Terrain 3D Module
with Cable

Version 5.0

Softree Technical Systems Inc.

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Getting Started

This manual is formatted as a hands-on tutorial, which can be used by novice or experienced users.

The tutorial files referred to in the examples are found in the installation default directory**.** The default directory is determined by product and security option selected.

The default directory for Terrain 2D and 3D - password protected is:
C:\Program Files\Softree\Terrain\Tutorial

The default directory for RoadEng, Terrain Tools Survey, Terrain Tools Forestry as well as 2D and 3D protected by security hardlock key is:
C:\Program Files\Softree\RoadEng\Tutorial\Terrain

If the location of this directory is moved remember to apply the corresponding change to the tutorial example.

NOTE: To re-install the tutorial files, select Install Tutorial Files from the CD.

Demonstration Mode

Demonstration Mode allows previewing of functions before purchasing. In *Demonstration Mode* printing, plotting, digitizing and file saving are disabled. Terrain Tools® reverts to Demonstration Mode whenever unprivileged function groups are enabled. A warning stating Demonstration Mode will appear on your screen.

Function Groups

The Terrain Module is divided into *function groups* such as CAD, Digitizing, Profiles, Terrain Modeling, Volumes, etc. The package being evaluated or purchased determines which *function groups* operate in *Demonstration Mode* or *Full Function Mode*. To determine the privileges set for each function group:

1) Select Module | Setup from the menu bar. A Terrain Option Dialog box appears. Click on the *General* tab.
2) Click on the *Menus* button to open the *Menu Customization Dialog box.*

Function group items with a red circle before them are permitted in Demonstration Mode only. A checkmark beside an item indicates it has been enabled.

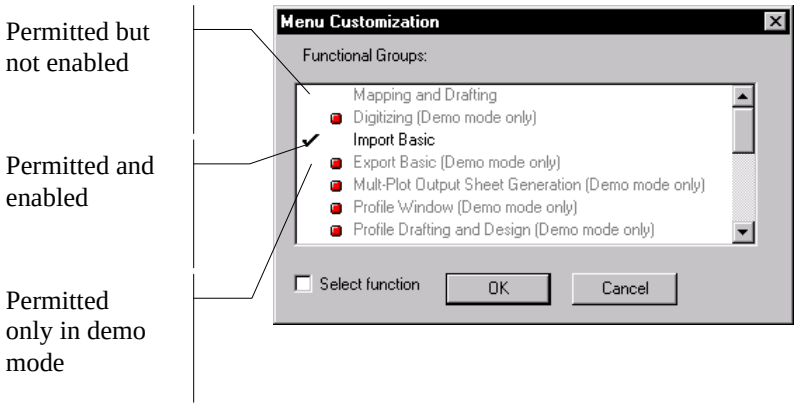


Figure 1.0: Function Groups Displayed in the Menu Customization Dialog

Function Groups Required for Examples
All required function groups are listed prior to each example in this manual. If you do not have permission to use all the required function groups, you may wish to skip the example. Also note that some function groups may be disabled even if *you* have permission to use them – this is so users with a lesser license can still do the example.

If you attempt to open a tutorial file containing function groups that are not permitted in your licensed software you will be prompted with the message box below:

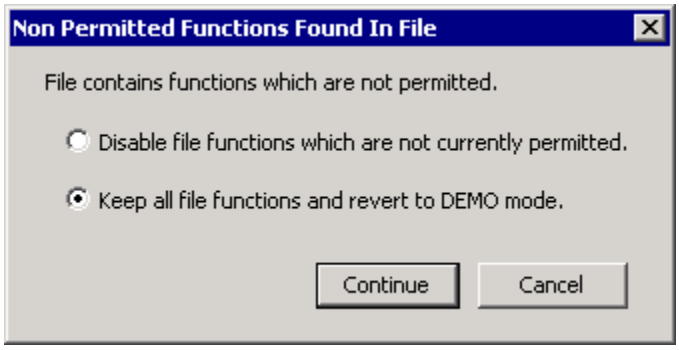


Figure 1.1: Function Groups Not Permitted Prompt

To continue the example you must respond *"Keep all file functions and revert to demo mode"*. In demo mode printing and saving are disabled.

On-line Help

Help information is available by choosing the *Help* menu or pressing F1. The On-line Help includes detailed technical information about menus, dialog 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.

Tutorial Units

Most examples in this tutorial are in metric units. To correctly follow the examples ensure Metric Units are enabled. Select Module | Setup before starting. 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.

Checkpoints ☑

Checkpoints identified by a checkmark indicate the beginning of an example. All files required to start from a checkpoint are included on the installation CD or from an Internet download file.

Conventions

The following conventions are used throughout the manual:

- Menu functions are delimited by a line "|". File|Open means to click on *File* in the menu bar and then select *Open* from the drop down menu.
- Checkboxes, dialog boxes, column headings, and button names are italicized.
- When directed to highlight, select, or activate a field or object, it becomes the active field or object. For instance, "highlight the profile window" means that click on the profile title bar to activate it.
- The symbols "< >" with words in between require some keyboard function to be performed. For example < shift + enter> means to hold down the *Shift* key and press *Enter*
- File names, path names and text to be typed in are in **bold.**
- File extensions are in upper case for file selection purposes only**.**

Overview

The Terrain Module provides you with the facilities for assembling and manipulating topographic and other map features. Information can be entered from a paper map using a digitizing tablet, from an external file or on the screen using the mouse.

The Terrain Module provides 8 windows: Profile, Plan, Status, Points, Features, 3D, Cable Data and Multi-Plot. The number and type of windows available depends on the *Function Groups* you have enabled. Figure 2.0 below shows a typical window arrangement.

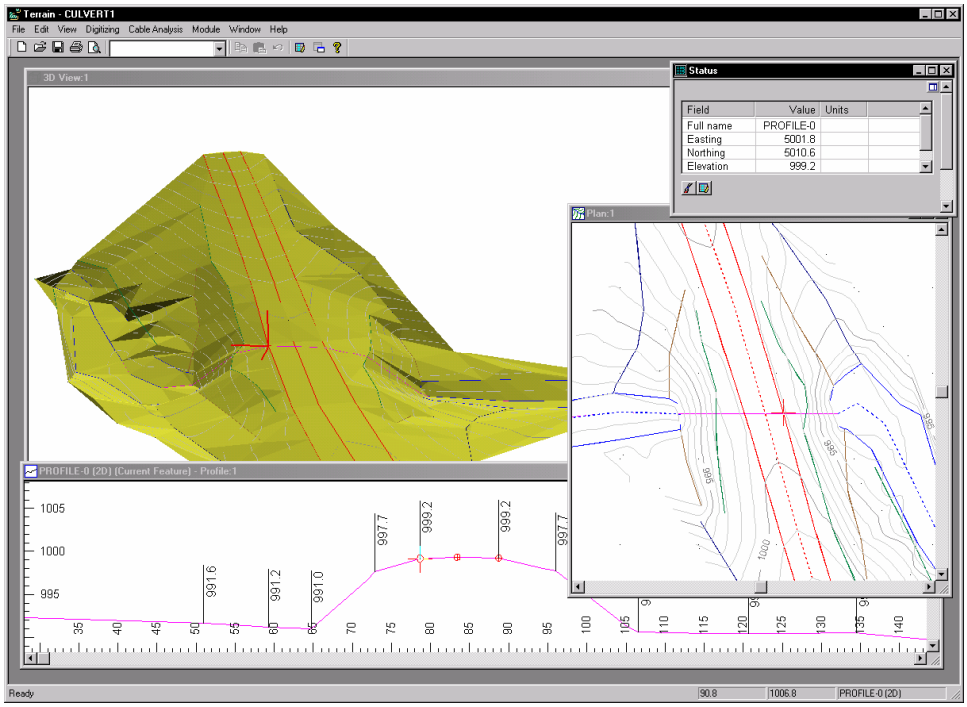


Figure 2.0: Terrain Module Windows

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.

Status Window displays 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 Window 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 Window 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.

Cable Data Window is used to display the results of cable analysis such as payload, deflection and clearances.

Each window has its own menu. These menus are available when the window is active. The active Window title bar will be highlighted and the menu Window | <active window name> will have a checkmark beside it. Each window can be sized, moved, maximized and minimized in the standard Microsoft fashion. All windows can be configured from the menu View | Active Window (<name>) Options.

Text Windows can be floating or docked to the right side of the screen. To dock a floating window, click the dock icon on the upper right side of the window. To float a docked window, click the float icon on the upper right side of the docked window.

Customizing Terrain using Screen Layouts

Options for all windows can be saved in a configuration file called a *Screen Layout*. To change the default configuration for Terrain:

1) Arrange the screen positioning of windows, scales, labels etc.
2) File | Save Screen Layout and specify **Normal.ILT** (other layout names can be used for creating layouts for different applications**. Normal.ILT** is the default).

NOTE: Layout files will be used extensively in the examples and are extremely valuable for saving and retrieving the large number of options available.

Tool Bars

Tool Bars display buttons or icons that are used to activate common functions. The function name appears when the cursor hovers over the icon. The Active buttons in the Tool Bar are dependent on the window selected. The various toolbars can be shown or hidden by selecting menu View | Toolbar or by right clicking on any currently visible toolbar. Toolbars can be floating or docked to the edge of the screen.

Screen Layouts can also specify which Tools options are displayed. For example, Standard Tools, Window Tools, Zoom Tools, Mode Tools and Navigation Tools are pre-set in **normal.ILT**.

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 .See *Function Groups* in the On-line help for more information).

Scaling Maps

Park Map Example

1. File | Open. Select and open **\Tutorial\Terrain\Terrain Cad\park map.TER.**

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

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. Activate the Plan Window by clicking on the Title Bar. The scale is set to 15000 in the *Scale Box* in the Toolbar. Change the scale to 25000 and press Enter.

Notice the change in the screen view.

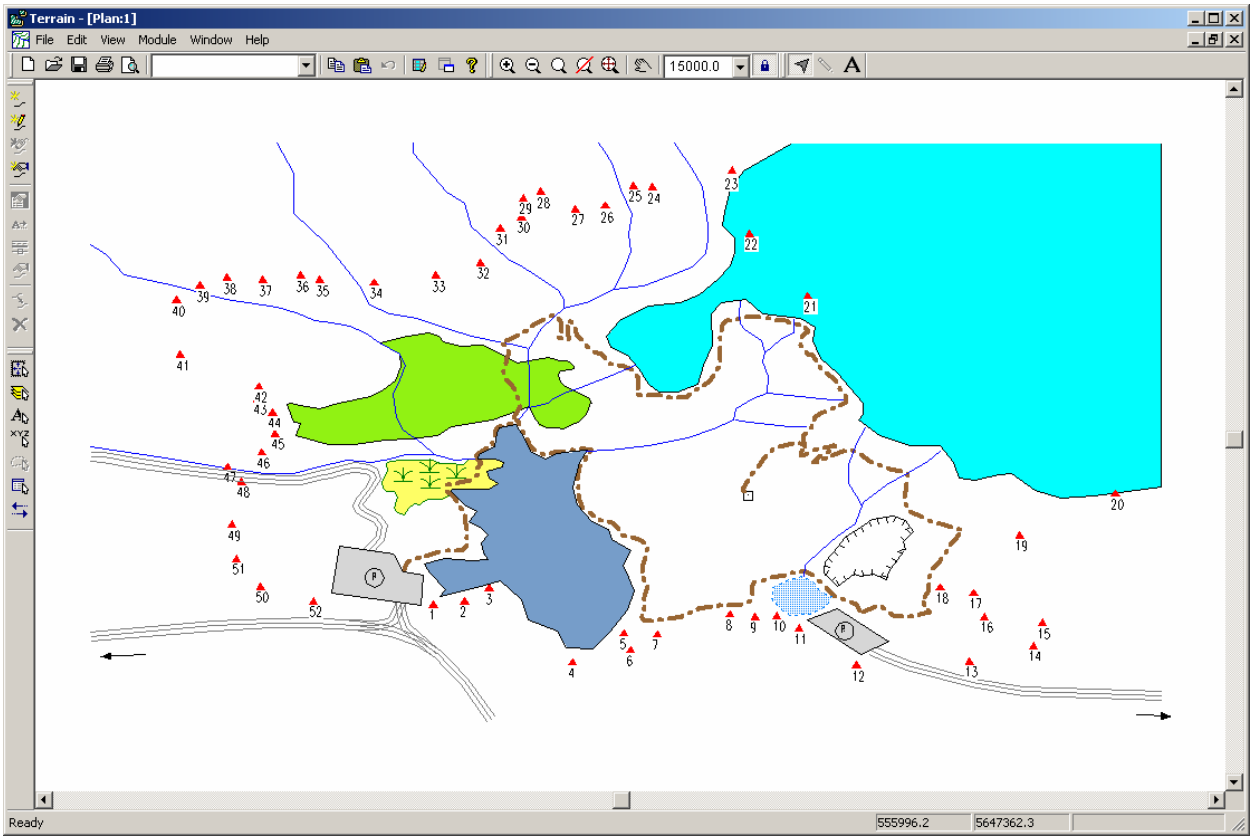


Figure 3.0: Park Map.TER

3. Choose menu View | Active Window (Plan) Options. Change the scale back to 15000. Enable *labels* checkbox and press OK.

4. Change the scale back to 25000. Notice the label sizes have remained the same but the map features have become smaller. Change the scale back to 15000.

NOTE: 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 making adjustments to label positions.

NOTE: Zooming functions magnify (or shrink) the entire drawing including labels, symbols and line-types when the *lock scale* 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.

5. With the *lock scale* button depressed, click on the *Magnification Double* and *Magnification Half* buttons several times. Notice that the label and line sizes change but the scale remains the same.

6. Turn off the *Lock Scale* button Repeat the above step. Notice that with *Magnification Double* the scale halves and with *Magnification Half* the scale doubles. Labels and line-types stay the same size as the scale changes.

7. File | New to close **park map.TER** and continue to the next example or File | Exit to leave program. 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.

1. File | Open. Select **\Tutorial\Terrain\Terrain Cad\drawing.TER**. Press Open. The file shown in Figure 3.1 will appear.

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

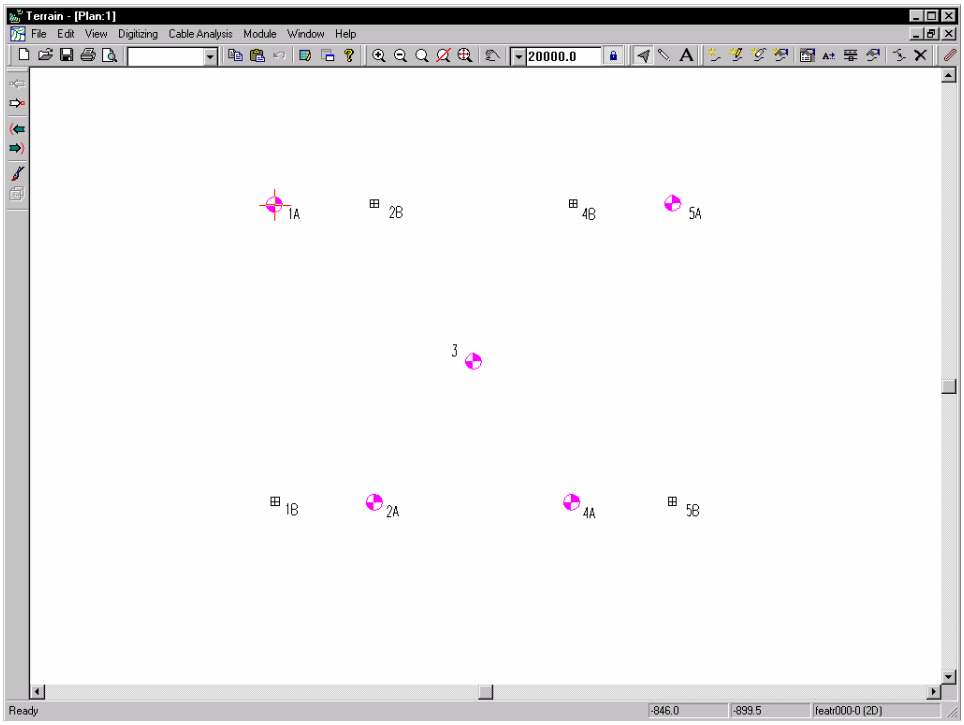


Figure 3.1: Drawing.TER

2. Left mouse click anywhere on the screen to de-select all features. A selected feature or features are displayed in magenta.

3. Press the *Draw New Feature* button. The Entry mode cursor appears in the Plan Window.

4. Locate the symbol labeled “1A” and left click once in the middle of the symbol. The point is now captured. The cursor will change to a red cross-hair.

5. Left click again and the cross-hairs will anchor to the point.

6. Locate the symbol labeled “2A”, and left click once in the middle of the symbol. This will attach point “1A” to the cursor by a rubber band line.

7. Left click again and the cross-hairs will anchor to the symbol labeled “2A”. This is now the current point of the current feature. The current feature is the line segment that attaches “1A” and “2A”. To undo any point, select *Edit | Undo Add A Point.*

8. Locate the symbol labeled “4A”. Left click once in the middle of the symbol.

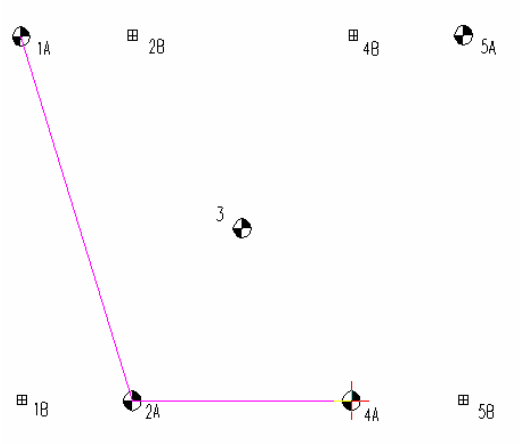


Figure: 3.2: Drawing with the mouse

9. Move the cursor over the line segment between 2A and 4A.

Notice the cursor changes to the insert cursor

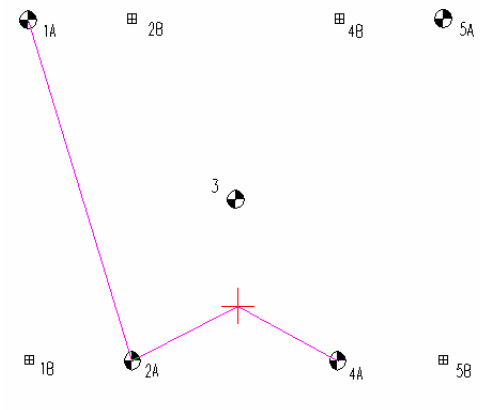


Figure 3.3: Inserting a Point at the End of a Segment

10. Left click on the line segment between 2A and 4A. Move to point 3, and left click to anchor the new point.

11. 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.

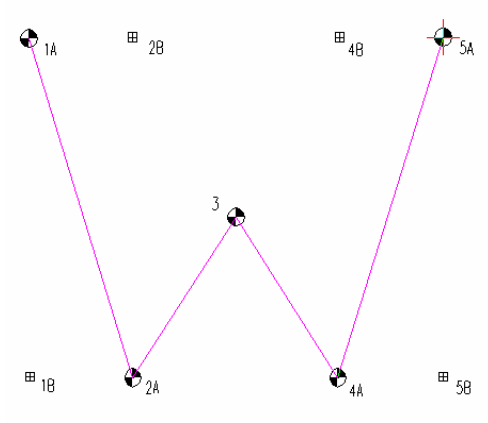


Figure 3.4: Completed W

12. Move the Entry mode cursor over “1A”. The entry mode cursor changes to edit points mode and the Edit cursor now appears over 1A.
13. Left click over symbol “1A”, the cursor will attach to the line segment.
14. Move the Edit cursor over symbol “1B” and left click again. This will attach the line segment to this point.
15. Repeat the above steps moving points “2A to 2B, 4A to 4B, and 5A to 5B. The W has changed to an M as shown in the Figure 3.5.
16. File | New to continue to the next tutorial or File | Exit to leave the program. Do not save changes

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.

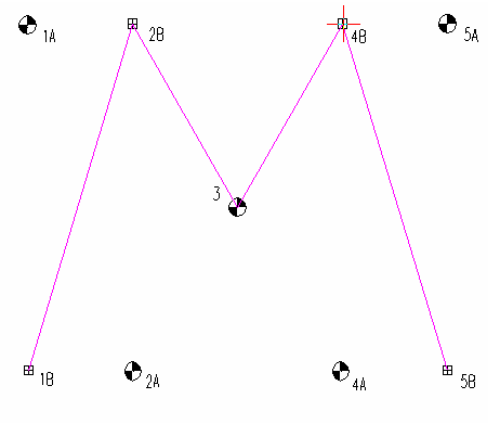


Figure 3.5: Completed M

Drawing Features Using the Mouse and Keyboard – Method Two

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

1. File | Open. Select **\Tutorial\Terrain\Terrain Cad\park map.TER**. Click on the *maximize* button in the upper right corner of the Plan:1 Window.

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

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: If *Snap to Point* is selected, when a new point is created or an existing point is edited, the nearest point on an adjacent feature is also selected provided that it is within a minimum distance (2 mm).

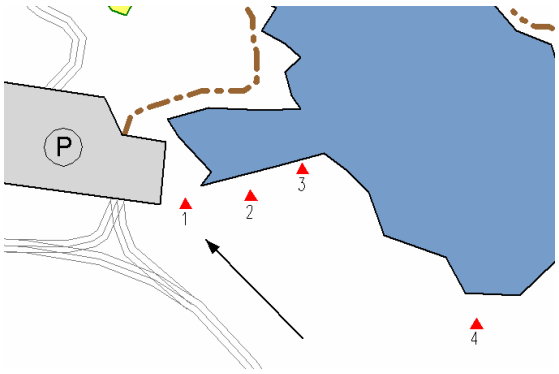


Figure 3.6: Boundary Starting Point

2. Press the *Draw New Feature* button. Position the cursor over the center of station 1 (indicated with the arrow in Figure 3.6) and press the number 5 key on the number pad. A new point should be created at the cursor position. If this does not happen, check that *Num Lock* on the keyboard is on.

NOTE: If your computer does not have a number pad, the letter S can be used instead of the number 5.

3. 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.

Elevation Entry While Using the Mouse

If you have created a new feature with elevations (Edit | New Feature – elevations on), it is possible to enter elevations using the following key definitions.

5	Same elevation as previous point. This may be overridden by Snap To Point including Z.
8	Up 1 contour interval. This may be overridden by Snap To Point including Z.
2	Down one contour interval. This may be overridden by Snap To Point including Z.
E or Ins	Enter co-ordinates including elevation

4. 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. Select **\Tutorial\Terrain\Terrain\Terrain Cad\park map.TER**. Press open.

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

2. 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).

3. Select another feature. Notice when a new feature is selected, the previous feature is de-selected. The information in the Status window also changes to reflect that of the new feature.

Selecting Groups of Features With The Mouse

4. 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.

5. With several features selected, press the delete key on the keyboard or press the *Delete* button. The features are deleted and disappear. Press Edit | Undo Delete and the features reappear.

6. Left mouse click in any blank area on screen to de-select all features.

7. 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.

8. 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.

Selecting All Features

9. Edit | Select Feature(s) | All or press the *Select All* button. All features are now selected (magenta).

Inverting Selection

10. Hold the <shift> key down and de-select one of the features

11. Select Edit | Select Feature(s) | Invert Selection or press the *Invert Selection* button, 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.

12. Proceed to Step #2 in Selecting by Layer or exit the program by selecting File | Exit. 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.

NOTE: 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. Select **Tutorial\Terrain\Terrain Cad\park map.TER**.

Note: Depending on the version of the software you are using you may get a 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 Edit | Undo Delete. Left click in any blank area to de-select all features.

2. Edit | Select Feature(s) | By Name or press the *Select By Name* button.

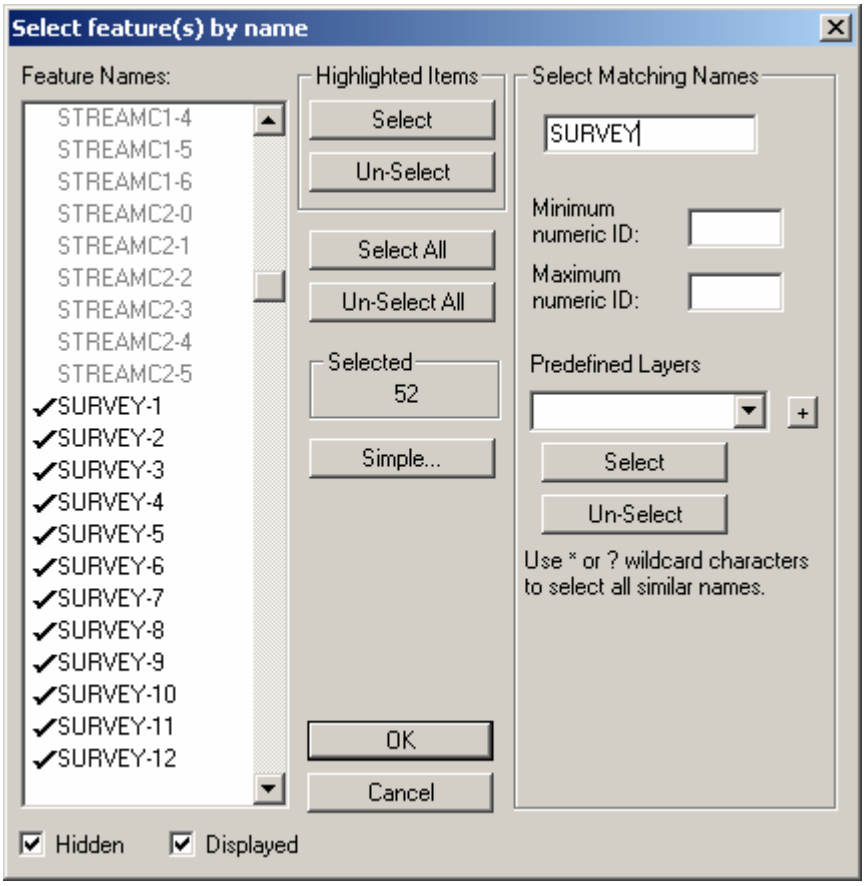


Figure 3.14: Select Feature(s) By Name Dialog

3. Press the *Advanced* button. Type "SURVEY" in the *Select Matching Names* area as shown above**.** Press the *Select* button in the *Select Matching Names* area. Press OK. A number of triangle features are selected. All of these features have the name SURVEY.

4. 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. Select **\Tutorial\Terrain\Terrain Cad\park map.TER**.

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

2. Edit | Select Feature(s) | By Layer or press the *Select By Layer* button to activate the S*elect Features by Layer* dialog box.

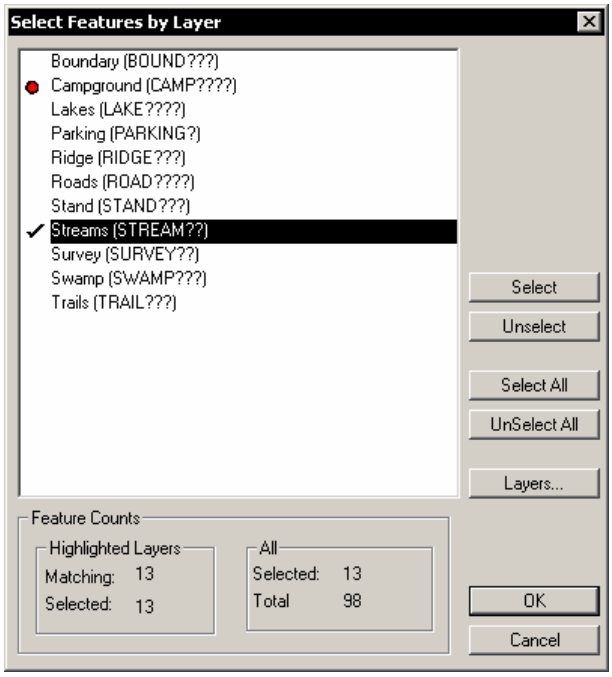


Figure 3.7: Select Features by Layer Dialog

3. Press the *Un-Select All* button to de-select all features.

4. Select Streams in the list-box and then press the *Select* button. The information in the *Feature Counts* changes indicating that 13 of the 98 features are streams. Press OK to return to the main screen. The 13 selected streams are highlighted in magenta.

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 dialog.

5. To create a new layer for the Class 1 streams, press the *Select By Layer* button or Edit | Select Features | By Layer to activate the S*elect Features by Layer* Dialog Box. Click on the *Layers* button to activate the *Layers* dialog box.

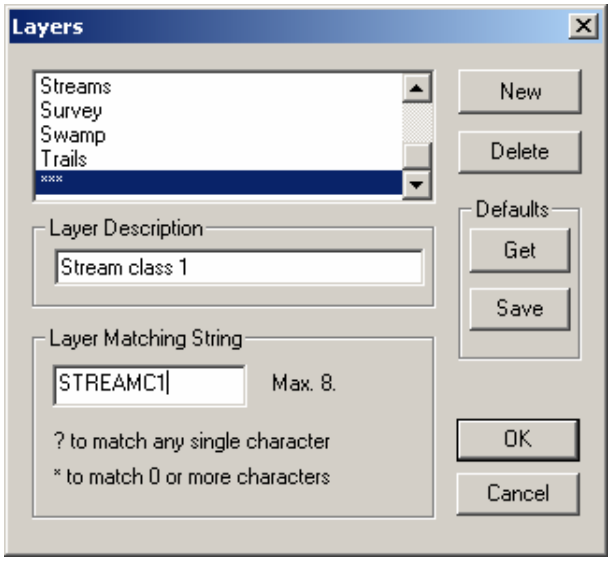


Figure 3.8: Add/Remove Layers Dialog

6. Press the *New* button. Type in the *Layer Description* field "Stream Class 1". Type in STREAMC1 into the *Layer Matching String*. Press OK to return to the *Select Features by Layer dialog*.

7. 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. 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.

The following steps demonstrate how to turn off the display of all features except the STREAMS.

8. Edit | Select Features | By Layer or press the *Select By Layer* button to activate the S*elect Features by Layers Dialog Box*. Press the *UnSelect All* button to un-select all features. Highlight *Streams* in the list-box and press the *Select* button to select them. Press OK.

9. Choose menu Edit Select Features | Invert Selection. This will this will switch the selected and unselected features so that <u>all features are now selected except the stream class 1 features</u>.

10. Edit | Modify Selected Feature(s) | Properties or press the *Properties* button in the toolbar. Turn off the *Display check box.* Press OK to return to the main screen.

NOTE: All the features are still displayed. Click on a blank area of the screen (where there are no features) to de-select all features.

11. Press the *Repaint All* button to redraw the entire screen (removes the hatched areas). Notice that only the streams are displayed. If the *Repaint All* button is not visible, select View | Toolbar | Navigation Tools.

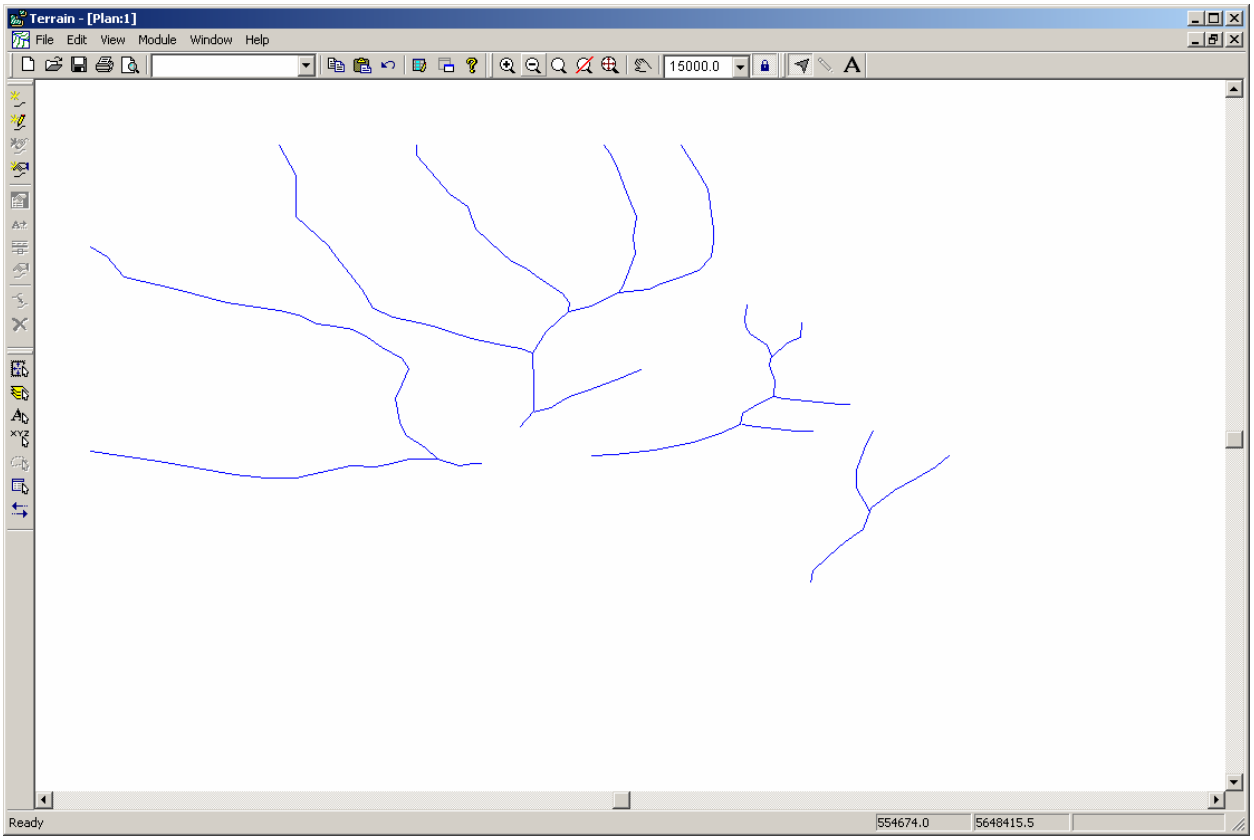


Figure 3.9: Streams Layer

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

Line-types

1. File | Open. Select **Tutorial\Terrain\Terrain Cad\park map.TER**. Press Open. Click on the *maximize* button in the upper right corner of the Plan:1 Window.

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

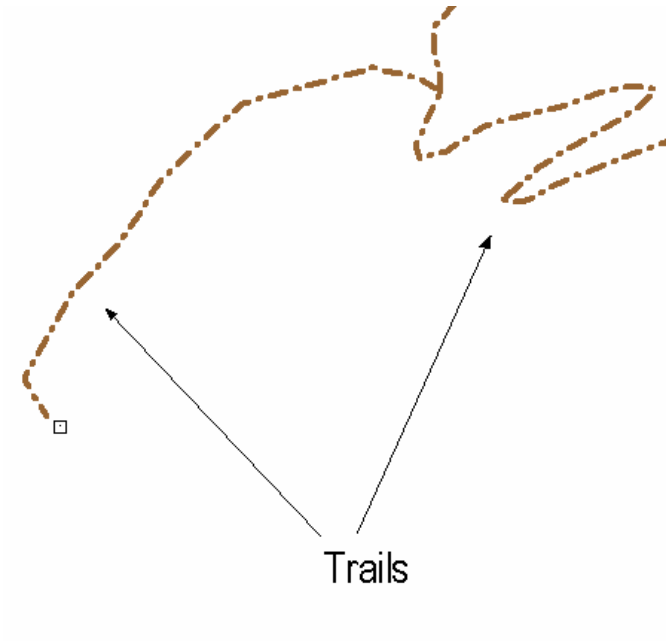


Figure 3.16: park map.TER

2. Dashed lines identify the trails in Park Map (see Figure 3.16). Hold down the <Shift> key, with the *Select* cursor left click on each of the trails. Use zoom and screen scrolling to see all of 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.

The trails could also have been selected by either pressing the *Select By Name* button or selecting menu Edit | Select Feature(s) | By Name.

3. Edit | Modify Selected Feature(s) | Line-types, Symbols or press the *Line style* button to activate the *Plan Window Feature Formatting* dialog box.

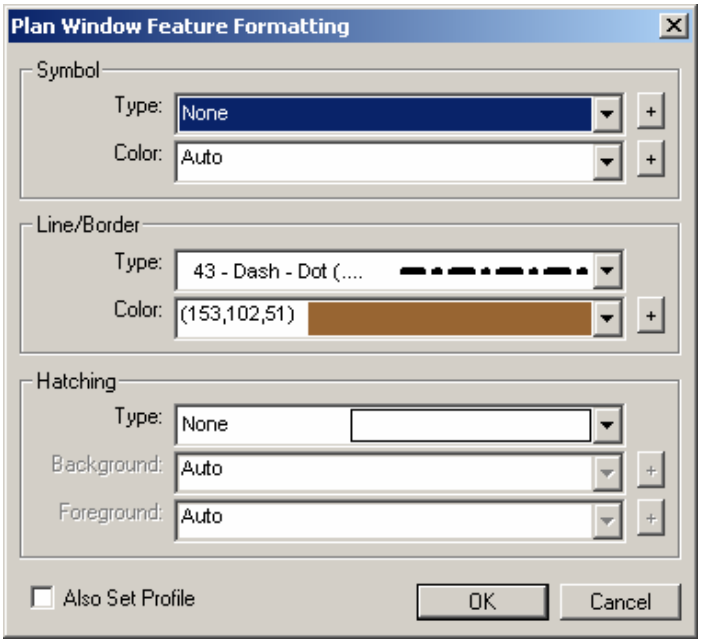


Figure 3.17: Line-types and Symbols Dialog

4. Change the line-type: from 43 Dash Dot to 43 - Dash x 2 (narrow). Press OK. Left click anywhere in the Plan Window to de-select trails.

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

Symbols

Park Map Example

1. File|Open. Select **\Tutorial\Terrain\Terrain Cad\park map.TER**. Press Open. Click on the *maximize* button in the upper right corner of the Plan: 1 Window. If continuing from the previous example, left click in a blank area to de-select all features.

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

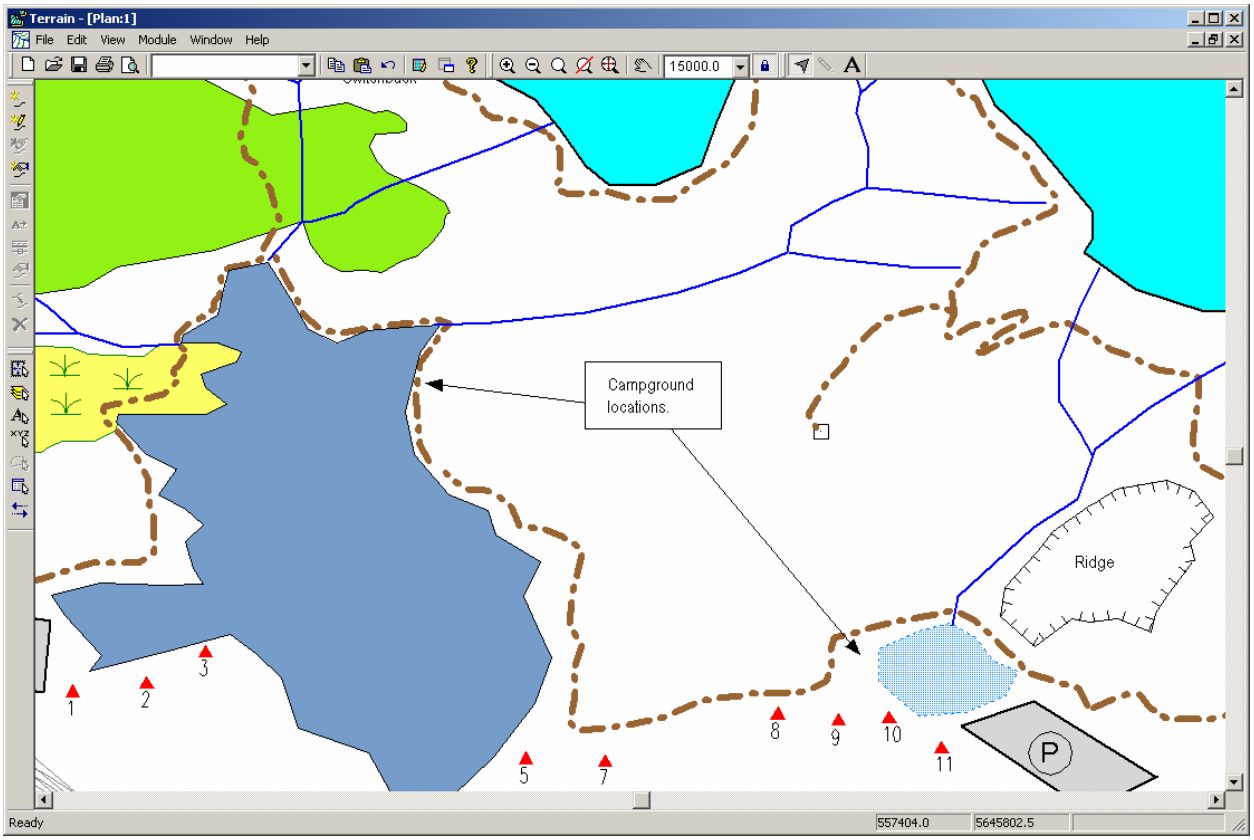


Figure 3.18: Campground Locations

2. Edit | New Feature to activate the *Feature Properties* dialog box. Select CAMP from the *Name combobox*. Turn off *Elevations* and *Modelled* as shown in Figure 3.19. Press the *Mouse* button.

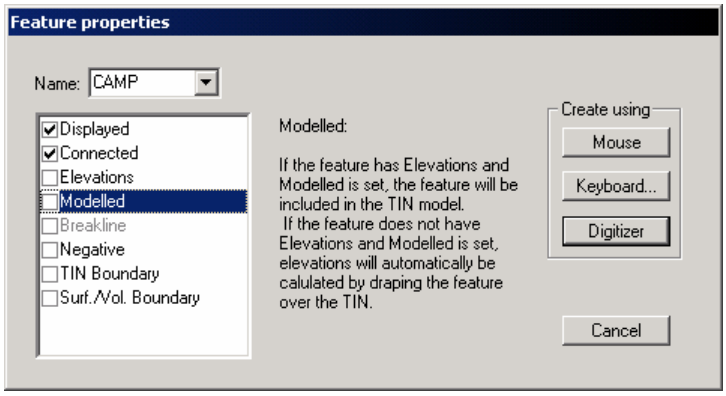


Figure 3.19: New Feature Properties Dialog

3. Move the cursor to one of the campground locations as indicated by the 2 arrowheads in Figure 3.18 and press the left mouse once to create (and capture) a new point. Left click again to anchor the new point.

4. Edit | Modify Current Point(s) | Symbols and choose *Campground* for the symbol. Press OK to return to the main window.

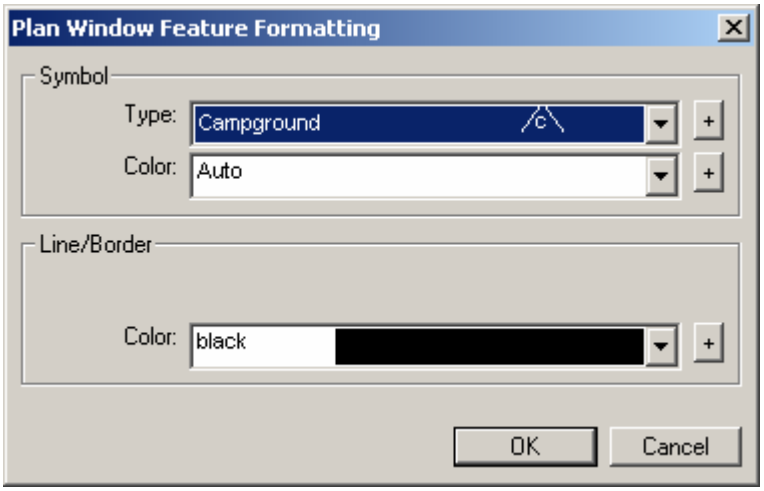


Figure 3.20: Campground Symbol Selection Dialog

5. Press the *Repaint All* button to redraw the entire screen.

A campground symbol has now been created. The following steps will duplicate this symbol at the other two campground locations.

6. With the campground symbol still selected, press <Ctrl +C> or press the *Copy* button to copy it. These are shortcuts for menu Edit | Copy.

7. Press <Ctrl +V> to paste symbol. A rectangle should appear around the campground symbol.

8. Move the cursor inside the rectangle. The cursor should change its' shape to a 4 sided arrow. Left click and drag the copied symbol to the other location.

9. Press the *Repaint All* button to redraw the entire screen.

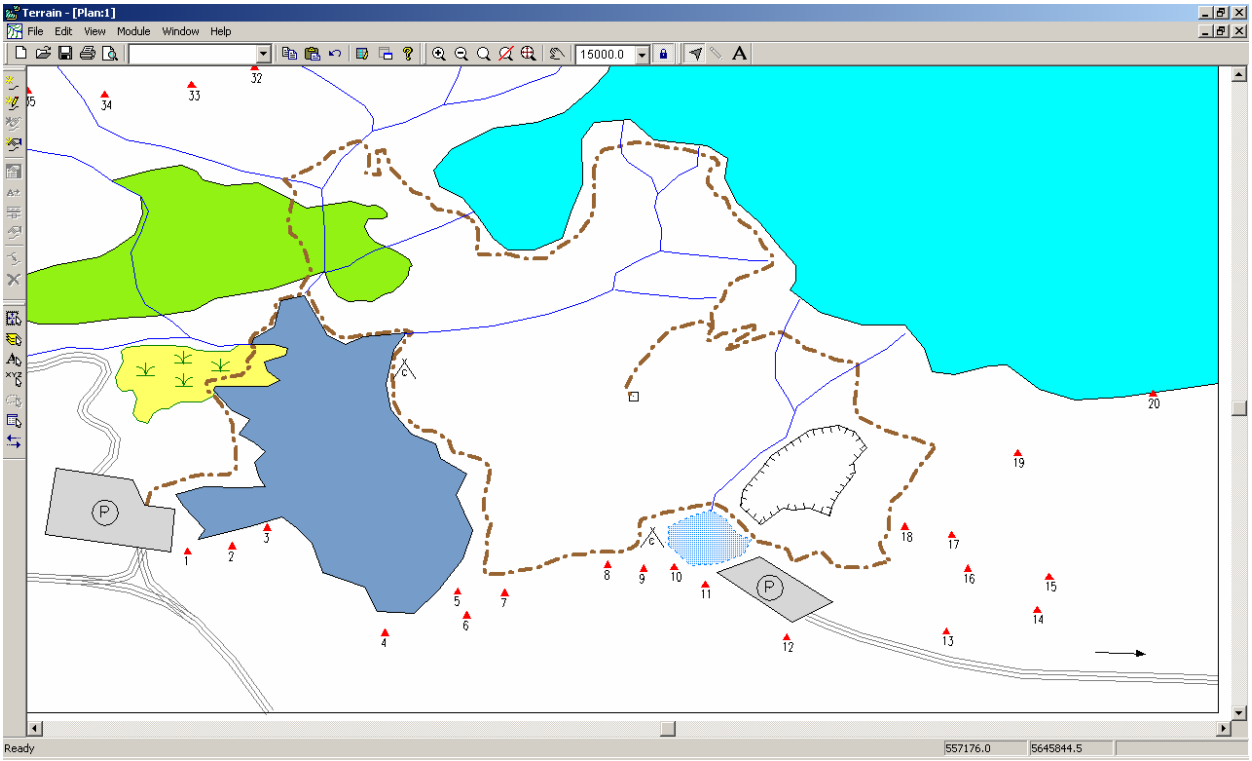


Figure 3.21: Park Example with Campground Symbols

10. 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 enable. See *Function Groups* in the On-line help for more information

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

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

2. Edit|Select Feature(s)|By Name or press the *Select By Name* button.

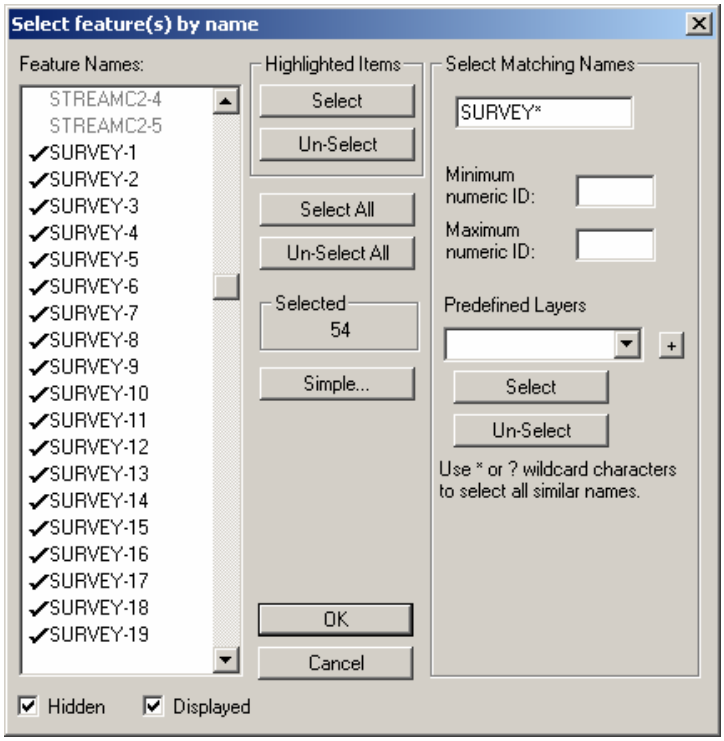


Figure 3.22: Select feature(s) by Name Dialog

3. Press the *Advanced* button and type **SURVEY*** into the *Select Matching Names* area as shown in the figure above. Press the *Select* button in the *Select Matching Names* area. Press OK. A number of triangle features are selected. All of these features have the name SURVEY.

4. Press the *Properties* button in the toolbar or Edit | Modify Selected Feature(s) | Properties. Turn *Connected* on. Press OK.

5. Edit | Modify Selected Feature(s) | Join. All the selected features will be joined.

6. Press the *Line style* button to activate the *Plan Window Feature Formatting* dialog box. Change the *Line-type* to *5-thick (medium*) and change the Symbol to *None.*

7. Edit | Modify Selected Feature(s) | Close. The boundary will close and the map should look like Figure 3.23.

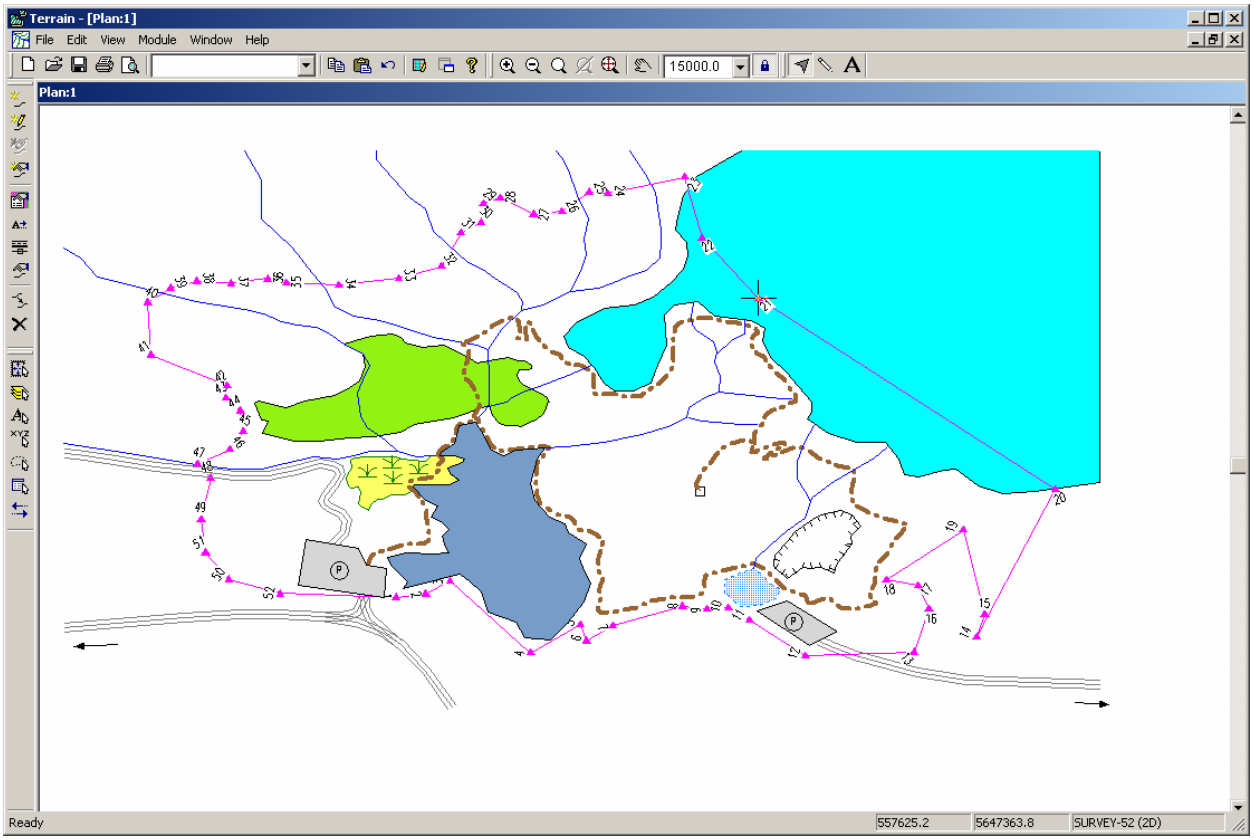


Figure 3.23: Park Boundary

Labels

There are two types of labels used in the Terrain Module, *Automatic 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 *View* | *Active Window (Plan) Options* | *Labels* | + .

8. Choose menu View | Active Window (Plan) Options | Labels tab. Turn on *Floating Labels* by double clicking on it in the list box. Press OK twice to return to the main screen.

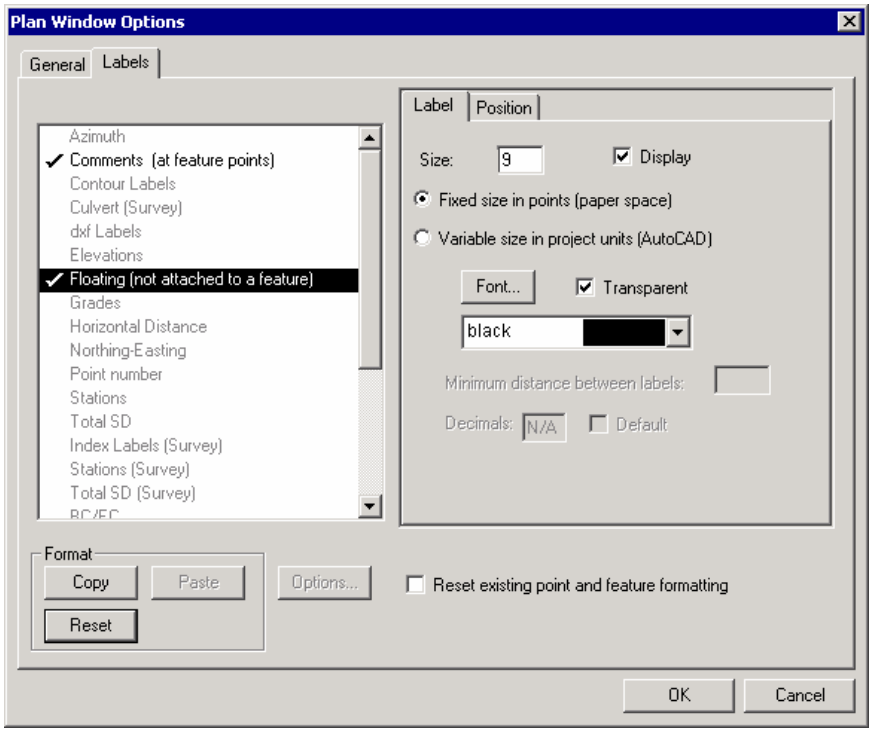


Figure 3.23a: Plan Window Options- Default Label Format

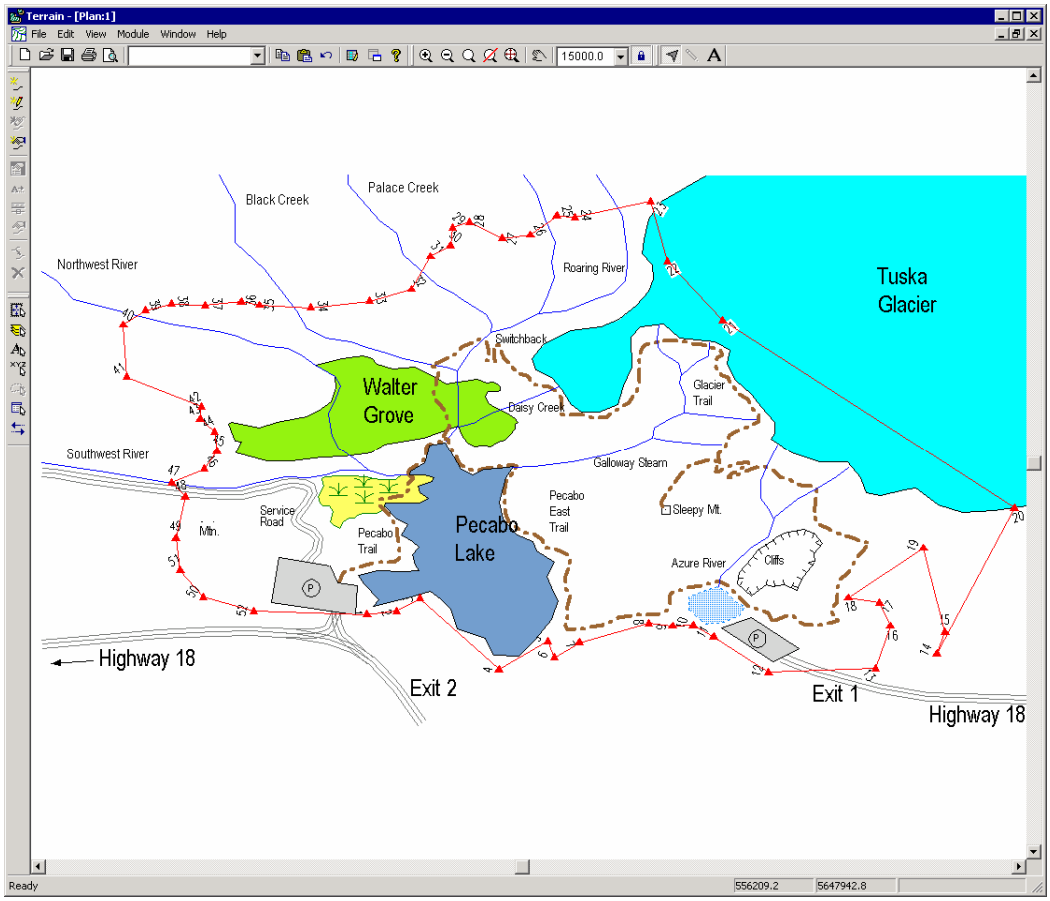


Figure 3.24: Plan Window with Floating Labels

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 menu Edit | Modify Selected Features | Labels. We will use this function to turn off the labels in our boundary.

9. Highlight the park boundary with the Selection cursor.

10. Choose menu Edit |Modify Selected Features | Labels. Turn off the display of *Comments (at feature points)* by double clicking in the list box.

11. Click the *Reset all existing point and feature formatting* checkbox. Press OK and answer "Yes" to the prompt "Do you wish to reset point formatting?"

We will now add a floating label to our park map.

12. Click on the A *Label Edit* button to initiate *Label Edit mode*.

13. With the ABC cursor click on upper left corner of the map and enter the text ("Park Boundary"). See Figure 3.24a.

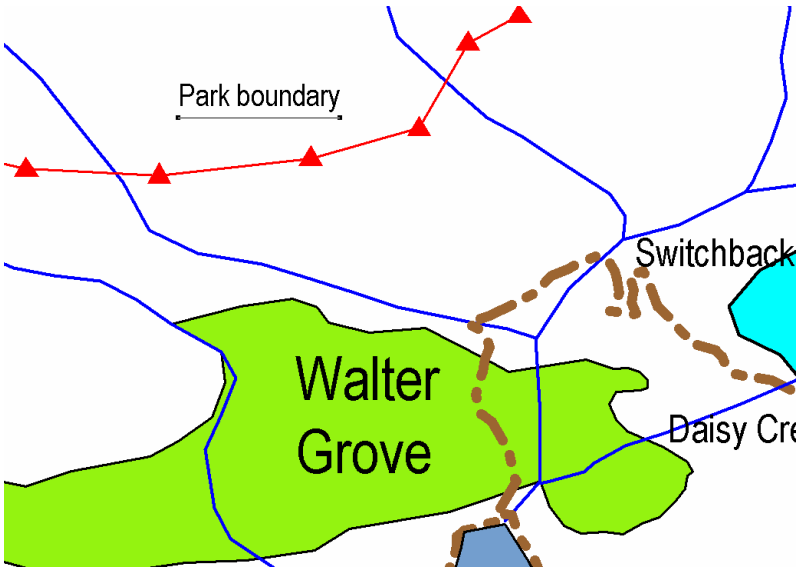


Figure 3.24a: Plan Window Feature Formatting Dialog Box

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.

Hatching

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

14. Highlight the park boundary with the Selection cursor.

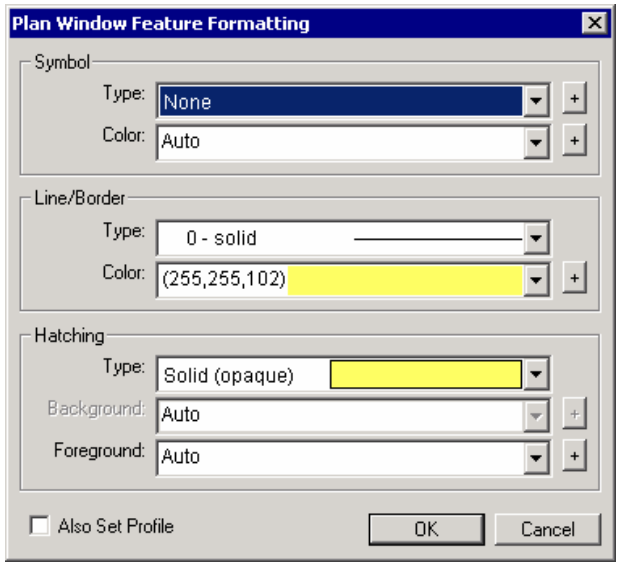


Figure 3.25: Plan Window Feature Formatting Dialog Box.

15. Edit | Modify Selected Feature(s) | Line-types, Symbols. Set Symbols to *None*, color *Yellow (255,255,102)* and hatch type *Solid (opaque)*. Press OK.

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 plus (+) button beside the color combo box and entering an RGB value.

16. With the boundary still selected, choose menu Edit | Modify Selected Feature(s) | Shuffle Display Order | Shuffle to back.

At this point your map should look similar to the Figure 3.26.

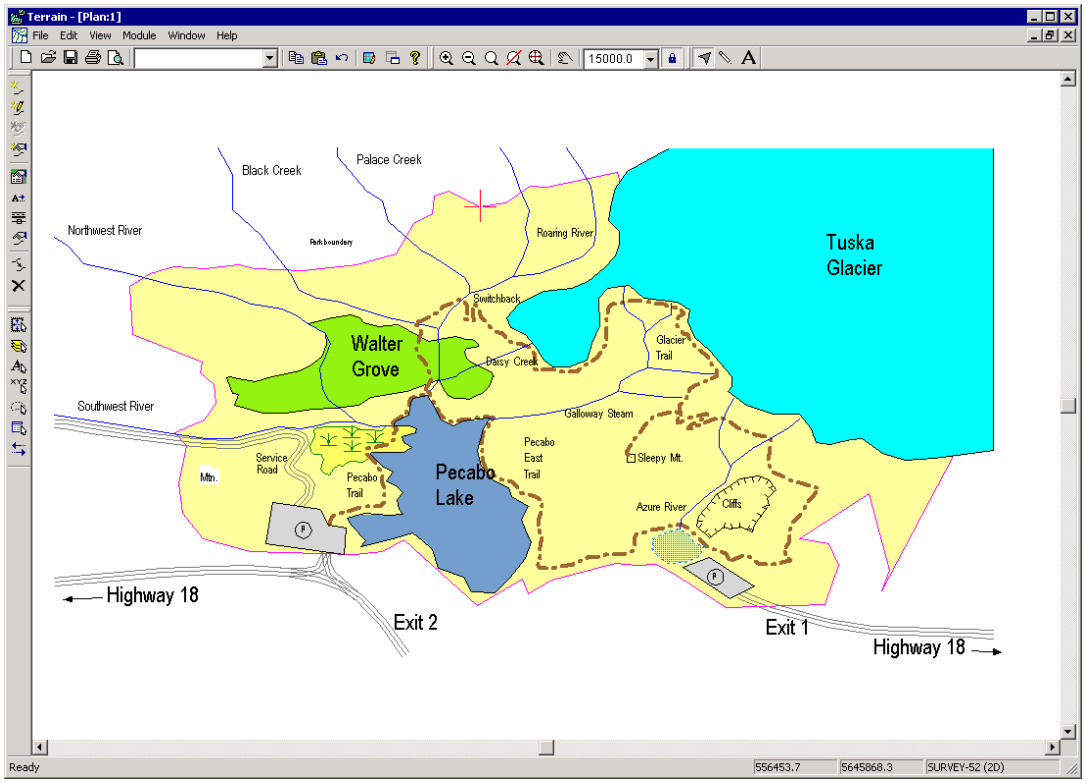


Figure 3.26: Map with Shaded Boundary Polygon

17. File | New. Do not save changes.

Creating an Output Sheet

Park Map Example

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

1. File | Open. Select **\Tutorial\Terrain\Terrain Cad\park map II.TER**. Press Open.

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

2. Go to File | 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.

3. Window | New Window | Multi-Plot, a blank multi-plot page will appear. Click on the *maximize* button in the upper right corner of the Multi-Plot Window.

4. Choose menu View | Multi-plot Options. Check *Snap to grid* and *Show Grid*. Press OK.

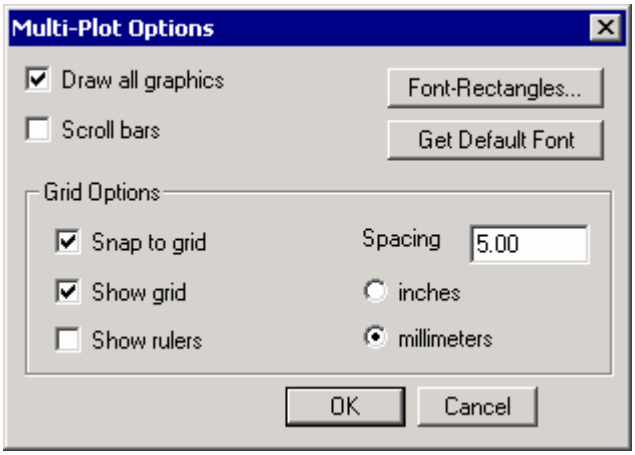


Figure 3.27: Multi-plot Options

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

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

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 Figure 3.28 will appear. Press OK and continue manually controlling the position of the Plan window using the <Shift +arrow >keys.

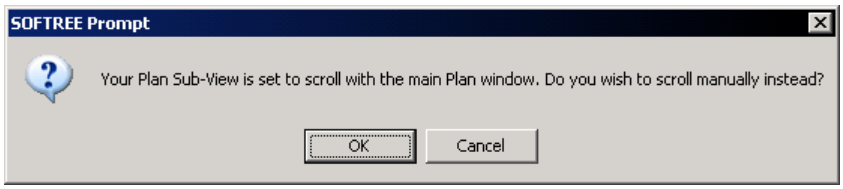


Figure 3.29: Plan Window Sub-view Manual Scrolling Prompt

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).

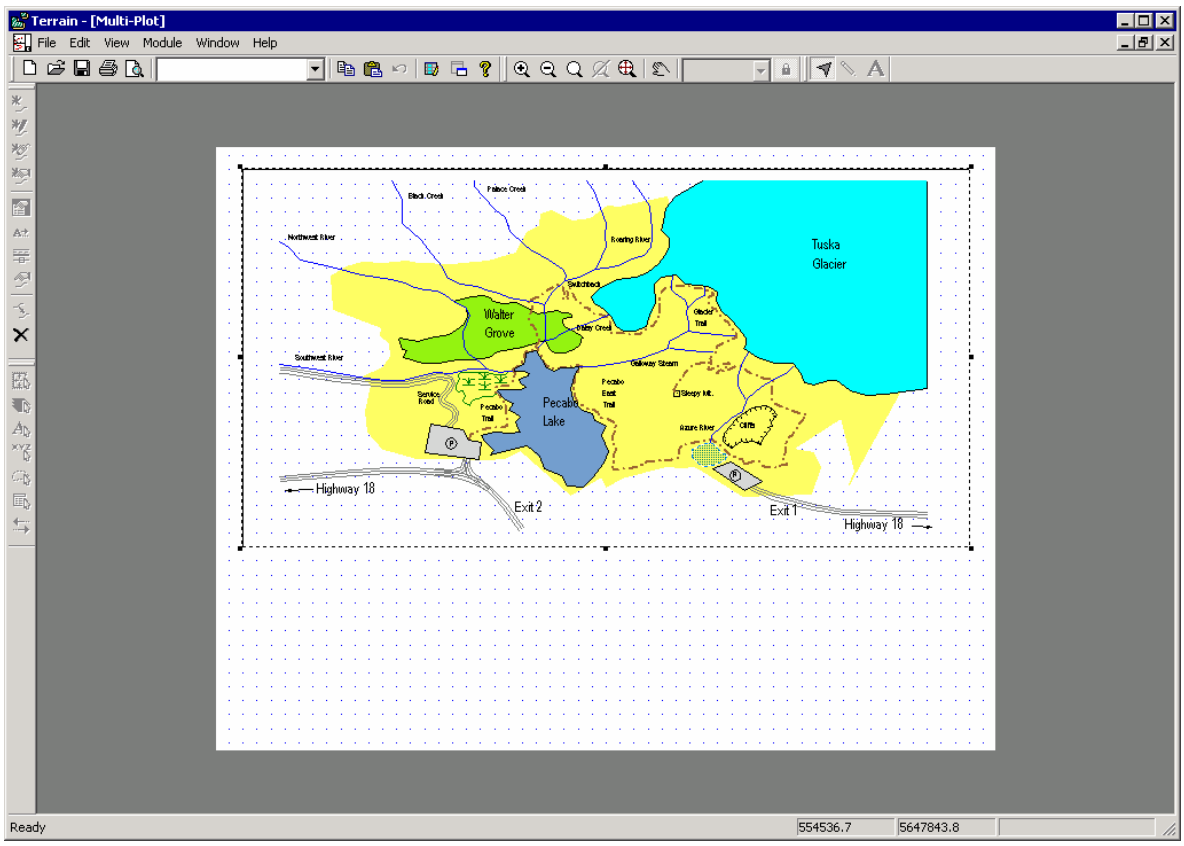


Figure 3.30: Multi-Plot Plan Sub-View of Plan1.TER

Adding a Legend and Scale Bar

8. Edit | New Sub-View | Legend. A legend will appear in the middle of your multi-plot sheet.

9. View | Multi-Plot Sub-View Options, to activate the Legend Sub-view Options dialog box or double click on the Legend sub-view will also activate this dialog box.

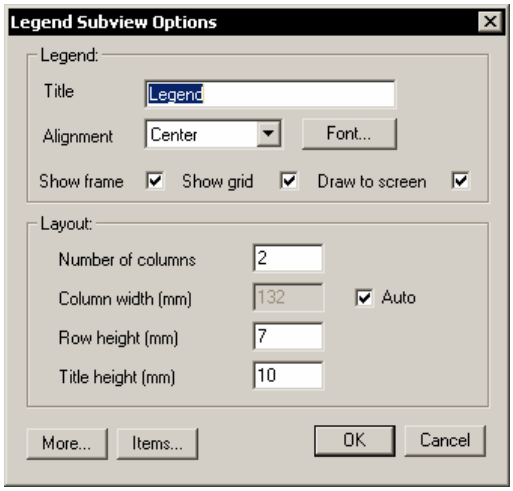


Figure 3.31: Legend Sub-view Options Dialog

NOTE: When the *Auto* check box 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. Configure the dialog box as shown in Figure 3.31 above.

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, press the Items button. Delete all line-types that do not appear in Figure 3.32. Change the descriptions to match. Do this by clicking on the desired list item and then changing the Description in the Current item area. Press OK to close dialog boxes.

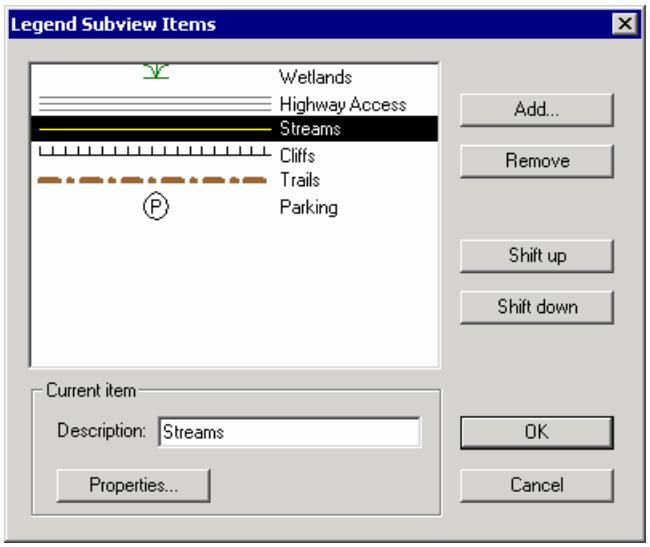


Figure 3.32: Legend Sub-view Options Dialog

12. Re-size and re-position the legend directly below the plan sub-view and on the left side of the page.

13. Edit | New Sub-View | Scale Bar, a scale bar will appear in the middle of your multi-plot sheet.

14. View | Multi-Plot Sub-View Options or double click on the scale bar to activate the Scale Bar Sub-view options dialog box.

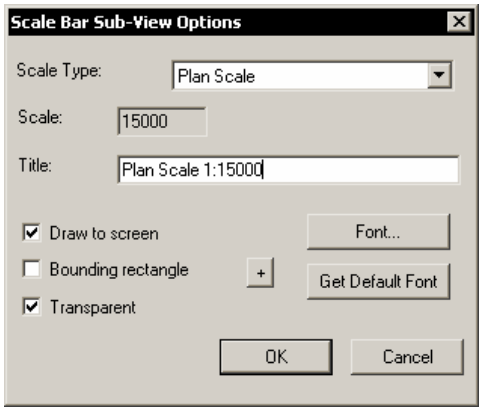


Figure 3.33: Scale Bar Sub-View Options Dialog

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

16. Re-size and re-position the scale bar inside the Plan sub-view (see 3.34 below). 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 Edit | Shuffle Front To Back menu to correct this.

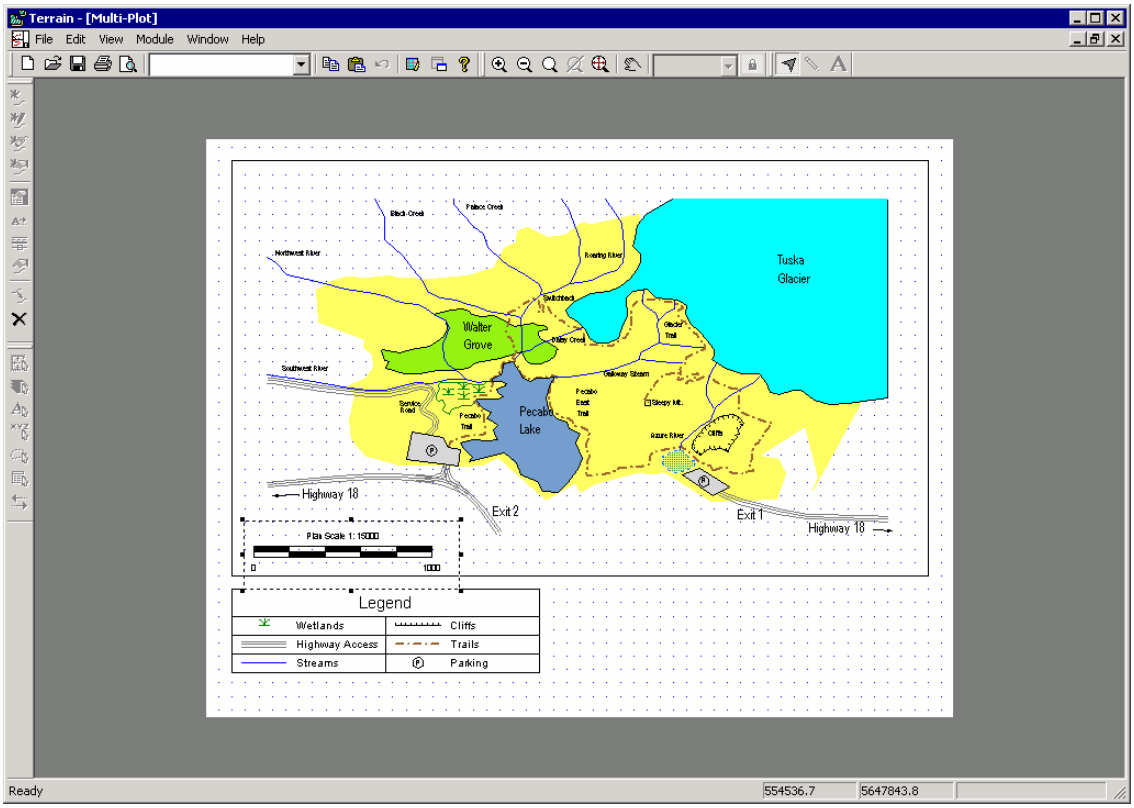


Figure 3.34: Final Multi-Plot Output

17. Choose menu Edit | New Sub-view | Rectangle. Type in the Text “Example Park Map” and choose the Font button and set the font size to 18. Press OK and position the sub-view as shown in figure 3.35.

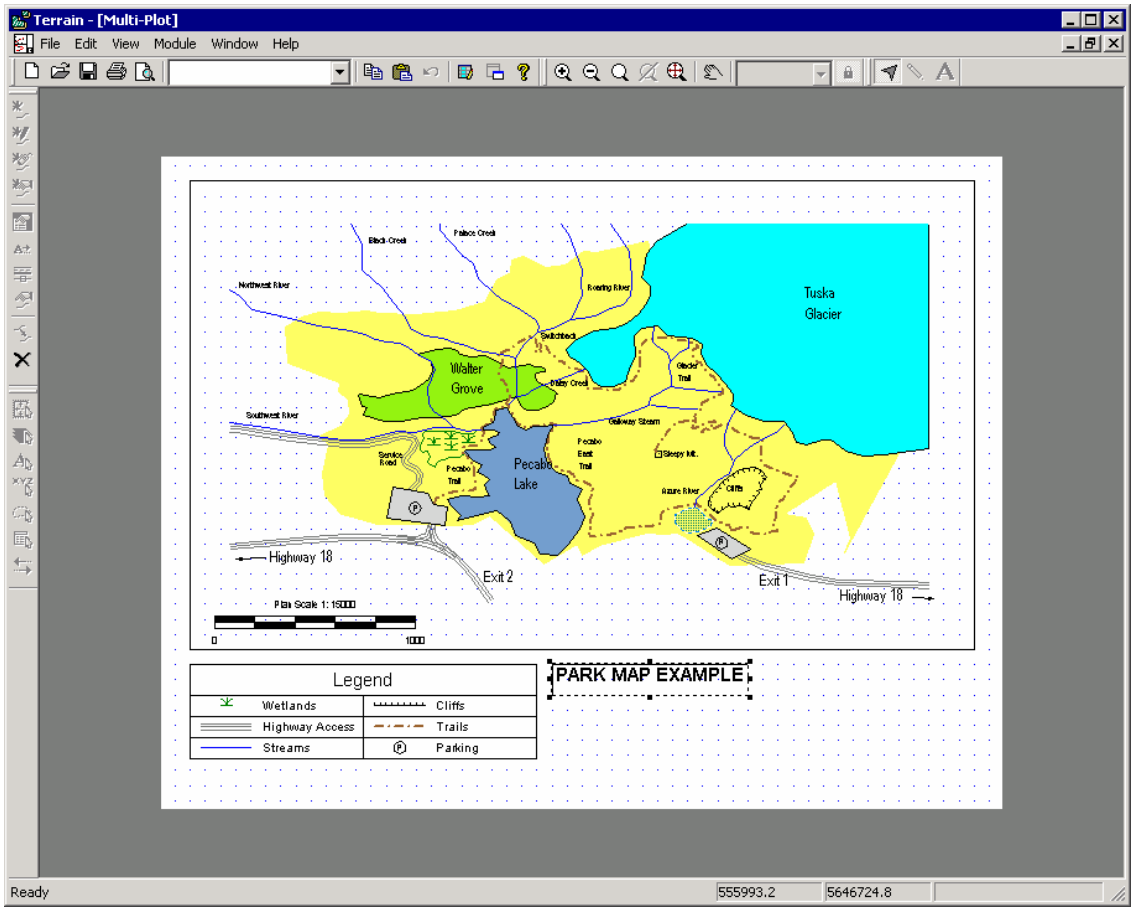


Figure 3.35: Multi-Plot Rectangle

18. Repeating the procedure from step 17, create and position several rectangles as shown in Figure 3.36. Enter any text you wish.

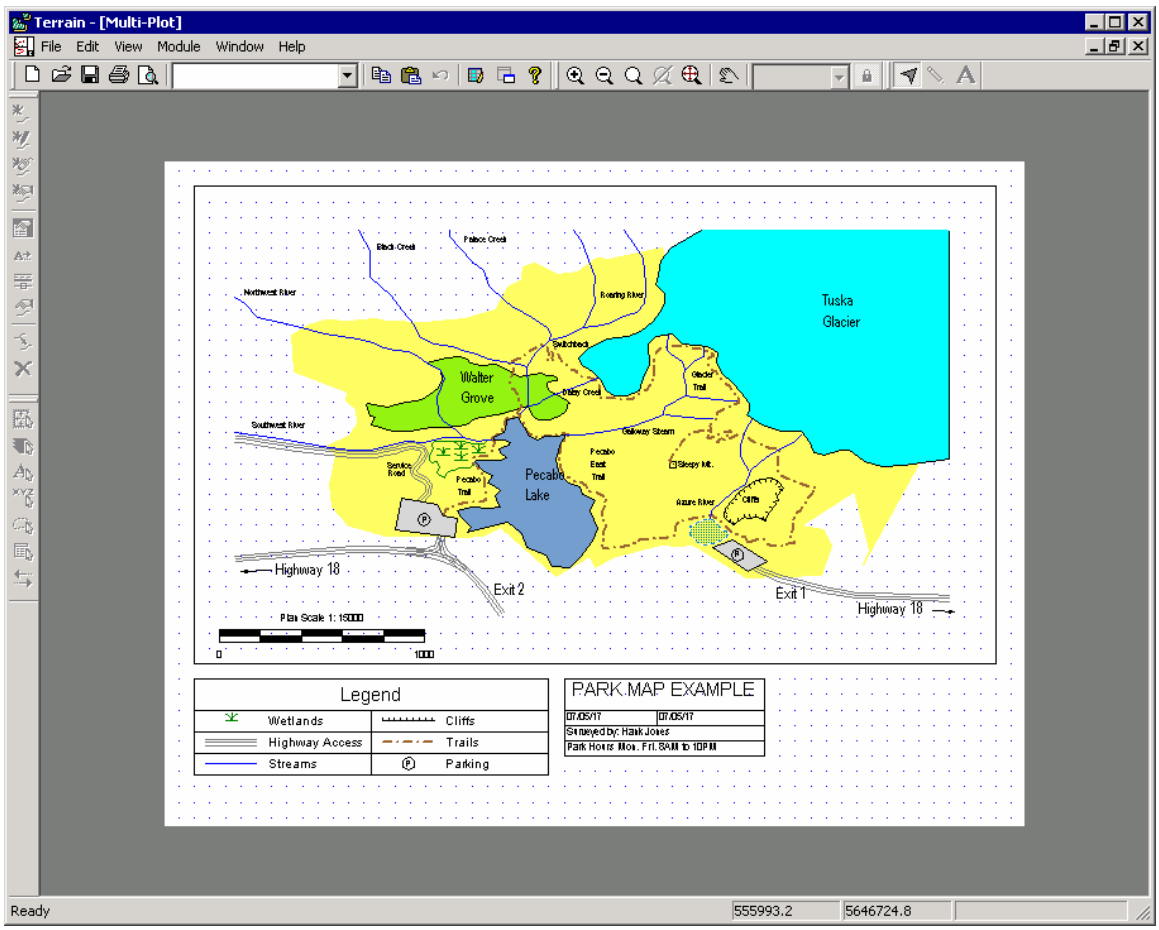


Figure 3.36: Multi-Plot With Rectangle

19. File | New. Do not save changes.

Bitmap 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. In order 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 georeference information. However, images from mapping or GIS sources contain this information. If an image is not georeferenced, Terrain Tools can used to create this information. This example will explore several methods for georeferencing 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

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.

NOTE: This procedure will only scale the image. The image is not corrected for position and rotation.

1. File│Retrieve Screen Layout. Select and open **\Tutorial\Terrain\Terrain Bitmap\bitmap scale.ILT**.

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

This screen layout sets options such as Plan Window location and scale. To check which options have been set go to View | Active Window (Plan) Options.

2. File | Insert File to activate the *Insert File* dialog box.

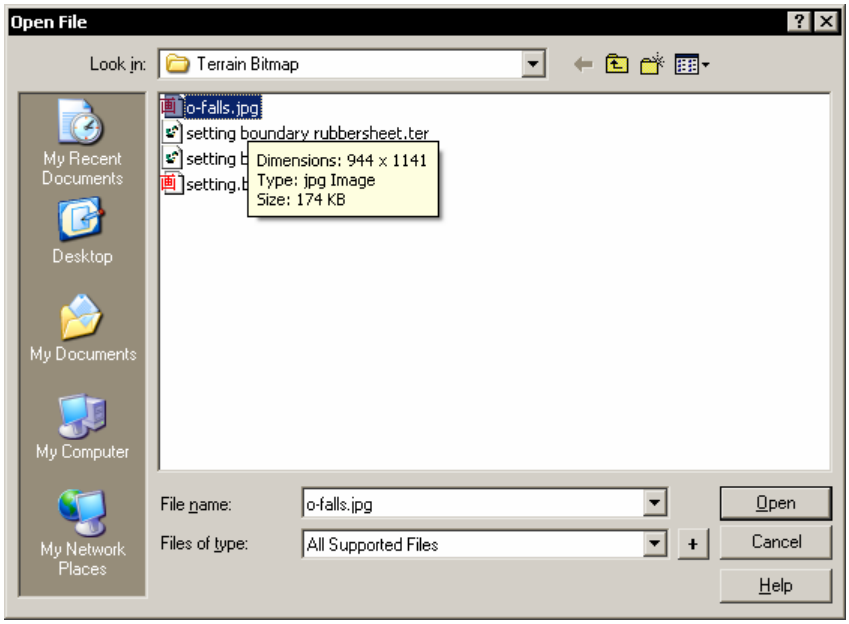


Figure 4.0: Insert File Dialog

Set *Files of type* to either *All Supported Files* or *Image Files [*.TIF, *.JPG, *.BMP]*. Select **\Tutorial\Terrain\Terrain Bitmap\O-FALLS.JPG** to activate the Import Options dialog box.

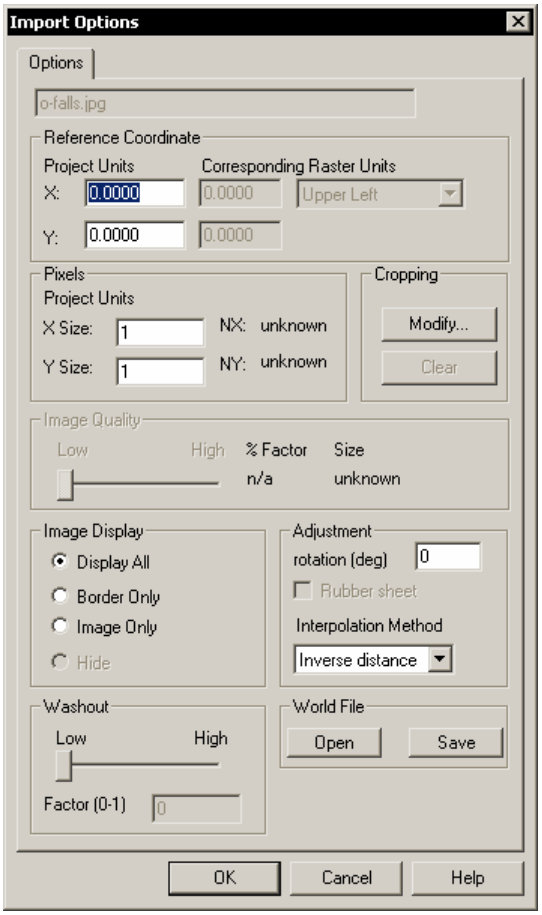


Figure 4.1: Import Bitmap Options Dialog (Used to Geo-Reference and Scale Bitmaps)

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:

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

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

In this example the natural scale is known, but the dots per inch are not. By creating a feature over the scale bar, you will be able to determine the length of the scale bar and calculate the pixel size accordingly.

3. Press *OK* to import the image. The Plan window now displays the imported bitmap.

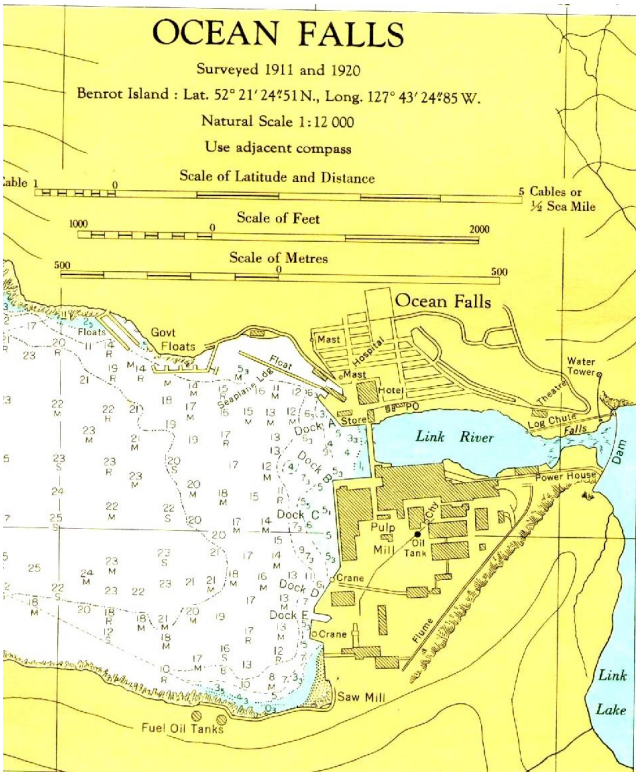


Figure 4.2: Imported Bitmap

4. Click the *Zoom In* button once or twice or use the *Zoom to Window* button and click and drag so the scale bars are clearly visible.

This map has three scale bars. This example is in metric units. Go to the Module | Setup dialog box to change units if necessary.

5. With the cursor in the Plan Window, right-click and choose menu *New Measurement*. Move the mouse until the cross-hair is over one end of the "*Scales of Metres*" bar and left-click, move the mouse over the other end of the scale bar. Create a second point in a similar way over the other end of the *"Scales of Metres*" bar.

The length of the new feature is now displayed in the Measure Tool window (see below).

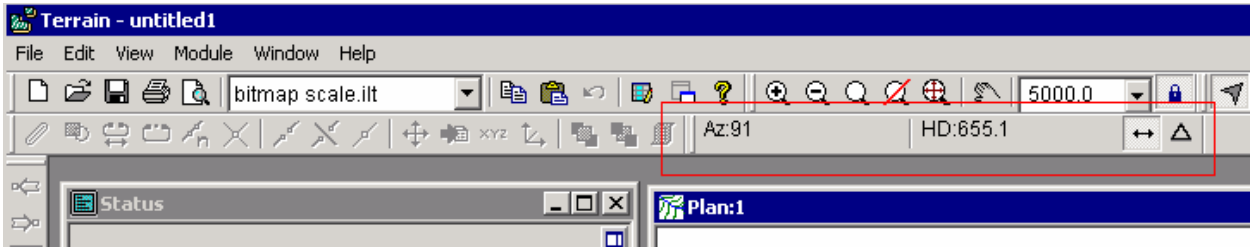


Figure 4.2a Measure Tool

The *"Scale of Metres"* bar should be about 655.1m long. This length is clearly wrong so the bitmap must be re-scaled.

6. Use the right mouse to change back to *select* mode . Left click on the bitmap border to select it (the border turns magenta).

7. Edit | Modify Selected Feature(s) | Properties or press the *Properties* button in the toolbar menu to activate the *Bitmap Options* dialog box.

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/655.1m = 1.526m

New Pixel Size (ft) = 1.0ft * 3000.0ft/597.8ft = 5.018ft

8. Type the appropriate pixel size (1.526m or 5.018ft) into both the *X size* and *Y size* fields assuming that the bitmap is not distorted). Press OK to close the dialog box and re-paint the image.

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.

9. Activate the Plan Window by clicking on the title bar and select menu View | Active Window (Plan) Options. Change the scale to 5000 if working in metric units (or 1000 if working in feet units).

10. Scroll the Plan window so that the pulp mill buildings are visible. Use to zoom in on buildings. Trace around the boundary of three of the buildings using the mouse tracing functions. See *Drawing a Feature* in the *Mapping and Drafting* section or *Tracing with the Mouse* in the On-line help.

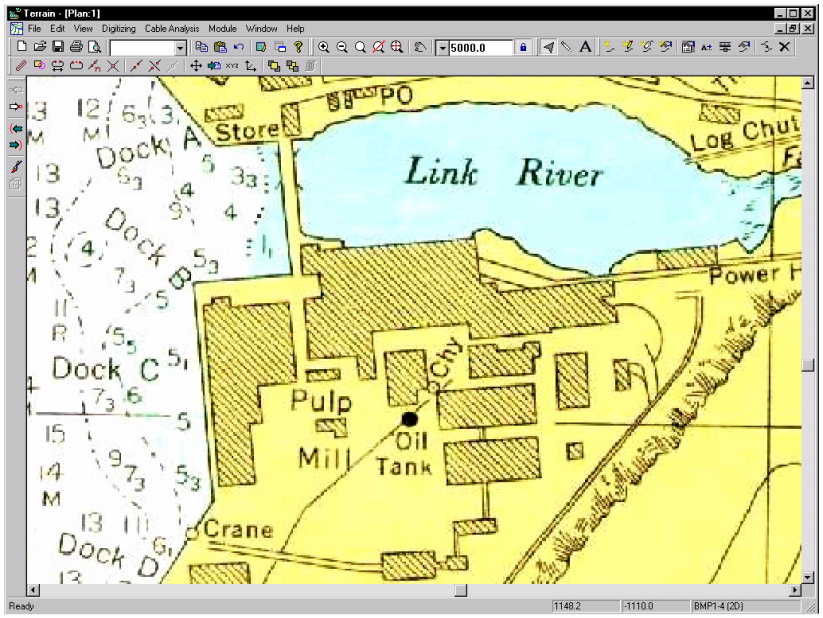


Figure 4.3: Ocean Falls Buildings

11. Make sure the Num/Lock is active on the computer keyboard. Click the *Draw New Feature* button to begin drawing a new feature. Move the pencil cursor over one of the corners of a building left click to anchor the new point. Move to next adjacent corner and left click again to create another point. Continue this procedure until you have traced around all the points in the building.

12. Click the *Draw New Feature* button to begin a drawing a new feature and repeat the above step to trace around the next two buildings.

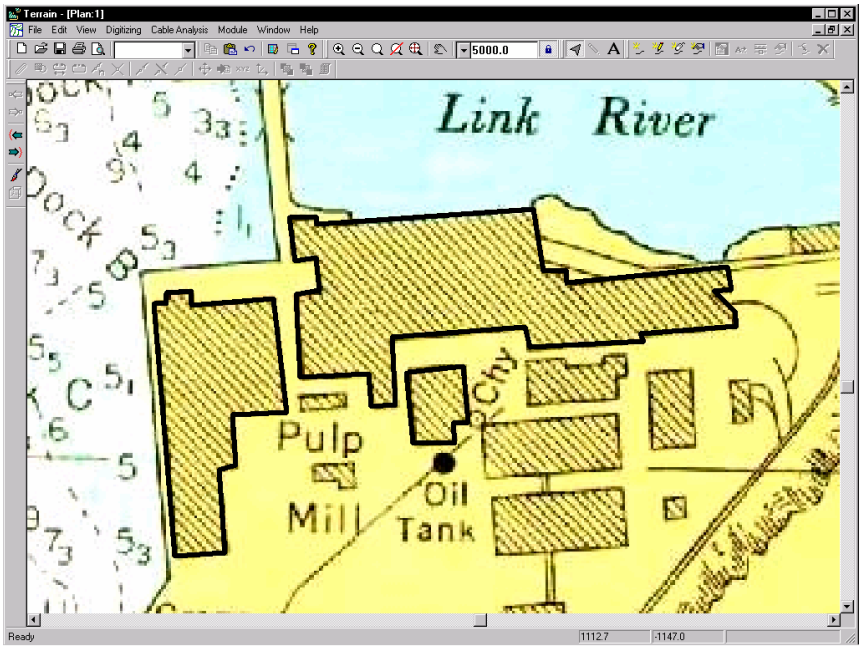


Figure 4.4: Traced Buildings

13. Use the right mouse to change back to *select* mode. To select all the traced buildings, left click and drag a rectangle to encompass all the traced buildings.

14. Edit | Modify Selected Feature(s) | Line-types, Symbols. Select line-type *6-thick (heavy)* and change the color to *blue*. Press OK.

15. Activate the Status Window to view the area of the selected features. 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).

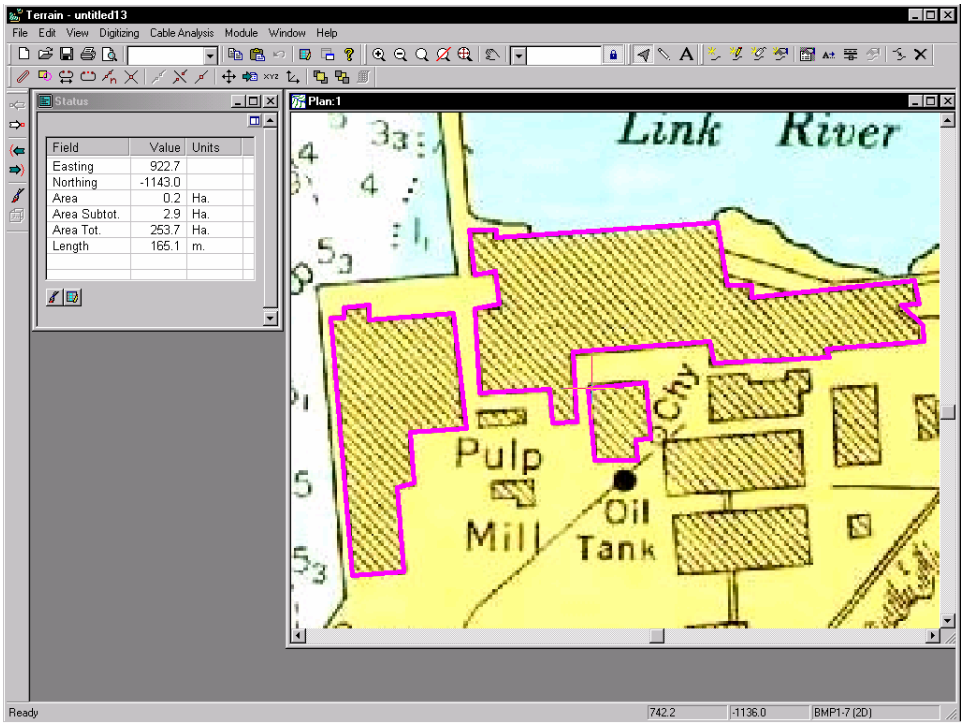


Figure 4.5: Selected Buildings with Area Reported in the Status Window

16. 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 Files *.*]*. Select **\Tutorial\Terrain\Terrain Bitmap\setting boundary shift.TER**.

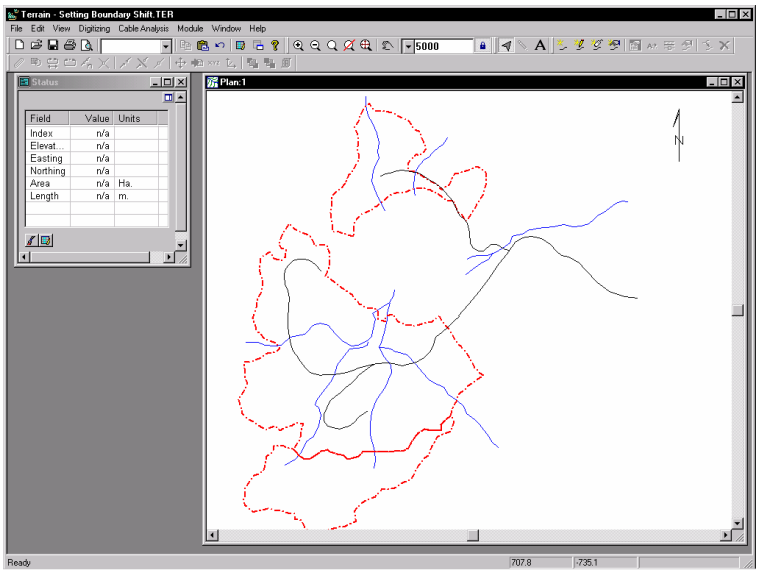


Figure 4.6: Setting Boundary Shift.TER - Surveyed Traverses

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. File│Insert File. Change Files of type to Image Files [*.TIF, *.JPG, *.BMP]. Select **\Tutorial\Terrain\Terrain Bitmap\setting.BMP**. Press Open. The Import Options dialog box appears. Press OK to insert the bitmap.

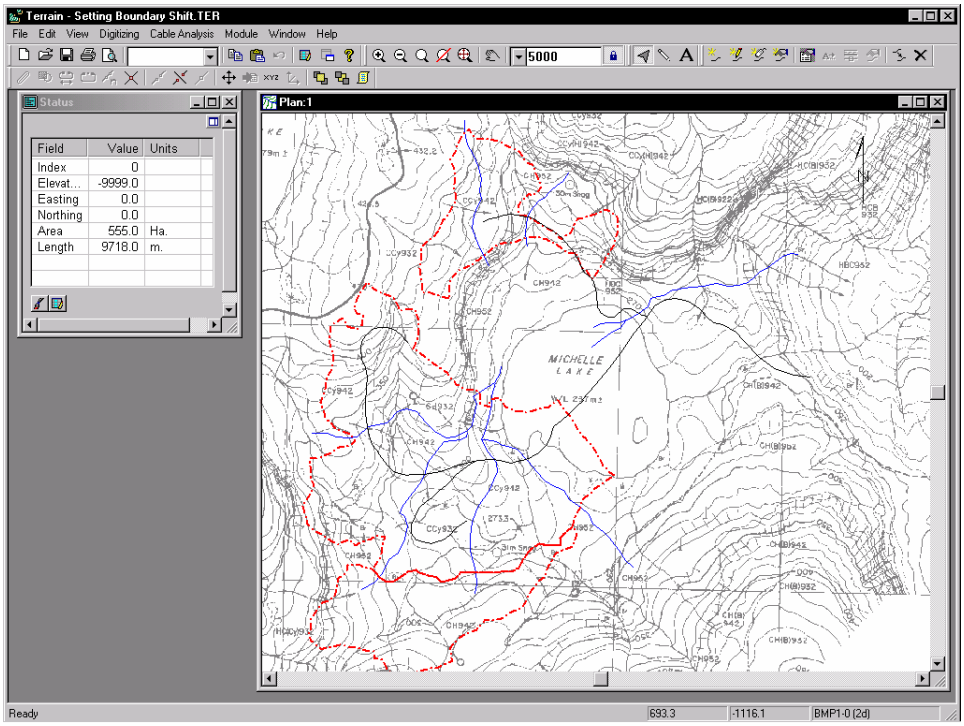


Figure 4.7: Plan Window after Adding setting.BMP

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). 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:

3. Select the bitmap by left clicking its boundary with the Selection cursor.

4. Edit|Modify Selected Feature(s)|Move/Size or press the *Move/Size* button. 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.

5. 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.

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

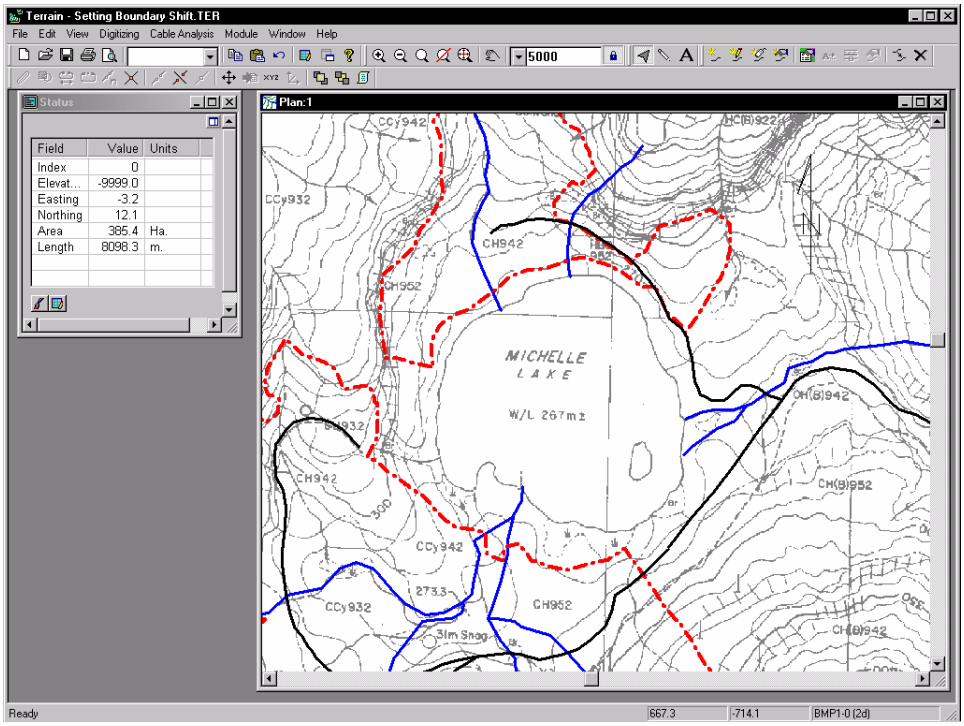


Figure 4.8: Lining Up Michelle Lake with Streams by Trial and Error

7. Repeat the above two steps until the lakeshore lines up with the traversed streams. This procedure involves some trial and error to adjust both the size and position of the bitmap. The Zoom In/Out buttons 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.

8. With the bitmap still selected, activate the Bitmap Options Dialog box by choosing Edit | Modify Selected Feature(s) | Properties or pressing the *Properties* button in the toolbar.

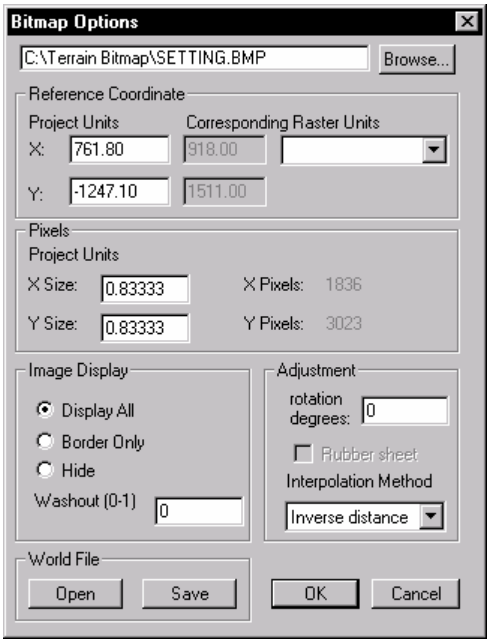


Figure 4.9: Bitmap Options Dialog

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 dialog box can be used to explicitly set the rotation, size and position of a bitmap.

9. Press Cancel. Select menu File | New. Do not save changes.

Rubbersheeting

This example requires *Mapping and Drafting*, *Import Basic*, *Export Basic* and *Image Adjustment* function groups enabled. *Image Adjustment* is available with the Survey Module. See *Function Groups* in the On-line help for more information.

The purpose of this example is to show that an image may be distorted to fit specific known points.

1. File|Open. Change the *File of Types* to *Softree-Terrain File *.TER)* Select **\Tutorial\Terrain\Terrain Bitmap\setting boundary rubbersheet.TER**.

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

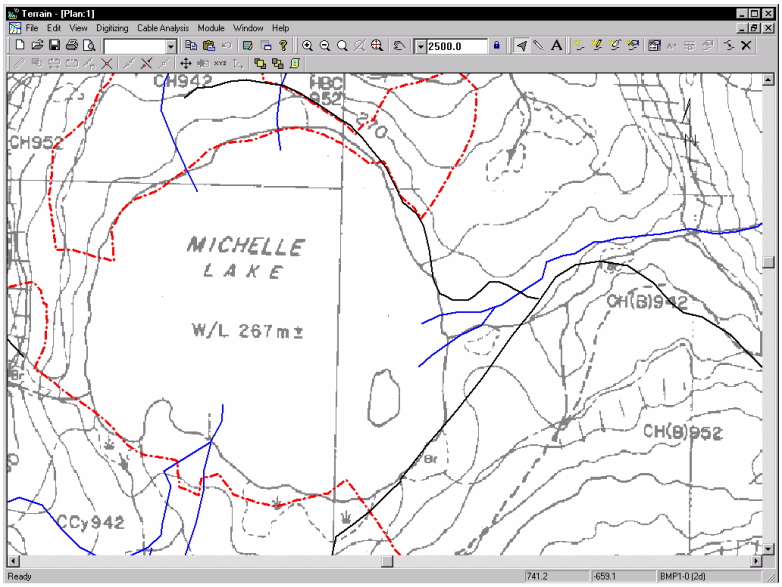
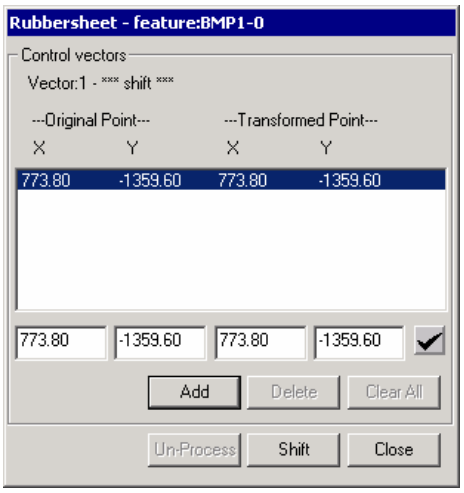


Figure 4.11: Rubbersheeting File

2. Press the *Rubbersheet* button or Edit|Modify Selected Features|Rubber Sheet Image to activate the Rubbersheet dialog box. In order to visualize the rubbersheeting feature click on the title bar of the dialog box and drag it over to the right side of the screen.

We will enter a series of vectors which will define the transformation. Depending on the transformation method (see Image Properties – Interpolation method for more information) these vectors will move, stretch and rotate the image. In our example the first vector moves the image to a known point. In other words it will shift the Original Point to a new Transformed Point.

Initial Vector



Shift Vector

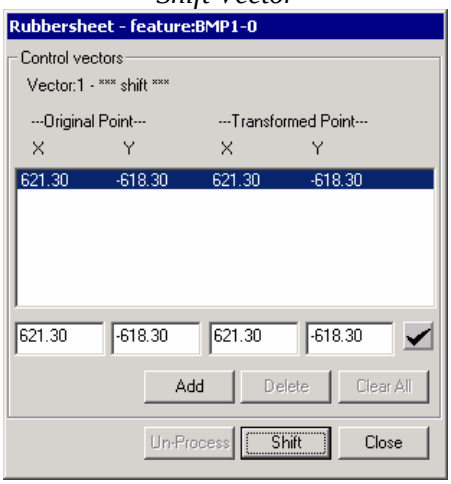


Figure 4.12: Rubbersheet Dialog

3. The dialog box already has a set of coordinates in. Enter the vector as shown on the right hand side of Figure 4.13 and press the check mark button to create the shift vector.

NOTE: The round circle on one end of the Vector is the Original Point on the bitmap. The arrow on the other end of the Vector is the Transformed Point.

There are different types of Vectors. Shift Vectors move the bitmap from the Original Point to the Transformed Point. The first Vector in the list of Control Vectors is always a Shift Vector. Stretch Vectors distort the image from the Original Point to the Transformed Point.

The feature has an arrowhead facing towards the center of the lake. This is the direction that the feature will be shifted. Notice that in the *Rubbersheet* dialog box the word *shift* appears opposite *Vector 1*. The first vector is always a shift operation.

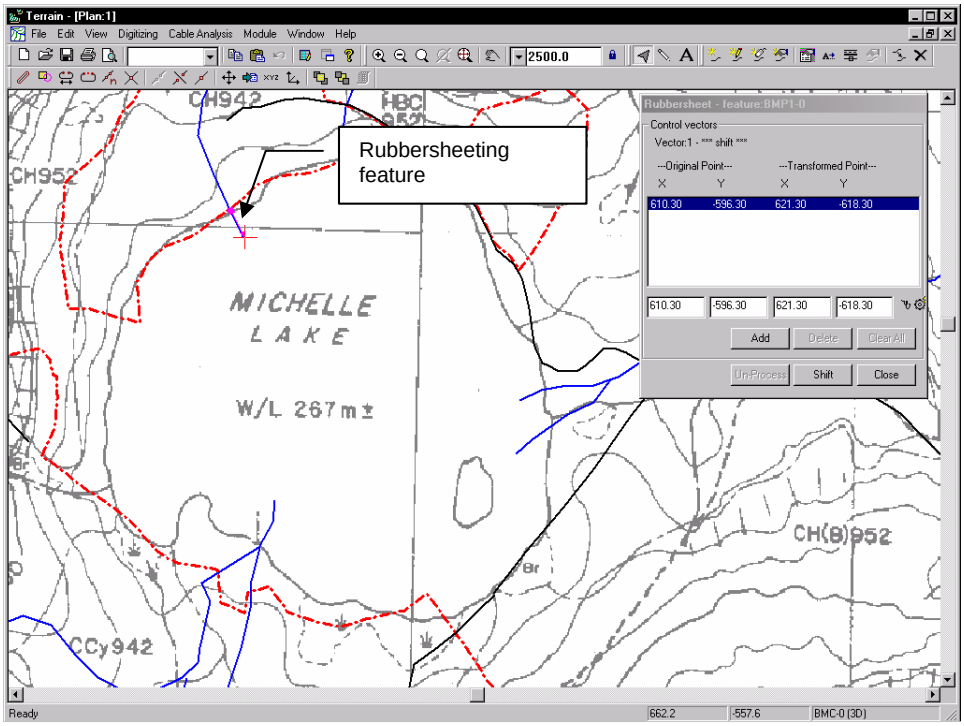


Figure 4.13: First Rubbersheeting Vector

4. To add additional vectors, press the *Add* button. Another vector will appear in the Plan Window as well as in the Rubbersheet dialog box.

5. Type in the next set of coordinates for Vector 2 as shown in Figure 4.14.
   Original Point type X **703.30** Y **–554.8**
   Transformed Point type X **705.8** Y **–578.30**

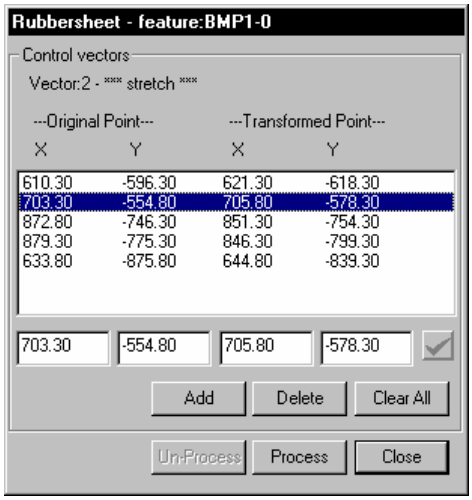


Figure 4.14: Rubbersheet Dialog

6. Press the green check mark. The feature will move to the new location in the Plan Window and update the list of coordinates.

Notice that this vector is a *stretch* vector.

7. Repeat the above steps for the three remaining vectors shown in Figure 4.14.

All of the vectors could have been moved with the mouse instead of entering in coordinates in the dialog box.

8. Press the *Process* button. Notice that after a few seconds of processing the bitmap will be stretched to fit the new coordinate information and should appear similar to Figure 4.15.

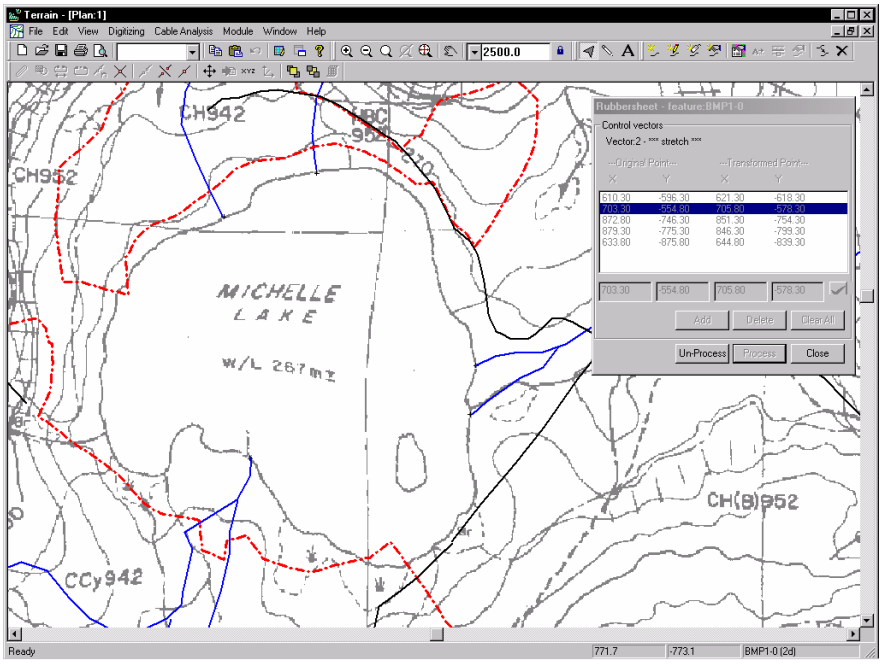


Figure 4.15: Bitmap Image after Rubbersheeting

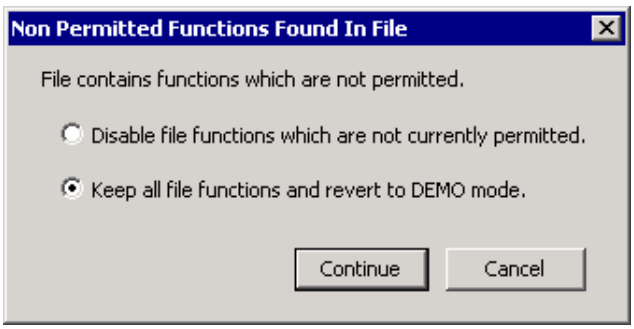
9. File│New. Do not save changes.

Importing Coordinates

Terrain Tools™ works with Cartesian coordinates such as UTM. Coordinates can be entered directly by typing them into a dialog box, traced from an existing map using the mouse or a digitizer (See *Digitizing*) or by importing them from an external file. This section of the documentation will familiarize you with some of the methods for importing from external files and for entering coordinates via the keyboard.

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.

If your software license does not include a required Function Group, when you open a file or screen layout you will be prompted:



Choose “Keep all the functions and revert to DEMO mode”. Examples in this section can be completed in Demonstration Mode. Contact Softree to upgrade your license to permit more functions.

Importing DWG or DXF Files

Municipal Plan Example

The Terrain Module will read most standard DWG files. Importing DWG files is easy. It is generally not necessary to understand the format of a DWG file since, in most cases, the file is created automatically by other software. More information about the technical aspects of DWG files can be found in the On-line help.

1. File | Retrieve Screen Layout. Open file **\Tutorial\Terrain\Terrain Import\city.ILT**.

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

The screen layout city.ILT contains screen settings such as scales used in this example. It is not required for importing DWG files.

2. File | Insert File. Change *Files of type to Autocad DWG [*.DWG]*. Select **\Tutorial\Terrain\Terrain Import\municipal.DWG**. Press Open.

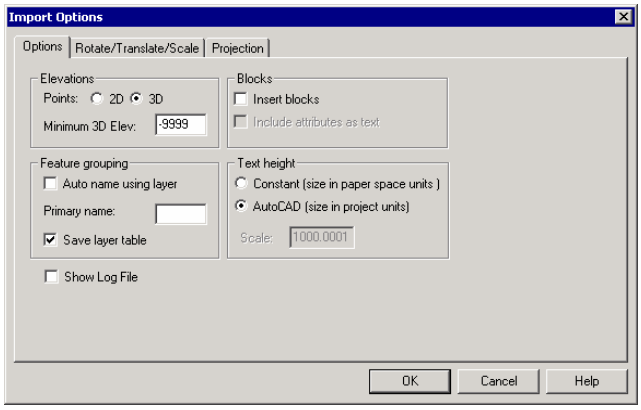


Figure 5.0: Import DWG/DXF Options Dialog

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

The options in the *Text Height* group box allow you to control the text size when importing the DWG file. If *Constant* is selected, the text size is based on the drawing scale entered in the *Scale* field. If *AutoCad* is selected, the text size is determined by the scale of the drawing. Changing the scale will resize the text. This is the best option to correctly size text.

3. Set the dialog options to match those shown in Figure 5.0 and press OK.

4. After the import process is complete press the *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.

5. Zoom in with the Magnify button to examine the details of the legal plans as shown in Figure 5.1.

NOTE: If *Primary Name* (from the *DWG Import Options dialog 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.

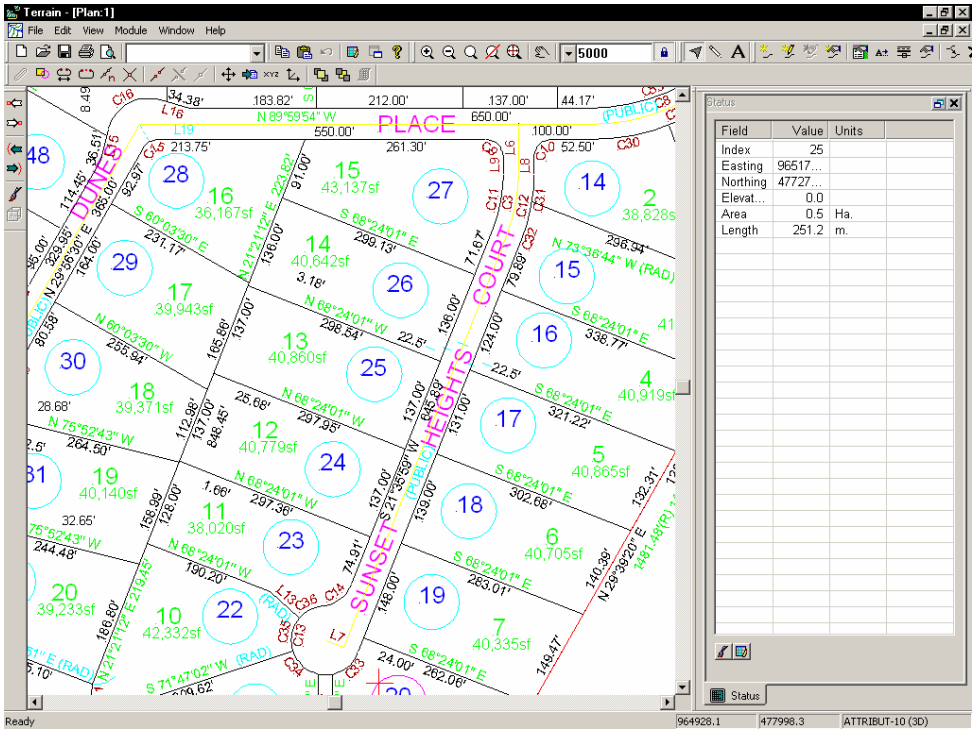


Figure 5.1: Imported DXF File

6. File | New. Do <u>not</u> save the 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. The position of X, Y, Z coordinates, descriptions and field delimit characters (TAB, space, comma etc.) can be specified as well as how the points are organized into features.

This example illustrates the use of these functions to import a site plan from a total station data collector file. The file (Figure 5.2) consists of a sequence number, X, Y, Z, and code separated by commas.

```
1, 5469160.150, 492582.842, 269.490, RP1
2, 5469112.743, 492575.602, 270.810, RP2
3, 5469172.251, 492534.767, 267.431, RP3
4, 5469195.868, 492566.517, 269.478, RP4
```

```
5, 5469065.895, 492602.503, 273.804, RD1
6, 5469077.143, 492598.650, 272.818, RD1
7, 5469091.730, 492591.373, 271.955, RD1
8, 5469106.665, 492581.080, 271.206, RD1
9, 5469126.966, 492565.644, 269.649, RD1
10, 5469146.155, 492553.177, 268.071, RD1
11, 5469164.442, 492540.689, 267.615, RD1
12, 5469180.404, 492527.023, 266.848, RD1
13, 5469192.047, 492525.252, 266.200, RD1
14, 5469179.074, 492537.460, 267.208, RD2
15, 5469174.058, 492541.835, 267.453, RD2
```

Figure 5.2: Excerpt from total.ASC

1. File | Retrieve Screen Layout menu. Select and open **\Tutorial\Terrain\Terrain Import\import.ILT.**

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

Import.ILT contains appropriate screen settings such as scale used in this example. It is not required for importing ASCII files.

2. Select Module | Setup, and press the *Import* tab

3. Press the *Add* button to activate the *Define New File Format Options* dialog as shown in Figure 5.3.

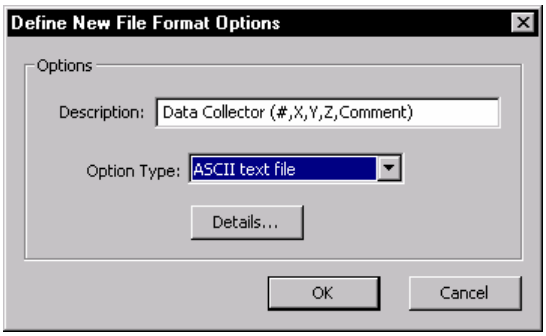


Figure 5.3: Define New File Format Options Dialog

4. Change the description and option type to match the dialog box above.

5. Click on the *Details* button to activate the *Import ASCII Options* Dialog box shown in Figure 5.4.

The *Import Ascii Options* dialog 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 dialog box are available by pressing F1.

6. Press the *Attributes* button, select Comment from the *Available* list, and press the *Add* button. The Comment attribute will appear in the selected column. Press OK.

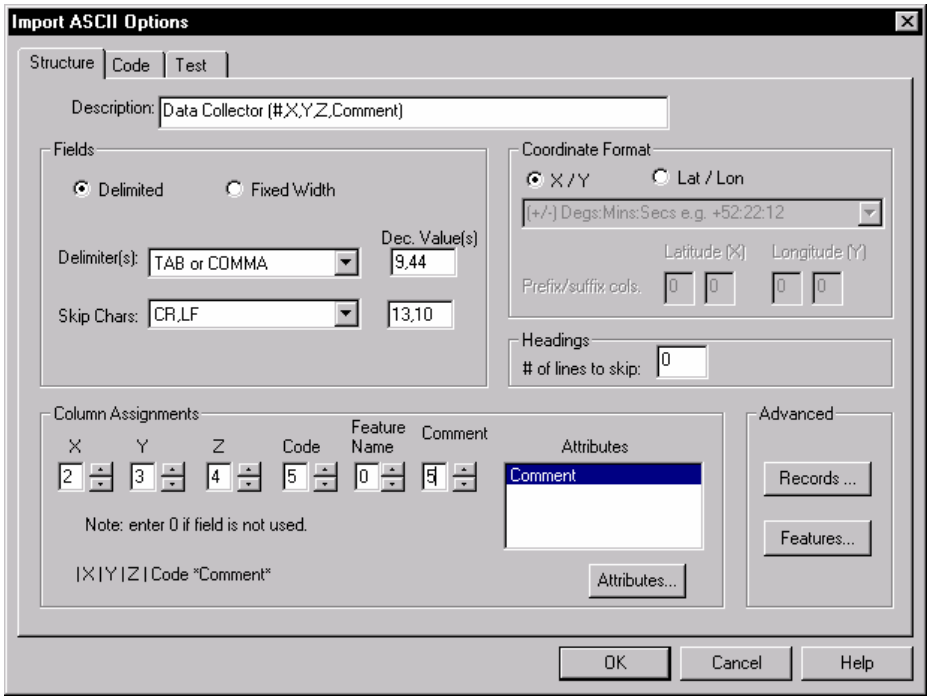


Figure 5.4: Import ASCII Options Dialog – Structure Tab

7. Change the entries in the dialog box to match Figure 5.4.

This configuration will read each record of the file as a single point feature. The feature ID (*ID field position*) will be taken from the comment field. Any duplicates will automatically be assigned different feature sub-id.

8. Press the *Records* button. Ensure that *All* is selected. Select OK to close the records dialog box.

NOTE: Wild card expressions are used in the *Record Selection* area of the *Records* dialog box if either *By Inclusion* or *By Exclusion* is chosen. The question mark ? in a wild card expression means any character will match. For example:
The wild card string ?ABC?? matches the following:
1ABC11
AABC1
AABC
It does not match the following:
ABC11
1ABC111

An Asterisk * at the end of a character string means include all characters after the primary string
The character string AB* matches
ABD-1278
ABF

9. Press the *Features* button and choose *Identify Features by Code* from the pull-down box. Press OK.

NOTE: The *Feature Detection Method* dialog allows specification of the logic used to group points together into a single feature. For a complete description of the methods available, see the online help by pressing F1.

10. Go to top of the dialog box and select the *Codes* tab to activate the Import ASCII Options Dialog box. Here you can assign symbols and line-types to the incoming points.

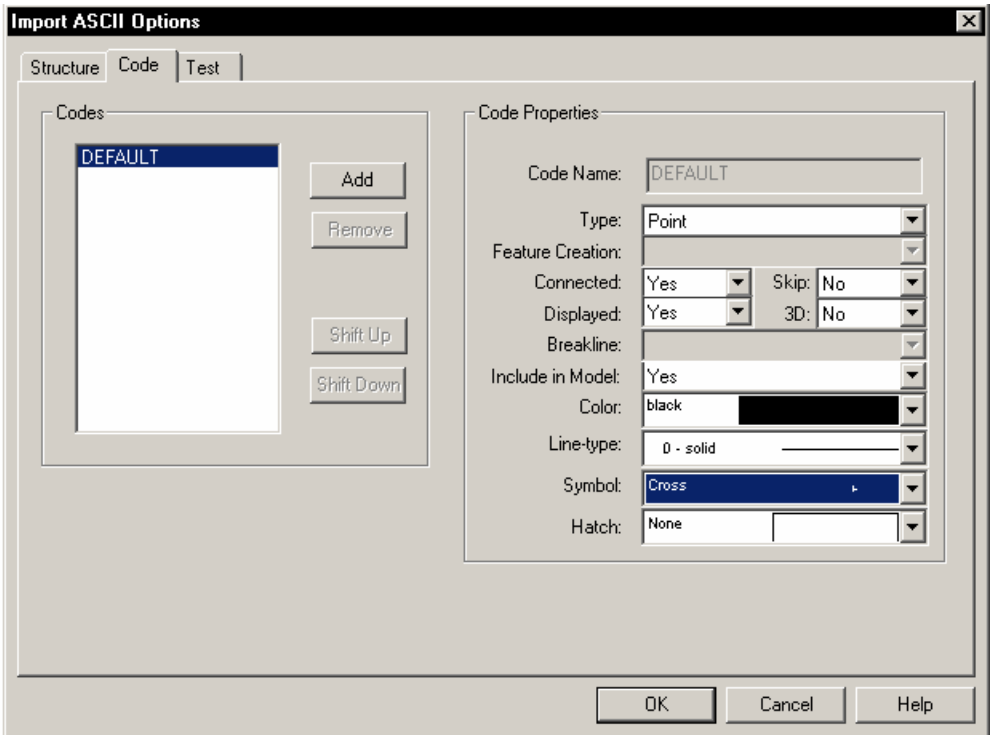


Figure 5.5: Import ASCII Options Dialog – Code Tab

11. Change your default code properties to match those shown in Figure 5.5.

NOTE: The Code Properties available are based on the Feature Detection Method set during step 9. The *Feature Creation* and *Breakline* properties are unavailable when the *Code Type* is set to *Point*.

12. Press *Add*. Type **RD1*** in place of NewCode1 in the *Code Name* field. Change *Type* to *Polyline*. Change Feature Creation to *Connect All*. Change *Connected* to *Yes* Change *3D to Yes.* Change *Breakline* to *Yes*. Change *Include in Model* to *Yes.* Change the *Color* to *Blue, Line-type* to *thick (medium)-5,* and *Symbol* to *triangle.*

13. Press *Add* button. Type **RD2*** in place of the NewCode2 in the *Code Name* field. Change the properties to match those of RD1*.

14. Press *Add again*. Type **CL*** in place of NewCode3 in the *Code Name* field. Change *Type* to *Polyline*. Change *Connected* to *Connect All*. Change *3D to Yes.* Change *Breakline to No*. Change *Include in Model* to *Yes.* Change the *Color* to *Red, Line-type* to *thick (heavy)-6,* and *Symbol* to *square (Large).*

15. To test the specification, press the *Test* Tab to open Import ASCII Options dialog box as shown in Figure 5.6.

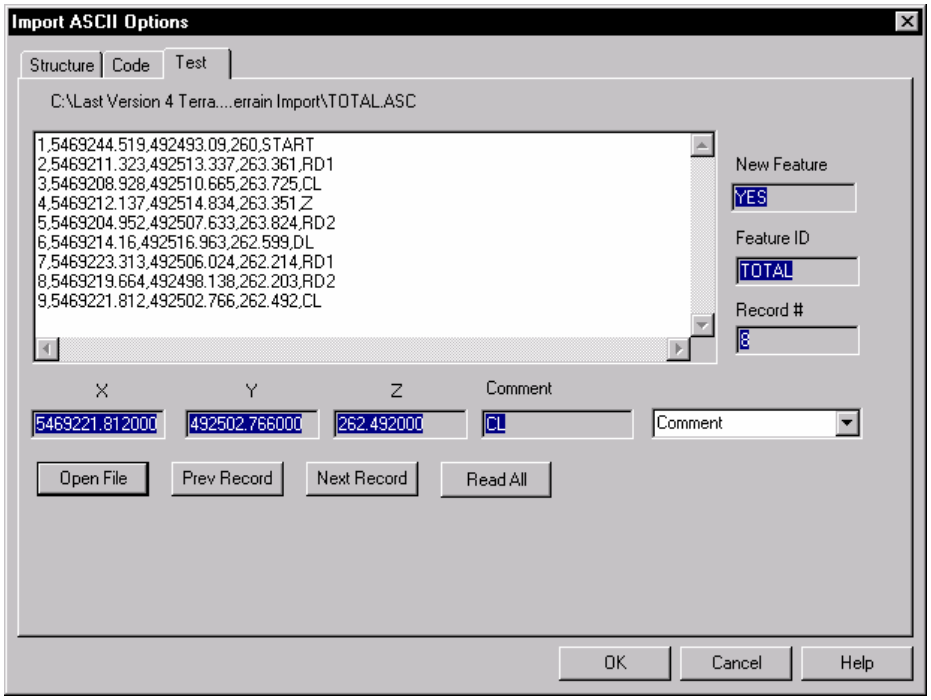


Figure 5.6: Import ASCII Options Dialog – Test Tab

16. Press the *Open file* button and choose **\Tutorial\Terrain\Terrain Import\total.ASC.**

17. Press the *Next Record* button several times. At the bottom of the dialog box the values of X,Y,Z and comment are displayed. Confirm that the incoming fields are being correctly interpreted and press the *OK button*. Press OK to close the dialog box.

18. To save the new import specifications for future use press the *Save* button and choose the file called *Normal.IOP* (Normal.IOP is a file that stores all import formats.) Press *Save* and then *Yes* to replacing Normal.IOP. Press OK and a new ASCII format specification has been created.

19. To open the file select File | Insert File. Change Files of type to *Data Collector (#,X,Y,Z,Comment)(*.ASC,* **.***TXT***,***CSV)*. Open **\Tutorial\Terrain\Terrain Import\total.ASC**.

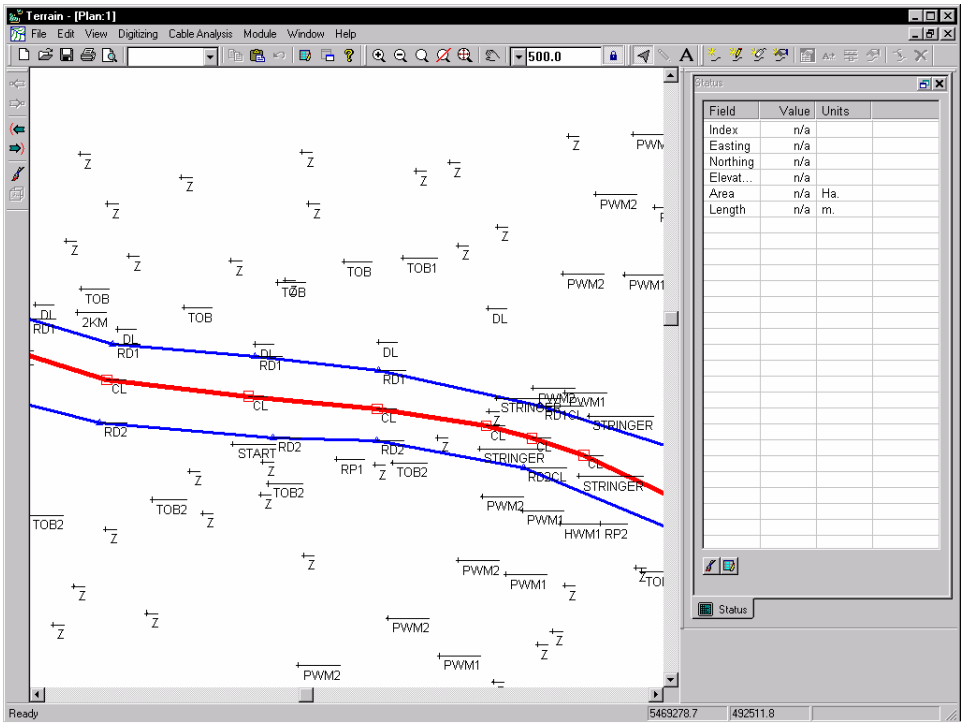


Figure 5.7: Plan Window after CL Feature Imported

20. Select a blank part of the Plan Window and left click to de-select all features. Note that the RD features are connected with a blue line and the CL feature is connected with a thick red line. The import specification was successful.

21. File | New. Do <u>not</u> save any 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 dialog box. This example will demonstrate this procedure by creating a plat boundary from the following legal description.

> *Beginning at the Northeast corner of Lot 23, Block 1, "Plat of Williams Beach";*
> *thence S 30º 15' E a distance of 403 feet of the Point of Beginning;*
> *thence S 43º 42' W a distance of 446 feet;*
> *thence N 67º 47' W a distance of 368 feet;*
> *thence N 3º 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 46º 16' E, and a chord distance of 272.66 feet;*
> *thence N 83º 37' E a distance of 231.97 feet to the Point of Beginning*

1. Module | Setup. Choose *Imperial (Ft)* for *Units* and <u>change Direction</u> to *Quadrant Deg:Mins N32:16W* . Press OK.

Note: Depending on the version of the software you are using you may get a message "Non Permitted Functions Found in File". If this message appears choose "Keep all functions and revert to DEMO Mode".

2. File | Retrieve Screen Layout. Select **\Tutorial\Terrain\Terrain Enter\deed.ILT**.

3. Edit | New Feature to activate the *Feature properties* dialog box

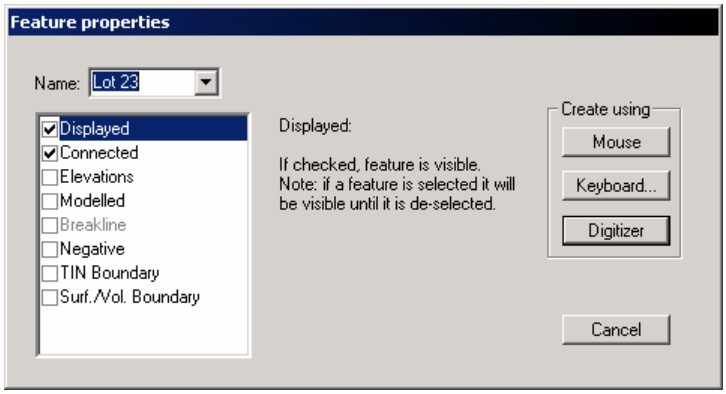


Figure 6.0: Feature Properties Dialog

4. Beside *Name* type **Lot 23**. Disable *Elevations* and *Modelled*. Press the *Keyboard* button to activate the *Feature Coordinates* dialog box.

5. Press the *Add* button. The cursor goes to the *Radius* field under *Current Shot* Group Box. Press <TAB> to skip the *Radius* field and move to the *Azimuth* field. Enter S30.15E and then press <TAB> to advance to the *Dist.* field. Enter a distance of **403**. Press <Enter> to accept the fields and add a new shot.

NOTE: An alternative is to press the *Add* button after typing in the distance instead of pressing the <Enter> key. Note that the azimuth is entered as S30.15E and displayed as S 30:15 E.

6. Press <TAB> to move to the *Azimuth* field. Enter **S43.42W** and then press <TAB> to advance to the *Distance* field. Enter a distance of **446**. Press <Enter> to accept the fields and begin the next shot.

7. Repeat the previous step for the next 2 shots.
   Type **N67.47W, 368** feet

   N3.18E, 317.5 feet

8. Enter a curve radius of **200** and press <TAB>.

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

9. Select *Right* curve. <TAB>. Enter a chord azimuth of **N46.16E**. <TAB>. Enter a chord distance of **272.66**. Press <Enter>.

10. Press the <TAB> key to skip the *Radius* field and enter **N83.37E** and a distance of **231.97**. After entering the distance, press the *Update List* button. (Do not press enter or add).

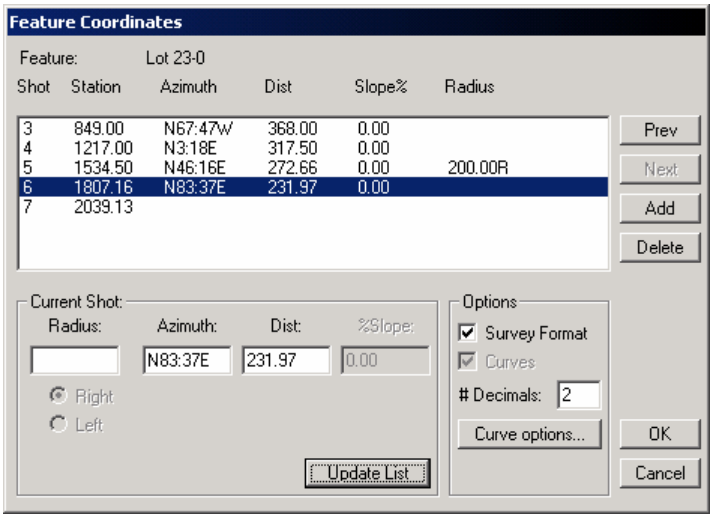


Figure 6.1: Feature Coordinates Dialog

11. Check the entered bearings and distances and then press OK.

12. Using the Selection Cursor click on the second lot corner, identified by the red cross-hair position in the Figure 6.2.

The Status Window reports the X, Y coordinate (i.e. Easting and Northing) for the current point is 203.0, -348.1.

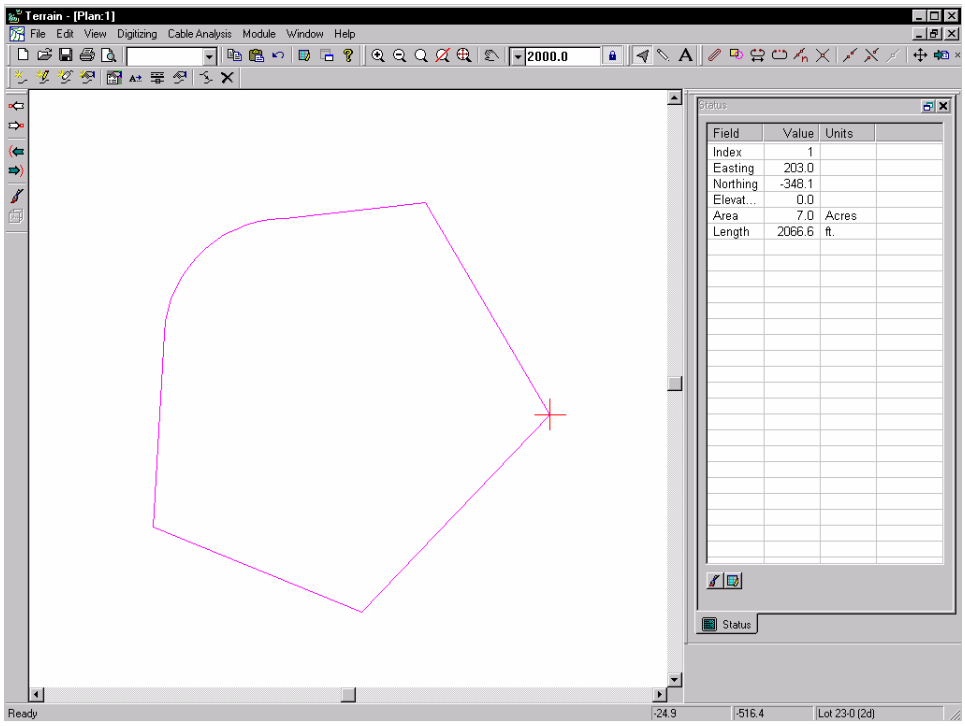


Figure 6.2: Lot Boundary

13. Select Edit | New Feature to activate the *Feature Properties* dialog box. Set the *Name* to **Easement**. Disable *Elevations* and *Modelled*. Enable *Negative*. Press *Keyboard* to open the *Feature Coordinates* Dialog box.

NOTE: Negative features create a hole or void. Their area will be subtracted when total areas are reported and the TIN will not enter these areas if TIN Boundary is also selected.

14. In the *Options* group box disable *Survey Format*. Enter **203.0**, **-348.1** as the X, Y coordinates and re-enable *Survey Format*.

This sets the starting point of the easement traverse to (203.0, -348.1).

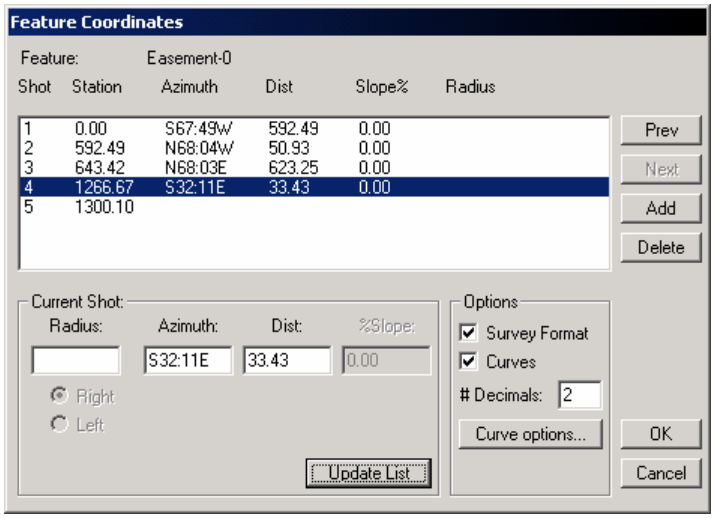


Figure 6.3: Easement Survey

15. Enter the *Easement Survey* traverse as above. After entering the last distance, press the *Update List* button. Press OK.

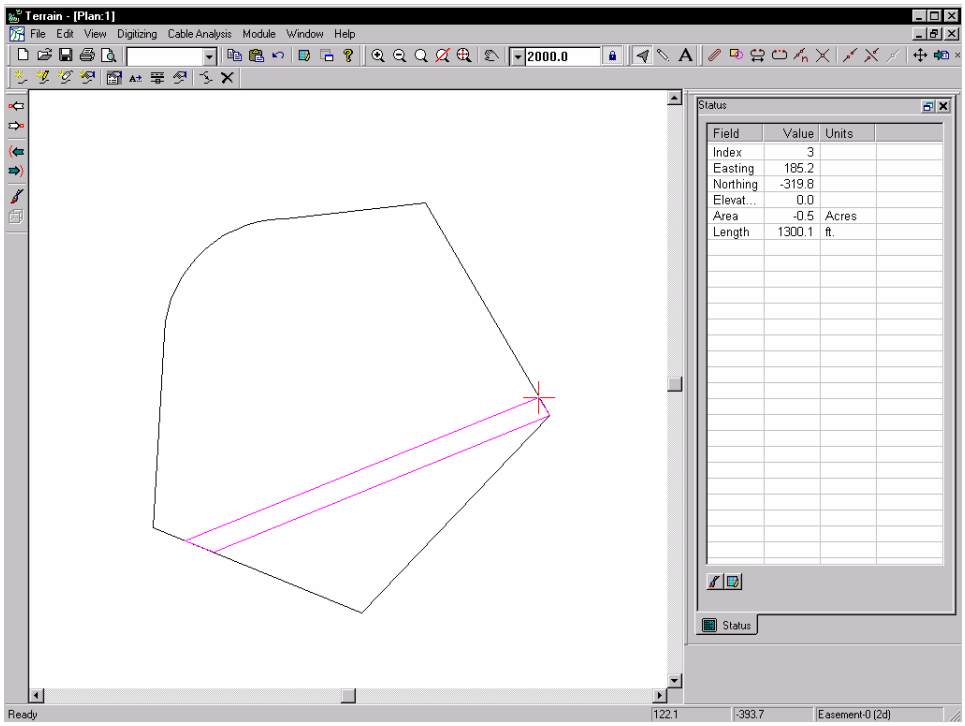


Figure 6.4: Lot Boundary and Easement

The map should now display the Lot Boundary and Easement as in Figure 6.4. Notice the negative area in the status window

16. Select the Lot Boundary.

17. Edit | Modify Selected Feature(s) | Labels. Turn on *Azimuth*, *Horizontal Distance*, *Curve Radius* and *Area* labels (double click on the appropriate item in the list-box). Press OK. The selected feature labels are now displayed in the Plan Window (Figure 6.5).

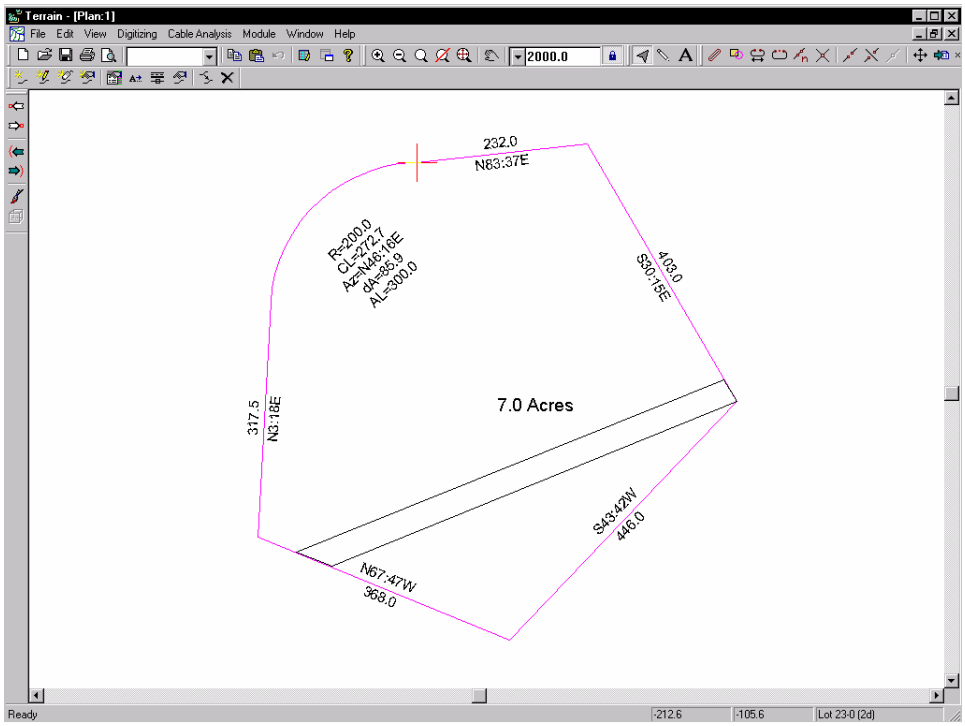


Figure 6.5: Annotated Lot Boundary and Easement

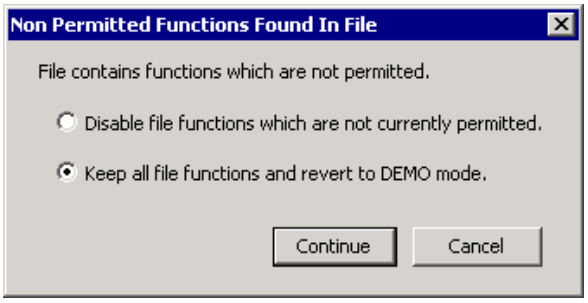
18. File | New. Do not save the changes.

Digitizing

Digitizing is a very useful method for calculating areas and lengths from a scaled map. It can also be used to capture contours or other planimetric information.

To follow the examples and procedures in this section you will need to have the *Mapping and Drafting* and *Digitizing* function groups enabled. See *Function Groups* in the On-line help for more information.

If your software license does not include the required Function Groups, when you open a file or screen layout you will be prompted:



Choose “Keep all the functions and revert to DEMO Mode”. Examples in this section can be completed in Demonstration Mode. Contact Softree to upgrade your license to permit more functions.

Choosing a Digitizer Driver

The Terrain module supports a variety of digitizers using either a *Softree ASCII format driver* or a *WINTAB* driver. The driver used is a matter of preference, however, if using the digitizer with other CAD or GIS software, WINTAB will provide greater compatibility.

1. Select Digitizing|Digitizer Config, to open the *Digitizer Configuration dialog box* shown in Figure 7.0.

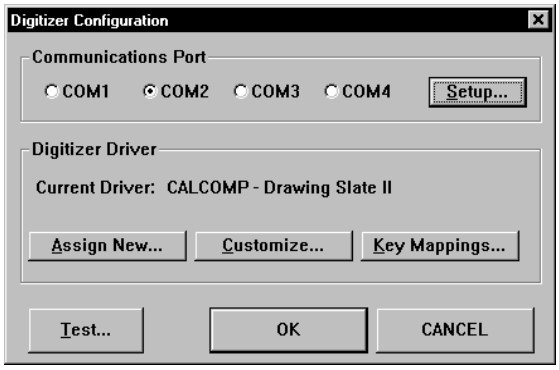


Figure 7.0: Digitizer Configuration Dialog Box

2. Press the *Assign New* button. Select the digitizer either by type and model or WINTAB from the list box. Press the *Select* button. Press OK. The selected driver is now identified as the "Current Driver".

3. Press OK to return to the main screen. A Softree prompt will appear "Warning Config will be Changed". Press OK.

If using WINTAB drivers, skip the next section on *Configuring an ASCII Format Driver*. The installation and configuration of WINTAB depends on the type of digitizer tablet used. Consult the manufacturers' manual for information on the recommended procedures for installing the WINTAB driver.

Configuring an ASCII Format Driver

The following steps are required when setting up a digitizer using an ASCII format driver.

1. To determine the required port communications parameters for your digitizer, press F1 for on line help. Search index topics for *Standard ASCII Digitizer Settings*.

2. Locate the brand, model and type of your digitizer. Make note of the following parameters:
   BAUD RATE (bits per second) *PARITY*
   DATA BITS *STOP BITS*
   FLOW CONTROL

3. To set the port communications parameters, select Digitizing | Digitizer Config, and press the *Setup* button to access the *Control Panel*.

Configuring port parameters from the Control Panel is different for each type of Windows operating system.

- **Windows NT:** double click on the *Ports* icon, double click on the correct Communication Port (usually COM 1 or COM 2) this will display a dialog box similar to that shown in the *Figure 7.1*.

- **Windows 2000 and XP:** Double click on the *System* icon. Select the *Hardware* tab. Press the *Device Manager* button. Double click on *Ports.* Double click on the correct Communication Port (usually COM 1 or COM 2). Choose the *Port Settings* tab to display the *Communication Port (COM) Properties dialog box* shown in Figure 7.1.

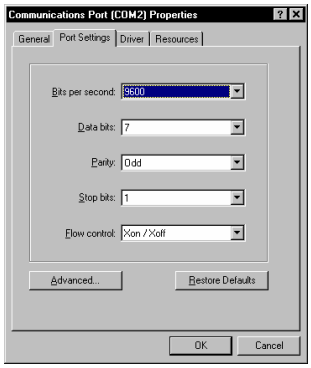


Figure 7.1: Communication Port (COM 2) Properties dialog box

4. Change the settings to match your digitizer. Press OK until all dialog boxes are closed. Close the Control Panel.

5. Ensure the appropriate port (COM1, COM2, etc.) is selected. Press OK. A Softree prompt appears”? Warning config has changed” Press OK.

Testing Your Digitizer

6. To test your digitizer, select Digitizing | Digitizer Config to open the *Digitizer Configuration dialog box.*

7. Press the *Test* button to check that the digitizer is transmitting characters properly. The *Digitizer Test dialog box* shown in Figure 7.2 appears. This dialog box will display characters transmitted from the digitizer. Try pressing a key on the digitizer. If the parameters have been setup correctly a new character string should appear at the bottom of the dialog box whenever a key is pressed on the digitizer keypad.

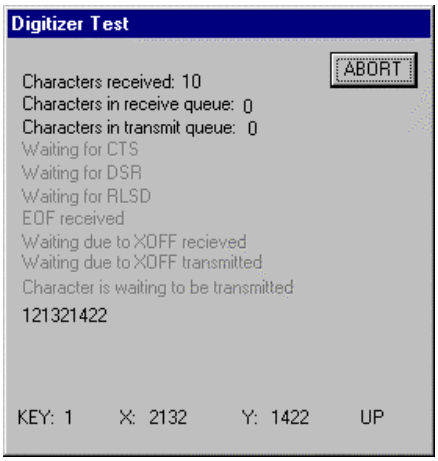


Figure 7.2: Digitizer Test dialog box

8. If you do not see any characters appearing in the *Config Test* dialog box check the digitizers switch settings and parameters as described in the previous section (*Configuring an ASCII Format Driver*).

If the test still does not work, check *Common Digitizer Setup Problems* in the on-line Help.

9. The digitizer transmits a 'packet' or string of ASCII characters whenever a key is pressed. Each packet contains a KEY field, an X coordinate field and an Y coordinate field. The Terrain Module will extract these fields from the packet. Using the *Test* option (as described in step 2) check that the key pressed on the digitizer matches the value displayed in the Key field at the bottom of the Test dialog box.

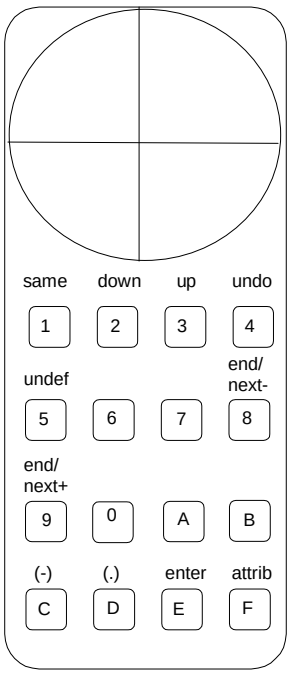


Figure 7.3: Typical Digitizer Keypad Definitions

The Terrain program is shipped with a standard set of digitizer key definitions. The key definitions depend on the type of digitizer and are defined in the *Standard Digitizer Settings* in the On-line Help. It is useful to attach these key definitions to your tablet for reference. (See also *Digitizer Key Definitions* in the On-line Help for information on the key functions).

10. To print a key definitions table, select File | Open menu, retrieve file Terrain Digitize\key definitions.TER.

11. Select menu File | Print Active Window. Respond No to "Plot Multi-Page Montage" prompt. File |New when printing is complete.

12. Digitizing | Digitizer Config and press the *Test* button. Press each key on the digitizing puck and record the assigned key definitions (if any) in the blank table (printed in the previous step). Cut out the table and tape it on or near the tablet.

SAME	
END/NEXT+	
END/NEXT-	
UP	
DOWN	
ENTER	
UNDEF	
UNDO	
ATTRIB	
DECIMAL	
NEG.	

Figure 7.4: Blank Key Definitions Table.

13. File | New. Do not save the changes.

Digitizing Areas

Planimeter Example

The Terrain Module is a useful tool for digitizing areas and lengths. This example demonstrates how to digitize areas. If you have not setup your digitizer, please refer to the previous section of this manual before proceeding.

In this example the *Same* and *End/Next* + and *End/Next* - digitizer cursor functions will be used.

1. File | Open. Select **\Tutorial\Terrain\Terrain Digitize\digitize area.TER.**

2. Highlight the Plan Window and select menu File | Print Active Window. Choose NO to plot current page only. Press OK

This will print the Plan View shown in the Figure 7.5. The boundaries will be digitized and the area checked against the original. The smaller polygon will be excluded

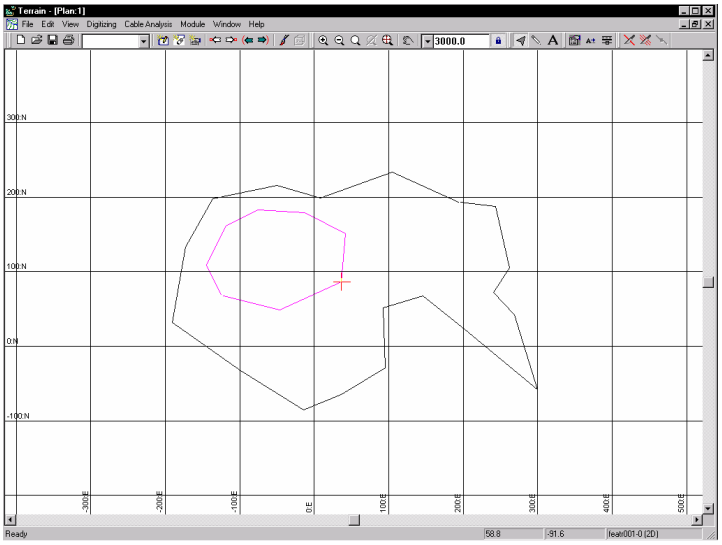


Figure 7.5: Plan View of digitize area.TER

3. Attach the Plan to your digitizer (so that it does not move).

4. In the Plan Window, click on the larger polygon with the *Select* cursor. Notice in the Status Window, the reported area is 9.67 Ha. or 2.2 acres if you are working in imperial units. Click on the smaller polygon. Note the area is -1.87 Ha. or -.43 acres. and the total area (*Area Tot.*) is 7.8 Ha (1.79 acres). File | New. Do not save the changes.

NOTE: The smaller polygon is negative because the feature has the "negative area" property set (see *Properties Dialog* in the On-line help). The negative area property is very useful for calculating the area of large polygon while subtracting one or more islands inside.

5. To set the sound option, open Digitizing | Sound and select *Partial*.

With sound set to *Partial*, an audible tone ("beep" or “click”) will be produced when near the start point (see On-line Help - *Closing Distance for Sound Warning* for more information).

6. File│Save Screen Layout. Type in the layout file name **area.ILT** and press OK. This will save the present screen configuration as a layout file, which can be activated the next time you want to digitize areas. This is a big time saver.

7. Press the *Digitize New Feature button* to activate the *Mapsheet Orientation dialog* box shown in Figure 7.6. Change the Map Scale from “5000.0” to “3000.0” (this is the scale of the printed boundary). Make sure “Enter a know map scale” is selected in the *Registration Method* combo box. Press OK.

Alternatively you could select Digitizing | Mapsheet setup. Change the Map Scale from “5000.0” to “3000.0” and press OK. Select Edit│New Feature. Disable *Elevations* and *Modelled.* Select *Create using Digitizer*

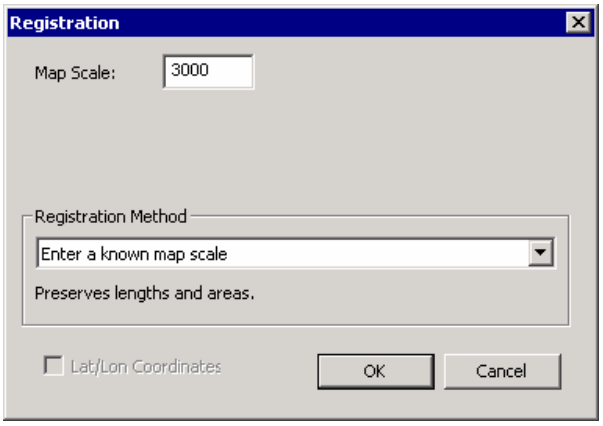


Figure 7.6: Mapsheet Orientation Dialog

This example is concerned about the area only, not preserving map coordinates (accounting for origin and skew).

8. The prompt ***Digitize featr0000-0 Pnt. #:1*** will appear. Choose a starting point on the larger boundary and begin tracing the outline by pressing the *Same* key over each point on the boundary. The image will appear in the Plan Window.

You can also digitize in *track mode* where holding down the *Same* key and sliding the digitizing cursor creates a continuous series of points. See the *Coordinate Digitizing of Map Features* example following this one.

9. The last point digitized is the starting point; a "beep" or click” will be audible when you digitize this point. Press the ***End/Next-*** key on the digitizer cursor. Pressing ***End/Next -*** ends the current feature and begins a new "negative area" feature.

10. The prompt ***Digitize featr0000-1 Pnt. #:1*** will appear. Choose a starting point on the smaller boundary and begin tracing the outline by pressing the *Same* key over each point on the boundary. As with the larger polygon you should see the shape appearing in the Plan Window.

11. Press the ***End/Next+*** key on the digitizer cursor twice (the first key press ends the current feature allowing you to begin digitizing another, the second press exits from digitizing mode).

12. Check the areas in the Status Window. They should match the areas noted in Step 4.

13. File |New. Do not save the changes.

Coordinate Digitizing of Map Features

The Terrain Module can also be used to digitize features from maps while preserving map coordinates.

This form of digitizing allows you to correctly position objects spatially. This is important if you are merging information from more than one source (e.g. such as map features and surveyed data) or if you are digitizing from the same map at a different time.

1. File│Open, select **\Tutorial\Terrain\Terrain Digitize\digitize area.TER**

The next 2 steps are the same as the previous example (*Digitizing Areas*) you can omit them if you have already done that example.

2. Highlight the Plan Window and select menu File│Print Plan. Choose NO to plot current page only. Press OK.

3. Attach the Plan to your digitizer (so that it does not move).

4. Again select Digitizing│Digitizing Options. Select *Digitize in Track Mode*. This sets your digitizer into track mode. (In track mode, holding down the *Same* key and sliding the digitizing cursor creates a continuous series of points.) If you get an error message stating (*Point/Track initialization String Undefined*) it means your digitizer does not support track mode. Continue this example in point mode. (In point mode, points are only created when you click a digitizer cursor button.)

5. On the map, sketch with a pencil a line across the block similar to the one shown below.

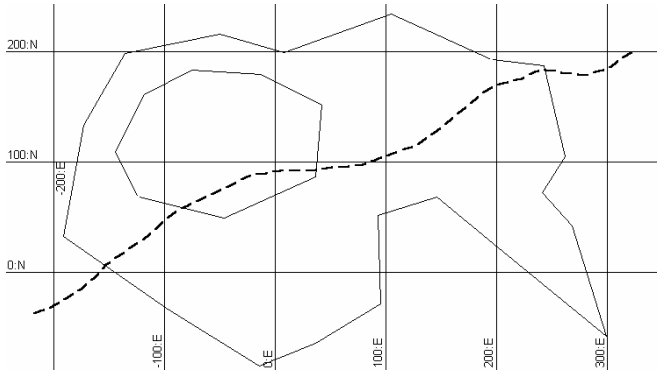


Figure 7.7: Plan View of digitize area.TER with Line Drawn

6. Select menu Digitizing│Mapsheet Setup (for digitizing) and the *Mapsheet Orientation* dialog box will appear. Select “Enter scale, match 1 coordinate and digitize a direction vector” and set the scale and origin to match those shown in Figure 7.8 below.

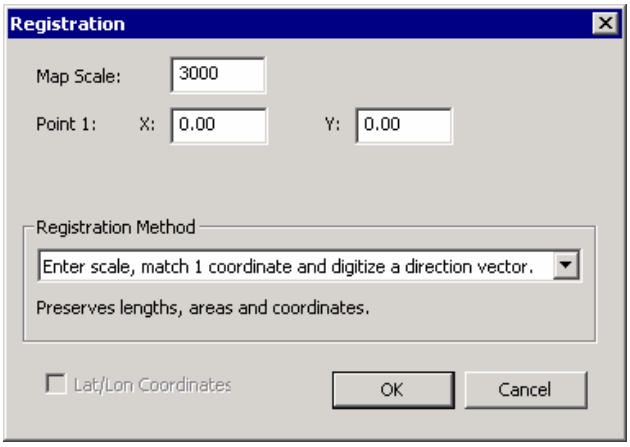


Figure 7.8: Mapsheet Orientation Dialog

7. After pressing OK, a message box will appear prompting you to ***Digitize Origin Point X:0.00 Y:00***. Find this point on the map and digitize it using the *Same* key.

8. Next the ***Digitize 1st direction vector point (Southmost)*** message will appear. Digitize point (0,0) on the map again using the *Same* key.

9. Next the ***Digitize 2nd direction vector point (Northmost)*** message will appear. Digitize point (0,200) on the map again using the *Same* key.

Steps 7, 8, 9 and 10 have "registered" the mapsheet on the tablet accounting for the coordinates and the skew of the paper. Digitizing will now preserve coordinates.

10. Select menu Edit | New Feature to activate the *Feature Properties* dialog box shown below. Change your dialog box to match Figure 7.9 and press *Digitizer.*

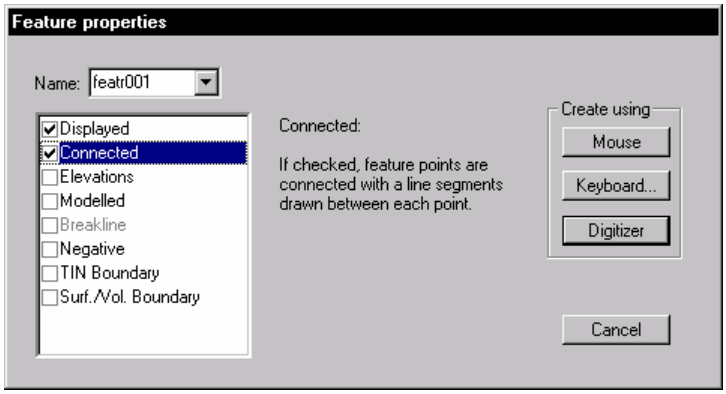


Figure 7.9: Feature Properties Dialog

11. Trace the line feature (that you drew) on the tablet using the *Same* key. In Track Mode you may click and drag to trace the line *or* do individual clicks to create fewer points. When complete press the *End/Next* key twice.

12. Notice in the Plan Window the line feature overlays the block and is in the correct position.

13. File | New. Do not save the changes.

Digital Terrain Modelling

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.

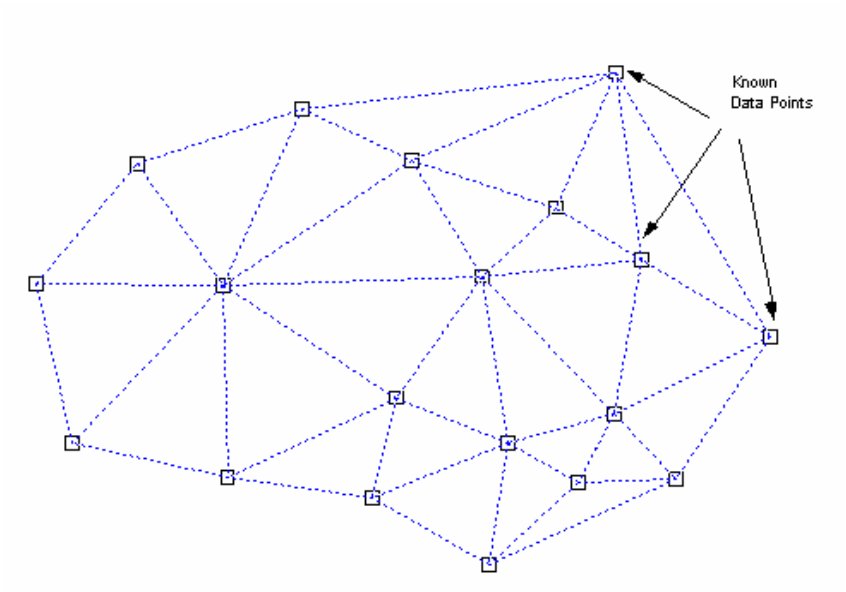
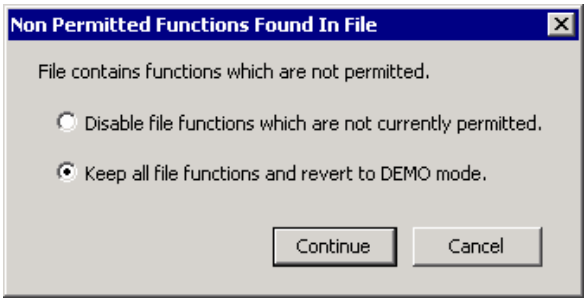


Figure 8.0: Triangle Model

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.

If your software license does not include the required Function Groups, when you open a file or screen layout you will be prompted:



Choose “Keep all the functions and revert to DEMO mode”. Examples in this section can be completed in Demonstration Mode. Contact Softree to upgrade your license to permit more functions.

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

1. File | Retrieve Screen Layout, open **\Tutorial\Terrain\Terrain DTM\model.ILT**.

2. Select menu File | Insert File. Select *AutoCad DXF* Import File from the *Files of Type*. Open **\Tutorial\Terrain\Terrain DTM\design1.DXF**. The *Import DWG/DXF Options* dialog will appear.

Although it is not relevant to this example, the *Import DWG/DXF Options* dialog contains several useful options. To find out more press the F1 key while this dialog is displayed to access On-line Help.

3. Set the dialog options to match those shown in Figure 8.1. Press OK.

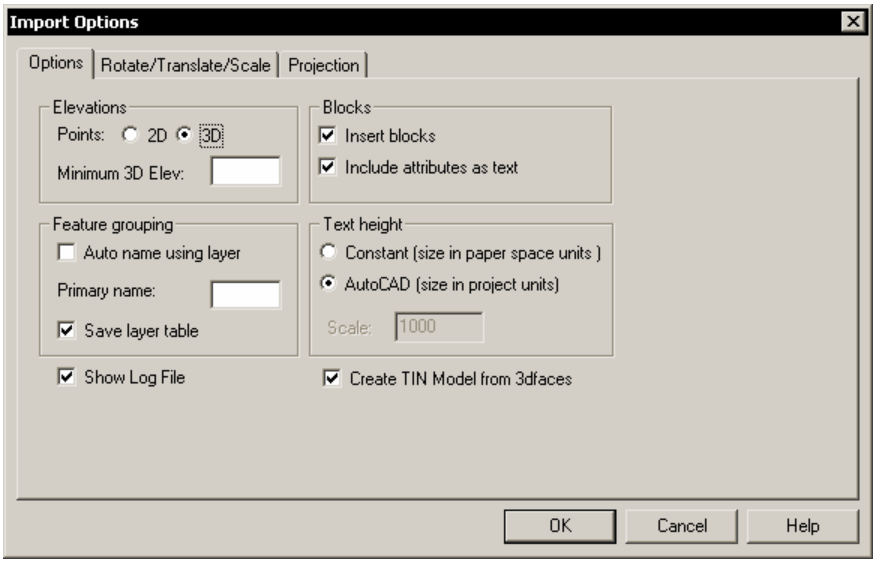


Figure 8.1: Import DWG/DXF Options Dialog

4. Press the *Zoom extents* button.

The Plan Window now displays the Imported Features with Road Edges, Slope Stakes and Right of Way shown in Figure 8.2

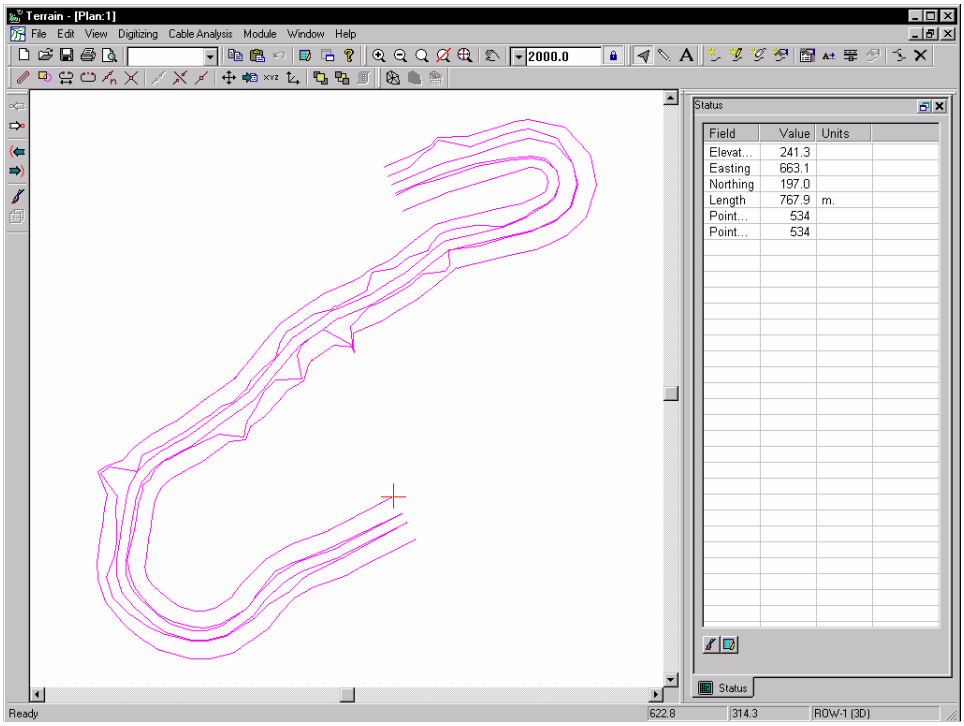


Figure 8.2: Imported Features
(Road Edges, Slope Stakes and Right of Way)

5. Press the *Generate TIN* button or Edit | Terrain Modelling | Calculate Terrain Model to open the *Terrain Calculation* dialog box.

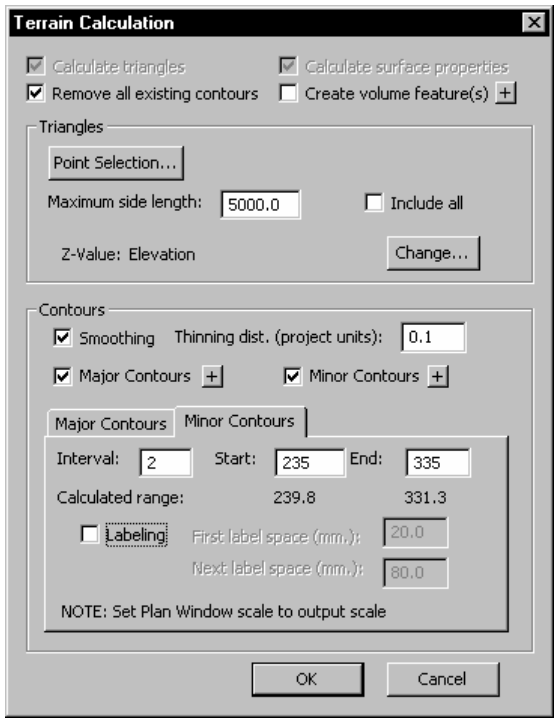


Figure 8.3: Terrain Calculation Dialog

6. Change your dialog box so it displays the same information as above. Note that Major Contour and Minor Contours are two separate tabs.

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

8. 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.

9. Press the + button beside *Minor Contours* and change the color and line-type to *Green* and *Solid* respectively. Press OK.

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

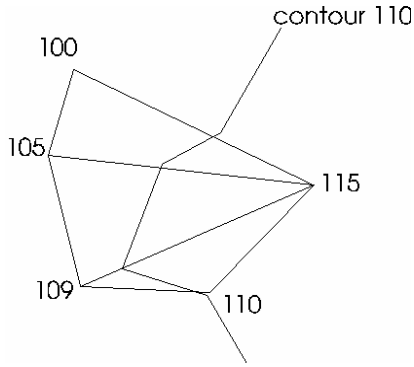


Figure 8.4: Example Contour Formation

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* figure above). This step effectively removes any small sharp bends in the contour. The resulting contour is then fitted with a mathematical (spline) curve.

10. Press OK to calculate triangles and contours.

The screen should now display the Contours as shown in Figure 8.5. The Major Contours are thick and labelled. The Minor contours are thin and un-labelled.

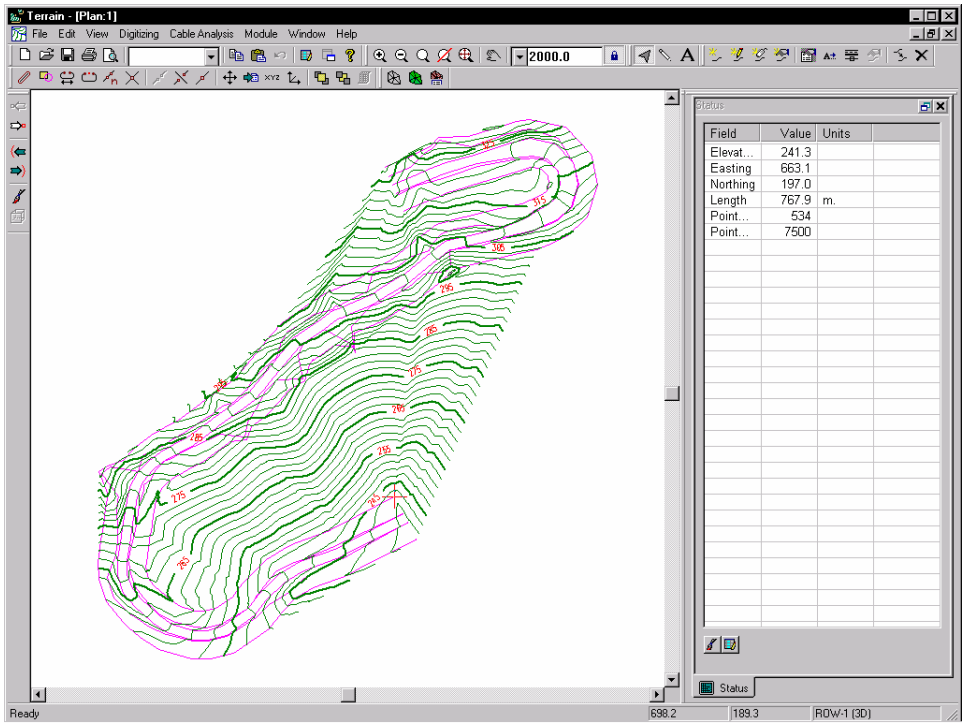


Figure 8.5: Contours - 2-Meter Interval

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

11. Edit | Terrain Modelling | Calculate Terrain Model or press the *Generate TIN* button to activate the *Terrain Calculation* dialog box. Select *Calculate Triangles*, de-select *Include all* and change the *Maximum side length* to 50. Press OK

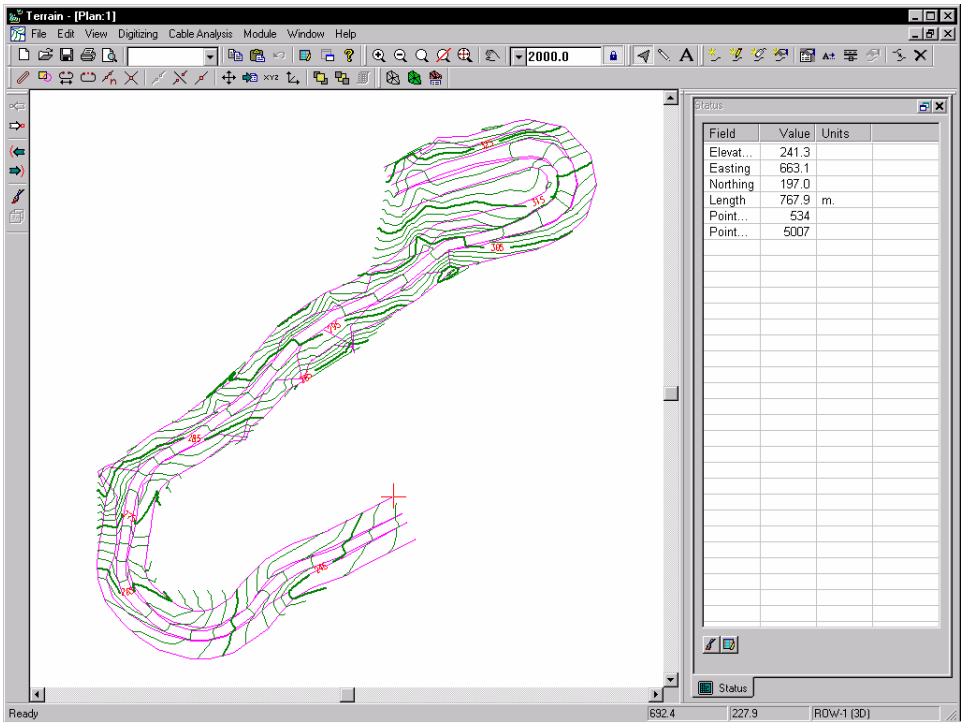


Figure 8.6: Contours Generated with Side Length Control

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.

12. Edit | Select Feature(s) | By Name. Press the *Un-Select All* button. Using the *Advanced* part of the dialog to *Select* features called *ROW*. Press OK.

13. Press the *Join* button or select Edit | Modify Selected Feature(s) | Join. (If this menu is disabled, then a minimum of two features have not been selected.) You will be prompted "Warning existing triangles will be cleared". Respond "OK". One of the ends will be joined.

14. With the joined feature still selected, press the *Properties* button to activate the *Feature Properties* dialog box.

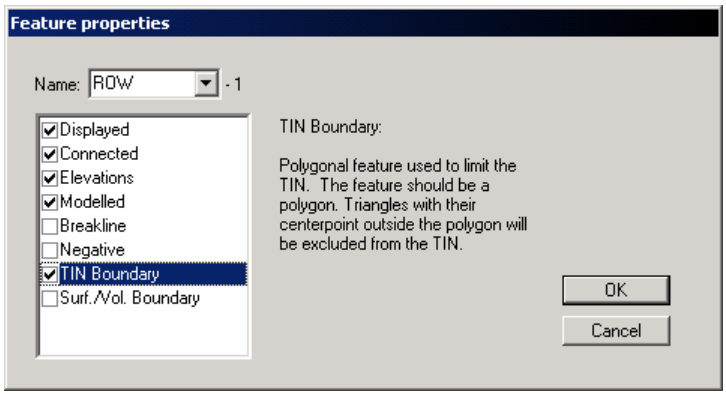


Figure 8.7: Tin Boundary Feature Set in Properties Dialog

15. 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.

16. Edit | Terrain Modelling | Calculate Terrain Model or press the *Generate TIN* button. 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.

17. Edit | Select Feature(s) | By Name. Press the *Un-Select All* button and then *Select* the features called REDGE-0 and REDGE-1. Press OK.

18. Select Modify Selected Feature(s)|Join (if this menu is disabled, then you have not selected two features) or press the *Join* button. You will be prompted "Warning existing triangles will be cleared. Respond "OK".

19. With the joined feature still selected, Edit | Modify Selected Feature(s) | Properties or press the *Properties* button in the toolbar.

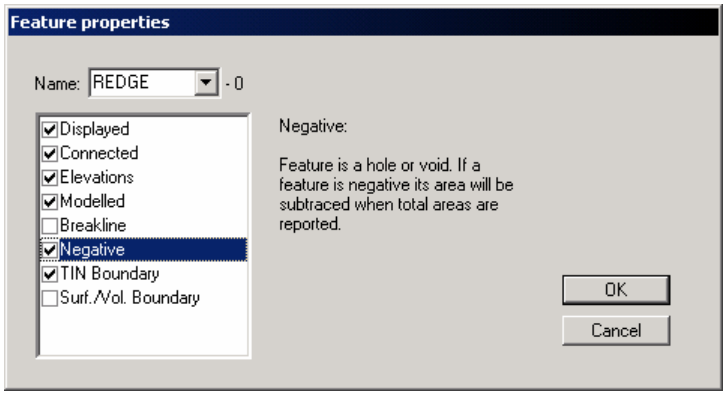


Figure 8.8: Negative Area Set For a TIN Boundary Feature

20. Change Feature Properties so that Negative and TIN Boundary are enabled. Press OK.

21. Edit | Terrain Modelling | Calculate Terrain Model. Make sure that *Major Contours* and *Minor Contours* are selected and press OK.

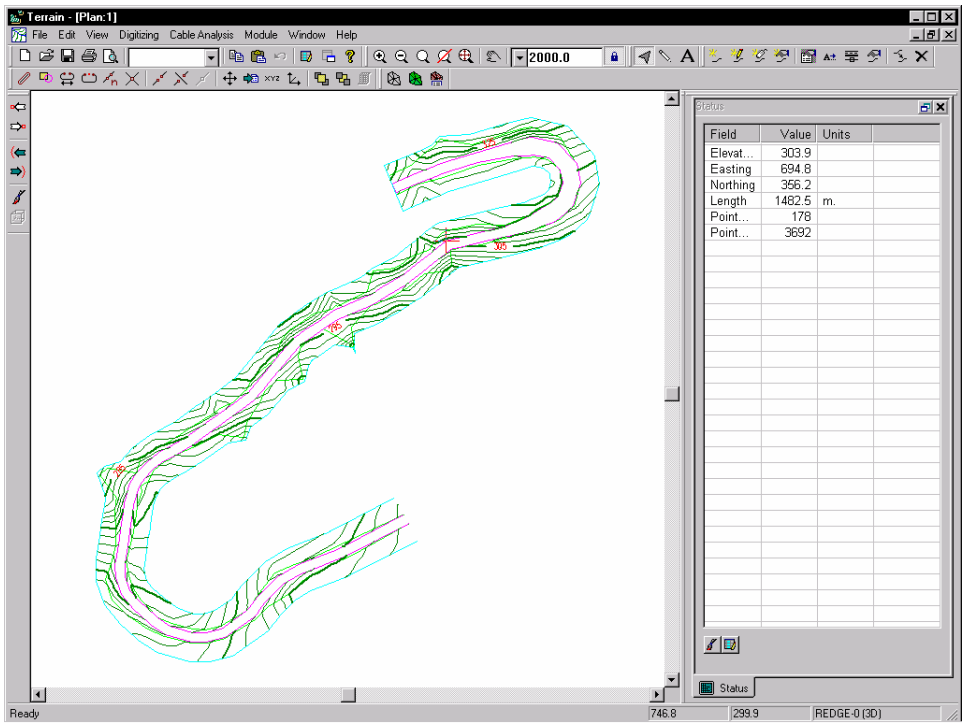


Figure 8.9: Contours Generated with Road Surface Excluded

22. File | New. Do not save changes.

Improving Contouring with Breaklines

Site Survey Example

Identifying and modelling 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 (*.TER).
2. Select **\Tutorial\Terrain\Terrain DTM\breakline.TER**. Press Open.
3. Press the *Generate TIN* button or Edit | Calculate Terrain Model to activate the *Terrain Calculation* dialog box.
4. Turn on *Major Contours*, *Minor Contours* and *Smoothing*. 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. Select the *Major Contours* tab and change the *Interval* to 5 and turn on *Labeling*. Press OK.

Once the calculation is complete, a model of a creek with poorly generated contours will be displayed. (Figure 8.10).

As an optional exercise, use View | Active Window (Plan) Options | Surface Tab. Enable the display of triangles. After looking at the triangles that represent the TIN model, turn the display off again for the rest of this example.

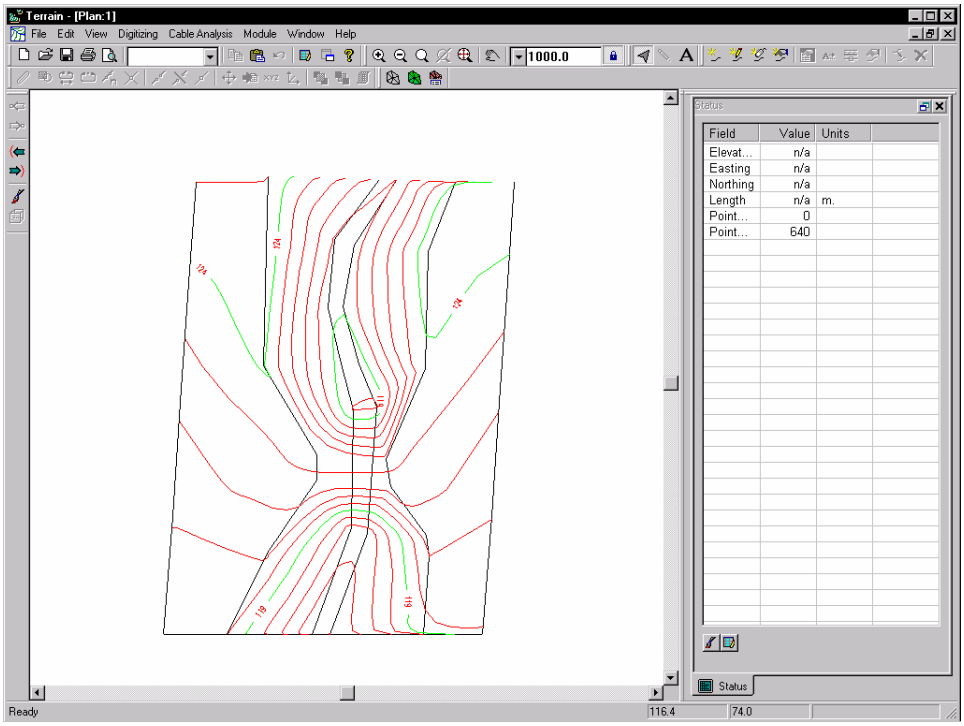


Figure 8.10: Model of Creek with Poorly Generated Contours

Figure 8.10 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.

5. Edit | Select Feature(s) | By Name. Select by double clicking the items shown in the Figure 8.11. Press OK.

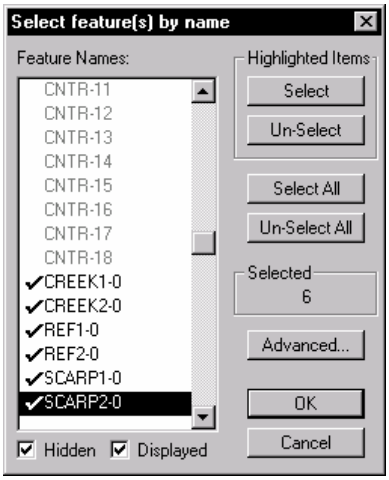


Figure 8.11: Select Feature(s) by Name Dialog

6. Press the *Properties* or Edit | Modify Selected Feature(s) | Properties. Enable Breakline. Press OK.

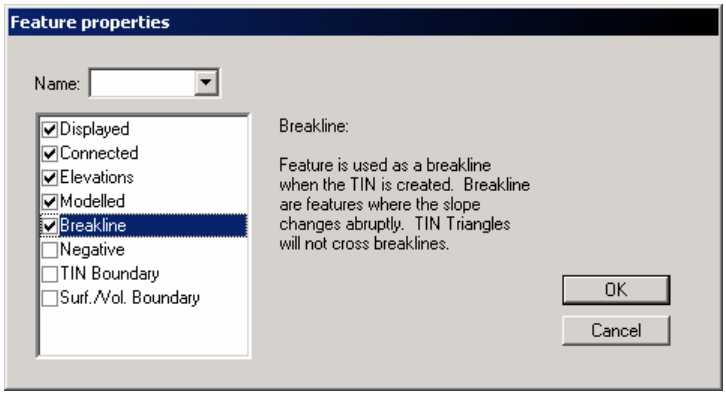


Figure 8.12: Modify Feature Properties Dialog

7. Press the *Generate TIN* button. Press OK. After re-calculating, the contour lines now indicate a continuous gully as shown in Figure 8.13.

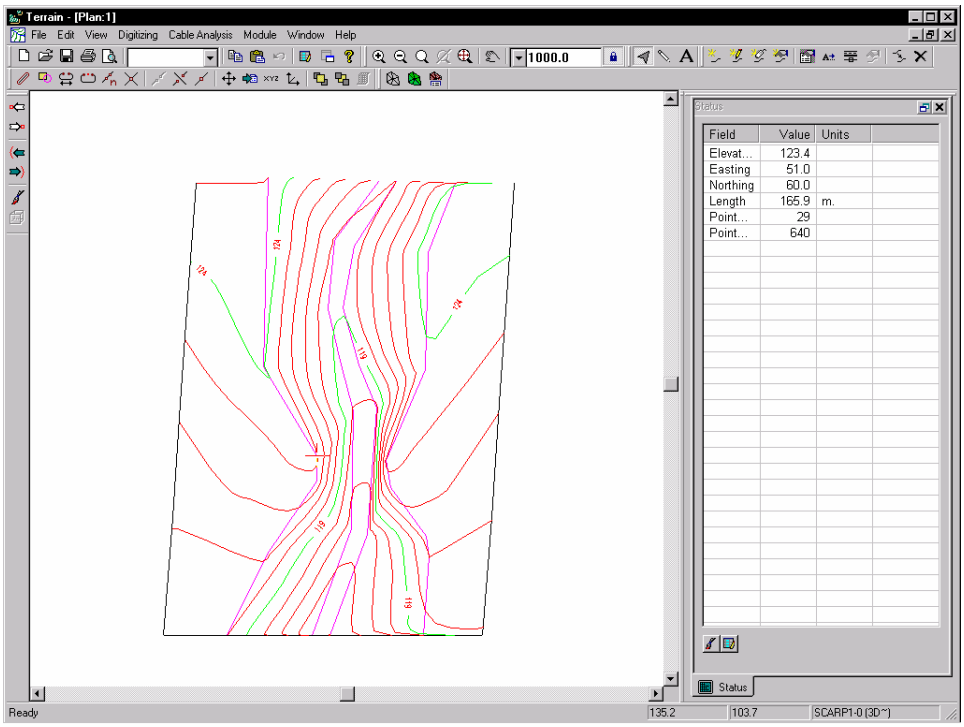


Figure 8.13: Contours after Breaklines have been Set

8. 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 can not be completed without the required function groups. Contact Softree to upgrade your license to permit more functions.

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. Select **\Tutorial\Terrain\Terrain DTM\original ground.TER**. Press OK.

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

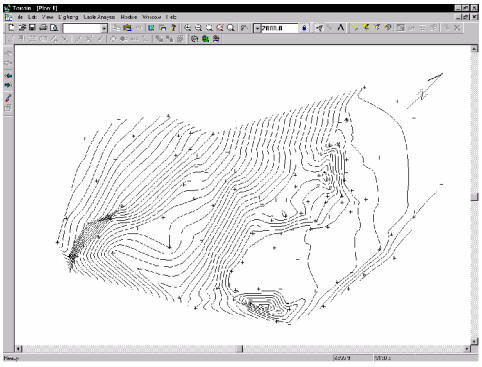


Figure 8.14: Original Surface (original ground.TER)

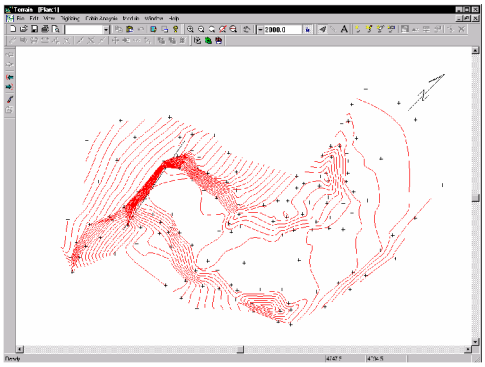


Figure 8.15: Surface after Excavation (excavation.TER)

2. Press the *Calculate Volumes* button or select Edit | Terrain Modelling | Calculate Volumes/Surf. Properties to activate the *Volume/Surf. Properties Calculation dialog* box as shown in Figure 8.16.

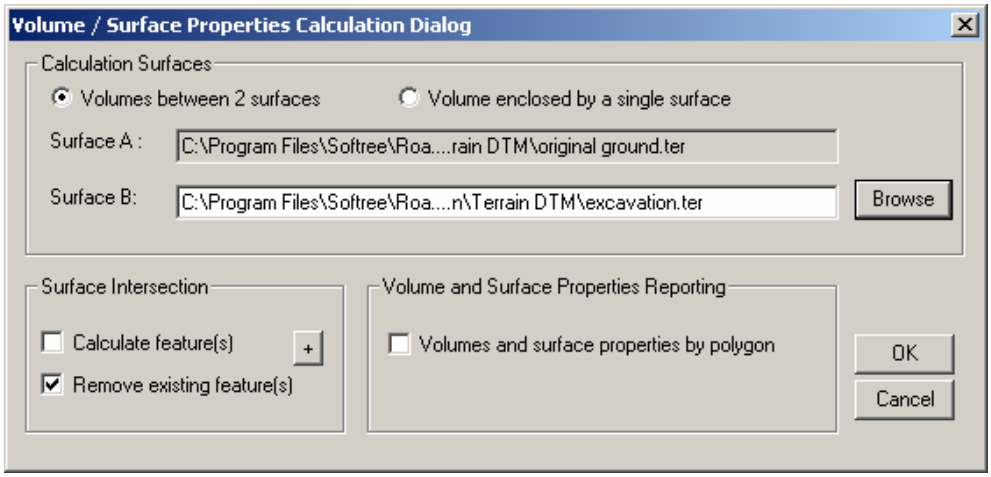


Figure 8.16: Volume / Surface Properties Calculation Dialog

NOTE: In order 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 Edit | Terrain Modelling | Calculate Volumes menu is disabled if the current file does not have a terrain model. The user specifies the other surface (surface B) in the *Volume Calculation dialog box*.

3. Press the *Browse* button opposite *Surface B*. Select **\Tutorial\Terrain\Terrain DTM\excavation.TER.**

Surface A should be set to original ground.TER and surface B should be set to excavation.TER. The order of these surfaces is not important as you will see later.

4. Press OK to begin the volume computation.

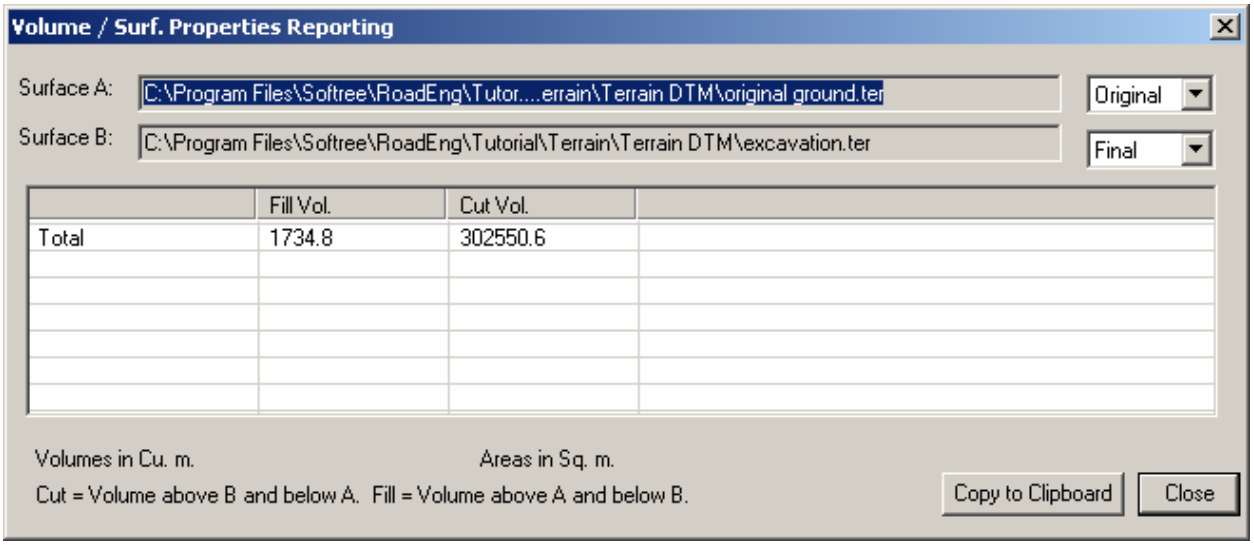


Figure 8.17: Volume / Surf. Properties Reporting Dialog

5. Press the *Close* button.

The following steps demonstrate how to include 2 polygonal boundaries and calculate the volume inside each one.

6. File | Insert File. Select and open **\Tutorial\Terrain\Terrain DTM\boundary.TER.** The *Import Options Dialog box* appears. Press OK to close. Two boundary polygons should now be visible in the Plan Window. If not press the Zoom Out button on the tool bar.

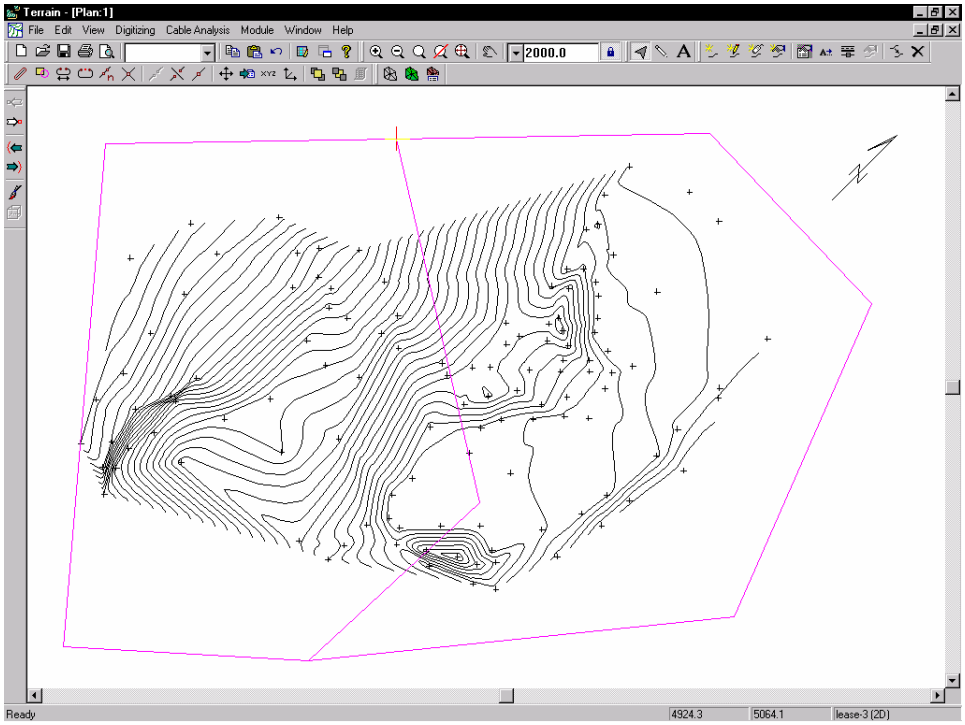


Figure 8.18: Original Topography with Boundary Polygons

7. Press the *Properties* or select Edit | Modify Selected Feature(s) | Properties. Enable *Surf/Vol Boundary*. Press OK.

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. Press the *Calculate Volumes* button to open the *Volume Calculation dialog box* shown Figure 8.19.

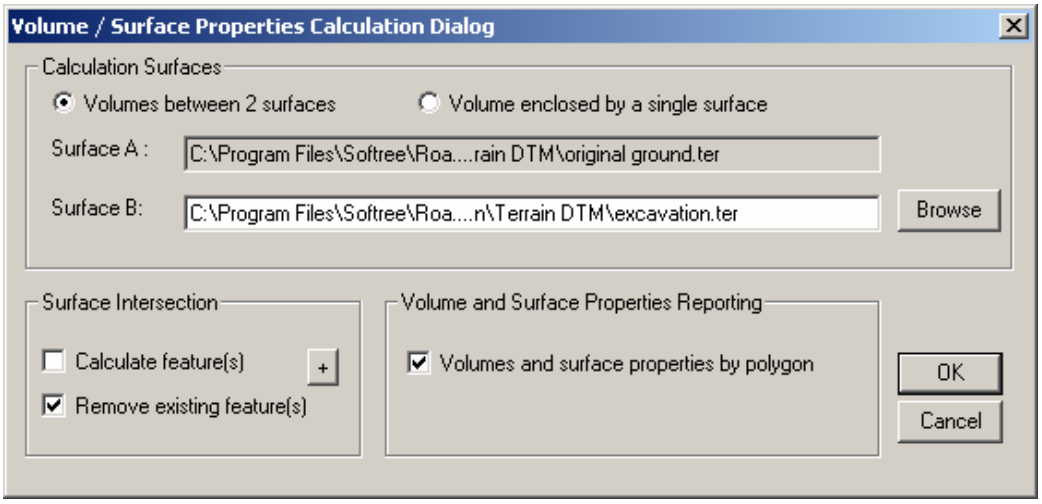
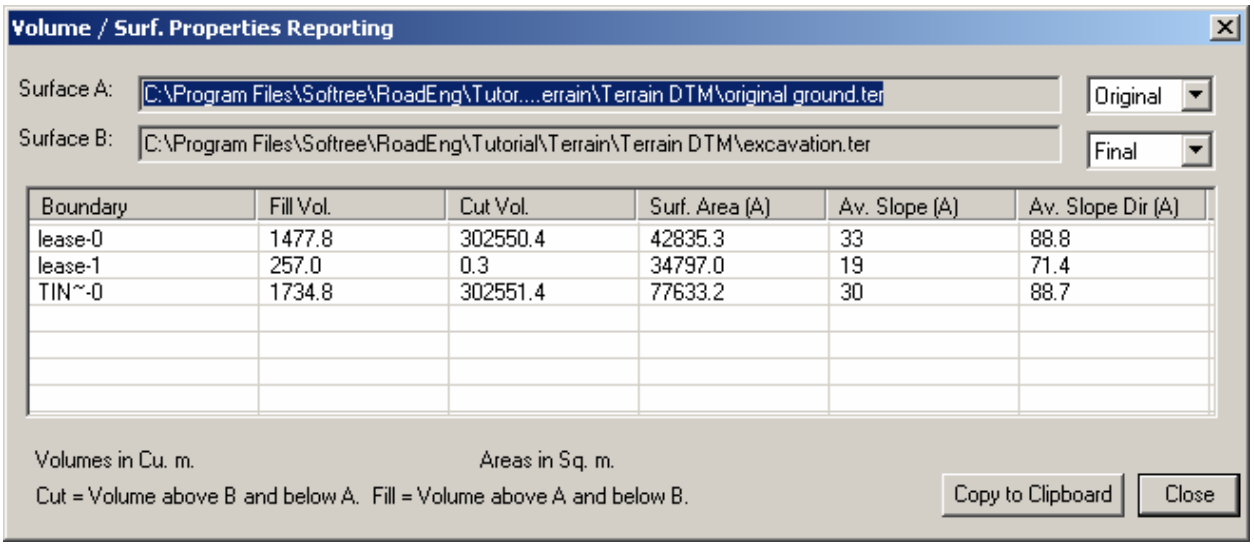


Figure 8.19: Volume / Surface Properties Calculation Dialog - Volumes by Polygon

9. Select *Volumes and surface properties by polygon* and press OK to begin the volume computation. When completed, the *Volume reporting dialog box* will appear. If you are working in imperial units (feet) the volumes will be reported in cubic yards.



Boundary	Fill Vol.	Cut Vol.	Surf. Area (A)	Av. Slope (A)	Av. Slope Dir (A)
lease-0	1477.8	302550.4	42835.3	33	88.8
lease-1	257.0	0.3	34797.0	19	71.4
TIN~-0	1734.8	302551.4	77633.2	30	88.7

Figure 8.20: Volumes/Surf. Properties by Polygon

Note the cut, fill quantities and surface properties are reported for the 2 polygons (lease-0 and lease-1). The TIN~.0 feature is the boundary of the *Surface A* TIN. It was automatically created during the volume calculation process.

10. Press *Close*.To view the values, create a status window by Window | New Window | Text | Status.

NOTE: Text Windows can be floating or docked to the right side of the screen. To dock a floating window, click the dock icon on the upper right side of the window. To float a docked window, click the float icon on the upper right side of the docked window

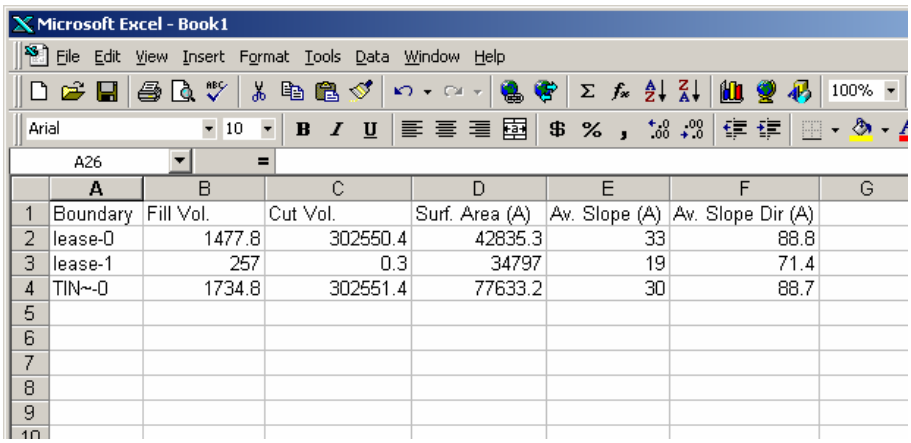
11. View | Active Window (Status) Options. Press the *Add/Remove* button. Change the Selected items list to include only *Area*, *Vol above* and *Vol below* (the latter two can be found in the *Surface Properties* folder). Press OK twice to return to the main screen. Size and move the Status window to make the values visible and to expose the Plan window.

12. The Status Window displays the volumes associated with each *lease* feature. Select each *lease* feature and see how the volume changes.

NOTE: 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.

13. Edit | Terrain Modelling | Display Volumes and press *Copy to Clipboard*.

14. Open Microsoft Excel® and create a new document. With the cursor positioned in the first cell select menu Edit | Paste. The volume information should appear in Figure 8.21.



	A	B	C	D	E	F	G
1	Boundary	Fill Vol.	Cut Vol.	Surf. Area (A)	Av. Slope (A)	Av. Slope Dir (A)	
2	lease-0	1477.8	302550.4	42835.3	33	88.8	
3	lease-1	257	0.3	34797	19	71.4	
4	TIN~-0	1734.8	302551.4	77633.2	30	88.7	
5							
6							
7							
8							
9							

Figure 8.21: Volume Report Exported to Microsoft Excel®

15. Close your spreadsheet. 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. Open file **\Tutorial\Terrain\Terrain DTM\stockpile.TER**. Press Open.

2. Choose menu Edit | Calculate Volumes/Surf. Properties.

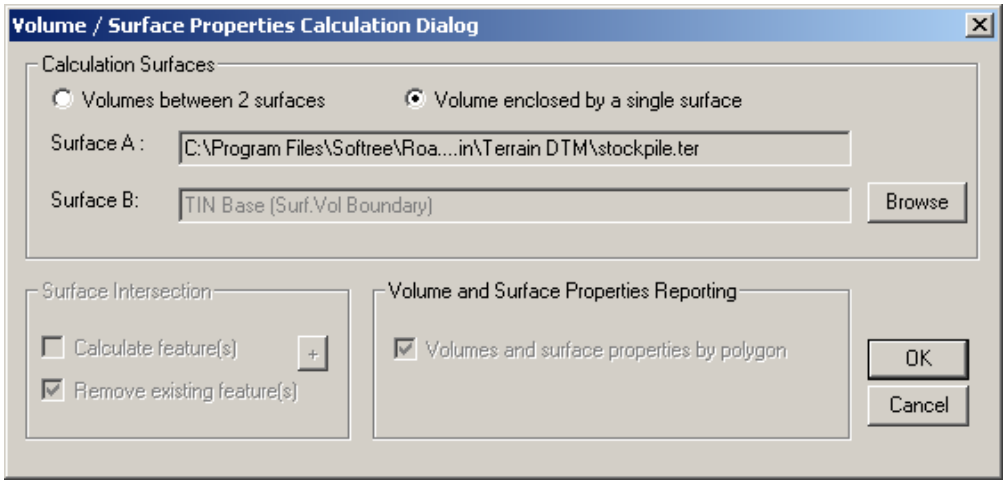


Figure 8.22: Volumes / Surface Properties Dialog

3. Choose the Volume enclosed by a single surface radio button. 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 Volumes and surface properties are saved with this polygon as attributes.

4. Once the calculation is complete, the Volume / Surf. Properties Reporting dialog will appear as shown in Figure 8.23. Press Close.

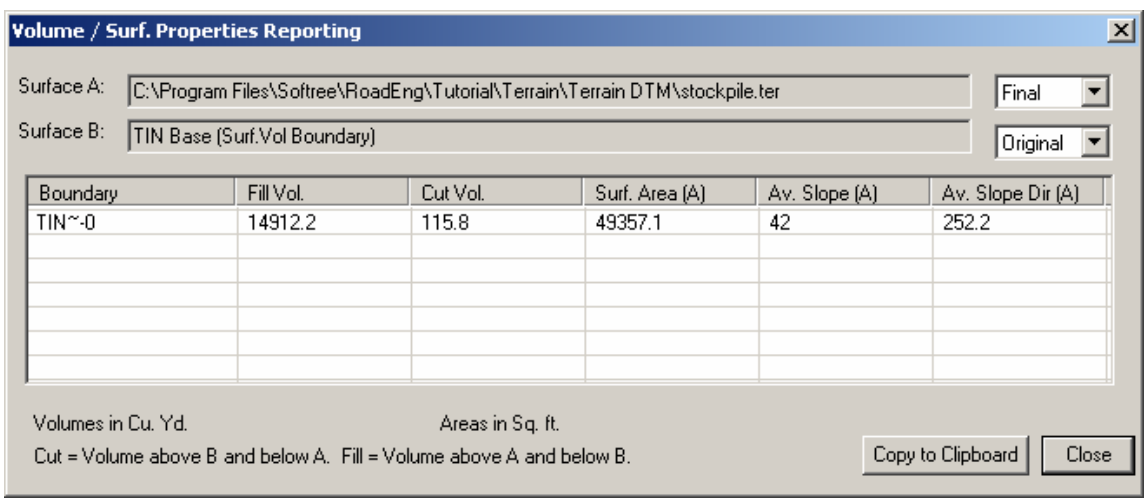


Figure 8.23: Volume / Surf. Properties Reporting dialog box.

NOTE: The cut volume (small compared to the fill), is because the toe of the pile of 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. Select the TIN~-0 boundary feature using the selection cursor , the volumes will be displayed in the Status Window.

NOTE: Volumes and other surface properties are saved as feature attributes

6. File | New. Do not save changes.

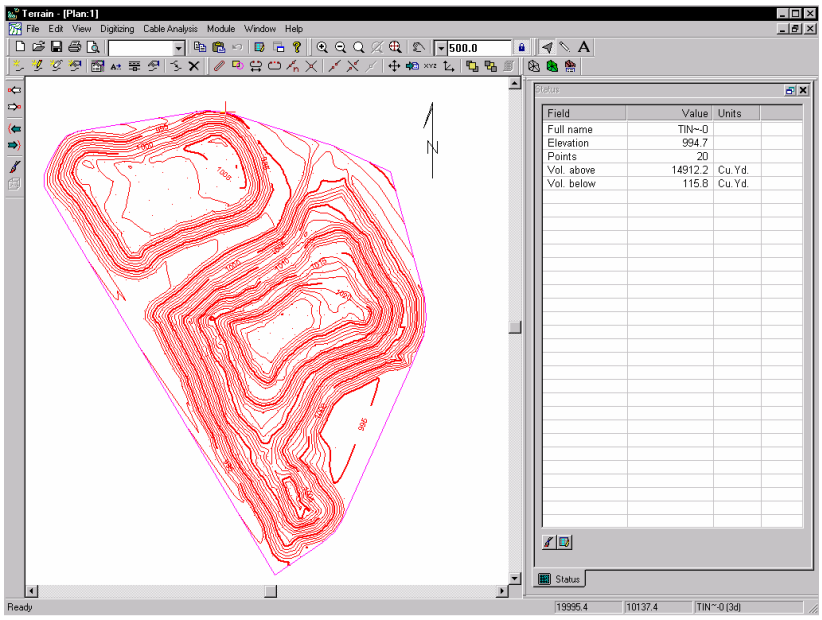


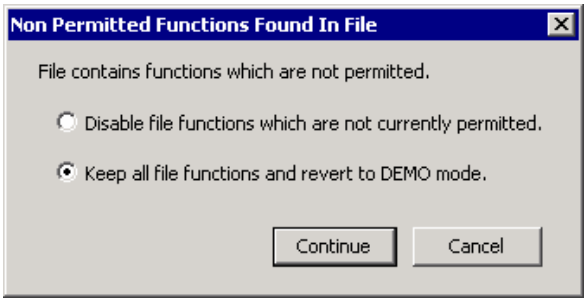
Figure 8.24: Surface/Volume Boundary with Associated Volumes Displayed in the Status Window

Profiles

The Terrain Module allows you to display and edit features in profile. 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.

If your software license does not include the required Function Groups, when you open a file or screen layout you will be prompted:



Choose “Keep all file functions and revert to DEMO mode”. Examples in this section can be completed in Demonstration Mode. Contact Softree to upgrade your license to permit more functions.

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

1. File | Open. Select **\Tutorial\Terrain\Terrain Profile\topograph.TER**. Press Open.
2. Select Stream-2 (the thick blue feature running down the middle) by clicking on it with the selection cursor .

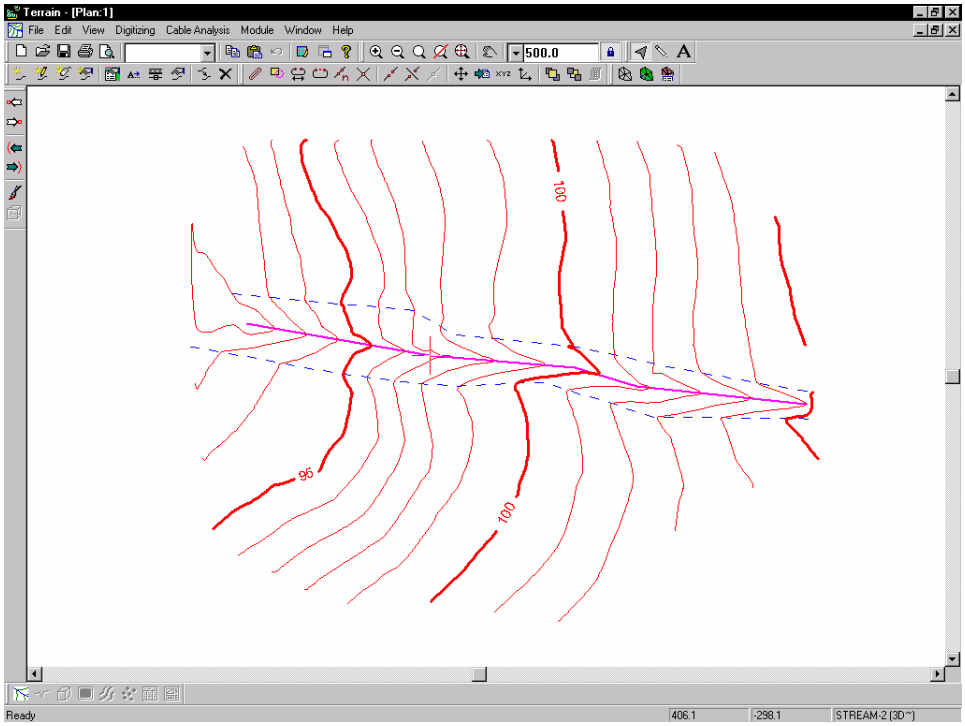


Figure 9.0: Stream Survey (topograph.TER)

3. Edit | Modify Selected Feature(s) | Coordinates or press the *Edit Coordinates* button to activate the *Feature Coordinates* dialog box.
   A Softree Prompt appears: "Warning, existing Terrain Triangles will be cleared". Press OK

Note the feature has XYZ coordinates and that the XYZ coordinates can be user defined. Press *Cancel* to return to the main screen.

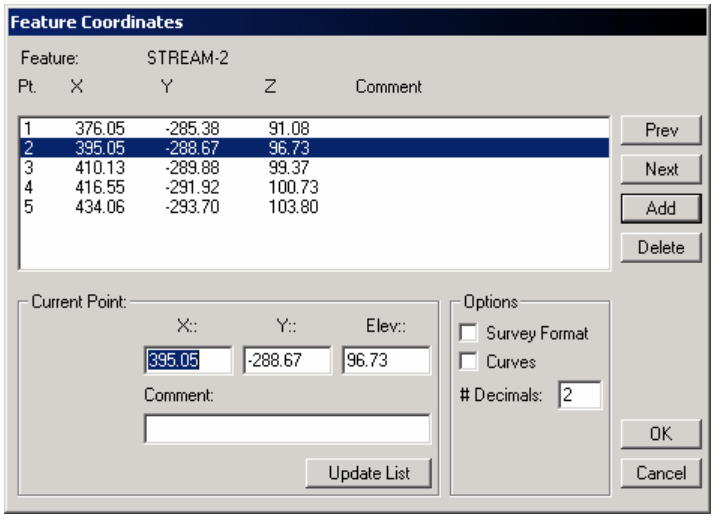


Figure 9.1: Feature Coordinates Dialog

4. To create a Profile Window, select Window | New Window | Graphics | Profile. Press the *Maximize* button on the profile window. Notice that the current feature is now the fence section feature.

5. Use the *Plan* button and the *Profile* button found at the bottom left of the screen to switch between the two views.

6. Using the <Ctrl-N> and <Ctrl-B> keys move the *current point* forward and backward on the *current feature*. Notice how the current point moves in both the Plan and Profile Windows (for more information about the current feature and point see the Mapping and Drafting section of this document).

The scale in the Profile Window is distorted (different in horizontal and vertical directions). To correct the distortion:

7. Activate the Profile Window by pressing the *Profile* icon. Choose menu View | Active Window (Profile) Options to popup the *Profile Window Options* dialog box. Notice the Scale is set to *Auto Scale*.

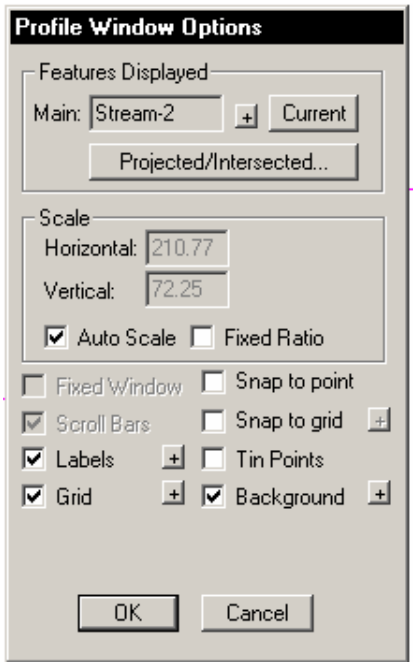


Figure 9.2: Profile Windows Options Dialog

8. De-select the *Auto Scale* and change the horizontal and vertical scales to 200 (120 if you are working in feet units). Press OK. The Profile Window has a new scale and the distortion has been removed.

With *Auto Scale* set, the horizontal and vertical scales are automatically set so that the entire feature fits in the Profile Window. In this mode scrolling and zooming operations are disabled.

9. View | Active Window (Profile) Options to view the *Profile Window Options* dialog box. Select the plus button beside *Labels* to activate the *Label Selection and Formatting* dialog box.

10. Turn on *Elevations* and *Grades* by double clicking on them in the list-box. Press OK twice to return to the main screen.

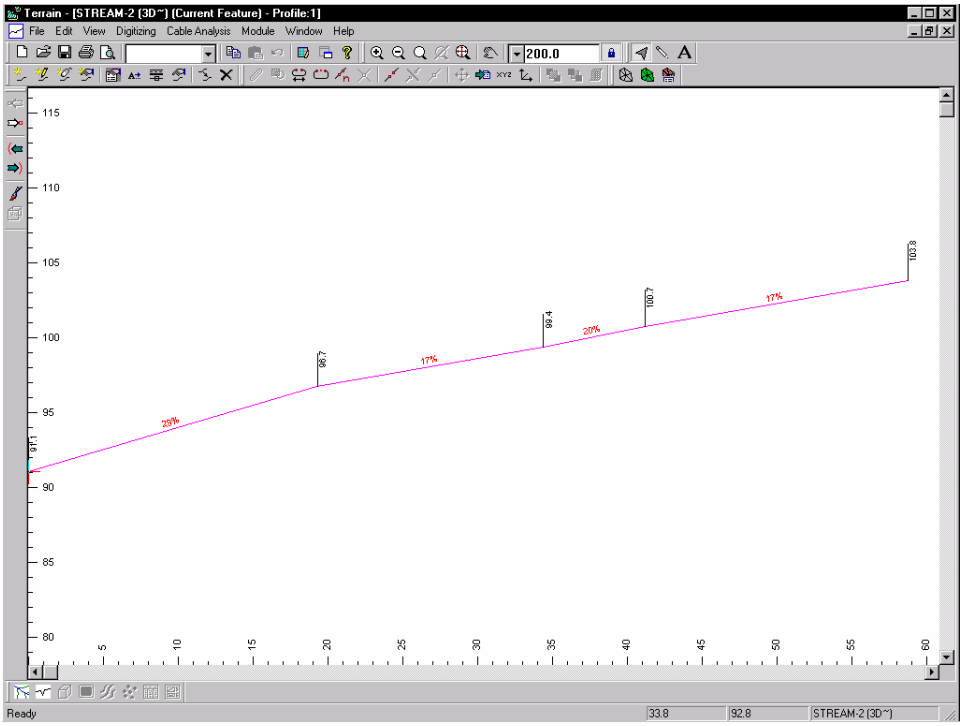


Figure 9.3: Stream Profile with Elevations and Grades

11. Edit | Modify Selected Feature(s) | Reverse or press the *Reverse* button. Press OK. Note the reversed direction of the profile.

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

2D and 3D Features

Stream Survey Example

A 3D feature has Z values explicitly defined at each point. 3D features are used to create a Terrain Model (DTM). 3D features are also known as "ELEVATION features".

A 2D feature, on the other hand, has undefined elevations (-9999) at each point unless a DTM exists. In the next example, the 2D feature gets its elevations from the DTM by "draping". A 2D feature with elevations derived from a DTM is called a *draped feature*. 2D features are also known as "NON-ELEVATION features".

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. Select **\Tutorial\Terrain\Terrain Profile\topograph.TER**

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

You may have noticed the text "(3D˜)" in the lower right corner of the screen. This indicates that the current feature has a Z coordinate explicitly defined at each point.

The ˜ after 3D indicates the feature is a breakline. (See *Digital Terrain Modelling* section of the documentation for information about breaklines).

3. Press the *Properties* button or Edit | Modify Selected Feature(s) | Properties. Notice the *Elevations* checkbox is selected. This indicates that the feature is a 3D feature. Press *Cancel*.

4. To create a 2D feature, click on the *Draw New Feature* button on the tool bar.

5. Draw a feature with two points perpendicular to the stream (similar to that shown in *Figure 9.4 - 2D Feature Across the Stream*) For more information about drawing a feature please refer to the Mapping and Drafting section of this manual. Right mouse click, and select "Select with Mouse".

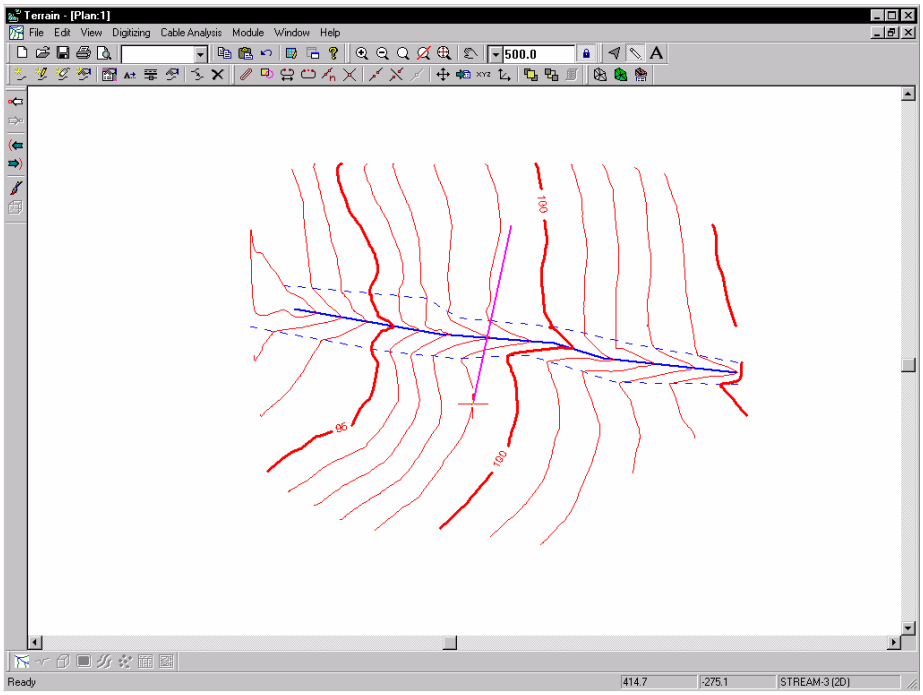


Figure 9.4: 2D Feature across the Stream

6. Select Window | New Window | Graphics | Profile to view a Profile of the feature. Press the *Maximize* button on the profile window.

Notice that additional points have been added (also the vertical is exaggerated by *Auto Scale*). These new points are called *TIN* points and they show the elevation of the underlying DTM. They are automatically calculated and inserted in 2D *(draped)* features wherever a triangle link line in the DTM is crossed. TIN points can not be edited.

7. Edit | Modify Selected Feature(s) | Properties or press the *Properties* button in the toolbar. Notice the *Elevations* checkbox is not selected. Press Cancel.

8. Press the *Edit Coordinates* button or select Edit | Modify Selected Feature(s) | Coordinates. Note the elevation box (Z value) is grayed out, indicating that this is a 2D feature. Press *Cancel*.

9. Edit | Modify Selected Feature(s) | Properties or press the *Properties* button in the toolbar. Check the *Elevations* checkbox and press OK.

Observe the Profile Window. Notice that it has maintained its 2D shape

10. Edit | Modify Selected Feature(s)| Coordinates (or press the *Edit Coordinates* button). Notice the Z values field is accessible for editing. The feature is now 3D. Press *Cancel*.

To recap:

- A 2D feature was created that was automatically draped over the DTM.
- Extra points (TIN points) were added wherever the feature crossed a DTM triangle.
- The feature was then changed to a 3D feature, which maintained all TIN points.

Multiple Surfaces

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 or Profile Windows.

For this example 2 DTM's have been prepared, **overburden.TER** and **overburden1.TER** (separating two overburden layers). These surfaces will be set as background terrains and the profile will be projected on them.

11. With the cross-section still the current feature, select menu Edit | Modify Selected Feature(s) | Properties or press the *Properties* button in the toolbar. De-select *Elevations* to convert the current feature back to 2D. Press OK.

12. View | Active Window (Profile) Options. Ensure *Background* is enabled and press the plus sign beside it to open the dialog box shown in Figure 9.5.

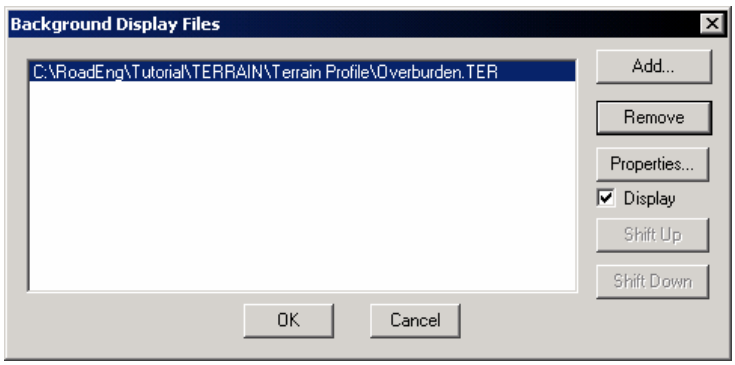


Figure 9.5: Background Display Files Dialog

13. Press the *Add* button from the *Background Display Files dialog*. Select **\Tutorial\Terrain\Terrain Profile\overburden.TER** and press Open**.** Press the *Add* button again. This time choose **overburden1.TER**. Press Open and OK twice to return to the main screen.

The next two steps identify how to set the color and hatching for each layer.

14. View | Active Window (Profile) Options. Press the plus sign opposite *Background*. With the file **overburden.TER** selected, click on the *Properties* button. Click on the *Profile Feature Format* button and set the color to *green* and hatch type to *dots 2*. Press OK twice. Repeat for **overburden1.TER** (choose your own color and hatch type). Press OK until you have returned to the main screen.

15. With the Profile Window active, choose menu View | Active Window (Profile) Options. Disable *Auto Scale* and set the horizontal to 100 and vertical scale to 50 (if you are working in feet units set horizontal to 50 and vertical to 25). Press OK.

Your Profile Window should now appear similar to the Figure 9.6.

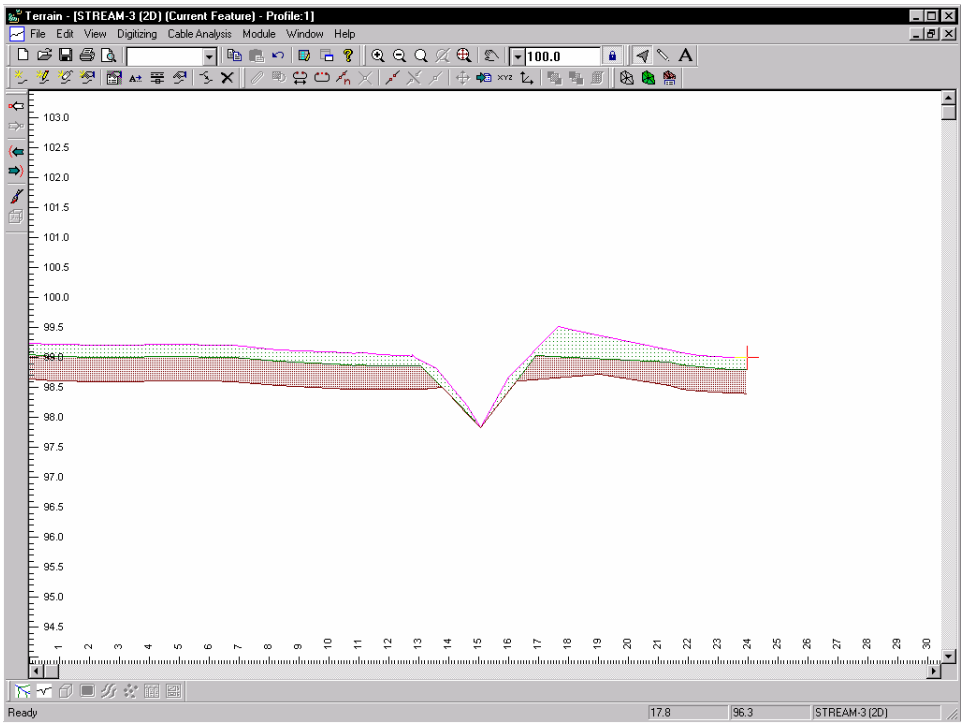


Figure 9.6: Profile Window with Multiple Layers

16. File |New. Do not 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 | Open. Select **\Tutorial\Terrain\Terrain Profile\topograph.TER.** Press Open.

The next three steps are the same as the previous example (*2D and 3D Features*).

2. Click on the *Draw New Feature* button on the tool bar to create a new 2D feature.

3. In the Plan Window, draw a feature with two points perpendicular and crossing the stream as shown in Figure 9.4.

4. Window|New Window|Graphics|Profile to view a Profile of the feature. Press the *Maximize* button on the profile window.

5. With the Profile Window active, choose menu View | Active Window (Profile) Options to open the *Profile Options dialog box*. De-select *Auto Scale* and change the horizontal and vertical scales to 100 (75 if you are working in feet units). Press OK.

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

6. Change to the cursor and hover over the left end point of the feature. Note the Edit cursor does not appear and hence the left most point on the fence section feature can not be modified in the Profile Window.

7. Press the *Properties* button in the toolbar or select Edit | Modify Selected Feature(s) | Properties. Check the *Elevations* checkbox and press OK.

8. Using the edit cursor, left click and capture the right hand profile endpoint and move it to a new position. Left click again to anchor it.

9. Move the insert cursor, to the center of the profile left click to create a new point. Left click again to anchor it at a new position.

10. File | New. Do not save the changes.

Profile Window Design and Drafting

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. Select **\Tutorial\Terrain\Terrain Profile\topograph.TER**. Press Open.

2. Using the Selection cursor select the blue feature running down the center of the creek (STREAM-2).

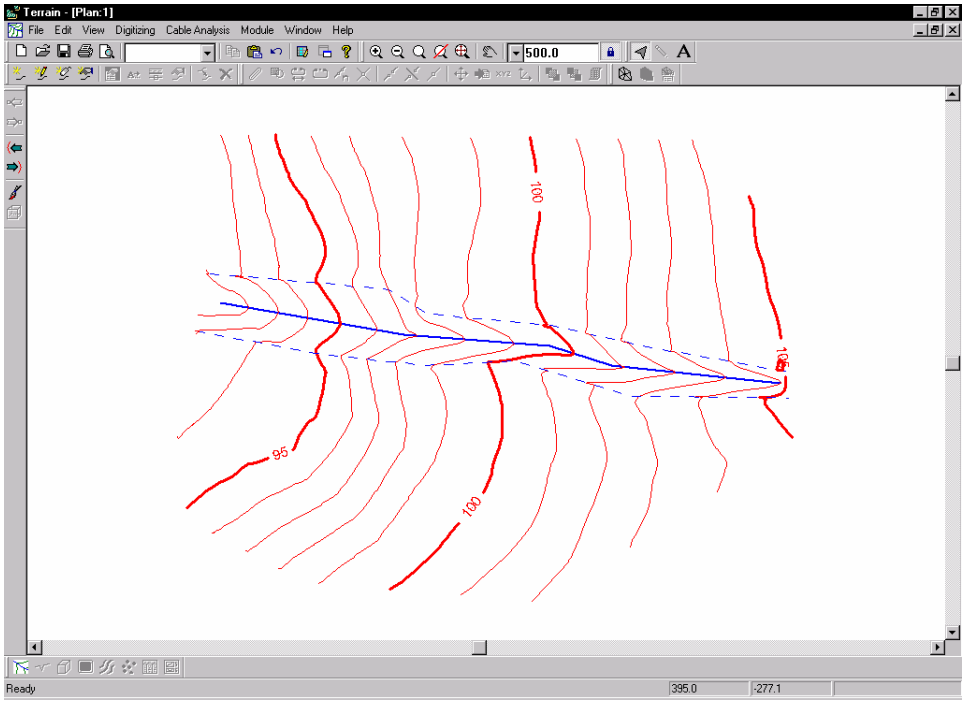


Figure 9.7: topograph.TER Screen Dump

3. Window | New Window | Graphics | Profile. This opens a Profile Window with the feature name, STREAM-2. Press the *Maximize* button on the profile window.

NOTE: To activate the Plan Window, press the *Plan* button. To activate the Profile Window, press the *Profile* button. The icons are located at the bottom of the screen.

4. Using the Selection cursor in the Plan Window, select the upper stream bank 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 | Current Feature To Profile (F5). The Profile Window should now display STREAM-0.

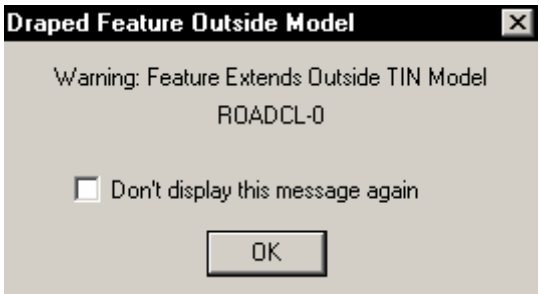
Current Feature to Profile changes the Profile Window to display the current feature (this function changes the active Profile Window).

6. Switch back to the Plan Window. Left mouse 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.

7. Edit | New Feature or press the *Create New Feature* button. Change the feature name to **ROADCL** and Make sure *Displayed*, *Connected*, and *Modelled* are on. All other properties should be off. Press the *Keyboard* button. You may get the following warning. Press OK



8. 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 >

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

9. Press the *Update List* button to accept the last coordinate.
10. Check the above coordinates, if satisfied they are correct, press OK. Notice the Plan Window now displays the new ROADCL feature.
11. Switch back to the Profile Window. Select menu View | Current Feature To Profile. Notice that the Profile now displays ROADCL.

NOTE: Turning on Auto-Scale 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.

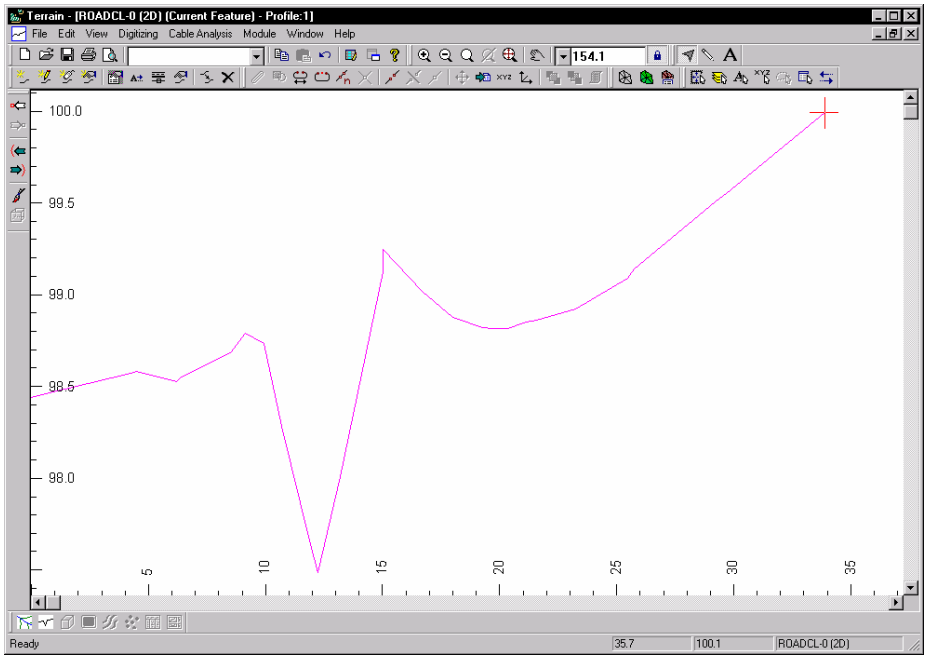


Figure 9.8: ROADCL Profile

12. To create a cross section parallel to the creek, select menu Edit | New Feature or press the *Create New Feature* button. Change the feature name to **SECTION.** Make sure *Displayed*, *Connected*, and *Modelled* 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 >.

13. Do not press <Enter > after the last coordinate. Press the *Update List* button Press OK.

14. Select Window | New Window | Graphics | Profile. A Profile Window appears with the feature name, SECTION-0, in the title bar.

Notice there is another feature in the Profile Window. This is feature STREAM-2 projected onto the 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.

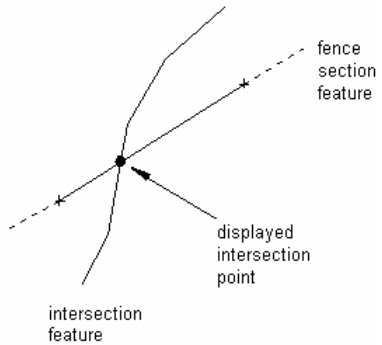


Figure 9.9: Intersected Feature (Plan View)

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

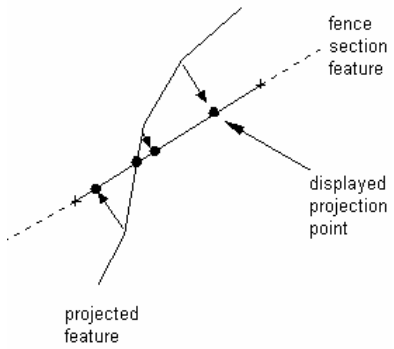


Figure 9.10: Projected Feature (Plan View)

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 dialog box.*

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

15. Select Window SECTION-0. With the cursor positioned in the Profile window, right mouse click and select *Active Window (Profile) Options.* Click on the *Projected/ Intersected* button. In the *Intersected Features* group box, press the *Select* button. Find and *Select* ROADCL-0. Press OK until you have returned to the main screen.

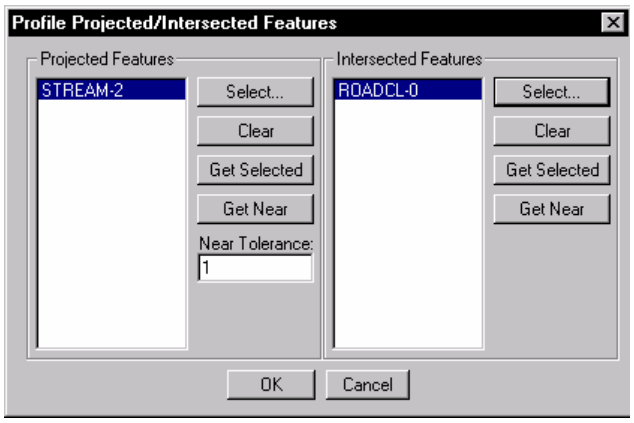


Figure 9.11:Profile Projected Intersected Features

16. Select Edit | Select Feature(s)|by Name. 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.

17. Right mouse 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

18. To position the culvert pipe in the stream, activate the road centerline profile ROADCL-0 by pressing the Profile icon until the ROADCL-00 title appears in the Profile Window title bar.

19. Position the cursor in the Profile Window, right mouse click and select *Active Window (Profile) Options*. Deselect the *Autoscale* checkbox and set both horizontal and vertical scales to 200.

20. Select *Snap to Grid* and press the "+" button to set the grid space (*SpaceX* and *SpaceY*) to 1.8m (to create an 1800 mm diameter pipe). Press OK. Return to the main screen.

21. Press the *Draw New Feature* button. Draw a horizontal line in the Profile window one grid space wide (1.8m). Each point requires two left clicks. See *Drawing and Editing a Feature* in the On-line help for more information.

22. Right mouse click and select Modify Selected Feature(s) | Shape or press the *Shape* button. Choose *Diameter to circle* from the list box. Press OK.

23. Again right mouse click, this time select Modify Selected Feature(s) | Properties or press the *Properties* button in the toolbar. Change the name to **PIPE**. Press OK.

24. While holding down the <Ctrl > press the <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. Left click and drag the circle to a reasonable position in the creek.(see Figure 9.12) 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 similar to the screen capture in Figure 9.12

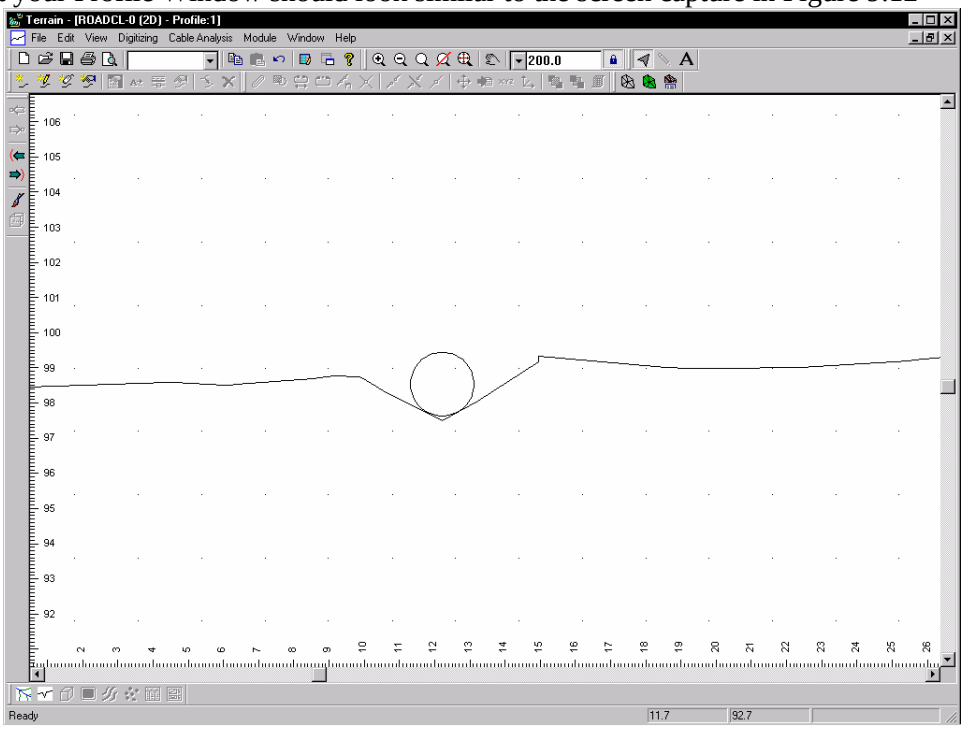


Figure 9.12: 1800mm Pipe Displayed in Road Centerline Profile

25. Click on the Profile Window button until SECTION-0 is displayed.

26. Select *Active Window (Profile) Options.* First, de-select the *Autoscale* checkbox and set both horizontal and vertical scales to 200. Then, 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. Press OK three times to return to the main screen.

You should now be able to see the projection of the culvert on the stream cross section. 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).

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

27. Press the *Draw New Feature* button.

This will create a new feature with *Displayed*, *Connected*, *Elevation* and *Modelled* turned on.

28. Left click once over the profile window

29. With the cursor positioned in the Profile Window right mouse click and select menu Modify Selected Feature(s) | Labels. Turn on the display of the *dLength* and *Grades* labels by finding them in the list box and double clicking. 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%).

30. With the length and grades displayed, draw a road prism for a 10 m wide road similar to the one shown Figure 9.13

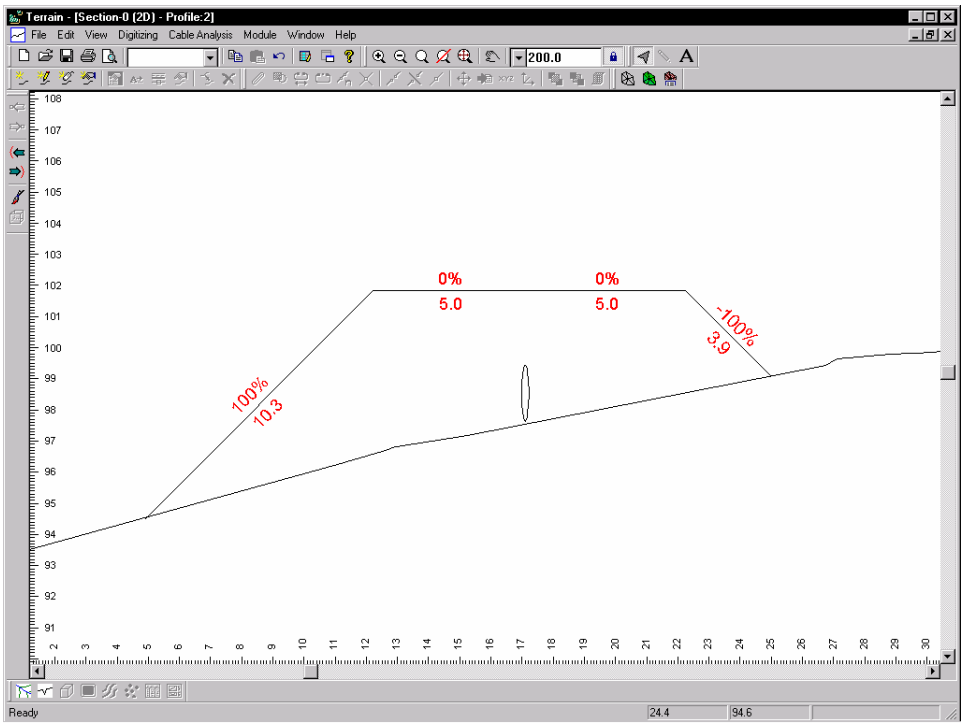


Figure 9.13: Cross Section with Road Template

31. Repeat the process to draw the top of the pipe. Press the *Draw New Feature* button . Left Click once over the Profile Window.

32. 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.

33. Draw the top of the pipe line from one side of the road to the other as shown in the Figure 9.14.

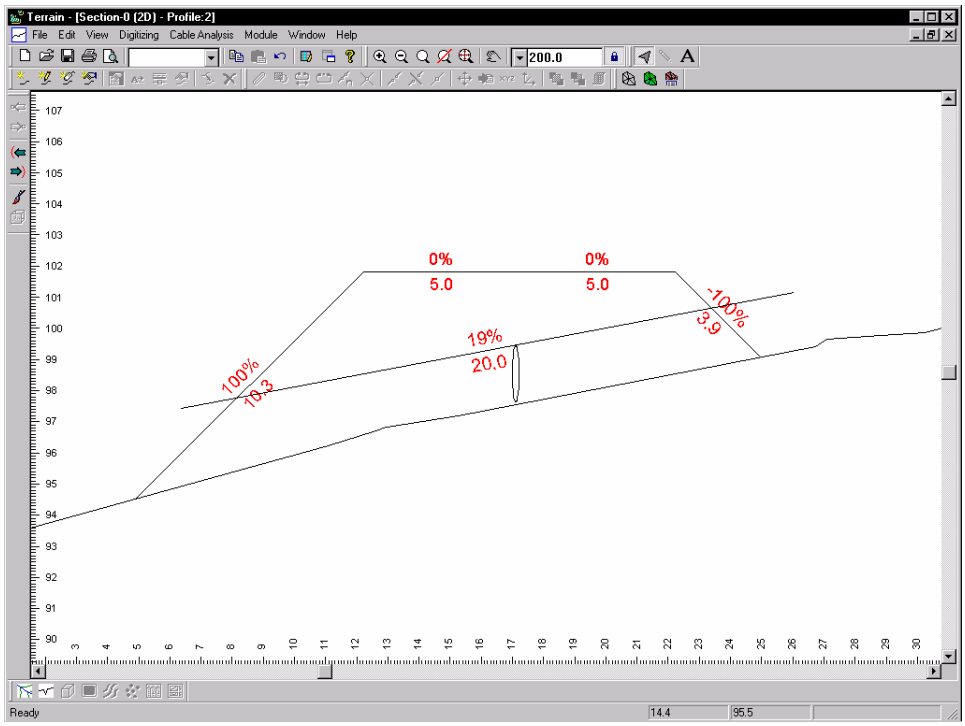


Figure 9.14: Cross Section with Preliminary Culvert Position

34. Using the selection cursor select the top of the pipe feature. While holding down <Ctrl > press the <D> key (or press the *Duplicate* button) to duplicate it. Move the cursor inside the new feature. Click and drag to move it to the bottom of the circular pipe feature.

35. Select the circular pipe feature in the center of the Profile Window. Duplicate it by holding down <Ctrl-key> press the <D> key or press the *Duplicate* button. 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.

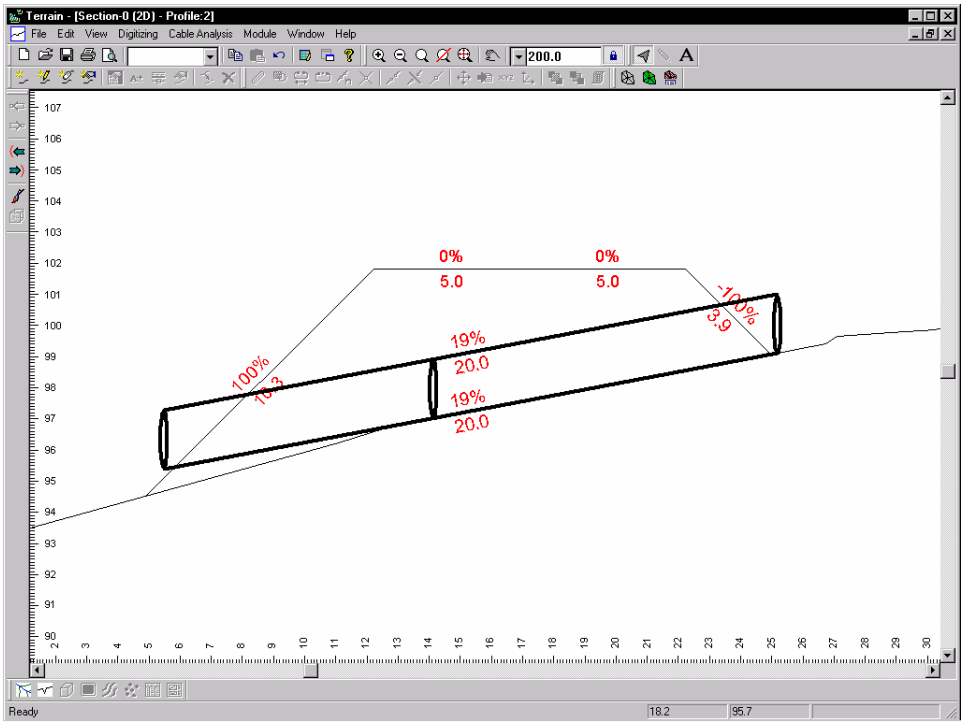


Figure 9.15: Cross Section with Culvert Position

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

36. Using the selection cursor depress <shift>, select the top of the pipe, the bottom of the pipe, and the circular elements. Right mouse click and choose menu Modify Selected Feature(s) | Line-types, Symbols. Choose Line-type *5-thick (medium)* and check *Also Set Plan* indicating that changes will also affect the Plan Window. Press OK.

37. Activate the Plan Window by pressing the *Plan* icon . Your screen should be similar to Figure 9.16.

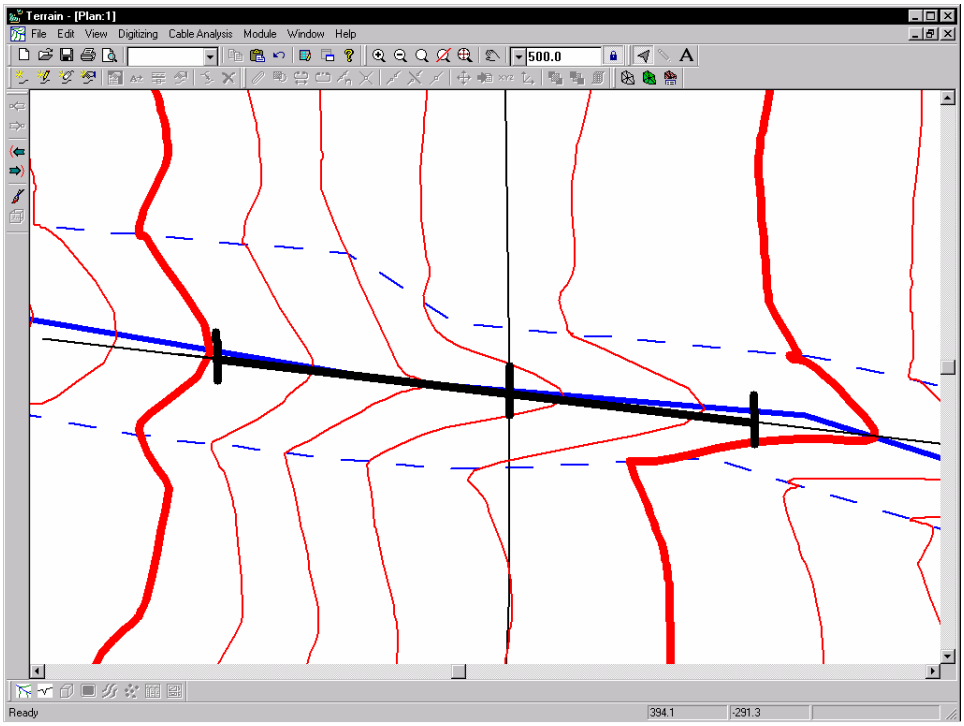


Figure 9.16: Plan Window with Culvert Position

Drafting in the Profile Window

As a final step in this example the hatching and annotation functions available in the Profile Window will demonstrated.

38. Activate the Profile Window by selecting menu Window | Section:0.

39. Press the *Draw New Feature* button and draw a polygon for the rock armor on the outlet side (see Figure 9.17).

40. Right mouse click and select menu Modify Selected Feature(s) | Line-types, Symbols. Choose hatch type *stones opaque*. Press OK.

41. Repeat the previous two steps to create rock armor on the inlet side.

42. Click on the *Edit Labels* button A and add the text **1800 mm Culvert Installed at 19% grade**.

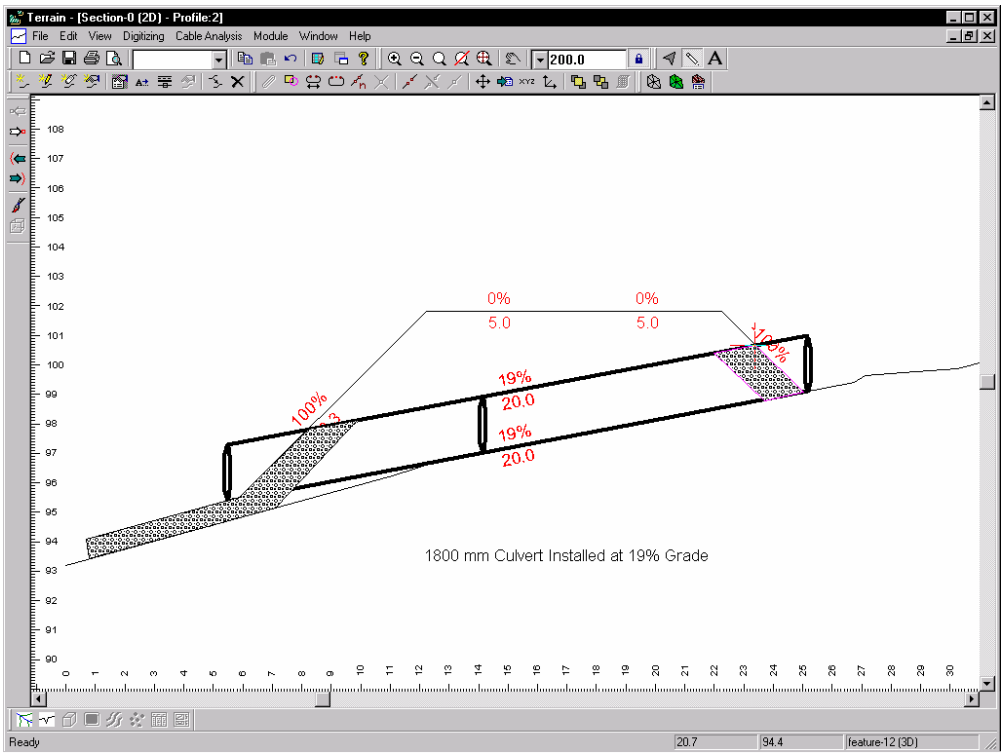


Figure 9.17: Culvert Cross Section with Annotation and Hatching

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

Digitizing Profiles from a Contour Map

Deflection Lines Example

The Terrain Module allows you to digitize profiles directly from contour maps. To do this, the points where the profile intersects contour lines are digitized. Profiles do not have to be straight lines.

To follow this example the *Mapping and Drafting*, *Digitizing*, and *Profile Window* function groups must be enabled.

This example demonstrates how to digitize a profile. If you have not setup your digitizer yet, please refer to the *Setting Up A Digitizer* section of this manual before proceeding. The *Same*, *Up*, *Down*, *Undef*, *Undo*, *Attrib*, and *End* digitizer keypad functions will be used. Refer to the *Standard Digitizer Settings* in the On-line Help for more information on these functions.

NOTE: If you are working with a 4 button cursor it is recommended that you assign the buttons to *Up*, *Down*, *Same* and *End* keys . If you have a 4 button cursor, you will not be able to complete the second half of this example.

1. File│Open **Tutorial\Terrain\Terrain Profile\digitize profile.TER**.

2. Select the Plan Window by clicking on the title bar. Select menu File│Print Active Window. Choose NO to plot current page only. Press OK. This will print the contour map shown in Figure 9.18

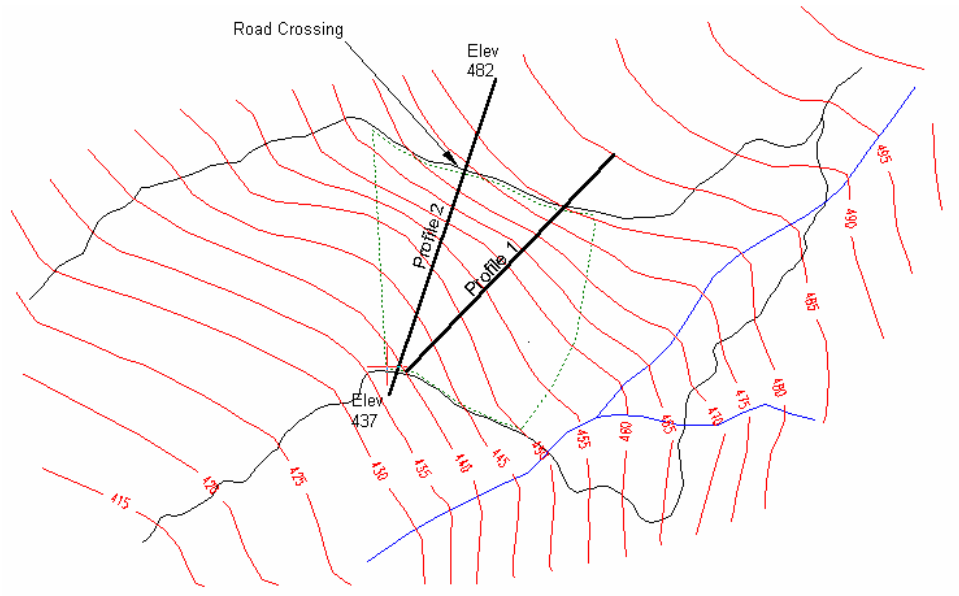


Figure 9.18: Plan View of digitize profile.TER.

3. Tape the printed contour map to your digitizer so that it does not move.

4. File│New. Organize the screen so that you can see the Status, Profile and Plan Windows. You may need to create a new Profile Window.

5. Select the Plan Window by clicking on the title bar.

6. Change Digitizing│Sound to *Full*.

7. With sound set to *Full*, an audible tone ("beep") will be produced when each point is digitized. The tone will confirm the key pressed (*Up, Down, Same, End* etc.).

Ensure that Coordinate Digitizing from Digitizing│Digitizing Options is <u>not</u> selected. This example is not concerned about preserving map coordinates (See *Coordinate Digitizing* example in this manual for more information).

NOTE: Steps 4 to 7 could have been done in one step by retrieving a Screen Layout already set up for digitizing profiles. Select menu File│Save Screen Layout. Type in the layout file name “digitize profile.ILT” and press Save. This will save the present screen configuration as a layout file, which can be activated the next time you want to digitize profiles. This is a big time saver.

8. Edit│New Feature. Change the *Name:* to *profile1*. Make sure that the *Connected* and *Elevations* check boxes are checked. Press *Digitizer*.

9. In the *Elevations* dialog type **440** for the *Start* Elevation and **5** for the *Interval*. Press OK

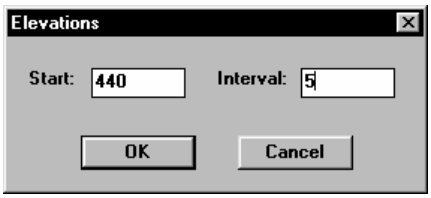


Figure 9.19: Elevations Dialog

10. In the Mapsheet Orientation, change the *Map Scale* to **5000.0** (this may already be the default). Press OK.

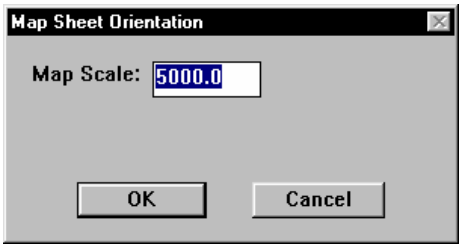


Figure 9.20: Mapsheet Orientation Dialog

11. The prompt ***Digitize Profile1-0 Pnt. #:1*** will appear. Start digitizing Profile1 at the 440 contour by pressing the *Same* key.

12. Move the digitizing puck over the next contour (elevation 445). Press the *Up* key on the puck. Notice in the Status Window the elevation is now 445.

13. Continue digitizing contour intersections until you have completed Profile 1. Press the *End* key twice (this is the same as pressing the cancel button with the mouse cursor).

NOTE: If you are working with a 4-button cursor you will not be able to complete the following steps.

14. Edit|New Feature. Change the *Name:* to *Profile2*. Check *Connected* and *Elevations*. Press *Digitizer*.

    3. In the *Elevations* dialog box type **440** for the *Start* Elevation and **5** for the contour *Interval*. Press OK.

15. The prompt ***Digitize Profile2-0 Pnt. #:1*** will appear. Start digitizing Profile2 at the 437-elevation point by pressing the *Enter* key on the puck. On the keypad of the puck type **437** followed by the *Enter* key again. This process can be used to digitize any known elevation points that do not lie on a contour.

16. Move to the intersection of Profile2 with contour 440. Press the *Same* key.

17. Move to the intersection of contour 445 and Profile2. Press the *Up* key.

18. Continue digitizing the contour intersections until you reach the road intersection. At this point press the *Undef* key. The elevation of this point will be undefined until it can be interpolated from the next contour point.

19. Now press the *Attrib* key (note the screen prompt) followed by 3 (the road label index) and the *Attrib* key again. This adds a label at the last digitized point (see *Digitizer Key Definitions* in the On-line Help for more information about the *Attrib* key).

NOTE: If you make a mistake while digitizing you can press the *Undo* key to go back to the last point. Use the Status Window for elevation feedback.

20. Continue digitizing the contour intersections at 475 and 480 using the *Up* key.

21. At the last point on the profile press the *Enter* key followed by **482** and the *Enter* key again.

22. Press the *End* key twice to end digitizing the profiles.

You can now examine the profiles in Plan and Profile using the Selection cursor the previous and next point keys (Ctrl + N and Ctrl + B) and menu View | Current Feature to Profile (F5).

23. File | New. Do not save changes.

Attributes

Importing Shape Files

In this example contours saved in a shape file (*.SHP) will be imported into the Terrain Module. The elevations of the contours are stored as attributes in the file. Terrain features are assigned elevations using the attribute data making the file useful for profiles, 3D viewing, surface area, volume calculations etc.

1. To import the shape file and corresponding attributes, select menu File | Open. In the *Files of Type* Combo box choose *ArcView Shape(*.SHP)*. Select **\Tutorial\Terrain\Terrain Attributes\theme 17.SHP**

2. The *Import Shapefile Options* dialog box appears. Confirm that Include *Attributes* and *Add themes to layer table* are selected. Press OK to import the file.

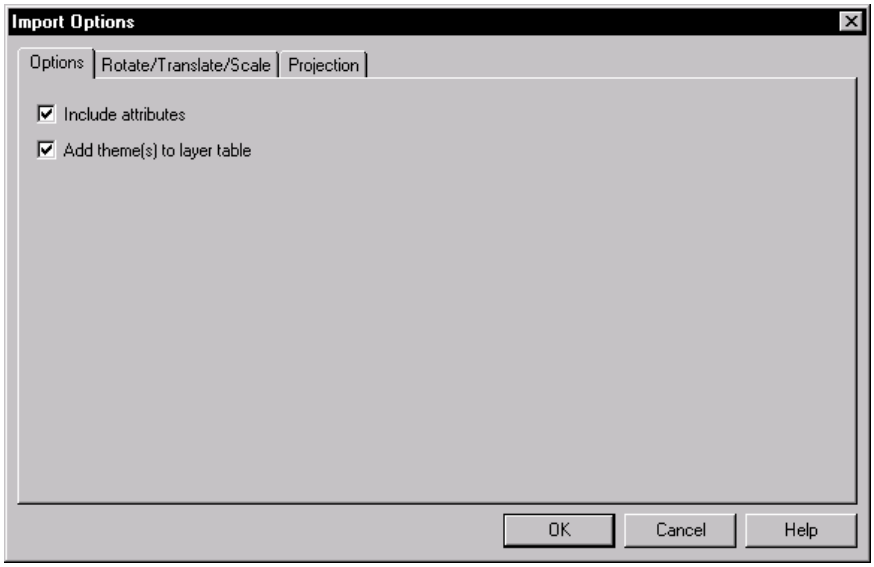


Figure 10.0: Shape File Import Options Dialog

3. File | Retrieve Screen Layout. Select **\Tutorial\Terrain\Terrain Attributes\shape.ILT**

4. Press the *Zoom Extents* button. A Softree Error appears, "Reached maximum zoom, can not show extents without scale change". Press OK.

5. From Edit | Select Features | All, select all features.

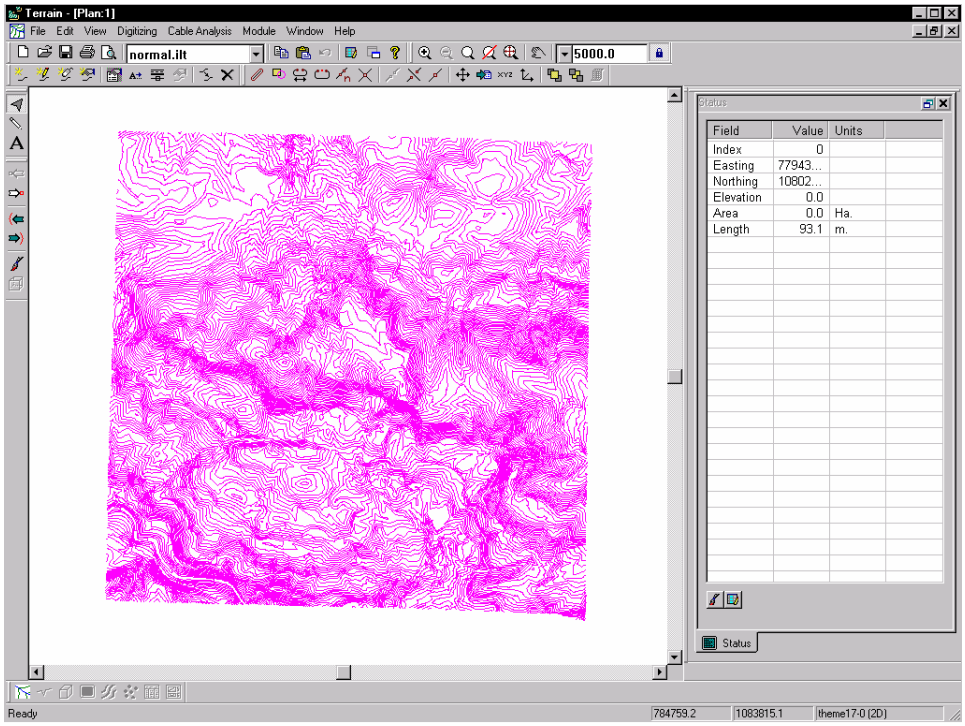


Figure 10.1: Imported Shape File

6. Select Edit | Modify Selected Features | Properties, change all features to “Elevations” and “Modelled”. “Warning No Space for Undo” appears Press OK to continue.

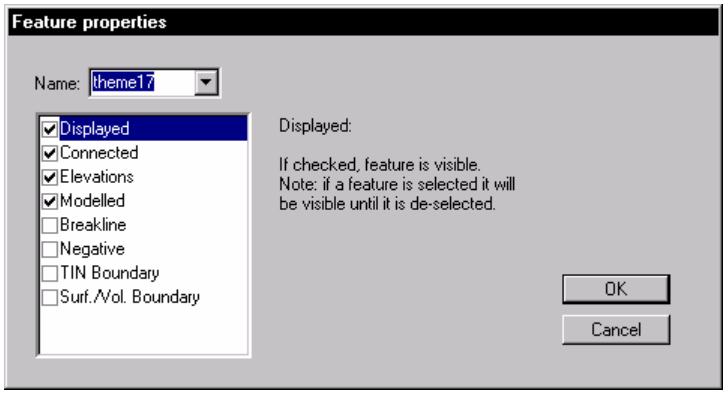


Figure 10.2: Feature Properties Dialog

7. Press the *Assign* button or select Edit | Modify Selected Feature(s) | Assign. Again “Warning No Space for Undo” appears Press OK to continue. Turn on the *Attrib* beside “Z” as shown in Figure 10.3.

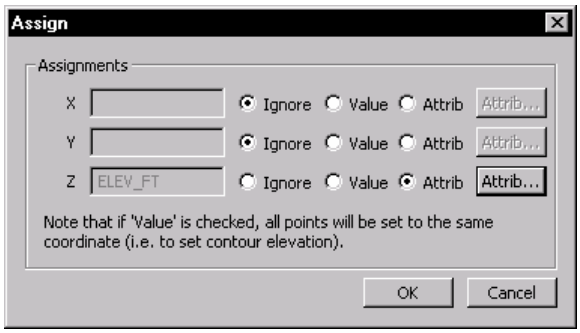


Figure 10.3: Assign Dialog

8. Press the *Attrib* button. A list off all standard Terrain attributes and any attributes imported from the shape file are displayed. In this example the contour elevations are stored in a table called *theme-17*. Open the *theme-17* folder, highlight *ELEV_FT* and click *Add* button. *ELEV_FT* now is displayed in the *Selected* column. Press OK twice to assign the attribute to the selected features.

NOTE: That all of the features have elevations suitable for Terrain Model Calculation, as indicated in the Status Window.

To focus on an area of interest, a clipping rectangle will be inserted and all features outside of the area will be removed.

9. File | Insert File. From the *Files of Type* pull-down choose *Softree Terrain File (*.TER).* Select and open **\Tutorial\Terrain\Terrain Attributes\polygon_clip.TER.** No changes are required in the Import Option dialog box. Press OK to import the polygon. The selected polygon outline is visual in the left bottom corner.

10. Press the *Break at Feature* button. This activates a box prompting you "No additional features selected, OK to break all features that cross the current feature". Press OK.

11. Select the Polygon feature with the mouse again, this time Edit | Select Feature(s) | By Boundary and choose *Outside* and keep *Retain Currently Selected Feature(s)* checked

12. Features outside of the clipping rectangle will be selected. Press the <delete> key to remove them.

13. Press the *Zoom Extents* button. The end result should be similar to Figure 10.4.

14. Proceed to Step 2 in Slope Vectors or File | New to exit the program. Do <u>not</u> save changes.

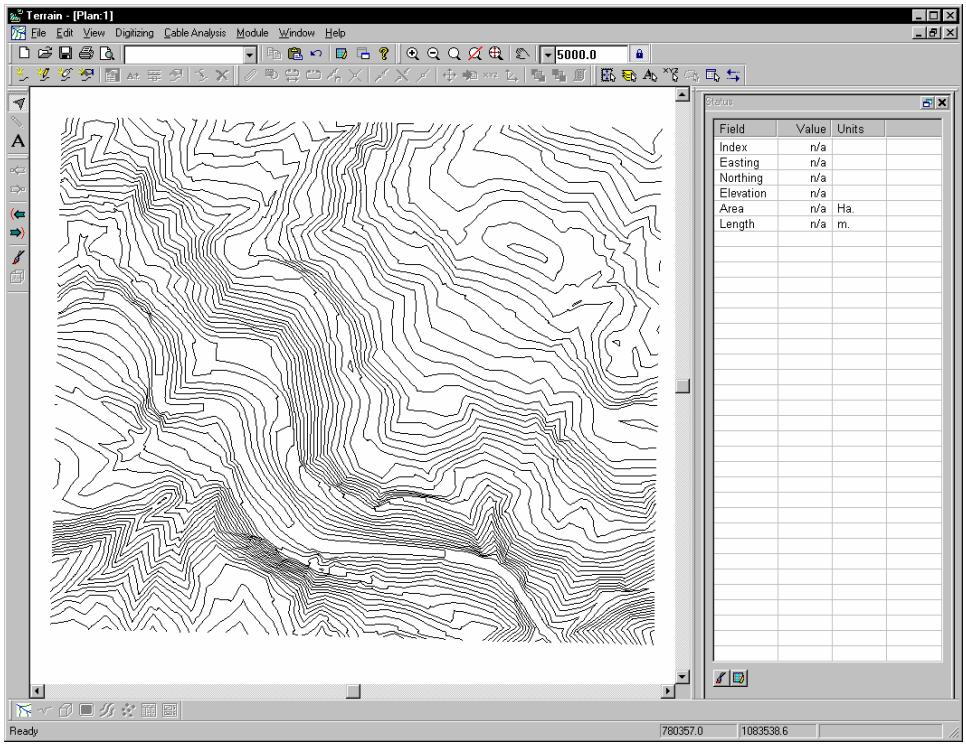


Figure 10.4: Remaining Features after Clipping

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 **Tutorial\Terrain\Surface Display\surface display.TER**
2. File | Insert **Tutorial \Terrain\Terrain Attributes\theme17_sw.TER (**this file is found in the Terrain\Attributes directory)
3. Select Edit | Terrain Modelling | Calculate Terrain Model to activate the Terrain Calculation dialog box shown in Figure 11.0. Turn off all options except *Include All*. Press OK.

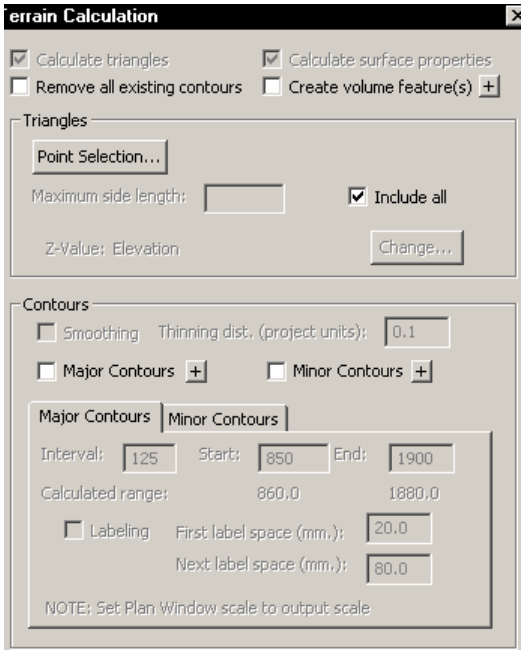


Figure 11.0: Terrain Calculation Dialog Box

Slope Vectors

4. Press the Active Window Options button or select View | Active Window (Plan) Options. Make sure that the *Surface* is enabled in the *General* tab. Press the *Surface* tab. Turn on *Slope Vectors* and press the + sign beside *Slope Vectors*.

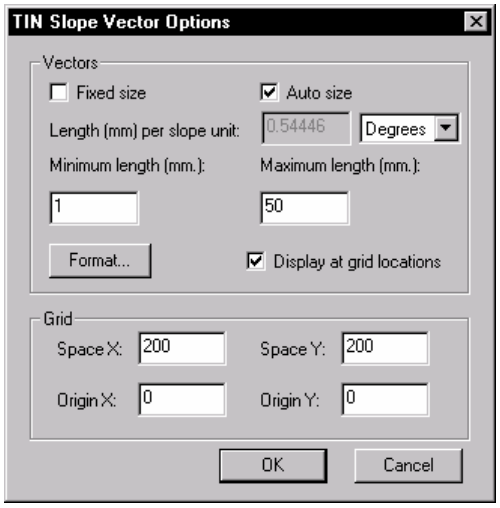


Figure 11.1: TIN Slope Vector Options Dialog

5. In the TIN Slope Vector dialog box, turn off *Fixed size* and turn on *Auto size.* Change *Maximum length (mm)* to **50.** Turn on *Display at grid locations* and type in a Spacing for both X and Y of **200** as shown.

6. Zoom in on any location to view the directional arrows close up. Notice all these arrows point in the downslope direction and the length of the arrows is directly proportional to the slope. The steeper the slope the longer the arrow as shown in Figure 11.2

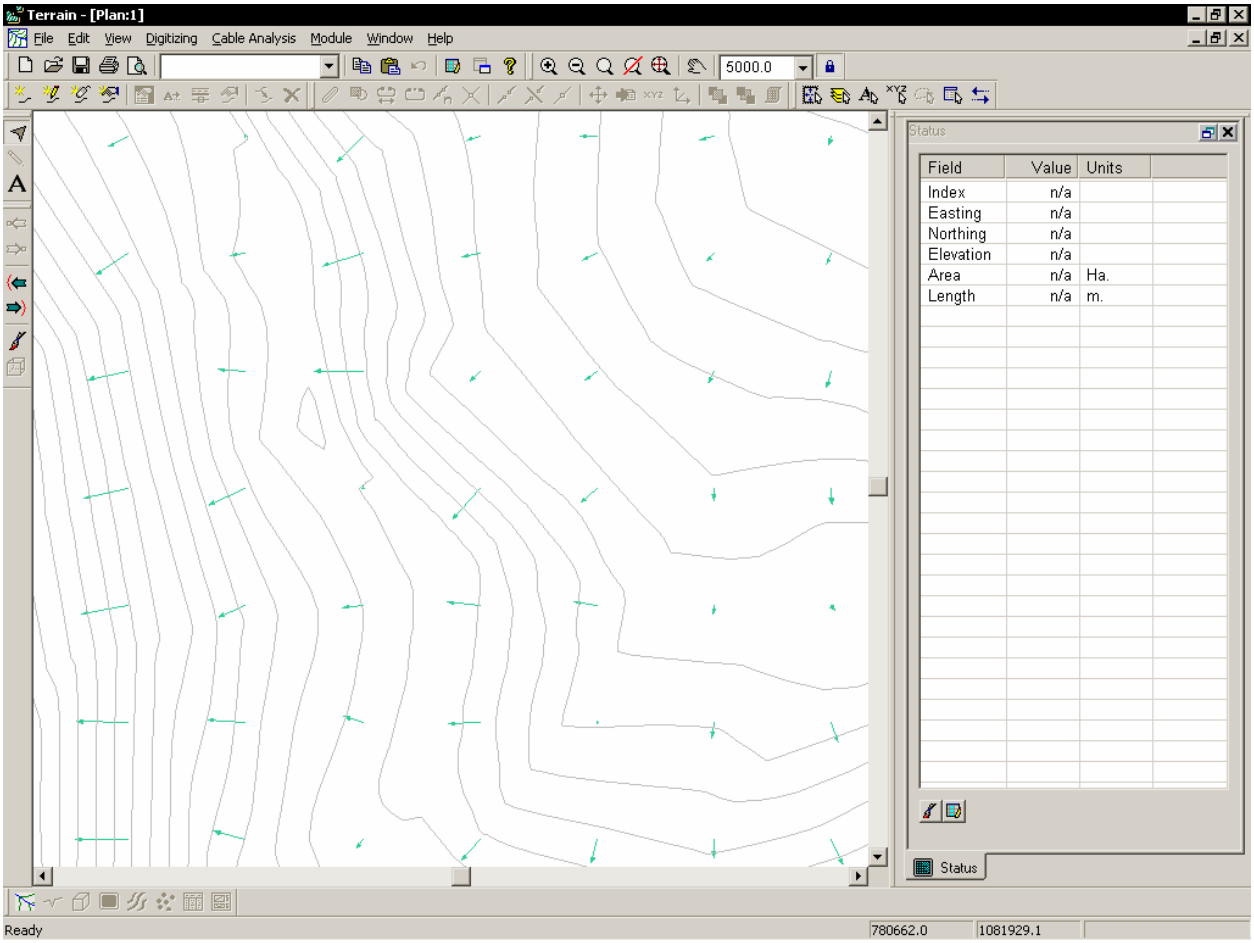


Figure 11.2: Slope Directional Arrows

Shading and Quick contours

7. Again open View | Active Window (Plan) Options. Turn off *Slope vectors* under the *Surfaces* tab and turn on *Shading/Quick contours.* Press the + sign beside *Shading/Quick contours*.

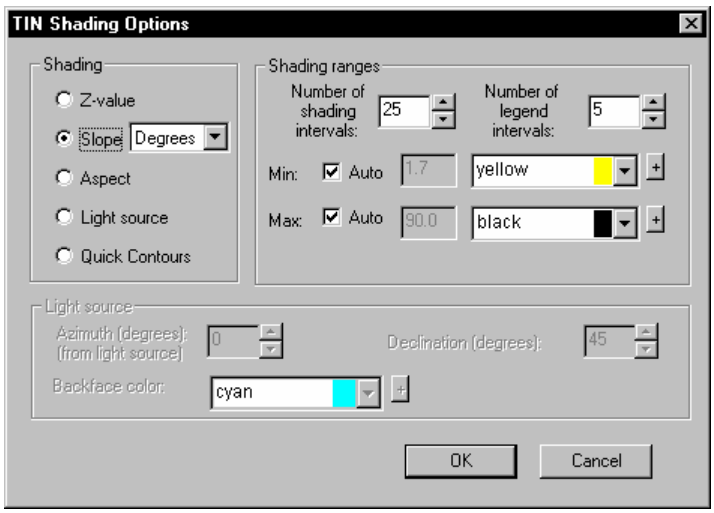


Figure 11.3: Tin Shading Options Dialog

Notice that there are five available *Shading* attributes. 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.

8. Change the Tin Shading options to those in Figure 11.3. Press OK. Notice the slope coloration. The steeper the slope the darker the color. The flatter the area the lighter the color.

NOTE: *Number of shading intervals:* In this example there are 25 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 five 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

3D Displays

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

9. Press the Active Window Options button or select View|Active Window (Plan) Options and turn off *Shading/Quick Contours* found in the *Surface* tab. Press OK.

10. Window|New Window|Graphics|3D and a 3D window will appear on your screen.

11. View|Active Window (3D) Options. Change your 3D options to match those shown in Figure 11.4. Press OK

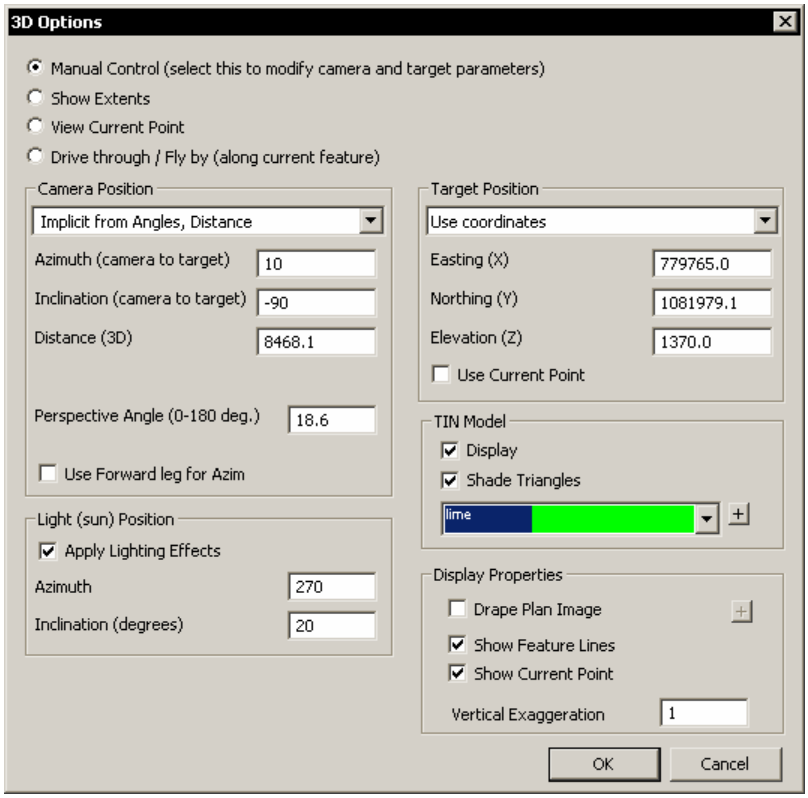


Figure 11.4: 3D Options Dialog

NOTE: *Always 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 of coordinates or the current point) entered in by the user in the *Target Position* area. If *UseForward 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.

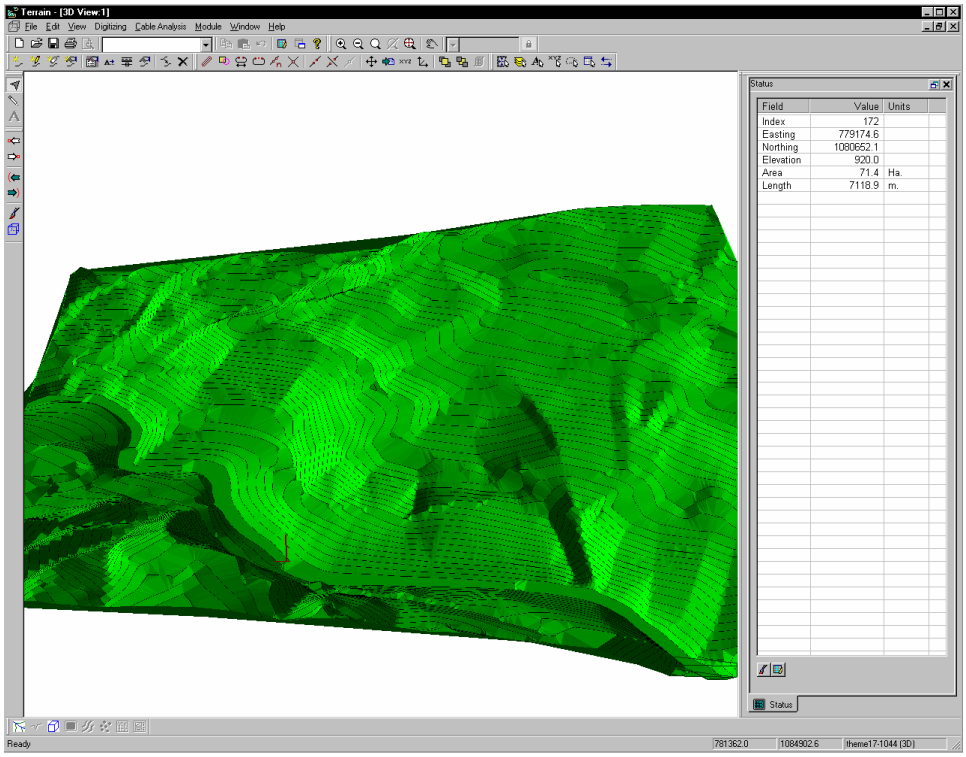


Figure 11.5: 3D View from GIS Contour Data

Zooming and P*anning* 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.

12. Click the *Pan* button in the Zoom Tools toolbar, move your cursor over the 3D window. Click and drag with the left mouse button. Note how 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.

13. 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

14. File | New. Do not save changes.

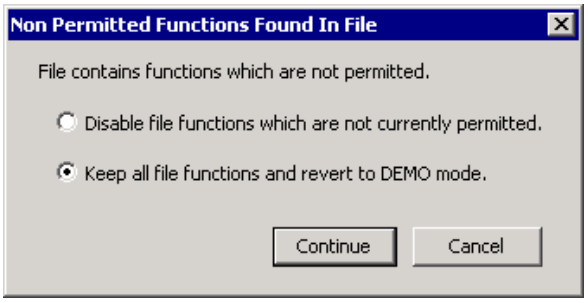
Traverse Data

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.

If your software license does not include the required Function Groups, when you open a file or screen layout you will be prompted:

Choose “Keep all file functions and revert to DEMO mode”. Examples in this section can be completed in Demonstration Mode. Contact Softree to upgrade your license to permit more functions.



Choose “Keep all the functions and revert to DEMO mode”. Examples in this section can be completed in Demonstration Mode. Contact Softree to upgrade your license to permit more functions.

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.

1. File│Retrieve Screen Layout. Select **\Tutorial\Terrain\Terrain Survey\profile.ILT.** profile.ILT has *Scroll Bars, TIN, Labels, Grid, North Arrow* and *Background* enabled.

2. File│Insert File. From the *Files of Type* pull-down choose *Softree Traverse Document (*.TR1,*.DB1).* Select and open **\Tutorial\Terrain\Terrain Survey\road.TR1.** Press Open and OK to bypass the *Import Options* dialog.

3. From the Windows drop down menu, select **ROAD-0 (3D)-Profile:1**

The ground profile, shown in the Figure 12.0, will appear in the Profile Window.

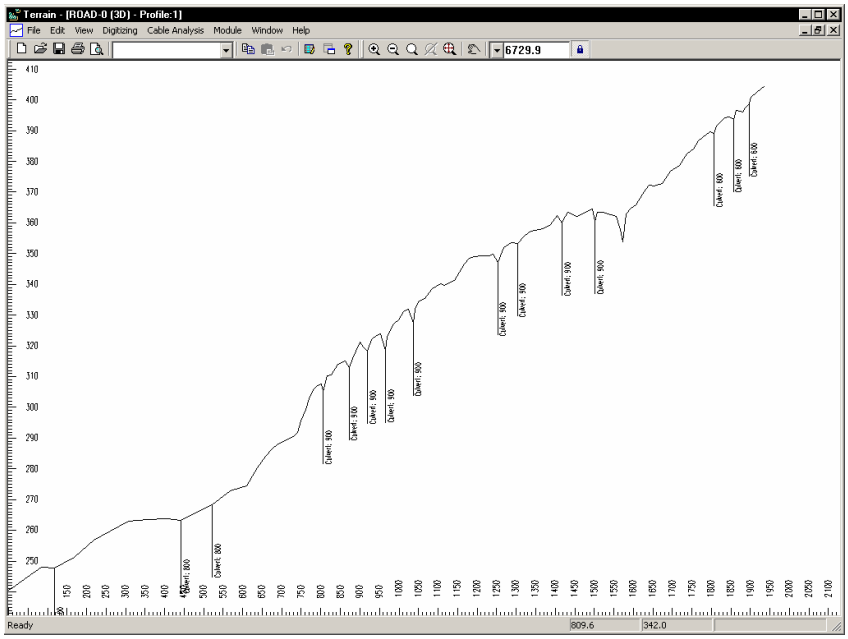


Figure 12.0: Profile of a Survey/Map Traverse Document

4. The scale has automatically been set to fit the entire traverse into the Profile Window. To change the scale: activate the Profile Window. Press the Active Window Options button or Select View | Active Window (Profile) Options to open the Profile Windows dialog box.

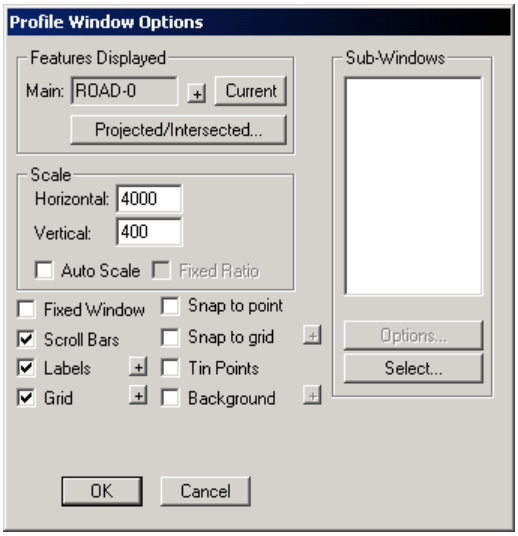


Figure 12.1: Profile Window Options Dialog

5. De-select *Auto Scale*. Set the *Horizontal scale* to 4000, the *Vertical scale* to 400 (for *feet* units set the *Horizontal scale* to 2000, and the *Vertical scale* to 200). Press OK.

6. 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).

7. To examine the profile near the proposed culvert at station 522. Using <Ctrl + N> and <Ctrl + B> move the current point to station 522 (as shown in Figure 12.2).

To display the station numbers, press the Active Window Options button. Press the + sign next to Labels. Double click to select Stations. Press OK to return to main screen. The Station numbers are now displayed.

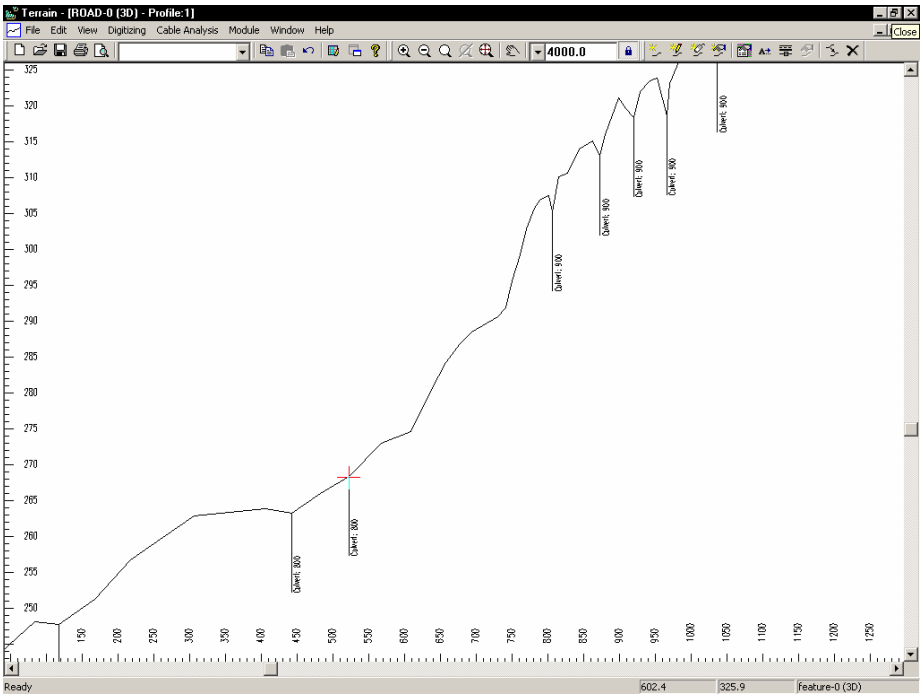


Figure 12.2: Profile with Current Station at 522

8. File│New. Do <u>not</u> 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. Select *Softree-Map Document (*.MAP)* from the *Files of Type* pull-down. Open **\Tutorial\Terrain\Terrain Survey\site.MAP**.

2. Make sure that *Include Side Shots* is **not** checked in the Import Options dialog box. Press OK.

3. File | Retrieve Screen Layout. Select and open **\Tutorial\Terrain\Terrain Survey\site.ILT**.

4. Press the *Zoom Extents* button. Your *Imported Site Map* should resemble Figure 12.3.

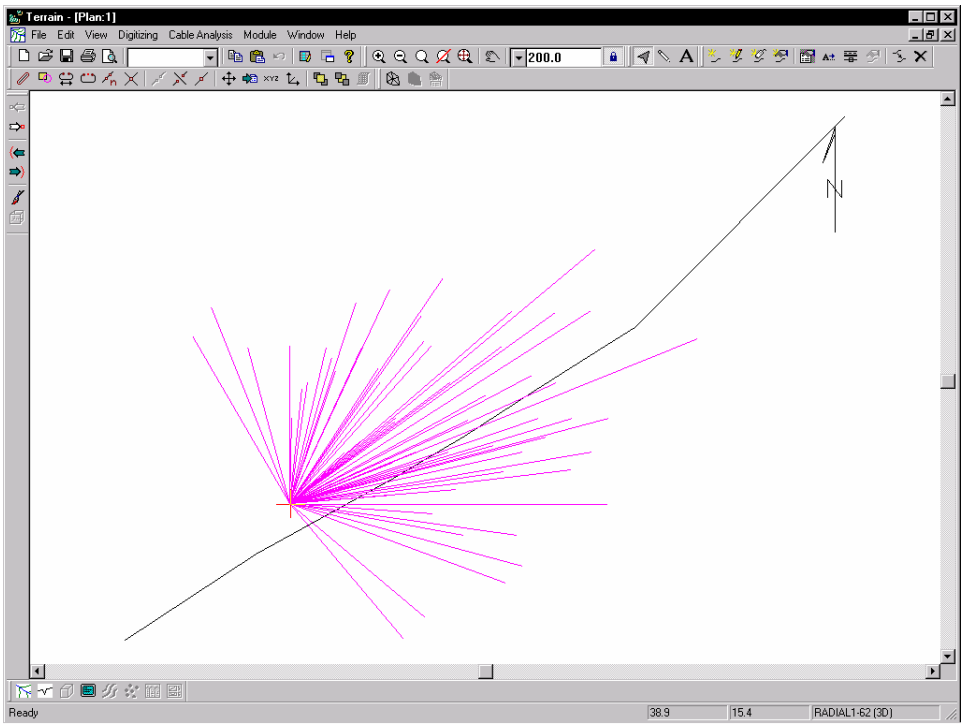


Figure 12.3: Imported Site MAP

5. For presentation purposes the imported survey information will be re-formatted and 'cleaned up'. Select Edit | Select Feature(s) | By Name,

6. Press the *Un-select All* button. Click on the *Advanced* button and type **RADIAL*** in the matching names area as shown in Figure 12.4. Press the *Select* button in the *Matching Names* area. Press OK. The selected features are displayed in magenta.

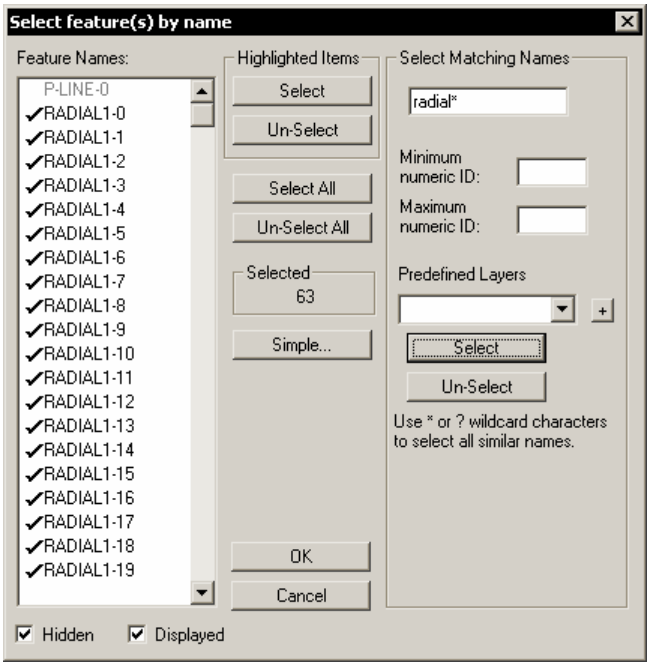


Figure 12.4: Select Features by Name Dialog

NOTE: The Select Matching names fields in the *Advanced* section of the *Select feature(s) by name* dialog 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. Press the *Line Style* button. Set symbols to *Cross*. Press OK.

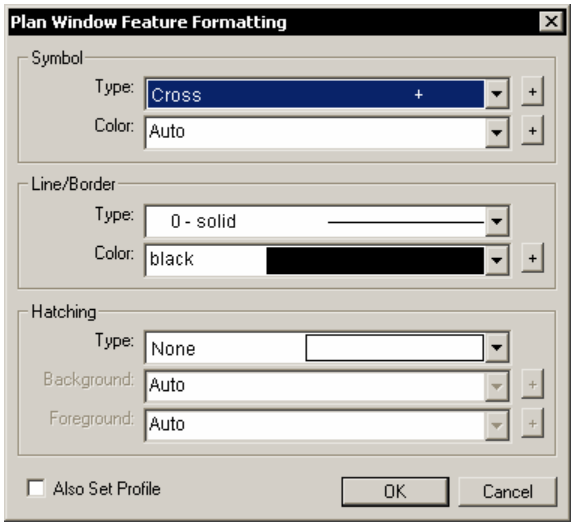


Figure 12.5: Line-types and Symbols Dialog

8. Press the *Properties* button and de-select the *Connected* property option. Press OK.

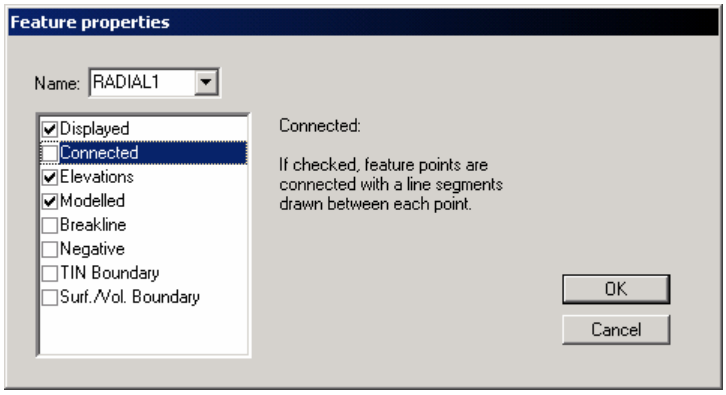


Figure 12.6: Feature Properties Dialog

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

10. Edit | Modify Selected Feature(s) | Labels or press the Labels button. Select *Stations (Survey)* by double clicking on the list box entry or enabling the *Display* checkbox. Press OK.

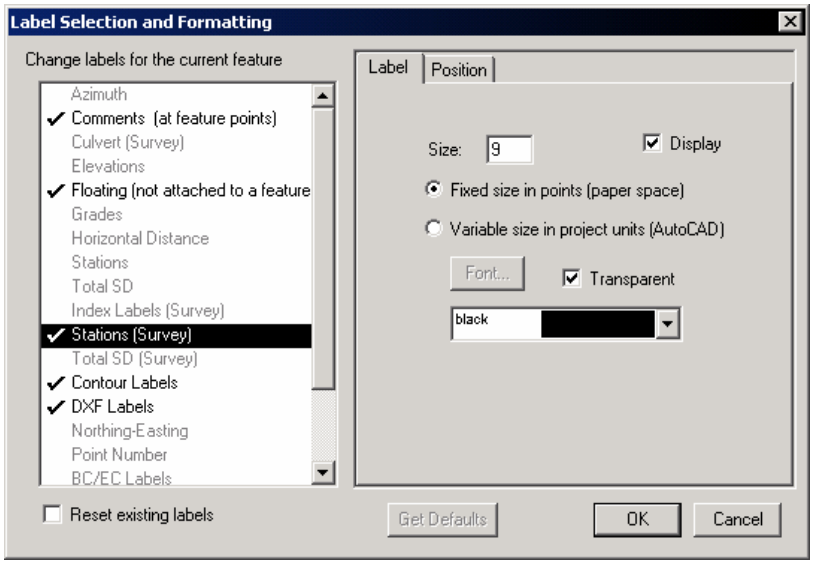


Figure 12.7: Label Selection and Formatting Dialog

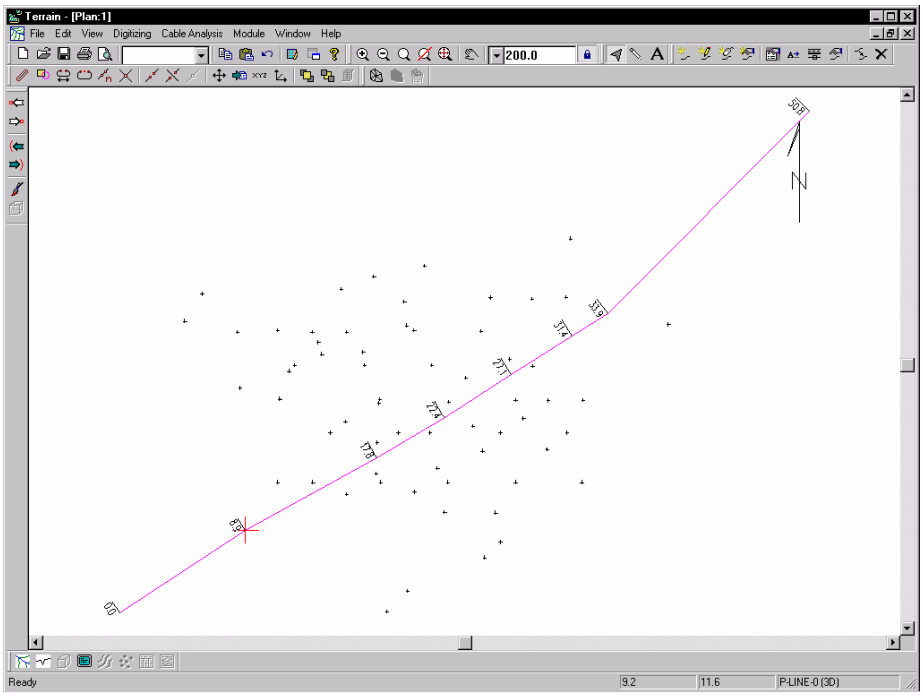


Figure 12.8: Site Plan after Formatting

11. Press the *Generate TIN* button to create a digital terrain model (DTM) and calculate contours. Set the parameters as shown in the Figure 12.9 Press OK

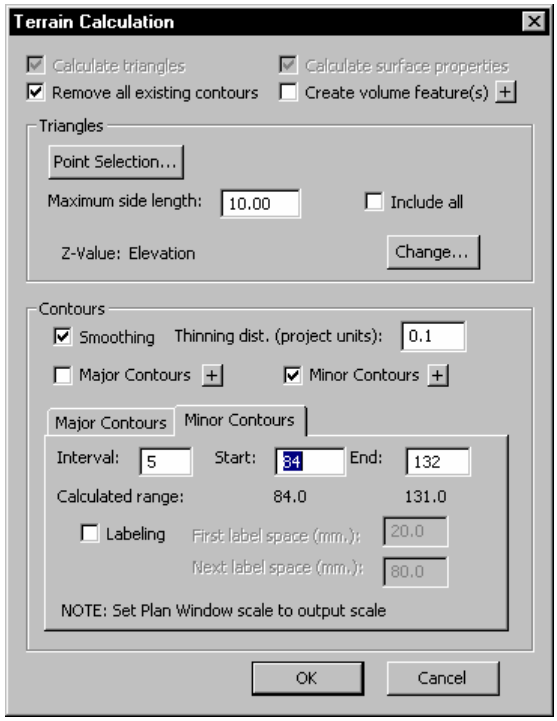


Figure 12.9: Terrain Calculation Dialog

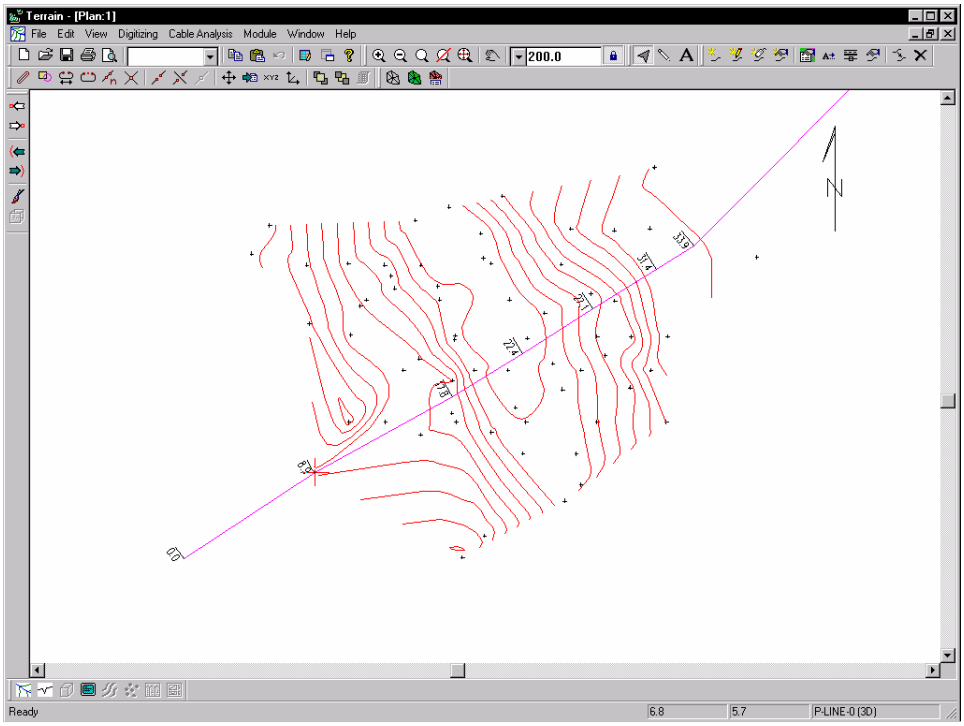


Figure 12.10: Site Plan with Contours

Your screen should now display contours of the stream crossing as shown in Figure 12.10.

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

Creating Custom Symbols and Line-types

In this section new symbols and line-types will be created. Tables of symbols and line-types are store together in TRF files. The default symbol and line table file is called **\RoadEng\normal.TRF**

Terrain and Location documents have private symbol/line tables stored in their files with extension **TE1** for Terrain and extension **DS3** for Location. The Survey/Map module always uses the default file **normal.TRF**.

Creating Symbols

A Symbol consists of Symbol Items and Text Items. Symbol items are a series of line segments. Text items are text and font information.

1. Module | Setup. Select the *General* tab. Press the *Symbols* button to activate the Symbols Editor.

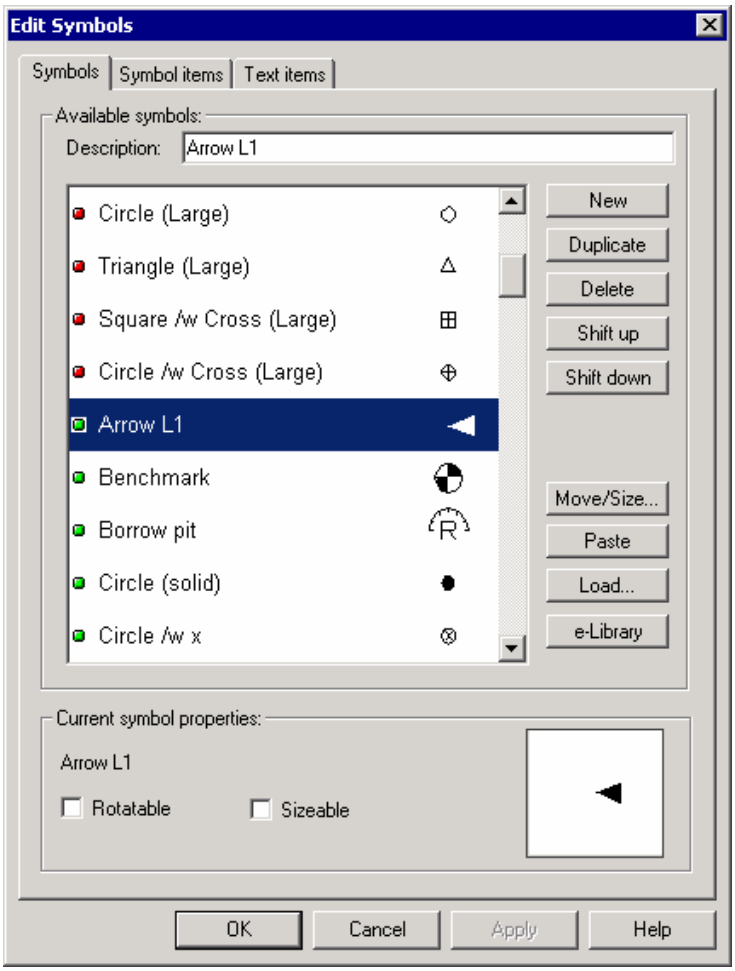


Figure 13.0: Symbol Editor Dialog

2. Press the *Load* button. Select and open the symbol table called **\Tutorial\Terrain\Terrain Customization\example.SYM**. You will need to select Softree V31.from the Files of Type dropdown menu.

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.

3. To select all of the symbols in the list, highlight the first item in the list. While holding down the shift key, scroll down using either <page down> or the <down arrow >to highlight all symbols. Press OK.

NOTE: Symbols will not be loaded if a symbol of the same name already exists in the table.

4. Press the *New* button and a new symbol *xxx* will appear in the *Existing symbols* list. The *Symbol items* and *Text items* tabs will be available.

5. Change the Description from *xxx* symbol to ***Tree*.**

6. Click on the *Symbol items* tab. Press the *New* button

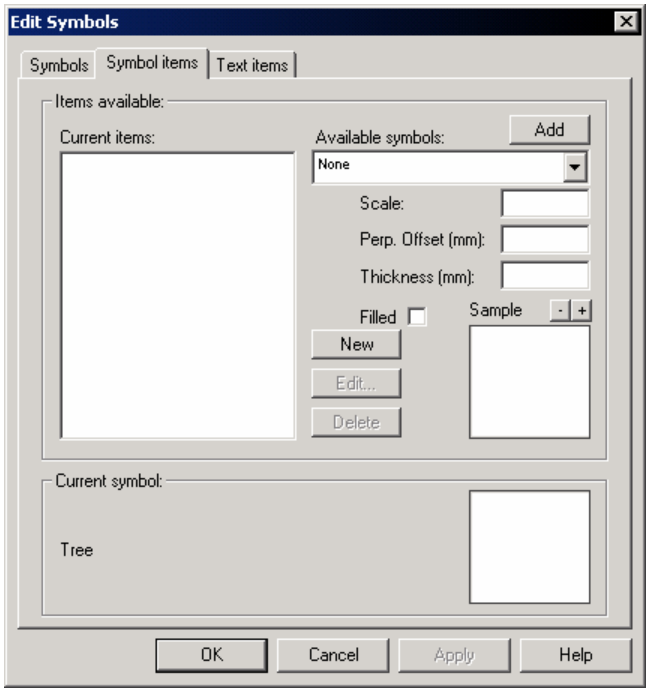


Figure 13.1: Symbol Editor Dialog - Symbol Items Tab

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 activated.

7. Press the Zoom button until you have zoomed to (x4).

8. Start 4 grid points above the red cross- hair. Click and drag with the arrow until you draw a straight line that is 4 grid points below the red cross-hair.

9. Repeat step 8. This time start 4 grid points to the left of the red cross- hairs and finish 4 grid points to the right of the red cross- hair.

10. Draw two more lines that run diagonally as shown in Figure 13.2. Once you are done press OK.

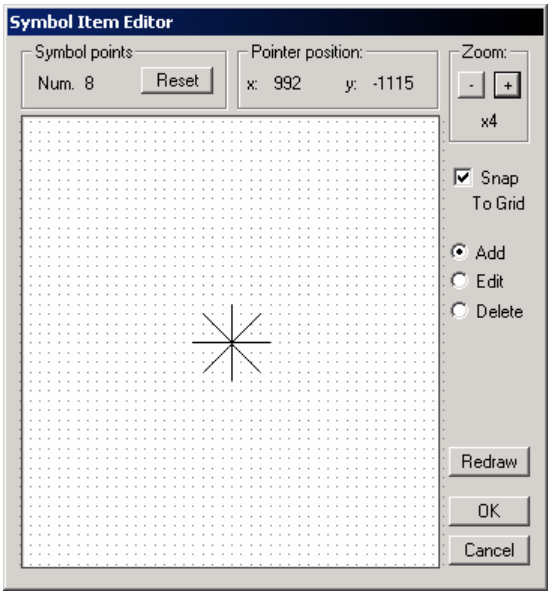


Figure 13.2: Symbol Item Editor

NOTE: This dialog 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.

11. Press the Symbols tab. The new symbol *Tree* is appears in the *Current Items* list and the *sample* box.

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.

If the symbol is a closed area you can:

- Fill it by activating the *Fill* option.
- Change the scale to something other than the default value of 1.00
- Perpendicularly offset the item by changing the *Perp Offset* option.
- Change the thickness of each item.

It is also possible to create symbols from characters and fonts. To make a compound symbol with one or more characters combined with one or more graphic items like the one created above.

12. To make a symbol with a single character, select the *Symbols* tab and press the *New* button. Change the *Description* from "xxx" to **Omega.** Click on the *Text items* tab.

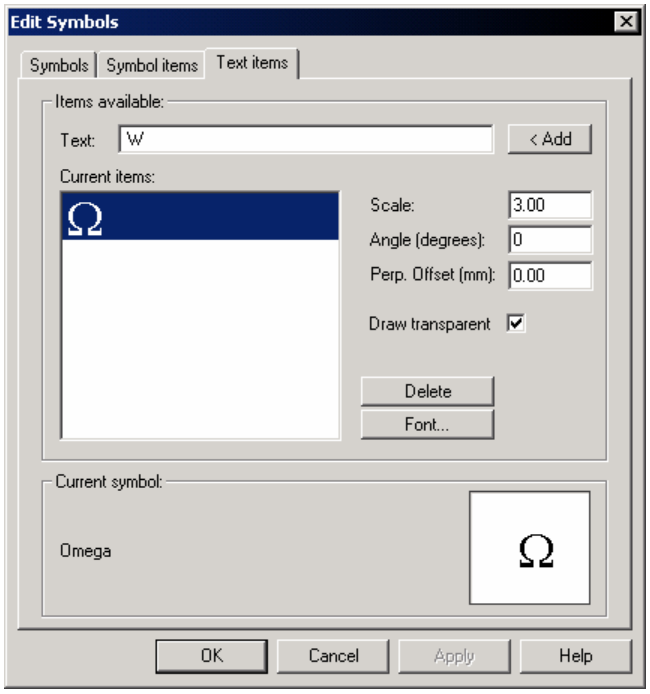


Figure 13.3: Symbol Editor Dialog - Text Items Tab

13. Type **W** in the *Text* field and press the *Add* button. Press the *Font* button to open the *Font Selection* dialog box. Select *Symbol* font, if available. Press OK.

NOTE: It is possible to create symbols from other specialized fonts as shown in the figure below.

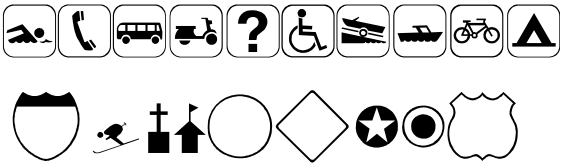


Figure 13.4: Symbols Created using Specialized Fonts

Fonts are not provided with the Terrain Module (check your software dealer or use the Internet to locate specialized font sets).

14. Press the Symbols tab. The new symbol *Omega* appears in the *Current Items* list and the *sample* box. Press *Save* in the Tables section of the Terrain Setup dialog. You are prompted with the File Save dialog box to save this table. Press *Cancel*.

15. Close the Symbols editor. Continue to step 2 in Creating Line-types or File | New to close. The symbol table files you create are available from the *Open* button.

If you save your file as **\RoadEng\normal.TRF** it will be the default Symbol and Line-type tables on your computer.

Creating Line-types

Line-types can contain periodic symbols and text as well as lines.

To load the Symbols Table please see steps 1-3 in the previous example Creating Symbols.

1. Select Module | Setup. Select the *General* tab. Press the *Line-types* button to activate the Edit Line-types Dialog box. (Figure 13.5)

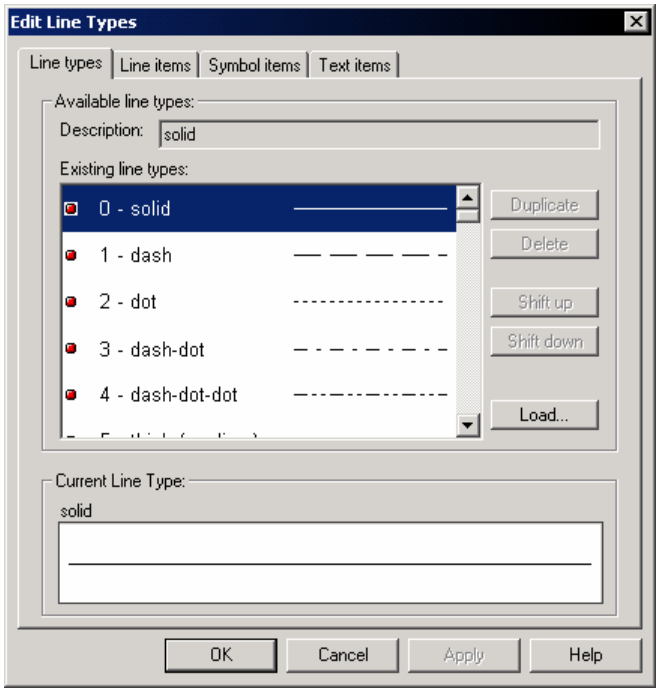


Figure 13.5: Edit Line-types Dialog Box

2. Click on the *Load* button and select the line-type table called **\Tutorial\Terrain\Terrain Customization\example.LIN**. From the *Files of Type – Softree V3.1 Lines (*.lin*) Press Open.

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 respectively), or from AutoCAD DWG files.

3. To select all of the line-types in the list, highlight the first item in the list. While holding down the shift key, scroll down using either <page down> or the <down arrow >to highlight all line-types. Press OK.

NOTE Line-types will not be loaded if a line-type of the same name already exists in the table.

4. From the *Existing line-types* list, scroll until you find the line-type called *Solid (.3 mm)* and select it. This will activate a number of buttons on the right side of the dialog box, as well as tabs at the top of the dialog box.

5. Press the *Duplicate* button. The Solid (.3 mm) will be duplicated at the end of the list. Change the *Description:* from *Solid (.3 mm)* to *Gully with S6 stream.*

6. Press the *Symbol items* tab, and the *Line-type Editor* will change to look like the Figure 13:6.

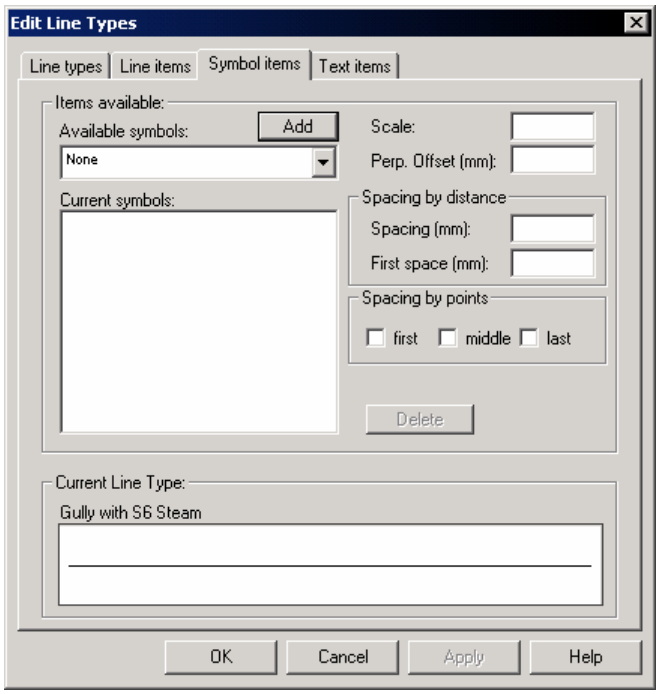


Figure 13.6: Line-type Editor Dialog - Symbol Items Tab

7. Scroll through the *Available symbols* list until you find a symbol called *open arrow* (near the end of the list). Select this symbol.

8. Press the *Add* button. The arrow symbol will be added to the *Current symbols:* list, and at the start of the *Current Line-Type.*

9. Un-select the F*irst* point option, and the symbol will now reappear every 10mm.

10. Again scroll through the *Available symbols* list select the symbol called *arrowhead*, and select the *last* point option. The arrowhead is now at the end of the line.

11. Press the *Text items* tab. Type **S6** in the *Text:* box, and press the *Add* button

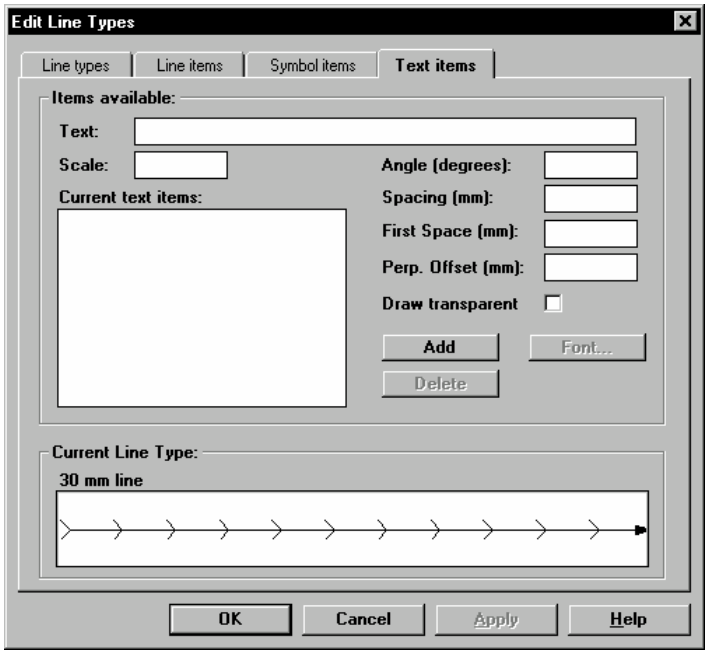


Figure 13.7: Line-type Editor Dialog - Text Item Tab

12. Change the *Spacing (mm):* to 20. Turn off the *Draw transparent* option. The text S6 will appear every 20-mm.

13. Click OK to return to the *Setup* dialog. Press *Save* in the Tables section of the Terrain Setup dialog box. You are prompted with the File Save dialog box to save this table. Press *Cancel*

Any TRF file you create is available from the *Open* button. If you save your file as **\RoadEng\normal.TRF** it will be the default Line-type and Symbol tables on your computer.

Cable Analysis

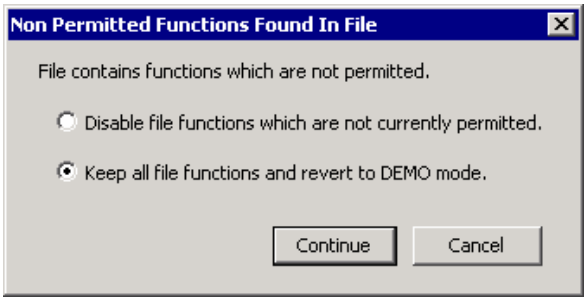
To understand the Cable Analysis Module you have to be well versed in Terrain Module components such as: displaying draped profiles, importing traverses from Survey/Map, and digitizing features.

The Cable Analysis Module calculates the behaviour of cable yarding systems. You provide a ground profile, logging setup (cable configuration, working tensions, and weight as well as carriage weight) and a calculation type. You can then display graphic or tabular results including tensions, load capabilities and ground clearance.

See the Cable Analysis On-line Help for details on modelling techniques and limitations. Calculations that require modelling (all except the *simple third point method*) assume a quasi-static load with no ground interference (flying load).

The examples in this section require the *Mapping and Drafting, Import Basic, Import Extended, Profile Window, Multi-Plot Output Sheet Generation* and *Cable Analysis* function groups enabled. See *Function Groups* in the On-line help for more information. D-Lines is part of Terrain Tools – Forest Engineer and RoadEng Forest Engineer packages only.

If your software license does not include the required Function Groups, when you open a file or screen layout you will be prompted:



Choose “Keep all the functions and revert to DEMO mode”. Examples in this section can be completed in Demonstration Mode. Contact Softree to upgrade your license to permit more functions.

This example is in metric units. To correctly follow the examples ensure Metric Units are enabled. Select Module | Setup before starting.

Cable Analysis on a Traversed Profile

Cable Logging Example

Any Terrain feature can be used as a ground profile for Cable Analysis, including imported or draped features. In this example a traversed profile (Deflection-Line or D-Line) will be analyzed for acceptable deflection, clearance, load, and tensions.

1. File│Open, select **\Tutorial\Terrain\Terrain Cable\cables.TER**. This example utilizes Logging Setups stored in this otherwise empty Terrain file.

2. File│Insert File, select *SOFTREE-Traverse Document (*.TR1,*.DB1)* from *File of Types*. Select **\Tutorial\Terrain\Terrain Cable\dline4.TR1**. Press Open.

3. Make sure *Include Side Shots* is disabled. Press OK.

4. From menu File | Retrieve Screen Layout, select **\Tutorial\Terrain\Terrain Cable\cables.ILT**. This sets up window positions and a large number of display options suitable for Cable Analysis.

5. Highlight the Profile or Data Windows, by selecting either window's title bar. Select Cable Analysis | Assign Setup to activate the D-Line Assign Setup dialog box shown in Figure 14.0.

6. Fill in all of the setup Parameters shown in Figure 14.0. Select *Slackline.* Press the *Select* button to select the corresponding equipment. In this case it is the *Thunderbird TY-90.* Press OK. Your computer screen should now appear similar to Figure 14.1

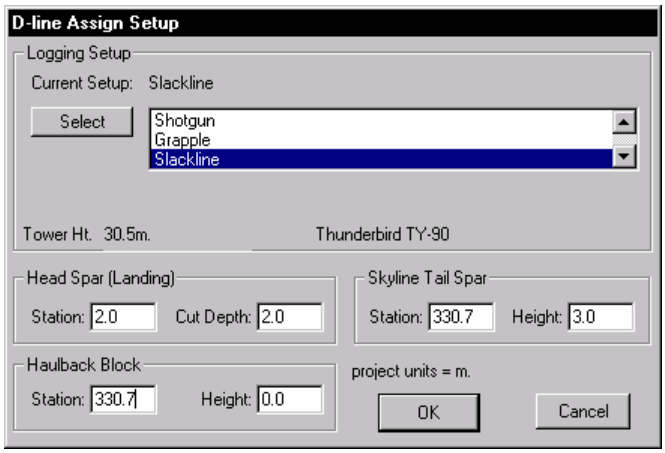


Figure 14.0 D-Line Assign Setup dialog box

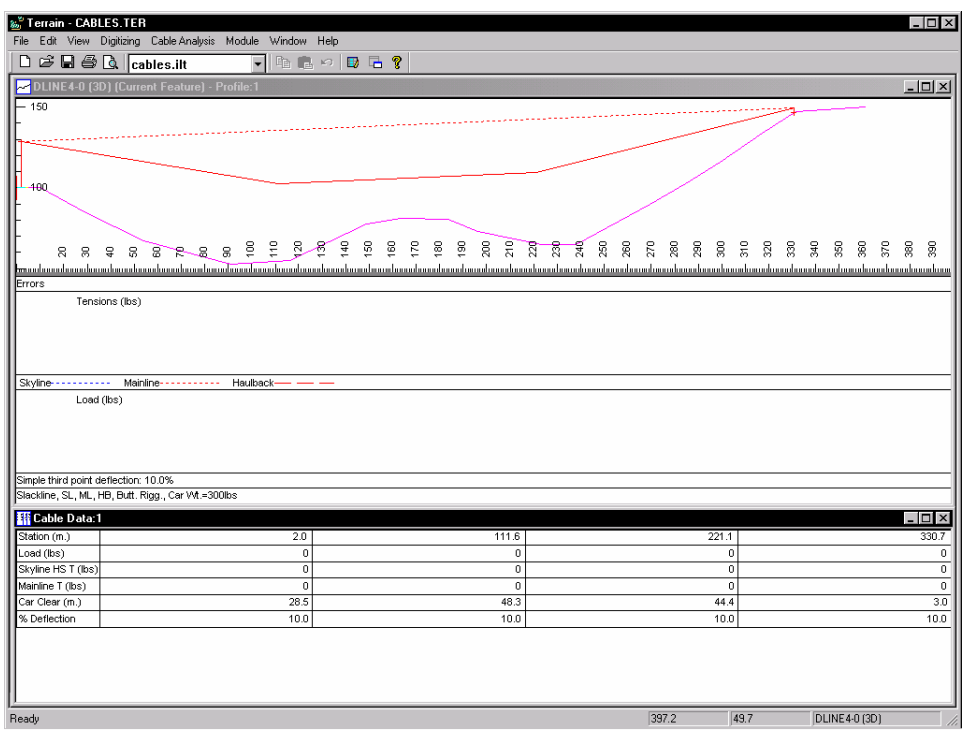


Figure 14.1 dline4.TR1 with cables.ILT applied.

This analysis shows simple percent deflection at thirds. In this analysis the only important result is clearance for a given deflection.

7. Select Cable Analysis | Calculation Parameters to activate the D-Line Calculation Options dialog box shown in Figure 14.2.

Note that *Simple third point Deflection* is selected and the value of *% Deflection (Equivalent mid span*) can be modified. The options displayed are contained in the screen layout loaded in step 4. **\Tutorial\Terrain\Terrain Cable\cables.ILT**

All types of analysis will be examined in the next few steps.

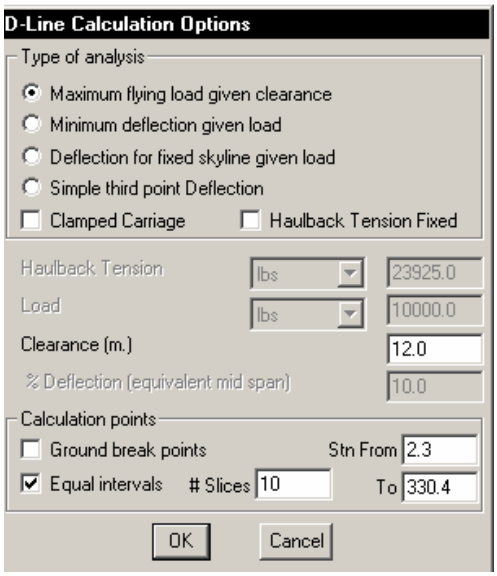
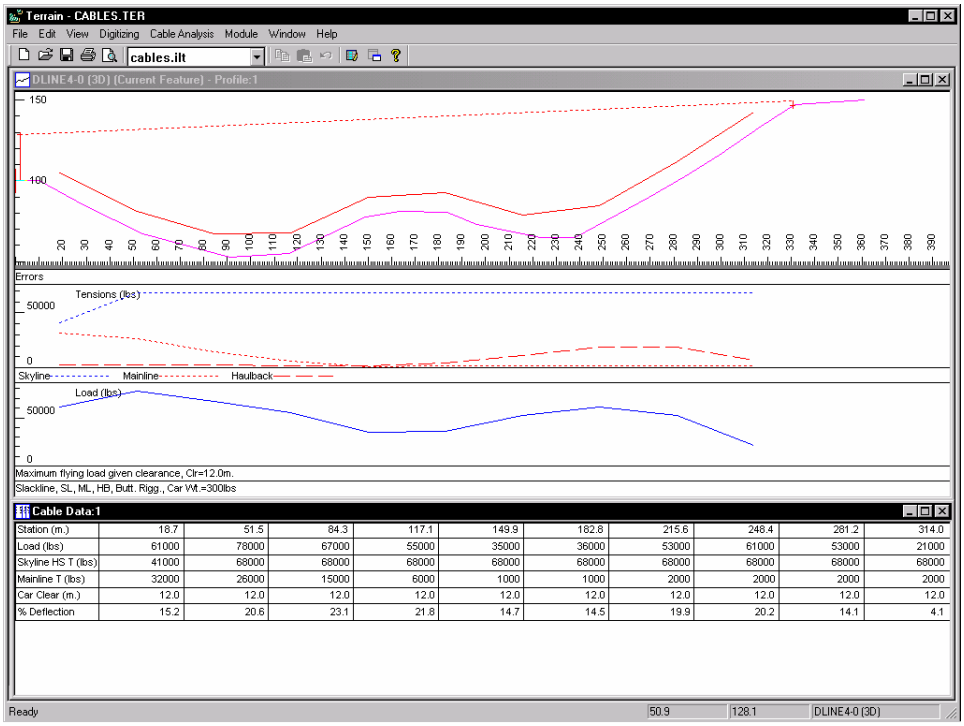


Figure 14.2 D-Line Calculation Options dialog box.

8. Enable the *Maximum flying load given clearance* option. Note that *Clearance* is the only parameter that can be changed. Press OK. Your screen should now appear like Figure 14.3.



Station (m.)	18.7	51.5	84.3	117.1	149.9	182.8	215.6	248.4	281.2	314.0
Load (lbs)	61000	78000	67000	55000	35000	36000	53000	61000	53000	21000
Skyline HS T (lbs)	41000	68000	68000	68000	68000	68000	68000	68000	68000	68000
Mainline T (lbs)	32000	26000	15000	6000	1000	1000	2000	2000	2000	2000
Car Clear (m.)	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
% Deflection	15.2	20.6	23.1	21.8	14.7	14.5	19.9	20.2	14.1	4.1

Figure 14.3 Deflection Analysis with Maximum Flying Load Given Clearance Option

Notice that the Cable Data Window shows a constant clearance (to top of carriage) above ground of 12.0m, and the load varies at each of the above stations. This analysis shows how much load you can lift at any point (given the desired clearance) and what deflection you would need to achieve this. At every point one of the cables is at its working tension and is therefore limiting any increase of load. See the *Creating a Logging Setup* section for information on defining and modifying working tensions.

Note that the *Maximum flying load given clearance* option does not model an actual yarding process as the skyline length would have to be adjusted continuously and it does not make sense to change the load every few meters.

9. Cable Analysis | Calculation Parameters, select the *Minimum deflection given load* option. Press OK. The screen should now appear similar to Figure 14.4.

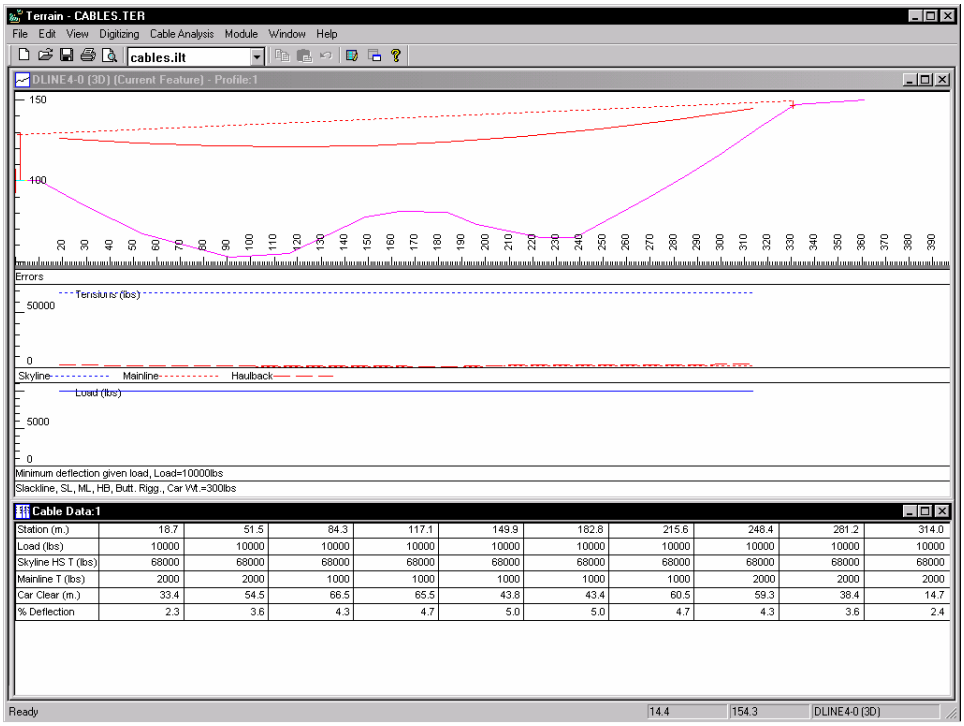


Figure 14.4 Deflection analysis with Minimum deflection given load.

As you increase the load the cable will sag more and more. Deflection has to increase so that the tensions on the cables do not exceed working tension.

Unlike the previous example, the *Minimum deflection given load* option does model a possible yarding process. The solid red line in the Profile Window represents the path the top of the carriage (where the cables join) would traverse if the operator adjusted the skyline dynamically to keep his cables at maximum working tension. This is not likely to happen for the current *Slackline* system (with a separate skyline) but may be reasonable for a running skyline logging setup.

10. To investigate *Deflection for fixed skyline given load* option, open Cable Analysis | Calculation Parameters. Note *load* and the *%Deflection* can be user defined. Press OK to accept changes. The screen should now appear similar to Figure 14.5.

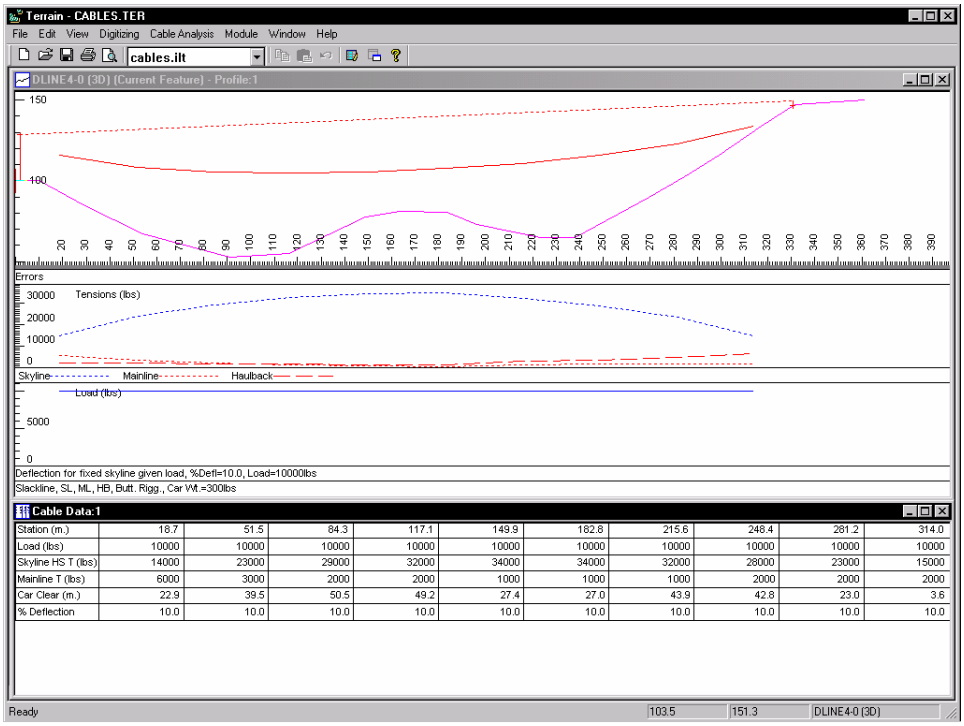


Figure 14.5 Deflection Analysis With Deflection For Fixed Skyline Given Load Option.

Deflection for fixed skyline given load shows the carriage path for a realistic yarding process for this setup.

11. Select Cable Analysis | Calculation Parameters and change the *Load* to 25000lb (or 11,000kg if you change the units combo box). Press OK. Note that a red bar appears in the *Errors* sub-window under the profile. Click on the red bar; an error report will inform you that in this area the skyline has exceeded working tension. Press OK.

12. Go back to Cable Analysis | Calculation Parameters and change *% Deflection* to 12. Press OK. Note that the error bar has disappeared.

13. File | New. Do not save changes.

Multiple Deflection Lines on a Page

Up to 10 deflection lines can be analyzed simultaneously. All 10 can be printed onto a legal size page. Multiple d-lines.TER is an example with 10 profiles and a layout that will create a Multi-Plot of 10 D-Lines.

1. File | Open. **\Tutorial\Terrain\Terrain Cable\multiple d-lines.TER**.

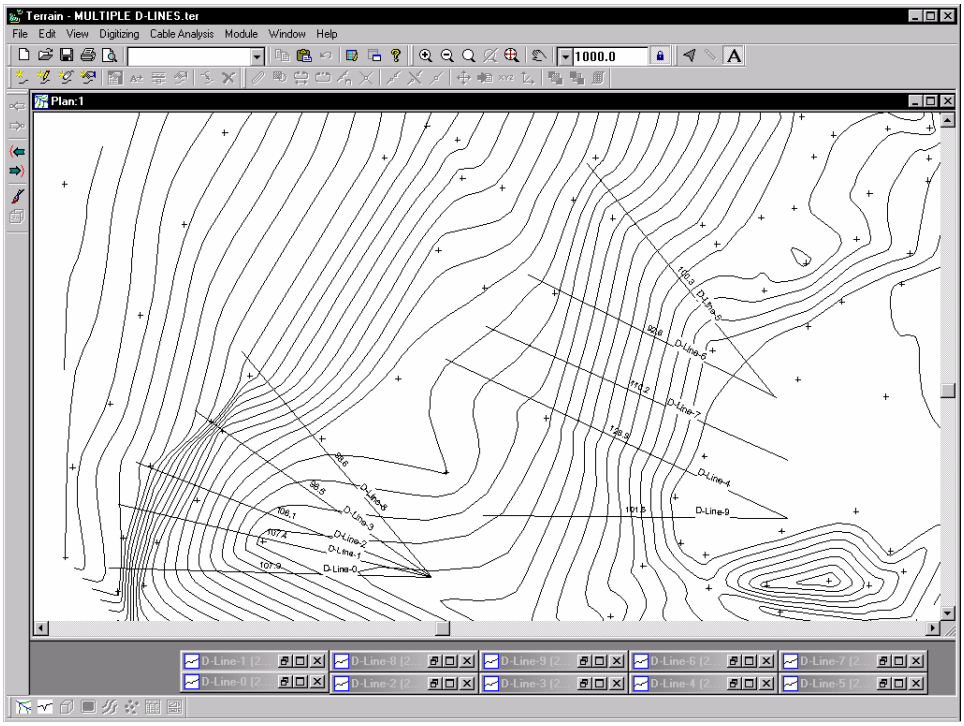


Figure 14.6 Terrain screen after opening multiple d-lines.TER.

Notice that the Plan Window has 10 black D-Lines that are labelled with the name D-Line. Each one of the D-Lines corresponds to a feature in a Profile Window shown at the bottom of your screen. They were created as draped features. (See On-line Help or *Creating Profiles from a Digital Terrain Model* for a description of draped features).

2. Maximize the *D-Line-0* Profile Window found at the bottom of your screen.

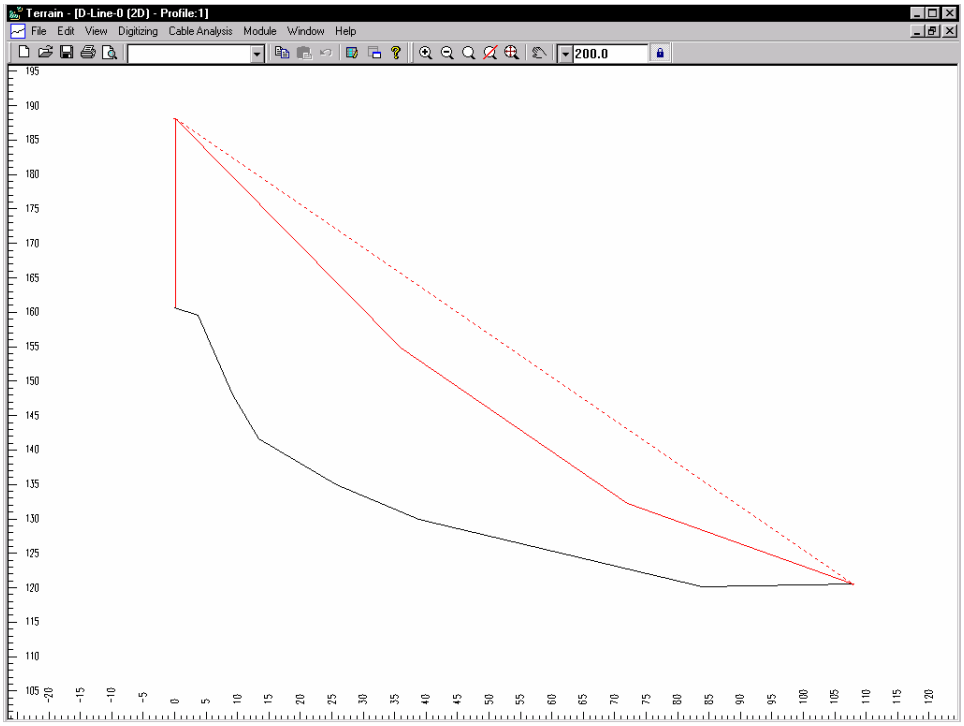


Figure 14.7 D-Line-0 (Profile:3) Window restored.

The Profile shown in Figure 14.7 displays D-Line-0 in the Plan Window. The analysis is a simple deflection at thirds, and the setup is Grapple with an American 7280B yarder and a 27.4m tower.

Since the analysis was done previously for all 10 D-Lines (see *Cable Analysis on a Traversed Profile*), a Multi-Plot displaying all ten can be created.

3. File│Retrieve Screen Layout, select **\Tutorial\Terrain\Terrain Cable\multiple cables.ILT.**

4. File│Printer Setup, change the paper orientation and size to Portrait and 8.5 X 14. Press OK

The Multi-Plot shown in Figure 14.8 will now be displayed. You are now ready to print your output.

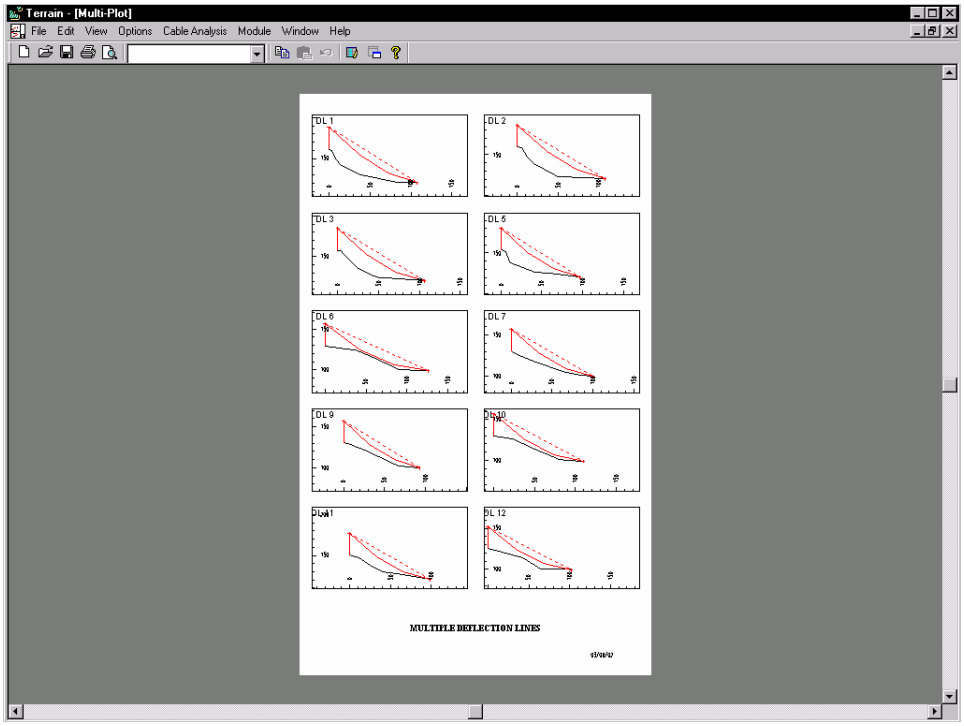


Figure 14.8 Multi-Plot Window of 10 D-Lines

NOTE: Use the **multiple cables.ILT** layout on your own D-Lines, and it will create the same output, except the contents will be different. Use File│Save Screen Layout to put this layout in your C:\Program Files\Softree\RoadEng directory so the layout name will be added to the combo box in your title bar.

5. File│New. Do not save changes.

Creating a Multi-Span Setup.

For some terrain, cable yarding with intermediate supports is the best solution. The Cable Analysis module does not handle such multi-span setups directly, however, this example will show you how to work with such a setup.

1. Select File│Retrieve Screen Layout, open **\Tutorial\Terrain\Terrain Cable\cables2.ILT**. Press OK.

2. From menu File│Insert File, select from *files of type Softree Traverse Document (*.TR1,*.DB1)* select and insert **\Tutorial\Terrain\Terrain Cable\dline6.db1**.

3. Make sure *Include Side Shots* is disabled. Press OK

First step is to create a setup to represent the first segment of the multi-span.

4. Highlight the Profile Window. Select Cable Analysis│Assign Setup to activate the D-Line Assign Setup dialog box shown in Figure 14.9

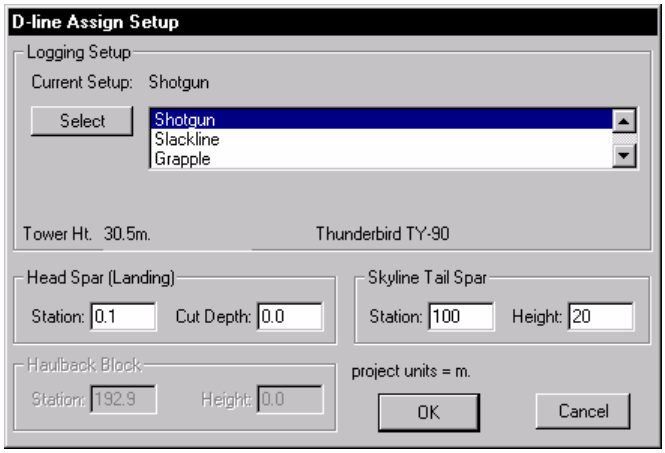


Figure 14.9 Assign Setup dialog box.

5. Change the setup data to match Figure 14.9. To select the *Shotgun* setup, highlight *Shotgun*, and then press the *Select* button. Press OK.

6. Select Cable Analysis│Calculation Parameters, change the *Type of Analysis* to *Minimum deflection given load*, and the *load* to 30000.0. Press OK.

Your Profile with analysis should appear similar to Figure 14.10

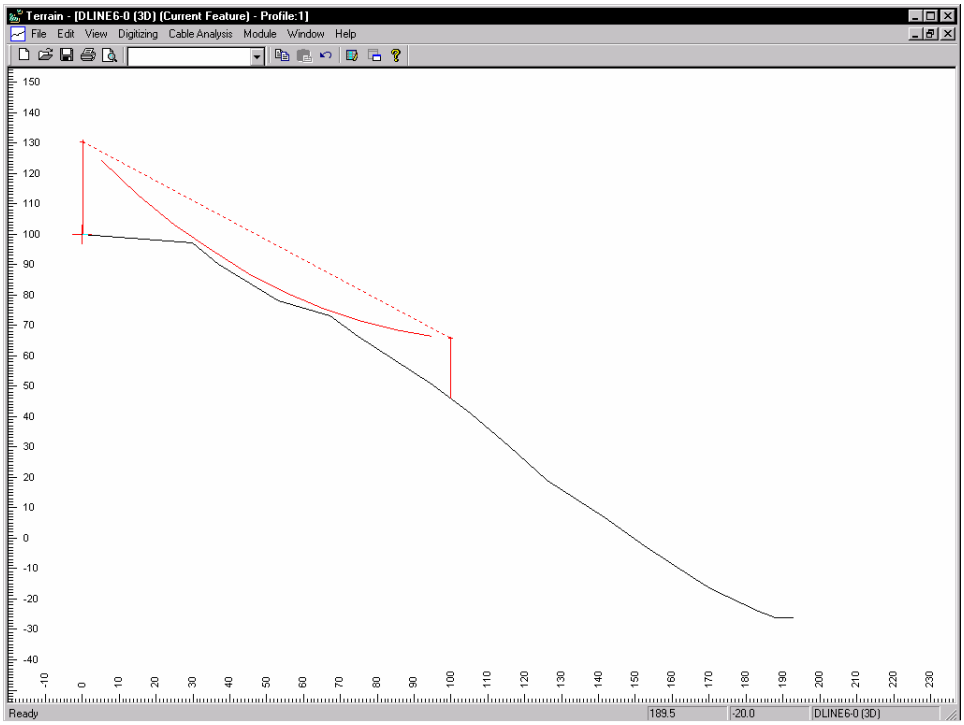


Figure 14.10 Profile:1 Window.

7. File│Insert File, select from *files of type Softree Traverse Document (*.TR1,*.DB1)* open and insert: **\Tutorial\Terrain\Terrain Cable\dline6.db1**..

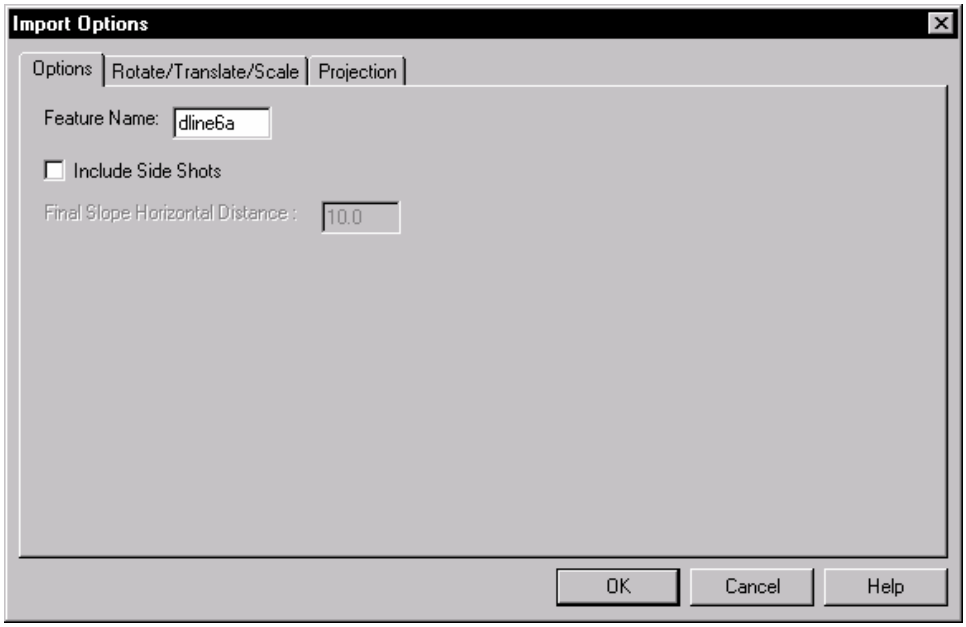


Figure 14.11 Import Options dialog box.

8. Change the Import Options box as above. Press OK. For the *Dline6a-0* profile to appear in the profile:1 Window it must be added in through the import options.

9. Press View | Profile Options button.

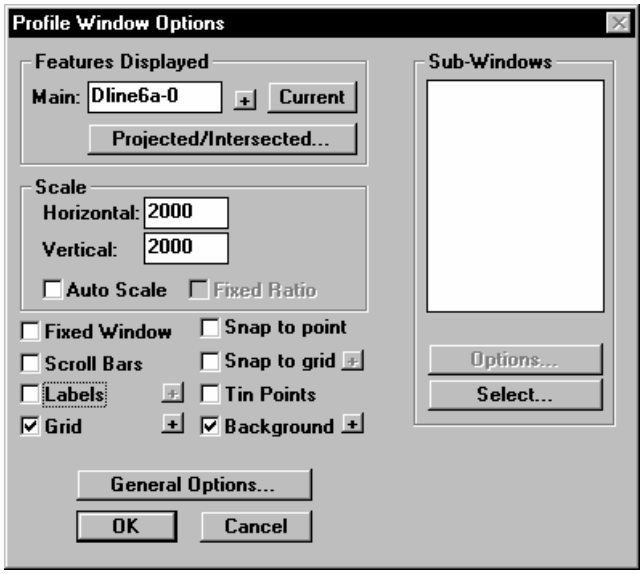


Figure 14.12 Profile Windows Options

10. Change the data in the Profile Windows Option dialog box to match Figure 14.12. To change the scales clear the *Auto Scale* check box and then type in the numbers shown. Press OK to accept changes.

11. Open Cable Analysis | Assign Setup dialog box as shown in Figure 14.13.

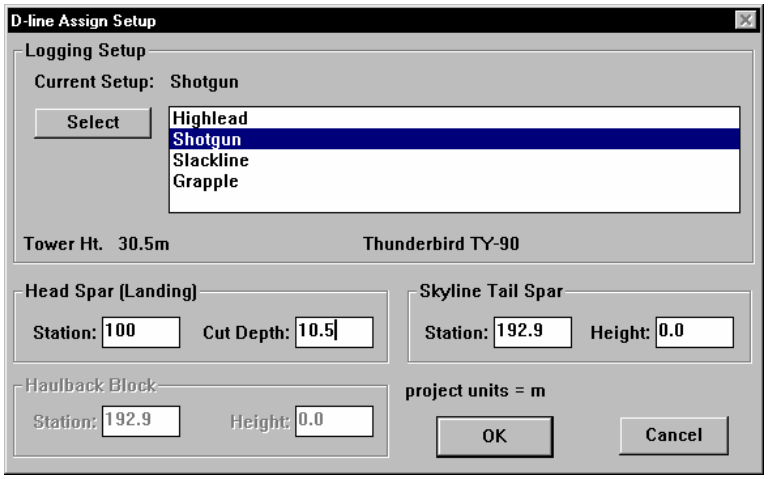


Figure 14.13 Assign Setup dialog box.

12. Change the dialog box to resemble Figure 14.13. Note that the *Station* for the Head Spar is the same as that for the previous Tail Spar; this is your intermediate support. The Cut depth of 10.5 effectively shortens the tower to 20m. Press OK when done. Figure 14.14 displays the new profile with analysis.

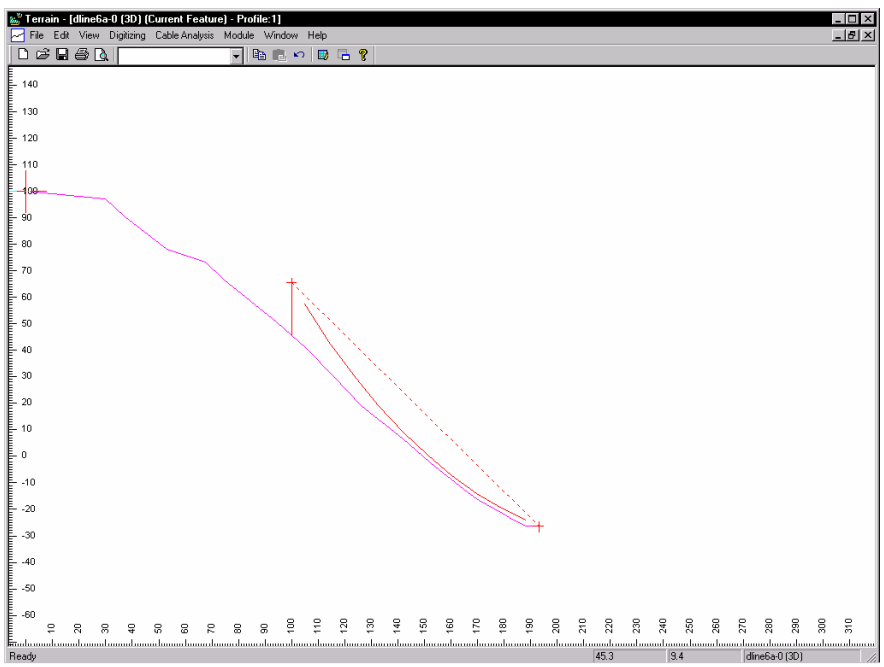


Figure 14.14 Profile:1 Window With New Feature and Analysis.

Before a Multi-Plot to represent the first half of our multi-span can be created, a second Profile Window must be created.

13. Window|New Window|Graphics|Profile. A new Profile Window will appear.

14. Press View|Active Window (Profile) Options button. Change the *Main Feature Displayed* to DLINE6-0 and make sure that the scale still reads 2000 *Vertical* and 2000 *Horizontal.* Press OK.

15. Window|New Window|Multi-Plot. An empty Multi-Plot Window will appear.

16. Edit|New Sub-View|Profile: 1. The Profile:1 Sub-View will appear in the center of the Multi-Plot.

17. Edit|New Sub-View|Profile: 2. The Profile: 2 Sub-View will appear over the Profile: 1 Sub-View in the Multi-Plot Window.

By default the two windows are aligned. The two separate setups appear as one multi-span as shown in Figure 14.15 The calculations are still based on two separate systems and do not incorporate the physics of a linked system; this is not important for the *simple third points* calculation and is an approximation for other calculations.

At this point you may want to adjust the position of the two Profile Sub-Views and add other information to the output sheet. Note that the Grid has been enabled in the View|Multi-Plot Options dialog box so that it is easy to get the windows aligned.

Use the Edit|Shuffle Front to Back menu if you wish to move or size the underneath sub-view. Also note that if you scroll one Profile you must scroll the other to maintain alignment.

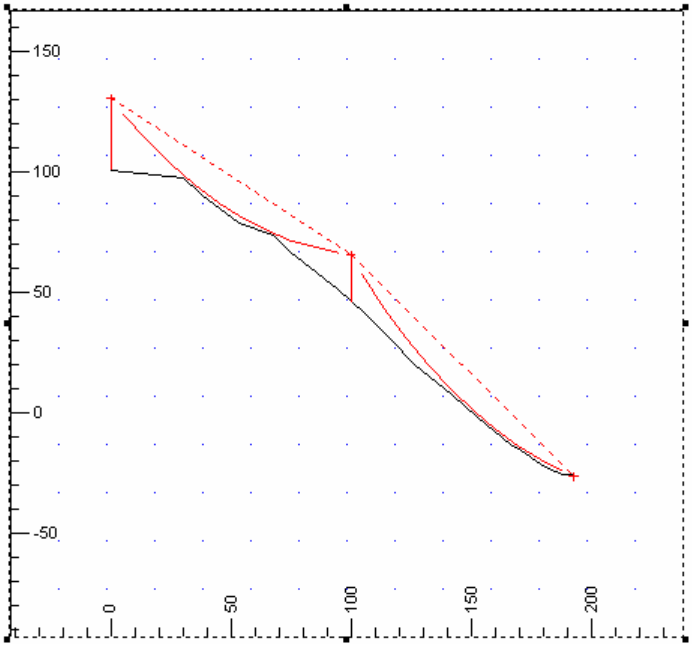


Figure 14.15 Multi-Plot of a Multi-span skyline.

18. File|New. Do not save changes.

Creating a Logging Setup

A Logging Setup represents the yarder, cables and carriage. A Logging Setup is a combination of Equipment and Logging Configuration.

1. To create a new yarder, select File|Retrieve Screen Layout, select **\Tutorial\Terrain\Terrain Cable\cables.ilt**. This loads the window positions and display options suitable for Cable Analysis.

2. Activate the Profile Window. Select Cable Analysis|Equipment to open the dialog box shown in Figure 14.16.

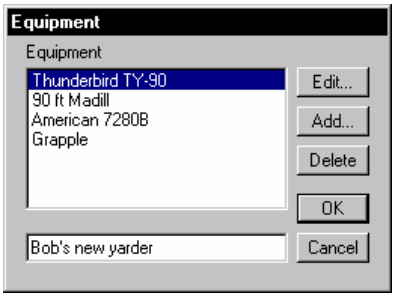


Figure 14.16 Equipment list dialog box

3. Type the name **Bob's New Yarder** in the bottom edit box then click the *Add* button this activates the *Equipment Edit dialog box* shown in Figure 14.17.

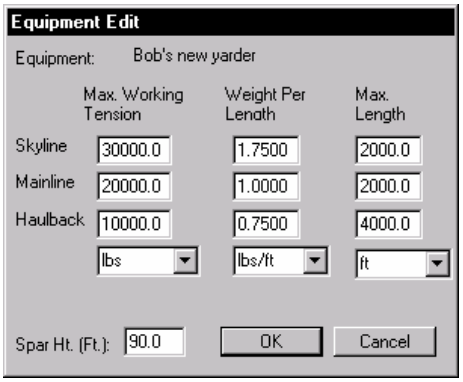


Figure 14.17 Equipment Edit dialog box

4. For this example there is no need to change any of the default values. If, however, this were a real yarder you would have to get correct values for *Max. Working Tension* and *Weight Per Length* for future analyses to be accurate. Press OK to exit the dialog box and add the new Equipment to your list. Press OK again to exit the Equipment list dialog box.

5. Select Cable Analysis|Setup.

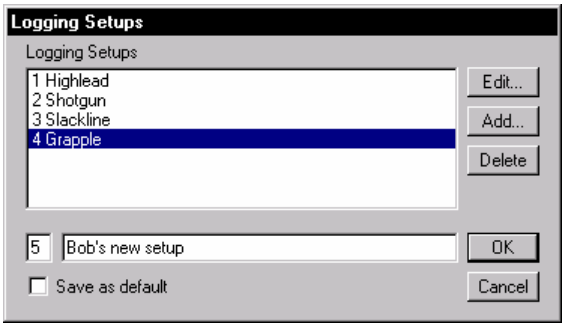


Figure 14.18 Logging Setups list dialog box

6. Type a new index number, **5**, and title, **Bob's New Setup**, as shown in Figure 14.18. Press the *Add* button to open Logging Setups dialog box.

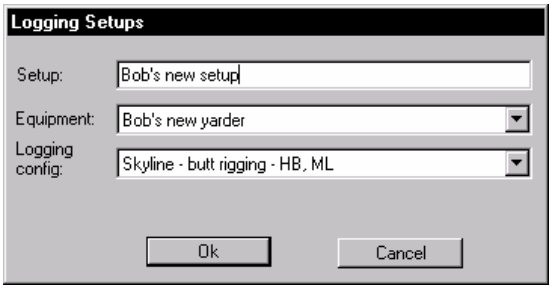


Figure 14.19 Logging Setups dialog box

7. Select the items shown in Figure 14.19. You are rigging *Bob's New Yarder* with a *Skyline* system. The carriage is a simple block attached to butt rigging; it is moved by both mainline and haulback cables. Press OK to add the new *Logging Setup* to your list. Do not exit the Logging Setups dialog box.

NOTE: The items in the *Logging config* list in the *Logging Setups* creation dialog box are not configurable and are described in On-line Help.

It is possible to create as many setups as you like with each yarder.

If you change cables on your yarder, then you should modify your equipment with the Cable Analysis | Equipment dialog box but this will only affect new setups. To modify the setup just created.

8. Click on the Edit button; the Logging Setup Options dialog box shown in Figure 14.20 will appear.

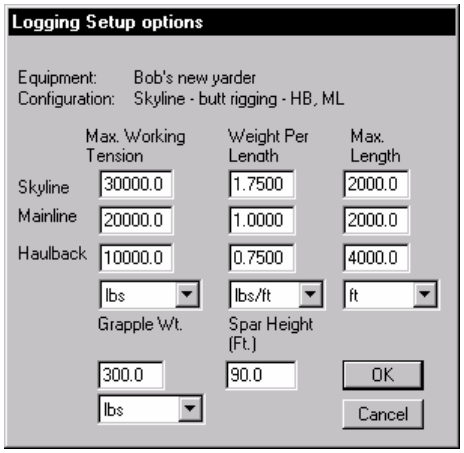


Figure 14.20 Logging Setups options dialog box

9. All the parameters extracted from the Equipment and Logging Configuration can be modified if required. Press Cancel to exit.

NOTE: Before you exit the Logging Setups dialog box, check the *Save as default* check box, Figure 14.18. If you do not check this item your setups will only be saved with the current Terrain. If you check *Save as default* your setups will also be saved in the **C:\Program File\Softree\RoadEng\cables.prm** file and will be available for the future.

10. File | New. Do not save changes

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