TerrainTools®

Terrain Tools 3D
Tutorial

Version 9

Softree Technical Systems Inc.

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Table of Contents

1. Getting Started

This manual is formatted as a hands-on tutorial, which can be used by novice or experienced users. Step by step examples use prepared documents and data files to illustrate tools needed for common Terrain Tools Forest Engineer and RoadEng® tasks.

Installation

The tutorial files referred to in the following examples can be installed from Softree's Support web site:

- Go to the *Support-Documentation Updates* page on Softree's web site: https://support.softree.com/product-updates/Documentation-Tutorials.
- Once *SoftreeTutorials.exe* has been successfully downloaded.
- *Double-click* on the file to begin installation.

During the installation you will be prompted to select which content to install, we recommend installing all the available tutorial options.

Documents

The tutorial files (data sets) will be installed in the folder below by default:

C:\Users\Public\Documents\softree\training90\Terrain

It is possible to change this folder at install time; you can also copy it to a new location afterwards if you wish. We will refer to the install folder as **<Terrain>** in the examples below.

Recommendation: To make accessing files easier as you work through the tutorial, we suggest pinning the <Terrain> folder to your Quick Access menu. To do so, open Windows Explorer, navigate to the folder <Terrain>. Right-click on the folder, select "Pin to Quick Access". This will now make the folder available on the left-hand side of Windows Explorer (see figure below).

Don't Save Files (in most cases)

Most of the following examples end with the phrase: "… do not save changes". If you modify the tutorial files, they will no longer work with the steps in the exercise; this will prevent you, or someone else, coming back and doing the exercise again.

If a file gets modified, delete the files in the training folder. Then re-install the tutorial files (per the original steps).

C:\Users\Public\Documents\softree\training90\Terrain

Defaults and Layouts

The setup and layout files are stored the folder below by default:

C:\ProgramData\Softree\Terrain

It is possible to change this folder, so we will refer to it as **<Defaults and Layouts>** in the examples below. A folder containing training specific files has also been added to this location:

<Defaults and Layouts>

Note: You can always determine the actual **<Defaults and Layouts>** folder by running the Terrain Module, selecting menu *Module* | *Setup* and clicking on the *Install* tab.

If RoadEng was installed, the default folder will be:

C:\ProgramData\Softree\RoadEng9

Function Groups

Some RoadEng® and Terrain Tools® products have certain features; we classify these optional features by *function group*.
To view the features enabled with your license:

1. Select *Setup* | *Module Setup* and click on the *General* tab.
2. Click on the *Menus…* to open the Menu Customization Dialogue box.

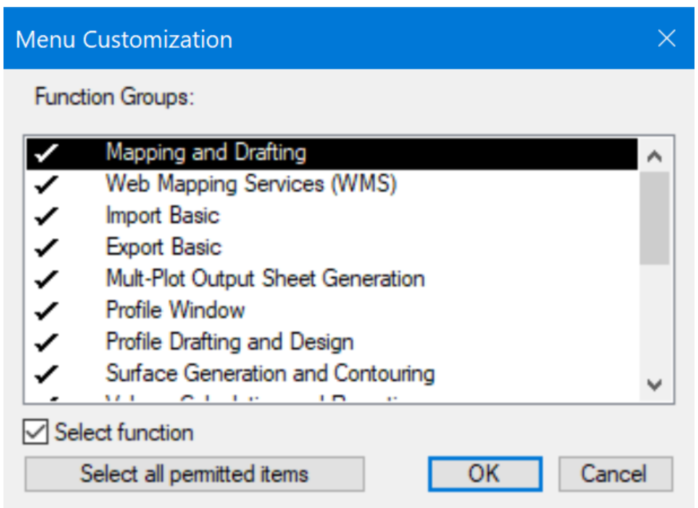


Figure 1-1 : Function groups displayed in the Menu Customisation dialogue

On-line Help

Help information is available by choosing the *Help* menu or pressing ***<F1>*** on your keyboard. The On-line Help includes detailed technical information about menus, dialogue boxes, and operation of the program. It may be useful to refer to the On-line Help while working through the examples in this manual.

Additional help is available through the Softree Knowledge Base:
https://www.support.softree.com/knowledge-base

Tutorial Units

Most examples in this tutorial are in Imperial Units (feet). To correctly follow the examples, ensure Imperial (ft) units are enabled in the *Setup* |*Setup Module Setup* | *Units* tab | Units: *Imperial (ft)*. If other units are used they will be specified at the start of the example. The procedures and concepts described apply to all unit systems.

Screen Layouts

Screen layouts are small files that save display options (window positions, labels, scales etc). Many of the examples in this training manual include a step to retrieve a screen layout; this change provides multiple view options in one quick step.

The *screen layout* drop-down control can be found in the Standard toolbar in all modules (figure below), *View* | *Screen Layout*:

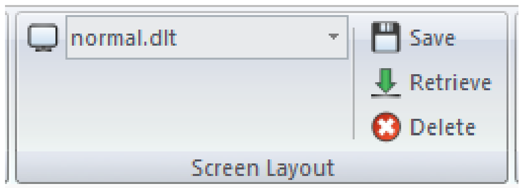


Figure 1-2: Accessing Screen Layouts Group

With the drop-down expanded, you can:

- <Right-click> on a screen layout in the *Screen Layouts* tool bar item to: Change Properties, Delete, Copy, Save

- <Right-click> on a folder (Softree or Custom) in the Screen Layouts tool bar item to:
    - Change properties (only the *Custom* folder can be changed here)
    - Paste a screen layout that was recently copied
    - Save new layout (define name and description)

The *Custom* folder is often defined on a network drive so that the layouts are accessible to all users.

- The *Save screen layout* button allows you to save a screen layout anywhere but only those in the *Custom* or *Softree* folders will appear in the *Screen Layouts* tool bar.
- The *Retrieve screen layout* button allows you to open a screen layout file anywhere including those in the *Custom*, *Training* or *Softree* folders.
- The *Delete screen layout* button opens up the screen layout folder where you can multiple layouts to delete.
- You can change the *Softree* folder from the menu *Module* | *Setup, Install* tab. Do not do this unless you understand the consequences; more than just screen layouts are stored in this folder. The most common change is to put *Settings and Layouts* into your *Documents* folder (private to one user only).

Note: Screen layouts were updated in Version 9. Softree recommends 'updating' any legacy user screen layouts to update their behavior. Version 9 layouts work better when moved between monitors of differing screen resolutions.

To 'update' your screen layouts:

If your legacy screen layout contains multi-plot information, please open your legacy screen layout in the multi-plot window first:

Select *Multi-Plot* tab | *Add New* ▼ | *Retrieve Other Layout.* Select ***Multi-Plot Old Screen Layout (.dlt)*** from the file type drop-down in the *Retrieve Screen Layout Dialog*. Select your legacy layout. Once open, press *Save Chapter* in the Multi-Plot ribbon.

Conventions

The following conventions are used throughout the manual:

- Menu functions are delimited by a line "|". *File* | *Open* means to click on Terrain *File* button in the corner of the menu bar and then select *Open* from the drop-down menu. Dialogue box control (like buttons) and heading names are *italicized*.
- The symbols "< >" contain keyboard functions. For example, < shift-enter> means: hold down the *Shift* key and press the *Enter* key.
- File names and path names are ***bold and italisized***.

User Interface Options: *Toolbar* & *Ribbon* Modes

This tutorial was written for the new Version 9 user interface in *Ribbon Mode*.
Please ensure that your Softree Optimal program is in *Ribbon Mode*. Your screen should appear with this group bar showing,

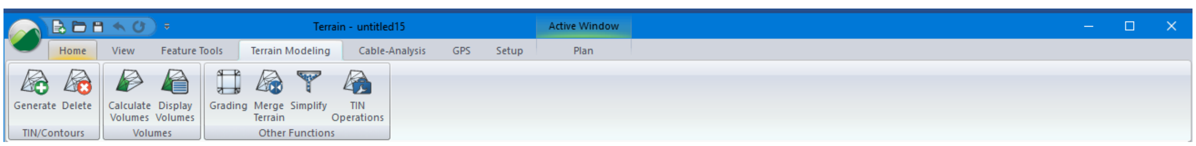


Figure 1-3: Ribbon Mode

To switch from tool bar mode into ribbon mode: Select *View* tab |*Ribbon Mode*

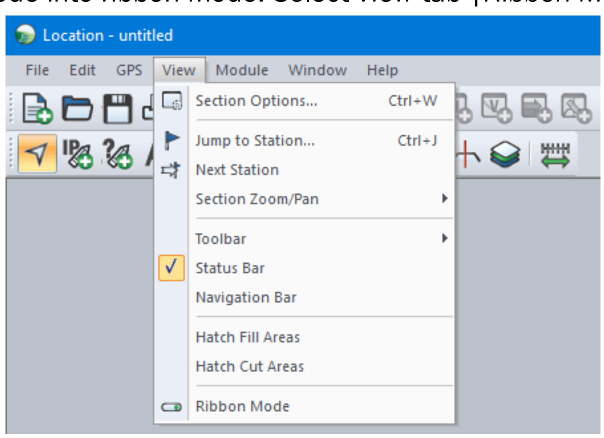


Figure 1-4: Changing to Ribbon Mode

2. Functional Overview

Softree software solutions are sold as modular products. Depending on the product you have purchased, it could include up to three *modules*:

1. *Survey/Map*
2. *Terrain*
3. *Location*

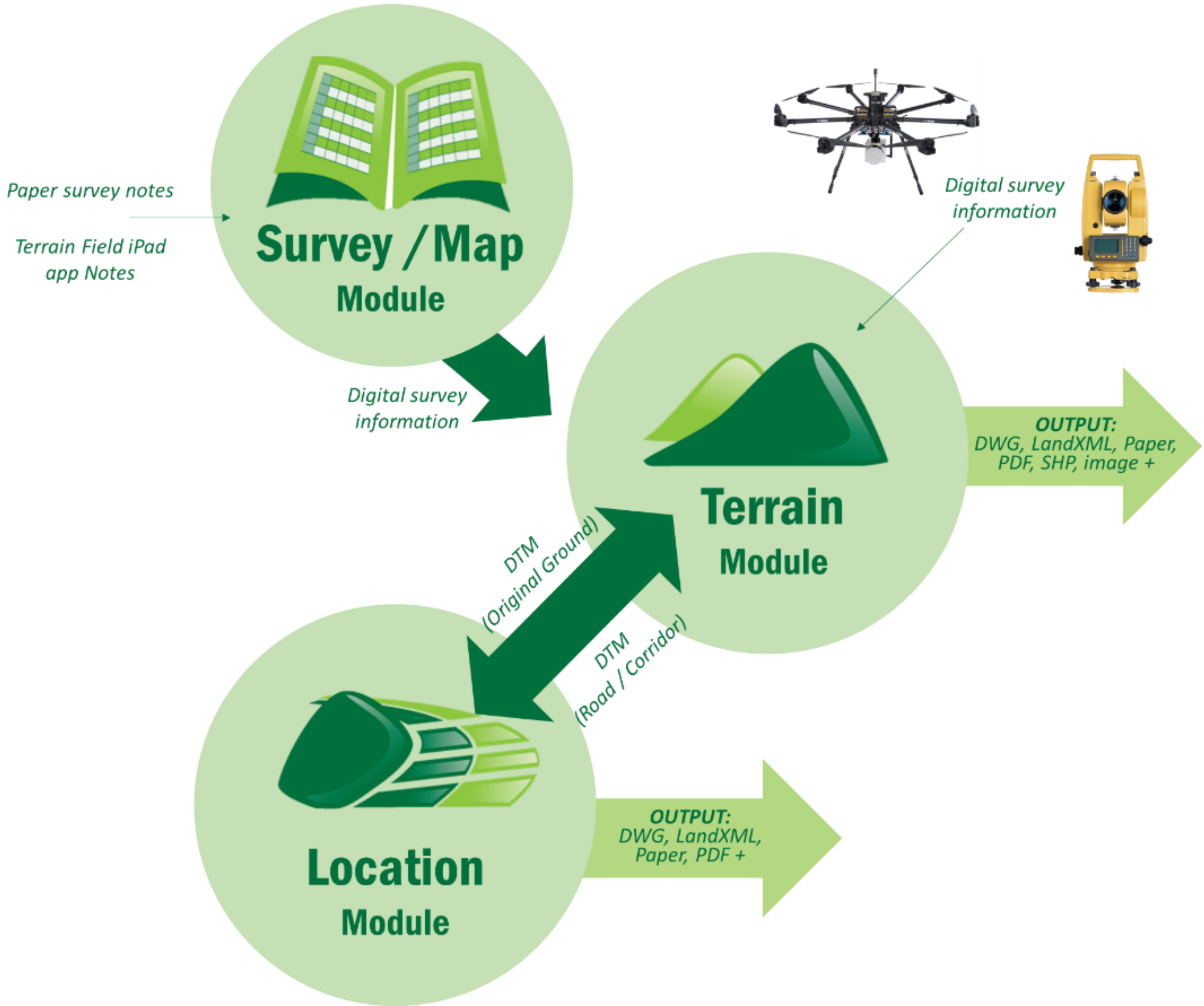


Figure 2-1: Relationship Between the Modules

Each of the modules can be started from the Windows Start menu, a desktop shortcut or from the *Setup* tab within either of the other modules.

Module Descriptions

Survey/Map Module

This module is used primarily to type paper survey notes into the computer. Azimuths, distances and slopes are entered and reduced to coordinates. Facilities exist to add perpendicular side shots to a traverse so that a group of terrain, suitable for a road design, can be easily captured with basic survey instruments.

Survey/Map also contains tools for adjusting traverses with respect to each other or to known coordinates.

Terrain Module

The Terrain Module provides basic CAD facilities for assembling and manipulating 2D and 3D points and features. Information can be imported from external sources like survey files, CAD files and image files. Three dimensional coordinates can be incorporated into a digital terrain model (DTM).

DTMs can be used for:

- Contour generation
- Section and profile display
- Volume calculations
- Pad, pit and site design (grading)
- 3D viewing
- Original ground for road design (Location module)

The Terrain module is also a capable mapping tool with control of line types, colors, symbols, hatching and labelling styles.

The Terrain Module (the focus of this tutorial manual) provides 5 main windows: Profile, Plan, 3D, Multi-Plot, and Cable; and 3 panel types: Feature Properties, and Points. The number and type of windows available depends on the *Function Groups* you have enabled. The figure below shows a typical window arrangement:

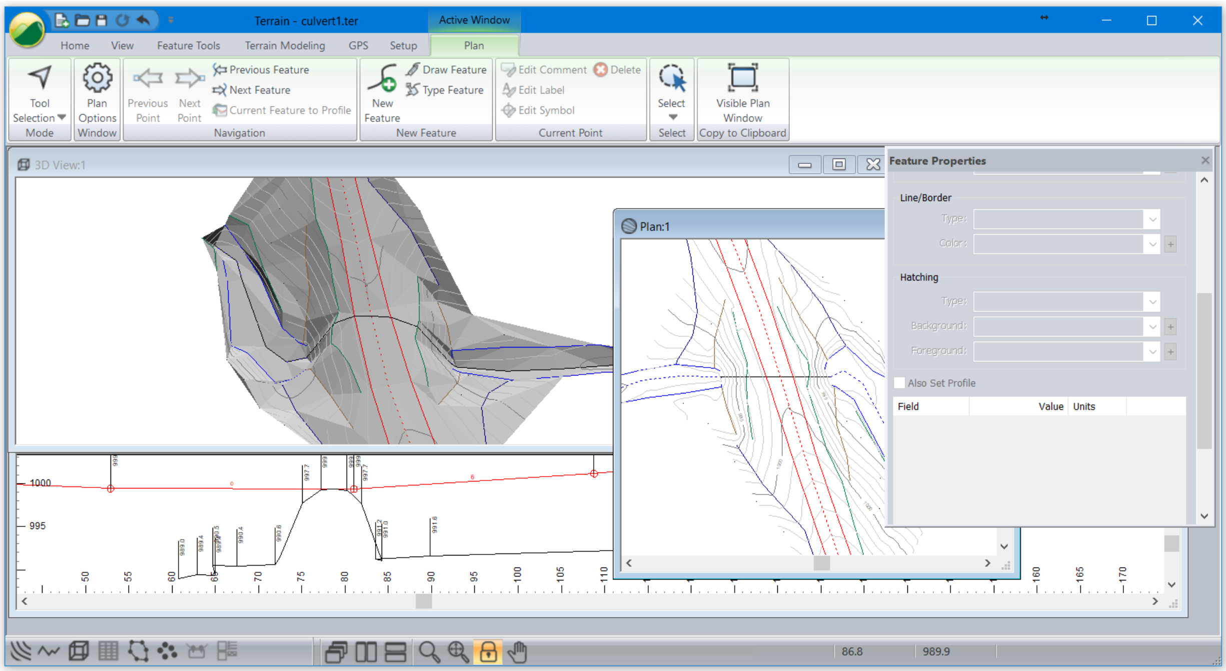


Figure 2-2: Various Windows Displayed in Terrain

Location Module

This is the module used to design road alignments. Location requires an original ground terrain (provided by the Survey/Map and/or Terrain modules). The designer controls cross section templates, alignment location and curves. Location provides real time feedback of volumes, mass haul, road footprint, cross sections, grades, etc.

Location can also export designed surfaces back to the terrain module where they can be merged into a composite surface. This is the most common way to prepare the original ground for an intersection design.

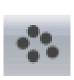
Terrain Functions

Window Types

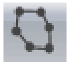
Plan Window displays a plan View. It is used to display and edit features.

Profile Window displays a profile view of one or more selected features. This window requires that the Profile Window function group be enabled.

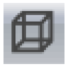
Feature Properties Panel displays the properties of the feature and numeric information about the current feature and point. It can be used as a floating window or as a docked panel window on the right-hand side of the screen.



Points Panel is used to report and/or modify attribute information about the current point. It can be used as a floating window or as a docked panel window on the right-hand side of the screen.



Features Panel is used to report and/or modify attribute information about the current feature. It can be used as a floating window or as a docked panel window on the right-hand side of the screen.



3D Window displays the features in a 3-dimensional view.

Multi-plot Window is used to create an output sheet containing plans, profiles, legends, scale bar, images etc. This window requires that the Multi-plot function group be enabled.

Each window can be sized, moved, maximized and minimized in the standard Microsoft fashion. All windows can be arranged using *View | Cascade, Tile Vertically, Tile Horizontally* buttons.

Text windows such as *Features* can be floating or docked to the right side of the screen. To dock a floating window, click the title bar of the window and move it over the right-hand side of the main window. The panel with dock automatically.

Points, Features, Attributes, and Feature Properties

Features

A feature is a collection of points such as a contour line, a lake boundary or a spot elevation point. Bitmap images are also considered to be features (in this case the corners are the points). Many operations in Terrain apply to features or groups of features such as formatting, moving, deleting etc. Feature attributes can be assigned to the features.

Points

Features consist of 1 or more XYZ coordinate points. Point attributes can be assigned to individual points.

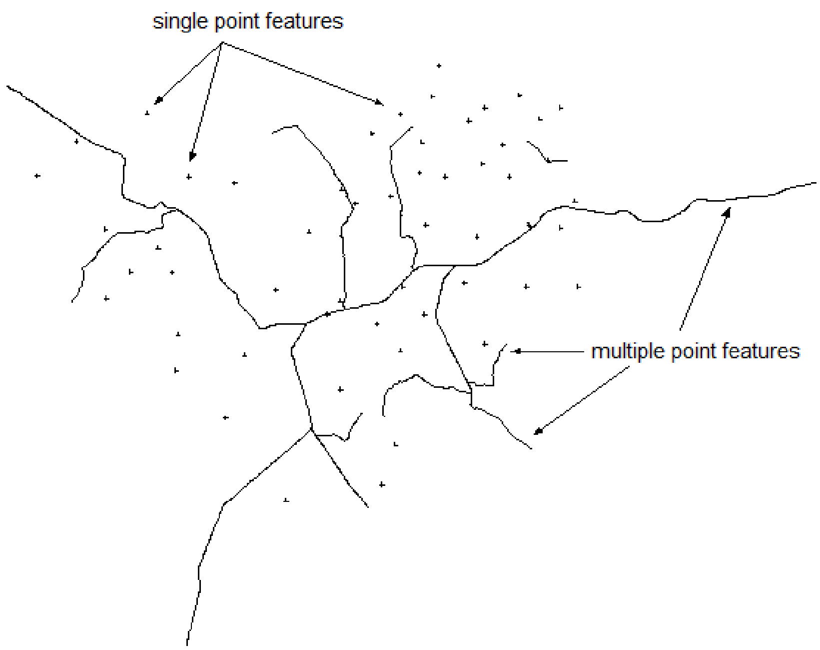


Figure 2-3: Single and Multiple Point Features

Attributes

Attributes are the properties of a particular object. They can be things like line type and color, which are editable feature attributes, or things like the number of features in a file which is a read-only attribute.

Attributes can be viewed through the Status Window, the Features Window or the Points Window. There are three broad classifications of attributes and they are as follows:

- Point Attributes - properties of a point on a feature.
- Feature Attributes - properties of a feature.
- File Attributes - properties of all the features and the file as a whole.

Attributes are grouped together in categories. Many categories are pre-defined, but you can create your own attribute definitions by adding a new category using the Attributes Setup Dialogue. An example of a pre-defined category is Format. The Format category contains feature attributes such as line type, color, and hatch. These attributes are not read-only, so you can modify them in the Features Window.

Fixed Feature Attributes (Feature Properties)

Every feature has a set of fixed attributes (additional attributes are optional). These attributes are saved in a feature header.

The following properties are saved with every feature:

Feature Name	Each feature has a unique name consisting of a 50-character Alphanumeric Id portion and a Numeric Id. It is possible to have more than 1 feature with the same Alphanumeric ID e.g. STREAM-1, STREAM-2 etc. The feature name is not case sensitive i.e. " RightOfWay11" = " RIGHTOFWAY11".
Line-type, Color, Symbol and Hatchtype	Drawing format
Displayed	Visibility e.g. displayed or hidden
Connected	Feature points are connected by lines or isolated (refer to Figure 2-4)
Elevation	Feature points have elevations
Modeled	Feature points will be included in the TIN model
Breakline	Feature is a breakline (TIN modeling)
Negative Area	Feature represents a hole with negative area. This option can be used with TIN Boundary below.
TIN Boundary	Feature is a TIN boundary
Surface Volume Boundary	Feature is used as a polygon to accumulate volumes in the volume calculations.

Note: When working with very large data sets it is not a good idea to use single point features because the memory overhead for the feature header can be significant. If possible, make sure that data are grouped into features containing a number of points (1000+).

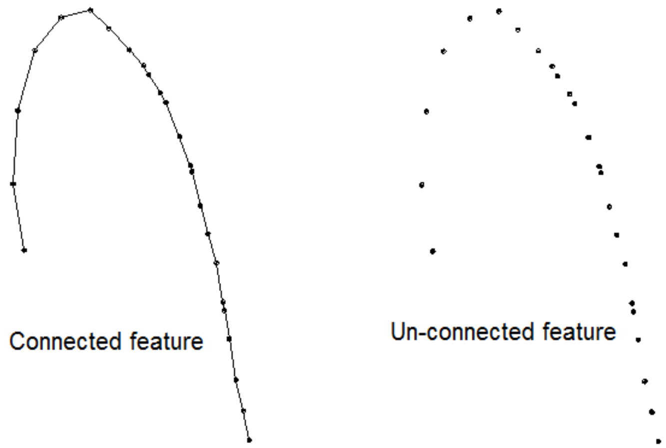


Figure 2-4*: Connected and Unconnected Feature Property*

Current Feature and Point

In the Terrain module, it is possible to *select* multiple features; selected features are the target of most operations (delete, move, change line-type, change properties, etc.). Often the concept of current point and current feature is used. At least one feature must be selected.

- There is no current point or feature if no features are selected. Selected features are always displayed with color magenta.
- The Current Point is displayed in the plan and profile windows with a red cross.
- The Current Feature is the selected feature containing the Current Point.
- Most of the information displayed in the Status window relates to the Current Feature and Current Point.
- Selecting with the mouse (in *selection mode*) is a common and simple way to change the *Current Feature* and *Current Point*.

3. Basic Mapping and Drafting

This section is intended to provide the user with an introduction to the Terrain Module mapping and drafting functions. No special knowledge of surveying or mapping is required other than some basic familiarity with scales and coordinates.

To do the examples in this section the *Mapping and Drafting, Import Basic and Export Basic* function groups must be enabled.

Scaling Maps: Park Map Example

Note: See Getting Started section for file install folders **<Terrain>** and **<Defaults and Layouts>**)

1. File | Open <Terrain>\CAD**park map.terx**

The Terrain Module works with natural scales. A natural scale of 1:5000 indicates 1 unit on the paper drawing = 5000 units on the ground. If working with mixed unit scale such as 1" = 200', then it must be converted to a natural scale before using it with Terrain (1":200' is the same as 1": 2400" i.e., a natural scale of 2400).

2. View | Change scale in Scale Box to **25,000**. Activate the Plan Window by clicking on the Title Bar. Experiment with the scale setting it to **15,000**, then change the scale to **25,000** and press <Enter>.

Notice the change in the screen view. Changing scales adjusts the size of map features. Labels, line-types and symbols are not adjusted and remain the same size. When creating a drawing, it is important to set the scale to the required output scale before adjusting label positions.

3. Your screen should look like the Figure 3-1. If it does not, maximize your Plan window.

Note: Zooming functions magnify (or shrink) the entire drawing including labels, symbols and line-types when the *Scale Lock* button is depressed or locked. When it is not depressed the scale will change but the labels, symbols and line-types will stay the same size.

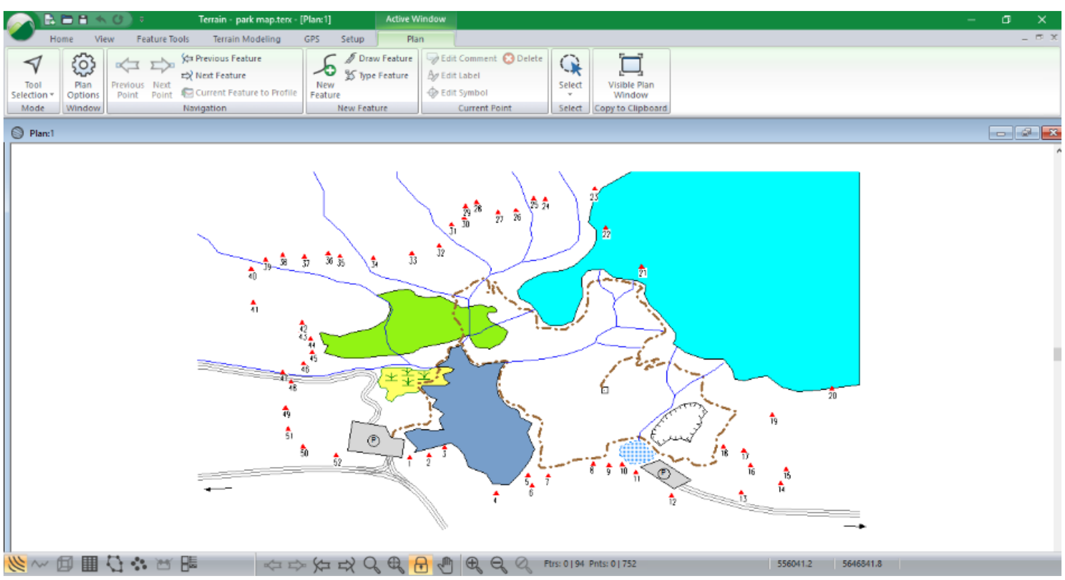


Figure 3-1*:* File *park map.terx* open in Terrain Tools

4. Turn on labels: Plan | Plan Options, select the Labels tab from within the Plan Window Options dialogue.
5. In the list of available Label options, double-click Feature Name. Press OK.

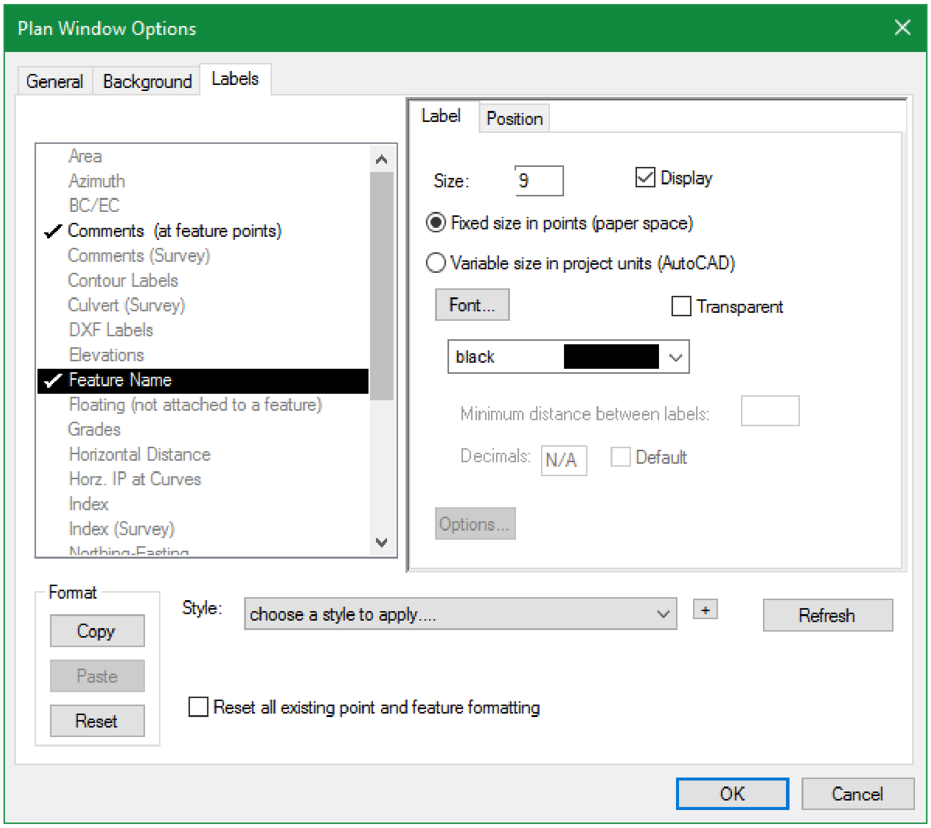


Figure 3-2: Plan Window Options - Label Control

This will have added Feature Names to every feature in your map.

6. With the Scale Lock button depressed (orange), click on the View | Zoom 200% or (Magnification Double) button and Zoom 50% button / (Magnification Half) button several times. Notice that the label and line sizes change but the scale remains the same. You can also use the mouse wheel to zoom in and out.
7. Turn off the Lock Scale button Repeat the above step. Notice that the windows toolbar buttons: Magnification Double button the scale halves and the Magnification Half button the scale doubles. Labels and line-types stay the same size as the scale changes.
8. With the scale unlocked zoom in then lock the scale. This will keep the labels a size that will not interfere with the drawing.
9. File | New to close **park map.terx**. Do not save any changes.

Drawing Features

Drawing Features Using the Mouse – Method One

There are three modes used to create and edit points on a feature.

Entry mode – New points are inserted at either end of the current feature.

Insert mode+ - New points are inserted in between existing points.

Edit mode- Existing points are edited.

This example demonstrates basic drawing operations using the mouse. Edit and entry modes will be used to draw and modify a feature.

10. File | Open <Terrain>\CAD**drawing.terx**.

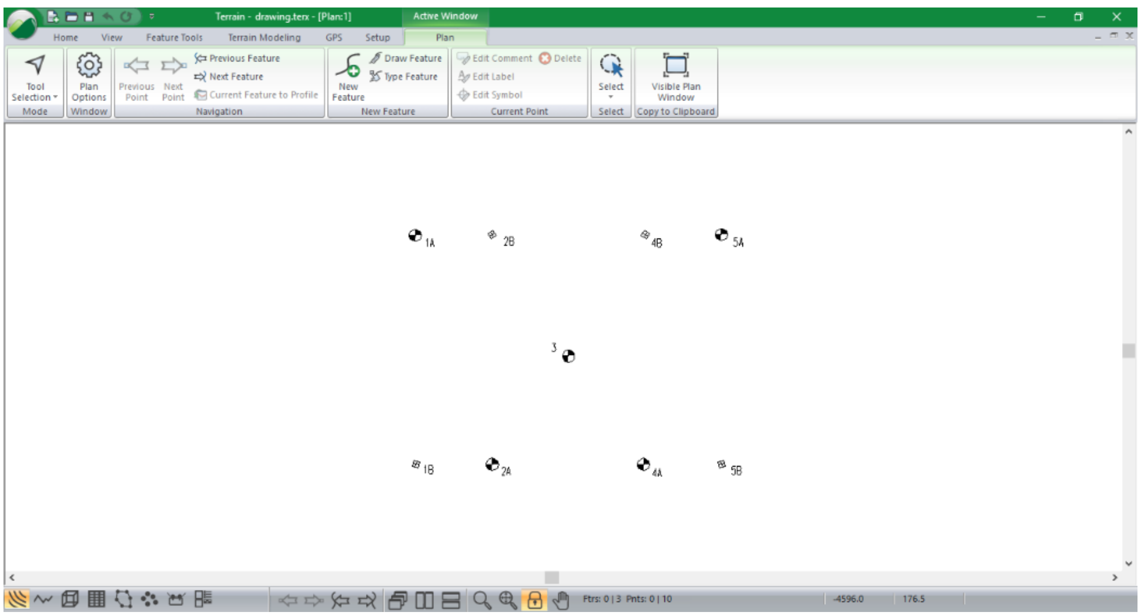


Figure 3-3: File *Drawing.terx* Open in Terrrain Tools

11. We are going to create a new feature using Plan | New Feature button.

12. From the dialog, select the Mouse button.

The Entry mode cursor appears in the Plan Window indicating that a mouse click will create the first point of your new feature. The menu *Edit-New Feature* provides an alternate method.

Note: Features can also be created *Plan* | *Draw Feature* button | *Mouse* button. Boxes *Displayed*, *Connected*, *Modelled* boxes should be *checked*.

Without *Elevations* box selected the line will be at the elevations of the existing points this is known as a *draped* feature. If the *Elevations* box is selected, the line can be drawn in at any elevation.

Over the next few steps, we will create the drawing as shown in the figure below:

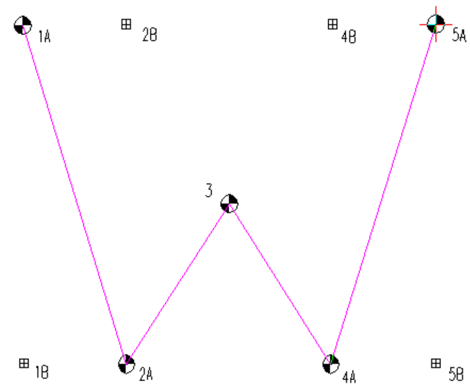


Figure 3-4: Creating a New Feature

Steps to create the drawing:

13. To make this easier (and more precise), we will first turn on the 'Snap to point/line'. Select the Plan | Plan Options button. On the general tab of the Plan Options dialog, check Snap to point/line. Press Ok.
14. Locate the symbol labeled "1A"; move your mouse cursor over it. Left-click on point, a new point is created and the cursor changes to a cross. The red cross-hair representing the position of the new point is tied to the mouse – we say the point is captured. Notice that the snap cursor appears.
15. Join the points by left-clicking and snapping to "2A":
16. Join point 2A to 4A by left-clicking on point 4A.

Note: To undo any point, use the *undo arrow* button on the left-hand side at the top of the screen or <*ctrl* + *Z*>.

Your screen should now look like Figure 3-5.

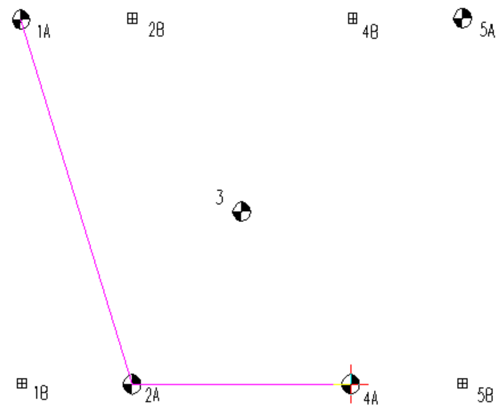


Figure 3-5: Drawing With The Mouse

17. Move the cursor over the line segment between 2A and 4A. Notice the cursor changes to the insert cursor . Left-click to insert point somewhere in the middle between 2A and 4A.

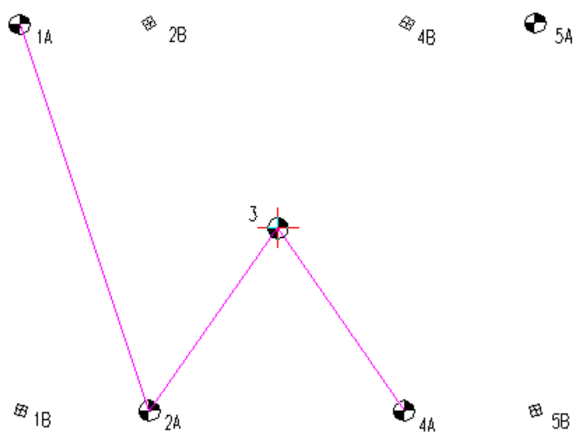


Figure 3-6: Inserting a Point at the Middle of a Segment

18. Move mouse upwards to point 3, and left-click to anchor the new point.
19. Move the cursor over the point labeled 5A and left-click twice to add a new point.

You should now see a 'W' as shown in the figure below.

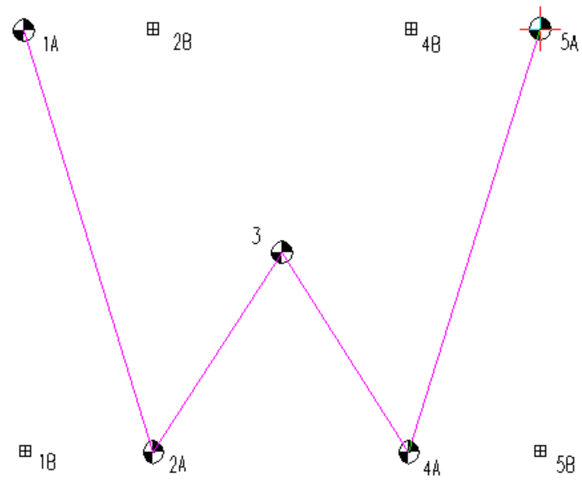


Figure 3-7*: Completed W, Points Connected With Mouse*

20. Try to change the 'W' to an 'M' as in the figure below:

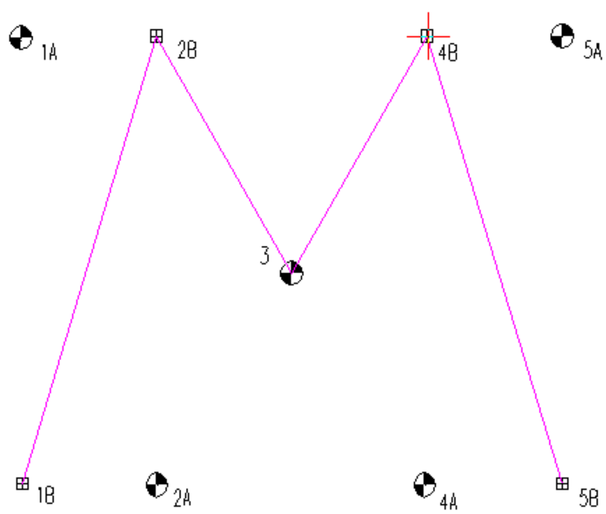


Figure 3-8*: Completed M Connected With Mouse*

21. If required, the steps to create this drawing Figure 3-8 are:
22. Move the Entry mode cursor over "1A". The entry mode cursor changes to edit point mode and the Edit cursor now appears over 1A.
23. Left-click over symbol "1A", the cursor will attach to the line segment.
24. Move the Edit cursor over symbol "1B" and left-click again. This will attach the line segment to this point.
25. Repeat the above steps moving points "2A to 2B, 4A to 4B, and 5A to 5B".

Note: When a point is captured it can be released by pressing the <***esc***> key and deleted by pressing the <***delete***> key. If the point is anchored and the <***delete***> key is pressed the entire feature will be deleted.

26. File | New, do not save changes. Continue to the next tutorial.

Drawing Features Using the Mouse & Keyboard: Method Two

This example demonstrates an easier method to draw a new feature using the mouse.

1. File | Open <Terrain>\CAD**park map.terx**. Click on the Zoom Extents button in the windows toolbar.

The *Plan Window* now displays triangular symbols with index stations 1 to 54. These index stations are surveyed points along the boundary. The following steps demonstrate how to trace the park boundary by "connecting the dots".

Note: Turn on *Snap to Point/line*: *Plan* | *Plan Options* button |*General* tab | *Check* box *Snap to point/line*. When a new point is created, or an existing point is edited, the nearest point on an adjacent feature is also selected if it is within a minimum distance (2 mm).

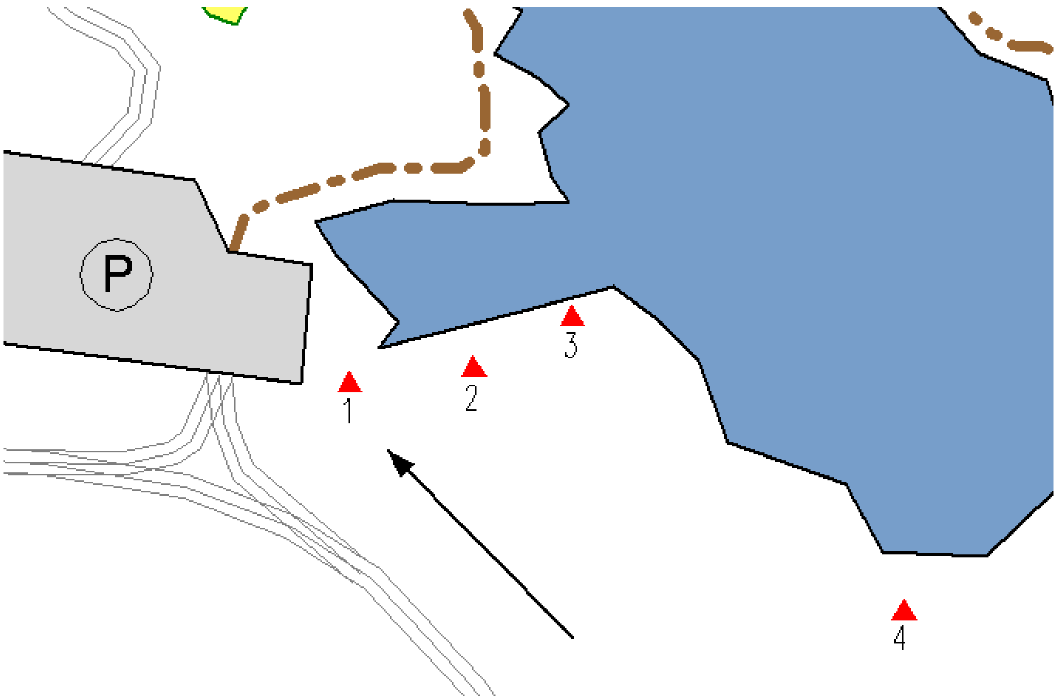


Figure 3-9: Boundary Starting Point

2. On either the Plan tab or the Home tab, select Draw Feature.
3. Position the cursor over the center of station 1 (indicated with the arrow in the figure above) and press the number 5-key on the number pad or if your computer does not have a number pad use the letter S. A new point should be created at the cursor position. If this does not happen, check that Num Lock on the keyboard is on.
4. Move the cursor to Station 2 and press the 5-key on the number pad (or S Key). A new point will be created at the cursor position. Continue adding points around the boundary until it is closed. In case of a mistake use the edit function as described below to correct the problem.

Note: To change the location of an anchored point, move the entry cursor over the desired point until the cursor changes to the edit cursor and *left-click*. Once the point is captured press the <delete> key to delete the point. Pressing the <Esc> key will restore the point to its previous location provided that the new point has not already been anchored. If the point needs to restored even after anchoring, use the *undo arrow* button or <*ctrl + Z*>.

5. If you have created a new feature with elevations (Feature Tools | Feature Properties button), it is possible to enter elevations using the following key definitions.

5 or *S*	Same elevation as previous point. This may be overridden by Snap to Point including Z.
8 or *U*	Up 1 contour interval. This may be overridden by Snap To Point including Z.
2 or *D*	Down one contour interval. This may be overridden by Snap to Point including Z.
Ins or *E*	Manually enter co-ordinates including elevation

6. File | New. Do not save changes.

Selecting Features

A feature is a collection of points such as a contour line, a lake boundary or a single spot elevation point. Bitmap images are also considered to be features (in this case the corners of the bitmap are the feature points).

A *Terrain document* is a collection of features. Each feature has a unique name consisting of an 8-character *Alphanumeric Id* portion and a *Numeric Id* example ROAD-21. It is possible to have more than 1 feature with the same Alphanumeric ID such as STREAM-1, STREAM-2 etc.

Note: Feature names are not case sensitive "F1" = "f1".

The next several examples demonstrate how to select features by layer, name, range, property, boundary, or by using the mouse.

Selecting Individual Features with the Mouse

1. File | Open <Terrain>\CAD**park map.terx**
2. Add the Feature Properties panel to your screen. Press the from the bottom status bar.
3. Move the Selection cursor , over one of the stream features in the Plan Window and left-click with the mouse. The stream feature should change color from blue to magenta (indicating that it is selected). Notice in the lower right corner the Name of the feature is displayed (STREAMCx-xx). Additional details on the feature are displayed in the Feature Properties panel including name, properties (displayed, connected, modelled etc), symbols, line-types etc.
4. Select another feature. Notice when a new feature is selected, the previous feature is de-selected. The information in the window also changes to reflect that of the new feature.

Selecting Groups of Features with the Mouse

5. Hold down the <Shift key> and left-click on a new feature. Notice that the previous feature remains selected. Use this technique to select several more features.
6. With several features selected, press the delete key on the keyboard or select Feature Tools | Delete. The features are deleted and disappear.
7. Press <ctrl + Z> or the undo arrow in the top left bar. Left-click in any blank area on screen to de-select all features.
8. Depress the left mouse button and move the mouse any direction. Notice a rectangle is formed from the position where the mouse was first clicked. Release the left button. All features inside (or crossing) the rectangle are now selected.
9. Hold down the <Shift key> and left-click on one of the selected features. This feature is de-selected, and the other features remain selected.
10. Left-click in any blank area on screen to de-select all features.

Selecting All Features

11. Plan | Select button | All Features **or** Right-click… | Select Features > All.

Inverting Selection

12. Hold the <shift> key down and left-click to de-select one of the features
13. Plan | Select | Invert Selection. Feature(s) previously selected are now un-selected and all feature(s) previously un-selected are now selected. In this case one feature will be selected and the rest will be de-selected.
14. Proceed to Step #2 in the next section, Selecting Features by Layer, or exit the program by selecting File | New. Do not save any changes.

Note: One of the selected features contains a red cross-hair. This indicates the *current point.* The feature containing the *current point* is the *current feature.* Information about the current feature and current point are displayed in the Status Window.

Most operations in the Terrain Module apply to a selected set of features or points such as formatting, moving, deleting etc.

Selecting Features by Name

1. File | Open <Terrain>\CAD**park map.terx.**

Note: Terrain Recreational users may get the message "Non-Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

If you are continuing from the previous example, select undo arrow in the top left bar .. Left-click in any blank area to de-select all features.

2. Plan | Select Button |By Name from dropdown or Right-Click | Selected Feature(s) > By Name…

3. Within the Select feature(s) by name dialogue box press the Advanced... button |Type "**Survey**" in the Select Matching Names | Select button. 52 items should come up as Selected. Press OK. The Selected features(s) by name dialogue box should appear as in Figure 3-10.

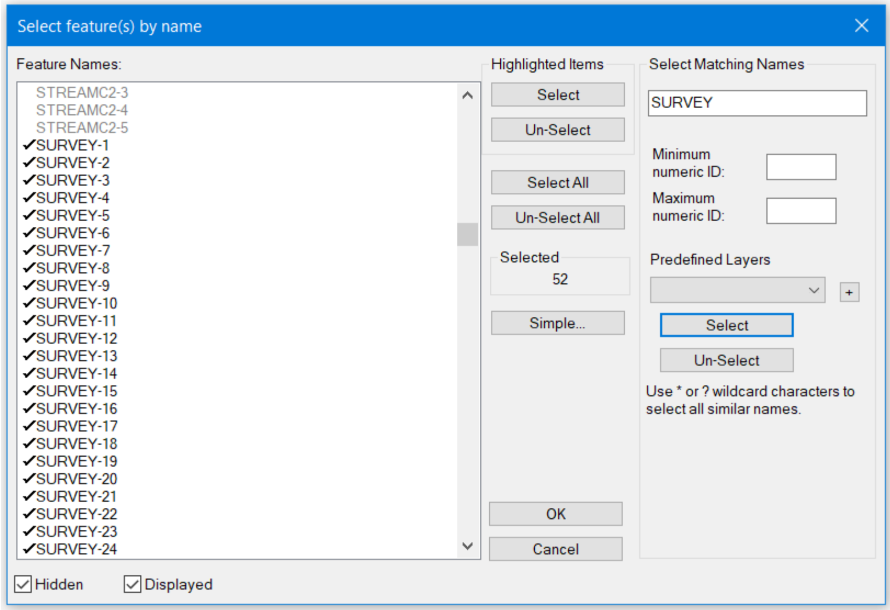


Figure 3-10: Select Feature(s) by Name Dialogue

4. If you scroll down on the sidebar you will see that many triangle features are selected and highlighted in magenta. These features have the name SURVEY. See Figure 3-11.

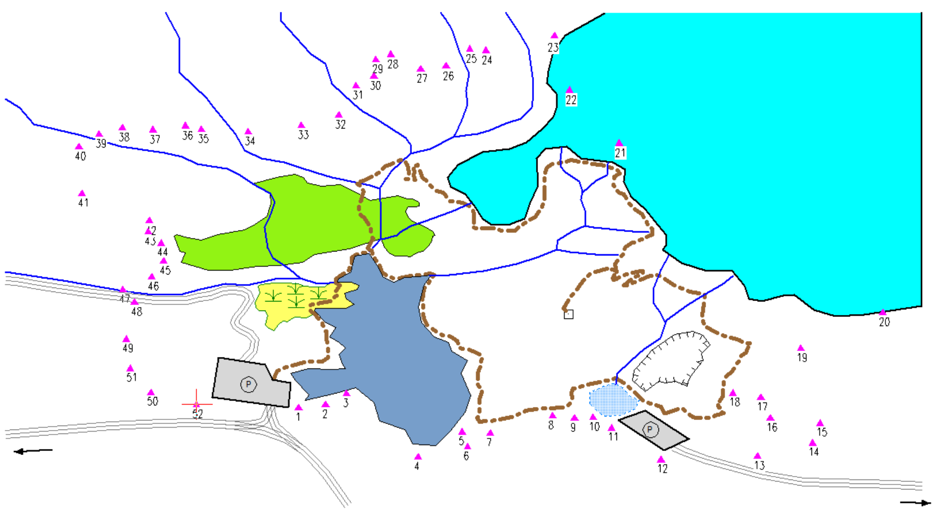


Figure 3-11: Triangle Features Highlighted in Magenta

5. File | New. Do not save any changes.

Selecting Features by Layer

Each feature has a unique ID. This name can be used to organize a map into different layers. For instance, in Park Map all Class 1 streams have been named STREAMC1 and Class 2 streams as STREAMC2. These names can be quickly used to select all Class 1 streams, Class 2 streams, or all streams.

1. File | Open <Terrain>\CAD**park map.terx**.
2. Home | Select | By Layer from dropdown. The Select Features by Layer dialogue box is shown below.

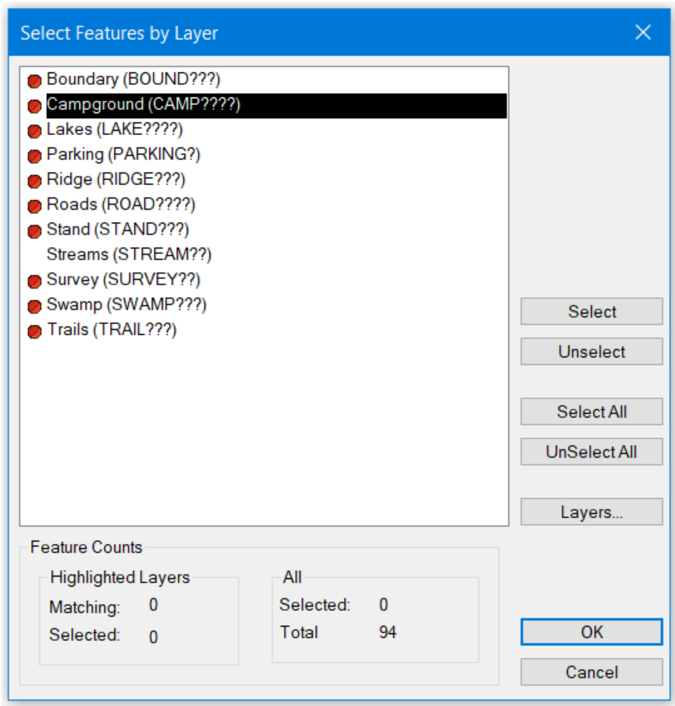


Figure 3-12: Select Feature by Layer Dialogue Box

3. Press the Un-Select All button to de-select all features.
4. Select Streams (STREAM??) in the list-box and then press the Select button. The information in the Feature Counts changes indicating that 13 of the 94 features are streams. Press OK button to return to the main screen. The 13 selected streams are highlighted in magenta.

Note: Features can also be selected or de-selected by double-clicking with the left mouse when the cursor is over the feature name in the dialogue box.

5. To create a new layer for the Class 1 streams: Home | Select | By Layer. Opens the 'Select Features by Layer' dialogue box.
6. Within the 'Select Features by Layer' dialogue box. Press the Layers... button to bring up the Layers dialog shown below:

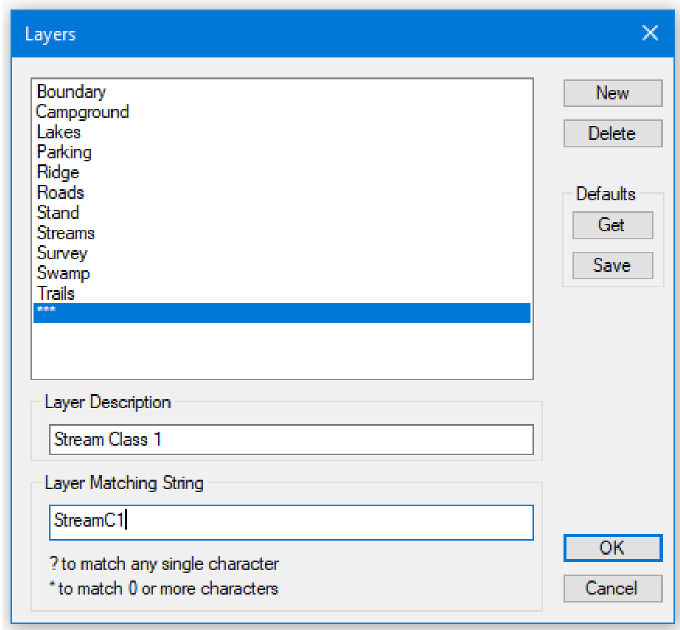


Figure 3-13: Add/Remove Layers Dialogue

7. Press New. Fill in the fields, Layer Description: "Stream Class 1". Layer Matching String: “STREAMC1”. Press OK to return to the Select Features by Layer dialogue. Note that the new Layer Stream Class 1 has been added.
8. Home | Select button | By Layer in dropdown list. Press the Un-Select All button to de-select all features. Select Streams Class 1 in the list-box and press the Select button to select all Class 1 stream features.
9. Look at the Streams item. Note the grey check mark beside Streams. This indicates that only part of the STREAM layer has been selected. Press OK to return to the main screen.

Turn off the display of all features except the STREAMS:

10. Home | Select | By Layer from dropdown list. Press Unselect All. Double-click on Streams (STREAM??) | Press OK.
11. Home | Select | Invert Selection. This will this will switch the selected and unselected features so that all features are now selected except the streams features.
12. Feature Tools | Feature Properties | uncheck Displayed box. Press OK to return to the main screen. You can also use the Feature Properties panel to uncheck Displayed (press Apply).
13. All the features are still displayed. Click on a blank area of the screen (where there are no features) to de-select all features. If any highlighted features still remain: View | Repaint All button.

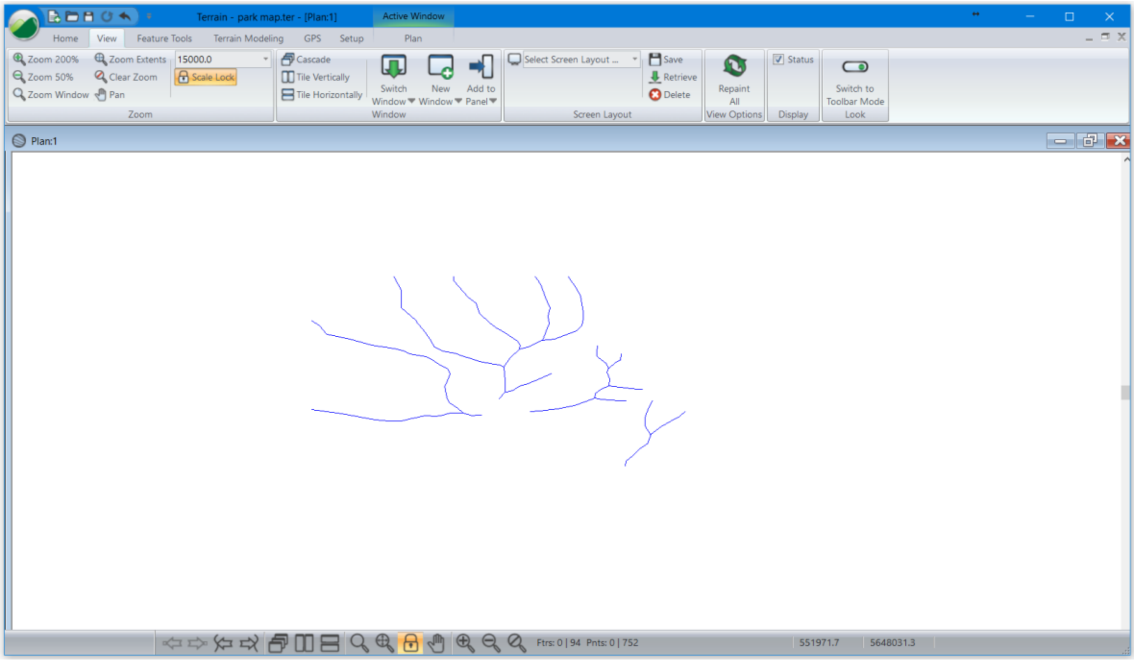


Figure 3-14: Streams Layer

14. File | New. Do not save any changes.

Line-types

1. File |Open <Terrain>\CAD**park map.terx.**

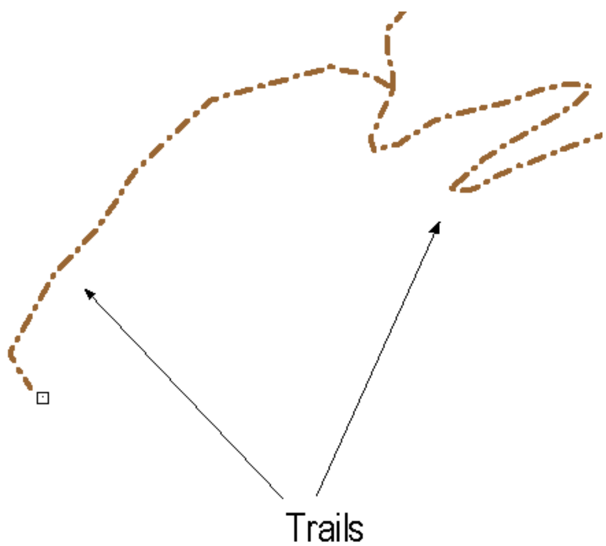


Figure 3-15: The Trail Features of *park map.terx*

2. Dashed lines identify the trails in Park Map (see figure above). Hold down the <Shift> key, then with the Select cursor left-click on each of the trails. Use zoom and screen scrolling to see all the trails.

If a wrong feature is accidentally selected, de-select by clicking again on the same feature with the shift key still depressed. To start again left-click in a blank area to de-select all features.

3. The trails could also have been selected: Plan | Select button |By Name from dropdown. Unselect All button. Highlight (or double-click) on all the TRAIL-? features, then press Select. Press OK to exit the dialog.

We will adjust the line type for all the trails:

4. Feature Tools | Line Types, Symbols **or** through the Feature Properties panel. Change line-type: from 43 Dash Dot to 44 - Dash x 2 (narrow). In the panel, press Apply. Left-click anywhere in the Plan Window to de-select trails.

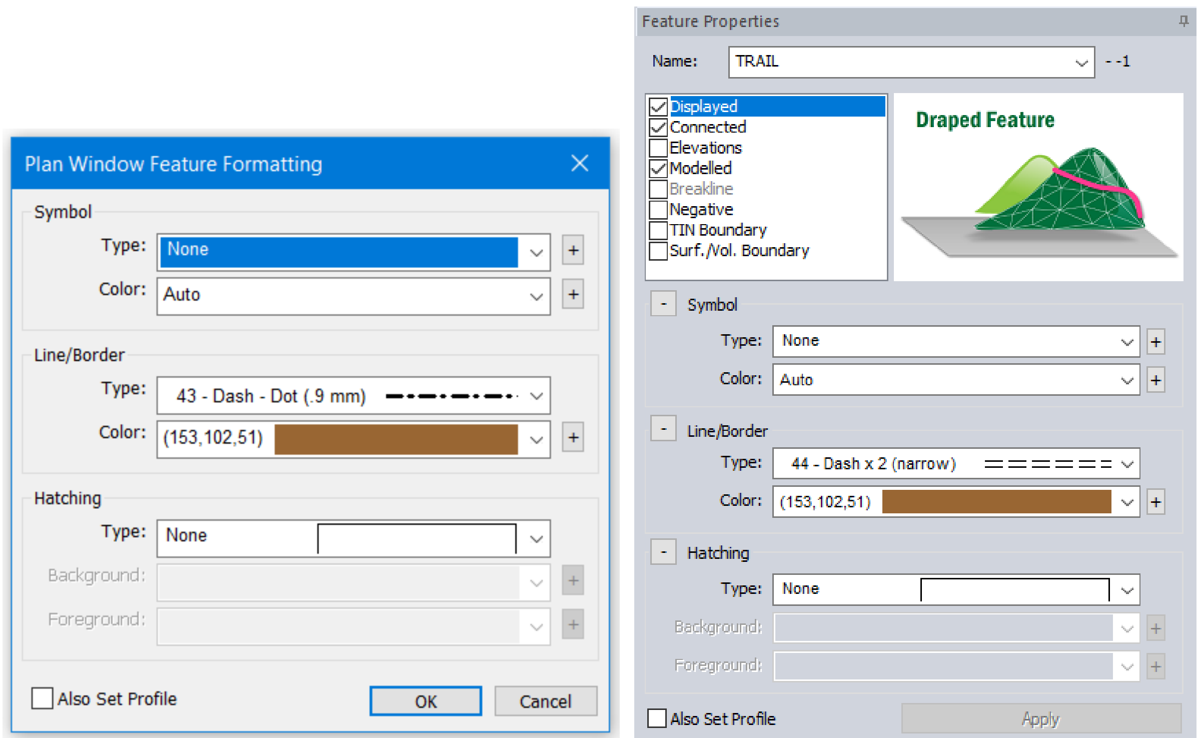


Figure 3-16: Two Ways to Edit Line-types and Symbols:
Line-Types, Symbols Dialogue and the Feature Properties Panel

5. Proceed to step #2 in Adding Symbols or File | New to exit the program. Do not save changes.

Symbols

1. File | Open <Terrain>\CAD**park map.terx**.

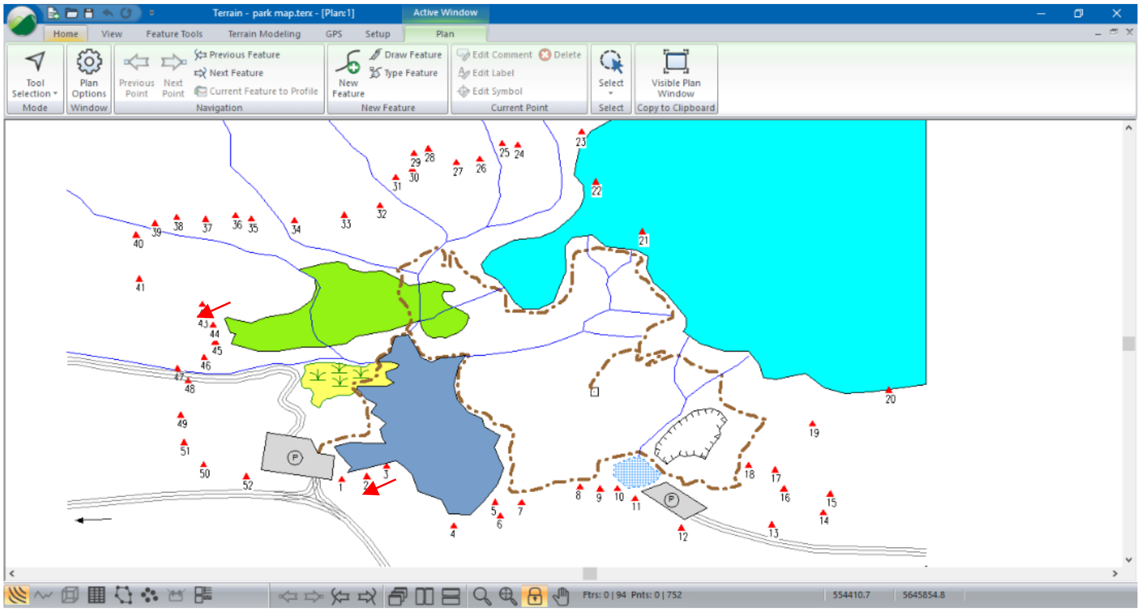


Figure 3-17: Red Arrows Depicting Campground Locations

2. Plan | New Feature. Select **CAMP** from Name drop down list. Uncheck Elevations and Modelled as shown in the figure below. Press Create Using Mouse.

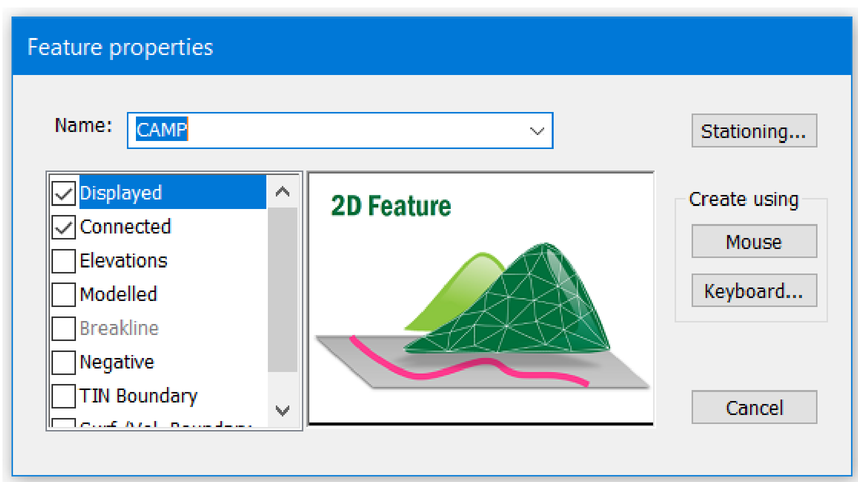


Figure 3-18: New Feature Properties Dialogue

3. Move the  cursor to one of the campground locations as indicated by the two red arrowheads in the figure at the start of the exercise and press the left mouse once to create (and capture) a new point. Left-click again to anchor the new point.

4. Change the symbol to campground: Right-click | Modify Selected Feature(s) | Linetypes, Symbols... In Symbol Type: Campground. Press OK to return to the main window.

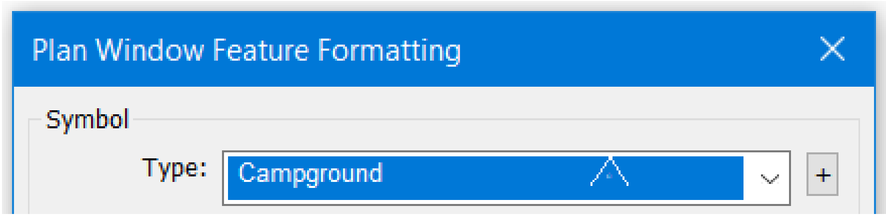


Figure 3-19: Campground Symbol Selection Dialogue

The following steps will duplicate this symbol at the other campground locations.

5. With the campground symbol still selected, Home | Copy | or press <Ctrl +C> to copy it.
6. Home | Paste or press <Ctrl +V>. This will paste the campground symbol right on top. You can determine if there is more than one feature by clicking on the center cross and a textbox will appear listing the features.
7. Move a symbol, to the new location: Feature Tools | Move, Size, Rotate or by pressing <Ctrl + M>.
8. Move the cursor on top of the symbol until a 4-sided arrow icon appears. Left-click and drag the copied symbol to the other location.

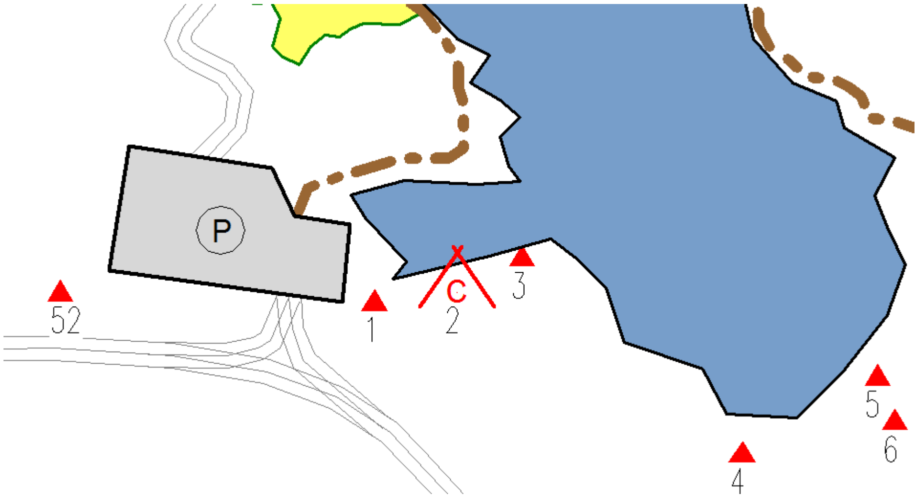


Figure 3-20: Park Example with Campground Symbol

9. Proceed to Step #2 of the next example or exit the program by selecting File | New. Do not save changes.

Creating a Boundary Polygon

To do this example the *Mapping and Drafting, Import Basic and Export Basic Enhanced Mapping and Drafting* must be enabled. See *Function Groups* in the On-line help for more information.

1. File | Open <Terrain>\ CAD**park map.terx**. If continuing from the previous example, left-mouse click in a blank screen area to de-select campgrounds.

2. Open the Select feature(s) by name dialog: Home | Select button | By Name from dropdown list.

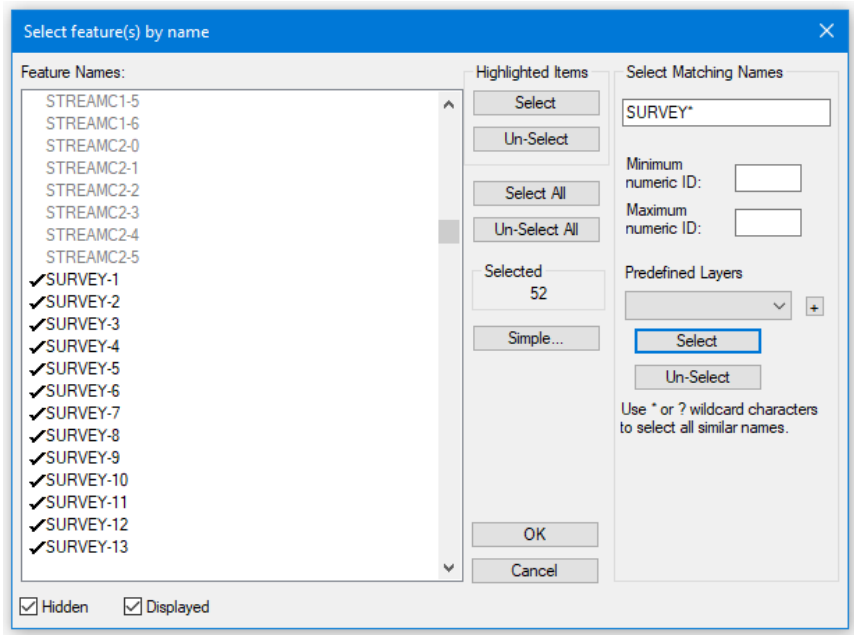


Figure 3-21: Select Feature(s) by name Dialogue

3. Press Advanced... and type SURVEY* into the Select Matching Names area as shown in the figure above. Press Select in the Select Matching Names area. Press OK.

Many triangle features are selected. These features have the name SURVEY. To connect features, they need to have the property *Connected* enabled.

4. Press the Feature Properties Panel  button in the windows toolbar (or Feature Tools | Feature Properties). Check Connected box, press Apply.
5. Feature Tools | Join. All the selected features will be joined.
6. Feature Tools | Line Types, Symbols. Change the Line/Border Type: 5-thick (medium) and change the Symbol to Type: None. Press OK.
7. Feature Tools | Close. The boundary will close and the map should look like the figure below.

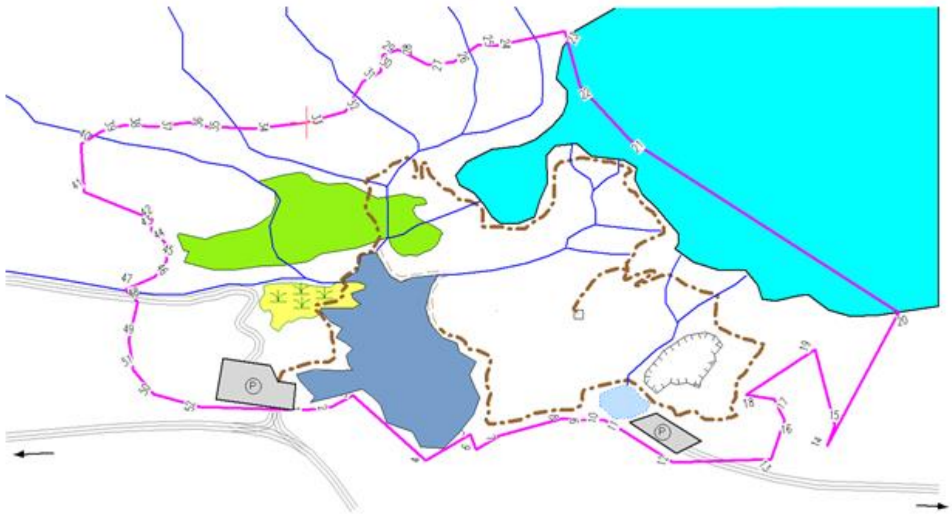


Figure 3-22: Park Boundary

Labels

There are two types of labels used in the Terrain Module, *Feature Labels* and *Floating Labels*.

- ***Feature Labels*** are labels associated with a feature. *Elevation*, *Azimuth*, and *Distance* are all examples of automatic labels. Point or feature attributes such as *Comments*, *Date, Point Numbers* etc. are Feature Labels. Whenever a feature is edited or deleted feature labels are modified accordingly.

- ***Floating Labels*** are simply user-defined text. They do not depend on any feature and can be placed anywhere and modified directly.

The default characteristics (position, font, size, orientation etc.) for each label class is controlled by window type (Plan, Profile etc.). For the Plan Window, these defaults are set in menu *Plan* | *Labels*.

8. Plan | Labels. Turn on Floating (not attached to a feature) by double-clicking on Floating Labels (not attached to a feature) and check the Display box.

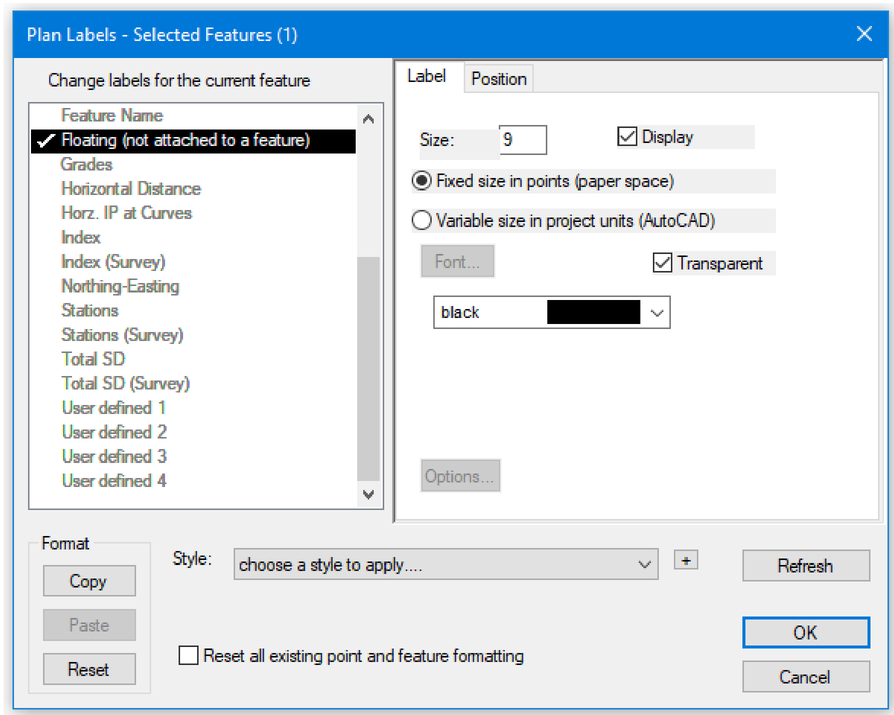


Figure 3-23*:* Plan Window Options- Default Label Format

9. Press OK to return to the main screen. The Plan Window will now look like figure below:

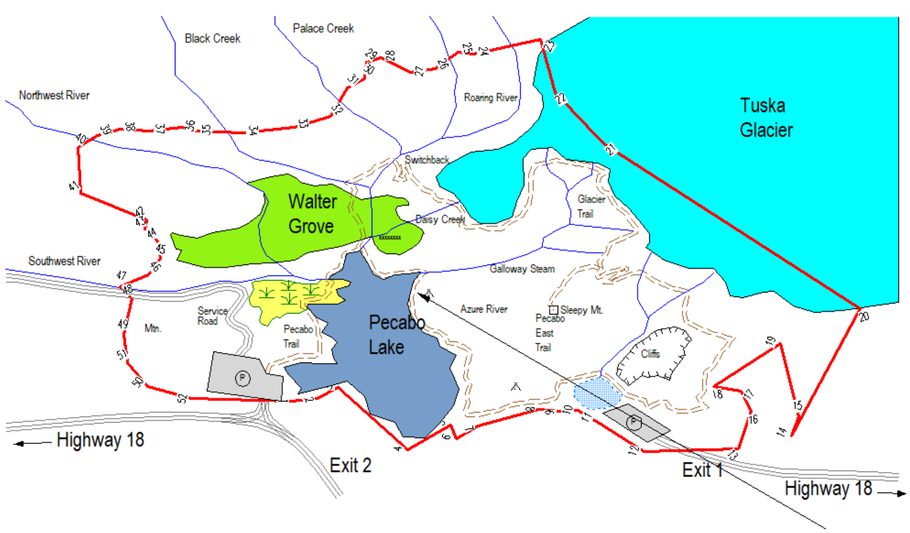


Figure 3-24: Plan Window with Floating Labels

It is often useful to override the default label positioning for individual features.

For instance, you may wish to turn on or off a certain class of labels for a specific feature. Label control of individual features is done using *Feature Tools* | *Labels*. We will use this function to turn off the labels in our boundary:

10. Highlight the park boundary with the Selection cursor.

11. Feature Tools | Labels. Turn off the display of Comments (at feature points), double-click in the list box or turning off the check box adjacent to Display.
12. Click the Refresh button. Press OK. We will now add a floating label to our park map.
13. Home | Tool Selection | Edit Labels with Mouse from dropdown.
14. With the cursor click on upper left corner of the map and enter the text ("Park Boundary"). See figure below:

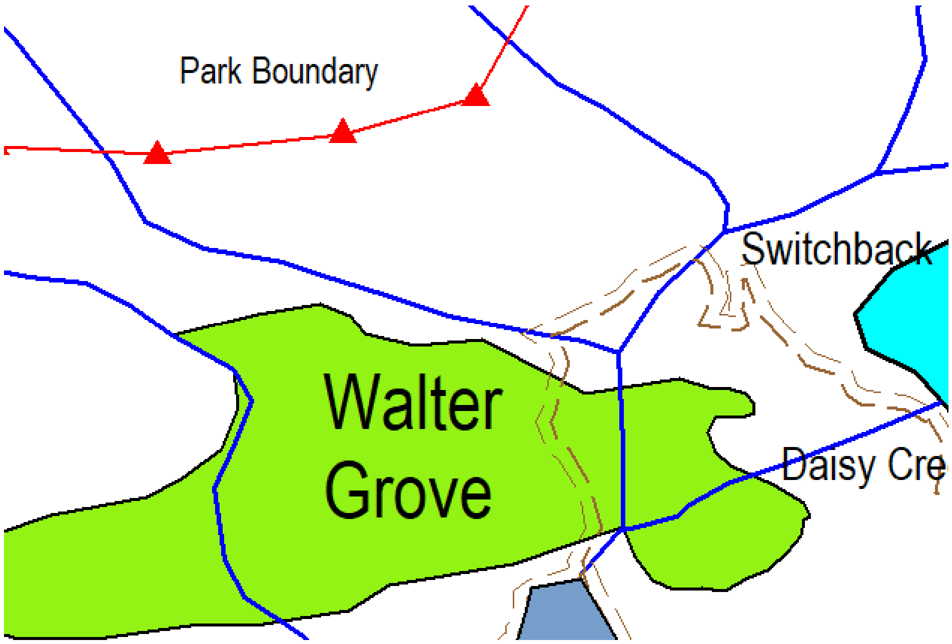


Figure 3-25: Plan Window Feature Formatting Dialogue Box

Note: The is referred to as the *Orientation handle* and the is referred to as the *Position Handle.*

To move the position of a label, move the cursor over the *Position Handle* (or any part of the label). Left-click and drag the label to a new location and release.

To rotate a label, move the cursor over the *Orientation Handle*. Left-click and pivot the label to the preferred position and release the left mouse when in the correct position.

Hatching

To complete the example, will be use hatching to shade the park area.

15. Highlight the park boundary with the Selection cursor.
16. Feature Tools | Line Types, Symbols. Use the following settings. Then press OK.
    - Symbols to Type: ***None***, Color: ***Auto***
    - Line/Border Type: ***0-Solid*** Color: ***Yellow (255,255,102)***
    - Hatching to Type: ***Solid (opaque)***. Foreground: ***Auto***

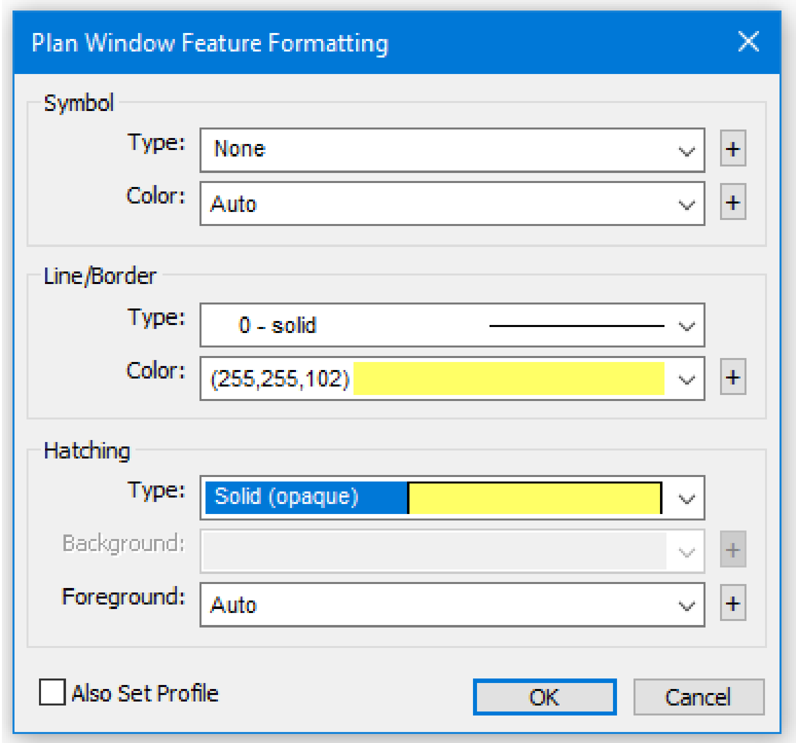


Figure 3-26: Plan Window Feature Formatting Dialogue Box

Note: (*255,255,102*) is a notation for Red, Green, Blue values. It is possible to create any color (supported by a graphics card) by clicking on the + button beside the color combo box and entering an RGB value.

17. With the boundary still selected, Feature Tools | Arrange Order | To Back.

At this point your map should look similar to the figure below. You may need to refresh (*View* | *Repaint All* button) or move your center wheel to see the changes.

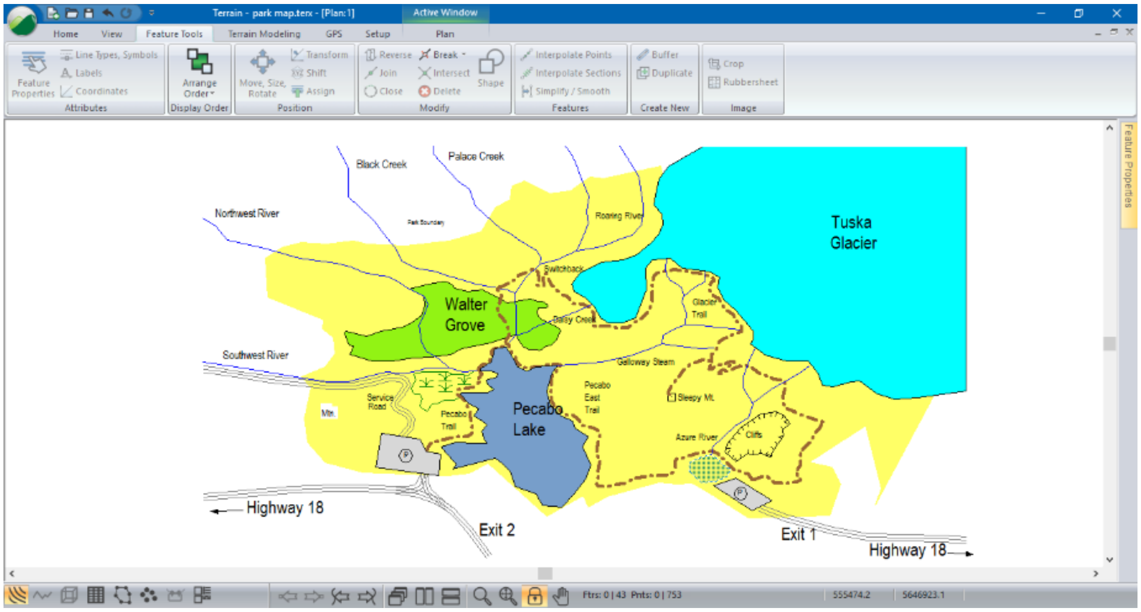


Figure 3-27: Map with Shaded Boundary Polygon

18. File | New. Do not save changes.

Creating an Output Sheet

This example is intended to familiarize you with the Multi-plot functions for creating an output sheet.

1. File | Open. Select <Terrain>\CAD\park map II.terx.
2. Press this Multi-Plot button in the status toolbar. A blank multi-plot page will appear.
3. Multi-Plot | Page / Printer Setup. Ensure the printer is setup for Letter size (21.59 x 27.94 cm or 8.5 x 11 in) and Orientation is Landscape.

Note: The Multi-Plot output setup depends on the paper size of your default printer.

4. Multi-Plot | Multi-Plot Options.... Check Snap to grid and Show grid and set the Spacing to 5.00 as shown in the figure below. Press OK.

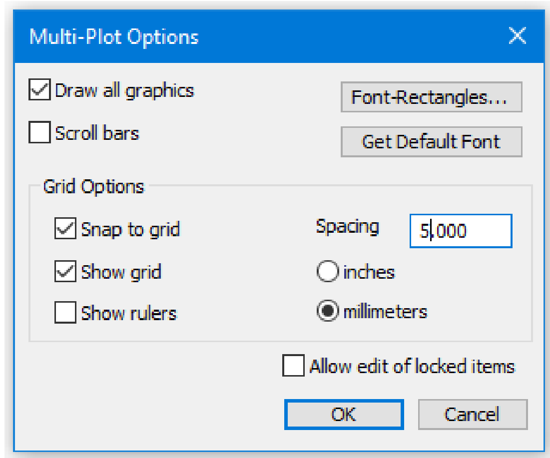


Figure 3-28: Multi-Plot Options

A Multi-Plot sheet consists of a series of *Sub-views* such as plans, profiles, legends, images, title blocks etc.

5. Multi-Plot | New Sub-View | Plan: 1. A Plan Sub-View will appear in the middle of your multi-plot sheet.

Note: Sub-view window options only allow you to add views that currently exist.

Notice that there are 8 handles that you can click and drag to change the size of the Sub-View. Click and drag anywhere else on the Plan Sub-View to move it. The <Delete> key will remove the selected Sub-View(s).

6. Resize and reposition the Plan Sub-View until it appears approximately in the top 2/3 of the output sheet (see Figure 3-30).
7. To center the map in the Plan window, press <Shift + Left Arrow >. A prompt as shown in the figure below will appear. Press OK and continue manually controlling the position of the Plan window using the <Shift + Arrow> keys.

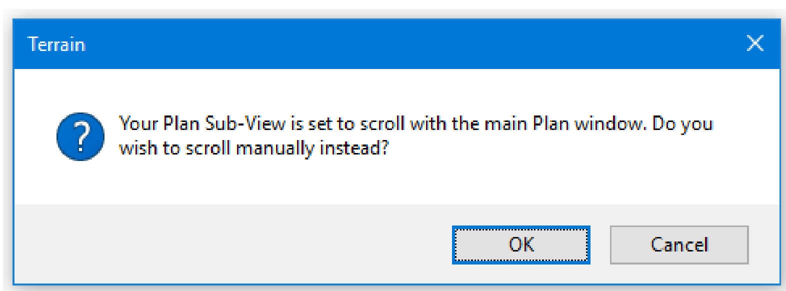


Figure 3-29: Plan Window Sub-View Manual Scrolling Prompt

Note: Positioning the map inside the Plan Window can be done using the <*Shift + Arrow*> keys. By default, the Plan Sub-View scrolls with the main Plan Window (menu Plan:1).

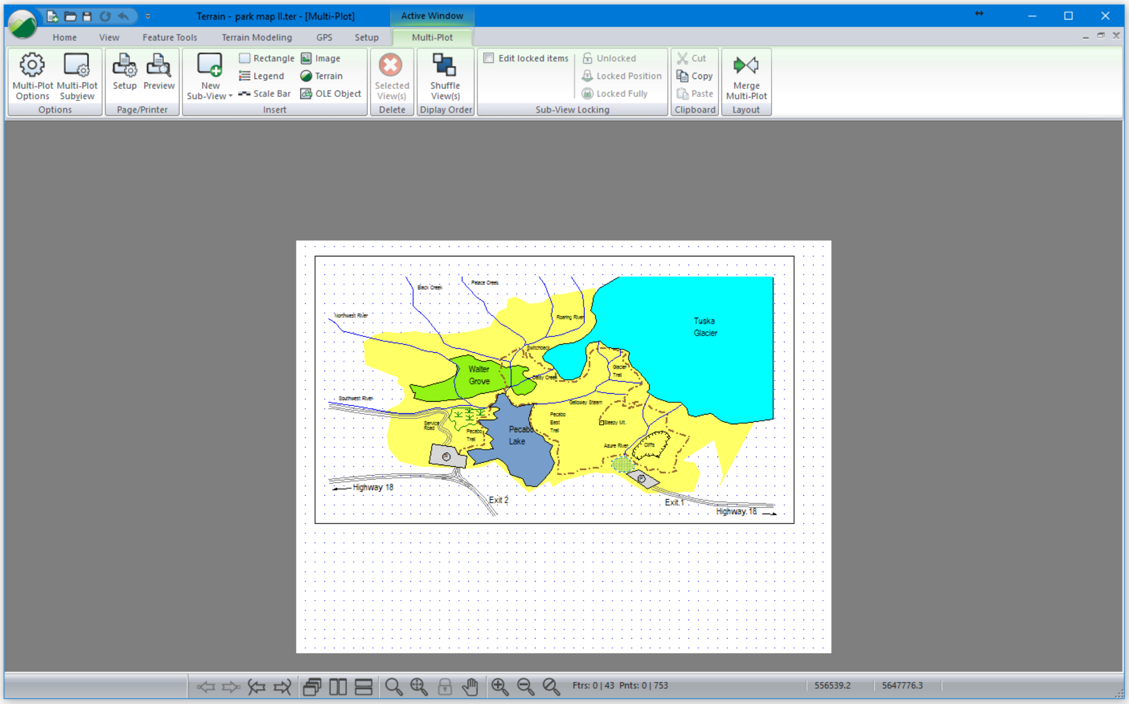


Figure 3-30: Multi-Plot Plan Sub-View of *plan1.ter*

Adding a Legend and Scale Bar

8. Multi-Plot | Legend. A legend will appear in the middle of your multi-plot sheet.
9. Double-click on the legend activate the Legend Sub-view Options dialogue box.

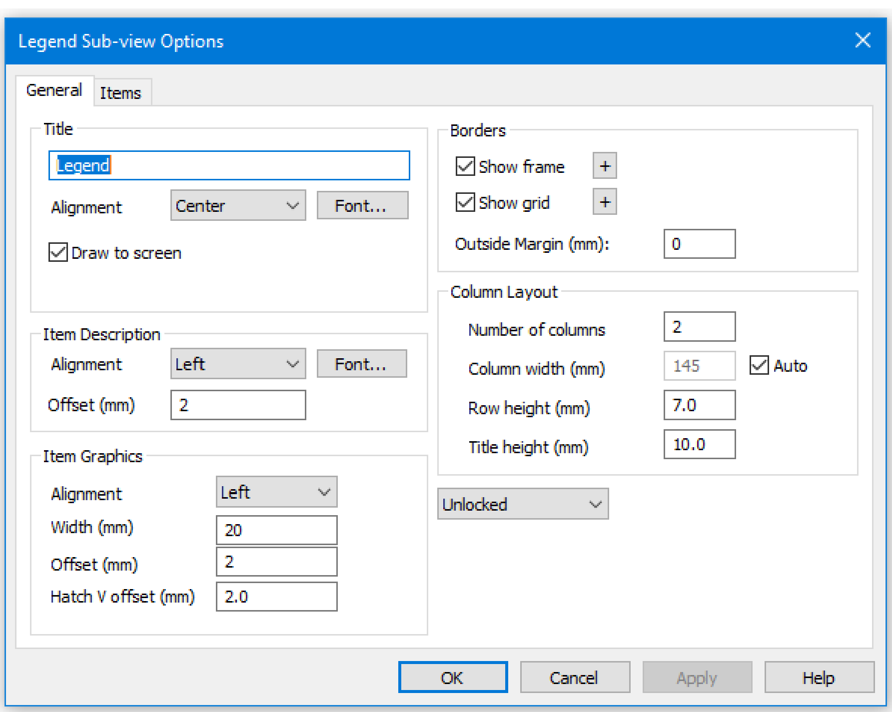


Figure 3-31: Legend Sub-View Options Dialogue

Note: When the *Auto* check box under column layout is enabled, the window frame size determines the width of the column. The frame can be made smaller or larger by clicking and dragging on any of the eight handles. If you disable the *Auto* option, the column width can be changed manually.

10. Ensure the Legend Sub-view Options dialogue box matches the Figure 3-31.

Note: When the Legend Sub-view is created, the current file is searched to find all distinct symbols, line-types, and hatch types. These items are included in the default legend along with their associated feature name.

11. To modify the legend entries, select the Items tab. We will remove all line-types that do not appear in the figure below. Change the descriptions to match the items on the right. Do this by clicking on the desired list item and then changing the Description in the Current item area. Press OK to close dialogue boxes.

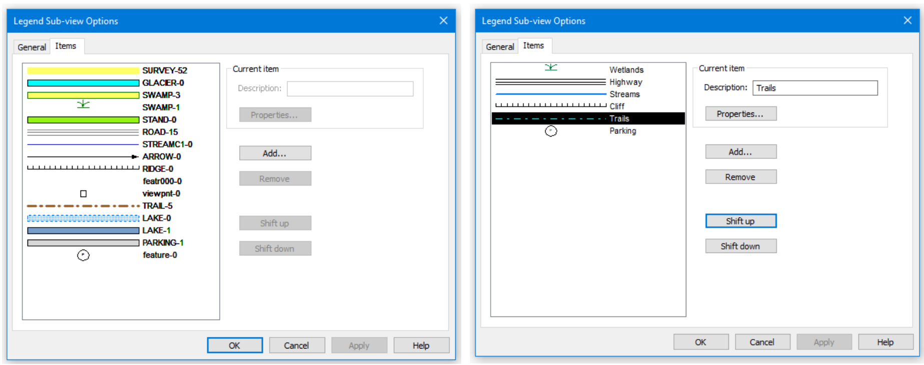


Figure 3-32: Legend Sub-View Options Dialogue Boxes

12. Re-size and re-position the legend directly below the plan sub-view and on the left side of the page as shown in Figure 3-32.
13. Multi-Plot | Scale bar. A scale bar will appear in the middle of your multi-plot sheet.
14. Right-click | Multi-Plot Sub-View Options**...** or double-click on the scale bar to activate the Scale Bar Sub-view Options dialogue box.

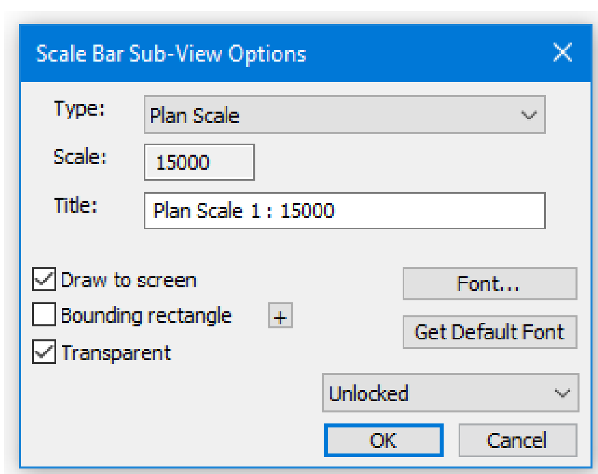


Figure 3-33*:* Scale Bar Sub-View Options Dialogue

15. Type in the Title: **Plan Scale 1:15000** as shown above and press OK.

16. Re-size and re-position the scale bar inside the Plan sub-view. If you click on the Plan Sub-View by mistake the scale bar will be shuffled to the back and you will no longer be able to move or size it with the mouse; use the Multi-Plot | Shuffle View(s) button or use Ctr +K.

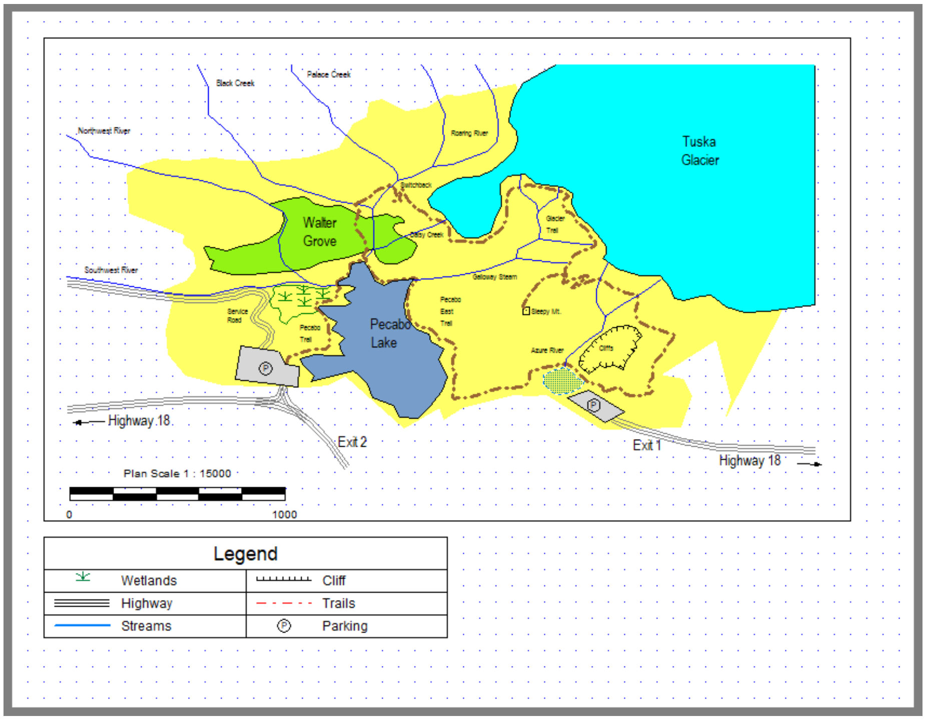


Figure 3-34: Final Multi-Plot Output

17. Multi-Plot | Insert Rectangle.

- Keep the text type as *User-Defined*.
- In the Text field type in the text "***PARK MAP EXAMPLE***"
- Change font size to ***18*** and ***bold***. Press *OK* and position the sub-view as shown in Figure 3-35.

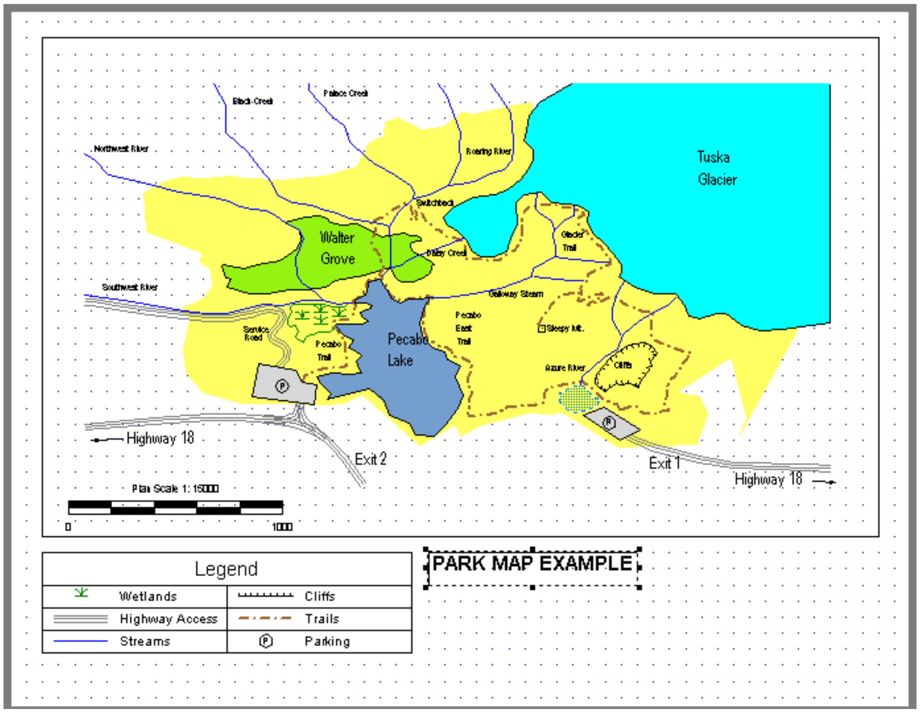


Figure 3-35: Multi-Plot Rectangle

18. File | New. Do not save changes.

4. Images

Digital images (or bitmaps) can be used to enhance the visual impact of a map or drawing. They can also be used to extract and/or represent geometric information. The Terrain Module allows you to import bitmap images in various standard formats such as BMP, JPG or TIF. To use images for mapping they must be *georeferenced*.

In GIS terminology, *Georeferenced* means 'tied to a specific geographic location on the earth'. A georeferenced image is one that has been scaled, rotated and stretched into position to correlate to a map projection. It may be an aerial photograph, a scanned paper map or a satellite image. What makes a georeferenced image distinct from other raster images is the inclusion of coordinate data used to locate its exact geographic position. This additional coordinate information can either be encoded in the image (e.g. Geotif), or as a separate "world" file (e.g. *.tfw).

Standard images (*.bmp, *.jpg etc) do not contain geo-reference information. However, images from mapping or GIS sources contain this information. If an image is not georeferenced, Terrain Tools can be used to create this information. This example will explore several methods for geo-referencing an image.

To do this example *Mapping and Drafting, Import Basic and Export Basic* function groups must be enabled. See *Function Groups* in the on-line help for additional information.

Scaling an Image

Real-estate Areas Example

In this example, we will measure a feature of known length on the image. The image will then be scaled (by setting the pixel size) so that the feature has the correct length. The image is not corrected for position and rotation.
We will provide options for both metric and English (feet) units. Use menu *Setup* | *Module Setup* | *Units* tab, if you want to change units.

Note: See **Getting Started** section for file install folders (**<Terrain>** and **<Defaults and Layouts>**)

1. File | New.
2. *Home* | *Insert File* button to open the *Insert File* dialogue box.

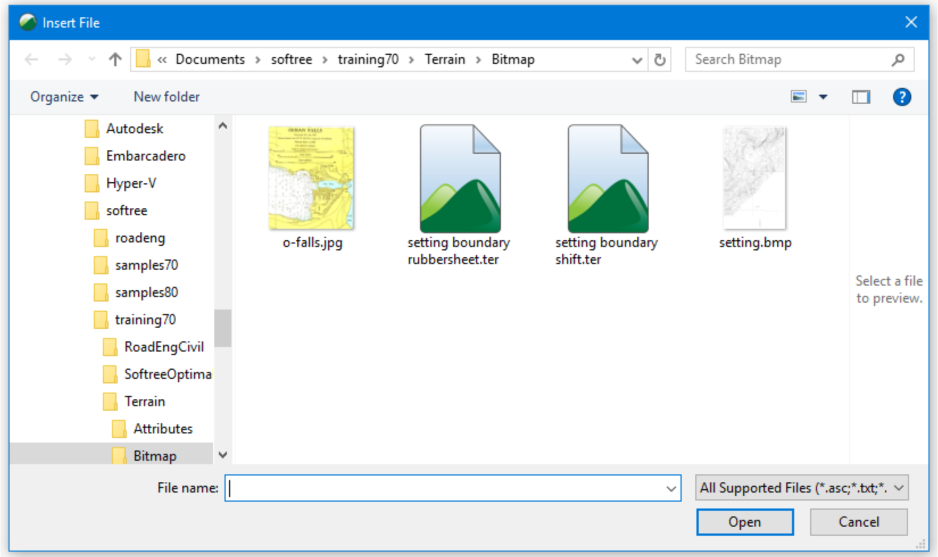


Figure 4-1: Insert File Dialogue

3. Ensure the file type drop-down is set to either *All Supported Files or Image Files (*.asc,*.txt, ...)* as shown in the figure above.
4. Select <Terrain>\ Bitmap**o-falls.jpg**. Press *Open*.

You will be presented with the *Import Options* dialogue box as shown below.

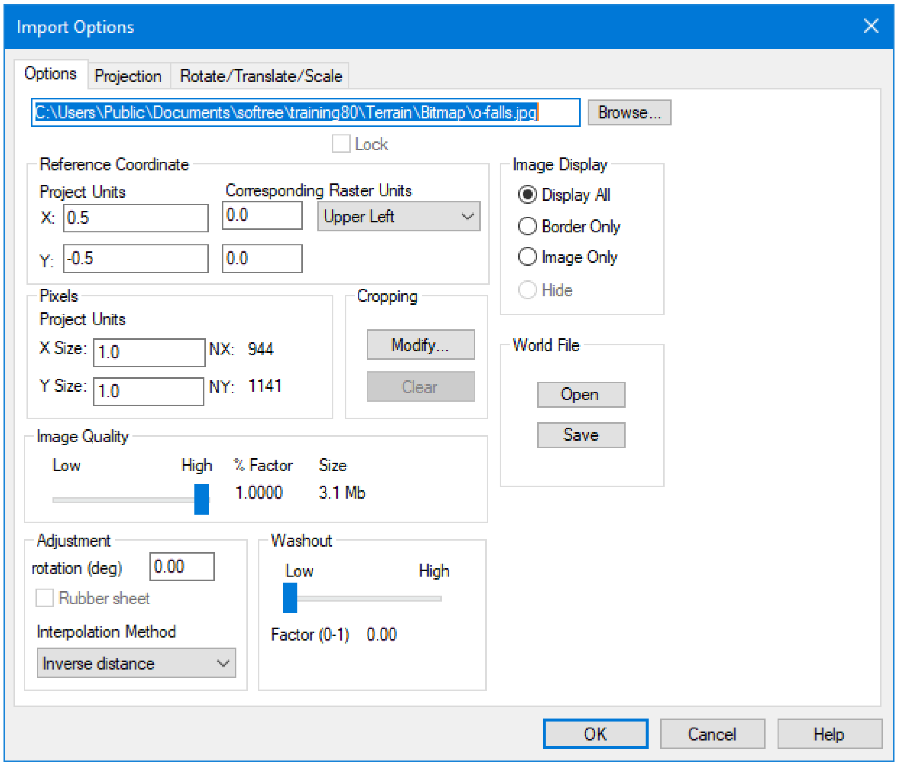


Figure 4-2: Image Import Options Dialogue
(Used to Geo-Reference and Scale Bitmaps)

The *Pixels* area is used for scaling the image.

Note: If the natural scale and the dots per inch (dpi) are known then the pixel size can be calculated using the following formula:

An image was scanned at 200dpi (dots per inch) and the natural scale is 1:12000. Hence:

$$\text{Pixel size} = \frac{1\text{map-inch}}{200\text{pixel}} * \frac{12000\text{inch}}{1\text{map-inch}} * \frac{25.4\text{mm}}{1\text{inch}} * \frac{1.0\text{m}}{1000\text{mm}}$$

$$= 1.524\ \text{m/pixel}$$

We won't change any of the import options – we'll determine pixel size later.

5. Press *OK* to import the image. And *OK* again if prompted by an import warning message.

The newly inserted image is selected; when an image is selected, the rectangle is hatched magenta.

6. Click outside the image to de-select.
7. View | Zoom Extents button.

The Plan window now displays the imported bitmap as shown in figure below.

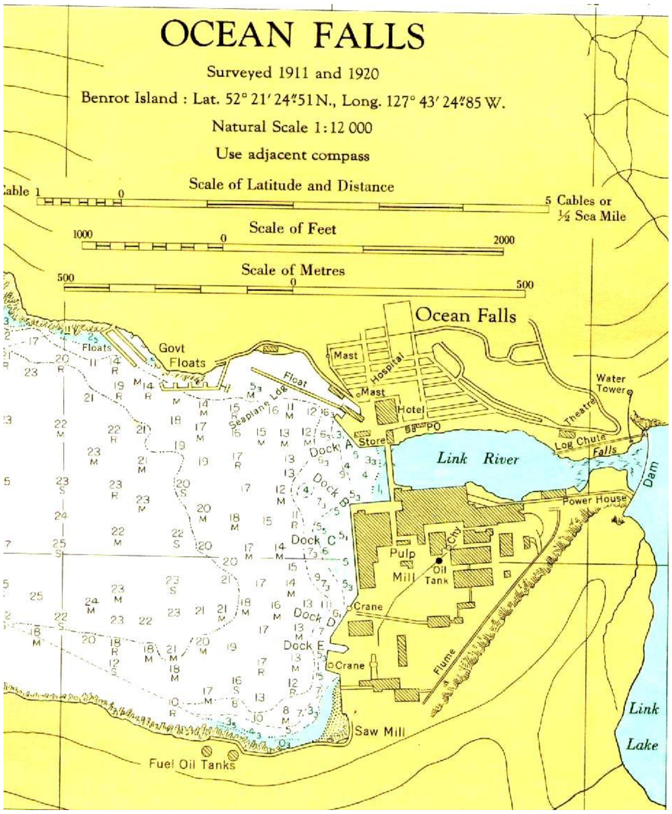


Figure 4-3: Imported Bitmap

8. Zoom in so the scale bars are clearly visible.

In this example, the natural scale is known, but the dots per inch are not. By measuring the scale bar, you will be able calculate the pixel size. This map has three scale bars. If you are working in meters, measure "Scale of Meters"; if you are working in feet, measure "Scale of Feet".

9. Measure the scale bar:
    a. With the cursor in the Plan Window, right-click and choose *Measure Tool* (length, area) from the menu.
    b. Move the mouse until the cross-hair is over one end of the scale bar and left-click.
    c. Move the mouse over to the other end of the scale bar and hover.

You can observe the length in two ways:

- The tooltip window (hover tip).
- The *Measurement* toolbar (this appeared at the lower left of your screen when you entered measure mode).

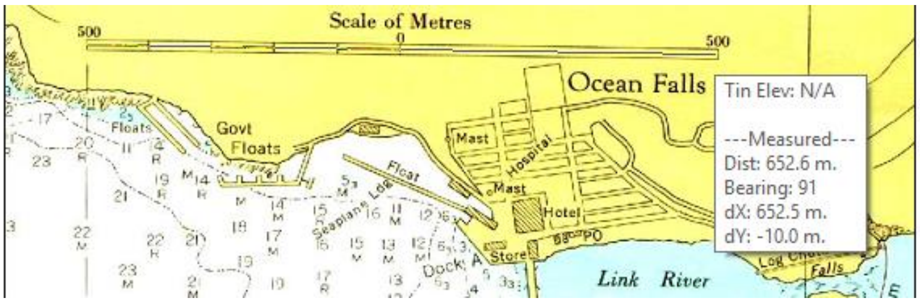


Figure 4-4*:* Measure Tool Hover Tip

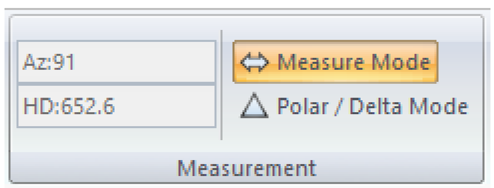


Figure 4-5: *Home* | *Measurement* tools

The *"Scale of Metres"* bar should be approximately 652 m long. This length is clearly incorrect; it should be 1000 m, so the image must be re-scaled.

If you were working in feet, you would find that the *"Scale of Feet"* scale bar is 600ft long; similarly, this should be 3000 feet, so image must be re-scaled.

10. <Right-click>, select *Stop Measuring* (or just type <escape>) to get out of measure mode.

Note: The *Measure Tool* does not disable editing with the mouse; this can be useful but most of the time you will want to be in selection mode before you use the *Measure Tool*.

Now we will re-scale the image by changing the pixel size:

11. <Left-click> on the bitmap select it.
12. *Feature Tools* | *Feature Properties* to open the *Image Import Options* dialogue box, as shown in Figure 4-2 above.

The current pixel size is set to ***1.0***. Scale it by multiplying by the true scale bar length divided by the measured scale bar length:

New Pixel Size (m) = 1.0m * 1000.0m/652m = *1.534 m*
New Pixel Size (ft) = 1.0ft * 3000.0ft/595.5.8ft = *5.038 ft*

13. Type the appropriate pixel size (1.534 m or 5.038 ft) into both the X size and Y size.
14. Press *OK* to close the dialogue box.

The image is scaled correctly. If the image were distorted, then the process should be repeated using a vertical feature of known length to calculate the *Y size.*

If desired, verify the image is scaled correctly by measuring the scale bar again.

Tracing Image Features

The following steps demonstrate how to trace features in the image and use them to calculate their area.

15. *Plan* | *Plan Options* | *General* tab. Change the scale to **5000** if working in metric units (or **1000** if working in feet units).
16. Scroll and zoom the Plan window so that the pulp mill buildings are visible as in figure below.

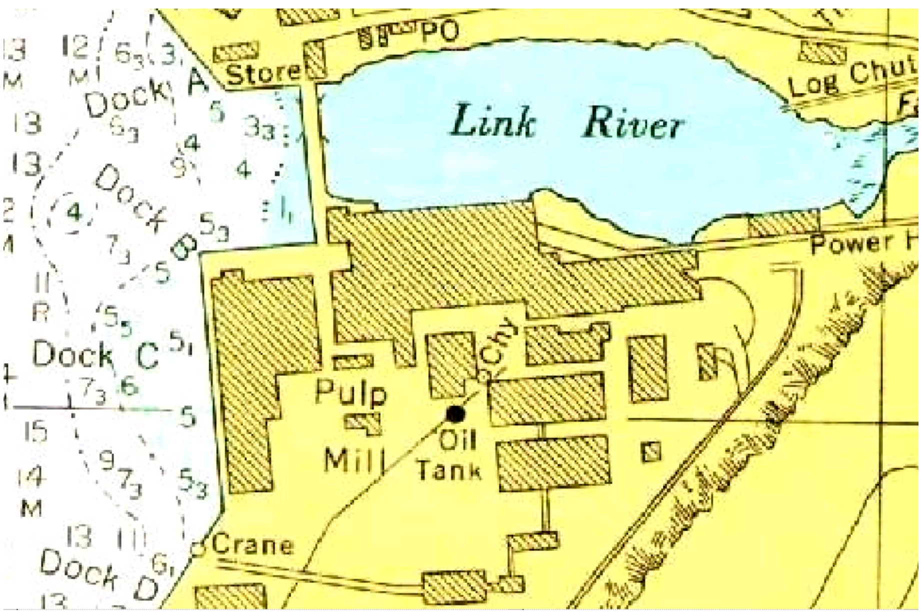


Figure 4-6*: Ocean Falls Buildings*

If you have already done the *Drawing Features* exercise in the *Basic Mapping and Drafting chapter* above, then you should have no problem with the next step. Otherwise, the sub-steps (a, b, c) should help.

17. Trace around the boundary of three of the buildings using the mouse (like in Figure 4-7):
    a. Home | Draw New Feature button.
    b. Begin drawing a new feature. *<Left-click>* anywhere to create a new point.

c. Position the cursor over one of the corners of a building and <*Left-click*> again to anchor the point.

d. <*Left-click*> away from the first point to create another point (note the line joining the new point to the old).

e. Position the cursor over the next corner and <*Left-click*> again to anchor the point.

f. Repeat until only one segment of the building is not outlined.

g. To join the last segment use *Feature Tools* | *Join*.

h. Click the *Draw Feature* button to begin a tracing a new building.

i. When you are finished, use the right-click to change back to select with mouse mode.

Note: The mouse can be used to edit existing points and insert points. Don't forget about the *Undo* button or<*Ctrl-Z*>.

If you have a number pad on your keyboard, there is a digitizing feature you might want to try; move your mouse cursor over a point of interest and type the <5> key on the number pad. This will create a new feature point in one step.

Determine the area of each building:

18. Select each building perimeter with the mouse and look at the Status portion of the Feature Properties window. (Figure 4-7). If the panel is not currently showing, select from the bottom navigation bar, or *View* | *Add to Panel* | *Feature Properties*.

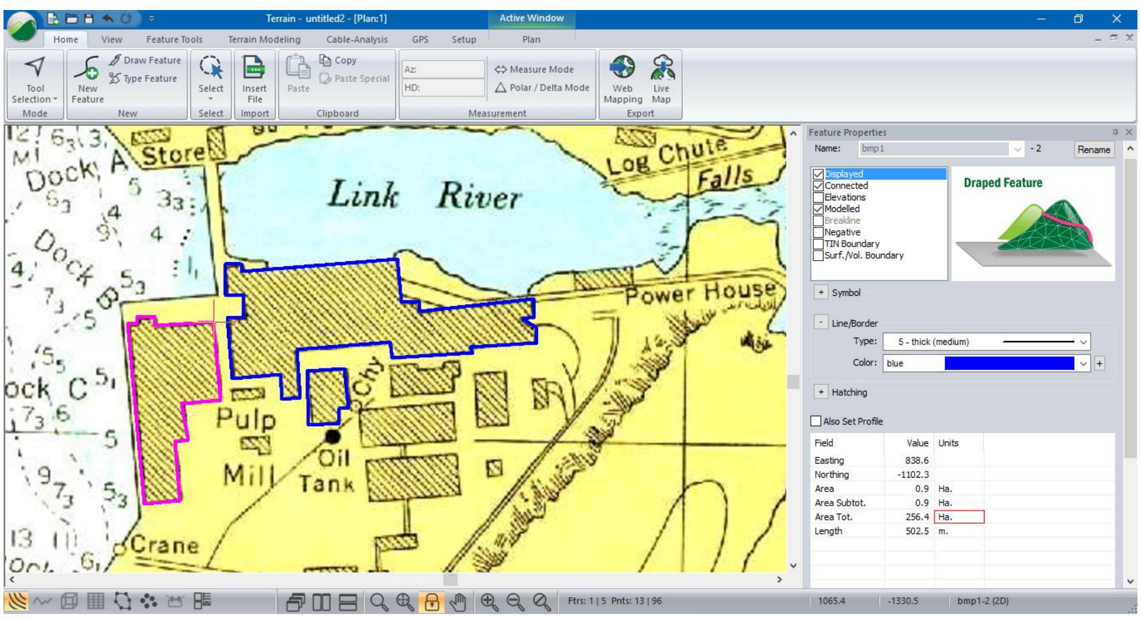


Figure 4-7*:* Traced Buildings with Status Details in the Feature Property Panel

19. Format the perimeter features and then determine the total area:

   - Select all the traced buildings, by holding down the <*Shift*> key and <left-clicking> on each of the building's traced boundaries.

- *Feature Tools* | Line-types, Symbols button (or type <Ctrl-L>).
- Select *Line/Border Type*: *6-thick (heavy)*.
- Change the color to *blue*.
- Press *OK*.

20. To see the area of the selected features: Area Subtot. If working in metric units, the area of the buildings should be approximately 2.9 Ha. (Imperial units the area should be approximately 7.0 acres).

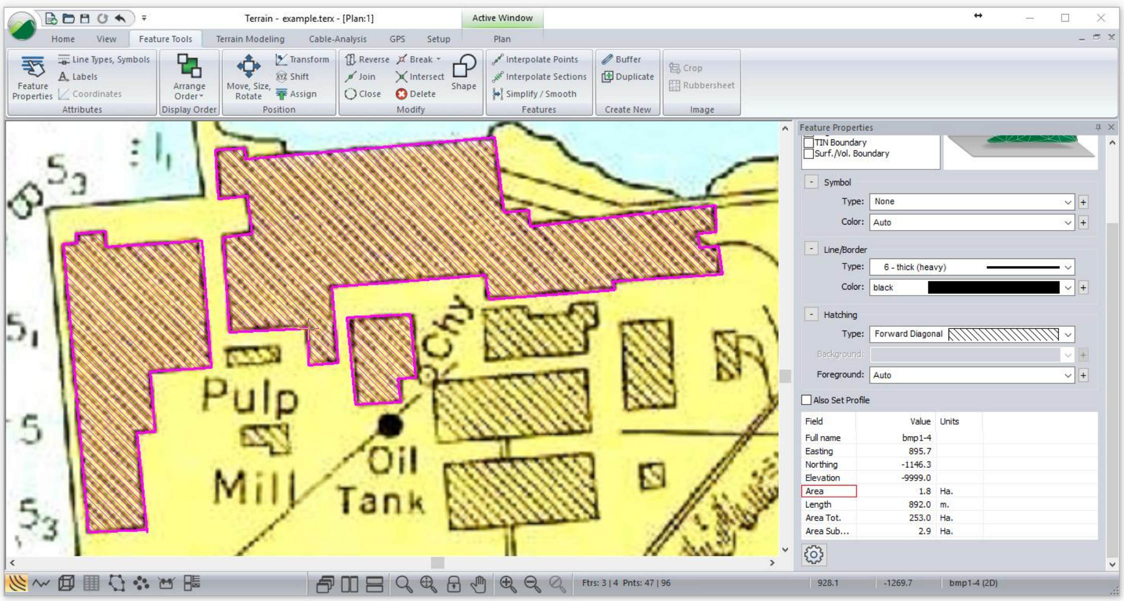


Figure 4-8*:* Selected Buildings with Area Reported in The Status Window

21. One can add or remove items by pressing the button at the bottom of the feature properties panel. Area Tot. and Area Subtot. can be added to list of selected features.
22. The total area (Area tot.) includes the bitmap boundary; the Area field shows only the area for the current feature (containing the red cross).

Note: The Status window options allow you to display areas in square meters (square feet) for the current feature. Click outside the image to de-select all.

23. *File* | *New*. Do not save changes.

Adjusting an Image

Forestry Cut Block Layout Example

This example requires *Mapping and Drafting, Import Basic and Export Basic* function groups enabled (see *Function Groups* in the On-line help for more information).

Moving and Resizing

This example demonstrates how to overlay a series of traverses on a scanned contour map. These traverses were entered in the Survey Module; however, they could have come from other sources.

1. File | Open. Change Files of Type to (All Supported Files *.asc; *.ter; ...). Select <Terrain>\ Bitmap**setting boundary shift.terx**.

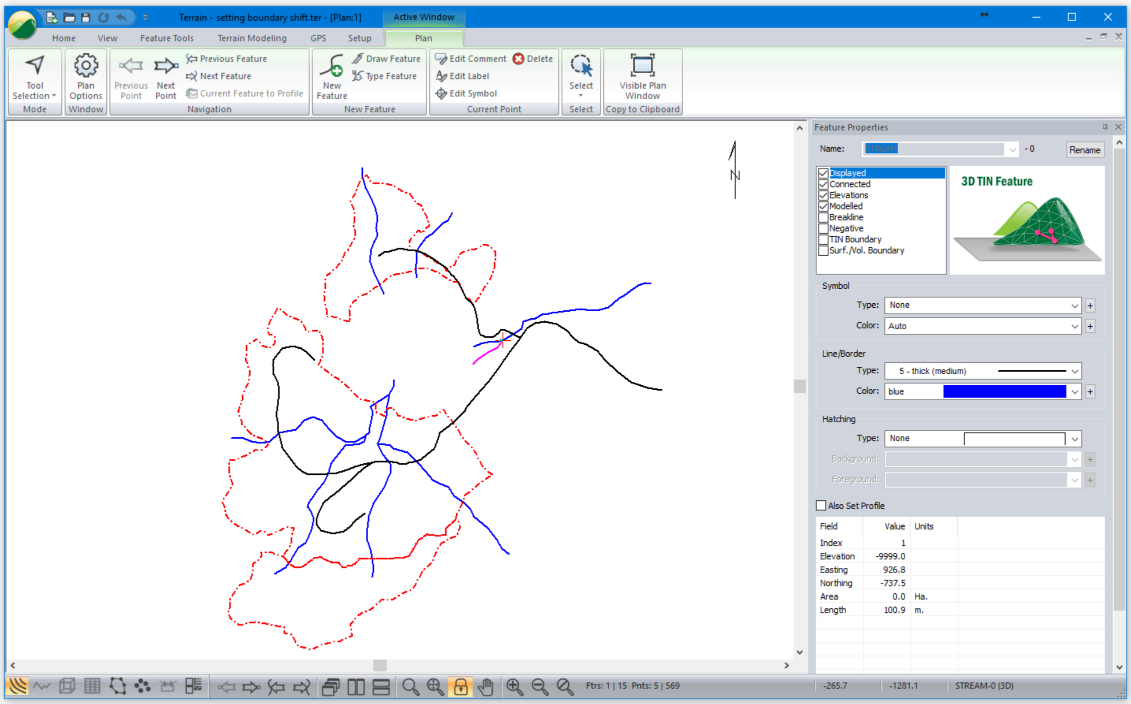


Figure 4-9: Setting Boundary *shift.ter* - Surveyed Traverses

The terrain file setting boundary *shift.ter* includes several block boundaries, roads and streams. Notice that the traverses are in correct positions with respect to each other. These traverses were entered and adjusted in the Survey/Map Module.

2. Home | Insert File. Change Files of type to Image Files (*.tif: *.jpg; *.bmp; *.sid; *.jp2; *.png;*.ecw; *.doq;....).
   Select File Name: <Terrain>\Bitmap**setting.BMP**. Press Open.

3. The Import Options dialogue box appears. Ensure that the default settings are set (X and Y are set to **0.0** for Pixels Project Units and the X and Y are set to **1.0**) as shown below. Press OK to insert the bitmap.

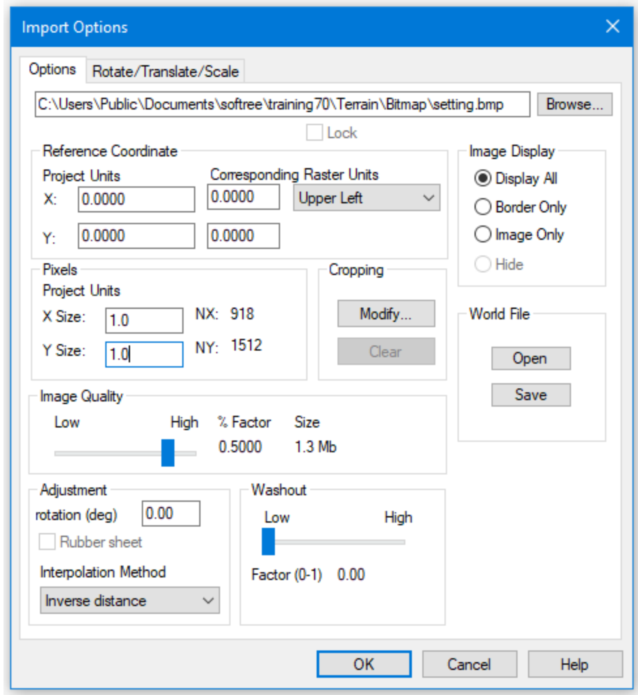


Figure 4-10: Import Options Dialogue Box

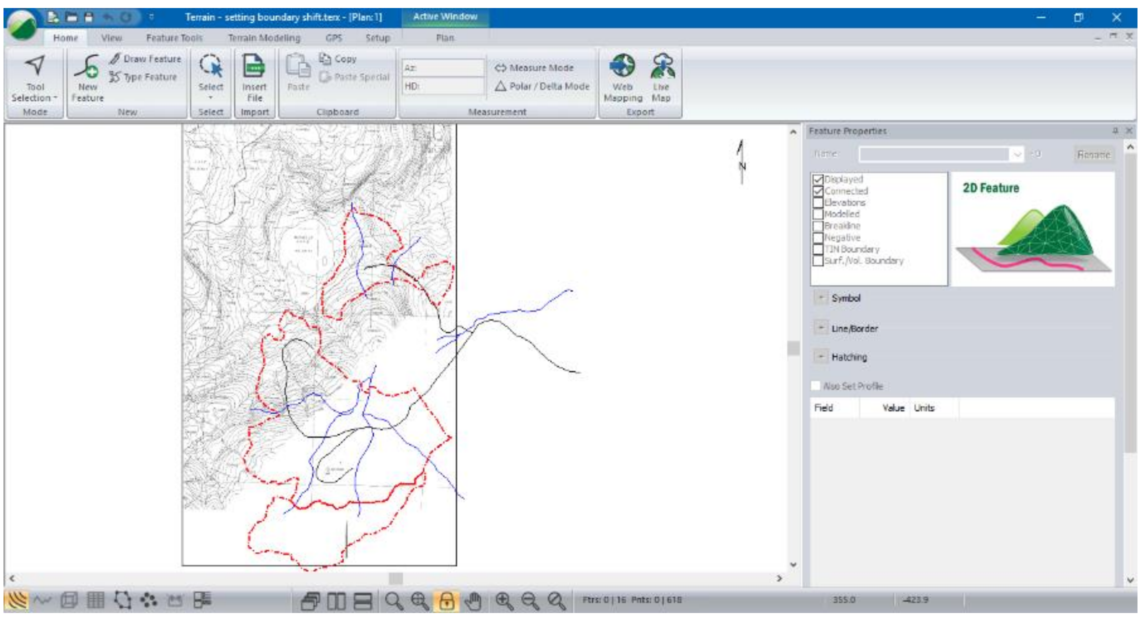


Figure 4-11: Plan Window After Adding *setting.bmp*

The bitmap file was created from a 1:5000 topographic map. The image was scanned and saved as a Windows Bitmap (*.bmp) using external software.

The bitmap is not correctly positioned with respect to the traverses (MICHELLE LAKE is offset) (See figure above). The size of the bitmap image is also incorrect. The next steps show how to adjust the position and size of the bitmap by trial and error (although it is possible to be more analytical if you know the pixel size and the coordinates of one corner of the scanned image).

Using the lakeshore to tie into the traversed streams:

4. Select the bitmap by <left-clicking> on its boundary with Selection cursor .
5. Feature Tools | Move, Size, Rotate. This activates Move/Size mode with the bitmap selected. The cursor changes to the Move cursor when it is inside the image. Zoom out several times to see the handles.
6. With the Move cursor displayed, <left-click> and drag to position MICHELLE LAKE so that the stream traverses line up with the lakeshore. Release the left mouse key to redraw the screen.

The bitmap image is too large to match with the traverses. The next step will reduce the size of the bitmap.

7. Still in Move/Size mode, hold down the <Ctrl> and press the <Down Arrow> on the keyboard. Notice that when the screen refreshes the bitmap image is smaller. Pressing the <Ctrl + Up Arrow> will expand the image, and <Shift + Ctrl + Arrow keys> allows for fine adjustments.

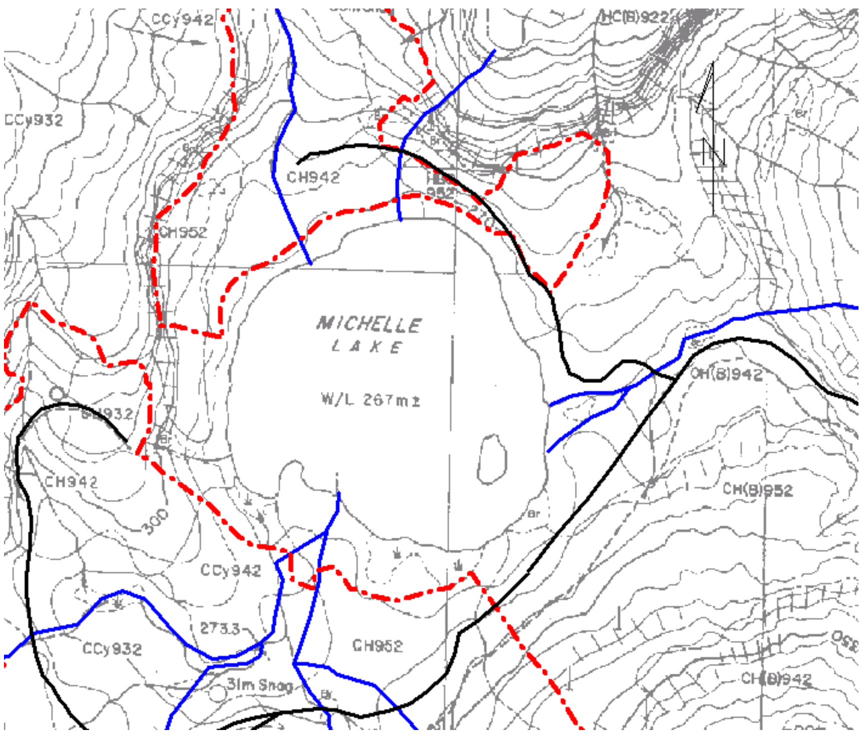


Figure 4-12: Lining Up Michelle Lake with Streams by Trial and Error

8. Repeat the above two steps until the lakeshore lines up with the traversed streams as in the figure above. This procedure involves some trial and error to adjust both the size and position of the bitmap. Zoom In/Out are useful in this process.

Information about the bitmap can be displayed and modified. This can be useful for rotating, scaling and positioning a bitmap using explicit coordinates.

9. With the bitmap still selected, activate the *Image Options* dialogue box: *Feature Tools* |*Feature Properties* button.

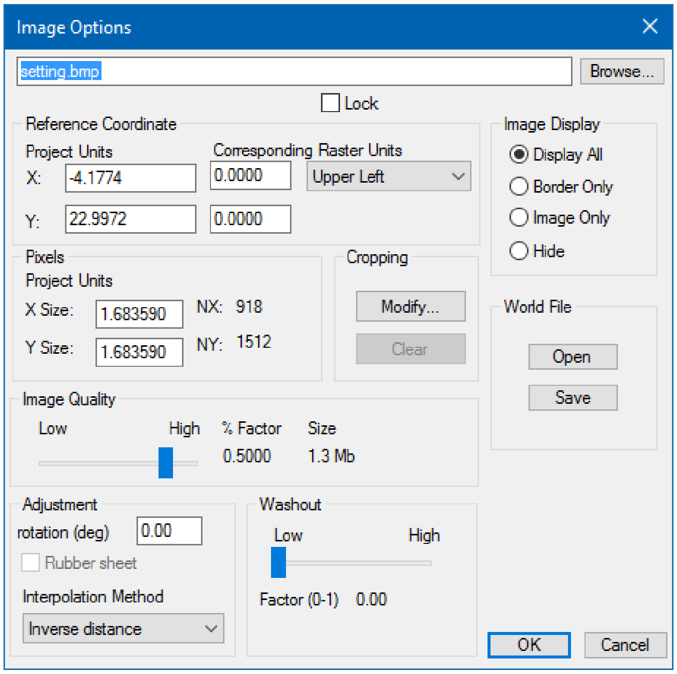


Figure 4-13: Image Options Dialogue

Note: The X and Y pixel sizes. The default size of bitmap pixels is 1. The coordinates of the upper left corner are 0,0. These defaults were changed when the bitmap was moved and sized in the previous example. This dialogue box can be used to explicitly set the rotation, size and position of a bitmap.

10. Press the *Cancel* button.

11. *File* | *New*. Do <u>not</u> save changes.

5. Features, Coordinates and Attributes

A feature is a collection of xyz coordinates. Features and coordinates can have attributes. Coordinates can be entered directly by typing them into a dialogue box, traced from an existing map using the mouse or a digitizer or by importing them from an external file.

This section of the documentation will familiarize you with some of the methods for creating features by importing coordinates from external files and for entering coordinates via the keyboard.

Note: Terrain works with Cartesian xyz coordinates such as UTM, Albers, State Plane Etc. Cartesian coordinates allow you to measure lengths and areas in the usual way. If you have non-Cartesian coordinates, such as Lat/Lon, it is recommended you convert them to a Cartesian coordinate system when you import them.

To follow the examples in this section the *Mapping and Drafting*, *Import Basic, and Import Extended* function groups must be enabled. See *Function Groups* in the On-line help for more information.

Importing DWG or DXF Files

Cadastral Survey Example

The Terrain Module will read basic geometric information from DWG files (some 'esoteric' drafting entities such as text leaders are ignored -- a log file indicates entities that are ignored). More information about the technical aspects of DWG files can be found in the On-line help.

Note: See Getting Started section for file install folders (**<Terrain>** and **<Defaults and Layouts>**)

1. *File* | *Open*. Change *file type* to Autocad DWG (*.dwg).
   Select <Terrain>\Import**municipal.dwg**. Press *Open*.

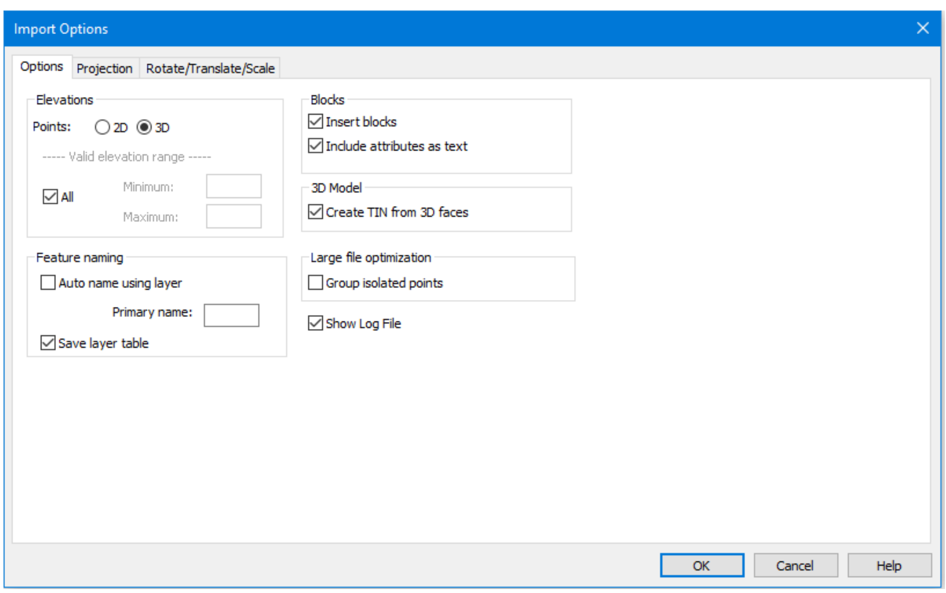
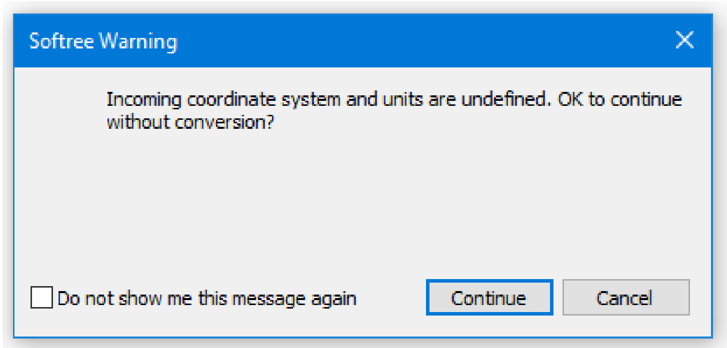


Figure 5-1: Import Options Dialogue

For on-line help descriptions for each of the dialogue box items, press F1 while the *Import DWG/DXF Options* dialogue is still active.

The options in the *Text Height* group box allow you to control the text size when importing the DWG file.

2. Set the dialogue options to match those shown in figure and press *OK*. You will get the warning message "Importing coordinate system and units are undefined. *OK* to continue without conversion." Press *Continue*. Another warning message such as 'unable to import 42 ArDbLeader' click *OK*.



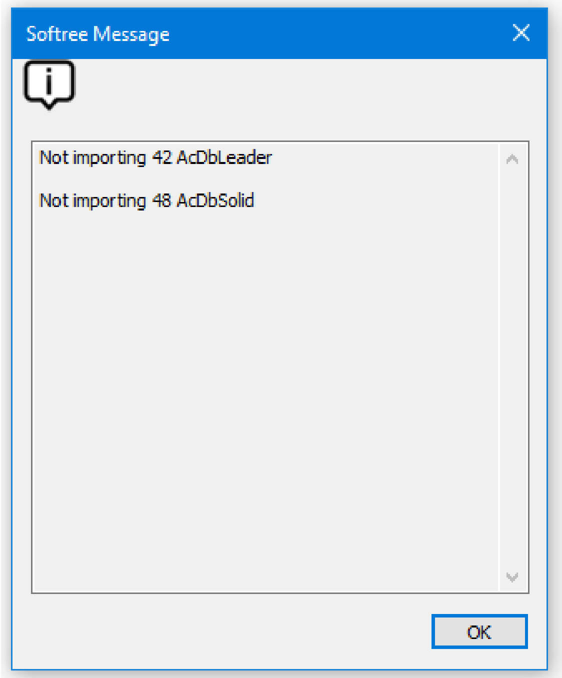


Figure 5-2: Softree Warning Messages.

3. After the import process is complete press *View* | *Zoom Extents* button. A city map with all the features selected will appear. De-select all features by clicking in a blank area of the Plan Window.
4. *View* | *Zoom Window*. Draw and rectangle with the mouse, this will zoom in to that specific area and allow you examine the details of the legal plans as shown in the figure below.

Note: If *Primary Name* (from the *DWG Import Options dialogue box*) is left blank, the incoming features will have their Alphanumeric ID set to the 1st 8 characters of the DWG layer name. The Numeric ID will be automatically generated.

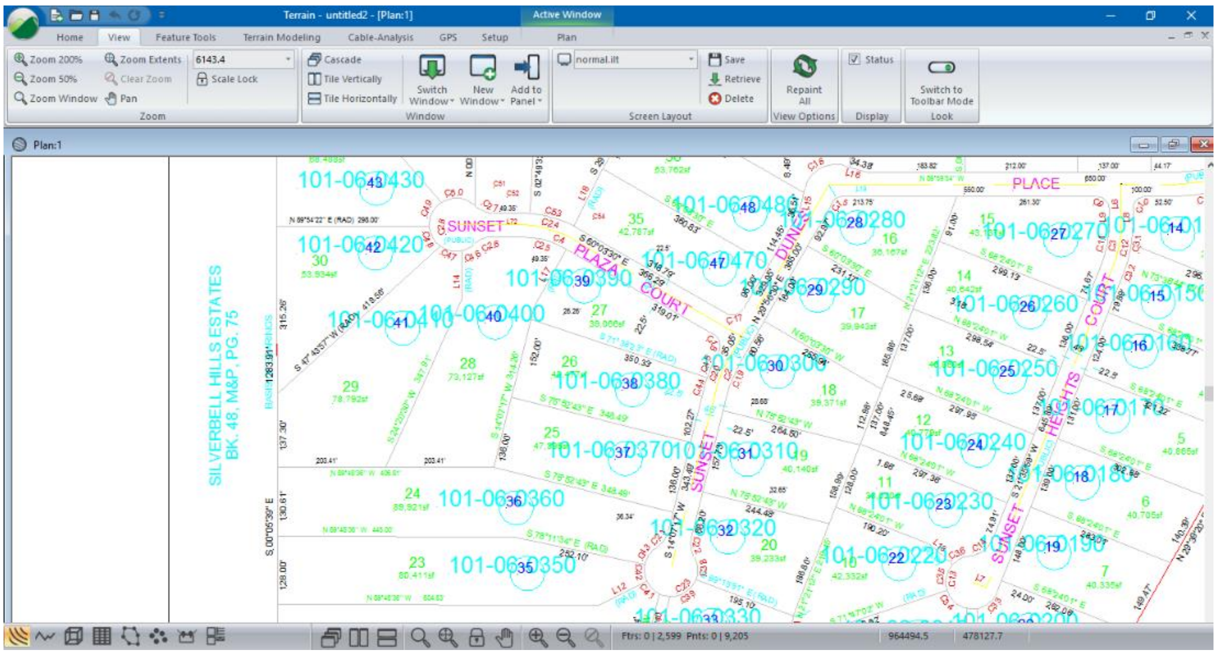


Figure 5-3*:* Imported DWG file after Zoom Window

Note: 2D vs. 3D DWG Files

DWG files are often only 2D and thus they can't be used to create 3D models. This is the case with *municipal.dwg*. If you click on a feature in the Plan window you will notice in the Status window the Elevation is reported as -9999, indicating that it has no elevations. Sometimes DWG files contain a mixture of 2D and 3D entities. If these files are to be used for 3D modeling, the different feature types must be selected and their property set to 2D or 3D accordingly.

5. File | New. Do <u>not</u> save the changes.

Importing Shape Files

Contour Map Example

Another common file format used is shape files. The Terrain Module will read (and write) Shape files including attributes.

1. *File* | *Open*. Change *Type of File* to ArcView Shape (*.shp).
   Select <Terrain>\ Import**topo.shp.** Press *Open*.
2. Set the *Import Options* dialogue box to match those shown in the figure below and press *OK*.

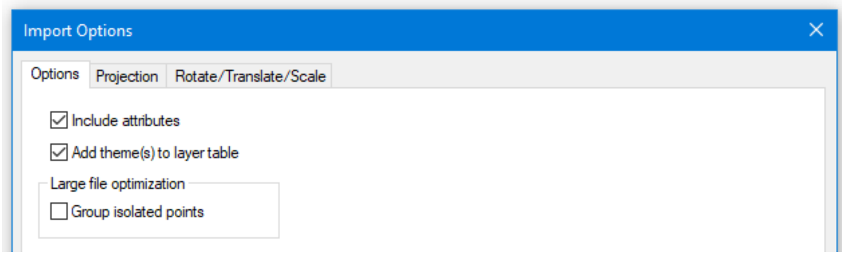


Figure 5-4*: Shape Import Options Dialogue*

After the import is complete the Plan window should appear as shown in the figure below.

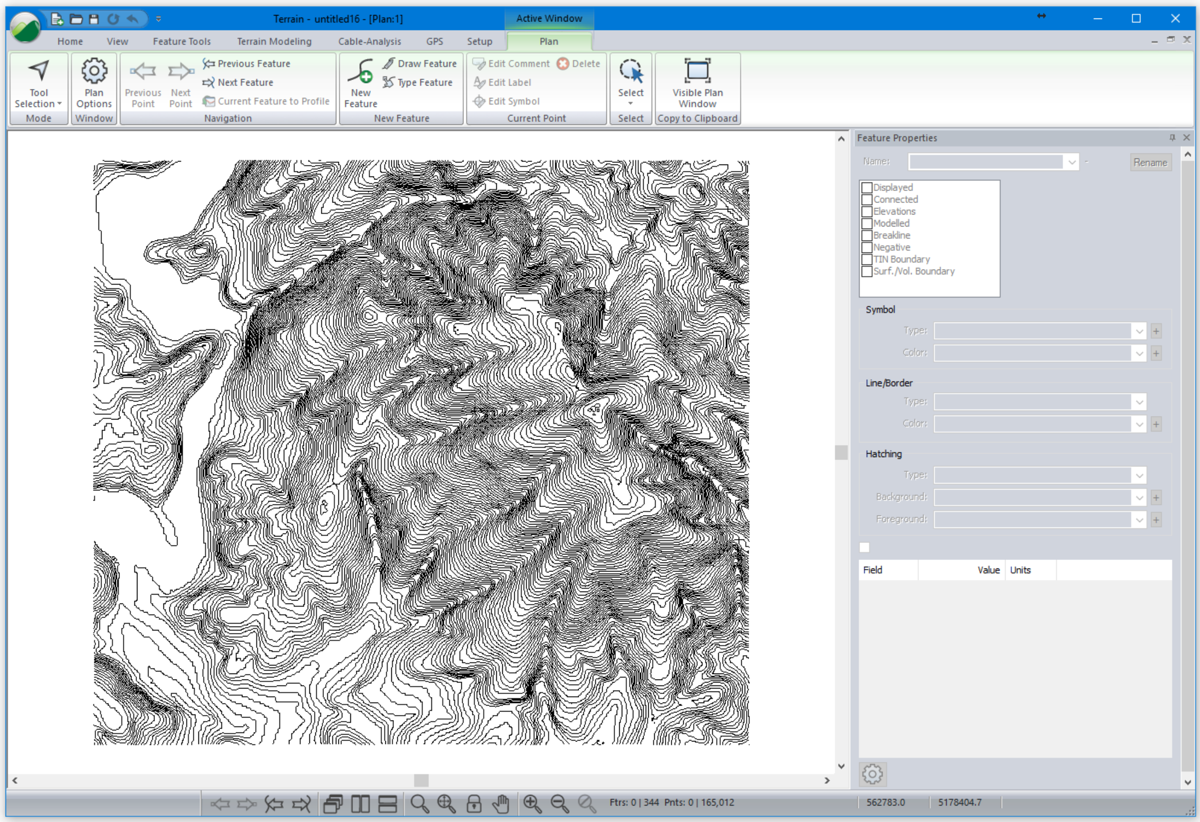


Figure 5-5*: Imported file topo.shp*

Note: If you click on any of the contour lines, the Status Window shows an elevation of 0.0. The elevation information has been saved in a separate attribute. Some Shape files save the elevation information with the coordinates; others (as in this case) save elevations in an attribute…

The next steps will show how to extract the elevations from an attribute and assign them to the contours, so they can be used to create a TIN model

3. *Home* | *Select* | *All Features* from dropdown. Click on the *Feature Properties Panel* located in the bottom Status Bar. Ensure *Elevations* property is checked. Press *Apply*.

4. Click on the *Status Options* button at the bottom of the Feature Properties panel. Press *Add/Remove* ... Scroll down to the bottom of the list on the left-hand side and locate the folder call "topo". From this folder add the item *Contour*. Press *OK* twice to return to the main screen

Note: You may notice in the *Status* elevations fields are all 0.0. The attributes must be assigned so that the program knows where to get the values from elevations.

5. *Feature Tools* | *Assign*. In the Z row select *Attrib* click the *Attrib...* button. Click on plus button next to topo and select *CONTOUR* | *Add* button. *OK* twice. Values should now be displayed in elevation.

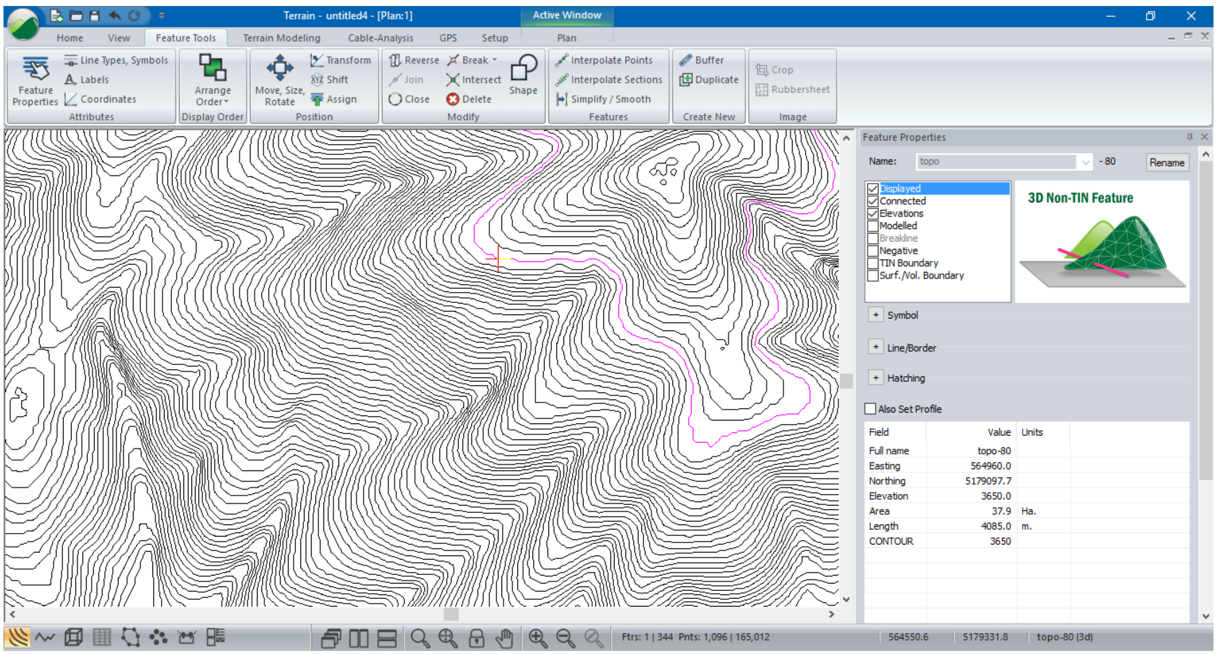


Figure 5-6: CONTOUR Attribute

6. *File* | *New*. Do not save changes.

Importing ASCII Files

Topographic Survey Example

The Terrain Module will accept a variety of different ASCII files by allowing the user to configure the import format. This example illustrates the use of the import functions to read a topographic survey file created by a total station data collector.

A Typical Data File

The file (excerpt below) consists of a *sequence number*, *X*, *Y*, *Z* and *code* separated by tabs.

501	100005.519	669380.4079	374.3334144	SIGN
502	100005.4794	669377.6708	378.4704648	TOB
503	100005.455	669381.2522	373.6119528	DITCH
504	100005.5069	669382.2581	373.6689504	SHOULDER!
505	100005.5678	669383.4834	373.6997352	EP!
506	100004.9978	669360.2576	381.6608064	SPOT
507	100006.4914	669386.827	373.7369208	CLP!
508	100004.7662	669349.7755	383.6218896	SPOT
509	100024.0052	669385.6383	373.5726336	CLP
510	100021.4448	669349.0349	382.406652	SPOT
511	100023.7247	669382.4074	373.5458112	EP
512	100023.9594	669381.0297	373.482108	SHOULDER
513	100023.9625	669380.2037	373.415052	DITCH
514	100022.8043	669363.6653	379.8536472	SPOT
515	100041.7689	669378.9815	373.1014128	DITCH
516	100023.7491	669376.4882	377.8693992	TOB
517	100041.6561	669379.9873	373.180356	SHOULDER
518	100041.2203	669375.9365	376.1890368	TOB
519	100041.6409	669381.3284	373.2388776	EP
520	100042.0036	669384.5227	373.2394872	CLP

Figure 5-7: Excerpt from Survey1.txt

Setting up an Import Format

1. File | New.
2. *Setup* | *Module Setup*. Select the *Units* tab, ***Units: Imperial*** **(ft**). The software cannot detect units from the information in an ASCII file.

Note: Import software cannot detect units from the information in an ASCII file.

3. Click on the *Import* |*Open*... button. Browse to find the import options file C:\ProgramData\Softree\Terrain Tutorials\Training**training Normal.iop.** Press *Open* button to read the file.

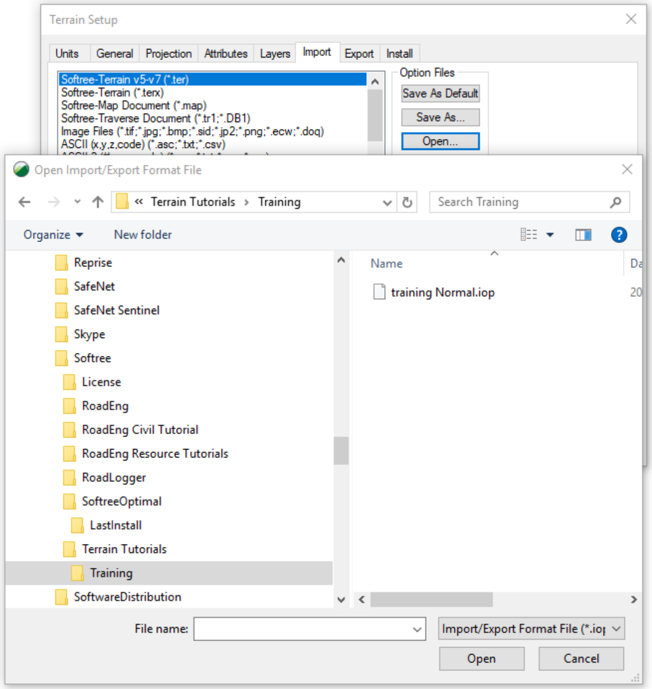


Figure 5-8*: Opening an Import/export Format File from Terrain Setup*

4. Select the format called "**ASCII (x,y,z,code)**", then press *Add***...** button to open the *Define New File Format Options* dialogue as shown in the figure below.

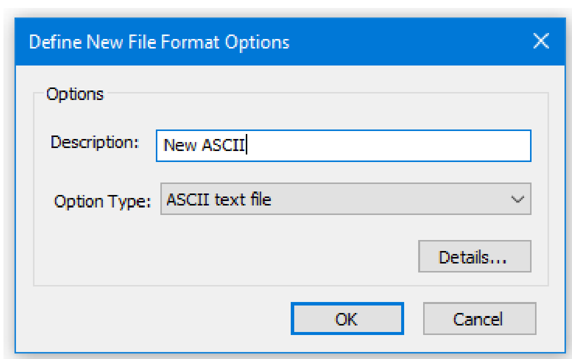


Figure 5-9*: Define New File Format Options Dialogue*

Note: When you create a new import format, it will initially be a copy of the one selected when you press the *Add* button ("ASCII (x,y,z,code) [*.asc,*.txt,*.csv] ", in this case).

5. Within the open dialogue box type "**New ASCII**" in the *Description* field and then click on *Details***...** to open the next *Import ASCII Options Dialogue* box shown below.

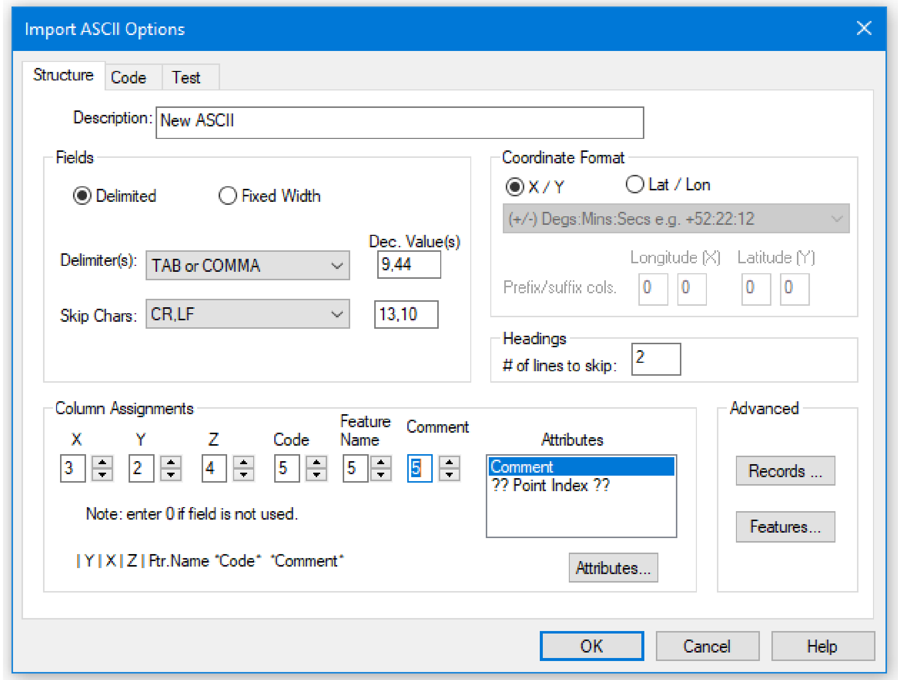


Figure 5-10: Import ASCII Options Dialogue – Structure Tab

The *Import ASCII Options* dialogue box allows you to describe the format of external files. Several options are available to identify, select and format incoming coordinate data. Detailed descriptions of the options in this dialogue box are available by pressing ***<F1>***.

6. Change the *Column Assignments* in the dialogue box to match the figure above (X=**3**, Y=**2**, Z=**4**, Code=**5**, Feature Name=**5** and Comment=**5**). Our file contains [point #, Y, X, Z, code] in each line.

You have now set up the import format to read data from the correct columns in the file.

7. On the *Code* tab, you can assign properties, symbols and line-types to the incoming points. Change your default code properties to match those shown in the below figure; 3D points with a black cross symbol.

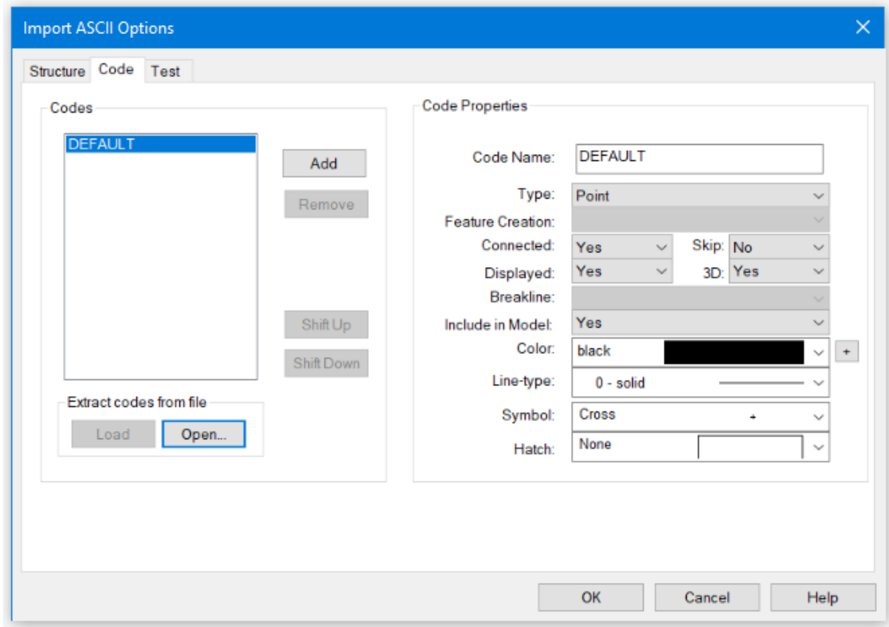


Figure 5-11*:* Import ASCII Options Dialogue – Code Tab

8. Press *Open*... button, within the existing dialogue and select <Terrain>\ASCII Import**survey1.txt**. This will extract all the codes found in the file.
9. Select the CONTROL code found in the codes list. Note that the options initially are the same as DEFAULT. Change the *Color*: **Navy** and Symbol: **Circle with Cross.**
10. Select EP (Edge Pavement) in the *codes* list and type in * beside EP, eg. 'EP*', in the *Code Name*. The "*" is a wild card – any code starting with "EP" will fall into this category. Make the following changes:
    - Type: *Polyline*
    - Connected: *Connect All by Code*
    - Breakline: *Yes*
    - Color: *Blue*
    - Symbol: *None*

Points with the EP code will be connected (in the order found in the file) and made into a blue breakline. The *Connect All by Code* property ensures that codes like EPL and EPR form separate features even though they both fit the EP* specification.

11. Select code name CLP (Center Line Pavement) in the code list. Make the following changes:
    - Type: *Polyline*
    - Connected: *Connect All*
    - Breakline: *Yes*
    - Color: *Red*
    - Line-type: *Dash-dot*
12. Go to the top of the dialogue box and select the Structure tab again. Press Features**...** in the Advanced section on the lower right. The dialogue shown in the Figure below will appear.

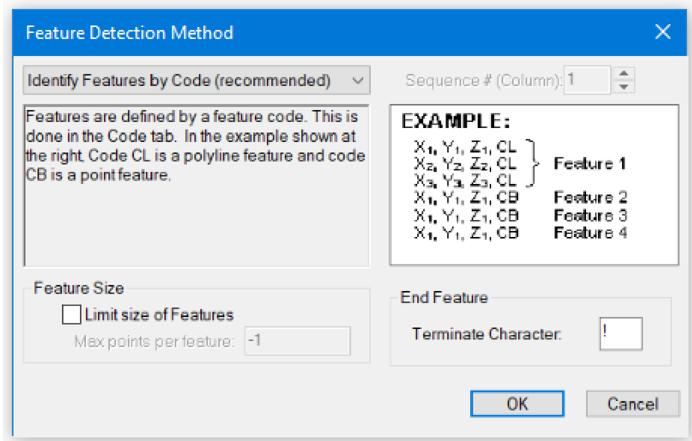


Figure 5-12: Feature Detection Method Dialogue Box

The dialogue box above allows you to limit the length of polyline features by defining a termination character to be found in the point code.

An exclamation point, “!”, is defined as the termination character in the *Feature Detection Method* dialogue box. If you refer to the **Survey1.txt** (see Figure 5-7 at the start of this exercise), you will see many of the point codes end with “!”; this means that a connected feature breaks after this point and a new feature will be created when the next point of this type is encountered. The *EP* polyline code (defined above) will import as two breaklines (left and right) because of a strategically placed “!” in the survey point codes.

13. Press *Cancel* to exit the *Feature Detection Method* dialogue box.
14. To test the specification, go to the *Test* tab (Figure 5-13).

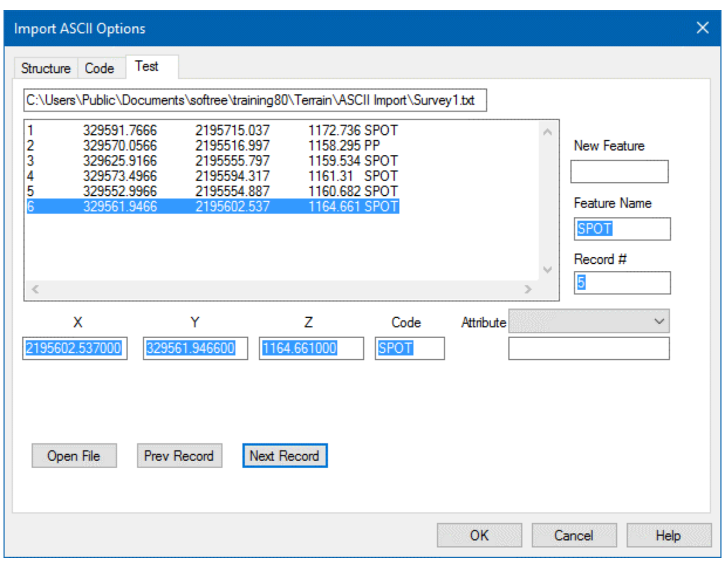


Figure 5-13: Import ASCII options dialogue – Test tab.

15. *Open* | *File* <Terrain>\ASCII Import**Survey1.txt**.

16. Press *Next Record* several times. At the bottom of the dialogue box the values of X, Y, Z and Code are displayed. Confirm that the incoming fields are being correctly interpreted; if not return to the other tabs to modify the format.
17. When satisfied, press *OK* to return to the *Terrain Setup* dialogue box.
18. To save the new import specifications for future use *Save As…* But in this case, we won't. Press *OK* to close the *Terrain Setup dialogue* box. Now we'll use the import format we've created to open the survey data file.

Note: Normally, you would choose *Normal.IOP* and write over it (to update your default settings) – do this only if you are working on a computer used for tutorial or training, otherwise save as *training.iop* or *Cancel* to avoid changing your defaults.

19. *File* | *Open*. Change dropdown menu in lower right-hand corner to *New ASCII* (at the bottom of the list). *Open* <Terrain>\ASCII Import**Survey1.txt**. You will be presented with the *Import Options* dialogue box to allow last minute changes. Press *Open* button to import the file.
20. Softree Warning appears: "Incoming coordinate system and units are undefined. *OK* to continue without conversion?" Click *Continue*.
21. *Select View* | *Screen Layouts*, select normal.ilt from the dropdown menu. This will set up your options and windows to look like the figure below.

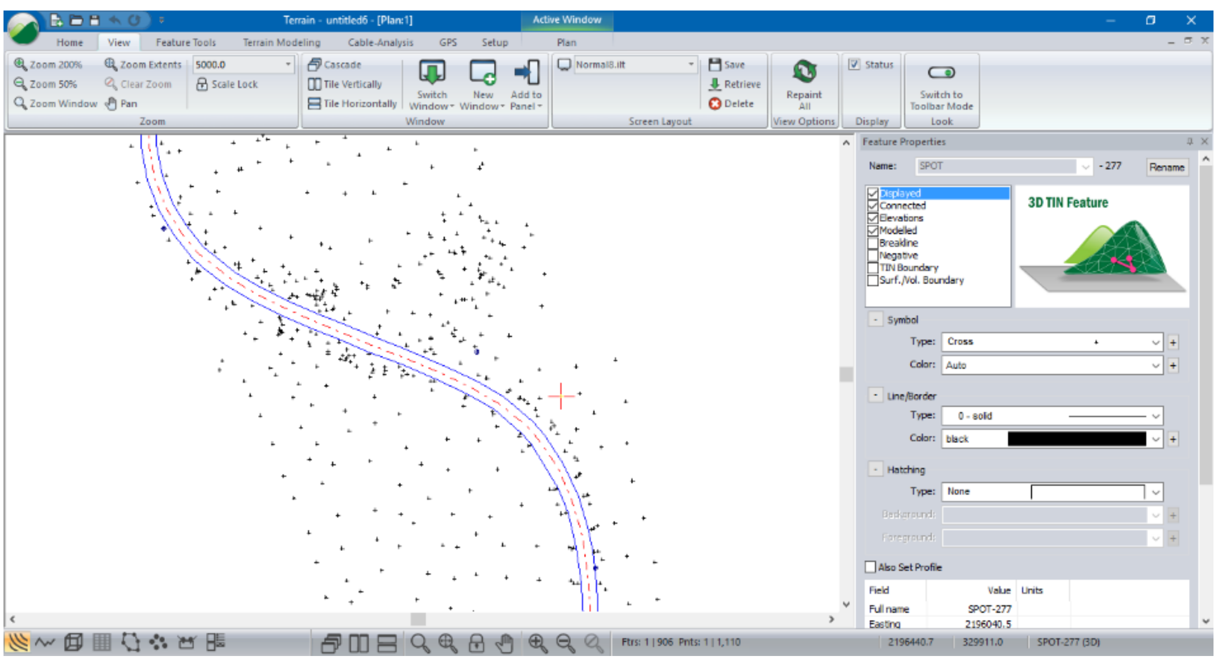


Figure 5-14: Plan Window After Importing Survey1.txt.

Note: The right **EP** feature is selected (note the properties displayed in the status window). Also note that there are many point codes that have not been formatted or connected to form breaklines. In the next steps, we will re-read the same data with a prepared import format.

22. Turn on the feature labels:
    - *Right-click* in plan view |*Select*| *All Features*
    - *Feature Tools* | *Labels*

- *Double-click* to turn on '*Comments (at feature points)'* and 'Feature Name'. Both should now have black checkmarks next to them.
- Press *OK*.

23. To reduce the size of the labels, zoom in by scrolling with the mouse wheel until the label font size is smaller and readable. Press the Scale Lock button. Now View | Zoom extents. The labels will remain the size of what they were when they were locked.

24. *File* | *Open*. Change *Files of type* to **ASCII 2 (#,y,x,z,code)**. *Open* <Terrain>\ASCII Import**Survey1.txt**. When prompted to save changes, choose *No*.

25. This will open the *Import Opti*ons dialogue; click on the *Code* tab to see the extra codes defined – no changes are required. Press *OK* to import the file. When prompted with the Softree Warning message hit *Continue*.

This will set up your options and windows to look like the figure below.

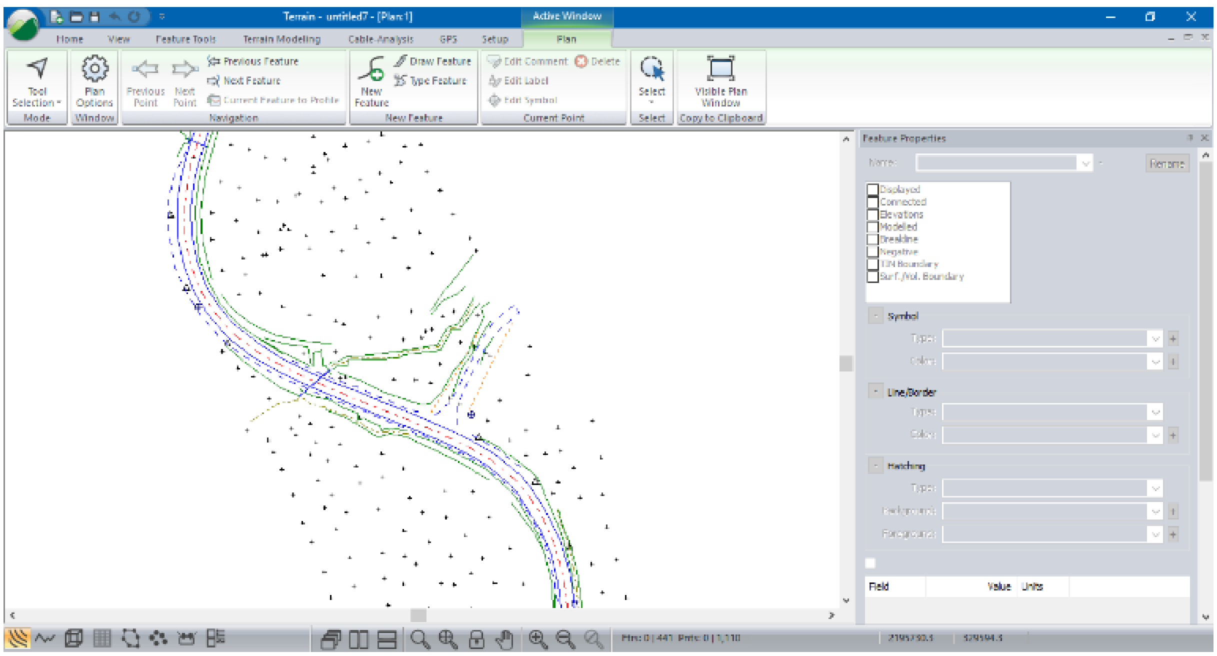


Figure 5-15*: Survey1.txt* imported with more point codes defined

26. You may wish to select features with the mouse to see what properties are displayed in the Status of the *Feature Properties* panel area.

27. The status panel on the right hand of the display. To add more attributes, press the gear button at the bottom of the status window then press Add/Remove... button. Select the features you would like to add or remove.

28. *File* | *New*. Do not save changes.

Keyboard Coordinate Entry

Legal Survey Example

To follow the examples in this section, the *Mapping and Drafting*, *Import Basic, Import Extended,* and *Enhanced Mapping and Drafting* function groups must be enabled. See *Function Groups* in the On-line help for more information.

The Terrain Module allows you to create a feature and enter its coordinates directly from a dialogue box. This example will demonstrate this procedure by creating a plat (cadastral) boundary from the following legal description.
Beginning at:

> Northeast corner of Lot 23, Block 1, "Plat of Williams Beach";
> thence S 30° 15' E a distance of 403 feet of the Point of Beginning;
> thence S 43° 42' W a distance of 446 feet;
> thence N 67° 47' W a distance of 368 feet;
> thence N 3° 18' E a distance of 317.5 feet;
> thence along a curve to the right having a radius of 200 feet, a chord bearing of N 46° 16' E, and a chord distance of 272.66 feet;
> thence N 83° 37' E a distance of 231.97 feet to the Point of Beginning

1. Set up *units* and *angle* format:
    - *Setup* | *Module Setup* button | *Units* tab.
    - Units: *Imperial (ft)*.
    - Direction: *Quadrant Deg:Mins N32:16W*.
    - Cut/Fill Slope: *Slope %*
    - Press *OK*.
2. *View* | *Retrieve Screen* Layout select <Defaults and Layouts>\Training**training deed.ilt.**

Note: Terrain Recreational users may get the message "Non-Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

Enter the Main Boundary

The following steps can be time consuming; you can jump ahead at any time to 'Enter the Easement Boundary' below.

3. Create a new 2D feature:
    - *Home* | *New Feature* button.
    - Enter *Name*: **Lot 23.**
    - Uncheck *Elevations* and *Modelled* (as below).

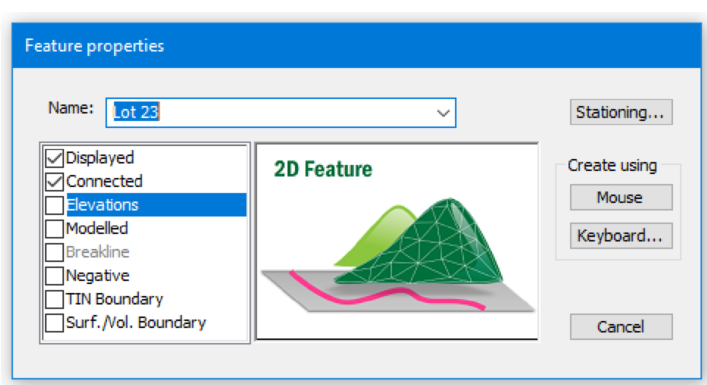


Figure 5-16*: Feature Properties Dialogue*

4. Press the *Create using Keyboard*... button to close *Feature Properties* and open the *Feature Coordinates* dialogue box.

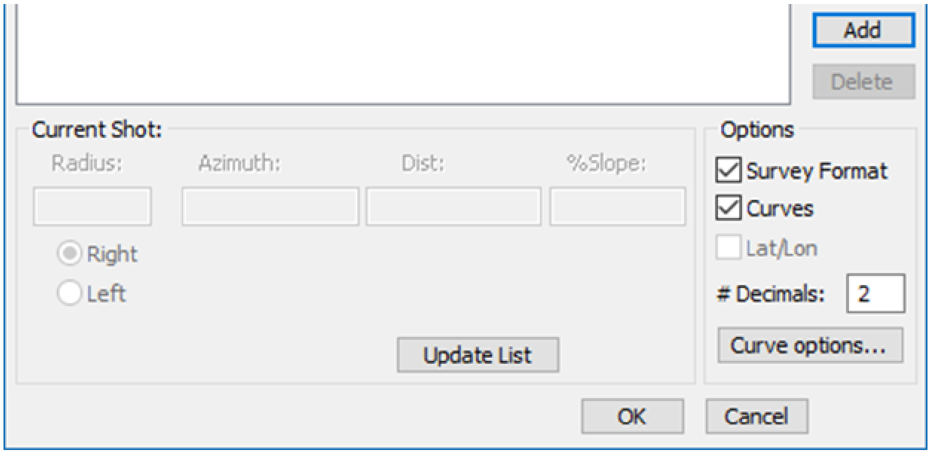


Figure 5-17: Feature Coordinates Dialogue Box Set Up for Survey Entry.

The *Feature Coordinates* dialogue box can be used for entering or modifying XYZ coordinates or survey information. In this case the *Survey Format* and *Curves* options are checked (figure above), so you can enter the survey information.

5. Add a shot:
   - Press the *Add* button.
   - Leave the radius blank and <*TAB*> to move to the next field
   - Azimuth: ***s30.15e***, <*TAB*>.

A new shot is added with default values in the fields; the cursor is in the *Radius* field in the *Current Shot* area.

Note: For azimuth, data entry, a period (or decimal) is OK to separate degrees and minutes and capitals are unimportant.

   - Dist: ***403***, <TAB>.
   - % Slope**:** ***0***, <Enter> (or press *Add*) to accept the fields and add a new shot.

6. Repeat for the next three shots:
   - ***S 43° 42' W***, ***446*** feet
   - ***N 67° 47' W***, ***368*** feet
   - ***N 3° 18' E***, ***317.5*** feet
7. Now enter the curve:
   - *Radius*: ***200***, <TAB>.
   - Use the <*arrow*> keys to select *Right* and <TAB> (you can also use the mouse for this).

Notice the headings change, after entering the radius, to *Chord Az*. and *Chord Dist*. Additional options for entering curve data are available by pressing *Curve Options* (see On-line help <F1> for more information).

- Enter a *chord azimuth* of ***N46.16E***, <TAB>.
- Enter a *chord distance* of ***272.66***, <TAB>.
- Enter slope ***0***, as usual, press <Enter>.

8. Enter the final shot: **N83.37E, 231.97** feet. After entering the **0** slope, press the Update List button. (Do not press enter or add). The Feature Coordinates dialogue box should now look like the figure below.

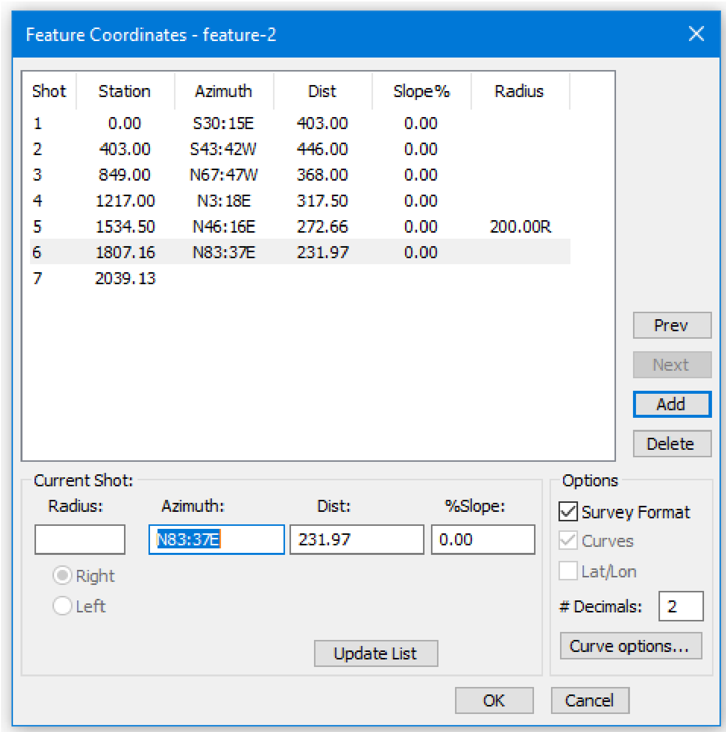


Figure 5-18: Feature Coordinates Dialogue After Survey Entry

9. Check the entered bearings and distances against those in the figure above and then press OK.

The screen should now look like the figure below.

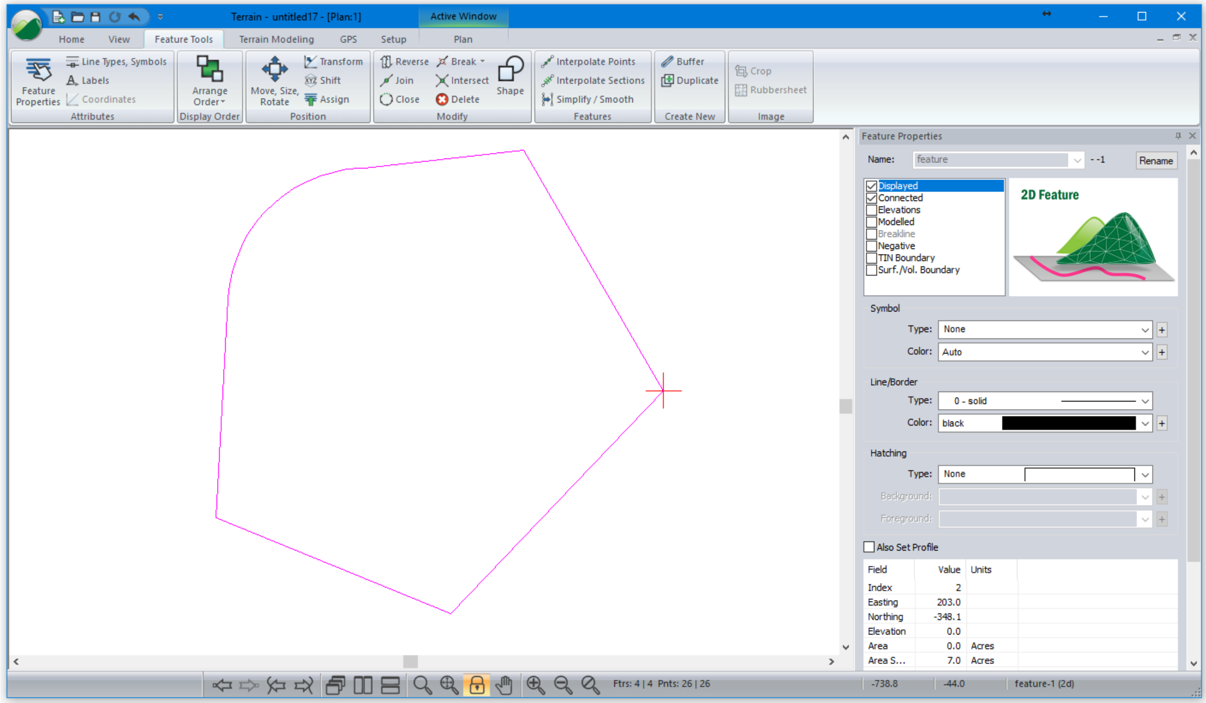


Figure 5-19: Lot Boundary (with Feature Properties Panel)

10. Using the selection cursor, click on the second lot corner, identified by the red cross-hair in the figure above.

The Status Window reports the X, Y coordinate for the current point is *203.0* (Easting), *-348.1* (Northing). This is the starting point for the next boundary.

Enter the Easement Boundary

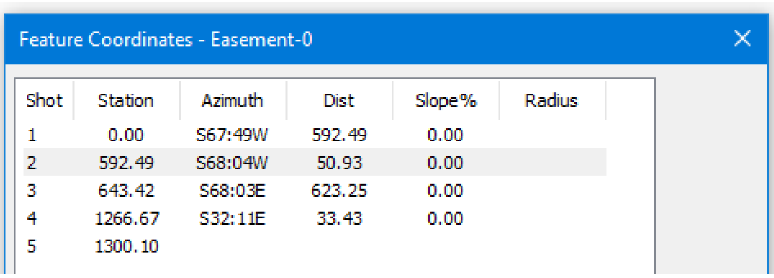
11. (Optional) If you did not finish the steps above, File | Open <Terrain>\Enter**deed.terx**.
12. Select the far-right corner of the easement boundary.
    - Create a new feature (properties will be inherited from the current feature):
    - *Home* | *New Feature* button to open the Feature properties dialogue box.
    - Enter Name ***Easement***.
    - Set the *Negative* check box; this will allow us to subtract the enclosed area later.
    - Press the *Keyboard...* button to close *Feature properties* and open the *Feature Coordinates* dialogue box.

Note: *Negative* features create a hole or void. Their area will be subtracted when total areas are reported and the TIN will exclude these areas if *TIN Boundary* is also selected.

13. Define *start coordinates* (we did not do this for our first feature). In the Options area clear the *Survey Format* check box.

Note that the starting X, Y coordinates have automatically been set to the corner point (*203.0*, *-348.1*) that we selected above. If they were not correct, you could modify the coordinates now.

14. Set back to Survey Format.
15. Enter the Easement Survey traverse as shown in the figure below (use the same procedure as the previous exercise).



Shot	Station	Azimuth	Dist	Slope %	Radius
1	0.00	S67:49W	592.49	0.00	
2	592.49	S68:04W	50.93	0.00	
3	643.42	S68:03E	623.25	0.00	
4	1266.67	S32:11E	33.43	0.00	
5	1300.10				

Figure 5-20: Easement Survey

16. After entering the last slope, press OK to close the Feature Coordinates dialogue box.

The plan should now display *Lot 23* and *Easement* as in the figure below. Notice the negative area in the status window for the selected easement and total area of 6.5 Acres (7.0 subtract 0.5).

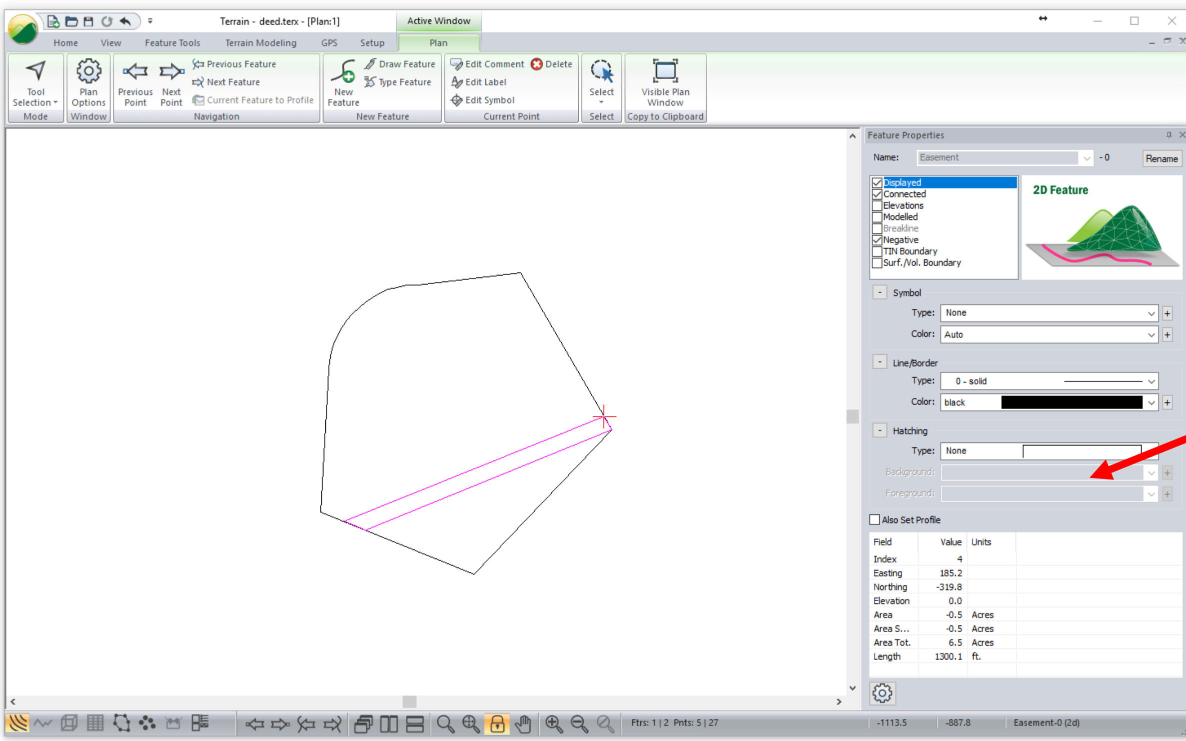


Figure 5-21: Lot Boundary and Easement

The survey entry is complete. The step below will turn on labels for the Lot 23 boundary only; this is called *Feature Formatting*.

17. Display survey information labels for Lot 23:

- Select the *Lot 23* boundary .
- *Feature Tools* | *Labels*. Turn on *Azimuth*, *Horizontal Distance*, *Horz. IP at Curves* (Curve Information) and *Area* labels (*double-click* on the items in the list-box).

- Press *OK*.

The selected feature labels are now displayed in the Plan Window:

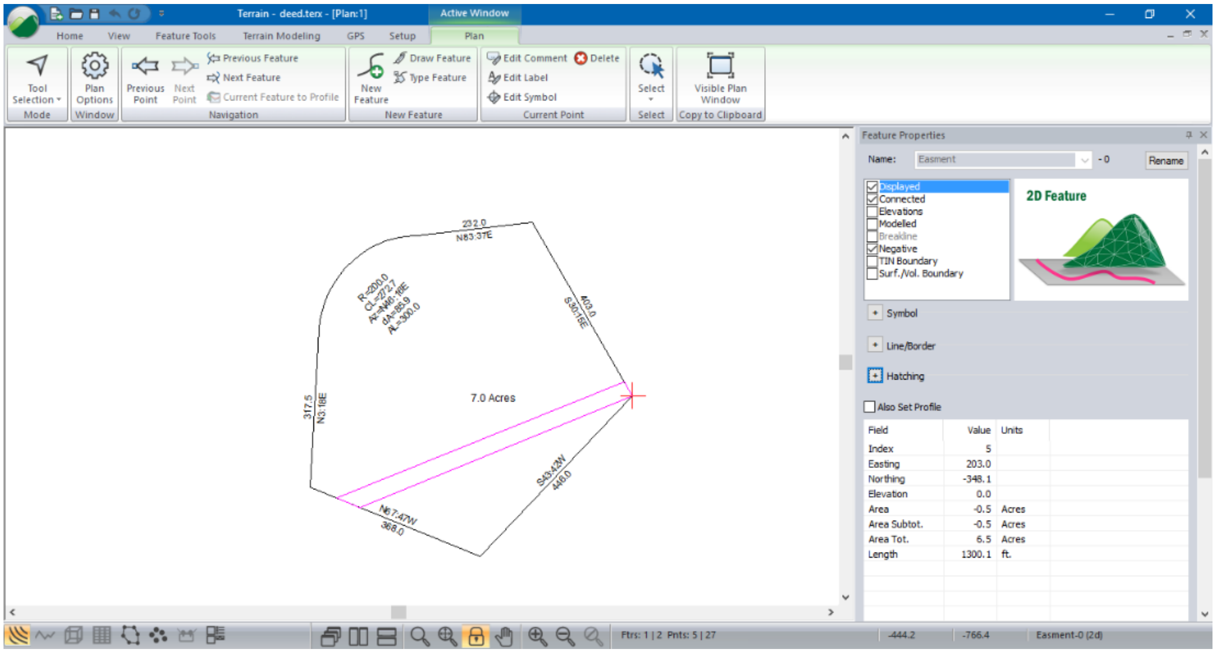


Figure 5-22: Annotated Lot Boundary and Easement

18. *File* | *New*. Do not save changes.

Coordinate Systems and Map Projections

Defining a coordinates system (map projection) allows you to place points at the correct location on the earth's surface. It also allows you to display Latitude and Longitude (Lat/Lon). This is called *geo-referencing*. For more information about coordinate systems please refer to an introductory textbook on mapping.

Terrain doesn't strictly need to work in a defined coordinate system or map projection. However; if you are importing and exporting data to external geo-referenced sources such as GPS or GIS you will want to work in a well-defined coordinate system. Some common coordinate systems include UTM, Albers, and State Plane.

Note: Terrain works in Cartesian coordinates (a system where coordinates are distances measured to perpendicular lines); usually, X=Easting, Y=Northing. Using Lat/Lon (Geographic Coordinates) as your X/Y coordinates <u>is not recommended</u> because distances, angles and areas are not well defined.

Many file types such as Shape, DEM, KML, TIF, TER etc. include geo-reference information. When these files are read into Terrain (using File | Open) the coordinate system is set to match the file. Other file types such as ASCII do not have geo-reference information. To geo-reference these you need manually set the coordinate system.

Note: If you do not need to import/export from/to a different coordinate system and you do not need to see Lat/Lon values, you do not need to define your coordinate system.

Setting Up a Coordinate System

1. *File* | *Open* <Terrain>\Import**roads_a.terx.**

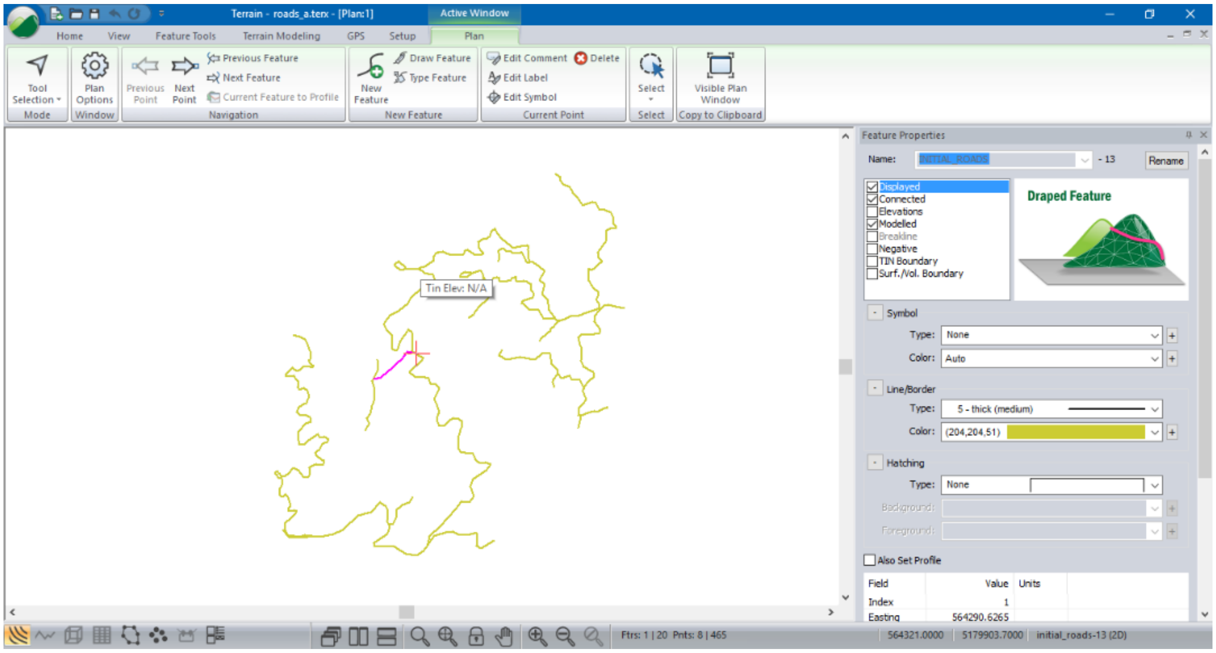


Figure 5-23: roads_a.terx Before the Projection is Defined.

Notice that the Status window displays coordinates (*Easting* and *Northing*) but *Latitude* and *Longitude* are undefined (figure above).

roads_a.terx does not have any coordinate information attached to it but it is known to be in **UTM Zone 11 NAD 83** coordinates. If we setup the coordinate system in Terrain, the file will be geo-referenced.

2. Define the UTM projection: Setup | Module Setup Button | Projection tab.
3. Change the *Projection* settings to those shown in the figure below. Press *OK*.

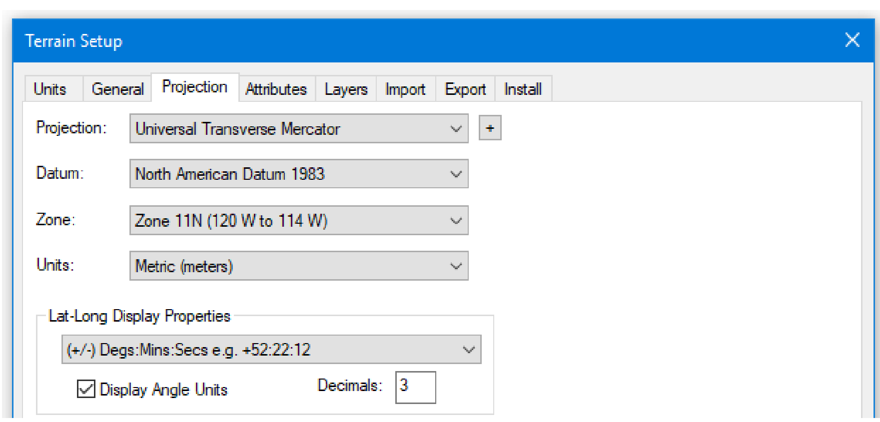


Figure 5-24: Projection Settings

Notice that the Status window now displays *Latitude* and *Longitude.*

Verifying a Coordinate System using Google Earth

A quick and easy way to check that a file is correctly geo-referenced, is to export it to *Google Earth*. Google Earth is a free web-based 3D mapping software (see www.google.com/earth for more information).

To complete the following steps, you will need to have Google Earth installed.
First, we will make sure you have a Google Earth export specification (KMZ); this depends on the ***Normal.iop*** file in your **<Defaults and Layouts>** folder.

4. Open Export Options and check for Google Earth:
5. Select menu *Module* | *Setup, Export* tab (figure below).
6. Scroll down and look for Google Earth (*.kmz).
7. If you find it, *Cancel* and continue to the step 5.

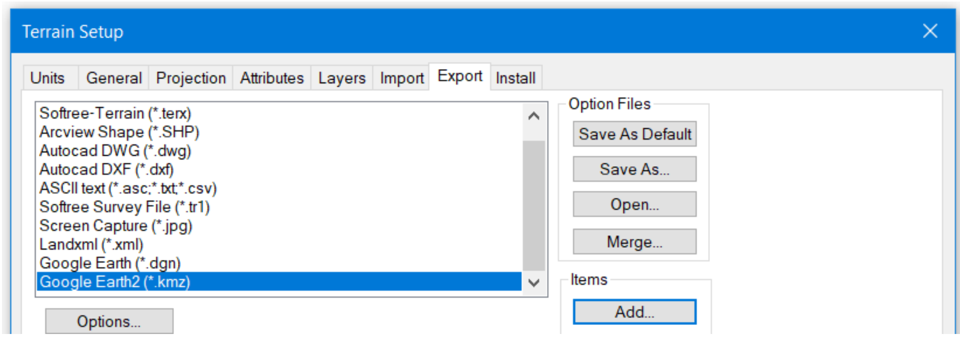


Figure 5-25: Export Specifications

8. If the Google Earth export format does not exist, press the *Add* button to open the dialogue box below.

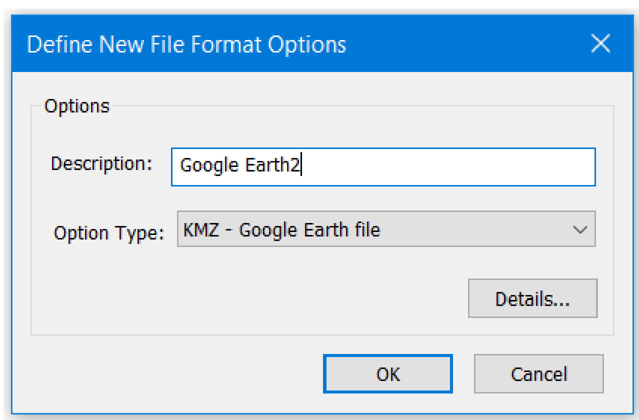


Figure 5-26: New export format options setup for Google Earth.

9. Set up the *Description* and select the *Option Type* as shown above.
10. Press *OK* to close the *New File Format Options* dialogue box.
11. Press the *Save As Default* button to save this export format for future use.
12. Press *OK*, to close the *Module* | *Setup* dialogue box.

You should now be ready to check the coordinate system by exporting to Google Earth.

13. *File* | *Save As* and choose Google Earth (.kmz) from the *Save as type* pull-down.
14. Enter a *File* name e.g. **roads_a.** Press *Save*.

The *Export Options* dialogue box will now open (figure below).

15. Make sure that *All Features* and *Open in Google Earth* are selected, as shown below. Press *OK*.

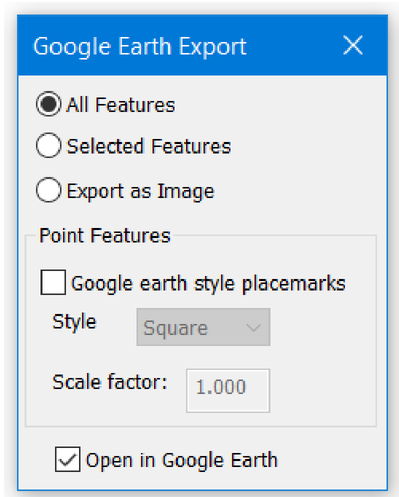


Figure 5-27: Google Earth export specification

This should run Google Earth and place your roads at the correct geographical position as shown in the figure below.

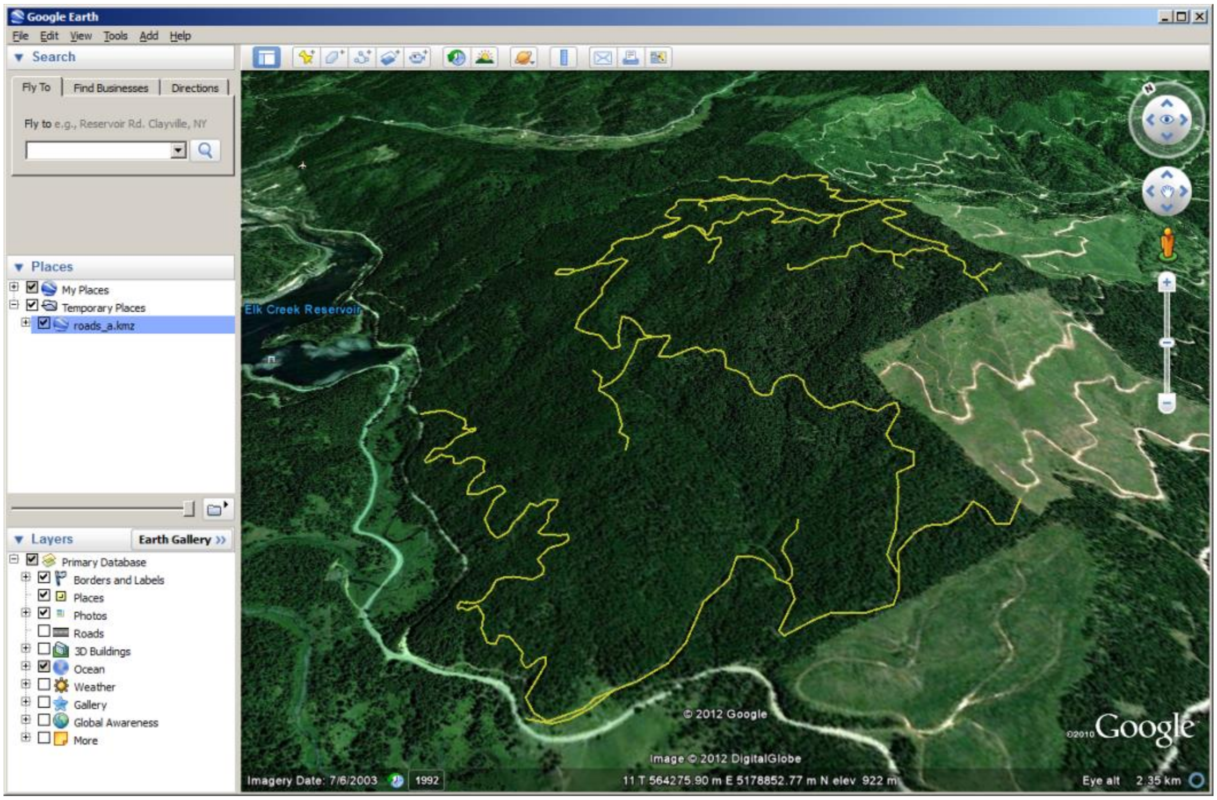


Figure 5-28: Google Earth Export

16. Close Google Earth

17. *File* | *New* to continue to the next example. *File* | *Exit* to close Terrain module. Do not save the changes.

6. Working with LiDAR

LiDAR (**Li**ght **D**etection **A**nd **R**anging) surveys produce very large amounts of relatively accurate three dimensional point data. The data includes points representing laser light scattered from the ground (bare earth), foliage, buildings, transmission lines and other objects. This data is usually broken into tiles, each containing a few million points.

Size and Accuracy Considerations

- The 32-bit version of RoadEng® is limited to approximately 5 million points. The 64-bit version of RoadEng® can handle more points depending on the speed of the user's CPU processor and amount RAM, 10 million points is reasonable.

- Interpolating the LiDAR into regular grid format is <u>not</u> recommended, because this creates points by interpolation (lost accuracy). For accuracy purposes, it is better to work with the raw data points.

- When importing LiDAR data, it is very important to group points together instead of making feature for every point. Features require a significant amount of memory (much more that a point) so it is best to store thousands of points per feature.

It is not uncommon to have data sets with hundreds of millions of points (well exceeding the recommended maximum of 10 million points). This limitation is generally not a problem for most corridor projects, if points outside the area of interest are thinned. Consider a relatively large road project say 20 kilometers (~ 12 miles). Assume that your LiDAR horizontal resolution is 1 meter (3 feet) and that you have identified a corridor that is 200 meters (~656 ft.) wide along a preliminary alignment. This yields about 4 million data points.

Importing LiDAR in ASCII format

Large data sets need to be loaded in such a way that they use the least amount of memory possible. In the next section, you will load a prepared LiDAR import format from an **IOP** (Input/Output Parameters) file.

Note: If your data is in LAS format, many of the steps in the next section are not required. However, the corridor thinning technique is required for both formats. LAS format is the preferred format for LiDAR, as it is compact and loads fast.

1. *File | Open* <Terrain>\LiDAR**Empty.terx**
2. *Setup | Module Setup* button. This opens a Terrain Setup dialogue box.
    - Select the *Import* tab.
    - Check if *LiDAR (x,y,z,code)* already existing in the dropdown menu. If that format in not present press *Merge...* button and browse to find the import options file. <Terrain>\LIDAR***Lidar2.iop***.
    - Press *OK*.
    - IOP files are Import/Export File Format and was already created.
    - Press *OK* button to close the Module Setup dialogue box.

Setting up a Linear Corridor Feature

Now you will read in a proposed center line and later use it to create an area of interest.

3. Home | Insert File button.
4. Browse for file <Terrain>\LiDAR\ **ProposedAlignment.SHP**. Press *Open* button.

The *Import Options* dialogue box below appears.

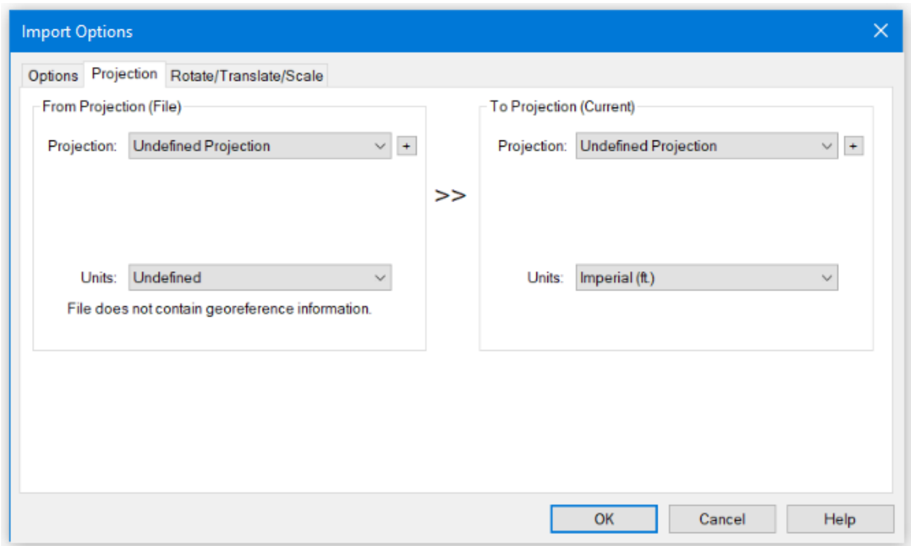


Figure 6-1: Import Options Dialogue Box

5. Press *OK*, Softree Warning stating “Incoming coordinate system and unit are undefined. OK to continue without conversion?”. Check box “Do not show this message again”.
6. Press *Continue* to load the proposed center line shown below. The reason for this is the coordinate system and units in **empty.terx** are correct.

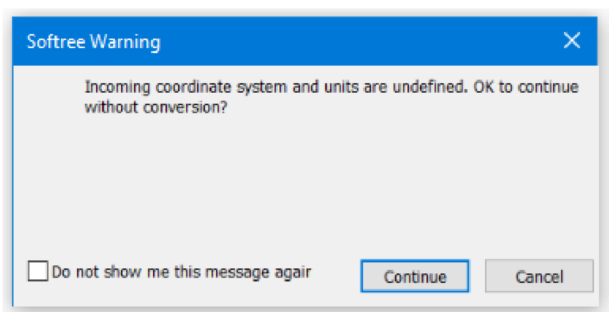


Figure 6-2: Softree Warning Message

Now that the road center line has been brought in, we can bring in the LIDAR data. This example only contains approximately 700,000 points to save download and file read time. In the following steps, we will read in the data at full resolution in the area of interest (AOI) and skip some points outside this area. In addition, we will follow some important guidelines to prevent slow draw times and memory overload.

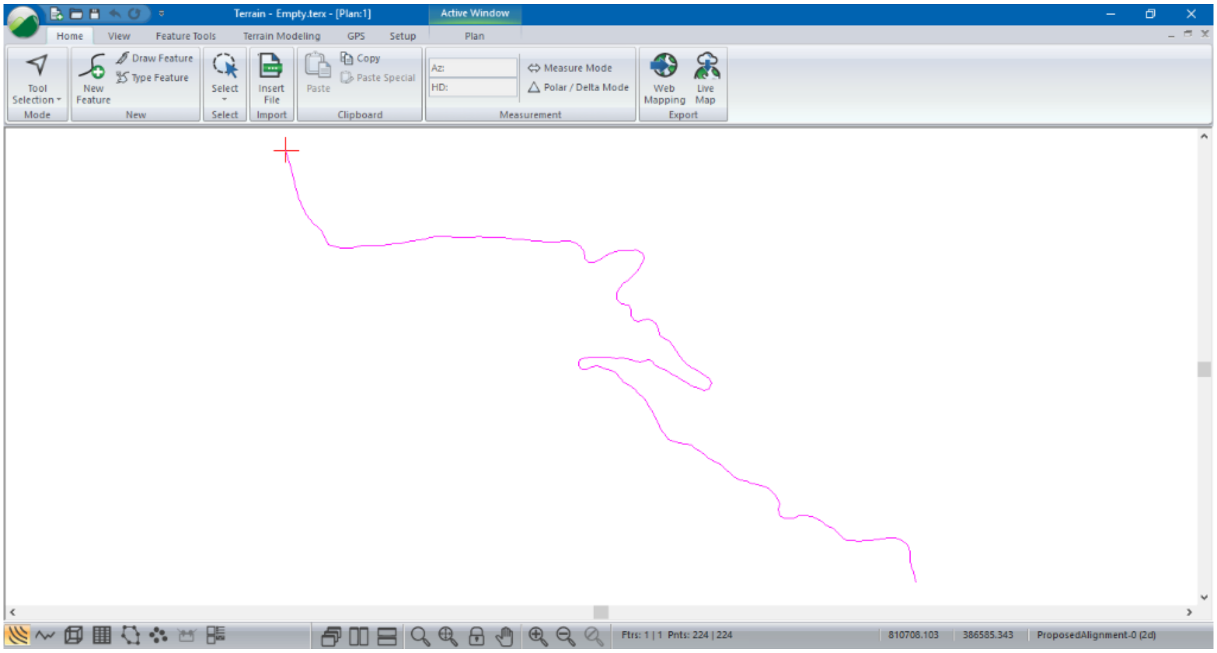


Figure 6-3: Proposed Road Center Line

7. Home | Insert File button.
8. Select *All Supported Files* from dropdown list and highlight both **.txt** files included with this example. <Terrain>**\LiDAR**

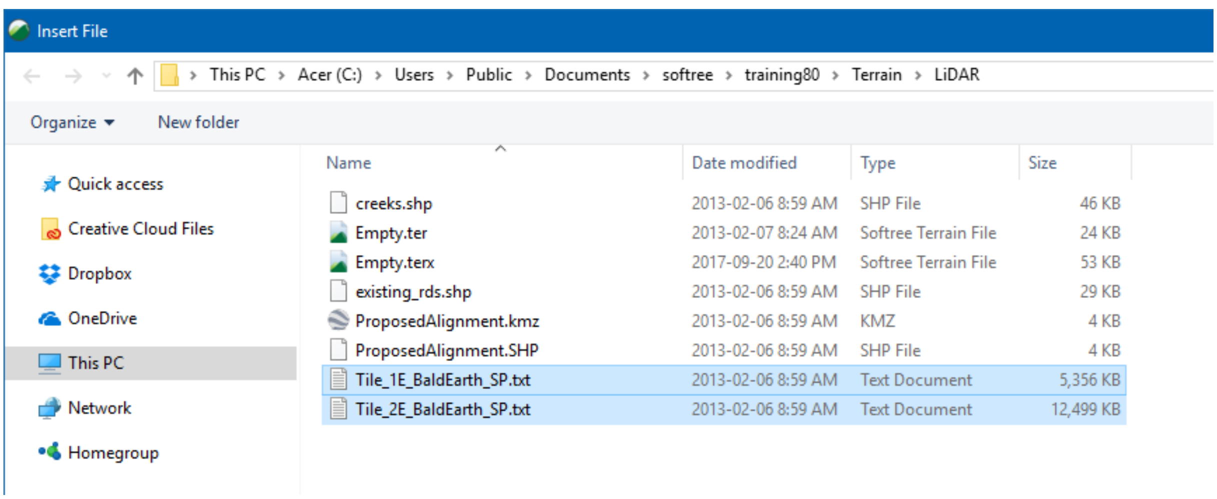


Figure 6-4: Inserting Multiple LiDAR files

9. Select ASCII Lidar (x,y,z) if prompted with a *Select Option* dialog. Press *OK*.

Note: Using *Home* | *Insert File* button unlike *File* | *Open* that allows multiple files at once and does not clear existing features from your Terrain.

You will now be presented with the import options (in case you want to make last minute changes).

10. Click the *Test* tab then *Next Record* button a few times to see what the file looks like.

Note that the *X, Y, Z* fields are showing the correct values (Figure 6-5). This indicates that the options set in the *Structure* tab are working correctly.

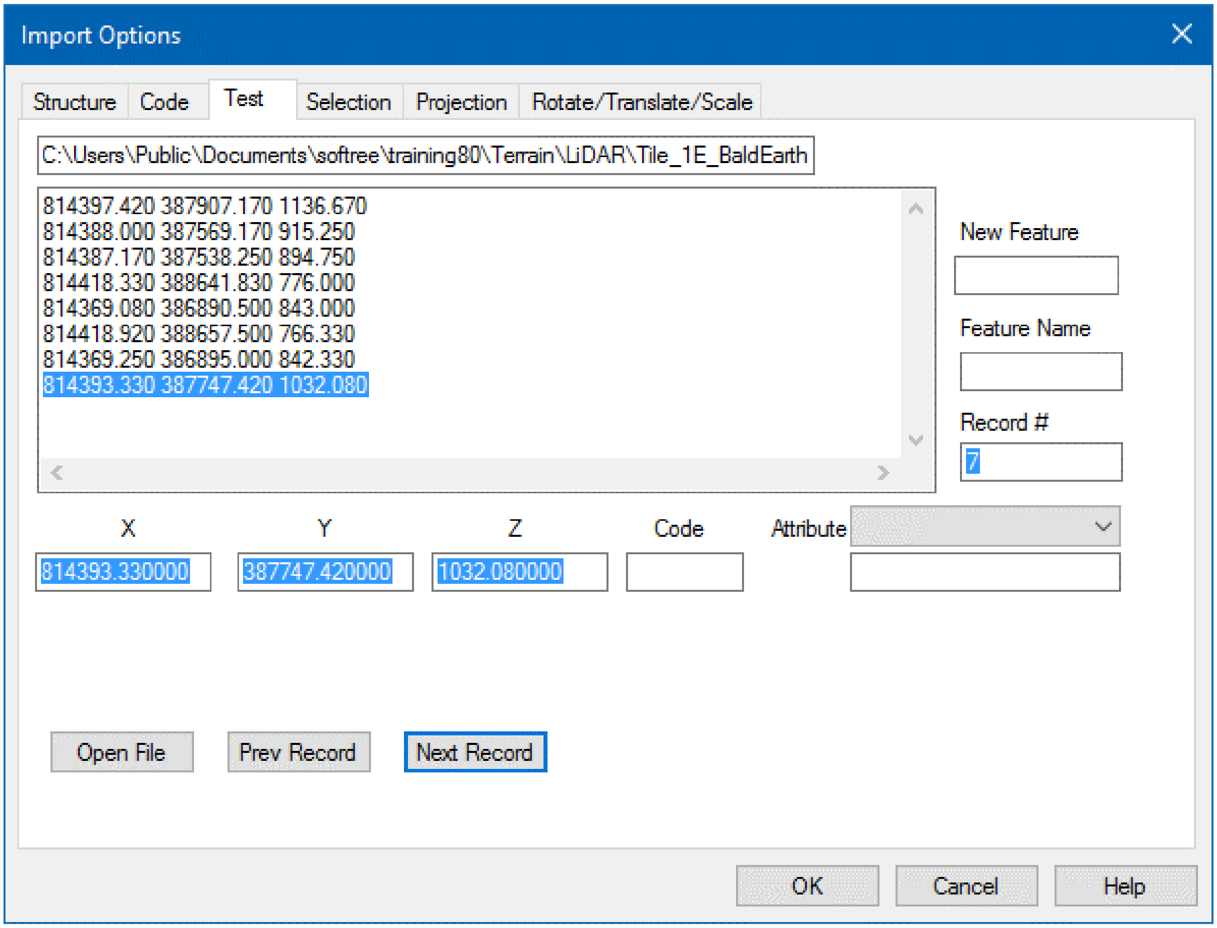


Figure 6-5: The *Test* Tab After Pressing the *Next Record* Button a Few Times

Note: Memory Usage / Display Speed Guidelines

Other *Import Options* have been setup to avoid using more memory than necessary and to make the resulting Terrain display manageable. The following rules are necessary when importing large data sets:

a) Do not attach comments or other attributes to every point.
b) Do not allow very large numbers of points in features.
c) Do not make every point into a separate feature.
d) Do not attach symbols to every point.
e) Do not turn on labels (such as Elevation) that will display at every point.

If you use the standard LiDAR import options, these guidelines will be taken care of for you.

11. Click on the *Structure* tab. Notice that there are no *Attributes* defined in the *Column Assignments* section (Rule A).

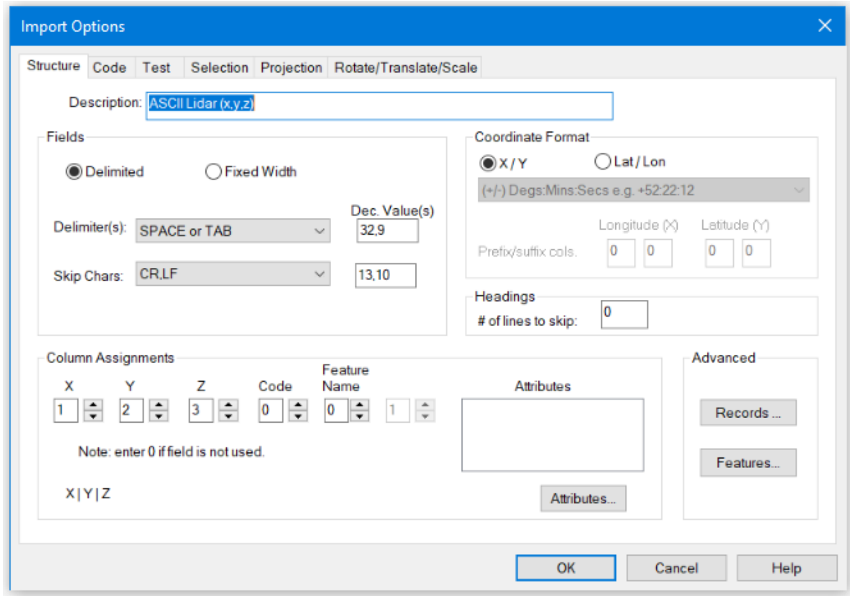


Figure 6-6: The Structure Tab Defines the Location of the X,Y,Z Coordinates

12. Structure tab | Features... Check Limit size of Features, Set Max points per feature: **1024**. Press OK to close.

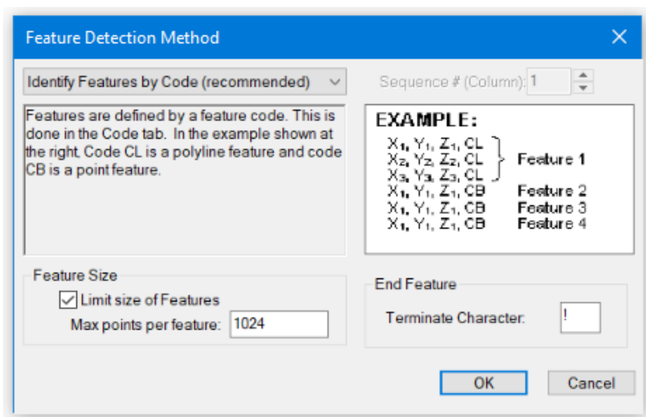


Figure 6-7: Feature Size is Limited to 1024 points

13. *Code* tab, set the following fields:

- Type: *Polyline*
- Feature Creation: *Connect All*
- Connected: *No (dropdown).*
- Also note that no symbol is defined (rule *D* above). In some cases, it makes sense to turn off the *Displayed* property, to speed draw time later.

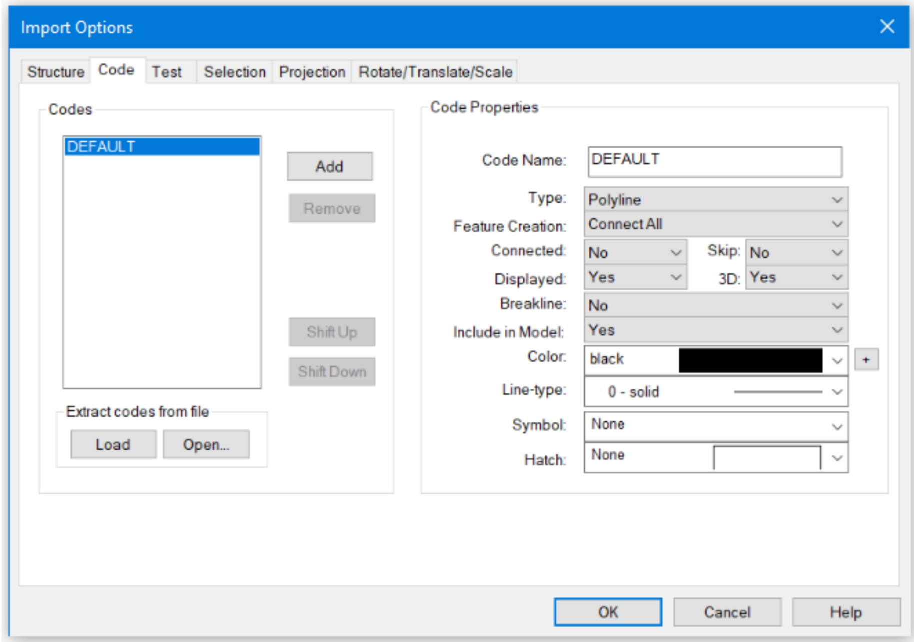


Figure 6-8: Point Code Properties Suitable For Large Data Set Import

Thinning Data on Import

There are now 3 different point-thinning options available in the Terrain module. This example will detail thinning at the time of import. When possible, it is recommended to use the two other methods (detailed later in this chapter), as they both result in more accurate surface representations.

14. Click on the *Selection* tab to show the options below:

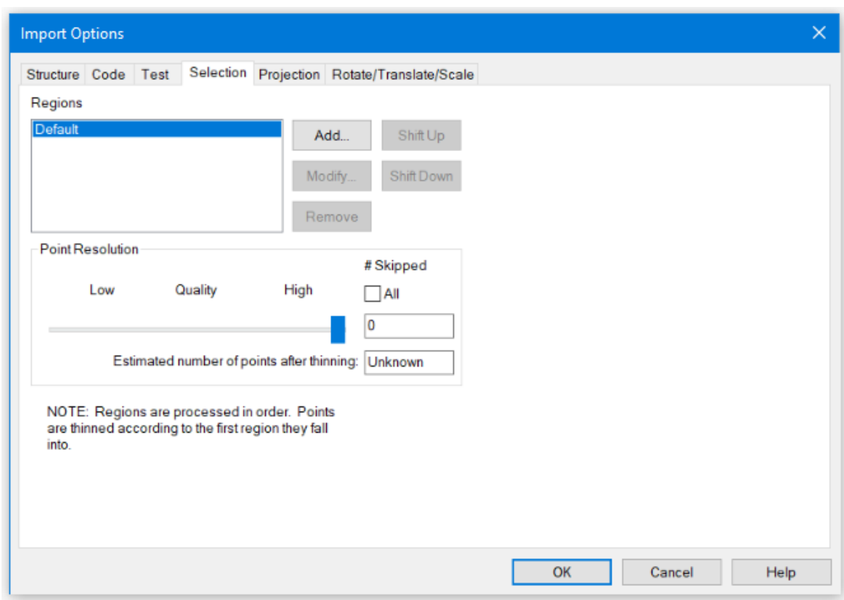


Figure 6-9: Selection Options

15. Press *Add...* to open the *Filtering Region* options as shown below.

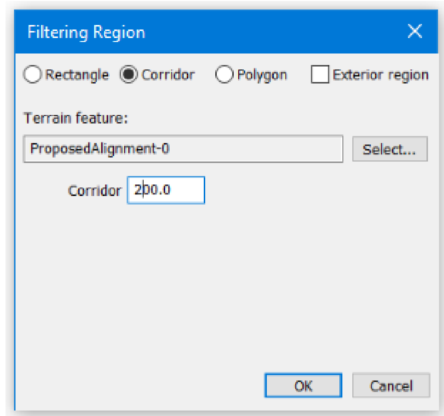


Figure 6-10: Filtering Options

16. Select *Corridor* (Figure 6-10). Then press *Select...*
17. This dialog allows you to specify features (rectangles, corridors or polygons) to filter around. <Double-clic>k on the alignment feature “ProposedAlignment-0”. Press *OK*.
18. Set the *Corridor width* to **200**. Press *OK*.

Refer to figure below:

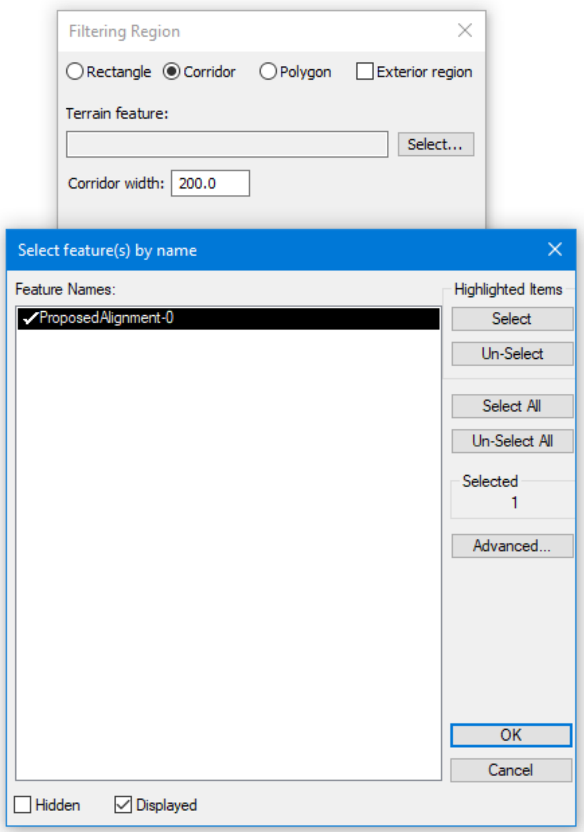


Figure 6-11: Defining a Corridor with a Linear Feature

19. Select *Default* in the list and set the *Point Resolution* to **9**.

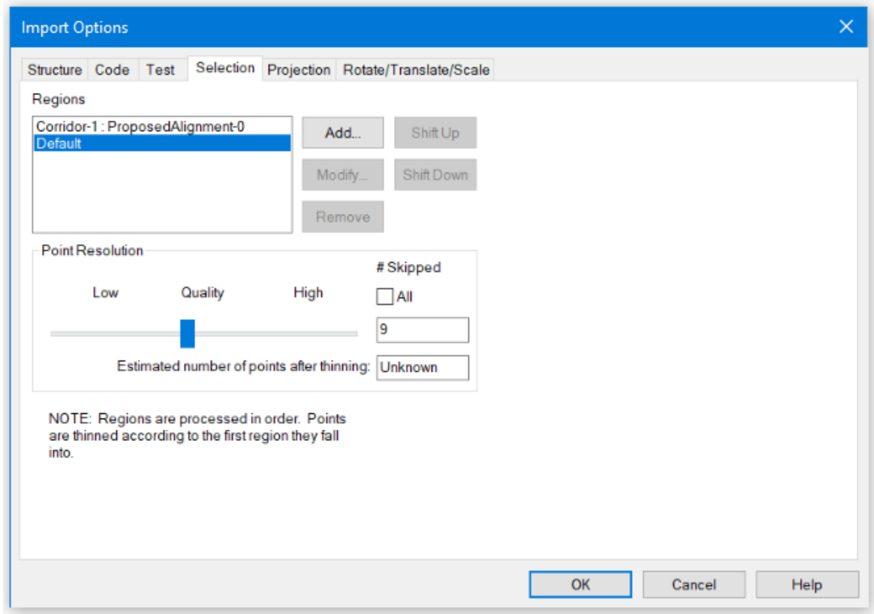


Figure 6-12: These Setup Options will Skip Most Points Outside of Corridor-1

20. Press the *OK* button to read the data.

It will take a couple of minutes to import about 69,000 points out of the 680,000 available.

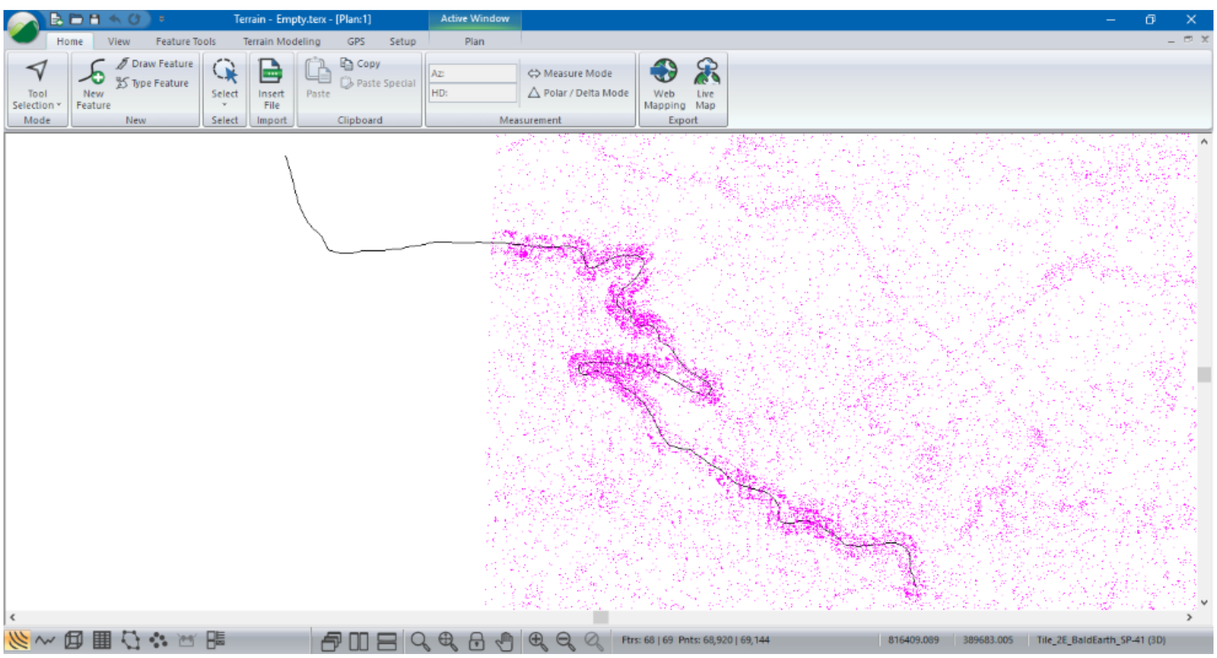


Figure 6-13: Full Point Density Along a Corridor, Reduced Density Outside

Thinning Data After Import

There are three new methods of thinning (simplification). The first two of these result in a more accurate surface representation than the thinning options on import:

- **Basic Grid Simplification (fast):** This thinning method is based off a defined grid size. One point per grid is retained. The *Calculate* button in *Point counts* can be used to quickly determine the % reduction of points.

- **Closest Point Removal (slow):** This thinning method utilizes both a minimum distance and a defined sample grid size. Multiple points per grid can be retained if they are further than the minimum distance. In the figure below, the minimum radius is represented in the first grid cell by the green circles. Neighboring points within the cell that fall in the radius are removed. This method is considerably slower than the basic grid. We recommend setting a radius smaller than the grid size.
- **Remove all points:** This thinning method removes all points. It is useful for removing wanted points that fall outside areas of interest (*Excluded regions*).

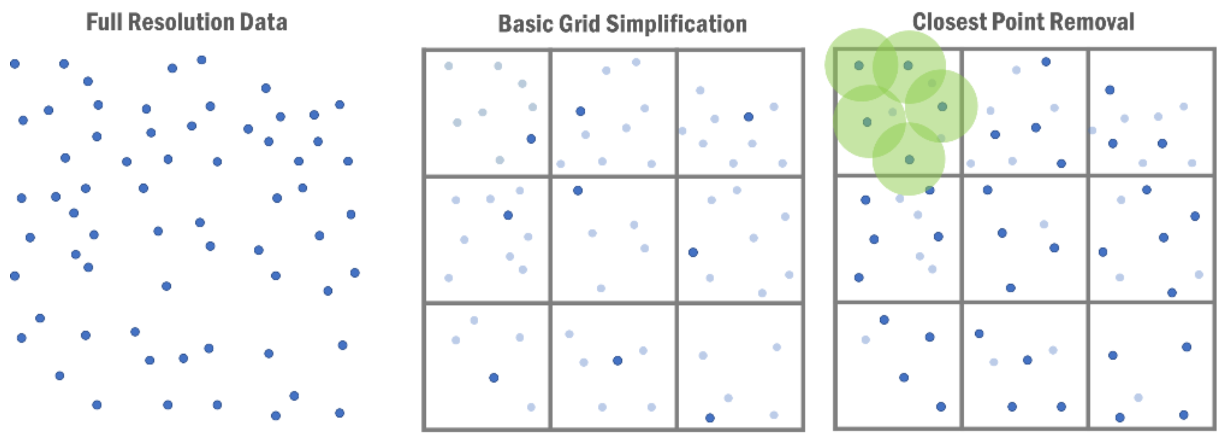


Figure 6-14: Thinning Methods

We will start by opening the previous design with shape file and LiDAR already imported, but in full resolution.

1. *File* | *Open* <Terrain>\LiDAR**Thinning After.terx**

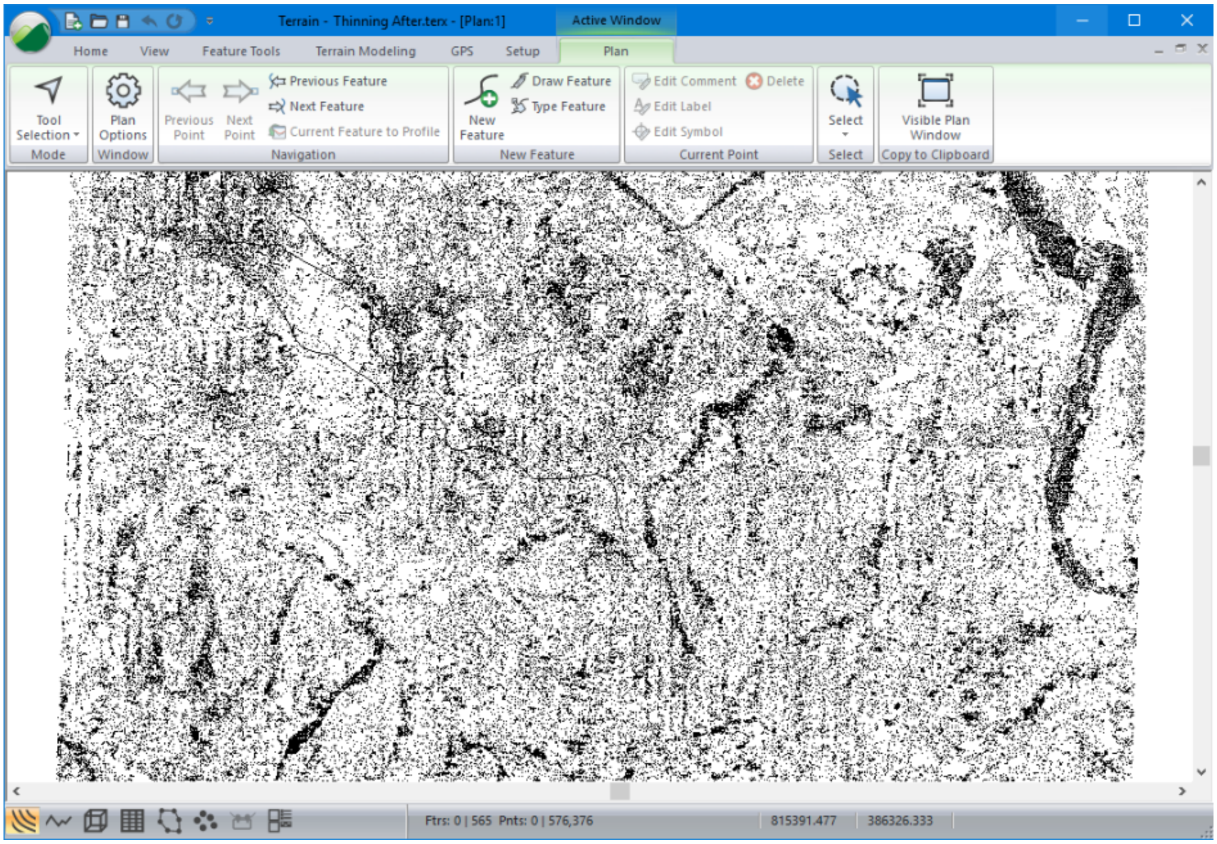


Figure 6-15: Thinning After.terx

2. Terrain Modeling | Simplify. This will open the Simplify Surface Point Data dialog.

Basic Grid Simplification (fast)

We will first explore basic grid simplification.

3. Ensure the Method is set to Basic Grid Simplification (Fast). Set the Sample Grid Spacing set at **20.00.**
4. Under Excluded Regions, press Add.
5. Select *Corridor* (similar to how we thinned on import in the previous example – see Figure 6-11). Then press *Select…*
6. This dialog allows you to specify features (rectangles, corridors or polygons) to filter around. <Double-click> on the alignment feature "ProposedAlignment-0". Press *OK*.
7. Set the *corridor width* to **200**. Press *OK*.
8. Press Calculate.

Your dialog should now look like the figure below. Under *Point Counts* you will see that our settings will result in a 74.1% reduction, but the area within the corridor will remain in full resolution.

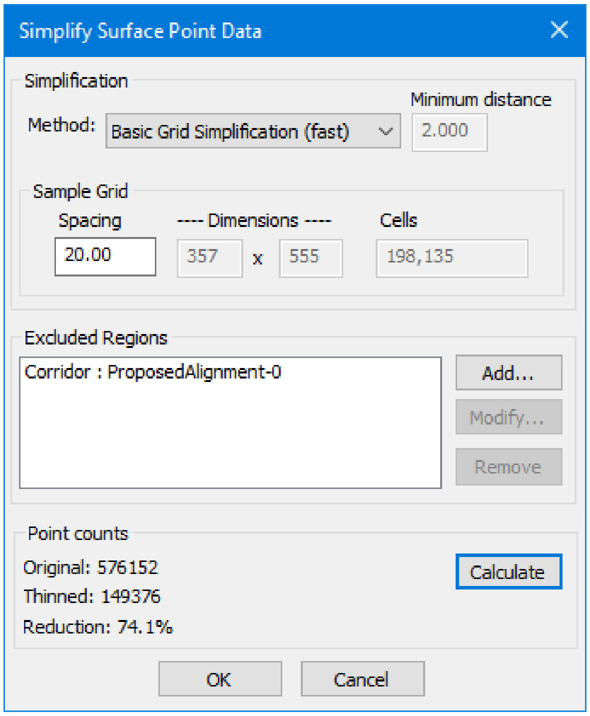


Figure 6-16: Basic Grid Simplification

9. Press *OK* to proceed with the thinning.
10. Press *OK* when prompted with the warning message: "Warning there is not enough space to UNDO this operation. Do you wish to continue?"

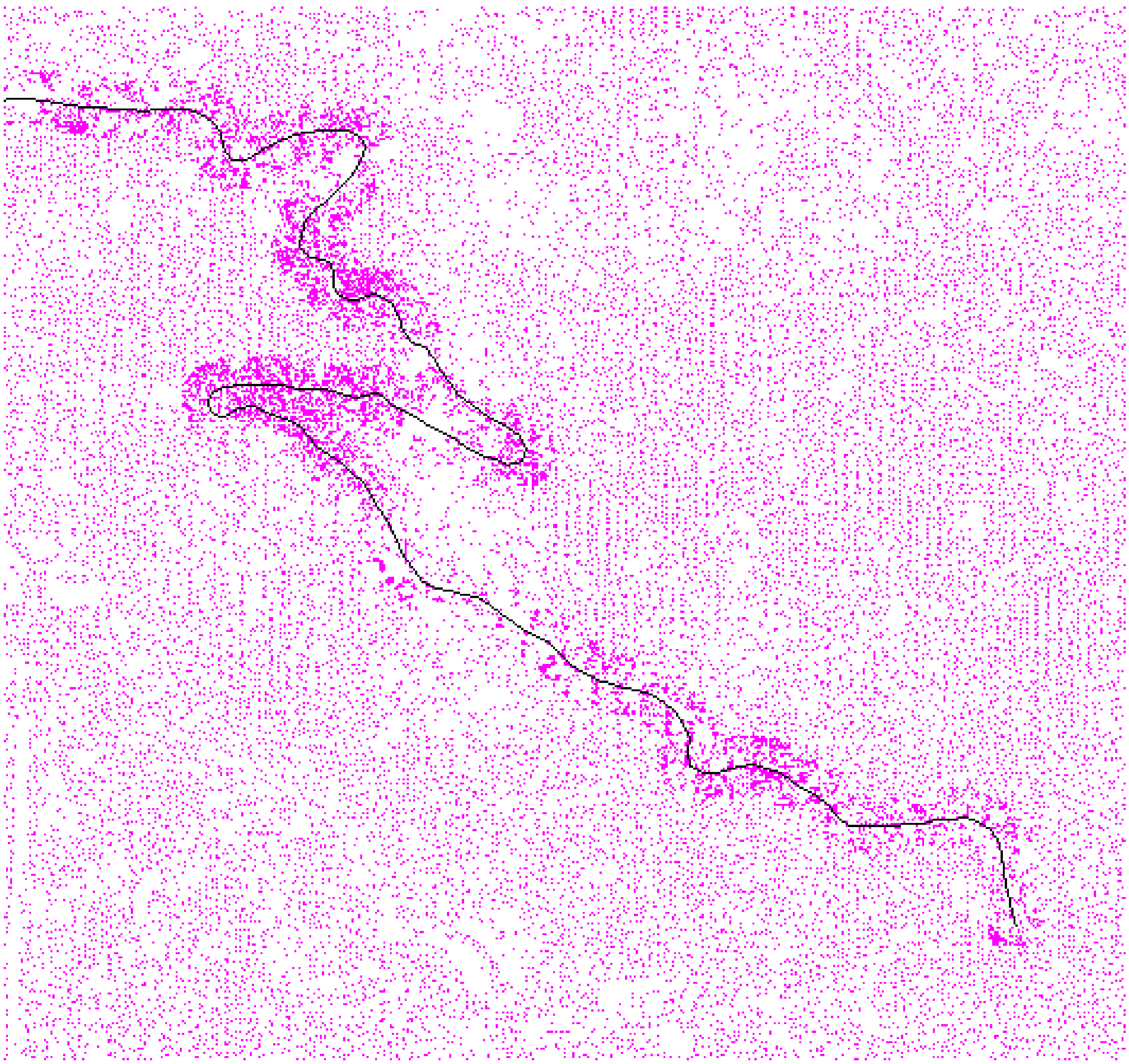


Figure 6-17: Basic Grid Thinning Results

The total point count of our surface has been reduced to 149,376 from the original 576,152.

11. *File* | *New*. Do not save changes.

Closest Point Removal (slow)

We will now see the impact Closest Point removal.

12. *File* | *Open* <Terrain>\LiDAR**Thinning After.terx**
13. Terrain Modeling | Simplify button. Ensure the Method is set to Closest Point Removal (Slow)**.** Set the Sample Grid Spacing set at **20.00.** Set the Minimum Distance at **10.**
14. Under Excluded Regions | Add… | Select Corridor | press Select…
15. <Double-click> alignment feature “ProposedAlignment-0. Press *OK*.

16. Set the *corridor width* to **200**. Press *OK*.

Your dialog should now look like the figure below:

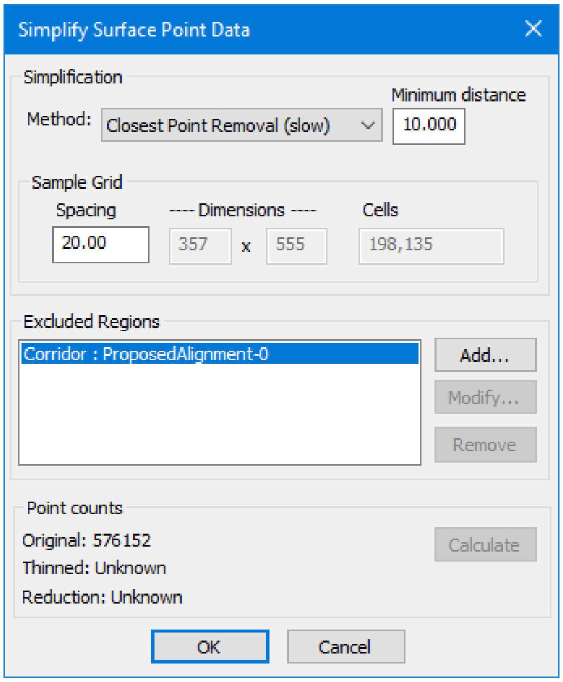


Figure 6-18: Closest Point Removal Setup in Dialog

17. Press *OK* to proceed. Press *OK* when prompted with the warning. The screen now displays the thinned points.

Note: Unlike the fast method, the Closest Point removal method cannot estimate point counts from within the dialog. Press *OK* to proceed with the thinning.

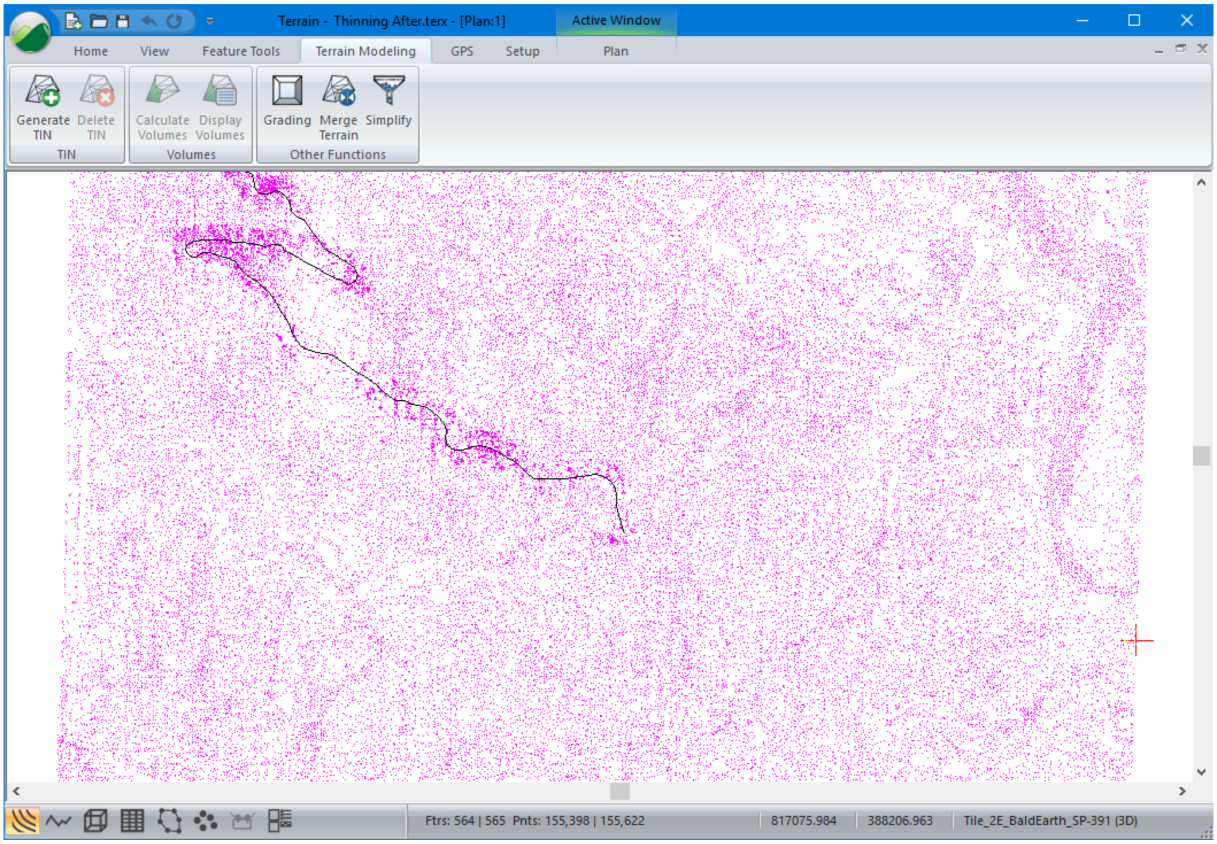


Figure 6-19: Basic Grid Thinning Results

The total point count of our surface has been reduced to 155,398 from the original 576,152.

7. Working with Live Maps

Depending on project requirements and what resources are available, your project may benefit from incorporating publicly available data hosted on the web. To help streamline this process, Live Maps was added to Terrain in Version 9. This feature acts as a portal to web-hosted data sets and allows the user to view ortho images and low-resolution DEM data on the web. Users can select the area they wish to download, and download the data directly into Terrain. By default, Terrain includes Google, Bing, and Map Tiler as potential data sources.

Importing USGS Format DEM Data With Live Maps

Occasionally course topographic data meets project requirements, it can act as a temporary placeholder until detailed topographic data has been procured, or it can be used to supplement detailed survey data. Map Tiler hosts topographic information for the entire earth, including topographic data in raster format.

Live Maps DEM Data Import Example

This example will explore steps required to download topographic data from Map Tiler to create a surface in Terrain. As a starting point, we will add a KMZ file with a preliminary alignment to set our project projection and use it's feature as a spatial reference to locate the data we wish to download.

1. Open a new terrain file, *File* | *New*
2. *Home* | *Insert File* <Terrain>\LiDAR\ProposedAlignment.kmz
3. In the *Projection* tab of the *Import Options* dialogue box change the *To Projection (Current)* to UTM zone 10N as shown in Figure 7-1 below.

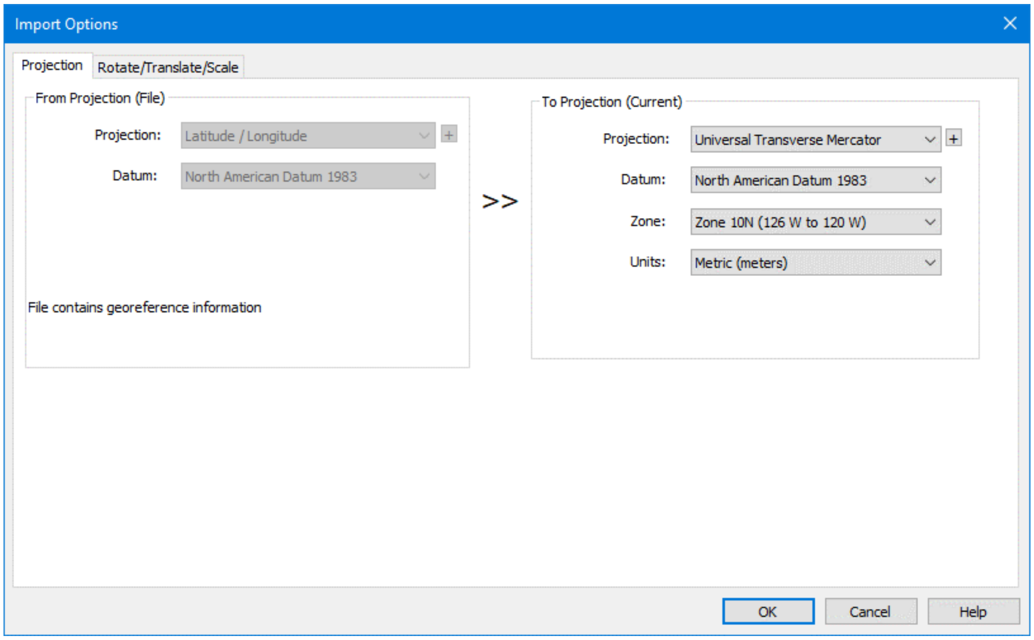


Figure 7-1: *Import Options* dialogue box.

Note: To import data from Live Maps, the Terrain file must have an assigned projection.

4. Press *OK*, then press *Apply Transformation (Recommended)* in the subsequent dialogue box.
5. Select the feature named *Layer #0* by clicking with the selection cursor or by using the *Select - By name* function found in the *Home* ribbon.
6. In the *Properties* panel, clear the *Elevations* check box and press *Apply*.
7. Press the import icon in the *Web Mapping* section of the *home* ribbon to open the *Live Map* dialogue box. The *Live Map Dialogue* box should appear similar to the one in Figure 7-2 below.

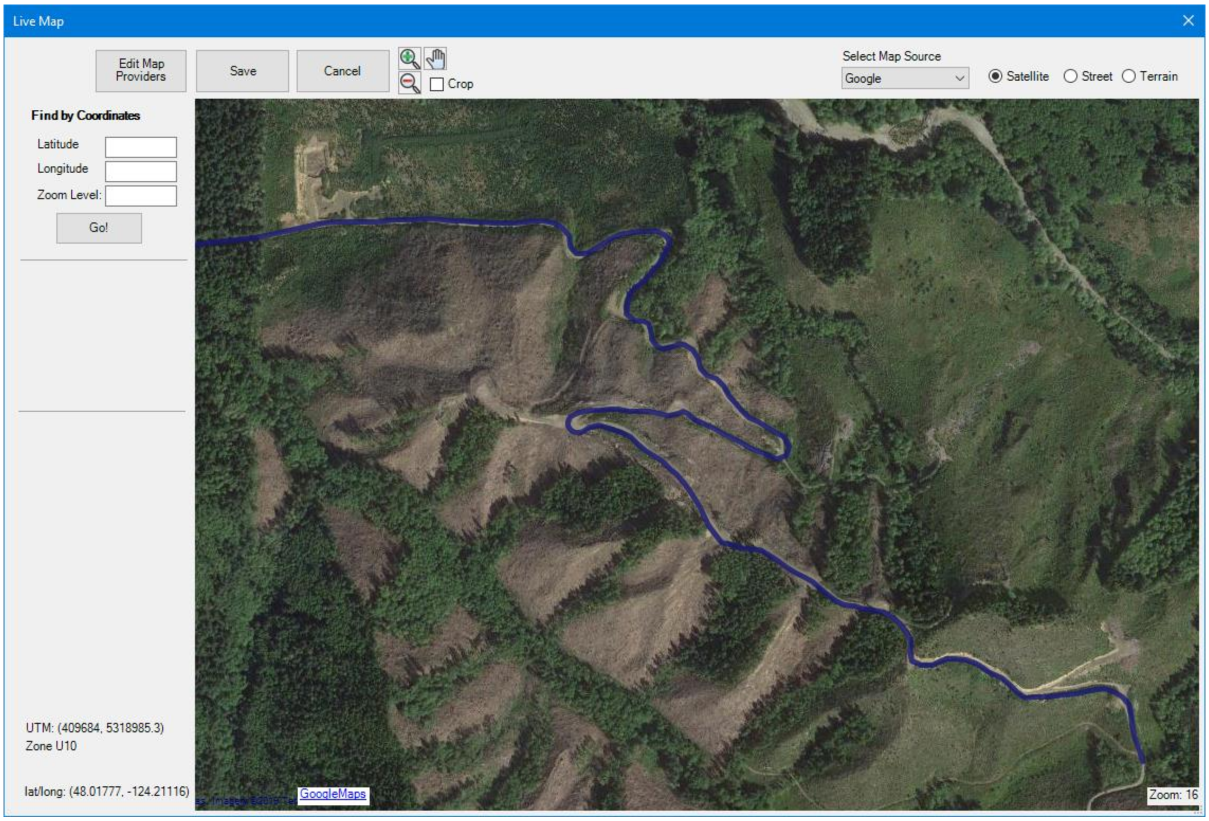


Figure 7-2: *Live Map* dialogue box.

8. In the upper right corner of the dialogue box, set the type of data to *Terrain*.
9. You will be presented with the advisory dialogue box below. Press *OK*.

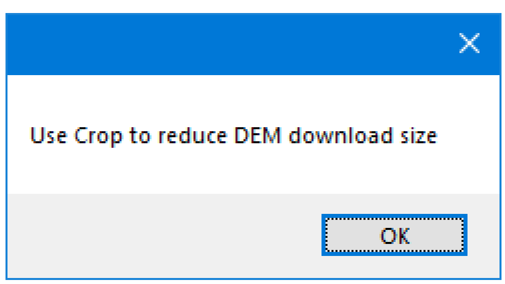


Figure 7-3: Warning dialogue box that appears when the live map content is changed from *Satellite* to *Terrain.*

10. In the dropdown list under *Select Map Source* select *Map Tiler*. Your *Live Map* dialogue box should now appear similar to the one below.

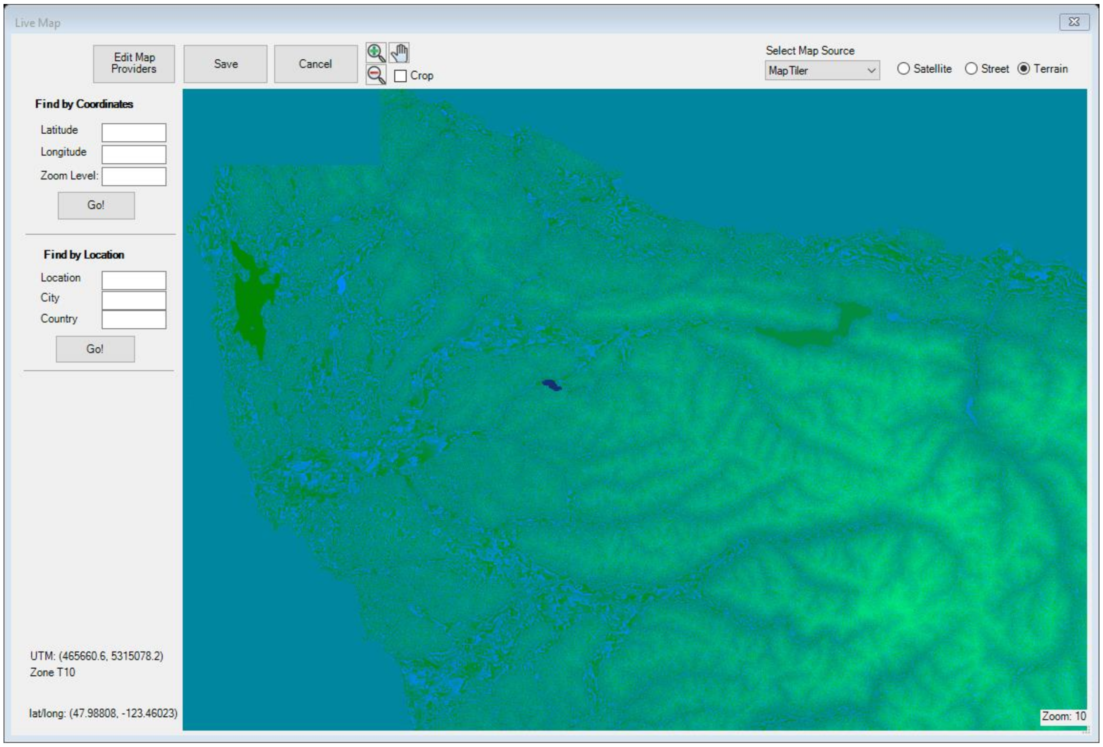


Figure 7-4: Live Map dialogue box with Map Tiler and Terrain data selected.

You may note that the *Live Map* window shows a large area and the proposed road alignment now appears as a blue, irregular dot in the middle of the screen. To avoid saving topographic data for the entire display area we will use the crop tool.

11. Set the *Crop* check box and draw a box around the proposed road by left clicking and dragging a grey box around the area of interest. Once complete, the *Live Map* dialogue box should appear similar to the one below.

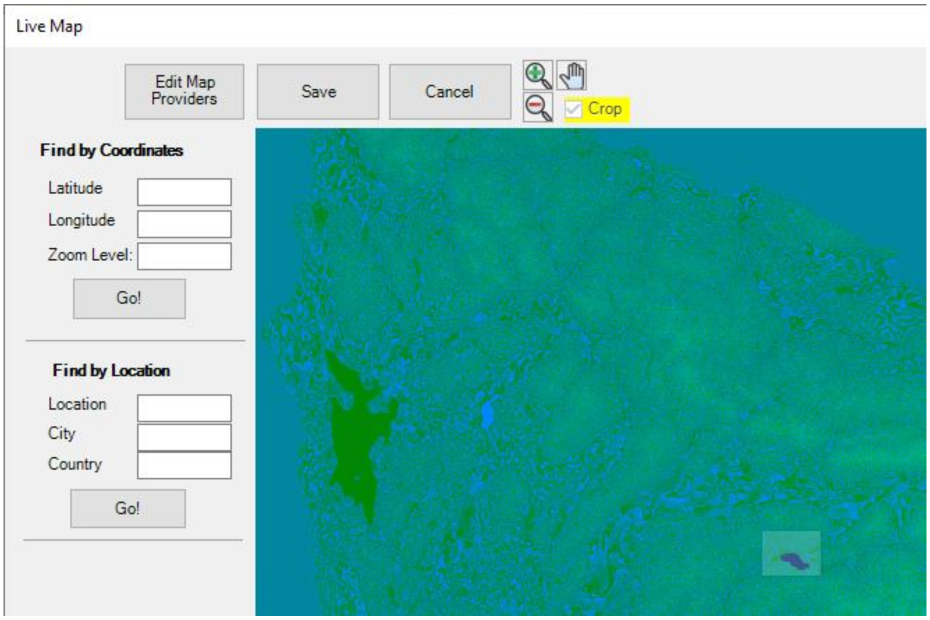


Figure 7-5: Live Map dialogue box with area to be cropped shown in grey.

12. Press *Save* in the *Live Map* dialogue box, then press *Save* in the subsequent *Save Form* dialogue box.
13. A *Warning* dialogue box will appear that informs you the number of tiles you will be downloading and the size of the resulting file. Press *Yes* to continue.

A progress bar will appear which illustrates the progress of the download. It will disappear, then the *Live Map* dialogue box will disappear. The DEM File Import dialogue box will appear in the main window as the topo data is brought in. Once the data has finished importing, a warning will appear that reads, *LiveMaps DEM data imported into Terrain model*.

14. Press *OK* to continue.

Now, generate a TIN for the area of interest and check the surface in the 3d view:

15. In the *Terrain Modeling* ribbon, press *Generate* button.
16. Set the *Terrain Calculation* parameters to match the ones shown in Figure 7-6 below, then press *OK.*

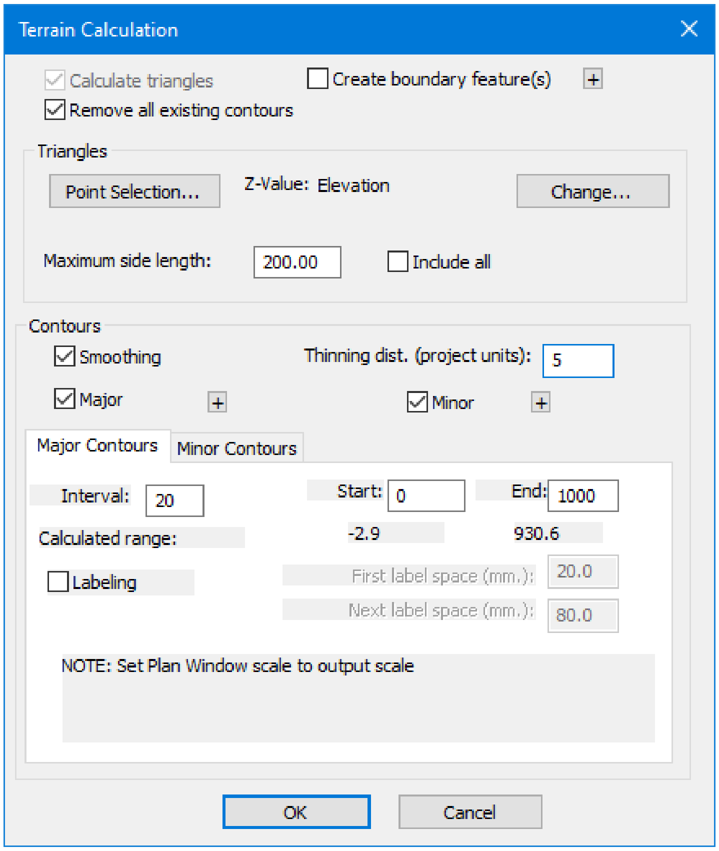


Figure 7-6: Terrain Calculation parameters to be used to generate TIN with Live Map DEM data.

The main screen should now appear similar to the one below.

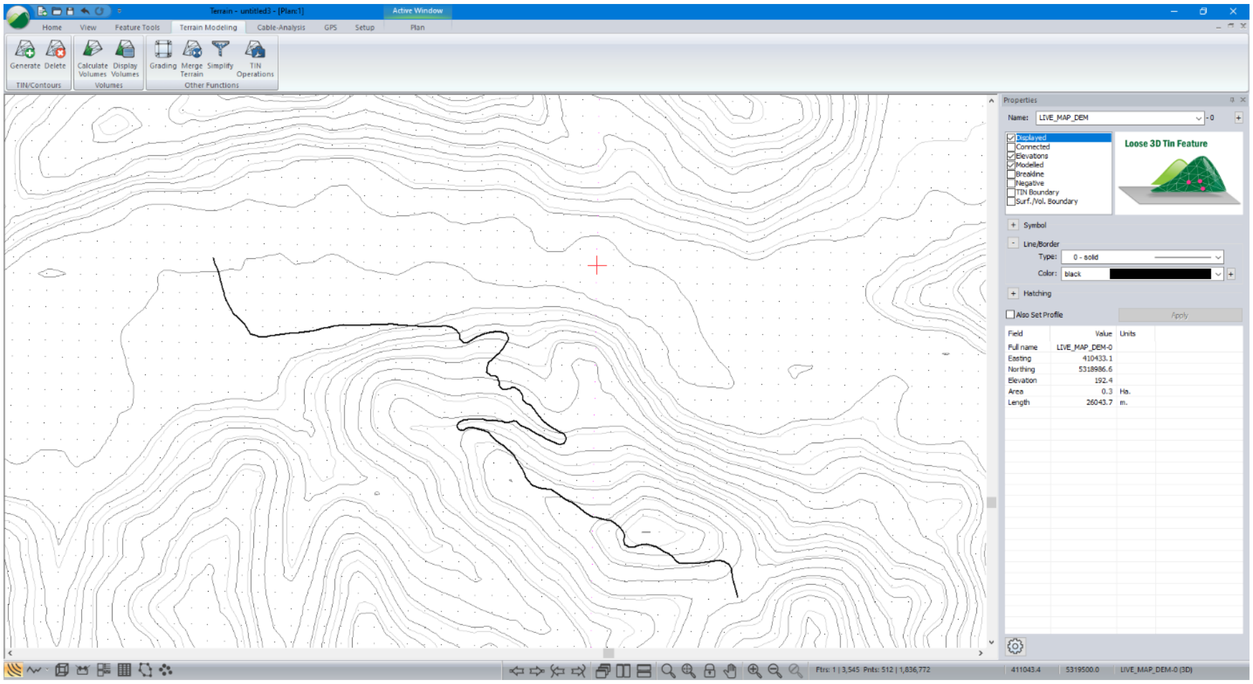


Figure 7-7: Main screen following TIN generation using topo data imported with LiveMaps.

Importing Ortho Imagery With Live Maps

Publicly available ortho imagery can be quite useful during the design process and can often be more current and of higher quality than images sourced privately if the private data is several years old. Live Maps can be used to streamline the download and import of publicly available ortho images to be used as a background in Terrain and Location.

Live Maps Ortho Image Import Example

17. Select the feature named *Layer #0* by clicking with the selection cursor or by using the *Select - By name* function found in the *Home* ribbon.

18. Press the import icon in the *Web Mapping* section of the home ribbon to open the *Live Map* dialogue box. The *Live Map* dialogue box should appear similar to the one in Figure 7-2 above.

The area visible in the *Live Map* dialogue box should be zoomed to show the extents of the selected feature and the default data source should be set to *Google*.

19. Press *Save*.

20. In the *Save Form* dialogue box, drag the Zoom marker to the far right to maximize image resolution. The dialogue box should appear similar to the one shown below.

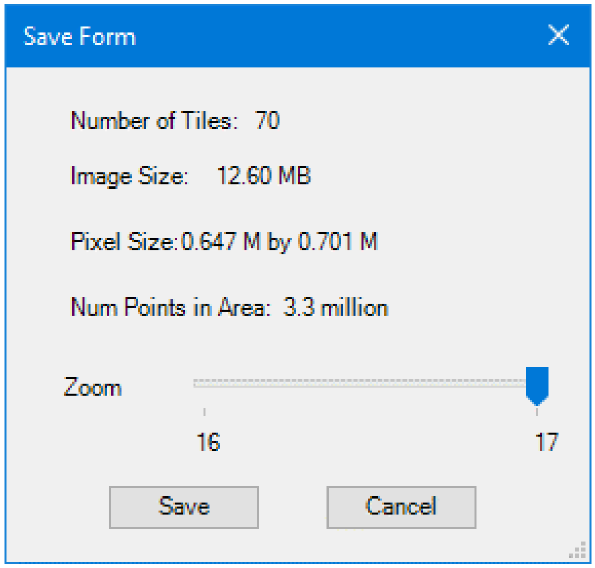


Figure 7-8: *Save Form* dialogue box with the *Zoom* marker dragged to the far right.

21. Press *Save*.
22. A *Warning* dialogue box will appear that informs you the number of tiles you will be downloading and the size of the resulting file. Press *Yes* to continue.

A progress bar will appear which illustrates the progress of the download. It will disappear, then a *Save an Image File* dialogue box will appear.

23. In the *Save an Image File* dialogue box, select a save location, name the file.

After pressing *Save, the Save as Image File, Save Form,* and *Live Map* dialogue boxes should disappear and the *Import Options* dialogue box should appear in the main window similar to that shown in below.

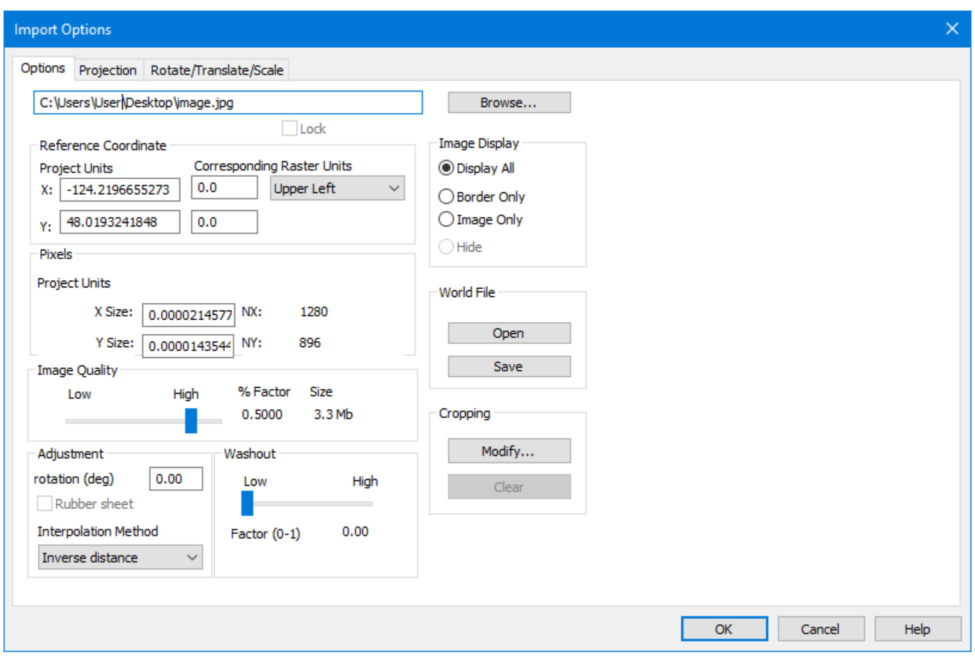


Figure 7-9: Import Options dialogue box.

24. Press *OK*.

Note: Typically, most of the parameters in the *Import Options* dialogue box will not require updating when using *Live Maps*. The exception to this is the *Image Quality* parameter. Depending on the size of the file being imported the quality of the image may be adjusted to improve computer performance. If you would like the image to appear in its full resolution, adjust the image quality marker to the far right (% Factor of 1).

The main screen should appear similar to the one shown in the figure below.

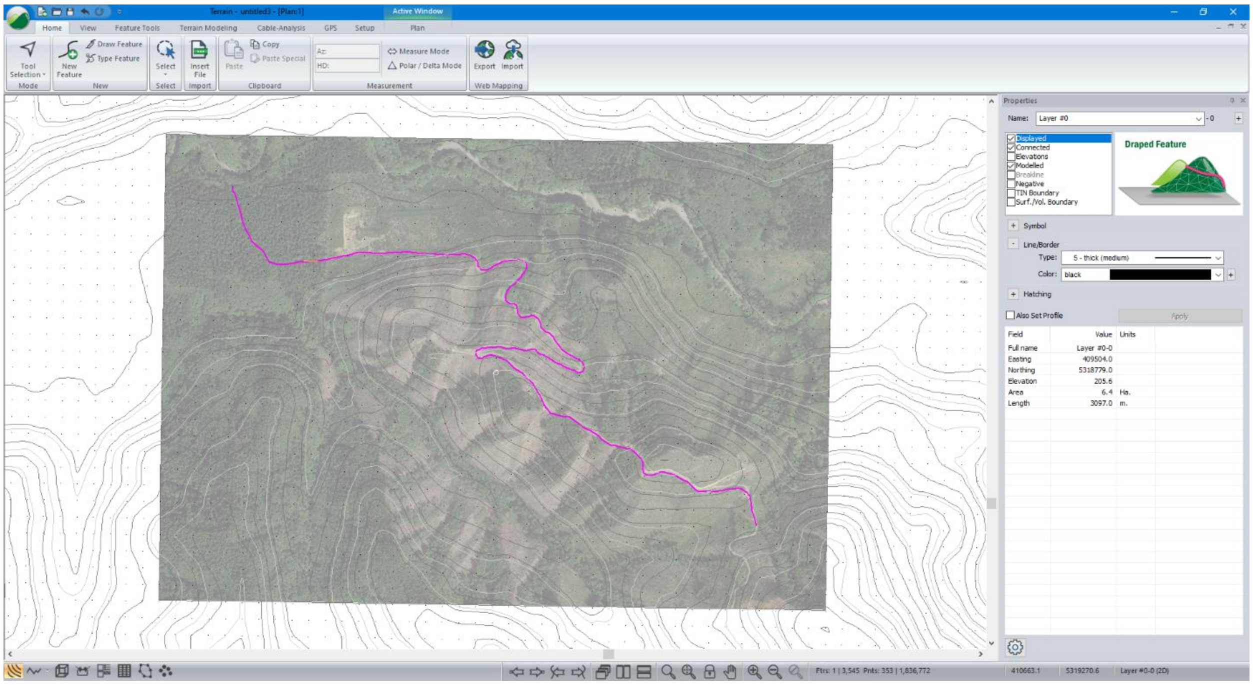


Figure 7-10: The main screen following the import of background imagery using Live Maps.

25. *File* | *New*, do not save changes.

8. Digital Terrain Modeling

A TIN (Triangular Irregular Network) Model is a 3-dimensional surface which can be used to generate contours and profiles. Each triangle is a planar facet with vertices at the known elevation points.

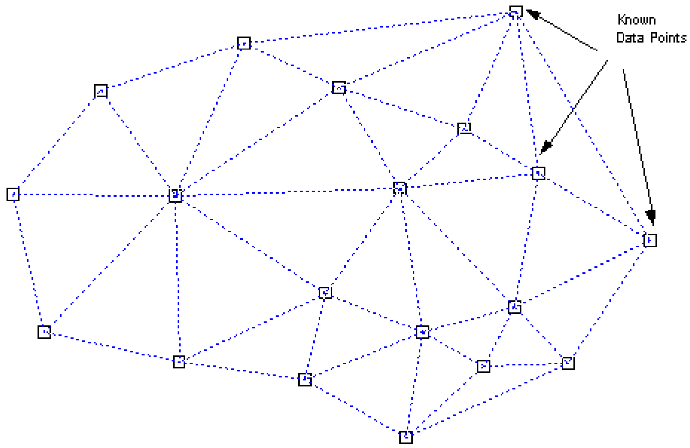


Figure 8-1: Triangle Mode

Once a TIN model has been created, the program can rapidly determine the elevation of a new point using the known elevations of the surrounding triangle. This allows contours and profiles to be generated.

To follow the examples and procedures in this section, the *Mapping and Drafting, Import Basic, Import Extended, Surface Generation and Contouring,* function groups need to be enabled. The last example also requires the *Volume Calculation and Reporting* function group. See *Function Groups* in the On-line help for more information.

Creating a Contour Map

Road Design Example

In this example, a DXF file containing a section of designed road will be imported. Although the file was created in the Softree - Location Module (by exporting the road edges, slope stakes and right of way lines), the concepts can be applied to coordinate data files generated by other methods (surveying, digitizing, GIS, GPS etc.).

Generating Contours

Note: See Getting Started section for file install folders (**<Terrain>** and **<Defaults and Layouts>**)

26. *File* |*Open* <Terrain>\LiDAR**Empty.terx**
27. *View* | *Retrieve Screen Layout* <Defaults and Layouts> \Training**training model.ilt**
28. *Home* | *Insert File*. From the *Files of Type* AutoCAD DXF (*dxf)
    Select <Terrain>\DTM**design1.dxf**.

The *Import DWG/DXF Options* dialogue will appear as shown in the figure below. Although it is not relevant to this example, the *Import DWG/DXF Options* dialogue contains several useful options. To find out more press the F1 key while this dialogue is displayed to access On-line Help.

29. Set the *Import Options* dialogue box *Options* tab to match those shown below. Press *OK*.

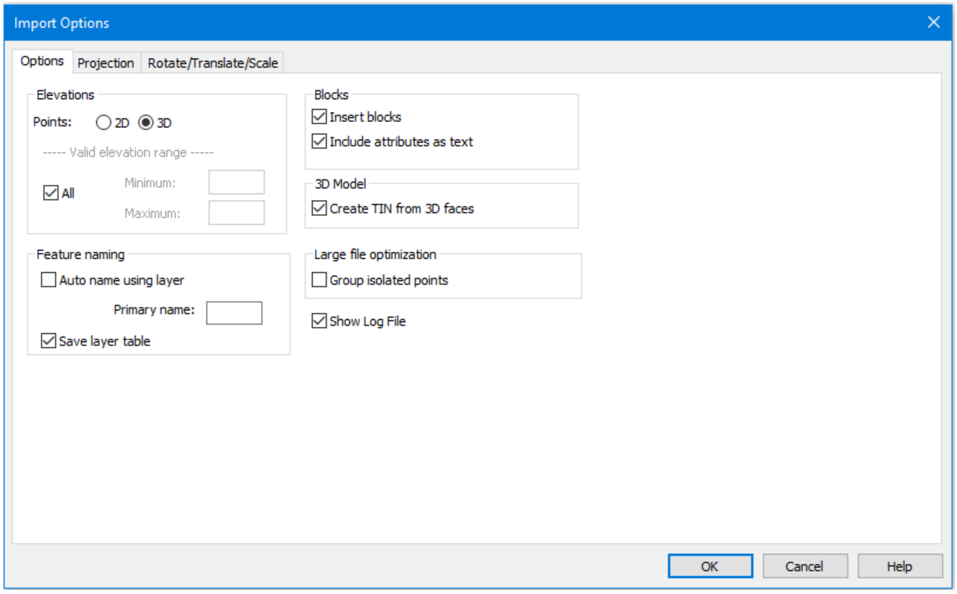


Figure 8-2: Import DWG/DXF Options Dialogue box Options Tab

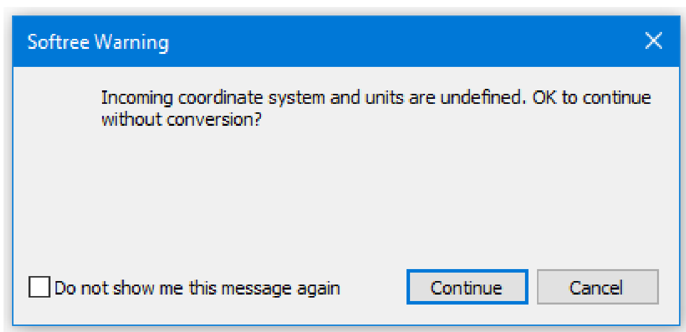


Figure 8-3: Softree Warning Message

30. Softree Warning appears – press *Continue*

31. *View* | *Zoom Extents* button.

The Plan Window now displays the Imported Features with Road Edges, Slope Stakes and Right of Way shown in the figure below.

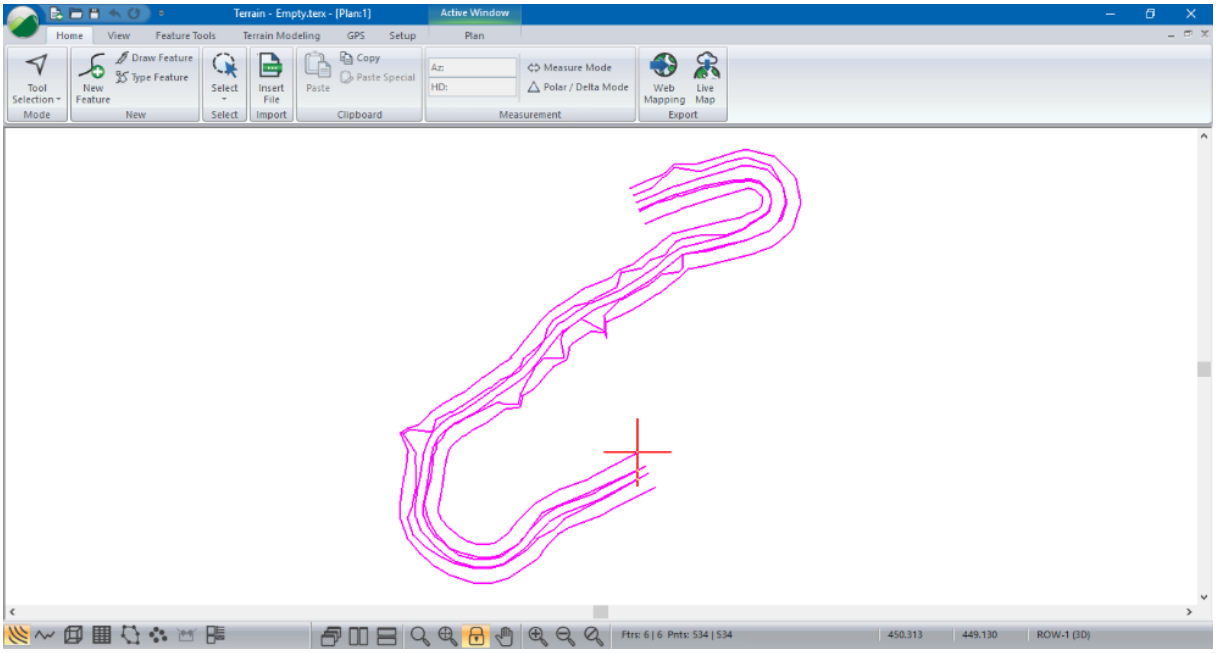


Figure 8-4: Imported Features (Road Edges, Slope Stakes and Right of Way)

32. Press the *Terrain Modeling* | *Generate TIN* button

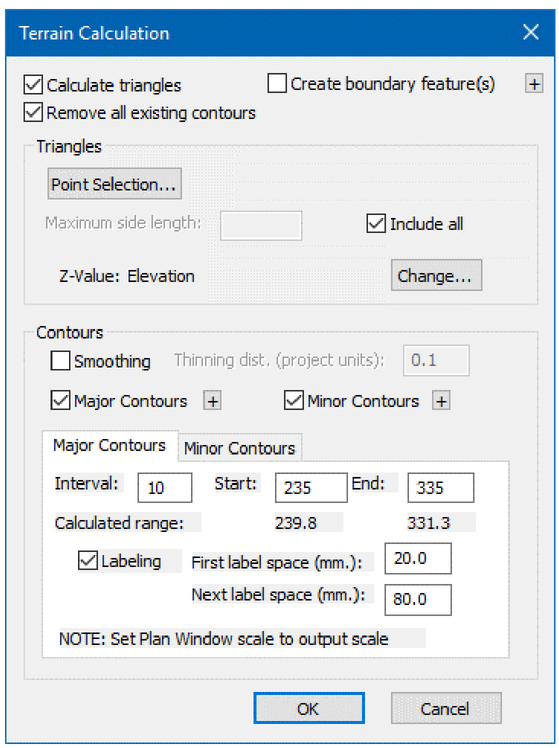


Figure 8-5: Terrain Calculation Dialogue

33. Change your dialogue box so it displays the same information as above. Note that *Major Contours* and *Minor Contours* are two separate tabs.

34. Select the *Major Contours* tab and change the *Interval* to **10** and turn on *labeling*.

35. To specify *color* and *line-type*, press the ⊞ button beside Major Contours. Change the *color* to **Green** and the *line-type* to **Thick (Medium)**. Press *OK*.
36. Press the plus button beside *Minor Contours* and change the *color* and *line-type* to Green and 0-Solid respectively. On the *Minor Contours* tab, change *Interval* to **2**. Press *OK*.

Once the TIN model has been generated, contours are formed by creating a straight-line segment across each triangle.

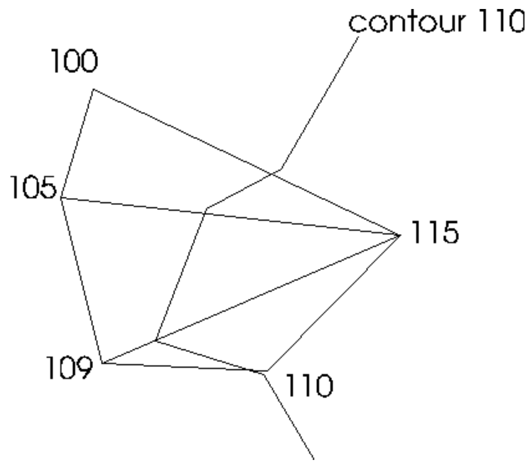


Figure 8-6: Example Contour Formation

If contour smoothing has been enabled, the resulting line segments are joined together and thinned to remove any points that are close together. The spacing is controlled by the *Thinning Distance* parameter (see *Example contour formation* in the figure above). This step effectively removes any small sharp bends in the contour. The resulting contour is then fitted with a mathematical (spline) curve.

37. Press *OK* to calculate triangles and contours.

The screen should now display the Contours as shown in the figure below. The Major Contours are thick and labelled. The Minor contours are thin and un-labelled.

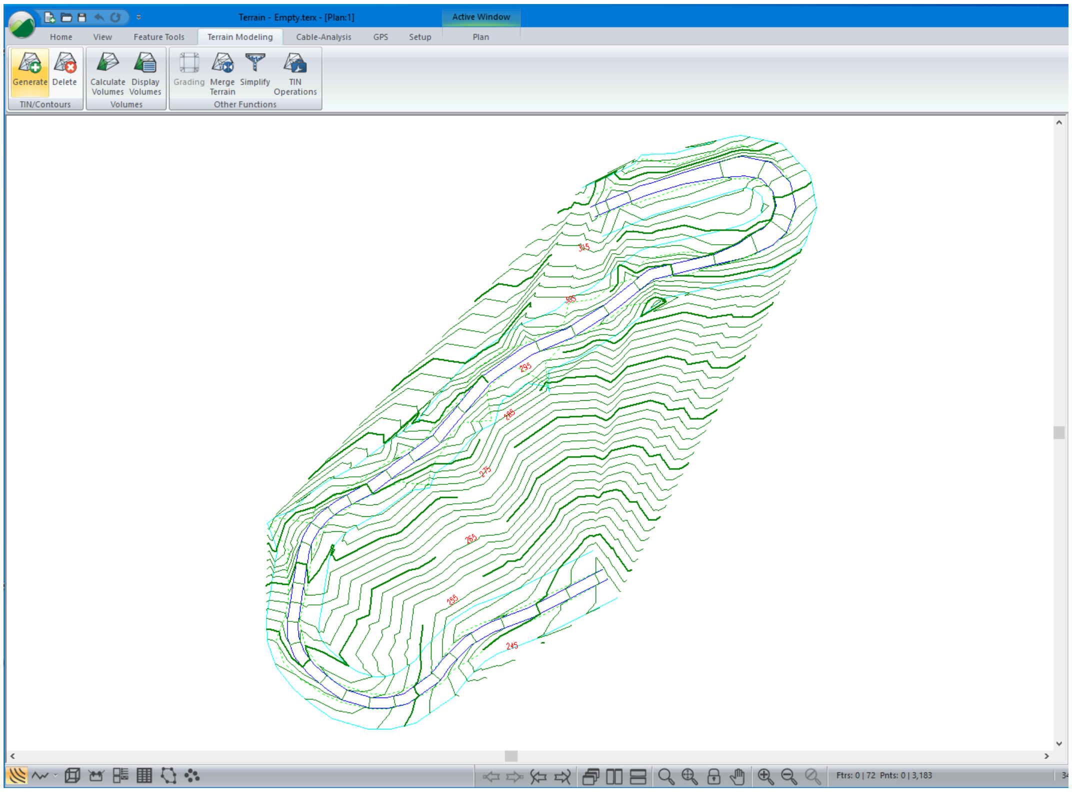


Figure 8-7: Contours - 2-meter Interval

Removing Void Areas

The contours extend outside of the road corridor, due to the formation of large triangles, which interpolate between widely spaced data points. These contours are not accurate because they are too far from the known data points. There are two methods to resolve this problem. Either method can be used. This example demonstrates both methods:

- Method 1 Limiting the side length of the triangle.
- Method 2 Defining a TIN Boundary

Method 1: Limiting the length of the triangle

38. *Terrain Modeling* | *Generate TIN* button. Check *Calculate Triangles* box, un-check *Include all* and change the *Maximum side length* to **50**. Press *OK*.

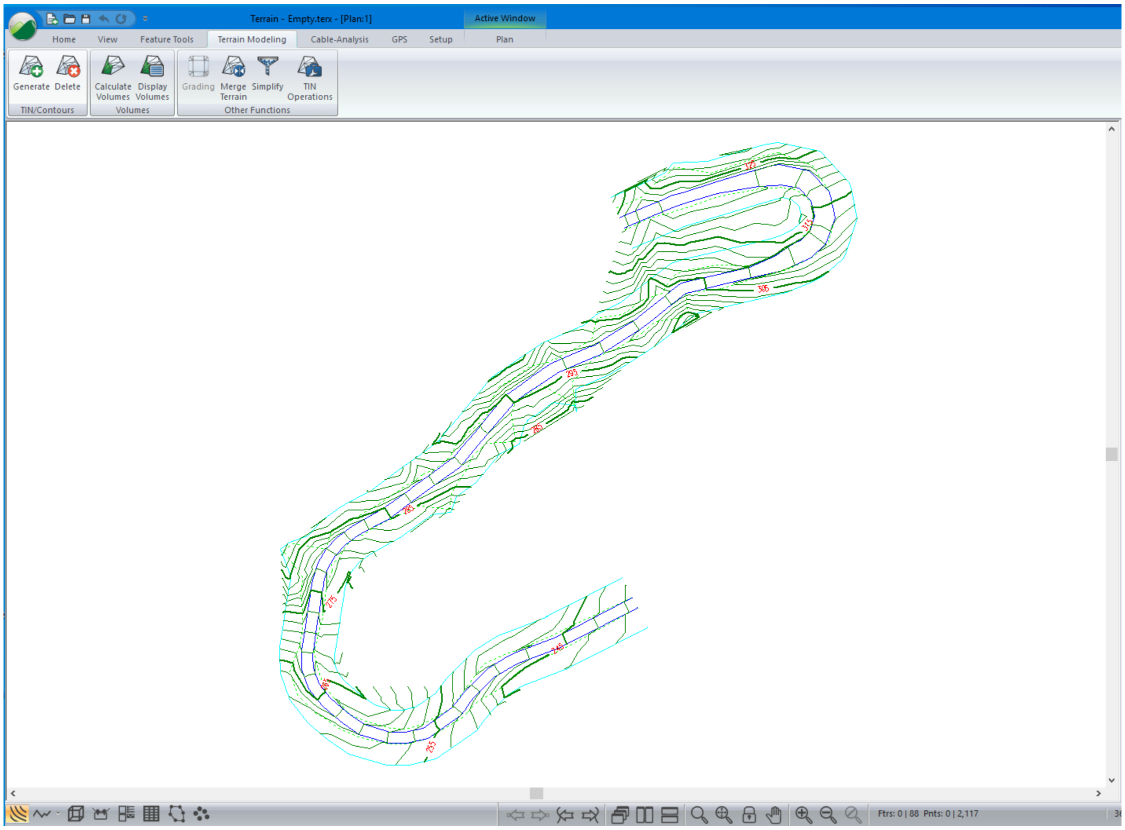


Figure 8-8: Contours Generated with Side Length Control

The contours now follow the road corridor; however, they still extend outside the road corridor particularly in the upper right corner.

Method 2 – Defining a TIN Boundary

The next step uses an explicit boundary feature to control the creation of triangles.

39. *Home* | *Select* | *By Name*. Press the *Un-Select All* button inside the *Select feature(s) by name* dialogue box as shown below.

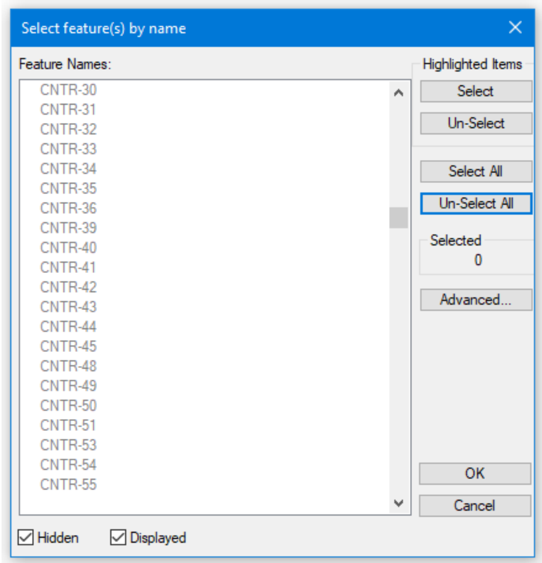


Figure 8-9*:* Select Feature(s) by name Dialogue Box

40. Press the *Advanced…* button and the *Select Feature(s) by Name* dialogue box will change and look as in the figure below, select **ROW** from the dropdown list in the *Predefined Layers* drop box and then press *Select* button. Press *OK*.

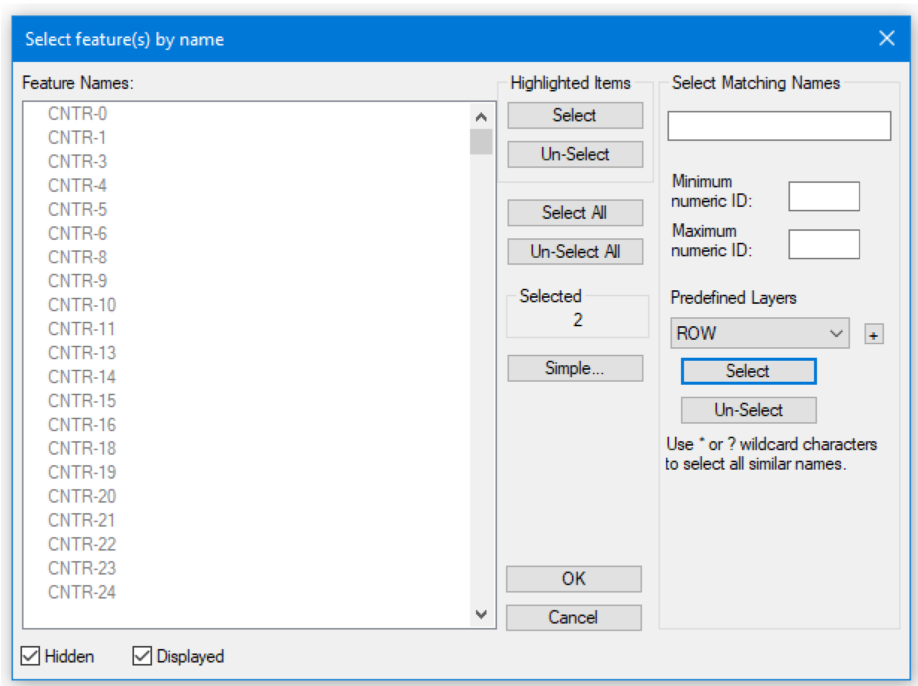


Figure 8-10: Select Feature(s) by name Dialogue Box with Advanced Section

41. *Feature Tools* | *Join*. You will be prompted 'Warning existing triangles will be cleared'. Respond *OK*. One of the ends will be joined.

42. With the joined feature still selected, *Feature Tools* | *Feature Properties*. This activates the *Feature Properties* dialogue box.

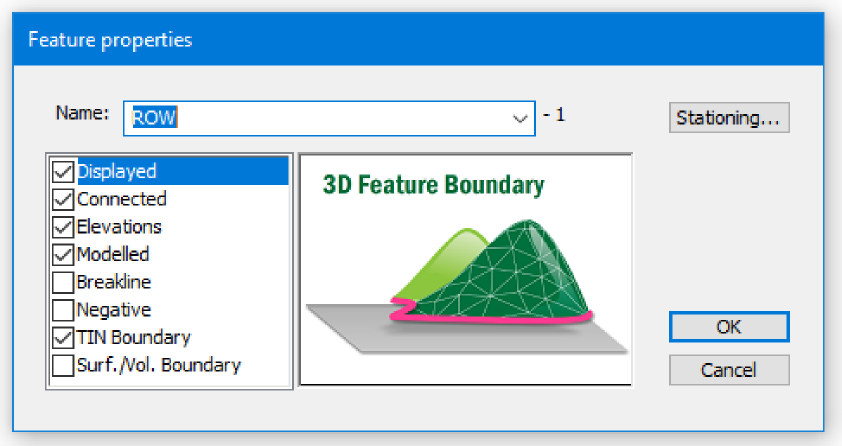


Figure 8-11: Tin Boundary Feature set in Properties Dialogue

43. Enable *TIN Boundary* and press *OK*.

When triangles are created, features with *TIN Boundary* activated are used to limit the extent of the triangulation. All triangles with their center point inside the TIN Boundary will be retained. If the TIN Boundary feature has the "Negative Area" property set, then its area will be excluded.

44. *Terrain Modeling* | *Generate TIN*. Make sure that *Major Contours* and *Minor Contours* are selected and press *OK*. The contours now fall completely inside the right of way boundary.

The following steps will demonstrate how to remove triangles inside a TIN Boundary polygon. In this case, they will be removed from the road surface.

45. *Home* | *Select By Name.* Press the *Un-Select All* button. Select the features called REDGE-0 and REDGE-1. Press *Select* button. Press *OK*.

46. *Feature Tools* | *Join* (if this menu is disabled, then you have not selected two features). You will be prompted 'Warning existing triangles will be cleared' Respond *OK*.

47. With the joined feature still selected, *Feature Tools* | *Feature Properties* button. Change *Feature Properties* so that *Negative* and *TIN Boundary* are enabled (see figure below). Press *OK*.

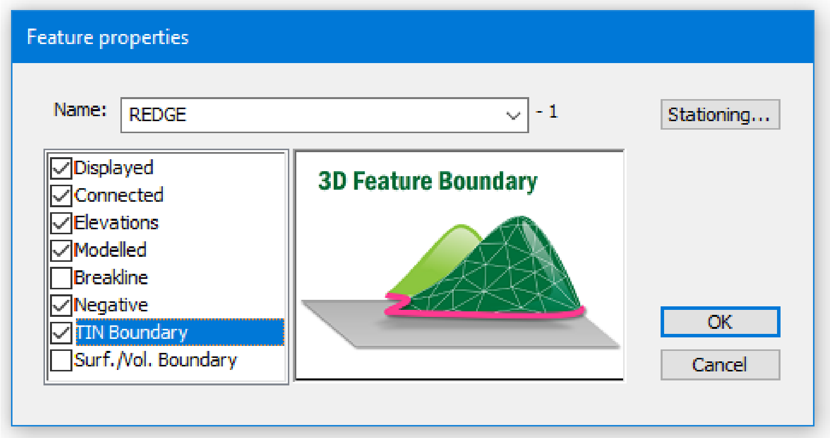


Figure 8-12: Negative Area set for a TIN Boundary Feature

48. *Terrain Modeling* | *Generate TIN*. Make sure that *Major Contours* and *Minor Contours* are selected and press *OK*.

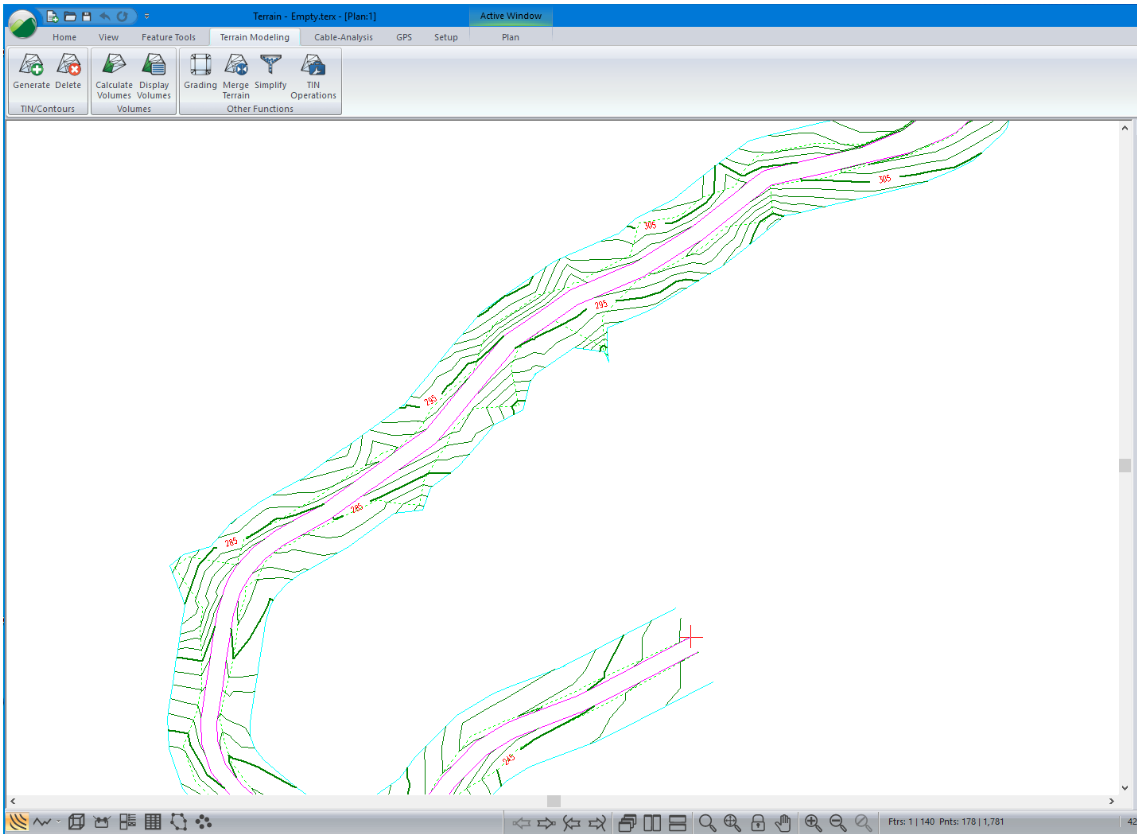


Figure 8-13: Contours Generated with Road Surface Excluded

49. *File* | *New*. Do not save changes.

Improving Contouring with Breaklines

Site Survey Example

Identifying and modeling breaklines can significantly improve the accuracy of a TIN model and associated contours. Breaklines are sharp changes in ground slope such as a creek bank, an edge of a road, an edge of ditch or a rock bluff.

Triangles should not be allowed to form across these features, since doing so would flatten the slope across the break. Features in the Terrain Module will be used as breaklines when their *Breakline* property is enabled. Triangle link lines will not cross *Breakline* features.

This breakline example uses a topographic survey around a creek. The data was created and adjusted in the Survey/Map module. See Survey/Map Tutorial - *Making a Map with Multiple Traverses* for more information.

1. *File* | *Open*. Change **Files of Type** to Softree-Terrain File (*.TERX).
2. Select <Terrain>\DTM**breakline.terx.** Press *Open*.
3. *Terrain Modeling* | *Generate TIN* button.
4. In the *Terrain Calculation* dialogue box:
    - Turn on *Major Contours, Minor Contours* and *Smoothing*.

- Check Calculate triangles, change the *Maximum Side Length* to ***60*** (there are no void areas in this model).
- Select the *Minor Contours* tab and change the *Interval* to ***1.0***.
- Select the *Major Contours* tab and change the *Interval* to ***5.0*** and turn on *Labeling*. Press *OK*.

Once the calculation is complete, a model of a creek with poorly generated contours will be displayed.

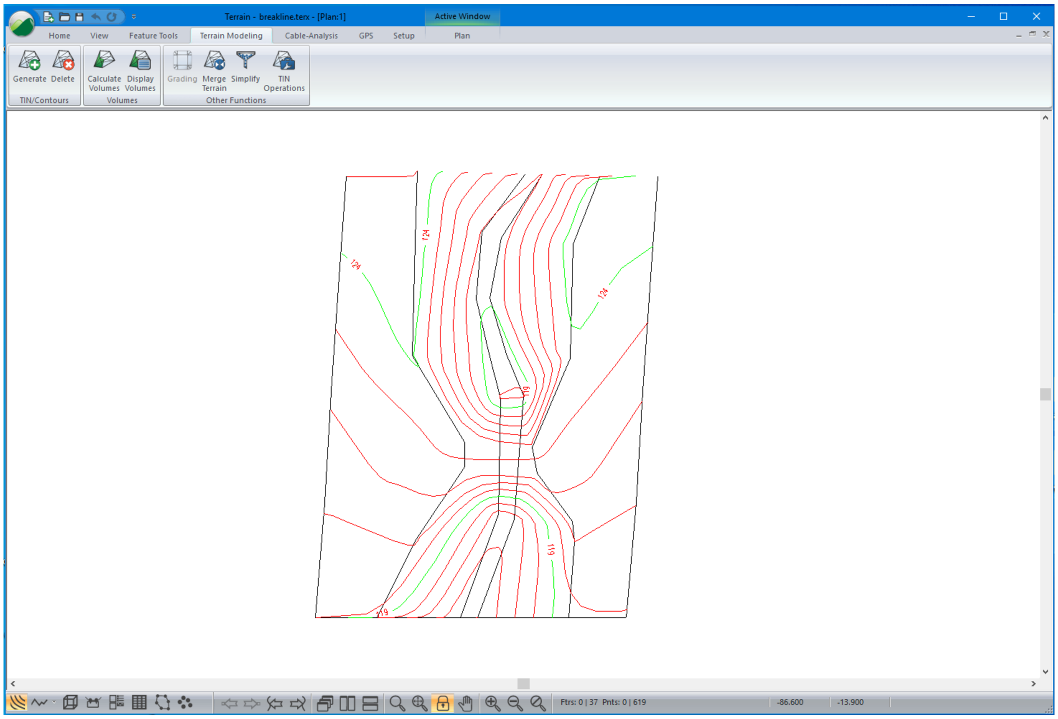


Figure 8-14: Model of Creek with Poorly Generated Contours

5. As an optional exercise, we can view the triangle outlines that the TIN model create: *Plan* | *Plan Options* | *Surface* tab. Enable Triangle outlines. After looking at the triangles that represent the TIN model, turn the display off again for the rest of this example.

The plan view in the figure above has contours that show the creek bottom rising up to the same elevation as the top of the banks (scarp 1, 2). This is due to triangles being formed between the scarp features and crossing over the creek features. To correct this, the defining features are made into breaklines.

6. *Home* | *Select* | *By name* in dropdown menu. Press *Un-Select All*, then select the features as shown in the figure below by double-clicking on them in the *Select feature* (s) *by name* window. Press *OK*.

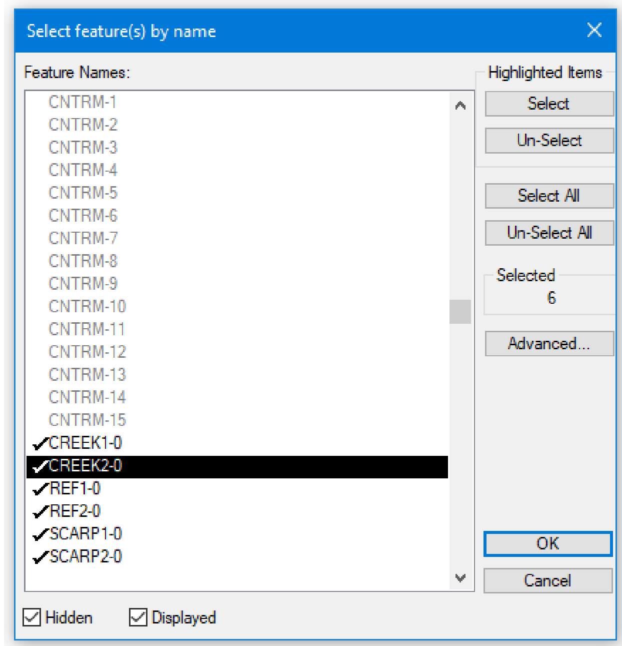


Figure 8-15: Select Feature(s) By Name Dialogue

7. Enable the *Feature Properties Panel* Enable *Breakline*. Press *Apply*.
8. *Terrain Modeling* | *Generate TIN*. Press *OK* to accept the settings.

After re-calculating, the contour lines now indicate a continuous gully as shown in the figure below.

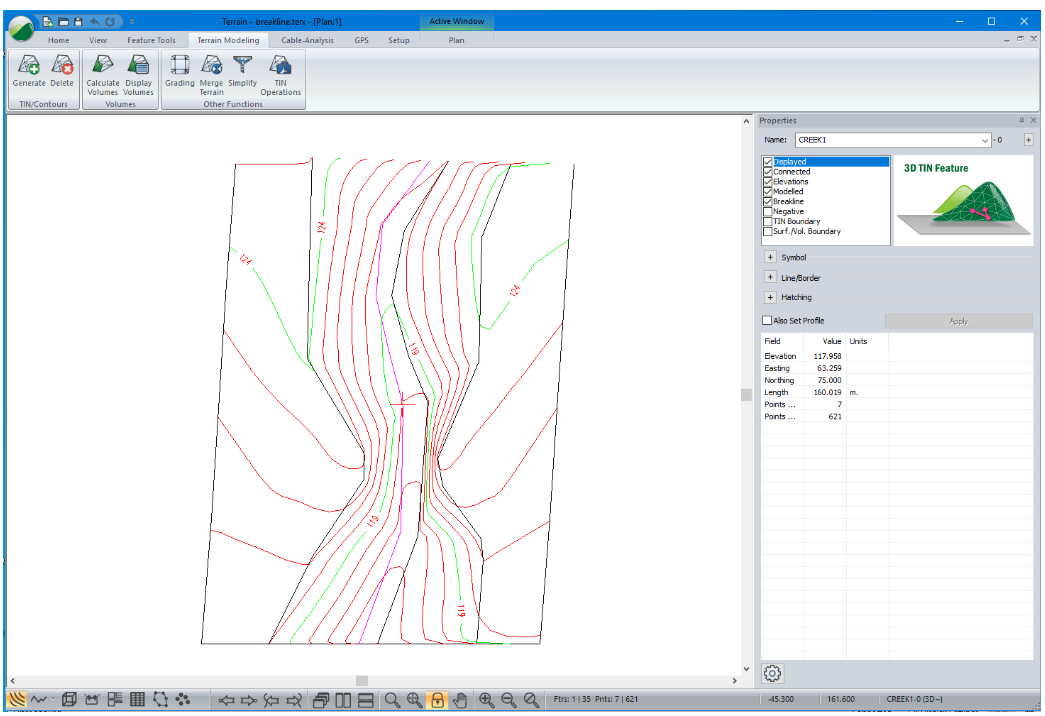


Figure 8-16: Contours After Breaklines Have Been Set

9. *File* | *New*. Do <u>not</u> save changes.

Calculating Volumes

This example requires *Mapping and Drafting, Import Basic, Surface Generation and Contouring and Volume Calculation and Reporting* function groups enabled. See *Function Groups* in the On-line help for more information.

This example cannot be completed without the required function groups. Contact Softree to upgrade your license to permit more functions if required.
Cut and fill quantities can be computed between any two triangulated surfaces or one surface and a TIN Boundary (another polygonal boundary can also be included to restrict the calculation to a specific area). Applications of this facility are numerous and include site design, stockpile and as-built quantities. To illustrate the concept, a rock quarry and a stockpile example will be done. The rock quarry example demonstrates volumes of material excavated using two surfaces and the stockpile example demonstrates volumes using only one surface.

Calculating Volumes Using Two Surfaces

Rock Quarry Example

1. *File* | *Open* <Terrain>\DTM**original ground.terx**.

Original ground.terx was created from a total station survey of a rock quarry. The XYZ coordinate points were imported, a triangulated surface and corresponding contours were generated and saved in a Terrain file (original ground.terx)

After the rock was removed from the quarry, another survey was done and again imported, triangulated and saved in a second Terrain file (excavation.terx).

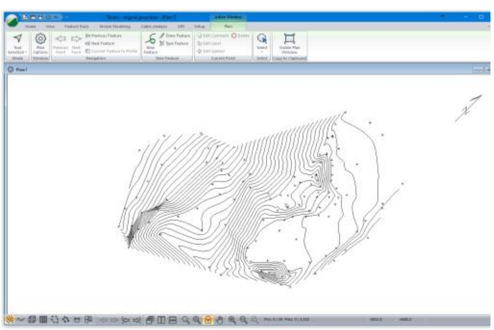


Figure 8-17: Original Surface (*original ground.terx*)

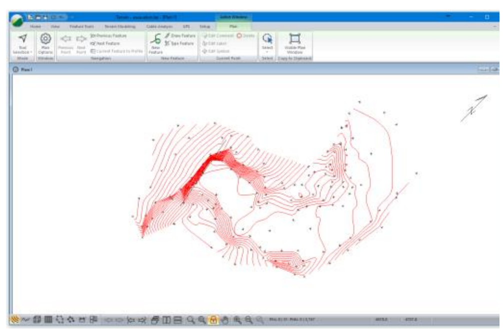


Figure 8-18: Surface After Excavation (*excavation.terx*)

2. *Terrain Modeling* | *Calculate Volumes*.   This will activate the dialogue box below.

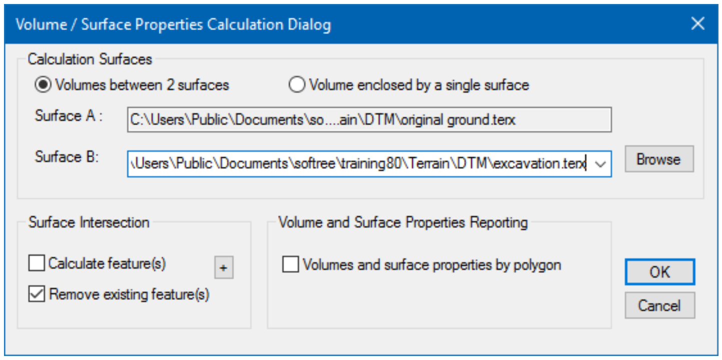


Figure 8-19: Volume / Surface Properties Calculation Dialogue

Note: To calculate volumes via this method, you must have created 2 terrain models and saved them in separate files. The first terrain model (surface A) is always the current Terrain.

The *Terrain Modeling* | *Calculate Volumes* is disabled if the current file does not have a terrain model. The user specifies the other surface (surface B) in the *Volume / Surface Properties Calculation dialogue box*.

3. Press the *Browse* button opposite Surface B. Select <Terrain>\DTM**excavation.terx.** Press *Open*. Surface A should be set to original ground.terx and surface B should be set to excavation.terx. The order of these surfaces is not important as you will see later.

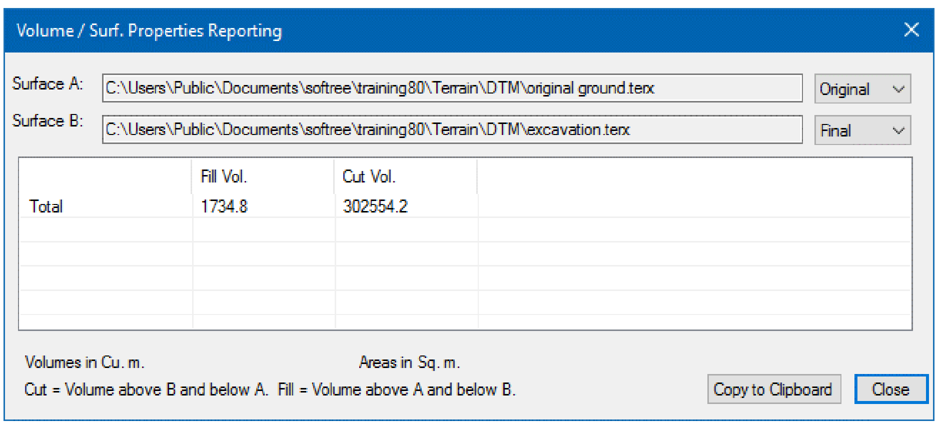


Figure 8-20: Volume / Surf. Properties Reporting Dialogue

4. Press *Close*.

The following steps demonstrate how to include two polygonal boundaries and calculate the volume inside each one.

5. *Home* | *Insert File*. Select and open <Terrain>\DTM**boundary.terx.** *Open* button. The *Import Options Dialogue* box appears. Press *OK*.
6. Softree Warning may appear, select do not display again. Press *OK*.

Two boundary polygons should now be visible in the Plan Window as in the figure below. If not visible press the *Zoom Out*  button on the tool bar.

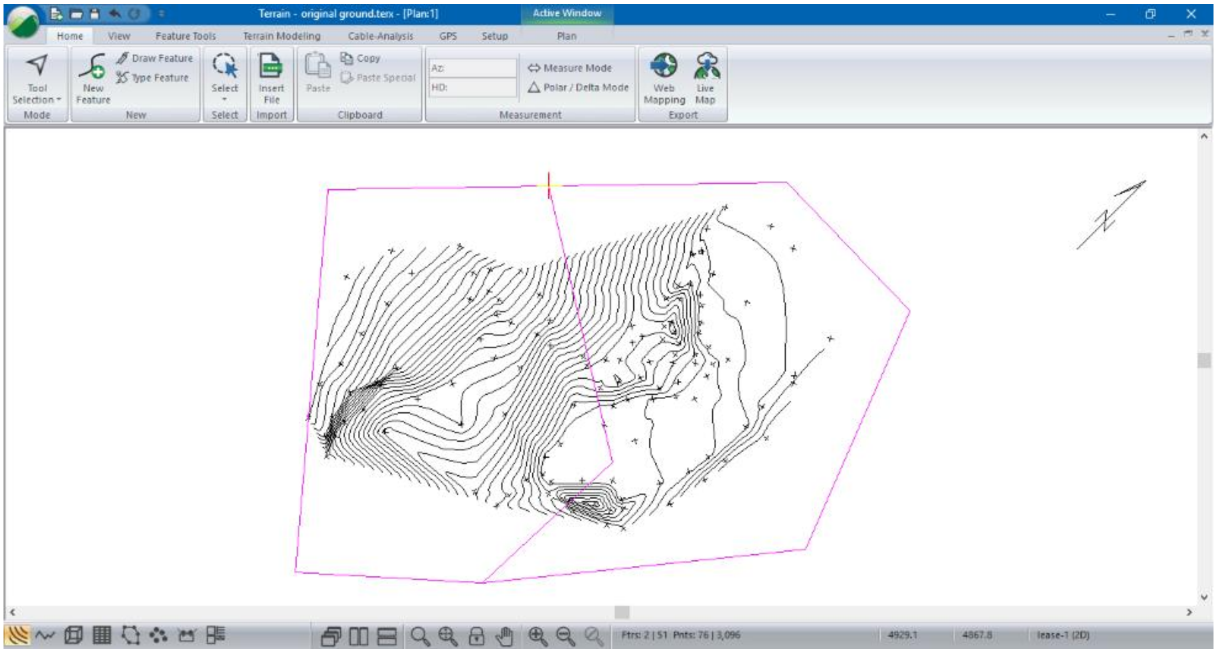


Figure 8-21: Original Topography with Boundary Polygons

7. Open the *Feature Properties* panel. Enable *Surf/Vol. Boundary*. Press *Apply*.

Note: When a feature has surface / volume boundary set volumes, surface area, slope and slope direction will be calculated and assigned to the feature as attributes.

8. *Terrain Modeling* | *Calculate Volumes* button to open the *Volume / Surface Properties Calculation* dialogue box shown in below.

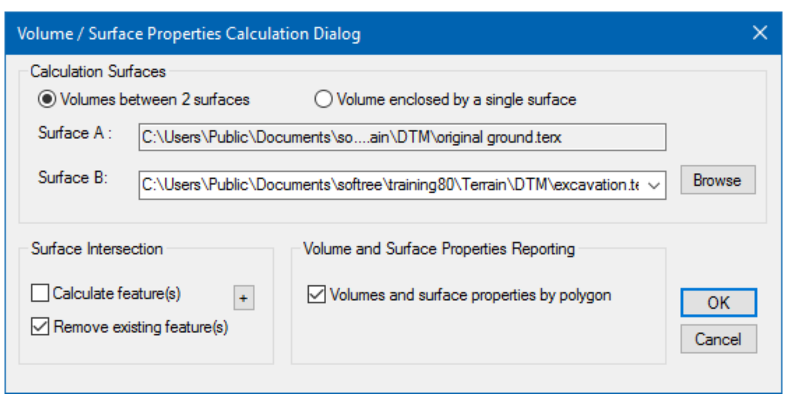


Figure 8-22: Volume / Surface Properties Calculation Dialogue - Volumes by Polygon

9. Check *Volumes and surface properties by polygon* and ensure all other selections are as indicated in the figure above. Press *OK* to begin the volume computation.

When completed, the *Volume/ Surf. Properties Reporting dialogue box* will appear (figure below). If you are working in imperial units (feet) the volumes will be reported in cubic yards.

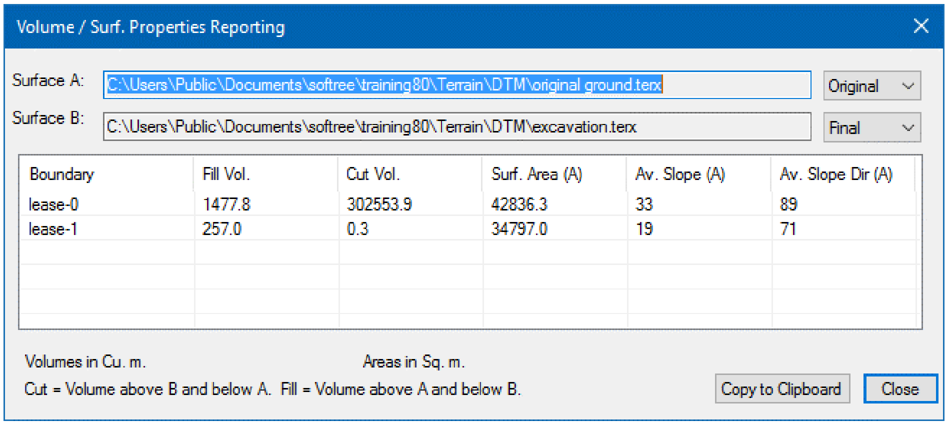


Figure 8-23: Volumes/Surf. Properties by Polygon

Note the cut, fill quantities and surface properties are reported for the 2 polygons (lease-0 and lease-1).

10. Press *Close*. To view the values again, create a status window by *Terrain Modeling* | *Display Volumes* button. *Close* window.

Volumes can also be viewed in the *status* portion of the *Feature Properties* panel.

11. With the boundary feature selected. Attributes can be added if you press the button at the base of the *Feature Properties panel* and press the *Add/Remove…* button. Change the Selected items list to include only *Area, Vol. above* and *Vol. below* (the latter two can be found in the *Surface Properties* folder).

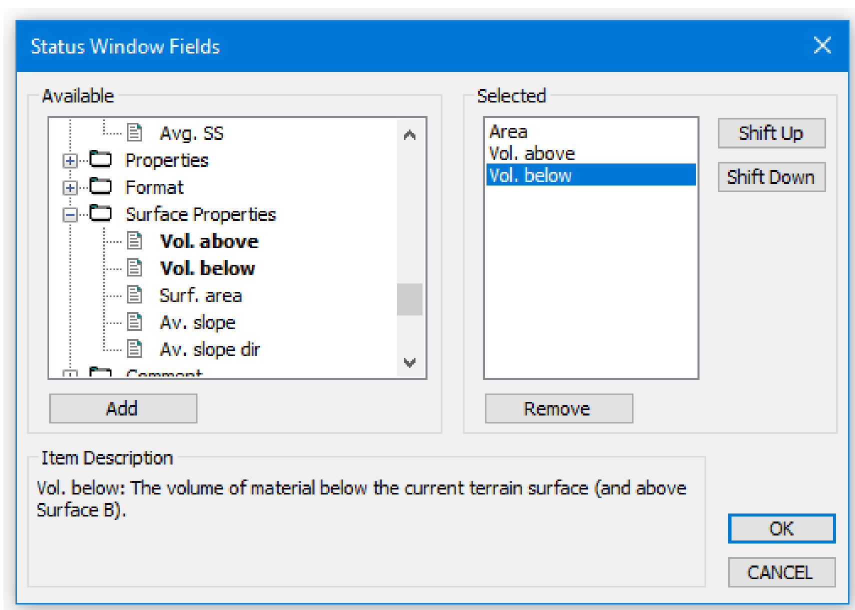


Figure 8-24: Add/Remove Items to Status Window

12. Press *OK* twice to return to the main screen.

13. The *Status* portion of the *Feature Properties Panel* displays the volumes associated with each lease feature. Select each lease feature and see how the volume changes.

14. To finish this example the results will be exported to a Microsoft Excel® spreadsheet using the Windows Clipboard. If you do not have a similar spreadsheet you can skip the next 2 steps.
15. *Terrain Modeling* | *Display Volumes* button. The *Volume/Surf. Properties Reporting* dialogue box will appear, then press *Copy to Clipboard* button.
16. Open Microsoft Excel® and create a new (blank) document. With the cursor positioned in the first cell select menu *Home* | *Paste*.

The volume information should appear as in the figure below:

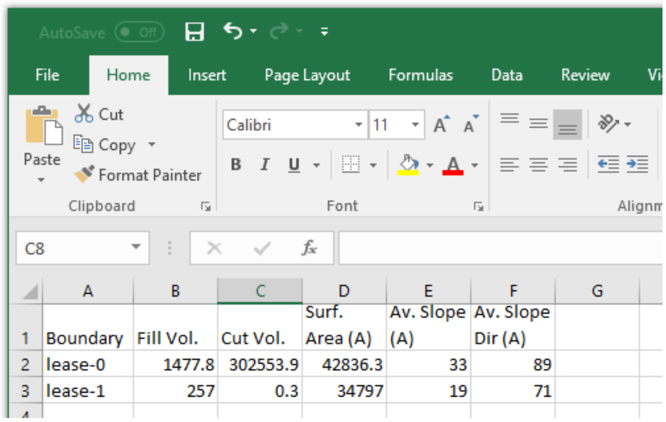


Figure 8-25: Volume Report Exported To Microsoft Excel®

17. Close your spreadsheet. Close Volume / Surf. Properties Reporting dialogue box.
18. *File* | *New*. Do not save the changes.

Calculating Volumes using a Single Surface

Stockpile Example

This example demonstrates how to quickly calculate pile or excavation volumes using the TIN boundary to define the lower surface. For most piles with simple convex boundaries this technique is appropriate and can save time since only one TIN surface is required.

This method can be applied to any earthwork calculation where the surface is defined by the toe of the pile (or crest of the excavation), and is an accurate representation of the original surface.

1. *File* | *Open* <Terrain>\DTM**stockpile.terx**.
2. Press the *Terrain Modeling* | *Calculate* Volumes button to open the *Volume / Surface Properties Calculation* dialogue box.

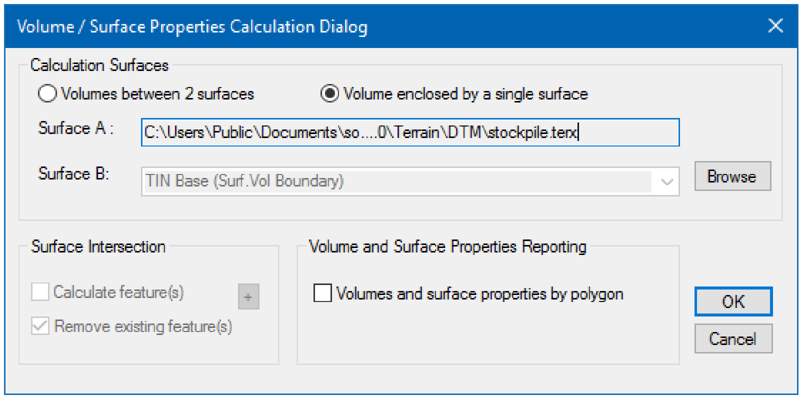


Figure 8-26: Volumes / Surface Properties Dialogue Box

3. Ensure the *Volume enclosed by a single surface* is enabled. Press *OK*.

Note: When Volume *enclosed by a single surface* is checked, the *Volume and surface properties by polygon* is automatically selected and disabled. This causes a boundary polygon to be automatically created but not shown.

4. Once the calculation is complete, the *Volume / Surf. Properties Reporting* dialogue box will display the cut and fill volumes.

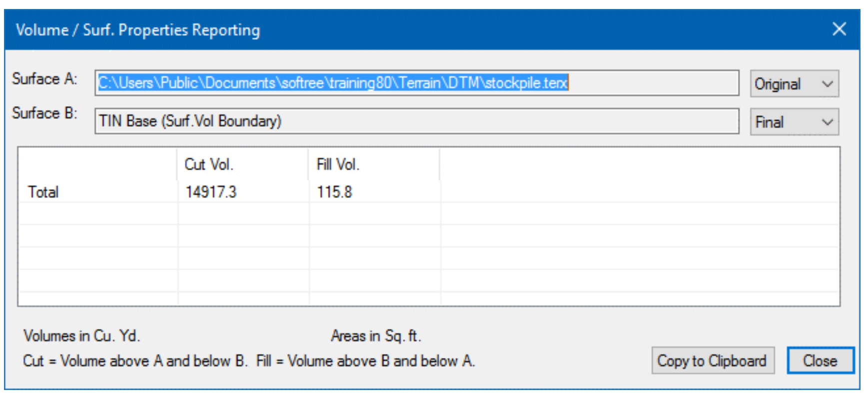


Figure 8-27: Display of Cut and Fill Volumes.

Note: The fill volume (small compared to the cut), is because the toe of the pile is not flat. If the initial surface is not planar, it is more accurate to use the 2-surface technique (described in the previous section) to calculate volumes.

5. *File* | *New*. Do not save changes.

Surface Display

Surface displays of the TIN model may be an important aid to design. Features such as Slope Vectors, Shading and 3D visualization can all simplify the design process.

Plan Displays

1. *File* |*Open* <Terrain>\Attributes**theme17_sw.terx**

2. *Home* | *Insert File*. <Terrain>\DTM**Surface Display.terx**. Press *Open*, Choose the default conversion as shown in the figure below. Press *OK*.

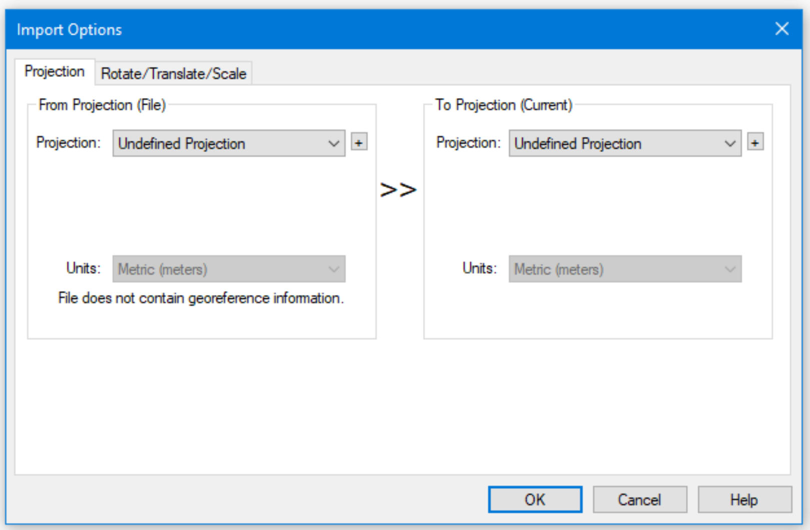


Figure 8-28: Import Options Dialogue Box - Projection Tab

3. *Terrain Modeling* | *Generate TIN* to activate the *Terrain Calculation* dialogue box. Turn off all options except *Include All* as shown in the figure below. Press *OK*.

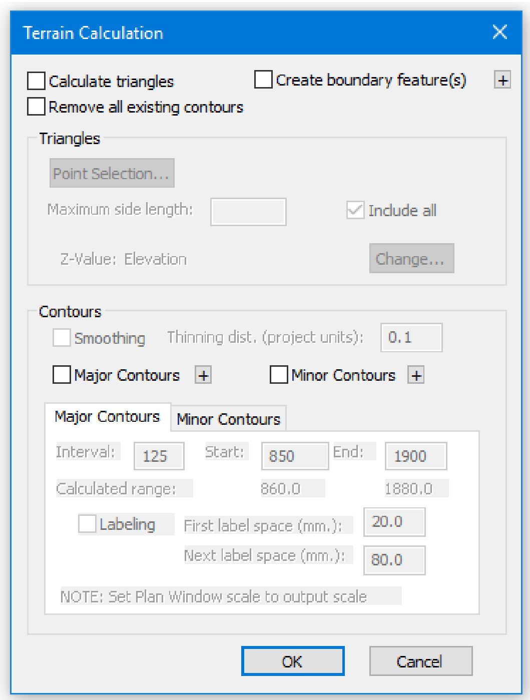


Figure 8-29: Terrain Calculation Dialogue Box

Slope Vectors

4. *Plan* | *Plan Options*, then select the *Surface* tab.

5. Check *Slope Vectors* box as in the figure below and press the ⊞ sign beside *Slope Vectors* which will open the *TIN Slope Vector Options dialogue* box.

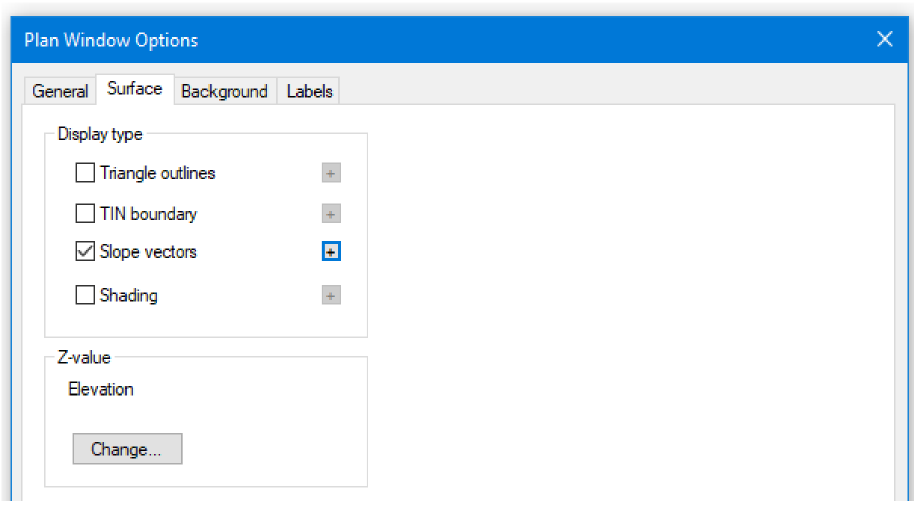


Figure 8-30: Plan Windows Options Dialogue Box – Surface Tab

6. In the *TIN Slope Vector* dialogue box:
    - Turn off *Fixed size*.
    - Turn on *Auto size*.
    - Change *Maximum length (mm)* to ***50***.
    - Turn on *Display at grid locations*
    - Type in a *Spacing* for both *X* and *Y* of ***200*** as shown in Figure 8-31 below.
7. Press *OK* twice.

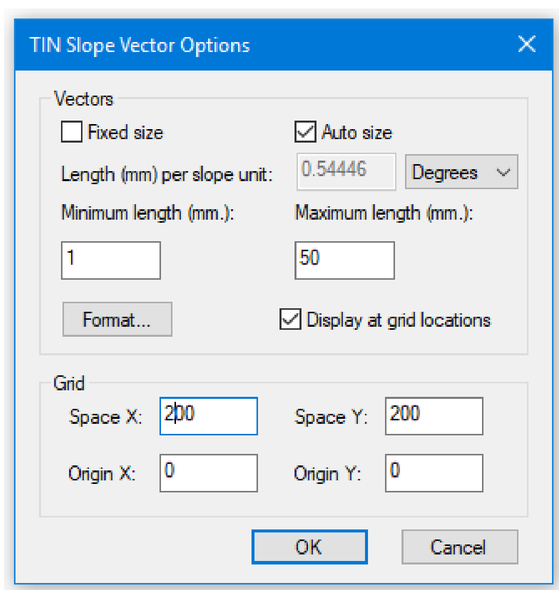


Figure 8-31: TIN Slope Vector Options Dialogue

8. Zoom in on any location to view the directional arrows close up. Notice all these arrows point in the down slope direction and the length of the arrows is directly proportional to the slope. The steeper the slope the longer the arrow as shown in the figure below.

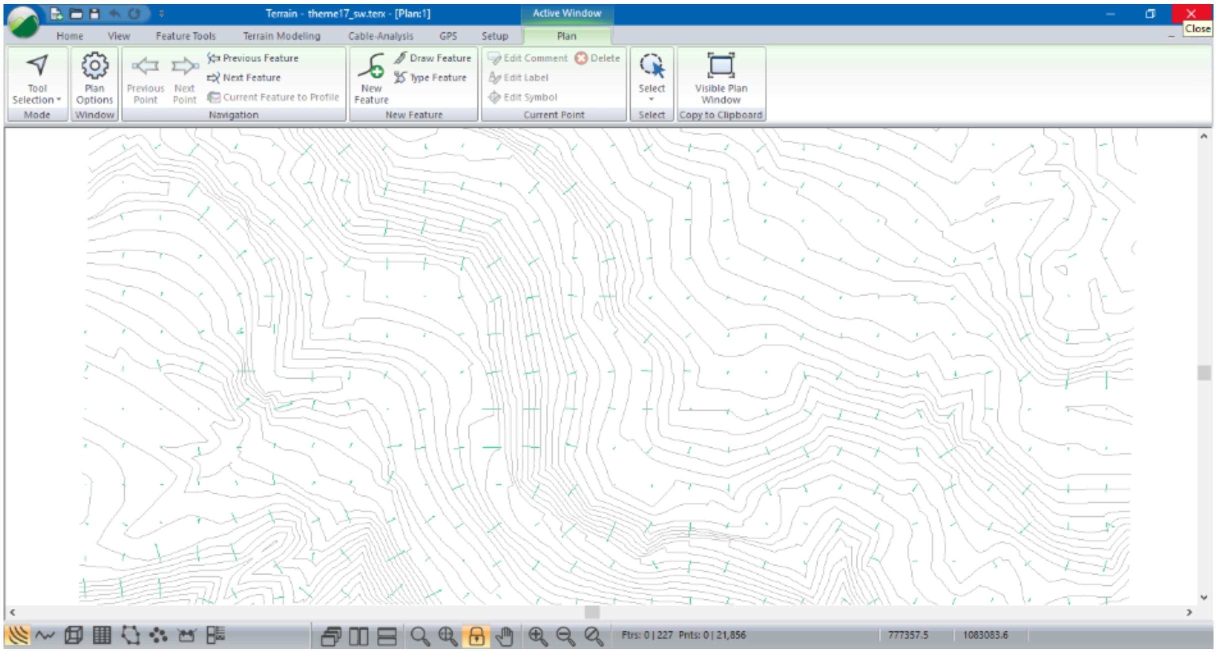


Figure 8-32: Slope Directional Arrows

Shading

9. *Plan* |*Plan Options* | *Surface* Tab. Turn off *Slope* and turn on *Shading*. Press the plus button + beside Shading. Select *Slope* and *Degrees* as the shading type.

10. Press the *Autogen* button and set the parameters as shown in the figure below. Press *OK*.

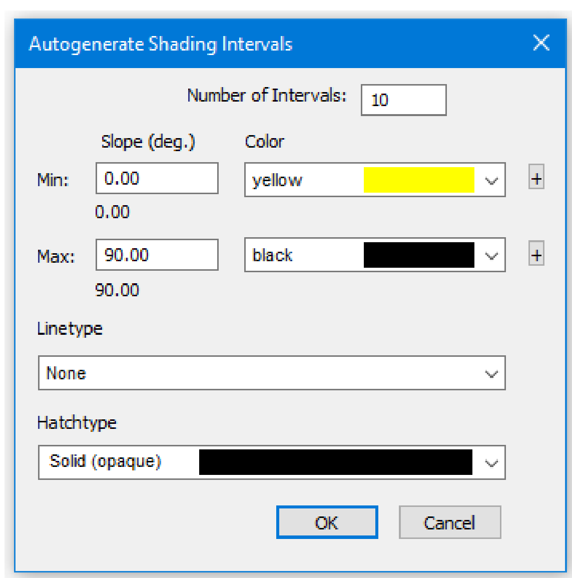


Figure 8-33: Autogenerate Shading Intervals Dialogue Box

Notice that there are 10 *Shading ranges* created. In this example only *Slope* is used. Try some of the other shading attributes to see what they do. They will not be explained in this example.

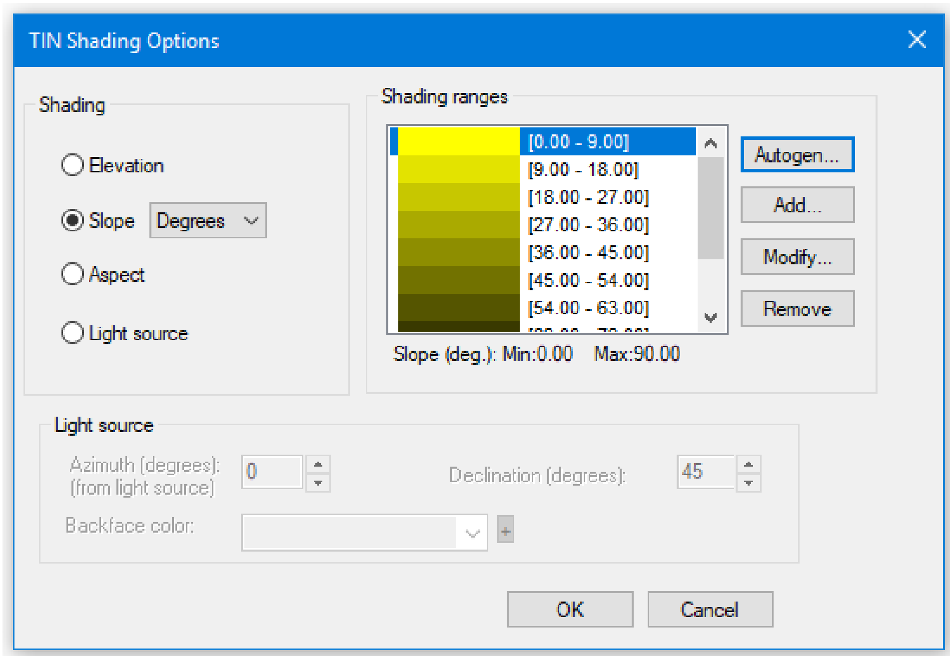


Figure 8-34: Tin Shading Options Dialogue

11. The *TIN Shading Options* should match those in the figure above. Press OK.

Notice the slope coloration. The steeper the slope the darker the color. The flatter the area the lighter the color (see Figure 8-35 below).

Note: *Number of shading intervals:* In this example, there are 10 shading intervals between yellow and black. The greater the shading intervals the smoother the transition from one color to the next.

Number of legend intervals: If this map is printed in a multi-plot window and a legend is created, the legend would show a color with an interval of slope breaking the total slope into 10 equal intervals. *Min/Max shading ranges*: If *Auto* is checked min and max slopes will be determined from the maximum and minimum slopes in the file. If unchecked a limit to the shading slope range can be entered. All other slopes that are outside of the range will remain white.

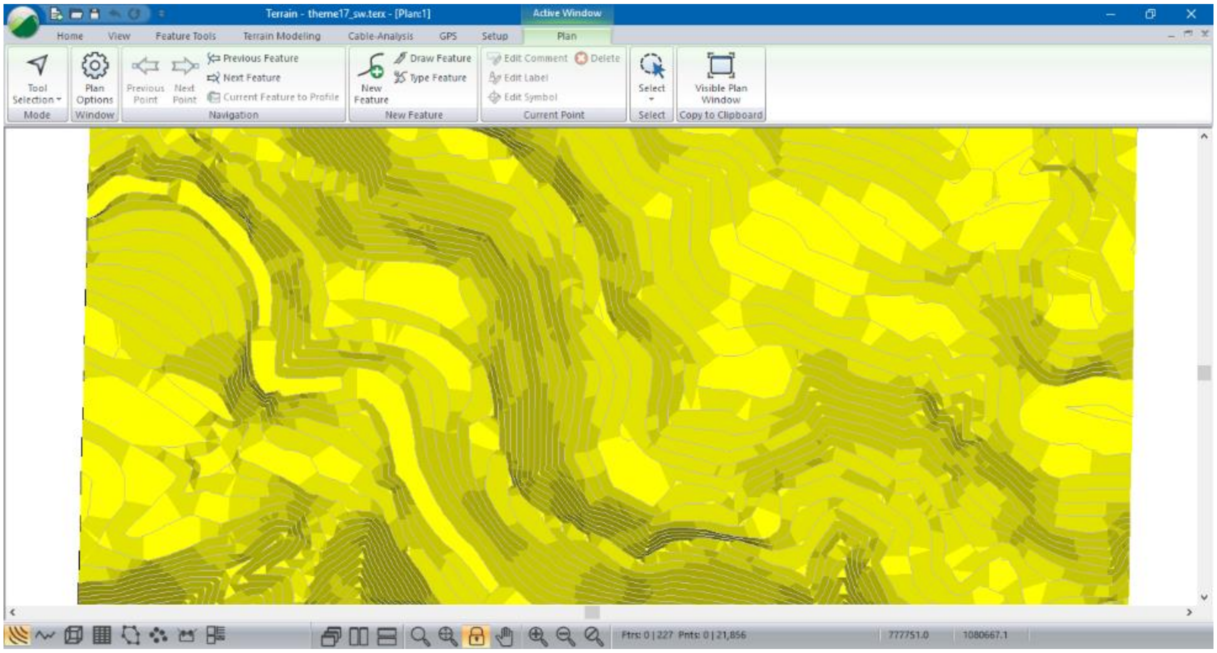


Figure 8-35: Shaded TIN Model

3D Displays

Another method of visualizing the TIN is with a 3D Window.

12. *Plan* | *Plan Options* button. Turn off *Shading* found in the *Surface* tab. Press *OK*.
13. Open the 3D Window. Select  from the Navigation part of the bottom Status bar.
14. *3D* | *3D Options*. Change your *3D Options* to match those shown in the figure below. There are two tabs (controlled at the bottom of the dialog), Content and View. Press *OK*.

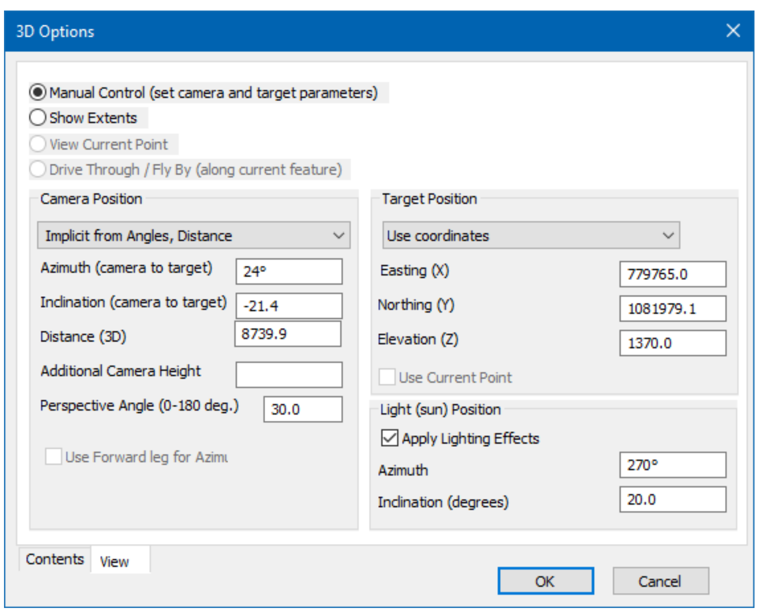


Figure 8-36: 3D Options Dialogue - View Tab

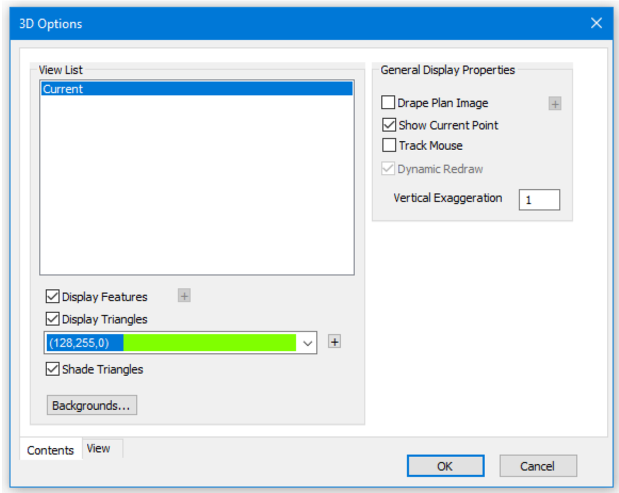


Figure 8-37: 3D Options Dialogue - Contents Tab

Note: *Show Extents:* Shows the entire View

Camera Position – Use Coordinates: Allows entry of the coordinates at which the camera will be placed and the *Perspective Angle*. The *Perspective Angle* is the view angle. The larger the angle the larger the view. If *Use Current Point* is checked the coordinates will be grayed out and the current point in the plan window will be used.

Camera Position - Implicit from Angles, Distance: Allows entry of the *Azimuth*, *Inclination,* and *Distance* to the target (which is a set ofcoordinates or the current point) entered in by the user in the *Target Position* area. If *Use Forward leg for Azim.* is checked then the camera will always face the direction of travel.

Light (sun) Position: The direction and angle of sun in the sky.

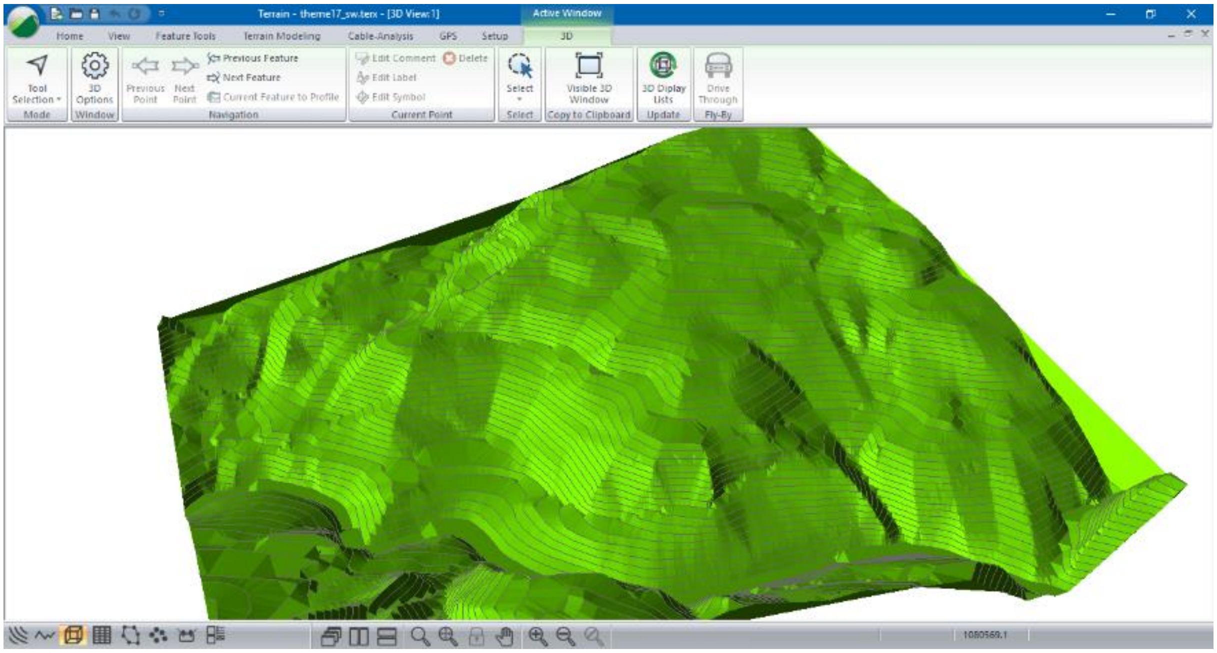


Figure 8-38: 3D View from GIS Contour Data

Zooming and *Panning* allow you to navigate the 3D image. The Zoom Tools toolbar allows you to zoom or pan once after selecting a function. If you have a mouse with a middle button and a roller you can zoom and pan at any time.

15. *View* | *Pan*, or select from the bottom status bar, move your cursor over the 3D window. Click and drag with the left mouse button.

Note: The view moves with your mouse. When you release the mouse the cursor changes back into its previous shape; you must click the *Pan* button again to initiate a second pan.

16. If you have a middle mouse (even if it is a roller), move your cursor over the 3D window, depress and hold the middle mouse button and note that the cursor changes to the Pan hand. Continue holding the middle mouse and drag to perform a Pan operation

17. <Left-click> (and hold) in the 3D window, you can now rotate and adjust the position of the 3D window.

18. *File* | *New*. Do <u>not</u> save changes.

9. Profiles and Draped Features

The Terrain module allows you to display and edit features in profile (or cross section) and to drape features onto a surface. This section will provide you with an overview of these functions.

To follow the examples in this section the *Mapping and Drafting, Enhanced Mapping and Drafting, Surface Generation and Contouring, Profile Window,* and *Profile Drafting and Design* function groups must be enabled. See *Function Groups* in the On-line help for more information. Some examples will have additional requirements.

Creating a Profile

Stream Survey Example

This example demonstrates how to create a profile, set scales and display properties.

A profile is created by assigning a *fence section feature* to a *Profile Window*. The horizontal axis in the *Profile Window* is the distance (horizontal) along the fence section feature. The vertical axis is elevation.

Any feature can be a *fence section* (even closed loops or features which cross themselves). If the fence section consists of two points the profile becomes a standard cross section.

Note: See Getting Started section for file install folders (**<Terrain>** and **<Defaults and Layouts>**)

1. *File* | *Open* <Terrain>\Profile**topograph.terx**.

You will see the features shown in the figure below.

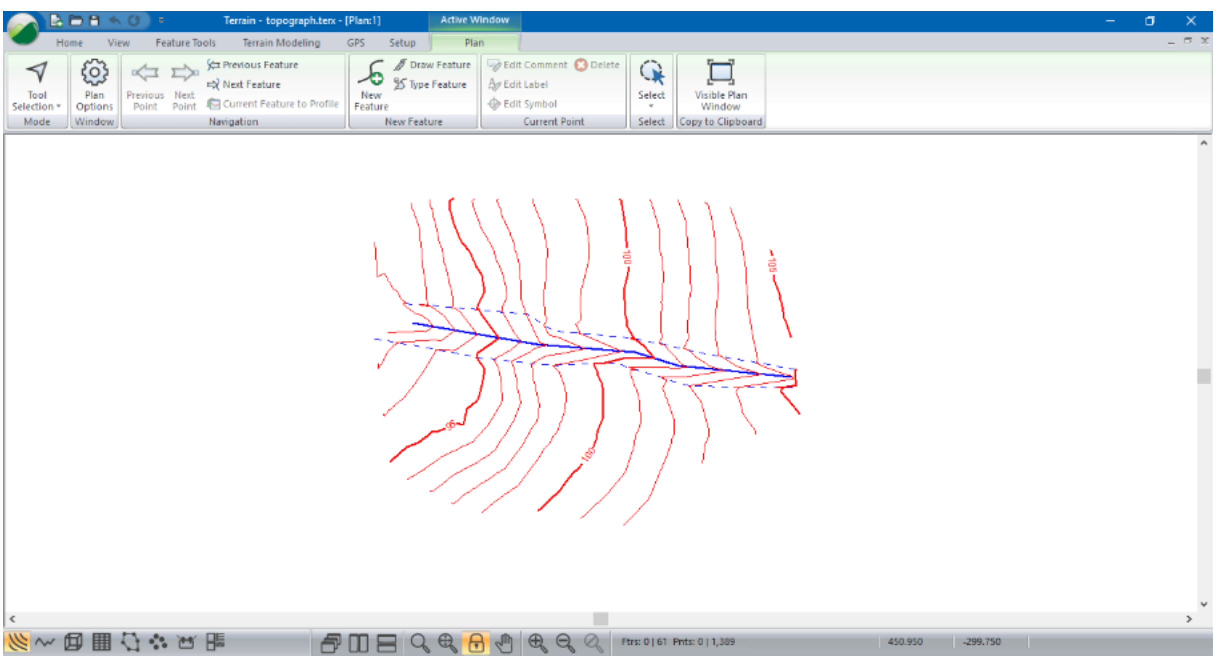


Figure 9-1: Stream Survey (topograph.terx)

The Terrain feature representing the stream is a three-dimensional polyline that is used to define the surface (and indirectly, to define the contours). In the steps below, you will view this feature in a Profile window.

Create a Profile window using the stream feature as you fence section:

2. Select **Stream-2** (the thick blue feature running across the middle) by clicking on it with the selection cursor .
3. *View* | *New Window* | *Profile* from dropdown menu.

The new Profile window uses the current feature as the fence section; the feature name is part of the Profile title bar (figure below).

4. *View* | *Tile Vertically* (or press from the Status Bar) to show Profile and Plan windows side by side (figure below).

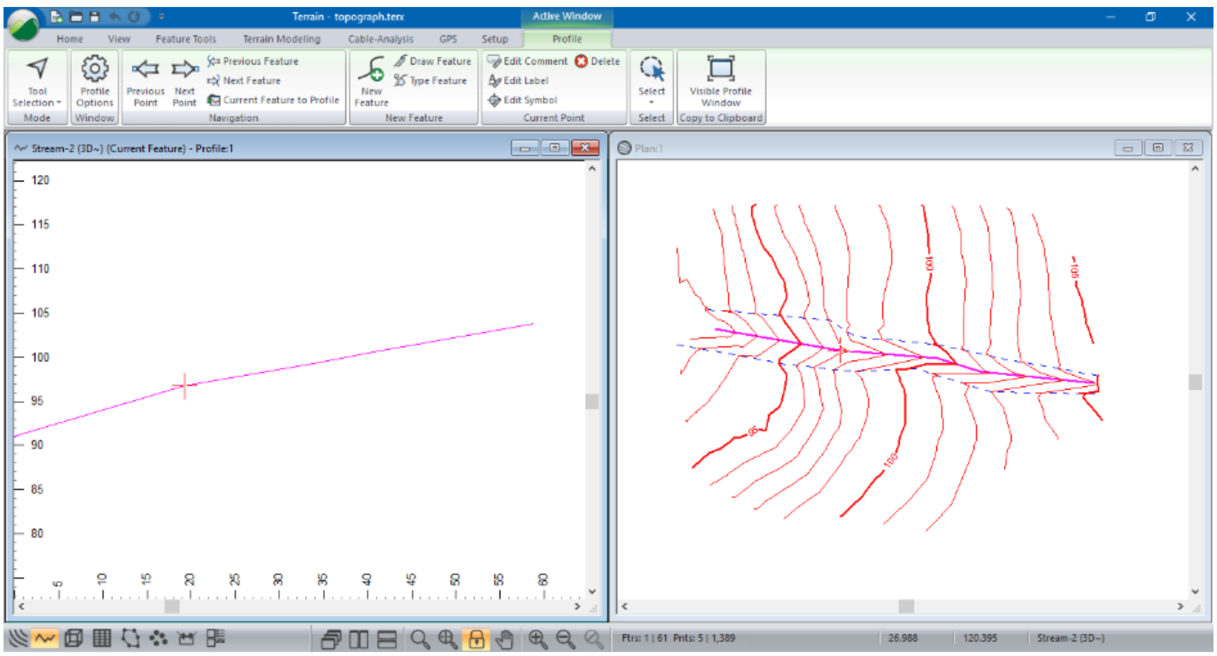


Figure 9-2: Profile with Stream-2 as Fence

Notice that the Plan and Profile windows both show the stream feature as selected (magenta in color) and both windows show the current point as a red cross. Sometimes it is not obvious how the profile view relates to the plan; the current point can help and there is a shadow cursor displayed in the windows that do not contain the mouse.

5. Using key strokes <Ctrl + N> and <Ctrl + B> move the current point forward and backward on the current feature.
6. Move your mouse around in the Plan window (don't click any mouse keys!) and watch the shadow cursor in the Profile window.
7. Similarly, move your mouse around in the Profile window and watch the shadow cursor in the Plan window.

The scale in the Profile is automatic, so the feature fills the window. Use the Profile window options to define an explicit scale with distortion:

8. <Right-click> the Profile window and select context menu *Active Window (Profile) Options*....

This will open *Profile Window Options* dialogue box (figure below). Notice the *Scale* is set to *Auto Scale*.

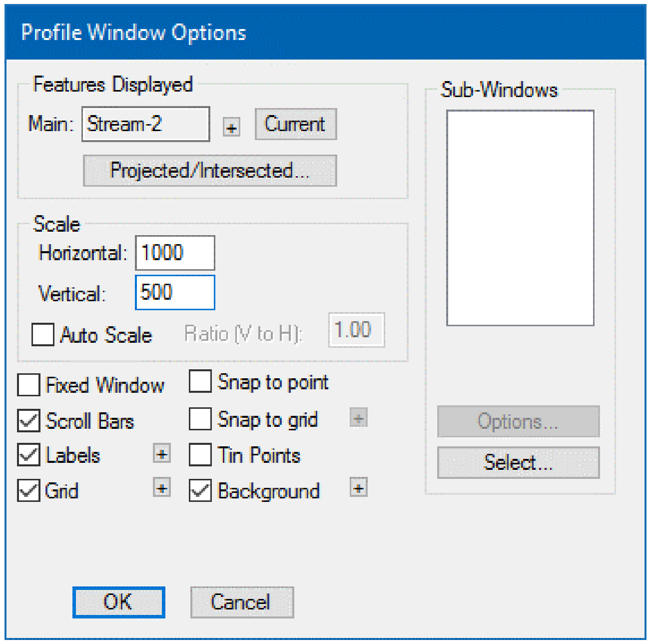


Figure 9-3: Profile Windows Options Dialogue Box

9. Clear the *Auto Scale* check box and change the *Horizontal* and *Vertical scales* to **1000** and **500** respectively.
10. Notice the other controls in the *Profile Windows Options* dialogue box; you can change the fence feature (*Main*) at the top of the dialogue box.
11. Press *OK* to close the dialogue box.

The Profile Window has a new scale with 2:1 vertical distortion. Now we'll display some automatic labels in the Profile.

12. Turn on *Elevations* and *Grades* labels: *Profile* | *Profile Options* to open the *Profile Window Options* dialogue box (Figure 9-3).
13. Push the ⊞ button beside *Labels* to open the *Profile Window Labels* dialogue box.
14. Turn on *Elevations* and *Grades* by <double-clicking> on them in the list-box.
15. Press *OK* twice to return to the main screen.

The screen should now look like the figure below.

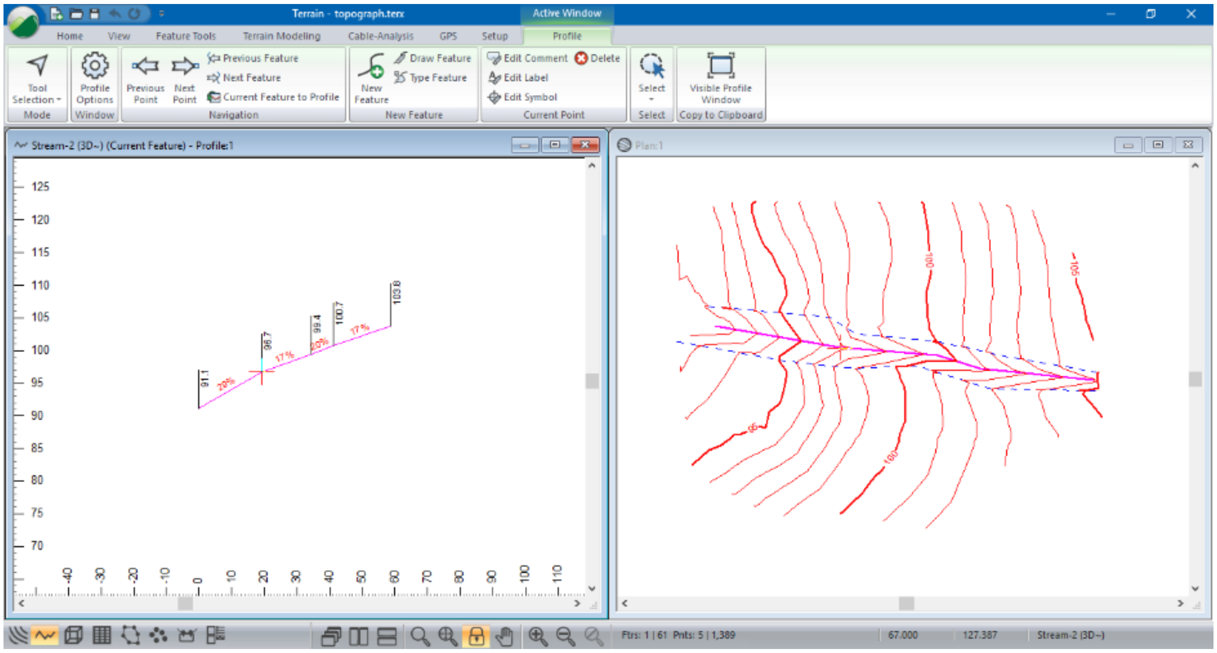


Figure 9-4: Stream Profile with Elevations and Grades

Reverse the direction of the stream feature:

16. Make sure the stream feature is still selected.
17. *Feature Tools* | *Reverse* button.
18. If there is a TIN surface in plan-view a dialogue box: “Warning, existing Terrain Triangles will be cleared”, press *OK*.

Notice that the labels update automatically. One should note that this reversal does not change the topographic contours and the natural direction of the stream would be such that the V’s in the contour would point to the downgrade direction of flow of the stream.

19. *File* | *New*. Do not save the changes.

Cross Sections - 2D and 3D Features

Stream Survey Example

A 3D feature has elevation (Z) values explicitly defined at each point (X, Y). A 2D feature, on the other hand, does not contain elevation data.

There two kinds of 3D feature:

- **3D modelled (3D):** Points contain elevation values that are used by Terrain to create the DTM surface (for example ground survey points).
- **3D not modelled (3D):** Elevations are defined but not used in the surface model (for example the bridge deck points).

There are also two kinds of 2D features:

- **2D draped (2D)**: The feature points can pick up the elevation of the DTM surface. If there is no surface under a point it will have an undefined elevation (-9999). A draped feature will create a profile (or cross section) of the surface wherever it is placed.
- **2D not draped (2D):** Elevations are always undefined (-9999).

The concept of 2D versus 3D features is simple but has several subtleties with important consequences. The next example investigates the properties of 2D and 3D features.

To follow the example the *Mapping and Drafting, Surface Generation and Contouring, Profile Window,* and *Profile Drafting and Design* function groups must be enabled.

1. *File* | *Open*. <Terrain>\Profile**topograph.terx**

This is the same example used in the previous exercise, see first figure in the "creating a profile" exercise above.

2. Select the thick blue feature (Stream-2) by clicking on it with the selection cursor.

The name and type of the current selected feature is displayed in the lower right corner of the screen: *Stream-2 (3D~)*. This indicates that the current feature is *3D modelled*; it is incorporated into the surface. The ~ symbol indicates the feature is a breakline. (See Digital Terrain Modeling for information about breaklines.

3. Open the *Feature Property* *Panel*.
4. The Feature Properties panel allows you to modify all properties (including the feature Name). Notice that both the *Elevations* and *Modelled* checkboxes are selected.

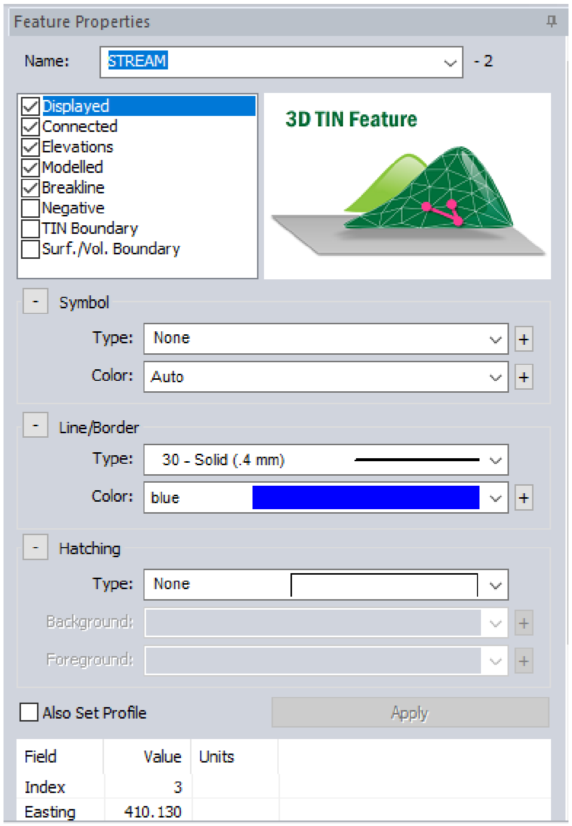


Figure 9-5: Feature Properties Panel

Now we will create a draped feature for cross section display.

Note: A draped feature has only X and Y coordinates the elevation Z of the feature comes from the existing terrain.

5. *Plan* | *New Feature*. This opens a *feature properties dialogue* box.

Note: If there is a feature selected, the feature created with *Right-click* | *New Feature...* will inherit the current feature properties.

6. Change the *Name* to **Cross Section.**
7. Uncheck the *Elevations* check box (this also clears the *Breakline* property).
8. Press the *Create using Mouse* button to close the dialogue box and begin creating points with the mouse.
9. Draw a feature with two points somewhat perpendicular to the stream (similar to that shown in Figure 9-6)
10. <Right-click> mouse and choose mode *Select with Mouse*.

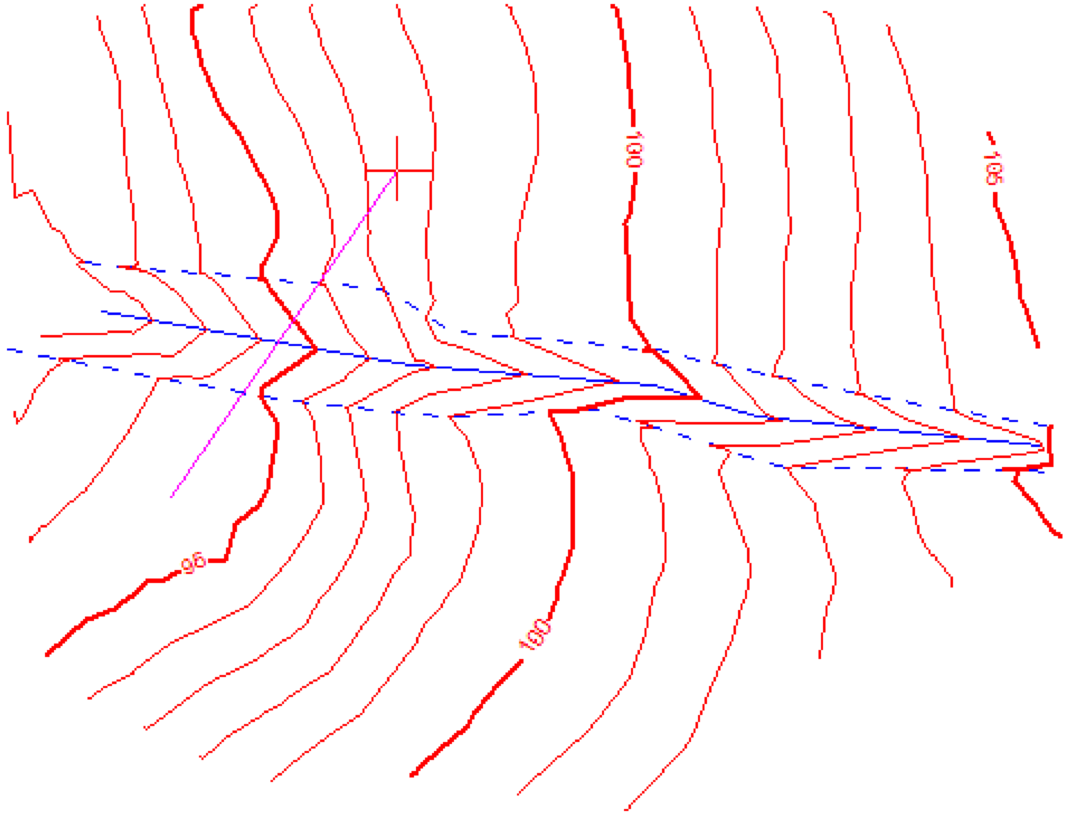


Figure 9-6: 2D Feature Across the Stream

11. With the cross section feature selected, *View* | *New Window* | *Profile* button to view a fence section of the feature.

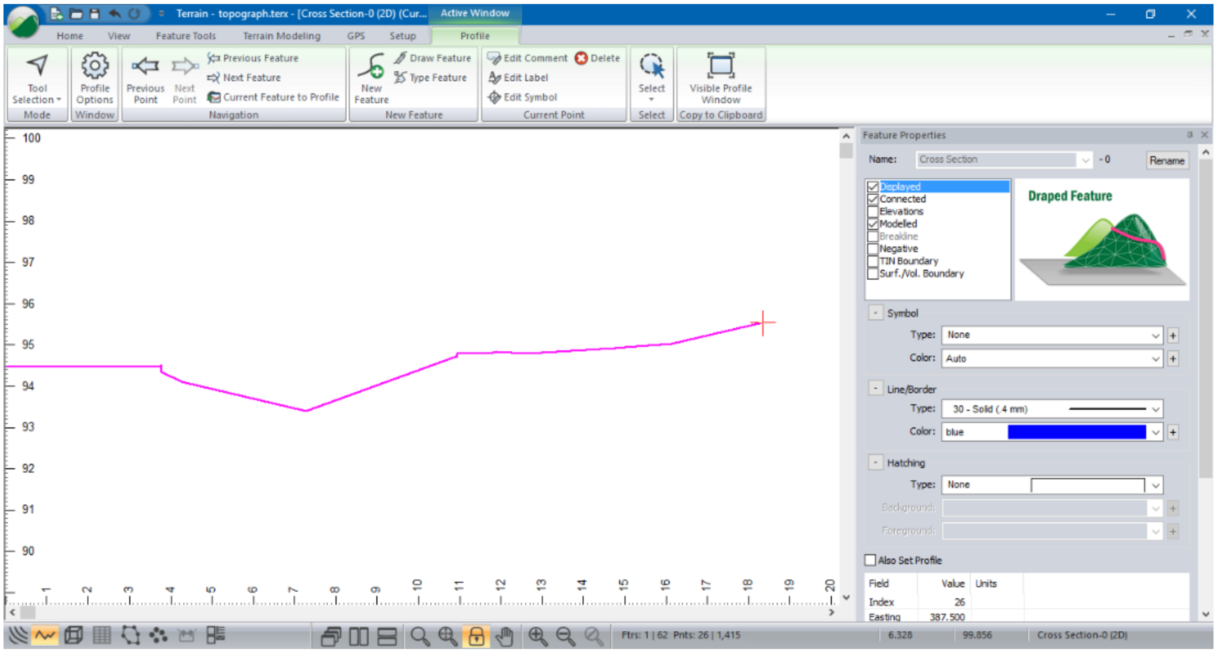


Figure 9-7: 2D Draped Feature Cross Section Depicts the Ground Elevation

Notice that the Profile window shows the ground surface between the two end points. These new points are called *TIN points* and they show the elevation of the underlying DTM. They are automatically inserted in 2D *draped* features wherever a triangle side is crossed.

Note: *TIN points* cannot be edited. They can, however, be labeled if you set the *TIN Points* check box in the Profile window options.

Stream Survey Example Continued

It is possible to drape a feature on multiple DTM surfaces. To do this, one or more Digital Terrain Models (DTM's) must have been created in separate terrain files. These files can be then displayed as *background terrains* in the Plan and Profile Windows.

For this example, two DTM's have been prepared, *overburden.terx* and *overburden1.terx* (separating two overburden layers). These surfaces will be set as background terrains and the profile will be draped on them.

To add background files:

12. *Profile* | *Profile Options* (also available in the right-click context menu) to open the *Profile Window Options* dialogue box.
13. Ensure *Background* is enabled and press the + button to open the *Background Display Files dialogue* box (figure below). Press *Add...* and choose <Terrain>\Profile**overburden.terx** and press *OK*.
14. Repeat for <Terrain>\Profile**overburden1.terx**.

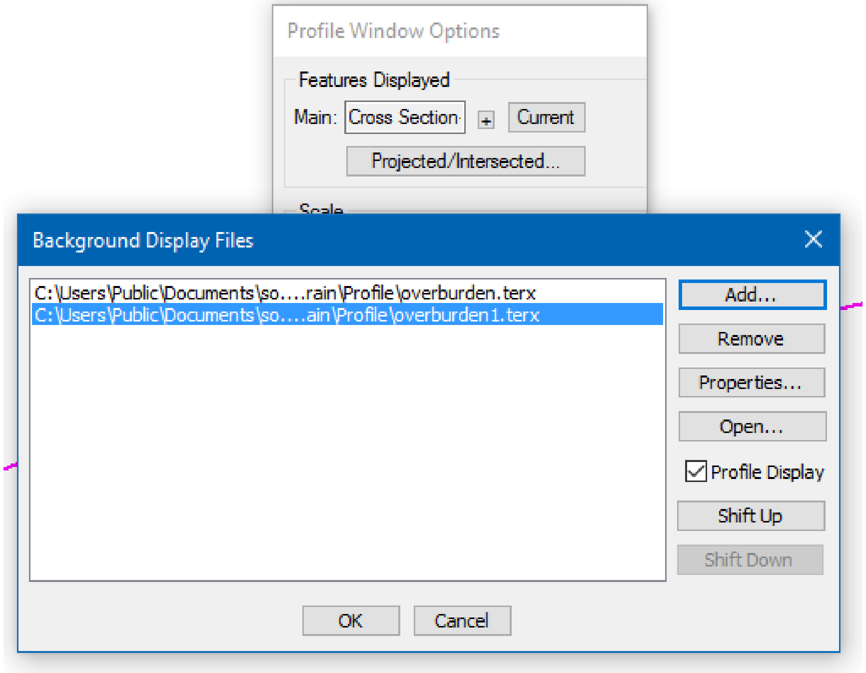


Figure 9-8: Adding Background Files

15. You should still be in the Background Display Files dialogue box. The next two steps set the color and hatching for each layer.
16. Select file **overburden.terx** and press the *Properties*... button.
17. Within the *Background Display Properties* dialog, select *Profile Feature Format* button and set the color to green and hatch type to dots 2 (Figure 9-9).

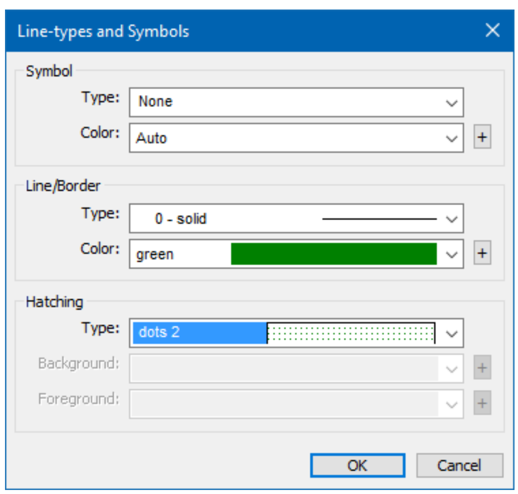


Figure 9-9: Configuring Background Surface Format.

18. Press *OK* twice to return to the *Background Display Files* dialog.
19. Repeat for **overburden1.terx** (choose your own color and hatch type).
20. Press *OK* until you have returned to the main screen.

Your Profile Window should now appear similar to Figure 9-10.

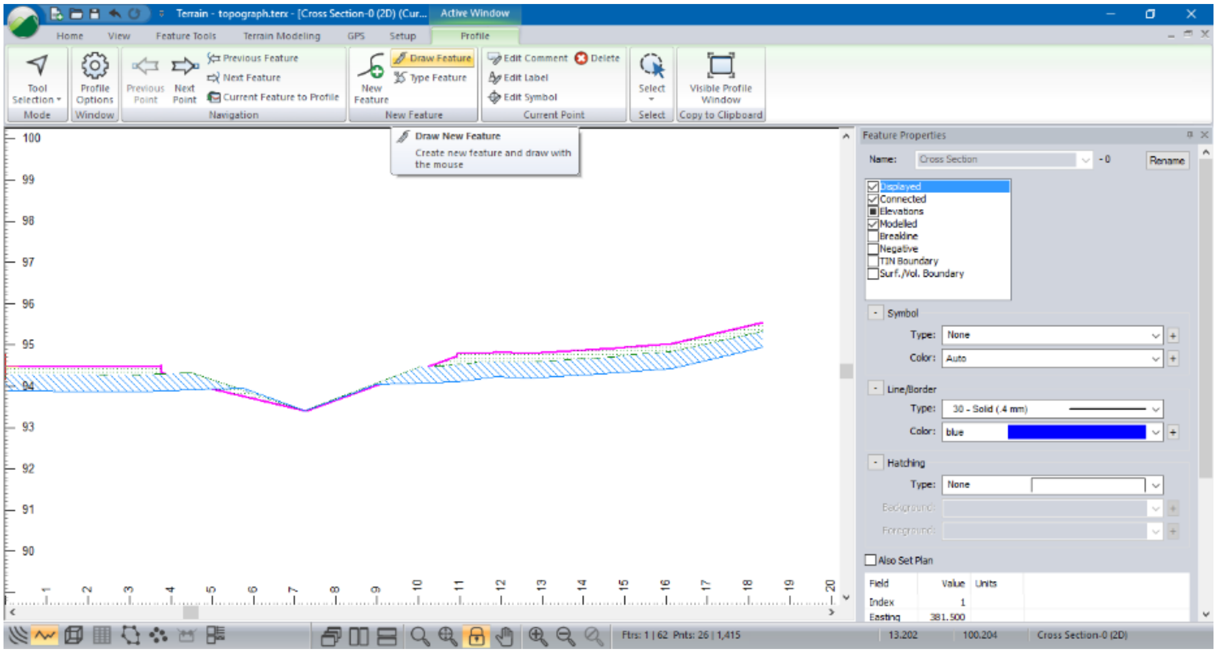


Figure 9-10: Profile Window with Multiple Layers

21. *File* |*New.* Do <u>not</u> save the changes.

Modifying Features in the Profile Window

Stream Survey Example

To follow this example, have the *Mapping and Drafting, Surface Generation and Contouring, Profile Window* and *Profile Window Drafting and Design* function groups enabled.

1. *File* /*New*. <Terrain>\Profile**topograph.terx**. This is the same example used in the previous exercise, refer to figure at start of the previous section.
2. Select the thick blue feature (Stream-2) by clicking on it with the selection cursor.
3. *View* | *New Window* |*Profile* from dropdown list to view this feature in a Profile window.

> **Note:** Editing a feature with *Auto Scale* set is confusing, because after each edit the screen redraws at a new scale.

Turn off auto-scaling by doing either of the following:

4. *Profile tab* | *Window group* | *Profile Options* button. Opens the *Profile Window Options* dialogue box. De-select *Auto Scale* and set the *horizontal* and *vertical scales*. Press *OK*.
5. Press the *zoom* button; you will be prompted "OK to turn off auto-scale?" Choose *OK*.
6. *Zoom* and *scroll* to center the stream profile.
7. <*Right-click*> in the Profile window and choose mode *Edit/Insert Points with mouse*.

Add a point at the end of the feature:

8. Click to the right of the last point on right; respond *OK* to the warning.

9. Move your mouse around observing the captured point and connecting segment.
10. Click a second time to anchor the new point.

Edit an existing point:

11. Move your mouse over one of the vertex points in the feature, note that the mouse changes to the edit cursor ⌜⌟. (The first point of a fence feature, however, is not editable.)
12. Click on a vertex ⌜⌟ and capture the point.
13. Move your mouse around observing the captured point and connecting segments.
14. <Left-click> again to anchor the point in a new position.
15. *View* | *Tile Vertically* button to show Profile and Plan windows side by side as in the previous exercise.
16. Because you have just modified one of the features in the model, your contours will be out of date. *Terrain Modelling* | *Generate TIN*.
17. Press *OK* to re-calculate with the previous settings.
18. *File* | *New*. Do <u>not</u> save the changes.

Profile Window Design and Drafting: Culvert Design

Culvert Design Example

This example illustrates profile window design and display using multiple features and multiple Profile Windows. The concept of *projected* and *intersected* features is also covered.

1. *File* | *Open* <Terrain>\Profile**topograph.terx**. Using the Selection cursor select the thick blue feature running down the center of the creek (STREAM-2) as shown in the figure below. It will turn magenta when selected.

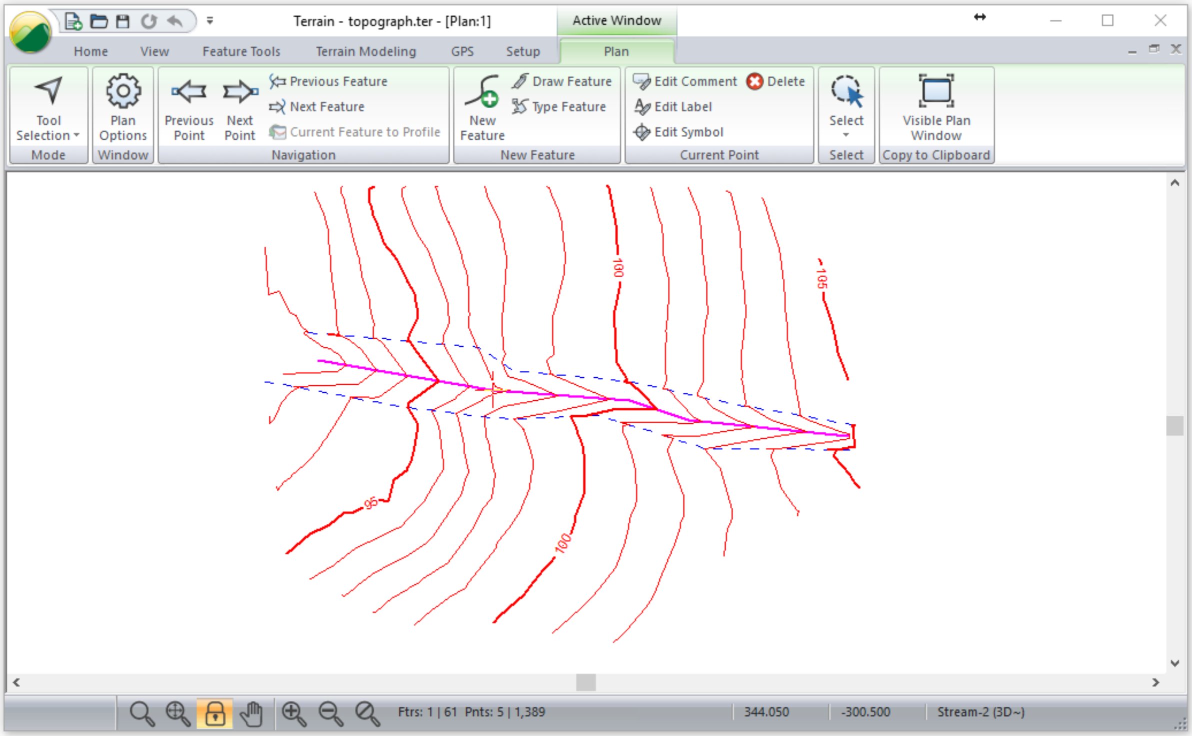


Figure 9-11*:* topograph.terx In Plan View

2. *View* | *New Window* | *Profile* from dropdown list. This opens a Profile Window with the feature name, STREAM-2.

Note: The Status Bar:

You can open or re-activate windows at any time using the *Status* Bar navigation buttons. To ensure it is displayed, right-click in the *Status* bar and make sure *Navigation* is selected.

3. Re-activate the Plan Window, by pressing .
4. Using the Selection cursor in the Plan Window, select the upper stream bank (the upper blue dashed line) feature (STREAM-0). Switch to the Profile Window. Note the feature in the Profile Window remains the same (STREAM-2) but it is no longer the current feature (no longer highlighted in magenta).
5. *View* | *New Window* | *Profile*. A new Profile Window will open displaying STREAM-0.
6. Current Feature to Profile changes the Profile Window to display the current feature (this function changes the active Profile Window).
7. Switch back to the Plan Window. <Left-click> in an empty area to deselect all features.

Note: When a new feature is created it inherits the formatting (line-type and color) of the currently selected feature. By deselecting all features, the new feature will not inherit any formatting.

The next several steps involve entering the coordinates of the road centerline as it crosses the stream and then profiling the road centerline.

8. *Plan* | *New Feature*. Change the feature name to **ROADCL** and make sure **Displayed**, **Connected**, and **Modelled** are on – this creates a Draped Feature (as shown in the property image to the right of the options within the dialog). All other properties should be off. Press the Keyboard button.

9. Enter the following X, Y coordinates:

399.2	<Tab>	**-276.8**	<Enter>
399.4	<Tab>	**-288.7**	<Enter>
399.4	<Tab>	**-296.0**	<Enter>
398.8	<Tab>	**-310.6**	<Tab>

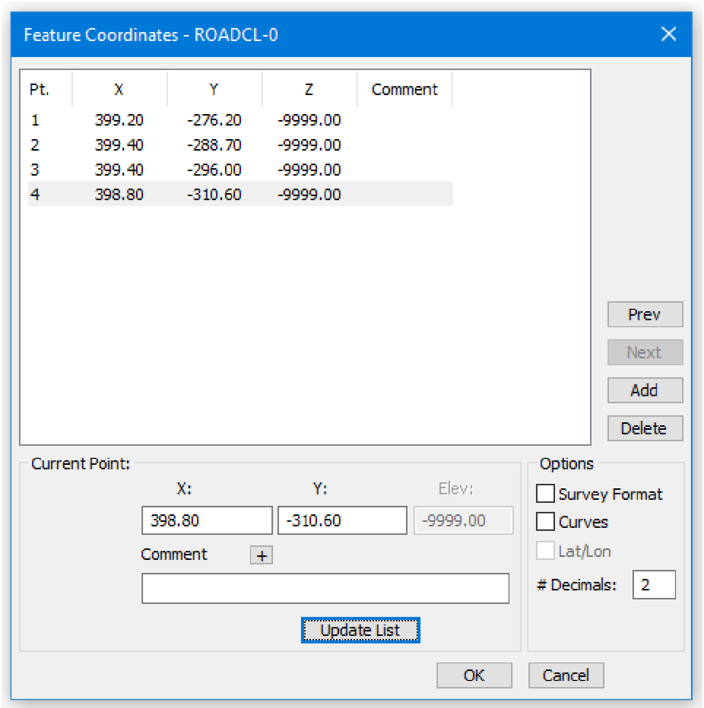


Figure 9-12: Feature Coordinates Dialogue Box

10. <u>Do not</u> press <**Enter**> after the last coordinate (if you accidentally do, use the Delete button to remove the last 0,0 coordinate).

11. Press the *Update List* button to accept the last coordinate.

12. Check the above coordinates if satisfied they are correct, press *OK*. Notice the Plan Window now displays the new **ROADCL** feature.

13. With the feature selected, select menu *View* | *New Window* | *Profile*. Refer to Figure 9-13.

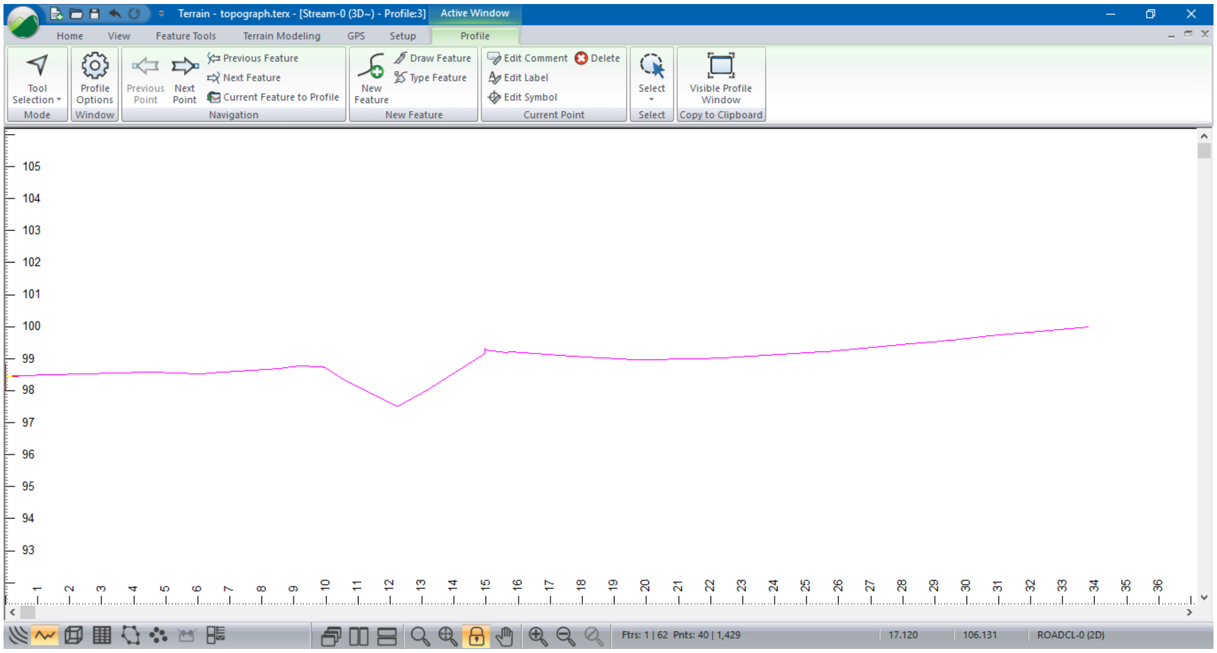


Figure 9-13*:* ROADCL Profile

14. *Profile* | *Window* | *Profile Options*. Re-ensure *Auto-Scale* is checked in the *Profile Window display options* will re-scale the view so that the profile line will fit to the extents of the profile view.

15. Set the *Ratio* (*V to H*) to **10.0**. Press *OK* to close the dialog.

16. To create a cross section parallel to the creek, select *Profile* | *New Feature* button. Change the feature name to **SECTION.** Make sure *Displayed*, *Connected*, and *Modeled* are on. All other properties should be off. Press the Keyboard button and enter the following X, Y coordinates:

382.4	<Tab>	**-287.1**	<Enter>
421.7	<Tab>	**-291.7**	<Tab>

17. Do <u>not</u> press <Enter> after the last coordinate. Press the *Update List* button. Press *OK* provided the *Feature Coordinates* - Section -0 dialogue box looks like the Figure 9-14.

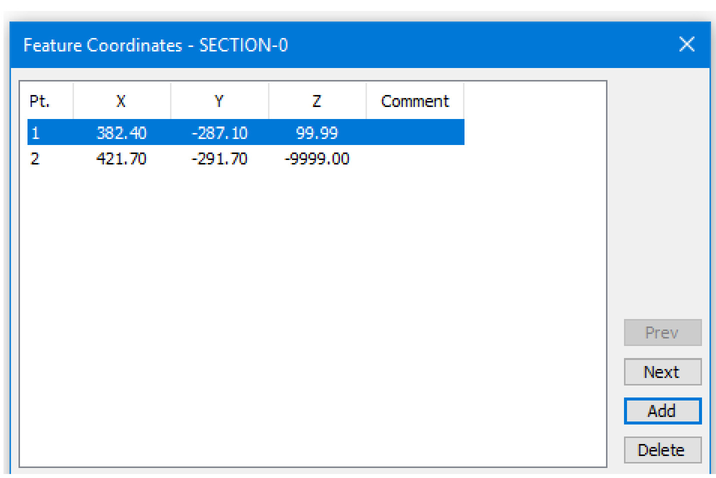


Figure 9-14*: Feature Coordinates - Section-0 Dialogue Box*

18. *View* | *New Window* | *Profile*. A Profile Window appears with the feature name, SECTION-0, in the bottom status bar.
19. Notice there is another feature in the Profile Window. This is feature STREAM-2 projected onto the SECTION-0 profile. See Figure 9-15.

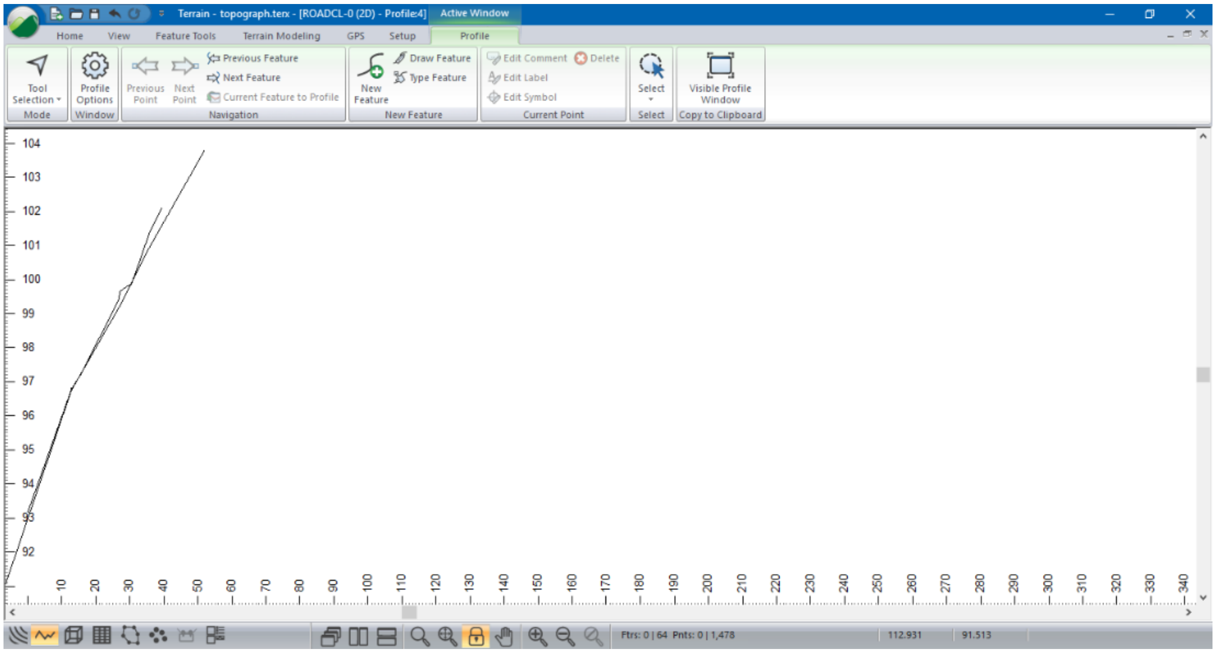


Figure 9-15: Screen Shot of STREAM-2 and SECTION-0 Profile

Intersected and Projected Features

Each Profile Window is based on a feature called the *Fence Section Feature*. It is possible to display additional *projected* or *intersected* features in a Profile Window.

Intersected features penetrate the vertical plane of the profile. These intersection points can be displayed with a symbol of your choice.

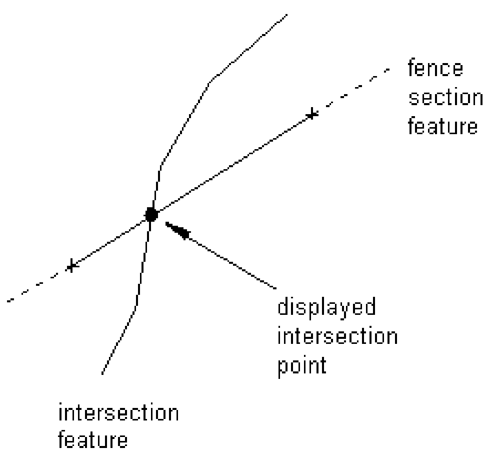


Figure 9-16: Intersected Feature (Plan View)

Projected features are displayed on the profile by projecting perpendicularly onto the fence section.

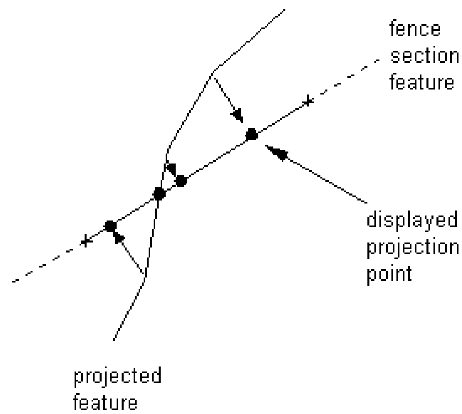


Figure 9-17: Projected Feature (Plan View)

Projected features are often on (or near) the fence section. If you draw features (other than the fence section) in a Profile Window they are automatically added to that windows list of Projected features.
A user configurable list of intersected and projected features is stored with each profile. This list can be accessed from the *Active Window (Profile) Options dialogue box.*

20. To display intersection of ROADCL on the creek section (SECTION-0):

    a. Select Profile Window SECTION-0. With the cursor positioned in the Profile window, right-click and select *Active Window (Profile) Options*.

    b. Click on the *Projected/ Intersected* button.

    c. In the *Intersected Features* group box, press the *Select* button. Find and Select ROADCL-0. (figure below) Press *OK* until you have returned to the main screen.

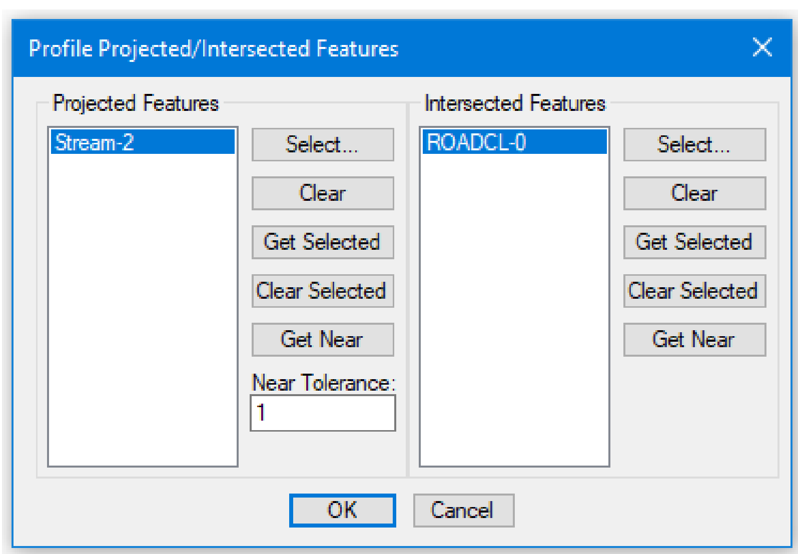


Figure 9-18: Profile Projected / Intersected Features

d. *Home* | *Select* | *By Name* from dropdown list. Press the *Un-select All* button and select the ROADCL-0 from the list with a <double-click>. Press *OK* to return to the main screen.

e. <Right-click> in the Profile Window, and select *Modify Selected Feature(s)* | *Line-types, Symbols*. Select *symbol* Triangle (Large). Press *OK*. A large triangle is now in the center of the creek profile indicating the position of the road centerline feature. Use *Zoom extents* or *Pan* the view if the road centerline is not visible.

Note the elevation of the road centerline lies on the streambed. This is because the road centerline feature has been 'draped' over the TIN model.

Design in the Profile Window

21. To position the culvert pipe in the stream, activate the road centerline profile ROADCL-0. Click in the white space and press the Profile button until the ROADCL-0 title appears in the Profile Window title bar.
22. Position the cursor in the Profile Window, right-click and select Active Window (Profile) Options. Deselect the *Autoscale* checkbox and set both *horizontal* and *vertical scales* to 200.
23. Select *Snap to Grid* and press the plus button to set the *grid space* (SpaceX and SpaceY) to 1.8 m (to create an 1800 mm diameter pipe). Press *OK*. Return to the main screen.
24. *Profile* | *Draw Feature*. Draw a horizontal line in the Profile window one grid space wide (1.8 m). Each point requires two left-clicks.
25. With the feature you drew still selected. *Feature Tools* | *Shape*. Choose *Diameter to circle* from the list box. Press *OK*.
26. *Feature Tools* | *Feature Properties*. Change the name to PIPE. Press *OK*.
27. Press <Ctrl + M> key to enter move/size mode or press the *Move/Size* button. Move the cursor inside the circle. Note it changes shape to a four-headed arrow.
28. <Left-click> and drag the circle to a reasonable position in the creek. Release the left mouse and <right-click>. Select menu *Select with mouse* to exit move/size mode.

At this point your Profile Window should look like the screen capture in the figure below:

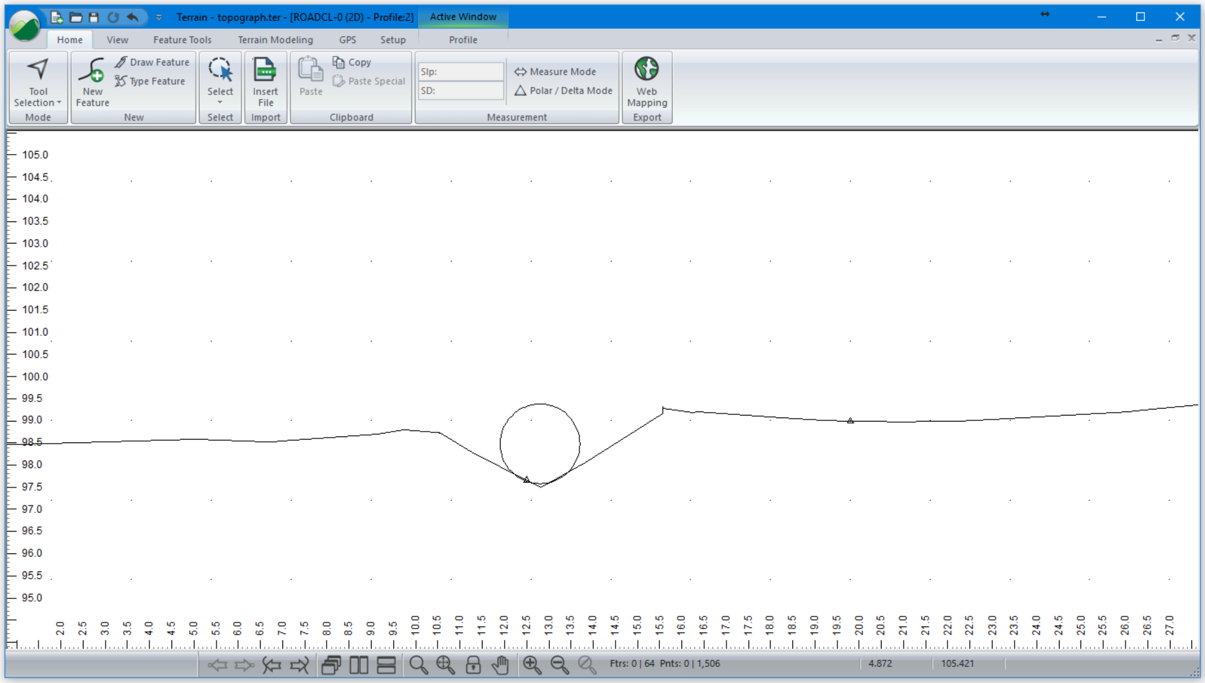


Figure 9-19: 1800 mm Pipe Displayed in Road Centerline Profile

29. Click on the Profile Window button until SECTION-0 is displayed.
30. *Profile* | *Profile Options*. First, de-select the *Autoscale* checkbox and set both *horizontal* and *vertical* scales to **200**.
31. Click on the *Projected Intersected*… button. In the *Projected Features group* box, press the *Clear* button and then the Select**…** button. Scroll down the list and double-click on PIPE-0. Press *OK* three times to return to the main screen.
32. You should now be able to see the projection of the culvert on the stream cross section. Use *Zoom* extents or *Pan* the view if the cross section is not visible. The projected pipe is displayed as a very thin oval shape (if the cross section was exactly perpendicular to the centerline it would be displayed as a vertical line). This should appear similar to the figure below:

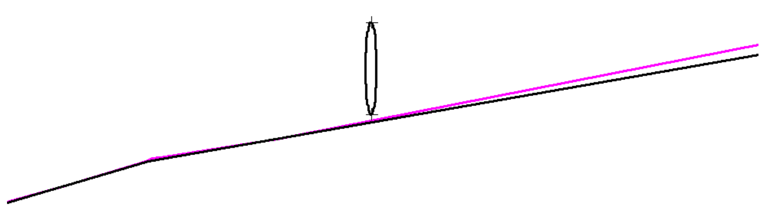


Figure 9-20: Culvert Displayed in SECTION-0 Profile

The next step is to draw a road template on the cross section:

33. Press the *Profile*| *New Feature* button. This will create a new feature with *Displayed*, *Connected*, *Elevation* and *Modeled* turned on. Select *Create using Mouse*.

34. <Left-click> once in the Profile window. Before continuing to draw our new feature, we will add labels to assist us.

35. With the cursor positioned in the Profile window. <Right-click> and select menu *Modify Selected Feature(s)* | *Labels*. Turn on the display of the *dLength* [length change] and *Grades* labels by finding them in the list box and double-clicking. Make sure all other labels are turned off. Press *OK* when they are selected.

The *dLength* label will display the 3D length of a segment. *Grades* label will display the slope % (rise/run *100%).

36. With the length and grades displayed, draw a road prism for a 10m wide road similar to the one shown below.

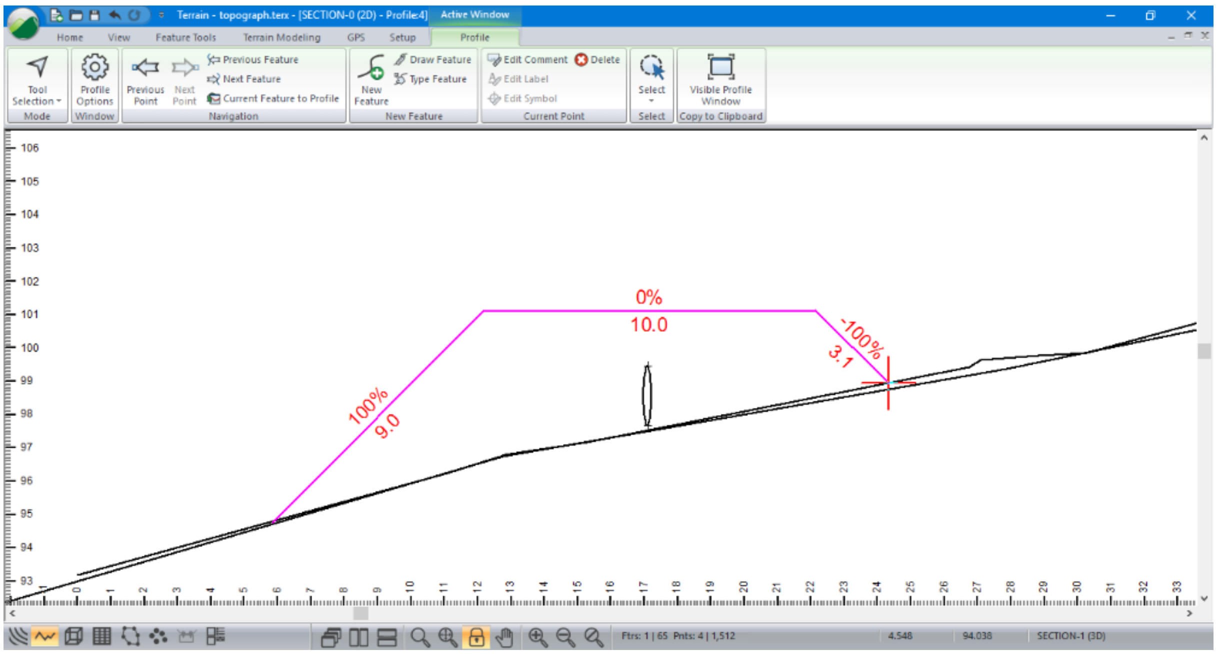


Figure 9-21*: Cross Section with Road Template*

37. Repeat the process to draw the top of the pipe. Press the *Profile* | *Draw Feature button…*| <Left-click> once over the Profile Window.

38. Keeping the cursor positioned in the Profile Window Right mouse click and select menu *Modify Selected Feature(s)* | *Labels*. In the list box find and enable the display of the *dLength* and *Grades* labels. Press *OK*.

39. Draw the top of the pipe line from one side of the road to the other as shown in below.

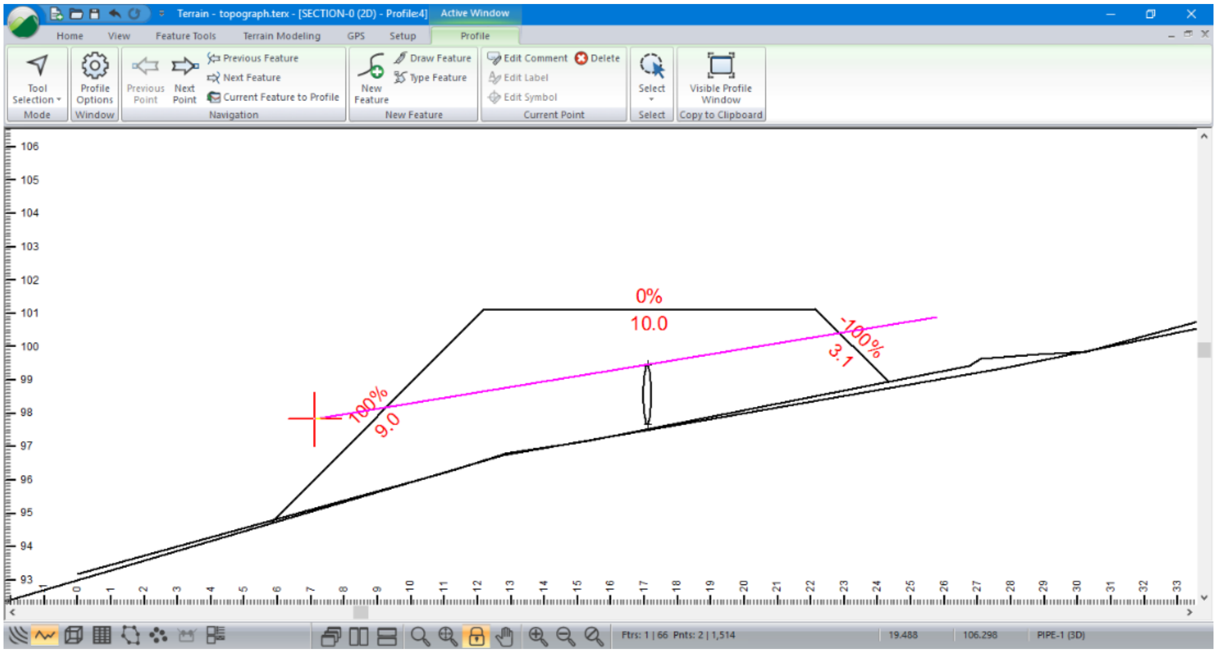


Figure 9-22: Cross Section with Preliminary Culvert Position

40. Using the selection cursor, select the top of the pipe feature. *Feature Tools* | *Duplicate* or press the <Ctrl + D> to duplicate it. Move the cursor inside the new feature. Click and drag to move it to the bottom of the circular pipe feature.

41. Using the selection cursor, select the circular pipe feature in the center of the Profile Window. *Feature Tools* | *Duplicate*. Move the cursor inside the new feature. Click and drag to move it to a new position at the end of the pipe on the right side. Repeat this procedure for the left. The result will be as shown in below.

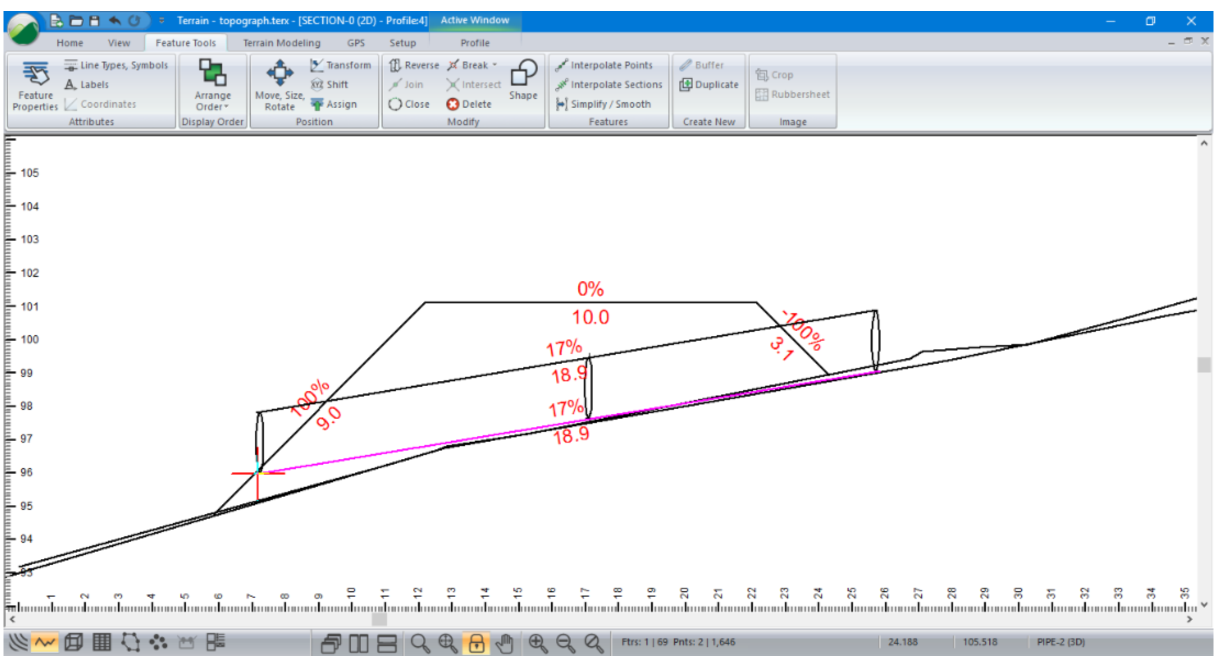


Figure 9-23: Cross Section with Culvert Position

42. Changing line-types makes it easier to identify the culvert features in the Plan Window.

43. Open the *Feature Properties panel* . Using the selection cursor depress <shift>, select the top of the pipe, the bottom of the pipe, and the circular elements. Under *Line-types, Symbols*: Choose Line-type 5-thick (medium) and check *Also Set Plan* indicating that changes will also affect the Plan Window. Press *Apply*.

44. Activate the Plan Window by pressing the Plan button . Your screen should be similar to the figure below.

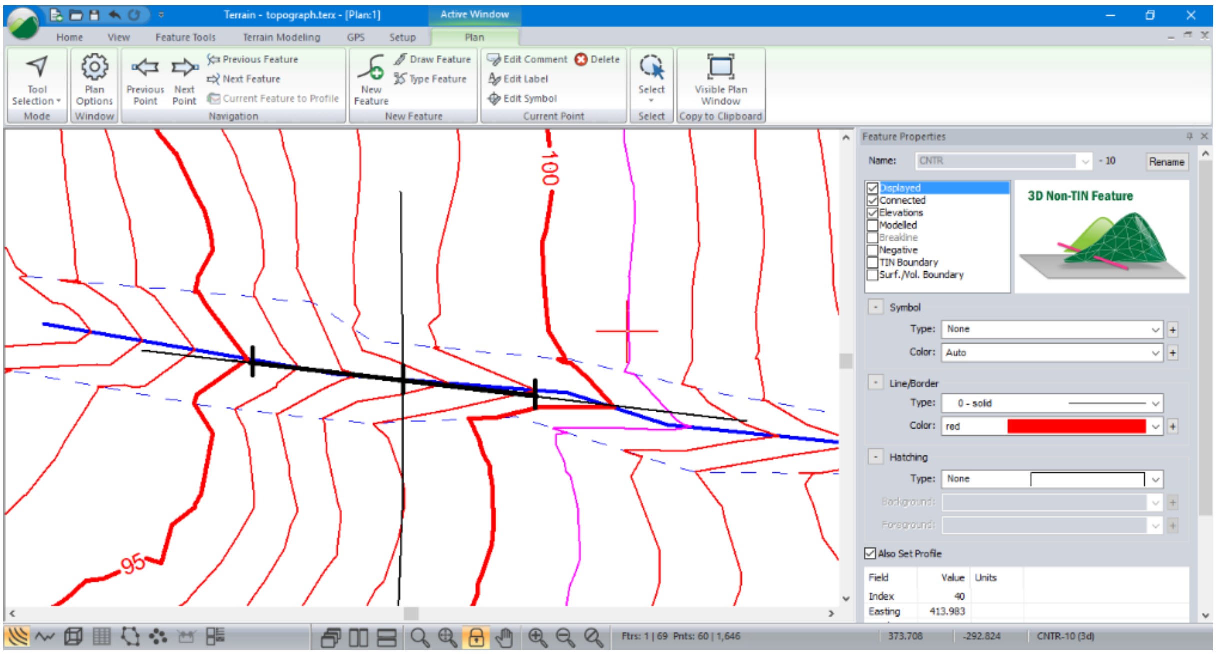


Figure 9-24: Plan Window with Culvert Position

45. *File* | *New*. Do not save the changes.

10. Grading

The Grading functions in Terrain are useful for designing polygonal shaped objects such pits, ponds and pads. It can also be used to design linear objects such as roads, channels and walls etc. although the RoadEng Location module is better suited for this purpose. To illustrate the concepts of grading we will design a platform.

Grading Concepts

Platform Example

In this example, a platform outline (polygon) will be created using the mouse. We will then iteratively adjust the elevation of the pad to balance the cut and fill quantities.

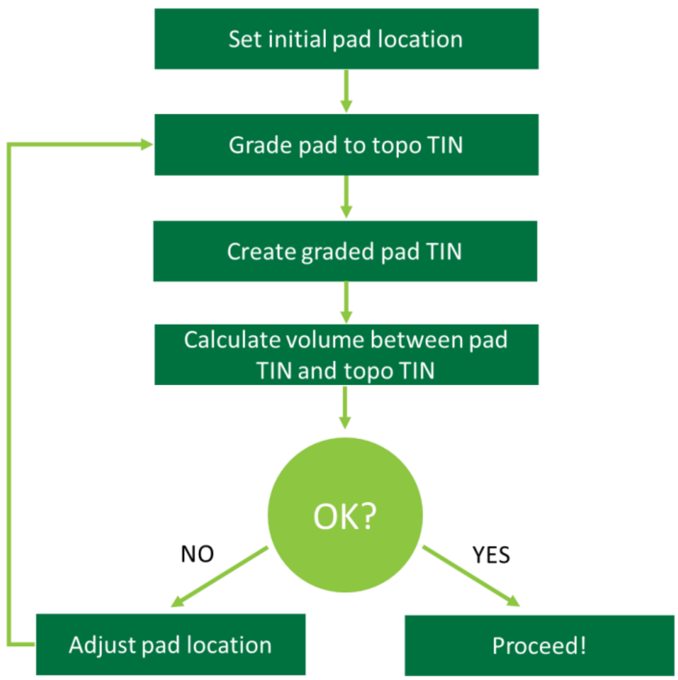


Figure 10-1*: Procedure for Balancing Cut and Fill*

Platform Design

The following steps will demonstrate how to set the initial pad location by entering its coordinates. The initial pad location could also be established by drawing it with the mouse or importing it from an external file (shape, dxf etc.).

Before the pad is created we will place the topo contours ("*OriginalGroundGrading.terx*") in the background for reference.

1. In a blank Terrain file, bring in the original ground terrain file in the background: *Plan* | *Plan Options* | *Background tab* | *Add*... button and select <Terrain>\Grading**OriginalGroundGrading.terx**. Press *Open*.
2. Use *Zoom Extents (View* | *Zoom Extents*) or *Pan* the view if the background is not visible.

Now, we will draw in the pad for grading:

3. *Plan* | *New Feature*, the *Feature Properties dialogue* box will appear. Type in the *name* "**Platform**" and keep the default properties (*displayed, connected, elevations, modeled*) as shown in the figure below.

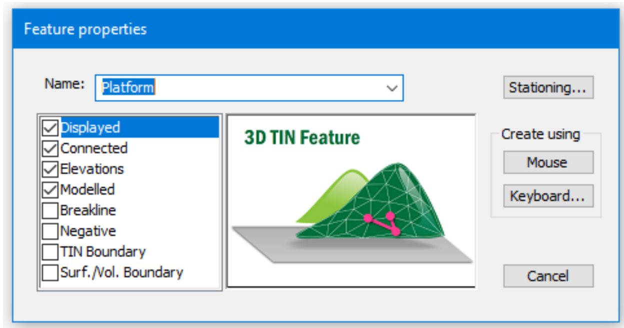


Figure 10-2: Feature Properties Dialogue

4. Create a rectangular platform by adding coordinates: Press the *Keyboard***...** button, and the *Feature Coordinates dialogue* box for the new feature called "Platform-0" will appear.

5. Add the coordinates found in the figure below. Make sure not to press <Enter> after the last entry, instead press *Update List*. With *Survey Forma*t option unchecked, press *OK*.

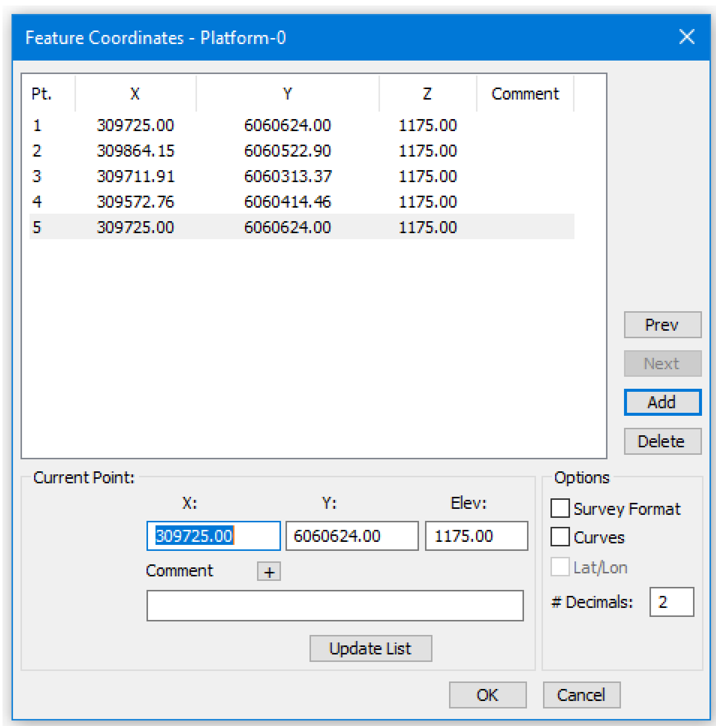


Figure 10-3: Feature Coordinates Dialogue

This should result in a rectangle the same as the figure below:

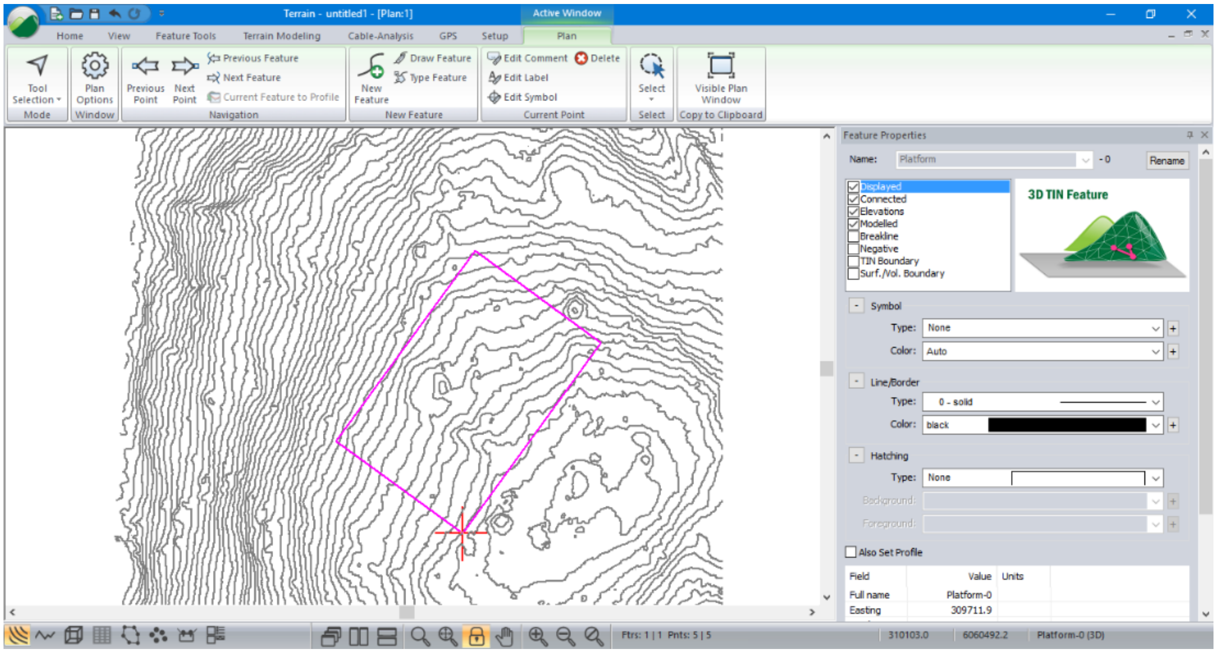


Figure 10-4: Initial Pad Location Overlaid on Topo Contours

Grading the Platform

The Grading option projects a feature at user specified cut/fill angles to a 'Target surface'. Slope lines are created at each feature point and at user specified interpolated points. The daylight line is also calculated as shown in the figure below.

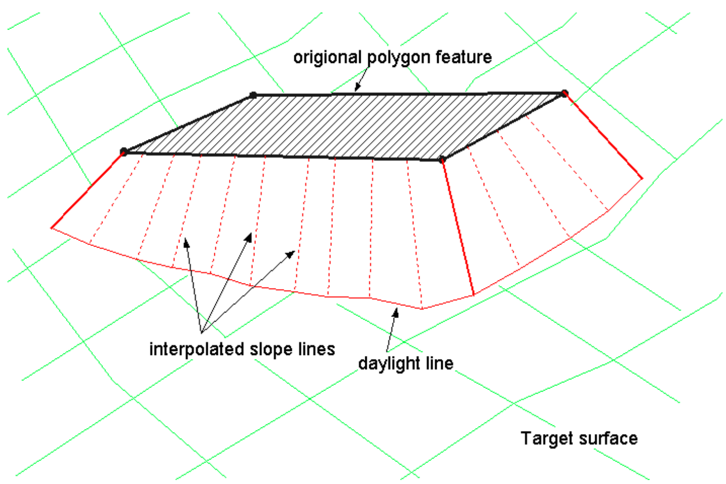


Figure 10-5: Grading a Polygon to a Target Surface

In this platform design example, we will assume the platform is in a good plan location (if this is not the case, the pad can be easily dragged to a new location using *Ctrl + M*). We will grade the platform top to a topo surface.

6. With the rectangle selected. Open the *Grading Dialogue* box: *Terrain Modeling* | *Grading*.

7. Within the *Grading Dialog* box press the *Browse***...** button and select file <Terrain>\Grading**OriginalGroundGrading.terx**. Press *Open*. Change the other fields to match those shown in the figure below. Press OK.
8. Still within the *Grading Dia*log box, check boxes *Interpolate*; *Spacing*: **5.0**; *Set breakline property*. Check all the boxes under *TIN / Volumes*: *Set Daylight to TIN boundary*; *Calculate TIN; Calculate Volumes.*

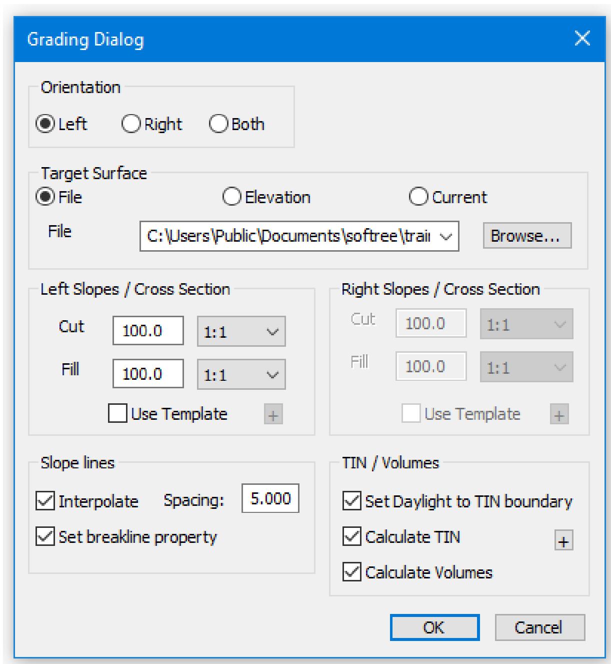


Figure 10-6: Grading Dialogue Box

The *Grading Dialogue* box controls how the slope is projected (*Orientation*), the elevation or surface (*Target Surface)* the *Slopes* from the pad to the surface, and the spacing (*Slope line interpolation spacing*) of the projected slope lines. The dialogue also allows you to calculate the TIN model as well as volumes after the grading calculation operation is complete.

After a few seconds, the grading calculation will complete and the *Volume / Surf. Properties Reporting* dialogue box will appear. Notice that there is a considerable amount of fill indicated in the *Volume / Surf. Properties Reporting* dialogue box.

9. Press *Close*.

Note: Ensure that the *OriginalGroundGrading.ter* file is designated as "Original" and the *Untitled.ter* file is designated as "Final" otherwise the cut and fills will be reversed. (Refer to the figure below).

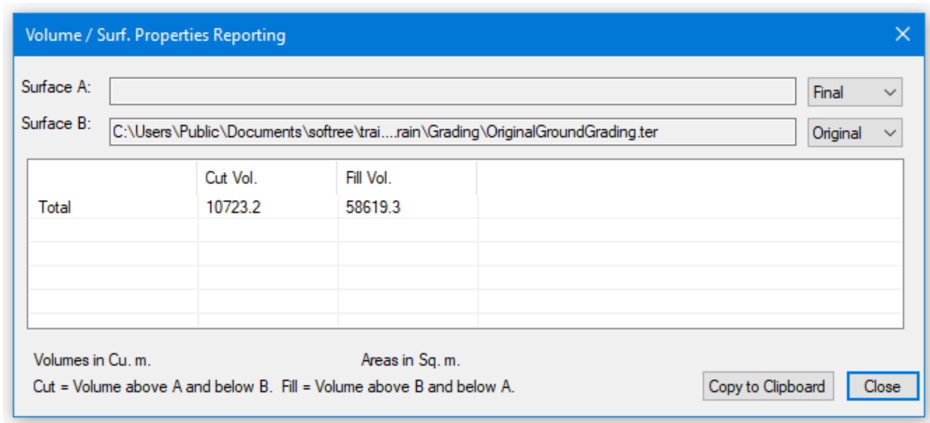


Figure 10-7: Volume/Surf. Properties Reporting Dialogue Box

To balance the cut and fills, let's try dropping the pad by 1-meter increments.

10. First, select the pad if it is not already selected. Select the pad top by using the selection cursor . It is not necessary to select the slope and daylight lines. (Refer to the Figure 10-8)

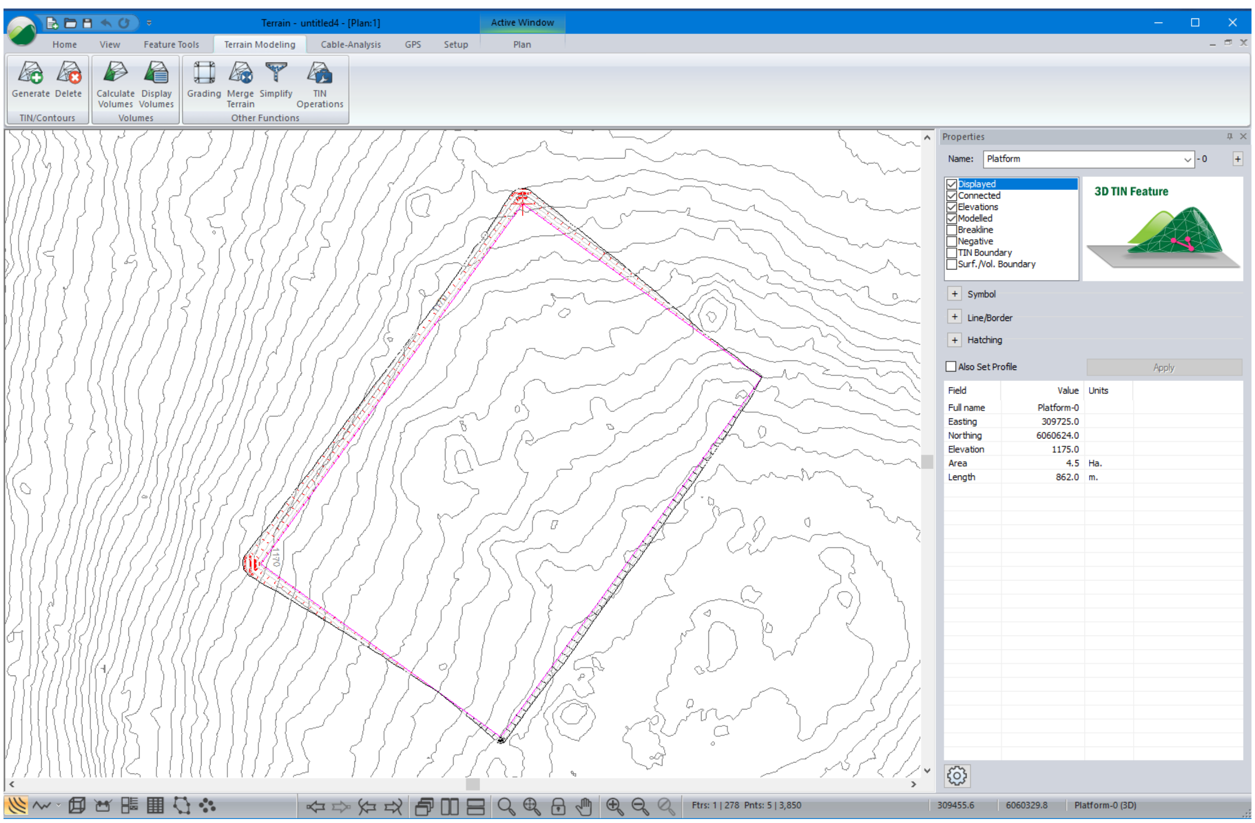


Figure 10-8: Screen Shoot with Pad Top Selected

11. *Feature Tools* | *Transform*. You may get a Terrain warning dialogue box as shown in the figure below. Press *OK*. Select the *Rotate/Translate/Scale* tab.

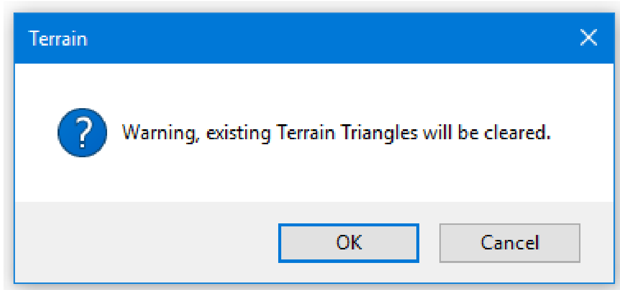


Figure 10-9: Terrain Warning Dialogue Box

12. Uncheck *Disable* (no coordinate adjustment) box. Change the *Shift Offset* Z to –1 as shown below. Press *OK*.

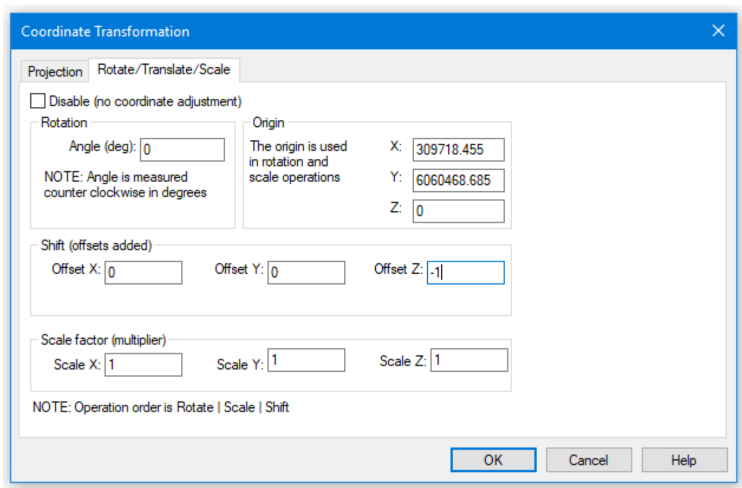


Figure 10-10: Coordinate Transformation Dialogue Box

13. *Terrain Modeling* | *Grading* button. Press *OK*.

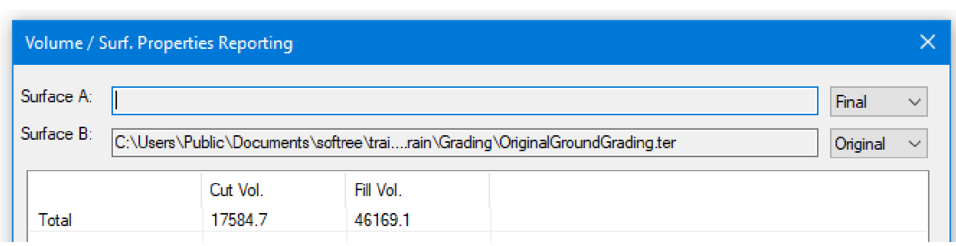


Figure 10-11: Volumes After Dropping the Pad by 1-meter

14. Open the *Feature Properties* panel. You should see the elevation of the platform decreased from 1175 to 1174 in the status portion.

15. Transform the elevation down 1m again. Repeat the above transform, grading, TIN and volume calculation as in Steps 11 through 13. Press *OK*. Once the grading calculation has completed you will notice that there is still too much fill.

16. Now select *Feature Tools* | *Shift*. Change Z to **1172.5** as shown in the figure below. Press *OK*.

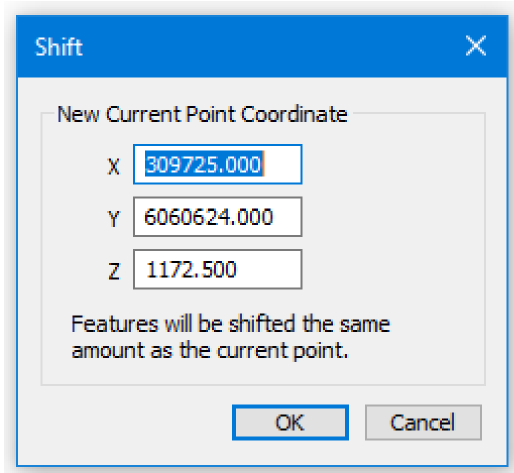


Figure.10-12: Using Shift to change elevation of "Platform"

17. *Terrain Modeling* | *Grading* button. Press *OK*.

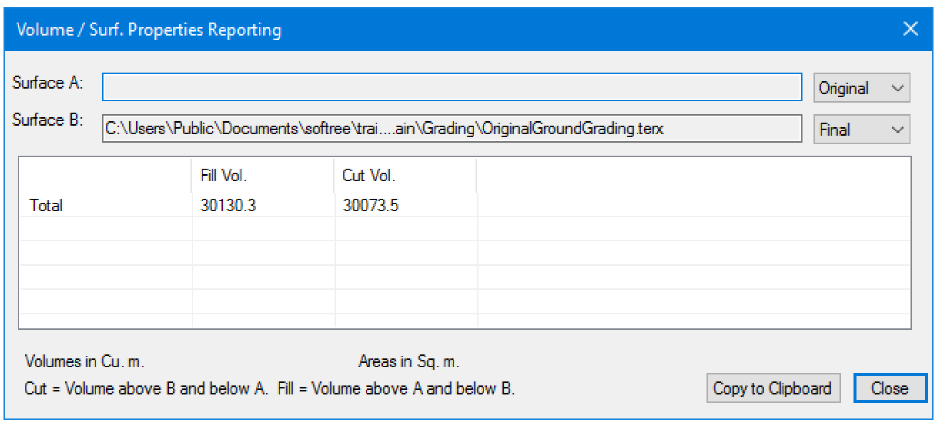


Figure 10-13: Screen Shot of Final Cut and Fill Slopes

The cut and fill are close to being balanced. (Refer to figure above).

18. *File* | *New*. Do not save changes.

Merging Terrains

The next few steps to will describe how to merge the pad with the **OriginalGroundGrading** file contours.

1. *File* | *Open* <Terrain>\Grading**OriginalGroundGrading.terx** A contour file will appear on your screen.
2. Next, we will merge the pad terrain into this terrain file. *Terrain Modeling* | *Merge Terrain*.

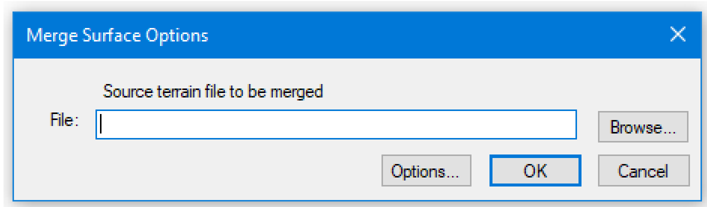


Figure 10-14: Merge Surface

3. Before continuing, make sure that the slope stakes on the pad form a distinct boundary. This is done by pressing the *Options***...** button and check *Include inside stitching (source) breakline* in the *TIN Merge Options dialogue* box as in the figure below. Press *OK* twice.

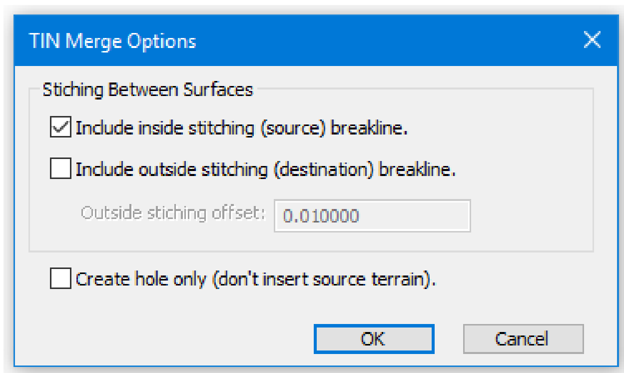


Figure 10-15: TIN Merge Options

4. Press the *Browse***...** button. Select <Terrain>\Grading\ **pad-grading after volume calc.terx**. A "Warning No Space for Undo" message box may pop up (figure below). Press *OK* to continue.

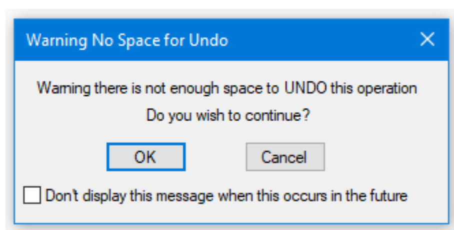


Figure 10-16: Warning No Space for Undo Dialogue Box

After a few seconds, the screen should now look like the figure below. Notice that the pad is now merged into the original ground surface.

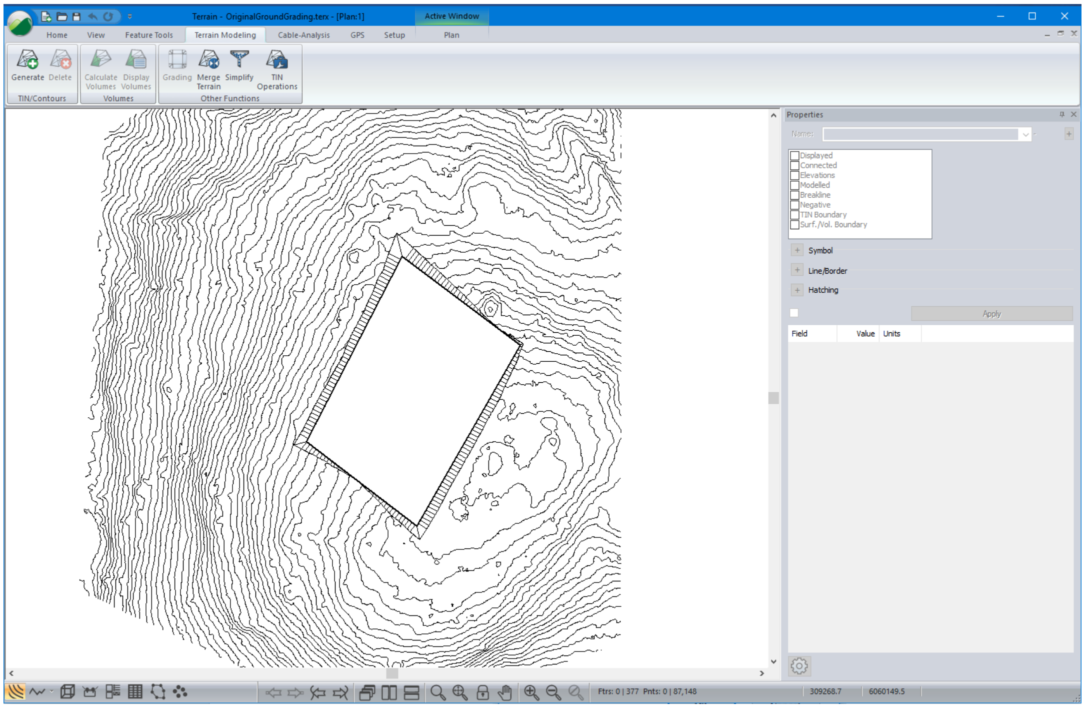


Figure 10-17: Platform Merged into OriginalGroundGrading.terx

5. *Terrain Modeling* | *Generate TIN*. Set the parameters as shown in the *Terrain Calculation* dialogue box below and press *OK* to re-triangulate the surface.

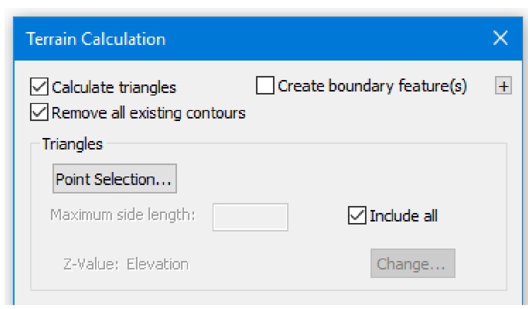


Figure 10-18: Terrain Calculation Dialogue Box

6. To view the platform file merged into the OrignalGroundGrarding.ter contours let us look at it in 3D. *View* | *New Window* | *3D* from dropdown menu. Rotate as required and you can see that the two files have been merged.

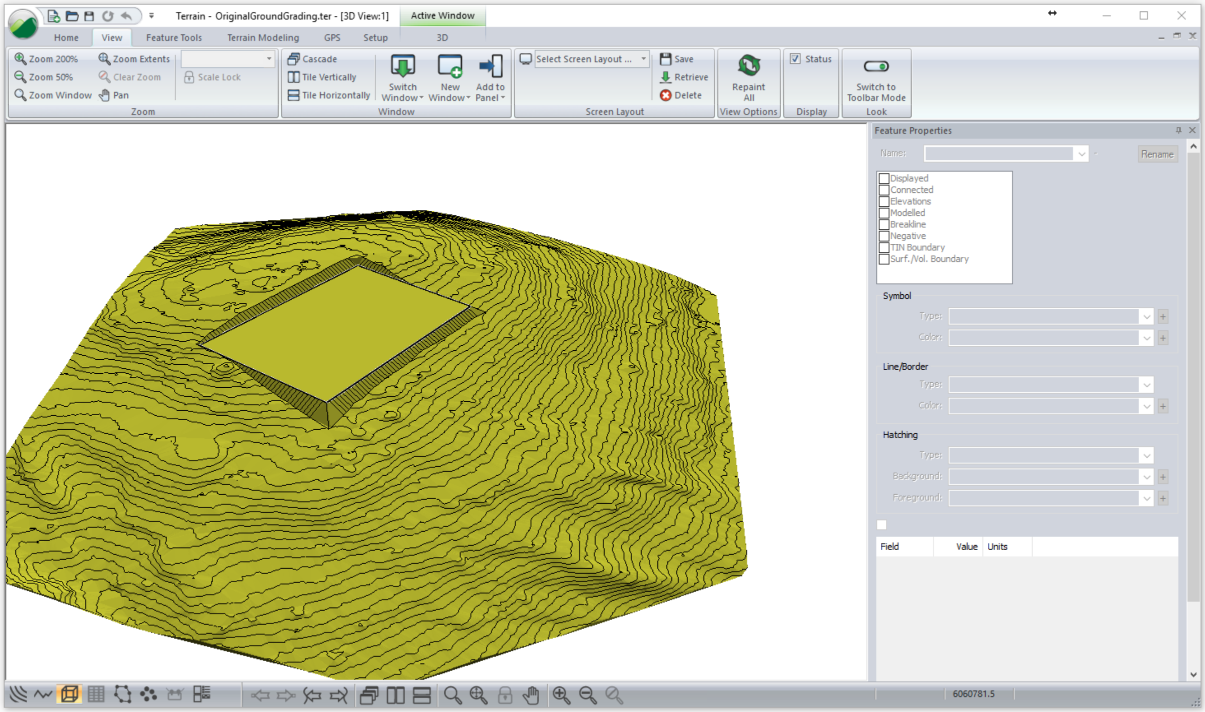


Figure 10-19: 3D Image of Merged Files (Platform.terx and OriginalGroundGrading.terx)

7. *File* | *New*. Do not save changes.

11. Traverse Data

The Terrain Module imports and exports traverse files used by the Survey/ Map and Location modules. This section will describe the procedures for working with traverses.

To follow the examples and procedures in this section the *Mapping and Drafting, Import Basic, Export Basic, Import Enhanced, Export Enhanced, Profile Window,* and *Surface Generation and Contouring* function groups must be enabled. See Function Groups in the On-line help for more information.

Creating a Profile from a Traverse

Road Design Example

A traverse document has been entered into the Survey/Map Module. This example will demonstrate how to display a profile of the traverse.

Note: See Getting Started section for file install folders (**<Terrain>** and **<Defaults and Layouts>**)

1. *View*| *Retrieve Screen Layout* <Defaults and Layouts>\Training**training terrain profile.ilt.** This screen layout has Scroll Bars, TIN, Labels, Grid, North Arrow and Background enabled.
2. *Home* | *Insert File*. From the Files of Type pull-down choose Softree Traverse Document (*.TR1,*.DB1). Select <Terrain>\Survey**road.tr1.** Press *Open*.

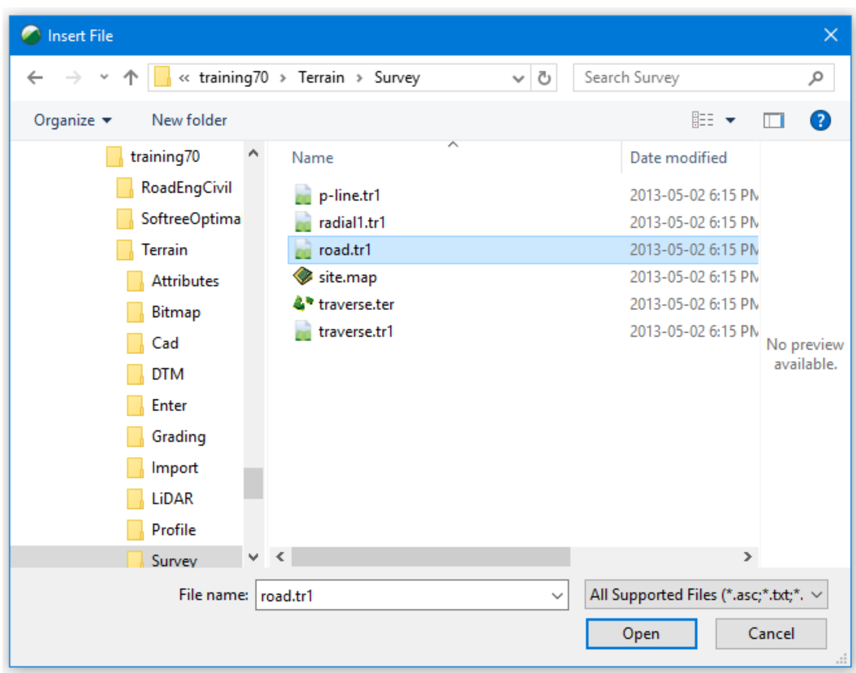


Figure 11-1: Insert File – Softree Traverse Document

3. Press *OK* to bypass the *Import Options dialogue* box.
4. Display the profile: *View* | *New Window* | *Profile* from drop down menu.
5. *Profile* | *Profile Options*. *Change Ratio (V to H)* to **10.0.** *OK*.

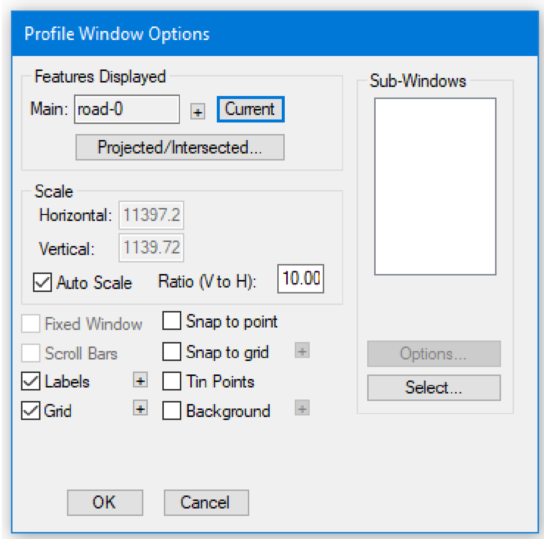


Figure 11-2: Profile of a Survey/Map Traverse Document

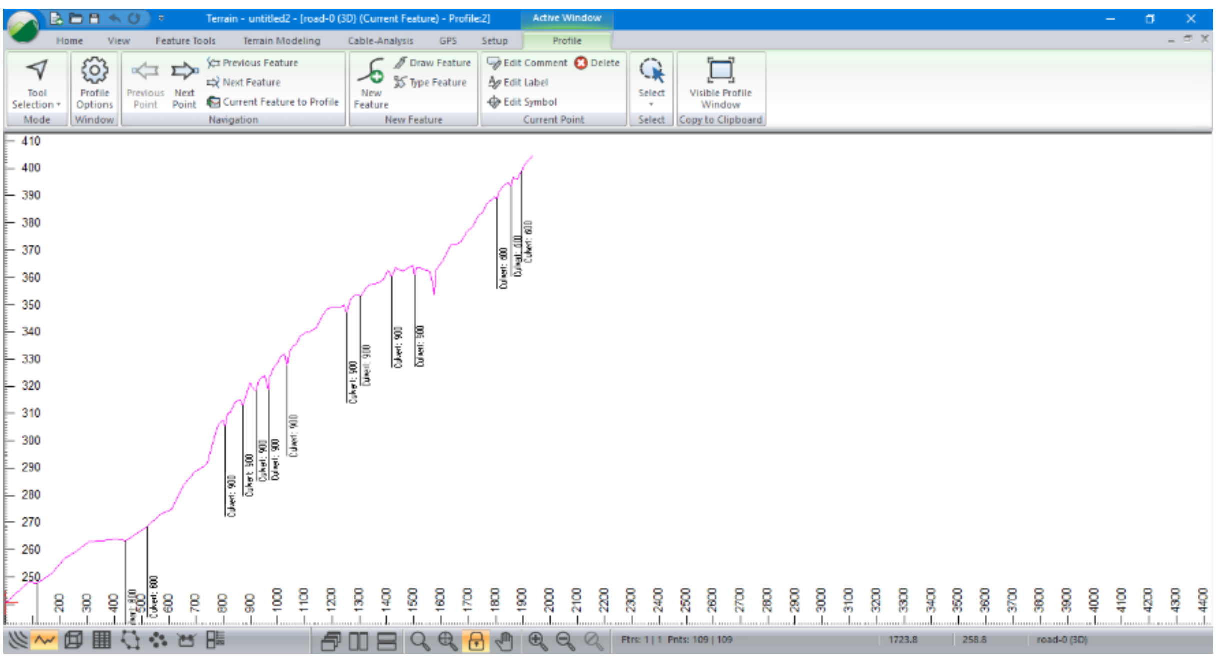


Figure 11-3: Profile of a Survey/Map Traverse Document

6. The scale has automatically been set to fit the entire traverse into the *Profile Window*. To change the scale: activate the Profile Window. *Profile* | *Profile Options* as shown in the figure below:

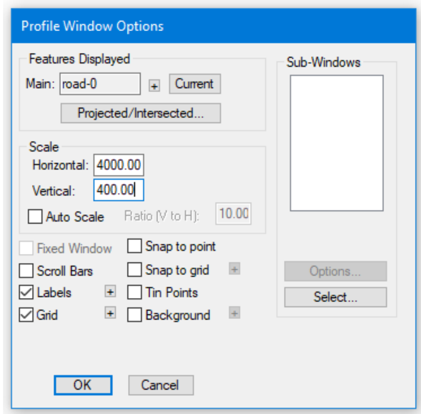


Figure 11-4: Profile Window Options Dialogue

7. De-select *Auto Scale*. Set the *Horizontal scale* to **4000**, the *Vertical scale* to **400** as shown above. Press *OK*.
8. At this point the Profile Window may be blank. Press the <Ctrl + N> key; the traverse should come into view.

Note: The <*Ctrl* + *N*> and <*Ctrl* + *B*> keys will change the current point (N=Next and B=Back).

9. To examine the profile near the proposed culvert at station 522 (the grid numbers in the X axis correspond with the stations). Using <Ctrl + N> and <Ctrl + B> move the current point to station 522 (as shown below). You can also use *Previous Point* and *Next Point* buttons in the *Profile* tab.

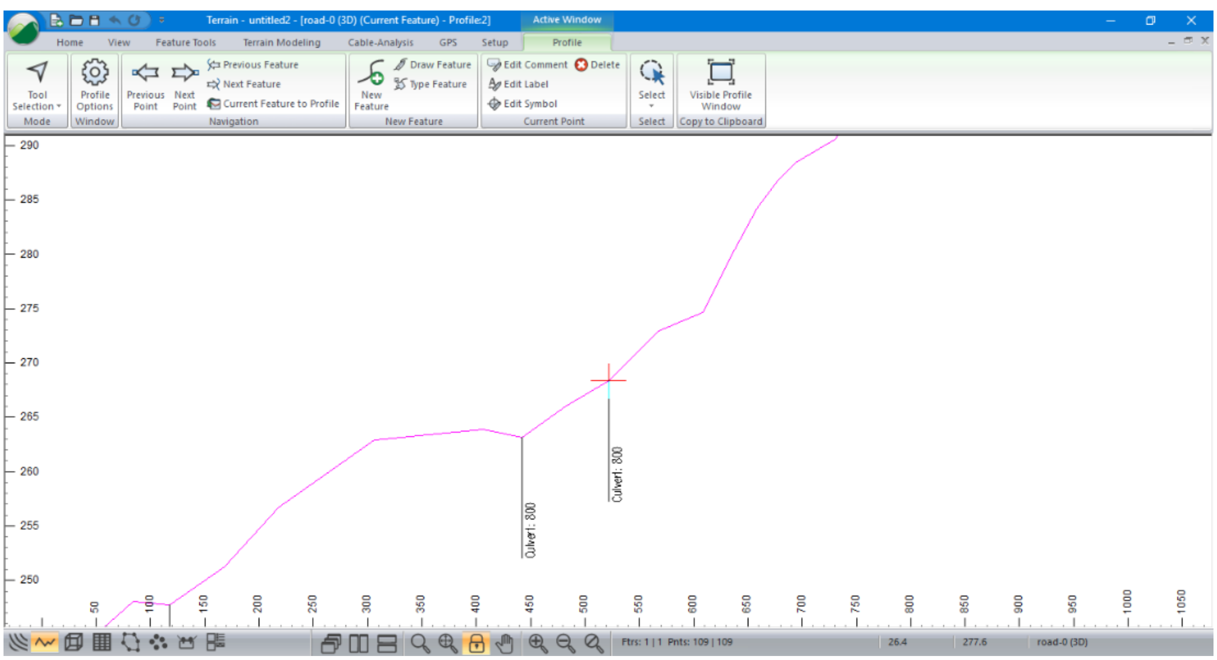


Figure 11-5: Profile with Current Station at 522

10. To display the station numbers: *Profile* | *Profile Options*. Press the plus button next to Labels. <Double-click> to select Stations. Press *OK* to return to main screen. The Station numbers are now displayed.

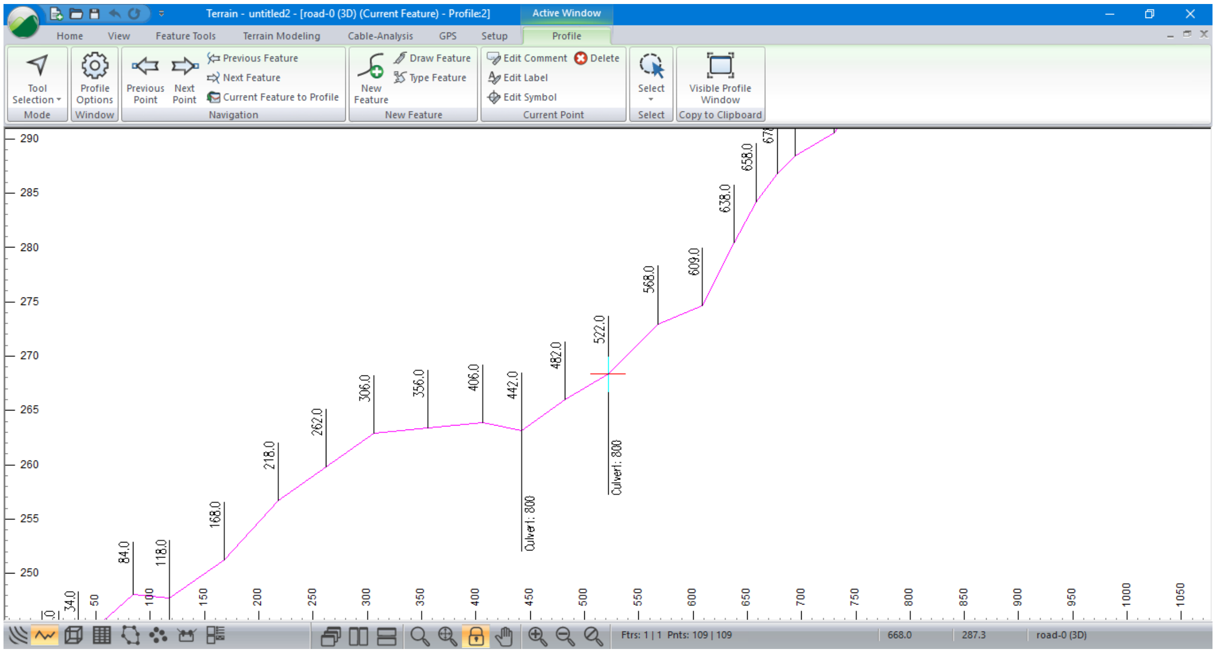


Figure 11-6: Traverse Profile with Station Numbers Displayed

11. *File* | *New*. Do not save changes.

Creating a DTM from a Radial Survey

Site Survey Example

The following example imports a *map document* containing a site survey. This example demonstrates how to import a map, format the points and create a DTM with contours.

The map consists of a radial survey taken from a single setup (See Survey/Map Tutorial - *Radial Surveys* for more information) and a road P-Line traverse.

1. *File* | *Open*. <Terrain>\Survey**site.map** (You may need to adjust the file type drop-down to include .map files). Press Open.
2. Make sure that Include Side Shots is not checked in the Import Options dialogue box. Press OK.
3. *View* | *Retrieve Screen Layout* <Defaults and Layouts>\training**training site.ilt**
4. *View* | *Zoom Extents*. Your screen should resemble the figure below.

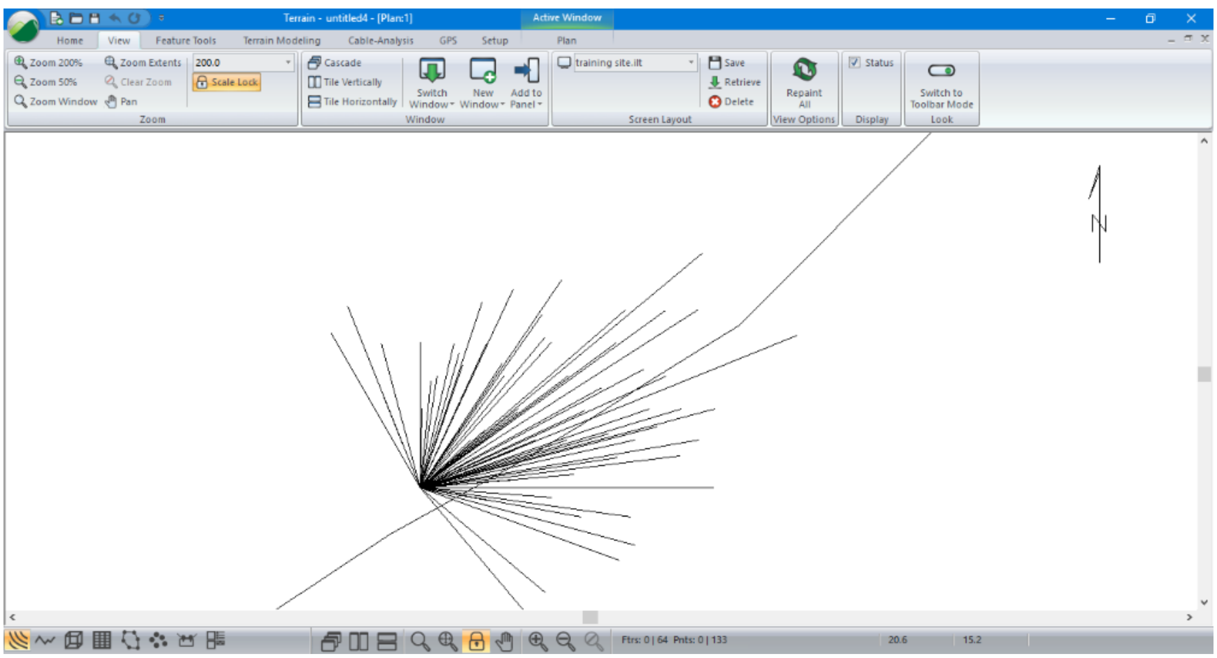


Figure 11-7: Imported site.map

For presentation purposes, the imported survey information will be re-formatted and 'cleaned up'.

5. *Home* | *Select* | *By Name* from dropdown list.
6. Press the *Un-select All* button. Click on the *Advanced*... button and type RADIAL* in the Select Matching Names area as shown in the figure below. Press the *Select* button in the *Select Matching Names* area. 63 features should be selected. Press *OK*. The selected features are displayed in magenta.

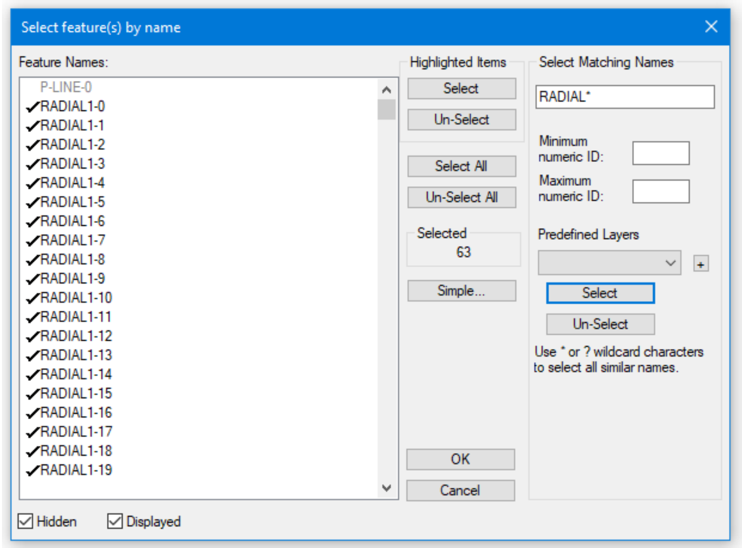


Figure 11-8: Select Features By Name Dialogue

Note: The *Select Matching Options* names fields in the *Advanced* section of the *Select feature(s) by name* dialogue box allows you to enter a character in each field you wish to match. "?" matches all characters, "*" matches all following characters and an empty field matches nothing.

For Example

"?ABC????" or "?ABC*" will match:

1ABC

1ABCXYZ

AABC

It will not match:

ABC

1AB2

Minimum and maximum numeric ID's allow you to select by a features numeric ID (for more information about feature naming see *Features* in the On-line Help).

7. *Feature Tools* | *Line Types, Symbols* button. Set *symbols* to **Cross**. See figure below. Press *OK*.

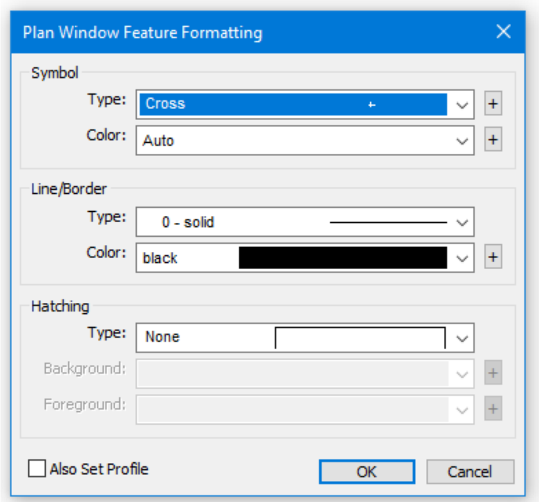


Figure 11-9: Line-Types and Symbols Dialogue

8. *Feature Tools* | *Feature Properties* button. De-select the *Connected* property option. This will make the feature a Loose 3D Tin Feature, as shown in the picture within the dialog. Press *OK*.

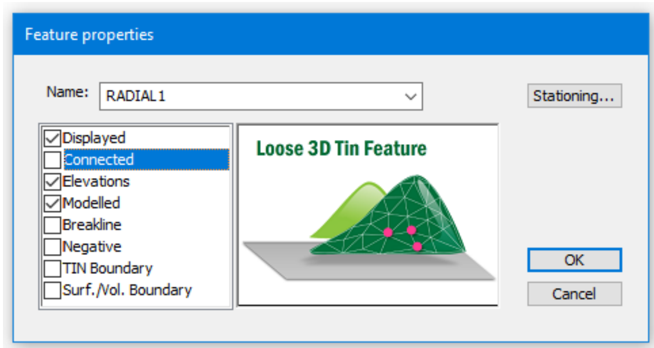


Figure 11-10: Feature Properties Dialogue

9. Select the P-Line traverse (the only remaining linear feature) by clicking on it with the Selection Cursor .

10. *Feature Tools* | *Labels*. In addition to what is already selected, select *Stations* (*Survey*) by double-clicking on the list box entry. Press *OK*.

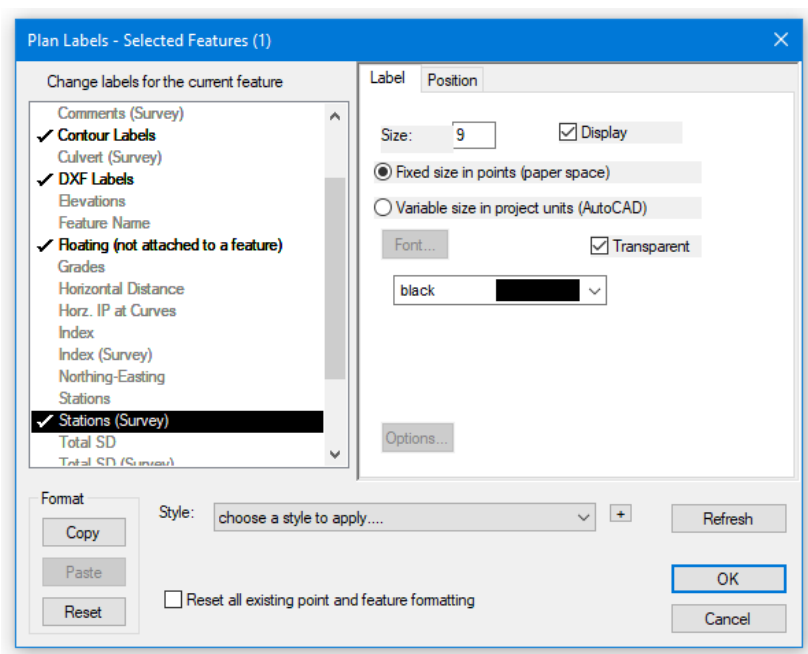


Figure 11-11: Label Selection and Formatting Dialogue

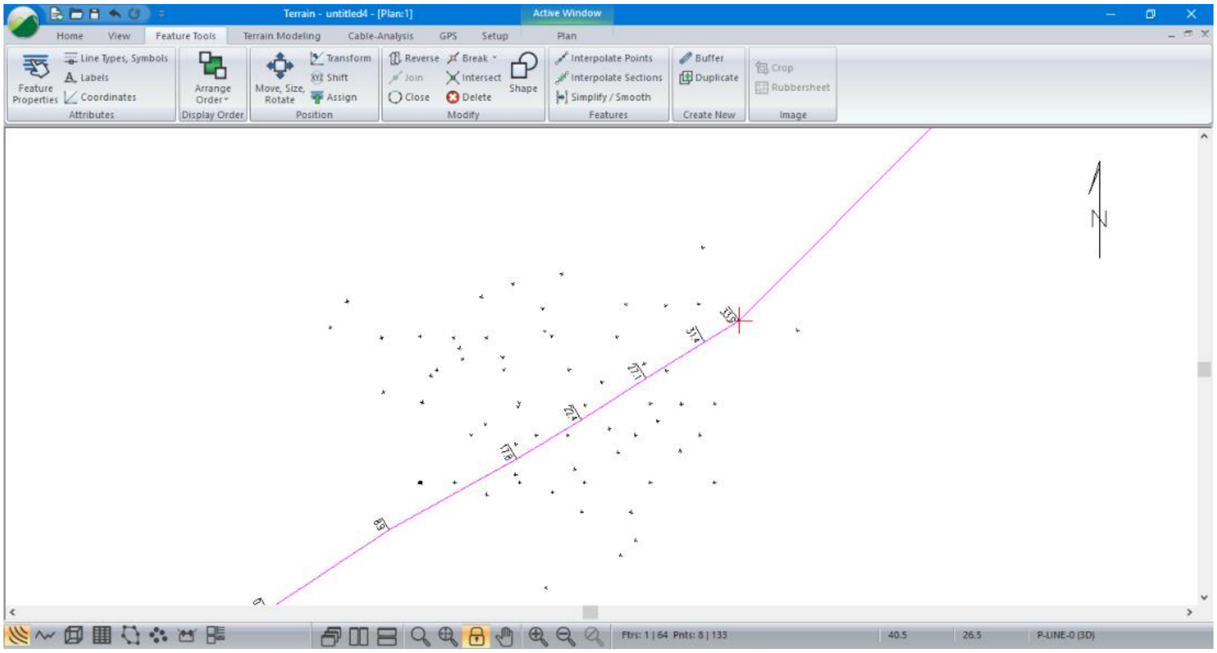


Figure 11-12: Site Plan after Formatting

11. *Terrain Modeling* | *Generate TIN* button to create a digital terrain model (DTM) and calculate contours. Set the parameters as shown in the figure below. Press *OK*.

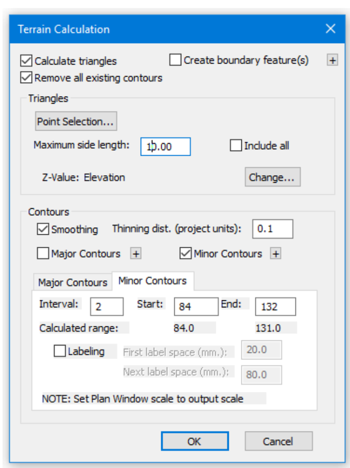


Figure 11-13: Terrain Calculation Dialogue

Your screen should now display contours of the stream crossing as shown in the figure below.

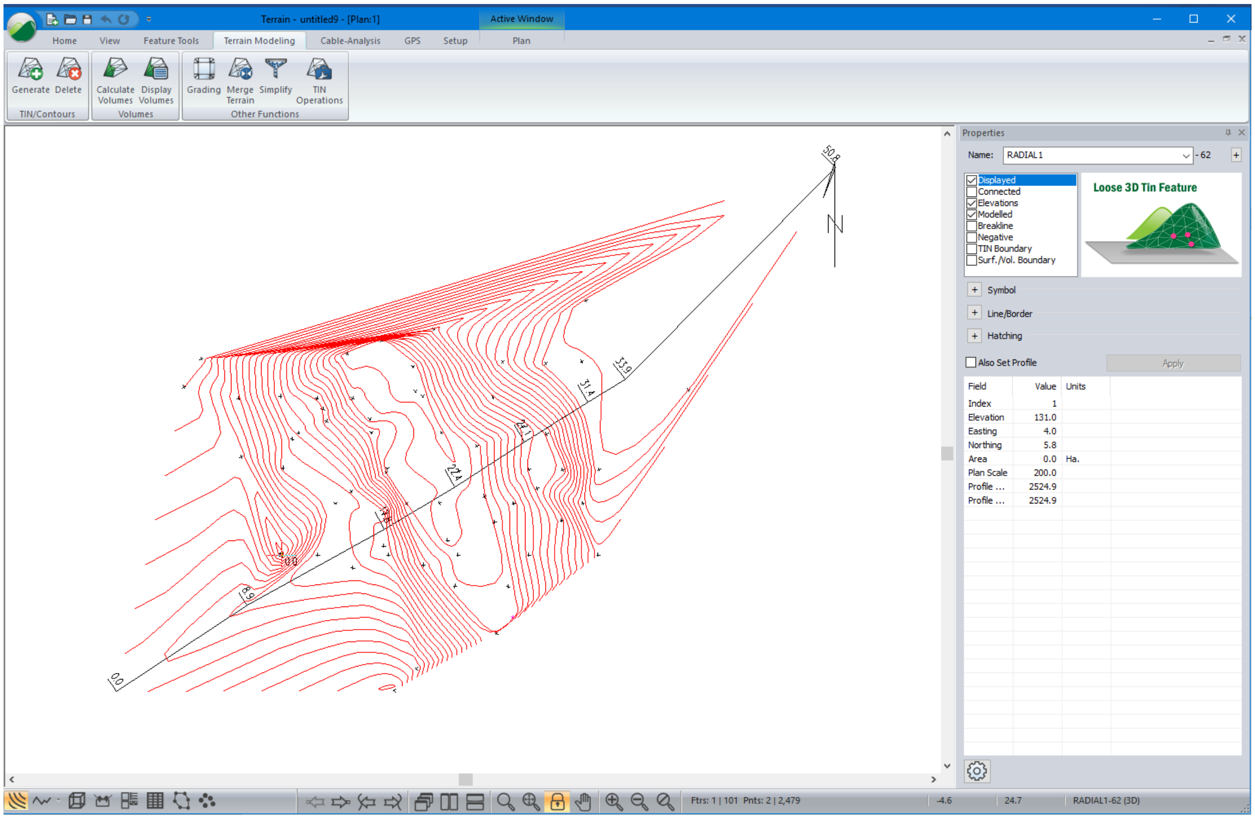


Figure 11-14: Site Plan with Contours

12. *File* | *New*. Do <u>not</u> save changes.

12. Creating Custom Symbols & Line-types

In this section, new symbols and line-types will be created. Tables of symbols and line-types are stored together in TRF files. The default symbol and line table file is <Defaults and Layouts>*normal.trf*.

Note: RoadEng does not write over your <Defaults and Layouts> files during an update; customizations you made in the past will not be overwritten. If you want to see the latest version of *normal.trf* (or any other setup file) look in <Defaults and Layouts>*LastInstall*.

Terrain and Location documents have private symbol/line tables stored in their files (extension *.te1* for Terrain and *.ds3* for Location). Survey/Map documents always use the defaults in *normal.trf*.

Creating Symbols

In this example, we will examine the tools for creating and editing symbols.

Note: See Getting Started section for file install folders (**<Terrain>** and **<Defaults and Layouts>**)

1. *Setup* | *Module Setup* button. Choose the *General* tab.

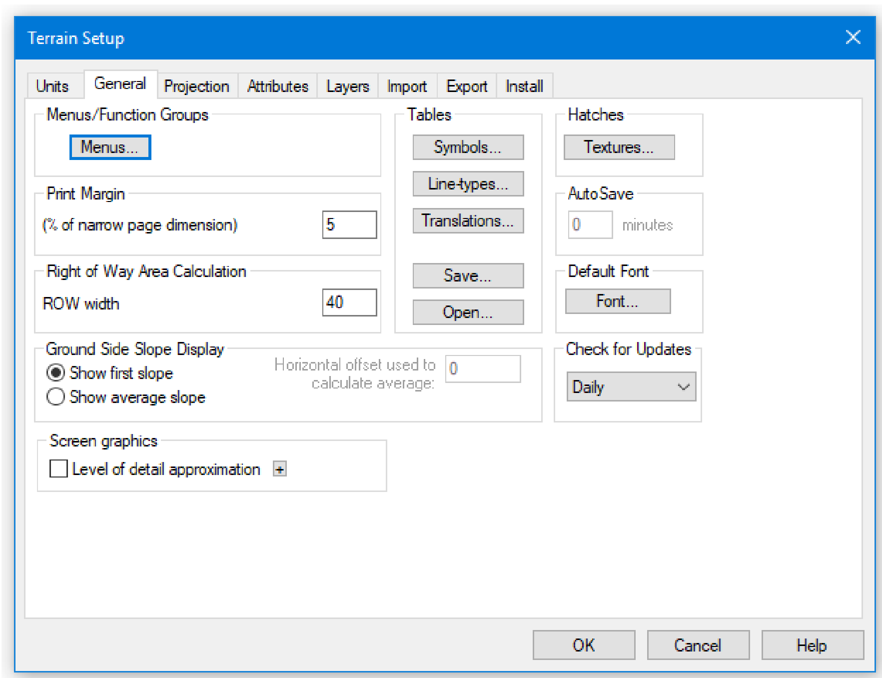


Figure 12-1: Module |Setup, General tab.

The tables on your computer may have been customized; the step below will open a Line/Symbol table suitable for this exercise.

2. Press the *Open*... button in the *Tables* group, and browse for <Defaults and Layouts>\Training**training normal.trf**. Press Open.
3. Press the *Symbols*... button to open the *Edit Symbols* dialogue box (figure below).

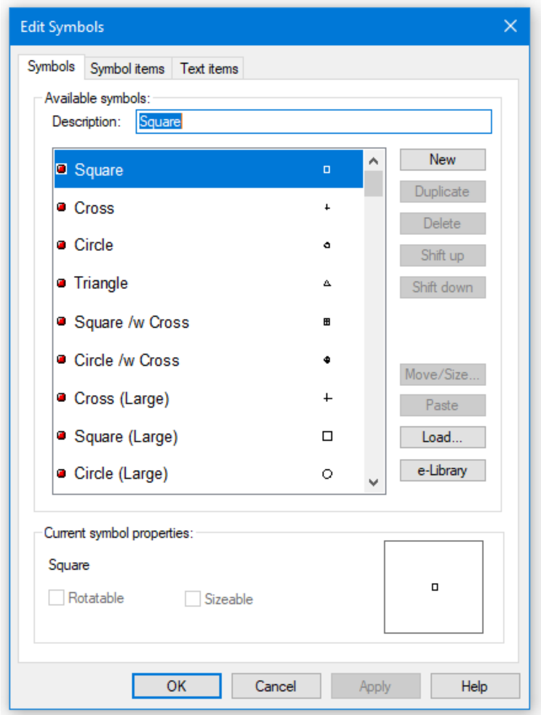


Figure 12-2: Edit Symbols dialogue box, Symbols tab.

The *Symbols* tab shows the same list you would see if you were changing the formatting of a Terrain or Location feature. The items preceded with the green dot are modifiable, those with a red dot are not.

A Symbol consists of *Symbol Items* and *Text Items*. Symbol items are a series of line segments; text items are characters with font information. When you select a modifiable symbol, you can click on the other two tabs to modify the selected symbol.

Load external Symbols

4. While it is possible to create New symbols from scratch, it is usually easier to Load (import) from an external source.

Note: Symbols and line-types can be loaded from Translation Files (extension TRF, TE1, or DS3), old-style symbol or line-type files (SYM or LIN), or from AutoCAD DWG files.

5. Scroll to the bottom of the list.

- Notice that the last item in the list is open arrow.
- Load a version 3.1 symbol table: Press the *Load*… button.
- Set the *Files of Type* from the drop-down menu to Softree V3.1 Symbols (*.sym).
- Browse and select <Defaults and Layouts>\Training**training example.sym.**
- Press *Open*.

6. This will open the Selective Load dialogue box shown below.

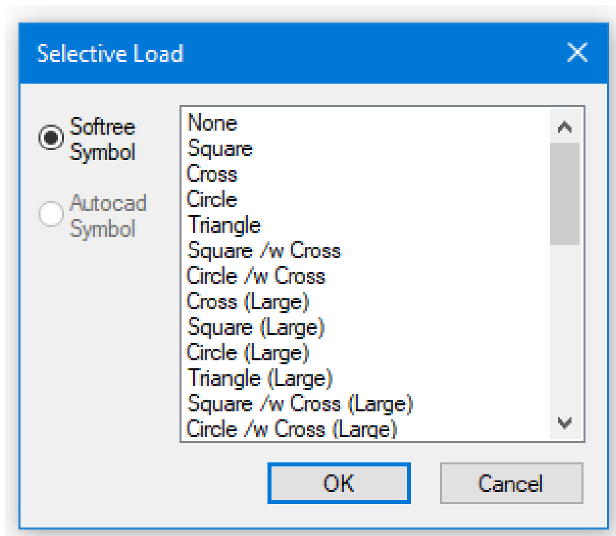


Figure 12-3*: Selective load* Dialogue Box for Symbols.

7. Select all of the symbols in the list:

   - Click on the first item in the list.
   - Scroll down to the bottom of the list.
   - Hold down the <*shift*> key, and click on the last item.
   - Press *OK* to load all selected symbols.
   - You will be prompted with the dialogue box shown below.
   - Press *Skip All*. Do not overwrite the existing symbols.

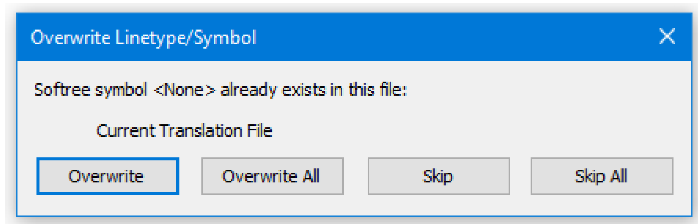


Figure 12-4: Overwrite Line-type / Symbol Dialogue Box

You will now see six new symbols at the end of the list.

Create a New Symbol

8. Still within the *Edit Symbols* dialogue, press the New button. A new symbol xxx will appear at the bottom of the *Available symbols* list.
9. Change the *Description* from xxx symbol to **Tree.**
10. Click on the *Symbol items* tab. The *Edit Symbols* dialogue box will appear as shown below.

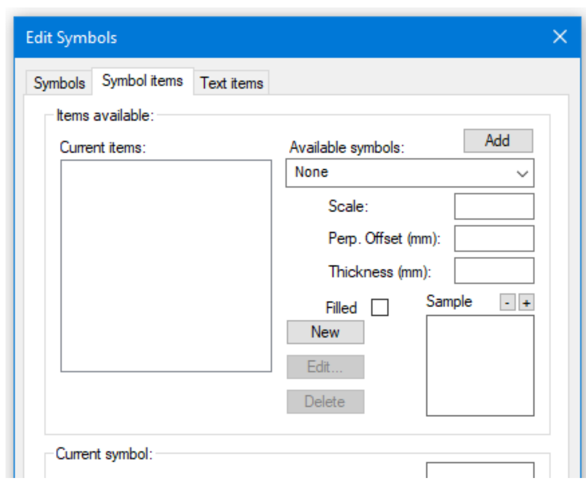


Figure 12-5: *Edit Symbols* dialogue box, Symbol items Tab

11. Press the *New* button.

You are ready to draw a new symbol. Notice that the main drawing surface is composed of a grid, and that the *Snap To Grid* and *Add* options are set as in **Error! Reference source not found.**below.

12. Press the *Zoom* button + until you have zoomed to X8.
13. Move the cursor around the drawing area and notice that the Pointer position is dynamically updated.

Note: The *Pointer position* is in units of 1/10mm. The symbol below will be 6mm on your screen (if not scaled).

---

14. Draw a vertical line:
    - Select *Add* mode (if it is not selected).
    - Move your mouse pointer above the center point (red cross-hair) until the *Pointer position* is roughly *(0, 350).*

- Click and drag with the mouse until you draw a straight line that ends the same distance below the center. Watch the Pointer position for *(0, -350).*
- Release the mouse button to finish the segment.
- If you need to edit the line, select *Edit* mode, and click and drag an end point.

15. Repeat the step above to draw a horizontal line: (350, 0) to (-350, 0).
16. Draw two more lines that run diagonally as shown in the figure below: (225, 225) to (-225, -225) and (-225, 225) to (225, -225).

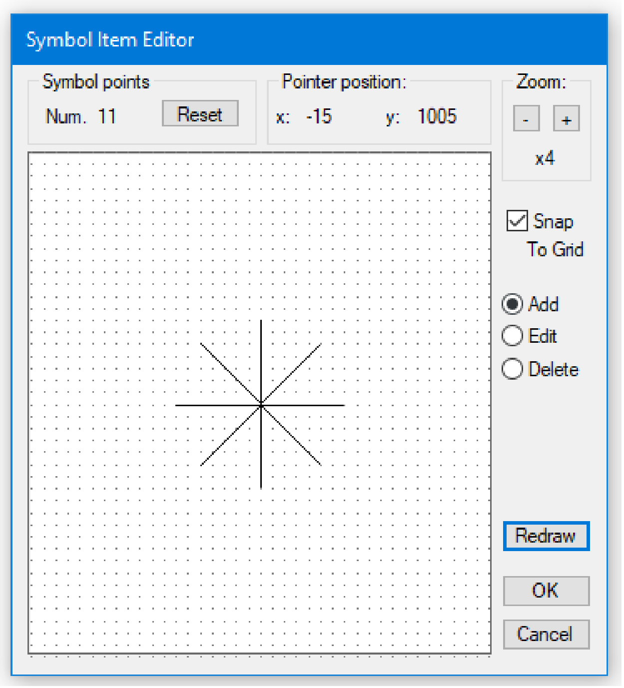


Figure 12-6: Symbol Item Editor Box

Note: This dialogue box contains some other useful features. The *Reset* button will clear the whole drawing, so that you can redraw the symbol. Activating the *Edit* or the *Delete* options will allow you to edit or delete a line segment by clicking on a point. The *Redraw* button refreshes the drawing surface. If you do not want the lines to attach to grid points, turn off the *Snap To Grid* option. Up to 20 points can be added to an item.

17. Once you are done press *OK*.

If the symbol is more complex than the one just drawn (i.e. more than 20 points) you will have to add portions of the symbol as separate items. You can also add *Available symbols* to the *Current items* list by selecting a symbol in the pull down box and pressing the *Add* button.

18. A Symbol is a collection of items. Each item can be controlled individually:
    - Fill an item by setting the *Filled* check box (do this *after* you have drawn the item).
    - Change the *Scale* to something other than the default value of ***1.00***.
    - Offset the item (perpendicular from the line it is assigned to) by changing the *Perp Offset* option.
    - Change the thickness of the segments in the item.

19. Select the *Symbols* tab. Do not press *OK* it closes the whole dialogue box.
20. The new symbol Tree appears in the *Available* Symbols list and the sample box (figure below).

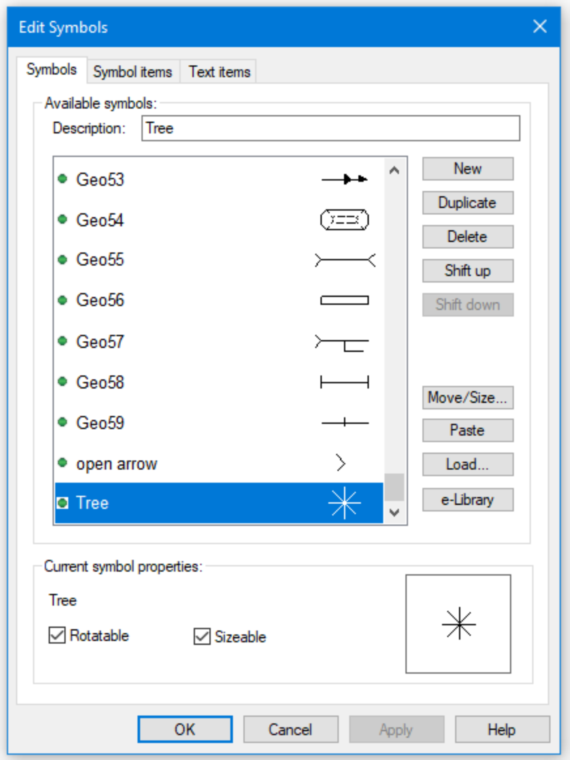


Figure 12-7: Creating a New Symbol

It is also possible to create symbols from characters and fonts. Or, to make a compound symbol with one or more characters combined with one or more graphic items.

Let's make a new symbol from a character with a special font.

21. Again, press the *New* button.
22. Change the Description from "xxx" to **Omega.**
23. Click on the *Text items* tab.

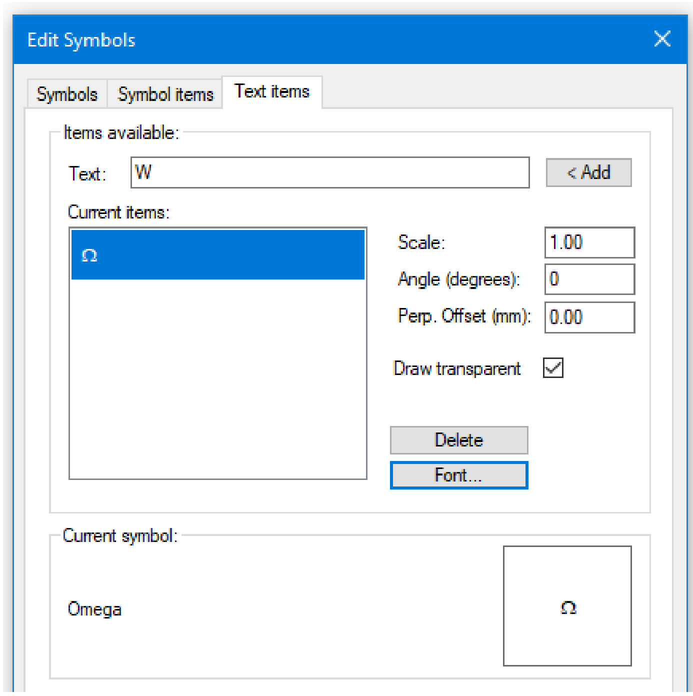


Figure 12-8: Symbol Editor Dialogue - Text Items Tab

24. Type **W** in the *Text* field and press the *Add* button.
25. Press the *Font...* button to open the *Font Selection* dialogue box. Select *Symbol* font, if available. Press *OK*.

The "W" is now rendered as the Greek character omega.

Note: It is possible to create symbols from other specialized fonts as shown in the figure below. Fonts are not provided with the Terrain Module (use the Internet to locate specialized font sets).

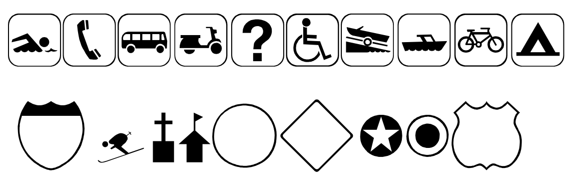


Figure 12-9: Symbols Created Using Specialized Fonts

Fonts are not provided with the Terrain Module (use the Internet to locate specialized font sets).

26. Select the *Symbols* tab again.

The new symbol Omega appears at the bottom of the list.

27. Press *OK*, to close the *Edit Symbols dialogue* box.
28. Press *Save...* in the *Tables* section of the *Terrain Setup dialogue* box.
29. You are prompted with the *File Save* dialogue box to save this table. You could save over your normal.trf file to modify your defaults, or you could save to another file.

30. Press Cancel. We do not want to save this example table.
31. Continue to step 3 in **Creating Line-types** below or *Cancel* to close.

Creating Line-types

Line-types can contain periodic symbols and text as well as lines. In this exercise, we will load lines from an external table and create a new line type from scratch.

1. Open the Terrain module and select menu *Setup* | *Module Setup*. Choose the *General* tab.

You will be presented with the *Terrain Setup* dialogue box as shown in Figure 12-1

The tables on your computer may have been customized; the step below will open a Line/Symbol table suitable for this exercise.

2. Press the *Open*... button in the Tables group, and browse for <Defaults and Layouts>\Training\training normal.trf. Press *Open*.
3. Press the *Line-types*... button in the *Tables* group to open the *Edit Line Types* dialogue box (Figure 12-10).

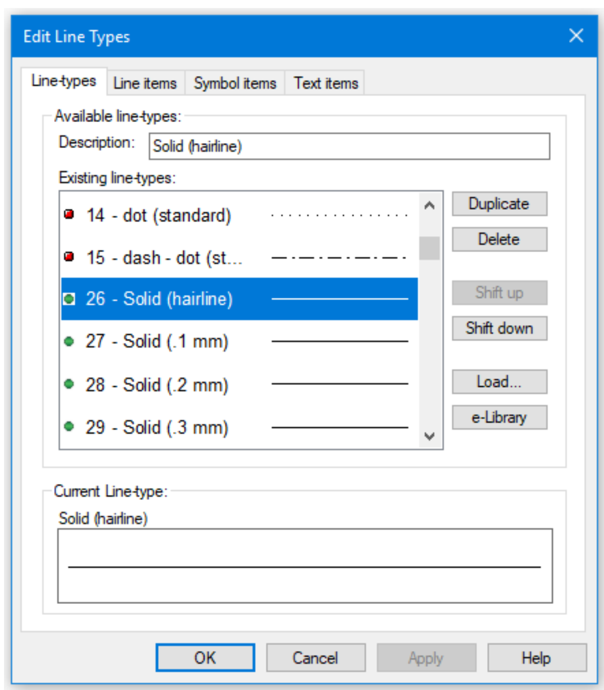


Figure 12-10: Edit Line Types Dialogue Box

The *Line-types* tab shows the same list you would see if you were changing the formatting of a Terrain or Location feature. The items preceded with the green dot are modifiable, those with a red dot are not.

A Line-type consists of *Line-Items*, *Symbol Items* and *Text Items*. *Line items* are linear patterns that may or may not be offset. *Symbol items* and *Text items* can be included at regular intervals or on the line vertex points. When you select a modifiable line-type, you can click on the other tabs to modify it.

Load External Lines

While it is possible to create *New* line-types from scratch, it is also possible to *Load* (import) from an external source.

Note: Symbols and line-types can be loaded from Translation Files (extension TRF, TE1, or DS3), old-style symbol or line-type files (SYM or LIN), or from AutoCAD DWG files.

4. Scroll to the bottom of the *Existing* line-types list. Notice that the last item in the list is ZIGZAG.
5. Load a version 3.1 line table:
    - Press the *Load…* button.
    - Set the Files of Type from the drop-down menu to *Softree V3.1 Lines (*.lin)*.
    - Browse for <Defaults and Layouts>\Training***training example.lin***. Press *Open*.
6. This will open the *Selective Load* dialogue box shown below.

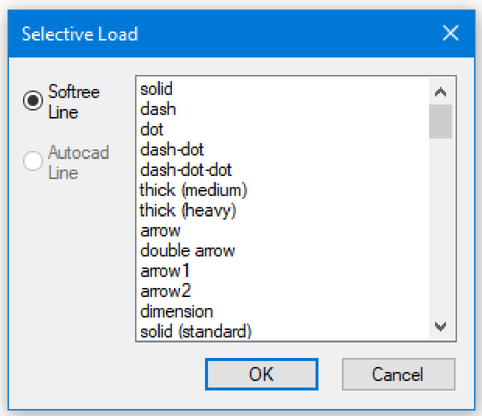


Figure 12-11: Selective Load Dialogue Box for Line-Types

7. Select all the line-types in the list:
    - Click on the first item in the list.
    - Scroll down to the bottom of the list.
    - Hold down the <*shift*> key, and click on the last item.
8. Press *OK* to load all selected symbols.

You will be prompted with the dialogue box shown below.

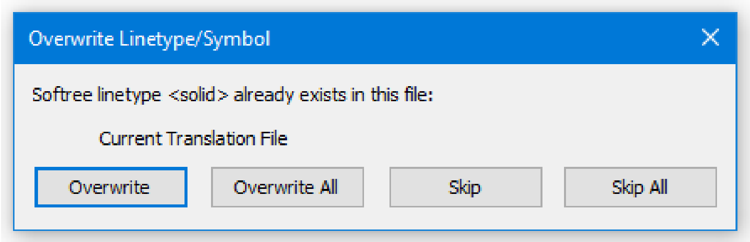


Figure 12-12: Overwrite Line-type/Symbol Dialogue Box

9. Press *Skip All*. Do not overwrite the existing line-types. You will now see six new line-types at the end of the list.

Create a new Line-type

10. We will now create a new line-type by duplicating an existing one.
11. Duplicate Solid (.3 mm):
    - Scroll until you find *29 - Solid (.3 mm)* and select it.
    - Press the *Duplicate* button.
    - The line-type will be duplicated and placed at the end of the list.
    - Change the Description: to *Gully with S6 stream.*
    - The line type is OK for our purposes. You may want to look in the Line items tab to see what options are set.
12. Add the open arrow symbol every 5mm:
    - Select the *Symbol items* tab.
    - The *Edit Line Types* dialogue box will change to look like the figure below.

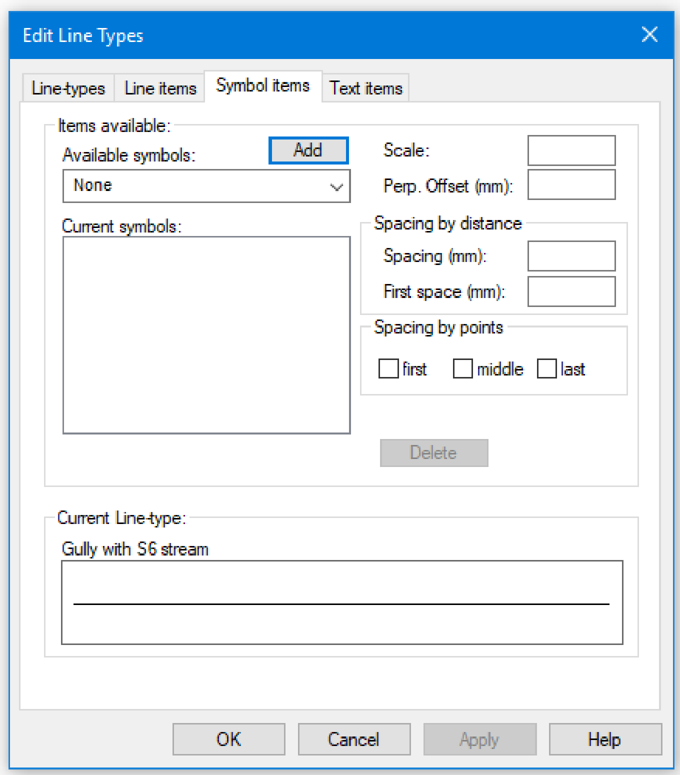


Figure 12-13: Edit Line Types Dialogue box - Symbol Items Tab

- Scroll through the *Available symbols* list until you find a symbol called *open arrow* (near the end of the list). Select this symbol.
- Press the *Add* button.

The arrow symbol will be added to the *Current symbols* list, and you will see it at the start of the *Current Line-type* graphic at the bottom of the dialogue box.

13. Clear the first check box under Spacing by points.
14. The symbol is now Spacing by distance; every 10 mm by default. Change the Spacing (mm) to **5** mm.
15. Add an arrow symbol at the end of the line:

   - Again, scroll through the *Available symbols* list select the symbol called *Arrow R1*.
   - Press the *Add* button.
   - Clear *first* and select *last* in the *Spacing by points* section.

The arrowhead is now at the end of the line and should look like the *Current Line-type* in figure below:

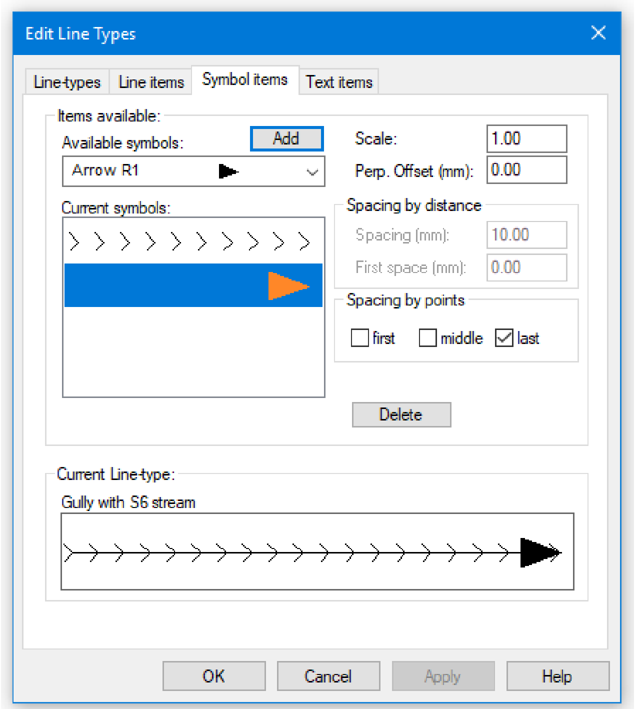


Figure 12-14: Edit Line Types dialogue box - Symbol Items Tab

16. Add "**S6**" text along the line:

- Press the *Text items* tab. The dialogue box now looks like the figure below.
- Type ***S6*** in the *Text* field.
- Press the *Add* button.
- Change the *Spacing (mm)* to ***20.0 mm.***
- Turn off the *Draw transparent* option.
- The result will be as displayed in the *Current Line-type* box below.

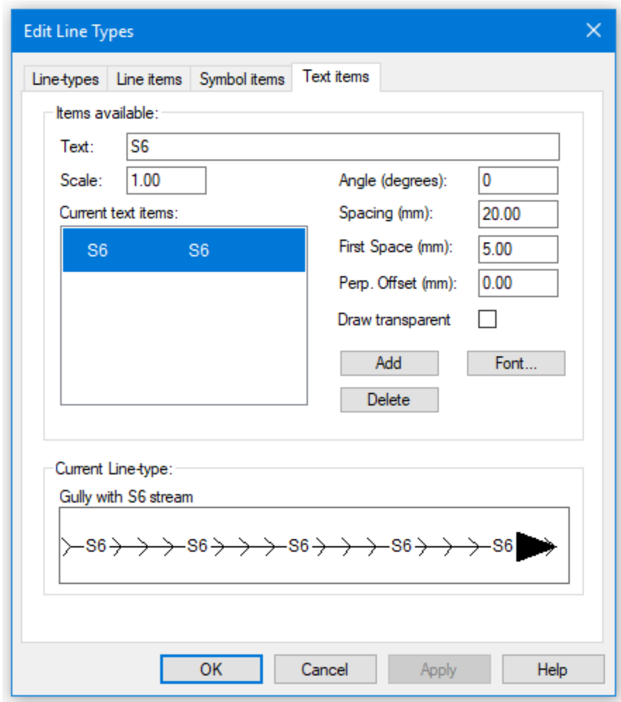


Figure 12-15: Edit Line Types Dialogue Box - Text items Tab

17. Click *OK* to return to the *Terrain Setup* dialogue box.
18. Press *Save…* in the Tables section of the *Terrain Setup* dialogue box. You are prompted with the file Save As dialogue box. If you write over <Defaults and Layouts>\Normal.trf, you will update your defaults for Terrain and Location modules.
19. Press *Cancel*. Do not save this example table.

Any TRF file you create is available from the *Open…* button. If you open an existing Terrain document and then change Line/Symbol table, the lines and symbols you have applied will change. Only the non-modifiable symbols and lines are guaranteed to remain unchanged.

20. You can draw a feature with the mouse and try changing it to the new line type Gully with S6 Stream.

Note: Symbols and Line-types are referenced by table index (not name). If you open an existing Terrain document and then insert lines or symbols near the beginning of the table, all features containing lines or symbols after the insertion point will change.

Note: Terrain documents can be created with different line/symbol tables. If you insert or paste features from one Terrain document into another, the line/symbol formatting may change.

21. Press *Cancel* again to exit the *Terrain Setup* dialogue box.
22. *File* | *Close*. Do <u>not</u> save changes.

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