Surfer® 10

Contouring & 3D Surface Mapping for Scientists & Engineers

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®   Quick Start Guide

Contouring and 3D Surface Mapping
for Scientists and Engineers

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January 2011

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Introduction to Surfer

Welcome to **Surfer**, a powerful contouring, gridding, and surface mapping program for scientists, engineers, educators, or anyone who needs to generate maps quickly and easily.

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, 3D surface, and 3D wireframe maps. Maps can be displayed and enhanced in **Surfer**, allowing you to produce the map that best represents your data. Adding multiple map layers, customizing the map display, and annotating maps with text allows you to create publication quality maps.

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, create an isopach map from two grid files. An isopach map shows the difference between two surfaces. 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.

New Features of **Surfer 10** are summarized:

- Online at: www.GoldenSoftware.com/products/surfer/surfernew.shtml
- In the program: click **Help | Contents** and click on the *New Features* page in the *Introduction* book

Who Uses Surfer?

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

System Requirements

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

- Windows XP SP2 or higher, Vista, 7, or higher
- 512MB RAM minimum for simple data sets, 1GB RAM recommended
- At least 100 MB of free hard disk space
- 1024 x 768 or higher monitor resolution with a minimum 16-bit color depth

Installation Directions

Installing **Surfer 10** requires logging onto the computer with an account that has Administrator rights. Golden Software does not recommend installing **Surfer 10** over any previous versions of **Surfer**. **Surfer 10** can co-exist with older versions (i.e. **Surfer 9**) as long as they are installed in different directories, which is the default. For detailed installation directions, see the Readme.rtf file.

To install **Surfer** from a CD:

1. Insert the **Surfer** CD into the CD-ROM drive. The install 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. Choose **Install Surfer (32-bit)** or **Install Surfer (64-bit)** 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 **Surfer**, open the program and click 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** 10.0 to **Surfer** 10.1), you will be prompted to download the update.

Uninstalling Surfer

Windows XP: To uninstall **Surfer**, go to the Control Panel and double-click *Add/ Remove Programs*. Select **Surfer 10 (32-bit)** or **Surfer 10 (64-bit)** from the list of installed applications. Click the *Remove* button to uninstall **Surfer 10**.

Vista and 7: To uninstall **Surfer** when using *Regular Control Panel Home*, click *Uninstall a program*. Select **Surfer 10 (32-bit)** or **Surfer 10 (64-bit)** from the list of installed applications. Click the *Uninstall* button to uninstall **Surfer 10**.

Vista: To uninstall **Surfer** when using *Classic View Control Panel,* double-click *Programs and Features*. Select **Surfer 10 (32-bit)** or **Surfer 10 (64-bit)** from the list of installed applications. Click the *Uninstall* button to uninstall **Surfer 10**.

A Note about the Documentation

The **Surfer** documentation includes this quick start guide and the 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. In the event the information you need cannot be located in the online help, other sources of **Surfer** help include our support forum, knowledge base, FAQs, and contacting our technical support engineers.

If you prefer printed documentation, you may print the online help in part or in full. See the *Printing the Online Help* section on page 45 for more information.

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

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

Three-Minute Tour

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

Example Surfer Files

To see example **Surfer** files:

1. Open **Surfer**.
2. Click the **File | Open** command and click on an .SRF file located in the Samples folder. By default, the **Surfer** installation folder is located in C:\Program Files\Golden Software\Surfer 10\ Samples.

CoordinateSystems.srf

The coordinate systems sample file contains a map with multiple map layers. The image map layer is color filled and in a State Plane coordinate system. The two base map layers show land areas and rivers and contain polylines and polygons in a UTM coordinate system. The target coordinate system, as shown by the axes, is in latitude and longitude.
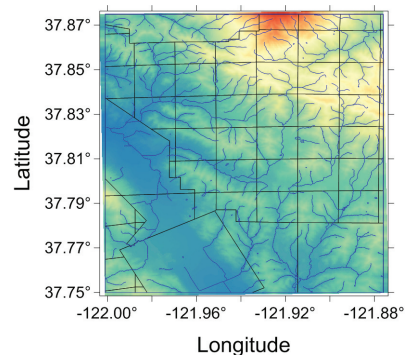
The CoordinateSystems.srf shows a map with multiple layers from different coordinate systems.

Transparent.srf

The transparent sample file contains two map layers: a contour map layer and a base map layer. The contour layer is partially transparent and shows a contamination site. The base map layer is an aerial photograph that displays the area below the contamination. The map layers are overlaid onto the same set of axes.
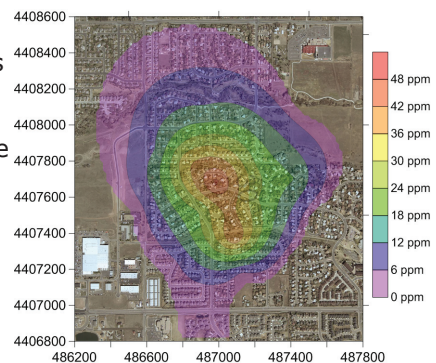
The Transparent.srf file shows a partially transparent contour layer overlaid onto an aerial phtograph.

Using Surfer

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 Excel, for example).

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

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

4. Click on the map to display the map properties in the **Property Manager** where you can customize the map to fit your needs.

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

Using Scripter

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

Example Scripter Files

To run a sample script:

1. Open **Scripter** by navigating to the installation folder, C:\Program Files\Golden Software\Surfer 10\Scripter. Double-click on the Scripter.exe application file.

2. Click the **File | Open** command and select a sample script .BAS file in the C:\Program Files\Golden Software\Surfer 10\Samples\Scripts folder.

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

4. Most sample scripts will open **Surfer** and display a map in the plot window.

Surfer User Interface

Surfer contains three document window types: the plot window, worksheet window, and grid node editor window. Maps are displayed and created in the plot window. The worksheet window displays, edits, transforms, and saves data in a tabular format. The grid node editor window displays and edits Z values for the selected grid. The **Surfer** user interface layout consists of the title bar, menu bar, toolbars, tabbed windows, **Object Manager**, **Property Manager**, and status bar.
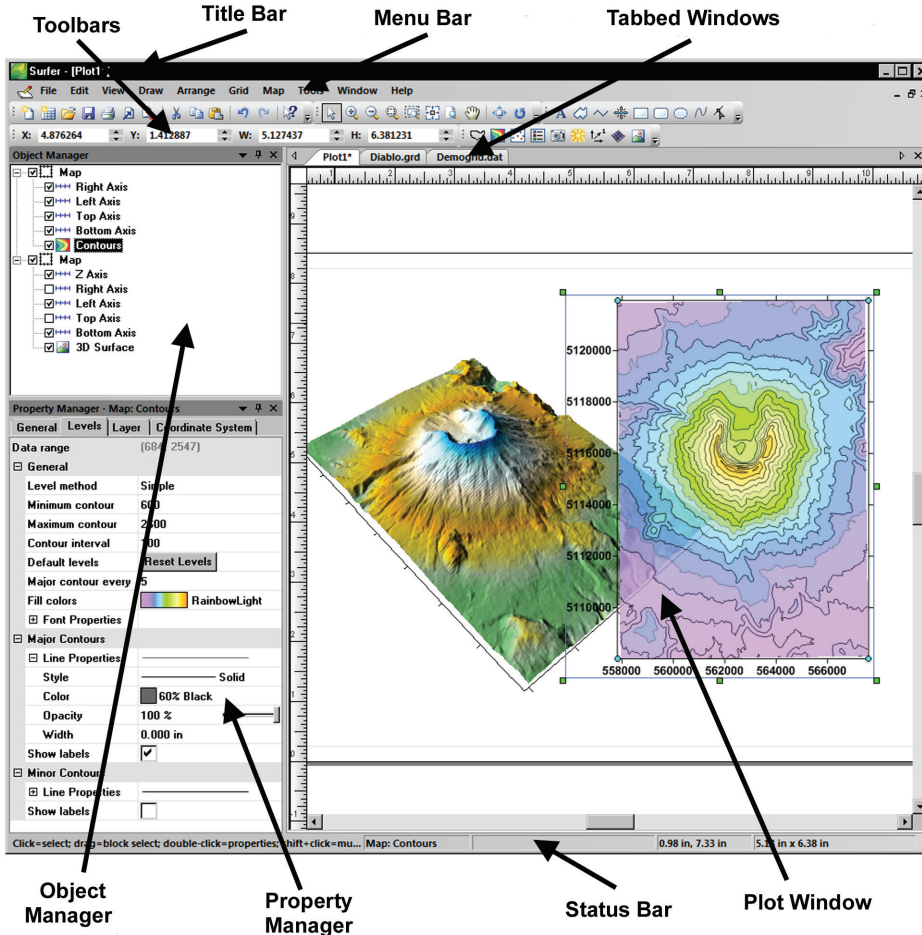
*This is the **Surfer** window with the **Object Manager** and **Property Manager** on the left side. The plot window, where the maps are displayed, is tabbed with a grid node editor window and a worksheet window. The toolbars and menu are displayed at the top and the status bar is displayed at the bottom.*

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 since it was last saved.
Menu Bar	The menu bar contains the commands used to run **Surfer**.
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. Toolbars can be docked or floating.
Tabbed Windows	Multiple plot windows, worksheet windows, and grid windows can be displayed as tabs. Click on the tab to display that window.
Object Manager	The **Object Manager** contains a hierarchical list of the objects in a **Surfer** plot window. These objects can be selected, added, arranged, edited, and renamed in the **Object Manager**. The **Object Manager** is initially docked on the left side above the **Property Manager**. Changes made in the **Object Manager** are immediately reflected in the plot window. The **Object Manager** can be dragged and placed at any location on the screen.
Property Manager	The **Property Manager** allows you to edit any of the properties of a selected object. Multiple objects can be edited at the same time by selecting all of the objects and changing the shared properties. Changes made in the **Property Manager** are immediately reflected in the plot window.
Status Bar	The status bar displays information about the activity in **Surfer**. The status bar is divided into five sections. The sections display basic plot commands and descriptions, the name of the selected object, the cursor map coordinates, the cursor 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.

Changing the Window Layout

The windows, 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. Refer to the *Changing the Windows Layout* topic in the online help for more information on layout options.

Docking Managers

Surfer has a docking mechanism feature that allows for easy docking of managers. Left-click the title bar of a manager and drag it to a new location while holding down the left mouse button. The docking mechanism displays arrow indicators as you move the manager around the screen. 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.
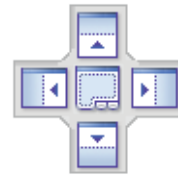
The docking mechanism has docking indicators.

Customizing Toolbars and Buttons

You may customize **Surfer's** toolbars and menus by clicking the **Tools | Customize** command. This is useful to create custom toolbars, rearrange menus, menu commands, and toolbar buttons. You can display image, text, or image and text depending on your preference. You can also create a new button appearance for a command.

Plot Window

A plot window is the area used 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. Multiple plot windows can be open at one time. Tabs can be used to easily move between multiple plot windows. If you need to change the display of tabs click the **Tools | Options** command. Select *User Interface* on the left side of the dialog. Set the *MDI tab style* on the right side. Setting this value to *None* turns the display of tabs off.

Menu Commands

The menus contain commands that allow you to add, edit, and control the objects on the plot window page. See the *Introduction* help book in the online help for the *Plot Window Commands* help book that detail the various plot window menu commands.

Toolbars

Toolbars display buttons that represent menu commands for easier access. Use the **View | Toolbars** commands to show or hide a toolbar. A check mark is displayed

next to visible toolbars. Hold the cursor over any button on the toolbar to display the function of the button as a screen tip. A more detailed description is displayed in the status bar at the bottom of the window.

Status Bar

The status bar is located at the bottom of the window. Use the **View | Status Bar** command to show or hide the status bar. The status bar displays information about the current command or activity in **Surfer**. The status bar is divided into five sections. The left section displays information about the selected command or item in the **Property Manager**. The second section shows shows the selected object name. The middle section shows the cursor coordinates in map units, if the cursor is placed above a map. The fourth section shows the cursor coordinates in page units of inches or centimeters. The right section displays the dimensions of the selected object.

Object Manager

The **Object Manager** contains a hierarchical list of the objects in a **Surfer** plot window. The objects can be selected, arranged, moved, renamed, or deleted in the **Object Manager**. Changes made in the **Object Manager** are reflected in the plot window, and vice versa.

Click the **View | Managers | Object Manager** command or the [button icon] button to show or hide the **Object Manager**. When the button is depressed, the manager is visible. When the button is not depressed, the manager is hidden.

You can increase the plot document space by minimizing the **Object Manager** with the *Auto Hide* feature. To hide the manager, click the [button icon] button in the upper right corner of the **Object Manager**. When the manager is hidden, place the cursor directly over the tab to display the **Object Manager** again. Click the [button icon] button to return the manager to docked mode.

Each item in the **Object Manager** list consists of an icon indicating the object type, a text label for the object, and a check box. A ☑ indicates that the object is visible. A ☐ indicates that the object is not visible. Click the check box to change the visibility of the item. Invisible objects do not appear in the plot window and do not appear on printed output.
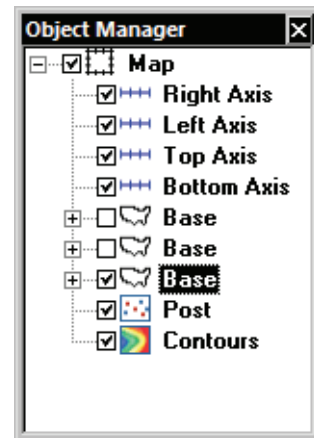
*The **Object Manager** contains a hierarchical list of the objects in the **Surfer** plot window.*

If an object contains sub-objects, a ⊞ or ⊟ button displays 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 type, such as a contour, and normally four axes. The *Map* can contain many other objects. To expand the *Map* tree to see the axes and map layers, click on the ⊞ button next to *Map*. To collapse the *Map* tree, click on the ⊟ button next to *Map*.

Click on the object name to select an object and display its properties in the **Property Manager**. The selection handles in the plot window change to indicate the selected item and the status bar displays the name of the selected object. To select multiple objects in the **Object Manager**, hold down the CTRL key and click on each object.

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

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 cursor changes to a black arrow if the object can be moved to the cursor location or a red circle with a diagonal line if the object cannot be moved to the indicated location. For example, a 3D surface map layer cannot be moved to a map that contains a 3D wireframe layer but can be moved into a map that only contains a contour map layer. In addition to dragging objects in the **Object Manager**, the order can be changed with the **Arrange | Order Objects** commands.

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

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.

Features with multiple options appear with a ⊞ or ⊟ to the left of the name. To expand a section, click on the ⊞. To collapse the section, click on the ⊟. For example, click on a contour map to select it. In the **Property Manager**, click on the **General** tab. Click the ⊞ next to *Filled Contours* and you see two options, *Fill contours* and *Color scale*.

To change a property in the **Property Manager**, click on the property's value next to the property name. Select a new property from the pop up box, scroll to a new number using the [↑↓] buttons, select a new value using the [——|——], select a new value from the drop-down list or palette, or type a property value. For example, a polyline has a *Line Properties* section that contains *Style*, *Color*, *Opacity*, and *Width* 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 left-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 other selections. For example, a polygon has **Line** and **Fill** tabs in the **Property Manager**. On the **Fill** tab, there is a *Pattern Offset* section, which is only available when an image fill type is selected as the *Pattern*.
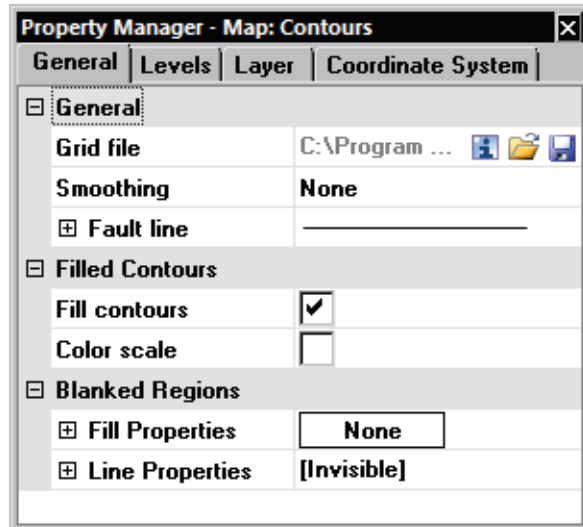
*The **Property Manager** is used to change properties of the selected object. Each tab controls different properties of the object.*

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

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.

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. 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 will appear in the **Property Manager**.

Worksheet Window

The worksheet window opens a data file for editing. Data can be altered, transformed, sorted, or filtered. In addition, data can be assigned a coordinate system. The components of the worksheet window are displayed below.
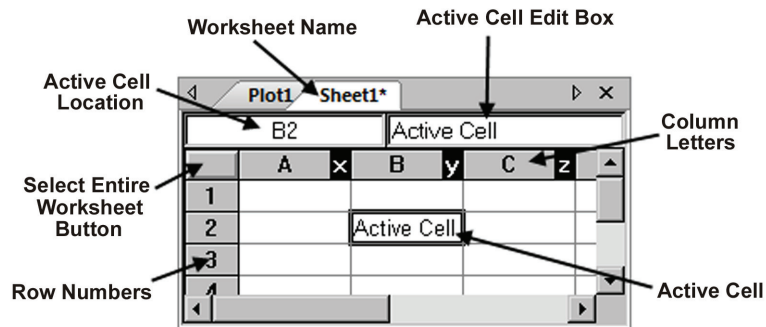
The components of the worksheet window shown above are described in the table below.

Component Name	Component Function
Column Letters	The column letters identify a column of the worksheet.
Row Numbers	The row numbers identify a row of the worksheet.
Active Cell	The active cell is highlighted with a bold outline. It is the cell that receives data input (numeric values or text strings) from the keyboard. Only one cell is active at a time.
Active Cell Location	The location of the active cell is indicated with the column letter and row number (i.e. B2).
Active Cell Edit Box	The box displaying the data or text contained in the active cell is shown in the active cell edit box. Data typed into an empty cell appears in both the edit box and the active cell.
Worksheet Name	The data file name of the worksheet or the worksheet number prior to saving is displayed on the tab.
Select Entire Worksheet Button	This button selects all cells in the worksheet.

Grid Node Editor

The grid node editor opens a grid file for editing. Nodes display with a black "+", blanked nodes with a blue "x", and the active node is highlighted with a red diamond. To move between nodes, press the ARROW keys, or click a node to make it active. The active node XY map coordinates and grid coordinates are displayed at the top of the window. You can enter a new Z value for the node in the edit box. You can save the edited grid file with the same name or a different name.
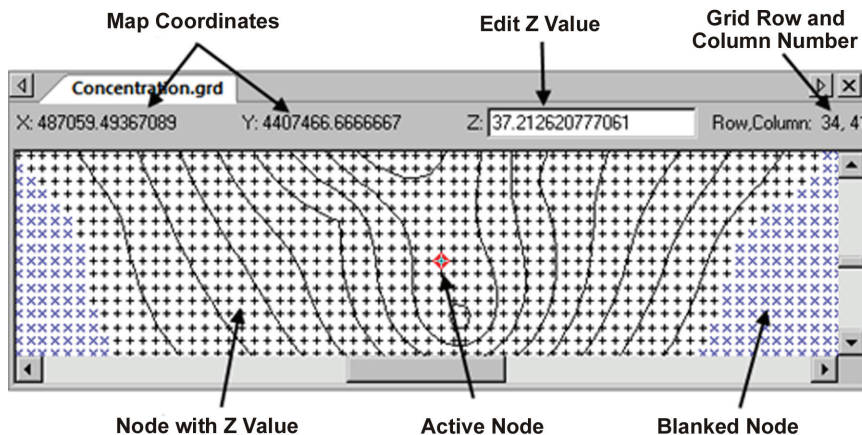
The grid node editor window allows Z values in a grid file to be changed or blanked. Individual nodes can be selected and altered.

File Types

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

Data Files

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

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

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Grid Files

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

Boundary Files

Boundary files contain XY location data such as state boundaries, rivers, or point locations. Boundary files can be used to create layers overlaid on other map types, or to specify the boundary limits for blanking, faults, breaklines, or slice calculations. Boundary files can be created from a wide variety of vector formats.

Surfer Files

Surfer .SRF files preserve all the objects and object settings contained in a plot window. Maps, grid files, base map files, and data files are all included in the .SRF.

Gridding

A grid is a rectangular region comprised of evenly spaced rows and columns. The intersection of a row and column is called a grid node. Rows contain grid nodes with the same Y coordinate. Columns contain grid nodes with the same X coordinate.

Contour maps, image maps, shaded relief maps, vector maps, 3D surface maps, and 3D wireframe maps all require grids in **Surfer**. The **Grid | Data** command provides several methods for generating a grid file from your XYZ data. **Surfer** can also use a variety of other grid files directly. For a list of these, refer to the online help.

Gridding is the process of taking irregularly spaced XYZ data and generating a Z value at each grid node by interpolating or extrapolating the data values. **Surfer** has several different gridding methods. These gridding methods define the way in which the XYZ data are interpolated when producing a grid file.

Grid Menu Commands

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

Creating a Grid File

Click the **Grid | Data** command to change gridding options. With this command, specify the parameters for the particular gridding method and the extents of the grid.

Gridding Methods

Gridding produces a regularly spaced, rectangular array of Z values from irregularly spaced XYZ data. The term *irregularly spaced* means that the points follow no particular pattern over the extent of the map, so there are many *holes* where data are missing. Gridding fills in these holes by extrapolating or interpolating Z values at those locations where no data exists. The gridding method determines the mathematical algorithms used to compute the Z value at each grid node. Each method results in a different representation of your data. It is advantageous to test each method with a typical data set to determine the gridding method that provides you with the most satisfying interpretation of your data.

Grid Line Geometry

The grid line geometry defines the grid limits and grid density. Grid limits are the *Minimum* and *Maximum* X and Y coordinates for the grid. Grid density is defined by the *# of Lines* in the X and Y direction of the grid. The grid limits and the number of lines define the *Spacing*, the distance in data units between adjacent grid nodes. The intersection of the X line with the Y line is referred to as a grid node.

Surfer automatically computes reasonable values based on the minimum and maximum X and Y values of the XYZ data file. The number of nodes is determined by the direction that covers the greater extent. By default, the larger distance is assigned 100 grid lines. The number of grid lines in the other direction is computed so that the grid line *Spacing* in the two directions are approximately the same. Any of the items in the *Grid Line Geometry* section can be altered.

Grid Line Geometry	Minimum	Maximum	Spacing	# of Lines
X Direction:	0	10	2.5	5
Y Direction:	0	25	6.25	5

Set the Grid Line Geometry *values to control the grid extents and grid density by entering the appropriate values. This grid will have a different spacing in the X and Y directions.*

Breaklines

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

The following gridding methods support breaklines: *Inverse Distance to a Power, Kriging, Minimum Curvature, Nearest Neighbor, Radial Basis Function, Moving Average, Data Metrics,* and *Local Polynomial*.

Faults

Faults are used to show discontinuity when gridding, similar to breaklines. A fault is a two-dimensional boundary file in .BLN format that defines a line with X and Y values at each vertex. Faults do not contain Z values. And, unlike a breakline, faults are barriers to information flow. Data on one side of a fault is not used when calculating grid node values on the other side of the fault. If the fault line is a closed polygon, the gridding algorithm will grid the data on the side of the polygon where the data is located. If the fault is not a closed polygon, gridding can search around the end of the fault to see a point on the other side of the fault, but this longer distance reduces the weight of the point in interpolating the grid node value. If a point lies directly on the fault line, random round-off error determines which side of the fault captures the point.

The following gridding methods support faults: *Inverse Distance to a Power, Minimum Curvature, Nearest Neighbor,* and *Data Metrics*.
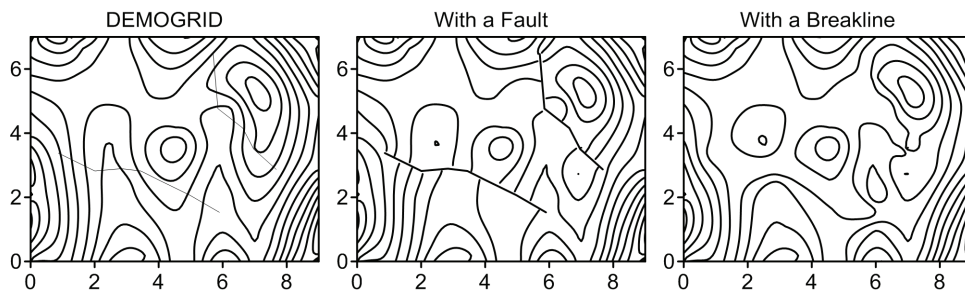
All three maps were gridded with the Minimum Curvature gridding method. The lines on the far left image were used as a fault and breakline in the other two images. Note the contours stop at the fault line and cross the location where the breakline would be.

Map Types

Several different map types can be created, modified, and displayed with **Surfer**. These map types include base, contour, post, classed post, image, shaded relief, vector, 3D surface, and 3D wireframe maps. A description and example of each map is listed below.

Base Map

Base maps display boundaries on a map and can contain areas, curves, points, text, images, or metafiles. Base maps can be overlaid with other map layers to provide details such as roads, buildings, streams, city locations, areas of no data, and so on. Base maps can be produced from several file formats. Individual base map objects can be edited, moved, reshaped, or deleted.
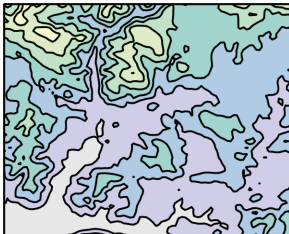
Contour Map

Contour maps are two-dimensional representations of three-dimensional data. Contours define lines of equal Z values across the map extents. The shape of the surface is shown by the contour lines. Contour maps can display the contour lines and colors or patterns between the contour lines.
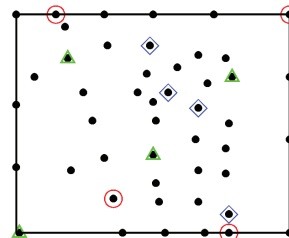
Post Map

Post maps and classed post maps show data locations on a map. You can customize the symbols and text associated with each data location on the map.

Classed Post Map

Classed post maps allow you to specify classes and change symbol properties for each class. Classes can be saved and loaded for future maps.
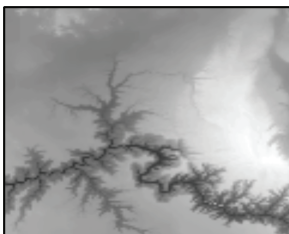
Image Map

Image maps are raster images based on grid files. Image maps assign colors based on Z values from a grid file. Blanked regions on the image map are shown as a separate color or as a transparent fill. Pixels can be interpolated to create a smooth image.
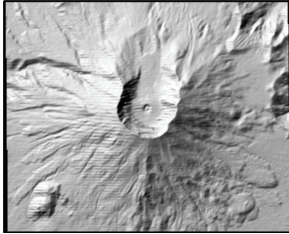
Shaded Relief Map

Shaded relief maps are raster images based on grid files. Shaded relief maps assign colors based on slope orientation relative to a light source. **Surfer** determines the orientation of each grid cell and calculates reflectance of a point light source on the grid surface. The light source can be thought of as the sun shining on a topographic surface.
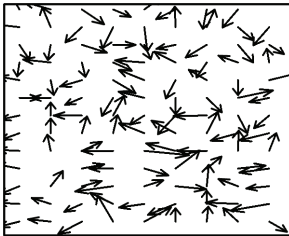
Vector Map

Vector maps display direction and magnitude data using individually oriented arrows. At any grid node on the map, the arrow points in the downhill direction of the steepest descent and the arrow length is proportional to the slope magnitude. Vector maps can be created using information in one grid file (i.e. a numerically computed gradient) or two different grid files (i.e. each grid giving a component of the vectors).
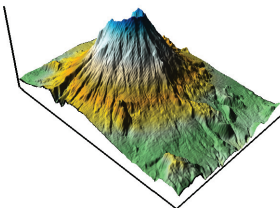
3D Surface Map

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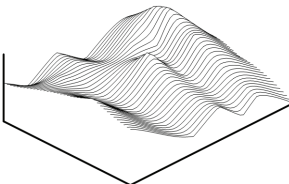
3D Wireframe Map

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

Map Layers

It is possible to combine several maps to create one map object with multiple layers. The **Map | Add** command allows you to add a map layer to the selected map. Most combinations of map types can be combined. You can add any combination of contour, base, post, image, shaded relief, vector, or 3D surface maps. You can add any combination of contour, base, post, and vector maps with 3D wireframe maps.

A *Map* uses a single set of X, Y, and Z axes. Individual map layers are positioned according to the map layer's coordinate system. If two or more map layers have the exact same X and Y values, the two layers will occupy the same map space. If two layers cover adjacent X and Y areas, the two layers will overlay next to each other in the correct relative position. Layered maps become a single *Map* object and are moved and scaled together. The opacity of each map layer can be adjusted individually to make a layer transparent or semi-transparent.

Refer to the *Introduction to Map Layers* topic in the online help for additional information about map layers.
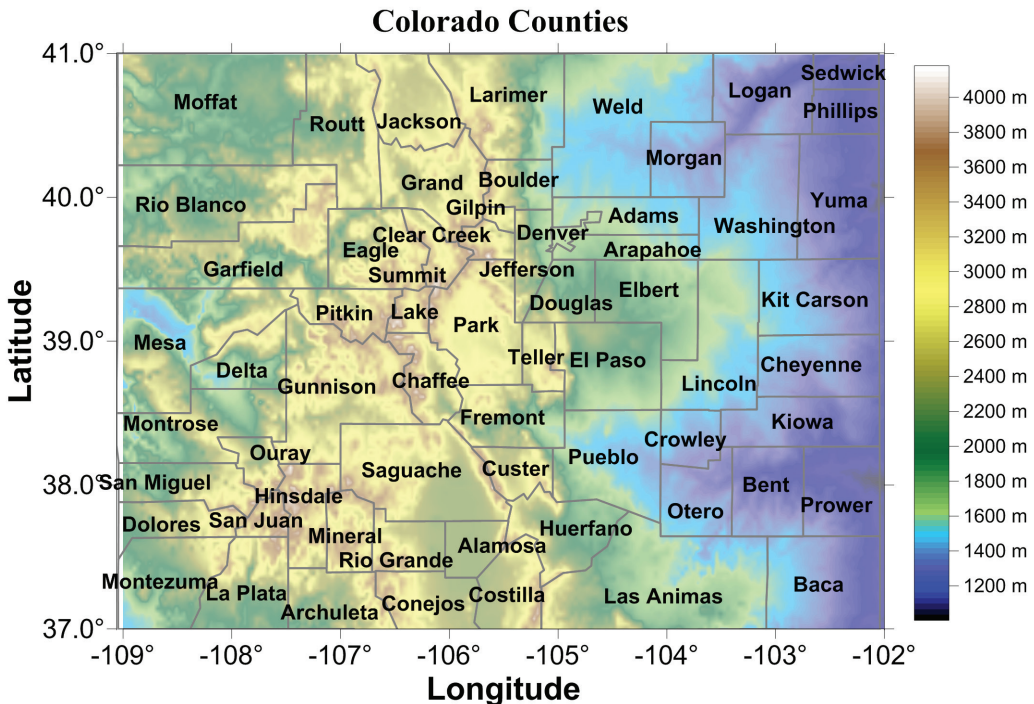
This map has multiple map layers that share axes. The map object controls the limits and scale. The individual map layers display the state and county boundaries, the county labels, and the image map showing elevation.

Coordinate Systems

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.

Using Coordinate Systems with Multiple Map Layers

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

1. Create the map by clicking on the appropriate **Map | New** command.

2. Click on the map layer to select it. In the **Property Manager**, click on the **Coordinate System** tab.

3. If the *Coordinate System* is not correct, click the *Set* button next to *Coordinate System*. The **Assign Coordinate System** dialog opens.

4. Make any changes in the dialog. This is the initial coordinate system for the map layer. When finished making changes, click *OK*.

5. To change the coordinate system for the entire map, click on the *Map* object in the **Object Manager**. In the **Property Manager**, click on the **Coordinate System** tab.

6. If the *Coordinate System* is not the desired output system, click on the *Change* button next to *Coordinate System* to set the desired target coordinate system. When finished, click *OK*.

7. All of the map layers are converted on-the-fly to the target coordinate system. The entire map is now displayed in the desired target system.

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

Tutorial

The tutorial is designed to introduce basic **Surfer** features and should take less than an hour to complete. After you have completed the tutorial, you will have the skills needed to create maps in **Surfer** using your own data. The tutorial can be accessed in the program using the **Help | Tutorial** command.

Tutorial Lesson Overview

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

- *Lesson 1 - Viewing and Creating Data* opens an existing data file and creates a new data file.
- *Lesson 2 - Creating a Grid File* creates a grid file, the basis for most map types in **Surfer**.
- *Lesson 3 - Creating a Contour Map* creates and edits a contour map.
- *Lesson 4 - Modifying an Axis* edits the tick labels and axis title.
- *Lesson 5 - Adding a Post Map Layer* adds a post map layer, displaying data points on the contour map. Both maps share the same axes, limits, and scaling.
- *Lesson 6 - Creating a 3D Surface Map* creates and edits a 3D surface map.
- *Lesson 7 - Adding Transparency, Color Scales, and Titles* changes the transparency of objects, adds a color scale, and add a map title.
- *Lesson 8 - Creating Maps from Different Coordinate Systems* loads two map layers from different coordinate systems and changes the final target coordinate system.

The lessons should be completed in order; however, they do not need to be completed at the same time. Advanced lessons are available in **Surfer** by clicking **Help | Tutorial**. The advanced lessons are optional, but we encourage you to read through them to provide additional detailed knowledge about **Surfer's** features.

Starting Surfer

To begin a **Surfer** session:

1. Navigate to the installation folder, which is c:\Program Files\Golden Software\ Surfer 10, 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 will be prompted for your serial number. Your serial number is located on the CD cover, or in the email download instructions, depending on how you purchased **Surfer**.

Lesson 1 - Viewing and Creating Data

A data file is a file containing columns of data values. At minimum, three columns are required to create grid-based maps in **Surfer**. These columns contain X, Y, and Z values. The X, Y, and Z values are frequently stored in columns A, B, and C, respectively, though this is not required. Data files can contain header information, labels, point identifiers, filter information, and multiple columns of additional data.
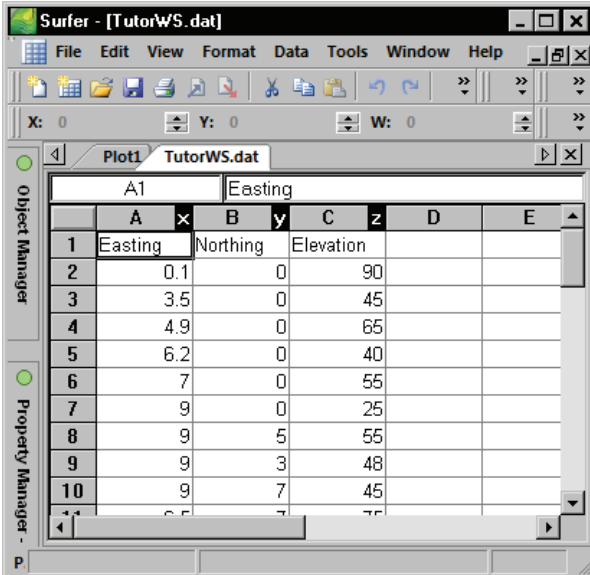
Opening an Existing Data File

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

1. Click the **File | Open** command, click the button, or press CTRL+O on the keyboard. The **Open** dialog displays.

2. If you are not in the Samples folder, browse to it. The Samples directory is located at C:\Program Files\Golden Software\Surfer 10\Samples, by default. 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 which column contains which data. When a header row exists, the information in the header row is used in the **Property Manager** when selecting worksheet columns.

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. After making changes to the worksheet, save the file by clicking the **File | Save** command.

The data is displayed in a worksheet window. Note that each variable, X, Y, and Z, is in a separate column. Row 1 is a description of what the column contains.

Creating a New Data File

The **Surfer** worksheet can also be used to create a new data file. Use these steps to open a new worksheet window and begin entering data. Refer to the *Worksheet Window* section on page 12 of this guide for information about the various portions of the worksheet window.

1. Click the **File | New | Worksheet** command, click the button, or press CTRL+W on the keyboard. A new empty worksheet window is displayed.

2. Data are entered into the active cell of the worksheet. 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. Press the ENTER key and the data are entered into the cell. Press the ESC key to cancel without entering the data.

6. 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 mouse, pressing one of the arrow keys, or pressing ENTER.

Saving the Data File

When you have completed entering all of the data, the data can be saved in a variety of formats.

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*.

6. The file is saved in the Data .DAT format with the file name you specified. The name of the data file appears in the title bar 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. 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 will use the TutorWS.dat sample file with this lesson.

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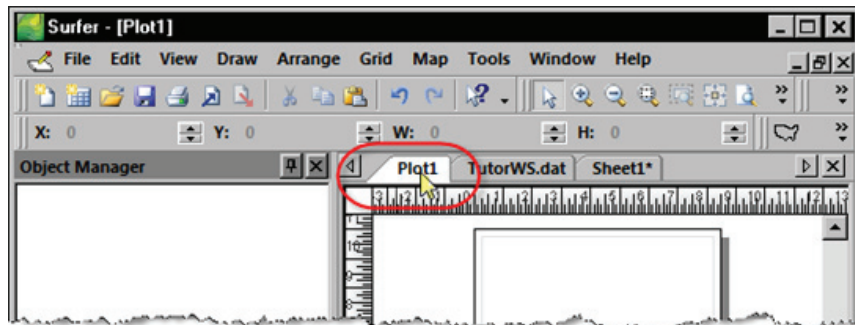
Click on the Plot1 *tab to select the plot window.*

2. In the plot window, click the **Grid | Data** command. The **Open Data** dialog is displayed.

3. In the **Open Data** dialog, click the TutorWS.dat Samples file. 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. Click *Open*. Alternatively, double-click on the data file name.

4. The **Grid Data** dialog is displayed. The **Grid Data** dialog allows you to control the gridding parameters and preferences. Take a moment to look over the various options in the dialog.

    -   The *Data Columns* section is used to specify the columns containing the X, Y, and 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 create a report with statistical information about the grid file created.

- 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 lines (also referred to as rows and columns) in the grid file.
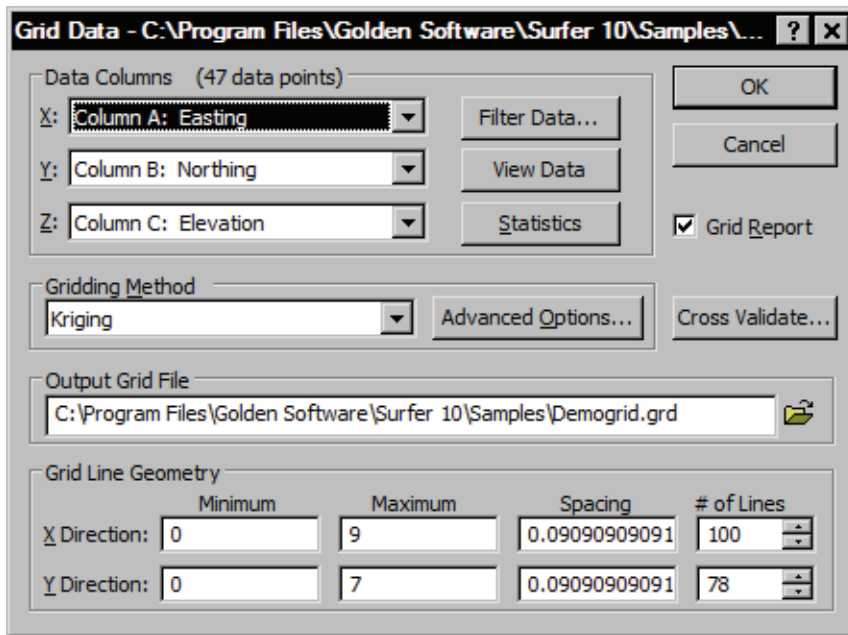
*The **Grid Data** dialog controls the options for gridding a data set. Set the Gridding Method, Advanced Options, Grid Line Geometry, and specify a Output Grid File name in the dialog before clicking OK. If the Grid Report box is checked, a report window will appear with information about the gridding process.*

5. 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.

6. A **Surfer** dialog appears after gridding the data with the full path and file name of the grid file that was created. Click *OK* and the grid file is created.

7. If *Grid Report* was checked, a detailed gridding report is displayed.

Lesson 3 - Creating a Contour Map

A contour map is a plot of three values. The first two dimensions are the X and Y coordinates. Changing the X and Y coordinates changes the size or limits of the map. The third dimension is the Z value, represented by lines of equal value on the map. The shape of the surface is shown by the contour lines.

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 can 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*.

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 you 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. 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 of the map you just created:

1. Place the cursor inside the limits of the contour map and click once. Or, click on the *Contours* 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 the Z value = 20. This is displayed next to *Minimum contour*. The *Maximum contour* level is Z = 105.

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 near this *Data range*.

*Set the contour level options on the **Levels** page in the **Property Manager**.*

or

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.

5. Click in the *Contour interval* box, highlight the current value, and type the value 10. Press ENTER on the keyboard and the map automatically updates to show contour lines every 10 Z units.

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. The major contour lines are frequently referred to as index contour lines. Let's set two different contour line properties.

1. Click in the box next to *Major contour every*. Highlight the existing value and type in a new value of 3. Press ENTER on the keyboard and every third line will be an index contour. In **Surfer**, the index contour is a major contour.

2. Click on the ⊞ next to *Major Contours*, if it is not already open. Click on the ⊞ next to *Line Properties* in the *Major Contours* section. The major line properties appear. Click the black color box next to *Color*. Select another color, such as *Red*, from the drop-down list. The map automatically updates.

3. Click in the box next to *Width* and change the value to 0.030 inches. Thick red lines now appear at the index contours.

4. To set the line style for the minor lines, click on the ⊞ next to *Minor Contours*, if it is not already open. Click on the ⊞ next to *Line Properties* in the *Minor Contours* section. The minor line properties appear. Click the black color box next to *Color*. Select another color, such as *80% Black*, from the drop-down list.

5. Click in the box next to *Style* and select a dashed line from the drop-down list. The minor contour lines appear as dashed gray lines.

*The major contour lines appear in a heavier solid line.*

Changing Contour Fill Properties

Color fill can be assigned to fill between contour lines by assigning a gradational color spectrum between two colors, or by selecting one of the preset color spectrums.

To display contour fill:

1. Click on the **General** tab in the **Property Manager**. Check the box next to *Fill contours*. The contour map automatically updates to display the default grayscale color fill between contours.

2. Click on the **Levels** tab. Click the color bar button next to *Fill colors*. A drop-down list of colormaps appear. Click one of the preset colormaps, such as *Rainbow*, and the map automatically updates to display the new colors.

3. If only a minimum and maximum color are desired, click the color bar next to *Fill contours*. Click the *Custom* button at the bottom of the drop-down list. The **Colormap** dialog appears.

4. The **Colormap** dialog allows you to select colors to assign to specific Z values. Click the color next to *Presets*. Select *GrayScale* from the list.

5. Click on the left node ▇ below the color spectrum. This selects the minimum color node. Click on the button next to *Color* and select the color *Blue* in the color drop-down list. The color scale now ranges from *Blue* to *White*. Alternatively, you could select a color spectrum from the *Presets* drop-down list, or by clicking the *Load* button.

6. (Optional) If you would like the color fill to be transparent, change the *Opacity* value by clicking and dragging the slider next to *Opacity*.

7. (Optional) If you want the color fill to be flipped, with *White* on the left at the minimum value and *Blue* on the right at the maximum value, click the *Reverse* button.

8. Click *OK* and the contour map is redrawn with the blue to white color fill.
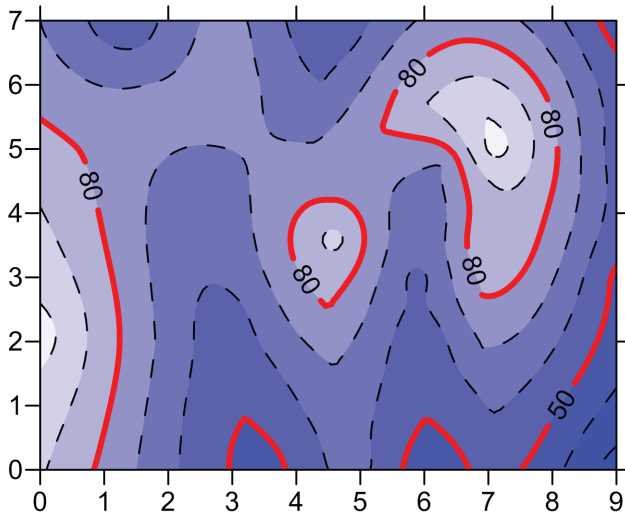
*The contour map is filled with a blue to white colormap after adjustments are made in the **Colormap** dialog.*

Setting Advanced Contour Level Properties

Contour map level properties can be set in the *Simple* manner, like was shown in the previous two sections. Or, you can change more advanced items, such as each individual contour line, by using the *Advanced* method.

To set advanced contour level properties for all levels:

1. In the **Property Manager**, click on the **Levels** tab.

2. Change the *Level method* by clicking on the word *Simple* next to *Level method* and selecting *Advanced* from the drop-down list.

3. Click the *Edit Levels* button next to *Contour levels* to open the advanced **Properties** dialog.

4. Click on the column header buttons to make bulk changes at regular intervals. This provides a way to emphasize contours. Click on the *Label* button. The **Labels** dialog opens.
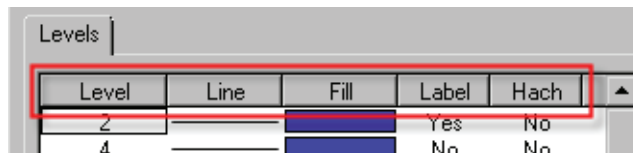

Click on one of the column header buttons to make bulk changes.

5. Change the *First* value to 2, the *Set* value to 1, and the *Skip* value to 2. This will set the label format for the second label, skip the third and fourth labels, and set the fifth label with the same format .

6. Click the *Font* button. The **Font Properties** dialog opens. Set the *Size (points)* to 12.

7. Set the *Foreground color and opacity* color to white. Click *OK*.

8. Click *OK* in the **Labels** dialog. Notice how the label status is changed in the **Properties** dialog.

9. Click on the *Hach* button.

10. Set the *First* to 1, the *Set* to 1, and the *Skip* to 0.

11. Check the *Hachure Closed Contours Only* box.

12. Change the *Direction* to *Uphill* and click *OK*. This changes all of the items under *Hach* to Yes. All closed contours will have hachure marks.

13. Click *OK* and the bulk changes are made to the contour map.

To set advanced contour level properties for individual levels:

1. Click once on *Contours* in the **Object Manager** to select the contour layer.

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 **Properties** dialog.

5. In the **Properties** 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.
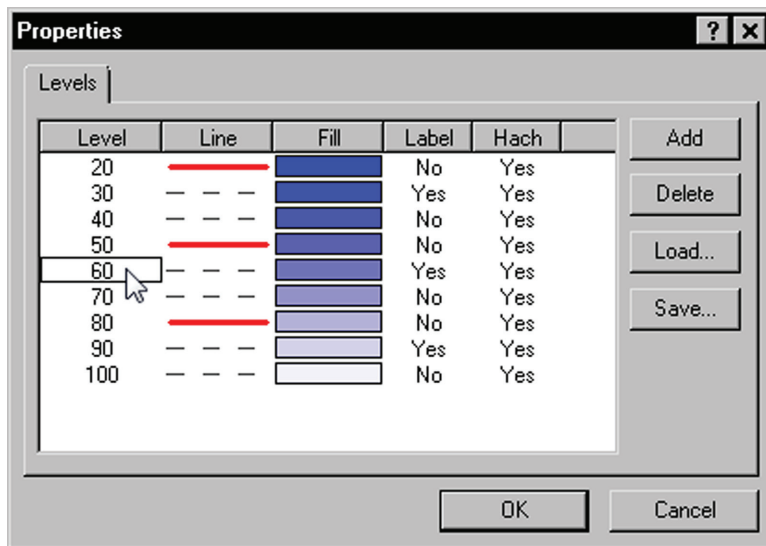
Double-click the 60 to change the Z value for this contour line.

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

7. 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.

8. 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 drop-down list. Click *OK*.

9. Let's add a single contour line halfway between two existing values. Click on the number 65 under the *Level* column. Click the *Add* button. The value 57.5 is added between the 50 and the 65.

10. Click *OK* and the individual settings are made to the contour map.

Adding, Deleting, and Moving Contour Labels

Contour label locations can be changed on an individual basis. Labels can be added, deleted, or moved. To add, delete, and move contour labels:

1. Right-click on the contour map and select *Edit Contour Labels*. You can also edit labels of a selected contour map using the **Map | Edit Contour Labels** command. The cursor changes to a black arrowhead ▶ to indicate that you are in edit mode. The 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. The cursor changes to ▶+ to indicate you are able to add a new label. Left-click the location on the contour line where you want the new label to be located.

4. Add several contour labels to the solid and dashed red lines by clicking on the line.

5. To move a contour label, left-click on the label, hold down the left mouse button, and drag the label. Release the left mouse button to complete the label movement.

6. To duplicate a label, hold the CTRL key on the keyboard while holding the left mouse button on an existing label. Drag the label to a new location along the line.

7. To exit the *Edit Contour Labels* mode, press the ESC key.

Lesson 4 - Modifying an Axis

Every contour map is created with four map axes: the bottom, right, top, and left axes. 3D maps have an additional Z axis. Additional X, Y, 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

To add an axis title to an axis:

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. 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.

4. 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. In the *Major interval* box, type the value 1.5 and press ENTER on the keyboard to place 1.5 X map units between tick marks. This spacing automatically updates on the map axis.

2. Click on the **General** tab and click the ⊞ next to *Labels*, if it is not already open. Click the ⊞ next to *Label Format* to open the *Label Format* section.

3. In the *Label Format* section, select *Fixed* for the *Type*.

4. Click in the box next to *Decimal digits*. Highlight the existing value, type 1, and press ENTER on the keyboard. This indicates that only one digit follows the decimal point for the axis tick labels.

5. The map is updated immediately after every change, showing the axis tick spacing, labels, and the axis title.
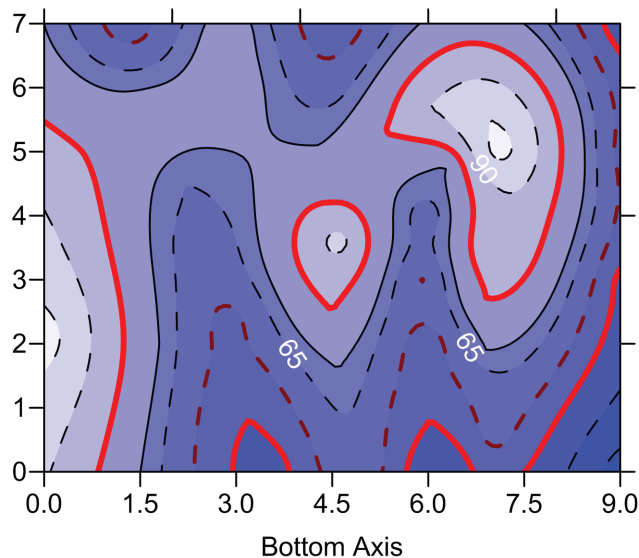
Change the axis tick mark and label properties or add an axis title to display your map exactly the way you want.

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 an .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 plot window tab indicates the file has been modified and the modifications have not yet been saved.

To save a map:

1. Click the **File | Save** command, or click the ![save] 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** Files (*.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.

5. If you are using the demo version of **Surfer** you will not be able to save or export the map. Please proceed to *Lesson 5 - Adding a Post Map Layer*.

Lesson 5 - Adding a Post Map Layer

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.

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, two sets of axes are also displayed, one set for each map. When you select a map and click 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.

Adding a Post Map Layer

1. Using the TutorWS.srf file you created in the previous lesson, click once on *Contours* in the **Object Manager**.
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 from the Samples folder and click *Open*.
4. 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 contour 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.

Editing the Post Map

Once you have created a post map layer, you can customize the post map properties. To change the post map properties:

1. Click on the *Post* in the **Object Manager** or on the post map in the plot window.
2. In the **Property Manager**, click on the **General** tab. Click the ⊞ next to *Default Symbol*, if it is not already open. Click the ⊞ next to *Marker Properties* to open the *Marker Properties* section.
3. Next to the *Symbol*, click on the existing symbol. In the drop-down list, click on the filled diamond symbol (*Symbol set*: Default Symbols, Number: 6) from the symbol palette.
4. Next to *Color*, click on the existing color. In the drop-down list, select the *Cyan* color.
5. *Opacity* can be adjusted to create semi-transparent symbols by dragging the slider next to *Opacity*, if desired.
6. In the *Symbol Size* section, click in the *Symbol size* box. Highlight the existing size and change it to 0.09 in and press ENTER on the keyboard. The post map is drawn with the updated symbol size.

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*.

Selecting and Renaming a Map Layer

After creating a multi-layer map with a post map layer and a contour map layer, you can still modify the individual map layers. An individual map layer can be selected in the multi-layer map by clicking on the layer in the plot window or clicking on the map layer in the **Object Manager**. The easiest way to select a map layer in a multi-layer map is to click on the layer name in the **Object Manager**.

However, you can also select the layer in the plot window with the mouse. Whenever two or more objects occupy the same position in the plot window, use the CTRL key and the left mouse button to select the desired object. The CTRL key allows you to cycle through the selection of overlapping objects. For example, if you want to select a contour map layer behind a post map layer, hold down the CTRL key and click until the contour map layer is selected. You can use the status bar to help you to determine which object is selected.

To select a map layer and assign or change the object name:

1. Click the contour map layer name in the **Object Manager**. In this case, click the word *Contours*. The status bar should now report *Map: Contours*.

2. Choose **Edit | Rename Object** or press the F2 key on the keyboard.

3. In the **Rename Object** dialog, type the name *Tutorial Contour Map* and click *OK*. The status bar and **Object Manager** update to reflect the name change.

4. Repeat steps 1-3 and rename the post map layer to *Tutorial Post Map*.

If you click on the *Tutorial Contour Map* layer in the **Object Manager**, notice that the **Property Manager** title changes to **Property Manager - Map: Tutorial Contour Map**. When you rename an object in **Surfer**, the **Property Manager** window reflects the name change making it easier for you to keep track of the object you are editing. For example, if you have eight maps in the plot window, it is beneficial to change the map names to something meaningful to save time when trying to edit them.

Adding Labels to the Post Map

You can add labels to the data points on post maps and classed post maps. To add labels:

1. Click on the *Tutorial Post Map* layer in the **Object Manager**.

2. In the **Property Manager**, click on the **Labels** tab. Next to *Worksheet column*, click the word *None*. A drop-down list displaying all of columns in TutorWS.dat are displayed.

3. Select *Column C: Elevation* from the list.

4. Click the ⊞ next to *Label Format* to open the *Label Format* section.

5. Change the *Type* to *Fixed*.

6. Change the *Decimal digits* value to zero and press ENTER on the keyboard.

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

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, right-click the post map and select *Edit Post Labels* to enter edit mode. A customizable leader line is automatically added from the data point label to the symbol. To move individual labels:

1. Select the *Tutorial Post Map* in the **Object Manager**.

2. Select the **Map | Edit Post Labels** command or right-click on the selected map and select *Edit Post Labels*. The cursor will change to a ✛ 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 label locations with the
Map | Edit Post Labels *command when the*
post map is selected.

Lesson 6 - 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.

Creating a 3D surface map

We are going to use the same grid file you used to created 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 to open a new plot document.

2. Select the **Map | New | 3D Surface** command or click the ![button] button.

3. In the **Open Grid** 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.

4. Click *Open* and the 3D surface is created using the default settings.

Adding a Mesh

Mesh lines can be applied to surfaces. 3D surface maps have more capability than 3D wireframe maps 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* in the **Object Manager** to select the surface map layer. The 3D surface properties are displayed in the **Property Manager**.

2. Click the **Mesh** tab.

3. Check the *Draw lines* boxes in both the *Lines of Constant X* and *Lines of Constant Y* sections. The mesh is automatically added to the selected 3D surface.

4. In the *Lines of Constant X* section, change the *Frequency* to five.

5. In the *Lines of Constant Y* section, change the *Frequency* to five.

Changing Surface Map Colors

Changing color schemes on 3D surfaces is similar to changing colors on other map types such as image maps or contour maps. You can load previously defined color schemes or create your own color schemes. To change the surface material color:

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

2. Click on the **General** tab. Click the ⊞ next to *Material Color* to open the section, if it is not already open. Click the color bar next to *Upper*. In the drop-down list, select one of the predefined colormaps, such as *Rainbow*. The color range automatically updates.

3. If you wish to define your own colors, click the color bar next to *Upper* and click on the *Custom* button at the bottom of the drop-down list. The **Colormap** dialog opens.

4. In the **Colormap** dialog, select a predefined colormap from the *Presets* drop-down 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.

5. 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.

6. 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 drop-down list next to *Upper*. Or, click the *Custom* button in the drop-down list and make changes in the **Colormap** dialog. You can experiment with selecting custom node locations and colors.
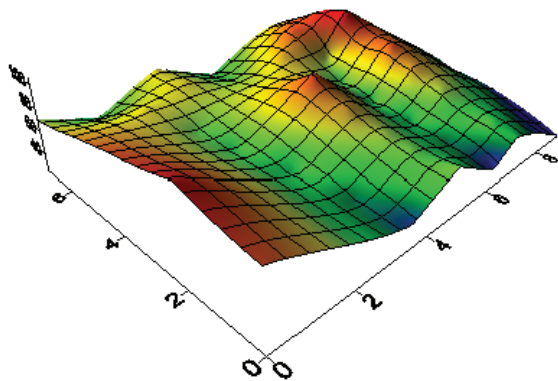

This is a 3D surface map with a mesh displayed at a frequency of five. The 3D surface map is using the preset Rainbow *color spectrum.*

Adding a Map Layer

You can add additional map layers to the 3D surface with the **Map | Add** commands. 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 planar layer to the surface you just created.

1. Click on *3D Surface* in the **Object Manager** and select **Edit | Rename Object**. Change the text to TutorWS to make it easier to distinguish the map layer in the **Object Manager** list. Click *OK*.

2. Add a planar 3D surface map layer, by clicking 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. Click *Open*, and the new surface map layer is added using the default settings.

4. Right-click on the new 3D surface in the **Object Manager** and select *Rename Object*. Change the text to TutorPL and click *OK*. This will make it easier to distinguish the two map layers in the **Object Manager** list.

5. Click on the *TutorPL* surface map in the **Object Manager**. In the **Property Manager**, click on the **General** tab. Open the *Material Color* section and click on the color next to *Upper*. Select *Rainbow* in the drop-down list to match the *TutorWS* color fill.
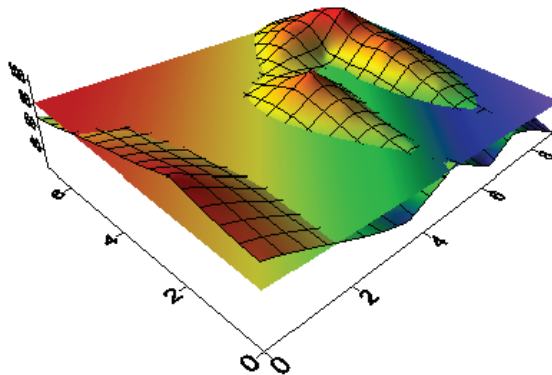
Here the two surface map layers are overlaid.
Depending on the Z values of the grid files, the two
surfaces can intersect, as this example shows.

Lesson 7 - Adding Transparency and Color Scales

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. An object can be made semi-transparent by adjusting the opacity value. Reducing the opacity of an object allows the ability to see through the object to other objects. 0% *Opacity* means that the object is invisible. 100% *Opacity* means that the object is fully opaque. Setting the opacity is useful when creating a semi-transparent map layer. For example, you may want to display a semi-transparent contour map layer over a satellite image base map layer so that both map layers can be seen. Being able to set the *Opacity* of entire layers is especially useful when you have multiple layers with filled objects and you need to see all of the layers.

Creating a Filled Contour Map

To create a contour map:

1. Click the **File | New | Plot** command. 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 and click *Open*. The map is created using the default settings. The TutorWS.grd, created in *Lesson 2 - Creating a Grid File*, is located in **Surfer's** Samples folder.

4. Click on the contour map to select it.

5. In the **Property Manager**, click on the **General** tab.

6. Check the box next to *Fill contours* to fill the contours with the default color.

Applying Opacity

You can adjust the *Opacity* value of a map layer, or of individual fill, text, lines, or symbols when the appropriate object is selected. The properties are displayed in the **Property Manager**. To add transparency to a contour map:

1. With the contour layer selected, click on the **Levels** tab in the **Property Manager**.

2. Set the *Level method* to *Simple*, if it is not already *Simple*.

3. Click the color bar next to *Fill colors*. Select *Rainbow* from the drop-down list. The *Fill colors* option changes the colors that are used between the contour lines.

4. Click on the **Layer** tab.

5. Change the *Opacity* to 43%. The opacity for the entire layer is decreased to 43%.

Adding and Editing a Color Scale Bar

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 a color scale to the contour map:

1. With the contour layer selected, click on the **General** tab in the **Property Manager**.

2. Check the box next to *Color scale*. A default color scale is created. A new *Color Scale* object is added to the **Object Manager**.

3. To change the color scale properties, click on the color scale bar to display the color scale properties in the **Property Manager**.

4. Make adjustments to the label or line properties. You may wish to change the *Opacity* to 43% to match the contour map. The color scale bar is automatically updated with the changed properties.

5. To add a title to the color scale bar, click the **Draw | Text** command. Click to the left of the scale bar. The **Text Properties** dialog opens.

6. In the *Text* section, enter *Elevation (Meters)*, and click *OK*. Click the ESC key on the keyboard to exit the text drawing mode.

7. Click on *Text* in the **Object Manager** to select the new text object.

8. Click the **Arrange | Rotate** command. In the **Rotate** dialog, enter *90* in the *Counterclockwise rotation in Degrees* box. 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. Once only those two objects are selected, use the **Arrange | Group** command to create a composite 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.

Adding a Shaded Relief Map Layer

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

1. Click on *Contours* in the **Object Manager** to select the contour layer.

2. Click the **Map | Add | Shaded Relief Layer** command.

3. Select the file TutorWS.grd, and click *Open*.

A shaded relief map 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.

Lesson 8 - 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. To combine multiple layers from different coordinate systems into a single map:

1. Click **File | New | Plot** 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 and click *Open*.

4. Click on *Contours* in the **Object Manager** to select the contour layer.

5. 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.

6. Create a new post map with the **Map | New | Post Map** command.

7. In the **Open Data** dialog, select the Diablo Example.dat file and click *Open*.

8. 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.

9. Click on *Post* in the **Object Manager** to select the post layer.

10. In the **Property Manager**, click on the **Coordinate System** tab. Note that the post map does not have a predefined coordinate system.

11. Click the *Set* button to define the coordinate system for the post map. Since we know this coordinate system, we can set it. Open the *Predefined* section. Open the *Projected Systems* section. Open the *UTM* section. Open the *North America* section. Click on the *North America NAD27 UTM Zone 10N* and click *OK*. On the **Coordinate System** tab, the post map layer now has a defined coordinate system.

12. In the **Object Manager,** click and drag the *Post* map layer into the *Map* object that contains the *Contours* map layer.

13. The two map layers are now overlaid. You can see the posted symbols are located on the contour lines, despite the different coordinate systems.

14. To change the target coordinate system, click on the *Map* object in the **Object Manager**.

15. In the **Property Manager**, click on the **Coordinate System** tab. Click the *Change* button.

16. In the dialog, open the *Predefined* section. Open the *Geographic (lat/lon)* section. Select *World Geodetic System 1984* and click *OK*. On the **Coordinate System** tab, the map now has a different coordinate system than either of the map layers. Notice that the axes are now showing latitude and longitude values, as well.

Printing the Online Help

The online help topics may be printed. You can print a single topic, a section of the table of contents, or all topics in the table of contents.

Printing One Topic

To print one topic:

1. Open the topic you wish to print.

2. Click the button.

3. If the **Contents** page is open in the help navigation pane, you are prompted to *Print the selected topic* or *Print the selected heading and all subtopics*. Select *Print the selected topic* and click *OK*.

Printing One Book

To print one book, such as the tutorial:

1. Open the online help by selecting **Help | Contents** in the **Surfer** window.

2. Click the **Contents** page on the left side navigation pane.

3. Click on the *Tutorial* book to select the book.

4. Click the button within the help window.

5. A prompt appears asking if you would like to *Print the selected topic* or *Print the selected heading and all subtopics*. Select *Print the selected heading and all subtopics* and click *OK*. All the topics included in the *Tutorial* book are printed.

Printing the Entire Help File

To print all of the topics in the help file table of contents:

1. Open the top-level book in the help book, ***Surfer 10***.

2. Click on the *Printing the Online Help* topic.

3. Click the button within the help window.

4. A prompt appears asking if you would like to *Print the selected topic* or *Print the selected heading and all subtopics*. Select *Print the selected heading and all subtopics* and click *OK*. All the topics included in the online help table of contents are printed.

WARNING: Printing the entire help file takes hundreds of letter-sized sheets of paper and is very time consuming to print. There is no table of contents or index printed with the file.

Getting Help

The quick start guide is a quick way to learn the basics in **Surfer**. There are also other sources of help with **Surfer**.

Online Help

Extensive information about **Surfer** is located in the online help. To access the online help, choose the **Help | Contents** command. You can navigate help using the **Contents**, **Index**, **Search**, and **Favorites** pages in the navigation pane to the left of the topic page.

Context-Sensitive Help

Surfer also contains context-sensitive help. Highlight a menu command, window region, or dialog, press the F1 key, and help is displayed for the highlighted item.

You may also access context-sensitive help by pressing SHIFT+F1 or clicking on the button. Then, click on a menu command, toolbar button, or screen region to view information specific to that item. The help dialog appears with additional information.

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.

Internet Resources

There are several Internet help resources.

- Direct links to the Golden Software home page (www.GoldenSoftware.com), the **Surfer** product page, the knowledge base, and the Frequently Asked Questions are available by selecting **Help | Golden Software on the Web**.

- Click the *Forums* button at the top of the online help (**Help | Contents**) to post a question to our public support forums.

- Use the **Help | Feedback** commands to send a problem report, suggestion, or information request by email directly to **Surfer** technical support.

Technical Support

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

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

- Your **Surfer** serial number (located on the CD shipping cover or in **Help | About Surfer**)
- Your **Surfer** version number, found in **Help | About Surfer**, including whether it is the 32-bit or 64-bit version of **Surfer**
- The operating system you are using (i.e. Windows XP, Vista, or 7), including whether it is 32-bit or 64-bit operating system

If you encounter problems with **Surfer**, you are welcome to send an email message to Golden Software using the **Help | Feedback | Problem Report** command. This message is delivered directly to surfersupport@goldensoftware.com. Report the steps you perform when the problem occurs and include the full text of any error messages that are displayed. You are welcome to attach a .ZIP file (10 MB maximum) containing the .SRF file and other files that illustrate the problem. Larger files may be uploaded to our FTP site at ftp://ftp.goldensoftware.ws/incoming/Surfer/.

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Before calling, please check the following available resources as your question may already be answered.

Registration: Register online at www.GoldenSoftware.com or fax or mail the *Registration Form.PDF*, located in the main directory on the CD
Knowledge Base: www.GoldenSoftware.com/activekb or in the **Surfer** program using the **Help | Golden Software on the Web | Knowledge Base** command
Forums: www.GoldenSoftware.com/forum or in the **Surfer** program using the **Help | Contents** command and click on Forums
Frequently Asked Questions: In the **Surfer** program using the **Help | Golden Software on the Web | Frequently Asked Questions** command
Tutorial: Complete the tutorial section in this quick started guide or in the **Surfer** program using the **Help | Tutorial** command
Online Help: In the **Surfer** program using the **Help | Contents** command
Support Videos: www.GoldenSoftware.com

Business Hours

Technical Support:

    Monday through Friday, 8:00 AM - 5:00 PM, Mountain Time

Product Sales:

    Online orders available 24 hours, 7 days a week with 2 business hour delivery

Golden Software Contact Information

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