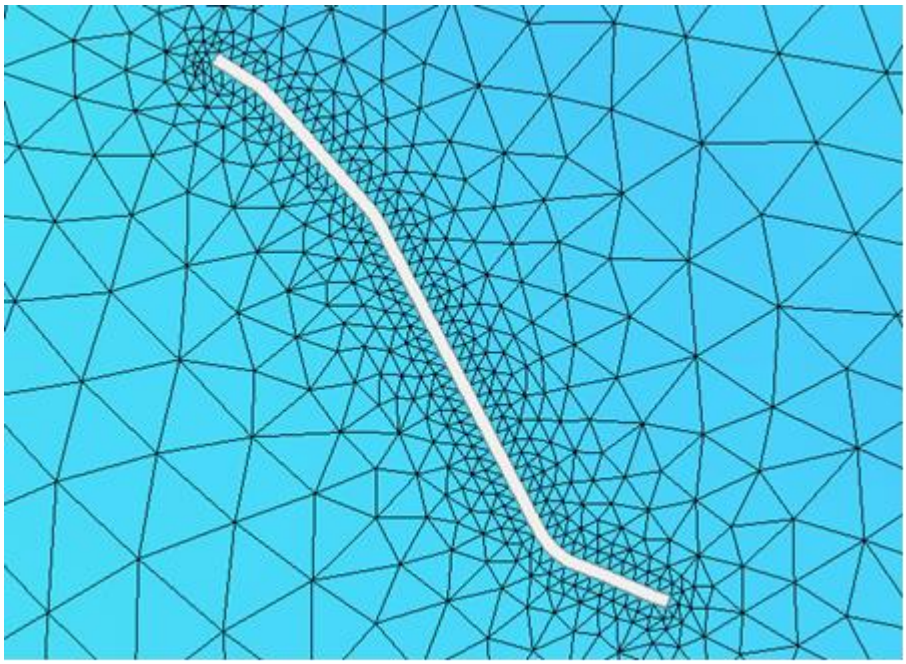
SMS 13.3 Tutorial

EWN Add ADCIRC Levee to Mesh

Use the EWN Tools to Add a ADCIRC Levee to a 2D Mesh



Objectives

This tutorial discusses how to use the EWN tools to insert ADCRIC levees into a mesh.

Prerequisite Tutorials

- Overview
- Map Module
- Mesh Generation

Required Components

- SMS Core

Time

- 15–30 minutes

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1 Introduction

The Engineering with Nature (EWN) tools in SMS are designed to make the insertion of natural features into an existing ADCIRC mesh easy as well as numerically stable.

This tutorial illustrates the steps used to add levees into existing ADCIRC simulations. The project site is located in the Chesapeake Bay. This exercise is for demonstration purposes only.

1.1 Getting Started

An initial project will be opened to start this exercise. The project contains an ADCIRC simulation and mesh. To open the starting project, complete the following:

1. Select *File* | **Open...** to bring up the *Open* dialog.
2. Select “All Files (*.*)” from the *Files of type* drop-down.
3. Browse to *data_files* folder for this tutorial and select “start.sms”.
4. Click **Open** to exit the *Open* dialog and import the project. This project will take approximately 30 seconds to load into SMS.

The initial ADICRC project should appear similar to Figure 1.

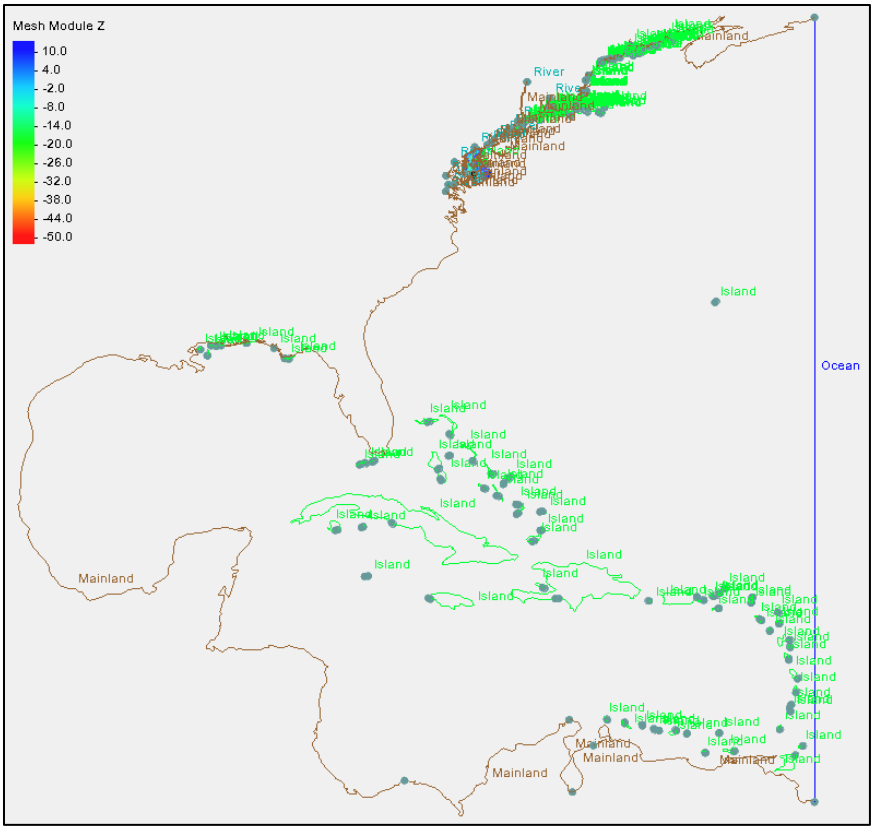

Figure 1 Initial project

2 Import a Shapefile

After opening the project, import a shapefile that contains the levee features which will be added to the mesh. To do this:

1. Select *File* | **Open...** to bring up the *Open* dialog.
2. Select "All Files (*.*)" from the *Files of type* drop-down.
3. Browse to the *data_files\Version_20201110* folder and select "P04.shp".
4. Click **Open** to exit the *Open* dialog and import the shapefile.
5. In the Project Explorer, right-click on " P04shp" and select **Zoom to Extents**.

The polygons in the shapefile should appear similar to Figure 2.

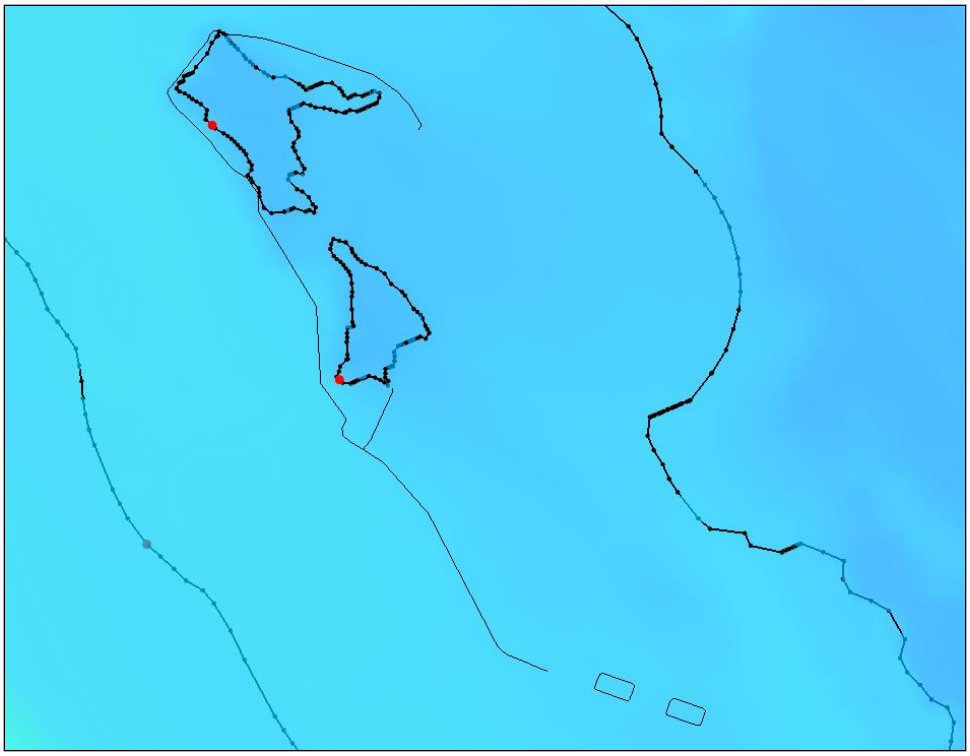

Figure 2 Imported shapefile polygons

3 Save the Project

At this point, save the project by doing the following:

1. Select *File* | **Save As...** to bring up the *Save As* dialog.
2. Browse to the *data files* directory and enter “Insert Levee” for the *File Name*,
3. Select **Save** to save the project and close the *Save As* dialog.

The project has now been saved.

4 Create an EWN Coverage

The EWN tools operate on polygons in a EWN coverage. Therefore, the first step of defining the EWN object is to create a coverage assigned as an EWN type. To do this, complete the following:

1. Right-click on “ Map Data” and select the **New Coverage…** command to open the *New Coverage* dialog.
2. Under *Coverage Type*, select **EWN Features** located in the *Models* section under *Engineering with Nature*.
3. For the *Coverage Name*, enter “Barren Island Levee”.
4. Click **OK** to close the *New Coverage* dialog.

A new coverage, “ Barren Island Levee” will appear in the Project Explorer.

5 Converting the Shapefile

With the EWN feature coverage created, the polygons from the shapefile can be transferred to the coverage for use in the project. To do this, complete the following:

1. Right-click on "P04shp" and select *Convert* **| Shapes → Feature Objects** to open the *GIS to Feature Objects Wizard – Step 1 of 2* dialog.
2. For *Select a coverage for mapping* make certain "Barren Island Levee" is selected and for *Select shapefiles to map* make certain "P04.shp" is selected.
3. Click **Next** to go to the *GIS to Feature Objects Wizard – Step 2 of 2* dialog.
4. It is not necessary to map any additional information so click **Finish** to close the *GIS to Feature Objects Wizard – Step 2 of 2* dialog.
5. In the Project Explorer, turn off the "P04shp".

The arcs will appear on the "Barren Island Levee" coverage.

6 Creating the Levee Polygon

The shape file provides an arc of the centerline of the desired levee. We will work with the arcs to create a polygon representing the ADCIRC levee. To do this:

1. Select the "Barren Island Levee" coverage to make it active.
2. Using the **Select Feature Arc** tool, select the long arc extending from the south of the island.
3. Right-click and select **Invert Selection**.
4. Press the *Delete* key to remove the selected arcs. Click **Yes** if a warning dialog appears.

The remaining arc is the proposed centerline of the new levee.

5. Right-click and select **Redistribute Vertices** to open the *Redistribute Vertices* dialog.
6. Make certain the *Length units* option is set to "Degrees".
7. Change the *Average spacing* to be "0.0003" arc degrees.
8. Click **OK** to close the *Redistribute Vertices* dialog.
9. Right-click and select **Offset Arc(s)** to open the *Offset Arcs Tool* dialog.
10. For *Side to offset*, select "Both".
11. Set the *Units* to "Degrees".
12. For the *Left* and *Right* fields under both *Begin* and *End*, enter "0.00015".
13. Click **OK** to close the *Offset Arcs Tool* dialog and generate new arcs.

The new offset arcs should appear similar to Figure 3.

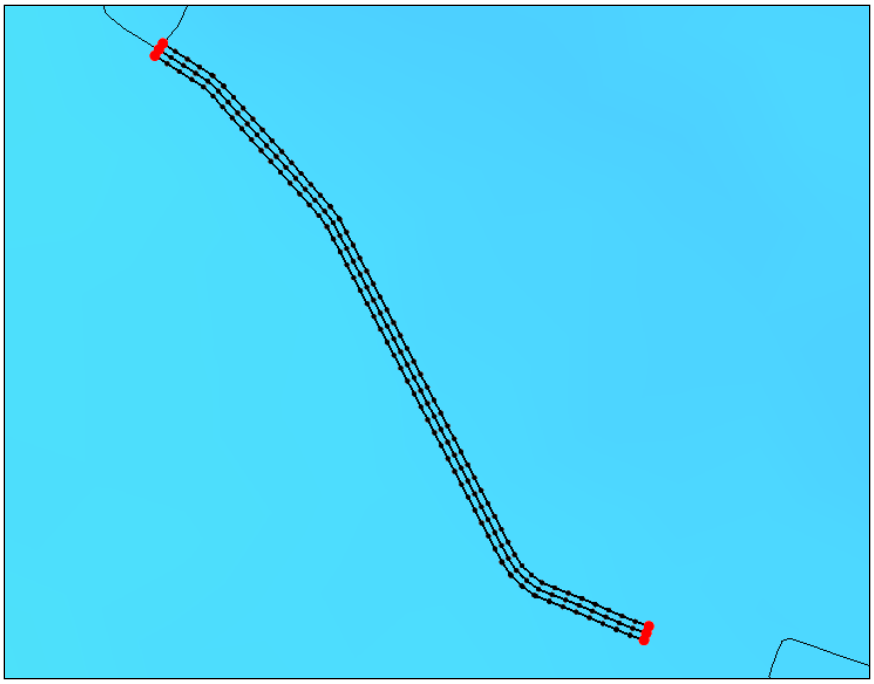

Figure 3 Generated offset arcs

14. Using the **Select Feature Arc** tool, select the centerline arc and use the *Shift* key to select one of the offset arcs.
15. Right-click and select **Redistribute Vertices** to open the *Redistribute Vertices* dialog.
16. Change *Specify* to “Source Arc”.
17. Make certain the *Source Arc* is set to the centerline (ID = 1) and the *Target Arc* is set to the offset arc.
18. Click **OK** to close the *Redistribute Vertices* dialog.
19. Repeat steps 14–18 for the offset arc that was not initially selected.
20. Using the **Select Feature Arc** tool, select the centerline and press the *Delete* key to remove the arc. If a warning dialog appears, select **Yes**.
21. Using the **Create Feature Arc** tool, create an arc that connects the top ends of the both offset arcs.
22. Repeat step 21 to connect the bottom ends of both offset arcs.
23. Click the **Build Polygon** macro.

A polygon representing the levee has now been built in in the project and should appear similar to Figure 4.

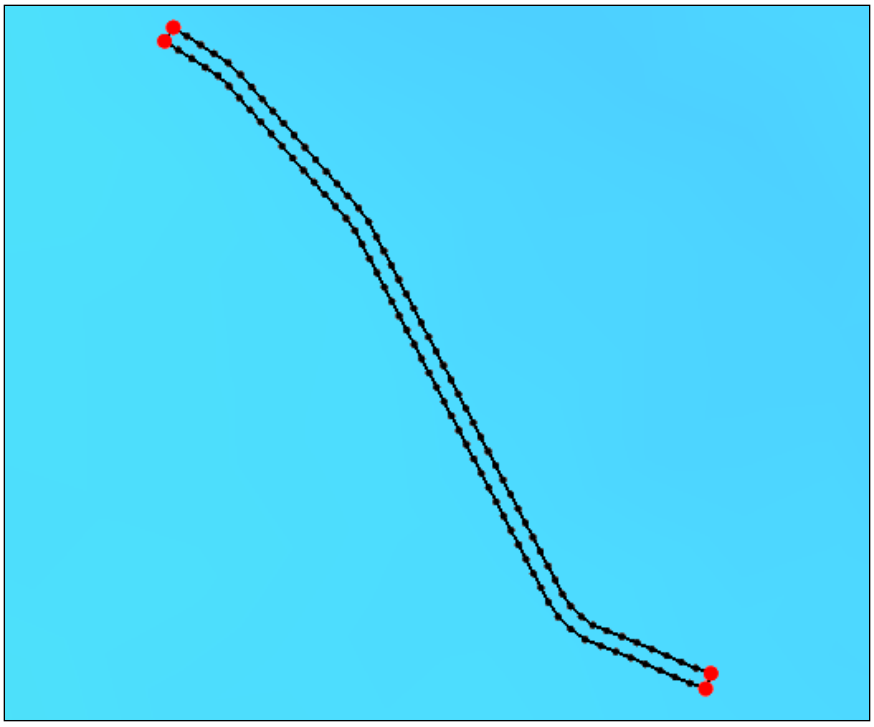

Figure 4 Levee polygon

7 Set EWN Polygon Properties

The EWN properties can now be defined for the levee polygon. To do this:

1. Using the **Select Feature Polygon** tool, double-click on the levee polygon to open the *EWN Polygon Properties* dialog.
2. For *Name*, enter “Barren Island Levee”.
3. For the *Classification*, select “Internal ADCIRC levee”.
4. Turn on *Insert feature*.
5. Click on the *Preview* tab to investigate how this levee will look in the mesh.
6. Click the **Select UGrid/Mesh** button to open the *Select UGrid/Mesh* dialog.
7. Select the “Trimmed_mesh” mesh.
8. Click **OK** to close the *Select UGrid/Mesh* dialog.
9. Click **Generate mesh with feature** to see a preview of how the mesh will look.

The magenta lines display the interface between the EWN feature and the existing mesh. Notice that the magenta lines in the mesh preview do not extend to the boundary so the bounding box factor is acceptable for this situation.

10. Click **OK** to close the *EWN Polygon Properties* dialog.

8 Inserting EWN Levee

With the EWN properties set, the new features can now be inserted into the mesh.

1. Right-click on the "Barren Island Levee" and select *Tools* | **Insert ADCIRC Levees** to open the *Insert ADCIRC Levees* dialog.
2. For the *Source geometry*, click **Select** to open the *Select Geometry* dialog.
3. Select the “Trimmed_mesh” mesh.
4. Click **OK** to close the *Select Geometry* dialog.
5. Under *ADCIRC BC coverages*, click the **Select** button to open the *Select Coverage* dialog.
6. Select the "Boundary Conditions" coverage.
7. Click **OK** to close the *Select Coverage* dialog.
8. For the *Element area change limit*, enter “0.5”.
9. Select **OK** to close the *Insert ADCIRC Levees*.

This operation produces two outputs. First, the EWN features have now been added to a new mesh named “EWN Feature Mesh” and that mesh has been loaded into SMS. Second, there is a new boundary condition coverage. This coverage is a copy of the input coverage (selected in step 6 above) with the new levee added.

9 Reviewing the Mesh

With the EWN features inserted into the mesh, the mesh can now be reviewed to see how the features were applied.

1. Select *Shift+Z* to go back to the previous view.
2. Click the **Display Options** macro to open the *Display Options* dialog.
3. Select *2D Mesh* from the list on the left.
4. Turn on *Elements*.
5. Click **OK** to close the *Display Options* dialog.
6. Using the **Rotate** tool, rotate the mesh.

Note the hole in the mesh representing the levee. Also note the levee arcs above the hole. The crest elevation assigned to the levee comes from the elevation of the arcs. In this case, that elevation is 0.0. In the next exercise we will review how to update levee elevations.

10 Reviewing the Boundary Condition

Next we will review the new boundary condition. To do this:

1. Select the “Boundary Conditions (2)” coverage that was created by the EWN process.
2. Using the **Select Feature Arc** tool, select one or both of the arcs defining the new levee.

3. Right-click and select **Assign BC...** to open the *Assign Linear BC* dialog.

The *Assign Linear BC* dialog displays the crest elevation and flow coeffients for the new levee with one point for each node pair.

4. Click **Cancel** to exit the *Assign Linear BC* dialog without changing anything.

11 Save the Project

Now save the project by doing the following:

1. Select *File* | **Save Project (Insert Levee.sms)**.

SMS saves the project.

12 Conclusion

This concludes the “EWN Add ADCRIC” tutorial. The following key concepts were discussed and demonstrated:

- Creating an EWN Feature coverage
- Defining EWN feature polygons for an ADCIRC levee
- Inserting an ADCRIC levee into a mesh

Continue exploring in SMS or exit the program.