

TPC Desktop Series

Geodetic Learning Guide

TPC Desktop 2011

Version 11.6

8/11

NOTICE

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Table of Contents

Using the Learning Guide	3
Introducing Geodetics	5
Selecting a Coordinate Reference System (CRS)	14
Project Factors and Preferences.....	17
Survey Distance and Direction.....	21
Latitude and Longitude.....	24
Geodetic Closure and Area.....	28
Geodetic COGO	31
Geodetic Drawing.....	33
Transformations	38
Geodetics and the PLSS.....	41

Typography

We will be using the following typography to distinguish items in the text:

[Enter] Brackets indicate keys on the keyboard.

flexibility Italics are used to highlight words for more emphasis.

"**Lot 2**" Numbers or text that you enter or will see on the screen.

System Requirements

This version of TPC Desktop requires Windows 7 / Vista / XP / 2000 and Internet Explorer Version 6.0 or later. We recommend you have 1 GB of RAM and 50 MB of free hard disk space in which to install the program.

Important Licensing Information

Our License Agreement allows you to use TPC on only one computer at a time. We do offer one courtesy installation for an additional home or field computer, assuming that the two programs are not being used at the same time. To request a courtesy license contact Traverse PC.

Using the Learning Guide

Welcome to the TPC Desktop Learning Guide. It's designed to help you learn how to do everyday tasks with Traverse PC Desktop.

The Learning Guide is divided into chapters highlighting function areas within the program like Importing Data from a Data Collector and Using ASCII Files. Within each chapter you'll find step-by-step instructions on how to do the most common tasks like adding a line to a legend or adding angled text to a drawing. We've also included useful hints to help you work more efficiently in TPC and references to the on-line Help so you can continue to learn after you have used the Learning Guide.

All of the topics in this Learning Guide are available in the Professional Edition of Traverse PC Desktop. The ones that are limited to specific Editions are clearly labeled, usually at the start of the chapter. Some specific functions are limited to specific Editions and are clearly labeled as such when the function is discussed in the text.

► This chapter demonstrates

Each chapter starts with a list of the things demonstrated in the chapter. This list corresponds with the individual tasks in the chapter.

► Not available in some Edition

Each chapter has an indication like this at the start if it only applies to specific Editions.

► We provide the starting file

Most chapters start by having you open one of the tutorial files provided with the Learning Guide. Just open the file and jump right in.

► One page per task

Most of the tasks fit on a single page. Review all the tasks in a chapter first, and then work through the tasks that are of interest to you. When you add up all the tasks in all the chapters there are literally hundreds of lessons in the Learning Guide.

► Follow the steps

Most tasks include steps for you to follow. Each task starts with step 1.

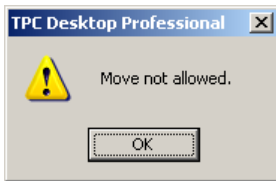
► Menu commands only

For the most part, the Learning Guide will include something like, choose **File | Save**. The bold typeface indicates text you'll see on the screen. In this case, you would left-click the **File** menu to open it, then left-click the **Save** command to execute it. "Choose" means to left-click on a specific item.

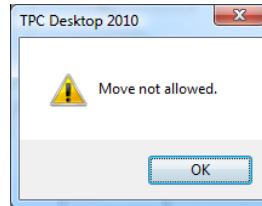
As you become familiar with Traverse PC Desktop you can also use the short-cut keys and tool bars.

► Windows Styles

Depending on your version of Windows and what visual styles you have selected, your dialogs and screens may look different than those shown in this Learning Guide. We include styles common in both Windows XP and Windows Vista in this learning guide as show here.



Windows XP style



Windows Vista & Windows 7 style

Introducing Geodetics

► This chapter demonstrates:

- Using the CRS (Coordinate Reference System) in TPC
- Entering grid data
- Entering geodetic data
- Computing geodetic positions

Overview

In this chapter we'll look at a survey in the east half of a Lambert State Plane projection. We'll talk about grid positions, geodetic positions, and State Plane projections to relate the two. The drawings in the sample survey will help clarify the terminology TPC uses.

In this learning guide, we will sometimes refer to a grid position as a grid coordinate or rectangular coordinate. We will also talk about a Cartesian grid or State Plane grid when referring to X,Y coordinates. These conventions all emphasize the X,Y coordinate as being fundamentally different from a geodetic position having a latitude and longitude.

🔗 To learn more about this topic

1. Choose **Help | Search For Help On...** and left-click the **Index** tab.
2. Scroll down to **Geodesy**, highlight it and choose **Display**.

► Getting started

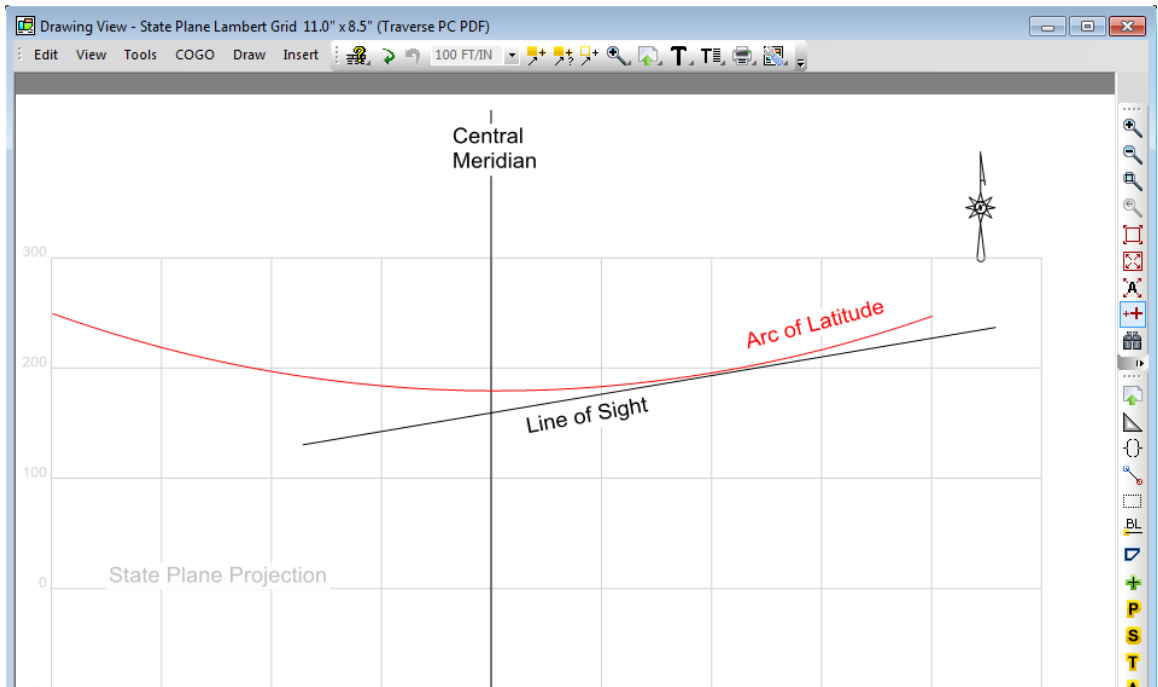
- 1) From the Tasks View choose **Sample Surveys**.
- 2) Double-click the **LEARN GEODETICS.TRV** file.
- 3) Choose **File | Save Survey As** then enter the name **Geodetics** and choose **Save**.
- 4) If prompted to replace the existing file, choose **Yes**.

How TPC Uses the State Plane Grid

Let's start by looking at a drawing.

1) From the Drawings Manager, choose **State Plane Lambert Grid**.

In this drawing, we are working east of the central meridian on a Lambert State Plane projection. TPC uses a Coordinate Reference System (CRS) to relate geodetic positions (latitude and longitude) with grid coordinates (northing and easting). In this survey, we selected the North Washington State Plane projection as our survey's CRS.



►Convergence and Scale Factor

The **Arc of Latitude** shown on the drawing represents a True East-West geodetic line. It differs from the *Line of Sight* in that it has constant latitude.

The **Line of Sight** line shown on the drawing represents a straight or grid line. It differs from the Arc of Latitude in that it has constant grid northing.

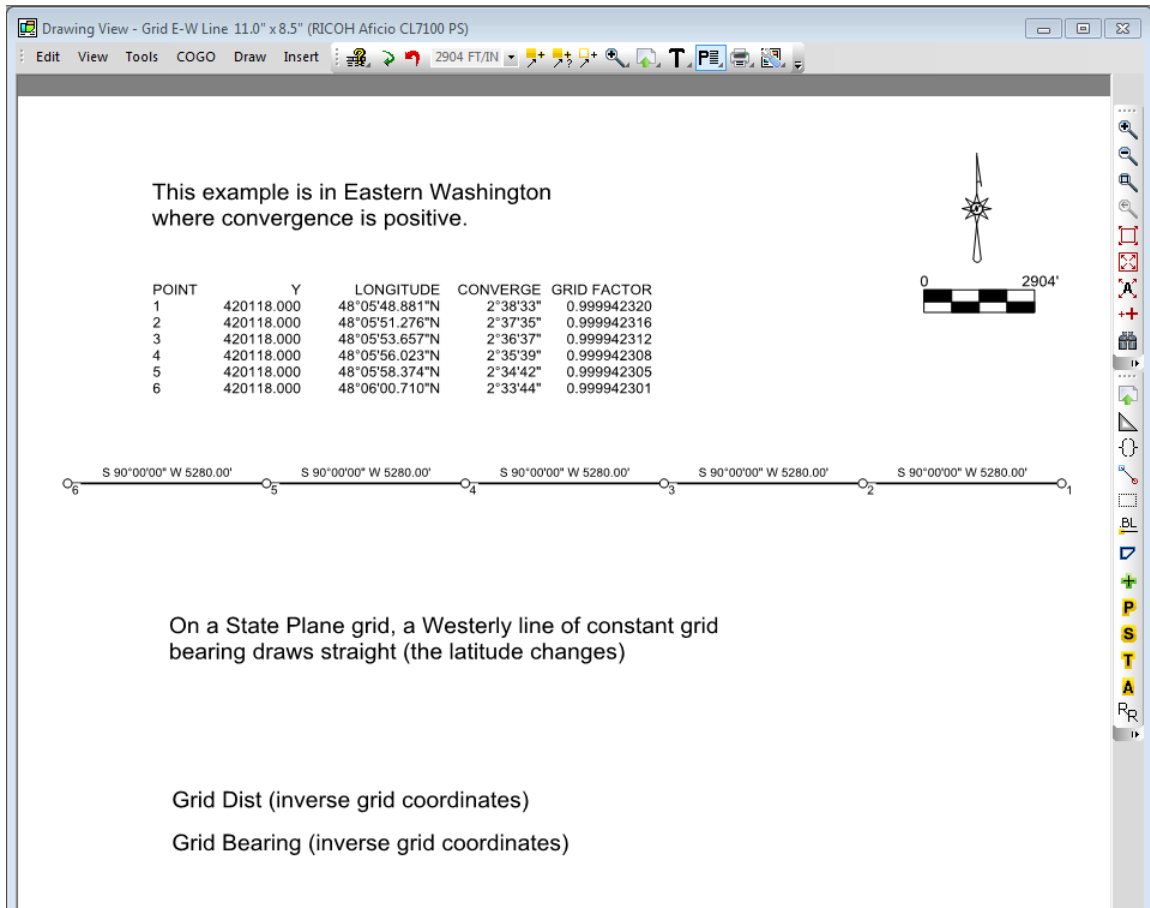
The directions of the two lines at any point on the State Plane grid are related by the *convergence angle*, sometimes called the *theta* or *mapping* angle.

Distances along the two lines are related by the *grid factor*, sometimes called the *scale factor*.

Entering Grid Data

Let's take a look at the straight line (grid line) by itself.

1) From the Drawings Manager, choose **Grid E-W Line**. You should see the following drawing.



Grid lines appear as straight lines when drafted.

Look at the Point table and notice that the Y (northing) value is constant while the LONGITUDE, CONVERGENCE and GRID FACTOR change as the line moves from east to west.

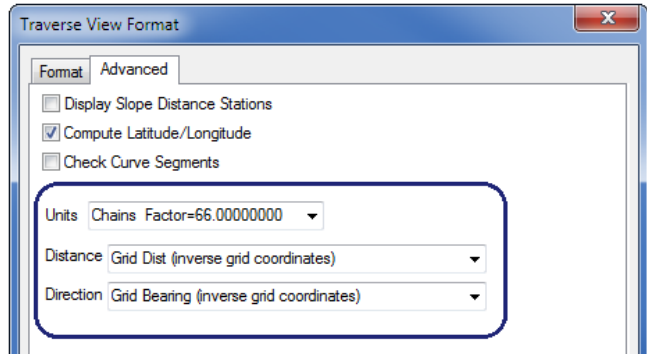
Notations near the bottom of the drawing indicate that annotations in the drawing are grid distance and direction.

2) In the Traverses Manager, double click the **E-W Grid Bearing** traverse.

This traverse was generated by entering a due west grid bearing and 80 chains grid distance for each point.

Point	Type	Grid Bearing	Grid Dist	Northing	Easting	Elevation	Latitude	Longitude	Converge
1				20118.000	2507410.000	0.00	48°05'48.881"N	117°17'02.704"W	2°38'33"
2		S90°00'00"W	80.00	20118.000	2502130.000	0.00	48°05'51.276"N	117°18'20.409"W	2°37'35"
3		S90°00'00"W	80.00	20118.000	2496850.000	0.00	48°05'53.657"N	117°19'38.116"W	2°36'37"
4		S90°00'00"W	80.00	20118.000	2491570.000	0.00	48°05'56.023"N	117°20'55.824"W	2°35'39"
5		S90°00'00"W	80.00	20118.000	2486290.000	0.00	48°05'58.374"N	117°22'13.535"W	2°34'42"
6		S90°00'00"W	80.00	20118.000	2481010.000	0.00	48°06'00.710"N	117°23'31.248"W	2°33'44"

3) Choose **View | Format View** to display the **Traverse View Format** dialog. Then left-click the **Advanced** tab.



Notice we've told TPC that we are entering a grid distances and bearings. Given this information, all Direct and Inverse computations will be on the grid.

The **Units** just tells TPC that distances are in chains, even though the survey is in feet.

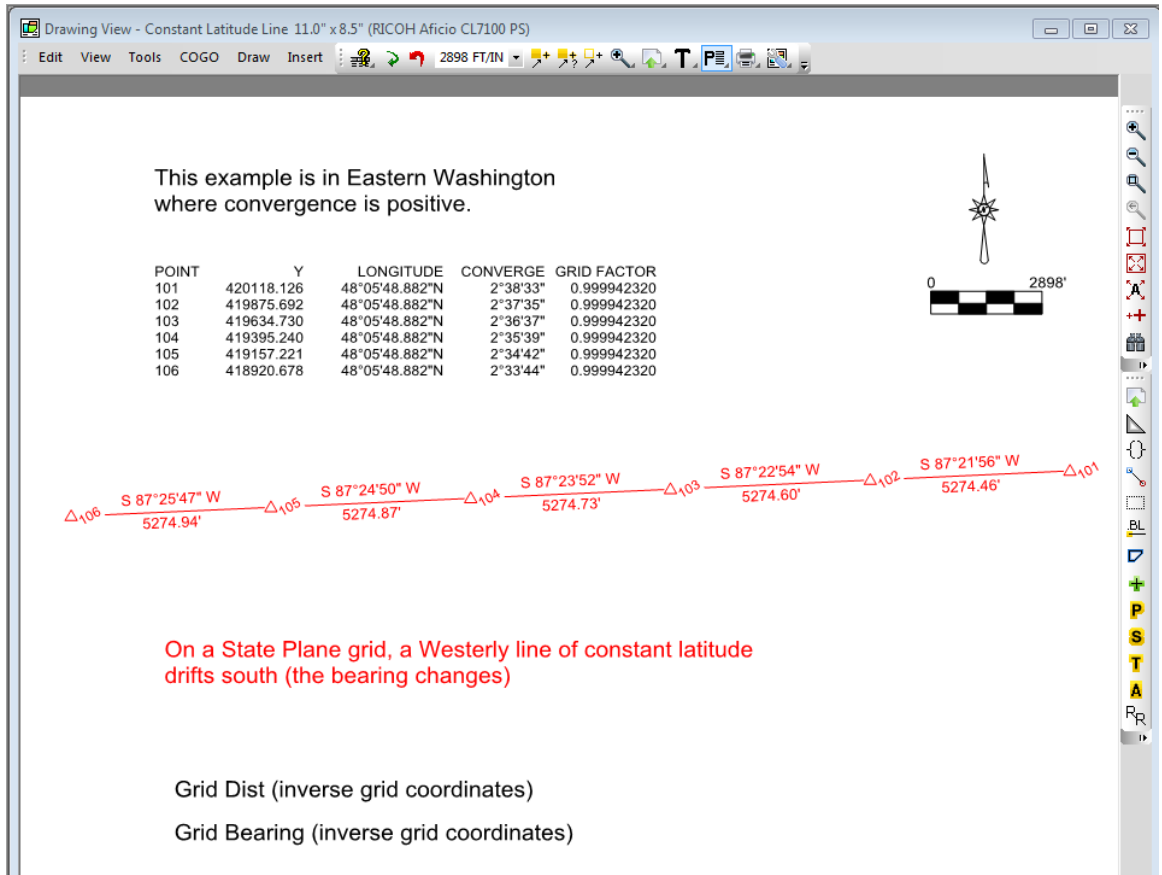
►Note

- If you thought switching between grid and geodetic computations was going to be hard, think again. In TPC, you just select the distance and direction types you want to use. That's how easy geodetics are to use in TPC.
- You make the same selections in COGO and drawings so you always know what kind of data you are working with.

Entering Geodetic Data

Let's take a look at a line of constant latitude.

- 1) From the Drawings Manager, choose **Constant Latitude Line**. You should see the following drawing.



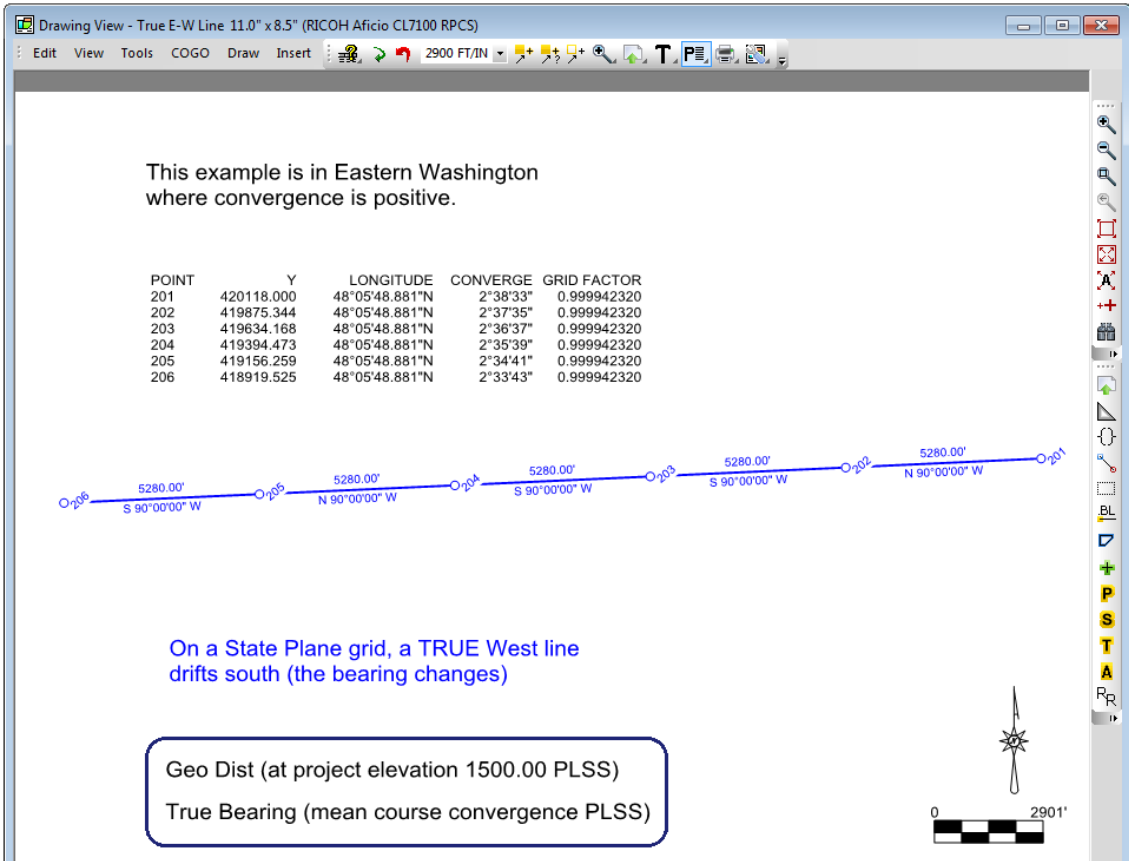
This drawing shows the **E-W Constant Latitude** traverse, in which we entered the same Latitude for each point. This line of constant latitude is actually drawn as an arc with a very large radius. Because of our position on the State Plane grid, this line drifts south as we move west. The bearing labels reflect this drift.

Finally, look at the point table and notice that the **LONGITUDE** and **GRID FACTOR** values remains constant while the others change as the line moves from east to west.

Entering Geodetic Distance and Direction

Let's take a look now at a line generated from geodetic distance and direction.

1) From the Drawings Manager, choose **True E-W Line**. You should see the following drawing:



Notice the information circled in the drawing above. The line is the same as the constant latitude line we looked at before, but the drawing settings have been changed to plot geodetic distance and direction as opposed to grid distance and direction.

In this example, we've selected the PLSS options (geodetic distance at the project elevation and true bearing based on mean course convergence).

2) In the Traverses Manager, double click the **E-W True Bearing** traverse.

This traverse was generated by entering a due west geodetic bearing (**True Bearing**) and 80 chains geodetic distance (**Geo Dist**) for each point.

Point	Type	True Bearing	Geo Dist	Elevation	Latitude	Longitude	Converge
201				1500.00	48°05'48.881"N	117°17'02.704"W	2°38'33"
202		N90°00'00"W	80.00	5000.00	48°05'48.881"N	117°18'20.480"W	2°37'35"
203		S90°00'00"W	80.00	1500.00	48°05'48.881"N	117°19'38.257"W	2°36'37"
204		S90°00'00"W	80.00	1500.00	48°05'48.881"N	117°20'56.033"W	2°35'39"
205		N90°00'00"W	80.00	1500.00	48°05'48.881"N	117°22'13.810"W	2°34'41"
206		S90°00'00"W	80.00	1500.00	48°05'48.881"N	117°23'31.586"W	2°33'43"

OP=203 FS=204 Mean course convergence

► **Note**

- Position the cursor over any bearing or distance and look at the status bar. In this example we've highlighted the bearing, and TPC displays **Mean course convergence** in the status bar, indicating the details of the bearing type.

3) Choose **View | Format View** to display the **Traverse View Format** dialog. Then left-click the **Advanced** tab.

Notice that this traverse uses geodetic distance and bearings. Given this information, all Direct and Inverse computations will be on the ellipsoid.

The **Units** tells TPC we are entering chains even though the survey is in feet.



► **Note**

- Here is a peek at the distance options. In addition to the grid option, there are four ground and three geodetic options.

Geodetic Computations

This is a good time to talk about geodetic computations. You can find this information in the Geodetic help topics inside the program.

► CRS Conversions

TPC uses the survey's CRS (Coordinate Reference System) to relate a geodetic position with a grid coordinate. Given a geodetic position, TPC can compute a grid coordinate and visa versa.

CRS conversions also produce a convergence angle and grid factor for each point being converted, regardless of whether you start with a geodetic position or grid coordinate.

For those of you familiar with State Plane computations, TPC does not do State Plane Direct and Reverse computations carrying State Plane coordinates forward in the process. Instead, it does true geodetic (ellipsoid) computations, resulting in a new geodetic position from which a grid coordinate can be computed using the CRS.

► Direct Geodetic Computations

When a new geodetic position is computed from an existing geodetic position, it's called a **Direct** computation. TPC computes a *geodesic* (true geodetic line).

The distance forward is the geodetic distance based on a great circle passing through the center of the ellipsoid and some height above or below the ellipsoid surface if desired. As a rule, it is slightly longer than a straight line between the equivalent grid points.

► Inverse Geodetic Computations

When two geodetic positions are known, TPC **inverses** the geodesic between them. The geodesic has a length, a mean bearing, and a unique bearing at each end. In the Traverse View and elsewhere, TPC displays the length and mean bearing.

► Thaddeus Vincety's 1975 Equations

When you select any of the geodetic distance options, TPC uses the equations from Thaddeus Vincety in his 'Direct and Inverse Solutions of Geodesics on the Ellipsoid with application of nested equations'. Published in 1975, these are the classic, iterative solutions for computing a geodesic foresight (Direct) and inverting the geodesic distance and end point directions (Inverse) between two geodetic positions.

► Geodetic Distances

Geodetic distances are derived from geodetic positions (latitude / longitude), as opposed to coordinate distances which are derived from grid (plane) coordinates (northings / eastings). Geodetic distances (geodesics) are always an arc distance at some height relative to the ellipsoid surface. As such, there are only three options for the elevation at which they are computed: 1) the mean course elevation 2) the project elevation or 3) on the ellipsoid surface itself.

Any geodetic point can be related back to Cartesian coordinates through the CRS.

►Geodetic Directions

All geodetic computations assume true bearings/azimuths. When you choose a geodetic distance option, TPC checks to make sure you have selected a corresponding geodetic direction.

►Geodetic Areas

TPC can also compute geodetic area instead of grid area. The difference between the two results from the grid factor, the elevation factor, and convergence of the lines.

Area types are tied to distance types. If you select a grid distance, you will also get a grid area.

►Latitudinal Arcs

TPC includes options to compute on latitudinal arcs per the Public Lands Survey System. These are Rhumb lines, not geodesics.

Some of you may be more comfortable with the terms great circle (passes through the center of the ellipsoid) and small circle (an arc of latitude with the equator being the only one that passes through the center of the ellipsoid).

TPC knows the difference between a geodesic (shortest distance between two geodetic positions) and an arc of latitude.

Selecting a Coordinate Reference System (CRS)

This chapter demonstrates:

- Selecting a CRS for a Survey
- Selecting an ellipse

Overview

The CRS determines how grid coordinates in your survey are related to geodetic positions.

A survey can have one Coordinate Reference System (CRS) that relates its geodetic and rectangular (Cartesian) coordinates. The CRS defines the ellipsoid used in the geodetic Direct and Inverse computations. TPC computes geodetic distances by inverting between two geodetic positions on the ellipsoid surface and applying the appropriate elevation factor (converting between the ellipsoid surface and the ground elevation). Since the CRS relates the coordinates of a point to its geodetic position, TPC can compute both the coordinate distance and a geodetic distance between any two survey points.

The transformation between grid coordinates and geodetic positions generates a scale factor and convergence angle for each survey point. These can be reported along with the other point data like coordinates, latitude, and longitude. They are also used to compute mean bearings of geodetic lines.

► Getting started

- 1) From the Tasks View choose **Sample Surveys**.
- 2) Double-click the **LEARN GEODETICS.TRV** file.
- 3) Choose **File | Save Survey As** then enter the name **Geodetics** and choose **Save**.
- 4) If prompted to replace the existing file, choose **Yes**.

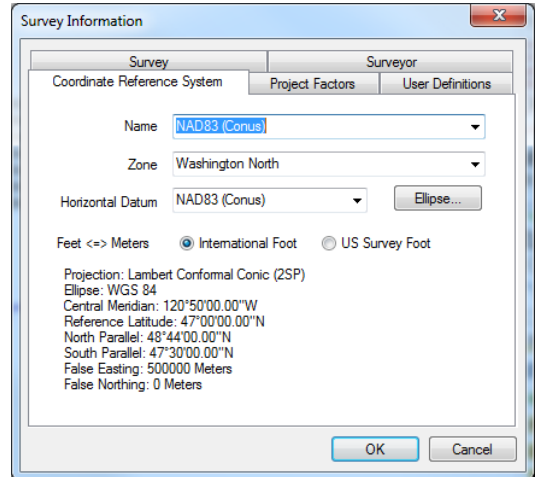
You can select a CRS when you start a new survey or anytime afterwards.

Selecting a CRS For a Survey

When you start a new survey, TPC needs to know what CRS you are using before it can convert between geodetic and grid positions.

1. From the desktop menu choose **File | New Survey**.
2. After naming your file, click the **Coordinate Reference System** tab. TPC displays the **CRS** dialog.
3. Select the **Name** of the CRS you want to use then select a **Zone** and **Datum**.
4. Click the **Ellipse** button to display the **Ellipse** dialog.
5. Change the ellipse values to match your published values.

TPC sets the CRS for the new survey. Any conversions between geodetic positions and grid coordinates will now be based on the CRS.



► Changing the CRS

1. From the desktop menu choose **Tools | Survey Information**.
2. Choose **Coordinate Reference System**. TPC displays the **CRS** dialog.
3. Select the **Name** of the CRS you want to use then select a **Zone** and **Datum**.
4. Click the **Ellipse** button to display the **Ellipse** dialog and select ellipse values to match your published values.

TPC resets the CRS for the current survey without doing any coordinate conversions. Any conversions between geodetic positions and grid coordinates will now be based on the new CRS.

► Recomputing Dependent Positions

When you make changes to the CRS, you change the relationship between geodetic positions and grid coordinates. As a result, a grid coordinate that was computed from a geodetic position may compute a different coordinate after the change to the CRS. TPC handles this automatically for you by telling each survey point to recompute its dependent position the next time it is needed.

If you entered the geodetic position for a point, that point has geodetic preference. The next time TPC needs a grid coordinate for that point, it will recompute the grid coordinate from the geodetic position so they have the correct relationship per the CRS changes.

► Editing Predefined CRS Data

Selecting a CRS

TPC stores CRS data in a file called TpcZone.dat found in the program folder. This is a self-documented text file. With a little evaluation, you will find it easy to add your own zones to the existing datums in the file.

► Low Distortion Zones

Some states like Oregon and Wisconsin are adopting smaller zones designed to reduce distortion of grid computations within the zone. TPC is adding these as they become available. Look for your state or county zones in the latest release of TPC.

➤ For more help on CRS settings, press F1 from this dialog.

Selecting an Ellipse

1) From the CRS dialog, left-click the **Ellipse** button.

This dialog lets you select a pre-define ellipse or add your own ellipse.

NAD27 uses the Clark 1866 ellipse and NAD83 uses the Geodetic Reference System 1980 ellipse.

► Creating a New Ellipse

Your CRS may specify a particular ellipse to use. If it is not in the list, add it with the **New** button.

The screenshot shows a dialog box titled "Ellipse" with a light blue border. It contains a table of fields and several buttons. The fields are:

Name	WGS 84	New
Semi-Major	6378137.00000000000000	Save
Semi-Minor	6356752.3142449996000	Delete
Reciprocal Flattening	298.257223567224	
Flattening	0.0033528106647	
Eccentricity Squared	0.0066943799901	Close

You will need the **Semi-Major**, **Semi-Minor**, **Reciprocal Flattening** and **Flattening** values for the ellipse you are creating. You should be able to find them in your state publications or surveying texts.

The Semi-Major and Semi-Minor values are always in meters.

► User Ellipse File

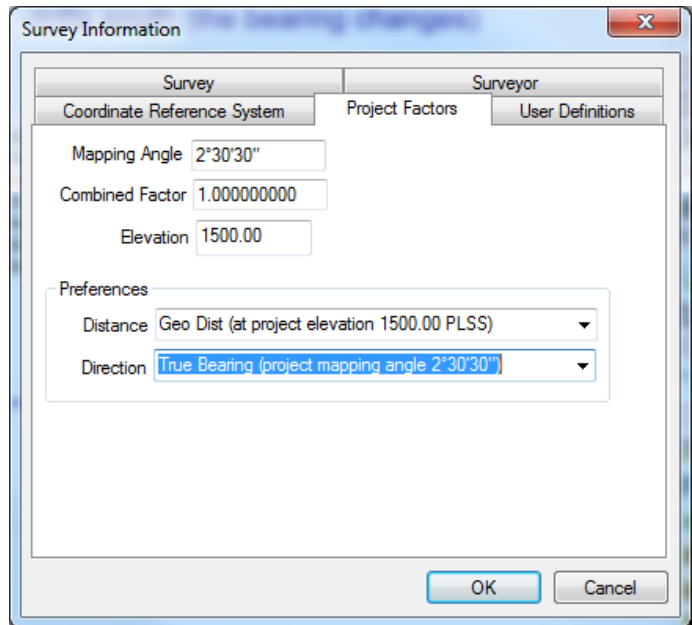
TPC stores any changes you make to the ellipse list in a file called UserEllipses.dat found the ProgramData folder.

➤ For more help on Ellipse settings, press F1 from the **Ellipse** dialog.

Project Factors and Preferences

► This chapter demonstrates:

- Understanding project preferences
- Using project factors for distance
- Using project factors for direction



Overview

TPC allows you to choose the level at which you wish to apply geodetics to your survey. This is where the Project Factors come into play.

Distances and directions can be based on the *Project Factors* you enter here.

For instance, all distances can be computed at a project elevation. This is how computations are done on the PLSS (Public Lands Survey System). Or you can assume a **Combined Factor** for the project to relate all grid and ground distances in the survey.

► Getting started

- 1) From the Tasks View choose **Sample Surveys**.
- 2) Double-click the **LEARN GEODETICS.TRV** file.
- 3) Choose **File | Save Survey As** then enter the name **Geodetics** and choose **Save**.
- 4) If prompted to replace the existing file, choose **Yes**.

Project Preferences

The **Distance** and **Direction** preferences you select here become the default for the survey. Any time you start a new traverse or drawing or open a COGO dialog, TPC sets the Distance and Direction options to these defaults. In each situation, you can accept the defaults or select a different Distance or Direction type as needed.

► Setting the Project Elevation

1) Enter **1500.00** for the **Elevation**.

Anywhere you can select a distance type, you will have the option of selecting either a ground or geodetic distance at this project elevation as one of the options. Don't worry about the elevation scale factor, TPC computes it based on this elevation and uses it when appropriate.

► Setting the Project Mapping Angle

1) Enter **2°30'30"** for the **Mapping Angle** (entered as 2.3030).]

2) Click **OK** to close the dialog.

Using Project Factors for Distance

- Ground distance can be computed using the **Combined Factor** or **Elevation**.
- Geodetic distance can be computed using the **Elevation**.

► Drawing View

Let's start by looking at drawing settings.

- 1) In the Drawings Manager, double click the **True E-W Line** drawing to open it in the Drawing View.
- 2) Choose **Tools | Drawing Settings** in the Drawing View and left click the **Miscellaneous** tab.
- 3) Expand the **Distance** list and choose **Geo Dist (at project elevation 1500.00 PLSS)**.

You just told TPC to label the drawing so that all distances are geodetic ground distance at the project elevation of 1500 feet. This is the **Elevation** you entered in the Project Factors dialog.

- 4) Find the text shown here in the bottom half of

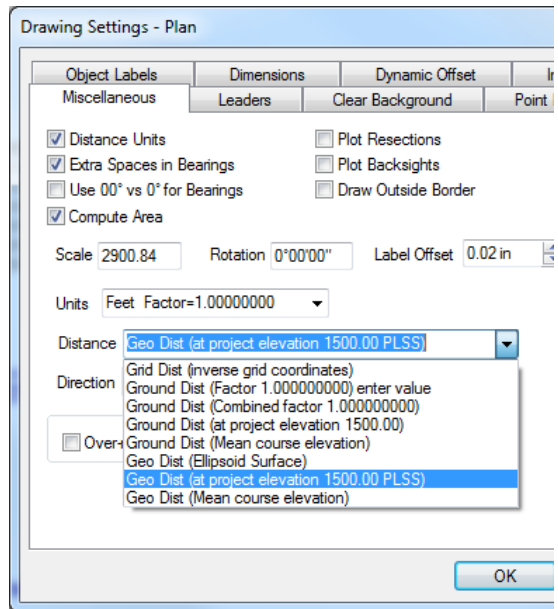
the drawing and place your cursor over it. The tooltip shows the drawing variable \$DISTANCETYPE.

If you enter the \$DISTANCETYPE variable anywhere in a drawing as a text object, TPC will display the distance type selected for line labels and lot areas.

► Traverse View

- 1) In the Traverses Manager double click **E-W True Bearing** to open the Traverse View.
- 2) Choose **View | Format View** in the Traverse View and left-click the **Advanced** tab.
- 3) Pull down the **Distance** list and choose **Geo Dist (at project elevation 1500.00 PLSS)**.

The distances in the Traverse View will now match the line labels in the drawing because they are both based on the same distance type.



Text*, 0 Layer
\$DISTANCETYPE
Insert: Y=412063.270 X=2483677.700 Z=0.00
Arial 0.15

Geo Dist (at project elevation 1500.00 PLSS)

Using Project Factors for Direction

➤ True Bearing/Azimuth can be computed using the Mapping Angle.

► Drawing View

- 1) In the Drawings Manager, double click the **True E-W Line** drawing to open it in the Drawing View.
- 2) Choose **Tools | Drawing Settings** and left click the **Miscellaneous** tab.
- 3) Expand the **Direction** list and choose **True Bearing (at project mapping angle 2°30'30")**.

You just told TPC to label the drawing using the mapping angle you entered in the Project Factors dialog.

- 4) Find the text shown here in the bottom half of the drawing and place your cursor over it. The tooltip shows the drawing variable `$DIRECTIONTYPE`.

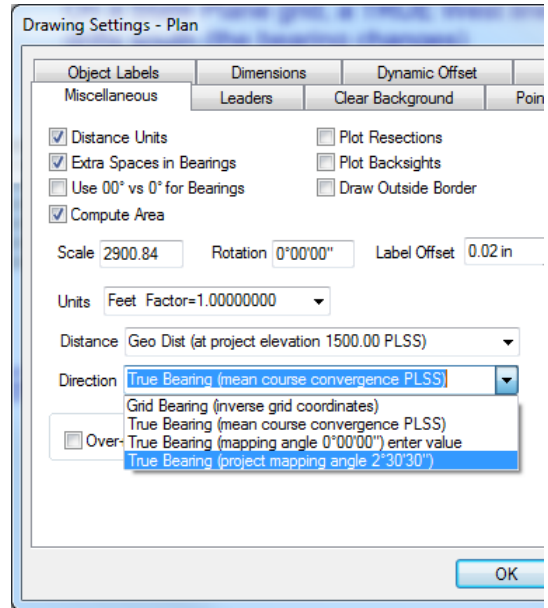
Enter the `$DIRECTIONTYPE` variable anywhere

in a drawing as a text object and TPC will display the direction type selected for line labels.

► Traverse View

- 1) In the Traverses Manager double click **E-W True Bearing** to open the Traverse View.
- 2) Choose **View | Format View** and left-click the **Advanced** tab.
- 3) Pull down the **Direction** list and choose **True Bearing (project mapping angle 2°30'30")**.

The directions in the Traverse View will now match the line labels in the drawing because they are both based on the same direction type.



Text*, 0 Layer
\$DIRECTIONTYPE
Insert: Y=412833.188 X=2483677.710 Z=0.00
Arial 0.15

True Bearing (project mapping angle 2°30'30")

Survey Distance and Direction

Depending on the Edition you have, TPC can use different Distance and Direction types. Geodetic types are not available in the Personal Edition.

Distance Types

► Grid distance (direct inverse between grid coordinates)

This is the distance computed by inverting between grid coordinates. This is a planar computation of X/Y coordinate pairs using simple Cartesian trigonometry.

➤ The Traverse View status bar doesn't display additional information for this type.

► Ground distance (Combined Factor = 0.9999865)

This option applies the combined factor you enter in the Project Factors dialog. The combined factor includes both a scale factor and an elevation factor. It is appropriate when the area covered by the survey is small and there is not much elevation change within the survey.

grid distance = ground distance x (project combined factor)

➤ The Traverse View status bar displays "Combined Factor = 0.9999865".

► Ground distance (at project elevation = 1,500')

Much like the combined factor, this is a combination of scale factor and elevation factor. For this type however, the project elevation factor is computed internally based on the project elevation you enter in the Survey Factors dialog. If the elevation change within the survey is not great, this can be a simple and acceptable way of relating grid and ground distances.

The mean course scale factor is the average of the scale factors computed for each end point of the course. The mean scale factor of a short course will be very nearly the scale factor of either end. For a long course, the mean may vary more significantly from the scale factors at each end.

grid distance = ground distance x (project elevation factor) x (mean course scale factor)

➤ The Traverse View status bar displays "Project Elevation = 1,500".

► Ground distance (mean course elevation)

The option computes a mean scale factor and mean elevation factor for each course. It disregards any combined factor or elevation you may have entered in the Project Factors and uses the geodetic position and elevation of each end point of the course to compute the respective factors. This is most rigorous computation for ground distance.

grid distance = ground distance x (mean course elevation factor) x (mean course scale factor)

➤ The Traverse View status bar displays "Mean Course Elevation"

► Ground distance (Manual Factor = 1.000000123)

You may choose to enter your own distance factor manually. If you have a special situation where the distances you are entering or reporting do not match the survey, you can enter a manual factor that will be used in place of any of the other methods listed here.

To enter a manual factor, type the factor directly into the Distance list. TPC will realize a manual factor is being entered and will re-display the list with your factor.

grid distance = ground distance x (manual factor)

➤ The Traverse View status bar displays "Manual Factor = 1.0000000123"

► **Geodetic Distance (at ellipsoid surface)**

Geodetic distance (at ellipsoid surface) = ground distance measured at ellipsoid surface

➤ The Traverse View status bar displays "Ellipsoid Surface"

► **Geodetic distance (at project elevation = 1,500')**

Geodetic distance (at ellipsoid surface) = ground distance measured at project elevation x (project elevation factor)

➤ The Traverse View status bar displays "Elevation = 1,500"

► **Geodetic distance (mean course elevation)**

Geodetic distance (at ellipsoid surface) = ground distance measured at mean course elevation x (mean course elevation factor)

➤ The Traverse View status bar displays "Mean course elevation"

Direction Types

► **Grid Bearing (Inverse grid coordinates)**

This is the direction computed by inverting between grid coordinates. This is a planar computation of X/Y coordinate pairs using simple Cartesian trigonometry.

➤ The Traverse View status bar does not display any additional information about this direction type.

► **True Bearing (mean course convergence PLSS)**

The option computes a mean direction for each course. It computes the beginning and ending direction of the geodesic or latitudinal arc for the course and then averages them to determine the mean direction.

➤ The Traverse View status bar displays "Mean course convergence"

► **True Bearing (mapping angle x°xx'xx") enter value**

You may choose to manually enter your own mapping angle. If you have a special situation in which the mapping angle is specified for a particular traverse or drawing, enter it here.

To specify the angle, enter the mapping angle directly into the Direction list field. TPC will re-display the list with your mapping angle. Remember to enter angles as DD.MMSS, so 2°30'30" would be entered as 2.3030.

➤ The Traverse View status bar displays "Mapping angle = x°xx'xx" "

► **True Bearing (project mapping angle x°xx'xx")**

This direction type uses the project mapping angle.

The Traverse View status bar displays "Project mapping angle = x°xx'xx" " .

Latitude and Longitude

► This chapter demonstrates:

- Working with geodetic positions in the Point Manager
- Understanding geodetic positions in the Traverse View
- Importing and exporting geodetic positions

Name	Latitude	Longitude	Converge	Grid Factor	Status
1	48°05'48.881"N	117°17'02.704"W	2°38'33"	0.999942320	E
2	48°05'51.276"N	117°18'20.409"W	2°37'35"	0.999942316	E
3	48°05'53.657"N	117°19'38.116"W	2°36'37"	0.999942312	E
4	48°05'56.023"N	117°20'55.824"W	2°35'39"	0.999942308	E
5	48°05'58.374"N	117°22'13.535"W	2°34'42"	0.999942305	E
6	48°06'00.710"N	117°23'31.248"W	2°33'44"	0.999942301	E
7	48°06'03.120"N	117°23'31.235"W	2°33'44"	0.999942298	E
100	48°05'48.881"N	117°17'02.704"W	2°38'33"	0.999942320	E
101	48°05'48.882"N	117°17'02.691"W	2°38'33"	0.999942320	E G
102	48°05'48.882"N	117°18'20.396"W	2°37'35"	0.999942320	E G
103	48°05'48.882"N	117°19'38.103"W	2°36'37"	0.999942320	E G
104	48°05'48.882"N	117°20'55.812"W	2°35'39"	0.999942320	E G
105	48°05'48.882"N	117°22'13.523"W	2°34'42"	0.999942320	E G
106	48°05'48.882"N	117°23'31.235"W	2°33'44"	0.999942320	E G
107	48°05'48.882"N	117°23'31.248"W	2°33'44"	0.999942320	E G
201	48°05'48.881"N	117°17'02.704"W	2°38'33"	0.999942320	

Overview

TPC Desktop Premium and Professional Editions include tools that allow you to use a Coordinate Reference Systems. You'll find the basic tools you need to relate your survey to published geodetic positions and report the latitude and longitude for points in your survey.

🔗 To learn more about this topic

- 1) Choose **Help | Search For Help On...** and left-click the **Index** tab.
- 2) Scroll down to **Geodesy**, highlight it and choose **Display**.

► Getting started

- 1) From the Tasks View choose **Sample Surveys**.
- 2) Double-click the **LEARN GEODETICS.TRV** file.
- 3) Choose **File | Save Survey As** then enter the name **Geodetics** and choose **Save**.
- 4) If prompted to replace the existing file, choose **Yes**.

Working with Geodetic Positions in the Point Manager

The Point Manager can display geodetic information about points just like it displays coordinates.

- 1) In the Point Manager, choose **Tools | View | Format View** to display the **Point Manager Format** dialog.
- 2) Change the **Display Sequence** to **PyxwsJ** and choose **OK**.

TPC now displays the geodetic information about the points.

The screenshot shows the 'Points' window in a software application. The window has a menu bar with 'Tasks', 'Traverses', 'Points', and 'Drawings'. Below the menu bar is a toolbar with various icons. The main area contains a table with the following columns: Name, Latitude, Longitude, Converge, Grid Factor, and Status. The table lists 17 points, with the last five points (101-107) having a 'G' in the Status column, indicating geodetic positions. A blue box highlights the 'G' characters in the Status column for points 101 through 107.

Name	Latitude	Longitude	Converge	Grid Factor	Status
1	48°05'48.881"N	117°17'02.704"W	2°38'33"	0.999942320	E
2	48°05'51.276"N	117°18'20.409"W	2°37'35"	0.999942316	E
3	48°05'53.657"N	117°19'38.116"W	2°36'37"	0.999942312	E
4	48°05'56.023"N	117°20'55.824"W	2°35'39"	0.999942308	E
5	48°05'58.374"N	117°22'13.535"W	2°34'42"	0.999942305	E
6	48°06'00.710"N	117°23'31.248"W	2°33'44"	0.999942301	E
7	48°06'03.120"N	117°23'31.235"W	2°33'44"	0.999942298	E
100	48°05'48.881"N	117°17'02.704"W	2°38'33"	0.999942320	E
101	48°05'48.882"N	117°17'02.691"W	2°38'33"	0.999942320	E G
102	48°05'48.882"N	117°18'20.396"W	2°37'35"	0.999942320	E G
103	48°05'48.882"N	117°19'38.103"W	2°36'37"	0.999942320	E G
104	48°05'48.882"N	117°20'55.812"W	2°35'39"	0.999942320	E G
105	48°05'48.882"N	117°22'13.523"W	2°34'42"	0.999942320	E G
106	48°05'48.882"N	117°23'31.235"W	2°33'44"	0.999942320	E G
107	48°05'48.882"N	117°23'31.248"W	2°33'44"	0.999942320	E G
201	48°05'48.881"N	117°17'02.704"W	2°38'33"	0.999942320	E

► Geodetic vs. Grid Precedence

Notice that the **Status** column includes the letter **G**. This indicates that these points were created by entering or computing their geodetic (marked with a (G)) positions. As a result, the geodetic position takes precedence over the grid coordinates.

When you enter or compute a point in TPC, you establish either its grid coordinates or its geodetic position. As a result, TPC uses the CRS to generate the grid or geodetic equivalent. If you then were to change some parameter in the CRS, TPC would need to recompute the grid or geodetic equivalent values.

The geodetic or grid precedence just determines which one to hold and which one to recompute in the event of such a change.

► Editing Geodetic Positions

- 1) To edit any latitude or longitude, highlight the value. Then press [space] to edit the existing value or enter an entirely new value.

► Adding Geodetic Points to the Survey

- 1) To add a new point to the survey, double click any blank line in the Point Manager or choose **Tools | Insert Point**. TPC will create a new point which you can now edit.

► Protecting Geodetic Positions

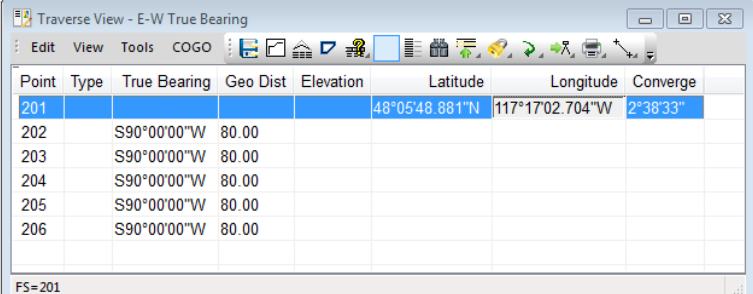
- 1) To protect a point's position, highlight the point and choose **Tools | Modify Points | Protect On**. If the geodetic position has precedence, that's what will be protected. If not, the grid coordinates will be protected.

Protecting points ensures they cannot be modified without explicit steps to do so.

Understanding Geodetic Positions in the Traverse View

1. In the Traverses Manager, double-click the **E-W True Bearing** traverse to display its Traverse View.
2. In its Traverse View, choose **View | Display Raw Data**. Your Traverse View should look like this.

Notice that this traverse starts with a geodetic position for point 201. The geodetic positions of points 201 through 206 are computed from the true bearings and geodetic distances entered in the traverse. Each of the points in this traverse will have geodetic position preference instead of grid coordinate preference.



Point	Type	True Bearing	Geo Dist	Elevation	Latitude	Longitude	Converge
201					48°05'48.881"N	117°17'02.704"W	2°38'33"
202		S90°00'00"W	80.00				
203		S90°00'00"W	80.00				
204		S90°00'00"W	80.00				
205		S90°00'00"W	80.00				
206		S90°00'00"W	80.00				

FS=201

► Entering Latitude and Longitude

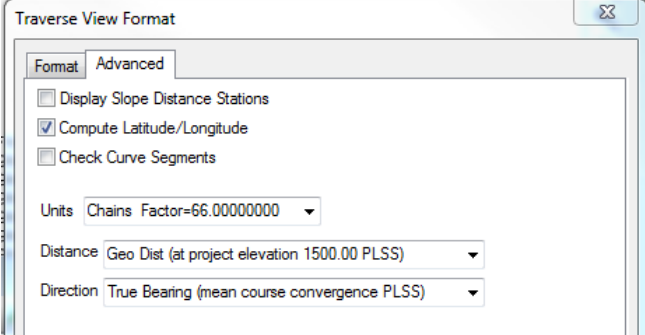
The **Latitude** for point 201 was entered as **48.0548881N** or just **48.0548881**.

The **Longitude** for point 201 was entered as **117.1702704W**. An upper-case or lower-case 'w' tells TPC to go west 117.1702704 degrees. It can be entered either before or after the longitude value. You can also enter -117.1702704. The negative value indicates a west longitude.

► Checking the Distance and Direction Type

- 1) In the Traverse View choose **View | Format View** to display the **Traverse View Format** dialog. Left click the **Advanced** tab.

The **Distance** and **Direction** types direct TPC to compute this traverse geodetically.



Traverse View Format

Format Advanced

Display Slope Distance Stations

Compute Latitude/Longitude

Check Curve Segments

Units: Chains Factor=66.00000000

Distance: Geo Dist (at project elevation 1500.00 PLSS)

Direction: True Bearing (mean course convergence PLSS)

► A Word About Raw Data

The bearings and distances entered for this traverse are raw data. In a traverse, the raw data values don't change.

Selecting geodetic distance and direction types causes TPC to treat the raw data as geodetic data. Selecting grid Distance and Direction types causes TPC to treat them as grid data. Either way, the raw data values remain constant.

Importing and Exporting Geodetic Positions

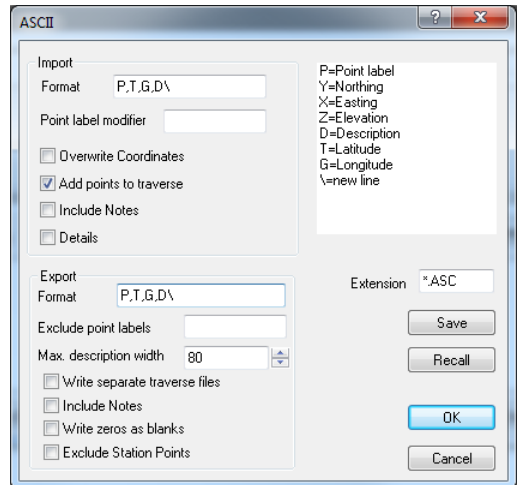
Many data collector files include geodetic positions. As a rule, TPC supports them.

TPC also supports geodetic positions through the generic ASCII coordinate file type which we will look at here.

► To Import Geodetic Positions

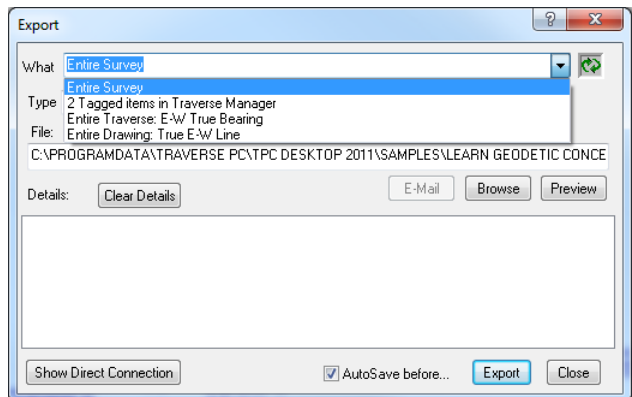
- 1) From the TPC Desktop choose **File | Import**. If prompted to save the survey choose **No**.
- 2) From the **Type** list, choose **ASCII**.
- 3) Left click the small ellipse box to the right of the list to display the **ASCII** dialog.
- 4) Change the **Import, Format** field to **P, T,G,D** and choose **OK**.
- 5) **Browse** to the file you want and choose **Import**.

We've selected an arbitrary format which includes latitude and longitude. You will want to enter a format that matches the data you are importing. You can use the **Preview** button to examine a file before importing it.



► To Export Geodetic Positions

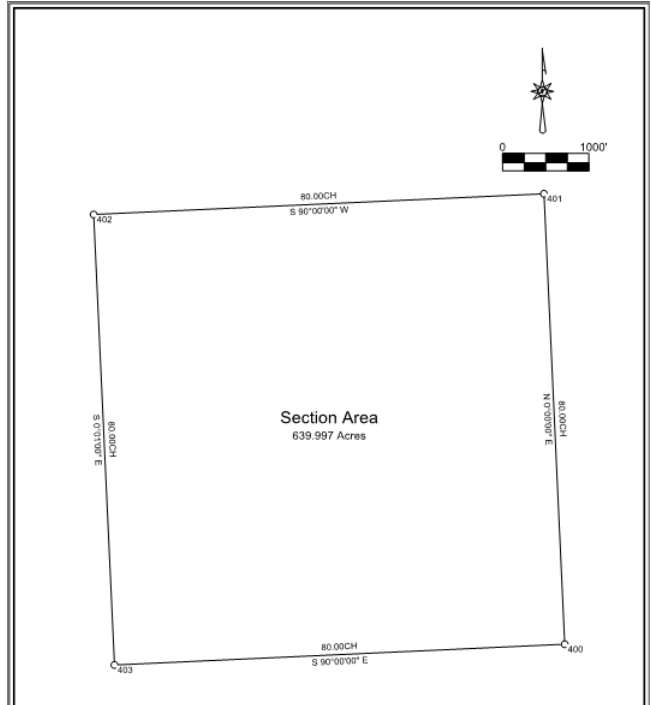
- 1) From the TPC Desktop choose **File | Export**. If prompted to save the survey choose **No**.
- 2) From the **Type** list, choose **ASCII**.
- 3) Left click the small ellipse box to the right of the list to display the **ASCII** dialog.
- 4) Change the **Export, Format** field to **P, T,G,D** and choose **OK**.
- 5) Select the points you want to export from the **What** list.
- 6) Enter a **File** name or **Browse** to a folder.
- 7) When you are ready to write the file, choose **Export**.
- 8) Choose **Preview** to look at the file you just exported.



Geodetic Closure and Area

► **This chapter demonstrates:**

- Geodetic closure
- Geodetic area



Overview

When it comes to closure and area, the differences between Cartesian coordinates and geodetic positions raises its ugly head. It's at this point that we need to clearly identify what kind of closure and area we are working with. TPC helps us keep track of this in an easily understandable way.

This topic will display the closure and area data in the Closure View. This same data can be included in the Traverses Manager, both the lot tables and lot labels in a drawing and in the legal description writer. The same closures and areas are displayed everywhere.

Geodetic closure and area are not available in the Personal Edition.

► **Getting started**

- 1) From the Tasks View choose **Sample Surveys**.
- 2) Double-click the **LEARN GEODETICS.TRV** file.
- 3) Choose **File | Save Survey As** then enter the name **Geodetics** and choose **Save**.
- 4) If prompted to replace the existing file, choose **Yes**.

Geodetic Closure

1) In the Traverses Manager, double click the **Sections Area** traverse to open its Traverse View.

This traverse was created by entering geodetic distances and directions. Because it is a PLSS survey, distances are in chains at the project elevation of 1,500 ft.

Point	Type	True Bearing	Geo Dist	Latitude	Longitude	Converge
400				48°05'48.881"N	117°17'02.704"W	2°38'33"
401		N0°00'00"E	80.00	48°06'40.982"N	117°17'02.704"W	2°38'33"
402		S90°00'00"W	80.00	48°06'40.982"N	117°18'20.502"W	2°37'35"
403		S0°01'00"E	80.00	48°05'48.881"N	117°18'20.479"W	2°37'35"
404		S90°00'00"E	80.00	48°05'48.881"N	117°17'02.703"W	2°38'33"

Notice that the course from 402 to 403 contains a 1' (one minute) convergence per the original GLO notes.

2) To display the Closure View, choose **Tools | Closure View** in the Traverse View.

Notice that the distance and direction types are included at the top of the view under the [[Closure View -]] section.

- **Geo Dist (at project elevation 1500.00 PLSS)**
- **True Bearing (mean course convergence PLSS)**

[[Closure View - Section Area]]

Geo Dist (at project elevation 1500.00 PLSS)
True Bearing (mean course convergence PLSS)

[Traverse Summary]
 Closed Loop 5 Points From 400 To 404
 Horizontal Distance: 21120.00 Feet Slope Distance: 21120.00 Feet
 Area: 27878255.05 SqFt 639.997 Acres

[Error Summary]
 Relative: 1.390509 **Linear: 0.05 Feet** Direction: S89°27'46"W
 Northing: 0.00 Feet Easting: 0.05 Feet Elevation: 0.00 Feet
 Angular: None

[Rectangular Limits (PLSS)]
 Latitude 1:3677572 Departure 1:204339

[Closing Points]

	Point	Northing	Easting	Elevation
From	400	420118.000	2507410.000	0.00
To	404	420118.003	2507410.054	0.00
Correct	400	420118.000	2507410.000	0.00

[Adjustments]

These indicate that the **Linear** error of 0.05 Feet and other information in the Closure View are based on geodetic computations per the PLSS.

If this traverse had been computed using grid coordinates, the **Linear** error would have been 1.54 Feet. The BLM Manual of Survey Instruction refers to this as *apparent misclosure*. With TPC, you bypass inappropriate errors altogether and get right to the heart of the actual geodetic closure.

► Traverse Adjustments

At his point, you could select any appropriate traverse adjustment. TPC would apply the adjustment to the geodetic positions and recompute their corresponding coordinates.

Geodetic Area

Look at the highlighted acres in the Closure View.

Three decimal places are shown here to make the point that for all practical purposes, the area for this square mile section is 640 Acres.

Notice that the distance and direction types are included at the top of the view under the [[Closure View -]] section.

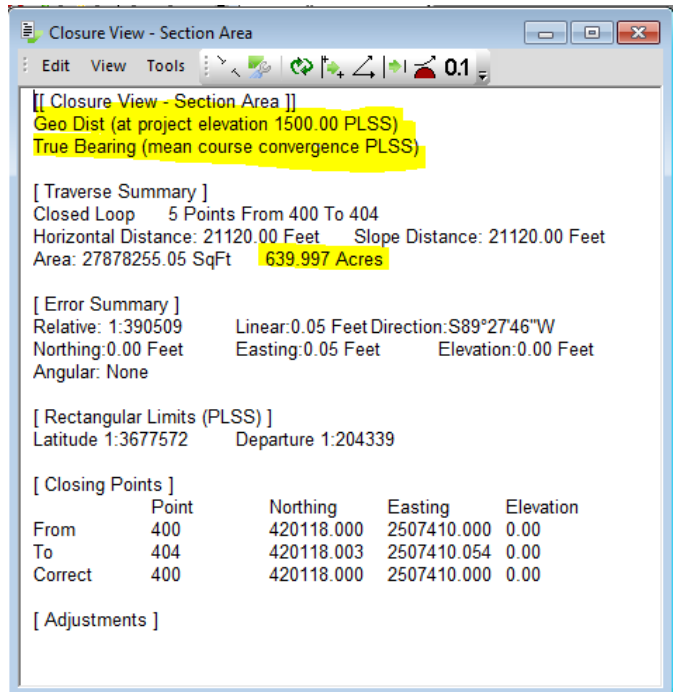
- **Geo Dist (at project elevation 1500.00 PLSS)**
- **True Bearing (mean course convergence PLSS)**

If this traverse had been computed using grid coordinates, the area would have been 639.907 Acres.

The BLM Manual of Survey Instruction says that it is acceptable to compute the grid area and do a Compass Rule adjustment to approximate the correct area, but why go to all the work when TPC computes the correct area right from the geodetic positions.

▶TPC Area Computations

TPC uses the Double Meridian Distance (DMD) method to compute areas. In the process, it factors in the appropriate scale factors. In the case shown here, the area at the project elevation of 1,500 Feet is 640 Acres. Using a different project elevation or a different distance type would have yielded a different area.



Geodetic COGO

► This chapter demonstrates:

- Choosing distance and direction types

Overview

The COGO routines in TPC are completely aware of grid coordinates and geodetic positions. They know that the length of a geodesic is not the same as the length of a straight grid line between the same two points. They also know the difference between a grid distance and a ground distance.

Some dialogs also include PLSS constraints to work on a latitudinal arc.

Geodetic distance and direction options are not available in the Personal Edition.

► Getting started

- 1) From the Tasks View choose **Sample Surveys**.
- 2) Double-click the **LEARN GEODETICS.TRV** file.
- 3) Choose **File | Save Survey As** then enter the name **Geodetics** and choose **Save**.
- 4) If prompted to replace the existing file, choose **Yes**.

Random Inverse (True Bearing, Geo Dist, Feet)

From: 201 To: 202

True Bearing: N89°59'59\"W Geo Dist: 5280.00 Slope Dist: 6334.13

V Dist: 3500.00 V Angle: 33°32'22\" Percent: 66.29

Buttons: Hide Options, Summary, Clear, Close

Options:

Units: Feet Factor=1.00000000 Feet-Meters: International Survey Foot

Distance: Geo Dist (at project elevation 1500.00 PLSS)

Direction: True Bearing (mean course convergence PLSS)

Offset Interval (True Bearing, Geo Dist, Feet)

What: Entire Traverse: Random Line

Line to Compute Offsets To:

From: To: Line: >>

Bearing: N0°00'00\"E Select the end point of a line or enter Bearing

Computed Points on Line:

Save Offsets as Side Shots - offsets are re inserted into the original traverse as sideshots which are automatically recomputed along with the traverse.

Create a New Traverse which includes each offset and it's corresponding Point on Line.

Type: Perpendicular Latitude Arc Add Offset Label to Description

Label: *DFS Next Label Desc

Buttons: Hide Options, Summary, Compute, Close

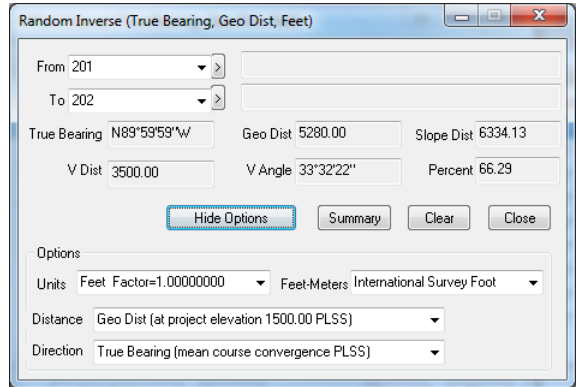
Options:

Distance: Geo Dist (at project elevation 1500.00 PLSS)

Direction: True Bearing (mean course convergence PLSS)

Choosing Distance and Direction Types

- 1) From the **COGO** menu at the top of the TPC Desktop, choose **Random Inverse**.
- 2) Enter the points **201** and **202** into the dialog as shown here.
- 3) Left click the **Show Options** button. It will change to **Hide Options** as it expands to show the **Options** section.
- 4) Select the **Distance** and **Direction** type you want to use. Some COGO dialogs also let you choose the units. In the Random Inverse dialog shown here, you might want to switch to chains to check a GLO plat.



TPC's COGO dialogs go out of their way to show what distance and direction they are using for their computations, even if you hide the **Options** section of the dialog. Let's take a quick look at them.

► Dialog Title Bar

The title bar displays a shortened version of the **Distance** and **Direction** types, along with the coordinate **Units** being displayed.

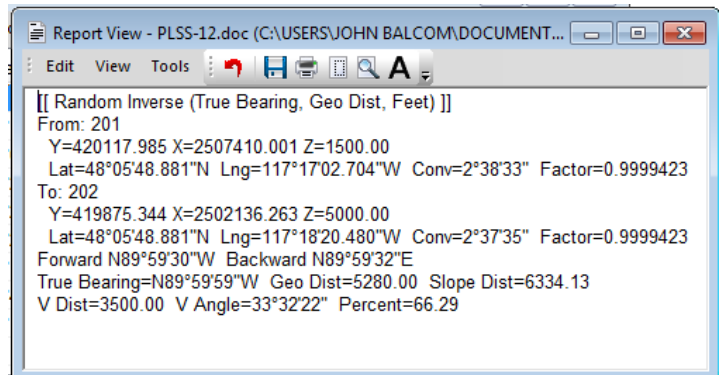
► Field Names

TPC updates the field names like **True Bearing** and **Geo Dist** to match the **Distance** and **Direction** types selected.

► Summary

- 5) Left click the **Summary** button and take a look at the Report View.

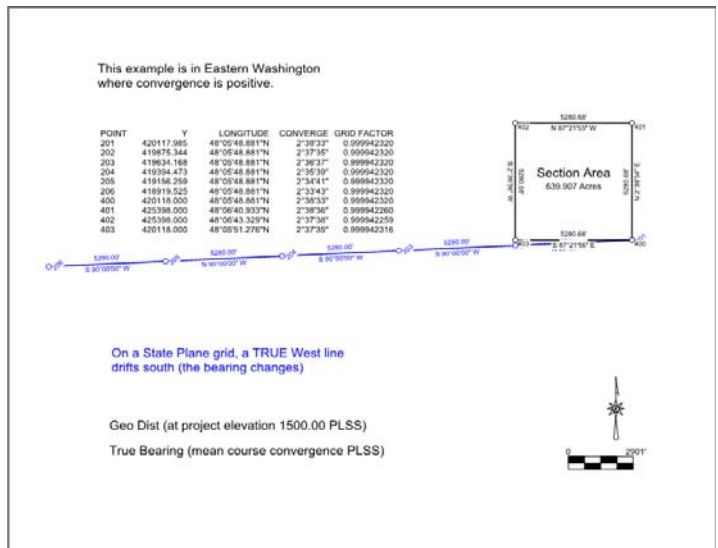
Notice that the summary includes more information than was displayed in the dialog. In this case, you see the forward and backward bearings of the geodesic from 201 to 202. You also get the convergence and scale factor at each end of the course.



Geodetic Drawing

► This chapter demonstrates:

- Setting the distance and direction types
- Documenting geodetic labels
- Including geodetic positions in point labels
- Including geodetic positions in the Point table



Overview

Switching a drawing from grid coordinates to geodetic positions is easy in TPC.

Just tell TPC what kind of distance and direction types to use and TPC does the rest.

🔗 To learn more about drawing templates

- 1) Choose **Help | Search For Help On...** and left-click the **Index** tab.
- 2) Scroll down to **Geodesy**, highlight it and choose **Display**.
- 3) Choose **Drawing Geodetic Data** and choose **Display**.

► Getting started

- 1) From the Tasks View choose **Sample Surveys**.
- 2) Double-click the **LEARN GEODETICS.TRV** file.
- 3) Choose **File | Save Survey As** then enter the name **Geodetics** and choose **Save**.
- 4) If prompted to replace the existing file, choose **Yes**.

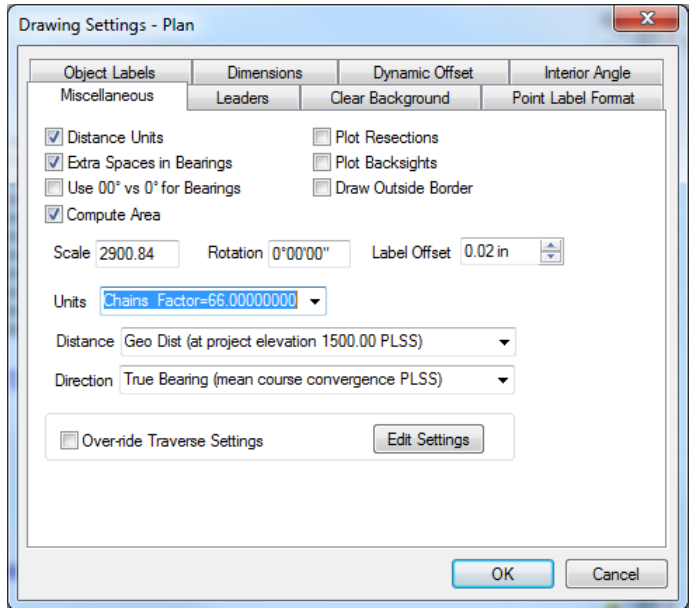
Setting the Distance and Direction Types

- 1) In the Drawings Manager, double click **True E-W Line**. TPC displays this drawing in the Drawing View.
- 2) In the Drawing View choose **Tools | Drawing Settings** and left click the **Miscellaneous** tab.

The **Distance** and **Direction** are the keys to drawing geodetic data.

- 3) Select **Chains Factor=66.0000** from the **Units** pulldown.
- 4) Choose **OK** to return to the drawing.

Take a look at the east end of the line and the Section Area traverse.



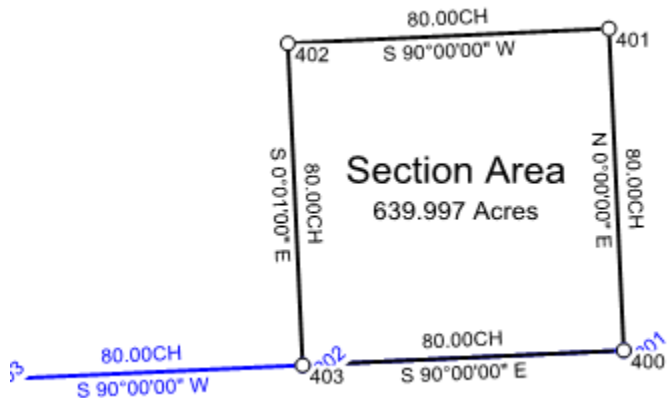
►Line Labels

Notice that the bearings are due East-West, even though the line is obviously not horizontal. That's because geodetic lines are plotted as arcs on a Cartesian grid.

TPC also changed the distance labels to chains because we changed the units to chains. These distances are also at the project elevation of 1500 feet.

►Lot Labels

The **Section Area** lot label displays the area of this traverse as **639.997 Acres** or about 640 Acres as we expect. This is the area of the section at the project elevation of 1500 feet.



- Note: Just setting the distance and direction types in one place updated all the labels in the drawing. The area computation is based on the distance type selected.

Documenting Geodetic Labels

TPC provides a convenient way for you to document the type of distance, direction and area labels shown on the drawing.

- 1) Choose **Draw | Text**.
- 2) Left click any blank spot on the drawing.
- 3) Type **\$DISTANCETYPE** and press [Enter] twice.

Notice that TPC replaces the drawing variable you just typed with **Geo Dist (at project elevation 1500.00 PLSS)**

Geo Dist (at project elevation 1500.00 PLSS)

True Bearing (mean course convergence PLSS)

Now do the same for the direction

- 4) Choose **Draw | Text**.
- 5) Left click any blank spot on the drawing.
- 6) Type **\$DIRECTIONTYPE** and press [Enter] twice.

Notice again that TPC replaces the drawing variable you just typed with **True Bearing (mean course convergence PLSS)**

► Drawing Templates

- 1) Choose **Tools | Drawing Settings** and change the **Distance** or **Direction** type to something else. Notice that the text for the associated drawing variables changes. You can include these drawing variables in any drawing template and they will update automatically as you change the distance and direction types used in a drawing.

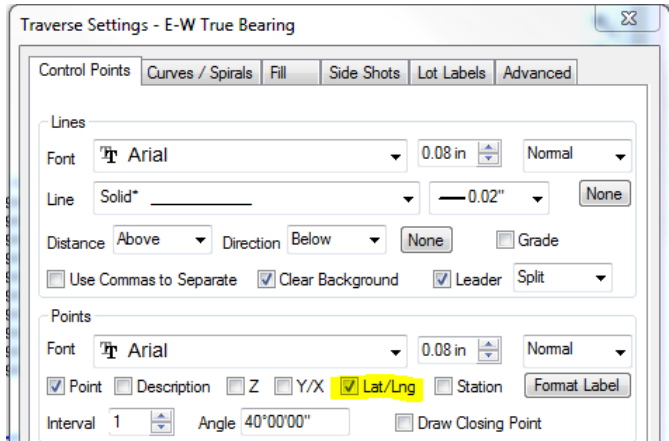
You create a drawing template from any existing drawing by choosing **Tools | Save Drawing as Template**.

Including Geodetic Positions in Point Labels

TPC can include the latitude and longitude of points in their point labels.

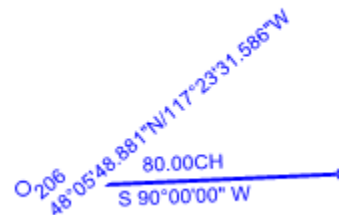
- 1) If your drawing includes a point table, right click any blank spot in the table and choose **Delete** to remove the table.
- 2) Double click any point label in the drawing to display the **Traverse Settings** dialog shown here.
- 3) Left click the **Control Points** tab.
- 4) In the **Points** box, turn on the **Lat/Lng** toggle and choose **OK** to return to the drawing.

TPC adds the geodetic position to each point label. In the example shown here, we've set the point label angle to 40 degrees so the point label information would be separated from the East-West line.



► Moving Point Labels

- 1) To move a point label, drag-and-drop it with the left mouse button.

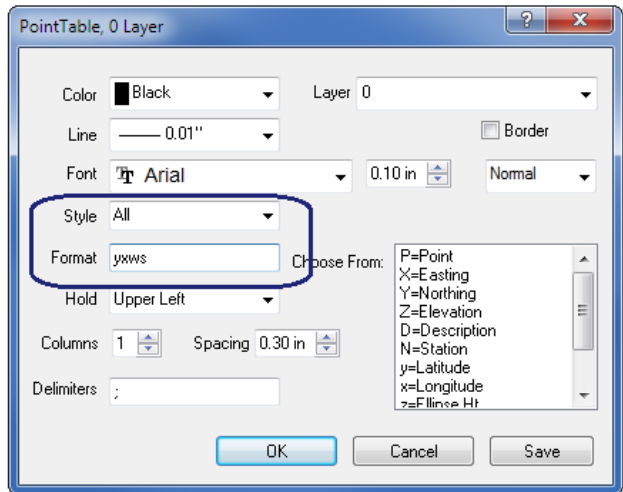


Including Geodetic Positions in the Point Table

You can also include point labels in a Point Table. The advantages are that the point labels don't crowd the drawing and you can include additional geodetic information about each point.

► Inserting a Point Table

- 1) In the Drawing View, choose **Insert | Point Table**.
- 2) Set the **Style** to **All**.
- 3) Enter **yxws** for the **Format** and choose **OK**.



TPC inserts the table on the right side of the drawing. Place the cursor over any blank spot in the table and drag-and-drop it onto the drawing as shown here.

► Referencing Points

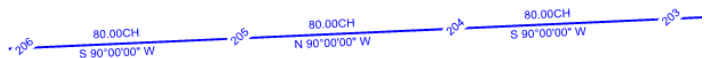
TPC provides two ways to reference the points in the table.

In the example shown here, we did NOT include the letter **P** in the **Format**. This tells TPC to use the point label itself to reference the points. So you will see **206** in the **Point** column and next to the point in the drawing.

If you had included the letter **P** in the **Format**, TPC would have used references like **P1**, **P2**, **P3**, etc. and included the original point labels in the **Label** column.

This example is in Eastern Washington where convergence is positive.

POINT	LONGITUDE	LATITUDE	CONVERGE	GRID FACTOR
201	48°05'48.881"N	117°17'02.704"W	2°38'33"	0.999942320
202	48°05'48.881"N	117°18'20.480"W	2°37'35"	0.999942320
203	48°05'48.881"N	117°19'38.257"W	2°36'37"	0.999942320
204	48°05'48.881"N	117°20'56.033"W	2°35'39"	0.999942320
205	48°05'48.881"N	117°22'13.810"W	2°34'41"	0.999942320
206	48°05'48.881"N	117°23'31.586"W	2°33'43"	0.999942320
400	48°05'48.881"N	117°17'02.704"W	2°38'33"	0.999942320
401	48°06'40.982"N	117°17'02.704"W	2°38'33"	0.999942260
402	48°06'40.982"N	117°18'20.502"W	2°37'35"	0.999942260
403	48°05'48.881"N	117°18'20.479"W	2°37'35"	0.999942320



► Editing the Point Table

- 1) To edit the Point Table, position the cursor over any blank spot in the table, right click and choose **Properties**.

Transformations

► **This chapter demonstrates:**

- Transforming points
- Transforming selected points
- Computing geodetic and grid coordinates for a single point
- Changing the survey units

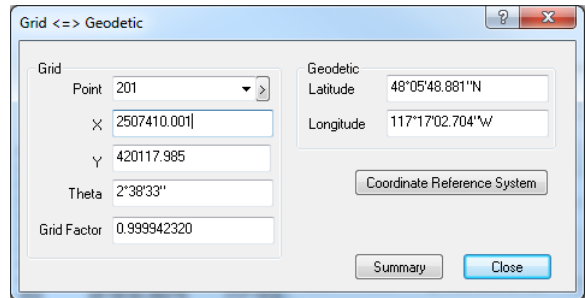
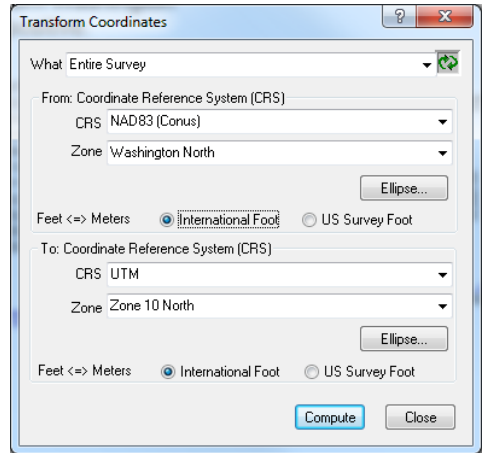
Overview

TPC provides a number of tools to help you keep all your points on the survey's CRS (Coordinate Reference System).

You may have said something like, "All my points are on the same grid", meaning they are all State Plane coordinates or maybe you are just using a local grid with its origin at 5000/5000.

➤ **Note:**

The transformation between NAD27 and NAD83 involves a datum shift which TPC's transformations do not include. These transformations require an additional translation to account for the shift.



🔗 To learn more about drawing templates

- 1) Choose **Help | Search For Help On...** and left-click the **Index** tab.
- 2) Scroll down to **Coordinate Transformations**, highlight it and choose **Display**.

► Getting started

- 1) From the Tasks View choose **Sample Surveys**.
- 2) Double-click the **LEARN GEODETICS.TRV** file.
- 3) Choose **File | Save Survey As** then enter the name **Geodetics** and choose **Save**.
- 4) If prompted to replace the existing file, choose **Yes**.

Transforming Points

If you have selected a CRS like NAD83, all the coordinates in the survey are NAD83 coordinates. You can convert the entire survey to, let's say, UTM coordinates by doing a *Coordinate Transformation*. TPC will use the new CRS to relate geodetic positions and grid coordinates.

1. From the desktop menu choose **Tools | Transform Coordinates**.
2. Select the data you want to transform from the **What** list.

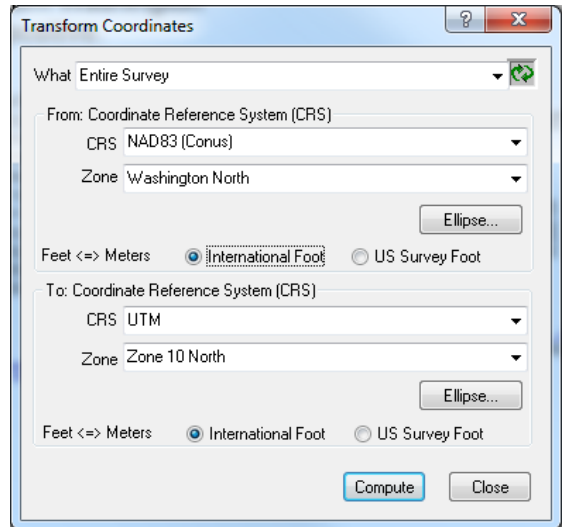
The **From** setting displays the current CRS.

3. Select the CRS you want in the **To** section and choose **Compute**.

If you have the Point Manager or any Traverse views open, they will display the transformed coordinates.

The coordinate transformation may have changed the coordinates of some survey points. If you don't see your survey in Drawing View, left-click Drawing View to activate it and choose **View | Zoom | Zoom Extents**. The Zoom Extents allows the Drawing View to catch up to the transformation.

After you **Compute** the transformation, the dialog displays an **Undo** button. During the transformation, TPC made a copy of each survey point that was transformed. Pressing Undo copies those original coordinates back into the transformed points.

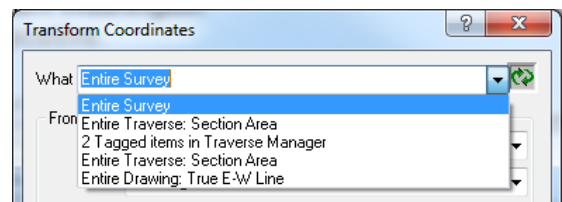


Transforming Selected Points

If you select **Entire Survey** from the **What** list, TPC updates the survey's CRS to match the transformation. After the transformation shown in the example here, the CRS would be **UTM, Zone 10**.

You can limit the points that are transformed by selecting the appropriate item from the **What** list.

The items listed here change as you select and tag items in the managers and views. If you don't see what you want, go to the appropriate manager or view, select or tag the items you want, then return here and refresh the list.



Computing Geodetic and Grid Coordinates for a Single Point

TPC lets you compute and compare the grid and geodetic coordinates of a single point based on any CRS. This is a great way to double check your tie to a published geodetic monument for which you have a particular grid coordinate.

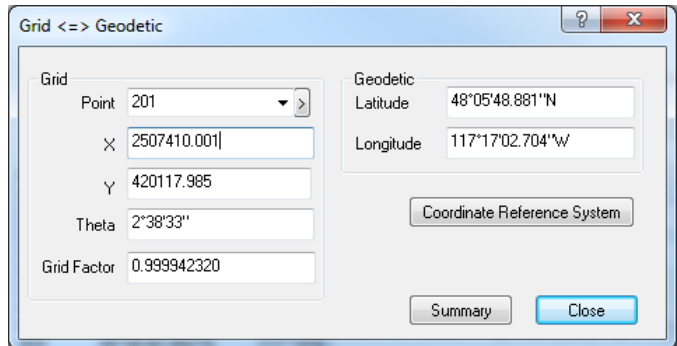
1. From the desktop menu choose **Tools | Grid↔Geodetic**.

2. Enter an existing **Point** or the **X** and **Y** coordinates in **Grid** and TPC will compute the equivalent **Geodetic** position.

3. Enter a **Geodetic** position and TPC will compute the equivalent **Grid** coordinates.

4. To use a CRS other than the current survey CRS, choose **Coordinate Reference System** and select the appropriate CRS. TPC does not update the current survey CRS based on this selection. The CRS you choose here is for the sole purpose of doing this single conversion.

5. Choose **Close**.



➤ Note: You can NOT save the CRS settings you choose here because this is a 'one time only' conversion.

Changing the Survey Units

A survey is restricted to one coordinate unit like Feet, Meters or Chains.

If you find that your survey is not in the units you want, but don't want to change any of the coordinate values, you can change the survey units without doing a transformation.

1) From the TPC Desktop choose **Tools | Survey Information** and left click the **Survey** tab.

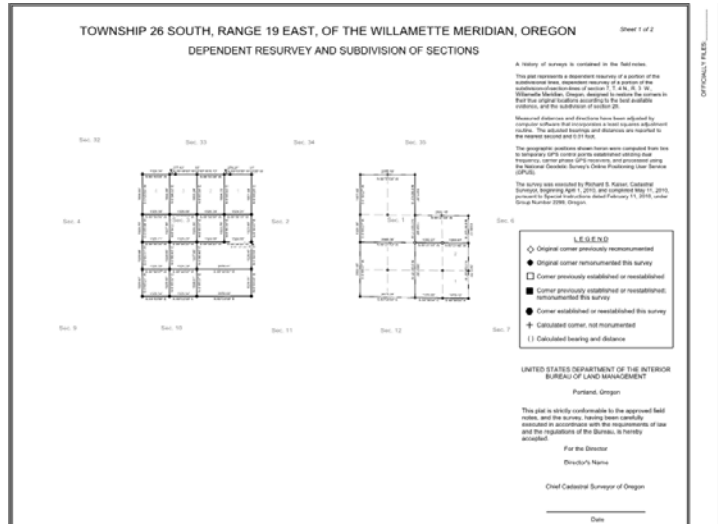
2) Expand the **Units** list and select the desired survey units.

That's it. Your survey units are now changed.

Geodetics and the PLSS

► This chapter demonstrates:

- Starting a PLSS survey
- Choosing PLSS distance and direction types
- Working with latitudinal arcs
- Performing a lost corner restoration



Overview

The goal of this chapter is to let you know TPC has tools to do PLSS surveys and show you how to get started.

Detailed instructions are included in the on-line videos for the PLSS and in the Cadastral Survey help topics.

The PLSS tools are available only in the Professional Edition.

🔗 To learn more about this topic

- 1) Choose **Help | Search For Help On...** and left-click the **Index** tab.
- 2) Scroll down to **Cadastral Surveys**, highlight it and choose **Display**.

Starting a PLSS Survey

When you start a new survey, you can select PLSS options right from the start. These become the defaults for the survey. In essence, it becomes a PLSS survey.

- 1) From the TPC Desktop choose **File | New Survey** to open the **Survey Information** dialog.
- 2) Left click the **Survey** tab. Enter **PLSS** for the **Filename** and choose **Feet** for the **Units**.
- 3) Left click the **Coordinate Reference System** tab and select a **Horizontal Datum, Zone** and **Ellipse**.

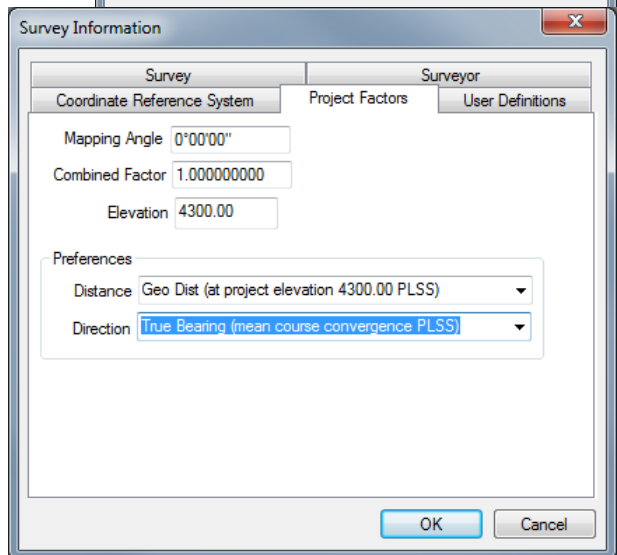
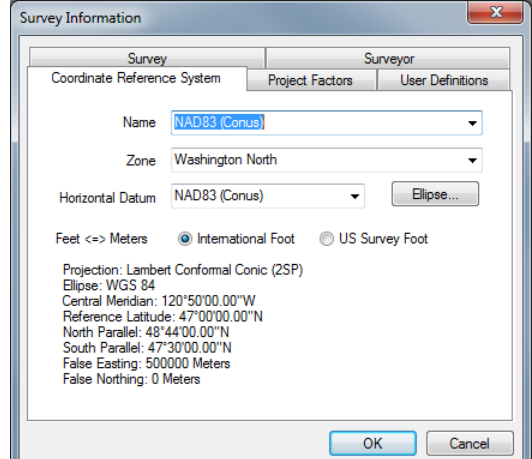
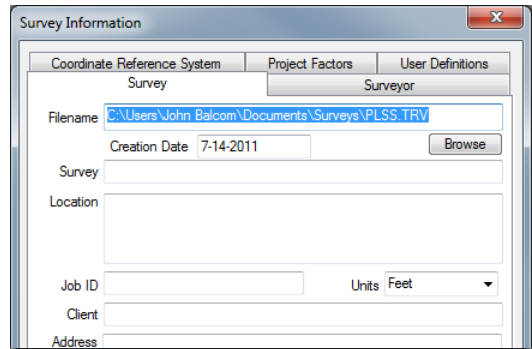
The CRS establishes the relationship between grid coordinates and geodetic positions in your survey. It determines the convergence and scale factors that are computed for each point in the survey.

In particular, it affects how your survey will be drawn. In the east half of a State Plane projection, a due west line will draw as sloping downward toward the south. This is what you would expect on this projection.

- 4) Left click the **Project Factors** tab. Enter **4300.00** for the **Elevation** then select the **Distance** and **Direction Preferences** shown here.

Notice that both the **Distance** and **Direction** pull downs include a PLSS option. These match the requirements in the BLM manual for true bearings and ground distance at the project elevation.

So now your survey is setup and ready to go for the PLSS.



Choosing PLSS Distance and Direction Types

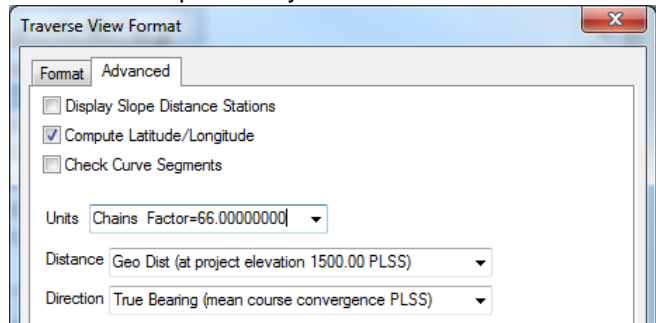
The PLSS specifies that surveys use ground distance at the project elevation and true bearings. TPC accommodates this in its Distance and Direction types. These show up in three places within the program. Let's take a brief look at all three in our sample survey.

- 1) From the Tasks View choose **Sample Surveys** and double-click the **LEARN GEODETICS.TRV** file.

► Traverse View

- 1) From the Traverses Manager double click the **E-W True Bearing** traverse to display its Traverse View.
- 2) Press **Tools | View | Format View** to

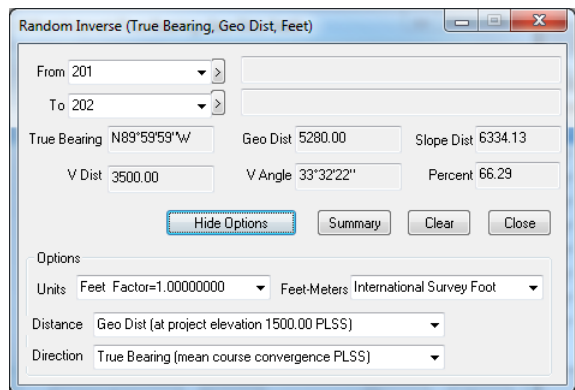
display the **Traverse View's Format** dialog and left click the **Advanced** tab.



Make sure both **Distance** and **Direction** are set to the PLSS options shown here. Notice that we also set the **Units** to chains.

► COGO

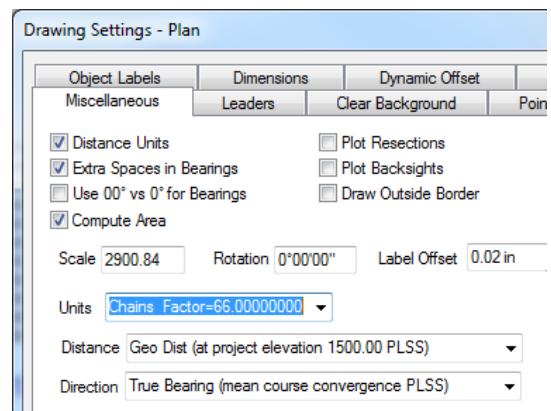
- 1) From the TPC Desktop, choose **COGO | Random Inverse** and enter points **201** and **202** as shown here.
- 2) Make sure dialog dialogs **True Bearing** and **Geo Dist** in the title bar. If not, left click the **Show Options** button and select the **Distance** and **Direction** you want.



► Drawings

- 1) In any drawing, choose **Tools | Drawing Settings**. In the **Miscellaneous** tab, set the **Distance** and **Direction** to the PLSS options shown here.

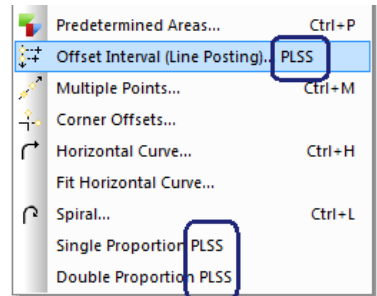
You can also set the **Units** to **Chains** to match the annotations on a GLO plot.



Working with Latitudinal Arcs

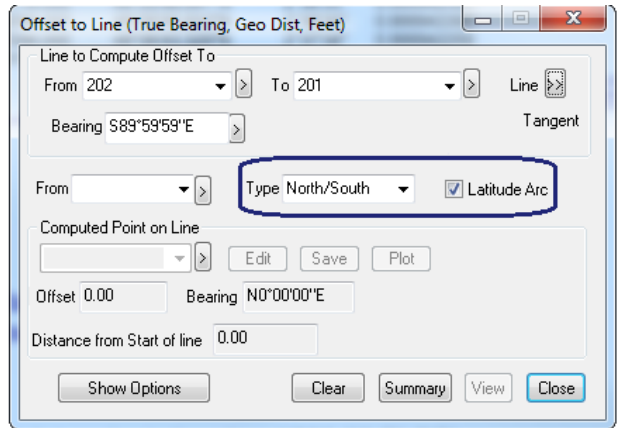
TPC's geodetic capabilities include the requirements of the PLSS.

Look for PLSS in the command name. In the COGO menu shown here, three of the commands include PLSS in the command name.



Computations on the Latitudinal Arc

Look at the **Offset to Line** dialog shown here. By setting the offset **Type** to **North/South** and turning on the **Latitude Arc** toggle, TPC will compute the offsets from a random line to the true East-West latitudinal arc as prescribed in the PLSS.



Performing a Lost Corner Restoration

Some of the PLSS routines are not COGO routines.

The Irregular and Grant Boundary adjustments are examples. They are included in the **Adjust Coordinates** command available in the Closure View as shown here. The results of these adjustments are included in the **Adjustment Details** of the Closure View.

