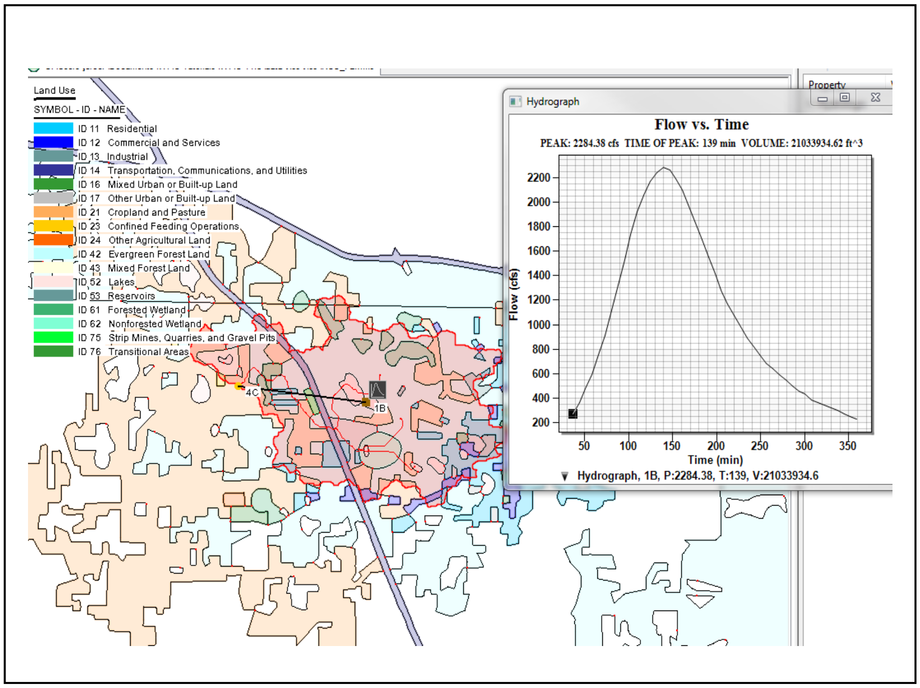
WMS

v. 11.0

WMS 11.0 Tutorial

Time of Concentration Calculations with NSS

Compute hydrologic parameters such as sub-basin time of concentration and curve number



Objectives

Learn how to compute coverage overlay percentages, time of concentration, and curve numbers for sub-basins.

Prerequisite Tutorials

- DEM Delineation

Required Components

- Data
- Drainage
- Map
- Hydrology
- Hydrologic Models
- NSS

Time

- 20–30 minutes

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1 Introduction

This tutorial discusses tools that are helpful in calculating the time of concentration (Tc) and in computing a composite curve number (CN). In particular the United States Geological Survey's (USGS) National Streamflow Statistics (NSS) will be discussed.

2 Getting Started

Starting with a new WMS project at the beginning of each tutorial is recommended. This resets the data, display options, and other WMS settings to their defaults. To do this:

1. If necessary, launch WMS.
2. If WMS is already running, press *Ctrl-N* or select *File* | **New…** to ensure that the program settings are restored to their default state.
3. A dialog may appear asking to save changes. Click **Don't Save** to clear all data.

The graphics window of WMS should refresh to show an empty space.

3 Opening the Drainage Basin

First, import a WMS project file containing a DEM previously downloaded from the Internet. A single watershed basin has been delineated from the DEM data and converted to feature objects.

1. Select *File* **| Open** to bring up the *Open* dialog.
2. Select "WMS XMDF Project Files (*.wms)" from the *Files of type* drop-down.
3. Browse to the nss\nss\ folder and select "NSS_FL.wms".
4. Click **Open** to import the project and exit the *Open* dialog.

A pre-delineated basin will appear in the Main Graphics Window (Figure 1).

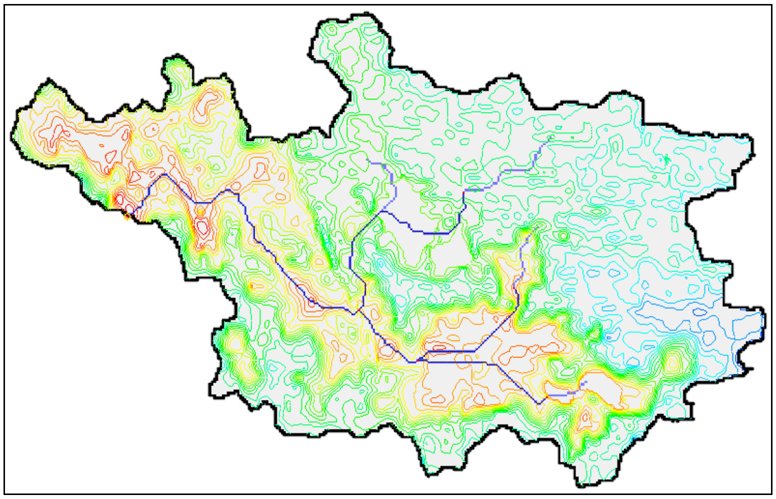

Figure 1 Initial pre-delineated basin

4 Preparing the Basin for Use with NSS

Now to use WMS to calculate the basin area, basin slope, and other parameters that can be used in conjunction with NSS.

1. Switch to the **Drainage** module.
2. Select *DEM* | **Compute Basin Data** to bring up the *Units* dialog.
3. Click **OK** to compute the parameters and close the *Units* dialog.

4.1 Display Settings and Appearance

To see the parameters that will be used with the NSS program, do the following:

1. Select *Display* | **Display Options…** to bring up the *Display Options* dialog.
2. Select "Drainage Data" from the list on the left.
3. On the *Drainage Data* tab, turn on *Basin Areas* and *Basin Slopes*.
4. Click **OK** to close the Display Options dialog.

Basin attributes are displayed at the centroid of the basin. In order to see the parameters more clearly, turn off the DEM visibility.

5. Expand the " Terrain Data" folder in the Project Explorer and turn off " DEM".

The project should appear similar to Figure 2.

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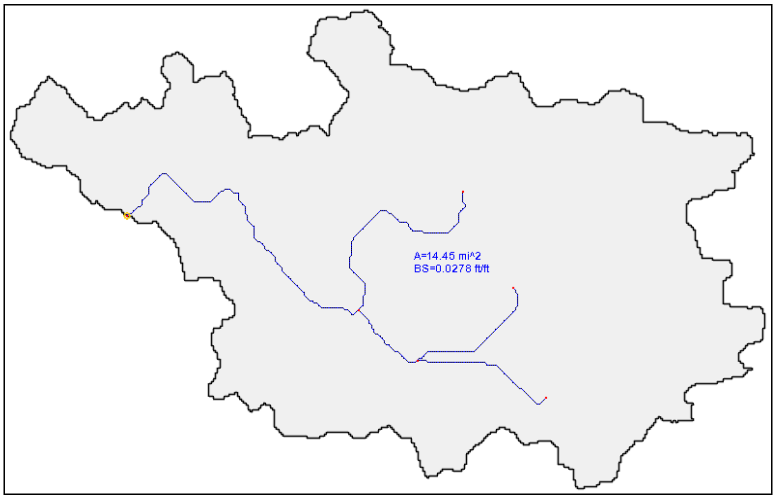

Figure 2 Drainage basin with parameters computed

5 Calculating Percentage of Lake Cover

The regression equation for Rural Region 2 of Florida includes a parameter (LK) to define the ratio of the area of lakes in the basin to the total basin area (as a percent). Use the *Compute Coverage Overlay* calculator in WMS to calculate the percentage of lake cover in the drainage basin.

The only other parameter in the regression equation for Rural Region 2 of Florida is drainage area (DA). This is automatically computed using the **Compute Basin Data** command.

5.1 Opening the Land Use Coverage

To compute the percentage of lake cover in the watershed, import land use data from a typical USGS land use file. Each polygon in the coverage is assigned a land use code that corresponds to a land use type. For this land use coverage, the codes for water bodies (lakes, reservoirs, wetlands) include 52, 53, 61, and 62. Look for these codes to determine the value for LK.

1. Right-click on " Coverages" in the Project Explorer and select **New Coverage** to bring up the *Properties* dialog.
2. Select "Land Use" from the *Coverage type* drop-down.
3. Click **OK** to close the *Properties* dialog.
4. Right-click on " GIS Data" and select **Add Shapefile Data…** to open the *Select shapefile* dialog.
5. Select "valdosta.shp" and click **Open** to import the shapefile and close the *Select shapefile* dialog.

This land use shapefile was obtained from Web GIS,[1] but the EPA and other websites contain similar information. Alternatively, land use polygons could have been digitized from an image as discussed in the "Introduction – Basic Feature Objects" tutorial.

6. Right-click on " Drainage" and select **Zoom to Layer**.
7. Select " Land Use" to make it the active coverage.

Notice that the drainage basin boundary and streams become grayed out.

8. Switch to the **GIS** module.
9. Using the **Select Shapes** tool, drag a selection box surrounding the grayed out border of the drainage basin polygon.
10. Select *Mapping* **| Shapes → Feature Objects** to bring up the *GIS to Feature Objects Wizard* dialog.
11. Select "Land Use" from the *Select a coverage for mapping* drop-down.
12. Click **Next** to go to the *Step 2 of 3* page of the *GIS to Feature Objects Wizard* dialog.
13. In the *Mapping Preview* section, select "Land use" from the *LUCODE* column drop-down.
14. Click **Next** to go to the *Step 3 of 3* page of the *GIS to Feature Objects Wizard* dialog.
15. Click **Finish** to close the *GIS to Feature Objects Wizard* dialog.
16. Turn off " valdosta.shp" in the Project Explorer.

Only the portion of the shapefile that was selected will be used to create polygons in the Land Use coverage. Figure 3 shows the resulting land use polygons and their respective land use codes. This land use classification is consistent among all of the USGS land use data, where codes from 10–19 are urban, 20–29 agricultural, etc. A complete listing of code values can be found in the WMS Help file.

The colors used for each code (Landuse ID) and the associated polygons can be changed, if desired.

1. Click **Display Options** to bring up the *Display Options* dialog.
2. Select "Map Data" from the list on the left.
3. On the right side, turn on *Land Use Legend*.
4. Turn on "Color Fill Polygons".
5. Click **Land Use Display Options** to bring up the *Land Use Display Options* dialog.
6. Select the desired "Landuse ID" from the list on the left and use the *Color* drop-down to set the desired color.
7. Repeat step 5 until the desired colors are set, then click **OK** to close the *Land Use Display Options* dialog.

[1] See http://www.webgis.com/.

8. Click **OK** to close the *Display Options* dialog.

Figure 3 shows a typical set of colors for ease of viewing.

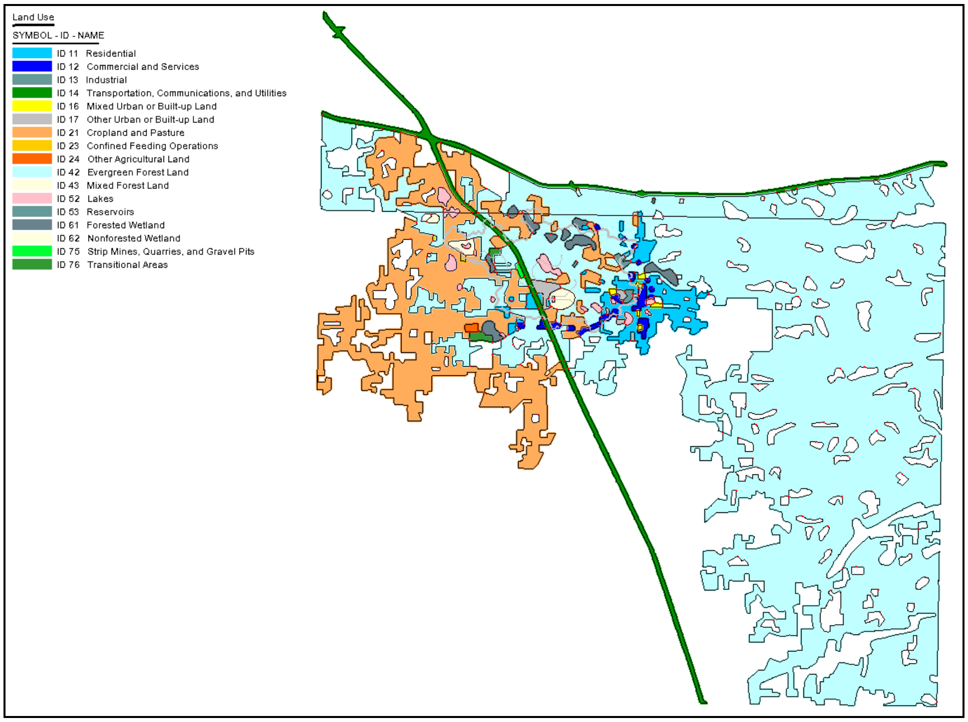

Figure 3 Land use codes used in “valdosta.shp”

5.2 Using the Compute Coverage Overlay Calculator

1. Switch to the **Hydrologic Modeling** module.
2. Select *Calculators* **| Compute Coverage Overlay…** to bring up the *Coverage Overlay* dialog.
3. Select “Drainage” from the *Input Coverage* drop-down.
4. Select “Land Use” from the *Overlay Coverage* drop-down.
5. Click **Compute**.

According to the USGS land use classification, code values in the 50’s and 60’s represent water bodies. To obtain the value for LK, sum together the computed overlay percentages for Land Uses 52, 53, 61, and 62, as shown in Figure 4.

This calculator can be used in a similar fashion to determine the percentage of forested areas (codes in the 40’s) or any other classification type in a land use or soil file.

6. Click **Done** to close the *Coverage Overlay* dialog.

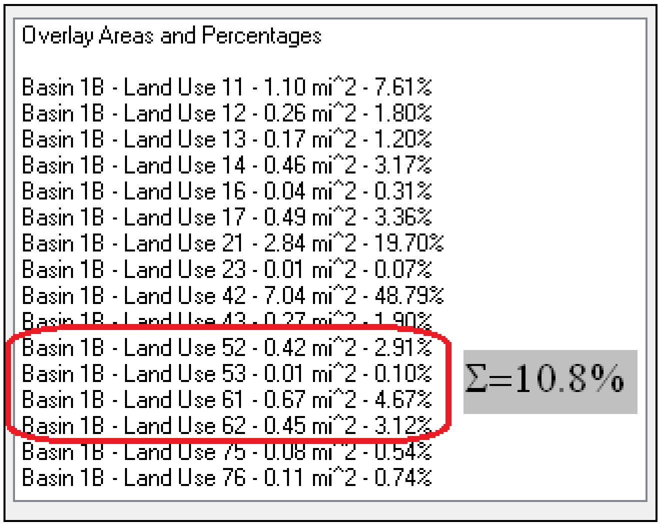

Figure 4 Summing the percentages of the codes representing water cover

6 Running NSS

The geometric data computed from the DEM has automatically been stored with the NSS data. Now run a simulation using the derived data.

1. Make sure that the Model drop-down is set to "NSS" (Figure 5).

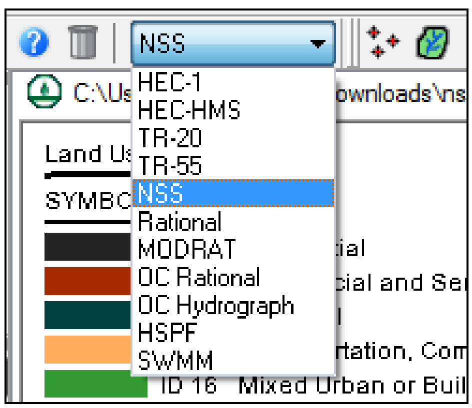

Figure 5 The Model drop-down

2. Using the **Select Basin** tool, double-click on the brown basin icon for Basin 1B (Figure 6) to bring up the *National Streamflow Statistics Method* dialog. It may be difficult to see the icon with all of the land use data, so **Zoom** in if necessary.

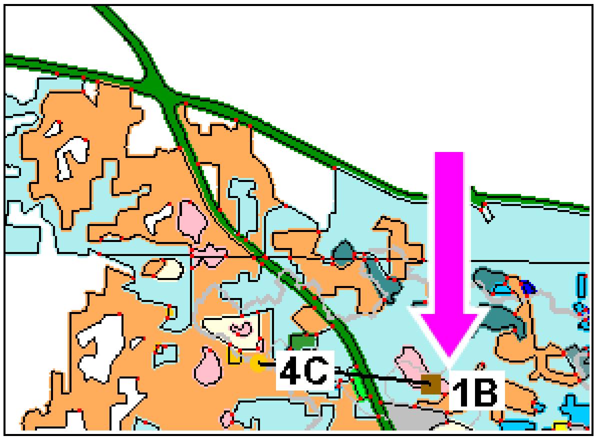

Figure 6 Location of Basin 1B icon (magenta arrow)

3. In the *Basin information* section, select “Florida” from the *State* drop-down.
4. In the *Regional regression equations* section, select “Rural Region 2 2011 5034” from the *Available Equations* list.
5. Click **Select→** to move the selected region to the *Selected Equations* list.
6. In the *Variable values* section, enter “10.8” in the *Value* column for the *Percent Storage from NLCD1992* variable.

Resize the dialog, if necessary, to see the *Percent Storage from NLCD1992* variable.

7. In the *Results* section, click **Compute Results**.

The peak flow (Q) values should appear in the spreadsheet below the **Compute Results** button.

6.1 Exporting the Flow Data

Once flow data is computed, it may be exported to a text file in the format shown in the window, along with pertinent information used in computing the peak flow values.

1. Below the spreadsheet, click **Export** to bring up the *Select the file name for the spreadsheet export file* dialog.
2. Select “Comma-Separated Values File (*.csv)” from the *Save as type* drop-down.

The file may be saved in any directory, as desired. In this case, it will be saved with the other project files for this tutorial.

3. Enter “nss_fl_export.csv” as the *File name*.
4. Click **Save** to export the file and close the *Select the file name for the spreadsheet export file* dialog.

Do not close the *National Streamflow Statistics Method* dialog yet. The exported file can be viewed using any word processor or inserted into a separate report document.

7 Time Computation / Lag Time Calculation

The NSS program provides a way to determine an average hydrograph based on the computed peak flow and a basin lag time. A dimensionless hydrograph is used to define a basin hydrograph for the watershed based on the computed peak flow.

1. In the *Results* section, scroll down to and select the "50" in the *Recurrence [years]* column.
2. Click **Compute Hydrograph…** to bring up the *NSS Hydrograph Data* dialog.
3. Click **Compute Lag Time – Basin Data…** to bring up the *Basin Time Computation* dialog.
4. Select "Custom Method" from the *Method* drop-down. It is the last option.
5. Click **OK** to close the *Basin Time Computation* dialog.

The computed lag time in minutes is shown in the *Basin lag time* field in the *Compute lag time* section. Time of concentration equations can also be used to calculate the basin lag time. WMS will convert the time of concentration to lag time by the equation:

$T_{lag} = 0.6*T_{c.}$

6. Click **Compute Lag Time – Basin Data…** to bring up the *Basin Time Computation* dialog.
7. Select "Compute Time of Concentration" from the *Computation type* drop-down.
8. Select "Kerby Method for overland flow" from the *Method* drop-down.
9. Click **OK** to close the *Basin Time Computation* dialog.

Note the difference in the calculated lag time between the two methods. These two equations, along with the other available options in the *Basin Time Computation* calculator, can be used to estimate the lag time of the basin. Compare the results of the different equations available to best describe the characteristics of the basin.

10. Click **OK** to close the *NSS Hydrograph Data* dialog.
11. Click **Done** to close the *National Streamflow Statistics Method* dialog.
12. Select the **Select Hydrograph** tool.

A hydrograph icon will appear next to the basin icon for Basin 1B. Examine the hydrograph in more detail:

13. Using the **Select Hydrograph** tool, double-click on the hydrograph icon to bring up the *Hydrograph* dialog.

The hydrograph for Basin 1B is displayed in the *Hydrograph* dialog.

14. Click the in the top right corner of the *Hydrograph* dialog to close it.

8 Conclusion

This completes the "Time of Concetration Calculations with NSS" tutorial. The following key topics were discussed and demonstrated:

- Preparing a basin to be used with the NSS model
- Calculating land use coverage percentages
- Running NSS

