SMS 13.4 Tutorial
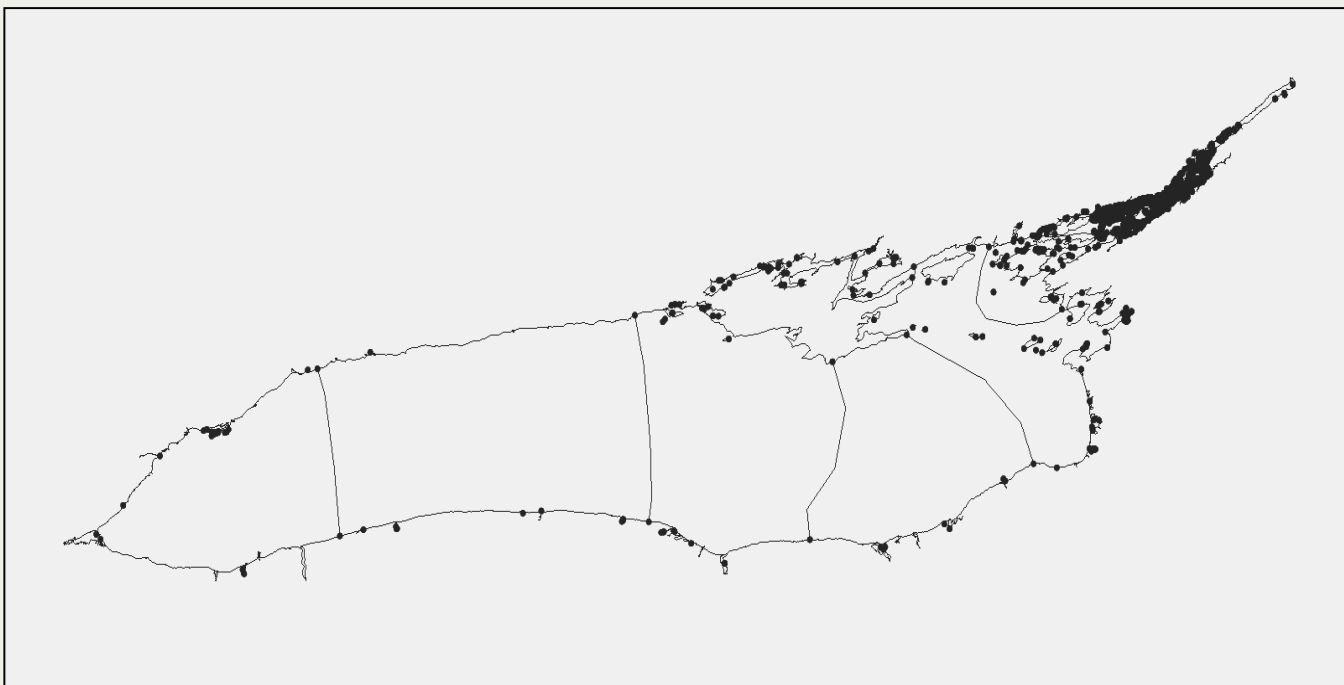
Clean Shapes – Delete Polygons

Removing Unwanted Complexity and Detail

Objectives

This tutorial is the second in a series that demonstrates how to prepare geographical information system (GIS) data for use in the process of constructing numerical hydrodynamic models.

Prerequisite Tutorials
- Overview
- Clean Shapes – Data Preparation

Required Components
- SMS Core

Time
- 10–15 minutes

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1   Introduction

A review of the "Clean Shapes – Data Preparation" tutorial, the first tutorial in the series, is recommended before proceeding. The objective of the *Clean Shapes* tool in SMS is to allow a user to efficiently review the data in a coverage visually and edit the data quickly to reduce the complexity and scope of the data without removing desired features.

The SMS program includes options to select arcs by length and polygons by area to identify very small features. One approach to simplifying a complex coverage is to remove arcs that are shorter than an arbitrary length or polygons that are smaller than an arbitrary area. This may work well; however, the specified parameter is arbitrary and may not be suitable for global application. Also, two (or more) short arcs or two (or more) small polygons would be more accurately represented by combining them.

This tutorial will illustrate operations in the *Clean Shapes* tool in SMS, which allows the user to quickly review and process many entities. This tutorial specifically focuses on deleting polygons that are too small to be of interest in a modeling application.

2   Getting Started

Start by loading the SMS project representing Lake Ontario.

1. Launch the SMS application*.*

2. Select *File* | **Open…** to bring up the *Open* dialog.

3. Browse to this tutorial's data files folder and select "LakeOntario.sms".

4. Click **Open** to exit the *Open* dialog and import the data.

This project is similar to the one saved from "Clean Shapes – Data Preparation" but with the original shapefile and intermediate coverage removed to optimize storage efficiency.

3   Using the Clean Shapes Tool

The "Clean Shapes" tool is accessed in the SMS toolbox. To invoke the tool:

1. Select the "🧰 Toolbox" macro from the toolbar to open the *Toolbox (beta)* dialog.

2. Expand the "📁 Coverages" folder.

3. Select "🔧 Clean Shapes" and click **Run Tool…** to open the *Clean Shapes* dialog.

4. For the *Input coverage* parameter, select "Map Data/Subdivided".

5. Set the *Geometry type* to "Polygons".

6. Enter "Polygons Deleted" as the *Output coverage* name.

7. Click **OK** to exit the *Clean Shapes* dialog.

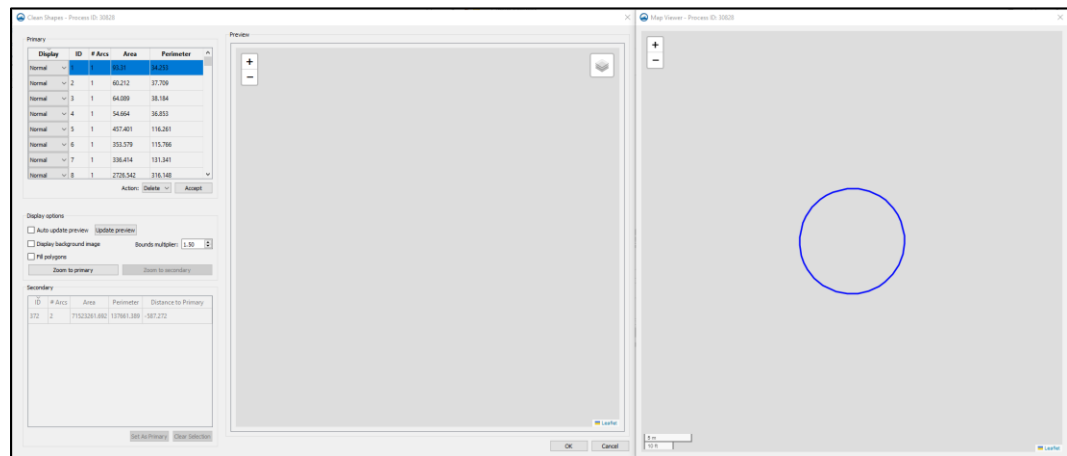Once the tool has come up, two dialog windows will appear, as shown in Figure 1.

*Figure 1   The Clean Shapes tool dialogs*

The *Clean Shapes* dialog displays a table of entities—either arcs or polygons, depending on the specified argument—extracted from the coverage. Initially, the table is displayed in index order with the first entity selected. In this case, polygon 1, which is circular, is displayed in the *Map Viewer*. This is the "primary" entity: the value that is the current focus of attention. Entities may be sorted based on various attributes, such as area or complexity, as shown in the *Primary* table.

This dialog also includes a *Preview* dialog that displays the result of applying the current action to the primary entity when the **Update preview** button is clicked. An option to turn on *Auto update preview* is available, though it can cause delays for complex shapes. The dialog contains other controls that will be described as they are used in the tutorial.

The *Map Viewer* dialog displays the entities around the primary entity.

These two dialog windows are designed to work together with the SMS Graphics Window to assist in editing entities.

4   Displaying a Background Image

As with the Graphics Window in SMS, displaying a background image behind the entities may make the display more intuitive. The "🔧 Clean Shapes" tool includes an option to display a background image. To illustrate this:

1. In the *Clean Shapes* dialog, turn on the *Display background image* option.

2. In the *Map Viewer* dialog, scroll the mouse wheel backwards to zoom out to view the lake (Figure 2).
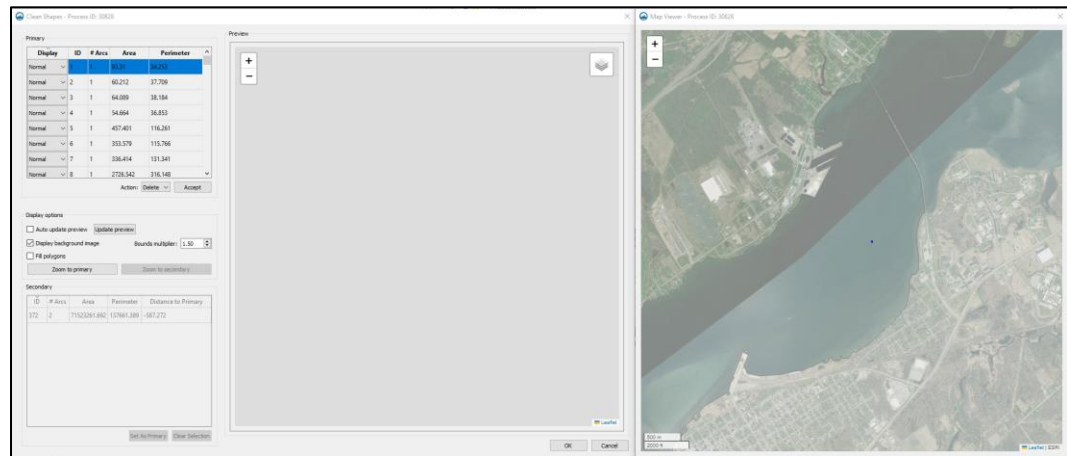
Figure 2   The Clean Shapes tool with background image enabled

3. Click **Zoom to primary** to refresh the *Map Viewer*.

Note that polygons are displayed over the image. If the display of the entities becomes unclear, there is an option to turn off the background image.

5   Sorting Entities

The first task is to reduce the number of polygons by removing the ones that will not affect the hydrodynamic processes within the lake domain.

To sort the polygons from smallest to largest:

1. Turn off the *Display background image* option.

2. Click on the *Area* column header in the *Primary* table.

Note that the small "^" symbol above the *Area* column header indicates that the list is sorted in ascending order by this property.

3. Scroll to the top of the table and select polygon 1441 as the primary entity (Figure 3).

Figure 3   The smallest polygon in the coverage (ID = 1441) and its neighbor

6   Deleting a Small Island Polygon

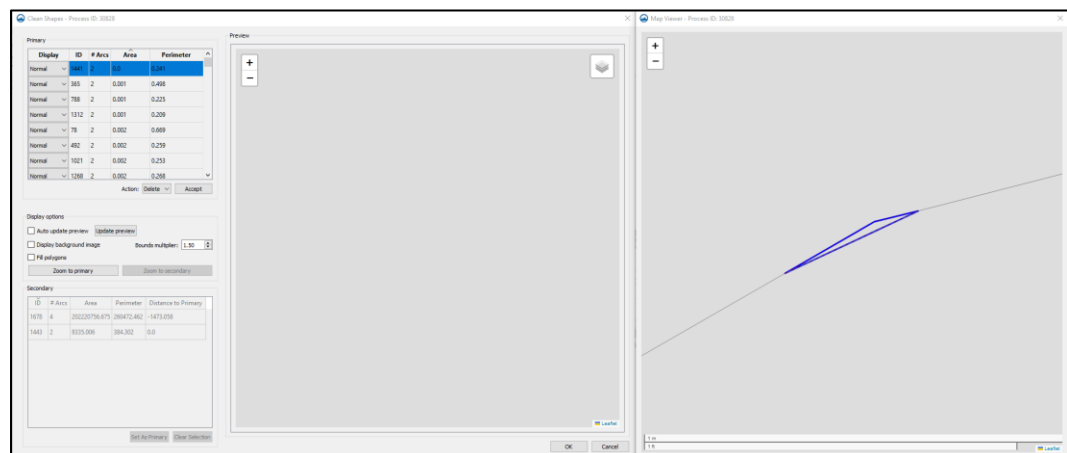The primary entity should now be set to polygon 1441. The actual area of this polygon is 0.0004 square meters, but because the tool displays only three significant digits, it appears as 0.000. Its presence in the GIS file suggests that multiple polygons were used to represent an island, and the representation was not properly resolved. The two sides of this polygon represent two possible edges of the island.

1. In the *Map Viewer* dialog, zoom out until the entire island is visible.

Note that the neighboring and containing polygons for the primary polygon are listed in the *Secondary* table, along with their distances. A negative value indicated containment, while 0.0—such as for polygon 1443—means they share an edge.

2. Click **Update preview** to refresh the *Map Viewer* dialog.

3. At the bottom of the *Primary* section, click **Accept** to delete polygon 1441.

Due to the large number of entities in the table, this "delete" action takes a second or two. After the action is complete, the tool updates to a new primary entity, which is now the smallest remaining in the table (polygon 788).

7   Deleting Multiple Island Polygons

Since the previous primary object was deleted, polygon 788 has become the new primary object. This polygon presents the same situation observed with polygon 1441. In fact, the next several polygons in the table are of this same type, representing small extensions of an island. To quickly review and delete these extensions as a group, do the following:

1. Scroll down and select polygon 1317 (area = 0.003).

2. Hold down the *Shift* key and select polygon 788 to select all the polygons between.

3. Click **Accept** to delete polygons 788 through 1317.

8   Deleting an Isolated Polygon

As mentioned above, polygon 1361 is not attached to any other polygons. To process this polygon:

1. In the *Max distance* edit field, enter "300.0" and click the *Tab* key.

2. In the *Map Viewer* dialog, zoom out until the nearest polygon edge is in view.

3. To view the context of the polygons, turn on and off the *Display background image* option.

4. Click **Accept** to delete polygon 1361.

9   Identifying Significant Polygons

Thus far, several insignificant polygons have been deleted. The threshold for significance depends on the maximum resolution of the numerical simulation. For this case, a minimum spacing of 30 meters will be used to resolved the lake shoreline and remaining islands, representing the simulation's maximum resolution.

With a minimum spacing of 30 meters, the smallest mesh elements would be an equilateral triangle with an area of about 390 square meters. Polygons smaller than this would not appear in the highest-resolution areas. Applying a factor of two for significance, islands should generally have an area of at least 800 square meters to be retained.

However, deleting all polygons than 800 square meters may remove desired features. This can happen when island boundaries are represented by multiple overlapping polygons or when nearby island—or islands near the shoreline—should be merged to reflect their combined hydraulic impact.

In a typical application, each polygon is reviewed sequentially until all insignificant polygons are removed or a special case is encountered. In this example, several polygons will be deleted to demonstrate another type of issue that can be addressed using this tool. To do this:

1. Scroll through the *Primary* table to polygon 1484 (area = 0.475) and select it.

2. Hold down the *Shift* key, scroll back to the top of the table, and click on polygon 30 to select all the polygons from 30 to 1484.

3. Click **Accept** to delete these polygons.

10   Handling Ambiguous Islands

GIS data may include overlapping and intersecting polygons, which can lead to ambiguous representations of features like islands. In this example, polygons 1680 through 1692 collectively represent a single island. It is the modeler's responsibility to determine which of these polygons should be deleted and which should be merged to create a single polygon.

To compare and review these polygons, locate polygon 1685.

1. Make sure polygon 1685 is selected as the primary entity.

2. Under the *Secondary filter* section, select the *Bounds multiplier* option.

3. Enter a value of 5, then 10, then 15, then 20, hitting *Tab* after each value (Figure 4).

This parameter serves an alternative to the *Max distance* option for identifying neighbors that appear in the *Secondary* table. This option also influences the zoom level in the *Map Viewer*. Larger values include more distant neighbors and results in a wider zoom. The ideal multiplier may vary depending on the task. While a value of 20 is likely too high, it can be useful for viewing an entire island.
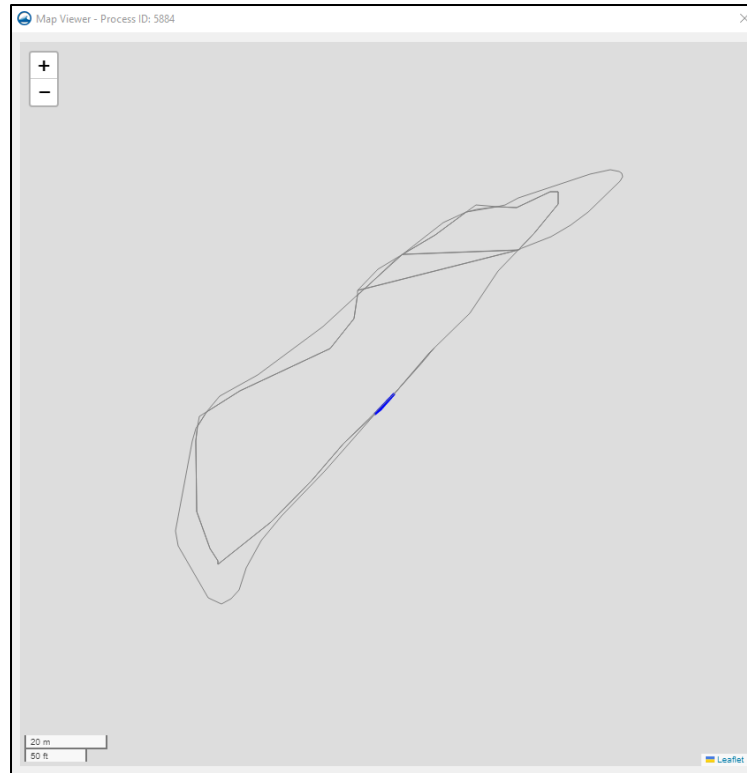
Figure 4   Ambiguous island definition including polygon 1554

11   Merging Polygons into a Single Island

To define the polygons that will comprise this island:

1. Below the *Primary* table, select "Merge" from the *Action* drop-down.

2. Change the *Bounds multiplier* to "3.00".

3. Within the *Secondary* table, click the *Distance to Primary* column to sort the secondary objects.

4. Select polygon 1691, the largest polygon (by area) with a distance of 0.0 from the primary object.

5. Click **Update preview** to observe how these two polygons (1685 and 1691) would combine.

6. Click **Accept** to accept the merge.

The operation merges the two polygons, and making the resulting polygon (ID = 1892) the new primary entity, with polygon 1692 as the secondary entity.

7. Click **Update preview** and then **Accept** to merge the polygons.

Polygon 1893 is now the primary entity while polygon 1688 is the secondary entity.

8. Click **Update preview** and then **Accept**.

To address polygon 1690, which is the new secondary entity, another action will be demonstrated. This polygon creates a small bump on the island that may be unnecessary.

9. Click **Delete secondary** to delete polygon 1690.

10. Click **Delete secondary** again to delete polygon 1684.

11. Click **Update preview** and then **Accept** to merge polygon 1687 into the island (ID = 1894).

Now the secondary entity (polygon 1682) only touches the island polygon only at a single point. While merging is possible, it is recommended to keep the island well-defined by leaving it separate.

12. Select polygon 1686 as the secondary entity.

13. Click **Update preview** and then **Accept**.

14. Select polygon 1689 as the secondary entity to get a shared edge.

15. Click **Update preview** and then **Accept**.

16. Select polygon 1683 as the secondary entity to get a shared edge.

17. Click **Update preview** and then **Accept**.

18. Click **Delete secondary** to delete polygon 1681.

19. Click **Update preview** and then **Accept** to merge polygons 1898 and 1682.

20. Click on **Zoom to primary** to view the entire island.

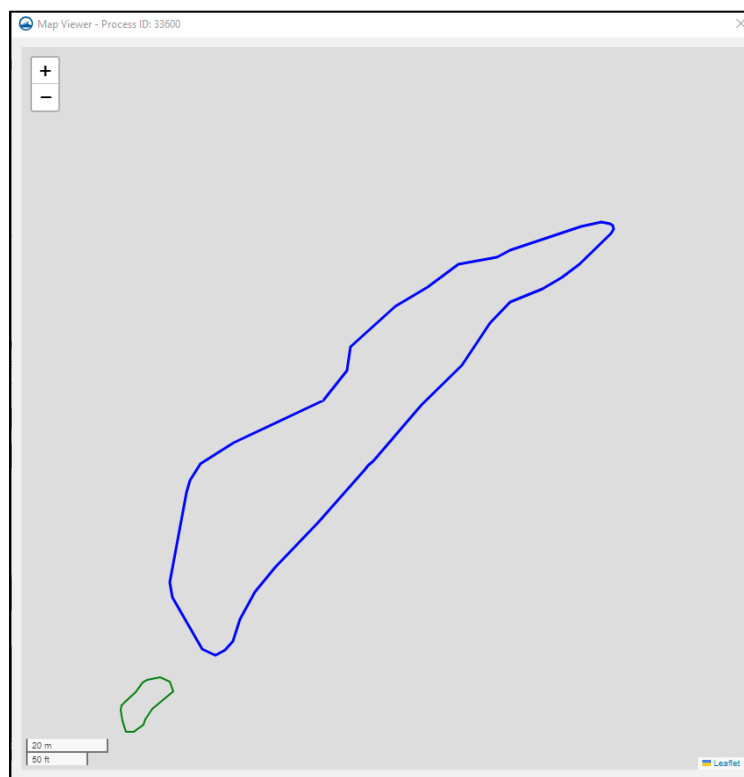The resulting island should look something like Figure 5.

Figure 5   Resolved Island shape

While the exact order of these operations and the choice between merging and deleting may seem somewhat arbitrary, the key issue is that the island's boundary was not well defined. The " ⚒ Clean Shapes" tool allows the polygons to be reviewed and modified quickly.

12   Selecting Adjacent Polygons

The island in the previous section is now clearly defined. This section illustrates a method of moving spatially through the data rather than using the list.

The display of the island shows another island to the southwest that is not clearly defined.

1. In the *Secondary* table, select polygon 1696 (a polygon that is part of this island).

2. Click **Set as primary** to make this polygon the primary entity.

3. Repeat the process of merging for the seven remaining polygons to clarify the definition of this island.

13   Deleting the Remaining Small Polygons

Typical applications involve stepping through the polygons to resolve ambiguities, simplify complex features, and reduce the total number of entities. For this tutorial, the remaining small polygons will be deleted. To do this:

1. Change the *Action* to "Delete".

2. Scroll to the top of the *Primary* table and select polygon 1157.

3. Hold down the *Shift* key, scroll down, and select polygon 1328, the first polygon with an area greater than 800 square meters.

4. Click **Accept** to delete all the selected polygons.

14   Saving the Project

To save this project before moving on to additional operations:

1. Click **OK** to close the tool.

2. Click **OK** to close the *Clean Shapes* tool progress dialog.

3. Click **Close** to close the *Toolbox (beta)* dialog.

4. A new coverage named "Polygons Deleted" appears in the Project Explorer.

5. Right-click on this coverage and select **Properties…** to bring up the *Properties* dialog.

Note that of the original 1891 polygons, only 914 remain.

6. Click **Cancel** to close the properties dialog.

7. Select *File* | **Save Project (LakeOntario.sms)** to save the updated project.

15   Conclusion

This concludes the "Clean Shapes – Delete Polygons" tutorial. Several features have been demonstrated including:

- Deleting small primary entity polygons that are on the edge of another polygon or isolated

- Deleting multiple small primary entity polygons together

- Deleting adjacent secondary entity polygons

- Merging adjacent polygons into a single polygon

This tutorial continues in the "Clean Shapes – Merge Polygons" tutorial.