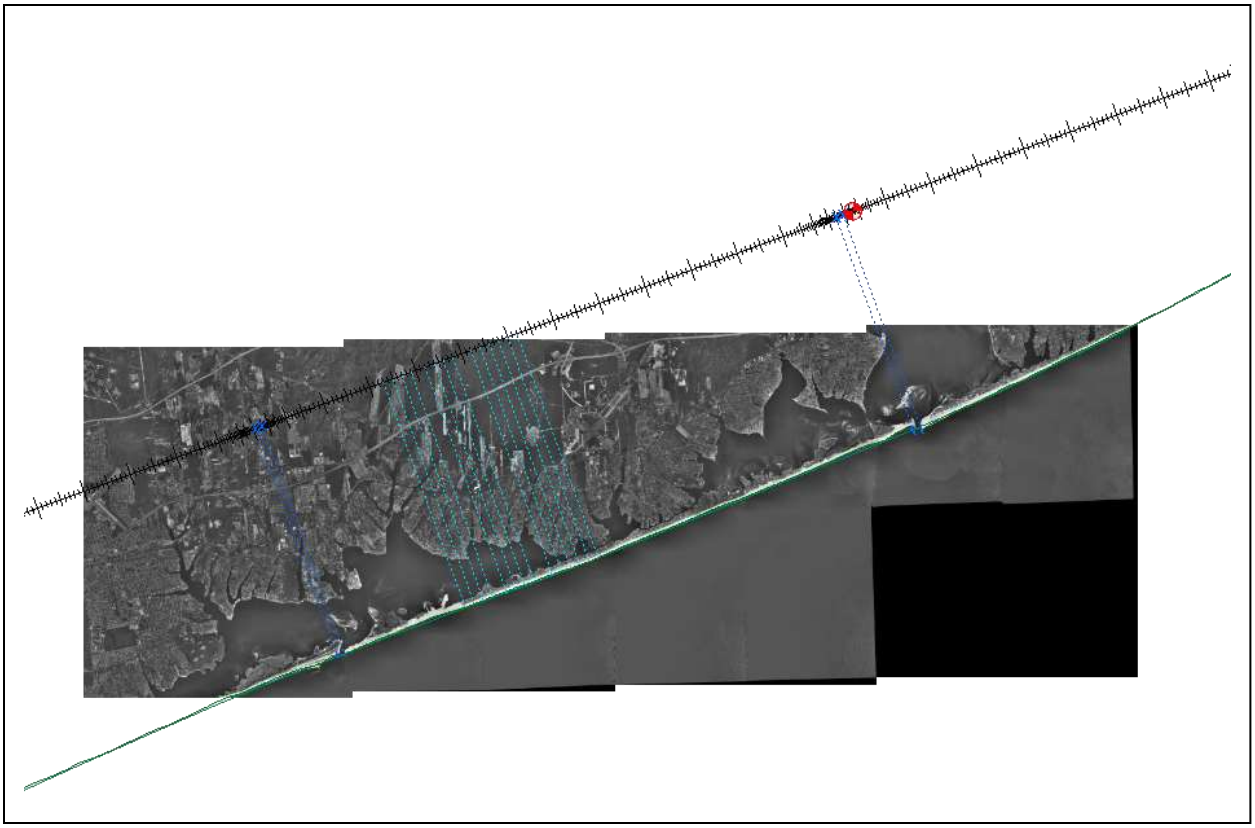
SMS

v. 13.1

SMS 13.1 Tutorial

GenCade



Objectives

This tutorial demonstrates setting up and running a GenCade model to show the efficacy of GenCade in modeling the coastal sediment transport, morphology change, and sand bypassing at inlets and other coastal structures.

Prerequisites

- Overview
- Map Module

Requirements

- Map Module
- 1D Grid Module

Time

- 30–45 minutes

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1 Introduction

GenCade is a regional model for calculating coastal sediment transport, morphology change, and sand bypassing at inlets and engineered structures.

GenCade requires that an initial shoreline be imported into SMS. The file must be in CST format for the file to be imported correctly into the conceptual model. The CST format requires the *x* and *y* coordinates of every point along the shoreline. A regional contour must also be imported.

Once the shoreline and regional contour are imported, the various structures are created on separate GenCade coverages. Once all of the structures are created and defined, all of the GenCade coverages are merged into a single coverage ("Merge coverage"). The original coverages are kept and turned off. It is a good idea to keep these unmerged coverages in the interface. If a problem occurs with the merged coverage, it can be deleted and a new merged coverage can be created.

This tutorial applies the GenCade model to parts of the south shore of Long Island, New York. This area was chosen because it has a long-term regional coastal database and includes multiple inlets and barrier islands with coastal structures. Most of the work in the tutorial will be done in the area around Jones Inlet, with some being done at Shinnecock Inlet.

2 Getting Started

The project file for this tutorial has several feature object structures (arcs and points) pre-created in order to save time. These include the coastline arc, regional contour arc, jetties, inlets, beach fills, refine points, groins, seawalls, and breakwaters. Attributes have been preset for most of them. A number of aerial photos of the inlets and surrounding areas have been included for reference.

The projection "NAD 1983 UTM Zone 18N" has been set for the project and all objects within the project. The display options have been set to make inactive coverages visible.

To open the project, do the following:

1. Select *File* | **Open…** to bring up the *Open* dialog.
2. Browse to the *Data Files* folder for this tutorial and select "LongIsland.sms".
3. Click **Open** to import the project and exit the *Open* dialog.

The project should appear similar to Figure 1.

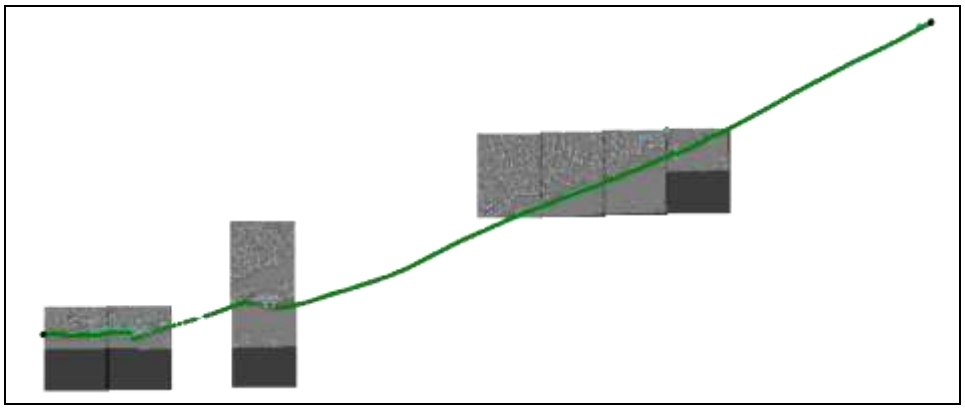

Figure 1 Initial project

Before proceeding with the tutorial, save the project under a new name:

4. Select *File* | **Save As…** to bring up the *Save As* dialog.
5. Enter "LongIsland_project.sms" as the *File name*.
6. Click **Save** to save the project under the new name and close the *Save As* dialog.

3 Grid Setup

As mentioned, most of the features in the project have been pre-defined in order to save time. These features include inlets, groins, seawalls, beach fills, breakwaters, jetties, and refine points. The remaining undefined features must now be defined. Please refer to the "Map Module" tutorial for details on creating feature objects such as arcs and points.

3.1 Inlets and Dredging Events

This project contains four main inlets: Jones Inlet, Fire Island Inlet, Moriches Inlet, and Shinnecock Inlet. Two of the inlets contain dredging events: Moriches and Shinnecock. This data has already been entered for Jones, Fire Island, and Moriches Inlets.

Define the inlet volume and dredging events for Shinnecock Inlet by doing the following:

1. Select "Inlets" to make it active.
2. **Frame** the project and **Zoom** to the last inlet on the right (Figure 2).
3. Using the **Select Feature Arc** tool, double-click on the inlet arc (the black arc in Figure 2) to bring up the *GenCade Arc Attributes* dialog.

4. In the *Arc Options* section, select "Inlet" from the drop-down.
5. Click **Attributes…** to bring up the *Inlets (Reservoir Model and Jetties)* dialog.

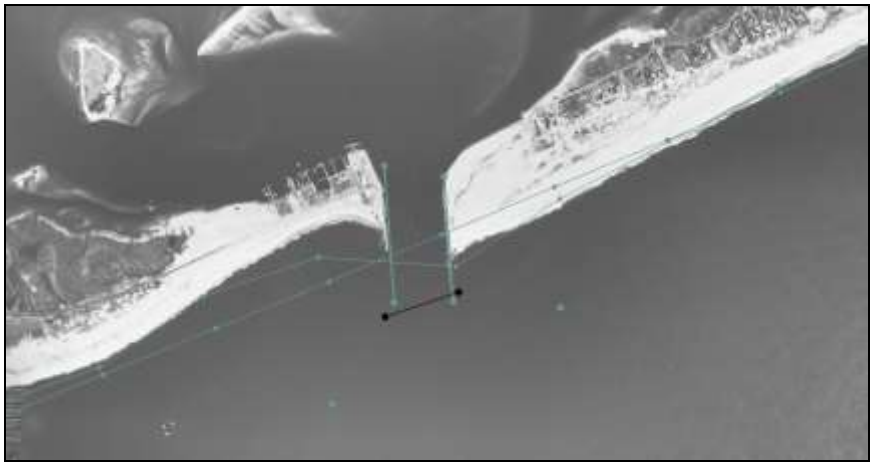

Figure 2 Shinnecock Inlet

6. Enter "Shinnecock" in the *Name of Inlet* field.
7. Click **Volume…** in the *(m^3)* column to bring up the *Inlet Shoal Volumes* dialog.
8. Outside of SMS, open the file "Inlets.xls" from the *Data Files* folder in a spreadsheet program.
9. Copy the values from the *Initial* column in the *Shinnecock Inlet Volume* section of the "Inlets.xls" file to the *Initial* column in the *Inlet Shoal Volumes* dialog.
10. Copy the values from the *Equilibrium* column in the *Shinnecock Inlet Volume* section of the "Inlets.xls" file to the *Equilibrium* column in the *Inlet Shoal Volumes* dialog.
11. Click **OK** to close the *Inlet Shoal Volumes* dialog.
12. In the *Manage* column, click **Dredging…** to bring up the *Dredging Events* dialog.
13. Copy the values from the *Begin Date* column in the *Shinnecock Dredging Events* section of the "Inlets.xls" file to the *Begin Date* column in the *Dredging Events* dialog.
14. Copy the values from the *End Date* column in the *Shinnecock Dredging Events* section of the "Inlets.xls" file to the *End Date* column in the *Dredging Events* dialog.
15. Copy the values from the *Shoal to Be Mined* column in the *Shinnecock Dredging Events* section of the "Inlets.xls" file to the *Shoal to Be Mined* column in the *Dredging Events* dialog.
16. Copy the values from the *Volume* column in the *Shinnecock Dredging Events* section of the "Inlets.xls" file to the *Volume (m^3)* column in the *Dredging Events* dialog.
17. Enter "1.0" in both the *Left Bypass Coef* and *Right Bypass Coef* columns.
18. Click **OK** to close the *Inlets (Reservoir Model and Jetties)* dialog.

19. Click **OK** to close the *GenCade Arc Attributes* dialog.

Feel free to review the attributes of the inlets at Jones Inlet, Fire Island Inlet, and Moriches Inlet, if desired.

3.2 Jetties

Jetties can be created to the left and right of the inlets. They can be given a length, permeability, and a seaward depth, and diffraction can be specified. The "left" and "right" in the name of the jetty is always determined as if facing the ocean with the land behind.

In this tutorial, three sets of jetties have already been created and two of the sets have been previously defined. Define the jetties for Jones Inlet by doing the following:

1. Select "Jetties" to make it active.
2. **Frame** the project and **Zoom** to the Jones Inlet.
3. Using the **Select Feature Arc** tool, double-click on the jetty to the west (the one at the top of Figure 3) to bring up the *GenCade Arc Attributes* dialog.
4. Select "Right Jetty on Inlet" in the *Arc Options* section.

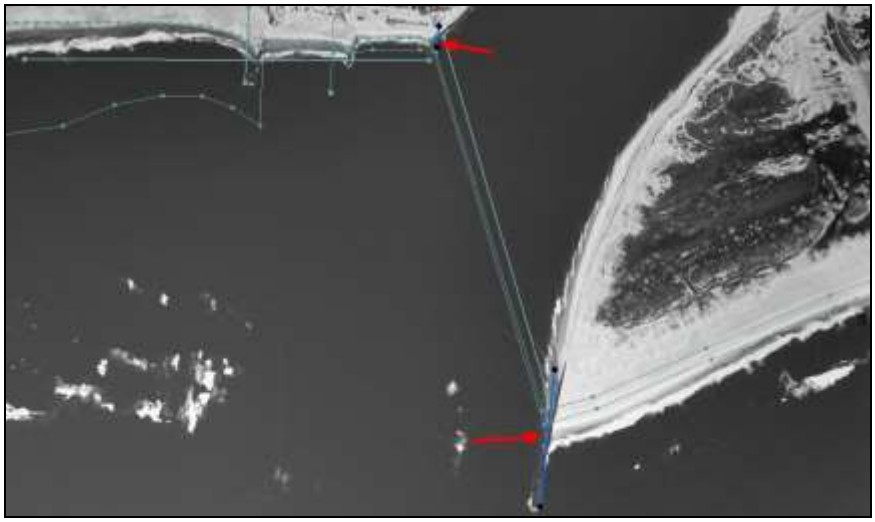

Figure 3 Jones Inlet with the two jetties indicated

5. Click the **Attributes** button to bring up the *Groins* dialog.
6. Enter "0.2" as the *Permeability*.
7. Turn on *Diffracting*.
8. Enter "7.0" as the *Seaward Depth*.
9. Click **OK** to close the *Groins* dialog.
10. Click **OK** to close the *GenCade Arc Attributes* dialog.
11. Using the **Select Feature Arc** tool, double-click on the east jetty (the one at the bottom of Figure 3).
12. Repeat steps 4–10, except select "Left Jetty on Inlet" in the *Arc Options* section.

Feel free to review the attributes of the jetties at Moriches Inlet and Shinnecock Inlet, if desired.

3.3 Groins

As with the inlets and jetties, all of the groins have been previously set up. All of them have been defined except the one just to the west of the right jetty at Jones Inlet. Parameters for characterizing groins include length, permeability, diffraction, and depth.

To define the remaining groin, do the following:

1. Select "Groins" to make it active.
2. Using the **Select Feature Arc** tool, double-click on the groin just to the west of the right jetty at Jones Inlet (Figure 4) to bring up the *GenCade Arc Attributes* dialog.
3. Select "Groin" from the drop-down list in the *Arc Options* section.
4. Click on the **Attributes** button to open the *Groins* dialog, and set the following:
5. Enter "0.1" as the *Permeability*.
6. Turn on *Diffracting*.
7. Enter "3.0" as the *Seaward Depth*.
8. Click **OK** to close the *GenCade Arc Attributes* dialog.
9. Click **OK** to close the *Groins* dialog.

Feel free to review the attributes of the other 26 groins (at Jones Inlet and those between Moriches Inlet and Shinnecock Inlet), if desired.

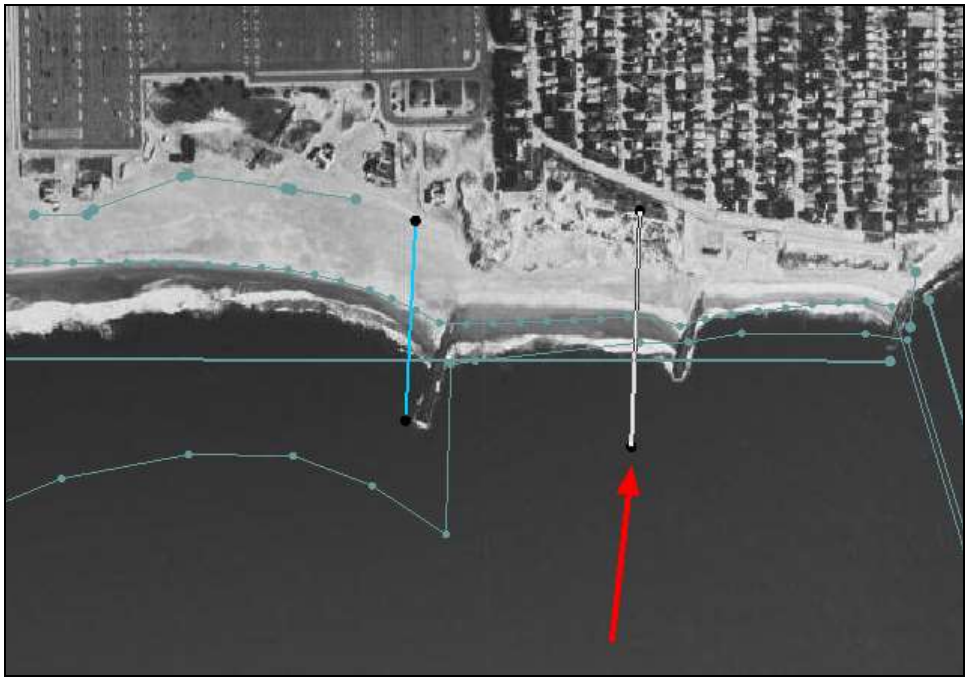

Figure 4 Groin that needs to be defined

3.4 Seawall

Parameters for characterizing seawalls include start and end location. The seawall must be drawn landward of the shoreline. If the seawall is drawn directly on top of the initial shoreline, an error will occur.

Care should be taken when drawing a seawall so the shape of the seawall in the GenCade model resembles the actual seawall as closely as possible. Additionally, since cell numbers are used in the GenCade model, the seawall shape may look different after converting from the conceptual model.

When the model is converted to a 1D grid, an error message referring to the seawall may pop up. This message should be ignored as GenCade will modify the cells defined for the seawall. When reviewing the seawall in the GenCade model, if the seawall does not resemble the actual seawall, the cell numbers and distances from the grid should be revised. A smaller cell size near the seawall may also be helpful.

There is only one seawall in this project. It has been pre-created approximately 500 meters west of the right jetty of Jones Inlet. To define the seawall attribute, do the following:

1. Select "Seawall" to make it active.
2. Using the **Select Feature Arc** tool, select all four arcs (Figure 5) by clicking on each while holding down the *Shift* key.
3. Right-click and select **Arc Attributes…** to bring up the *GenCade Arc Attributes* dialog.
4. Select "Seawall" from the drop-down in the *Arc Options* section.
5. Click **OK** to close the *GenCade Arc Attributes* dialog.

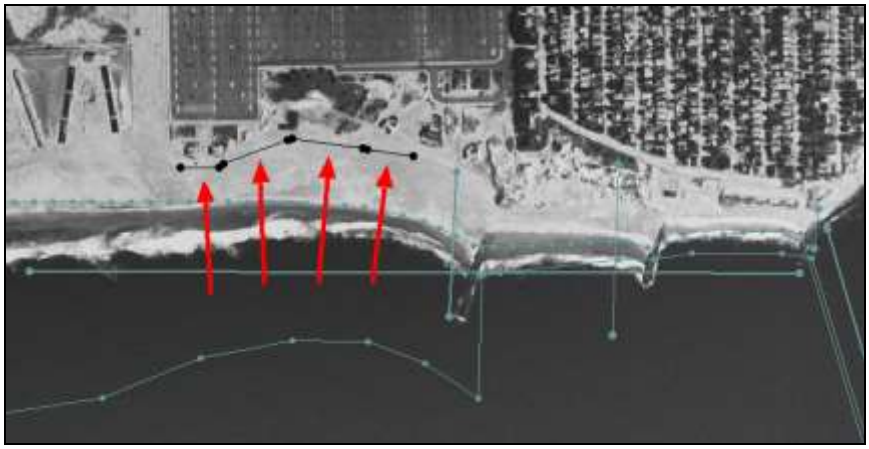

Figure 5 Location of the seawall arcs

3.5 Beach Fill Events

Parameters for characterizing beach fills include begin and end time, location, and width. Each GenCade project will generally have at least one beach fill. For this project, a total of four beach fills were created. The beach fill at the Jones Inlet still needs to have attributes defined.

To define the beach fill attributes for Jones Inlet, do the following:

1. Select "Beach Fills" to make it active.
2. Using the **Select Feature Arc** tool, double-click the beach fill arc (Figure 6) to bring up the *GenCade Arc Attributes* dialog.
3. Select "Beach Fill Event" from the drop-down in the *Arc Options* section.
4. Click the **Attributes** button to bring up the *Beach Fill* dialog, and set:
   - *Begin Date* to "01-Mar-1994".
   - *End Date* to "30-Apr-1994".
   - *Added Berm Width* to "10.0".
5. Click **OK** to close the *Beach Fill* dialog.
6. Click **OK** to close the *GenCade Arc Attributes* dialog.

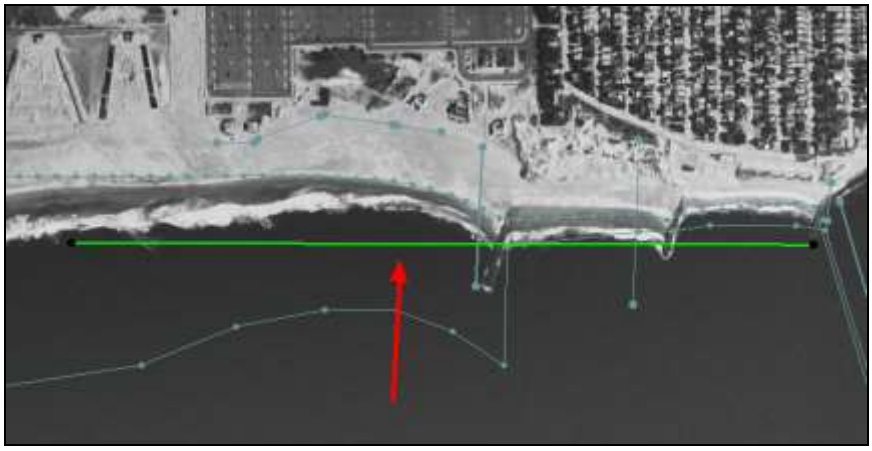

Figure 6 Beach fill arc at Jones Inlet

Feel free to review the attributes of the other three beach fills (at Moriches Inlet, Shinnecock Inlet, and northeast of Shinnecock Inlet, at the end of the coastline arcs), if desired.

3.6 Breakwater

Parameters for defining breakwaters include start and end location, depth, and transmission coefficient. This project requires one breakwater, which has already been created.

To define the breakwater attributes, do the following:

1. Select "Breakwater" to make it active.
2. **Frame** the project and **Zoom** in to the coastline about 5800 m northeast of Shinnecock Inlet.
3. Using the **Select Feature Arc** tool, double-click the breakwater arc (Figure 7) to bring up the *GenCade Arc Attributes* dialog.
4. Select "Breakwater" from the drop-down in the *Arc Options* section.

5. Click the **Attributes** button to bring up the *Detached Breakwaters* dialog, and set:
   - *Depth 1* to "3.0".
   - *Depth 2* to "5.0".
   - *Transmission* to "Constant"
6. Click **OK** to close the *Detached Breakwaters* dialog.
7. Click **OK** to close the *GenCade Arc Attributes* dialog.

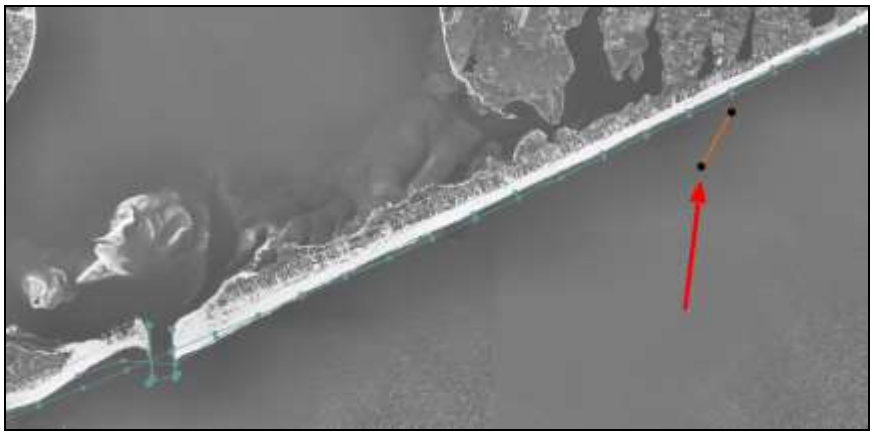

Figure 7 Breakwater northeast of Shinnecock Inlet

3.7 Grid Resolution

After defining the shorelines, any necessary structures, and events, the grid should be set up. The cell size can be constant or variable. This tutorial uses a variable cell size. In order to have variable cell sizes, refine points must be created. Refine points tell the GenCade model where to have variable cell sizes on the 1D grid.

All of the refine points have been created previously. They have each been defined except for the easternmost refine point at Jones Inlet.

To define the attributes for the remaining refine point, do the following:

1. Select "Refine Points" to make it active.
2. **Frame** the project and **Zoom** to Jones Inlet as shown in Figure 8.
3. Using the **Select Feature Point** tool, select the easternmost refine point (Figure 8).
4. Right-click and select **Point Attributes…** to bring up the *Refine Point* dialog.
5. Turn on *Refine grid in I direction*.
6. Set *Base cell size* to "60.0".
7. Click **OK** to close the *Refine Point* dialog.

Feel free to review the attributes of the other refine points, if desired.

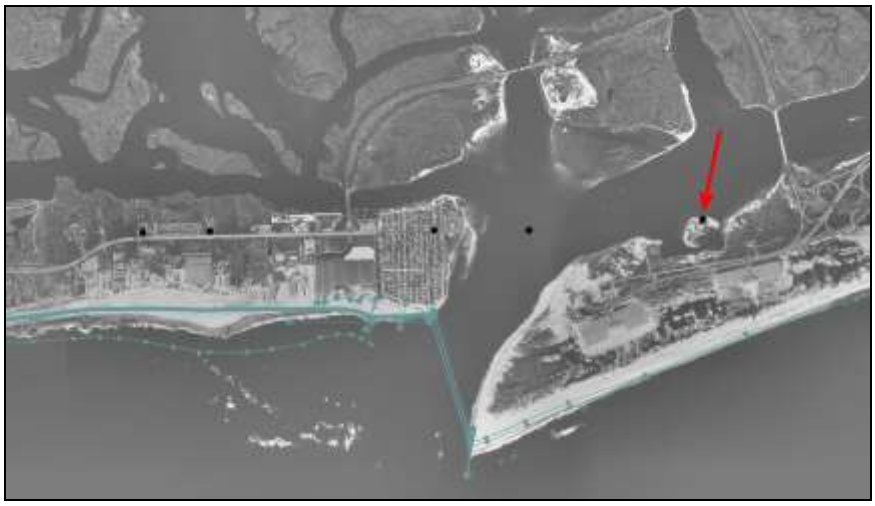

Figure 8 Location of the refine points near Jones Inlet

3.8 Merging GenCade Coverages

GenCade uses one coverage that contains all structures and events. In this tutorial, each type of structure was created on its own GenCade coverage. If desired, all structures and events can be created on one structure instead.

Because multiple coverages were used, all of the GenCade coverages must be merged prior to creating the 1D grid. To do this, do the following:

1. Select "GenCade".
2. While holding down the *Shift* key, select "Refine Points".

All nine of the coverages should now be selected.

3. Right-click on the selected coverages and select **Merge Coverages**.
4. When asked if the coverages used should be deleted, click **No**.

A new "Merge coverage" should appear in the Project Explorer.

5. Turn off all coverages except "Merge coverage".

3.9 Grid Orientation and Cell Size

The 1D grid frame can now be created by following these steps:

1. Select "Merge coverage" to make it active.
2. **Frame** the project.
3. Using the **Create 1-D Grid Frame** tool, click once just above the top right of the project coastline to create a start point, then a second time just to the left of the Jones Inlet images to create the end point for the 1D grid (Figure 9).
4. Using the **Select 1-D Grid Frame** tool, double-click on selection box of the newly created grid frame to bring up the *Grid Frame Properties* dialog.
5. Enter "754605.0" as *Origin X*.

6. Enter “4548955.0” as *Origin Y*.
7. Enter “200.0” as *Angle*.
8. Enter “158915.0” as *I size*.
9. Turn on *Use refine points.*
10. Enter “200.0” as *Maximum cell size*.
11. Enter “1.08” as *Maximum bias*.
12. Turn on *Use inner growth*.
13. Click **OK** to close the *Grid Frame Properties* dialog.
14. Right-click on “ Merge coverage” and select *Convert* | **Map → 1D Grid** to bring up the *Map → 1D Grid* dialog.

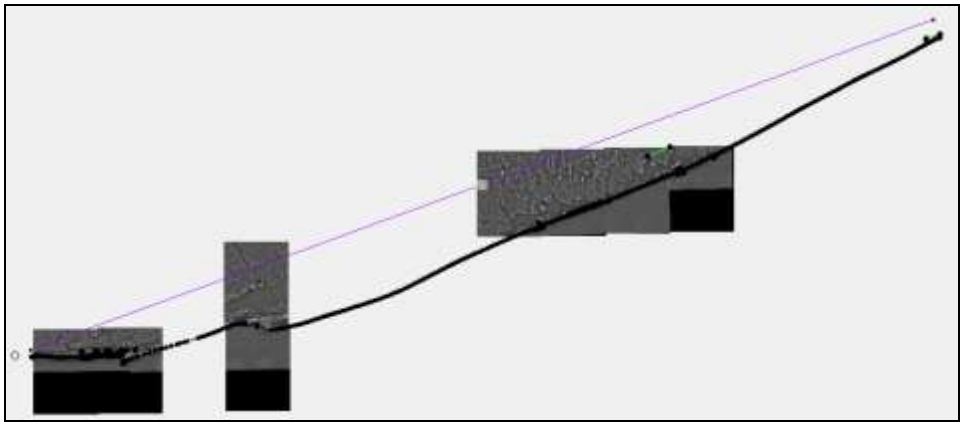

Figure 9 Location of 1D grid frame

Notice that all of the parameters set in the *Grid Frame Properties* dialog are already set.

15. Click **OK** to create the 1D grid.
16. If a dialog appears stating degenerate seawall segments were ignored, click **OK**.
17. If the *Model Checker (Potential Issues Found)* dialog appears stating that groins need to be at least two cells apart, click **Cancel** to close the *Model Checker (Potential Issues Found)* dialog.
18. Select “ GenCade Grid” in the Project Explorer to make it active.
19. Select *GenCade* | **Edit Groins** to bring up the *Groins* dialog.
20. In the *Cell Index* column, edit the numbers to make sure they are at least four cells apart.
21. Once done, click the **OK** button to close the *Groins* dialog.

The 1D grid should now be created and the project should appear similar to Figure 10.

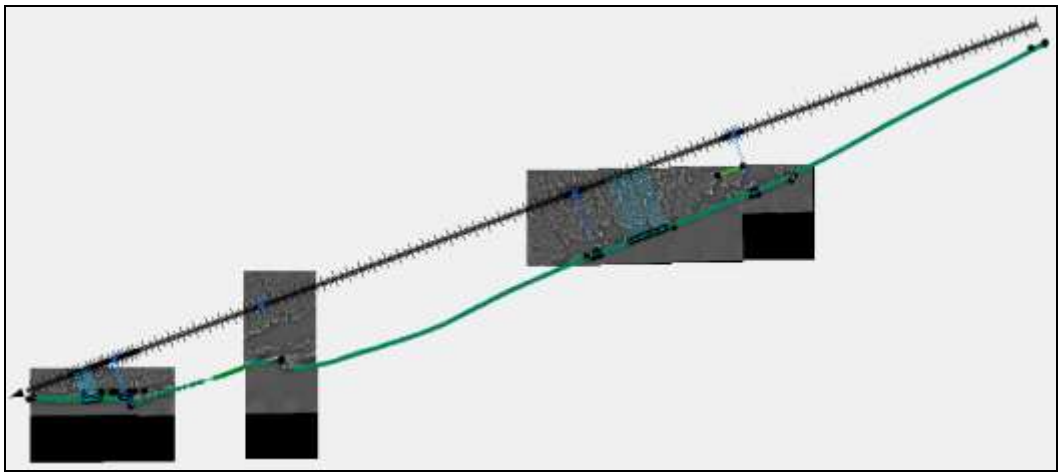

Figure 10 The 1D grid

4 Wave Data

Now that the 1D grid is created, the wave data can be loaded into the project by doing the following:

1. Select "GenCade Grid" in the Project Explorer to make it active.
2. Select *Gencade* | **Edit Wave Data…** to bring up the *Wave Gages* dialog.
3. In row *1*, enter "1" in the *Cell* column and "36.0" in the *Depth* column.
4. Click **Data…** to open the *Wave Events* dialog.
5. Outside of SMS, open the file "Wave_Data_Gage_1.xls" in a spreadsheet program.
6. Copy the values from the *Date* column of the "Wave_Data_Gage_1.xls" file to the *Date* column in the *Wave Events* dialog.
7. Copy the values from the *H0 (m)* column of the "Wave_Data_Gage_1.xls" file to the *H0 (m)* column.
8. Copy the values from the *Period (sec)* column of the "Wave_Data_Gage_1.xls" file to the *Period (sec)* column.
9. Copy the values from the *Direction (deg)* column of the "Wave_Data_Gage_1.xls" file to the *Direction (deg)* column.
10. In the *Interpret Directions As* section, select "Shore Normal" from the *Convention* drop-down.
11. Click **OK** to close the *Wave Events* dialog.

Enter the data for the second gage by doing the following:

12. In the second row of the *Wave Gages* dialog, enter "244" in the *Cell* column and "27.0" in the *Depth* column.
13. Click **Data…** to open the *Wave Events* dialog.
14. Repeat steps 5–11 using the file "Wave_Data_Gage_2.xls"

Then enter the data for the third gage by doing the following:

15. In the third row of the *Wave Gages* dialog, enter "678" in the *Cell* column and "24.0" in the *Depth* column.
16. Click **Data…** to open the *Wave Events* dialog.
17. Repeat steps 5–11 using the file "Wave_Data_Gage_3.xls"
18. Click **OK** to close the *Wave Gages* dialog.

The project should now appear similar to Figure 11.

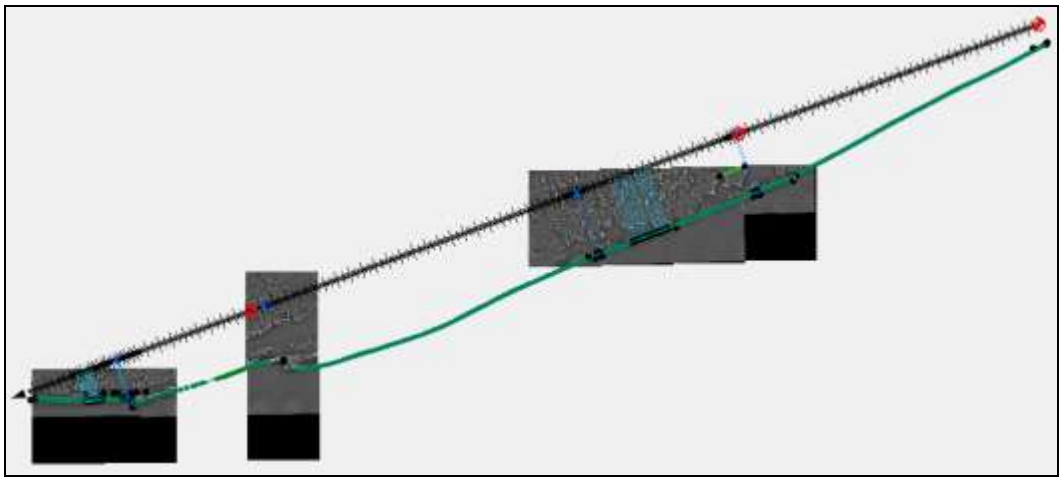

Figure 11 The red icons indicate wave data has been entered

5 Model Control and Saving the Project

Prior to running GenCade, set the parameters of the model in the model control by doing the following:

1. Select *GenCade* | **Model Control…** to bring up the *GenCade Model Control* dialog.
2. On the *Model Setup* tab, in the *Computation Time* section, set:
   - *Start Date* to "01-Jan-1983 12:00 AM".
   - *End Date* to "01-Jan-1995 12:00 AM".
   - *Time Step* to "1.0".
   - *Recording Time Step* to "168.0".
3. On the *Beach Setup* tab, set:
   - *Effective Grain Size* to "0.3".
   - *Average Berm Height* to "1.0".
   - *Closure Depth* to "8.0".
   - *K1* to "0.3".
   - *K2* to "0.15".

4. On the *Seaward BC* tab, set *Number of Cells in Offshore Contour Smoothing Window* to "11".
5. On the *Lateral BC* tab, select "Pinned" in the *Type* drop-down in both the *Left Lateral BC* and the *Right Lateral BC* sections.
6. Click **OK** to close the *GenCade Model Control* dialog.

Now save the project before running GenCade:

7. Click **Save** to save the project under the working title.

6 Running GenCade

When running GenCade, a window opens that describes the simulation. This window indicates if an error occurs and advises of the progress each time a year is completed. The window also gives an alert when the model is finished. GenCade generally runs quickly.

To run GenCade, do the following:

1. Select *GenCade* | **Run GenCade…** to bring up the *GenCade* model wrapper dialog. If any potential issues are identified by the Model Checker, the *Model Checker (Potential Issues Found)* dialog will appear. If it does not appear, skip to step 3.
2. Resolve any issues by following the directions in the *Fix* section of the *Model Checker (Potential Issues Found)* dialog.

If the problems are not cleared even after following the directions, the GenCade model can still be run, but it may encounter errors.

3. Click on the **Run Model** button to run GenCade.
4. Once it is finished, you can save the *GenCade Output* as a text file, or simply click **Exit**.

6.1 Gencade Output Files

Following a GenCade simulation, at least seven output files will be created in the assigned directory.

- The print file (*.prt) saves all of the information related to the simulation including wave heights, shorelines, and transport rates.
- The shoreline position output file (*.slo) documents the shoreline position for each time step for every cell in the grid.
- The net transport rate file (*.qtr) prints the net transport rate for each cell at every time step.
- The inlet shoal volume file (*.irv) lists volumes for each inlet shoal for every time step. A separate inlet shoal volume file is created for each inlet represented in the simulation. If the grid does not include an inlet, the *.irv file will not be created.

- The mean net annual transport files (*.mqn [mean annual net transport], *.mql [mean transport to the left], and *.mqr [mean transport to the right]) list the transport for each cell for each time step.
- The offshore contour for each time step for each cell is included in the offshore contour file (*.off).

All of the files except the print file may be opened and viewed in SMS. The aforementioned files contain the majority of the information needed to evaluate the results of a simulation.

7 Visualizing the Results

As mentioned in the previous section, many of the output files may be opened in the SMS for visualization. The first of these files is the SLO file, or shoreline change file.

1. Click **Open** to bring up the *Open* dialog.
2. Select "LongIsland.slo" and click **Open** to import the solution file and exit the *Open* dialog.

The*Time Steps* section will appear in the SMS window. An arc representing the calculated shoreline should appear in the grid window. The default color and size of the calculated shoreline may be difficult to view, so the display options should be adjusted.

3. Click **Display Options** to bring up the *Display Options* dialog.
4. Select "1D Grid" from the list on the left.
5. Click on the wide button to the left of *Current shoreline* to bring up the *Line Attributes* dialog.
6. Enter "3.0" as the *Width*.
7. Click on the *Line color* button to bring up the *Color* dialog.
8. Select *Red* and click **OK** to close the *Color* dialog.
9. Click **OK** to close the *Line Attributes* dialog.
10. Click **OK** to close the *Display Options* dialog.

The calculated shoreline should now be more visible as a red arc (Figure 12). The size and color of the initial shoreline, regional contour, and structures can also be changed using these same steps.

The default time under *Time Steps* is "Relative Time". To view the simulated dates:

1. Right-click on *Time Steps* in the SMS window and select **Time Settings** to bring up the *Time Settings* dialog.
2. Enter "1/1/1983 12:00:00 AM" as the *Zero time* to match the first date in the simulation.
3. In the *Time Display* section, select "Absolute Time/Date" from the *Display as* drop-down.
4. Click **OK** to close the *Time Settings* dialog.
5. **Zoom** in on the desired location.

6. Select the first time step and use the arrow keys on the keyboard to scroll through them.

View the current shoreline at any date during the simulation and compare it with the initial shoreline or other reference lines. There should be varying fluctuations in the location of the current shoreline compared to the initial shoreline when scrolling through the time steps.

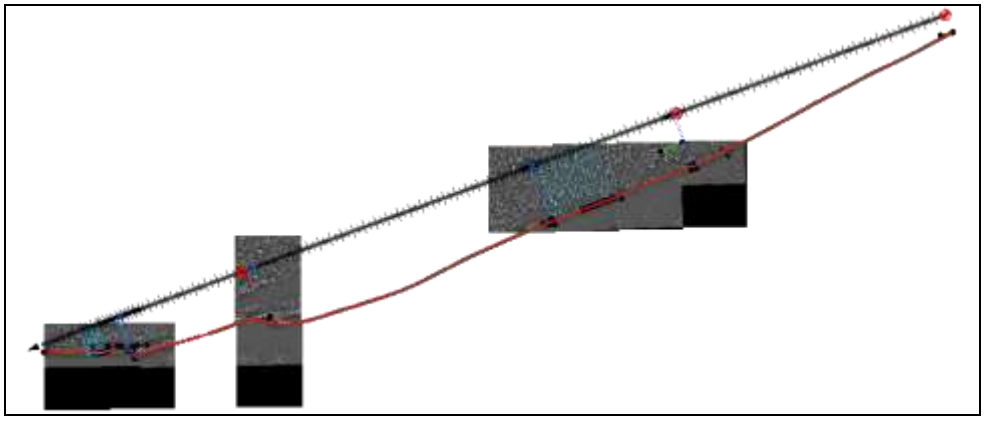

Figure 12 Calculated shoreline

8 Conclusion

This concludes the "GenCade" tutorial. Feel free to continue to experiment with GenCade in SMS, or exit the program.