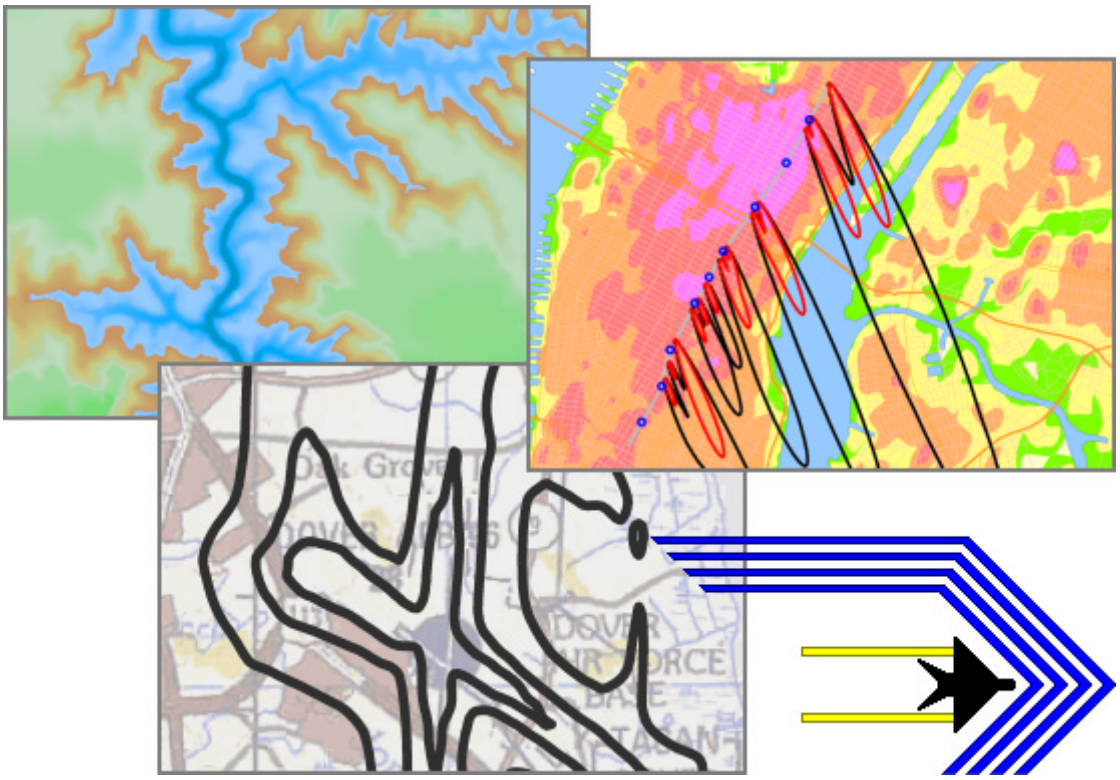
NMPlot 4.958 User's Guide



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Chapter 1

Introduction

1.1. What is NMPlot?

NMPlot is a Microsoft Windows application for viewing and editing sets of georeferenced data points. These data sets, also know as *grids*, represent measurable quantities that vary with geographic location. Examples include noise levels around an airport, monthly records of rainfall across a state, and water temperature measurements in a lake.

1.2. What Can NMPlot Do?

NMPlot has the ability to:

- Read and write georeferenced data point grids
- Apply a mathematical function to the points in a grid
- Merge two grids
- Compute the sum or difference of two grids
- Display a contour plot of a grid
- Create a plot that displays a grid using a smoothly varying color gradient
- Overlay a plot over a background map
- Overlay one plot on top of another
- Draw a plot using a printer or plotter
- Export a plot to the clipboard and to a bitmap image file

- Create an animated plot from a series of grids
- Import background maps in the following formats:
    - ARC/INFO Shapefile (SHP)
    - Digital Line Graph (DLG)
    - AutoCAD Data Exchange Format (DXF)
    - Georeferenced Bitmap (BMP, TIF, JPG, PNG)
    - Compressed ARC Digitized Raster Graphics (CADRG)
- Export a plot to a Geographic Information System (GIS) in the following formats:
    - ARC/INFO Shapefile (SHP)
    - AutoCAD Data Exchange Format (DXF)

1.3. Brief History of NMPlot

The original development of NMPlot was sponsored by the United States Air Force (USAF) and the United States Federal Aviation Administration (US FAA). It was developed to produce contour plots for their airport noise models.

Version 1.0, released in May 1989, was a Microsoft MS-DOS application. It was written in Borland Pascal, and had limited capabilities. Numerous successive versions have steadily increased its power and features.

In January 1997, work began on a Microsoft Windows version of NMPlot. As part of this project, the entire application was ported to C++, numerous sections were rewritten from scratch, and the user interface was modified to conform to Microsoft Windows conventions. The first Microsoft Windows version of NMPlot was released in February, 1998.

While NMPlot was originally designed to support noise models, it is neutral to any particular application domain. It can just as easily process data from other types of models (for example, air pollution models) or from sources other than computer models (for example, measured data).

NMPlot is currently shipped as the standard graphical analysis tool of the following applications.

- BNoise2, the United States Army's application for modeling noise from artillery and explosive operations

- INM, the US FAA's application for modeling noise around civilian airports
- Noisemap, the USAF's application for modeling noise around military airports
- ROUTEMAP, the USAF's aircraft training route noise model
- SANCTE, the Swiss environmental agency's Swiss Aircraft Noise Calculation Test Environment
- SARNAM, the United States Army's application for modeling noise from small arms firing ranges
- SIPS, the United States Navy's model of noise from explosive operations
- TNM, the United States Federal Highway Administration's traffic noise model

1.4. Distribution License

NMPlot is distributed as acknowledgement-ware: it may be freely used and distributed, provided that Wasmer Consulting is acknowledged as the author.

Chapter 2

Getting Started

2.1. Minimum System Requirements

To take full advantage of NMPlot, your computer should meet the following minimum requirements.

- *Operating System* - Microsoft Windows 2000, XP, or Vista
- *Processor* - 1.0 GHz Pentium
- *Memory* - 512 MB

  Additional memory may be required to process very large grid files. NMPlot requires approximately 1 MB of memory for every 10,000 grid points.

  Tip:

  If NMPlot runs very slowly, and your hard drive is continuously accessed (i.e., your hard drive light stays on), it is likely that your computer does not have enough memory.

- *Monitor* - 64,000 colors (i.e., 16-bit color), resolution of 1024 x 768

  For best results, you should set your monitor to display the maximum number of colors possible. True color (i.e., 24- or 32-bit color) is desirable. To change the color and monitor resolution, go to the Microsoft Windows control panel and select Display.

- *Hard Drive Space* - 20 MB

2.2. Obtaining NMPlot

Visit the NMPlot web page, http://wasmerconsulting.com/nmplot.htm, to download the latest version of NMPlot.

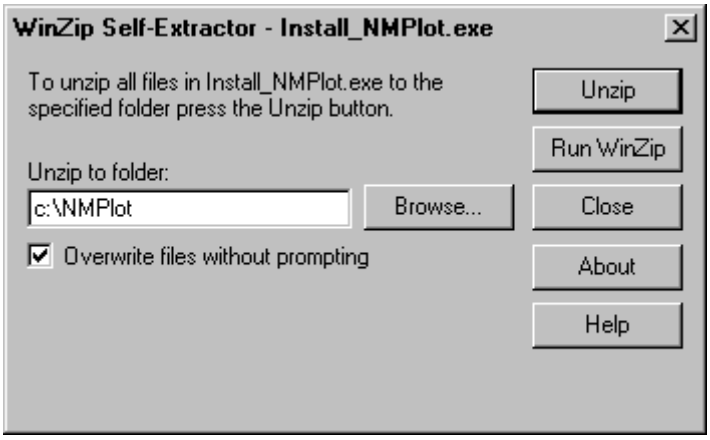
If desired, you can subscribe to the mailing list, and be notified by e-mail when new versions of NMPlot are released. See the NMPlot web page for additional information.

2.3. Installing NMPlot

NMPlot is distributed as a self-extracting WinZip file. Installation consists of nothing more than uncompressing the NMPlot files and copying them onto your hard drive. To install NMPlot, follow these steps.

1. Go the the NMPlot web site, http://wasmerconsulting.com/nmplot.htm, and click on the Download NMPlot link. A file named `install_nmplot.exe` will be transferred to your computer.

2. From Windows Explorer or My Computer, find the file `install_nmplot.exe` and double-click on it. The Installing NMPlot dialog box appears.



3. In the *Unzip To Folder* text box, type the name of the directory where you wish to install NMPlot. Press the Browse button to display the Browse for Folder dialog box, which allows you to select an existing directory.

4. Press the Unzip button. The NMPlot files are copied to your hard disk. NMPlot is now installed.

5. The file `install_nmplot.exe` is no longer needed. Delete it if you wish.

2.4. Upgrading to a Later Version of NMPlot

To upgrade to a later version of NMPlot, simply perform a normal installation, noting these points.

- If NMPlot is running, close it before performing an upgrade.
- Install NMPlot to the same directory that NMPlot was previously installed to.
- On the Installing NMPlot dialog box, make sure the *Overwrite Files Without Prompting* box is checked.

All NMPlot configuration information is stored in the file `NMPlot.cfg`. This file will not be overwritten when you install later versions. Therefore, your configuration will be preserved.

2.5. Uninstalling NMPlot

The NMPlot installer does not make any hidden changes to your computer. In particular, it does not install any files in the Windows or System directories, and does not modify the registry. To uninstall NMPlot, simply use Windows Explorer or My Computer to delete the directory where NMPlot is installed.

2.6. Starting NMPlot

To start NMPlot, follow these steps.

1. Using Windows Explorer or My Computer, navigate to the folder where NMPlot is installed.
2. Double-click on the NMPlot icon,  , labeled `NMPlot.exe`.

2.7. Viewing the Sample Files

To verify that NMPlot is functioning correctly, you can open the sample files. Follow these steps.

1. Start NMPlot.

2. Choose Open from the File menu. The standard Microsoft Windows dialog box for opening files is displayed. Familiarity with the use of this dialog box is assumed.

3. Navigate to the directory where NMPlot is installed, and open the file `Sample Plot - Map Overlay.nmp`. A sample plot is displayed, showing contours over a background map.

4. If desired, repeat the previous two steps and open the other sample files. *Appendix D, List of NMPlot Files*, briefly describes the sample files.

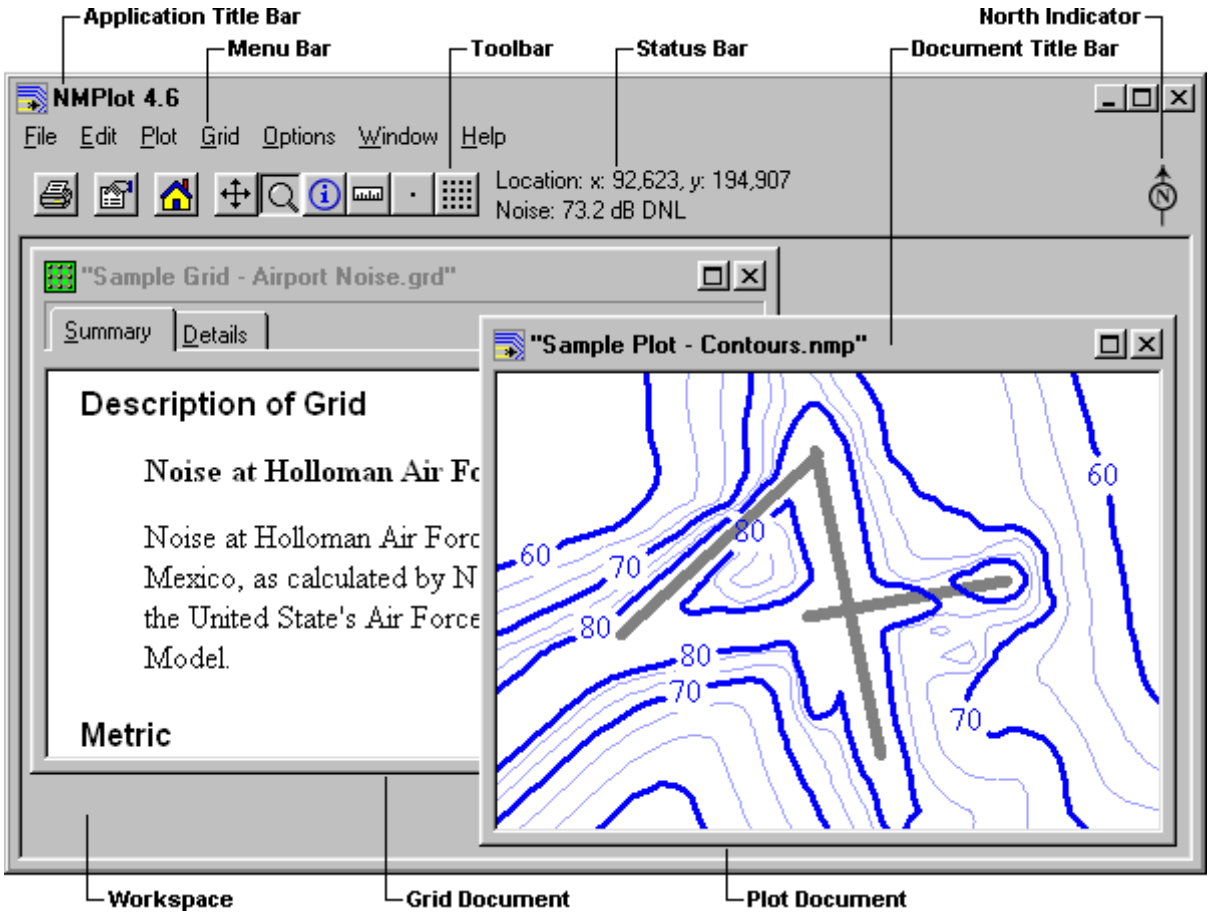
2.8. Getting Help

Press the F1 key at any time to access NMPlot's extensive online help system. Press Ctrl + F1 to display the NMPlot User's Guide table of contents. *Chapter 22, Accessing Help*, discusses the help system in detail.

Chapter 3

A Brief Tour of NMPlot

The following screen capture shows NMPlot's main window as it would appear after opening two files: the plot `Sample Plot - Contours.nmp` and the grid `Sample Grid - Airport Noise.grd`. The main components of NMPlot are labeled.



3.1. Application Title Bar

NMPlot's application title bar displays the program icon, the program name and version, and buttons to minimize, maximize, and close the application.

Clicking on the program icon displays the Control menu, which contains commands for positioning, resizing, minimizing, maximizing, and closing NMPlot. Double-clicking on the program icon closes NMPlot. Double-clicking on the title bar toggles the window between its maximized and normal sizes.

3.2. Menu Bar

The menu bar displays the headings for each of NMPlot's menus.

To display a menu, either click on its heading with the mouse, or press the Alt key plus the underlined letter in the heading of the menu. For example, to display the Help menu, press Alt + H. Note that on some versions of Microsoft Windows, the underline segments will be hidden until you press the Alt key.

To choose an item on a menu, either: click on the item; press the key corresponding to an underlined letter in the item's text; or select the item using the up and down arrow keys, and then press the Enter key.

The result of choosing a menu item depends on the item's type.

- Choosing a menu item that ends with a small triangle will cause a secondary menu to appear.
- Choosing a menu item that ends with three dots ... displays a dialog box. All dialog boxes have a Cancel button. Therefore, if you are browsing NMPlot's user interface, it is always safe to click on a menu item ending in three dots. You can inspect the dialog box and then cancel it.
- Choosing any other menu item will cause an action to immediately occur.

Menu items that do not currently apply will appear in gray.

3.3. Toolbar

The toolbar displays buttons that provide quick access to frequently used commands in NMPlot. To activate a command, press its toolbar button. If a command is unavailable, its toolbar button will be gray.

The toolbar contains the following buttons:

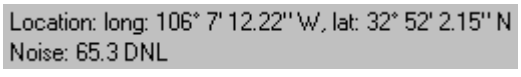
Button	Description
	Print a plot
	Print preview a plot
	Change a plot's options
	Go to a plot's home view
	Activate Panning tool
	Activate Zooming tool
	Activate Display Properties tool
	Activate Measurement tool
	Activate Point of Interest Computation tool
	Activate Grid Computation tool

If you forget the purpose of a toolbar button, briefly hold the mouse cursor over it. A tooltip window will appear, displaying a brief description of the button.

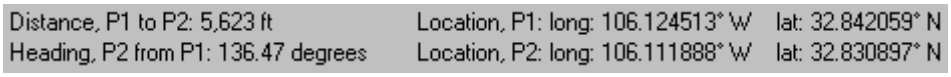
3.4. Status Bar

The status bar, located to the right of the toolbar, displays information that varies, depending on the action you are currently performing.

- If you are viewing a plot, the status bar displays the location of the mouse, and the grid data level at that point. You can change the coordinate system used to display the mouse location: see *Section 21.4, Mouse Location Display Coordinates*.



- If you are using the Measurement tool, the status bar displays the distance and heading between two points on a plot. You can set the units used to display the measured distance: see *Section 21.3, Physical Units*.



- If NMPlot is busy performing a lengthy operation, the status bar displays a message describing the operation. If possible, it also displays a progress bar showing the percentage of the operation completed.

3.5. North Indicator

The north indicator shows the direction of north on a plot.

To display the exact direction of north, briefly hold the mouse cursor over the north indicator. A tooltip window will appear, displaying the direction of north in degrees.

When NMPlot is busy performing a lengthy operation, the north indicator is replaced with an animated image of a stopwatch.

3.6. Workspace

The workspace occupies the entire NMPlot application window below the toolbar. When you open a file, a new document window appears in the workspace. Any number of document windows can be open simultaneously.

A document window can be moved and resized in the workspace. Alternatively, it can be maximized so that it fills the entire workspace.

Use the Window menu to manage document windows.

3.7. Document Title Bar

The title bar of a document window is similar to the title bar of an application. It displays the document icon, the document file name, and buttons to maximize and close the window.

At any given time, one document window is *active*. The active window will appear in front of other document windows, and the text on its title bar will be darker. The active document is the focus of your actions: all mouse, keyboard, toolbar, and menu activity is directed to it. In order to work with a document, you must first activate it.

To active a document window, you can:

- Click on the document window title bar.
- Choose from the list of open documents at the bottom of the Window menu.
- Repeatedly choose Next View or Previous View from the Window menu until the desired window becomes active.
- Repeatedly press F6 or Shift + F6 until the desired window becomes active.

To maximize a document window, you can:

- Press the maximize button  on the document title bar.
- Double-click on the document title bar.
- Choose Maximize from the Window menu.

To restore a maximized document window, you can:

- Press the restore button  on the document title bar.
- Double-click on the document title bar.
- Choose Restore from the Window menu.

To close a document window, you can:

- Press the close button on the document title bar.
- Choose Close from the File menu.

3.8. Plot Document

When you create a new plot, or open an existing one, NMPlot displays it in a plot document window. See *Chapter 7, Introduction to Plots*, for an overview of the plot window.

When a plot document is active, you can:

- Zoom, pan, measure, and display properties of the plot. See *Chapter 8, Working With Plots*.
- Modify the plot's options, which control how the plot appears. See *Chapter 9, Contour Plots*, *Chapter 10, Color Gradient Plots*, *Chapter 11, Displaying Grid Data Points*, and *Chapter 12, Displaying Geographic Annotations*.
- Modify the plot's background, displaying the plot over background maps and plots of other grids. See *Chapter 13, Changing the Plot Background*, and *Chapter 14, Background Map Formats*.
- Print the plot. See *Chapter 15, Printing Plots*.
- Export the plot to a Geographic Information System (GIS). See *Chapter 17, Exporting Plots to a Geographic Information System*.
- Export the plot as a bitmap image. See *Chapter 18, Exporting Plots as Bitmap Images*.

3.9. Grid Document

When you open a grid file, NMPlot displays it in a grid document window. This window shows you the contents of the grid file, as described in *Chapter 5, Viewing Grids*. Additional background information about grids can be found in *Chapter 4, Introduction to Grids*.

When a grid document is active, the commands in the Grid menu are available, allowing you to work with the grid. These commands are covered in *Chapter 6, Working With Grids*.

Chapter 4

Introduction to Grids

4.1. What is a Grid?

4.1.1. An Example

Imagine that you are assigned the task of creating a navigational chart for a lake. The chart must accurately display the lake's depth at any location, so boaters can avoid dangerously shallow areas. However, the depth of the lake has never been surveyed, so you will need to measure it yourself.

You get a boat, sail to various points in the lake, and measure the depth. At each point, you carefully mark your location on a map, and write the measured depth next to it. You have created a model of the varying depth of the lake by sampling it at discrete points.

In the terminology of NMPlot, you have created a *grid* .

4.1.2. The Definition of a Grid

When you measure something that can be expressed as a single number (the length of a rope, the weight of a brick), you are making a *scalar measurement*.

Often, a quantity being measured will vary depending on exactly where you measure it. Consider the depth of a lake. It varies smoothly, starting from zero at the shoreline, typically increasing towards the center. If you measure the depth near the shore, you will get a much different result than if you measure it near the center. The depth is a *scalar field* : a measurable scalar quantity that varies as a function of the measurement location. The world is full of scalar fields. Examples include the water temperature of the sea and the elevation of the Earth's surface above sea level.

Engineers and scientists often want to record and analyze scalar fields. This can rarely be done with perfect accuracy. Usually, the best that can be done is to record measurements made at a number of discrete locations. If enough measurement locations are used, the field can be recorded

to an acceptable level of accuracy. Such a set of measurements, along with any auxiliary information (such as the units of measurement), is defined as a *grid*. Each measurement is called a *grid point*, or alternatively, a *data point*.

Using a grid, it is possible to compute a *data value* at any point by interpolating or extrapolating from the grid's data points. The data value is the best estimate, using the information in the grid, of the value of the scalar field at that location. If the distribution of grid points is adequate, the data value will be close to the scalar field's actual value.

The term grid comes from the fact that measurements are often taken at regularly-spaced locations defined by a two- or three-dimensional rectangular grid. However, this is not a requirement. Sets of measurements taken at arbitrary locations are also considered grids.

4.1.3. NMPlot Works With Two-Dimensional Georeferenced Grids

NMPlot works with a specific type of grid: one that characterizes a scalar field that varies with geographic location. Such grids are two-dimensional: a measurement location can be specified by two numbers. Furthermore, the grids are *georeferenced*, which means that we know where on the surface of the Earth that the measurement points are located. In practice, this means that it is possible to determine the longitude and latitude of each measurement location.

NMPlot cannot process three-dimensional grids, such as a set of air temperatures measured throughout the atmosphere. If can, however, work with a series of grids measuring the air temperature at a height of 1000 feet, 2000 feet, etc.

4.1.4. Additional Examples of Grids

The following are all examples of grids that NMPlot can work with.

- The level of an air pollutant measured at sampling stations located throughout a city.
- The predicted noise level surrounding an airport, as calculated by an airport noise model.
- The level of insect infestation observed at farms located throughout a state.
- Tomorrow's predicted high temperatures at various cities, as predicted by a weather forecast.
- The relative humidity measured at 1000 feet above ground level.

4.2. Parts of a Grid

A grid is composed of the following parts.

4.2.1. Data Points

Certainly, the most important part of a grid is the set of data points. Each data point consists of three numbers: two for the geographic location of the point on the Earth, and one for the data value at that location.

In practice, the location of each data point may not be explicitly stored in the grid. For example, the data points may be stored as a two-dimensional regular grid. In this case, only the dimensions and location of the grid needs to be specified. The location of individual data points can be calculated from this information. Of course, if the data points are irregularly distributed, with no pattern to their locations, then the location of each point must be explicitly included in the grid.

4.2.2. Coordinate System

A grid's coordinate system specifies how to interpret geographic coordinates. It georeferences the grid, defining how to relate a given geographic coordinate in the grid with a location on the Earth.

Examples of coordinate systems include:

- Longitude and latitude
- Universal Transverse Mercator (UTM)
- Meters east and north of the Empire State Building

4.2.3. Data Metric

A grid's *data metric* specifies what is being measured by the data points in the grid, and what physical units are used.

Examples of data metrics include:

- Air temperature, measured in ° F
- Noise level, measured in dB
- Grasshopper population density, measured in grasshoppers/m^2

4.2.4. Valid Data Limits

A grid's *valid data limits* define the minimum and maximum data levels that are considered valid. Any data points with values outside these limits are considered invalid, and should not be used in calculations.

If the data points in a grid are stored as explicit location-value pairs, invalid data can simply be excluded from the grid. However, if the data points are stored as a two-dimensional rectangular grid, there is no easy way to exclude invalid points. In this case, invalid points are given an extreme value, far beyond the limits of actual valid data, and the valid data limits are set so that the extreme value is recognized as invalid.

Invalid data points are common. It is rare that a large data set is collected without error. Instruments malfunction. Mistakes are made.

Invalid data points can also be generated by computer models. As an example, consider NOISEMAP, the United States Air Force's airport noise model. NOISEMAP writes a large two-dimensional grid of predicted noise levels. For data points located far from where airplanes fly, NOISEMAP does not perform calculations, but simply writes the value -50 dB into the grid. This value is invalid, in the sense that it does not represent a prediction. It simply means that no calculations were performed at those points.

Tip:

An informal convention in science and engineering is to use large positive or negative numbers consisting entirely of the digit nine (-999, 9999, etc.) to denote invalid data. Be suspicious of any data of this form.

4.2.5. Defined Area Polygon

The *defined area polygon* is the area inside which a grid accurately records a scalar field. A grid is a record of a continuous smoothly-varying scalar field, made by measuring it at discrete points. Using the grid, you can compute an approximation of the original scalar field at any location by interpolating or extrapolating from the measured points. The defined area polygon specifies the area where it is wise to do so. It is the portion of the Earth's surface where a grid adequately describes a scalar field.

Any calculations using the grid should be restricted to locations inside the defined area polygon. For example, if a contour plot of the grid is displayed, no contours should be drawn outside of the defined area.

In practice, extrapolation is often unreliable. Therefore, as a rule of thumb, the defined area polygon equals the area where it is mathematically possible to perform interpolation. This area is

known as the *convex hull* of the data points. The convex hull is the smallest convex polygon that completely encloses a set of data point locations.

In some cases, even interpolation is unreliable. Consider the arrangement of data points in *Figure 4.1*. While it is possible to interpolate values in the area marked A, it may be unwise to do so, as the results may be inaccurate. Most likely, you would like interpolation to be restricted to the area surrounded by the dashed line.

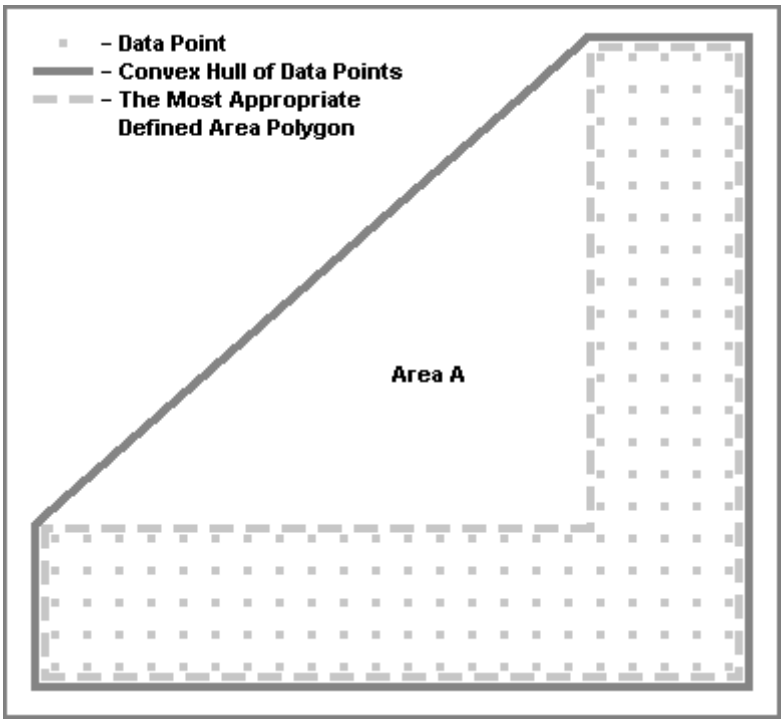


Figure 4.1 An arrangement of data points for which the convex hull would be an inappropriate defined area polygon. Although we could interpolate between the data points in the area marked A, it may be unwise to do so, as it may yield inaccurate results. Most likely, we would like the defined area polygon to equal the area marked by the light gray dashed line.

If we draw contours based upon this set of data points, they should be restricted to the defined area polygon, as shown in *Figure 4.2*.

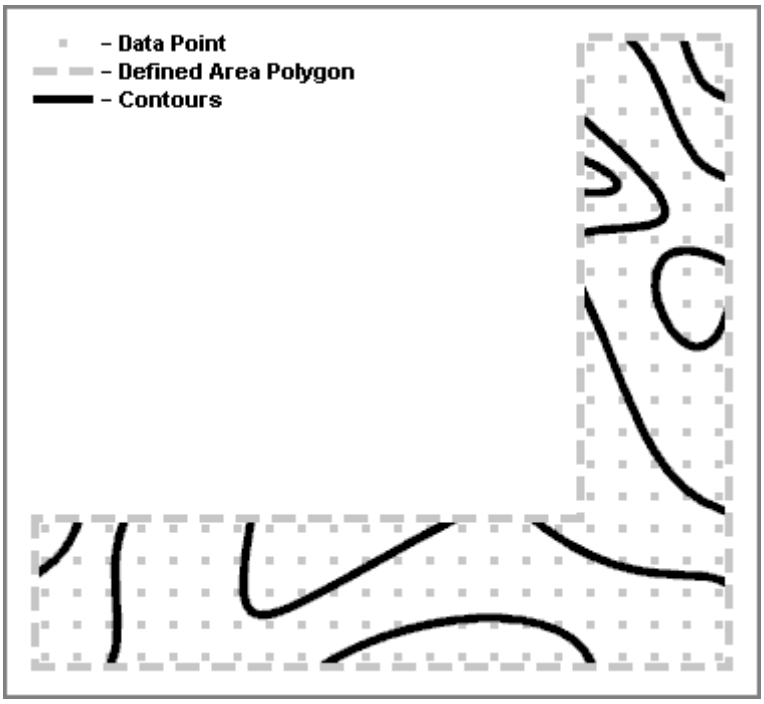


Figure 4.2 Contours should be clipped to the defined area polygon (i.e., the area in which interpolation can be reliably performed).

The defined area polygon is an optional part of a grid. If it is not present, then the default defined area polygon, defined by the convex hull of the data points, should be assumed.

4.2.6. Geographic Annotations

Geographic annotations comprise any relevant map data stored in a grid. While optional, such data can be of value in working with the grid. For example, in a grid of air pollutant readings around an industrial site, it would be useful to include the site boundary. A plotting program could then draw the boundary when creating a contour plot of the grid, and an analysis program could warn if any off-site readings were above the legal limit.

Such map data can also be stored in an external file. Storing it directly in a grid is simply an organizational convenience. As a rule of thumb, only map data that is particularly relevant to the grid should be stored internally. Extensive general-purpose map data should be stored in external files.

4.2.7. Bookkeeping Information

Bookkeeping information consists of any additional information that may be useful to include with a grid. Examples of bookkeeping information include:

- A detailed description of the data in the grid
- The time and date when the grid was created
- Contact information for the person or organization responsible for the grid
- For measured data, a description of the instruments and procedures used to collect the data
- For data produced by a computer model, a description of the model, and of any parameters and input files used to run it

Chapter 5

Viewing Grids

5.1. Opening a Grid

To open a grid in NMPlot, follow these steps.

1. Choose Open from the File menu. The standard Windows dialog box for opening files is displayed. Familiarity with the use of this dialog box is assumed.
2. Navigate to the directory where your grid file is located, then open the file. Grid files typically have the extension `.grd`.
3. A Grid Document window appears, displaying the contents of the grid.

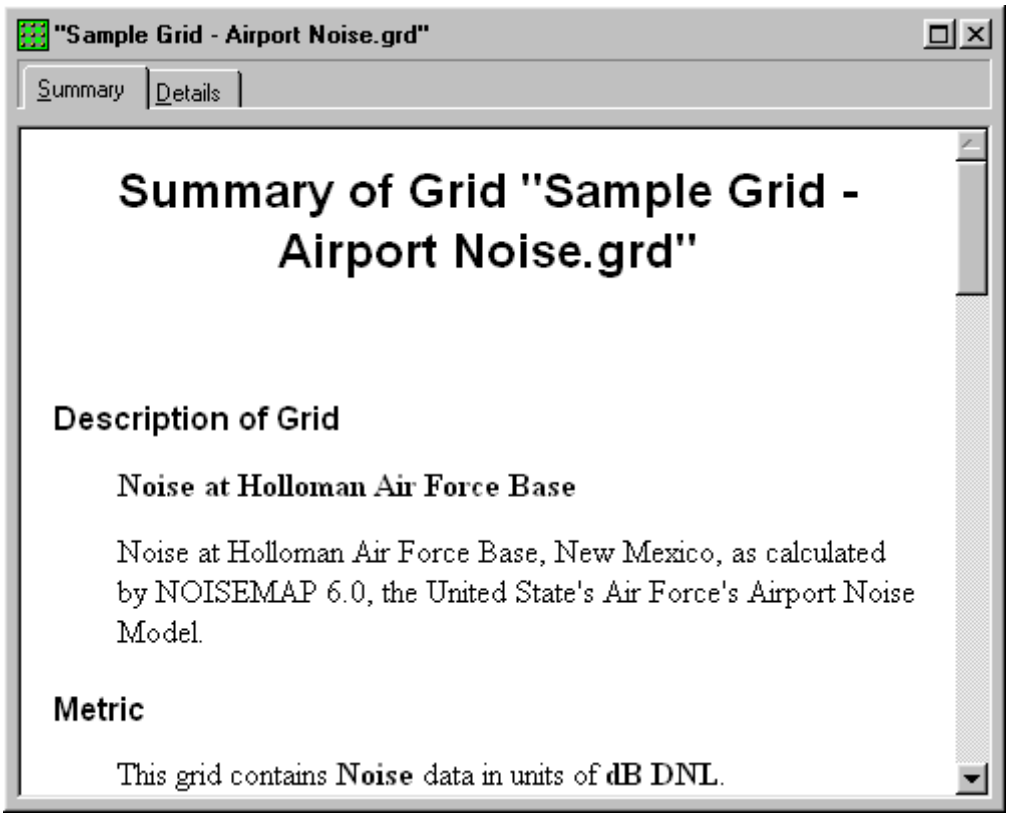
5.2. The Grid Document Window

The Grid Document window displays the contents of a grid. The window has two panes. The Summary pane displays a concise summary of the grid. The Details pane displays an exhaustive list of the grid's contents.

Use the tabs at the top of the window, just below the title bar, to switch between the two panes. To display the Summary pane, click on the tab labeled Summary, or press Alt + S. To display the Details pane, click on the tab labeled Details, or press Alt + D.

5.3. The Summary Pane

The Summary pane of the Grid Document window displays a summary of a grid in report form.



You can scroll through the report, print it, and save it as an HTML document. See *Section B.13, Document Display Control*, for details.

See *Appendix C, A Sample Grid Summary Report*, for a sample summary report.

5.4. The Details Pane

The Details pane of the Grid Document window displays a complete list of the contents of a grid. It is intended for advanced users who need more detail than the Summary pane provides. If you are just learning NMPlot, it is recommended that you skip this section, and return to it if you later find that the Summary view does not provide enough information.

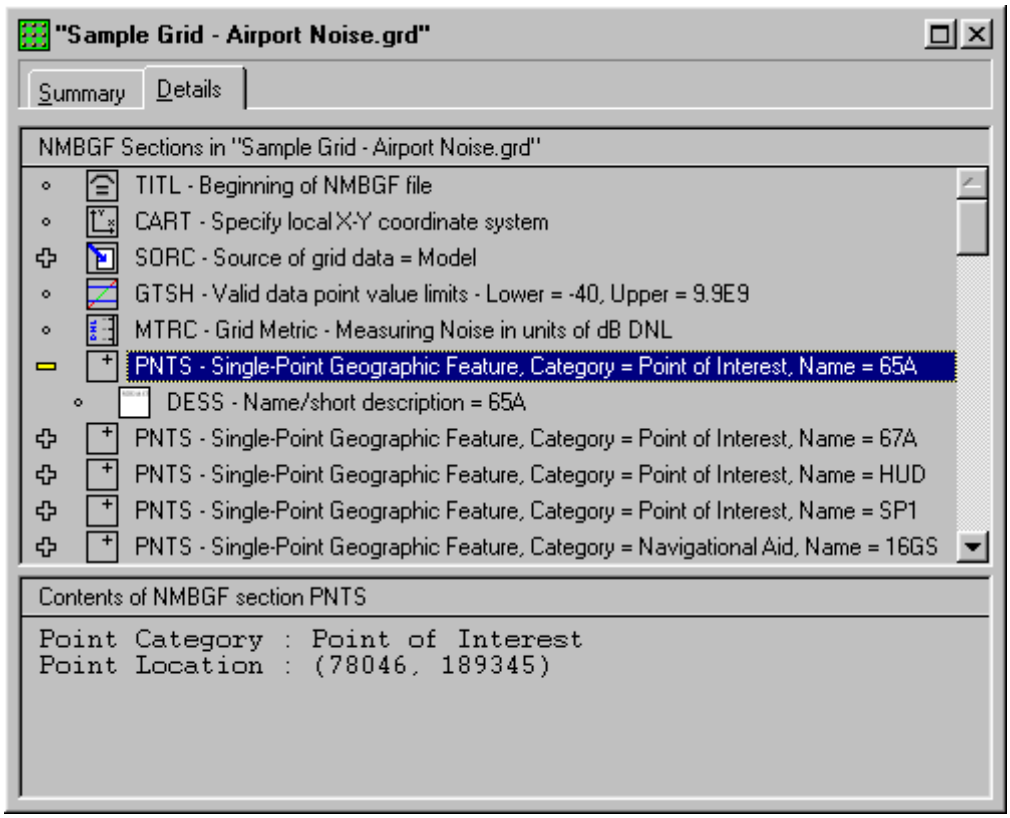
5.4.1. The Noise Model Grid Format (NMGF) Standard

In order to use the Details pane, you will need to understand the Noise Model Grid Format (NMGF) standard. NMGF is a documented way of representing a grid and its auxiliary information as a group of named *sections*. An introduction to NMGF is available in *Appendix F,*

Introduction to the Noise Model Grid Format. Complete NMGF documentation is available from the NMGF web page, http://wasmerconsulting.com/nmgf.htm.

Internally, NMPlot processes all grids using NMGF. If you open a grid file that is stored in a format other than NMGF, NMPlot will automatically translate the data into the NMGF format as it reads the file.

The Details pane displays the grid as raw NMGF sections.



5.4.2. The NMGF Section List

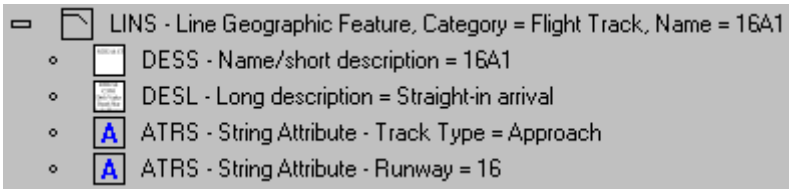
The top portion of the Details pane lists all NMGF sections in the grid. Each item in the list represents a section. Here is an example.

For each NMGF section, five pieces of information are displayed, from left to right.

1. A symbol indicating the presence of subsections. A small dot ◦ indicates that the section does not have subsections. A plus sign ✣ indicates that the section has subsections.

2. An icon for the section type. In the example above, the icon is  .
3. The four-letter name of the section type. In the example above, the four-letter name is *LINS*.
4. A short description of the section type. In the example above, the short description is *Line Geographic Feature*.
5. A summary of the data stored in the section and its subsections. In the example above, the summary is *Category = Flight Track, Name = 16A1*.

Click on the plus sign to the left of the section to view its subsections. The subsections will be displayed.



One section in the list is always selected. This section is highlighted with a different background color. Click on a section to select it.

5.4.3. The NMGF Section Browser

The bottom portion of the Details pane contains the section browser. It displays the contents of the section currently selected in the section list.

You can copy text from the browser window to the clipboard. To do so, first select the desired text by dragging over it with the mouse. Then, copy the text by either a) choosing Copy from the Edit menu, or b) pressing Ctrl + C.

5.4.4. Resizing the Section List and Section Browser

To change the relative sizes of the section list and section browser windows, use the mouse to drag the separator between the two windows.

Chapter 6

Working With Grids

Using NMPlot, you can modify grids in a variety of ways. As an analogy, consider a word processor, which allows you to open, view, edit, save, and rename word processing documents. NMPlot allows you to work with grid files in a similar fashion.

Typically, you will open a grid, modify it by choosing commands from the Grid menu, and then save it by choosing either Save or Save As from the File menu.

Tip:

If you are modifying a grid, but want to preserve the original grid file unchanged, it is recommended that you follow these steps.

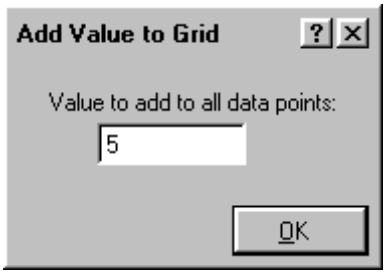
1. Open the grid you want to modify.
2. Choose Save As from the File menu, and save the grid using a new name.
3. Make your modifications to the grid.
4. Choose Save from the File menu to save your modifications.

This does introduce an extra step that is not strictly necessary: you could skip the second step and simply choose Save As after making your modifications. However, it is all too easy to forget and choose Save instead, overwriting the original grid file with the modified version.

When NMPlot modifies a grid, it updates the grid's bookkeeping information with a description of the modifications. The original bookkeeping information is preserved, resulting in an audit trail of changes made to the grid.

6.1. Adding a User-Supplied Value to a Grid

NMPlot allows you to add a user-supplied constant to the value of every data point in a grid. To do so, choose Add Value to Grid from the Grid menu. The Add Value to Grid dialog box appears.

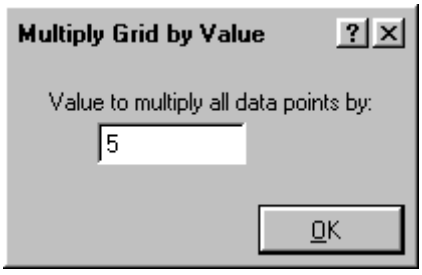


Type the value to add, then press OK. The grid is immediately modified.

Invalid data points (i.e., data points with values outside the valid data limits) are not changed.

6.2. Multiplying a Grid by a User-Supplied Value

NMPlot allows you to multiply the value of every data point in a grid by a user-supplied constant. To do so, choose Multiply Grid by Value from the Grid menu. The Multiply Grid by Value dialog box appears.

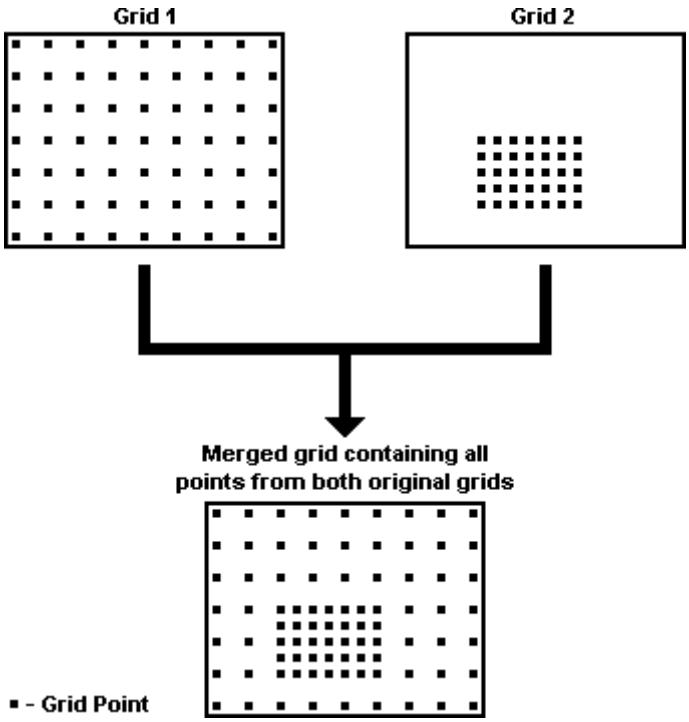


Type the value to multiply by, then press OK. The grid is immediately modified.

Invalid data points (i.e., data points with values outside the valid data limits) are not changed.

6.3. Merging Two Grids

Merging refers to creating a new grid that contains the data points from two or more existing grids.



For example, assume that you are modeling the noise levels around an airport with a noise analyses program that can only generate regular rectangular grids. To model the noise adequately, you generate two grids.

The first grid captures the gross structure of the noise over a large area around the airport. It covers an area 20 miles across with a resolution (i.e., a distance between adjacent data points) of 1000 feet. The second grid captures the fine structure of the noise near the airport. It covers an area only two miles across with a finer resolution of 100 feet.

Using NMPlot, you merge these two grids into a single grid. You then plot noise level contours based upon this merged grid. This plot adequately displays the noise levels at all scales of interest.

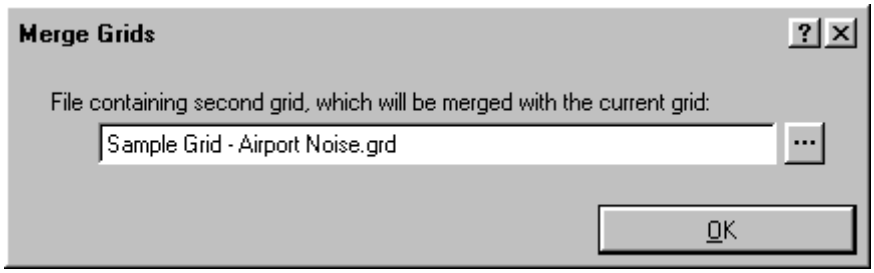
Caution:

Do not confuse merging grids with combining grids. To insure that you choose the correct action, you should review *Section 6.4, Combining Two Grids*.

6.3.1. Step-by-step Guide To Merging Grids

To merge two or more grids, follow these steps.

1. Open the first grid.
2. Choose Save As from the File menu, and give the grid a new name.
3. Choose Merge Grids from the Grid menu. The Merge Grids dialog box appears.



4. Type the name of the file containing the second grid. Press the Browse button ..., located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file.
5. Press OK. The data points from the second grid are merged into the first grid.
6. Repeat steps 3 through 5 for any additional grids you want to merge.
7. Choose Save from the File menu to save the merged grid.

6.3.2. Merging Grids With Different Metrics

If you merge two grids with different metrics or physical units (for example, trying to merge a data set of noise levels with a data set of air pollutant levels), a warning is added to the merged grid.

Caution:

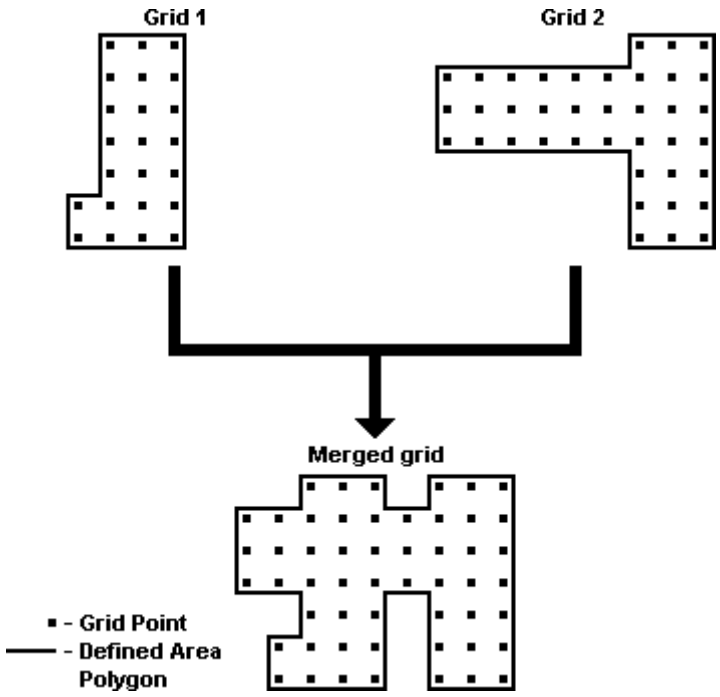
NMPlot does not prevent the merging of grids with different metrics. The decision to allow this was a pragmatic one. It is not uncommon for the same metric to be referred to by different names. For example, one person might refer to the outside temperature as "Air Temperature", while another might use "Ambient Temp.". To facilitate the merging of grids from different sources, NMPlot allows you to merge grids with different metrics. You are responsible for determining whether the metrics are equivalent.

6.3.3. Merging Grids That Cover Different Geographic Areas

NMPlot can merge any two grids. The geographic area covered by the two grids can overlap totally, partially, or not at all. The grids can have different coordinate systems.

6.3.4. The Merged Grid's Defined Area Polygon

The defined area polygon of the merged grid is equal to the union of the two original grids' defined area polygons. That is, the new defined area polygon consists of the geographic area in the first grid's defined area polygon, the second data grid's defined area polygon, or both.

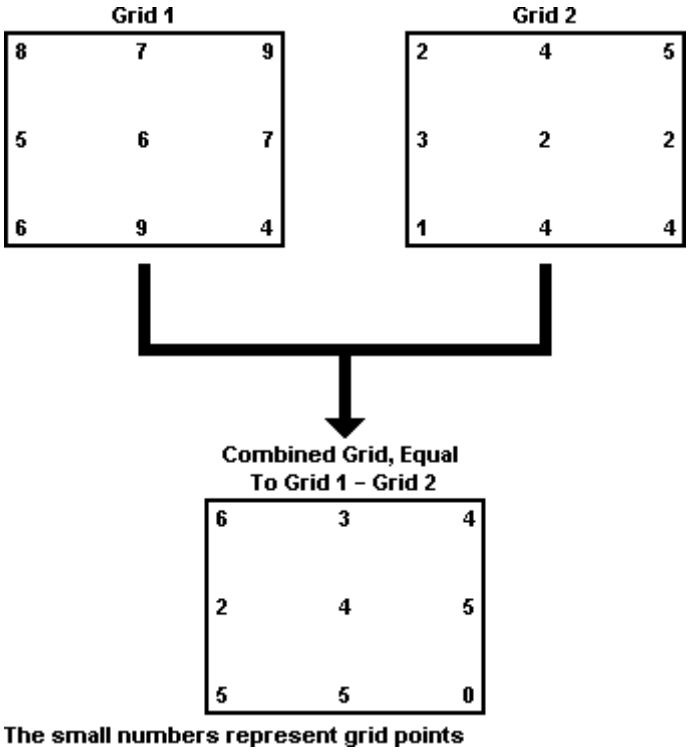


6.3.5. Geographic Annotations

NMPlot does not merge geographic annotations. This capability may be added in the future.

6.4. Combining Two Grids

Combining refers to creating a new grid by performing a mathematical operation, such as addition or subtraction, on the data points in two existing grids.



As an example, assume that you have two grids. The first represents the existing levels of an air pollutant across a city, while the second represents the predicted levels a few years in the future, after several proposed changes have been made at local factories. You use NMPlot to subtract the first grid from the second, and display the combined grid using contours on a background map of the city. This contour plot clearly indicates whether a particular neighborhood can expect its air quality to improve or deteriorate.

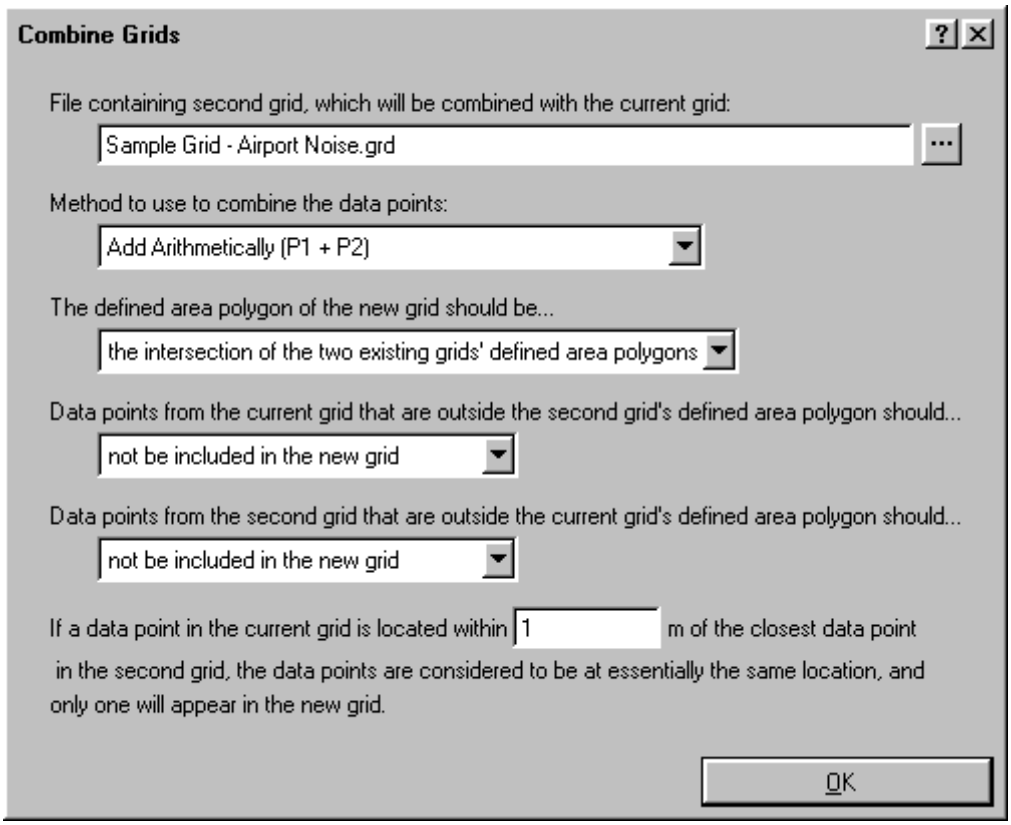
Caution:

Do not confuse combining grids with merging grids. To insure that you choose the correct action, you should review *Section 6.3, Merging Two Grids*.

6.4.1. Step-by-step Guide To Combining Two Grids

To combine two grids, follow these steps.

1. Open the first grid.
2. Choose Save As from the File menu, and give the grid a new name.
3. Choose Combine Grids from the Grid menu. The Combine Grids dialog box appears.



4. Type the name of the file containing the second grid. Press the Browse button ..., located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file.

5. Select the method for combining the grids. You have three options. In the list of options, P1 and P2 represent grid data values from the first and second grids being combined, respectively.

   - Arithmetic addition (P1 + P2)
   - Arithmetic subtraction (P1 - P2)
   - Addition of noise decibels ($10 \text{ Log}_{10} (10^{P1/10} + 10^{P2/10})$)

6. Select the method for computing the combined grid's defined area polygon. You have two options.

   - *Intersection* - The combined grid's defined area polygon is the area covered by both of the two existing grids' defined area polygons. This is the recommended option for most situations.

- *Union* - The combined grid's defined area polygon is the area covered by either or both of the two existing grids' defined area polygons.

7. Select how to handle a grid's data points that are outside the defined area polygon of the other grid. You have two options.

   - *Do Not Include The Points* - The data points are discarded. This is the recommended option for most situations.

   - *Include the Points Unchanged* - The data points are included in the combined grid. Their values are not changed.

8. Type the minimum tolerance distance that must separate two data points in order for them to be considered distinct. If a data point in one grid is located within the tolerance distance of a data point in the other grid, the data points are considered to be at the same location. In this case, only one will appear in the combined grid.

   Typically, the tolerance distance should be set to a small value: 1 meter is a reasonable default value. However, there are situations where you may want to use a larger tolerance. It is recommended that after combining grids, you create a plot of the combined grid and display its grid points. You may see spurious points.

If this happens, use the Measurement tool to measure the distance between the pairs of points, and set the tolerance to a somewhat larger distance. Then recombine the grids. The spurious points should be gone.

9. Press OK. The data points from the second grid are combined with those in the first grid.
10. Choose Save from the File menu to save the combined grid.

6.4.2. Combining Grids That Cover Different Geographic Areas

NMPlot can combine grids that do not have identical data point locations. In this case, interpolation is used to combine the two grids. The geographic areas covered by the two grids do not have to be identical. However, there must be at least some overlap between them. The grids can have different coordinate systems.

6.5. Creating a Plot of a Grid

If you are viewing a grid, you can easily create a plot of it by choosing Create Plot Of This Grid from the Grid menu.

Chapter 7

Introduction to Plots

A *plot* is a graphical representation of a grid that displays a combination of the following elements.

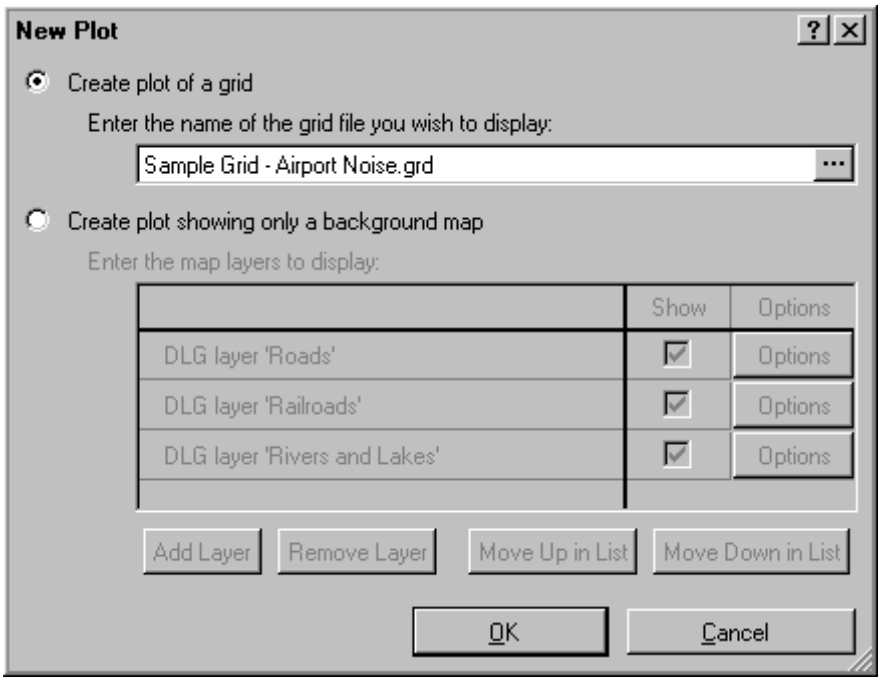
- A set of contours representing the grid's scalar field
- Smoothly varying gradients of color representing the grid's scalar field
- A map of the location of the grid's data points
- The grid's geographic annotations
- A background map

This chapter discusses the basics of creating and configuring plots. Later chapters discuss the various elements of a plot in detail.

7.1. Creating a New Plot

To create a new plot, follow these steps.

1. Choose New from the File menu, then choose Plot. The New Plot dialog box appears.



2. Select the type of plot to create. You have two choices.

   - *Create plot of a grid* - This is the most common choice. A contour plot of a grid will be created.

     Type the name of the grid file that you want the plot to display. Press the Browse button ..., located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file.

   - *Create plot showing only a background map* - A plot will be created that shows one or more background map layers. No grid file is required. This is useful for previewing the contents of a map file.

     Specify the background map layers that you wish to display. See *Section 13.2, Background Layers*, for more information.

3. Press OK. A plot document window appears, displaying the new plot.

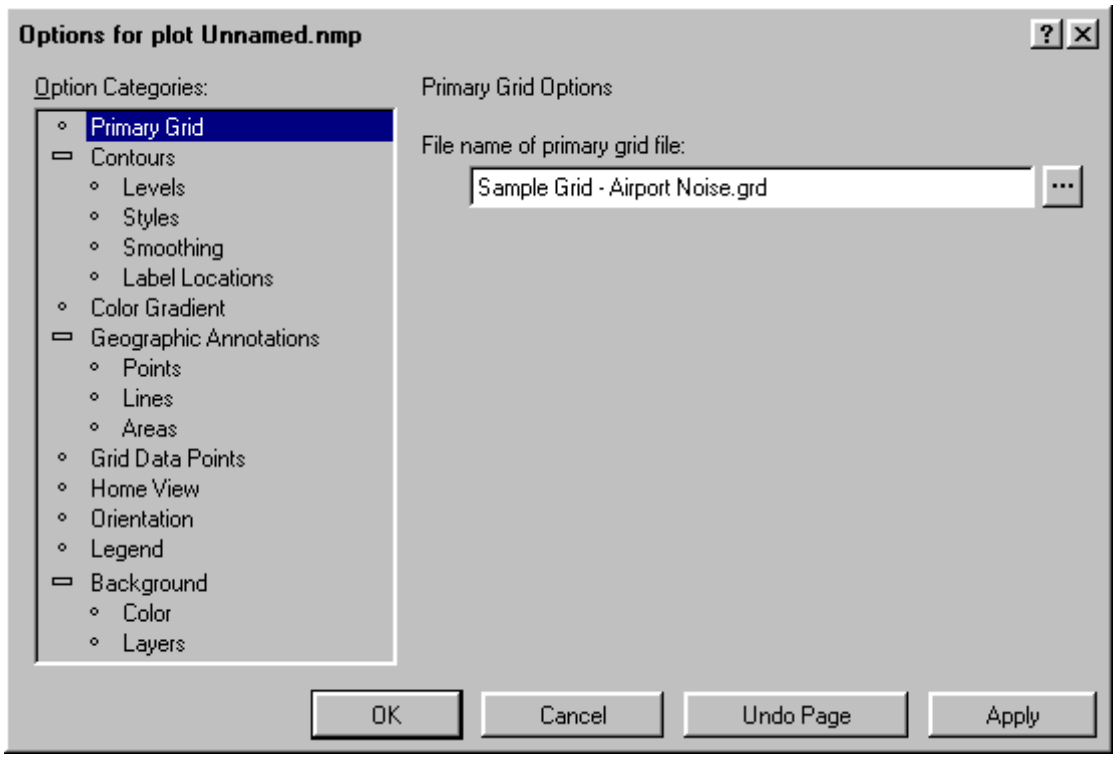
7.2. The Plot Options Dialog Box

To display the Plot Options dialog box, you can:

- Choose Options from the Plot menu.

- Press the Options button  on the toolbar.

Use the Plot Options dialog box to change a plot's appearance. All plot options are set from here.



The left portion of the dialog box displays a list of option categories. One category in this list is always selected. The right portion of the dialog box displays controls that allow you to change the options in the selected category.

The Plot Options dialog box is a Multiple Page dialog box. See *Section B.2, Multiple Page Dialog Boxes*, for more information.

7.3. The Primary Grid of a Plot

The purpose of a plot is to graphically display a grid, which is know as the plot's *primary grid*.

Note:

In addition to the primary grid, one or more additional grids may be displayed as background layers. See *Section 13.3, Overlaying Grids*, for more information.

NMPlot assumes that the primary grid is stored in a file. When a plot is created, you are prompted for the name of the primary grid file. If you later want to change the primary grid, follow these steps.

1. Display the Primary Grid page of the Plot Options dialog box.

2. In the box provided, type the name of the grid file containing the primary grid. Press the Browse button ..., located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file.

To display a plot's primary grid, choose Display Primary Grid of this Plot from the Plot menu. NMPlot will open the primary grid and display a summary of it. See *Chapter 5, Viewing Grids*, for more information.

7.4. Saving a Plot

You can save a plot to a file, referred to as a *plot file* . All options on the Plot Options dialog box are saved. Plot files typically have the extension `.nmp`, which is short for NMPlot Plot.

To save a plot, choose either Save or Save As from the File menu.

7.5. Opening a Plot

To open a plot that has been saved to a file, follow these steps.

1. Choose Open from the File menu. The standard Windows dialog box for opening files is displayed. Familiarity with the use of this dialog box is assumed.

2. Navigate to the directory where your plot file is located, then open the file. Plot files typically have the extension `.nmp`.

3. A Plot Document window appears, displaying the plot.

NMPlot can read all previous versions of plot files.

Chapter 8

Working With Plots

8.1. Mouse Location Displayed On Status Bar

To determine the geographic coordinates of a location on a plot, point to that location with the mouse. The coordinates are displayed on the status bar. You can change the coordinate system used to display the location: see *Section 21.4, Mouse Location Display Coordinates*.

If the location is within the primary grid's defined area polygon, the data value of the grid at that location is also displayed. If the location is between grid data points, two-dimensional interpolation is used to compute the data value.

If the location is outside the primary grid's defined area polygon, dashes ---- are displayed for the data value.

The coordinates and the data value are automatically updated as the mouse is moved.

8.2. Mouse Tools

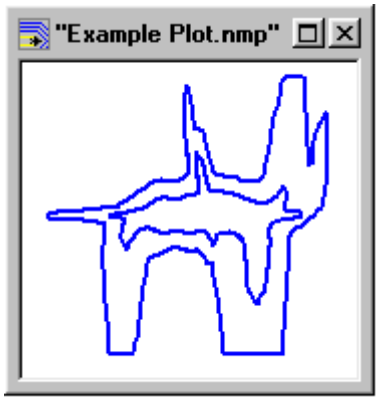
NMPlot provides a number of tools for working with plots. For example, the Measurement tool allows you to measure the distance between two points on a plot.

To use a tool, you must first *activate* it by pressing its button on the toolbar. When the mouse cursor is over a plot, the cursor changes shape to indicate which tool is active.

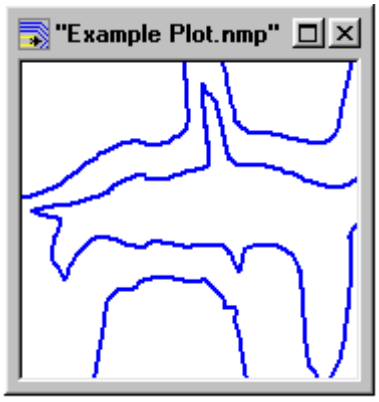
The tools are described in detail in this chapter.

8.3. Zooming and Panning

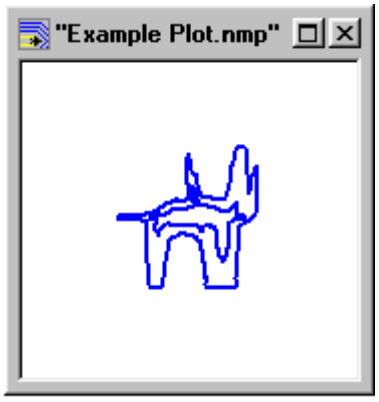
Zooming refers to increasing or decreasing the magnification level at which a plot is displayed.



A Sample Plot

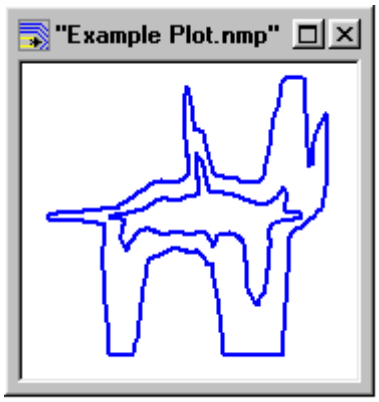


A Sample Plot After Zooming In

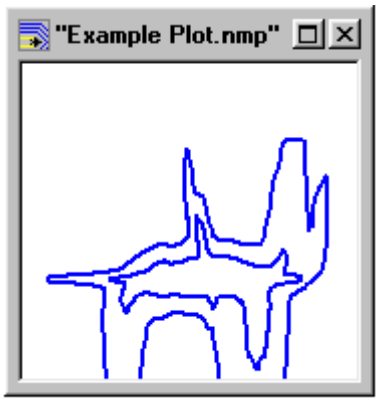


A Sample Plot After Zooming Out

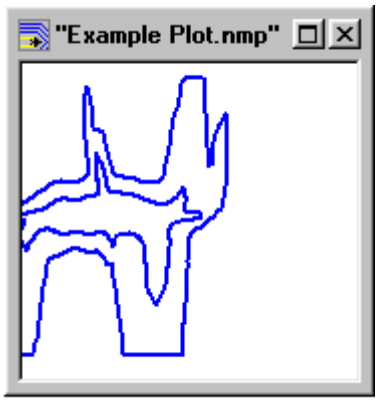
Panning refers to moving a plot horizontally or vertically, so that previously hidden portions of the plot become visible.



A Sample Plot



A Sample Plot After Panning Up



A Sample Plot After Panning Right

8.3.1. The Zoom Mouse Tool

Activate the Zoom mouse tool by pressing its button on the toolbar. When the Zoom tool is active, you can:

- Zoom in by clicking on a plot with the left mouse button.
- Zoom out by clicking on a plot with the right mouse button.

8.3.2. The Pan Mouse Tool

Activate the Pan mouse tool by pressing its button  on the toolbar. When the Pan tool is active, you can pan the plot the clicking with the left mouse button. The point that you click upon is shifted to the center of the plot window.

Clicking near the center of the plot window will cause the plot to pan a small amount. Clicking near the edge of the plot window will cause the plot to pan a larger amount.

8.3.3. Dragging a Rectangular Area of Interest

When either the Zoom or Pan tool is active, you can drag a rectangular area using the left mouse button. The plot is zoomed and panned so that this area fills the plot window.

8.3.4. Using the Mouse Wheel

If your mouse has a wheel button, you can use it to zoom and pan the plot.

Roll the wheel forward to zoom in. Roll the wheel backward to zoom out.

Pan by pressing and holding the wheel button. A small marker appears at the point where you press the button. While holding the button down, move the mouse cursor away from the marker. The plot pans in the direction that you move the mouse. The farther the mouse is from the marker, the faster the plot pans. Release the mouse button to stop panning.

Alternatively, click and release the wheel button. NMPlot enters panning mode. Move the mouse to pan the plot. Exit panning mode by clicking the wheel button a second time.

Tip:

You can zoom and pan using the mouse wheel regardless of which mouse tool is active. This provides you with a convenient way to zoom and pan while using the other mouse tools.

8.3.5. Keyboard Shortcuts

The following keyboard shortcuts allow you to pan and zoom a plot regardless of which mouse tool is active.

Key	Action
↑	Pan up
Ctrl + ↑	Pan up faster
↓	Pan down
Ctrl + ↓	Pan down faster
←	Pan left
Ctrl + ←	Pan left faster
→	Pan right
Ctrl + →	Pan right faster
+	Zoom in
-	Zoom out

8.4. The Home View

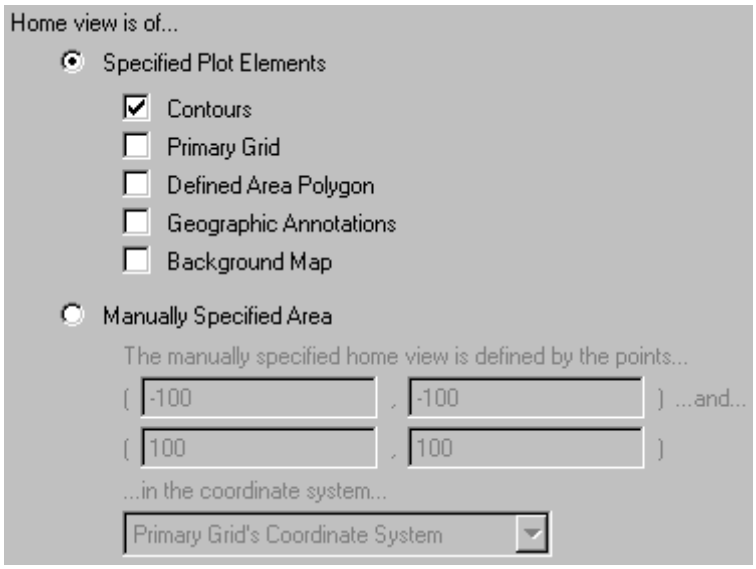
When a plot is first displayed, it is automatically zoomed and panned so that the "interesting" features of the plot (the contours, the geographic annotations, etc.) fill the plot window. This is called the *home view*.

If, after scrolling and zooming, you wish to return to the home view, you can:

- Press the Home View button  on the toolbar
- Press the Home key

To change the home view of a plot, follow these steps.

1. Display the Home View page of the Plot Options dialog box.



2. Select the method for computing the home view. You have two choices.

   - *Specified Plot Elements* - The home view fills the plot window with the selected parts of the plot. You may choose any combination of the following parts.

     - The contours
     - The primary grid's data points
     - The primary grid's defined area polygon
     - The primary grid's geographic annotations
     - The background map layers

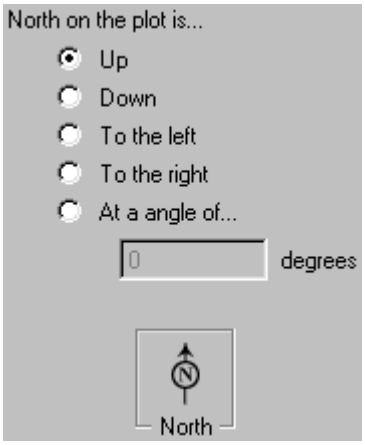
   - *Manually Specified Area* - The home view fills the plot window with a rectangular portion of the plot defined by two points that you specify. Enter the coordinates of two points that define opposite corners of this rectangle. Select the coordinate system used to specify these points. You have two choices.

     - The primary grid's coordinate system
     - Longitude and latitude, specified in decimal degrees east and north. Note that west longitudes are negative

8.5. Plot Orientation

Following mapping conventions, plots are typically displayed with north at the top. However, NMPlot allows you to display plots at any orientation. To set the orientation of a plot, follow these steps.

1. Display the Orientation page of the Plot Options dialog box.

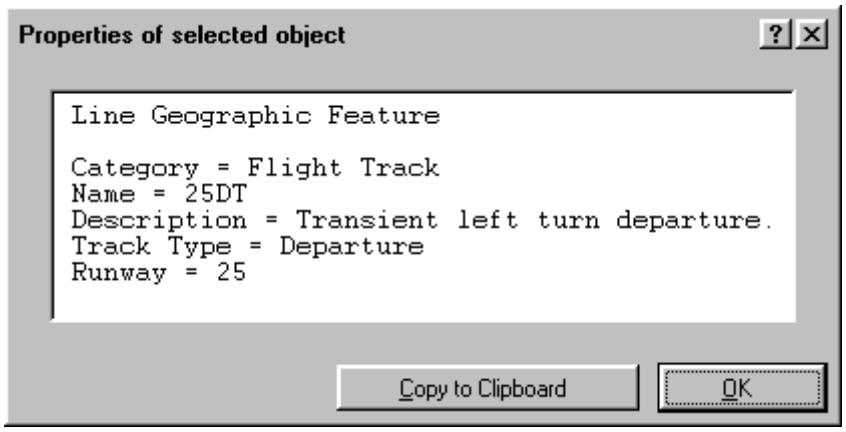


2. Select the direction of north. If you select *At an angle of*, type the direction of north, in degrees clockwise from the top of the plot.

The north indicator at the bottom of the dialog box page displays the direction of north that you have selected.

8.6. The Display Properties Mouse Tool

Use the Display Properties tool to display information about objects in a plot. Activate the tool by pressing its button on the toolbar. Click on an object in a plot to display the Properties of Selected Object dialog box, which shows information about the object.



To copy the information to the clipboard, press the Copy to Clipboard button. To copy only a portion of the text, select it (by dragging over it with the mouse) before pressing the button.

Tip:

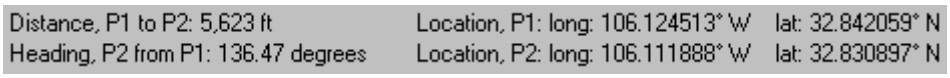
If you click upon a contour, NMPlot displays the area inside the contour. You can change the units used to display the area: see *Section 21.3, Physical Units*.

Note:

NMPlot cannot display information about objects in background layers.

8.7. The Measurement Mouse Tool

Use the Measurement tool to measure the distance and angle between two points on a plot. Activate the tool by pressing its button on the toolbar. To measure the distance between two points, press and hold the left mouse button over the first point, then move the mouse to the second point. The status bar displays the coordinates of the two points, the distance between them, and the directional heading from the first point to the second.



You can change the coordinate system used to display the location of the two points: see *Section 21.4, Mouse Location Display Coordinates*.

You can change the units used to display the distance between the two points: see *Section 21.3, Physical Units*.

The heading is the direction of the second point as seen from the first point, measured in degrees east of true north.

8.8. The Point Of Interest Computation Mouse Tool

Use the Point of Interest Computation tool to perform a detailed analysis of the conditions at a specific location on a plot. In order to use this tool, the plot's primary grid must have been created by a third-party numerical model supported by a client-specific extension to NMPlot. Point of Interest extensions have been developed for the following models.

- NOISEMAP 7.0, the United State Air Force's airport noise model

To use the Point of Interest Computation tool, follow these steps.

1. Activate the tool by pressing its button  on the toolbar.
2. Using the left mouse button, click on a plot at the location where you want to perform the point of interest analysis.
3. A client-specific dialog box may appear, asking you for additional information. Enter the requested information, then press the OK button. See *Section 21.5, Client-Specific Extensions*, for more information.
4. NMPlot runs the appropriate third-party numerical model, instructing it to perform a detailed point of interest analysis at the indicated location.
5. The results of the analysis are displayed in the New Point of Interest dialog box.
6. The results of the analysis are added to the plot's primary grid as a point geographic annotation. When you close the plot, you are given a chance to save the modified primary grid in a file.

See *Section 21.5, Client-Specific Extensions*, for more information about client-specific extensions to NMPlot. See *Section 21.6, NOISEMAP 7.0 Client-Specific Extension*, for more information about the NOISEMAP 7.0 client-specific extensions.

8.9. The Grid Computation Mouse Tool

Use the Grid Computation tool to increase the resolution of a grid by merging additional data points into it. In order to use this tool, the plot's primary grid must have been created by a third-party numerical model supported by a client-specific extension to NMPlot. Grid Computation extensions have been developed for the following models.

- NOISEMAP 7.0, the United State Air Force's airport noise model

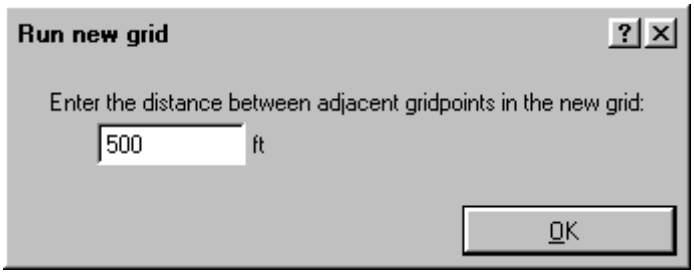
To use the Grid Computation tool, follow these steps.

1. Activate the tool by pressing its button on the toolbar.

2. Using the left mouse button, drag a rectangular area on a plot where you want to increase the resolution of the plot's primary grid . That is, move the mouse to one corner of the rectangular area, press and hold the left mouse button, move the mouse to the opposite corner of the rectangular area, and release the mouse button.

3. A client-specific dialog box may appear, asking you for additional information. Enter the requested information, then press the OK button. See *Section 21.5, Client-Specific Extensions*, for more information.

4. The Run New Grid dialog box appears.



   Type the resolution of the data points (i.e., the distance between adjacent data points) you want to merge into the primary grid.

5. Press the OK button. NMPlot runs the appropriate third-party numerical model, instructing it to create a new grid with data points distributed on a two-dimensional rectangular grid of locations. The area covered by this new grid will be the rectangular area that you specified using the mouse. The distance between adjacent data points will be the resolution you specified in the Run New Grid dialog box.

   The new grid is automatically merged into the primary grid, and the plot is updated.

6. When you close the plot, you are given a chance to save the modified primary grid in a file.

See *Section 21.5, Client-Specific Extensions*, for more information about client-specific extensions to NMPlot. See *Section 21.6, NOISEMAP 7.0 Client-Specific Extension*, for more information about the NOISEMAP 7.0 client-specific extensions.

Tip:

Use the Grid Computation tool to increase a grid's resolution in areas where a contour plot of the grid appears ragged, or where the contours break up into unconnected islands. This will often improve the appearance of the contours.

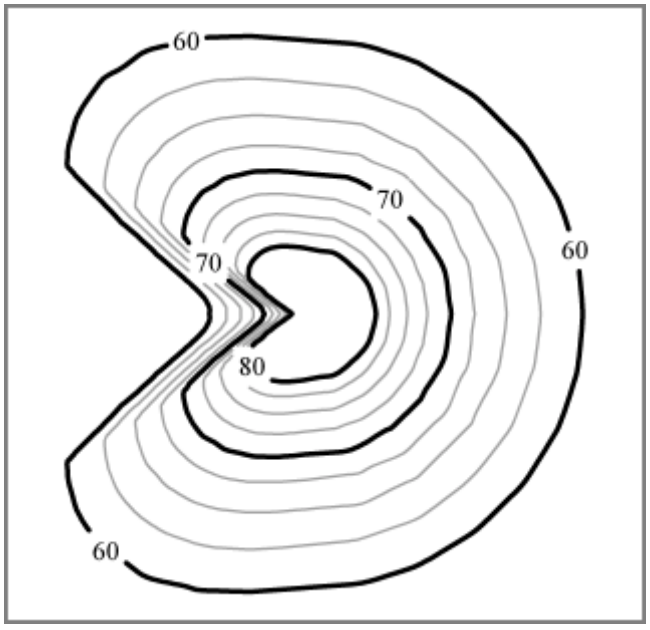
Chapter 9

Contour Plots

Contours are a powerful tool for visualizing a grid. Using NMPlot, you can easily create publication-quality contour plots.

9.1. Primary and Secondary Contours

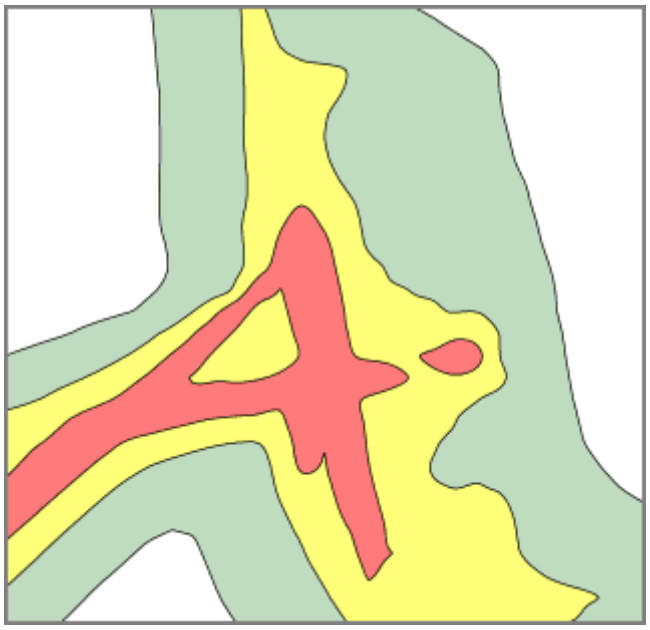
Consider the following contour plot.



Note that this plot has two different *styles* of contour lines. One is thick, black, and labeled with the contour level. The other is thin, gray, and not labeled.

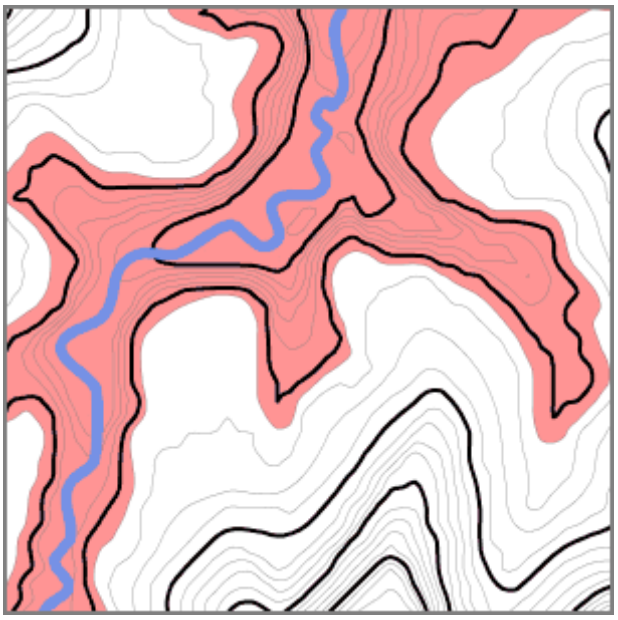
Typically, contour plots are drawn using two styles of contours. *Primary contours* are bolder and often labeled. *Secondary contours* are subtler. There are usually several secondary contours between every adjacent pair of primaries. This reduces clutter, and results in a plot that is both informative and readable.

However, there are situations where additional contour styles are required. An example is a plot in which each contour is filled with a different color.



Tip:

Use additional contour styles to highlight contour levels of specific interest. The following example plot uses conventional primary and secondary contours to show the terrain elevation near a river. The river's flood plain is highlighted by an additional red-filled contour.



9.2. Displaying Contours

To display contours on a plot, follow these steps.

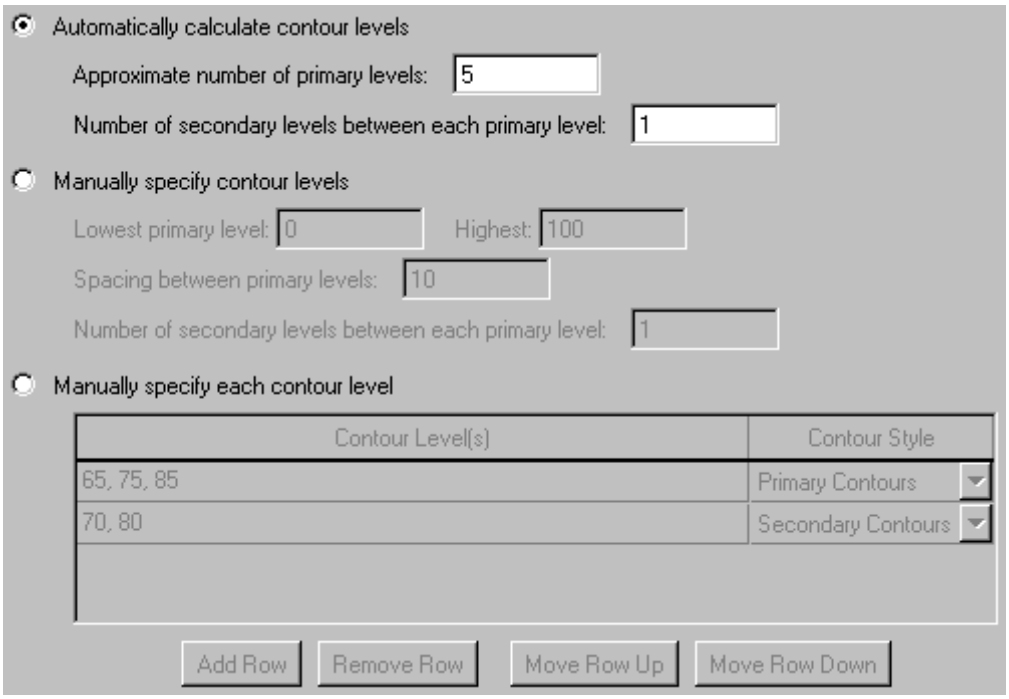
1. Go to the Contours page of the Plot Options dialog box.

2. Check the box labeled *Show Contours*.
3. Visit the other contour pages of the Plot Options dialog box, and set the options as desired.

9.3. Contour Levels

To set the levels at which contours are drawn, follow these steps.

1. Go to the Levels page of the Plot Options dialog box.



2. Select how you would like to specify the contour levels.

   - *Automatically calculate contour levels* - NMPlot inspects the data values in your grid, and automatically chooses an appropriate set of contour levels.

     1. Type the approximate number of primary contours that will be drawn. In order to select an aesthetically pleasing set of levels, NMPlot may choose to display a slightly different number of primary contours.

     2. Type the number of secondary contours that will be drawn between every adjacent pair of primary contours. Type zero to turn off the display of secondary contours.

     The primary and secondary contours will be drawn using the *Primary Contours* and *Secondary Contours* styles, respectively. See *Section 9.4, Contour Styles*, for more information.

   - *Manually specify contour levels* - NMPlot calculates the contour levels based on a set of conditions that you specify.

     1. Type the levels of the highest and lowest primary contours.

     2. Type the spacing between primary levels: i.e., the difference in levels between adjacent primary contours. For example, if you specify 50, 90, and 10 for the

lowest level, highest level, and spacing, respectively, NMPlot will draw primary contours at the following levels: 50, 60, 70, 80, and 90.

3. Type the number of secondary contours that will be drawn between every adjacent pair of primary contours. Type zero to turn off the display of secondary contours.

The primary and secondary contours will be drawn using the *Primary Contours* and *Secondary Contours* styles, respectively. See *Section 9.4, Contour Styles*, for more information.

- *Manually specify each contour level* - You explicitly specify the level and style of every contour.

  Enter one or more levels, and select the contour style associated with each. Press the Add Row button to add another row to the table. Press the Remove Row button to remove a row.

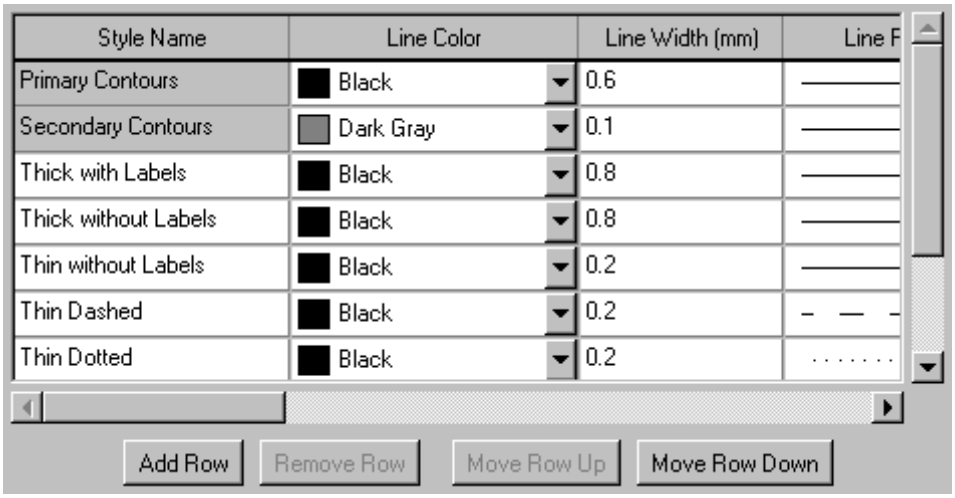
  To associated more than one contour level with a particular style, type a list of levels, separated by commas. For example, "10, 20, 30".

  You can specify the levels in any order.

9.4. Contour Styles

NMPlot gives you full control over the styles (color, thickness, labeling, etc.) of your contours. The set the styles, follow these steps.

1. Go to the Styles page of the Plot Options dialog box.



2. Contour styles are displayed using a standard spreadsheet control, which functions much like a spreadsheet such as Microsoft Excel. See *Section B.7, Spreadsheet Control*, for more information on using spreadsheet controls.

   Press the Add Row button to add a style. Press the Remove Row button to remove the style that contains the selected cell.

   Press the Move Row Up and Move Row Down buttons to change the order in which styles are listed. The order is irrelevant to NMPlot, but you may wish to list styles in a logical order for organizational purposes.

   ☞ ***Note:***

   Two styles, named *Primary Contours* and *Secondary Contours*, cannot be deleted. These styles are used for the primary and secondary contours. See *Section 9.3, Contour Levels*, for more information.

3. In the *Style Name* column, type a unique, descriptive name for each of your styles.

   ☞ ***Note:***

   You cannot change the names of the *Primary Contours* and *Secondary Contours* styles.

4. In the *Line Color* column, select the color of the lines used to draw your contours. See *Section B.10, Color Control*, for information on selecting colors.

5. In the *Line Width* column, type the width, in millimeters, of the lines used to draw your contours. Typically, widths are between 0.2 to 1.0 millimeters.

6. In the *Line Pattern* column, select the dash pattern (dashed, dotted, solid, etc.) of the lines used to draw your contours. See *Section B.11, Line Pattern Control*, for information on selecting line patterns.

7. In the *Label* column, type the text used to label your contours. If you do not want the contours labeled, delete the label text.

   See *Section 9.6, Contour Label Locations*, for information on setting the locations where contours are labeled.

   The label can include *symbolic fields*, placeholders for text that is automatically inserted when the label is displayed. For example, the field {Level} is automatically replaced with the contour level.

   Press the Insert Symbolic Field button  , located to the right of the text box, to display a list of fields from which you can choose.

   Some of the fields commonly used in contour labels are:

Field	Description
{Level}	Level of the contour being drawn
{Metric}	Metric of the grid being plotted: i.e., what is being measured by the grid
{Units}	Physical units of the grid being plotted

   See *Section B.5, Symbolic Fields Text Control*, for more information about symbolic fields.

8. In the *Label Font* column, select the font used to draw contour labels. See *Section B.9, Font Control*, for information on selecting fonts.

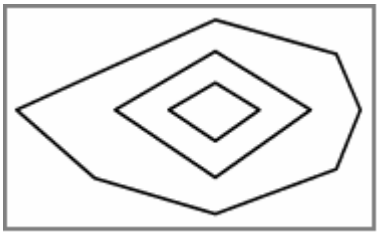
9. In the *Fill Contour* column, check the box to fill contours with a solid color. If this box is not checked, only the contour line is drawn.

10. In the *Fill Color* column, select the color used to fill your contours. See *Section B.10, Color Control*, for information on selecting colors.

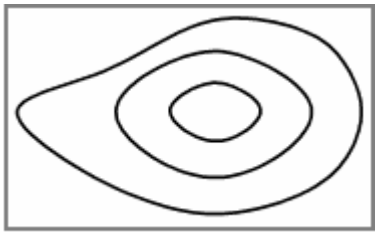
11. NMPlot allows you to export a plot to a Geographic Information System (GIS) in a number of common formats. Some GIS formats support the concept of named layers. In the *Contour Lines Layer Name* and *Contour Labels Layer Name* columns, type the names of the layers that contour lines and contour labels are exported in. To export to the default unnamed layer, delete the layer name.

9.5. Smoothing Contours

If the distance between data points in a grid is relatively large, then a contour plot of the grid may contain sharp angles. NMPlot allows you to improve the appearance of these contours by smoothing them.



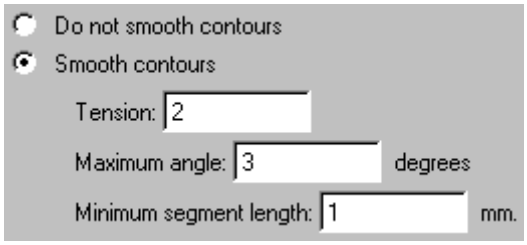
Unsmoothed Contours



Smoothed Contours

To smooth contours, follow these steps.

1. Go to the Smoothing page of the Plot Options dialog box.



2. Select the *Smooth Contours* radio button.

3. *Tension:* Type the smoothing tension. NMPlot uses a smoothing method called Splines Under Tension. Intuitively, you can imagine a contour as a rubber band. Without tension, the rubber band curves smoothly. When pulled tight, the rubber band becomes straight.

   You can set the tension to any value between 0.1 and 100. A tension of 1 or 2 will produce nicely smoothed contours. Smaller values will make the contours more rounded. Larger values will decrease the smoothing effect. Large tensions, above about 50, effectively disable smoothing.

4. *Maximum angle:* When NMPlot draws smoothed contours, what appears to be a continuous curve is actually drawn as a large number of tiny straight line segments. Type the maximum angle, in degrees, that is allowed between adjacent segments.

   Decreasing the angle makes the contours appear smoother, but also increases the time required to draw them. A value of 3 degrees is a reasonable compromise: it usually results in contours that appear smooth to the naked eye.

The Maximum Angle has the greatest effect on broadly curving contours.

5. *Minimum segment length:* When NMPlot draws smoothed contours, what appears to be a continuous curve is actually drawn as a large number of tiny straight line segments. Type the minimum allowed length, in millimeters, of a line segment.

   Decreasing this length makes the contours appear smoother, but also increases the time required to draw them. A value of 1 millimeter is a reasonable compromise: it usually results in contours that appear smooth to the naked eye.

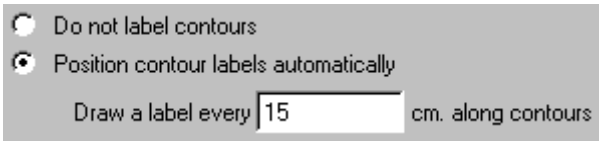
   The Minimum Segment Length has the greatest effect on sharply curving contours.

Caution:

Use care when smoothing contours. While it does improve the appearance of a plot, smoothing can give the impression that your grid has a finer resolution than it actually does. Unsmoothed contours will not mislead you about the accuracy of your data.

9.6. Contour Label Locations

Use the Contour Label Locations page of the Plot Options dialog box to control where contour lines are labeled.



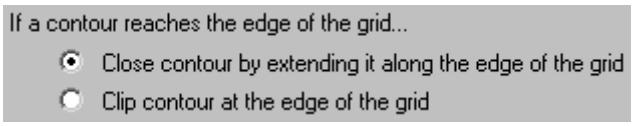
Select the *Do not label contours* radio button to turn off contour labeling.

Select the *Position contour labels automatically* radio button to turn on contour labeling. Type the distance, in centimeters, between adjacent labels along each contour line.

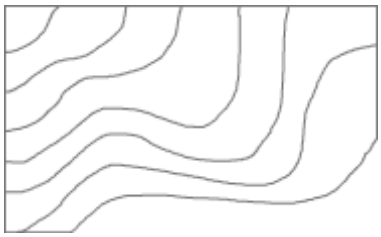
See *Section 9.4, Contour Styles*, for information on setting the text used to label contours.

9.7. Contour Clipping

Use the Contour Clipping page of the Plot Options dialog box to control how contours are displayed if they reach the edge of the grid.



Select *Close contour by extending it along the edge of the grid* if you want your contour lines to always appear as closed polygons. If a contour reaches the edge of the grid, it will follow the edge until it reaches the location where the contour reenters the grid.



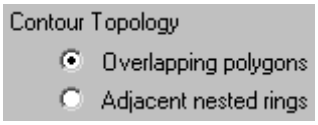
Select *Clip contour at the edge of the grid* to stop contour lines at the edge of the grid. In this case, the contours will form isolated line segments instead of closed polygons.

Note:

A grid's edge is defined by its defined area polygon: see *Section 4.2.5, Defined Area Polygon*.

9.8. Contour Topology

Use the Contour Topology page of the Plot Options dialog box to control the topology of the polygons that represent contours.



Select *Overlapping polygons* to generate contour polygons with overlapping areas. For example, if you draw contours with levels of 10 and 20, the contour polygon representing level 10 will enclose all points with a grid value above 10.

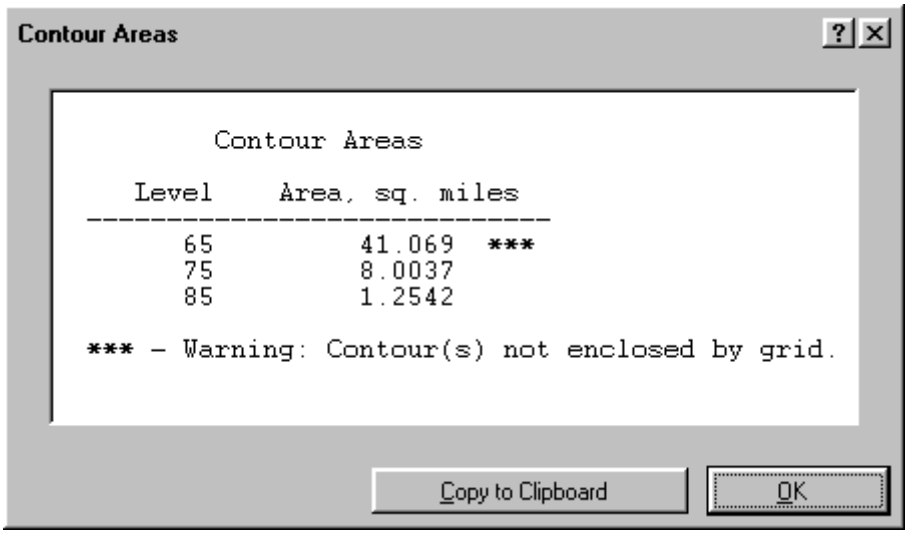
Select *Adjacent nested rings* to generate contour polygons with adjacent, non-overlapping areas. For example, if you draw contours with levels of 10 and 20, the contour polygon representing level 10 will enclose all points with a grid value above 10 and below 20.

Tip:

Unless you have special needs, it is recommended that you select *Overlapping polygons*.

9.9. Displaying Contour Areas

To display the area inside each contour on a plot, choose Display Contour Areas from the Plot menu. The Contour Areas dialog box appears.



You are warned if any contours are not completely enclosed by your grid's defined area polygon. In this case, the displayed contour area is too low, since the area calculation does not include the portion of the contour beyond the edge of your grid.

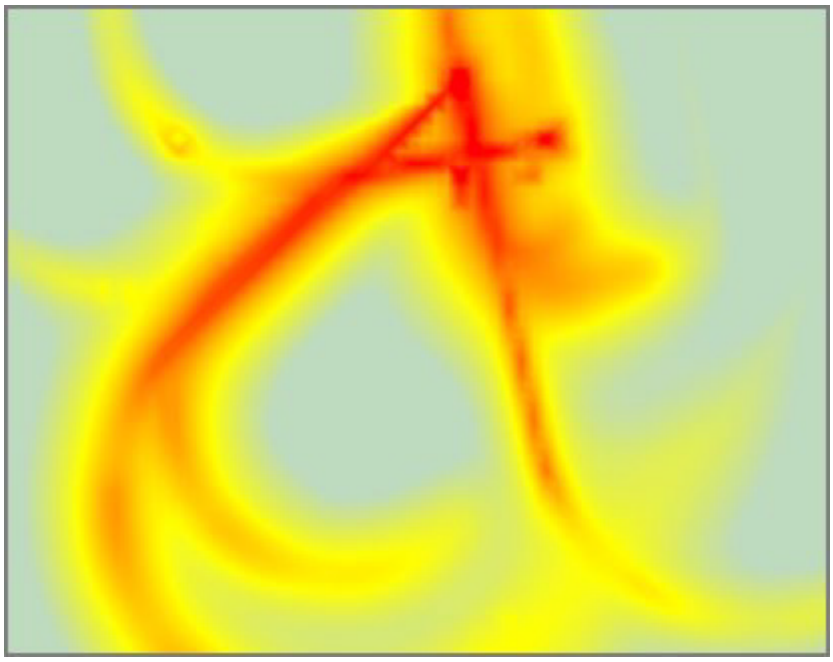
You can change the units used to display the areas. See *Section 21.3, Physical Units*.

The current contour topology controls the meaning of a contour's area. See *Section 9.8, Contour Topology*. If the topology is set to *Overlapping polygons*, then a contour's area includes all points where the grid value is greater than the contour's level. If the topology is set to *Adjacent nested rings*, then a contour's area includes all points where the grid value is greater than the contour's level but less than the next higher contour's level.

Chapter 10

Color Gradient Plots

Color gradient plots display a grid using smoothly varying colors. They can bring out subtle details in your data that are difficult to visualize using contours.



10.1. The Color Gradient Table

To create a color gradient plot, you must define a *color gradient table*, which maps grid data values to colors. For example:

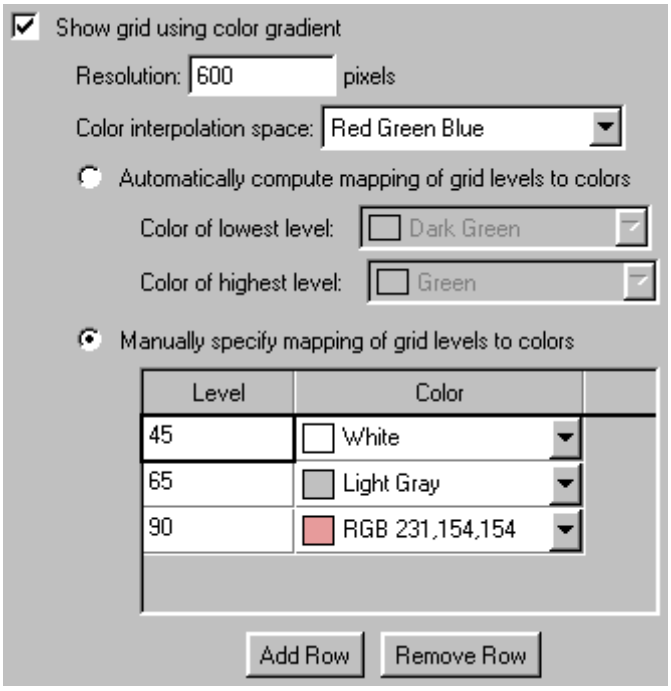
Data Level	Color
10	Black
20	Dark Green
30	Light Green

NMPlot draws a color gradient plot by computing grid data values at a large number of locations, then interpolating in the color gradient table to find the corresponding colors to draw. For example, based upon the color gradient table above, a point on a plot where the grid data value is 25 would be colored medium green.

10.2. Creating a Color Gradient Plot

To create a color gradient plot, follow these steps.

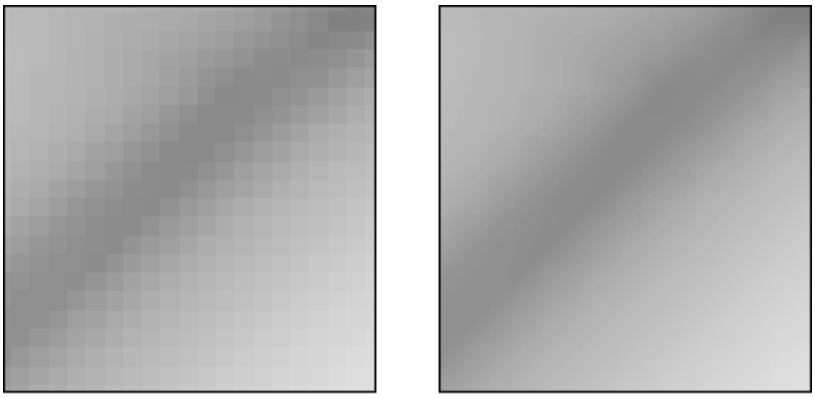
1. Go to the Color Gradient page of the Plot Options dialog box.



2. Check the box labeled *Show Grid Using Color Gradient*.

3. *Resolution:* Type the resolution of the color gradient plot. This should be an integer between 2 and 10,000. Higher values produce smoother gradients, but also use more memory, and take longer to display.

It is recommended that you initially try a resolution between 500 and 1000. If your color gradient plot appears blocky, increase the resolution.



If your computer takes an excessively long time to display a color gradient plot, decrease the resolution. When NMPlot is creating a color gradient plot, it displays the message "Building color gradient image" on the status bar.

4. *Color Interpolation Space:* Select the method used to interpolate colors in the color gradient table.

   There are two common ways to represent colors mathematically. One method uses the relative intensities of the three primary colors: red, green, and blue. The other method use the color's hue, luminance, and saturation. You can select which method is used to represent colors when interpolating in the color gradient table.

   It is not necessary to understand the details of the interpolation methods. Simply be aware that the two methods will produce different results. You should try both, and select the one that produces the best results for your particular grid and color table.

5. Select the method used to specify the color gradient table. You have two choices.

   - *Automatically compute mapping of grid levels to colors* - Choose the colors associated with the lowest and highest data values in your grid. NMPlot will automatically construct the color gradient table.

   - *Manually specify mapping of grid levels to colors* - Enter two or more levels, and the color associated with each. Press the Add Row button to add another row to the table. Press the Remove Row button to remove a row.

You can specify the rows in any order. NMPlot will sort them if necessary.

See *Section B.10, Color Control*, for information on using the drop-down color control to specify colors.

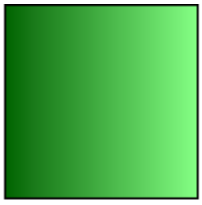
10.3. Tips and Suggestions

Tip:

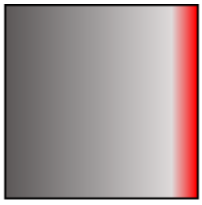
Set your plot's background color to the color associated with the lowest level in your color gradient table.

Tip:

Avoid color gradient plots where the colors vary across the spectrum. Numerous studies have shown that the eye does not naturally give a visual ordering to colors, with the exception of red, which is interpreted as representing higher levels than other colors. Favor color gradients that vary by lightness and not by hue. For example, have your color gradient vary from dark green to light green. Alternatively, vary your colors from dark to light gray, with red to highlight extreme levels.



Good color gradient
Colors vary by lightness



Good color gradient
Colors vary by lightness
Red used as highlight

Poor color gradient
Colors vary by hue

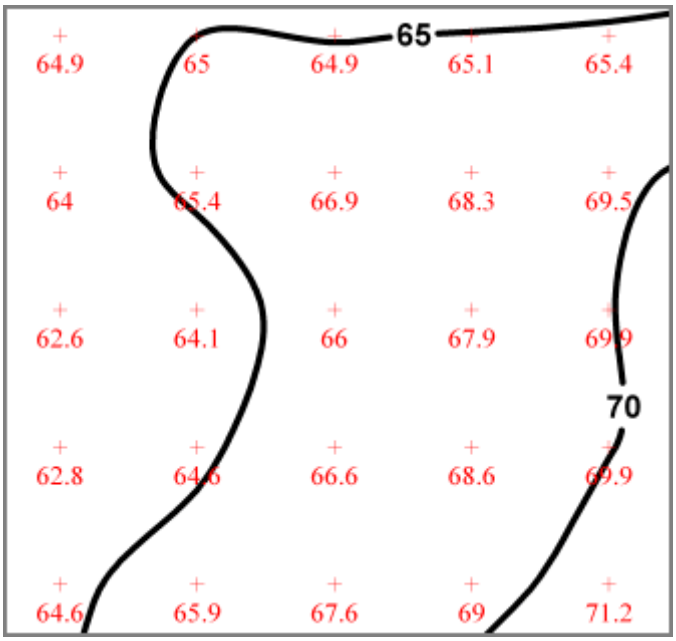
Tip:

For a powerful plot, consider adding bold contours to a color gradient plot.

Chapter 11

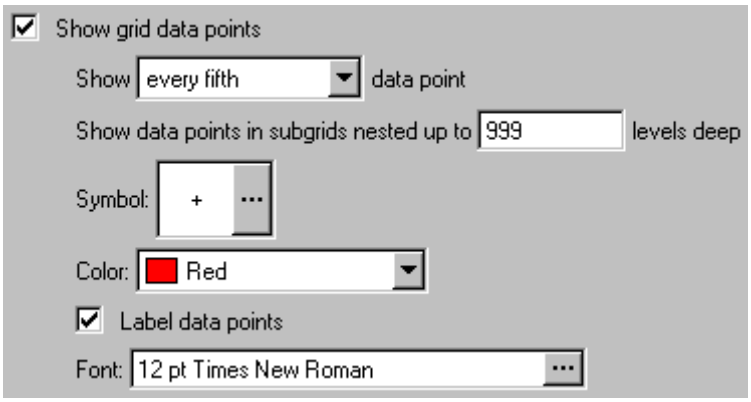
Displaying Grid Data Points

NMPlot can display a grid's data points on a plot. The location of each data point is marked with a symbol, and optionally labeled with the point's value.



To display the data points of a plot's primary grid, follow these steps.

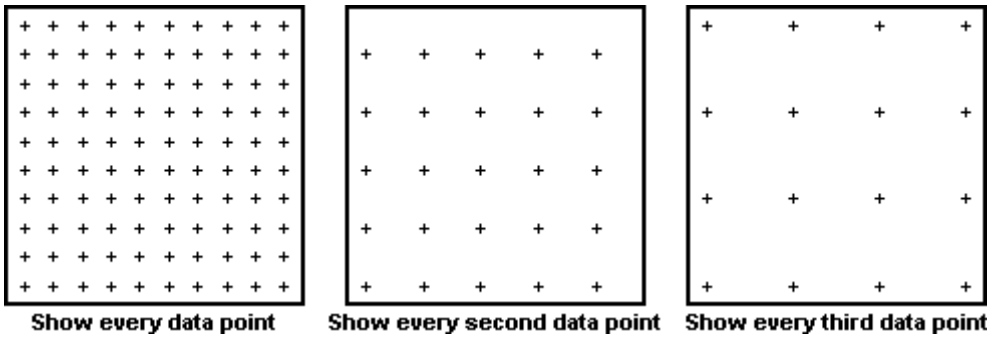
1. Go to the Grid Data Points page of the Plot Options dialog box.



2. Check the box labeled *Show Grid Data Points*.

3. You can choose to display only a portion of the data points in your grid: for example, every third point. This can make your plot less cluttered.

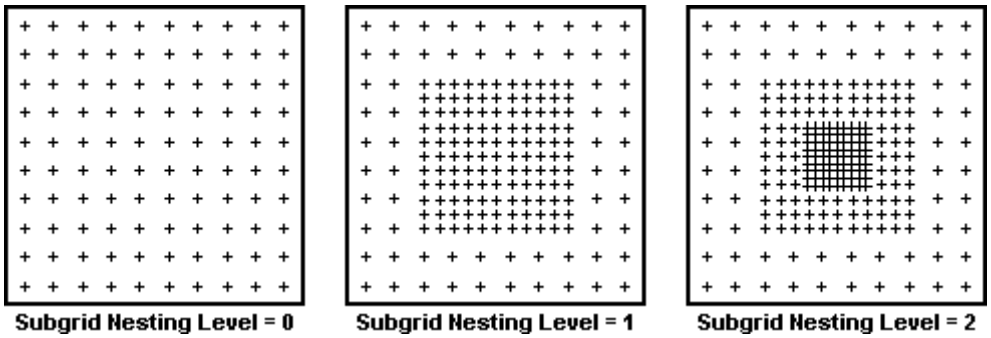
   Select which subset of the data points to display: every second data point, every third data point, etc. Select *Show every data point* to display all data points.



4. NMPlot supports the concept of *nested subgrids*: i.e., sets of data points that double the resolution of a portion of a grid. Nested subgrids can, in turn, have their own subgrids.

   If your grid contains nested subgrids, you can choose to show only the data points in a portion of the subgrids. This is an alternative way to make your plot less cluttered.

   Type the maximum nesting level of the subgrids that you want to display. This can be any integer between zero and 999. A nesting level of zero means that no subgrids are displayed, while a nesting level of 999 means that all subgrids are displayed.



5. *Symbol:* Choose the symbol used to display data points on your plot. Press the Select Symbol button ... to display the Select Symbol dialog box, which allows you to browse the available symbols. See *Section B.12, Symbol Control*.

6. *Color:* Select the color used to display data points. See *Section B.10, Color Control*.

7. *Label Data Points:* Check this box to label each data point with its value.

    - *Font:* Select the font used to label data points. Press the Select Font button ... to display the Font dialog box, which allows you to browse the available fonts. See *Section B.9, Font Control*.

Chapter 12

Displaying Geographic Annotations

Grids can contain *geographic annotations*: optional map data stored in the grid. See *Section 4.2.6, Geographic Annotations*. NMPlot can display geographic annotations on a plot.

12.1. Types of Geographic Annotations

There are three types of geographic annotations.

- *Points* - Point geographic annotations represent point-like features, such as the location of schools and hospitals.
- *Lines* - Line geographic annotations represent linear features, such as roads and rivers.
- *Areas* - Area geographic annotations represent two-dimensional features, such a lakes and city boundaries.

12.2. Geographic Annotation Categories and Names

Every geographic annotation has the following two properties.

- *Category* - A geographic annotation's category specifies the broad class of objects that the annotation belongs to. Examples of categories are "Schools", "Streets", and "Lakes".

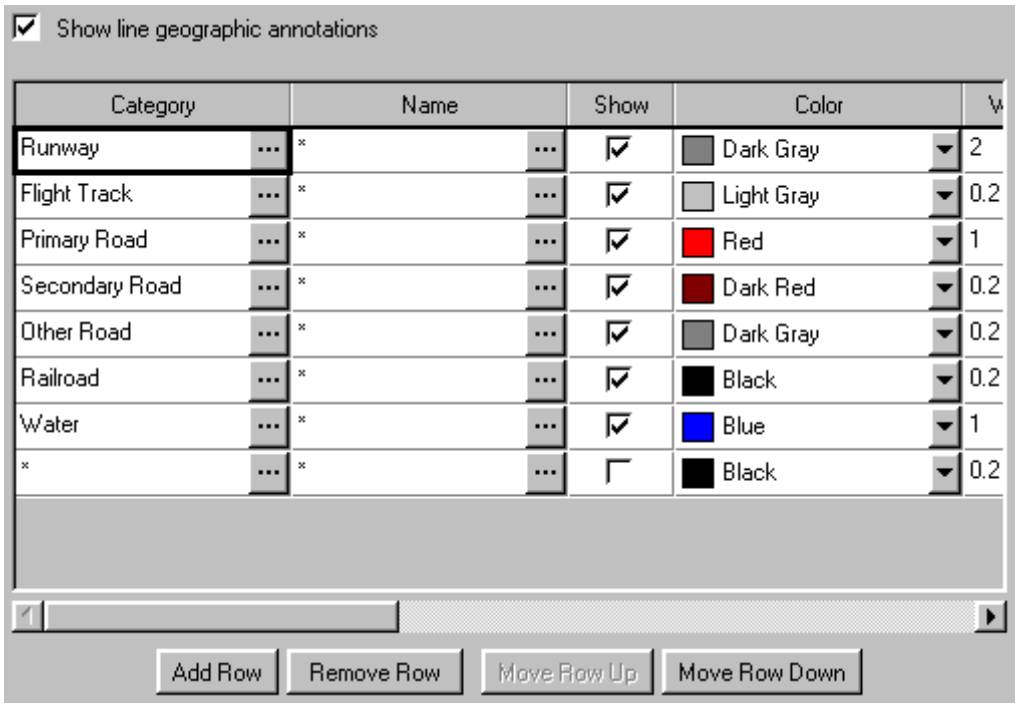
- *Name* - A geographic annotation's name specifies its proper name: i.e., the name of a specific object. Examples of names are "Baker High School", "Main Street", and "Lake Michigan".

Use the Summary pane of the Grid Document window to find information about the geographic annotations in a grid. The summary report lists the types of annotations present in a grid, their categories, and their names. See *Chapter 5, Viewing Grids*, for more information.

12.3. Display Rules

The Plot Options dialog box has a separate page for each type (point, line, or area) of geographic annotation. However, you set the options for displaying all three types of annotations in a similar fashion. The method for setting display options for line geographic annotations will be described. Keep in mind that display options for point and area geographic annotations are set in a similar fashion.

For reference, here is the page used to specify how line geographic annotations should be displayed.



Note the spreadsheet-like table that occupies most of the page. This is referred to as the *display rule table*. Each row in the table defines a *display rule*.

The first two columns in the table, labeled Category and Name, specify the categories and names that each rule applies to. The rest of the columns in the table specify *display options*: colors, line widths, fonts, etc. The display options specify how to draw and label the geographic annotations.

12.3.1. Searching the Display Rule Table

When NMPlot displays a plot, it attempts to draw each of the primary grid's geographic annotations in the following fashion.

1. NMPlot searches the appropriate display rule table (i.e., either the point, line, or area table) for a display rule whose category and name match the geographic annotation's category and name. The table is searched from the top to the bottom.

2. If a matching rule is found, the geographic annotation is drawn using the display options associated with that rule.

3. If a matching rule is not found, the geographic annotation is not displayed.

The case of letters (upper verses lower case) is not considered when searching for a matching rule. For example, a display rule category of "STREET" would match a geographic annotation with a category of "street".

Spaces are also not considered when searching. For example, a display rule category of "PavedRoad" would match a geographic annotation with a category of " Paved Road ".

12.3.2. Category and Name Wildcards

The Category and Names columns of a display rule table can contain *wildcards*. These are characters that have special meanings. They allow you to match groups of categories and names.

For example, you can create a rule that will refer to any geographic annotation with the word "Road" in its category. Such a rule will match annotations with categories of "Primary Road" and "Paved Road".

You may be familiar with wildcards used by many operating systems, which allow you to refer to groups of file names: for example, *.txt to refer to all text files. The "*" in this example is a wildcard.

NMPlot recognizes the following wildcards.

- ***** - Matches any sequence of zero or more characters. For example, A*B would match AB, AXB, or AXXB.

- **?** - Matches exactly one of any character. For example, A?B would match AXB, but not AB or AXXB.
- **[ABC]** - Match any one of the characters A, B, or C. For example, A[XY]B would match AXB or AYB, but not AB, AXXB, or AZB.
- **,** - Matches either what is on the left or right of the comma. For example, AA,BB would match AA or BB.

Wildcards can be combined in powerful ways. As an example, consider a display rule with a Category of "Roads" and a Name of "US10*,IL10?". This rule would match roads named US10, US10B, and IL10B, but not IL10 or IL10BB.

12.3.3. An Example

Consider the following sample display rule table. For simplicity, only the Category, Name, and Color columns are shown.

Category	Name	Color
Road	Peachtree Road	Red
Road	*Lane	Green
Road	*	Black
Railroad	*	Gray
River,Creek	*	Blue
*	*	Brown

The following table lists the color that would be used to draw a variety of geographic annotations, based upon the above rule table.

Annotation Category	Annotation Name	Color Used To Display Annotation
Road	Peachtree Road	Red
Road	Peachtree Lane	Green
Road	Peachtree Street	Black
Railroad	L & M RR	Gray
River	Mississippi	Blue
Creek	Trout	Blue
Trail	Baker Hill	Brown

Note the last rule in the sample display rule table. The * wildcard is used for both the category and name. This rule serves as a catch-all, matching any geographic annotation not matched by an earlier rule.

Caution:

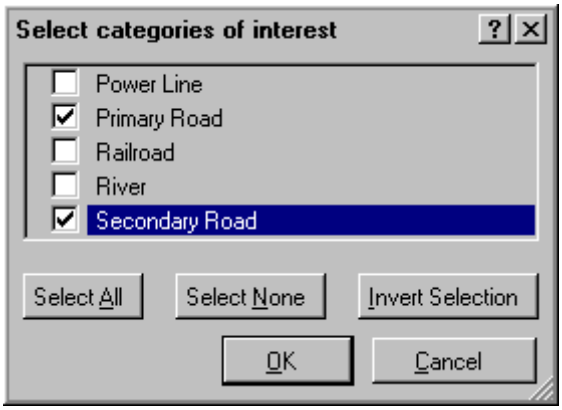
The order of rules is important. Rules are matched starting at the top of the rule table. Place more specific rules above more general rules, as was done in the sample rule table. Consider the last rule in the sample table, which uses the * wildcard for both the category and name. If this rule appeared at the top of the table, the other rules would never be used, since the first rule would match all annotations.

12.3.4. Editing Rule Tables

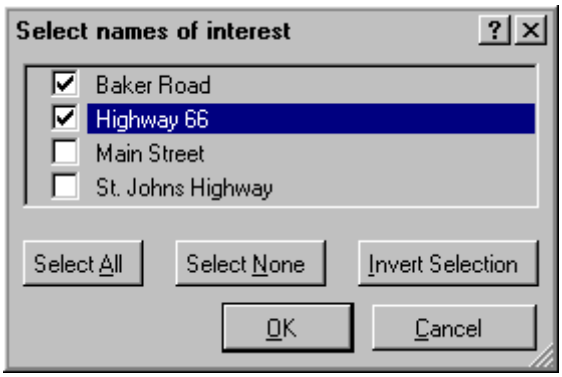
Rule tables are displayed using a standard spreadsheet control, which functions much like a spreadsheet such as Microsoft Excel. See *Section B.7, Spreadsheet Control*, for more information on using spreadsheet controls.

Press the Add Row button to add a rule. Press the Remove Row button to remove the rule that contains the selected cell. Use the Move Row Up and Move Row Down buttons to change the ordering of rules.

In the Category column, type the categories that each rule applies to. Alternatively, press the Select Categories From List button ... A list of the categories in your grid file is displayed, and you can choose from them.



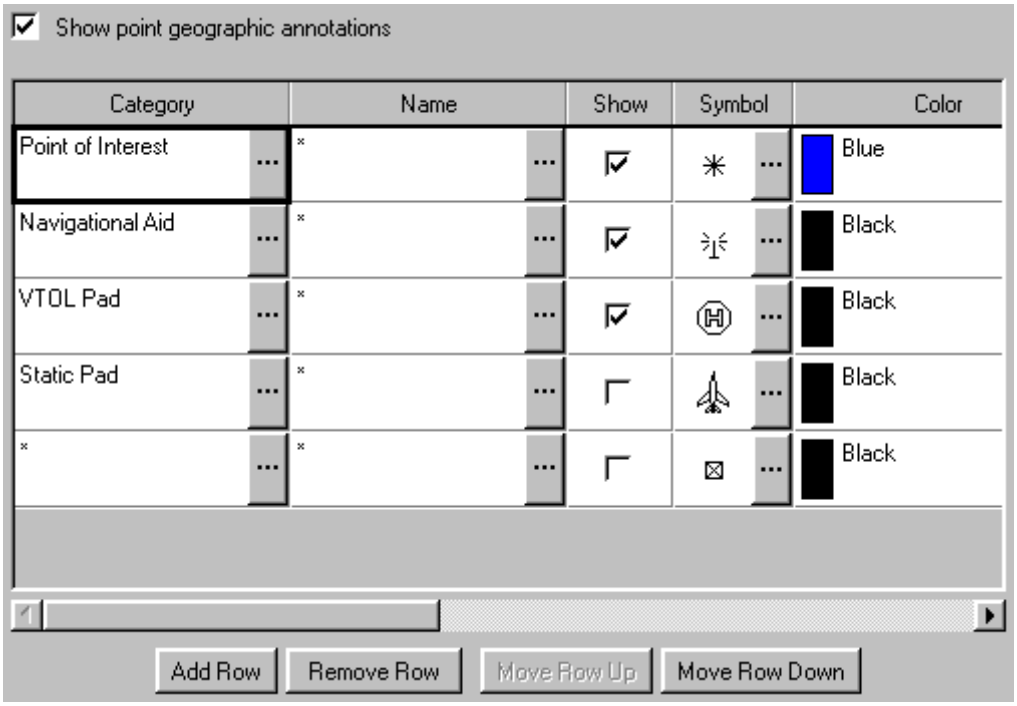
In the Name column, type the names that each rule applies to. Use wildcards if desired. Alternatively, press the Select Names From List button ... A list of the names in your grid file that match the rule's categories is displayed, and you can choose from them.



12.4. Displaying Point Geographic Annotations

To display point geographic annotations, follow these steps.

1. Go to the Points page of the Plot Options dialog box.



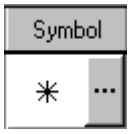
2. Check the box labeled *Show point geographic annotations*. If this box is not checked, no point annotations will be displayed on your plot.

3. Add display rules to the table, and set the Category and Name columns for each rule. See *Section 12.3, Display Rules*, for instructions.

4. For each display rule in the table, set the value of each display option column.

- *Show* - 

  Check this box to display point annotations. If this box is not checked, point annotations matched by this display rule will not be displayed.

- *Symbol* - 

  Select the symbol used to display point annotations matched by this display rule. Press the Select Symbol button  to display the Select Symbol dialog box, which allows you to browse the available symbols. See *Section B.12, Symbol Control*.

- *Color* - 

  Select the color used to display point annotation matched by this display rule. See *Section B.10, Color Control*.

- *Label* - 

  Check this box to label each point annotation matched by this display rule. The points' names will be displayed on the plot.

- *Label Font* - 

  Select the font used to label point annotations matched by this display rule. Press the Select Font button  to display the Font dialog box, which allows you to browse the available fonts. See *Section B.9, Font Control*.

- *Point Layer and Label Layer Names* -

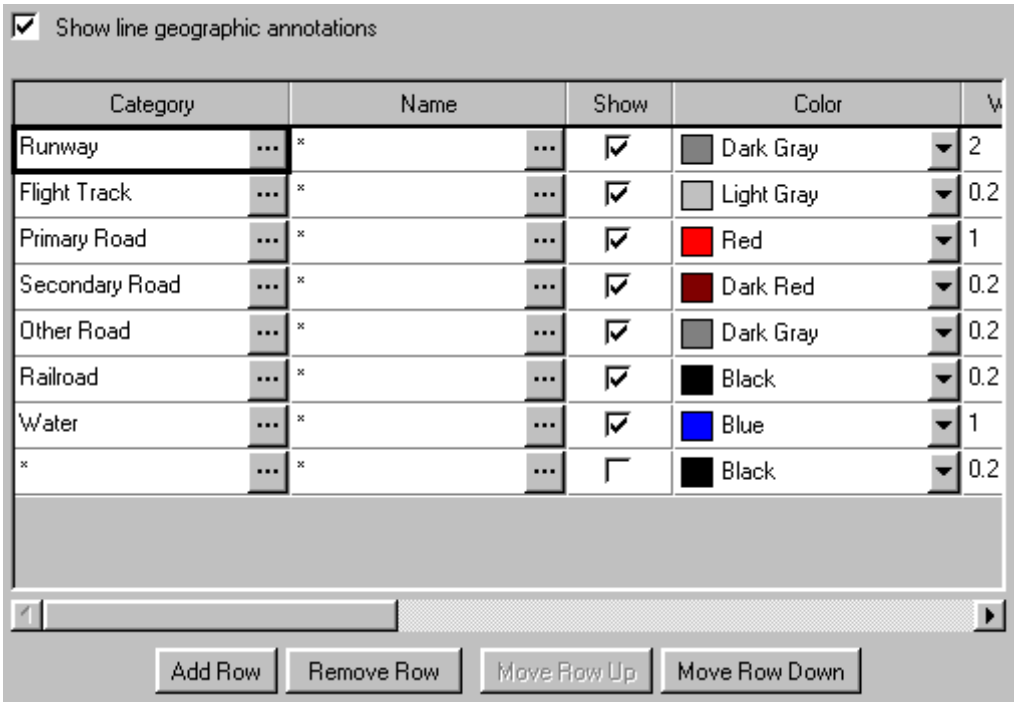
Point Layer Name	Label Layer Name
Specific Points	Specific Point Labels

  NMPlot allows you to export a plot to a Geographic Information System (GIS) in a number of common formats. Some GIS formats support the concept of named layers. Type the layer names used for point annotations matched by this display rule. You can specify different layers for the point symbols and the point labels.

12.5. Displaying Line Geographic Annotations

To display line geographic annotations, follow these steps.

1. Go to the Lines page of the Plot Options dialog box.



2. Check the box labeled *Show line geographic annotations*. If this box is not checked, no line annotations will be displayed on your plot.

3. Add display rules to the table, and set the Category and Name columns for each rule. See *Section 12.3, Display Rules*, for instructions.

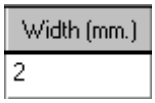
4. For each display rule in the table, set the value of each display option column.

- *Show* - 

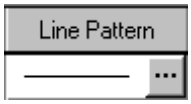
  Check this box to display line annotations. If this box is not checked, line annotations matched by this display rule will not be displayed.

- *Color* - 

  Select the color used to draw line annotations matched by this display rule. See *Section B.10, Color Control*.

- *Width* - 

  Type the width of the line, in millimeters, used to draw line annotations matched by this display rule.

- *Line Pattern* - 

  Select the dash pattern (dashed, dotted, solid, etc.) used to draw line annotations matched by this display rule. Press the Select Line Pattern button  to display the Select Line Pattern dialog box, which allows you to browse the available patterns. See *Section B.11, Line Pattern Control*.

- *Label* - 

  Check this box to label each line annotation matched by this display rule. The lines' names will be displayed on the plot.

- *Label Font* - 

  Select the font used to label line annotations matched by this display rule. Press the Select Font button  to display the Font dialog box, which allows you to browse the available fonts. See *Section B.9, Font Control*.

- *Line Layer and Label Layer Names* -

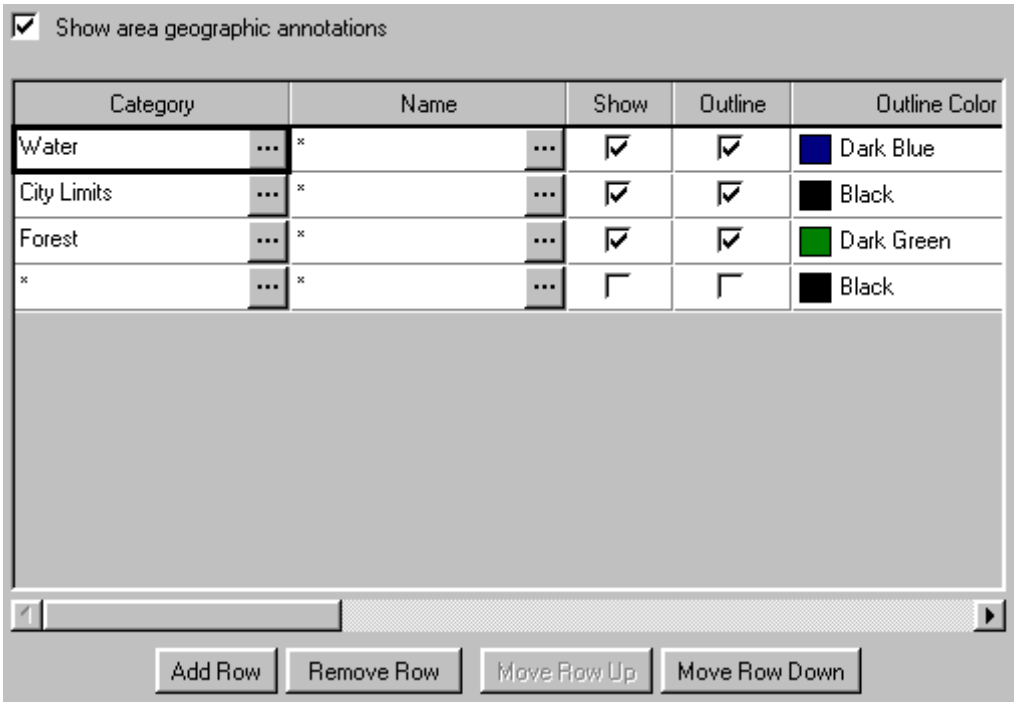
Line Layer Name	Label Layer Name
Runways	Runway Labels

  NMPlot allows you to export a plot to a Geographic Information System (GIS) in a number of common formats. Some GIS formats support the concept of named layers. Type the layer names used for line annotations matched by this display rule. You can specify different layers for the lines and the line labels.

12.6. Displaying Area Geographic Annotations

To display area geographic annotations, follow these steps.

1. Go to the Areas page of the Plot Options dialog box.



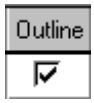
2. Check the box labeled *Show area geographic annotations*. If this box is not checked, no area annotations will be displayed on your plot.

3. Add display rules to the table, and set the Category and Name columns for each rule. See *Section 12.3, Display Rules*, for instructions.

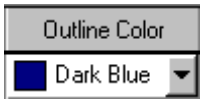
4. For each display rule in the table, set the value of each display option column.

- *Show* - 

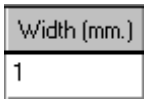
  Check this box to display area annotations. If this box is not checked, area annotations matched by this display rule will not be displayed.

- *Outline* - 

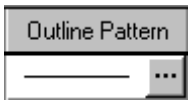
  Check this box to draw the outlines of area annotations matched by this display rule. If you do not display outlines, you should choose to fill the areas (see *Fill* below). Otherwise, the areas will not be visible.

- *Outline Color* - 

  Select the color used to draw the outlines of area annotations matched by this display rule. See *Section B.10, Color Control*.

- *Width* - 

  Type the width of the line, in millimeters, used to draw the outline of area annotations matched by this display rule.

- *Outline Pattern* - 

  Select the dash pattern (dashed, dotted, solid, etc.) used to draw the outline of area annotations matched by this display rule. Press the Select Line Pattern button  to display the Select Line Pattern dialog box, which allows you to browse the available patterns. See *Section B.11, Line Pattern Control*.

- *Fill* - 

  You can fill area annotations on your plot with a solid color. Check this box to fill the area annotations matched by this display rule. If you do not fill areas, you should choose to display the area outlines (see *Outline* above). Otherwise, the areas will not be visible.

- *Fill Color* - 

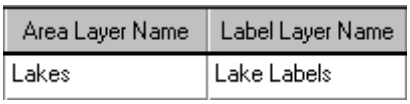
  Select the color used to fill area annotations matched by this display rule. See *Section B.10, Color Control*.

- *Label* - 

  Check this box to label each area annotation matched by this display rule. The areas' names will be displayed on the plot.

- *Label Font* - 

  Select the font used to label area annotations matched by this display rule. Press the Select Font button  to display the Font dialog box, which allows you to browse the available fonts. See *Section B.9, Font Control*.

- *Area Layer and Label Layer Names* - 

  NMPlot allows you to export a plot to a Geographic Information System (GIS) in a number of common formats. Some GIS formats support the concept of named layers. Type the layer names used for area annotations matched by this display rule. You can specify different layers for the areas and the area labels.

Chapter 13

Changing the Plot Background

NMPlot gives you considerable control over the background of a plot. It can be as simple as a solid color, or as complicated as a set of map layers displaying themes such as roads and rivers. The background can also include plot elements, such as contours and geographic annotations, from other girds. This allows you to overlay contours from two or more grids.

13.1. Background Color

When NMPlot draws a plot, it first fills the entire plot with the background color. To set the background color, follow these steps.

1. Go to the Background Color page of the Plot Options dialog box.

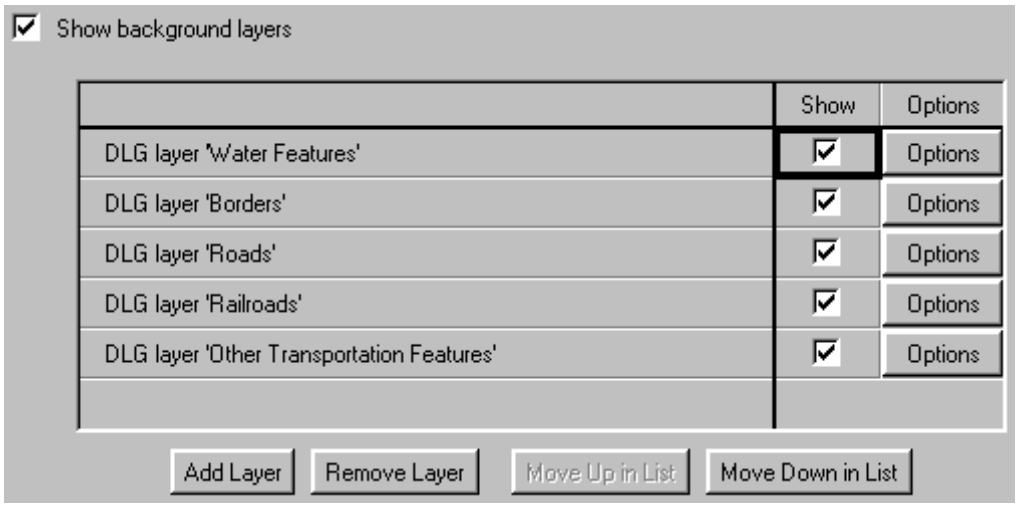
2. *Background color:* Select the background color. See *Section B.10, Color Control*, for information on selecting colors.

13.2. Background Layers

You can add any number of background layers to a plot. Use Map Background Layers to display background maps. Use Grid Overlay Background Layers to overlay contours from two or more grids.

13.2.1. Managing Background Layers

Use the Background Layers page of the Plot Options dialog box to manage background layers.



Check the *Show background layers* box to display background layers. If this box is not checked, no layers will be shown.

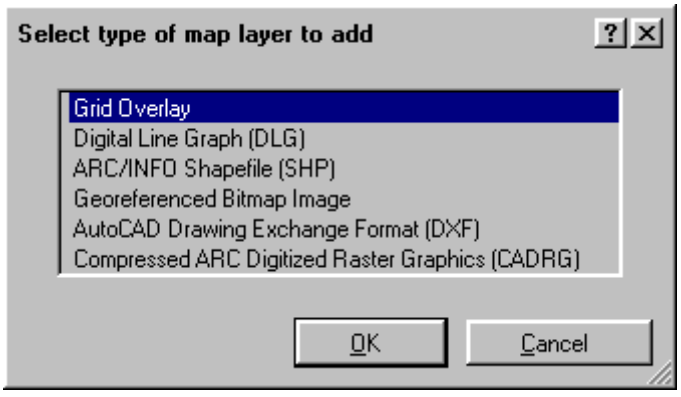
The *background layers list* displays all background layers. This list is presented using a spreadsheet control. See *Section B.7, Spreadsheet Control*, for more information.

13.2.2. Adding a Background Layer

To add a background layer, follow these steps.

1. If desired, select an existing layer by clicking on it. The new layer will be added just before the selected layer. Ignore this step if the list is empty.

2. Press the Add Layer button, located below the background layers list. The Select Layer Type dialog box is displayed.



3. Choose the type of layer you would like to add, then press OK. As a shortcut, simply double-click on the desired layer type.

   The Grid Overlay layer type is described in *Section 13.3, Overlaying Grids*. The background map layer types are described in *Chapter 14, Background Map Formats*.

4. A new layer, of the appropriate type, is added to the list.

5. Press the new layer's Options button. The layer's options dialog box appears. Set the layer options as desired.

13.2.3. Removing a Background Layer

To remove a background layer, follow these steps.

1. Select the layer to remove by clicking on it in the background layers list.

2. Press the Remove Layer button, located below the background layers list.

13.2.4. Ordering Background Layers

Background layers are drawn in order, starting with the last layer in the background layers list. This means that the topmost layer in the list is drawn last, and therefore appears on top of other layers. Generally, you will want to order the list so that the most important layers are at the top.

 ***Note:***

Background layers are drawn in three stages. All area features are drawn first, followed by all line features, and finally all point features. This means that a filled area feature will not obscure a point feature, regardless of the ordering of the layers. This matches most people's intuitive idea of how layers should work.

To change the ordering of layers in the list, follow these steps.

1. Select a layer by clicking on it in the background layers list.

2. Press the Move Up In List or Move Down In List button to move the selected layer. These buttons are located just below the background layers list.

   If you press and hold one of these button, it will automatically repeat. This is useful for moving a layer several rows up or down.

13.2.5. Hiding or Displaying a Background Layer

Use the Show column of the background layers list to selectively hide or display individual layers. A layer will be displayed only if its Show box is checked.

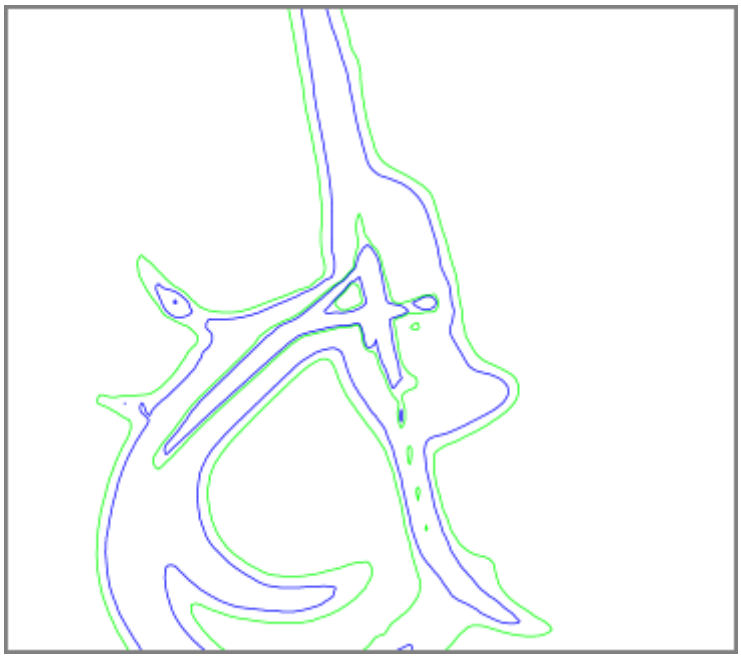
13.2.6. Changing a Background Layer's Options

Use the Options column of the background layers list to change the options used to display a layer. Pressing a layer's Options button will display that layer's options dialog box.

13.3. Overlaying Grids

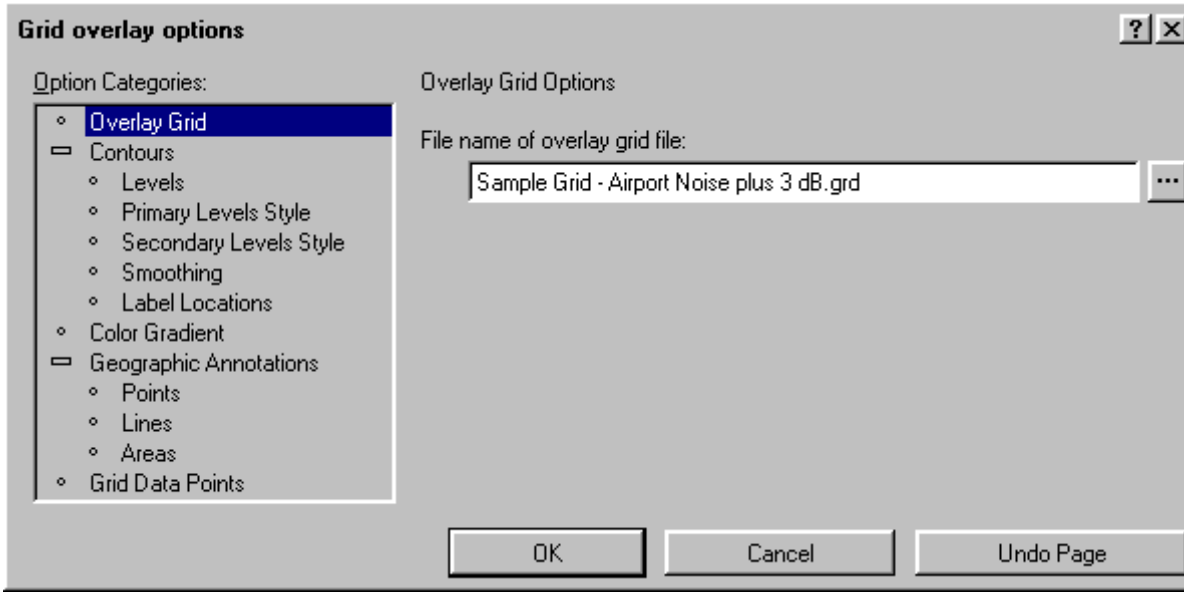
Using Grid Overlay background layers, you can overlay the plot elements from two or more grids. For instance, you can create a plot that displays contours from two different grids. This is useful for comparing grids representing alternative scenarios.

As an example, assume that you have two grids. The first represents the existing noise levels around an airport, while the second represents the predicted levels a few years in the future, after air traffic has increased. You create a plot that displays both the current and predicted noise level contours. This plot clearly shows how far the noise contours are expected to grow. See the sample plot included with NMPlot, `Sample Plot - Contour Overlay.nmp`, for an example.



To create a plot overlaying two grids, follow these steps.

1. Create a new plot, and set its primary grid equal to the first of the grids you want to overlay.
2. Add a new Grid Overlay background layer to your plot. See *Section 13.2, Background Layers*, for instructions.
3. Click on the new layer's Options button. The Grid Overlay Options dialog box appears.



4. The Grid Overlay Options dialog box looks very similar to the Plot Options dialog box. In fact, with the exception that some pages are missing, it is nearly identical. Set the options for the overlay just as you would set the options for a regular plot. Set the overlay grid (which is the Grid Overlay's equivalent to a plot's primary grid) equal to the second of the grids you want to overlay.

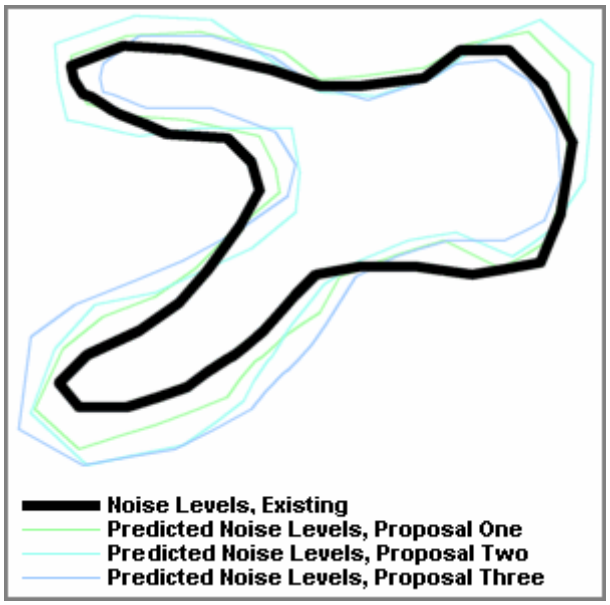
Note:

The missing pages on the Grid Overlay Options dialog box contain options that are not applicable to an overlay. For example, the Plot Orientation page is missing, as it is nonsensical to have the overlay oriented differently than the main plot.

Tip:

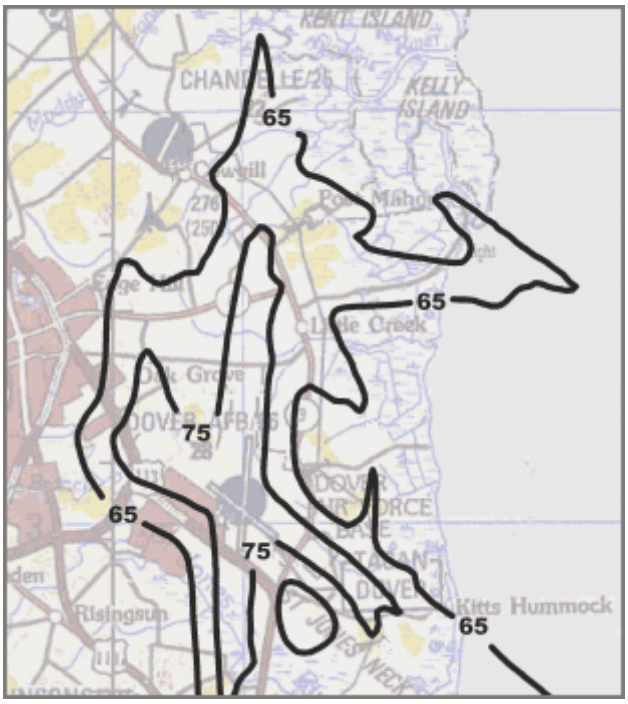
You can overlay as many grids as you wish. Take care, however, as overlaying more than two sets of contours can result in a cluttered plot that is difficult to interpret. A plot overlaying contours from several grids works best if you make one set of contours very

bold (use thick, solid lines in a dark color), and make the rest of the contours more subtle (use thin, possibly dashed lines in lighter colors).



13.4. Displaying Background Maps

NMPlot can display your plot over one or more background map layers.



The map layers can be stored in a number of common Geographic Information System (GIS) formats. These formats are discussed in detail in *Chapter 14, Background Map Formats*.

To add a background map to your plot, simply add a new background layer of the appropriate type, as described in *Section 13.2, Background Layers*. See *Chapter 14, Background Map Formats*, for instructions on setting the layer options associated with each map format.

Chapter 14

Background Map Formats

NMPlot can display background map layers stored in the following Geographic Information System (GIS) formats.

- ARC/INFO Shapefile (SHP)
- Digital Line Graph (DLG)
- AutoCAD Data Exchange Format (DXF)
- Georeferenced Bitmap (BMP, TIF, JPG, PNG)
- Compressed ARC Digitized Raster Graphics (CADRG)

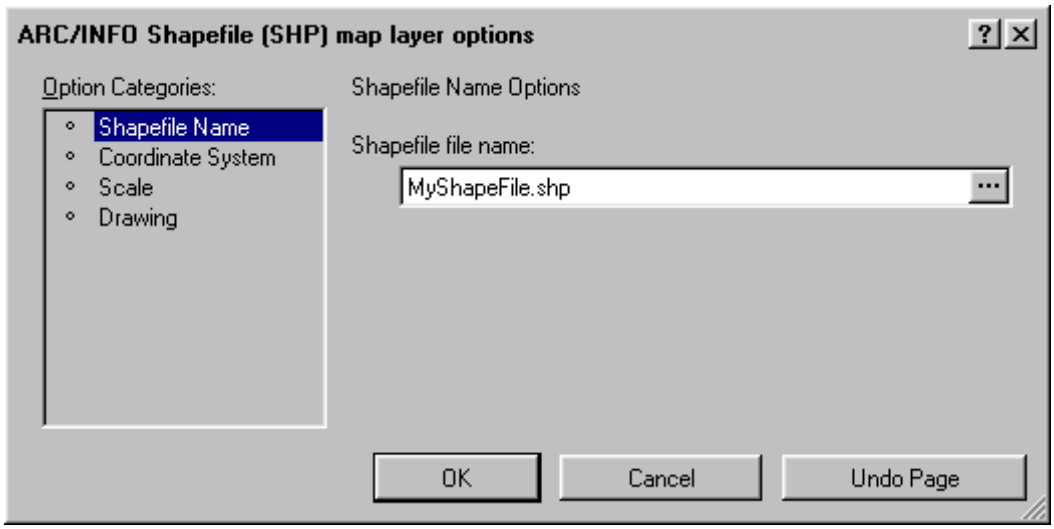
This chapter discusses each of these formats in detail.

See *Section 13.2, Background Layers*, for instructions on adding background map layers to a plot.

14.1. ARC/INFO Shapefile (SHP)

14.1.1. Shapefile Map Layer Options Dialog Box

Use the Shapefile Map Layer Options dialog box to configure a shapefile map background layer.



The Shapefile Map Layer Options dialog box is a Multiple Page dialog box. See *Section B.2, Multiple Page Dialog Boxes*, for more information.

14.1.2. Shapefile Name Options Page

Use the Shapefile Name page of the Shapefile Map Layer Options dialog box to set the name of the shapefile you wish to display.

Type the name of the file containing the shapefile. Press the Browse button ..., located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file.

☞ *Note:*

A single shapefile actually consists of three files: a main file, an index file, and an attribute file. These files should have the extensions `.shp`, `.shx`, and `.dbf`, respectively. On the Shapefile Name page, specify the name of the main file (i.e., the `.shp` file).

14.1.3. Coordinate System Options Page

Use the Coordinate System page of the Shapefile Map Layer Options dialog box to specify the coordinate system used by the shapefile.

See *Section 20.1, Coordinate System Control*, for instructions on specifying a coordinate system.

14.1.4. Scale Options Page

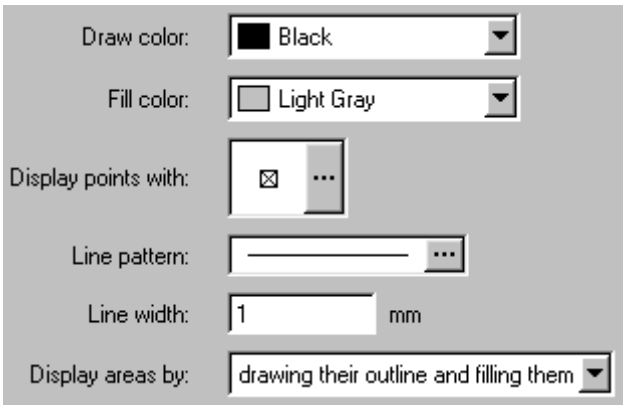
Use the Scale page of the Shapefile Map Layer Options dialog box to specify the scales at which this shapefile is displayed.

If a plot is displayed at a scale below the one you specify, the shapefile layer is not displayed. This is useful if you have shapefiles with varying levels of detail. Using multiple shapefiles, you can construct maps that reveal more detail as you zoom in.

For example, assume that you have two shapefiles. The first contains main roads, and the second contains secondary roads. You can set the main roads layer to display at all scales, and the secondary roads layer to display only at scales above 1:24,000. This prevents the secondary roads from cluttering the plot if you view it at a smaller scale.

14.1.5. Drawing Options Page

Use the Drawing page of the Shapefile Map Layer Options dialog box to specify the style (colors, line widths, etc.) used to draw features in the shapefile.



You can set the following options.

- *Draw color:* Select the color used to draw point features, line features, and the outlines of area features. See *Section B.10, Color Control*, for information on selecting colors.
- *Fill color:* Select the color used to fill the interior of area features. For example, if the shapefile contains areas representing lakes, you can set the fill color to blue.
- *Display points with:* Select the symbol used to display point features. Press the Select Symbol button ... to display the Select Symbol dialog box, which allows you to browse the available symbols. See *Section B.12, Symbol Control*.
- *Line pattern:* Select the dash pattern (dashed, dotted, solid, etc.) of lines used to draw line features and the outlines of area features. See *Section B.11, Line Pattern Control*, for information on selecting line patterns.
- *Line width:* Type the width, in millimeters, of lines used to draw line features and the outlines of area features. Typical widths are between 0.2 to 1.0 millimeters.
- *Display areas by:* Select how area features are displayed. You have three options.
  - Draw their outlines
  - Fill their interiors with a solid color
  - Both draw their outlines and fill their interiors

14.1.6. Technical Details

NMPlot can display shapefile records of the following types.

- Point

- PointZ
- PointM
- Multipoint
- MultipointZ
- MultipointM
- PolyLine
- PolyLineZ
- PolyLineM
- Polygon
- PolygonZ
- PolygonM

Shapefiles containing a mixture of record types are supported.

Only the Main (.shp) file is required. The Index (.shx) and Attribute (.dbf) files may be present, but are not used. Attributes are not loaded.

The shapefile format is controlled by Environmental Systems Research Institute, Inc (ESRI), the makers of the ARC/INFO GIS system. The official specifications are documented in an ESRI white paper titled "ESRI Shapefile Technical Description", which can be found on the ESRI web site, http://www.esri.com . As of September 2000, the URL for this document was http://www.esri.com/library/whitepapers/pdfs/shapefile.pdf.

14.2. Digital Line Graph (DLG)

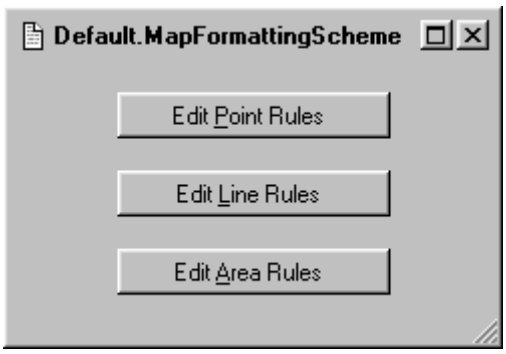
14.2.1. Map Formatting Schemes

Every map feature in a Digital Line Graph (DLG) file contains *attribute codes* that specify properties of the feature. For example, a line feature might have the attribute codes for Primary Road and Under Construction. An attribute code consists of two integers: a 3-digit *major code*, and a 3- or 4-digit *minor code*. Attribute codes are standardized and documented: see *Section 14.2.3, Technical Details*.

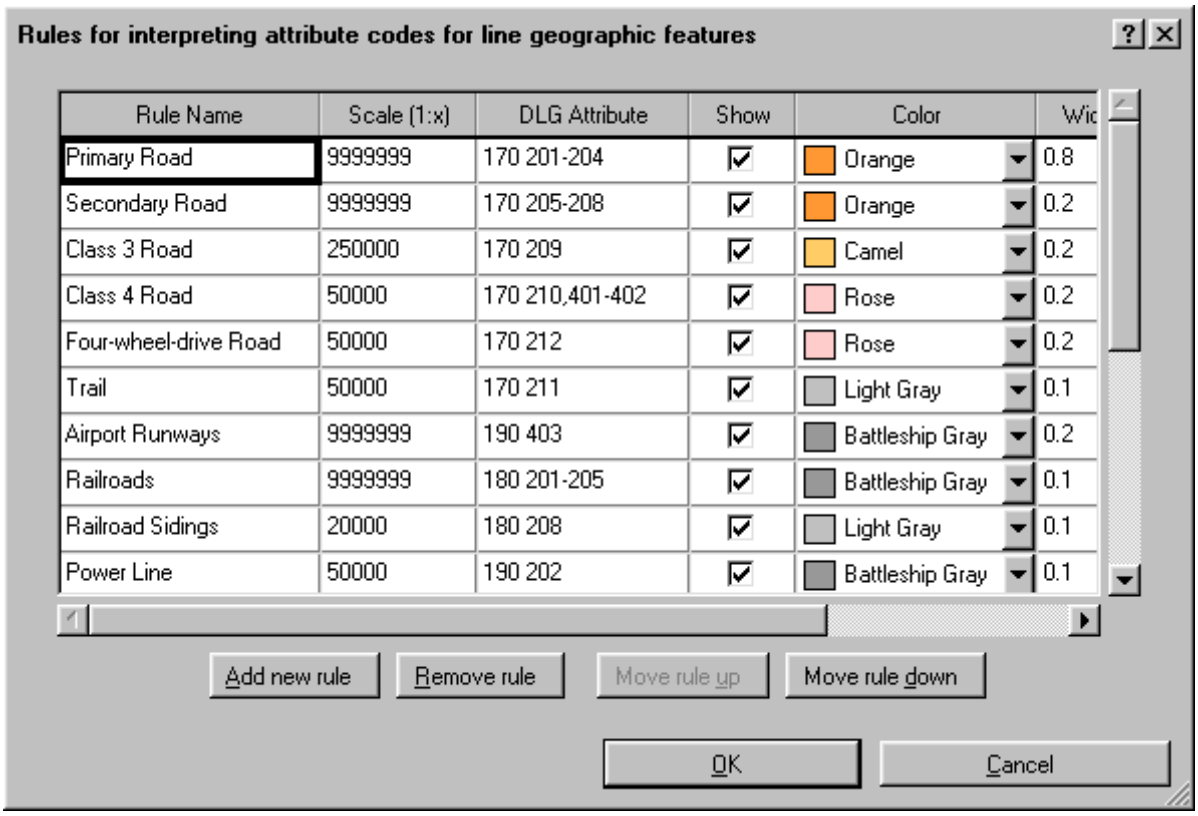
A *map formatting scheme* is a file containing rules that associate attribute codes with display styles. For example, a rule might state that line features with the code 170 212 (four-wheel-drive roads) should be drawn in a thin gray dashed line.

Map formatting schemes are stored in files with the extension `.mapformattingscheme`. You can create, view, and edit map formatting schemes using NMPlot.

To open an existing scheme, choose Open from the NMPlot File menu, then select a map formatting scheme file. A map formatting scheme document window appears.



Map formatting scheme rules are divided into three groups, according to whether they apply to point, line, or area map features. Press one of the buttons to edit a group's rules. For example, if you press the Edit Line Rules button, a dialog box appears that allows you to edit the rules used for line features.



The rules in a map formatting scheme are very similar to the display rules used for grid geographic annotations. Please review *Chapter 12, Displaying Geographic Annotations*, which describes display rules and discusses how they are edited. Map Formatting Scheme rules are edited in the same fashion, with three exceptions.

1. Map Formatting Scheme rule tables have an additional column labeled Rule Name. This column is used to give a descriptive name to a rule.

2. Instead of columns labeled Category and Name, map formatting scheme rule tables have a column labeled DLG Attribute Codes. Map Formatting Scheme rules are matched against a DLG feature's attribute codes in the same way that Grid Geographic Annotation display rules are matched against an annotation's category and name. In the DLG Attribute Codes column, type the attribute codes associated with each rule. Here are some examples.

    - "170 201" matches DLG features with the attribute code 170 201.
    - "170 201..205" matches DLG features with a major code of 170, and a minor code between 201 and 205.
    - "170 201,203" matches DLG features with a major code of 170, and a minor code of either 201 or 203.

- "170 201 and 170 603" matches DLG features with both attribute codes 170 201 and 170 603.
- "170 201 then 170 603" matches DLG feature with both attribute codes 170 201 and 170 603, with 170 603 following 170 201 in the feature's list of codes.
- " " matches DLG features with no attribute codes.

As an example, "170 201-208 and 170 603,604" matches all primary and secondary roads under construction.

3. Map Formatting Scheme rule tables have an additional column labeled Scale (1:x). This column allows you to specify the minimum scale at which matching DLG features are displayed. If a plot is displayed at a scale below a rule's scale, any DLG features matching that rule are not displayed. This allows you to construct maps that reveal more detail as you zoom in.

 ***Note:***

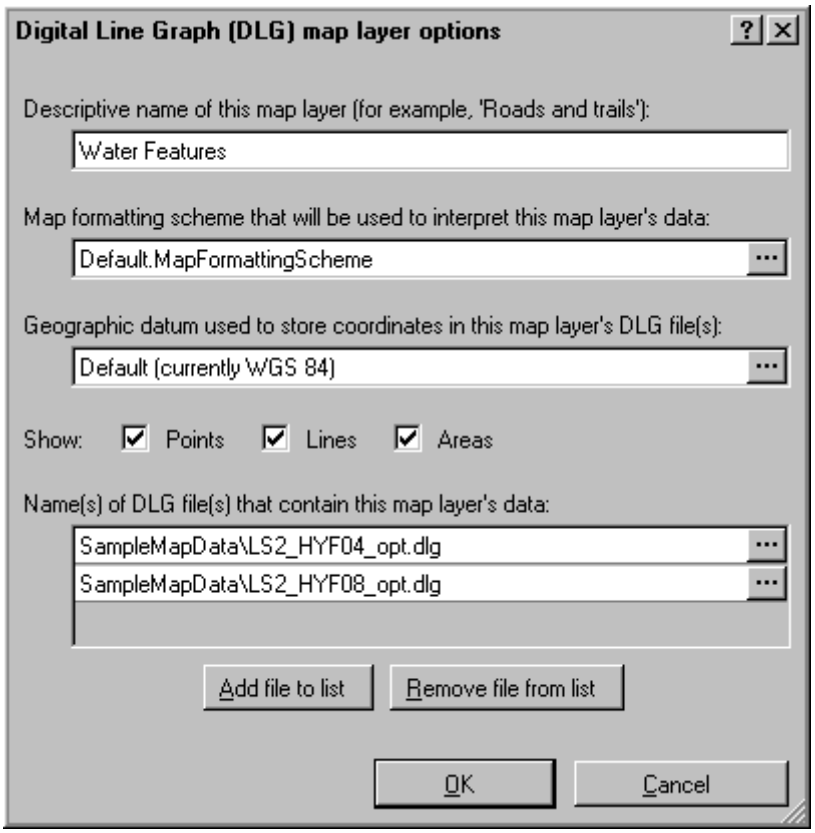
NMPlot is distributed with a default map formatting scheme. This scheme is in the file `Default.MapFormattingScheme`, which can be found in the directory where NMPlot is installed.

 ***Note:***

This section provides only the briefest introduction to attribute codes. If you intend to modify map formatting schemes, obtain the official DLG documentation, which describes attribute codes in detail. See *Section 14.2.3, Technical Details*, for information on obtaining the documentation.

14.2.2. Digital Line Graph (DLG) Options Dialog Box

Use the Digital Line Graph Map Layer Options dialog box to configure a DLG map background layer.



Descriptive name of this map layer: Type a short description of this map layer. Examples are "Roads" and "Water Features". This allows you to identify this layer in the future.

Map formatting scheme that will be used to interpret this map layer's data: Type the name of the file containing the map formatting scheme used to display this DLG layer. Press the Browse button ..., located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file. Map formatting schemes typically have the extension `.mapformattingscheme`. See *Section 14.2.1, Map Formatting Schemes*.

Geographic datum used to store coordinates in this map layer's DLG file(s): Select the DLG files' geographic datum. See *Section B.14, Datum Control*, for information on selecting datums. See *Appendix H, Introduction to Datums*, for general information on datums.

Important:

Many DLG files supplied by the United States Geological Survey (USGS) are in the North American Datum of 1927 (NAD-27). Make sure that you know the correct datum for your DLG files.

Show Points, Lines, Areas: Check the boxes corresponding to the geographic features you wish to display. Typically, all three boxes should be checked. However, if necessary, you can restrict which features are displayed. For example, you can choose to display only point geographic features.

Name(s) of DLG file(s) that contain this map layer's data: Type the names of the DLG files that you wish to display as part of this layer. Any number of files can be listed. Press one of the Browse buttons  , which are located to the right of the file name text boxes, to display the Open File dialog box, which allows you to browse for a file. DLG files typically have the extension `.dlg`.

Press the Add File To List button to add a file. Remove a file by clicking on it with the mouse, and then pressing the Remove File From List button.

14.2.3. Technical Details

NMPlot can read 1:24000 and 1:100000, level 3, optional format DLG files.

The coordinate system of the DLG file must be Universal Transverse Mercator (UTM).

The DLG file cannot contain DLG accuracy records.

NMPlot can display DLG records of the following types.

- N (Node)
- L (Line)
- A (Area)

DLG files containing a mixture of record types are supported.

NMPlot can merge DLG topology data in layers containing more than one DLG file.

The DLG format is controlled by the National Mapping Division of the United States Geological Survey (USGS). The official specifications are documented in a technical report titled "Standards for Digital Line Graphs", which can be found on the USGS web site, http://www.usgs.gov. As of September 2000, the URL for this document was http://rockyweb.cr.usgs.gov/nmpstds/dlgstds.html. This document contains a list of all DLG attribute codes.

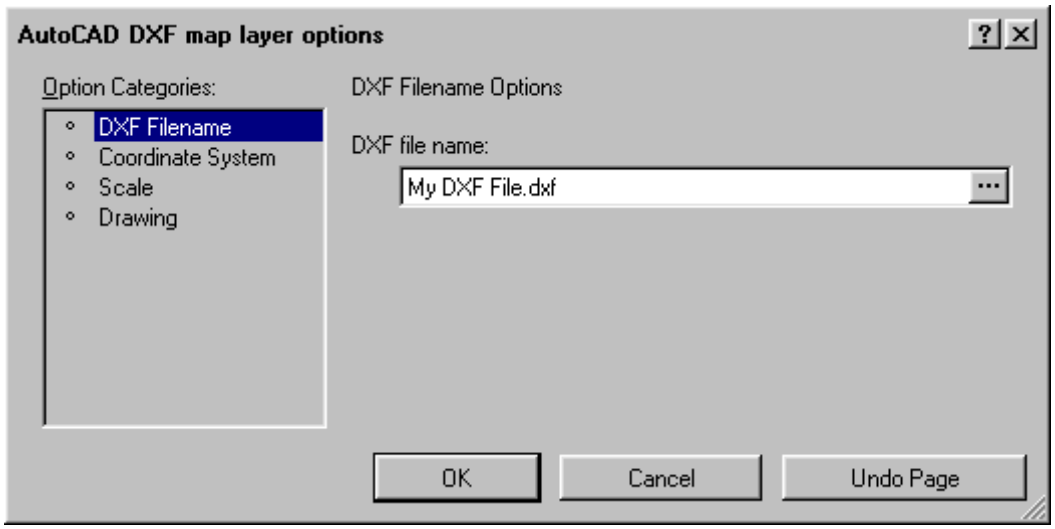
14.3. AutoCAD Data Exchange Format (DXF)

Warning:

Use the DXF format as a last resort, only if no alternative is available. DXF is a very ambiguous format, which results in different applications interpreting the same DXF file in different ways. You can expect fewer problems using other formats, such as ARC/INFO Shapefile or Digital Line Graph.

14.3.1. DXF Map Layer Options Dialog Box

Use the DXF Map Layer Options dialog box to configure a DXF map background layer.



The DXF Map Layer Options dialog box is a Multiple Page dialog box. See *Section B.2, Multiple Page Dialog Boxes*, for more information.

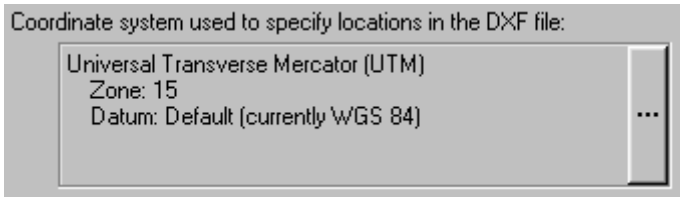
14.3.2. DXF Filename Options Page

Use the DXF Filename page of the DXF Map Layer Options dialog box to set the name of the DXF file you wish to display.

Type the name of the DXF file. Press the Browse button ..., located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file. This file will typically have the extension `.dxf`.

14.3.3. Coordinate System Options Page

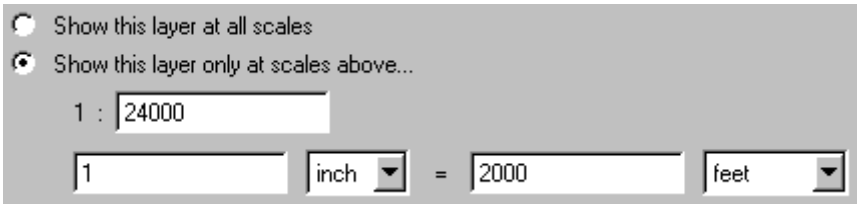
Use the Coordinate System page of the DXF Map Layer Options dialog box to specify the coordinate system used by the DXF file.



See *Section 20.1, Coordinate System Control*, for instructions on specifying a coordinate system.

14.3.4. Scale Options Page

Use the Scale page of the DXF Map Layer Options dialog box to specify the scales at which this DXF file is displayed.

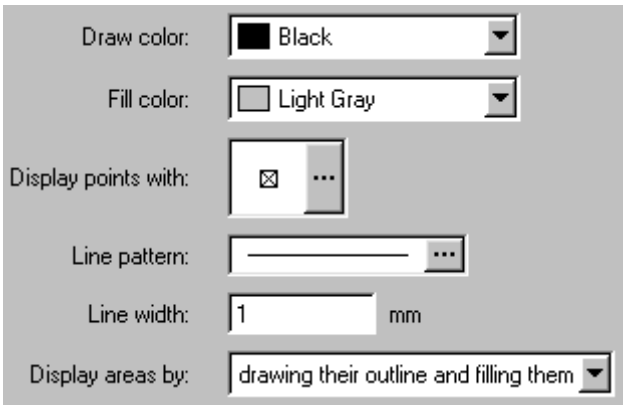


If a plot is displayed at a scale below the one you specify, the DXF layer is not displayed. This is useful if you have DXF files with varying levels of detail. Using multiple DXF files, you can construct maps that reveal more detail as you zoom in.

For example, assume that you have two DXF files. The first contains main roads, and the second contains secondary roads. You can set the main roads layer to display at all scales, and the secondary roads layer to display only at scales above 1:24,000. This prevents the secondary roads from cluttering the plot if you view it at a smaller scale.

14.3.5. Drawing Options Page

Use the Drawing page of the DXF Map Layer Options dialog box to specify the style (colors, line widths, etc.) used to draw features in the DXF file.



You can set the following options.

- *Draw color:* Select the color used to draw point features, line features, and the outlines of area features. See *Section B.10, Color Control*, for information on selecting colors.
- *Fill color:* Select the color used to fill the interior of area features. For example, if the DXF file contains areas representing lakes, you can set the fill color to blue.
- *Display points with:* Select the symbol used to display point features. Press the Select Symbol button ... to display the Select Symbol dialog box, which allows you to browse the available symbols. See *Section B.12, Symbol Control*.
- *Line pattern:* Select the dash pattern (dashed, dotted, solid, etc.) of lines used to draw line features and the outlines of area features. See *Section B.11, Line Pattern Control*, for information on selecting line patterns.
- *Line width:* Type the width, in millimeters, of lines used to draw line features and the outlines of area features. Typical widths are between 0.2 to 1.0 millimeters.
- *Display areas by:* Select how area features are displayed. You have three options.
  - Draw their outlines
  - Fill their interiors with a solid color
  - Both draw their outlines and fill their interiors

14.3.6. Technical Details

NMPlot can display DXF entities of the following types.

- POINT

- LINE
- POLYLINE

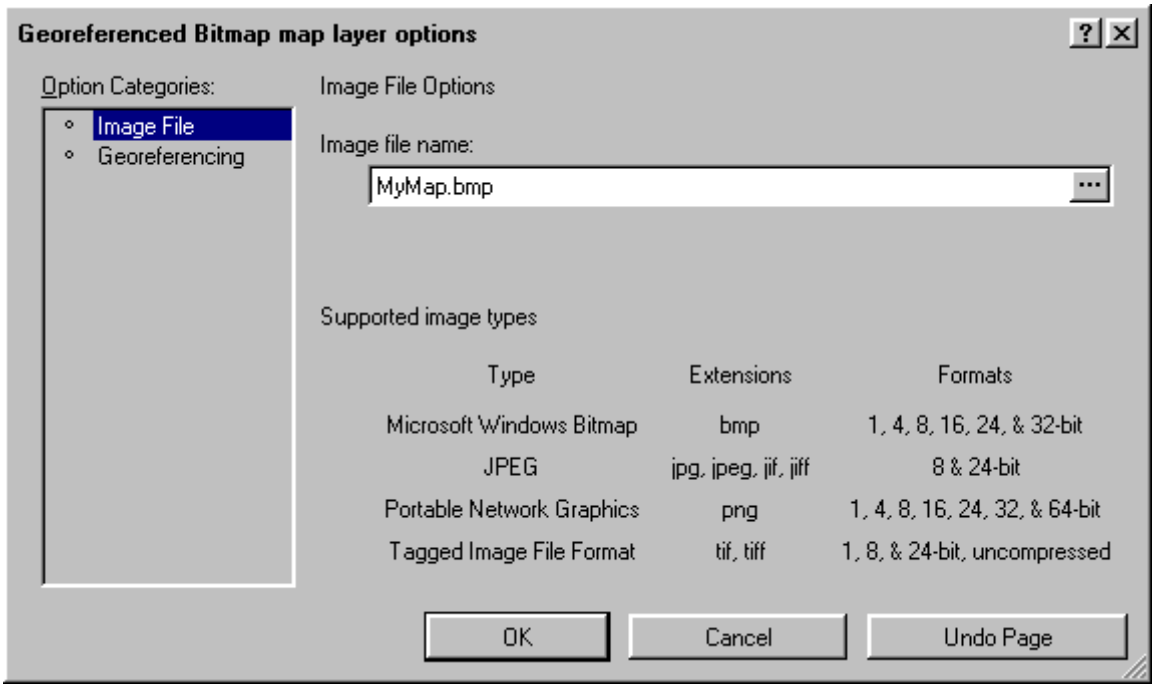
NMPlot recognizes entities in either BLOCKS or ENTITIES sections.

The DXF format is controlled by Autodesk, Inc., the makers of AutoCAD. The official specifications are documented in an appendix of the AutoCAD Reference Manual.

14.4. Georeferenced Bitmap

14.4.1. Georeferenced Bitmap Map Layer Options Dialog Box

Use the Georeferenced Bitmap Map Layer Options dialog box to configure a Georeferenced Bitmap Image map background layer.



The Georeferenced Bitmap Map Layer Options dialog box is a Multiple Page dialog box. See *Section B.2, Multiple Page Dialog Boxes*, for more information.

14.4.2. Image File Options Page

Use the Image File page of the Georeferenced Bitmap Map Layer Options dialog box to set the name of the bitmap image file you wish to display.

Type the name of the bitmap image file. Press the Browse button ..., located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file.

NMPlot can read the following types of bitmap image files.

- Microsoft Windows Bitmap (bmp)
- JPEG (jpg, jpeg)
- Portable Network Graphics (png)
- Tagged Image File Format (tif, tiff), uncompressed

14.4.3. Georeferencing Options Page

Use the Georeferencing page of the Georeferenced Bitmap Map Layer Options dialog box to specify the portion of the Earth's surface represented by the bitmap image.

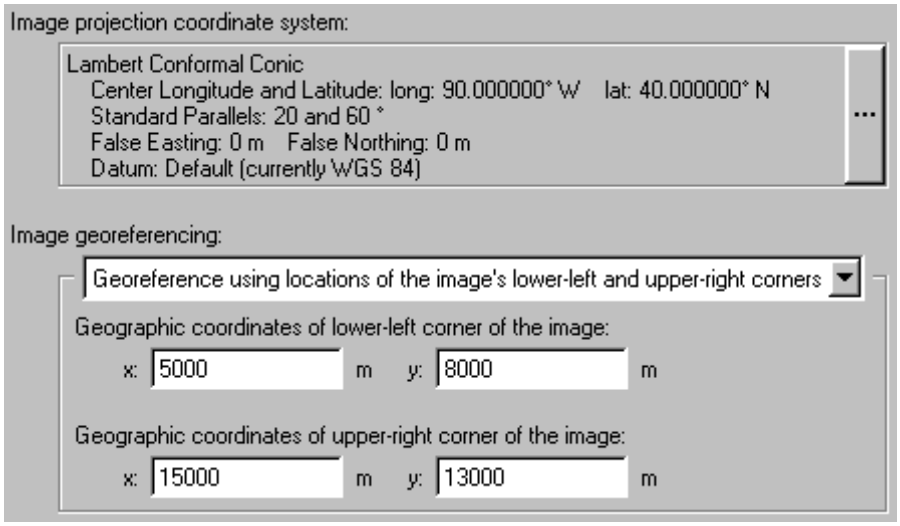


Image projection coordinate system: Select the projection coordinate system of the bitmap image. See *Section 20.1, Coordinate System Control*, for information on specifying a coordinate system.

Image georeferencing: Use the drop-down list to select the method for georeferencing the image. You have three choices.

- *Georeference using locations of the image's lower-left and upper-right corners* - Specify the geographic coordinates of the image's lower-left (i.e., southwest) and upper-right (i.e., northeast) corners. The coordinates must be supplied in the image's projection coordinate system.

- *Georeference using location of the image's lower-left corner, and size of the image* - Specify the geographic coordinates of the image's lower-left (i.e., southwest) corner. The coordinates must be supplied in the image's projection coordinate system. Also specify the width (i.e., the east-west extent) and the height (i.e., the north-south extent) of the image. The units used to specify the width and height depend upon the projection coordinate system.

- *Georeference using location of the image's lower-left corner, and size of an image pixel* - Specify the geographic coordinates of the image's lower-left (i.e., southwest) corner. The coordinates must be supplied in the image's projection coordinate system. Also specify the width (i.e., the east-west extent) and the height (i.e., the north-south extent) of a single pixel in the image. The units used to specify the width and height depend upon the projection coordinate system.

- *Georeference using location of the image's upper-left corner, and size of the image* - Specify the geographic coordinates of the image's upper-left (i.e., northwest) corner. The coordinates must be supplied in the image's projection coordinate system. Also specify the width (i.e., the east-west extent) and the height (i.e., the north-south extent) of the image. The units used to specify the width and height depend upon the projection coordinate system.

- *Georeference using location of the image's upper-left corner, and size of an image pixel* - Specify the geographic coordinates of the image's upper-left (i.e., northwest) corner. The coordinates must be supplied in the image's projection coordinate system. Also specify the width (i.e., the east-west extent) and the height (i.e., the north-south extent) of a single pixel in the image. The units used to specify the width and height depend upon the projection coordinate system.

- *Georeference using world file* - NMPlot will read georeferencing information from a world file associated with the image. The world file must have the same file name as the image, and must have one of the following extensions:

  .wld, .wf, .worldfile, .twf, .tifw, .tiffw, .tfw, .bwf, .bmpw, .bpw, .pwf, .pngw, .pnw, .pgw, .jwf, .jpgw, .jpegw, .jpw, .jgw

For example, if the image file is named "Chicago.bmp", an acceptable world file name would be "Chicago.wld".

 ***Note:***

A world file is a standard way of specifying georeferencing information for a bitmap image. The format was defined by Environmental Systems Research Institute, Inc (ESRI).

A world file is a simple text file consisting of 6 numbers, each on a separate line.

The first number is the size of an image pixel in the X (east-west) direction.

The second and third numbers are rotation terms. NMPlot does not currently support world file rotation. Therefore, these numbers must be zero.

The fourth number is the size of an image pixel in the Y (north-south) direction. This number is usually negative: see below.

The fifth number is the X coordinate of the center of the upper-left image pixel.

If the fourth number is **negative**, the sixth number is the Y coordinate of the center of the **upper**-left image pixel.

If the fourth number is **positive**, the sixth number is the Y coordinate of the center of the **lower**-left image pixel.

 ***Note:***

You should be able to find georeferencing information in the documentation that accompanies your bitmap image. If you do not have this information, ask the person or organization who supplied the image. Or, contact your local GIS expert. If NMPlot does not support your image's projection, contact the developers: see *Appendix I, Contacting Wasmer Consulting*.

Georeferenced bitmap images are often distributed with an accompanying world file, which contains georeferencing information. However, keep in mind that a world file does not contain information about an image's projection. Your image's projection must be entered into NMPlot by hand.

 ***Caution:***

You can display any number of georeferenced images on a single plot. However, all of the images must have compatible projection coordinate systems. NMPlot will allow you to

create a plot with images in different projections, but this should be attempted only if you have a thorough understanding of map projections. To be safe, novices should insure that all georeferenced images have exactly the same projection.

14.4.4. Technical Details

NMPlot can read bitmap images in the following formats.

- BMP: 1-, 4-, 8-, 16-, 24-, and 32-bits
- JPEG: 8- and 24-bits
- PNG: 1-, 4-, 8-, 16-, 24-, 32-, and 64-bits
- TIFF: 1-, 8- and 24-bits, uncompressed

14.5. Compressed ARC Digitized Raster Graphics (CADRG)

14.5.1. Compressed ARC Digitized Raster Graphics (CADRG) Map Layer Options Dialog Box

Use the Compressed ARC Digitized Raster Graphics (CADRG) Map Layer Options dialog box to configure a CADRG map background layer.

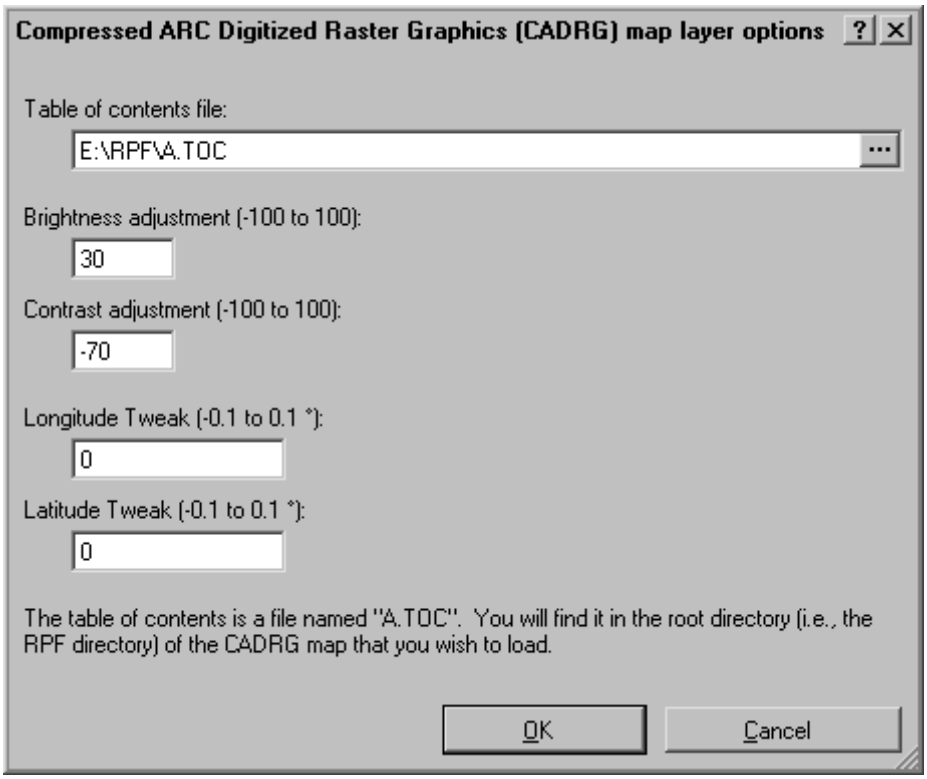


Table of contents file: Type the name of the CADRG table of contents file. Press the Browse button ..., located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file.

The CADRG table of contents is a file is named `A.TOC`. You will find it in the root directory (i.e., a directory named `RPF`) of the CADRG map you wish to load.

Brightness adjustment:
Contrast adjustment: Type numbers between -100 and 100 to indicate how much the brightness and contrast of the CADRG map should be adjusted before it is displayed. Values of 0 leave the map unchanged. Values above 0 increase the brightness and contrast; value below 0 decrease the brightness and contrast.

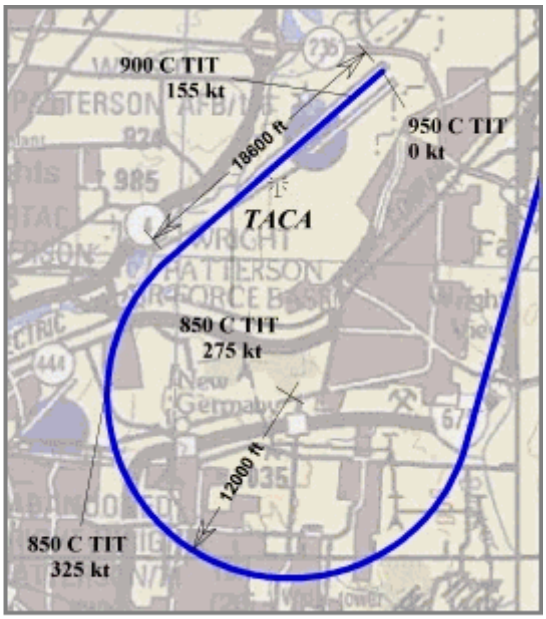
Longitude Tweak:
Latitude Tweak: Type numbers between -0.1 and 0.1 to indicate how much the CADRG map should be shifted in degrees longitude and latitude. If foreground elements do not line up exactly with the background CADRG map, use non-zero values to shift the map slightly. The appropriate tweak values are best found using trial and error.

Tip:

As distributed, most CADRG maps are poor backgrounds. The map colors are too intense, making it difficult to see any foreground detail displayed over the map.

In most situations, you should adjust the brightness and contrast so that the map colors are muted. As a starting point, try a brightness adjustment of 30 and a contrast adjustment of -70. These values have been found to work well with most CADRG maps distributed by the United States' National Imagery and Mapping Agency.

Brightness = 0, Contrast = 0



Brightness = 30, Contrast = -70

Tip:

CADRG maps are typically distributed on a CD-ROM. If desired, you can copy the CADRG map to your hard drive. Simply copy the RPF directory, taking care to preserve the subdirectory structure.

A CADRG map will load much faster from a hard drive. It may also be more convenient to use, since you do not have to insert a CD-ROM.

Warning:

CADRG maps can be huge. Uncompressed, they can be several thousand megabytes in size. NMPlot supports incremental loading: it reads sections of the CADRG map on an as-needed basis. However, as you zoom out on a plot, you cause more CADRG map data to

be loaded. If you zoom out far enough, enough map data can be loaded to overwhelm even the largest computer.

 ***Note:***

Do not confuse the Compressed ARC Digitized Raster Graphics (CADRG) format with the Digital Raster Graphics (DRG) format developed by the United States Geological Survey. They are different formats.

14.5.2. Technical Details

Compressed ARC Digitized Raster Graphics (CADRG) is a georeferenced bitmap format for storing background maps. It was developed by the United States Department of Defense's Defense Mapping Agency (now known as NIMA, the National Imagery and Mapping Agency).

The CADRG format is documented in military specification MIL-PRF-89038 (formerly MIL-C-89038), dated 6 October 1994, and Amendment 1, dated 27 April 1999. These documents can be downloaded from the NIMA web site, http://www.nima.mil/. As of September 2001, the URLs for PDF versions of these documents were http://www.nima.mil/publications/specs/printed/89038/89038_CADRG.pdf and http://www.nima.mil/publications/specs/printed/89038/89038_A1.pdf.

Chapter 15

Printing Plots

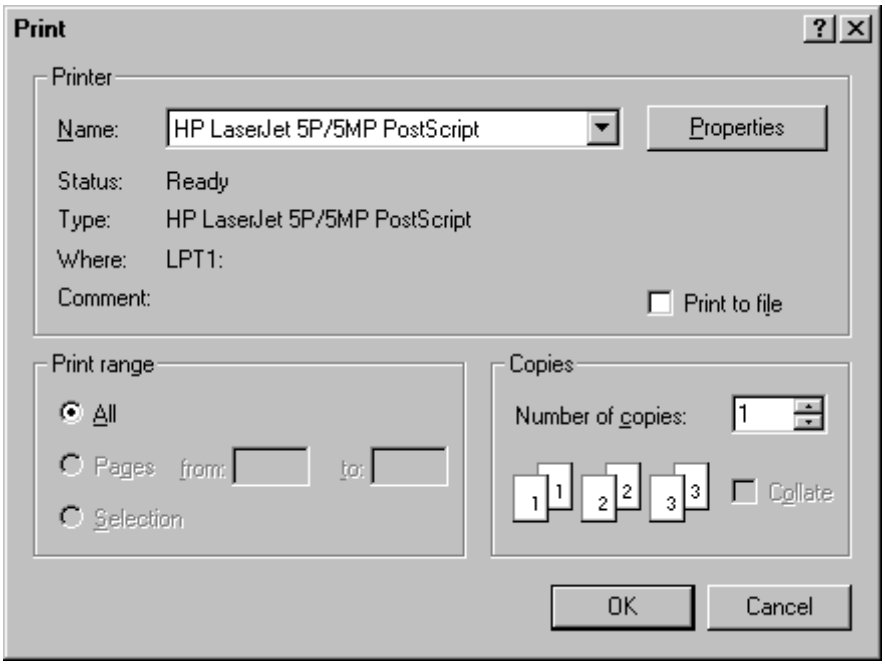
NMPlot lets you print any plot. You can choose a scale to print the plot at, and add a detailed legend.

15.1. Print Dialog Box

To print a plot, you can:

- Choose Print from the File menu
- Press the Print toolbar button 
- Press Ctrl + P

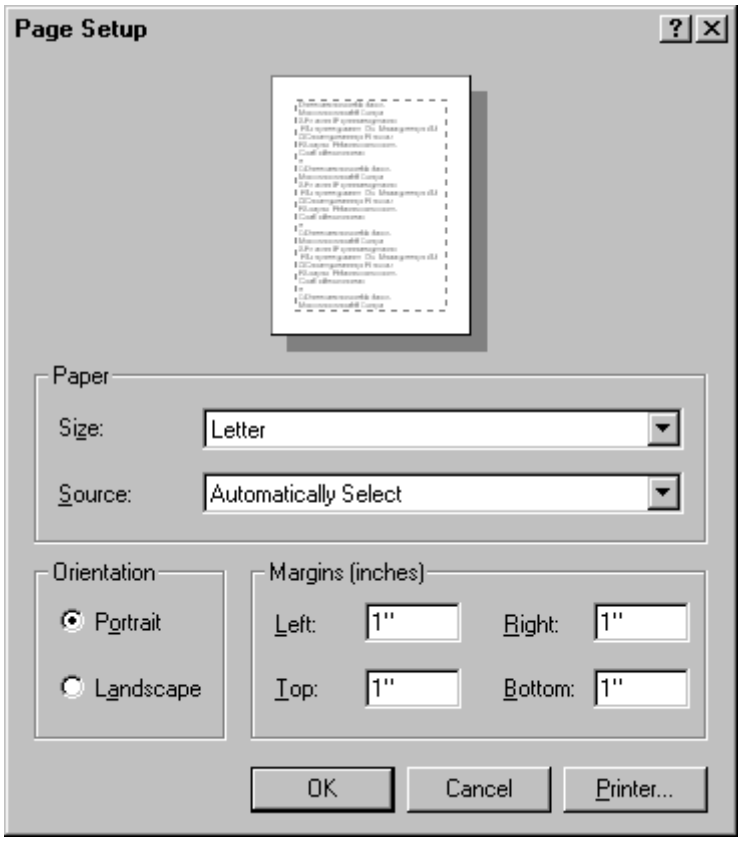
The standard Microsoft Windows Print dialog box appears.



The exact appearance of this dialog box will vary, depending on the version of Windows you are using. However, all versions let you choose a printer. Familiarity with this dialog box is assumed. Choose a printer, and press OK. Your plot is sent to the selected printer.

15.2. Page Setup

Microsoft Window's standard Page Setup dialog box lets you select the paper orientation (portrait or landscape) and page margins of your printer.



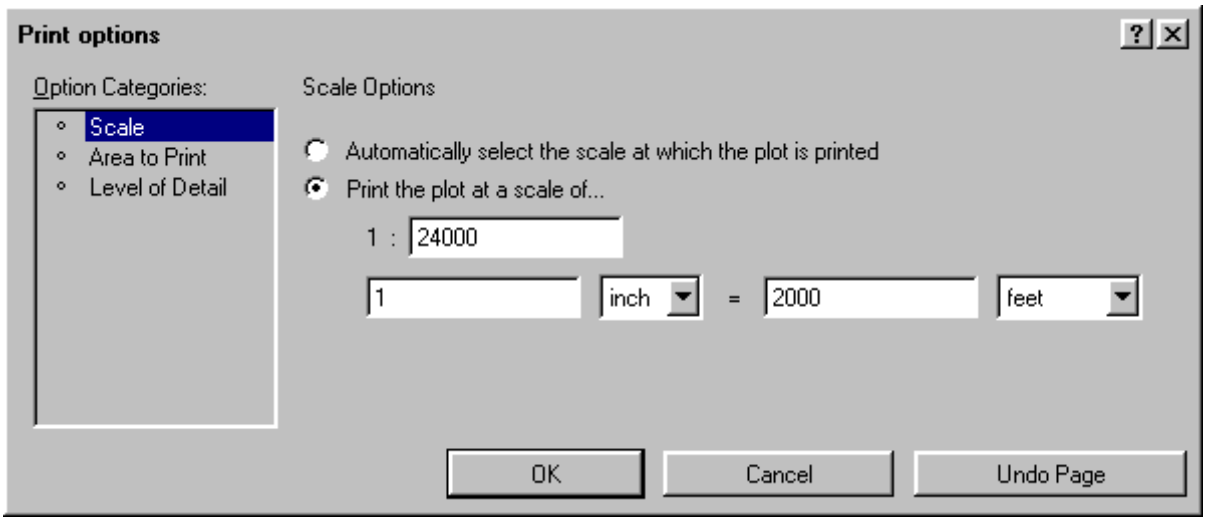
The exact appearance of this dialog box will vary, depending on the version of Windows you are using. Familiarity with this dialog box is assumed.

To display the Page Setup dialog box, you can:

- Choose Page Setup from the File menu
- Press Ctrl + Shift + P

15.3. Print Options

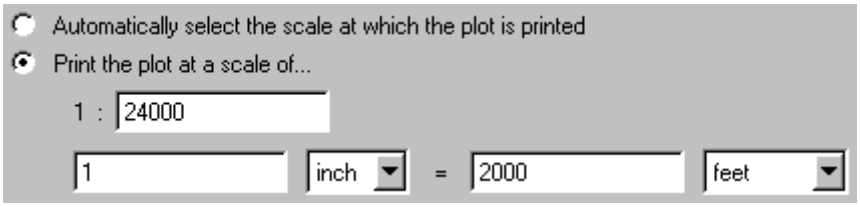
Choose Print Options from the File menu to display the Print Options dialog box. Use it to control how plots are printed.



The Print Options dialog box is a Multiple Page dialog box. See *Section B.2, Multiple Page Dialog Boxes*, for more information.

15.3.1. Scale

Use the Scale page of the Print Options dialog box to set the scale at which a plot is printed.



Select how the scale is determined.

- *Automatically select the scale at which the plot is printed* - NMPlot selects a scale so that the plot's area of interest just fills the paper's margins when printed. The area of interest is specified on the Area To Print page. See *Section 15.3.2, Area to Print*.
- *Print the plot at a scale of* - Specify the scale at which the plot is printed.

15.3.2. Area to Print

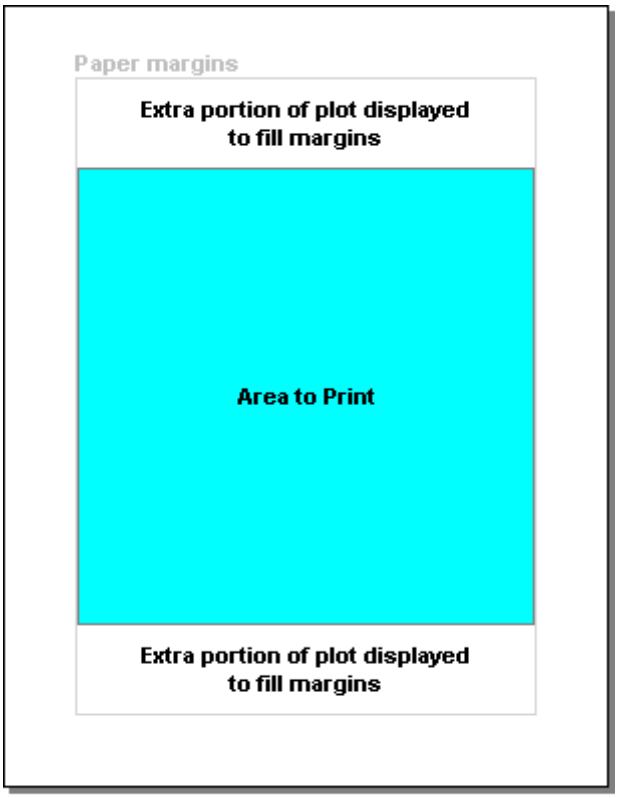
Use the Area To Print page of the Print Options dialog box to select the portion of your plot that is printed.

Select the area to print. You have two choices.

- *Print the home view* - The home view of the plot is printed. See *Section 8.4, The Home View*, for more information about the home view.
- *Print the area currently displayed on the screen* - The portion of the plot currently displayed on your computer's monitor is printed. If you want to print only a small portion of your plot, zoom in on that section, then print the plot, choosing to print the area currently displayed on the screen.

Note:

If the Area to Print is not the same shape as the paper on which a plot is printed (i.e., if the aspect ratios are different), the area printed will be larger that the area requested. For example, if you select an Area to Print that is square, and then print on paper that is tall and narrow, the requested square area will fill the paper to the left and right margins. In addition, a portion of the plot beyond the area requested will appear at the top and bottom of the paper.



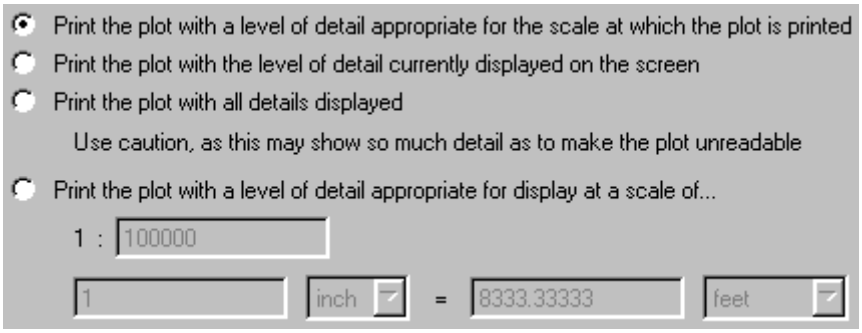
Printing a plot with a square Area to Print on a tall, narrow sheet of paper

Note:

If you print a plot to scale, NMPlot attempts to display the Area To Print at the requested scale. If the requested scale is too large, this area will not fit on the paper. In this case, you have three options: 1) choose a smaller scale, 2) choose a smaller Area To Print, or 3) print to a larger sheet of paper.

15.3.3. Level of Detail

Use the Level Of Detail page of the Print Options dialog box to control how much background map detail is displayed when you print a plot.



Many background maps specify a minimum scale at which various features should be displayed. As you zoom in on such a map, additional detail is displayed. The intent is to prevent excessive detail from cluttering a plot when it is displayed at a small scale. See *Chapter 14, Background Map Formats*.

Use the Level of Detail page to control how NMPlot uses this recommended scale information when you print a plot. You have four choices for how NMPlot determines how much detail to display.

- *Print the plot with a level of detail appropriate for the scale at which the plot is printed* - Any recommended scale information in the background map is used.
- *Print the plot with the level of detail currently displayed on the screen* - The level of detail is the same as that currently displayed by the plot on your computer's monitor.
- *Print the plot with all details displayed* - Any recommended scale information in the background map is ignored.

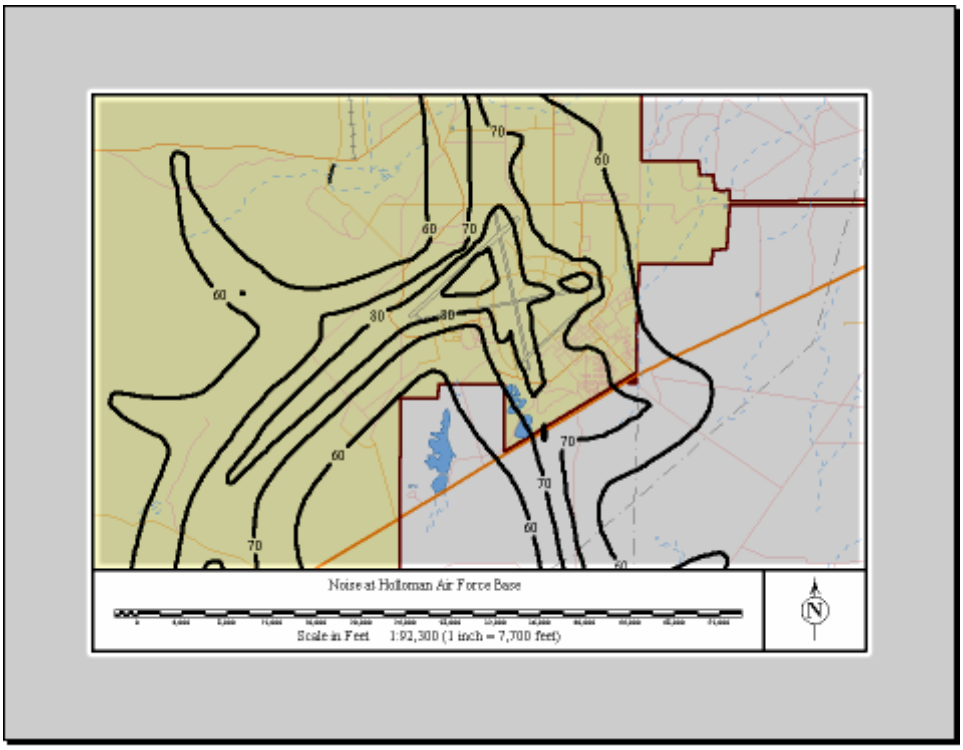
Caution:

This may display so much background map detail as to make the plot illegible.

- *Print the plot with a level of detail appropriate for display at a scale of* - The level of detail is the same as if the plot was being printed at a scale you specify.

15.4. Legends

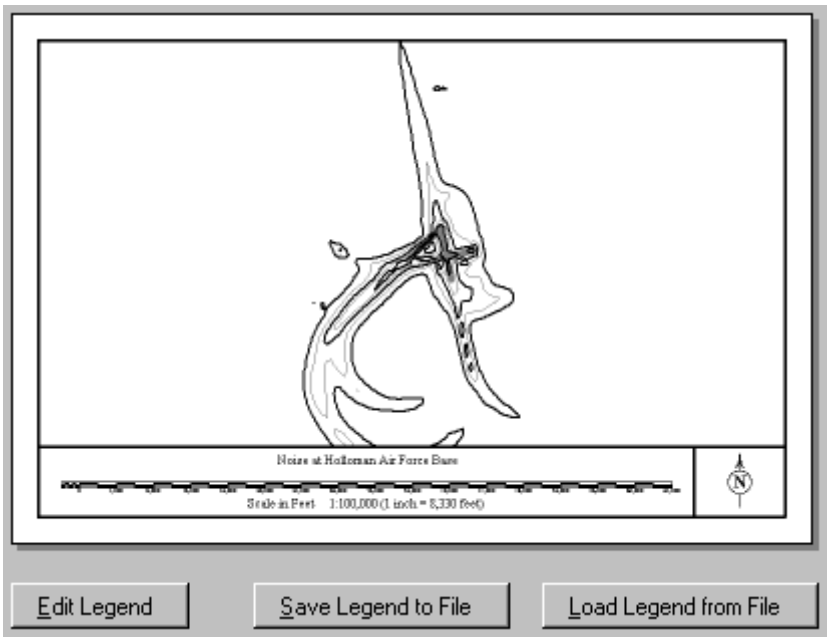
When printing a plot, you can add a legend that displays information about the plot.



Sample plot, with the legend highlighted

You have full control over the appearance and content of the legend. The legend can have multiple fonts, colors, and borders. Text can be segregated into outlined rectangular areas, much like an architectural blueprint legend. A graphical scale and north arrow are supported.

To change the legend, display the Legend page of the Plot Options dialog box.



A sample of the current legend is displayed.

Press the Edit Legend button to edit the legend. The Edit Legend dialog box is displayed. See *Section 15.5, Editing Legends*, for information on editing legends.

Creating a legend from scratch involves a significant amount of work. Therefore, NMPlot gives you the ability to save and load legends to and from files. The intent is that you will create a small number of legends, and then reuse them as needed.

Press the Save Legend To File button to write the current legend to a file. Press the Load Legend From File button to read a previously saved legend. In both cases, you will be asked for the file's name.

NMPlot is distributed with several ready-to-use legends. These legends are stored in files that have the extension `.nmplot_legend`, and are located in the same directory as the NMPlot program file, `NMPlot.exe`. If you do not wish to go to the trouble of learning how to edit legends, you can simply use one of these ready-to-use legends.

Tip:

If you intend to create your own legend, you may wish to start with one of the ready-to-use legends included with NMPlot, and then edit it incrementally. You will likely find this easier than creating a new legend from scratch.

15.5. Editing Legends

15.5.1. Legend Concepts

An NMPlot legend is an area that surrounds a plot when it is printed. The legend displays information about the plot, such as descriptive text, a graphical scale, and a north arrow. The legend may also include a border around the plot.

NMPlot's legends are based upon a concept of *cells*. Cells are rectangular areas of the paper that can contain text, graphical features such as scales and north arrows, and other cells. In addition, there is a cell that contains the plot itself. Each cell has a variety of properties, such as a background color, a margin, and a border.

The printable area of the paper (i.e., the paper minus any margins) is the *outermost cell*. You build a legend by adding cells to this outermost cell, and setting their properties. Recall that cells can contains other cells. The legend consists of a hierarchy of cells, with the outermost cell as the hierarchy root.

There are three types of cells:

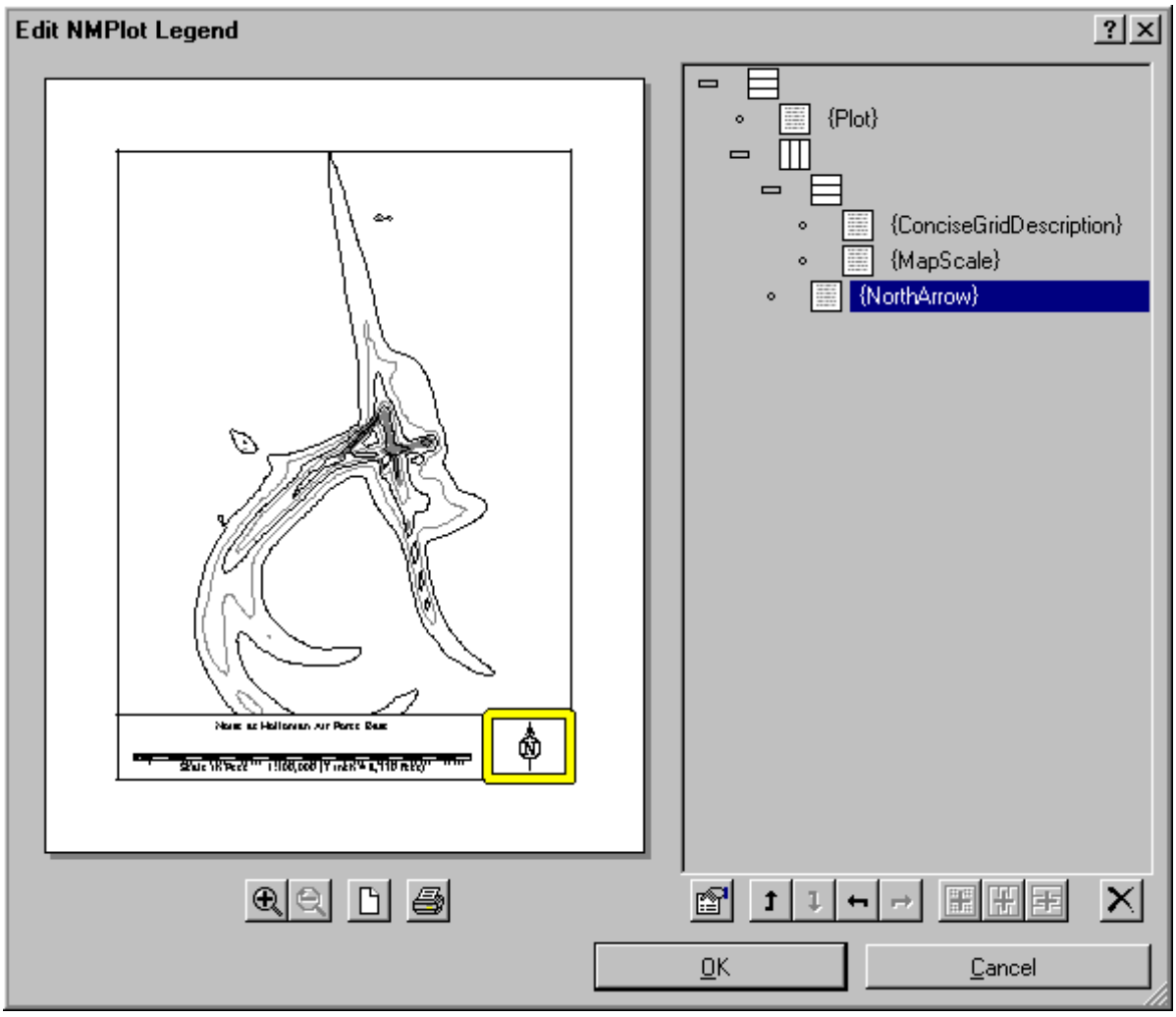
- *Text Cells* - These cells contain text, and possibly, graphical elements such as a north arrow and the plot itself.

  Horizontal Organizer Cells - These cells contain a horizontal row of other cells.

  Vertical Organizer Cells - These cells contain a vertical column of other cells.

15.5.2. Edit Legend Dialog Box

Use the Edit Legend dialog box to inspect and edit an NMPlot legend.



The left side of the Edit Legend dialog box displays a preview of what the current legend will look like when printed. This is know as the *legend preview*.

The right side of the Edit Legend dialog box displays a hierarchical list of the cells in the legend. This is known as the *cell list*.

At any given time, one cell is selected. This *selected cell* is the one that you are currently working with. The selected cell is highlighted in both the legend preview and the cell list.

15.5.3. Working with the Legend Preview

Press the Zoom In button to magnify the legend preview for close study. Press the Zoom Out button to reduce the magnification level.

Press the Change Sample Paper Size button to select the size and orientation of the hypothetical piece of paper used to display the legend preview.

Press the Print Sample Legend button to print the legend preview.

Click on a cell in the legend preview to select it. Double-click on a cell to displays the cell's Edit Legend Cell dialog box, which allows you to inspect and change the cell's properties. See *Section 15.5.5, Edit Legend Cell Dialog Box*.

15.5.4. Working with the Cell List

The cell list displays a hierarchical list of the cells in the legend being edited. The selected cell is always highlighted. To change the selected cell, either use the arrow keys, or click on the cell to be selected.

To edit the properties of the selected cell, you can:

- Press the Edit Cell button
- Press Alt + E
- Double-click on the cell in the cell list

The cell's Edit Legend Cell dialog box, which allows you to inspect and change the cell's properties, is displayed. See *Section 15.5.5, Edit Legend Cell Dialog Box*.

Use either the keyboard or the Move buttons to move the selected cell.

Key	Button	Action
Alt + ↑		Move selected cell up in the cell list.
Alt + ↓		Move selected cell down in the cell list.
Alt + ←		Move selected cell in one level towards the root of the cell list.
Alt + →		Move selected cell out one level away from the root of the cell list.

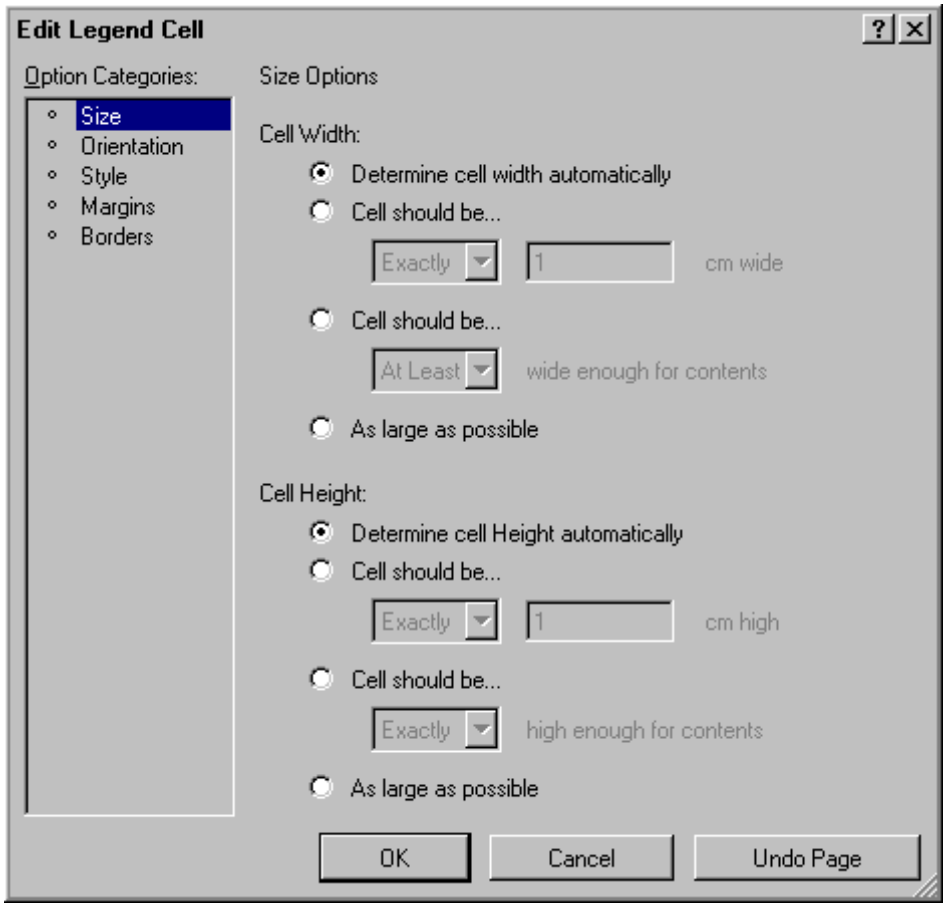
Use either the keyboard or the Add buttons to add a new cell as the child of the selected cell.

Key	Button	Action
Alt + T;		Add a new text cell
Alt + H		Add a new horizontal organizer cell
Alt + V		Add a new vertical organizer cell

Delete the selected cell by either pressing the Delete button , or by pressing the Delete key.

15.5.5. Edit Legend Cell Dialog Box

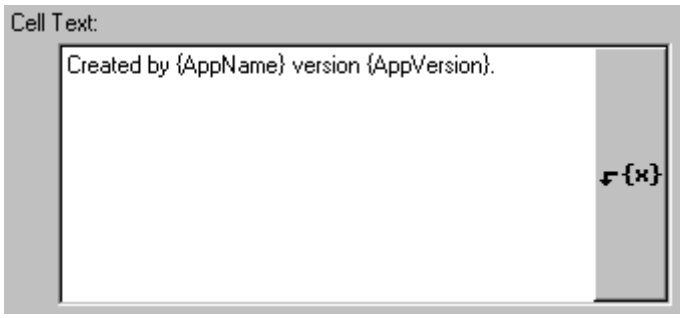
The Edit Legend Cell dialog box allows you to inspect and change the properties of the selected cell.



The Edit Legend Cell dialog box is a Multiple Page dialog box. See *Section B.2, Multiple Page Dialog Boxes*, for more information.

15.5.6. Text Page

The Text page of the Edit Legend Cell dialog box allows you to change the text of a text cell.



Type the desired text in the box provided. The text can have as many lines as desired: press the Enter key to insert a new line.

The text can include *symbolic fields*, placeholders for text that is automatically inserted when the legend is printed. For example, the field {ConciseGridDescription} is automatically replaced with a short description of the plot's primary grid.

Symbolic fields can also represent graphical elements, such as a north arrow. Of particular interest is the {Plot} symbol, which represents the plot being annotated by the legend. Each legend should contain exactly one text cell that has the {Plot} symbol as part of its text.

Some commonly used symbolic fields are:

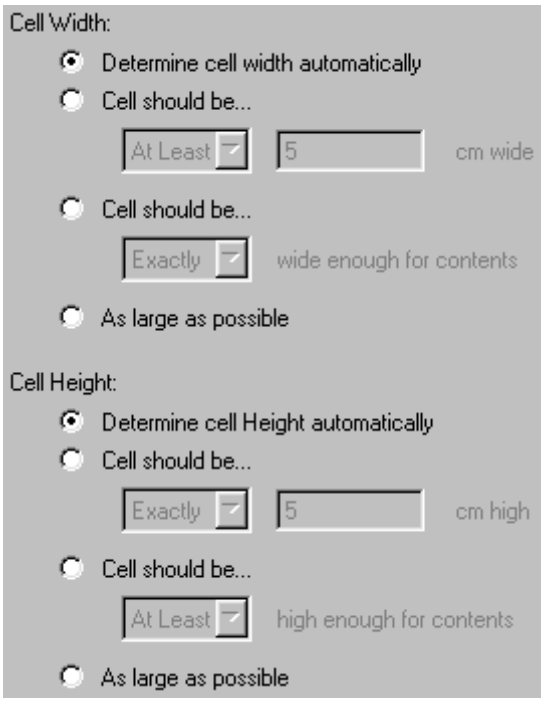
Field	Description
{ConciseGridDescription}	Short description of the plot's primary grid
{DetailedGridDescription}	Longer, more detailed description of the plot's primary grid
{Metric}	The data metric of the plot's primary grid: i.e., what is being measured by the grid. For example, "aircraft noise" or "water temperature"
{Units}	Physical units of the plot's primary grid. For example, "dB" or "degrees C".
{GridFilename}	Name of the file containing the plot's primary grid
{CurrentDate}	Date on which the plot is printed
{CurrentTime}	Time at which the plot is printed

{Plot}	The plot being printed
{NorthArrow}	An arrow indicating the direction of north on the plot
{MapScale}	A graphical distance bar showing the plot scale

Press the Insert Symbolic Field button  , located to the right of the text box, to display a list of fields from which you can choose. See *Section B.5, Symbolic Fields Text Control*, for more information.

15.5.7. Size Page

The Size page of the Edit Legend Cell dialog box allows you to specify the horizontal and vertical size of a cell.



You can specify both the cell's width (i.e., horizontal size) and height (i.e., vertical size). Since the width and height are specified in an analogous manner, only the width is described in detail.

Select the method used to specify the cell's width. You have four choices.

- *Determine cell width automatically* - NMPlot will automatically calculate an appropriate width for the cell. For text cells, the width is computed from the text being displayed. For organizer cells, the width is computed from the widths' of the cell's child cells.

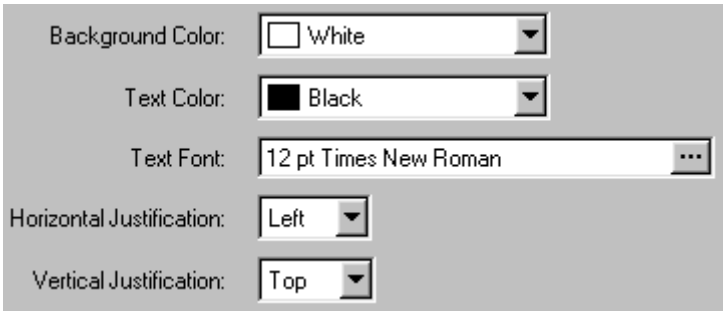
- *Cell should be* - Type the width of the cell, in centimeters. Choose *Exactly* from the drop-down list to force the cell to be exactly the width you supplied. Choose *At least* to allow the cell to be wider: NMPlot will assign the cell a larger width if there is room for it.

- *Cell should be* - Choose how the cell uses its contents (either its text or child cells) to determine its own width. Choose *Exactly* to restrict the cell to the smallest width that will accommodate its contents. Choose *At least* to allow the cell to be wider: NMPlot will assign the cell a larger width if there is room for it.

- *As large as possible* - The cell will be as wide as possible: it will fill the horizontal space available for it.

15.5.8. Style Page

The Style page of the Edit Legend Cell dialog box allows you to specify the visual appearance of a cell: its color, font, and justification.



Background color - Select the background color of the cell. See *Section B.10, Color Control*, for information on selecting colors.

Note that for some organizer cells, the background color will not be visible, as the entire cell will be filled with other cells that have their own background colors. Typically, you will set the background colors of all text cells, and all organizer cells that have non-zero margins.

Text Color - Select the color of the cell's text. This is relevant only for text cells.

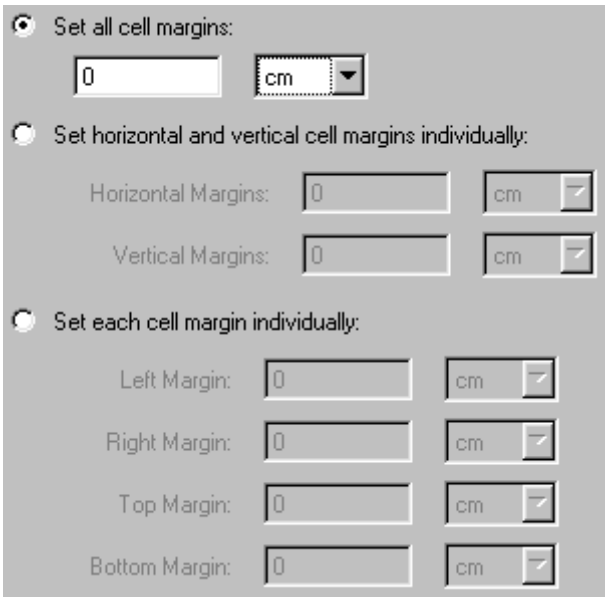
Text Font - Select the font used to display the cell's text. This is relevant only for text cells. See *Section B.9, Font Control*, for information on selecting fonts.

Horizontal Justification - Select how the cell's contents (either its text or its child cells) are horizontally justified. You have three choices: *Left*, *Center*, and *Right*.

Vertical Justification - Select how the cell's contents (either its text or its child cells) are vertically justified. You have three choices: *Top*, *Center*, and *Bottom*.

15.5.9. Margins Page

The Margins page of the Edit Legend Cell dialog box allows you to specify a cell's margins. The margins are white space around the edge of the cell, similar to the margins on a piece of paper.

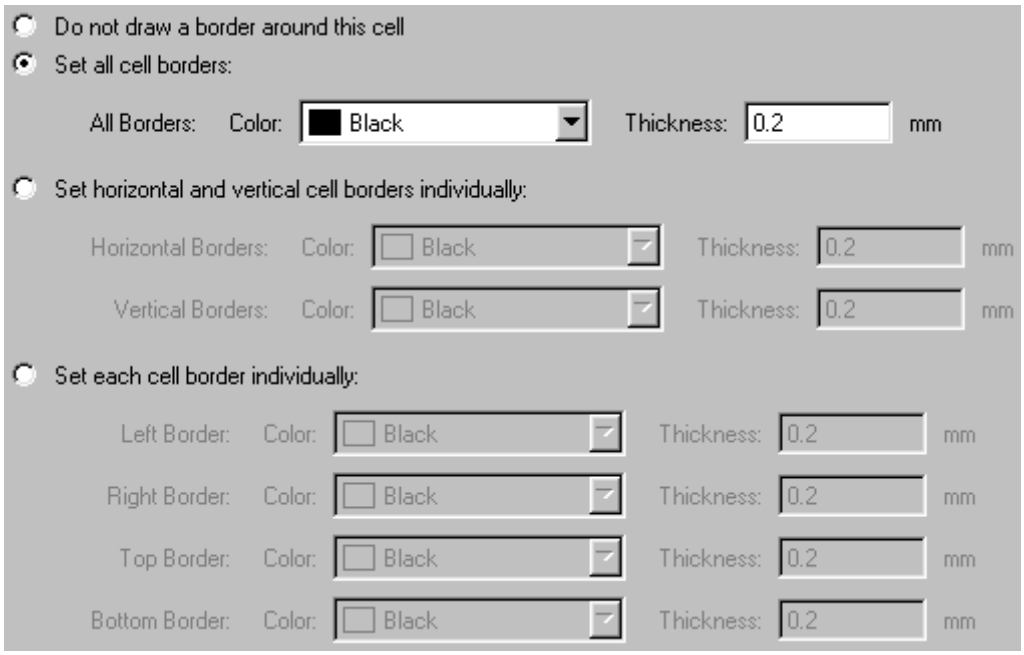


Choose the method used to specify the margins. You have three choices: specifying a single margin for all four sides of the cell, specifying different margins for the left-right and top-bottom sides of the cell, and specifying the margins for all four sides individually.

Type the desired margin or margins, and select the units used to specify the margins.

15.5.10. Borders Page

The Borders page of the Edit Legend Cell dialog box allows you to specify a cell's borders. The borders are optional lines that can be drawn around some or all of the four edges of the cell, just outside of the margins.



Choose the method used to specify the borders. You have four choices: displaying no borders, specifying a single border style for all four sides of the cell, specifying different border styles for the left-right and top-bottom sides of the cell, and specifying the border styles for all four sides individually.

Select the desired color(s) of the line(s) used to draw the borders. See *Section B.10, Color Control*, for information on selecting colors.

Type the desired width(s) of the line(s) used to draw the borders, in millimeters. If a width of zero is specified, then the border is not drawn.

Chapter 16

Using Print Preview

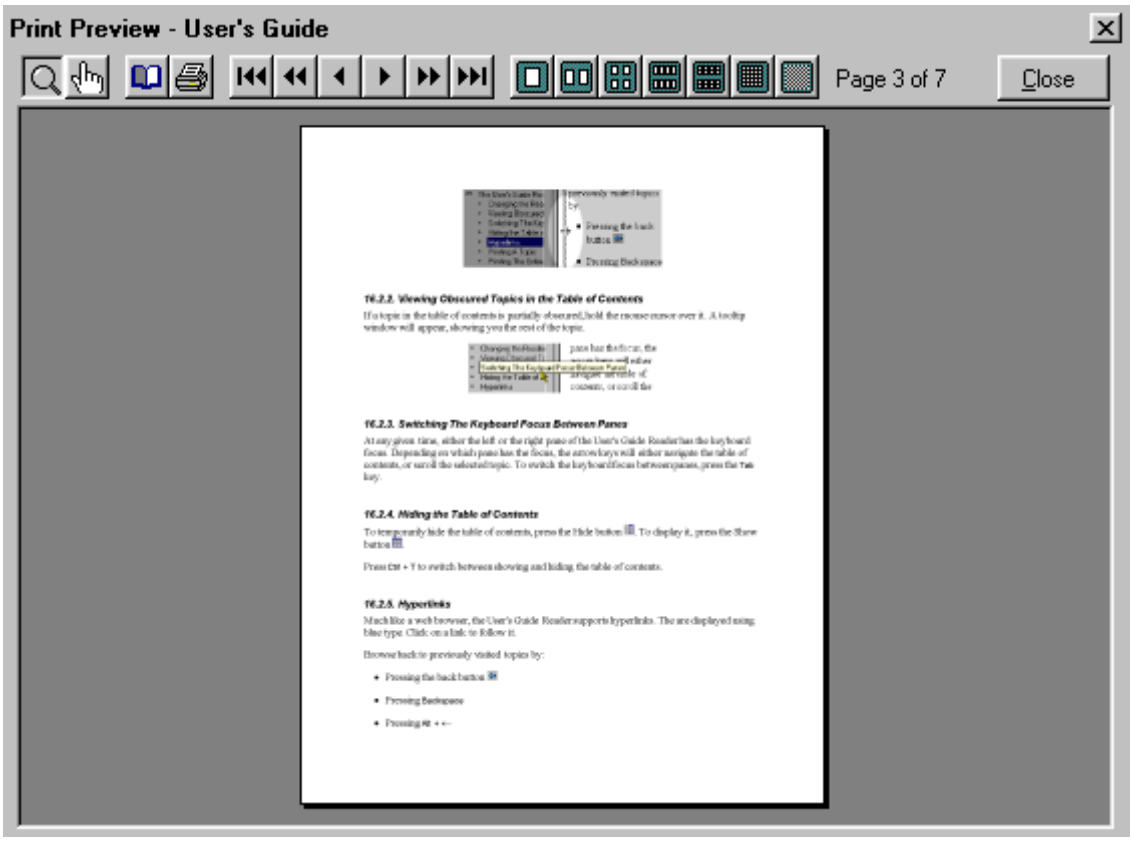
NMPlot's print preview capability lets you view the pages of a document before you print it. You can select paper orientation and margins, view 1, 2, 4, or more pages at a time, magnify individual pages for close inspection, and select individual pages to print.

To print preview a plot, either press the Print Preview button  on the application toolbar, or choose Print Preview from the File menu.

To print preview the NMPlot User's Guide, press the print preview button  on the User's Guide reader toolbar. See *Chapter 22, Accessing Help*, for more information.

16.1. Print Preview Dialog Box

The Print Preview dialog box is used to print preview documents.



Use either the toolbar buttons or the keyboard to navigate through the pages.

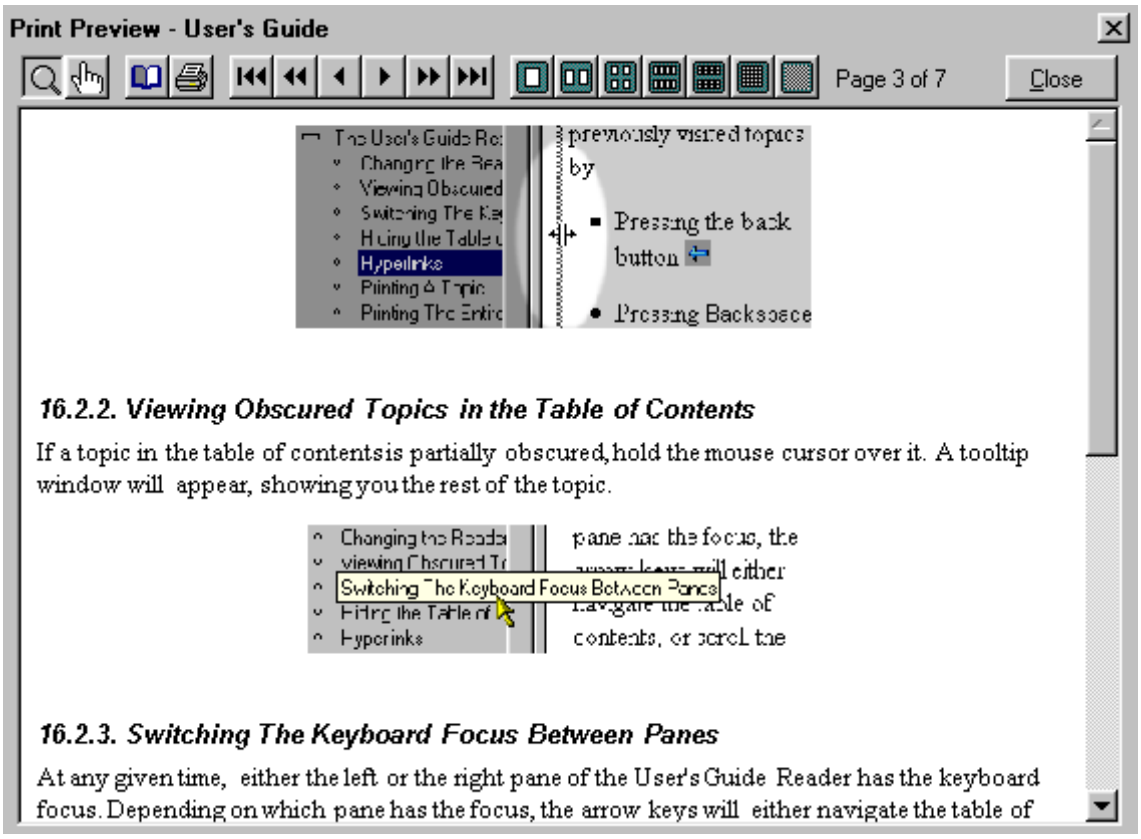
Button	Key	Description
▶	→	Go forward to next page
◀	←	Go back to previous page
▶▶	Page Down	Go forward to next group of pages
◀◀	Page Up	Go back to previous group of pages
▶▶|	End	Go to last page
|◀◀	Home	Go to first page

16.2. Magnifying a Page

You can magnify a page to study it in detail. Follow these steps.

1. Press the Magnify toolbar button 🔍. This activates the Magnify Page tool.

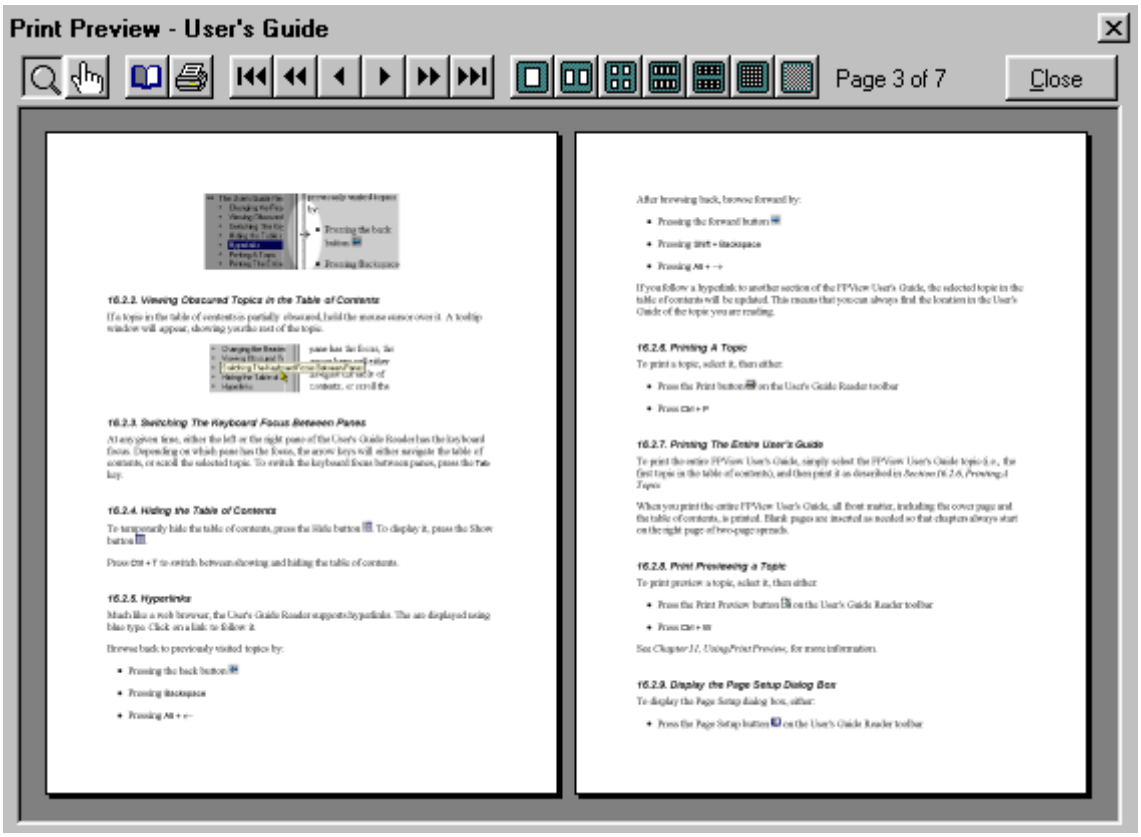
2. Click on a page. The page is magnified so that it fills the print preview window.



3. Click on the page a second time to return it to its normal size. Alternatively, press the - key.

16.3. Displaying Multiple Pages at a Time

You can display 1, 2, 4, or more pages simultaneously.



Use either the toolbar buttons or the keyboard to change the number of pages simultaneously displayed.

Button	Key	Description
	Ctrl + 1	Show 1 page at a time
	Ctrl + 2	Show 2 page at a time
	Ctrl + 3	Show 4 page at a time
	Ctrl + 4	Show 8 page at a time
	Ctrl + 5	Show 16 page at a time
	Ctrl + 6	Show 32 page at a time
	Ctrl + 7	Show 64 page at a time

Press the + key to decrease the number of pages displayed simultaneously. Press the - key to increase the number of pages displayed simultaneously.

Note:

The functions of the + and - keys may seem backwards to you. To help remember the meanings of these two keys, note that the + key makes each page bigger. Indeed, if you press the + key when only a single page is displayed, that page is magnified.

16.4. Printing All Pages

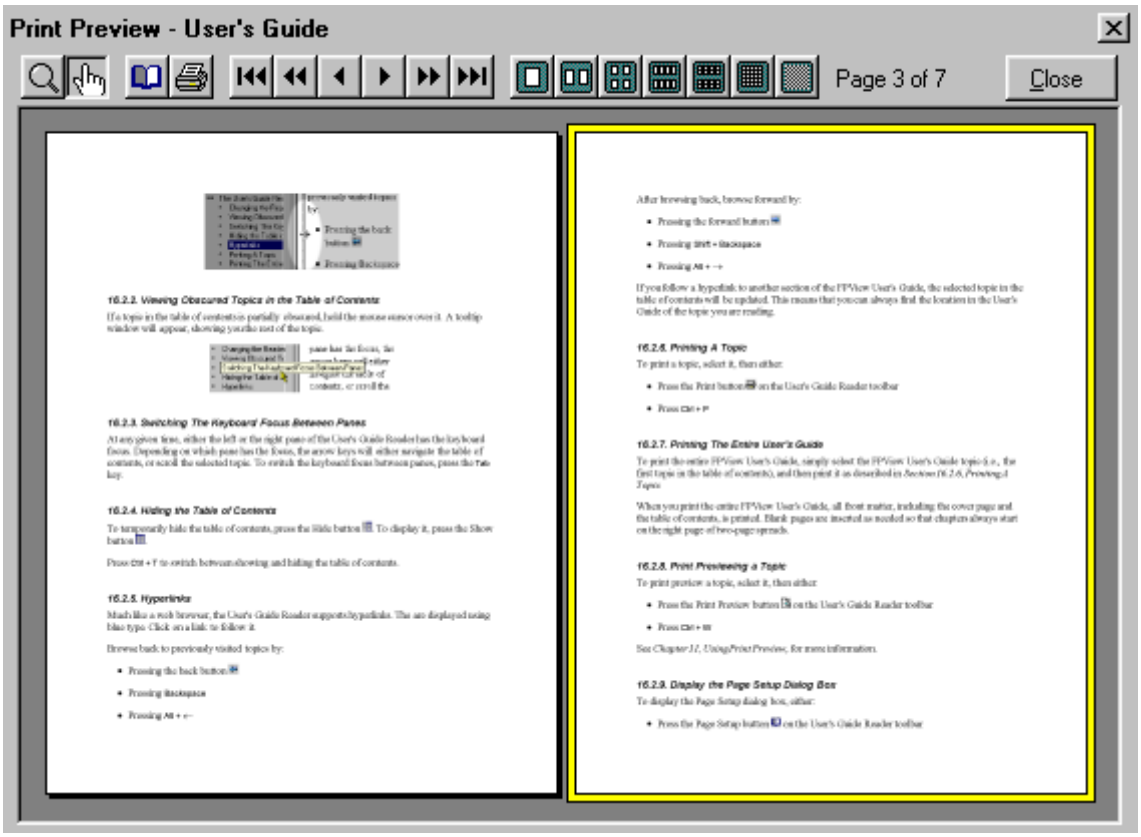
To print all pages from the print preview window, follow these steps.

1. Display the Print dialog box by either:
   - Pressing the Print button  on the print preview toolbar
   - Pressing Ctrl + P
2. In the Page Range section of the Print dialog box, choose All. Then press the OK button.

16.5. Selecting Pages to Print

To print a subset of the pages in the print preview window, follow these steps.

1. Press the Page Selection toolbar button  . This activates the Page Selection tool.
2. Click on the pages you want to print. A border will appear around the pages you select.



Click on a selected page a second time to deselect it.

To select a range of pages, click on the first page in the range, then Shift + click (i.e., click while holding down the Shift key) on the last page in the range.

To deselect a range of pages, click on the first page in the range, then Ctrl + click (i.e., click while holding down the Ctrl key) on the last page in the range.

3. Display the Print dialog box by either:

   - Pressing the Print button on the print preview toolbar
   - Pressing Ctrl + P

4. In the Page Range section of the Print dialog box, choose Selection. Then press the OK button.

16.6. Changing the Paper Margins and Orientation

Display the Page Setup dialog box by either:

- Pressing the Page Setup button  on the print preview toolbar
- Pressing Ctrl + Shift + P

Microsoft Window's standard Page Setup dialog box lets you select the paper orientation (portrait or landscape) and page margins of your printer. The exact appearance of this dialog box will vary, depending on the version of Windows you are using. Familiarity with this dialog box is assumed.

16.7. Closing the Print Preview Dialog Box

To close the Print Preview dialog box, you can:

- Press the Close button
- Press the Esc key

Chapter 17

Exporting Plots to a Geographic Information System

NMPlot allow you to export plots to a Geographic Information System (GIS) in the following formats.

- ARC/INFO Shapefile (SHP)
- AutoCAD Data Exchange Format (DXF)

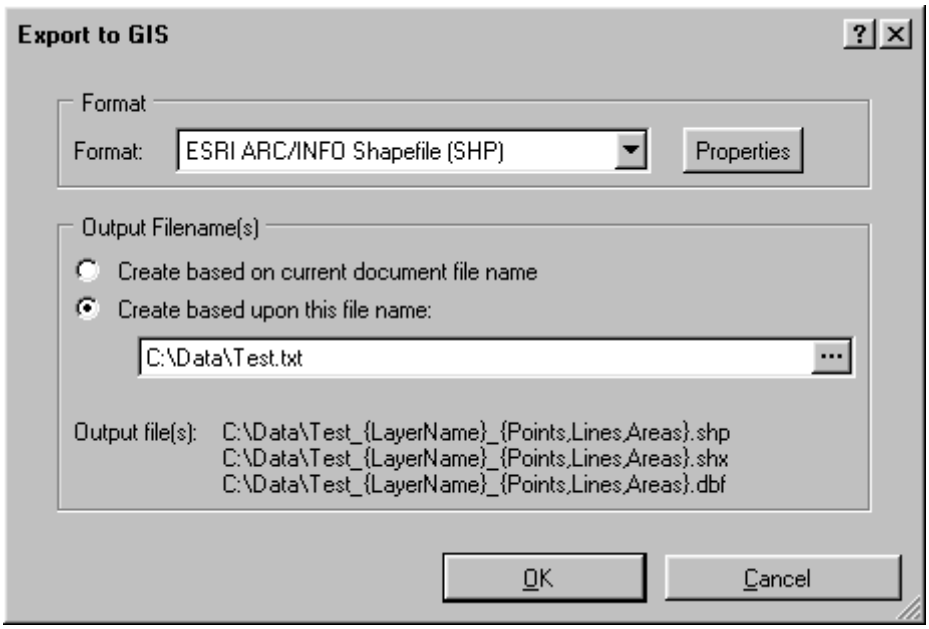
Warning:

Use the AutoCAD DXF format as a last resort, only if no alternative is available. DXF is a poorly-documented format, which results in different applications interpreting the same DXF file in different ways. You can expect fewer problems using another format, such as ARC/INFO Shapefile.

17.1. Export to GIS Dialog Box

To export a plot to a Geographic Information System (GIS), follow these steps.

1. Choose Export to GIS from the File menu. The Export To GIS dialog box appears.



2. *Format* - Select the GIS format that you want to use to export the plot. Press the Properties button to display the GIS Export Options dialog box, which allows you to set the export options associated with the selected format.

3. *Output Filename(s)* - Specify the name(s) of the file(s) that the exported plot will be written to. Depending on the export format, more than one file may be created. You specify a *base file name*. The names of all output files are constructed from this base name by changing the extension and/or adding a suffix.

   At the bottom of the box labeled Output Filename(s), the files that will be created are listed, based upon your current selections for the export format and the base file name.

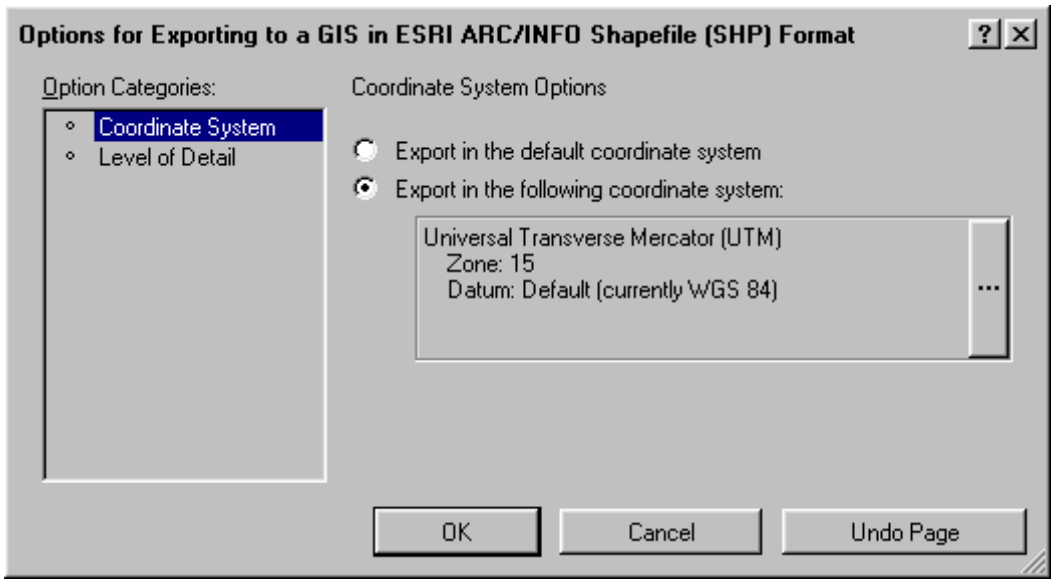
   Select the method used to specify the base file name. You have two choices.

   - *Create based on current document file name* - The name of the plot (.nmp) file you are exporting will be used as the base file name.

   - *Create based upon this file name* - Type the base file name in the box provided. Press the Browse button ..., located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file.

17.2. GIS Export Options Dialog Box

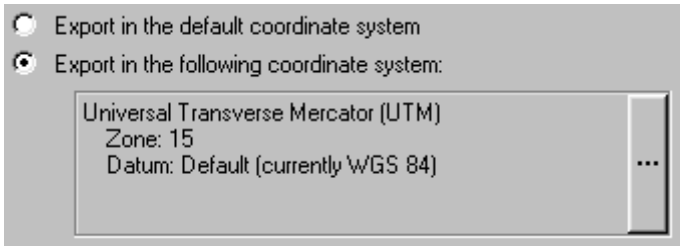
Use the GIS Export Options dialog box to control how a plot is exported to a GIS.



The GIS Export Options dialog box is a Multiple Page dialog box. See *Section B.2, Multiple Page Dialog Boxes*, for more information. The pages on this dialog box vary, depending on which GIS format you selected.

17.2.1. Coordinate System Page

Use the Coordinate System page of the GIS Export Options dialog box to select the coordinate system that coordinates are exported in.

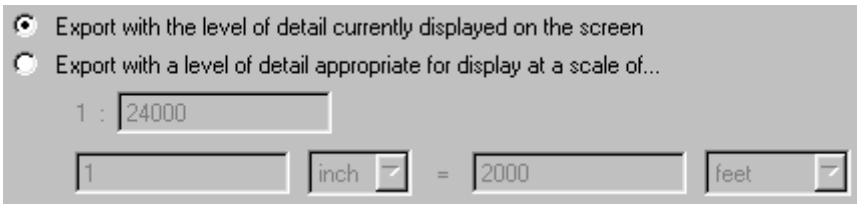


Choose *Export in the default coordinate system* to use the primary grid's coordinate system.

Choose *Export in the following coordinate system* to specify a coordinate system. See *Section 20.1, Coordinate System Control*.

17.2.2. Level of Detail Page

Use the Level Of Detail page of the GIS Export Options dialog box to control how much background map detail is exported.



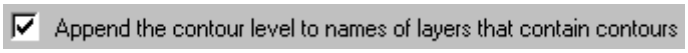
Many background maps specify a minimum scale at which various features should be displayed. As you zoom in on such a map, additional detail is displayed. The intent is to prevent excessive detail from cluttering a plot when it is displayed at a small scale. See *Chapter 14, Background Map Formats*.

Use the Level of Detail page to control how NMPlot uses this recommended scale information when you export a plot to a GIS. You have two choices for how NMPlot determines how much detail to export.

- *Export with the level of detail currently displayed on the screen* - The level of detail is the same as that currently displayed by the plot on your computer's monitor.
- *Export with a level of detail appropriate for display at a scale of* - The level of detail is the same as if the plot was displayed at a scale you specify.

17.2.3. Contours Page

Use the Contours page of the GIS Export Options dialog box to control how contours are exported.



Most GIS formats allow attributes to be associated with objects. When exporting contours in one of these formats, the contours' levels are associated with the contours as attributes.

The DXF format does not support attributes. However, it does support named layers. If you check this box, NMPlot will export each contour in a separate layer. The name of each of these layers is created by taking the contour layer name and appending the contour's level to it.

Note:

This page appears on the GIS Export Options dialog box only if you are exporting to a GIS in AutoCAD DXF format.

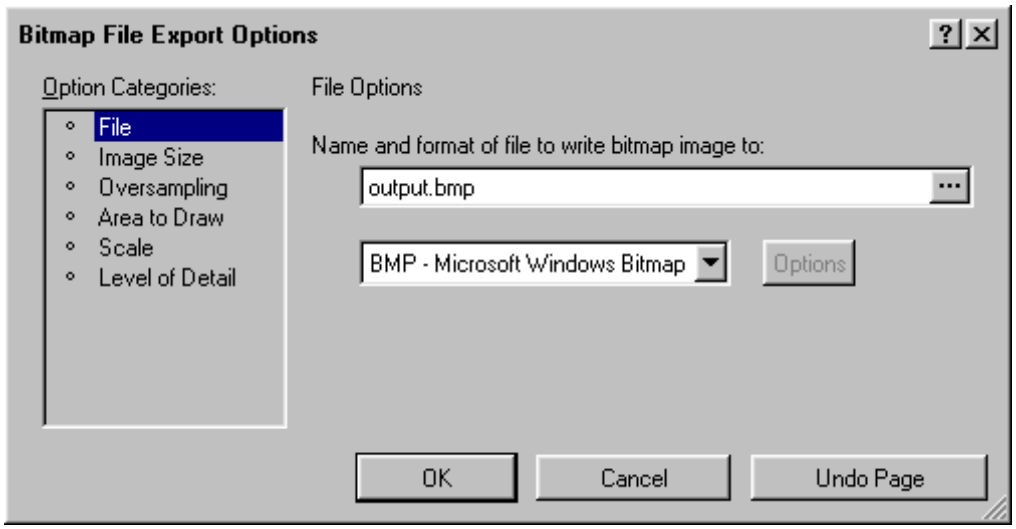
Chapter 18

Exporting Plots as Bitmap Images

Using NMPlot, you can create a bitmap image of a plot. The image can be stored in a file or copied onto the clipboard. More than a mere screen capture, the image can be created at a high resolution (for example, 600 pixels per inch), resulting in a publication-quality image. For low-resolution plots that will be displayed on a computer monitor, you can use oversampling to improve the plot's appearance.

18.1. Exporting a Plot to a Bitmap Image File

To export a plot to a bitmap image file, choose Export to Bitmap from the File menu. The Bitmap File Export Options dialog box appears.



The Bitmap File Export Options dialog box is a Multiple Page dialog box. See *Section B.2, Multiple Page Dialog Boxes*, for more information.

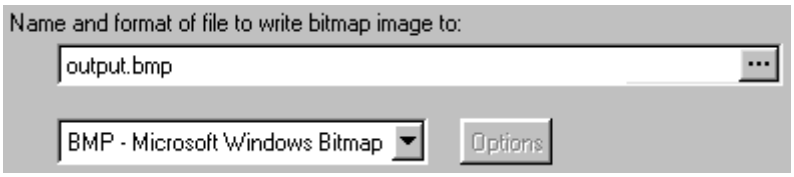
18.2. Copying a Plot to the Clipboard

To copy a bitmap image of a plot onto the clipboard, choose Copy from the Edit menu, or press Ctrl + C. The Clipboard Copy Options dialog box appears. This dialog box is identical to the Bitmap File Export Options dialog box, with the exception that the page used to specify the destination file and format is not present.

In this chapter, only the Bitmap File Export Options dialog box will be discussed. Keep in mind, however, that the options described also apply when a plot is copied to the clipboard.

18.3. Destination File Name and Format

Use the File page of the Bitmap File Export Options dialog box to set the name and format of the file where the bitmap image is written.



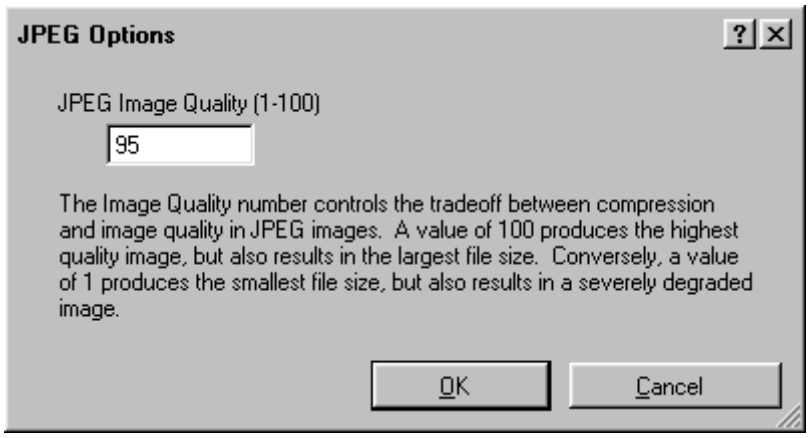
In the box provided, type the name of file where the bitmap image will be written. Press the Browse button ..., located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file.

Select the image format of the file. You have the following choices.

- BMP - Microsoft Windows Bitmap Format
- JPG - JPEG Format
- TIF - Tagged Image File Format (TIFF)
- PNG - Portable Network Graphics Format

18.3.1. JPEG Options

If you select the JPEG format, the Options button will be available. Press it to display the JPEG Options dialog box.



Type the image quality number, an integer between 1 and 100. The Image Quality number controls the tradeoff between compression and image quality in JPEG images. A value of 100 produces the highest quality image, but also results in the largest file size. Conversely, a value of 1 produces the smallest file size, but also results in a severely degraded image.

18.3.2. Selecting an Image Format

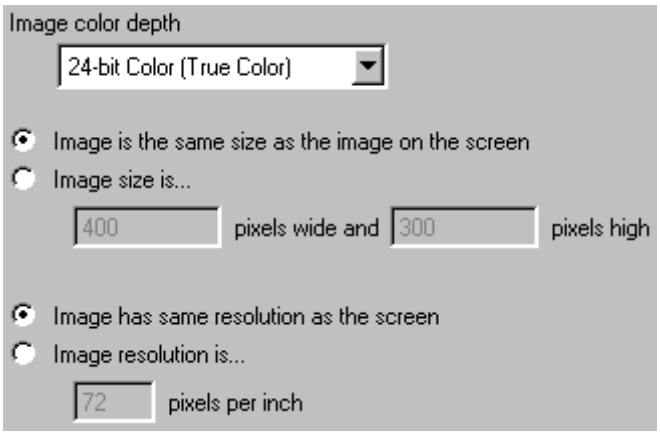
The JPEG format is intended for storing photographs. Most plots are line images, so one of the other image formats will usually be a better choice. However, if your plot has areas of smoothly-changing color (for example, a color gradient plot), JPEG will be the best format.

Neither the BMP nor the TIFF formats are compressed, so they will produce large files. However, both are very common formats. The BMP format, in particular, is very well supported on the Microsoft Windows platform. If you intend to import your image into another program, the BMP format is an excellent choice.

If you intend to archive the image, or display it on the web, the PNG format is a good choice. It achieves high compression on most plots (not color gradient plots, however). It is a newer format than the others, but most applications (and in particular, most web browsers) now support it.

18.4. Image Size

Use the Image Size page of the Bitmap File Export Options dialog box to select the size, resolution, and color depth of the bitmap image you will export your plot to.



18.4.1. Image Color Depth

Select the color depth of the bitmap image. This is the maximum number of colors in the bitmap. You have the following choices.

- *24-bit Color (True Color)* - Each pixel in the bitmap requires 24 bits (3 bytes) of memory. The bitmap can display over 16,000,000 colors. It is recommended that 24-bit color be used when exporting color gradient plots.

- *8-bit Color, Optimized Palette* - Each pixel in the bitmap requires 8 bits (1 byte) of memory. The bitmap can display 256 colors. The 256 colors are selected so that they best represent the colors in your plot. This color depth requires one-third the memory of 24-bit color. Many plots can be reduced to 256 colors with little loss in quality.

- *8-bit Color, Web Palette* - Each pixel in the bitmap requires 8 bits (1 byte) of memory. The bitmap can display 256 colors. The 256 colors are those that all web browsers can display without dithering. This color depth requires one-third the memory of 24-bit color, but the image quality can be poor unless you carefully select the colors in your plot.

- *8-bit Grayscale* - Each pixel in the bitmap requires 8 bits (1 byte) of memory. The bitmap can display 256 shades of gray. This color format is useful if the bitmap will be printed on black-and-white laser printers.

18.4.2. Image Size

Select the method used to specify the dimensions of the bitmap image (i.e., the width and height of the bitmap, in pixels) that your plot will be exported to. You have two choices.

- *Image is the same size as the image on the screen* - The bitmap image has the same dimensions (in pixels) as the portion of the screen currently used to display the plot.

- *Image size is* - Type the width and height of the bitmap image, in pixels.

Caution:

Your computer's memory limits the maximum size and color depth of an export bitmap image. If your computer takes an exceptionally long time to export a plot to a bitmap, you may not have enough memory. This is especially true if your hard drive light stays on constantly while creating the image. Try reducing the image's size and/or color depth.

The image's resolution does not affect the amount of memory used.

18.4.3. Image Resolution

The resolution of a bitmap measures the size of the pixels. It is typically expressed in pixels per inch or pixels per centimeter.

As an example, assume that your plot has features that are drawn with 1-millimeter-wide lines. If you export this plot to a bitmap image with a resolution of 100 pixels per centimeter, these lines will be 10 pixels wide.

Computer monitors typically have a resolution of 70 to 90 pixels per inch. Laser printers typically have a resolution of 600 to 1200 pixels per inch.

Select the method used to specify the image resolution. You have two choices.

- *Image has same resolution as the screen*
- *Image resolution is* - Type the resolution, in pixels per inch.

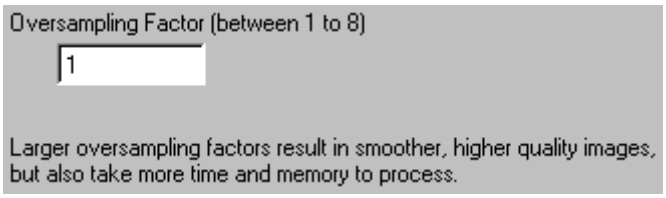
18.5. Oversampling

NMPlot can use oversampling to improve the appearance of low-resolution plots. Oversampling reduces jagged edges. In technical terms, it antialiases your entire plot.

The amount of oversampling is controlled by the *oversampling factor*, an integer between one and eight. An oversampling factor of one means that oversampling is not performed. Higher factors result in smoother, higher-quality images, but also dramatically increase the amount of memory required to export a plot.

Oversampling Factor = 1 **Oversampling Factor = 2** **Oversampling Factor = 6**

Use the Oversampling page of the Bitmap File Export Options dialog box to set the oversampling factor used when exporting a plot to a bitmap image.



Type the oversampling factor in the box provided.

When using oversampling, you should choose 24-bit true color or 8-bit grayscale color for your image. See *Section 18.4.1, Image Color Depth*.

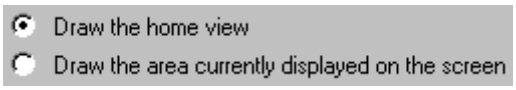
Caution:

Oversampling dramatically increases the amount of memory needed to export a plot to a bitmap image. The amount of memory required is proportional to the square of the oversampling factor.

Until you gain familiarity with your computer's capabilities, it is recommended that you initially export your plot with a low oversampling factor, and then attempt to export it with gradually increasing factors. If your computer takes an exceptionally long time to export a plot, you may not have enough memory. This is especially true if your hard drive light stays on constantly while exporting. Try reducing the oversampling factor.

18.6. Area to Draw

Use the Area To Draw page of the Bitmap File Export Options dialog box to select the portion of your plot that is drawn on the exported bitmap image.



Select the area to draw. You have two choices.

- *Draw the home view* - The home view of the plot is drawn. See *Section 8.4, The Home View*, for more information about the home view.
- *Draw the area currently displayed on the screen* - The portion of the plot currently displayed on your computer's monitor is drawn. If you want to export only a small portion of your plot, zoom in on that section, then export the plot, choosing to draw the area currently displayed on the screen.

Note:

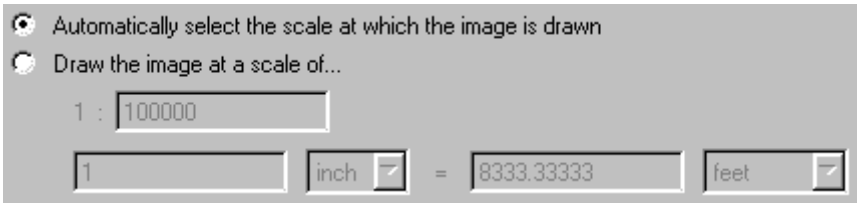
If the Area to Draw is not the same shape as the export bitmap image (i.e., if the aspect ratios are different), the area drawn will be larger that the area requested. See the note in *Section 15.3.2, Area to Print*, for more information.

Note:

If you export a plot to scale, NMPlot attempts to display the Area To Draw at the requested scale. If the requested scale is too large, this area will not fit on the bitmap image. In this case, you have four options: 1) choose a smaller scale, 2) choose a smaller Area To Draw, 3) increase the size of the bitmap image, or 4) decrease the resolution of the bitmap image.

18.7. Scale

Use the Scale page of the Bitmap File Export Options dialog box to set the scale at which your plot is drawn on the export bitmap image.



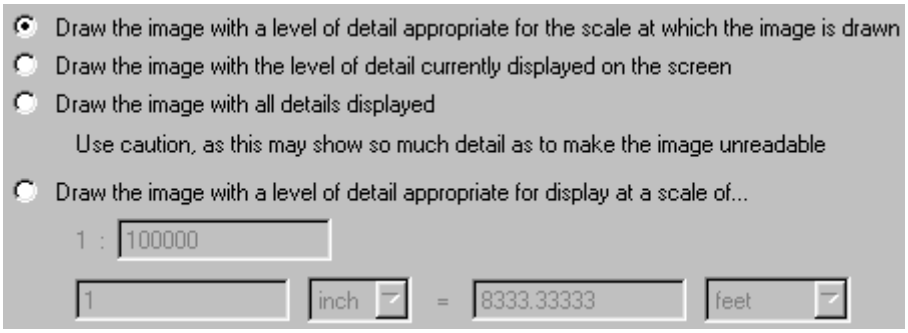
Select how the scale is determined.

- *Automatically select the scale at which the image is drawn* - NMPlot selects a scale so that the plot's area of interest just fills the export bitmap image. The area of interest is specified on the Area To Draw page. See *Section 18.6, Area to Draw*.

- *Draw the image at a scale of* - Specify the scale at which the plot is drawn on the export bitmap image.

18.8. Level of Detail

Use the Level Of Detail page of the Bitmap File Export Options dialog box to control how much background map detail is displayed when you export your plot as a bitmap image.



Many background maps specify a minimum scale at which various features should be displayed. As you zoom in on such a map, additional detail is displayed. The intent is to prevent excessive detail from cluttering a plot when it is displayed at a small scale. See *Chapter 14, Background Map Formats*.

Use the Level of Detail page to control how NMPlot uses this recommended scale information when you export your plot as a bitmap image. You have four choices for how NMPlot determines how much detail to display.

- *Draw the image with a level of detail appropriate for the scale at which the image is drawn* - Any recommended scale information in the background map is used.

- *Draw the image with the level of detail currently displayed on the screen* - The level of detail is the same as that currently displayed by the plot on your computer's monitor.

- *Draw the image with all details displayed* - Any recommended scale information in the background map is ignored.

Caution:

This may display so much background map detail as to make the exported image illegible.

- *Draw the image with a level of detail appropriate for display at a scale of* - The level of detail is the same as if the plot was being exported at a scale you specify.

Chapter 19

Creating Movies

Using NMPlot, you can create a movie from a group of grid files. The movie's frames consist of plots of your grid files.

As an example, consider the high temperature on January 1 of last year, as measured at a number of cities across the United States. You could make a grid file containing these measurements, and then use NMPlot to create a contour plot of the temperatures, displayed over a background map of the United States. This plot would show you the distribution of high temperatures on January 1.

Now assume that you have 365 of these grid files, each corresponding to a single day of last year. Using NMPlot, you could create a movie from these grids. This movie would display the plot of high temperatures mentioned in the previous paragraph. Only now, the plot would be animated. The contours would move, and you could see how the high temperatures varied throughout the year.

19.1. Steps in Creating a Movie

To make a movie, follow these steps.

1. Create grid files from your data. See *Appendix G, Quick-Start Guide to Importing Data into NMPlot*, *Chapter 4, Introduction to Grids*, and *Appendix F, Introduction to the Noise Model Grid Format*, for information on creating grid files.

   All of the grid files must be located in the same directory, and must have identical file names, with the exception of a number just before the extension at the end of the file name. For example, the following list of grid file names would meet these conditions.

   - `C:\temp\MyData1.grd`
   - `C:\temp\MyData2.grd`
   - `C:\temp\MyData3.grd`

The movie will display plots of your grid files, ordered by the numbers at the end of the grids' file names. Leading zeros in the file names (MyData**00**9.grd, MyData**0**10.grd, MyData**0**11.grd) are allowed but not required.

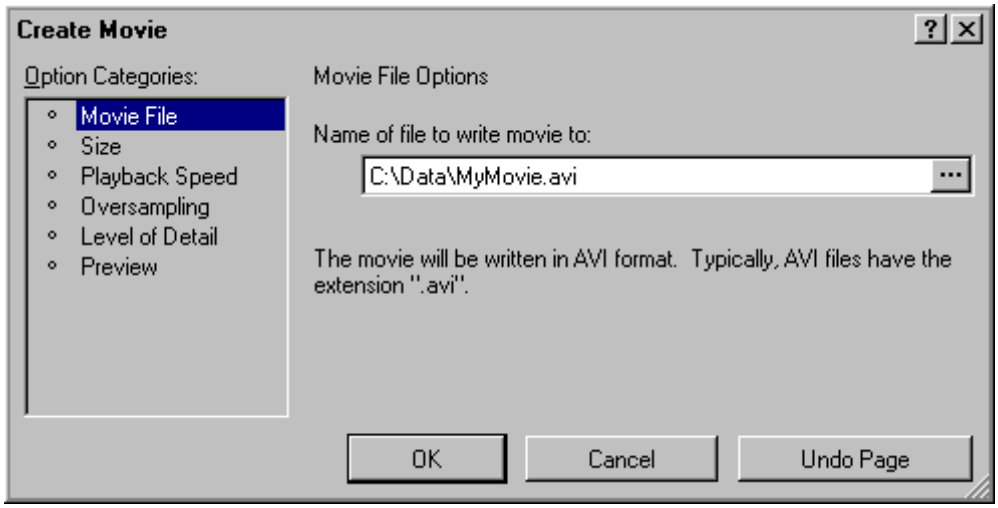
2. Create a plot of one of the grids (it does not matter which one). Set all plot options (contour levels, background maps, etc.) as desired. See *Chapter 7, Introduction to Plots*.

Tip:

Pay particular attention to the plot's home view. By default, the home view displays the area covered by the largest contour. This works well for a single plot. However, for movies where the contours move, such a home view may cause the plot's background to also move. This can be distracting.

For best results, set the home view to the primary grid and/or the define area polygon. Or, manually specify the home view. See *Section 8.4, The Home View*, for more information.

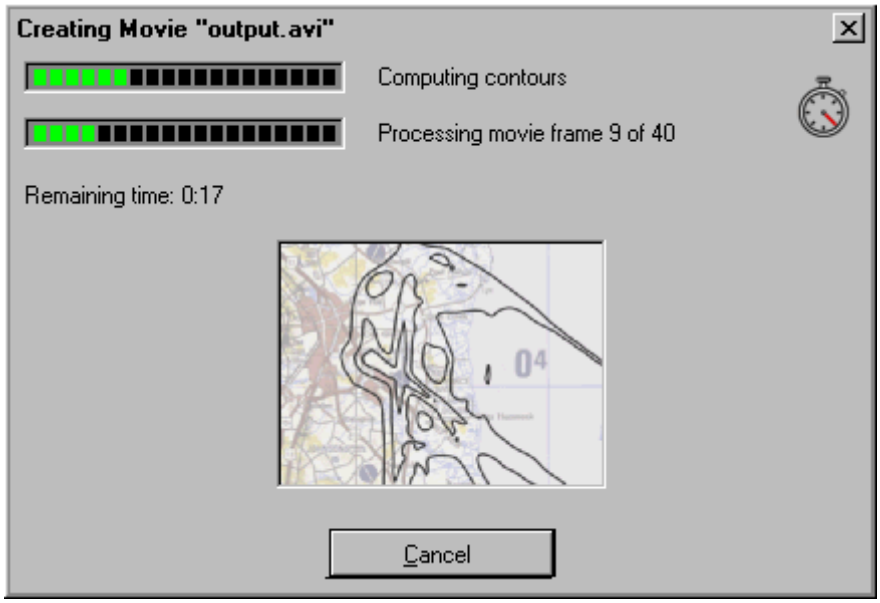
3. Choose Create Movie from the File menu. The Create Movie dialog box appears.



The Create Movie dialog box is a Multiple Page dialog box. See *Section B.2, Multiple Page Dialog Boxes*, for more information.

Set the various movie options as desired, and then press the OK button.

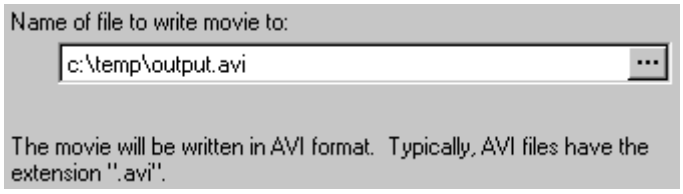
4. NMPlot begins creating the movie. Depending on the options you selected, this can take anywhere from a few seconds to a few hours. A dialog box is displayed that shows NMPlot's progress.



When the movie is finished, this dialog box disappears. The movie will be in the AVI file whose name you specified on the Movie File page of the Create Movie dialog box. You can display the movie using any third-party multimedia application capable of playing AVI files (for example, Microsoft Media Player). You can also post the movie on the Internet, or load it into a third-party movie editing program for editing.

19.2. Movie File

Use the Movie File page of the Create Movie dialog box to set the name of the file where your movie will be written.

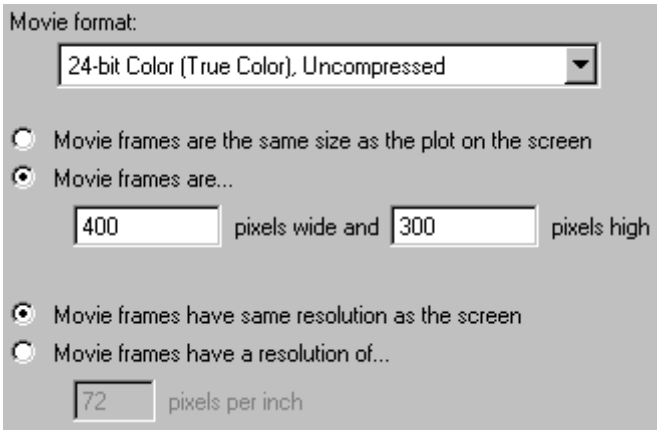


In the box provided, type the name of file where your movie will be written. Press the Browse button  , located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file.

Your movie will be written as an AVI file. Typically, AVI files have the extension `.avi`.

19.3. Size

Use the Size page of the Create Movie dialog box to select the size, resolution, and format of the frames in your movie.



19.3.1. Movie Format

Select the format of the frames in your movie. This is a combination of the color depth (the maximum number of colors in each frame) and the compression method. You have the following choices.

- *24-bit Color (True Color), Uncompressed* - Each frame pixel requires 24 bits (3 bytes) of memory. Frames can display over 16,000,000 colors. No compression is used. It is recommended that this format be used if your movie displays a color gradient plot.
- *8-bit Color, Optimized Palette, Uncompressed* - Each frame pixel requires 8 bits (1 byte) of memory. Frames can display 256 colors. No compression is used.
- *8-bit Color, Optimized Palette, Compressed with RLE* - Each frame pixel requires 8 bits (1 byte) of memory. Frames can display 256 colors. Frames are compressed using Run Length Encoding (RLE). This format will usually result in the smallest movie file.
- *8-bit Grayscale, Uncompressed* - Each frame pixel requires 8 bits (1 byte) of memory. Frames can display 256 shades of gray. No compression is used.
- *8-bit Grayscale, Compressed with RLE* - Each frame pixel requires 8 bits (1 byte) of memory. Frames can display 256 shades of gray. Frames are compressed using Run Length Encoding (RLE).

19.3.2. Movie Frame Size

Select the method used to specify the dimensions of the frames in your movie (i.e., the width and height of your movie, in pixels). You have two choices.

- *Movie frames are the same size as the plot on the screen* - Your movie has the same dimensions (in pixels) as the portion of the screen currently used to display the plot that this movie is based upon.
- *Movie frames are* - Type the width and height of your movie, in pixels.

19.3.3. Movie Frame Resolution

The resolution of a movie frame measures the size of the pixels. It is typically expressed in pixels per inch or pixels per centimeter.

As an example, assume that your movie has features that are drawn with 1-millimeter-wide lines. If your movie has a resolution of 100 pixels per centimeter, these lines will be 10 pixels wide.

Movies typically have the same resolution as computer monitors: i.e., 70 to 90 pixels per inch.

Select the method used to specify the resolution. You have two choices.

- *Movie frames have same resolution as the screen*
- *Movie frames have a resolution of* - Type the resolution, in pixels per inch.

19.4. Playback Speed

Use the Playback Speed page of the Create Movie dialog box to set the rate at which your movie should be displayed.

In the box provided, type the speed at which your movie should be played, in frames per second. Typical speeds are between 8 and 36 frames per second.

Divide the total number of frames in your movie (i.e., the number of grid files) by the playback speed to determine the total length of your movie, in seconds.

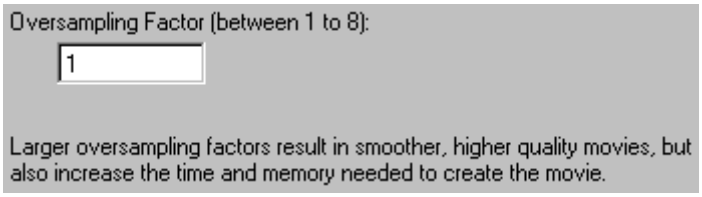
19.5. Oversampling

NMPlot can use oversampling to improve the appearance your movie. Oversampling reduces jagged edges. In technical terms, it antialiases your movie's frames.

The amount of oversampling is controlled by the *oversampling factor*, an integer between one and eight. An oversampling factor of one means that oversampling is not performed. Higher factors result in smoother, higher-quality movies, but also dramatically increase the amount of memory required to create them.

Oversampling Factor = 1 **Oversampling Factor = 2** **Oversampling Factor = 6**

Use the Oversampling page of the Create Movie dialog box to set the oversampling factor used when creating your movie.



Type the oversampling factor in the box provided.

When using oversampling, you should choose 24-bit true color or 8-bit grayscale color for your movie's color depth. See *Section 19.3.1, Movie Format*.

Caution:

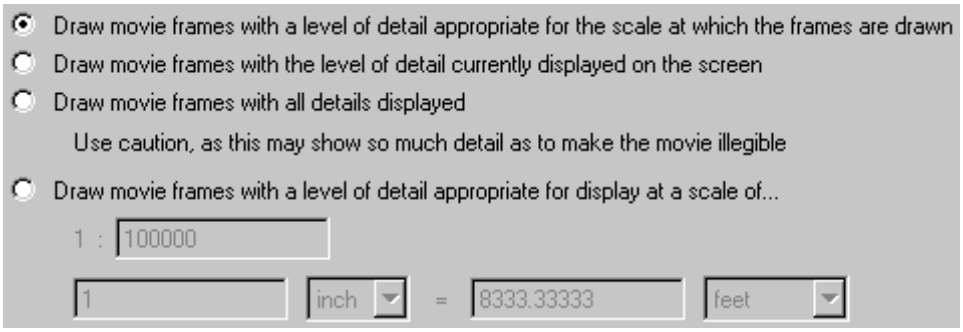
Oversampling dramatically increases the amount of memory needed to create your movie. The amount of memory required is proportional to the square of the oversampling factor.

Until you gain familiarity with your computer's capabilities, it is recommended that you initially create your movie using a low oversampling factor, and then attempt to create it

with gradually increasing factors. If your computer takes an exceptionally long time to create your movie, you may not have enough memory. This is especially true if your hard drive light stays on constantly. Try reducing the oversampling factor.

19.6. Level of Detail

Use the Level of Detail page of the Create Movie dialog box to control how much background map detail is displayed in your movie.



Many background maps specify a minimum scale at which various features should be displayed. As you zoom in on such a map, additional detail appears. The intent is to prevent excessive detail from cluttering a plot when it is displayed at a small scale. See *Chapter 14, Background Map Formats*.

Use the Level of Detail page to control how NMPlot uses this recommended scale information when you create your movie. You have four choices for how NMPlot determines how much detail to display.

- *Draw movie frames with a level of detail appropriate for the scale at which the frames are drawn* - Any recommended scale information in the background map is used.
- *Draw movie frames with the level of detail currently displayed on the screen* - The level of detail is the same as that currently displayed by the plot on your computer's monitor.
- *Draw movie frames with all details displayed* - Any recommended scale information in the background map is ignored.

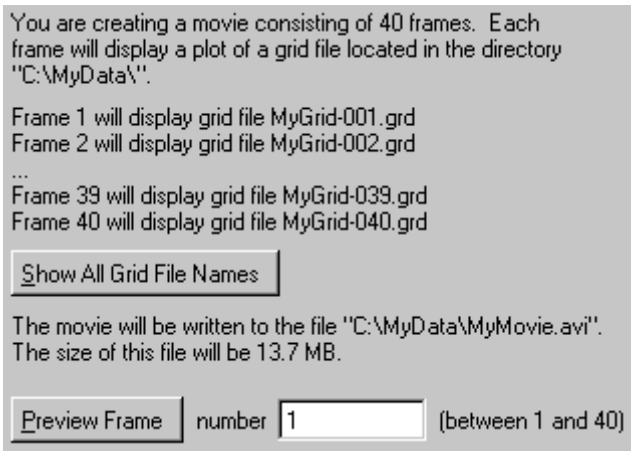
Caution:

This may display so much background map detail as to make your movie illegible.

- *Draw movie frames with a level of detail appropriate for display at a scale of* - Your movie is created with a level of detail appropriate for the scale you specify.

19.7. Preview

Use the Preview page of the Create Movie dialog box to see a summary of the options that will be used to create your movie, and to preview selected frames.



The text presents a brief summary of the movie that will be created. This summary includes a listing of grid files associated with the first and last frames in the movie. To see a full listing of the grids files that will be used, press the Show All Grid File Names button.

Important:

Pay particular attention to the size of the AVI movie file that will be created. Movies can be very large: ensure that you have enough free hard disk space to hold the movie. Also, the AVI file must be smaller than 1.96 Gigabytes: a warning will be displayed if this limit may be exceeded.

To preview a frame from your movie, type the frame number in the box provided, then press the Preview Frame button. The requested frame will be displayed. There may be a delay before the frame appears.

Tip:

Movies can take a long time to create. Therefore, you should preview a representative sampling of your movie's frames to insure that you are satisfied with the options you have selected.

Chapter 20

Geographic Coordinate Systems

The location of a point on the Earth's surface can be numerically described in a number of ways. Examples include:

- the longitude and latitude of the point (100.5° west, 45.3° north)
- the location with respect to another known point (500 feet northwest of the Empire State Building)
- the Universal Transverse Mercator coordinates of the point (715,326.1 meters east, 5,037,295.1 meters north, UTM zone 15)

Each of these methods of describing a location is known as a *geographic coordinate system*. When working with maps, the term *projection* is also commonly used. While there are technical differences, for most practical purposes, you can consider the terms "coordinate system" and "projection" as synonymous.

NMPlot allows you to use a number of common coordinate systems when working with geographic data. The supported coordinate systems are:

- Equirectangular
- Lambert Azimuthal Equal Area
- Lambert Conformal Conic
- Local Flat-Earth X-Y
- Longitude and Latitude
- Orthographic
- Stereographic

- Universal Transverse Mercator (UTM)

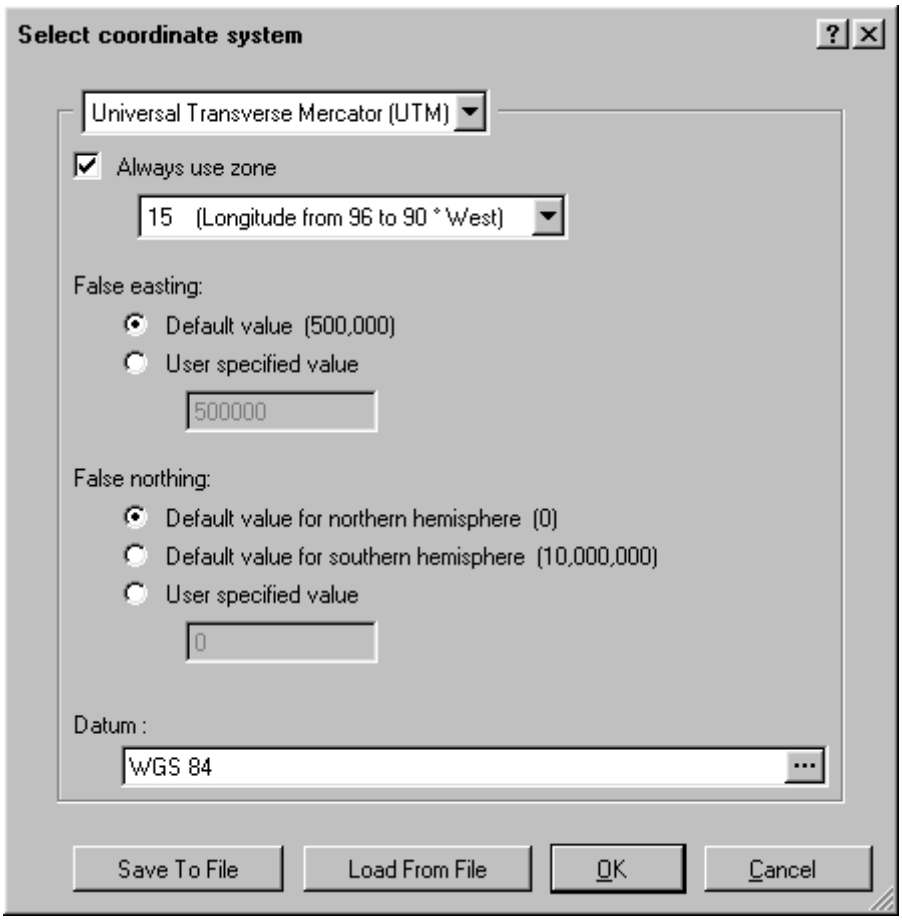
For additional information about coordinate systems, the following references are recommended.

- *An Album of Map Projections*, U.S. Geological Survey Professional Paper 1453, by John P. Snyder and Philip M. Voxland, United States Government Printing Office, 1989.
- *Map Projections—A Working Manual*, U.S. Geological Survey Professional Paper 1395, by John P. Snyder, United States Government Printing Office, 1987.

20.1. Coordinate System Control

A Coordinate System Control is used to select a geographic coordinate system.

The current coordinate system is displayed in the box. To change it, either press the Space Bar, or press the Select Coordinate System button  . The Select Coordinate System dialog box is displayed.



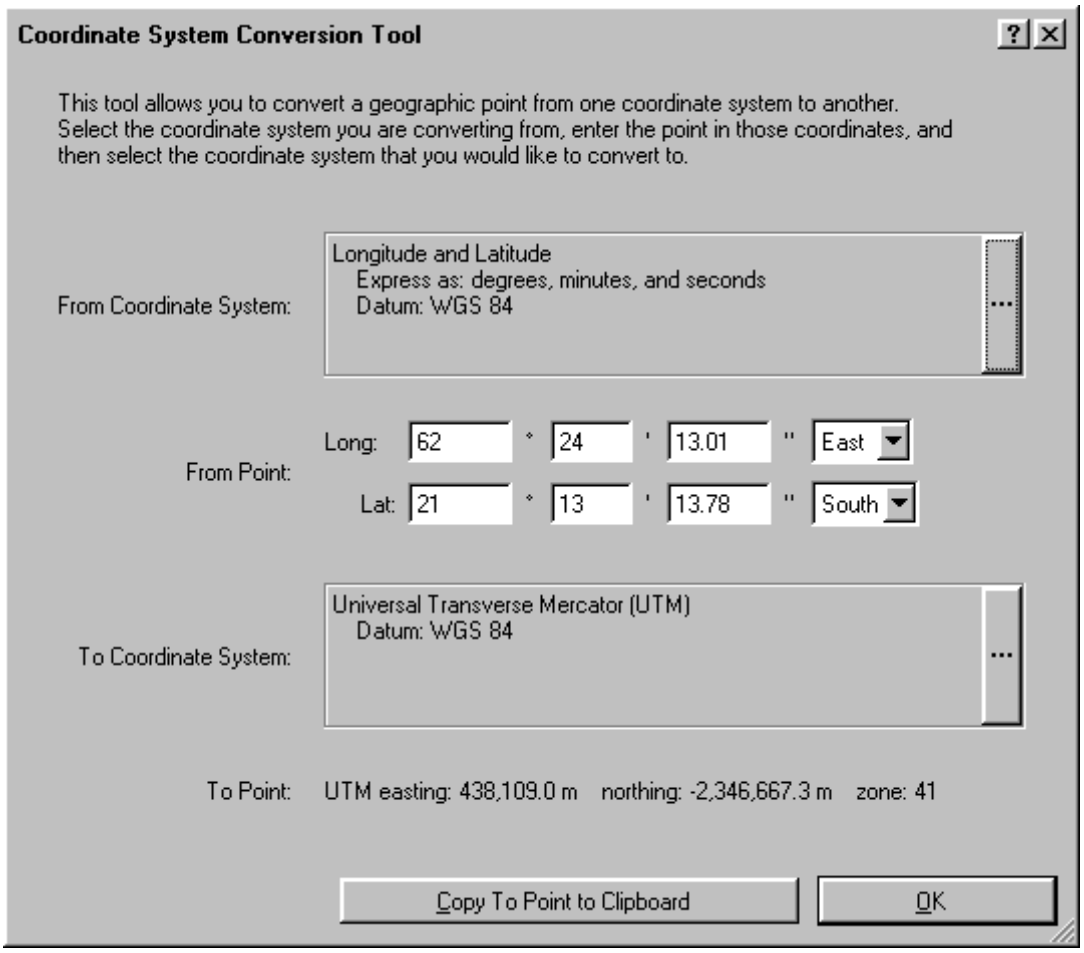
Use the drop-down list at the top of the outlined area to select the coordinate system. Then supply values for the selected system's parameters.

Some coordinate systems have numerous parameters, which can be tedious to enter. Therefore, NMPlot allows you to save coordinate systems to files for later reuse. Press the Save To File button to save the current coordinate system to a file. Press the Load From File button load a previously saved coordinate system.

20.2. Coordinate System Conversion Tool

The coordinate system conversion tool allows you to convert a point's coordinates from one geographic coordinate system to another. To use the tool, follow these steps.

1. Choose Coordinate System Conversion Tool from the Tools menu. The Coordinate System Conversion Tool dialog box appears.



2. *From Coordinate System* - Select the geographic coordinate system that you are converting from. See *Section 20.1, Coordinate System Control*, for information on selecting a coordinate system.

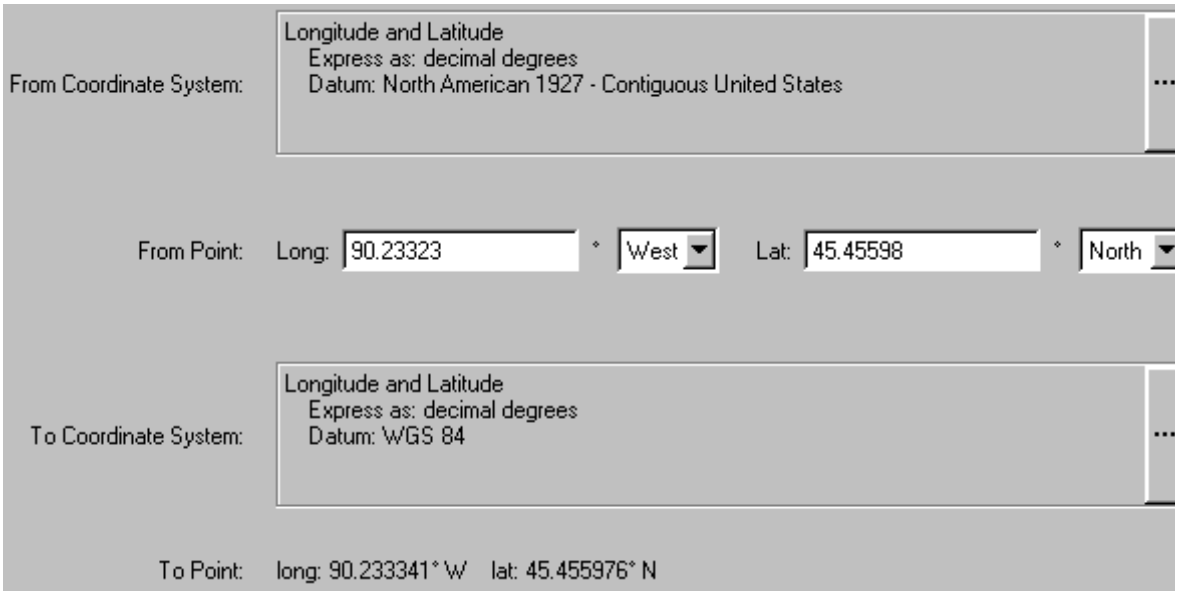
3. *From Point* - Specify the geographic coordinates of the point in the coordinate system you are converting from. The controls available for entering the point will vary, depending on the From coordinate system.

4. *To Coordinate System* - Select the geographic coordinate system that you are converting to. See *Section 20.1, Coordinate System Control*, for information on selecting a coordinate system.

5. *To Point* - The geographic coordinates of the point, expressed in the To coordinate system, are displayed. Press the "Copy To Point to Clipboard" button to put this text onto the clipboard.

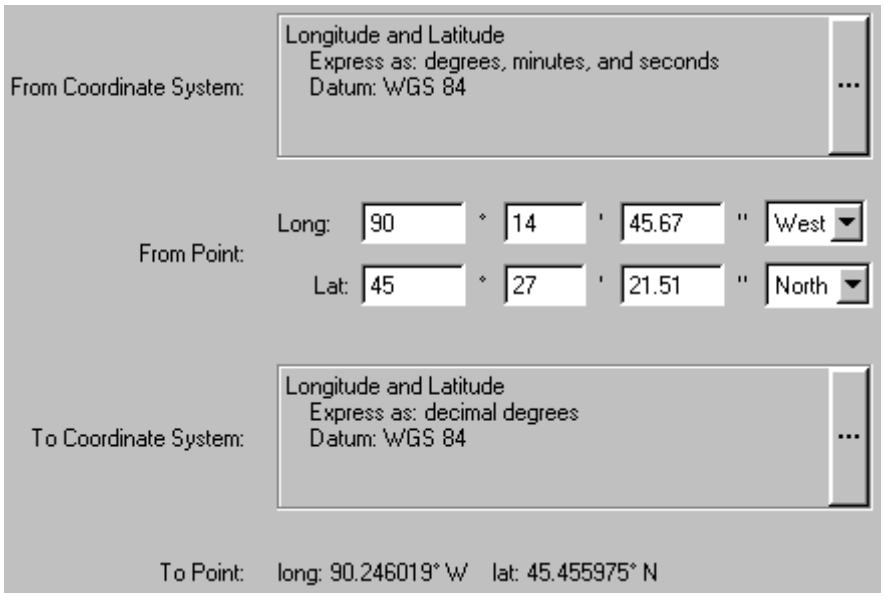
Tip:

You can use the coordinate system conversion tool to convert between datums. Choose "Longitude and Latitude" for both the From and To coordinate systems. Set the datums of the From and To coordinate systems to your From and To datums, respectively.



Tip:

You can use the coordinate system conversion tool to convert a longitude and latitude from decimal degrees to degrees, minutes, and seconds, or vice versa. Make sure that you use the same datum for both the From and To coordinate systems.



20.3. Equirectangular

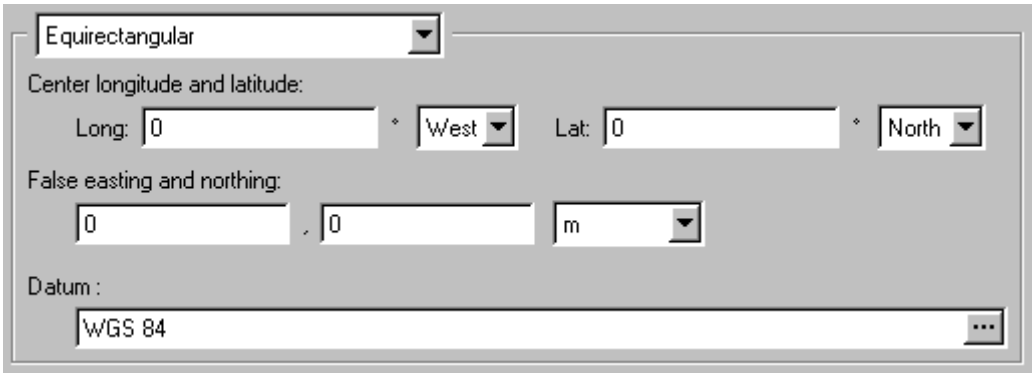
20.3.1. Description

The Equirectangular coordinate system is essentially a direct scaling of longitudes and latitudes to distances east and north, with the scaling selected such that distortion is minimized along the central latitude parallel. Distortion increases with distance from the central latitude: this increase becomes quite rapid near the poles.

The Equirectangular coordinate system is most useful for maps of regions that are predominantly east-west in extent. The Equirectangular coordinate system is often used to map bands that encircle the Earth and are enclosed by two fairly close parallels of latitude: for example, the region between latitudes 20° north and 30° north. It is also used in situations where ease of mapping is paramount.

This coordinate system is also know by the names Equidistant Cylindrical, Rectangular, and La Carte Parallelogrammatique.

20.3.2. Parameters



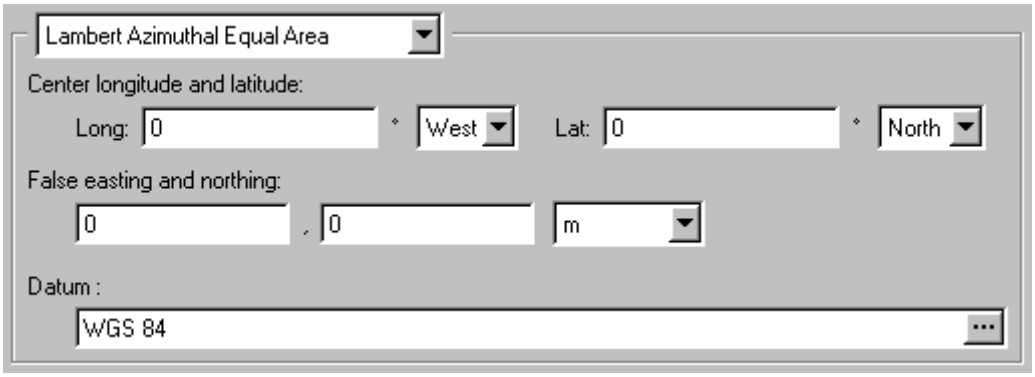
- *Center longitude and latitude* - Type the center longitude and latitude. To minimize distortion, the center latitude should be near the center of your area of interest.
- *False easting and northing* - Type the false easting and northing, and select the units used to express them. Locations in this coordinate system are expressed using these units.
- *Datum* - Select the coordinate system's datum. See *Section B.14, Datum Control*, and *Appendix H, Introduction to Datums*, for information on selecting datums.

20.4. Lambert Azimuthal Equal Area

20.4.1. Description

The Lambert Azimuthal Equal Area coordinate system is commonly used for both small- and large-scale maps of regions that are roughly circular in extent. This is an equal-area coordinate system, meaning that the areas of all regions are shown in the same proportion to their true areas.

20.4.2. Parameters



- *Center longitude and latitude* - Type the center longitude and latitude. To minimize distortion, the center longitude and latitude should be near the center of your area of interest.
- *False easting and northing* - Type the false easting and northing, and select the units used to express them. Locations in this coordinate system are expressed using these units.
- *Datum* - Select the coordinate system's datum. See *Section B.14, Datum Control*, and *Appendix H, Introduction to Datums*, for information on selecting datums.

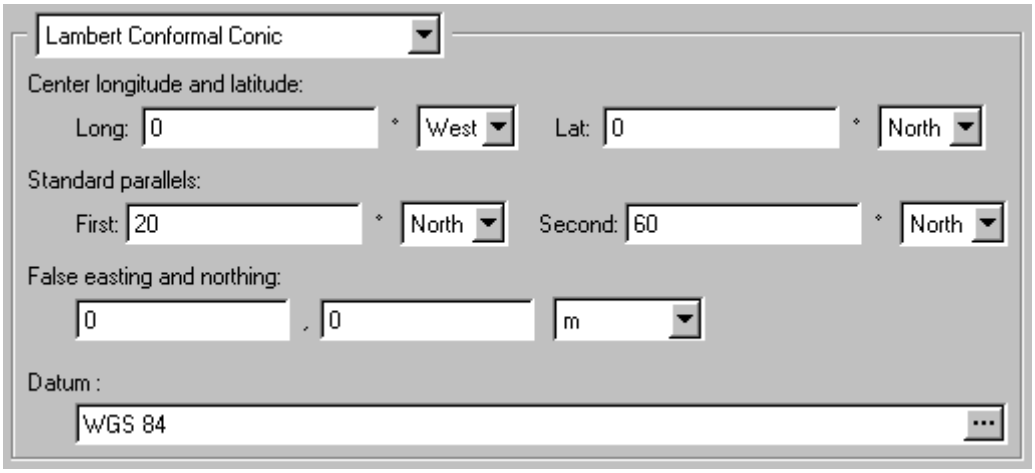
20.5. Lambert Conformal Conic

20.5.1. Description

The Lambert Conformal Conic coordinate system is commonly used for large-scale maps of regions that are predominantly east-west in extent.

This coordinate system is also know by the name Conical Orthomorphic.

20.5.2. Parameters



- *Center longitude and latitude* - Type the center longitude and latitude. To minimize distortion, the center latitude should be near the center of your area of interest.

- *Standard parallels* - Type the first and second standard parallels. Typically, these will be near the southern and northern borders of your area of interest.

Important:

The standard parallels cannot be symmetrical spaced on opposite sides of the equator. For example, standard parallels of 30° south and 30° north are illegal.

- *False easting and northing* - Type the false easting and northing, and select the units used to express them. Locations in this coordinate system are expressed using these units.

- *Datum* - Select the coordinate system's datum. See *Section B.14, Datum Control*, and *Appendix H, Introduction to Datums*, for information on selecting datums.

20.6. Local Flat-Earth XY

20.6.1. Description

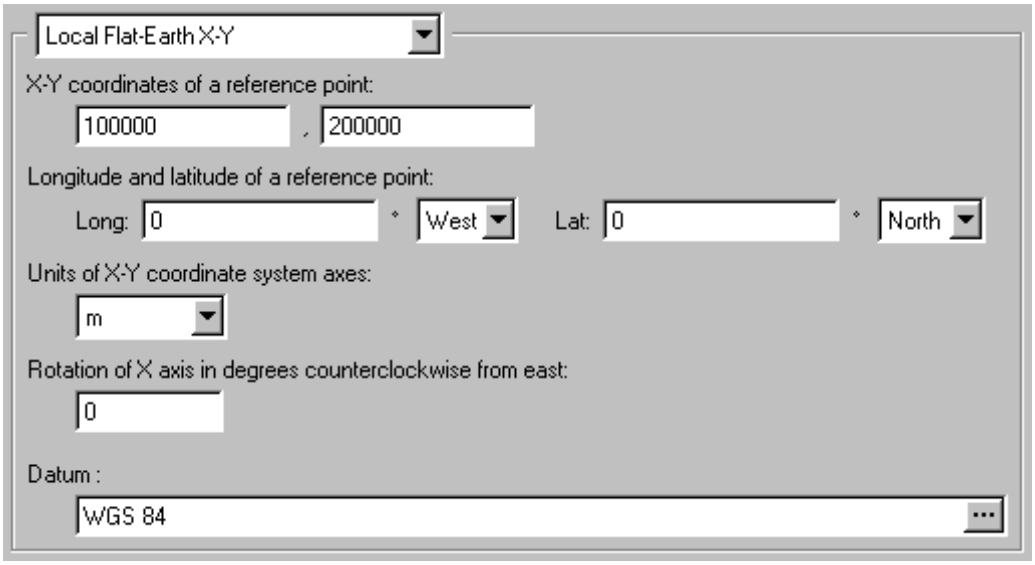
In the Local Flat-Earth XY coordinate system, locations are specified using a local Cartesian coordinate system: for example, meters east and north of a reference point. To specify this coordinate system, you must know both the X-Y and Longitude-Latitude coordinates of a reference point.

To minimize distortion, you should select a reference point near the center of your area of interest.

The Local Flat-Earth XY coordinate system is good general-purpose projection for maps of fairly small regions (tens of miles across) that have roughly the same east-west and north-south extent.

Technically, this projection is based upon a conical projection developed by the US Federal Aviation Administration for use by their Integrated Noise Model (INM). It is documented in an appendix of the INM User's Guide.

20.6.2. Parameters



- *X-Y coordinates of a reference point* - Specify the (X, Y) coordinates of the reference point.
- *Longitude and Latitude of a reference point* - Specify the longitude and latitude of the reference point, in decimal degrees.
- *Units of the XY coordinate system axes* - Select the units used to measure distances along the X-Y coordinate system axes.
- *Rotation of X axis in degrees counterclockwise from east* - Typically, projections measure distances east and north from a reference point. However, rotated projections are also possible. Specify the direction that the X axis points, in degrees counterclockwise from east.
- *Datum* - Select the coordinate system's datum. See *Section B.14, Datum Control*, and *Appendix H, Introduction to Datums*, for information on selecting datums.

As an example, assume a Local Flat-Earth XY coordinate system is defined as follows.

- Reference Point, X-Y: 100, 200
- Reference Point, Longitude and Latitude: 90° west, 45° north
- Units of XY Axes: feet
- Rotation of X Axis: 45°

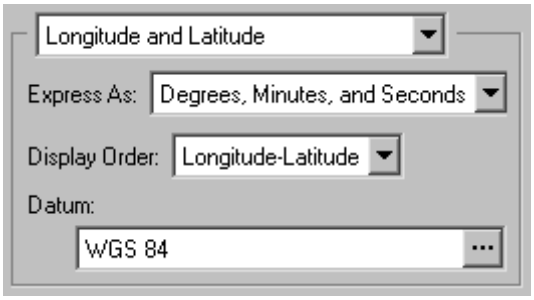
In this example coordinate system, the point (110, 200) would be located 10 feet northeast of longitude 90° west, latitude 45° north.

20.7. Longitude and Latitude

20.7.1. Description

Longitude and Latitude is the most common and well-known geographic coordinate system. Locations are specified in degrees of east longitude and north latitude.

20.7.2. Parameters



- *Express as* - Select how the longitude and latitude should be presented. You have three choices.
  - Decimal Degrees (for example, 85.175000°)
  - Degrees, Minutes, and Seconds (for example, 85° 10' 30.00")
  - Degrees and Decimal Minutes (for example, 85° 10.5000')

☞ ***Note:***

In some situations, the *Express as* choice will not be available.

- *Display Order* - Select the order in which longitude and latitude are presented. You have two choices.
  - Longitude-Latitude (long: 85.175° W lat: 35.675° N)
  - Latitude-Longitude (lat: 35.675° N long: 85.175° W)

☞ ***Note:***

In some situations, the *Display Order* choice will not be available.

- *Datum* - Select the coordinate system's datum. See *Section B.14, Datum Control*, and *Appendix H, Introduction to Datums*, for information on selecting datums.

20.8. Orthographic

20.8.1. Description

The Orthographic coordinate system is most often used to display an entire hemisphere. Such a map will appear similar to the Earth as seen from a spacecraft located directly above the center longitude and latitude.

When the center latitude is 90 south or 90 north, this projection is also used to display the polar regions of the Earth.

20.8.2. Parameters

- *Center longitude and latitude* - Type the center longitude and latitude. To minimize distortion, the center longitude and latitude should be near the center of your area of interest.

- *False easting and northing* - Type the false easting and northing, and select the units used to express them. Locations in this coordinate system are expressed using these units.

- *Datum* - Select the coordinate system's datum. See *Section B.14, Datum Control*, and *Appendix H, Introduction to Datums*, for information on selecting datums.

20.9. Stereographic

20.9.1. Description

The Stereographic coordinate system is commonly used for both small- and large-scale maps (showing one hemisphere or less) of regions that are roughly circular in extent.

When the center latitude is 90 south or 90 north, this projection is also used to display the polar regions of the Earth.

20.9.2. Parameters

- *Center longitude and latitude* - Type the center longitude and latitude. To minimize distortion, the center longitude and latitude should be near the center of your area of interest.

- *False easting and northing* - Type the false easting and northing, and select the units used to express them. Locations in this coordinate system are expressed using these units.

- *Datum* - Select the coordinate system's datum. See *Section B.14, Datum Control*, and *Appendix H, Introduction to Datums*, for information on selecting datums.

20.10. Universal Transverse Mercator (UTM)

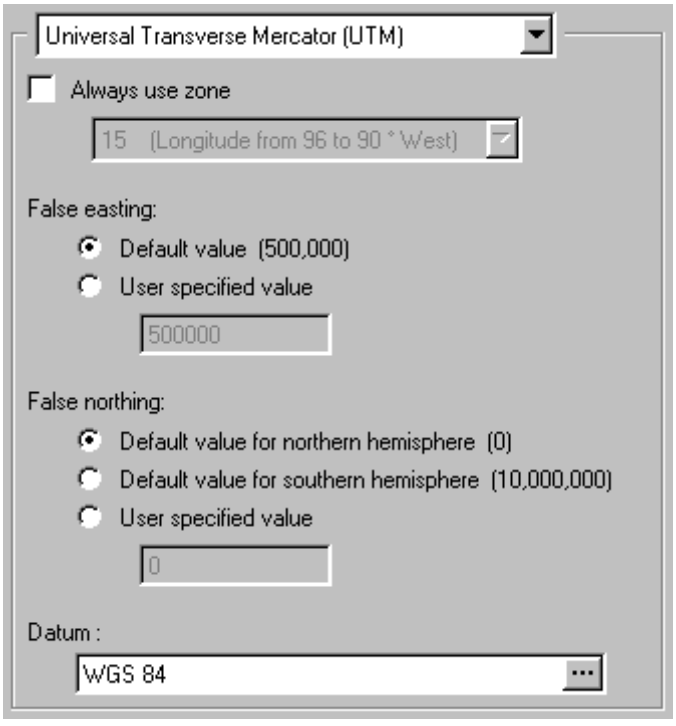
20.10.1. Description

Universal Transverse Mercator, or UTM, is a common coordinate system that specifies locations in meters east and north from a reference point.

The UTM system divides the globe into 60 *zones*, each 6 degrees of longitude wide and stretching from 80 degrees south latitude to 80 degrees north latitude.

UTM is suitable for mapping regions that are contained entirely within a single zone and its two adjacent zones. Beyond this, distortion increases rapidly.

20.10.2. Parameters



- *Always use zone* - If you check this box, select the UTM zone number that will always be assumed. If you do not check this box, you will be asked for the zone whenever you enter coordinates.

 ***Note:***

In some situations, you will be required to specify the UTM zone number.

- *False easting* - Select the false easting. Typically, this is 500,000, but in rare situations, a different value may be used. Unless you know otherwise, use the default of 500,000.

- *False northing* - Select the false northing. This is usually 0 in the northern hemisphere. In the southern hemisphere, 10,000,000 is often used. Unless you know otherwise, use the recommended default of 0 or 10,000,000, depending on your hemisphere.

- *Datum* - Select the coordinate system's datum. See *Section B.14, Datum Control*, and *Appendix H, Introduction to Datums*, for information on selecting datums.

Chapter 21

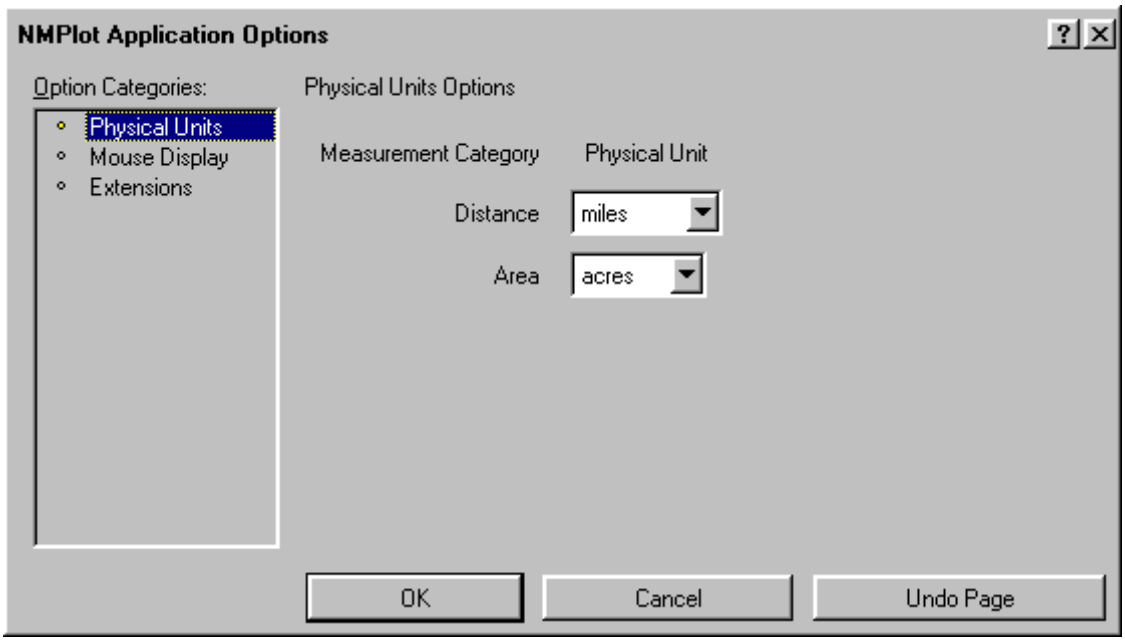
Setting NMPlot Application Options

Application options allow you to customize NMPlot.

21.1. The NMPlot Application Options Dialog Box

Most application options are set using the NMPlot Application Options dialog box. To change these options, follow these steps.

1. Choose Application Options from the Options menu. The NMPlot Application Options dialog box appears.



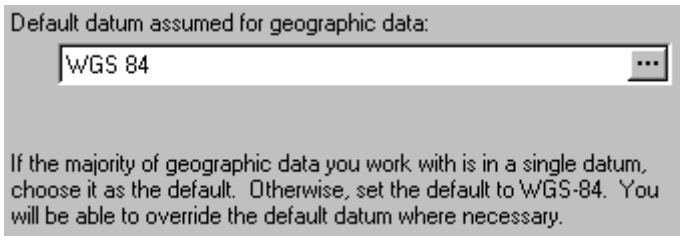
2. The left portion of the dialog box displays a list of option categories. One category in this list is always selected. The right portion of the dialog box displays controls that allow you to change the options in the selected category. Select the desired category by clicking on it.

   The Application Options dialog box is a Multiple Page dialog box. See *Section B.2, Multiple Page Dialog Boxes*, for more information.

3. Change the options as desired, then press OK.

21.2. Default Datum

Use the Default Datum page of the NMPlot Application Options dialog box to set the *default datum*.



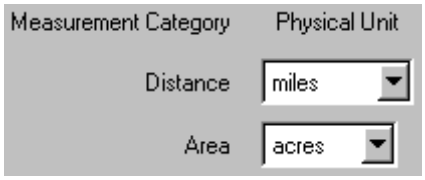
If the majority of the geographic data that you work with is in a single datum, choose it as the default. Otherwise, set the default to WGS-84.

NMPlot will assume that all geographic data is in the default datum unless you specify otherwise. You will be able to override the default datum where necessary.

See *Appendix H, Introduction to Datums*, for general information on datums. See *Section B.14, Datum Control*, for information about the datum control, which you use to specify the default datum.

21.3. Physical Units

Use the Physical Units page of the NMPlot Application Options dialog box to set the units of measurement NMPlot uses to display information.

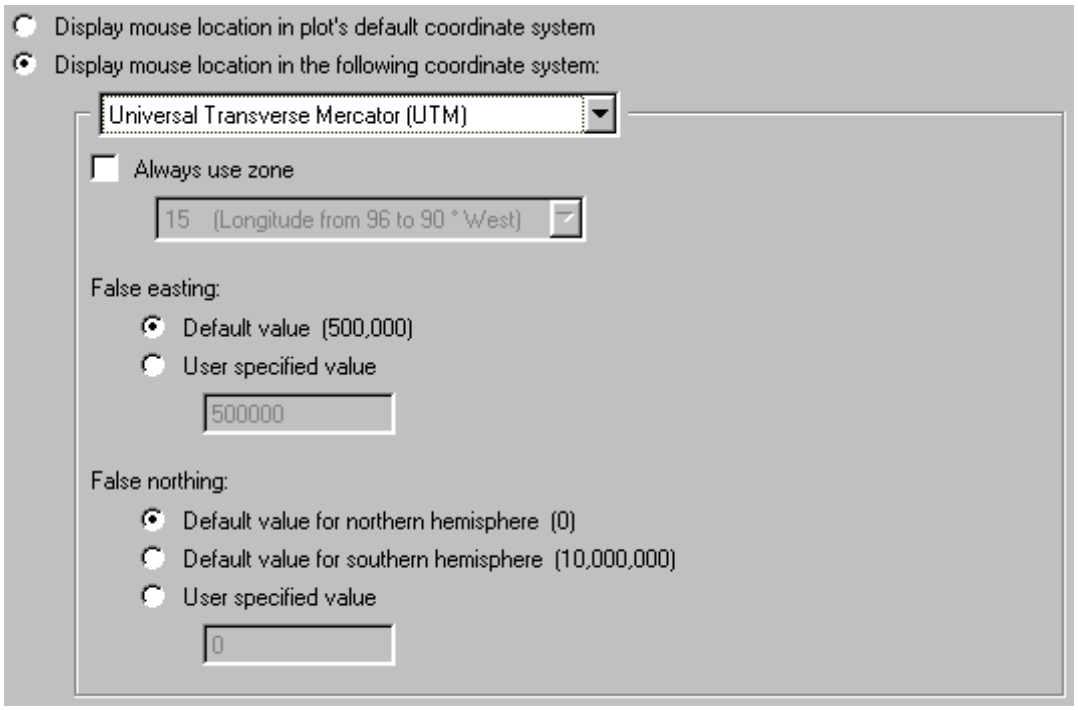


You can select the units used for:

- *Distance* - The Distance units are used to display the distance between two points when using the Measurement tool.
- *Area* - The Area units are used to display contour areas in both the Contour Area and Properties Of Selected Object dialog boxes.

21.4. Mouse Location Display Coordinates

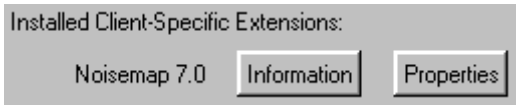
Use the Mouse Location Display Coordinates page of the NMPlot Application Options dialog box to set the geographic coordinate system NMPlot uses to display the location of the mouse on the status bar.



Select whether to use the coordinate system of a plot's primary grid, or to specify a global coordinate system used for all plots. If you select a global coordinate system, set the system's options. See *Section 20.1, Coordinate System Control*, for more information on setting coordinate system options.

21.5. Client-Specific Extensions

Use the Client-Specific Extensions page of the NMPlot Application Options dialog box to configure any extensions installed in your version of NMPlot. Client-specific extensions give NMPlot additional capabilities when working with grids created by specific third-party sources.



The Client-Specific Extensions page lists all installed extensions. Press the Information button to learn more about an extension. Press the Properties button to change an extension's options.

21.6. NOISEMAP 7.0 Client-Specific Extension

NOISEMAP is a computer program used to calculate the noise impacts of aircraft operations on the area surrounding an airport. It was developed by the United States Air Force, but is used world-wide for aircraft noise calculations. The NOISEMAP extension to NMPlot lets you interactively run NOISEMAP from within NMPlot. Both grid and point-of-interest calculations can be performed. The extension also allows NMPlot to read NOISEMAP Point-Of-Interest (POI) files.

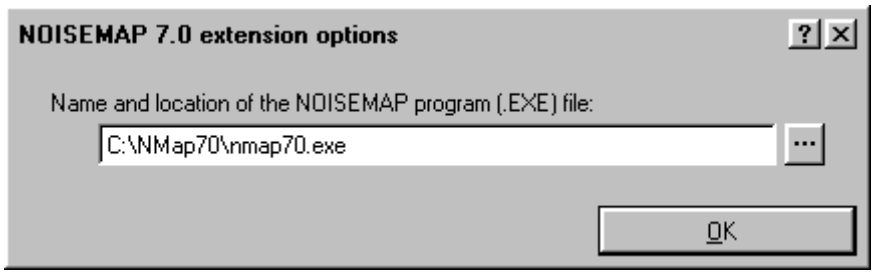
21.6.1. Requirements

In order to use the NOISEMAP extension to NMPlot, you must have NOISEMAP 7.0 installed on your computer.

21.6.2. Configuring the NOISEMAP 7.0 Extension

To configure the NOISEMAP 7.0 extension, follow these steps.

1. Choose Application Options from the Options menu. The Application Options dialog box appears.
2. Select the Extensions page.
3. Press the Properties button associated with the NOISEMAP 7.0 extension. The NOISEMAP 7.0 Extension Options dialog box appears.



4. Type the name and location of the NOISEMAP computer program (i.e., the .EXE file).

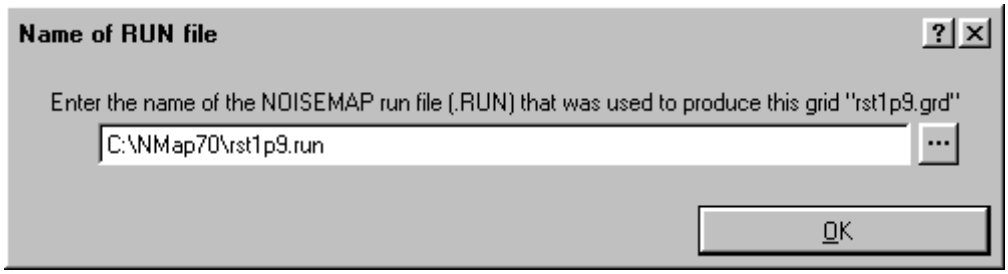
   Press the Browse button ..., located to the right of the text box, to display the Open File dialog box, which allows you to browse for the file.

   The NOISEMAP computer program will typically have the name `NMAP70.EXE`.

21.6.3. Performing a NOISEMAP Point-Of-Interest Analysis From Within NMPlot

You can use NMPlot's Point of Interest Computation tool to perform a NOISEMAP point of interest analysis from within NMPlot. See *Section 8.8, The Point Of Interest Computation Mouse Tool*, for information on using this tool.

When you use the Point of Interest tool on a NOISEMAP grid, NMPlot will, if necessary, ask you for the name and location of the NOISEMAP run (.RUN) file associated with that grid.

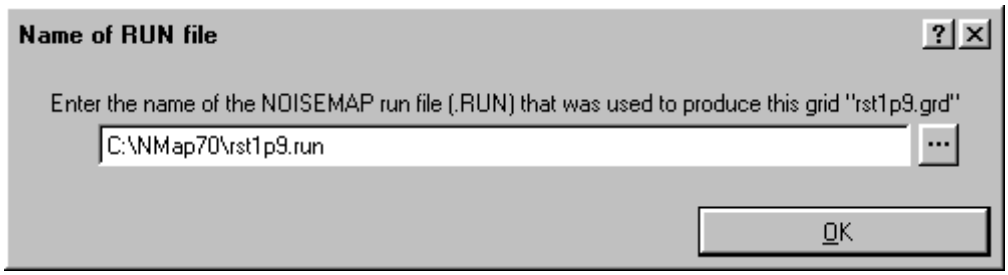


After performing the analysis, NMPlot will display the results, including the ranked flight and static event tables.

21.6.4. Performing a NOISEMAP Grid Calculation From Within NMPlot

You can use NMPlot's Grid Computation tool to perform a NOISEMAP grid calculation from within NMPlot. Typically, you will use this feature to enhance the grid resolution around areas of high noise gradients (for example, near runways and static pads). See *Section 8.9, The Grid Computation Mouse Tool*, for information on using the Grid Computation tool.

When you use the Grid Computation tool on a NOISEMAP grid, NMPlot will, if necessary, ask you for the name and location of the NOISEMAP run (.RUN) file associated with that grid.



21.6.5. NOISEMAP Point-Of-Interest (POI) Files

When NMPlot opens a grid file created by NOISEMAP 7.0, it looks for a Point-Of-Interest file that has the same name as the grid file, but with the extension `.poi`. If a POI file is found, it will be read along with the grid file.

If you display a plot of a NOISEMAP 7.0 grid, and choose to display points of interest, you can click on a point using the Display Properties mouse tool and display a full report on that point, including the ranked flight and static event tables.

21.7. Setting New Plot Options

To set the options of new plots created with the New command on the File menu, follow these steps.

1. Create a new plot, or open an existing one.
2. Display the Plot Options dialog box, and set the options as desired.
3. Choose Save As from the File menu. The Save As dialog box is displayed.
4. Navigate to the directory where you installed NMPlot: i.e., the directory where `NMPlot.exe` is located. Save the plot in this directory with the name `Default.nmp`.

In the future, when you create a new plot, it will have the same options as `Default.nmp`. For example, if the background color of the plot in `Default.nmp` is blue, then all new plots will have a blue background.

 ***Note:***

The primary grid of the plot in `Default.nmp` is irrelevant, since you are queried for the primary grid every time you create a new plot.

Chapter 22

Accessing Help

22.1. Displaying the User's Guide Table of Contents

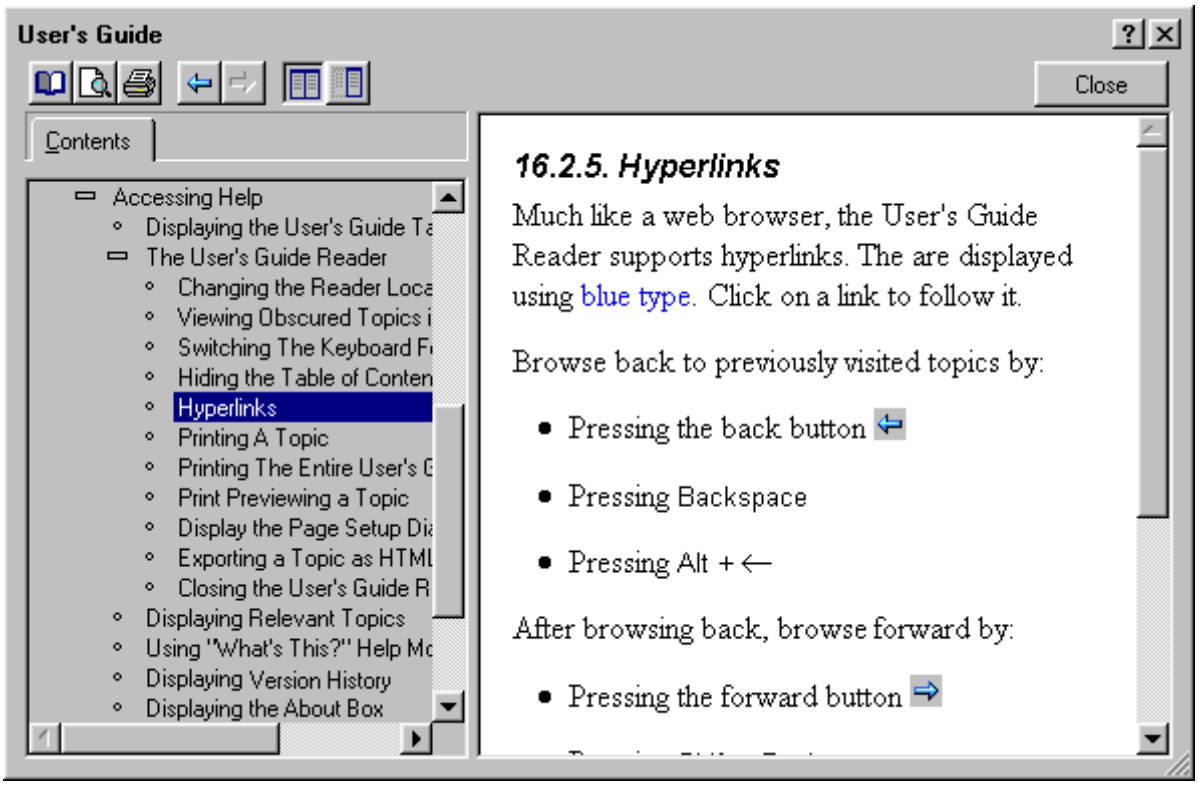
The entire NMPlot User's Guide (this document) can be browsed online. To display the table of contents, either:

- Press Ctrl + F1.
- Choose Contents from the Help menu.

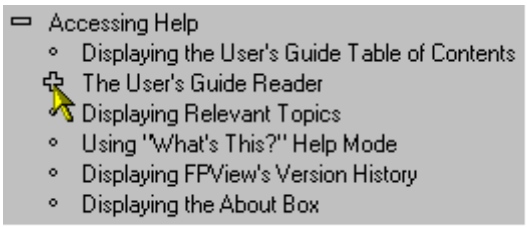
The User's Guide Reader will be displayed, showing the table of contents.

22.2. The User's Guide Reader

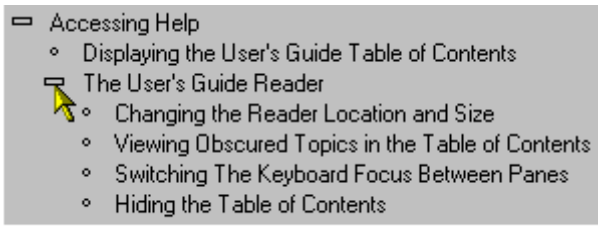
Use the User's Guide Reader to browse the User's Guide online.



The left side of the Reader displays the table of contents. One topic is always highlighted. It is referred to as the *selected topic*. To select a topic, click on it. Click on a plus symbol ✚ in the table of contents to display subtopics.



Click on the ✚ symbol next to a topic...



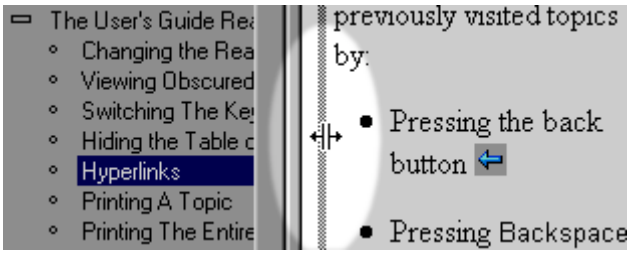
...to display its subtopics

The right side of the Reader displays the selected topic using a document display control. See *Section B.13, Document Display Control*, for more information.

22.2.1. Changing the Reader Location and Size

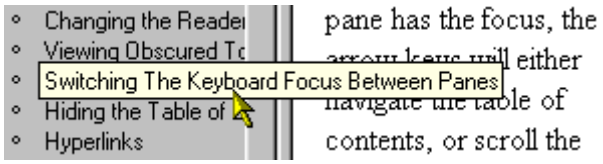
The User's Guide Reader window can be moved and resized as necessary. Drag its title bar to move it. Drag one of its edges to resize it.

To change the relative sizes of the two panes in the Reader, use the mouse to drag the separator between the two panes either left or right.



22.2.2. Viewing Obscured Topics in the Table of Contents

If a topic in the table of contents is partially obscured, hold the mouse cursor over it. A tooltip window will appear, showing you the rest of the topic.



22.2.3. Switching The Keyboard Focus Between Panes

At any given time, either the left or the right pane of the User's Guide Reader has the keyboard focus. Depending on which pane has the focus, the arrow keys will either navigate the table of contents, or scroll the selected topic. To switch the keyboard focus between panes, press the Tab key.

22.2.4. Hiding the Table of Contents

To temporarily hide the table of contents, press the Hide button . To display it, press the Show button .

Press Ctrl + T to switch between showing and hiding the table of contents.

22.2.5. Hyperlinks

Much like a web browser, the User's Guide Reader supports hyperlinks. The are displayed using blue type. Click on a link to follow it.

Browse back to previously visited topics by:

- Pressing the back button
- Pressing Backspace

- Pressing Ctrl + B

After browsing back, browse forward by:

- Pressing the forward button 
- Pressing Shift + Backspace
- Pressing Ctrl + Shift + B

If you follow a hyperlink to another section of the NMPlot User's Guide, the selected topic in the table of contents will be updated. This means that you can always find the location in the User's Guide of the topic you are reading.

22.2.6. Printing A Topic

To print a topic, select it, then either:

- Press the Print button  on the User's Guide Reader toolbar
- Press Ctrl + P

22.2.7. Printing The Entire User's Guide

To print the entire NMPlot User's Guide, simply select the NMPlot User's Guide topic (i.e., the first topic in the table of contents), and then print it as described in *Section 22.2.6, Printing A Topic*.

When you print the entire NMPlot User's Guide, all front matter, including the cover page and the table of contents, is printed. Blank pages are inserted as needed so that chapters always start on the right page of two-page spreads.

22.2.8. Print Previewing a Topic

To print preview a topic, select it, then either:

- Press the Print Preview button  on the User's Guide Reader toolbar
- Press Ctrl + W

See *Chapter 16, Using Print Preview*, for more information.

22.2.9. Display the Page Setup Dialog Box

To display the Page Setup dialog box, either:

- Press the Page Setup button  on the User's Guide Reader toolbar
- Press Ctrl + Shift + P

The Page Setup dialog box lets you select a printer, set the paper orientation (portrait or landscape), and set the page margins.

22.2.10. Exporting a Topic as HTML

To export a topic as HTML, select the topic, then press Ctrl + H. You will be prompted for the name of the HTML file that the topic will be written to.

22.2.11. Closing the User's Guide Reader

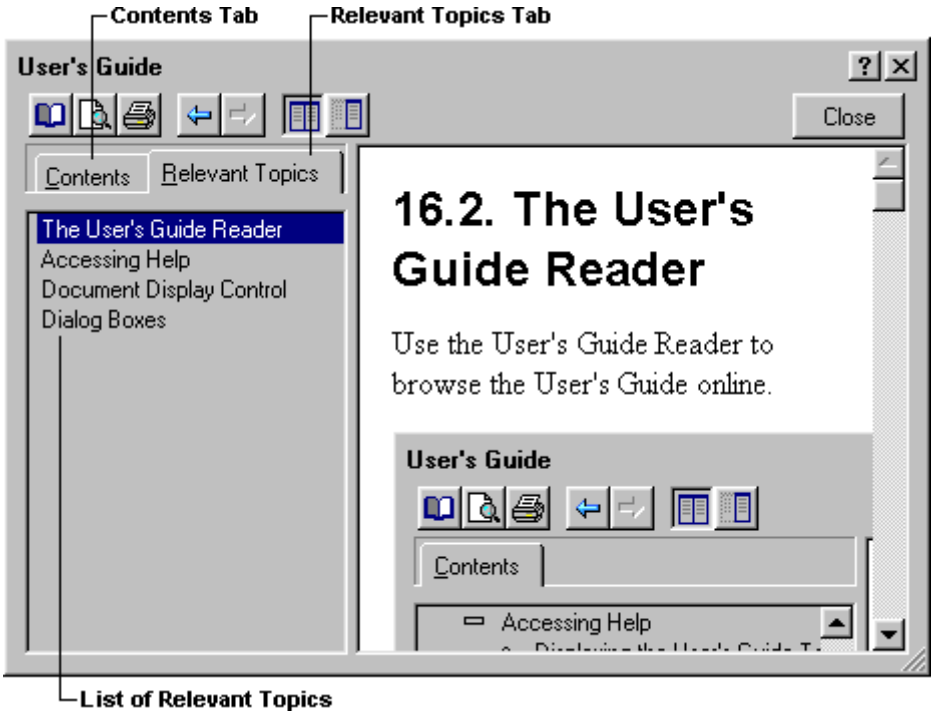
To close the User's Guide Reader, you can:

- Press the Close button
- Press the Esc key

22.3. Displaying Relevant Topics

Context-sensitive help, meaning help that is relevant to your current activity, can be displayed in NMPlot by:

- Pressing the F1 key
- Selecting Relevant Topics from the Help menu



NMPlot displays the User's Guide Reader, with a list of relevant topics listed in the left pane. The topics are ordered, with the most relevant at the top of the list.

To display the table of contents, click on the Contents tab, or press Alt + C.

To display the list of relevant topics, click on the Relevant Topics tab, or press Alt + R.

22.4. Using "What's This?" Help Mode

NMPlot's "What's This?" help mode lets you click on an object in NMPlot and have the relevant section of the User's Guide displayed. To enter "What's This?" help mode, you can:

- Press Shift + F1
- Choose What's This? from the Help menu
- Press the "What's This?" button ? on the title bar of a dialog box

NMPlot enters "What's This?" help mode, and the mouse cursor changes to a question mark  . Click anywhere on the NMPlot application. The NMPlot User's Guide is displayed with a list of topics relevant to the location where you clicked.

If you accidentally enter "What's This?" help mode, cancel it by pressing the Esc key.

22.5. Displaying NMPlot's Version History

To display the version history of NMPlot, choose Show Version History from the Help menu. The version number and new feature summary of all NMPlot versions is displayed.

22.6. Displaying the About Box

To display the NMPlot about box, choose About from the Help menu. The about box shows important information about the NMPlot application, including:

- The version
- The build number
- The list of sponsors
- Developer contact information

If you need to know the version of NMPlot you are running, check the about box.

Appendix A

Sponsors

- **United State Air Force**
  Air Force Research Laboratory
  Wright-Patterson Air Force Base, Ohio

- **United State Army**
  Construction Engineering Research Laboratory (CERL)
  Champaign, Illinois

- **United States Department of Transportation**
  Federal Aviation Administration
  Office of Environment and Energy, AEE-120
  Washington, DC

Appendix

Details of Various NMPlot Components

B

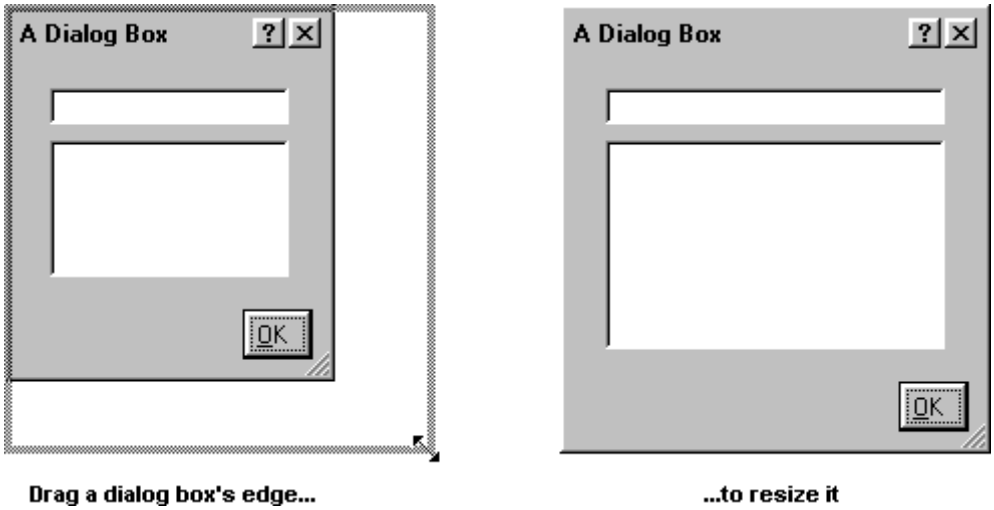
NMPlot uses a number of specialized components. Some of these components (for example, the coordinate system control) are specific to NMPlot, and are described in detail. Other components (for example, the text edit control) are commonly used by Microsoft Windows applications. Familiarity with these common components is assumed: only unique or non-obvious aspects are described in this appendix.

B.1. Dialog Boxes

Most NMPlot dialog boxes can be moved and resized. NMPlot remembers the new position and size, and uses them the next time that dialog box is displayed.

To move a dialog box to a new location, drag it by its title bar.

To resize a dialog box, drag one of its edges. The layout of the dialog box's contents will be updated to fit the new size.



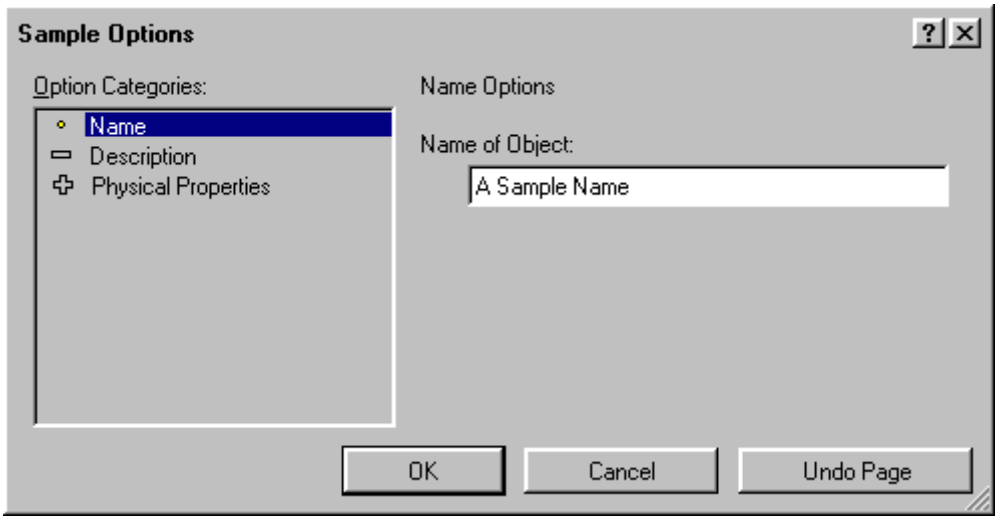
Drag a dialog box's edge...

...to resize it

Press Tab and Shift + Tab to move the keyboard focus between controls in a dialog box.

B.2. Multiple Page Dialog Boxes

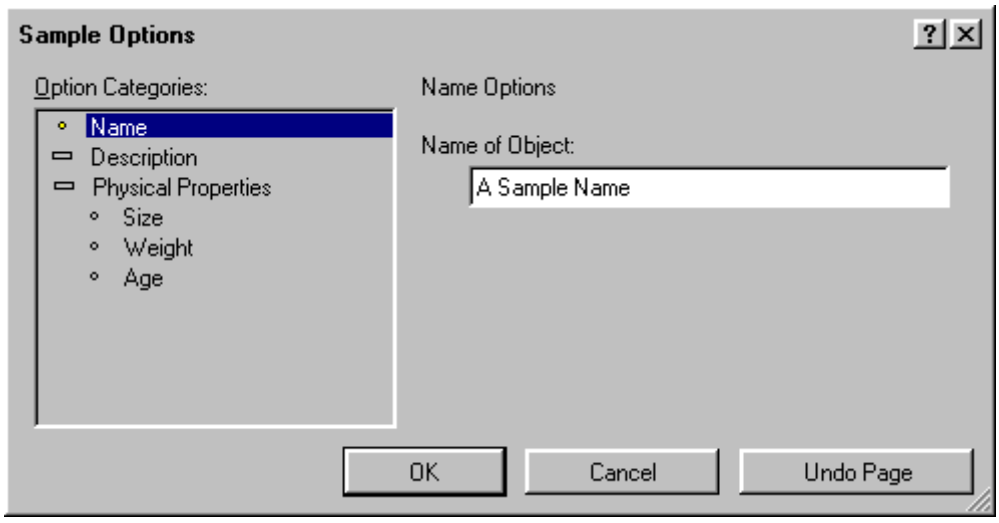
NMPlot makes extensive use of Multiple Page Dialog Boxes. These dialog boxes have one or more *pages* of options that can be displayed.



The left portion of a Multiple Page dialog box displays a list of option categories (in the example above, these are Name, Description, and Physical Properties). One category in this list is always selected (in the example above, Name is selected). Click on a category to select it.

The right portion of the dialog box displays controls that allow you to change the options in the selected category (in the example above, this is the Name of Object text edit box).

For organizational purposes, options are arranged in a hierarchy. If an option category has a plus sign ✣ next to it, this means that it has one or more subpages. To display the subpages, click on the plus sign.

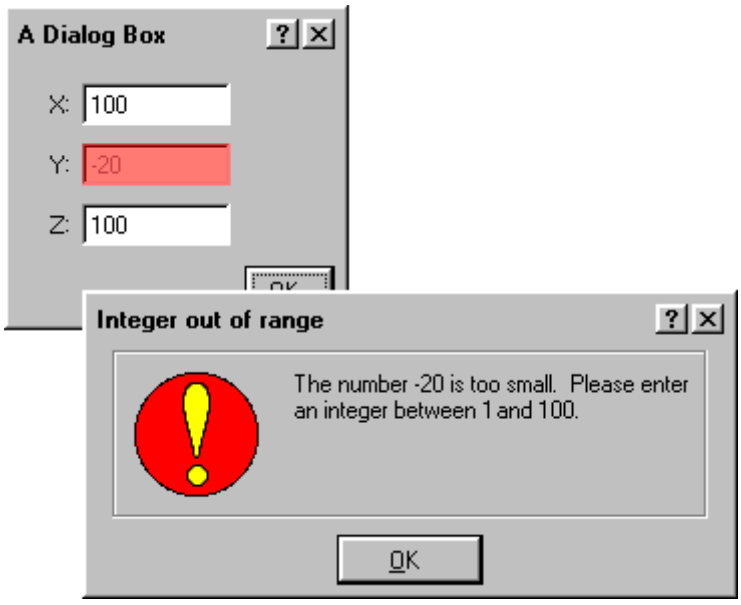


Click on the Undo Page button to discard all changes you have made to the controls on the selected page. All controls are set to the values they had when you opened the dialog box.

Click on the Cancel button to discard all changes you have made since opening the dialog box, regardless of the page.

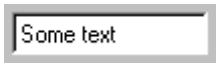
B.3. Error Messages

If an error message must be displayed, NMPlot will highlight the relevant portion of the user interface by tinting it red.



B.4. Text Control

A Text Control allows you to enter text.



It is assumed that you are familiar with using a text control. Therefore, only the functions of certain keys are listed.

Key	Action
Shift + Arrow Key	Move the caret while selecting text
Ctrl + ←	Move one word to left
Ctrl + →	Move one word to right
Ctrl + C	Copy selected text to the clipboard
Ctrl + X	Cut selected text
Ctrl + V	Paste text from clipboard
Ctrl + A	Select all text

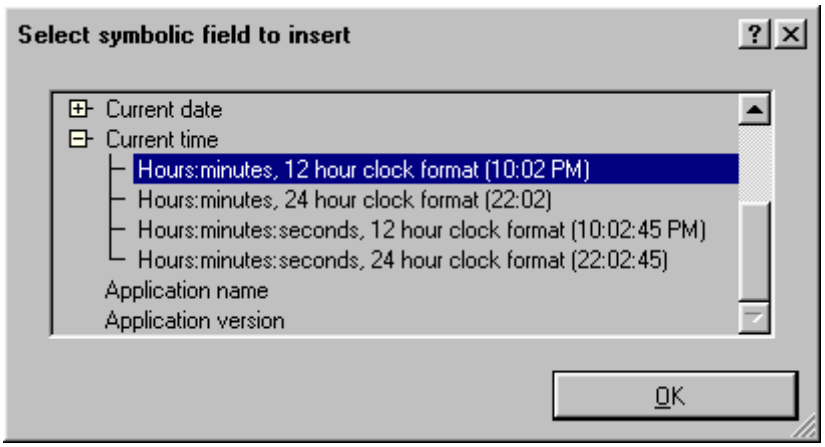
B.5. Symbolic Fields Text Control

A Symbolic Field Text Control allows you to enter text that contains *symbolic fields*: placeholders for information that is automatically inserted when the text is displayed. For example, in the text "You are using {AppName} version {AppVersion}", {AppName} and {AppVersion} are fields representing, respectively, the name and version of the application you are using. The text would be displayed as "You are using NMPlot version 4.958".

A Symbolic Fields Text Control is a text control with a button located to its right.

Edit the text as you would using a regular text control. To insert a symbolic field at the caret location, either press Alt + Space Bar, or press the Insert Symbolic Field button

. The Select Symbolic Field To Insert dialog box is displayed.

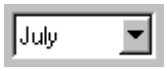


Select the symbol to insert, then press the OK button.

Note that the list of symbols is hierarchical. Click on one of the small + signs to display subsymbols. Often, these subsymbols are alternative ways of formatting the parent symbol. For example, in the screen capture of the Select Symbolic Field To Insert dialog box above, symbols for several ways of formatting the current time are shown.

B.6. Drop-down List Control

A Drop-down List Control allows you to select a single item from a list of choices.

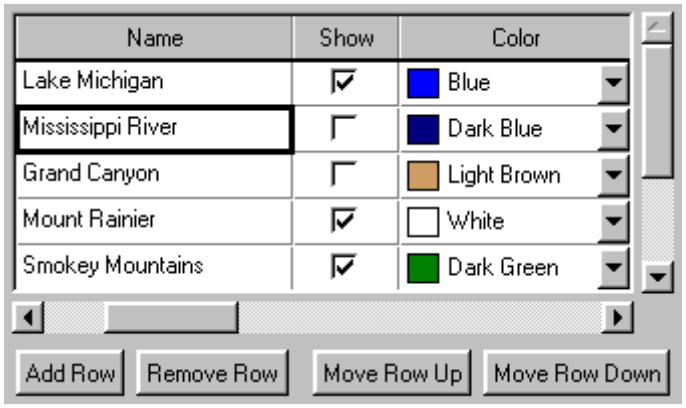


It is assumed that you are familiar with using a drop-down list control. Therefore, only the functions of certain keys are listed.

Key	Action
Letter key A through Z	Cycle through the choices beginning with that letter. For example, if you are using a drop-down list control that presents a choice of month names, pressing A will alternate the selected month between April and August.
Space Bar	Display the drop-down list
Alt + ↓	Display the drop-down list
↓	Select the next choice in the list
↑	Select the previous choice in the list

B.7. Spreadsheet Control

A Spreadsheet Control is used to enter a two-dimensional table of information.



A spreadsheet control works much like a commercial spreadsheet, such as Microsoft Excel. A two-dimensional table of *cells* is presented. One cell is always *selected*. This is indicated by a dark outline. In the example above, the Mississippi River cell is selected. The selected cell is the one that you are currently editing. The *selected row* is the row containing the selected cell.

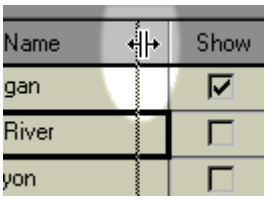
To select another cell, click on it. Alternatively, use the following navigation keys.

Key	Action
Arrow Key	Move one cell in the indicated direction
Ctrl + Arrow Key	Move one page in the indicated direction
Enter	Move one cell down
Shift + Enter	Move one cell up
Tab	Move right one cell, or to start of next row if at end of current row
Shift + Tab	Move left one cell, or to end of previous row if at beginning of current row
Page Up	Move up current column one page
Page Down	Move down current column one page
Ctrl + Page Up	Move to top of current column
Ctrl + Page Down	Move to bottom of current column
Home	Move to first column in current row
End	Move to last column in current row

Most spreadsheet controls have Add and Remove buttons. The Add button adds a new row, located just below the selected row. The Remove button removes the selected row.

Some spreadsheet controls have Move Row Up and Move Row Down buttons that move the selected row up or down in the table. Use these buttons to change the relative ordering of rows.

In most spreadsheet controls, you can change a column's width by dragging the separator between column headers.

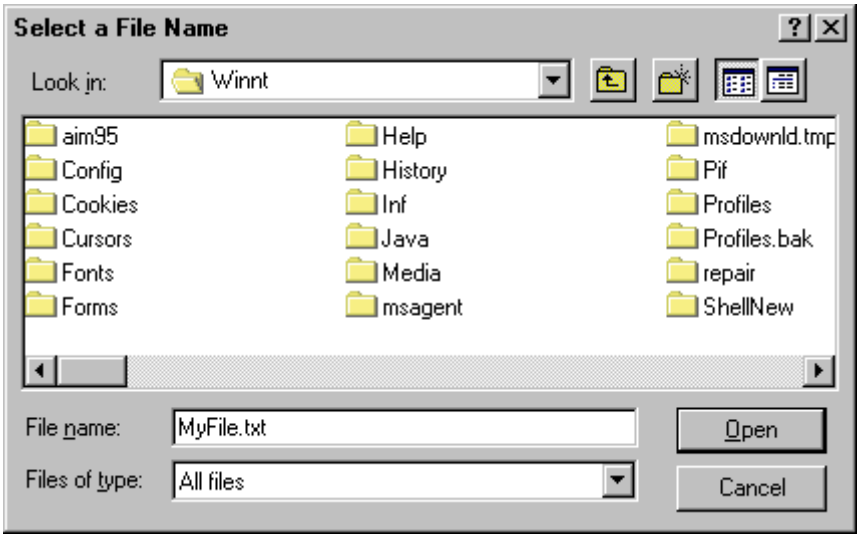


B.8. File Name Control

A File Name Control is used to enter the name of a file.

You can type the name of the file in the box provided.

To browse for the file, either press Alt + Space Bar, or press the Browse button  , located to the right of the text box. The standard Microsoft Windows Open File dialog box is displayed.

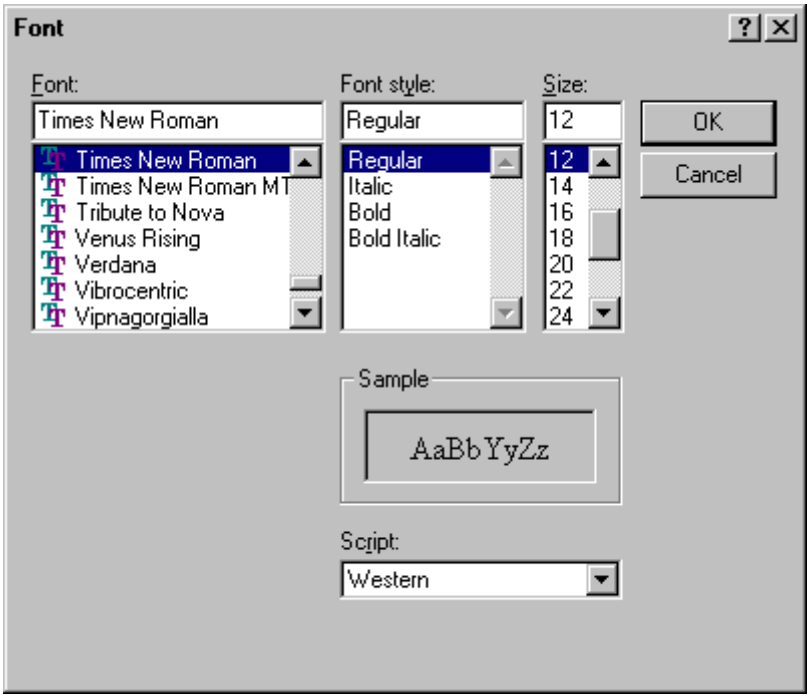


The exact appearance of the Open File dialog box will vary, depending on the version of Microsoft Windows that you are using. Familiarity with this dialog box is assumed. See your Microsoft Windows documentation for additional information.

B.9. Font Control

A Font Control is used to select a typeface font.

The current font is displayed in the box. To change it, either press the Space Bar, or press the Select Font button  . The standard Microsoft Windows Font dialog box is displayed.



The exact appearance of the Font dialog box will vary, depending on the version of Microsoft Windows that you are using. Familiarity with this dialog box is assumed. See your Microsoft Windows documentation for additional information.

B.10. Color Control

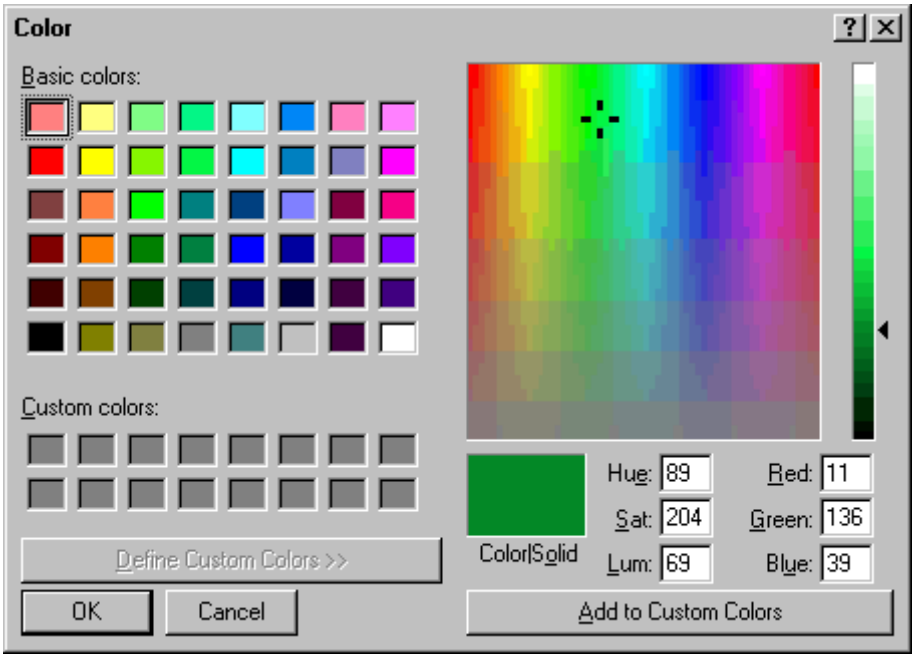
A Color Control is used to select a color.

A sample of the current color is displayed in the box, followed by a name for that color. If the color is one of the standard ones recognized by NMPlot, its common name is displayed. Otherwise, the relative intensities of red, green, and blue are displayed, as in "RGB 10, 100, 255". The RGB values can range from 0 to 255.

Press a letter key, A through Z, to cycle through all colors with names beginning with that letter.

Press Alt + ↓, the Space Bar, or the drop-down button to display a drop-down list of named colors.

Select Custom Color to display the standard Microsoft Windows Color dialog box, which will allow you to pick from all possible colors.

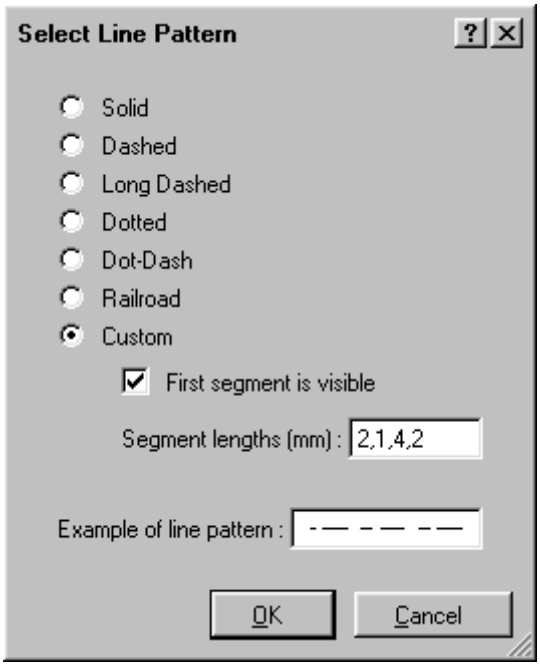


The exact appearance of the Color dialog box will vary, depending on the version of Microsoft Windows that you are using. Familiarity with this dialog box is assumed. See your Microsoft Windows documentation for additional information.

B.11. Line Pattern Control

A Line Pattern Control is used to select a line dash pattern (solid, dashed, dotted, etc.).

The sample of the current line pattern is displayed in the box. To change the pattern, either press the Space Bar, or press the Select Pattern button  . The Select Line Pattern dialog box is displayed.



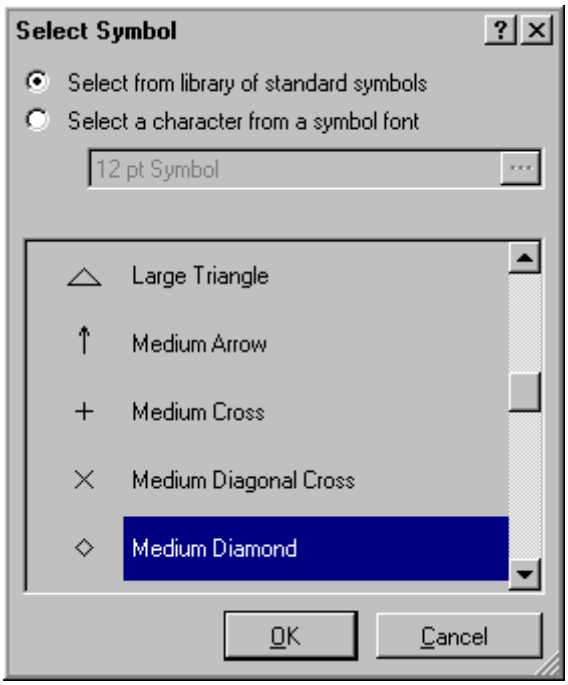
The box at the bottom of the dialog box displays a sample of the current line pattern. You can choose one of the predefined patterns, such as Solid or Dashed. Alternatively, you can select Custom, and define your own line pattern.

To define a line pattern, type a list of numbers, separated by commas, in the box labeled *Segment lengths*. These numbers are the lengths, in millimeters, of alternating line segments and gaps in the line pattern. If the *First segment is visible* box is checked, the first number represents the length of a line segment. Otherwise, the first number represents the length of a gap.

B.12. Symbol Control

A Symbol Control is used to select a graphical symbol.

The current symbol is displayed in the box. To change it, either press the Space Bar, or press the Select Symbol button  . The Select Symbol dialog box is displayed.



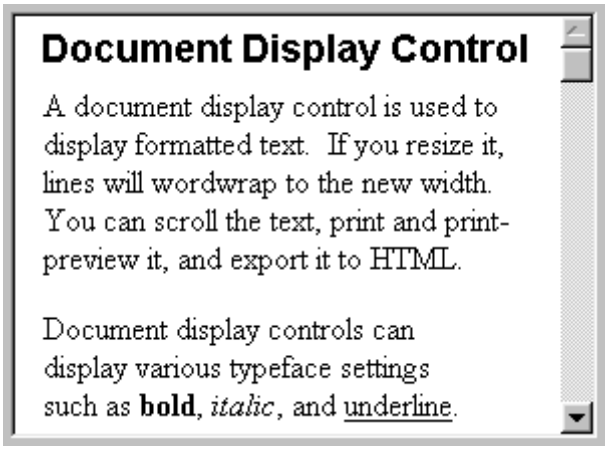
You can select from a library of standard symbols that are included with NMPlot. Alternatively, you can select a character from a symbol font.

Tip:

Symbol fonts are available from a variety of third-party sources. Some (for example, "Symbol") are distributed with Microsoft Windows. Some are available for purchase. Still others may be freely downloaded from the World Wide Web.

B.13. Document Display Control

A document display control displays formatted text.



The following keys have special functions when using a document display control.

Key	Action
↑	Scroll up one line
↓	Scroll down one line
Page Up	Scroll up one page
Page Down	Scroll down one page
Home	Go to the top of the document
End	Go to the bottom of the document
Ctrl + P	Print the document
Ctrl + W	Print preview the document
Ctrl + H	Save the document as HTML

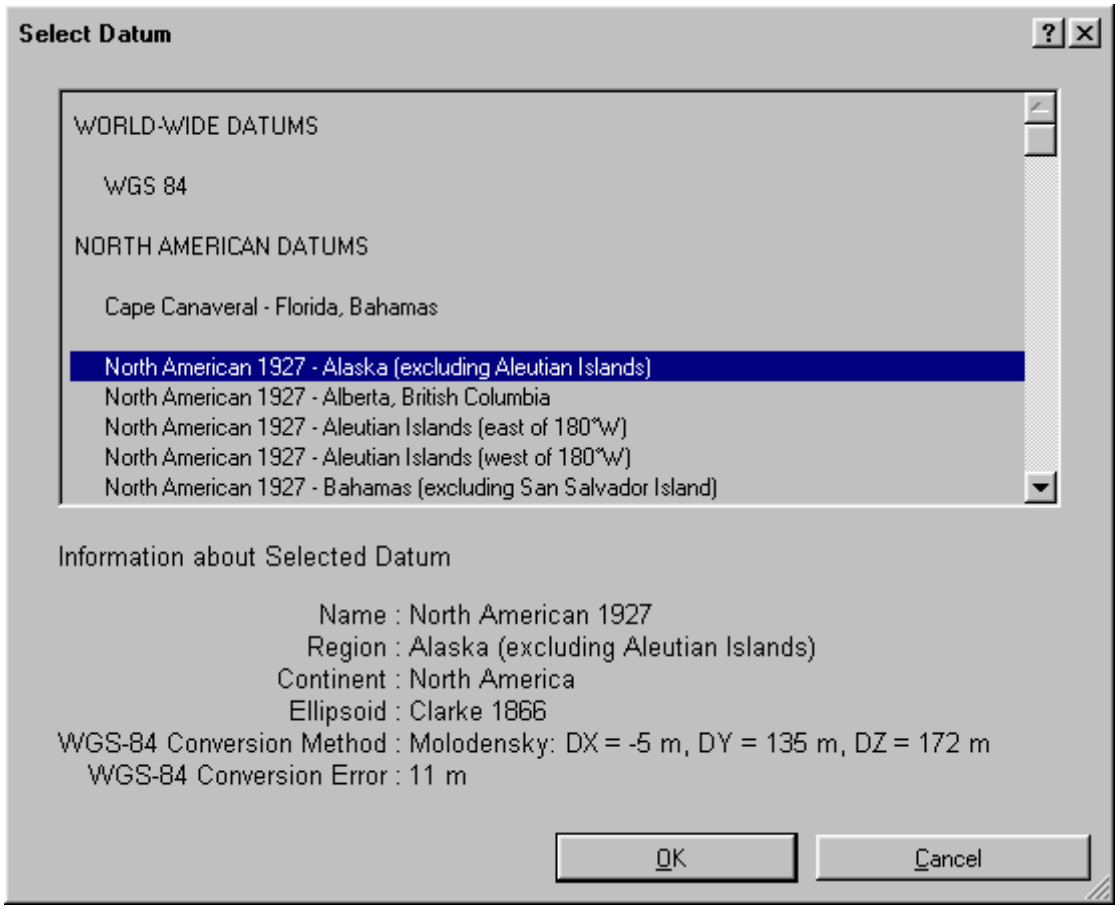
If your mouse has a middle mouse button, you can use it to scroll the document. Press and hold the middle button, then move the mouse up or down.

If your mouse has a wheel button, you can scroll the document by turning the wheel.

B.14. Datum Control

A Datum Control is used to select a geographic datum.

The current datum is displayed in the box. To change it, either press the Space Bar, or press the Select Datum button ... The Select Datum dialog box is displayed.



The list at the top of the dialog box displays all available datums, grouped by continent or ocean (North America, Pacific Ocean, etc.). Within these groups, datums are listed alphabetically.

Below the list, the following information about the selected datum is presented:

- The datum's name
- The applicable geographic region for this datum
- The continent or ocean that contains the datum's applicable region
- The datum's reference ellipsoid

- The method used to convert between this datum and the WGS-84 datum (for the 3-parameter Molodensky transformation, the three transformation parameters DX, DY, and DZ are displayed)

- An estimate of the worst-case error when converting from this datum to WGS-84

See *Appendix H, Introduction to Datums*, for general information on datums. See *Section 21.2, Default Datum*, for information about the default datum.

Tip:

Some datums are listed several times, each associated with a different area or region. For example, the "North American 1927" datum is listed 20 times: "North American 1927 - Alaska (excluding Aleutian Islands)", "North American 1927 - Alberta, British Columbia", etc. Generally, you should pick the one with the smallest associated region that completely encloses your area of interest. For example, if you are working with North American 1927 map data for the state of New York, you should select "North American 1927 - Contiguous United States east of Mississippi River" instead of "North American 1927 - Contiguous United States."

Tip:

Datums are often abbreviated using their initials and two-digit year. For example, the North American 1927 datum is commonly abbreviated as NAD-27.

Appendix

A Sample Grid Summary Report

C

When a grid is opened, NMPlot displays a Grid Document window. Among other information, this window displays a report summarizing the contents of the grid. This appendix contains a sample grid summary report.

Summary of Grid "Sample Grid - Airport Noise.grd"

Description of Grid

Noise at Holloman Air Force Base

Noise at Holloman Air Force Base, New Mexico, as calculated by NOISEMAP 6.0, the United State's Air Force's Airport Noise Model.

Metric

This grid contains **Noise** data in units of **dB DNL**.

Coordinate System

Coordinate system used to specify geographic locations in this grid:
User-defined XY coordinate system
Reference point in longitude and latitude: **106.107224° west, 32.8663902° north**
Reference point in local (X-Y) coordinates: **99992, 200000 feet**

Point of Contact

Point of contact for this grid:

Fred Wasmer
Wasmer Consulting
e-mail wasmer@wasmerconsulting.com

Time and Date

This grid was created at **11:35 AM** on **Thursday, February 23 1989**.

Program

This grid was created by **NOISEMAP** version **6**.

Other Attributes

The following attributes are associated with this grid:

Temperature (F) = 69
Humidity (%) = 28
Magnetic Declination (degrees east) = 10.69

Valid Grid Data Point Value Limits

All grid data points with values less than **-40** or greater than **9.9E9** are ignored. They are treated as missing data.

Grid Point Statistics

There are **9296** valid data points in this grid.

The data points range in value from **34.4** to **102.1 dB DNL**.

Geographic limits of the data point locations:

x: 50,000, y: 150,000
to
x: 149,000, y: 249,000

Geographic Features

This grid contains the following geographic features.

Point Features

8 features of category **Navigational Aid**

16GS
22GS
BW5
HMN
IHMN
IMUK
P.R.
S.R.

4 features of category **Point of Interest**

65A
67A
HUD
SP1

16 features of category **Static Pad**

807B
A638
B638
CRA
CRB
CRC
CRD
CRE
ERA
ERB
ERC
ERD
ERE
ERF
R11
TC

Line Features

4 features of category **Runway**

16
22
25
34

19 features of category **Flight Track**

16A1
16A2
16C1
16C2
16C3

16D1
16D2
22D1
22D2
25D1
25D2
25D3
25DT
34A1
34A2
34C1
34C2
34C3
34D1

Appendix D

List of NMPlot Files

D.1. List of Files Shipped With NMPlot

The following files are distributed as part of the NMPlot installation package.

- **NMPlot.exe** - The NMPlot application.
- **NMPlot_VersionHistory.txt** - A text file containing a record of the released versions of NMPlot.
- **Sample Grid - Airport Noise.grd** - A sample grid of aircraft noise levels, expressed in decibels (dB), around Holloman Air Force Base, New Mexico. This grid is displayed by all of the sample plots.
- **Sample Grid - Airport Noise plus 3 dB.grd** - A grid created by using NMPlot's grid modification capability to add 3 dB to all data points in the grid `Sample Grid - Airport Noise.grd`. This file is used to demonstrate the overlaying of two sets of contours.
- **Sample Plot - Contours.nmp** - A sample plot that demonstrates the contouring capability of NMPlot. The plot is of 60 through 80 dB noise level contours.
- **Sample Plot - Annotations.nmp** - A sample plot demonstrating NMPlot's ability to draw geographic annotations. Flight tracks (the paths that airplanes follow as they fly patterns near Holloman Air Force Base), navigational aids, and points of interest are shown. 60, 70, and 80 dB noise level contours are also displayed, demonstrating NMPlot's ability to draw contours filled with solid colors.
- **Sample Plot - Color Gradient.nmp** - A sample plot demonstrating the color gradient capability of NMPlot. The grid `Sample Grid - Airport Noise.grd` is plotted with smoothly varying colors indicating noise levels. The 65 dB contour is also drawn.

- **Sample Plot - Contour Overlay.nmp** - A sample plot demonstrating NMPlot's ability to overlay contours from two or more grids. This plot is of the 65 and 80 dB contours from two grids: `Sample Grid - Airport Noise.grd` and `Sample Grid - Airport Noise plus 3 dB.grd`.

- **Sample Plot - Map Overlay.nmp** - A sample plot that demonstrates NMPlot's ability to display plots over background maps. 60, 70, and 80 dB noise level contours are displayed over a map of Holloman Air Force Base, New Mexico.

- ***.nmplot_legend** - Legends that you can select from when printing plots. See *Section 15.4, Legends*, for more information.

- **Default.MapFormattingScheme** - Controls the colors, line styles, etc. used to display Digital Line Graph (DLG) maps. See *Section 14.2.1, Map Formatting Schemes*.

- **SampleMapData*.dlg** - The `SampleMapData` subdirectory contains map data for Holloman Air Force Base. It is used by the sample plot `Sample Plot - Map Overlay.nmp`. The data consists of 1:100,000 Digital Line Graph (DLG) files downloaded from the United States Geological Survey (USGS) web site.

- **Documentation*.*** - The `Documentation` subdirectory contains the NMPlot User's Guide, stored in XML format.

D.2. Files Created by NMPlot

The following files are not included in the NMPlot distribution package, but may appear after running NMPlot.

- **NMPlot.cfg** - Contains application-wide NMPlot configuration information. An example of the type of information stored in this file is the last size and location of many dialog boxes. If this file is deleted, all options will return to their default values.

- **NMPlot.log** - Log of debugging, error and warning messages from the last time NMPlot was run.

- **NMPlot Fatal Error Report.txt** - A report containing debugging information for the last fatal error experienced by NMPlot. This file may contain information allowing the cause of the error to be determined.

Appendix

Command-Line Options

E

The name of one or more grid or plot files may be specified on the NMPlot command line. These files will be opened when NMPlot runs. This allows you to associate the extensions `.nmp` and `.grd` with the NMPlot application, and invoke NMPlot by double-clicking on a plot or grid file from Microsoft Windows Explorer.

Enclose file names containing spaces with double-quotes, as in...

```
C:\>nmplot "Sample Grid - Airport Noise.grd"
```

NMPlot recognizes the following command-line options.

E.1. Display Help

E.1.1. Synopsis

-Help

E.1.2. Description

Displays the NMPlot User's Guide.

E.1.3. Example

```
C:\>nmplot -help
```

E.2. Display a Plot of a Specific Grid

E.2.1. Synopsis

-LoadPlotSetGrid *plotfilename gridfilename*

E.2.2. Description

Loads the plot file ***plotfilename***, sets the plot's primary grid to ***gridfilename***, saves the modified plot, and then displays the plot. Note that this operation modifies the existing plot file ***plotfilename***.

E.2.3. Example

```
C:\>nmplot -loadplotsetgrid myplot.nmp mygrid.grd
```

E.2.4. Comments

This command-line option is for third-party applications that use NMPlot to display graphical output. As an example, consider how a hypothetical numerical model called X might use NMPlot.

X's developers create a plot file named `X.nmp` that is distributed with X. This plot's options are set appropriately for displaying grid files created by X.

When a user running X requests a contour plot, X performs the following actions.

1. X creates a grid file named *`UserCase`*`.grd`, where *UserCase* is the name of the user's current scenario in X.
2. X copies `X.nmp` to *`UserCase`*`.nmp`.
3. X runs NMPlot using the command line:

   nmplot -loadplotsetgrid "*UserCase*.nmp" "*UserCase*.grd"
4. NMPlot displays the plot. The user can use the full power of NMPlot to explore X's predictions.
5. The user can access the plot later by simply double-clicking on *`UserCase`*`.nmp`. X no longer needs to be running.

E.3. Export a Plot in ARC/INFO Shapefile (SHP) Format

E.3.1. Synopsis

-se gridfilename [coordsys plotfilename shapefilename]

E.3.2. Description

Exports a plot in ARC/INFO Shapefile (SHP) format. NMPlot reads the plot from file ***plotfilename***, temporarily sets the plot's primary grid to ***gridfilename***, and exports the plot to a Geographic Information System (GIS) in ARC/INFO Shapefile (SHP) format.

coordsys controls the coordinate system of the Shapefile(s) that are created. If it equals "default", then the primary grid's default coordinate system will be used. Otherwise, ***coordsys*** must be the name of an NMPlot coordinate system file. To create a coordinate system file, 1) start NMPlot, 2) choose Export to GIS from the File menu, 3) press the Properties button, 4) choose Export in the Following Coordinate System, 5) press the Browse button  to display the Select Coordinate System dialog box, 6) select the desired coordinate system, including the datum, and 7) press the Save To File button, then type the desired file name.

plotfilename is used to specify the plot options: the contour levels, whether geographic annotations are exported, etc. This file is not modified.

shapefilename is a model file name that controls the name(s) of the Shapefile(s) created. This model file name works exactly like the Output Filenames section of NMPlot's Export to GIS dialog box. See *Section 17.1, Export to GIS Dialog Box*, for more information.

The last three parameters — ***coordsys***, ***plotfilename***, and ***shapefilename*** — are optional. If they do not appear, then their values are constructed by taking ***gridfilename*** and changing the file extension to `.coordsys`, `.nmp`, and `.shp`, respectively.

E.3.3. Examples

```
C:\>nmplot -se mygrid.grd mycoordsys.coordsys myplot.nmp myoutput.shp

C:\>nmplot -se mygrid.grd default myplot.nmp myoutput.shp

C:\>nmplot -se mygrid.grd
```

E.3.4. Comments

This command line is intended to be used as part of a batch operation. NMPlot will exit after creating the Shapefile(s).

E.4. Export a Plot in DXF Format

E.4.1. Synopsis

-ExportToDXF *gridfilename plotfilename dxffilename coordsys*

E.4.2. Description

Exports a plot in AutoCAD Data Exchange Format (DXF) format. NMPlot reads the plot from file ***plotfilename***, temporarily sets the plot's primary grid to ***gridfilename***, and exports the plot to a Geographic Information System (GIS) in DXF format.

plotfilename is used to specify the plot options: the contour levels, whether geographic annotations are exported, etc. This file is not modified.

dxffilename is the name of the DXF file that will be created.

coordsys controls the coordinate system used for locations in the DXF file. It must be either "Default" for the primary grid's default coordinate system, or "LongLat" for decimal degrees of east longitude and north latitude.

E.4.3. Example

```
C:\>nmplot -ExportToDXF mygrid.grd myplot.nmp myoutput.dxf LongLat
```

E.4.4. Comments

This command line is intended to be used as part of a batch operation. NMPlot will exit after creating the DXF file.

E.5. Interpolate Grid Data Levels at a List of User-Supplied Points

E.5.1. Synopsis

-pi *gridfilename [coordsys pointsfilename resultsfilename]*

E.5.2. Description

NMPlot reads the grid from file ***gridfilename***, reads the file ***pointsfilename*** (a text file containing a list of point coordinates specified using the coordinate system denoted by the ***coordsys*** parameter), determines the grid data level at each point by interpolating into the grid, and then writes the interpolated grid data levels to the text file ***resultsfilename***.

coordsys controls the coordinate system used to specify locations in the points file. If it equals "default", then the primary grid's default coordinate system will be used. Otherwise, ***coordsys*** must be the name of an NMPlot coordinate system file. To create a coordinate system file, 1) start NMPlot, 2) choose Export to GIS from the File menu, 3) press the Properties button, 4) choose Export in the Following Coordinate System, 5) press the Browse button  to display the Select Coordinate System dialog box, 6) select the desired coordinate system, including the datum, and 7) press the Save To File button, then type the desired file name.

pointsfilename is a simple text file. Its lines specify the points, one per line. Each line consists of three fields, separated by either commas or tab characters. The three fields contain:

1. A descriptive alphanumeric name for each point
2. The X coordinate of each point
3. The Y coordinate of each point

The meaning of the X and Y coordinates will depend on the coordinate system of the points. For example, if the coordinate system is longitude and latitude, X is the longitude and Y is the latitude.

Here is an example points file.

```
Baker High School,          -95.2343, 32.4857
Jackson Junior High School, -95.2938, 32.4492
St. Mary's Hospital,        -95.3037, 32.5088
```

resultsfilename is a simple text file. Its lines specify the interpolated grid data levels for each point, one per line, in the same order as the points appear in the points file. Each line consists of

two fields, separated by either commas or tab characters (depending on the character used to separate columns in the points file). The two fields contain:

1. The descriptive alphanumeric name of each point

2. The interpolated grid data level for each point, or -9999 if the point is located outside of the grid's defined area polygon

Here is an example results file.

```
Baker High School,          65.4
Jackson Junior High School, 62.3
St. Mary's Hospital,        53.8
```

The last three parameters — ***coordsys***, ***pointsfilename***, and ***resultsfilename*** — are optional. If they do not appear, then their values are constructed by taking ***gridfilename*** and changing the file extension to `.coordsys`, `.pts`, and `.out`, respectively.

E.5.3. Examples

```
C:\>nmplot -pi mygrid.grd mycoordsys.coordsys mypoints.pts results.out

C:\>nmplot -pi mygrid.grd default mypoints.pts results.out

C:\>nmplot -pi mygrid.grd
```

E.5.4. Comments

This command line is intended to be used as part of a batch operation. NMPlot will exit after creating the results file.

Appendix F

Introduction to the Noise Model Grid Format

The Noise Model Grid Format (NMGF) is a well-documented standard way of representing a grid and its auxiliary information.

Internally, NMPlot processes all grids using NMGF, as shown in the Details pane of the Grid Document window.

The NMGF standard includes a format for storing grids in files. Many third-party applications communicate with NMPlot using NMGF grid files. Writing a NMGF file is the easiest ways to import third-party data into NMPlot. For a quick-start guide to creating NMGF files for this purpose, see *Appendix G, Quick-Start Guide to Importing Data into NMPlot*.

F.1. Full Documentation for NMGF

This appendix provides an overview of the NMGF standard. Complete documentation is available from the NMGF web page, http://www.wasmerconsulting.com/nmgf.htm.

F.2. Why Was NMGF Developed?

There are a number of computer models in use that calculate the noise impacts of installations, such as airports and railroads, upon the surrounding community. Examples of such models include the United States Air Force's (USAF) NOISEMAP and the United States Federal Aviation Administration's (US FAA) Integrated Noise Model (INM).

In the early 1990's, each model defined its own output file format. This resulted in duplicate effort developing post-processing utilities that performed essentially the same tasks. For example, both the USAF and the US FAA independently developed contour plotting utilities for use with their respective noise models.

To promote the development of shared post-processing utilities, the USAF and the US FAA sponsored the development of a standard grid file format that met the needs of both models. This format is known as the Noise Model Grid Format (NMGF). Version 1.0 of this format was released in September 1993.

F.3. NMGF: Not Just For Environmental Noise Models

While NMGF was originally developed to support noise models, it is neutral to any particular application domain. A NMGF grid can just as easily contain data from other types of models (for example, air pollution models) or from sources other than computer models (for example, measured data).

F.4. NMGF Sections

Data is stored in the NMGF format as a list of *sections*. There are more than 30 types of sections, each with a specific purpose. For example, a CART section defines a coordinate system used to specify geographic locations in a grid.

Section types are defined that specify data points (both on rectangular grids and as lists of location-value pairs), information about data points (the physical units, the range of valid data point values, etc.), geographic annotations (for example, the locations of roads and buildings), and bookkeeping information (where the data came from, who created the data, etc.).

F.5. Child Sections

The NMGF data structure is hierarchical. That is, sections can have subsections, called *child sections*. A child section specifies an attributes of its parent section.

As an example, consider the ZCRD section, which specifies an altitude or height. A ZCRD section by itself is meaningless: you do not know what the altitude refers to. The ZCRD section is always used as a child of the section it refers to.

Consider the PNTS section, which specifies information about a point geographic feature (for example, the location of a house). This section has several required parameters, such as the geographic coordinates of the point. The altitude of the point is not a required parameter. However, the ZCRD section can optionally appear as a child of the PNTS section to specify the altitude of the point.

F.6. Types of NMGF Sections

F.6.1. Geographic Coordinate System Specification

This NMGF section defines a geographic coordinate system used to specify locations in the grid. If a grid does not contain a CART or UTMC section, longitude and latitude are assumed.

- **CART** - Define a local flat-Earth Cartesian coordinate system for specifying geographic coordinates
- **UTMC** - Define a Universal Transverse Mecator (UTM) coordinate system for specifying geographic coordinates

F.6.2. Data Point Specification

These NMGF sections specify information about the data points in a grid.

- **DAPY** - Specify the grid's defined area polygon: i.e., the geographic area where data is known. See *Section 4.2.5, Defined Area Polygon*.
- **DPAL** - Specify a group of data points as a list of location-value pairs.
- **GRID** - Specify a group of data point arranged on a regular rectangular grid
- **GTSH** - Specify the range of data point values that is considered valid
- **MTRC** - Specify what is being measured by the data points, and what units of measurement are used
- **SUBG** - Specify a *nested subgrid*: i.e., a set of data points that doubles the resolution of a portion of a grid

F.6.3. Geographic Annotations

These NMGF sections specify map data stored in a grid.

- **AREM** - Define a geographic feature consisting of one or more closed polygons
- **ARES** - Define a geographic feature consisting of a single closed polygon
- **BKMP** - Define information about a background map that is stored in an external file
- **LINC** - Define a geographic feature consisting of a series of (possibly non-contiguous) lines and arcs, described by a series of commands that move a hypothetical cursor
- **LINM** - Define a geographic feature consisting of one or more continuous lines
- **LINS** - Define a geographic feature consisting of a single continuous line
- **PNTM** - Define a geographic feature consisting of one or more points
- **PNTS** - Define a geographic feature consisting of a single point

F.6.4. Audit Trail

This NMGF section is used to record the creation and modification history of a grid.

- **SORC** - Specify audit trail information about a grid: how, why, when, where, and by whom it was created

F.6.5. Predefined Optional Attributes

These NMGF sections allow predefined optional attributes to be specified. They are used only as child sections.

- **DATE** - Specify a date
- **DESL** - Specify a detailed multiple-line description of an object
- **DESS** - Specify the proper name or a short one-line description of an object
- **HEAD** - Specify the direction (i.e., the heading) of an object
- **PERS** - Specify information about a person: name, telephone number, etc.
- **PROG** - Specify the name and version of a computer program

- **TIME** - Specify a time
- **WARN** - Specify a problem or limitation of the data in a NMGF grid
- **ZCRD** - Specify the height or altitude of an object

F.6.6. Arbitrary Optional Attributes

These NMGF sections allow grids to store information that was not anticipated by the designers of the NMGF format: arbitrary attributes can be specified as name-value pairs. These sections are used only as child sections.

- **ATRC** - Specify a coordinate as an arbitrary attribute of a NMGF section
- **ATRF** - Specify a floating point number as an arbitrary attribute of a NMGF section
- **ATRI** - Specify an integer as an arbitrary attribute of a NMGF section
- **ATRS** - Specify text as an arbitrary attribute of a NMGF section
- **ATRT** - Specify a table of information as an attribute of a NMGF section

F.6.7. File Control

These NMGF sections control the processing of a NMGF grid when it is stored in a file.

- **ENDF** - Mark the end of a NMGF grid file
- **TITL** - Mark the beginning of a NMGF grid file, and specify the NMGF version number

F.7. Simple Rectangular Grid Optimization

If a grid meets the following conditions, NMPlot can use alternative interpolation and contouring algorithms that are faster and use less memory.

- The grid contains a single GRID section, and does not contain any DPAL or SUBG sections.
- The grid either a) does not contain a GTSH section, or b) does not contain any invalid data points (i.e., data points whose values are outside the valid range specified by the GTSH section).

For large grids, the time and memory savings can be substantial. Therefore, if your data points are arranged on a regular, rectangular lattice of locations, they should be specified using a GRID section instead of a DPAL section.

Appendix

Quick-Start Guide to Importing Data into NMPlot

G

NMPlot is a powerful application for working with grid data sets. If you would like to use NMPlot to work with your data, you must first put it into a format that NMPlot can import. This appendix is a quick-start guide to doing so with a minimum of effort.

The easiest way to import your data is to create a text-based NMGF grid file. The NMGF format, while powerful and well-documented, can be somewhat intimidating when all you want to do is create a simple grid file. Therefore, this appendix describes the bare minimum necessary to do so.

 ***Note:***

If you are using NMPlot as part of a third-party application (BNOISE2, INM, NOISEMAP, ROUTEMAP, SARNAM, SIPS, or TNM), you can skip this section, as these applications write files that NMPlot can read directly.

G.1. What is the bare minimum I have to do to create an NMGF file?

Create a text file with the following text, replacing the sample data points with your own.

```
{TITL Grid Vers 2 3}
{DPAL 5
    (-90.02, 45.00) 50.0
    (-90.02, 45.02) 50.0
    (-90.00, 45.02) 50.0
    (-90.00, 45.00) 50.0
    (-90.01, 45.01) 60.0
```

```
}
{ENDF}
```

The first and last lines, beginning with {TITL and {ENDF, denote the beginning and end of the data set. They must appear exactly as shown.

The middle seven lines specify the actual data. The line...

```
{DPAL 5
```

...specifies that 5 Data Points with Arbitrary Locations (DPAL) follow. Each data point is specified by a location (the numbers in parentheses) and a data value at that location (the numbers after the parentheses). The locations are specified in decimal degrees of east longitude and north latitude. West longitudes are negative, so the point (-90.02, 45.00) is at longitude 90.02 degrees west, latitude 45.00 degrees north.

G.2. Do I Have To Use Longitude and Latitude to Specify My Data Point Locations?

No, you can use Cartesian coordinates to specify locations. Add the following line just after the line that begins with {TITL.

```
{CART -90.0 45.0 0 0 METR 0}
```

This specifies that all locations will be given in meters east and north from longitude 90.0 west, latitude 45.0 north. If you want to use feet, replace METR with FEET.

Here is the modified example file.

```
{TITL Grid Vers 2 3}
{CART -90.0 45.0 0 0 METR 0}
{DPAL 5
    (  0,   0) 50.0
    (  0, 100) 50.0
    (100, 100) 50.0
    (100,   0) 50.0
    ( 50,  50) 60.0
}
{ENDF}
```

G.3. How Do I Specify The Physical Units of the Data Points?

Add the following line just before your data points.

```
{MTRC "Air Temperature" "F"}
```

The first quoted text string describes what is being measured. The second specifies the physical units.

Here is the modified example file.

```
{TITL Grid Vers 2 3}
{CART -90.0 45.0 0 0 METR 0}
{MTRC "Measured air temperature" "F"}
{DPAL 5
    (  0,   0) 50.0
    (  0, 100) 50.0
    (100, 100) 50.0
    (100,   0) 50.0
    ( 50,  50) 60.0
}
{ENDF}
```

G.4. Can I Add More Detailed Notes About My Data?

Yes. Add the following lines just after the line that begins with {TITL.

```
{SORC "Measured"
    {DESS "Measured air temperature at 1 meter above ground level"}
    {DESL "Measurements made using a ACME model X34 thermocouple"}
}
```

The quoted text after SORC specifies the broad category of the data's origin. It can be any text, but it is suggested that "Measured" be used for measured data, and "Model" be used for the output of numerical models.

The quoted text after DESS is a short description of the data in the file. If possible, it should be kept under 60 characters in length. This text should be appropriate for use as, say, the title of a contour plot of the data.

The quoted text after DESL is a long, detailed description of the data in the file and any notes you wish to add. It can be as long as necessary, and can contain line breaks.

Here is the modified example file.

```
{TITL Grid Vers 2 3}
{SORC "Measured"
    {DESS "Measured air temperature at 1 meter above ground level"}
    {DESL "Measurements made using a ACME model X34 thermocouple"}
}
{CART -90.0 45.0 0 0 METR 0}
{MTRC "Measured air temperature" "F"}
{DPAL 5
    (  0,   0) 50.0
    (  0, 100) 50.0
    (100, 100) 50.0
    (100,   0) 50.0
    ( 50,  50) 60.0
}
{ENDF}
```

G.5. Where Can I Get Additional Information?

The NMGF standard has many additional features that you can use to describe and annotate your data. To learn more, visit the NMGF web page, http://wasmerconsulting.com/nmgf.htm.

Appendix H

Introduction to Datums

H.1. What is a Datum?

A datum is a detailed survey of a country, continent, or some other portion of the Earth's surface. As part of the survey, the longitudes and latitudes of a large number of points are measured using the best available methods. Once the survey is complete, maps of the region can be constructed.

Over time, the accuracy of surveying methods has steadily improved. Therefore, most regions of the Earth of been surveyed many times, with increasingly accuracy. Each of these surveys is referred to as a datum. With each new datum, the longitude and latitude of a given point on the Earth will change. This change can be as large as several hundred meters.

H.2. Why are Datums Important?

Adopting a new datum is expensive. Maps must be reprinted. Data files must be converted. Computer programs must be modified. Therefore, at any given time, more than one datum will likely be in use for a given region.

For example, in the United States, both the North American Datum of 1927 (NAD-27) and the World Geodetic System of 1984 (WGS-84) are in widespread use. In addition, maps and data in numerous lesser-used datums are also available.

For this reason, longitude and latitude alone are insufficient to describe the location of a point with an accuracy better than a few hundred meters. If greater accuracy is required, another piece of information is needed: the datum.

☞ *Note:*

Even if you are certain that all of your data and maps are in a single, consistent datum, you still may need to know what that datum is. For example, the datum is required in order to convert from Universal Transverse Mercator (UTM) coordinates to longitude and latitude. This is because the conversion depends on the ellipsoid (a mathematical model of the Earth's shape), and the ellipsoid is part of the datum.

H.3. Doesn't WGS-84 Solve the Datum Problem?

Most datums are local, intended to be used for only a portion of the Earth's surface. However, in recent decades, improved surveying techniques have enabled global datums to be established. These datums can be used to accurately map the entire Earth.

The most recent, and most accurate, datum is the World Geodetic System of 1984 (WGS-84). While future improvements in surveying techniques may result in modifications to this datum, these are expected to be minor: the coordinates of locations should shift by only a few centimeters. Therefore, for most practical applications, WGS-84 represents the ultimate datum.

Once all maps and data are converted to WGS-84, the problems associated with multiple datums will disappear. Therefore, mapping organizations throughout the world are converting to WGS-84.

Unfortunately, the goal of a single global datum has not yet been attained. Converting to a new datum is expensive and time-consuming. Therefore, the conversion to WGS-84 is proceeding slowly, and may take decades. Certainly for the foreseeable future, the existence of multiple datums will be a reality. Anyone who works with geographic data must be prepared to deal with this fact.

H.4. How NMPlot Converts Between Datums

NMPlot can convert between most common datums. The 3-parameter Molodensky transformation is used for this purpose. Transformation parameters were taken from *Department of Defense World Geodetic System 1984—Its Definition and Relationships with Local Geodetic Systems*, NIMA Technical Report TR8350.2, Third Edition, Amendment 1, 3 January 2000.

H.5. Recommendations

If errors of several hundred meters are acceptable, you can ignore the entire issue of datums. However, if you require greater accuracy, then you must know the datum of any geographic data you use.

Whenever you obtain geographic data (maps, computer files, tables of locations), make sure that you determine the datum of that data. For maps, the datum can often be found printed in the legend area of the map. For computer files, the datum is often listed in the accompanying documentation. If you cannot determine the datum, ask your source. Any reputable source of geographic data should be able to supply this information.

Similarly, whenever you supply geographic data to others, make sure you tell them the datum. Include the datum in any documentation you provide.

If you are working with computer programs that process geographic data, insure that you know how those programs handles datums. Some programs (such as NMPlot) allow you to specify the datum of your data. Others require that all data be in a fixed datum. Consult the program's documentation.

If you are working with a global positioning system (GPS), make sure you know the datum that your GPS displays locations in. Many allow you to select the display datum.

If you absolutely cannot determine the datum of your data, then WGS-84 should be assumed. However, be aware of the potential errors if this assumption is incorrect.

Appendix

Contacting Wasmer Consulting

I

NMPlot was developed by Wasmer Consulting, a software development firm specializing in scientific and engineering applications. Since 1989, Wasmer Consulting has been developing products with an emphasis on quality and usability.

Wasmer Consulting welcomes your comments about NMPlot: both reports of problems and suggestions for future enhancements.

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