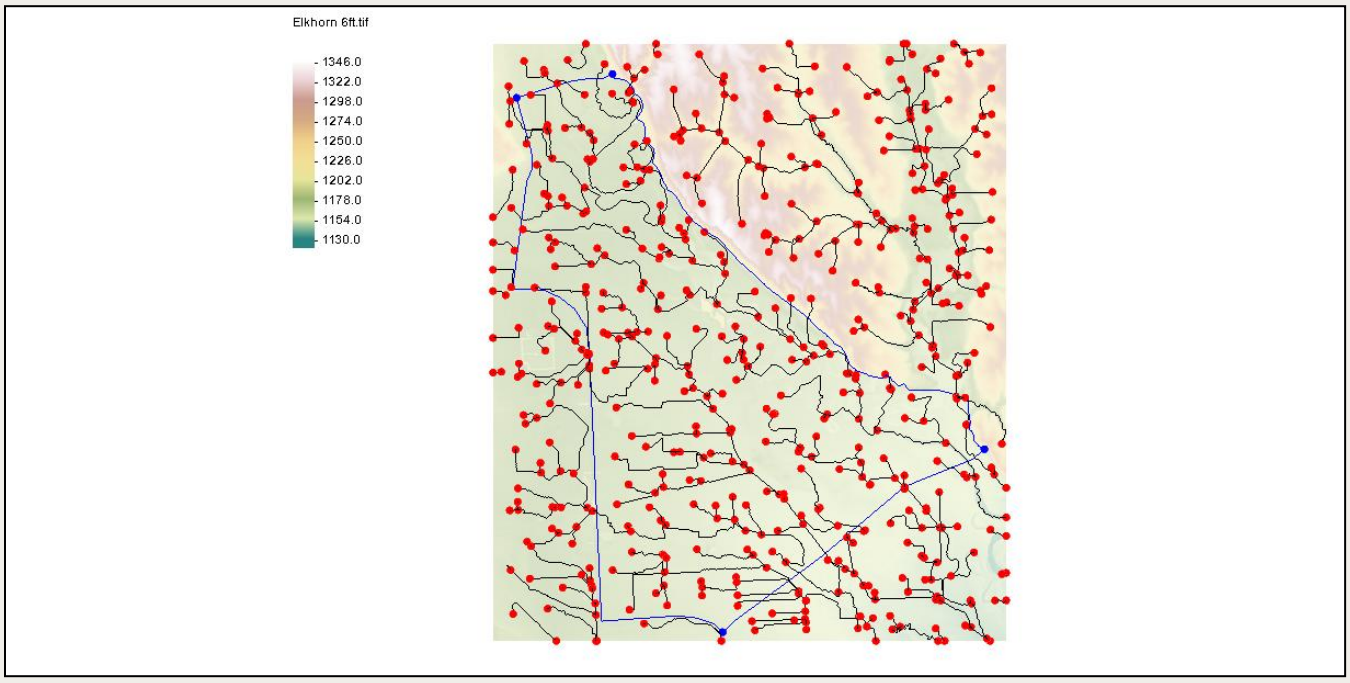
SMS 14.0 Tutorial

Extract Features for Mesh Generation

Extracting features arcs from a raster



Objectives

This tutorial demonstrates how to extract centerline and embankment feature arcs from a raster to use in generating a 2D mesh.

Prerequisite Tutorials

- Overview
- Map Module
- Raster
- Define Domain

Required Components

- SMS Core

Time

- 15–20 minutes

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1 Introduction

This tutorial demonstrates how to extract feature arcs from a raster. The features that will be extracted from raster data include stream centerlines, ridge centerlines, and channel banks.

The *Extract Features* function requires the existence of an elevation raster representing the topography in the model domain. This elevation raster can be imported or created in SMS from scatter data, mesh data, or LiDAR data.

This tutorial uses a location on the Elkhorn River in Nebraska. The project begins with a raster file and a map coverage identifying some locations in the coverage to keep the workflow consistent.

2 Getting Started

Start by importing a project file containing an existing mesh:

1. Launch the SMS application.
2. Select *File* | **Open…** to bring up the *Open* dialog.
3. Select "Project Files (*.sms)" from the *Files of type* drop-down.
4. Browse to the *data files* folder for this tutorial and select "Elkhorn.sms".
5. Click **Open** to import the project and exit the *Open* dialog.

The project should appear similar to Figure 1. The project contains an elevation raster and two map coverages. The "Guidance" coverage contains points that will be used to guide the generation of feature objects. The "Domain Limits" coverage contains arcs that define the domain limits of the project. See the "Define Domain" tutorial for how the domain limits were determined. The projection for the project has already been set.

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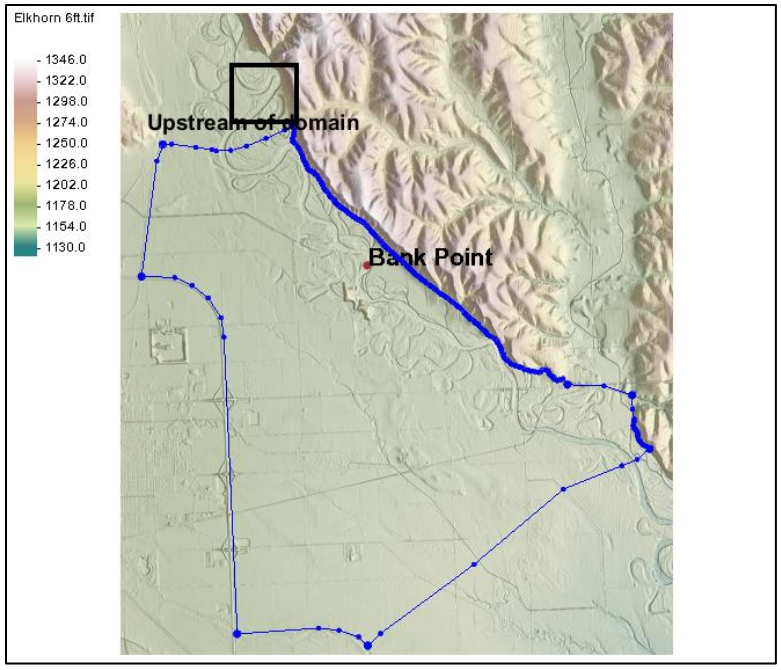

Figure 1 Initial project

3 Extracting a Stream Network

The *Features from Raster* tool can also be used to generate networks of streams or ridges represented in the raster. Normally it is good to be aware of the area of the domain when generating feature networks. To find the area of the domain:

1. Turn on and select the "Domain Limits" coverage to make it active.
2. Using the **Select Feature Polygon** tool, select the only polygon in the coverage.

At the bottom of the screen, SMS displays that the area of the domain is approximately 714 million square feet.

To generate a stream network:

3. Click the **Toolbox** macro to open the *Toolbox* dialog.
4. In the *Tools* tab, expand the "Coverages" folder.
5. Double-click on the **Features from Raster** tool to open the *Features from Raster* dialog.
6. For the *Input raster*, select "GIS Data/ElkhornRiver.tif".
7. For the *Feature type*, select "Stream".
8. In the *Input* section, for *Threshold area*, enter "2,000,000" square feet.

This represents approximately 0.30% of the area of the domain (2 M/668 M). A larger number will decrease the density of the network and make the operation faster. A smaller number will increase the density and make the operation slower.

9. For the *Pre-processing engine*, make certain it is set to "Whitebox rho8".
10. For the *Output Coverage*, enter "2,000,000 sq ft (0.30%) Streams".

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11. Click **OK** to close the *Features from Raster* dialog to run the tool.

The tool may take some time to run.

12. When the tool finishes, click **OK** to close the *Features from Raster* dialog.
13. In the Project Explorer, turn off all coverages except "2,000,000 sq ft (0.30%) Streams" to see the results.

Stream arcs have been generated for all streams in the raster (Figure 2).

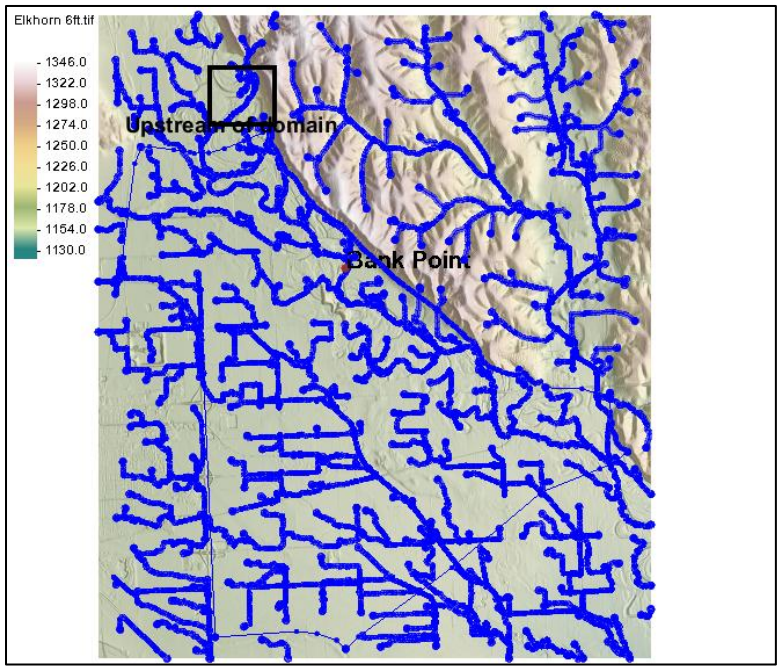

Figure 2 Streams extracted from the raster

4 Extracting the Main Channel

The *Extract Features* tool can extract streams from specific starting points. The starting point should be created in the channel area when extracting a stream arc. However, it does not need to be precisely positioned in the center of the channel. In this example, a starting point location has been created in the "Guidance" coverage so that the work flow will be consistent.

To extract a centerline arc, do the following:

1. Right-click on "2,000,000 sq ft (0.30%) Streams" and select **Duplicate**.
2. Right-click on the new "2,000,000 sq ft (0.30%) Streams (2)" coverage and select **Rename**.
3. Enter "Channel CL" as the new name.
4. In the Project Explorer, hide the "2,000,000 sq ft (0.30%) Streams" coverage.
5. Select the "Channel CL" coverage to make it active.
6. Select *Feature Objects* | **Clean…** to open the *Clean Options* dialog.
7. Turn on the *Full clean* and *Snap points, nodes, and vertices together* options. Turn off all other options.

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8. Click **OK** to close the *Clean Options* dialog.
9. **Zoom** into the area marked as “Upstream of domain”.
10. Using the **Select Feature Arc** tool, select the arc in the center of the marked area. (Figure 3)

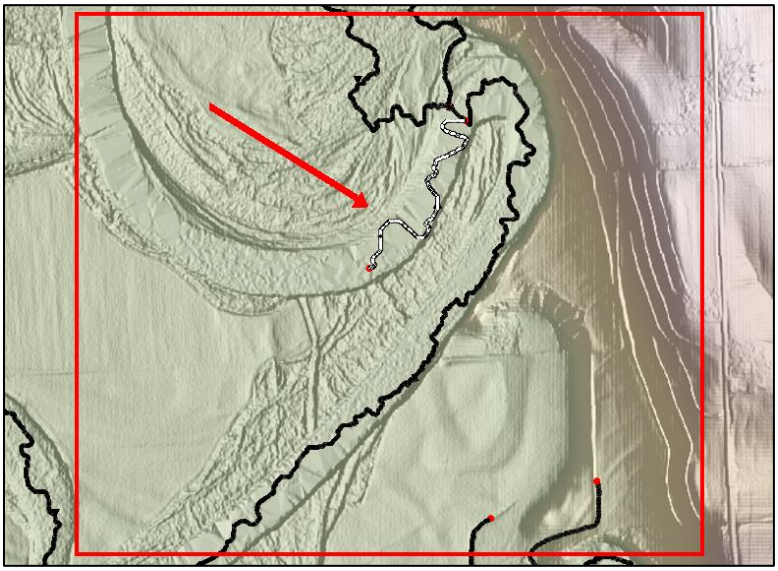

Figure 3 Location of starting arc

11. Right-click and choose *Select Connected Arcs* | **Forward in Stream**. This will select all arcs that are in the main channel of the stream.
12. Right-click and select **Invert Selection…** . Now all arcs outside of the main channel are selected.
13. Press the *Delete* key and click **Yes** at the warning to remove these arcs.
14. Using the **Select Feature Point** tool, right-click and choose Select All to select the nodes connecting the channel arcs.
15. Right-click and select **Nodes** ↔ **Vertices**. This will merge all the arcs into a single channel arc.

A stream arc should now be visible in the Graphics Window, as shown in Figure 4. Hide the other coverages if necessary in order to more clearly see the arc.

The data for this simulation does not include well-defined bathymetry. For this reason, the path of the channel centerline is rather jagged. This is a common occurrence when well-defined bathymetric cross sections were not available to represent the shape of the low flow channel. This makes this example similar to many of the projects that may be encountered in modeling practice. The purpose of this simulation is assumed to be to generate a maximum floodplain and subsequent floodway corridor, and that the approximate low flow channel is representative of the conveyance of the natural channel.

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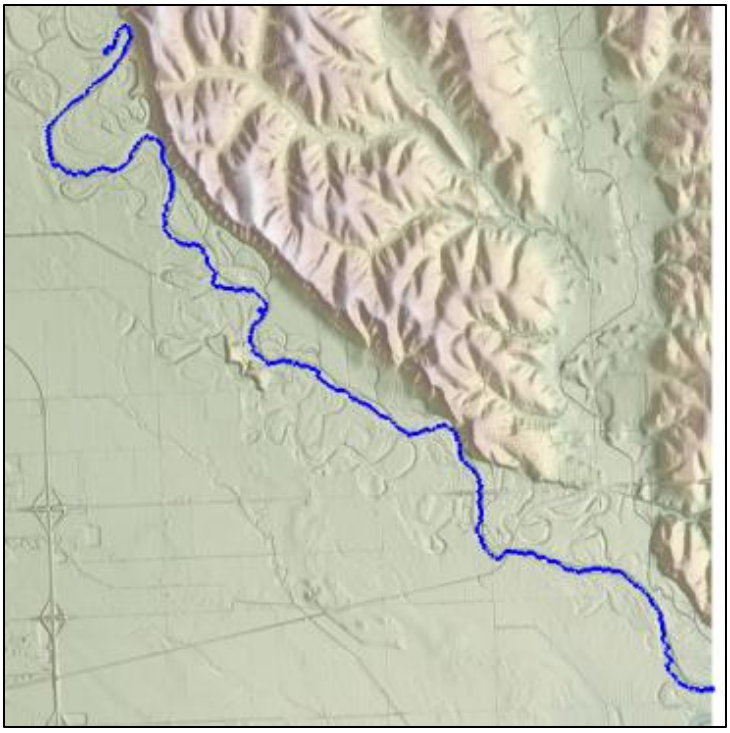

Figure 4 Stream arc created using the Extract Features tool

5 Extracting Channel Bank Arcs

The *Extract Features* tool can be used to generate arcs along channel banks or approximate flooding limits following a stream arc in a raster. A point along one of the channel banks identifying the desired water level is needed.

1. Turn on and select the "Guidance" coverage to make it active.
2. Using the **Select Feature Point** tool, select the point labeled "Bank Point".
3. Right-click and select **Copy to Coverage…** to open the *Select Coverage* dialog.
4. Select "Channel CL" and click **OK** to close the *Select Coverage* dialog.

To delineate a low flow channel, do the following:

5. Select the "Channel CL" coverage to make it active.
6. **Zoom** into the area around the bank point.
7. Using the **Select Objects** tool, select the stream arc by holding the *Ctrl* key down and dragging a line across the arc.
8. Hold down the *Shift* key and select the bank point.
9. Right-click and select **Extract Banks…** to bring up the *Extract Features (Beta)* dialog.
10. Ensure that the *Use the depth that is* option is set to "Closest to previous".
11. In the *Output Coverage* section, on the *Banks* line, enter the name "Channel" in the edit field.

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12. Click **OK** to close the *Extract Features (Beta)* dialog and run the tool.
13. Click on the "Channel" coverage to make it active and see the arcs extracted at the banks of the channel.

The channel bank arcs should appear on each side of the centerline arc (Figure 5).

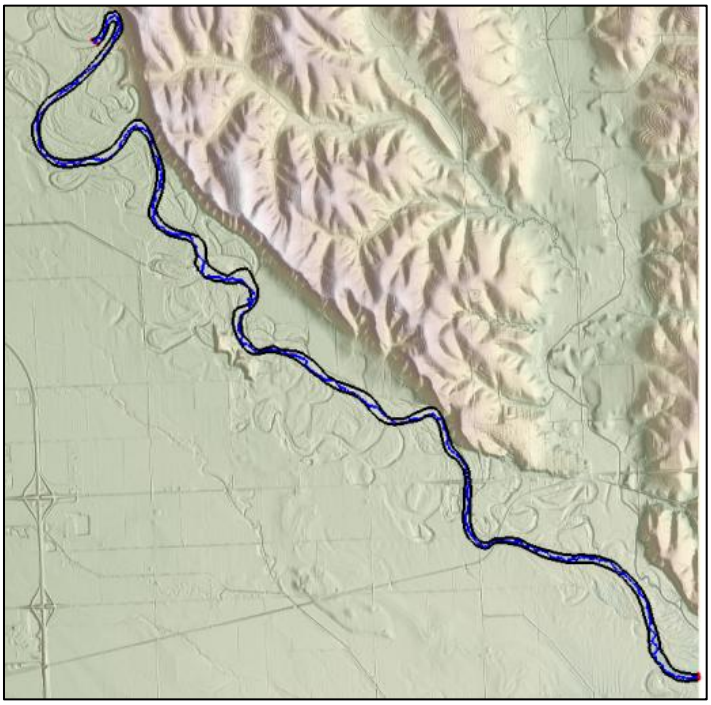

Figure 5 Low flow channel bank arcs created using the Extract Features tool

Note: because of the randomness of natural geography, the *Extract Features* tool may generate arcs that do not follow a bank consistently. See the wiki for guidance on placing the bank point and other options available.

Refer to the other tutorial on feature extraction for additional information on channel extraction.

6 Extracting a Network of Ridges

Ridge arcs can also be generated from a raster using the *Extract Features* tool. This process is similar to what was done to extract a stream network. To do this:

1. Click the **Toolbox** macro to open the *Toolbox* dialog.
2. In the *Tools* tab, expand the "Coverages" folder.
3. Double-click on the **Features from Raster** tool to open the *Features from Raster* dialog.
4. For the *Input raster*, select "GIS Data/ElkhornRiver.tif".
5. For the *Feature type*, select "Ridge".
6. In the *Input* section, for *Threshold area*, enter "4,000,000" square feet.
7. For the *Pre-processing engine*, make certain it is set to "Whitebox rho8".
8. For the *Output Coverage*, enter "4,000,000 sq ft (0.6%) Ridges".

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9. Click **OK** to close the *Features from Raster* dialog to run the tool.

The tool may take some time to run.

10. When the tool finishes, click **OK** to close the *Features from Raster* dialog.
11. In the Project Explorer, turn off all coverages except "4,000,000 sq ft (0.6%) Ridges" to see the results.

A network of ridge arcs has been generated from the raster data, as shown in Figure 6. Note how this network separates streams. Also note how the ridges also follow the roadway embankments.

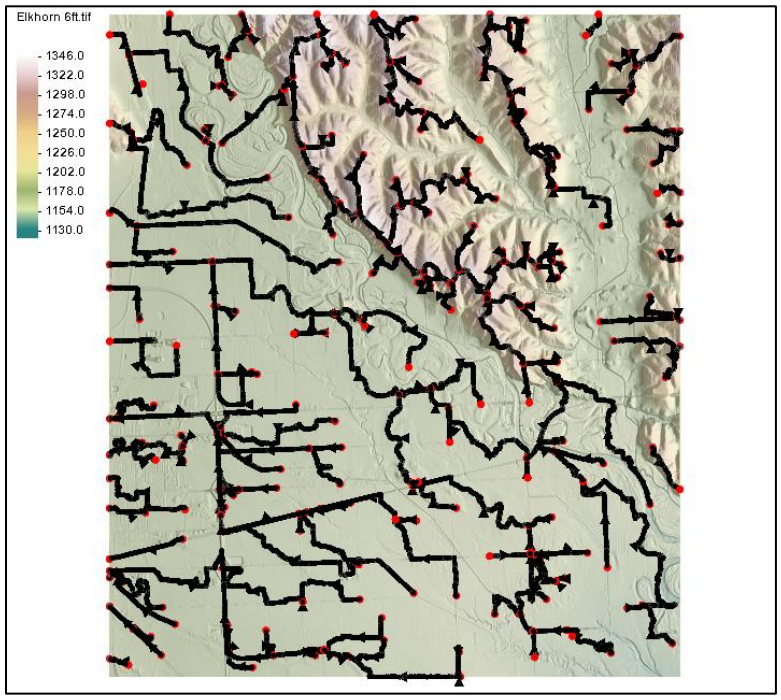

Figure 6 Ridges extracted from raster data with streams in background

7 Conclusion

This concludes the "Extract Features for Mesh Generation" tutorial. If desired, experiment with the following:

- Extracting networks with a variety of area thresholds.
- Extracting streams or ridges.
- Extracting channel banks from a variety of bank points.

The features generated in this tutorial are used to generate a mesh in the "Mesh Generation from Extracted Features" tutorial.

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