Survey Map Tutorial

Version 7

Softree Technical Systems Inc.

Document Version - September 11, 2015

The software described in this document is furnished under a license agreement or non-disclosure agreement. The software may be used or copied only in accordance with the terms of that agreement. No part of this manual may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, for any purpose other than the purchaser's personal use without the written permission of Softree Technical Systems Inc.
No warranty is expressed or implied as to the documented function or performance of the software described. The user of the software is expected to make the final evaluation of the results in the context of his /her own application.

Trade Marks

AutoCAD is a registered trademark of Autodesk.
Criterion and LaserSoft are registered trademarks of Laser Technology, Inc.
Hewlett-Packard, HP and LaserJet are trademarks of Hewlett-Packard Company
Microsoft Windows 2000, NT, XP, Vista, Microsoft Word, and Microsoft Excel are trademarks of Microsoft Corporation
Terrain Tools® and RoadEng® are registered trademarks of Softree Technical Systems Inc.

Suite 204 - 1075 West 1st Street
North Vancouver BC
Canada V7P 3T4

Table of Contents

1. **Getting Started**

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

Files

The tutorial files referred to in the following examples can be installed from the RoadEng install CD/Flash Drive or from Softree's web site:

CD or Flash Drive
An Auto-run screen should appear when the RoadEng Forest Engineer install medium is inserted. (If Auto-run is disabled, view the device in Windows Explorer and run the executable manually). Select *Install the Tutorial Files*.

Web Go to the *Support-Documentation Updates* page on Softree's web site: **http://www.softree.com/Support/Support_Documentation.aspx** . In the *Forest Engineering* section, click the link to download the *Tutorial Files and Documentation* installer. Open this file to install.

Documents

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

C:\Users\Public\Documents\Softree\Training70\SurveyMap

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

Defaults and Layouts

The setup and layout files required for the examples are saved in the folder below:

<Defaults and Layouts>\Training

Where **<Defaults and Layouts>** depends on your operating system and application install. The common location for **<Defaults and Layouts>** is shown below**:**

XP:	**C:\Documents and Settings\All Users\Application Data\Softree\RoadEng**
Vista:	**C:\ProgramData\Softree\RoadEng**
Windows7:	**C:\ProgramData\Softree\RoadEng**

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

Don't save files (in most cases)

Most of the following examples end with the phrase: "… do not save changes". If you modify the tutorial files, they will no longer work with the steps in the exercise; this will prevent you, or someone else, coming back and doing the exercise again. In the event that the files do get modified, you can always delete and re-install the tutorial files.

Demonstration Mode

RoadEng® requires a password or USB hardware key (dongle) for each licensed copy. If you do not have a license, *Demonstration Mode* allows you to preview and test functions before purchasing. In *Demonstration Mode* printing and file saving are disabled.

Note: Many of the examples in this manual can be successfully completed in *Demonstration Mode*.

Function Groups

Some RoadEng® (and Terrain Tools®) products have certain features; we classify these optional features by *function group*.

If you do not have a password or hardware key, then only a few Terrain Module *function groups* are permitted without entering *Demonstration Mode*. To view or change the enabled function groups:

1. Select *Module* / *Setup* from the menu bar; an Options Dialogue box appears. Click on the *General* tab.

2. Click on the *Menus* button to open the Menu Customization Dialogue 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.
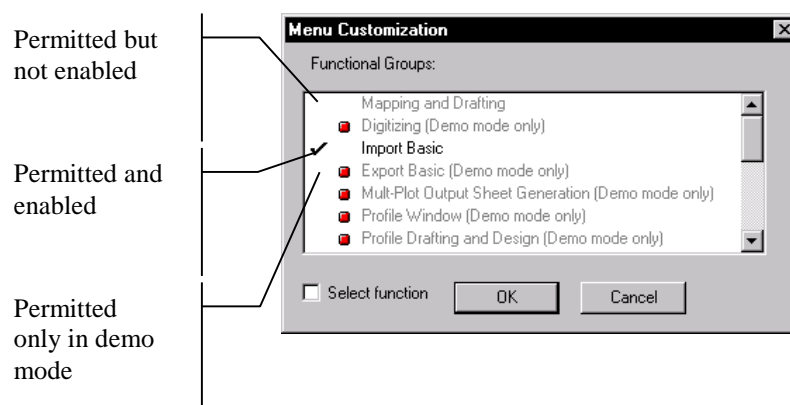

Figure 1.1: Function groups displayed in the menu customization *dialogue*

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:
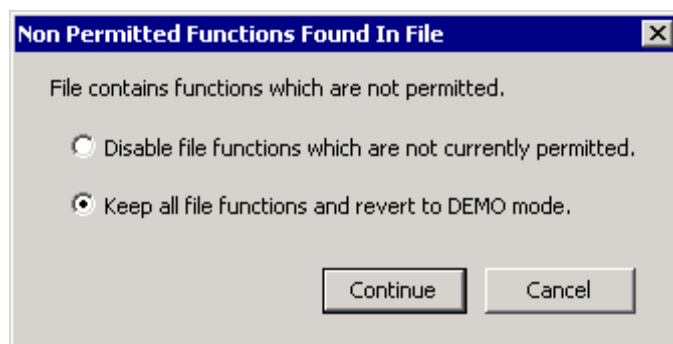

Figure 1.2: Function groups not permitted prompt

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> on your keyboard. The On-line Help includes detailed technical information about menus, dialogue boxes, and operation of the program.

It may be useful to refer to the On-line Help while working through the examples in this manual.

Tutorial Units

Most examples in this tutorial are in Imperial Units (feet). To correctly follow the examples ensure Imperial (ft) units are enabled in the *Module | Setup* dialogue box. 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 the checkmark above) indicate the beginning of an example or a place where you can jump in without completing any earlier steps. All files required to start from a checkpoint are included in the Tutorial install.

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.
- Dialogue box control (like buttons) and heading names are *italicized*.
- The symbols "< >" contain keyboard functions. For example < shift-enter> means: hold down the *Shift* key and press the *Enter* key.
- File names and path names are **bold.**

2. **Functional Overview**

The Survey/Map module was developed for survey applications in the forest industry. It can be used with a variety of survey equipment and accuracy requirements, including clinometer/compass, theodolite, level, and EDM. GPS coordinates can also be included to geo-reference traverses and for coordinate adjustments.

Survey Map Screen

Survey/Map includes facilities for field note capture, adjustment and display. Two main screens are available for entering and manipulating survey data; a fully customizable spreadsheet for field note capture (*Traverse Screen*) and a fully customizable plan display window for displaying one or more traverses (*Map Screen*).
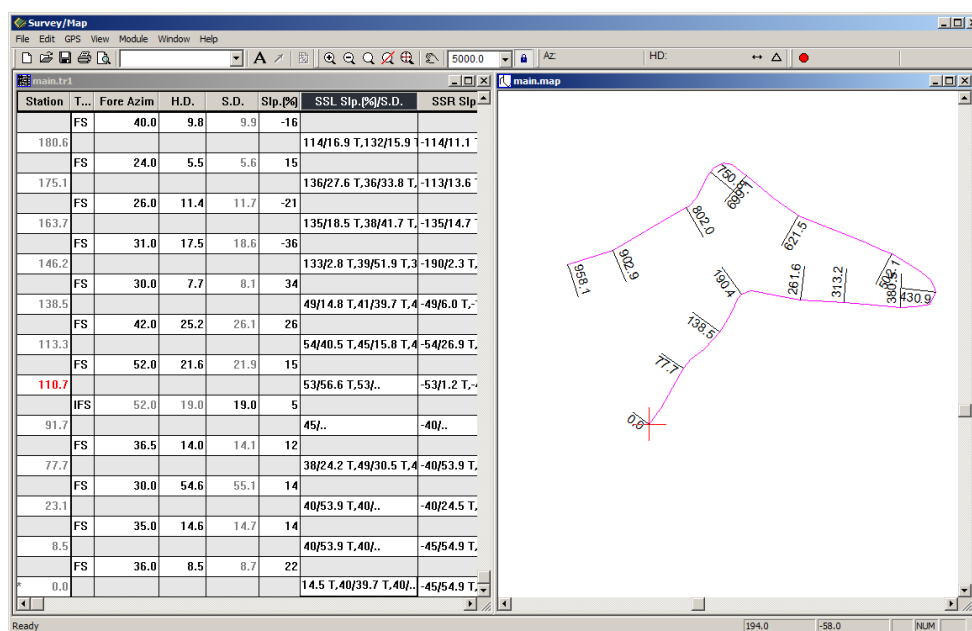

Figure 2.1: Survey/Map screens

Shot Types

The following terminology is used in Survey / Map:

FS **Foreshot** is a shot on the traverse centerline from current instrument position to the next instrument position.

BS **Backshot** is a shot on the traverse centerline from current instrument position to previous instrument position. Matching FS and BS shots are averaged.

IFS **Intermediate field shot** is a shot on the centerline which is not a turning point. The bearing of the IFS shot is assumed to be the same as the next FS which follows.
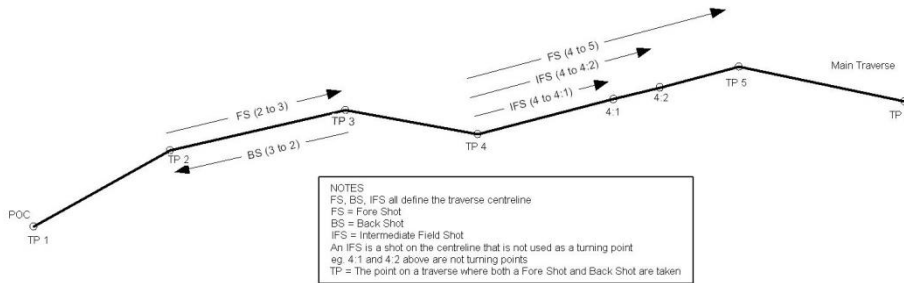
Figure 2.2: Centerline shots (FS, BS and IFS)

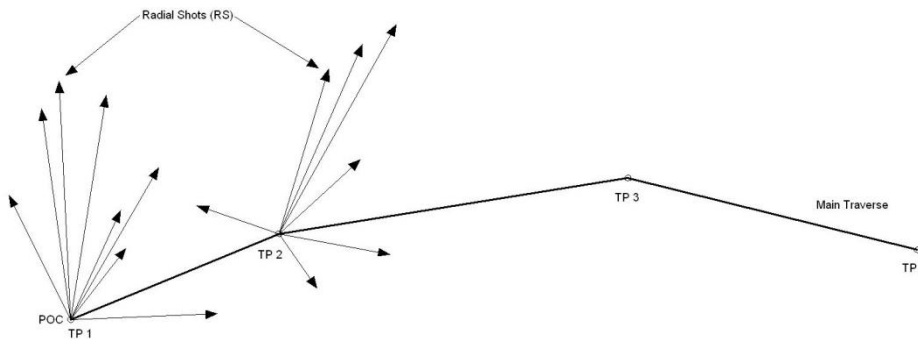*RS*   **Radial shot** is a fore shot off the traverse at any orientation.

Figure 2.3: Radial shots (RS)

SSL (SSR)   **Side Slope Left (Right)** are shots assumed to be on a perpendicular bisector cross section to the main centerline. There are two different types of Side Slope shots and can be used in conjunction with one another. They are:

SSL-FS (SSR-FS) is a foreshot on the perpendicular bisector cross section. This point is considered a turning point

SSL-IFS(SSR-IFS) is an intermediate field shot on the perpendicular bisector cross section. This point is not a turning point.
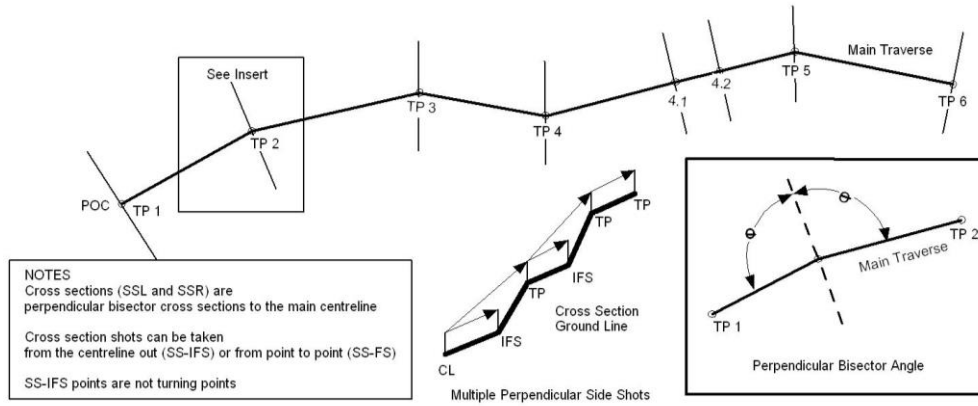
Figure 2.4: Cross section shots (SSL-FS, SSR-FS, SSL-IFS, SSR-IFS)

3. **Entering and Closing a Boundary Traverse**

This exercise demonstrates how to customize the notes entry options, enter survey notes for a boundary traverse, close the traverse and create a map.

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

Setting up the Traverse Entry Screen

1. Open the Survey/Map Module. Select *Module │Setup* from top toolbar. Check that the *Units* are in metric. If correct press cancel.

2. Select menu *File / New*, select *Traverse Document*. Press *OK*.

The Starting Coordinate dialogue box will open. If you enter a start coordinate in a known coordinate system (UTM, Albers, State Plane, etc), the traverse will be geo-referenced. This is useful for exporting to GIS systems or Google Earth (see Terrain module). If you are not concerned where the traverse is located geographically you can accept the default coordinate which is (0,0,100).

The following steps demonstrate how layout files can be used to quickly change the screen format.

3. *File / Retrieve Screen Layout* and select **<Defaults and Layouts>\Training\training block.slt**. Notice how the columns change after this screen layout is read in. Change back to the default screen layout, by selecting **normal.slt** from the *Screen Layouts* box in the toolbar.

Note: Commonly used screen layout files are saved in the **<Defaults and Layouts>** directory allowing them to be accessed from the *Screen Layouts* box. See Getting Started.

4. To customize the traverse entry screen and create a personalized layout file, choose *Edit│Traverse Entry Options* or double click on any gray area of the traverse notes to pop up the *Traverse Entry Options* dialogue box shown in the figure below.

Layout files are useful for personalizing the Survey/Map module screen. Window options such as scales, columns, tab/enter sequence etc. can be setup and saved in a layout file for future use. The default layout screen for a new traverse is **normal.slt.**
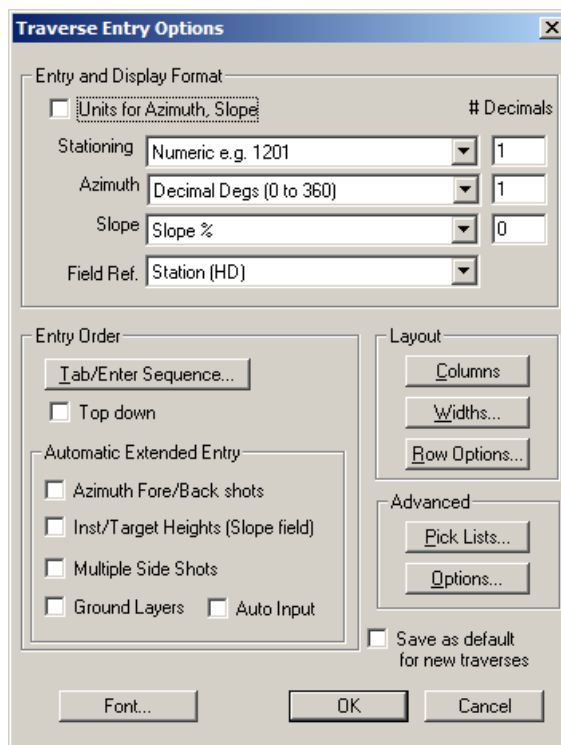

Figure 3.1: Traverse entry options dialogue box

5. To add or remove columns, press the *Columns* button to open *Columns Select* dialogue box as shown below.
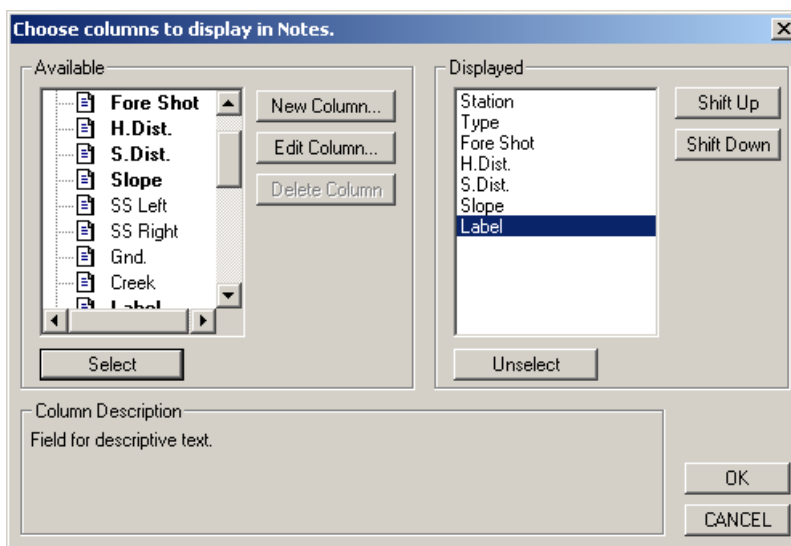

Figure 3.2: Columns select dialogue box

6. Change the items in the *Displayed* list to match the *Displayed* list in the figure above. To remove an item from the *Displayed* list, highlight it and press the *Unselect* button. Similarly to add an item to the *Displayed* list, highlight it under *Available* and press the *Select* button. The new item will appear at the bottom of the *Displayed* list. Use the *Shift Up* or *Shift Down* buttons to move item positions in the list. When done, press OK.

7. Click on the *Tab/Enter Sequence* button to open a similar dialogue box to Figure 3.2. Using the same procedure as above, list in order *Label, Type, Fore Shot, Slope* an*d S.Dist*. in the *Selected* list. Press *OK* twice to close both dialogue boxes.

Note: To enter horizontal distance, use Edit│Traverse Entry Options, and select the *Tab/Enter Sequence* option then add *H. Dist*. At the same time remove *S.Dist*.

8. *File│Save Traverse Screen Layout*. Save the layout as **unit** in the **<Defaults and Layouts>\Training\training unit**

A Softree Prompt appears stating "To make the layout available in your tool bar it must end in **.dlt** (Location), **.ilt** (Terrain), **.slt** or **.mlt** (Survey/Map). " Press OK.

The new customizations are now saved (along with the rest of the Traverse Entry Options), so that they can be retrieved at another time without having to re-customize. The screen layout will be saved with the given name and the extension ***.slt**. If you save a screen layout to the **\RoadEng** directory, it will appear in the Screen Layouts Box in the tool bar for quick access.

Entering Survey Notes

In the steps above, we have set up the columns and entry mode to allow us to enter a sample set of notes with the minimum amount of key strokes.

Note: Our sample notes are recorded from the bottom up; if you work the other way, set the *Top Down* check box in the *Entry Order* area of the *Traverse Entry Options* dialogue box (Figure 3.1).

Start entering the Block 1 traverse notes shown below.

Sta.	Az.	H.D.	%slope	S.D	June-2-97
0+898.0	= End Traverse				
	345.0	43.1	+16	43.6	
0+855.0					
	297.0	44.8	+16	45.4	
0+810.2					
	291.0	88.5	+11	89.0	
0+721.7					
	291.5	12.4	-4	12.4	
0+709.3					
	254.5	27.8	-21	28.4	
0+681.5					= main 502.1
	234.5	62.3	-34	65.8	
0+619.2					
	197.0	21.1	-51	23.7	
0+598.1					
	197.0	30.0	-21	30.7	
0+568.1					
	197.0	46.0	-50	51.4	
0+522.1					= end of spur
	199.0	43.0	-50	48.1	
0+479.1					
	196.5	65.2	-20	66.5	
0+413.9					
	98.5	97.7	+19	99.4	
0+316.2					
	94.5	145.0	+25	149.5	
0+236.2					
	IFS	65.0	+20	66.3	
0+171.2					
	25.0	100.0	0	100.0	
0+126.1					
	IFS	54.9	+5	55.0	
0+071.2					
	12.0	29.2	+24	30.0	
0+042.0					
	354.5	42.0	+22	43.0	
0.000	= Start Traverse				= main 699.1

Figure 3.3: Block1 traverse notes

9. Place your cursor in the *label* field at the bottom of the screen and type **main 699.1** then press <Enter> to move to the *Type* field.

The <Enter> or <Tab> key will move between the fields selected in the Tab/Enter Sequence; <Shift +Enter> or <Shift +Tab> will reverse the direction.

10. Press <Enter> again to accept the default **FS** indicating that this is a normal foreshot.

11. Type **354.5** under the *Fore Azim* column <Enter>.

12. Type **22** under the *Slp%* column <Enter>.

13. Type **43** under the *S.D.*column <Enter>, and <Enter> again to bypass the *Labels* column.

Note that:

- The Station is calculated and displayed.
- The cursor skips over the *HD* column to the *Slp%* column.
- Horizontal distance is automatically calculated from the slope distance and the percent slope.
    14. Press <Enter> to indicate that the 2nd line of the traverse is an **FS** type shot and continue to enter the notes in the figure above.

At Station 71.2 (the 3rd line of the traverse) the *Type* of the next shot is not FS.

    15. When you reach station 71.2, *Type* field, type "**I"** or select *IFS* from the drop menu and press <Enter>. This indicates that this shot will be an IFS (Intermediate Foreshot).

Note: IFS shots (Intermediate Foreshots) differ from Foreshots (FS Type) in a number of ways. Foreshots have an azimuth while IFS shots do not. An IFS shot has the same azimuth as the next FS type shot. Secondly, IFS shots always start at the last station or hub. A number of IFS shots in a row will all start at the last turning point and all distances will reference back to that station.

When and why are IFS shots used instead of Foreshots or FS shots?
IFS shots are used when approaching a location where topography is important but creating a hub is not (such as a gully or stream crossing). IFS shots are used rather than FS shots because the total chainage does not increase and hence neither does the error that can build up with excessive FS type entry.

Radial Shots (RS type shots) like IFS shots always start at the last station hub or turning point but unlike IFS shots have their own azimuth and hence do not define the centerline of the survey. They are used as reference (tie) stations or for topography.

    16. Press <Enter> .The program will correct the IFS azimuth later when it is defined. In this case it will be the bearing of the subsequent shot (25.0 degrees).

This traverse has been saved in the tutorial directory as **<SurveyMap>\Notes\ block1.tr1.**

    17. *File | Close*. Say NO when prompted to save changes.

Creating a Map Document ✔️

A Map Document is a collection of traverse names. Traverses can be added or removed from the map without affecting the traverse documents.

In this section a map of the boundary traverse entered in the previous section will be created.

    1. *File⏐ Open* **<SurveyMap>\Notes\ block1.tr1**.

    2. To create a map from an open traverse, select View⏐Quick Map menu, or the *Create Map* button
       🖼 from the tool bar. A Map will open that has the name Untitled Map 1. Alternatively right mouse click | select Quick Map.

    3. *File⏐Save* the Untitled Map 1 as **<SurveyMap>\Notes\block1.map** (**block1.map** already exists. Press Yes when prompted to overwrite the existing file).

4. Arrange the map and traverse screens side by side, with Window│Tile Vertically. To view the Station column in **block1.tr1** slide the bottom scroll bar to the far left

Note: Clicking on the title bar of a document will activate it. Menu functions and toolbar buttons will change depending on which type of document is active.

5. Click on **block1.map** title bar.

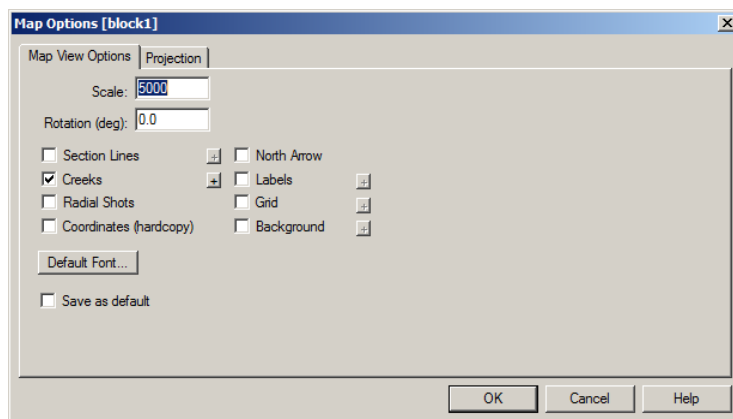6. Select *View│Options* to open the *Map View Options* dialogue box as shown in the figure below.

Figure 3.4: Map view options *dialogue box.*

7. Select *Labels*. A check mark will appear beside word *Labels*. Press the adjacent ⊞ button that highlights as soon as *Labels* is selected. The dialogue box shown below will appear.
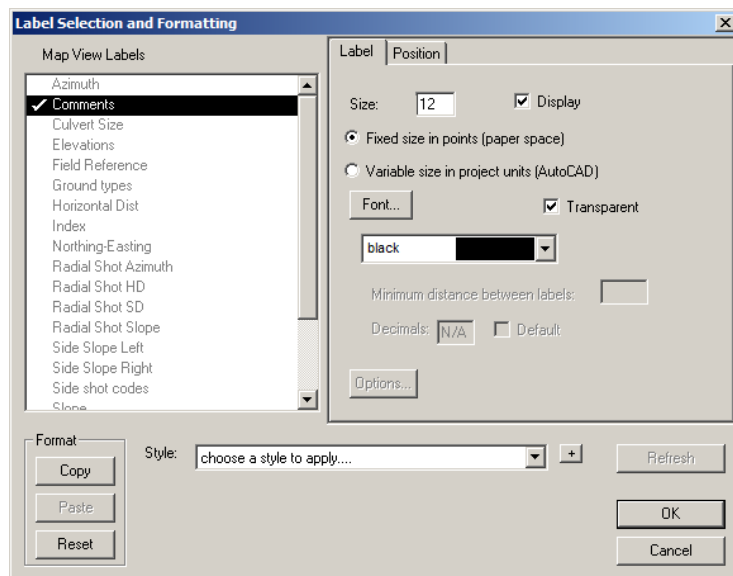
Figure 3.5: Label selection and formatting *dialogue box*

8. If necessary, activate the C*omments* label by selecting or highlighting *Comments*, and select *Display*. A check mark will appear beside the word *Display*, and in front of the label name. A double click on the label name will also activate and de-activate the label. Press OK twice to return to main screen.

Map View now displays the 3 comments in the Label column, (main699.1, end spur and main502.1).

9. Select a station in the traverse notes and the cross-hair will move to the corresponding station in the map.

10. Hover the arrow cursor over the boundary line of the block in the *block1.map* window, a text box will appear with the name of the traverse and the station that you are closest to.

11. Left click on the top right corner of the boundary. Two things have happened, the cross-hair moved to that station in the map and to the corresponding station in the traverse notes.

Note: Double-clicking on a traverse in a map document will open the corresponding traverse notes
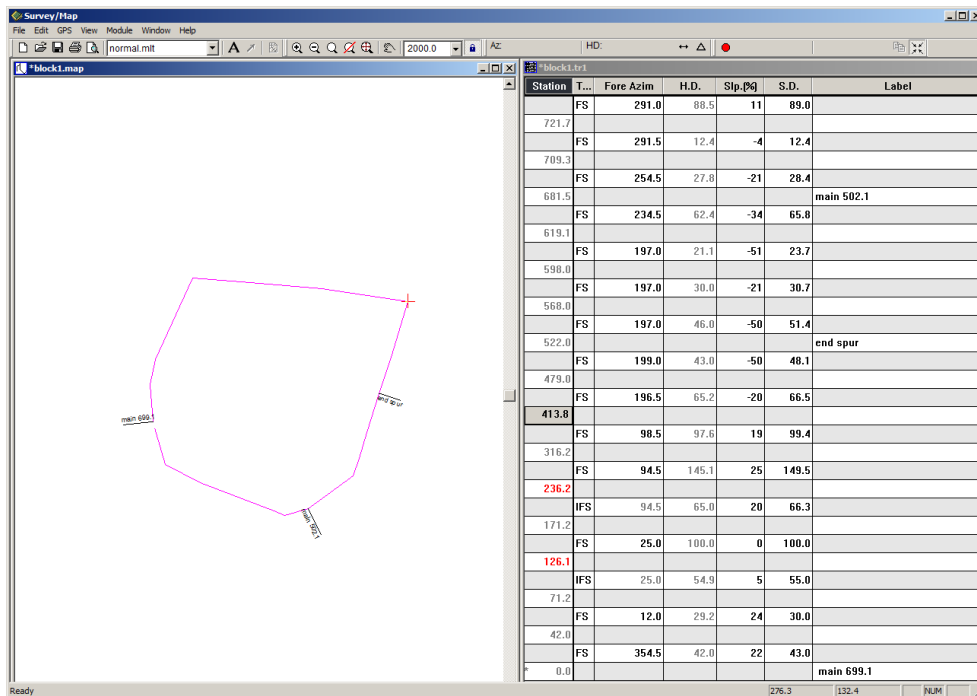
Figure 3.6: Final traverse and map documents

Closing the Boundary Traverse

This example illustrates how to close a boundary by determining its area and the closing error.

1. If the previous exercise was not completed then *File│Open* **<SurveyMap>\Notes\block1.tr1** and **<SurveyMap>\Notes\block1.map**.

2. Use *Window│Tile Vertically* to arrange the map and traverse documents side by side

Note there is a small gap between the first and last station. See the figure above.

3. Click on the Traverse Document title bar (titled **block1.tr1**) to activate it.

4. Select *Coordinates│Close Traverse*. A confirmation prompt will appear asking whether you want to close the traverse. Press OK.
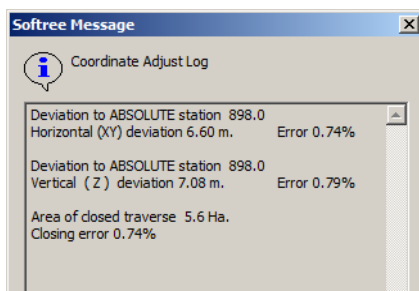

Figure 3.7: Coordinate adjust log

5. Another dialogue box will appear called C*oordinate Adjust Log*. It states that there is a Horizontal (XY) and a Vertical (Z) deviation to Absolute Station 898.0. Area of closed traverse 5.6 Ha and a closure error of 0.74%. Press OK.

Note: Scroll the traverse notes so that the last shot is visible. Station 898.0 now has an asterisk beside it (indicating an absolute coordinate). This means that station 898.0 has fixed X, Y, and Z coordinates, in this case the same as station 0.0. The coordinates of the first station in a traverse are always absolute. The coordinates between absolute stations are determined using the Compass Rule.

Figure 3.8: Asterisk showing absolute coordinates

6. *File│Close* both map and traverse. Do not save changes.

4. **Road P-Line Traverse with Cross Sections Example**

Entering traverse notes without using the mouse is a faster method for the experienced user. All functions for entering traverse notes can be accomplished with keystrokes. The following example demonstrates some techniques using keystrokes to minimize data entry time.

Customizing the Traverse Screen for a P-Line Survey ✔️

Unlike the previous boundary example, the P-line traverse in this example includes perpendicular side slopes, creek crossings, and ground types. To accommodate this additional information you will configure your entry screen and save it as a new layout.

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

1. *File│New*; select *Traverse Document*; press *OK*. You will be prompted for the start coordinates; press *OK* to take the defaults. Maximize the window by clicking the maximize button 🔲 on the top right of the traverse document window.

The columns, entry order and other options currently reflect the settings in your default screen layout (**<Defaults and Layouts>\Normal.slt**). For consistency, we will start this exercise from a screen layout provided with the tutorial.

2. *File | Retrieve Screen Layout* **<Defaults and Layouts>Training\training block.slt**.

3. Change the columns displayed:

   a. Select *Edit │Traverse Entry Options* (or right mouse click and select *Traverse Entry Options*) to open the dialogue box.

   b. Press the *Columns* button to open the column selection dialogue box (Figure 3.2 above).

   c. In the *Displayed* list, select in order (use the *Shift Up/Down* buttons if necessary):

      i. *Station*

      ii. *Type*

      iii. *Fore Shot*

      iv. *Back Shot*

      v. *Slope*

      vi. *S.Dist*

      vii. *SS Left*

      viii. *SS Right*

      ix. *Gnd*

      x. *Creek*

      xi. *Label.*

d. Press *OK*.

4. Change the entry order:

   a. Press the *Tab/Enter Sequence* button.

   b. Ensure the *Selected* list displays, in order:

      i. *SS Left*

      ii. *SS Right*

      iii. *Gnd*

      iv. *Creek*

      v. *Label*

      vi. *Type*

      vii. *Foreshot*

      viii. *Backshot*

      ix. *Slope*

      x. *S.Dist*.

   c. Press *OK*.

5. Enable the *Multiple Side Shots* in the *Automatic Extended Entry* area.

6. Press *OK* to exit the *Traverse Entry Options* dialogue box.

7. Save your customized traverse screen layout by *File│Save Traverse Screen Layout*. Save as **<Defaults and Layouts>\Training\pline.slt**.

You can later retrieve this layout using menu *File│Retrieve Screen Layout* or the *Screen Layout* drop down in the main toolbar.

8. Optional: if you had trouble with the previous step, *File│Retrieve Screen Layout* **<Defaults and Layouts>\Training\training pline.slt**.

Note: If a layout is saved in the RoadEng directory, **<Defaults and Layouts>** or **<Defaults and Layouts>\training**, it will be available through the *Screen Layouts* toolbar dropdown. You can also create your own screen layouts folders; right click on the **Softree** folder in the *Screen Layouts* toolbar dropdown.

9. Save the empty Traverse Document, *File│ Save,* as <**SurveyMap>\Notes\spur2.tr1**.

Entering a Traverse with Side Shots

10. Double left click in the *SSL* field at the bottom of the screen to open the *Extended Side Shot Edit* dialogue box (figure below). The *Extended Side Shot Edit* dialogue box allows perpendicular side shots (cross section shots) to be entered.
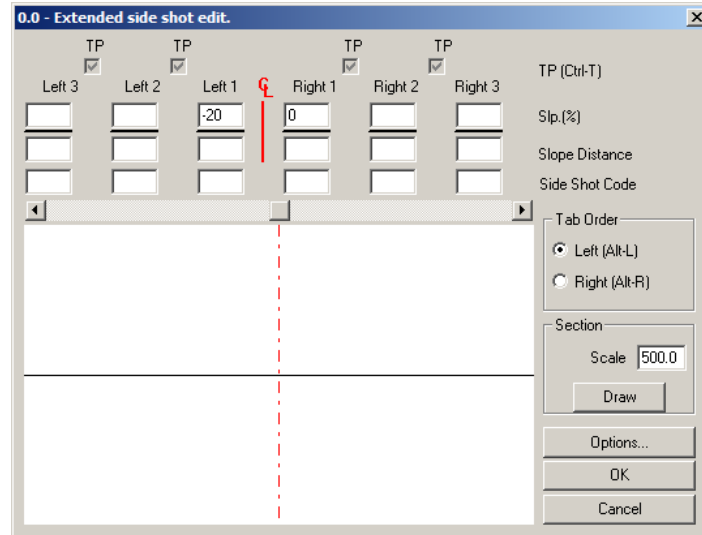
Figure 4.1: Extended side Shot edit dialogue box

Note: Pressing the <Tab> key moves the cursor from field to field within dialogue boxes. Pressing <Shift + Tab> reverses the direction. In the *Extended Side Shot Edit* dialogue box, <Page Up> mimics <Shift + Tab> and <Page Down> mimics <Tab>; this allows one-handed entry from the keyboard.

Referring to the Traverse notes in the figure below:

11. Type the first left slope **-20**, press <Page Down>.

12. Type slope distance **40**, press <Page Down>.

13. Type final left slope **–100**. Press <Enter> or click OK. T

The dialogue box will re-fresh. The cursor will positioned to enter the shots right of the centerline (<Alt + R> will also jump to the right hand side).

14. Type **25** in this box. Press <Enter> to exit the *Extended Side Shot Editor*.

Figure 4.2: Spur traverse notes

Note: The extended side shots defined in the dialogue box will be displayed in the *SSL* and *SSR* fields as one line of text (-20/40.0 T,-100/..). It is possible to directly type extended side shots in the *SSL* and *SSR* fields once the syntax is known. The "T" stands for turning point and represents a check in the corresponding *TP* box in the dialogue box. A slash, "/", can be typed instead of a comma between shots if desired.

15. The cursor should be positioned in the *GND* column. Type **SR** (Solid Rock), under the *GND* column. Press <Enter> <Enter> to skip the *creek* column.

Note: Ground types are used to determine engineering properties, such as cut/fill angles for road design. It is important to record them in the field correctly. If using the traverse for road design, check to see that the cut/fill angles and ground types are pertinent to the geographic location. Changing the ground types can be done using Edit│Ground Types Editor menu item.

16. The cursor should now be in the *Label* column, type **main stn 657.5**, press <Enter>.

17. Press <Enter> again, to accept the default shot type **FS** (Foreshot).

18. Type **330.0** in *Fore Azimuth* column, press <Enter>. Type **150** in *Back Azimuth* column, press <Enter>.

19. Type **7** in the *slp%* column, press <Enter>.

20. Type **47.7** in the *S.D.* column, press <Enter>.

21. The *Extended Side Shot Edit* dialogue box will appear again. Type **–15** <Page Down> type **10** <Page Down> type **–50** <Enter>; and for the right type **15** <Enter>.

22. Press <Enter> again to indicate that **SR** will also apply to the second survey station, and <Enter> <Enter> to skip Creeks and Labels entry fields.

Use *Edit ⁄ Traverse Entry Options ⁄ Tab/Enter Sequence* to remove any columns infrequently used (such as *Creeks* and *Labels*) from the entry sequence; these fields can always be selected with the mouse or use <Control + Arrow keys> to move the cursor to the field to input data.

23. Continue entering notes in Figure 4.2 until station 82.2 *GND* field. The ground type at station 82.2 indicates a 1.0m layer of HP on top of SR.

24. At station 82.2, with the cursor in the *GND* column, double click or press <Control + O> to open the *Ground Layers* dialogue box (figure below).
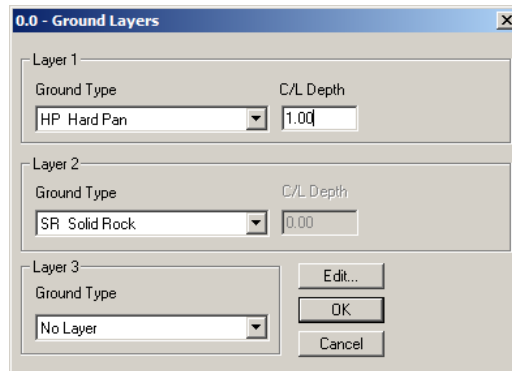
Figure 4.3: Ground layers *dialogue box*

25. Select *HP Hard Pan* depth 1.0 for *Layer1*; select *SR Solid Rock* for *Layer2*. Note the depth for *Layer 1* cannot be entered until a ground type for *Layer 2* is selected. Layer 2 depth is ignored unless there is a third layer. Press OK.

For the next two stations the program will automatically default to the previous ground type. Ground types only have to be entered in when the ground type has changed. Don't forget to change the ground type to HP at station 121.1.

Note: Extended depths and ground types can be entered by double clicking in the *GND* column, or by <Control + O> when the cursor is in the *GND* column and entering the data into the *Ground Layers Dialogue Box*. The materials and layer depths can also be typed directly in the *GND* field (i.e. **HP/1/SR**).

Note: Layers are displayed in the cross section of the *Extended Side Shot Edit* dialogue box.

26. Continue entering notes in Figure 4.2 until station 349.3.

Note: For IFS (Intermediate Foreshots) shots, type **I** under the *Type* column or select IFS from the drop box and skip the *Azimuth* column(s). The azimuth of the IFS will automatically be determined from the azimuth of the next non-IFS shot.

Note: For culvert dimensions, type the pipe diameter in mm in the *CRK* column. <Control + O> or a double click in the CRK field will provide more options for entering creek/culvert information.

27. *File ⁄ Close*. Do not save changes.

5. **Survey Adjustments**

S urveys may be adjusted for a number of reasons.

- Traverses may tie to other traverses as well as to features on the ground or to GPS coordinates.
- Alternate routes for a part of a road traverse may be considered. Instead of re-traversing the entire road, a traverse segment may be inserted at the location of the alternate route
- Files may be joined and closed to determine the area enclosed by a number of traverses.
- Traverses may be corrected in areas with magnetic anomalies.

Making a Map with Multiple Traverses ✔

The next example demonstrates how to display several traverses on the same map and adjust the positions of the traverses with respect to each other.

Note: See **Error! Reference source not found.** section for file install folders (**<SurveyMap>** and **<Defaults nd Layouts>**)

1. *File⌐Open* **<SurveyMap>\Adjust\block1.map.**

2. Maximize the window by clicking the maximize button 🔲 on the top right of the traverse document window. Edit⌐Add/Remove Traverses, the *Map traverses* dialogue box, shown in below will appear.
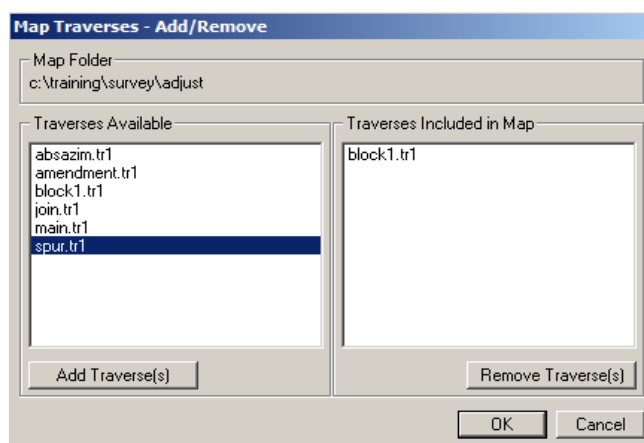
Figure 5.1: Add/Remove *traverses dialogue box*

3. Select **spur.tr1** and press the *Add Traverse* button. **spur.tr1** appears in the *Traverse included in map* list box. Do the same with **join.tr1** and **main.tr1** Press OK.

4. *File | Retrieve Screen Layout*, select
   <Defaults and Layouts>Training\training Adjust\block1.mlt.

> **Note:** The same map can be also be created by selecting menu *File │New*, choosing Map Document, and then selecting the four traverses **block1.tr1, spur.tr1, join.tr1 and main.tr1** with the mouse, while holding the <Control> key.
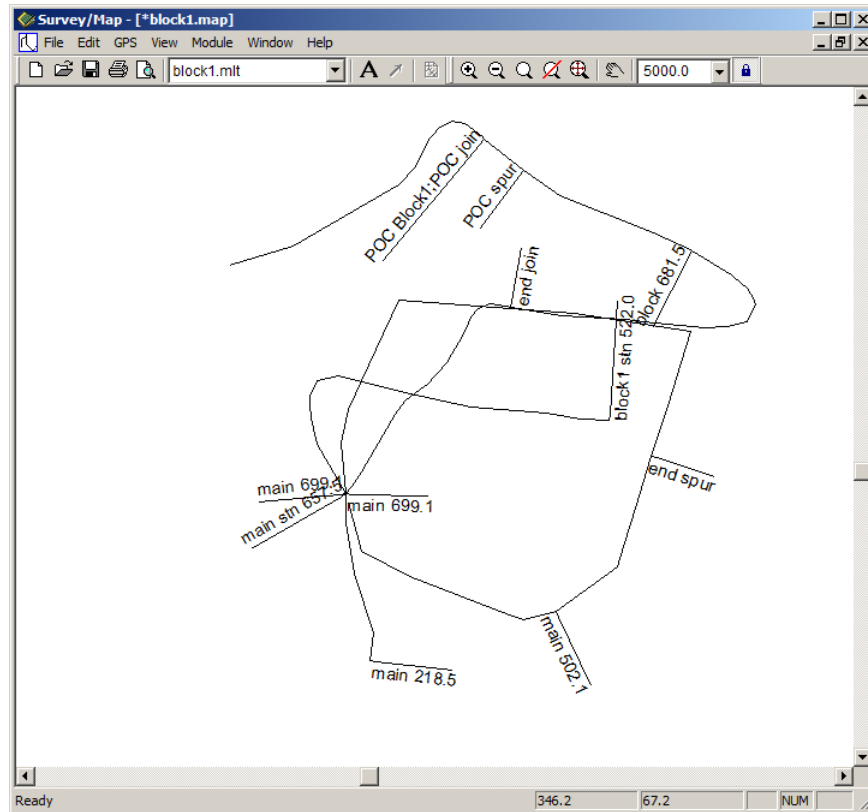

Figure 5.2: Map view after adding additional traverses

5. Double-click on any of the traverses in block1.map and the corresponding traverse notes will open.

6. *File│Close* all documents. Do not save changes.

Absolute Coordinates

All traverses start from an absolute coordinate. By default, all other coordinates are calculated from this starting point. Arbitrarily, the value (0, 0, 100) is assigned for the X, Y, and Z coordinate of the first station. If these coordinates are changed the entire traverse is shifted (provided no other absolute coordinates have been set). Other coordinates within the traverse can be set absolute by using the *Coordinates │Set/Get XYZ Coordinates* menu (Traverse Document), *Coordinates │Close Traverse* menu (Traverse Document), or the *Edit │Coordinate Adjustment* menu (Map Document). The traverse is stretched or shrunk, using the Compass Rule, to fit between two or more absolute coordinates, as shown in the figure below.
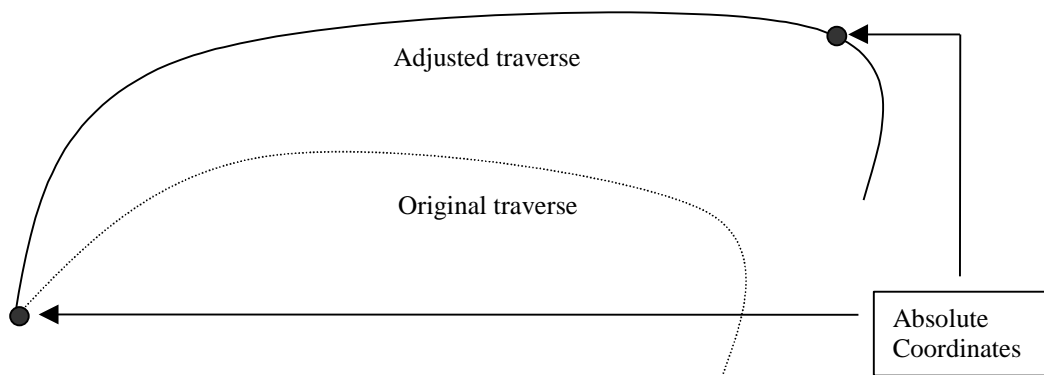
Figure 5.3: Adjusted traverse and original traverse

Shifting, Joining, and Adjusting Traverses

Method 1 demonstrates how to make a coordinate adjustment in the Traverse Document. Method 2 shows how to modify traverses from the Map Document. In both cases the coordinate changes are saved with the Traverse Document. Raw field data (bearings, distances etc.) remain unchanged.

Method 1 -Setting Absolute Coordinates in the Traverse Document ✔️

1. *File│Open* **<SurveyMap>\Adjust\method1.map**.

There are two traverses in this map, **main.tr1** and **block1.tr1;** se figure below.
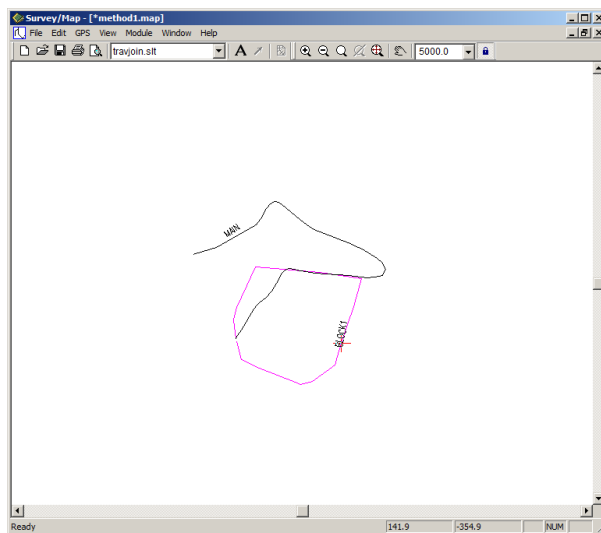
Figure 5.4: Method1.map before adjustments

2. Double-click on each traverse (one at a time) in the Map Window to open the corresponding traverse document. The selected traverse will turn magenta. Select *Window / Tile Vertically* after opening each traverse document to arrange the windows.

3. Click on the **block1.tr1** title bar. From menu *File / Retrieve Screen Layout*t **<Defaults and Layouts>\Training\training travjoin.slt**. Press Open. Select **main.tr1** title bar and retrieve screen layout **\travjoin.slt**

This screen layout displays stations, corresponding labels and XYZ coordinates.

In this example, Block1 will be adjusted with respect to Main because Main is more accurate.

4. Highlight **main.tr1**. Scroll to find **POC block1** in the *Label* column (station 699.1). Note the X, Y, and Z coordinates (this is the "Point of Commencement" of block1).

5. Highlight **block1.tr1**, and select Station 0.0.

6. From menu *Coordinates│Set/Get XYZ Coordinates*, change Station 0.0 coordinates of **block1.tr1** to the same coordinates at **main.tr1** station 699.1 Type **114.9** for X, **294.2** for Y and **193.0** for Z. Press OK.

7. Close **block1** by selecting *Coordinates│Close Traverse* menu. Press OK to confirm closing of the traverse.

Alternatively to close the Block1 traverse, you could have scrolled to the last station (898.0) in **block1.tr1.** Selected Coordinates│Set/Get XYZ Coordinates. Turned on *XY Absolute* and *Z Absolute* and changed the coordinates to equal those of station 0.0. (X=114.9, Y= 294.2 and Z=193.0)

Note: In addition to opening the Coordinate box by selecting Coordinates│Set/Get XYZ Coordinates the Coordinate box can also be opened by left clicking in the x, y, or z field.

8. A *Coordinate Adjust Log* dialogue box appears, indicating the deviation to Absolute station 898.00, area of the closed traverse of 5.6Ha and a closure error of 0.74%. Press *OK*.

9. Find label "block 681.5" (station 502.1) in the *Label* column of **main.tr1**. Make note of the coordinates (286.8, 201.4 and 174.9). This corresponds to station 681.5 in **block1.tr1**.

10. Highlight **block1.tr1**. Scroll to find "main 502.1" in the *label* column (Station 681.5).

11. Choose menu *Coordinate│Set | Get XYZ Coordinates*, turn on *XY Absolute* and *Z Absolute* and change the coordinates to equal those of Station 502.1 in **main.tr1**. Type **286.8** for X, **201.4** for Y, **174**.9 for Z. Press *OK*

A *Coordinate Adjust Log* dialogue box appears as shown below. It lists the (XY) and (Z) adjustments, area of the closed traverse and a closing error.
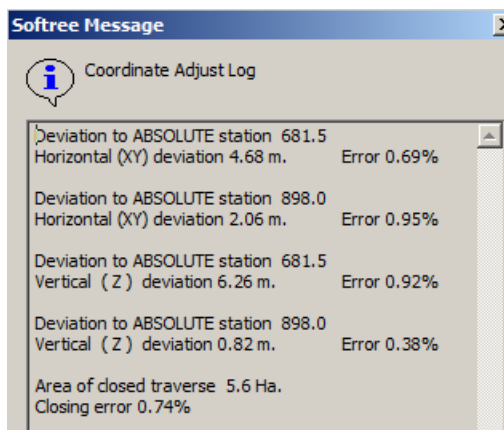
12. Press *OK*.

Figure 5.5: Coordinate adjust log

block1.tr1 is now closed and adjusted to match the two stations intersecting **main.tr1**. The figure below shows **method1.map** before and after the final adjustments.
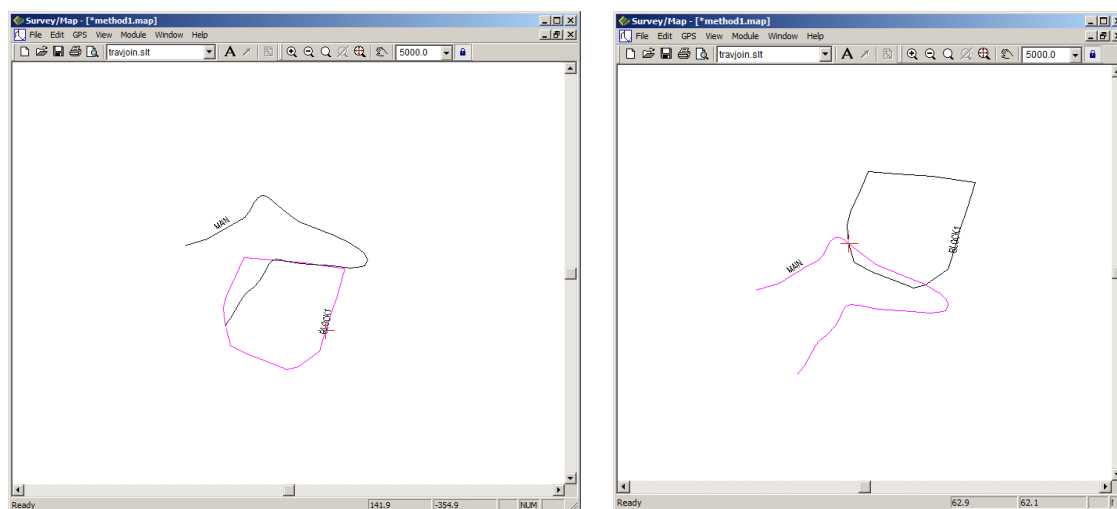

*Figure 5.6: **Method1.map** before (left) and after (right) final adjustment*

13. *File│Close* both the Traverse and Map Documents. Do not save the changes.

Method 2 - Adjusting in the Map Screen ✔

The map display (Method 2) provides a simpler method of implementing, undoing shifts and other adjustment functions. It demonstrates how to do adjustments without modifying the Traverse Document coordinates.

Method 2 has the following advantages over Method 1

- Opening of multiple Traverse Documents not required.
- Direct feedback on whether the adjustment worked or not, as the user is viewing the map rather than coordinates within Traverse Documents.

- The last adjustment can be undone using the *Delete* key in the Traverse Adjustments dialogue.

1. *File│Open* **<SurveyMap>\Adjust\method2.map.** Unlock Lock Scale 🔒 by ensuring the button is not highlighted and press the *Zoom Extents* 🔍 button.

The map shown in the figure below will appear.

2. Maximize the window by clicking the *maximize* button 🗖 on the top right of the Traverse Document window.
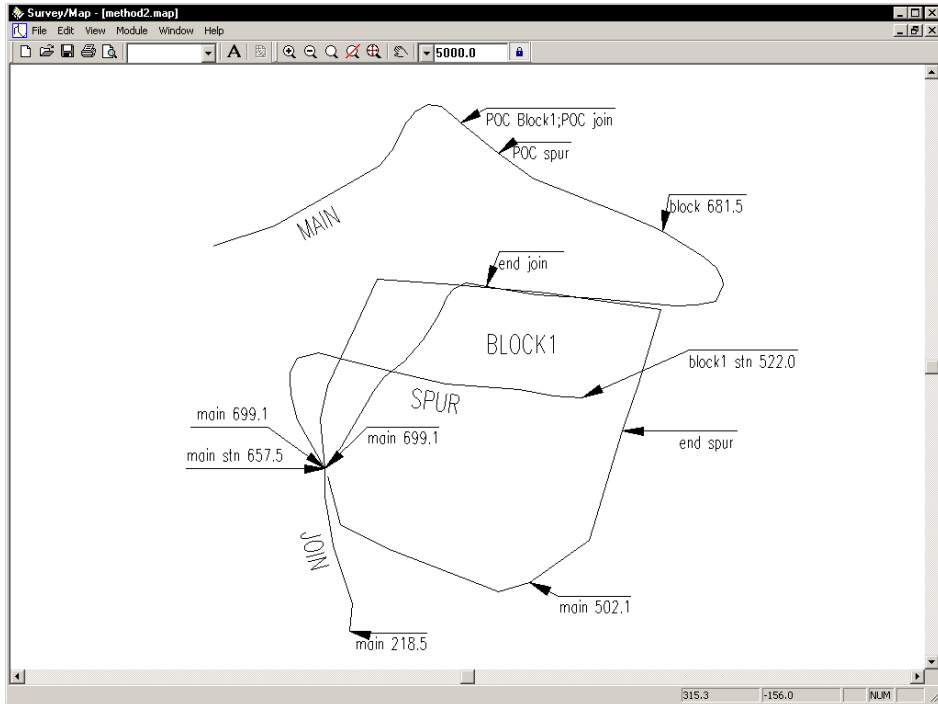
Figure 5.7: Map document of method2.map

This example includes four traverses main, block1, spur and join.

3. Select *Edit / Coord Adjustment* to open the Traverse Adjustments dialogue box shown below.
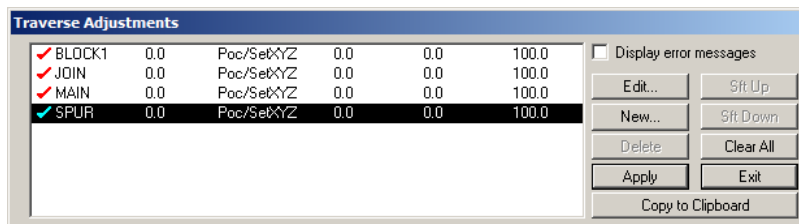
Figure 5.8: Traverse adjustment dialogue box

4. Press the *New* button, and change the information in the dialogue box to match the figure below. Note that both *Shift* and *Set absolute XY* is checked. Press *OK* and then press *Apply*.
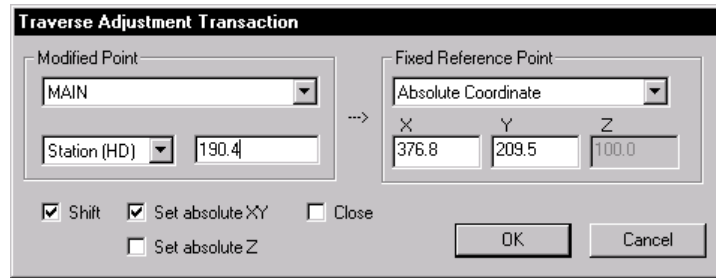
Figure 5.9: Traverse adjustment transaction *dialogue box*

Note that main traverse has been shifted to the set of coordinates on the *Fixed Reference Point* side. You may need to left click on the Traverse Adjustment title bar and drag the dialogue box down and sideways to see the map changes.

Note: The absolute coordinates used in this example are local coordinates. UTM or any other coordinate system can be used.

5. Press the *New* button. Change the *Modified Point* to **Main** and *Modified Point Station* to **9999**. (9999 is used for end station). Change the *Fixed Reference Point* to **Absolute Coordinate** and the *Fixed Reference Point X* to **172.6** and *Fixed Reference Point Y* to **246**. Ensure that *Set AbsoluteXY* is the only selected option. Press OK.

6. A Softree Prompt "Station not found. Press YES to use nearest station (958.1). The *Modified Point Station* will automatically change to 958.1. Press *Apply*. A checkmark will appear in front of that adjustment in the adjustment list. The traverse was stretched to fit between the two sets of local coordinates.

7. Press *New* and change the *Modified Point* to **Block1** and *Modified Point Station(HD)* to **0.0.** Change the *Fixed Reference Point* to **Main** and the *Reference Station(HD)* to **699.1** Make sure *Shift* and *Set AbsoluteXY* are selected. Press OK and then *Apply*.

The start of **main.tr1** identified by labels "POC Block1, POC join" now coincides with the start of **block1.tr1**.

	Action	Modified traverse	Modified Station	Fixed Traverse	Fixed Station	Result
1	Shift and Set Absolute XY	Main	190.4	376.8 X and 209.5 Y	0.0	Puts main in correct position with respect to Absolute set of coordinates
2	Set Absolute XY	Main	End	172.6 X and 246 Y	End	Accommodate second absolute set of coordinates (main is stretched). Note that "9999" is used for end station. Main is now tied to the 2 Absolute points.
3	Shift and Set Absolute	Block 1	0.0	Main	699.1	Shifts Block1 to Main.
4	Close					Close Block1.
5	Set Absolute XY	Block 1	681.5	Main	502.1	Shift Block to position on Main
6	Shift and Set Absolute	Spur	0.0	Main	657.5	Shift Spur to position on Main.
7	Set Absolute XY	Spur	End	Block 1	522.0	Attach Spur to Block1.

Table 1 Traverse adjustment steps

8. Press *New* and make sure that *Close* is checked. Press *OK* then *Apply*. The **Block1** traverse will close. (Step 4 of Table 1)

9. Zoom in. Note that the "block 681.5" and "main 502.1" do not coincide. Block1 needs to tie to main at this point.

10. Press *New* and turn off the *Close* option. Change the *Modified Point* Traverse to **block1** and *Modified Point Station* to **681.5**. Change the *Fixed Reference Point Traverse* to **main** and the *Reference Station* to **502.1**. Make sure that *Shift* is **not** checked and *Set Absolute XY* is checked. Press OK and then *Apply*. "block 681.5" and "main 502.1" now coincide.

11. Follow the above procedure to complete steps 6 and 7 of Table 1. The two figures below should provide some guidance.
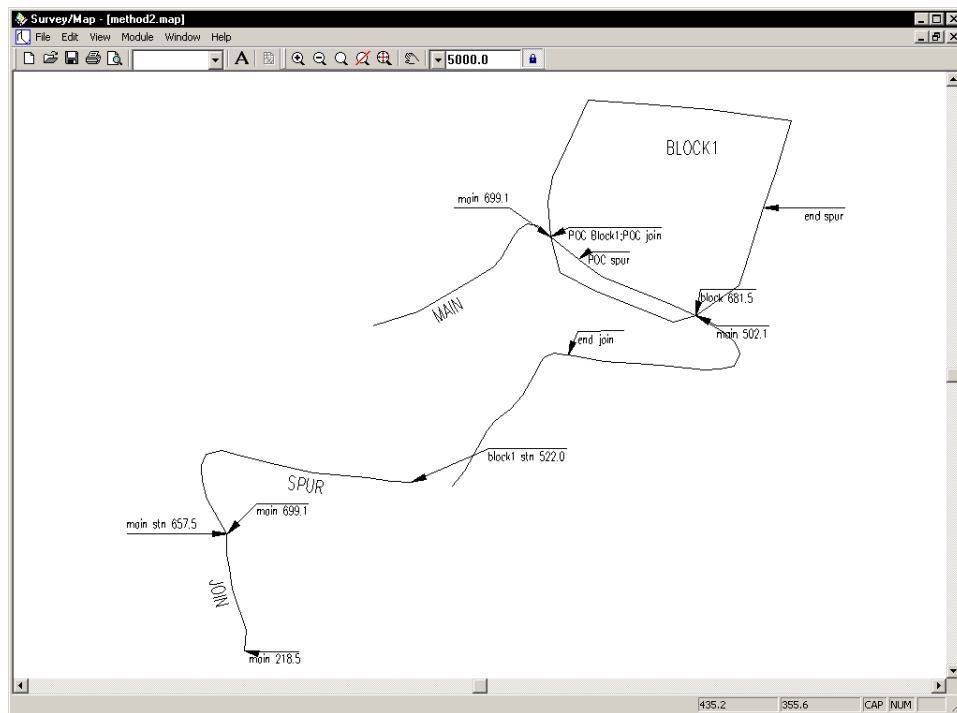
*Figure 5.10: Method2.map before adjusting **spur.tr1***
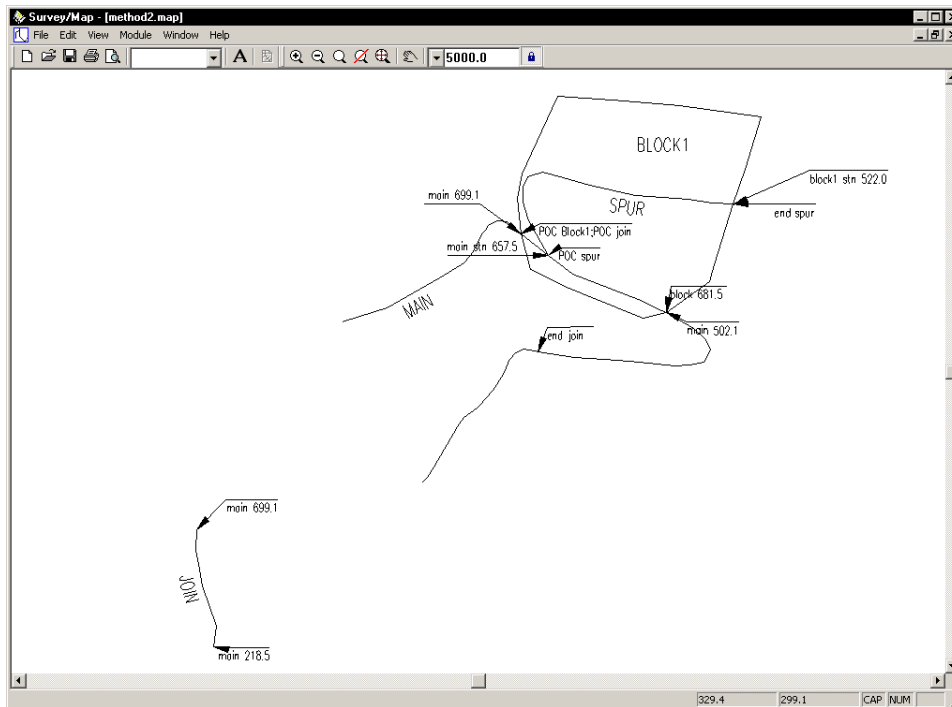
Figure 5.11: Method2.map after adjusting spur.tr1

At this point all traverses except join have been adjusted. This operation is similar to that for **spur**. Keep in mind the final position of **join** in shown below.
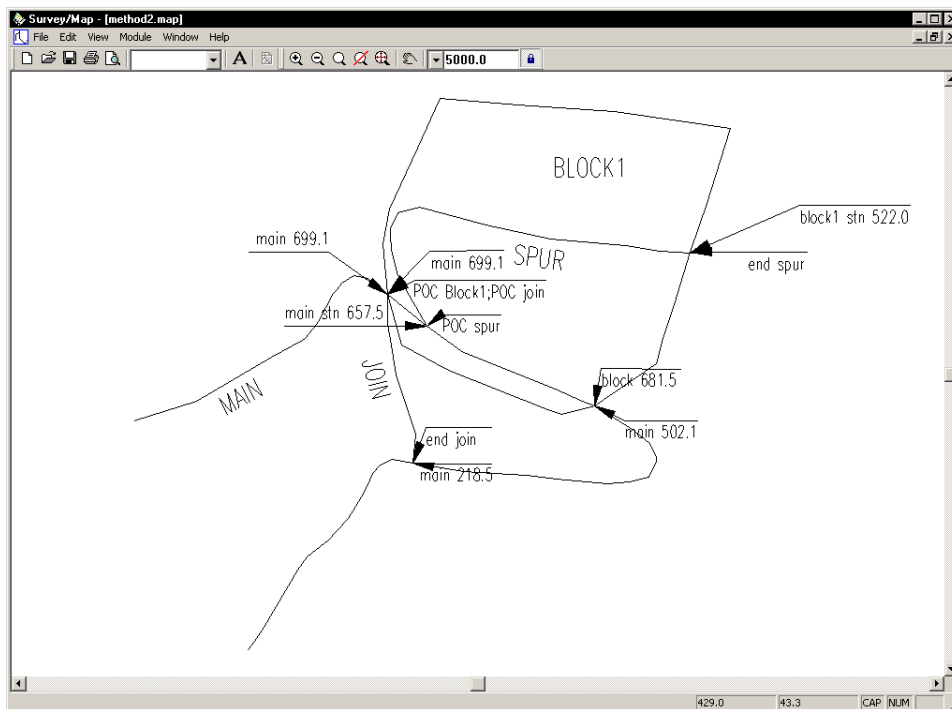
*Figure 5.12: method2.map after adjusting **join.tr1***

Note: Only coordinates and absolute points are modified by adjustments. Raw traverse data (Azimuth, Distance, Slope, etc…) are unaffected. All adjustments can be removed by pressing the *Delete* or *Clear All* buttons in the Traverse Adjustment dialogue box (see Figure 5.8).

Adjustments can be independent or dependent on previous adjustments. It all depends on the order of operations. The last operation in the list supersedes previous operations for that traverse. For example, move the end of **main** to a different location.

12. Press *New* and change the Modified Point Traverse to **main** and the Modified Point Station to **958.1**. Change the Fixed Reference Point Traverse to Absolute Coordinate and the Fixed Reference Point Station to **376.8** for X and **209.5** for Y. Make sure that Shift is checked and press OK and then Apply.

You will notice that **main** has moved without affecting other traverses and that last operation on traverse **main** supersedes the previous operations.

To move other traverses with **main** simply change the hierarchy of the last operation.

13. Using the *Shift up* button, move last operation so that it is just above the operation:
    block1   0.0   Shift/Set XY   main   699.1
    Press *Apply.*

14. Now press the *Delete* button and press *Apply*. The final adjustment will now look like Figure 5.11, because the previous main adjustments in the list now take effect.

Note: All adjustments in this example were with reference to the XY direction (2D) only. 3D adjustments can also be done by turning on *Absolute Z* in the Traverse Adjustment Transaction dialogue box.

15. *File│Close*. Do not save changes.

Inserting a File ✔

This example demonstrates how to extract a section of a traverse from one document and insert it into another.

In the figure below, the entire traverse **amendment** is inserted into a section of **main** from stations 430.9 to 720.1
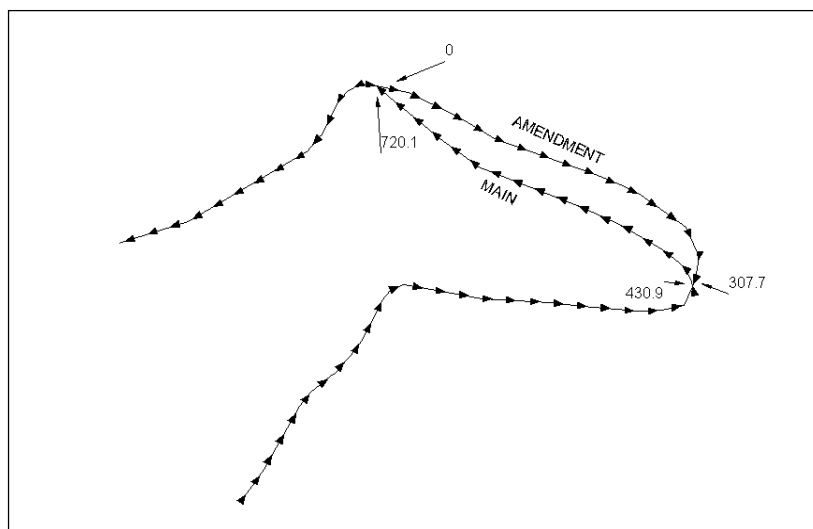

Figure 5.13: Original traverse and amendment.

1. *File│New*. Select *Traverse Document*. Press *OK*. When prompted for Starting Coordinate, press *OK* to take the default.

2. Place the cursor at station **0.0** of the new traverse. Choose menu *Station│Insert File*, select and open **<SurveyMap>\Adjust\main.tr1**.

The *Insert File* dialogue box shown below will appear.
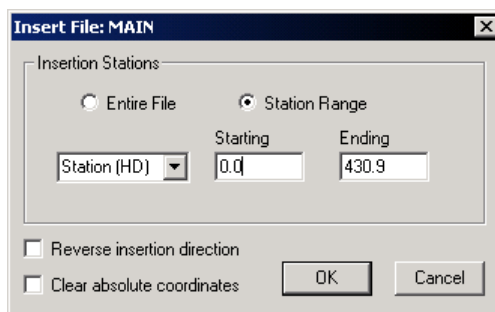
Figure 5.14: File insert dialogue box.

3. Configure the dialogue box so that we are only inserting up to station **430.9**, as shown above. Ensure *Clear Absolute Coordinates* is not checked. Press *OK*. A prompt appears "Insert file at Station 0.0?'; press *OK* to confirm

All Stations from 0 to 430.9 appear in the new traverse. A "+" sign appears in the *Station* column signifying the stations which were added.

The next step is to insert the entire traverse called **amendment**. Notice in Figure 5.13, that **amendment** is running in the opposite direction to **main** and must be inserted in the reverse direction.

4. Place the cursor at Station 430.9 in the *Station* column of the untitled traverse.

5. *Station│Insert File*, select **<SurveyMap>\Adjust\amendment.tr1**. Press *Open*.

6. In the *Insert File* dialogue box, *Entire File* and *Reverse Insertion Survey Direction* should be selected. Press OK.

7. Again, press *OK* to confirm.

Stations 0 to 307.7 appear above station 430.9 as Stations 436.2 to 738.5.

8. Place the cursor Station 738.5 in the *Station* column.

9. From menu *Station│Insert File*, select **<SurveyMap>\Adjust\main.tr1**. Press Open.

10. Configure the dialogue box so that it appears as shown in the figure below. Be sure that *Clear Absolute Coordinates* is not checked. Press *OK*.
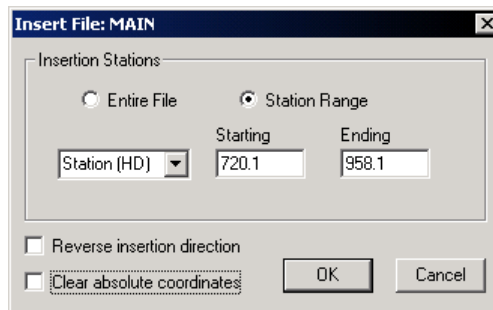
Figure 5.15: File Insert Dialogue Box

11. A Softree Prompt appears "Insert file at Station 738.5?" Press OK to confirm

12. *File│Save*. Type **new main2.tr1** Press Save

13. Press the *Create Map* 🔳 button. The map displays creeks. To turn off the Creek display, right click. Select Map Options. Disable Creek. Press OK to return to map view.

14. To verify the changes made select Edit│Add/Remove Traverses. Highlight **main.tr1** on the left. Press the *Add Traverse* button. **main.tr1** now appears on the right. Press *OK*.

The map now resembles the original traverse and amendment as shown in Figure 5.13.

15. *File│Close*. Do not save changes.

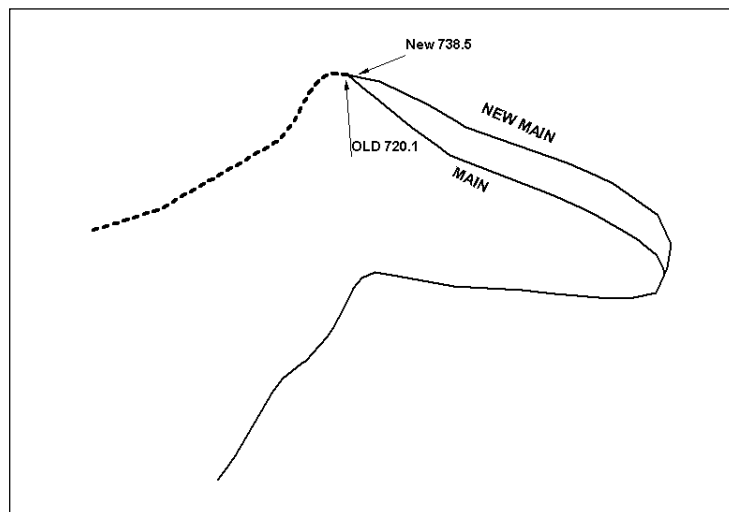## *Correcting a Traverse using Station Equations* ✔

Figure 5.16: Old route (main) and new route (new main)

Note the discrepancy between the stations of **main** (old route) and **new main** (new route) in the figure above. If the stationing is left as is, the stations after 720.1 in the field would be different than the stations in the traverse module. To correct this a *Field Reference* column is added to the new main traverse notes.

1. *File│Open* **<SurveyMap>\Adjust\main.tr1** and **<SurveyMap>Adjust\new main.tr1**.

2. Place the Traverses side by side using *Window│Tile Vertically*.

3. Highlight **main.tr1** and scroll up to station 720.1. Highlight **new main.tr1** scroll up to station 738.5.

4. To add a *Field Reference* column to **new main.tr1**. Select *Edit│Traverse Entry Options*. Press the *Columns* button and add *Field Ref.* from the *Available* side to the *Displayed* side. Press the *Shift Up* button until *Field Ref* is just below *Station* on the *Displayed* Side. Press OK twice.

5. Select *Edit│Current Field Options* in the Survey Information Dialogue Box press the *Stn. Equations* button.

6. Press the *Add* button in the resulting dialogue box.

7. Type **738.5** in the *Backwards* frame, and **720.1** in the *Forwards* frame. Press OK to close all dialogue boxes.

Survey/Map - new main.tr1

File Edit Station Coordinates View Module Window Help

new main.tr1

Station	Field Ref.	T...	Fore Azim	H.D.	S.D.	Slp.(...	SSL...	SSR...	G...
		FS	218	4.5	4.6	19			
769.2	750.8						-42/17.	46/12.9	HP
		FS	219	6.8	6.8	12			
762.5	744.1						-43/10.	43/6.2	SR
		FS	240	12.1	12.6	28			
750.4	732.0						-27/15.	27/1.5	SR
		FS	280	11.8	12.0	-18			
738.5	738.5=720.1						-24/24.	36/15.3	SR
		FS	281	11.5	12.5	-42			
727.0	727.0						-27/6.3	13/17.8	HP
		FS	281	9.8	10.0	-19			
717.2	717.2						-12/0.2	12/21.8	HP
		FS	277	0.1	0.1	-20			
717.1	717.1						-20/3.3	12/21.5	HP
		FS	277	1.9	1.9	-7			
715.2	715.2						-19/1.0	20/3.0	HP
		FS	277	0.7	0.7	-8			
714.5	714.5						-20/13.	19/1.2	HP
		FS	277	0.7	0.7	-7			
713.8	713.8						-21/13.	21/1.5	HP
		FS	296	25.3	25.3	1			
688.5	688.5						-21/18.	21/25.6	HP

main.tr1

Station	T...	Fore Azim	H.D.	S.D.	Slp.(%)	SSL Slp.(%)/S.D.
	FS	240.0	12.1	12.6	28	
732.0						-27/15.8 T,-20/0.2 T,-3
	FS	280.0	11.8	12.0	-18	
720.1						-24/24.4 T,-47/17.7 T,
	FS	309.0	18.8	19.4	-25	
701.3						-43/25.5 T,-79/12.0 T,
	FS	311.0	2.2	2.2	6	
699.1						-21/3.1 T,-43/23.4 T,-
	FS	309.0	41.6	41.7	5	
657.5						-21/19.6 T,-45/32.7 T,
	FS	306.0	24.1	24.1	4	
633.4						-46/55.0 T,-46/..
	FS	306.0	11.9	12.3	24	
621.5						-49/55.6 T,-49/..
	FS	291.0	84.0	84.5	11	
537.5						-50/21.9 T,-31/26.6 T,
	FS	295.0	24.2	24.4	14	
513.3						-31/34.3 T,-31/18.0 T,
	FS	295.0	11.1	11.2	-2	
502.1						-31/29.0 T,-31/23.3 T
	FS	301.0	38.3	38.3	1	
463.8						-30/2.6 T,-31/41.4 T,-

*Figure 5.17: **new main.tr1** with field reference to **main.tr1***

The *Field Ref* column opposite station 738.5 of **new main.tr1** reads 738.5 = 720.1. Notice that in the *Field Ref* column of *New Main.tr1* above station 738.5 corresponds to the stations in *Main.tr1* above station 720.1.

8. *File │ Close*. Do not save changes.

Adjusting for Magnetic Anomalies ✔

Certain geographic locations have problems with magnetic fields that may disturb compass readings. If the foreshots to next station and the backshots from next station differ significantly, magnetic anomalies may be the problem. This example will demonstrate how to correct this problem.

1. *File│Open <SurveyMap>***Adjust\absazim.map** and **Adjust\absazim.tr1**.
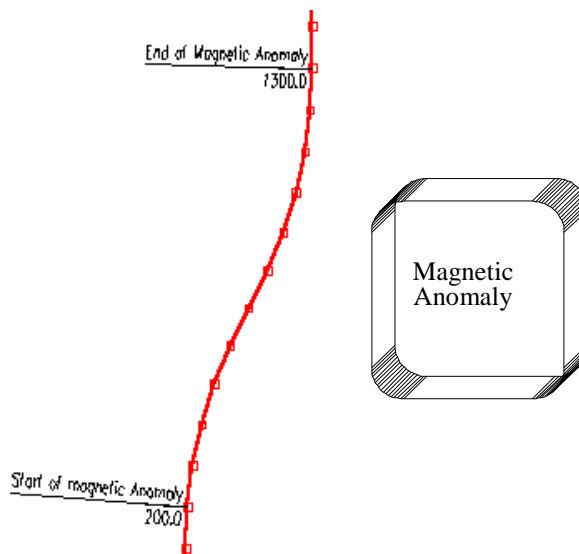
2. Select *Window│Tile Vertically*.

Figure 5.18: Compass errors from magnetic anomalies

The traverse should have been a straight line at a bearing of 0, but due to a magnetic anomaly, the traverse is skewed. The traverse is correct up to station 200. After station 200, the foreshot and corresponding backshot start to differ. Once the traverse proceeds beyond the anomaly (Station 1300), it reverts back to the initial bearing. There is a simple way of fixing this problem.

3. Select the Traverse Document title bar.

4. *Edit│Traverse Entry Options* menu, choose the *Options* button and select the *Automatic Magnetic Anomaly Adjustment* check box. Press OK twice.

This automatically enables the *Foreshot/Backshot Tolerance (degrees)* option and the default setting of 1.00. This means that when the foreshot and corresponding backshot differ by more than 1.00 degree, there will be an adjustment to correct for the magnetic anomaly.
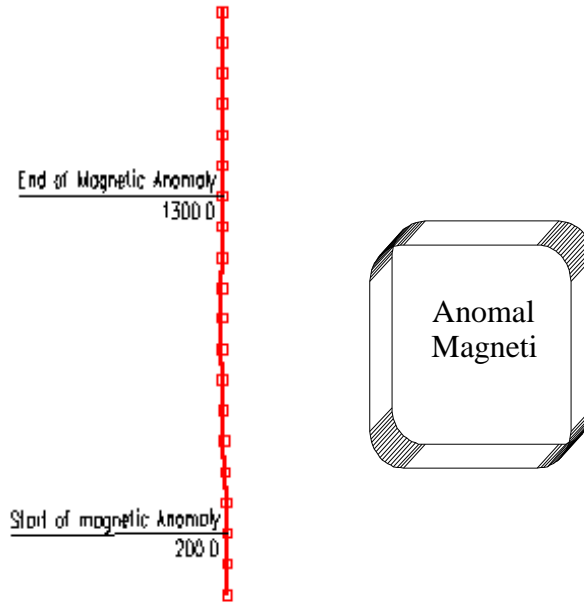
Figure 5.19: Corrected Traverse

Note: Magnetic Anomalies are corrected by using foreshot and backshot to calculate relative changes in angle (turning angles). These turning angles are used to calculate each azimuth from the previous one (similar to a theodolite survey). This works because the deflection error from the anomaly is the same for both the foreshot and the backshot taken from the same point.

5. Highlight the traverse document. Open *Coordinates│Adjust XYZ.* The *Coordinate Adjust Log,* as shown below, appears. Press *OK*.
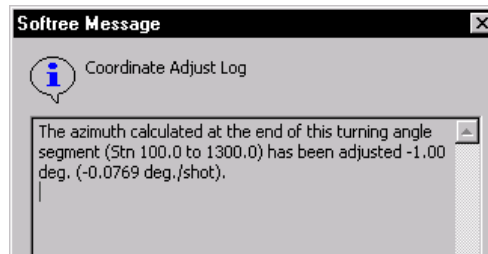
Figure 5.20: Turning angle adjustment message

This dialogue box identifies the azimuth error adjustments, when a calculated azimuth at the end of a relative segment is reconciled with an absolute azimuth. In this case the azimuth was adjusted 1.0 degree.

The symbol " ~ " appears in the *Station* column, indicating the stations which were calculated using turning angles.

Warning: You might at some point find that the difference between foreshot and corresponding backshot = zero "0.0", when you pass through an anomaly, as shown in the Foreshot/Backshot dialogue box below. In this case the magnetic anomaly may not be corrected automatically, and a manual adjustment of the offending station may be required.

To manually adjust a magnetic anomaly, double click on the Foreshot field to display this dialogue box shown below. Enable the *Calculate Azimuth using Turning Angle and last Azimuth* option.

You can also set up the Traverse Entry Options to automatically display the dialogue box by selecting Edit│Traverse Entry Options and enable Azimuth Fore/Back shots under Automatic Extended Entry.

```
┌─────────────────────────────────────────────────────────────┐
│ Stn 378.2 - FORESHOT/BACKSHOT                            [X] │
│                                                              │
│  Foreshot          Backshot                  ┌──────────┐    │
│  to Next Station   from Next Station         │    OK    │    │
│                                              └──────────┘    │
│  ┌────────────┐    ┌────────────┐            ┌──────────┐    │
│  │ 114.0      │    │ 294.0      │ Unadjusted │  Cancel  │    │
│  └────────────┘    └────────────┘            └──────────┘    │
│                    ┌────────────┐                            │
│                    │ 114        │ Adjusted by                │
│                    └────────────┘ 180 deg                    │
│          Average = 114.0                                     │
│          Difference = 0.0                                    │
│  [✓] Calculate Azimuth using Turning Angle and last Azimuth  │
└─────────────────────────────────────────────────────────────┘
```

6.   *File│Close* both documents. Do not save changes.

6. **Survey Formats and Customization**

This section demonstrates several features such as instrument and target height, initial backshot angle, and vertical angle formats to allow entry of theodolite and leveling surveys.

Transit Survey (An Example of a Block Boundary) ✔

Transit surveys are conducted by taking an initial backshot, and a series of foreshots that are calculated using turning angles. The horizontal angle is measured by turning right (clockwise) from the backshot to the foreshot.

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

1. F*ile*⎢*New*, select *Traverse Document*. Press *OK* to create a new traverse.

The *Starting Coordinate* dialogue box below will open with default values (0.0, 0.0, 100.0).
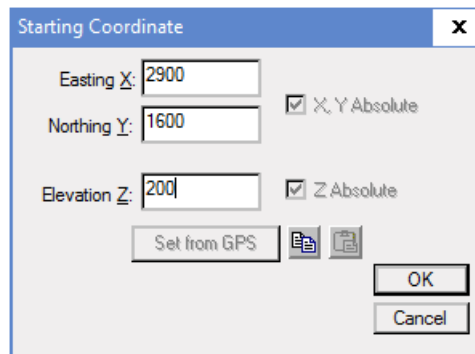
Figure 6.1: Starting Coordinate *dialogue box after setting initial position.*

2. Set the coordinates as shown above: type **2900.0** for *Easting* (X), **1600.0** for *Northing* (Y) and **200.0** for Elevation (Z). Press *OK*.

The notes entry table is now set up according to the contents of your default screen layout (**Normal.slt**). We need to change to accommodate theodolite data.

3. *File*⎢*Retrieve Screen Layout*, select **<Defaults and Layouts >\Training\training transit.slt**.

4. Double click in any gray area to access the Traverse Entry Options dialogue box (this is also available from the right click context menu). The screen layout **training transit.slt** has been configured for entry of *Azimuth* in *Deg:Mins:Secs (0 to 360)*, and *Slope* in *Zenith deg:min:sec (0 to 180)* angle. Press the *Options* button; note that the horizontal angles will be calculated using *turning angles*. Press *Cancel*, and *Cancel* again, to return to main screen.

5. Right click in any gray area on the Traverse screen; select *Traverse Options* (at the bottom of the context menu) to open the dialogue box shown below (or you can select *Edit*⎢*Traverse Options* from the main menu). Select the *Survey Information* tab.

Figure 6.2: Survey information *dialogue box*

6. Type in the *Initial Backshot* **346:32:28** as shown above.

7. Click on the *Projection* tab and change *Units* to *Imperial (ft.)* (if necessary). Press *OK*.

8. Place the cursor in the *Label* column at Station 0.00. Type in **BM** (short for bench mark) as the first label. Press <Enter>.

9. Refer to the Theodolite Survey notes in Figure 6.3 below. In the *Fore Right* field (HORZ ∠) for Pt # 2 type **106.4409**. Press <Enter>.

An error prompt appears, stating "Invalid value (minutes and seconds must be from 0 to 60)". The format used in the paper notes (ddd.mmss) is not supported.

10. Press *OK* to close the message box.

11. Type **106.44.09** instead. Press <Enter**>**.

Note: Type all Horizontal angles (*Fore Right*) and Vertical angles (*Zenith*) as *deg.min.sec* or *deg:min:sec*, for example 106.44.09 or 106:44:09 **not** 106.4409.

With the exception of labels, the notes can be entered using the number pad only. Use decimal point delimited fields for ease of entry. The values will be displayed with the colon delimiter.

12. In *S.D.* (Foresight slope distance) type **137.33**. Press <Enter>.

13. For *Zenith* (VERT ∠) type **89.12.20**. (See Note above) Press <Enter>.

14. Type in the *Inst. Height* (HI) of **5.2**. Press <Enter>.

15. Type in the *Target Height* (Rod Ht.) of **5.2**. Press <Enter>.

Notice that the instrument and target heights have been copied into the next record. Any changes can be typed in, otherwise <Enter> will accept the previous value.

16. Enter the remaining notes from the figure below, continuing from PT # 3.

PT	HORZ<	S.D.	VERT<	ROD Ht
SET UP ON PT#1			NORTHING :1600	
			EASTING : 2900	
			ELEVATION : 200	
		BS PT#9 = 346.3228		
			H.I.= 5.2	
PT#2	106.4409	137.33	89.1720	5.2
SET UP ON PT#2			HI = 5.2	
PT#3	180.0000	1034.91	89.1220	6.3
SET UP ON PT#3		HI = 5.2		
PT#4	107.4347	60.08	90.3030	5.2
SET UP ON PT#4		HI = 5.2		
PT#5	180.0000	615.06	91.3000	5.2
SET UP ON PT#5		HI = 5.2		
PT#6	109.4501	349.813	90.5040	6.12
SET UP ON PT#6		HI = 5.2		
PT#7	94.0409	451.038	89.4515	5.2
SET UP ON PT#7		HI = 5.2		
PT#8	225.1929	560.387	89.3010	6.5
SET UP ON PT#8		HI = 5.2		
PT#9	180.0000	340.09	89.2012	6.0
SET UP ON PT#9		HI = 5.2		
PT#1	79.2325	419.80	89.4008	8.4

Figure 6.3: Theodolite survey notes

17. **Optional**: If you did not complete the notes entry, open **<SurveyMap>\Other\transit.tr1** and skip the following step.

18. *File | Save*. Save as **<SurveyMap>\Other\transit2.tr1.**

This traverse represents a closed polygon. However, due to an imperfect survey, the end point is not coincident with the start.

19. *Coordinates | Close Traverse*. Press *OK* to confirm closing of traverse. A *Coordinate Adjust Log* appears reporting a closure error and area of closed traverse. Press *OK*.

Notice that an asterisk, *, appears next to the final station to indicate that it is an absolute station (coordinates are set to match the start).

20. Double click on any of the stations in the station column to open the *Survey Information* dialogue box (figure below). Closure error is 0.002%, Area 16.73 Acres, and the length of the traverse is 3968.0391 meters. Press *OK*.
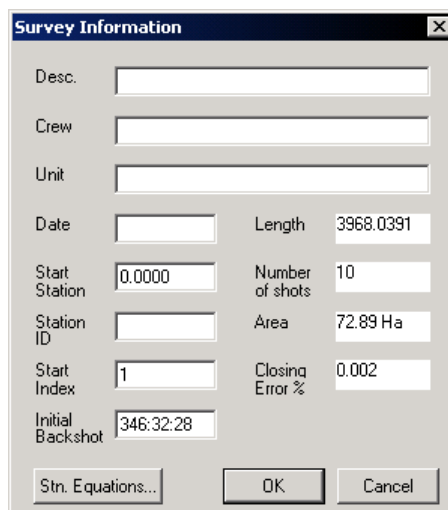
Figure 6.4: Survey information *dialogue box.*

21. Press the *Create Map* toolbar button ⬚ to open a map of the current Traverse.

22. *File | Retrieve Screen Layout*, select **<Defaults and Layouts>\Training\training transit.mlt**.

23. Arrange windows side by side with menu *Window | Tile Vertically.*

The screen should now appear as shown in the figure below.
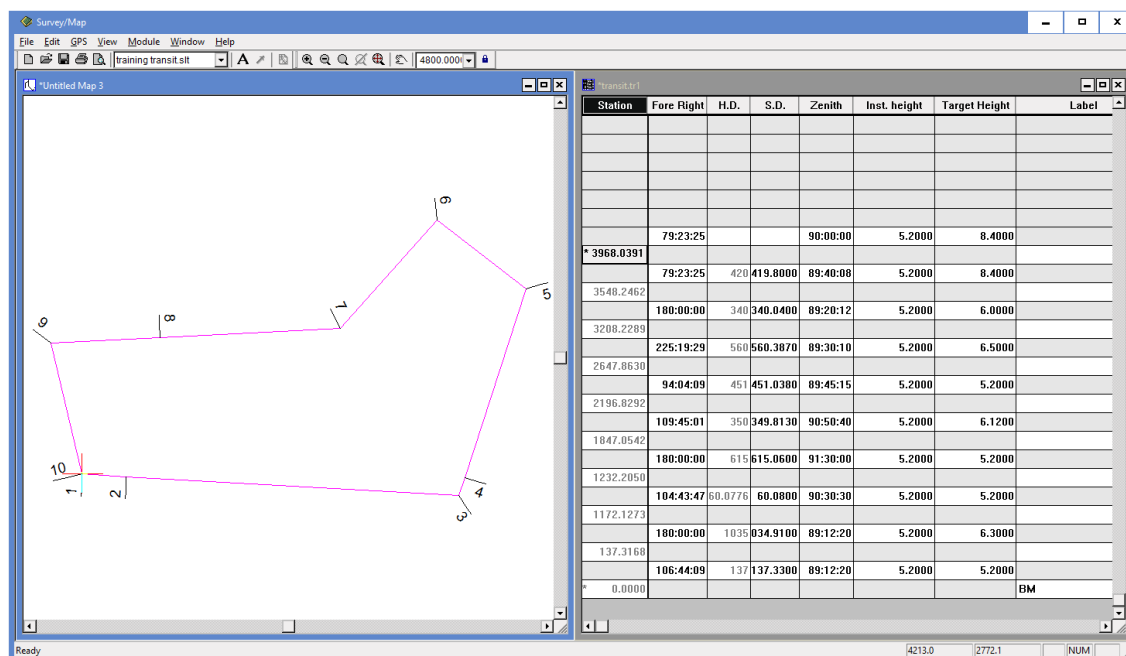
Figure 6.5: Final closed block boundary.

Note: If you select a shot in the Traverse window, the Map window will indicate the selected shot with a red cross.

24. *File│Close* both the Traverse and Map Documents. Do not save changes.

Level Survey ✔

This example will demonstrate how to enter a level survey with radial shots. The main survey is created using *Backshot*s and *Foreshot*s at station hubs; multiple elevation shots originate from these hubs. We will work from the notes in Figure 6.7.

1. Create a new traverse: *File│New*, select *Traverse Document*. Press *OK*.

The *Starting Coordinate* dialogue box below will open with default values (0.0, 0.0, 100.0).
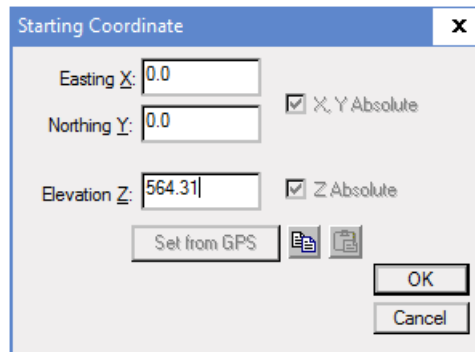
Figure 6.6: Starting Coordinate dialogue box after setting initial position.

2. Type in the *Elevation* **564.31**; we will keep the default X, Y values. Press *OK*.

The notes entry table is now set up according to the contents of your default screen layout (**Normal.slt**). We need to change to accommodate level survey data.

3. *File│Retrieve Screen Layout* **<Defaults and Layouts>\Training\training level.slt**.

4. Double click on any gray area in the traverse document to open the *Traverse Entry Options* dialogue box. Notice that the screen layout, **training level.slt** has been configured for entry of *Azimuth* in *Quadrants* (e.g. N32W), and slope in *Level (elevation)*. Press *Cancel* to close.

At this point, your traverse is set to use your default units (meters or feet). This exercise works in any units, but if you want to change them, choose menu *Edit | Traverse Options* and select the *Projections* tab.

Now we will create the first radial shot (RS) from the first station.

5. Press <Enter> to move to the *Type* column. Type **RS** (**r** is sufficient) or select **RS** from the drop down. Press <Enter>.

6. Type **E** (due East) under the *Fore Bearing* column. Press <Enter>.

7. Type **10** under the *S.D.* (slope distance) column. Press <Enter>.

8. Type **565.17** under the *Next Z* (elevation) column. Press <Enter>.

	Bearing	S.D.	BS	HI	RS	FS	ELEV	dZ
BM28			1.56	565.87			564.31	
605	E	10.0			0.70		565.17	+.86
606	N45W	20.0			2.90		562.97	-1.34
607	S50W	10.0			3.50		562.37	-1.94
608	S20E	15.0			6.70		559.17	-5.14
609	N25E	15.0			11.90		553.97	-10.34
TP.2	N10E	20.0	0.41	554.65		11.63	554.24	-10.07
610	N45E	10.0			3.20		551.45	-2.79
611	N10W	10.0			8.60		546.05	-8.19
612	S30W	10.0			9.00		545.65	-8.59
613	S40E	20.0			12.20		542.45	-11.79
614	S20E	10.0			9.30		545.35	-8.89
615	N60W	10.0			8.40		546.25	-7.99
616	S85E	10.0			7.10		547.55	-6.69
617	N15E	20.0			8.40		546.25	-7.99
618	N25W	20.0			7.00		547.65	-6.59
619	N65E	10.0			4.10		550.55	-3.69
TP.3	N	25.0	8.02	559.98		2.73	551.92	-2.32
			9.99					
					564.31	14.36		
					559.98	9.99		
				check	4.37=	4.37	✓ OK.	

Figure 6.7: Level survey notes

Before you enter the rest of the shots, note that only *Type*, *Bearing, S.D.* and *Elev* fields are required. Also note that **TP.2** and **TP.3** are foreshots (**FS** in the *Type* column). All other shots are radial shots (**RS** in the *Type* column).

9. Enter the rest of the traverse notes above, continuing from point 606.

10. **Optional**: If you did not complete the notes entry, open **<SurveyMap>\Other\level.tr1** and skip the following step.

11. *File | Save* the Traverse Document as **<SurveyMap>\Other\level2.tr1**

12. Select *View | Quick Map* or press toolbar button 🔲 to open a new Map Document.

13. *File | Retrieve Screen Layout* **<Defaults and Layouts>\Training\training\normal.mlt**

14. Arrange windows side by side with menu *Window | Tile Vertically.*

15. Press the *Zoom Extents* toolbar button ⊕ to scale appropriately.

16. Right click in the map document. Select menu *Map Options* and enable *Radial Shots*. Press *OK*.

Your screen should look similar to the figure below.
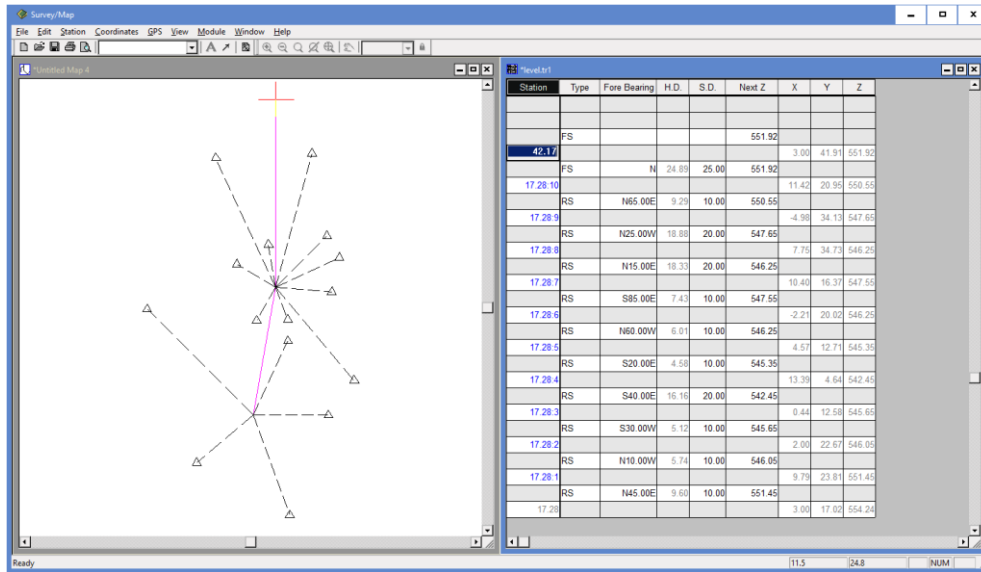
Figure 6.8: Map of Level Survey

Note: If you select a shot in the Traverse window, the Map window will indicate the selected shot with a red cross.

17. *File│Close*. Do not save changes

User Defined Columns and Pick Lists ✔

In this section we will describe additional features for creating *User Defined Columns* and *Picklists.*

User defined columns can be used to save information along the traverse. To demonstrate user defined attributes we will create a new column for *Tree Species.*

1. *File│New*, select Traverse Document. Press OK. Press *OK* again to accept the default start coordinates.

2. *Edit | Traverse Entry Options*. Press the *Columns* button then select *New Column*. The *Create New Column* dialogue box will appear as shown below.
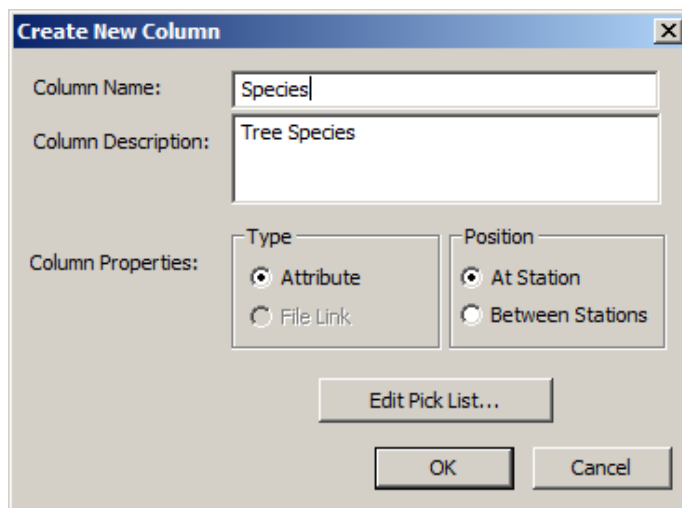
Figure 6.9: New column dialogue box

3. Type in <Species> for Column Name and type in the description as shown above.

4. Pick lists allow you to predefine common field entries. With pick lists users can quickly pick a column entry from a list.

5. Press *Edit Pick List*. Press the *Add Item* and type <Spruce>. Press the <enter> key and create a Hemlock entry. Continue this process and create entries for Fir and Cedar. Then press OK.
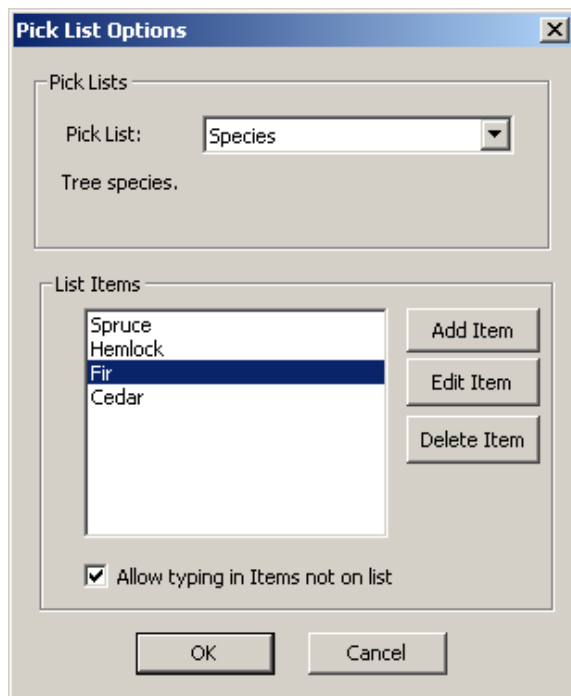
Figure 6.10: Pick list options dialogue box

After returning to the main traverse screen, notice how the new species column allows picklist entries.
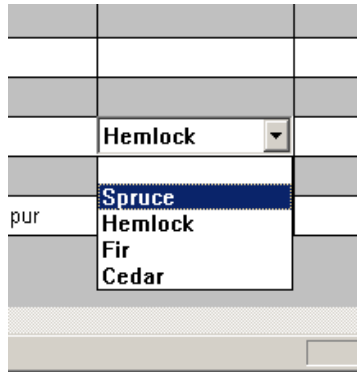
Figure 6.11: Picklist entry

6. *File│Close*. Do not save changes

7. **Working with a GPS Device**

GPS coordinates can be incorporated into Survey/Map, either by directly attaching a GPS or by entering coordinates. Traditional survey methods (bearing, distance and slope) can be combined with GPS in several ways to improve accuracy and productivity. The following examples illustrate ways to combine GPS data with conventional surveys:

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

Tying to known GPS benchmark(s). This is done either in the field or in the office using the Station |Set/Get Coordinates
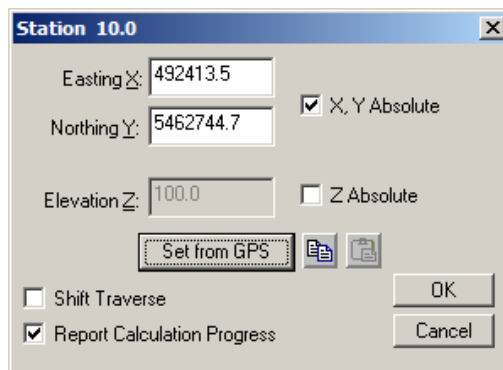
Figure 7.1: Set/Get coordinates dialogue

XY from GPS, Z from slope. This is done using the *Station | Insert Shot dialogue*, *X-Y-Slope*. XY coordinates are taken from the GPS and the slope % (or similar measure of vertical angle) is entered.
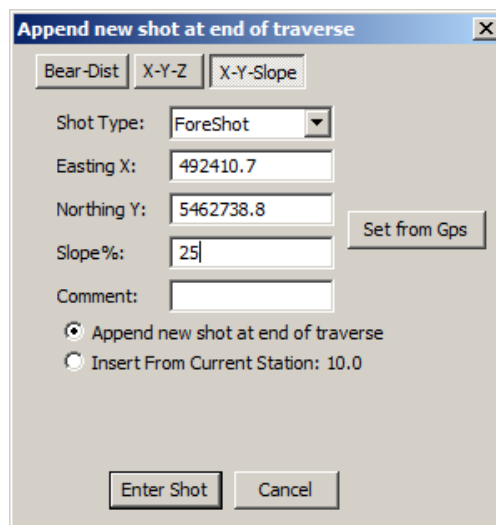
Figure 7.2: XY from GPS combined with slope angle

XYZ from GPS. This is done using the *Station | Insert Shot dialogue, X-Y-Z.* XYZ coordinates are taken from the GPS.
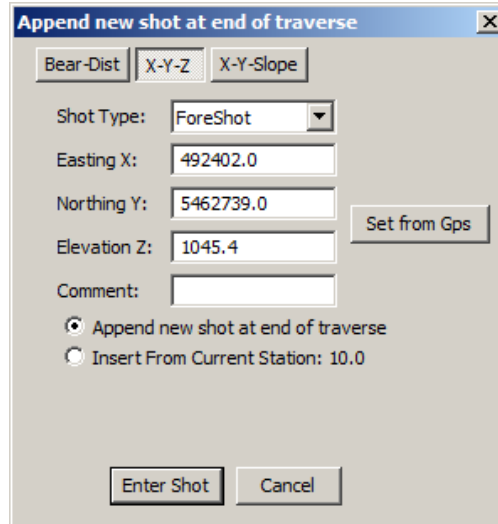
Figure 7.3: XYZ from GPS

Configuring a GPS Device ✔

Before going out in the field with Survey/Map it is important to make sure your GPS device is properly configured.

Identify the Connection Type (either Serial or USB):

Survey/Map supports Garmin devices in either a serial (RS232) connection or a direct USB connection. The connection type can be determined by how the cable plugs into the Garmin device. If the cable plugs into a round Garmin-type connector on the back of the GPS unit, then it is a serial connection. If the cable plugs into a standard USB connector on the back of the GPS unit (same plug type as on digital cameras), then it is a USB connection.

Set the Device Mode (either NMEA or Garmin):

USB Garmin devices only communicate in Garmin proprietary mode. For some reason, the newer Garmin USB devices do not support the industry standard NMEA mode. Set USB Garmin devices to Garmin Data Format on the Interface - Settings page of the GPS unit.

Serial Garmin devices communicate using serial (RS232) protocol, however most laptops only support USB ports. This means you may require a *serial to USB adapter cable* to connect your GPS to Survey/Map. Specifications for the serial interface are included in Appendix B – GPS Hardware Configuration. Set Serial Garmin devices to NMEA Data Format on the Interface - Settings page of the GPS unit.

To test your GPS device

1. Connect the GPS to the laptop using either a Serial or USB cable and turn on your GPS device.

2. Start Survey/Map and choose menu *GPS | Open port*.

Survey/Map should automatically detect the GPS device. The *GPS Confirmation Dialogue* will appear showing the connection information.
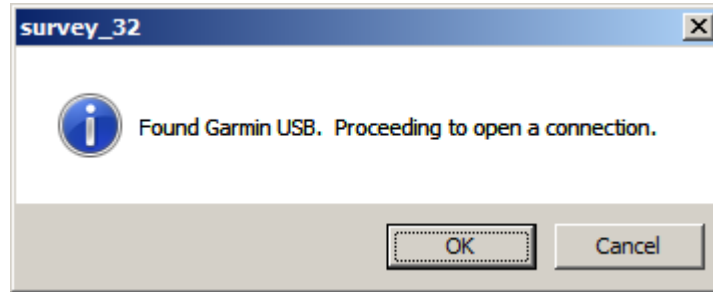
Figure 7.4: GPS auto-detect confirmation

Survey/Map should now be connected and ready to track GPS coordinates. Try moving the GPS device near a window or taking it outside. When the GPS has enough satellites the red indicator on the tool bar should turn to green.
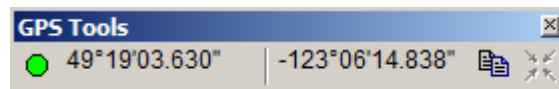
Figure 7.5: GPS tracking indicator

If the GPS device is not found, check to make sure you have the GPS in the correct mode (NMEA mode for serial connections or Garmin mode for USB connections) and that the cables are connected correctly.

8. **Index**

U

V

W

Z