Surfer®

Powerful contouring, gridding & surface mapping system

Quick Start Guide

Surfer® Registration Information

Your **Surfer** product key is located in the download instructions email and in your account at MyAccount.GoldenSoftware.com.

Register your **Surfer** product key online at www.GoldenSoftware.com. This information will not be redistributed.

Registration entitles you to free technical support, download access in your account, and updates from Golden Software.

For future reference, write your product key on the line below.

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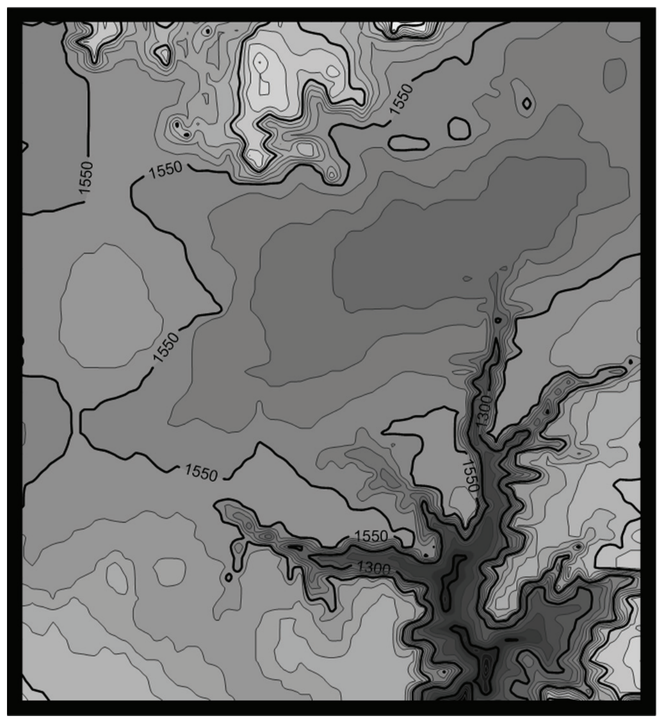
Surfer®

Quick Start Guide

Contouring and 3D Surface Mapping
for Scientists and Engineers



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Introduction to Surfer

Welcome to **Surfer**, a powerful contouring, gridding, and surface mapping package for scientists, engineers, educators, or anyone who needs to generate maps quickly and easily. Producing publication quality maps has never been quicker or easier. Adding multiple map layers and objects, customizing the map display, and annotating with text creates attractive and informative maps. Virtually all aspects of your maps can be customized to produce the exact presentation you want.

Surfer is a grid-based mapping program that interpolates irregularly spaced XYZ data into a regularly spaced grid. Grids may also be imported from other sources, such as the United States Geological Survey (USGS). The grid is used to produce different types of maps including contour, color relief, and 3D surface maps among others. Many gridding and mapping options are available allowing you to produce the map that best represents your data.

An extensive suite of gridding methods is available in **Surfer**. The variety of available methods provides different interpretations of your data, and allows you to choose the most appropriate method for your needs. In addition, data metrics allow you to map statistical information about your gridded data. Surface area, projected planar area, and volumetric calculations can be performed quickly in **Surfer**. Cross-sectional profiles can also be computed and exported.

The grid files can be edited, combined, filtered, sliced, queried, and mathematically transformed. For example, grids can be sliced to create cross-sectional profiles, or the **Grids | Calculate | Math** command can be used to create an isopach map from two grid files. Grids can be edited with an intuitive user interface in the grid editor.

Scripter

The **Scripter™** program, included with **Surfer**, is useful for creating, editing, and running script files that automate **Surfer** procedures. By writing and running script files, simple mundane tasks or complex system integration tasks can be performed precisely and repetitively without direct interaction. **Surfer** also supports ActiveX Automation using any compatible client, such as Visual BASIC. These two automation capabilities allow **Surfer** to be used as a data visualization and map generation post-processor for any scientific modeling system.

New Features

The new features in **Surfer** are summarized:

- Online at www.GoldenSoftware.com/products/surfer
- In the web help at http://surferhelp.goldensoftware.com/#t=topics%2Fnew_features.htm
- In the program, click the help button , and click on the *New Features* page in the *Introduction* book

Who Uses Surfer?

People from many different disciplines use Surfer. Since 1984, over 100,000 scientists and engineers worldwide have discovered Surfer's power and simplicity. Surfer's outstanding gridding and contouring capabilities have made Surfer the software of choice for working with XYZ data. Over the years, Surfer users have included hydrologists, engineers, geologists, archeologists, oceanographers, biologists, foresters, geophysicists, medical researchers, climatologists, educators, students, and more! Anyone wanting to visualize their XYZ data with striking clarity and accuracy will benefit from Surfer's powerful features!

System Requirements

The system requirements for **Surfer** are:

- Windows 7 SP1, 8 (excluding RT), 10 or higher
- 512MB RAM minimum for simple data sets, 1GB RAM recommended
- At least 500MB free hard disk space
- 1024x768 or higher monitor resolution with a minimum 16-bit color depth

Installation Directions

Installing **Surfer** requires Administrator rights. Either an administrator account can be used to install **Surfer**, or the administrator's credentials can be entered before installation while logged in to a standard user account. If you wish to use a **Surfer** single-user license, the product key must be activated while logged in to the account under which **Surfer** will be used. For this reason, we recommend logging into Windows under the account for the Surfer user, and entering the necessary administrator credentials when prompted. Golden Software does not recommend installing **Surfer 17** in the same location as any previous versions of **Surfer**.

To install Surfer from a download:

1. Log into Windows under the account for the individual who will be licensed to use **Surfer**.
2. Download **Surfer** according to the emailed directions you received.

3. Double-click on the downloaded file to begin the installation process.
4. Once the installation is complete, run **Surfer**.
5. License **Surfer** by activating a single-user license product key or connecting to a license server.

Updating Surfer

To update your version of **Surfer**, open the **Surfer** program and choose the **File | Online | Check for Update** command. This will launch the Internet Update program which will check Golden Software's servers for any updates. If there is an update for your version of **Surfer**, you will be prompted to download and install the update.

You can also email your registered **Surfer** product key to surfersupport@goldensoftware.com and request to download the full product update. See the *Check for Update* topic in the help for additional information.

Uninstalling Surfer

To uninstall **Surfer**, follow the directions below for your specific operating system.

Windows 7

To uninstall **Surfer** go to the *Windows Control Panel* and click the *Uninstall a program* link. Select **Surfer** from the list of installed applications. Click the *Uninstall* button to uninstall **Surfer**.

Windows 8

From the *Start* screen, right-click the **Surfer** tile and click the *Uninstall* button at the bottom of the screen. Alternatively, right-click anywhere on the *Start* screen and click *All apps* at the bottom of the screen. Right-click the **Surfer** tile and click *Uninstall* at the bottom of the screen.

Windows 10

Select *Settings* in the **Start** menu. In *Settings*, select **System | Apps & features**. Select **Surfer** and then click *Uninstall*. To uninstall **Surfer** from the Windows Control Panel, click **Programs | Programs and Features**. Select **Surfer** and click *Uninstall*.

Surfer Trial Functionality

The **Surfer** trial is a fully functioning time-limited trial. This means that commands work exactly as the command works in the full program for the duration of the trial. The trial has no further restrictions on use. The trial can be installed on any computer that meets the system requirements. The trial version can be licensed by activating a product key or connecting to a license server.

Three-Minute Tour

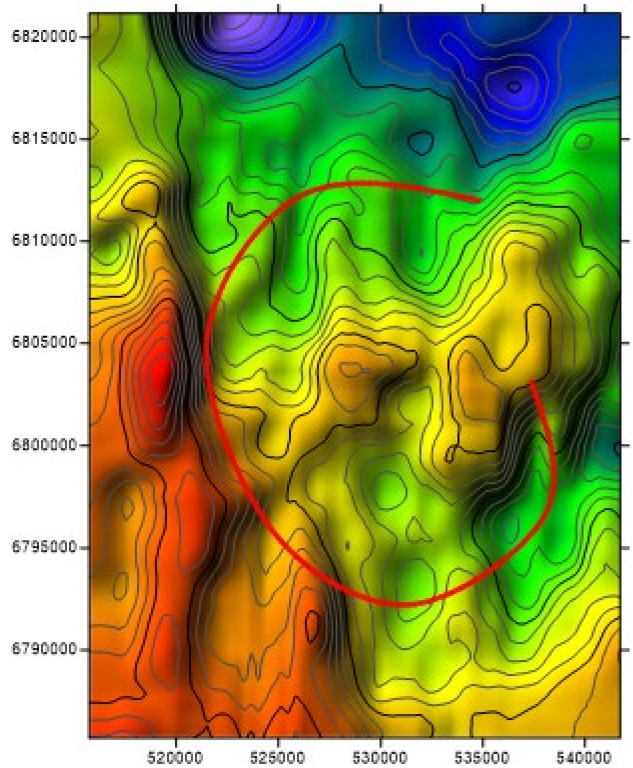
We have included several sample files with **Surfer** so that you can quickly see some of **Surfer's** capabilities. Only a few files are discussed here, and these examples do not include all of **Surfer's** many map types and features. The Contents window is a good source of information as to what is included in each file.

To see the example files:

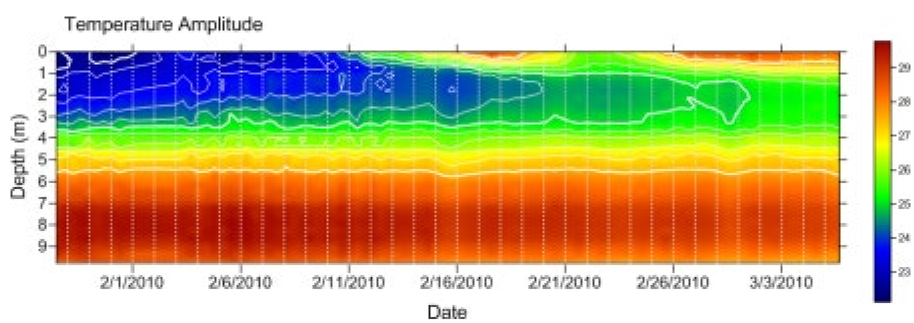
1. Open **Surfer**.
2. Click the File | Open command.
3. In the **Open**dialog, navigate to the **Surfer** Samples folder. The **Surfer** Samples folder is located in C:\Program Files\Golden Software\Surfer\ by default.
4. Select the sample .SRF file of interest and click *Open*. The sample file is now displayed. Repeat as necessary to see the files of interest.

3DView.SRF

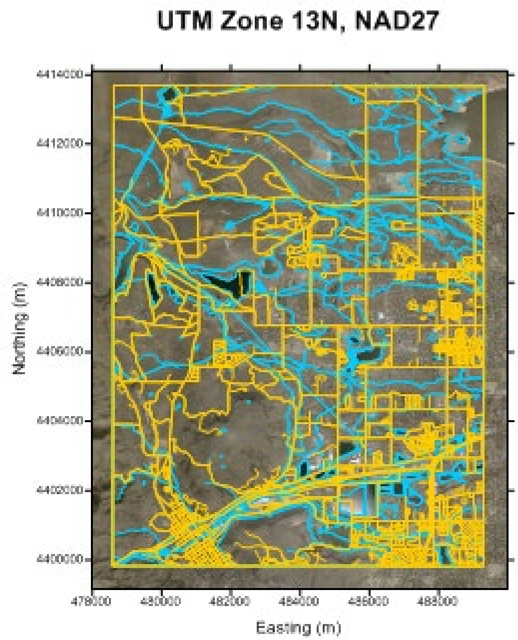
The *3DView.SRF* sample file includes contour and color relief layers, as well as a base (vector) layer that is used for a 3D view fly-through. Select the map and click **Map Tools | View | 3D View** to open a 3D view. Click **3D View | Fly-Through | Play** to view the example fly-through.



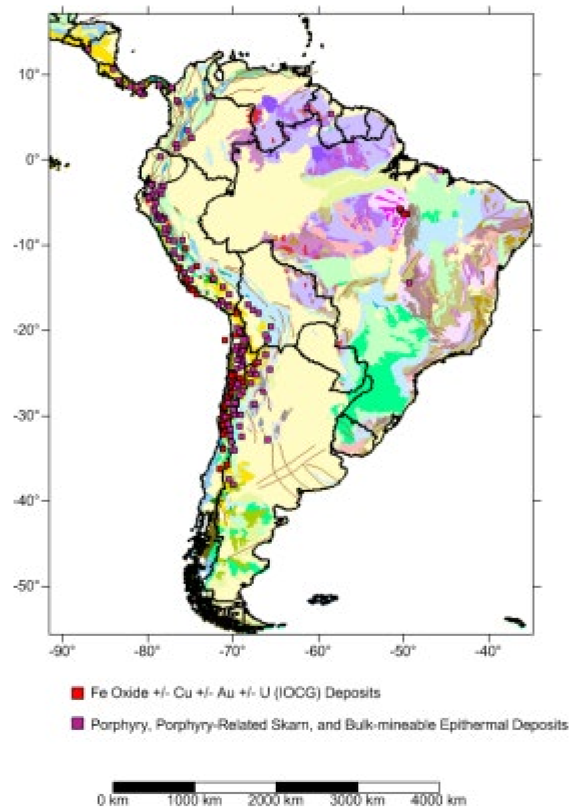
The Axes.SRF file contains a contour map layer and color relief map layer overlaid. The grid file used for the two map layers is the same and includes dates as the X values. The X Axis is displayed using date formatting.



The Base.SRF sample file displays three base map layers showing road transportation, stream hydrology, and a USGS urban area satellite image for Golden, Colorado, USA. The individual polygons and polylines that make up the base maps can be edited or deleted by expanding the base map layer in the Contents window.

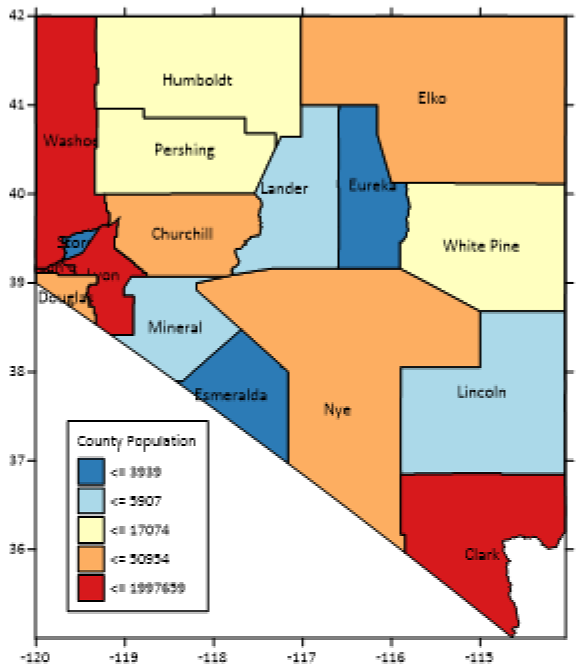


The BaseMapFromServer.SRF file contains five base maps of South America, showing Distribution of various minerals, national boundaries, and generalized geology. All base maps were created by downloading images from online servers.

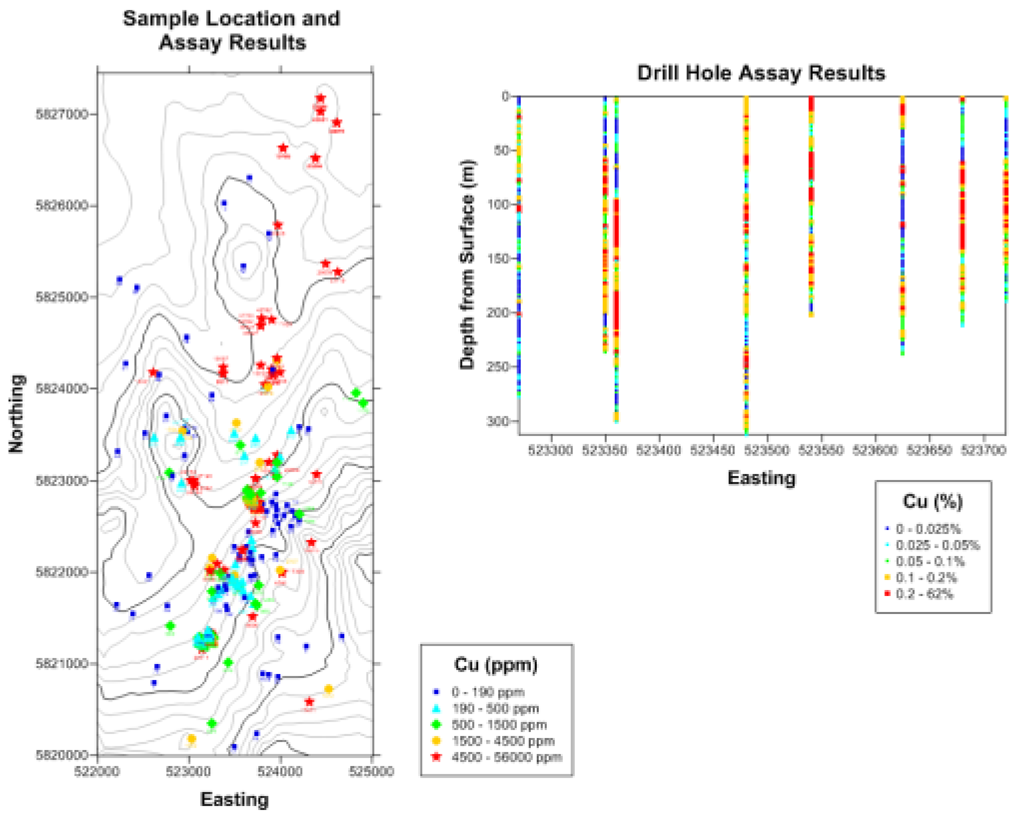


BaseSymbology.SRF

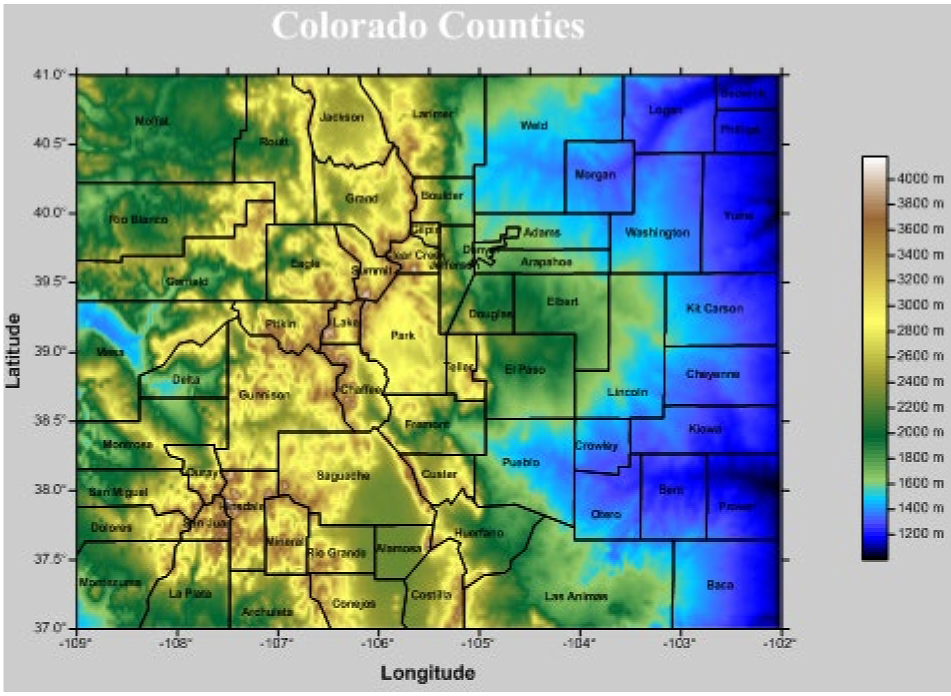
The *BaseSymbology.SRF* sample file includes a base (vector) layer with classed colors symbology applied to a map of Nevada. Counties are classified and colored by population. A legend is included to indicate the upper class values for each of the five classes.



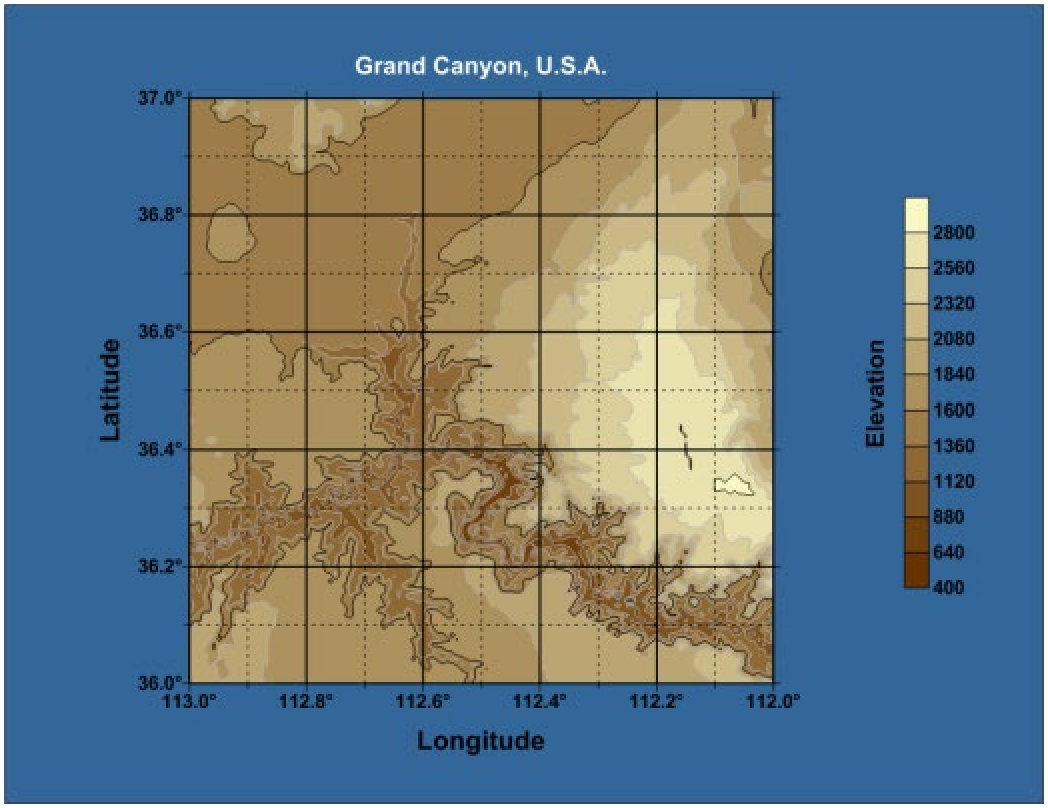
The Classed Post.SRF sample file displays two maps. The left map is a contour map with a classed post map layer displaying the sample location and assay results over a study area. The right map is a classed post map that displays the drill hole assay results by comparing the depth from surface to the Easting. A classed post map legend has been added to each map.



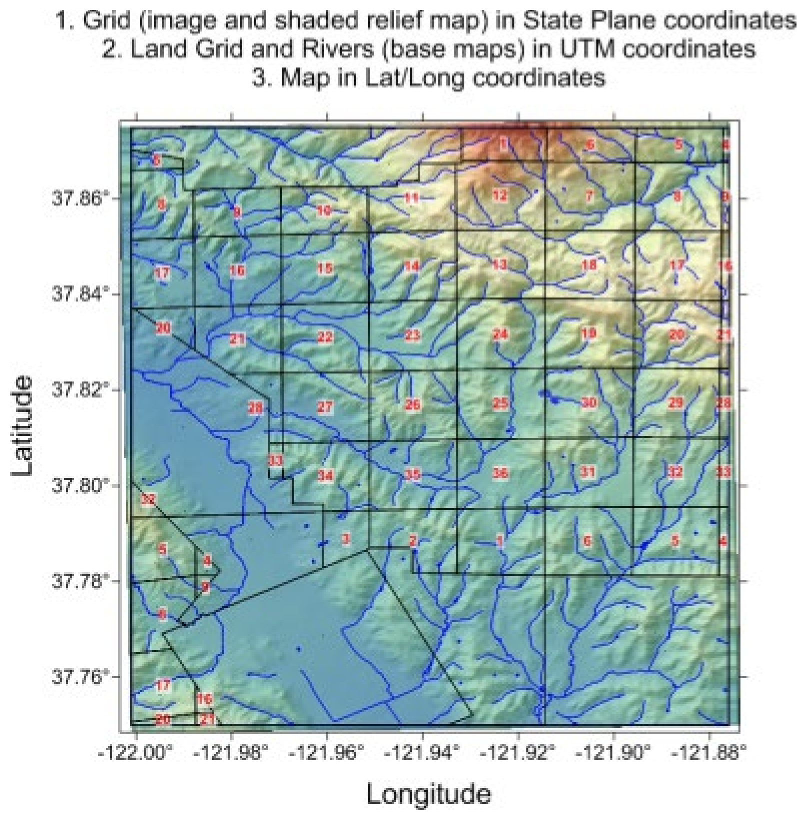
The ColorRelief.SRF sample file displays a color relief map with a base map layer and a post map layer. The color relief map displays the elevation changes across the state of Colorado. A color scale has been added to show the elevation values. The base map layer displays the county boundaries. The post map layer displays the county names.



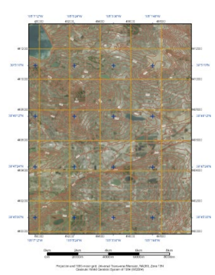
The Contours.SRF sample file displays a contour map of the Grand Canyon, USA. The left axis and bottom axis have the major and minor grid lines shown.



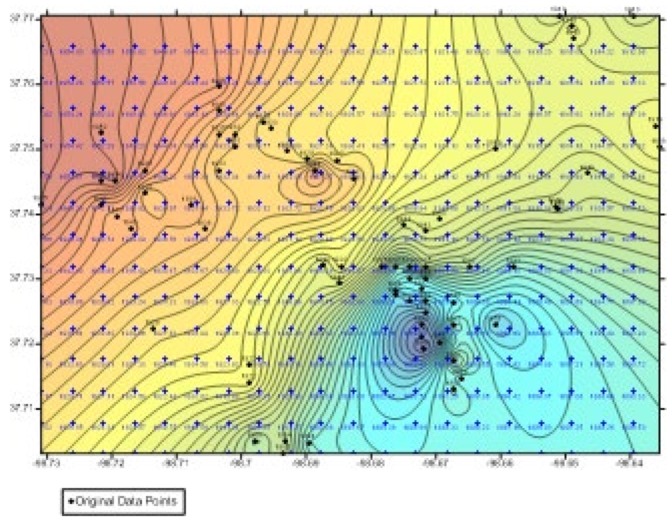
The CoordinateSystem.SRF sample file displays two base map layers showing stream hydrology, and a land grid. An image map showing topography for the Mt. Diablo region is overlaid. The base map layers use a UTM coordinate system. The image map layer uses a state plane coordinate system. The final map is displayed in latitude and longitude coordinates.



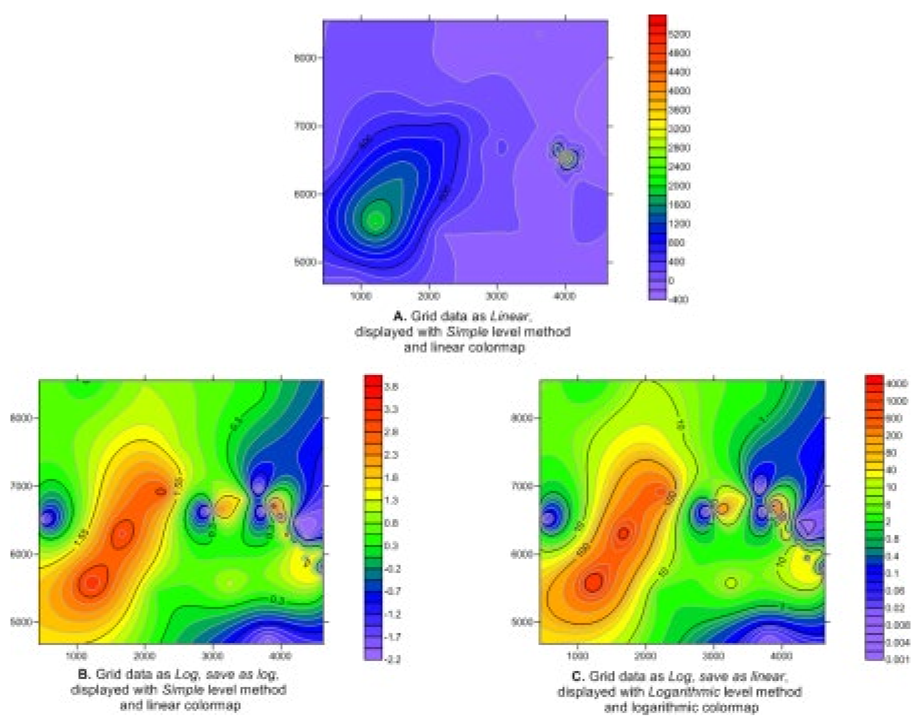
The Graticule.SRF file shows a contour layer overlaid on a downloaded base layer. The map also includes a graticule, scale bars, and grid lines.



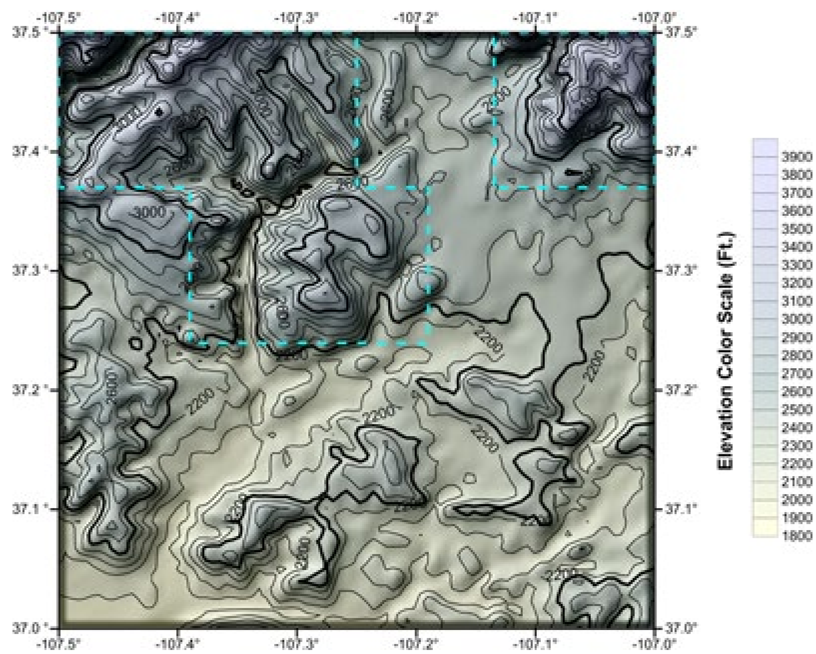
The *GridValues.srf* sample file displays a grid values, post, and filled contour layer overlaid in a single map. The grid values layer is used to visualize the grid geometry or post grid values on the map.



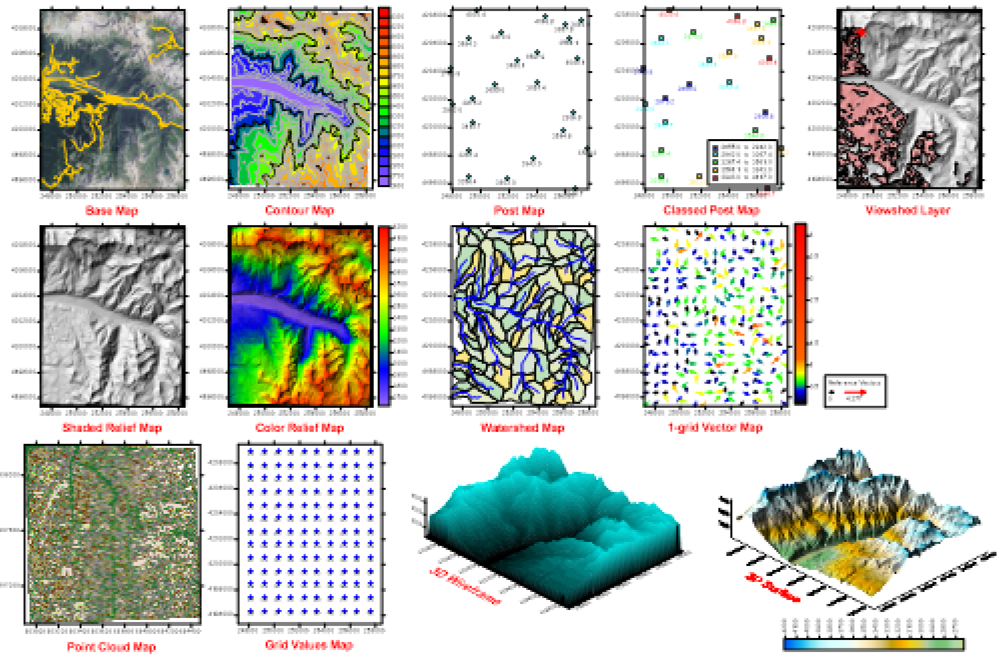
The Logarithmic.SRF file contains the same data gridded in three different ways. The top map shows the data gridded in the normal *Linear Z* method. The bottom two maps show the data gridded in the *Log Z* method. The map on the left has the Z data saved in log form. The map on the right has the Z data saved in linear form, but the contour level method is set to logarithmic.



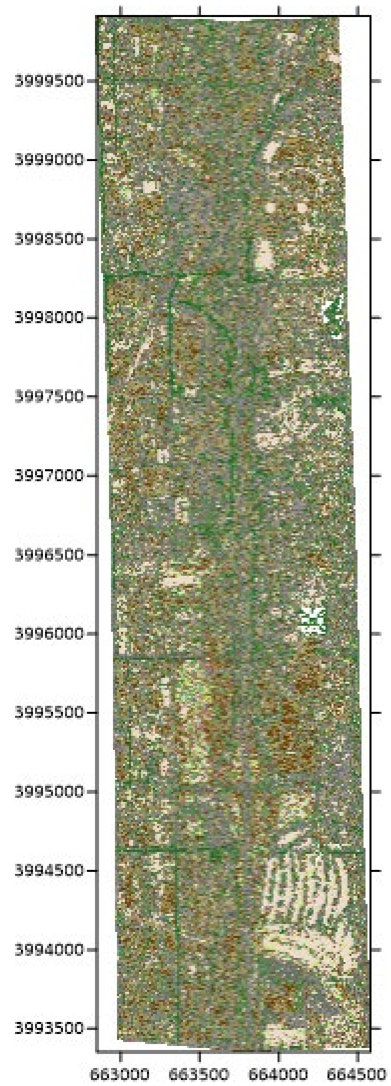
The MapLayers.SRF sample file displays a map with a contour layer, a shaded relief layer, and a base layer defining a national forest boundary. The contour map is semi-transparent, allowing the ability to see through the filled contours to the shaded relief map layer. The base map boundary was created from a blanking file .BLN. Blanking files can be created from known points, or by digitizing points. The color scale displays the elevation values for the contour map.



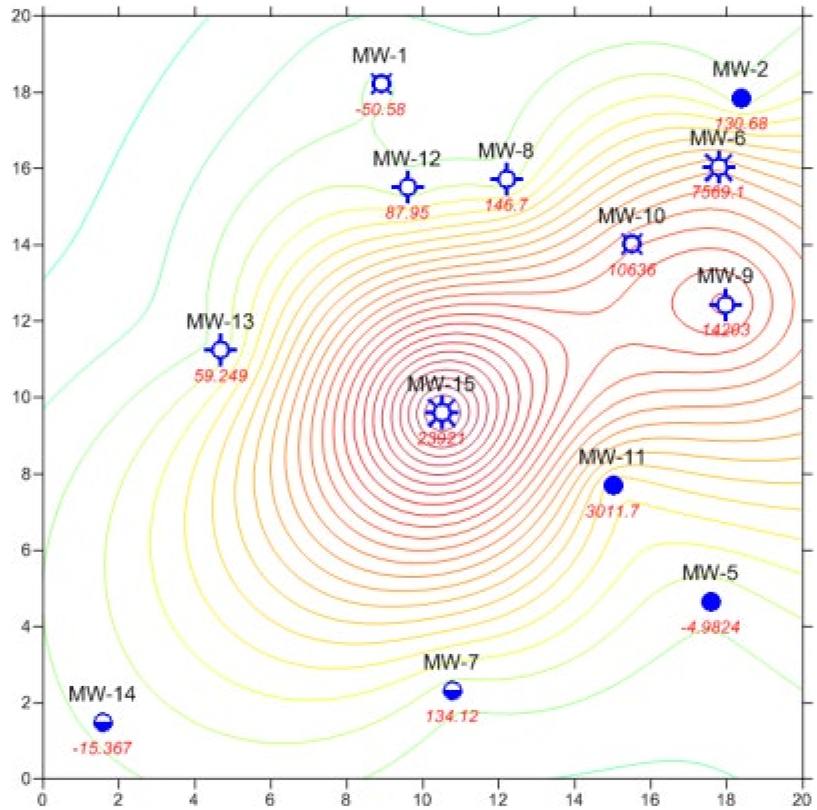
The MapTypes.SRF file contains a sample map for each of the map types. All grid based map types are created from the same Telluride.grd file. The classed post and post map are created from the same data file, which contains elevation of various locations in the same Telluride area.



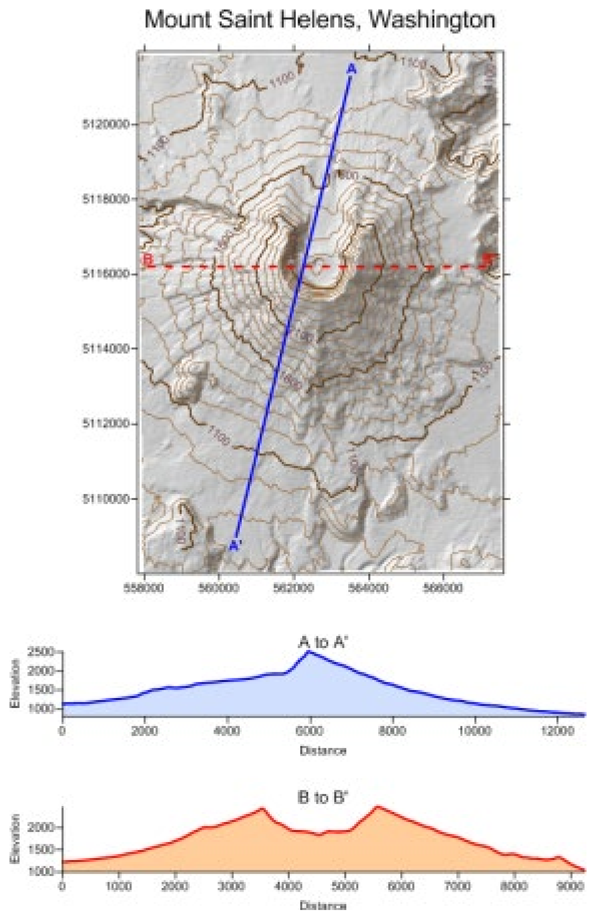
The PointCloud.SRF sample file includes a point cloud map with four source LAZ files. The map is a section of Las Vegas, NV. The point cloud is colored by intensity with a custom colormap.



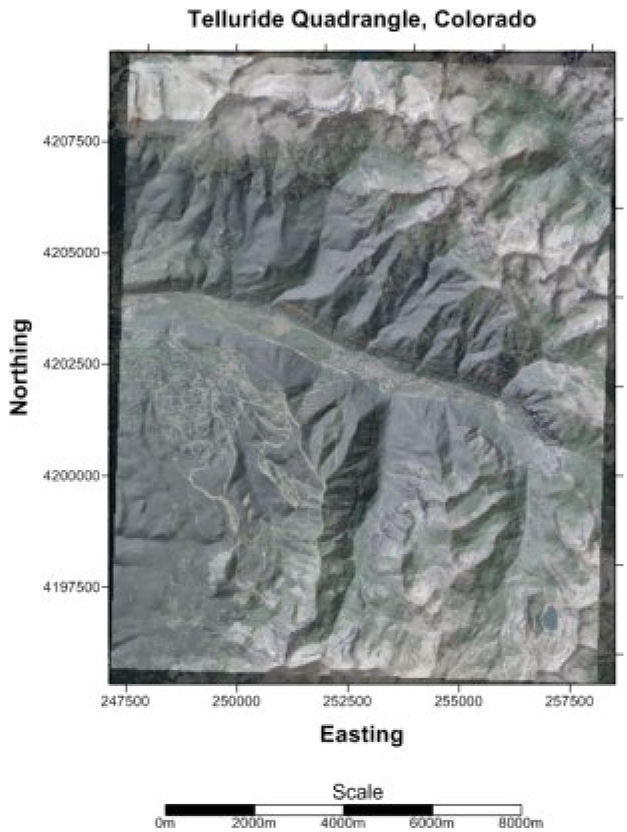
The Post.SRF sample file displays a post map with a contour map layer. The post map is using a symbol column from the worksheet and contains multiple labels. The contour map is using a gradational line color.



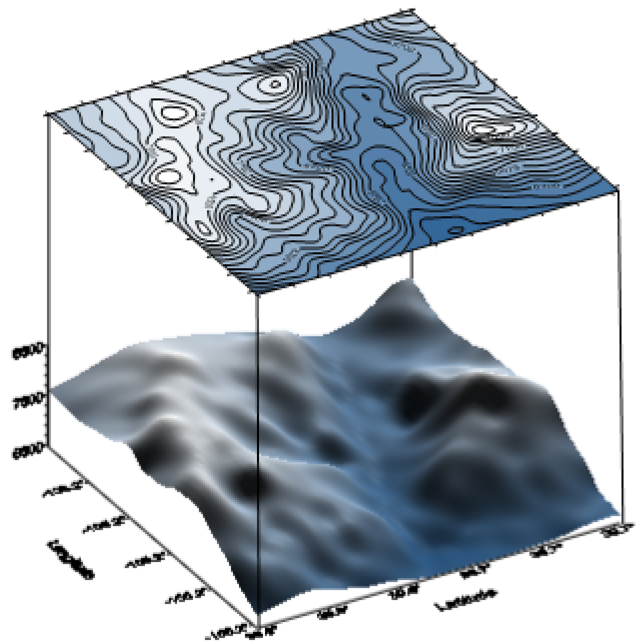
The Profile.SRF file contains a map with two base map layers, a contour layer, and a shaded relief layer. The base maps were created with the **Map Tools | Add to Map | Profile** command. At the bottom of the page, the two profiles lines are displayed, showing the elevation across the profile.



The Shaded Relief.SRF sample file displays a shaded relief map of the Telluride Quadrangle, Colorado on an aerial image of the same area. A map scale has been added.

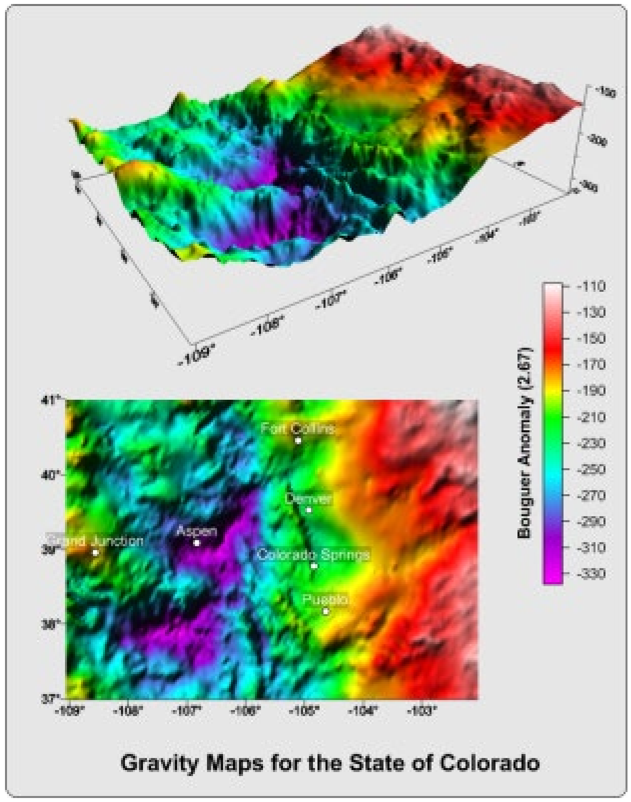


The Stacked Maps.SRF sample file displays two maps. The top map is a contour map, and the bottom map is a 3D surface of the same grid file. The two maps were aligned with the **Map Tools | Map Tools | Stack Maps** command and polylines were added. The top contour map has an index contour, where every fifth line is bold.

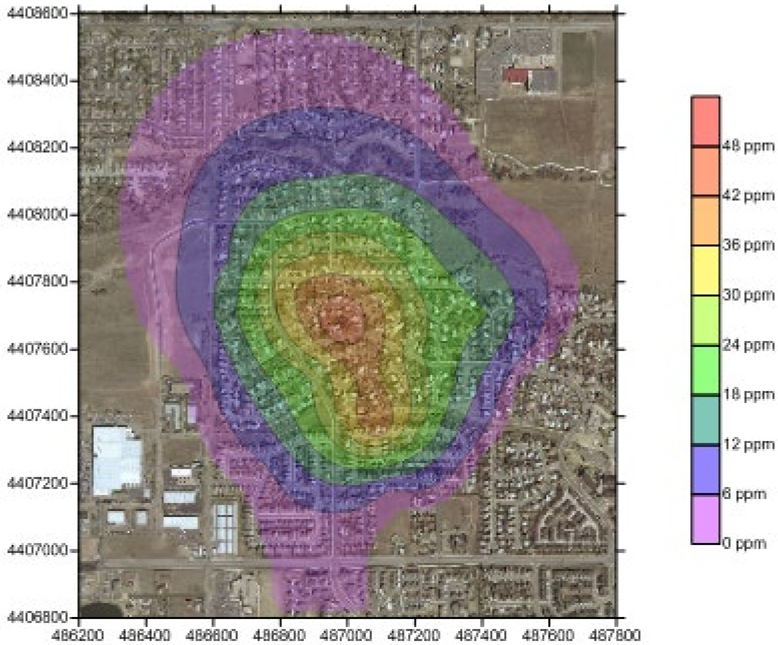


Southwest Corner of the Morrison Quadrangle, Colorado

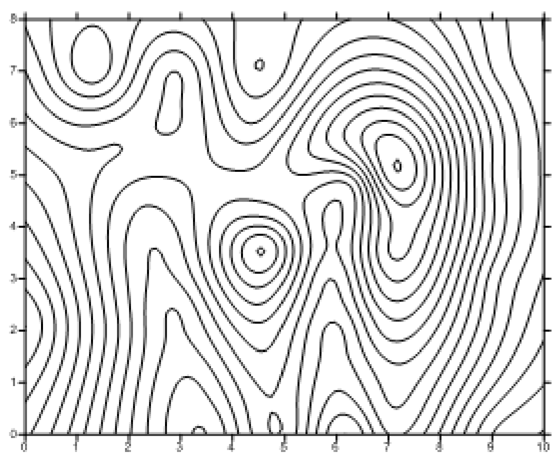
The Surface.SRF sample file displays three maps. The top map is a 3D surface gravity map for the state of Colorado. The bottom maps display the same 3D surface map from a different view, and a post map of some Colorado cities for reference. A color scale has been added to display the values for the Bouger anomaly.



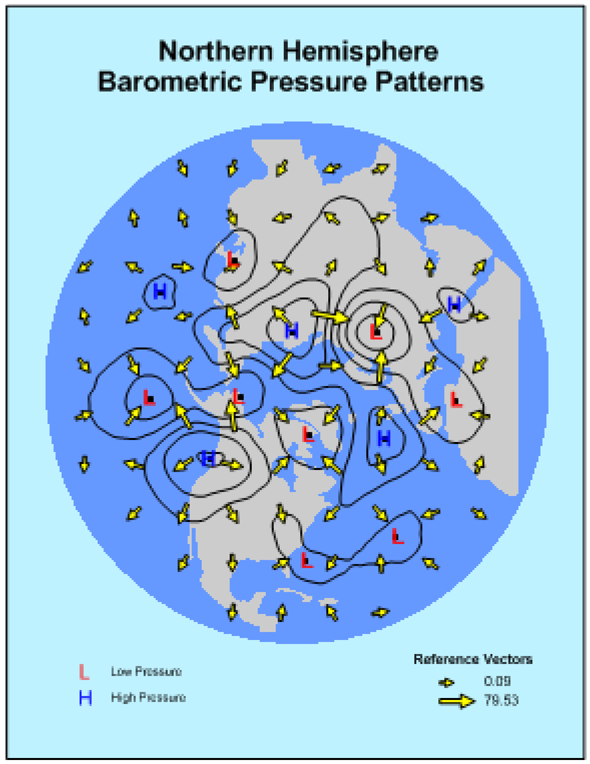
The Transparent.SRF file displays a contour map overlaid on a base map created from an aerial photograph. The contour map is filled with a partially transparent pattern.



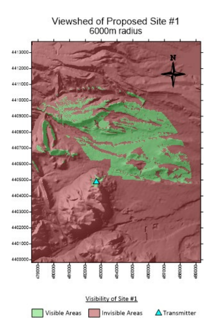
The Tutorial.SRF file displays a sample contour map.



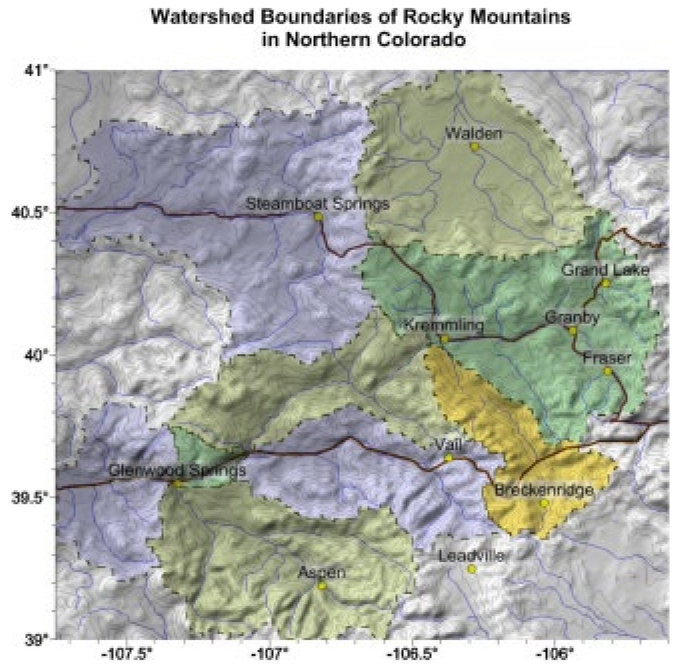
The Vectors.SRF sample file displays a vector map with contour and post layers. The vectors show barometric pressure patterns in the Northern Hemisphere. A legend has been added to show the reference vector sizes.



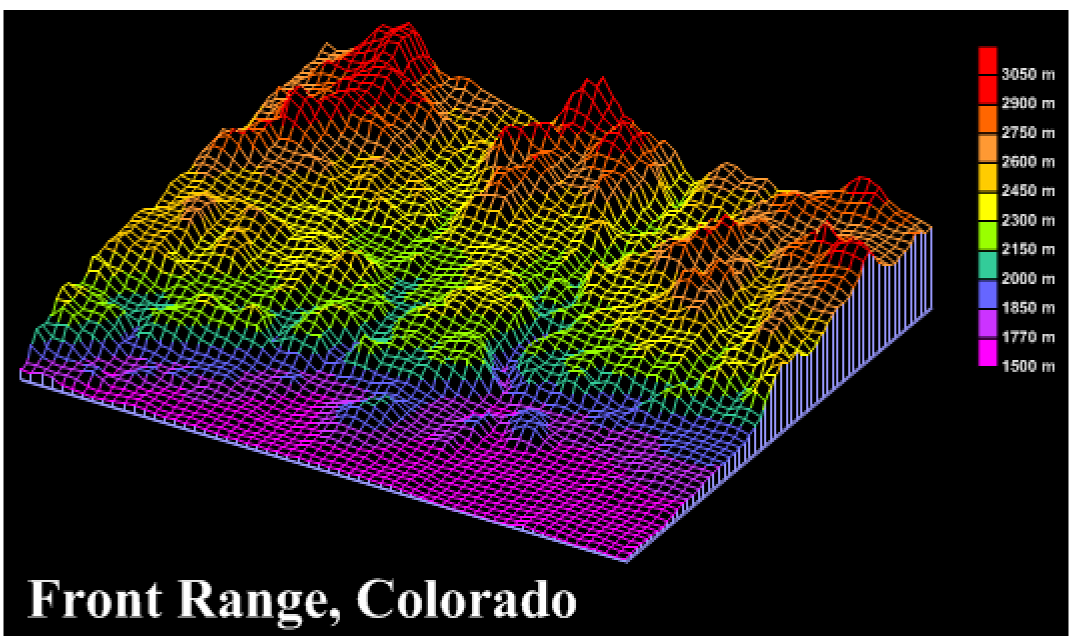
The Viewshed.SRF sample file shows a shaded relief layer with viewshed layers added. The transmitter location is represented by the blue triangle symbol. The visible regions are highlighted in green, and the invisible regions are highlighted in red. The viewshed radius is limited to 6000km.



The *Watershed.srf* sample file displays a post map, two base maps, a contour map, a watershed map, and a surface map layer. The map shows roads, rivers, and the watershed delineation of a section of the Rocky Mountains in Colorado.



The Wireframe.SRF sample file displays a 3D wireframe map of the Colorado Front Range. A color scale has been added to show the elevation values.



Using Surfer

The most common application of **Surfer** is to create a grid-based map from an XYZ data file. The Grid Data command uses an XYZ data file to produce a grid file. The grid file is then used by most of the Home | New Map commands to produce maps. Post maps and base maps do not use grid files. The general steps to progress from an XYZ data set to a finished grid-based map are as follows:

1. Create an XYZ data file. This file can be created in a **Surfer** worksheet window or outside of **Surfer** (using an ASCII text editor or Microsoft Excel, for example).

2. To display the data points, click the **Home | New Map | Post** command.

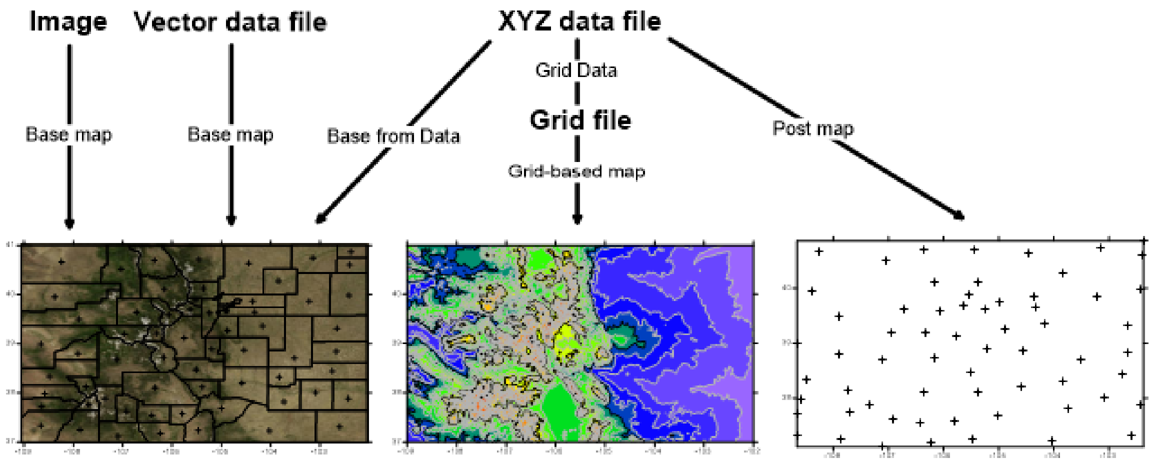
3. Create a grid file .GRD from the XYZ data file using the **Home | Grid Data | Grid Data** command.

4. To create a map, select the map type from the **Home | NewMap** commands. Select the grid file from step two. Grid-based maps include contour, 3D surface, 3D wireframe, color relief, vector, watershed, viewshed, and grid values maps.

5. Click on the map to display the map properties in the **Properties** window where you can customize the map to fit your needs.

6. Click the **File | Save** command to save the project as a Surfer .SRF file which contains all the information needed to recreate the map.

This flow chart illustrates the relationship between XYZ data files, grid files, vector files, image files, and various maps. This example displays only one of the grid based maps, a contour map.



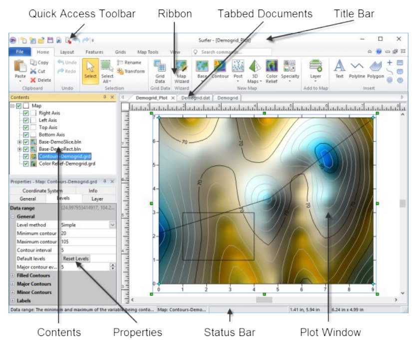
Using Scripter

Tasks can be automated in **Surfer** using Golden Software's **Scripter** program or any ActiveX Automation-compatible client, such as Visual BASIC. A script is a text file containing a series of instructions for execution when the script is run. **Scripter** can be used to perform almost any task in **Surfer**. Scripts are useful for automating repetitive tasks and consolidating a sequence of steps. **Scripter** is installed in the same location as **Surfer**. Refer to the *Surfer Automation* help book for more information about **Scripter**. We have included several example scripts so that you can quickly see some of **Scripter's** capabilities.

1. Open **Scripter** by navigating to the installation folder, C:\Program Files\Golden Software\Surfer\Scripter. If you are running a 32-bit version of **Surfer** on a 64-bit version of Windows, navigate to C:\Program Files (x86)\Golden Software\Surfer\Scripter. Right-click on the *Scripter.exe* application file and select **Run as administrator**.
2. Choose the **File | Open** command.
3. Select a sample script .BAS file. These are located in the C:\Program Files\Golden Software\Surfer\Samples\Scripts folder or, if you are running a 32-bit version of **Surfer** on a 64-bit version of Windows, the C:\Program Files (x86)\Golden Software\Surfer\Samples\Scripts folder.
4. Click the **Script | Run** command and the script is executed. Most sample scripts open **Surfer** and display a map in the plot window.

Surfer User Interface

Surfer contains four document window types: the plot document, worksheet document, 3D view, and grid editor. Maps are created and displayed in the plot document and 3D view. The worksheet document displays, edits, transforms, and saves data in a tabular format. The grid editor displays and edits Z values for the grid with various editing tools.



*This is the **Surfer** plot window with the **Contents** and **Properties** windows on the left and the worksheet and grid editor tabs on the top of the horizontal ruler.*

Surfer Layout

The following table summarizes the function of each component of the **Surfer** layout.

Component Name	Component Function
Title Bar	The title bar lists the program name plus the saved Surfer .SRF file name (if any). An asterisk after the file name indicates the file has been modified.
Quick Access Toolbar	All window types in **Surfer** include the quick access toolbar to the left of the title bar. The quick access toolbar contains buttons for many common commands. The quick access toolbar can be customized to add or remove buttons with the Customize Ribbon command.
Ribbon	The ribbon includes all of the commands in **Surfer**. Commands are grouped under the File menu and various tabs. Some commands and tabs are only available in specific views. For example, the **Features | Insert | Polyline** command is only available in the plot window. The ribbon commands can be modified and rearranged with the Customize Ribbon command.
Tabbed Documents	The plot, 3D view, worksheet, and grid editor windows are displayed as tabbed documents. The tabs may be reordered by clicking and dragging. When more than one window is open, tabs appear at the top of the document, allowing you to click on a tab to switch to a different window. When a document contains unsaved changes, an asterisk (*) appears next to its tabbed name.

Contents	The **Contents** window contains a hierarchical list of all the objects in a Surfer plot document, grid editor, or 3D view window displayed in a tree view. The objects can be selected, added, arranged, or edited. Changes made in the **Contents** window are reflected in the plot document, grid editor, or 3D view and vice versa. The **Contents** window is initially docked at the left side of the window.
Properties	The **Properties** window contains all of the properties for the selected object or objects. Changes made in the **Properties** window are reflected in the plot document, grid editor, or 3D view. The properties in the **Properties** window are grouped by page. The **Properties** window is initially docked below the **Contents** window.
Status Bar	The status bar displays information about the current command or activity in **Surfer**. The status bar is divided into five sections. The sections display basic plot commands and descriptions, the name of the selected object, the cursor map coordinates and units, the cursor page coordinates, and the dimensions of the selected object.

Opening Windows

Selecting the File | Open command opens any of the three window types, depending on the type of file selected. The File | New | Plot command creates a new plot window. The File | New | Worksheet command creates a new worksheet window. The Map Tools | View | 3D View command opens a 3D view of the selected map. The Grids | Editor | Grid Editor command opens a grid in the grid editor.

Changing the Layout

The plot, worksheet, grid editor, or 3D view window, **Properties** window, **Contents** window, and ribbon display in a docked view by default. However, they can also be displayed as floating windows. The visibility, size, and position of each item may also be changed.

Visibility

Use the **View | Show/Hide** commands to toggle the display of the rulers, drawing grid, status bar, Contents window, and Properties window. Alternatively, click the or buttons in the **Contents** and **Properties** windows to auto-hide or close the windows.

Right-click the ribbon or quick access toolbar to minimize the ribbon, move the quick access toolbar above or below the ribbon, and customize the ribbon or quick access toolbar.

Auto-Hiding the Contents or Properties Windows

Click the button to auto-hide a docked Contents or Properties window. The window slides to the side of the **Surfer** main window and a tab appears with the window name.

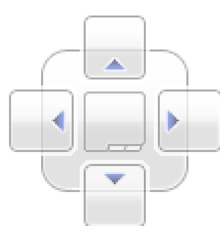
Position the mouse pointer over the tab to view the window. Move your mouse away from the window and the window "hides" again. You can also click inside the window to anchor it at its current position. Click in another window to release the anchor and hide the window. Click the button to return the window to a docked position.

Size

You can drag the sides of the application window, **Contents** window, **Properties** window, or document window to change its size. If a window is docked, its left and right bounds are indicated by a cursor, and its upper and lower bounds are indicated by a cursor. Click and drag the cursor to change the size.

Position

To change the position of a docked window, click the title bar and drag it to a new location. To dock the **Contents** or **Properties** windows, use the docking mechanism. You can also double-click the window's title bar to toggle between floating and docked modes. Left-click the title bar of a window and drag it to a new location while holding the left mouse button. The docking mechanism displays with arrow indicators as you move the window.



*The docking mechanism makes it easy to position the **Contents** and **Properties** windows.*

When the cursor touches one of the docking indicators in the docking mechanism, a blue rectangle shows the window docking position. Release the left mouse button to allow the window to be docked in the specified location.

Restoring the Windows to Their Original Locations

If the **Contents** or **Properties** windows have moved or become invisible, or if they are in undesired locations, you can use the View | Windows | Reset Windows command to move them back to their original locations. You must restart **Surfer** for the changes to take effect.

Menu and Tab Commands

The ribbon contains the commands that allow you to add, edit, and control the objects on the plot, worksheet, grid editor, or 3D view window page.

Plot Document Commands

When viewing a plot document, the main ribbon tab commands are available:

File	Open and save files, import or export data, print, and set options and defaults
Home	Contains common editing, selection, feature, grid, and map commands
Layout	Set the page display and arrange or position maps and objects in the plot document
Features	Draw features and perform geoprocessing
Grids	Perform grid operations
Map Tools	Add map layers, and edit or analyze maps and map layers
View	Controls the display of toolbars, status bar, rulers, grids, and managers, resets window positions, tracks cursor between map and worksheet, and controls the zoom level of the plot

Point Cloud Commands

The commands for editing the points within a point cloud layer are located in the **Point Cloud** tab. The **Point Cloud** tab is only displayed when a point cloud layer is selected.

3D View Commands

The commands for changing the view, creating fly-throughs, and copying images in the 3D view window are located in the **3D View** tab. The **3D View** tab is only displayed while viewing a map in the 3D view.

Worksheet Commands

The primary commands when viewing a worksheet window are located on the **Data** tab. However, many of the **File** menu and **Grid** tab commands are also available when viewing a worksheet window, and a few of the **Home** and **View** tab commands are available as well.

Grid Editor Commands

The primary commands when viewing a grid in the grid editor are located on the **Grid Editor** tab. The **Grid Editor** tab includes commands and tools for editing the grid values.

The Application/Document Control menu commands control the size and position of the application window or the document window.

Status Bar

The status bar is located at the bottom of the **Surfer** window. The status bar displays information about the current command or activity in **Surfer**. Click the **View | Show/Hide |Status Bar** check box to show or hide the status bar. A check mark next to **Status Bar** indicates that the status bar is displayed. Clear the **Status Bar** check box to hide the status bar.

Status Bar Sections

The status bar is divided into five sections. The left section displays information about the selected command or item in the **Properties** window. The second section shows the selected object name or the number of objects/points in the selection. The middle section shows the cursor coordinates in map units, if the cursor is placed above a map. The fourth section shows the cursor coordinates in page units of inches or centimeters. The right section displays the dimensions of the selected object.

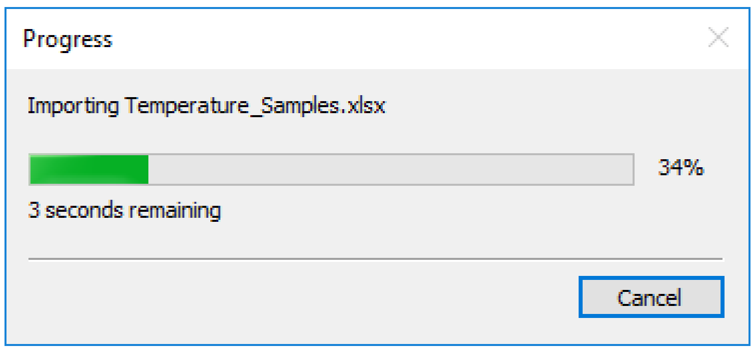
When viewing a grid in the grid editor, the first three sections of the status bar display a description for the selected property in the Properties window, the active grid node grid coordinates, and the map coordinates of the cursor location.

Adjust Section Width

The status bar section widths can be adjusted to display additional text. If "..." is displayed at the end of the text, additional text can be displayed. To change the width, place the cursor over a section division. When the cursor changes to a , left-click and drag the divider left or right to a new location.

Progress

The **Progress** dialog indicates the progress of a procedure, such as gridding. The percent of completion and time remaining will be displayed. Click *Cancel* to stop the current process.

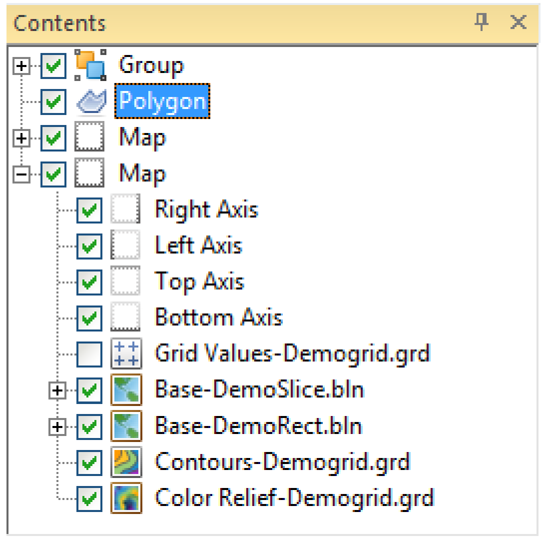


*The progress of a procedure is shown in the **Progress** dialog.*

When the program does not know how much time is required to complete a task, the *Indeterminate* mode is displayed in the **Progress** dialog. This indicates that the program is actively completing the task, with an unknown time of completion. The program is not frozen.

Contents

The **Contents** window contains a hierarchical list of all objects in the plot, grid editor, or 3D view window. The objects can be selected, arranged, moved, renamed, or deleted in the **Contents** window. Changes made in the **Contents** window are reflected in the plot, grid editor, or 3D view window and vice versa.



*The **Contents** window displays the structure of all the objects in the plot window.*

Object Tree

If an object contains sub-objects, a ⊞ or ⊟ is located to the left of the object name. Click on the ⊞ or ⊟ button to expand or collapse the list. For example, a map object normally contains at least one map layer (e.g. Contours) and four axes. The *Map* object may contain many other objects. To expand the *Map* tree, click on the ⊞ control. You can also select the item, and press the PLUS key on the numeric keypad or press the RIGHT ARROW key on your keyboard. To collapse a branch of the tree, click on the ⊟ control. You can also select the item, and press the MINUS key on the numeric keypad or press the LEFT ARROW key. The expansion state of sub-objects in the **Contents** window is retained in the **Surfer** file .SRF. Use the *Expand new Contents window items* option in the Options dialog to control the expansion state of new objects in **Contents** window.

Arranging Objects

To change the display order of the objects with the mouse, select an object and drag it to a new position in the list above or below an object at the same level in the tree. The pointer changes to a black arrow if the object can be moved to the cursor location, or a red circle with a diagonal line if the object cannot be moved to the indicated location. Alternatively, select an object and use the Bring to Front, Send to Back, Bring Forward, and Send Backward commands. These commands can be accessed in the **Layout | Arrange** command group or by right-clicking on an object in the **Contents** window.

Moving Features

Features such as points, polylines, and polygons can be moved between base (vector) layers and the plot document. The Move/Copy to Layer command can be used to move or copy features. Features can also be moved in the **Contents** window. To move a feature to another base (vector) layer, select the feature and drag it to a new position within another base (vector) layer. To move a feature to the plot document, select the feature and drag it to a new position above, between, or below the top-level objects in the **Contents** window.

Object Visibility

Each object in the **Contents** window includes an icon indicating the type of object and a text label for the object. All objects also have a check box that indicates if the object is visible. A ☑ indicates the object is visible. A ☐ indicates the object is not visible. Click on the check box to change the visibility state of the object. Invisible objects do not appear in the plot window and do not appear on printed output. The visibility check box also controls the visibility for all of its sub-objects. For example, if a *Map* object is made invisible the axes and layers within the *Map* will also be hidden. Note that if a surface is made invisible, any overlays also become invisible.

Locked Objects

Objects and layers can be locked to prevent changes to their size and position with the Lock Position command. When an object or layer is locked, a small lock icon appears in the lower-right corner of the visibility check box. When a map, group, or base layer object is locked, all of its sub-objects are automatically locked.

Selecting Objects

To select an item in the **Contents** window, click on the item or press the arrow keys, and the object text is highlighted. The selection handles in the plot change to indicate the selected item. If you select an object in the plot window, its name is selected in the **Contents** window as well. Only one nested object can be selected at a time. For example, it is not possible to select two axes at once.

To select multiple objects at the same level in the tree, hold down the CTRL key and click on each object. To select multiple contiguous objects at the same level in the tree, select the first object, and then hold down the SHIFT key and click on the last object.

Renaming Objects

To edit an object's text ID, select the object in the **Contents** window and then click again on the selected item (two slow clicks) to edit the text ID associated with an object. You must allow enough time between the two clicks so it is not interpreted as a double-click. Enter the new name into the box. Alternatively, you can right-click on an object name and select **Rename Object**, select the object and click the Rename command, or select the object and press F2 on the keyboard. Enter an ID in the **Rename Object** dialog and click *OK*.

Deleting Objects

To delete an object, select the object and press the DELETE key. To move a map layer from one map to a new map, click on the map layer and click Map Tools | Layer Tools | Break Apart. Alternatively, right-click on the map layer and select **Break Apart Layer**.

Scroll the Contents Window

If the list of objects in the **Contents** window is long, you can use the scroll bar on the side of the **Contents** window to scroll down to an object. Alternatively, you can use the mouse scroll wheel to scroll down. To scroll down using the mouse, click once in the **Contents** window to select the window. Roll the mouse wheel backward to scroll lower in the **Contents** window. Roll the mouse wheel forward to scroll higher in the **Contents** window.

Properties

The **Properties** window allows you to edit the properties of a selected object, such as a contour map or axis. The **Properties** window contains a list of all properties for the selected object. The **Properties** window can be left open so that the properties of the selected object are always visible.

To display the properties for an object, click once on the object in the Contents window or in the plot window. The properties are displayed in the **Properties** window. When the **Properties** window is hidden or closed, double-clicking on an object in the Contents window opens the **Properties** window with the properties for the selected object displayed. To activate the **Properties** window, click inside the **Properties** window or press ALT+ENTER on the keyboard.

For information on a specific feature or property that is shown in the **Properties** window, refer to the help page for that **Properties** window page. For instance, if you are interested in determining how to set the *Fill* *colors* for a contour map or how to save data for a post map, refer to the contour map *Levels* help topic or post map *General* help topic respectively.

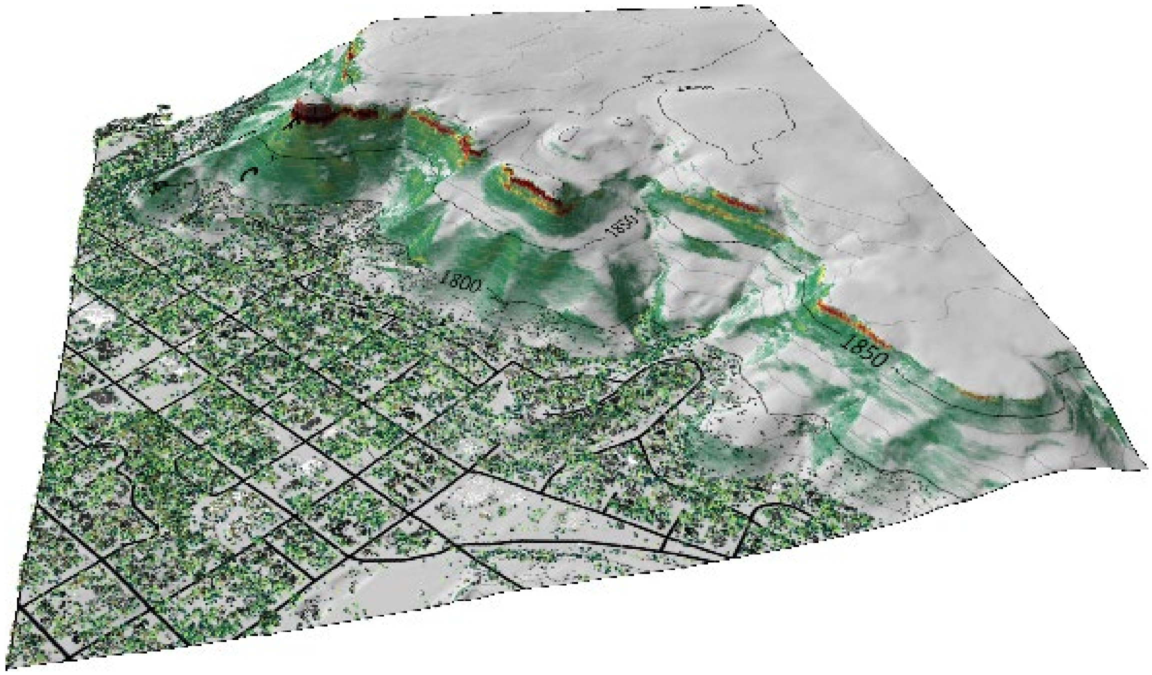
Changing Properties

3D View Window

The 3D view window displays a map in a three-dimensional view space. The input grids from grid-based layers are rendered as surfaces in the 3D view. Base (vector and raster), post, and classed post layers are overlaid on the surfaces. Point data in base (vector) layers are also displayed in 3D. The visualizations from the grid-based maps are also overlaid on the surface. For example, contour lines or color relief layers will be overlaid on the surfaces. Point cloud layers are rendered as a 3D point cloud. Contour lines may be rendered as 3D polyline objects. However, contours are displayed as overlays on a surface and not as 3D polylines by default.

The 3D view window only displays layers that are visible in the map in the plot window. Show or hide surfaces, textures, and vectors in the 3D view with by selecting or clearing the visibility check boxes in the 3D view **Contents** window. Completely remove a surface, texture, or vector from the 3D view by switching to the plot window and hiding the associated map layer.

Click the **Map Tools | View | 3D View** command or *3D View* button in the *Map* frame View properties page to open a 3D view window of the selected map. A new 3D view is created for the selected map. A 3D view can also be created by right-clicking a map or map layer and clicking **3D View** in the context menu. The map must include at least one grid-based layer or point cloud layer to create a 3D view. The document tab includes the file name and view number. For example, when a 3D view is created for a map in the Plot1 plot window, the plot window tab name is *Plot1:1* and the 3D view window tab name is *Plot1:2*.

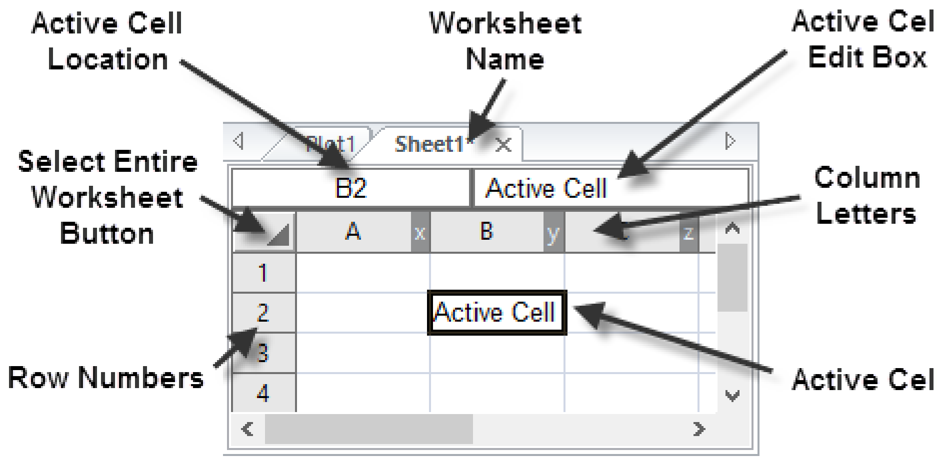


The 3D view displays the map in a three-dimensional space. This map includes contour, color relief, post, base, and point cloud layers.

Worksheet Document

Worksheet windows are a view of the data file and are designed to display, edit, enter, and save data. The worksheet windows have several useful and powerful editing, transformation, and statistical operations available. In addition, a coordinate system can be assigned to the data file. Several import and export options are available for opening data files from other spreadsheet programs. The components of the worksheet window are displayed below.

To enter data in a worksheet, click the File | Open command to open an existing data file or click the File | New | Worksheet command to create a blank worksheet. The components of the worksheet window are discussed below.



The components of a worksheet window shown above are described in the table below.

Component Name	Component Function
Column Letters	The letter that identifies a column of the worksheet.
Row Numbers	The number that identifies a row of the worksheet.
Active Cell	The cell highlighted with a bold outline. The active cell receives data input (numeric values or text strings) from the keyboard. Only one cell is active at a time.
Active Cell Location	The location of the active cell, specified by column letter and row number.
Active Cell Edit Box	The box displaying the data or text contained in the active cell. Data typed into an empty cell appears in both the edit box and the active cell.
Worksheet Name	The name of the data file displayed in the worksheet or the worksheet number prior to saving.
Select Entire Worksheet Button	The button used to select all cells in the worksheet. Located in the top left corner of the worksheet.

Grid Editor

The **File | Open**, **Grids | Editor | Grid Editor**, and **Map Tools | Edit Layer | Grid** commands open the grid editor as a new document.

- The **File | Open** command opens the grid editor when a grid or image file is selected in the Open dialog.

- The **Grids | Editor | Grid Editor** command opens a grid file with the Open Grid dialog.
- The **Map Tools | Edit Layer | Grid** command opens the grid file from the selected map layer in the plot document. You can also edit the grid for a map layer by right-clicking on the map layer and clicking **Edit Grid**. This command enables the Update Layer command in the grid editor. The **Map Tools | Edit Layer | Grid** command is not available for 1-grid vector and 2-grid vector layers.

The grid editor contains various methods for editing the grid Z values. Editing the grid Z values will change the appearance of any grid-based maps. For example, the grid editor can be used to edit contours on a contour map or change the surface in a 3D surface map.

Each grid node is indicated with a black "+" in the grid editor window by default. Each NoData grid node is indicated with a blue "x" by default. The active node is highlighted with a red diamond. To move between grid nodes, press the arrow keys, or click a node with the **Select** tool active to make it the active node. The grid editor also includes contours, node labels, and a color fill. The grid appearance is controlled by the items in the **Contents** window and the properties displayed in the **Properties** window. Note the Undo command does not undo changes in the **Properties** window in the grid editor.

A grid requires a single floating point value at each grid node. Images contain colors which are three separate values (Red, Green, Blue) at each pixel.

Color Image

Color image formats are converted to a single floating point value by calculating the intensity of each color value using the intensity equation:

$$I = A(.30R + .59G + .11B)$$

where I = intensity, R,G,B,A are the normalized red, green, blue, and alpha.

For example, a pixel from a color image with Red=255, Green=0, and Blue=0 would be mapped to a grid node with the value of:

$$I = .30*1.0 + .59*0.0 + .11*0.0 = 0.3$$

Note the normalization process converted the color's (0 to 255) range to (0.0 to 1.0).

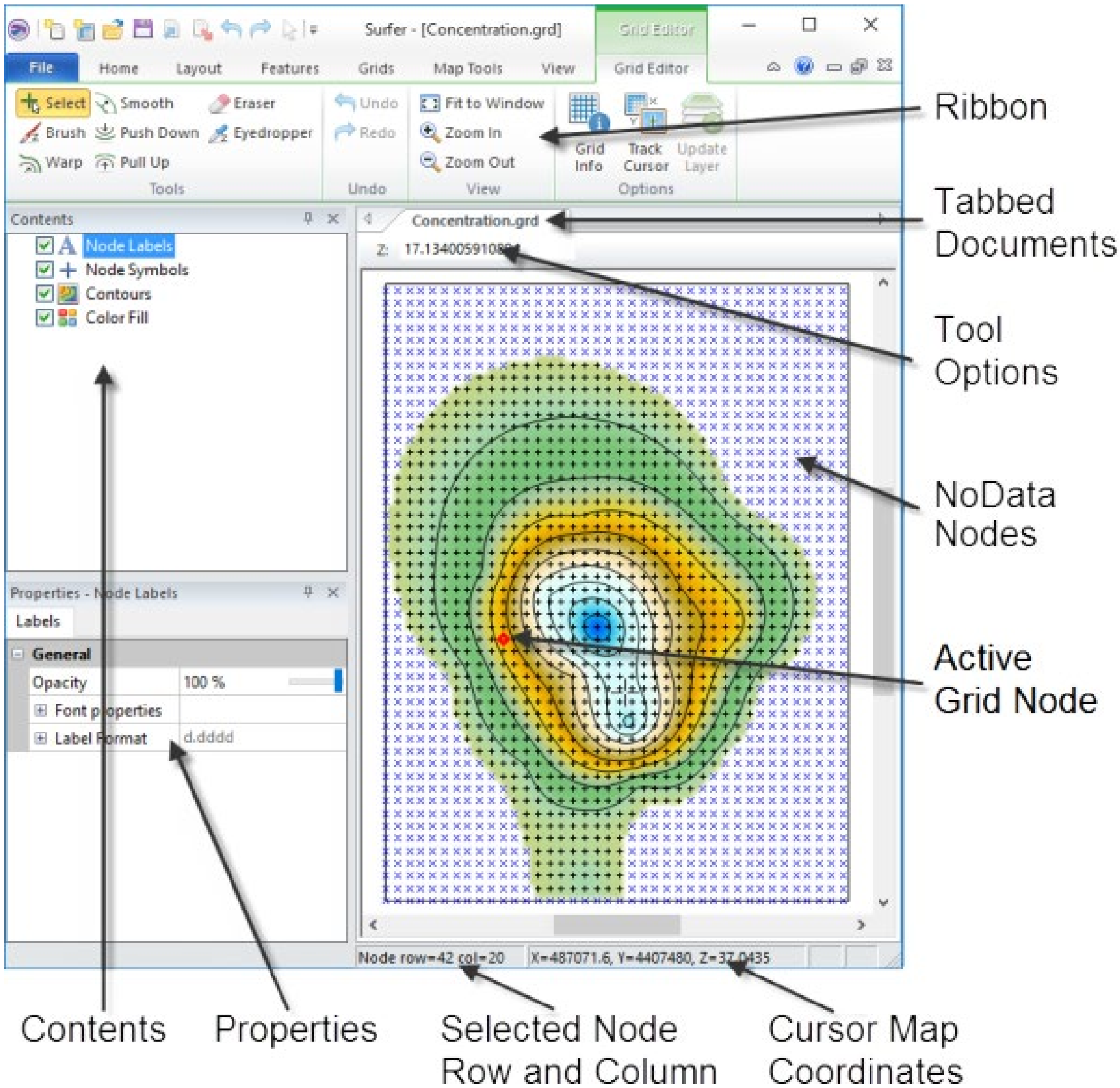
Grayscale Image

Grayscale images are imported directly. Grayscale images have a single color value and do not need to use the intensity equation. **Surfer** does not normalize the grayscale value. The value is used exactly as specified in the image.

For example, consider a grayscale image with a pixel that contains a value of 55. The grid node value would be set to 55.

Grid Editor Window

The following image and table explain the purpose of the grid editor window components.



*This is the **Surfer** grid editor with the **Contents** and **Properties** windows on the left and grid editor window on the right.*

Component Name	Component Definition
Ribbon	The ribbon contains the **Grid Editor** commands.
Contents	Toggle the display of the Node Labels, Node Symbols, Contours, and Color Fill with the **Contents** window.
Properties	Edit Node Labels, Node Symbols, Contours, and Color Fill display properties in the **Properties** window.

Tabbed Documents	Plot windows, worksheet windows, and grid editor windows are displayed as tabbed documents.
Tool Options	The tool options bar contains the Z value box, *Brush size*, *Density*, and/or *Pressure* depending on the selected tool mode.
Active Node	The node that is currently selected. The active node is highlighted with a red diamond.
Grid Node	Each grid node is indicated with a black "+" in the grid editor window by default. NoData nodes are indicated with a blue "x".
Status Bar	The status bar includes information about the selected property, active node grid coordinates, and cursor map coordinates.

Using the Grid Editor

The grid editor can be used on existing map layers or on grid files without first creating a map.

To edit a map layer's grid

1. Select the map layer you wish to edit in the plot document **Contents** window. Only the grid for this map layer will be edited, even when multiple layers use the same grid file.
2. Click **Map Tools | Edit Layer | Grid** in the plot window. The grid file is opened and is represented by a filled contour map. The location of each grid node in the file is marked with a black "+". NoData nodes are marked with a blue "x".
3. Use the **Grid Editor | Tools** commands to make the desired adjustments to the grid.
4. When you are done editing the grid, click the **Grid Editor | Options | Update Layer** command to update the map layer in the plot document with your grid.
5. Click the plot document tab to view the changes to the map layer. If you wish to revert the changes to the map layer, click the **Undo** command while viewing the plot window. If you are satisfied with the changes to the map layer, you may wish to save the edited grid to a file.
6. If you wish to save your edits to a file, click File | Save Asto create a new grid file. Click File | Save to overwrite the existing grid file. It is necessary to save your edits to a file with **Save** or **Save As** if you wish to update all layers in your map to use the edited grid.
7. To close the grid editor window, click the **File | Close** command or click the X in the grid editor document tab. To view an existing window and keep the grid editor window open, click on another document tab.

To edit a grid file

1. Click the **Grids | Editor | Grid Editor** command and select the grid file in the Open Grid dialog. Alternatively, click the **File | Open** command and select a grid file in the Open dialog. The grid file is opened and is represented by a filled contour map. The location of each grid node in the file is marked with a black "+". NoData nodes are marked with a blue "x".
2. Use the **Grid Editor | Tools** commands to make the desired adjustments to the grid.
3. When you are done editing the grid, click File | Save Asto create a new grid file. Click File | Save to overwrite the existing grid file. It is necessary to save your edited grid to a file with **Save** or **Save As** if you wish to create map layers with the grid.
4. To close the grid editor window, click the **File | Close** command or click the X in the grid editor document tab. To view an existing window and keep the grid editor window open, click on another document tab.

File Types

Surfer uses four basic file types: data, grid, base map, and **Surfer** .SRF files.

Data Files

Data files are used to produce grid files, post data points on a map, or generate a residuals log. These files are generally referred to as XYZ data files or data files throughout the help. Data can be read from various file types. Most data files contain numeric XY location coordinates and optional Z values. The Z values contain the variable to be modeled, such as elevation, concentration, rainfall, or similar types of values.

XYZ data files contain raw data that **Surfer** interprets to produce a grid file. To create a grid file, you must start with an XYZ data file. XYZ data files are organized in column and row format. Surfer requires the X, Y, and Z data to be in three separate columns.

Grid Files

Grid files produce several different types of grid-based maps, are used to perform grid calculations, and to carry out grid operations. Grid files are a regularly spaced rectangular array of Z values in columns and rows. Grid files can be created in **Surfer** using the Home | Grid Data | Grid Data command or can be imported from a wide variety of sources such as WCS servers or other applications.

Base Map Files

Base map files contain XY location data such as aerial photography, state boundaries, rivers, or point locations. Base map files can be used to create layers overlaid on other map types, or to specify the limits for assigning NoData values, faults, breaklines, or slice calculations. Base map files can be created from a wide variety of vector and image formats. Base map files may be referred to as vector data files, raster data files, and images or image files in the help, depending on the type of data in the base map file.

Surfer Files

Surfer .SRF files preserve all the objects and object settings contained in a plot window. These files are called **Surfer** .SRF files throughout the documentation. **Surfer** can open .SRF files from previous versions as far back as **Surfer 7**. **Surfer** can save files to previous .SRF formats for sharing with other users. For example, the *Surfer 15 Document .SRF* file type can be opened in **Surfer15**, but does not contain features that are in later **Surfer** versions. Beginning with version 16, the *Surfer Plot (*.srf)* file type is backwards compatible with all **Surfer** versions 16 and newer.

Gridding Overview

A grid is a rectangular region comprised of evenly spaced rows and columns. The intersection of a row and column is called a grid node. Rows contain grid nodes with the same Y coordinate. Columns contain grid nodes with the same X coordinate. Contour, color relief, grid values, vector, viewshed, watershed, 3D surface, and 3D wireframe map layers all require grids in **Surfer**.

What is Gridding?

Gridding is the process of taking irregularly spaced XYZ data and generating a regularly spaced grid of Z values at each grid node by interpolating or extrapolating the data values. In addition to gridding data, **Surfer** can also use a variety of other grid files directly. For a list of these, refer to the *File Format Chart* in the online help.

Gridding Methods

Gridding the data produces a regularly spaced, rectangular array of Z values from irregularly spaced XYZ data. The term "irregularly spaced" means that the distance between data points varies in the X or Y direction, or both. Irregularly spaced data often has many holes where data are missing. Gridding fills in these holes by extrapolating or interpolating Z values at those locations where no data exists. The gridding method determines the mathematical algorithms used to compute the Z value at each grid node. Each method results in a different representation of your data. It is advantageous to test each method with a typical data set to determine the gridding method that provides you with the most satisfying interpretation of your data.

When your XYZ data is regularly spaced, meaning the distance between data points does not change in the X and Y directions, you may produce a grid file that uses the Z values directly and does not interpolate values for the grid nodes. See the *Producing a grid file from a regular array of XYZ data* help topic for more information.

General Gridding Options

Each gridding method has its own set of gridding options. Some of the options are the same or similar for the different gridding methods, while other options are specific to particular gridding methods. Some options that are available to multiple gridding methods include: Search, Anisotropy, Breaklines, and Faults.

Grids Tab Commands

There are many ways to manipulate grid files in **Surfer**. The **Grids** tab contains commands used to assign the NoData value, convert, create, extract, filter, mosaic, slice, smooth, and transform grid files. In addition, volume calculations, variogram generation, calculus operations, cross section creation, and residual calculations can be performed using the commands under the **Grids** tab.

Grid Data

Grid files are necessary in **Surfer** to create grid-based maps types. Data files are typically randomly spaced files, and this data must be converted into an evenly spaced grid before using many of **Surfer's** features. Grid files are produced from XYZ data using the **Home | Grid Data | Grid Data** or the **Grids | New Grid | Grid Data** command. With this command, you can specify the parameters for the particular gridding method and the extents of the grid. The gridding methods define the way in which the XYZ data are interpolated when producing a grid file. Refer to the tutorial for more information on data and gridding data.

When creating a grid file you can usually accept all of the default gridding parameters and generate a grid file that represents your data well. Under most circumstances, the recommended gridding method is kriging with the default linear variogram. This is the selected default gridding method because it gives good results for most XYZ data sets.

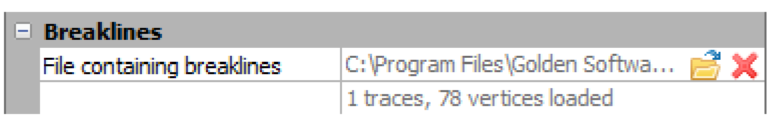
- [Select Data]
- [Variogram]
- [Options]
- [Cross Validation]
- [Output]

Breaklines

Breaklines are used when gridding to show discontinuity in the grid. A breakline is a three-dimensional boundary file that defines a line with X, Y, and Z values at each vertex. When the gridding algorithm sees a breakline, it calculates the Z value of the nearest point along the breakline, and uses that value in combination with nearby data points to calculate the grid node value. **Surfer** uses linear interpolation to determine the values between breakline vertices when gridding. Unlike faults, breaklines are not barriers to information flow, and the gridding algorithm can cross the breakline to use a point on the other side of the breakline. If a point lies on the breakline, the value of the breakline takes precedence over the point. Breakline applications include defining streamlines, ridges, and other breaks in the slope.

Using Breaklines when Gridding

The breaklines options are displayed in the *Breaklines* section of the Grid Data Advanced Options dialog when the selected interpolation method supports breaklines.



The Breaklines section is displayed when an interpolation method supports breaklines.

Click the button in the *File containing breaklines* field to select the blanking file BLN containing the breaklines. In the **Open** dialog, specify the blanking file and click **Open**. The blanking file will be displayed in the *File containing breaklines* field. The number of traces and the number of total vertices are displayed under the file name. Delete the file name to exclude the breaklines from the interpolation process. Breaklines must contain 3 columns: X, Y, and Z. If the Z column is missing, the .BLN file cannot be used as a breakline. Note that .TXT files can be used to define breaklines, but the data must be formatted similarly to the .BLN format.

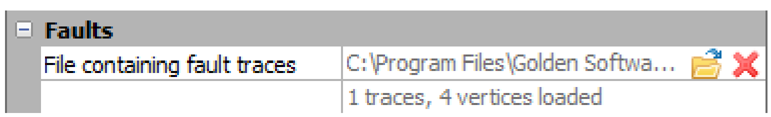
Faults

Faults are used to show discontinuity when gridding, similar to breaklines. A fault is a two-dimensional boundary file defining a line acting as a barrier to information flow when gridding. When gridding a data set, data on one side of a fault is not directly used when calculating grid node values on the other side of the fault.

If the fault line is a closed polygon, the gridding algorithm will grid the data on the side of the polygon where the data are located. If the fault line is not a closed polygon, the gridding algorithm can search around the end of the fault to see a point on the other side of the fault, but this longer distance reduces the weight of the point in interpolating the grid node value. If a point lies directly on the fault line, random round-off error determines which side of the fault captures the point.

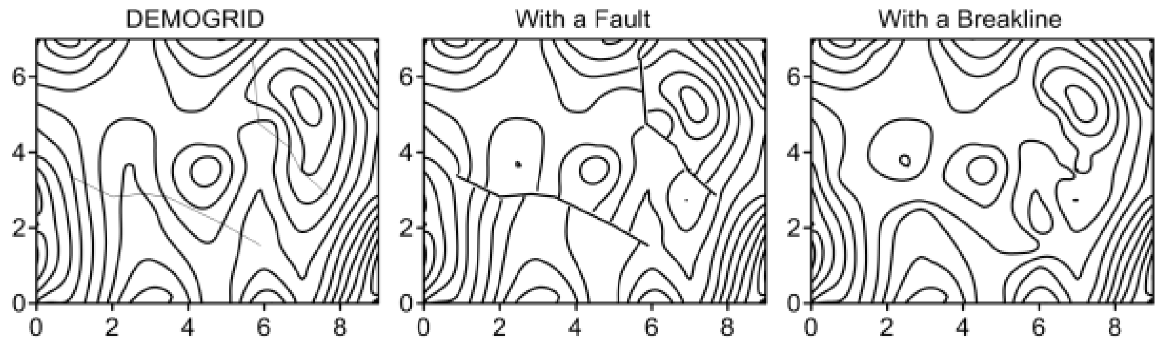
Using Faults when Gridding

The faults options are displayed in the *Faults* section of the Grid Data Advanced Options dialog when the selected interpolation method supports faults.



The Faults section is displayed when an interpolation method supports faults.

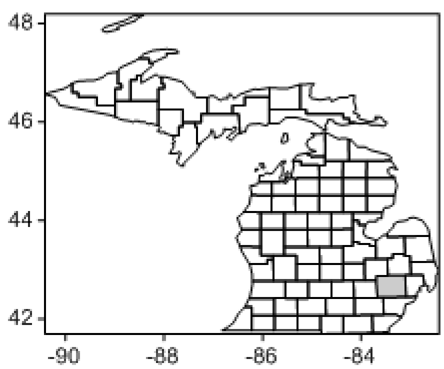
Click the button next to *File containing fault traces* to select the blanking file BLN containing the fault traces. In the **Open** dialog, specify the blanking file and click *Open*. The blanking file will be displayed in the *File containing fault traces* field. The number of traces and the number of total vertices are displayed under the file name. Delete the file name to exclude the fault traces from the interpolation process. Note that .TXT files can be used to define faults, but the data must be formatted similarly to the .BLN format.



The map on the left is created from demogrid.dat using default gridding settings. The center map is created with two fault lines. The right map is created with breaklines.

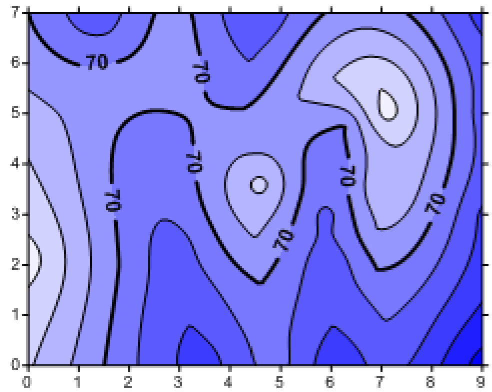
Map Types

Several different map types can be created, modified, and displayed with **Surfer**. These map types include base, contour, post, classed post, 3D surface, 3D wireframe, color relief, grid values, watershed, 1-grid vector, and 2-grid vector maps. A brief description and example of each map is listed below.



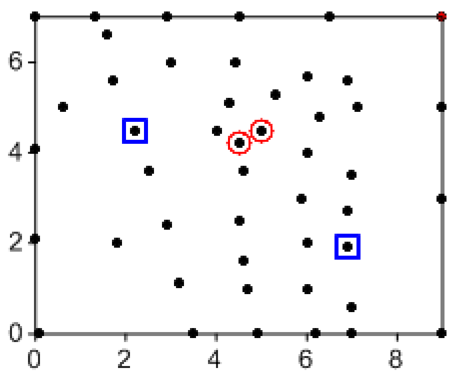
Base Map

Base maps display boundaries on a map and can contain polygons, polylines, points, text, images, or metafiles. Base maps can be overlaid with other map layers to provide details such as roads, buildings, streams, city locations, areas of no data, and so on. Base maps can be produced from vector files, images, and data files. Individual base map objects can be edited, moved, reshaped, or deleted. Symbology can be added to a base map to communicate statistical information about the map features. Empty base maps can be created and used for drawing objects on other maps. Raster (image) and vector base maps can be downloaded from online WMS, OSM, and WFS mapping servers.



Contour Map

Contour maps are two-dimensional representations of three-dimensional data. Contours define lines of equal Z values across the map extents. The shape of the surface is shown by the contour lines. Contour maps can display the contour lines and colors or patterns between the contour lines. Contours can be linearly or logarithmically spaced, or a custom spacing can be set between each set of lines.

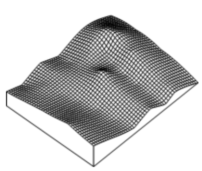


Post Map

Post maps and classed post maps show data locations on a map. You can customize the symbols and text associated with each data location on the map. Each location can have multiple labels. Classed post maps allow you to specify classes and change symbol properties for each class. Classes can be saved and loaded for future maps.

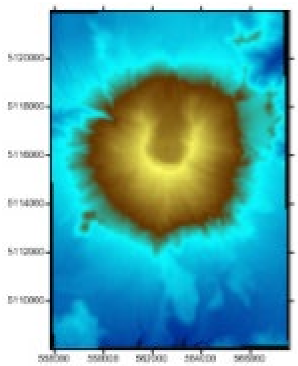
3D Surface Map

3D surface maps are color three-dimensional representations of a grid file. The colors, lighting, overlays, and mesh can be altered on a surface. Multiple 3D surface maps can be layered to create a block diagram.



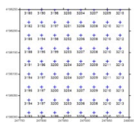
3D Wireframe Map

3D wireframe maps are three-dimensional representations of a grid file. Wireframes are created by connecting Z values along lines of constant X and Y.



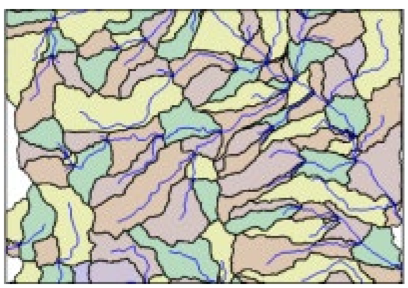
Color Relief Map

Color relief maps are raster images based on grid files. Color relief maps assign colors based on Z values from a grid file. NoData regions on the color relief map are shown as a separate color or as a transparent fill. Pixels can be interpolated to create a smooth image. Hill shading or reflectance shading can be applied to the color relief map to enhance its depth and appearance.



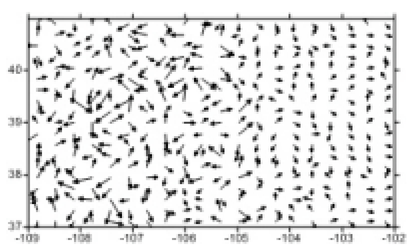
Grid Values Map

Grid values maps show symbols and labels at grid node locations across the map. The density of the labels and symbols is controlled in the X and Y directions independently. Symbol color can vary by value across a colormap, and symbols and labels can be displayed for only a specific range of values. Grid lines can be added to the map.



Watershed Map

Watershed maps display the direction that water flows across the grid. The watershed map breaks the grid into drainage basins and streams. Colors can be assigned to the basins and line properties can be associated with the streams. In addition, depressions can be removed by filling the depression.

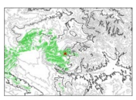


Vector Map

1-grid and 2-grid vector maps display direction and magnitude data using individually oriented arrows. At any grid node on the map, the arrow points in the downhill direction of the steepest descent and the arrow length is proportional to the slope magnitude. Vector maps can be created using information in one grid file (i.e. a numerically computed gradient) or two different grid files (i.e. each grid giving a component of the vectors).

Point Cloud Map

Point cloud maps display LAS/LAZ data as points at XY locations. LAS/LAZ data can be combined from multiple files and filtered with various criteria when creating a point cloud map. Color is assigned to the points by elevation, intensity, return number, or classification. Surfer includes commands for modifying, classifying, and exporting points in a point cloud layer. A grid can be created from the point cloud layer. Point cloud layers are displayed in the 3D View as three-dimensional points.



Viewshed Layer

Viewshed layers highlight the regions of a map that are visible (or invisible) from a transmitter location. The transmitter, receiver, and obstruction height above the surface can be specified. The viewshed analysis radius and angle can also be specified. Viewsheds can be added to any 2D grid based map. A viewshed can also be added to a 3D surface map that is displayed with no tilt (90 degrees) and in the orthographic view.

Symbology

Vector base maps can include symbology. Symbology uses symbols or colors to display statistical information about the features in the base layer. Symbology applies line, fill, and/or symbol properties to features in the base layer depending on an attribute value. The symbology can be included in a legend. The type of symbology and the layer's appearance are controlled in the **Symbology** dialog. Click *Edit Symbology* in the Base (vector) layer **Properties** window General page to open the **Symbology** dialog. There are five symbology types in **Surfer**:

- *Unique Values* - Line, fill, and/or symbol properties are specified for unique values in the attribute field.
- *Unclassed Colors* - Colors from a color spectrum are applied to the features by numeric attribute value.
- *Unclassed Symbols* - Symbols are added for each polygon feature and scaled proportionally by numeric attribute value, or point features are scaled by numeric attribute value. *Unclassed Symbols* symbology is not applied to polylines.

- *Classed Colors* - Colors are applied to the features by classifying numeric attribute values.
- *Classed Symbols* - Symbols are added for each polygon feature and classified by a numeric attribute value, or point features are classified by a numeric attribute value. *Classed Symbols* symbology is not applied to polylines.

A symbology can be added to a base (vector) layer by clicking *Edit Symbology* in the **Properties** window General page. Select the symbology type, specify the attribute field for the symbology, and then specify the various line, fill, and/or symbol properties for the symbology in the **Symbology** dialog. Click *OK* or *Apply* to apply the symbology to the base layer.

To apply symbology, the features in the base (vector) layer must have at least one attribute field. Any of the five symbology types can be applied to an attribute field that contains numeric data. The *Unique Values* symbology can be applied to text or numeric data. Add or edit attribute data in the base layer with the Attribute Table.

Map Layers

A map layer is a single map type contained in a larger map object. The map layer may be a contour layer, a post layer, a base layer, or any other layer type that **Surfer** can create. The larger map object contains all of the individual map layers and axes used to create the entire map. Map layers can be created as separate maps or added to a single map object.

It is possible to combine several maps created from related data to create one map object with multiple map layers. You can add any combination and number of contour, base, post, color relief, vector, watershed, viewshed, or 3D surface layers to a single map. However, a map can contain only one 3D wireframe layer.

There are multiple ways to overlay map layers in **Surfer**. If you have multiple maps and wish to move only one layer, you can drag a map layer from one map object to another map object in the **Contents** window. If you wish to combine all the layers from multiple maps, you can select all of the maps and use the Map Tools | Map Tools | Overlay Maps command. This moves all of the map layers to a single map object. If you have already created a map and need to add map layers to it, you can select the map and use one of the Home | Add to Map | Layer commands to add a map layer to the existing map.

Coordinate Systems

A coordinate system is method of defining how a file's point locations display on a map. Different types of coordinate systems exist that control how the coordinates are shown on the map. In **Surfer**, a map can be unreferenced in local coordinates, referenced to a geographic latitude and longitude coordinate system, or referenced to a known projection and datum. Each data set, grid, map layer, and the map frame can have an associated coordinate system. All coordinate systems for individual layers are converted “on the fly” to the map’s target coordinate system. This allows maps with different coordinate systems to be easily combined in **Surfer**.

A local coordinate system generally is considered unreferenced. A local system has a location that begins numbering at an arbitrary location and increments numbers from this location. This is frequently referred to as a *Cartesian coordinate system*. The distance units can be specified for an unreferenced local system in the **Assign Coordinate System** dialog.

A *Geographic* coordinate system uses a spherical surface to define locations on the earth. Geographic coordinate systems are commonly called unprojected lat/long. **Surfer** has several predefined geographic coordinate systems available. Each system has a different datum. The same latitude and longitude value will plot in different locations depending on the datum.

A *Projected* coordinate system consists of a projection and a datum. Each projection distorts some portion of the map, based on the ellipsoid and datum specified. Coordinates can be lat/long, meters, feet, or other units. Different projections cause different types of distortion. It is recommended that you do not use projected coordinate systems if you do not need to convert between coordinate systems or if all your data are in the same coordinate system.

Source Coordinate System - Map Layer

Maps can be created from data, grids, or base map files in any coordinate system. The *Source Coordinate System* is the coordinate system for the original data, grid, or base map used to create a map layer. Each map layer can reference a different projection and datum. If some map layers are using a different source coordinate system than what you want the map to display, the map layer is converted to the map's *Target Coordinate System*.

3D surface maps and wireframe maps do not have an associated coordinate system and cannot be converted to a different coordinate system. When a layer with a coordinate system is overlaid onto either a surface or wireframe map, the layer's coordinate system is removed and the layers are displayed in Cartesian coordinates.

Target Coordinate System - Map

Maps can be displayed in any coordinate system. The map is displayed in the coordinate system defined as the *Target Coordinate System*. A coordinate system normally has a defined projection and datum. When a map layer uses a different a different Source Coordinate System than the map's *Target Coordinate System*, the map layer is converted to the map's *Target Coordinate System*.

The standard procedure for creating maps in a specific coordinate system is as follows:

1. Create the map by clicking on the appropriate **Home | NewMap**command.
2. Click on the map layer to select it.
3. In the Properties window, click on theCoordinate Systemtab.
4. If the *Coordinate system* is not correct, click the *Set* button next to *Coordinate System*. The **Assign Coordinate System** dialog opens. This is the initial coordinate system for the map layer, i.e. the coordinate system for the source data. Select the correct coordinate system in the dialog. When finished making changes, click *OK*.
5. To change the target coordinate system for the map, click on the *Map*object in the **Contents** window. In the **Properties** window, click on the Coordinate System tab. This is the coordinate system in which you want the map to display.
6. Click on the*Change*button next to*Coordinate System*to set the desired target coordinate system. When finished, click*OK*.
7. All of the map layers are converted on the fly to the target coordinate system. The entire map is now displayed in the desired coordinate system.

Surfer does not require a map projection be defined. Maps can be created from unreferenced data, grid, and map layers. As long as all map layers have the same X and Y ranges, coordinate systems do not need to be specified. If you do not specify a source coordinate system for each map layer, it is highly recommended that you do not change the target coordinate system. Changes to the target coordinate system for the map can cause the unreferenced map layers to appear incorrectly or to not appear.

Tutorial Introduction

The tutorial is designed to introduce basic **Surfer** features and should take less than an hour to complete. After you have completed the tutorial, you will have the skills needed to create maps in **Surfer** using your own data. The tutorial can be accessed in the program by clicking the button and navigating to the *Tutorial* book or by clicking *Tutorials* in the Welcome to Surfer dialog.

If you find you still have questions after you have completed the tutorial, you should consider reviewing the material in **Surfer's** extensive in-program help. The help is also available on the web. The Golden Software website contains a knowledge base of questions and answers, and training videos. Usually, the answers to your questions are found in one of these locations. However, if you find you still have questions, do not hesitate to contact Golden Software's technical support team. We are happy to answer your questions before they become problems.

Tutorial Overview

The following is an overview of lessons included in the tutorial.

Starting Surfer	shows you how to begin a new Surfer session and open a new plot window.
Lesson 1 - Viewing and Creating Data	opens and edits an existing data file and creates a new data file.
Lesson 2 - Using the Map Wizard	creates a grid file, the basis for most map types in **Surfer**, and a map with contour, post, and color relief layers.
Lesson 3 - Changing Layer Properties	edits the contour, post, and color relief layer properties.
Lesson 4 - Modifying an Axis	edits the axis tick labels and axis title properties.
Lesson 5 - Creating a Profile	creates a profile line on the contour map and displays the profile.
Lesson 6 - Saving a Map	saves your map and all the information it contains to a **Surfer** .SRF file.
Lesson 7 - Creating a 3D Surface Map	creates and edits 3D surface map.
Lesson 8 - Adding Transparency, Color	changes the transparency of various objects, adds a color scale, and adds a map title.

Scales, and Titles	
Lesson 9 - Creating Maps from Different Coordinate Systems	loads multiple map layers from different coordinate systems and sets the target coordinate system for the entire map.

A Note about the Documentation

Various font styles are used throughout the **Surfer** quick start guide and online help. **Bold** text indicates commands, dialog names, tab names, and page names. *Italic* text indicates items within a dialog or the Contents or Properties windows such as section names, options, and field names. For example, the **Save As** dialog contains a *Save as type* list. Bold and italic text may occasionally be used for emphasis.

Also, commands appear as **Home | New Map | Contour**. This means, "click or scroll to the **Home** tab at the top of the plot window, then click on the **Contour** command within the **New Map** command group." The first word is always the menu or ribbon tab name, followed by the command group, and finally the command name within the menu list or on the ribbon.

Sample File Location

The sample files used in the tutorial lessons are located in the **Surfer** SAMPLES folder. The SAMPLES folder is located by default at C:\Program Files\Golden Software\Surfer\Samples. Note, if you are running the 32-bit version of **Surfer** on a 64-bit version of Windows, the SAMPLES folder is located at C:\Program Files (x86)\Golden Software\Surfer\Samples, by default.

Starting Surfer

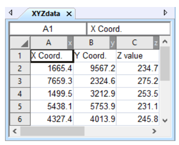
To begin a **Surfer** session:

1. Navigate to the installation folder, which is C:\Program Files\Golden Software\Surfer by default.
2. Double-click on the Surfer.exe application file.
3. The Welcome to Surfer dialog appears. Click *New Plot* to open a new blank plot window.
4. A new empty plot window opens in **Surfer**. This is the work area where you can produce grid files, maps, and modify grids.

If this is the first time that you have opened **Surfer**, you are prompted to license Surfer. Activate your Single-User product key, select a license server, or continue using the trial. Your product key is located in the download instructions email. You may also access your product key at your Golden Software My Account page.

If you have already been working with **Surfer**, open a new plot window before starting the tutorial. To open a new plot window, click the File | New | Plot command.

An XYZ data file is a file containing at least three columns of data values. The first two columns are the X and Y coordinates for the data points. The third column is the Z value assigned to the XY point. Although it is not required, entering the X coordinate in column A, the Y coordinate in column B, and the Z value in column C is a good idea. **Surfer** looks for these coordinates in these columns by default. You can customize the default columns for XYZ data with the Assign XYZ Columns worksheet command. **Surfer** requires the use of decimal degree Latitude (Y) and Longitude (X) values when using Latitude and Longitude values.



A simple XYZ data file. Notice that the X, Y, and Z data are placed in columns A, B, and C, respectively.

Lesson 1 - Viewing and Creating a Data File

The **Surfer** worksheet can also be used to create a new data file. To open a worksheet window and begin entering data:

1. Click the File | New | Worksheet command, click the on the quick access toolbar, or press CTRL+W on the keyboard. A new empty worksheet window is displayed.
2. Data is entered into the active cell. The active cell is selected by clicking on the cell or by using the arrow keys to move between cells. The active cell is indicated by a heavy border and the contents of the active cell are displayed in the active cell edit box. The active cell location box shows the location of the active cell in the worksheet. Letters are the column labels and numbers are the row labels.
3. When a cell is active, enter a value or text, and the information is displayed in both the active cell and the active cell edit box.
4. The BACKSPACE and DELETE keys can be used to edit data as you type.
5. To preserve the typed data in the active cell, move to a new cell. Move to a new cell by clicking a new cell with the pointer, pressing one of the

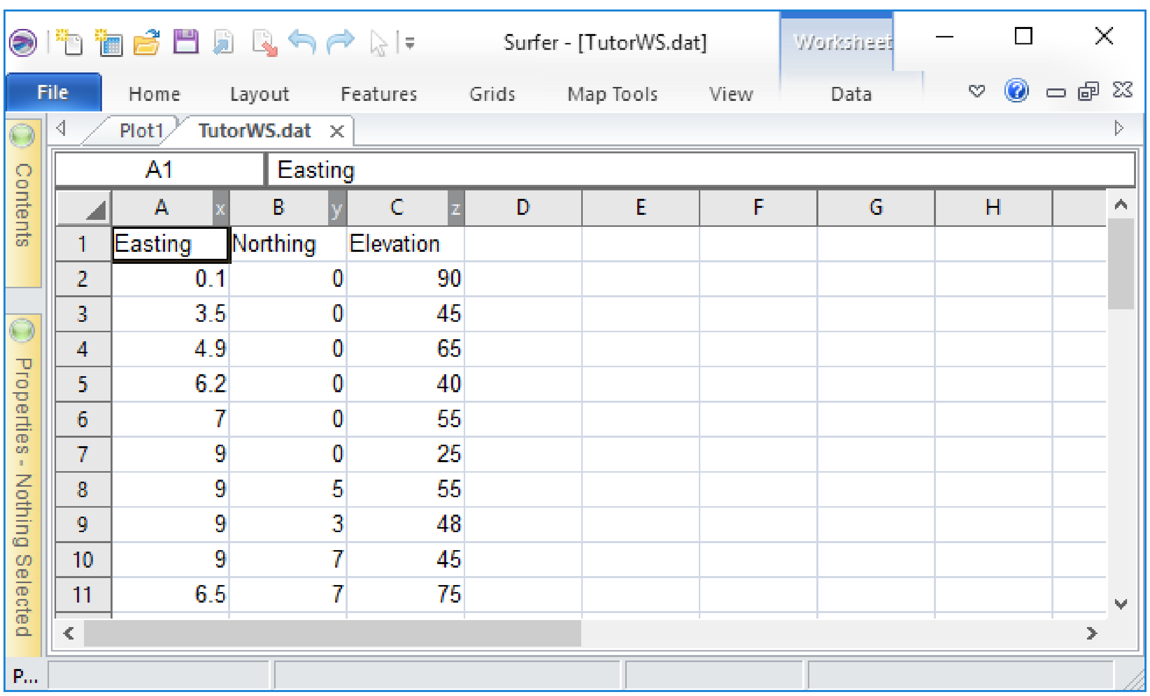
arrow keys, or pressing ENTER. Press the ESC key to cancel without entering the data.

Opening an Existing Data File

To look at an example of an XYZ data file, you can open any sample data file in a worksheet window:

1. Click the [File | Open]() command, click the button on the quick access toolbar, or press CTRL+O on the keyboard to open the **Open** dialog.
2. If you are not in the *Samples* folder, browse to it. By default, the *Samples*folder is located in C:\Program Files\Golden Software\Surfer\. In the list of files, click *TutorWS.dat*.
3. Click *Open* to display the file in the worksheet window.

Notice that the X coordinate (Easting) is in column A, the Y coordinate (Northing) is in column B, and the Z value (Elevation) is in column C. Although it is not required, row 1 contains header text, which is helpful in identifying the type of data in the column. When a header row exists, the information in the header row is used in the **Properties** window when selecting worksheet columns.

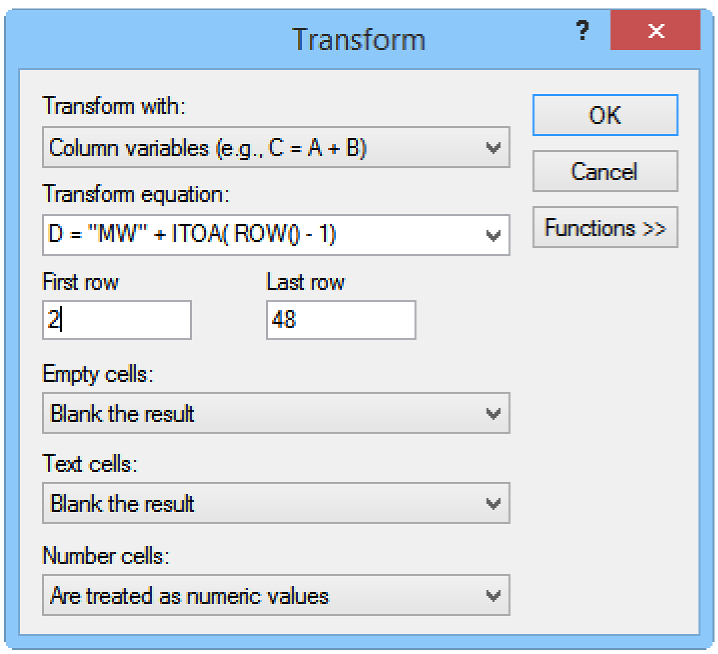


When a data file is displayed, the name of the file is shown in the title bar and in the worksheet tab. In this file, row 1 contains descriptive information about each column of data.

Adding New Data

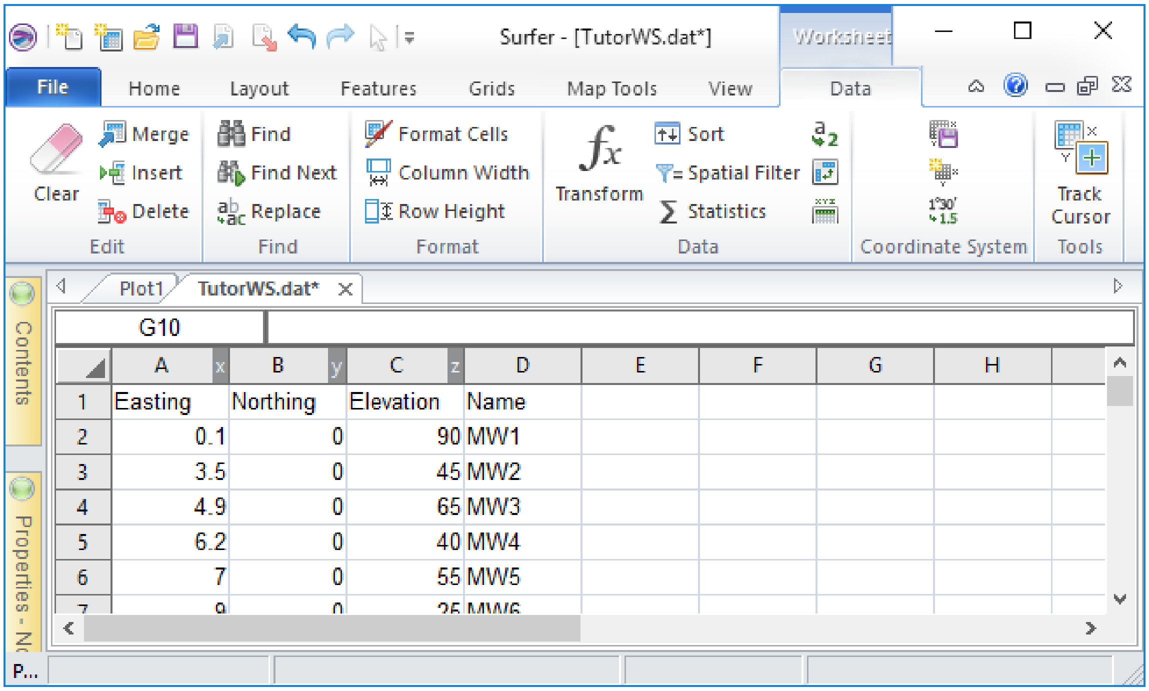
To edit any value, click in the cell to select it. Type information and the existing value is overwritten. Data can be transformed, sorted, or filtered in this window. New columns can be added. For instance, an ID column can be added which labels each row with a unique identifier. To do this,

1. Click in cell D1.
2. Type the text *Name*.
3. Press ENTER to save the text and move the active cell to cell D2.
4. Click the Data | Data | Transform command.
5. In the **Transform** dialog, set the *Transform with* to *Column variables (e.g., C = A + B)*.
6. Set the *Transform equation* to *D = "MW" + ITOA(ROW() - 1)*. This equation will use a prefix of "MW" before a number. The number is the row number minus 1 for each row. The ITOA function converts the ROW() -1 number to text.
7. Set the *First row* to 2.
8. Set the *Last row* to 48 (the last row in the worksheet).
9. Leave the *Empty cells*, *Text cells*, and *Number cells* set to the defaults.
10. Click *OK* and each row will have a unique identifier.



*Set the options in the **Transform** dialog as above to add a unique identifier to each row.*

The worksheet should now have a unique identifier column:



The new column contains a unique identifier for each row. This can be used for labels later in the tutorial.

Saving the Data File

When you have completed entering all of the data, the file can be saved.

1. Click the File | Save As command. The **Save As** dialog is displayed.
2. Navigate to the folder in which you wish to save the tutorial, for example the *Documents* folder.
3. In the *Save as type* list, choose the *DAT Data (*.dat)* option.
4. Type *Tutorial*into the *File name* box.
5. Click the *Save* button and the Data Export Options dialog opens.
6. Accept the defaults in the **Data Export Options** dialog by clicking *OK*.

The file is saved in the *Data .DAT* format as *Tutorial.dat*. The name of the data file appears in the title bar and on the worksheet tab.

Lesson 2 – Using the Map Wizard

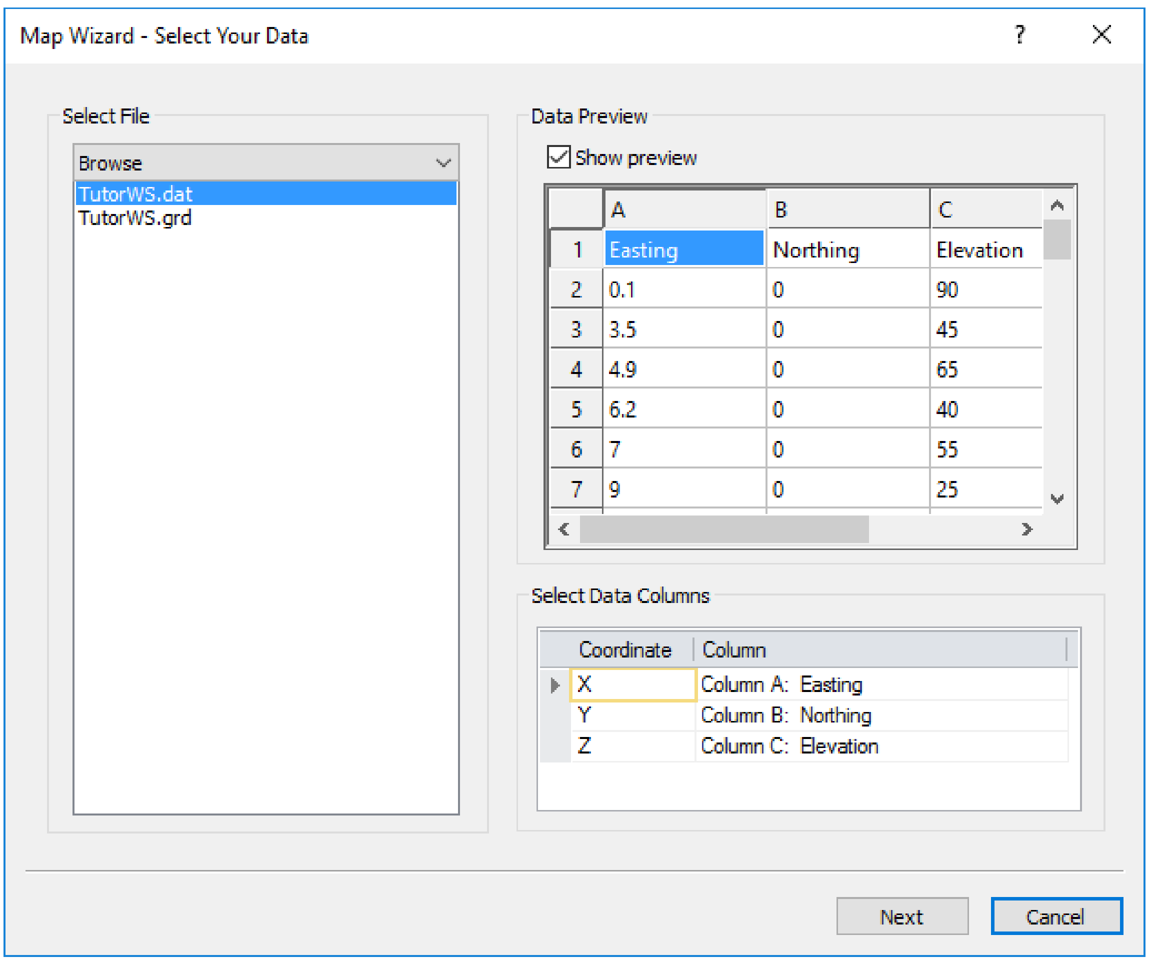
Now that we have saved the data file, we will use the Map Wizard to create a grid and a map with contour and post layers. The **Map Wizard** steps through the map creation process from raw data to a map with one or more layers. The **Map Wizard** is useful for creating multiple map types from a single data file. The **Map Wizard** can use a data, grid, or boundary file as an input file.

1. If you have the worksheet window open, click on the **Plot1** tab above the worksheet window. Alternatively, you can create a new plot window with the **File | New | Plot** command.
2. Click the **Home | Wizard | Map Wizard** command.

The **Map Wizard** opens to the first page, the Select Your Data page. The remaining topics in Lesson 2 will step through the pages of the Map Wizard.

Select Your Data

The first page in the Map Wizard is the **Select Your Data** page. Here you select the XYZ data, grid, vector data, or image file you wish to use to create your map.

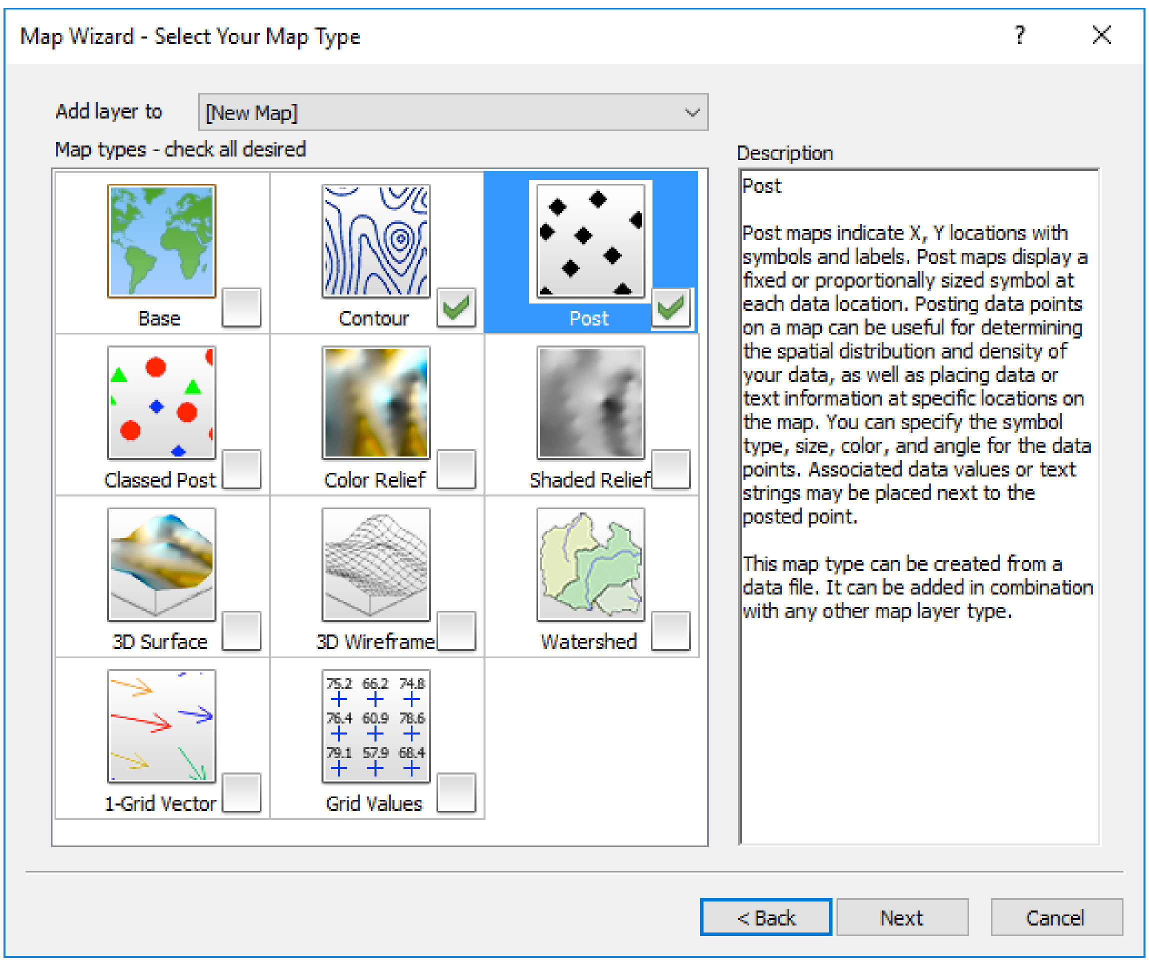


*Select the data file from Lesson 1 in the **Select Your Data** page.*

1. By default, the **Map Wizard** displays the sample files in the *Select File* list. Click *Sample files* and select *Browse* from the list. The Open dialog is displayed. You can also display *Recent files* and *Project files* in the *Select File* list.
2. In the **Open** dialog, navigate to the *Tutorial.dat* file you saved in *Lesson 1 - Saving the Data File*.
3. Select the *Tutorial.dat* file and click *Open*. The *Tutorial.dat* file is loaded in the *Data Preview* section. The column letters and header row information is displayed in the *Select Data Columns* list. By default the *X* coordinate is column A, the *Y* coordinate is column B, and the *Z* coordinate is column C. Any other valid input files in the folder are also displayed in the *Select File* list.
4. Click *Next* in the **Map Wizard**.

Select Your Map Type

Now that you have selected a data file and specified the data columns, we can select which map layers will be included in the map on the **Map Wizard - Select Your Map Type** page.



*Select the map layers you wish to create with the **Map Wizard**.*

XYZ data files are the most flexible input file type. All of the layers are available in the **Select Your Map Type** page after selecting an XYZ data file on the **Select Your Data** page. Some map types will be unavailable after choosing an image, vector, or grid file on the **Select Your Data** page. The data file type and the map type selections determine if a map is created after the **Select Your Map Type** page or if a grid must be created first.

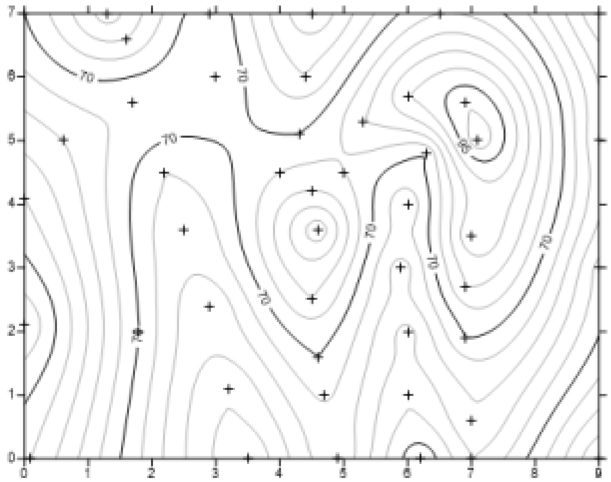
For this tutorial we will include a contour and post layer in our map:

1. Click the *Post* map in the *Map types - check all desired* list to select it. Notice a description is displayed in the *Description* field.
2. Click the *Contour* map in the *Map types - check all desired* list to select it. The *Finish* button changes to *Next*. This is because we must create a grid from the XYZ data file before we can create a contour map.
3. Click *Next*.

Select Gridding Parameters

Grid files are required to produce a grid-based map. Grid-based maps include contour, color relief, vector, viewshed, watershed, 3D wireframe, and 3D surface map layers. If necessary, grid files are created with the **Map Wizard**. Grid files can also be created at any time by using the Home | Grid Data | Grid Data command.

A grid must be created from the *Tutorial.dat* file to display a contour map. The **Map Wizard - Select Gridding Parameters** page controls the gridding options and output grid file name. The **Select Gridding Parameters** page displays a preview color relief map for you to quickly compare gridding methods. We will create a grid with the default gridding method and options.



A map is created with default contour and post layers.

1. Verify that the *Gridding method* is set to *Kriging*. If it is not, click the current gridding method and select *Kriging* from the list.
2. Verify that the *Assign NoData outside convex hull of data* option is not checked.
3. Verify that the *Output grid file* is named *Tutorial.grd* and in the desired directory, for example your *Documents* folder. If it is not, click and select the desired path for the created grid file.
4. Click *Finish*.

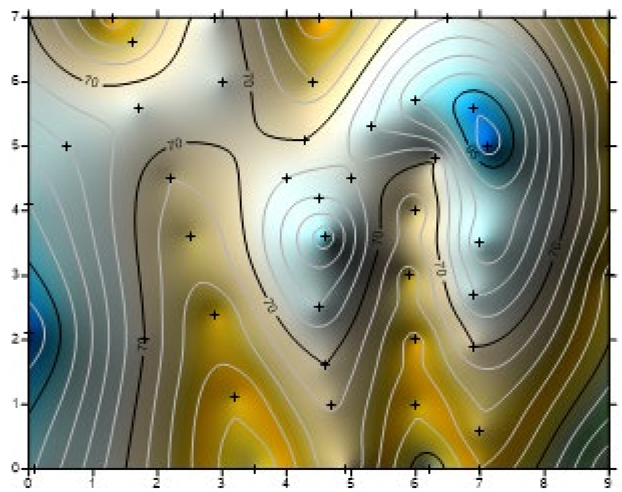
The grid is created and saved, and a map is created in the plot window with a contour and post layer. The map uses the default display properties. The **Map Wizard** is a useful tool for quickly creating maps and grids. However, it is not necessary to use the **Map Wizard**. Grids can be created with the **Grid Data** command, and maps and layers can be created with the **Home | New Map** and **Home | Add to Map | Layer** commands.

Adding a Color Relief Layer

[Map layers](#) allow you to add multiple maps to an existing map to create one map object displaying a variety of map types. The map uses a single set of axes and the map layers are positioned according to the [target coordinate system](#). For example, if you have a contour map of weather data, you can add a post map layer displaying the location and station names of each data collection station.

Multiple map layers can be created at one time when using the **Map Wizard**. However, map layers can also be added to an existing map by selecting the map and using the **Home | Addto Map | Layer** command, by dragging an existing map layer from one map object to another, or by selecting all maps and using the **Map Tools | Map Tools | Overlay Maps** command. Now we will add a color relief layer to the map:

1. Click on the *Map* object in the Contents window, or click on the map in the plot window, to select it.
2. Click the **Home | Add to Map | Layer | Color Relief** command. The Open Grid dialog is displayed.
3. Navigate to the *Tutorial.grd* file you created in *Select Gridding Parameters* and select it.
4. Click *Open* to add the color relief layer to the map.

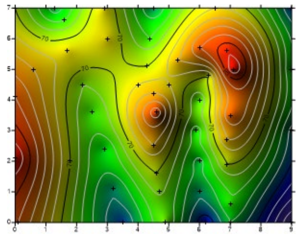


Now a color relief layer is also displayed in the map.

The color relief layer is added to the map and uses the default display properties. In Lesson 3, we will edit the appearance of the map by changing the color relief, contour, and post layer properties.

Lesson 3 – Changing Layer Properties

The map's appearance is mainly determined by the properties of the map layers. This lesson will demonstrate a few of the common properties for controlling the display of contour, post, and color relief layers. However, each map type has many properties and display options. A description and explanation is included for every property in the help.



This color relief layer uses the Rainbow colormap.

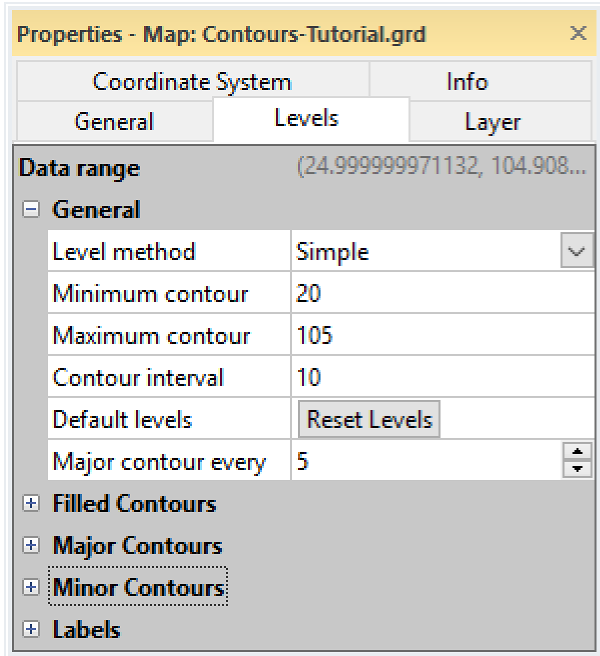
We will begin by changing the color relief layer's colors:

1. Click the *Color Relief-Tutorial.grd* layer in the Contents window to select it. When multiple layers are overlaid in a single map, it is often easier to select the desired layer in the **Contents** window. When the color relief layer is selected, the color relief layer properties are displayed in the Properties window.
2. Click the **General** tab in the **Properties** window to display the General page.
3. If necessary, click the ⊞ button next to *General* to expand the *General* section.
4. The *Colors* property determines the colormap used in the color relief map. The default colormap is *Terrain*. Click *Terrain* and select *Rainbow* from the *Colors* list.

Now the color relief layer is using the *Rainbow* colormap. You can click the ... next to the *Colors* property to customize the colormap in the Colormap Editor.

Changing Contour Levels

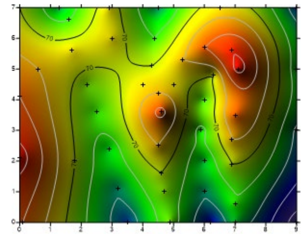
You can easily modify any of the contour map features. For example, you might want to change the contour levels displayed on the map.



*Go to the **Levels** page to display the contour level properties.*

To change the contour levels:

1. Click on the *Contours-Tutorial.grd* object in the **Contents** window. When the contour layer is selected, the contour properties are displayed in the Properties window.
2. In the **Properties** window, click the Levels tab to display the contour levels and contour line properties for the map. In this example, the contour levels begin at Z = 20. This is displayed next toMinimum contour. TheMaximum contourlevel is
3. To change the contour range, click in the box next to *Minimum contour* or *Maximum contour*. Highlight the current value and type a new value. The *Data range* of the grid file is displayed at the top of the **Levels** page, making selecting an appropriate range easier. For best results, select values for *Minimum contour* and *Maximum contour* that are in or near this *Data range*.
4. The *Contour interval*, or the frequency of contour lines, is five. This means that a contour line will be displayed every five Z units. We should see contour lines at 20, 25, 30, 35, etc. up to 105. Click in the *Contour interval* box, highlight the value 5, and type the value 10.
5. Press ENTER on the keyboard. The map automatically updates to show contour lines every 10 Z units. The minimum contour level is Z = 20, and the largest contour level is Z = 100.



The contour map is redrawn using new contour levels based on a contour interval of 10.

Changing Contour Line Properties

You can set any of the options in the list on the Levels page to customize the contour map. The *Major contour every* value allows the setting of two different line styles, the major and minor contour lines, for the contour map. By default, the major contour lines are black and labeled and the minor contour lines are gray and unlabeled. The number of minor contour lines and the line properties for both the major and minor contours can be changed.

Setting the Major Contour Value

1. Highlight the number in the box next to *Major contour every* and type in a new value of 3.
2. Press ENTER on the keyboard and every third line is a major contour line.

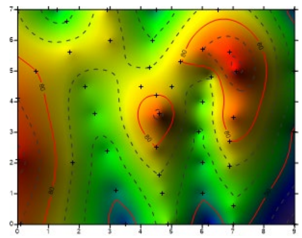
Changing the Major Contour Line Properties

1. Click the next to *Major Contours,* if the section is not already expanded.
2. Click the next to *Line Properties* in the *Major Contours* section. The major line properties appear.
3. Click the *Black* color box next to *Color*. Select another color, such as *Red*, from the list. The map automatically updates.
4. Click the next to *Width* and change the value to 0.03 inches. Thick red lines now appear at the major contours.

Changing the Minor Contour Line Properties

1. Click the next to *Minor Contours,* if the section is not already expanded.

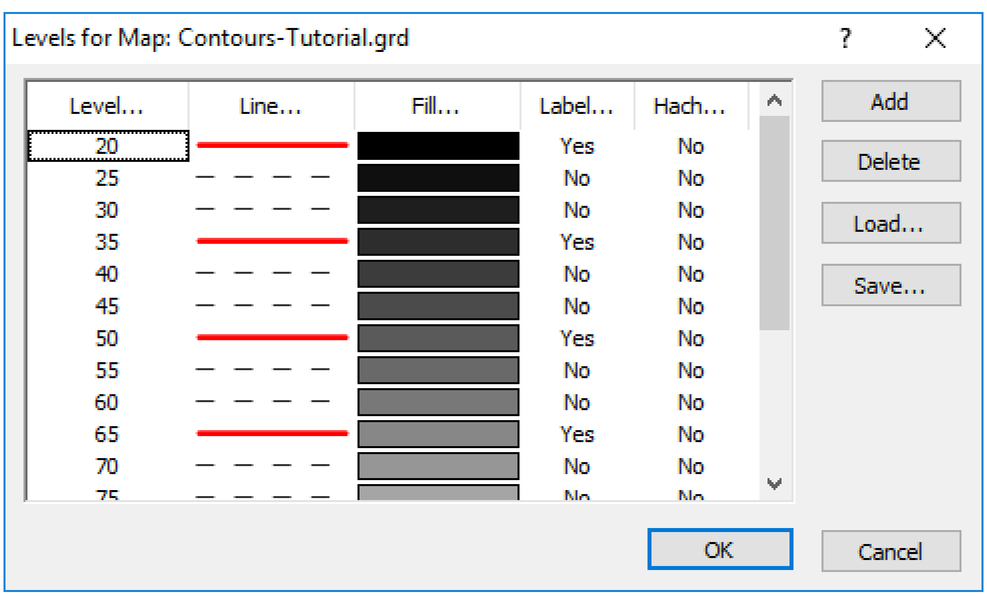
2. Click the ⊞ next to *Line Properties* in the *Minor Contours* section. The minor line properties appear.
3. Click the *30% Black* color box next to *Color*. Select another color, such as *80% Black*, from the list.
4. Click in the box next to *Style* and select a dashed line from the list. Dashed gray lines now appear at the minor contours.



The contour map should look similar to this example after changing the major and minor line properties.

Advanced Contour Level Properties

Contour map level properties can be set in one of three methods: *Simple*, *Logarithmic*, or *Advanced*. As seen is the previous topic, the *Simple* method is easy to use and quick to adjust. The *Logarithmic* method is very similar to the *Simple* method, but it uses a logarithmic scale rather than a linear scale. When using the *Advanced* method, each contour line is individually controlled.



*The **Levels for Map** dialog is used to adjust level properties with the Advanced level method.*

Control advanced settings for the *Level, Line, Fill, Label,* and *Hach* properties of the contour map in the **Levels for Map** dialog. Properties can be adjusted for all contours at once by clicking on the column buttons, or for individual contours by double-clicking on the specific contour level.

The changes that can be made by clicking the **Levels for Map** dialog header buttons include the following:

- Set the minimum, maximum, and contour interval by clicking the *Level* button.
- Set the line properties for all lines to a uniform or gradational color and style by clicking the *Line* button.
- Set the colormap for the foreground and background color and the fill pattern between all contour lines by clicking the *Fill* button.
- Set the label properties for all contour labels or contour labels on a frequency basis by clicking the *Label* button.
- Set the hachure properties for all contours or on a frequency basis by clicking the *Hach* button.

Individual level changes that can be made include the following items:

- Set an individual level value by double-clicking on the level value to enter a new Z value.
- Set the individual line properties for a single level by double-clicking the line style for that level.
- Set the fill color or pattern for a single level by double-clicking on the fill pattern for that level.
- Set the label properties for a single contour label by double-clicking on the *Yes* or *No* under the *Label* column for that level.
- Set the hachure properties for a single contour level by double-clicking on the *Yes* or *No* under the *Hach* column for that level.

Now we will apply the *Advanced* level method and customize the contour levels with some bulk changes:

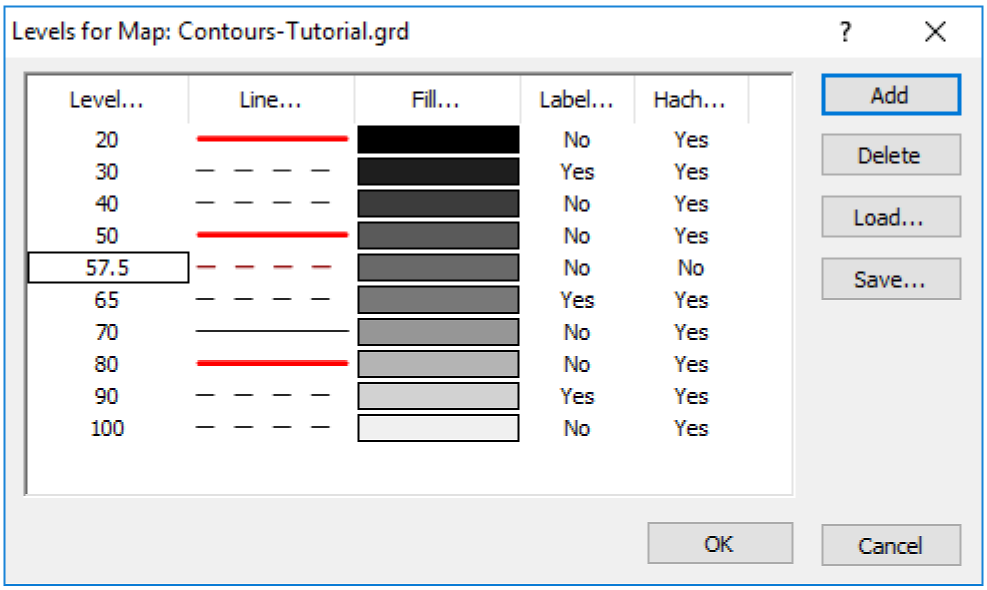
1. In the **Contents** window, click once on the *Contours-Tutorial.grd* contour layer to select it.
2. In the **Properties** window, click on the**Levels**tab.
3. Change the*Level method*by clicking on the word*Simple*next to*Level method*and selecting*Advanced*from the list.
4. Click the *Edit Levels* button next to *Contour levels* to open the advanced Levels for Map dialog.
5. Clicking the column header buttons makes bulk changes at regular intervals. Click on the *Label* button. The **Labels** dialog opens.

6. Change the *First* value to 2, the *Set* value to 1, and the *Skip* value to 2.
    - The *First* value tells **Surfer** which contour line to first change. This says to set the label format for the second contour line (Z=30).
    - The *Set* value tells **Surfer** how many lines to set with this style. This says to set only one line with the label format.
    - The *Skip* value tells **Surfer** how many lines to skip before setting the next contour line. This says to skip two contour lines. So, the Z=40 and Z=50 contours are not set. The next contour line Z=60 uses the label format. Z=70 and Z=80 are skipped. Z=90 is set. Z=100 is skipped.
7. Click the *Font* button. The **Font Properties** dialog opens.
8. Set the *Size (points)* to 14.
9. Set the *Foreground color and opacity* color to *White*.
10. Click *OK* in the **Font Properties** dialog.
11. Click *OK* in the **Labels** dialog. Notice how the label status is changed in the **Levels for Map**dialog.
12. Click on the *Hach* button. The **Hachures**dialog opens.
13. Set the *First* to 1, the *Set* to 1, and the *Skip* to 0.
    - The *First* value tells **Surfer** to set the hachure setting for the first contour line, Z=20.
    - The *Set* value tells **Surfer** to set only one contour line to the hachure style.
    - The *Skip* value tells **Surfer**how many contours to skip. In this case, no contours are skipped. This means that all of the contours will have the hachure style.
14. Check the *Hachure Closed Contours Only* box, if it is not already checked.
15. Change the *Direction* to *Uphill.*
16. Click *OK* in the **Hachures** dialog. This changes all of the items under *Hach* to Yes. All closed contours will have hachure marks.
17. Click *OK* in the **Levels for Map** dialog and the bulk changes are made to the contour map.

Now we will open the **Levels for Map** dialog again and set properties for individual contour levels:

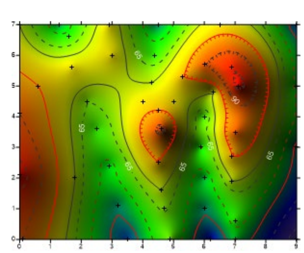
1. In the **Contents** window, click once on the *Contours-Tutorial.grd* contour layer to select it.
2. In the **Properties** window, click on the**Levels**tab.
3. Make sure that the*Level method*is set to*Advanced*.
4. Click the *Edit Levels* button next to *Contour levels* to open the advanced **Levels for Map** dialog.
5. In the **Levels for Map** dialog, you can double-click an individual Z value in the list underneath theLevelbutton to change the
6. In the Z Level dialog, highlight the value 60 and type in 65.
7. Click *OK* in the **Z Level** dialog, and the contour line level changes to 65.

8. You can also double-click the line style for an individual level to modify the line properties for the selected level. This provides a way to emphasize individual contour levels on the map. Double-click on the line style next to the level 70.
9. In the Line Properties dialog, change the *Style* to a solid line by clicking on the dashed line and selecting the *Solid* line from the list.
10. Click *OK* in the **Line Properties** dialog.
11. Let's add a single contour line halfway between two existing values. Click on the number 65 under the *Level* column.
12. Click the *Add* button. The value 57.5 is added between the 50 and the 65.



*Use the **Levels for Map** dialog to make bulk and individual changes to contour levels.*

13. Click *OK* in the **Levels for Map** dialog and the individual settings are made to the contour map.

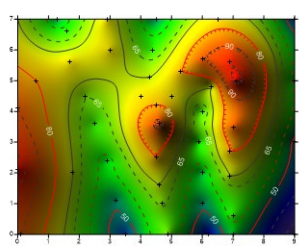


Now the advanced level properties have been applied to the contour map.

Adding, Deleting, and Moving Contour Labels

Contour label locations can be changed on an individual basis. Labels can be added, deleted, or moved. This section will demonstrate adding, deleting, and moving contour labels:

1. Select the contour layer by clicking the *Contours-Tutorial.grd* object in the **Contents** window.
2. Click the [Map Tools | Edit Layer | Contour Labels] command or right-click on the contour map and select **Edit Contour Labels**. The cursor changes to to indicate that you are in edit mode. Contour labels have rectangular boxes around them in edit mode.
3. To delete a label, click on the label and press the DELETE key on the keyboard. For example, left-click on one of the 65 labels and press the DELETE key on your keyboard.
4. To add a label, press and hold the CTRL key on the keyboard and left-click the location on the contour line where you want the new label to be located. The cursor changes to a black arrowhead with a plus sign to indicate you are able to add a new label. Add several contour labels to the red lines.
5. To move a contour label, left-click on the label, hold down the left mouse button, and drag the label. Release the left mouse button to complete the label movement.
6. To duplicate a label, hold the CTRL key and then click and drag an existing label. The duplicate label will be dragged to a new location along the line.
7. To exit the *Edit Contour Labels* mode, press the ESC key, click the **Home | Selection | Select** command, or click the **Map Tools | Edit Layer |Contour Labels** command.



*Contour labels can be moved, added, or deleted with the **Map Tools | Edit Layer | Contour Labels** command.*

Exporting 3D Contours

When you have completed a contour map in the plot window, you can export the contour lines with associated Z values to an AutoCAD DXF, 2D SHP, 3D SHP, or TXT file. To export contour lines to a DXF, 2D or 3D SHP, or TXT file:

1. Select the contour map layer by clicking *Contours-Tutorial.grd*in the Contents window.
2. Click the Map Tools | Layer Tools | Export Contours command.
3. In the **Save As** dialog, type *Tutorial contours* in the *File name* box.
4. Select *AutoCAD DXF File (*.dxf)*, *2D Esri Shapefile (*.shp)*, *3D Esri Shapefile (*.shp)*, or *Text format (*.txt)* in the *Save as type* list.
5. Click *Save* and the file is exported to the current directory. This creates a file titled *Tutorial contours.dxf*, *Tutorial contours.shp*, *or Tutorial contours.txt* depending on what file type you selected. Additional files may also be created that accompany the DXF or SHP file.

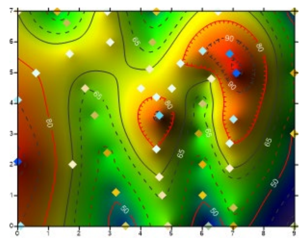
The contours are exported as polylines or polygons. The labels and gaps are removed. The exported file can be used in **Surfer** as a base map, or used in other applications. The File | Export command can also be used to export 2D or 3D contours. A comparison between the **Export Contours** and **Export** commands is available on the *Export Contours* help topic.

Changing the Post Layer Properties

Symbols in a post map can all be the same or can be selected with a worksheet column. Symbol sizes can all be the same or have proportional sizes. Symbol colors can all be the same or have color based on a column. Now we will edit the post map layer properties:

1. Click on the *Post-Tutorial.dat* layer in the **Contents** window.
2. In the **Properties** window, click on the Symbol tab.
3. Click the ⊞ next to *Symbol*, if the *Symbol* section is not already expanded.
4. Click the ⊞ next to *Symbol Properties* to open the Symbol Properties section.
5. Click the selected symbol next to the *Symbol* property. In the list, click on the filled diamond symbol (*Symbol set: GSI Default Symbols, Number:6*) from the symbol palette.
6. Click the ⊞ next to *Symbol Size* to open the *Symbol Size* section.
7. Highlight the value next to the *Symbol size* option and type 0.15 in.
8. Press ENTER on the keyboard. The symbols update with the new symbol size.
9. Click the ⊞ next to *Symbol Color*.
10. To change the symbol colors based on a worksheet value, click on the*None*next to the*Color column*option and select*Column C: Elevation*.
11. Verify that the *Color method* is set to *Numeric via colormap*.
12. Click the colormap next to the *Symbol colors* and select the desired colormap, such as *Terrain*.

If the post map is not visible, ensure that the post layer is on top of the contour layer in the **Contents** window. The order the layers are listed in a map object is the order the map layers are drawn in the plot window. To move the post layer in the **Contents** window, left-click and drag the post layer above the other layers in the map object. Alternatively, select the post layer and click the **Layout |Arrange | Bring to Front | Bring Forward** command, or right-click the post layer and select **Order Objects | Move Forward**.



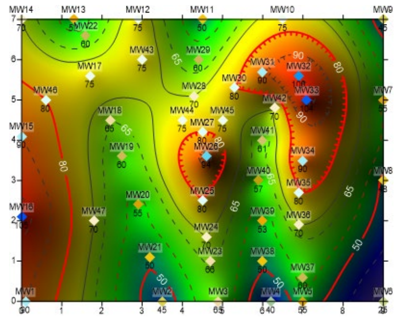
The updated post map is displayed overlaid on the contour layer and color relief layer.

Adding Labels to the Post Layer

You can add labels to the data points on post maps and classed post maps. Multiple labels can be added to display all of the information desired in the map. We will add labels showing the elevation and names for the data points:

1. Click on the *Post-Tutorial.dat* layer in the Contents window.
2. In the **Properties** window, click on the **Labels** tab.
3. Click the ⊞ next to *Label Set 1*, if the section is not already open.
4. Next to *Worksheet column*, click the word *None*. A list displaying all of the columns in *Tutorial.dat* are displayed. Select *Column C: Elevation* from the list.
5. For the *Position relative to symbol* option, click on the existing option and select *Below* from the list.
6. Click the *Add* button next to the *Add label set* option to add a second label to the post map.
7. Next to *Worksheet column*, click the word *None*. A list displaying all of the columns in *Tutorial.dat* are displayed. Select *Column D: Name* from the list.
8. For the *Position relative to symbol* option, click on the existing option and select *Above* from the list.
9. Click the ⊞ next to *Font Properties* to open the *Font Properties* section.
10. Change the *Background opacity* to *33%*. This places a semi-transparent white box around the names.

The post map layer is automatically redrawn with labels on each of the data points.

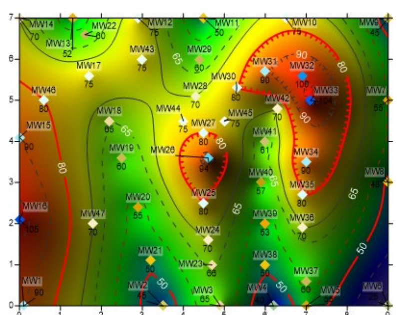


*Add labels to post maps in the **Properties** window on the **Labels** tab.*

Moving Individual Post Labels

You can move individual labels on post maps and classed post maps with the Map Tools | Edit Layer | Post Labels command. Alternatively, add labels, and then right-click the post map and select **Edit Post Labels** to enter edit mode. A customizable line is automatically added from the data point label to the actual X, Y data point location.

1. Select the *Post-Tutorial.dat* layer in the **Contents** window.
2. Click the Map Tools | Edit Layer | Post Labels command or right-click on the selected map and select **Edit Post Labels**. The cursor will change to to indicate you are now in post label editing mode.
3. Left-click on a label, hold the left mouse button down, and drag the label to a new location. With the left mouse button held down, the arrow keyboard keys can be used to nudge the label location. Release the left mouse button to place the label in the new location. A leader line will be added from the point location to the new label location by default. The leader line visibility and line properties are controlled on the **Labels** page in the **Properties** window when the post layer is selected.
4. Press the ESC key to exit the post label editing mode.



*Customize the post map labels with the **Edit Post Labels** command.*

Lesson 4 – Modifying an Axis

Every map is created with four map axes: the bottom, right, top, and left axes. 3D maps also have an additional Z axis. You can control the display of each axis independently of the other axes on the map. Additional left, right, top, bottom, or Z axes can be added to a map with the **Map Tools | Addto Map | Axis** commands. In this example, we will change the axis label spacing and add an axis title:

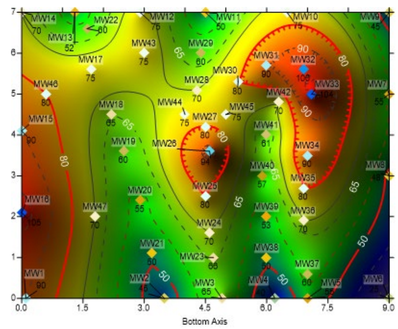
1. Move the cursor over one of the axis tick labels on the bottom X axis and left-click the mouse. In the status bar at the bottom of the plot window, the words "Map: Bottom Axis" are displayed. The *Bottom Axis* object is selected in the **Contents** window. This indicates that you have selected the bottom axis of the map. Additionally, blue circle handles appear at each end of the axis, and green square handles appear surrounding the entire map. This indicates that the axis is a "sub-object" of the entire map.
2. The bottom axis properties are displayed in the Properties window. Click on the General tab.
3. Click the ⊞ next to *Title* to open the *Title* section if it is not already open.
4. Click in the box next to *Title text*. Type *Bottom Axis* and press the ENTER key on the keyboard. This places a title on the selected axis. Alternatively, click the Σ button. Type the text in the Text Editor and click *OK*.
5. If you cannot see the axis title, click the View | Zoom | Selected command. The map automatically increases its size to fill the plot window.

Changing the Tick Label Properties

All properties of the axis can be edited, including the tick label format and frequency. We will change both format and frequency in this example:

1. In the **Properties** window, click on the Scaling tab to display the axis scaling options.
2. In the *Major interval* field, highlight the value 1 and type the value 1.5.
3. Press ENTER on the keyboard to place 1.5 X map units between tick marks. This spacing automatically updates on the map axis.
4. Click on the **Labels** tab in the **Properties** window.
5. Click the ⊞ next to *Labels*, if it is not already open.
6. Click the ⊞ next to *Label Format* to open the Label Format section.
7. In the *Label Format* section, select *Fixed* for the *Type*.
8. Click in the box next to *Decimal digits.* Highlight the existing value and type the value 1.
9. Press ENTER on the keyboard. This indicates that only one digit follows the decimal point for the axis tick labels.

The map is updated immediately after every change, showing the axis tick spacing, labels, and the axis title.



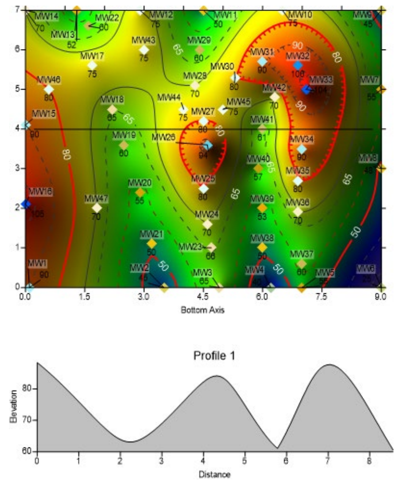
You can use the axis properties to change the tick mark and axis title properties.

Lesson 5 - Creating a Profile

The ability to slice a grid file in **Surfer** to create a file of data points along a specified line of section is a very powerful tool. The sliced data can be visually displayed as a profile in **Surfer**, or multiple profiles can be combined to display a cross section. However, the Map Tools | Add to Map | Profile command provides an excellent quick method to producing a profile from a grid-based map. The profile trace will be drawn directly on the map:

1. Click once on the *Contours-Tutorial.grd* contour layer to select it.
2. Click the **Map Tools | Add to Map | Profile** command. The cursor changes to a  to indicate that you are in the drawing mode.
3. Click inside the contour map near the (0,4) and (9,4) coordinate locations. The exact coordinates of the cursor are displayed in the status bar for reference.
4. After the second point has been clicked, a line connects the points. Press ENTER on the keyboard to end drawing mode.
5. Click the **View | Zoom | Fit to Window** command to see the entire map and profile.

The *Base(vector)-Profile 1* layer is automatically added to the map and the profile graph is automatically created. The properties can be edited by clicking on the *Profile 1* object in the **Contents** window and adjusting the properties in the **Properties** window.



The profile trace is displayed on the map. The profile is displayed in a graph below the contour map.

Lesson 6 - Saving a Map

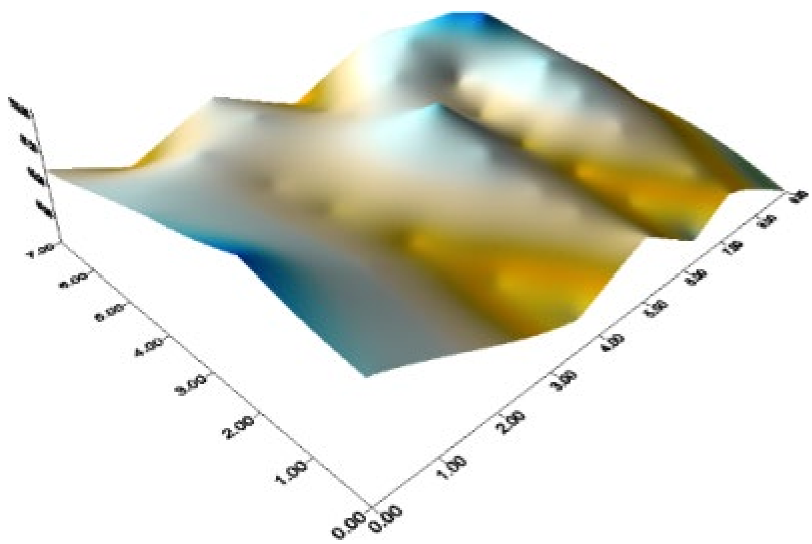
When you have completed the map in the plot window, you can save the map to a **Surfer** .SRF file. **Surfer** .SRF files contain all the information necessary to reproduce the project. When you save a map as a .SRF file, all the scaling, formatting, and map properties are preserved in the file. An asterisk (*) next to the file name in the title bar and tab indicates the file has been modified and the modifications have not yet been saved.

1. Click the File | Save command or click the button on the quick access toolbar. The **Save As** dialog is displayed because the map has not been previously saved. Set the *Save in*directory to any directory on your computer.
2. In the *File name* box, type *Tutorial*.
3. Make sure that the *Save as type* is set to *Surfer Document (*.srf)*.
4. Click *Save* and the file is saved to the current directory with a .SRF extension. The saved map remains open and the title bar changes to reflect the name change. There is no longer an asterisk next to the file name.

If desired, the *Save as type* can be set to *Surfer 11 Document (*.srf)*, *Surfer 12 Document (*.srf)*, *Surfer 13 Document (*.srf)*, or *Surfer 14 Document (*.srf)* if the file is to be shared with users using **Surfer 11**, **Surfer 12**, **Surfer 13**, or **Surfer 14**. After selecting the format, click *Yes* in the dialog. Any new features are lost when saving to a previous **Surfer** version format.

Lesson 7 – Creating a 3D Surface Map

Surfaces are three-dimensional shaded renderings of a grid file. Surfaces provide an impressive visual interpretation of data. Surfaces can be layered with other surfaces, so that the surfaces will intersect with each other. Surfaces can also have layers of other map types, excluding 3D wireframes. Surfaces allow you to generate an elevation model of your area of interest and then add layers of data on the top of the surface. You can control the color, lighting, overlay blending, and wire mesh grid of a 3D surface.



The 3D surface map shows the grid with a 3D aspect and color filled areas.

For example, if you have location (X, Y) and temperature (Z) data for a region and you have the same location (X, Y) and corresponding elevation (Z) data for the area, you could create a grid file with the Z variable being elevation and a grid file with the Z variable being temperature. You could create a 3D surface of the elevation grid to represent topography, then add a contour map of the temperature variation. You could continue to add map layers, such as a classed post map layer with the temperature collection stations that have different symbols depending on the elevation.

We are going to use the same grid file you used to create the tutorial contour map. The 3D surface map will provide a new perspective to the contour map you have already created. Although we are going to create this map in a new plot window, the surface map could easily be added to the existing plot window.

1. Click the **File | New | Plot** command or click the  button on the quick access toolbar to open a plot document.
2. Click the Home | New Map | 3D Surface command.

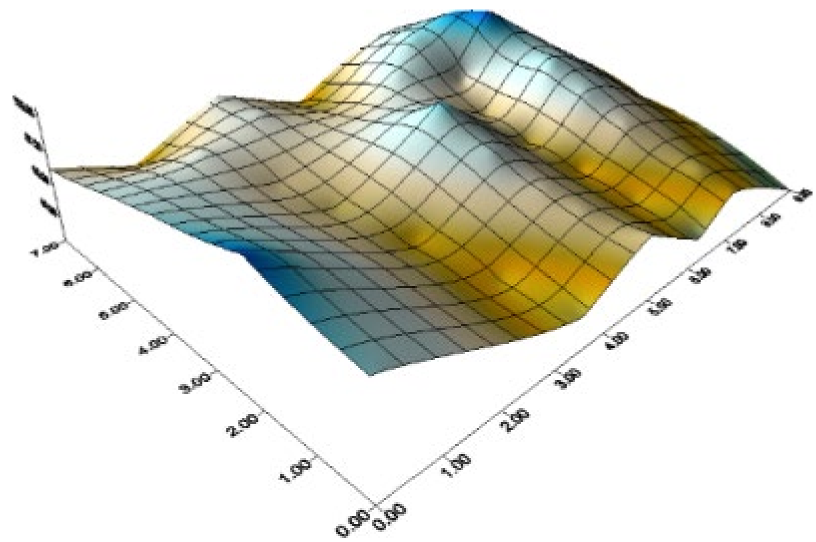
3. In the **Open** dialog, select the grid file *Tutorial.grd* from the list of files. The *Tutorial.grd* file was created in Lesson 2 - Using the Map Wizard.
4. Click *Open* and the 3D surface is created using the default settings.

Adding a Mesh

Mesh lines can be applied to surfaces. 3D surface maps have more capability than 3D wireframe maps. 3D surfaces can be combined with more map types, and the surface map limits can be changed. Adding mesh lines to a 3D surface map simulates a 3D wireframe map. We will add a surface mesh to the map:

1. Click once on *3D Surface-Tutorial.grd* in the **Contents** window to select it. The 3D surface properties are displayed in the **Properties** window.
2. Click the Mesh tab.
3. Check the box next to the *Draw lines* option in both the *Lines of Constant X* and *Lines of Constant Y* sections.
4. Change the *Frequency* in both the *Lines of Constant X* section and *Lines of Constant Y* section to 5.

The mesh is automatically added to the selected 3D surface.



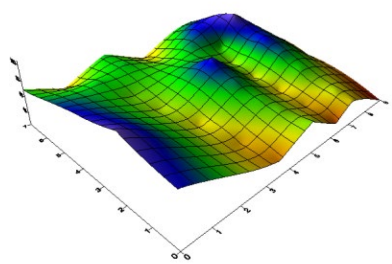
The mesh lines indicate lines of constant X and Y on the 3D surface.

Changing the 3D Surface Layer Colors

Changing color schemes on 3D surfaces is similar to changing colors on other map types such as color relief maps or contour maps. A colormap is used to load previously defined color schemes or to create your own color schemes. In this example, we will use a modified *Rainbow* colormap:

1. Click on the *3D Surface-Tutorial.grd* layer in the **Contents** window to select it.
2. In the **Properties** window, click on the General tab.
3. Click the ⊞ next to *Material Color* to open the section if it is not already open.
4. Click the ... button to the right of the selected colormap for *Upper*. The **Colormap Editor** opens.
5. In the **Colormap Editor**, select the *Rainbow* colormap from the *Presets* list. The *Presets* list contains a variety of predefined color schemes.
6. The *Rainbow* preset has six nodes that range from purple to red. You can add, remove, apply opacity, customize the nodes, or accept the default selections. To reverse the color order, click the *Reverse*button.
7. Click *OK* in the **Colormap Editor** to update the surface map properties with your color changes.

You can continue to experiment with the colors by selecting other color spectrums from the list next to *Upper*. Or, click the ... button to the right of the colormap and make changes in the **Colormap Editor**. You can experiment with selecting custom node locations and colors.



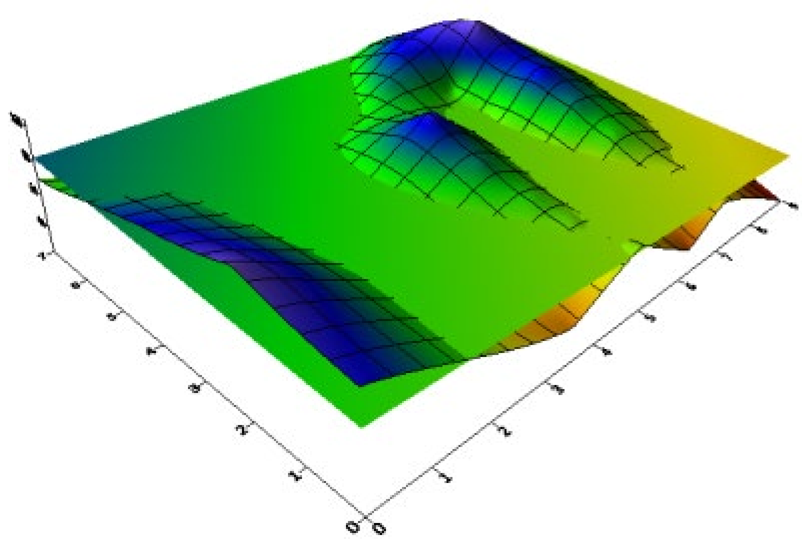
This is a 3D surface map with a mesh displayed at a frequency of five. The 3D surface map is using the reverse of the Rainbow color spectrum.

Adding a Surface Map Layer

You can add additional map layers to the 3D surface with the **Home | Add to Map | Layer** command. All map layers, except other 3D surfaces, are converted into a type of image known as a texture map. This texture map is then applied to the surface by stretching it and shrinking it as necessary. When these maps are added to the surface map, you have a choice on how to treat the texture map. You can use the colors from overlays only, from the surface only, or blend colors from the overlays and surface. For example, you could create a color filled contour map, add the contour map and surface, and then use the colors from the contour map only.

When multiple 3D surfaces of differing elevations are added, the surfaces can intersect and overlap each other. If a surface map is added to another surface map with the **Home | Add to Map | Layer | 3D Surface** command and the two maps are adjacent to each other in the X or Y direction, the surfaces are drawn side-by-side. In this example, we will add a planar layer to the surface you just created:

1. Click on the *3D Surface-Tutorial.grd* layer in the **Contents** window.
2. Click the **Home | Add to Map | Layer | 3D Surface** command, or right-click the surface map and select **Add to Map | 3D Surface**.
3. In the **Open Grid** dialog, select the planar grid, *TutorPl.grd* from **Surfer's***Samples* directory. If you are not in the *Samples* folder, browse to it. By default, the *Samples* folder is located in C:\Program Files\Golden Software\Surfer\.
4. Click *Open*and the new surface map layer is added using the default settings.
5. Click on the *3D Surface-TutorPl.grd* surface map layer in the **Contents** window.
6. In the **Properties** window, click on the **General** tab.
7. Click the ⊞ next to *Material Color* to open the *Material Color* section.
8. Click the ... next to *Upper* to open the **Colormap Editor**.
9. Select *Rainbow* in the *Presets* list.
10. Click *Reverse* to match the colormap in the *3D Surface-Tutorial.grd* layer.
11. In the *Data to Color Mapping* section, type *25* in the *Minimum* field, and type *104.9* in the *Maximum* field. Now the surfaces use the same colormap mapped to similar data values.



You can overlay two or more 3D surfaces. Depending on each surface's XYZ ranges, the surfaces may overlap or intersect each other. This example shows the intersection of the Tutorial.grd and TutorPl.grd *sample files.*

If you wish to save your map, click the **File | Save** command. We will create a new plot in the next lesson.

Lesson 8 - Adding Transparency, Color Scales, and Titles

The opacity of a map, image, text, line, fill, symbol, or entire layer can be customized in **Surfer**. Opacity is the amount of light that is obscured by an object. An object can be made semi-transparent by adjusting the opacity value. Reducing the opacity of an object makes other objects visible through the less than 100% opaque object. An *Opacity* value of 0% means that the object is invisible. An *Opacity* value of 100% means that the object is fully opaque. Setting the opacity is useful when creating a semi-transparent map layer. For example, you may want to display a semi-transparent contour map layer over a satellite image base map layer so that both map layers can be seen. Being able to set the Opacity of entire layers is especially useful when you have multiple layers with filled objects and you need to see all of the layers.

Creating a Filled Contour Map

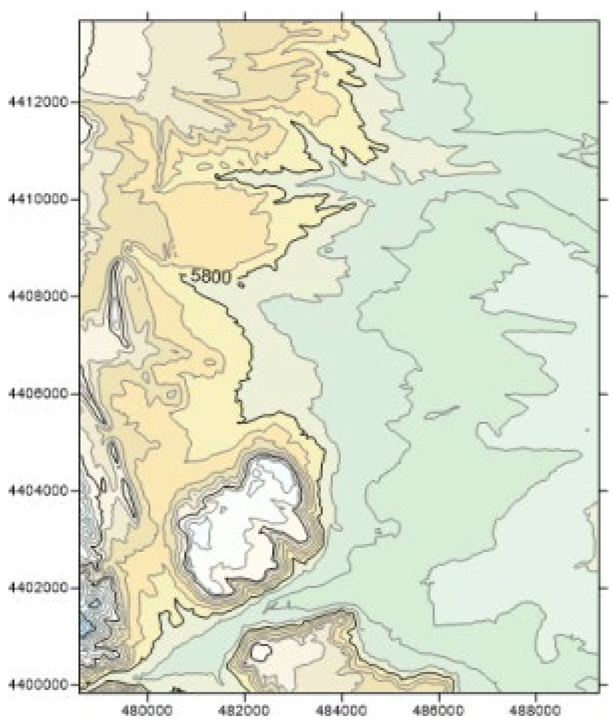
First, we will create a filled contour map:

1. Click the **File | New | Plot** command or click the button on the quick access toolbar. A new empty plot window is displayed.
2. Click the **Home | New Map | Contour** command.
3. Select the grid file *Golden.grd* from the list of files in the **Open Grid** dialog. By default, the *Samples* folder is located in C:\Program Files\Golden Software\Surfer.
4. Click *Open.* The map is created using the default settings. Some settings are persistent while **Surfer** is open. If you have completed Lesson 3 in the same session, the map created in this step will have uphill hachures and white-text contour labels.
5. Click on the contour map layer to select it.
6. In the **Properties** window, click on the **Levels** tab.
7. Set the *Level method* to *Simple*, if it is not already *Simple*.
8. Click the ⊞ next to *Filled Contours*to open the*Filled Contours*section, if it is not already open.
9. Check the box next to *Fill contours* to fill the contours.
10. Click the ⊞ next to *Labels* to open the *Labels* section, if it is not already open.
11. Click the ⊞ next to *Font properties* to open the *Font properties* section.
12. If the *Foreground color* is not *Black*, click the current color and select *Black* from the color palette.

Adding Transparency to Map Layers

You can adjust the *Opacity* value of a map layer or of individual contour fill, polygon fill, text, lines, or symbols when the appropriate object is selected. Adjusting the *Opacity* for an entire layer may be useful when you have multiple map layers and need to make one or more layers semi-transparent to best represent your data. For this example, we will adjust the opacity for the contour fill while keeping the contour lines and labels completely opaque.

1. Click on the *Contours-Golden.grd* layer in the **Contents** window to select it.
2. In the **Properties** window, click on the **Levels** tab.
3. Click the ... button next to *Fill colors*. The Colormap Editor opens.
4. Click the current selection in the *Presets* list and select *Terrain*.
5. Verify the *Apply opacity to ALL nodes* check box is checked. If it is not checked, click the check box.
6. Highlight the existing *100%* value next to the *Opacity* option and type *30*.
7. Click *OK* in the **Colormap Editor**. The *Terrain* colormap and 30% opacity setting is applied to the contour layer's *Fill colors*. Notice *Custom* is displayed in the *Fill colors* field.



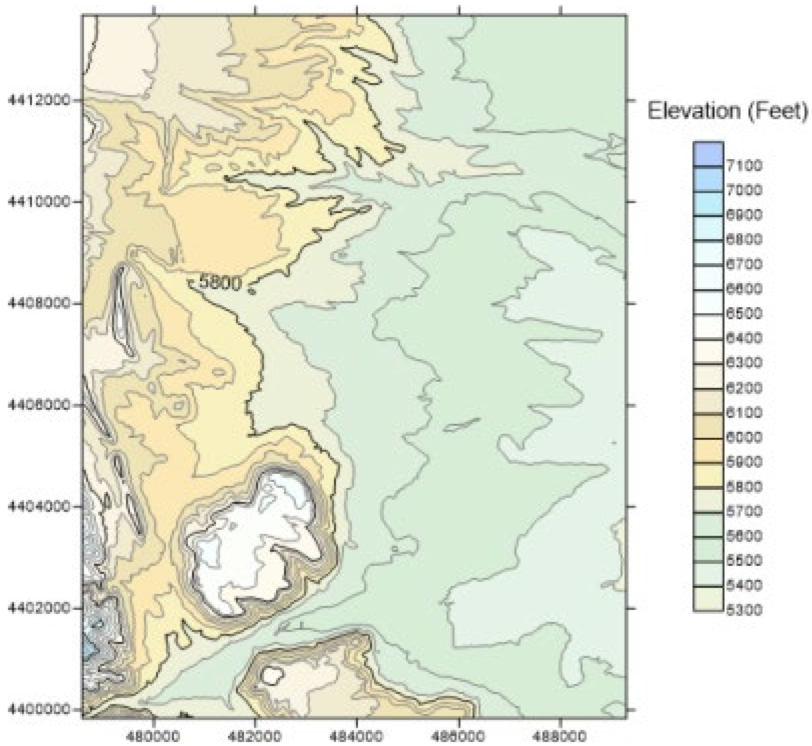
The contour map is displayed with a partially transparent fill color.

Adding and Editing a Color Scale

Color scales are legends that show the fill colors. Color scales are available for contour, 3D wireframe, 3D surface, color relief, and vector maps. The color scale displays the colors assigned to levels in a filled contour map or 3D wireframe, the colors used in a color relief map or 3D surface, and the fill assigned to vector symbols. Let's add a color scale and color scale title to the contour map

1. Click on the *Contours-Golden.grd* contour layer to select it. The properties are displayed in the **Properties** window.
2. Click on the Levels tab in the **Properties** window.
3. Click the ⊞ next to *Filled Contours* to open the *Filled Contours* section, if it is not already open.
4. Select the box next to *Color scale*. A default color scale is created. A new *Color Scale* object is added to the **Contents** window.
5. Click on *Color Scale* in the **Contents** window to select it.
6. In the **Properties** window, click on the **General** tab to edit the color scale properties.
7. Click the ⊞next to *Title* to open the *Title* section, if it is not already open.
8. Click in the empty box next to *Title text.*
9. In the *Title text* field, type *Elevation (feet)*.
10. Press ENTER. The title is added with the default settings.
11. Change the title position by clicking the current selection next to *Position*. Select *Top* from the *Position* list.

Notice the color scale title moves to the top of the color scale, and the text orientation automatically changes to horizontal. The color scale has the same opacity as the contour layer when transparency is applied to the contour layer *Fill colors* colormap.

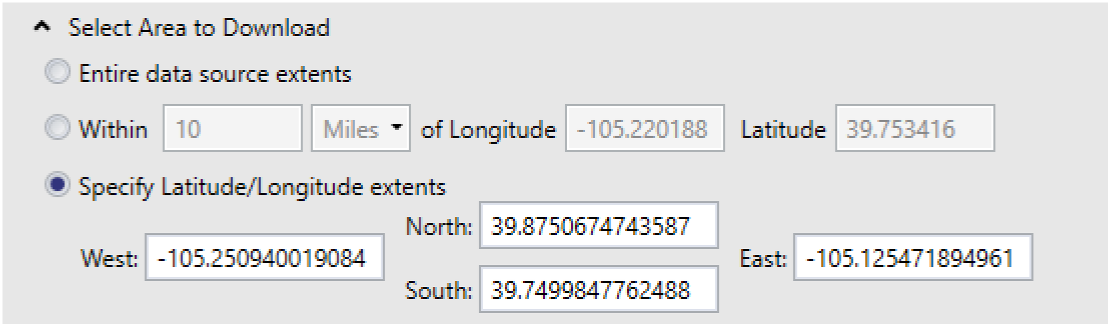


The map and color scale object are shown in this image.

Downloading an Online Base Map Layer

A base map layer can be added below the existing semi-transparent contour layer to enhance the map's appearance. To add a base map layer from an online server,

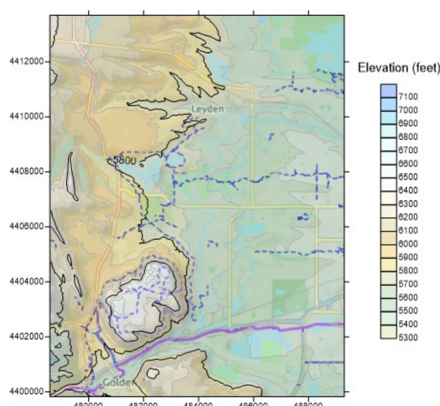
1. Click anywhere on the map to select it.
2. Click the **Home | Add to Map | Layer | Base from Server** command to download an image base map from an online server. The Download Online Maps dialog is displayed. **Surfer** can download base layers from WMS, OSM, and WFS servers. **Surfer** can also download grids from WCS servers.
3. In the **Download Online Maps** dialog, click the ▷ next to *OpenStreetMapsImagery*.
4. Click the *OpenCycleMap* server in the *OpenStreetMaps Imagery* category. A preview is displayed in the preview section.
5. Notice *Specify Latitude/Longitude Extents* is selected, and the values are set to the boundaries of the *Map*. When the map coordinate system is a geographic or projected system and the **Home | Add to Map | Layer | Base from Server** command is used, the area to download will be automatically set to the map extents.



The Specify Latitude/Longitude extents values are automatically filled with the extents of the selected map.

6. For the tutorial, we will use the default setting in the *Select Image Resolution to Download* section.
7. Click *OK* and the base layer downloads. The base layer is automatically placed behind the contour layer. If a **Surfer Warning** dialog appears prompting you to adjust the map limits, click *No*.

Increasing the image resolution will increase the download size when retrieving layers with the **Download Online Maps** dialog. With some servers such as the *OpenCycleMap* server, increasing the resolution will also return a different layer than the one displayed in the preview. Feel free to experiment with different resolutions by repeating steps 2 through 9 and selecting a higher or lower resolution in step 7. You will need to hide previous base layers to view the new one. In the **Contents** window, clear or select the check box next to the *Contours-Golden.grd* or *Base(raster)-OpenCycleMap* layers to toggle the visibility of the maps on and off.



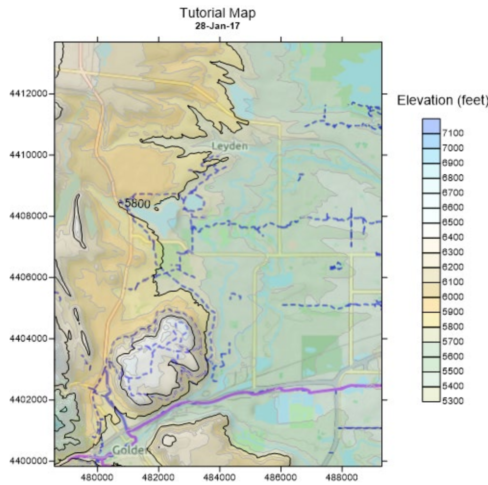
The base map is visible behind the partially transparent contour map.

Adding a Map Title

Adding a title to a map is a great way to stay organized and create publication quality maps.

1. Click once on the *Top Axis* in the **Contents** window to select it.
2. In the **Properties** window, click on the General tab.
3. Click the next to *Title*, if the section is not already open.
4. In the box next to *Title text*, click the button to open the Text Editor. The **Text Editor** provides more control over the text appearance than the **Properties** window.
5. Type *Tutorial Map*and press the ENTER key on the keyboard.
6. On the second line, we will use a dynamic predefined math text instruction to insert the current date. Click the button.
7. In the Date/Time Format Builder dialog, select the desired date/time format in the *Predefined date/time formats* list. For instance, select *dd-MMM-yy*.
8. Click *Insert* next to the selected date/time format in the *Predefined date/time formats* list. Notice the format in the *Date/Time format* field updates to the selected format.
9. Click *OK* in the **Date/Time Format Builder** dialog. Today's date is added to the **Text Editor**.
10. Select the date in the **Text Editor** by double-clicking the date or by clicking and dragging across the date.
11. Click the button to make the highlighted text bold.
12. Select the *Tutorial Map* text.
13. Change the *Size (points)* to 14. The size is located immediately to the right of the font name.
14. Click the center justification button to center the text.
15. Click *OK* to close the **Text Editor**.

The map is automatically updated with the new map title. Save the project if you wish. We will open a new plot window in the next lesson.



This map contains a semi-transparent contour layer on top of a base layer. A color scale and title were added to the map.

Lesson 9 – Creating Maps from Different Coordinate Systems

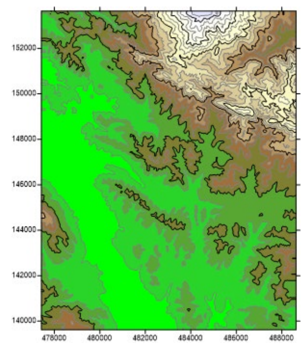
Map layers from different coordinate systems can be created in the same map frame. **Surfer** converts the source coordinate system for each map layer to the target coordinate system for the entire map. The axes display the target coordinate system. A coordinate system is method of defining how a file's point locations display on a map. Different types of coordinate systems exist that control how the coordinates are shown on the map. In **Surfer**, a map can be unreferenced in local coordinates, referenced to a geographic lat/long coordinate system, or referenced to a known projection and datum.

Creating the First Map

First, we will create a map with a defined coordinate system in **Surfer**:

1. Click the **File | New | Plot** command to open a new plot window.
2. Click **Home | New Map | Contour** to create the map with a contour layer.
3. In the **Open Grid** dialog, click on the *Diablo.grd* file from **Surfer's** *Samples* folder. If you are not in the *Samples* folder, browse to it. By default, the *Samples* folder is located in C:\Program Files\Golden Software\Surfer.
4. Click *Open*. The contour map is created.
5. Click on *Contours-Diablo.grd* in the **Contents** window to select the contour layer.

6. Click the Levels tab in the **Properties** window. Set the interval, fill, and contour lines properties for the contour map using the methods described in Lesson 3 and Lesson 8.
7. In the **Properties** window, click on the Coordinate System tab. Note that the contour map layer was imported with a coordinate system already specified. This map layer is in the *State Plane 1927 - California III (Meters)* coordinate system.



The first map layer is created with a predefined coordinate system.

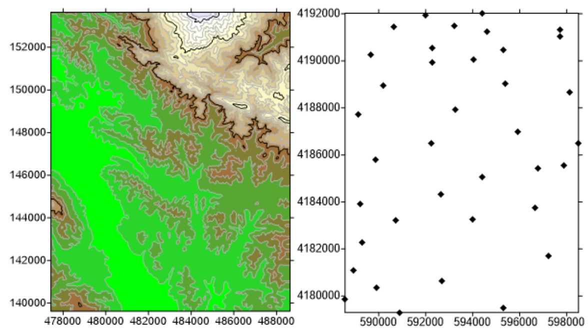
Adding a Post Map Layer

Maps can be created without predefined coordinate systems and assigned the correct coordinate system in the layer properties.

1. Create a new post map with the **Home | New Map | Post** command.
2. In the **Open Data** dialog, select the *Diablo Example.dat* file in the **Surfer***Samples* directory. If you are not in the *Samples* folder, browse to it. By default, the *Samples* folder is located in C:\Program Files\Golden Software\Surfer.
3. Click *Open*.
4. Click on the *Map* in the **Contents** window that contains the post map to select it.
5. Click and drag the map in the plot window to move the post map. Move the post map until the two maps are side by side. Note that the axes on the two maps have very different coordinates.
6. Click on *Post-Diablo Example.dat* in the **Contents** window to select the post layer.
7. In the **Properties** window, click on the **Coordinate System** tab. Note that the post map does not have a predefined coordinate system.
8. Click the *Set* button to define the coordinate system for the post map. The Assign Coordinate System dialog is displayed. Since we know this coordinate system, we can set it.
9. We can use the search bar to reduce the number of projections listed in the **Assign Coordinate System** dialog, since we know the map

coordinate system. In the *Search for text or EPSG code* box, type *UTM Zone 10N*.

10. Press ENTER or click the button.
11. In the **Assign Coordinate System** dialog, click the ⊞ next to *Predefined* to open the *Predefined* section.
12. Click the ⊞ next to *Projected Systems* to open the *Projected Systems* section.
13. Click the ⊞ next to *UTM* to open the *UTM* section.
14. Click the ⊞ next to *North America* to open the *North America* section.
15. Click on the *North America NAD27 UTM Zone 10N* coordinate system to select it.
16. Click *OK*. On the **Coordinate System** tab, the post layer shows the defined coordinate system next to *Name*.



The two maps are displayed side by side with very different coordinates displayed on the axes.

17. In the **Contents** window, click and drag the *Post-Diablo Example.dat* layer into the *Map* just above the *Contours-Diablo.grd* map layer. The two map layers are now overlaid. You can see the posted symbols are located on the contour lines, despite the different coordinate systems.

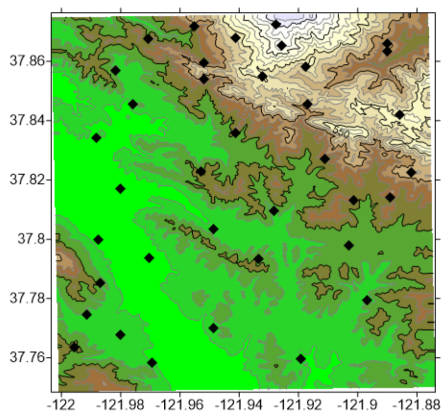
Setting the Target Coordinate System for the Map

The target coordinate system is the system displayed in the plot and on the map axes. Once all map layers are defined, the target coordinate system can be changed to any desired coordinate system.

1. Click on the *Map* object in the **Contents** window.
2. In the **Properties** window, click on the Coordinate System tab.
3. Click the *Change* button.
4. In the **Assign Coordinate System** dialog, click the ⊞ next to *Predefined* to open the *Predefined* section.
5. Click the ⊞ next to *Geographic (lat/lon)* to open the *Geographic (lat/lon)* section.

6. Click on *World Geodetic System 1984* near the bottom of the list to select it.
7. Click *OK*.

The map now has a different coordinate system than either the contour or post map layers on the **Coordinate System** page. Notice that the axes are now showing latitude and longitude values as well. In the above section, we did not use the search function in the **Assign Coordinate System** dialog. When searching in the **Assign Coordinate System** dialog, the search string must exactly match a portion of the desired coordinate system name or EPSG code. However, the search string does not need to be the complete name or EPSG code. For example, searching for *System 1984* will return the *World Geodetic System 1984* coordinate system, but searching for *World 1984* returns no results.



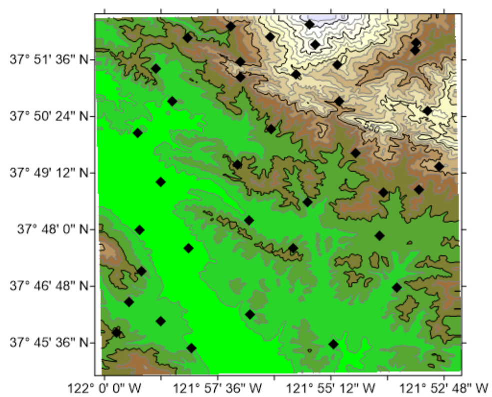
The map axes now display latitude and longitude coordinates.

Changing the Axis Label Format

The axis labels can be displayed in a variety of number formats. We will change the axis labels to Degrees, Minutes, Seconds format.

1. Click on the *Left Axis* object in the **Contents** window.
2. In the **Properties** window, click on the **General** tab to view the General page.
3. Click the ⊞ next to *Labels* if the *Labels* section is not already open.
4. Click the ⊞ next to *Label Format* to view the *Label Format* properties.
5. Click the current selection next to *Type* and select *DMS (Lat/long)* from the list.
6. Click on the *Bottom Axis*object in the **Contents** window.
7. Repeat steps 2 through 5 for the *Bottom Axis*.

The axis labels are now in Degrees, Minutes, Seconds format. Many additional edits can be made to the map. You can continue to experiment with the various coordinate systems or editing any portion of the map layers.



The final map contains two overlaid layers, each with different source coordinate systems. The axis labels are in Degrees, Minutes, Seconds format.

Tutorial Complete

Congratulations! You have completed the **Surfer** tutorial. The remaining tutorial lessons are optional advanced lessons. It is recommended that you complete the optional lessons, because these lessons provide additional information about how **Surfer** works. If you have questions, try looking for answers in the online help, and online knowledge base. If you find you still have questions, do not hesitate to contact Golden Software's technical support team.

Getting Help

Within **Surfer**, the help file is opened by clicking the **Home | Help | Help** command or the help button in the upper right corner of the ribbon. You can also quickly search the help by typing a term in the command and help search above the ribbon and clicking *Search help file* in the results. Alternatively, press F1 at any time to open the help. You can navigate help using the **Contents**, **Index**, **Search**, and **Favorites** pages in the navigation pane to the left of the topic page.

Context-Sensitive Help

To obtain context-sensitive help about dialogs or highlighted commands:

- Find the function of commands by hovering the cursor over the command and pressing F1.

- Click the ? button, the *Help* button, or press F1 in dialogs to open the help topic pertaining to that dialog.
- Press SHIFT + F1 on your keyboard, then click a command or screen region to view information regarding that item.

Internet Help Resources

There are several Internet help resources.

- Use the **File | Feedback** commands to send an Information Request, Problem Report, or Suggestion by email.
- Search our website at www.goldensoftware.com or use the **File | Online** commands for additional help, including the Golden Software Home Page, Surfer Product Page, and Frequently Asked Questions.
- The Golden Software support website has a variety of resources including training videos, a blog, a user image gallery, and a variety of downloads.
- The **Surfer** web help can be viewed in a browser window by navigating to surferhelp.goldensoftware.com.

Technical Support

Golden Software’s technical support is free to registered users of Golden Software products. Our technical support staff is trained to help you find answers to your questions quickly and accurately. We are happy to answer all of your questions about any of our products, both before and after your purchase. We also welcome suggestions for improvements to our software and encourage you to contact us with any ideas you may have for adding new features and capabilities to our programs.

Technical support is available Monday through Friday 8:00 AM to 5:00 PM Mountain Time, excluding major United States holidays. We respond to email and fax technical questions within one business day. When contacting us with your question please have the following information available:

- Your **Surfer** product key
- Your **Surfer** version number, found in File | About Surfer
- The operating system you are using (Windows 7, 8, 10 or higher)
- The steps taken to produce your problem
- The exact wording of the first error message that appears (if any)

If you cannot find the answer to your question in online help, the quick start guide, or on our web page FAQs or KB, please do not hesitate to contact us:

Phone: 303-279-1021

Fax: 303-279-0909

Email: surfersupport@goldensoftware.com

Web: www.goldensoftware.com

Mail: Golden Software, LLC, 809 14th Street, Golden, Colorado, 80401-1866, USA

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