# Guided GenCade Example for an Idealized Case: Galveston Island, TX

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# 1. Introduction

Setting up GenCade for an idealized case along Galveston Island, TX illustrates model setup and application. This area was chosen because it includes many of the various structures and features that may be included within a GenCade model. It is important to note that the model presented has not been verified and many of the parameters included were chosen to exaggerate results or clarify model limitations. Figure 1 shows the area to be modeled and identifies major features to be included. The overall goal of this guided example is to allow the user to work with real and simulated datasets at a realistic location to demonstrate model capabilities.

**Goals for the exercise:**

1. Set up a GenCade Model
2. Modify model to include different engineering alternatives
3. Visualize & process results

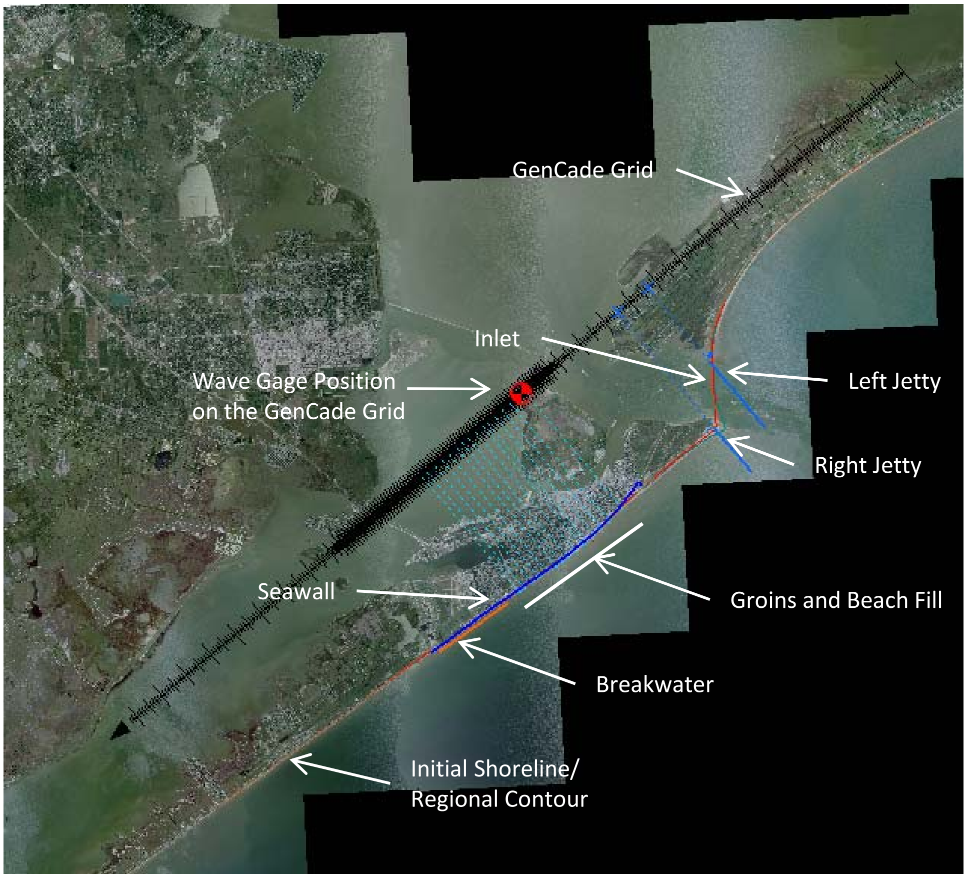



Figure 1. Example feature overview.

This document begins with simplified step by step instructions for setting up the model. The intention is for the beginner to moderate user to be able to follow the steps and visualize everything in SMS similarly to the given figures. As the topics become more advanced throughout this document, less explicit instructions are given.

Many of the steps presented can be done in more than one way or in a different order. The example format is set up so that advanced users can try other methods or skip sections. An SMS project file, .sms, and map file, .map, were created for each major section in the provided data. SMS files are saved under the *GenCade\Hands-On Example\SMS Project Files* folder. Map files are saved under the *GenCade\Hands-On Example\Map Files* folder. In order to start from any point in the exercise, go to the section of interest and open the related SMS project file. Users are referred to the online user guide at the link below for more detailed information on setting up and using GenCade.

http://cirp.usace.army.mil/wiki/GenCade_Users_Guide

# 2. Conceptual Model Setup

As much of the setup as possible is done in conceptual model space through the SMS map module. Creating the model in this manner, as opposed to making changes in the 1D grid module, enables modification without duplication of effort.

## *2.1. Set Up SMS*

GenCade is set up to run from SMS 11.1, a licensed copy of which must be installed on your machine. Take the following steps to set up SMS:

- Open SMS 11.1
- Identify location of GenCade executable.
    1. *Edit->Preferences*. Select the *File Locations* tab and scroll down to *GenCade* under *Model Executables*.
    2. Click the button under *Executable* located directly to the right of *GenCade.*
    3. Browse to the latest model version *GenCade\Hands-On Example\Models\ GenCade_v1_1w.exe*, the newest provided executable.
- Change coverage type to GenCade.
    1. Right click on the default coverage.
    2. Select *Type-> Models->GenCade.*
- Set display projection.
    1. Click *Edit->Projection* then select *Global projection*.
    2. Set projection to *UTM zone 15, NAD 83, meters*.
    3. Set vertical projection to local with units in meters.
- ***Note: The sign convention for the conceptual model grid is in degrees counterclockwise from the x axis. The sign convention will change after converting to the GenCade grid.***

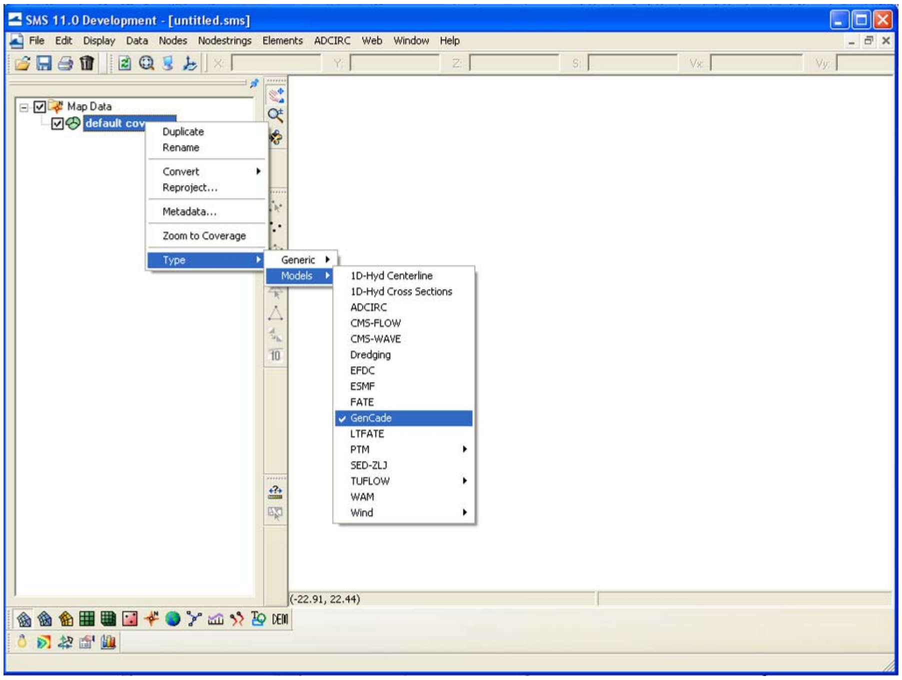



Figure 2. Set model type to GenCade.

- Set map data projection in SMS.
    1. Right click on the Coverage name and select *Projection (floating).*
    2. Select *Global* projection.
    3. Set projection to *UTM zone 15, NAD 83, meters*.
    4. Set vertical projection to *local* with units in *meters*.

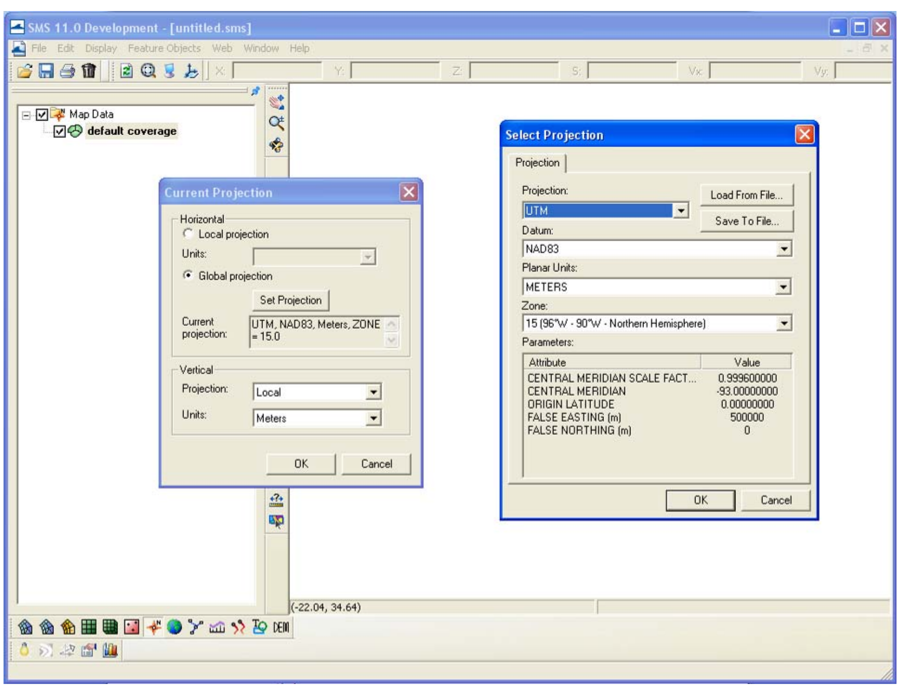



Figure 3. Select model projection.

- Change the background color to white.
    1. Click *Display->Display Options* then select the *General* window.
    2. Change the background color to white by clicking inside the sample and selecting white.
    3. Other display settings may be changed here to suit user preference.
    4. Click *File->Save Settings* to make the current settings the default.

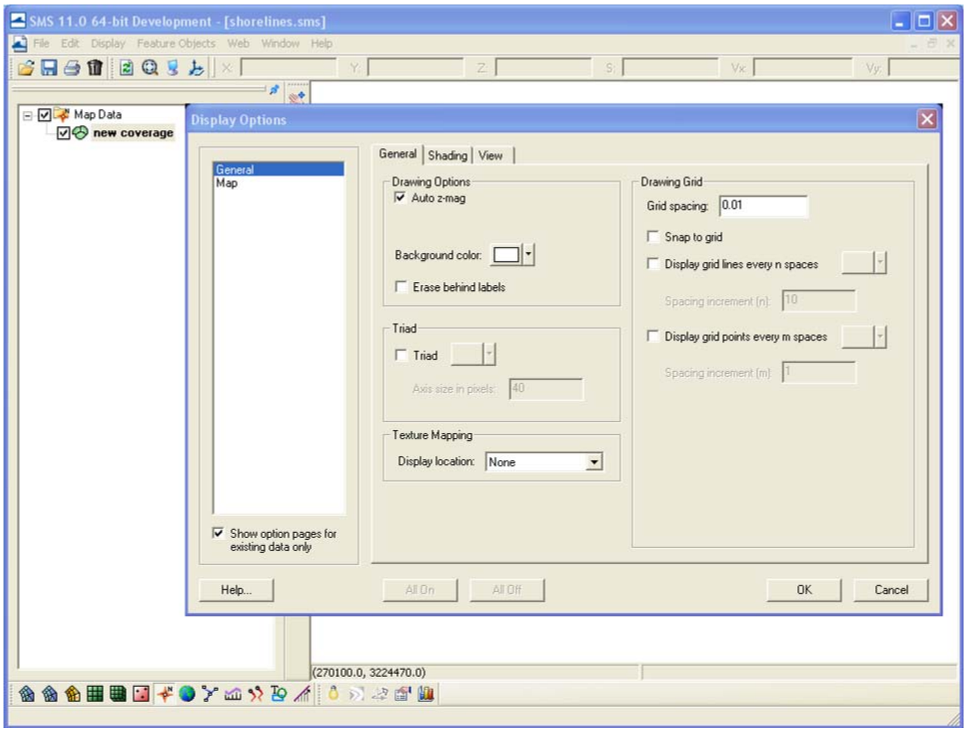



Figure 4. Change display options.

## *2.2. Import Aerial Photographs*

Georeferenced aerials provide an easy way of identifying features to include in GenCade, forming the basis for much of the model setup. Take the following steps to import aerials:

- Georeferenced aerials can be obtained from many sources including:
    - New flights
    - Government entities
        - http://datagateway.nrcs.usda.gov/
    - Commercial entities
        - http://www.esri.com/software/arcgis/arcgisonline/
        - Use Arcmap to save aerials at the desired extent with world file
    - SMS built in search
        - *Web->Find Data->Image*
- *Open*  *2008_Galveston.jpg* files under *GenCade\Hands-On Example\Aerials*

    1. Alternatively, images can be dragged from windows explorer to the SMS graphics window.
    2. SMS will auto-detect and apply world files (.jgw, etc.).
    3. Verify projection in SMS.
        - Right click on the image name and select *Projection*.
        - Select *Global* projection.
        - Set projection to *UTM zone 15, NAD 83, meters*.
        - Set vertical projection to *local* with units in *meters*.

- *Save often (*  *)*!

### 2.3. Initial Shoreline and Regional Contour

The initial shoreline represents the initial condition from which model calculations begin. The regional contour represents the equilibrium shape of the shoreline in a regional context. A regional contour could be specified as an offshore contour, shoreline, or any other contour that accurately represents the regional shoreline trends.

Create the initial shoreline:

- Shoreline position data may be obtained from various sources including:
    - Aerials or charts.
    - Pick elevation from survey data.
    - Arcmap.
    - Texas Shoreline Change Project: used for this example.
- The following steps are intended to provide an overview of how to convert raw data into an initial shoreline.
    1. *Open* .shp files under *GenCade\Hands-On Example\Shoreline Data.*
    2. Left click *1995.shp* under *GIS Data* in the project explorer window.
    3. Convert shapes to features: Click *Mapping-> Shapes->Feature Objects.*
        - Select *Yes* to use all shapes.
        - Click *Next* twice and *Finish* to create features.
    4. The imported arc is in many different segments, but the initial shoreline must be a single segment. Use the general directions below to merge and adjust shoreline data to create a single representative shoreline arc. In order to complete the exercise in the allotted time, open the saved map file rather than processing the entire initial shoreline.
        - Click the *Feature Arc Selection*  button and delete any unnecessary arcs; those beyond the area of interest, in bays, etc.
        - Click the *Feature Point Selection*  button and select all points.
        - Right click and select *Convert to Vertices* to merge connected segments. This merges already connected segments imported from the shapefile.

- Select all points then zoom to any identified Feature Points not at the ends of the desired shoreline.
- Use the *Create Feature Arc*  tool to close gaps in the shoreline segment, then delete unneeded arc segments, and convert Feature Points to Vertices to create a single continuous arc (Figure 4).
- Select the arc, then right click and select *Attributes*, choose *Initial Shoreline* from the dropdown menu.
- If necessary to save time for the workshop example, *Open 1995_shoreline.map* under *GenCade\Hands-On Example\Map Files*, then delete previous coverage.

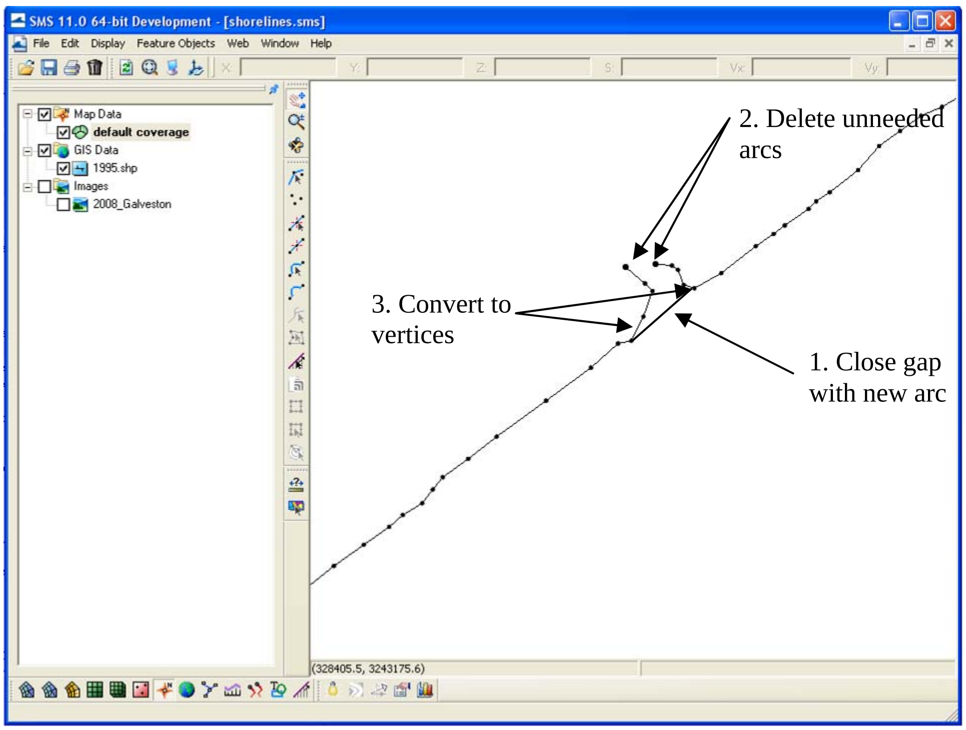



Figure 5. Merge discontinuous arcs to create a single shoreline arc.

5. Rigorous quality control is required to make sure the initial shoreline accurately represents the shoreline of interest.
   - This is a tedious process requiring detailed inspection of the shoreline.
   - Smoothing algorithms may be applied to speed up the process.
     - Select the shoreline arc.
     - Right click and select *Smooth Arcs* from the dropdown menu, use default settings, select *OK* .
     - Inspect shoreline for accuracy.

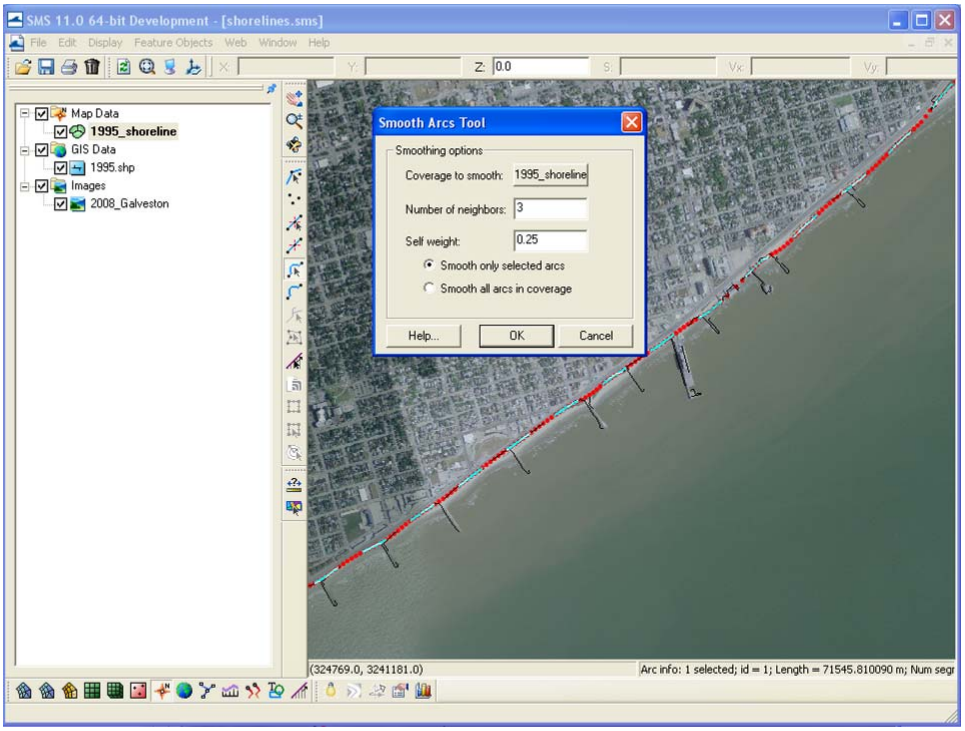



Figure 6. Smooth shoreline segment and inspect for accuracy.

Create the regional contour:

- Obtain data to represent regional contour:
  - Use initial shoreline.
  - Trace from aerials or charts.
  - Pick elevation from survey data; any contour may be used.
- Create regional contour.
  - For this example, the initial shoreline is smoothed to estimate the regional contour to provide a clear example of how changes in the regional contour influence model results. For engineering applications, the selection of the regional contour must be carefully considered during the model verification process.
  1. Rename active coverage: right click *1995_shoreline* coverage, select *Rename* and type “Initial Shoreline”.
  2. *Open* “1995_shoreline.map” under *GenCade\Hands-On Example\Map Files*, then select the arc.
  3. Right click and select *Attributes*, choose *Regional Contour* from the dropdown menu.
  4. Right click and select *Smooth Arcs* from the dropdown menu, set *Number of Neighbors* to 50, select *OK.*
  5. Inspect contour to verify that it follows the regional shoreline trends.
  6. Modify vertices as needed to shape the contour to match regional trends.
     - Zoom to the area near the south jetty.

        - Reshape arc so that it follows the shoreline trend.
    7. Rename active coverage to “Regional Contour.”
    8. Save often.
    9. To simplify the workshop and ensure a uniform data set for later comparison, *Open* “regional_contour.map” to load prepared initial shoreline and regional contour coverages. New coverages will be loaded with a (2) after the title. Delete old coverages and rename new coverages to delete the (2).

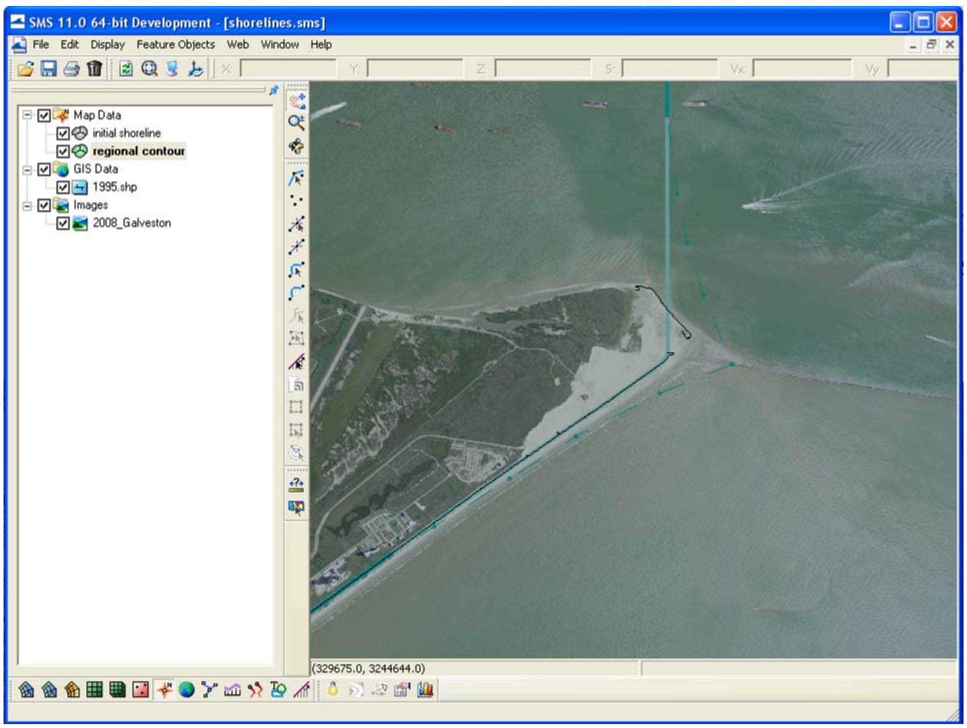



Figure 7. Close up of initial shoreline and regional contour.

- Merge Regional Contour and Initial Shoreline coverages.
    1. Select the initial shoreline and regional contour coverages; hold down CTRL to select multiple coverages.
    2. Right click and select *Merge Coverages*.
        - A dialog provides the option to delete the source coverages. Select *No* to save the old coverages in case you need to merge again.
        - A new coverage is created named *Merge coverage.*
    3. Delete the initial shoreline and regional contour coverages if no longer needed.
- Convert the data to the state plane coordinate system.
    *1.* Right Click the coverage name, then select *Reproject*
    2. Acknowledge the SMS warning that this is a non-reversible command.

3. Select *Global projection* under *New projection*.
4. Set projection to *State Plane Coordinate System, Texas South Central* zone, *NAD 83, feet*.
5. Set vertical projection to local with units in U.S. survey feet.
   - When working in U.S survey feet all input data and parameters must be entered in US customary units with the exception of the effective grain size (which is always in mm) and the wave height (which is always in m).

- Convert the display projection to the state plane coordinate system.
  1. Select Edit ->*Projection*
  2. Select *Global projection*, then *Set Projection*.
  3. Set projection to *State Plane Coordinate System, Texas South Central* zone, *NAD 83, feet*.
  4. Set vertical projection to local with units in U.S. survey feet.

## 2.4. Inlets

1. Create a feature arc extending across the inlet. Position of the inlet on the GenCade grid is controlled by the location of the two endpoints.
2. Once the inlet is drawn, select the arc and double-click on the line representing the inlet.
3. Select Inlet from the drop down menu.
4. Select Attributes.
5. Name the inlet "Galveston".
6. Set Inlet Shoal Volumes under the Volume button to match Table 1.
   - Shoal volumes presented are for illustration purposes only. Shoal volumes can be measured with surveys or predicted using various relationships. For more information the reader is referred to Walton, T.L., Jr., and Adams, W.D. (1976). "Capacity of inlet outer bars to store sand,"*Proc. 15th Coastal Eng. Conf.*, ASCE, 1,919-1,937.

Table 1. Inlet Shoal Volumes.

| | **Initial, $yd^3$** | **Equilibrium, $yd^3$** |
|---|---|---|
| **Ebb** | 5,000,000 | 5,000,000 |
| **Flood** | 1,000,000 | 1,000,000 |
| **Left Bypass** | 1,000,000 | 1,000,000 |
| **Left Attachment** | 500,000 | 500,000 |
| **Right Bypass** | 1,000,000 | 1,000,000 |
| **Right Attachment** | 500,000 | 500,000 |

7. Specify a dredging event of 1,000,000 $yd^3$ from the *Ebb Shoal* starting 1/1/1996 and ending 3/1/1996 under the *Dredging* button. Note that these are hypothetical quantities and do not represent the actual study area.

8. Set the bypassing coefficients *Y left* and *Y right* to 1.0.
9. *OK* to exit Attributes, the feature arc will turn blue representing an inlet.

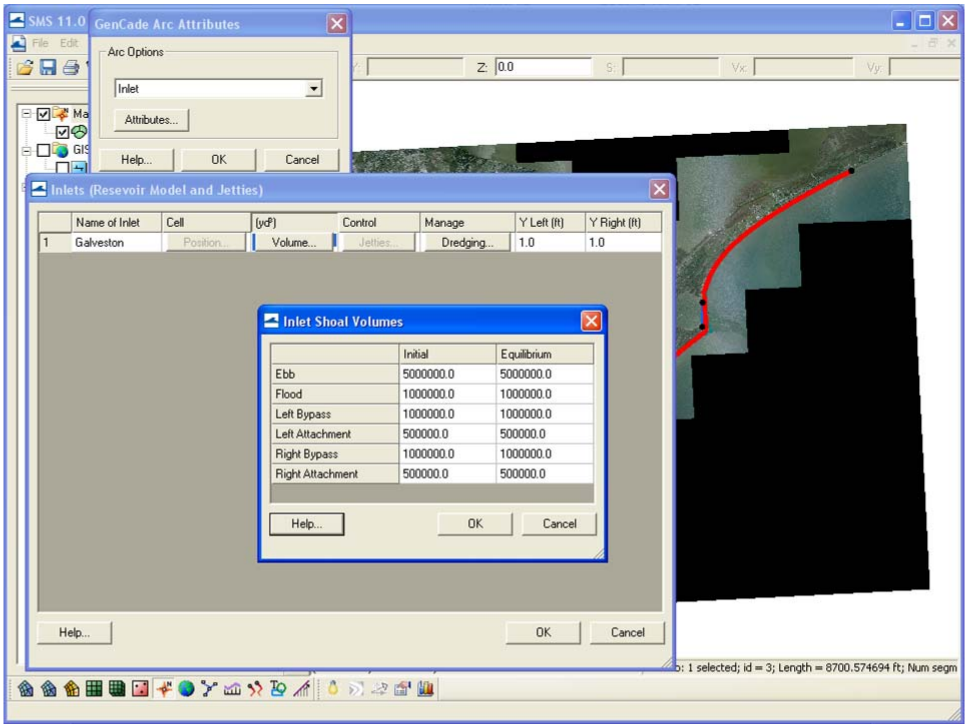



Figure 8. Assign inlet attributes.

## 2.5. Jetties

1. Draw a feature arc over each jetty.
2. Once each jetty is drawn, click on the *Select Feature Arc* button and double-click on the line representing the jetty.
3. Select *Left* or *Right Jetty on Inlet* from the drop down menu.
   - The left jetty is to the left of the inlet when looking seaward from the beach.
4. Select *Attributes* and set *Permeability* to 0.5 for the left jetty and 0.3 for the right jetty.
5. Check the *Diffracting* box and set the *Seaward Depth* to 25 ft for both jetties.

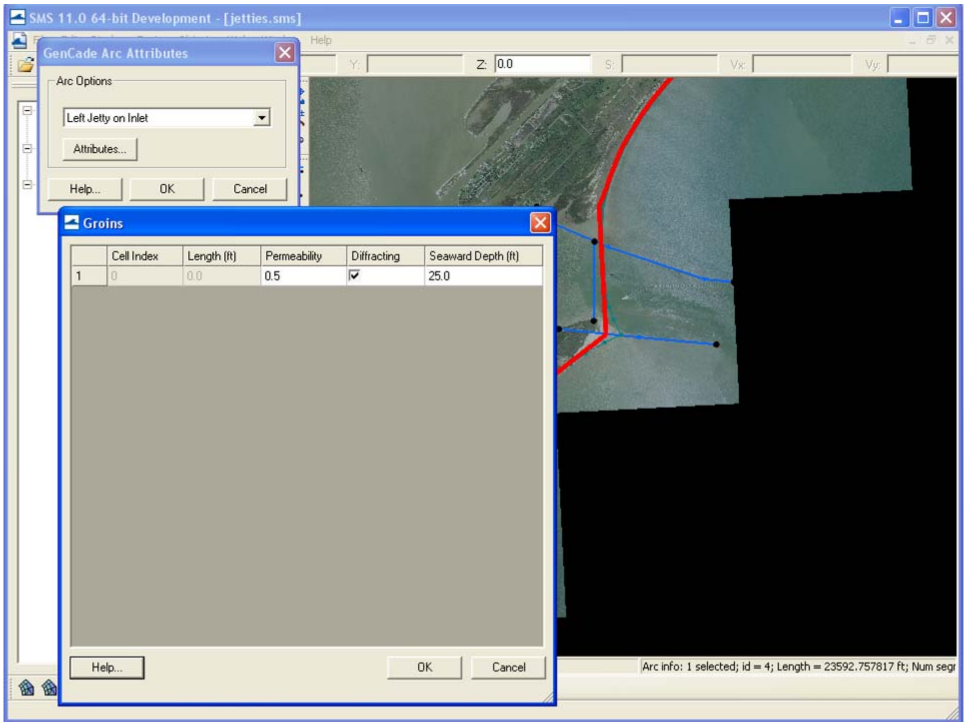



Figure 9. Assign jetty attributes.

## *2.6. Seawall*

1. Draw a feature arc over the seaward edge of the seawall.
    - Be careful not to click on an existing feature arc. This will split the arc. If this occurs, delete the new arc, convert the newly created feature node to a vertex, and reassign arc attributes as necessary.
    - Zoom to an extent that allows you to build the feature arc easily. Create an arc across the view extents, then pan over and join a new arc to the last arc created. When the entire seawall is covered, select all feature nodes and *convert to vertices* to merge the segments into a single arc.
2. Activate the *Select Feature Arc* button and double-click on the line representing the seawall, choose *Seawall* from the drop down menu.
3. To expedite the example, draw a less detailed seawall or Open “seawall.map” to load prepared coverages; delete other coverages and rename as required.

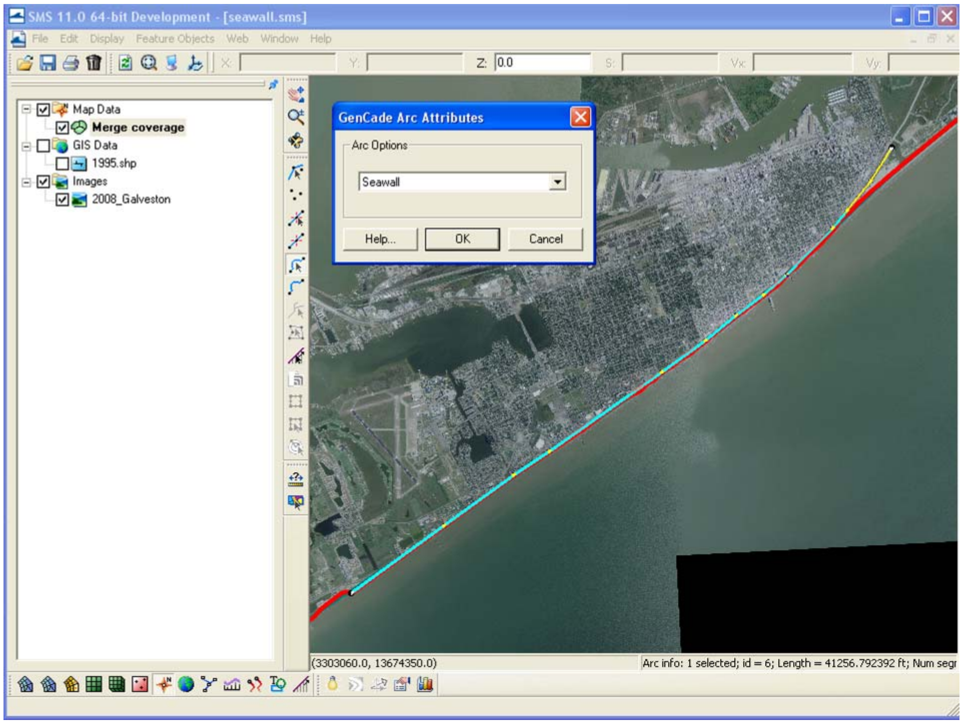


Figure 10. Add a seawall.

## *2.7. Groins*

1. Zoom in to an area with groins and then draw a feature arc over the groin.
    - Be careful not to click on an existing feature arc. This will split the arc. If this occurs, delete the new arc, convert the newly created feature node to a vertex, and reassign arc attributes as necessary.
2. Once the arcs are drawn, click on the *Select Feature Arc* button and select each arc representing a groin.
3. Right click and select *Attributes*, then choose *Groin* from the drop down menu and specify the following parameters:
    - Permeability: 0.1.
    - Diffracting: checked.
    - Seaward depth: 8 ft.
4. To expedite the example, create two groins only or *Open* “groins.map” to load prepared coverage and delete other coverages. The prepared coverage includes 15 groins.

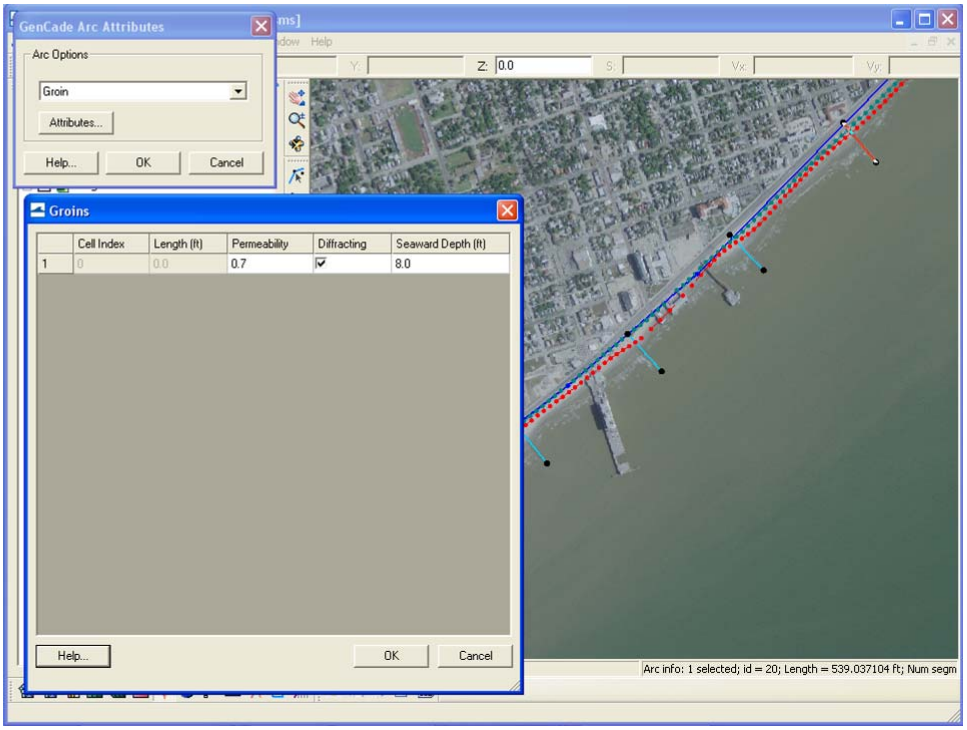
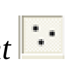



Figure 11. Add groins to the map.

## *2.8. Refine Points*

Refine points allow increased grid resolution near structures or rapidly changing shorelines. Using less grid cells decreases run time, therefore it is advantageous to use a coarse grid with refine points where needed, whenever possible.  Take the following steps to include refine points:

- Identify locations where a finer grid may be suitable.
  - Any place with a steep gradient in the shoreline, smaller grid cells may be required.
  - Often, poor results will prompt addition of refine points iteratively.
  - Visually inspect the shoreline for locations that may require refine points.
  - For this example, refine points will be placed near the terminus of each structure.
- Create Refine Points.
  1. Create a new feature point using the *Create Feature Point*  button near each end of the seawall.
  2. Select the Feature Points then right click and select *Node Attributes*.
  3. Check the *Refine grid in I direction* box and set the *Base cell size* to 50 ft.
  4. Repeat for each Feature Point.
     - Multiple feature points can be selected and defined as refine points simultaneously.

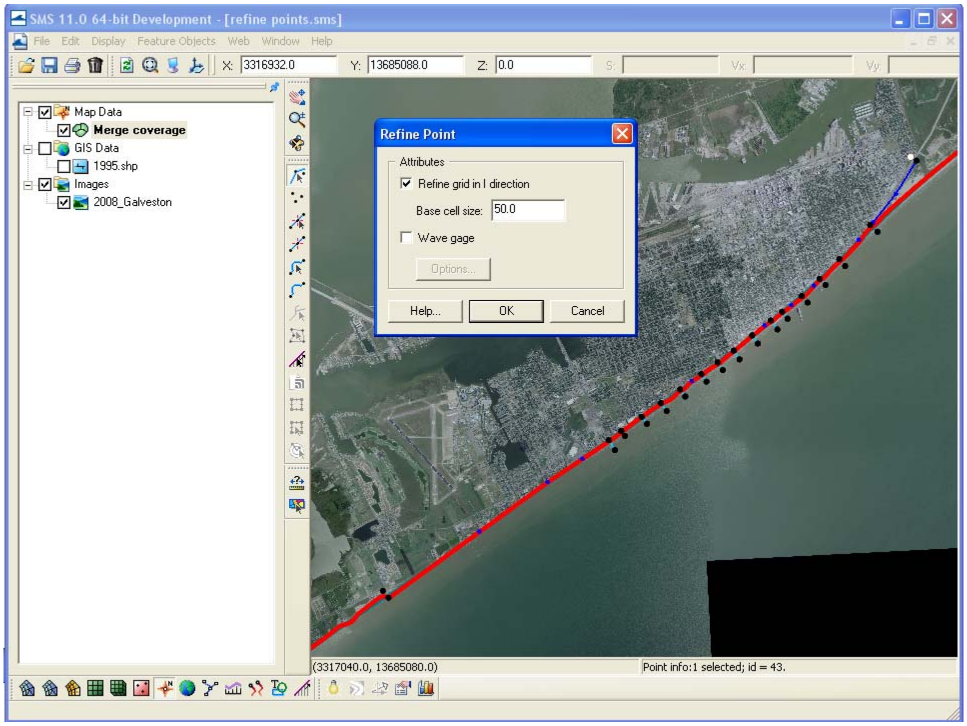



Figure 12. Add refine points near structures.

### *2.9. Grid Frame*

1. Click the *Create 1-D Grid Frame* button , then click the location you want the grid frame to start, then click again at the desired ending location.
    - If a person was walking down the grid to the arrow, the water would be to the left and the land would be to the right. For example, if the GenCade grid arrow was pointing south, the water would be to the east (left) and the land would be to the west (right).
2. Click on the *Select 1-D Grid Frame* button , then click inside the rectangle that appears on the grid frame.
    - The grid frame can be lengthened or shortened by dragging the end point and rotated by dragging the circle at the end of the frame.
3. Right click and select *Properties* to define the following values:
    - *Origin X*: 3,358,200 ft (X coordinate of grid start point)
    - *Origin Y*: 13,747,700 ft (Y coordinate of grid start point)
    - *Angle*: 220º (Orientation of grid, º counterclockwise from x axis)
    - *I size*: 155,000 ft (Length of grid)
    - Select *Use Refine Points*
    - *Maximum Cell Size*: 500 ft (Maximum size of any grid cell)
    - *Maximum Bias*: 1.1 (Rate of cell size growth, i.e. 1.1 implies that each adjacent cell is 10% larger than its neighbor until the maximum is reached)

- Do not check *Use inner growth*. (If the use inner growth option is selected, the cells will also grow between the two refine points, rather than remain at the finer scale.)

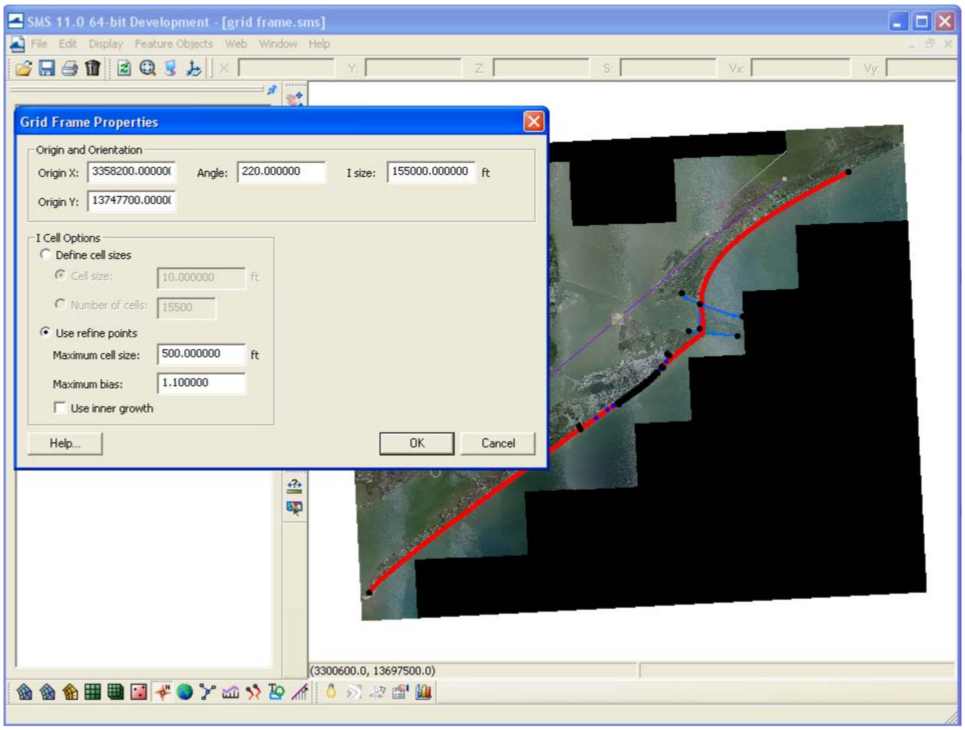



Figure 13. Set up 1D grid frame.

## *2.10. Wave Data*

Waves provide the forcing for shoreline change. SMS will accept wave data in meteorological, oceanographic, Cartesian, or shore normal convention and then automatically convert to the shore normal convention required by GenCade. Real wave data often has gaps or errant data. Therefore, wave data must be processed before it can be applied in GenCade. For this example, a simple averaged wave condition will be applied to clarify model results. Optionally, instructions for processing WIS data are provided in Section 2.10.1 to demonstrate a typically required step.

- Open “waves_averaged.xlsx” under *GenCade\Hands-On Example\Wave Data.*
- Add wave data to SMS
    1. Click *Edit->Single Point Projection* to add a feature point at coordinates of the wave gage.
        - Under *Convert From* select *Global Projection* and *Set Projection* to Geographic with NAD83 as the horizontal datum and Arc Degrees as the *Planar Units*. Set the *Vertical Projection* to Local and the *Units* to feet.
        - Under *Convert To* select *Global Projection* and *Set Projection* to State Plane Coordinate System, Texas South Central zone, with

NAD83 as the horizontal datum and feet as the *Planar Units*. Set the *Vertical Projection* to Local and the *Units* to feet.

- Longitude: -94.6
- Latitude: 29.1
- Z: 50
- Check the *Create feature point* box.
- Select *Close*

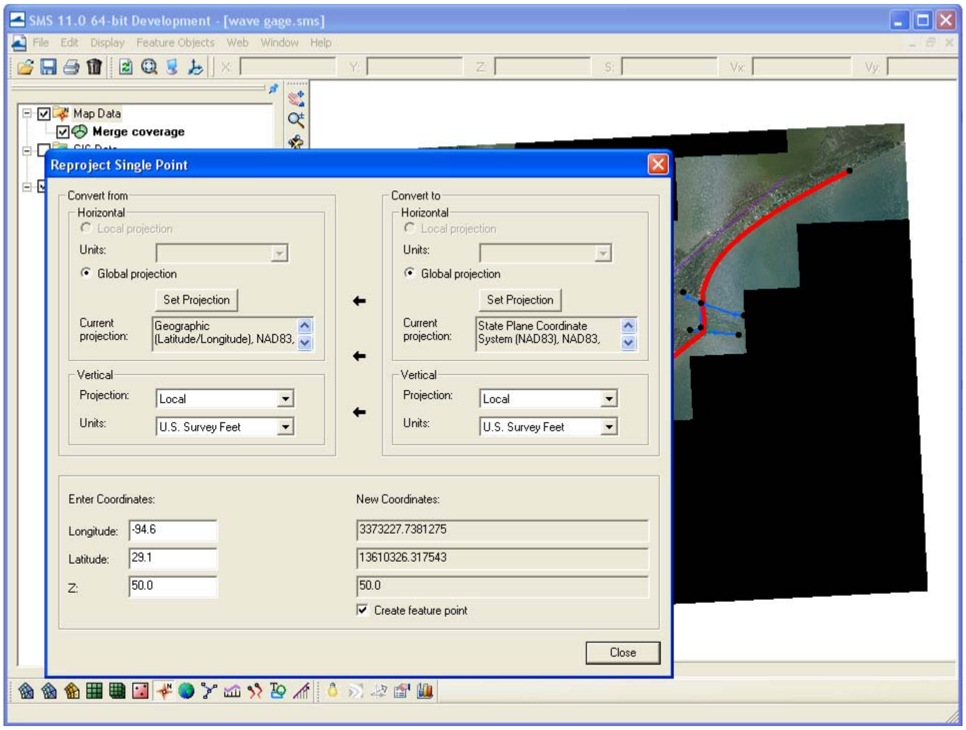



Figure 14. Add feature point for wave gage.

2. Double click on the feature point with the *Select Feature Point* tool active and check the *Wave gage* box, and then click the *Options* button.
3. Enter *Depth* of 50 ft and click the *Data* button.
4. Copy wave data from “waves_averaged.xlsx,” paste to the *Wave Events* window.
5. Specify the angle convention of the wave data (Provided data is in Shore Normal Convention).
    - Select *Shore Normal* from the *Convention* drop down menu.

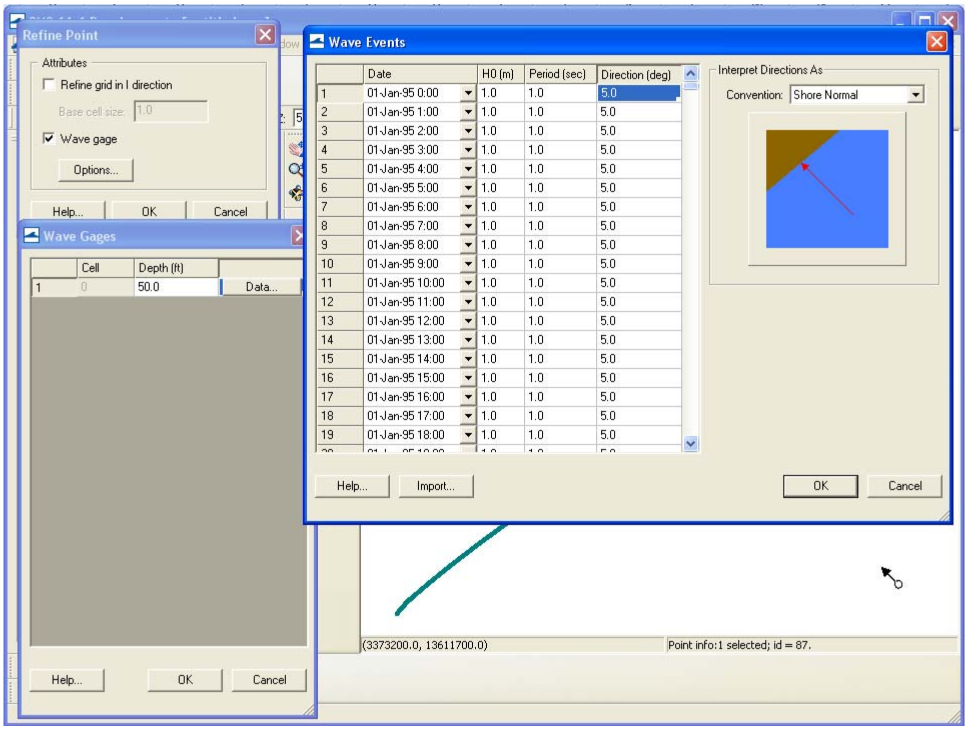


Figure 15. Add data to wave gage.

# 3. Convert to GenCade Model Grid

Now that all of the data have been loaded and organized, the grid can be created. Take the following steps to create the GenCade grid:

- Load example map file:
  1. In order to use the specified cell numbers in the following examples, it is necessary to load the exact input data used throughout this example. If you choose not to load the example map file, some of the values in the remainder of this example should be expected to vary.
  2. *Open wave gage.map* under *GenCade\Hands-On Example\Map Files*, and then delete previous coverage.
- Convert map to 1-D grid.
  1. Right click on the GenCade coverage and select *Convert ->Map->1-D Grid.*
  2. Verify that the settings in the properties window haven't changed and select *OK.*
  3. Inspect the grid to ensure that all of the features translated from the conceptual model properly. Locations of features on the grid often require adjustment when the shoreline angle is steep relative to the grid.
- Move the locations of the attachment bars so that they are at least 2 cells away from the jetties.
  1. Select the GenCade grid in the Project Explorer.
  2. *GenCade->Edit Inlets* opens the Inlet Reservoir Model window.

3. Under the Cell Position button for the Galveston inlet set/verify the following parameters:
    - Inlet beg. cell: 104
    - Inlet end cell: 115
    - Left bypass beg. cell: 101
    - Left bypass end cell: 102
    - Right bypass beg. cell: 117
    - Right bypass end cell: 118

- Verify that all information entered in the conceptual model is correct in the GenCade model.
    1. Select the GenCade grid in the Project Explorer.
    2. Under the *GenCade* menu all of the various inputs can be reviewed or modified.
    3. Select *GenCade->Edit Grid* and notice that the *Azimuth* is not the same as the angle selected in the conceptual grid frame.
- ***Note: The sign convention for the GenCade model grid is in degrees clockwise from north. Wave data must be relative to the orientation of the GenCade model grid and not the conceptual model grid.***

## 4. Setup and Run GenCade Model

Take the following steps to set up the model control parameters and run GenCade:

- Set model parameters.
    1. Select the GenCade grid in the Project Explorer.
    2. *GenCade->Model Control* opens the GenCade model control window with four tabs.
    3. Under the *Model Setup* tab enter the following:
        - Check the *Full print output* box
        - Start Date: 1/1/1995 00:00
        - End Date:  1/1/2000 00:00
        - Time Step: 1 hr
        - Recording Time Step: 720 hr
    4. Under the *Beach Setup* tab enter the following:
        - Effective grain size: 0.17 mm
        - Average berm height: 3 ft
        - Depth of Closure: 20 ft
        - K1: 0.4
        - K2: 0.2
    5. Under the *Seaward BC* tab enter the following:
        - Number of cells in the offshore contour smoothing window: 50
    6. Under the *Lateral BC* tab change the following:
        - Right lateral BC
            - Type: Moving
            - -10 ft per simulation period
- Save GenCade

    1. *File->Save as*, create a new folder, save "initial run".
- Run GenCade
    1. *GenCade->Run GenCade.*
    2. Wait for model to run and click *Exit.*

# 5. Visualize Results in SMS

This section demonstrates visualization of results in SMS. Working with GenCade output files in other programs is discussed in Section 8.

- GenCade output files used in this example:
    1. *.slo – Shoreline Change File: The shoreline change file includes the shoreline position at each recording time step.
    2. *.irv – Inlet Shoal Volume File: Volumes for each component are output at each recording time step in this file.
    3. *.shi – Initial Shoreline Position File: This file contains the initial shoreline position.
    4. *.qtr – Longshore Transport File: The longshore transport file includes the calculated net transport at each recording time step.
    5. *.shdx – Grid Size File: This file enables easy conversion of model output to horizontal space. Each number in the file represents the size of each grid cell.
    6. *.prt – Print File: The print file includes all of the information saved during the run including shoreline position, shoreline change, breaking wave angle, offshore wave angle to the x-axis, and transport volume to the left and right after each year. The print file cannot be automatically imported into SMS.
- Working with data in SMS.
    1. Open "initial run.slo" and "initial run.qtr".
    2. Four data sets are now available under the GenCade grid in the Project Explorer and the Time Step window has opened.
    3. Change between datasets by clicking on the dataset of interest.
    4. Change time steps by clicking on time step of interest.
    5. Once selected, the arrow keys may be used to navigate through the lists.
    6. Transport rate, shoreline change, and rate of change are shown relative to the GenCade grid, while shoreline position is shown in the selected coordinate system.
    7. Select the *Shoreline* data set, zoom into an area of interest so you can see the initial and calculated shorelines, and then change the time step to observe shoreline change in time.
    8. *Data->Film Loop* will create a movie of the shoreline change at the selected zoom extents.
    9. To open a shoreline graph window click *Display->Plot Wizard*, select *GenCade Shoreline* from the *Plot Type* list on the *Step 1* window, select *Active data set* and *Active time step* from the *Step 2* window.
    10. Changes to the data set and time step are automatically applied to the graph.

11. Right click inside the *Plot* window and select *Display Options* to modify plot settings.
12. To open an inlet time series graph window click *Display->Plot Wizard*, select *GenCade Inlet TS* from the *Plot Type* list on the *Step 1* window, choose the *Inlet* “Galveston”, *Start time* “1/31/1995”, *End time* “12/6/1999”, and select the “Ebb” *Dataset* from the *Step 2* window.
13. After data have been loaded to a plot window data can be exported to figures or text by right clicking and selecting *Export/Print*.

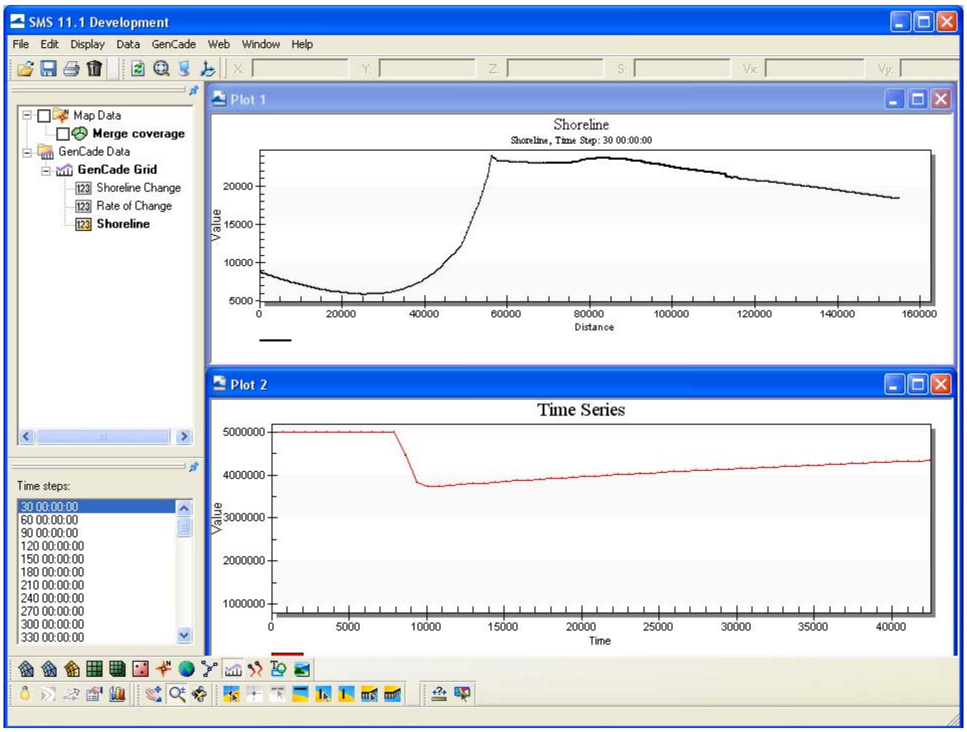



Figure 16. Display results in SMS.

## 6. Note on Model Calibration and Verification

There is not sufficient time in the workshop to calibrate and verify a model; however it is important to note that this point in the example is where that process would occur. The general process requires starting with a known condition, running the model over a period of time for which data exists, then comparing model results to measured data. The empirical transport coefficients, *K1* and *K2*, would then be varied until the model results match measured data. In practice, a lack of data or some initially misunderstood process often requires varying other aspects of model setup to obtain good calibration (the condition where model calculations match observations). Ideally, another time period for which data exists would be simulated, using the same model setup, to verify that the model accurately represents the physical processes involved. It is important to remember to always base engineering decisions on a verified model.

# 7. Modifying GenCade for Project Analyses

Now that you have a working GenCade model, it can be modified to evaluate potential projects that might include beach nourishment, dredging, jetties, groins, breakwaters, or seawalls. Modifications may also be necessary to investigate model sensitivity to different input parameters.

## *7.1. Sensitivity Analysis*

The next few tasks demonstrate sensitivity of GenCade to some model parameters:

- Modify inlet shoal volumes to investigate relative importance of shoal volumes in the model.
    1. Save the GenCade model to a new folder, name it "shoal volumes".
    2. Delete solution datasets in the Project Explorer.
    3. *GenCade->Edit Inlet* and select the Volume button
        - Change all initial volumes to match table 2 below:

Table 2. Inlet Shoal Volumes.

| | **Initial, yd$^3$** | **Equilibrium, yd$^3$** |
|---|---|---|
| **Ebb** | 3,000,000 | 5,000,000 |
| **Flood** | 600,000 | 1,000,000 |
| **Left Bypass** | 600,000 | 1,000,000 |
| **Left Attachment** | 300,000 | 500,000 |
| **Right Bypass** | 600,000 | 1,000,000 |
| **Right Attachment** | 300,000 | 500,000 |

4. Save and run GenCade.
5. Open "shoal volumes.slo", then open "initial run.slo". The last added data sets will be designated with a sequential numeric value in parentheses. Compare shoreline change near the inlet.
6. Open an inlet time series graph to observe change in inlet volumes over time.

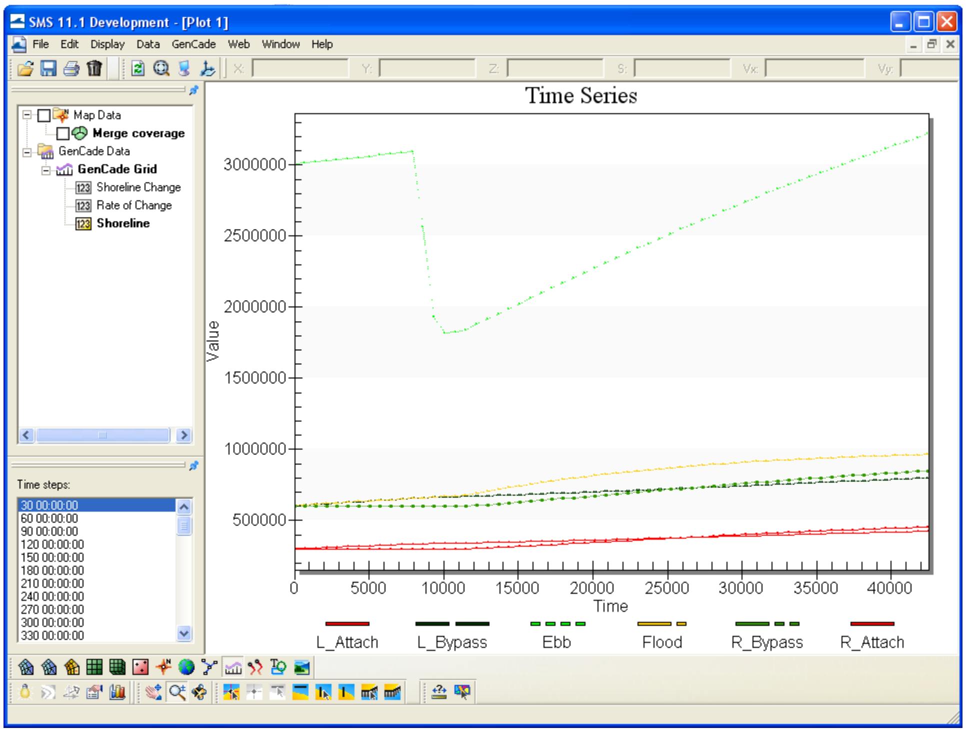



Figure 17. Modify inlet shoal volumes.

- Modify empirical transport coefficient, *K1*.
  1. Save the GenCade model to a new folder, name it “transport mod”.
  2. Reset the inlet shoal volume data.
  3. Delete solution datasets in the Project Explorer.
  4. Change *K1* to 0.5 on the *Beach Setup* tab under *Model Control*.
  5. Save and run GenCade.
  6. Compare transport volumes in the print file.
     - Open transport mod.prt and shoal volumes.prt in a text editor (notepad, wordpad, etc) for quick comparison.
- Modify number of cells in offshore contour smoothing window.
  1. Save the GenCade model to a new folder, name it “smoothing window”.
  2. Reset *K1* to 0.4.
  3. Delete solution datasets in the Project Explorer.
  4. Change *Number of Cells in Offshore Contour Smoothing Window* to 10 on the *Seaward BC* tab under *Model Control*.
  5. Save and run GenCade.
  6. Compare transport volumes in the print file.
     - Open transport mod.prt and shoal volumes.prt in a text editor (notepad, wordpad, etc) for quick comparison.
  - **Note: Sensitivity analysis should always be conducted to determine the appropriate value for this parameter.**

- Modify the regional contour.
    1. Save the GenCade model to a new folder, name it “regional contour mod”.
    2. Use the Select Feature Vertex button to drag points on the regional contour reshaping it near the south jetty.
    3. Convert to 1-D grid, setup and run GenCade.
    4. Evaluate results.

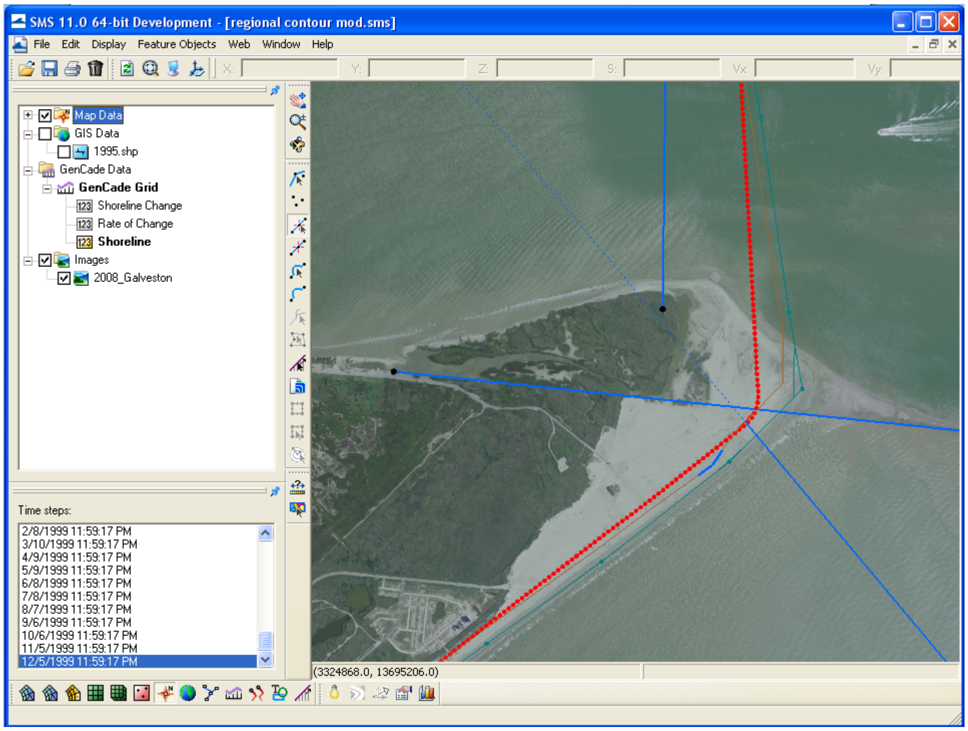



Figure 18. Modify regional contour.

- Run GenCade without the regional contour.
    1. Save the GenCade model to a new folder, name it “no regional contour”.
    2. Delete the GenCade grid in the Project Explorer.
    3. Delete the regional contour.
    4. Convert to 1-D grid, setup and run GenCade.
    5. Evaluate results, notice large differences near the jetties and west end of the seawall.

## *7.2. Beach Fill*

Add beach nourishment along the seawall:

1. Open the previously saved model “initial run.sms”.
2. Save the GenCade model to a new folder, name it “beachfill”.
3. *GenCade->Edit Beachfills.*
4. Input the following data in the *Beach Fill* window
    - Start date: 8/1/1995
    - End date: 12/1/1995

- Start cell: 213
- End cell: 703
- Added berm width: 150 ft

5. Save and run GenCade and evaluate results.

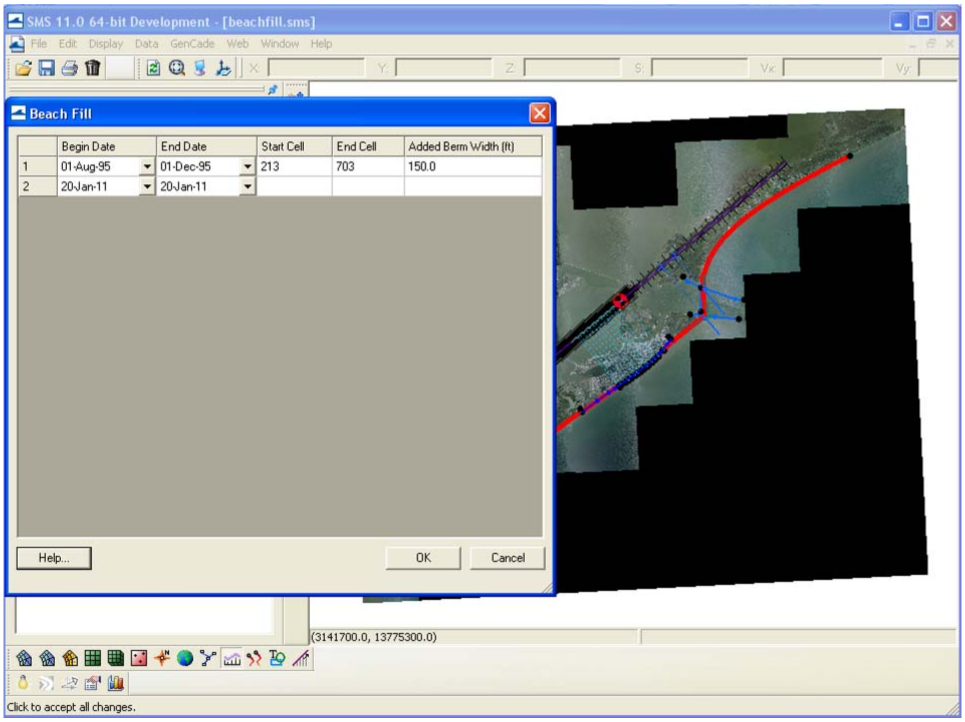



Figure 19. Add a beach fill.

### *7.3. Breakwater*

Add a breakwater near the west end of the seawall:

1. Save the GenCade model to a new folder, name it “breakwater”.
2. Delete the GenCade grid in the Project Explorer.
3. Draw a new feature arc in the location you want the breakwater.
4. Define the feature arc as a *Breakwater* and input the following data in the *Detached Breakwaters* window:
    - Depth 1: 12 ft
    - Depth 2: 12 ft
    - Constant Transmission
    - Permeability (Perm): 0
5. Convert to 1-D grid, setup and run GenCade, and evaluate results.

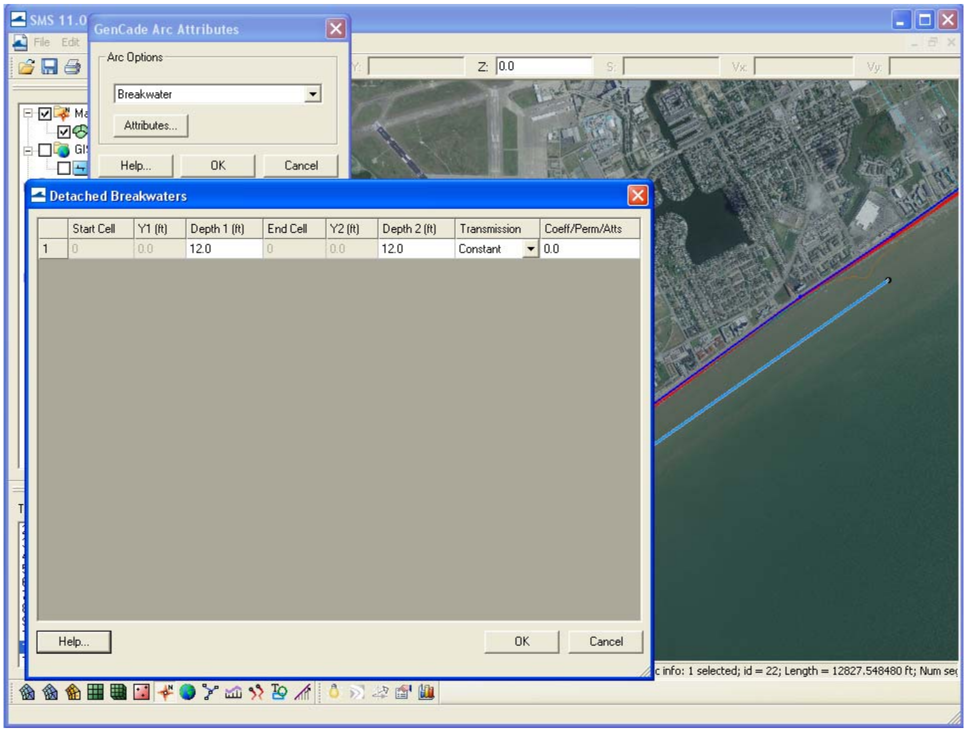



Figure 20. Add a breakwater.

# 8. Processing Data in Excel

It is often necessary to analyze data in programs other than SMS. The following tasks demonstrate some typical tasks, illustrating the general procedure for working with GenCade output files.

- Open “initial run.slo” with Excel, use space as the column delimiter.
    1. Files used in this example are located in *GenCade\Hands-On Example\SMS Project Files\initial run.*
- Save the excel file as “work.xlsx” and rename the active sheet to “initial run_slo”.
    1. File “excel plots.xlsx” in *GenCade\Hands-On Example\Excel* contains the results of this section.
- Since refine points were used to create a grid with variable spacing, the .shdx file must be used to determine the position of each cell.
    1. Data in the .shdx file is in a matrix format instead of in a single column or row. Each entry in the .shdx file represents the size of each cell.
    2. A Matlab program, “shdx_column.m”, is included in the Tools folder to convert grid size data in the .shdx file into a single column representing distance from grid origin. Matlab must be installed on your computer to run this program. Alternatively, this task can be completed in Excel.
    3. Open the file created by the Matlab program, “shore_position.out”, and copy into “work.xlsx” on a sheet named “shore_position”.

- Open “transport mod.slo” with Excel and copy into “work.xlsx”, name the sheet “transmod_slo”.
- Create a plot with shoreline position at the end of each year for the initial run.
    1. Select values for the 19951227 time step on the “initial run_slo” sheet.
    2. Click *Insert->Scatter*, select scatter with smooth lines.
    3. With the new chart highlighted, click *Design->Move Chart* and select *New Sheet* title “initial run”.
    4. Right click in the chart area and click *Select Data*.
    5. Click *Edit*, then change the *Name* to the date, and add the *X Series* data from the “shore_position” sheet.
    6. Click *OK*, then *Add* data for shoreline position at the end of each year.
    7. Label axes as desired.
- Calculate shoreline change for the initial run.
    1. Since the .slo file only contains shoreline position, the initial shoreline is needed to calculate shoreline change.
    2. The .shi file contains the initial shoreline position in a matrix format.
    3. To convert to a single row or column, either copy and paste in Excel or use a short program. The Matlab program, “shi.m,” will convert the data to a single row. The program writes the data to a file named “SHI.out.”
        - Note: A reference shoreline can be converted to grid format by assigning the shoreline as the initial shoreline and then converting to 1-D grid. SMS will then save the shoreline in the .shi file. This is convenient for model calibration/verification.
    4. Open “SHI.out” and copy into excel plot.xlsx to a sheet named “initial shoreline.”
    5. Make a copy of the “initial run_slo” sheet and name it “initial run_change”.
    6. Subtract the initial shoreline position from each calculated shoreline position.
        - Type “='initial run_slo'!B2-'initial shoreline'!A$1” into cell B2 then drag all the way to the right, then down.
    7. Positive values are accretion, negative values are recession.
- Create a plot of the total shoreline change for the initial run.
    1. Follow the general guidelines above and use the last time step of shoreline change for the *Series Y Values*.
    2. Put the new chart on a new sheet named “Total Shoreline Change”.
- Calculate shoreline change for “transport mod.slo” and plot the total change on the same plot created for the initial run.
    1. Follow general guidelines described above.
- Working with the other GenCade output files follows the same general method above.

# 9. Supplemental Data for Example Model Setup

This section contains model setup parameters and cell addresses used for the inlet and structures in the example. Advanced users can skip to this section to quickly locate data needed for the example.

Table 3. GenCade model setup parameters.

| Parameter | Value |
|---|---|
| Start Date | 1/1/1995 0:00 |
| End Date | 1/1/2000 0:00 |
| Time Step | 1 |
| Recording Time Step | 720 |
| Effective Grain Size, mm | 0.17 |
| Average Berm Height, ft | 3 |
| Depth of Closure, ft | 20 |
| K1 | 0.4 |
| K2 | 0.2 |
| Height Amplification Factor | 1 |
| Angle Amplification Factor | 1 |
| Angle Offset | 0 |
| Wave Components to Apply | Primary |
| Number of cells in offshore contour smoothing window | 50 |
| Left Lateral Boundary Condition | Pinned |
| Right Later Boundary Condition, ft per sim. period | Moving (-10) |

Table 4. Conceptual grid frame parameters.

| Parameter | Value |
|---|---|
| Origin X, ft | 3,358,200 |
| Origin Y, ft | 13,747,700 |
| Angle, º | 220 |
| I size, ft | 155,000 |
| Use refine points | yes |
| Maximum cell size, ft | 500 |
| Maximum bias | 1.1 |
| Use inner growth | no |

| Table 5. Inlet cell locations. | | |
|---|---|---|
| | **Beginning Cell** | **Ending Cell** |
| **Inlet** | 104 | 115 |
| **Left Bypass** | 101 | 102 |
| **Right Bypass** | 117 | 118 |

| Table 6. Seawall segment locations. | | | |
|---|---|---|---|
| **Start Cell** | **Y1, ft** | **End Cell** | **Y2, ft** |
| 157 | 21,830 | 201 | 22,558 |
| 201 | 22,558 | 244 | 22,984 |
| 244 | 22,984 | 270 | 23,232 |
| 270 | 23,232 | 347 | 23,603 |
| 347 | 23,603 | 382 | 23,627 |
| 382 | 23,627 | 422 | 23,527 |
| 422 | 23,527 | 469 | 23,506 |
| 469 | 23,506 | 532 | 23,284 |
| 532 | 23,284 | 692 | 22,628 |
| 692 | 22,628 | 742 | 22,349 |
| 742 | 22,349 | 842 | 21,994 |
| 842 | 21,994 | 976 | 21,538 |

| Table 7. Groin locations and parameters. | | | |
|---|---|---|---|
| **Cell Index** | **Length, ft** | **Permeability** | **Seaward Depth, ft** |
| 247 | 23,582 | 0.1 | 8 |
| 303 | 23,911 | 0.1 | 8 |
| 336 | 24,019 | 0.1 | 8 |
| 366 | 24,142 | 0.1 | 8 |
| 397 | 24,108 | 0.1 | 8 |
| 414 | 24,210 | 0.1 | 8 |
| 443 | 24,101 | 0.1 | 8 |
| 472 | 24,125 | 0.1 | 8 |
| 496 | 23,968 | 0.1 | 8 |
| 519 | 23,870 | 0.1 | 8 |
| 550 | 23,735 | 0.1 | 8 |
| 578 | 23,682 | 0.1 | 8 |
| 606 | 23,510 | 0.1 | 8 |
| 636 | 23,217 | 0.1 | 8 |
| 656 | 23,490 | 0.1 | 8 |

| Table 8. Beach fill parameters. | | | | |
|---|---|---|---|---|
| **Begin Date** | **End Date** | **Start Cell** | **End Cell** | **Added Berm Width, ft** |
| 1-Aug-95 | 1-Dec-95 | 213 | 703 | 150 |

| Table 9. Breakwater parameters. | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Start Cell** | **Y1, ft** | **Depth 1, ft** | **End Cell** | **Y2, ft** | **Depth 2, ft** | **Transmission** | **Coefficient** |
| 706 | 23,331 | 12 | 961 | 22,192 | 12 | Constant | 0 |