WMS 11.2 Tutorial

DEM Delineation – Stream Arcs

Model man-made and natural drainage arcs

Objectives

Learn to manipulate the default watershed boundaries by assigning map features such as road embankments, gutters, and known watershed boundaries to watershed delineations.

Prerequisite Tutorials

- DEM Delineation

Required Components

- Data
- Drainage
- Map

Time

- 15–20 minutes

AQUAVEO™

1 Introduction

Some terrain features are not well represented in DEMs, especially if the DEM resolution is coarse. This can lead to erroneous automated watershed delineation. In addition, it may be desirable to evaluate future alterations in terrain that result from development scenarios. WMS has tools for manipulating DEM delineation results in order to accurately represent the actual watershed drainage basins.

Sometimes it is necessary to add stream arcs to a basin to represent water that accumulates along, in, or behind man-made objects such as roads, canals, dams, dikes, or levees. These often disrupt the natural flow of watersheds, acting as a barrier that collects water, creating a man-made stream or collection pond. The water collected in these locations needs to be added into the watershed in order to properly model the hydrology. Stream arcs can be used to edit flow directions associated with the DEM, routing water into the proper drainage basins.

This tutorial teaches how to manipulate DEM data for more accurate drainage analysis by discussing and demonstrating how to use stream arcs to manipulate basin delineation.

2 Getting Started

Starting WMS new 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.

Next, open the starting project file containing a DEM data file and background image. Complete this by doing the following:

1. Click **Open** to bring up the *Open* dialog.
2. Browse to the *demdel-stream-arcs**demdel-stream-arcs*\ directory and select "start.wms".
3. Click **Open** to exit the *Open* dialog and import the project.

The Graphics Window should appear similar to Figure 1.

Figure 1 With topo map background

3 Running TOPAZ

Run TOPAZ to compute flow direction and accumulation grids.

1. Switch to the **Drainage** module.
2. Select *DEM* | **Compute Flow Direction/Accumulation…** to bring up the *Flow Direction/Accumulation Run Options* dialog.
3. Click **OK** to close the *Flow Direction/Accumulation Run Options* dialog and open the *Units* dialog.
4. In the *Parameter units*, select “Square miles” from the *Basin Areas* drop-down.
5. Click **OK** to close the *Units* dialog and open the *Model Wrapper* dialog.
6. Once TOPAZ finishes running, turn on *Read solution on exit* and click **Close** to exit the *Model Wrapper* dialog.
7. Right-click on “ 86666671 (Converted)” in the Project Explorer and select **Display Options…** to bring up the *Display Options* dialog.
8. Select “DEM Data” from the list on the left.
9. On the *DEM* tab, enter “0.04” as the *Minimum Accumulation For Display.*
10. Click **OK** to close the *Display Options* dialog**.**

4 Basin Delineation

1. **Zoom** in to the area near the bottom of the project as indicated in Figure 2.

Figure 2 Zoom area

2. Switch to the **Drainage** module.
3. Using the **Create outlet point** tool, click anywhere on the DEM to create an outlet.
4. Click **OK** if a message appears stating that the outlet is not located in a flow accumulation cell.
5. In the *Properties* window on the right side of the WMS display, enter "373777.7" as the *Feature Point X* and "3784742.5" as the *Feature Point Y*.

This moves the outlet location to the new coordinates near the lower right of the area selected in step 1.

6. Select *DEM* **| Delineate Basins Wizard** to bring up the *Stream Feature Arc Options* dialog.
7. Click **OK** to close the *Stream Feature Arc Options* dialog and bring up the *Units* dialog.

This runs the WMS menu commands **DEM → Stream Arcs…**, **Define Basins**, **Basins → Polygons**, and **Compute Basin Dat**a.

8. Click **OK** to close the *Units* dialog.
9. Click **Display Options** to bring up the *Display Options* dialog.
10. Select "DEM Data" from the list on the left.
11. On the *DEM* tab, turn off *Fill Basin Boundary Only*.
12. Select "Map Data" from the list on the left.
13. On the *Map* tab, click **Drainage Basin Display Options** next to *Color Fill Polygons* to bring up the *Drainage Basin Display Options* dialog.
14. Click the button under *Pattern* on the right, select "Lime" from the list of colors.
15. Click **OK** to close the *Drainage Basin Display Options* dialog.
16. Select "Drainage Data" from the list on the left.
17. On the *Drainage Data* tab, turn on *Basin Names*, *Show Units*, *Basin Areas*, *Basin Slopes*, and *Max Flow Distance*.
18. Click **OK** to close the *Display Options* dialog.

The DEM cells assigned to the delineated drainage basin are now color-filled and should appear similar to Figure 3.

The results do not quite look like what might be expected in an urban area. Even though the drainage basin was delineated using ~10 meter elevation data, there are still many features of the urban terrain that are not well represented in the DEM data. One example is the railroad running diagonally across the lower portion of Figure 3 along which the outlet point is located.

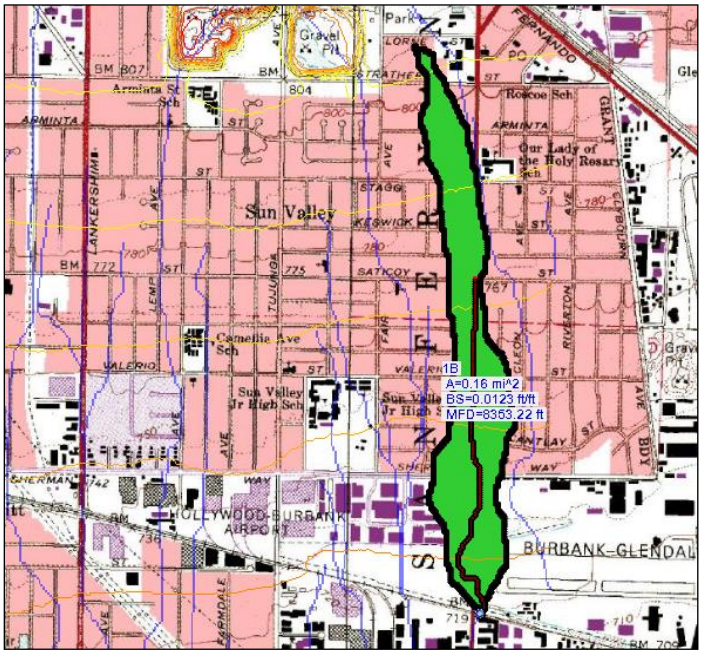

Figure 3 Initial delineation results

5 Displaying Flow Directions

The DEM flow directions will show water flowing right across the railroad tracks instead of collecting along the tracks.

1. Click **Display Options** to bring up the *Display Options* dialog.
2. Select “DEM Data” from the list on the left.
3. On the *DEM* tab, enter “5” as the *Point Display Step*.
4. Turn on *Flow Direction* and *Points*.
5. Click **OK** to close the *Display Options* dialog.

Notice that flow direction arrows for DEM points are visible. Because the display of flow directions is adaptive, not every DEM point has a flow direction arrow visible. More flow directions are displayed when zooming in and fewer flow directions are visible when zooming out.

6. **Zoom** in along the railroad tracks until the DEM flow directions for each DEM point are visible.

Notice that flow goes right over the railroad tracks.

7. Select *Display* **| Display Options…** to bring up the *Display Options* dialog.

8. Select “DEM Data” from the list on the left.
9. On the *DEM* tab, turn off *Flow Direction* and *Points*.
10. Click **OK** to close the *Display Options* dialog.
11. Right-click on “ Drainage” in the Project Explorer and select **Zoom To Layer**.

6 Adding Stream Arcs along Railroad

In WMS, a stream arc can be used to conceptually model runoff collecting along the railroad tracks.

1. **Zoom** in to the outlet point for the delineated drainage basin.
2. Switch to the **Map** module.
3. Select the **Create Feature Arc** tool.
4. Select *Feature Objects* **| Attributes…** to bring up the *Feature Arc Type* dialog.
5. In the *Type* section, select *Stream* and click **OK** to close the *Feature Arc Type* dialog.
6. Using Figure 4 as a guide, begin a new stream arc attached to the existing stream arc by clicking on the vertex just upstream of the outlet point.

Click far enough away from the outlet point that WMS does not snap to the outlet point.

Figure 4 Start point for the railroad stream arc

7. Using Figure 5 as a guide, create the arc along the railroad, double-clicking to end the arc at the location shown by the blue arrow (the orange arrow indicates where the arc started, just to the right of the outlet point).

Use the scroll wheel button on the mouse to zoom and pan while creating the arc.

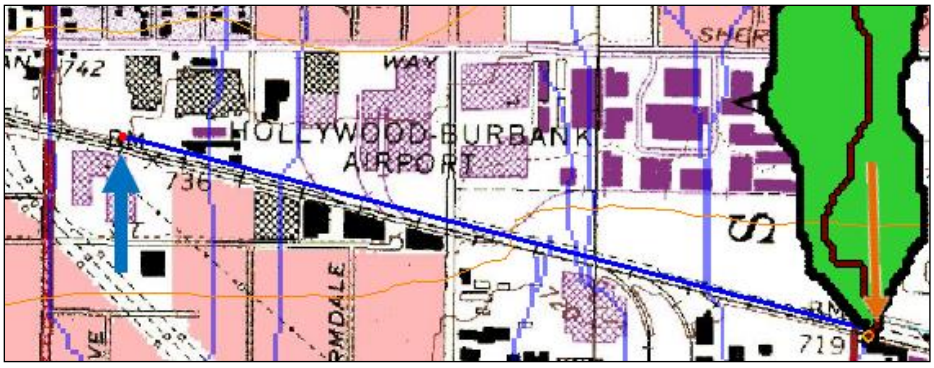

Figure 5 Start (orange) and end (blue) points of the railroad stream

7 Basin Delineation with the New Stream

When the basin is defined, WMS will change flow directions for DEM cells under the stream arc so that they are aligned with the stream arc. The basin definition will then include all area which has flow paths intercepted by the stream arc.

The **DEM** → **Stream Arcs…** and **Delineate Basins Wizard** menu commands for delineating drainage basins should not generally be used once the automated delineation results are manually manipulated—in this case, by adding a stream arc to collect runoff along the railroad tracks. This is because WMS will delete all existing feature data except for outlet points when these tasks are performed, removing the stream arcs added for manual manipulation as well. Instead, use the **Define Basins** and **Basins** → **Polygons** commands to update the delineation.

1. Switch to the **Drainage** module.
2. Select *DEM* **| Define Basins**.

Notice that the basin area has expanded significantly.

3. Select *DEM* **| Basins** → **Polygons**.

Notice that the polygon boundary has shifted to encompass the expanded area of the drainage basin (Figure 6).

4. Select *DEM* **| Compute Basin Data** to bring up the *Units* dialog.
5. Click **OK** to close the *Units* dialog.
6. Right-click on "Drainage" in the Project Explorer and select **Zoom To Layer**.

The drainage basin data has been recalculated (Figure 6).

Figure 6 New drainage basin area with basin data

7. Right-click on "86666671 (Converted)" in the Project Explorer and select **Display Options…** to bring up the *Display Options* dialog.
8. Select "DEM Data" from the list on the left.
9. On the *DEM* tab, turn on *Flow Direction* and *Points* and turn off *Stream*, *Flow Accumulation*, and *Color Fill Drainage Basins.*
10. Click **OK** to close the *Display Options* dialog.
11. **Zoom** in to the stream arc along the railroad track until flow directions for each DEM point are visible.

Notice that the flow directions are now aligned with the stream arc so that flow no longer crosses the railroad tracks. When zoomed out to the extents of the project, the Graphics Window should appear similar to Figure 7.

12. Right-click on "86666671 (Converted)" and select **Display Options…** to bring up the *Display Options* dialog.
13. Select "DEM Data" from the list on the left.
14. On the *DEM* tab, turn off *Flow Direction* and turn on *Stream*, *Flow Accumulation*, *Color Fill Drainage Basins*, and *Fill Basin Boundary Only*.
15. Click **OK** to close the *Display Options* dialog.
16. Right-click on "Drainage" in the Project Explorer and select **Zoom to Layer**.

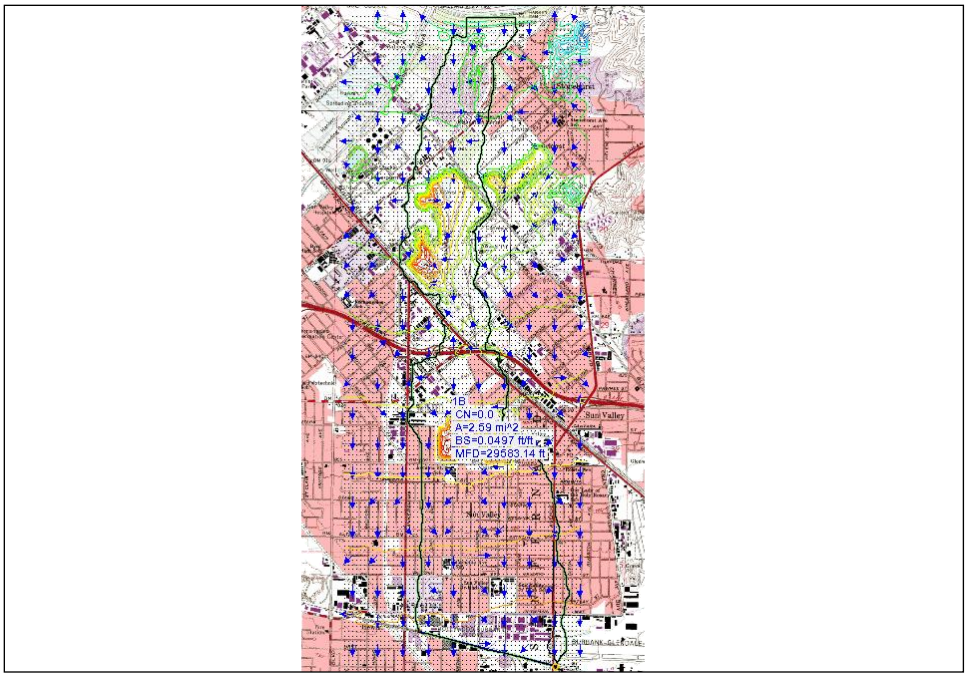

Figure 7 The drainage basin delineated with the railroad stream

8 Conclusion

This concludes the “DEM Delineation – Stream Arcs” WMS tutorial. These tools can be used for many different scenarios where the automated delineation does not yield the expected results.

The following basin delineation features were discussed and demonstrated:

- Using stream arcs to manipulate basin delineation
- Mapping polygons representing drainage basins to the DEMs

Feel free to continue to experiment with these tools, or exit the program.