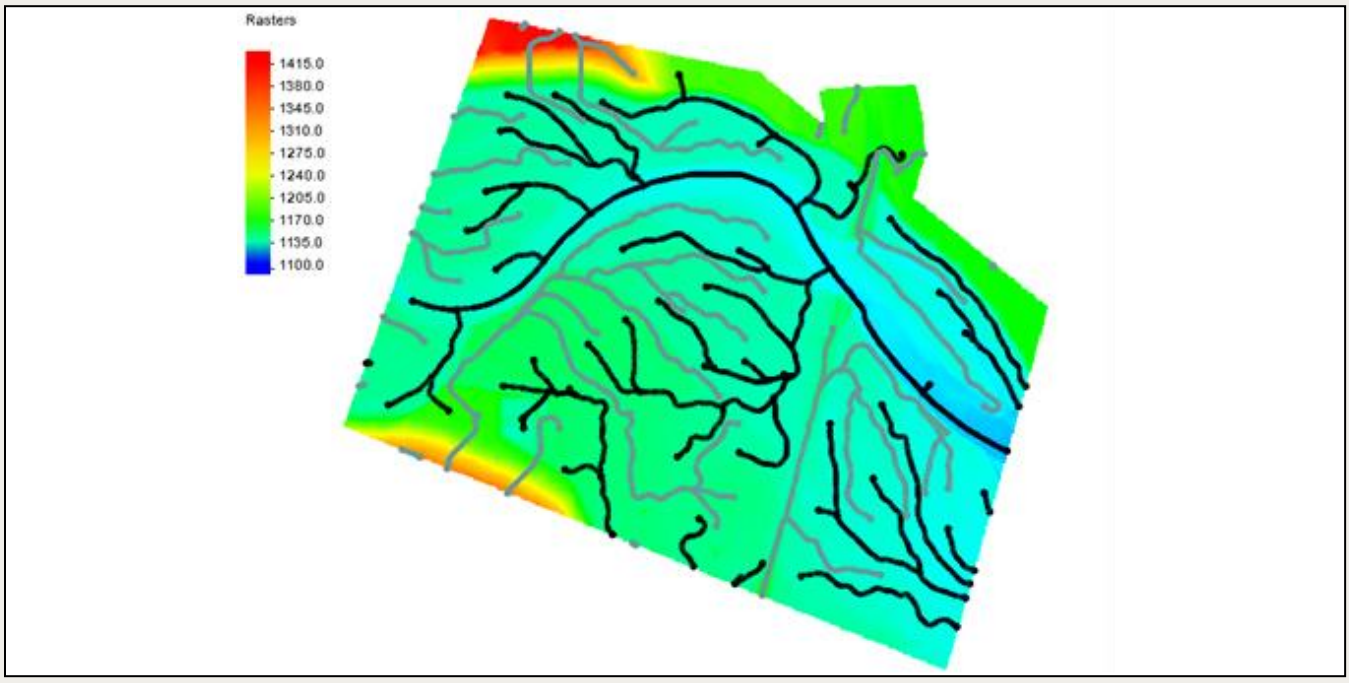
SMS 13.3 Tutorial

Extract Features

Extracting features from a raster



Objectives

This tutorial demonstrates how to extract centerline and embankment feature arcs from a raster.

Prerequisite Tutorials

- Overview
- Map Module
- Raster

Required Components

- SMS Core

Time

- 10–20 minutes

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1 Introduction

This tutorial demonstrates how to extract feature arcs from a raster. Features that can 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 created from scatter data, mesh data, or LiDAR data.

This tutorial makes use of a location on the Tazlina River in Alaska. The project begins with a raster file that has been trimmed to remove excess data. It also includes a map coverage with starting points for the project.

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 “start.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 a map coverage name “ Starting points”. In the coverage, multiple points exist that will be used throughout this tutorial.

> ***Note:*** the raster has been trimmed to remove digital dams. Digital dams, usually artifacts from stamping channels or from unprocessed LIDAR data, cause problems determining flow directions on the raster. The pre-processing engines (TOPAZ and TauDEM) fill these digital dams prior to computing flow directions. This can be a problem for the extraction process.

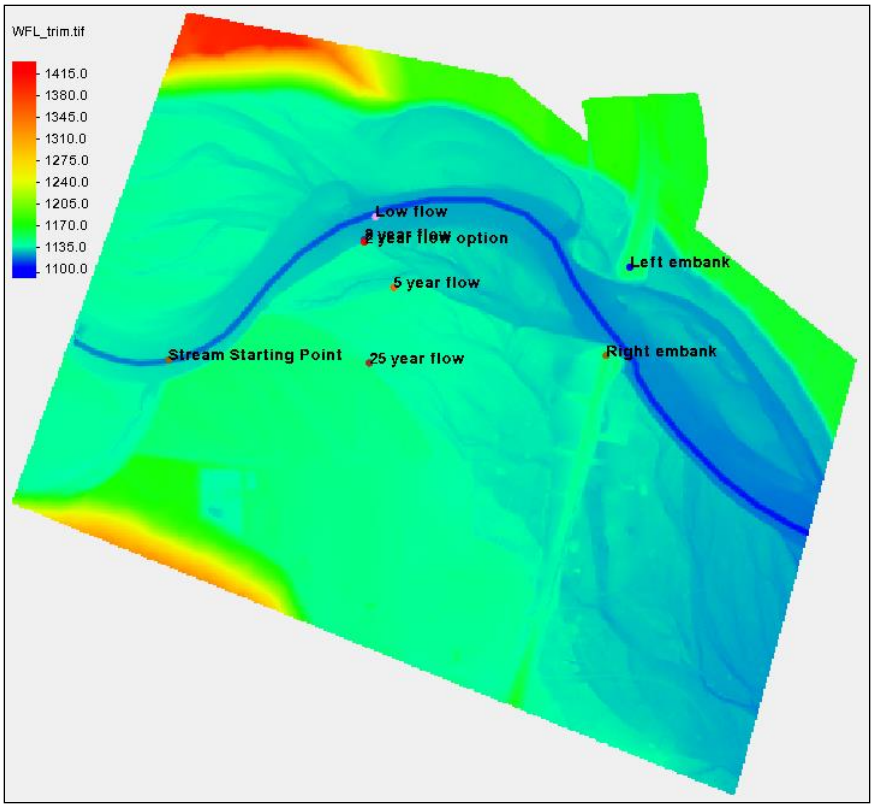

Figure 1 Initial project

3 Pre-Processing the Raster

The feature extraction function requires that the elevation raster is pre-processed using either the TOPAZ or the TauDEM pre-processor. These utilities compute flow directions and flow accumulation for each cell in the raster and handle raster anomalies such as local depressions (referred to as “pits”). This data is used to determine the location of channels and ridges. When running the pre-processor, accessory files are written for later use in Extract Features function. It is recommended that the image be processed before attempting to extract any features.

> ***Note:*** pre-processing can be quite time consuming. For some large rasters this can be hours.

To pre-process the image, do the following:

1. In the Project Explorer, right-click on the “ WFL_trim.tif” image and select **Run TOPAZ**.

SMS will launch the TOPAZ utility in a separate process. When the process is finished, a message will appear indicating that the process is complete and the feature extraction can proceed.

2. Click **OK** to close the message that TOPAZ has been run.

In this case, the pre-process operation is very fast, but it can be slow. If a user attempts to use any of the feature extraction functions without preprocessing, the pre-processor can be launched from inside the tool.

There are options in the feature extraction that can require the use of specified “pits”. In this case the pre-processor must be rerun each time the utility is executed. This feature is not illustrated in this tutorial.

4 Extracting a Stream

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 has already been created. The channel point has already been created on the map coverage.

To extract a centerline arc, do the following:

1. Select the “ Starting Points” coverage to make it active.
2. Using the **Select Feature Point** tool, select the point on the left labeled “Stream Starting Point”.
3. Right-click and select **Extract Feature…** to bring up the *Extract Feature* dialog.

Note that the message in the dialog reads: “Files exist. Ready to extract features.” This indicates that TOPAZ was run in the previous section.

4. In the *Output Coverage* section, select “Starting Points” as the output coverage for the *Stream/ridges*.

The default option of the *Stream/ridges* field is to create a new coverage that will contain the extracted features. However, in this case, the stream arc will be created on the “ Starting Points” coverage to use it in conjunction with other starting points in this tutorial.

5. Click **OK** to close the *Extract Features* dialog.

A stream arc should now be visible in the Graphics Window, as shown in Figure 2.

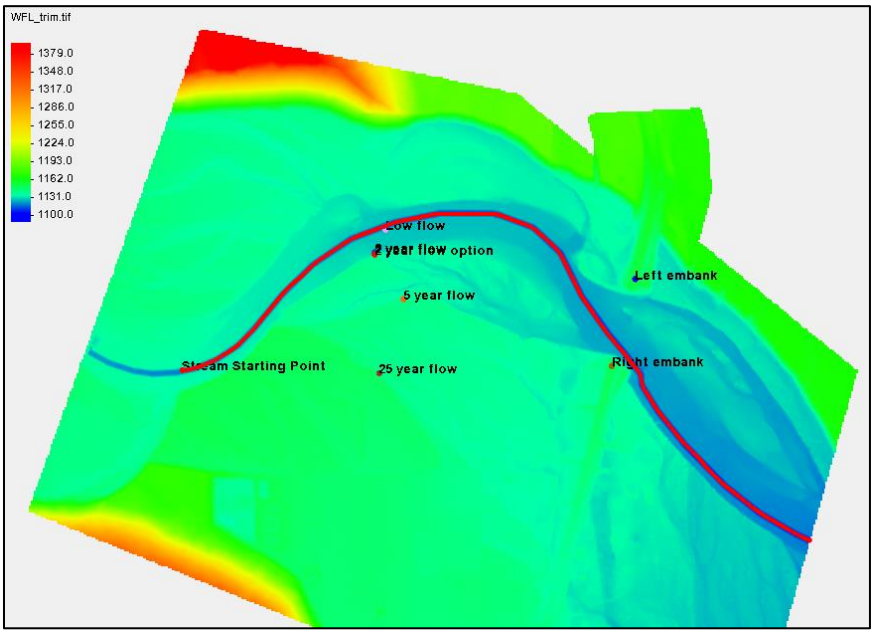

Figure 2 Stream arc created using the Extract Features tool

5 Extracting Channel Bank Arcs

The Extract Features tool can be used to generate arcs along channel banks or approximate flooding limits using a stream arc and a raster. A point along one of the channel banks identifying the desired water level is also needed. Multiple bank points have already been created in the "Starting Points" coverage.

To delineate a low flow channel, do the following:

1. Select the "Starting Points" coverage to make it active.
2. Using the **Select Objects** tool, select the stream arc by holding the *Ctrl* key down and dragging a line across the arc.
3. Hold down the *Shift* key and select the point labeled "Low flow" next to the channel.
4. Right-click and select **Extract Banks…** to bring up the *Extract Feature* dialog.
5. In the *Output Coverage* section, on the *Banks* line, enter the name "Low flow" in the edit field.
6. For the *Bank line smoothing*, select "Simple smoothing".

This option will smooth out the extracted feature to attempt to create a less erratic approximation to what could be very erratic natural bank lines. This is useful when the extracted features will be used to delineate "patches" for mesh generation. (See the Mesh Generation tutorial for more information.)

7. Click **OK** to close the *Extract Features* dialog.
8. Click on the "Low flow" coverage to see the arcs extracted at the banks of the low flow channel.

The channel bank arcs should appear on each side of the centerline arc (Figure 3).

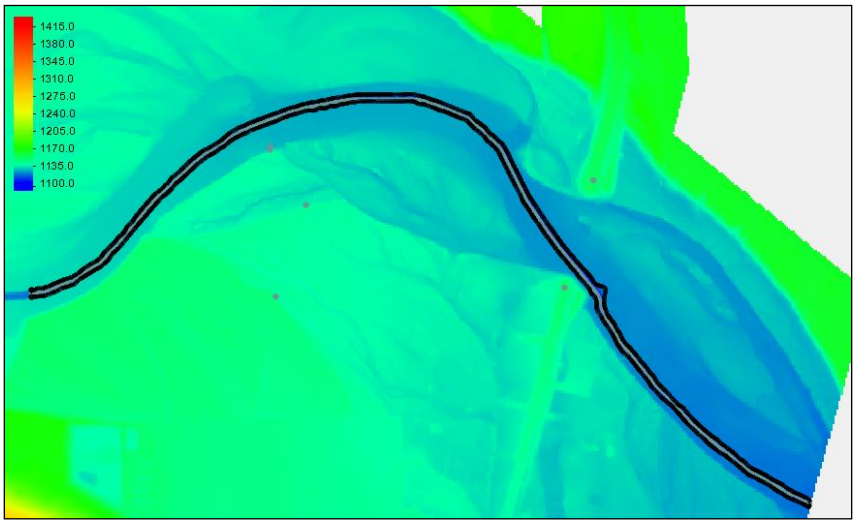

Figure 3 Low flow channel bank arcs created using the Extract Features tool

9. Repeat steps 1–8 using the point labeled "2 year flow" and creating a coverage named "2 year flow".

Note how the extracted arcs tend to follow the bank further away from the channel (Figure 4). This bank is not as strongly defined, so the bank arcs are more erratic.

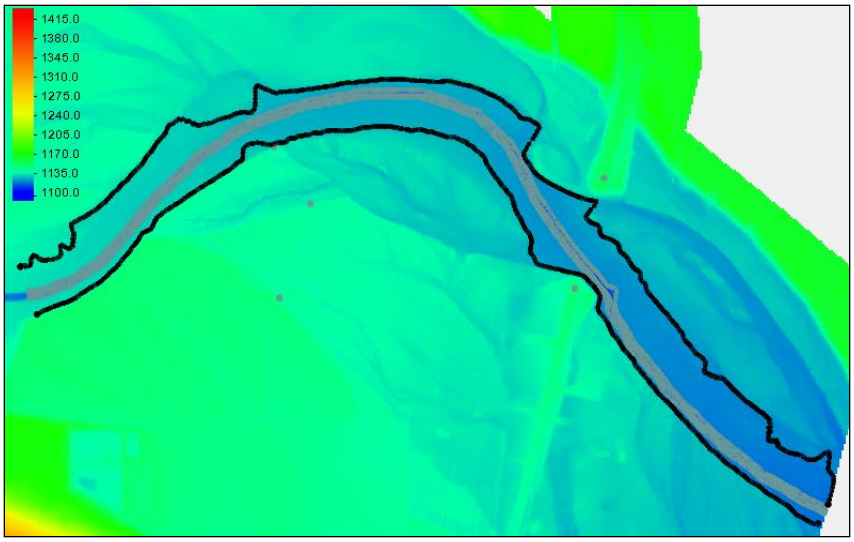

Figure 4 2 year flow channel bank arcs

10. Repeat steps 1–8 using the point labeled “2 year flow (option)” and creating a coverage named “ 2 year flow (option)”.

This point is located a few feet higher up the bank, but that difference causes the bank arcs to become erratic across the flood plain (Figure 5). This illustrates that it may produce more usable results if the bank point is moved away from the lip of the bank.

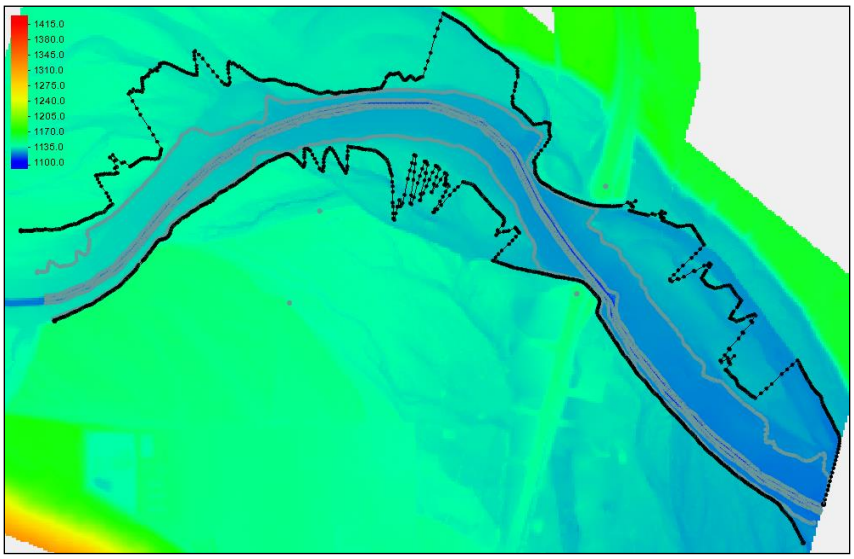

Figure 5 2 year fow (optional) channel bank arcs

11. Repeat steps 1–8 using the point labeled “5 year flow” and creating a coverage named “5 year flow”. However, this time change the *Use the depth that is* option in the *Input* section to “Closest to previous”.

This option addresses a situation where the same water level could exist more than one time in a floodplain cross section. In this case the option is set to use the option closest to bank point upstream and downstream. Also note that the roadway embankment interferes with the natural features of the bank line (Figure 6). Future versions of this tool may address this type of anomaly.

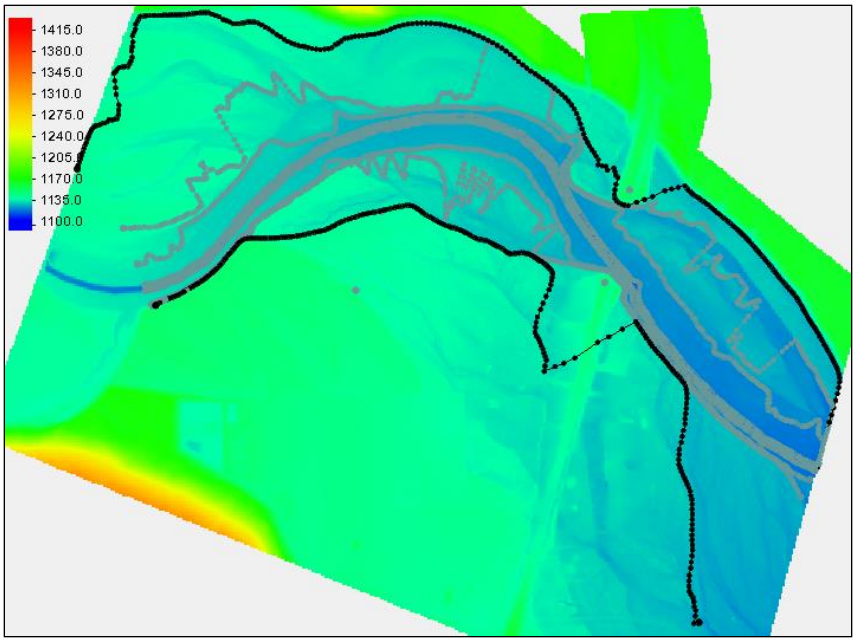

Figure 6 5 year flow channel bank arcs

12. Repeat steps 1–8 using the point labeled “25 year flow” and creating a coverage named “25 year flow”. Again change the *Use the depth that is* option in the *Input* section to “Closest to previous”.

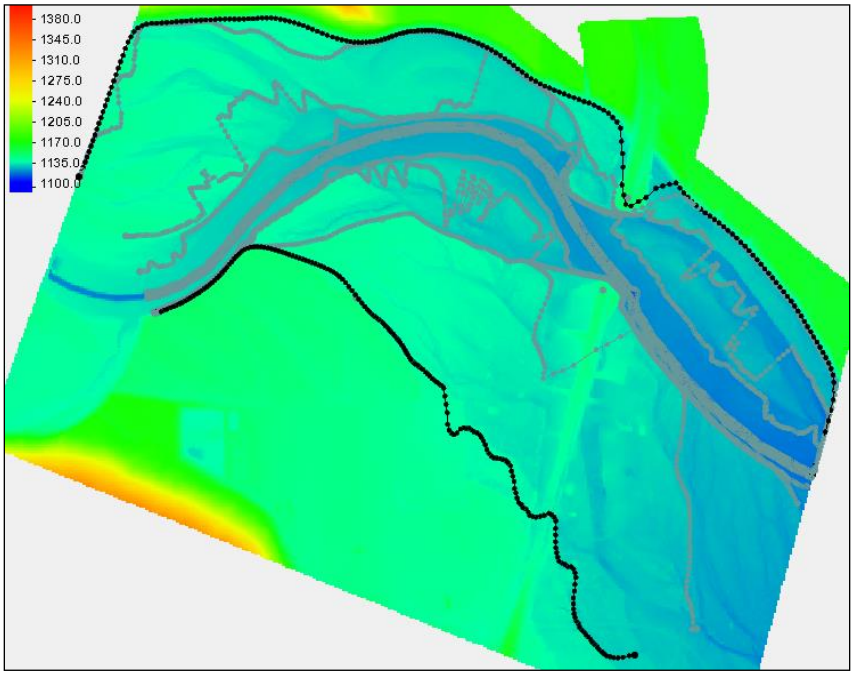

Figure 7 25 year flow channel bank arcs

The bank arcs extracted from a natural terrain can become very erratic. Experiment with different smoothing options and starting points to gain experience with the effects.

6 Extracting a Stream Network

The Extract Features tool can also be used to generate networks of streams or ridges represented in the raster. To do this:

1. Select the "Starting Points" coverage to make it active.
2. In the Project Explorer, right-click on "WFL_trim.tif" and select **Extract Network…** to bring up the *Extract Feature* dialog.
3. In the *Input* section, enter a *Threshold area* of "180000".

This represents approximately 10% of the area of the raster. 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.

4. In the *Output Coverage* section, select "<Create New>" from the *Stream/ridges* drop-down.
5. Enter "Streams" in the text field to the right of the *Streams/ridges* drop-down.
6. Click **OK** to close the *Extract Features* dialog.
7. Select the "Streams" to see the results.

Stream arcs have been generated for all ridges in the raster (Figure 8).

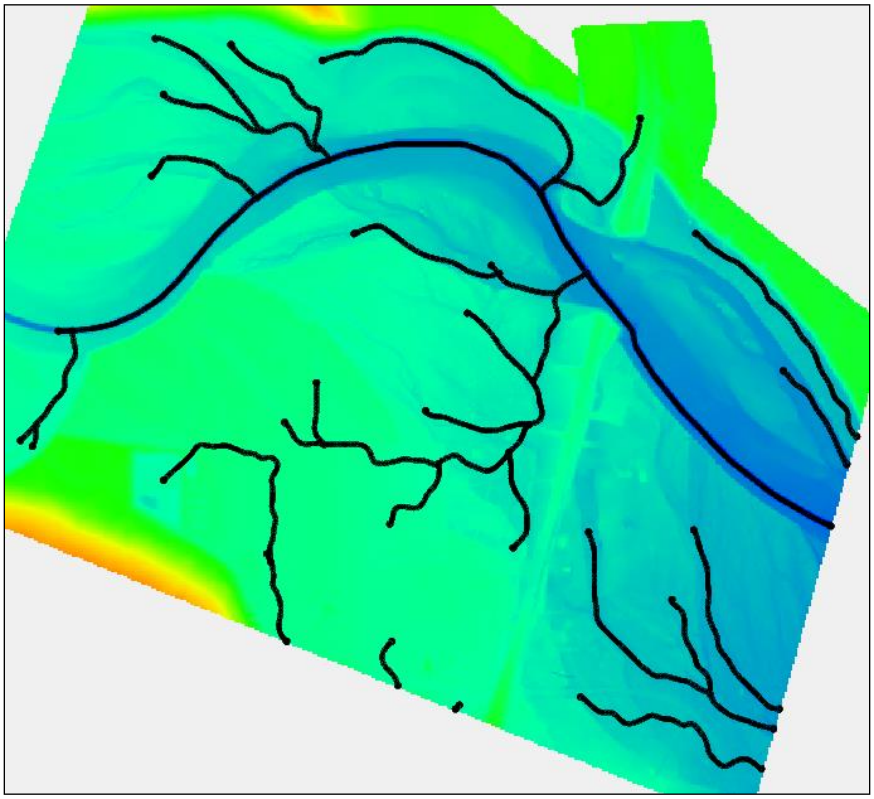

Figure 8 Centerlines of ridges extracted from a raster

7 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. In the Project Explorer, right-click on "WFL_trim.tif" and select **Extract Network…** to bring up the *Extract Feature* dialog.
2. In the *Input* section, select "Ridge" from the *Feature type* drop-down.
3. Leave the threshold as it was set in the previous section.
4. In the *Results* section, select "<Create New>" from the *Coverages* drop-down.
5. Enter "Ridges" in the text field to the right of the drop-down for the "Features" line
6. Click **OK** to close the *Extract Feature* dialog.
7. Select the "Ridges" to make it active.

A network of ridge arcs has been generated from the raster data, as shown in Figure 9. Note how this also follows the roadway embankments. If desired, turn on *Inactive coverage* option in the *Display Options* dialog to see how the arcs align with centerline arcs created in the previous section.

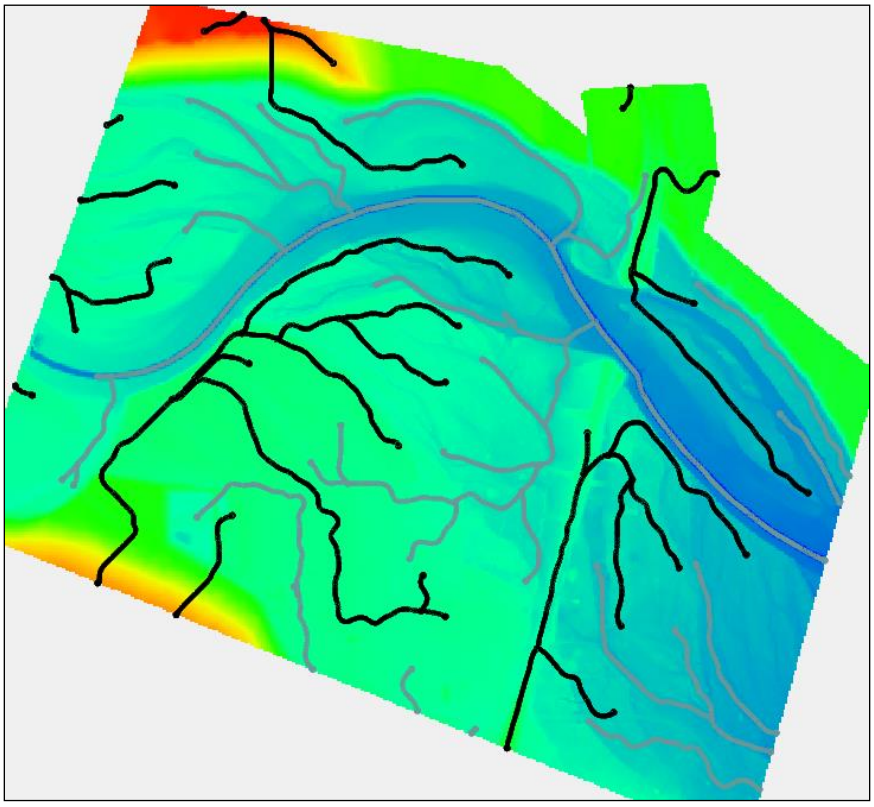

Figure 9 Embankments extracts from raster data

8 Conclusion

This concludes the “Extract Features” tutorial. This example showed extracting banks features from a river or stream channel. The same process can be applied to roadways if desired. Feel free to continue to experiment with the SMS Extract Features tool, or exit the program.