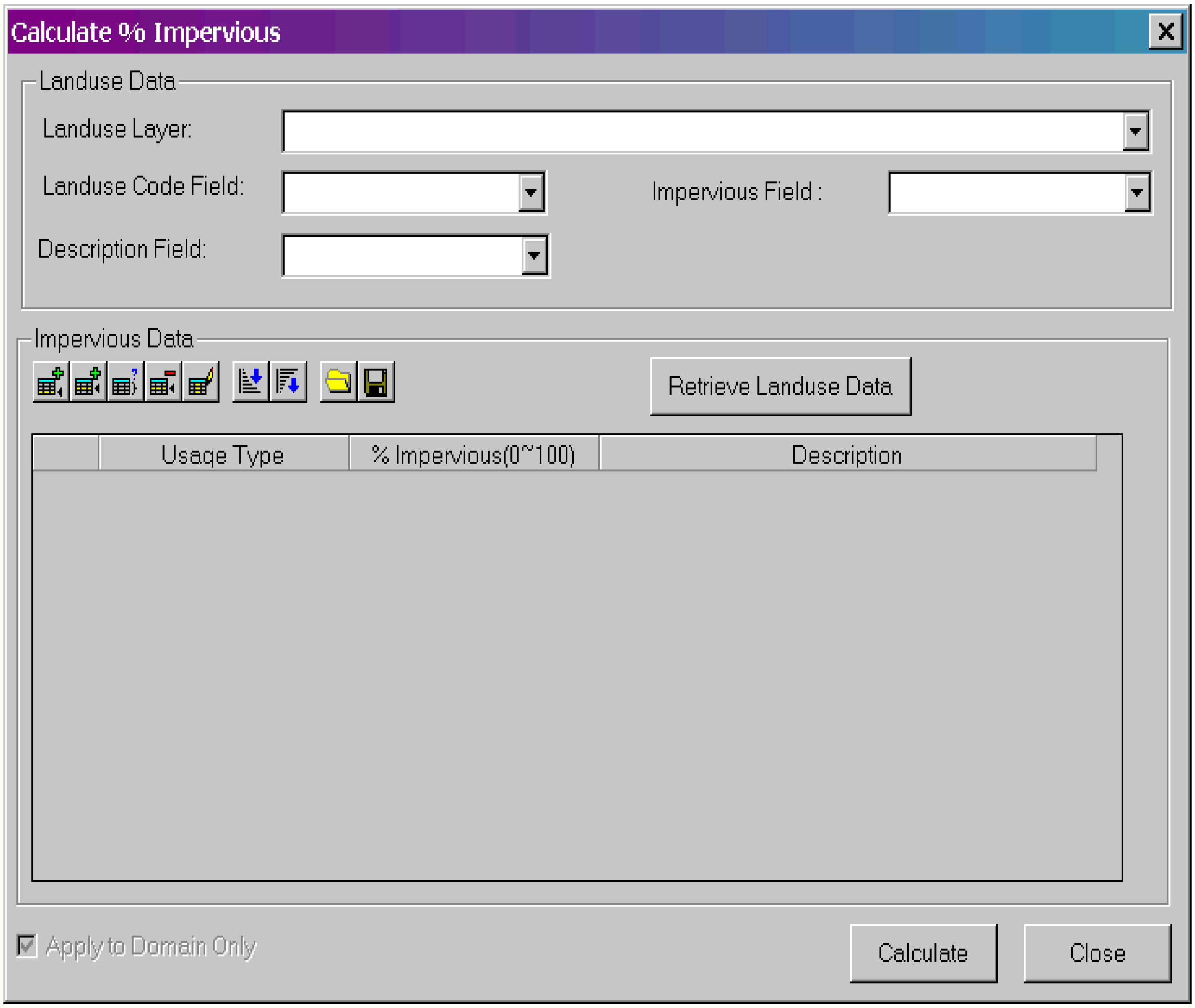
Content of the calculate subcatchment slope dialog box are described below.

- **Method** - Lets you specify the method to be used when calculating subcatchment slope.
- **Average slope within Subcatchment** - Computes slope as the average slope of all cells within a subcatchment.
- **Landuse Code Field** - Computes slope as the average slope of the longest flow path through the subcatchment.
- **Raster Data** - Lets you choose the data sources to use for the slope calculations.
- **Slope Raster** – Pick the slope raster used to calculate slope.

- **Slope Measurement** – Select the units of the slope raster.
- **Input Flow Direction Raster** - Choose the flow direction raster created from the DEM with no sinks.
- **Flow Accumulation Raster** - Pick the flow accumulation grid created from the flow direction raster specified.
- **Minimum Number of Cells for a Flow**
- **Apply to Domain Only** – Checking this box will reduce the slope attribute population to Subcatchments in the current domain.
- **Calculate** – Assigns slope to Subcatchments using the chosen method.
- **Close** – Closes the dialog box.

Assign % Impervious

Assigns or calculates the percent imperviousness from shapefiles or DEM files to your InfoSWMM Subcatchment elements.



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Content of the calculate % impervious dialog box are described below.

- **Data Source** - Lets you specify or select the data elements to be included in the landuse allocation.

- **Landuse Layer** - Pick the landuse layer from which to extract landuse information. The landuse layer must be ESRI polygon format.
- **Landuse Code Field** - Choose the field containing values for unique landuse types.
- **Impervious Field** - Choose the field containing values for impervious percentage (not required).
- **Description Field** – Choose the field that describes the landuse type.
- **Impervious Data** - Lets you review the information from the data source.
- **Retrieve Landuse Data** – Adds all unique values from the data source to the landuse data table.
- **Usage Type** – The unique values retrieved from the landuse code field
- **% Impervious (0~100)** - The percentage impervious for each land use. These values may be retrieved from the landuse data source or manually entered in the Impervious data table.
- **Description** - The descriptions of the landuse code field values from the description field.

 Append Row: This command is used to append a row to the table.

 Insert Row: This command is used to insert a row into the table.

 Set Row: The set row command is used to specify the number of rows in the table.

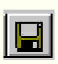
 Delete Row: The delete command may be used to manually delete data corresponding to any land use class/classification field. Note that deleting a row will only remove land use data associated with the classification field. Any impervious class/classification field without a specific percentage impervious value will be assumed to be zero.

 Block Edit: The block edit command allows the user to simultaneously effect multiple changes to the usage table. This command allows the user to select a number of rows in a single column simultaneously and enter a common value to make global changes to the % Impervious table.

 Sort Ascending: This command is used to sort data in ascending order.

 Sort Descending: This command is used to sort data in descending order.

 Load: This command is used to import impervious data file (*.dat file).

 Save: This command is used to save changes made to the impervious data table.

- **Apply to Domain Only** – Checking this box will reduce the impervious attribute population to Subcatchments in the current domain.
- **Calculate** – Processes the landuse polygons and assigns impervious percentage to Subcatchments.
- **Close** – Closes the dialog box.

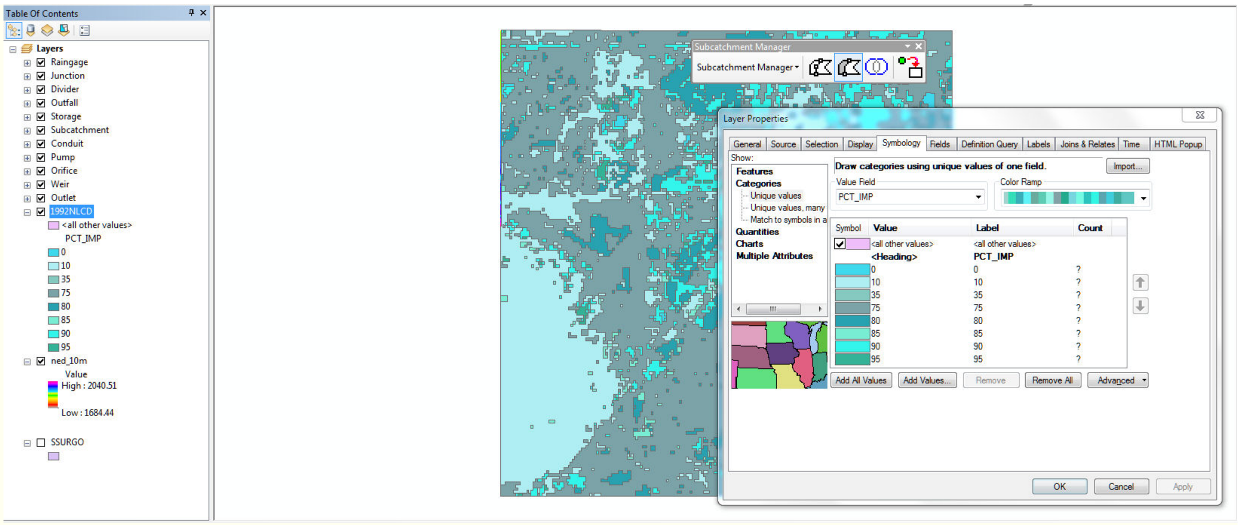


Table Of Contents
Layers
Raingage
Junction
Divider
Outfall
Storage
Subcatchment
Conduit
Pump
Orifice
Weir
Outlet
1992NLCD
<all other values>
PCT_IMP
0
10
35
75
80
85
90
95
ned_10m
Value
High : 2040.51
Low : 1684.44
SSURGO
Subcatchment Manager
Layer Properties
General
Source
Selection
Display
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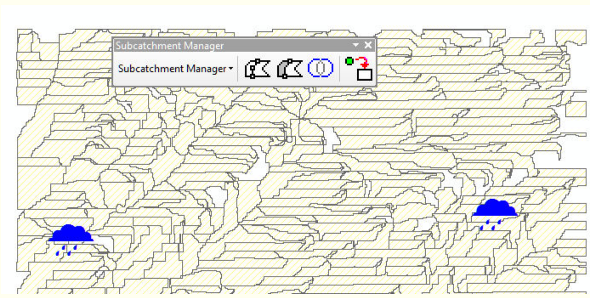
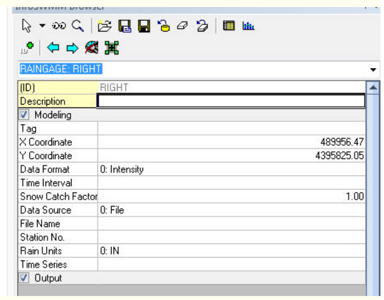
Fields
Definition Query
Labels
Joins & Relates
Time
HTML Popup
Show:
Features
Categories
Unique values
Unique values, many
Match to symbols in a
Quantities
Charts
Multiple Attributes
Draw categories using unique values of one field.
Import...
Value Field
PCT_IMP
Color Ramp
Symbol
Value
Label
Count
<all other values>
<Heading>
Add All Values
Add Values...
Remove
Remove All
Advanced
OK
Cancel
Apply

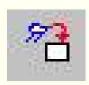
Assign Rain Gages and Outlets

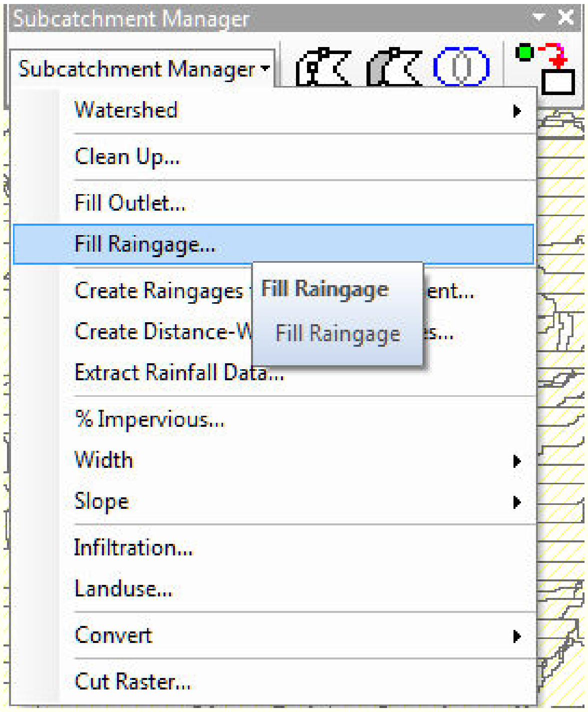
Assigning rain gages and outlet nodes to Subcatchments is simple with the InfoSWMM Subcatchment Manager. To assign rain gages, a gage is first selected. Subsequently, all Subcatchments requiring rainfall data from the selected rain gage may be selected simultaneously. The assign outlet tool simplifies the procedure for creating the network. To link an outlet and Subcatchment, select the outlet then the Subcatchment.

1. Click the “Create Raingage”  icon from the INFOSWMM EDIT NETWORK toolbar.

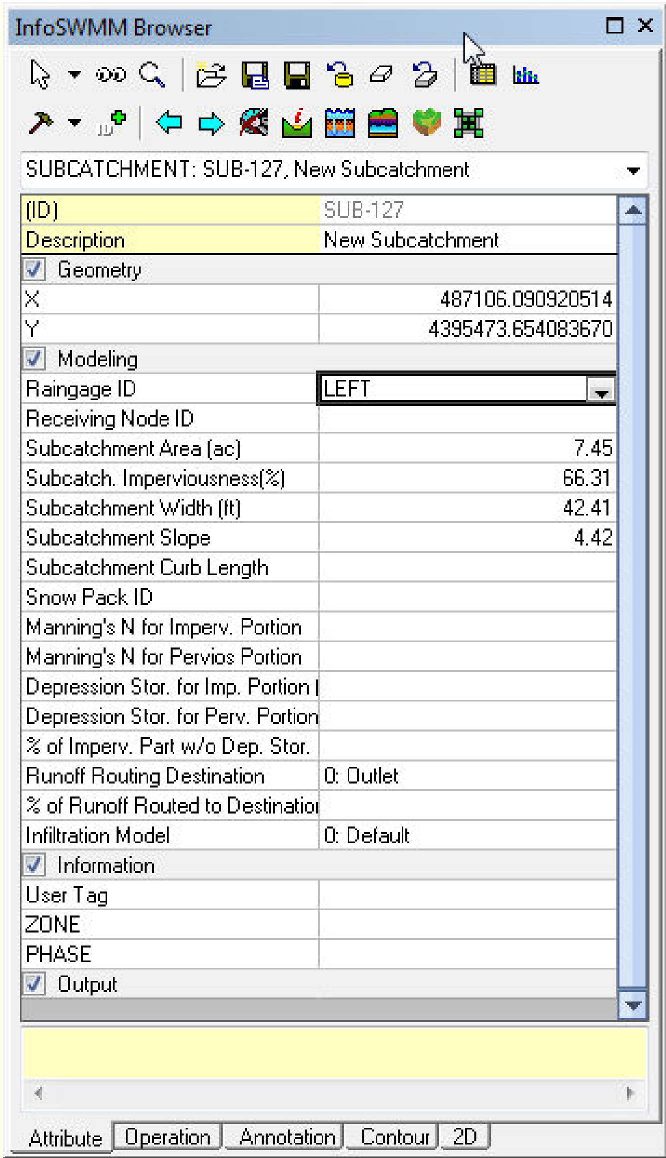
- 2. Create two new raingages: Place one on the left side of the map and the other on the right side of the map. Accept the default ID’s and descriptions for the raingages but change the iD to RIght and Left.
- 



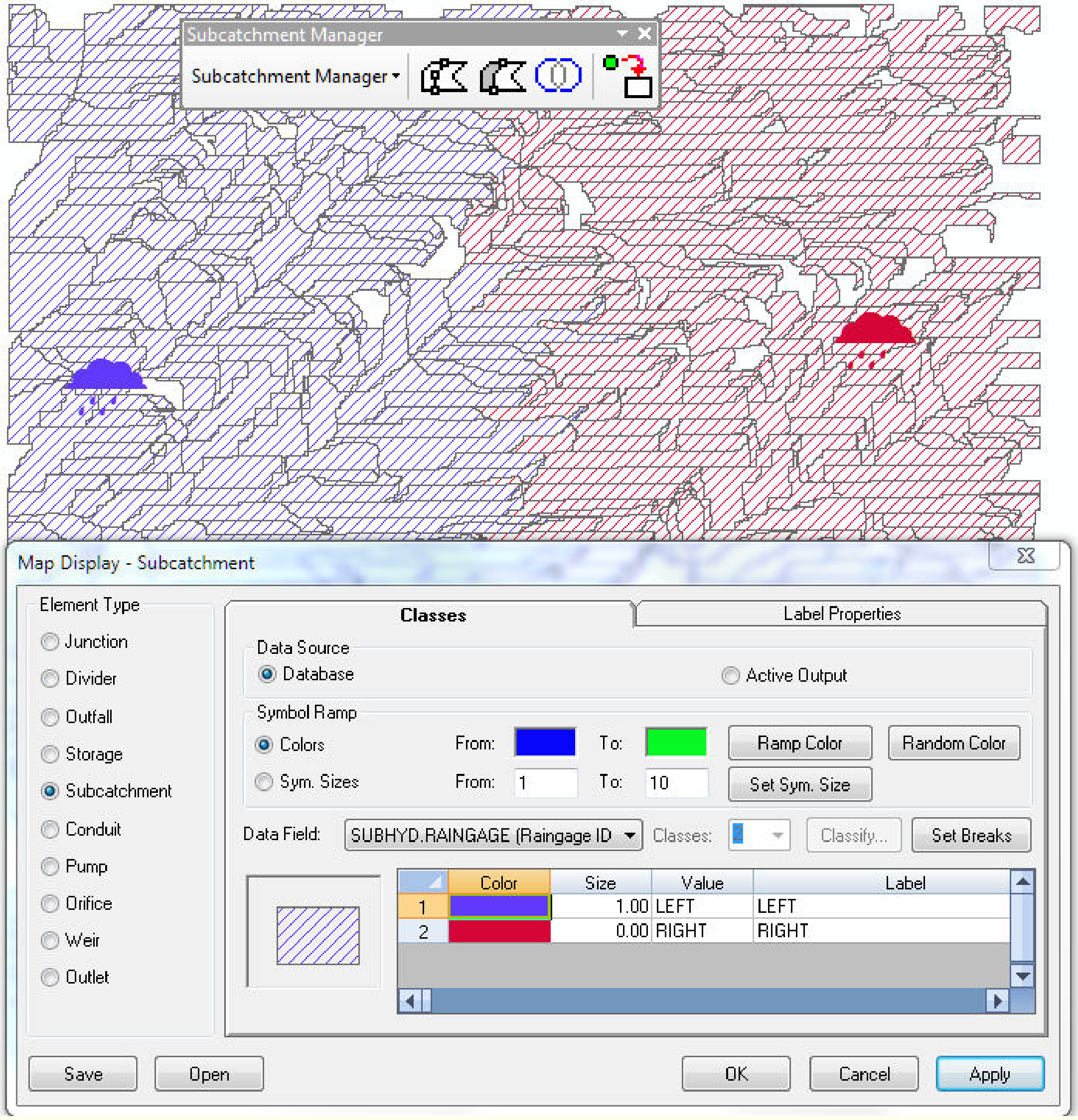
- 3. Click the “Fill Raingage”  icon from the SUBCATCHMENT MANAGER toolbar.

- 

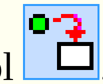
- 4. Select the Raingage on the left
- 5. Select a group of Subcatchments
- 6. Repeat steps 3 to 5 for the Raingage on the right.
- 7. Save the project.
- 8. Select random Subcatchments and examine the attributes that have been globally populated.



- 9. You can use Map Display and color in the Raingage for each Subcatchment.


Subcatchment Manager
Subcatchment Manager
Map Display - Subcatchment
Element Type
Junction
Divider
Outfall
Storage
Subcatchment
Conduit
Pump
Orifice
Weir
Outlet
Classes
Label Properties
Data Source
Database
Active Output
Symbol Ramp
Colors
From:
To:
Ramp Color
Random Color
Sym. Sizes
From: 1
To: 10
Set Sym. Size
Data Field: SUBHYD.RAINGAGE (Raingage ID
Classes:
Classify...
Set Breaks
Color
Size
Value
Label
1 1.00 LEFT LEFT
2 0.00 RIGHT RIGHT
Save
Open
OK
Cancel
Apply

Assign Outlet

Assign an outlet to a Subcatchments with the assign outlet tool . Select the outlet to be assigned; then select the Subcatchment(s) that drain to the selected outlet.

Subcatchment Manager Outputs

All

outputs from the Subcatchment Manager are stored by default in location

specified as the working directory.

Output

files may be stored in a unique location by clicking the  icon next to the output

box.

Slope Measurement

Slope can be displayed in degrees or percent.

Using percent slope is recommended as InfoSWMM uses percent slope in runoff calculations.

See Also

Calculate Subcatchment Slope

Create a Slope Raster

Digital Elevation Models

Digital

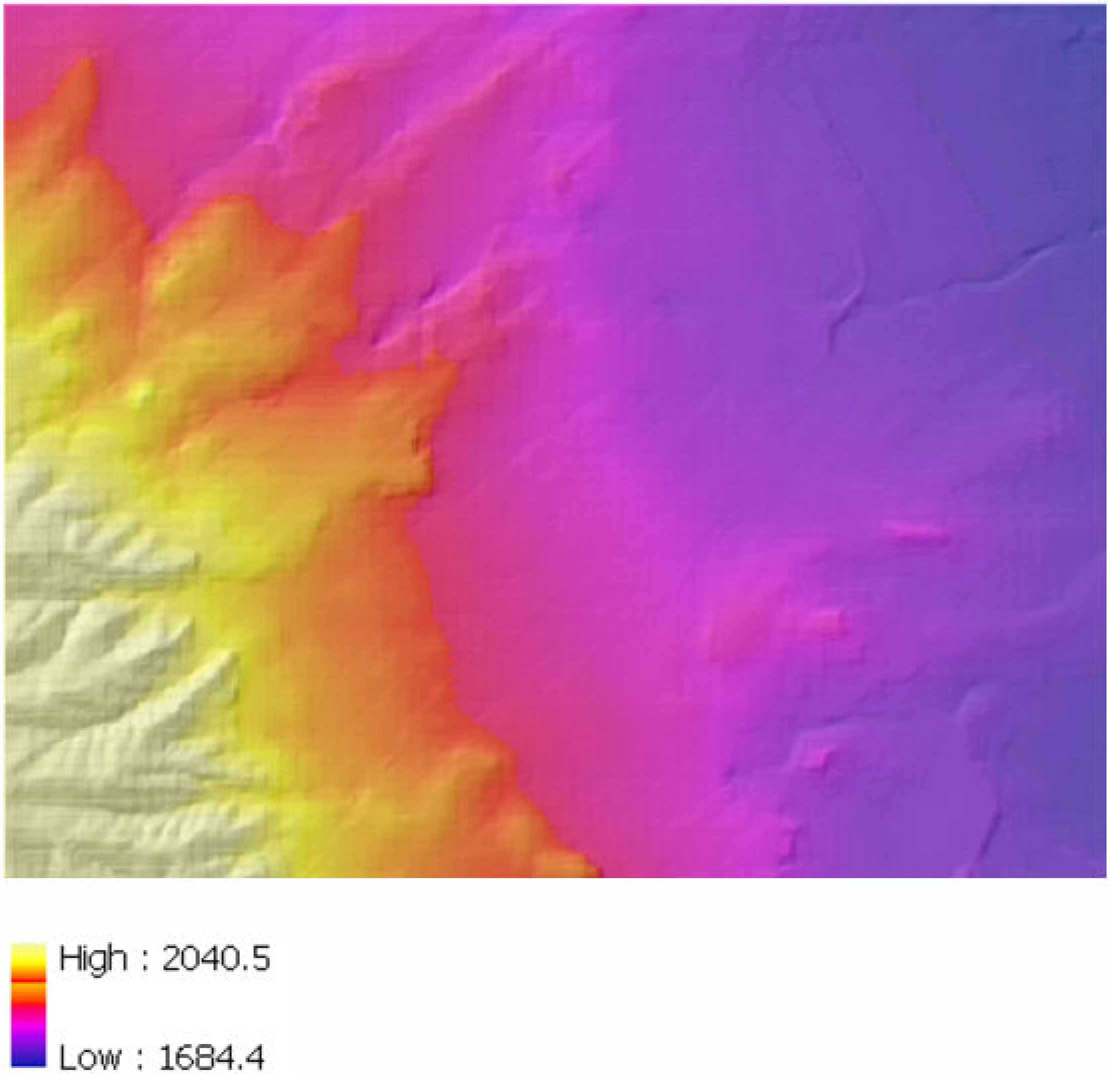
Elevation Models (DEM's) are raster data with each pixel or cell containing a unique elevation value.

A

DEM is the only valid type of Input Elevation Surface. Points and contours can be converted to a DEM

with the Subcatchment Manger.

A Digital Elevation Model


High : 2040.5
Low : 1684.4

Output Cell Size

The length of each side of every cell in the output raster. The default value is the cell size of the input raster.

Minimum Number of Cells for a Flow

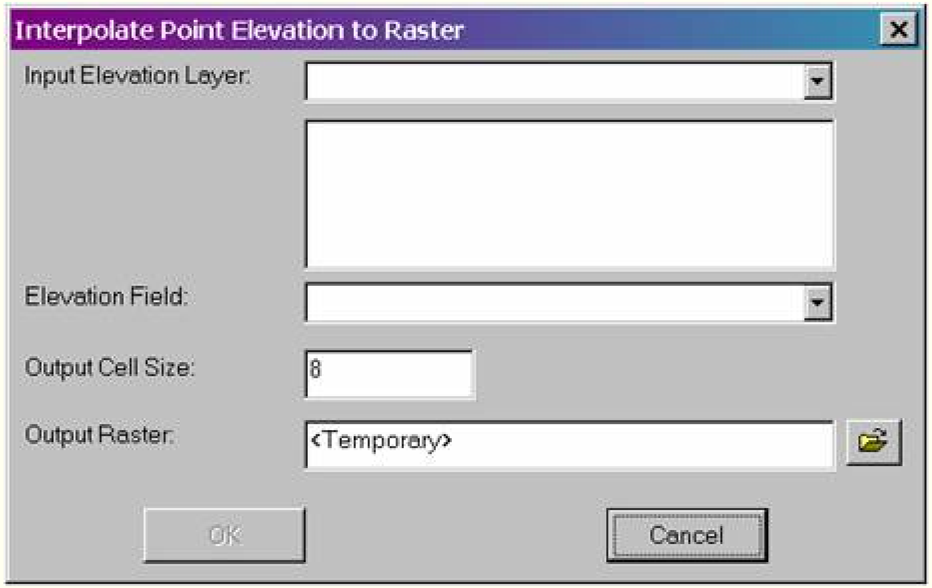
Minimum number of cells required to accumulate and to form a stream flow; the default is 1 % of maximum value of flow accumulation.

Streams can be defined from the flow accumulation and direction grids.

Z Factor

The number of horizontal (x, y) units in one vertical (z) unit. Enter 1 if the vertical and horizontal units are equal.

Interpolate Point Elevation to Raster



* Please Leave the mouse cursor on the dialog box item to see its help string

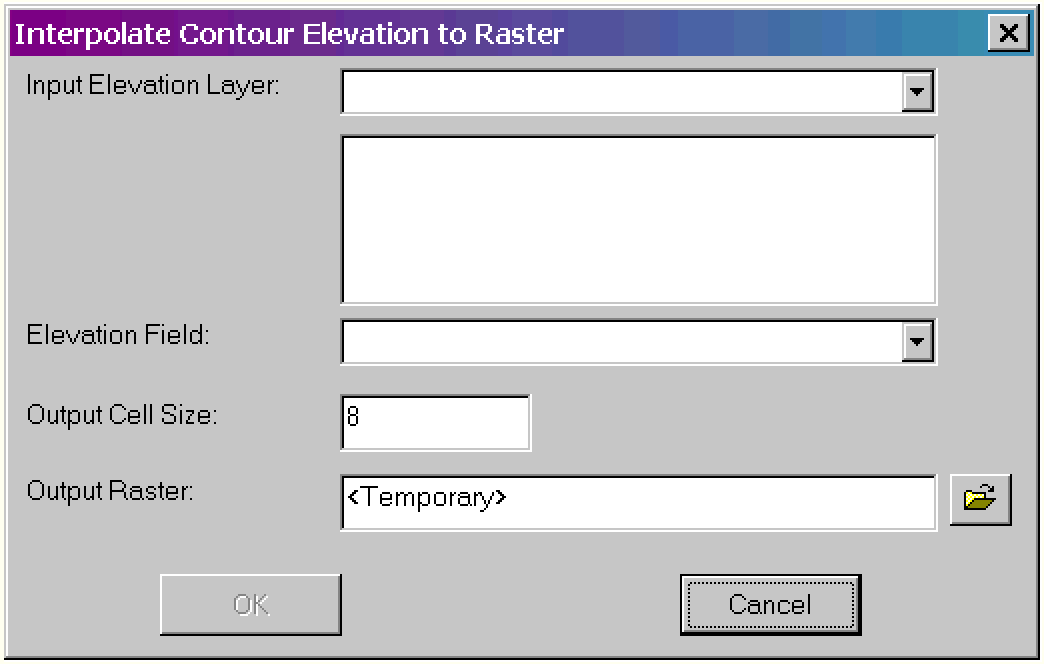
---

Content of the interpolate point elevation to raster dialog box are described below.

- **Input Elevation Layer** - Choose the point layer from which to create a DEM. The point elevation layer must be ESRI point format.
- **Elevation Field** - Choose the field in the point layer database that represents elevation values.
- **Output cell size** - Enter the desired size of cells in the output DEM.
- **Output Raster** - Enter a name for the output DEM and the location where the file will be stored.

- **<Temporary> -** If an output file name is not specified, the DEM created will only remain in the map until the project is closed. Specify an output name to create a permanent file.
- **OK** – Creates a DEM.
- **Cancel** – Cancels the operation and closes the dialog box.

Interpolate Contour Elevation to Raster



* Please Leave the mouse cursor on the dialog box item to see its help string

Content of the interpolate contour elevation to raster dialog box are described below.

- **Input Elevation Layer** - Choose the contour layer from which to create a DEM. The contour elevation layer must be ESRI line format.
- **Elevation Field** - Choose the field in the contour layer database that represents elevation values.
- **Output cell size** - Enter the desired size of cells in the output DEM.
- **Output Raster** - Enter a name for the output DEM and the location where the file will be stored.

- **<Temporary> -** If an output file name is not specified, the DEM created will only remain in the map until the project is closed. Specify an output name to create a permanent file.
- **OK** – Creates a DEM.
- **Cancel** – Cancels the operation and closes the dialog box.

Convert Raster to Subcatchment

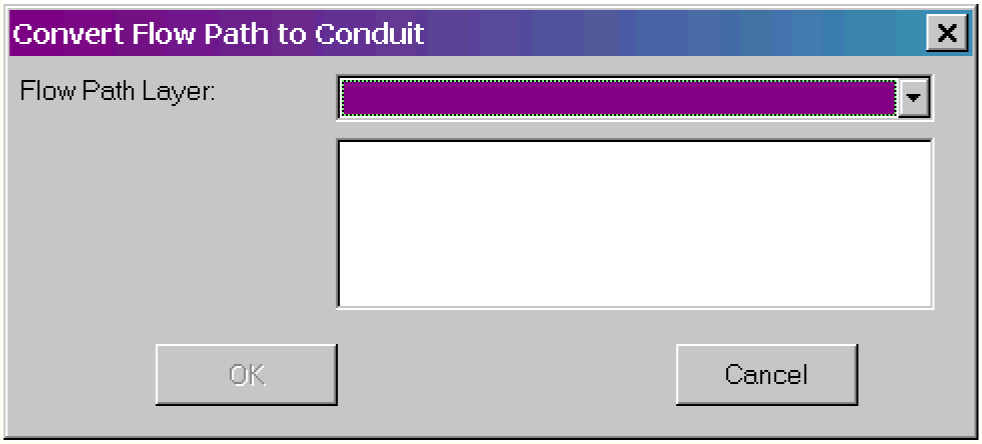
* Please Leave the mouse cursor on the dialog box item to see its help string

---

Content of the convert raster to Subcatchment dialog box are described below.

- **Input Watershed Raster** - Choose the raster layer to be converted into InfoSWMM Subcatchments. Watershed rasters are converted to the InfoSWMM Subcatchment layer and assigned ID's in the InfoSWMM database. Values in the Input Watershed Raster must represent unique Subcatchments.
- **OK** – Converts the raster data to Subcatchments.
- **Cancel** – Cancels the operation and closes the dialog box.

Convert Flow Path to Conduit



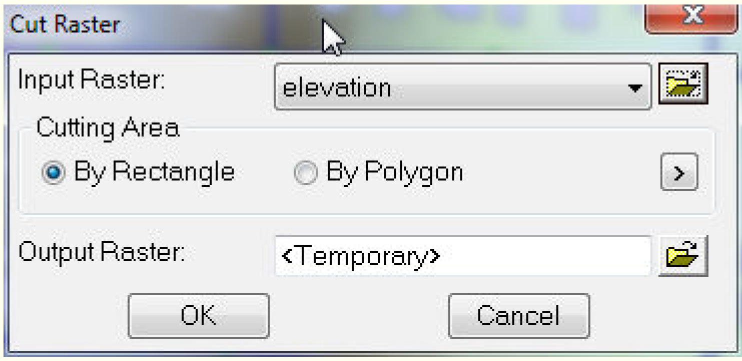
* Please Leave the mouse cursor on the dialog box item to see its help string

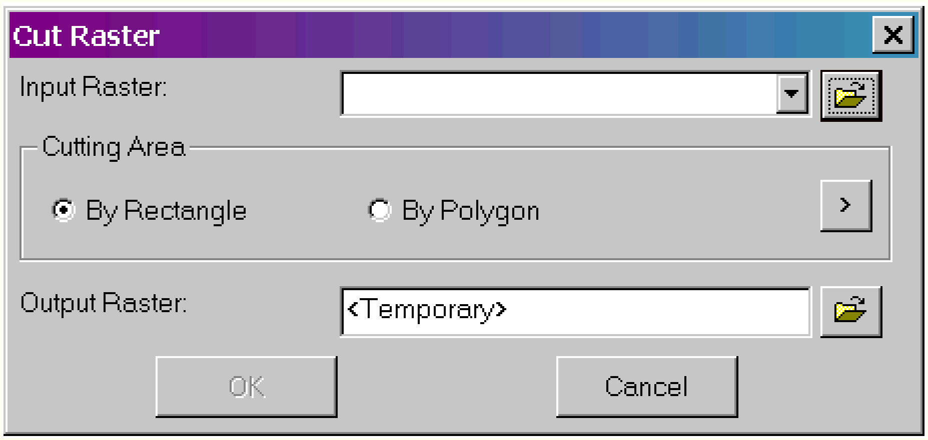
---

Content of the convert flow path to conduit dialog box are described below.

- **Flow Path Layer** - Choose the flow network to be converted into InfoSWMM conduits. Flow Paths are converted to the InfoSWMM Conduit layer and assigned ID's in the InfoSWMM database.
- **OK** – Converts flow paths to conduits.
- **Cancel** – Cancels the operation and closes the dialog box.

Cut Raster



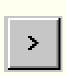


* Please Leave the mouse cursor on the dialog box item to see its help string

---

Content of the cut raster dialog box are described below.

- **Input Raster** - Choose the raster to be cut.
- **Cutting Area** - Specifies the shape and location where the raster is to be cut.
- **By Rectangle** - A rectangle is specified to cut the raster
- **By Polygon** - A rectangle is specified to cut the raster

   Click this button to draw the rectangle or polygon on the raster to be cut.

- **Output Raster** - Enter a name for the output cut raster and the location where the file will be stored.
  - **<Temporary>** - If an output file name is not specified, the cut raster created will only remain in the map until the project is closed. Specify an output name to create a permanent file.
- **OK** – Cuts the specified raster and creates a new raster from the area inside the cutting area.
- **Cancel** – Cancels the operation and closes the dialog box.

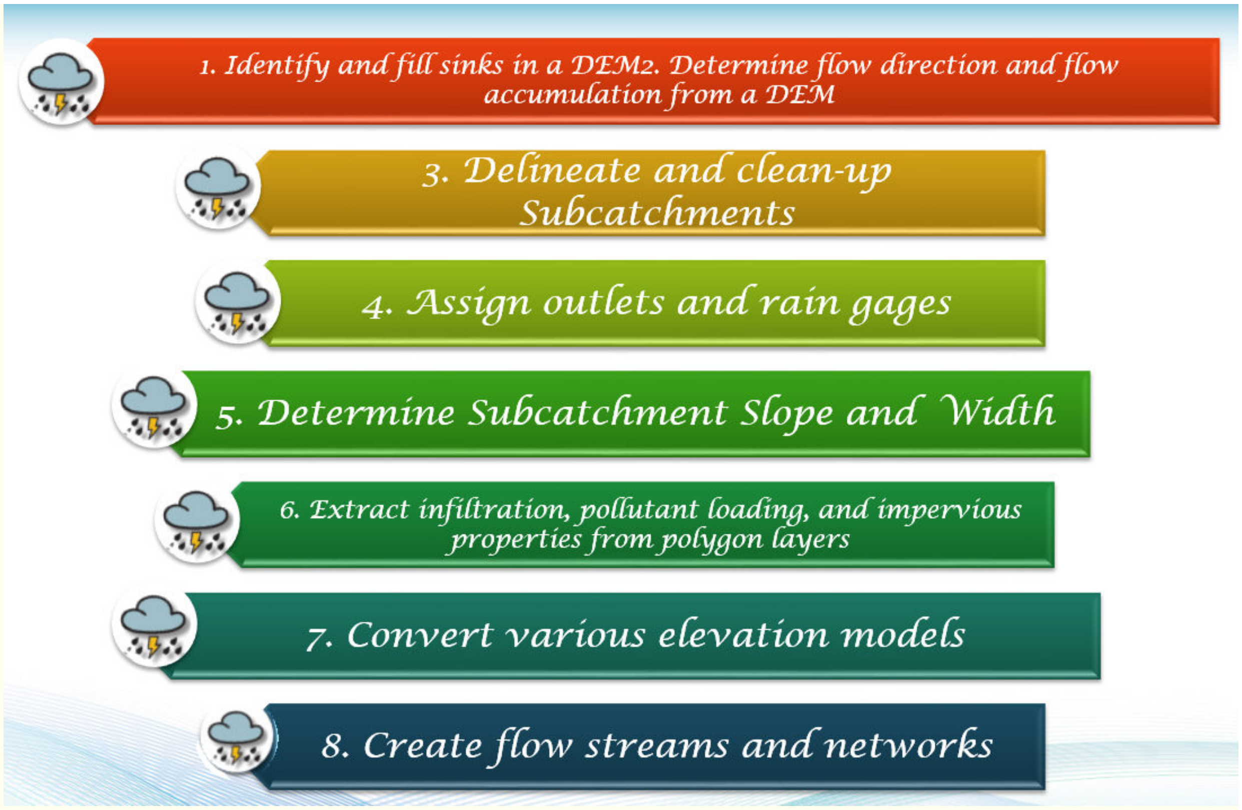
Automated Hydrologic Models

Proper delineation of watersheds is critical for accurate stormwater modeling applications. Watersheds can be delineated from many sources of elevation models including contours, points, and digital elevation models (DEM). These data are analyzed to determine the direction of surface runoff. The size and shape of the delineated watershed influence the characteristics of the watershed such as area, width, slope, flow path length, and centroid. Inconsistent or inadequately defined methods of determining such attributes can lead to poor analysis and design/improvement recommendations of storm sewer systems.

InfoSWMM Subcatchment Manager brings you unprecedented speed, accuracy, flexibility, and consistency for delineating watersheds and determining their properties. This important module fully automates the global population of subcatchment attributes to ensure the timely development of an unbiased rainfall / runoff model. It also aids in the development of a sewer network model.

An indispensable master planning tool, InfoSWMMSubcatchment Manager offers you multiple highly advanced and efficient geospatial methods for defining subcatchments and establishing their characteristics. You can:

1. **Identify and fill sinks in a DEM**
2. **Determine flow direction and flow accumulation from a DEM**
3. **Delineate and clean-up Subcatchments**
4. **Assign outlets and rain gages**
5. **Determine Subcatchment slope and width**
6. **Extract infiltration, pollutant loading, and impervious properties from polygon layers**
7. **Convert various elevation models**
8. **Create flow streams and networks**



The first tool lets you identify local low areas in a DEM and remove them to ensure a continuous sloping surface that conveys water through each subcatchment. The second tool lets you determine the flow direction for each cell in the DEM. After the flow direction is computed, the total number of DEM pixels draining to every individual pixel is calculated in the flow accumulation raster. The flow direction and flow accumulation are used by the third tool to determine watershed boundaries and create clean polygon edges. A user defined threshold or any defined collection point layer is used to determine the boundary locations of each subcatchment. The fourth tool lets you link each subcatchment to the nearest rain gage. In addition, the “drains to” outlet for each subcatchment is assigned when a collection point layer was utilized in delineating the watersheds. The fifth tool lets you populate attributes for subcatchment slope and width. Two methods are provided for calculating the slope and four techniques are available for computing width, thus allowing the engineer to use judgment when determining these attributes. The sixth tool makes use of advanced polygon processing to extract information from soils, land use, and impervious percentage layers. The seventh tool enables you to convert point data or contours to a DEM for use with the other tools. The final function is used to create stream networks. Flow streams are defines from the flow accumulation grid and can then be converted to conduits in the sewer network.

Within a true GIS environment, InfoSWMMSubcatchment Manager lets you to edit, manipulate, and manage all your GIS polygons and their associated data with incredible ease and speed. Both existing sewer system and future system conditions such as build-out and phased land use and impervious percentage projections can be considered – a necessary feature for effectively staging capital improvement programs. These comprehensive capabilities will allow you to effectively utilize your engineering knowledge and judgment, leverage your existing GIS data investments, and strategically define subcatchments and the network in your master planning effort.

You can now readily build and analyze more complete, representative, and reliable rainfall/runoff models than ever before and in record time. Without that credibility, the most complex and theoretically sound model that could be developed would not be effective in helping you plan and design a sound system. Sound methodology for subcatchment delineation and attribute population will not only result in more precise and comparable simulations, but will also greatly assist you in more effectively calibrating, operating, and managing your watersheds and in developing rigorous system performance improvement alternatives.

We are happy to bring you this practical and highly sophisticated geospatial subcatchment application tool to continue to effectively support your rainfall/runoff management activities.

Our high-level, state-of-the-art research and development effort in GIS-based network modeling is continuing at a rapid pace and we intend to update and refine InfoSWMM Subcatchment Manager to reflect this progress. We are pleased to be at the forefront of this vital computer technology and to continue to advance it to an unprecedented level of comprehensiveness, reliability and performance.

Paul F. Boulos, Ph.D., BCEEM, Hon.D.WRE, Dist.D.NE, F.ASCE

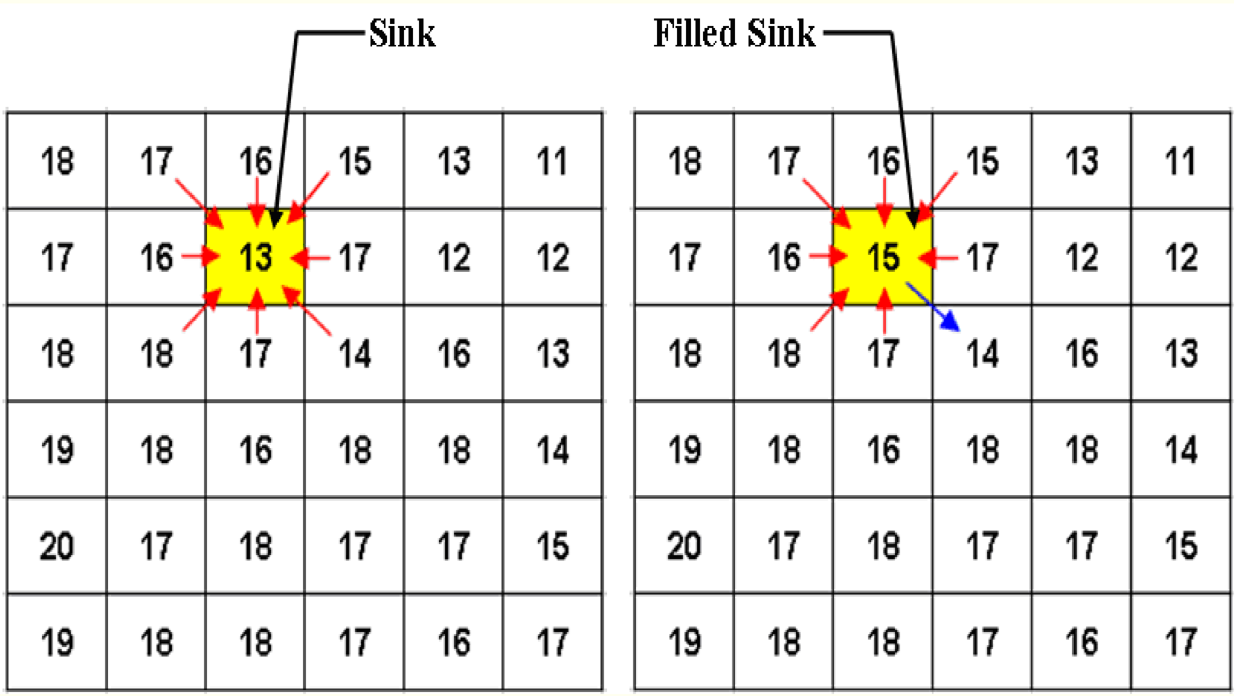
President, COO and Chief Technical Officer, Innovyze Inc.

January 30, 2019

DEM Sinks

A sink is a pixel in a DEM with an elevation value lower than all eight cells surrounding it. A moving window or kernel, 3 pixels by 3 pixels, is used to analyze the elevation of cells surrounding each individual (reference) cell. A sink is a cell with an undefined drainage direction; no cells surrounding it are lower.

The Identify Sinks function locates each sink in the DEM by creating a flow direction grid from the raw DEM. Any non-standard flow direction value indicates a sink. Filling sinks modifies reference DEM pixels values to be between the minimum and maximum values from the eight surrounding cells.



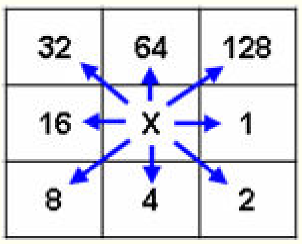
A DEM with sinks The DEM after filling sinks

Water naturally flows overland and collects in channels. Rainfall / runoff modeling assumes water is either lost within the Subcatchment (infiltration, depression, etc.) or it flows to the outlet. Residence time in local depressions is not considered when analyzing the time of concentration. Therefore, local depressions or sinks should not be included in such models.

> A sink is a cell or set of spatially connected cells whose flow direction cannot be assigned one of the eight valid values in a flow direction raster. This can occur when all neighboring cells are higher than the processing cell or when two cells flow into each other, creating a two-cell loop.
>
> Sinks are considered to have undefined flow directions and are assigned a value that is the sum of their possible directions. For example, if the steepest drop and, therefore, flow direction are the same to both the right (1) and left (http://desktop.arcgis.com/en/arcmap/10.3/tools/spatial-analyst-toolbox/how-sink-works.htm16), the value 17 would be assigned as the flow direction for that cell.
>
> To create an accurate representation of flow direction and, therefore, accumulated flow, it is best to use a dataset that is free of sinks. A digital elevation model (DEM) that has been processed to remove all sinks is called a depressionless DEM.
>
> Sinks in elevation data are most commonly due to errors in the data. These errors are often caused by sampling effects and the rounding of elevations to integer numbers. Naturally occurring sinks in elevation data with a cell size of 10 meters or larger are rare (Mark 1988), except in glacial or karst areas, and generally can be considered errors. As the cell size increases, the number of sinks in a dataset also often increases. Source http://desktop.arcgis.com/en/arcmap/10.3/tools/spatial-analyst-toolbox/how-sink-works.htm

Flow Direction

Water flows from a reference cell to one of the eight cells surrounding it, specifically the one providing the greatest elevation difference from the reference cell. Flow direction is represented by a numerical value (1, 2, 4, 8, 16, 32, 64, or 128) and used for evaluating flow paths, delineating watersheds, and determination of flow accumulation. A 3 by 3 kernel is also used for defining these grids.



Flow Direction Values

18	17	16	15	13	11
17	16	15	17	12	12
18	18	17	14	16	13
19	18	16	18	18	14
20	17	18	17	17	15
19	18	18	17	16	17

2	2	4	2	1	X
1	1	2	1	128	64
128	128	1	128	64	64
2	1	128	64	128	64
1	128	64	32	128	64
128	64	1	1	128	64

A DEM without sinks The Flow Direction Grid for the DEM on the Left

The output of the Flow Direction tool is an integer raster whose values range from 1 to 255. The values for each direction from the center are the following:

32	64	128
16		1
8	4	2

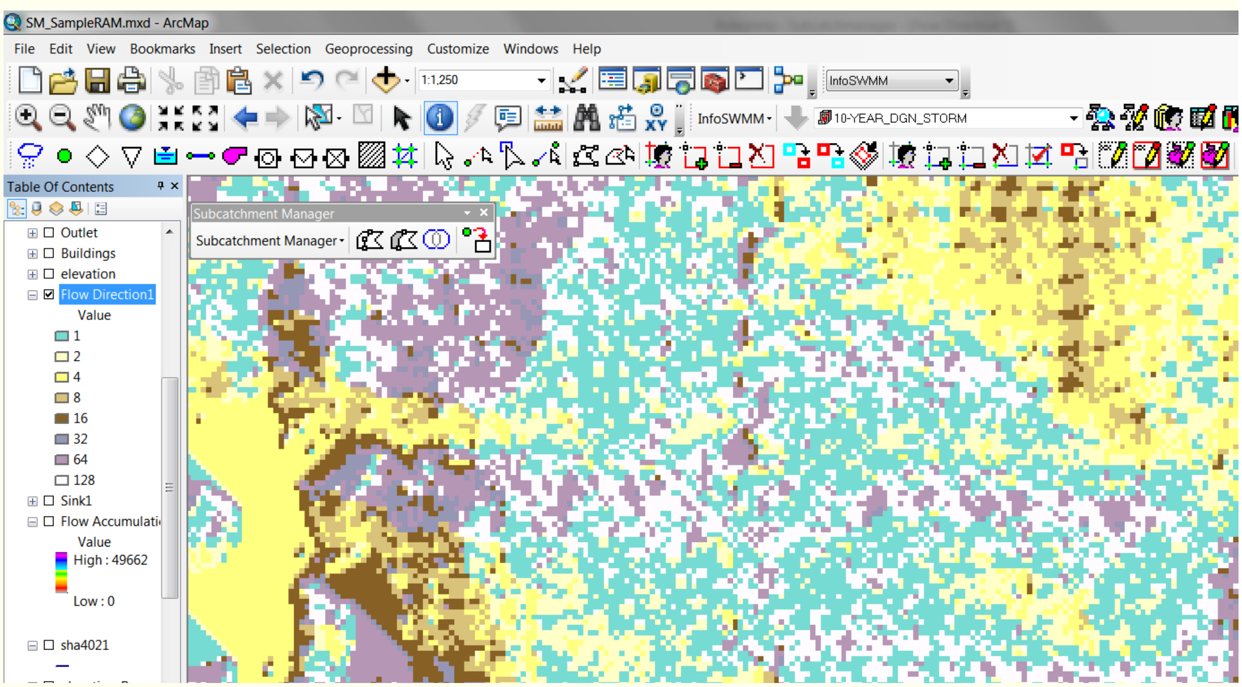
For example, if the direction of steepest drop was to the left of the current processing cell, its flow direction would be coded as 16.

If a cell is lower than its eight neighbors, that cell is given the value of its lowest neighbor, and flow is defined toward this cell. If multiple neighbors have the lowest value, the cell is still given this value, but flow is defined with one of the two methods explained below. This is used to filter out one-cell sinks, which are considered noise.

If a cell has the same change in z-value in multiple directions and that cell is part of a sink, the flow direction is referred to as undefined. In such cases, the value for that cell in the output flow direction raster will be the sum of those directions. For example, if the change in z-value is the same both to the right (flow direction = 1) and down (flow direction = 4), the flow direction for that cell is 1 + 4 = 5. Cells with undefined flow direction can be flagged as sinks using the Sink tool.

Source - http://desktop.arcgis.com/en/arcmap/10.3/tools/spatial-analyst-toolbox/flow-direction.htm

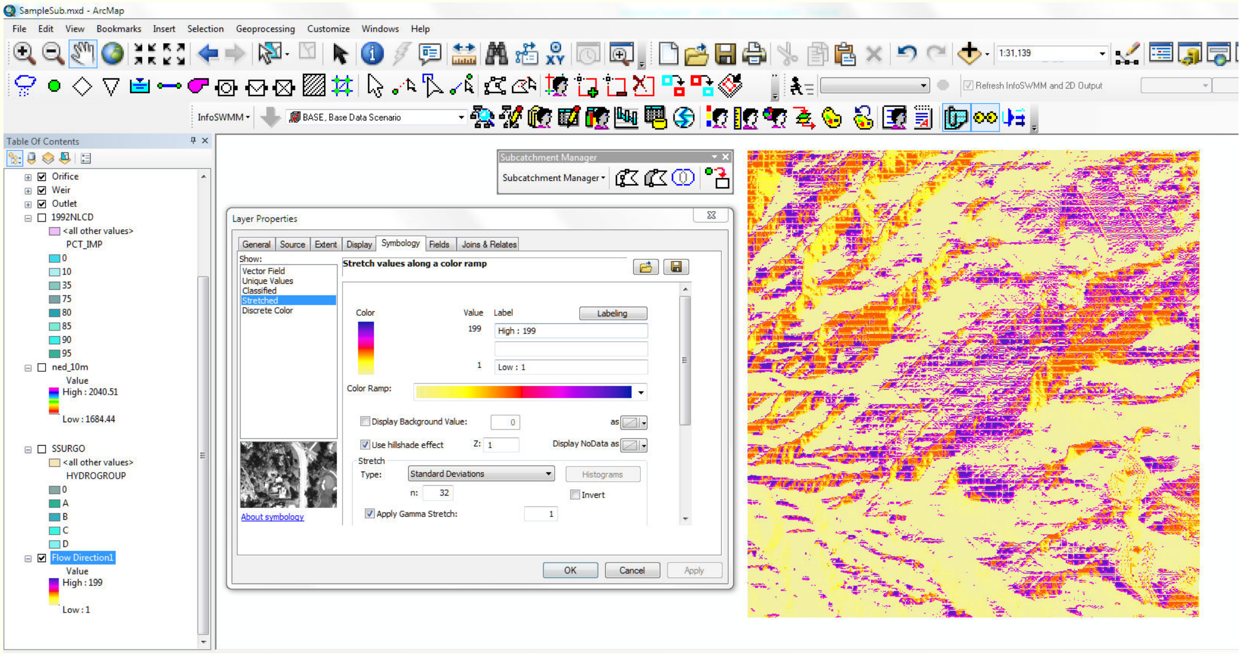
You can see the Flow Direction Values in InfoSWMM by using the Arc Map TOC Symbology



See Also

[***Create a Flow Direction Grid***]()

In the Table of Contents you can open up any later Property and color the layer using either the Display or Symbology Tabs. You can also label the data.



Flow Accumulation

Flow accumulation defines the amount of water flowing into any reference cell. The flow accumulation grid essentially counts cells along the flow path. The value of any given cell is the number of cells that drain into it. The convention used by InfoSWMM is that a cell with no surrounding cells flowing into it has a flow accumulation of zero. The flow accumulation grid is created from the flow direction grid. Delineating subcatchments based on a minimum threshold for flow definition utilizes the flow accumulation grid.

2	2	4	2	1	X
1	1	2	1	128	64
128	128	1	128	64	64
2	1	128	64	128	64
1	128	64	32	128	64
128	64	1	1	128	64

0	0	0	0	0	35
0	3	7	0	23	9
0	0	0	19	0	8
0	0	8	0	0	6
0	4	0	0	0	4
0	0	0	1	2	0

A Flow Direction Grid The Flow Accumulation Grid for the Flow
Direction Grid on the Left

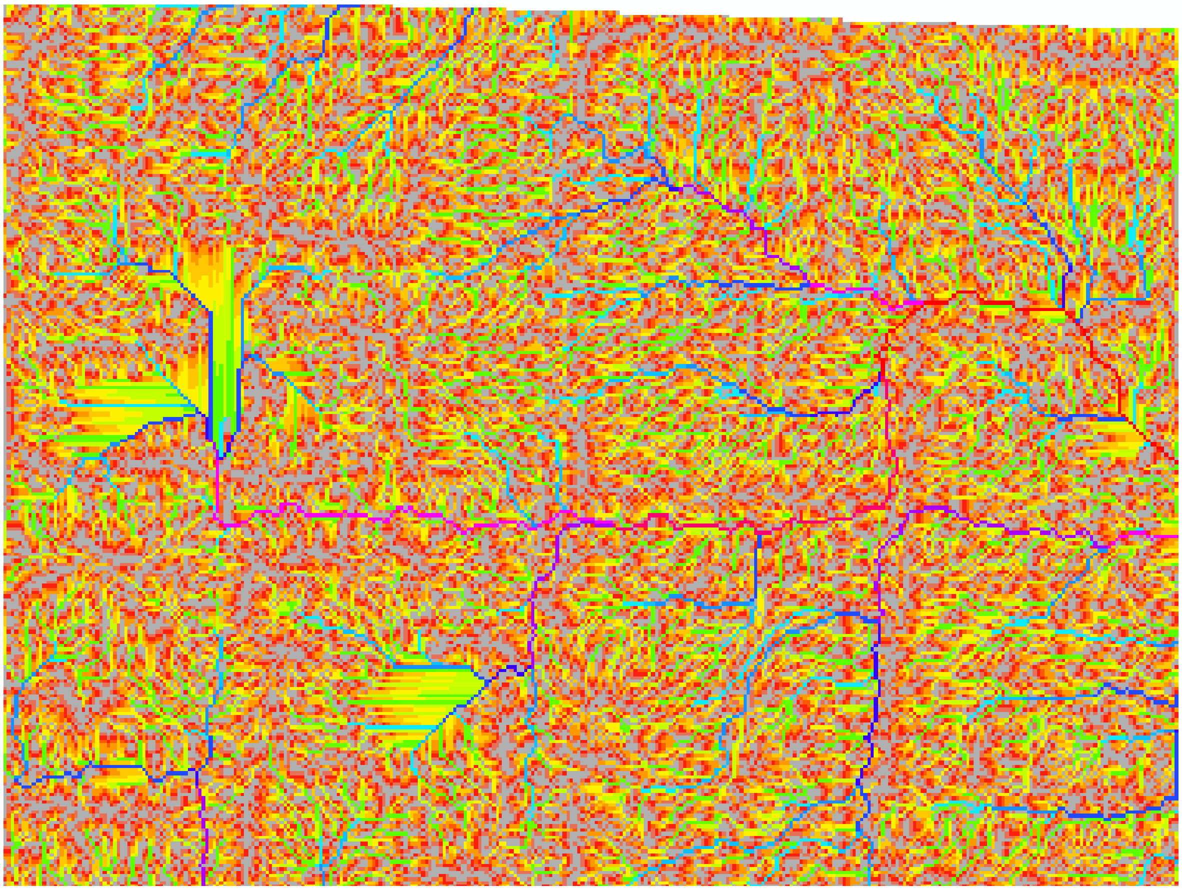
The result of Flow Accumulation is a raster of accumulated flow to each cell, as determined by accumulating the weight for all cells that flow into each downslope cell.

Cells of undefined flow direction will only receive flow; they will not contribute to any downstream flow. A cell is considered to have an undefined flow direction if its value in the flow direction raster is anything other than 1, 2, 4, 8, 16, 32, 64, or 128.

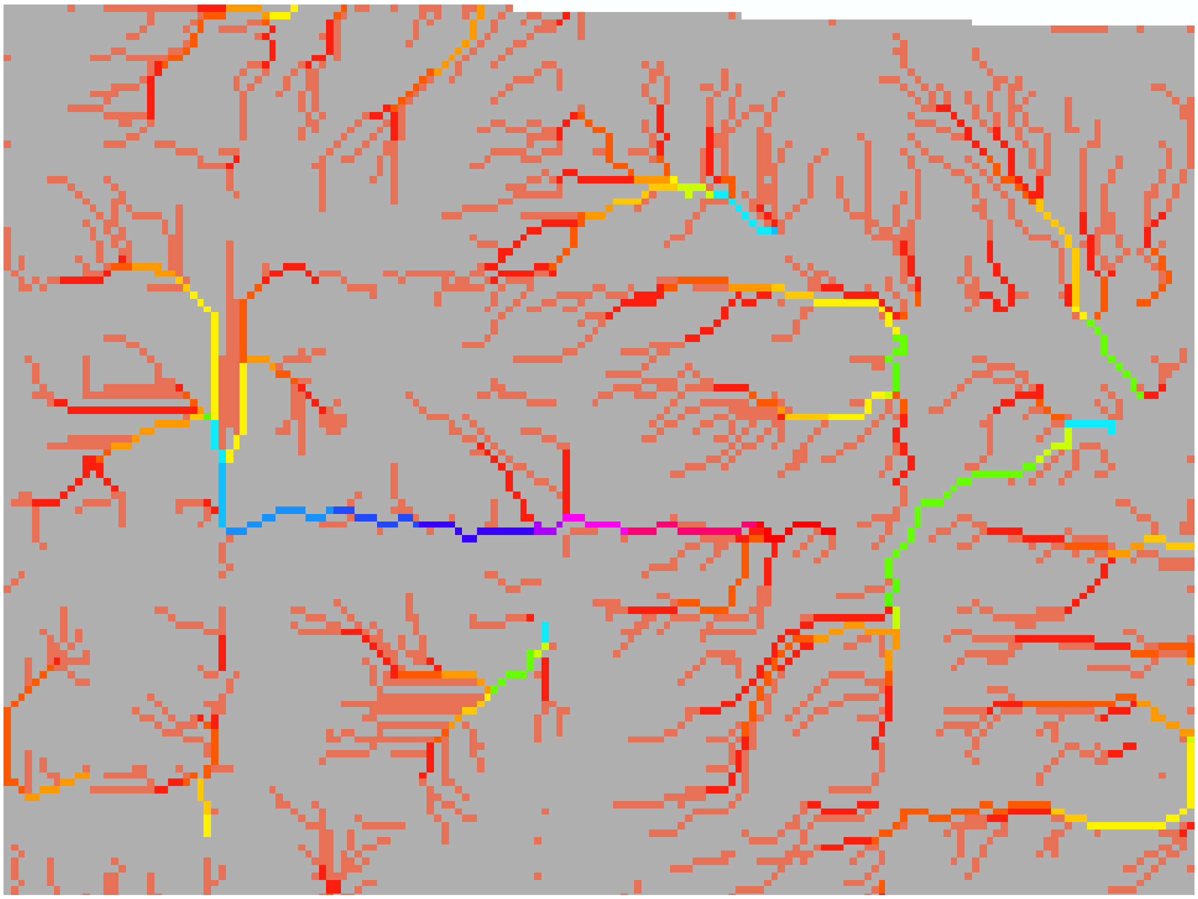
The accumulated flow is based on the number of cells flowing into each cell in the output raster. The current processing cell is not considered in this accumulation.

Output cells with a high flow accumulation are areas of concentrated flow and can be used to identify stream channels.

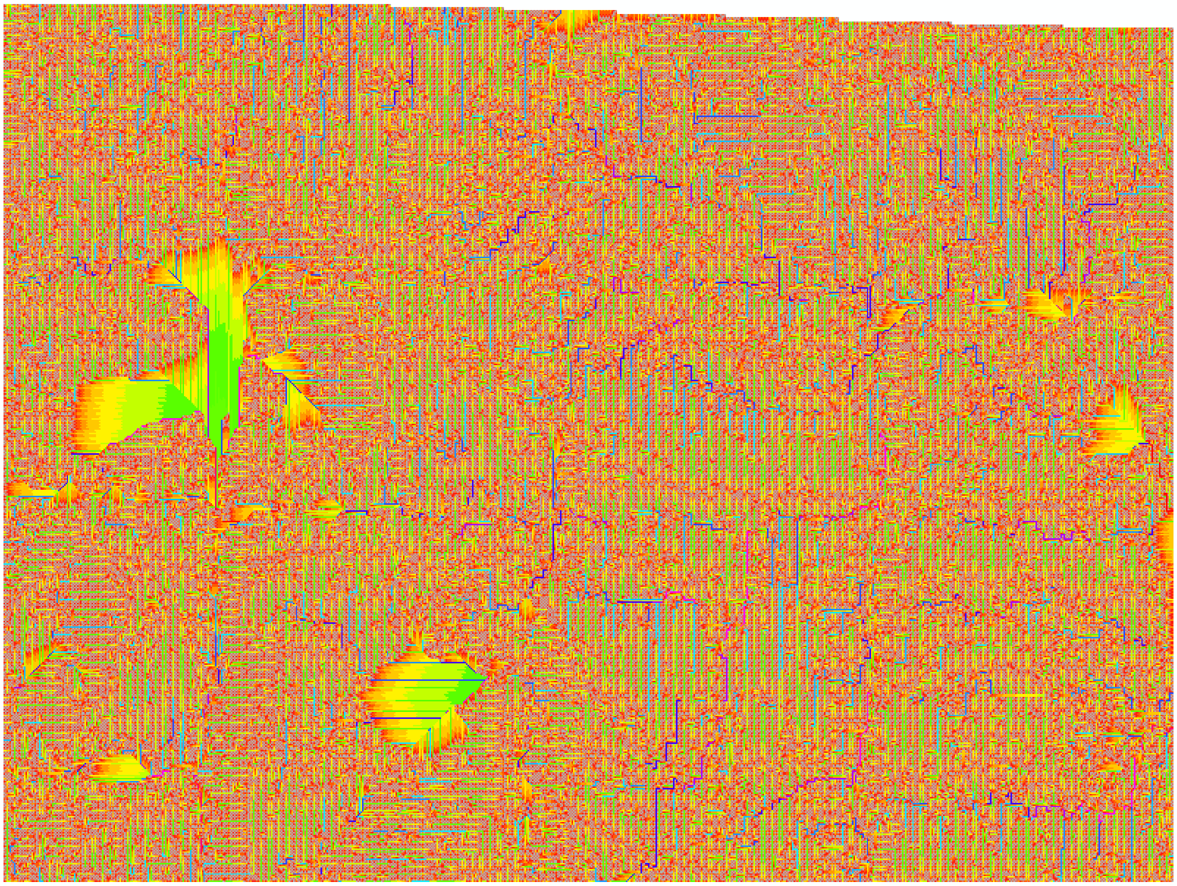
You can see the Flow Accumulation Values in InfoSWMM by using the Arc Map TOC Symbology. Here is the Symbology for a 5x5 Raster.



You can see the Flow Accumulation Values in InfoSWMM by using the Arc Map TOC Symbology. Here is the Symbology for a 10x10 Raster.



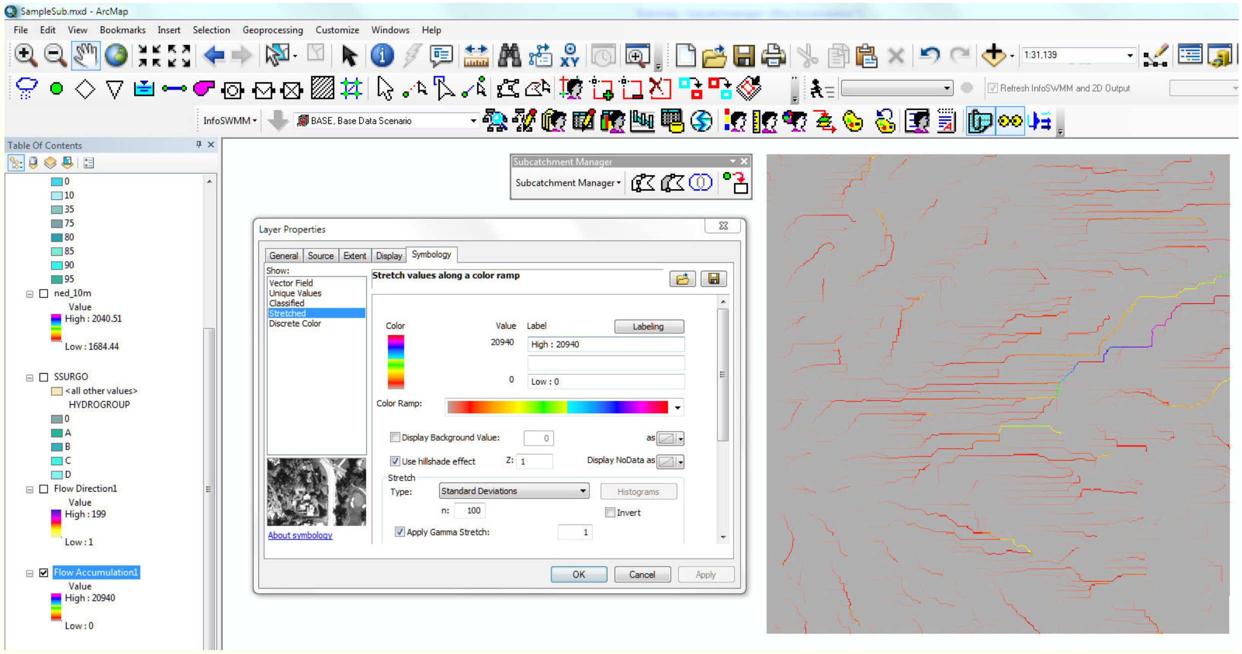
You can see the Flow Accumulation Values in InfoSWMM by using the Arc Map TOC Symbology. Here is the Symbology for a 1x1 Raster.



See Also

Create a Flow Accumulation Grid

In the Table of Contents you can open up any later Property and color the layer using either the Display or Symbology Tabs. You can also label the data.


SampleSub.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Refresh InfoSWMM and 2D Output
InfoSWMM
BASE, Base Data Scenario
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ned_10m
Value
High : 2040.51
Low : 1684.44
SSURGO
<all other values>
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High : 199
Low : 1
Flow Accumulation1
High : 20940
Low : 0
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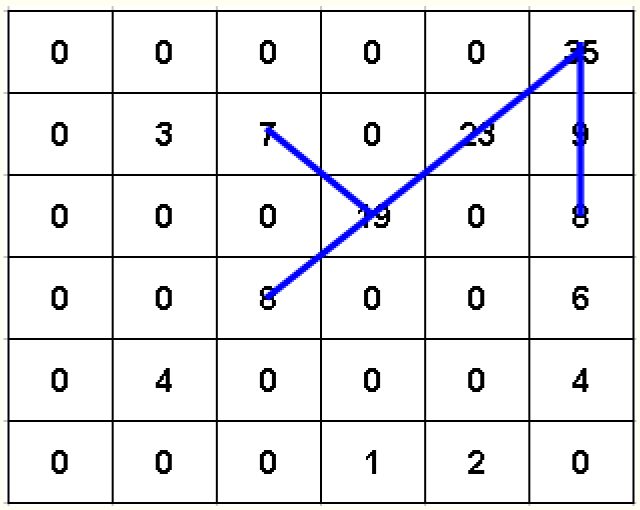
Symbology
Show:
Vector Field
Unique Values
Classified
Stretched
Discrete Color
Stretch values along a color ramp
Color
Value
Label
Labeling
High : 20940
Low : 0
Color Ramp:
Display Background Value:
Use hillshade effect
Display NoData as
Stretch
Type:
Standard Deviations
Histograms
Invert
Apply Gamma Stretch:
About symbology
OK
Cancel
Apply

Flow Network

Streams are defined from the flow accumulation grid based on a user defined threshold. Cells with a flow accumulation greater than the limit will be digitized to a line shapefile. The figure below details a flow network with a stream definition of 7.



A Flow Network displayed on the Flow Accumulation Grid

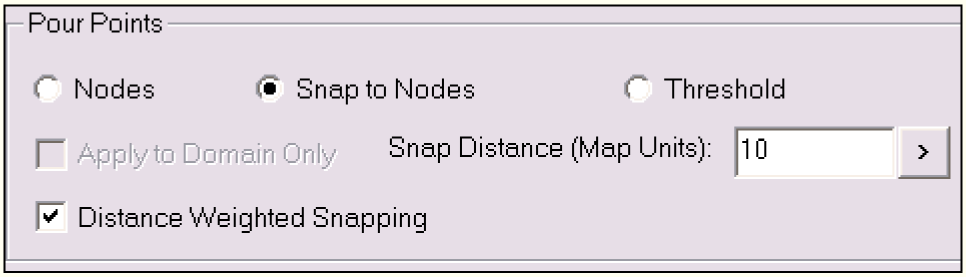
These streams may be directly converted to conduits in the network model. The InfoSWMMtools can be used to place junctions at the intersections of the streams. Refer to the InfoSWMM Help Menu for details.

See Also

Create Flow Network

Watershed Delineation

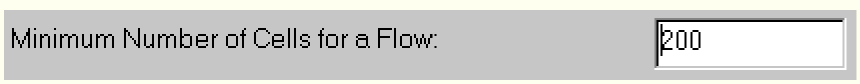
Three methods are available for delineating Subcatchments: Nodes, Snap to nodes, or Threshold.



1. Use a threshold for the minimum number of cells to create flow from the flow accumulation grid

    - The threshold method uses the flow accumulation grid and delineates watersheds

      dependant on the

Use a collection point layer. This applies to the Node and the Snap to Node options

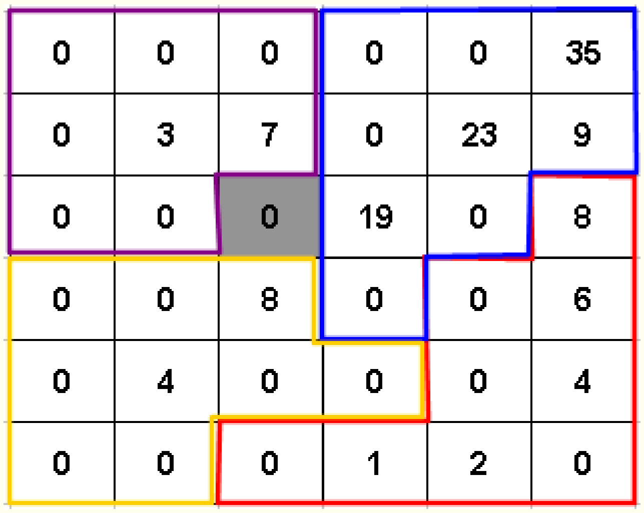
- The point collection layer must be ESRI point format and in the map document.
- The Node option delineates subwatersheds that drain to each node. The option may be used if the nodes are located on top of major flow paths. Otherwise, the area delineated may be much smaller than what was intended.
- The Snap to Nodes option is a better alternative to the Node option if one or more nodes are not located on top of the major flow paths. The Snap to Node option snaps to the node located within the snap distance (specified by the user) from the major flow paths and avoids the possibility of creating small subwatersheds.

- Using the Distance Weighted Snapping option, one may reduce the likelihood of the pour point (load point) snapping downstream further than necessary on the flow accumulation grid. With this option on, the program will re-create flow accumulation and put more weight to the cells closer to nodes.

Manual editing of subcatchment vertices may be required to accurately depict some subcatchments. A clean-up tool is included in the Subcatchment Manager that removes overlapping areas, because the subcatchment edges do not always maintain topology after delineation. Merging subcatchments is accomplished by deleting the subcatchments to be merged and using the provided auto completing append subcatchment tool.

The figure below details a possible delineation with a threshold of 9 cells. Notice the lone cell in the middle.

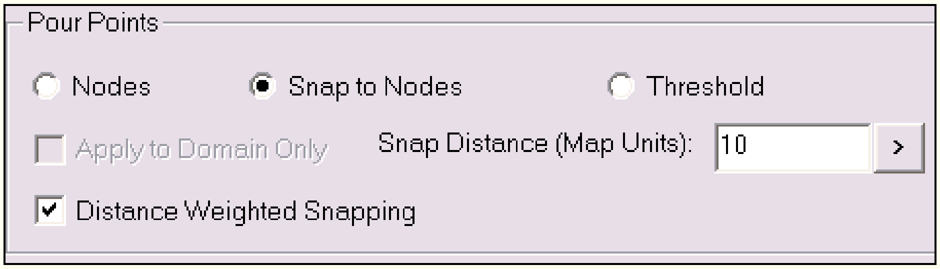
0	0	0	0	0	35
0	3	7	0	23	9
0	0	0	19	0	8
0	0	8	0	0	6
0	4	0	0	0	4
0	0	0	1	2	0



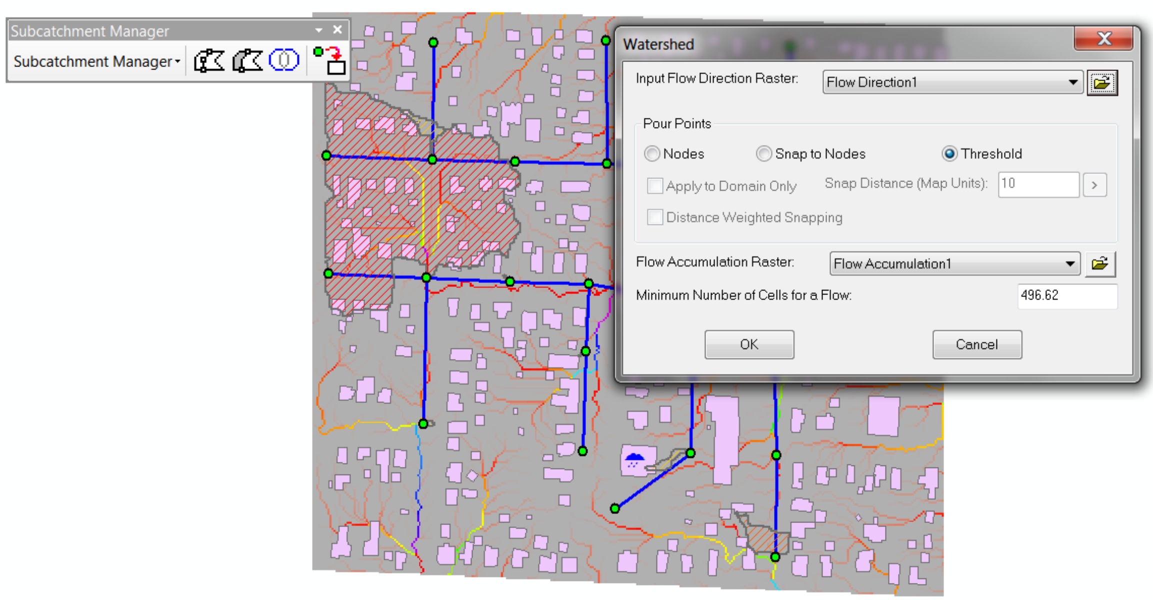
A Flow Accumulation Grid The Delineated Watersheds for the Flow Accumulation Grid on the Left

Pour Points - Nodes

This section shows examples of how the three Pour Points work in the InfoSWMM Subatchment Manager.

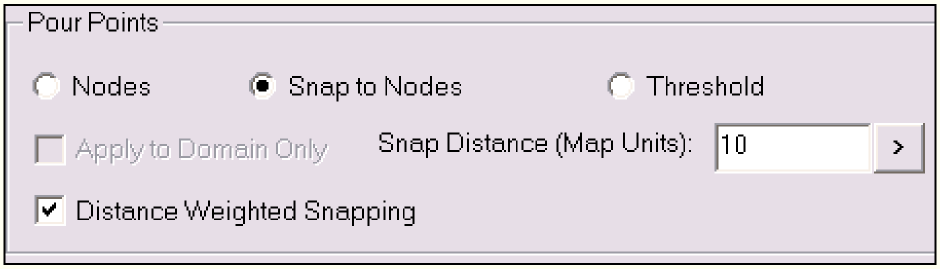


The Node option delineates subwatersheds that drain to each node. The option may be used if the nodes are located on top of major flow paths. Otherwise, the area delineated may be much smaller than what was intended.



Snap to Nodes

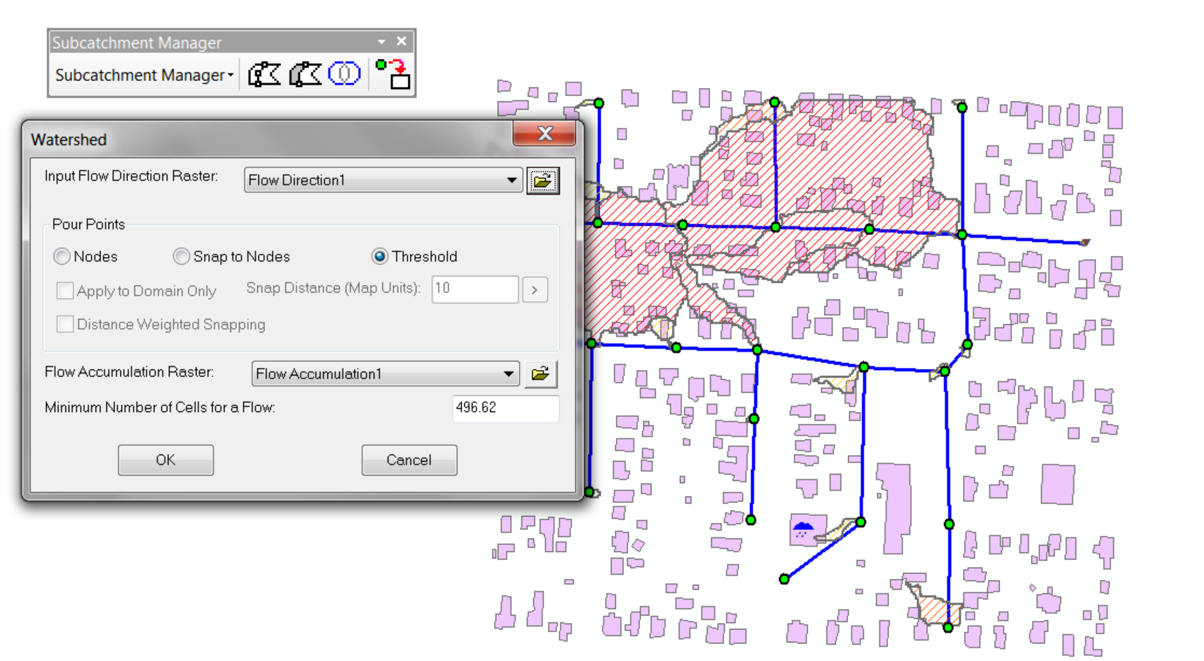
This section shows examples of how the three Pour Points work in the InfoSWMM Subatchment Manager.



The Snap to Nodes option is a better alternative to the Node option if one or more nodes are not located on top of the major flow paths. The Snap to Node option snaps to the node located within the snap distance (specified by the user) from the major flow paths and avoids the possibility of creating small subwatersheds.

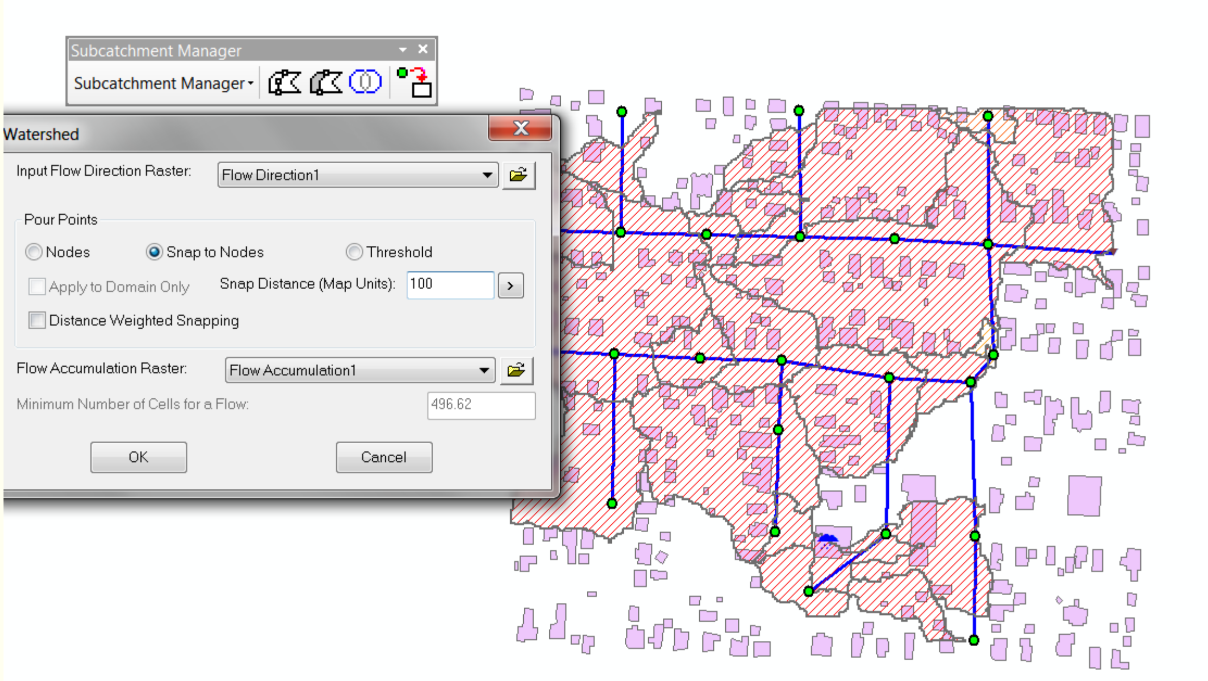
Example 1

Example 1 uses a Snap Distance of 10 Map Units and does not use Distance Weighting - 30 Subcatchments are created with these parameters.



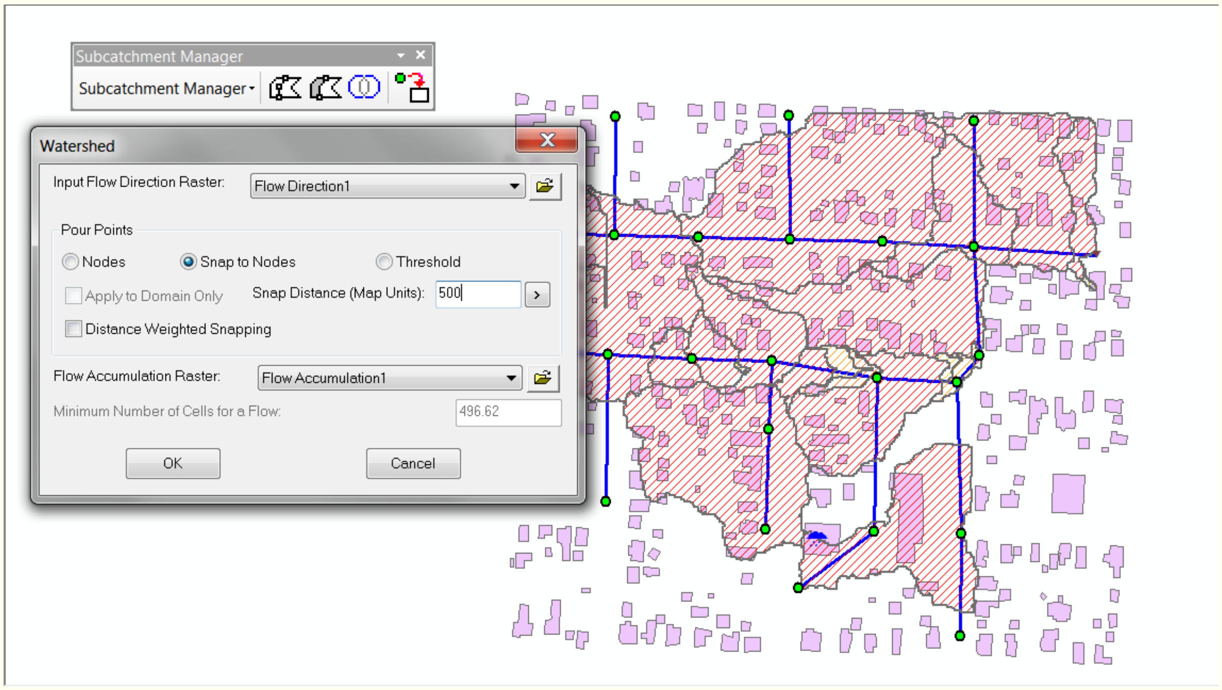
Example 2

Example 2 uses a Snap Distance of 100 Map Units and does not use Distance Weighting - 31 larger Subcatchments are created with these parameters.



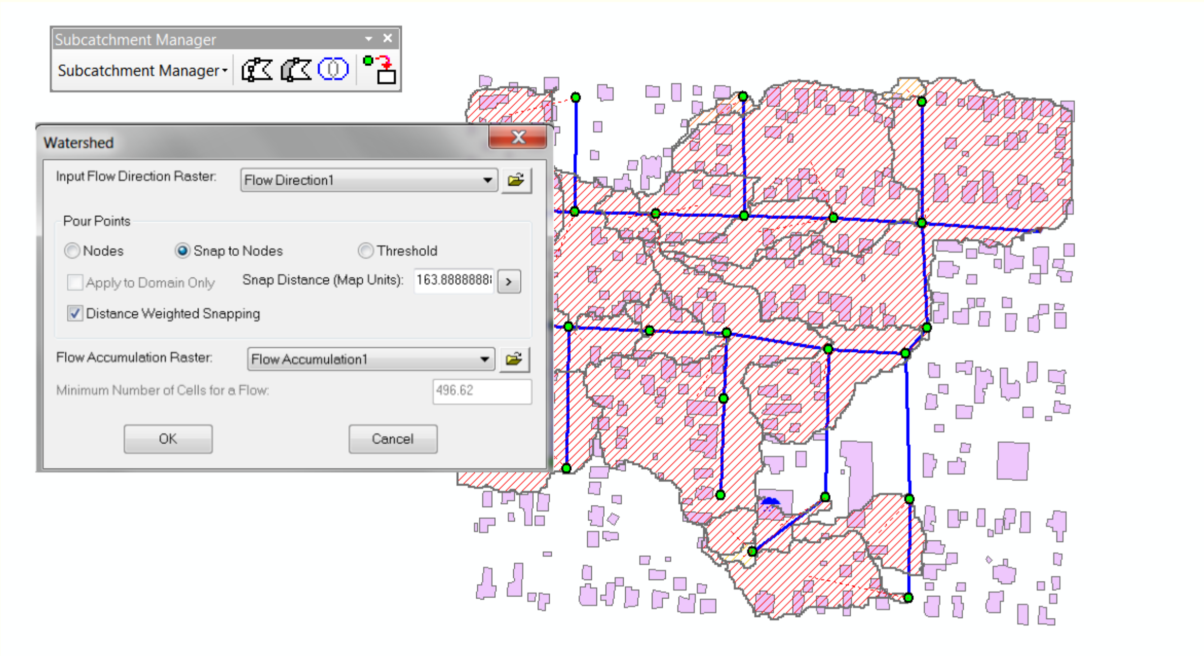
Example 3

Example 3 uses a Snap Distance of 500 Map Units and does not use Distance Weighting - 31 Subcatchments are created with these parameters.



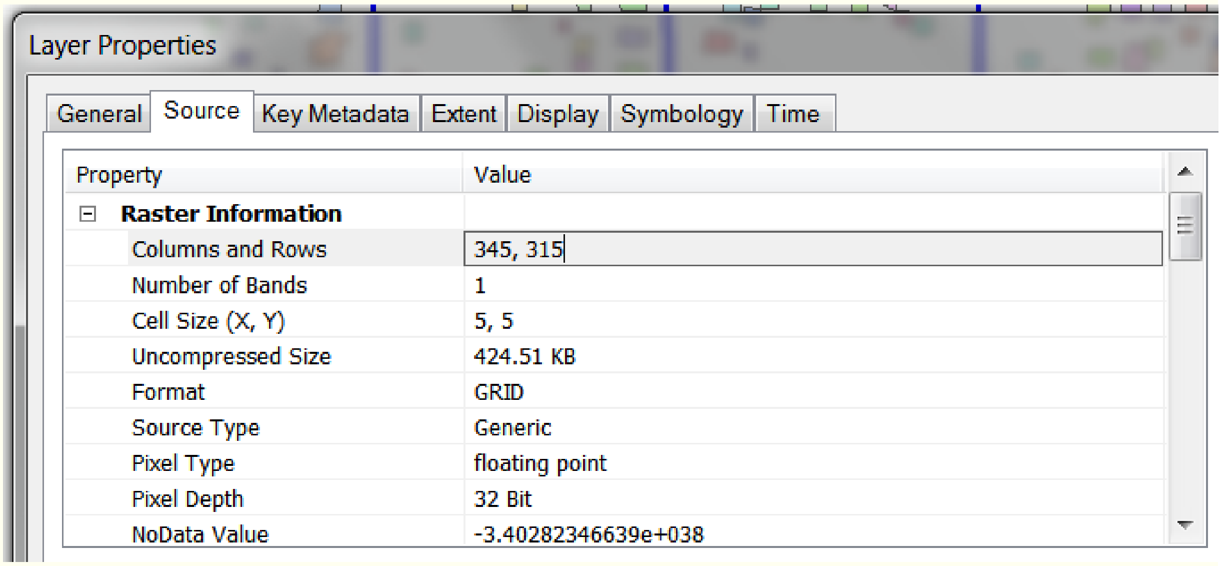
Example 4

Example 4 uses a Snap Distance of 164 Map Units (User defined) and USE Distance Weighting - 24 Subcatchments are created with these parameters.

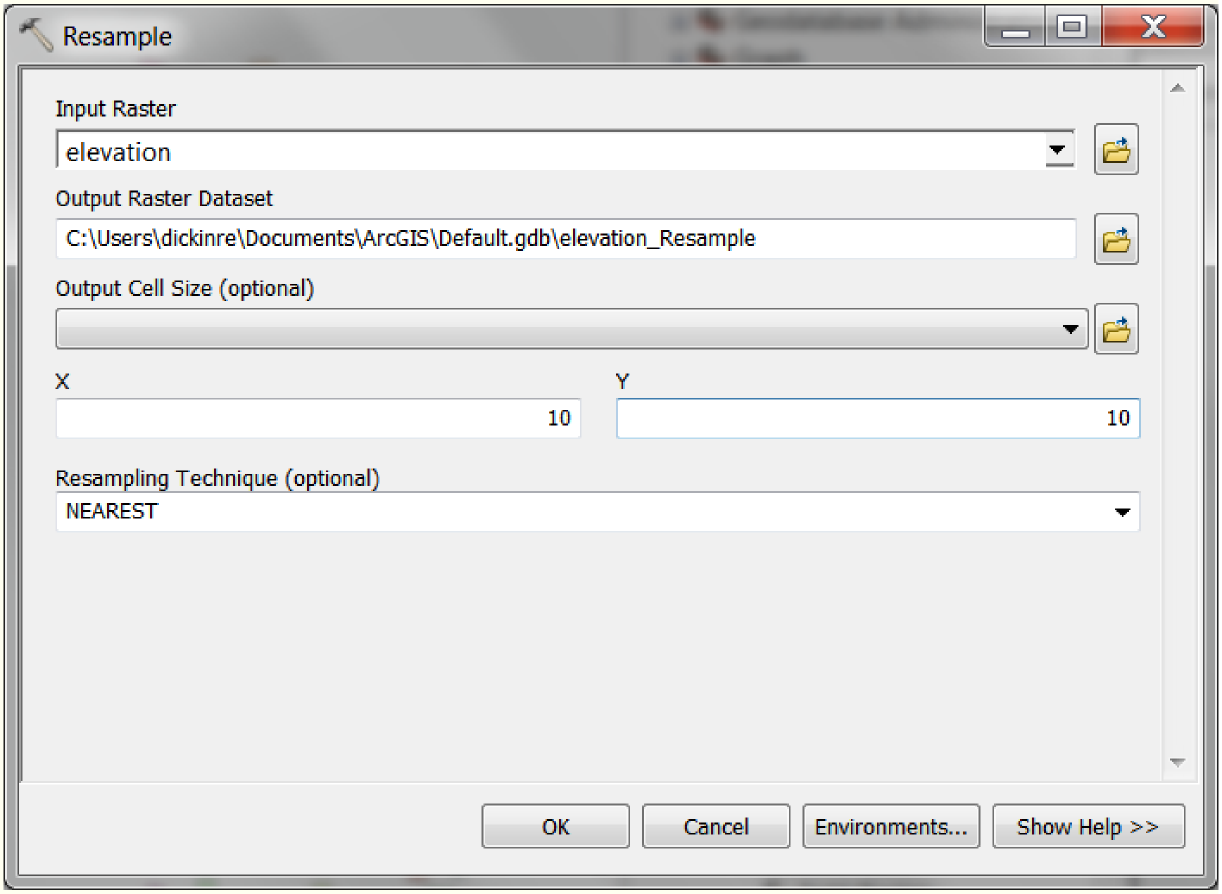


Example 5

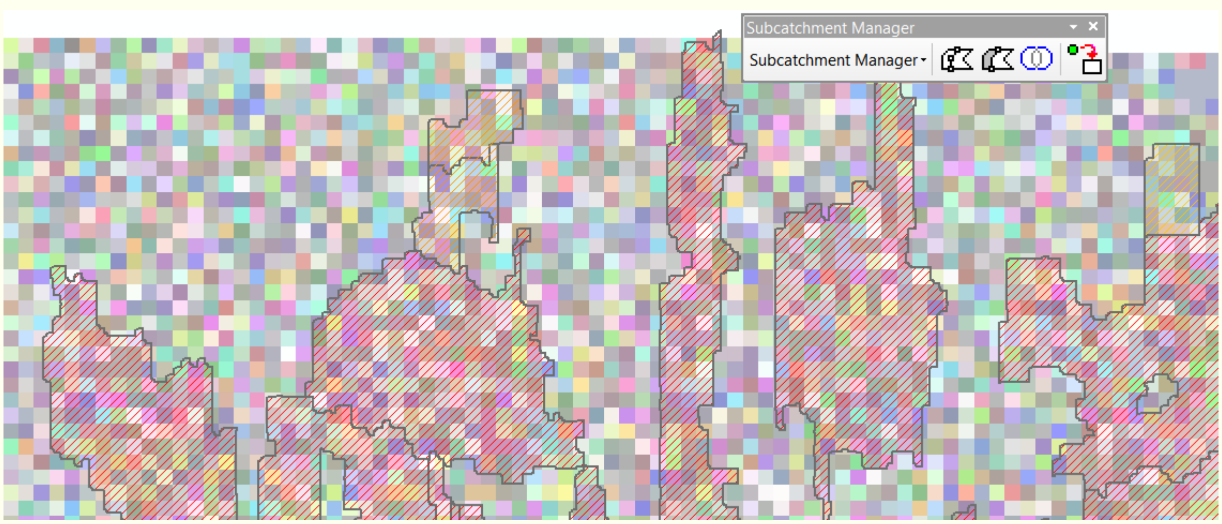
The size of the raster is important, so example 5 will use a coarser raster by using the tool Resample in Arc Toolbox



to a 10 by 10 raster

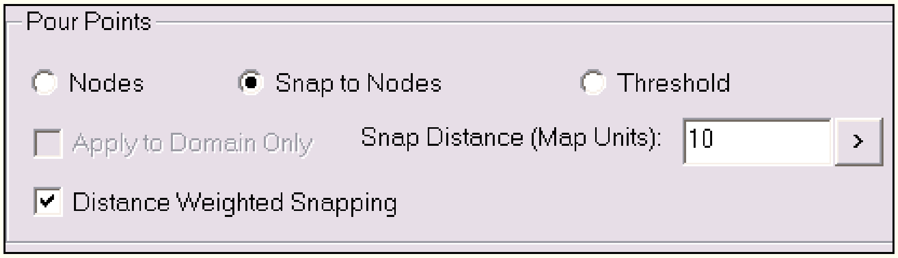


and to a 1 by 1 raster

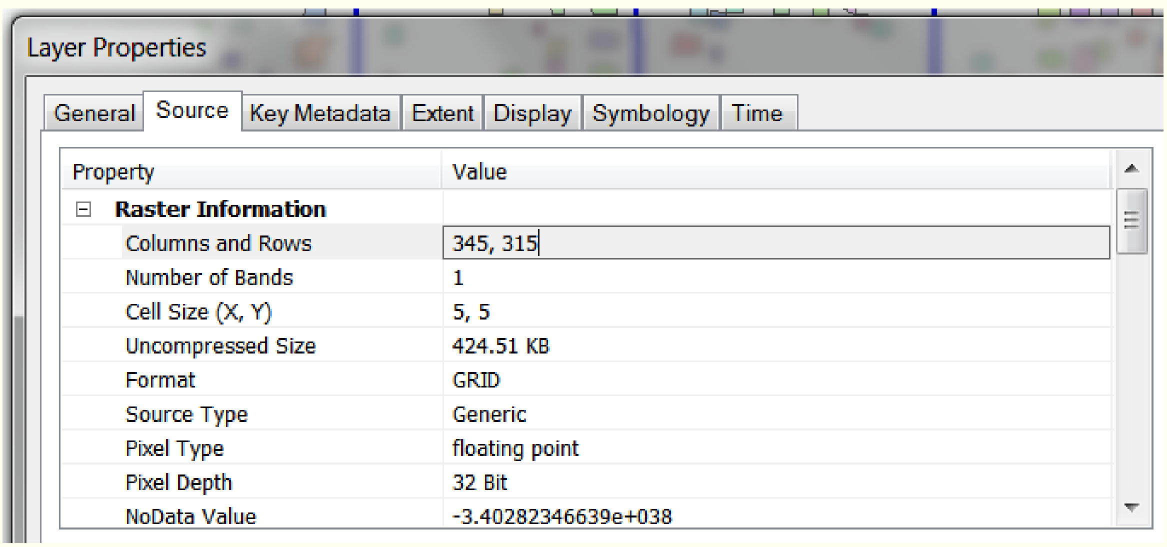


Pour Points - Threshold

This section shows examples of how the three Pour Points work in the InfoSWMM Subatchment Manager.



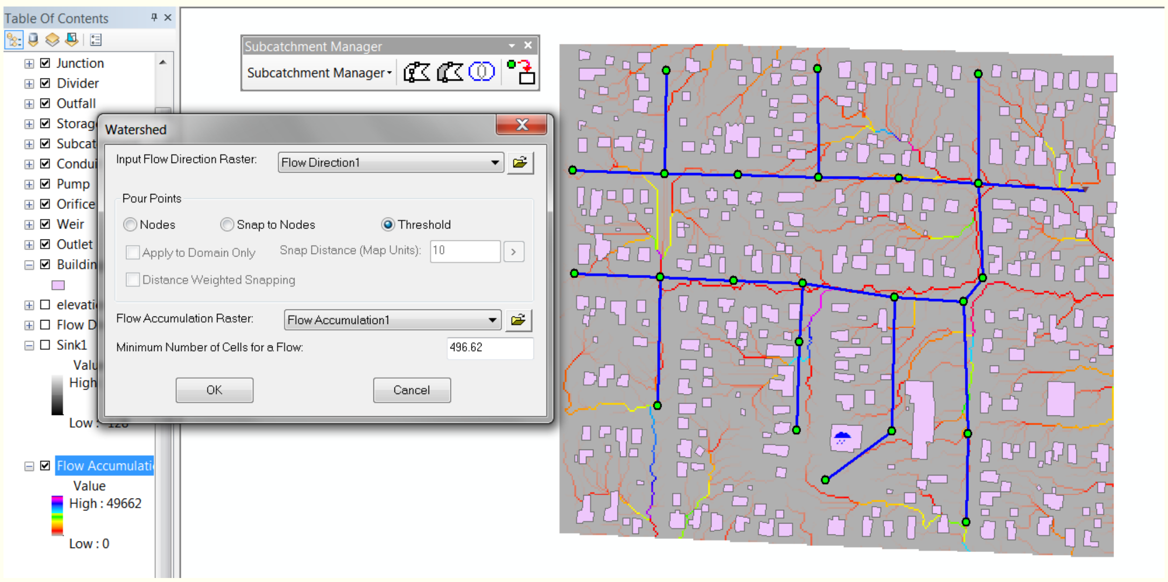
The size of the raster is important, 108,675 is 345 by 315



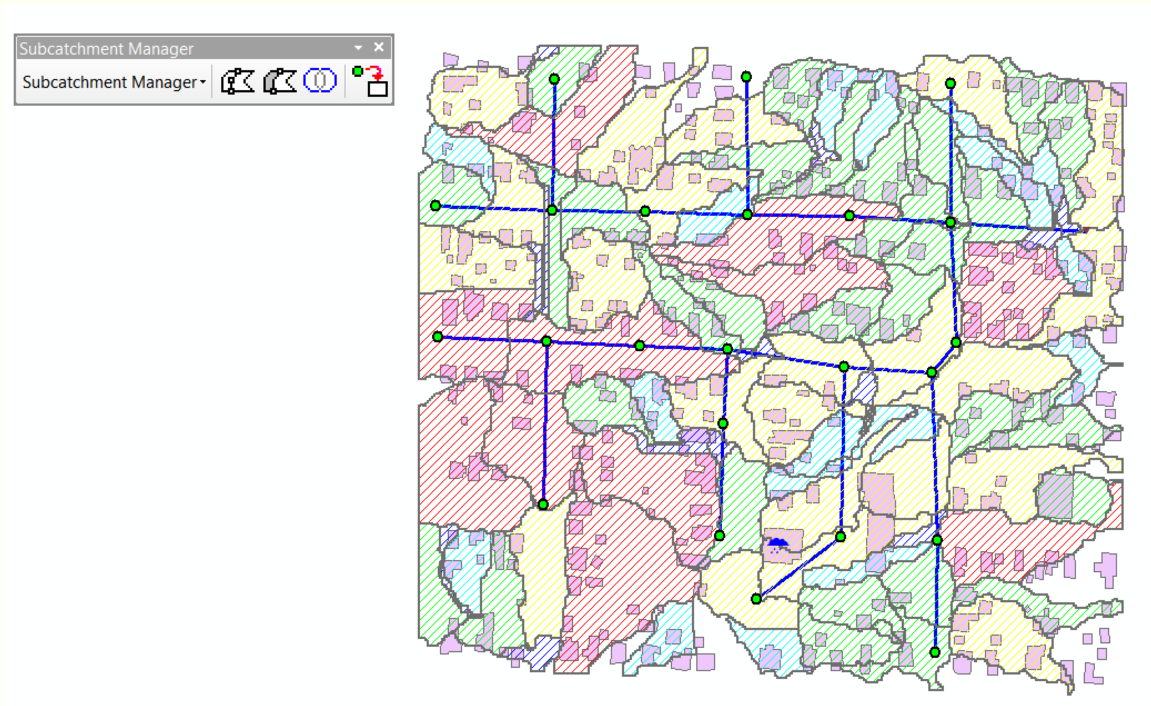
Example 1

We will used the suggested threshold value of 469 which is

1. Use a threshold for the minimum number of cells to create flow from the flow accumulation grid
    - The threshold method uses the flow accumulation grid and delineates watersheds dependant on the minimum number of cells for a Flow



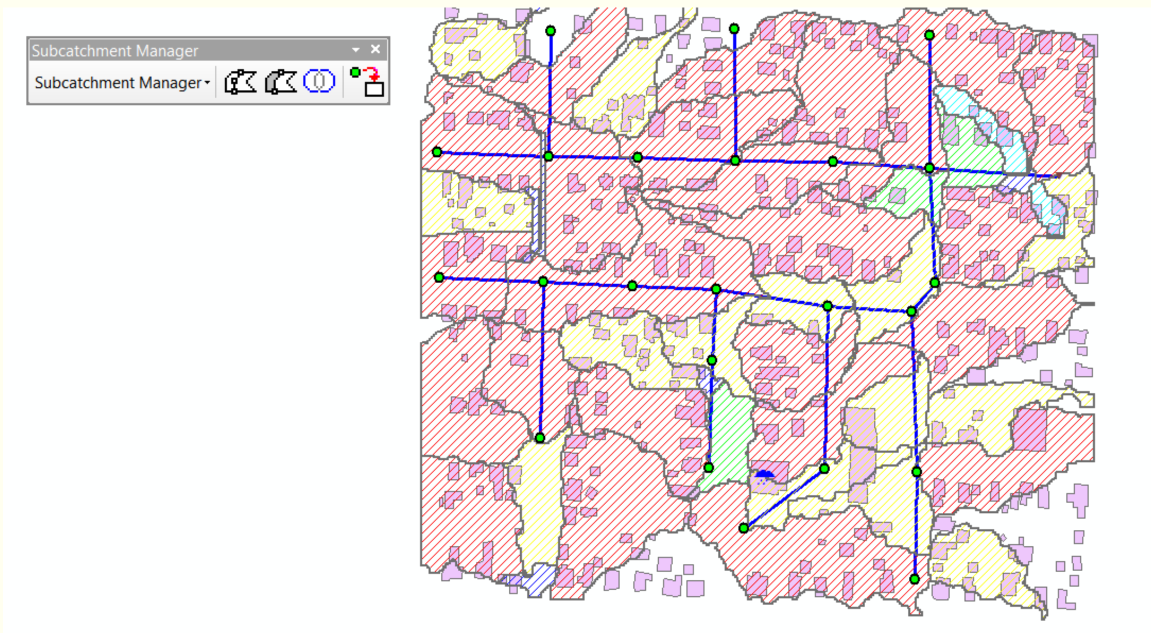
A total of 109 Subcatchments were made using Example 1 threshold vales


Subcatchment Manager
Subcatchment Manager

Example 2

We will used the suggested threshold value of 1000 which is which is larger than the suggestion value of 469

1. Use a threshold for the minimum number of cells to create flow from the flow accumulation grid
    - The threshold method uses the flow accumulation grid and delineates watersheds dependant on the minimum number of cells for a Flow

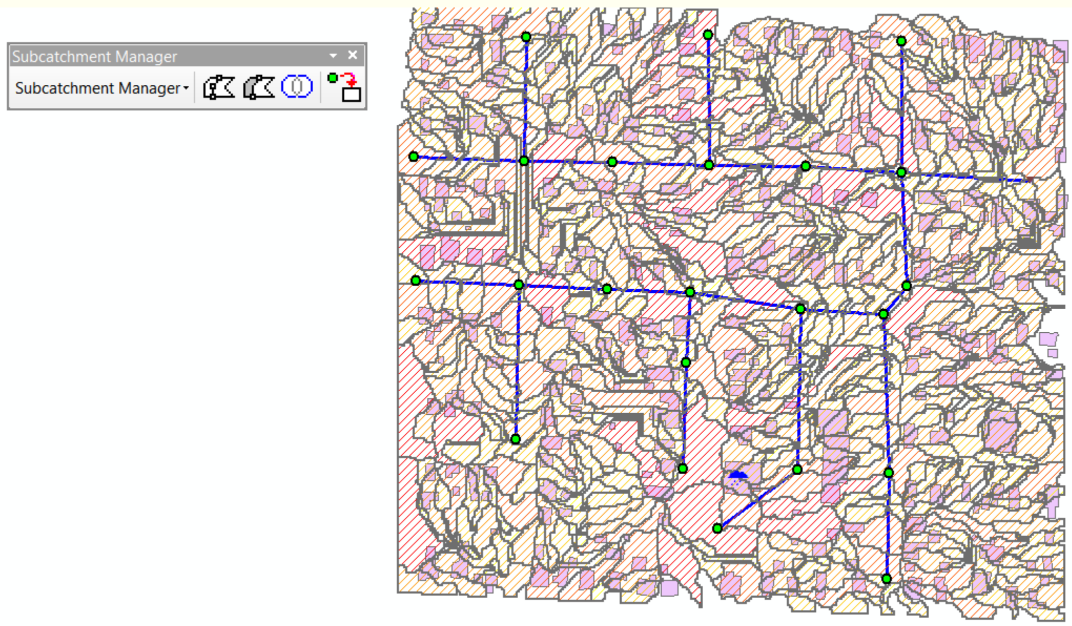


A total of 52 Subcatchments were made using Example 2 threshold vales

Example 3

We will used the suggested threshold value of 100 which is which is smaller than the suggestion value of 469

1. Use a threshold for the minimum number of cells to create flow from the flow accumulation grid
    - The threshold method uses the flow accumulation grid and delineates watersheds dependant on the minimum number of cells for a Flow



A total of 728 Subcatchments were made using Example 3 threshold vales

Watershed Iterations

It is also possible to iteratively create Subcatchments using the Snap to Nodes tool

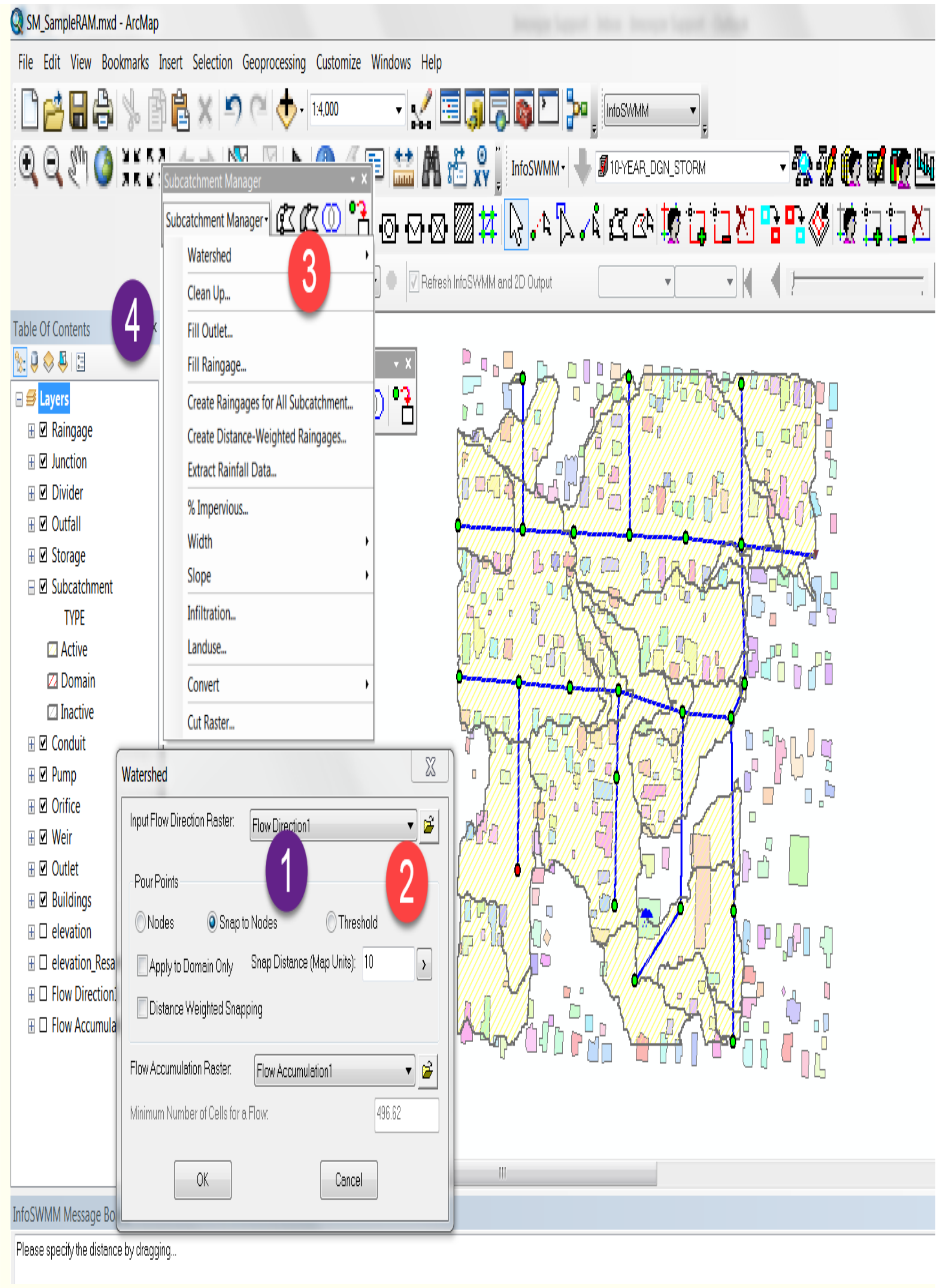
1. Use Snap to Nodes so that only the nodes are loaded

2. Perform the command a few times using different snapping distances

3. Use the Clean up tool to get rid of overlapping polygons

4. Use the Fill Outlet command

5. Now you have a nice group of Subcatchments


SM_SampleRAM.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:4,000
InfoSWMM
InfoSWMM
10-YEAR_DGN_STORM
Subcatchment Manager
Subcatchment Manager
Watershed
Clean Up...
Fill Outlet...
Fill Raingage...
Create Raingages for All Subcatchment...
Create Distance-Weighted Raingages...
Extract Rainfall Data...
% Impervious...
Width
Slope
Infiltration...
Landuse...
Convert
Cut Raster...
Refresh InfoSWMM and 2D Output
3
4
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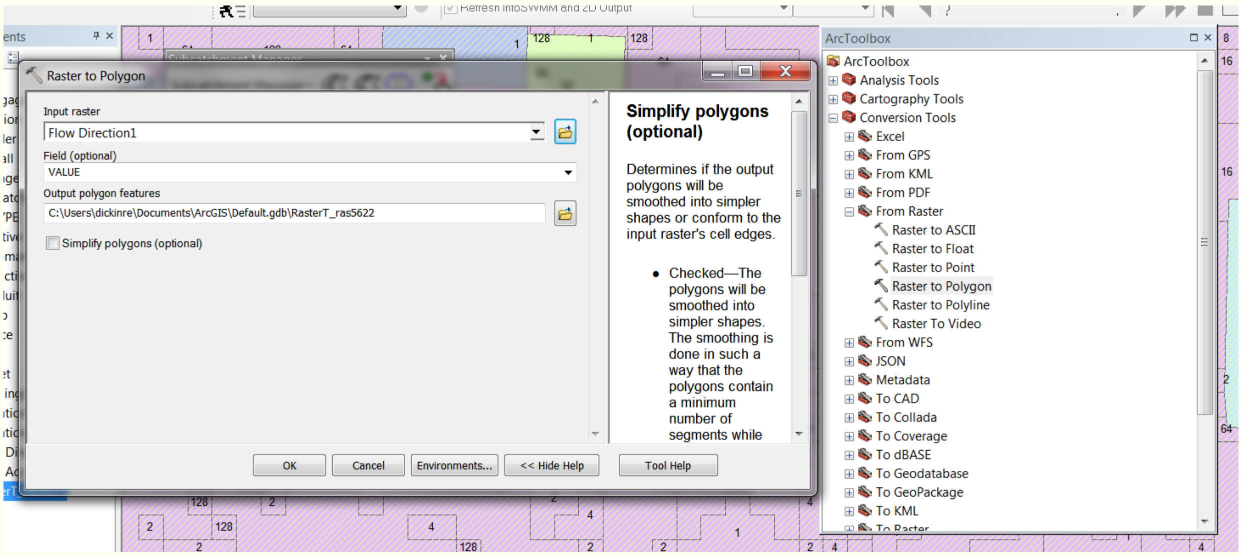
Junction
Divider
Outfall
Storage
Subcatchment
TYPE
Active
Domain
Inactive
Conduit
Pump
Orifice
Weir
Outlet
Buildings
elevation
elevation_Resa
Flow Direction
Flow Accumula
Watershed
Input Flow Direction Raster:
Flow Direction1
1
2
Pour Points
Nodes
Snap to Nodes
Threshold
Apply to Domain Only
Snap Distance (Map Units):
10
Distance Weighted Snapping
Flow Accumulation Raster:
Flow Accumulation1
Minimum Number of Cells for a Flow:
496.62
OK
Cancel
InfoSWMM Message Bo
Please specify the distance by dragging...

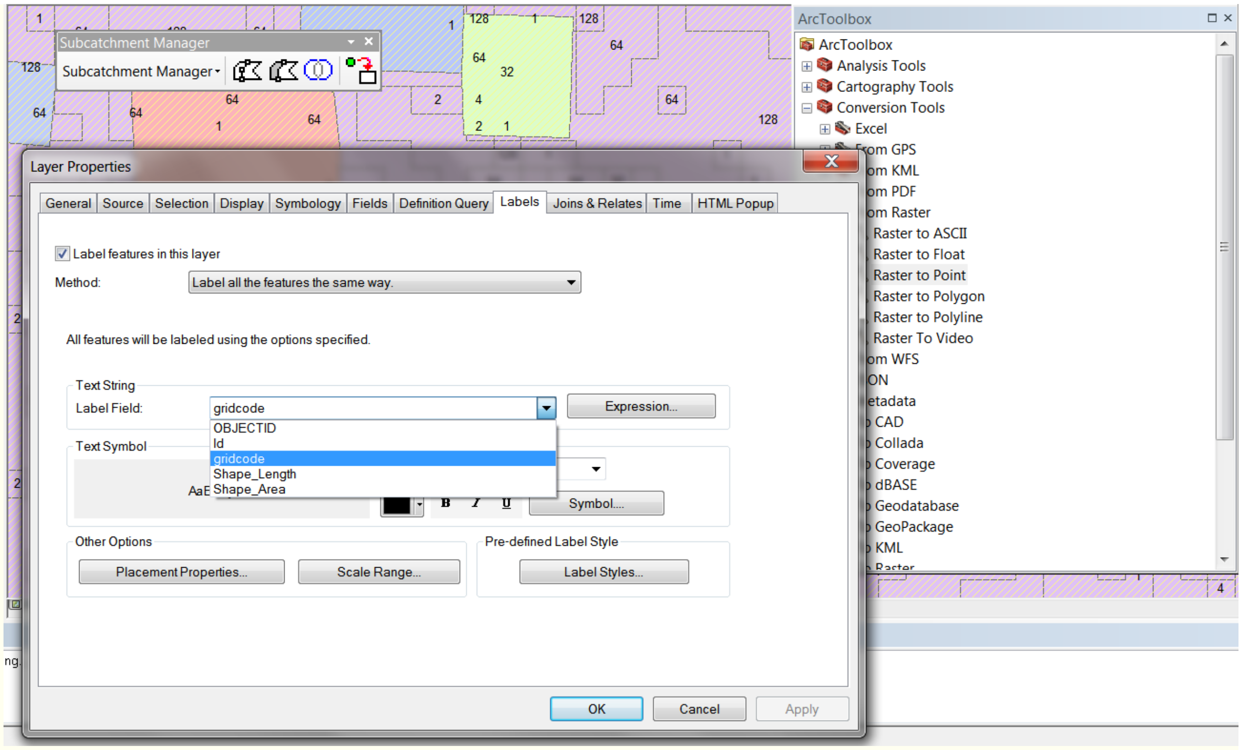
How to View the Values in the Rasters

You cannot use the TOC Properties dialog in Arc GIS to see the Flow Direction, Raster and the flow Accumulation Rasters. Howerer, you can conver these to Polygons and points using the Convert Tools in Arc Toolbox.

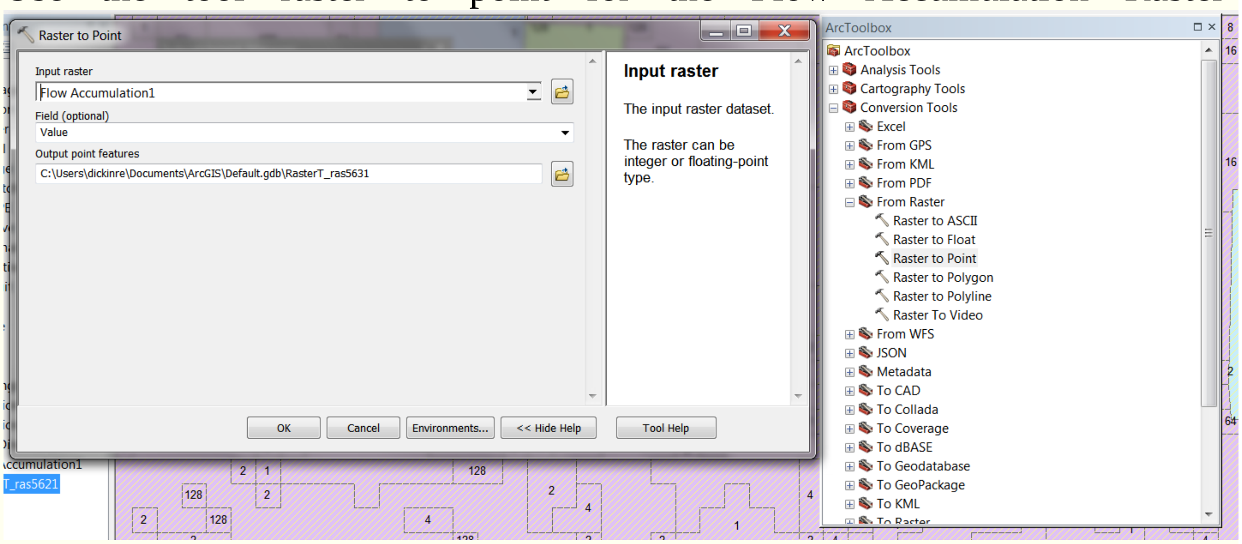
The Flow Direction created by InfoSWMM Subcatchment Manager can be converted to a polygon.



Use layer properties to show the labels on the Arc Map



Use the tool raster to point for the Flow Accumulation Raster



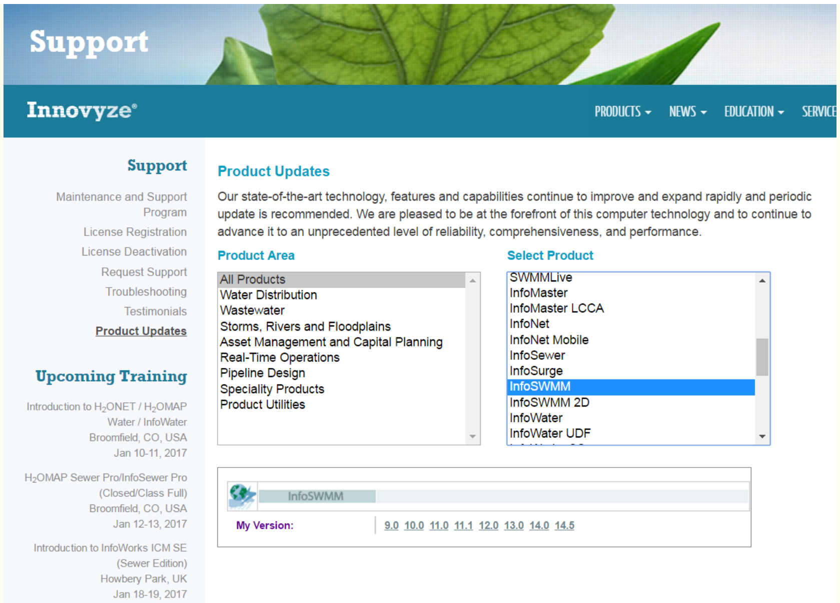
Installation Guide

System Requirements for InfoSWMM w ArcGIS	
Compatible 32-bit OS:	Windows Server 2008 R2, Windows Server 2012 R2, Windows 7/8/8.1/10 pro or above
Compatible 64-bit OS:	Windows Server 2008 R2, Windows Server 2012 R2, Windows 7/8/8.1/10 pro or above
Compatible ArcGIS:	10.0, 10.1, 10.2, 10.3, 10.4, and 10.5 (**Check your PC ability to run ArcG**
Prerequisites:	**Microsoft Visual C++ 2008 Redistributable - x64 v9.0.30729.17**/**Microsoft Visual C++ 2008 x86 v9.0.30729.17**, **Microsoft Visual C++ 2010 Redistributable - x86 v10.0.40219.1**/**Microsof Redistributable - x64 v10.0.40219.1** and **Windows Internet Explorer 7 or later**
Hardware Requirements:	CPU Speed: 2.2 GHz minimum or higher; Hyper-threading (HHT) or Multi-core recommended Processor: Intel Pentium 4, Intel Core Duo, or Xeon Processors; SSE2 (or greater) Memory/RAM: 2 GB or higher Screen Resolution: 1024 x 768 recommended or higher at Normal size (96dpi) Disk Space: 500 MB of free space to accommodate a full setup installation and additional di much free disk space available as possible. Its virtual memory system needs additional free working on large projects Video/Graphics Adapter: 64 MB RAM minimum, 256 MB RAM or higher recommended. INTEL chipsets supported Networking Hardware: Simple TCP/IP, Network Card or Microsoft Loopback Adapter is requi Manager **Language:** Support Multiple Languages (English, French: Menu, German: Menu & Dialogu Spanish: Menu, and Turkish: Menu) - To change display languages: Control Pa Language -> Formats tab -> select [Language] from the Format select box. **(For the display of InfoSWMM Language Setting)**

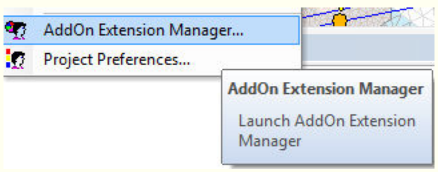
Installing Innovyze Software Add On's and Extensions

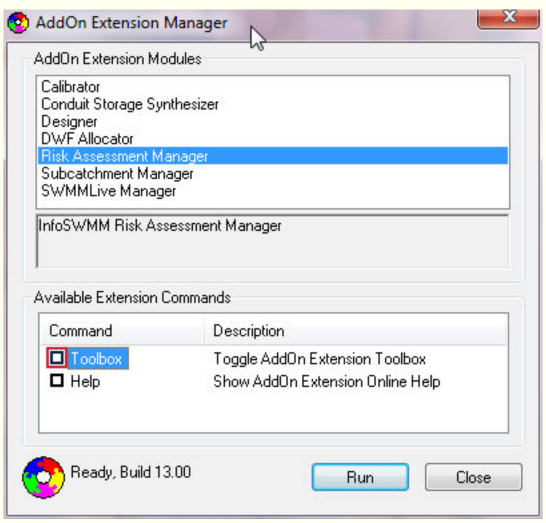
Innovyze programs can only be installed from our Internet website. To install this program or a single user, perform the following procedure:

- Turn on your computer and start Windows. Close any other applications that are currently running.
- Start your Internet Browser software and go to http://www.Innovyze.com. Once on Innovyze® Inc's homepage, please go to http://www.innovyze.com/updates/ Choose the *program* tab and click on the link. This will launch the File Download dialogue box.
- Choose the *SAVE THIS PROGRAM TO A Directory* option and follow the on-screen instructions. When saved on your hard drive run the Execute (*.exe) file from the folder that was downloaded and follow the on-screen instructions.



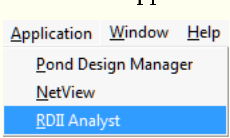
Upon successful installation of the program, the program is initialized from inside InfoSWMM by using the "AddOn Extension Manager" tool. From the Tool Menul, select an Add On as shown below.

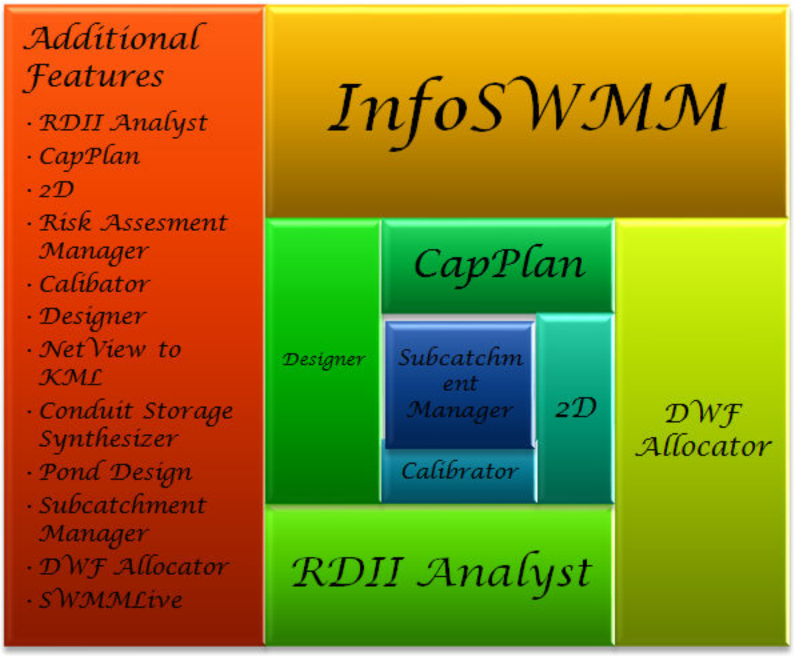




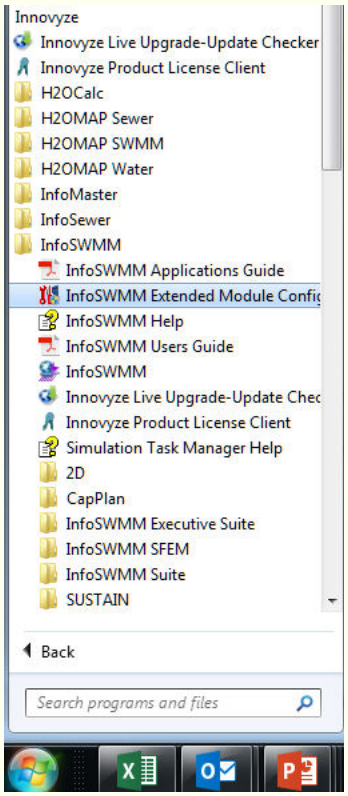
The selected run dialog appears, and it is now available for use. Section 2 discusses each icon and the menu shown below in detail. This program is part of the InfoSWMM Suite.

Or use the Application Window where there are additional AddOns for InfoSWMM





If you do not see the AddON's or Applications for the InfoSWMM Suite version of then you can use the InfoSWMMExtended Module Configuration from Windows Start.



Using the On Line Help

Innovyze provides on-line Help with extensive information about modeling features and capabilities. The documentation includes numerous topics, each including narrative descriptions, illustrations, and diagrams describing the features of each program.

The on-line Help offers the ability to search for a desired topic rapidly or to move between related topics in a fast, efficient manner. An extensive index is available allowing you to search on any number of words, phrases, or commands. Innovyze Help includes several major sections, each identified by a magenta book in the Help Contents. Each section contains numerous related topics.

StartingInnovyze Help

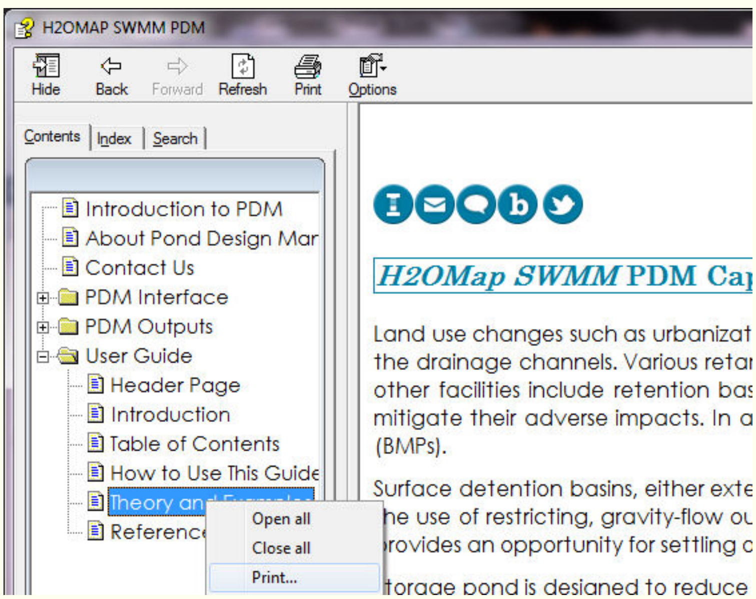
Innovyze Help is available by opening any Innovyze dialog box and pressing the F1 key. You may click on any portion of the dialog box in the help topic for more information.

Navigating the On Line Help

Use either Innovyze Help Contents or the Index to navigate to the desired topic. Choose the Help Topic button in the upper left-hand corner of the Help window to access the Help contents and index. Embedded in the text of each topic are numerous *links*, identified as underlined blue text, to related topics. Simply click on the desired link text with the mouse to move immediately to the related topic.

Printing the OnLine Help

You may print any Innovyze Help topics you desire. To do so, navigate to the desired Help topic and then choose the Print Topic command from the Help window File menu.



Instructions to Renew the CD and License Keys for the Innovyze (MWH Soft) Floating License Server

Below are instructions to renew the CD and License Keys for the Innovyze (MWH Soft) Floating License Server and the floating licenses to reflect the current expiration date.

1. Open the Innovyze (MWH Soft) Floating License Server.
2. Go to the **Help** -> **About** menu in the upper left corner.
3. Go to the Request License Key On-line for dropdown menu and select Renewal. Press the **Go** button. This will open our On-Line License Registration page.

4. Complete the requested information and press the **Submit** button. This should return to you a new CD Key and License Key.

5. Copy and paste the new keys into the appropriate boxes in the **About** dialog box.

6. Press the **Apply License Changes** button. A new Subscription Expiration Date should appear.

7. Close the **About** box and the Innovyze (MWH Soft) Floating License Server.

8. Download and run the update for the Innovyze (MWH Soft) Floating License Server from the attached link:

- [Innovyze Floating License Server 5.0 Update 020 (22.03 MB), 12/10/2015]

9. Open the Innovyze (MWH Soft) Floating License Server.

10. If your FLM is installed on a virtual server, go to the upper left corner and select **Action** -> **Register Virtual Environment …**

11. Select the License Administration tab.

12. Go to the Request License Key On-Line for dropdown menu and select **Renewal**. Press the **Go** button. This will open our On-Line License Registration page.

13. Complete the requested information and press the **Submit** button. This should return to you a new CD Key and License Key.

14. Copy and paste the new keys into the appropriate boxes in the License Administration tab.

15. Press the **Apply** button. A new Expiration Date should appear.

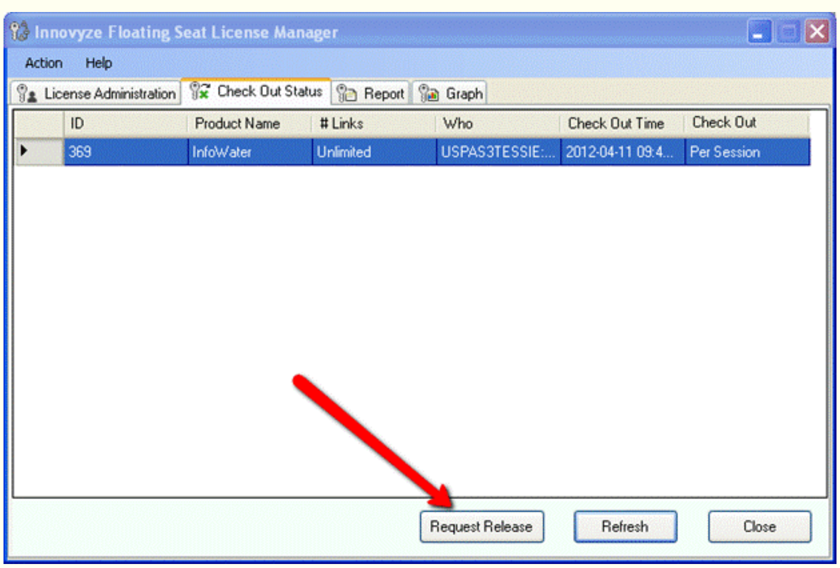
Press the Close button

Please follow the instructions below to request a license release key for a floating license.

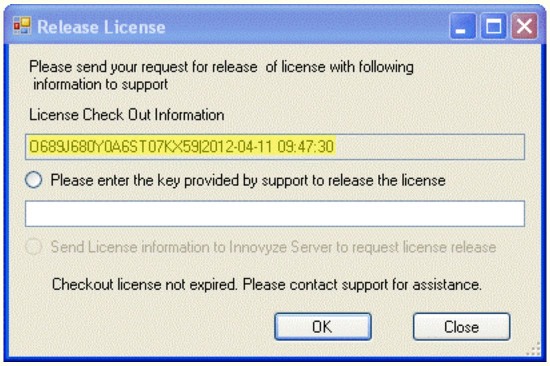
Please follow the instructions below to request a license release key for a floating license. Most likely this will need to be forwarded to someone who has access to the Innovyze Floating Seat License Manager on a server.

- Open the Innovyze Floating Seat License Manager and select the Check Out Status tab.

- Select the license to release and press the Request Release button.



Copy the License Check Out Information generated and paste into an email to support@innovyze.com



- We will return to you a code to enter in to the second field.
- Once both fields are populated in the Release License dialog box, press the OK button to release the license.

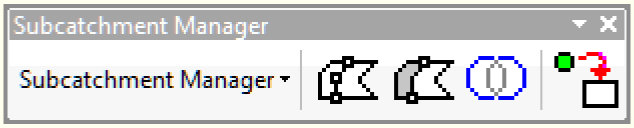
Technical Support On the Web and by Email

See the Help file Topic Contact Us for detailed Innovyze Technical Support information.

SUBCATCHMENT MANAGER

USER GUIDE

Innovyze Contact Information



You can reach Innovyze® Inc. by phone, Monday through Friday.

Innovyze® technical support can be reached at:

Phone: (626) 568-6869 Fax: (626) 568-6870

Support Email: Support@Innovyze.com

Sales Email: Sales@Innovyze.com

Innovyze®Internet: http://www.Innovyze.com

Innovyze® Blog: http://blog.innovyze.com/

Innovyze® Forum: http://forums.innovyze.com/forum.php

Innovyze® Twitter: https://twitter.com/Innovyze

Innovyze® Linkedin Users: Innovyze Linkedin

Or write us at Innovyze® Inc., 605 East Huntington Drive. Monrovia, CA 91016.

Software License Agreement

“The current version of Innovyze’s Software License Agreement can be found at the following location:

http://www.innovyze.com/licensing/”

INFOSWMM SUBCATCHMENT MANAGER CAPABILITIES

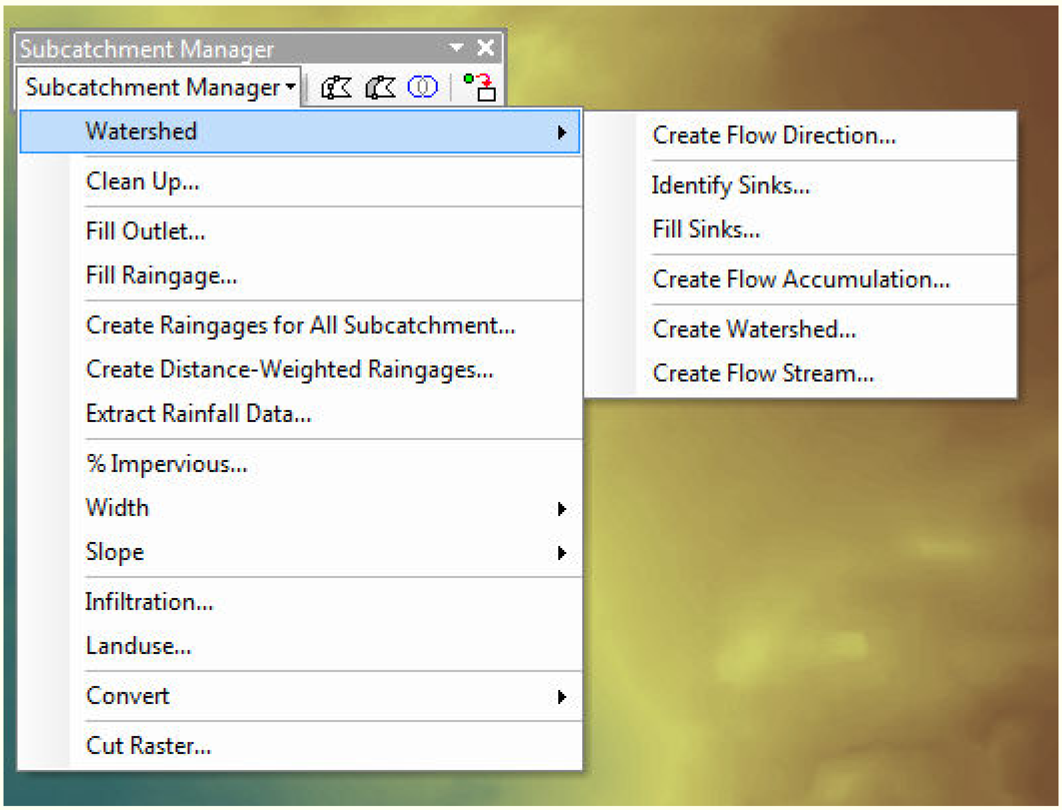
Subcatchments represent the area that drains to one point in a watershed. This area must be accurately estimated in a consistent manner to properly represent and simulate the watershed and sewer system. The process of defining these areas is known as delineating Subcatchments or watersheds. Assigning properties to each subcatchment is essential prior to the utilization of a rainfall / runoff model, either for planning/design purposes or operational studies.

InfoSWMM Subcatchment Manager is specially designed to utilize digital topology data to define Subcatchments and calculate their hydrologic parameters. It allows users to delineate subcatchment boundaries based on Digital Elevation Models (DEMs), contours, TINs, or point elevation sets. Subcatchment delineation can then be easily verified with the overlay of aerial photography or other background information. The module also includes tools to augment subcatchment boundaries and easily connect Subcatchments to the appropriate rain gages and outlets.

The evolution of GIS and information management systems has led to the availability of efficient geospatial tools for delineation of Subcatchments. The InfoSWMM Subcatchment Manager works synergistically with InfoSWMM, using advanced geometric polygon processing algorithms derived from computational geometry to automate the determination of infiltration, pollutant, and pervious properties of Subcatchments and transferring this data to the appropriate fields in the network model.

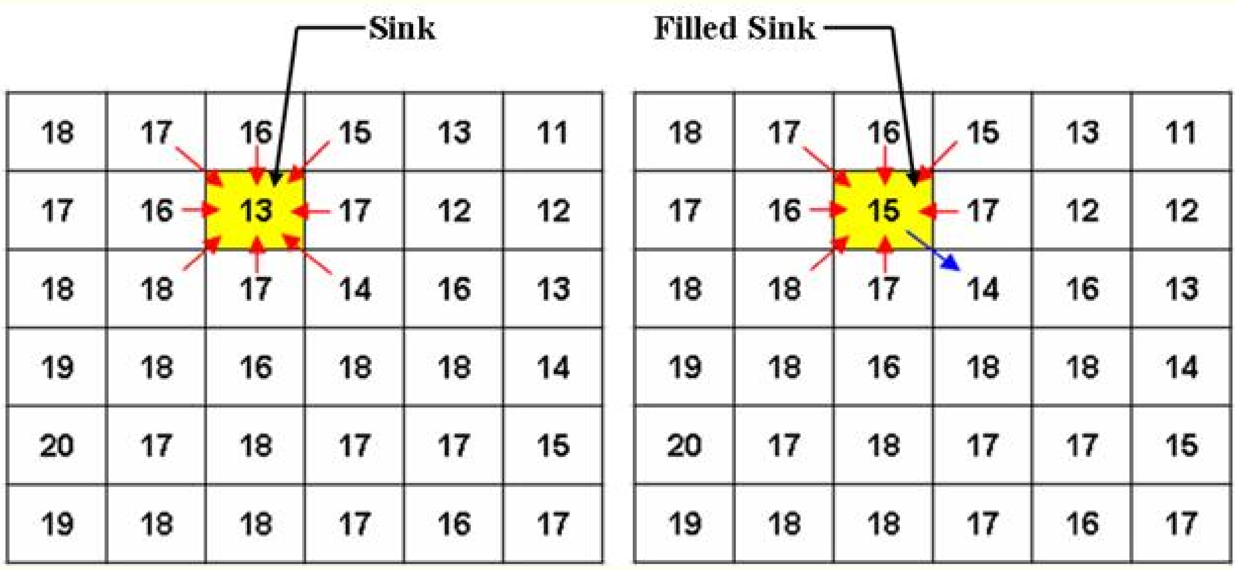
InfoSWMM Subcatchment Manager Features

The InfoSWMM Subcatchment Manager is organized by task. All commands required to delineate Subcatchments are contained in the Watershed tab of the Subcatchment Manager menu. Point and contour elevation data must be converted to a DEM prior to using the following commands. For best results, these commands should be used in the specified order.



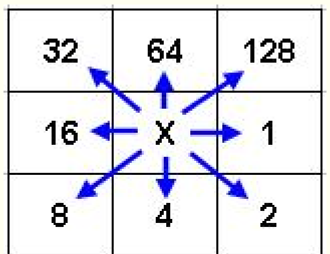
1. Identify and Fill Sinks in a DEM

A sink is a pixel in a DEM with an elevation value lower than all eight cells surrounding it. A moving window or kernel, 3 pixels by 3 pixels, is used to analyze the elevation of cells surrounding each individual (reference) cell. Water naturally flows overland and collects in channels. Rainfall / runoff modeling assumes water is either lost within the subcatchment (infiltration, depression, etc.) or it flows to the outlet. Residence time in local depressions is not considered when analyzing the time of concentration. Therefore, local depressions or sinks should not be included in such models. The Identify Sinks function locates each sink in the DEM by creating a flow direction grid from the raw DEM. Any non-standard flow direction value indicates a sink. Filling sinks modifies reference DEM pixels values to be between the minimum and maximum values from the eight surrounding cells.



2. Flow Direction and Flow Accumulation Grids

Flow direction and flow accumulation grids are used to trace water movement within a DEM. Water flows from the reference cell to one of the eight surrounding cells, specifically the one providing the greatest elevation difference from the reference cell. Flow direction is represented by a numerical value (1, 2, 4, 8, 16, 32, 64, or 128) and used for evaluating flow paths, delineating watersheds, and determination of flow accumulation. A 3 by 3 kernel is also used for defining these grids.



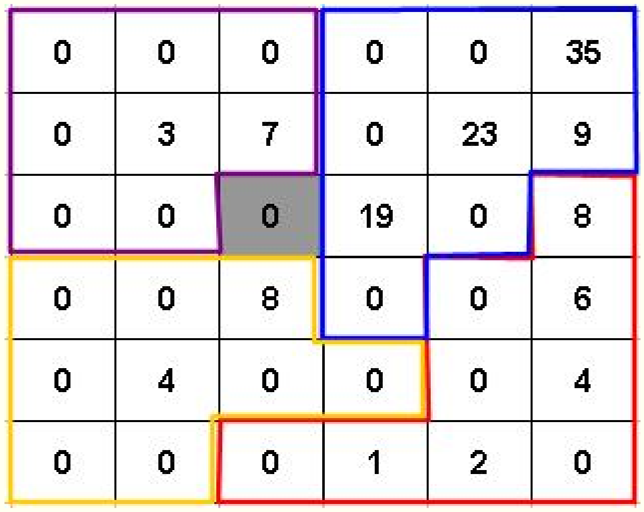
2	2	4	2	1	X
1	1	2	1	128	64
128	128	1	128	64	64
2	1	128	64	128	64
1	128	64	32	128	64
128	64	1	1	128	64

Flow accumulation defines the amount of water flowing into any reference cell. The flow accumulation grid essentially counts cells along the flow path. The value of any given cell is the number of cells that drain into it. The convention used by InfoSWMM is that a cell with no surrounding cells flowing into it has a flow accumulation of zero. Delineating Subcatchments based on a minimum threshold for flow definition utilizes the flow accumulation grid.

0	0	0	0	0	35
0	3	7	0	23	9
0	0	0	19	0	8
0	0	8	0	0	6
0	4	0	0	0	4
0	0	0	1	2	0

3. Delineate the Subcatchments

Two methods are available for delineating Subcatchments. The user can define a threshold for the minimum number of cells to create flow or use a collection point layer. The threshold method uses the flow accumulation grid and delineates watersheds dependant on the minimum number of cells for stream definition. The figure below details a possible delineation with a threshold of 9 cells. Notice the lone cell in the middle.



The collection point method uses the flow direction grid for delineation. Caution must be used with this method; if a point is not located on top of major flow paths, the area delineated may be much smaller than was intended.

Manual editing of subcatchment vertices may be required to accurately depict some Subcatchments. A clean-up tool is included in the Subcatchment Manager that removes overlapping areas, because the subcatchment edges do not always maintain topology. Merging Subcatchments is accomplished by deleting the Subcatchments to be merged and using the provided auto completing append polygon tool.. Delineate the Subcatchments

Calculating Subcatchment Slope and Width

The InfoSWMM Subcatchment Manager provides multiple methods for determining slope and width, allowing the user chose a preferred calculation. This removes the burden of calculating slope and width manually while maintaining a consistent methodology. Two methods for slope calculations and four techniques for width computations are available.

Slope may be calculated with the traditional method of using the average slope of the longest flow path. With GIS capabilities, calculating the average slope of the whole subcatchment is feasible. To calculate slope, a slope raster must be first generated from the digital elevation model. The Subcatchment Manager includes this geoprocessing feature within the slope menu.

5. Calculating Subcatchment Slope and Width Most available procedures for width calculation require a user defined constant, enabling the user to apply engineering judgment. Width calculations may be processed using the perimeter, area, and flow length as the basis of computation. This calculation may be applied to any domain of Subcatchments so the width of Subcatchments with similar characteristics may be calculated in a consistent manner.

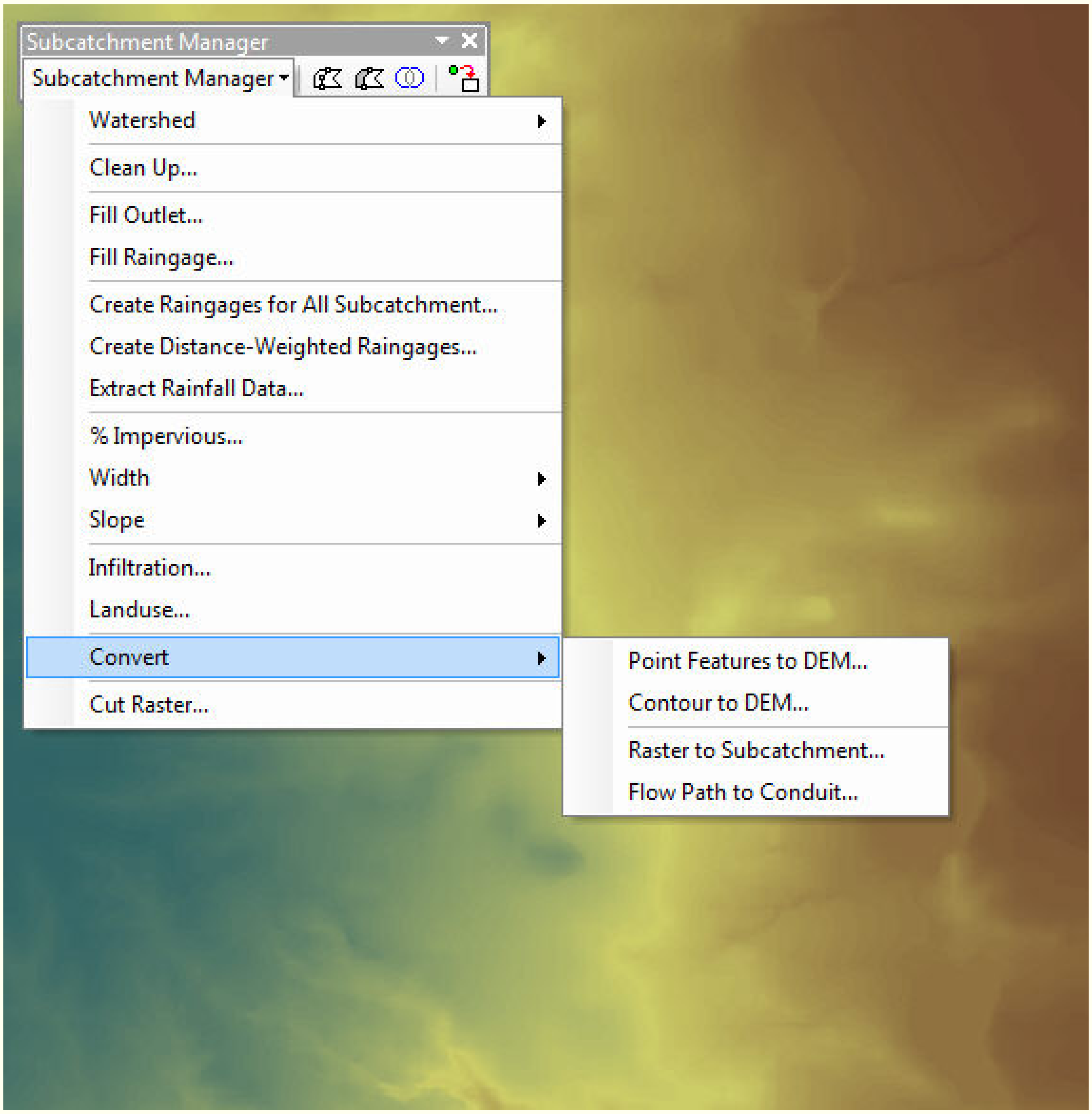
6. Polygon Processing

Manual determination of the soil, land use, and percent impervious coverage for Subcatchments are difficult processes. The InfoSWMM Subcatchment Manager greatly simplifies this process when GIS polygon data for soils and land use is available. Advanced polygon processing determines the area each soil type or land use comprises within subcatchment. After the soil and land use coverage for each subcatchment has been determined, the infiltration and pollutant buildup parameters for each soil and land use type may be assigned.

Soils data requires only the hydrologic soil group. For land use data, only the type is required. If the percent impervious will be generated using recommended values based on land use, a percent impervious attributes may be entered manually or contained in the land use database.

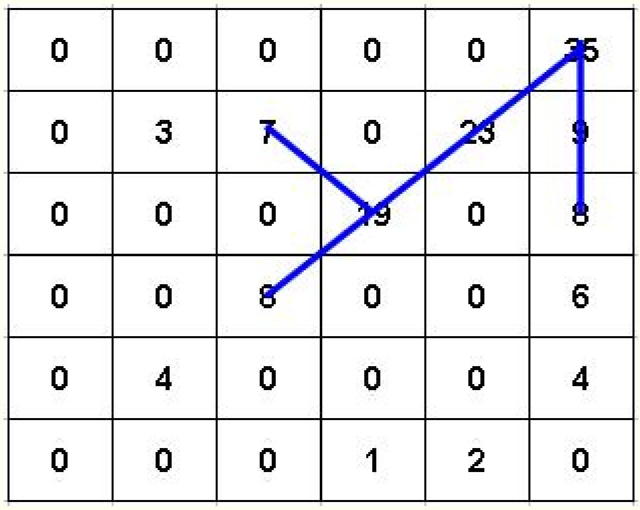
7. Conversions

Conversion tools are included with the Subcatchment Manager to accommodate various data types for model creation. Point features or contours can be converted to a raster DEM. In addition, existing raster data representing Subcatchments can be directly converted to InfoSWMM Subcatchments.



8.Flow Streams and Networks

Streams are defined from the flow accumulation grid based on a user defined threshold. Cells with a flow accumulation greater than the limit will be digitized to a line shapefile. The figure below details a stream network with a stream definition of 7.



These streams may be directly converted to conduits in the network model. The InfoSWMM tools can be used to place junctions at the intersections of the streams. Refer to the InfoSWMM User's Guide for details.

2.2 The Core Interface

The InfoSWMM Subcatchment Manager is designed to work synergistically with InfoSWMM to create and simulate realistic network models of sewerage collection systems. InfoSWMM supports the mapping of multiple layers that can be imported from many data sources. Points, contours, and DEM's are valid terrain models. Polygon data sets are used for soils, land use, and pervious / impervious processing.

To utilize the Subcatchment Manager, all relevant data must first be added to the current InfoSWMM session. This is done by clicking the *Add Data* icon  found under ArcMap's standard toolbar. Once the land use, soils, and elevation data has been added to the current session, you can begin to create the InfoSWMM model. All tools are found under the *SUBCATCHMENT MANAGER* menu.

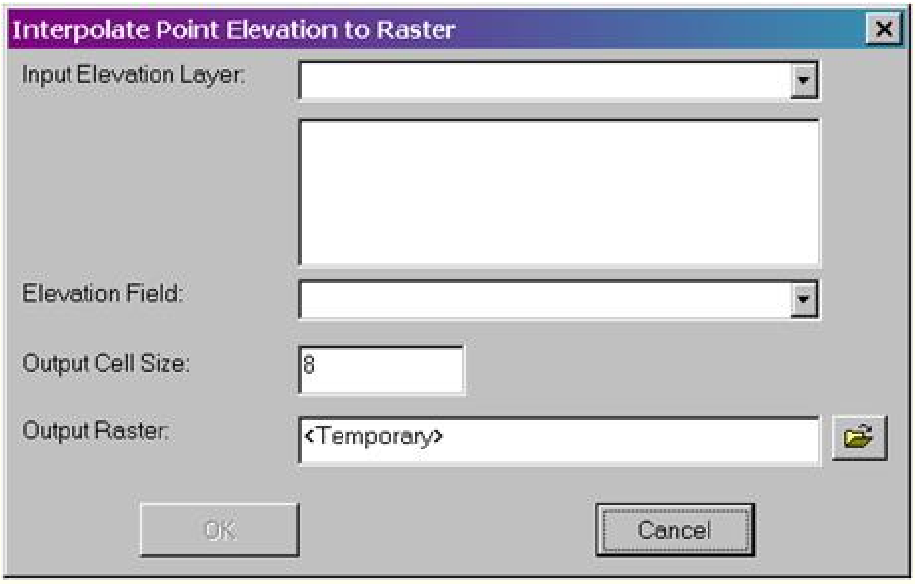
Because the Subcatchment Manager utilizes Spatial Analyst, outputs are stored in a working directory. This directory should be specified before using the Subcatchment Manager. Additional options can be set to reduce processing time and specify output parameters. Select *OPTIONS* from the *SUBCATCHMENT MANAGER* menu. Refer to ArcGIS Spatial Analyst documentation and help for information on these options.

NOTE: *Any changes made to the external shapefiles and rasters are automatically saved, even thought you exit InfoSWMM without saving your current project.*

Watershed processing starts with the terrain model. The terrain model must be a DEM. If contours or point data was added, use *CONVERT* from the *SUBCATCHMENT MANAGER* menu to create a DEM.

To use point data:

Create a DEM from a point layer.



Input Elevation Layer: The point data from which the DEM will be created.

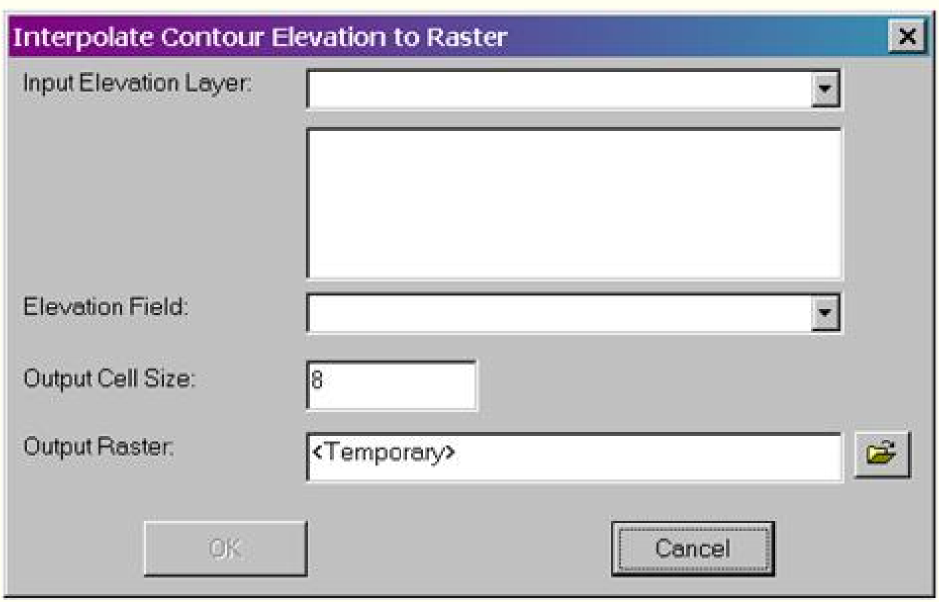
Elevation Field: The field containing elevation values.

Output Cell Size: The size of each cell (in map units) in the output DEM.

Output Raster: The location and file name for the DEM.

To use contour data:

Contour to DEM... Create a DEM from a contour layer.



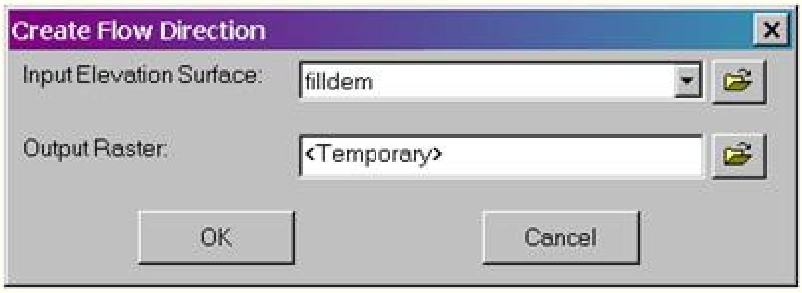
Input Elevation Layer: The contour data from which the DEM will be created.

Elevation Field: The field containing elevation values.

Output Cell Size: The size of each cell (in map units) in the output DEM.

Output Raster: The location and file name for the DEM.

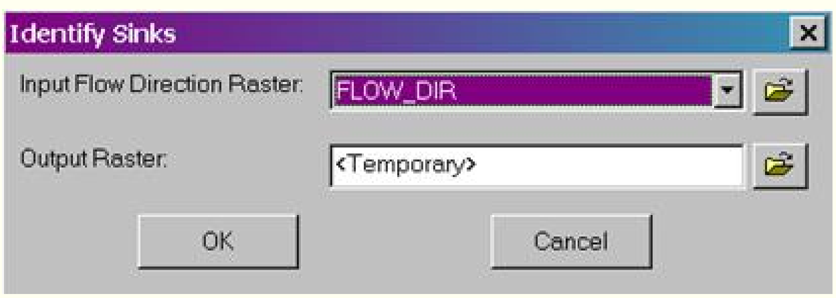
To begin delineation, use the *WATERSHED* option from the *SUBCATCHMENT MANAGER* menu. Delineating watersheds with the Subcatchment Manager is a cascading process. Sinks should be identified and removed prior to delineating Subcatchments. A flow direction grid is used to identify sinks. Click *WATERSHED / CREATE FLOW DIRECTION* from the *SUBCATCHMENT MANAGER* menu to create the flow direction grid.



Input Elevation Surface: The raw DEM containing potential sinks.

Output Raster: The location and file name for the flow direction grid.

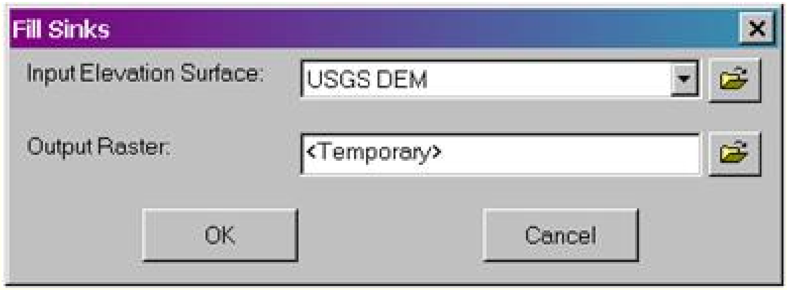
Choose *WATERSHED / IDENTIFY SINKS* from the *SUBCATCHMENT MANAGER* menu to find sinks.



Input Elevation Surface: The initial Flow Direction Grid.

Output Raster: The location and file name for output raster.

Sinks should be removed unless they are hydrologic features such as lakes. Use an analysis mask to prevent lakes from being removed when filling sinks. Select *WATERSHED / FILL SINKS* from the *SUBCATCHMENT MANAGER* menu to fill sinks in the DEM.



Input Elevation Surface: The DEM to modify.

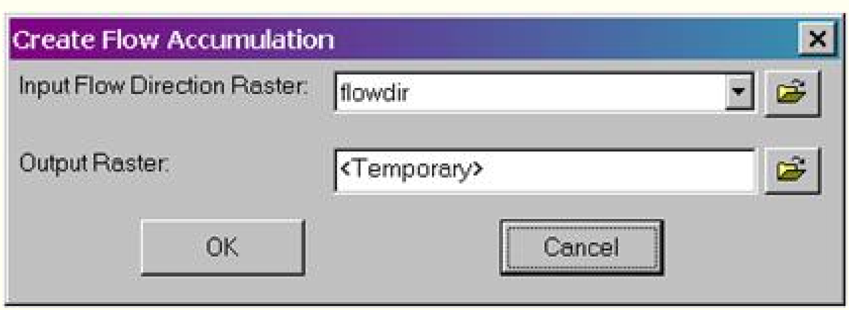
Output Raster: The location and file name for the modified DEM.

A final flow direction grid must be generated to define how water moves across the surface. Click *WATERSHED / CREATE FLOW DIRECTION* from the *SUBCATCHMENT MANAGER* menu to create the flow direction grid.

Input Elevation Surface: The modified DEM containing no unwanted sinks.

Output Raster: The location and file name for the final flow direction grid.

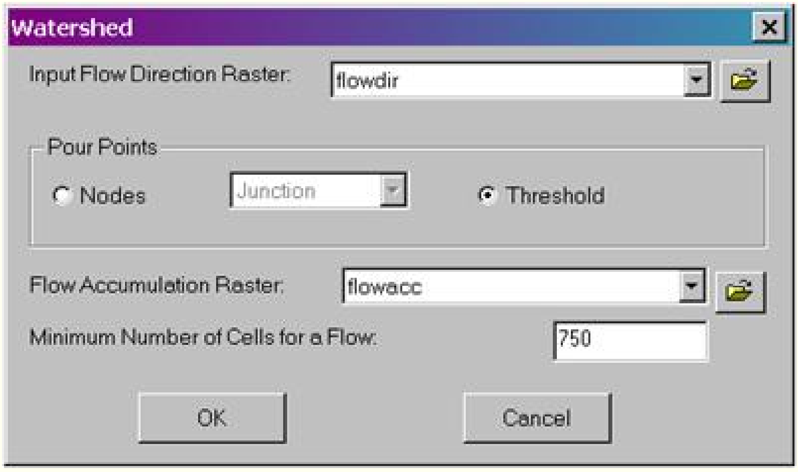
A flow accumulation grid is required to detail how much water drains to each cell. Pick *WATERSHED / CREATE FLOW ACCUMULATION* from the *SUBCATCHMENT MANAGER* menu to generate a flow accumulation grid.



Input Flow Direction Raster: The final flow direction grid previously generated.

Output Raster: The location and file name for the flow accumulation grid.

Subcatchments can be delineated after processing the flow direction and accumulation grids. The Subcatchments are automatically assigned unique ID’s and added to the subcatchment layer in InfoSWMM. The Subcatchment Manager provides two methods for delineation.



Threshold This method uses a threshold for the minimum number of cells for flow to be defined. The delineation may be repeated with alternate thresholds until the desired results are achieved

Nodes This method uses a man made collection point layer and delineates each point in the dataset. The defined area will misrepresent the actual basin if the collection point is not located on a stream in the DEM. This method is recommended for DEM’s with a resolution of 1 meter or less where collection systems exist.

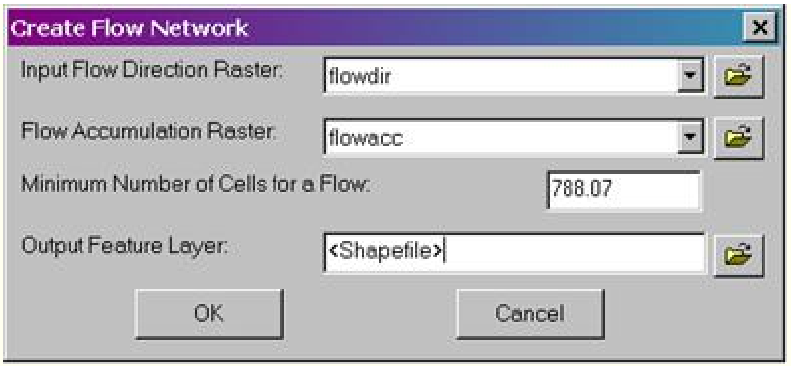
Input Flow Direction Raster: The flow direction grid created from the filled DEM, used for both methods.

Flow Accumulation Raster: The flow accumulation grid previously produced, used for the threshold method.

Pour Points Specifies the method used for delineating watersheds.

Minimum Number of Cells for a Flow: Minimum number of cells required to accumulate and to form a stream flow; the default is 1 % of maximum value of flow accumulation.

Streams can be defined from the flow accumulation and direction grids. A pixel is defined as a stream when the number of cells draining into it exceeds the input threshold.



Input Flow Direction Raster: The flow direction grid.

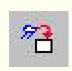
Flow Accumulation Raster: The flow accumulation grid.

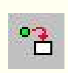
Minimum Number of Cells for a Flow: The threshold for stream definition.

Output Feature Layer: The location and file name for stream shapefile.

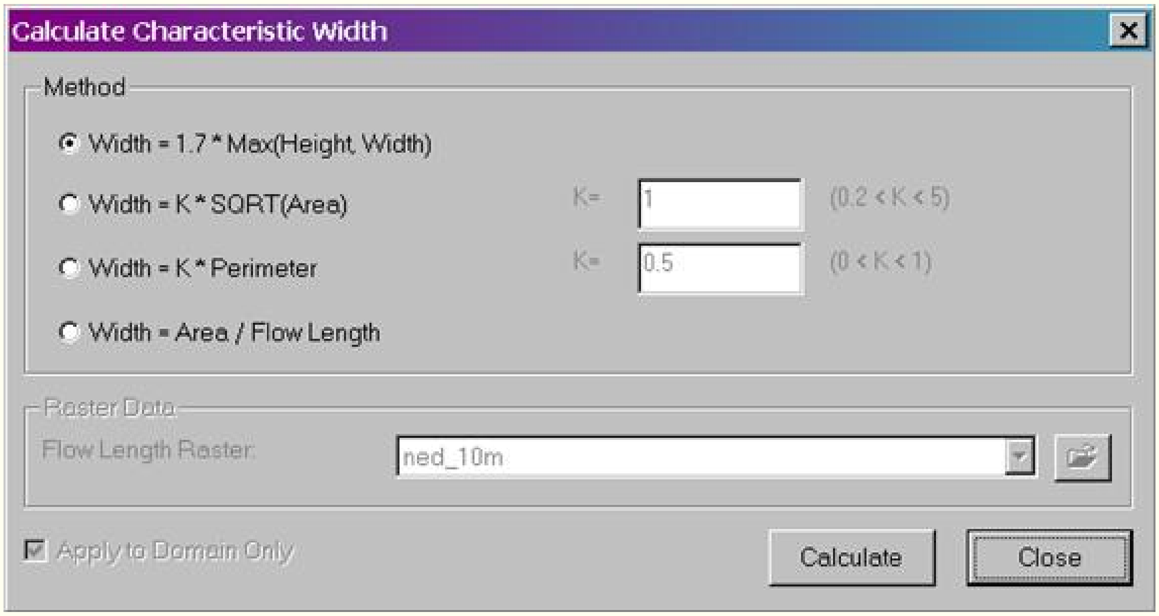
Automatically generated Subcatchments often require modification to produce a quality model. The InfoSWMM Subcatchment Manager supplies two methods to assist the clean up process. To fix overlapping Subcatchments, choose *CLEAN UP* from the*SUBCATCHMENT MANAGER* menu. Other Subcatchments may need merged or refined, and should be deleted or modified. After deleting undesired Subcatchments and improving the shape of others, missing Subcatchments can be redrawn with the *append subcatchment tool*  that snaps the new subcatchment to the vertices of acceptable Subcatchments.

The network and its attributes can be created after the Subcatchments are acceptable. The Subcatchment Manager provides simple methods for assigning rain gages and outlets to Subcatchments. The outlets and rain gages must be created prior to assignment to a subcatchment.

Raingages can be assigned by using the assign Raingage icon  or by selecting *ASSIGN RAINGAGE* from the *SUBCATCHMENT MANAGER* menu. The raingage to be assigned must first be selected. All Subcatchments that receive rainfall data from that raingage are selected next. This process is repeated for each rain gage.

Outlets can be assigned by using the assign Outlet icon  or by selecting *ASSIGN OUTLET* from the *SUBCATCHMENT MANAGER* menu. The outlet is selected then the subcatchment is chosen. The same technique is used for each outlet. Many subcatchment properties can be automatically populated by the Subcatchment Manager. Additional information must be added to the map to enable the subcatchment Manager to populate attributes.

Subcatchment width can be calculated with user defined functions. The calculate width dialog can be opened by clicking WIDTH / *CALCULATE SUBCATCHMENT WIDTH* from the*SUBCATCHMENT MANAGER* menu.



Apply to Domain Only Calculates width only for Subcatchments in the current domain.

Width = 1.7 * Max(Height, Width) Width equals the larger of the maximum height and maximum width and multiplying it by 1.7.

Width = K * SQRT(Area) Width equals the square root of the subcatchment area times a user defined constant ranging from 0.2 to 5.0.

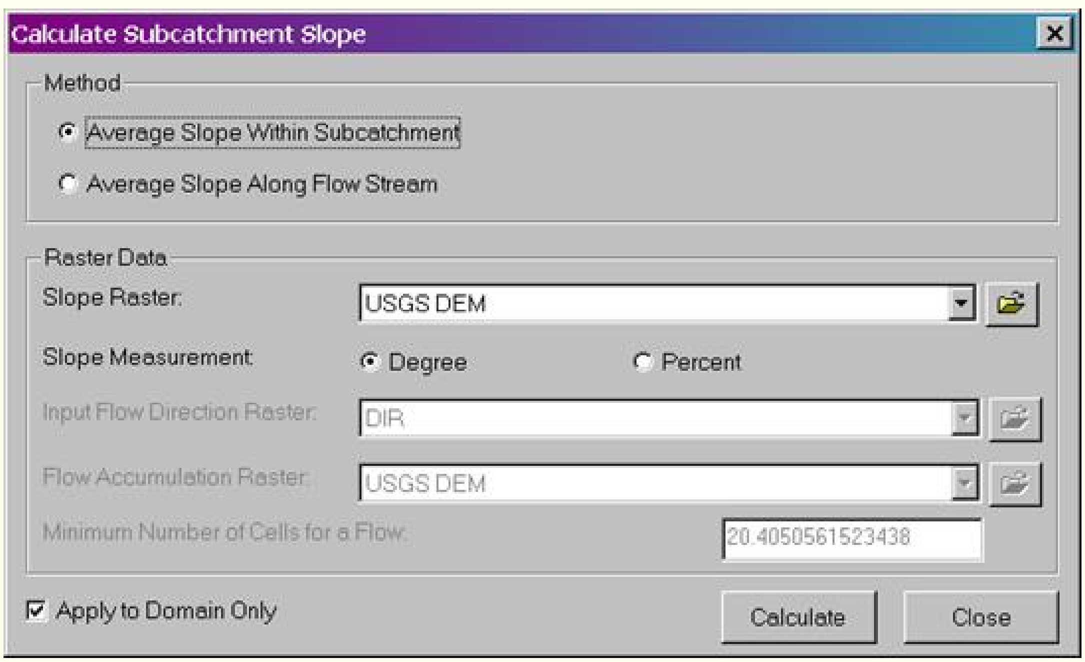
Width = K * Perimeter Width equals the perimeter of the subcatchment times a user defined constant ranging from 0.0 to 1.0.

Width = Area / Flow Length Width equals the subcatchment area divided by the longest flow path within the subcatchment. This method requires an input for Flow Length Raster:. This raster can be created by selecting WIDTH / *FLOW LENGTH* from the*SUBCATCHMENT MANAGER* menu.

Input Flow Direction Raster: The flow direction grid previously generated.

Output Raster: The location and file name for the flow length grid.

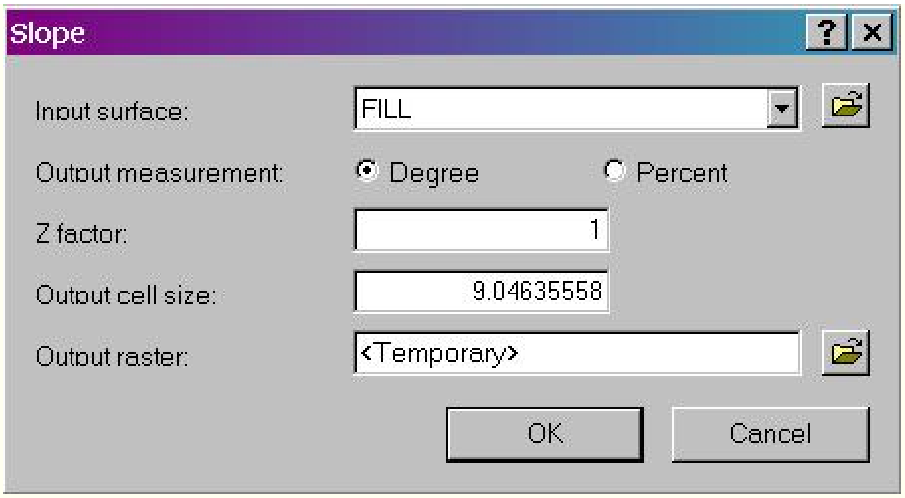
Slope may be calculated by the traditional method of analyzing the longest flow path. GIS processing can also be used to determine the average slope within the subcatchment. The calculate slope dialog box can be opened by clicking SLOPE / *CALCULATE SUBCATCHMENT SLOPE* from the*SUBCATCHMENT MANAGER* menu.



Apply to Domain Only Calculates slope only for Subcatchments in the current domain.

Slope Raster: Both methods require a slope raster to be generated from the filled DEM.

Slope Measurement: The units of the slope raster. The percent option is recommended, as InfoSWMM uses percent slope. To calculate the slope raster, choose SLOPE / *DEM TO SLOPE* from the *SUBCATCHMENT MANAGER* menu.



Input surface: The filled DEM.

Output measurement: The output units for slope, degree or percent.

Z factor: A factor to relate the vertical units to the horizontal units. Use 1 if all units are the same.

Output cell size: The cell size of the output raster. Note that the default is taken from *OPTIONS* under the *SUBCATCHMENT MANAGER* menu.

Output Raster: The location and file name for the slope grid.

NOTE: *The DEM layer must be in the* ***SAME*** *Projected Coordinate System for correct calculation of slope values.*

Average Slope Within Subcatchment Both methods require a slope grid to be generated from the filled DEM. The slope of each cell within each subcatchment is summed and divided by the number of cells in the subcatchment.

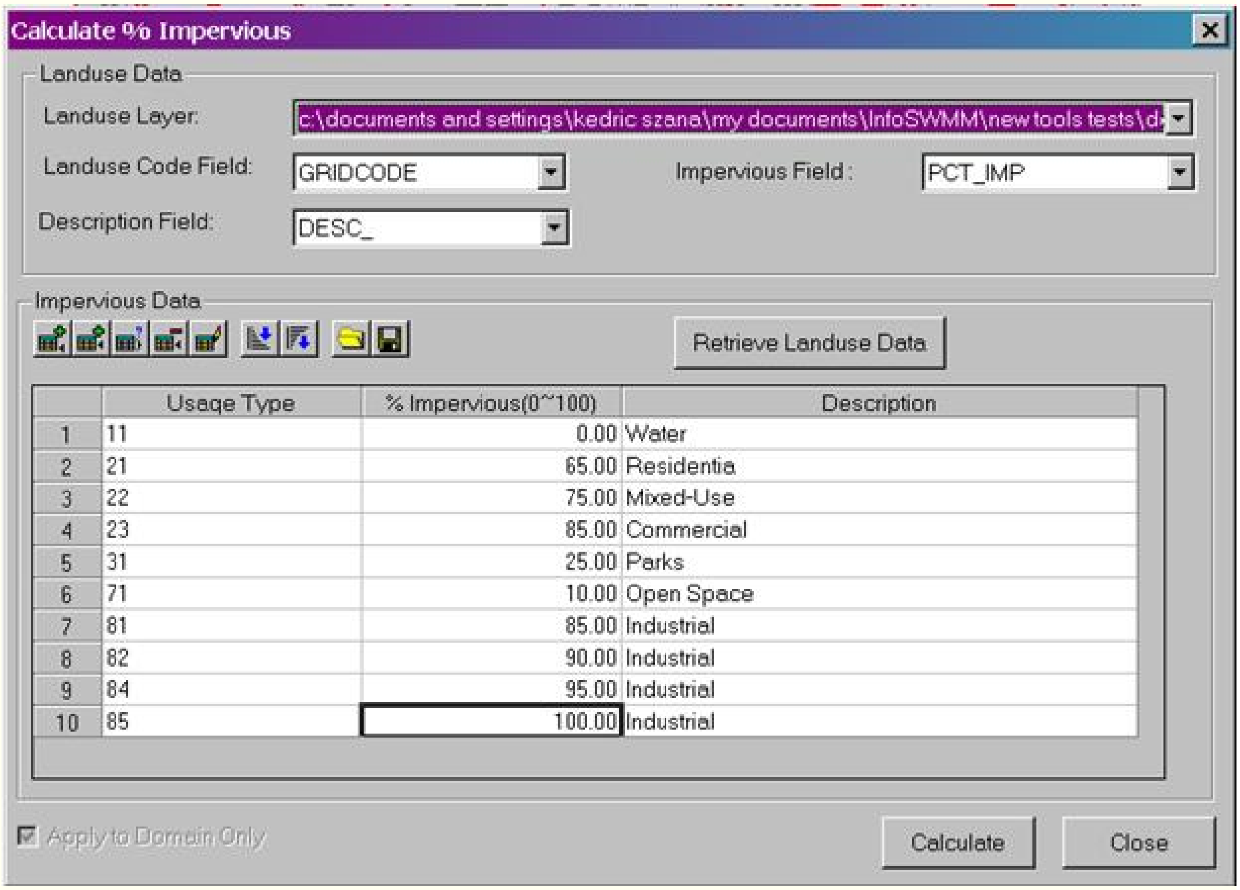
Average Slope Along Flow Stream This is the traditional method of calculating slope. This method requires:

Input Flow Direction Raster: The flow direction grid.

Flow Accumulation Raster: The flow accumulation grid.

Minimum Number of Cells for a Flow: The minimum number of cells for an acceptable flow path.

To assign the percent impervious for each subcatchment, a land use polygon layer must be added to the map. Select *% IMPERVIOUS* from the *SUBCATCHMENT MANAGER* menu to assign the percentage impervious to each subcatchment



Landuse Layer: The layer containing the land use types.

Landuse Code Field: The field with unique land use codes.

Description Field: The field describing the land use

Impervious Field : The field containing impervious values (not required).

Retrieve Landuse Data Automatically populates the impervious data table attribute values for land use type and description.

The percentage impervious data may be imported from the database or filled in manually. Values recommended by local code should be used to populate this field.

Calculate Populates the percent impervious attributes for all Subcatchments within the spatial extent of the land use data.

Close Closes the calculate % impervious dialog box.

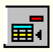
NOTE: *The Land Use layer must be in the* ***<u>SAME</u>*** *Projected Coordinate System for correct assignment of percent impervious values.*

The tools used to modify the impervious data table are explained below.

 *Append Row*: This command is used to append a row to the table.

 *Insert Row*: This command is used to insert a row into the table.

 *Set Row*: The set row command is used to specify the number of rows in the table.

 *Delete Row*: The delete command may be used to manually delete data corresponding to any land use class/classification field. Note that deleting a row will only remove land use data associated with the classification field. Any impervious class/classification field without a specific percentage impervious value will be assumed to be zero.

 *Block Edit*: The block edit command allows the user to simultaneously effect multiple changes to the usage table. This command allows the user to select a number of rows in a single column simultaneously and enter a common value to make global changes to the % Impervious table.

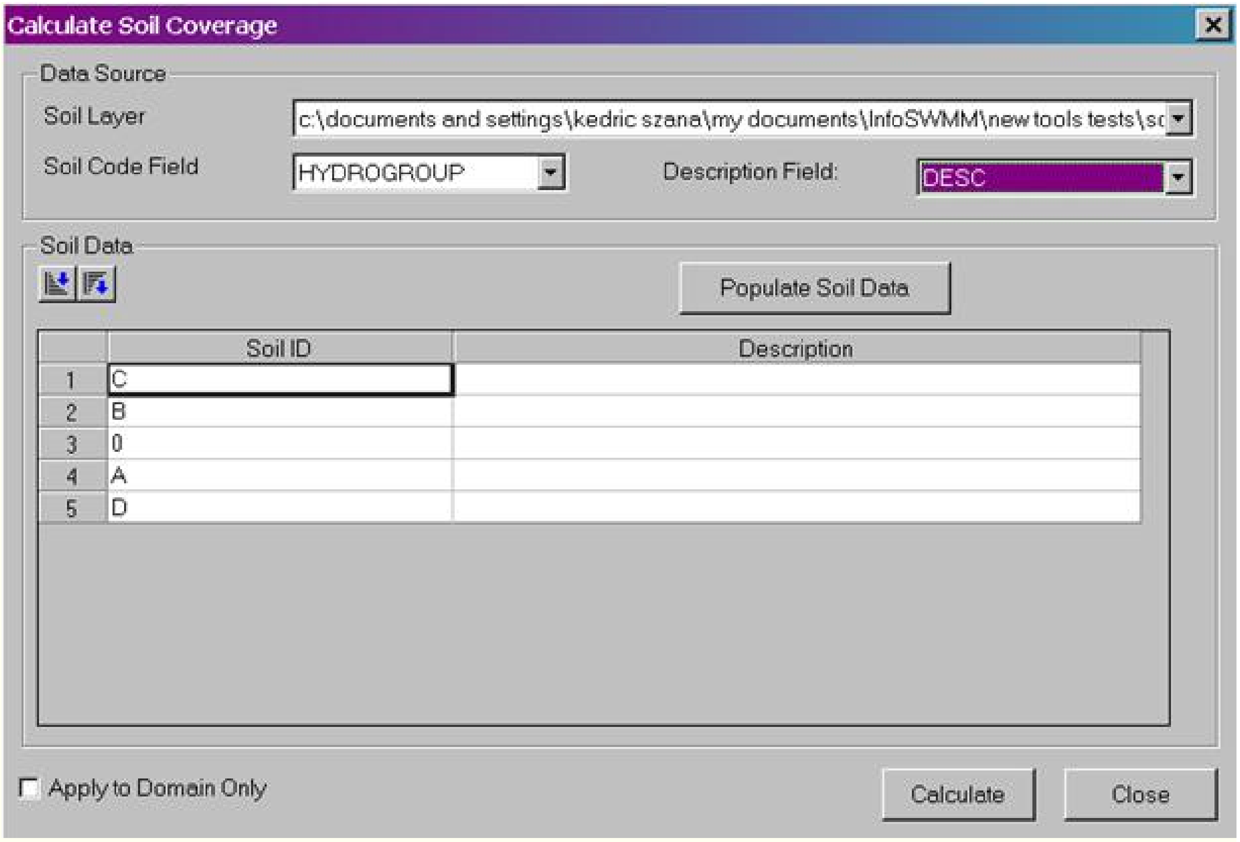
 *Sort Ascending*: This command is used to sort data in ascending order.

 *Sort Descending*: This command is used to sort data in descending order.

 *Load*: This command is used to import impervious data file (*.dat file).

 *Save*: This command is used to save changes made to the impervious data table.

Infiltration data is assigned to Subcatchments based on soil type. To allocate soil types, a soils polygon layer must be added to the map. Select *INFILTRATION* from the*SUBCATCHMENT MANAGER* menu.



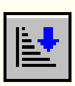
Apply to Domain Only Calculates soil coverage only for Subcatchments in the current domain.

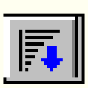
Soil Layer The soil polygon layer.

Soil Code Field The soil code or hydrologic group.

Description Field: A description of the soil type.

Populate Soil Data Automatically populates the soil data table attribute values for soil type and description.

 *Sort Ascending*: This command is used to sort data in ascending order.

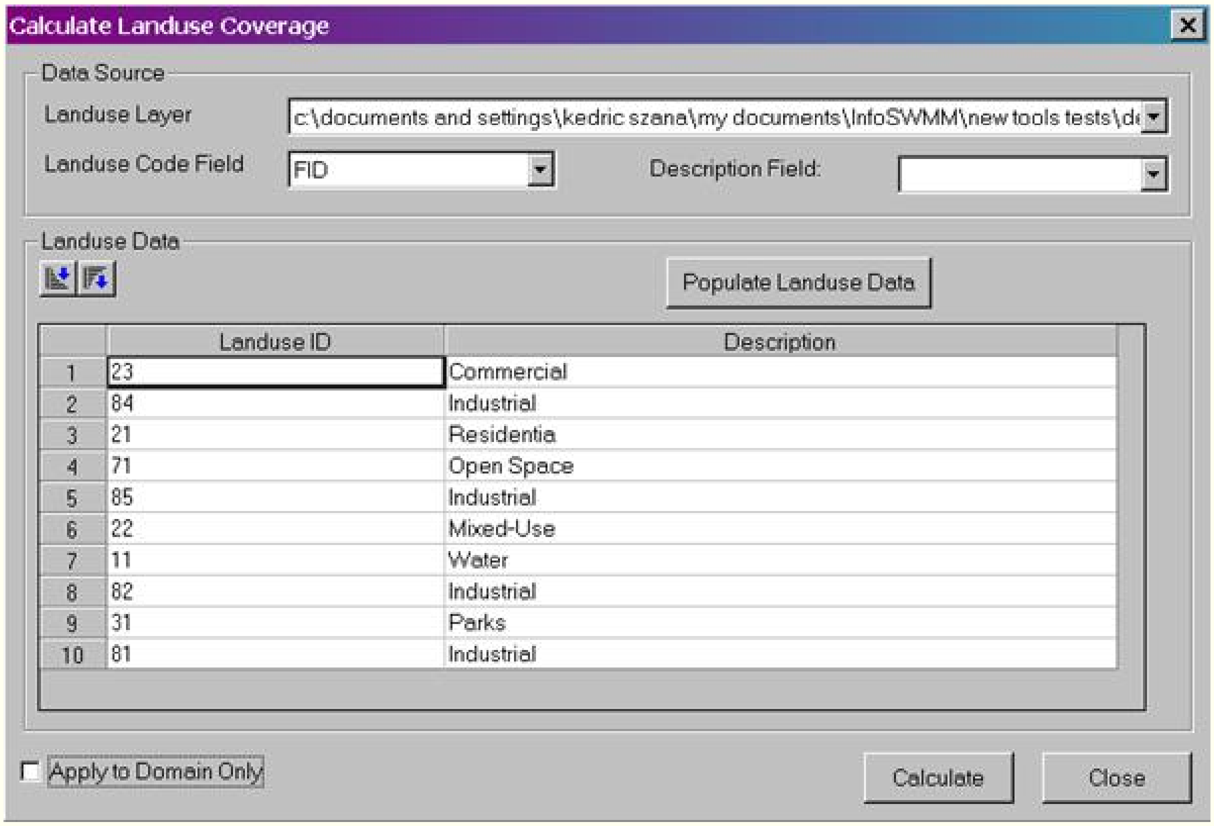
 *Sort Descending*: This command is used to sort data in descending order.

Calculate Populates the soil coverage attributes for all Subcatchments within the spatial extent of the soils data.

Close Closes the calculate soil coverage dialog box.

> **NOTE:** *The Soils layer must be in the* ***<u>SAME</u>*** *Projected Coordinate System for correct allocation of soil types.*

To allocate land use for pollutant buildup in every subcatchment, a land use polygon layer must be added to the map. To assign land use, select *LANDUSE* from the *SUBCATCHMENT MANAGER* menu.



Apply to Domain Only Generates land use coverage only for Subcatchments in the current domain.

Landuse Layer: The layer containing the land use types.

Landuse Code Field: The field with unique land use codes.

Description Field: The field describing the land use

Retrieve Landuse Data Automatically populates the land use data table attribute values for land use type and description.

Calculate Populates the land use attributes for all Subcatchments within the spatial extent of the land use data.

Close Closes the calculate land use coverage dialog box.

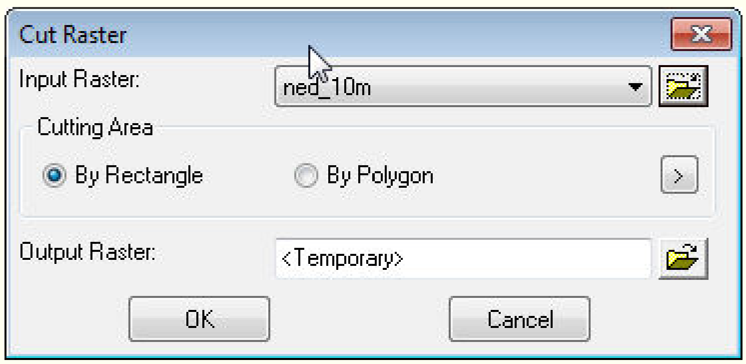
NOTE: *The Land Use layer must be in the* ***<u>SAME</u>*** *Projected Coordinate System for correct assignment of land use values.*

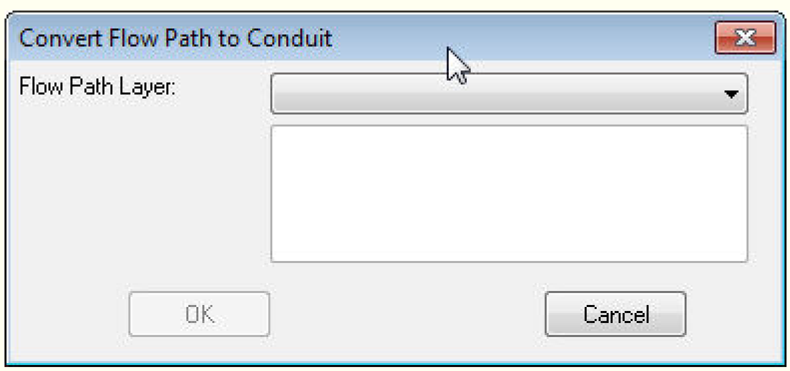
2.3 Additional Subcatchment Manager Options

Other options provided in InfoSWMM Subcatchment Manager are explained as below:

A *CUT RASTER* tool is available in the *SUBCATCHMENT MANAGER* menu. This tool prompts the user to draw a polygon on the screen, and then extracts the raster within the polygon. This tool is useful for reducing processing time due to the evaluation of unnecessary raster data.

Streams defined during subcatchment delineation can be directly converted to conduits in InfoSWMM. Click *CONVERT / FLOW PATH TO CONDUIT* from the *SUBCATCHMENT MANAGER* menu.





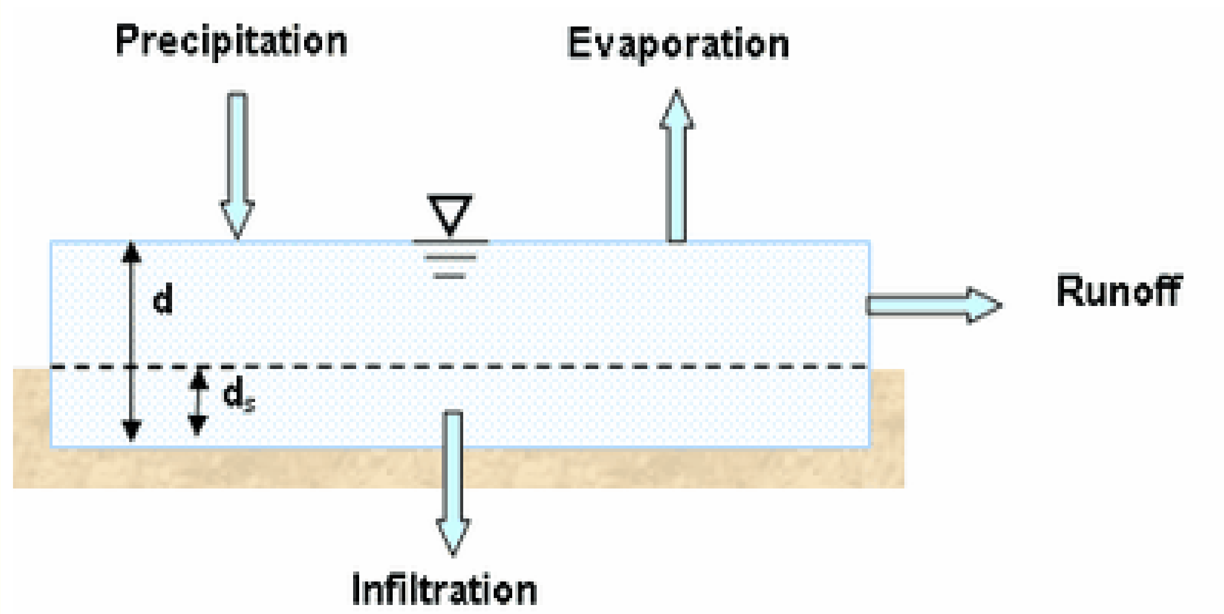
The flow path layer created during subcatchment delineation.

NOTE: *Any changes made to the external shapefiles and rasters are automatically saved, even thought you exit*

InfoSWMM without saving your current project.

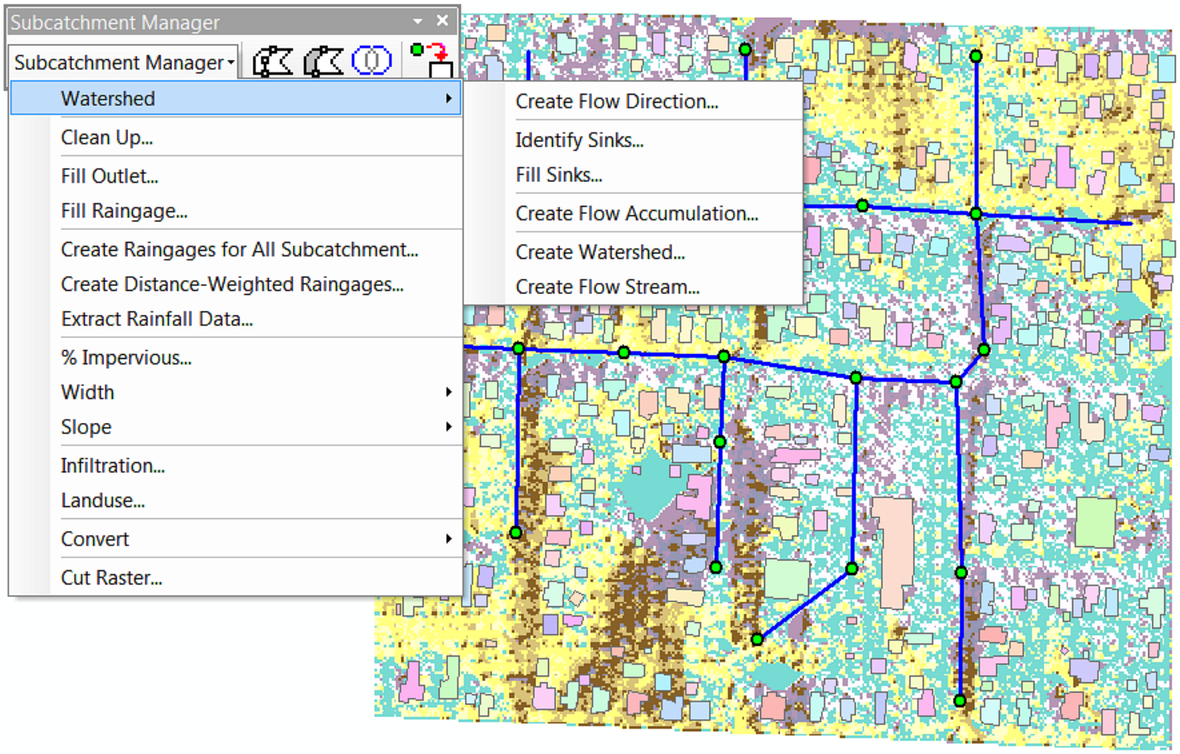
Runoff Theory

The conceptual view of surface runoff used by SWMM, SWMM5 and InfoSWMM is illustrated in the figure below.



Each subcatchment surface is treated as a nonlinear reservoir. Inflow comes from precipitation and the runoff from any designated upstream subcatchments. Outflows consist of infiltration, evaporation, and surface runoff. The capacity of this "reservoir" is the maximum depression storage, which is the maximum surface storage provided by ponding, surface wetting, and interception. Surface runoff, **Q**, occurs only when the depth of water **d** in the "reservoir" exceeds the maximum depression storage, $\mathbf{d_s}$, in which case the outflow is given by Manning's equation. Depth of water over the subcatchment (**d**) is continuously updated with time by solving numerically a water balance equation over the subcatchment.

InfoSWMM's Subcatchment Manager helps you define the area, width, imperviousness and slope of the Subcatchments.


Subcatchment Manager
Subcatchment Manager
Watershed
Clean Up...
Fill Outlet...
Fill Raingage...
Create Raingages for All Subcatchment...
Create Distance-Weighted Raingages...
Extract Rainfall Data...
% Impervious...
Width
Slope
Infiltration...
Landuse...
Convert
Cut Raster...
Create Flow Direction...
Identify Sinks...
Fill Sinks...
Create Flow Accumulation...
Create Watershed...
Create Flow Stream...

Quick-Start Tutorial

The Quick-Start tutorial is designed for first-time users of InfoSWMM Subcatchment Manager and provides a guided tour to core commands and functions used for delineating Subcatchments and globally populating their attributes.

The Quick Start tutorial will help first-time users become familiar with the core set of InfoSWMM Subcatchment Manager features and should be used as a launching point to a more comprehensive understanding of the program.

The estimated time to complete the Quick Start tutorial is approximately 30 minutes.

The Quick Start tutorial will help first-time users become familiar with the following:

- Generate rasters tracking watershed movement
- Delineate Subcatchments
- Calculate subcatchment slope and width
- Allocate infiltration, land use, and impervious percentage to Subcatchments

During the Quick Start tutorial, the user will modify a project named "**SampleSub**". This project is provided with InfoSWMM Subcatchment Manager Software installation and can be found in the InfoSWMM Examples directory in Windows 7:

C:\Users\Public\Documents\InfoSWMM\Examples\SampleSub.mxd

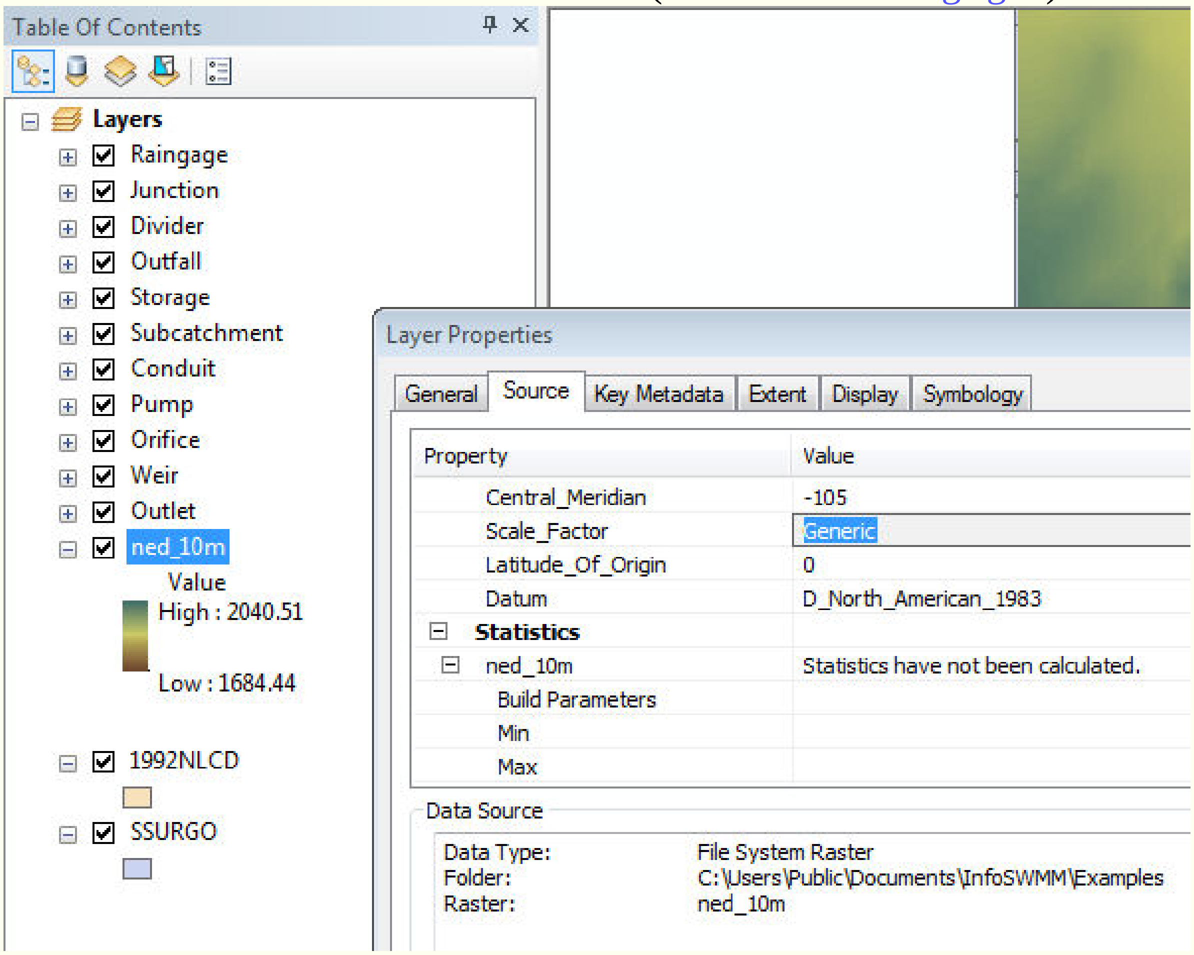
(May be different for custom installations).

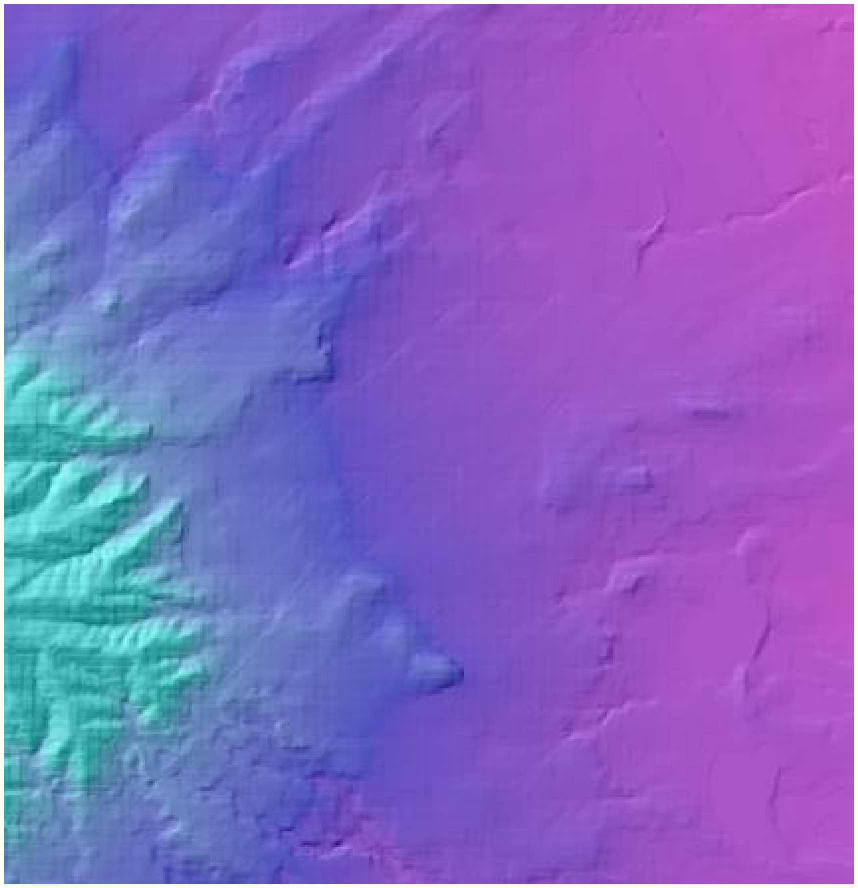
The **"SampleSub"** project modified in this tutorial illustrates how the InfoSWMM Subcatchment Manager delineates Subcatchments and automatically calculates and allocates their properties.

The **"SampleSub"** data is shown below. The data consists of the following components:

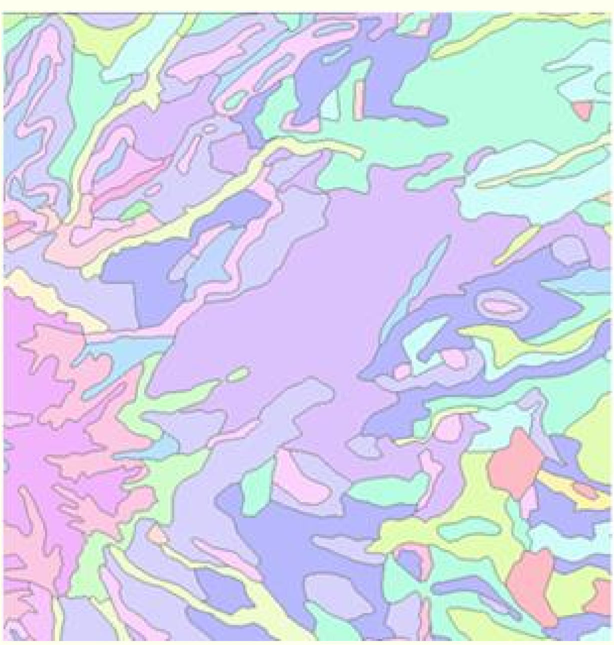
- · USGS National Elevation Dataset 1/3 Arc-Second DEM (www.seamless.usgs.gov)
- · SSURGO Soils Polygon Shapefile (http://www.ncgc.nrcs.usda.gov/products/datasets/ssurgo/)

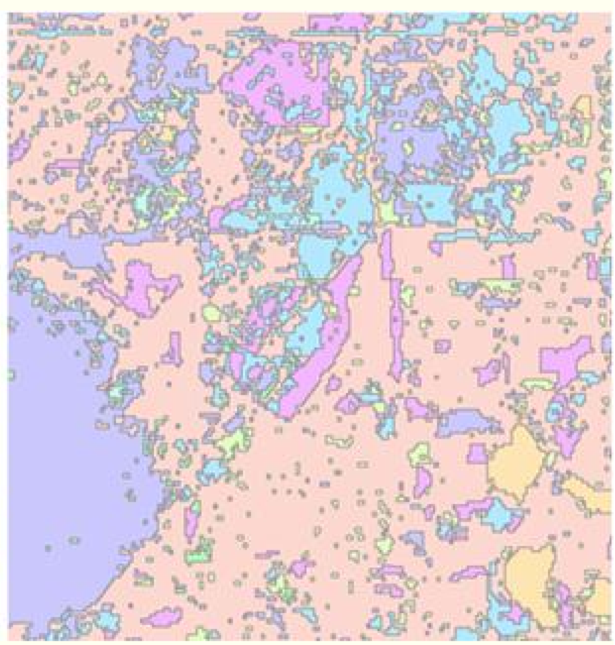
· 1992 National Land Cover Dataset (www.seamless.usgs.gov)





1/3 Arc-Second DEM



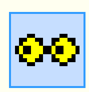
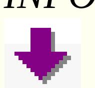


SSURGO Soils Data 1992 Land Cover

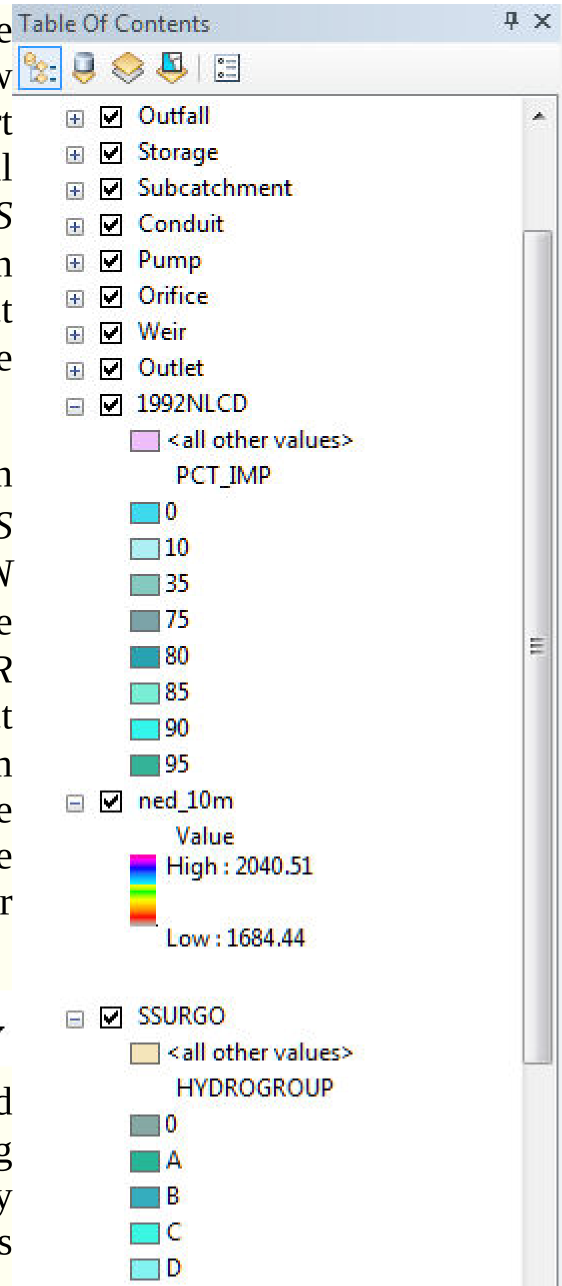
Step 1: Open the SampleSub Project

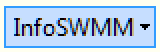
Step 1: Open the SampleSub Project

The first step is to open the InfoSWMM project.

- **1.** From the Windows "Start" menu, select Programs and navigate to the *InfoSWMM x* program group. Once there, open *InfoSWMM*.
- **2.** In the *ARCMAP* window, select *AN EXISTING MAP* option in the *START USING ARCMAP WITH* area and then click on "OK" button. If the *ARCMAP* window is not shown, simply choose *OPEN* command from the *FILE* menu.
- **3.** On the *OPEN* dialog box, navigate to the directory containing the "SampleSub" project and choose that file.
- C:\Users\Public\Documents\InfoSWMM\ **SampleSub.mxd** (the path may be different for custom installations)
- **4.** Go to the *VIEW* menu, choose *TOOLBARS* and then click on the *INFOSWMM CONTROL CENTER* command to view the *INFOSWMM CONTROL CENTER* toolbar. Repeat the above step, to view the *INFOSWMM EDIT NETWORK* toolbar and the *INFOSWMM OUTPUT* toolbar.
- **5.** Click on the *ATTRIBUTE BROWSER* icon  and the *MESSAGE BOARD* icon  from the *INFOSWMM CONTROL CENTER* toolbar to view the *ATTRIBUTE BROWSER* window and *MESSAGE BOARD* window.
- **6.** Go to the *TOOLS* menu, choose *EXTENSIONS* and then click on the *INFOSWMM* checkbox. Click on the *MAGENTA DOWN ARROW* icon  to initialize InfoSWMM. When initialized, the icons on the InfoSWMM toolbars will be enabled for use.

- **7.** Before continuing, save the "SampleSub" project to a new project name. If you wish to restart the tutorial, the original project will be available. Choose the *SAVE AS* command from the *FILE* menu. On the dialog box enter the new project name "**Tutorial**". This becomes the active project.



- **8.** Click on the InfoSWMM button 

and then from the *TOOLS* menu choose *ADD-ON EXTENSION MANAGER*. With the *ADD-ON EXTENSION MANAGER* dialog box open, select *SUBCATCHMENT MANAGER* from the drop down list and click the "Run" button. This will load the InfoSWMM Subcatchment Manager Toolbar.

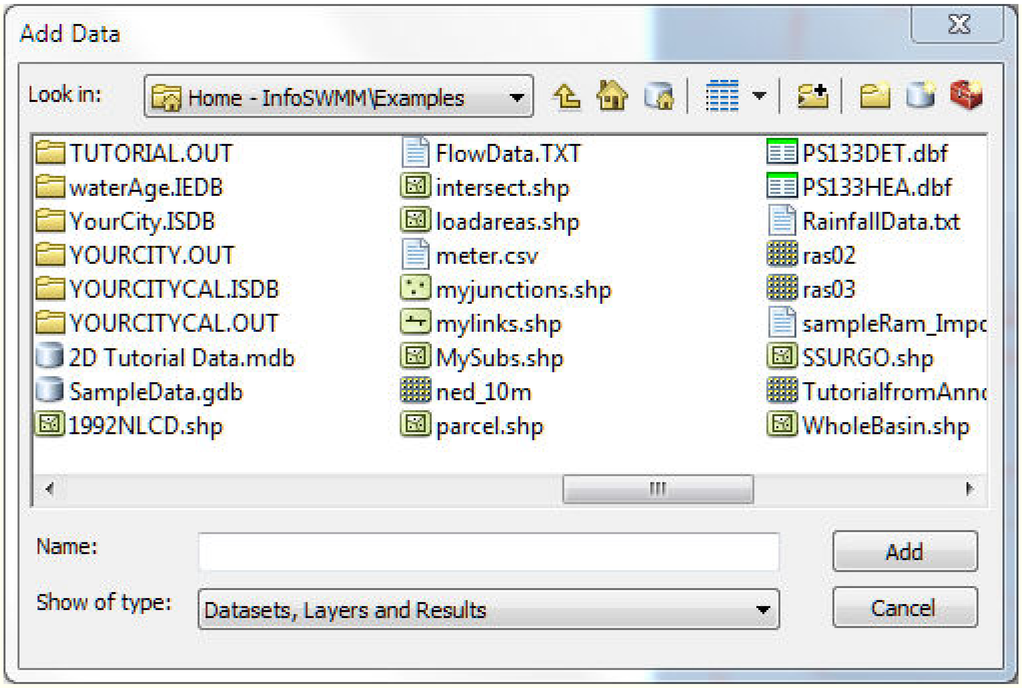
- **9.** Click on the *Add Data* icon  found under ArcMap's standard toolbar. In the *ADD DATA* dialog box, navigate to the directory containing the following three files and select those files.

C:\Users\Public\Documents\InfoSWMM\Examples\1992NLCD.shp

C:\Users\Public\Documents\InfoSWMM\Examples\SSURGO.shp

C:\Users\Public\Documents\InfoSWMM\Examples\NED_10m

(The path may be different for custom installations)



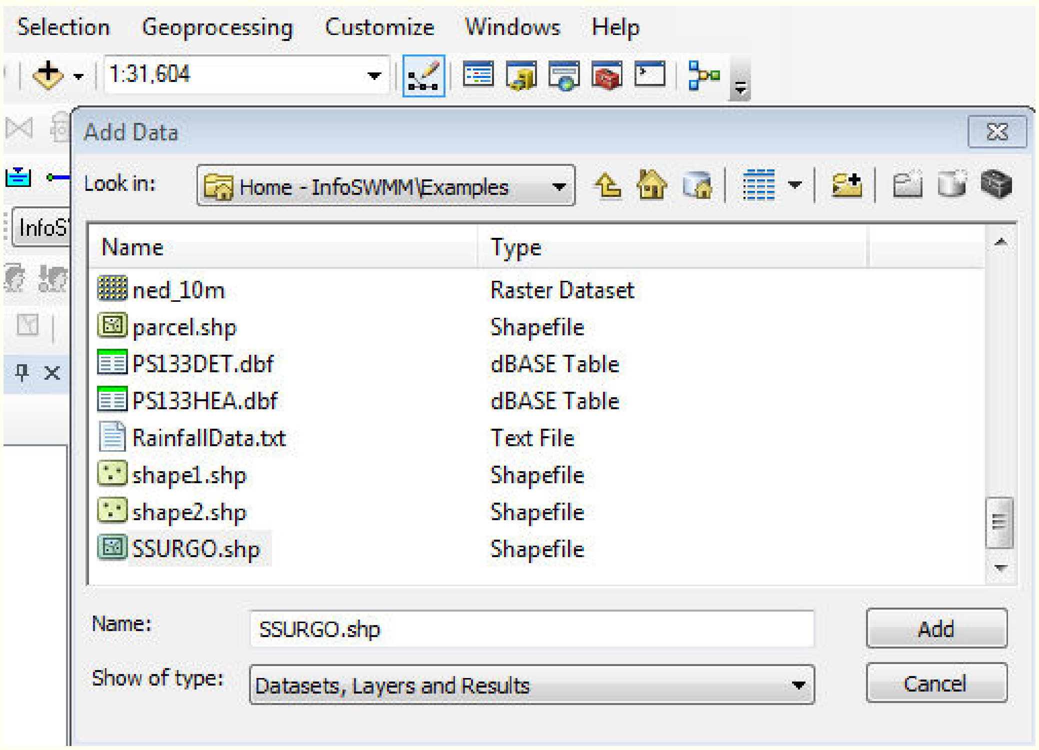
Add Data
Look in:
Home - InfoSWMM\Examples
TUTORIAL.OUT
waterAge.IEDB
YourCity.ISDB
YOURCITY.OUT
YOURCITYCAL.ISDB
YOURCITYCAL.OUT
2D Tutorial Data.mdb
SampleData.gdb
1992NLCD.shp
FlowData.TXT
intersect.shp
loadareas.shp
meter.csv
myjunctions.shp
mylinks.shp
MySubs.shp
ned_10m
parcel.shp
PS133DET.dbf
PS133HEA.dbf
RainfallData.txt
ras02
ras03
SSURGO.shp
WholeBasin.shp
Name:
Show of type:
Datasets, Layers and Results
Add
Cancel

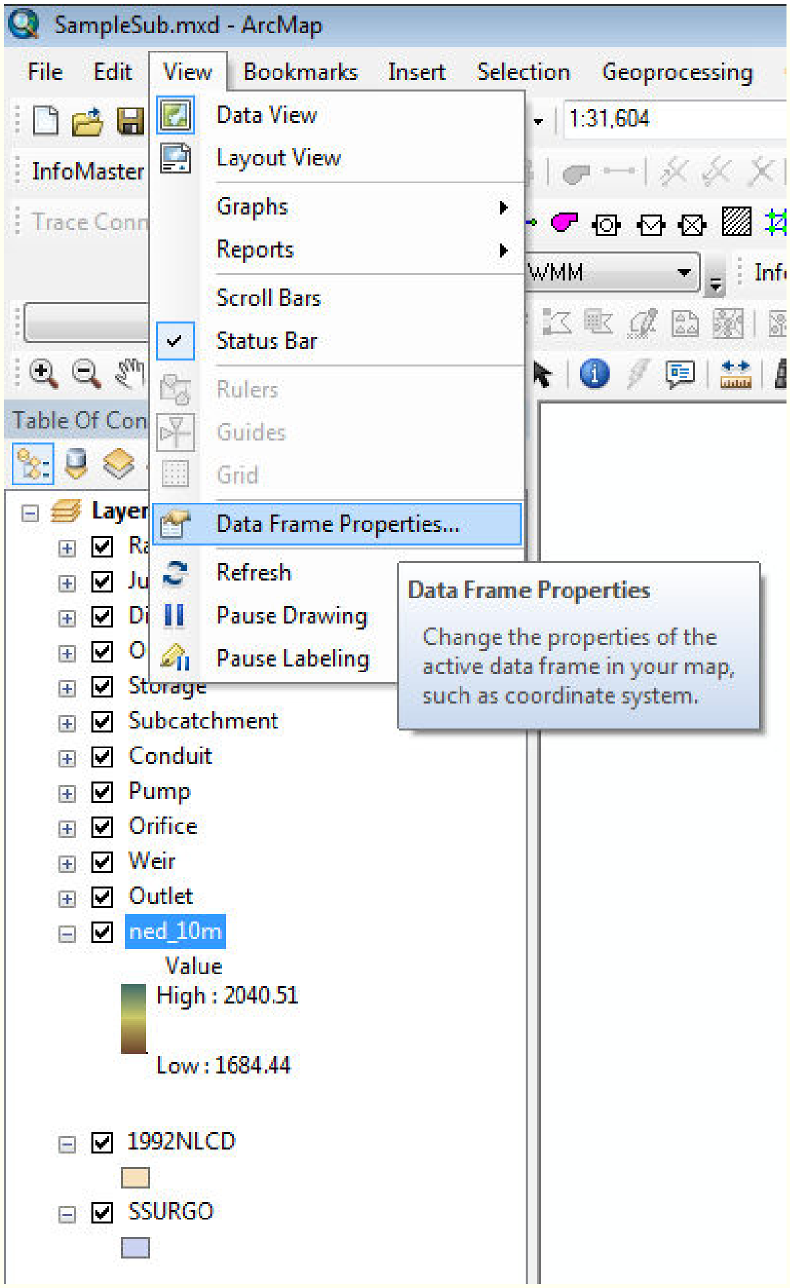
Step 2: Set the Arc Map Options

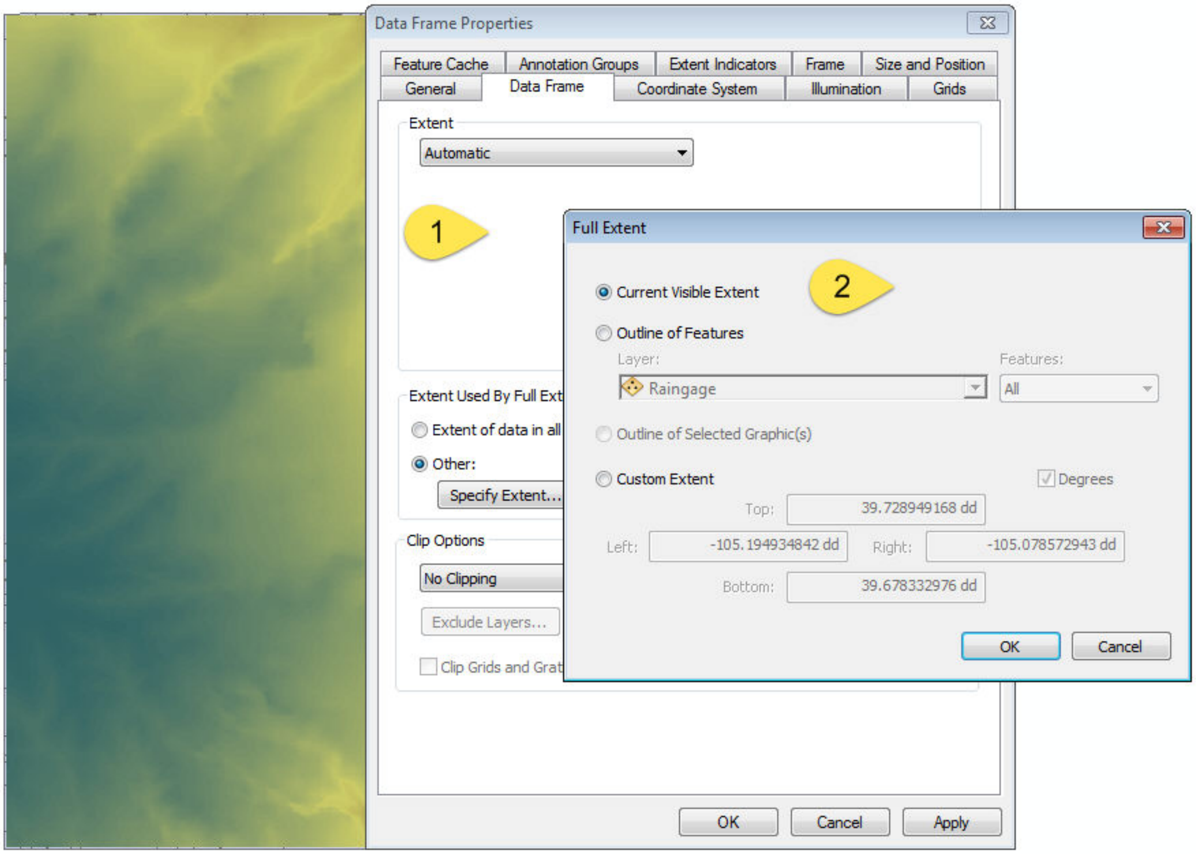
Step 2: Set the Arc Map Options

The next step in the Subcatchment generation process is to set the working directory and analysis options. The working directory is the location that each shapefile or raster created will be stored. The analysis settings improve processing time.

Subcatchments cannot be delineated outside of the DEM. Therefore, Land Use and Soils data outside the spatial limit of the DEM do not need to be considered.

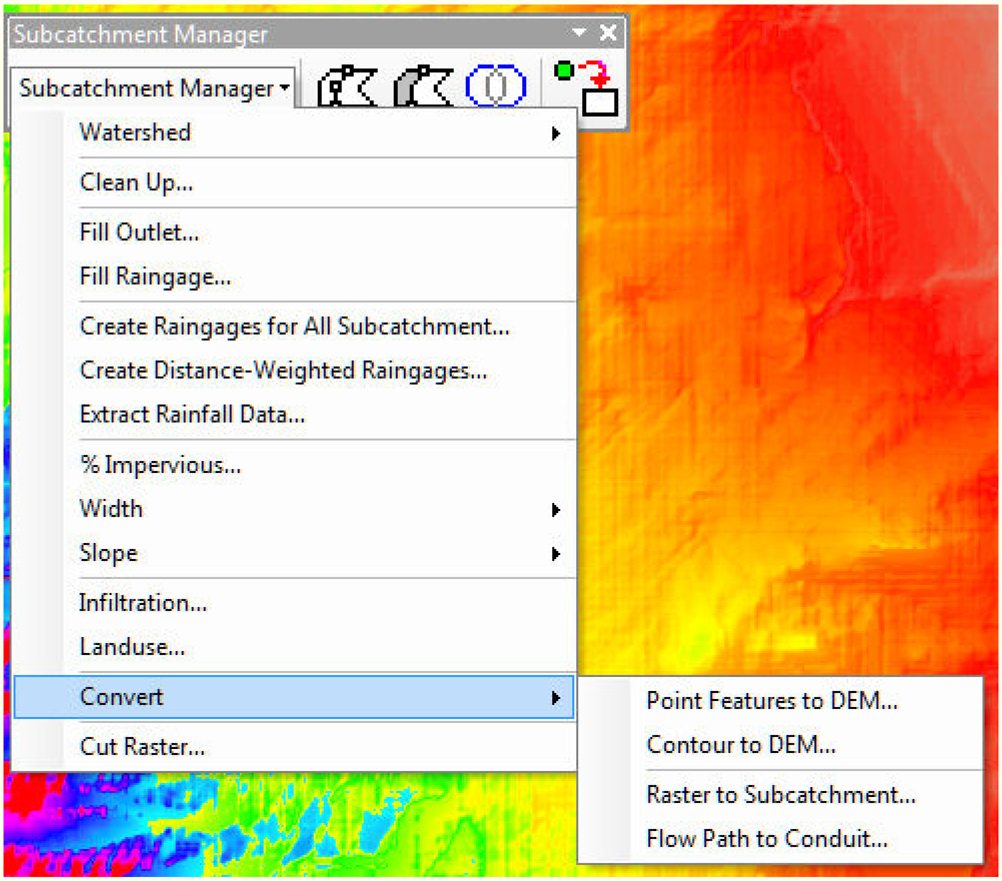



SampleSub.mxd - ArcMap
File
Edit
View
Bookmarks
Insert
Selection
Geoprocessing
1:31,604
InfoMaster
Trace Conn
WMM
Table Of Con
Data View
Layout View
Graphs
Reports
Scroll Bars
Status Bar
Rulers
Guides
Grid
Data Frame Properties...
Refresh
Pause Drawing
Pause Labeling
Data Frame Properties
Change the properties of the active data frame in your map, such as coordinate system.
Layer
Storage
Subcatchment
Conduit
Pump
Orifice
Weir
Outlet
ned_10m
Value
High : 2040.51
Low : 1684.44
1992NLCD
SSURGO


Data Frame Properties
Feature Cache
Annotation Groups
Extent Indicators
Frame
Size and Position
General
Data Frame
Coordinate System
Illumination
Grids
Extent
Automatic
1
Extent Used By Full Ext
Extent of data in all
Other:
Specify Extent...
Clip Options
No Clipping
Exclude Layers...
Clip Grids and Grat
OK
Cancel
Apply
Full Extent
2
Current Visible Extent
Outline of Features
Layer:
Raingage
Features:
All
Outline of Selected Graphic(s)
Custom Extent
Degrees
Top:
39.728949168 dd
Left:
-105.194934842 dd
Right:
-105.078572943 dd
Bottom:
39.678332976 dd
OK
Cancel

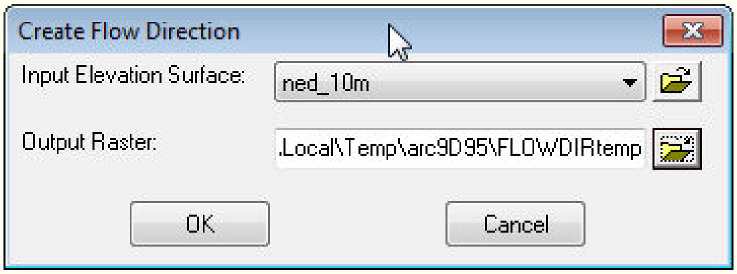
Step 3: Use The Subcatchment Manager

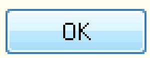
The watershed tools contain all processes necessary to delineate Subcatchments and define streams. Some tools must be used multiple times.



Step 4. Create Initial Flow Direction Grid

- **1.** The first step in delineating watersheds is to create a preliminary "*Flow Direction Grid*". Choose *WATERSHED / CREATE FLOW DIRECTION* from the *SUBCATCHMENT MANAGER* menu to create the flow direction grid.



- **2.** Select "*ned_10m*" for the "*Input Elevation Surface*"
- **3.** Click on the  icon next to *"Output Raster"*
- **4.** Type "*FLOWDIRtemp*" in the "*Name*" box and click "*Save*"
- **5.** Click on the "OK" button 

to generate the flow direction grid and close the dialog box.

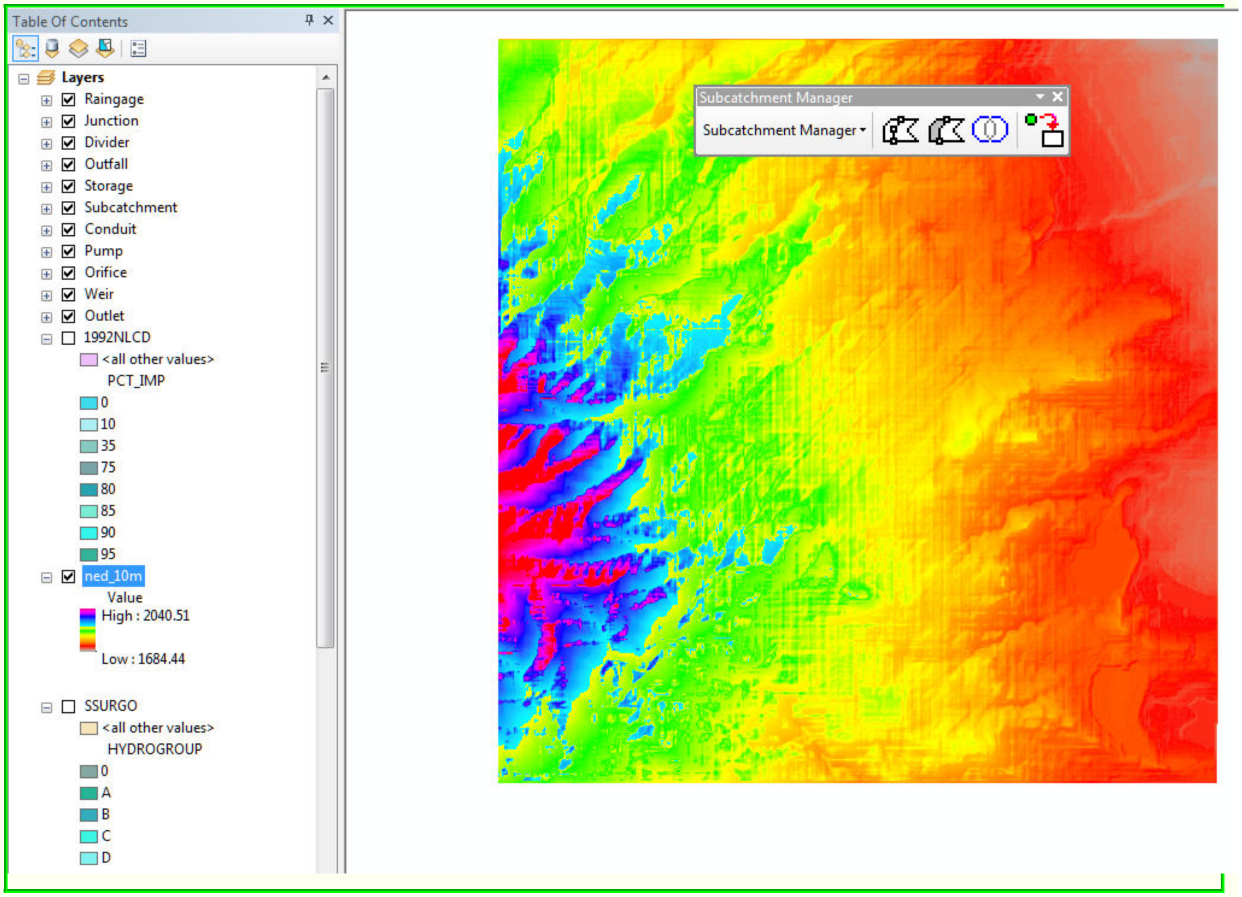
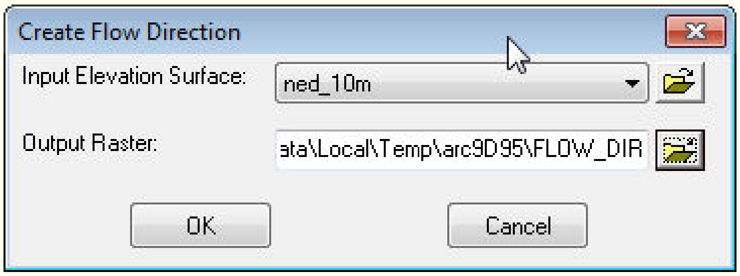


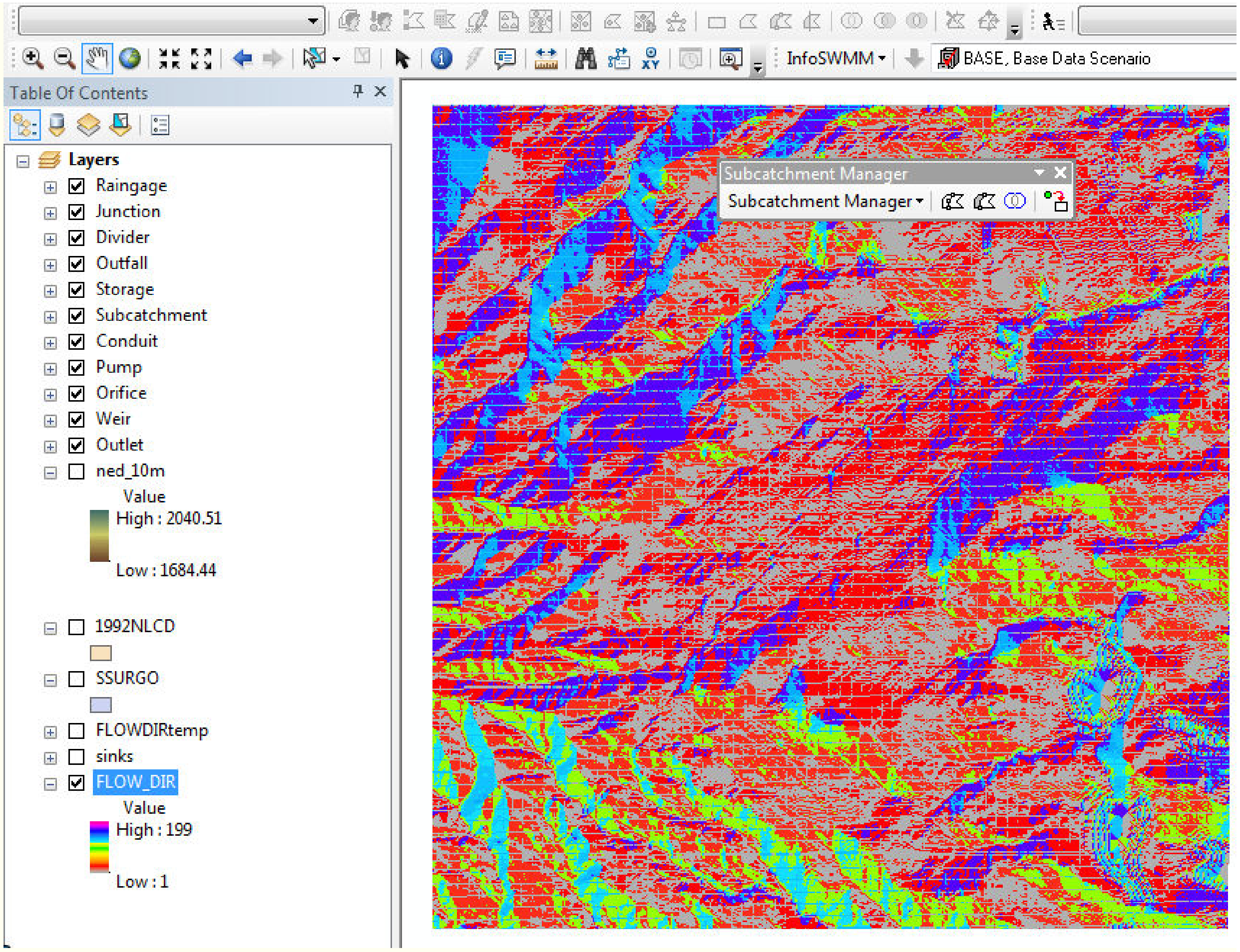
Table Of Contents
Layers
Raingage
Junction
Divider
Outfall
Storage
Subcatchment
Conduit
Pump
Orifice
Weir
Outlet
1992NLCD
<all other values>
PCT_IMP
0
10
35
75
80
85
90
95
ned_10m
Value
High : 2040.51
Low : 1684.44
SSURGO
<all other values>
HYDROGROUP
0
A
B
C
D
Subcatchment Manager
Subcatchment Manager

Step 5. Create Final Flow Direction Grid

- **1.** The permanent "*Flow Direction Grid*" can be created now that the DEM contains no unwanted sinks. Choose *WATERSHED / CREATE FLOW DIRECTION* from the *SUBCATCHMENT MANAGER* menu to create the flow direction grid.

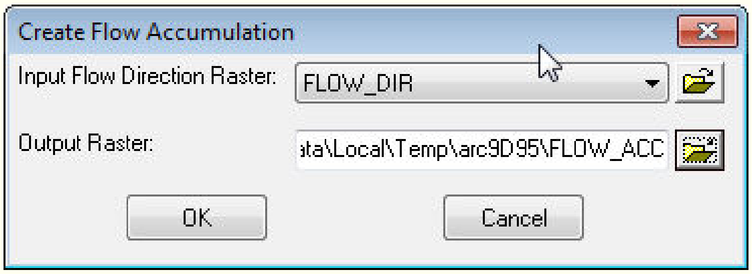


- **2.** Select "ned_10m" for the "*Input Elevation Surface*"
- **3.** Click on the icon next to *"Output Raster"*
- **4.** Type "*FLOW_DIR*" in the "*Name*" box and click "*Save*"
- **5.** Click on the "OK" button OK to create the flow direction grid and close the dialog box.


InfoSWMM
BASE, Base Data Scenario
Table Of Contents
Layers
Raingage
Junction
Divider
Outfall
Storage
Subcatchment
Conduit
Pump
Orifice
Weir
Outlet
ned_10m
Value
High : 2040.51
Low : 1684.44
1992NLCD
SSURGO
FLOWDIRtemp
sinks
FLOW_DIR
Value
High : 199
Low : 1
Subcatchment Manager
Subcatchment Manager

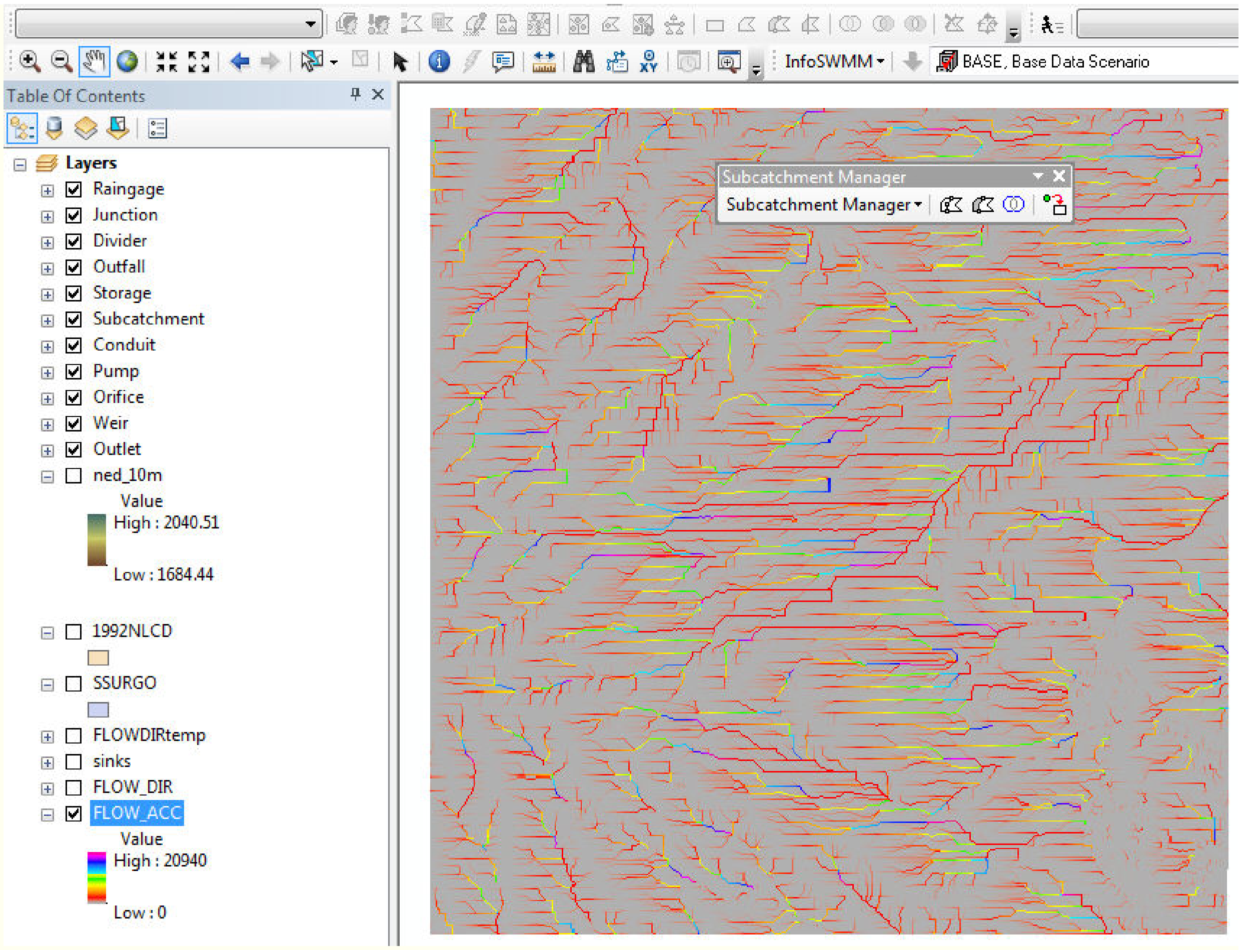
Step 6. Create Flow Accumulation Grid

- **1.** The "*Flow Accumulation Grid*" can be created from the flow direction grid. Choose *WATERSHED / CREATE FLOWACCUMULATION* from the *SUBCATCHMENT MANAGER* menu to generate the flow accumulation grid.

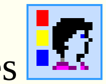


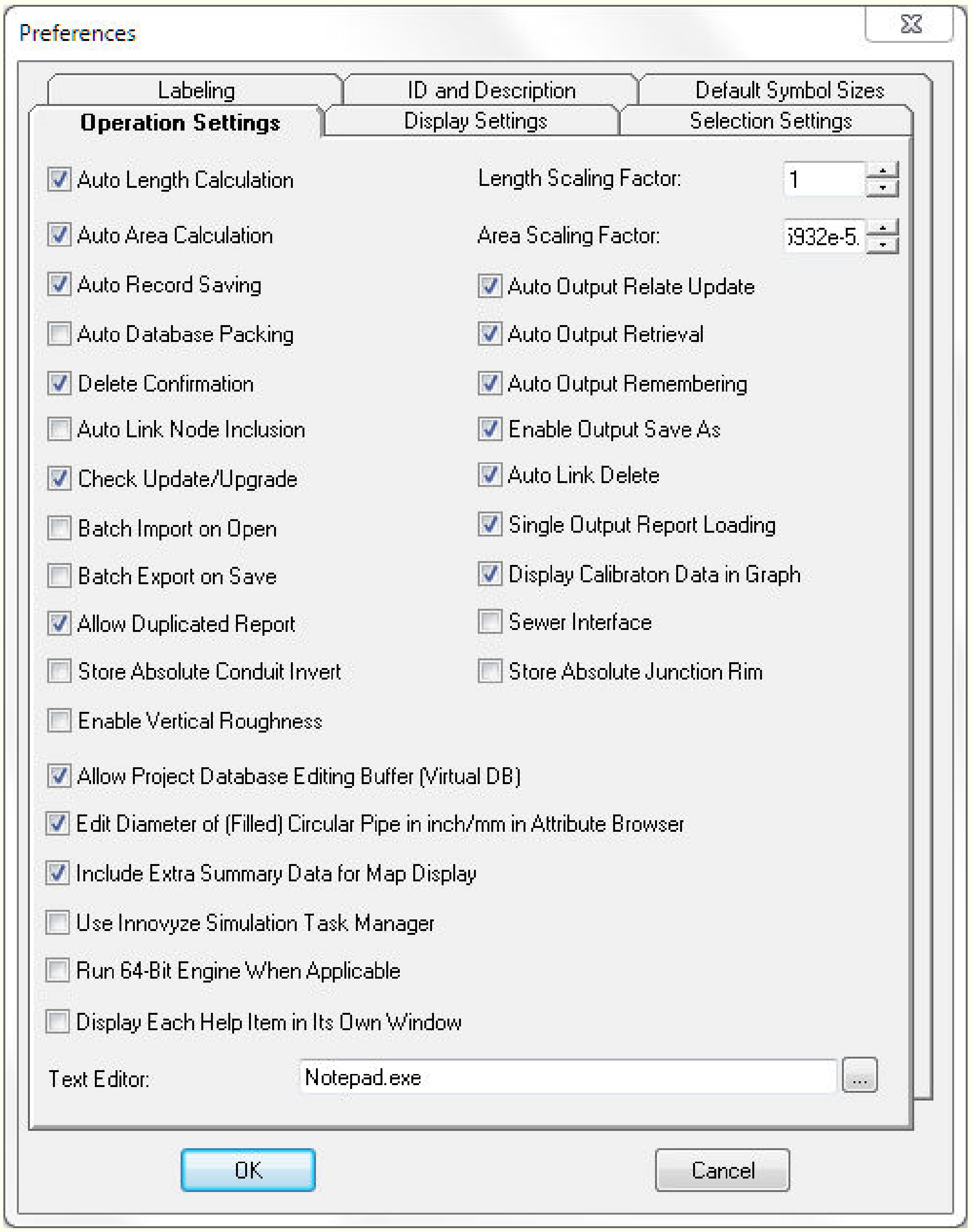
- **2.** Select "*FLOW_DIR*" for the "*Input Flow Direction Raster*"
- **3.** Click on the  icon next to *"Output Raster"*
- **4.** Type "*FLOW_ACC*" in the "*Name*" box and click "*Save*"
- **5.** Click on the "OK" button 

 to process the flow direction grid and close the dialog box.

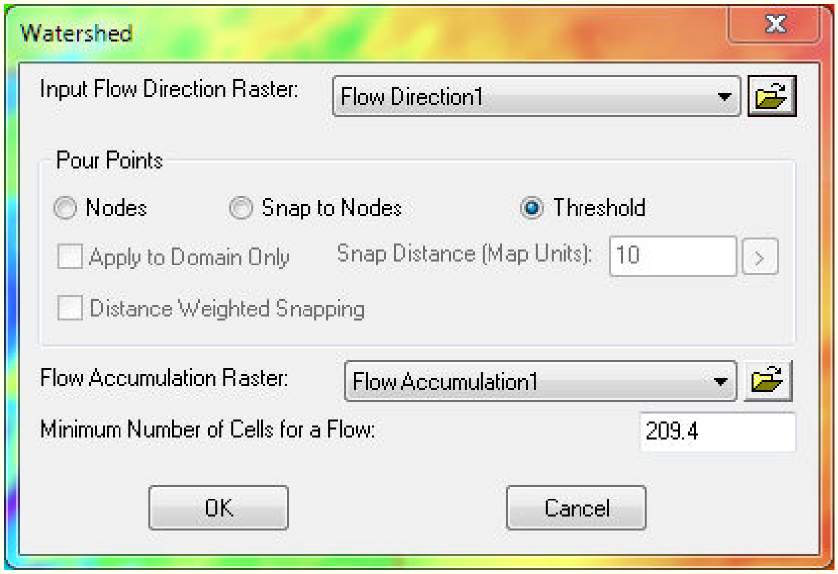

InfoSWMM
BASE, Base Data Scenario
Table Of Contents
Layers
Raingage
Junction
Divider
Outfall
Storage
Subcatchment
Conduit
Pump
Orifice
Weir
Outlet
ned_10m
Value
High : 2040.51
Low : 1684.44
1992NLCD
SSURGO
FLOWDIRtemp
sinks
FLOW_DIR
FLOW_ACC
Value
High : 20940
Low : 0
Subcatchment Manager
Subcatchment Manager

Step 7. Delineate Subcatchments

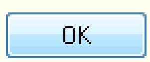
- 1. For this tutorial the Subcatchments will be created from a flow accumulation threshold. Click the InfoSWMM Project Preferences  icon from the INFOSWMM CONTROL CENTER toolbar, select the Operation Settings Tab, check Auto Length / Area Calculation, and set the Area Scaling Factor to 2.295684113865932e-5. Click OK.



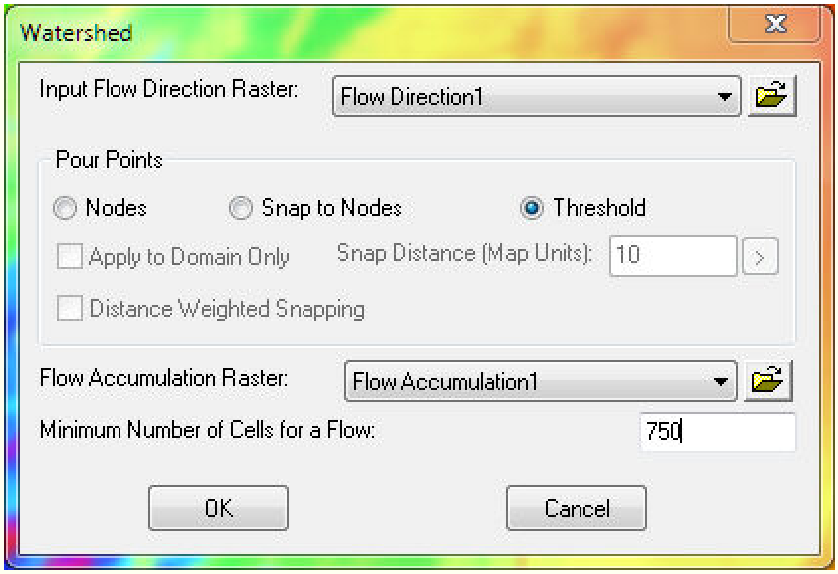
- **2.** To delineate Subcatchments, select *WATERSHED / CREATE WATERSHED* from the *SUBCATCHMENT MANAGER* menu.



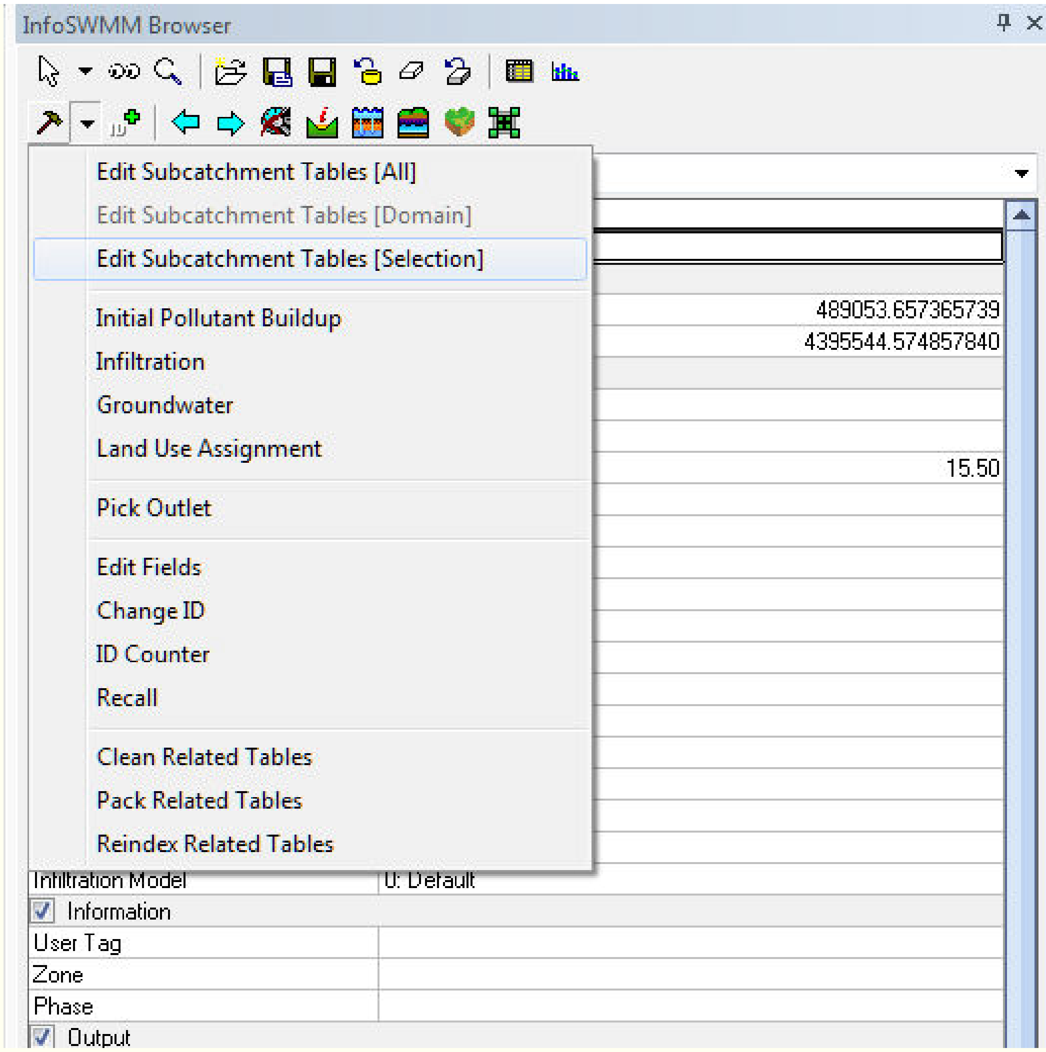
- **6.** Select "*FLOW_DIR*" for the "Input *Flow Direction Raster*" or the current Input Flow Direction you have created.
- **7.** Choose 

 for *"Pour Points"*
- **8.** Pick "*FLOW_ACC*" for the "*Flow Accumulation Raster*" or the current Flow Accumulation Raster you have created.
- **9.** Set the threshold for the *"Minimum Number of Cells for a Flow*" to 750.
- **10.** Click on the "*OK*" button 

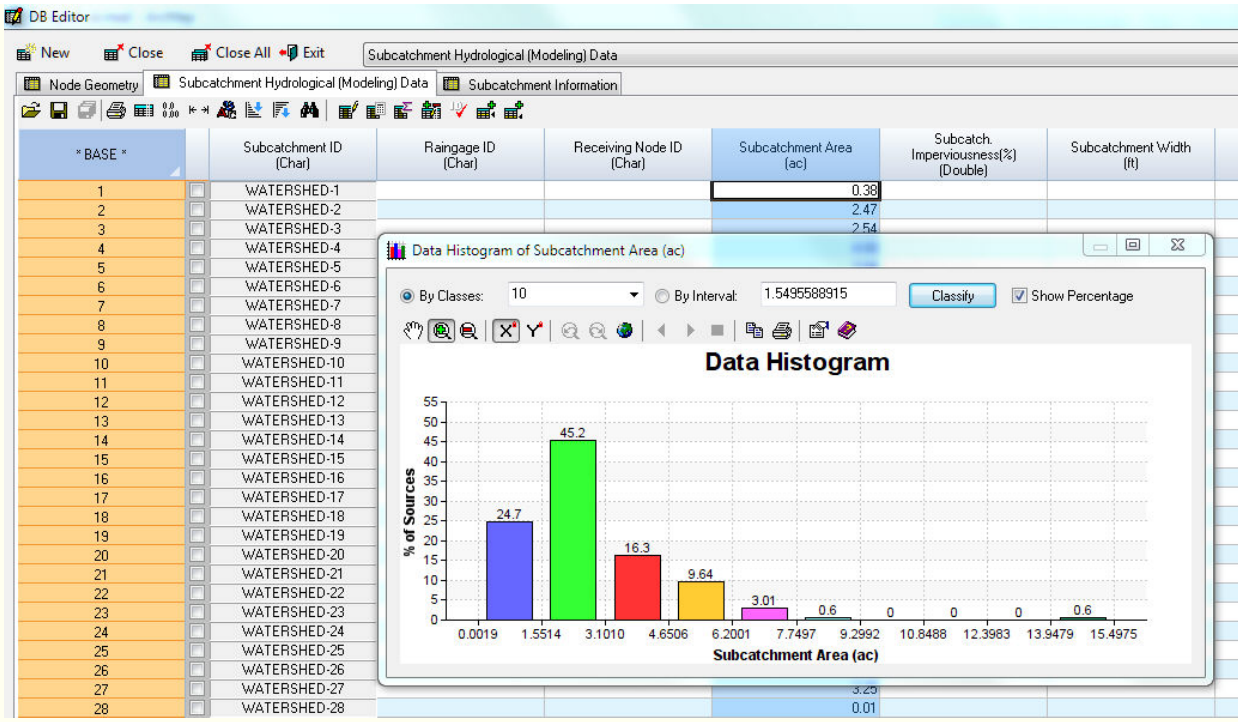
 to create Subcatchments and close the dialog box.



- **11.** You can see the areas of the created Subcatchments by using the Subcatchment Data Grid or DB Table.

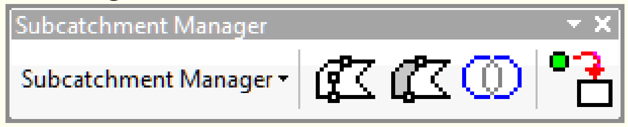


- **12.** You can see the areas of the created Subcatchments by using the Subcatchment Data Grid or DB Table and viewing the Area Data Histogram using the Right Mouse Set of Commands.



- **13.** You can also see the Areas using Map Display and selecting Subcatchment Area.

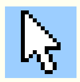
Step 8. Clean Up Subcatchments

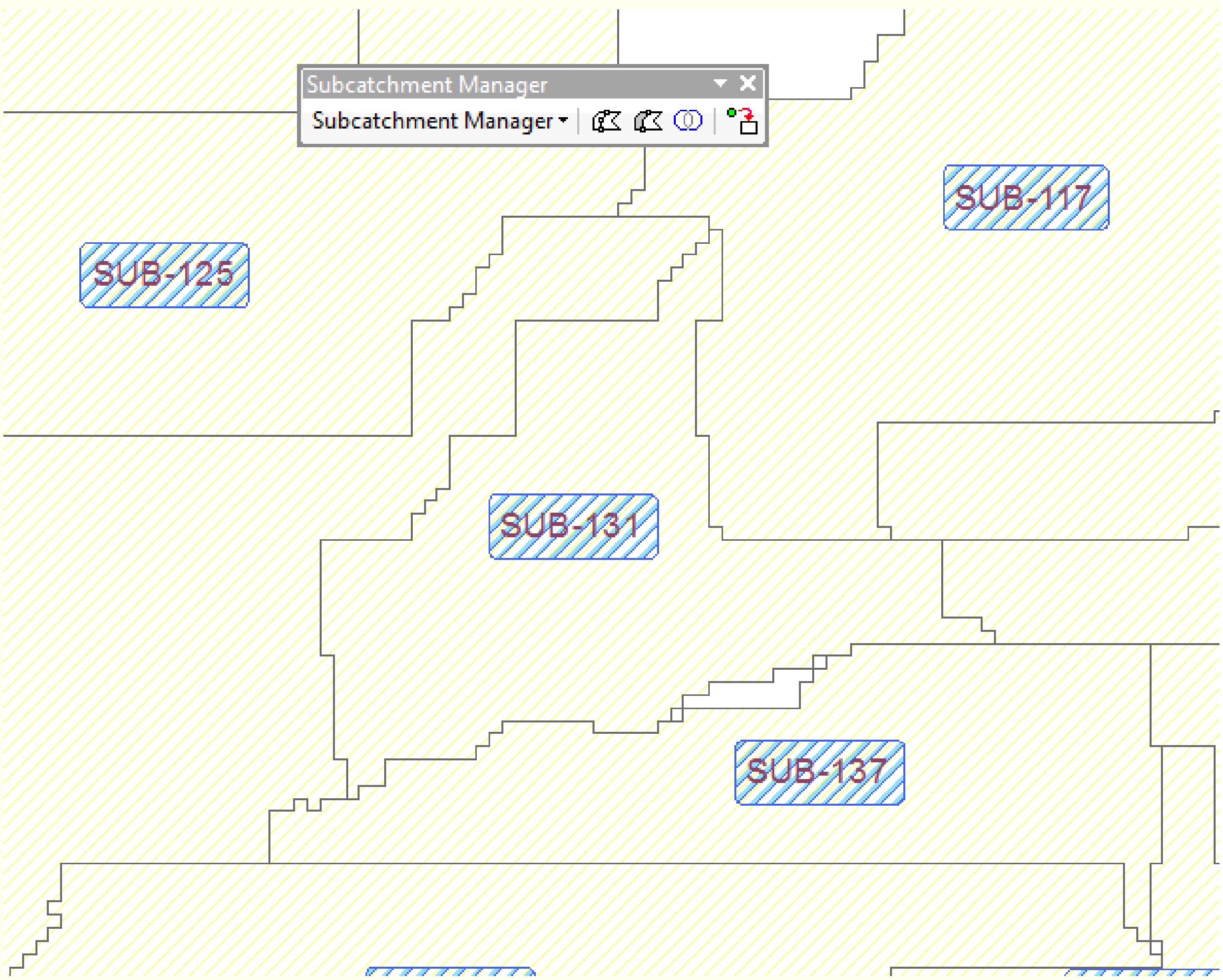
- **1.** To remove all overlapping subcatchment edges, select *CLEAN UP* from the 

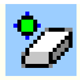
SUBCATCHMENT MANAGER menu.

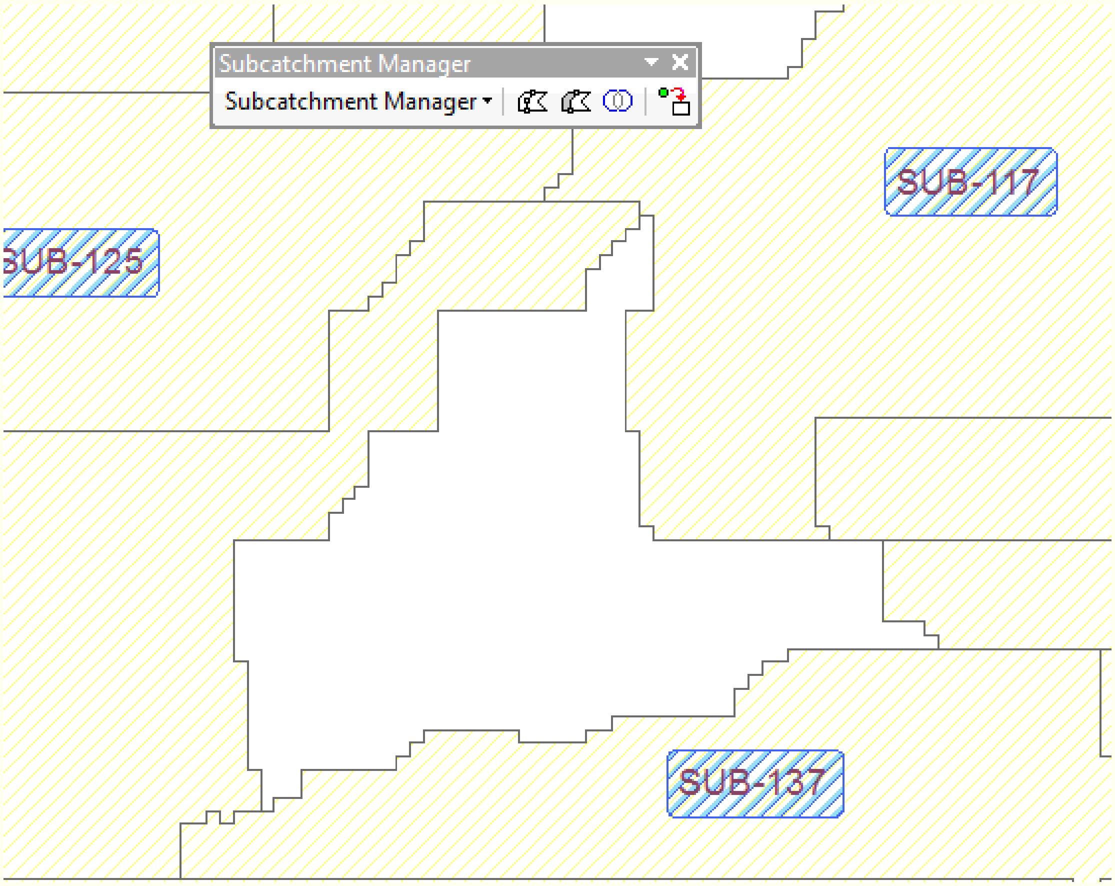
- ***2.*** From the *INFOSWMM CONTROL CENTER*, chose *INFOSWMM / UTILITIES / LOCATE / SUBCATCHMENT*

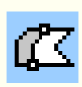
- **3.** Type SUB-131 in the *ID* box and click the "*OK*" button 

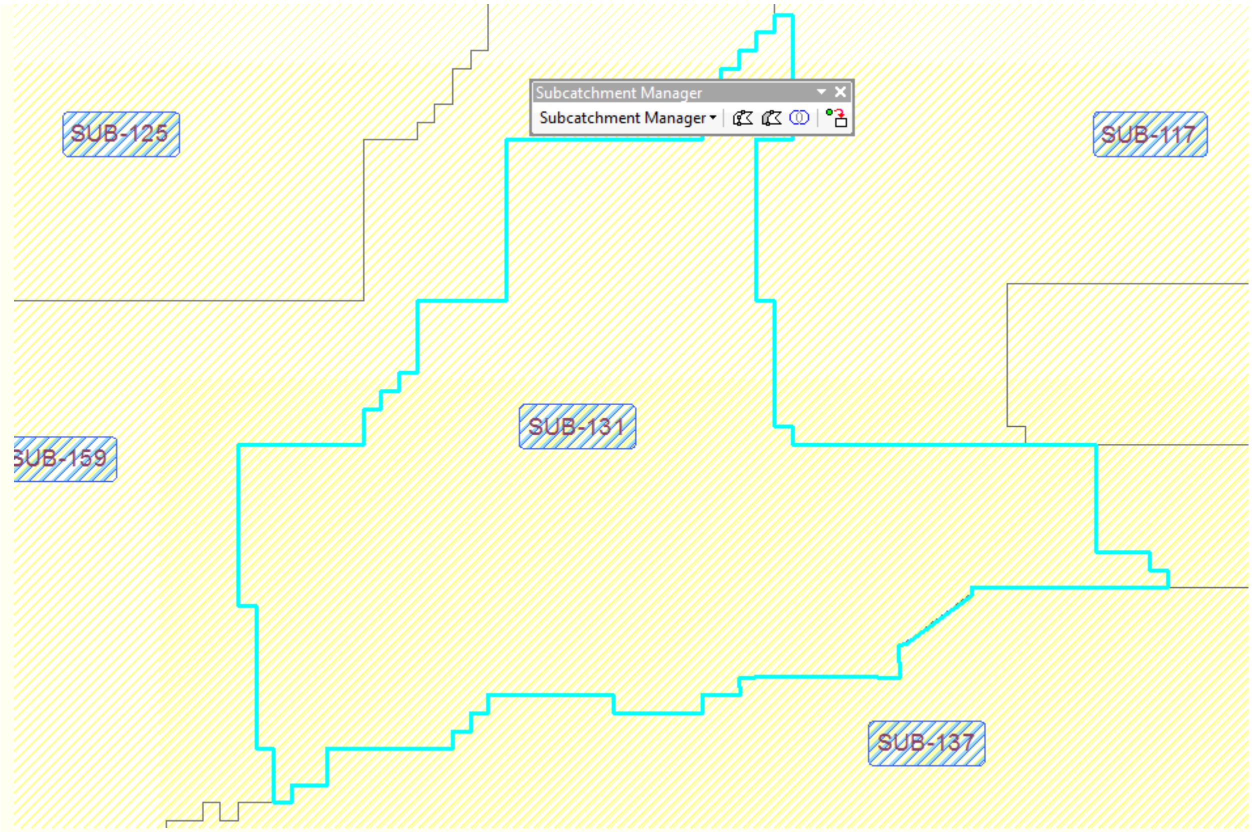
- **4.** Use the *Select Element*  Tool from the *INFOSWMM EDIT NETWORK* toolbar to find Subcatchments 128 and 146 just to the right of subcatchment 131.



- **5.** Use the *Delete Node*  icon from the *INFOSWMM EDIT NETWORK* toolbar to delete Subcatchment 131.

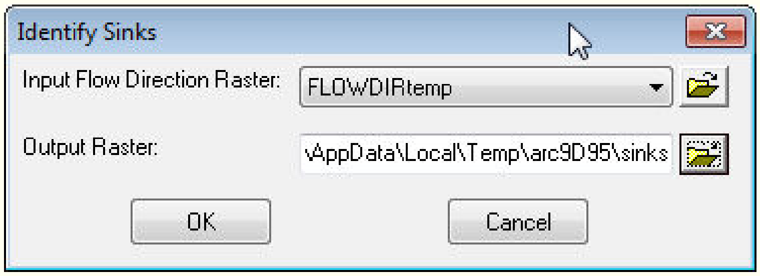


- **6.** Click the *Append Subcatchment*  icon from the *SUBCATCHMENT MANAGER* toolbar and draw a polygon around the area the deleted Subcatchments covered. Double-click to close the polygon. Notice that the new subcatchment automatically snaps to the existing edges of the surrounding Subcatchments.

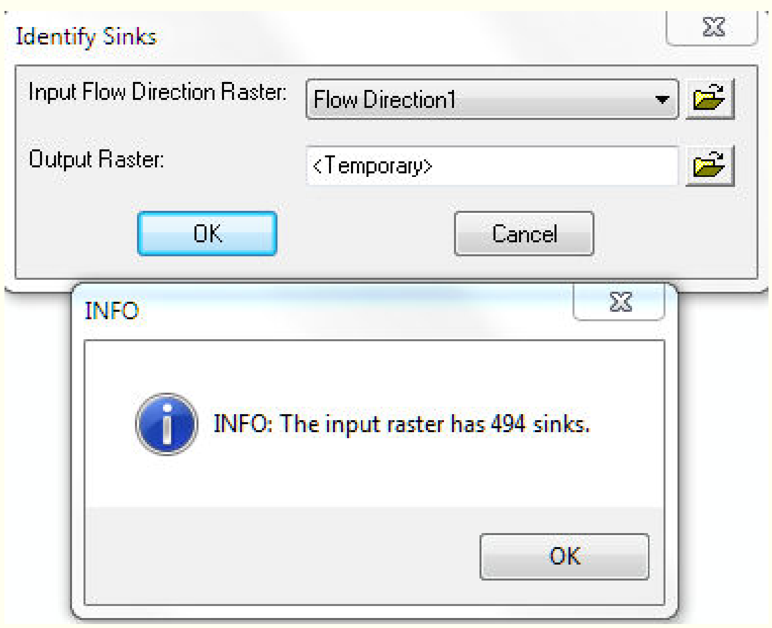

Subcatchment Manager
Subcatchment Manager
SUB-125
SUB-117
SUB-131
SUB-159
SUB-137

Step 9: Identify Sinks

- **1.** The flow direction grid is used to identify sinks. Choose *WATERSHED / IDENTIFY SINKS* from the *SUBCATCHMENT MANAGER* menu to find all sinks.



- **2.** Select "*FLOWDIRtemp*" for the "*Input Flow Direction Grid*"
- **3.** Click on the  icon next to *"Output Raster"*
- **4.** Type "sinks" in the "*Name*" box and click "*Save*"
- **5.** Click on the "OK" button  to create a sink grid and close the dialog box.



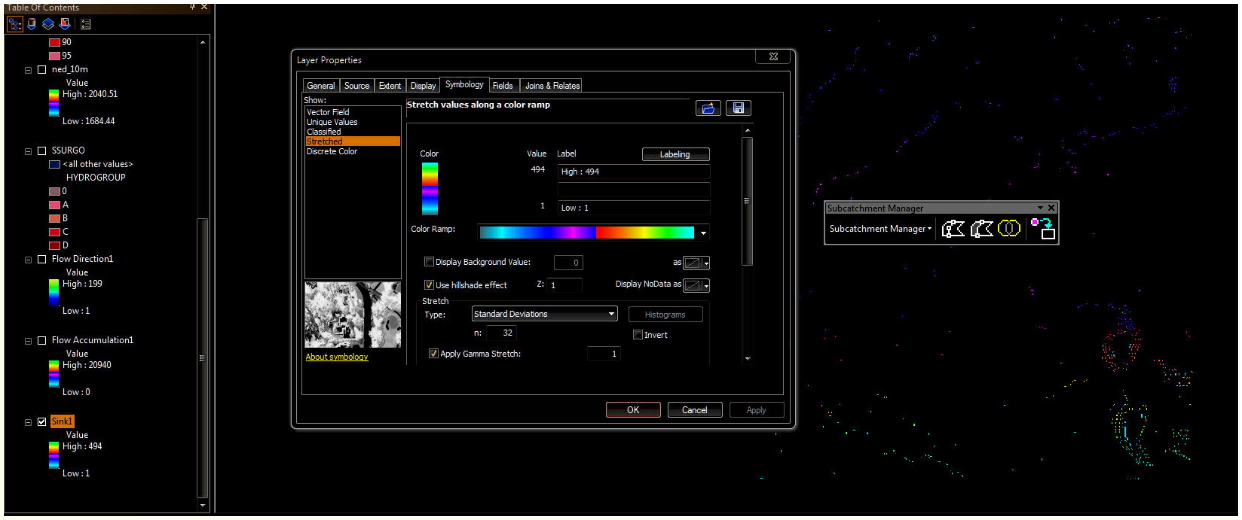
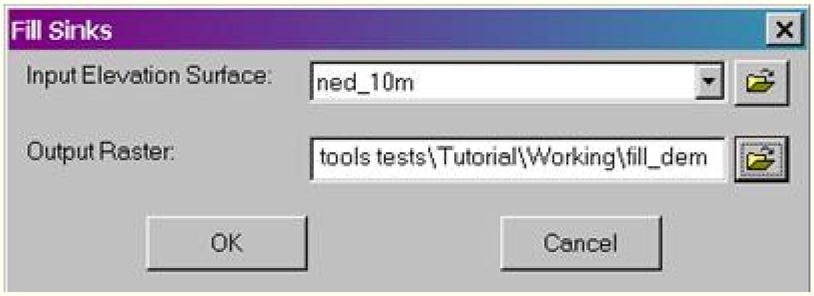


Table Of Contents
90
95
ned_10m
Value
High : 2040.51
Low : 1684.44
SSURGO
<all other values>
HYDROGROUP
0
A
B
C
D
Flow Direction1
Value
High : 199
Low : 1
Flow Accumulation1
Value
High : 20940
Low : 0
Sink1
Value
High : 494
Low : 1
Layer Properties
General
Source
Extent
Display
Symbology
Fields
Joins & Relates
Show:
Vector Field
Unique Values
Classified
Stretched
Discrete Color
Stretch values along a color ramp
Color
Value
Label
Labeling
494
High : 494
1
Low : 1
Color Ramp:
Display Background Value:
0
as
Use hillshade effect
Z:
1
Display NoData as
Stretch
Type:
Standard Deviations
Histograms
n:
32
Invert
Apply Gamma Stretch:
1
About symbology
OK
Cancel
Apply
Subcatchment Manager
Subcatchment Manager

Step 10: Fill Sinks

- **1.** The DEM is modified when filling sinks. Choose *WATERSHED / FILL SINKS* from the *SUBCATCHMENT MANAGER* menu to fill all sinks.



- **2.** Select "*ned_10m*" for the "*Input Elevation Surface*"
- **3.** Click on the icon next to *"Output Raster"*
- **4.** Type "*fill_dem*" in the "*Name*" box and click "*Save*"
- **5.** Click on the "OK" button OK to produce a DEM without sinks and close the dialog box.

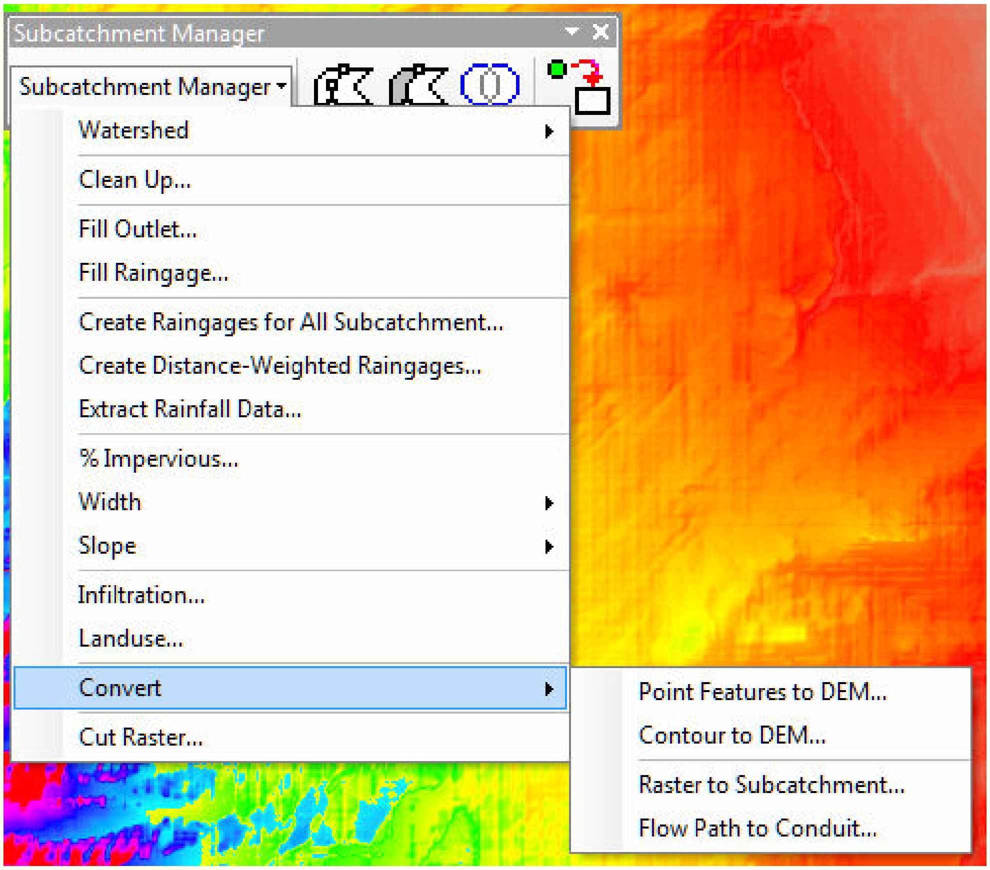
Note: If you get a error message in the InfoSWMM Message dialog please ignore for now as you can make the watersheds without the Fill Sink command.

ERROR 010067: Error in executing grid expression.

Step 11: Allocate Subcatchment Data

Step 11: Allocate Subcatchment Data

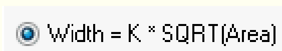
Subcatchment parameters must be assigned after the Subcatchments have been generated. Characteristics assigned in this Tutorial include Slope, width, infiltration, land use, % Impervious, and Raingages.



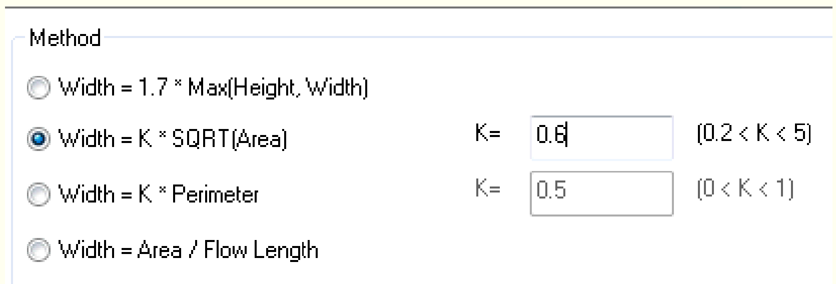
Subcatchment Manager
Subcatchment Manager
Watershed
Clean Up...
Fill Outlet...
Fill Raingage...
Create Raingages for All Subcatchment...
Create Distance-Weighted Raingages...
Extract Rainfall Data...
% Impervious...
Width
Slope
Infiltration...
Landuse...
Convert
Cut Raster...
Point Features to DEM...
Contour to DEM...
Raster to Subcatchment...
Flow Path to Conduit...

Step 12. Calculate Subcatchment Width

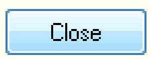
Step 12. Calculate Subcatchment Width

- **1.** Choose *WIDTH / CALCULATE SUBCATCHMENT WIDTH* from the *SUBCATCHMENT MANAGER* menu to assign subcatchment width to each subcatchment.
- **2.** Select 

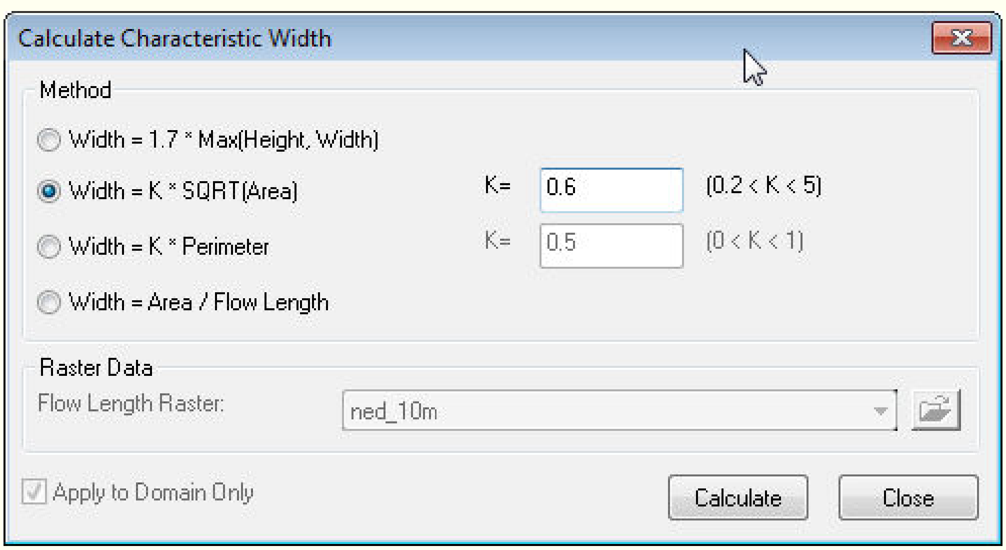
for the "Method"



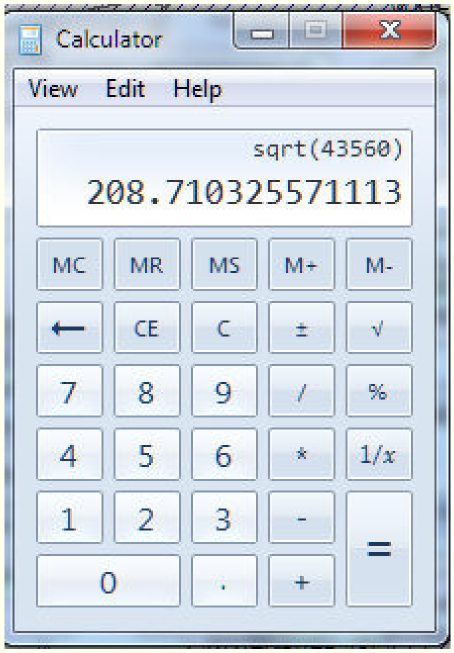
- **3.** Set K equal to 0.6
- **4.** Click on the "*Calculate*" 

button to assign width to each Subcatchment
- **5.** Click on the "*Close*" button 

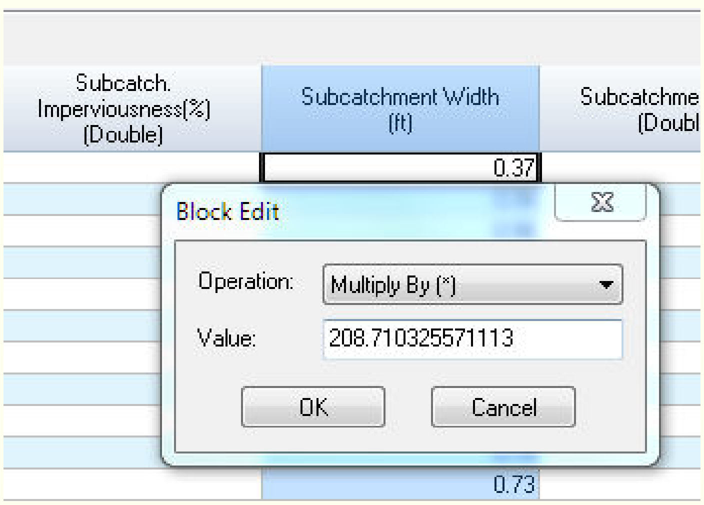
to close the calculate characteristic width dialog box. The Subcatchments now have widths in feet as you can see in the Attribute Browser or the DB Tables. The width as calculated is based on the area in sqquare meters or square feet. The width needs to be altered by the square root of either 10,000 or 43,560 depending on the units (USA or SI)



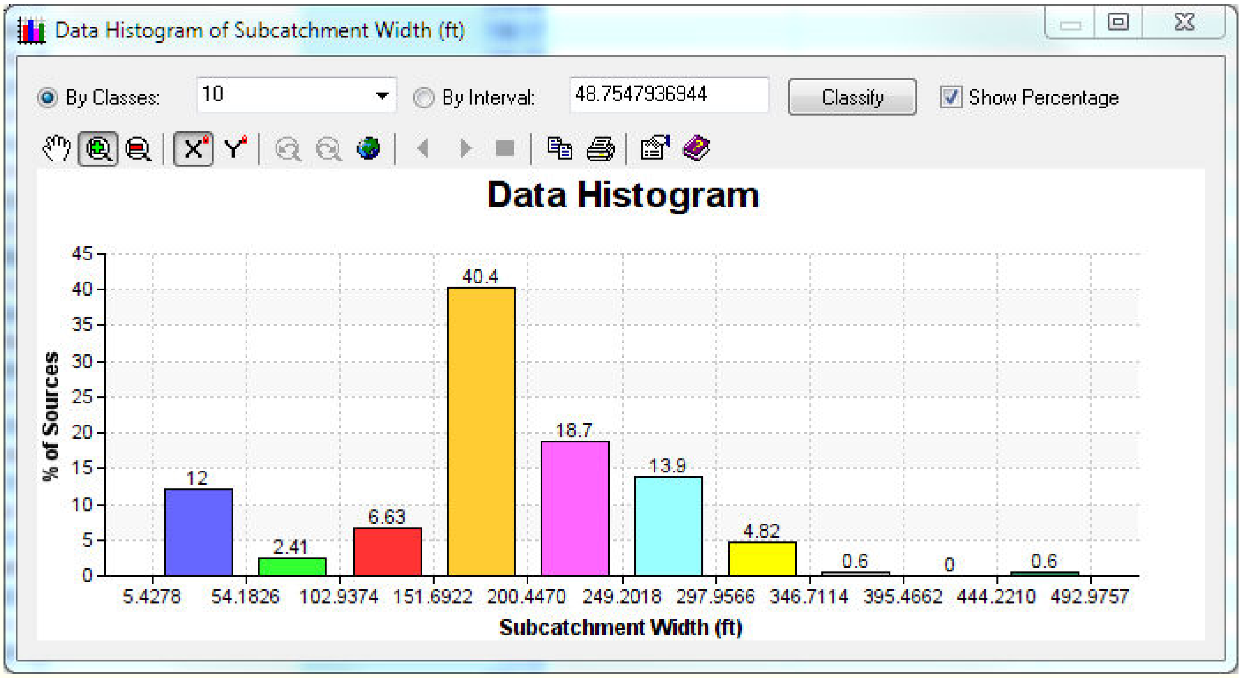
- **6.** The width needs to be altered by the square root of either 10,000 or 43,560 depending on the units (USA or SI).



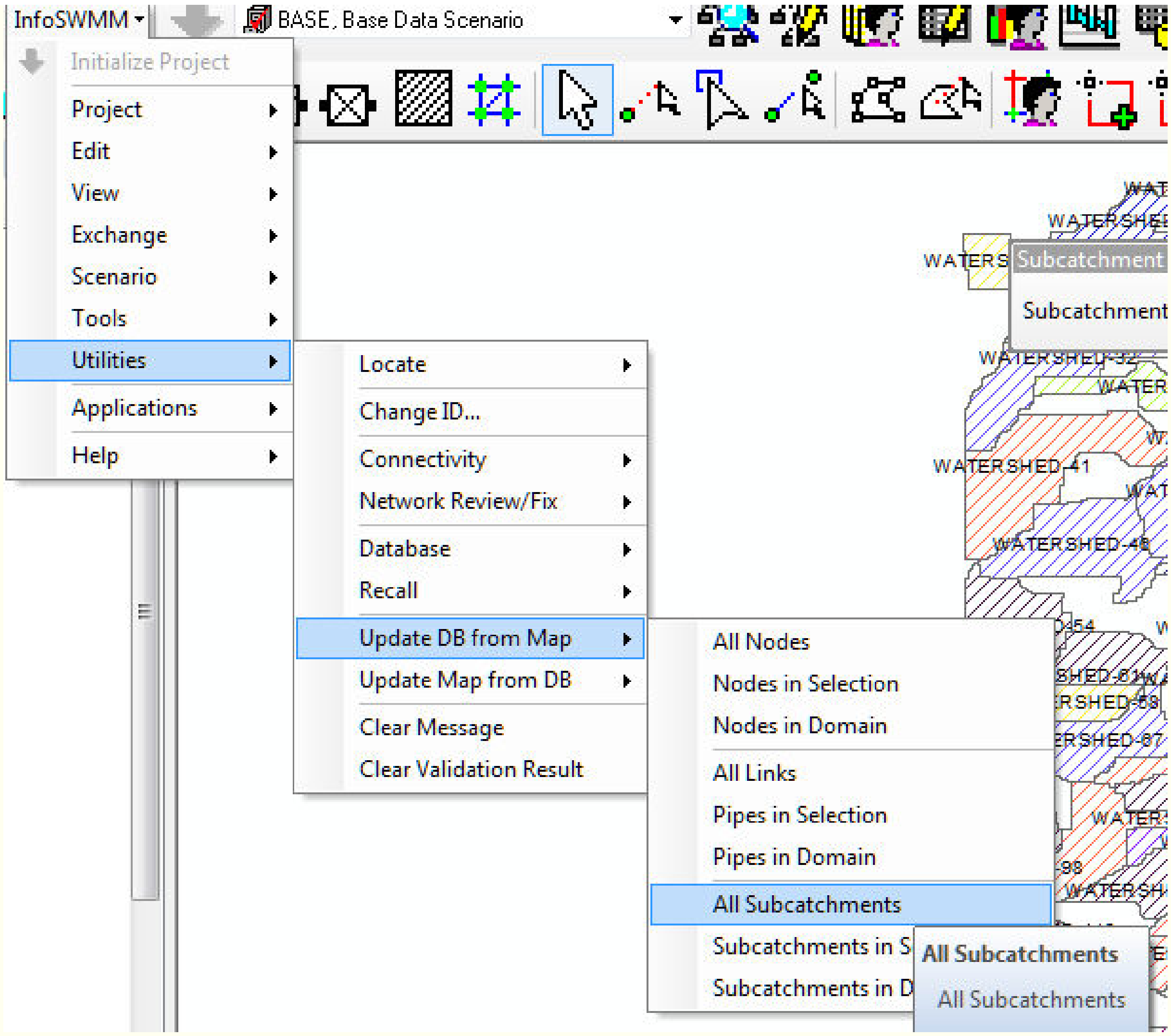
- **7.** Use the DB editor to alter the Width by the square root of either 10,000 or 43,560 depending on the units (USA or SI)



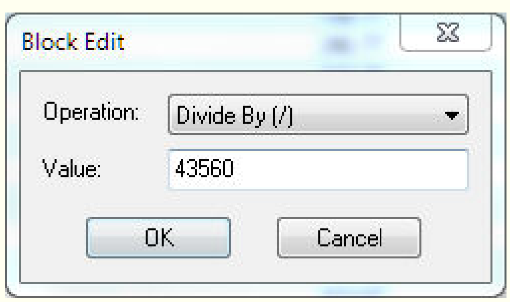
- **8.** Use the Right Mouse Click to pick the Option for viewing the Width Data Histogram.



- **9.** Whatever the units of the area of the Subcatchments they can be changed easily by using the Tool Update DB from Map.



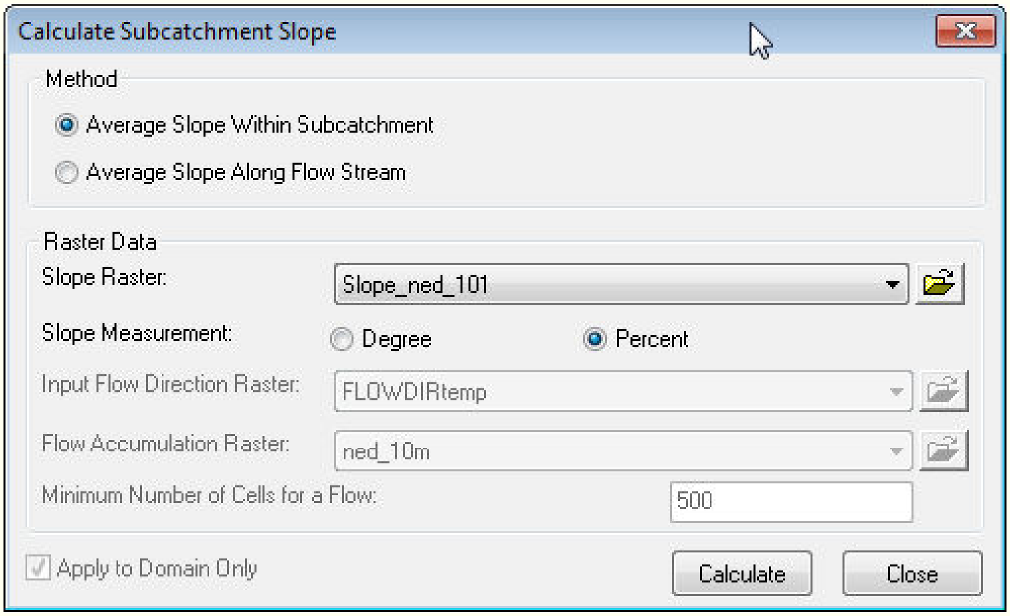
- **10.** Or they can be changed using the Block Edit tool in the DB Tables for the Subcatchment Area.

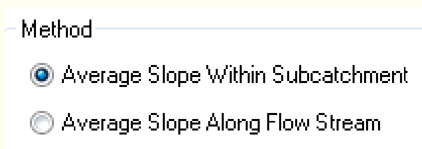


Step 13. Calculate Subcatchment Slope

Step 13. Calculate Subcatchment Slope

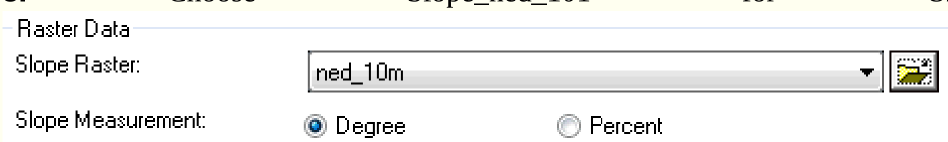
1. Select *SLOPE / CALCULATE SUBCATCHMENT SLOPE* from the *SUBCATCHMENT MANAGER* menu to create the slope grid.



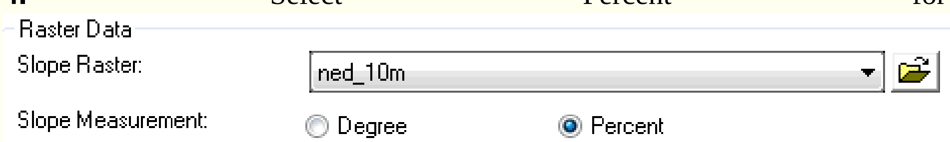
2. Select 

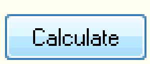
for the "*Method*"

3. Choose "Slope_ned_101" for "*Slope* *Raster*"

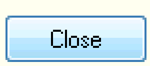


4. Select Percent for the

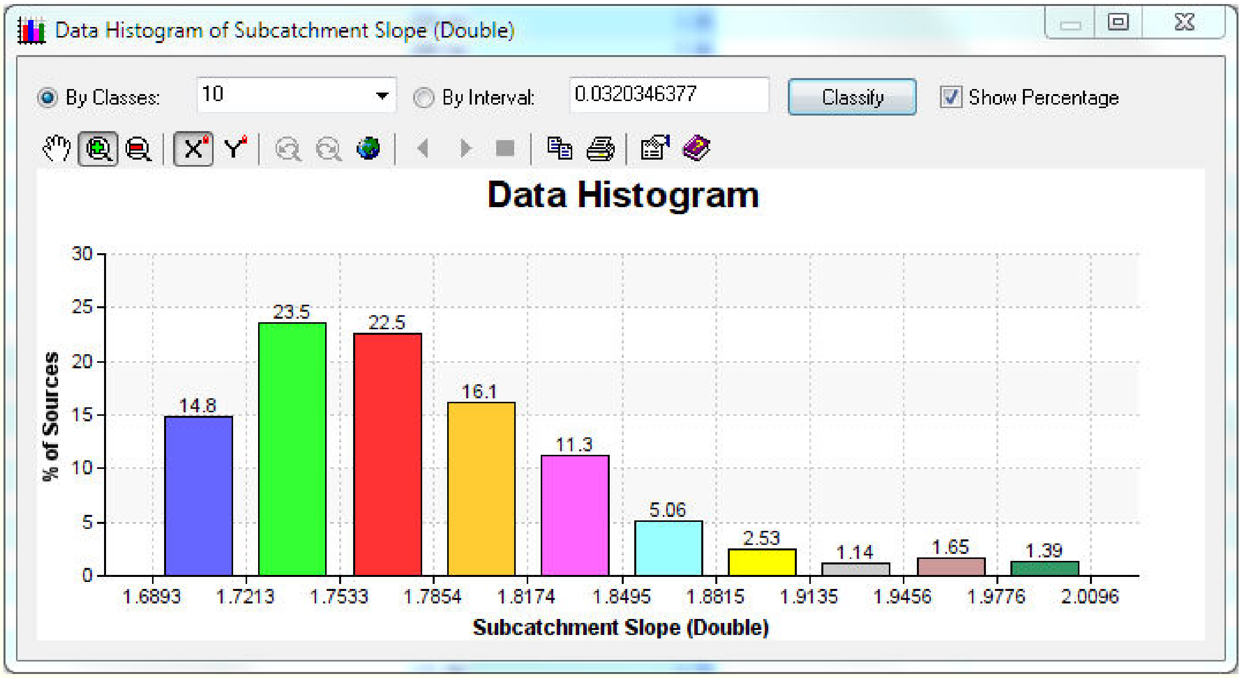


5. Click on the "*Calculate*" 

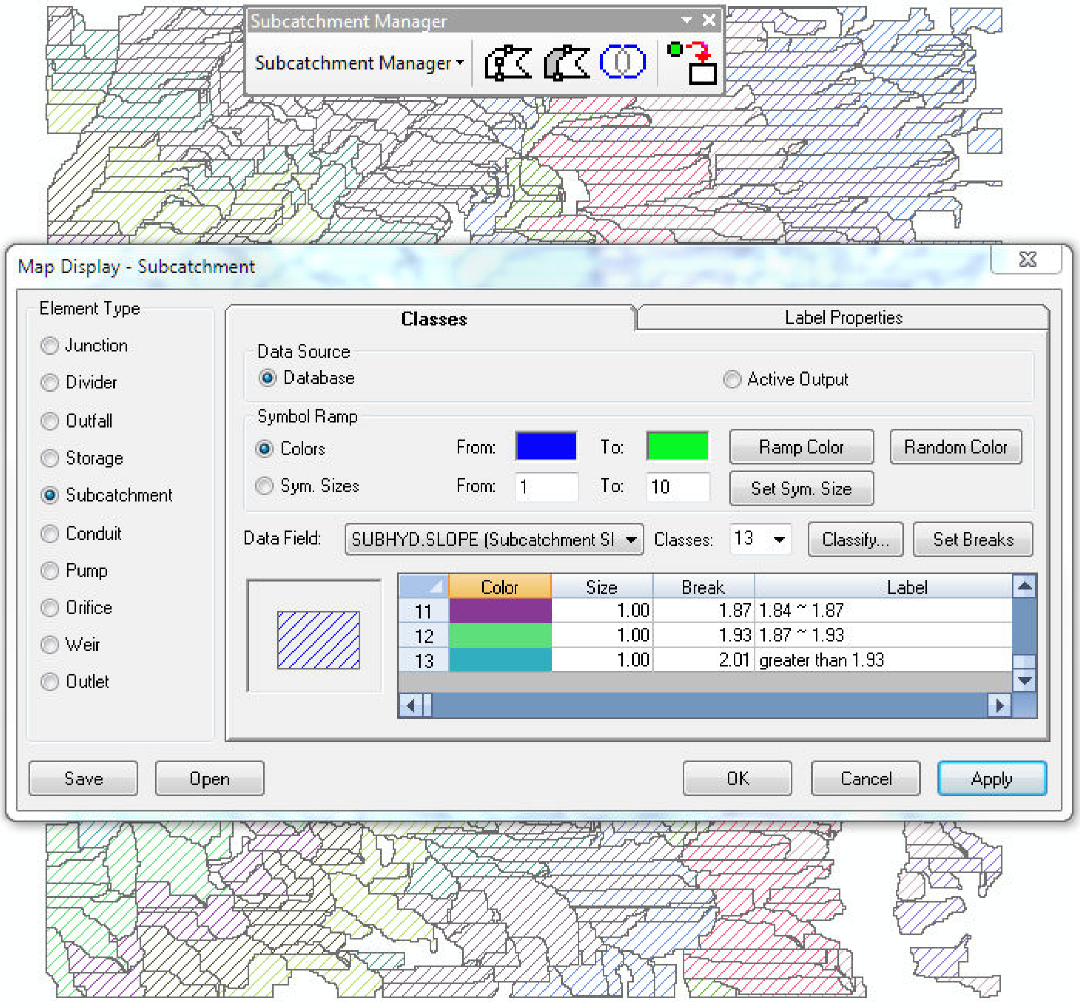
button to assign slope to each Subcatchment

6. Click on the "*Close*" button 

to close the calculate Subcatchment slope dialog box. The Subcatchments now have slopes in percent as you can see in the Attribute Browser or the DB Tables. You can use the Right Mouse click and plot the Data Histogram.

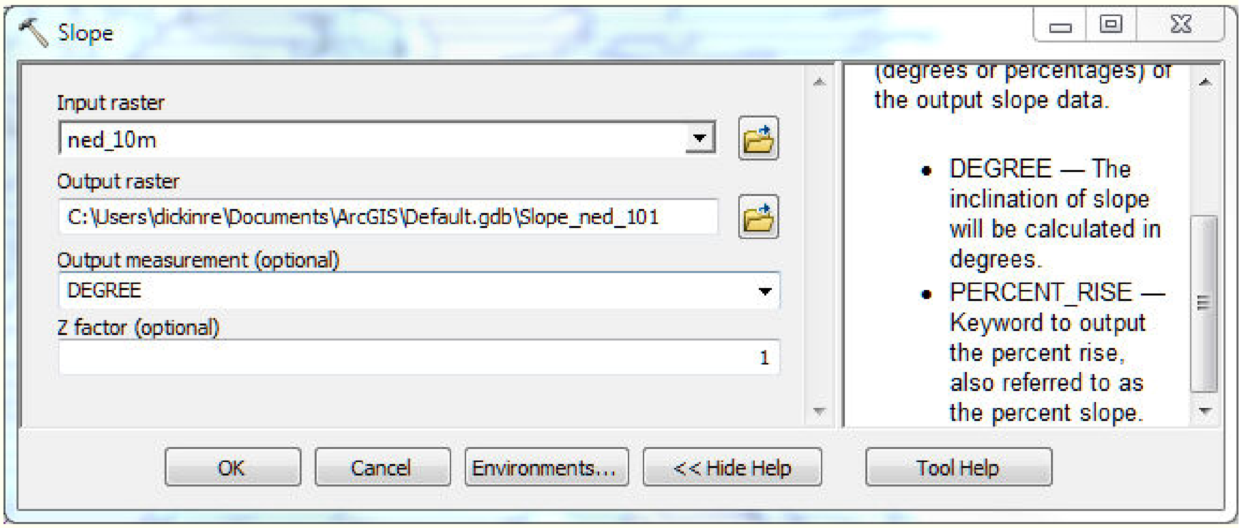


7. Map display of slope.


Subcatchment Manager
Subcatchment Manager
Map Display - Subcatchment
Element Type
Junction
Divider
Outfall
Storage
Subcatchment
Conduit
Pump
Orifice
Weir
Outlet
Classes
Label Properties
Data Source
Database
Active Output
Symbol Ramp
Colors
From:
To:
Ramp Color
Random Color
Sym. Sizes
From: 1
To: 10
Set Sym. Size
Data Field: SUBHYD.SLOPE (Subcatchment Sl
Classes: 13
Classify...
Set Breaks
Color Size Break Label
11 1.00 1.87 1.84 ~ 1.87
12 1.00 1.93 1.87 ~ 1.93
13 1.00 2.01 greater than 1.93
Save
Open
OK
Cancel
Apply

Step 10. Generate a Slope Grid

1. A slope raster must be generated from the DEM prior to assigning slope. Choose *SLOPE / DEM TO SLOPE* from the *SUBCATCHMENT MANAGER* menu to create the slope grid.



2. Select “ned_10m” for the “Input *surface*”

3. Choose 

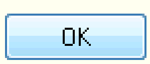
for *“Output Measurement”*

4. Set the *“Z factor*” to 1 because the horizontal and vertical units match.

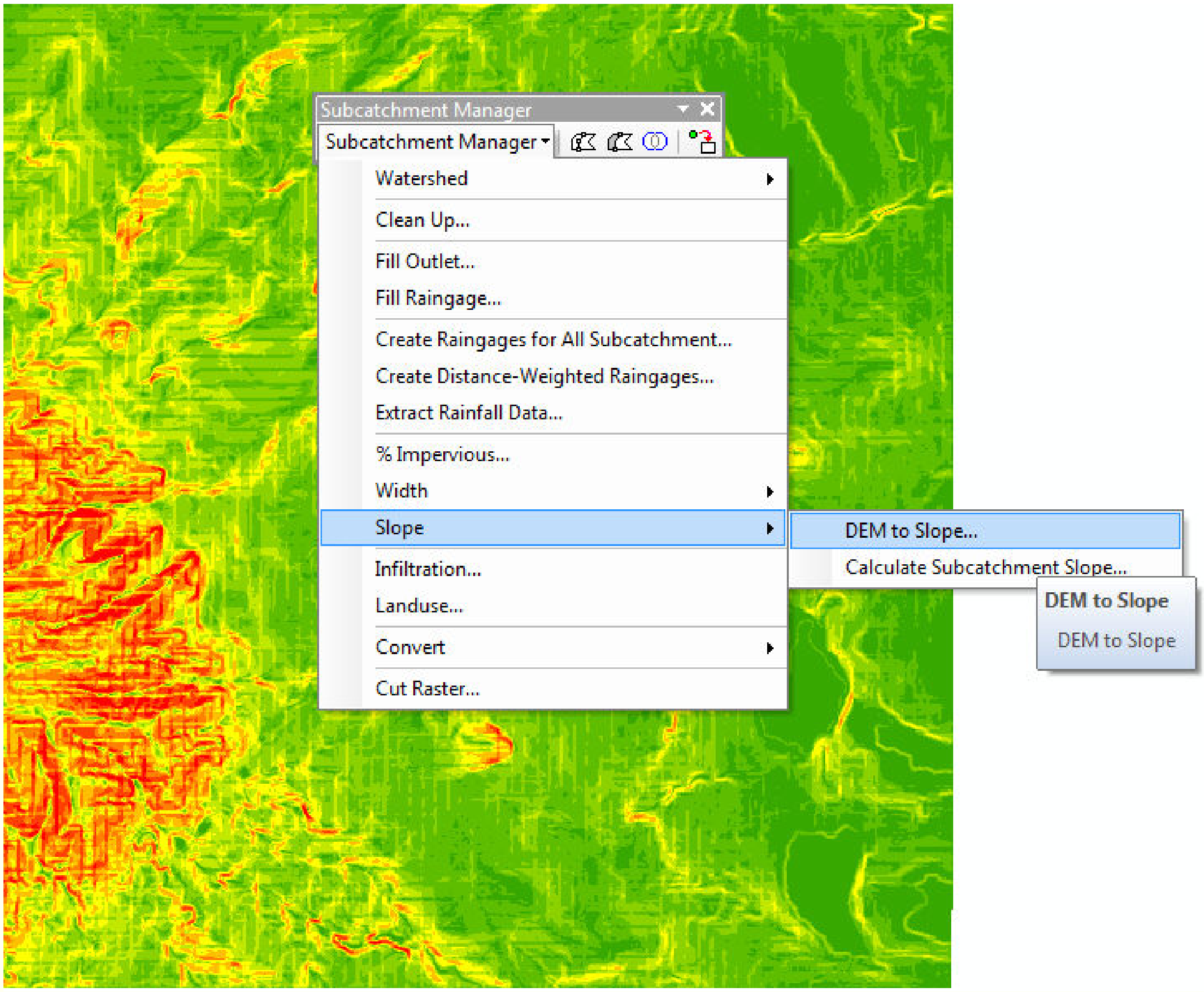
5. Accept the default for *“Output cell size*”.

6. Click on the  icon next to *“Output Raster”*

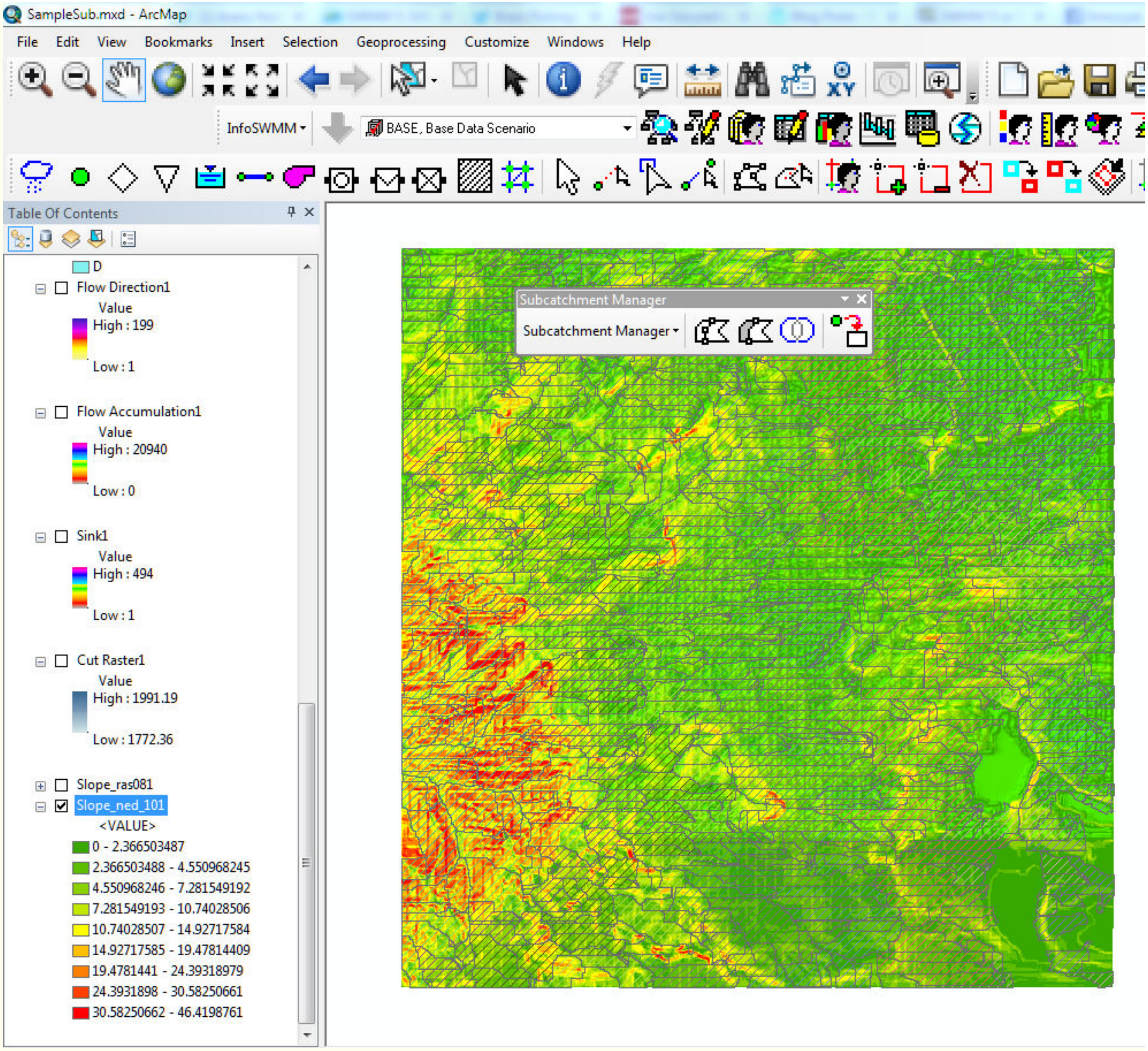
7. Type “Slope_ned_101” in the “*Name*” box and click “*Save*”

8. Click on the “*OK*” button 

to create the slope raster and close the dialog box.

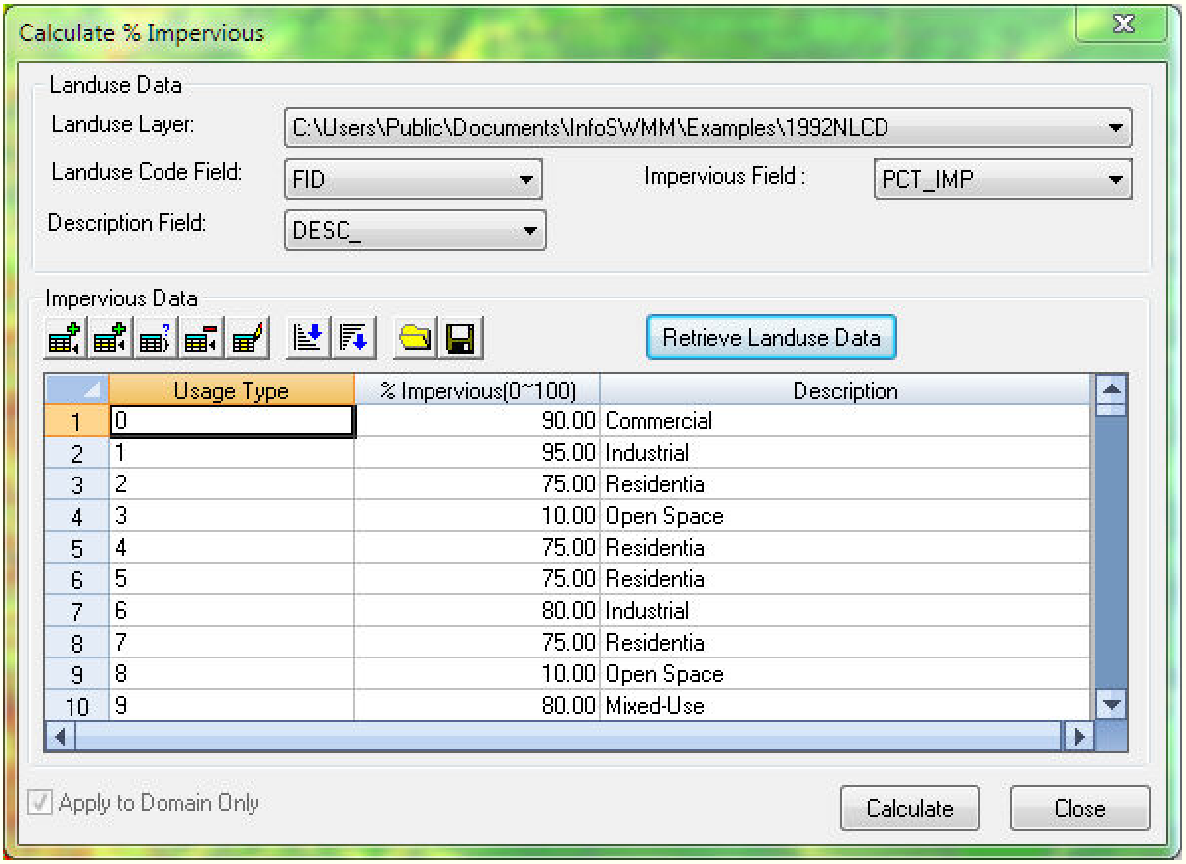


9. The created output slope raster.


SampleSub.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
InfoSWMM
BASE, Base Data Scenario
Table Of Contents
D
Flow Direction1
Value
High : 199
Low : 1
Flow Accumulation1
Value
High : 20940
Low : 0
Sink1
Value
High : 494
Low : 1
Cut Raster1
Value
High : 1991.19
Low : 1772.36
Slope_ras081
Slope_ned_101
<VALUE>
0 - 2.366503487
2.366503488 - 4.550968245
4.550968246 - 7.281549192
7.281549193 - 10.74028506
10.74028507 - 14.92717584
14.92717585 - 19.47814409
19.4781441 - 24.39318979
24.3931898 - 30.58250661
30.58250662 - 46.4198761
Subcatchment Manager
Subcatchment Manager

Step 11. Assign % Impervious

1. Select *% IMPERVIOUS* from the *SUBCATCHMENT MANAGER* menu to allocate impervious percentages to each Subcatchment.



2. Select "*1992NLCD.shp*" for the "*Landuse Layer*"

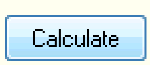
3. Select "*GRIDCODE*" for the "*Landuse Code Field*"

4. Select "*DESC_*" for the "*Description Field*"

5. Select "*PCT_IMP*" for the "*Impervious Field*"

6. Click on the "*Retrieve Landuse Data*" 

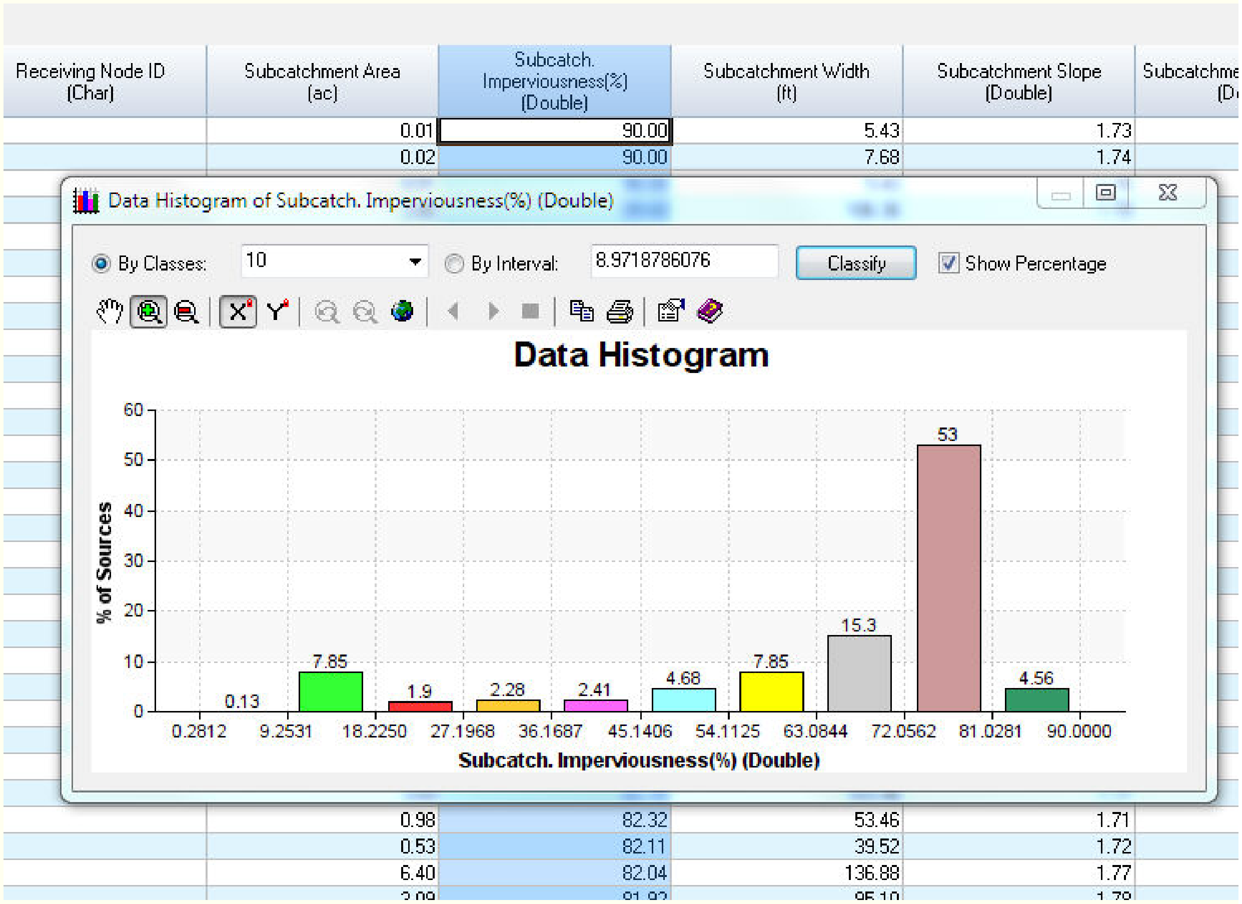
button to populate the "*Impervious Data*" Table.

7. Click on the "*Calculate*" 

button to allocate % Impervious to each subcatchment

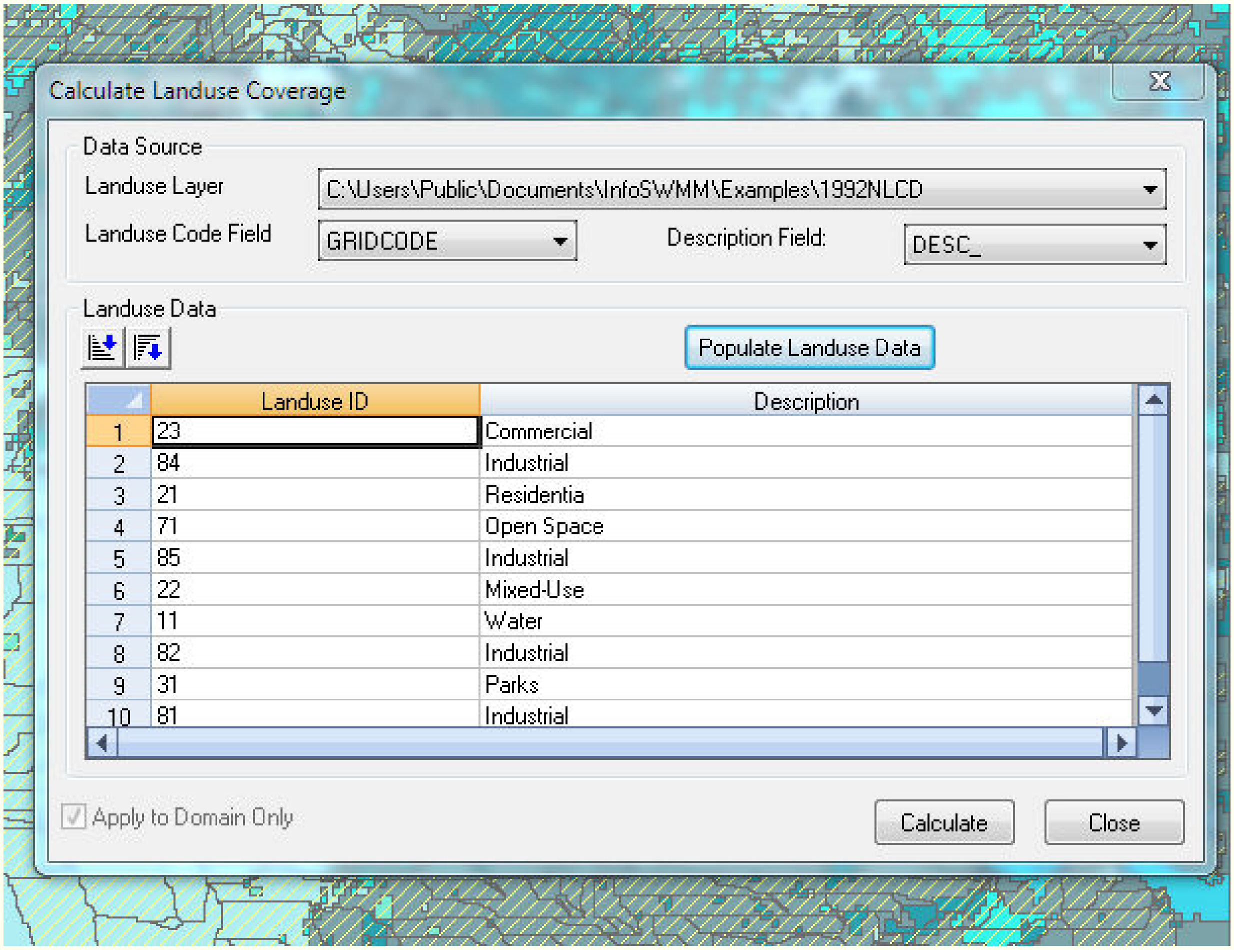
8. Click on the "*Close*" button 

to close the calculate % Impervious dialog box. The Subcatchments now have impervious values in percent as you can see in the Attribute Browser or the DB Tables.



Step 12. Assign Land Use

1. Select *LANDUSE* from the *SUBCATCHMENT MANAGER* menu to allocate Landuse Coverages to each Subcatchment.



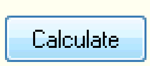
2. Select *"1992NLCD.shp"* for the *"Landuse Layer"*

3. Select *"GRIDCODE"* for the *"Landuse Code Field"*

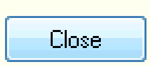
4. Select *"DESC_"* for the *"Description Field"*

5. Click on the "*Populate Landuse Data*" 

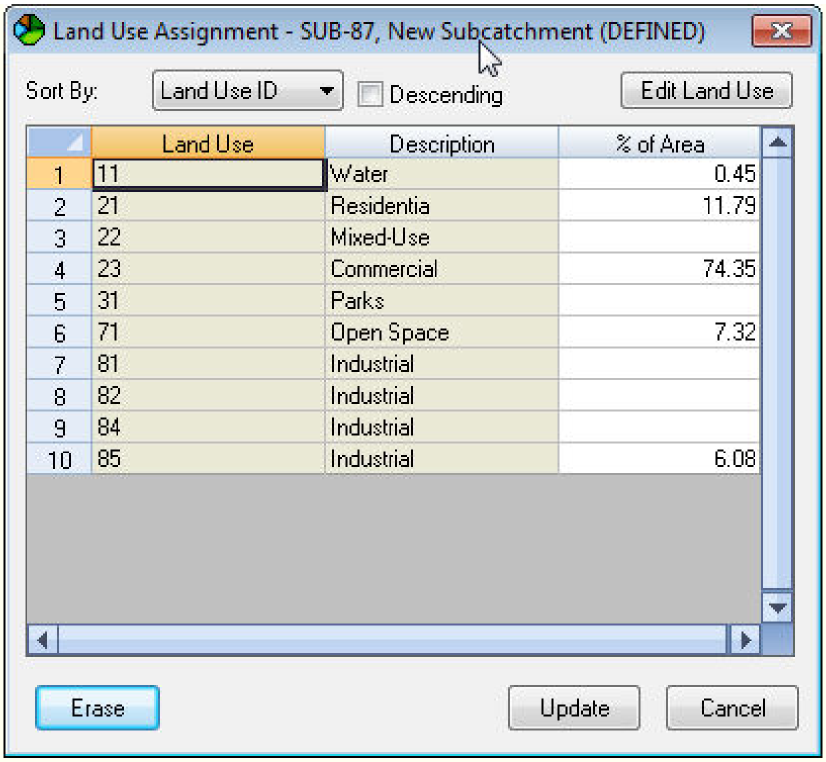
button to populate the "*Landuse Data*" Table.

6. Click on the "*Calculate*" 

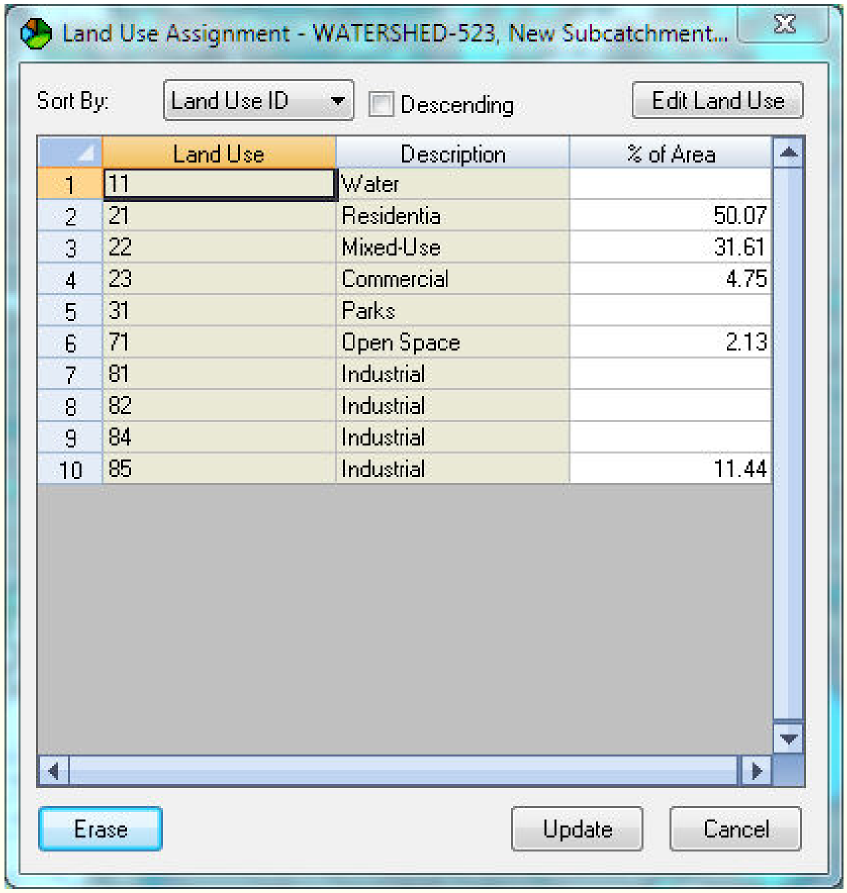
button to allocate Landuse to each subcatchment

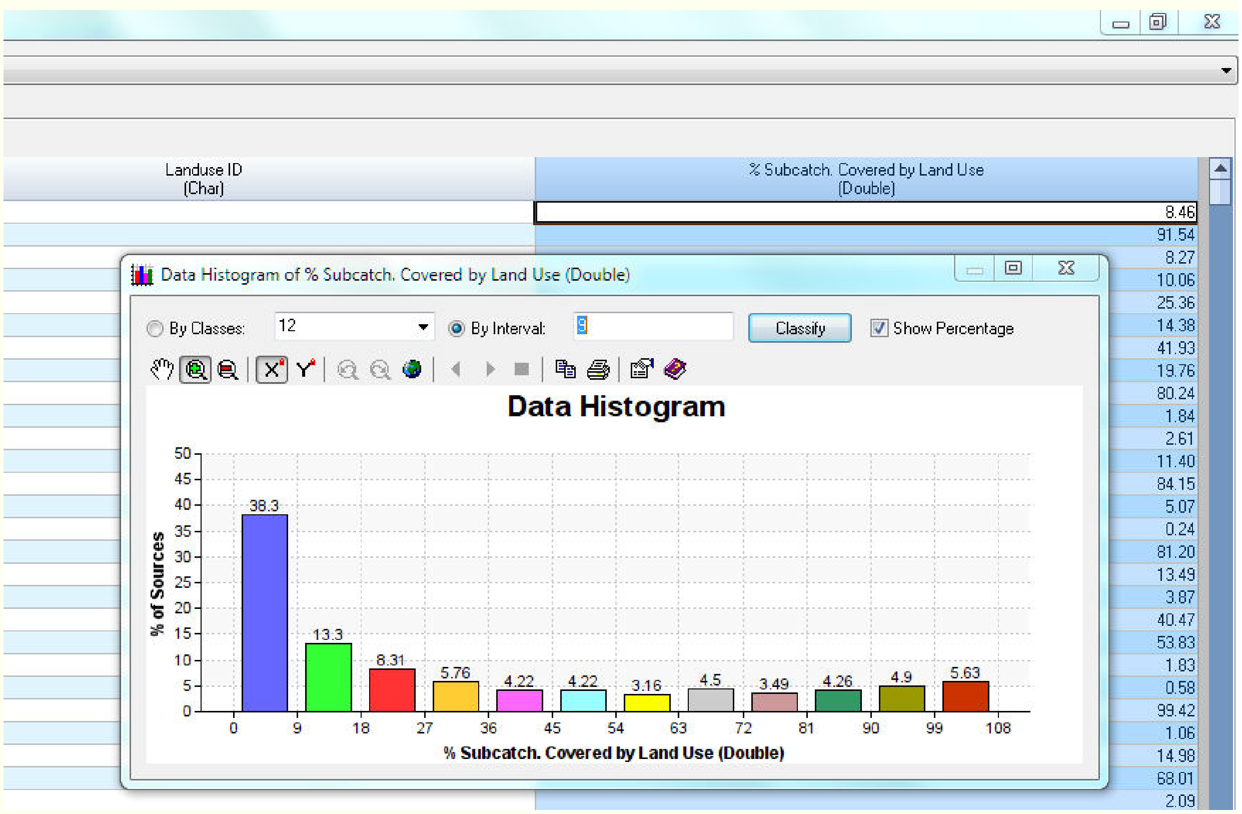
7. Click on the "*Close*" button 

to close the calculate Landuse Coverage dialog box.



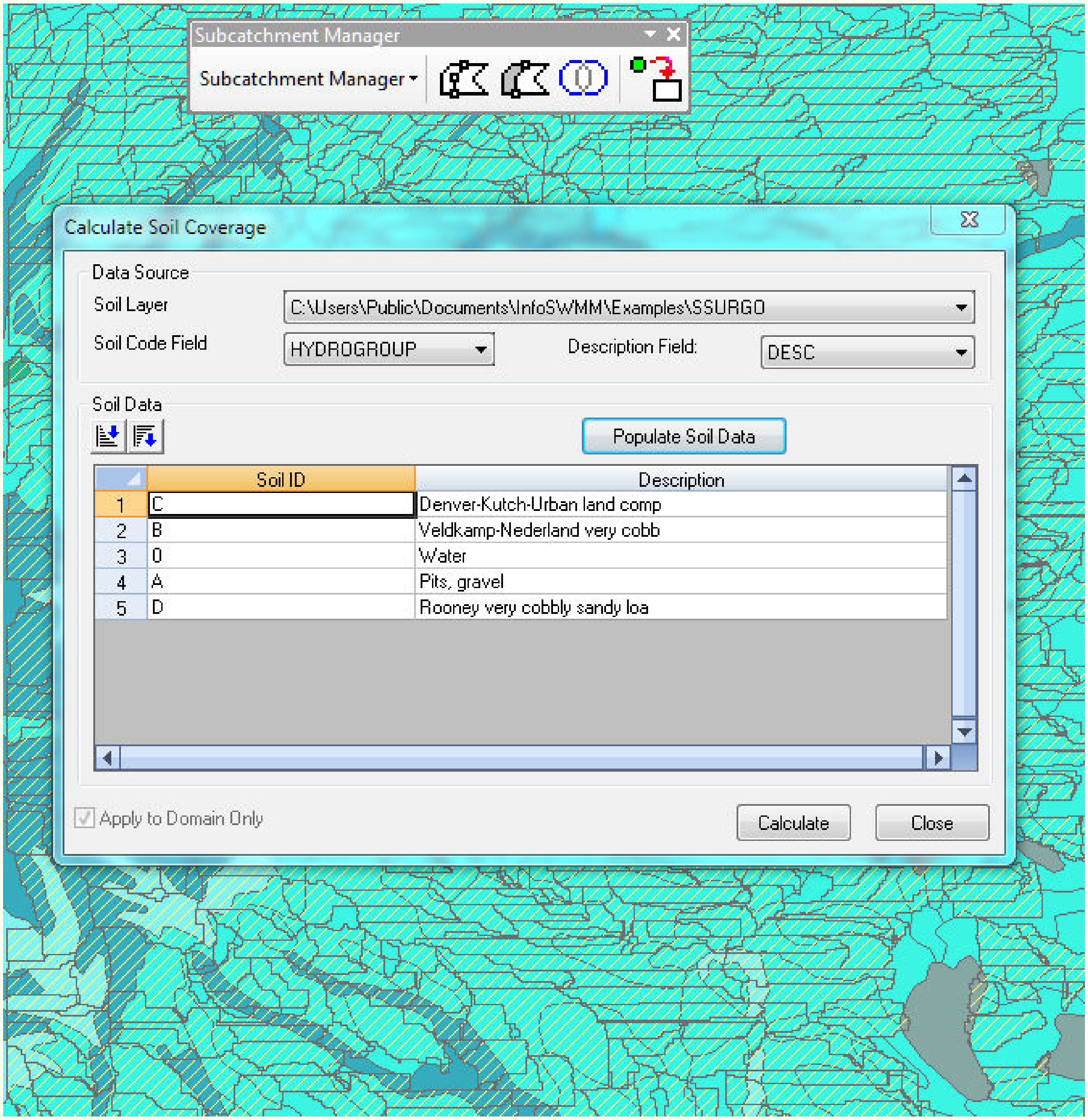
8. Each Subcatchment now has the proper land use. You can see the land use by clicking on the Land Use Icon in the Attribute Browser (AB) or by viewing the DB table Subcatchment Landuse Coverage Subcatchment Landuse Coverage.


Land Use Assignment - WATERSHED-523, New Subcatchment...
Sort By:
Land Use ID
Descending
Edit Land Use
Land Use
Description
% of Area
1 11 Water
2 21 Residentia 50.07
3 22 Mixed-Use 31.61
4 23 Commercial 4.75
5 31 Parks
6 71 Open Space 2.13
7 81 Industrial
8 82 Industrial
9 84 Industrial
10 85 Industrial 11.44
Erase
Update
Cancel


Landuse ID
(Char)
% Subcatch. Covered by Land Use
(Double)
8.46
91.54
8.27
10.06
25.36
14.38
41.93
19.76
80.24
1.84
2.61
11.40
84.15
5.07
0.24
81.20
13.49
3.87
40.47
53.83
1.83
0.58
99.42
1.06
14.98
68.01
2.09
Data Histogram of % Subcatch. Covered by Land Use (Double)
By Classes:
12
By Interval:
9
Classify
Show Percentage
Data Histogram
% of Sources
38.3
13.3
8.31
5.76
4.22
4.22
3.16
4.5
3.49
4.26
4.9
5.63
0
9
18
27
36
45
54
63
72
81
90
99
108
% Subcatch. Covered by Land Use (Double)

Step 13. Assign Soil Coverage

1. Select *INFILTRATION* from the *SUBCATCHMENT MANAGER* menu to assign Soil Coverages to each subcatchment.



2. Select *"SSURGO.shp"* for the *"Soil Layer"*

3. Select *"HYDROGROUP"* for the *"Soil Code Field"*

4. Select *"DESC"* for the *"Description Field"*

5. Click on the "*Populate Soil Data*" 

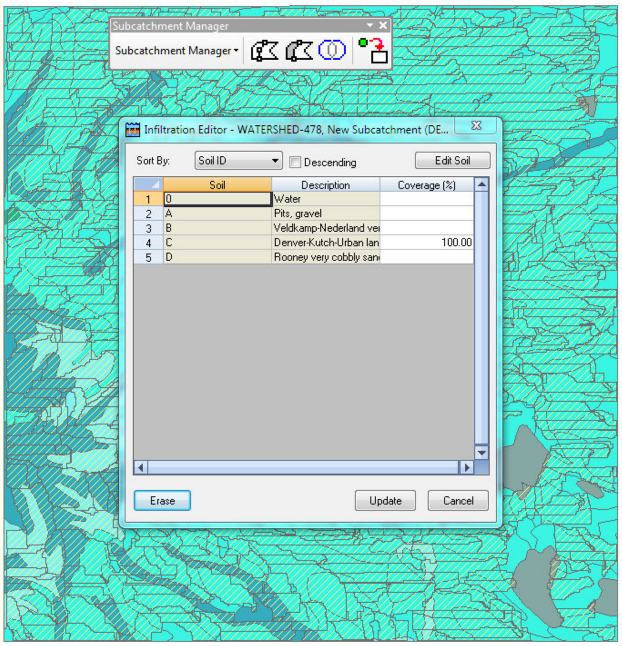
button to populate the "Soil *Data*" Table.

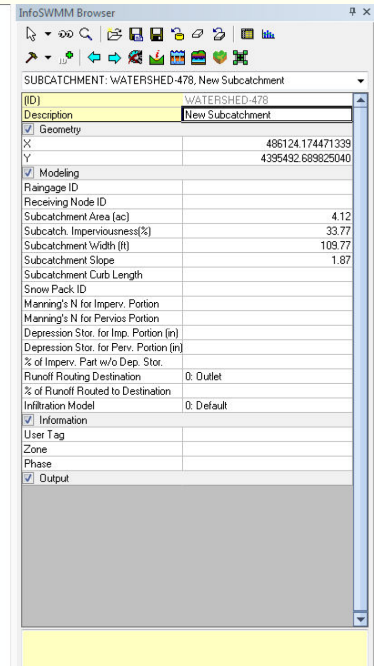
6. Click on the "*Calculate*" 

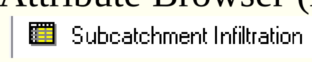
button to assign Soil Coverages to each Subcatchment

7. Click on the "*Close*" button 

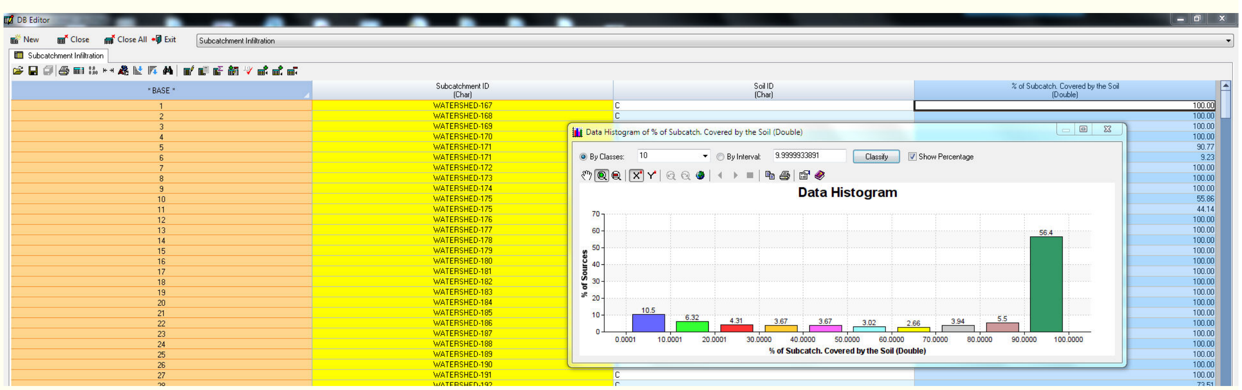
to close the calculate Soil Coverage dialog box.





8. Each Subcatchment now has the proper infiltration coverage. You can see the land use by clicking on the Land Use Icon in the Attribute Browser (AB) or by viewing the DB table Subcatchment Infiltration 

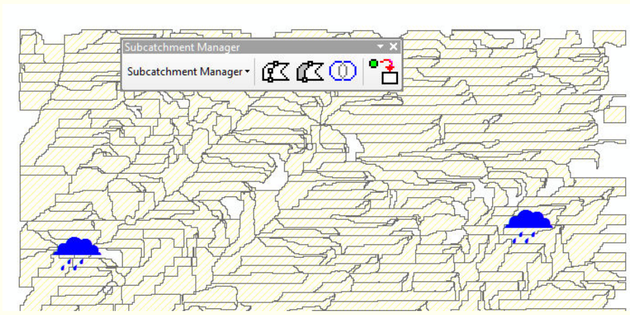
.

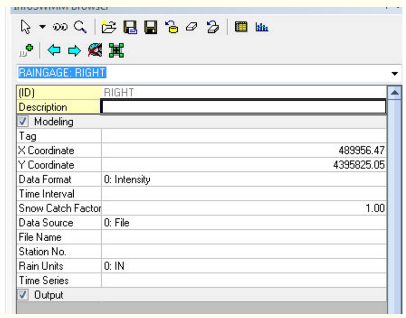


Step 14. Assign Raingages

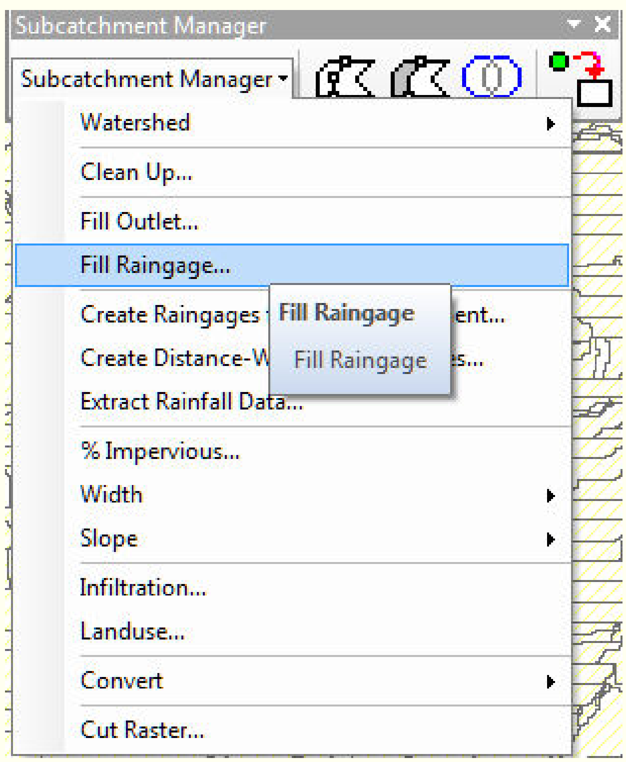
1. Click the “*Create Raingage*”  icon from the InfoSWMM *EDIT NETWORK* toolbar.

2. Create two new raingages: Place one on the left side of the map and the other on the right side of the map. Accept the default ID’s and descriptions for the raingages but change the iD to RIght and Left.





3. Click the “Fill *Raingage*”  icon from the *SUBCATCHMENT MANAGER* toolbar.



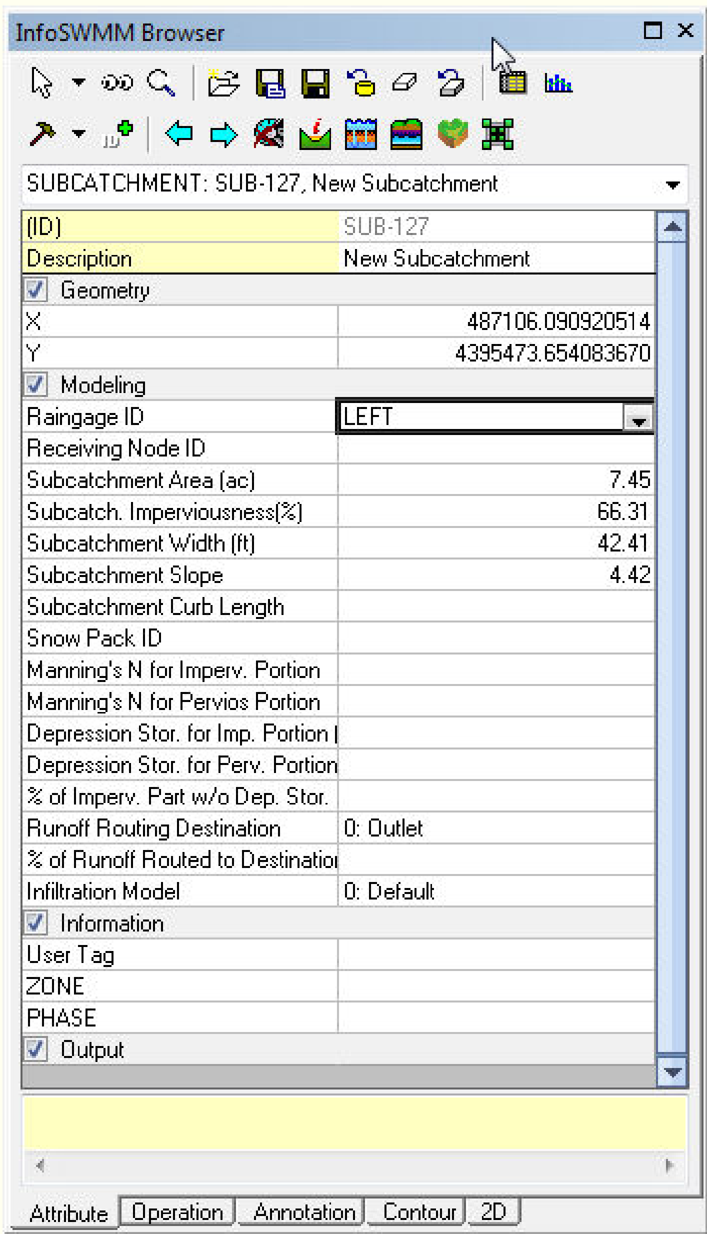
4. Select the Raingage on the left

5. Select a group of Subcatchments

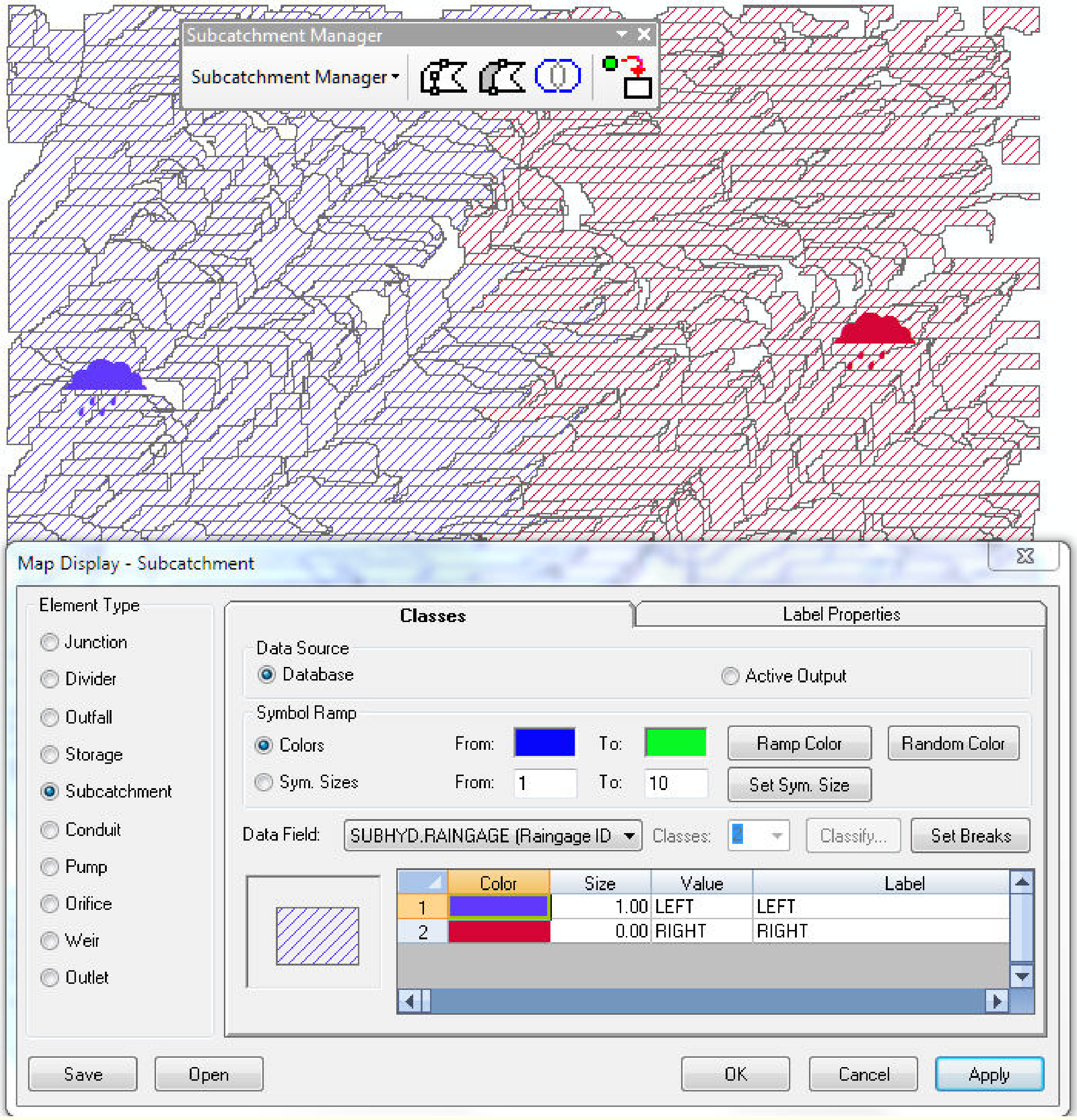
6. Repeat steps 3 to 5 for the Raingage on the right.

7. Save the project.

8. Select random Subcatchments and examine the attributes that have been globally populated.

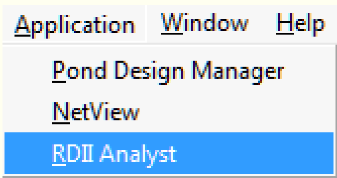


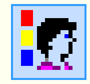
9. You can use Map Display and color in the Raingage for each Subcatchment.

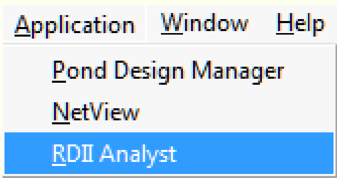


Step 15. How to Rename Your Subcatchments

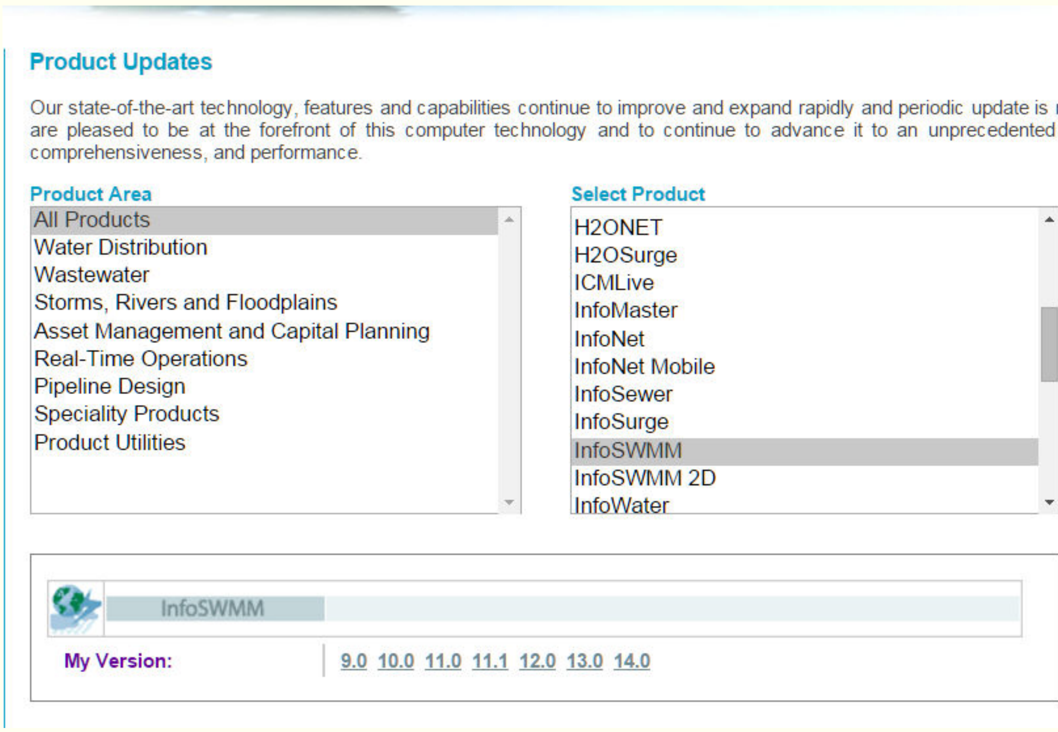
Step 15. How to Rename Your Subcatchments



1. Click on the "Project Preferences" icon  to set up how Watersheds or Subcatchments are named when they are created.



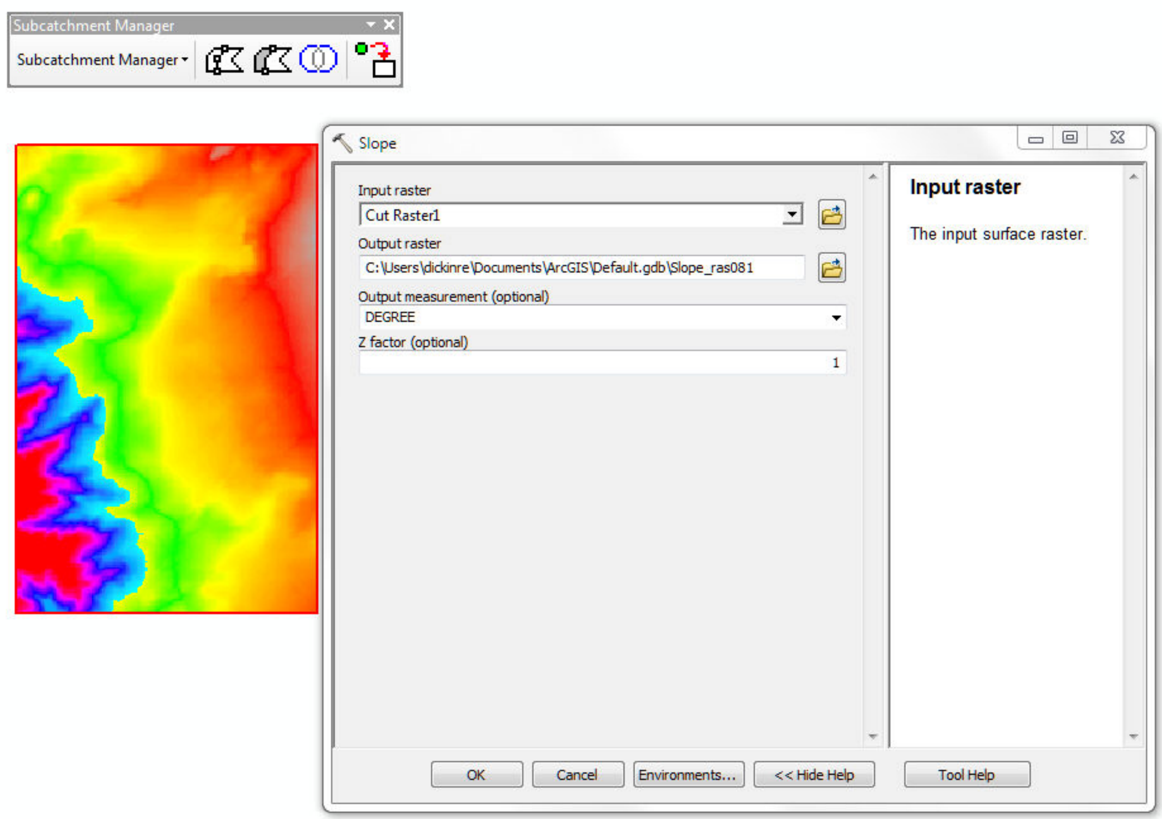
2. We will use Watershed-1 as the Prefix and start with 1 as the 1st created Subcatchment.



Step 16. DEM to Slope

You can also make a slope raster from a **DEM or TIN** DEM to Slope....

- **Input Raster -** Raster to use to make the Slope Raster.
- **Output Raster -** Created Output Raster



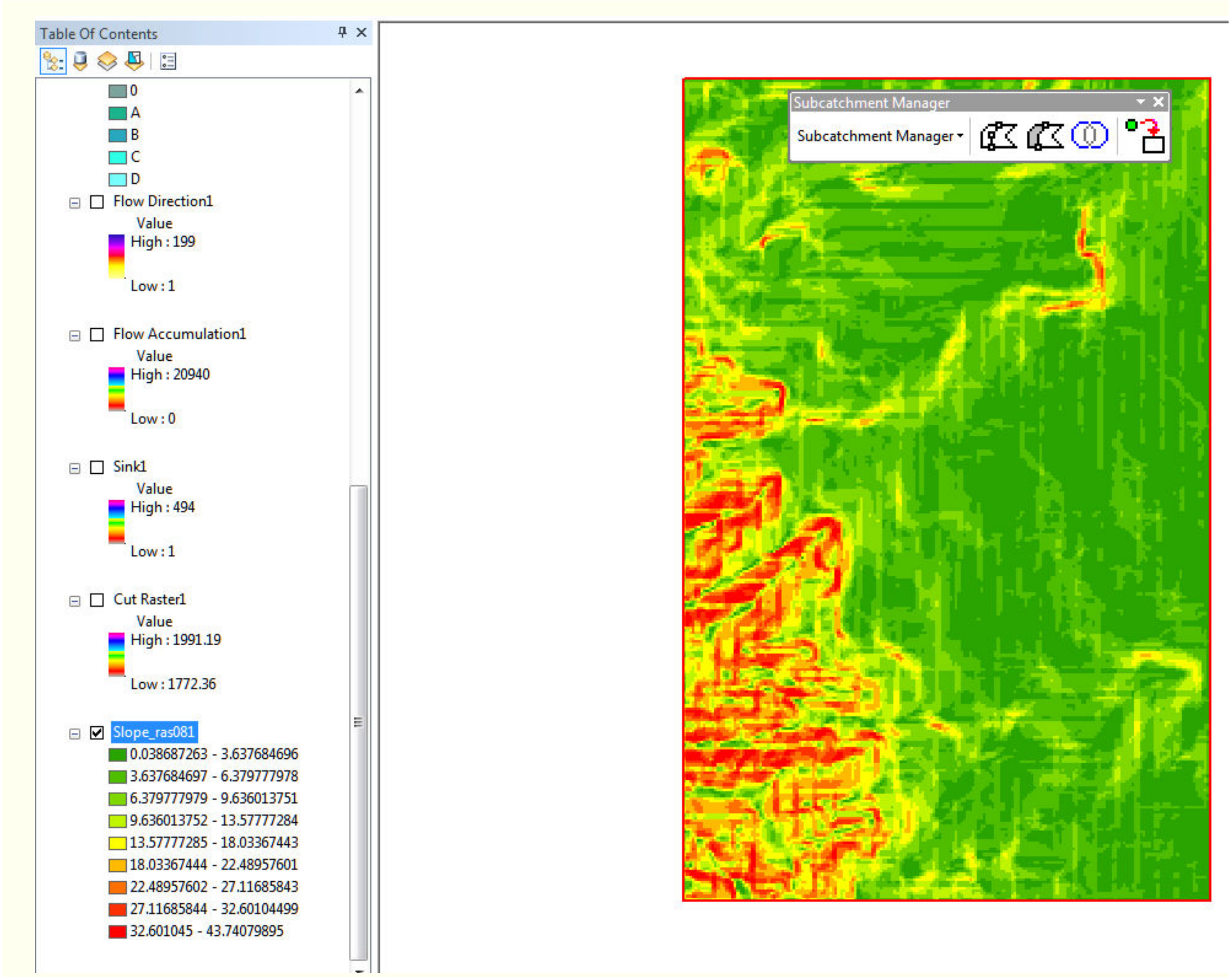
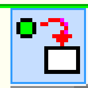
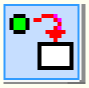
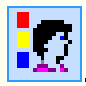
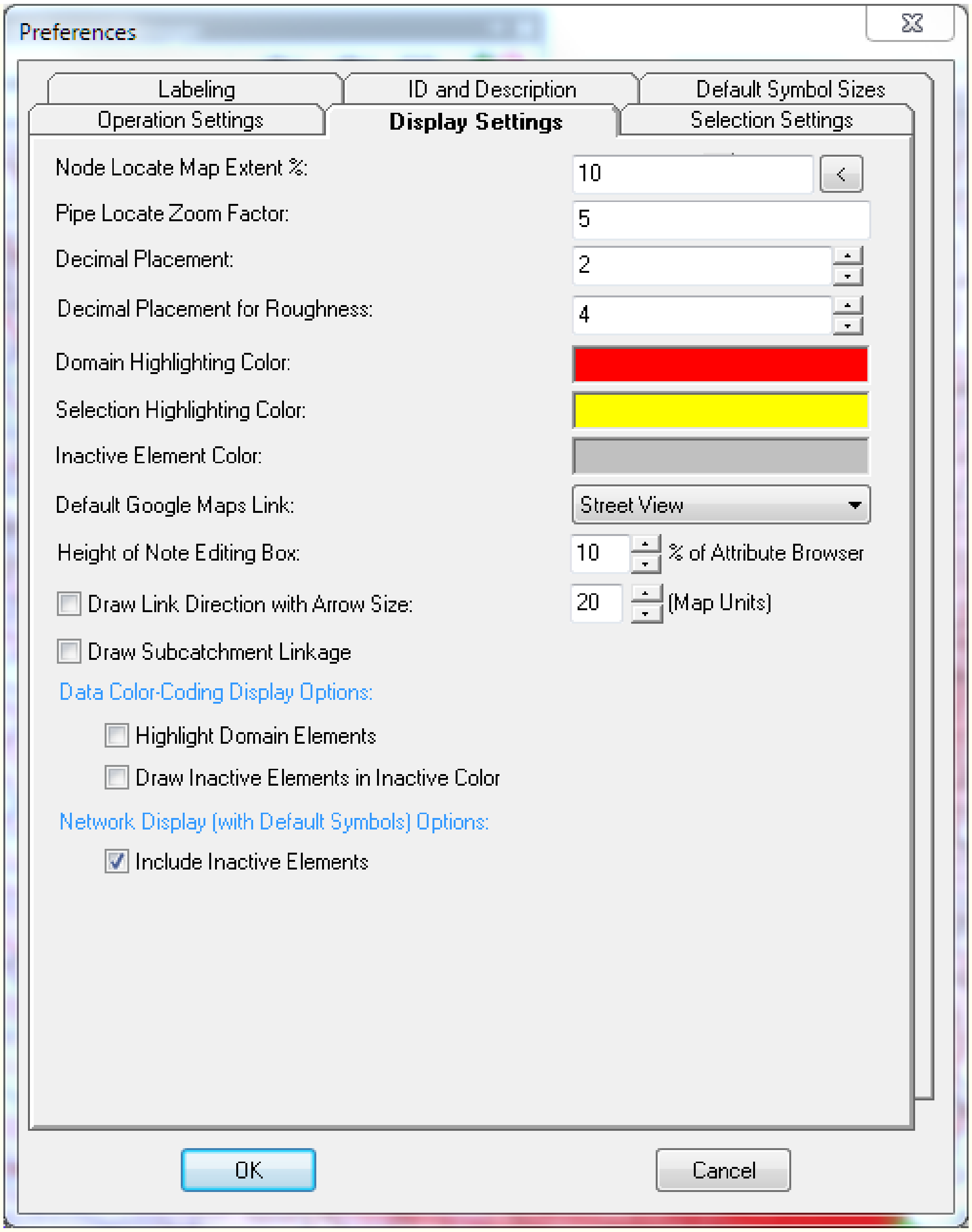


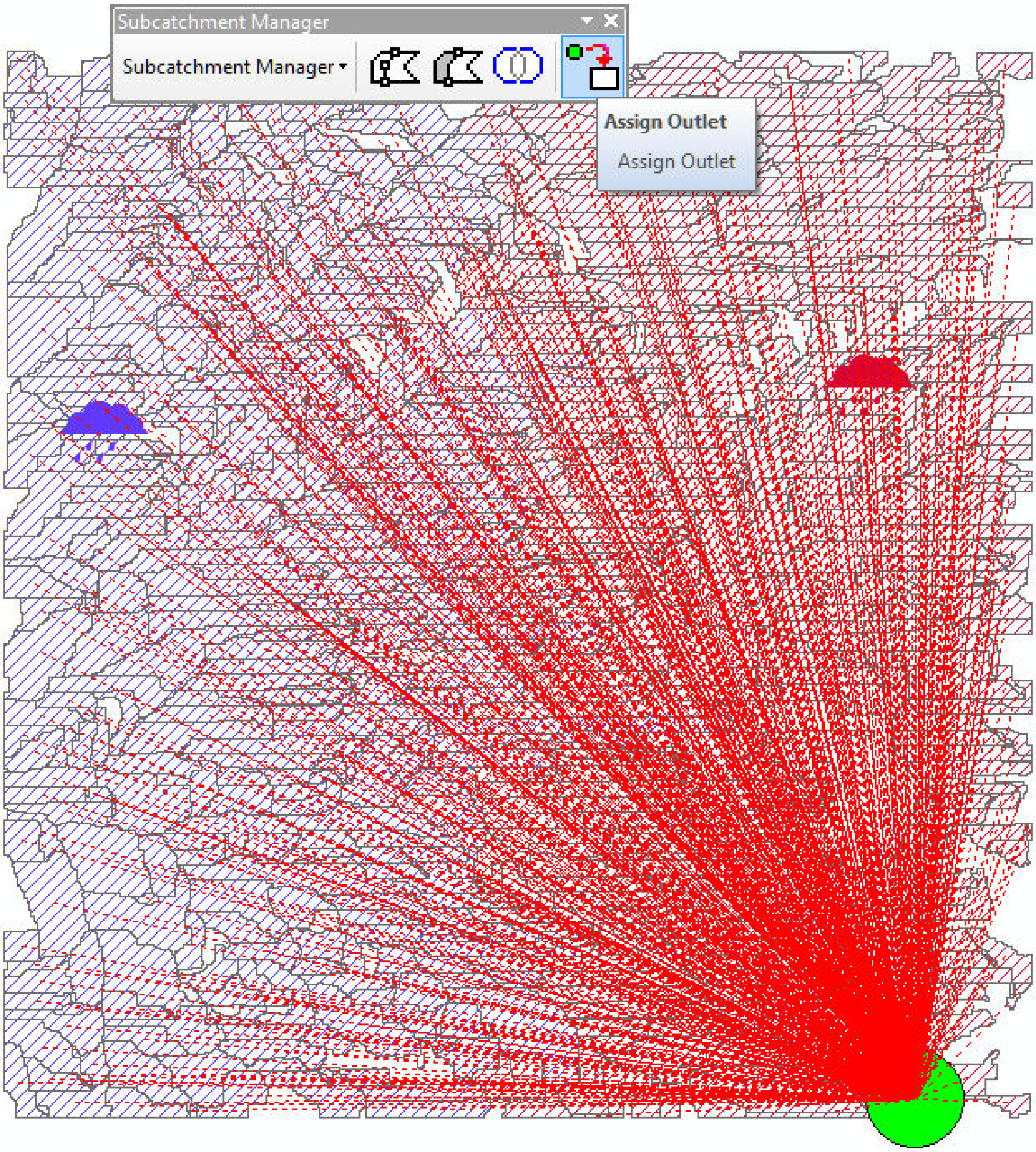
Table Of Contents
0
A
B
C
D
Flow Direction1
Value
High : 199
Low : 1
Flow Accumulation1
Value
High : 20940
Low : 0
Sink1
Value
High : 494
Low : 1
Cut Raster1
Value
High : 1991.19
Low : 1772.36
Slope_ras081
0.038687263 - 3.637684696
3.637684697 - 6.379777978
6.379777979 - 9.636013751
9.636013752 - 13.57777284
13.57777285 - 18.03367443
18.03367444 - 22.48957601
22.48957602 - 27.11685843
27.11685844 - 32.60104499
32.601045 - 43.74079895
Subcatchment Manager
Subcatchment Manager

Step 17. Assign Outlets

Step 17. Assign Outlets 

- The assign outlet tool simplifies the procedure for creating the network 
- To link an outlet and Subcatchment, select the outlet then the Subcatchment.
- You can change the link to the Subcatchment Outlet by using Project Preferences/Display Settings .

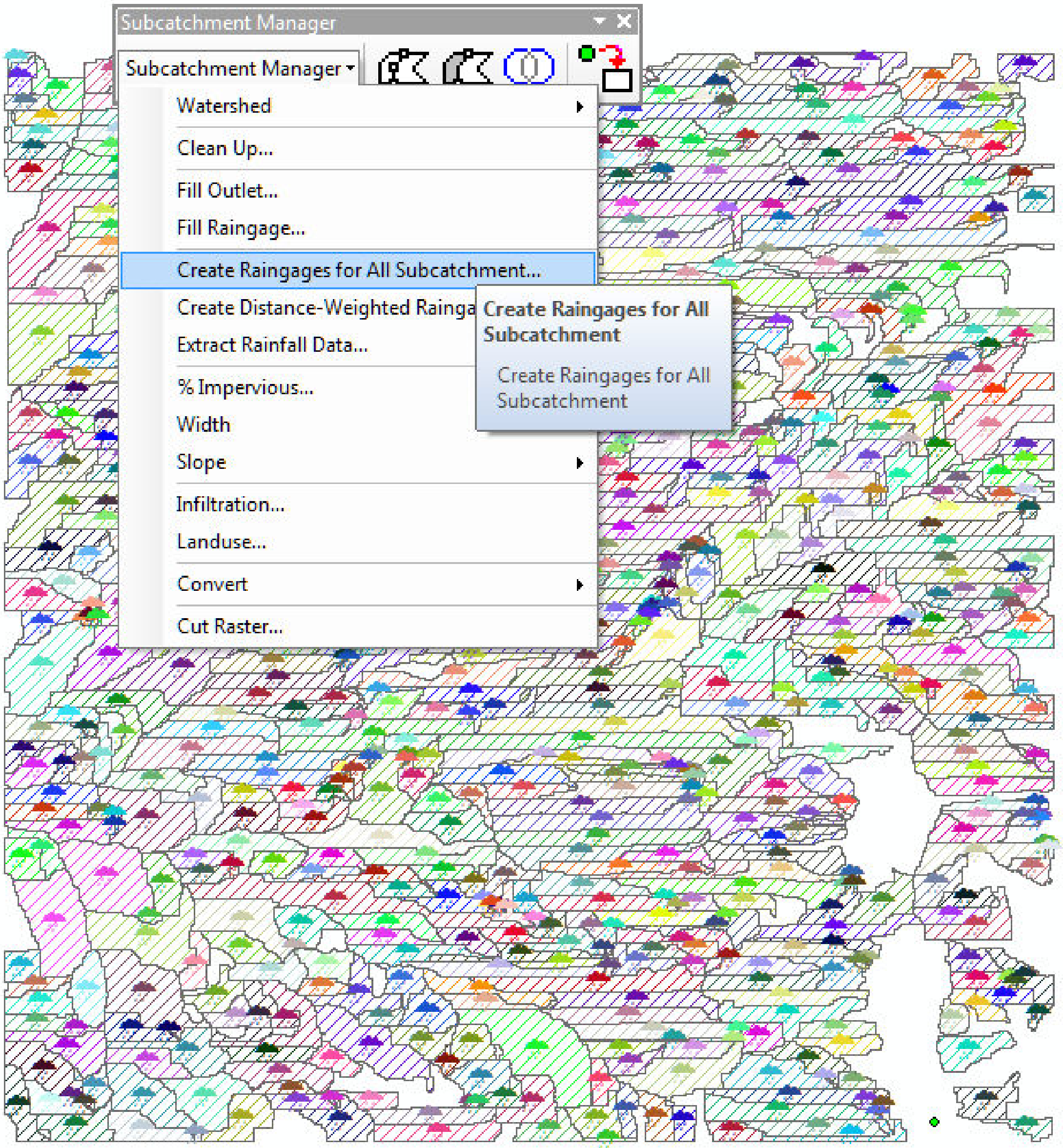

Preferences
Labeling
ID and Description
Default Symbol Sizes
Operation Settings
Display Settings
Selection Settings
Node Locate Map Extent %:
10
Pipe Locate Zoom Factor:
5
Decimal Placement:
2
Decimal Placement for Roughness:
4
Domain Highlighting Color:
Selection Highlighting Color:
Inactive Element Color:
Default Google Maps Link:
Street View
Height of Note Editing Box:
10
% of Attribute Browser
Draw Link Direction with Arrow Size:
20
(Map Units)
Draw Subcatchment Linkage
Data Color-Coding Display Options:
Highlight Domain Elements
Draw Inactive Elements in Inactive Color
Network Display (with Default Symbols) Options:
Include Inactive Elements
OK
Cancel


Subcatchment Manager
Subcatchment Manager
Assign Outlet
Assign Outlet

Step 18. Create Raingages for All Subcatchments

Step 18. Create Raingages for All Subcatchments

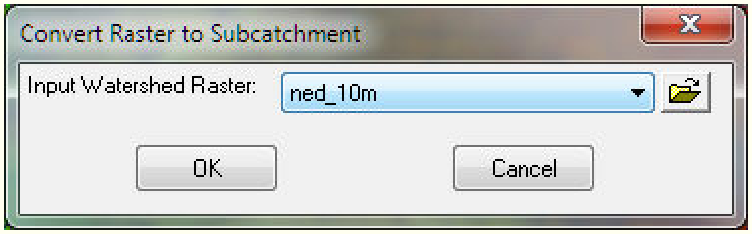
- If you use the menu command Create Raingages for All Subcatchments a Raingage will be created for each Subcatchment.
- Each Raingage can be colored and Mapped with the Map Display.

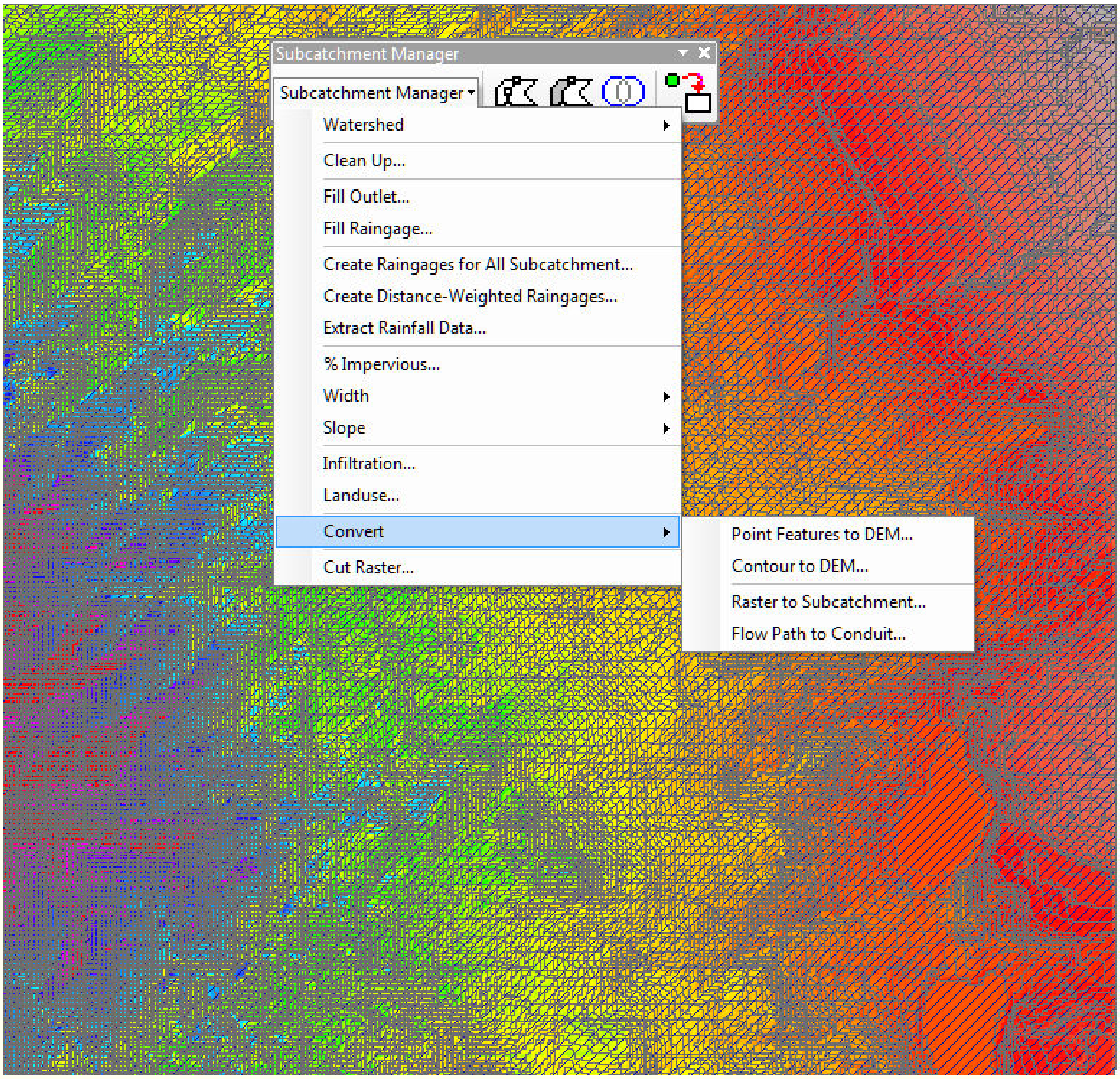


Step 19. Convert Raster to Subcatchment

Step 19. Convert Raster to Subcatchment

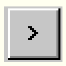
- Another option for making Subcatchments is to use the command Convert Raster to Subcatchment
- The Subcatchment look like this from the tool.



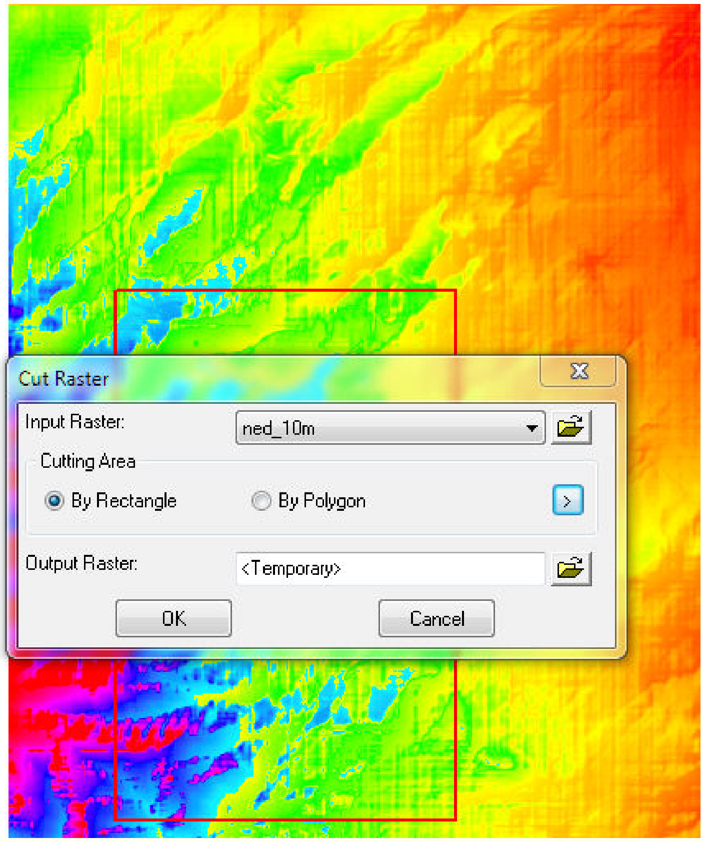

Subcatchment Manager
Subcatchment Manager
Watershed
Clean Up...
Fill Outlet...
Fill Raingage...
Create Raingages for All Subcatchment...
Create Distance-Weighted Raingages...
Extract Rainfall Data...
% Impervious...
Width
Slope
Infiltration...
Landuse...
Convert
Cut Raster...
Point Features to DEM...
Contour to DEM...
Raster to Subcatchment...
Flow Path to Conduit...

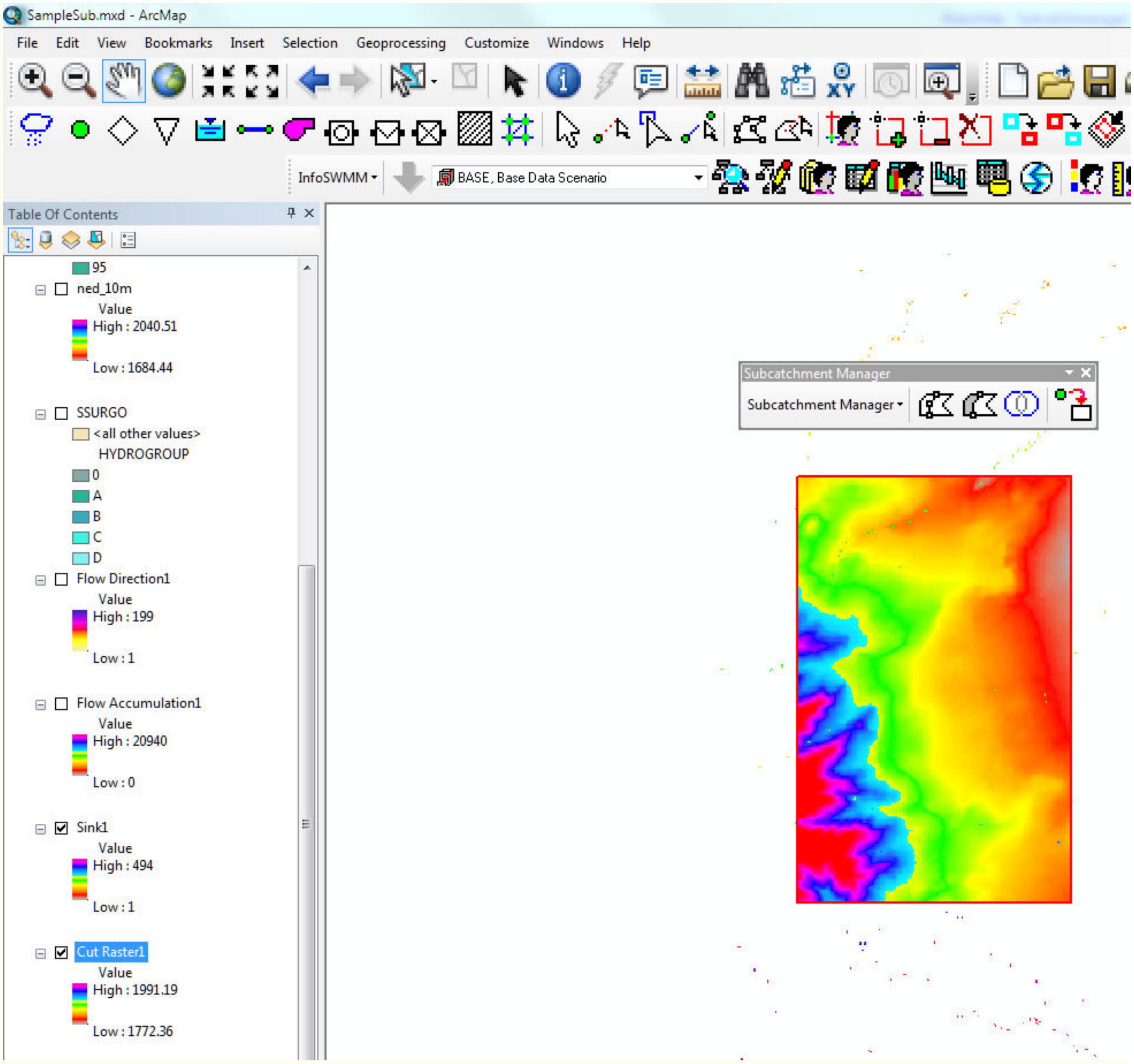
Step 20. Cut Raster

The Cut Raster allows you to make a smaller Raster of the DEM or TIN for customized Subcatchment Delineation.

- **Input Raster** - Choose the raster to be cut.
- **Cutting Area** - Specifies the shape and location where the raster is to be cut.
- **By Rectangle** - A rectangle is specified to cut the raster
- **By Polygon** - A rectangle is specified to cut the raster
-  Click this button to draw the rectangle or polygon on the raster to be cut.
- **Output Raster** - Enter a name for the output cut raster and the location where the file will be stored.
- **<Temporary>** - If an output file name is not specified, the cut raster created will only remain in the map until the project is closed. Specify an output name to create a permanent file.
- **OK** – Cuts the specified raster and creates a new raster from the area inside the cutting area.
- **Cancel** – Cancels the operation and closes the dialog box.

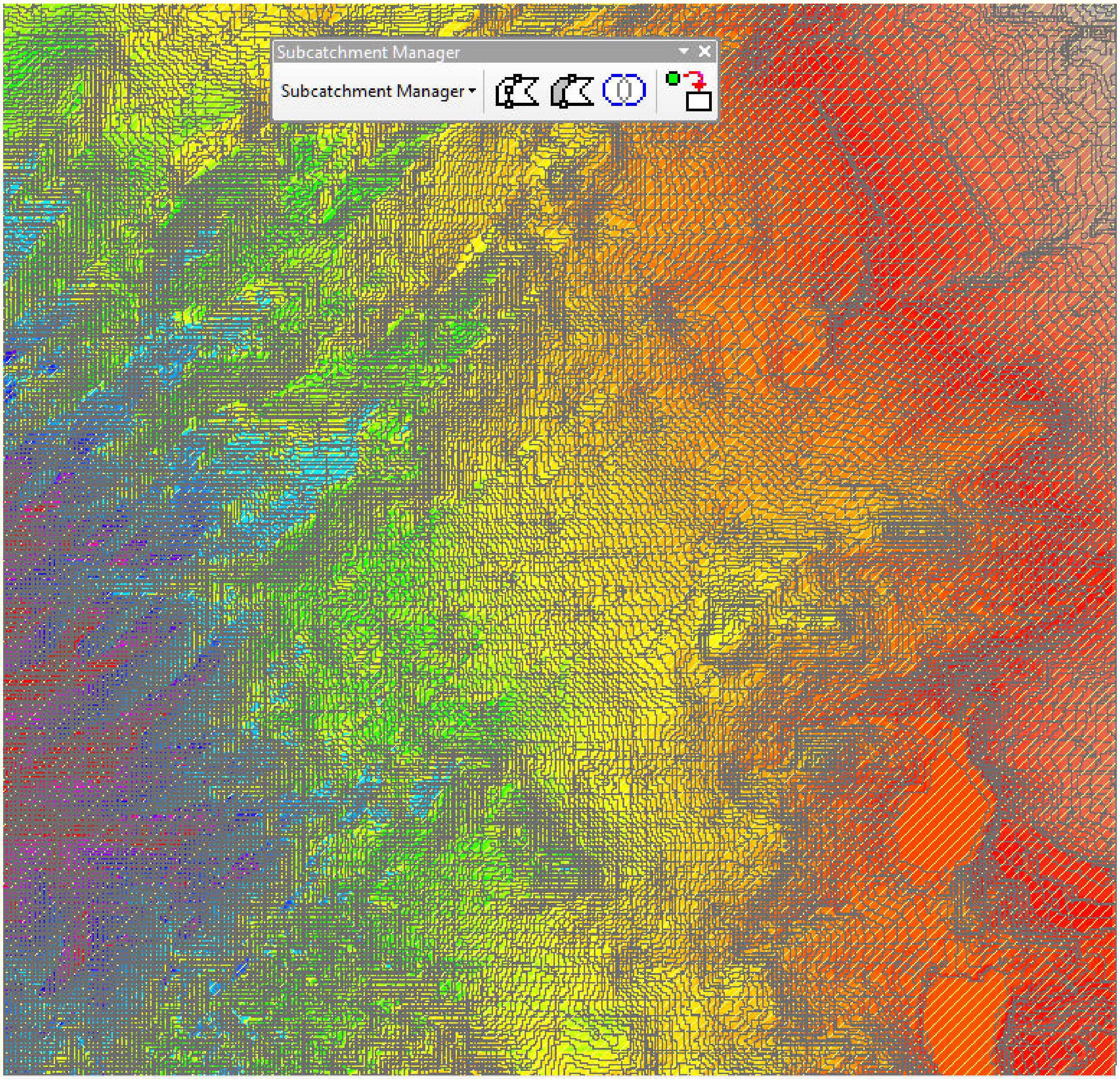

Subcatchment Manager
Subcatchment Manager


Cut Raster
Input Raster:
ned_10m
Cutting Area
By Rectangle
By Polygon
Output Raster:
<Temporary>
OK
Cancel


SampleSub.mxd - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
InfoSWMM
BASE, Base Data Scenario
Table Of Contents
95
ned_10m
Value
High : 2040.51
Low : 1684.44
SSURGO
<all other values>
HYDROGROUP
0
A
B
C
D
Flow Direction1
Value
High : 199
Low : 1
Flow Accumulation1
Value
High : 20940
Low : 0
Sink1
Value
High : 494
Low : 1
Cut Raster1
Value
High : 1991.19
Low : 1772.36
Subcatchment Manager
Subcatchment Manager

Step 21. Final Model

Step 21. Final Model

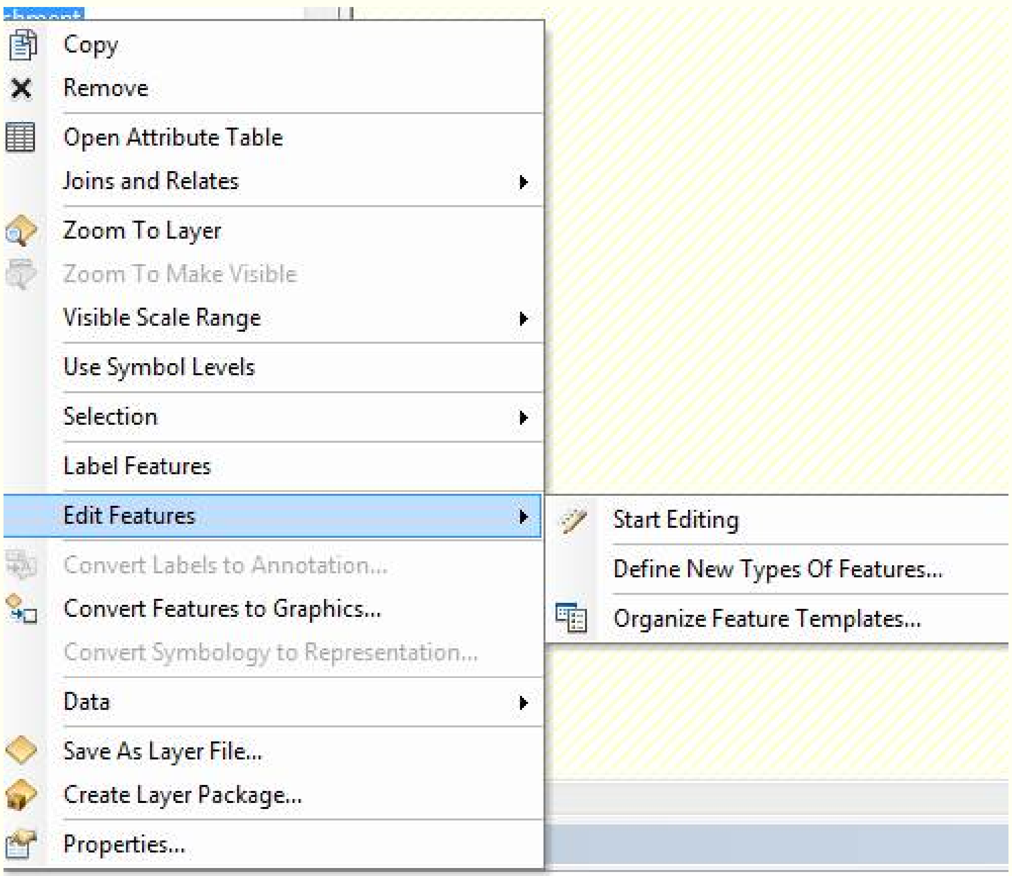


Congratulations! You have now completed the Quick-Start tutorial. Please refer to the InfoSWMM User's Guide for assistance with creating a network model from the Subcatchments generated in this tutorial.

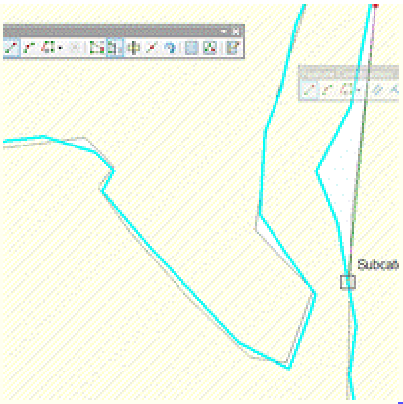
How to Edit the Subcatchment Polygons in InfoSWMM with Arc Map

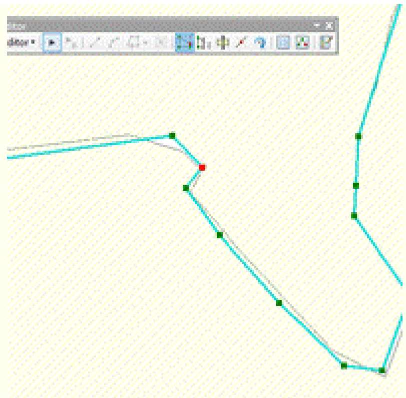
Subject: How to Edit the Subcatchment Polygons in InfoSWMM with Arc Map

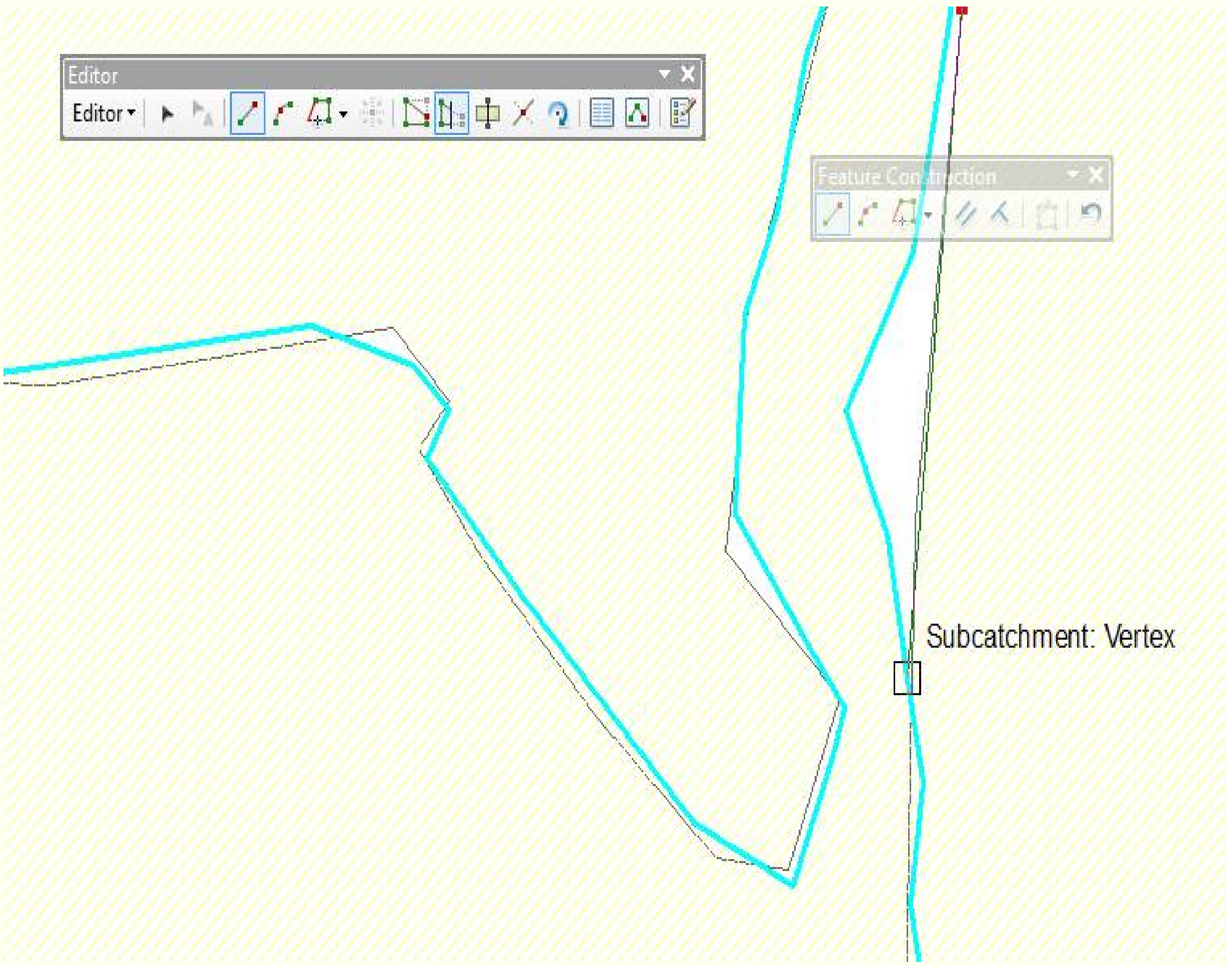
You can edit the polygon boundaries of the Subcatchments in Arc GIS by using the Editor command and either editing the vertices or by using the Reshape Feature Tool to adjust the boundaries or snap to the polygon lines or vertex points. You should start the editing session by right mouse clicking n the Subcatchment Feature layer



Vertex Editing and Reshape Feature Tool







Editor
Editor
Feature Construction
Subcatchment: Vertex

How to Import Subcatchments from GIS into InfoSWMM

Subject: How to Import Subcatchments from GIS into InfoSWMM

Step 1: Add your shapefile using the Add Data command.

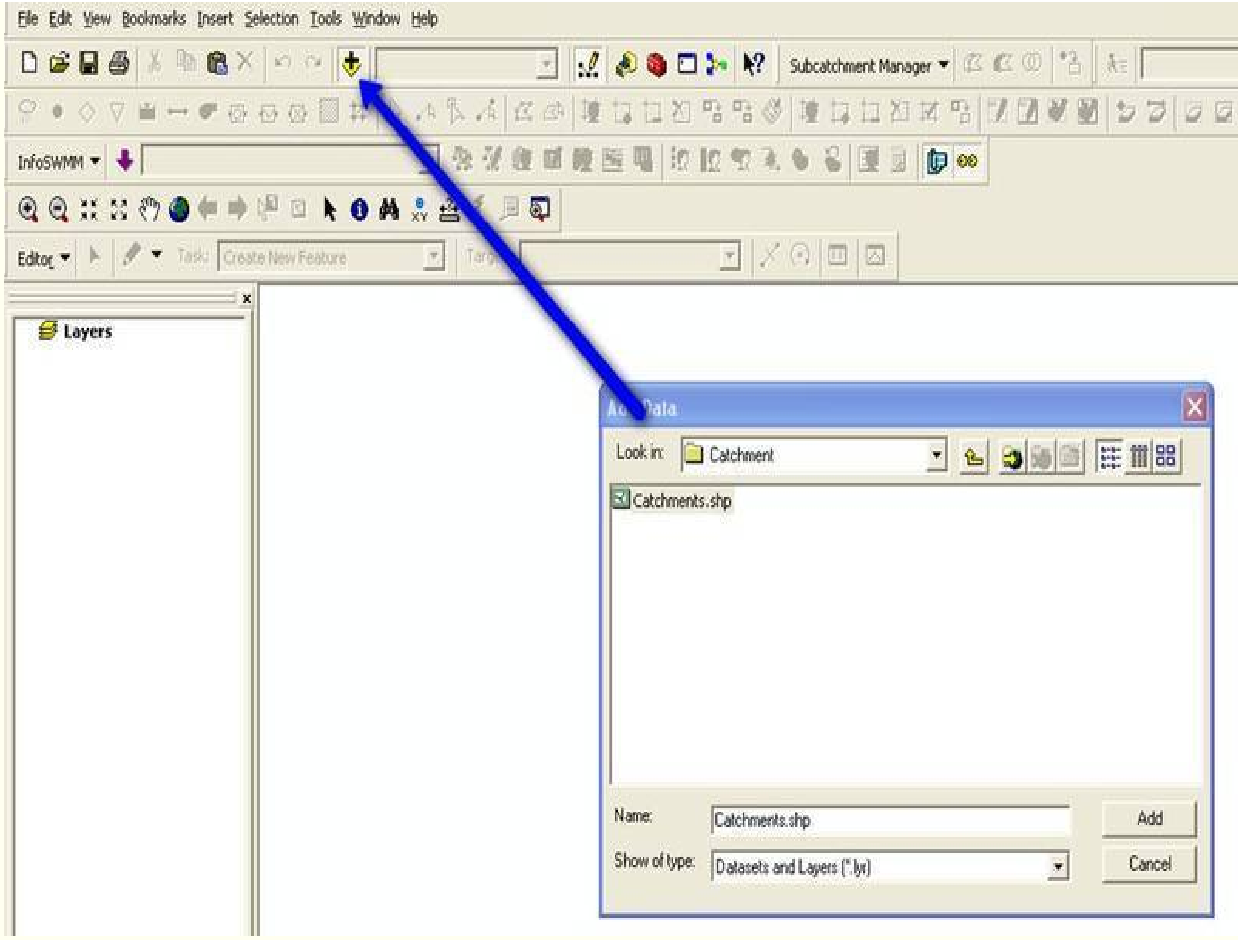
Step 2: Your imported shape file has no subcatchment data before we initialize the project.

Step 3: Add your subcatchment data using the GIS Exchange Cluster Import

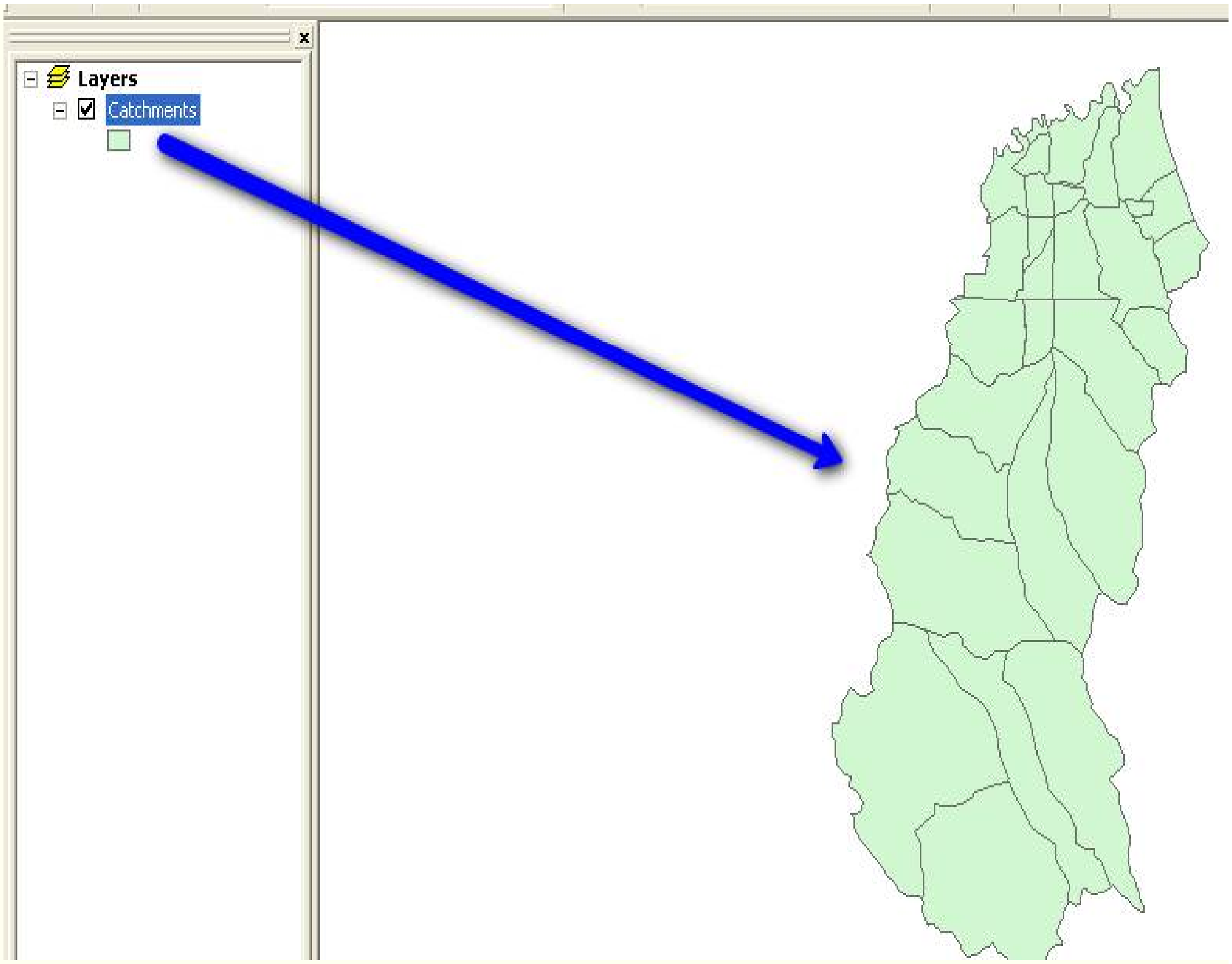
Step 4: Now you have the Subcatchments in the DB Tables and can now calculate the area.

====================================

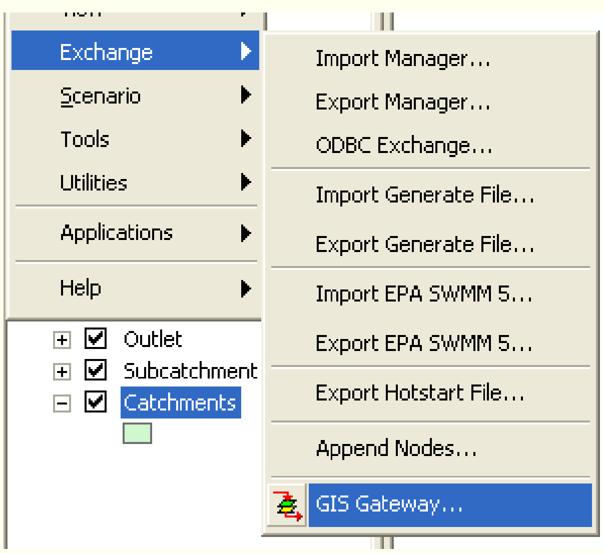
Step 1: Add your shapefile using the Add Data command.



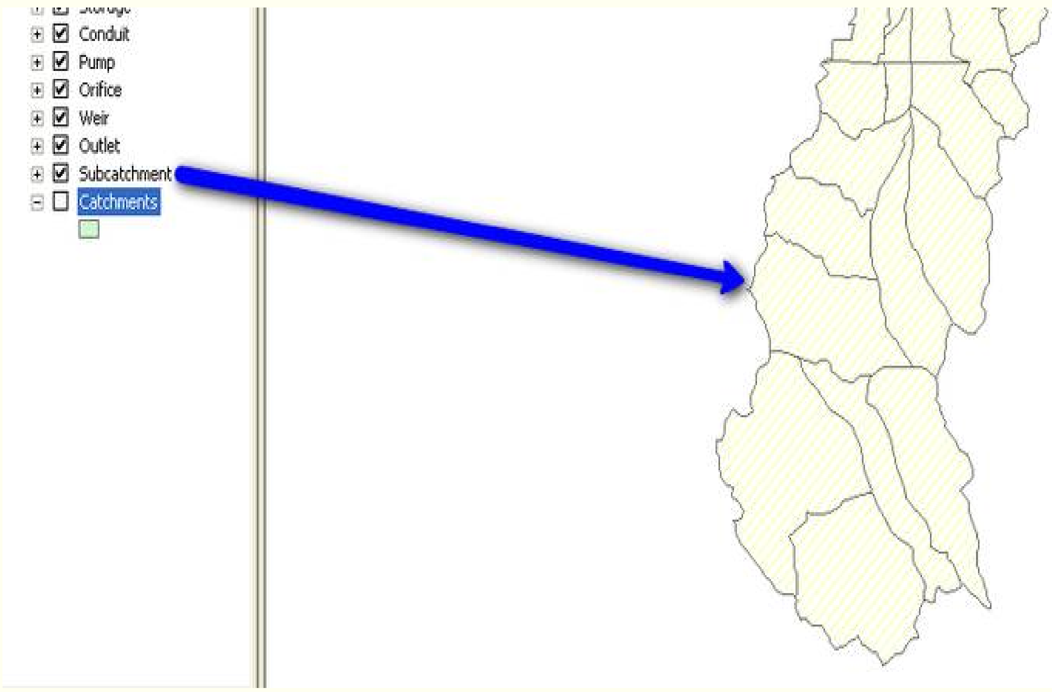
Step 2: Your imported shape file has no subcatchment data



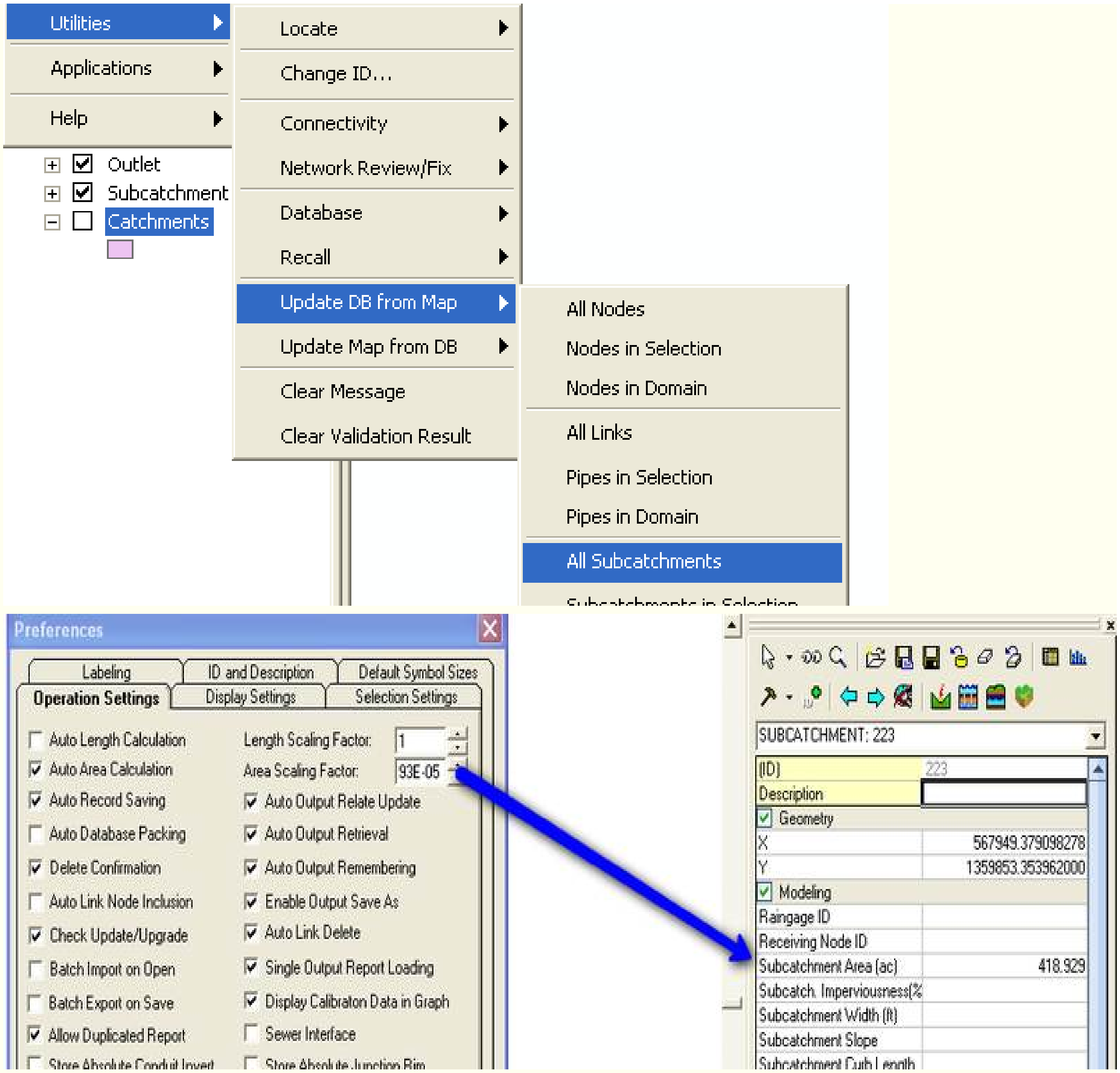
Step 3: Add your subcatchment data using the GIS Exchange Cluster Import



Step 4: Now you have the Subcatchments in the DB Tables and can now calculate the area.



We still have to enter 1/10000 to get the right units for subcatchment area using the Auto Area Calculation under Tools preferences. You first import the shape file and then you turn on Auto Area Calculation, enter a value for the Area Scaling Factor and then use the tool Utilities, Update DB from Map, All Subcatchment to get the Subcatchment Area in hectares.

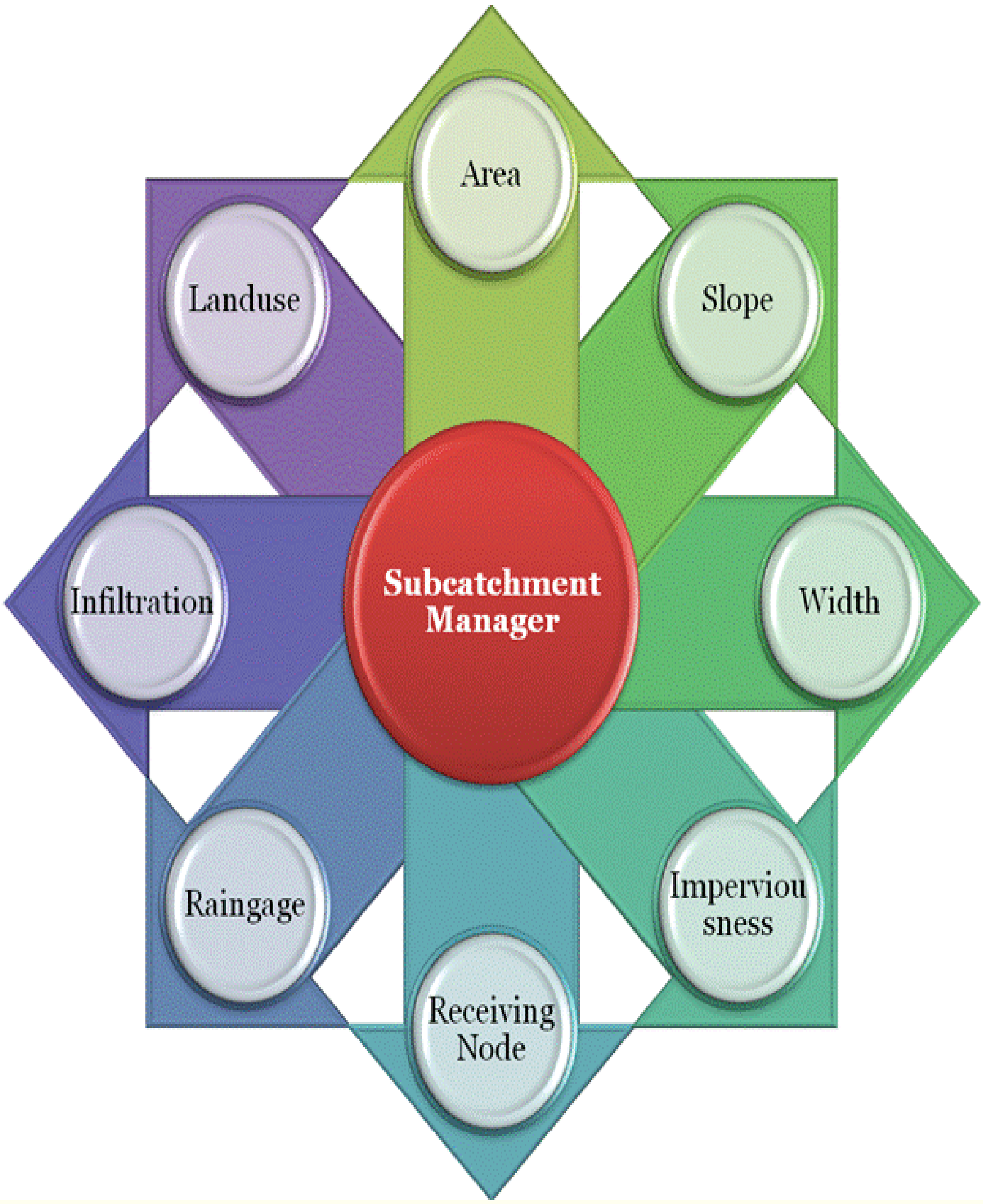

Utilities
Applications
Help
Outlet
Subcatchment
Catchments
Locate
Change ID...
Connectivity
Network Review/Fix
Database
Recall
Update DB from Map
Update Map from DB
Clear Message
Clear Validation Result
All Nodes
Nodes in Selection
Nodes in Domain
All Links
Pipes in Selection
Pipes in Domain
All Subcatchments
Preferences
Labeling
ID and Description
Default Symbol Sizes
Operation Settings
Display Settings
Selection Settings
Auto Length Calculation
Auto Area Calculation
Auto Record Saving
Auto Database Packing
Delete Confirmation
Auto Link Node Inclusion
Check Update/Upgrade
Batch Import on Open
Batch Export on Save
Allow Duplicated Report
Length Scaling Factor:
1
Area Scaling Factor:
93E-05
Auto Output Relate Update
Auto Output Retrieval
Auto Output Remembering
Enable Output Save As
Auto Link Delete
Single Output Report Loading
Display Calibraton Data in Graph
Sewer Interface
SUBCATCHMENT: 223
(ID)
223
Description
Geometry
X
567949.379098278
Y
1359853.353962000
Modeling
Raingage ID
Receiving Node ID
Subcatchment Area (ac)
418.929
Subcatch. Imperviousness(%
Subcatchment Width (ft)
Subcatchment Slope

Create Watershed Data Using the InfoSWMM Subcatchment Manager

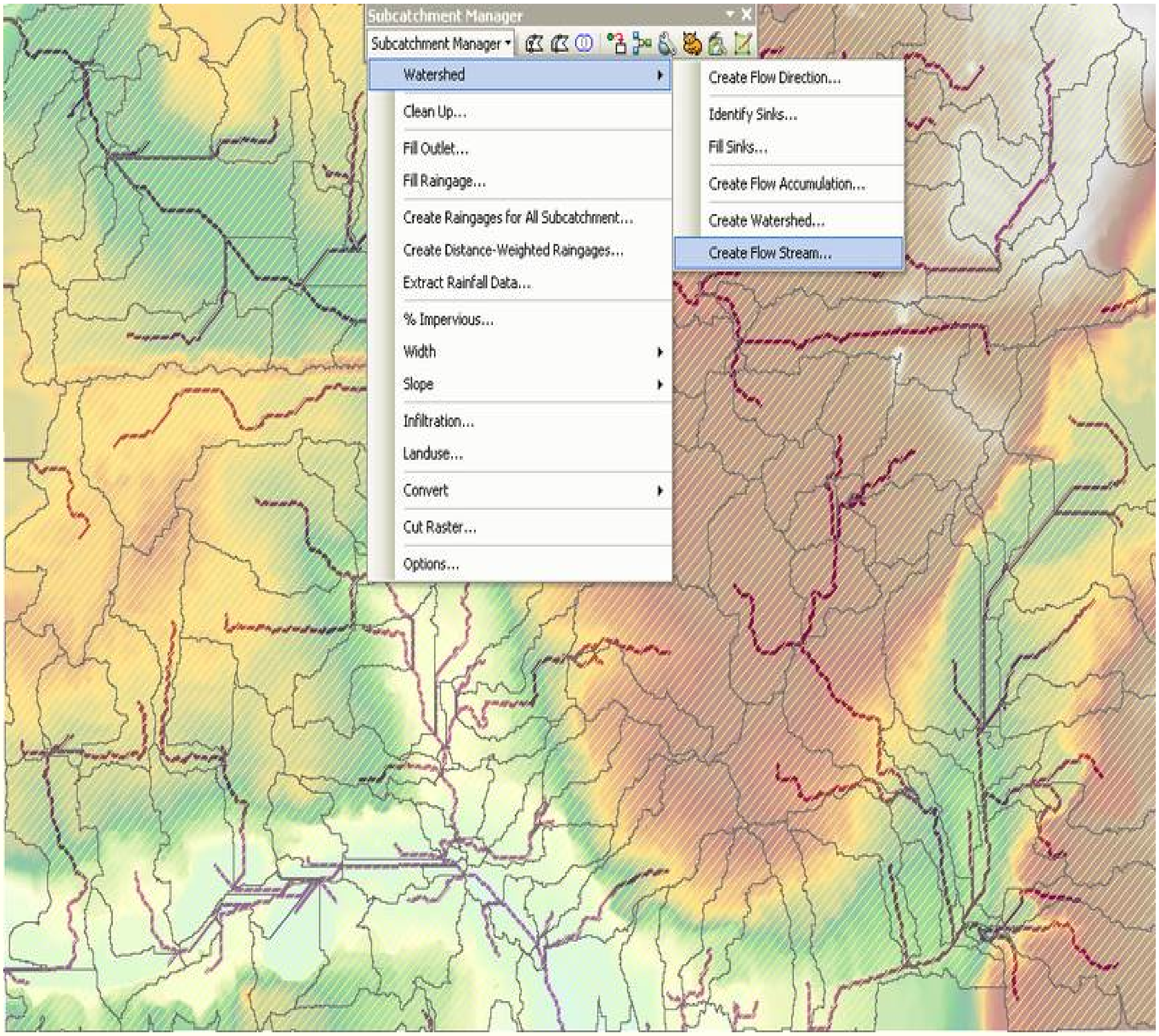
Subject: Create Watershed Data Using InfoSWMM Subcatchment Manager

The Subcatchment Manager of InfoSWMM will help calculate most of the physical parameters associated with a Watershed or Subcatchment in SWMM 5 from a Digital Elevation Data (Step 1). The Subcatchments slope is estimated from a slope raster (Step 2) and the Slope Calculator (Step 4). The created watershed area are calculated using the command Update DB from Map (Step 6) along with the Subcatchment Width (Step 3) and the Impervious Area (Step 5). The physical parameters estimated from the DEM are shown in Figure 1.

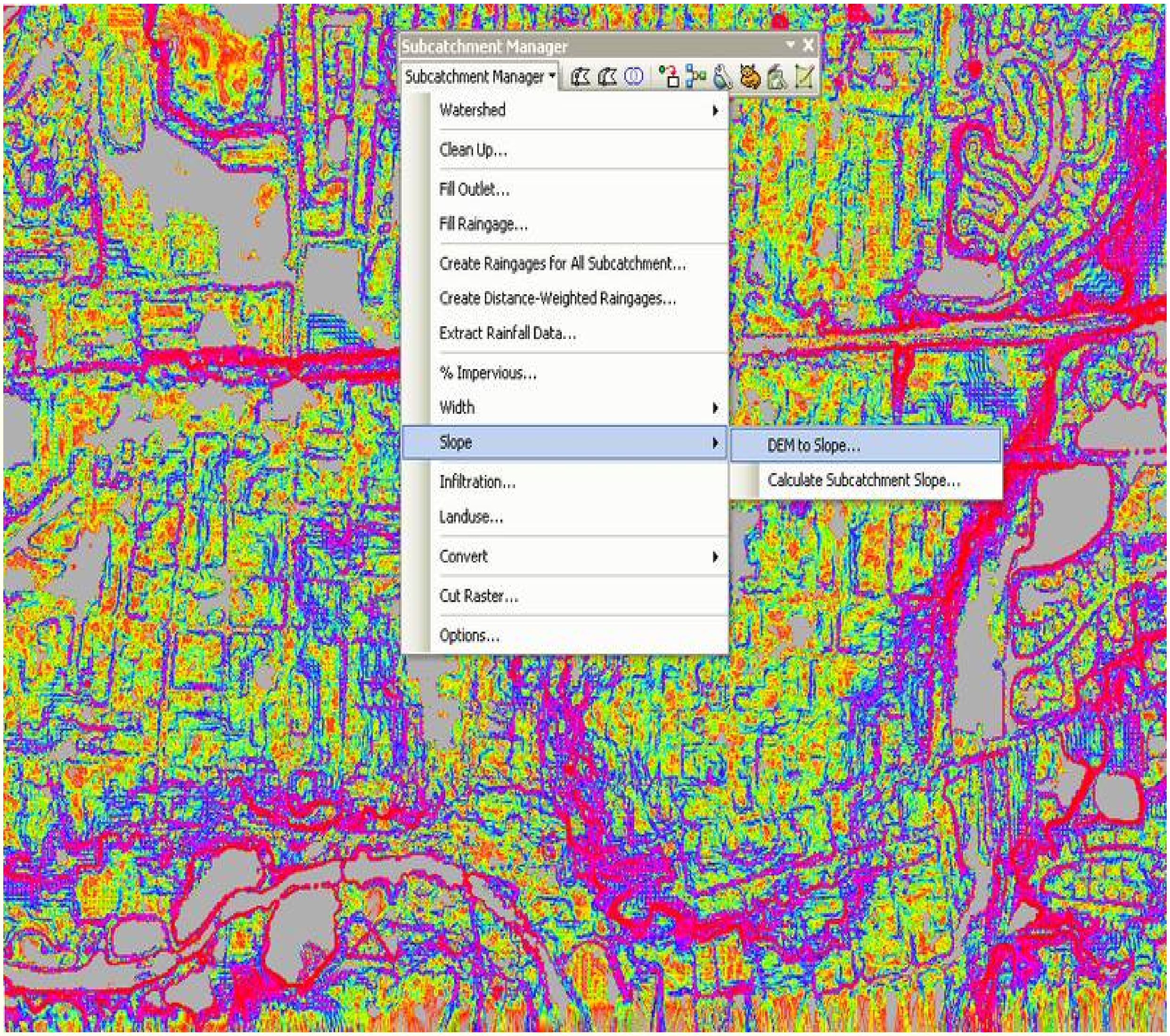
Figure 1. Physical Data Estimated from a DEM using the Subcatchment Manager in InfoSWMM.



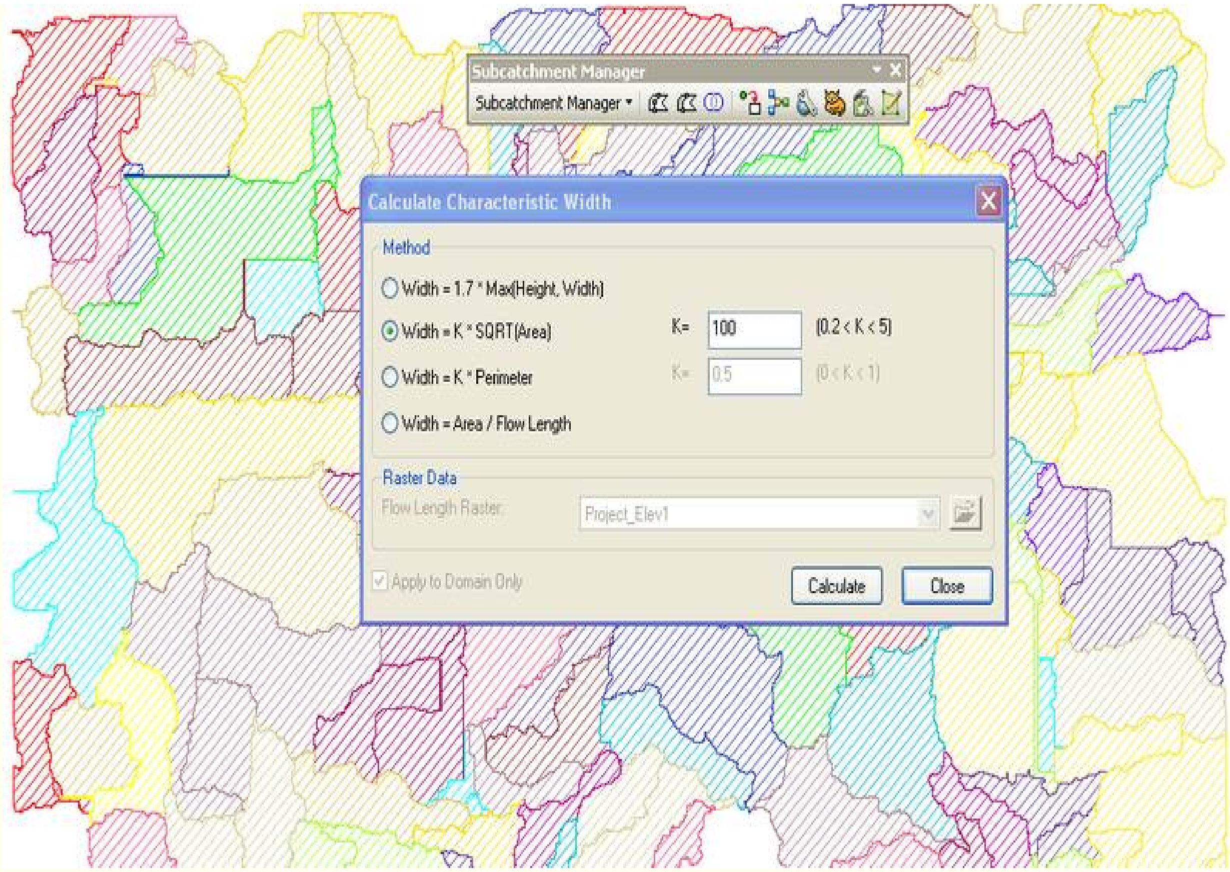
Step 1. Use the command Create Flow Stream to create a Flow Stream for the DTM or DEM that can be used later.



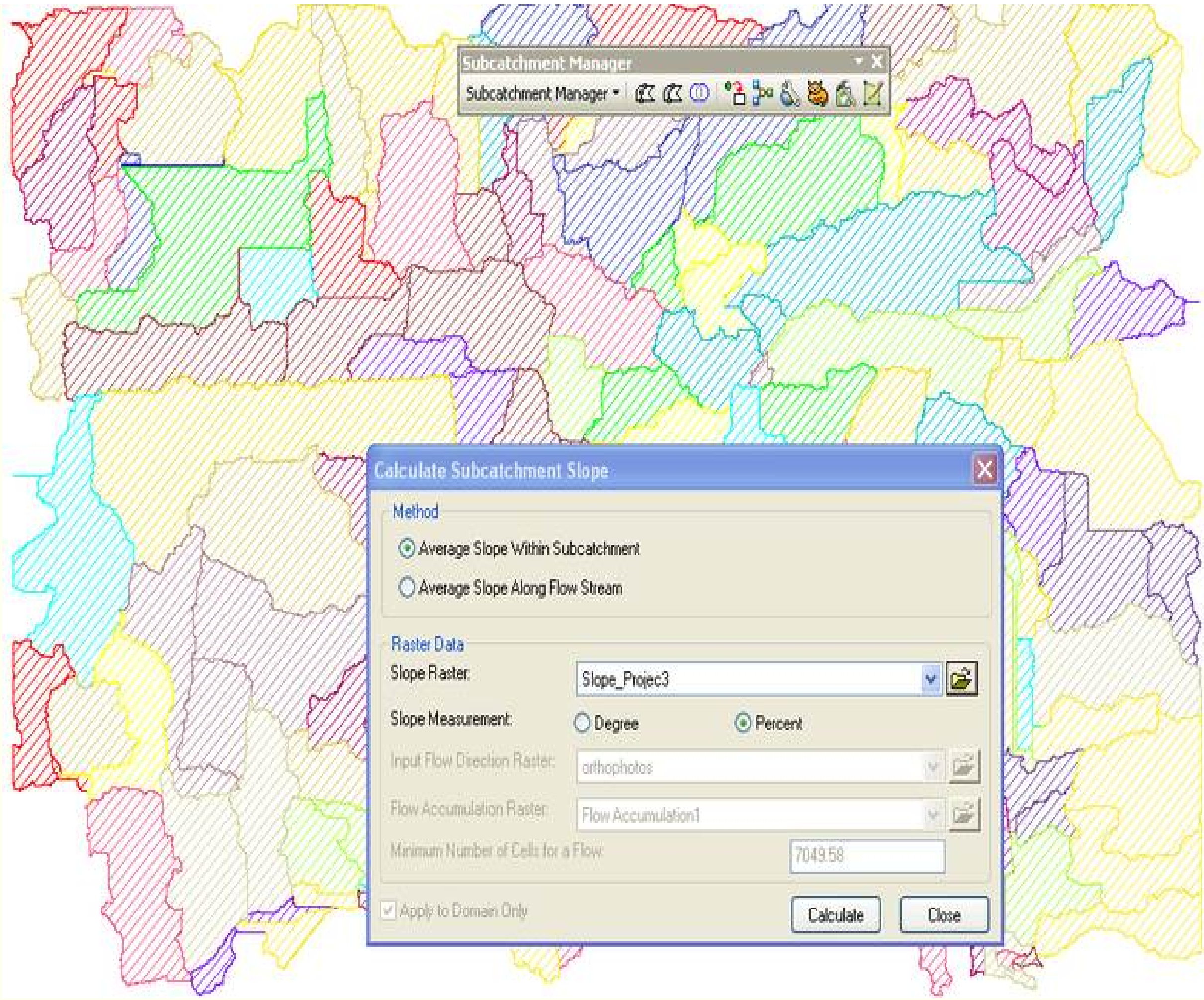
Step 2. Create a Slope Raster from the DEM for later usage in the Slope Calculator.



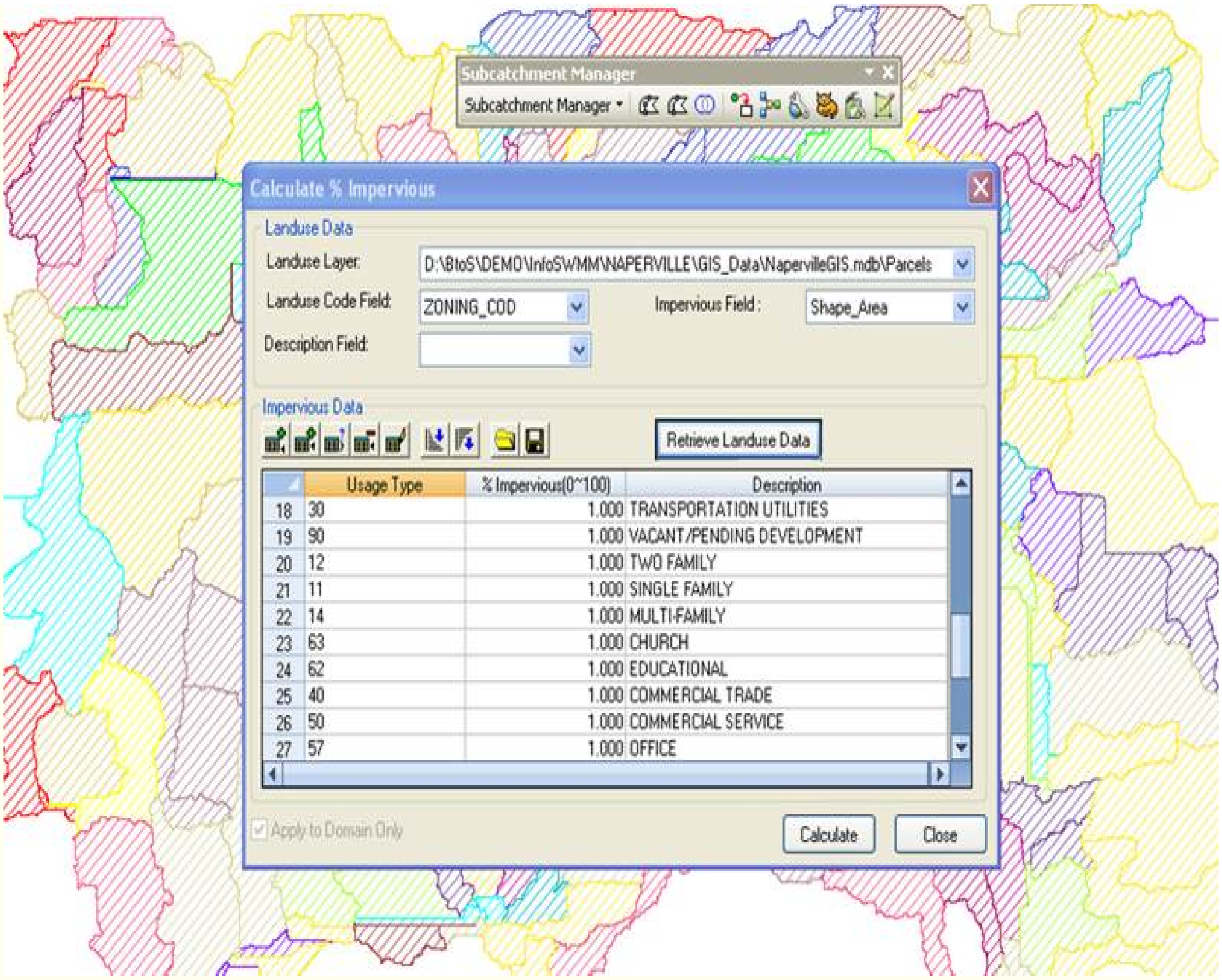
Step 3. Calculate the Width of the Subcatchment using one of five methods.



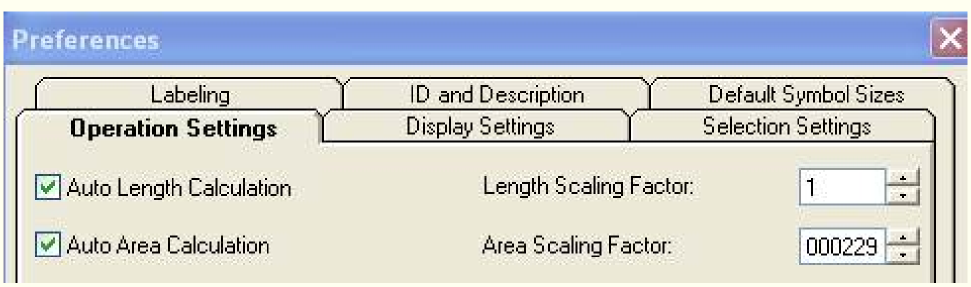
Step 4. Calculate the Slope in percent from the Slope Raster created in Step 2.



Step 5. Populate the Impervious area percentage using a Parcel shape file and the Created Subcatchments.



Step 6. Use Arc Map to calculate the area of the Subcatchments using the command Update DB from Map and the following Operation Flags.



How to Delete Invisible InfoSWMM Subcatchments

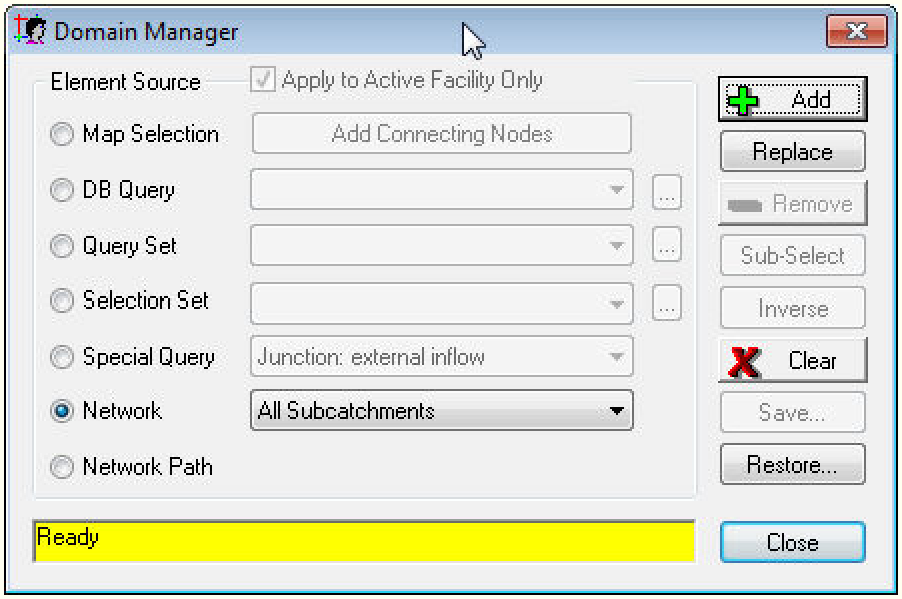
Note: You could delete the Subcatchments if you saw them on the screen. What I did here was to make a list of the Subcatchments I wanted to delete; made a simple SWMM 5 import file simply containing the Subcatchment names and the POLYGON field

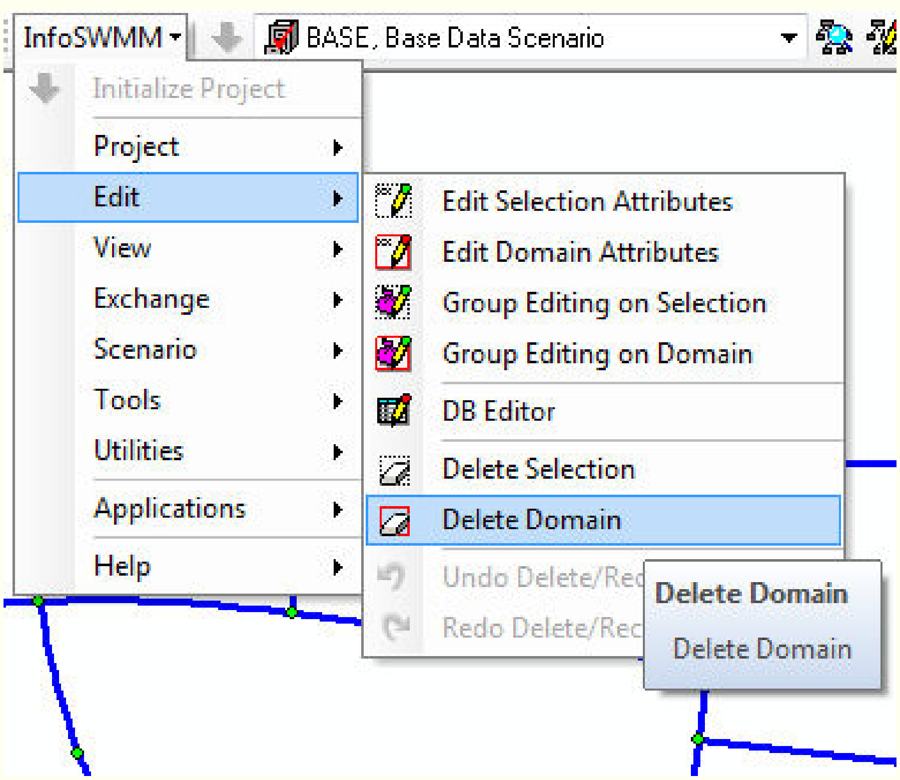
I found a workaround that uses a part of the SWMM 5 input file but does not require you to export all of the SWMM 5 data to EPA SWMM 5. If you make a POLYGON file in this example format for all of the Subcatchments you want to delete then you can import JUST the polygon data using the EPASWMM 5 import, selecting Clear All and Import. The Subcatchments can then be located using the Locate command and you can easily delete the data using the delete selection icon.
I found it is best to bring in the polygon surrounding the Subcatchment in the form of a triangle as this example shows.

[POLYGONS]
L33 1 1
L33 11 11
LS3 3 99
LS33 3 9
LS33 11 11
LS33 3 199

How to Delete All Subcatchments

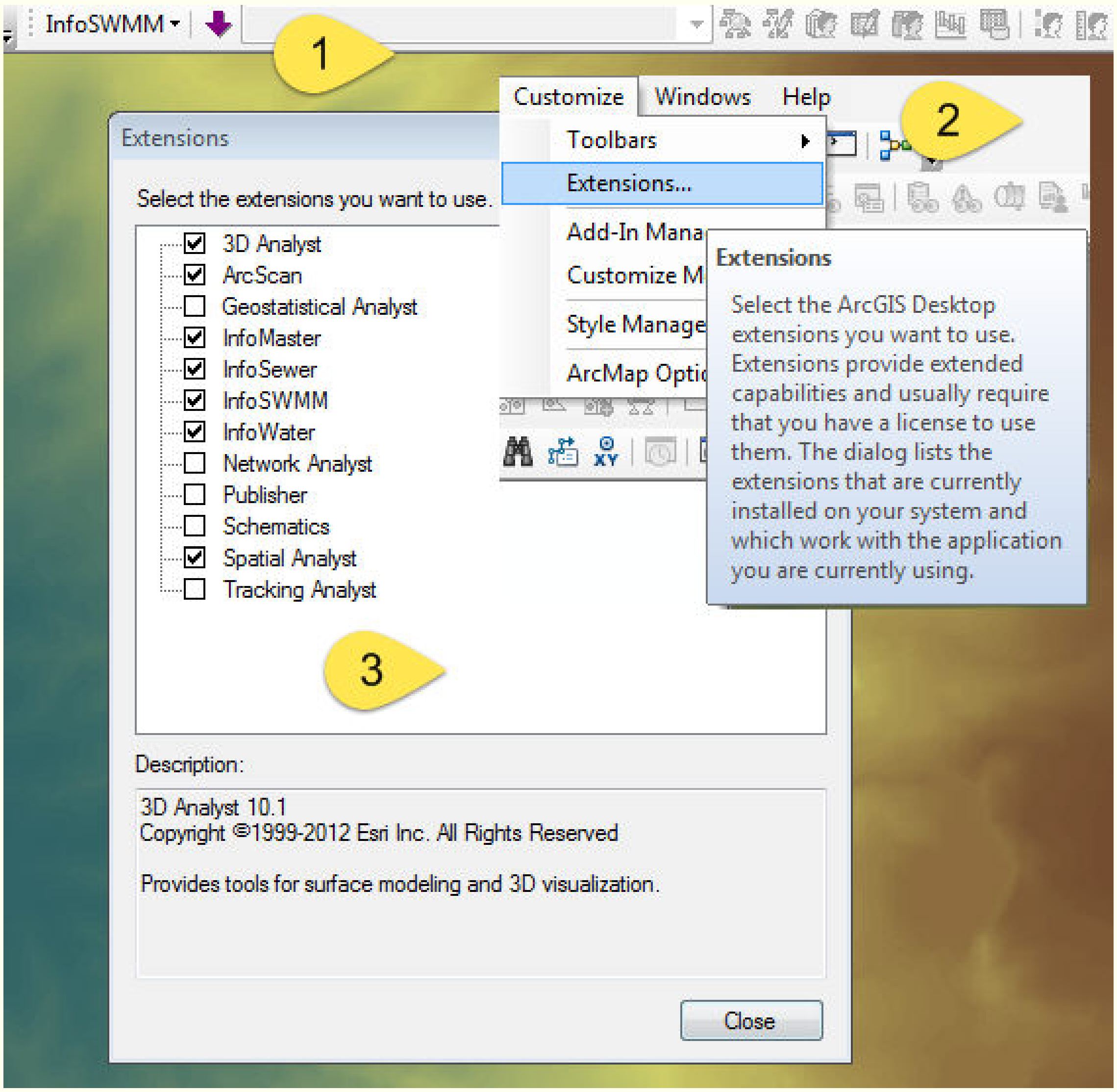
Procedure - Add all of the Subcatchments to the Domain and then delete the domain.



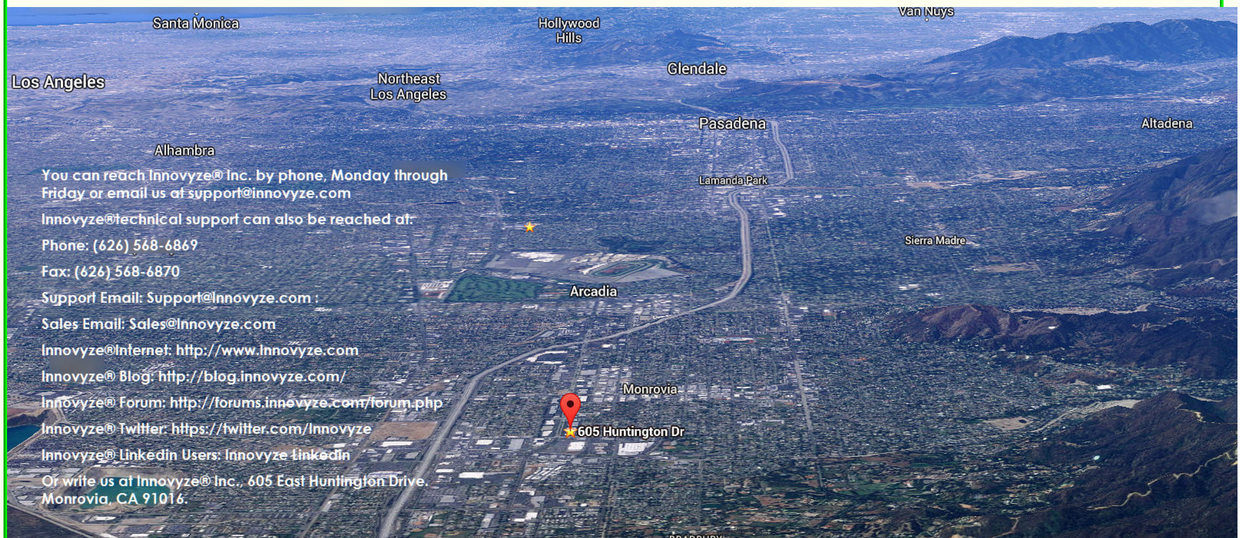


TroubleShooting New Installs

A common problem with new installs of InfoSWMMin a new version of Arc Map or a new Computer is having a greyed out Initialization Arrow. It normally is due to the Extension for InfoSWMM be turn off. You can find the Extensions in the Arc Map Customize Menu.



Contact Us



You can reach **Innovyze® Inc.** by phone, Monday through Friday or email us at support@innovyze.com

Innovyze®technical support can also be reached at:

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Fax: (626) 568-6870

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Sales Email: Sales@Innovyze.com

Innovyze®Internet: http://www.Innovyze.com

Innovyze® Blog: http://blog.innovyze.com/

Innovyze® Forum: http://forums.innovyze.com/forum.php

Innovyze® Twitter: https://twitter.com/Innovyze

Innovyze® Linkedin Users: Innovyze Linkedin

Or write us at **Innovyze® Inc., 605 East Huntington Drive. Monrovia, CA 91016.**

If you contact Innovyze by telephone you will be asked to supply a number of details:

- Your name
- Your company details
- Innovyze product name and version number
- Operating system on which the software is running
- The level of urgency of the problem
- A brief description of the enquiry, fault or problem

If you contact the support team by fax or e-mail, please include all this information. It will help us to deal with your request more quickly.

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