surfer® 12

Powerful Contouring, Gridding & 3D Surface Mapping

Full User's Guide

Golden Software, Inc.

Surfer® Registration Information

Your **Surfer** serial number is located on the CD cover or in the email download instructions, depending on how you purchased **Surfer**.

Register your **Surfer** serial number online at www.GoldenSoftware.com. Or, complete the *Registration Form.PDF*, located in the main directory of the installation CD. Return the *Registration Form.PDF* by mail or fax. This information will not be redistributed.

Registration entitles you to free technical support, free minor updates, and upgrade pricing on future **Surfer** releases. The serial number is required when you run **Surfer** the first time, contact technical support, or purchase **Surfer** upgrades.

For future reference, write your serial number on the line below.

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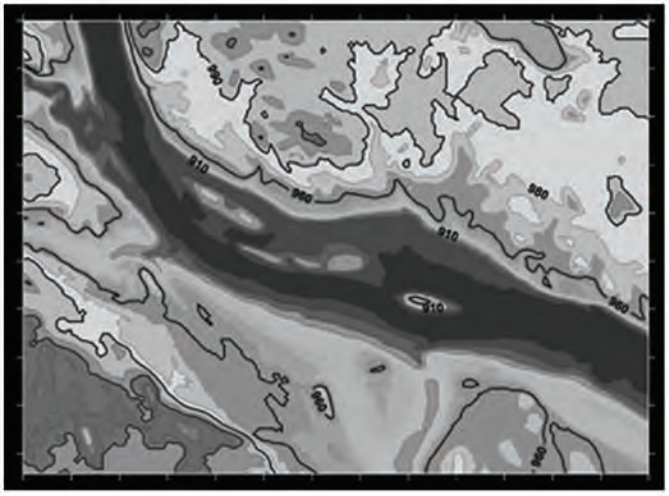
Surfer®

User's Guide

Powerful Contouring, Gridding,
and Surface Mapping



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Chapter 1

Introducing Surfer

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. Maps can be displayed and enhanced in **Surfer**. Adding multiple map layers, customizing the map display, and annotating with text creates publication quality maps. Virtually all aspects of your maps can be customized to produce exactly the 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, vector, image, shaded relief, watershed, 3D surface, and 3D wireframe maps. 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 gather 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 themselves can be edited, combined, filtered, sliced, queried, and mathematically transformed. For example, you can create an isopach map from two grid files. You will need the original surface grid file and the surface grid file after a volume of material was removed. Subtract the two surfaces to create an isopach map. The resulting map displays how much material has been removed in all areas.

The **Scripter™** program, included with **Surfer**, is useful in 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.

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.

New Features

This is an overview of some of **Surfer 12's** new features.

User Friendly

- Save in **Surfer** 11 or **Surfer** 12 .SRF format for easier sharing between versions.
- Added the *Trackball* command to right-click menu for easier rotation of maps.
- New modern interface appearance schemes.
- Zoom to the cursor location using the mouse.
- Added new larger predefined page sizes to the **Page Setup** dialog.
- Set a printer option to get the paper size from the **Page Setup** dialog.
- Rename individual objects in a base layer without entering the group.
- 150 new complex line styles.
- New logarithmic colormap options.
- Display color scale and labels using logarithmic or linear values.
- Press ALT+ENTER on the keyboard to access the **Property Manager**.
- Press ALT+F11 on the keyboard to access the **Object Manager**.

Map Features

- Set the units and numeric format for the **Map | Measure** command.
- Base Maps
    - Download base maps from online map servers from WMS servers
    - Rename individual objects in a base map layer without entering the group.
- Contour Maps
    - Set the contour label font and format properties when using the Simple *Level Method*
    - Added a Logarithmic contour map *Level Method*
    - Minor contour lines default color is now 30% Black, to quickly differentiate major and minor contours on the map.
- Post Maps and Classed Post Maps
    - Set the symbol color for post maps from a worksheet column.
    - Use a colormap to link values in the worksheet with colors in the colormap for post maps.
    - Display multiple labels on post maps.
    - Connect points in a post map with a line.
    - Use Date/Time data for post map creation.
    - Use 3D DXF files as XYZ data for post map creation.
- Classed Post Maps
    - Apply a color gradation to classed post map symbol colors.
    - Apply a size gradation to classed post map symbol sizes.
    - Change symbols for all classes at once.
    - Display multiple labels on classed post maps.
    - Connect points in a classed post map with a line.
    - Use Date/Time data for classed post map creation.
    - Use 3D DXF files as XYZ data for classed post map creation.
- Image Maps
    - Increased the number of discrete colors for image map layers to 16 million (from 254). This creates better color definition with large number of bins in a CLR file.

- Watershed Maps
    - Change line properties for watershed map basin boundary lines.
- Axes
    - Reverse axis direction to make descending axes.
    - Format axis labels using Date/Time labels.

Gridding Features

- Grid data using linear or logarithmic options.
- Create a buffer around the convex hull of the data when gridding.
- Use Date/Time data for gridding or post map creation.
- Use 3D DXF files as XYZ data for gridding or post map creation.

Drawing and Boundary Editing Features

- Smooth polylines and polygons.
- Thin or simplify polylines and polygons.
- Added an option to disable the OpenGL acceleration on the video card. This is used in rare circumstances where the top of a 3D surface map is black or gives errors when creating the 3D surface map.
- Improved the classed post map color/symbol CLS file format to include line and fill color separately.

Data Features

- Import data in Excel XLSM format.
- Import data from SP1 and SEG file formats.
- Import DXF AutoCAD Drawing Data file formats into a worksheet.
- Set worksheet cells to use date/time formats in the Format Cells dialog.
- Flip or transpose columns to rows and rows to columns.
- Round data with the **Data | Transform** *Round* equation.
- Calculate values in the worksheet with the PI expression in **Data | Transform**.
- Added a percentage number format for easier conversion of data.
- Added a new \n math text directive to create new lines.

- Treat empty cells as blank, as the number zero, or as an empty text string when transforming data.
- Treat text strings as blank, as text, as the number zero, or convert to a number (if possible) when transforming data.
- Treat numbers as blank, as text, as the number, or as an empty text string when transforming data.

Import and Export Improvements

- Export multiple maps and non-map objects to a single coordinate system for raster export.
- Export multiple maps and non-map objects to a single coordinate system for vector export.
- Create georeferenced base maps from warped images with correct rotation, skew, distortion, warp, and coordinate system.
- Import SP1 and SEG file formats.
- Export SP1 and SEG file formats.
- Import Adobe PDF raster file formats.
- Import GeoPDF format in raster PDF files
- Import JPEG2000 file formats.
- Export JPEG2000 file formats.
- Export SVG file formats.
- Import HGT SRTM Elevation Data grid file formats.
- Import netCDF NC Network Common Data Form grid file formats.
- Export netCDF NC Network Common Data Form grid file formats.
- Improved DXF AutoCAD Drawing import to allow data DXF files to import in a worksheet.
- Improved GIF file format to export with transparent background.
- Improved ZMap Grid file import to handle additional non-standard fields.
- Improved KML export to have all symbols export to a single GIF.
- Improved ESRI ADF grid file import to read mult-tiled datasets.
- Improved the Geosoft grid file import to read compressed grid formats.
- Improved LiDAR LAS data file filtering.

Automation

- Added a Transform3 command to transform worksheet data with various options for empty cells, text cells, and numeric cells.

Projections, Coordinate Systems, and Datums

- New Projections
- New Coordinate Systems
    - Albany Grid 1984 (Australia)
    - Albany Grid 1994 (Australia)
    - Australia New South Wales ISG (Integrated Survey Grid)
    - Australian Grid, 37 new coordinate systems
    - Barrow Island and Onslow Grid 1994
    - Broome Grid 1984
    - Broome Grid 1994
    - Busselton Coastal Grid 1984
    - Busselton Coastal Grid 1994
    - Carnarvon Grid 1984
    - Carnarvon Grid 1994
    - Christmas Island Grid 1984
    - Christmas Island Grid 1994
    - Cocos (Keeling) Islands Grid 1992
    - Cocos (Keeling) Islands Grid 1994
    - Collie Grid 1994 (Australia)
    - Esperance Grid 1984
    - Esperance Grid 1994
    - European 1950 (Portugal/Spain variant) - UTM Zone 29N
    - Exmouth Grid 1984
    - Exmouth Grid 1994
    - Geraldton Coastal Grid 1984
    - Geraldton Coastal Grid 1994
    - Goldfields Grid 1984
    - Goldfields Grid 1994

- Hartebeesthoek / Lo, 10 new zones
- Idaho Transverse Mercator 1927 (IDTM27)
- Idaho Transverse Mercator 1983 (IDTM83)
- Irish Transverse Mercator (ITM)
- Jurien Coastal Grid 1984
- Jurien Coastal Grid 1994
- Kalbarri Grid 1994
- Karratha Grid 1984
- Karratha Grid 1994
- Kununurra Grid 1984
- Kununurra Grid 1994
- Lancelin Coastal Grid 1984
- Lancelin Coastal Grid 1994
- Margaret River Coastal Grid 1984
- Margaret River Coastal Grid 1994
- Mount Eden Circuit 2000
- Mount Eden Circuit 1949
- NZGD2000, 28 new circuits
- Perth Coastal Grid 1984
- Perth Coastal Grid 1994
- Portuguese National Grid, Greenwich Meridian
- Portuguese National Grid, Lisbon Meridian
- Portuguese National Grid, Lisbon Meridian (zero easting/northing)
- POSGAR 94 - Argentina
- POSGAR 98 - Argentina
- Port Hedland Grid 1984
- Port Hedland Grid 1994
- SVY21 / Singapore TM
- Sweden - SWEREF99 TM
- SWEREF99 local zones
- SWEREF99 / RT90 emulation zones

- New Datums
    - IRENET95
    - Lisbon 1937 (Lisbon Meridian)
    - NWS-84
    - Posiciones Geodesicas Argentinas 1994 (WGS84 base)
    - Posiciones Geodesicas Argentinas 1998 (WGS84 base)
    - SVY21 (WGS84 base)
    - Sweden - SWEREF99
- New Ellipsoids
    - NWS-84 Sphere

System Requirements

The minimum system requirements for **Surfer** are:

- Windows XP SP2 or SP3, Vista, 7, 8, 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 12** requires logging onto the computer with an account that has Administrator rights. Golden Software does not recommend installing **Surfer 12** over any previous version of **Surfer**. **Surfer 12** can coexist with older versions (i.e. **Surfer 11**) as long as they are installed in different directories. By default, the program directories are different. For detailed installation directions, see the Readme.rtf file.

Installing Surfer

To install **Surfer** from a CD:

1. Insert the **Surfer** CD into the CD-ROM drive. The installation program automatically begins on most computers. If the installation does not begin automatically, double-click on the Autorun.exe file located on the **Surfer** CD.
2. Click *Install **Surfer*** from the **Surfer Auto Setup** dialog to begin the installation.

To install **Surfer** from a download:

1. Download **Surfer** according to the directions you received.
2. Double-click on the downloaded file to begin the installation process.

Updating Surfer

To update your version of **Surfer**, open the **Surfer** program and choose the **Help | 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** (i.e. **Surfer 12.0** to **Surfer 12.1**), you will be prompted to download the update.

You can also email your registered **Surfer 12** serial number to **Surfer**support@goldensoftware.com and request to download the full product update. See the *Check for Update* help topic for additional information.

Uninstalling Surfer

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

Windows XP

To uninstall **Surfer**, go to the Control Panel and double click on *Add/Remove Programs*. Select **Surfer 12** (or **Surfer 12 Demo** for the demo version) from the list of installed applications. Click the *Remove* button to uninstall **Surfer**.

Windows Vista

To uninstall **Surfer** when using the *Regular Control Panel Home,* click the *Uninstall a program* link. Select **Surfer 12** (or **Surfer 12 Demo** for the demo version) from the list of installed applications. Click the *Uninstall* button to uninstall **Surfer**.

To uninstall **Surfer** when using the *Classic View*, go to the Control Panel and double click on *Programs and Features*. Select **Surfer 12** (or **Surfer 12 Demo** for the demo version) from the list of installed applications. Click the *Remove* button to uninstall **Surfer**.

Windows 7

To uninstall **Surfer** go to the *Windows Control Panel* and click the *Uninstall a program* link. Select **Surfer 12** (or **Surfer 12 Demo** for the demo version) from the list of installed applications. Click the *Uninstall* button to uninstall **Surfer**.

Windows 8

From the *Start* screen, right-click the **Surfer 12** tile (or **Surfer 12 Demo** tile for the demo version) 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 12** tile (or **Surfer 12 Demo** tile for the demo version) and click *Uninstall* at the bottom of the screen.

Surfer Demo Functionality

The **Surfer** demo version is a fully functioning read-only demo. This means that most commands work exactly as the command works in the full program. Saving, exporting, printing, and copying are disabled in the demo version.

The demo has no further restrictions on use. Any data set or image can be used to create any project. All properties can be changed in the demo version. The demo does not have a “time-out period” so will not expire after a certain number of hours or days of use. The demo can be installed on any computer that meets the system requirements.

A Note about the Documentation

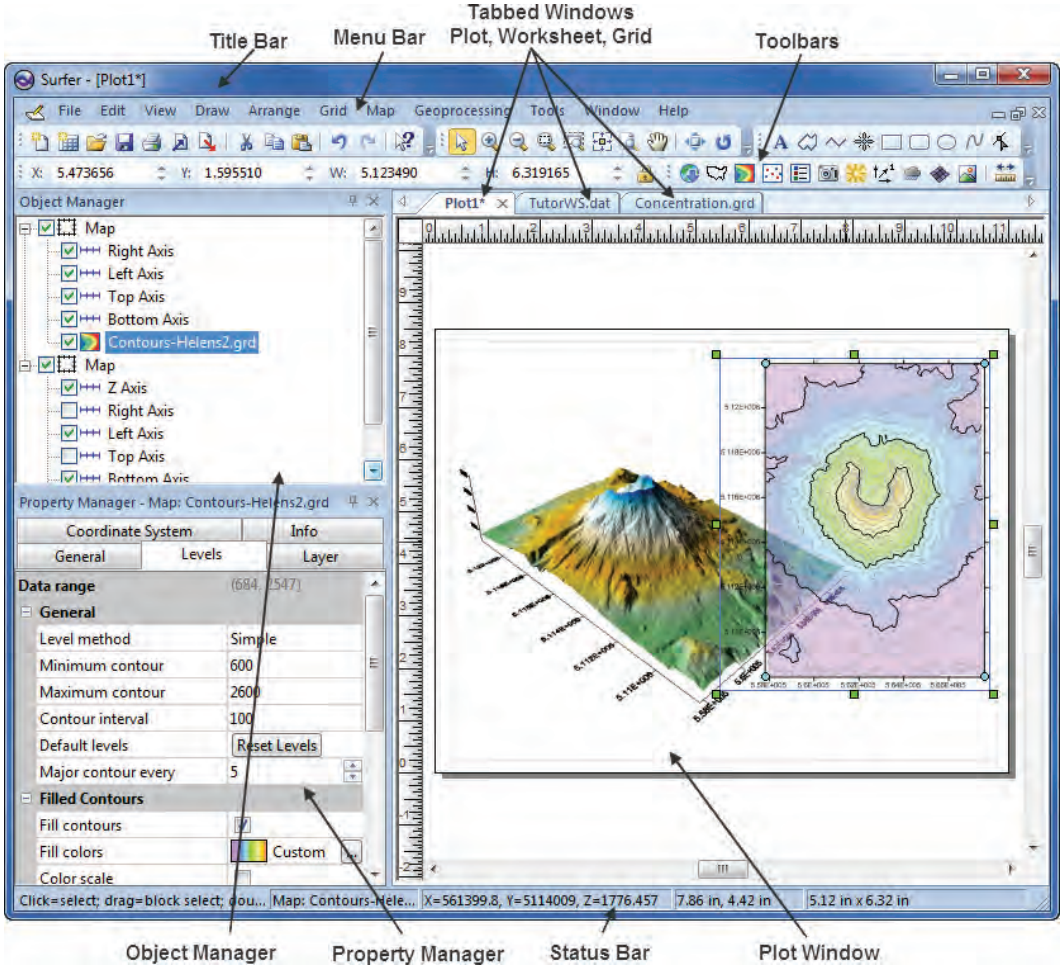
The **Surfer** documentation includes the online help and the quick start guide. Use the **Help | Contents** command in the program to access the detailed online help. Information about each command and feature in **Surfer** is included in the online help. In the event the information cannot be located in the online help, other sources of **Surfer** help include our support forum, FAQs, knowledge base, and contacting our technical support engineers.

Various font styles are used throughout the **Surfer** documentation. **Bold** text indicates menu commands, dialog names, and page names. *Italic* text indicates items within a dialog such as group names, options, and field names. For example, the **Save As** dialog contains a *Save as type* list. Bold and italic text occasionally may be used for emphasis.

In addition, menu commands appear as **File | Open**. This means, "click on the **File** menu at the top of the document, then click on the **Open** command within the **File** menu list." The first word is always the menu name, followed by the commands within the menu list.

Surfer User Interface

Surfer contains three document window types: the plot document, worksheet document, and grid node editor. Maps are created and displayed in the plot document. The worksheet document displays, edits, transforms, and saves data in a tabular format. The grid node editor displays and edits Z values for the selected grid.



*This is the **Surfer** plot window with the **Object Manager** on the left, the worksheet and grid node editor tabs on the top of the horizontal ruler.*

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.
Menu Bar	The menu bar contains the commands used to run **Surfer**.
Tabbed Documents	**Surfer** supports tabbed documents. Multiple plot documents, worksheet documents, and grid node editor documents can be tabbed.
Toolbars	The toolbars contain **Surfer** tool buttons, which are shortcuts to menu commands. Move the cursor over each button to display a tool tip describing the command. Toolbars can be customized with the **Tools | Customize** command.
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 pointer map coordinates and units, the pointer page coordinates, and the dimensions of the selected object. The status bar also indicates the progress of a procedure, such as gridding. The percent of completion and time remaining will be displayed
Object Manager	The **Object Manager** contains a hierarchical list of all the objects in a **Surfer** plot document displayed in a tree view. The objects can be selected, added, arranged, and edited. Changes made in the **Object Manager** are reflected in the plot document, and vice versa.
Desktop	The area behind the plot, worksheet, and grid node editor.
Border	The edge of the plot, worksheet, grid node editor, or application windows.

Opening Windows

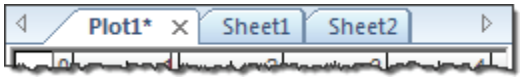
Selecting the **File | Open** command opens any of the three window types, depending on the type of file selected. The **File | New | Plot** command creates a new plot window. The **File | New | Worksheet** command creates a new worksheet window.

Selecting and Closing Windows

To select a tab to view, click the tab name. To close a tab, right-click and select *Close* or click the X next to the tab name. If unsaved changes are present in the document, you will be prompted to save the changes before the file is closed.

Unsaved Changes

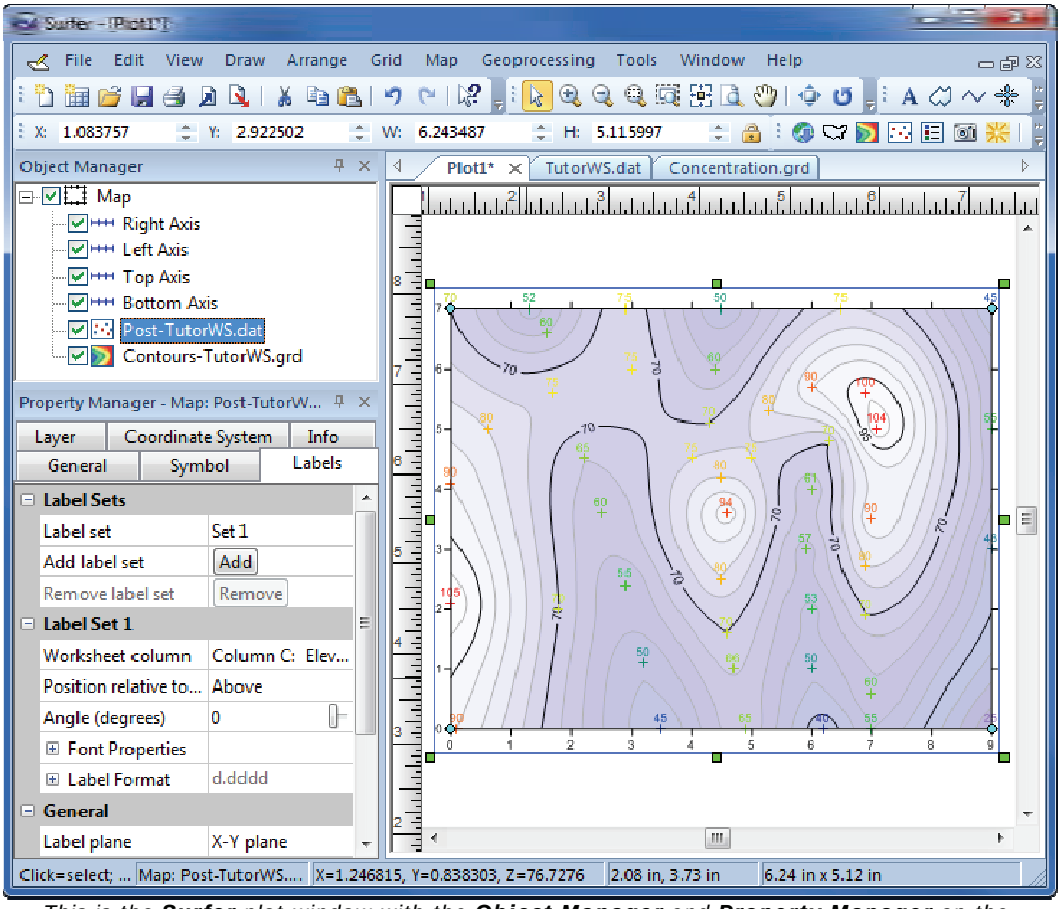
When a document contains unsaved changes, an asterisk (*) appears next to its tabbed name. The asterisk disappears once the unsaved changes have been saved.



The Plot1 *tab has unsaved changes, indicated by the (*) asterisk. The* Sheet1 *and* Sheet2 *tabs do not have saved changes.*

Plot Document

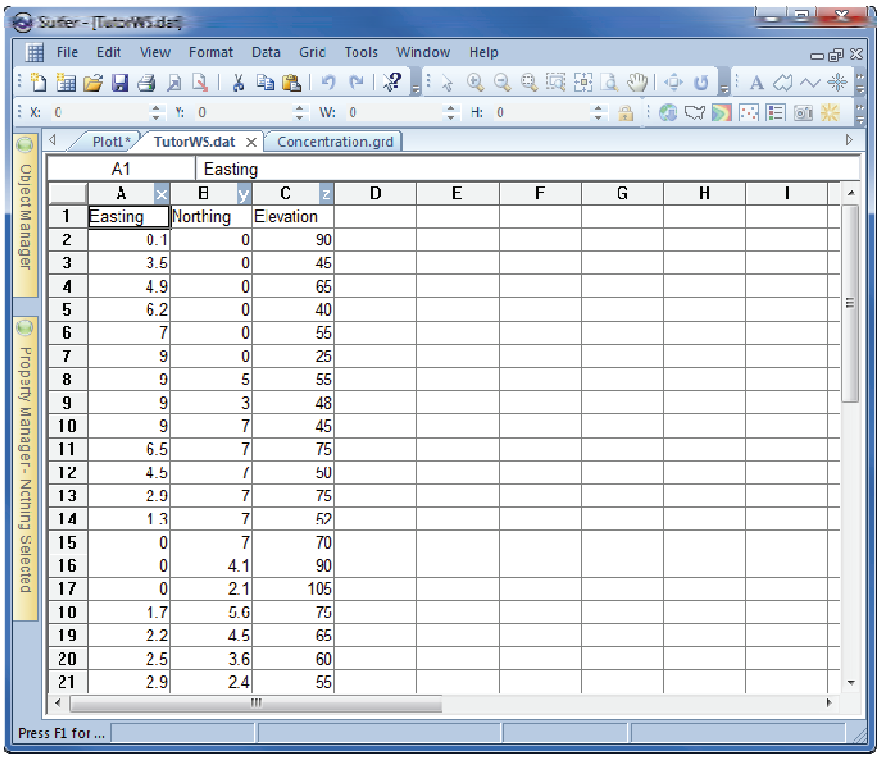
Plot windows contain the commands for creating and modifying grid files, and for creating all types of maps. When you first start **Surfer** you are presented with an empty plot window.



*This is the **Surfer** plot window with the **Object Manager** and **Property Manager** on the left, the plot, worksheet, and grid node editor tabs at the top of the horizontal ruler.*

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. Several import and export options are available for opening data files from other spreadsheet programs.



	A	B	C	D	E	F	G	H	I
1	Easting	Northing	Elevation						
2	0.1	0	90						
3	3.6	0	46						
4	4.9	0	65						
5	6.2	0	40						
6	7	0	55						
7	9	0	25						
8	9	5	55						
9	9	3	48						
10	9	7	45						
11	6.5	7	75						
12	4.5	7	50						
13	2.9	7	75						
14	1.3	7	52						
15	0	7	70						
16	0	4.1	90						
17	0	2.1	105						
18	1.7	5.6	75						
19	2.2	4.5	65						
20	2.5	3.6	60						
21	2.9	2.4	55						

*This is the **Surfer** worksheet document with the **Object Manager** and **Property Manager** in auto hide mode on the left, and the plot document and grid node editor tabs at the top of the worksheet.*

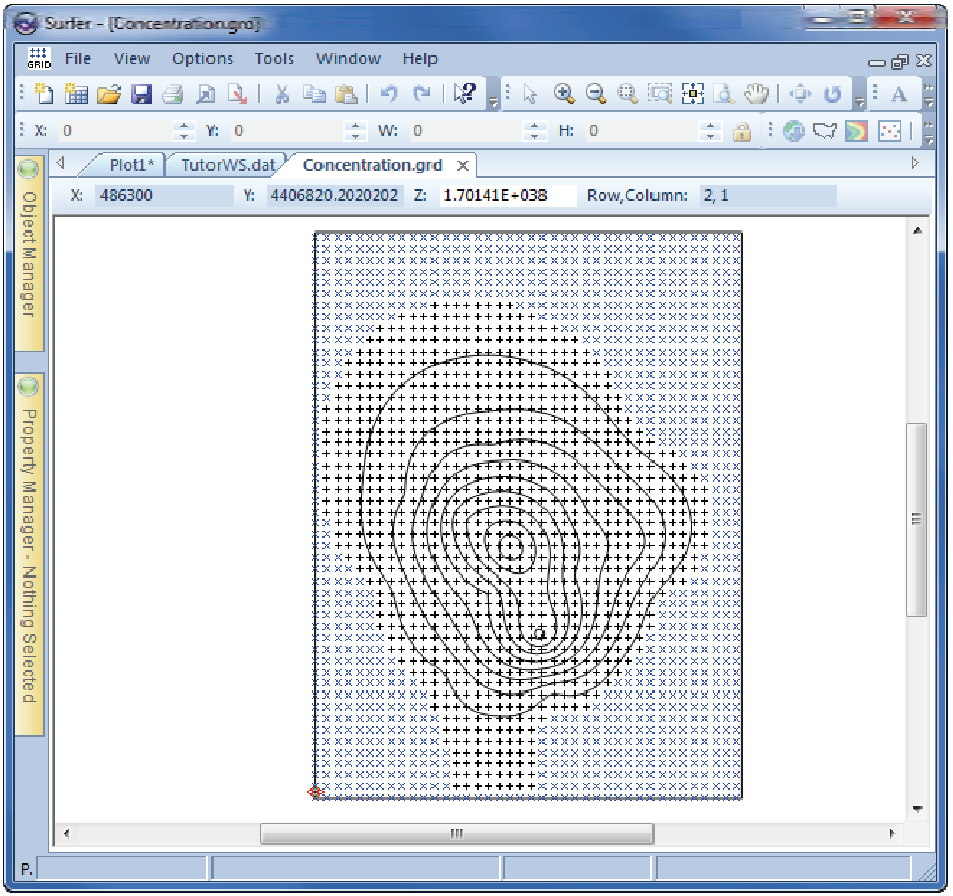
Grid Node Editor

The **Grid | Grid Node Editor** command opens the grid node editor as a new document.

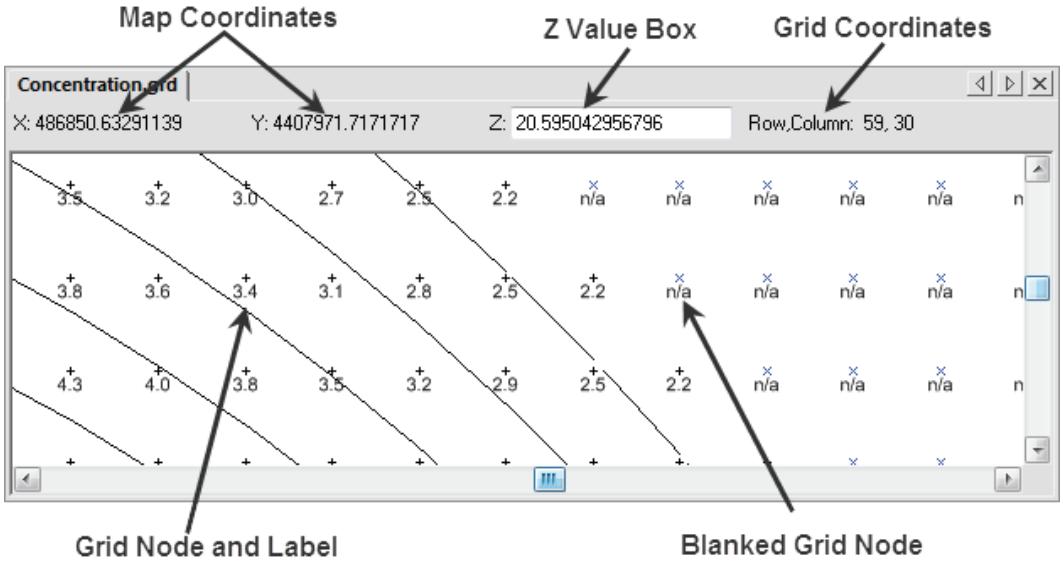
The grid node editor allows you to change or blank Z values at individual grid nodes in a grid file. Each grid node is indicated with a "+" in the grid editor window by default. Each blanked grid node is indicated with a blue "x" by default. The active node is

highlighted with a red diamond. To move between grid nodes, press the arrow keys, or click a node to make it the active node.

The active node XY map coordinates and grid coordinates are displayed at the top of the window, and the Z value is given in the Z box. You can enter a new Z value for the selected grid node into the box. Press ENTER, an arrow key, or click another node to enter the new value into the grid. The contour map is redrawn with your change when the **Options | Show Contours** menu option is selected. You can save the edited grid file with the same name or a different name.



*This is the **Surfer** grid node editor with the **Object Manager** and **Property Manager** in auto hide mode on the left and the plot document and worksheet document tabs at the top of the grid node editor.*



The grid node editor modifies individual grid nodes in a grid file.

Component Name	**Component Definition**
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 "+" in the grid editor window by default.
Grid Coordinate	The location of the active node, specified by row and column number.
Map Coordinate	The X and Y coordinates of the active node.
Z Value Box	The Z coordinate of the active node. You can enter a new Z value for the selected grid node into the box. Press ENTER, an arrow key, or click another node to enter the new value into the grid. The contour map is redrawn with your change when the **Options | Show Contours** menu option is selected.

Object Manager

The **Object Manager** contains a hierarchical list of the objects in a **Surfer** plot document displayed in a tree view. The objects can be selected, arranged, and edited in both the **Object Manager** and through the plot document menu commands. Changes made in the **Object Manager** are reflected in the plot document, and vice versa.

Opening and Closing the Object Manager

The **Object Manager** is opened and closed from the **View | Managers | Object Manager** command, or by clicking the button. Alternatively, you can click on the button in the title bar of the **Object Manager** to close the window or use the **View | Managers | Object Manager** command to turn the manager off. You can also right-click on the **Object Manager** title bar and select **Hide**. To activate the **Object Manager**, click inside the **Object Manager** or press ALT+F11 on the keyboard.

Auto Hide the Object Manager

You can increase the plot document space by minimizing the **Object Manager** with the *Auto Hide* feature. To hide the manager, click on the button in the upper right corner of the **Object Manager**.

*Click on the autohide button to display the **Object Manager** as a tab.*

The manager hides on the left, top, or right side of the plot window as a small tab labeled **Object Manager**.

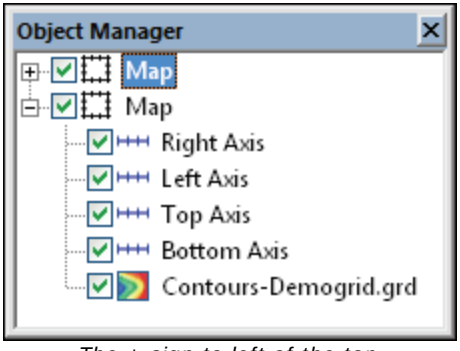
To view the contents of the **Object Manager** while in tab view, place the cursor directly over the tab. Click in the window to keep it open for use. Click outside the window to return it to the hidden position. Click on the button to return it to the

normal display mode. Alternatively, right-click the **Object Manager** title bar and select **Auto Hide**. You can also drag the sides of a floating **Object Manager** to change the size of the window.

Object Manager 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 contains a map layer (i.e. Contours) plus four axes. To expand the tree, click on the + control, or select the item and press the plus button on the numeric keypad, or press the right arrow key on your keyboard. To collapse a branch of the tree, click on the - control, or select the item and press the minus button on the numeric keypad, or press the left arrow key.

The expansion state of sub-objects in the **Object Manager** is retained in the **Surfer** file .SRF. Use the *Expand new **Object Manager** items* option in the **Options** dialog to control the expansion state of new objects in **Object Manager**.



The + sign to left of the top map indicates it is collapsed. The - sign to the left of the bottom map indicates it is expanded.

Arranging Objects

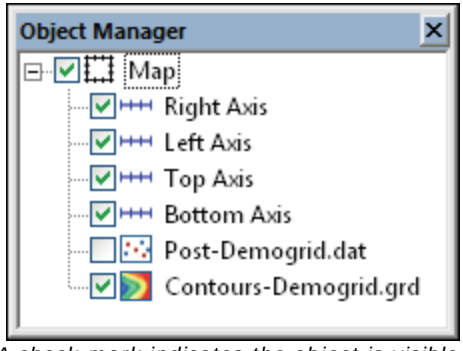
To change the display order of the objects with the mouse, select an object and drag it to a new position in the list above or below an object at the same level in the tree. The pointer changes to a black right arrow if the object can be moved to the pointer location, or a black circle with a diagonal line if the object cannot be moved to the indicated location. Alternatively, select an object and use the **Arrange | Order Objects** command which includes the Move to Front, Move to Back, Move Forward,

and Move Backward options. These menu items are accessed through the plot document **Arrange** menu or by right-clicking on an object in the **Object Manager**.

To change the display order of the map layer objects within a map frame with the keyboard, select an object, hold down the CTRL key, and press the up and down arrow keys to move one step at a time. Hold down the SHIFT key and press the up and down arrow keys to move to the top and bottom of the same branch.

Object Visibility

Each row in the list consists of an button 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. To change the visible status of an object, click on the check box to the left of the object button. A check in the box indicates it is visible; an empty box indicates that the object is not visible. Invisible objects do not appear in the plot window and do not appear on printed output. Note that if a surface is made invisible, the overlays also become invisible.



A check mark indicates the object is visible. In this example, the post map is not visible.

Opening Object Properties

To display the properties for an object, click once on the object in the **Object Manager** or in the plot window. The properties are displayed in the **Property Manager**. To display a context menu of available actions for an object, right-click on that object.

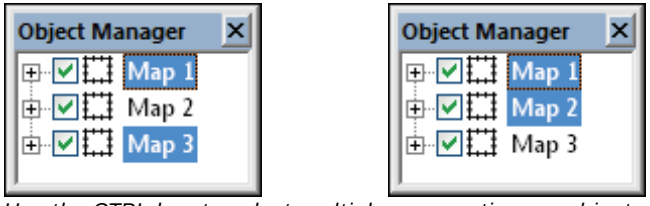
When the **Property Manager** is hidden or closed, double-clicking on an object in the **Object Manager** opens the **Property Manager** with the properties for the selected object displayed.

The map properties control the map's *View, Scale, Limits*, *Frame,* and *Coordinate System*. Each map layer has specific properties that controls the options for the specific map type. Each map axis also has properties.

Selecting Objects

To select an item in the **Object Manager**, 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 **Object Manager** as well. Only one nested object can be selected at a time. For example, it is not currently 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.



*Use the CTRL key to select multiple non-contiguous objects in the **Object Manager**, as on the left. Use the SHIFT key to select multiple contiguous objects in the **Object Manager**, as on the right.*

Scroll in Object Manager

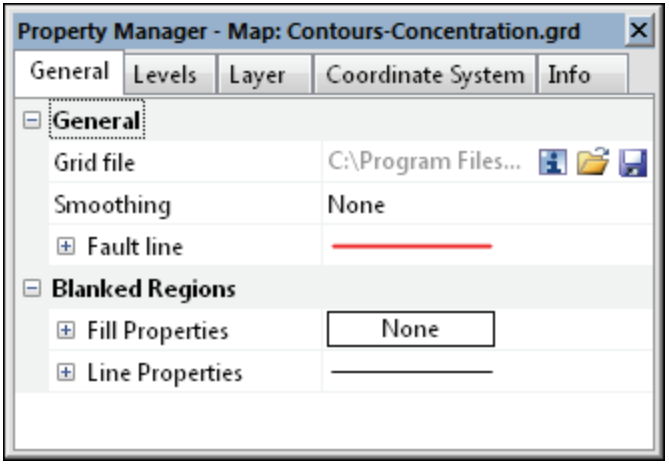
If the list of objects in the **Object Manager** is long, you can use the scroll bar on the side of the **Object Manager** to scroll down to an object. Alternatively, you can use the mouse scroll wheel to scroll down. To scroll down using the mouse, click once in the **Object Manager** to select the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

Property Manager

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

When the **Property Manager** is hidden or closed, double-clicking on an object in the **Object Manager** opens the **Property Manager** with the properties for the selected object displayed. To activate the **Property Manager**, click inside the **Property Manager** or press ALT+ENTER on the keyboard.

For information on a specific feature or property that is shown in the **Property Manager**, refer to the help page for that feature. 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 specific pages for contour map levels or post maps.

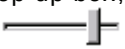


*The **Property Manager** displays the properties associated with the selected object.*

Expand and Collapse Features

Features with multiple options appear with a plus (+) or minus (-) to the left of the name. To expand a group, click on the + icon. To collapse the group, click on the - icon. For example, the expanded *Filled Contours* section contains two options, *Fill contours* and *Color scale*.

Changing Properties

The **Property Manager** displays the properties for selected objects. To change a property, click on the property's value and select a new property from the pop up box, scroll to a new number using the  buttons, select a new value using the  slider, select a new value from the list or palette, or type a property value. For

example, a polyline has *Style, Color, Opacity, Width,* and *End Styles* properties. Changing the *Color* requires clicking on the current color and selecting a new color from the color palette. Changing the *Width* requires highlighting the current width and typing a new number or scrolling to a new number. Changing the *Opacity* requires highlighting the existing percentage and typing a new number or clicking on the slider bar and dragging it to a new value.

You can modify more than one object at a time. Only shared properties are editable when multiple objects are selected. For example, you can right-click on a polyline in the **Object Manager**. Hold the CTRL key and click on a polygon. You can then change the line properties of both objects at the same time. Fill properties, which are available if only a polygon was selected, are not available as the polyline does not have fill properties.

Occasionally, some properties are dependent on your other selections. For example, there is a *Pattern Offset* section on the **Fill** page. This section is only available when an image fill type is selected as the *Pattern.*

Applying Property Manager Changes

Object properties automatically update after you select an item from a palette, press ENTER, or click somewhere else in the **Property Manager**.

Keyboard Commands

To activate the **Property Manager**, press ALT+ENTER on the keyboard. When working with the **Property Manager**, the up and down arrow keys move up and down in the **Property Manager** list. The TAB key activates the highlighted property. The right arrow key expands collapsed sections, e.g., *Filled Contours*, and the left arrow collapses the section.

Property Defaults

Use the **Tools | Options** command to change the default settings. Default settings for rulers, drawing grid, line, fill, text, symbol, label format, and advanced settings that control each map type can be set from the Options dialog.

Property Manager Information Area

If the *Show info area in the* ***Property Manager*** is checked on the **Tools | Options | User Interface** page, a short help statement for each selected command in the **Property Manager**.

Changing the Window Layout

The plot window, toolbars, managers, and menu bar 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 | Toolbars** commands to toggle the display of the toolbars. Alternatively, use the **Tools | Customize** command to open the **Customize** dialog. The **Toolbars** page of the **Customize** dialog displays all of the toolbars. A check mark indicates the toolbar is currently visible. Reset or create new custom toolbars with the **Customize** dialog.

Use the **View | Managers** commands to toggle the display of the **Object Manager** and **Property Manager**. Alternatively, you can click the button in the title bar of the **Object Manager** or **Property Manager** or floating toolbars to close the manager window.

Auto-Hiding Managers

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

*The **Object Manager** appears as a tab on the side of the window.*

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

Size

You can drag the sides of a manager, toolbar, or menu bar to change its size. If a manager is docked, its upper and lower bounds are indicated by a  and  cursor. Move the cursor to change the size.

Position

To change the position of a docked manager, click the title bar and drag it to a new location. A thick light gray rectangle indicates that the manager is floating. To dock the manager, use the docking mechanism. You can also double-click the manager's title bar to toggle between floating and docked modes.

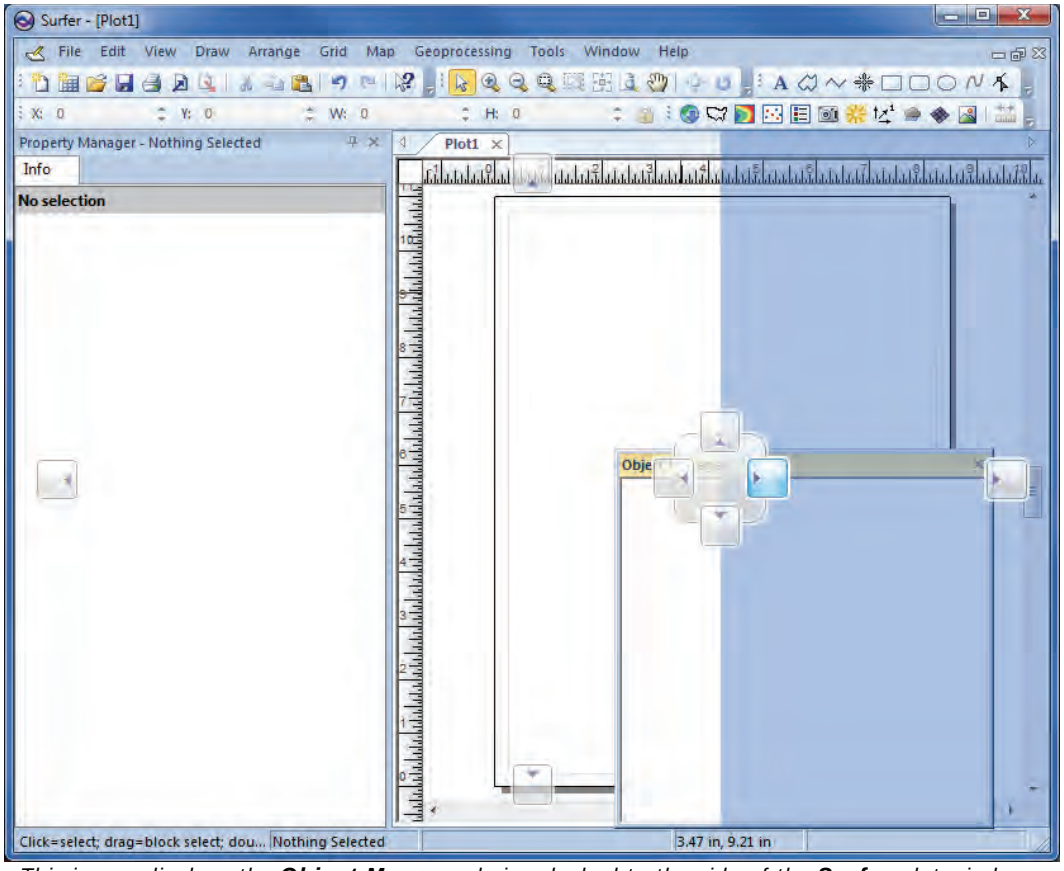
The toolbars and menu bar can also be moved or displayed in floating windows. To dock the toolbar or menu bar in a new location, click the "grip" bar along the toolbar or menu bar edge, hold the left mouse button, and then drag the toolbar or menu bar to a new location. Drag the toolbar or menu bar away from a window edge to display the toolbar as a floating window.

Docking Mechanism

Left-click the title bar of a manager and drag it to a new location while holding the left mouse button. The docking mechanism displays with arrow indicators as you move the manager.

The docking mechanism makes it easy to position managers.

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 manager to be docked in the specified location.



*This image displays the **Object Manager** being docked to the side of the **Surfer** plot window.*

Restoring the Managers and Windows to Their Original Locations

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

Tabbed Documents

The plot window, worksheet window, and grid node editor windows are displayed as tabbed documents. When more than one window is open, tabs appear at the top of the screen, allowing you to click on a tab to switch to that window. The tabs may be dragged to reorder them. When a document contains unsaved changes, an asterisk (*)

appears next to its tabbed name. The asterisk is removed once the changes have been saved.

When viewing in tabbed document mode, the tabs may be dragged to reorder them. Left-click on a tab, hold the left mouse button, drag to a new location, and release the mouse button to move the tab to a new location.

To move to the next tab, you can use the Next command. Alternatively, press CTRL + F6 to move to the next tab. The  and  buttons on the sides of the tabs are used to scroll the tabs should there be more tabs than can fit along the top of the window.

The style of the tab can be changed in **Tools | Options | User Interface**. Select a new tab style from the *MDI tab style* list. Tabs can be turned off in **Tools | Options | User Interface**. Select a *None* from the *MDI tab style* list.

Toolbars

All window types in **Surfer** include toolbars that contain buttons for many common commands. The toolbars are initially docked, but they can be dragged and placed anywhere on the screen.

Show or Hide Toolbars

Use the **View | Toolbars** command to show or hide the *Standard*, *View, Drawing*, *Grid, Position*/*Size*, and *Map* toolbars. A check mark is displayed next to visible toolbars.

Tool Tip Display of Button Function

Hold the cursor over any tool button on the toolbar to display the function of the button. Tool tips cannot be customized. Hold the cursor over the toolbar images to see tool tip examples.

If tool tips do not display, click **View | Toolbars | Customize**. Click on the **Options** tab. Check the box next to *Show ScreenTips on toolbars*. Click *OK.*

Customize Toolbars

Use the **View | Toolbars | Customize** command to open the Customize dialog and customize toolbars, menus, and keyboard shortcuts.

Toolbar Positions

Surfer toolbars can be docked to any side of the window or they can be displayed as a floating window. To dock the toolbar in a new location, click the "grip" bar along the edge of the toolbar, hold the left mouse button, and then drag the toolbar to a new location. Drag the toolbar away from a window edge or hold down the CTRL key while dragging to display the toolbar as a floating window.

Types of Toolbars

Menu Bar

The **Menu** toolbar displays the **Surfer Menu** commands.

*Use the **Menu Bar** toolbar to see menu commands like **File | Save**.*

Standard

The **Standard** toolbar displays commonly used **File** and **Edit** menu commands.

*The **Standard** toolbar has buttons for many of the **File** and **Edit** menu commands.*

Map

The **Map** toolbar displays commonly used **Map** menu commands.

*The **Map** toolbar has buttons for many of the **Map** menu commands.*

Drawing

The **Drawing** toolbar displays commonly used **Draw** menu commands.

*The **Drawing** toolbar has buttons for the **Draw** menu commands.*

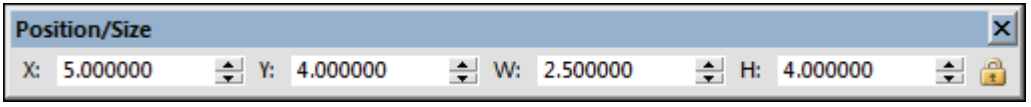
View

The **View** toolbar displays commonly used **View** and **Edit** menu commands.

*The **View** toolbar has buttons for many of the **View** and **Edit** menu commands.*

Position/Size

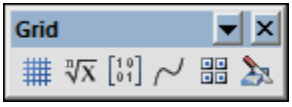
The **Position/Size** toolbar displays the position and size of the current selection in page units. Enter new values in the X, Y, W, or H boxes to edit the position or size of the selected object. The controls allow you to update the position and size of the selected object accurately. Objects can also be locked with the **Position/Size** toolbar.



The Position/Size toolbar displays the X, Y position and width / height of the object.

Grid

The **Grid** toolbar displays commonly used **Grid** menu commands, such as **Grid | Data**, **Grid | Mosaic**, and **Grid | Spline Smooth**.



*The **Grid** toolbar displays commonly used **Grid** menu functions.*

Custom

You can create custom toolbars using the **Tools | Customize** command. You can specify a custom toolbar name and add any command that you commonly use to your custom toolbar.

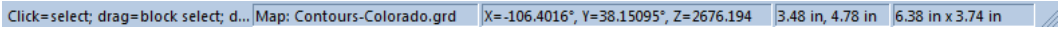
*Custom toolbars can be created for frequently used menu commands with the **Tools | Custom** command.*

Status Bar

Click on **View | Status Bar** to show or hide the status bar. A check mark next to **Status Bar** indicates that the status bar is displayed.

Status Bar Sections

The status bar is divided into five sections. Click on each section in the graphic to display more information about each pane. In the worksheet, the status bar displays tool tips.



The status bar has five sections of information. Click on each section to display detailed information.

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.

A portion of the status bar. The "..." in the left section indicates there is additional text.

A portion of the status bar after making the left section larger. The "..." indicates there is additional text.

Progress

The status bar indicates the progress of a procedure, such as gridding. The percent of completion and time remaining will be displayed.

*The progress of a **Surfer** procedure is shown in the status bar.*

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

The status bar displays 0% when it is indeterminate mode and does not have a time estimate for the task.

Cancel

Click the *Cancel* button on the status bar to abort the current process.

Rulers

Use the **View | Rulers** command, or click the  button to toggle between showing and hiding the rulers on the top and left sides of the main plot window. When the ruler button is depressed, the rulers are shown. **Surfer** will remember your preference to have the ruler on or off when the program restarts.

You can also right-click on a ruler and select **Ruler and Grid Settings** to open the Options dialog.

Drawing Grid

Click the **View | Drawing Grid** command, click the  button, or right-click on the plot window and select *Drawing Grid* to toggle between showing and hiding a grid which is superimposed over the plot window. A check mark beside the command indicates that the grid is displayed. **Surfer** will remember your preference to have the drawing grid on or off when the program restarts.

The drawing grid is a series of evenly spaced dots, similar to graph paper, which is used to help align objects in the plot window.

You can control the number of grid divisions in a page unit by choosing **Tools | Options** and clicking on the Rulers and Grid page.

Reset Windows

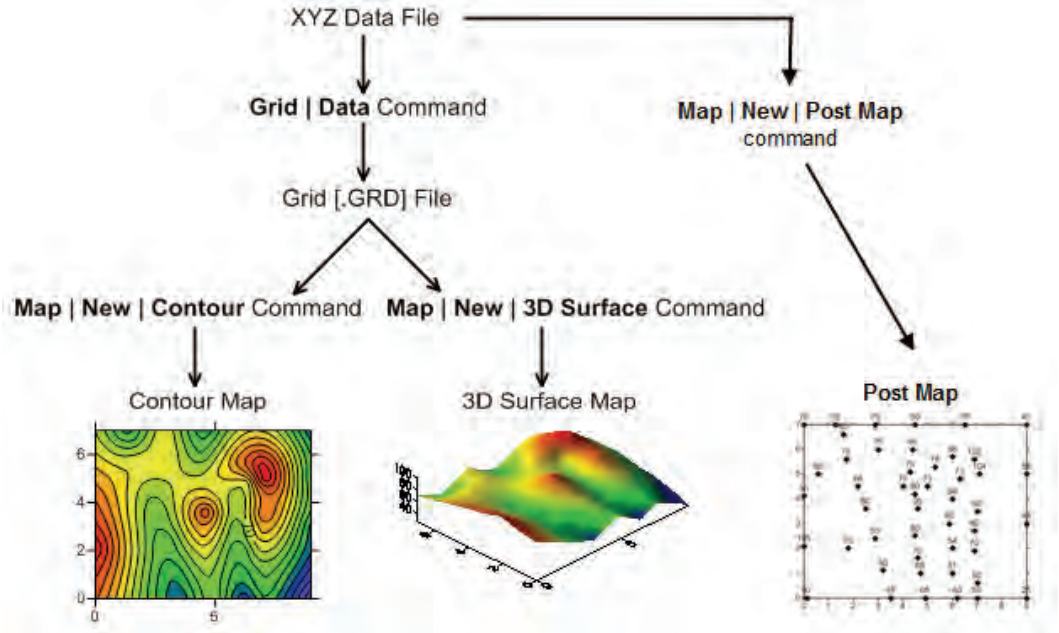
Use the **View | Reset Windows** command to change the display of the program. This command resets the **Object Manager** and **Property Manager** windows back to the default size and position. It also resets all menu customizations and custom shortcuts back to the defaults. In addition, all toolbars are reset to the default location and state.

This command is especially handy if your windows or managers become hidden by mistake.

You must restart **Surfer** in order for this command to take effect. Click *Yes* in the dialog, close the program, and reopen **Surfer**. The managers are now in the default locations.

Surfer Flow Chart

This flow chart illustrates the relationship between XYZ data files, grid files, contour maps, and 3D surface maps. This flow chart can be applied to any grid based map types. This example displays only two of the grid based maps (i.e. contour and 3D surface).



This flow chart illustrates the relationship between XYZ data files, grid files, post maps, contour maps, and 3D surface maps.

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.

Example Surfer Files

To see the example files:

1. Open **Surfer**.
2. Click the **File | Open** command.

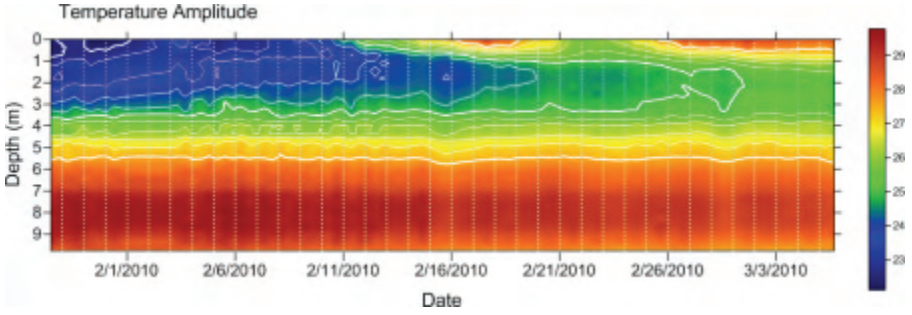
3. In the **Open** dialog, navigate to the **Surfer** Samples folder. By default, the **Surfer** installation folder is located in C:\Program Files\Golden Software\Surfer 12\Samples.
4. Select the sample .SRF file of interest and click *Open*. The sample file is now displayed. Repeat as necessary to see the files of interest.

Overview of Sample Surfer .SRF Files

Below are an image of the sample file and a brief explanation of what the sample file contains. Only four samples are described below. Other examples exist in the help file.

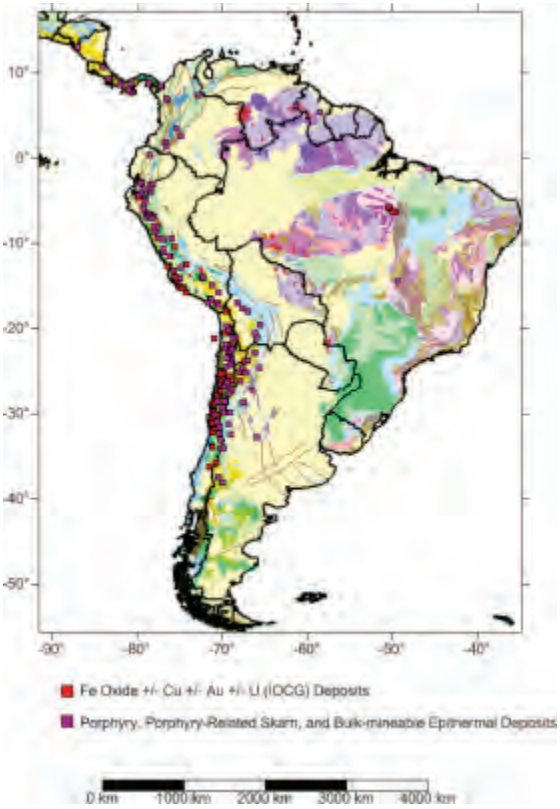
Axes.SRF

The Axes.SRF file contains a contour map layer and image 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.



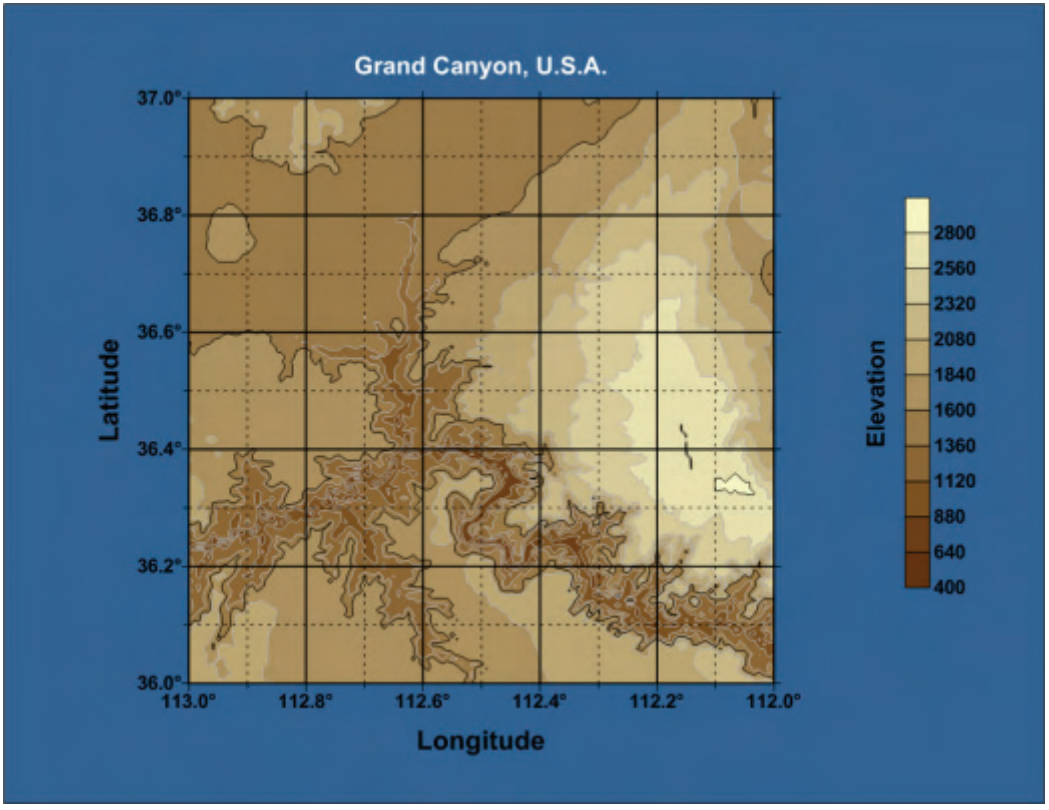
BaseMapFromServer.SRF

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.



Contours.SRF

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.



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 Map menu commands to produce maps. Post maps and base maps do not use grid files.

The general steps to progress from a XYZ data set to a finished, grid-based map are as follows:

1. Create a 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).

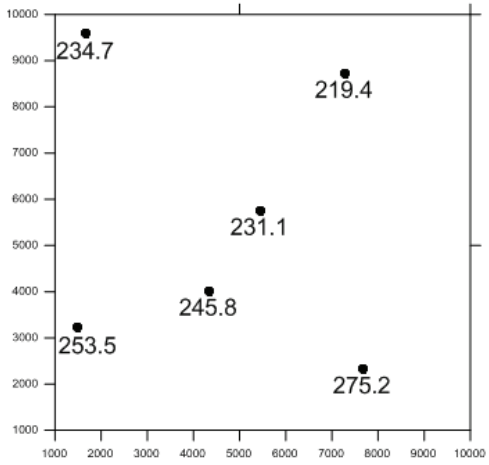
XYZdata.dat

A1 | X Coord.

	A	B	C
1	X Coord.	Y Coord.	Z value
2	1665.4	9567.2	234.7
3	7659.3	2324.6	275.2
4	1499.5	3212.9	253.5
5	5438.1	5753.9	231.1
6	4327.4	4013.9	245.8

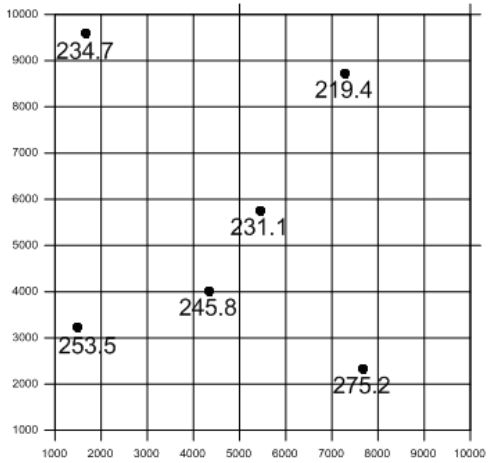
Start with irregular XYZ data in three columns.

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



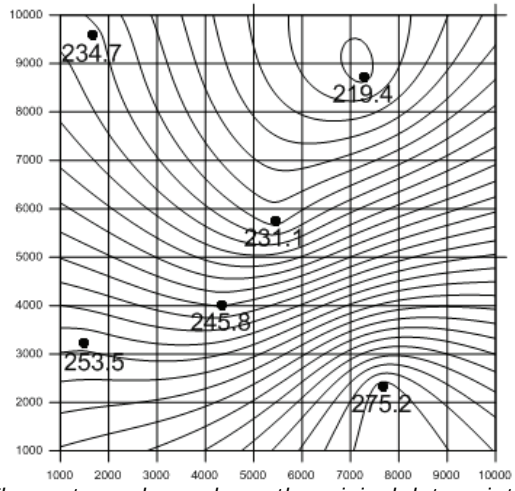
A post map displays the original XYZ data locations.

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



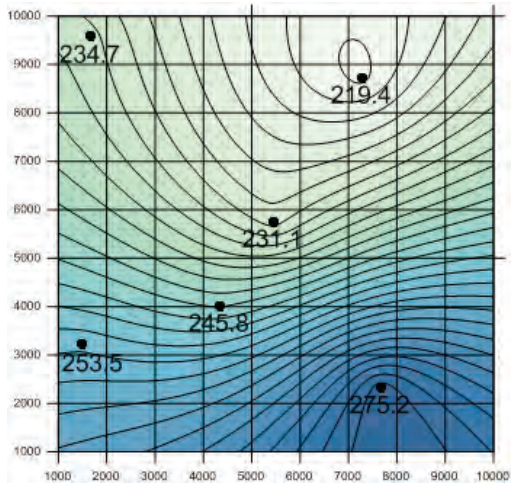
Gridding interpolates a Z value at the intersection of each row and column in the grid file. This fills the holes in the data. Here the rows and columns are represented by grid lines.

4. To create a map, select the map type from the **Map | New** menu commands. Select the grid file from step two. Grid-based maps include contour, image, shaded relief, vector, 3D surface, and 3D wireframe maps.



The post map layer shows the original data points. The contour map layer shows the grid based contour map.

5. Make any changes to the map. Click **File | Save** to save the map as a **Surfer** file .SRF.



The contour map layer is filled with a gradational color fill.

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**. You can do practically everything with a script that you can do manually with the mouse or from your keyboard. 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.

Example Script Files

To run a sample script file:

1. Open **Scripter** by navigating to the installation folder, C:\Program Files\Golden Software\Surfer 12\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** 12\Scripter. Double-click on the Scripter.EXE application file.
2. Choose the **File | Open** command and select a sample script .BAS file. These are located in the C:\Program Files\Golden Software\Surfer 12\Samples\SCRIPTS folder or the C:\Program Files (x86)\Golden Software\Surfer 12\Samples\SCRIPTS folder, if you are running a 32-bit version of **Surfer** on a 64-bit version of Windows.

3. Click the **Script | Run** command and the script is executed.

File Types

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

Data Files

Data files contain the input data provided by the user, and 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 documentation. Data can be read from various file types, and most contain numeric XY location coordinates as well as optional numeric Z values and label information. The Z values contain the variable to be modeled, such as elevation, concentration, rainfall, or similar types of values.

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

Grid Files

Grid files are used to produce several different types of grid-based maps, to perform calculations such as volume, residuals, and grid math, and to carry out blanking, smoothing, and slice operations. Grid files contain a regularly spaced rectangular array of Z data organized in columns and rows. **Surfer** can also use other common grid file types to perform most of the operations that can be performed with grid files.

Boundary Files

Boundary files contain XY location data such as state boundaries, rivers, or point locations. Boundary files are used to create a base map or base map layer on another map. Boundary files can also be used to specify the boundary limits for blanking, faults, breaklines, and slice calculations. Boundary files can be vector files, metafiles, or image files.

Surfer Files

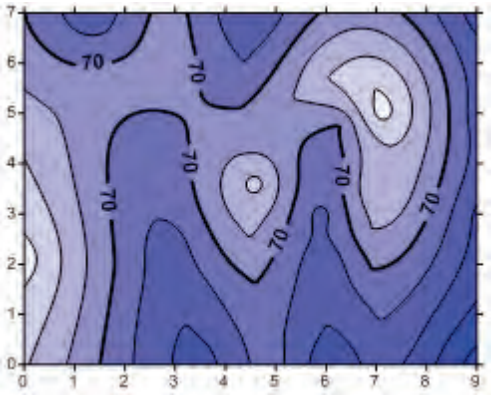
Surfer .SRF files preserve al the objects and object settings contained in a plot window. These files are called **Surfer** .SRF files throughout the documentation. **Surfer 12** can open .SRF files from previous versions of **Surfer 7, 8, 9, 10,** and **11**. **Surfer 12** saves in **Surfer 11** and **Surfer 12** .SRF format. The **Surfer 11** .SRF file

can be opened in **Surfer 11** or **Surfer 12**, but does not contain features that are new in **Surfer 12**. Previous versions of **Surfer** (i.e. **Surfer 11**) cannot open **Surfer 12** .SRF files.

Map Types

Several different map types can be created, modified, and displayed with **Surfer**. These map types include contour, base, post, classed post, image, shaded relief, 1-grid vector, 2-grid vector, watershed, 3D surface, and 3D wireframe maps.

Contour Maps

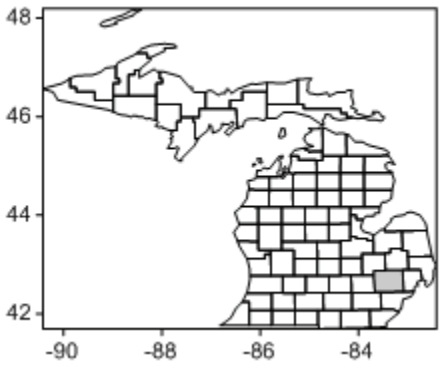


A contour map is a two-dimensional representation of three-dimensional data. Contours define lines of equal Z values across the map extents. The shape of the surface is shown by the contour lines. Contour maps can display the contour lines; they can also display colors and patterns between the contour lines.

Base Map

Base maps display boundaries on a map. Boundaries can include roads, buildings, streams, lakes, etc. Base maps can be produced from several file formats.

Empty Base Maps allow you to create a base map with no objects. Objects can be manually added and removed as needed.



Post Maps

Post maps and classed post maps show data locations on a map. Post symbols and the individual post label positions can be customized. Multiple labels can exist for each symbol in a post or classed post map layer.

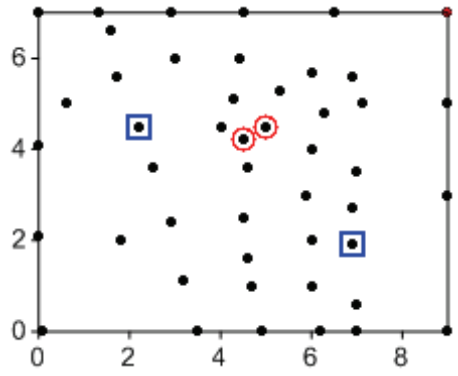
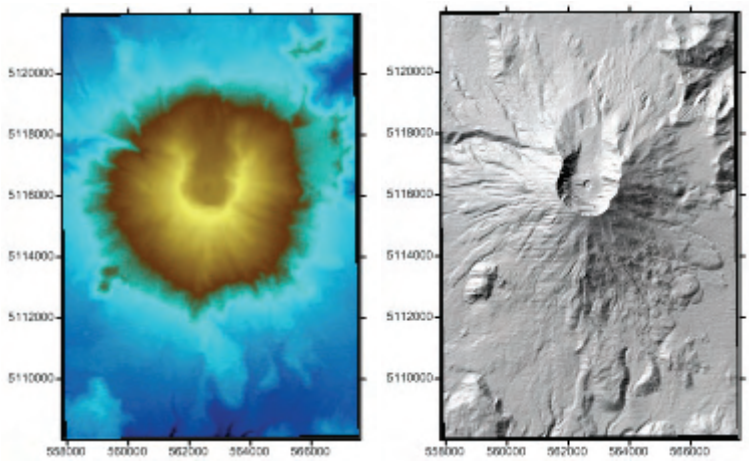


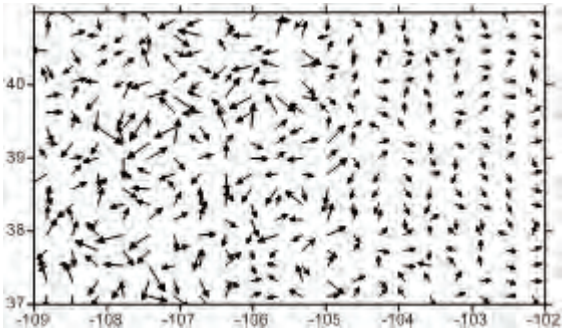
Image Maps and Shaded Relief Maps

Image maps and shaded relief maps are raster images based on grid files. Image maps assign colors based on Z values from a grid file. Shaded relief maps assign colors based on slope orientation relative to a light source.



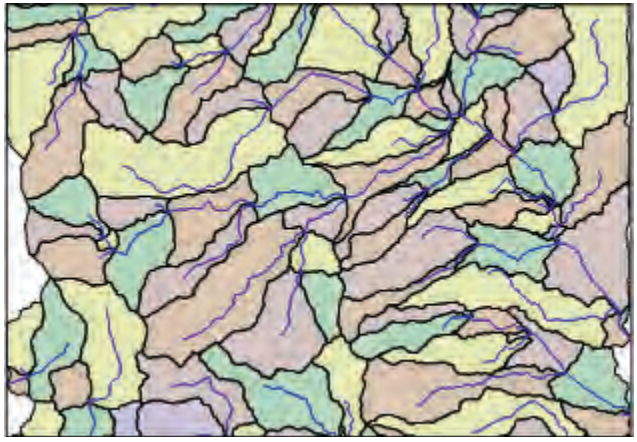
Vector Maps

1-grid and 2-grid vector maps display direction and magnitude data using individually oriented arrows. For example, at any grid node on the map, the arrow points in the direction of steepest descent ("downhill") and the arrow length is proportional to the slope magnitude. In **Surfer**, vector maps can be created using the 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).



Watershed Maps

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.

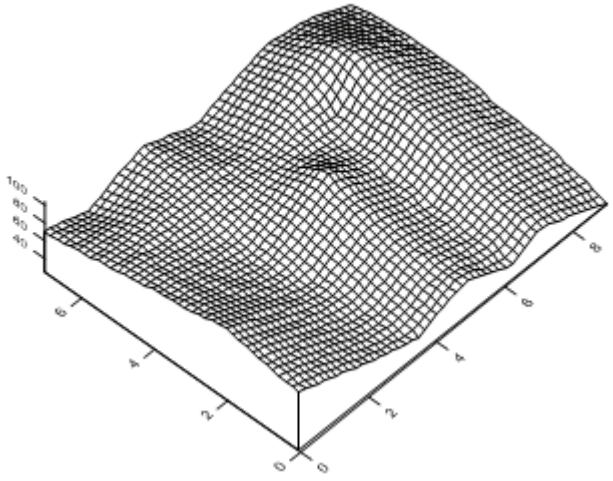


3D Surfaces

Surfaces are three-dimensional color representations of a grid file. The colors, lighting, overlays, and mesh can be altered on a 3D surface.

3D Wireframes

Wireframes are three-dimensional representations of a grid file. A wireframe is created by connecting Z values along lines of constant X and Y. At each XY intersection (grid node), the height of the wireframe is proportional to the Z value assigned to that node. The number of columns and rows in the grid file determines the number of X and Y lines drawn on the wireframe.

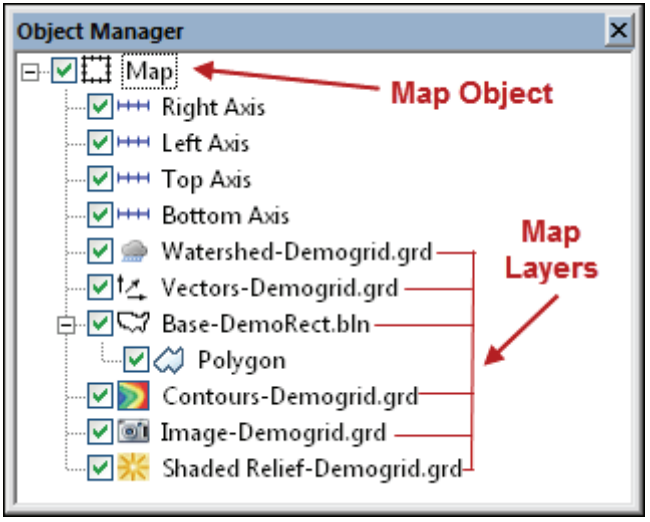


Introduction to Map Layers

A map layer is a single map type contained in a larger map object. The map layer may be a contour map, a post map, a base map, or any other map 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 separately or created in a single map object.

There are multiple ways to overlay map layers in **Surfer**. If you only have two maps with one map layer each, you can drag a map layer from one map object to another map object in the **Object Manager**. If you only have a single map created and need to add map layers to it, you can select the map and use the **Map | Add** command to add a map layer to the existing map. If you have many separate map layers already created, you can select all of the maps and use the **Map | Overlay Maps** command. This moves all of the map layers 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 of contour, base, post, image, shaded relief, vector, or 3D surface maps. Maps can contain only one 3D wireframe layer, however.



This one map object contains six map layers. There is a watershed layer, vector layer, base layer, contour layer, an image layer, and a shaded relief layer.

Using Map Layers

When you use map layers, the layers use a single set of X, Y, and Z axes and the maps are positioned according to the map object coordinate system. If two or more maps use the same limits, they will overlay on top of one another. If maps cover adjacent areas, adding a map layer places them in the correct position relative to one another and creates a single set of axes that span the entire range. Layered maps become a single object and are moved and scaled as a single entity.

Consider a contour map and a base map that displays the outline of a lake on the contour map. The limits of the base map are the X, Y extents of the lake and are not the same as the contour map limits. If you create both the base map and the contour map in a single plot window as separate maps by using the **Map | New** command for both maps, they do not overlay correctly because the maps have different scaling. In addition, each map uses a different set of X, Y axes. The two maps can be overlaid to correctly position the lake on the contour map by dragging the base map layer to the other map object that has the contour layer. The result will be a map object with a base map layer and contour map layer. Alternatively, if you create the contour map and then added a base map layer with the **Map | Add | Base Layer** command, the two maps are automatically scaled and combined into a single map using a single set of axes. The lake is correctly positioned on the contour map.

Layers and 3D Wireframes

When you layer a contour, post, or base map on a 3D wireframe, the maps are draped over the wireframe. The wireframe is drawn in the usual fashion but the base, vector, or contour maps are "molded" over the top of the wireframe lines. Hidden lines are not removed from maps layered on wireframes. For example, contour lines are not hidden when the contour map lies over a wireframe.

Layers and 3D Surfaces

When you layer maps on top of 3D surface maps, hidden lines are removed and the maps are "molded" on the surface. Surface maps and images, vector files, and even other surface maps can be overlaid onto a single map object. The Overlays page in the surface properties dialog contains options for handling color in these cases.

Layer Exceptions

The **Map | Add** command allows you to add a map layer to the selected map. Most combinations of map types can be layered. The exceptions are combining a 3D wireframe and 3D surface map, adding a raster map layer to a wireframe, and adding multiple wireframe layers. Raster maps include shaded relief maps, image maps, surfaces, and base maps containing an image. The options under the **Add** command

change to fit the existing map. For example, if a 3D wireframe map is selected, the **Map | Add | 3D Surface Layer** command is grayed out.

Method 1: Adding a Map Layer to an Existing Map Frame

1. Create a new map with the **Map | New** command. For example, you can choose **Map | New | Contour Map** to create a contour map.
2. Select the map and use the **Map | Add** command to add a map layer. Select the map layer type to add to your existing map. For example, select the contour map and use the **Map | Add | Post Layer** command to add a post map layer to the contour map.
3. The maps are combined in the correct position based on their coordinates and limits. For example, in the **Object Manager**, you will see one map object with a contour map layer and a post map layer.

Method 2: Overlaying Two Existing Map Layers

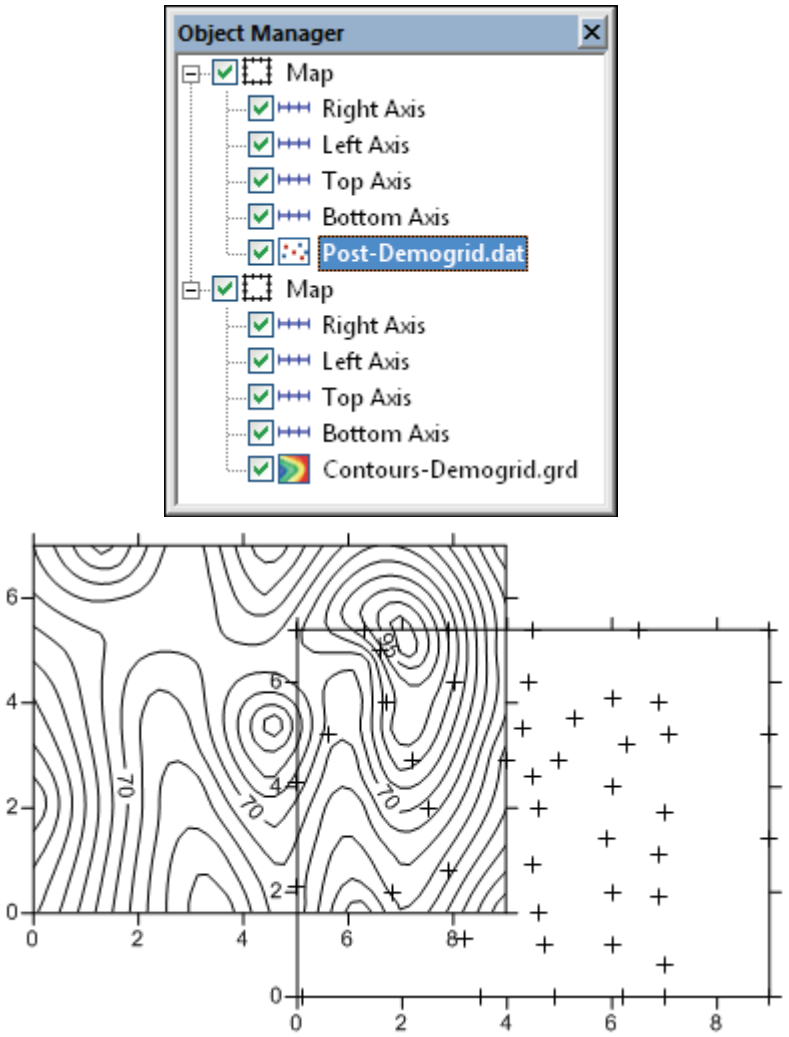
1. Create a map with the **Map | New** command. For example, you can click **Map | New | Contour Map** to create a contour map.
2. Create a second map with the **Map | New** command. You could create a post map with the **Map | New | Post Map** command.
3. Note that each map has an independent set of axes.
4. Click **Edit | Select All** to select both the contour and post maps.
5. Click **Map | Overlay Maps**. The two maps are combined onto a single map object with a single set of axes. The empty map object is automatically deleted.

This method works well when you have multiple map layers that you want to combine.

Method 3: Combining Two Existing Map Layers in the Object Manager

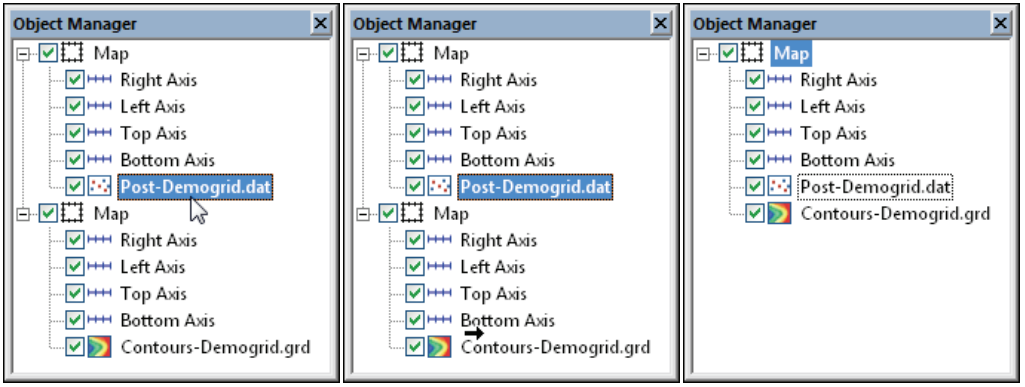
If two maps already exist, you can move (or overlay) a map layer from one map frame into the other map frame by dragging and dropping in the **Object Manager**.

1. Create a map with the **Map | New** command. For example, you can choose **Map | New | Contour Map** to create a contour map.
2. Create a second map with the **Map | New** command. You could create a post map with the **Map | New | Post Map** command.
3. Note that each map has an independent set of axes.



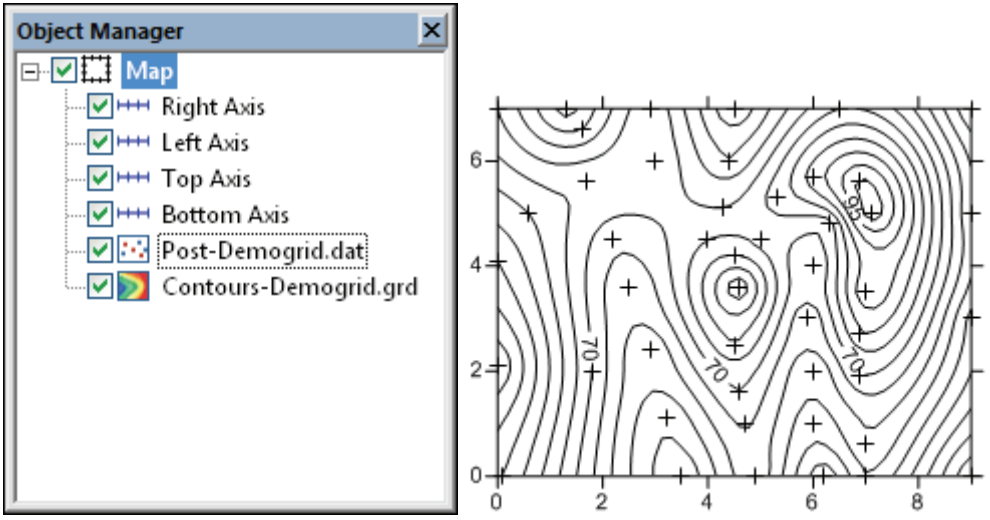
*The contour map layer and the post map layer are displayed in separate map objects in the **Object Manager** and the plot window.*

2. Select the post map layer in the **Object Manager** and drag it to the contour map object. To do this, left-click and hold the left mouse button while you drag the map layer to a new map frame. When the cursor changes to a horizontal arrow, release the left mouse button and the map layer is added to the contour map's map frame. The post map will now be overlaid on the contour map. An empty map frame may remain after removing the last map layer from the map object, depending on your options.



First left-click and select the post map layer (left), then drag the post map layer to the other map object. When the cursor is a horizontal arrow (middle), release the mouse button to drop the map layer in the new location (right).

3. If an empty map frame exists, select the empty map frame and press DELETE on the keyboard to remove the empty map frame. The end result is a single map object with two map layers: a post map layer and a contour map layer. Additional map layers can be added with the **Map | Add** command.



The result of this method is one Map object with two map layers.

Layer Map Limits

If a map layer is added to a map frame and the map layer exceeds the current map limits, a **Surfer** warning message will be displayed allowing you to adjust the map limits to include all layers. Select *Yes* to adjust the map to include all layers. Select *No* to leave the current map limits.

Editing a Map Layer

To edit individual layers in a multi-layer map, select the map layer (i.e. *Contours*) in the plot window or **Object Manager** and use the **Property Manager** to edit the properties. Make the desired changes in the map layer properties, and the map layer is redrawn with the specified changes.

Hiding a Map Layer

After adding map layers, it is possible to hide one or more of the layers. To temporarily hide a map layer, uncheck the visibility box next to the map layer name (i.e. *Contours*) in the **Object Manager**. The map is redrawn without the selected overlay. To make the overlay visible again, recheck the visibility box. Note that if a surface is made invisible, the overlays are also made invisible.

Removing a Map Layer

Select the map layer and use the **Map | Break Apart Layer** command to remove a map layer from a map object. Alternatively, right-click on the map layer and select **Break Apart Layer**.

Deleting a Map Layer

To delete a map layer from a map frame, select the map layer in the **Object Manager** and press the DELETE key on the keyboard. Alternatively, you can select the map layer and use the **Edit | Delete** command, or right-click the map layer and select **Delete**.

Coordinate System Overview

A coordinate system is a 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 in local coordinates, in a geographic latitude and longitude system, or in a known projection and datum.

A *local coordinate system* is considered unreferenced by **Surfer**. 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. Most maps are created in local coordinate systems. In these cases, you can ignore the options on the **Coordinate System** tab in the **Property Manager**, as long as all map layers contain the same X and Y coordinates.

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.

In **Surfer**, data, grids, map layers, and maps can have an associated coordinate system. All coordinate systems defined by the data, grids, and map 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**.

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

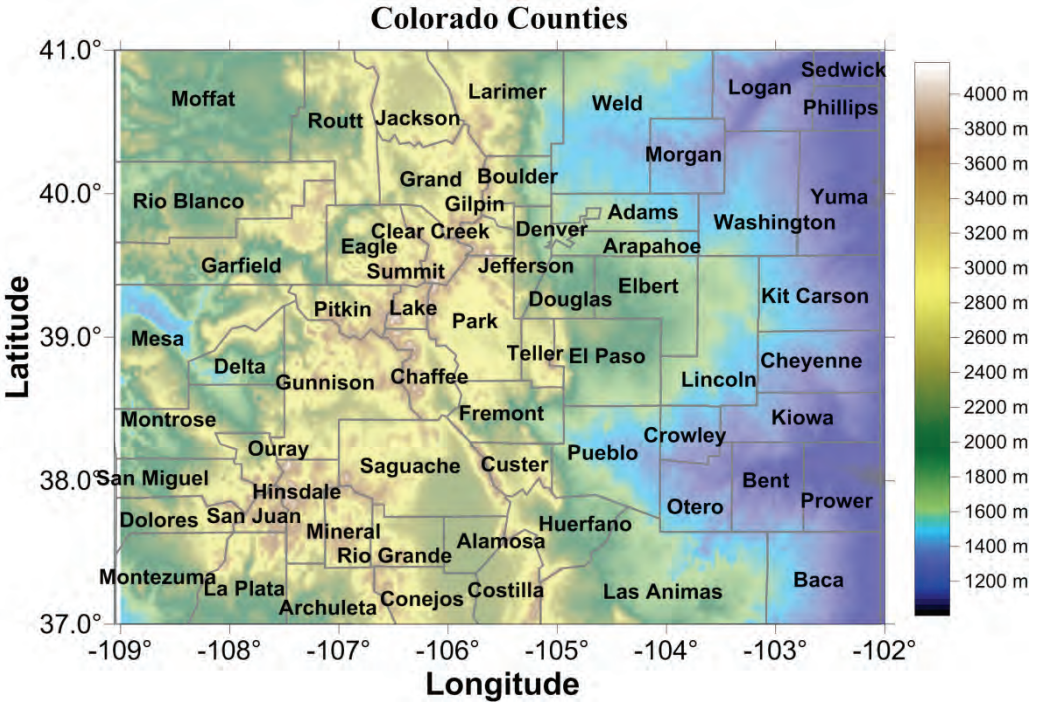
Maps can be created from data, grids, or base map files in any coordinate system. The *Source Coordinate System* is the coordinate system for the data, grid, or base map file used to create the map layer. Each map layer can reference a different projection and datum. When a map layer has a source coordinate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

3D surface maps and wireframe maps do not have a coordinate system associated with them. When a map with a coordinate system is overlaid onto either of these map types, the map coordinate system is removed and the maps are displayed in the 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 source coordinate system than the map's target coordinate system, the map layer is converted to the map's *Target Coordinate System*. The map's *Target Coordinate System* is the coordinate system in which you want to display your map.

Refer to *Chapter 18* for more information on coordinate systems.



Setting the Coordinate System

In **Surfer**, data, grids, map layers, and maps can have an associated coordinate system. All coordinate systems defined by the data, grids, and map 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**.

The standard procedure for creating maps in a specific coordinate system are:

3. Create the map by clicking on the appropriate **Map | New** command.
4. Click on the map layer to select it. In the **Property Manager**, click on the **Coordinate System** tab.
5. If the *Coordinate System* is not correct, click the *Set* button next to *Coordinate System*. The **Assign Coordinate System** dialog opens.
6. Make any changes in the dialog. This is the existing coordinate system for the map layer. When finished making changes, click *OK*.
7. To change the coordinate system for the map, click on the *Map* object. In the **Property Manager**, click on the **Coordinate System** tab.
8. If the *Coordinate System* is not correct, click on the *Change* button next to *Coordinate System* to set the desired target coordinate system. When finished, click *OK*.

The entire map is now displayed in the desired target system.

Surfer does not require a map projection be defined. Maps can be created from non-referenced data, grid, and map layers, working in the same manner as previous versions of **Surfer** worked to create unreferenced maps. 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 for the map. Changes to the target coordinate system for the map can cause the unreferenced map layers to appear incorrectly.

3D surface maps and wireframe maps cannot be converted to a new coordinate system.

Getting Help

Surfer comes with a quick start guide that provides a quick way to learn the basics of **Surfer**. There are other sources of help, including this full length guide, that will help you learn **Surfer**.

Online Help

Use the **Help | Contents** command in the program to access the detailed online help. Information about each command and feature of **Surfer** is included in the online help.

Context Sensitive Help

Surfer contains context sensitive help for help on menu commands, dialogs, buttons, and screen regions. To obtain context sensitive help for an item, click on the item and press the F1 key. Alternatively, click the  button. The cursor will appear as  , and you can select the item for which help is desired with the modified pointer and a help window appears. This method will produce a detailed help page for the item of interest.

In addition, most dialogs contain a help button. Click the  button in the dialog title bar to obtain help for that dialog or click the *Help* button at the bottom of the dialog.

Internet Help

Golden Software's website is located at www.GoldenSoftware.com. The website contains information about **Surfer** and other Golden Software products. In addition, there is a knowledge base and a user support forum on the website.

Frequently Asked Questions

Use the **Help | Golden Software on the Web | Frequently Asked Questions** command to access the most current **Surfer** FAQs. Open a connection to the Internet before selecting this command. The frequently asked questions page is located at www.GoldenSoftware.com/faq.shtml.

Golden Software User Forums

The online forums are located on the Golden Software website. The forums are moderated by Golden Software, but also allow peer interaction. Once you create a free user name, you can post new questions, or comment on current questions or discussion. No question goes unanswered.

Find answers to your technical questions and interact with our technical support staff and fellow Golden Software users through the online **Surfer** forum.

The forums are located at http://www.goldensoftware.com/forum/index.php.

Golden Software Knowledge Base

The knowledge base is a repository of constantly updated product frequently asked questions, troubleshooting suggestions, program tips, and common procedures.

Use the **Help | Golden Software on the Web | Knowledge Base** command to connect to Golden Software's knowledge base. Open a connection to the internet before selecting this command. The knowledge base page is located at http://www.goldensoftware.com/index.php?option=com_fss&view=kb&prodid=&Itemid=182.

Automation Help

The ***Surfer*** *Automation* help book in the table of contents is designed to help you work with Scripter. Each object, method, and property has a help topic in **Surfer**. Use the object hierarchy to determine how to access each object. Also, each method and property contains some sample code lines with the command. To find out how a particular method or property is accessed click the object name in the *Used by* list. In some cases you may need to change some words to work with the particular object if the sample was not specifically written for the object. Sample scripts are also available in the SAMPLES folder (C:\Program Files\Golden Software\Surfer 12\Samples\Scripts) to help get you started.

Complete the Surfer Tutorial

The **Surfer** tutorial is a great way to get started in **Surfer**. Tutorial lessons one through ten will teach you the basics of creating and editing a map. There are also additional optional advanced tutorial lessons available. If you are using the demo version of **Surfer**, you will not be able to complete some of the tutorial steps that require saving or exporting. The demo version is a fully functional read-only version of the program. When this is a factor it is noted in the text and you are directed to proceed to the next step that can be accomplished with the demo.

Technical Support

Golden Software's technical support is free to registered users of our products. Our technical support staff is trained to help you find answers to your questions quickly and accurately. We are happy to answer any 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. To allow us to support all customers equitably, an individual user's daily support time may be limited.

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** serial number
- Your **Surfer** version number, found in **Help | About Surfer**
- The operating system you are using (Windows XP, Vista, 7, 8, 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, KB, or support forum, please do not hesitate to contact us:

Register Serial Number

Please remember to register your software by filling out the registration form online. Registering your serial number entitles you to free technical support, announcements, and **Surfer** upgrade pricing. Our database is confidential. Please take a minute to register your copy of **Surfer** with us.

Your serial number is located on the CD cover or in the email download instructions, depending on how you purchased **Surfer**. Please take a minute to register your copy of **Surfer** with us.

Suggestions

We 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. If you have a suggestion you would like to share with us, please send it to us by clicking **Help | Feedback | Suggestions**.

Golden Software Contact Information

The Golden Software mailing address, sales phone number, and technical support phone number are listed by clicking the **Help | About** command. You can also use the **Help | Feedback** command to contact technical support.

Phone: 303-279-1021

Fax: 303-279-0909

Email: **Surfer**support@goldensoftware.com

Web: www.goldensoftware.com

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

Chapter 2

Tutorial

Tutorial Introduction

Welcome to the **Surfer** tutorial. This tutorial is designed to introduce you to some of **Surfer's** features. We cannot cover all aspects of the program in a tutorial, so this tutorial teaches the basics of **Surfer**. After you have completed the tutorial, you will have the skills needed to begin creating your own grids and maps.

If you find you still have questions after you have completed the tutorial, you should consider reviewing the material in the quick start guide and accessing the rest of **Surfer's** extensive online help. The Golden Software website contains a knowledge base of questions and answers, an interactive forum, 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.

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 12\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 12\Samples, by default.

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 shows you how to import a data file and how to create a new data file.
- Lesson 2 - Creating a Grid File shows you how to create a grid file, the basis for most map types in **Surfer**.
- Lesson 3 - Creating a Contour Map shows you how to create a contour map and change the contour map properties.
- Lesson 4 - Modifying an Axis shows you how to modify axis properties.

- Lesson 5 - Posting Data Points and Working with Map Layers shows you how to add a post map layer to display data points on the contour map. Both maps will share the same axes, limits, and scaling.
- Lesson 6 - Creating a Profile shows you how to draw a profile line on the map and automatically create a cross section from it.
- Lesson 7 - Saving a Map shows you how to save your map and all the information it contains to a **Surfer** .SRF file.
- Lesson 8 - Creating a 3D Surface Map shows you how to create a 3D surface map and change the surface map properties.
- Lesson 9 - Adding Transparency, Color Scales, and Titles shows you how to add transparency, color scales, and map titles to your maps.
- Lesson 10 - Creating Maps from Different Coordinate Systems shows you how to create a map with multiple map layers and change the coordinate system for the entire map.

Advanced Tutorial Lessons

In addition, there are advanced (optional) lessons available, as well. The optional advanced tutorial lessons are available to demonstrate additional features of **Surfer**.

- Lesson 11 **-** Custom Toolbars and Keyboard Commands shows you how to create custom toolbars and keyboard shortcuts to improve your efficiency in **Surfer**.
- Lesson 12 - Overlaying Map Layers shows you the three methods to overlay map layers.
- Lesson 13 - Blank a Grid File shows you how to create a blanking file and use the **Grid | Blank** command to create a grid file with an irregular boundary.
- Lesson 14 - Changing the Projection in the Worksheet shows you how to change the projection of a data set in the **Surfer** worksheet.

Using the Tutorial with the Demo Version

If you are using the demo version of **Surfer**, you will not be able to complete some of the tutorial steps that require saving or exporting. The demo version is a fully functional read-only version of the program. When this is a factor it is noted in the text and you are directed to proceed to the next step that can be accomplished with the demo.

A Note about the User's Guide and Online Help

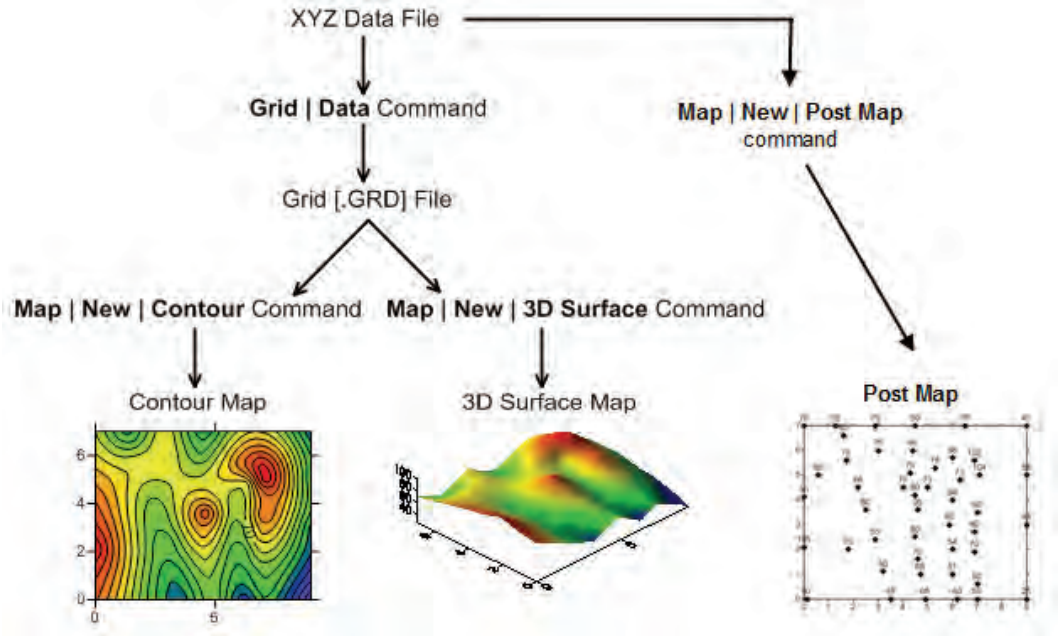
Various font styles are used throughout the **Surfer** quick start guide and online help. **Bold** text indicates menu commands, dialog names, tab names, and page names.

Italic text indicates items within a dialog or the manager 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, menu commands appear as **File | Open**. This means, "click on the **File** menu at the top of the plot window, then click on **Open** within the **File** menu list." The first word is always the menu name, followed by the commands within the menu list.

Surfer Flow Chart

This flow chart illustrates the relationship between XYZ data files, grid files, contour maps, and 3D surface maps. This flow chart can be applied to any grid based map types. This example displays only two of the grid based maps (i.e. contour and 3D surface).



This flow chart illustrates the relationship between XYZ data files, grid files, post maps, contour maps, and 3D surface maps.

Starting Surfer

To begin a **Surfer** session:

1. Navigate to the installation folder, C:\Program Files\Golden Software\Surfer 12 by default.

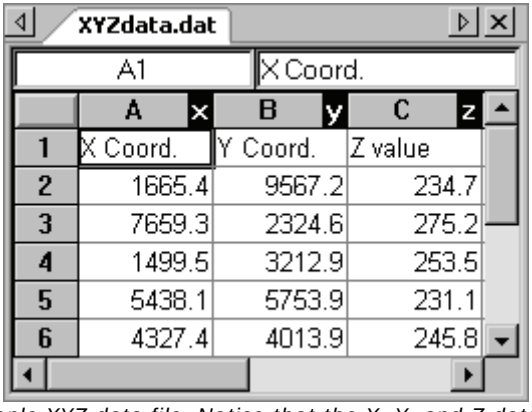
2. Double-click on the Surfer.EXE application file.
3. A new empty plot window opens in **Surfer**. This is the work area where you can produce grid files, maps, and modify grids.

If this is the first time that you have opened **Surfer**, you are prompted for your serial number. Your serial number is located on the CD cover or in the email received with the download directions. You may also access your serial number at any time by clicking **Help | About Surfer** in the **Surfer** window.

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.

Lesson 1 - Viewing and Creating Data

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 **Data | Assign XYZ Columns** worksheet command. **Surfer** requires the use of decimal degree Latitude (Y) and Longitude (X) values when using Latitude and Longitude values.



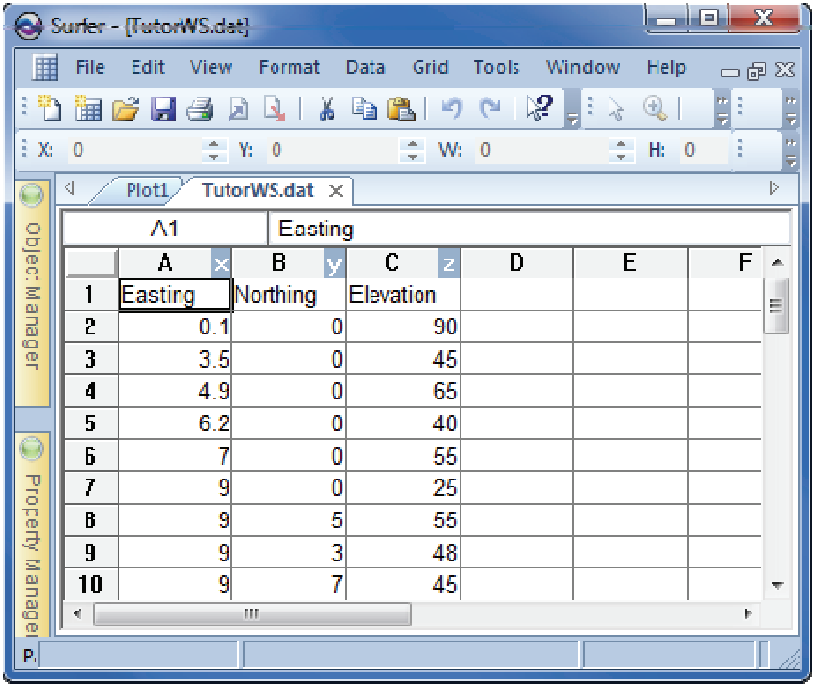
A simple XYZ data file. Notice that the X, Y, and Z data are placed in column A, B, and C, respectively.

Opening an Existing Data File

To look at an example of an XYZ data file, you can open *TutorWS.dat* in a worksheet window:

1. Click the **File | Open** command, click the  button, 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 12\Samples. 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 **Property Manager** when selecting worksheet columns.



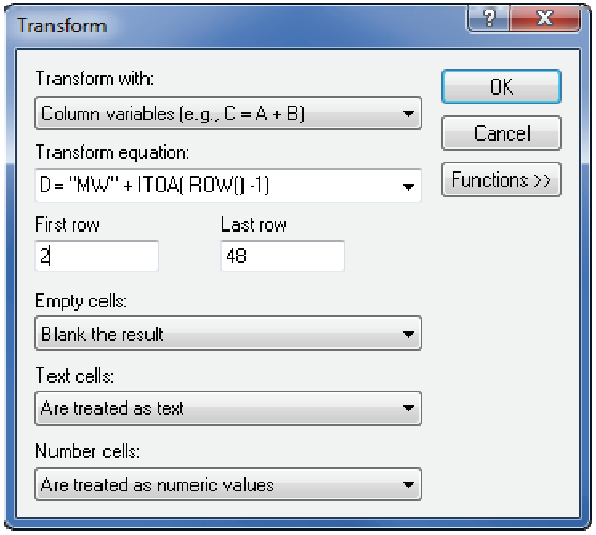
When a data file is displayed, the name of the file is shown in the title bar and in the worksheet tab. In this file, row 1 contains descriptive information about each column of data.

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.

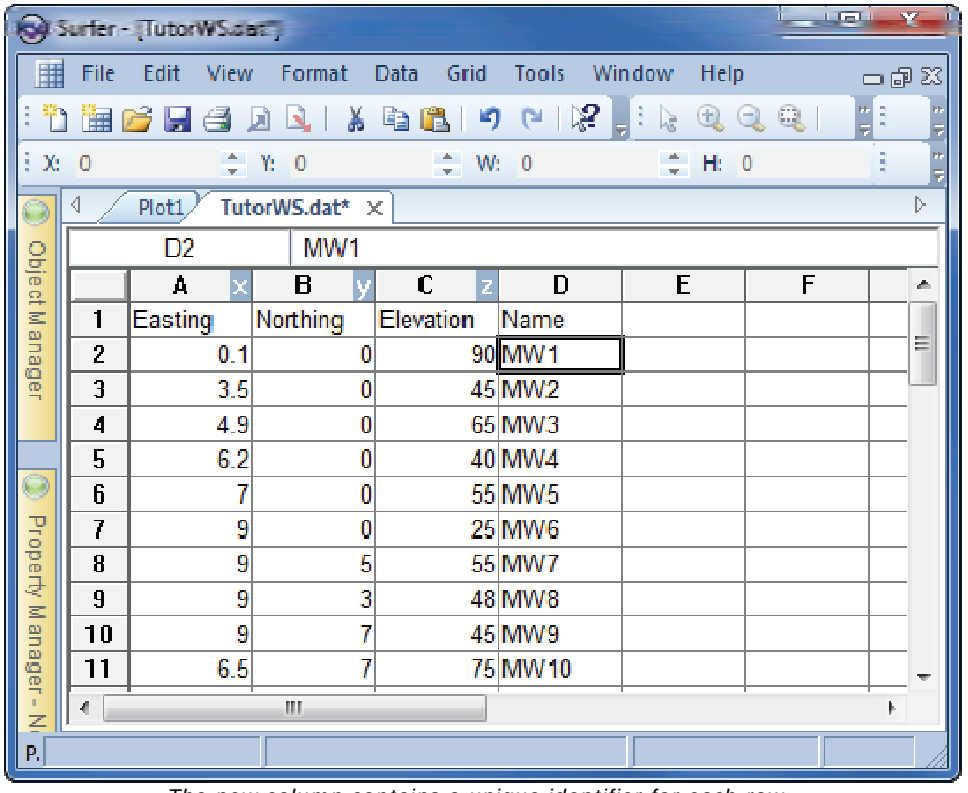
To do this:

1. Click in cell D1.
2. Type the text *Name*.
3. Click in cell D2.
4. Click the **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:



	A	B	C	D	E	F
1	Easting	Northing	Elevation	Name		
2	0.1	0	90	MW1		
3	3.5	0	45	MW2		
4	4.9	0	65	MW3		
5	6.2	0	40	MW4		
6	7	0	55	MW5		
7	9	0	25	MW6		
8	9	5	55	MW7		
9	9	3	48	MW8		
10	9	7	45	MW9		
11	6.5	7	75	MW10		

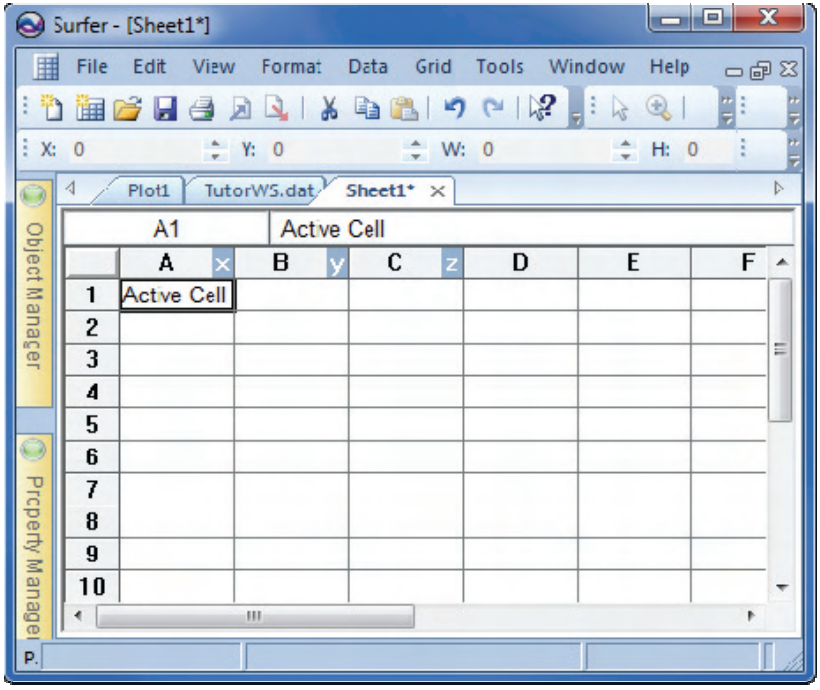
The new column contains a unique identifier for each row.
This can be used for labels later in the tutorial.

After making changes to the worksheet, save the file by clicking the File | Save command. Note that the data cannot be saved in the demo version.

Creating a New 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  button, or press CTRL+W on the keyboard. A new empty worksheet window is displayed.



Data are entered into the active cell of the worksheet.
Click on the text "A1" or "Active Cell" for the definition of
the active cell, active cell location, and the active cell edit box.

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.

Saving the Data File

When you have completed entering all of the data, the file can be saved. Note that this option is not available in the demo version.

1. Click the **File | Save** command, click the  button, or press CTRL+S on the keyboard. The **Save As** dialog is displayed if you have not previously saved the data file.
2. In the *Save as type* list, choose the *DAT Data (*.dat)* option.
3. Type the name of the file into the *File name* box.
4. Click the *Save* button and the Data Export Options dialog opens.
5. Accept the defaults in the **Data Export Options** dialog by clicking *OK*.

The file is saved in the Data .DAT format with the file name you specified. The name of the data file appears at the top of the worksheet window and on the worksheet tab.

Lesson 2 - Creating a Grid File

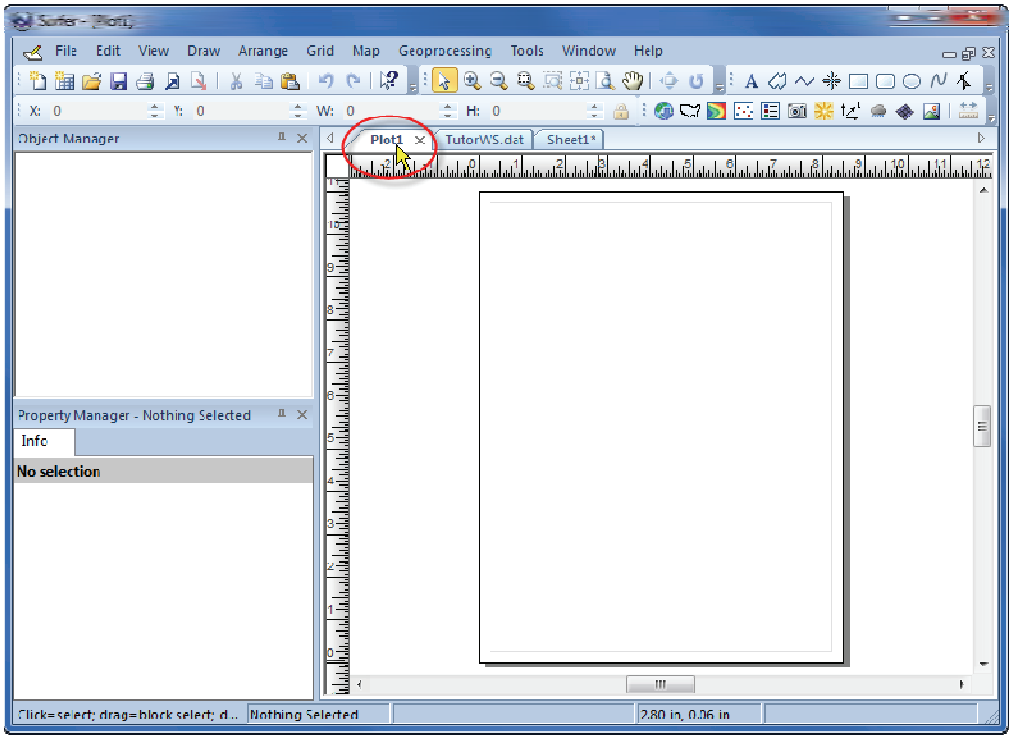
Grid files are required to produce a grid-based map. Grid-based maps include contour maps, image maps, shaded relief maps, 1-grid vector maps, 2-grid vector maps, 3D wireframes, and 3D surfaces.

How are grid files produced?

Grid files are created using the Grid | Data command. The **Grid | Data** command requires data in three columns: one column containing X data, one column containing Y data, and one column containing Z data. We have included a sample XYZ data file (*TutorWS.dat*) with **Surfer** for you to see how to produce a grid file. After completing the tutorial, if you need to produce an XYZ data file of your data for your work, see Lesson 1 - Creating an XYZ Data File.

Creating a Grid File

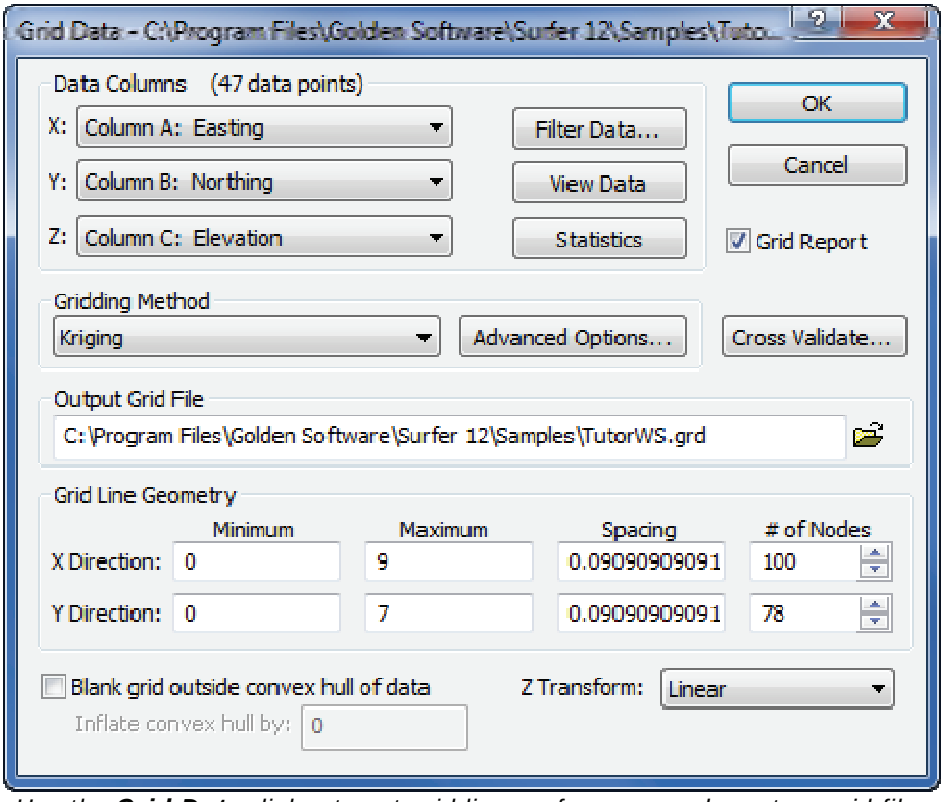
1. If you have the worksheet window open, click on the **Window** menu and choose **Plot1**, or click on the **Plot1** tab. Alternatively, you can create a new plot window with the **File | New | Plot** command.



Click on the Plot1 *tab to return to the plot window.*

2. In the plot window, click the **Grid** | **Data** command, or click the  button in the grid toolbar. The **Open Data** dialog is displayed.
3. In the **Open Data** dialog, click the file *TutorWS.dat* file located in the *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 12\Samples. You can select the file in the file list section or in the *Open worksheets* section of the dialog by clicking once on the file name. The name appears in the *File name* box below the list of data files.
4. Click *Open.* Alternatively, double-click on the data file name.
5. The **Grid Data** dialog is displayed. The **Grid Data** dialog allows you to control the gridding parameters. Take a moment to look over the various options in the

dialog. Do not make changes at this time, as the default parameters create an acceptable grid file.



*Use the **Grid Data** dialog to set gridding preferences and create a grid file.*

- The *Data Columns* section is used to specify the columns containing the X and Y coordinates, and the Z values in the data file.
- The *Filter Data* button is used to filter your data set.
- The *View Data* button is used to see a worksheet preview of your data.
- The *Statistics* button is used to open a statistics report for your data.
- The *Grid Report* option is used to specify whether to create a statistical report for the data.
- The *Gridding Method* option is used to specify the interpolation gridding method.
- The *Advanced Options* button is used to specify advanced settings for the selected *Gridding Method*.
- The *Cross Validate* button is used to assess the quality of the gridding method.

- The *Output Grid File* displays the path and file name for the grid file.
- The *Grid Line Geometry* section is used to specify the XY grid limits, grid spacing, and number of grid nodes (also referred to as rows and columns) in the grid file.
- The *Blank grid outside convex hull of data* automatically blanks any locations that are outside the data area. When checked, the *Inflate convex hull by* option is available. This allows the area to be gridded to be expanded or contracted beyond the data locations by the value specified.
- The *Z Transform* controls whether the actual Z value or the log (base 10) of the Z value is gridded and how the Z value is stored in the grid file.

6. Click *OK*. In the status bar at the bottom of the window, a display indicates the progress of the gridding procedure. By accepting the defaults, the grid file uses the same path and file name as the data file, but the grid file has a .GRD extension.

7. By default, a **Surfer** dialog appears after gridding the data with the full path and file name of the grid file that was created. Click *OK* in the **Surfer** dialog.
8. If *Grid Report* was checked in the **Grid Data** dialog, a report is displayed. You can minimize or close this report. This report contains detailed information about the gridding process.

Lesson 3 - Creating a Contour Map

A contour map is a plot of three values. The first two dimensions are the X, Y coordinates, and the third (Z) is represented by lines of equal value (the contour lines on the map) across the map extents. The shape of the surface is shown by the contour lines.

What are contour maps used for?

Contour maps are used for a variety of applications. You can contour any Z value of data. If you have multiple Z values for your X, Y values, you could create multiple contour maps. For example, you could create a contour map for X, Y, Z (elevation) to show the topography of your study area. You could then create a contour map for X, Y, Z (concentration) to show the concentration values across your study area. The Z value could be temperature, concentration, frequency, or any other numeric column of data.

The **Map | New | Contour Map** command creates a contour map based on a grid file. This lesson will create a contour map from the .GRD file created in *Lesson 2 - Creating a Grid File*.

Creating a Contour Map

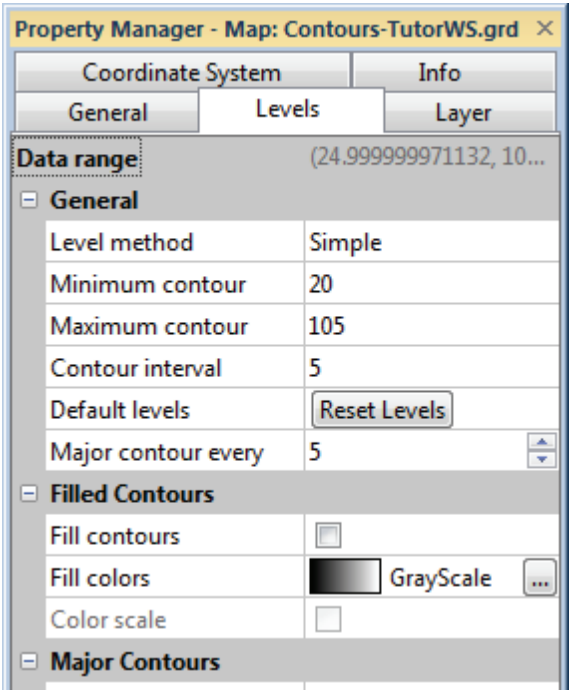
1. Click the **Map | New | Contour Map** command, or click the  button in the map toolbar.
2. The **Open Grid** dialog is displayed. Select the *TutorWS.grd* file created in Lesson 2 - Creating a Grid File by clicking once on its name. The file name is entered in the *File name* box.
3. Click *Open* and the map is created using the default contour map properties.
4. If you want the contour map to fill the window, click the **View | Fit to Window** command, click the  button, or press CTRL+D on the keyboard. Alternatively, if you have a wheel mouse, roll the wheel forward to zoom in on the contour map. The zoom is changed so that the cursor location remains on the screen. Click and hold the wheel button straight down while you move the mouse to pan around the screen.

Changing Contour Levels

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

To change the contour levels:

1. Place the cursor inside the limits of the contour map and click once. Or, click on the *Contours-TutorWS.grd* object in the **Object Manager**. When the contour layer is selected, the contour properties are displayed in the **Property Manager**.
2. In the **Property Manager**, 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 to *Minimum contour*. The *Maximum contour* level is Z = 105.

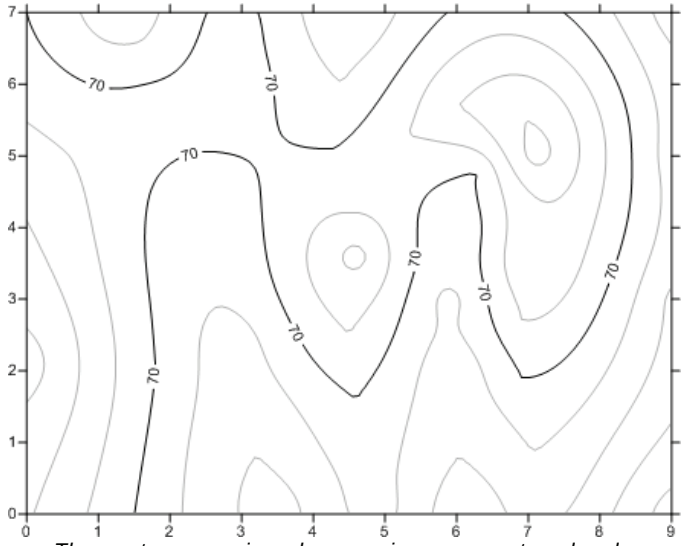


*Go to the **Levels** page to display the contour level properties.*

3. To change the contour range, click in the box next to *Minimum contour* or *Maximum contour*. Highlight the existing 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 = 105.



The contour map is redrawn using new contour levels based on 10-foot contour intervals.

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

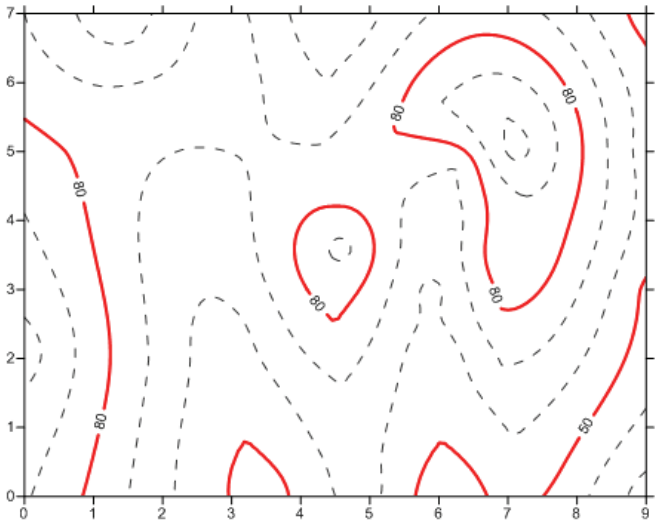
1. Highlight the number in the box next to *Major contour every* and type in a new value of 3.
2. Press ENTER on the keyboard and every third line is a major contour line.

Changing the Major Contour Line Properties

1. Click the ⊞ next to *Major Contours,* if it is not already open.
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 0.030 inches. Thick red lines now appear at the major contours.

Changing the Minor Contour Line Properties

1. Click the ⊞ next to *Minor Contours,* if it is not already open.
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.

Changing Contour Fill Properties

Color fill can be assigned to fill between contour lines.

Displaying Contour Fill

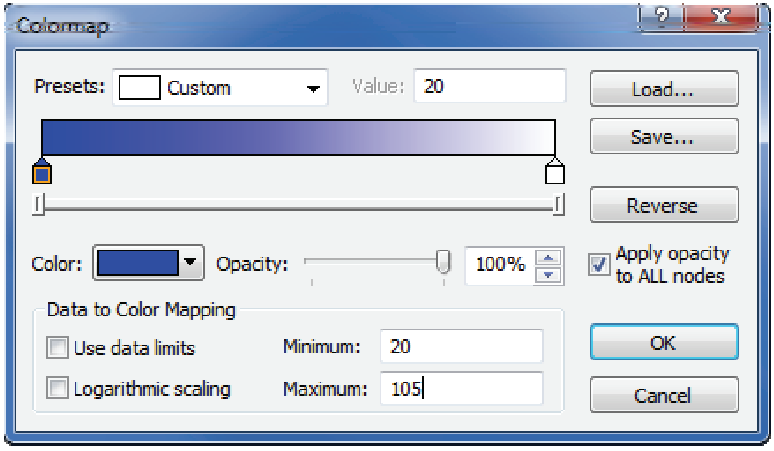
To display contour fill:

1. Click once on the contour map to select it. The contour map properties are shown in the **Property Manager**.
2. Click on the Levels tab.
3. Click the ⊞ next to *Filled Contours*, if it is not already open.
4. Check the box next to *Fill contours*. The contour map automatically updates to display the default grayscale color fill between contours.

Changing Fill Color

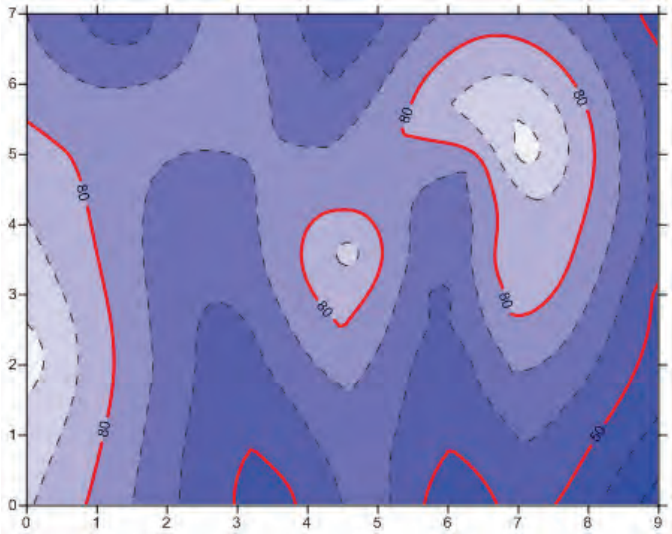
The color fill can be changed to assign a gradational color spectrum between two colors, or by selecting one of the preset color spectrums. To change the colors:

1. Click the color bar next to *Fill colors.* A list of colormaps appear. Click one of the preset colormaps, such as *Rainbow*, and the map automatically updates to display the new colors.
2. If only a minimum and maximum color are desired, click the  button next to the colormap beside *Fill colors*. The Colormap dialog appears.
3. The **Colormap** dialog allows you to select colors to assign to specific Z values. Click the colormap next to *Presets*. Select *Grayscale* from the list.
4. Click on the left node  below the color spectrum. This selects the minimum color node. Click on the color button next to *Color* and select the color *Blue* in the color palette. The color scale now ranges from *Blue* to *White*. Alternatively, you could select an existing color spectrum from the *Presets* list, or a custom colormap by clicking the *Load* button.



*Change the color spectrum properties in the **Colormap** dialog.*

5. If you would like the color fill to be transparent, change the *Opacity* value by clicking and dragging the slider next to *Opacity*.
6. Click *OK* and the contour map is redrawn with the blue to white fill.



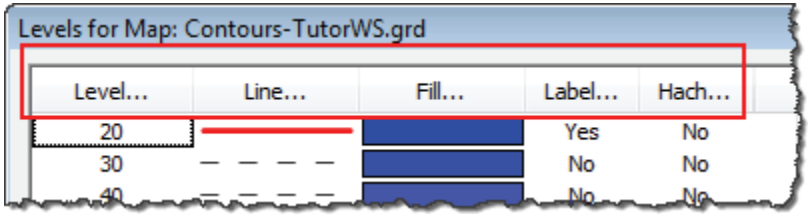
*The contour map is filled with a blue to white colormap after adjustments are made in the **Colormap** dialog.*

Setting Advanced Contour Level Properties

Contour map level properties can be set in the *Simple* manner, like was shown previously. Or, you can change more advanced items, such as displaying contours on a logarithmic scale using the *Logarithmic* method or each contour line individually controlled by using the *Advanced* method.

To set advanced contour level properties for all levels:

1. Click once on the contour map to select it.
2. In the **Property Manager**, 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. Click on the column header buttons to make bulk changes at regular intervals. This provides a way to emphasize contours.



Click on one of the column header buttons to make bulk changes.

6. Click on the *Label* button. The **Labels** dialog opens.
7. Change the *First* value to 2, the *Set* value to 1, and the *Skip* value to 2.
   a. 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).
   b. The *Set* value tells **Surfer** how many lines to set with this style. This says to set only one line with the label format.
   c. 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.
   d. 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.
8. Click the *Font* button. The **Font Properties** dialog opens.
9. Set the *Size (points)* to 12.
10. Set the *Foreground color and opacity* color to *White*.
11. Click *OK*.

12. Click *OK* in the **Labels** dialog. Notice how the label status is changed in the **Levels for Map** dialog.
13. Click on the *Hach* button. The **Hachures** dialog opens.
14. Set the *First* to 1, the *Set* to 1, and the *Skip* to 0.
    a. The *First* value tells **Surfer** to set the hachure setting for the first contour line, Z=20.
    b. The *Set* value tells **Surfer** to set only one contour line to the hachure style.
    c. 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.
15. Check the *Hachure Closed Contours Only* box, if it is not already checked.
16. Change the *Direction to Uphill.*
17. Click *OK*. This changes all of the items under *Hach* to Yes. All closed contours will have hachure marks.
18. Click *OK* and the bulk changes are made to the contour map.

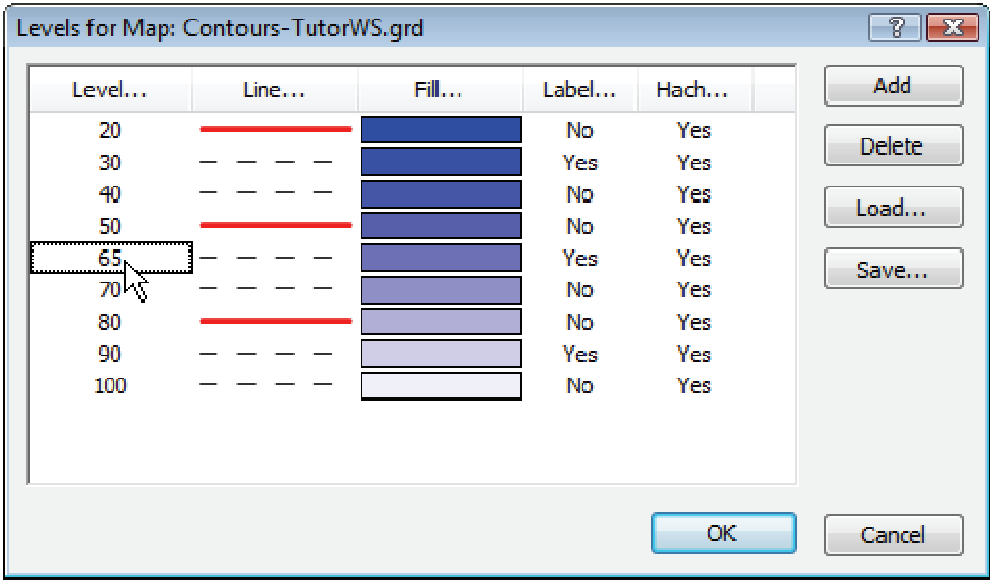
Bulk changes that can be made include:

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

To set advanced contour level properties for individual levels:

1. Click once on the contour map to select it.
2. In the **Property Manager**, 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 the *Level* button to change the Z value for that particular contour level. Let's double-click on the number 60.

6. In the **Z Level** dialog, highlight the value 60 and type in 65.
7. Click *OK* and the contour line changes to 65.



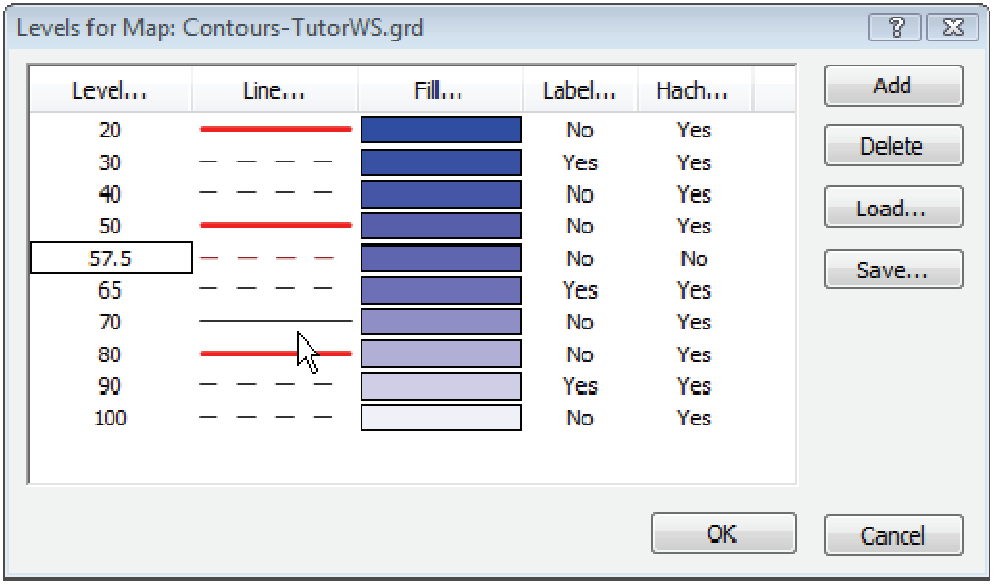
Double-click on the 60 to change the Z value for this contour line.

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 70.
9. In the Line Properties dialog, change the *Style* to a solid line by clicking on the existing dashed line and selecting the *Solid* line from the list.
10. Click *OK*.
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.
13. Click *OK* and the individual settings are made to the contour map.

Individual level changes that can be made include:

- setting an individual level value by double-click on the level value to enter a new Z value,
- setting the individual line properties for a single level by double-clicking the line style for that level,
- setting the fill color or pattern for a single level by double-clicking on the fill pattern for that level,

- setting the label properties for a single contour label by double-clicking on the Yes or No under the *Label* column for that level,
- or setting the hachure properties for a single contour level by double-clicking on the Yes or No under the *Hach* column for that level.



*Double-click on an individual elements in the **Levels** dialog to set specific parameters for the selected level. This example shows the line for the Z = 70 after it is changed to a solid line.*

Adding, Deleting, and Moving Contour Labels

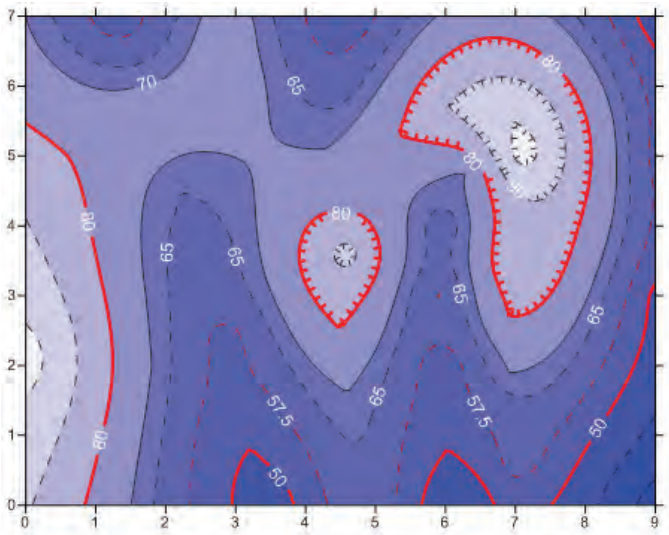
Contour label locations can be changed on an individual basis. Labels can be added, deleted, or moved.

To add, delete, and move contour labels:

1. Click the **Map | Edit 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.
2. To delete a label, click on the label and press the DELETE key on the keyboard. For example, left-click on one of the center 65 labels and press the DELETE key on your keyboard.
3. 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 solid and dashed red lines.

4. 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.
5. To duplicate a label, hold the CTRL key on the keyboard while holding the left mouse button on an existing label. Drag the label to a new location along the line.
6. To exit the *Edit Contour Labels* mode, press the ESC key.



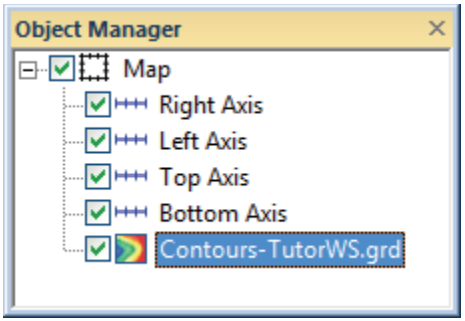
*Contour labels can be moved, added, or deleted with the **Map | Edit Contour Labels** command.*

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 file, 2D SHP, 3D SHP, or to a Text Format TXT file.

To export contour lines to 3D DXF, 2D SHP, 3D SHP, or TXT File:

1. Select the contour map layer by clicking on the map layer in the plot window or by clicking on the word *Contours-TutorWS.grd* in the **Object Manager**.



*Select the contour map by clicking on the Contours-TutorWS.grd object in the **Object Manager** or by clicking on the map in the plot window.*

2. Click the **Map | Export Contours** command.
3. In the Save As dialog , type *TutorWS* in the *File name* box.
4. Specify AutoCAD DXF File (*.dxf), 2D ESRI Shapefile (*.shp), 3D ESRI Shapefile (*.shp), or Text format (*.txt) in the *Save as type* box.
5. Click *Save* and the file is exported to the current directory. This creates a file titled *TutorWS.dxf*, *TutorWS.shp*, or *TutorWS.txt* depending on what file type you selected. Additional files may also be created that accompany the DXF, SHP, or TXT file.

Lesson 4 - Modifying an Axis

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

Adding an Axis Title

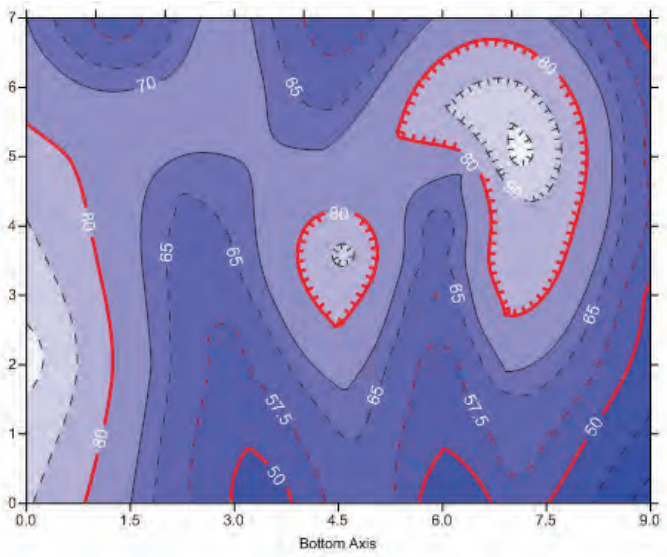
1. Move the cursor over one of the axis tick labels on the bottom X axis and left-click the mouse. In the status bar at the bottom of the plot window, the words "Map: Bottom Axis" are displayed. The *Bottom Axis* object is selected in the **Object Manager**. This indicates that you have selected the bottom axis of the contour 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 **Property Manager**. 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 are editable, including the tick label format and frequency. To change the axis tick labels:

1. In the **Property Manager**, click on the Scaling tab to display the axis scaling options.
2. In the *Major Interval* box, 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 **General** tab in the **Property Manager**.
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.
10. 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 - Posting Data Points and Working with Layers

Post maps are created by placing symbols representing data points at the X, Y data point locations on a map. Posting data points on a map can be useful in determining the distribution of data points, as well as placing data or text information at specific points on the map. Data files contain the X, Y coordinates used to position the points on the map. Data files can also contain the labels associated with each point.

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 created, you can add a post map layer displaying the location and station names of each data collection station.

How are map layers added to existing maps?

Map layers can be added to an existing map by selecting the map and using the **Map | Add** command, by dragging an existing map layer from one map object to another, or by selecting all maps and using the **Map | Overlay Maps** command.

Adding a Post Map Layer

When a new post map is created with **Map | New | Post Map**, it is independent of any other maps in the current plot window. When the two maps are displayed, notice that two sets of axes are also displayed, one set for each map. When you select a map and then use the **Map | Add** command, a new map layer, axis, or scale bar can be added to the selected map.

If two maps already existed, a map layer can be dragged to a different map object in the **Object Manager**. Alternatively, select both maps and click the **Map | Overlay Maps** command. All selected map layers are moved to a single map object.

To delete a map layer, select the layer in the **Object Manager** and press the DELETE key. To remove a map layer from a map object, right-click the layer and select *Break Apart Map Layer*.

If you have not already completed Lesson 1 - Viewing and Creating Data, do so now. This lesson adds a worksheet column that is used for the post map labels.

To add a post map layer to the current tutorial map:

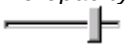
1. Click once on the *Contours-TutorWS.grd* layer in the **Object Manager** to select it.
2. Click the **Map | Add | Post Layer** command, or right-click on the contour map and select *Add | Post Layer*.
3. In the **Open Data** dialog, select *TutorWS.dat* in the *Open worksheets* section at the bottom of the dialog. If the *TutorWS.dat* file is not already open, browse to the Samples directory and select it in the file list. By default, the *Samples* folder is located in c:\Program Files\Golden Software\Surfer 12\Samples.
4. Click *Open*.

The post map layer is added to the contour map. Notice in the **Object Manager** that the post map layer has been added to the *Map*. The two map layers now share the same set of axes. Changes made to the map properties will affect both the contour map layer and the post map layer.

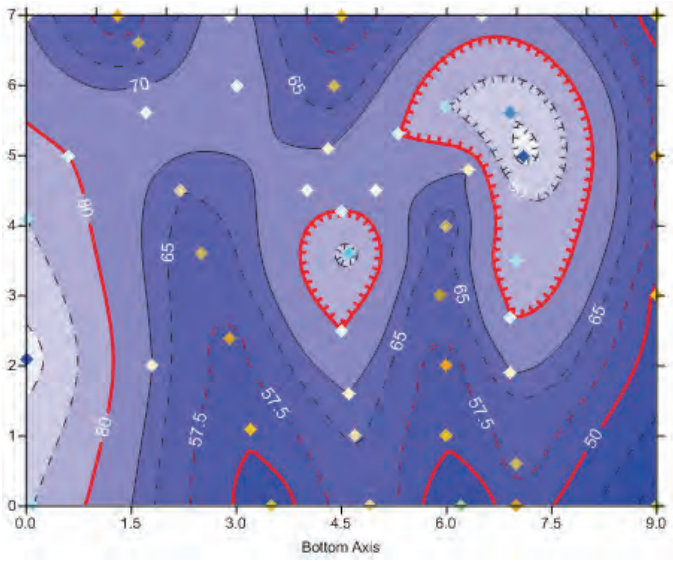
Changing the Post Map Properties

Once you have created a post map layer, you can customize the post map 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.

To change the post map properties:

1. Click on the *Post-TutorWS.dat* layer in the **Object Manager** or on the post map layer in the plot window.
2. In the **Property Manager**, click on the Symbol tab.
3. Click the ⊞ next to *Symbol*, if it is not already open.
4. Click the ⊞ next to *Marker Properties* to open the *Marker Properties* section.
5. Next to the *Symbol*, click on the existing symbol. In the list, click on the filled diamond symbol (*Symbol set: GSI Default Symbols, Number: 6*) from the symbol palette.
6. Next to *Fill color*, click on the existing color. In the color palette, select the *Cyan* color. The symbol is now cyan on the inside and black on the outside.
7. *Fill opacity* and *Line opacity* can be adjusted to create semi-transparent symbols by dragging the  next to *Fill opacity* or *Line opacity*, if desired.
8. Click the ⊞ next to *Symbol Size*.
9. Highlight the value next to the *Symbol size* option and type 0.09 in.
10. Press ENTER on the keyboard. The symbols update with the new symbol size.
11. Click the ⊞ next to *Symbol Color*.
12. 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*.
13. Verify that the *Color method* is set to *Numeric via colormap*.
14. 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 **Object Manager**. The order the layers are listed in a map object is the order the map layers are drawn in the plot window. To move a map layer, left-click and drag up or down in the map object. Alternatively, select the map layer and use the **Arrange | Order Objects** command or right-click and select *Order Objects*.



The updated post map is displayed overlaid on the contour map.

Adding Labels to the Post Map Layer

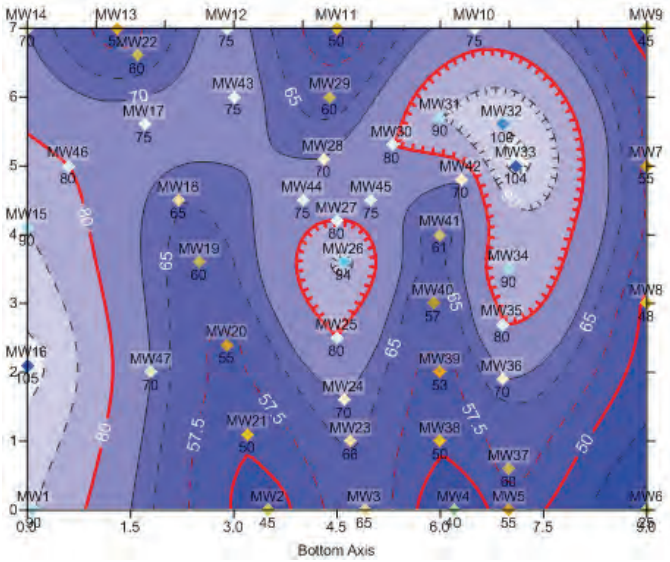
You can add labels to the data points on post maps and classed post maps. Multiple labels can be added to display all of the information desired in the map.

To add labels:

1. Click on the *Post-TutorWS.dat* layer in the **Object Manager**.
2. In the **Property Manager**, 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 *TutorWS.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 *TutorWS.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 slightly 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 **Property Manager** on the **Labels** tab.*

Moving Individual Post Map Labels

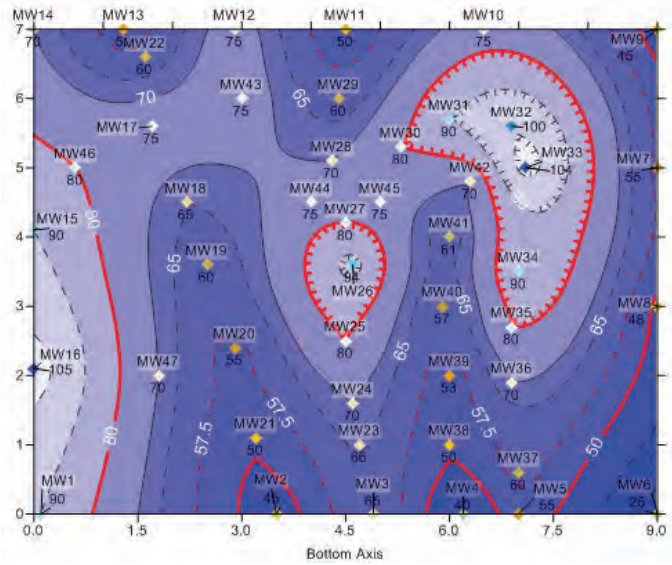
You can move individual labels of post maps and classed post maps with the **Map | Edit Post Labels** command. Alternatively, add labels, and then right-click the post map and select *Edit Post Labels* to enter edit mode. A customizable line is automatically added from the data point label to the actual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

To move individual labels:

1. Select the *Post-TutorWS.dat* layer in the **Object Manager**.
2. Click the **Map | Edit 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 **Property Manager** when the post map 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 6 - 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. Sometimes, a simpler process is desired because the data is not the end result. If being able to visually see the profile on the map and on a graph is the desire, the **Map | Add | Profile** command provides an excellent quick method.

To start off, you must first have a grid file of your surface data. The profile line will be drawn directly on the map.

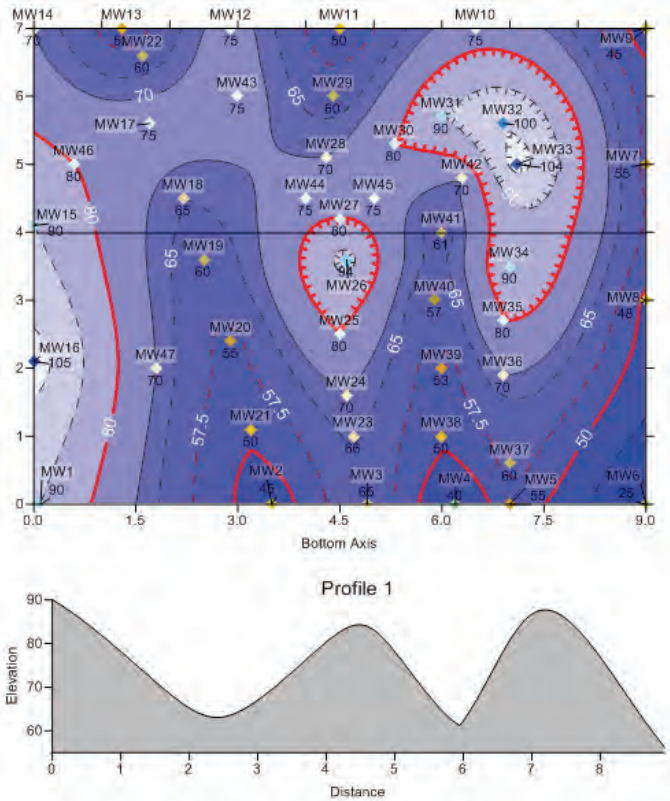
Creating the Profile

1. Click once on the contour map to select it.

2. Click the **Map | Add | 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 | Fit to Window** command to see the entire map and profile.

The base map layer is automatically added to the contour map and the profile graph is automatically created. The properties can be edited by clicking on the *Profile 1* object in the **Object Manager**.



The location of the profile is displayed on the contour map.
The actual profile is displayed in a graph below the contour map.

Lesson 7 - 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.

If you are using the demo version of **Surfer** you will not be able to save or export the map. Please proceed to the next lesson.

Saving a Map

1. Click the **File | Save** command, or click the  button. 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 TutorWS.
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)*, if the file is to be shared with users using **Surfer 11**. After selecting the **Surfer 11** format, click *Yes* in the dialog. Any **Surfer 12** specific features are lost when saving to the **Surfer 11** format.

Lesson 8 - 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.

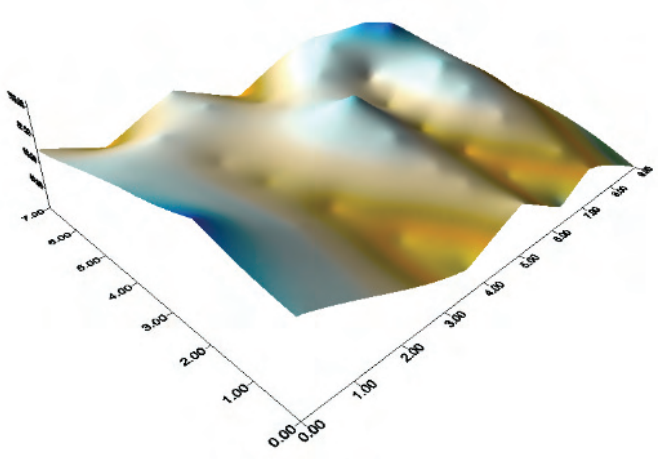
For example, if you have location (X, Y) and temperature (Z) data for a region and you have the same location (X, Y) and corresponding elevation (Z) data for the area, you could create a grid file with the Z variable being elevation and a grid file with the Z

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.

Creating a 3D Surface Map

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 to open a plot document.
2. Click the **Map | New | 3D Surface** command or click the  button.
3. In the **Open** dialog, select the grid file *TutorWS.grd* from the list of files. The *TutorWS.grd*, created in Lesson 2 - Creating a Grid File, is located in **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 12\Samples.
4. Click *Open* and the 3D surface is created using the default settings.



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

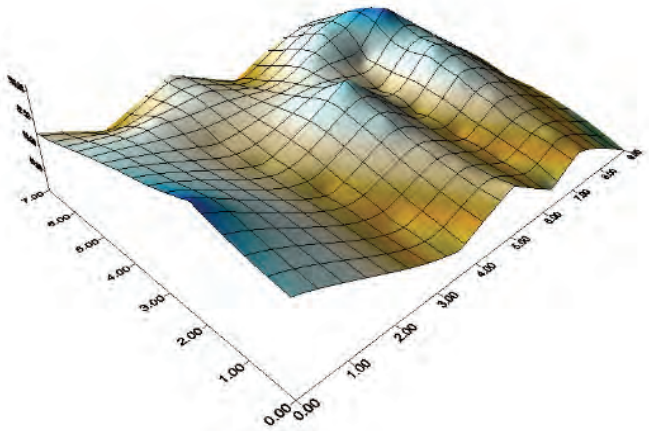
Adding a Mesh

Mesh lines can be applied to surfaces. 3D surface maps have more capability than 3D wireframe maps because surfaces can be combined with more map types and can change the map limits. Adding mesh lines to a 3D surface map simulates a 3D wireframe map.

To add a surface mesh:

1. Click once on *3D Surface-TutorWS.grd* in the **Object Manager** to select it. The 3D surface properties are displayed in the **Property Manager**.
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 five.

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



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

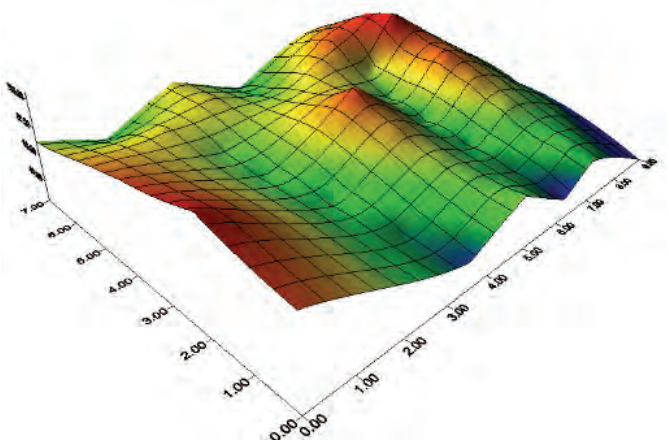
Changing the 3D Surface Layer Colors

Changing color schemes on 3D surfaces is similar to changing colors on other map types such as image maps or contour maps. A Colormap is used to load previously defined color schemes, or to create your own color schemes.

To change the surface material color:

1. Click on the *3D Surface-TutorWS.grd* to select it.
2. In the **Property Manager**, 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 color bar next to *Upper*. In the list, select one of the predefined colormaps, such as *Rainbow*.
5. If you wish to define your own colors, click the … button to the right of the selected colormap. The **Colormap** dialog opens.
6. In the **Colormap** dialog, select a predefined colormap from the *Presets* list. The *Presets* list contains a variety of predefined color schemes. Alternatively, you can click the *Load* button and select a custom color spectrum .CLR file. The ColorScales folder, located in the **Surfer** installation directory, contains many sample .CLR files.
7. 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.
8. Click *OK* in the **Colormap** dialog 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** dialog. 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 preset Rainbow *color spectrum.*

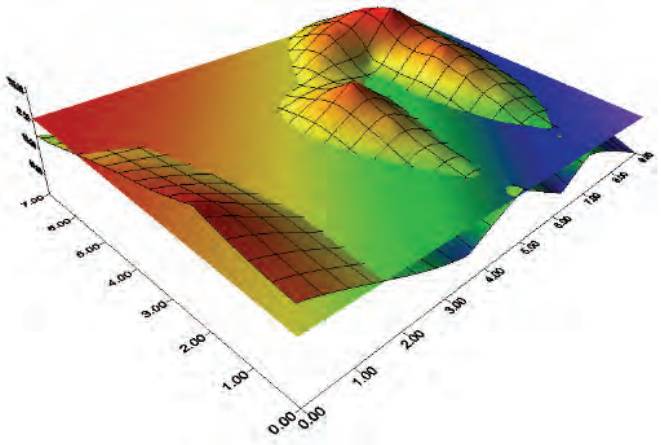
Adding a Map Layer

You can add additional map layers to the 3D surface with the **Map | Add** 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. A 3D wireframe layer cannot be added to a 3D surface map.

When multiple 3D surfaces of differing elevations are added as layers to an existing surface map, the surfaces can intersect and overlap each other. If a surface map is added to another surface map with the **Map | Add | Surface Layer** 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 plane layer to the surface you just created.

To add a planar 3D surface map layer:

1. Click on the *3D Surface-TutorWS.grd* layer in the **Object Manager**.
2. Click the **Map | Add | 3D Surface Layer** command, or right-click the surface map and select *Add* | *3D Surface Layer*.
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 12\Samples.
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 **Object Manager**.
6. In the **Property Manager**, click on the **General** tab.
7. Click the ⊞ next to *Material Color* to open the *Material Color* section.
8. Click on the color next to *Upper*. Select *Rainbow* in the list to match the *3D Surface-TutorWS.grd* color fill.



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 intersection of the TutorWS.grd and TutorPl.grd sample files.

Before moving on to the next lesson, be sure to save your progress with the **File | Save** command. Type a new *File name*, such as *TutorWS-Surface.SRF*. Click *Save* and the new file will be saved to include all the steps from this lesson.

Lesson 9 - 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 that you can see through an object or that light can pass through an object. By default, objects are displayed with 100% opacity, meaning no light can pass through the object. An object can be made semi-transparent by adjusting the opacity value. An *Opacity* of 0% would be fully transparent, or fully invisible.

What is transparency used for?

Reducing the opacity of an object allows the ability to see through the object to other objects. This may be useful when wanting to create a semi-transparent map or object. For example, you may want to display a semi-transparent contour map over a base map of a satellite image. 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.

What are color scales?

Color scales are available for contour, 3D wireframe, 3D surface, image, and vector maps. Color scales are legends that show the fill assigned to each contour level on a filled contour map, the colors assigned to levels in a 3D wireframe, the colors used in an image map, or 3D surface, and the fill assigned to vector symbols.

How can these features improve the final map?

Having a completed map with multiple layers, color scale legends, and titles allow you to provide well organized and easily understandable publication quality maps.

Creating a Filled Contour Map

To create a contour map:

1. Click the **File | New | Plot** command, or click the  button. A new empty plot window is displayed.
2. Click the **Map | New | Contour Map** command.
3. Select the grid file *TutorWS.grd* from the list of files in the **Open Grid** dialog. The *TutorWS.grd*, created in Lesson 2 - Creating a Grid File, is located in **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 12\Samples.
4. Click *Open.* The map is created using the default settings.
5. Click on the contour map layer to select it.
6. In the **Property Manager**, 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 with the default color scale.

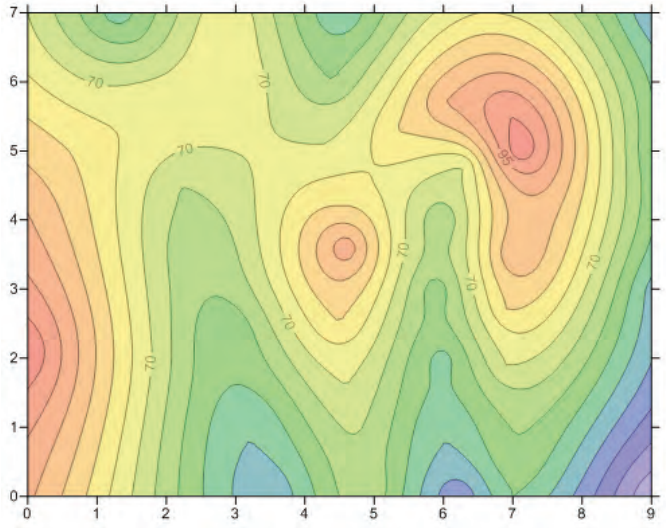
Adding Transparency to Map Layers

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. The properties are displayed in the **Property Manager**.

Adjusting the *Opacity* may be useful when you have multiple map layers and need to make one or more layers semi-transparent to best represent your data.

To add transparency to a contour map:

1. Click on the contour map to select it.
2. In the **Property Manager**, click on the **Levels** page.
3. Click the color bar next to *Fill colors*. Select *Rainbow* from the list.
4. Click on the **Layer** tab.
5. Highlight the existing 100% value next to the *Opacity* option and type 43.
6. Press ENTER on the keyboard and the opacity for the entire layer is decreased to 43%.



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, image, and vector maps. The color scale displays the colors assigned to levels in a filled contour map or 3D wireframe, the colors used in an image map or 3D surface, and the fill assigned to vector symbols.

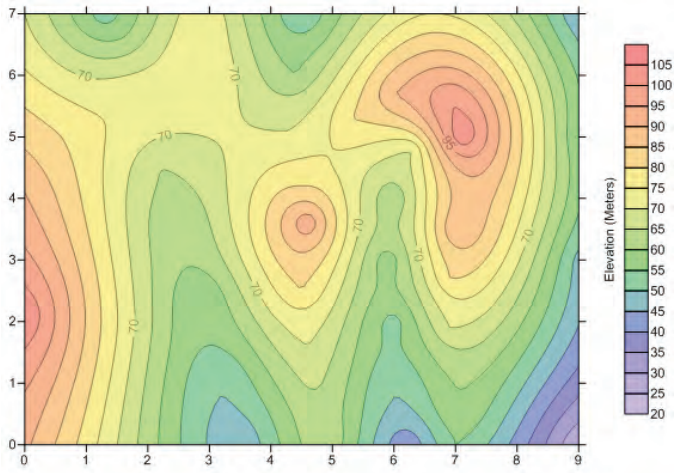
To add and edit a color scale to the contour map:

1. Click on the contour map layer to select it. The properties are displayed in the **Property Manager**.
2. Click on the **Level** tab. Be sure the *Fill contours* options is checked.
3. Click the ⊞ next to *Filled Contours* to open the *Filled Contours* section, if it is not already open.

4. Check the box next to *Color scale*. A default color scale is created. A new *Color Scale* object is added to the **Object Manager**.
5. Click on the color scale bar in the **Object Manager** to select it.
6. In the **Property Manager**, click on the **General** tab to edit the color scale properties.
7. You may wish to change the *Opacity* to 43% to match the contour map.
8. Make adjustments to the label or line properties. The color scale bar is automatically updated with the changed properties.

To add a title to the color scale bar:

1. Click the **Draw | Text** command, or the  button. Click to the left of the scale bar. The **Text Editor** opens.
2. In the **Text Editor**, type the text: *Elevation (Meters),*
3. Click *OK*.
4. Press the ESC key on the keyboard to exit the text drawing mode.
5. Click on the *Text* object in the **Object Manager** to select the new text object.
6. Click the **Arrange | Rotate** command.
7. In the Rotate dialog, highlight the *0* and type *90* in the *Counterclockwise rotation in Degrees* box.
8. Click *OK*.
9. Click and drag the text box to position it next to the color scale.
10. Select the color scale and the text in the **Object Manager** by selecting the first object, holding the CTRL key, and selecting the second object.
11. Once only those two objects are selected, use the **Arrange | Group** command to create a *Group* object. Items in a grouped object can be individually edited, but they are moved together. To move the items individually, use the **Arrange | Enter Group** command.



The map and color scale Group object are shown in this image. The color scale shows the same opacity as the contour map, so that the colors match.

Adding a Shaded Relief Map Layer

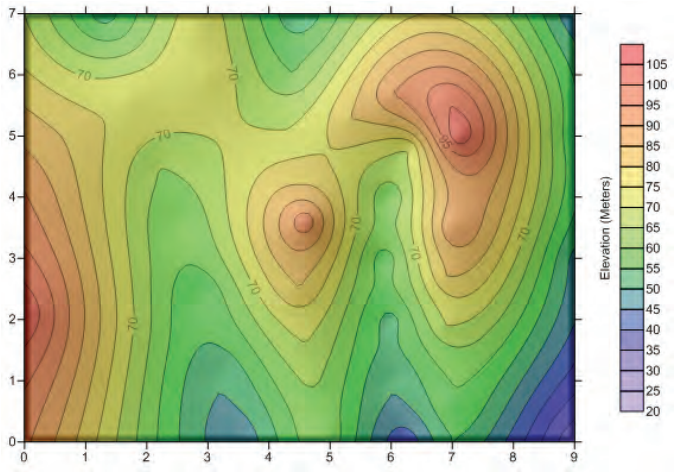
Adding a shaded relief map layer to the existing semi-transparent map will help display the elevation behind the contour fill.

To add a shaded relief map layer:

1. Click on *Contours-TutorWS.grd* in the **Object Manager** to select the contours.
2. Click the **Map | Add | Shaded Relief Layer** command.
3. In the **Open Grid** dialog, select the file *TutorWS.grd* 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 12\Samples.
4. Click *Open*.

A shaded relief layer is added to the map object in the **Object Manager**. Notice how the shadows of the shaded relief map layer help distinguish the topography of the grid file.

In the **Object Manager**, you may want to click the check mark next to the *Contours-TutorWS.grd* or *Shaded Relief-TutorWS.grd* layers to toggle the visibility of the maps on and off.



The shaded relief map is visible behind the partially transparent contour map.

Adding a Map Title

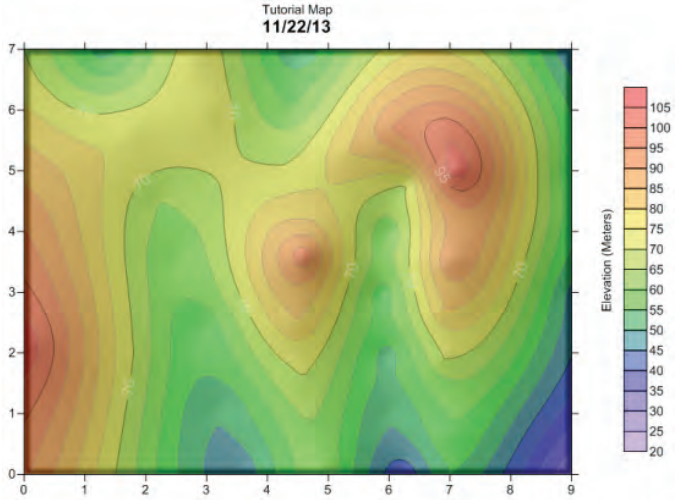
Adding a title to a map is a great way to stay organized and create publication quality maps.

To add a title to the tutorial map:

1. Click once on the *Top Axis* in the **Object Manager** to select it.
2. In the **Property Manager**, 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 Σ button to open the **Text Editor**. This dialog allows multiple lines of text to be created or individual characters to have a different appearance.
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 1/1-AM button.
7. In the Insert Date/Time dialog, select the desired date format. For instance, select *mm/dd/yy*.
8. Click *Insert*.
9. Highlight the date in the **Text Editor**.
10. Click the **B** button to make the highlighted text bold.

11. Change the *Size (points)* to 14. The size is located immediately to the right of the font name.
12. Click *OK* to close the **Text Editor**.

The map is automatically updated with the new map title.



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

Lesson 10 - Creating Maps from Different Coordinate Systems

Map layers from different coordinate systems can be created in the same map object. **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.

What is a Map 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.

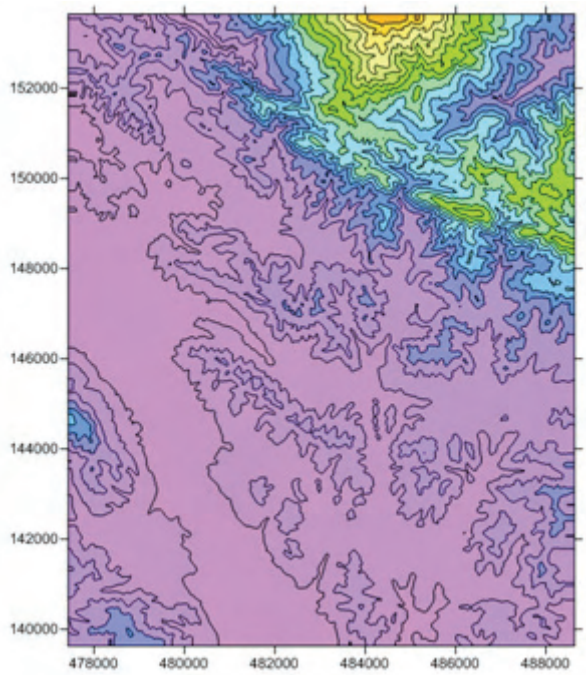
What is a Coordinate System Used For?

If your data, grids, and base maps are in different coordinate systems, you will want to set the coordinate system for each map layer and the entire map. If you want to change the projection of your data, grid, or base map, you will want to set the coordinate system.

Creating the First Map Layer

To create a map layer with a defined coordinate system in **Surfer**:

1. Click the **File | New | Plot** command or click the  button to open a new plot window.
2. Click **Map | New | Contour Map** to create the first map layer, a new contour map.
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 12\Samples.
4. *Click Open*. The contour map is created.
5. Click on *Contours-Diablo.grd* in the **Object Manager** to select the contour layer.
6. In the **Property Manager**, 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 *State Plane 1927 - California III (Meters)*, as shown in the *Name* field.



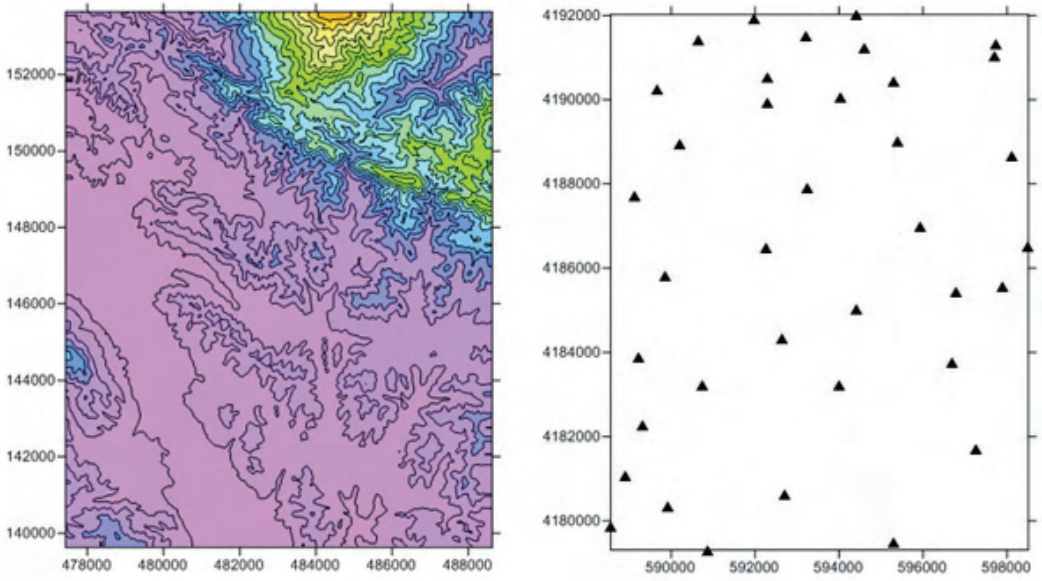
The first map layer is created with a predefined coordinate system.

Adding a Post Map Layer

Maps can be created without predefined coordinate systems and assigned the correct coordinate system in the map properties. To add a new map with a post map layer:

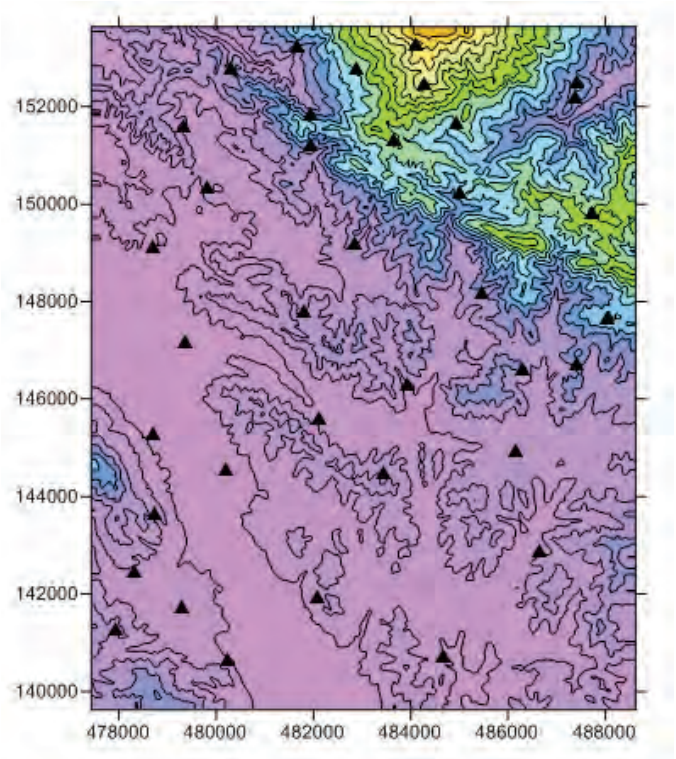
1. Create a new post map with the **Map | New | Post Map** command.
2. In the **Open Data** dialog, select the *Diablo Example.dat* file in the **Surfer** *Samples* directory. If you are not in the *Samples* folder, browse to it. By default, the *Samples* folder is located in c:\Program Files\Golden Software\Surfer 12\Samples.
3. Click *Open*.
4. Click on the *Map* that contains the post map and drag it in the plot window so that the two maps are side by side. Note that the axes on the two maps have very different coordinates.
5. Click on *Post-Diablo Example.dat* in the **Object Manager** to select the post layer.
6. In the **Property Manager**, click on the **Coordinate System** tab. Note that the post map does not have a predefined coordinate system.
7. Click the *Set* button to define the coordinate system for the post map. Since we know this coordinate system, we can set it.

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



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

14. In the **Object Manager**, click and drag the *Post-Diablo Example.dat* map layer into the *Map* object that contains 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.



The two maps are overlaid. Notice that the axes use only one of the map layer's limits.

Setting the Target Coordinate System for the Map

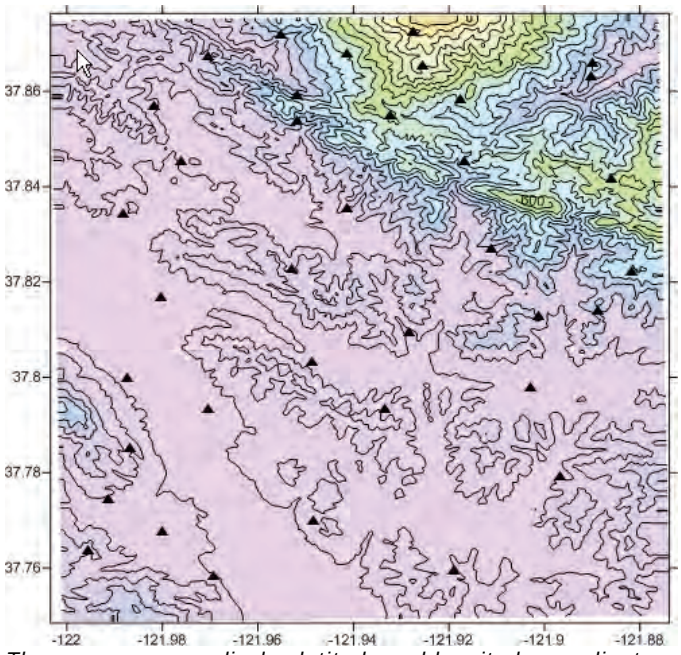
The target coordinate system is the system displayed on the map axes. Once the map layer is defined, the target coordinate system can be changed to any desired coordinate system.

To change the target coordinate system:

1. Click on the *Map* object in the **Object Manager**.
2. In the **Property Manager**, 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* to select it.

7. Click *OK*.

On the **Coordinate System** tab, the map now has a different coordinate system than either the contour or post map layers. Notice that the axes are now showing latitude and longitude values, as well.



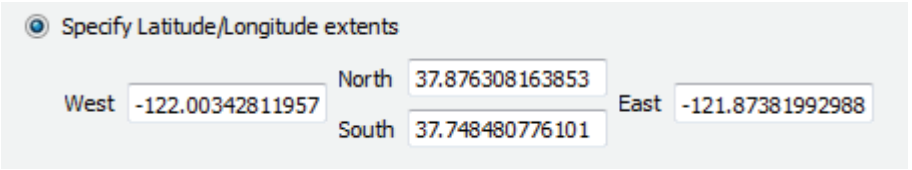
The map axes now display latitude and longitude coordinates.

Downloading an Online Base Map Layer

New layers with any coordinate system can be added to the map. To add a new map layer an online web map server:

1. Click anywhere on the map to select it.
2. Click the **Map | Add | Base Layer from Server** command or click the button to download an image base map from a web mapping server.
3. In the **Download Online Maps** dialog, click the ▷ next to *Imagery*.
4. Click the ▷next to the *NAIP Color Imagery for US* server name.
5. Click on the *Orthoimager/USGS_EDC_Ortho_NAIP* layer.

6. Notice the *Specify Latitude/Longitude Extents* is selected with the boundaries of the selected *Map*.



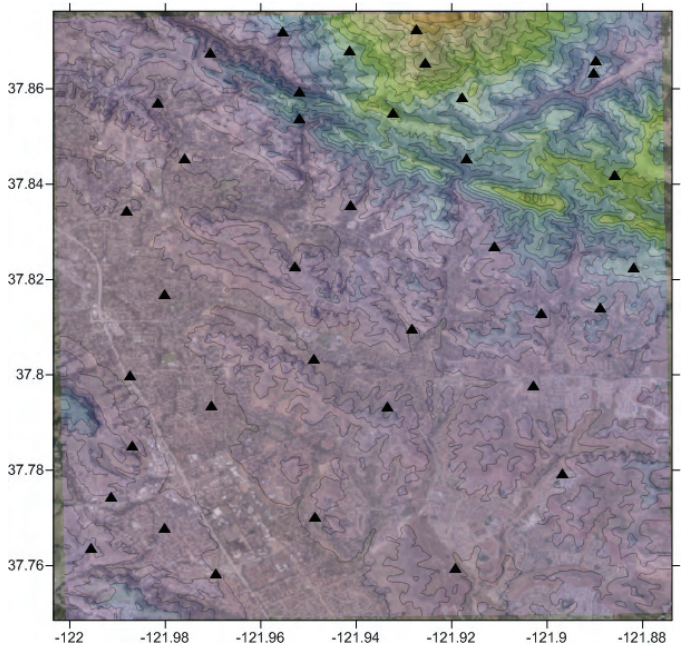
The Specify Latitude/Longitude extents is automatically filled with the extents of the existing map.

7. In the *Select Image Resolution to Download* section, drag the slider to the right to increase the image resolution. The farther to the right the slider is located, the better the resolution and the larger the image. Clicking on one of the lines in the middle toward the left side of the slider downloads a map of sufficient quality that is smaller in size.
8. Click *OK* and the base layer downloads. The base layer is automatically placed behind the contour and post layers.
9. Click on the *Base - Orthoimagery/USGS_EDC_Ortho_NAIP* layer in the **Object Manager** to select the new base layer.
10. In the **Property Manager**, click on the **Coordinate System** tab. Note that the base layer was imported with a coordinate system already specified. This map layer is in World Geodetic System 1984, as shown in the *Name* field.

The base map layer was automatically placed behind the existing layers. Because the contour map layer is filled, the contour map layer must be made partially transparent to see the base map layer behind it.

To make the contour map layer partially transparent:

1. Click on the *Contours-Diablo.grd* in the **Object Manager** to select the contour map layer.
2. In the **Property Manager**, click on the **Layer** tab.
3. Click and drag the  until the opacity is approximately 40%. Alternatively, highlight the existing value and type 40. Press ENTER on the keyboard and the contour map layer is now partially transparent and the base map layer can be seen behind the contours.



Once the contour layer is partially transparent, the base map layer can be viewed behind the contours.

Adding Text to the Base Map Layer

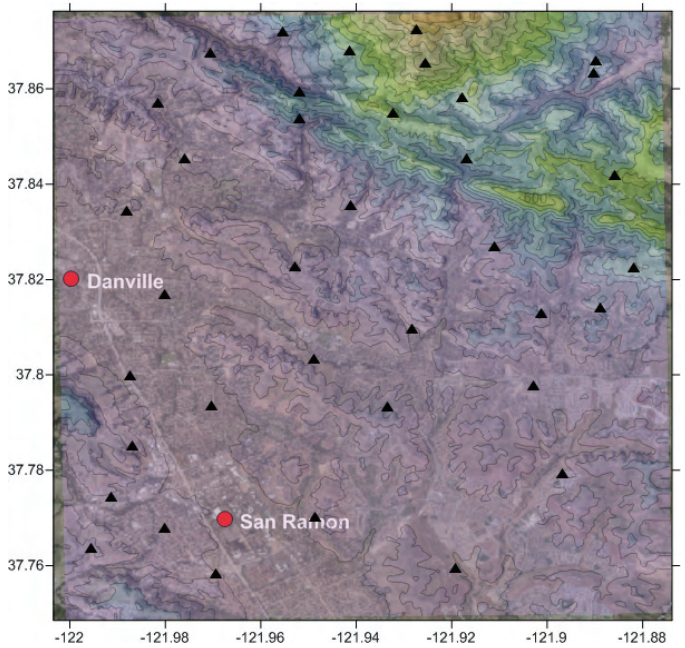
Text is often added to base maps to clarify portions of the map. To enter the base map layer and add location names, the *Map* must have the same coordinate system defined as the base map layer. Since both the *Base-Orthoimagery/USGS_EDC_Ortho_NAIP* map layer and the *Map* are in *World Geodetic System 1984,* the labels can be added to the base map layer.

To add the labels:

1. Click on *Base-Orthoimagery/USGS_EDC_Ortho_NAIP* layer in the **Object Manager** to select the base map layer.
2. Click the **Arrange | Enter Group** command. This allows the base map to be directly edited.
3. Click the **Draw | Symbol** command.
4. Click on the screen in the desired area. For the first object, click at approximately -121.97, 37.77. A cross hair symbol appears at the location.
5. Click on the screen at the second area, at approximately -122.00, 37.82. Another cross hair symbol appears.

6. Press ESC on the keyboard to end drawing mode.
7. Click on the first symbol to select it.
8. In the **Property Manager**, on the **Symbol** tab, change the *Symbol* to a filled circle.
9. Change the *Fill color* to *Red*.
10. Repeat steps 7-9 for the second symbol.
11. Click the **Draw | Text** command.
12. Click on the screen in the desired area. For the first text object, click to the right of the first red symbol.
13. In the **Text Editor**, type the text that should be added to the map. For instance, you might add the city name of *San Ramon*.
14. Click *OK* and the text is added to the base map layer.
15. Repeat steps 11 through 14, adding the city name of *Danville* to the second red circle.
16. Click the **Arrange | Exit Group** command to return to normal editing mode. The text is now a part of the base map and will stay in the same relative map location as the map changes.
17. To change the text properties of the city names, click the ⊞ next to *Base-Orthoimagery/USGS_EDC_Ortho_NAIP* in the **Object Manager**.
18. Click on the *Text* object just below the base name. The *Danville* text is highlighted on the map.
19. In the **Property Manager**, click on the **Text** tab.
20. Click the ⊞ next to *Font Properties* to open the font section.
21. Make any desired changes. For instance, change the *Size (points)* to a larger value, check the box next to *Bold*, or change the *Foreground Color*.
22. Repeat steps 18 through 21 with the second *Text* object. The *San Ramon t*ext is highlighted on the map and changed.

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 text identifying the cities in the map area.

Optional Advanced Lessons

By completing Lesson 1 through 10 of the tutorial, you now have a basic understanding of **Surfer** and how to create and customize basic maps. The remaining tutorial lessons are optional advanced lessons.

Lesson 11 - Custom Toolbars and Keyboard Commands

If you use a command frequently, you may want to add the command button to an existing toolbar or create a new custom toolbar. This can easily be accomplished in **Surfer**.

To create a custom toolbar:

1. Select the **Tools | Customize** command to open the **Customize** dialog.
2. Click on the **Toolbars** tab. Click the *New* button. The **Toolbar Name** dialog opens.
3. Type a name for the new toolbar, such as *My Custom Commands*. Click *OK*. An empty condensed floating toolbar will appear.

4. Drag the new toolbar to the top of the **Surfer** screen to dock it next to the other toolbars.

The floating condensed toolbar appears first.

Dock the custom toolbar near existing toolbars. In this example, the empty custom toolbar is docked to the right of the map toolbar.

To add a button or command to a toolbar or menu:

1. If the **Customize** dialog is not still open, open it by clicking the **Tools | Customize** command.
2. Click on the **Commands** tab. The **Commands** page displays all of the **Surfer** menus in the *Categories* list.
3. Select a category from the *Categories* list.
4. Select a menu command from the *Commands* list.
5. Drag the command to a toolbar. Continue adding commands as needed.
6. When you are done creating your custom toolbar, click *Close* in the **Customize** dialog.
7. The custom toolbar can be toggled on or off with the **View | Toolbars** command.

*This custom toolbar has many common **Help** menu commands.*

Creating Keyboard Shortcuts

There are often times where you may use a command often enough to merit creating a custom keyboard shortcut. This can easily be accomplished in **Surfer**.

The **Help | Keyboard Map** command displays a list of the current keyboard commands. The *Category* list contains the menu commands for the selected accelerator. The *Show Accelerator for* list allows you to view the keyboard commands for the *Plot Document, Grid Document,* or *Worksheet*.

In this example, we will create a custom keyboard shortcut for the commonly used **Grid | Data** command.

To create a custom keyboard command:

1. Let's verify that the **Grid | Data** command does not have a keyboard shortcut assigned to it. Click **Help | Keyboard Map**.
2. In the **Help Keyboard** dialog, change the *Category* to Grid.
3. Visually scroll down the list of **Grid** menu commands. Notice that there is no *Keys* assigned to GridData. Close the dialog by clicking the X in the upper right corner of the dialog.
4. Click the **Tools | Customize** command to open the **Customize** dialog.
5. Click on the **Keyboard** tab to open the Keyboard page.
6. Select *Plot Document* from the *Set Accelerator for* list.
7. Select *Grid* from the *Category* list.
8. Select *Data* from the *Commands* list.
9. Click in the box next below *Press New Shortcut Key*.
10. Press the CTRL + SHIFT + D keys on the keyboard. The shortcut will appear automatically in the *Press New Shortcut Key* box.
    a. If no other command has this keyboard shortcut, *[Unassigned]* will be displayed below *Assigned to*. If the shortcut is not assigned to another command, click the *Assign* button. The shortcut is added to the *Current Keys* list.
    b. If another command has the keyboard shortcut, the command is listed below *Assigned to*. If this is the case, the *Assign* button is grayed out. Select a different shortcut key for the command. Each shortcut key can be assigned to only one command.
11. Once you have assigned CTRL + SHIFT + D to the *Plot Document, Grid | Data* command, click the *Close* button.
12. In the plot window, press the CTRL + SHIFT + D command on the keyboard. The **Grid | Data** command is executed, and the **Open Data** dialog opens.

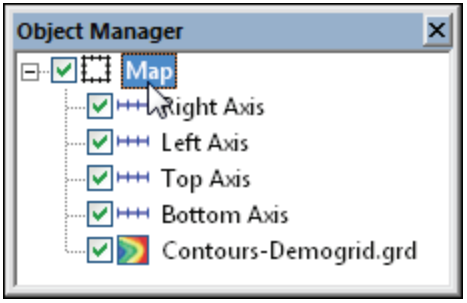
Lesson 12 - Overlaying Map Layers

Surfer 12 has three methods of overlaying map layers onto a single map object. You can drag a map layer from one map object to another map object in the **Object Manager**, you can select a map and click the **Map | Add** command to add a map layer, or you can select multiple map objects and use the **Map | Overlay Maps** command.

This tutorial will cover all three methods that are available to overlay map layers in **Surfer**. This tutorial will also cover combining maps from different **Surfer .SRF** files.

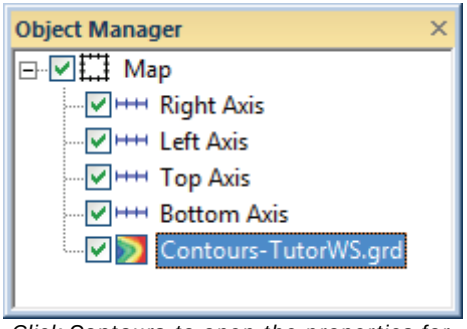
Before we start, it is important to understand the difference between a map object and a map layer. The **Object Manager** is the easiest place to see the difference between a map object and a map layer.

- A map object is listed in the **Object Manager** as *Map*. A map object consists of axes and an optional map layer or map layers. Click on the *Map* object to open the map properties in the **Property Manager**, where the *View, Scale, Limits, Frame, Coordinate System*, and *Info* are controlled.



Click the Map *object to display properties for the entire map in the* ***Property Manager***.

- A map layer is listed in the **Object Manager** as the map type name (i.e. *Contours*). A single map layer or multiple map layers can be part of a map object. Click on the map layer (i.e. *Contours*) to open the properties for the selected map type (i.e. contour map properties) in the **Property Manager**. The specific properties related to the map type are controlled separately from the entire map properties.

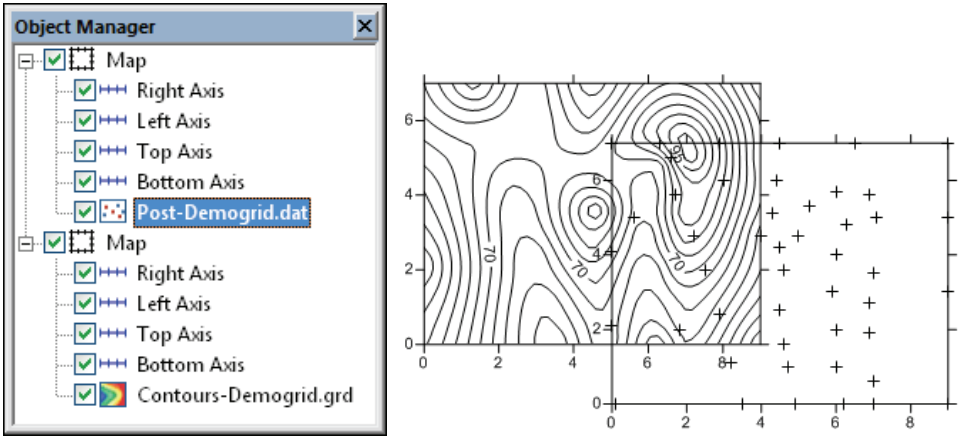


Click Contours *to open the properties for the contour map in the* ***Property Manager***.

Method 1: Overlaying Two Existing Maps by Dragging in the Object Manager

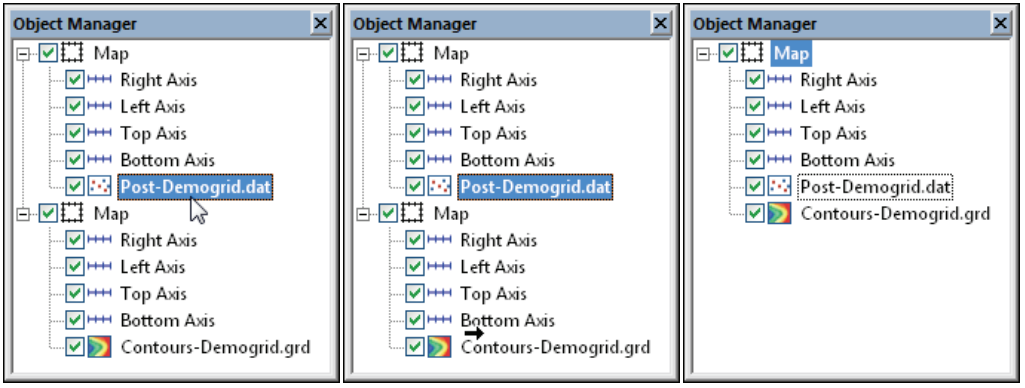
We will start by creating two separate map objects. In this method, we will create a post map and a contour map. Note that each map has an independent set of axes before they are overlaid. After the maps are overlaid, they share a set of axes.

1. Click the **File | New | Plot** command to open a blank plot window.
2. Click the **Map | New | Contour Map** command.
3. In the **Open Grid** dialog, select the *Demogrid.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 12\Samples.
4. Click *Open*.
5. Leave *Unreferenced local system* selected in the **Assign Coordinate System** dialog and click *OK*. The contour map is displayed in the plot window and the **Object Manager**.
6. Click the **Map | New | Post Map** command to create a second map.
7. In the **Open Data** dialog, select the sample file *Demogrid.dat* 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 12\Samples.
8. Click *Open*.
9. Leave *Unreferenced local system* selected in the **Assign Coordinate System** dialog and click *OK*. The post map is displayed in the plot window and the **Object Manager**.

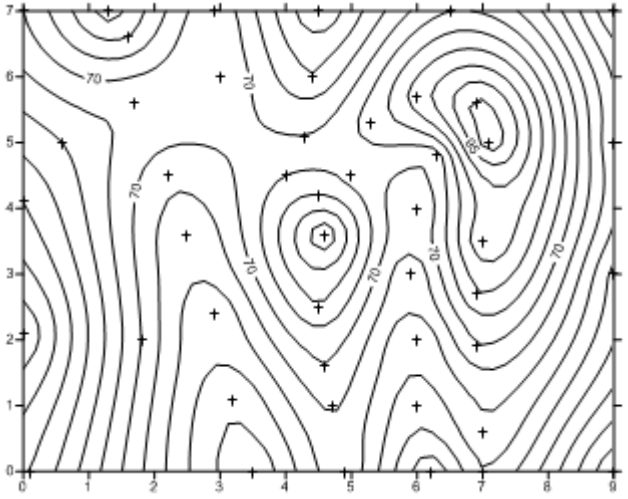


*The contour map layer and the post map layer are displayed in separate map objects in the **Object Manager** and the plot window.*

10. Click on the *Post* map layer in the **Object Manager**. Hold down the left mouse button and drag the *Post* map layer to the map that contains the *Contours* map layer. When the cursor changes to a horizontal arrow, release the left mouse button, and the map layer is added to the new map frame. The post map will now be overlaid on the contour map with a single *Map* object.



Click on the post map layer (left). Drag the post map layer to the other map object. When the cursor is a horizontal arrow (middle), release the mouse button to drop the map layer in the new location (right).



The post map layer was dragged to overlay on top of the contour map layer. The Map object now has two map layers (Post, Contours).

11. Additional map layers from other map objects can be overlaid on this map object using any of the three methods.

Method 2: Overlaying Two Existing Maps by using the Map | Add Command

This method eliminates the requirement to make two maps before overlaying. Start with one map object with any number of map layers. Click the **Map | Add** command to immediately add a new map layer to an existing map object.

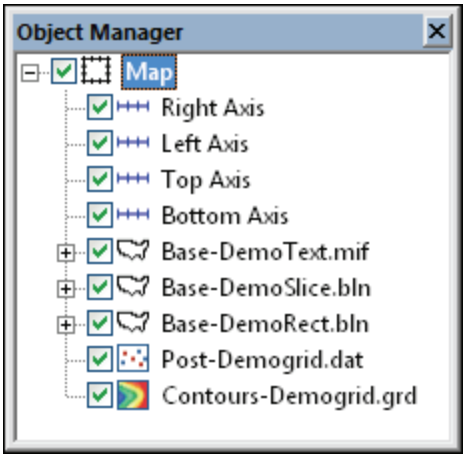
1. Select the map created in Method 1.
2. Click the **Map | Add | Base Layer** command. Alternatively, right-click once on the map or one of the map layers and click *Add* | *Base Layer*.
3. In the **Import** dialog, select the *Demorect.bln* file from **Surfer's** *Samples* folder. If you are not in the *Samples* folder, browse to it. By default, the *Samples* folder is located in c:\Program Files\Golden Software\Surfer 12\Samples.
4. Click *Open.*
5. Leave *Unreferenced local system* selected in the **Assign Coordinate System** dialog and click *OK*. A base map of a rectangle is displayed in the plot window and the **Object Manager** as a new map layer to the existing *Map* object.

Method 3: Overlaying Maps with the Map | Overlay Maps Command

This method works well when you have multiple maps and map layers to overlay and the maps already exist.

1. Click the **Map | New | Base Map** command.
2. In the **Import** dialog, select the *Demoslice.bln* 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 12\Samples.
3. Click *Open*.
4. Leave *Unreferenced local system* selected in the **Assign Coordinate System** dialog and click *OK*. The new base map is displayed in the plot window and the **Object Manager** in a separate map object.
5. Click the **Map | New | Base Map** command.
6. In the **Import** dialog, select the *DemoText.mif* 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 12\Samples.
7. Click *Open*.
8. Leave *Unreferenced local system* selected in the Assign Coordinate System dialog and click *OK*. The new base map is displayed in the plot window and the Object Manager in a separate map object.
9. Click the **Edit | Select All** command to select all three map objects.

10. Click the **Map | Overlay Maps** command. The three separate map objects are combined into a single map object with 5 map layers.



All maps are displayed as separate layers in the same Map *object.*

Method 4: Combing Maps from Different Surfer Files

This method works well when you have multiple maps in different plot windows.

1. Click the **File | New | Plot** command.
2. Click the **Map | New | Base Map** command.
3. In the **Import** dialog, select the *Demoslice.bln* 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 12\Samples.
4. Click *Open*.
5. Leave *Unreferenced local system* selected in the **Assign Coordinate System** dialog and click *OK*. The new base map is displayed in the plot window and the **Object Manager** in a separate map object.
6. Click the **File | New | Plot** command.
7. Click the **Map | New | Base Map** command.
8. In the **Import** dialog, select the *DemoText.mif* 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 12\Samples.
9. Click *Open*.
10. Leave *Unreferenced local system* selected in the **Assign Coordinate System** dialog and click *OK*. The new base map is displayed in the plot window.
11. Click the **Edit | Select All** command to select the entire map object.

12. Click the plot tab for the first plot window or click the **Window | Plot** name.
13. Click the **Edit | Paste** command.
14. Click the **Edit | Select All** command to select both map objects.
15. Click the **Map | Overlay Maps** command. The separate maps are combined into a single map object with 2 map layers.

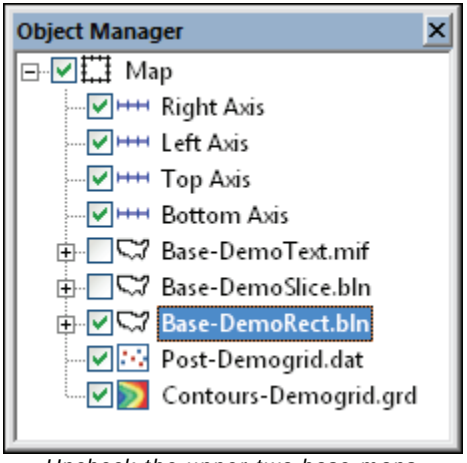
Lesson 13 - Blank A Grid File

Surfer creates grid files that are always rectangular or square. When you need to have a grid file where the contour lines are not rectangular or square, the grid will need to be blanked. The **Grid | Blank** command combines an irregularly shaped blanking .BLN file with a rectangular grid file. The result is a new grid file where the contours stop at the boundary of the blanking file.

To display a base map of a blanking file on a contour map:

In the previous lesson (Overlaying Map Layers) in method 1-3, you created a map with a contour map layer, a post map layer, and a three base map layers. The first base map displays the rectangular area of interest, while the contour map displays a larger area than we need to display. Using the blanking command, we will create a new grid file that has everything outside the base map rectangle blanked.

Click on the plot window that contains the overlaid map layers from the previous lesson. Click on the ☑ next to the upper two base maps. This will turn the display of these base maps off.

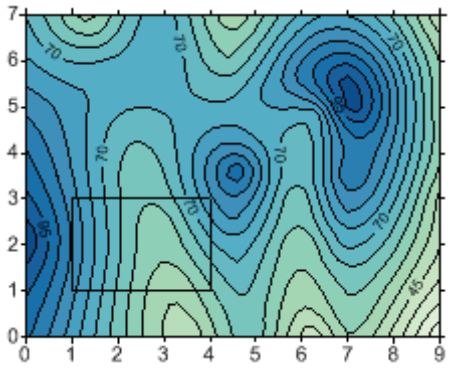


Uncheck the upper two base maps so only the contour, post, and original base map are displayed.

To blank the grid file:

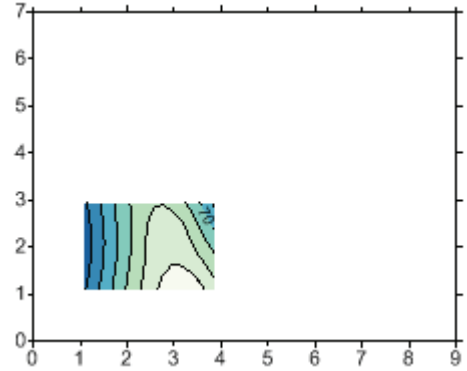
1. Before blanking, click the **File | Open** command.
2. Select the *Demorect.bln* file from **Surfer's** *Samples* folder. If you are not in the *Samples* folder, browse to it. By default, the *Samples* folder is located in c:\Program Files\Golden Software\Surfer 12\Samples.
3. Click *Open*. The .BLN file opens in the worksheet.
4. The first row displays the blanking header information. Cell A1 displays the total number of vertices (in this example, 5). Cell B1 displays the blanking flag. The blanking flag can be either a "0" to indicate "blank outside" or a "1" to indicate "blank inside". We want to blank outside the rectangle, so ensure the blanking flag is set properly. A blanking flag of zero is shown in cell B1, so the file can be closed without any changes. Click **File | Close**.
5. In the plot window, click the **Grid | Blank** command.
6. In the **Open Grid** dialog, select the *Demogrid.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 12\Samples. Click *Open*. This is the grid file used to create the original contour map.
7. In the **Open** dialog, select the *DemoRect.bln* 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 12\Samples. Click *Open.* This is the boundary file displayed on the map.
8. In the **Save Grid As** dialog, type a *File name*, such as *Demogrid_Blanked.grd*. Change the *Save as type* to the desired grid file format. Select *GRD Surfer 7 Binary Grid (*.grd)* to save a **Surfer** grid file. Click *Save*.
9. A **Surfer** dialog confirms the location and name of the blanked grid file created. Click *OK*.
10. Click once on the existing contour map layer to select it.
11. In the **Property Manager**, click on the **General** tab. Next to *Grid file*, click the  button. The **Open Grid** dialog appears. Select the new *Demogrid_Blanked.grd* file and click *Open.*
12. Leave the *Unreferenced local system* selected in the **Assign Coordinate System** dialog and click *OK*.
13. The contour map is updated with the blanked grid file.

Before Blanking:



The blanking file is displayed as a base map layer on the contour map.

After Blanking:



This is a contour map created from the blanked grid file.

Lesson 14 - Changing the Projection in the Worksheet

The **New Projected Coordinates** command in the worksheet allows you to specify a new projection and datum for your data. A coordinate conversion adjusts the values of the existing coordinate system and maps them to new values.

A common example of when you would use the **New Projected Coordinates** command would be if your base map is in latitude/longitude but your data file is in UTM. You can use this command to convert the data file from UTM to latitude/longitude so that you can overlay it with your base map.

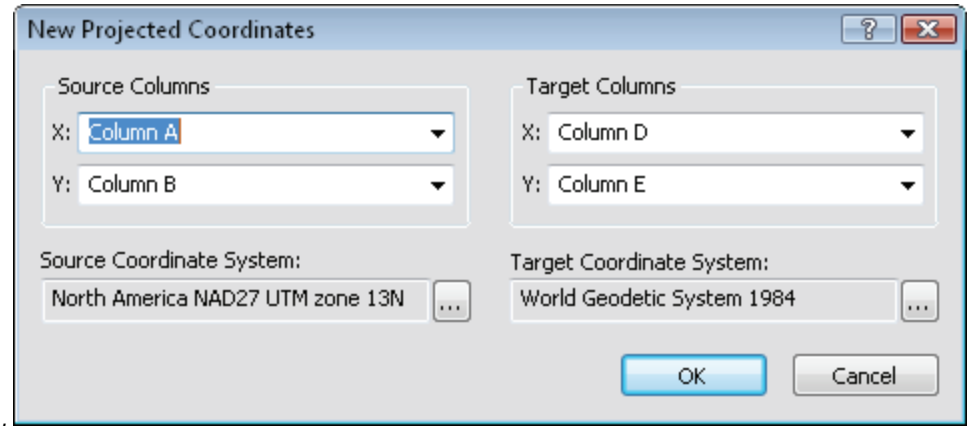
In this example, we will convert a grid file to a data file. Once we have a data file, we will import the data file into the **Surfer** worksheet and change the UTM coordinates to latitude/longitude.

To convert a grid file to a data file:

1. Use the **File | New | Plot** command to open a new blank plot window.
2. In the plot window, click the **Grid | Convert** command.
3. In the **Open Grid** dialog, select the sample file TutorialTerraServ.GRD 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 12\Samples. Click *Open*.
4. In the **Save Grid As** dialog, change the *Save as type* to *DAT XYZ (*.dat)*.
5. Enter the *File name Tutorial14.dat*, and click *Save*. The data file is saved.

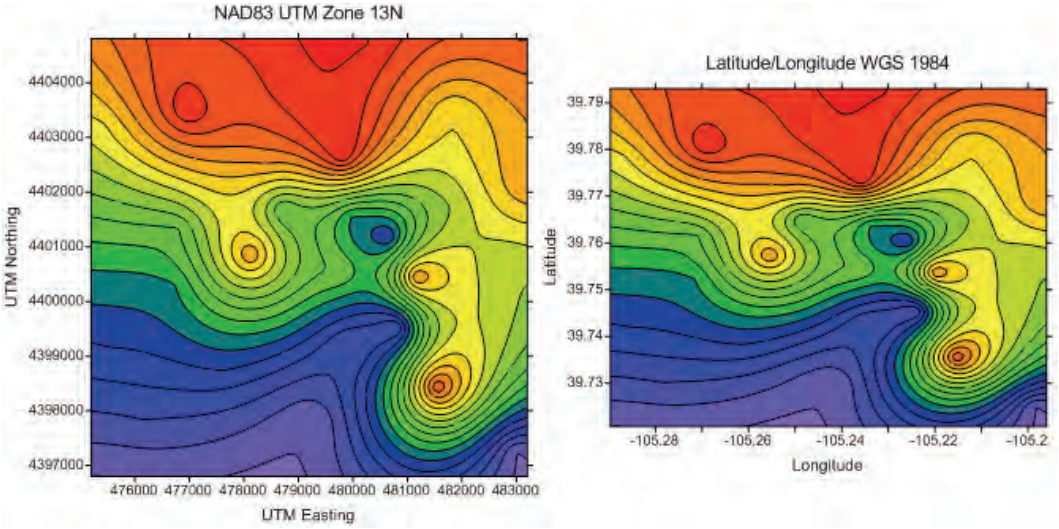
To change the projection in the worksheet:

1. Use the **File | Open** command. In the **Open** dialog, select the *Tutorial14.dat* file and click *Open*. The data file opens in the worksheet.
2. Use the Data | New Projected Coordinates command to open the **New Projected Coordinates** dialog.
3. In the **New Projected Coordinates** dialog, change the *Source Columns* (the columns containing the data you want to reproject) to *X: Column A*, *Y: Column B*.
4. Click the  button to set the *Source Coordinate System* (the current projection of the source data). The Assign Coordinate System dialog opens.
5. In the **Assign Coordinate System** dialog, click the ⊞ button to the left of *Predefined*.
6. Click the ⊞ next to *Projected Systems.*
7. Click the ⊞ next to *UTM.*
8. Scroll down and click the ⊞ button to the left of *North America*.
9. Scroll down and select *North America NAD83 UTM zone 13N.* If you will use this projection often, click the *Add to Favorites* button to save this projection to your *Favorites* list to help easily locate *North America NAD83 UTM zone 13N* in the future.
10. Once the projection is selected, click the *OK* button. The *Source Coordinate System* is updated with the selected projection in the **New Projected Coordinates** dialog.
11. Specify the *Target Columns* (the columns you want the reprojected data to go into) to *X: Column D, Y: Column E.*
12. Click the  button to set the *Target Coordinate System* (the projection you want the data to be projected to). The **Assign Coordinate System** dialog opens.
13. In the **Assign Coordinate System** dialog, click the ⊞ button to the left of *Predefined.*
14. Click the ⊞ button next to *Geographic (lat/lon)*.
15. Scroll down and select *World Geodetic System 1984*. If you will use this projection often, click the *Add to Favorites* button to save this projection to your favorites list to help easily locate *World Geodetic System 1984* in the future.
16. Once the projection is selected, click *OK*. The *Target Coordinate System* is updated with the selected projection in the **New Projected Coordinates** dialog.



*Specify the Source and Target columns and coordinate systems in the **New Projected Coordinates** dialog.*

16. Click the *OK* button in the **New Projected Coordinates** dialog. The new longitude and latitude data are displayed in the target columns specified (column D and E).
17. Use the **File | Save** command to save the updated data file.
18. In the **Data Export Options** dialog, set the *Delimiter* to Comma and the *Text Qualifier* to None. Click *OK*. The updated file is saved.
19. Click the **File | Close** command to close the worksheet window. Alternatively, click on the **Plot1** tab to switch back to the plot window.
20. In the plot window, click the **Grid | Data** command to create a grid file from the new data file.
21. In the **Open Grid** dialog, select the data file and click the *Open* button to open the **Grid Data** dialog.
22. In the **Grid Data** dialog, change the *Data Columns* to *X: Column D*, *Y: Column E*, and *Z: Column C*. Select *Kriging* for the *Gridding Method*. Leave the *Output Grid File,* and *Grid Line Geometry* groups set to the defaults. Uncheck the *Grid Report* option.
23. Click the *OK* button to create the grid file. A **Surfer** dialog appears with the full location and name of the created grid file.
24. Use the **Map | New | Contour Map** command to open the **Open Grid** dialog.
25. Select the grid file and click the *Open* button to create a contour map from the new grid file.



In this example, the coordinate data was used to create a grid file. The grid file was used to create two contour maps. The map on the left was created from the original coordinates (NAD83 UTM zone 13N). The map on the right was created from the new projected coordinates (Latitude/Longitude WGS 1984).

Tutorial Complete

Congratulations! You have completed the **Surfer** tutorial lessons.

If you have questions, try looking for answers in the online help, quick start guide, online knowledge base, and interactive forum. If you find you still have questions, do not hesitate to contact Golden Software's technical support team.