GIS Module User's Guide

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Welcome to the FFI GIS module

This *User's Guide* covers installation and operation of the FFI GIS module, which is a component of the FFI ecological monitoring utilities toolset.

FFI GIS is accessible as a toolbar in ArcMap 9.2, and requires installation of FFI and ArcGIS on your desktop computer. The FFI GIS module provides support in developing project units and candidate plots. A custom tool within the module lets you overlay different types of GIS layers to identify the geographical area occupied by sample populations. FFI GIS also allows you to randomly or selectively choose sample points. In addition, the module includes tools to identify severity thresholds in dNBR layers for CBI sampling.

About FFI

FFI version 1.02 is an integration of FEAT and FIREMON, two respected, science-based programs used for fire effects monitoring on public lands. Developed jointly by the National Park Service and the Bureau of Reclamation, FFI was designed as a comprehensive, database-driven framework that organizes sampling protocols, stores field data, and provides analysis tools for vegetation sampling and monitoring programs. FFI is designed for people with vegetation sampling experience who need a way to organize their sampling data so that it can be readily accessed.

The goal of FFI is to act as a robust monitoring tool that can be used across public agencies, as well as private entities, to consistently describe ecological systems. It incorporates components necessary to conduct a successful monitoring program, including an integral database, analysis and reporting tools, a protocol manager that enables users to develop their own sampling methods when needed, as well as FFI GIS, the spatial component. For more information about FFI, visit the on-line information page at frames.nbii.gov/ffi.

About the *User's Guide*

There are three separate User's Guides :

- FFI (main application)
- Protocol Manager
- GIS Module

Each *User's Guide* is available in three formats: on-line, as desktop help, and in PDF format. It will be updated as FFI is revised, and updates will be announced to the user community via the on-line FFI information page at frames.nbii.gov/ffi.

See also: Roadmap to the User's Guide

Links

- On-line (missing or bad snippet) information at FRAMES
- On-line users community at Google Groups

There are three separate User's Guides available at FRAMES and on-line:

- (missing or bad snippet) (main application)
- Protocol Manager
- GIS Module

User's Guide roadmap

Follow the links to reach the components of the User's Guide:

- Getting help
- Installation
- FFI GIS basics
- Using the FFI GIS toolbar in ArcMap
- Using the FFI GIS toolbar for CBI

Getting additional help

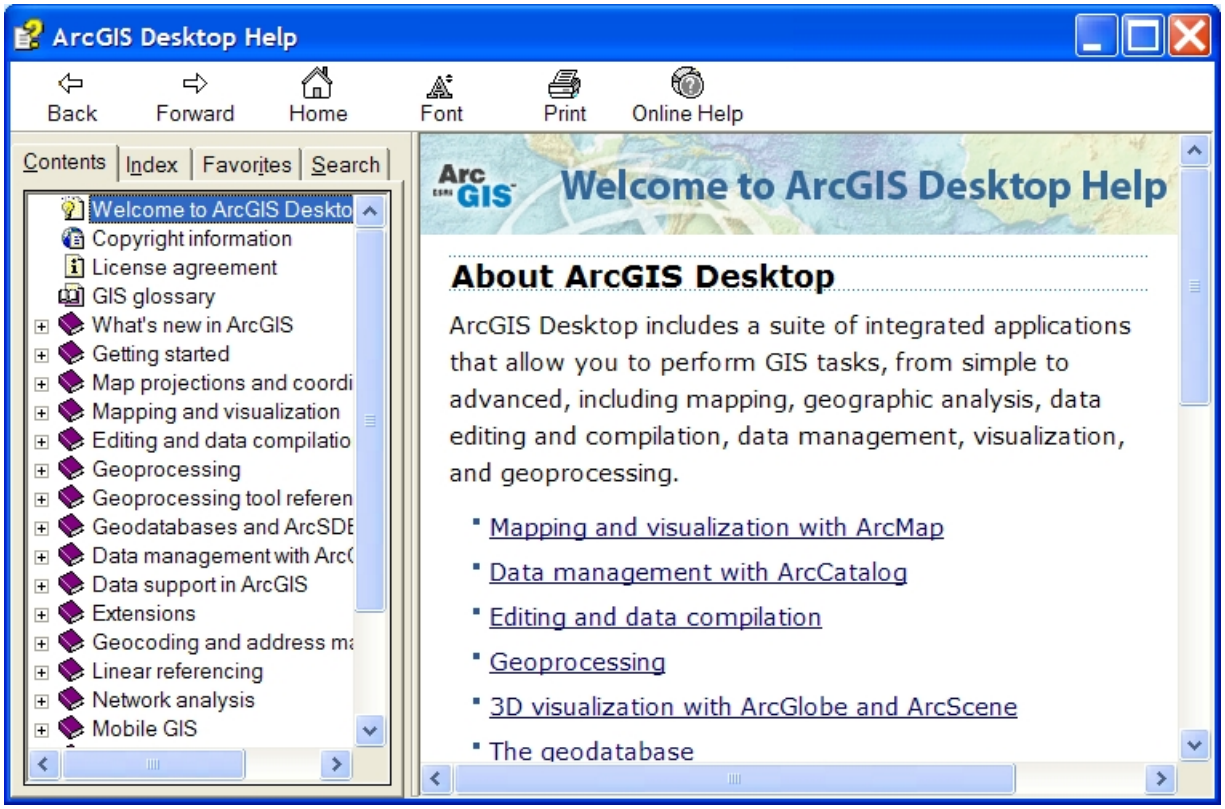
If you need help beyond the information provided in this *User's Guide*, visit the on-line FFI information page at frames.nbii.gov/ffi. This FRAMES page provides:

- Information about the FFI ecological monitoring utilities.
- Links to FFI documentation and training information.
- Links to other FRAMES pages.
- Calendar of upcoming events.
- Contact information for members of the FFI team.

Also visit the on-line users community at Google Groups

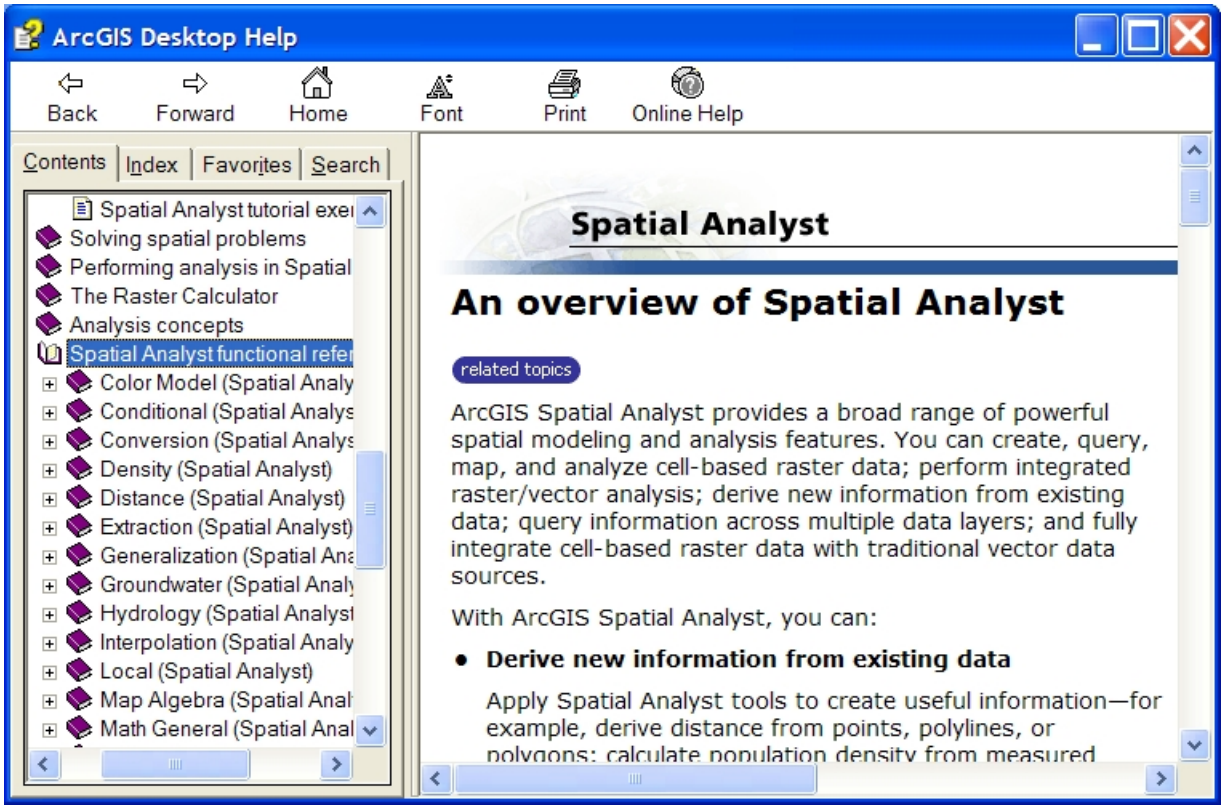
Using ArcGIS desktop help

Further information on using ESRI ArcGIS is available both on-line and in book format. Refer first to Chapter 1 in the Using ArcMap handbook or open the comprehensive ArcGIS Desktop Help file at **C:\Program Files\ArcGIS\Help**.



NOTE: ESRI offers a two-part on-line training course, and other tutorials are available from ESRI's virtual campus. If you would like additional ArcGIS training, visit ESRI at campus.esri.com or visit www.esri.com for seminar opportunities. The two-part training course is available to National Park Service employees at no charge.

For more help with Spatial Analyst and its functions, including manipulation of GRID data, go to **Extensions > Spatial Analyst>Spatial Analyst functional reference** in ArcGIS Desktop Help. Like ArcGIS Help, this reference contains an index and search capabilities.



Installation

This section outlines the three steps in installing the FFI GIS toolbar in ArcMap.

- Installing FFI GIS
- Starting ArcMap
- Loading the FFI GIS toolbar

Installing FFI GIS

FFI GIS is an optional FFI module, designed to be used as a toolbar within ArcMap 9.2.

Required software

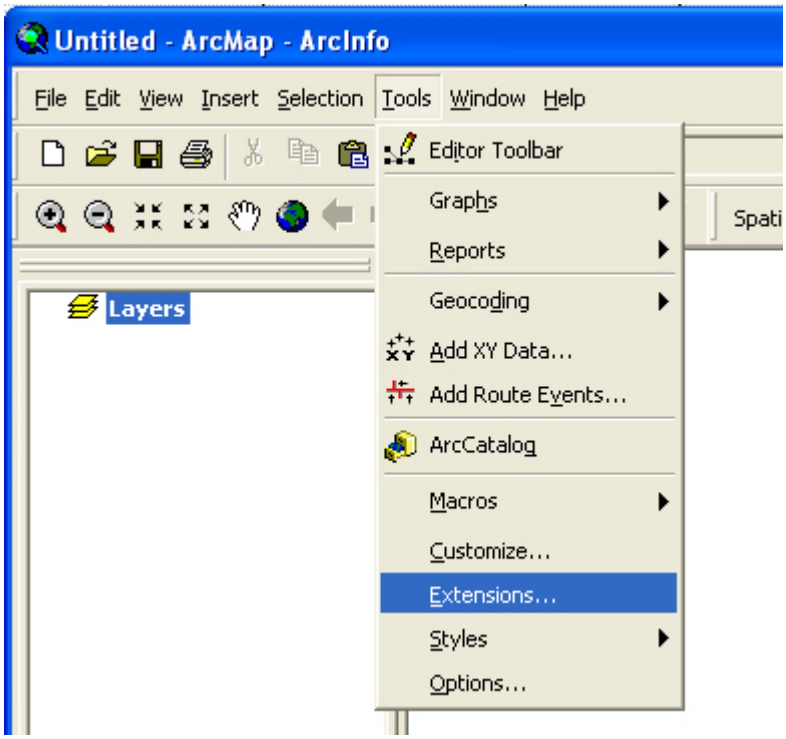
- FFI version 1.02
- ESRI ArcGIS 9.2 with:
  - Service Pack 2 or later
  - ESRI .NET support feature
- ESRI Spatial Analyst 9.2 with Service Pack 2 or later

NOTE: If you do not have Service Pack 2, visit the ESRI Web site.

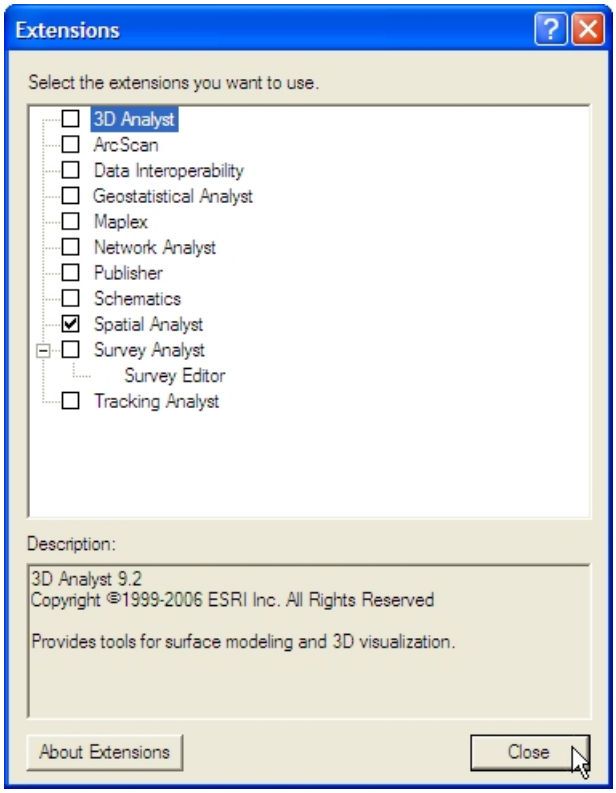
Installation procedure

To install FFI GIS:

1. Download the FFI GIS toolbar installer to your desktop.
2. Ensure that all required software is installed.
3. Double-click the FFI_GIS .exe icon on your desktop and follow the instructions. This will add the FFI GIS toolbar to ArcMap.
4. Open ArcMap.
5. To ensure that ESRI Spatial Analyst is installed and turned on, click the **Tools** pull-down menu.
6. Select **Extensions.**



7. In the **Extensions** list, check the box next to **Spatial Analyst** and click **Close.**



8. Close ArcMap and any other ArcGIS modules that might be open.

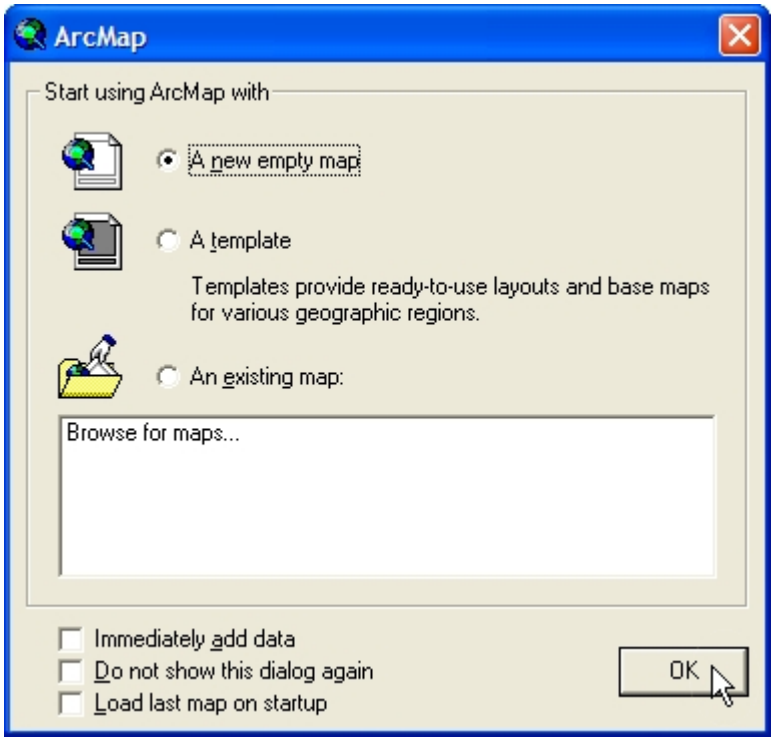
All of the Spatial Analyst functions should now be available for use. If Spatial Analyst does not appear in the list of extensions, install it from the ESRI CD.

Next: Starting ArcMap

Starting ArcMap

After you have installed the FFI GIS toolbar, navigate through **Start > Programs > ArcGIS > ArcMap**.

You will be prompted with the following window:



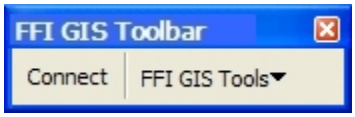
- If you have not used the FFI GIS toolbar before, select **A new empty map.**
- If you have already created a map for use with FFI, select **An existing map** and browse to the directory where the map is saved.

NOTE: See Storing maps and map data for information on where to file maps and data sources.

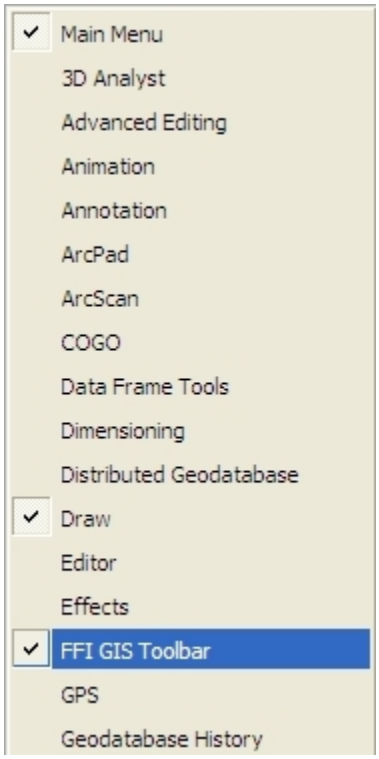
Next: Loading the FFI GIS toolbar in ArcMap

Loading the FFI GIS toolbar

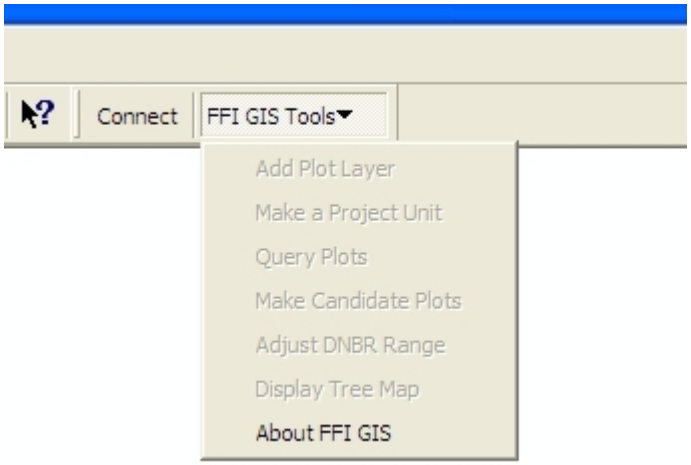
When ArcMap opens, look for the FFI GIS toolbar. The toolbar may be docked with the other toolbars at the top of the ArcMap window, or it may be floating on your screen.



If you do not see the toolbar, right-click anywhere in the toolbar area at the top of the ArcMap window. In the list that opens, select **FFI GIS Toolbar**.



Drag the toolbar and dock it with the other toolbars if desired.



NOTE: If the toolbar does not appear in the list of extensions, it has not yet been installed. Make sure that the Spatial Analyst Extension is installed and turned on before attempting to install the FFI GIS Toolbar.

Next: FFI GIS basics

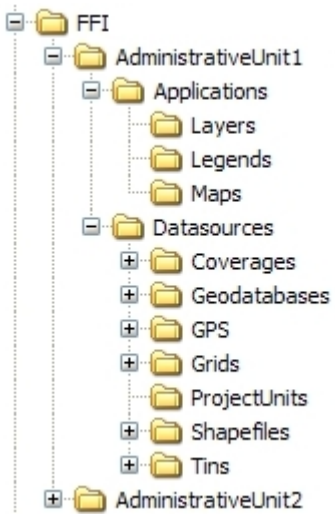
FFI GIS basics

This section provides a framework for using maps and data with the FFI GIS toolbar.

- Storing maps and map data
- Connecting your map
- Adding data to your map
- Setting project parameters
- Converting layers to GRID format

Storing maps and map data

GIS datasets can be used by FFI GIS wherever they are stored on your system. You do not need to copy datasets to a special folder. You may wish to create a folder structure as pictured below for storing maps and datasets that you create as you use the tool. This suggested structure provides a folder for the project unit raster files that you will generate.



To save your map in the recommended project unit folder, go to **File > Save As** and browse to the folder: FFI\AdminUnit\Applications\Maps.

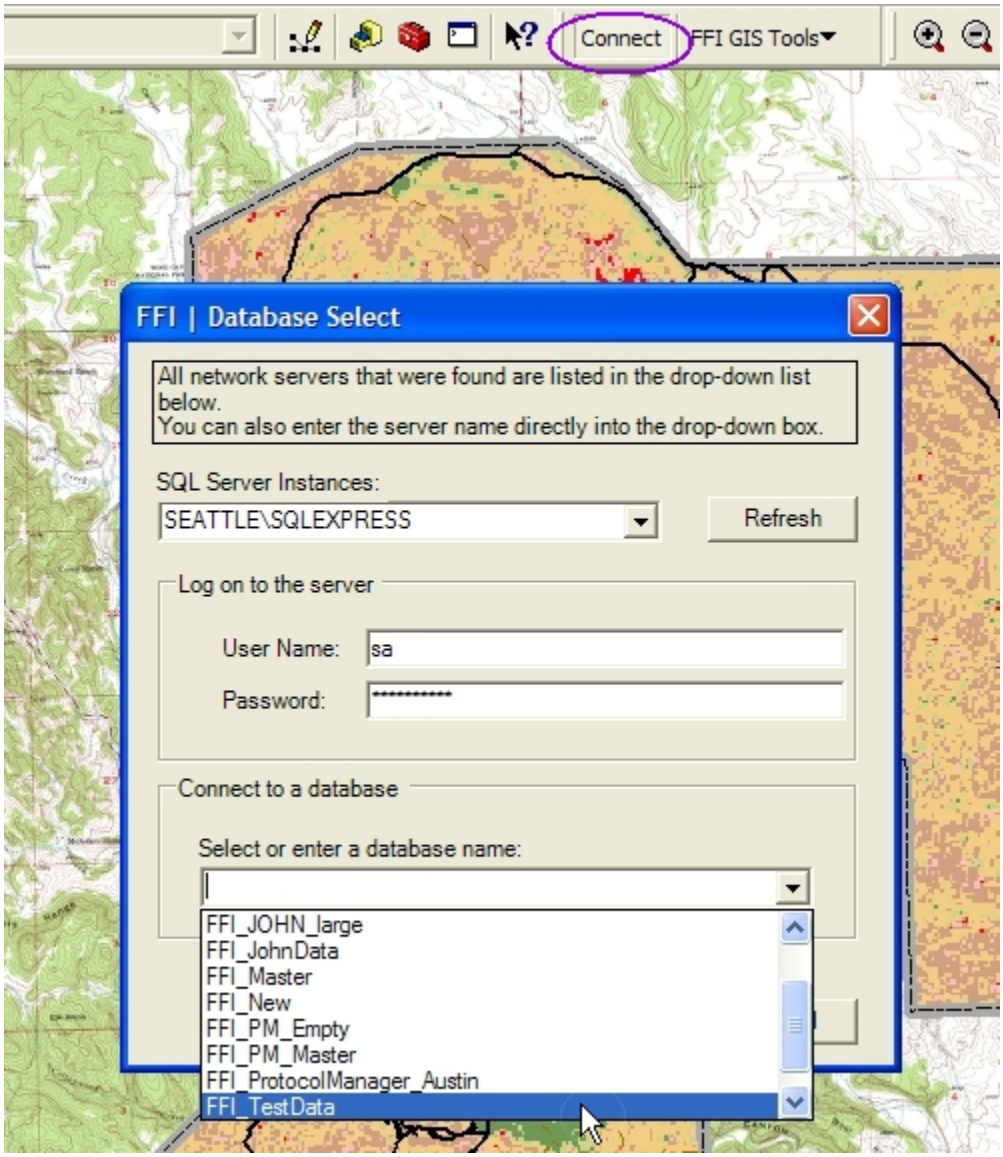
- The folder FFI\AdminUnit\Datasources\Shapefiles can be used to store vector data.
- The folder FFI\AdminUnit\Datasources\Grids can be used to store raster data.

Next: Connecting your map

Connecting your map

In order to use the tools in the FFI GIS toolbar (with the exception of the **Adjust dNBR Range** tool), you must connect your map to your SQL Server database. Follow the steps below to connect your map.

1. Open the map you wish to work with.
2. Ensure that Spatial Analyst is turned on.
3. Click **Connect** in the FFI GIS toolbar and connect to your SQL Server database.



NOTE: You will need to connect each time you open your map.

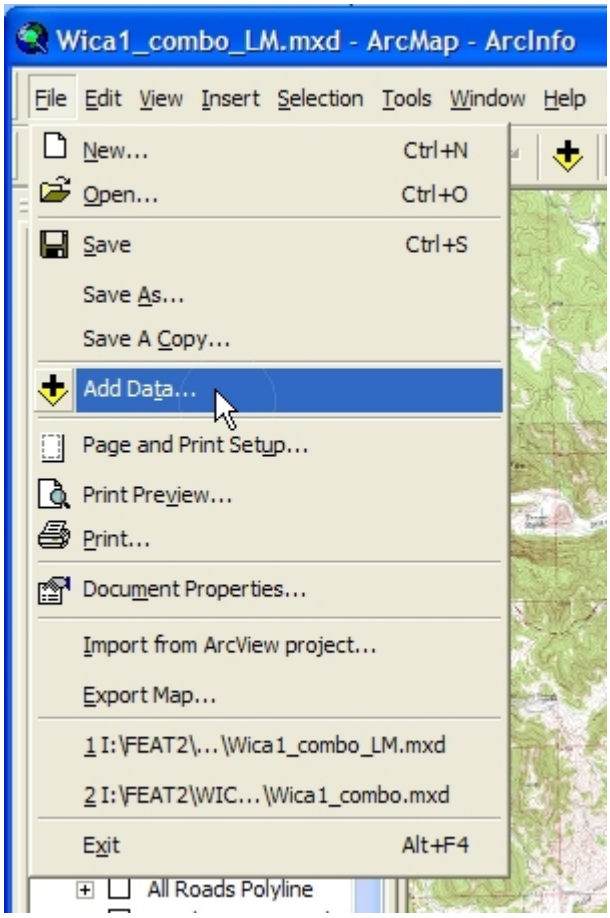
You can connect remotely to an FFI server from a computer that is running ArcGIS and FFI GIS. Your maps and data do not need to be stored on the server and neither ArcGIS nor FFI GIS need to be installed on the server.

Next: Adding GIS data to your map

Adding GIS data to your map

To add data to your map:

1. In ArcMap, select **File > Add Data.**



2. In the **Add Data** dialog box, navigate to the location where the GIS data for the administrative unit is stored.

NOTE. This data can reside on a local computer or on a server. However, if you plan to use the FFI GIS toolbar on a computer that is not connected to your network, the GIS data must reside on the local hard drive.

Below is a partial list of layers that are typically included. See your GIS specialist to determine what data layers are available for your area.

- Park Boundary
- DRGs/DOQs 1:100,000 or 1:24,000
- Elevation
- Slope
- Park Facilities
- Existing Plot Locations

- Vegetation
- Available Fuels
- Roads
- Streams
- Surface Hydrology
- Burn History

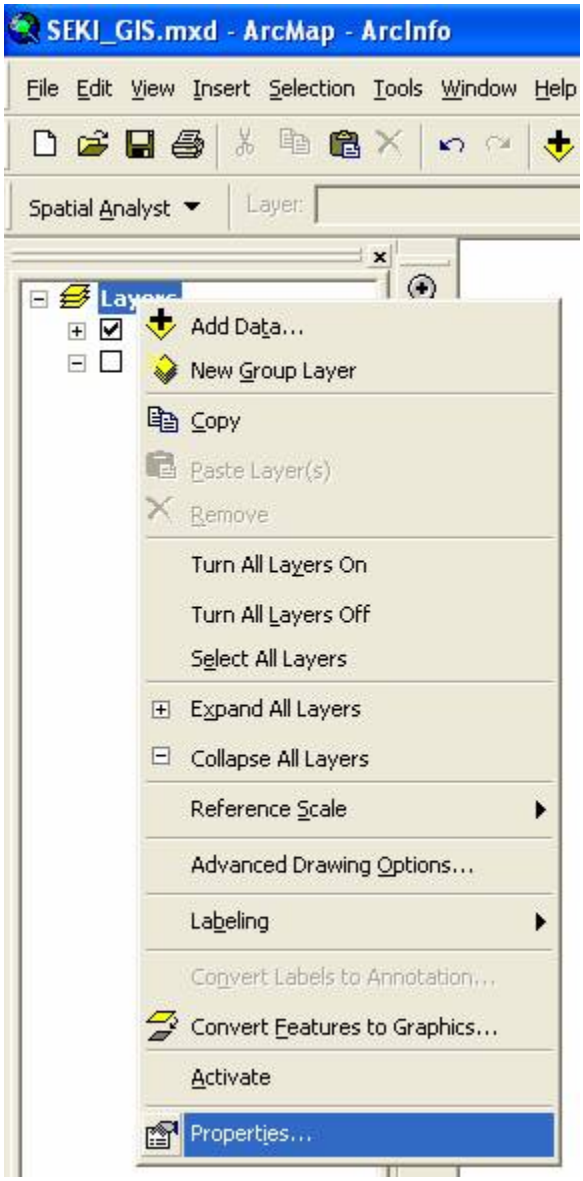
NOTE: Be sure to create a consistent file structure to contain your maps and GIS data. See Storing maps and map data for a suggested file structure.

Next: Setting project parameters

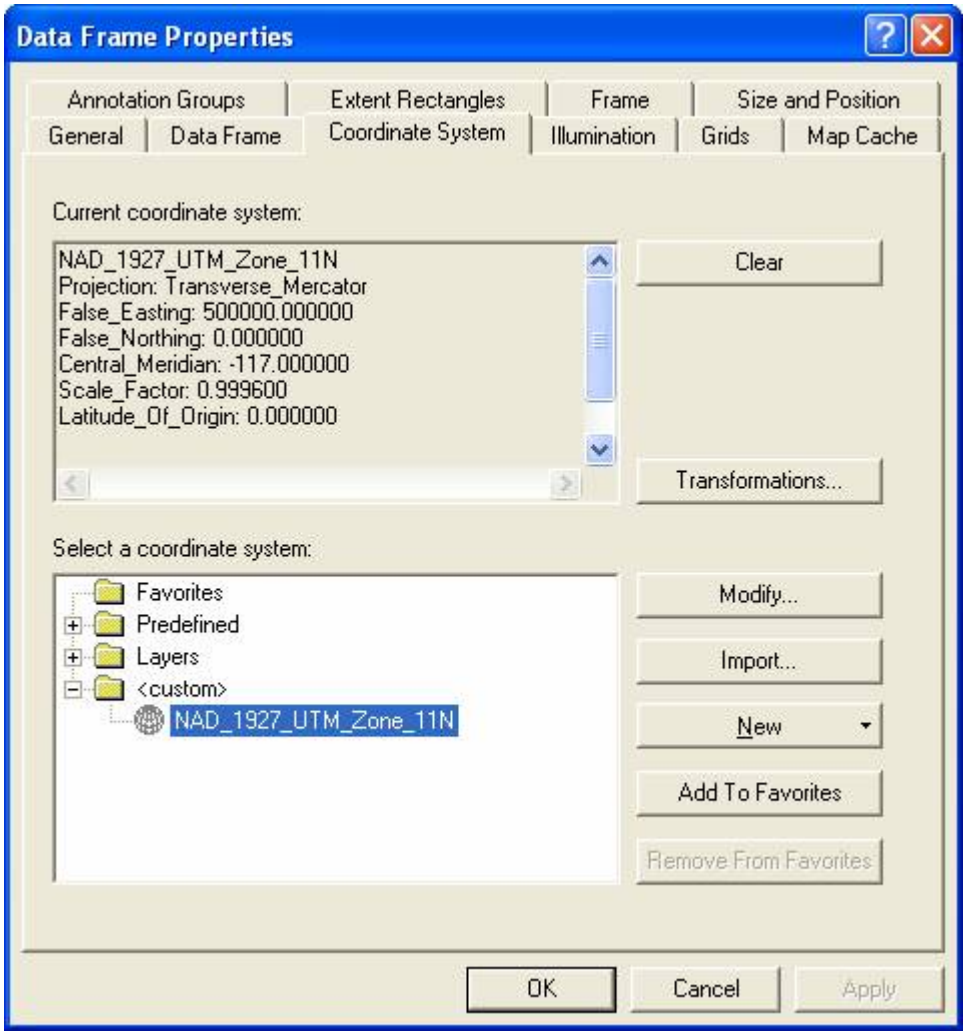
Setting project parameters

It is best to use map data that is all in the same projection. Consult with your GIS specialist to determine what projection your data is in. The projection of your map should be the same as the projection of your recorded plot location coordinates.

To set the projection of your map, right-click on **Layers** and select **Properties.**



This will open the **Data Frame Properties** dialog box. Select the **Coordinate System** tab. This tab will display the current coordinate system of your map. This should be the same coordinate system that you use to record your FFI plot locations. If it is not, you will need to reset the coordinate system of your map.



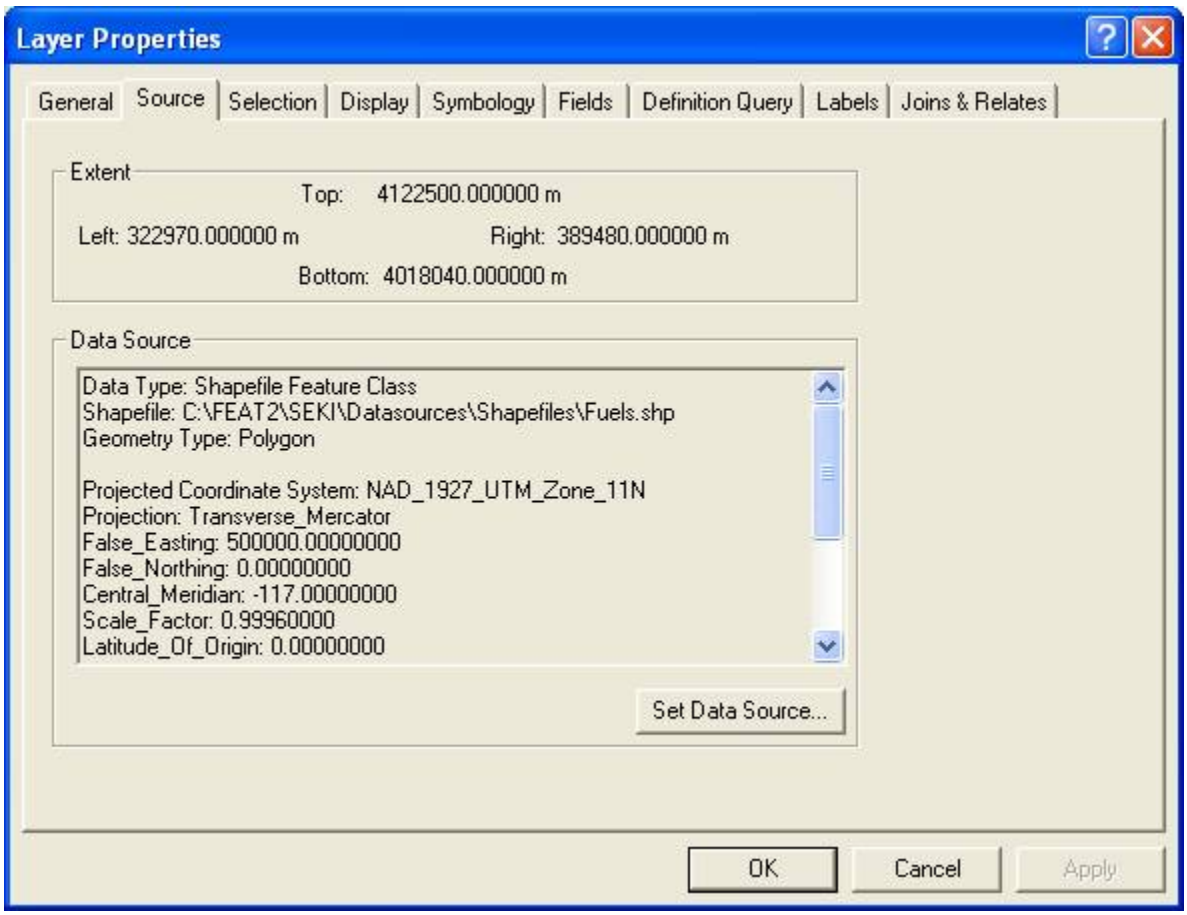
To change the coordinate system of your map, see your GIS specialist. If the coordinate system that you use for plot locations is different from the coordinate system used by your park for your GIS layers, see your GIS specialist.

Next: Converting layers to GRID format

Converting layers to GRID format

Input layers to the project unit form must be in ESRI GRID raster format. These include any layers that you might use to define your project unit, such as vegetation, fuels, elevation, slope, etc. Layers such as elevation and slope are normally in GRID format already. Check layers that will be used to define monitoring units to determine whether they are in GRID format. Use ArcCatalog, rather than Explorer, to manage (move or copy) spatial data.

Double-click on a layer to bring up the **Layer Properties** dialog box. Select the **Source** tab. Under **Data Type** it will read **Shapefile Feature Class** if your data is a shapefile. Shapefiles need to be converted to GRID format for use with the Monitoring Unit form. If your data is already in GRID format, it will read **File System Raster** under **Data Type**. These files are already in GRID format and do not need to be converted.



To convert layers to GRID format:

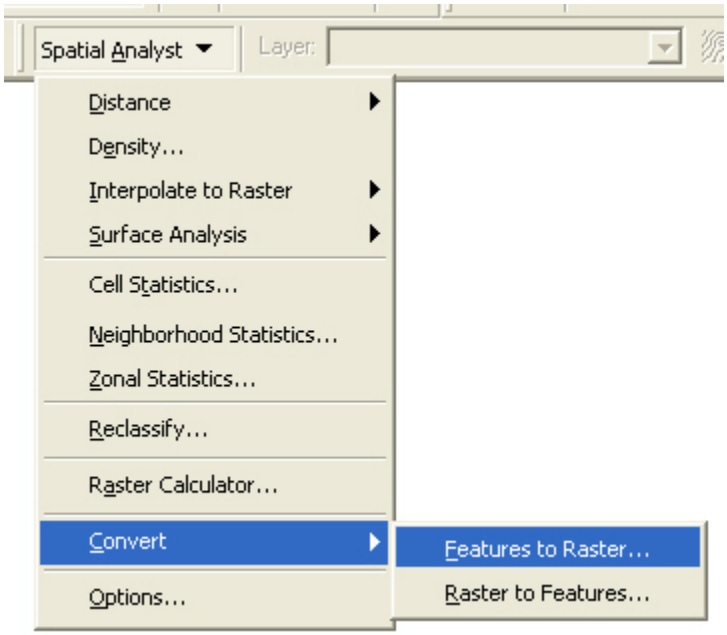
1. Set the Spatial Analyst options.

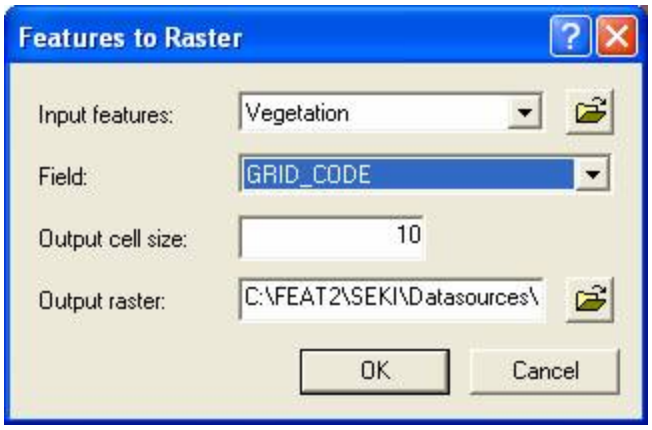
- Select **Options** from the **Spatial Analyst** drop-down.
- Under the **General** tab, click **Browse** to select a working directory. This is the directory where grid data will be stored. You may want to discuss data storage with your GIS specialist. A good choice for the working directory is the folder FFI_Data\ Admin\Datasources\Grids.

- You can leave the rest of the items under the **General** tab as their default values.
- Under the **Extent** tab, click on the **Analysis Extent** drop-down menu. Select a layer that covers your entire administrative unit. The administrative unit boundary layer is a good choice. The other items under this tab can be left as their default values.
- Under the **Cell Size** tab, set the cell size to an appropriate value. Consult with your GIS specialist if you are not sure. This value should probably be set to the smallest cell size found in your various base datasets. Ten meters is a common choice. The other items under this tab can be left as their default values.

2. Select the **Convert** option from the Spatial Analyst drop-down.
3. Select **Features to Raster.**

- In the dialog box, select the file you want to convert to GRID in the **Input** features box.
- In the **Field** drop-down, select the field that you would like to see represented in the output GRID. For example, for vegetation this would be a field which identifies the vegetation type. For fuels this would be the field that identifies the fuel type.
- The **Output Cell Size** should already be set, since you defined it in the **Options** dialog.
- The output raster location will be set to the location you selected for the **Working Directory** in the **Options** dialog. If needed, you can change it now.





4. Click OK to initiate the conversion. Depending on the size of the file, this could take several minutes.

Next: Using the FFI GIS toolbar

Using the FFI GIS toolbar

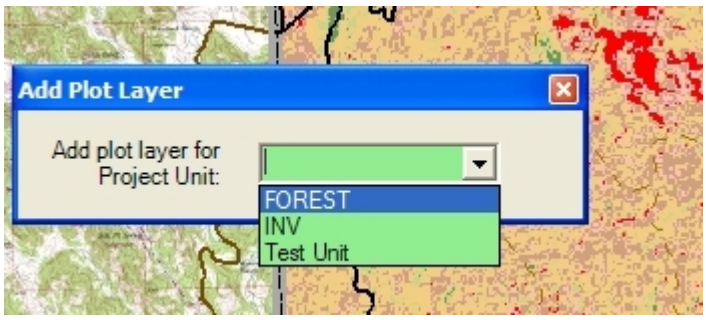
This section outlines the functions included in the FFI GIS toolbar.

- Adding a plot layer
- Making a project unit
- Querying plots
- Making candidate plots
- Adjusting dNBR range
- Displaying a tree map

Adding a plot layer

This menu item adds a plot layer to the map. You can add a plot layer for a single project unit at a time; however, you can add a layer for each project unit and symbolize each differently in order to view the plots separately. Plot layers can be saved with the map but will not be 'live', and will not always display the current plots.

Plot locations are based on the X, Y coordinates in your FFI database. These must be in the same projection as your map. When the map is re-opened, this layer displays without the need to click **Connect**.



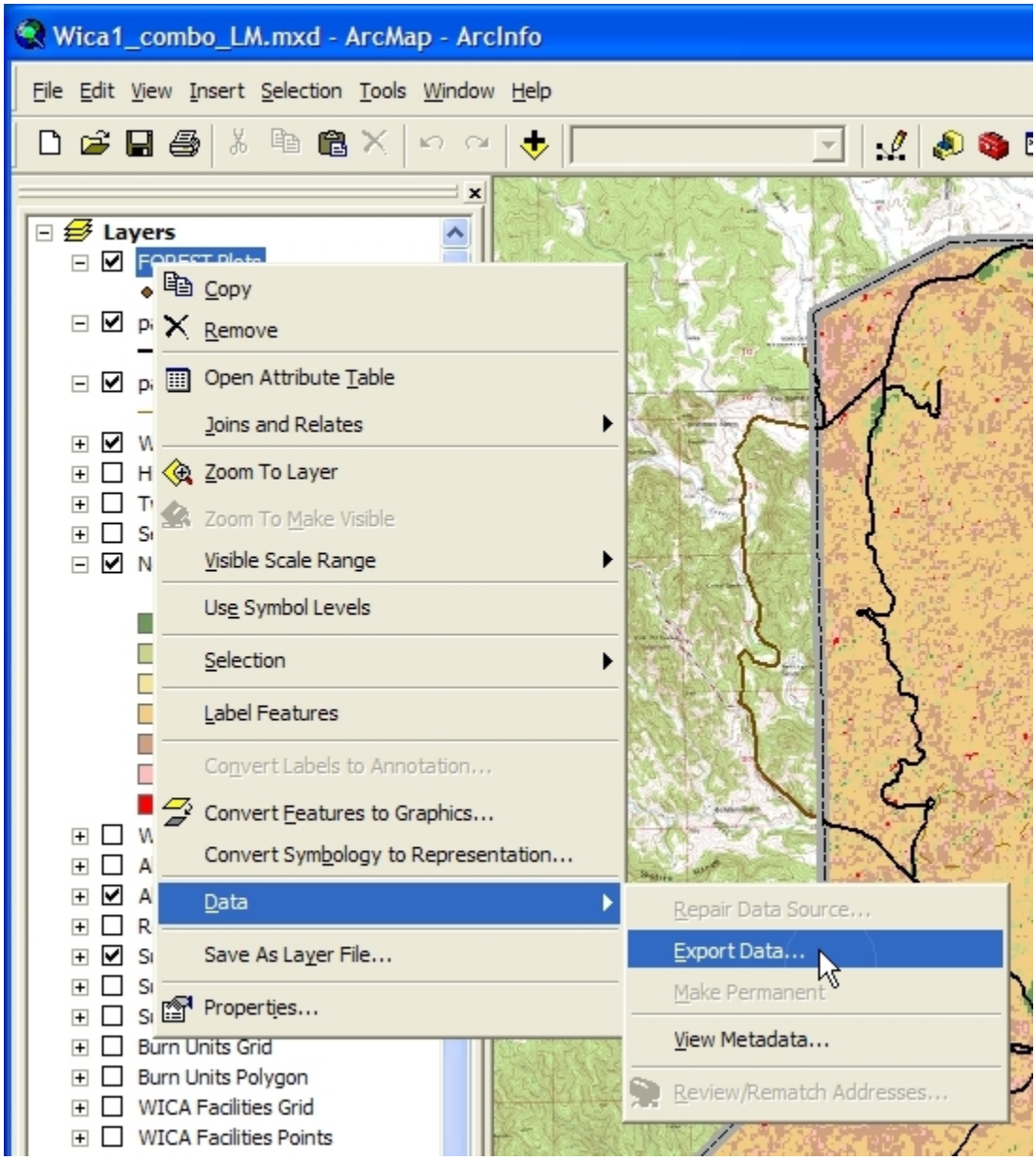
You can add labels to the layer.

Converting a layer to a shapefile

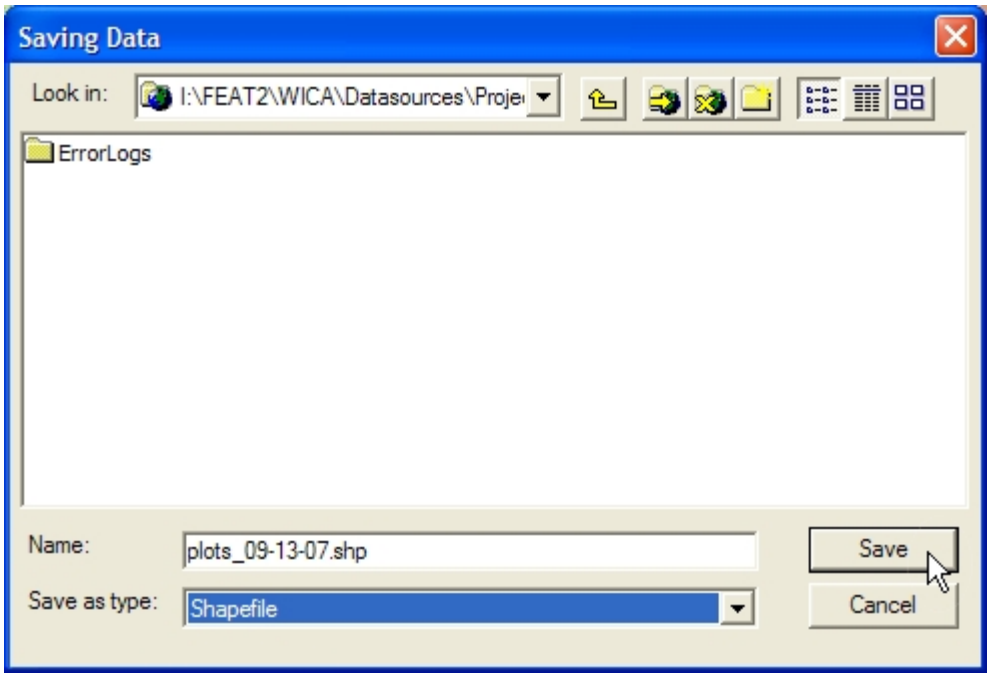
Converting a layer to a shapefile can be useful if you need to share your plot location data with someone else in another park or division, or to use your plot location data in a different map.

To convert a layer:

1. Right-click the plots layer in the tree view and select **Data > Export Data.**



2. This will bring up the **Export Data** dialog box. Leave the **Export** drop-down at the default 'All features'. If you have set the projection of your map, as described in the Projection Parameters section, set the **Use the same coordinate system as:** toggle to **the data frame**. If desired, rename the shapefile in the **Output shapefile or feature class** box.



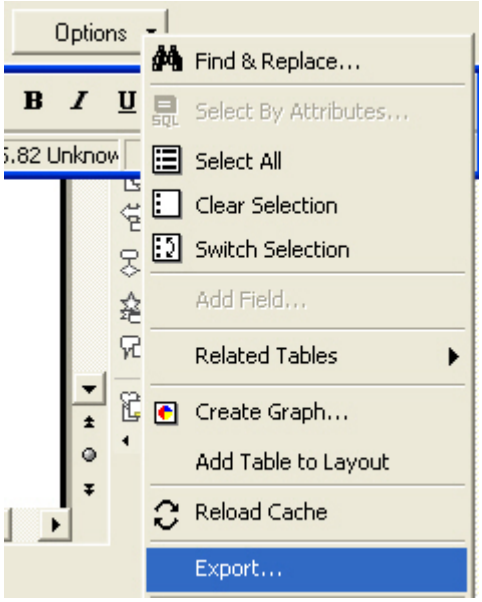
You should change the coordinate system toggle if you set the projection of the data frame to the same projection as your plot and map data as described in the Projection Parameters section. If you didn't set the projection of your data frame, use the default value ***this layer's source data.*** *This will leave your exported shapefile without a projection defined. See your GIS specialist to define the projection.*

Exporting the layer to a table

It may be useful to export the layer to a table. This will give you a list of the X, Y coordinate values for each plot as well as information on plot type, aspect, azimuth, etc.

To export the layer:

1. Right-click the layer in the tree view.
2. Select **Open Attribute Table**.
3. When the table opens, select **Export** from the **Options** drop-down (at the bottom of the table).



Next: [Making a project unit]

Making a project unit

This section describes how to create spatial definitions (raster layers) for new and existing project units. It covers:

- Identifying the project unit
- Range of values criteria
- Discrete values criteria
- Other considerations when defining project units

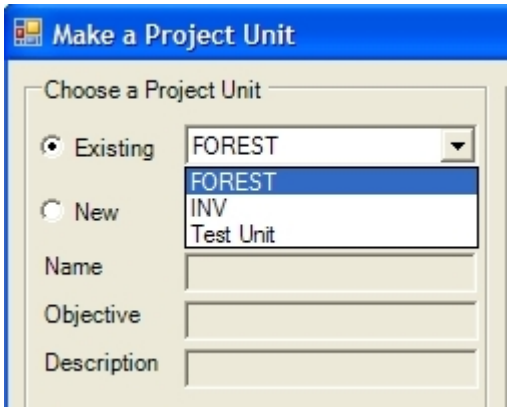
Identifying the project unit

The **Make a Project Unit** menu item in the FFI GIS toolbar opens a form for creating spatial definitions (raster layers) for new and existing project units. Project units do not need to be spatially defined, but defining them can help with plot management and allows you to use the FFI GIS toolbar to create random points for new plot generation. Project units are spatially defined based on the monitoring unit metadata. Common characteristics used to define a project unit might be vegetation type, distance from roads or water, elevation, etc.

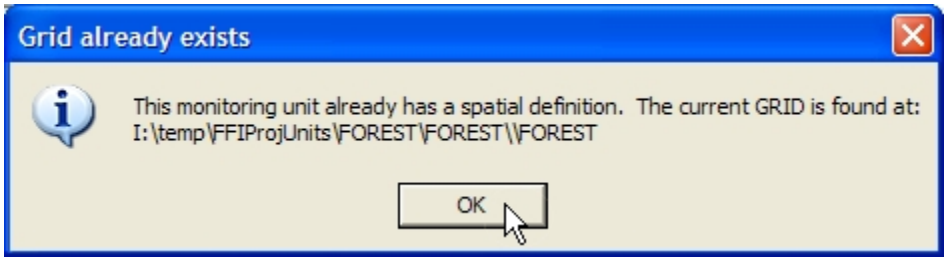
Spatially defining an existing project unit

See the following example for a step-by-step description of spatially defining an existing project unit.

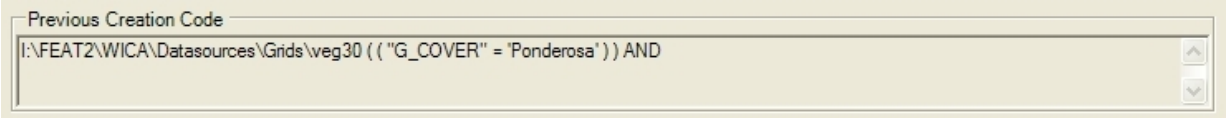
Choose the project unit to be spatially defined using the **Existing** drop-down list. (You can also click **New** to create a new project unit.)



If you select a project unit that is already spatially defined, a dialog box will tell you where you can locate the current GRID.



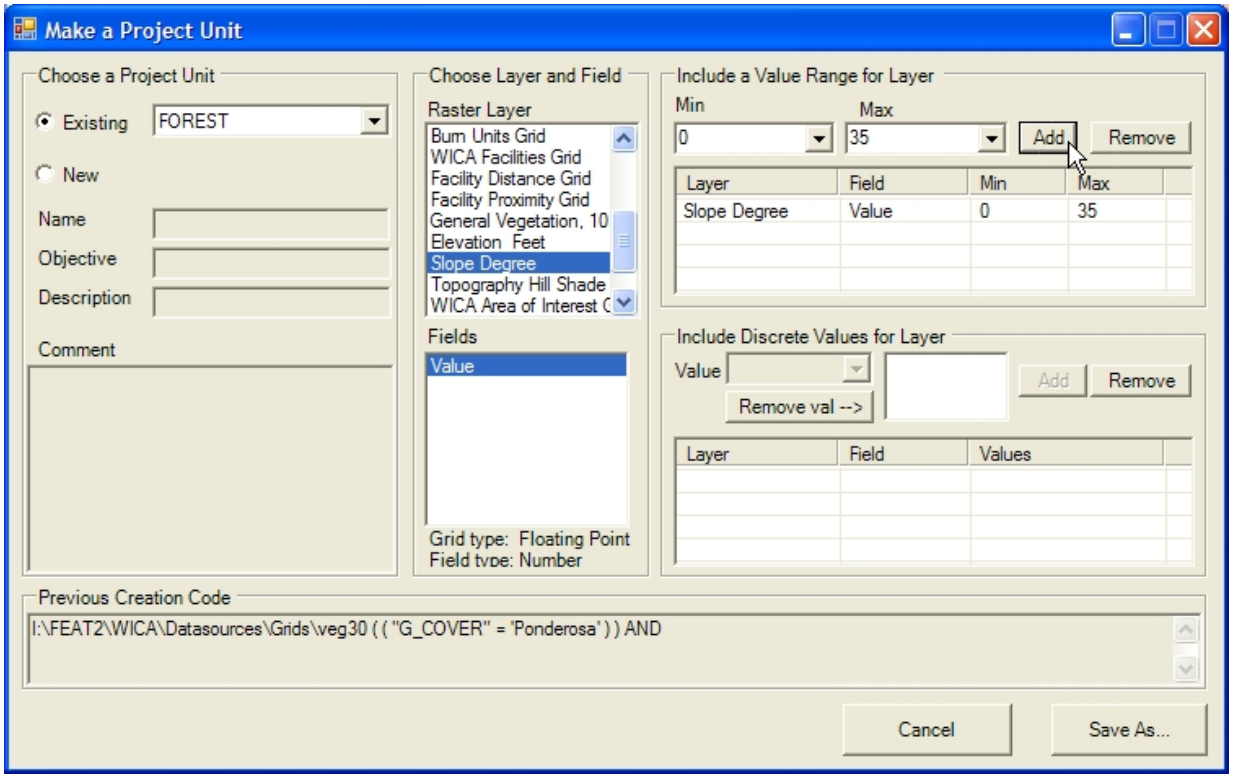
The **Make a Project Unit** form will display the previous creation code at the bottom of the form for reference, but you can create a new spatial definition with any parameters you choose.



Next: [Range of values criteria]

Range of values criteria

You can define the project unit based on a range of values.



1. First, select the raster layer you would like to use to define your monitoring type from the list under **Choose Layer and Field.** This example uses *Slope Degree* as the raster layer.
2. Choose a field under the **Fields** list to define your project unit. Select the field that contains the information that you are using to define the project unit. In this case, the slope data is stored in the **Value** field**.**

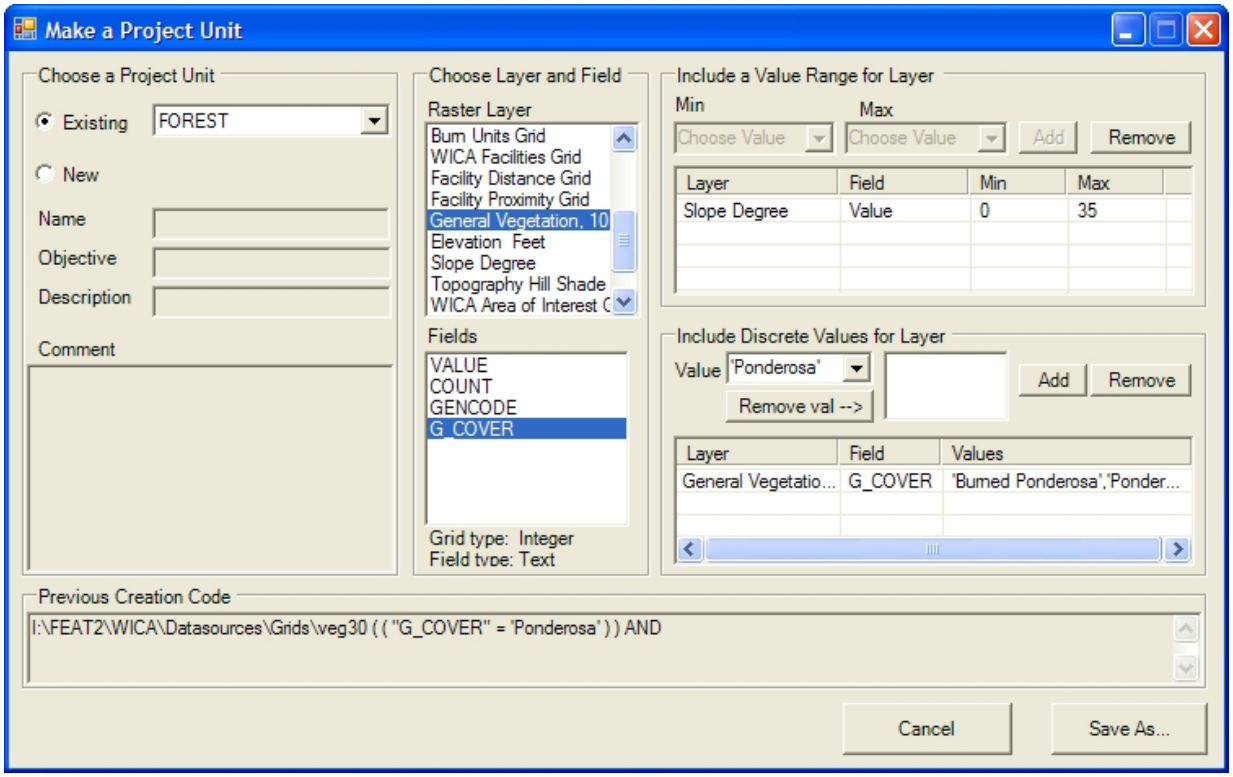
3. Set a range of values to be included in your project unit. You can select values from the **Min** and **Max** drop-down lists or type your own values directly into the **Min** and **Max** boxes. In this example, the FOREST project unit should only include areas below 35 degrees slope, so the range is set from a minimum of 0 m to a maximum of 35 m.

4. After defining the range, click **Add**, and the range you defined will appear in the list, as shown in the example.

Next: Discrete values criteria

Discrete values criteria

You can also define the project unit based on a discrete value or set of values.



1. First, select the raster layer you would like to use to define your monitoring type from the pull-down list under **Choose Layer and Field**. In the example below, vegetation is selected as the raster layer.

2. Choose a field under the **Fields** list to define your project unit. In the example, the vegetation layer has a general vegetation field, so G_COVER is selected**.**

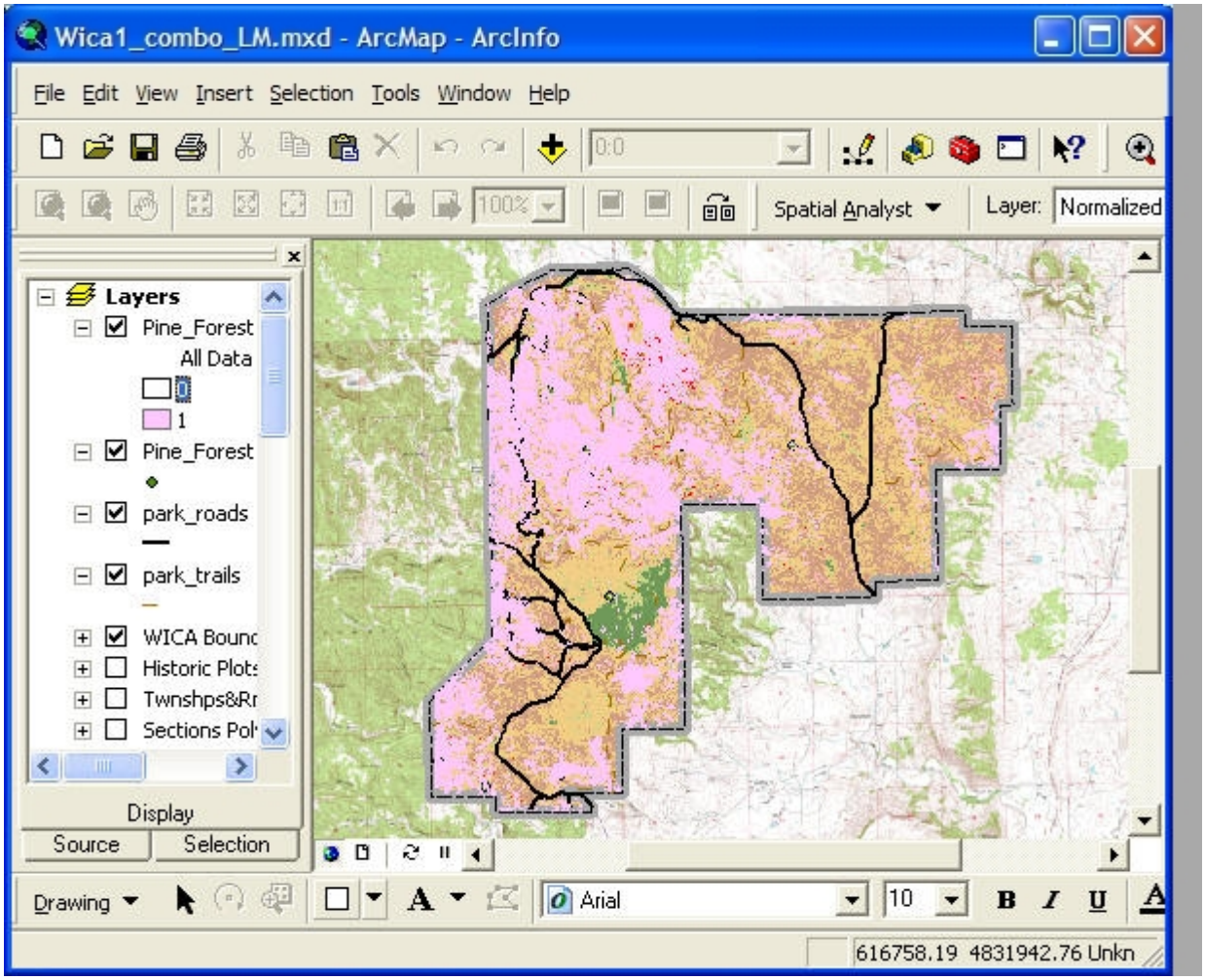
3. Select the specific values that you would like to include in your monitoring type from the **Value** drop-down under **Include Discrete Values for Layer.** In the example, both *Ponderosa* and *Burned Ponderosa* are selected.

4. Click **Add** and your selection will appear in the list, as shown in the example.

*Make sure that your values for a layer appear on only one line in the data grid. This example means "give me all the areas that are Ponderosa **OR** Burned Ponderosa". If the two values appeared on separate rows on the data grid, the meaning would be*

*"give me all the areas that are Ponderosa **AND** Burned Ponderosa at the same time", which is incorrect because any given area in the raster layer can have only one value.*

In this example, the FOREST project unit has been defined to include all areas with a *Ponderosa* or *Burned Ponderosa* vegetation type and have a slope of less than 35 degrees. Areas in pink represent the project unit.

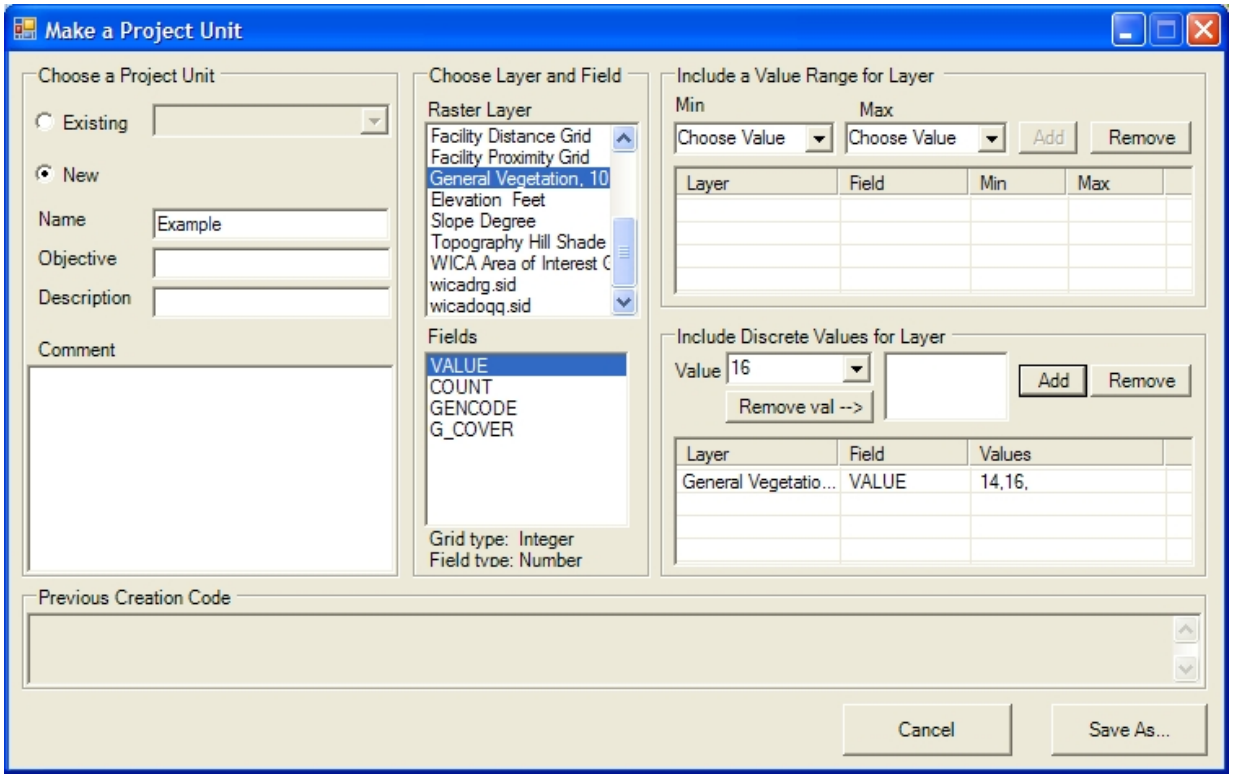


5. Click **Save As** and name the new raster layer. The calculations take a while to run, and then the new raster layer is added to the map.

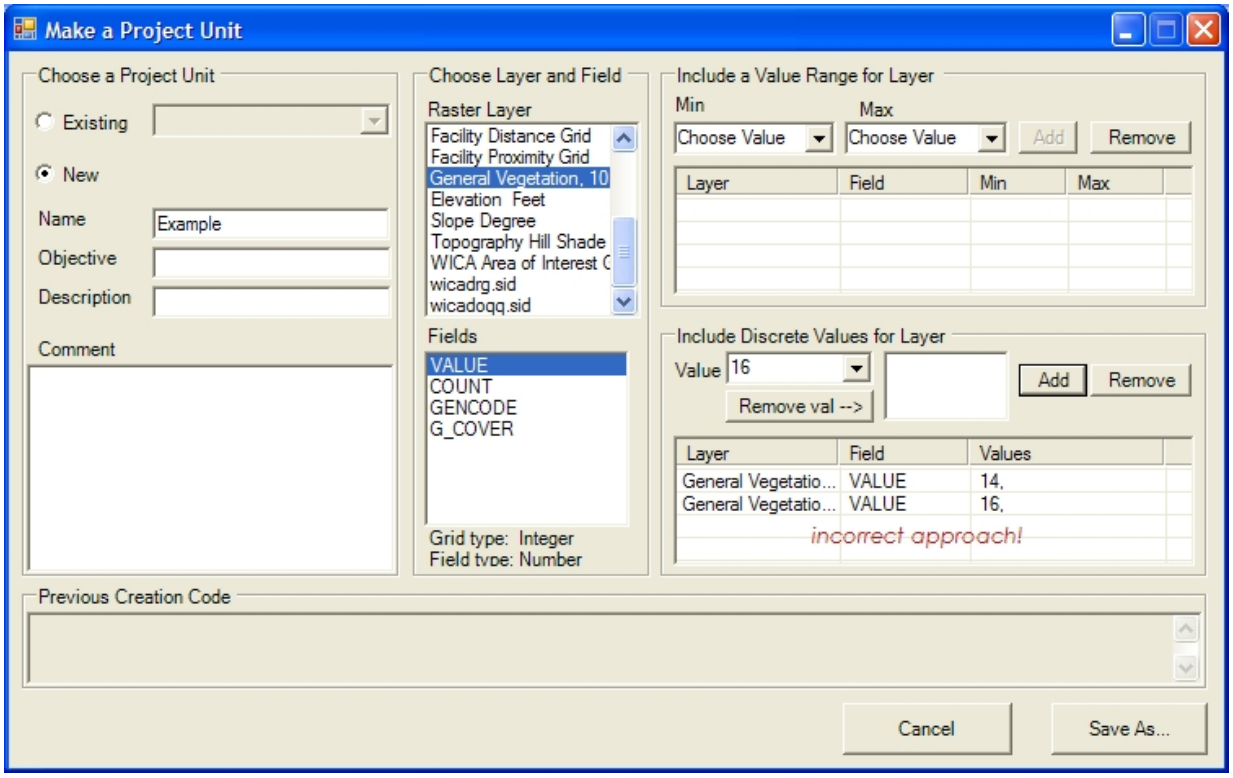
See also Other considerations when defining project units

Considerations when defining project units

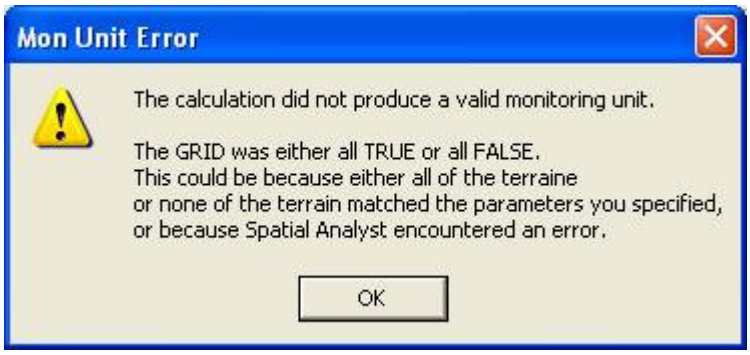
It is important to note that the criteria you select in the **Make a project unit** form are *additive*. For example, you might want to make a new project unit that includes low- and mid-elevation short-needle pine. These are different vegetation types, and are coded as 14 and 16 in the **Vegetation GRID** layer. To include them both in the project unit, you must select them both from the **Value** drop-down list under **Include Discrete Values for Layer**. Press **Add** only after both values have been selected.



If you select each value separately and add it as a separate line to the table, as shown below, you will receive an error message and no raster layer will be generated. This is because an area cannot include both low-elevation short-needle pine and mid-elevation short-needle pine.



If you specify two values that don't overlap as your parameters for defining the project unit, you will see this error message:



All raster inputs to the **Make a Project Unit** form MUST be in the same projection.

See also: Query plots

Querying plots

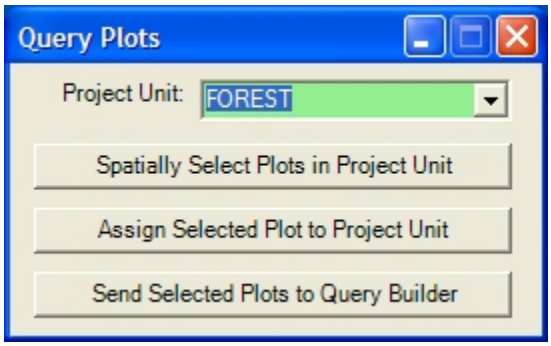
This section describes how to work with plot selection. It covers:

- Choosing a project unit
- Spatially selecting plots
- Assigning selected plots to a project unit
- Sending selected plots to FFI Query

Selecting the project unit

The **Query Plots** menu item in the FFI GIS toolbar opens a form that allows you to work with plot selection. When the form opens, a copy of the plots layer called **Plots_Temp** appears in the map. This layer is static (that is, if you create a new plot in FFI, it will not show up in **Plots_Temp**) and will disappear when you close the **Query Plots** form. Unlike the **Plots** layer, you can make selections in this layer while the form is open.

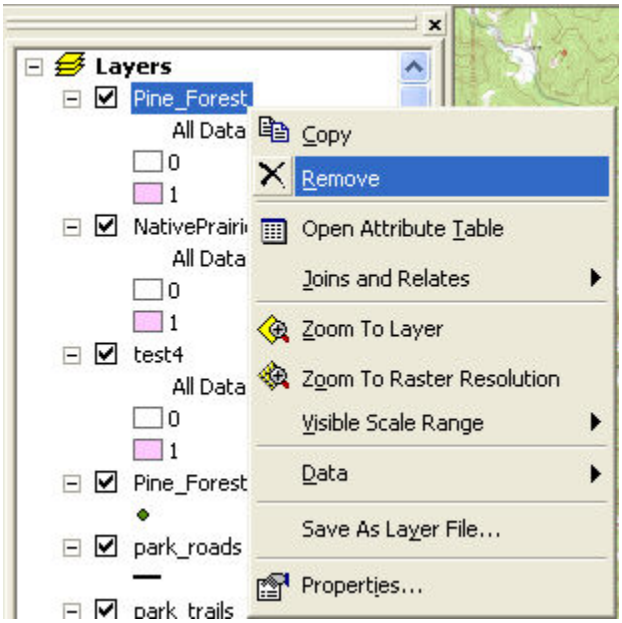
In the **Project Unit** drop-down, select the project unit to associate plots with.



*NOTE: If you select a project unit that has not been spatially defined (see previous section), the **Spatially Select Plots in Project Unit** button will be grayed out. However, the **Assign Selected Plot to Project Unit** and **Send Selected Plots to Query Builder** buttons will function.*

Removing unneeded layers

Each time that you select a project unit in this way, a raster layer for the spatial definition will be added to your map. You might want to remove these layers from your map when you are done with them. Right-click the layer in the tree view and select **Remove**.

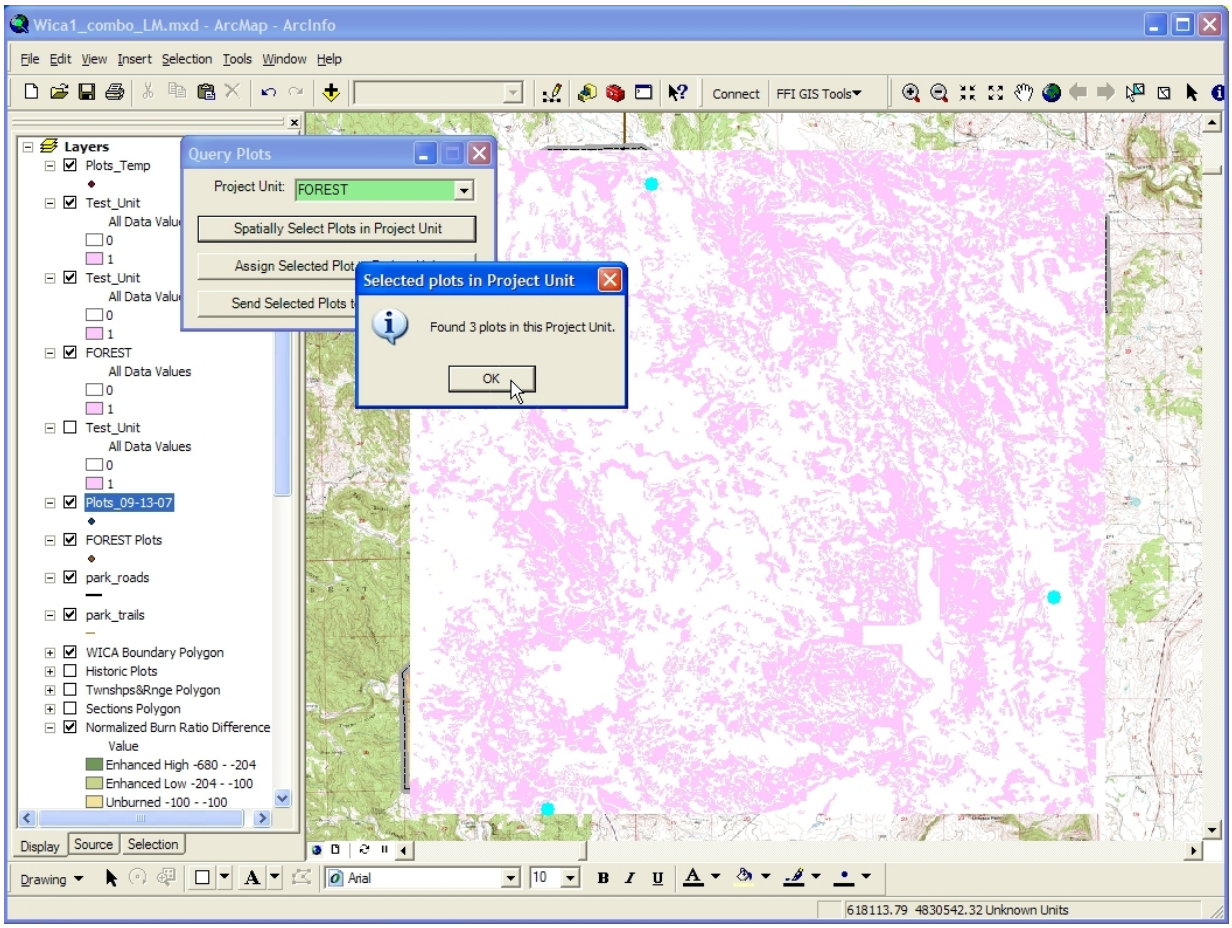


Next: Spatially select plots

Spatially selecting plots in the project unit

Click **Spatially Select Plots in Project Unit** to select plots in the **Plots_Temp** layer that fall within the raster layer of the selected project unit. To do this, the project unit must be spatially defined.

As shown in the example, three plots were selected in the FOREST project unit. Click **OK** to close the window.



Next: [Assign selected plots to project unit]

Assigning selected plots to a project unit

The **Assign Selected Plot to Project Unit** button assigns the selected macro plots to the project unit, but does not give any visual feedback. You can use this function as an alternative to using the **Macro Plot Builder** in FFI.

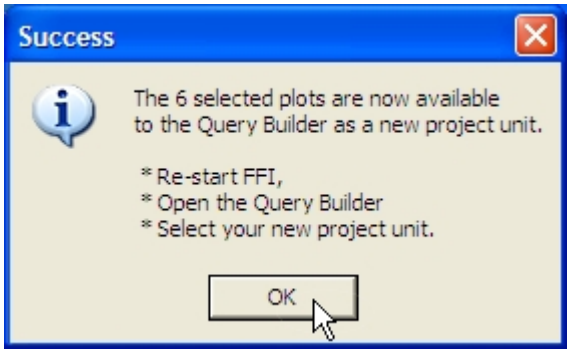
Next: [Send selected plots to FFI Query]

Sending selected plots to FFI Query

The **Send Selected Plots to Query Builder** function lets you analyze your selected macro plots using FFI **Query**. When you select this option, FFI GIS creates a new project unit that contains the plots that you have selected.

1. Select the desired macro plots using the **Spatially Select Plots in Project Unit** button or the **Select** tool in ArcMap. If you use the **Select** tool, make sure to leave the **Query Plots** form open during selection.
2. Once you have selected the plots, click **Send Selected Plots to Query Builder**.
3. The **New Project Unit** window opens. Enter the project unit name and additional information, and click **OK**.

4. A **Success** window opens. Click **OK**.



5. Next, open FFI and navigate to **Query** or **Reports and Analysis** to work with the plots in the newly created project unit.

Next: Making candidate plots

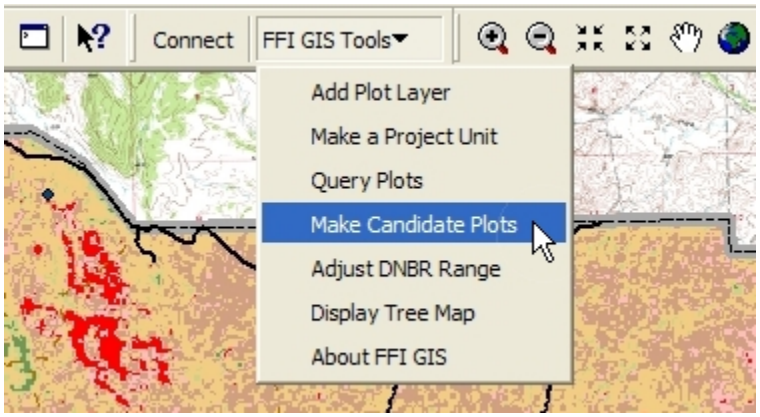
Making candidate plots

This section covers constructing candidate plots for generating new macro plots, and briefly addresses creation of CBI plots.

NOTE: For in-depth information about using this tool for CBI, see Using the FFI GIS toolbar for CBI.

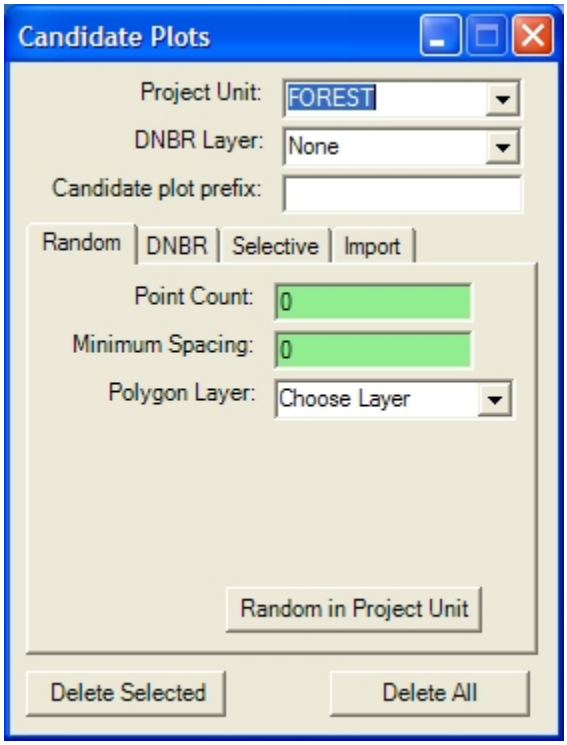
To create new candidate plots:

1. Click **Make Candidate Plots** in the **FFI GIS** toolbar. The **Candidate Plots** window opens.



*When the **Candidate Plots** window opens, a temporary layer called CandidatePlots_Temp is added to your map. This layer will disappear when you close the **Candidate Plots** form.*

2. Select your project unit in the **Project Unit** drop-down list.



3. The **DNBR Layer** is for use with CBI plot generation. If you are not creating CBI plots, you can leave this blank. To create CBI plots, set this drop-down to the layer containing your dNBR data.

NOTE: For more information, see Using the FFI GIS toolbar for CBI.

4. If you wish, you can add a **Candidate plot prefix** for use as a prefix to identify a specific set of candidate plots.

The following sections discuss the **Candidate Plots** form tabs:

- Random tab.
- DBNR tab.
- Selective tab.
- Import tab.

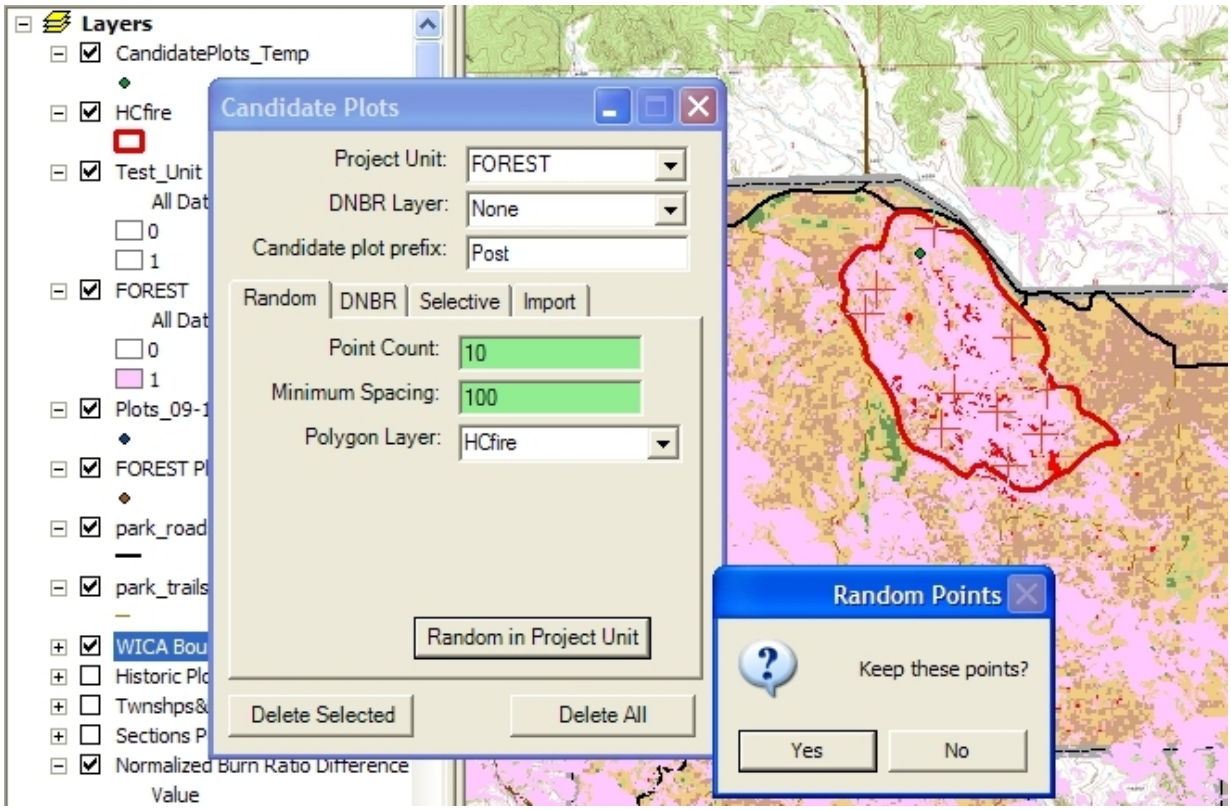
Candidate plots: Random tab

The **Random** tab in the **Candidate Plots** window is used to create random candidate plots within a project unit. This is useful if you are installing new macro plots and need a set of random points to choose from.

- **Sample Count**. The number of random sample points that you want to create.
- **Minimum spacing**. The minimum distance in map units between sample points and from existing macro plots.
- **Polygon Layer**. *Optional*. Points are restricted to polygons in a layer that you select.

Creating random plots

In the example below, ten random plots with a minimum spacing of 100 meters will be created in the FOREST project unit within the perimeter of a burn unit. Their prefix will be *Post*. After you click **Random in Project Unit**, the program processes for a short time and then draws the points as fine red crosses. When the operation is complete, you can click **Yes** or **No** to keep or discard the points.

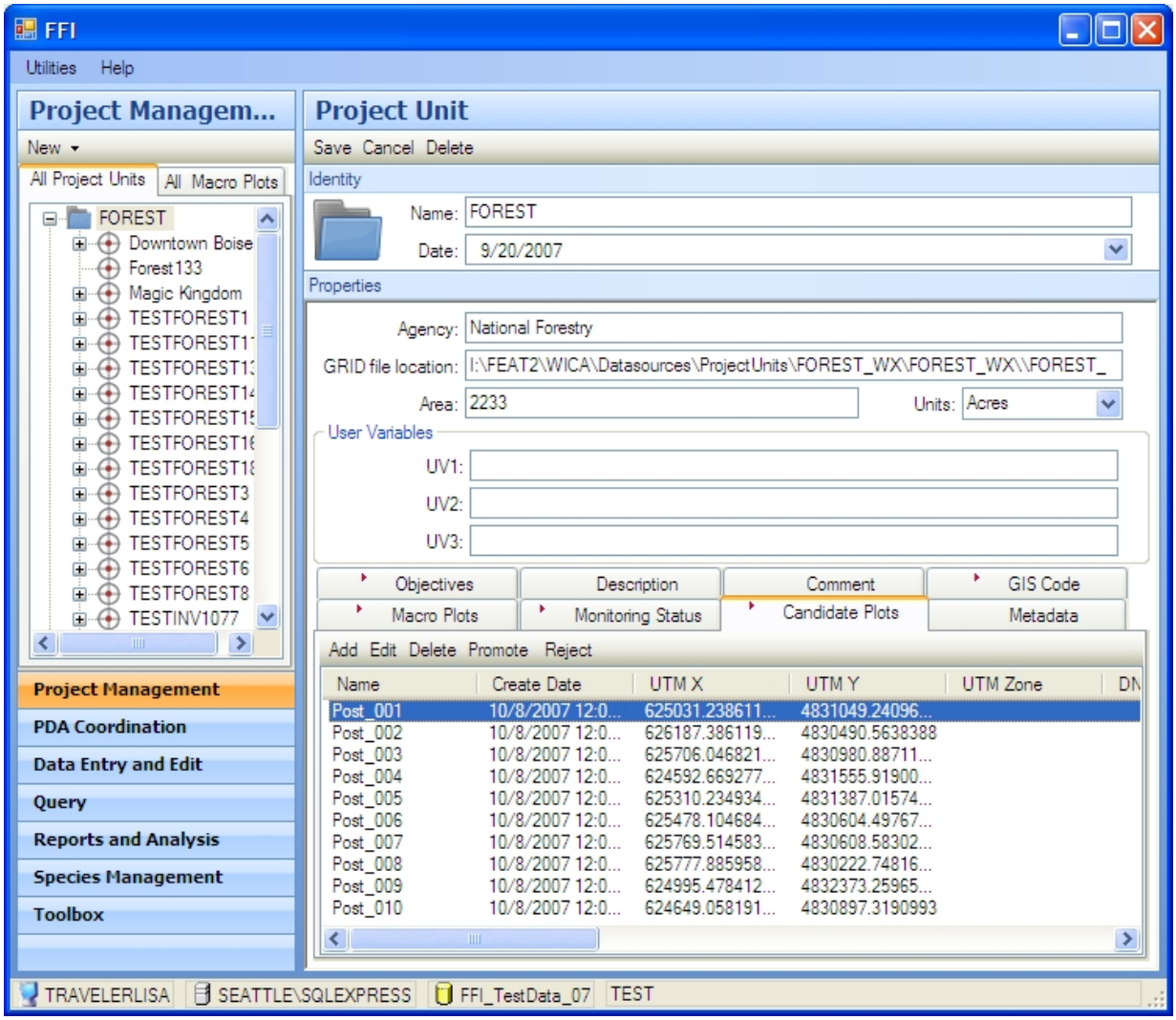


You can use these plots to create a random candidate plot map to take into the field. To do this, export the candidate plots to a shapefile or print a map from your working FFI map document. You can also export the table associated with the **candidate plots** layer (see Add a plot layer for instructions on exporting a table). This table contains X,Y coordinates for each point as well as eight random azimuths.

Importing candidate plots into FFI

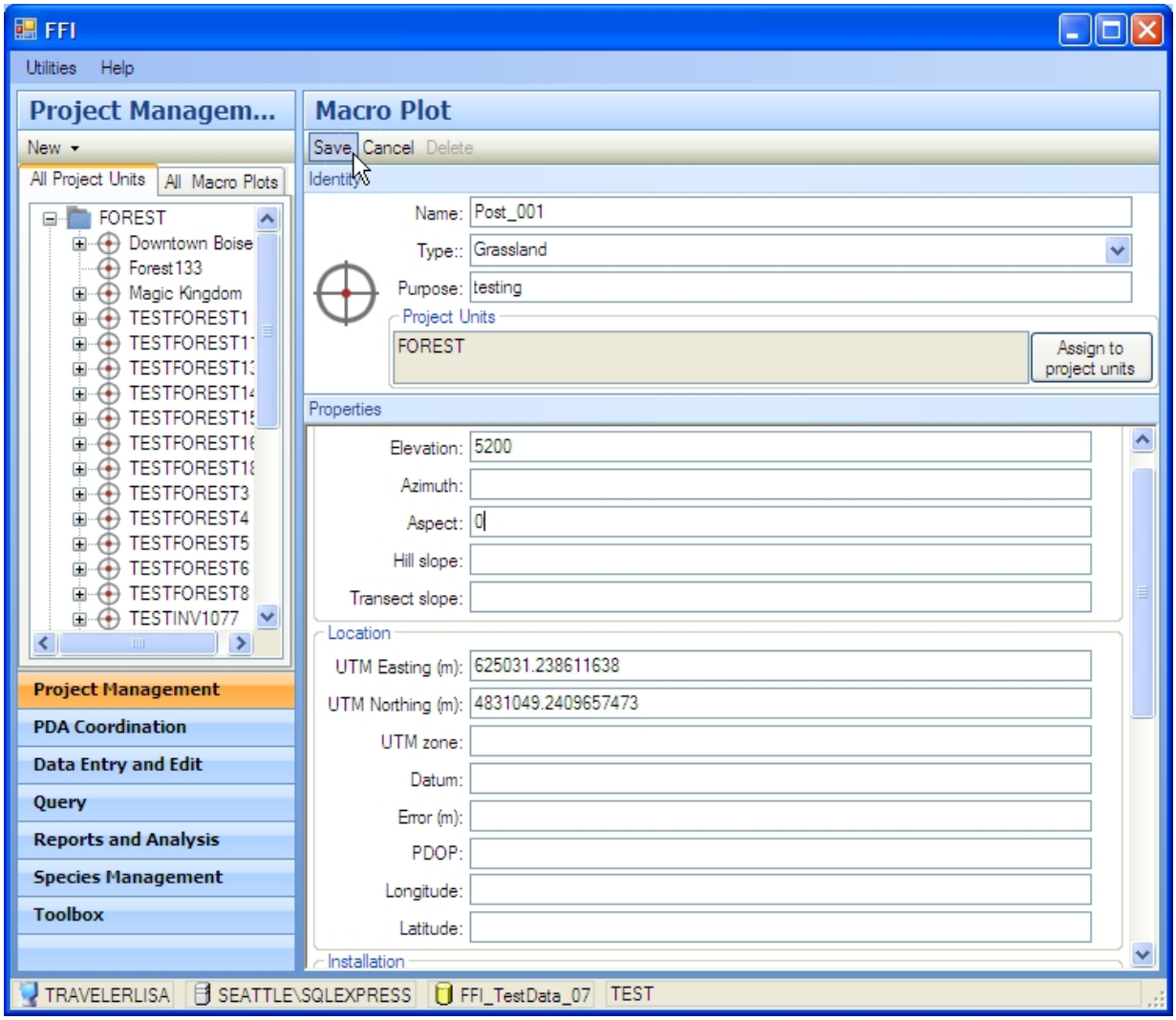
If you are not using a PDA, you can import the random plots that you selected for use while in the field directly into the **Project Unit** window in FFI after you return to the office. To do this:

1. Be sure to save the candidate plots.
2. Log into FFI. (If you were already logged into FFI, leave the program and start again.)
3. In the FFI **Project Management** window, select the appropriate project unit.
4. Select the **Candidate Plots** tab. Your candidate plots will be listed with the candidate plot prefix you selected. In this example, the prefix is **Post**.



*NOTE: You can now use the **Candidate Plots** function buttons to edit the plot data, delete the plot, promote the candidate plot to a macro plot (at which point it will be listed in the tree view), or reject the candidate.*

5. Select a candidate of interest. In this example, **Post_001** is selected.
6. To promote the candidate plot to a macro plot, click **Promote**. The **Macro Plot** window opens.
7. Add any other available data for the plot, and click **Save**. The new macro plot will be listed in the tree view.



Next: DNBR tab

Candidate plots: DNBR Tab

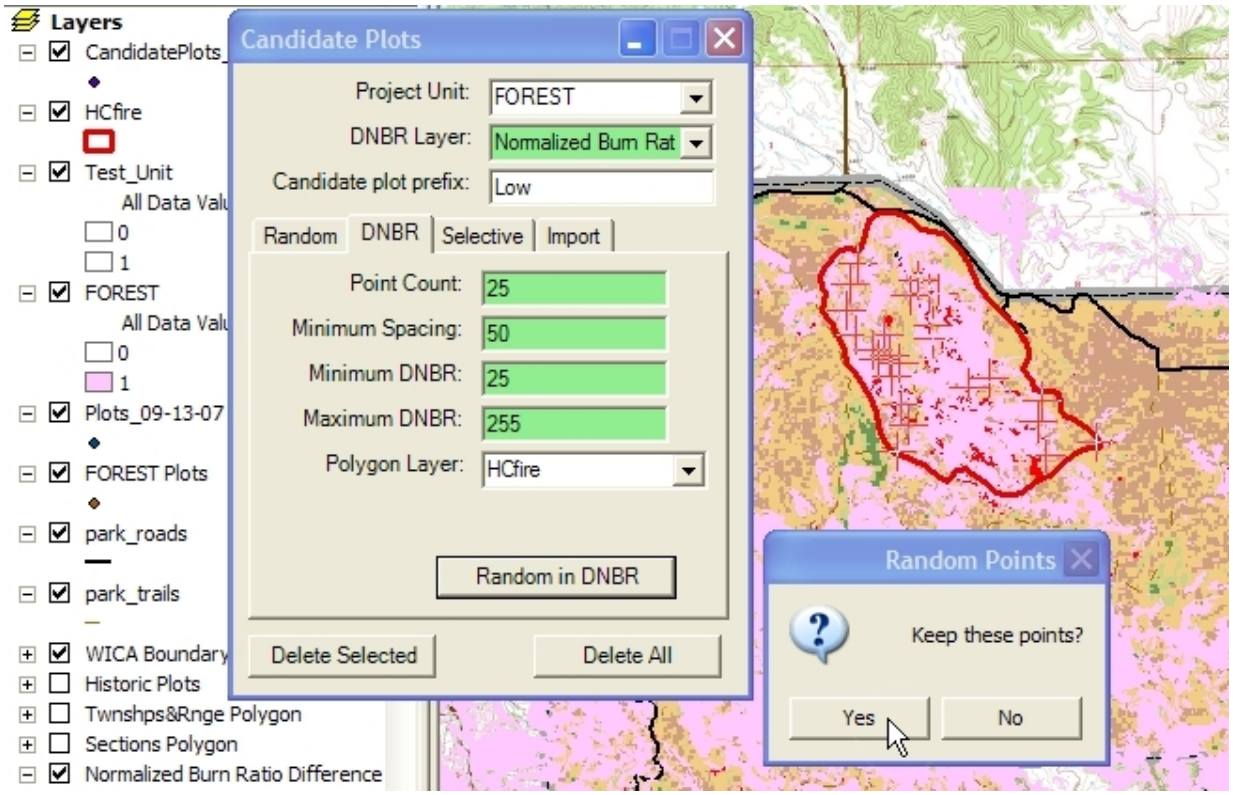
The **DNBR** tab in the **Candidate Plots** window lets you select a DNBR layer and create random points within a range of values. You can create stratified samples by creating several sets of points with different prefixes. For example, you might use the prefix 'low' for a range of 25 - 255, 'med' for a range of 255 – 400, and 'high' for a range of 400 – 1000.

For a more in-depth discussion of how to use the FFI GIS toolbar with DNBR and CBI plot generation, see Using the FFI GIS toolbar for CBI.

- **Minimum DNBR**. The lowest value within the DNBR layer for acceptable sample sites.
- **Maximum DNBR**. The highest value within the DNBR layer for acceptable sample sites.
- **Polygon Layer**. Same functionality as in the **Random** tab; allows you to restrict the plot selection to a predefined polygon layer.

Creating random DNBR points

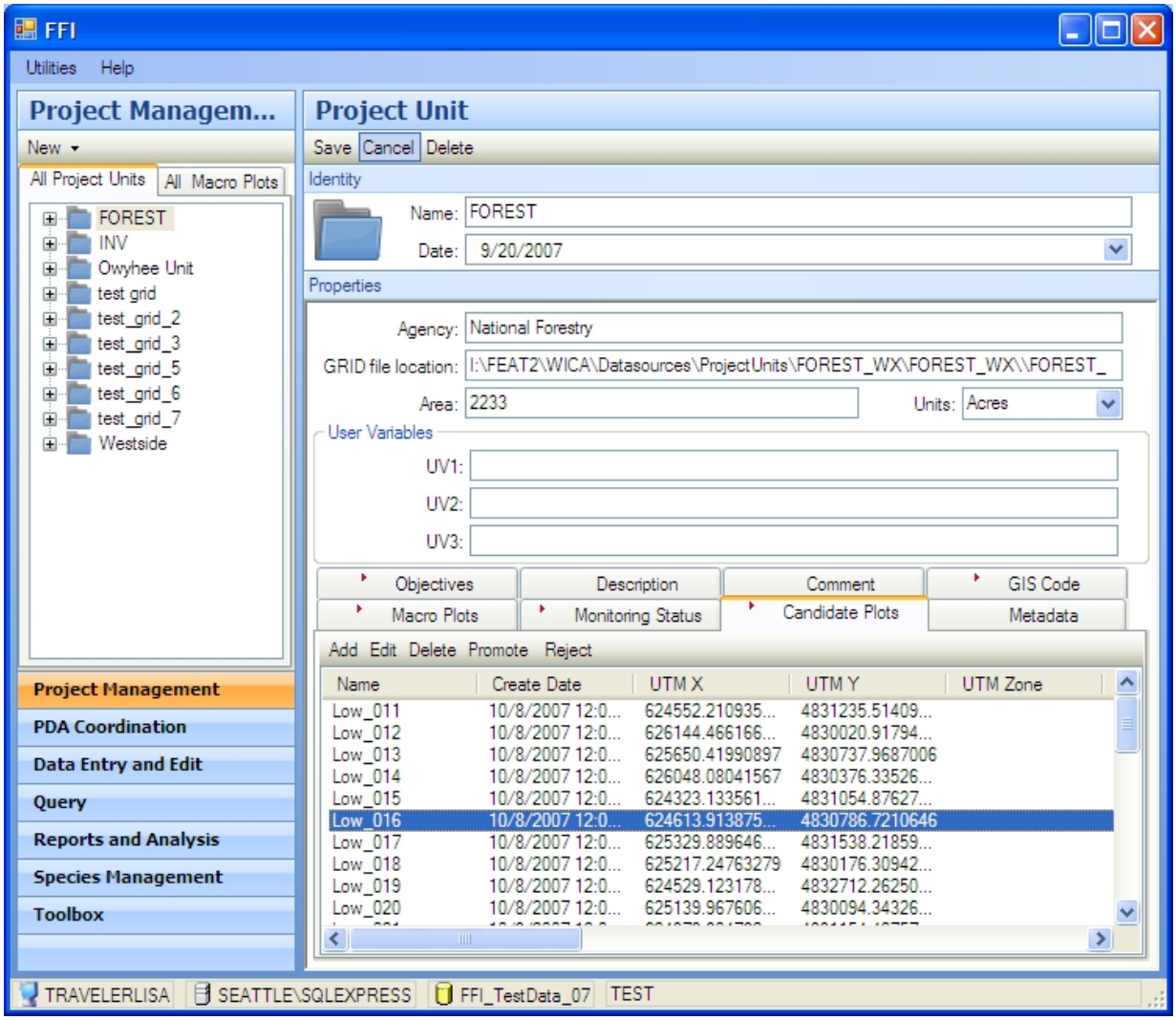
In the example below, 25 random DNBR points with a minimum spacing of 50 meters, with a minimum DNBR of 25 and maximum of 255, will be created in the FOREST project unit within the perimeter of a burn unit. After you click **Random in DNBR**, the program processes for a short time and then draws the points as fine red crosses. When the operation is complete, you can click **Yes** or **No** to keep or discard the points.



Importing candidate DNBR plots into FFI

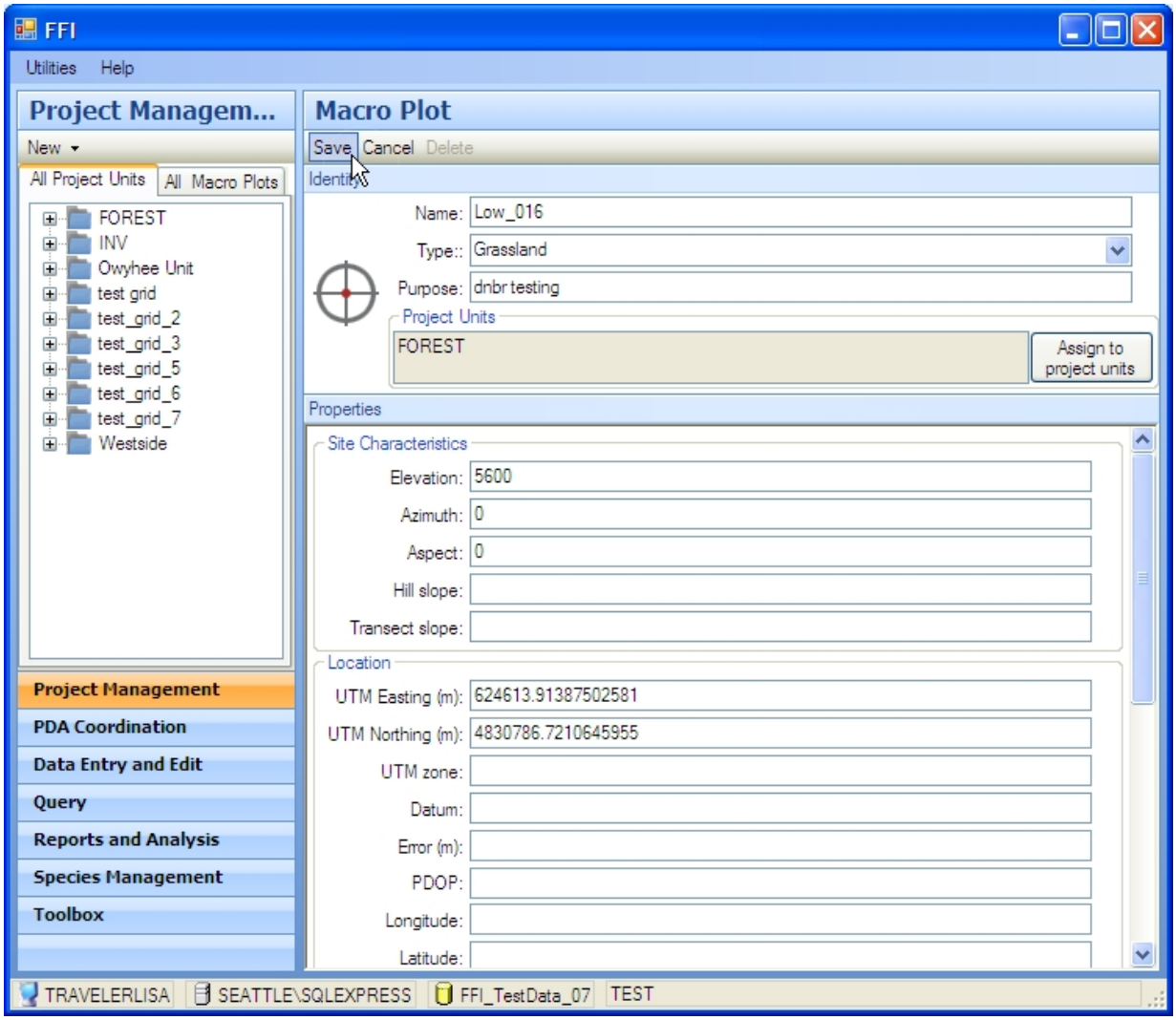
You can import the DNBR plots directly into the **Project Unit** window in FFI. To do this:

1. Be sure to save the candidate DNBR points.
2. Log into FFI. (If you were already logged into FFI, leave the program and start again.)
3. In the FFI **Project Management** window, select the appropriate project unit.
4. Select the **Candidate Plots** tab. Your candidate DNBR points will be listed with the candidate plot prefix you selected. In this example, the prefix is **Low**.



*NOTE: You can now use the **Candidate Plots** function buttons to edit the plot data, delete the plot, promote the candidate plot to a macro plot (at which point it will be listed in the tree view), or reject the candidate.*

5. Select a candidate of interest. In this example, **Low-016** is selected.
6. To promote the candidate DNBR point to a macro plot, click **Promote**. The **Macro Plot** window opens.
7. Add any other available data for the plot, and click **Save**. The new macro plot will be listed in the tree view.



Next: Selective tab

Candidate plots: Selective tab

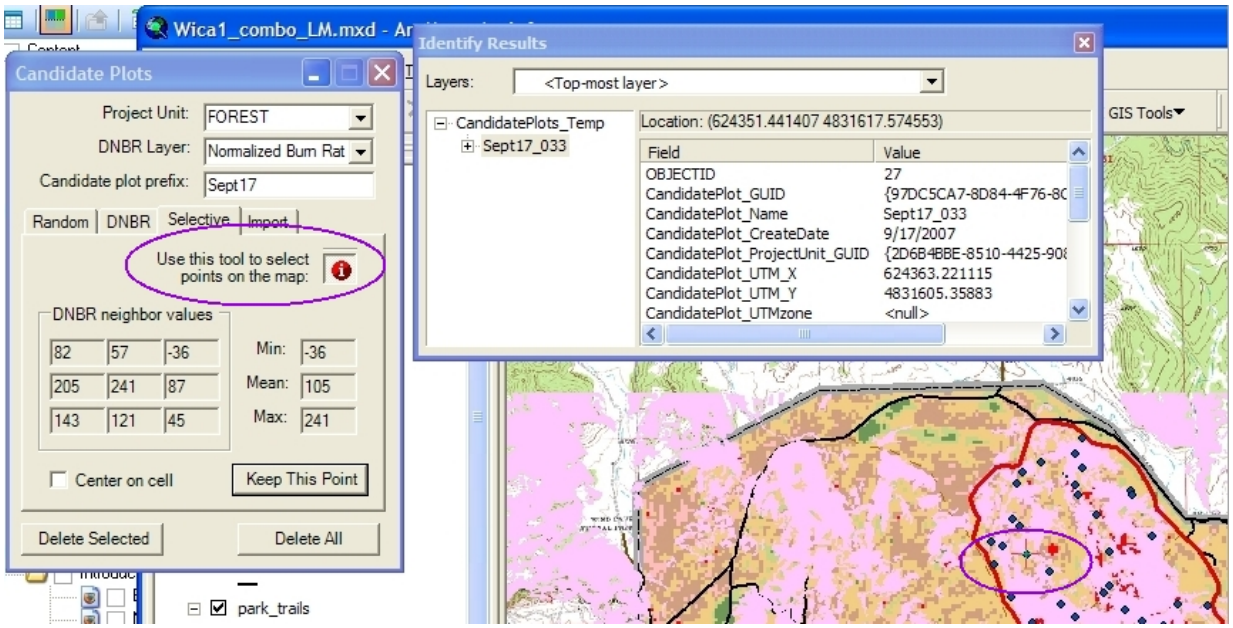
The **Selective** tab in the **Candidate Plots** window is used to interactively digitize candidate plots on the map.

When you click the map with the **candidate sites** tool (circled on the screenshot), values are displayed for the cell itself and the eight neighboring cells as well as the minimum, mean, and maximum values for all nine cells. A fine red cross symbol (also circled on the screenshot) is drawn at the point where you clicked. The point is not added as a candidate plot until you click **Keep This Point**. When you use this tool, the **ArcMap Identify Results** window opens, which can be useful for monitoring values in other layers.

For a more in-depth discussion of how to use the FFI GIS toolbar with DNBR and CBI plot generation, see Using the FFI GIS toolbar for CBI and Selective sampling.

- **Center on Cell** checkbox. When this box is checked, digitized points will be placed exactly in the center of the DNBR cell on which they fall.

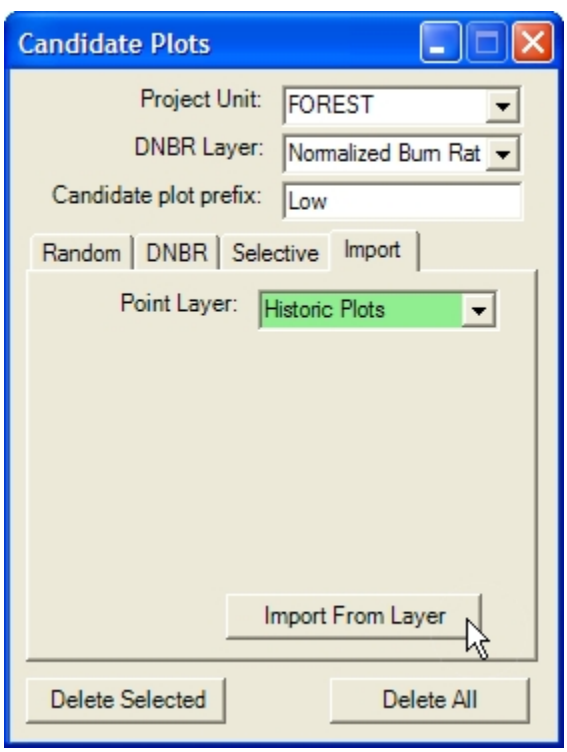
- **Keep This Point** button. The point is not added to the **candidate plots** layer until you click this button.



Next: Import tab

Candidate plots: Import tab

The **Import** tab in the **Candidate Plots** window lets you import sample plots from a point layer in the map. The DNBR values are captured and the points are numbered with the prefix that you specify.

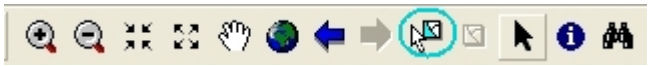


Next: Deleting candidate plots

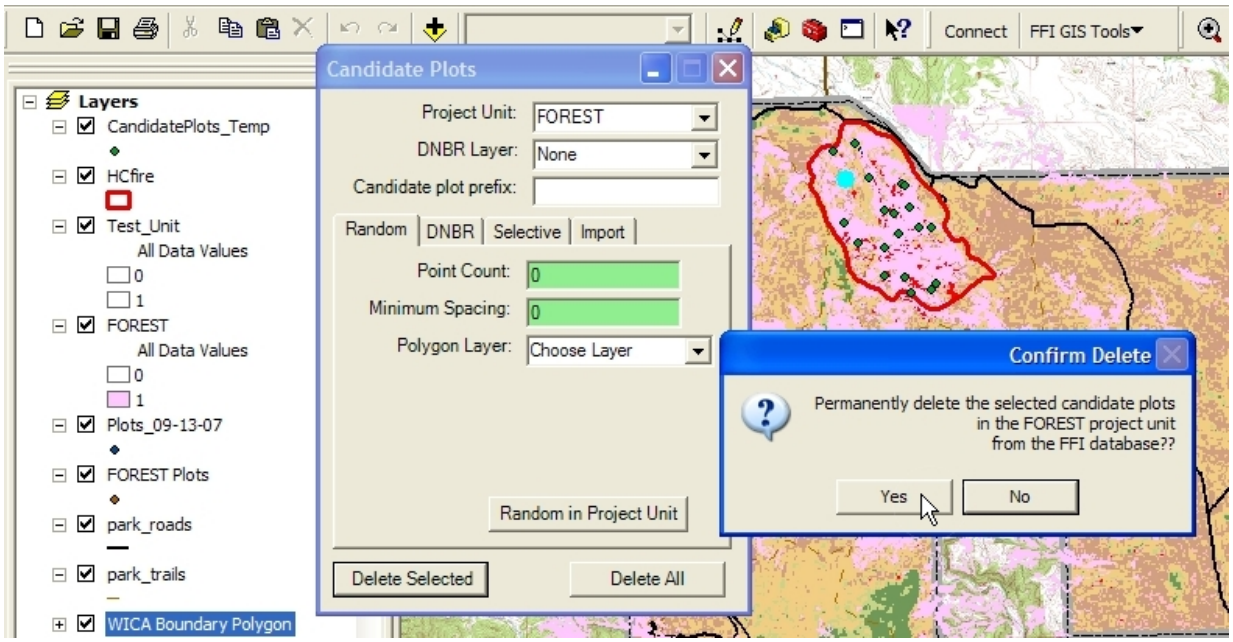
Deleting candidate plots

To delete unneeded candidate plots from a project unit:

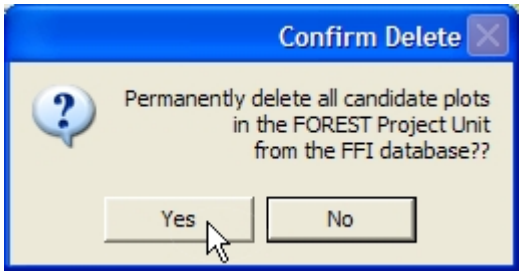
1. Select the plot in Arc Map using the **Select Features** tool (shown here circled in the ArcMap Tools toolbar) or by some other method in Arc Map.



2. Click **Delete Selected** to delete the selected candidate plot from the project unit. Confirm the deletion as shown.



3. To delete all candidate sites from the current project unit, click **Delete All**. Confirm the deletion as shown.



NOTE: Deleting candidate plots will not affect macro plots that were generated from them.

See also: Adjusting dNBR range

Adjusting dNBR range

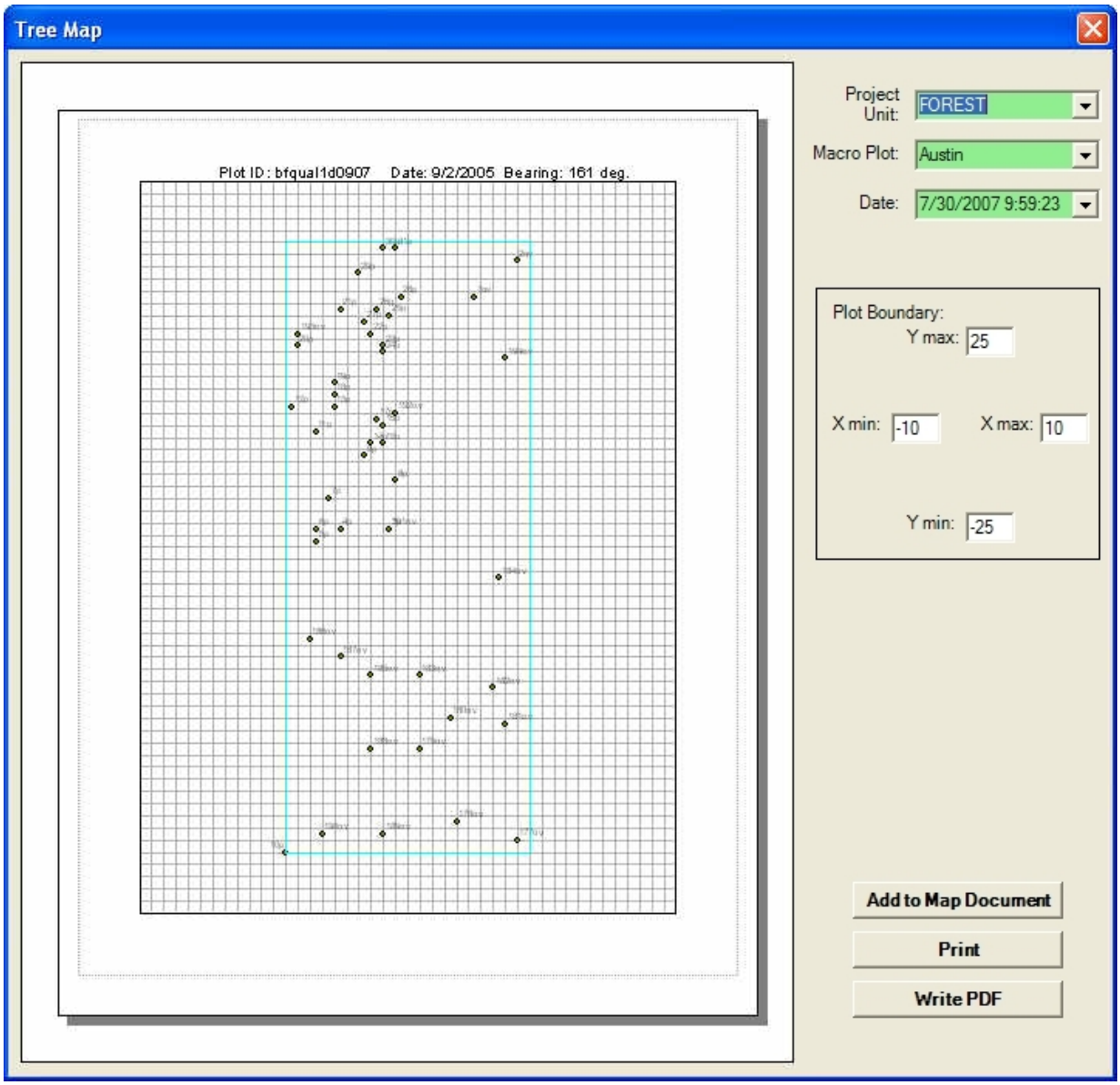
The **Adjust DNBR Range** tool in the FFI GIS toolbar allows you to visually determine thresholds between severity classes. The selected layer must be an integer grid with a classified legend. This topic is discussed in detail in the section Using the FFI GIS toolbar for CBI.

See also Displaying a tree map

Displaying a tree map

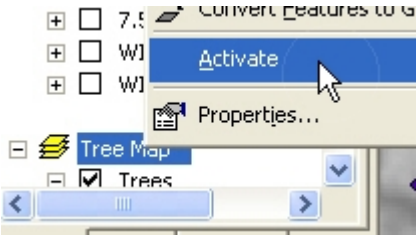
The **Display Tree Map** menu item in the FFI GIS toolbar opens a form with a map control for printing tree maps.

This form reads the database directly; it has no relationship to the layers in the map. Only trees that have been saved as subsamples are mapped.



- **Project Unit** drop-down. Use this option to filter the macro plots.
- **Macro Plot** drop-down. Select a plot to see its map.
- **Date** drop-down. Indicates the date that the macro plot was created.

- **Plot Boundary** text boxes. FFI does not populate the plot dimensions. Enter the minimum and maximum local plot coordinates in relation to the plot origin to control the area shown by the map and the blue box around each map.
- **Add to Map Document** button. This adds a new dataframe to the current map document with the tree map. Look for it at the bottom of the ArcMap tree view. Right-click the new dataframe and select **Activate** to view it in the map window. Note that this dataframe shows only trees on the most recent tree map because it is driven by a static table in the personal geodatabase.



- **Print** button. Sends the map to the default printer.
- **Write PDF** button. Creates a PDF of the map in the administrative unit folder under FFI\{mypark}\Documents\PDFs named with the plot name and the date.

Return to Using the FFI GIS toolbar

Using the FFI GIS toolbar for CBI

The FFI GIS toolbar can help you prepare to do CBI plots. The toolbar lets you visually determine preliminary thresholds between severity classes and select potential CBI plot locations that are stratified by severity class.

This section addresses:

- Adjusting DNBR range
- Stratified sampling

Adjusting DNBR range

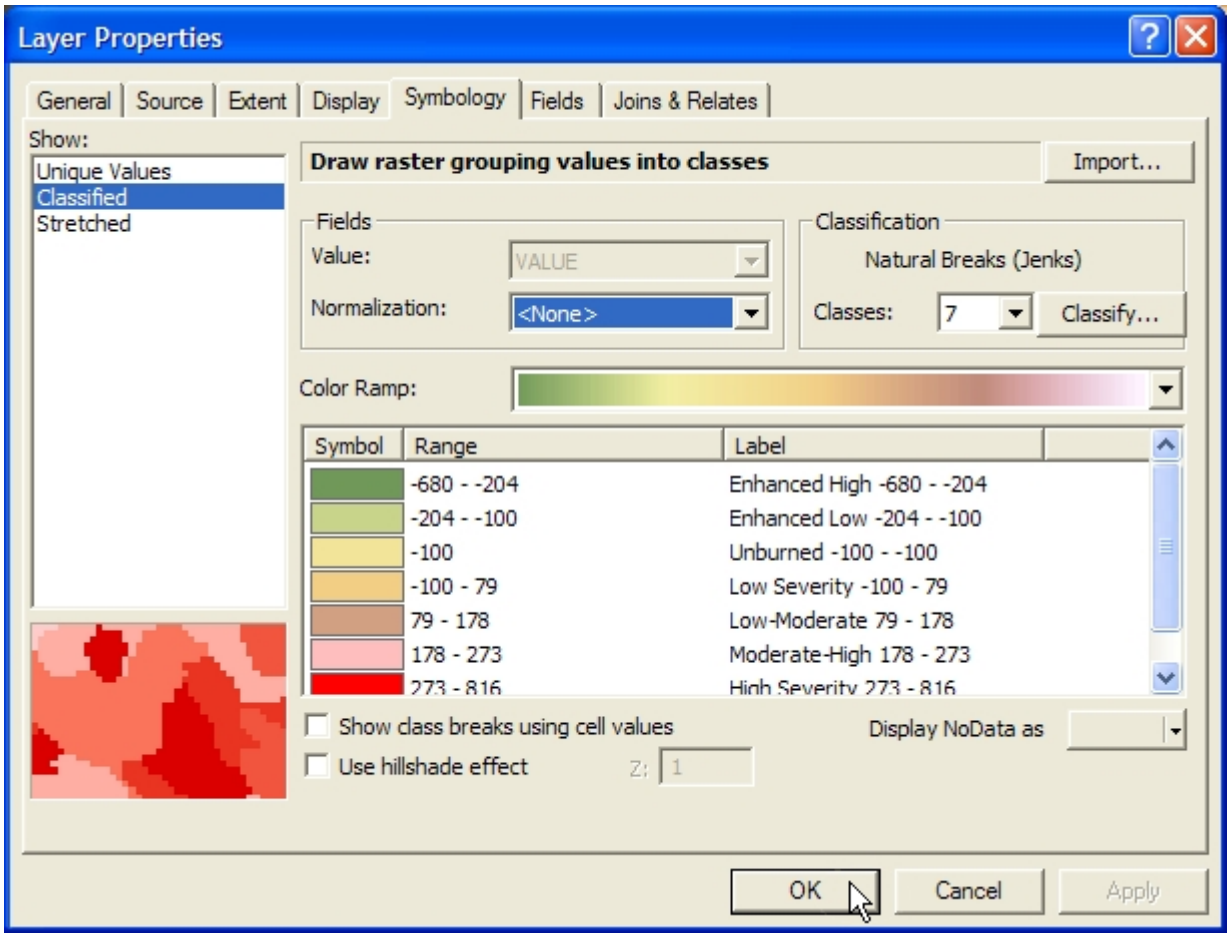
The **Adjust DNBR Range** tool allows you to visually determine thresholds between severity classes. The selected layer must be an integer grid with a classified legend. If you are unsure whether your dNBR layer is an integer grid, consult your local GIS specialist.

The tool can be used in a variety of ways. The example in this section shows one way to use this tool to determine severity class thresholds. The method is based on the Landscape Assessment documentation Remote Sensing of Burn Severity: The Normalized Burn Ratio (Key & Benson, 2004).

Set legend to Classified

The **Adjust Legend** tool requires that the legend be classified and that it have exactly seven severity classes.

1. To set the legend to **Classified**, double-click on the name of your dNBR layer in the tree view. This brings up the **Layer Properties** dialog.



2. Click on the **Symbology** tab and select **Classified** under **Show** at the left side of the form.

3. In the **Classes** drop-down list, select '7' as the number of severity classes for your legend.
4. Double-click on the colored **Symbol** box for each class to set the legend colors. Select a color for each class.

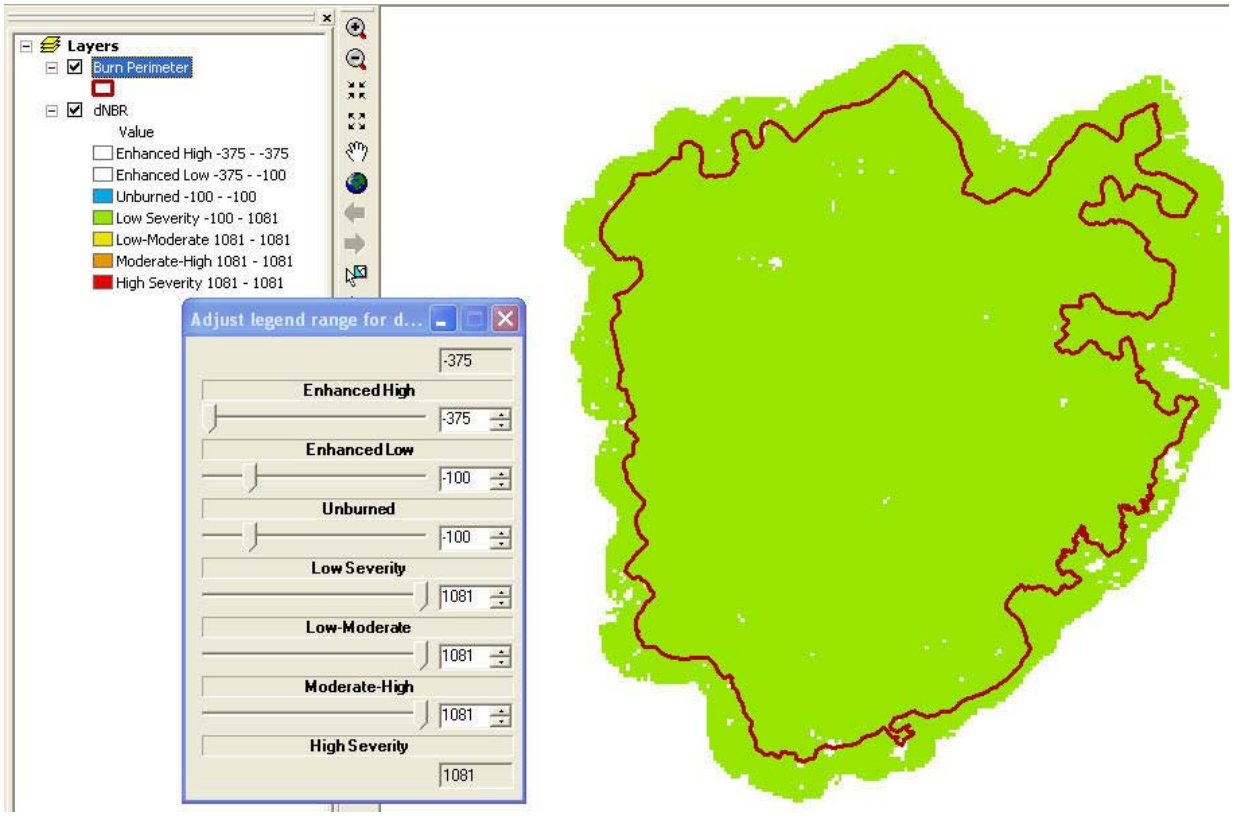
Next: Identify unburned areas

Identifying unburned areas

A good first step is to identify unburned areas and areas of enhanced regrowth. Enhanced regrowth refers to areas, such as some herbaceous communities, that have increased post-fire productivity. These areas have strongly negative dNBR values. Enhanced regrowth is often classified as areas with dNBR values less than -100. Unburned areas normally fall into the range between about -100 to 99 and should form a clear perimeter around a burn.

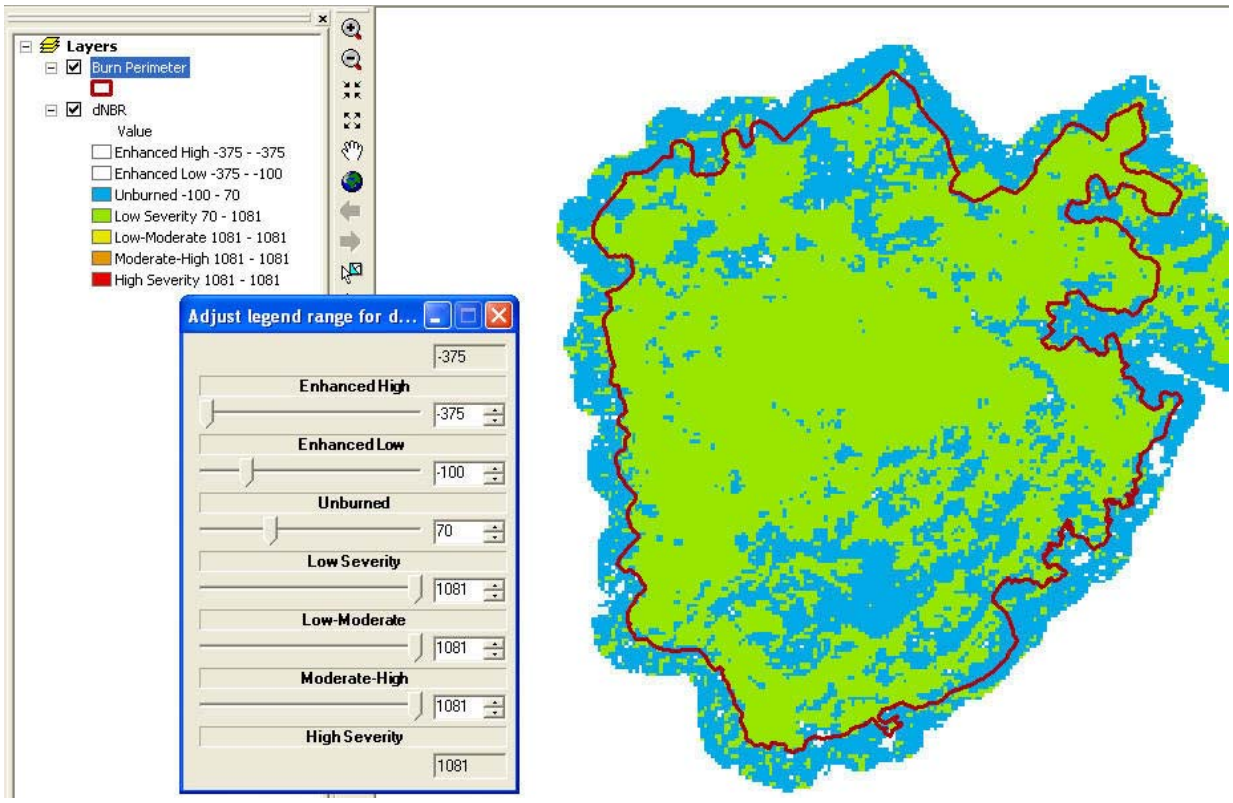
To identify unburned areas:

1. First, in the **Layer Properties** dialog, set the color for the **Enhanced Low** and **Enhanced High** to **No Color**.
2. Click **OK** to close the dialog box and then open the **Adjust DNBR Range** tool in the FFI GIS toolbar.
3. In the **Adjust legend range** box that opens, set the upper bound for both **Enhanced Low** and **Unburned** classes to -100. To simplify the image, you may also want to set the values for **Low Severity**, **Low-Moderate**, **Moderate-High**, and **High Severity** all to your highest dNBR value (1081 in this example). At this point, most of your dNBR layer will appear as **Low Severity**.



3. Next, slowly increase the upper limit of the **Unburned** class. As you do this, **Unburned** colored areas will begin to appear around the perimeter of the burn. These will be scattered at first and then gradually form clumps around the perimeter of the burn.
4. When the burn area is clearly delimited, typically at a value around 100, you have reached the upper threshold for unburned dNBR values. Record this value.

Ideally, unburned pixels should be concentrated along the perimeter of the burn, but this is not always the case, as you can see below.

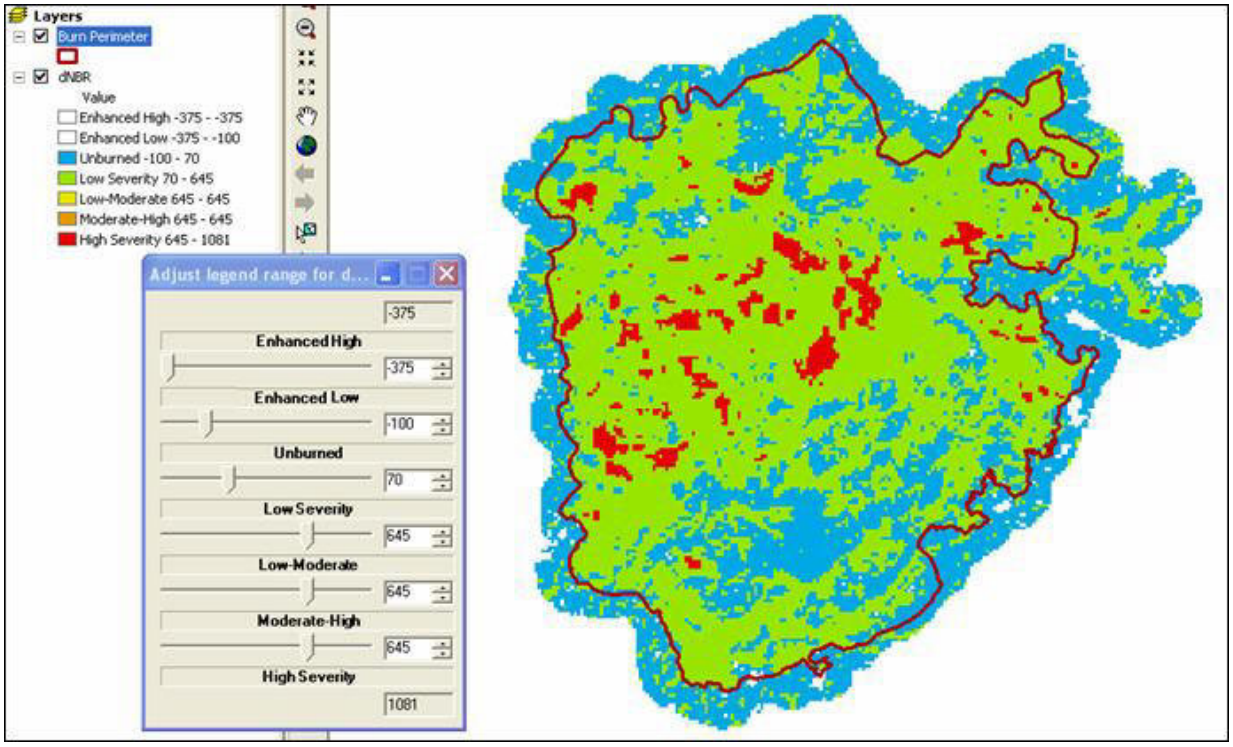


Next: Identify classes

Identifying severity classes

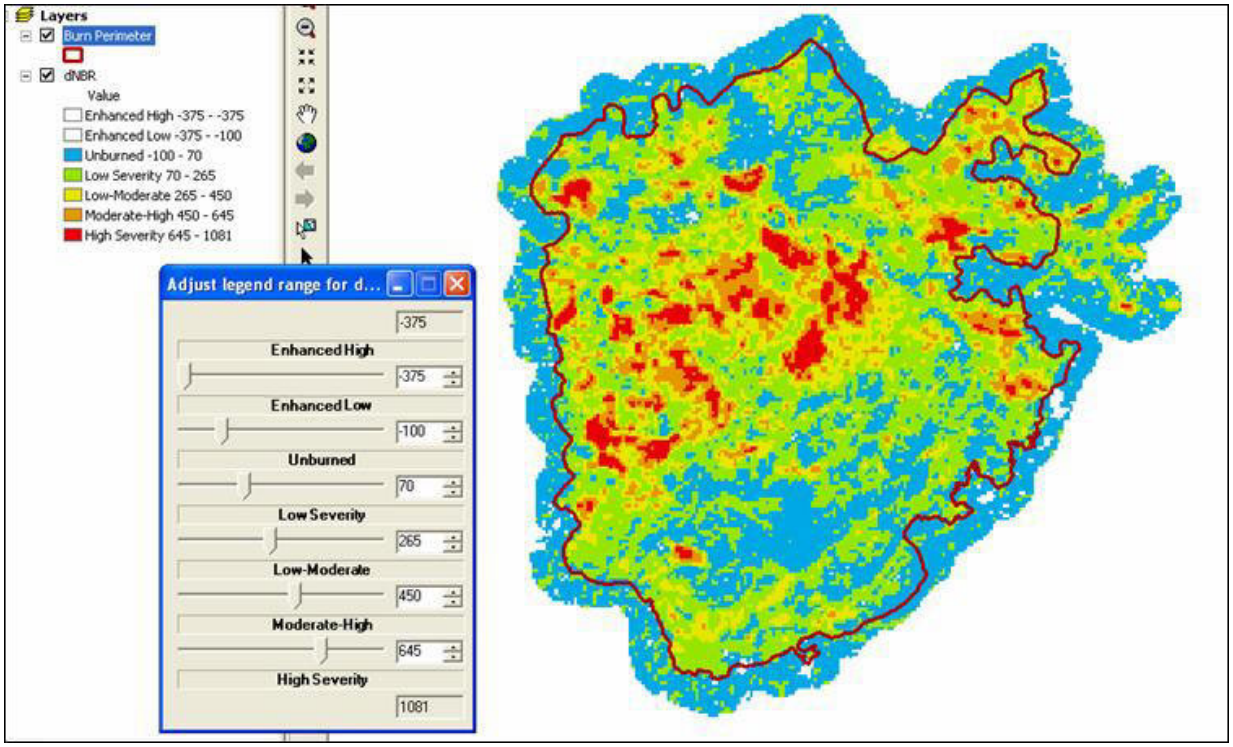
High-severity areas

Next, it is useful to establish the lower threshold for high-severity areas. To do this, slowly decrease the lower limit of the **High Severity** class (the same as the upper limit for the **Moderate-High Severity** class). **High Severity** colored pixels should appear in a few scattered locations and then begin to form clumps. After these patches fill in, but before they begin to coalesce, note your dNBR value. If it is somewhere in the range of 600 to 750, it represents the lower threshold of the high-severity burn class.



Remaining classes

Finally, separate the remaining pixels that fall between unburned and high severity into low, moderate-low, and moderate-high classes. You can do this based on Table LA-2 from Key & Benson, 2004.



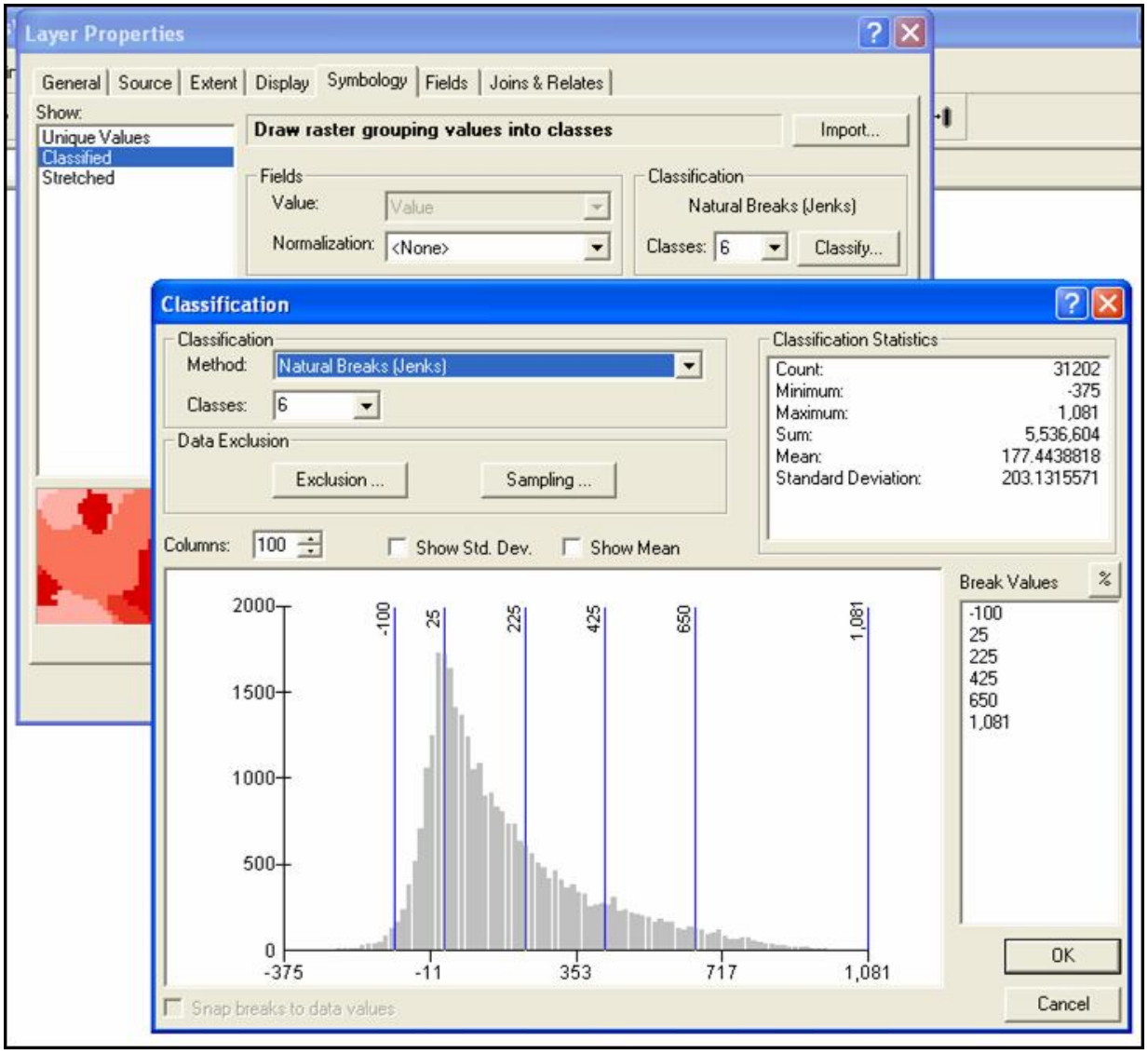
Next: Map classes

Map classes

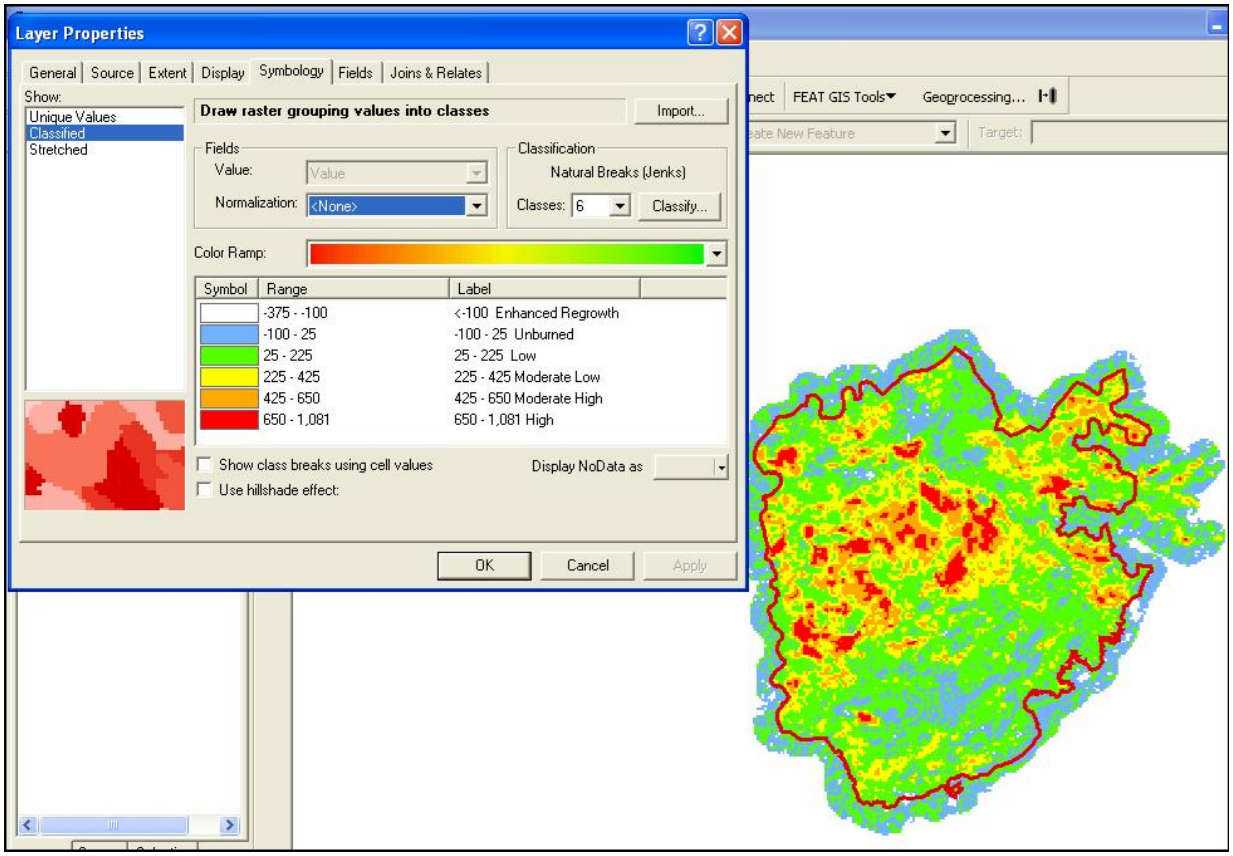
To depict classes in your map, return to the **Symbology** tab in the **Layer Properties** form.

Select **Classification** and set the number of classes at 6. Click the **Classify** button to set your threshold values. Under **Break Values**, you can enter your thresholds directly. The first (lowest) threshold value should be the lower threshold for unburned (in most cases this is -100).

The next threshold value should be the upper threshold for unburned/the lower threshold for lower severity. Continue in this fashion so that each break point between severity classes is recorded in the **Break Values** section of the **Classification** form.



Finally, you can recolor the symbol for each class as desired.



See also: [Stratified sampling]

Stratified sampling for CBI

The FFI GIS toolbar allows you to quickly and easily create candidate plots for CBI sampling within each burn severity class. The following example shows the step-by-step process for creating candidate plots for CBI.

Random from DNBR

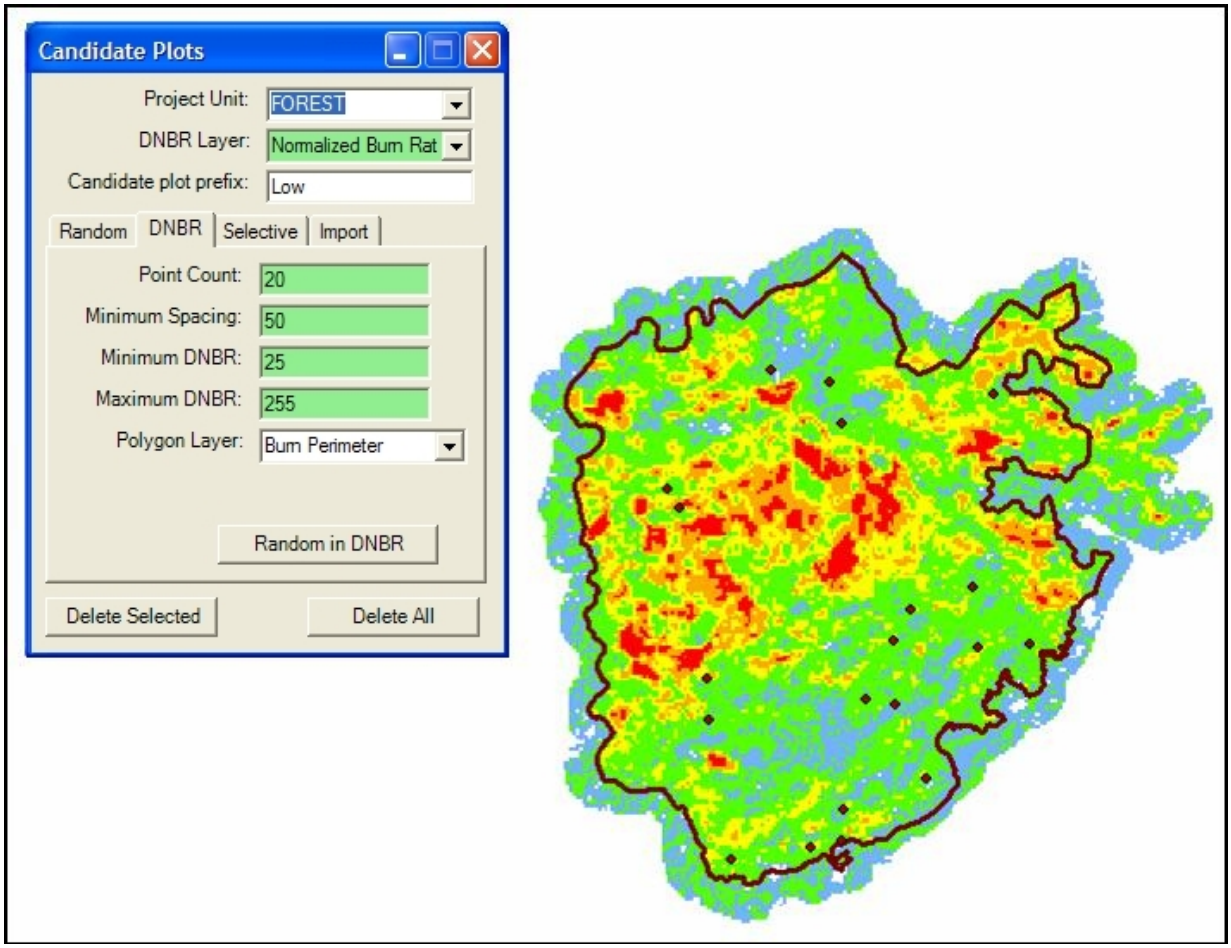
Using the **DNBR** tab on the **Candidate Plots** form in the FFI GIS toolbar is one way to create random sample points for CBI plots.

1. First, select the project unit in the **Project Unit** drop-down list.
2. Set **DNBR Layer** to the DNBR layer in your map.
3. Under **Candidate plot prefix,** enter the name of the severity class for which you are creating samples.
4. Enter the number of candidate points you would like to create, the desired spacing between candidate plots, and the range of dNBR values that you would like the candidate plots to fall within.

You can select from the **Polygon Layer** drop-down list to define a polygon that all candidate sites will fall within. In the example below, the burn perimeter is used.

When you click **Random in DNBR**, random candidate sites will be created according the parameters that you set. In the example below, 20 points are created in areas of dNBR ranging from 25 to 225 that are at least 50 meters apart and that fall within the burn perimeter.

Repeat this process for each severity class, resetting the **Candidate plot prefix** and the **Minimum** and **Maximum dNBR** values as appropriate.



Next: Selective sampling

Selective sampling

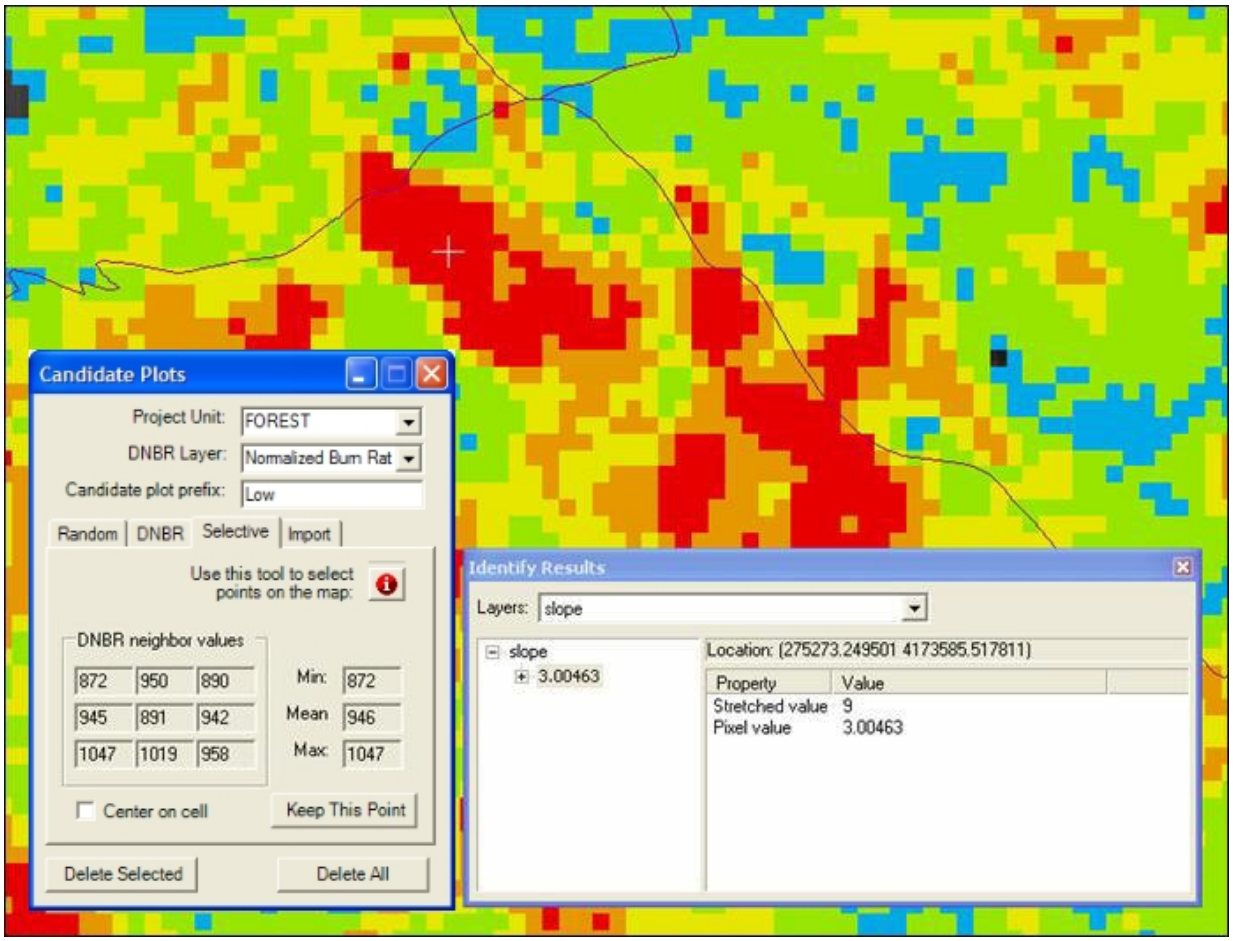
The **Selective** tab in the **Candidate Plots** form in the FFI GIS toolbar allows you a greater degree of control in locating potential CBI plots. This tab lets you place plots in areas that are accessible and have relatively homogeneous dNBR values.

1. First, select the project unit in the **Project Unit** drop-down list.
2. Set **DNBR Layer** to the dNBR layer in your map.
3. Under **Candidate plot prefix,** enter the name of the severity class that you are creating samples for.
4. Click the **Selective** tab.

You can now use the tool on this tab to select sites for CBI plots. When you click a location on the map, the **DNBR neighbor values** shows the dNBR value of that pixel and its eight neighbors. The **Min**, **Mean**, and **Max** boxes show the minimum, maximum, and average values of all nine cells.

The ArcMap **Identify Results** dialog will also appear, and you can use that to display another parameter of interest, such as the slope or vegetation type at the location you selected. When you find a site that is relatively homogenous and meets your requirements in terms of accessibility (proximity to roads, slope, etc.), click **Keep This Point**

and the point will be added to your **CandidatePlots_temp** layer. The **Center on Cell** checkbox will place a selected point in the center of the cell that it falls in.



Next: Field sampling

Field sampling

Once you have created the desired number of sample plots in each severity class, you can create a map of these plots for field sampling directly in your working FFI map document, or you can export the **CandidatePlots** layer to a shapefile and create a separate field sampling map. You can also export a table from your **CandidatePlots** layer or shapefile and import the candidate site coordinates directly from the table into your GPS unit.

If you are planning to collect CBI data in the field using a PDA, you must create your macro plots before you go to the field. Since you won't know which CBI plots you'll be using until you visit and evaluate the candidate plots, you should add "placeholder" macro plots to the PDA. You can add the desired number of "placeholder" plots and then add the coordinate and other plot data into FFI after you return from the field.

Return to Using the FFI GIS toolbar for CBI

References

Key, C H and N C Benson. 2005. Landscape Assessment: Sampling and Analysis Methods. USDA Forest Service, GTR RMRS 164. http://burnseverity.cr.usgs.gov/.