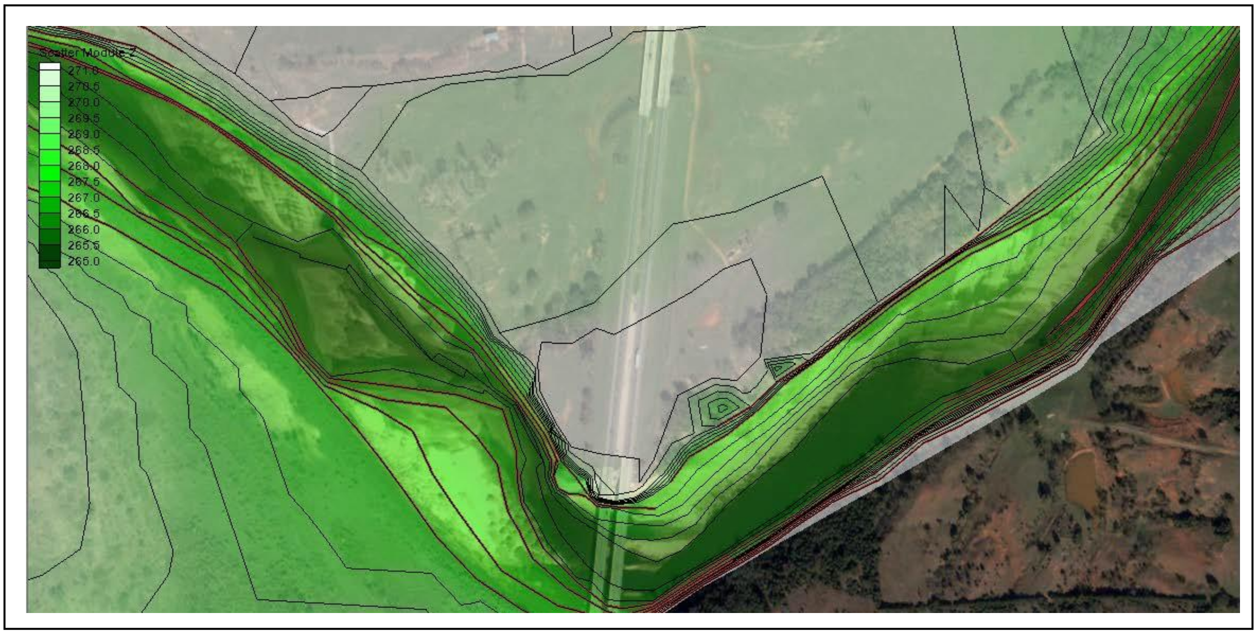
SMS 12.1 Tutorial
Scatter Data – TINs



Objectives

This tutorial covers the basics of working with TINs (triangulated irregular networks) using the scatter module of SMS, including: importing TIN data, editing and filtering data, and exporting TIN data.

Prerequisites
- None

Requirements
- Scatter Module
- Map Module

Time
- 45–60 minutes

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1 Importing Topographic Data – Cimmaron Survey Data

A common method of obtaining data points for two-dimensional hydrodynamic modeling is from scattered survey points or cross sections. SMS can import delimited text files which can then be triangulated. Start by importing data from the file “cimarron_survey_tab.txt”.

To import the “cimarron_survey_tab.txt” file:

1. Select File | **Open** to bring up the *Open* dialog.
2. In the data files folder for this tutorial, select the file “cimarron_survey_tab.txt” then click **Open**. The *File Import Wizard* will appear.
3. The first step of the *File Import Wizard* gives the option to specify delimiters and specify a starting point for importing. Make sure that *space* is checked on, under *Set the column delimiters*.
4. Change *Start import at row* to “2” and uncheck *Heading row*. The other defaults are fine for this dataset, so click on the **Next** button.
5. In the second step, make sure the *SMS data type* option is set to “Scatter Set”. This tells SMS to bring these points into the program as scatter points. Note also that the *Triangulate data* option is turned on to have SMS triangulate the points into a TIN.
6. Click the **Finish** button to close the *File Import Wizard* and finish importing the scatter set.

If the scatter set does not appear:

7. Select the *Display* | **Display Options** command to bring up the *Display Options* dialog.
8. Highlight *Scatter* in the list on the left and turn on *Points* then click **OK** to set the display options.
9. Click on the **Frame** macro to center the scatter set in the Graphics Window.

The XYZ data points from the file are converted into a TIN. Adjust the display settings to see the triangles as well as the surface data.

1. Select *Display* | **Display Options** to bring up the *Display Options* dialog.
2. Highlight *Scatter* in the list on the left and turn on the *Triangles* and *Contours*

options.

3. Under the *Contours* tab, change the *Contour Method* to “Color Fill”.
4. Click **OK** to exit the *Display Options* dialog.
5. The resulting image should appear similar to Figure 1.

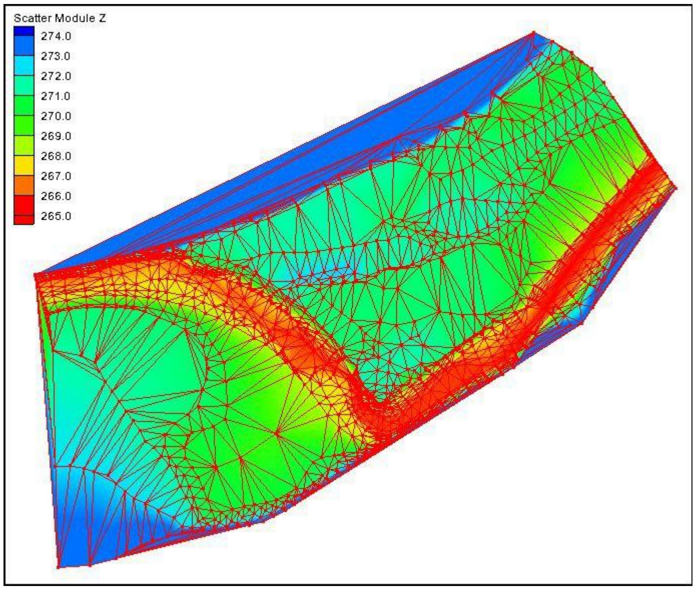


Figure 1 Triangulated and contoured data points

2 Editing TIN Data

The TIN data can be edited by deleting boundary triangles and solving triangulation issues.

1.1 Deleting Boundary Triangles

The triangulation process creates triangles from all the points in the set. It uses a boundary called a convex hull. This results in areas being included in the surface that are not really represented well by the points.

For example, if the survey includes cross sections around a bend of a river, but does not have data points on the inside overbank, the surface will cover the inside overbank, but will not represent any data in that region. In a similar fashion, long skinny triangles may be formed around the edge of the surface that connect points that are a long ways from each other, and don't represent the surface. To make the surface represent the conditions being modeled, delete these extra triangles.

Triangles can be deleted in different ways. A common and intuitive method is to select (by clicking) a triangle and then delete it. However, this method can be time consuming if a very large dataset is being used.

SMS includes a utility called the *Process Boundary Triangles* function. This utility speeds up the process of identifying and possibly removing unwanted boundary triangles. It selects boundary triangles that have an edge ratio higher than a user specified value. The edge ratio of a triangle is calculated by dividing the length of the triangle edge on the boundary by the length of the smallest triangle edge.

To delete unwanted boundary triangles:

1. Select *Triangles* | **Process Boundary Triangles...** to bring up the *Process Boundary Triangles* dialog.

2. The best edge ratio can be found by trial and error. Set the *Aspect ratio* to “1” and select **Preview**. The Graphic Window display will update, highlighting the triangles that are connected to the boundary with an edge ratio greater than 1. In this case "connected" means all triangles between that location and the boundary have an edge ratio greater than 1. Note that a large portion of the surface is selected. The utility can't distinguish between skinny triangles that actually represent the surveyed region, and undesirable boundary triangles. That means care must be used to select an edge ratio. Try a few values and use preview to see how many triangles would be affected.

3. For consistency in this exercise, enter “36.00” for the *Aspect ratio* and select **Preview**. This value for the edge ratio selects mostly undesirable thin triangles. However, there are some triangles on the bottom that are selected just because of the high resolution of the cross section sampling. These triangles need to be unselected before deleting, so make sure that the *Select* option is on and click **OK**.

4. **Zoom** in to the bottom of the dataset as shown in Figure 2.

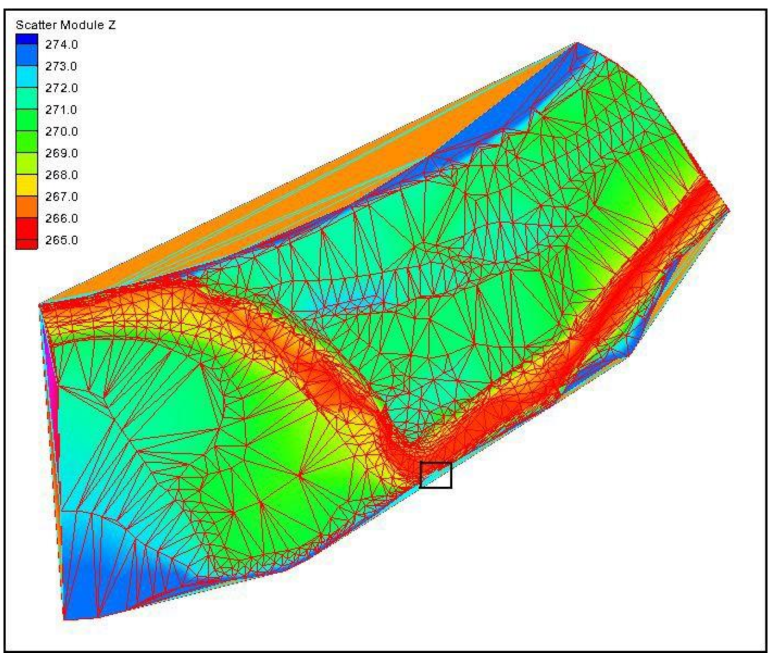


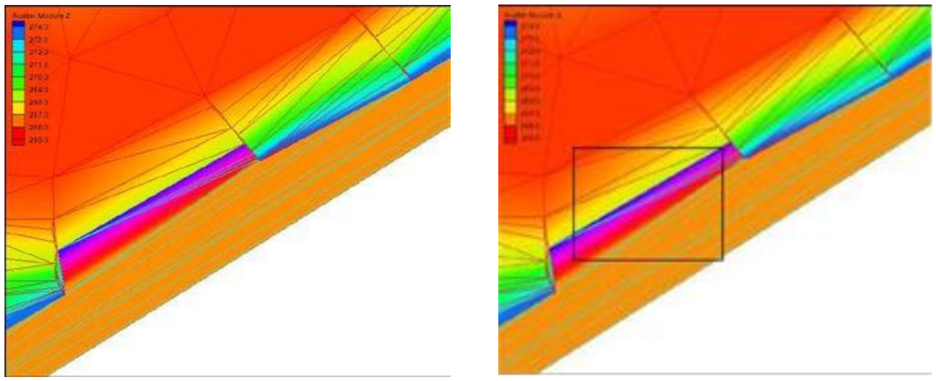
Figure 2 Zoom area

SMS provides several modifier keys that can be used in connection with the graphical selection tools to make it easy to perform a number of selection related tasks. If the *Shift* key is pressed, newly selected items are added to the selection and previously selected items are removed from the selection. If the *Alt* key is pressed, newly selected items are selected if they were not previously selected (nothing is unselected). If both the *Alt* and *Shift* are pressed, newly selected items are removed from selection list (nothing is added).

1. Make sure the **Select Triangle** tool is selected.

2. Holding *Alt* and *Shift*, drag a box around the triangles that users want to deselect (as shown in Figure 3b). All selected triangles, whose centroid lies inside this box, will be deselected.

3. Delete the selected triangles by pressing the *Delete* key. If prompted to confirm deleting these triangles, click **Yes**.



a. Zoomed region *b. Deselection box*

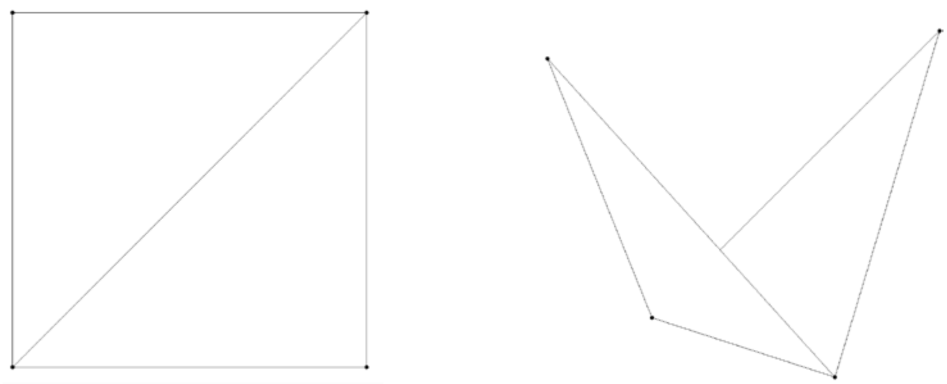
Figure 3 Unselecting selected triangles

This process does not remove all undesirable boundary triangles. Manual selection and deletion of boundary triangles, or applying this process with multiple edge ratios or after some manual removal may be required. In this situation, both the upstream and downstream ends of the river still have long skinny triangles that must be deleted manually because the survey data is so dense. It is not necessary to delete these triangles to complete the tutorial, but this should normally be done.

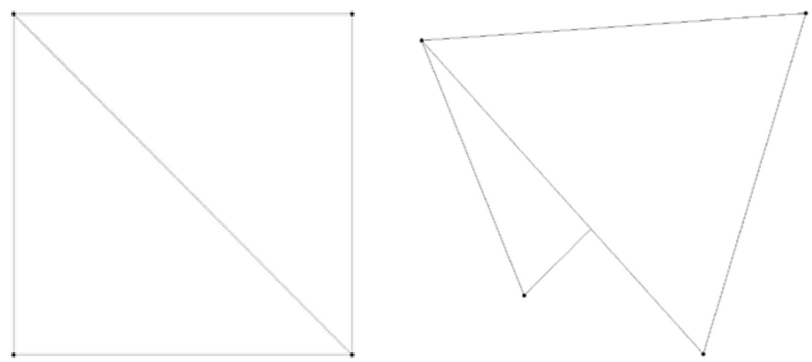
1.2 Solving Triangulation Issues

SMS builds a triangulation that conforms to the Delaunay criterion which is intended to create triangles that are as close to equilateral triangles as the data sampling will allow. In general, this avoids skinny triangles. While this is a good general triangulation strategy, it doesn’t always represent the surface well. This section will go step-by-step on how to swap edges to improve surface definition. A numerical model cannot represent a set of physical conditions, if the surface it is based on is incorrect. Care should be taken to ensure the TIN is accurate.

How vertices are connected into triangles has a large effect on the surface that is represented. Connecting vertices differently will give different surfaces. Consider the simple triangulation shown in Figure 4(a). When the surface is viewed from an angle, Figure 4(b) can be seen. Notice how the triangulation creates a trough or channel. Figure 4(c) shows the same set of points after the common triangle edge (diagonal of the quadrilateral) is swapped. When viewed from an angle as seen in Figure 4(d), it is observed that instead of the trough that was formed before, a ridge or dam is formed. This simple example illustrates that the direction of the triangles edges can drastically changed the surface created by the triangulation. This is why the **Swap Edge** tool is very important and has to be used carefully to better define channels, etc.



a. Planar view of Triangulation. *b. Oblique view showing triangles.*



c. Triangulation after swapping edges *d. Oblique view after swapping edges*

Figure 4 Differences that are made by swapping triangle edges

Manually Swap Edges

The first editing tool is a manual edge swap. This method is usually straightforward, but may involve a lot of effort. It is illustrated here because many situations require manual clean up and the process is the basis for all of the TIN editing techniques.

1. Select *Display* | **Display Options** to bring up the *Display Options* dialog.
2. Make sure that "Scatter" is selected from the menu on the left and that *Contours* is checked on.
3. Switch to the *Contours* tab. Set the *Contour Method* to "Color Fill and Linear".
4. Click on the *Line color* button to bring up the *Line Attributes* dialog.
5. Change the *Width* to "2" then click **OK** to close the *Line Attributes* dialog.
6. Click on the **Color Ramp** button to bring up the *Color Option* dialog
7. Change the *Palette Method* to *Intensity Ramp.* Move the arrow on the left in the *Current Palette* range out of the black.
8. Click **OK** to exit the *Color Options* dialog.

9. Back in the *Display Options* dialog, turn on *Specify a range* and enter “265” for the minimum and “271” for the maximum. Set the number of contours to “13” in *Contour Interval*.

10. Click **OK** to close the *Display Options* dialog.

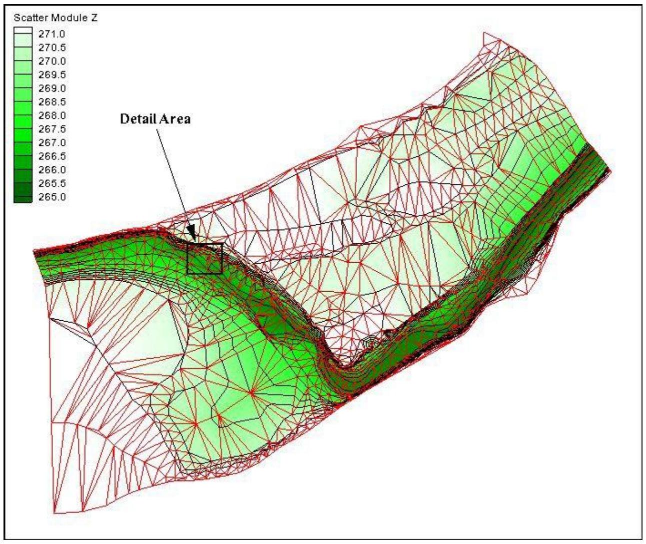


Figure 5 Manual swap detail area

11. **Zoom** to the detail area as shown in Figure 5.

After zooming, the screen should look like Figure 6. Note the linear contour around the edges to be swapped. It is not smooth or straight. In fact, two contours actually converge to a single line. This is possible if a vertical cliff exists, but is not likely in this situation. Natural contours tend to be smooth. A good guideline is to swap edges so that linear contours are smooth.

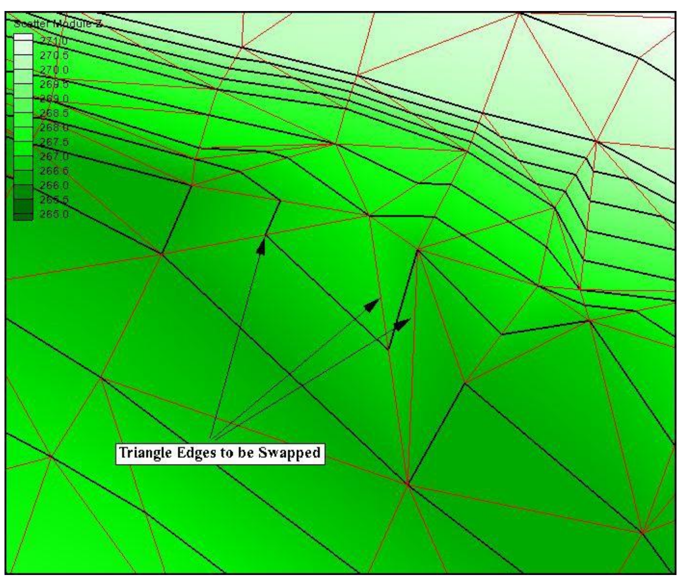


Figure 6 Zoomed out area showing triangle edges to be swapped

To fix triangles:

1. Select the **Swap Edge** tool. Click on each of the three edges identified in Figure 6. The TIN should be edited to appear like Figure 7. Note how the two contours are now distinct and much smoother.

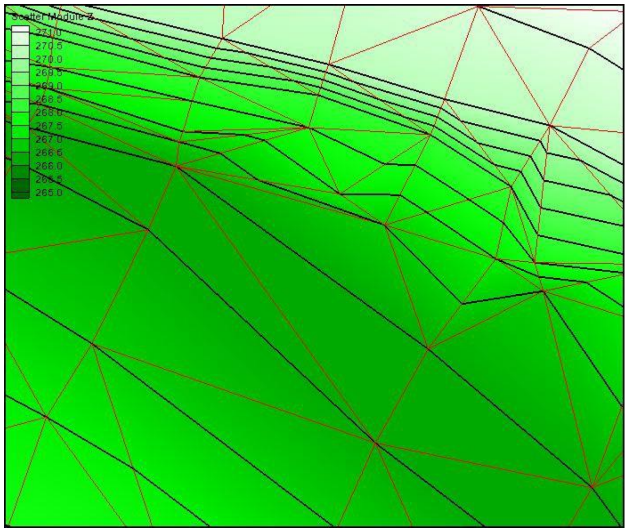


Figure 7 Figure showing triangle after edge has been swapped

A word of caution when using the swap tools, if not carefully used with regards to where it is clicked, a different edge may be swapped than the desired edge and the quality of the surface can suffer. While swapping edges, make sure that the surface is being defined accurately.

Adding Breaklines to Smooth Contours

While it is always possible to get the desired surface by swapping edges, it is often time consuming and may be impractical. When wanting a feature represented in a TIN; such as the bottom of a channel, bank, or man-made feature; it might be time consuming to determine all the right edges to swap to connect the feature. Breaklines can be used in these cases to force triangle boundaries along a feature. Breaklines can also be imported in various formats as part of the scattered data (from the surveyor) and SMS also includes the capability to create breaklines from CAD or GIS data.

As noted above, an easy way to spot triangulation problems is to look for jagged contour lines. Breaklines can be used to connect vertices of similar elevations to prevent jagged contours. The following steps illustrate how to use breaklines to edit the TIN. not working directly with the edges, it helps to turn them off. This unclutters the display and simplifies interaction with the scattered data points. It is also useful to use 3D views to understand the shape of the surface. Normally to do this, rotate the view and experiment with their surface. In this case, a view will be specified as an illustration.

1. Select *Display* | **Display Options** to bring up the *Display Options* dialog.
2. Make sure *Scatter* is selected from the list on the left. Turn on the *Points* option and turn off the *Triangles* option.
3. Click on the point symbol button to bring up the *Symbol Attributes* dialog.
4. Set the *Size* to "4" then click **OK** to close the *Symbol Attributes* dialog.
5. Select the *General* option from the list on the left. Turn off the *Auto z-mag* option and set the *Z magnification* to "10".
6. In the *View* tab, turn on *View angle* then set the *Bearing* to "30", the *Dip* to "50", the *Looking at point* to *X:* "648700.0", *Y:* "3984000.0", *Z:* "2675.0", and the *Width* to "800".

7. Click **OK** to exit the *Display Options* dialog.

The resulting view should be similar to that shown in Figure 8.

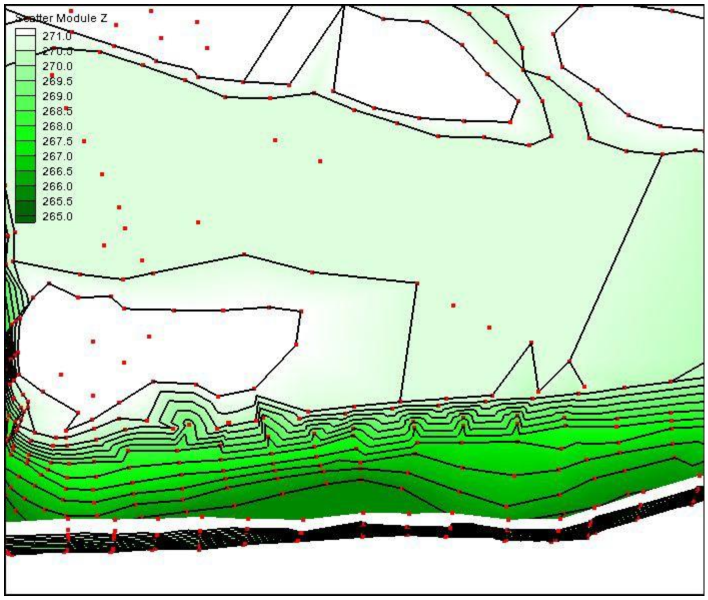


Figure 8 Angle (oblique) view of contours and points

Note how the contours tend to connect the vertices of common elevation. However, they connect with very crooked lines. A breakline, connecting vertices with straight lines, can force the triangulation to follow those straight lines.

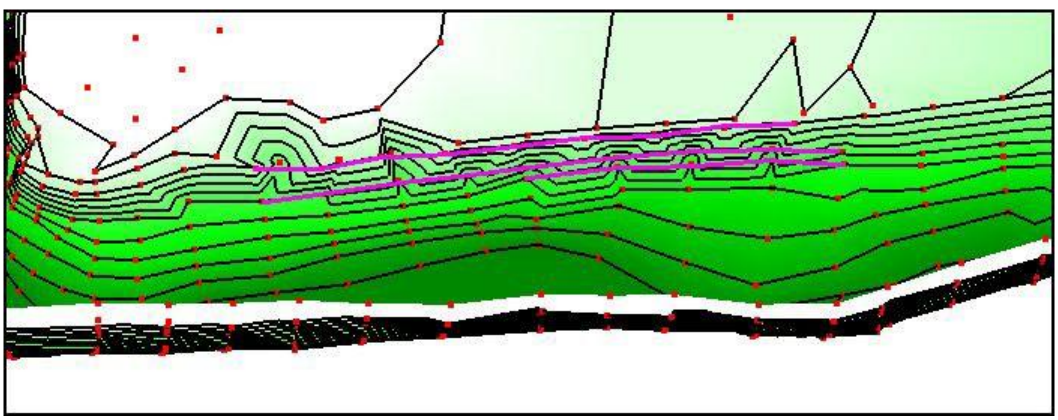


Figure 9 Connectivity for breaklines on the bank

8. Select the **Create Breakline** tool and add breaklines along the bank of the channel. Do this by clicking on the scatter points with common elevations as shown in Figure 9 (This illustrates three separate breaklines). End a breakline with double clicking on the last point.

9. Switch to the **Select Breakline** tool, select each breakline while holding down the *Shift* key.

10. Right-click and select **Force Breakline.** The screen should now look similar to Figure 10.

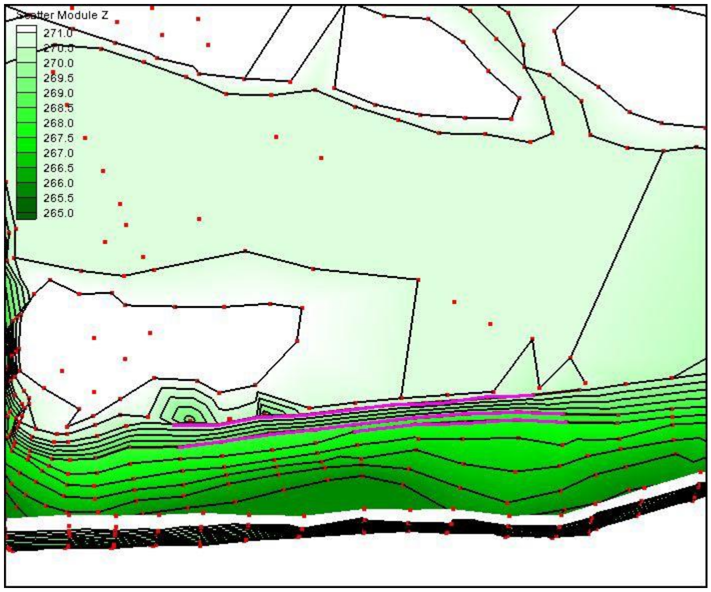


Figure 10 TIN with breaklines forced

11. After forcing the breaklines, the breakline can be deleted by using the **Select Breakline** tool and pressing the *Delete* key.

These breaklines smoothed out one section of the bank. If desired, experiment with the 3D view to get a better impression of the surface. More breaklines can be added around the scatter set to force the triangulation in other areas.

Even with the ability to force breaklines, cleaning up an entire survey can still be very time consuming. An updated and cleaned up file of the scatter set has been provided.

12. To view the updated surface, select *File* | **Open** to bring up the *Open* dialog.
13. Select the file "cimarron_updated.sms" and click **Open**. If asked to delete existing data, click **Yes.**

The final scatter set should be similar to Figure 11. View the breaklines in this file to see the 26 created line used for cleanup.

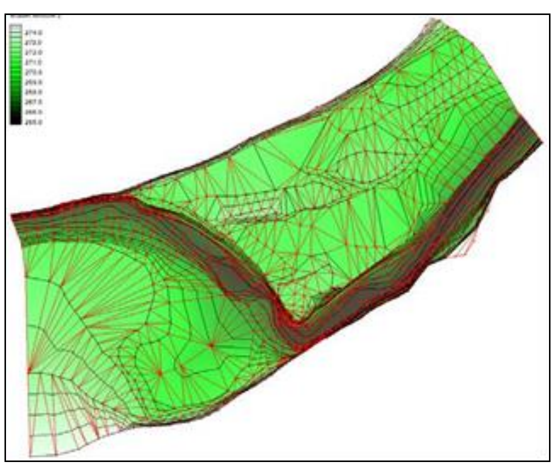


Figure 11 Clean TIN of the Cimarron River

3 Modifying Scatter Sets

Scatter sets may not represent all the features or the area being modeled and therefore need enhancement. Verifying the TIN with another data source, such as an aerial photo or topographic map can ensure the adequacy of the surface for modeling purposes. Some features may be too small to have been captured in the survey, but still have significant impact on the hydrodynamics of the region. Other features, such as man made structures (embankments or levees) may not have existed at the time of the survey. Remember that features change over time, so verification must include data from the appropriate time period.

Do the following to import the image file:

1. Select *File* | **Open** to bring up the *Open* dialog.
2. Select the file "ge_highres.jpg" and click **Open**.
3. Click on the **Plan View** icon to ensure the image is being viewed in plan view to make the image visible.

Once the image is loaded, adjust the scatter data display to see the road. To do this:

4. Select *Display* | **Display Options** to bring up the *Display Options* dialog.
5. Select *Scatter* from the list on the left and turn off *Points* and turn on *Triangles*. Leave *Contours* turned on.
6. Select the *Contours* tabs and set the *Transparency* to "70"%.
7. Click **OK** to exit the *Display Options* dialog.

The graphics window should look similar to Figure 12.

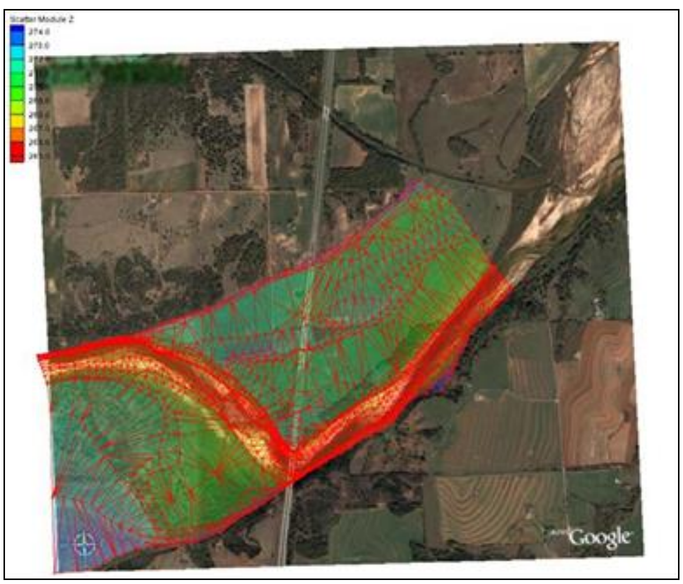


Figure 12 TIN with background image

The aerial photo reveals that a roadway cuts through this domain. The survey and TIN surface do not represent the roadway embankment. This may have been intentional, if the study was intended to compare preconstruction conditions to post-construction or if a modified structure is desired. In any event, the TIN would require modification to accurately represent the flood plain and the roadway with its embankment. There are several methods available for incorporating a feature into a TIN.

These include:

1. Using the stamped feature option in SMS (refer to the *Feature Stamping* tutorial for details on this process).
2. Merge another TIN into the current surface.
3. Add vertices at specified points or along feature lines.

The first two options are illustrated in the *Feature Stamping* tutorial and will not be discussed in this exercise.

3.1 Adding and Editing TIN Vertices

Digitization to add points to a scatter set functions in SMS after a surface is created just as when starting out. Using the **Create Scatter point** tool, new scatter vertices can be placed at any location simply by clicking at that location. The elevation of the point defaults to the current elevation. Changing the elevation of a newly created point, using the *Z* edit field, changes the current elevation.

Vertices can also be moved interactively by dragging the individual entities. To prevent accidental edits to scattered vertex locations, SMS includes an option to lock the vertices in the *Vertices* menu.

When adding a structure, such as a roadway embankment, it may be tedious to insert each vertex one at a time. An alternative is to use a feature line. The feature line is an arc in a coverage in the Map module. SMS includes features to convert CAD files or GIS files to feature arcs. Refer to *Overview*, *GIS* and *Observation* tutorials as well as to the section at the end of this tutorial for more description of these processes.

For this exercise, the roadway is a straight line with a constant elevation, so create the feature arcs interactively. To do this:

1. **Zoom** in to the bottom of the TIN as seen in Figure 13.
2. Select the "Area Property" coverage in the Project Explorer. This will enable the Map module toolbox.
3. Select the **Create Feature Arc** tool and create two arcs as shown in Figure 13. No intermediate points are required at this time.
4. Switch to the **Select Feature Arc** tool and, using the *Shift* key, select the two arcs.
5. Select *Feature Objects* | **Transform Feature Objects**… to bring up the *Transform Feature Objects* dialog.
6. Change the arc elevations to "273" ft using the *Z* edit field then click **OK** to close the *Transform Feature Objects* dialog.

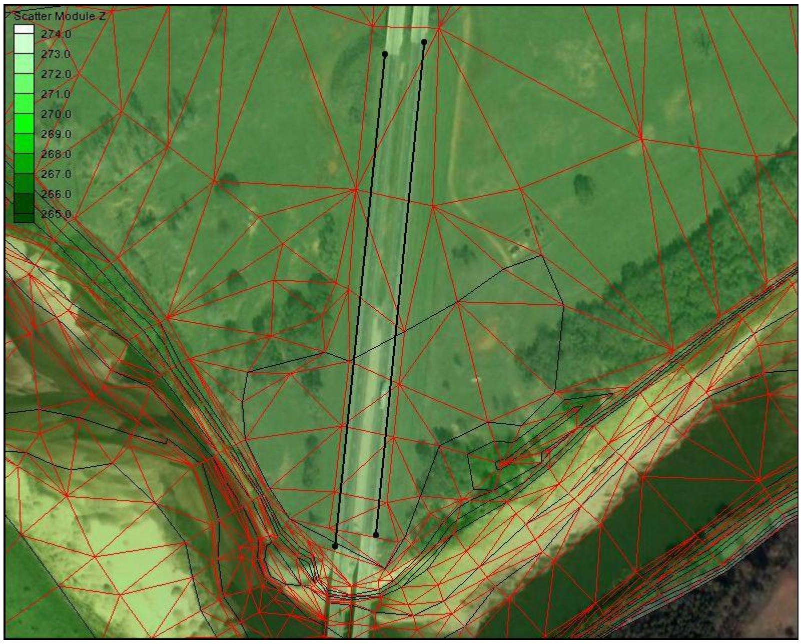


Figure 13 Arcs along embankment edges

7. With both arcs still selected, right-click on either and select **Redistribute Vertices...** to bring up the *Redistribute Vertices* dialog.

8. Make sure *Specify* is set to "Specified Spacing" as the redistribution option and enter an *Average* value of "50" ft. This is the approximate spacing of the vertices in the TIN. It is useful to be consistent with spacing when possible and it is not excessive. Click **OK** to close the *Redistribute Vertices* dialog.

The resulting arcs, with their distributed vertices should appear as shown in Figure 14.

9. Right-click on the "Area Property" coverage in the Project Explorer and select the *Convert* | **Map → 2D Scatter** command. The *Map → Scatter* dialog will appear.

10. Make sure *Arc elevation* is selected as the *Scatter Point Z-Value Source*. Accept all other settings and click **OK** to exit the *Map → Scatter* dialog.

SMS creates a new scatter set, with breaklines along the arcs. (Note that there are other options to provide z values for the newly created points. This gives more flexibility.)

11. Select the newly created scatter set in the Project Explorer.

12. Select *Scatter* | **Merge Sets**. The *Merge Scatter Sets* dialog will appear.

13. Check the box next to both scatter sets under the *Merge* column and click **OK**.

A new scatter set is created that includes points and breaklines along the edges of the roadway embankment. (***Note***: refer to the Feature Stamping tutorial to learn more about the merging options.)

14. After the *Merge Report* appears, click **Close.**

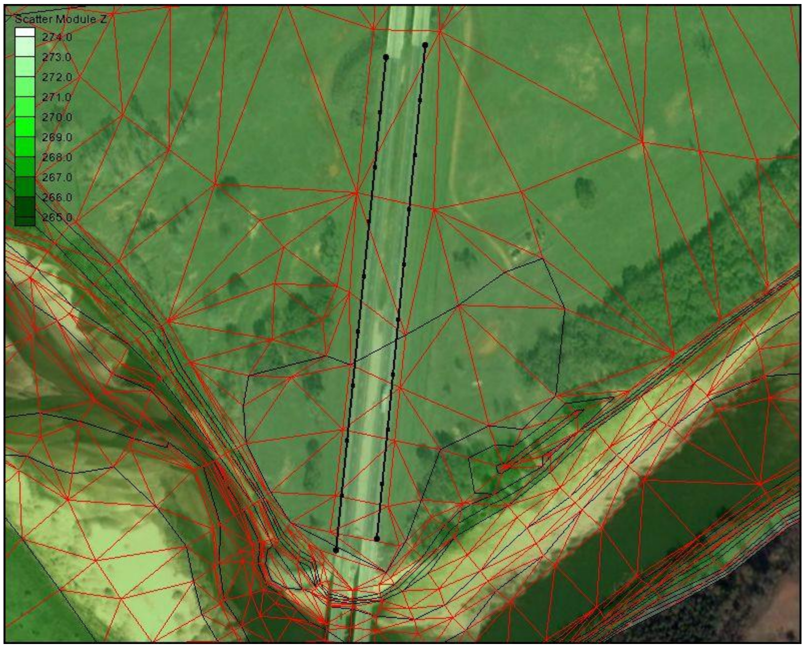


Figure 14 TIN with additional inserted points

4 Exporting to Tabular Data

TIN data can be exported into a tabular format from SMS for use in other software. To export the existing data:

1. Select *File* | **Save As…** The *Save As* dialog will appear.
2. Enter a *File Name* as "cimarron_updated_tabular" and change the *File Type* to "Tabular Data files" then click **Save**. The *Export Tabular File* dialog will appear.
3. Change the *Number of Columns* to "4".
4. In the first column, click on the **Data…** button to open the *Format Column Data* dialog.
5. Change the *Data Type* to "Vertex Id" and click **OK** to close the *Format Column Data* dialog.
6. In second column, click on the **Data…** button to open the *Format Column Data* dialog again.
7. Select "x location" under *Dataset to Export* then click **OK**.
8. Similarly, repeat steps 6 and 7, changing the third column to "y location" and the fourth column as "elevation".
9. Check on *column headings.*
10. Change the headings to "Vertex Id", "X", "Y" and "elevation" respectively. Click **OK** to exit the *Export Tabular File* dialog and save the file.

5 Filtering Data in large files

Sometimes available data can be rather large which could result in time consuming processing. In the case where the available data is too large to effectively process, SMS provides different ways to filter certain data points that are not important for later simulations.

For this part of the tutorial, a set of evenly distributed cross section data points are defined in the file "Raster-in.xyz" and these data points will be read into SMS using two types of filter options.

5.1 File Import Filter Options

Input date files can be large. They may have higher resolution that is needed or cover a larger area that is needed for a specific project. In those situations, it is useful to limit the data imported into SMS. SMS provides options to perform this filtering. Before importing the file, change the display options to show the points.

1. Select *File* | **Delete All** to clear out the data in SMS. When a prompt asks whether or not to continue, select **Yes.**
2. Select *Display* | **Display Options** to bring up the *Display Options* dialog.
3. Turn off the *Show option pages for existing data only* option.
4. Select *Scatter* from the options on the left and make sure *Triangles* are off and *Points* are on.
5. Click on the point symbol button to bring up the *Symbol Attributes* dialog.
6. Change the symbol from a square to a circle and increase the *Size* to "8". Click **OK** to exit the *Symbol Attributes* dialog.
7. Turn on *Use contour Color Scheme* for the *Points.*
8. Set the *Inactive color* to a purple or magenta color, by clicking the color button next to the option. This will cause the *Color* dialog to appear.
9. Choose a purple or magenta color then click **OK** to close the *Color* dialog.
10. Click **OK** to exit the *Display Options* dialog.

Now, import the "Raster-in.xyz" file multiple times to illustrate the options. First, to import the entire file:

1. Select *File* | **Open** to bring up the *Open* dialog.
2. Select the file "Raster-in.xyz" and click **Open**. The *File Import Wizard* will appear.
3. The first step gives the option to specify delimiters and specify a starting point for importing. Make sure *Space* is toggled on, under *Set the column delimiters.* The remaining defaults are fine for this dataset, so click on the **Next** button.
4. In step 2, ensure the *SMS data type* option is set to "Scatter Set". This tells SMS to bring these points into the program as scatter points. Note also that the toggle is set

to have SMS triangulate the points into a TIN. Triangulation is not needed for this tutorial so turn off the *Triangulate data* option.

5. Click the **Finish** button to close the *File Import Wizard*. SMS reads in the raster data and converts each point to a scattered vertex. This may take a few minutes due to the fact that there are over 561000 points in this dataset. (Figure 15)

6. Repeat steps 1-3 to read in the "Raster-in.xyz" file again but this time with filtering so as to then compare the two resulting scatter sets to understand the differences made by filtering. The data will be loaded as "Raster-in (2)".

7. In step 2 of the *File Import Wizard*, click on the **Filter Options** button. The *File Import Filter Options* dialog will appear. The different options allow for only certain sections of the data to be read into SMS. Sections can be read into SMS in 3 different ways:

   • nth Point. This option allows only the nth points to be selected, n being any positive whole number. The whole area will be read into SMS but will be less dense and easier to work with if the file is significantly big.

   • Area. This option can be used when only a section of the data is needed. A rectangle of data will be selected with specified X and Y coordinates.

   • Grid. This option is similar to the filtering by nth point except that it is done on a grid basis.

8. Choose *nth point* as the *Filter Type* and import every 4th point by typing "4" in the edit box. Click **OK** to exit the *File Import Filter Options* dialog.

9. Click the **Finish** button to close the *File Import Wizard*. SMS will create the second scattered dataset. Its display will appear almost identical to the other one. (Figure 15). It may be necessary to hide the file which was first imported.

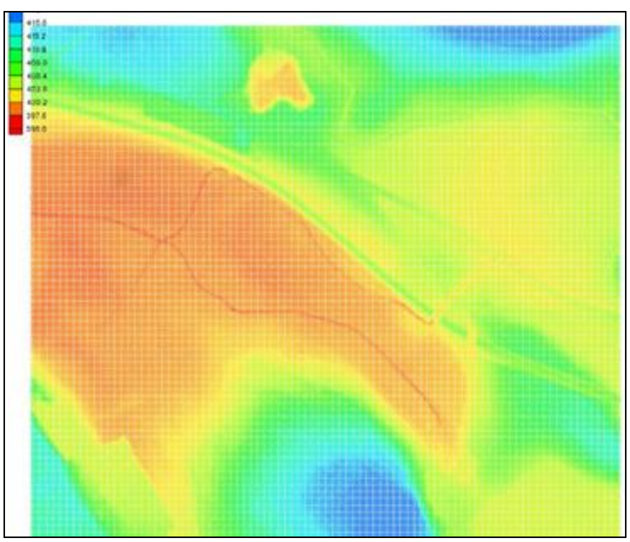


Figure 15 Scatter set for raster data

10. Once the file has been loaded two times, make sure that both scattered datasets are turned on (boxes next to each should be checked), and that "Raster-in" is selected.

11. **Zoom** in to the top left corner of the dataset. The purple or magenta points are

the filtered data. Only those exist in the filtered set. The unfiltered scattered dataset includes all of the points.

5.2 Filtering based on Angle

Now investigate another filtering option that is available after a file has been imported into SMS.

1. Uncheck the box next to the filtered dataset "Raster-in (2)" to turn it off.
2. Select the "Raster-in" scattered dataset in the Project Explorer to make it active and frame the data.
3. Select the **Triangulate** command in the *Triangles* menu. These filtering options operate on the TIN and therefore require triangulation.

Another way to filter data involves the removal of redundant data. This data does not add any details to the TIN surface. For example, when a point lies in the plane of all the surrounding points, no new features are represented and that point is superfluous.

In the next filtering option, the user can specify a tolerance angle. Each data point is checked to see if it is within that tolerance of being flat. (Note: a dot product of the "normal vectors" is used to determine this - see Figure 16). Vertices that are deemed to be redundant are deleted.

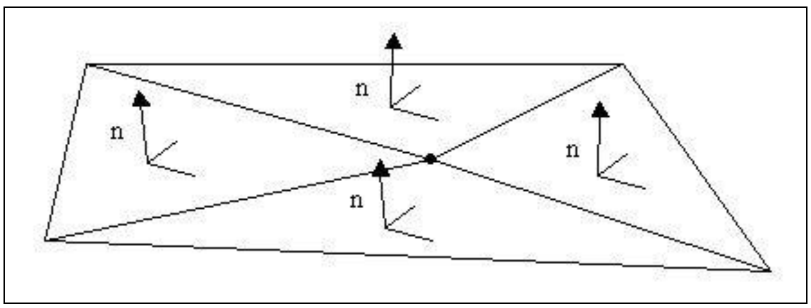


Figure 16 Triangles with relatively same normals

To filter based upon normal angle:

1. To save a copy of the dataset that has not been filtered. Therefore, it is a good idea to create a copy, and filter the copy. To do this, right-click on the "Raster-in" dataset and select **Duplicate**.
2. Right-click on the duplicate and select **Rename** then change the name to "Raster-in -2 degree filter".
3. Select *Data* | **Filter…** to bring up the *Filter Options* dialog.
4. Change the *Filter angles* to "2" degrees and click **OK**.
5. The *Filter Report* dialog will appear showing the number of points deleted through the filtering process. Click **Close** after viewing the report.

It might take a little while for the all data points to be found and deleted. In this case around 50,000 points can be deleted. This represents about 9% of the total. (***Note:*** SMS re-triangulates the remaining points, so any editing of the TIN performed on the original will be lost.) The screen should now look like Figure 17. Notice the blank spaces where the data has been deleted.

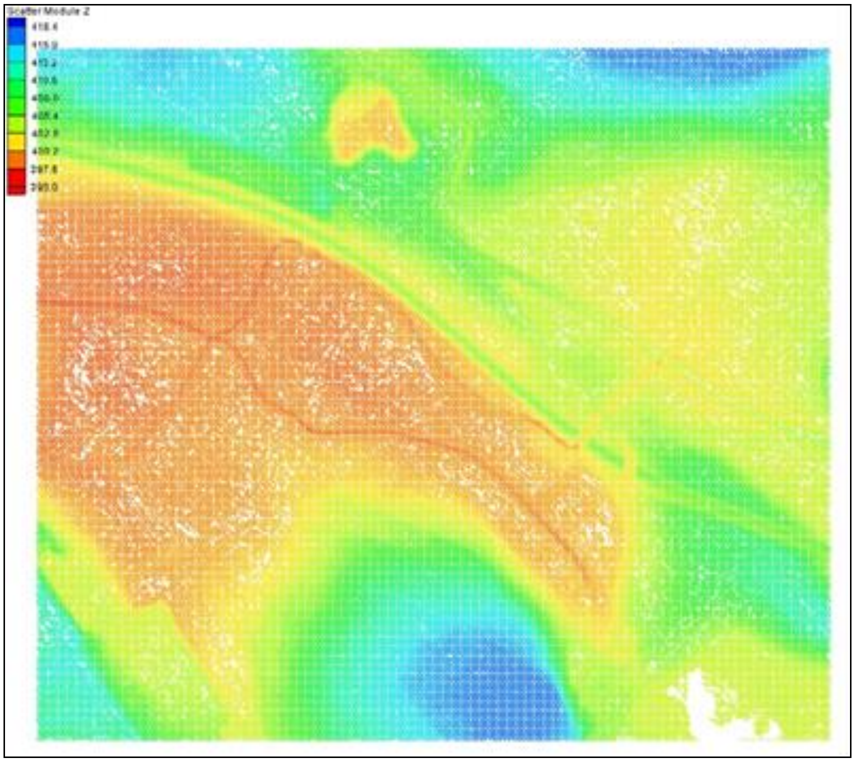


Figure 17 Scatter set after filtering by angles

6 Converting DXF files to Scatter Data

SMS can import many files generated by other software in their native format. One of the files that can be imported are DXF files (AutoCAD files) which are vector drawing data used for background display or for conversion to feature objects.

For this part of the tutorial, the file stmary.dxf will be imported into SMS as a scatter dataset.

To import the "stmary.dxf" file:

1. Select *File* | **Delete All** to clear out the data in SMS. Click **Yes** when prompted.
2. Select *File* | **Open** to bring up the *Open* dialog.
3. Select the file "stmary.dxf" and click **Open**.

After the file is imported, notice that in the Project Explorer there is a "CAD Data" section with a set of contours. The Main Graphics window displays those contours. In order to convert CAD data to scatter data, it needs to be changed to map data. To do this:

4. Right-click on "stmary.dxf" under "CAD Data" in the Project Explorer and select *Convert* | **CAD → Map** from the drop-down menu. The *Clean Options* dialog will appear.
5. Click **OK** in the *Clean Options* dialog.

6. There will be a new coverage named "CAD" created. Select this coverage to make the Map module active.
7. Right-click on the "CAD" coverage and select *Convert* | **Map → 2D Scatter** from the menu. The *Map → Scatter* dialog will appear.
8. Leave everything unchanged and click **OK** to close the *Map → Scatter* dialog.

SMS does a duplicate point check as it creates the scattered dataset. Since the spacing of the points along the contours in the CAD data is fairly high resolution. This process takes a few minutes.

9. **Zoom**  in to the top west part of the scatter set in order to better see scatter points and scatter breaklines. Turn off the "CAD" map coverage in order to see the scatter set better.

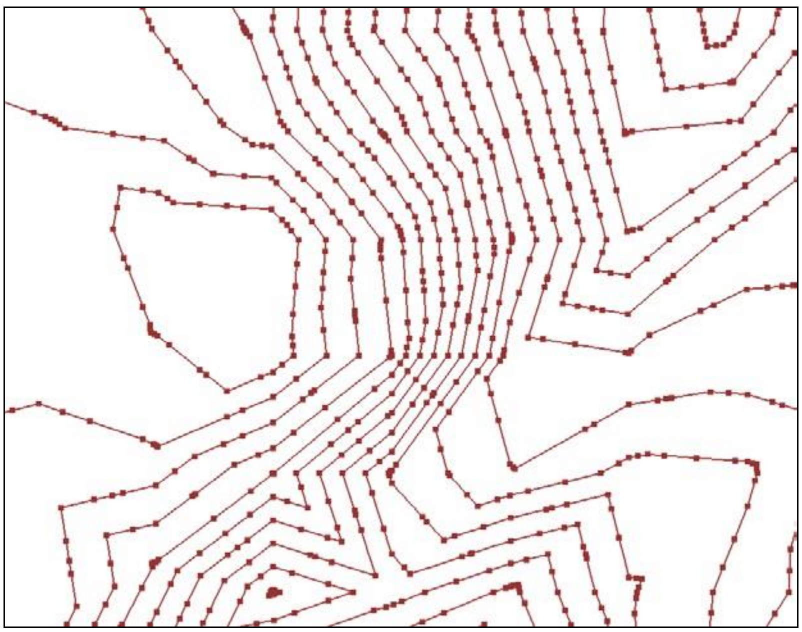


Figure 18 Scatter points and breaklines

In some situations, agencies provide data that includes scatter breakline information. Since these breaklines generally improve surface representation SMS supports a few standard file formats for breaklines. This section illustrates how to import this data.

For this part of the tutorial, the file "stmary.csv" will be imported into SMS as a scatter dataset.

To import the "stmary.csv" file:

1. Select *File* | **Open**  to bring up the *Open* dialog.
2. Select the file "stmary.csv" and click **Open**.
3. Since this is a commas separated values file, it may be interpreted in a variety of ways. SMS will ask for a format in the *Open File Format* dialog. Select the *Use Import Wizard* option and click **OK**.
4. In the *File Import Wizard*, in step 1 accept the default parameters and click **Next**.

5. In step 2, make sure that the *SMS data type* is set to "Scatter Set". In the *File preview* window, change the mapping of the fourth column to "Breakline". This will open up the *Scatter Breakline Options* dialog.
6. Turn on *Tags* and then turn on *Continue* and *End*. Change *Start* to "1", *Continue* to "2" and *End* to "4". (Note: there are other options for defining breaklines in tabular data. These include named breaklines, for which each breakline has a specific name. When name changes, SMS starts a new breakline. If name is blank the vertex will not be in a breakline).
7. Click **OK** to close the *Scatter Breakline Options* dialog.
8. Click **Finish** to close the *File Import Wizard* and import the file.

When SMS reads the survey file, it creates a new scattered dataset that could be combined with the scattered dataset from the CAD file. Both sets include breaklines to ensure the TIN surface is true to the original surface.

7 Conclusion

This concludes the TIN tutorial which reviewed some of the features that SMS provides for importing and editing the TIN Data. Continue to experiment with the interface or exit the program.

To exit SMS at this point, do as follows:

1. Choose *File* | **Exit**.
2. If asked to save, click the **No** button, as the file should already be saved.

