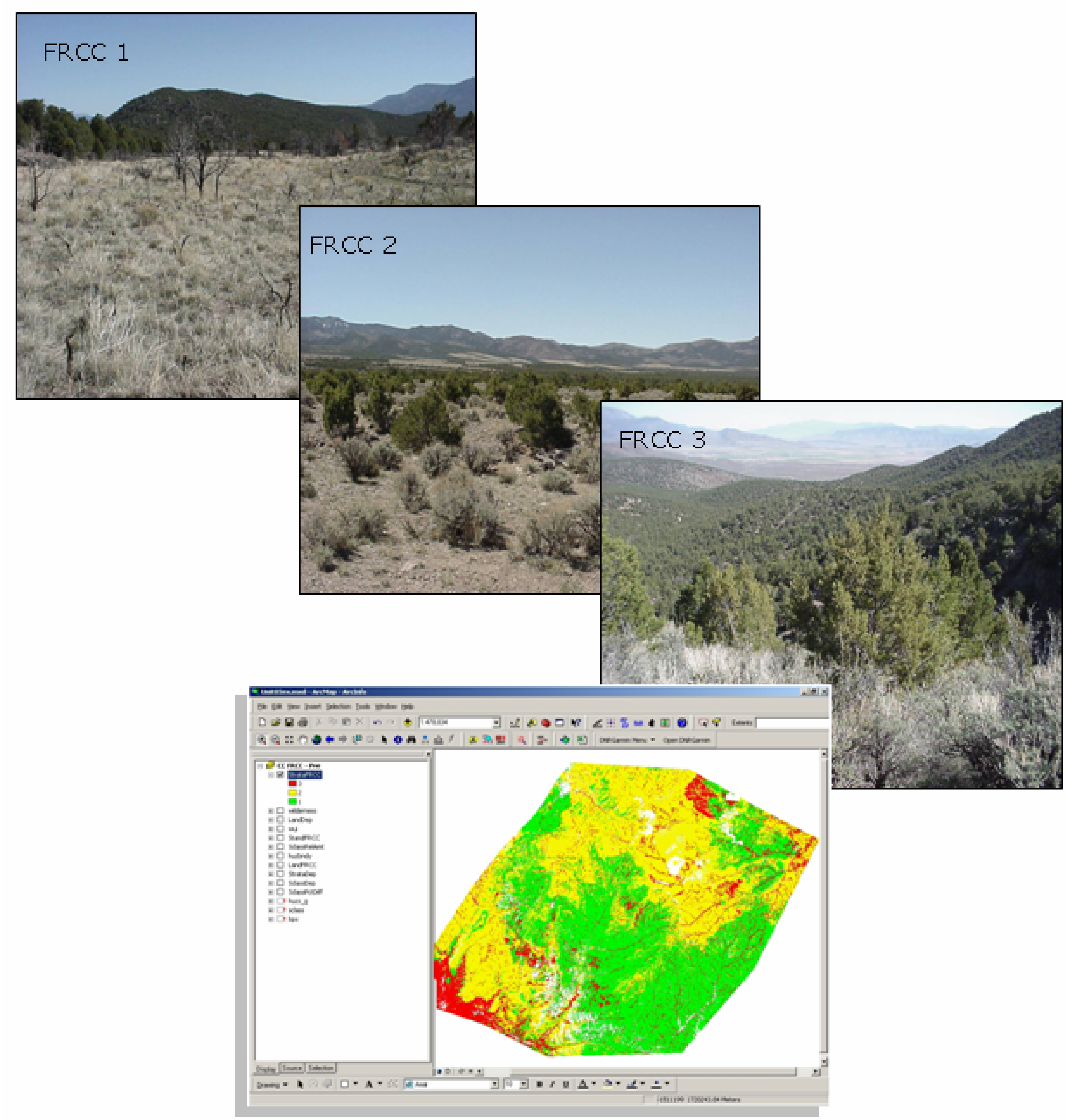


Fire Regime Condition Class Mapping Tool

User's Guide

Version 2.2.0

For ArcMap 9.2

July 7, 2008

National Interagency Fuels Coordination Group

Preface

Many federal land management agencies have been directed to manage lands to sustain ecosystems through time (USDA 1999, USDA 2000a, USDA 2000b). Allen and Hoekstra (1992) suggested that sustainability could be achieved only if managers worked with the underlying processes of the system to be managed, not against them. Several important scientific concepts have been developed to help address sustainability through assessing ecosystem condition. The scientific concepts important to the development and understanding of the Fire Regime Condition Class Mapping Tool – or FRCC Mapping Tool – include the historical range of variation (HRV), ecological departure, fire regime condition class (FRCC), and FRCC versus fire hazard.

Historical range of variation

Recent federal policy has identified the need to consider current ecosystem condition in the context of historical variation (USDA 2000a, 2000b). Historical range of variation (HRV) can be used as a reference to aid in understanding and evaluating change, as well as for evaluating current and future management goals (Hann and others 1997; Morgan and others 1994; Hessburg and others 1999; Swetnam and others 1999). Disturbance-driven spatial and temporal variation is a vital attribute of nearly all ecosystems (Landres and others 1999). Landres and others (1999) suggest that a primary objective in characterizing HRV is to understand: 1) how the driving ecosystem processes vary from site to site, 2) how these processes affected ecosystems in the past, and 3) how these processes might affect both current and future ecosystems. For example, historical conditions can be used to assess the impact of altered fire regimes on the structure and composition of forest ecosystems and for assessing the effectiveness of wildland fire use programs (Brown and others 1994; Hann and others 1997; Skinner and Chang 1996).

Certain photos courtesy of Fire Management Today

Ecological departure

Managers need to understand how ecosystem processes and functions have changed before they can develop strategies for sustaining those systems through time. An understanding of ecosystem departure provides the context necessary for managing sustainable ecosystems. The amount of change or departure from reference conditions can be derived by comparing the condition of existing or future ecosystems to the historical range of variation. Recent land management initiatives have addressed these important concepts with respect to fire and call for the development of spatial maps showing historical fire regimes as well as an estimate of fire regime departure (or condition class) (USDA 2000a; USDA 2000b; Healthy Forests Initiative: W House 2002; Healthy Forests Restoration Act: U.S. Congress 2003).

Fire regime condition class

Fire regime condition class (FRCC) is an index of ecological departure from reference conditions. The FRCC departure metric can be derived by evaluating the change in composition of succession classes, fire frequency, and fire severity (Hann and others 2004). Three classes corresponding to low, moderate, and high departure have been defined (Hardy and others 2001; Schmidt and others 2002) (see Appendix B). Common causes of departure include fire suppression, timber harvesting, livestock grazing, introduction and establishment of exotic plants, as well as introduced insects and disease (Schmidt and others 2002).

FRCC is derived by comparing current conditions to an estimated central tendency of the historical range of variability that existed before significant Euro-American settlement. Departure of current conditions from this historical baseline can serve as a useful proxy for potential uncharacteristic fire effects and can be used to address risks to the sustainability of fire-adapted ecosystems. In applying the condition class concept (Schmidt and others 2002), we assume that historical fire regimes represent conditions under which fire-adapted ecosystems have evolved and been maintained over time (Hardy and others 1998). Thus, if we observe that fire intervals, fire severity, vegetation structure, and/or vegetation composition have changed from historical conditions, we would also expect fire size, fire intensity, and burn patterns to be subsequently altered. If these basic fire characteristics have changed, then it is also likely that ecosystem components adapted to these historical fire regimes have been affected as well.

FRCC versus fire hazard

Fire regime condition class cannot be used to indicate fire hazard potential since the relationships between condition class and fire behavior are inconsistent at best. For example, some low departure areas may exhibit very active fire behavior, whereas in other instances, fire behavior may be relatively benign. The opposite is also true: some high departure areas may show fire behavior ranging from benign to very active. In addition, fire behavior and FRCC are considered at different scales. FRCC is a landscape metric, whereas fire behavior is typically analyzed on a stand basis (such as a homogeneous patch with uniform topography and fuels). FRCC is derived according to succession class composition (for example, stands within a given landscape). Consequently, some succession classes have characteristics that may result in a low fire behavior hazard (such as in early seral stands), whereas others may have a high hazard (such as in late seral stands).

The FRCC Mapping Tool

The FRCC Mapping Tool quantifies the departure of vegetation conditions from a set of reference conditions representing the historical range of variation. The tool, which operates from an ArcGIS platform, derives several metrics of departure by comparing the composition of current successional states to the composition of successional states representing the reference conditions. FRCC Mapping Tool outputs can be used to develop management plans and treatment strategies aimed at restoring vegetation conditions.

Version 2.2.0 of the FRCC Mapping Tool was released in October, 2007. Future versions may incorporate additional features, so be sure to check the NIFTT website (www.niftt.gov) for possible updates and enhancements.

What's new in version 2.2.0?

Some terms and concepts have changed since the release of earlier versions of the FRCC Mapping Tool. The term "potential natural vegetation group" (PNVG) was replaced by "biophysical setting" (commonly abbreviated as BpS) and "vegetation-fuel class," was replaced by "succession class" (S-Class).

Some elements of the Reference Condition Table have been changed to reduce common errors. Lastly, the FRCC Mapping Tool can now modify BpS and S-Class grids even if they do not coincide with the Reference Condition Table. Two new output layers have been added: Landscape FRCC and Stand Departure (Chapter 5). In addition, the Management Report has been renamed Summary Report and several new fields have been added (see Summary Report).

Recent changes specific to the FRCC Mapping Tool version 2.2.0 include:

- Bps models not in the Reference Condition Table (refcon table) are removed automatically as are S-classes other than A, B, C, D, E, and U.
- S-classes UN and UE are combined into class U. No notification is provided to the user.
- New modified rasters do not appear in ArcMap's Table of Contents
- Modified rasters are saved with the project in a folder named Modified Rasters
- Initial classes have their own tables
- The SClassPctDiff spatial layer is no longer available
- Additional error-trapping has been added
- The User Interface has been improved
- When spatial layers are added to ArcMap's Table of Contents, they are "open" and new symbology is not applied. However, after the FRCC Mapping Tool completes a run, the expected symbology (red, green, yellow) is applied as in previous versions
- The Mapping Tool has been updated for compatibility with Arc 9.2.
- The following Reference Condition Tables are now included with the installation: Custom, gb_Alaska, gb_EastUS, gb_WestUS, LFnat_east, LFnat_west, ra_EastUS, and ra_WestUS.

  Note: The "LFnat_east" Reference Condition Table is in progress. Check www.niftt.gov for periodic updates to this Reference Condition Table.

Prerequisites

FRCC Mapping Tool users should be familiar with the FRCC assessment process. As a minimum, users should review the Interagency Fire Regime Condition Class Guidebook (Hann and others 2003) prior to working with the FRCC Mapping Tool. Completion of online FRCC training available at www.frcc.gov is also recommended. Since the FRCC Mapping Tool is a GIS application, users must also have a working knowledge of ArcGIS. Lastly, because the FRCC Mapping Tool incorporates Microsoft Access and Excel, users should have a basic working knowledge of these programs. Specific requirements are detailed in Chapter 1.

Obtaining copies

To obtain additional copies of this FRCC Mapping Tool User's Guide or the FRCC Mapping Tool Tutorial, follow these steps:

1. Go to www.niftt.gov
2. Under *NIFTT Quick Links* at the left side of the page, click on **NIFTT Tools and User Documents**.
3. At the center of the page under *NIFTT Tools and User Documents*, click on **NIFTT User Documents**.
4. Click on the material you wish to download (User's Guide or Tutorial).

Obtain the FRCC Mapping Tool Help Utility, Installation Notes, or the latest version of the FRCC Mapping Tool as follows:

1. Go to www.niftt.gov
2. Under *NIFTT Quick Links* at the left side of the page, click on **NIFTT Tools and User Documents.**
3. At the center of the page under *NIFTT Tools and User Documents*, click on **NIFTT Tools**.
4. Click on the material you would like to download (Help Utility, Installation Notes, or the latest version of the FRCC Mapping Tool).

Credits

A beta version of the FRCC Mapping Tool was developed for the National Interagency Fuels Technology Team (NIFTT) by J.D. Zeiler and Jeff Jones of the USDA Forest Service. Early versions of the software have been substantially modified by Lee Hutter of Systems for Environmental Management (SEM) under the auspices of NIFTT.

Funding was provided by the USDA Forest Service and the US Department of Interior.

This FRCC Mapping Tool User's Guide was written by NIFTT members Jeff Jones of the USDA Forest Service and Deb Tirmenstein of Systems for Environmental Management.

Lastly, we thank Christine Frame of Systems for Environmental Management (and NIFTT member) for her editorial proficiency.

Your input

We value your input. Please forward any questions, comments, reports of bugs, or ideas to the National Interagency Fuels Technology Team (NIFTT) at helpdesk@niftt.gov.

Table of Contents

Chapter 1: About the FRCC Mapping Tool User's Guide

1.1 Before you begin

This user's guide describes the basic operation of the FRCC Mapping Tool, which quantifies the departure of vegetation conditions from a set of reference conditions.

We recommend that FRCC Mapping Tool users understand the concepts and methods presented in the Interagency FRCC Guidebook (Hann and others 2004 available at www.niftt.gov) 3) prior to working with the Mapping Tool This user's guide reviews many of the concepts, definitions, and methods discussed in the Interagency FRCC Guidebook, but does not consider them in detail.

Lastly, FRCC Mapping Tool users must be familiar with Microsoft Windows and basic ArcGIS functions.

1.2 How to use this guide

It is not necessary to read the entire guide to carry out a specific task. Once you are familiar with the basic concepts associated with the FRCC Mapping Tool, you can quickly locate commonly performed tasks by reviewing the headings in the Table of Contents located near the beginning of this guide. You can then refer to the specific section pertaining to your needs. Whenever possible, screen captures are used to illustrate steps required to complete a task.

The FRCC Mapping Tool User's Guide is not intended to provide step-by-step guidance on the tool's operation; rather, it is intended to serve as a reference guide. The FRCC Mapping Tool Tutorial provides basic step-by-step instructions using a specific management scenario as an example.

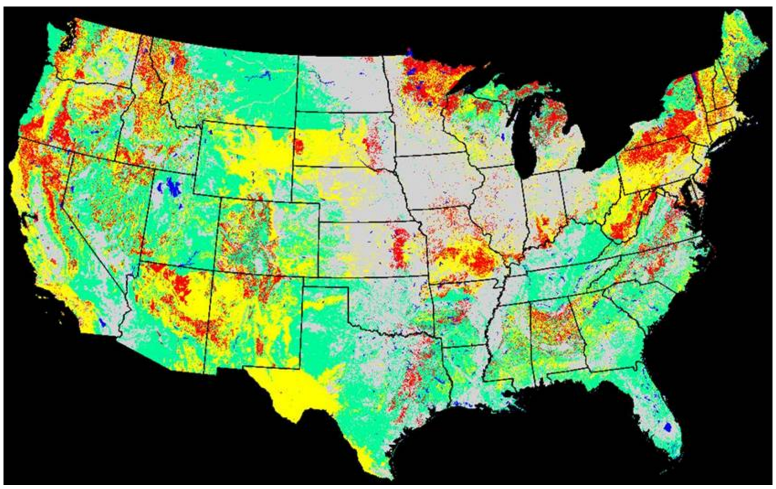
1.3 Computer requirements

Ensure the following programs are installed and functioning properly on your computer:

- ArcGIS 9.2
- Spatial Analyst extension of ArcGIS 9.2
- Microsoft Excel (2000 or higher)
- Microsoft Access (2000 or higher)

Although system requirements to run ArcGIS 9.2 will suffice to run NIFTT tools, at least 10 GB of free hard drive space and 2 GB of RAM are recommended. Generally, faster processors, more memory, and increased free hard drive space will improve performance. In addition, NIFTT tools were developed for Windows Operating Systems.

> ***Note****: Make sure that you have sufficient space and adequate permissions for storing FRCC Mapping Tool outputs on your computer.*
>
> ***Tip:*** *Make sure that the FRCC Mapping Tool version you are using correctly matches the version of ArcGIS on your computer. Use FRCC Mapping Tool version 2.2.0 only with ArcGIS 9.2. FRCC Mapping Tool version 2.1.0 is compatible with ArcGIS 9.0 or 9.1.*
>
> ***Note****: Although not required, ArcCatalog is a highly valuable tool for managing and organizing ArcMap data layers and should be used for all data manipulation such as copying, pasting, renaming, and deleting.*



Chapter 2: FRCC Mapping Tool Function

2.1 How the FRCC Mapping Tool operates

The FRCC Mapping Tool works within ArcMap to spatially assess the departure of vegetation conditions from a set of reference conditions. These reference conditions represent the midpoint of the historical range of variation (see Preface). The tool generates a suite of metrics that characterizes vegetation departure with varying degrees of thematic detail and at various levels of ecosystem organization. For example, some metrics are based on continuous values, whereas others use categorical data made up of relatively few discrete classes. Departure indices are generated at the landscape, biophysical setting, and succession class levels. Users can select the metrics that best address a specific analysis question.

The FRCC Mapping Tool uses protocols and algorithms outlined in the Interagency FRCC Guidebook (Hann and others 2004) to derive FRCC and related departure metrics. However, unlike the FRCC field assessment technique, the tool cannot estimate departure of fire frequency and severity. All departure metrics produced by the FRCC Mapping Tool are based solely on vegetation conditions.

> ***Note**: Future versions of the FRCC Mapping Tool will include fire regime departure.*

2.2 Processing steps

The FRCC Mapping Tool integrates ArcGIS and Access applications. ArcGIS combines the spatial landscape, biophysical setting, and succession class layers so that each value in the resulting raster layer denotes a unique combination of values from the three input layers. A series of queries is then made in an Access database to derive the composition of succession classes (S-Class) for every biophysical setting (BpS) within each landscape. The S-Class composition is then compared to the reference conditions contained within another Access database, known as the Reference Condition Database. Various departure indices are then computed within Access and, after that, joined back to the combined raster. Individual rasters representing each departure metric are then produced by ArcMap.

Finally, tabular data are exported to Excel where the difference between current and reference conditions is displayed. The Excel worksheet displays the amount of change necessary to restore or maintain landscapes according to reference condition.

2.3 Applications

Outputs from the FRCC Mapping Tool can be used to develop management plans and treatment strategies aimed at improving the sustainability of fire-adapted ecosystems. That is, the FRCC Mapping Tool can be used to spatially identify restoration opportunities by determining the amount of changed needed across a landscape. The tool can also be used to evaluate the effectiveness of proposed treatments in restoring departed landscapes. The FRCC Mapping Tool can be used for broad- to fine-scale planning; however, careful consideration should be given to the resolution, type, and accuracy of the input data when designing and interpreting Mapping Tool applications.

Chapter 3: Input Data

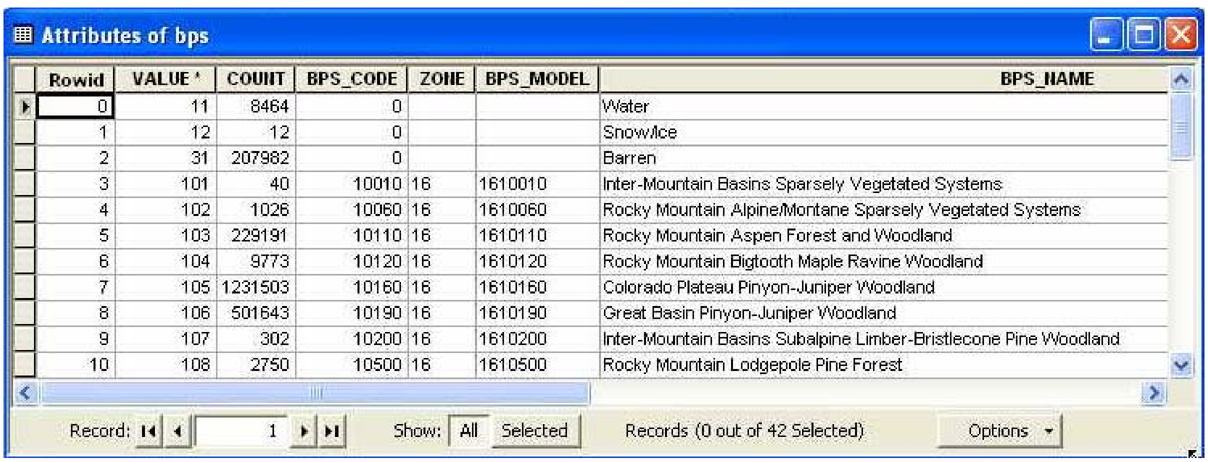
3.1 Description of input data

The FRCC Mapping Tool requires three kinds of spatial information in ArcGRID format: a layer or attribute depicting biophysical settings (BpS); a layer depicting succession classes (S-Class), and a layer depicting the landscape units (reporting units) within which the composition of succession classes is analyzed. This spatial information can be provided by a single layer having BpS, S-Class, and landscape levels as attributes, or the information can be provided by three unique layers which characterize BpS, S-Class, and landscape units separately. If multiple layers are used, all must have identical coordinate systems and projections. In addition, we recommend that the spatial layers also have identical cell sizes, cell alignment, and geographic extents. The tool also requires a set of reference conditions that can be associated with the BpS layer. These reference conditions are stored in a table (the Reference Condition Table) contained within an Access database. Each of the inputs will be considered in this user's guide, but readers are encouraged to refer to the Interagency FRCC Guidebook (Hann and others 2004; available at www.niftt.gov) for a more detailed discussion of concepts pertaining to biophysical settings, succession classes, and reference conditions.

3.1.1 Biophysical Settings (BpS) layer

Biophysical settings reflect the integration of soils, climate, and topography which define native disturbance regimes and the composition of resulting plant communities. Biophysical settings are the taxonomic units used to characterize reference conditions. The natural composition of succession classes has been determined for each BpS by using either spatial vegetation succession and disturbance models, such as LANDSUM (Keane and others 2006) and TELSA (ESSA Technologies Ltd. 2005a) or aspatial vegetation succession and disturbance models, such as the Vegetation Dynamics Development Tool (VDDT) (ESSA Technologies Ltd. 2005b).

The FRCC Mapping Tool derives departure values, and subsequently fire regime condition classes, for each BpS within the analysis area. Therefore, the BpS layer must contain attributes with codes that coincide with BpS codes in the Reference Condition Table (figs. 3-1 and 3-5). Departure values will be derived only for those biophysical settings common to both the BpS layer and the Reference Condition Table. Biophysical settings lacking a set of reference conditions (such as barren, water, agriculture, and urban) are ignored when calculating landscape composition and deriving departure indices. For example, if agriculture comprises 10 percent of a landscape, the composition of succession classes is determined from the remaining 90 percent of that landscape.


Attributes of bps

Rowid	VALUE *	COUNT	BPS_CODE	ZONE	BPS_MODEL	BPS_NAME
0	11	8464	0			Water
1	12	12	0			Snow/Ice
2	31	207982	0			Barren
3	101	40	10010	16	1610010	Inter-Mountain Basins Sparsely Vegetated Systems
4	102	1026	10060	16	1610060	Rocky Mountain Alpine/Montane Sparsely Vegetated Systems
5	103	229191	10110	16	1610110	Rocky Mountain Aspen Forest and Woodland
6	104	9773	10120	16	1610120	Rocky Mountain Bigtooth Maple Ravine Woodland
7	105	1231503	10160	16	1610160	Colorado Plateau Pinyon-Juniper Woodland
8	106	501643	10190	16	1610190	Great Basin Pinyon-Juniper Woodland
9	107	302	10200	16	1610200	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland
10	108	2750	10500	16	1610500	Rocky Mountain Lodgepole Pine Forest

Record: 1 Show: All Selected Records (0 out of 42 Selected) Options

Figure 3-1. The attribute *Bps_model* in the Value Attribute Table from a BpS layer must correspond to the field labeled *Bps_model* in the Reference Condition Table.

***Tip**: To view an example attribute table, open ArcMap and right click on any desired layer in the Table of Contents. Select Open Attribute Table from the menu options.*

3.1.2 Succession Classes (S-Class) layer

The Succession Classes (S-Class) layer identifies the successional state at a particular point in time, often representing what is "currently" on the landscape. Succession classes are unique to a BpS and can be interpreted only within the context of the BpS. Consequently, succession classes must be nested within the BpS layer. Succession classes typically denote both seral status (early-, mid-, or late-seral) and structure (open or closed canopy) and are generally derived from a characterization of species composition (such as cover type), diameter and/or height classes, and density or cover.

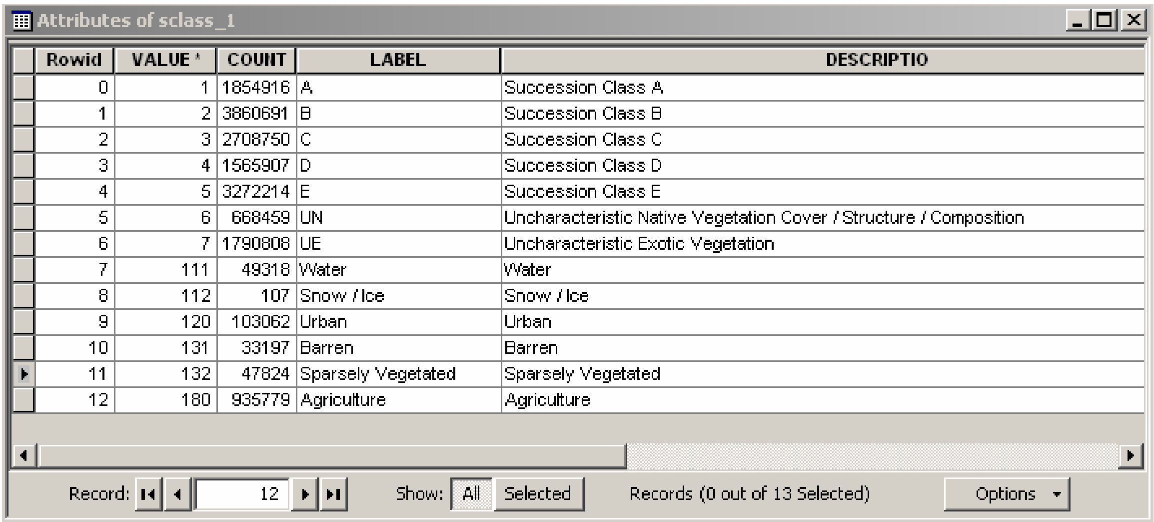
The FRCC Mapping Tool can accept up to seven succession classes for a given BpS. This includes five natural states (early-seral, mid-seral closed, mid-seral open, late-seral open, late-seral closed), and two "uncharacteristic" states denoting unnatural conditions that did not occur during the reference period, such as unnatural structures (UN) or exotic species (UE). These states are commonly denoted by A, B, C, D, E, UN, and UE, respectively. However, not all biophysical settings are characterized by five natural states and the description of each state is not necessarily consistent. For example, some biophysical settings do not have open structures and some lack mid-seral states. For this reason, users must be familiar with the BpS model descriptions that apply to their local areas. For additional information on bps models go to http://www.landfire.gov/NationalProductDescriptions/

The FRCC Mapping Tool computes the existing composition of succession classes for each BpS within a given landscape (fig. 3-2). The existing composition is then compared to the reference composition to derive the departure indices. Consequently, every pixel in the BpS layer that has been assigned to a BpS having a reference condition, must also be assigned to an S-Class. Biophysical settings lacking a reference condition (such as rock, barren, mines, agriculture, urban, and water) do not need a corresponding S-Class since they are ignored when departure is derived.

The S-Class layer must contain an attribute denoting the S-Class as A, B, C, D, E, U, UE or UN (fig. 3-2) so that the layer can be associated with the Reference Condition Table. In the following example, the attribute Label relates the S-Class layer to the succession classes in the Reference Condition Table (fig. 3-5). Succession classes identified by anything other than A, B, C, D, E ,U, UE, or UN will be ignored when calculating the S-Class composition of a BpS.

***Note**: The S-Class layer must have an attribute that can be related to the Reference Condition Table.*

The FRCC Mapping Tool is particular about the format of the S-Class layer in terms of grid values and the attribute values relating to the Reference Condition Table. Grid values 1 through 5 must correspond to S-Classes A through E, respectively. Furthermore, grid values 6 and 7 must correspond to the uncharacteristic classes (UN and UE), respectively. If only one uncharacteristic class is used (that is, U), it must be assigned to grid value 6. All grid values exceeding 7 are ignored when deriving departure metrics. When the FRCC Mapping Tool detects two uncharacteristic classes (for example, grid values 6 and 7 for UN and UE, respectively), the two classes are merged into a single class denoted as U prior to deriving the departure metrics.



Rowid	VALUE *	COUNT	LABEL	DESCRIPTIO
0	1	1854916	A	Succession Class A
1	2	3860691	B	Succession Class B
2	3	2708750	C	Succession Class C
3	4	1565907	D	Succession Class D
4	5	3272214	E	Succession Class E
5	6	668459	UN	Uncharacteristic Native Vegetation Cover / Structure / Composition
6	7	1790808	UE	Uncharacteristic Exotic Vegetation
7	111	49318	Water	Water
8	112	107	Snow / Ice	Snow / Ice
9	120	103062	Urban	Urban
10	131	33197	Barren	Barren
11	132	47824	Sparsely Vegetated	Sparsely Vegetated
12	180	935779	Agriculture	Agriculture

Figure 3-2. Example of a Value Attribute Table derived from an S-Class layer produced by the LANDFIRE Project.

Note: *The S-Class layer produced by LANDFIRE may have two uncharacteristic classes: "UE" represents an uncharacteristic condition due to exotics, whereas "UN" depicts uncharacteristic native, a condition due to unnatural structure.*

3.1.3 Landscape layer

The Landscape layer identifies a geographic area for deriving the composition of succession classes for any given BpS. Thus, the Landscape layer and the BpS layer together create the strata for which vegetation departure and FRCC are derived. The concepts of ecological departure and FRCC are scale-dependent. Consequently, results will differ as the landscape used to report those results changes in size and/or shape. It is therefore very important to select appropriately sized landscapes when using the FRCC Mapping Tool.

To select an appropriately sized landscape, consider historical fire regimes and the resulting vegetation patterns that historically dominated a particular area. The landscape should be large enough to encompass the historical range of variation (HRV). That is, it should be large enough so that the full expression of succession classes would occur given natural disturbance processes. For example, in a forested setting, infrequent, high-severity fire regimes commonly led to relatively large patches of vegetation (in other words coarse-grained patterns), whereas frequent, low-severity fire regimes resulted in relatively small patches (fine-grained patterns). Thus, larger landscapes would be required to incorporate the full expression of HRV in areas having coarse-grained patterns, whereas smaller landscapes may suffice in areas having fine-grained patterns. Estimates of departure tend to be inversely correlated with landscape size. That is, departure estimates tend to increase as the landscape size decreases. Conversely, using exceedingly large landscapes may produce departure estimates that are too low.

Tip: *The creation of a landscape layer commonly involves clipping a pre-existing layer. This process often creates slivers around the boundary of the assessment area. If these small slivers are not incorporated into the larger, adjacent landscape, erroneous departure estimates can result. In some instances, it may be advantageous to extend the assessment area beyond a project area's actual boundary.*

A nested hierarchy of up to three landscape levels (small, medium, and large) can be used to derive the composition of succession classes. A nested hierarchy allows for the analysis of areas containing multiple biophysical settings and historical fire regimes. For example, the smallest landscape level could be used to assess the departure of biophysical settings dominated by low-severity fire regimes (in other words, regimes resulting in fine-grained vegetation patterns); the mid-sized landscape level could be used to assess biophysical settings dominated by mixed-severity regimes (regimes resulting in both fine- and coarse-grained vegetation patterns); and the largest landscape level could be used to assess biophysical settings dominated by high-severity regimes (regimes resulting in coarse-grained vegetation patterns).

If multiple landscape levels are used, the smaller landscape levels must be nested within the larger landscape levels. To ensure that the landscape levels are in fact nested, we recommend using a single landscape layer that contains an attribute for each level of the hierarchy. For example, if a watershed hierarchy based on a hydrologic unit code (HUC) is used, the layer could contain three attributes representing subbasins (large), watersheds (medium), and subwatersheds (small). Similarly, if an ECOMAP hierarchy (Cleland and others 1997) is used, the landscape layer could contain attributes for subsections (large), landtype associations (medium), and landtypes (small). Figures 3-3 and 3-4 show examples of a nested landscape layer made up of watersheds and an associated Value Attribute Table.

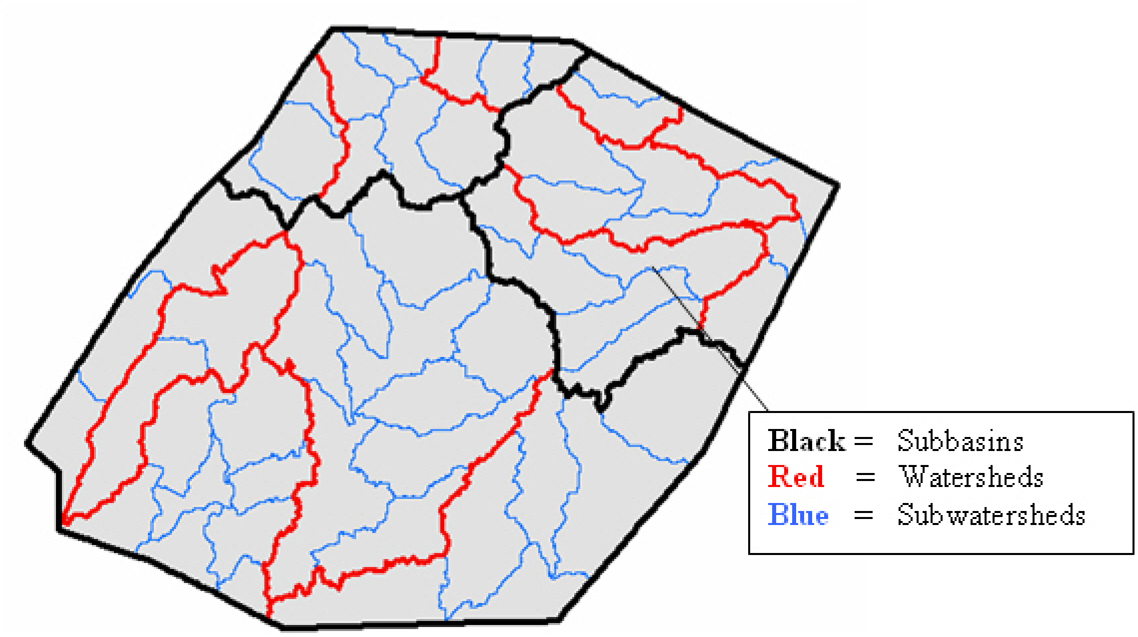
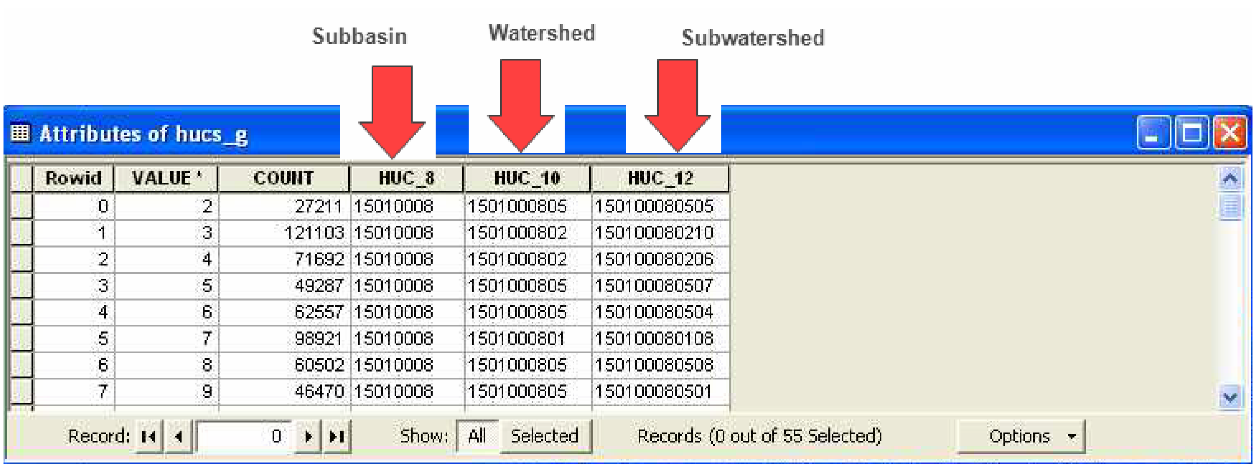


Figure 3-3. Example of nested landscapes comprised of subbasins, watersheds, and subwatersheds.



Rowid	VALUE *	COUNT	HUC_8	HUC_10	HUC_12
0	2	27211	15010008	1501000805	150100080505
1	3	121103	15010008	1501000802	150100080210
2	4	71692	15010008	1501000802	150100080206
3	5	49287	15010008	1501000805	150100080507
4	6	62557	15010008	1501000805	150100080504
5	7	98921	15010008	1501000801	150100080108
6	8	60502	15010008	1501000805	150100080508
7	9	46470	15010008	1501000805	150100080501

Figure 3-4. Example Value Attribute Table from a Landscape layer comprised of nested watersheds.

Although the FRCC Mapping Tool can use three hierarchical levels of landscapes to assess departure, it is not necessary to use all three. Using only one level may be appropriate if the analysis area is dominated by a single fire regime group. Similarly, for a small analysis area dominated by a single fire regime group, it might be appropriate to use a single landscape (analysis area boundary). In this instance, the landscape layer would contain only a single value (for example, one subwatershed).

***Tip**: The "LandscapeLevel" field in the Reference Condition Table must match the desired number of analysis levels. If you prefer to use one or two levels, then the "LandscapeLeve"l field in the default Reference Condition Table must be edited. For example, if only one level is used, then the "LandscapeLevel" field must contain a value of 1 for every record in the table. If two levels are used, then the "LandscapeLevel" field must contain a value of 1 or 2 for every record. (Refer to section 3.14 for additional information).*

3.1.4 Reference Condition Table

The Reference Condition Table provides three key pieces of information for use with the FRCC Mapping Tool: 1) a list of biophysical settings that occur within a particular analysis area, 2) the succession classes and corresponding reference condition for each BpS, and 3) the dominant historical fire regime group. Select one or more landscape levels according to the fire regime group(s) to compute the composition of the existing succession classes. Reference conditions are typically derived by a vegetation succession and disturbance model such as VDDT (ESSA Technologies Ltd. 2005b), TELSA (ESSA Technologies Ltd. 2005a), or LANDSUM (Keane and others 2006). However, some users have developed Reference Condition Tables by consulting the literature or by using General Land Office survey information. The Reference Condition Table identifies the proportional distribution of succession classes (expressed as a mid-point) within each BpS that would likely occur across a landscape as a result of the historical disturbance regime.

The Reference Condition Table (fig. 3-5) must be formatted so that it can be associated with BpS and S-Class layers. For example, the first field in the Reference Condition Table, BpS_Model, denotes the BpS and must coincide with an attribute in the BpS layer. The third through eighth fields in the Reference Condition Table, succession classes A through U, correspond to the S-Class and provide percent composition within a particular BpS. The field headings must coincide with an attribute of the S-Class layer.

***Note:** The "U" field denoting the "uncharacteristic" class must be populated with a value of "0" because uncharacteristic succession classes did not occur naturally during the reference period.*

The next field, Fire Regime Group (FRG) describes the dominant historical fire regime (see Appendix C) for each BpS. The dominant fire regime group is used to assign a value to the last field, LandscapeLevel.

LandscapeLevel identifies the appropriate landscape level to use for deriving the existing composition of succession classes within a BpS. The values in the LandscapeLevel field – 1, 2, and 3 – correspond to the small, mid-sized, and large landscapes, respectively.

Two fields in the Reference Condition Table, Name and FRG, are optional and are not directly used by the FRCC Mapping Tool. These fields are included only for convenience and need not be populated. However, if the Name field is not populated in the Reference Condition Table, then the Summary Report will not show the BpS names (see Chapter 5).

Reference Condition Tables can be found in an Access database labeled refcon.mdb, which is located at C:\NIFTT\FRCC Mapping Tool 2.2.0\Reference Conditions Database (provided the recommended default path was used during the installation procedure). The following default Reference Condition Tables are included with the FRCC Mapping Tool installation: GB_Alaska, GB_East, and GB_West (adapted from the Interagency FRCC Guidebook) (Hann and others 2004), RA_East and RA_West (adapted from the Rapid Assessment phase of the LANDFIRE Project), and LFnat_east, and LFnat_west. (LANDFIRE National).

***Note**: Review the "FRG" and "LandscapeLevel" fields of the default Reference Condition Tables to verify that values are reasonable for a specific assessment area. Unreasonable values should be changed.*

ra_WestUS : Table

BpS_Model	Name	A	B	C	D	E	U	FRG	LandscapeLevel
R#ABAMlw	Pacific Silver Fir--Low Elevation	15	20	3	10	52	0	3	2
R#ABAMup	Pacific Silver Fir--High Elevation	10	25	2	3	60	0	5	3
R#ABLA	Subalpine Fir	15	20	2	3	60	0	4	3
R#AGSP	Bluebunch Wheatgrass	5	70	25	0	0	0	1	1
R#ALME	Alpine and Subalpine Meadows and Grasslan	5	90	5	0	0	0	5	3
R#DFHEdy	Douglas-fir Hemlock-Dry Mesic	5	15	5	15	60	0	3	2
R#DFHEwt	Douglas-fir Hemlock-Wet Mesic	5	15	1	4	75	0	5	3
R#DFWV	Douglas-fir Willamatte Valley Foothills	15	15	10	30	30	0	1	1
R#JUPIse	Western Juniper Pumice	3	12	15	10	60	0	5	3
R#MCONdy	Mixed Conifer - Eastside Dry	15	1	30	40	14	0	1	1
R#MCONms	Mixed Conifer - Eastside Mesic	15	40	15	10	20	0	3	2
R#MCONsw	Mixed Conifer - Southwest Oregon	15	5	10	50	20	0	1	1
R#MEVG	California Mixed Evergreen North	15	10	50	20	5	0	1	1
R#MGRA	Idaho Fescue Grasslands	10	70	20	0	0	0	2	1
R#MTHE	Mountain Hemlock	10	10	15	10	55	0	5	3
R#OAPI	Oregon White Oak/Ponderosa Pine	25	5	20	47	3	0	1	1
R#OWOA	Oregon White Oak	10	1	20	64	5	0	1	1
R#PICOpu	Lodgepole Pine - Pumice Soils	20	15	50	10	5	0	4	3
R#PIJEsp	Pine Savannah - Ultramafic	15	45	40	0	0	0	1	1
R#PIPOm	Dry Ponderosa Pine - Mesic	10	10	35	40	5	0	1	1
R#PIPOxe	Ponderosa Pine - Xeric	25	5	25	40	5	0	3	2
R#REFI	Red Fir	10	20	15	20	35	0	3	2
R#SAWD	Subalpine Woodland	25	20	55	0	0	0	3	2
R#SBDWlw	Low Sagebrush	35	15	50	0	0	0	3	2
R#SBMT	Mountain Big Sagebrush (Cool Sagebrush)	20	10	35	30	5	0	2	1
R#SPFI	Spruce - Fir	3	22	25	20	30	0	4	3
R#SSHE	Sitka Spruce - Hemlock	5	10	1	10	74	0	5	3
R#TAOAco	Oregon Coastal Tanoak	10	10	50	25	5	0	1	1

Record: 7 of 148

Figure 3-5. Example Reference Condition Table from LANDFIRE Rapid Assessment. *BpS_Model* = the BpS code; *Name* = BpS name; *A* through *U* = succession classes; *FRG* = Fire regime group; *LandscapeLevel* = level at which to assess each BpS.

Some general guidelines for creating a Reference Condition Table in Access are as follows:

1. The name of the Reference Condition Table cannot contain spaces or special characters (`~! @#$^()-+={ }[ ]|\?/:;"'< >, .) and should be between three and eight characters long.

2. The Name and FRG fields are optional and do not need any values. They are included within the Reference Condition Table for convenience.

3. The S-Class fields A through U cannot contain missing values (cannot be left blank). For example, the record must contain a value of 0 in cases where an S-Class did not occur naturally; therefore, the U field must contain 0 for every record in the table. In addition, S-Class values should total 100 percent for each BpS.

4. The LandscapeLevel field in the Reference Condition Table must match the desired number of analysis levels. The default

Reference Condition Tables were developed assuming that three analysis levels would be used to assess departure. If you prefer to use one or two levels, then the LandscapeLevel field in the default Reference Condition Table must be edited. For example, if only one level is used, then the LandscapeLevel field must contain a value of 1 for every record in the table. If two levels are used, then the LandscapeLevel field must contain a value of 1 or 2 for every record.

5. The total path length for the location of the FRCC Mapping Tool software, and consequently the Reference Condition Table, must be less than 80 characters.

6. The FRCC Mapping Tool can only use a Reference Condition Table in the form of an Access database labeled refcon.mdb. This database is created during software installation. If the default path was selected during the installation process, then the refcon.mdb will be located as follows: C:\NIFTT\FRCC Mapping Tool 2.2.0\Reference Conditions Database. (The path cannot contain any folders with spaces such as Program Files, My Documents, or Documents and Settings).

7. Removing the FRCC Mapping Tool will also remove any custom Reference Condition Tables that you may have developed. We therefore recommend making a backup copy of the refcon.mdb prior to removing the software, if it contains any custom Reference Condition Tables.

The design or structure of the Reference Condition Table is critically important for successful execution of the FRCC Mapping Tool.

The required structure for Reference Condition Tables is displayed in table 3-1. An empty table labeled Custom (provided with the installation of the software) has the appropriate design specifications, and users wishing to create their own Reference Condition Table are encouraged to use the Custom table as a template. An alternative approach for creating a customized Reference Condition Table is to copy one of the default tables included with the installation, rename it, paste it in the database and then edit values of interest.

Table 3-1. Required structure of the Reference Condition Table.

Field name	Data type	Field size	Decimal places	Required	Allow zero length	Default value	Indexed	Unicode compression	IME mode	IME sentence mode
BpS_Model	Text	16		Yes	No		Yes (No duplicates)	Yes	No Cntrl.	None
Name	Text	128		No	Yes		No	Yes	No Cntrl.	None
A	Number	Double	Auto	Yes		0	No			
B	Number	Double	Auto	Yes		0	No			
C	Number	Double	Auto	Yes		0	No			
D	Number	Double	Auto	Yes		0	No			
E	Number	Double	Auto	Yes		0	No			
U	Number	Double	Auto	Yes		0	No			
FRG	Text	4		Yes	No		No	Yes	No Cntrl.	None
Landscape Level	Number	Long Integer	Auto	Yes		1	No			

Chapter 4: Obtaining Input Data from National Map LANDFIRE

4.1 Options for acquiring input data

The NIFTT tool suite utilizes LANDFIRE data layers as input. A complete description of LANDFIRE data products can be found at www.landfire.gov

LANDFIRE National layers represent vegetation composition and structure, historical fire regimes, and surface and canopy fuel characteristics. The LANDFIRE project is scheduled to complete consistent, comprehensive maps of the entire nation, including Alaska and Hawaii, by the end of 2009.

1. Navigate to www.landfire.gov and click on **Data Products**.

2. Under *LANDFIRE National*, locate the *Data Product Access* menu listing four methods for accessing LANDFIRE data. The first two methods, the USGS National Map and LANDFIRE Data Access Tool, are the focus of these instructions. After reading about the various options, you may find the remaining options more suitable to your needs.

3. The first method describes the process for downloading data directly from the National Map LANDFIRE. The second method briefly describes use of the LANDFIRE Data Access Tool (LFDAT), which facilitates the downloading of LANDFIRE data from the National Map within the ArcGIS application ArcMap.

4.2 Downloading data directly from the National Map

1. On www.landfire.gov click on the **Link to National Map LANDFIRE** found on the bottom left side of that page.

   The National Map LANDFIRE website can also be accessed directly at http://landfire.cr.usgs.gov/viewer/.

2. When the National Map LANDFIRE opens, notice the legend for data availability and the links for additional support. Two links – *Data Versioning Alerts* and *Data Notifications* – provide up-to-date information on LANDFIRE data and can also be subscribed to through RSS feeds with Internet Explorer 7.0 or higher.

3. After viewing the legend, click on the map in your geographic area of interest, according to your data needs.

4. The next web page will display a shaded relief map of the approximate geographic location that you selected in the previous step. Options for navigating the National Map are on the left side of the map and options to Display and Download data are on the right.

   Using the navigation tools on the left, zoom in and out and pan until the specific area of interest is within view. If needed, use the *Display* tab to access layers under the *Places and Boundaries* menus to better help locate your area of interest. (fig. 4-1).

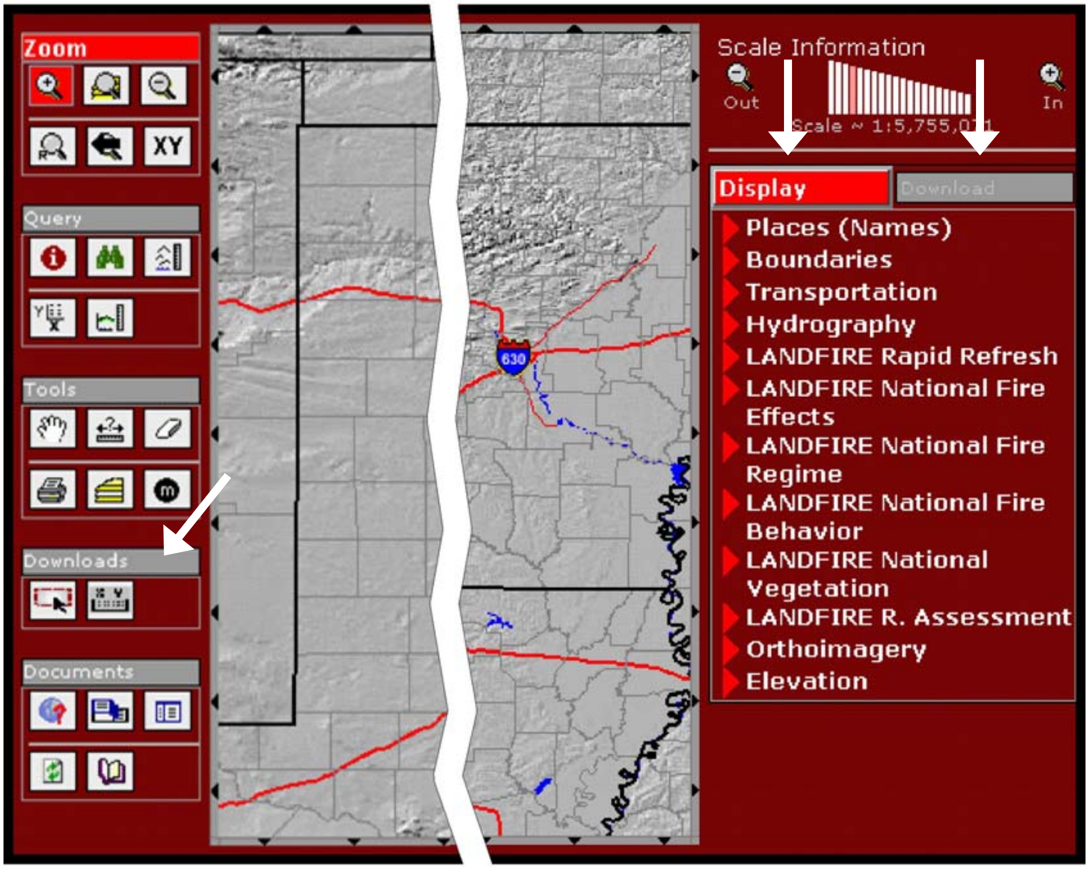


Figure 4-1. National Map LANDFIRE.

5. Click on the **Download** tab to identify the LANDFIRE layers that you wish to download. Check all layers to be downloaded. Be sure to check the data input requirements for the specific NIFTT tool to ensure that you will download all necessary data layers.

6. Under the *Downloads* tools on the left-hand side of the map (fig. 4-1), click on either of the two download options: **Define Rectangular Download Area** or **Define Download Area by Coordinates**.

   If you chose the *Define Rectangular Download Area*, click and drag the mouse until you get the rectangular extent that encompasses your area of interest. Otherwise, if you chose the *Define Download Area by Coordinates* option, enter the extent coordinates in the fields provided.

7. When you have finished drawing an extent rectangle or selecting coordinates, the *Data Server Summary Request* page (fig. 4-2) will appear with a list of all layers selected for download. Notice the Modify Request, Tutorial, and Help buttons located near the top.

The Modify Request allows you to select:

- additional layers for download
- the data format
- an output projection and datum
- a Landscape (.lcp) file

To return to the *Request Summary Page*, click one of the two options at the bottom of the *Modify Request* page.

On the *Request Summary Page*, the Tutorial gives a thorough overview on how to use the National Map. Help provides additional information on modifying a data request.

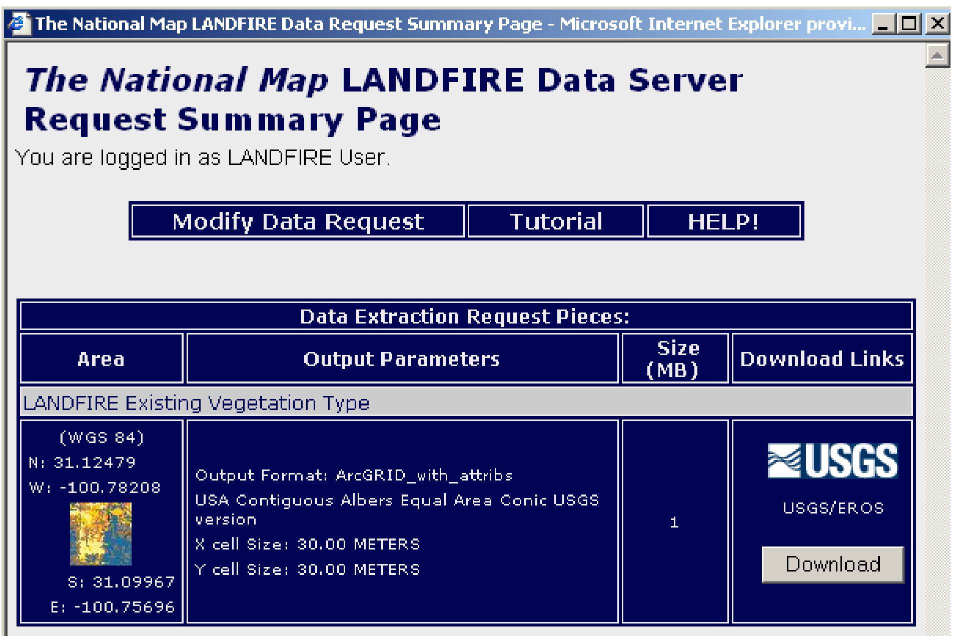


Figure 4-2. Request Summary Page.

8. Click on the **Download** button next to the first layer in your summary report and the file will download as a .zip file with a random numeric name. The .zip file will contain a grid identified by the same random number as the .zip file.

   After unzipping the file, it is recommended that you change the name of the grid in ArcCatalog to reflect the thematic nature of the layer. One way to determine the name of the grid is to open ArcCatalog and select the grid. Click on the Metadata tab and the name of the grid will appear in the metadata title.

9. At this point, the data should be ready for further processing as input for one of the NIFTT tools.

4.3 Downloading data using LFDAT

1. Once you are familiar with the National Map, acquiring LANDFIRE data using the LANDFIRE Data Access Tool (LFDAT) is the most efficient method and recommended if a broadband Internet connection is available. LFDAT allows a user to download and process LANDFIRE data directly within ArcMap.

2. The LFDAT can be obtained directly from www.niftt.gov under Other Tools. Because the following information only briefly describes the use of the LFDAT, it is strongly recommended that the LFDAT Tutorial be taken prior to this tutorial. (The tutorial is found at the same location as the tool).

3. Open ArcMap to a new map document. From the LFDAT toolbar, click on the  button to add the LANDFIRE data availability layer to your project. Notice that the green polygons represent zones where data are available for download.

4. To begin, click the **Get LANDFIRE National Map Data** tool icon: . With the tool, click to the upper left of the area of interest and drag a box to the lower right. (fig. 4-3).

   Drag a box as many times as needed until you have the extent that you want. To do so, you will need to close out the *Download Data* window that appears after every extent box has been drawn.

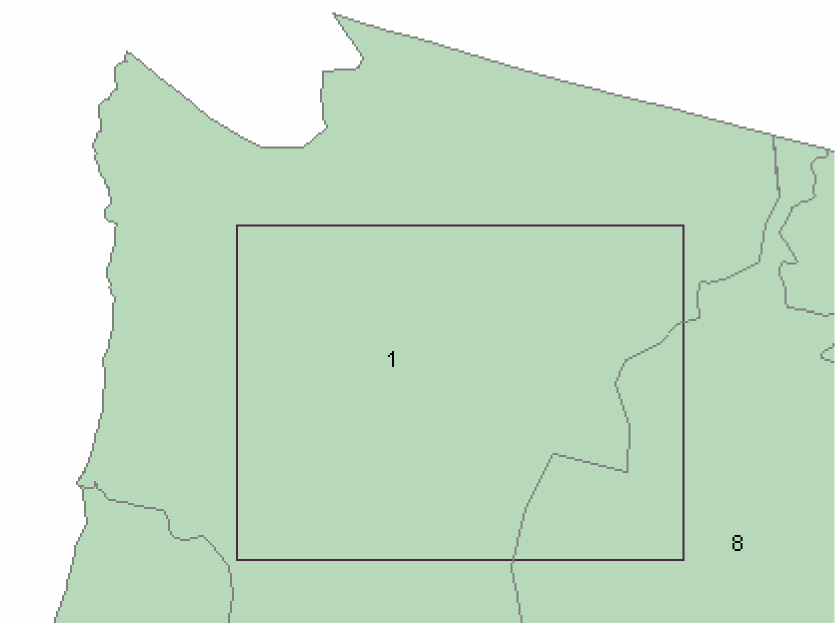


Figure 4-3. *Draw extent* box.

5. Once you have the extent you want, save the extent in the *Download Data* window by typing a meaningful name in the box labeled *Save this extent as:* and click the **Save** icon: . You will only need to do this once for each extent. This allows you to go back and download additional data with the same extent.

6. Click the down arrow to the left of *Request Download* and select the desired layer. For demonstration purposes, we will choose the first layer, *13 Anderson Fire Behavior Fuel Models* (fig. 4-4).

   If you experience difficulties downloading data from the National Map via LFDAT, click the About LANDFIRE Data Access Tool button on the LFDAT toolbar and check for updates. If you continue to have problems, open your Internet browser to The National Map LANDFIRE (http://landfire.cr.usgs.gov/viewer/) and click on **Having Trouble Downloading**?

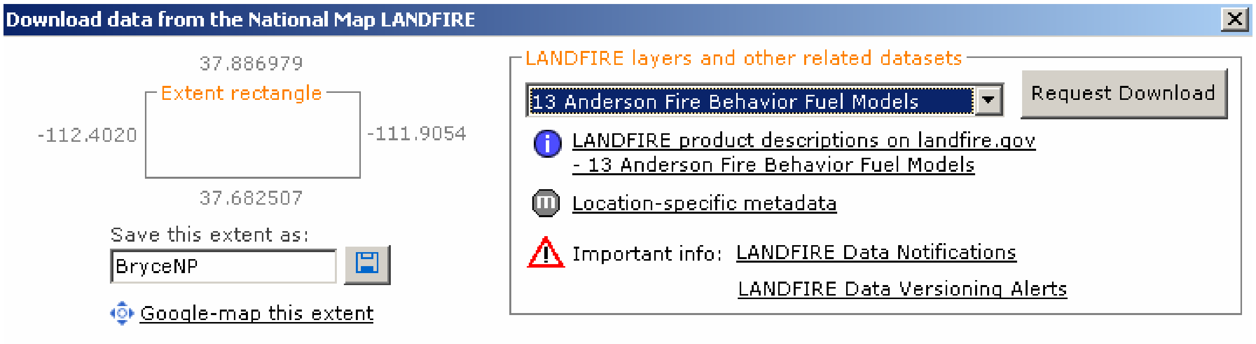


Figure 4-4. Request Download from National Map.

7. With the 13 Fire Behavior Fuel Models selected from the list, click on the **Request Download** button. This button initiates a process that extracts the data from the National Map.

8. Click on the **Download** button from the *SDDS Request Summary Page* to save the data to your computer. After the Raster Extract completes, a File Download dialog box appears. Click **Save.**

9. In the *Save As* dialog box, navigate to a location of your choice, right-click in the white space in the dialog box and select **New > Folder** (fig. 4-5).

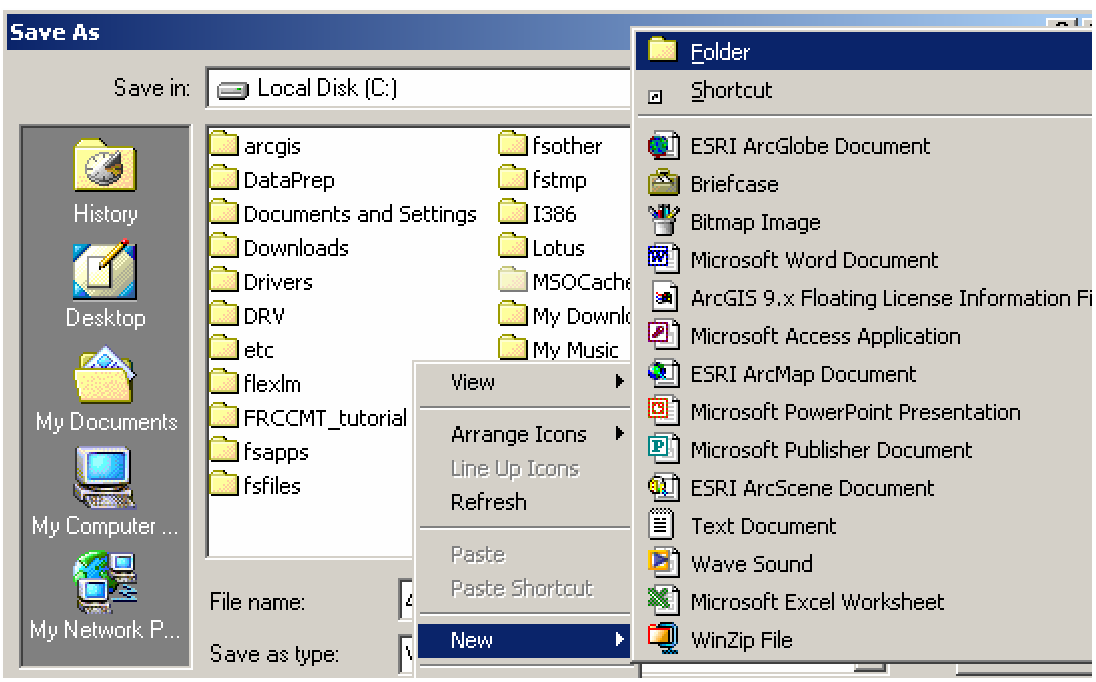


Figure 4-5. Create new folder.

10. Name the new folder *LF_Inputs* and double-click on it to save and open this folder. Click the **Save** button and the file will download into the *LF_Inputs* folder.

11. A progress window opens during the save process. After the download is complete, close the *Raster Extract Has Completed* window. To download additional files, you need to repeat this process for each data layer. For instance, the Fire Behavior Assessment Tool (FBAT) requires eight layers.

12. Close the *Download Data* window from the National Map LANDFIRE. Next, click on the *Process and Assemble LANDFIRE National Map Data* tool , also referred to as the Smart Assembler.

13. In the top entry of the dialog box, navigate to the *LF_Inputs* folder. Click the folder icon for an output location. Click **New Folder** and name the new folder *LF_Outputs*. Keep the default output file type ESRI GRID. Use separate input and output folders for each download and processing session for best results. The ESRI GRID format will allow the Smart Assembler to attach attributes. Other options are available, but LFDAT does not automatically add the attributes with the Smart Assembler (fig. 4-6).

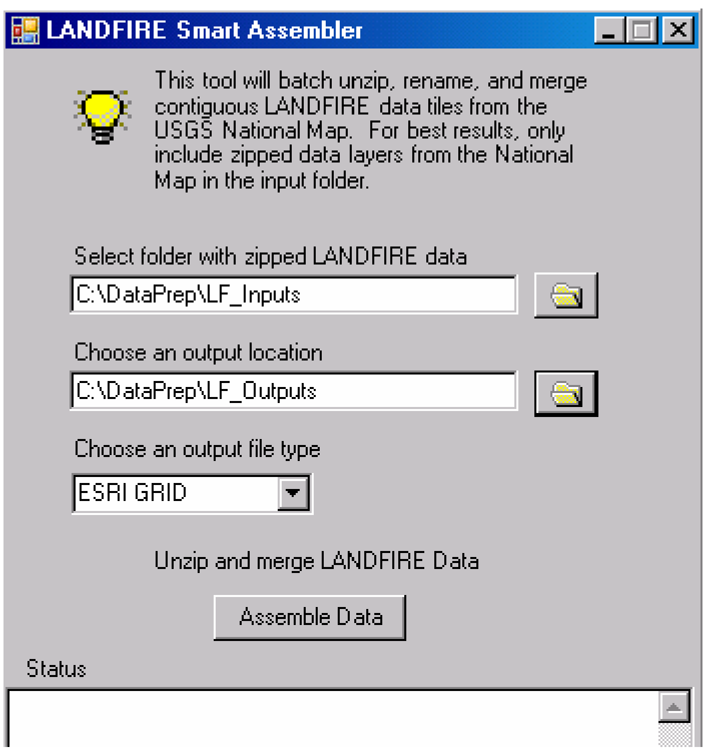


Figure 4-6. The *LANDFIRE Smart Assembler* dialog box.

14. Click on the **Assemble Data** button. A progress bar displays at the bottom of the dialog box. Close the Smart Assembler when the process completes.

15. Add the layer from *LF_Outputs* folder to the map. Notice that the LFDAT Smart Assembler appropriately renames the downloaded data layers.

16. At this point, the data should be ready for further processing as input for one of the NIFTT tools.

4.4 Reference conditions

Three sets of reference conditions are included with the installation of the FRCC Mapping Tool version 2.2.0. One set, associated with the Interagency FRCC Guidebook (Hann and others 2004) (www.frcc.gov) includes the first iteration of relatively coarse biophysical settings occurring across the United States. These are labeled: gb_West, gb_East, and gb_Alaska for the western U.S, eastern U.S., and Alaska, respectively.

These biophysical settings were later refined for the continental United States through the Rapid Assessment phase of the LANDFIRE Project (www.landfire.gov). The two Reference Condition Tables developed for the LANDFIRE Rapid Assessment project labeled ra_West and ra_East for the western U.S. and eastern U.S., respectively are included with the FRCC Mapping Tool installation.

A third set of reference conditions is derived non-spatially from VDDT models in connection with the LANDFIRE National Project. Two reference condition tables LFnat_east and LFnat_west, for the eastern and western United States respectively are included with the FRCC Mapping Tool installation. LANDFIRE National data products are produced at scales that may be useful for prioritizing and planning hazardous fuel reduction and ecosystem restoration projects; however, the applicability of data products varies by location and specific use, and products may need to be adjusted by local users.

> ***Note**: The "LFnat_east" Reference Condition Table is currently under development. Check www.niftt.gov for periodic updates to this Reference Condition Table.*

Chapter 5: Output Data

The FRCC Mapping Tool derives a suite of departure metrics from the BpS, S-Class, and Landscape input layers (table 5-1). These outputs were designed so that managers could select from a variety of layers to meet local analysis objectives. Thus, not all outputs will be useful to all users. Identifying which output layers are potentially useful depends largely on management questions and on the amount of detail needed.

Output layers are available to address management questions at the landscape, BpS, and S-Class levels. Some output layers simply provide a broader classification of other output layers. Thus, a user can determine the amount of detail needed to address management questions and then select appropriate output layers. In some instances, the level of detail desired depends on the audience. For example, a decision maker may determine that less detail will provide greater clarity when explaining a complicated scenario to members of the general public.

Table 5-1. Output layers produced by the FRCC Mapping Tool.

Layer Description	Layer Name	Analysis Level	Thematic Detail (number of potential values)
S-Class Relative Amount	SclassRelAmt	S-Class	Six
S-Class Departure	SclassDep	S-Class	Several hundred
Stand FRCC	StandFRCC	S-Class	Four
Strata Departure	StrataDep	BpS	Several hundred
Strata FRCC	StrataFRCC	BpS	Four
Landscape Departure	LandDep	Landscape	Several hundred
Landscape FRCC	LandFRCC	Landscape	Four

The following section discusses each of the FRCC Mapping Tool outputs, including derivation and potential applications.

5.1 Succession class (S-Class) outputs

5.1.1 S-Class Departure (SclassDep)

The S-Class Departure layer indicates those succession classes that are excessive relative to reference conditions. The values in the S-Class Departure layer represent a continuous variable with values ranging from 0 (no departure or under-represented) to 100 percent (completely departed). Because we did not want to produce a floating point grid, we simply rounded the calculation of the S-Class Departure and then assigned each unique outcome to a unique value in the ArcGRID layer.

Note*: A floating point grid is a layer in which values are denoted by a type of numeric field for storing real numbers with a decimal point. The decimal point can be in any position in the field and, thus, may "float" from one location to another for different values stored in the field.*

At a stand-level, an S-Class that is under-represented (in other words, value = 0) simply indicates that there is too little of that class. That is, there is no need to treat that stand if the management objective is to emulate reference conditions. On the other hand, values greater than 0 suggest an increasing need for treatment.

5.1.2 S-Class Relative Amount (SClassRelAmt)

The S-Class Relative Amount layer which characterizes the relative departure of succession classes is divided into six categories (Trace, Under-represented, Similar, Over-represented, Abundant and Unclassified; table 5-2).

The S-Class Relative Amount layer provides information for those who would like to restore and maintain vegetation to emulate reference conditions. It indicates whether the current amount of an S-Class is deficient or excessive relative to reference conditions. In this respect, the

S-Class Relative Amount layer is more informative than the S-Class Departure layer because the S-Class Relative Amount layer indicates departure on both sides of the scale. The S-Class Relative Amount layer suggests whether a landscape has too much or too little of each S-Class within each BpS. If excessive amounts exist, a manager may want to convert some proportion of that class into another class that is deficient.

Not all excessive classes present restoration opportunities. For example, if the early seral class is excessive, little can be done except to allow succession to advance. On the other hand, if a class is deficient, a manager may want to maintain the amount that remains. It may not be practical to pursue treatment objectives in some instances because of costs or other management concerns. Treatment objectives should always be developed in an interdisciplinary context.

5.1.3 Stand FRCC (StandFRCC)

The Stand FRCC layer is the final classification for the S-Class (stand) level of analysis. As used here, the term "stand" refers to all pixels having the same successional state within a given BpS. The Stand FRCC layer is derived by grouping the S-Class Relative Amount into three fire regime condition classes (table 5-2). Consequently, the Stand FRCC layer is not as informative as the S-Class Relative Amount layer; information is lost due to the broader classification scheme. The overall premise behind the Stand FRCC layer is that from a departure perspective, there is no reason to change the proportion of an S-Class that is either deficient across a landscape (Trace or Under-represented) or that occurs in approximately the same proportion as reference conditions (Similar).

The Stand FRCC layer can be used for various management purposes (table 5-2). For example, if emulating reference conditions is the management goal, then Stand FRCC 1 suggests maintenance or recruitment, whereas Stand FRCC 2 and 3 suggests that the area extent of the S-Class should be reduced. The Stand FRCC layer may be useful in reporting systems that identify stand-level accomplishments such as the National Fire Plan Operations and Reporting System (NFPORS).

Table 5-2. Relationship between S-Class Departure, S-Class Relative Amount, and Stand FRCC.

S-Class Departure	S-Class Relative Amount	Stand FRCC	Suggested Management Scenario[1]
(Value)	(Class)	(Class)	
-9999 (Undetermined)	-99 (Unclassified)	-99 (Unclassified)	None
0	Trace	1	Maintain/Recruit
0	Under-represented	1	Maintain/Recruit
0	Similar	1	Maintain/Recruit
Same as Percent Difference	Similar	1	Maintain/Reduce
Same as Percent Difference	Over-represented	2	Reduce
Same as Percent Difference	Abundant	3	Reduce

[1] *When the objective is to manage towards reference conditions.*

5.2 Strata (BpS) outputs

5.2.1 Strata Departure (StrataDep)

Strata departure, defined by the Interagency FRCC Guidebook (Hann and others 2003) as "Veg-fuel Class Departure," describes the overall departure across all succession classes within a particular BpS. It is derived by first determining the percent similarity between the existing BpS' S-Class composition and the reference conditions for that BpS. The sum of the percent similarities is then subtracted from 100 (Hann and others 2003). Thus, the layer represents a continuous variable with values ranging from 0 (no departure) to 100 percent (completely departed).

Managers can use the Strata Departure layer to identify those biophysical settings within given landscapes that exhibit the highest degree of departure. Therefore, it is useful for prioritizing biophysical settings for restoration. Although the Value Attribute Table could have hundreds of potential values, the default symbology uses a color ramp ranging from blue (low departure) to red (high departure) to facilitate interpretation. The layer can be further simplified by changing the symbology and by classifying values into user-defined categories designed to visually rank the biophysical settings by departure.

5.2.2 Strata FRCC (StrataFRCC)

The Strata FRCC layer depicts biophysical settings that have a low, moderate, or high departure. It is derived by classifying the Strata Departure layer into three condition classes plus an unclassified category (table 5-3). Consequently, the Strata FRCC layer is not as informative as the Strata Departure layer, which may contain hundreds of values. On the other hand, it is much easier to interpret since it has only four values. The FRCC Mapping Tool does not derive a metric corresponding to departure of fire frequency and severity. Consequently, the Strata FRCC metric represents only the vegetation component of FRCC.

Because the Strata FRCC layer depicts biophysical settings that have been classified into low, moderate, or high degree of departure, it is commonly used to help identify areas that may present opportunities for restoration (Fire Regime Condition Classes 2 and 3) or maintenance (Fire Regime Condition Class 1). However utility of the Strata FRCC layer is limited because it provides little insight on actual treatment objectives or management prescriptions. For example, although the Strata FRCC layer indicates relative departure, it does not indicate whether a landscape has too much or too little of a particular S-Class. Only the succession class outputs provide enough information for a determination of whether to maintain, reduce, or recruit an S-Class in a particular landscape, provided the management goal is to mimic reference conditions.

Table 5-3. Derivation of the Strata FRCC layer.

Strata Departure	Strata FRCC	Description
-9999 (not calculated)	-99 (not calculated	Unclassified
<34%	1	Low departure
34-66%	2	Moderate departure
>66%	3	High departure

5.3 Landscape outputs

5.3.1 Landscape Departure (LandFRCCDep)

The Landscape Departure layer represents the coarsest characterization of departure produced by the FRCC Mapping Tool. It is derived by computing an area-weighted average of the Strata Departure values within the Level 1 Landscapes. The Landscape Departure layer can have values ranging from 0 to 100 percent.

Level 1 landscapes are the lowest (in other words, smallest) level of the landscape hierarchy used in the analysis. For example, if the landscape layer consists of a watershed hierarchy of subwatersheds, watersheds, and subbasins, the Landscape Departure metric would be derived at the subwatershed level. The lowest level of the landscape hierarchy is used as the reporting unit because it provides the most detailed information of the three landscape levels. That is, spatial information is commonly washed out when data are summarized by larger and larger units (in other words, decreasing resolution and increasing granularity).

The Landscape Departure layer can be used to prioritize entire landscapes based on restoration need. Although useful for broad-level decisions at a landscape level, the Landscape Departure layer does not provide information about what may be "wrong" with a particular landscape in terms of succession class composition. FRCC Mapping Tool outputs at the succession class and strata (BpS) levels are more helpful for formulating restoration strategies.

5.3.2 Landscape FRCC (LandFRCC)

The Landscape FRCC layer is derived by classifying the Landscape Departure layer into three categories (low, moderate, and high departure) (table 5-4). The class thresholds are the same as those used to classify Strata Departure for deriving the Strata FRCC layer.

Table 5-4. Derivation of the Landscape FRCC layer.

Landscape Departure	Landscape FRCC	Description
-9999 (not calculated)	-99 (not calculated	Unclassified
<34%	1	Low departure
34-66%	2	Moderate departure
>66%	3	High departure

The Landscape FRCC layer has the least thematic detail and spatial resolution of the FRCC Mapping Tool metrics because data are summarized into four classes at the landscape level. The layer has the same limitations as the Landscape Departure layer in that it cannot be used to directly address BpS or S-Class issues. However, it can be useful for producing a very simple map with departure summarized at the landscape level.

5.4 Summary Report

Because formats of FRCC Mapping Tool-produced layers do not provide information that can be readily used to interpret data or develop treatment strategies, the Summary Report was created to facilitate treatment designs on the basis of managing landscapes towards reference conditions. The Summary Report can be used to identify what restorative actions are needed and where they should occur across an assessment area.

The Summary Report is a Microsoft Excel file that contains an individual worksheet corresponding to each landscape level that was used to derive the departure layers (fig. 5-1). For example, three worksheets are automatically included in the Excel file if three landscape levels were used in the analysis. These worksheets - named LL1Report, LL2 Report, and LL3Report - correspond to landscape levels 1, 2, and 3, respectively.

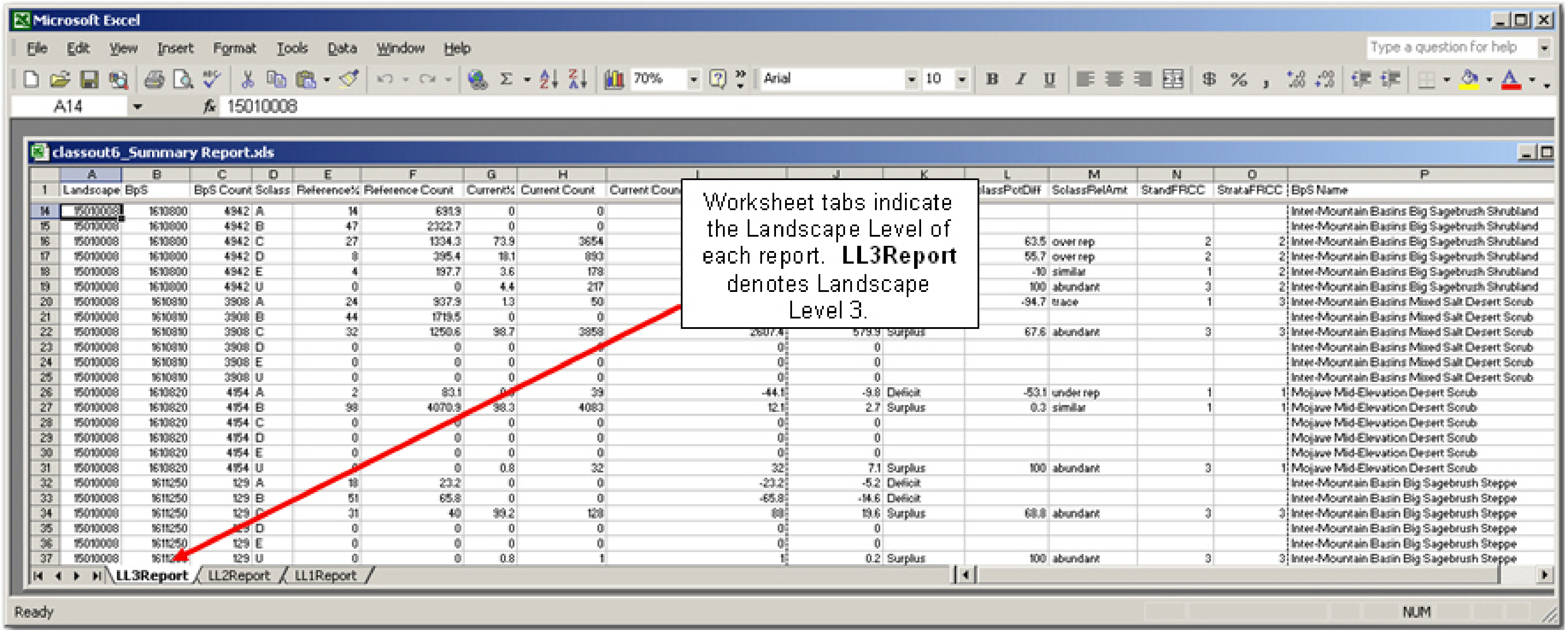


Figure 5-1. Example of a Landscape Level 3 Summary Report (*LL3Report* tab). Landscape Level 3 includes the reporting units used to derive estimates of vegetation departure for those biophysical settings dominated by fire regime groups 4 and 5 (in other words, higher severity and longer fire return intervals). This example shows four biophysical settings (Inter-Mountain Basins Big Sagebrush Shrubland, Inter-Mountain Basins Mixed Salt Desert Scrub, Mojave Mid-Elevation Desert Scrub, and Inter-Mountain Basin Big Sagebrush Steppe) occurring within a single landscape unit (Subbasin 1501008). (See table 5-5 for field descriptions).

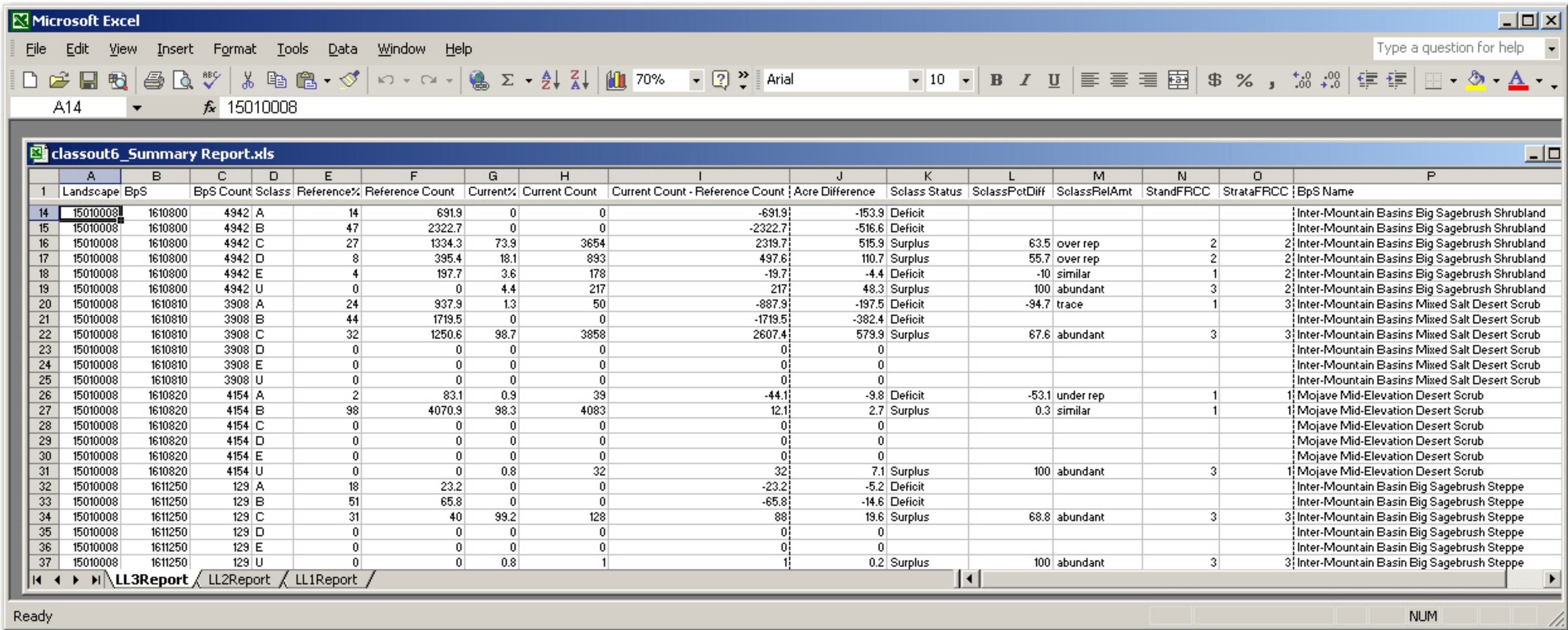
Table 5-5. Description of fields contained within the Summary Report.

Field	Description
Landscape	The landscape identifier contained in the landscape layer.
BpS	The BpS model identifier corresponding to BpS_Model in the Reference Condition Table.
BpS Count	The total number of pixels of a specific BpS within a specific landscape.
Sclass	The S-Class identifier.
Reference%	The reference condition percentage of an S-Class of a BpS. Expressed as the mid-point of the simulated historical range of variation.
Reference Count	The number of pixels required for the S-Class to have the same composition percentage as the reference composition for that BpS in the landscape.
Current%	The current condition composition percentage of an S-Class within a BpS and a given landscape.
Current Count	The current number of pixels occurring within a specific S-Class of a BpS within a specific landscape.
Current Count – Reference Count	The difference between the current number of pixels and the number of pixels necessary to meet reference conditions.
Acre Difference	The difference between the current condition and reference condition expressed in acres.
Sclass Status	Indicates whether a particular S-Class is currently in a deficit or surplus condition. Deficit denotes that the composition percentage is less than the reference composition percentage. Surplus denotes that the composition percentage exceeds the reference composition percentage.
SclassRelAmt	Grouped into six classes (Trace, Underrepresented, Similar, Over-represented, Abundant, and Unclassified).
StandFRCC	Final classification for the S-Class (stand) level of analysis; derived by grouping the S-Class Relative Amount into four fire regime condition classes.
StrataFRCC	Depicts biophysical settings that have a low, moderate, or high departure; derived by classifying the Strata Departure layer into three condition classes plus an unclassified category.
BpS Name	The name of the BpS as identified in the Reference Condition Table.

The reports, which are sorted by landscape, BpS, and S-Class (table 5-5), first identify the total pixel count of a BpS within a specific landscape. The reference condition of each S-Class within a BpS is then identified along with the corresponding pixel count necessary to simulate that reference condition. The report then compares current pixel counts in each S-Class to the pixel count of reference conditions to derive the number of acres of a particular S-Class to be maintained or converted to some other S-Class. Information pertaining to S-Class Relative Amount, Stand FRCC, and Strata FRCC are also included in the Summary Report.

> ***Tip:*** *The report can be sorted in various configurations depending on management questions. However, be careful to sort the entire worksheet. Excel worksheets can be easily scrambled, making them useless if only a subset of the fields is sorted independently of the other fields. We also recommend saving a master copy of the worksheet under another name before sorting and editing.*

The Summary Report can help address the following questions: "How much change is necessary to mimic the reference condition?" and "Which succession classes need to be treated?" The report designates succession classes as surplus or deficient for easy identification of the S-class status within specific landscapes and biophysical settings. Prescriptions can be developed by identifying succession classes to be recruited by adding additional acres versus those to be reduced by decreasing acreage. For example, if we focus on a single BpS and a single landscape as shown in figure 5-2, it appears that there are excess acres of the late-seral closed class (E), and deficient acreage in mid-seral classes (B and C) and the late-seral open class (D).



	Landscape	BpS	BpS Count	Sclass	Reference%	Reference Count	Current%	Current Count	Current Count - Reference Count	Acre Difference	Sclass Status	SclassPctDiff	SclassRelAmt	StandFRCC	StrataFRCC	BpS Name
14	15010008	1610800	4942	A	14	691.9	0	0	-691.9	-153.9	Deficit					Inter-Mountain Basins Big Sagebrush Shrubland
15	15010008	1610800	4942	B	47	2322.7	0	0	-2322.7	-516.6	Deficit					Inter-Mountain Basins Big Sagebrush Shrubland
16	15010008	1610800	4942	C	27	1334.3	73.9	3654	2319.7	515.9	Surplus	63.5	over rep	2	2	Inter-Mountain Basins Big Sagebrush Shrubland
17	15010008	1610800	4942	D	8	395.4	18.1	893	497.6	110.7	Surplus	55.7	over rep	2	2	Inter-Mountain Basins Big Sagebrush Shrubland
18	15010008	1610800	4942	E	4	197.7	3.6	178	-19.7	-4.4	Deficit	-10	similar	1	2	Inter-Mountain Basins Big Sagebrush Shrubland
19	15010008	1610800	4942	U	0	0	4.4	217	217	48.3	Surplus	100	abundant	3	2	Inter-Mountain Basins Big Sagebrush Shrubland
20	15010008	1610810	3908	A	24	937.9	1.3	50	-887.9	-197.5	Deficit	-94.7	trace	1	3	Inter-Mountain Basins Mixed Salt Desert Scrub
21	15010008	1610810	3908	B	44	1719.5	0	0	-1719.5	-382.4	Deficit					Inter-Mountain Basins Mixed Salt Desert Scrub
22	15010008	1610810	3908	C	32	1250.6	98.7	3858	2607.4	579.9	Surplus	67.6	abundant	3	3	Inter-Mountain Basins Mixed Salt Desert Scrub
23	15010008	1610810	3908	D	0	0	0	0	0	0						Inter-Mountain Basins Mixed Salt Desert Scrub
24	15010008	1610810	3908	E	0	0	0	0	0	0						Inter-Mountain Basins Mixed Salt Desert Scrub
25	15010008	1610810	3908	U	0	0	0	0	0	0						Inter-Mountain Basins Mixed Salt Desert Scrub
26	15010008	1610820	4154	A	2	83.1	0.9	39	-44.1	-9.8	Deficit	-53.1	under rep	1	1	Mojave Mid-Elevation Desert Scrub
27	15010008	1610820	4154	B	98	4070.9	98.3	4083	12.1	2.7	Surplus	0.3	similar	1	1	Mojave Mid-Elevation Desert Scrub
28	15010008	1610820	4154	C	0	0	0	0	0	0						Mojave Mid-Elevation Desert Scrub
29	15010008	1610820	4154	D	0	0	0	0	0	0						Mojave Mid-Elevation Desert Scrub
30	15010008	1610820	4154	E	0	0	0	0	0	0						Mojave Mid-Elevation Desert Scrub
31	15010008	1610820	4154	U	0	0	0.8	32	32	7.1	Surplus	100	abundant	3	1	Mojave Mid-Elevation Desert Scrub
32	15010008	1611250	129	A	18	23.2	0	0	-23.2	-5.2	Deficit					Inter-Mountain Basin Big Sagebrush Steppe
33	15010008	1611250	129	B	51	65.8	0	0	-65.8	-14.6	Deficit					Inter-Mountain Basin Big Sagebrush Steppe
34	15010008	1611250	129	C	31	40	99.2	128	88	19.6	Surplus	68.8	abundant	3	3	Inter-Mountain Basin Big Sagebrush Steppe
35	15010008	1611250	129	D	0	0	0	0	0	0						Inter-Mountain Basin Big Sagebrush Steppe
36	15010008	1611250	129	E	0	0	0	0	0	0						Inter-Mountain Basin Big Sagebrush Steppe
37	15010008	1611250	129	U	0	0	0.8	1	1	0.2	Surplus	100	abundant	3	3	Inter-Mountain Basin Big Sagebrush Steppe

Figure 5-2. Example Summary Report showing a single BpS in a single landscape. The Summary Report can be used to determine how to treat a BpS if your objective is to mimic reference conditions. In this example, the Rocky Mountain Ponderosa Pine Savanna BpS appears to have an overabundance of the late-seral closed successional state (class E) and lacks mid-seral and late-seral open successional states (classes B, C, and D). (See Table 5-5 for field descriptions).

The Summary Report can be used to monitor the effectiveness of proposed treatments in reducing vegetation departure by comparing pre- and post-treatment conditions. The Summary Report can be used to calculate the total acres that would have to be treated within an analysis area to mimic reference conditions. To determine the total acreage to be treated, first total the acres (either positive or negative numbers – not both) in each landscape-level worksheet and then add those totals to calculate an overall sum.

Larger analysis areas generate larger summary reports which can be unwieldy to work with in an Excel spreadsheet. Few would want to use a spreadsheet to process thousands of records to glean information that could be useful in formulating treatment prescriptions. Since Excel has a limit of 65,536 records the Summary Report worksheet may be truncated to 65,536 records and some data may be lost. If this occurs, the analysis area has too many landscapes and/or biophysical settings to export the entire report to Excel. For large assessment areas exceeding one million acres in size the Summary Report may be more useful if worksheets are imported into an Access database, which is better suited for summarizing large data sets.

5.5 Access database

Most FRCC Mapping Tool users will not need the Access database because it simply calculates departure metrics that are in turn used to create the output layers in ArcMap (Chapter 2). However, advanced users may find it helpful in diagnosing data problems or for summarizing some additional types of data. There are 74 tables in the Access database. Many are empty tables created for a geodatabase (those containing a GDB prefix). Other query-derived tables are used to determine composition and departure metrics but have little or no actual utility for most managers. The most useful tables are described in table 5-6.

The Access database is created in the user-specified folder which contains all FRCC Mapping Tool outputs. The Access database has the same name as the output folder (although the database will have an .mdb extension). Those interested in more detailed information on the FRCC Mapping Tool Access database should contact helpdesk@niftt.gov.

Table 5-6. Primary tables of interest contained within the Access database created by the FRCC Mapping Tool.

Table Name	Description
frcc_sclass_relative_amount	Identifies landscape, BpS, S-Class, and S-Class Relative Amount
frcc_strata_departure	Identifies landscape, BpS, and Strata Departure
frcc_strata_frcc	Identifies landscape, BpS, and Strata FRCC
frcc_landscape_departure	Identifies landscape and Landscape Departure (area-weighted average of the Strata Departure)
frcc_join	Identifies landscape, BpS, S-Class, and all of the departure metrics

Chapter 6: Installing the FRCC Mapping Tool

6.1 General installation instructions

All NIFTT tools, including the FRCC Mapping Tool, are now downloaded and installed as single tools. A complete or package install is no longer available for versions of NIFTT tools compatible with ArcMap 9.2.

> ***Note**: For the FRCC Mapping Tool version 2.2.0 to operate properly, you will need to verify that you are using ArcGIS 9.2.*

If you have an earlier version of the FRCC Mapping Tool installed on your computer, you will first need to uninstall it before proceeding with installation of the current version.

To determine which version is currently installed on your computer, go to **Start > Control Panel > Add or Remove Programs** as shown:

Figure 6- 1. FRCC Mapping Tool version 2.2.0.

> ***Note**: NIFTT naming conventions are as follows: FRCCMT_ 220_071113 indicates that this "install" is version 2.2.0 which was completed on 11/13/2007.*

You may need administrative privileges to install the FRCC Mapping Tool. Contact your system administrator if you experience problems with the installation.

6.2 FRCC Mapping Tool installation

6.2.1 Downloading the FRCC Mapping Tool

If you would like to install or reinstall the FRCC Mapping Tool follow these steps:

***Note**: If you have an earlier version of the FRCC Mapping Tool installed on your computer, you will first need to uninstall it before proceeding with installation of the current version. Refer to section 6.1 for more information on this subject.*

Download the FRCC Mapping Tool from the website at www.niftt.gov. Go to **NIFTT > Downloads** located at the left side of the page.

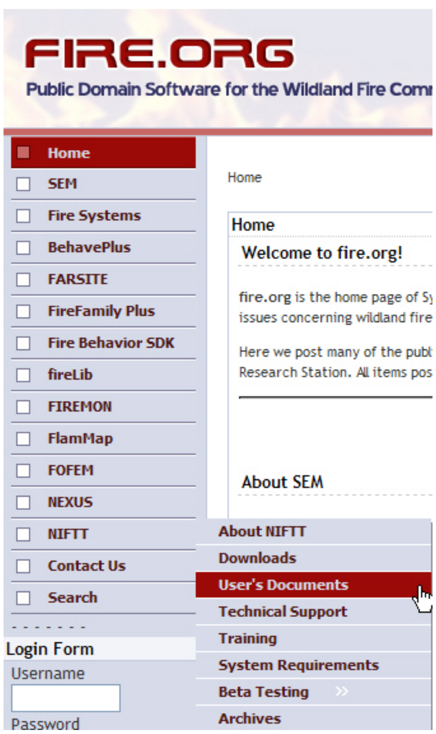


Figure 6- 2. Select Downloads.

Click on the **FRCC Mapping Tool Install File** from the table as shown to begin the download process.

Individual Tool Install for: **Fire Regime Condition Class Mapping Tool (FRCCmt)** *Note: This tool is for use with ArcMap versions 9.0 or 9.1. **Installation Notes (FRCCmt)** **FRCCMT Help Utility** **Reference Condition Tables and related material**	February 2007 Version 2.1.0	Download **Fire Regime Condition Class (FRCCmt) Install File,** Download **FRCCmt Installation Notes** Download **FRCCMT Help Utility** Click here for **Mapping Tool Reference Condition Tables and related material**

Figure 6- 3. Click on Fire Regime Condition Class Install File.

> ***Note**: To continue with the download, you will need to have WinZip or a similar program installed on your computer.*
>
> Click **OK** or **Save File** to download the self-extracting WinZip FRCC Mapping Tool installation file and then save it to a convenient location on your computer.

Figure 6- 4. Download and save installation file.

6.2.2 Beginning the installation process

Go to the folder in which you stored the FRCC Mapping Tool file.

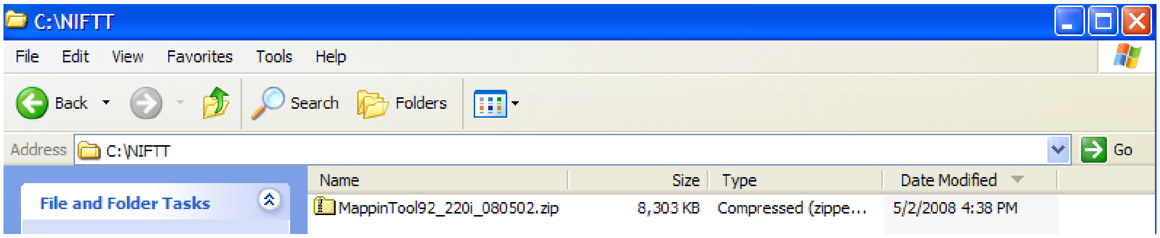


Figure 6- 5. Self-extracting FRCC Mapping Tool installation file has been downloaded and saved.

The box shown in figure 6-6 will open. Unzip the files to the default location (C:\\NIFTT as shown in fig. 6-5) or to another location of your choice by right-clicking on the file name. Select the option *Extract to folder*.

***Note**: Do not install the FRCC Mapping Tool or any other NIFTT tool to a path that contains a space in the folder name such as "My Documents" or "Program Files."*

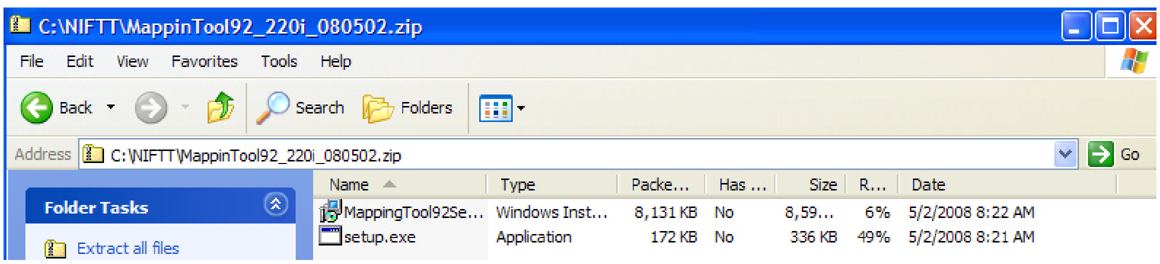


Figure 6- 6. FRCC Mapping Tool installation files.

Click on **setup.exe**.

***Note**: If the setup determines that an earlier version of the FRCC Mapping Tool is already installed on your computer, go to **Start > Control Panel** and select **Add/Remove Programs**. Uninstall the previous version of the FRCC Mapping Tool and then rerun setup.exe.*

If the setup.exe determines that you already have the proper .NET Framework (2.0) installed on your computer, the FRCC Mapping Tool zip file contains everything that you will need for installation. A series of dialog boxes will now open. Skip to section 6.2.4 to continue installation.

6.2.3 Obtaining the latest .NET Framework

If the installer determines that the setup requires a .NET Framework which has not been previously installed on your computer, you will see a dialog box similar to figure 6-7 instead of the first screen of the FRCC Mapping Tool Setup Wizard as shown in figure 6-14.

Figure 6-7. Dialog box indicating the need to first install .NET Framework for installation to proceed.

Click on **Yes** and follow all prompts as directed. If the .NET Framework 2.0 has not been previously installed on your computer, the setup will at this point direct you to a website where you will be able to download the appropriate file (See fig. 6-8).

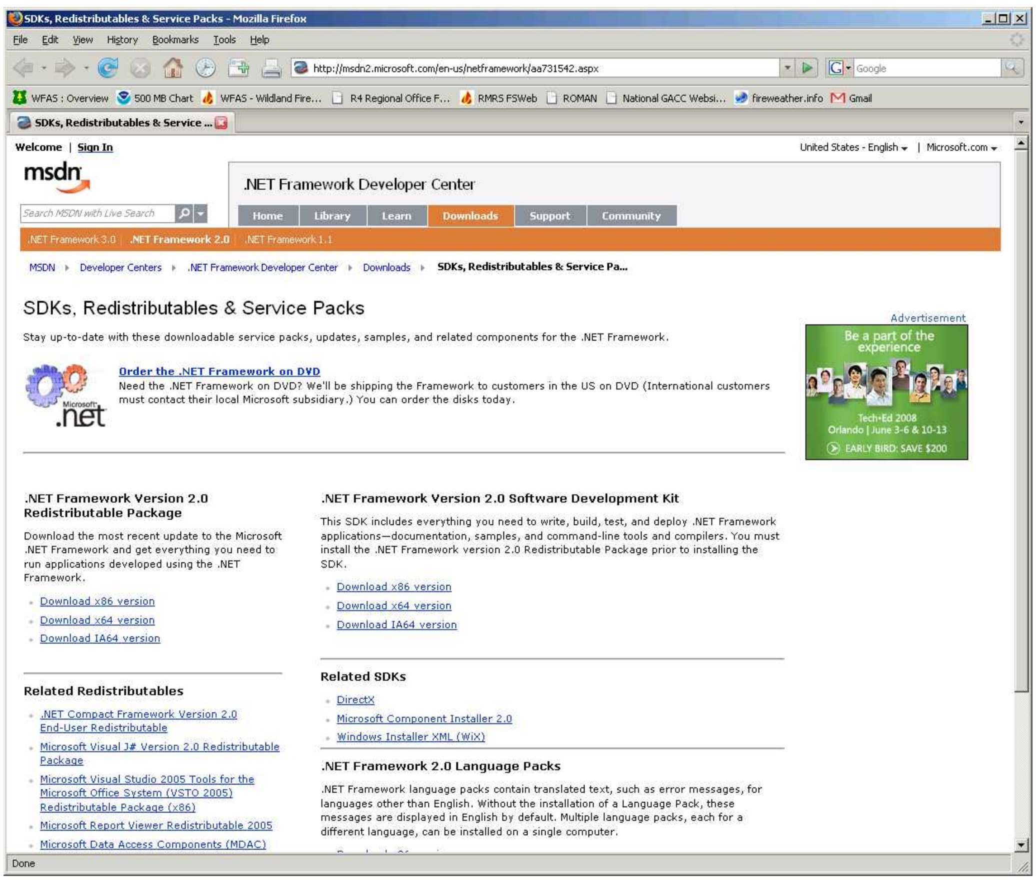


Figure 6-8. Website for downloading .NET Framework 2.0.

As shown in figure 6-9, you will now need to specify which version of .NET Framework you would like to install on your computer. Select the x86 version if you have a Pentium (or other 32-bit) computer. Click on **Download x86 version**.

Tip: *Most users will need to specify the x86 version of NET Framework 2.0. If you are unsure, contact your system administrator.*

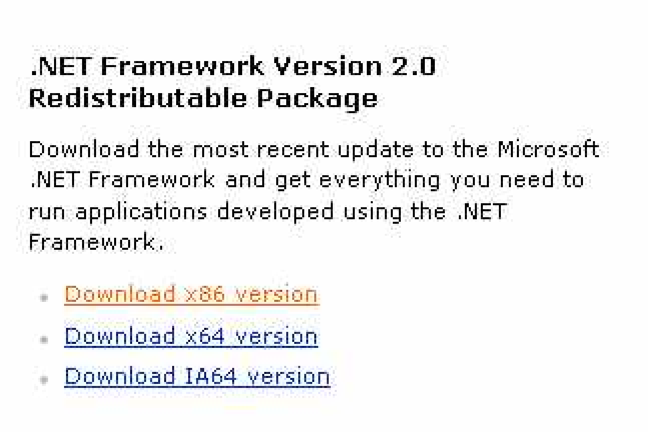


Figure 6-9. Select an appropriate version of .NET Framework.

A screen similar to the following will appear after your selection has been made. Click on the **Download** button to continue.

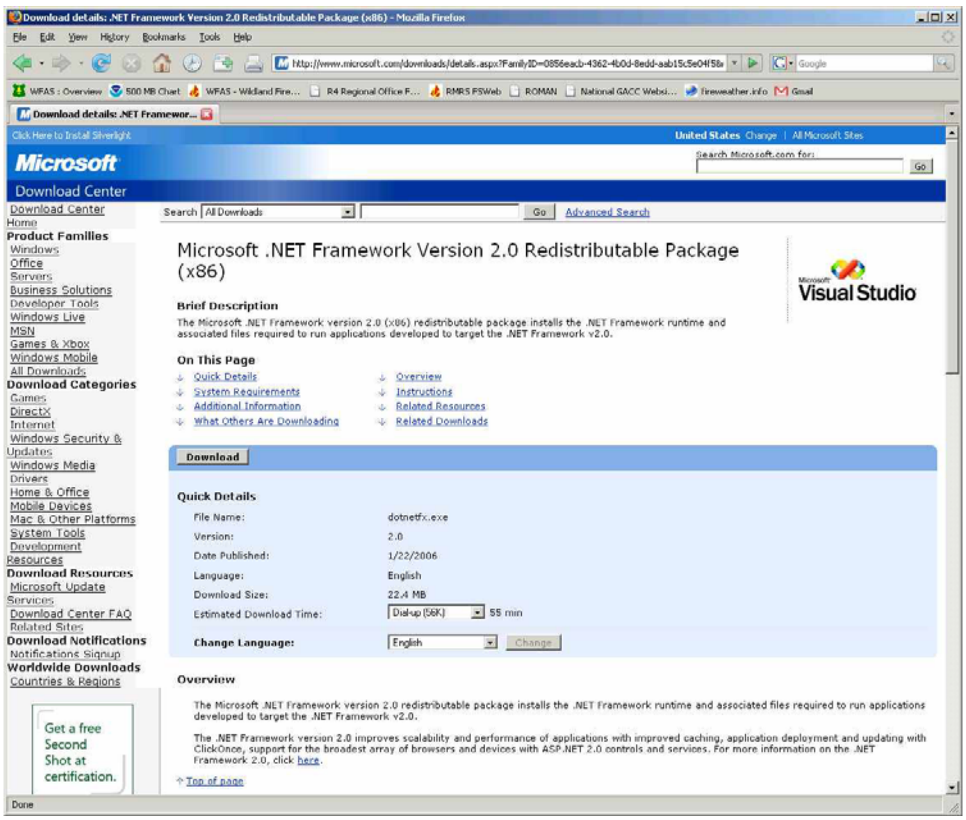


Figure 6-10. Microsoft .NET Framework Version 2.0 (x86) download page.

Browse to a location of your choice. Download and save the dotnetx.exe file as shown in figure 6-11.

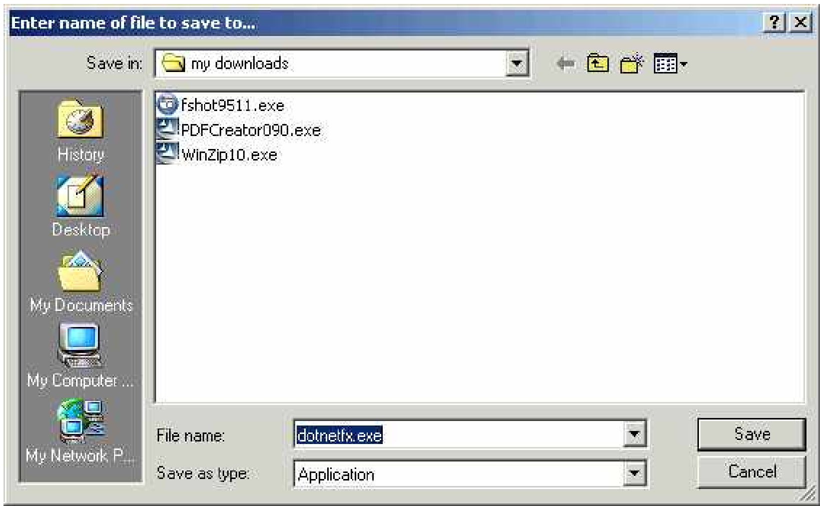


Figure 6-11. Save the file to a location of your choice.

Figure 6-12. Progress bar for download of dotnetfx.exe.

The Microsoft .NET framework 2.0 will download, extract and install automatically as shown in figures 6-12 and 6-13.

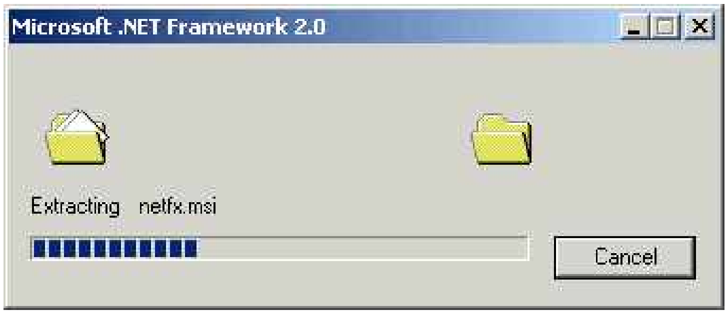


Figure 6-13. .NET Framework installation

Click on the **setup.exe** file as shown in figure 6-6 to initiate the setup wizard and to continue installation of the FRCC Mapping Tool.

At this point, you may need administrative privileges to continue. Contact your system administrator if you experience problems

6.2.4 Finishing the installation

After clicking on the setup.exe file, the first in a series of FRCC Mapping Tool Setup Wizard dialog boxes will open. Follow instructions as directed by the dialog boxes in the Setup Wizard. During the installation process you may see a radio button asking you to specify whether the tool is to be installed for "Everyone" or "Just Me." Select the "Everyone" option.

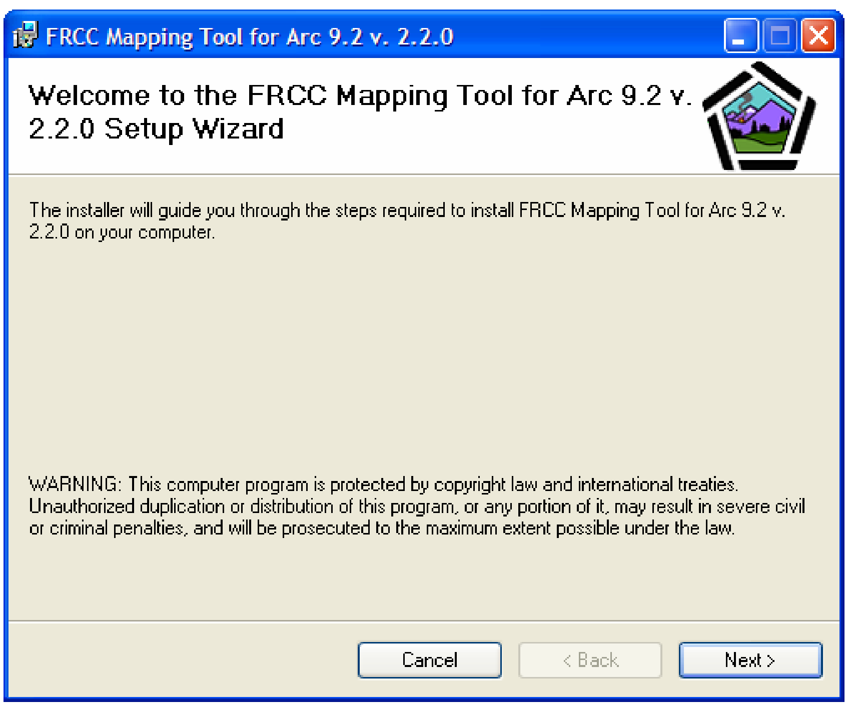


Figure 6- 14. First dialog box of the FRCC Mapping Tool setup wizard.

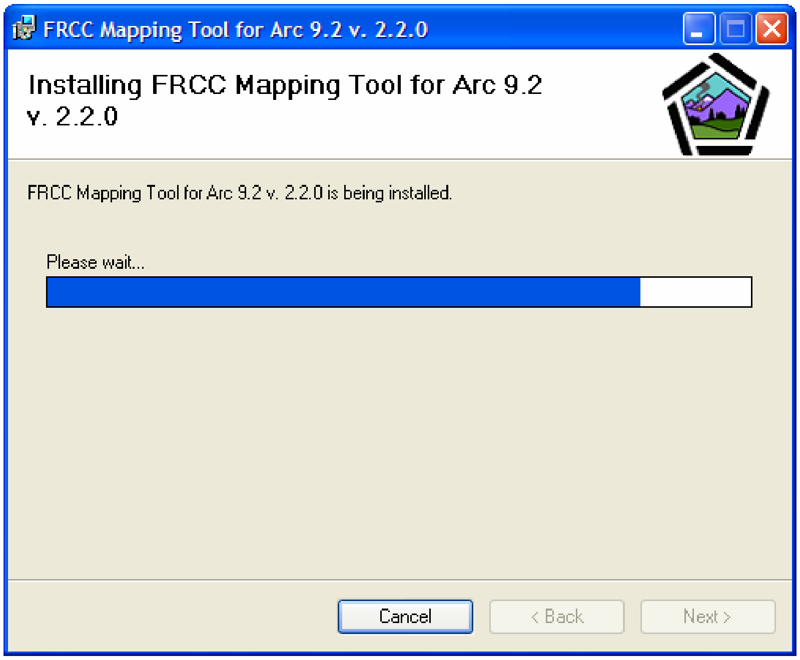


Figure 6-15. Setup Wizard continues installation.

Click on **Finish** when the FRCC Mapping Tool installation is complete.

Open ArcMap and make sure that the FRCC Mapping Tool toolbar  is visible.

Note: *The toolbar may be "floating" and if so, you will need to anchor it in a convenient location.*

Tip: *For best results, make sure that you have installed the most recent ArcGIS service packs and patches. Go to www.esri.com to verify that you have the most recent versions for 9.2 already installed on your computer. If you do not, download the newer service packs and patches as directed on the website.*

6.3 Troubleshooting FRCC Mapping Tool installation

If the FRCC Mapping Tool toolbar as shown to the right,  does not install automatically, you may need to select **Tools > Customize** and check the box to the left of *FRCC Mapping Tool 2.2.0* as shown in figure 6-12.

***Note**: To continue this process, it may first be necessary for you to log on as an "Administrator." Contact your systems administrator if you experience problems.*

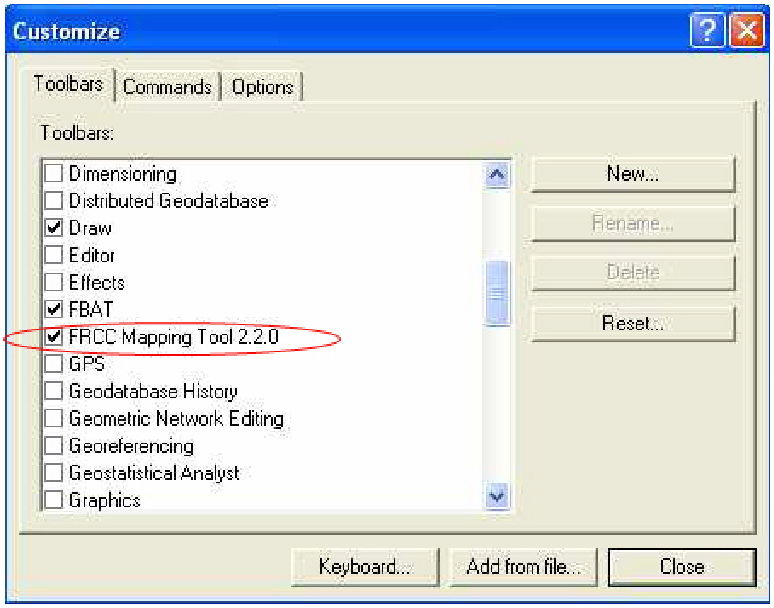


Figure 6-12. Selecting the FRCC Mapping Tool toolbar.

Chapter 7: Using the FRCC Mapping Tool

7.1 The FRCC Mapping Tool toolbar

The following diagram shows icons and associated tool tips on the FRCC Mapping Tool toolbar. Refer to the discussions below to learn more about the basic functions of each icon.

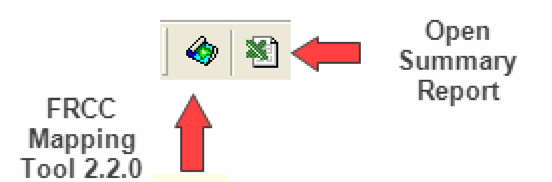


Figure 7-1. The FRCC Mapping Tool toolbar.

The *FRCC Mapping Tool 2.2.0* icon opens the FRCC Mapping Tool dialog box which is used to select inputs and outputs.

The *Open Summary Report* icon opens the Summary Report, an Excel spreadsheet designed to help summarize and present data obtained from an FRCC Mapping Tool run.

7.2 How to run the FRCC Mapping Tool

7.2.1 Creating a new project

Start ArcMap and select **A new empty map** as shown in figure 7-2:

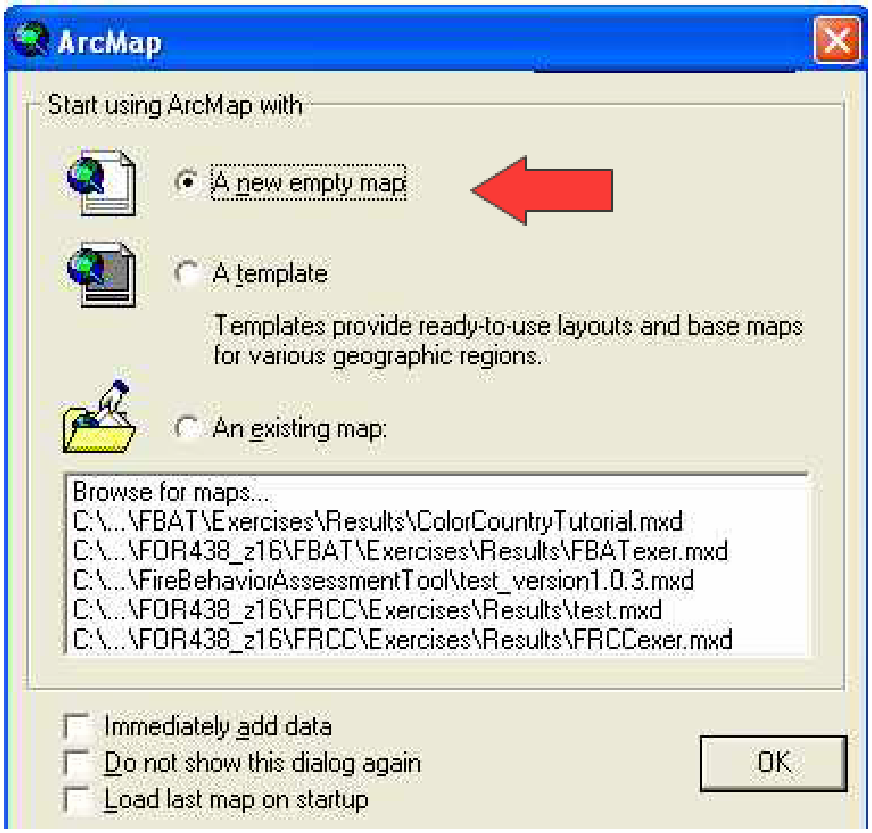


Figure 7-2. Creating a new project.

7.2.2 Loading data

Click on the **Add Data** icon to load input layers (fig. 7-3).

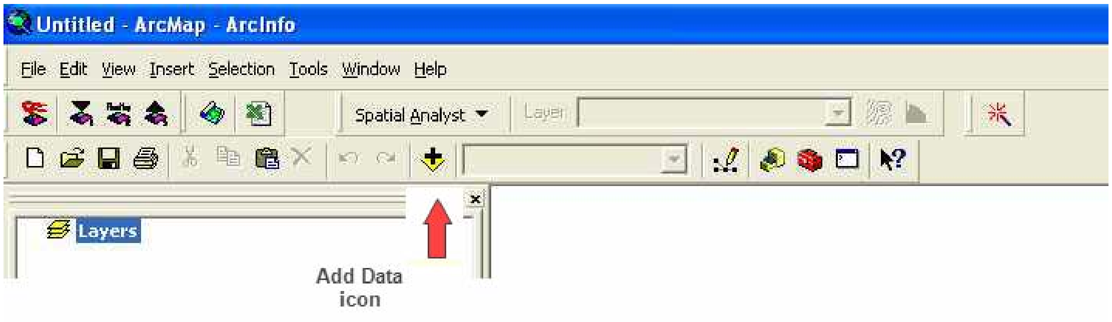


Figure 7-3. Adding data.

Add the three required input layers: BpS, S-Class, and Landscape (fig. 7-4). You can also add ancillary layers such as cities, roads, and wildland-urban interface. Navigate to the directory where data layers are stored and add any desired layers.

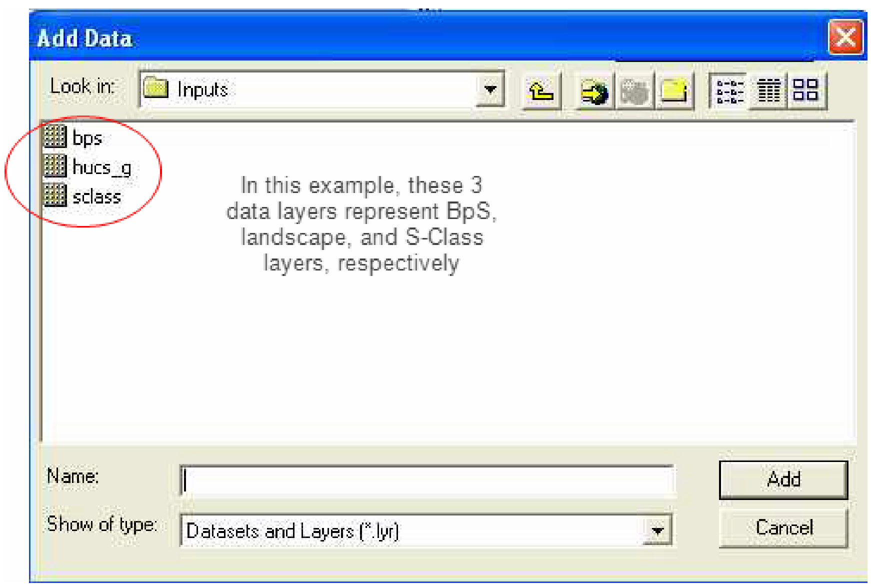


Figure 7-4. Adding required input layers.

> ***Tip:*** *You may see the following "Create pyramids" dialog box at this point. Click No to speed up processing. If you do not want to see this box again, put a check in the lower left-hand corner to disable it.*

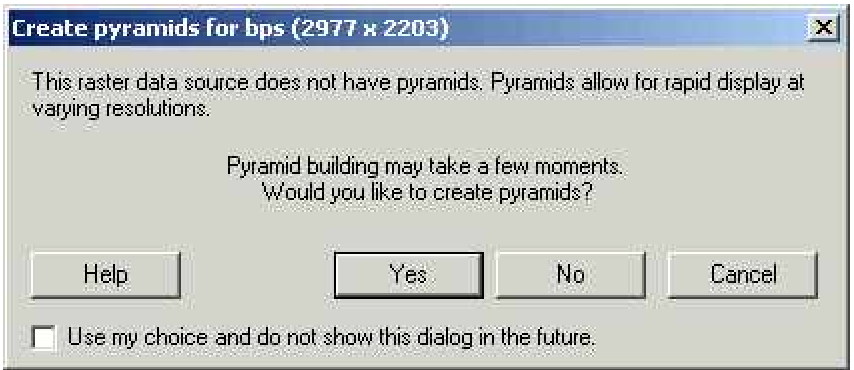


Figure 7-5. Create pyramids dialog box.

> ***Note:*** *The path and folder name containing your input layers should not exceed ten characters in length and should not contain any spaces, leading numbers, or special characters (`~! @#$^()-+={ }[ ]|\?/:;"'< >, .)*

Save your project and, if desired, rename it by clicking on **Layers** as shown in figure 7-6:

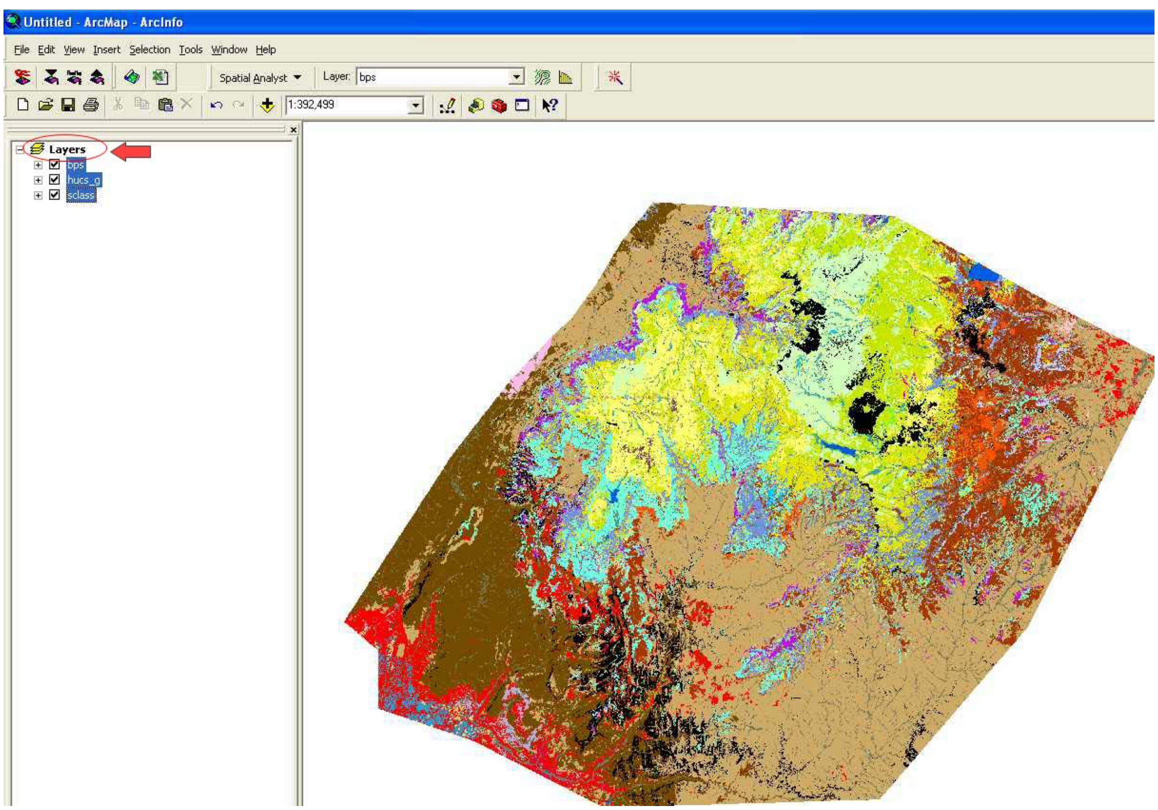


Figure 7-6. If desired, rename the project.

Note: *When naming the file, you do not need to include a file extension. However, the file name must not exceed ten characters in length and should not contain any spaces, leading numbers, or special characters (`~!@#$^()-+={ }[ ]|\?/:;"'< >, .).*

***Tip**: Convenient file names might include a location, a run number, or perhaps an indication of the number of landscape levels analyzed (such as SmithCr, sc1, or sc1_1).*

Click the first icon (Open FRCC Mapping Tool 2.2.0) on the FRCC Mapping Tool toolbar as shown in figure 7-7:

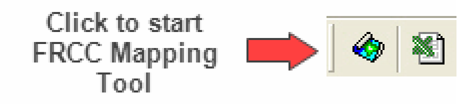


Figure 7-7. Launching the FRCC Mapping Tool.

The following dialog box (showing default selections) will appear after the FRCC Mapping Tool has been launched:

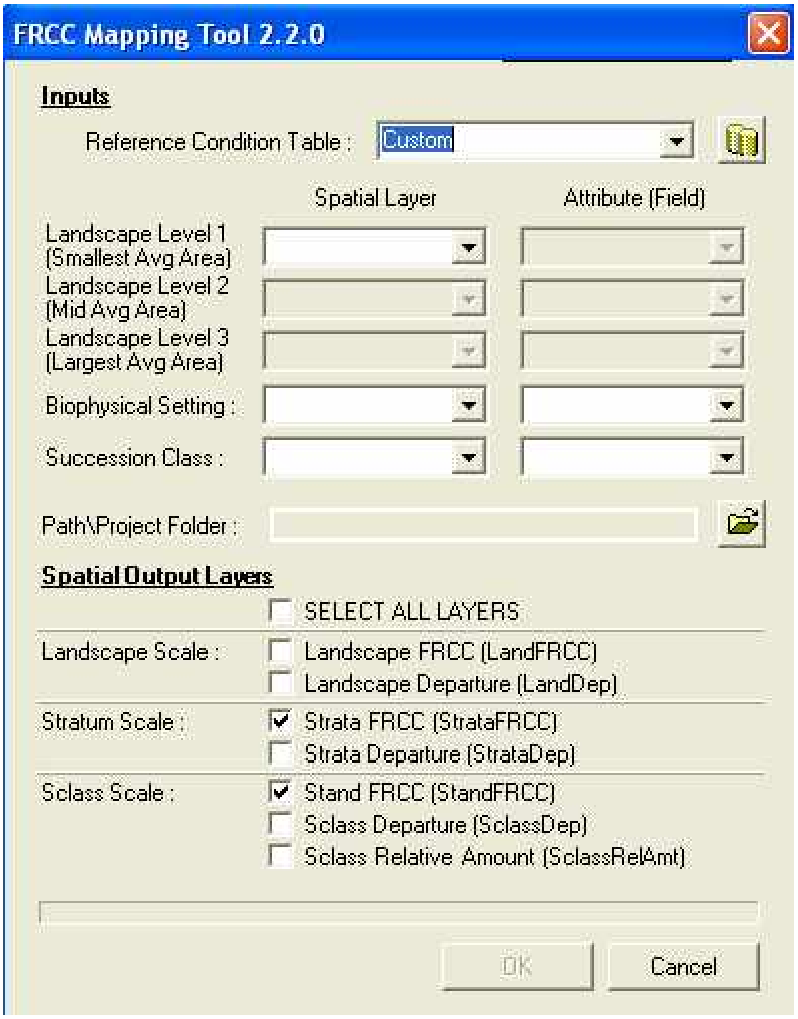


Figure 7-8. FRCC Mapping Tool dialog box showing default selections.

This dialog box contains information necessary for:

- Selecting the appropriate Reference Condition Table
- Selecting the input layers and associated attributes that the FRCC Mapping Tool will use for conducting the analysis
- Identifying the path and folder for the outputs of the run
- Selecting the desired output from among available output layers in the Spatial Output Layers menu

7.2.3. Selecting a Reference Condition Table

First select an appropriate Reference Condition Table from the drop-down menu as shown in figure 7-9. Three sets of Reference Condition Tables are now included when the FRCC Mapping Tool is installed. The first set (gb_Alaska, gb_EastUS, and gb_WestUS) was developed for the Interagency FRCC Guidebook (Hann and others 2003). The second (ra_East and ra_West) was developed for the Rapid Assessment phase of the LANDFIRE Project. A third set, includes the LANDFIRE National reference condition tables for both the eastern and western U.S. (LFnat_east and LFnat_west).

***Note**: The "LFnat_east" Reference Condition Table is currently under development. Check www.niftt.gov for periodic updates.*

Any locally-developed custom Reference Condition Tables must first be imported into the FRCC Mapping Tool.

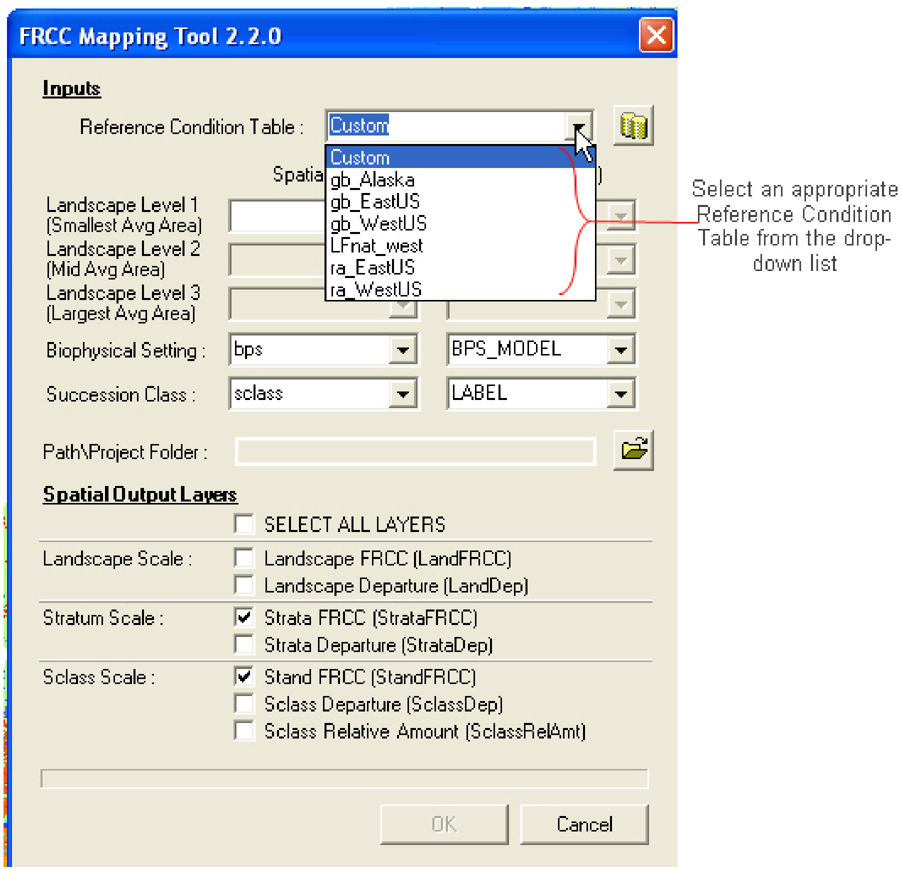


Figure 7-9. Selecting a Reference Condition Table.

***Note:** Reference Condition Tables are stored in an Access database labeled "refcon.mdb" in the same directory that was selected for the Mapping Tool during installation. (The default is "C:\NIFTT\FRCC Mapping Tool 2.2.0\Reference Conditions Database\refcon.mdb"). Navigate to the Reference Condition Database and double-click on refcon.mdb to display the default Reference Condition Tables.*

If you do not wish to use a default table, you must import your own custom Reference Condition Table as described below:

1. Click on the **Move a refcon table between databases** icon, which is to the right of the Reference Condition Table drop-down menu.

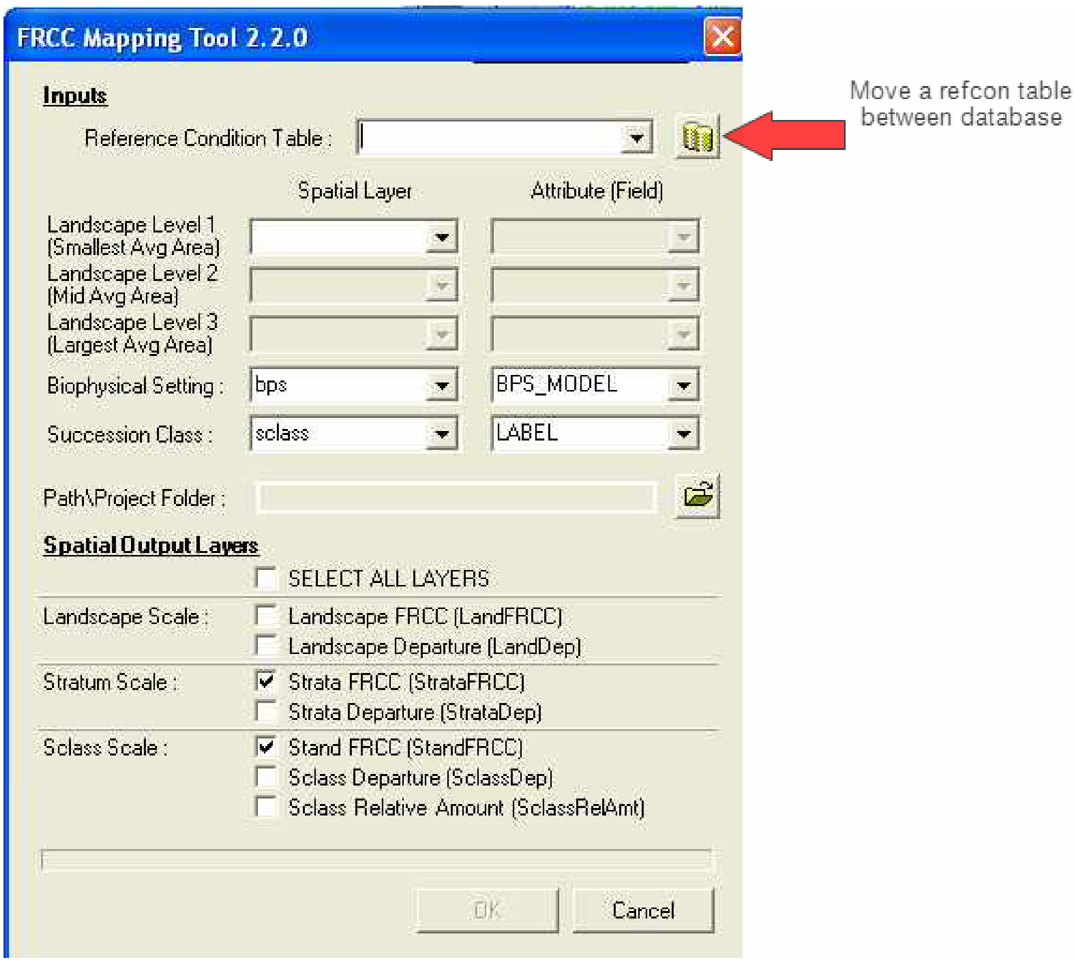


Figure 7-10. Selecting a custom Reference Condition Table.

2. When the *Move Reference Condition Table* dialog box appears, click on the browse button to the right of the Import table from box and navigate to the Access database that contains the desired table. Use the drop-down menu to the right of the Import Table and select the appropriate table in that database. Use the browse button to the right of Import table to box to navigate to the Reference Condition Database used by the FRCC Mapping Tool. Click **OK**.

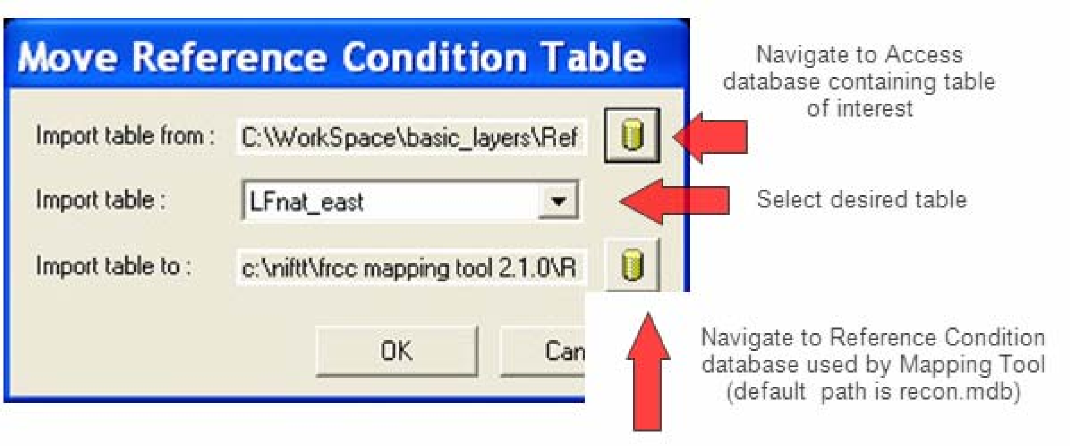


Figure 7-11. Importing tables.

You can rename the table when finished and the changes will be saved automatically. A file extension is not required and the name should not exceed ten characters in length or contain any spaces, leading numbers, or special characters (`~! @#$^()-+={ }[ ]|\?/:;"'< >, .).

Note: *If a Microsoft Security Warning appears, click Open to proceed. Then click OK to load the table into the FRCC Mapping Tool Reference Condition Database. After a few seconds, you should see a pop-up message indicating that the table was successfully loaded into the Reference Condition Database. When you see that message, click OK again to finish the process. The Reference Condition Database should be installed to a directory with write access; that is, the directory should not be "read only". A new Reference Condition Table cannot be imported if the directory is read only.*

7.2.4 Selecting input layers

Next specify the landscape levels that you will be using. Remember that these landscape levels correspond to a nested hierarchy (for example, a layer containing subwatershed, watershed, and subbasin units) that will be used in the analysis. The number of landscape levels used in the analysis must match the LandscapeLevel field in the Reference Condition Table. If three different levels are represented in the LandscapeLevel field of your Reference Condition Table, then three levels must be used. Otherwise, output layers will contain a large number of pixels classified as NoData. Alternatively, if you want to assess departure using only a single landscape level, then all values in the LandscapeLevel field must be 1.

BpS_Model	Name	A	B	C	D	E	U	FRG	LandscapeLevel
R#ABAMlw	Pacific Silver Fir--Low Elevation	15	20	3	10	52	0	3	2
R#ABAMup	Pacific Silver Fir--High Elevation	10	25	2	3	60	0	5	3
R#ABLA	Subalpine Fir	15	20	2	3	60	0	4	3
R#AGSP	Bluebunch Wheatgrass	5	70	25	0	0	0	1	1
R#ALME	Alpine and Subalpine Meadows and Grasslands	5	90	5	0	0	0	5	3
R#DFHEdy	Douglas-fir Hemlock-Dry Mesic	5	15	5	15	60	0	3	2

Figure 7-12. Landscape-level field in the Reference Condition Table.

You must also select a spatial layer and an appropriate attribute to the right of Landscape Level 1 in the drop-down menus. No entries are made in the Landscape Level 2 and Landscape Level 3 boxes if only one landscape level is used in the analysis. Refer to Chapter 3 for more information on landscape levels.

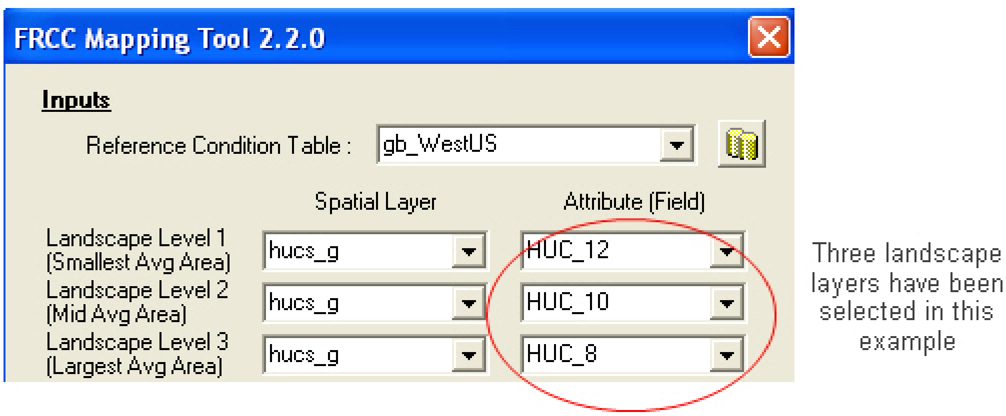


Figure 7-3. FRCC Mapping Tool Dialog box with three landscape layers selected.

Both the Spatial Layer and Attribute (Field) drop-down boxes must be populated (fig. 7-14).

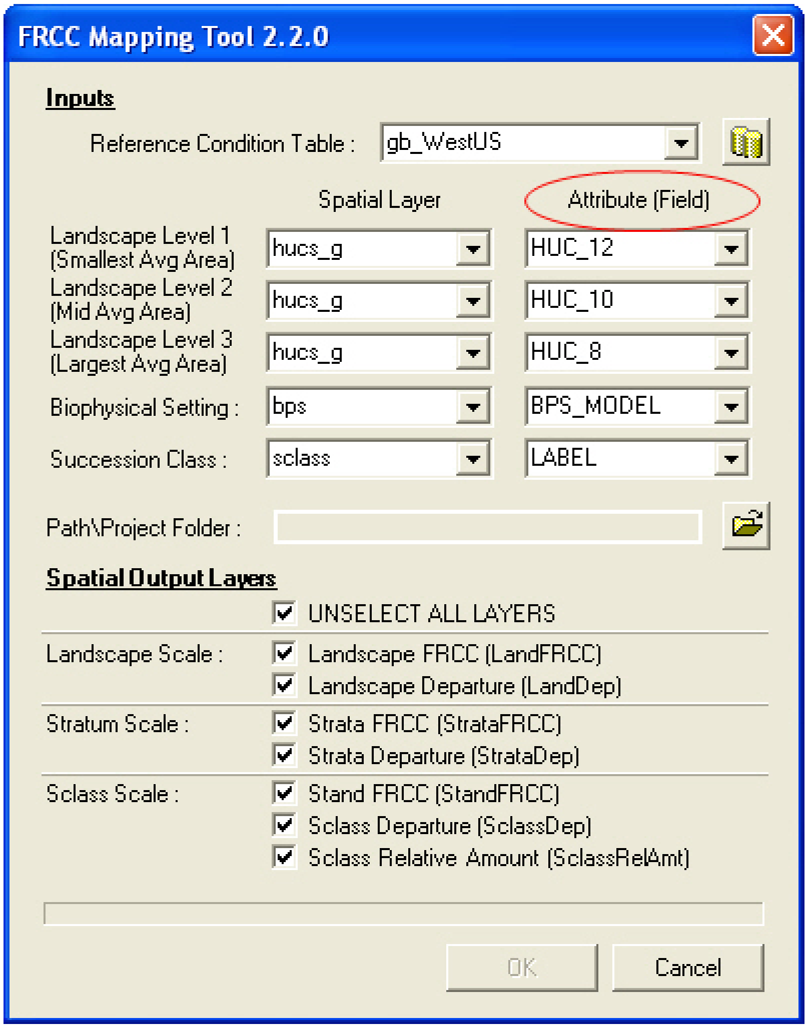


Figure 7-14. Example *FRCC Mapping Tool* dialog box.

In the example shown in figure 7-14, three landscape levels have been selected because we are working with a tri-level nested hierarchy of landscape units, ranging from multiple subwatersheds to a single subbasin encompassing the entire analysis area. Only one spatial layer (hucs_g) has been chosen for the analysis. However, the selected layer (hucs_g) has three different attributes (Huc_12, Huc_10, and Huc_8) which correspond to landscape levels 1, 2, and 3, respectively.

An alternative approach would be to use three unique spatial layers for each of the landscape levels used in the analysis. However, this approach can sometimes lead to problems caused by limitations of ArcMap. When ArcMap attempts to combine the five spatial layers (in this example, Huc_12, Huc_10, Huc_8, S-Class, and BpS), the software conducts an internal test to evaluate the potential number of unique combinations. An error message will appear if the software determines that there could be more than 10 million possible combinations. This error message can be misleading as there may not actually be 10 million possible combinations among the five layers. This inconsistency results from the fact that the internal software test is largely based on grid values rather than on the actual number of unique values.

For example, if an analysis area has three landscapes with values of 1000, 2000, and 3000, ArcMap will determine that there are actually 3,000 landscapes instead of three landscapes. The likelihood of this problem occurring can be substantially reduced by using a single layer containing individual attributes for the landscape levels. Using a single layer will also ensure that the multiple landscape levels are nested. Consequently, we recommend using a single landscape layer that contains multiple attributes to denote the different landscape levels.

***Note**: Store all input layers on the computer's local hard drive. Performance time is slowed down significantly if layers are stored on a network drive.*

Next select the appropriate BpS layer (labeled Biophysical Setting and displayed under Spatial Layer) and an associated Attribute (Field) from the drop-down menu as shown in figure 7-14.

***Note**: The Attribute that is selected from the BpS layer must match the BpS_Model field in the Reference Condition Table. Departure indices will be derived only for those BpS codes that coincide with the Spatial Layer as specified in the dialog box and the Reference Condition Table.*

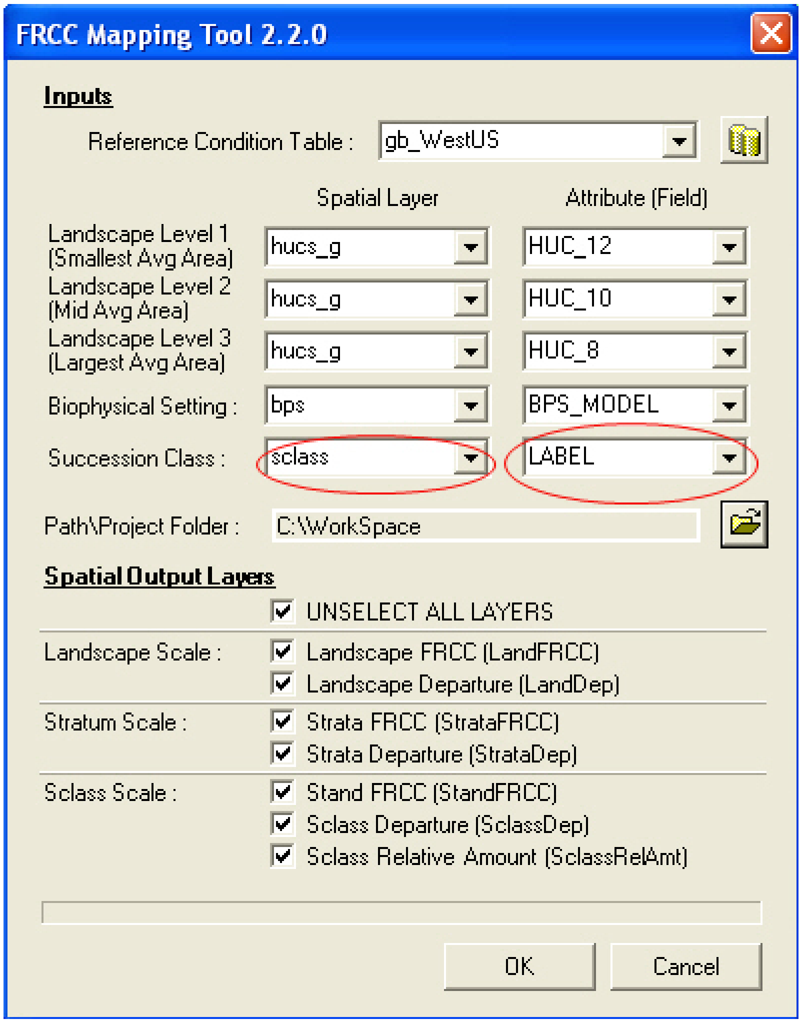


Figure 7-15. Selecting a Succession Class Spatial Layer and an associated Attribute.

***Note**: BpS and S-Class raster names should not exceed ten characters in length and should not contain any spaces, leading numbers, or special characters (`~! @#$^()-+={ }[ ]|\?/:;"'< >, .).*

Select the S-Class layer labeled Succession Class and an associated Attribute (Field) from the drop-down menus as shown in figure 7-15. In this example, the attribute Label contains the S-Class codes A, B, C, D, E, and U, which the Mapping Tool then links to the selected Reference Condition Table (fig. 7-16).

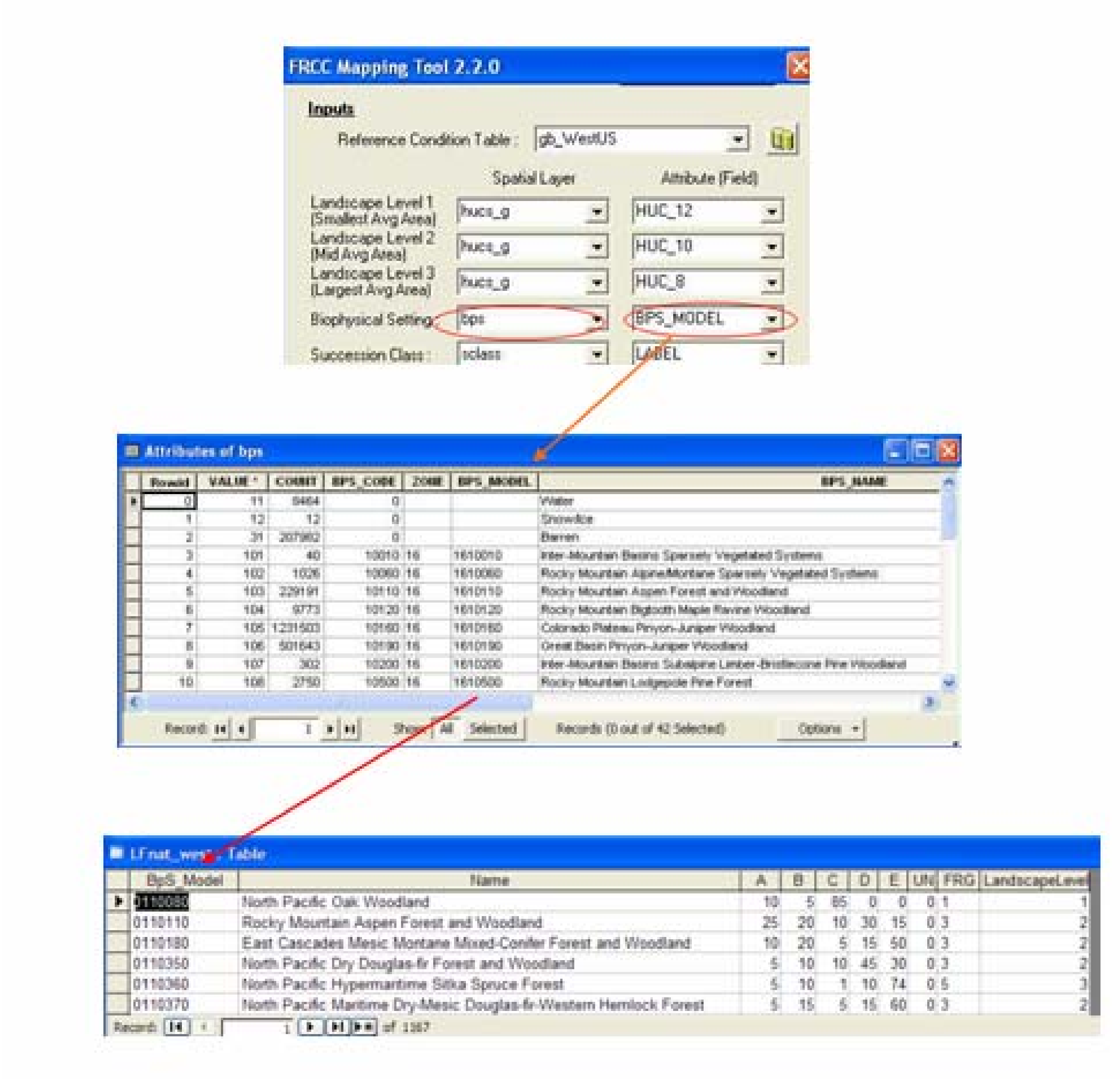


Figure 7-16. Relationship between the FRCC Mapping Tool dialog box, the Value Attribute Table for the BpS layer, and the Reference Condition Table.

7.2.5 Selecting output layers

Select an output path and a folder name for storing the outputs of your run. The folder will be located in the path identified under the Path\Project Folder as shown in figure 7-17.

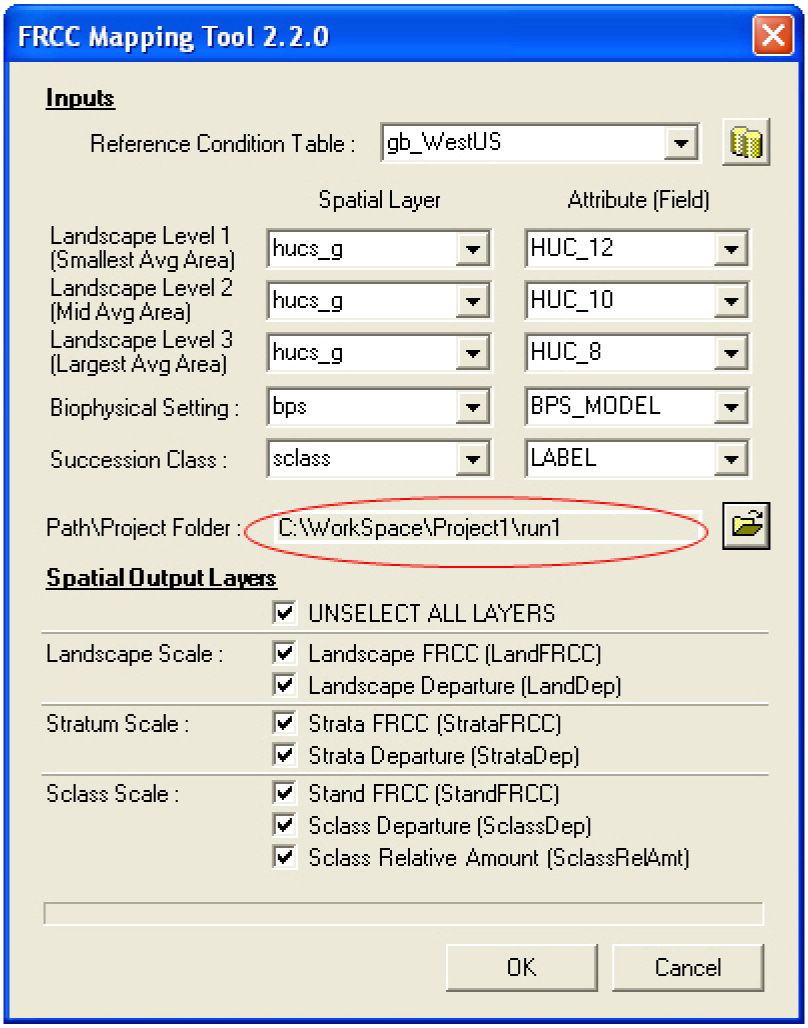


Figure 7-17. Selecting output path and folder name.

***Tip**: Make sure there are no spaces in the output path.*

In this example, all outputs will be stored in a folder labeled run1 in C:\WorkSpace\Project1. In addition to the output grids, the FRCC Mapping Tool will create at least one and potentially three folders in the output folder. A folder labeled RasterLayers contains layer files for each of the output grids. A layer file maintains an assigned legend when loaded into an ArcMap project. Two additional folders are created if the Mapping Tool creates new BpS or S-Class grids by deleting classes that do not correspond to the Reference Condition Table. These new grids are stored in a folder labeled CleanRasters. A Logs folder containing text files identifying the biophysical settings and succession classes that do not match the Reference Condition Table is also created.

***Tip:** Clean rasters can be saved and used in place of the original BpS and S-Class rasters.*

***Note**: Be sure to store outputs on your local hard drive. The following problems may occur when outputs are stored on a network server:*

- Performance (runtime) will be substantially slower
- The server may time out preventing file transport
- Permission problems may prevent file transport
- Overly long paths may exceed ESRI's limitation
- Special characters, leading numbers, or spaces in the path will cause run failure

***Note**: The name of the output folder should not exceed ten characters in length and should not contain any spaces, leading numbers, or special characters (`~! @#$^()-+={ }[ ]|\?/:;"'< >, .).*

Finally, select the desired spatial output layers by checking the boxes to the left of the output layers to be analyzed (fig. 7-18). Two output layers of greatest interest to most users, StrataFRCC and StandFRCC, are checked by default. (See Chapter 5 for more information on output layers).

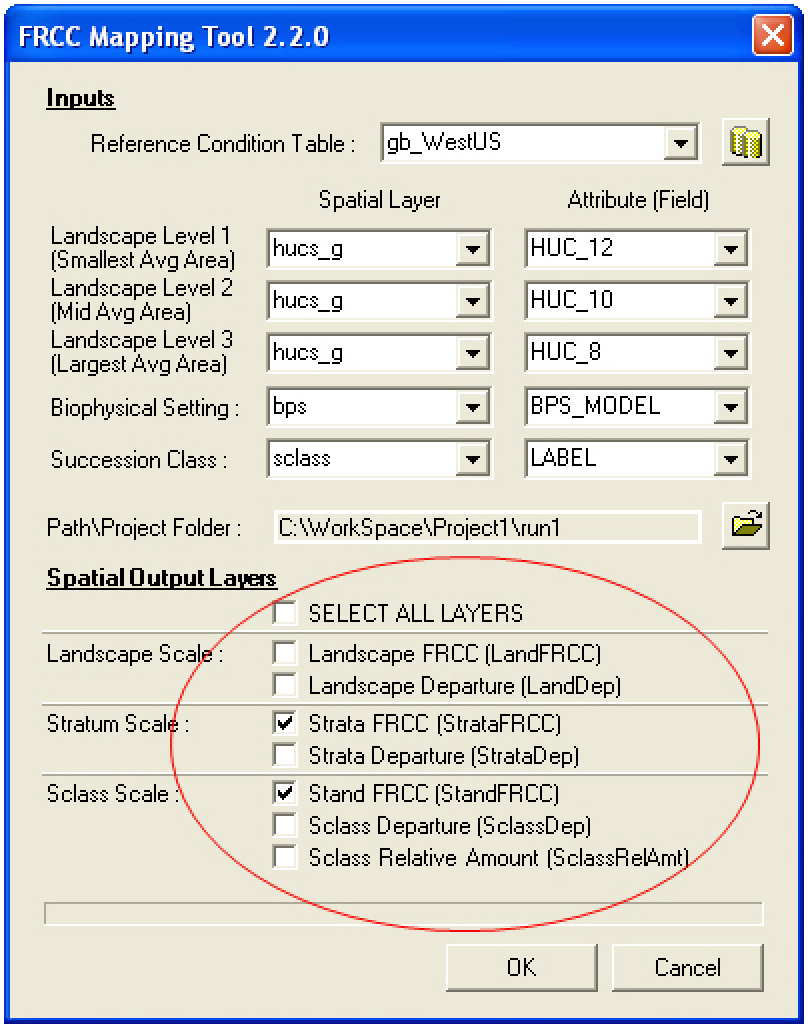


Figure 7-18. Check the boxes to the left of the spatial layers to be analyzed.

7.2.6 Running the tool

When done with your selections, click **OK** and wait for the run to finish. After all selections have been made, the FRCC Mapping Tool automatically performs an internal error checking routine to identify any discrepancies between the biophysical settings in the Spatial Layer and biophysical settings in the Reference Condition Table. An active progress bar at the bottom of the dialog box (fig. 7-19) indicates that the run is proceeding. The run may take a few minutes.

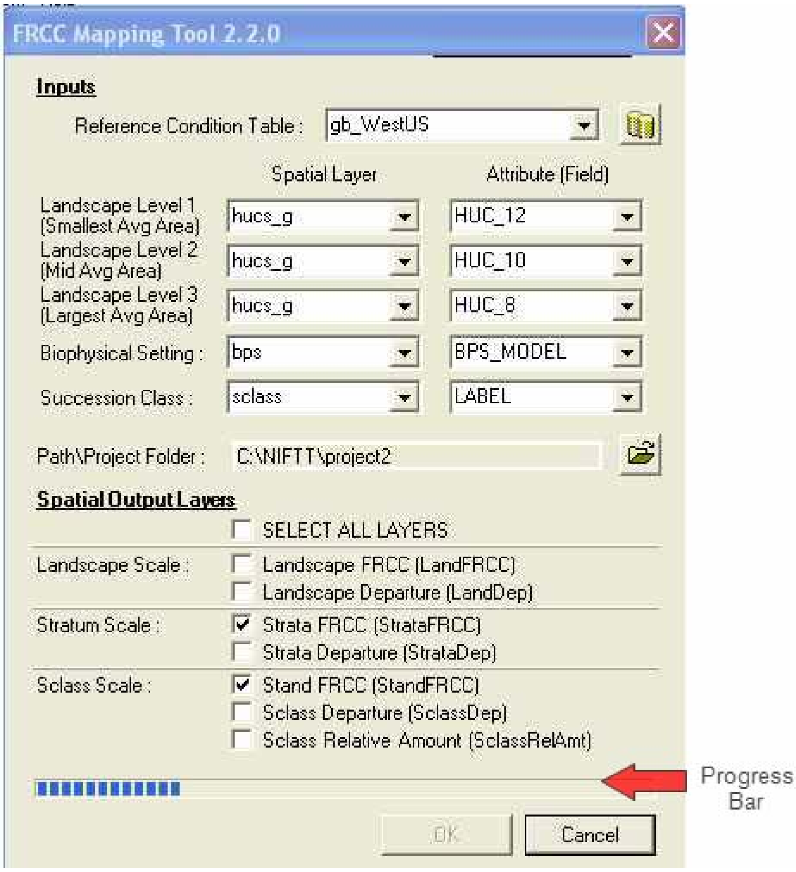


Figure 7-19. Progress bar indicates that the FRCC Mapping Tool is running.

The pop-up window in figure 7-20 will appear when none of the biophysical settings in the BpS layer coincide with those in the Reference Condition Table. This error message suggests that you may have inadvertently selected the wrong Reference Condition Table, selected an incorrect attribute for the BpS layer, or that the Reference Condition Table is structured incorrectly.

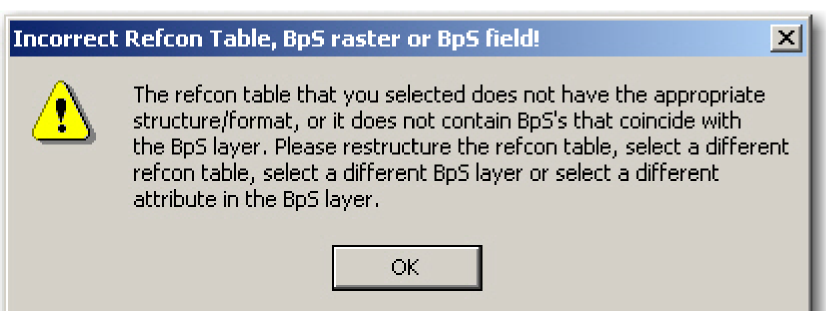


Figure 7-20. Error message indicating that none of the biophysical settings in the BpS layer correspond with those in the Reference Condition Table.

As the run progresses, each selected output layer will be added automatically to your ArcMap project and will appear in the Table of Contents along with several tables from the Access database. However, you must click on the Source tab at the bottom of the Table of Contents to view the tables. These output tables may prove useful for diagnosing some data problems. To open the output table, right-click on the table's name and select **Open** from the context menu.

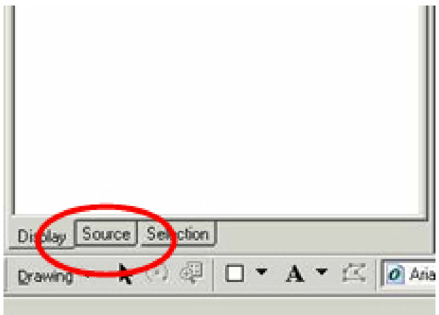


Figure 7-21. Select Source tab to view output tables.

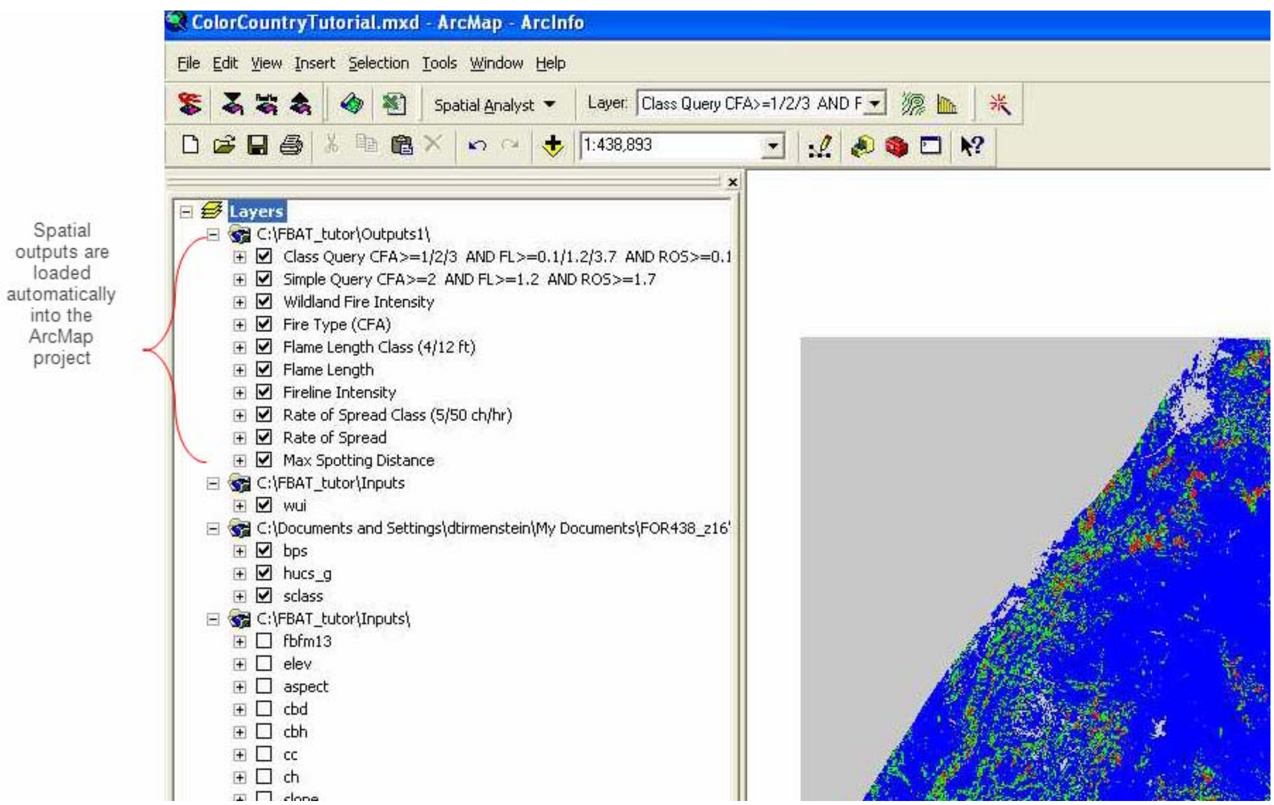


Figure 7-22. ArcMap Table of Contents.

Save your results.

Chapter 8: Troubleshooting the FRCC Mapping Tool – Common Errors, Symptoms, and Solutions

8.1 Data quality

The output layers produced by the FRCC Mapping Tool can only be as accurate as the input data used to derive them. If any of the output layers seem questionable, the problem can often be diagnosed by comparing the output layers to the input data. Problems with the input data often go unnoticed until concerns are raised about the outputs. Experience with FRCC Mapping Tool suggests that there are four primary sources of output error:

1. The S-Class layer does not adequately reflect conditions on the ground
2. The BpS Class layer does not adequately reflect conditions on the ground
3. The Reference Condition Table does not adequately reflect the BpS model, or the BpS model does not adequately reflect the historical range of variation for the assessment area
4. An inappropriate landscape scale was used to assess the composition of succession classes for a given BpS or group of biophysical settings

8.1.1 Output error related to the S-Class layer

FRCC Mapping Tool outputs seem to be most sensitive to the S-Class layer. Subtle changes in the classification of succession classes will often change the output layers substantially. Succession classes are commonly assigned by using canopy cover as one of the discriminating variables. Small changes to canopy cover thresholds may substantially change the composition of succession classes within a BpS, resulting in dramatic changes to any of the departure metrics. For example, it may be problematic if a canopy cover threshold of 40 percent was used in the model to distinguish open from closed classes, but the only canopy cover layer that is available for deriving succession classes has been grouped into classes with thresholds of 25 and 60 percent cover.

In addition, deriving an S-Class layer using remote sensing data can be particularly difficult. Thresholds defined in BpS models and used to develop succession classes are often based on field estimates of canopy cover, rather than on remotely sensed data. Ground-based estimates of canopy cover may not coincide with satellite-based estimates and, consequently, the S-Class layer may be biased towards either more open or more closed classes. Mapping the Uncharacteristic S-Class with remotely sensed data alone can also be problematic due to limitations in data resolution. As a result, uncharacteristic conditions, such as the presence of exotic species or lack of large-diameter trees, can be particularly difficult to detect.

In some cases, the S-Class characteristics in a BpS model may have been inadequately defined or mapped. Diagnosing a possible problem with the output layers is best conducted by overlaying that output with the BpS and S-Class input layers.

8.1.2 Output error related to the BpS layer

Remember that interpretation of succession classes depends on the BpS in which they occur. Therefore, the S-Class layer cannot be used independently of the BpS layer. We recommend using a single spatial layer that contains attributes for both the BpS and S-Class layers. Use of a single layer to depict both attributes will help ensure that the succession classes are indeed nested within biophysical settings.

If the BpS and S-Class layers do not seem reasonable, you should examine the process that was used to derive these layers. It is imperative that you completely understand the limitations of the input data for deriving departure metrics. This understanding can help you develop improvements for deriving the BpS and S-Class layers.

8.1.3 Output error related to the Reference Condition Table

If both the BpS and S-Class layers seem reasonable, the next troubleshooting step is to examine the Reference Condition Table. Remember that reference conditions depict the midpoint of the historical range of variation as characterized by succession and disturbance simulation models. Although modeling errors are always a concern, errors can also occur when transcribing model outputs to the Reference Condition Table, especially if the information is entered manually (for example, typographical errors). Carefully proofread the Reference Condition Table to ensure that the composition of succession classes seems reasonable for a given BpS and that it matches model descriptions. A thorough understanding of the BpS models is critical for those using the FRCC Mapping Tool.

8.1.4 Output error related to landscape scale

Lastly, review the landscape levels used to derive the output layers. The compilation of reference conditions and departure indices are scale-dependent; that is, values are, in part, dictated by the geographic extent of the reporting unit – the unit used to derive composition. The most appropriate-sized landscape is the smallest landscape in which the full expression of succession classes would be observed under the natural disturbance regime.

In theory, the smaller the reporting unit, the greater the likelihood that you will obtain higher departure values. (As reporting units get smaller and smaller, the probability of detecting the optimum S-Class composition decreases). Use of reporting units that are inappropriately small will often produce departure metrics that are too high. We recommend evaluating the departure metrics for sensitivity to changes in reporting unit or landscape size. To do this, complete three different FRCC Mapping Tool runs using a single landscape level to assess departure. Use a different landscape for each of the runs (for example, subbasin, watershed, and subwatershed). If the outputs vary dramatically, you should critically evaluate which landscape level is most appropriate for estimating departure. If the results do not vary substantially, then any unexpected outputs are probably not caused by use of an inappropriate analysis scale.

8.2 Landscape patterns

The FRCC Mapping Tool does not assess landscape patterns such as the departure in patch size and arrangement from that of reference conditions. Consequently, an analysis produced by the FRCC Mapping Tool may underestimate departure if current patterns are substantially different from historical patterns. In such cases, it may be advisable to supplement FRCC Mapping Tool results with information obtained from other sources that address landscape patterns, such as fire history studies.

8.3 Naming conventions

Several problems associated with the FRCC Mapping Tool can be attributed to the improper naming of files and folders. Special characters, spaces, and leading numbers should not be used as part of a file or folder name. This rule applies to paths used for data inputs and outputs as well as to Access databases and tables.

8.4 Reference Condition Database

The most common problems encountered while using the FRCC Mapping Tool are typically associated with the Reference Condition Database. Most errors are related to the following:

- The design of the Reference Condition Table must match the criteria specified in Table 3-1
- The name of the Reference Condition Table cannot contain spaces or special characters and should be ten characters or less in length
- The values in the Landscape Level field of the Reference Condition Table must correspond to the landscape levels used for the analysis. Often, one landscape level is selected, but users forget to change the Reference Condition Table so that the Landscape Level field contains only the value "1."

To report a bug, please contact helpdesk@niftt.gov.

Appendix A: References

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Appendix B: Fire Regime Condition Classes

Class	Description
1	Fire regimes are within the natural or historical range of variation and risk of losing key ecosystem components is low. Vegetation attributes (composition and structure) are intact and functioning.
2	Fire regimes have been moderately altered. Risk of losing key ecosystem components is moderate. Fire frequencies may have departed by one or more return intervals (either increased or decreased), potentially resulting in moderate changes in fire and vegetation attributes.
3	Fire regimes have been substantially altered. Risk of losing key ecosystem components is high. Fire frequencies may have departed by multiple return intervals, potentially resulting in dramatic changes in fire size, fire intensity and severity as well as landscape patterns. Vegetation attributes have been substantially altered.

Appendix C: Fire Regime Groups

Group	Frequency	Severity
I	0 – 35 years	Low to mixed
II	0 – 35 years	Replacement
III	35 – 200 years	Low to mixed
IV	35 – 200 years	Replacement
V	200+ years	Any severity

Appendix D: Entering a New Reference Condition Table into the FRCC Mapping Tool

The following instructions are for those wanting to import a reference condition table that is not currently available with the FRCC Mapping Tool.

1. Download the new Access database of interest from www.niftt.gov/. Click on **NIFTT > Downloads > FRCC Mapping Tool Reference Condition Tables and Related Material**.

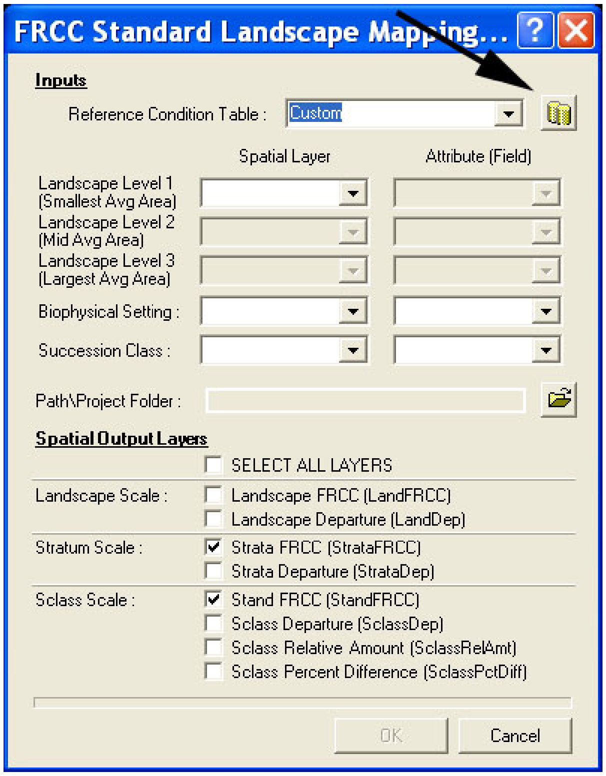
   Save the file to a convenient location on your hard drive.

2. Open ArcMap, and start the FRCC Mapping Tool by clicking the left button on the toolbar.

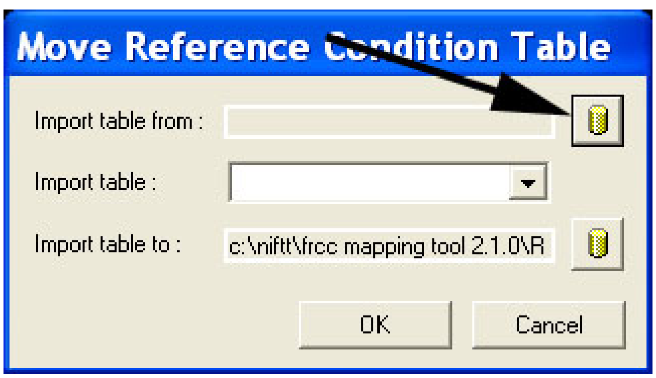
   

   ***Note**: The following process will extract the necessary table from the Access database that you just downloaded and store it in the FRCC program folder you created while installing the tool. If you import a table that has the same name as an existing table, the new table will overwrite the existing one; therefore, be aware of naming conventions as you may inadvertently overwrite existing tables during this process.*

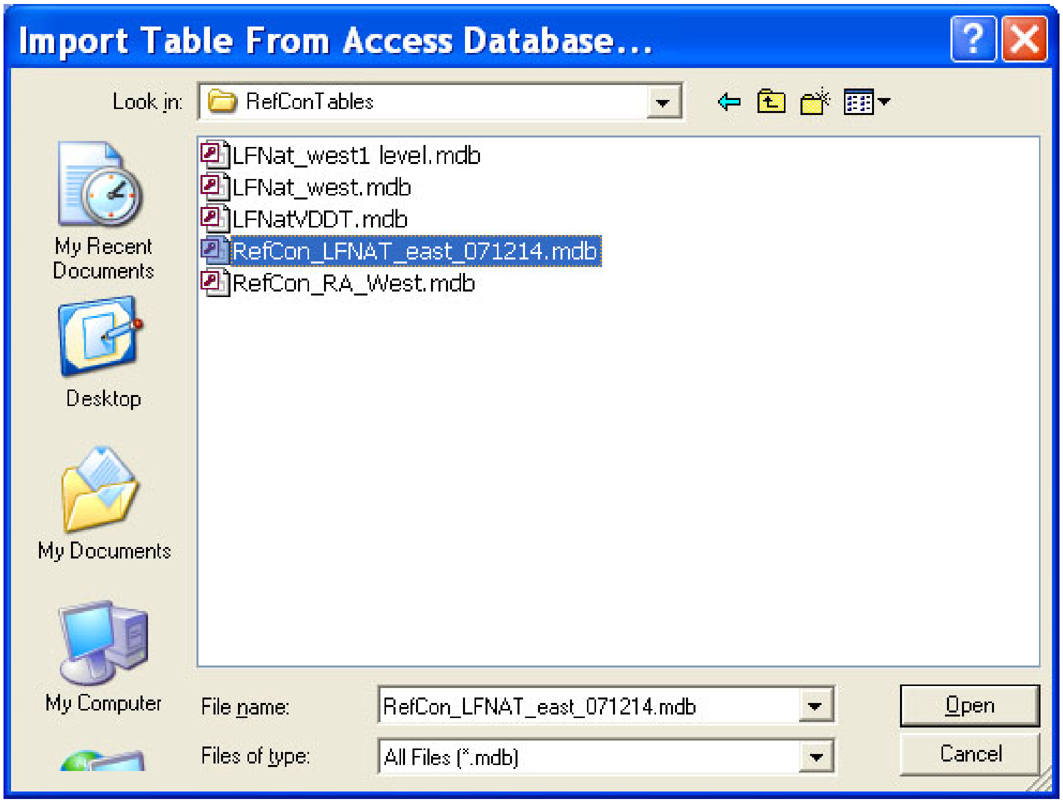
3. Click the **Move a refcon table between databases button**, which is to the right of the Reference Condition Table text box.



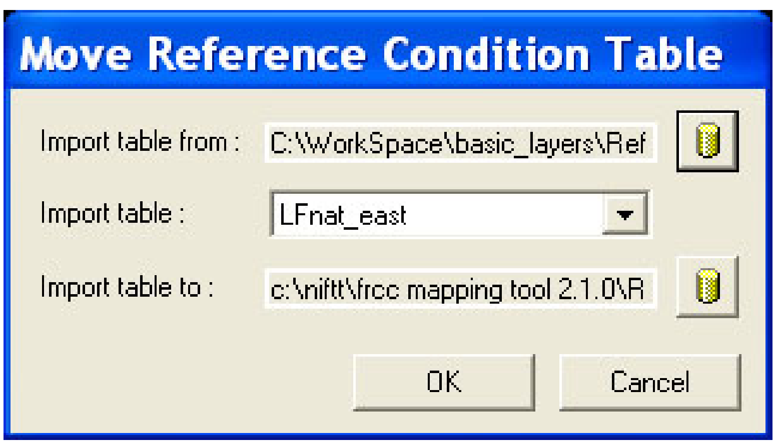
4. In the *Move Reference Condition Table* dialog box that opens, click the **Database** icon which is to the extreme right of the *Import table from text* box. This opens Windows Explorer.



5. Navigate to the folder in which you put the new database, select the new database file, and click **Open**.



6. The Windows Explorer window will close, and the *Move Reference Condition Table* dialog box will be filled in. The Import table and Import table to text boxes are filled in automatically.

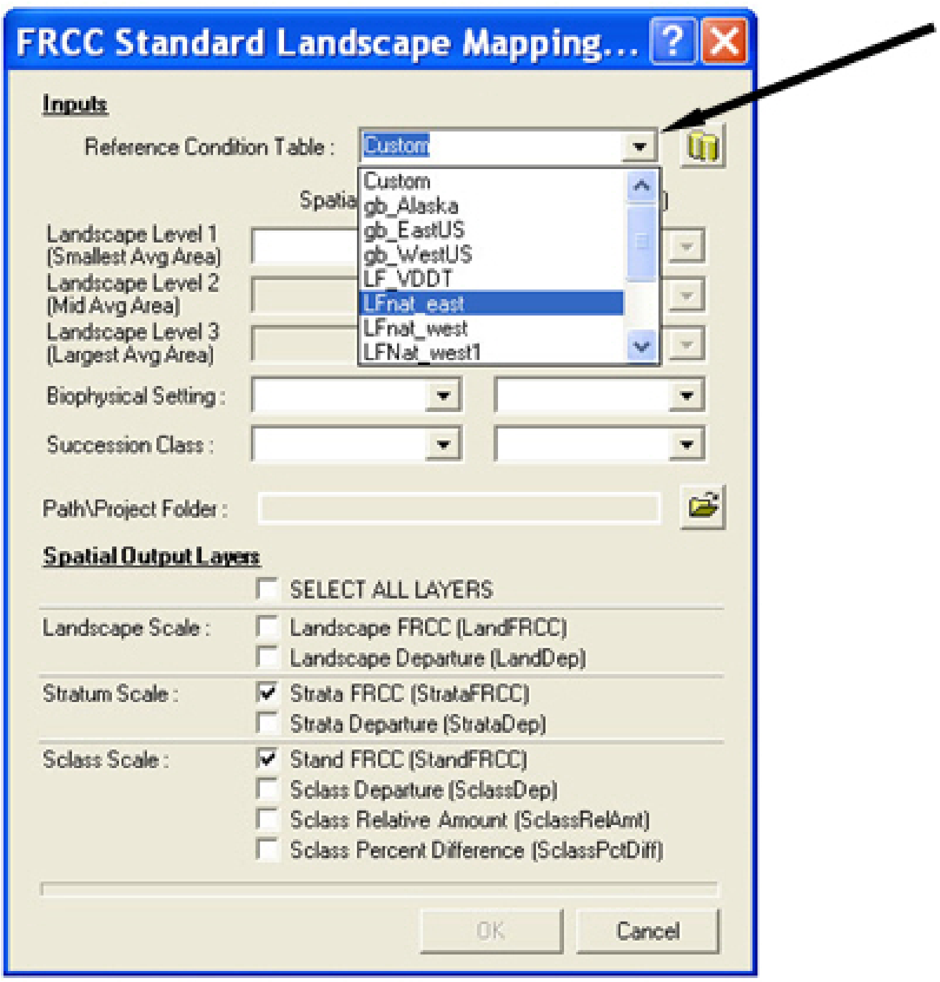


7. Click **OK**.

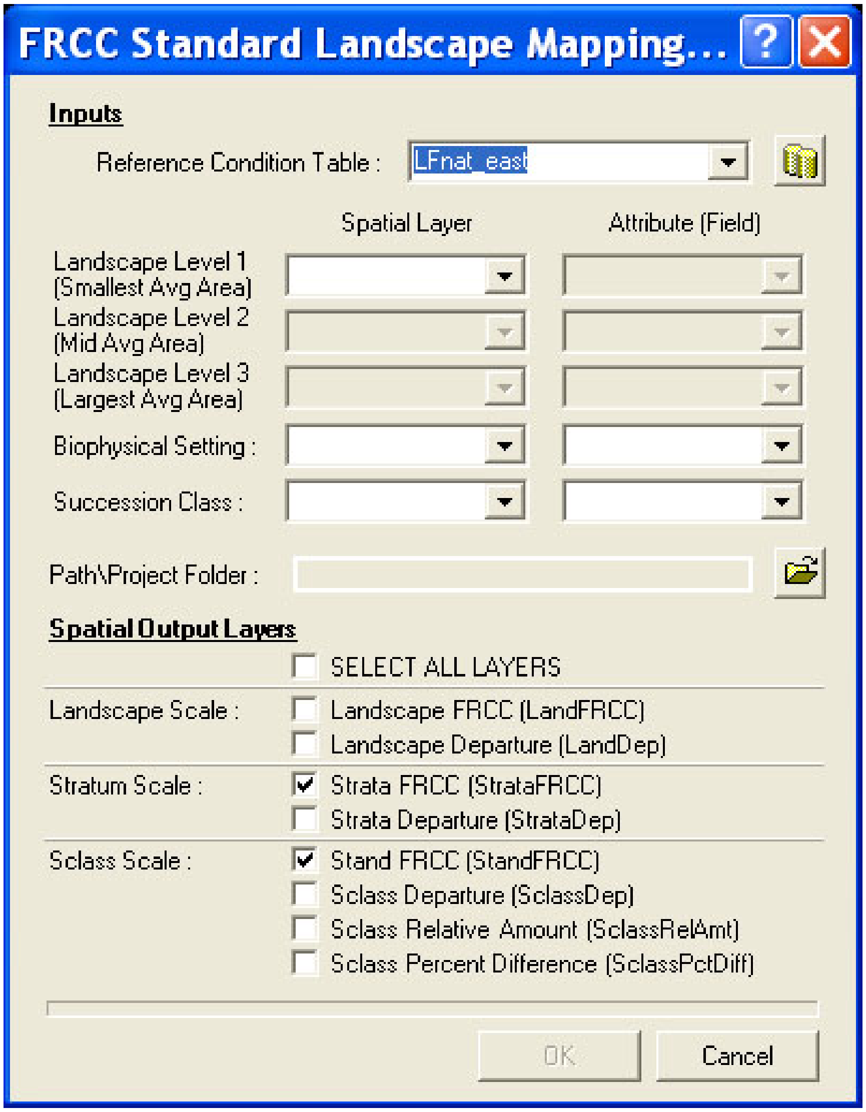
8. A results prompt will display if the import has been successful.

9. Click **OK** to return to the FRCC Mapping Tool dialog box.

10. Click the down arrow to the right of the *Inputs/Reference Condition Table* text box as shown below. A drop-down list of all the reference condition tables available will appear.



11. Click on the Reference Condition Table that you just imported (in this example, LFNat_east) to select it. You are now ready to continue with the FRCC Mapping Tool inputs.



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