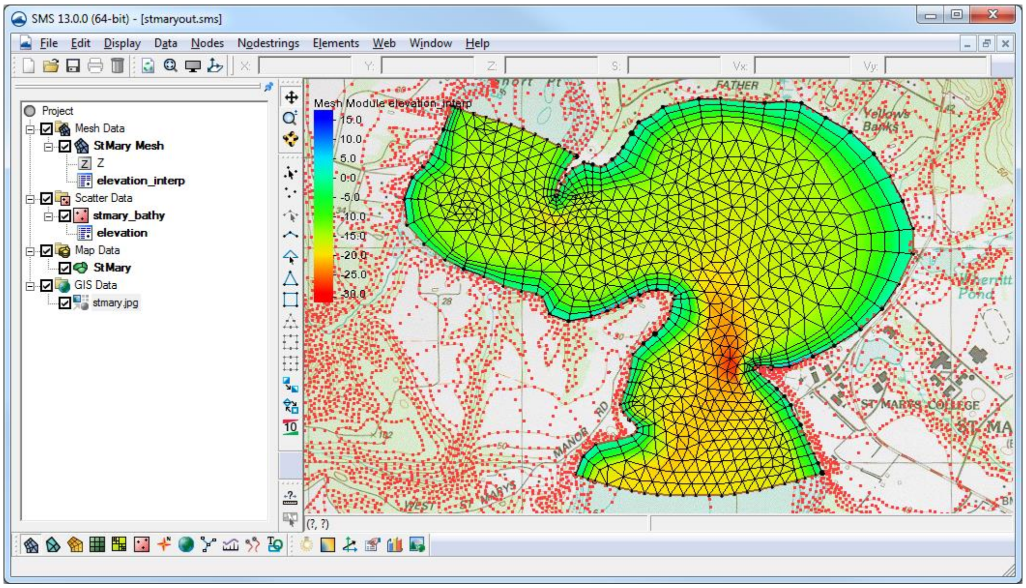
SMS

v. 13.0

SMS 13.0 Tutorial
Overview



Objectives

This tutorial describes the major components of the SMS interface and gives a brief introduction to the SMS modules. Ideally, this tutorial should be completed before any other tutorial.

Prerequisites

- None

Requirements

- Scatter Module
- Map Module
- GIS Module
- Cartesian Grid Module

Time

- 15–20 minutes

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1 Getting Started

Before beginning this tutorial, SMS should have been installed. If SMS has not yet been installed, please do so before continuing.

Each section of this tutorial demonstrates the use of a specific component of SMS. If all modules of SMS have not been purchased, or if evaluating the software, run SMS in Demo Mode to complete this tutorial.

When using Demo Mode, it will not be possible to save files. For this reason, all files that are to be saved have been included in the *data files\Output* subdirectory. When asked to save a file while running Demo Mode, instead open the file from this output directory.

To start SMS, do the following:

1. Open the *Start* menu.
2. Go to *All Programs*.
3. Click on the “SMS 13.0” folder.
4. Click on **SMS 13.0**.
5. Alternatively, a shortcut icon may already be on the desktop if that option was selected during installation. If so, simply click on that icon.

2 Requirements

In order to complete this tutorial, the core modules of SMS (Mesh, Cartesian Grid, Scatter, Map, and GIS) must be available under the current SMS license. To check if these modules are enabled:

1. In SMS, select *Help* | **Register…** to open the *Register* dialog.

A list of components and the status of each are displayed in the dialog that appears.

2. Turn off *Show only enabled modules* to show both enabled and disabled components.
3. When done reviewing the components, click **Close** to exit the *Register* dialog.

All purchased editions of SMS have these modules enabled.

3 The SMS Screen

The SMS screen is divided into six main sections (Figure 1): the Main Graphics Window, the Project Explorer, the Toolbars, the Edit Window, the Menu Bar, and the Status Bars. The Main Graphics Window normally fills the majority of the screen, though its size can be adjusted. Plot windows can also be opened to display 2D plots of various data. Plot windows appear outside of the SMS screen as independent windows.

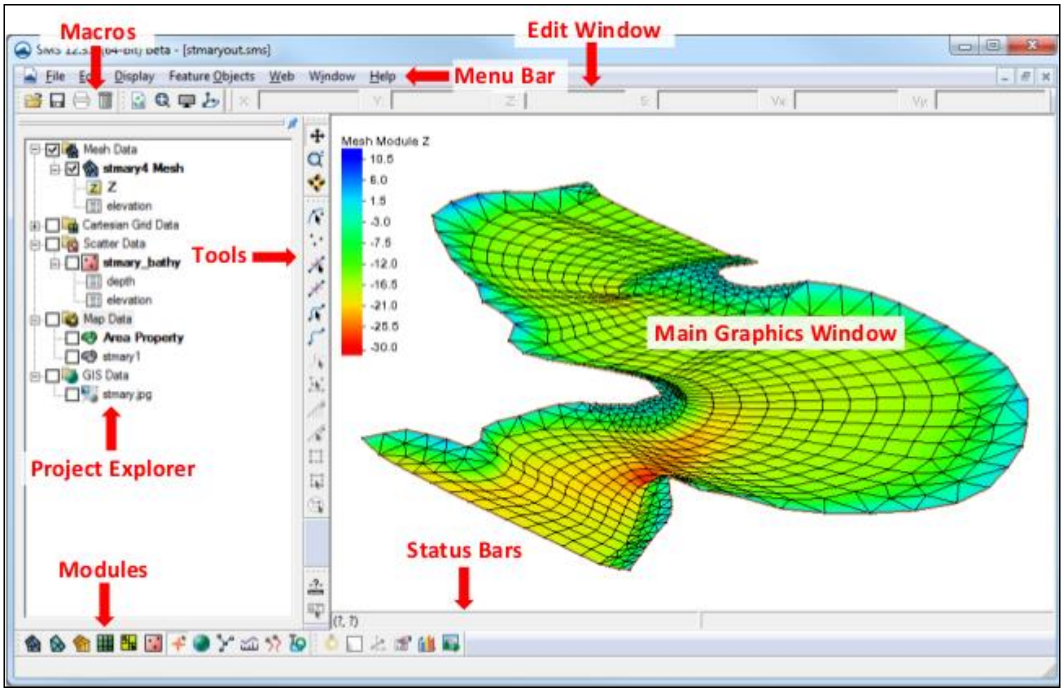


Figure 1 The SMS screen

3.1 The Main Graphics Window

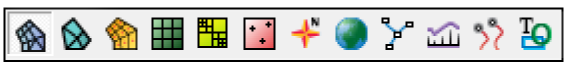
The Main Graphics Window (or just Graphics Window) is the biggest part of the SMS screen. Most of the data manipulation is done in this window.

3.2 The Toolbars

Toolbars are dockable windows with a series of icons representing operations or command within the SMS. By default, they are positioned at various locations on the left side of the application, but can be positioned around the interface as desired. The macro toolbars that appear at startup are set in the *Preferences* dialog under the *Toolbars* tab. The *Preferences* dialog is accesed by selecting *Edit* | **Preferences…** or right-clicking in the Project Explorer and select **Preferences…**.

The toolbars include the following:

Modules



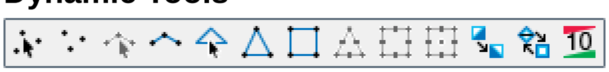
This image shows the SMS Modules. As described in the SMS Online Help,[1] these icons control what menu commands and tools are available at any given time while operating in SMS. Each module corresponds to a specific type of data.

For example, the  icon corresponds to meshes, the  icon to Cartesian grids, and the  icon to scattered data. If the scattered data module is active, the commands that operate on scattered data are available. Change modules by selecting the icon for the module, by selecting an entity in the Project Explorer, or by right-clicking in the Project Explorer and selecting *Switch Module* and the desired module from the pop-up menu. The module toolbar is displayed by default at the bottom left of the application.

Static Tools

This toolbar contains a set of tools that are the same for all modules. They are used for panning, zooming, or rotating the display. This toolbar appears vertically by default at the top left of the display, between the Project Explorer and the Graphics Window.

Dynamic Tools



These tools change according to the selected module and the active model. The example above shows the Dynamic Toolbar when the Mesh module is active. They are used for creating and editing entities specific to the module. By default, the toolbar appears between the Project Explorer and the Graphics Window below the Static Tools.

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[1] See http://www.xmswiki.com/wiki/SMS:SMS

Macros

There are three separate Macro Toolbars. These are shortcuts for menu commands. By default, the standard macros and the file toolbar appear above the Project Explorer when displayed, and the Optional Macros appear between the Project Explorer and the Graphics Window below the Dynamic Tools.

Macros

File Toolbar

Optional Macros

3.3 The Project Explorer

The Project Explorer (Figure 2) allows viewing of all the data that makes up a part of a project. It appears by default on the left side of the screen, but can be docked on either side, or viewed as a separate window.

It is used to switch modules, select a coverage to work with, select a dataset to be active, and set display settings of the various entities in the active coverage. By right-clicking on various entities in the Project Explorer, it is possible to also transform, copy, or manipulate the entity.

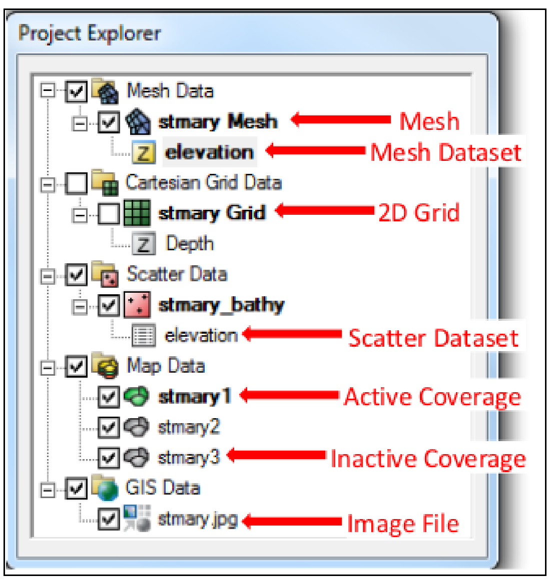

Figure 2 The Project Explorer window

3.4 Time Steps Window

The Time Steps window (Figure 3) is used to select a time step to be active and is only visible if a transient dataset has been loaded into the project. By default, it appears below the Project Explorer.

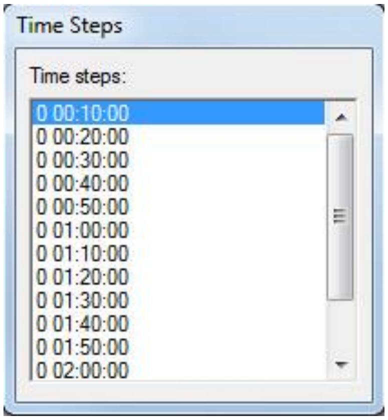

Figure 3 The Time Steps window

3.5 The Edit Window

The Edit Window (Figure 4) appears below the menus at the top of the application. It is used to show and/or change the coordinates of selected entities. It also displays the functional data for those selected entities.

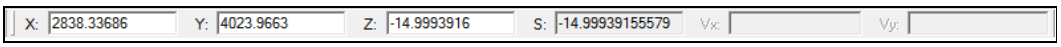

Figure 4 The Edit Window

3.6 The Menu Bar

The Menu Bar contains commands that are available for data manipulation. The menus shown in the Menu Bar depend on the active module and numerical model.

3.7 The Status Bars

There are two status bars: one at the bottom of the SMS application window and a second attached to the Main Graphics Window. The status bar attached to the bottom of the main application window shows help messages when the mouse hovers over a tool or an item in a dialog box. At times, it also may display a message in red text to prompt for specific actions, such as that shown in the Figure 5 below.

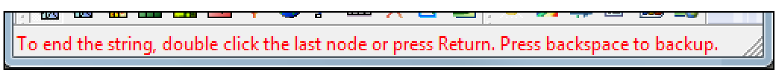

Figure 5 Status bar showing prompt

The second status bar (Figure 6), attached to the Main Graphics Window, is split into two separate panes. The left shows the mouse coordinates when the model is in plan view. The right pane shows information for selected entities.

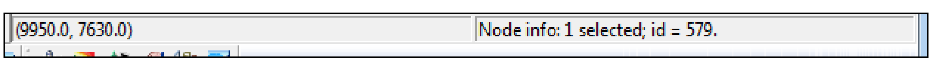

Figure 6 Status bar showing information for a selected entity

4 Building Projects in SMS

There are many ways to build projects in SMS. The process may vary with each project, but a suggested process is to:

- Import background images and data
- Build a conceptual model
- Generate geometries such as a mesh or grid
- Set up model parameters and simulations
- Run the model simulation
- Analyze the simulation results

Setting up model parameters will not be addressed in this tutorial. Instead, refer to the model tutorials for more information on how to set up each model. The other parts of building a project are introduced in the rest of the tutorial using the files located in the "data files" folder of this tutorial.

5 Background Images

A good way to visualize the model is to import a digital image of the site. For this tutorial, an image was created by scanning a portion of a USGS quadrangle map and saving the scanned image as a JPEG file. SMS can open most common image formats including TIFF, JPEG, and Mr.Sid images. Once the image is inside SMS, it is displayed in plan view behind all other data, or it can be mapped as a texture onto a finite element mesh or triangulated scatter point surface.

5.1 Opening the Image

Do the following to open the JPEG image in this example:

1. Select *File* | **Open…** to bring up the *Open* dialog.
2. Browse to the *SMS_Overview\data files* folder and select "stmary.jpg".
3. Click **Open** to import the file and close the *Open* dialog.

The image should appear similar to Figure 7 in the Graphics Window.

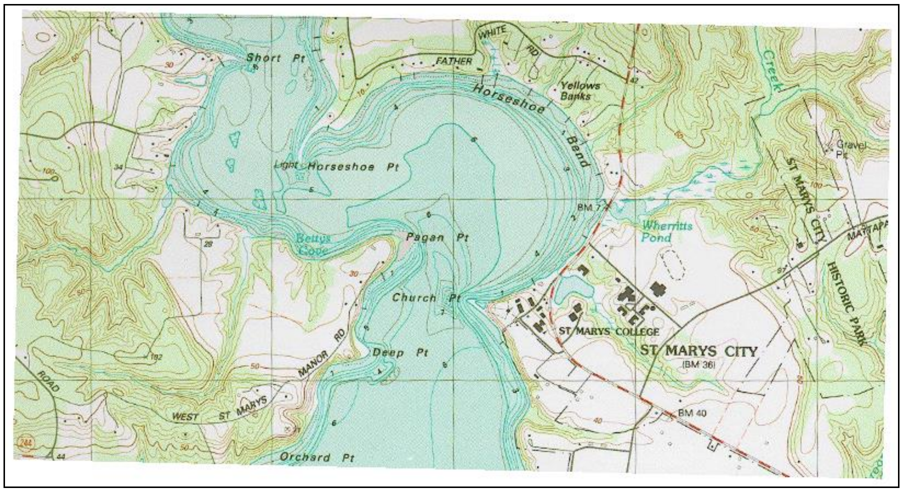

Figure 7 Imported image

When importing an image file, SMS searches for image georeferencing data. Georeferencing data define the world locations (x, y) that correspond to each point in an image. It is usually contained inside a world file or sometimes the image itself. A world file could have the extension ".wld," ".tfw," ".jpgw," and so on. If SMS finds georeferencing data, the image will be opened and displayed.

Notice the " stmary.jpg" entry under " GIS Data" in the Project Explorer

For more information on using the GIS module, see the "GIS" tutorial. For more information on georeferencing, see the "Projections" tutorial.

6 Background Data

SMS includes tools to work with, edit, view, and use surfaces. Most commonly, these surfaces represent physical surfaces such as the topographic land surface or a bathymetric surface beneath a water body. Such surfaces are created from surveys or observations, and are stored either as unstructured points or regular grids. SMS can import and use data in a variety of formats. To illustrate this:

1. Select *File* | **Open…** to bring up the *Open* dialog.
2. Select "stmary_bathy.h5" and click **Open** to import the scatter point dataset and close the *Open* dialog.

The screen will refresh, showing a set of scattered data points. Each point represents a survey measurement. Scatter points are used to interpolate bathymetric (or other) data onto a grid for numerical analysis.

3. Experiment with the newly loaded scatter set by doing the following:
4. Select the " stmary_bathy" scatter set to make it active in the Project Explorer and to make the Scatter module active.
5. Use the **Select Scatter Point** tool to click on any point and view the associated elevation (*Z* value) in the Edit Window.

6. Select the **Rotate** tool then click and drag in the Graphics Window to view the elevation in the scatter set (Figure 8).
7. Click on the **Plan View** macro when done rotating the scatter set.

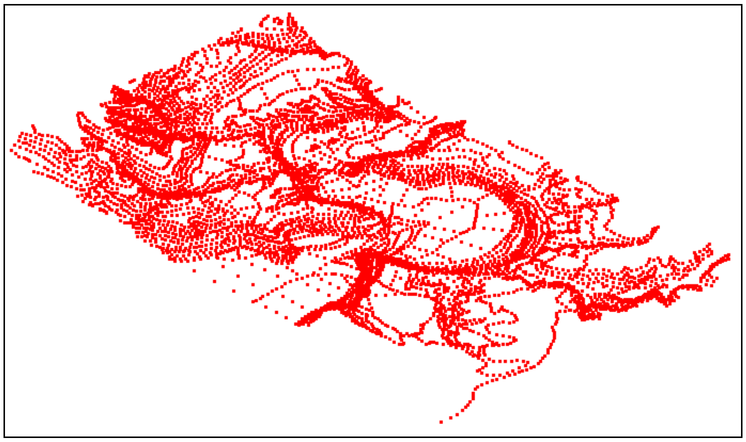

Figure 8 Example scatter set rotated to show elevation

For more information on using scatter sets, see the "Scatter Datasets" tutorial.

7 Changing the Display

How data is shown in the Graphics Window can be changed using the display options. In this case, change the scatter set to show contour elevations.

1. Uncheck the box next to " GIS Data" in the Project Explorer to hide the imported JPG image.
2. Select *Display* | **Display Options…** to bring up the *Display Options* dialog.
3. Select "Scatter" from the list on the left.
4. On the *Scatter* tab, click the **All Off** button, then turn on the *Contours* option.
5. On the *Contours* tab, in the *Contour method* section, select "Color Fill" from the first drop-down.
6. Click **OK** to close the *Display Options* dialog.

The scatter set now displays the contour values (Figure 9).

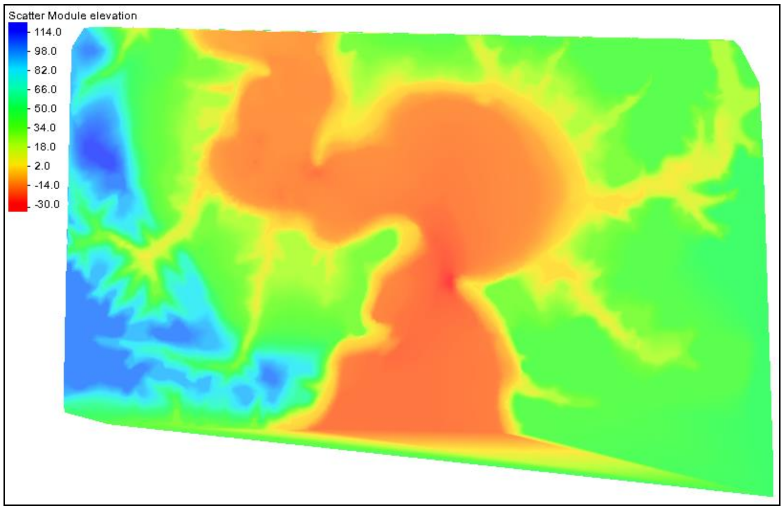

Figure 9 Scatter set with contour display options turned on

Changing the display option is useful in reviewing data once it has been imported into SMS and also used to examine solutions from a model simulation run. For more information on using display options in SMS, see the "Data Visualization" tutorial.

8 Conceptual Model

A conceptual model consists of a vector based representation (lines and curves) of the situation being modeled. This includes the geometric extents (domain limits), geometric feature definition such as channels or banks, the location of local forcing functions acting on the domain (such as inflow or water level boundary conditions), and the physical characteristics (such as roughness or friction). It does not include numerical details like elements. This conceptual model is normally constructed over a background image using feature objects in the Map module.

8.1 Feature Objects

Feature objects in SMS include points, nodes, arcs, and polygons, as shown in Figure 10. Feature objects are grouped into sets called "coverages." One coverage is active in SMS at a time. The active coverage is displayed in a bolder font in the Project Explorer window and objects in this coverage are displayed with specified display attributes. These objects can be selected and edited in the Graphics Window.

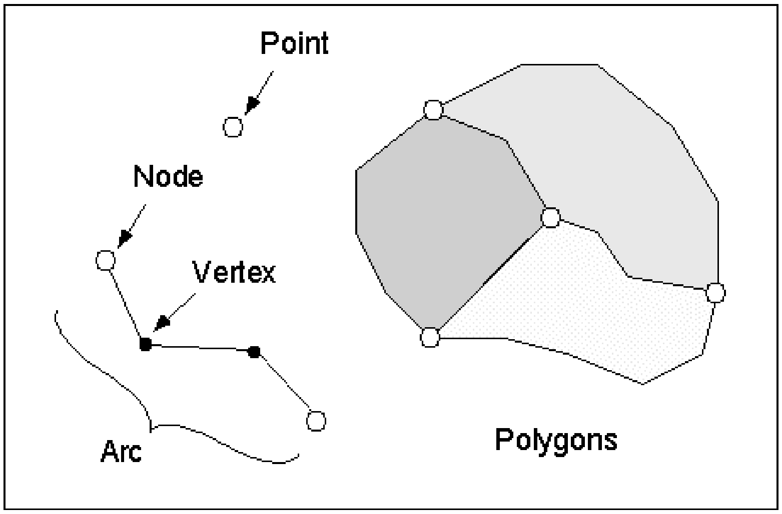

Figure 10 Feature Objects

A feature point defines an (x, y) location in the conceptual model. It is a standalone point and is not attached to any other objects. Points are used to define the location of a measured field value or a specific location of interest such as a velocity gauge. SMS can extract data from a numerical model at such a location, or force the creation of a mesh node at the specific location.

A feature node is the same as a feature point, except that it is attached to at least one arc.

A feature arc is a sequence of line segments grouped together as a polyline entity. Arcs represent linear features such as channel edges or zone boundaries. The two end points of an arc are called "feature nodes," and the intermediate points are called "feature vertices."

A feature polygon is constructed from a closed loop of feature arcs. A feature polygon can consist of a single feature arc or multiple feature arcs, as long as a closed loop is formed. It may also include holes.

8.2 Creating Feature Arcs

A set of feature objects can be created to define topographically important features such as river channels and material region boundaries. Feature objects can be digitized directly inside SMS, converted from an existing CAD file (such as DXF or DWG), or they can be extracted from survey data. For this example, the feature objects will be digitized inside SMS using the registered JPEG image as a reference. To create the feature arcs by digitizing:

1. Turn off " stmary_bathy" in the Project Explorer and turn on " GIS Data" .
2. Select the " Area Property" coverage to make it active.
3. Using the **Create Feature Arc** tool from the dynamic toolbox, click out the left riverbank, as shown in Figure 11 (if necessary, use the **Zoom** tool to get a closer view). (Note: the river flows from the top to the bottom, and the reference

to the left bank is based on looking in the direction of flow.) While creating the arc, if a mistake happens and there is a need to back up, press the *Backspace* key. If there is a need to abort the arc and start over, press the *Esc* key.

4. Double-click the last point to end the arc.

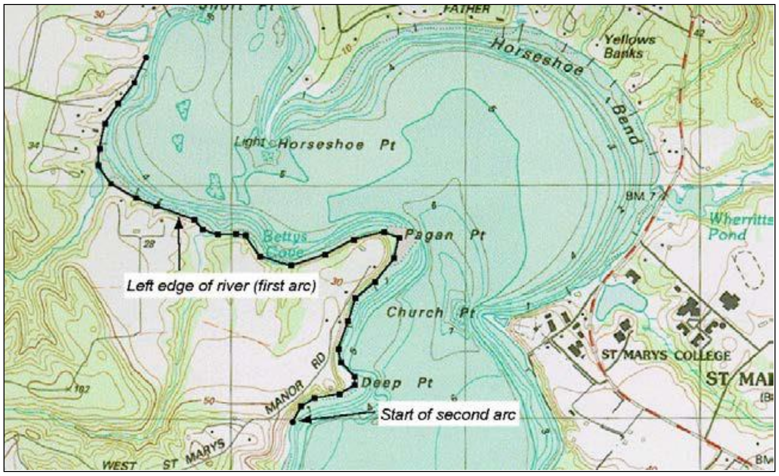

Figure 11   Creation of the first feature arc

A feature arc has defined the general shape of the left riverbank.

For more information on creating arcs and other feature objects, see the “Map Module” tutorial.

9 Sample Mesh Generation

A mesh consists of nodes that are grouped together to form elements. These nodes and elements define the computational domain of the numerical model. A numerical simulation requires a geometric definition of its domain. For many numerical analysis codes, this geometric definition is a mesh.

SMS contains several methods for generating a mesh. The following steps illustrate generating a mesh from a completed conceptual model:

1. Select *File* | **Open…** to bring up the *Open* dialog.
2. Select the file “StMary.map” and click **Open** to import the file and close the *Open* dialog.
3. SMS opens the file and a new coverage named “ StMary” appears.
4. Right-click on the “ StMary” coverage and select *Convert* | **Map → 2D Mesh** to open the *Mesh Name* dialog.
5. Accept the default name of “StMary Mesh” and click **OK** to finish generating the mesh.

When SMS finishes generating the mesh, it will be visible in the Graphics Window (Figure 12). The mesh “ StMary Mesh” will appear in the Project Explorer.

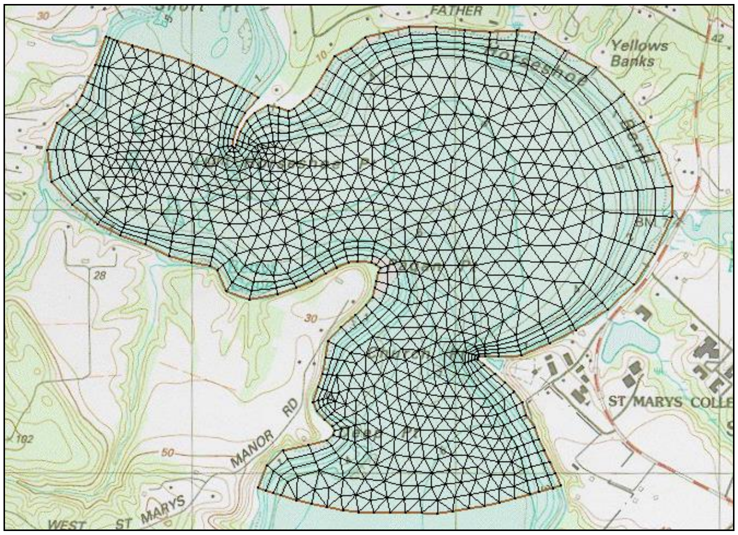

Figure 12 Example of a generated 2D mesh

For more information on mesh generation, see the “Mesh Generation” tutorial.

10 Creating a 2D Grid

The process of creating a 2D grid is similar to creating a finite element mesh.

10.1 Creating a Grid Frame

Before features objects can be converted to a 2D grid, the area of the grid needs to be defined. The grid area is determined using a grid frame created in a map coverage. This is done using a grid frame.

Start by doing the following:

1. Turn off “ Mesh Data” in the Project Explorer
2. Right-click on “ StMary” and select **Duplicate**.
3. Right-click on “ StMary (2)” and select **Rename**.
4. Enter “StMary_Grid” and press *Enter* to set the new name.
5. Select “ StMary_Grid” to make it active.
6. Right-click “ StMary_Grid” and select *Type* | *Generic* | **CGrid Generator**.

The **Create 2D Grid Frame** tool is now active and can be used. A grid frame is created by clicking in three locations in the Graphics Window. Each location will become a corner of the grid frame. SMS will automatically calculate the fourth corner based on the location of the other three corners.

7. Using the **Create 2D Grid Frame** tool, click on location 1 as shown in Figure 13.
8. Click on location 2, then on location 3 to complete the grid frame.

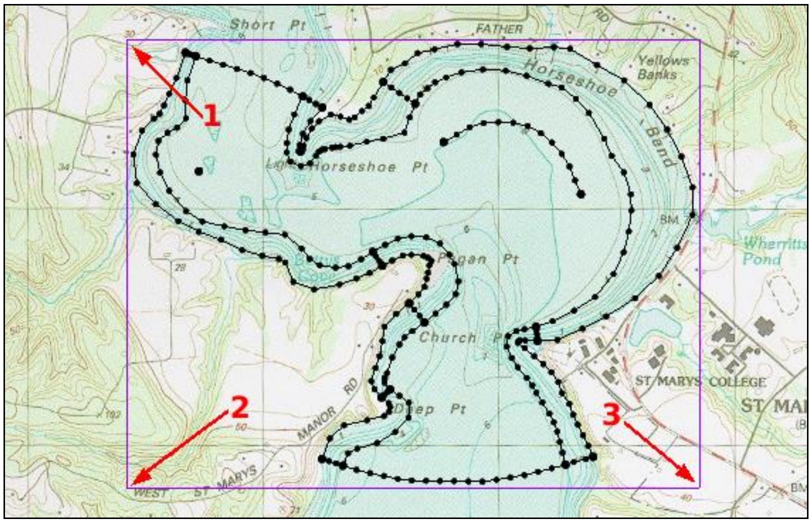

Figure 13 Grid frame locations

10.2 Generating a Cartesian Grid

With the grid frame defined, convert the coverage to a Cartesian grid.

1. Right-click on the “StMary_Grid” coverage in the Project Explorer and select *Convert* | **Map → 2D Grid** to open the *Map → 2D Grid* dialog.
2. In the *I Cell Options* section, enter “100.0” as the *Cell size*.
3. Repeat step 2 for the *Cell size* in the *J Cell Options* section.
4. Click **OK** to close the *Map → 2D Grid* dialog and generate the grid.

A simple Cartesian grid has now been generated (Figure 14). Elevation, boundary condition parameters, and other features can be added to the grid.

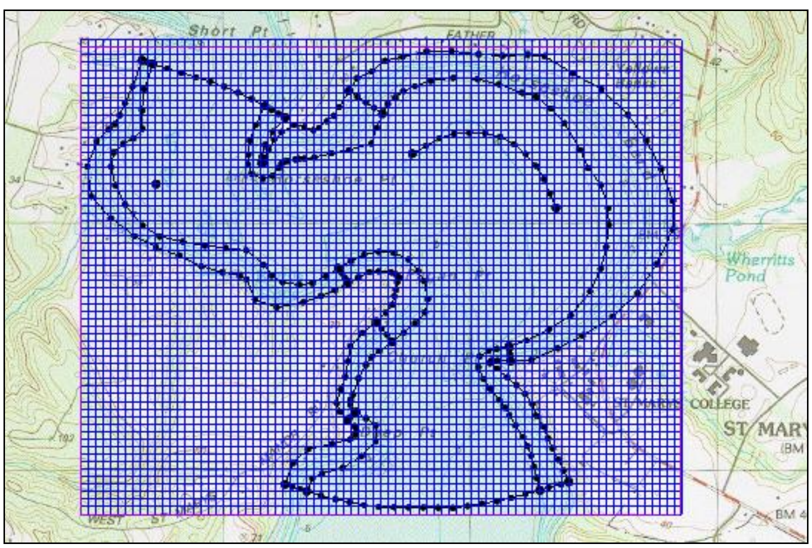

Figure 14 A simple Cartesian grid

For more information on generating a Cartesian grid in SMS, see the “Grid Generation” tutorial.

11 Saving a Project File

The modeling processes facilitated in SMS require large amounts of data. The steps in this tutorial have loaded several types of data, but nothing has been saved yet. Frequently saving the data prevents loss of work and provides backups.

For fastest operation, the data can all be saved in a project file. When a project file is saved, separate files are created for the map, scatter data, and data for numerical analysis. The project file (*.sms) is a binary file in HDF5 format that references the individual data files.

To save all this data for use in a later session:

1. Select *File* | **Save New Project…** to bring up a *Save* dialog.
2. Enter “stmaryout.sms” as the *File name* and click **Save** to create the project file.

12 Conclusion

This concludes the “SMS Overview” tutorial. Topics covered in this tutorial included:

- A general overview of the SMS layout and interface
- Importing a background image
- Importing background field data
- Creating or importing a conceptual model
- Generating a simple mesh
- Generating a simple grid
- Saving a project file

Feel free to continue to experiment with the SMS interface, or exit the program.

