Interagency
Fire Regime Condition Class (FRCC)
Guidebook

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Abstract

An understanding of fire regimes, ecological departure from historical reference conditions, and landscape pattern is an important part of modern land management. Federal initiatives such as the 2001 National Fire Plan continue to emphasize the restoration of fire-adapted ecosystems and maintenance of land health. Developed in 2003, the Fire Regime Condition Class (FRCC) assessment system has provided a vital connection between managers' understanding of fire regimes, ecological departure, and efforts to maintain sustainable landscapes (USDA, USDI 10-Year Comprehensive Strategy and Implementation Plans 2001-2002).

The FRCC Standard Landscape assessment system provides tools for fire regime and vegetation assessment at the both the landscape and stand scales. These methods can be used to describe general fire regime and vegetation traits for the historical (reference condition) versus current periods to produce departure estimates. (In this document, the terms "historical," "reference," and "natural" all refer to native ecosystems as they existed prior to EuroAmerican settlement.)

Fire Regime Condition Class is defined as follows: FRCC 1 represents ecosystems with low (<33 percent) departure from a defined reference period – that is, landscapes still within the natural or historical range of variation; FRCC 2 indicates ecosystems with moderate (33 to 66 percent) departure; and FRCC 3 indicates ecosystems with high (>66 percent) departure from reference conditions. The Interagency Fire Regime Condition Class Guidebook applies – at a finer scale and with minor refinements – the original FRCC concepts and definitions published in Hardy and others (2001), Hann and Bunnell (2001), and Schmidt and others (2002). FRCC assessment methods were developed and implemented by an interagency working group partnered with The Nature Conservancy, with oversight of the FRCC program provided by the National Interagency Fuels Management Committee. In addition, the FRCC methods, software, website, and associated publications have been developed in parallel with the national LANDFIRE vegetation, wildland fuel, and fire regime mapping project.

The FRCC Guidebook includes two procedures for determining FRCC: the FRCC Standard Landscape Worksheet Method and the FRCC Standard Landscape Mapping Method. These methods allow the user to quantify FRCC from the landscape to stand scales. Importantly, the stand-scale outputs can help users satisfy treatment reporting requirements, such as those contained in the National Fire Plan Operations and Reporting System (NFPORS).

The FRCC Guidebook provides step-by-step instructions for conducting assessments with the non-spatial FRCC Standard Landscape Worksheet Method (see Chapter 3). In addition, Chapter 4 provides an overview of two custom software tools. First, the FRCC Software Application (FRCCSA) provides a convenient way to quickly calculate and graph FRCC outcomes via the Standard Landscape Worksheet Method. Second,

the FRCC Mapping Tool (FRCCMT) is GIS software that uses the Standard Landscape Mapping Method to generate spatial assessments of FRCC. Regarding user support, www.frcc.gov provides biophysical settings models, data entry forms, downloadable software, training opportunities, a helpdesk contact, and other FRCC-related resources (details provided below).

FRCC Guidebook Version 3.0 Highlights

Following is a list of changes that have occurred since FRCC Guidebook version 1.3.0 was released in 2008.

- **Refined FRCC Methods:** FRCC version 3.0 incorporates two important algorithm changes. First, Stratum FRCC is now determined by *averaging* the vegetation and regimes departures instead of using the highest departure between those two sets of variables. And second, new Stand FRCC thresholds have been established in response to user feedback and subsequent sensitivity testing (see chapters 2 and 3).

- **New Biophysical Settings models:** In early 2010, the LANDFIRE Project completed its reference condition modeling for the entire U.S (models are available at www.frcc.gov). In addition to the LANDFIRE National models, a refined set known as the LANDFIRE Refresh models will be available in 2011.

- **Revised Data Fields & Forms**: Standard Landscape Method data fields have been added, deleted, or renamed; in addition, all data forms and associated summary graphs have been updated and streamlined (see Chapter 3 and Appendix A)

- **Revised FRCC Software Application & User Guide (version 3.0):** The FRCC Software Application (FRCCSA) has been substantially upgraded. For example, the input data pages have been redesigned to make the program more user friendly, new reporting functionality has been added, and several sets of default biophysical settings models for conducting FRCC assessments are now embedded in the software. In addition, a new user's guide has been developed (see Chapter 4). Both the software and user's guide are available at www.frcc.gov under Tools & User Documents.

- **Revised FRCC Mapping Tool & User Guide (version 3.0):** A new version of the FRCC Mapping Tool (FRCCMT) has been designed for ArcGIS 9.3 and later versions. The mapping tool now incorporates the new FRCC algorithms mentioned above, the outputs menu includes several new data layers, and a new FRCC Mapping Tool User Guide has been developed. In addition, a new tool called the Fire Frequency & Severity Editor has been incorporated into the mapping tool that allows users to generate current fire frequency and severity data and associated input rasters (see Chapter 4). Both the software and user's guide are available at www.frcc.gov under Tools & User Documents.

- **Updated References**: Numerous literature citations have been added throughout the Guidebook.

- **Revised Glossary:** The FRCC glossary has been updated (see Glossary).

- **New Frequently Asked Questions section**: This section provides answers to common user FRCC-related queries (see Appendix D).

- **New Overview of LANDFIRE FRCC Geospatial Products section**: The LANDFIRE Project has continued producing FRCC-related GIS layers since the last FRCC Guidebook release. For example, biophysical settings (BpS) and succession classes (S-Class) layers are now available for the entire U.S., as are subsequent maps depicting fire regimes and FRCC status. In addition, the LANDFIRE Refresh mapping phase is producing a set of streamlined biophysical settings models and a succession classes layer that will be available in 2011, both of which can be used for FRCCMT assessments (see Appendix E and www.landfire.gov for details).

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Chapter 1: Overview

Guidebook Structure

The FRCC Guidebook is organized into four chapters: Chapter 1 provides an introduction to and overview of the FRCC process, and Chapter 2 contains a detailed discussion of the theory and principles behind FRCC. Chapter 3 provides step-by-step instructions for using the FRCC Standard Landscape Worksheet Method. The Standard Landscape Worksheet Method facilitates the determination of FRCC with field-based data and can be used with the assessment medium that best suits the user's needs. Chapter 4 presents an overview of the two available software tools: the FRCC Software Application and the FRCC Mapping Tool (GIS software used with the Standard Landscape Mapping Method). The FRCC Software Application provides automated computation of data entered using the non-spatial Standard Landscape Worksheet Method, and the FRCC Mapping Tool produces multiple spatial GIS layers that correspond to the attributes derived by the Standard Landscape Worksheet Method.

> ***Note***: For additional information about FRCC objectives, data resources, and quality control issues, please see the list of frequently asked questions and associated answers in Appendix D.

Introduction to FRCC

Ecosystem maintenance and restoration are integral parts of most federal land management agency missions. Fundamental to the concepts of biodiversity and landscape ecology is the increasing recognition that functioning disturbance regimes are key components of ecosystems. Consequently, data documenting the status of disturbance regimes and associated vegetation are important components of modern land management planning and subsequent management treatments (Hann and others 2003; Zimmerman 2003).

Over the years, land managers have conducted a wide variety of ecological assessments, using various methods, scales, and reporting metrics. However, most assessments have been limited in scope. That is, assessments are often conducted on relatively small project-scale sites or for particular vegetation types and successional stages. Recently, however, managers have become increasingly aware of the value of conducting larger-scale assessments that cover multiple biophysical settings and often range from watershed to sub-basin scales (referred to as "Landscape assessments" in FRCC terminology). FRCC Landscapes can also be delineated according to landtype associations, soil types, fire management units, or ownership units. Landscape assessments have distinct advantages over those conducted for smaller-scale units. First, ecosystem trends often become more apparent at broader scales, providing more context for ecosystem maintenance and restoration. In addition, increasing accuracy and availability of landscape-scale spatial data and widespread use of geographic information systems (GIS) facilitate the planning process by saving time and increasing cost-effectiveness.

The FRCC Standard Landscape Worksheet Method and Mapping Method were initially developed and implemented between 2002 and 2005 by an interagency working group teamed with The Nature Conservancy (TNC). The FRCC working group, chartered and managed by the National Interagency Fuels Management Committee, later evolved into the National Interagency Fuels Technology Team (current name: National Interagency Fuels, Fire, and Vegetation Technology Transfer [NIFTT]). NIFTT was formally chartered to develop and coordinate FRCC training and certification, and to manage the FRCC website (www.frcc.gov). In addition, the FRCC Standard Landscape Worksheet and Mapping methods, software, website, and associated publications have been developed in parallel with the LANDFIRE Project (see www.landfire.gov and Appendix E).

In 2003, the Fire Regime Condition Class (FRCC) assessment method was established to provide managers with a relatively simple, fast, and effective way to evaluate landscapes among the wide array of biophysical settings throughout the U.S. Although other techniques exist for evaluating reference versus current ecological conditions, managers often find these statistically rigorous methods (such as Keane and others 2006; Steele and others 2006; Keane and others 2007) difficult to understand and apply. For this reason, FRCC continues to serve as an important tool for assessing land health among federal land management agencies. For example, data on Fire Regime Group and Condition Class are required fields for management projects entered into the National Fire Plan Operations and Reporting System (NFPORS) and for the Forest Service Activities Tracking System (FACTS). Some agencies also require the use of FRCC data in Land Use Plans and Fire Management Plans. In addition, some allocation models, such as the Ecosystem Management Decision Support System (EMDS) use FRCC as modeling input. Looking ahead, FRCC will likely be used in other federal agency applications that require an understanding of fire regimes and ecological departure.

At its core, FRCC provides a solid foundation for understanding historical fire regimes and associated vegetation. Of course, FRCC assessments might not be key planning components where ecosystem restoration is not the primary management objective. For example, fuel management projects conducted in the wildland-urban interface

(WUI) typically focus on fire behavior modification rather than on ecological values. Similarly, treatments aimed at improving wildlife habitat often focus on one vegetation seral stage rather than on the full array of vegetation that existed historically. Even in those cases, however, FRCC data can provide useful context regarding the natural ecosystems that comprise the surrounding landscapes.

FRCC Overview

As noted above, FRCC assessments describe general landscape fire regime and vegetation characteristics. Estimates of current characteristics are calculated for comparison with estimates of historical or reference condition characteristics. From these estimates, current landscape departure from reference conditions can be determined, and the landscape is assigned to one of three fire regime condition classes: low departure (FRCC 1), moderate departure (FRCC 2), and high departure (FRCC 3).The data collected describe the size of the area being assessed, its geographic location, and biophysical conditions in terms of vegetation and fire regime characteristics.

During an assessment, the fire and vegetation variables are evaluated at various scales ranging from entire landscapes to individual stands or patches as described in Chapter 2. (Note: The term *stand* will be used throughout this document when referring to small-scale units of relatively homogeneous vegetation; that is, units composed of single seral stages). In FRCC methodology, a landscape is defined as the contiguous area within a delineation that is large enough to exhibit the natural variation in fire regimes and associated vegetation. FRCC assessment areas (also referred to as FRCC Landscapes) are then subdivided into Strata, which are subdivisions of the landscape based on biophysical settings (BpS) or fire regime groups, as described in Chapter 2. Finally, each stratum is delineated according to Succession Classes (or S-Classes), which represent discrete units of early-, mid-, or late-succession vegetation that can be quantified to assess possible ecological departure between the current and reference (or historical) periods.

> ***Note***: The following terminology has changed from the early FRCC literature: 1) Potential Natural Vegetation (PNV) has since been updated to the term Biophysical Setting (BpS) and 2) Vegetation-fuel Class (Veg-fuel Class; VFC) has been updated to Succession Class (S-Class). Such terminology changes were made, in part, to remain consistent with terminology used by the LANDFIRE Project (see www.landfire.gov and Appendix E).

During FRCC assessments, current fire regime and vegetation conditions are compared to those of the reference period as estimated through modeling. First, landscape-scale departure and FRCC are determined by evaluating the composition of seven reference condition variables (up to five succession classes plus fire frequency and severity) against those for the current period. Next, Stand FRCC is estimated by comparing the amount of a given vegetation succession class (S-Class) to the reference condition amount. See

Chapter 2 for a detailed discussion of reference condition concepts and modeling procedures.

> ***Note***: Before determining stand-level FRCC, the larger landscape must first be assessed using the Standard Landscape Method – either non-spatially via field estimation and accompanying worksheets and/or data entry software (chapters 3 and 4; Appendix A) or by using the FRCC Mapping Tool GIS software (Chapter 4). In addition to providing ecological context, the landscape scale data serve as inputs for determining stand-level condition classes (more on this in Chapter 3).

Since FRCC's inception, many aspects of the FRCC assessment system have evolved and continue to do so, including methodology improvements, BpS model refinements, FRCC software upgrades, and improved user support. Therefore, current and prospective users should regularly visit the FRCC website (www.frcc.gov) to keep abreast of ongoing improvements.

FRCC Objectives

Specific objectives guiding development of the FRCC resources were as follows:

1) FRCC will be the standard assessment tool used by federal agencies in implementing Goal #3 of the National Fire Plan ("Restoring Fire-adapted Ecosystems").
2) Procedures will be designed in conjunction with the fire regimes and associated FRCC descriptors that were initially defined by Hardy and others (2001) and Schmidt and others (2002), and subsequently refined by Menakis and others (2004); the goal will be to develop an FRCC index based on ecological sustainability that could be used to support multi-scale planning and monitoring as described by Hann and Bunnell (2001).
3) Both spatial and non-spatial methods will be developed in such a way that users will readily understand the applications of FRCC.
4) Procedures will be based on simple calculations, classifications, and commonly available data so that users could easily calculate and classify data based on field or map assessments.
5) Standard quantitative methods will be developed that will be flexible in application, economical in terms of time and personnel requirements, detailed in terms of outputs, and that will be readily understood and supported by managers.
6) FRCC procedures will use concepts and terminology similar to those used by other resource assessment methods (for example, when assessing watershed, forest, and rangeland conditions), which will facilitate interdisciplinary communication and an integrated approach to multi-level planning and monitoring.

Data Entry Resources

FRCC data entry forms and software for the worksheet and mapping methods can be downloaded from www.frcc.gov. We recommend that users of the Standard Landscape Worksheet Method who have computer capability also use the FRCC Software Application, which is Java-based data entry and reporting software. This custom-designed software provides an efficient system for storage, filing, data correction, sensitivity testing, and production of finished reports with graphics and photos.

Quality Control

To date, no formal mechanism exists for tracking the quality of the various FRCC assessments that have been conducted across the U.S. However, to acquire a solid foundation for conducting FRCC assessments, users are encouraged to participate in the FRCC online course, which certifies users upon completion – details available at www.frcc.gov. In addition to providing user training and certification, we strongly encourage users to conduct internal quality control, such as 1) using a team approach consisting of qualified vegetation and fire ecology experts when conducting FRCC assessments, 2) soliciting internal and external review comments to improve the quality of FRCC assessments, 3) staying informed about the latest FRCC developments and training opportunities as indicated on www.frcc.gov, 4) taking FRCC refresher courses, and 5) establishing professional Internet networks such as list serves that can serve as "FRCC chat rooms." In addition, prospective users can inquire about becoming certified by contacting the FRCC helpdesk at helpdesk@frcc.gov.

Chapter 1 Summary

- The FRCC Guidebook is organized into four chapters, as follows. Chapter 1 provides an introduction to and overview of the FRCC process, Chapter 2 contains a detailed discussion of FRCC theory and principles, Chapter 3 provides step-by-step instructions for using the FRCC Standard Landscape Worksheet Method, and Chapter 4 presents an overview of the two available software tools.
- Ecosystem maintenance and restoration are increasingly important management tasks that require baseline data to support planning decisions.
- FRCC assessments provide a relatively simple and efficient way to characterize landscape health in terms of vegetation and fire regimes in relation to those that existed during the historical reference era.
- FRCC data also can help managers fulfill reporting requirements, such as those within NFPORS.
- Although FRCC data are not necessary for every planning task, FRCC data can still provide useful information about naturally functioning ecosystems.
- During an assessment, the fire and vegetation variables are evaluated at various scales, ranging from entire landscapes to individual stands.

- An FRCC Landscape is defined as a contiguous area large enough to exhibit natural variation in fire regimes and associated vegetation.
- FRCC data entry forms and software for the worksheet and mapping methods can be downloaded from www.frcc.gov.
- In terms of quality control, high quality FRCC assessments can be assured by taking advantage of available training opportunities and user certification, using a team approach for conducting assessments, soliciting input and critiques from peer professionals, and contacting the FRCC helpdesk regarding specific questions or issues.

Chapter 2: Fire Regime Condition Class Theory and Principles

Overview

Fire regimes and fire regime condition classes (FRCC) were originally defined and mapped by Hardy and others (2001), Hann and Bunnell (2001), and Schmidt and others (2002). Most inputs for the FRCC methods were identified through landscape-level FRCC mapping tests and demonstration projects (Hann and Strohm 2003) with substantial modifications based on subsequent informal workshops and field tests. Based upon this work, FRCC was found to be applicable to most wildland settings in the U.S.

Fire regime groups

A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human intervention but including the possible influence of aboriginal fire use (Agee 1993; Brown 1995; Brown and Smith 2000).

Coarse-scale definitions for natural fire regimes were initially developed by Hardy and others (2001) and Schmidt and others (2002) and subsequently re-interpreted by Hann and Bunnell (2001). The five natural fire regime groups are classified based on the average number of years between fires (fire frequency or mean fire interval [MFI]) combined with characteristic fire severity reflecting percent replacement of dominant overstory vegetation. These five natural fire regimes are defined as follows:

Table 2-1. Fire regime groups and descriptions.

Group	Frequency	Severity	Severity description
I	0 – 35 years	Low / mixed	Generally low-severity fires replacing less than 25% of the dominant overstory vegetation; can include mixed-severity fires that replace up to 75% of the overstory
II	0 – 35 years	Replacement	High-severity fires replacing greater than 75% of the dominant overstory vegetation
III	35 – 200 years	Mixed / low	Generally mixed-severity; can also include low-severity fires
IV	35 – 200 years	Replacement	High-severity fires
V	200+ years	Replacement / any severity	Generally replacement-severity; can include any severity type in this frequency range

Note: These regime groups have been modified slightly from earlier versions (Hardy and others 2001; Schmidt and others 2002; FRCC Guidebook Version 1.2.0) to remain consistent with the ongoing LANDFIRE Project (specifically, Fire Regime III now includes low-severity fires and Fire Regime V includes fires of any severity type).

The above definitions use 25 and 75 percent as severity thresholds between the low, mixed, and replacement regimes, rather than 10 and 90 percent as suggested by previous researchers (Morgan and others 1998; Hardy and others 2001; Schmidt and others 2002). Field reconnaissance by fire ecologists during the FRCC beta testing period suggested that 25 and 75 percent thresholds are more realistic measures, whereas the 10 and 90 percent thresholds were largely theoretical. For example, although most experts would agree that landscapes heavily dominated by even-age stands without fire scars should be classified as a replacement regime (Brown 1995; Brown and Smith 2000), field reconnaissance often reveals that such fires commonly produce less than 90 percent replacement of dominant overstory vegetation. This interpretation is generally supported by Brown and Smith's (2000) "Fire Effects on Flora" fire ecology compendium (otherwise known as the "Rainbow Series").

Departure & condition classes

Fire regime condition classes reflect the current conditions' degree of departure from modeled reference conditions. FRCC assessments measure departure in two main components of ecosystems: 1) fire regime (fire frequency and severity) and 2) associated vegetation. Managers can use the departure and condition class data to document possible changes to key ecosystem components (Schmidt and others 2002). Examples include vegetation characteristics (species composition, structural stage, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances, such as insect and disease mortality, grazing, and drought. Common causes of departure include advanced succession, effective fire suppression, timber harvesting, livestock grazing, introduction and establishment of exotic plant species, and introduced insects and disease (Brown and Smith 2000; Schmidt and others 2002; Brown and others 2004; Hood and Miller 2007; Tausch and Hood 2007; Stambaugh and others 2008; Keane and others 2009).

The three fire regime condition classes have been defined (Schmidt and others 2002) as follows: 1) FRCC 1 represents ecosystems with low (<33 percent) departure and that are still within an estimated historical range of variation as determined by modeling for the pre-EuroAmerican era (discussed below); 2) FRCC 2 indicates ecosystems with moderate (33 to 66 percent) departure; and 3) FRCC 3 indicates ecosystems with high (>66 percent) departure from reference conditions (Hann and Bunnell 2001; Hardy and others 2001; Schmidt and others 2002). As discussed below, departure is based on a *central tendency* (or mean) metric that represents a composite estimate of the reference condition vegetation and fire regime characteristics.

Characteristic conditions are defined as those occurring within the natural fire regime and associated vegetation (for example, low departure [FRCC 1]). Stated another way, characteristic conditions are those described in available biophysical settings models. In contrast, *uncharacteristic* conditions are those that did not occur within the natural regime, and hence produce an FRCC 3 (high departure) assessment outcome. *Uncharacteristic* conditions include (but are not limited to): invasive species (weeds and insects), diseases, "high graded" forest composition and structure (in which, for example, large fire-tolerant trees have been removed and small fire-intolerant trees have been left within a frequent surface fire regime), or overgrazing by domestic livestock that adversely impacts native grasslands or promotes unnatural levels of soil erosion.

It is important to note that FRCC is *not* a fire hazard metric (Hardy 2005; Odion and Hanson 2006; Hammer and others 2007). Instead, FRCC is a tool for measuring ecological trends. Nonetheless, indirect inferences about fire risk can sometimes be made after examining fuels data in tandem with FRCC data (Hann and others 2003; Zimmerman 2003; Williams 2004; Laing and others 2005; O'Laughlin 2005; Stephens and Ruth 2005; Hyde and others 2006; Platt 2006; Hessburg and others 2007; McKenzie and others 2007; Miller 2007;Theobald and Romme 2007). For example, a savanna BpS that has become heavily invaded by trees as a result of long-term fire exclusion would often be considered to reflect both FRCC 3 and high fire hazard. Similarly, FRCC might serve as a proxy for predicting second-order fire effects (R. Keane, personal communication). Examples include FRCC 3 scenarios where uncharacteristically severely burned sites are expected to develop high vulnerability to soil erosion, insect outbreaks, or invasive weeds.

Also note that FRCC metrics for vegetation departure – especially those derived via the non-spatial method described in Chapter 3 – describe only vegetation *amounts* in relation to reference amounts. FRCC metrics do not address the question of natural spatial patterns. For example, a low departure rating such as FRCC 1 can result even where patch sizes and arrangements currently are beyond the natural range of variation. In such cases, other sources of information such as local expert opinion or fire history studies can be used to supplement FRCC data.

FRCC overview summary

- Extensive field testing during the FRCC methods development phase suggested that FRCC is applicable to most wildland biophysical settings.
- A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human intervention but including the possible influence of aboriginal fire use.
- Five fire regime groups have been defined, ranging from high frequency-low severity regimes to low frequency-high severity regimes.
- Fire regime condition classes reflect the current conditions' degree of departure from reference conditions in terms of two main ecosystem components: fire regime and associated vegetation.
- Three fire regime condition classes have been defined based on the following criteria: FRCC 1 represents ecosystems with low (<33 percent) departure from reference conditions and that are still within the estimated historical range of variation of a specifically defined reference period; FRCC 2 indicates ecosystems with moderate (33 to 66 percent) departure; and FRCC 3 indicates ecosystems with high (>66 percent) departure.

- FRCC departure and condition classes measure the amount of *characteristic* versus *uncharacteristic* conditions that exist in the current landscape.
- FRCC is *not* a fire hazard metric; rather, it is a tool for measuring ecological trends.
- FRCC departure and condition classes for the vegetation component of assessments measure only vegetation amounts; they do not account for spatial patterns relative to reference conditions.

Biophysical Settings & Reference Conditions

Biophysical settings definition

Biophysical settings (BpS) are the primary environmental descriptors used for determining a landscape's natural fire regimes, vegetation characteristics, and resultant FRCC diagnoses. Biophysical settings can be classified based on a single attribute, such as vegetation, soils, or geomorphology, or they can be classified based on integrated attributes, such as ecological types (Winthers and others 2005), ecological sites (NRCS 2003), or ecological systems (Comer and others 2003). For FRCC purposes, biophysical settings use dominant vegetation types and their associated fire regimes as a proxy for the integration of a landscape's biotic and abiotic components. Note that FRCC assessments incorporate natural disturbances because most BpS types in the U.S. are fire-adapted ecosystems.

Biophysical settings have been described according to their respective fire regimes and vegetation compositions (native overstory species) and structures (major succession stages) based on research describing historical ranges of variation (HRV). For example, BpS classifications such as those used by the national LANDFIRE Project provide a useful foundation for determining FRCC. (For more information on the BpS classification and mapping conducted by LANDFIRE, see www.landfire.gov and www.natureserve.org).

Vegetation as a proxy for biophysical settings

Although biophysical settings represent the collective, integrated attributes of an environment, FRCC assessments use disturbance-adapted vegetation as a proxy to describe them. In other words, vegetation is simply a practical surrogate for the BpS. And inclusion of disturbance is critical for FRCC determination because the metric is based on an estimate of departure from vegetation seral stages and their interrelationships with fire frequency, fire severity, and other disturbances across landscapes historically.

An important FRCC principle centers on the concept of historical vegetation. *Historical vegetation* is the flora that existed during the reference period prior to EuroAmerican settlement, and these ecosystems were sometimes influenced by Native American fire use (Barrett and Arno 1982; Gruell 1985; Barrett and Arno 1999; Boyd 1999; Vale 2002; Mann 2006). Note, however, that the onset of EuroAmerican settlement varies throughout the United States, from the early 1600s in coastal Virginia and New England to the late 1700s in the Appalachians to the late 1800s throughout much of the Northern Rockies and the Pacific Northwest. For this reason, the length of the reference period for describing historical vegetation varies according to geographic location. For example, the Interior Columbia Basin Ecosystem Management Project scientific assessment (Keane and others 1996; Quigley and Arbelbide 1997) in the Pacific Northwest used a time frame of 400 years, from 1450 to 1850 (the latter being the approximate date of the onset of EuroAmerican settlement).

Describing variation in biophysical settings

Data describing the historical range of variation (HRV) within biophysical settings is important for modern management planning (NCSSF 2005). For FRCC purposes, the word “historical” refers to the period pre-dating EuroAmerican settlement – the onset of which varied regionally within the U.S. As discussed later in this chapter, reference condition modeling and subsequent FRCC assessments estimate BpS variation in terms of: 1) vegetation seral stages (succession classes) and 2) fire regimes (fire frequency and severity). FRCC metrics incorporate variation as a key ecological principle, because landscapes do not exist as fixed states, but rather exist within a range of dynamic equilibrium or homeostatic balance (Pickett and White 1985).

Some ecologists have questioned use of the HRV concept in planning because pre-EuroAmerican settlement climatic conditions were somewhat cooler than present conditions (Bradley and Jones 1993; Veblen 2003; McKenzie and others 2004). However, fire regimes and associated vegetation for most BpS types were relatively stable for at least several centuries before attempted fire exclusion (Agee 1993; Swetnam and Baisan 1996; Barrett and others 1997; Frost 1998; Morgan and others 1998; Brown and Smith 2000; Hemstrom and others 2001; Heyerdahl and others 2007; Miller 2007; Heyerdahl and others 2008; Keane and others 2008; Nowacki and Abrams 2008). Therefore, HRV-based reference conditions are acceptable for use in FRCC and other types of ecological assessments (Keane and others 2007; Morgan and others 2007).

Data describing the present natural range of variation (PNRV [or PRV]) could also be useful (NCSSF 2005), but few landscapes today remain unaffected by modern land use activities. And, because few PNRV data exist, HRV represents the most practical benchmark for management planning (Morgan and others 1994; Fule and others 1997; Landres and others 1999; Swetnam and others 1999; Hemstrom and others 2001; Dorner 2002; Wong and Iverson 2004; Keane and others 2009). Note, however, that

BpS models can be edited in the future if climatic or other factors suggest that such editing would be merited (Floyd and others 2004; Fule and Laughlin 2007).

Reference condition modeling

Biophysical settings (BpS) have been modeled for FRCC purposes based on fire regimes and associated vegetation seral stages, or succession classes (S-Classes). For example, a state and transition model (also referred to as a *visual dynamics model* or *5-box model*) is used to characterize S-Class composition and structural traits (figs. 2-1 and 2-2) in response to successional advancement and periodic disturbances, such as fire (described below). Note that the term 5-box model refers to the fact that modelers use up to five S-Classes per BpS, ranging from early seral (post-disturbance) stages to late seral stages, such as old growth forest.

The state and transition model is defined as follows: 1) S-Class A: early-seral, post-replacement; 2) S-Class B: mid-seral, closed canopy; 3) S-Class C: mid-seral, open canopy; 4) S-Class D: late-seral, open canopy; and 5) S-Class E: late-seral, closed canopy. Note, however, that not all biophysical settings conform to the standard 5-box model. For example, some grassland types might have only two or three succession classes. Moreover, modelers sometimes used different S-Class definitions than those presented above. For instance, many mesic types in the eastern U.S., Pacific Northwest, and Alaska often do not have open-grown seral conditions (Bray 1956; Lertzman 1992; Agee 1993; Kneeshaw and Begeron 1998). Users therefore are cautioned to carefully read the model descriptions (available at www.frcc.gov) before attempting to use those default models for FRCC assessments.

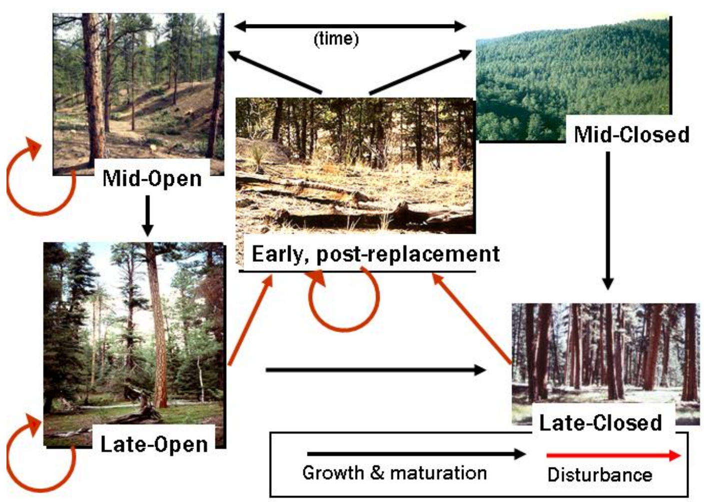


Figure 2-1. State and transition model (standard 5-box) for a forest ecosystem.

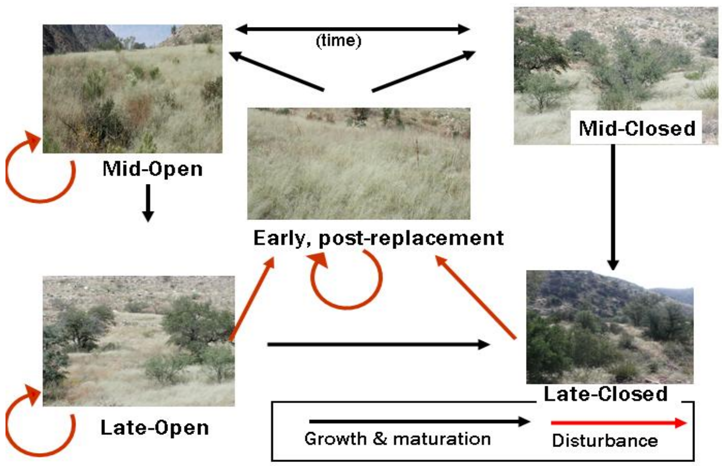


Figure 2-2. State and transition model (standard 5-box) for a rangeland ecosystem.

The modelers estimated BpS reference conditions by using a non-spatial vegetation and disturbance dynamics model called the Vegetation Dynamics Development Tool (VDDT; Beukema and others 2003a). Each model was developed based on literature reviews, expert opinion, and field data, where available. The inputs to the model included: 1) estimates of transition (succession or growth and development) rates between succession classes (states or seral stages) and 2) probabilities (frequencies) of disturbance that either maintain a given S-Class or cause a transition from one S-Class to another. Note that VDDT was used to generate *central tendency estimates* (means) rather than ranges (such as minimum vs. maximum values) because the literature has been inconsistent in terms of reporting ranges as opposed to central tendency values like mean fire intervals.

> ***Note***: To learn more about the modeling process, go to www.landfire.gov and read the data product description for Vegetation Dynamics Models.
>
> ***Note***: In this document, the terms "reference condition model" and "biophysical settings (BpS) model" are synonymous (also be aware that the LANDFIRE Project (www.landfire.gov) uses the term "vegetation dynamics model" instead).

As described below and in Chapter 3, several sets of default biophysical settings models are available for describing biophysical settings in the conterminous U.S. and Hawaii. These downloadable models are the product of a series of increasingly refined development efforts to describe vegetation succession class (S-Class) composition, fire frequency, fire severity, and other key traits. The models were developed with the Vegetation Dynamics Development Tool (VDDT; Beukema and others 2003a) based on literature reviews, field surveys, and consultation with local experts. Model refinement will be ongoing through 2011 via the LANDFIRE National Refresh phase, so please visit the LANDFIRE website (www.landfire.gov under Vegetation Dynamics Models) regularly to stay abreast of latest developments. And finally, users can develop their own reference condition models using FRCC Guidebook protocols (see Appendix C). The following sets of models as well as a document called *Using the LANDFIRE BpS Model Descriptions* are available through www.frcc.gov.

1) Between 2002 and 2005, 186 FRCC Guidebook models were initially developed by the FRCC Working Group (Hann and others 2004) for the lower 48 states and Alaska. In addition, a replacement set of 17 models for Alaska was subsequently developed by several ecologists in Alaska.

2) Next, model refinement and expansion occurred during the Rapid Assessment phase of the LANDFIRE Project between 2004 and 2005; that effort, conducted through numerous modeling workshops involving input from local expert ecologists, produced 231 models for the conterminous 48 states.

3) Similarly, model refinement and expansion occurred during the LANDFIRE National phase between 2005 and 2009. This effort produced several hundred BpS models by refining some of the Rapid Assessment models and creating some new models for the entire U.S.

4) In 2009, a subsequent refinement effort called the LANDFIRE Refresh phase was begun. The objective of that effort, which is scheduled to be completed in 2011, is to provide an alternative set of substantially reduced number models by aggregating any ecologically similar LANDFIRE National biophysical settings that happen to occur in adjacent LANDFIRE mapping zones.

   Note: Although all of these sets of models are suitable for FRCC assessments, users should bear in mind the above refinement process when evaluating which set of models to use for a given assessment. (However, users who are re-assessing FRCC for a given landscape are advised to use the same models that were used during the initial assessment.)

Biophysical settings & reference conditions summary

- Biophysical settings (BpS) are the primary landscape units used for FRCC assessments.
- Vegetation and associated fire regimes are used as proxies for describing the biophysical setting.
- FRCC assessments incorporate natural disturbances because most BpS types in the U.S. are fire-adapted ecosystems.
- Vegetation is a proxy representing the collective attributes of a given BpS, and historical vegetation represents the reference benchmark for FRCC assessments.

- Until sufficient data are available to describe sustainable landscapes under the modern climatic regime, FRCC reference conditions will be based on the historical range of vegetation and fire regimes that existed during the pre-EuroAmerican settlement era.
- Reference condition traits for all BpS types in the U.S. have been described in models built by numerous ecologists through syntheses of expert knowledge, published literature, and historical information in combination with the state and transition modeling software the Vegetation Dynamics Development Tool.
- To measure departure from reference conditions, FRCC assessments use central tendency estimates rather than a range of variation because data on the latter are lacking in the literature.
- Several sets of downloadable models, representing a series of increasingly refined models from several modeling efforts, are available through www.frcc.gov.

FRCC Scale Issues

Definition of scale as used in landscape ecology

In the realm of landscape ecology, scale refers to the spatial or temporal dimension of an object or process; it is characterized by grain (resolution) and extent (Turner and Gardner 1991). Grain is the finest level of spatial resolution possible within a given data set (for example, the pixel size for raster data). Extent is the size of the study area or the duration of time under consideration. For example, the scale of LANDFIRE map layers is 30 square meters (resolution) across the entire U.S. (extent). "Fine scale" refers to minute resolution or a small study area and "broad scale" refers to coarse resolution or a large study area. In a landscape assessment context, it is best to refer to scale in terms of extent. Terminology such as "broad" versus "fine" is unambiguous and easy to understand. Note, however, that the scale parameters for a given FRCC Landscape must always be quantified to facilitate documentation and communication between users. For example, a regional planning document might state that assessments were conducted for landscapes ranging in size from 100,000 to 200,000 acres each.

Landscape delineation and stratification

An understanding of the effects of analysis scale and related concepts becomes important because FRCC is a scale-dependant metric. FRCC outcomes can vary depending on both the size of the analysis area and on the accuracy of the strata delineations within the area (discussed below). First, recall that an FRCC Landscape is defined as a relatively large, contiguous area big enough to potentially exhibit the full range of historical variation in fire regimes and associated vegetation. The delineation process is critically important because assessment areas that are too small would likely produce inaccurate outputs, which could then lead to subsequent planning errors

(Shlisky and DeMeo 2004). Conversely, assessment areas that are too large might hamper a manager's ability to discern changes in FRCC after small- to mid-scale treatments or other disturbances.

FRCC Landscapes can often be delineated based on dominant fire regime groups (guidelines appear below). For example, because fire regime groups I and II typically produce relatively fine-grained patch variation, the assessment landscape can be substantially smaller than the average historical fire size when one or both of those regime groups predominate. In contrast, mixed-severity fires (such as in Fire Regime Group III) generally produce somewhat larger patch size variation, which might require assessment areas that are from one to two times larger than the average historical fire size. Areas that are dominated by the infrequent replacement-severity regimes (fire regime groups IV and V) can require FRCC Landscapes that are two to five (or more) times larger than the historical fire size. And finally, when a proposed assessment area contains a diverse mix of fire regime groups, rather than just one or two dominant types, the assessment area size should be scaled to the type that requires the largest size delineation. Below are some general guidelines for determining appropriate assessment area sizes. In addition, local expert opinion and area fire atlases might be useful for estimating historical fire size.

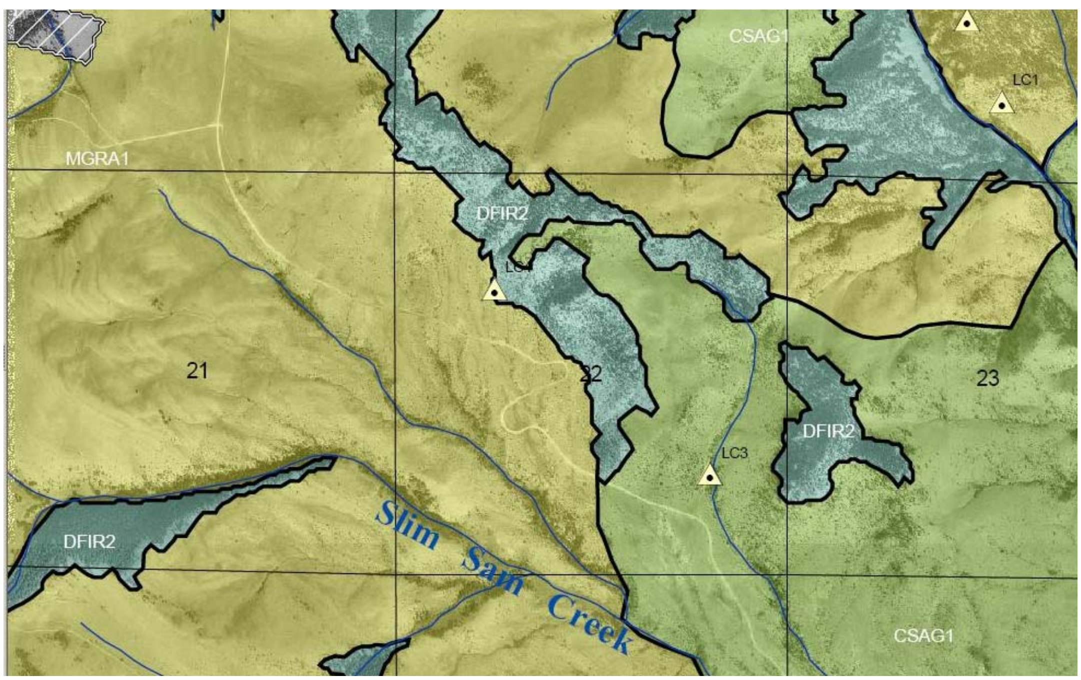
Table 2-2. Suggested minimum size ranges (in acres) for FRCC Landscape delineation.

Fire regime group	Assessment area size (acres)
I – 0-35 years, low / mixed	500 – 5,000
II – 0-35 years, replacement	500 – 10,000
III – 35-200 years, mixed / low	5,000 – 20,000
IV – 35-200 years, replacement	20,000 – 500,000
V – 200+ years, low / mixed	1,000 – 20,000
– 200+ years, replacement	200,000 – 500,000

Note: When a proposed analysis area consists of scattered small polygons (as sometimes occurs with fragmented ownership parcels, for example) two options exist for delineating the final assessment area boundaries. The preferred option is to expand the scope of the analysis beyond the ownership parcels to obtain an ecologically cohesive unit. After first characterizing FRCC for the larger landscape, users can then report stand-level results for any agency parcels within that area (see Chapter 3 for more information). Another option is to adjust the reference condition values to accommodate the artificially constrained analysis scale (see Appendix C for more information).

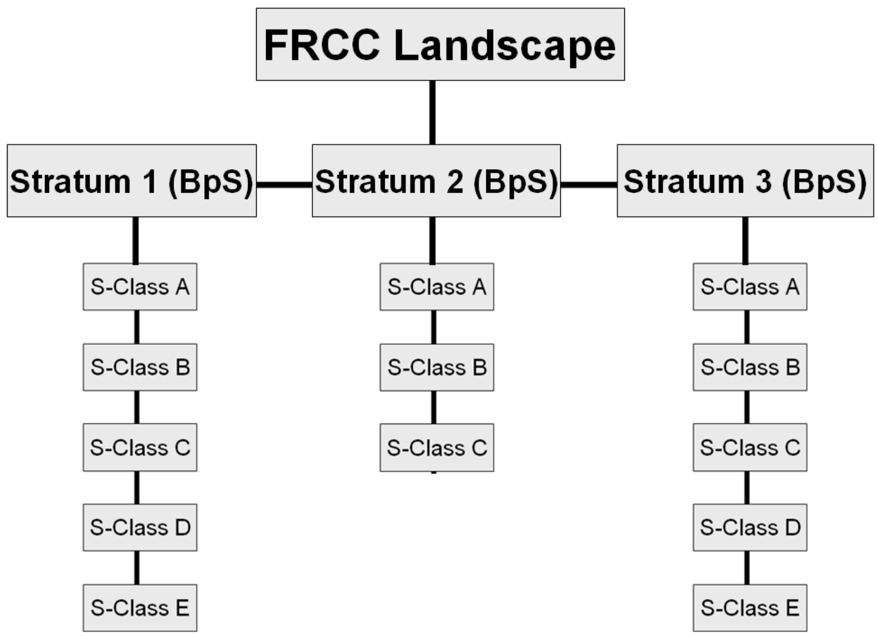
Standardized map unit classifications can be useful for delineating the final boundaries of proposed FRCC Landscapes. Doing so not only promotes consistency, but can also help users in a given region coordinate FRCC assessments for summarizing broad-scale outputs. For well dissected terrrain, such as in many areas of the western U.S., you might want to delineate your FRCC Landscapes according to watersheds or sub-basins (that is, according to hydrologic unit codes such as HUCs 10 and 12, respectively). In contrast, users in the eastern U.S. might find landtype associations (LTAs) to be more useful because the terrain often has substantially less relief. Whichever classification is used, remember to scale the assessment area boundaries according to the dominant fire regime groups, as discussed above. For instance, sub-watershed and watershed HUCs would likely be too small to exhibit the natural array of succession classes for BpS types that are dominated by infrequent replacement-severity regimes. In such cases, sub-basins might be more appropriate for analyzing the vegetative component of the FRCC algorithm.

Once the FRCC Landscape boundaries have been delineated, the area must be subdivided according to the dominant biophysical settings. Recall from the overview above that these subdivisions are referred to as *strata*. In general, the assessment area will contain multiple BpS strata, with the final number dependent upon how many major vegetation types occur in the area. Below is an example of a mapped stratification based on three BpS types: The tan-colored stratum is the Mountain Grassland (MGRA1) BpS; the green stratum is the Cool Sagebrush (CSAG1) BpS; and the blue stratum is the Interior Douglas Fir (DFIR2) BpS as defined by the original FRCC Guidebook models.



Stratifying the assessment area allows you to generate FRCC outputs for three scales: Landscape, Strata, and Stand, as detailed in Chapter 3. For example, a condition class diagnosis can be generated for the entire FRCC Landscape, which, although a course depiction, is nonetheless useful for comparing various FRCC Landscapes in a given region. The strata-scale outputs are potentially more useful for management planning; specifically, for monitoring FRCC trends for one or more BpS types. And finally, stand-scale FRCC outputs can be obtained by comparing the amount of each BpS succession class (or stand) to modeled reference amounts. Stand FRCC outputs allow users to track stand-scale FRCC trends and are useful for pre- and post-treatment reporting and monitoring, and for so-called "futuring" exercises that test the efficacy of various treatment alternatives.

In summary, the following graphic illustrates the hierarchical relationship between the various FRCC stratification units. In this hypothetical example, note that Stratum numbers 1 and 3 contain five S-Classes, whereas Stratum 2 contains just three:



FRCC reporting units

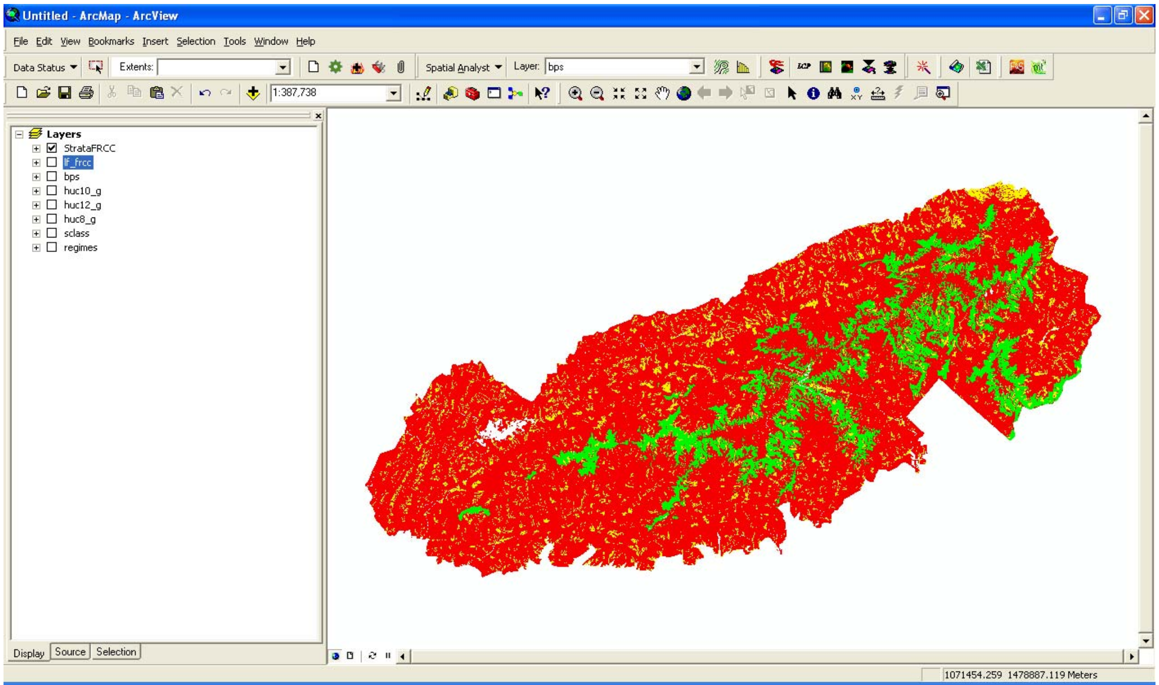
In addition to the stratification process described above, prospective users should also be aware that GIS-based FRCC assessments use *reporting units* (also known as *summary units*) because such assessment areas typically are much larger than those analyzed with the non-spatial Standard Landscape Worksheet Method. Because GIS assessments based on the Standard Landscape Mapping Method using the FRCC Mapping Tool commonly exceed a million acres each, the resultant voluminous data must be analyzed according to individual map units such as HUCs – any one of which might be equivalent to one FRCC Landscape when using the non-spatial Standard Landscape Worksheet Method.

(For more information on GIS assessments, please see Chapter 4 for an overview of the FRCC Mapping Tool software.)

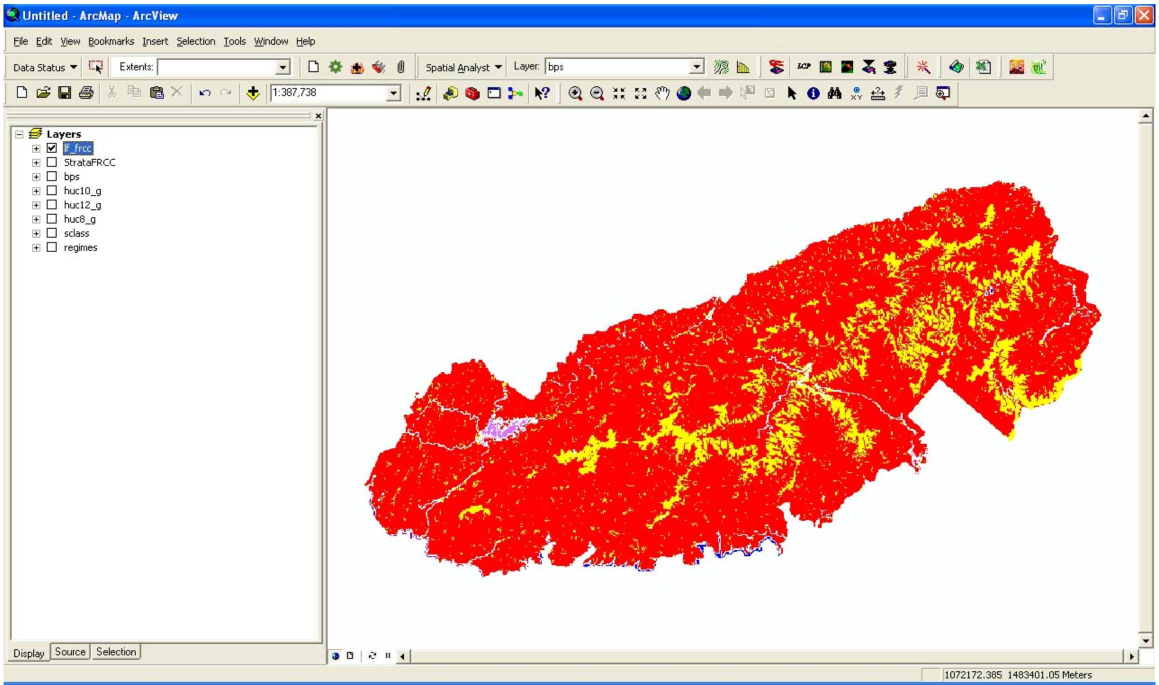
FRCC analysis scales

Analysis scales are likewise important in the FRCC system. For instance, reference condition models and FRCC assessments both use mean fire intervals (MFI) from representative stands (that is, "cluster scale" data [Arno and Peterson 1983]) to characterize landscape-scale fire frequency for each BpS. Initially, this might seem counterintuitive because a main goal of the FRCC modeling and assessment process is to first characterize *landscape* fire regimes and associated vegetation conditions before characterizing at the stand scale. However, representative stand metrics such as mean MFI from multiple sample sites (Brown and others 1994; Barrett and others 1997) are useful for characterizing fire frequency at multiple scales. For example, stand MFIs can be used to determine a fire cycle metric (Heinselman 1973; Heinselman 1981; Brown and Smith 2000) for any given BpS, regardless of landscape size (Barrett and others 1997; Morgan and others 1998). In essence, the stand MFI metric serves as a lowest common denominator for characterizing fire frequency at multiple scales, which is useful for FRCC purposes because assessment landscapes can vary widely in size.

Another key concept to be aware of is the potential effects that different analysis scales can have on FRCC outcomes. To understand how FRCC is a scale-dependant metric, consider the following two sets of GIS outputs for the half-million acre Great Smoky Mountains National Park in the southeastern U.S. The first set of results was derived from the FRCC Mapping Tool when vegetation composition was summarized according to the area's hydrological units as described above. In this case, condition classes 1 through 3 occupy an estimated 13, 9, and 78 percent of the park, respectively (green, yellow, and red polygons, respectively).



The second set of FRCC results below was derived from the LANDFIRE National mapping project, which summarized vegetation composition at much broader scales (data processing limitations and other logistical issues forced LANDFIRE personnel to summarize composition across entire LANDFIRE mapping zones, which often span tens of millions of acres each.) These FRCC results are substantially different when "clipped" to the park boundary, with condition classes 1 through 3 occupying 0, 22, and 77 percent, respectively. As for why these results differ from the above, vegetative conditions across the whole of LANDFIRE mapping zone 57 apparently are somewhat worse than within the park itself.



(**Note**: For more information about the LANDFIRE Project, analysis scales, and related issues, see Chapter 4 and appendices D and E).

FRCC scale issues summary

- The scale parameters for a given FRCC Landscape must always be quantified in order to facilitate documentation and communication between users.
- For FRCC purposes, an assessment landscape is defined as a contiguous area that is large enough to exhibit the natural variation of fire regimes and associated vegetation.
- Ecologically-based criteria (for example, using dominant fire regimes) are useful for determining appropriate FRCC Landscape sizes.
- The FRCC Landscape delineation process is important because FRCC is a scale-dependant metric; inaccurate outputs can thus lead to planning errors or make it difficult to discern changes after small- to mid-scale disturbances.
- Standard map classifications, such as hydrologic units, can be useful for delineating the final boundaries of FRCC Landscapes.
- Each FRCC Landscape is subdivided into *strata*, which has a distinct fire regime and structure; most FRCC assessments use an area's *biophysical setting* (BpS) to define the respective strata.
- The smallest level of FRCC outputs occurs at the succession class, or stand, scale of analysis; such data are useful for measuring, monitoring, and tracking FRCC trends before and after relatively localized land treatments.
- Reporting (or Summary) Units are useful for summarizing the typically large amounts of data produced by GIS-based FRCC assessments.

- Stand fire frequency and severity data are used for modeling and assessing FRCC because such data represent a lowest common denominator for calculating fire cycles at multiple scales.
- Because FRCC is a scale-dependent metric, different analysis scales can be expected to produce different FRCC outcomes.

FRCC science background

Research conducted by U.S. Forest Service Rocky Mountain Research Station personnel, by private contractors, and by the National Interagency Fuels, Fire, & Vegetation Technology Transfer (NIFTT) has provided much insight into the scientific foundation of FRCC. For example, ground-truthing of BpS model accuracy in the central Great Basin (Heyerdahl and others 2007; Swetnam 2006; Swetnam and Brown 2010) revealed that, while some FRCC Guidebook and LANDFIRE models were relatively accurate in terms of fire regimes traits and succession class composition, other models (particularly those biophysical settings with infrequent, mixed-severity and replacement fire regimes) occasionally contained substantial inaccuracies due either to high natural variation or a lack of empirical data. Research conducted in central Montana examining the spatial and compositional accuracy of LANDFIRE National models (P. M. Brown, personal communication) likewise found substantial variation during ground surveys. Similarly, four FRCC case studies conducted by LANDFIRE personnel revealed that both the biophysical setting inputs and the succession class inputs, particularly for rangeland vegetation, could be improved with additional plot data and imagery reinterpretation (for more information, read the FRCC Documentation in the Documents section of www.landfire.gov).

GIS accuracy problems also were initially encountered but were later largely resolved by Provencher and others (2008). The researchers conducted an FRCC Mapping Tool assessment for the 45,000-acre Mt. Grant area in western Nevada, which is dominated by xeric non-forest and forest vegetation. Here, initial satellite imagery-based inputs often had to be edited to improve accuracy before processing with the FRCC Mapping Tool. Another study in the Great Basin region (Menakis and others 2003) found that initial attempts to create coarse-scale FRCC GIS maps were hampered by a lack of accurate input data. However, subsequent mapping was aided by very high resolution data that allowed the researchers to map cheatgrass (*Bromus tectorum*) dominated areas and hence improve the FRCC outputs.

> ***Note***: In view of the limitations that are often posed by imagery-based data (Schmidt and others 2002; Menakis and others 2003; Menakis and others 2004; Rollins and others 2004; Provencher and others 2008; Blankenship and others 2009; Provencher and others 2009), prospective users of the GIS-based FRCC Mapping Tool should plan to validate both their input and output data through ground surveys, additional locally derived data (such as from stand exams), and local expert knowledge whenever possible. Note, however, that relatively small inaccuracies are usually acceptable because the FRCC algorithm provides for

substantial variation in the departure formula and in the resultant coarse condition class assignments.

NIFTT has also conducted many unpublished sensitivity tests. For example, FRCC Mapping Tool assessments have been conducted for numerous representative landscapes across the U.S. That is, the mapping tool was used to test the use of different Stand FRCC thresholds (as described below), to research the implications of using different analysis scales and for other in-house development purposes.

Although published research has provided relatively few recommendations for changing and improving the FRCC methodology from its initial concept and design, research to date has produced the following recommendations for FRCC assessments and subsequent management planning based on FRCC results: 1) users should carefully evaluate the available BpS models to identify which set is the most applicable for a given FRCC assessment, 2) prospective users of LANDFIRE data for GIS-based assessments should carefully evaluate BpS and succession class inputs for potential applicability and overall accuracy, and 3) users should stay abreast of the latest research on BpS model accuracy and the accuracy of associated spatial inputs for calibration and integration of new findings with new or previous FRCC assessments (Miller 2008).

FRCC science background summary

- GIS-based FRCC assessments and related ground surveys have shown mixed results in terms of the accuracy of LANDFIRE BpS and succession class data layers.
- Before using FRCC outputs for planning purposes, users should conduct validation checks based on ground surveys and local expert opinion to assess the accuracy of inputs and outputs.
- Published research to date has provided relatively few recommendations for changing and improving the FRCC methodology from its initial concept and design.

Version 3.0 FRCC methodology changes

Stratum FRCC algorithm

FRCC Guidebook version 3.0 contains two important FRCC methodology changes that differ substantially from the methods described in FRCC Guidebook v. 1.3 and earlier versions. These new methods are only briefly described here, since Chapter 3 provides detailed instructions on all FRCC methodology. The first algorithm change relates to how Stratum FRCC is determined. Whereas the previous method used the worst-case departure between the stratum vegetation and fire regime variables, Stratum FRCC is now determined by *averaging* the two departures. (The new method also subsequently affects the landscape-scale outcome because the Landscape FRCC metric is based on the area-weighted strata departures.) Sensitivity testing conducted by NIFFT suggested that averaging the two departures would produce a more comprehensive measure of ecological status. That is, rather than allowing the vegetation or fire regimes variables to dominate in the FRCC algorithm, equal weight is now given to both sets of those key inputs. Similarly, note that FRCC Mapping Tool version 3.0 has the ability to evaluate both vegetation and fire regime departures for each BpS stratum, unlike earlier software versions that could measure only the vegetative component (see Chapter 4 for more information).

Stand FRCC algorithm

The second methodology change relates to the stand-scale FRCC algorithm. User feedback based on results from previous assessments had indicated that the algorithm was likely biased toward outputting excessive amounts of condition classes 1 and 3, at the expense of FRCC 2. Subsequent FRCC Mapping Tool tests of numerous landscapes of varying sizes across the U.S. verified that indeed a systematic bias existed when condition class thresholds of 33 and 66 percent were used in the algorithm. However, after testing various sets of threshold pairs, thresholds of 5 and 80 percent were found to yield Stand FRCC amounts that were closely similar to those in the associated Strata FRCC layers. Therefore, FRCC Guidebook version 3.0 uses the 5 and 80 percent values as new thresholds for the Stand FRCC algorithm.

> ***Note***: Be aware that outputs from previous assessments based on earlier Guidebook versions might differ substantially from those generated by the new version 3.0 methods described above. Consequently, users have two options for re-assessing previously analyzed FRCC Landscapes: 1) use the version 3.0 methods and tools to analyze both the original and subsequently updated input data (recommended) or 2) if necessary, continue using the old FRCC methods and tools to conduct the re-assessment.

Version 3.0 methodology changes summary

- FRCC Guidebook version 3.0 uses new algorithms for calculating strata and stand FRCC, based on extensive sensitivity testing.
- For the stratum-scale algorithm, the vegetation and fire regime departures are averaged to diagnose Stratum FRCC (rather than the previous method of using the worst-case departure).
- For the stand-scale algorithm, condition class departure thresholds of 5 and 80 percent are used to diagnose Stand FRCC (rather than the previous method of using 33 and 66 percent threshold values).
- Users who have already conducted assessments with previous FRCC Guidebook methods should be aware that the Version 3.0 methodology would likely produce substantially different outputs.

Chapter 3:
FRCC Standard Landscape Worksheet Method

This chapter provides step-by-step instructions for diagnosing Landscape, Stratum, and Stand FRCC metrics using the non-spatial Standard Landscape Worksheet Method. As mentioned, the user can choose between various options for assessing FRCC. The Standard Landscape Worksheet Method can be conducted by 1) completing the full worksheet in the field and performing manual calculations, 2) completing the worksheet in the field and then later using the FRCC Software Application (FRCCSA) to automatically compute values, or 3) using the Standard Landscape Field Form (which is a short-hand version of the Standard Landscape Worksheet) in the field for later data entry into the full worksheet or into FRCCSA. Alternatively, the FRCC Mapping Tool (FRCCMT) can be used for conducting GIS-based spatial assessments (see Chapter 4). Note that the FRCC website (www.frcc.gov) provides all data entry worksheets, forms, and computer software, in addition to training information, a helpdesk contact, and other FRCC-related resources.

> ***Note***: Whichever method you employ, it is important that you still read this Chapter 3 on the Standard Landscape Worksheet Method for a foundational understanding of the various data fields.

> ***Note***: The total number of data fields has been reduced from 104 in previous FRCC Guidebook versions to 75 fields in this FRCC Guidebook version 3.0. In

addition, some data fields have been renamed, and several new fields have been created. Therefore, be sure to use only the updated data forms in Appendix A rather than any older versions you may have on file. In addition, Appendix B contains two tables that show the new versus old field names and numbers and all discontinued field names.

Note: Data field names that appear in bold on the Worksheet and Field Form (see Appendix A) signify *required* data.

Landscape Data (fields 1- 15)

Fields 1 to 15 are used for documenting landscape-scale characteristics, whereas subsequent data fields describe strata-scale traits.

Registration Code (field 1) – Required – Enter up to a 12-character code to represent your agency affiliation (alphanumeric format is acceptable).

Note: Your registration code can be any unique identifier that is meaningful to you. For example, you might want to use your National Wildfire Coordination Group unit identifier (see www.nwcg.gov for more information). Or you can create your own custom code, such as "BMDI" for the BLM Battle Mountain District. In any event, we encourage the use of only one Registration Code per management unit, followed by unique Landscape Codes (field 2, below) for each assessment area.

Landscape Code (field 2) – Required – Enter a unique code to identify the FRCC Landscape, for example:

TCRESTOR = Tenderfoot Creek Restoration
BurntFk = Burnt Fork Project
SCPF1 = Swan Creek Prescribed Fire, Unit 1
BoxCkDem = Box Creek Demonstration Project

For efficiency, you may want to use the same code you would use for the National Fire Plan Operations and Reporting System (NFPORS) or similar databases.

Characterization Date (field 3) – Required – Enter the date of examination or data entry to help distinguish this assessment from previous or subsequent ones. Enter as an 8-digit date in the MM/DD/YYYY format. For example, April 10, 2011 would be entered 04/10/2011.

Note: For subsequent re-assessments, such as after management treatments or wildfires, you should use the same Landscape Code but change the Characterization Date. Whereas data for any strata that have *not* changed can simply be copied from the previous assessment, data for any altered strata must be entered anew.

Examiner Code (field 4) – Required – This is the user's email address (or other custom identifier if no email address is available).

Landscape Name (field 5) – Required – Enter a name for the FRCC Landscape. For example, use the name of a major drainage or other prominent geographic feature. Or, you might want to use a name already designated for NFPORS or similar databases.

Landscape Area (field 6) – Required – Enter the size of the assessment area in this field and then specify the measurement unit (in acres or hectares) in field 7 below.

Acres/Hectares (field 7) – Required – Circle the applicable measurement unit on the form or select from the software drop-down menu.

Recording a georeferenced Landscape position (fields 8 to 10)

The following fields provide georeferencing for your FRCC Landscape. These required fields are important for activities such as conducting repeat photography, locating the area in a geographic information system, and for cross referencing with other databases such as NFPORS.

We recommend using a global positioning system (GPS) receiver to record latitude and longitude (fields 8-9) in decimal degrees, rather than using degrees, minutes, and seconds. When possible, select a central position with a panoramic view that might be useful for photographic documentation (field 11).

> ***Note***: If you do not have a GPS receiver, you can estimate latitude and longitude using a USGS 1:24,000 topographic map.

Latitude (field 8) – Required – Enter the applicable latitude in decimal degrees to the sixth decimal place (for example, 45.951234).

Longitude (field 9) – Required – Enter the applicable longitude in decimal degrees to the sixth decimal place (for example, 95.951234).

Datum (field 10) – Required – Enter / select the datum, which is listed in your GPS receiver (or contact your local GIS coordinator to see which datum is preferred). If you are not using GPS coordinates, leave this field blank.

Alternatively, you may want to enter the same georeferenced position used in NFPORS or another database (typically a central location within a treatment area).

Documenting the Landscape with current vs. historical photos (fields 11 to 14)

Digital photographs and scans are useful because they help document vegetation patterns and other traits for a given FRCC Landscape. You can use landscape-view or aerial photographs to document current conditions, and reference conditions sometimes can be documented with early-day photographs taken in the same area or in similar landscapes. Repeat photography is also useful for comparing landscape changes after management treatments or other disturbances. Photos serve as excellent communication tools for describing FRCC assessments to other professionals and to the general public.

Current Photo (field 11) – Not Required **–** Enter a name and location for the photo (a pathway on your computer or other location indicating where the photo is stored).

Current Photo Date (field 12) – Not Required **–** Enter the date the current photo was taken as an 8-digit date in the MM/DD/YYYY format.

Reference Condition Photo (field 13) – Not Required **–** Enter a name and location for the photo (a pathway on your computer or other location indicating where the photo is stored).

Reference Condition Photo Date (field 14) – Not Required **–** Enter the date the reference condition photo was taken as an 8-digit date in the MM/DD/YYYY format.

Comments (field 15) – Not Required **–** Briefly enter any relevant comments about the FRCC Landscape that might be helpful to managers and future assessors. For example, you can document general information about ecological conditions, dates of wildland fire or prescribed fire use, historical information, and other ancillary data.

Strata Data: General Information, Biophysical Settings, Reference and Current Fire Regimes (fields 16- 46)

As discussed in chapters 1 and 2, the assessment area typically is stratified according to major BpS types. Delineate as many strata as necessary, keeping in mind that the combined strata must total 100 percent of the FRCC Landscape. In general, we suggest designating strata that comprise 20 percent or more of the Landscape. However, you can also include any minor BpS types that have important management implications.

Important – For multiple strata:

Worksheet: copy an ***additional*** Stratum Page (p. 2 of the FRCC Standard Landscape Worksheet) to complete the data fields for ***each*** of your strata.

> *Field Form:* use the additional Stratum Data sections provided to complete the data fields for ***each*** stratum.

Stratum Number (field 16) – Required –

Assign a number to each stratum on the stratum worksheets beginning with the number "1."

Identifying biophysical settings

Correctly identifying the applicable biophysical setting for each stratum (field 17 below) is imperative for obtaining an accurate FRCC assessment. Local vegetation summaries or GIS products, such as the LANDFIRE BpS layer, can assist your preliminary identification. A final determination of the applicable BpS can then be made by reading the associated BpS descriptions and by reviewing other data sources, such as reference condition photos, professional literature, diagnostic keys, and expert opinion.

We recommend using the LANDFIRE National biophysical settings models (called "Vegetation Dynamics Models" on www.landfire.gov) or the distilled set known as the Refresh models, which will be available in 2011, because both model sets represent the most advanced iterations of all the modeling conducted to date. To obtain the applicable BpS descriptions, visit the Biophysical Settings Resources section of www.frcc.gov. Once you have obtained the model description package, you can conduct a search for potentially applicable models. For example, to locate all ponderosa pine-dominated BpS types, type that species name in the respective search panes (or open the Windows search pane by typing *Ctrl F* on your keyboard).

> ***Note***: The Biophysical Settings Resources section of www.frcc.gov contains a helpful document titled "Using the LANDFIRE Biophysical Settings Model Descriptions."

Also available are the coarser-scale LANDFIRE Rapid Assessment (RA) models, which are applicable only to the conterminous U.S. In addition, the original FRCC Guidebook models can also be used. Although much less detailed than the subsequent LANDFIRE models, the FRCC Guidebook models are still useful for re-assessing any FRCC Landscapes that were previously stratified with those models.

> ***Note***: The default data from the above-mentioned models can be replaced with local data based on the following protocol. The assessor must document: 1) which suitable reason(s) from Appendix C justify such editing, 2) that the new reference condition data were derived from local data in combination with state-and-transition modeling with software such as the Vegetation Dynamics Development Tool (Beukema and others 2003a), and 3) the names and credentials of the modelers, along with the sources of supporting literature and other input data.

BpS Code (field 17) – Required – Enter the unique identifier for the BpS. Typically, this would be a numeric code or acronym originally assigned by the LANDFIRE or other modeling efforts. For example, LANDFIRE model code "110080" refers to the *Rocky Mountain Aspen Forest and Woodland* BpS. In contrast, the FRCC Guidebook models use descriptive acroynms, such as *DFIR2* (*Douglas-fir Interior Rocky Mountains* BpS).

Enter the applicable BpS code from the reference condition summary table or BpS description document. Or, enter your own custom-designed code for any locally generated BpS data.

Stratum Composition Percent (field 18) – Required – Estimate the percentage of the total FRCC Landscape that is occupied by the stratum. For example, enter "20" to represent 20 percent, not a decimal. (And note again that the sum of all strata must total 100 percent of the FRCC Landscape when you have finished entering all data.)

Documenting fire regimes data (fields 19-22)

Fields 19 through 22 represent the *central tendency* (means) of the reference condition and current fire frequencies and severities. Note that precise estimates are not necessary since the inputs are assumed to have plus or minus 33 percent variation for FRCC purposes. Remember that the reference condition fire frequencies and severities can be obtained directly from the BpS descriptions and summary tables. Or, enter your own estimates from any reference condition models that you and your colleagues have developed.

Stratum Reference Condition Fire Frequency (field 19) – Required – Enter a mean fire interval (MFI) estimate for the Reference Condition Fire Frequency. MFI is defined as the average number of years between fires in representative stands (that is, "cluster scale" data [Arno and Peterson 1983]). Also note that the term "representative" ideally refers to an average MFI (grand mean) from multiple sites sampled during field research and subsequently cited by BpS modelers.

Worksheet: Obtain the MFI from the models' reference condition summary tables, from regional literature, or from your own local estimates. For the latter approach, estimate a representative stand-level MFI as follows: Divide the number of years in the fire period (*not* the total tree age) by the number of fires minus one (N-1). For example, if six fires occurred between 1800 and 1860, the MFI formula would be:

$$(1860 – 1800) / (6 -1) = 12 \text{ MFI}$$

Finally, compute a grand mean by averaging the entire stand MFI data obtained for that BpS.

> ***Note***: Some of the LANDFIRE National biophysical settings, such as *Sonora-Mojave Mixed Salt Desert Scrub* and *Alaskan Pacific Maritime Western Hemlock Forest* are considered to be non-fire ecosystems (hereafter referred to as "non-fire strata" or "non-fire BpS"). Consequently no fire regimes information appears in those model descriptions. In such cases, you can simply enter "9999" for the reference fire frequency to serve as a quasi-infinity value.

Estimating current fire frequency (MFI) (field 20)

In field 20 below, you'll be asked to estimate a representative current fire frequency for each stratum by analyzing post-EuroAmerican settlement fire activity. Tally all spreading fires caused by lightning and humans (including prescribed fires) regardless of whether the severity pattern was natural. (Note that Current Fire Severity will be addressed in field 22). In other words, the goal is to analyze fires that substantially influenced the vegetation.

Whether to include comparatively small suppressed fires (such as size classes A through C) is up to your discretion. Small fires can certainly be important ecologically (Barrett and others 1991; Barrett 1994; Larson and others 2009), especially if such fires occurred in the natural fire regime or if the stratum is limited in extent. In general, you wouldn't include "Class A" fires, which are limited in extent.

Following are three possible methods for estimating Current Fire Frequency, the first using fire atlas records and the others using field examinations.

Below is a method for estimating Current Fire Frequency using **fire atlas records**. Be aware, however, that fire atlases are often incomplete and spatially inaccurate (Shapiro-Miller and others 2007). Consequently, try to assess the potential usefulness of your atlas records before attempting to derive estimates of current fire frequency for a given stratum.

> Step 1 - For the reference condition period, estimate the mean annual burned acres by dividing the BpS acreage by its associated fire frequency (MFI).
>
> *EXAMPLE*: A 10,000-acre stratum with a 10-year MFI yields an average of 1000 burned acres per year (10,000 / 10 = 1000).
>
> Step 2 - Estimate the mean annual burned acres for the current period by analyzing fire atlas records.
>
> *EXAMPLE:* Fire records indicate that fires have burned a total of 3,500 acres in the stratum since 1940. Therefore, modern-day fires have burned an average of 50 acres per year (3,500 acres / 70 years = 50).

Step 3 – Estimate Current Fire Frequency by comparing the results. The current period value computes to a twenty-fold reduction in natural fire occurrence (1000 reference period acres / 50 current period acres = 20). So, multiply the reference period MFI by a conversion factor of twenty to determine current fire frequency and then enter the result in field 20.

EXAMPLE: 10-year reference MFI x 20 = 200-year current MFI.

Next are two methods for estimating Current Fire Frequency (MFI) based on general field examinations (for *forest* biophysical settings only). Remember, the goal is to characterize representative fire frequency for the stratum by estimating how often a typical site has burned during the post-settlement era.

Method A: Examine fire-scarred stumps with known logging dates. If no stumps are available, you may have to sample some live trees (for examples, see Arno and Sneck 1977 and Barrett and Arno 1988). Estimate the stand MFI by dividing the number of years in the fire period by the number of fire intervals (total scars minus 1) (see Figure 3-1 below). Then compute a grand mean by averaging all stand MFI data obtained for that BpS.

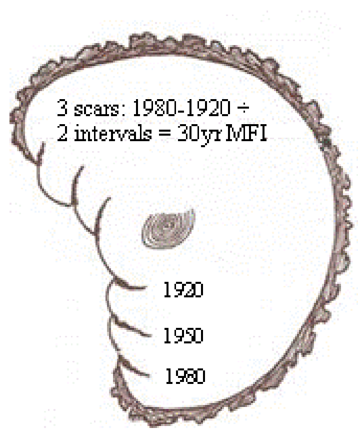


Figure 3-1. Estimating current fire frequency (MFI) from a stump with multiple fire scars (*after*: Barrett and Arno 1988).

Method B: (Alternative method) If it is not possible to estimate a representative MFI, use the number of years since the last fire to represent Current Fire Frequency (see Figure 3-2 below). For example, this value can be estimated by: 1) examining stumps with known logging dates, 2) using an increment borer to estimate the date of the last fire scar on live trees, or 3) estimating post-fire regeneration dates for even-aged stands (such as in lodgepole pine [*Pinus contorta*] forests). Then compute a grand mean by averaging all of the years-since-last-fire data obtained for that BpS.

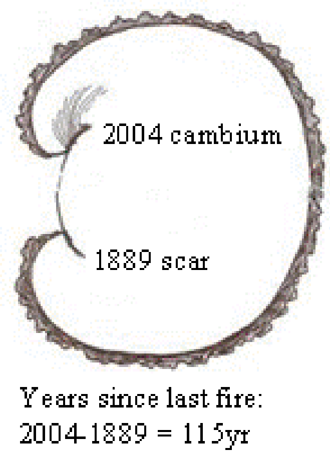


Figure 3-2. Estimating Current Fire Frequency using the number of years since the last fire (*after*: Barrett and Arno 1988).

Stratum Current Fire Frequency (field 20) – Required – Now enter your estimate for Current Fire Frequency (MFI). *Note*: If there is no evidence of fires occurring during the post-settlement era, we recommend entering 100 years as a default value for any BpS types that experienced relatively frequent fires during the reference era (fire regime groups I, II, and the low to mid-range portion of Fire Regime III). For BpS types in regimes IV and V, simply re-enter the reference values if you believe that fire frequency has not changed. For any non-fire strata, simply re-enter a "9999" default value as mentioned above if modern fire frequency has not changed.

Stratum Reference Condition Fire Severity (field 21) – Required – This metric refers to the proportion of stand replacement (defined as 75 to 100 percent upper-layer lifeform replacement) during 90th percentile burning conditions. For example, if the stratum is comprised of scattered large conifers with a grass understory, estimate the proportion of replacement within the conifer component, not the grass layer. You can use the default derived from simulation modeling that appears in the reference condition summary table, or you can develop your own estimate after conducting similar modeling. Also note that this estimate refers only to vegetation that actually burned, not to any unburned areas within gross fire perimeters.

> ***Note***: For any non-fire strata, you might want to enter a relatively high severity default value like "99" even though the model descriptions often show zeroes (or blank data fields) for the non-fire BpS types. Using a proxy value such as "99" will help you avoid making diagnostic errors, because entering *any* value other than zero for current fire severity (field 22 below) would automatically produce an FRCC 3 outcome.

Stratum Current Fire Severity (field 22) – Required – Estimate current replacement potential based on modern fire records and/or local expert opinion. Enter the percentage as an integer, not a decimal. If your analysis suggests more than a 10 percent departure from the reference severity, you may select a midpoint value from the following list. Again, base your evaluation on only the burned vegetation (or vegetation expected to burn during future fires) while excluding any unburned areas within gross fire perimeters.

0-5 percent (upper canopy layer replacement)	central tendency = **3** percent
6-15 percent (upper canopy layer replacement)	central tendency = **10** percent
16-25 percent (upper canopy layer replacement)	central tendency = **20** percent
26-55 percent (upper canopy layer replacement)	central tendency = **40** percent
56-85 percent (upper canopy layer replacement)	central tendency = **70** percent
86-100 percent (upper canopy layer replacement)	central tendency = **90** percent

> ***Note*:** If your analysis suggests that fire severity potential hasn't changed during the current period, simply re-enter the reference value. For example, fire severity potential likely has not changed substantially in most stand replacement types (regimes II, IV, and V) since the reference period. Similarly, for any non-fire strata, you might want to use a relatively high severity default such as "99" as described in field 21 above, unless current fire severity potential has changed during the modern era.

The next portion of the worksheet (fields 23-46) is used for entering ancillary data. Although these data are not required, we recommend recording as much of this information as possible to help describe and document the stratum.

Stratum BpS Lifeform (field 23) – Not Required **–** This field represents the dominant lifeform associated with the BpS. You can determine this information from BpS Descriptions or from field reconnaissance.

Enter the 2-character code from table 3-1 below for the dominant lifeform.

Table 3-1. BpS lifeform codes.

Code	BpS lifeform
AQ	Aquatic – lake, pond, bog, river
NV	Non-vegetated – bare soil, rock, dunes, scree, talus
CF	Coniferous upland forest – pine, spruce, hemlock
CW	Coniferous wetland or riparian forest – spruce, larch
BF	Broadleaf upland forest – oak, beech, birch
BW	Broadleaf wetland or riparian forest – tupelo, cypress
SA	Shrub-dominated alpine – willow
SU	Shrub-dominated upland – sagebrush, bitterbrush
SW	Shrub-dominated wetland or riparian – willow
HA	Herbaceous-dominated alpine – dry
HU	Herbaceous-dominated upland – grasslands, bunchgrass
HW	Herbaceous-dominated wetland or riparian – ferns
ML	Moss- or lichen-dominated upland or wetland
WD	Woodland
OT	Other BpS vegetation lifeform

Stratum BpS indicator species (fields 24 to 26) – Not Required – Use these three data fields to document the dominant vegetation during the reference (historical) period. Base your estimates on only the reference conditions, since modern influences such as fire exclusion and logging have reduced or eliminated many species. For guidance, please see the BpS description documents.

Enter up to three species, using the applicable NRCS species codes (at www.frcc.gov under *Other FRCC Resources*).

Stratum Landform (field 27) – Not Required **–** Enter a coarse-scale Landform Code from table 3-2 below.

Table 3-2. Landform codes.

Code	Landform
GMF	Glaciated mountains-foothills
NMF	Non-glaciated mountains-foothills
BRK	Breaklands, river breaks, badlands
PLA	Plains, rolling plains, plains with breaks
VAL	Valleys, swales, draws
HIL	Hills, low ridges, benches

Stratum Average Slope Class (field 28) – Not Required **–** Enter a Slope Class from table 3-3 below.

Table 3-3. Slope percent class codes.

Code	Slope percent
GENTL	0-10
MOD	11-30
STEEP	31-50
VSTEEP	> 50

Stratum Insolation Class (field 29) – Not Required **–** Insolation refers to the relative amount of solar exposure, typically related to slope aspect and airflow influences. Enter an Insolation Class from table 3-4 below.

Table 3-4. Insolation class codes.

Code	Insolation
LOW	NW, N, NE, E aspect or flat if cold air drainage
MOD	Flat (≤ 10 percent slope)
HIGH	W, SW, S, SE aspect or warm air upflow from adjacent valley

Stratum Low Elevation (field 30) – Not Required **–** Enter an elevation value in feet or meters to represent the lower limits of the stratum in your assessment area (note that field 32 documents the measurement units.)

Stratum High Elevation (field 31) – Not Required **–** Enter an elevation value in feet or meters to represent the upper limits of the stratum.

Stratum Elevation Units (field 32) – Not Required **–** Circle either feet or meters as the elevation measurement unit for fields 30 and 31 above.

Recording a georeferenced position (fields 33-37)

The next set of data fields provide georeferencing for the stratum. Although not required, such data are highly recommended because they can be important for conducting repeat photography, for locating the stratum in a geographic information system, and for satisfying NFPORS and FACTS database requirements.

If possible, use a global positioning system (GPS) receiver to record latitude and longitude in decimal degrees (rather than recording degrees, minutes, and seconds). Select a central point in the stratum or a location that provides a good visual overview of the stratum. If you do not have a GPS receiver, you can estimate latitude and longitude using a USGS 1:24,000 quadrangle map. Or, if you cannot estimate the latitude and longitude, enter "0" into the fields and enter a legal location description in the comments (field 46).

Stratum Latitude (field 33) – Not Required **–** Enter the latitude of the stratum centroid in decimal degrees to the sixth decimal place (for example, 45.951234).

Stratum Longitude (field 34) – Not Required **–** Enter the longitude of the stratum centroid in decimal degrees to the sixth decimal place (for example, 95.951234).

Datum (field 35) – Not Required **–** Enter the datum (such as WGS84) which is a model that represents map coordinates on the Earth's surface. If you do not know which model to specify, contact your local GIS coordinator to see which datum is preferred. (Please leave the field blank if you are not using GPS coordinates.)

Current Stratum Photo (field 36) – Not Required **–** Enter a name and location for the photo, such as a pathway on your computer or other location indicating where the photo will be filed for future reference and retrieval.

Current Stratum Photo Date (field 37) – Not Required **–** Enter the date the stratum photo was taken as an 8-digit date in the MM/DD/YYYY format.

Stratum Reference Condition S-Class Percent Composition Source (field 38) – Not Required **–** Enter a code from table 3-5 to represent the source from which you acquired the reference succession class data. (The S-Class data will be entered later in field 48). Note that the sources below are ordered from least to most rigorous in terms of presumed validity:

Table 3-5. Reference condition S-Class composition source codes.

Code	Source
N	Non-local expert estimate
D	Reference conditions determined through literature review and modeling workshops
R	Regional / state default values from literature review and modeling workshops
L	Local expert estimate
T	Interdisciplinary team (IDT) consensus with local expert
M	Local expert estimate with literature review and modeling
B	IDT consensus from literature review and modeling workshops with local expert
F	Published local study with literature review and modeling workshops

Stratum Current S-Class Percent Composition Source (field 39) – Not Required **–**

Enter a code from table 3-6 to represent the source from which you acquired the current succession class data. (Note that the latter will be entered later, in field 49). Again, the sources below are ordered from least to most rigorous in terms of presumed validity:

Table 3-6. Current S-Class composition source codes.

Code	Source
V	Visual estimate
R	Visual estimate and field survey
M	Mapped source

Stratum Uncharacteristic S-Classes (fields 40 to 45) – Not Required **–** The next six data fields can be used for documenting up to three Uncharacteristic scenarios in the stratum. (An estimate of the percent of the stratum affected by *all* Uncharacteristic classes combined is entered in field 49, when applicable.) First, use fields 40, 42, and 44 to enter the applicable codes from the following table 3-7. Next, use Comment fields 41, 43, and 45 to enter any additional descriptive information for each Uncharacteristic class. (*Note*: When more than one U class exists in the stratum, please include in the comments your estimate of the proportion of each subclass expressed as a percent of the total area occupied by all U classes).

Table 3-7. Uncharacteristic S-Class codes.

Code	Uncharacteristic S-Classes
UNIP	Invasive plants
UTHV	Timber management not mimicking natural regime
UGRZ	Grazing management not mimicking natural regime
UFUS	Unnatural fuels accumulation and succession
UFEF	Uncharacteristic fire effects
USHD	Unnatural soil disturbance
UIDS	Insects / disease: exotic or unnaturally severe
UCLR	Cultural (for example, tree plantations)
UPAT	Unnatural stand patches or landscape patterns
UOTH	Other (describe in fields 41, 43, 45)

Stratum Comments (field 46) – Not Required **–** Use this field to record any other descriptive information about the stratum. For example, you might want to record any management issues relating to the stratum. (To save space in this data field, please economize with abbreviations as necessary).

Stratum Succession Class Composition Data (fields 47- 57)

For fields 47 through 57, you'll be asked to evaluate the structure and composition of each succession class (S-Class) in the BpS stratum. As a reminder, the characteristic succession classes in the standard 5-box model are:

S-Class A: early-seral, post-replacement
S-Class B: mid-seral, closed canopy
S-Class C: mid-seral, open canopy
S-Class D: late-seral, open canopy
S-Class E: late-seral, closed canopy

Table 3-8 below provides additional information about the five standard S-Classes. Be aware, however, that not all BpS models conform to the standard 5-box scenario. Grassland models, for example, often use only two or three S-Classes, and their ecological traits might differ from those described here. So, always read the BpS description documents carefully to determine how each class was defined by the modelers.

Reminder:
You will need to complete one Stratum data page for *each* stratum in your assessment landscape. That is, you will complete multiple copies of page 2 of the Standard Landscape Worksheet before summarizing the data for the entire landscape on page one (see Appendix A for additional forms). Field Form users: use the additional strata sections provided (again, see Appendix A).

Table 3-8. S-Class codes and descriptions for the 5-box model.

S-Class code & description	Process	Forest & woodland	Shrubland & grass
A: Early-seral, post-replacement	Post-replacement disturbance; young age	Single layer; fire response shrub, graminoids, and forbs; typically < 10% tree canopy cover; standing dead and down	Fire response forbs; resprouting shrubs; resprouting graminoids
B: Mid-seral, closed canopy	Mid-succession; mid-age; competition stress	One to two upper layer size classes; > 35% canopy cover (crown closure estimate); standing dead & down; litter/duff	Upper layer shrubs or grasses; < 15% canopy cover (line intercept)
C: Mid-seral, open canopy	Mid-succession; mid-age; disturbance-maintained	One size class in upper layer; < 35% canopy cover; fire-adapted understory; scattered standing dead and down	Upper layer shrubs or grasses; > 15% canopy cover shrubs
D: Late-seral, closed canopy	Late-succession; mature age; disturbance-maintained	Single upper canopy tree layer; one to three size classes in upper layer; < 35% canopy cover; fire-adapted understory; scattered standing dead and down	Upper layer shrubs or grasses; < 15% canopy cover
E: Characteristic; Late-seral, closed canopy	Late-succession; mature age; competition stress	Multiple upper canopy tree layers; multiple size classes; > 35% canopy cover; shade-tolerant understory; litter/duff; standing dead and down	Upper layer shrubs or grasses; > 15% canopy cover shrubs

S-Class Code (field 47) – Required – First, determine which of the five succession classes exist in the stratum. (For convenience, you might want to circle those S-Class labels in the data column; for fields 48-57, simply leave blank any S-Classes that do not occur in the stratum).

If any *uncharacteristic* S-Classes exist, circle the "U" code in this column (and remember to enter in fields 40-45 the applicable 4-character code(s) from table 3-7 as well as any descriptive comments).

S-Class Reference Percent Composition (field 48) – Required – Enter the reference condition composition percentage (mean) using a whole integer for each S-Class in the stratum. (*Reminder*: The value for *uncharacteristic* S-classes is always "0" because such classes did not occur in natural ecosystems.) Enter values from the reference condition summary tables or from your own estimates. Remember that the sum of the entries for all S-Classes must total 100 percent.

S-Class Current Percent Composition (field 49) – Required – Enter your estimate (central tendency, whole integers) of the current composition percentage for each S-Class in the stratum, including any uncharacteristic classes. You can derive the estimates from sources such as aerial photographs, maps, or extensive field examinations. Again, the sum of the entries for all S-Classes must total 100 percent. Also note that, if a given S-Class that was present during the reference era no longer exists, enter a zero for the integer.

> ***Note***: In rare cases, you might find that a current S-Class comprises 100 percent of a given stratum, yet the model description suggests that multiple succession classes occurred during the reference period. Such situations usually arise from a scale issue, wherein the assessment area is either too small or a recent large disturbance encompassed the whole stratum. If one of the above situations applies, you should increase the size of the assessment area, or adjust the reference condition data in field 48 to account for such scale-induced "errors" (see Appendix C: Suitable Reasons for Replacing Default Reference Condition Values with Local Values.
>
> In addition, be aware of the potentially important affect that *uncharacteristic* S-Classes can have on FRCC outcomes. Given the negative impacts that have resulted from many modern land use activities, S-Class U should be assigned whenever the structure, species, or function of a current seral stage does not resemble that of the associated reference S-Class. And when more than one S-Class U exists in a given stratum (see fields 40-45 and the FRCC Code Sheet), your estimate should reflect the percent of the stratum affected by *all* uncharacteristic scenarios combined.

Ancillary Descriptive Data (fields 50-57)

Although fields 50 through 57 represent ancillary data (not required), they are still useful for fully documenting each stratum. (Note that consulting the S-Class portion of the associated BpS description document might be helpful here.)

S-Class Upper Layer Lifeform (field 50) – Not Required (for each S-Class in the BpS) **–** Work sequentially through table 3-9 below until you find the criteria that match the stratum's upper layer lifeform, then enter the applicable 4-character code for each S-Class.

Table 3-9. Upper layer lifeform codes.

Code	Lifeform	Upper layer determination criteria
CONT	Coniferous trees	≥ 10 percent canopy cover
BRDT	Broadleaf trees	≥ 10 percent canopy cover
SHRB	Shrubs	≥ 5 percent line intercept cover or ≥10 percent canopy cover
HERB	Herbaceous (graminoids, forbs, and ferns)	≥ 15 percent ground cover
MOSS	Moss or lichens	≥ 5 percent ground cover
NVEG	Non-vegetated	< 5 percent any vegetation cover
NNNN	Does not fit any category	

S-Class Upper Layer Size Class (field 51) – Not Required **–** From table 3-10 below, select the 4-character size class code for the stratum's dominant upper layer lifeform for each S-Class.

Table 3-10. Upper layer lifeform size class codes.

Size class code	Dimensions
Coniferous and Broadleaf Trees	
SEED	Seedling - Trees that are < 4.5 feet (1.37 meters) tall
SAPL	Sapling - Trees that are ≥ 4.5 feet (1.37 meters) tall and < 5.0 inches (13 cm) Diameter Breast Height (DBH)
POLE	Pole - Trees that are ≥ 5 inches (13 cm) DBH and < 9 inches (23 cm) DBH
MEDM	Medium - Trees that are ≥ 9 inches (23 cm) DBH and < 21 inches (53 cm) DBH
LARG	Large - Trees that are ≥ 21 inches (53 cm) DBH and < 33 inches (83 cm) DBH
VLAR	Very large - Trees that are ≥ 33 inches (83 cm) DBH
Shrubs	
LOWS	Low - Shrubs that are ≤ 3 feet (1 meter) tall
MEDS	Medium - Shrubs that are > 3 feet (1 meter) tall and < 6.5 feet (2 meters) tall
TALS	Tall - Shrubs that are ≤ 6.5 feet (2 meters) tall
Herbaceous	
LOWH	Low - Herbaceous ≤ 2 feet (0.6 meters) tall
TALH	Tall - Herbaceous > 2 feet (0.6 meters) tall
Other	
MMLL	Moss, lichens, litter/duff
BARN	Barren, rock, gravel, soil
NNNN	Does not fit any category; unable to assess

S-Class dominant species (fields 52 to 55)

The next four fields are used for documenting the dominant species in each S-Class. Note that the dominant species might be the same as the BpS indicator species that you entered earlier (fields 24-26). (Again, you can consult the BpS description documents if you are unsure about which species apply).

For fields 66-69, enter from one to four dominant species in each S-Class. (For consistency, and to foster efficient communication, we recommend using the NRCS plant codes, available at www.frcc.gov under Other FRCC Resources).

S-Class Dominant Species 1 (field 52) – Not Required **–** Follow directions above for each S-Class in the BpS.

S-Class Dominant Species 2 (field 53) – Not Required **–** Follow directions above for each S-Class in the BpS.

S-Class Dominant Species 3 (field 54) **–** Not Required **–** Follow directions above for each S-Class in the BpS.

S-Class Dominant Species 4 (field 55) – Not Required **–** Follow directions above for each S-Class in the BpS.

S-Class Photo (field 56) – Not Required **–** Enter a name and location (for example, a pathway on your computer) for any representative photograph that you might have.

S-Class Photo Date (field 57) – Not Required **–** Enter an 8-digit long photo date (MM/DD/YYYY format).

Similarity, Departure, Relative amount, and FRCC Calculation Fields (fields 58- 72)

> ***Worksheet Note***: The remaining data fields are all required (and hence are not individually labeled as such in the instructions presented below). Also remember that one stratum page must have been completed for each stratum (page 2 of the Worksheet) before FRCC can be calculated for the entire assessment area (page 1 of the Worksheet).
>
> ***Field Form Note****:* At this point, you have entered all the necessary data for this stratum. Use the additional stratum data sections on the form for each additional stratum. When you have entered the data for all strata, use either the Standard Landscape Worksheet (pages 1 and 2) or enter the data into the software application to complete the calculations.

S-Class Similarity (field 58) – For each S-Class, this percentage represents the similarity between the current and reference amounts. Proceeding from left to right across the row, enter the lesser value of fields 48 and 49 for each S-Class. Again note that the default value is always zero for any Uncharacteristic S-Classes that may exist in the stratum.

Stratum Similarity (field 59) – Next, stratum similarity is calculated by summing the individual S-Class similarity values (field 58). Enter the sum of the field 58 values.

S-Class Percent Difference (field 60) – This percentage represents the difference between the current and reference amounts of each S-Class in the stratum.

Use one of the following equations, whichever applies:

If (field 49 < field 48), difference = ([field 49 – field 48] / field 48) * 100

If (field 49 ≥ field 48), difference = ([field 49 – field 48] / field 49) * 100

S-Class Relative Amount (field 61) – This classifies the current amount of each S-Class relative to its estimated reference amount. Please refer to Figure 3-3 below to determine the applicable Relative Amount classes. For each S-Class, enter the applicable letter code from table 3-11 below. That is, compare the value from field 60 with the graph in Figure 3-3 to determine the Relative Amount Class.

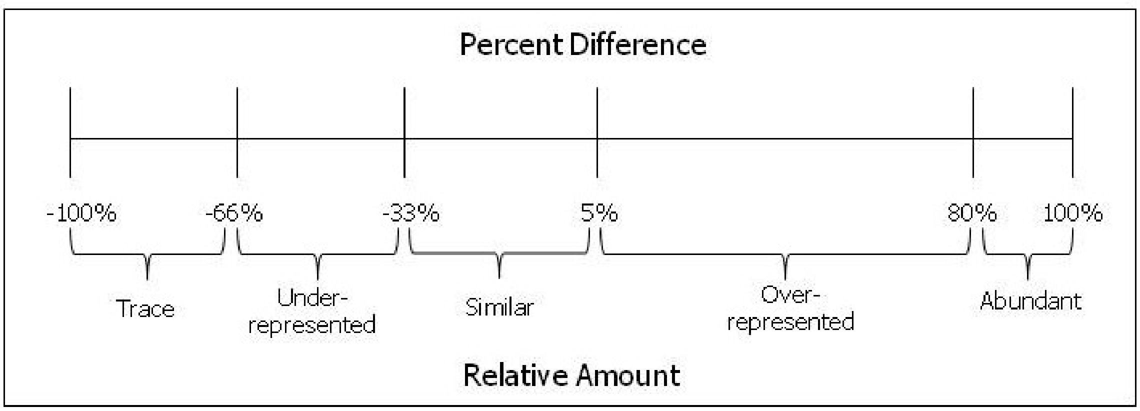


Figure 3-3. Percent Difference and Relative Amount scale, with which a given current S-Class is evaluated against its reference period amount.

Table 3-11. Relative Amount class codes.

Code	Relative Amount Class	Range
T	Trace	(<-66 percent departure)
U	Underrepresented	(≥ -66 percent and < -33 percent departure)
S	Similar	(≥ -33 percent and ≤ +5 percent departure)
O	Overrepresented	(> +5 percent and ≤ +80 percent departure)
A	Abundant	(> +80 percent departure or > 0 percent uncharacteristic classes)

Next you will determine the percent departure and FRCC for each S-Class (or "stand") in the Stratum. Note that these fine-scale metrics are useful for monitoring treatment effectiveness, and they can help managers fulfill planning and reporting requirements, such as those within NFPORS.

Stand Departure (field 62) – For each S-Class, this metric represents the percent departure from the reference amount:

Use one of the following equations and then enter your result:

If S-Class Pct. Difference (field 60) ≥ 0, then Stand Departure = field 60 value

or

If S-Class Pct. Difference (field 60) < 0, then Stand Departure = 0

Stand Fire Regime Condition Class (field 63) – Now use table 3-12 below to determine the Stand FRCC outcome for each S-Class in your Stratum. Note that the Relative Amount variable (field 61) forms the basis for determining the associated condition class.

Table 3-12. Stand FRCC and appropriate management response for vegetation improvement.

Relative Amount (field 61)	Stand FRCC (field 63)	Stand Condition Improves if:	Landscape improves if S-Class is:
Trace	1	Maintained or protected	Recruited
Underrepresented	1	Maintained or protected	Recruited
Similar	1	Maintained or protected	Maintained
Overrepresented	2	Reduced	Reduced
Abundant	3	Reduced	Reduced

Note: At the *stand scale*, a common management strategy would be to maintain the Trace, Underrepresented, or Similar classes, while simultaneously reducing the amount of the Overrepresented or Abundant S-Classes. At the *landscape scale*, the overall goal would be to recruit any S-Classes that are categorized as Trace or Underrepresented, maintain those S-Classes that are categorized as Similar, and reduce S-Classes that are considered Overrepresented or Abundant.

As you can see from the table, a diagnosis of Stand FRCC 3 results only when an S-Class exhibits high departure (>80 %). If initial results appear to underestimate such acreage in the assessment area, you should revisit your assignment of *uncharacteristic* classes, if present, in field 49. (Recall that S-Class U automatically receives an FRCC 3 rating because such conditions did not exist during the reference period.)

Stratum Area of Vegetation Departure (field 64) – This field represents the area (in acres or hectares) that each S-Class has departed from the reference condition amount.

Use the following equation:

Field 6 * (field 18 / 100) * ([field 49 – field 48] / 100) = Area departed

Note: Based on the above formula, positive integers (those greater than zero) suggest that the stratum likely contains an excess of that particular S-Class when compared to the reference condition; conversely, negative integers suggest a deficit.

Stratum Vegetation Departure (field 65) – This field represents the percent deviation of the stratum's vegetation (all S-Classes) from the reference condition composition. Subtract the value in field 59 from the integer 100.

Stratum Vegetation Condition Class (field 66) – This field classifies the stratum vegetation's departure according to the standard three-tier classification.

Classify the field 65 departure percent according to one of the following three vegetation condition classes and enter the result:

1 = ≤ 33 percent (within the reference condition range of variation)
2 = > 33 percent to ≤ 66 percent (moderate departure)
3 = > 66 percent (high departure)

Stratum Fire Frequency Departure (field 67) – This field documents the current fire frequency deviation from the reference condition central tendency.

Use the following equation:

(1 - [(smaller of fields 19 and 20) / (larger of fields 19 & 20)]) * 100

Stratum Fire Severity Departure (field 68) – This field documents the current fire severity deviation from the reference condition central tendency.

Use the following equation:

(1 - [(smaller of fields 21 and 22) / (larger of fields 21 & 22)]) * 100

Stratum Regime Departure (field 69) – This field reflects the deviation of the current fire frequency-severity combined value from the reference condition fire regime.

Use the following equation:

(field 67 + field 68) / 2

Stratum Regime Condition Class (field 70) – This field represents the classification of the regime departure value according to one of the three condition classes described above.

Classify the field 69 departure percent according to one of the following and enter the result:

1 = ≤ 33 percent (within the reference condition range of variation)
2 = > 33 percent to ≤ 66 percent (moderate departure)
3 = > 66 percent (high departure)

Stratum Departure (field 71) – This is the departure rating for the entire stratum based on the combined vegetation and fire regime departures.

Use the following equation:

(field 65 + field 69) / 2

Stratum Fire Regime Condition Class (field 72) – This is the FRCC rating for the entire stratum.

Classify the field 71 departure percent according to one of the following and enter the result:

1 = ≤ 33 percent (within the reference condition range of variation)
2 = > 33 percent to ≤ 66 percent (moderate departure)
3 = > 66 percent (high departure)

> ***Note***: Be aware of the closely similar field names for field 70 and field 72. Recall that the FRCC algorithm is based on an evaluation of vegetation (S-Class) inputs and regime (fire frequency and severity) inputs. So, the name *Stratum Regime Condition Class* (field 70) reflects only the frequency and severity departures when averaged together and classified according to the three condition classes. In contrast, *Stratum Fire Regime Condition Class* (field 72 above) reflects the endpoint diagnosis – that is, the average of the vegetation departure (field 65) and the "regime" departure (field 69), subsequently classified.

Landscape FRCC Calculations (Page 1)

After completing all of your Stratum Data pages as described above, you can begin to diagnose FRCC for the entire assessment area. To do so, please turn to the Landscape data section at the middle of page 1 and complete the following data fields.

Stratum Composition Percent (field 18) – If you recall, this data field represents the percent of the FRCC Landscape that is occupied by each stratum. Enter the data from the Stratum Data pages (field 18) and ensure that the sum of all strata equals 100 percent.

Stratum Departure (field 71) – If you recall, this field documents the departure percent for each stratum. Enter the applicable field 71 values.

Stratum Weighted Departure (field 73) – This field represents the area-weighted departure value for each stratum, as follows. Refer to your Stratum Data pages. Calculate the weighted departure for each Stratum using this equation: (field 18 / 100) * field 71.

> ***Note***: If desired, the above formula can be adjusted to account for relatively minor amounts of permanently non-vegetated terrain. If, for example, 15 percent of the Stratum were occupied by rocklands and water bodies, the formula would be: (field 18 / 85) * field 71. Conversely, you should create separate Strata for any such types that are relatively extensive within the assessment area.

Landscape Departure (field 74) – This data field reflects the sum of the stratum weighted departures above. Sum the field 73 values and enter the result.

Landscape Fire Regime Condition Class (field 75) – This is the FRCC rating for the entire assessment area.

Classify the field 74 value according to one of the following classes and enter the result:

1 = ≤ 33 percent (within the reference condition range of variation)
2 = > 33 percent to ≤ 66 percent (moderate departure)
3 = > 66 percent (high departure)

Completing the Standard Landscape Worksheet Graphs

Worksheet users can display their results by using the two graphs at the bottom of worksheet page one. (Note that the FRCC Software Application will automatically generate these graphs after data entry has been completed [see Chapter 4]). First, the FRCC Fire Regimes graph (bottom left corner of page 1) is used for displaying the fire regime group for each stratum. Please use the following instructions to create bar graphs, and label each bar according to the respective stratum numbers or other logical descriptors.

Step 1. For each stratum, place a mark on the Y-axis to represent the reference condition fire frequency value (field 19).
Step 2. Similarly, mark the X-axis to represent the reference condition fire severity (from field 21).
Step 3. Correlate the two variables by projecting the Y-axis value horizontally and the X-axis value vertically. As you can see on the following example, the intersection of those two lines reveals the stratum fire regime group. (***Note***: For any non-fire BpS strata, use "Regime V" as the default).

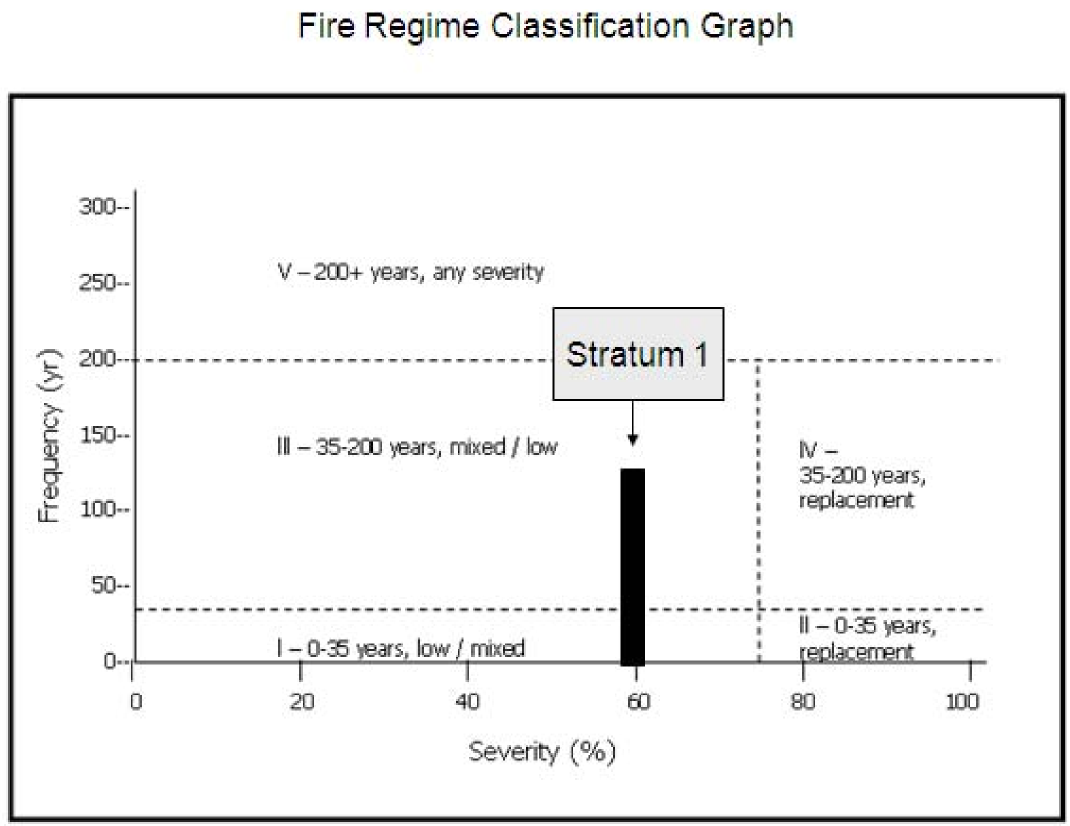


Figure 3-4. Example graph for a stratum in Fire Regime Group III. In this hypothetical example, the fire frequency value was 125 years, and the associated severity value was 60 percent.

Next, use the FRCC Graph (bottom right corner of page 1) to display the departures and condition classes for each stratum and then for the entire assessment area. That is, use the following instructions to create bar graphs, and label each bar according to the respective stratum numbers or other logical descriptors. (When more than five strata exist, either subdivide the 5 columns to create more room or continue entering the data on another copy of the blank graph).

Step 1. Using the Y-axis as a guide, plot the various departure values for each stratum. That is, plot the vegetation departure (field 65), then the regimes departure (field 69), then the overall departure for each stratum (field 71). When you finish graphing the individual strata, graph the Landscape departure (field 74) on the far right side (see example below).

> ***Note***: Any zero departure values can be graphed by placing an asterisk or similar symbol above the applicable stratum number to signify that you have in fact graphed the departure outcome.

Step 2. As you can see from the example below, plotting the departures also reveals the applicable condition classes (fields 72 and 75), which are labeled on the far right side of the graph.

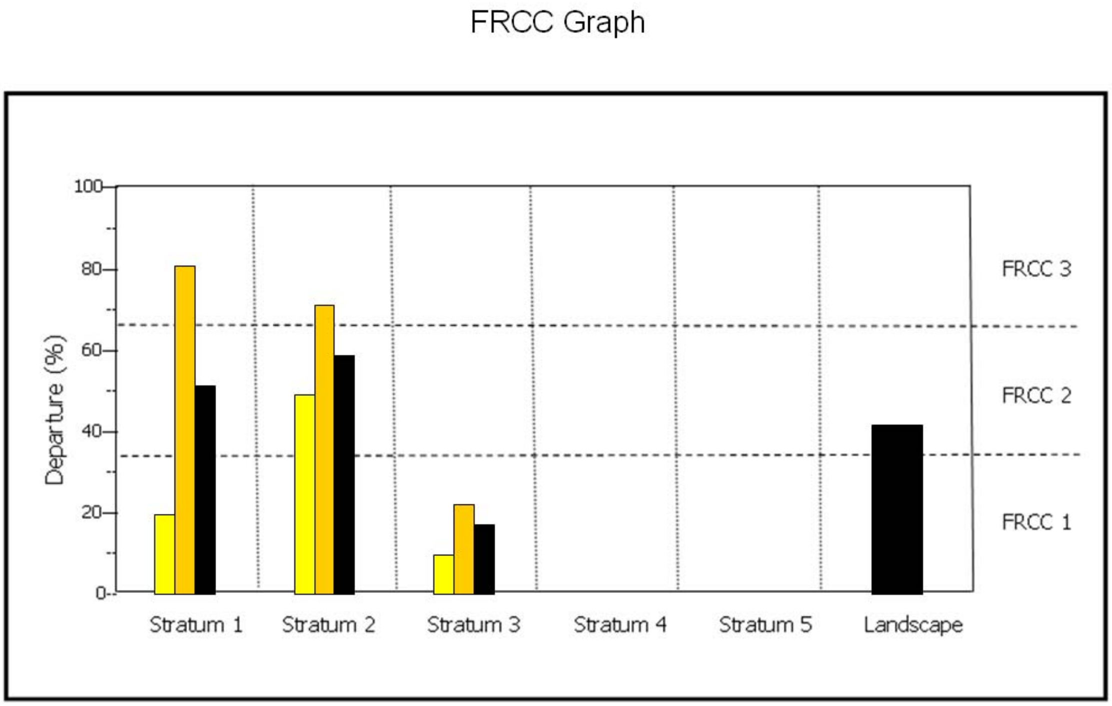


Figure 3-5. Example FRCC graph showing results for three hypothetical strata and for entire FRCC Landscape (Stratum Vegetation Departure = yellow; Stratum Regimes Departure = orange; Stratum & Landscape Departures = black).

FRCC Applications

Tracking post-treatment progress toward Fire Regime Condition Class 1

> ***Note***: The following guide can help you evaluate the effects of landscape-scale treatments or other disturbance after an initial assessment has been conducted. This does not correspond to a formal data field in the worksheet; rather, the procedure is meant as a general guide.

At the landscape scale, progress toward (or regression from) FRCC 1 can be calculated using pre-treatment and post-treatment assessments with the following Difference Formula:

Difference Percentage =
([Pre-treatment field 74 – Post-treatment field 74] / [Pre-treatment field 74]) * 100.

The results from the "difference" calculation will be used to classify progress toward (or regression from) FRCC 1 as follows:

D – Degradation in FRCC = ≤ -10 percent difference

N – No change in FRCC = > -10 pct. difference and < +10 pct. difference

I – Improvement in FRCC = ≥ +10 percent difference

(Also note that you can use the above formula for stratum-scale assessments simply by substituting field 71 for field 74).

For stand-level treatments, use the following basic guidelines for determining whether treatments or other disturbance have maintained or improved FRCC trends:

Table 3-13. Management implications for the stand-level fire regime condition class based on the S-Class relative amount.

S-Class relative amount	Stand FRCC	Improving condition if stand is:
Trace	1	Maintained
Underrepresented	1	Maintained
Similar	1	Maintained
Overrepresented	2	Reduced
Abundant	3	Reduced

Reporting FRCC for treatment accomplishment

As you have seen so far in this chapter, FRCC can be summarized and reported at a variety of scales. For example, broad-scale FRCC data are applied to describe national ecological conditions for all wildlands. Mid-scale FRCC assessments are used to describe the condition of agency ownerships or delineations such as Fire Management Units. And, at the finest scale, FRCC can be applied to individual seral stages (S-Classes). The latter metric (stand FRCC) is based on the scarcity or overabundance of current seral stages when compared to reference values for a given BpS. Documenting stand FRCC acres likewise allows the user to demonstrate ecological improvement and helps fulfill agency reporting requirements.

One of the primary applications of FRCC within federal agencies is for treatment reporting, and the stand condition class metric was developed for this purpose. In the National Fire Plan Operations and Reporting System (NFPORS) and the Forest Service

Activity Tracking System (FACTS), observations for the historical fire regime, pre-treatment condition class, and post-treatment condition class are required.

When reporting FRCC for treatment accomplishment, users are strongly encouraged to use the FRCC Software Application (detailed in Chapter 4). The software can quickly generate a report that summarizes stand FRCC acres for the various seral stages in a given BpS, as well as display the associated fire regime group, as described below:

1. First, conduct an FRCC assessment of the broader landscape within which the treatment occurs.
2. Next, click the *Report* button. Doing so automatically calculates the departures and condition classes for each BpS and associated S-Classes (or "stands"), as well as for the entire FRCC Landscape.
3. Within the Report, scroll down to the tables titled *Succession Classes*, which summarize the individual BpS and stand outcomes. Such data are useful for documenting conditions in any past or proposed treatment areas. An example is shown below:

Succession Classes

Code	Upper Layer Majority Lifeform	Size	Dominant Species				Ref Comp	Curr Comp	Acres	Sim	Diff	Relative Amount	Stand FRCC	Stand Depart	S-Class Acres Departed from Reference
A	HERB	NNNN	PSSP6	STTH2	POSE	ARTRW8	20	35	7699	20	43	OVER REP	2	43	3300
B	SHRB	NNNN	PSSP6	STTH2	ARTRW8	POSE	50	20	4400	20	-60	UNDER REP	1	0	-6600
C	SHRB	NNNN	ARTRW8	PSSP6	STTH2	POSE	30	10	2200	10	-67	TRACE	1	0	-4400
D							0	0	0	0	N/A				0
E							0	0	0	0	N/A				0
U			TACA8	BRJA	BRTE		0	35	7699	0	100	ABUNDANT	3	100	7700
						Total	100	100		50					

Stratum Vegetation Departure: 50
Stratum Vegetation Condition Class: 2
Stratum Fire Regime: IV- Infrequent Replacement

Stratum Fire Frequency Departure: 63
Stratum Fire Severity Departure: 6
Stratum Departure: 42

Stratum Regime Departure: 34
Stratum Regime Condition Class: 2
Stratum Fire Regime Condition Class: 2

4. Review the column titled "Stand FRCC." Select the seral stage your treatment is being (or has been) applied to. The pre-treatment condition class is in the corresponding "Stand FRCC" column. For example, if you were planning to treat S-Class U in order to reduce conifer encroachment, then the pre-treatment reporting metric would be Stand FRCC 3, as shown above.
5. Next, identify the target S-Class that represents the desired future condition (in other words, where the pre-treatment S-Class U acres will be "moved" to). The post-treatment condition class will likewise be reflected in the "Stand FRCC" column. Using the above example, if the treatment will shift the S-Class U acres into the S-Class C category, then the post-treatment condition class will be Stand FRCC 1. Conversely, if you are simply maintaining a given seral stage

through treatment, then the pre- and post-treatment condition classes will remain the same.

6. If you also need to report the historical (reference) fire regime, that trait can be found in the lower left hand side of the table (see the "Stratum Fire Regime" field above).
7. If desired, digital images (popularly known as "screen scrapes") of the software tables can also be useful supplements to planning documents and similar treatment reports.

Summarizing FRCC outputs for agency planning documents

FRCC summarization is a required element for certain land management agencies. Depending on the agency, FRCC summaries may be required for Landscape Assessments, Fire Management Plans, or Land Use Plans. In these documents, FRCC summaries can provide a useful overview of current ecological conditions for one or more BpS types as well as the associated fire regimes.

Both the FRCC Software Application (FRCCSA) and FRCC Mapping Tool (FRCCMT) (versions 3.0) provide summary reports that can satisfy federal agency requirements for summarizing Stand FRCC outcomes into a concise tabular format. The reports meet agency requirements for non-spatial FRCC summaries. The tables below show the type of information and format required.

Juniper Butte FMU					
Biophysical Setting	Historic Fire Regime (I-V)	Condition Class 1 (acres)	Condition Class 2 (acres)	Condition Class 3 (acres)	Total Acres
Wyoming Big Sagebrush	IV	48,000	53,000	126,000	227,000
Salt-Desert Shrub	V	18,000	6,500	84,000	108,500
Pinyon-Juniper	IV	115,000	36,000	9,600	160,600
Mountain Shrub	II	53,000	101,000	35,000	189,000
Total Acres by Condition Class		234,000	196,500	254,600	685,100

Figure 3-6. Example of FRCC summarized for a Fire Management Unit.

Badlands Resource Management Plan					
Biophysical Setting*	Historic Fire Regime (I-V)	Condition Class 1 (acres)	Condition Class 2 (acres)	Condition Class 3 (acres)	Total Acres
Wyoming Big Sagebrush	IV	96,000	106,000	252,000	454,000
Salt-Desert Shrub	V	36,000	13,000	168,000	217,000
Pinyon-Juniper	IV	230,000	72,000	19,200	321,200
Mountain Shrub	II	53,000	101,000	35,000	189,000
Ponderosa Pine	I	124,000	83,000	289,000	496,000
White Fir, Mixed Conifer	III	22,000	17,000	149,000	188,000
Total Acres by Condition Class		561,000	392,000	912,200	1,865,200

Figure 3-7. Example of FRCC summarized for a Land Use Plan.

Chapter 3 Summary

In this chapter, you learned how to complete the FRCC Standard Landscape Worksheet. Specifically, you learned how to enter the data, perform departure computations, and diagnose condition classes for BpS strata, for individual S-Classes ("stands") within a given stratum, and for the FRCC Landscape as a whole. Doing so establishes a sound foundation for understanding the principles and uses of the various FRCC algorithms, which is necessary regardless of which tool you ultimately choose for conducting assessments. In addition, we discussed some FRCC applications, including how the data are useful not just for management planning but also for fulfilling agency reporting requirements.

Chapter 4: Software for FRCC Assessments

Overview

This chapter briefly describes the major attributes of the two FRCC-related software programs available from the Tools & User Documents section of www.frcc.gov: the FRCC Software Application (FRCCSA) and the FRCC Mapping Tool (FRCCMT). The purpose of this chapter is to provide an introduction to these tools in order to promote their use.

First, the FRCC Software Application can be used for assessing FRCC via the non-spatial Standard Landscape Worksheet Method described in Chapter 3. This tool provides an efficient way to enter, edit, and store data compared to using paper data forms and hand-calculations. In addition, the software is potentially more useful for pre- and post-treatment monitoring and reporting, for sensitivity testing and "futuring," and for enhancing the production of finished reports that use graphics, tables, and photographs. Second, the FRCC Mapping Tool is a GIS application that provides geospatial analyses of FRCC via the Standard Landscape Mapping Method and is also a highly efficient and useful means by which to conduct FRCC assessments.

Each assessment approach and associated software has both strengths and limitations. For example, although the Standard Landscape Worksheet Method (via either the FRCCSA or manual calculations) produces non-spatial outputs, this approach has the advantage of using field-based data produced by local experts. Conversely, the Standard Landscape Mapping Method (via FRCCMT) can provide spatial outputs for much larger assessment areas, but the results are dependent on the accuracy of spatial data serving as inputs to the tool.

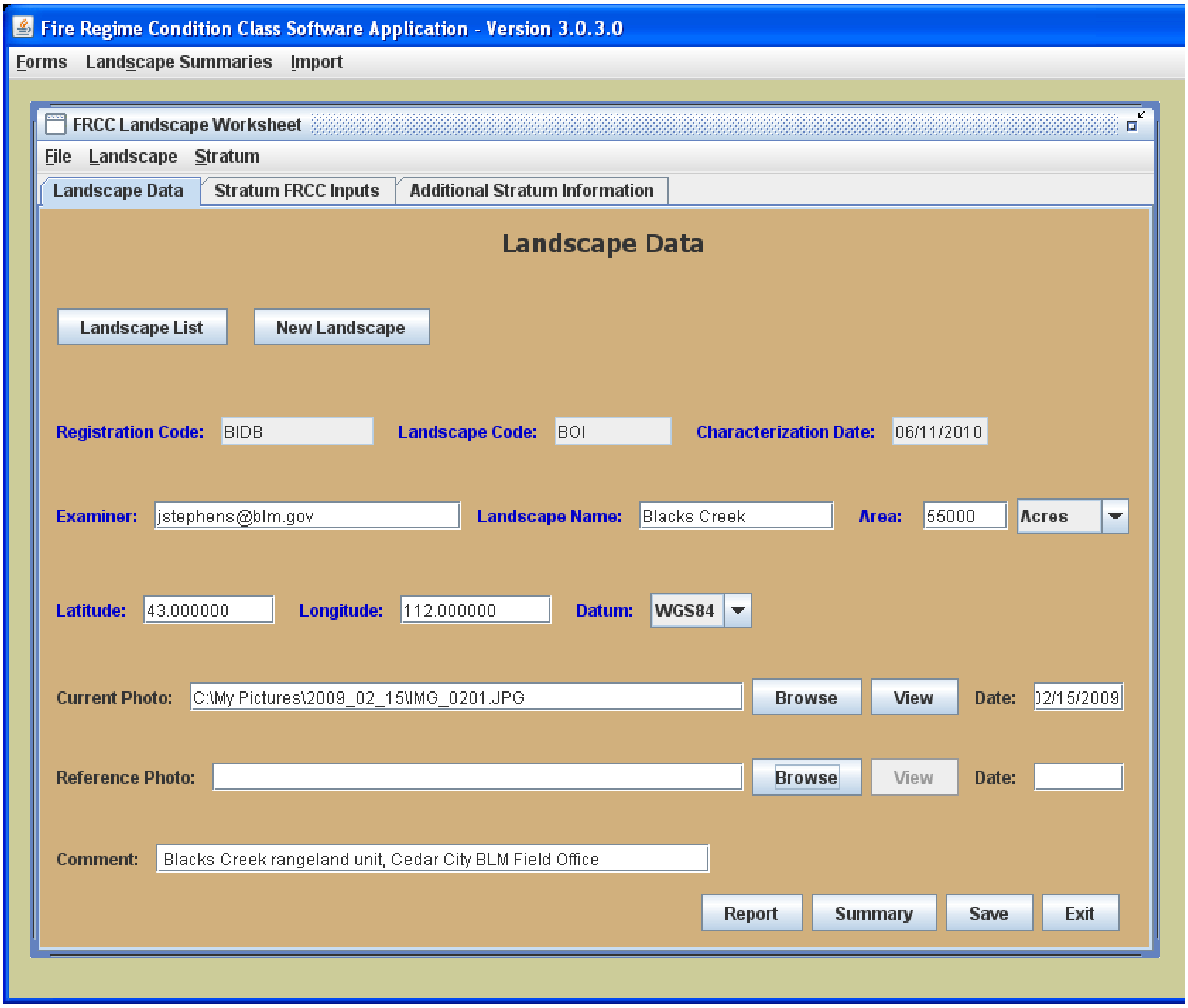
> ***Note***: Prospective users of these software tools must be familiar with the FRCC principles, concepts, and methods that are described in chapters 2 and 3. Although no special skills are required to successfully operate the FRCC Software Application, prospective users of the FRCC Mapping Tool must have at

least basic GIS proficiency. For more information and detailed software instructions, please consult the associated user guides, tutorials, online courses, and the FRCC Mapping Tool Help Utility available at www.frcc.gov.

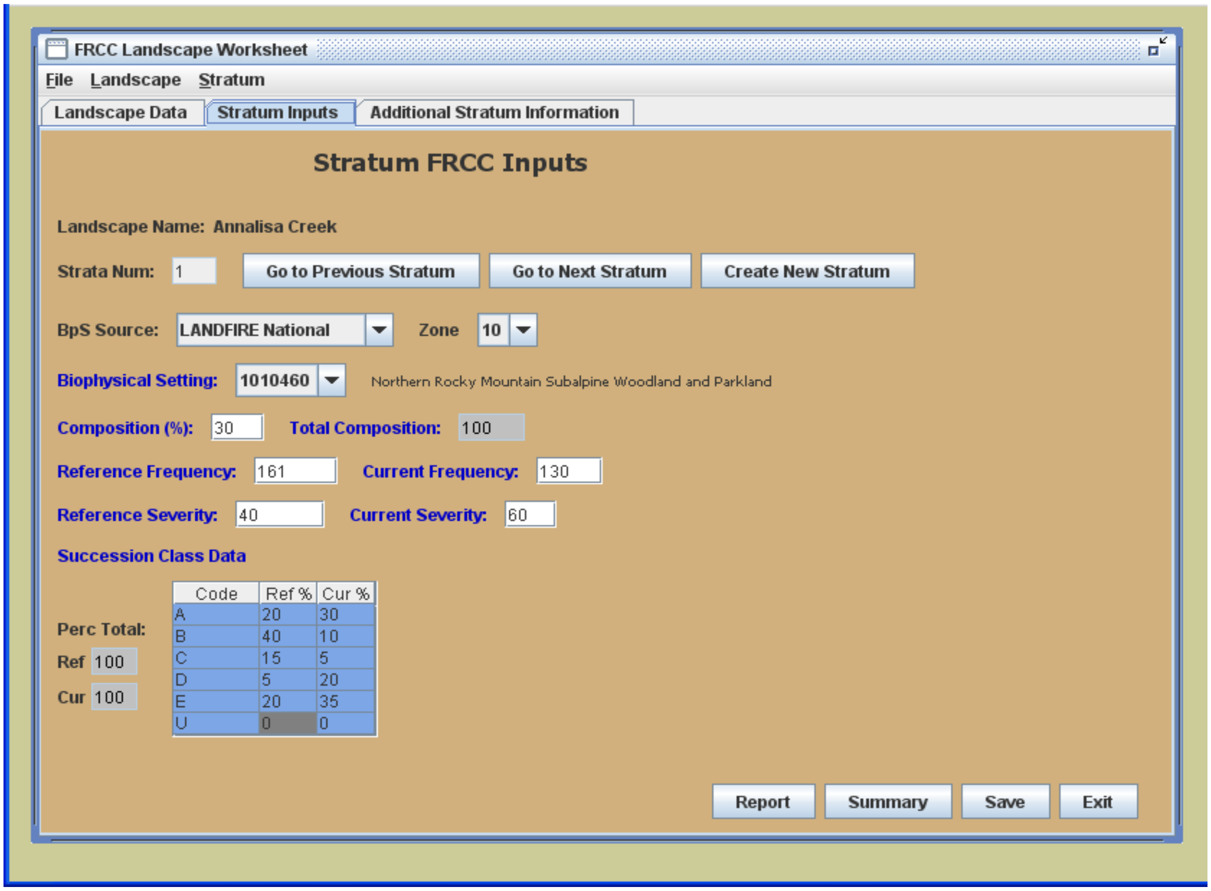
FRCC Software Application (FRCCSA) Version 3.0

FRCCSA data inputs

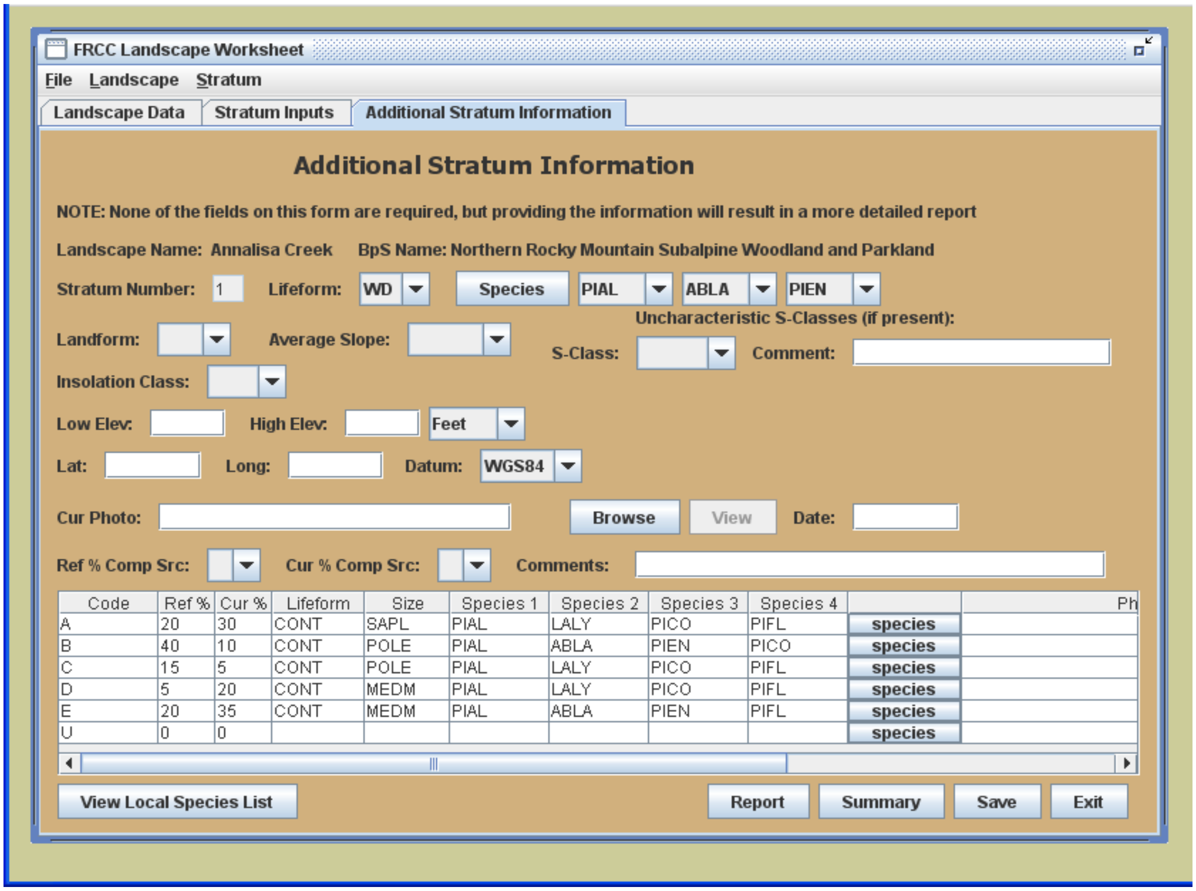
The FRCCSA inputs are identical to those for the Standard Landscape Method Worksheet and Standard Landscape Method Field Form (as described in Chapter 3). However, the software data entry procedure and automated computations are much faster and more convenient than manual paper-and-pencil assessments. For instance, the FRCCSA organizes the data according to a logical sequence of easy-to-read pages, and data entry is facilitated by drop-down menus and other common user interface controls. The following graphics show the three separate pages used for housing various classes of data. As you can see, these pages are accessed via white tabs labeled Landscape Data, Stratum Inputs, and Additional Stratum Data, respectively. On the example Landscape Data page below, notice the user friendly layout that uses simple buttons and other intuitively labeled controls. Also notice the data fields labeled in bold blue font, which indicate required fields. (For convenience, the software will display field-specific error messages if the user forgets to enter required data.)



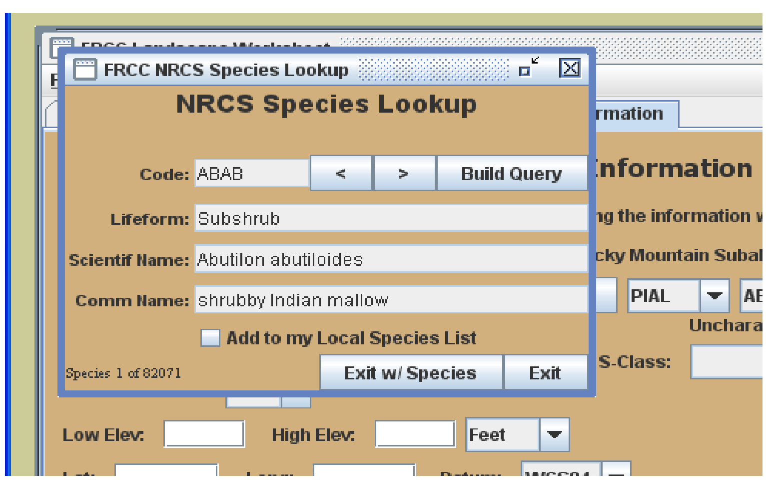
On the Stratum Inputs page below, notice the menus that are labeled BpS Source, Zone, and Biophysical Setting. These fields are used for selecting an applicable BpS model for the stratum. Also notice the other stratum descriptors, such as the fire regimes variables and the table that houses the S-Class data.



The third inputs page (graphic below) is labeled Additional Stratum Information. Although none of those data are required for the FRCC computations, the information can be useful for further describing the stratum. For example, the page contains lifeform type, representative species, elevations, and dominant aspect, among other descriptors.



Another convenient feature is the species lookup function, which is activated by clicking the Species button (graphic below). Doing so enables a search sequence for quickly locating and selecting from among the approximately 80,000 species on the Natural Resources and Conservation Service list of plants for the U.S.

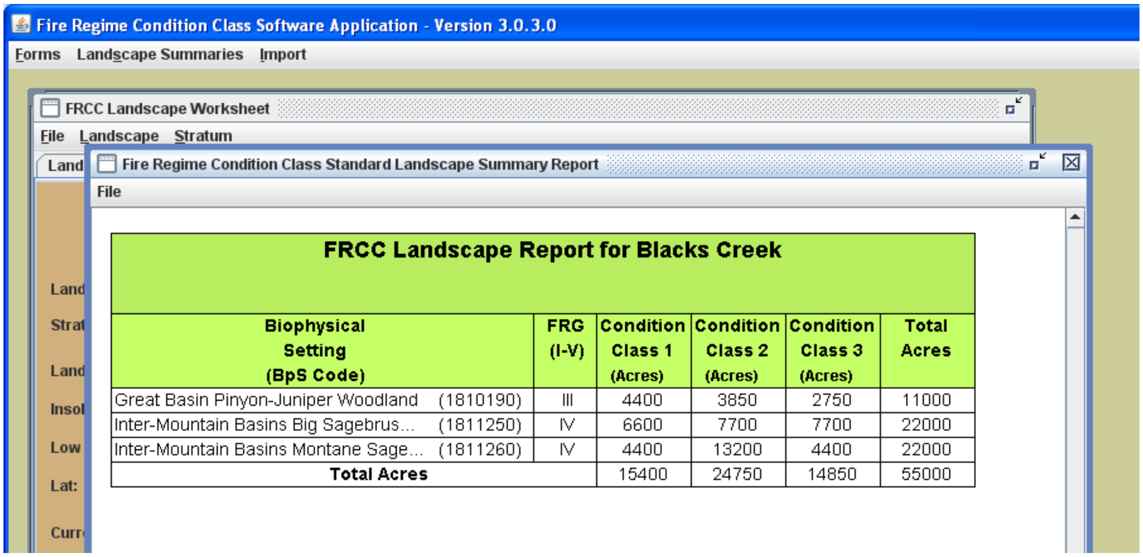


FRCCSA data outputs

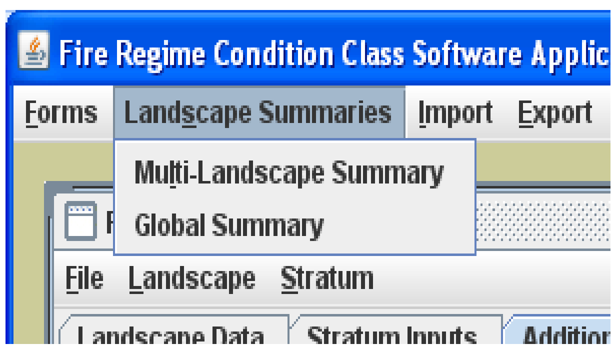
After all of the required data have been entered, the software can quickly perform the FRCC calculations for the Strata and Landscape. In addition, the program will produce summary tables and graphs. These functions are accessed by clicking on the Report and Summary buttons at the bottom of any inputs page:

For example, the Report function generates the various departure and FRCC outputs as illustrated below:

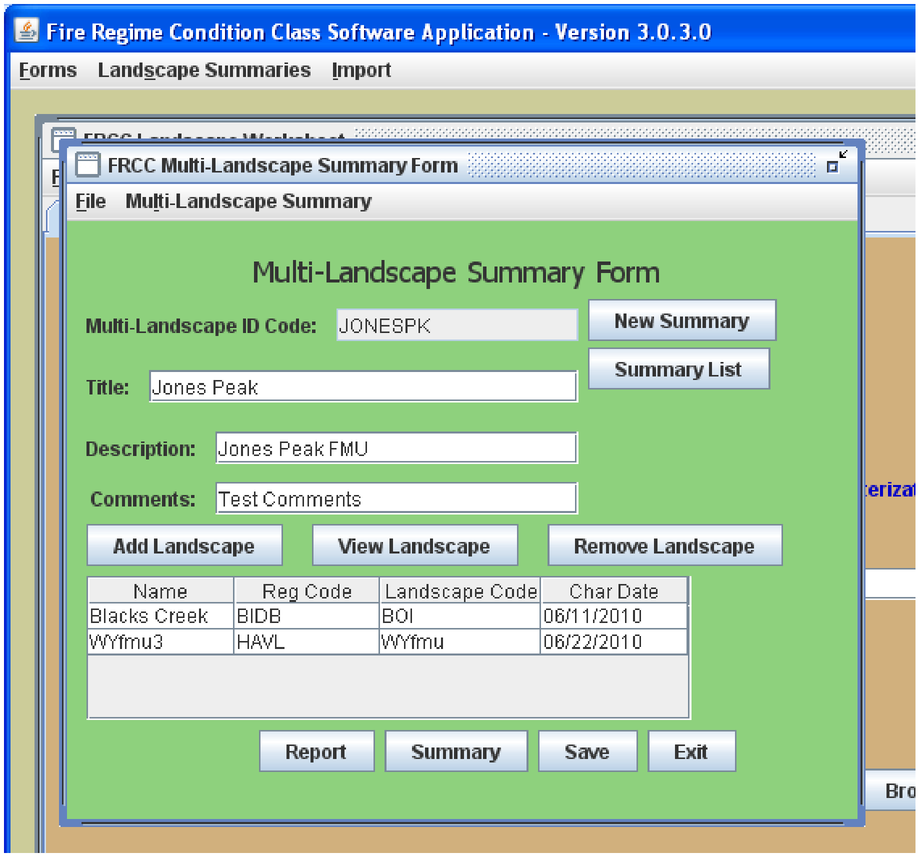
Then you can obtain the Stand FRCC acreages for each Stratum and Landscape by clicking the Summary button:



And finally, you can generate summary reports for multiple FRCC Landscapes in your FRCCSA database as follows. The user first clicks on the Landscape Summaries function at the top of the main page and then selects from between two options in a drop-down menu.



For example, selecting the Multi-Landscape Summary option activates a dialog box that is used for specifying which Landscapes to summarize:



Although we have described here only a few of the major features and capabilities of the FRCC Software Application, you can see that the program provides a more convenient way to conduct non-spatial FRCC assessments than does the Standard Landscape Worksheet.

Next let's consider how our custom GIS software can be used for conducting spatial FRCC assessments via the Standard Landscape Mapping Method.

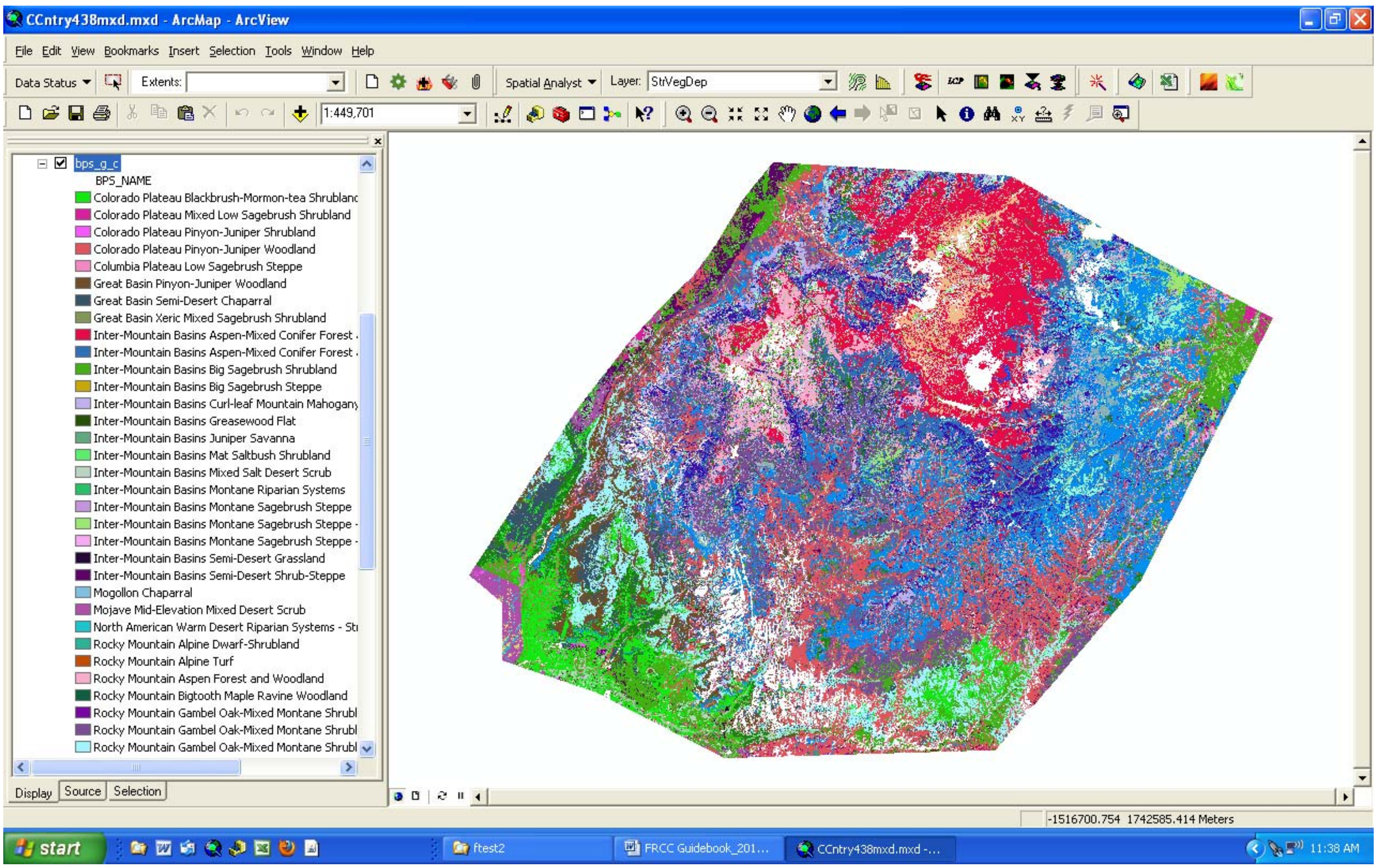
FRCC Mapping Tool (FRCCMT) Version 3.0

FRCCMT data inputs

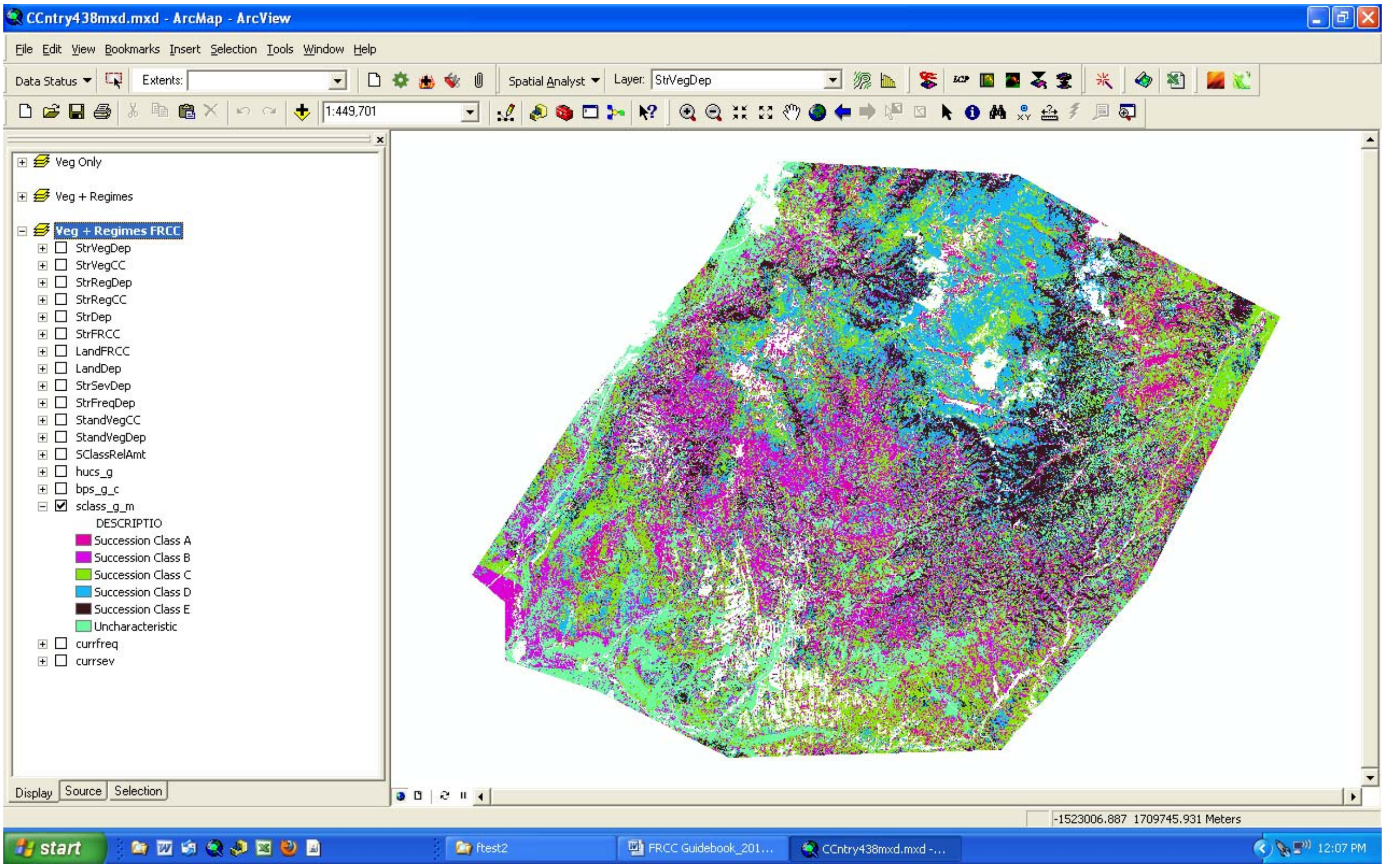
Although FRCCMT inputs differ somewhat from those for the FRCCSA, the mapping tool nonetheless analyzes the same sets of key FRCC variables – the vegetation and fire regimes data for each stratum in a given assessment area. There are three input layers for FRCCMT: the Biophysical Settings (BpS) layer, the Succession Classes (S-Class) layer, and the Landscape layer. Note that a convenient source for the vegetation inputs are the LANDFIRE BpS and S-Class layers, which can be obtained through www.frcc.gov in the Biophysical Settings Resources section.

Inputs for analyzing vegetation departures

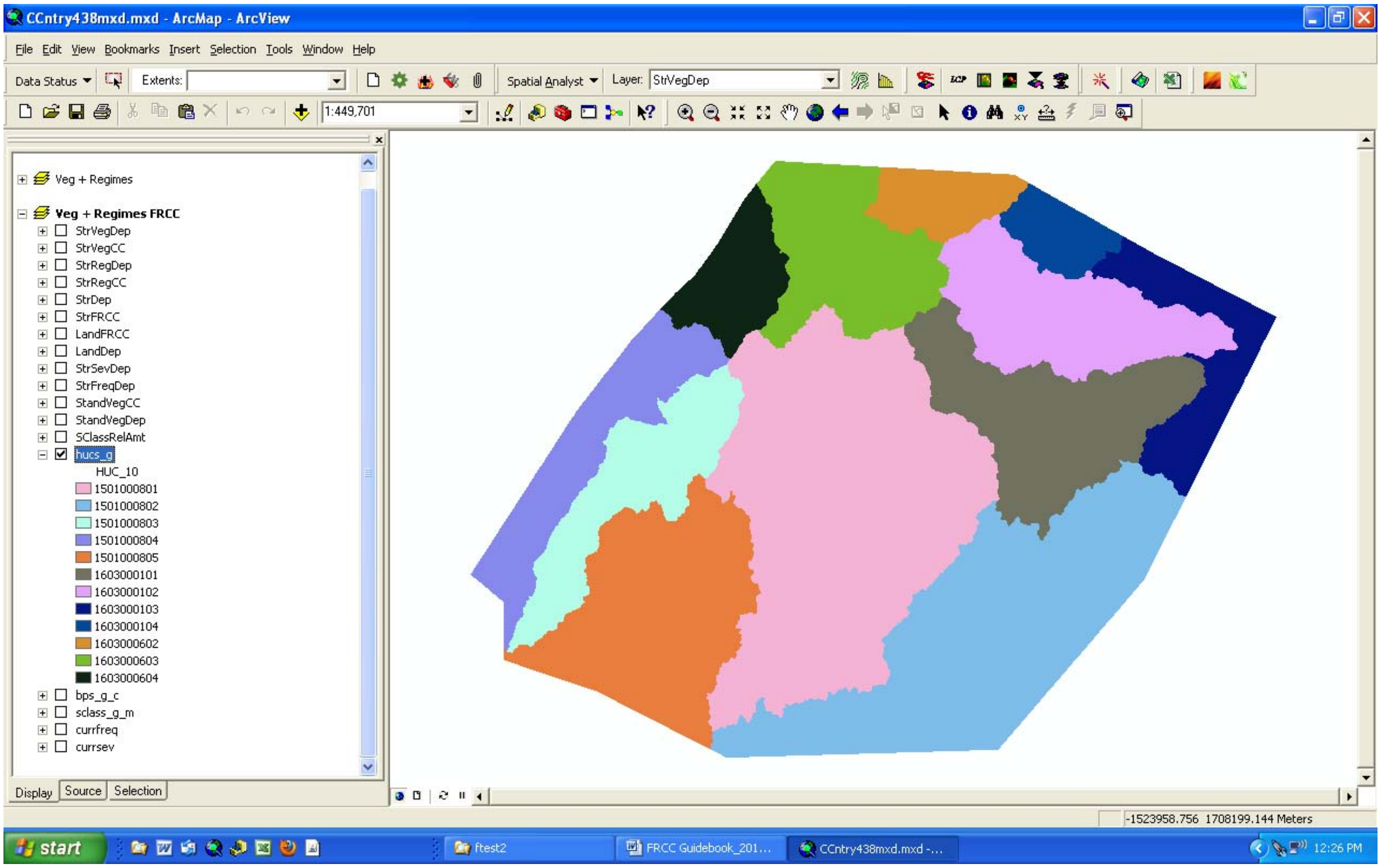
If you recall from Chapter 3, we generally recommend defining no more than five major strata when using the non-spatial Standard Landscape Worksheet Method for a given assessment area. In contrast, one advantage of using the GIS approach is that the FRCCMT can analyze much larger assessment areas and a greater number of strata. Notice how many BpS types occur in the following LANDFIRE BpS example. That is, nearly 40 BpS types (strata) occupy this million-acre assessment area in southwestern Utah:



In contrast, the S-Class input layer typically will be much less complex. Notice in the graphic below that only the five standard S-Classes and one uncharacteristic class are depicted for our Utah assessment area:



The third input layer necessary for analyzing the vegetation departure is the Landscape layer. This layer represents a nested hierarchy of hydrological units or other data that allows FRCCMT to conduct scale-appropriate analyses for each stratum according to its associated fire regime group (see the FRCCMT User's Guide, available at www.frcc.gov, for more information). For example, the graphic below displays the watershed units that are used for summarizing S-Class compositions for strata dominated by Fire Regime Group III:



<u>Inputs for analyzing fire regime departures</u>

Included with FRCCMT version 3.0 is a tool called the Fire Frequency & Severity Editor. This tool allows the user to produce rasters for current fire frequency and current fire severity, which can then serve as inputs to the Strata FRCC algorithm. Below is an example of the data table that must be attributed before generating the rasters. Notice that the user has edited some of the Current Frequency and Current Severity values to reflect departure from the associated reference conditions.

BpS_Model	Name	Area %	Reference Frequency	Current Frequency	Reference Severity	Current Severity	Fire Regime
1610520	Southern Rocky ...	4	33	100	18	50	1
1610611	Inter-Mountain B...	5	10	50	22	50	1
2310860	Rocky Mountain ...	0	23	75	22	40	1
1610540	Southern Rocky ...	13	15	100	6	50	1
1611170	Southern Rocky ...	1	8	50	5	30	1
1610612	Inter-Mountain B...	9	32	32	46	46	1
2310540	Southern Rocky ...	0	15	15	6	6	1
2310510	Southern Rocky ...	0	10	10	12	12	1
1611350	Inter-Mountain B...	0	25	25	33	33	1
1611460	Southern Rocky ...	0	10	10	52	52	1
1610860	Rocky Mountain ...	3	23	23	22	22	1

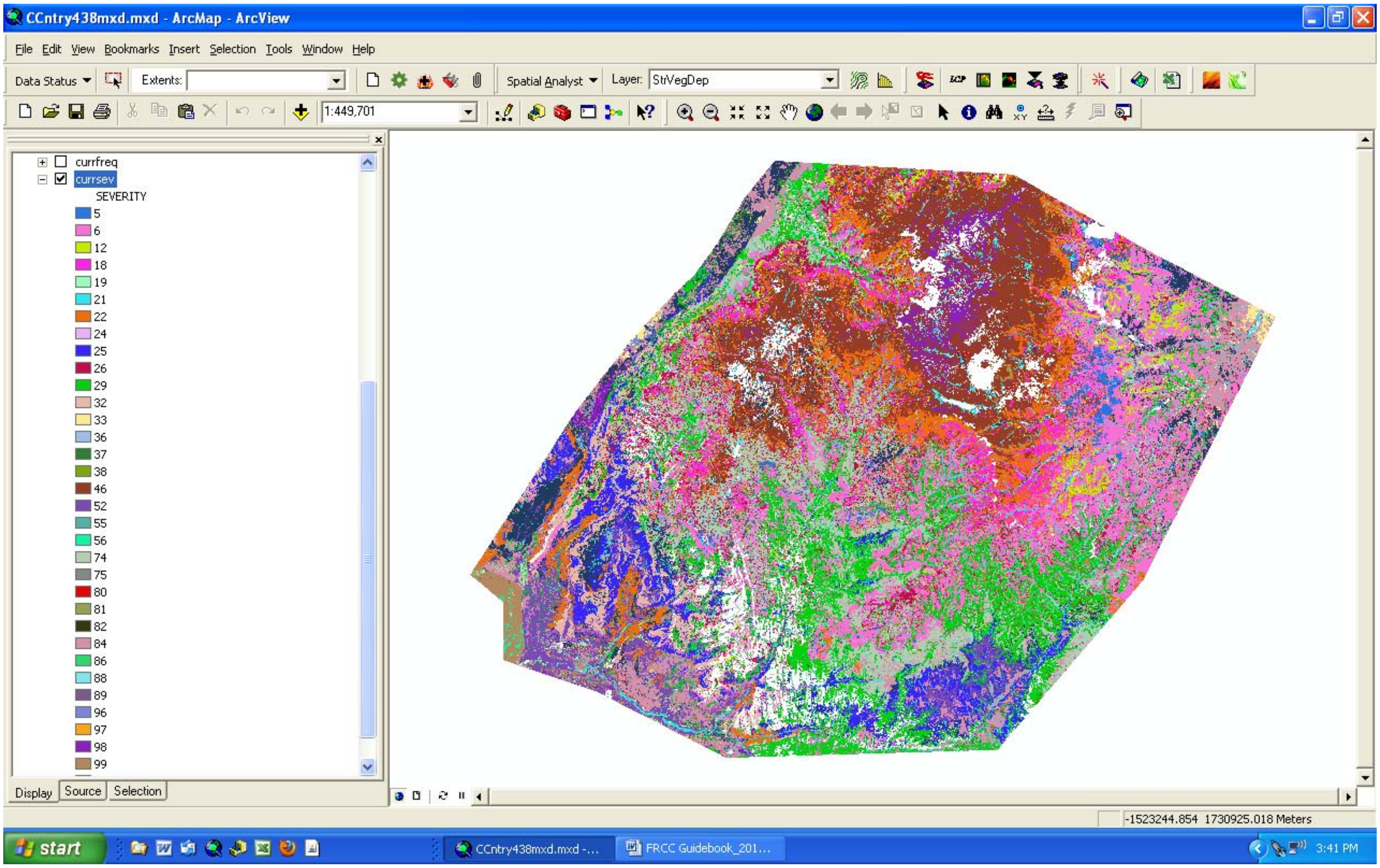
95 Records

Rocky Mountain Lower Montane-Foothill Shrubland

Save Edits

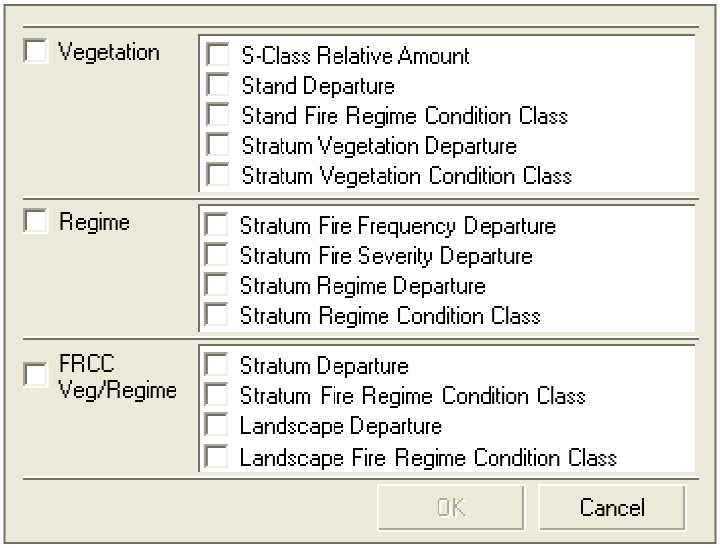
Cancel Edits

And here is an example of the Current Severity raster produced after the data have been edited:

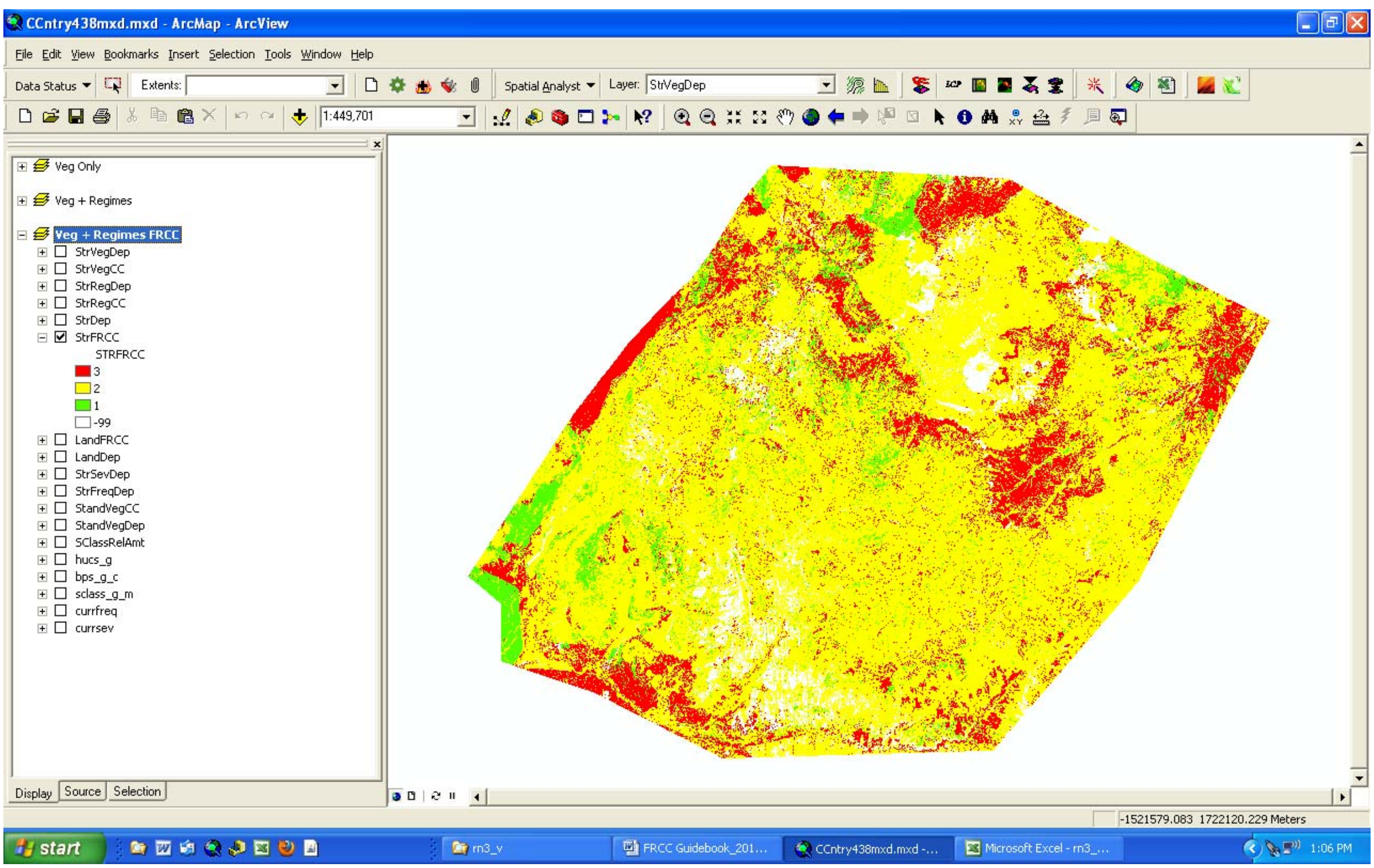


FRCCMT data outputs

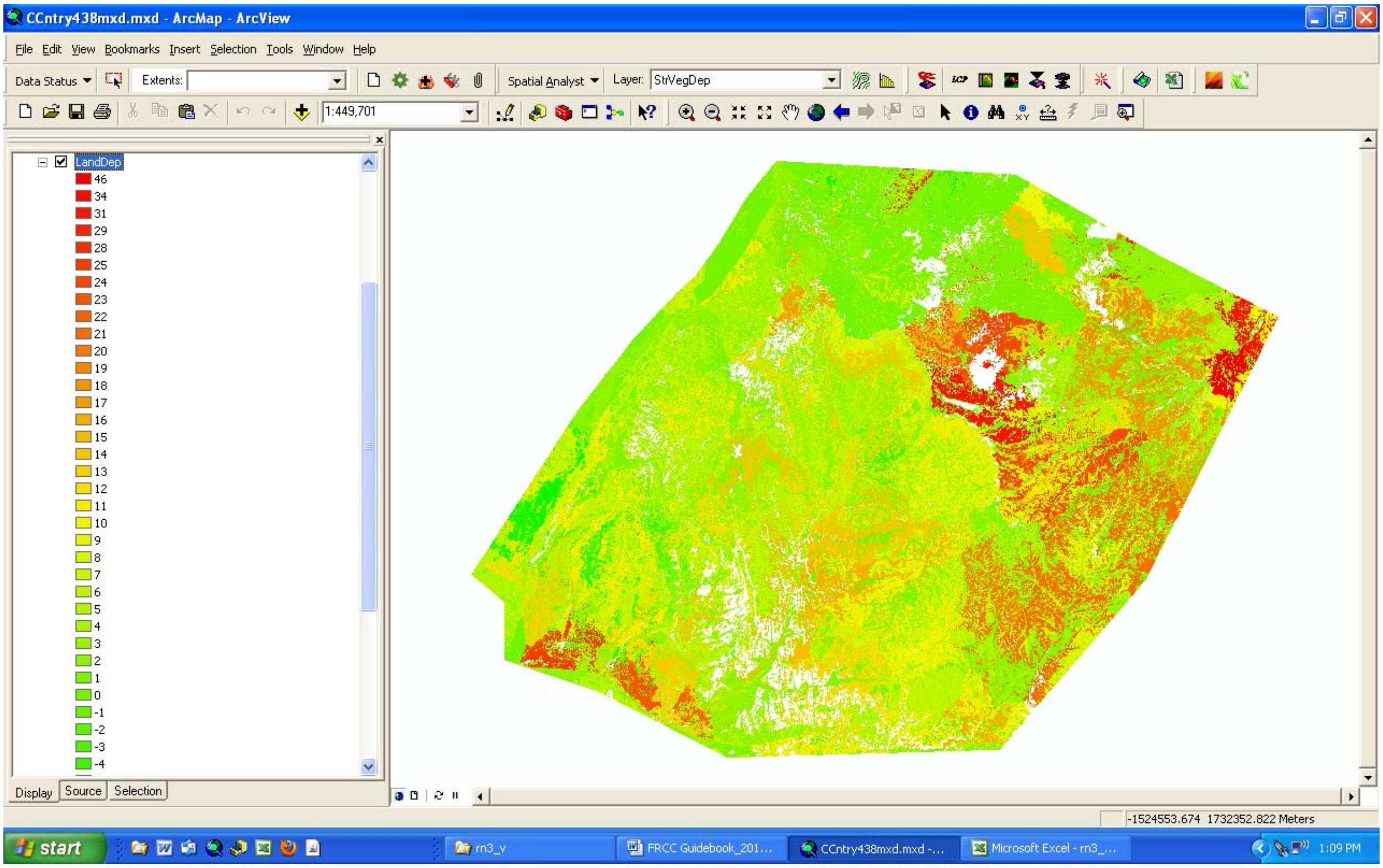
To date, a total of 13 output layers and associated summary reports are available for supporting the various analysis, planning, and treatment monitoring tasks typically conducted by land managers. As you can see from the FRCCMT user interface menu below, the tool can generate vegetation-only outputs, regimes-only outputs, and outputs based on a combination of those two key input variables. Also notice that the outputs are organized according to three scales: 1) stand level, 2) strata level, and 3) landscape level:



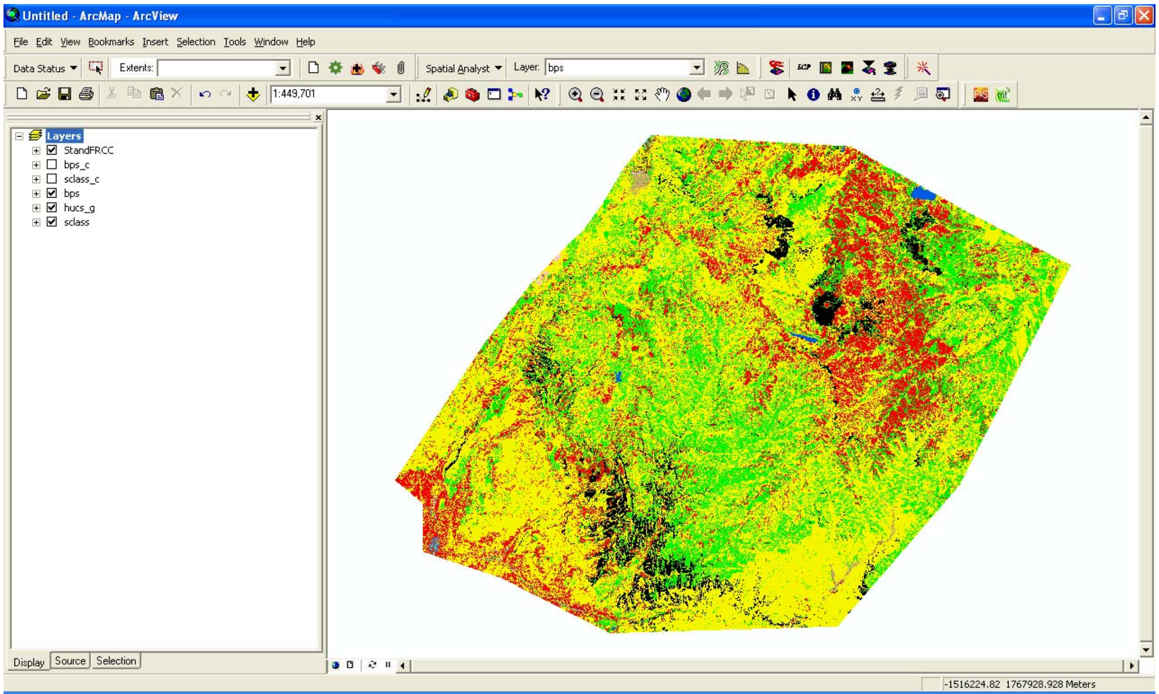
Below are just a few examples of FRCCMT outputs for our Utah assessment area. First is the Strata FRCC layer, which shows the BpS-specific results:



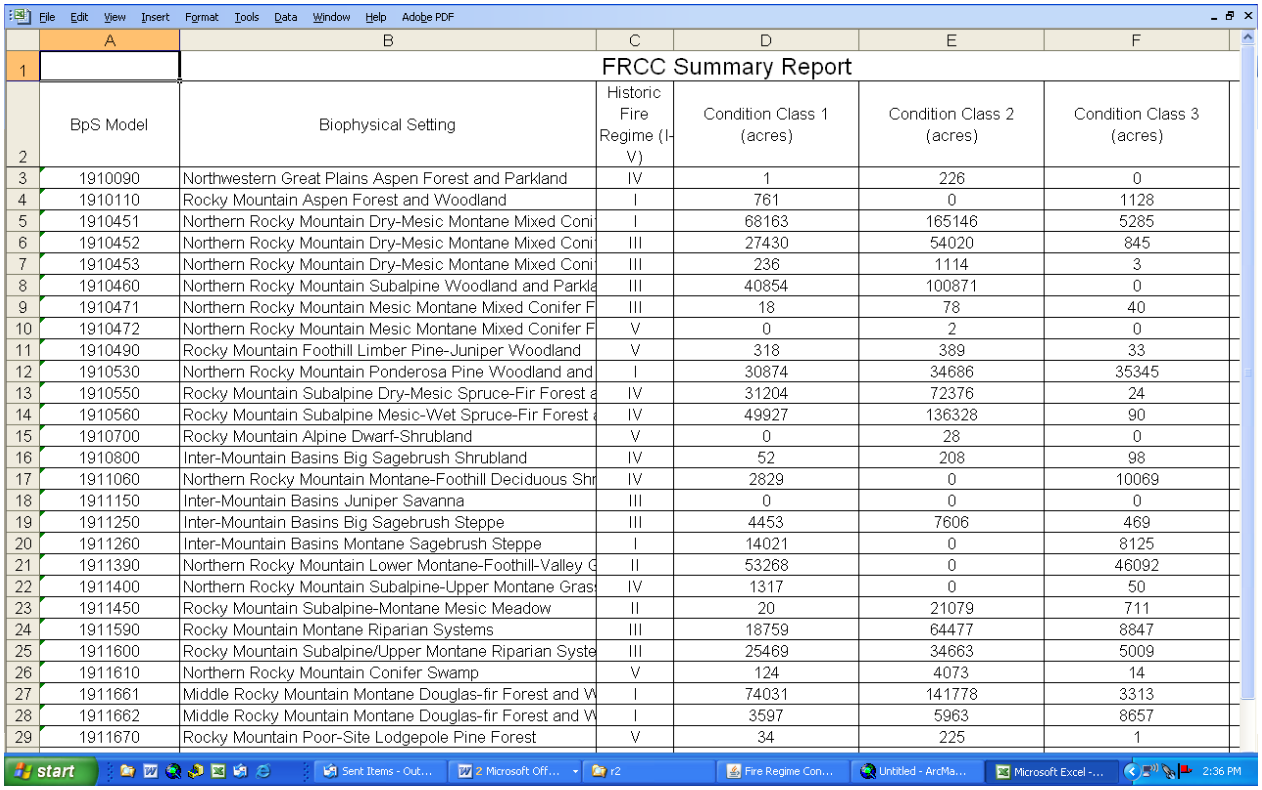
Our next example shows the Landscape Departure layer, which is an aggregate of the strata departures in each hydrological unit (such as watersheds):



Our final example of the output layers is the Stand FRCC layer, which is useful for fine-scale treatment reporting and monitoring and for so-called "futuring" exercises that can help planners devise restoration strategies:



In addition to output rasters, the mapping tool also generates several summary reports that can be useful for pre- and post-treatment documentation, scenario testing, and monitoring of FRCC trends. Below is an example of the Excel summary report that displays Stand FRCC acreages for each BpS stratum (note also that the format of this report matches the one used for the FRCCSA summary report):



FRCC Summary Report

BpS Model	Biophysical Setting	Historic Fire Regime (I-V)	Condition Class 1 (acres)	Condition Class 2 (acres)	Condition Class 3 (acres)
1910090	Northwestern Great Plains Aspen Forest and Parkland	IV	1	226	0
1910110	Rocky Mountain Aspen Forest and Woodland	I	761	0	1128
1910451	Northern Rocky Mountain Dry-Mesic Montane Mixed Coni	I	68163	165146	5285
1910452	Northern Rocky Mountain Dry-Mesic Montane Mixed Coni	III	27430	54020	845
1910453	Northern Rocky Mountain Dry-Mesic Montane Mixed Coni	III	236	1114	3
1910460	Northern Rocky Mountain Subalpine Woodland and Parkla	III	40854	100871	0
1910471	Northern Rocky Mountain Mesic Montane Mixed Conifer F	III	18	78	40
1910472	Northern Rocky Mountain Mesic Montane Mixed Conifer F	V	0	2	0
1910490	Rocky Mountain Foothill Limber Pine-Juniper Woodland	V	318	389	33
1910530	Northern Rocky Mountain Ponderosa Pine Woodland and	I	30874	34686	35345
1910550	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest a	IV	31204	72376	24
1910560	Rocky Mountain Subalpine Mesic-Wet Spruce-Fir Forest	IV	49927	136328	90
1910700	Rocky Mountain Alpine Dwarf-Shrubland	V	0	28	0
1910800	Inter-Mountain Basins Big Sagebrush Shrubland	IV	52	208	98
1911060	Northern Rocky Mountain Montane-Foothill Deciduous Shr	IV	2829	0	10069
1911150	Inter-Mountain Basins Juniper Savanna	III	0	0	0
1911250	Inter-Mountain Basins Big Sagebrush Steppe	III	4453	7606	469
1911260	Inter-Mountain Basins Montane Sagebrush Steppe	I	14021	0	8125
1911390	Northern Rocky Mountain Lower Montane-Foothill-Valley G	II	53268	0	46092
1911400	Northern Rocky Mountain Subalpine-Upper Montane Gras	IV	1317	0	50
1911450	Rocky Mountain Subalpine-Montane Mesic Meadow	II	20	21079	711
1911590	Rocky Mountain Montane Riparian Systems	III	18759	64477	8847
1911600	Rocky Mountain Subalpine/Upper Montane Riparian Syste	III	25469	34663	5009
1911610	Northern Rocky Mountain Conifer Swamp	V	124	4073	14
1911661	Middle Rocky Mountain Montane Douglas-fir Forest and W	I	74031	141778	3313
1911662	Middle Rocky Mountain Montane Douglas-fir Forest and W	I	3597	5963	8657
1911670	Rocky Mountain Poor-Site Lodgepole Pine Forest	V	34	225	1

<u>Chapter 4 Summary</u>

This concludes our overview of the two FRCC software programs. We hope this introduction has helped motivate you to become a skilled user of one or both of these tools. To learn more about these custom software programs, user support, and associated training opportunities, please visit www.frcc.gov.

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Glossary

Abundance. The amount of a species. For vegetation, abundance is typically measured as percent areal cover. Other measures include biomass and stems per unit area.

Algorithm: A procedure used to solve a mathematical or computational problem or to address a data processing issue. In the latter sense, an algorithm is a set of step-by-step commands or instructions designed to reach a particular goal.

Area-weighted average: A measure of the relative proportions of different size units in relation to the total area in question. Individual values, such as FRCC strata departure metrics, are first multiplied by each unit's percentage of the total Landscape and then divided by the total area percentage.

Attributes: Descriptive characteristics of an entity in a database. Location is a mandatory attribute in a geographic information system (GIS), as is at least one graphic element (that is, point, line, or polygon). The term is often used in GIS to refer to all non-graphic data.

Biophysical unit: A division of the landscape with similar biological and physical characteristics.

Biophysical setting (BpS): A grouping of ecologically similar vegetation types modeled with characteristic disturbance inputs and used for FRCC assessments. In FRCC, this term is synonymous with potential natural vegetation group (PNVG). (See also historical vegetation, PNV, and reference condition model).

Box model: A standardized BpS dynamics model with succession classes (boxes or seral states) and defined pathways (transitions) that move vegetation from one class to another via disturbance or succession. Box models are based on state and transition modeling concepts and use the Vegetation Dynamics Development Tool (VDDT) software.

Canopy: Forest or woodland tree biomass above surface vegetation and fuels.

Canopy cover: 1) The proportion of ground – usually expressed as a percentage – that is occupied by the perpendicular projection down onto it of the aerial parts of the vegetation or the species under consideration. The additive cover of multiple strata or species may exceed 100 percent (FGDC 1997). 2) The percentage of ground covered by a vertical projection of the outermost perimeter of the natural spread of foliage of plants. Small openings within the canopy are included (SRM 1989; NRCS 1997). Canopy cover is synonymous with canopy closure (Helms 1998). For woody plants, canopy cover is synonymous with crown cover (NRCS 1997; Helms 1998).

Characteristic/Uncharacteristic: Characteristic conditions and processes are those similar to conditions occurring in the natural or historical regime, whereas uncharacteristic conditions are those that would not have occurred. See "Uncharacteristic."

Class: The box model succession class within each BpS, based on succession (seral) stage, composition, and structure (see table below). Reference conditions for each BpS are based on as many as five characteristic classes (A through E); current conditions might have additional classes (called "uncharacteristic").

Seral Stage (see "Seral")	**Composition & Structure**	
	Attribute (such as Open)	***Attribute (such as Closed)***
Post-Replacement	S-Class A	
Mid-Development	S-Class C	S-Class B
Late-Development	S-Class D	S-Class E

Closed: A structural characteristic in which the upper layer of vegetation canopy is relatively closed. Default values for closed forest, woodland, or herbaceous classes are greater than 40 percent if based on canopy cover. Default values for closed shrub classes are greater than 15 percent if based on line intercept cover. These are commonly applied as structure attributes for succession classes B and E.

Coarse-scale FRCC map: General term referring to the initial FRCC modeling and mapping work of Schmidt and others (2001), which yielded a 1-km pixel resolution map for the conterminous 48 states. Available at: www.fs.fed.us/fire/fuelman/

Composition: The species in an ecosystem and their abundances, often expressed as percent of area.

Cover: The percent of upper layer canopy density. Commonly based on canopy cover estimates for forest, woodland, and herbaceous types and on line intercept estimates for shrub and grass types.

Condition class: In FRCC methodology, a synonym for one of the three fire regime condition classes: 1) <33 percent (low) departure from reference conditions, 2) 33-66 percent (moderate) departure, 3) >66 percent (high) departure.

Datum: In the field of surveying, a datum is any point, line, or surface used as a reference for a measurement of another quantity. Commonly used datums for referencing spatial data are North American Datum 1983 (NAD 83) and North American Datum 1927 (NAD 27)

Default reference condition characteristics: Derived from national, regional, or subregional modeling of BpS reference conditions using a box model framework within the Vegetation Dynamics Development Tool (VDDT) modeling software. These provide an average percentage estimate for up to 5 characteristic succession classes per BpS in addition to estimates of fire frequency and fire severity for the natural regime. These reference values are defaults in FRCC methodology and can be adjusted by the user according to local data.

Departure: The inverse of similarity. For the succession classes and fire frequency-severity variables, this is the percentage of difference between current and reference conditions (see "Similarity" for a comparison of difference).

Desired future conditions (DFC): A characterization of future conditions commonly designed as a goal for management that integrates ecological and social factors. It is not synonymous with fire regime condition class or the end state of succession for a BpS. Users should be aware that DFC is not necessarily synonymous with FRCC 1 because DFC is usually based on social and economic factors rather than on a single goal such as maintaining or restoring natural ecosystems.

Disturbance. Disruption of successional processes by fire, wind, flooding, insects, pathogens, and other change agents.

Ecosystem. An interacting unit of organisms and their environment with a set of characteristic structure, functions, and composition. Ecosystems can occur at multiple scales.

Early-seral, post-replacement: The BpS stage in which vegetation is in an early-succession (or young) stage. In forested and woodland biophysical settings, this type will typically have less than 10 percent tree canopy cover and in shrubland biophysical settings, less than 5 percent canopy cover. Ages will vary greatly depending on individual biophysical settings. This is typically "Class A" in FRCC methodology (see also "Seral").

Emulate, Mimic, Represent, or Simulate natural conditions and processes: Various terms to indicate the use of management activities (such as timber harvest, thinning, grazing, prescribed fire, restoration, and non-suppression of wildland fire) to change landscape composition and associated disturbance regimes to more closely reflect natural reference conditions.

Fire frequency / Mean fire interval (MFI): In FRCC methodology, this is the average number of years between fires for representative stands (defined as *cluster scale* by Arno and Peterson 1983). This is a measure of central tendency (average) and will be estimated for both reference fire frequency (default values will be used if the user does not specify a value) and for current fire frequency.

Fire regime: In FRCC methodology, a five-group classification based on fire frequency and fire severity. Note that reference fire regimes (also known as "natural" or "historical" fire regimes) may differ from current regimes, as measured by FRCC departure metrics.

Fire Regime Condition Class (FRCC): A classification of the amount of departure of conditions at a given time period (such as current or future) from ecological reference (historical) conditions. Pre-settlement ecosystems are commonly used as a benchmark for reference conditions and include possible Native American influence in the natural fire regime. As described below, the FRCC system uses three condition classes to signify low, moderate, or high departure from the natural fire regimes and associated vegetation.

Forest Service Activities Tracking System (FACTS): An activity tracking system used by the U.S. Forest Service to document and monitor treatment activities, timber sales, contracts and permits, NEPA decisions, and many other management activities at all levels of the agency.

FRCC characteristics: A measure of departure from reference (pre-settlement or natural or historical) ecological conditions that typically result in alterations of native ecosystem components. These ecosystem components include attributes such as species composition, structural stage, stand age, canopy closure, and fuel loadings. One or more of the following activities may have caused departures: fire suppression, timber harvesting, livestock grazing, introduction and establishment of exotic plant species, introduced insects or diseases, or other management activities. There are three classes:

Class	Description
1	Less than 33 percent departure from the central tendency of the historical range of variation (HRV): Fire regimes are within the natural or historical range and risk of losing key ecosystem components is low. Vegetation attributes (composition and structure) are well intact and functioning.
2	33 to 66 percent departure: 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). This departure may result in moderate changes in fire and vegetation attributes.
3	Greater than 66 percent departure: Fire regimes have been substantially altered. Risk of losing key ecosystem components is high. Fire frequencies may have departed by multiple return intervals. This may result in dramatic changes in fire size, fire intensity and severity, and landscape patterns. Vegetation attributes have been substantially altered.

FRCC Guidebook models: A set of BpS (PNVG) reference condition models developed by the FRCC Working Group between 2002 and 2005, based on Kuchler's (1964) classification of natural vegetation types for the conterminous U.S.

FRCC Mapping Tool (FRCCMT): An ArcGIS-based application for spatially assessing FRCC and for assisting spatial prioritization, and planning. The Mapping Tool uses the same algorithms as those used by the FRCC Standard Landscape Worksheet Method described below.

FRCC Standard Landscape Worksheet Method: A standardized landscape assessment system designed to support fire, vegetation, and fuels management planning. This method describes reference landscape characteristics based on fire regimes and associated vegetation, which are then evaluated against current conditions to produce departure and FRCC ratings. FRCC assessments can be conducted for two scales: *landscape-level FRCC* for assessing departure from reference conditions at the landscape scale and *stand-level FRCC* for assessing FRCC in smaller areas in the context of landscape-level FRCC. The landscape-level FRCC method must be conducted first in order to generate context inputs for stand-level FRCC assessments.

FRCC Working Group: The group of federal agency personnel and associated cooperators that developed the initial FRCC Guidebook methodology between 2002 and 2004; the team subsequently evolved into the larger National Interagency Fuels, Fire, & Vegetation Technology Transfer Team (NIFTT).

Fire regime group: A categorization of historical fire regimes to describe the frequency and severity of fires (based on Heinselman1973). The FRCC classification uses five fire regime groups:

Group	Frequency	Severity
I	0-35 years	Low / mixed
II	0-35 years	Replacement
III	35-200 years	Mixed / low
IV	35-200 years	Replacement
V	200+ years	Replacement / any severity

Fire severity: In FRCC methodology, this is the effect of fire in terms of upper layer canopy replacement. Replacement may or may not cause a lethal effect on the plants. For example, replacement fire in grassland simply removes the leaves, which usually resprout from the basal crown, whereas replacement fire in most conifers causes total tree mortality.

Severity Class	Effects
No Fire Effects	< 5 percent replacement
Low	6-25 percent replacement
Mixed	26-75 percent replacement
Replacement	> 75 percent replacement

Function. Ecosystem processes, such as water and nutrient cycling, disturbance, and succession.

Geographic Information System (GIS): A geographic information system consists of computer software, hardware, and peripherals that transform geographically referenced spatial data into information on the locations, spatial interactions, and geographic relationships of the fixed and dynamic entities that occupy space in the natural and built environments.

Historical conditions: See "Reference Conditions."

Historical range of variation (HRV): The variability and central tendencies of biophysical, disturbance, and climatic systems, across landscapes and through time, in the absence of modern human interference. Natural disturbances include native anthropogenic influences that have contributed to the development of native species adaptations and natural disturbance regimes. Both the terms *Historical range of variation* and *Natural range of variation* are in common use (Landres and others 1999) and are used to refer to a timeframe prior to EuroAmerican settlement. The critical items to include are the timeframe and the assumptions regarding disturbance. Because historical climate no longer exists, development of a "present natural range of variation" metric – for the era from the present projected 100-500 years into the future – may be warranted. Until this concept has been more fully developed and models built, however, relying on estimates from the historical period is appropriate. See also "Present natural range of variation."

Historical vegetation: The vegetation that developed prior to the EuroAmerican settlement era. Historical vegetation was a reflection of land potential and disturbance regime. Historical vegetation is used to define the reference conditions of FRCC and is essentially the same as the disturbance-constrained definition of potential natural vegetation. See also "Natural range of variation" and "Reference conditions."

LANDFIRE: A five-year, multi-partner project producing consistent and comprehensive maps and data describing vegetation, wildland fuel, and fire regimes across the United States. It is a shared project between the wildland fire management programs of the U.S. Department of Agriculture Forest Service and U.S. Department of the Interior. LANDFIRE data products include layers of vegetation composition and structure, surface and canopy fuel characteristics, and historical fire regimes. LANDFIRE National methodologies are science-based and include extensive field-referenced data. LANDFIRE data products are designed to facilitate national- and regional-level strategic planning and reporting of wildland fire management activities. Data products are created at a 30-meter grid spatial resolution raster data set. For more information, visit www.landfire.gov.

LANDFIRE National models: A set of BpS reference condition models for the entire U.S. that was developed by LANDFIRE personnel, The Nature Conservancy, and associated local experts between 2005 and 2009.

LANDFIRE Rapid Assessment models: An initial set of LANDFIRE BpS reference condition models for the continental U.S. that was developed by LANDFIRE personnel, The Nature Conservancy, and associated local experts between 2004 and 2005.

LANDFIRE Refresh models: A distillation of the LANDFIRE National BpS reference condition models for the entire U.S. begun by LANDFIRE personnel in 2009 and scheduled to be completed in 2011.

Landscape: In FRCC methodology, an assessment area exhibiting an array of biophysical settings and their associated natural vegetation and disturbance patterns.

Late-seral: The stage in a BpS in which vegetation is in a late-succession (or mature) stage for a given succession path. Ages will vary greatly depending on individual biophysical settings. This stage is typically associated with succession classes D and E in FRCC methodology.

Low-severity fire: Any surface fire replacing less than 25 percent of the dominant upper canopy layer in a succession class; as a result, low-severity fires can open or maintain a given succession class.

Map or method consistency/accuracy: In FRCC, consistency is a measure of agreement between the departure measure and class assignment across different geographic areas given the same combinations of inputs. For FRCC, accuracy refers to the similarity between calculation inputs and actual field conditions.

Mid-seral: The stage in a BpS in which vegetation is in a mid-succession (or immature) stage for a given succession path. Ages will vary greatly depending on individual biophysical settings. This stage is typically associated with succession classes B and C in FRCC methodology (see also "Seral").

Mixed-severity fire: A generally broad fire severity classification that refers to fire effects intermediate between the low severity and replacement severity ends of the fire regimes continuum. For FRCC purposes, mixed-severity fires refer to fires producing between 25 and 75 percent upper-layer replacement during a given event. Mixed-severity fires can open or maintain a succession class.

Mosaic fire: Generally refers to mixed-severity fires. However, the term can be problematic because other fire severity types can produce landscape mosaic patterns composed of a mix of burned and unburned patches. Accordingly, more-precise terms such as low, mixed, or replacement fire may be better terms for describing fire regimes for multiple analysis scales.

National Fire Plan Operations and Reporting System (NFPORS): An interagency system designed for submission and reporting of accomplishments for work conducted under the National Fire Plan and other agency fuels and resource programs.

National Interagency Fuels, Fire, & Vegetation Technology Transfer (NIFTT): A group of federal agency personnel and associated cooperators (previously called the National Interagency Fuels and Technology Team) that is chartered by the National Interagency Fuels Management Committee to assist land managers in the implementation of effective fuels, fire, and vegetation management technology for addressing risks related to severe fire behavior & fire effects and to restore healthy ecological systems. Part of NIFTT's mission is to develop, maintain, and support FRCC-related tools and technology transfer.

Natural conditions: See "Reference conditions."

Natural fire regime: The reference (or historical) fire regime that is operating in the absence of modern human interference. Natural fire regimes can include anthropogenic influences, such as Native American fire use, that may have contributed to the development of native species' fire adaptations.

Natural range of variation (NRV): See "Historical range of variation."

Open: A stand's structural trait describing a relatively sparsely occupied upper layer vegetation canopy. For FRCC purposes, the default canopy cover values for open forest, woodland, or herbaceous classes are less than 40 percent if based on canopy cover; default values for open shrub classes are less than 15 percent if based on line intercept cover. These are commonly applied as structure attributes for "open" succession classes C and D.

Patch: See "Stand."

Potential natural vegetation (PNV): The potential of a land area to support a specific type of natural vegetation. It refers to the composition of successional stages that would occur in the absence of modern human interference. This concept has been interpreted in two main ways: 1) succession proceeds to a climax state limited only by climatic constraints and 2) succession proceeds to a point where a disturbance (such as fire) limits further development. The former is used by the USDA Forest Service (Winthers and others 2005) and includes the potential vegetation type concept. Kuchler's (1964) Potential Natural Vegetation classification is one example of the latter, as is the historical climax plant community used by NRCS and Interior agencies (NRCS 2003). PNV is used in FRCC as a proxy to describe the environmental setting, and hence land capability, to generate a specific ecosystem.

Potential natural vegetation group (PNVG): A grouping of ecologically similar vegetation types modeled with characteristic disturbance inputs and used for FRCC assessments. In FRCC, this term has been replaced by the term biophysical setting (BpS). (See also "Historical vegetation," "Potential natural vegetation," and "Reference condition model.")

Potential vegetation type (PVT): The potential of a land area to support one or more climax plant associations using a climate-constrained rather than disturbance-constrained concept. PVT is based on identification of land that will support climax plant association indicator species. This plant association concept is based on the traditional Clementsian view of succession continuing to an end climax condition in the absence of disturbance. The plant association is typically named by the climax plant indicator species. This concept is most commonly used in the Northern Rockies. (Note that climate-constrained climax classifications are not used for FRCC assessments because both vegetation and fire regimes can vary widely within and between PVTs on a given landscape. See "Potential natural vegetation" for a comparison with disturbance-constrained definitions).

Potential vegetation type group (PVTG): A grouping of PVTs for coarse-scale assessment.

Present natural range of variation (PNRV): The variability and central tendencies of biophysical, disturbance, and climatic systems across landscapes, projected from the present into the future, in the absence of modern human interference. The concept therefore is predictive and somewhat speculative, but offers the advantage of a time frame with the current and predicted climate, rather than an historical climate that no longer exists. If used, the time frame must be specified and might be on the order of 100-500 years into the future. Until this concept has been more fully developed and models built, however, relying on a specified historical period (the method currently used to determine reference conditions in FRCC) is appropriate. See also "Historical range of variation" and "Natural range of variability."

Reference conditions: An estimate of the central tendency of the range (HRV) of succession class composition, fire frequency, and fire severity for a biophysical unit within a Landscape. Reference conditions are the basis for calculating the ecological departure used to determine FRCC. A time frame for this variation is always specified during the model development process. Reference conditions could also use the present natural range of variability (PNRV) for current or future conditions with the present or expected future climatic regime. Because data and models are generally lacking for this approach, however, most modelers continue to use HRV as defined for a specific pre-settlement period and associated climatic regime. PNRV offers the advantage of using the current or future climatic regime, but HRV will be used for the time being because it can be more easily characterized by studies of historical vegetation and disturbance.

Reference condition model: The box model of succession and disturbance pathways calibrated to characterize the range of variation (HRV or potentially PNRV) and central tendencies for reference conditions for a BpS. Reference condition models are used to determine the default reference values for reference percent composition of vegetation succession classes A through E and for fire frequency and severity in the FRCC methodology. Although these are provided as defaults at www.frcc.gov, users can also customize these values to better reflect local conditions using VDDT modeling with available local data.

Reference condition state and transition model: See "Box model."

Relative amount class: Succession class relative amount is the amount of a current S-Class compared to the estimated average amount for the reference period. The result is then classified into one of four categories: *Trace*, *Underrepresented*, *Similar*, *Overrepresented*, or *Abundant*.

Replacement-severity fire: Any fire that causes greater than 75 percent removal of the dominant upper canopy layer, reverting that succession class to an early-seral class. Note that such fires may or may not cause a lethal effect on the dominant plants. For example, replacement fire in grassland removes the leaves, but leaves resprout from the basal crown, whereas replacement fire in most conifers causes mortality of the plant.

Seral (or Seral stage): A hypothesized step-wise process of vegetative succession that proceeds from an initial post-replacement disturbance state to later succession states (see also "Succession").

Scale: As used in landscape ecology, scale refers to the spatial or temporal dimension of an object or process; it is characterized by both grain (finest level of spatial resolution) and extent (size of study area or duration of time under consideration). As used in cartography, scale is the degree of spatial reduction; it is the ratio of the distance on a map to the distance on the earth's surface. In a landscape assessment context, it is best to refer to scale in terms of extent ("broad" versus "fine").

Similarity: In FRCC methodology, time period conditions (current or future) across a landscape are compared to a central tendency estimate for the natural or historical reference conditions of the BpS. In FRCC, this is determined for succession class composition across the landscape and for changes in fire frequency and fire severity. The method used to determine succession class composition similarity was developed by Clements (1934) and is a relatively simple formula that can be hand-calculated in the field. The method used to determine fire frequency and severity similarity is a simple ratio of the smallest to the largest (Mueller-Dombois and Ellenberg 1974) that can also be hand-calculated. (See "Departure" for comparison of difference).

Small area: See "Stand."

Stand: For FRCC purposes, a stand is a small unit of relatively homogenous vegetation in a given succession class, often ranging from as little as 1 hectare (2 acres) to 100 hectares (250 acres) in size. Although the term "stand" is usually associated with forest and woodland biophysical settings and "patch" is generally used for rangeland and grassland types, note that the term "stand" is used for both situations throughout this Guidebook.

Stand-level assessment: A method for assigning FRCC to a given stand, patch, or small area comprising a succession class based on the relative amount of that succession class on the landscape. Note, however, that an FRCC assessment must first be performed for the entire surrounding landscape before attempting to assess individual stands.

Stratum (*plural*: Strata): For FRCC assessments, a delineation of a given landscape, generally based on the area's array of biophysical settings.

Succession: The progression of change in the composition, structure, and processes of a plant community through time.

Succession class (S-Class): In FRCC methodology, a seral stage classification based on descriptions of structure and composition, disturbance processes, and pattern. S-Classes are grouped into those that are characteristic of the natural or historical conditions and those that are uncharacteristic of these conditions.

State and transition model: See "Box model."

Uncharacteristic: A vegetation succession class that did not occur historically in a given biophysical setting. Uncharacteristic succession classes can occur as a result of invasive plants or introduced diseases, timber or grazing management that doesn't emulate natural disturbances, severe soil disturbance, or effects from native insects or diseases that are beyond their historical ranges of influence.

VDDT: Vegetation Dynamics Development Tool. A public domain software program created by the company ESSA. This tool provides software for reference condition modeling and is available at www.essa.com.

Vegetation-fuel Class (VFC): An early vegetation descriptor that was replaced in FRCC Guidebook version 1.3 by the current term *succession class* (*S-Class*).

Appendix A: Data Forms

FRCC Standard Landscape Method Worksheet
Field Form
FRCC Code Sheet
Simple 7 Form*

*The Simple 7 data form emphasizes the seven key variables used in diagnosing Stratum FRCC. This form, which is user friendly and self-explanatory, can be used for in-house training and other educational purposes.

Fire Regime Condition Class Standard Landscape Worksheet (landscape page)

Landscape Data (fields 1-15)

Registration Code	1	**Landscape Code**	2	**Characterization Date**	3 / /	
Examiner Code	4	**Landscape Name**	5	**Landscape Area**	6	**acres / hectares** (circle one) (7)

Georeferenced Landscape Position

Latitude	8	**Longitude**	9	**Datum**	10

Landscape Photos:

		Photo Dates:
Current	11	12 / /
Reference	13	14 / /

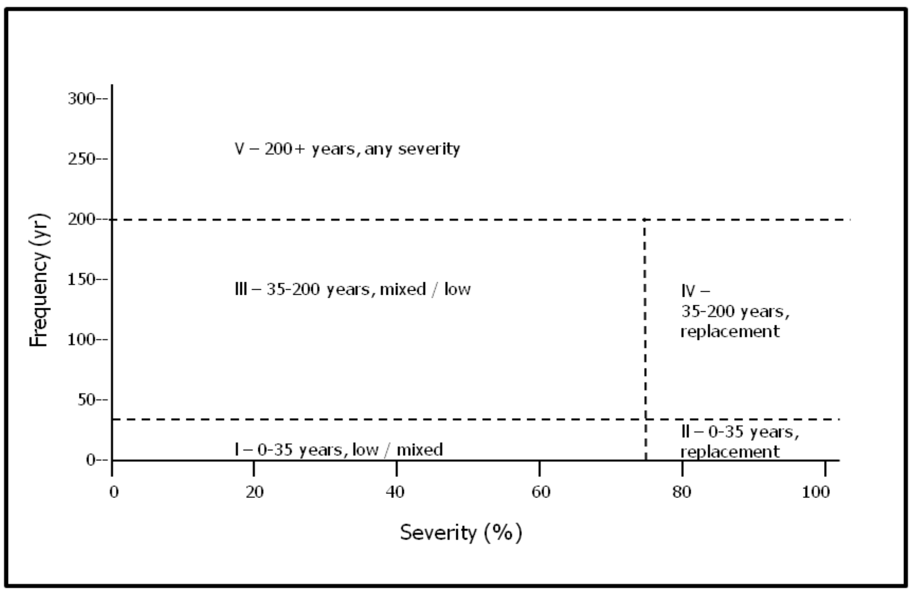
Comments:

15

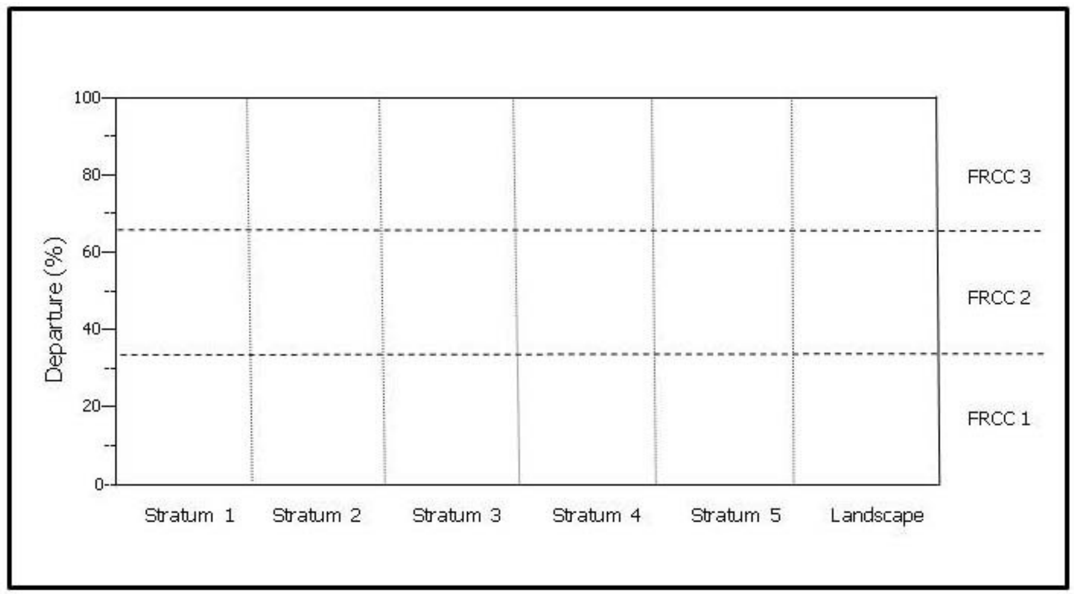
Before completing the section below, complete one stratum page for each stratum in the landscape (over)

Landscape Summary (fields 71-75)			Strata 1	Strata 2	Strata 3	Strata 4	Strata 5	Landscape Totals
Field 18	**Stratum % Compositions.** Enter the % of the landscape that each stratum comprises (field 18 of the stratum page)	18						100 %
Field 71	**Stratum Departures.** Enter field 71 from the stratum worksheet.	71						
Field 73	**Stratum Weighted Departures.** (field 18 / 100) * field 71	73						
Field 74	**Landscape Departure.** Enter the sum of field 73 columns 1 - 5	74						%
Field 75	**Landscape Fire Regime Condition Class.** Enter "1" if field 74 is 0 - 33%, "2" if 34 - 66%, "3" if 67 - 100%	75						

Fire Regime Classification Graph



FRCC Graph



Fire Regime Condition Class Standard Landscape Worksheet (stratum page)

- Use One Page Per Stratum -

Stratum Data (fields 16-46)

Stratum Num	16	**BpS Code**	17
Composition	18	(% of landscape)	
Reference Fire Frequency	19	**Current Fire Frequency**	20
Reference Fire Severity	21	**Current Fire Severity**	22

BpS Lifeform	23	Indicator Species	24		25		26
Landform	27	Avg Slope Class	28	Insolation Class	29		
Low Elevation	30	High Elevation	31	Elevation Units	32 ft / m		
Latitude	33	Longitude	34	Datum	35		
Current Photo	36	Photo Date	37 / /	Ref Percent Comp Source	38	Curr Percent Comp Source	39
Comments	46						

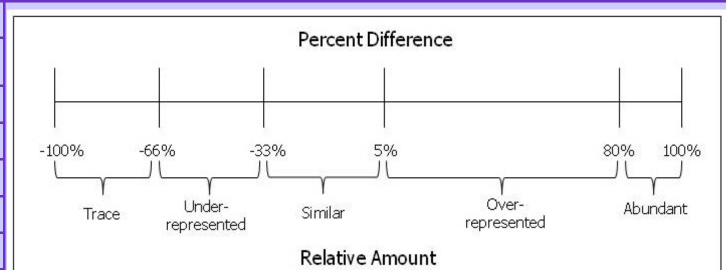
	Unchar. S-Classes Code	Comments
1	40	41
2	42	43
3	44	45

Stratum Data: Succession Class (S-Class) Composition Data (fields 47-57)

Succession Class (47)	**Ref % Comp** (48)	**Curr % Comp** (49)	Upper Layer Lifeform (50)	Upper Layer Size Class (51)	Dominant Species 1 (52)	Dominant Species 2 (53)	Dominant Species 3 (54)	Dominant Species 4 (55)	Photo (filename/pathway) (56)	Photo Date (57)
A	%	%								/ /
B	%	%								/ /
C	%	%								/ /
D	%	%								/ /
E	%	%								/ /
U (all)	0 %	%								/ /

Stratum Data: Stratum Totals (fields 58-72)

			A	B	C	D	E	U	Stratum Totals	
Field 47	S-Class (rows above become columns here for fields 47, 48 and 49)	47	A	B	C	D	E	U		
Field 48	**Reference Percent Composition**. Enter the values from field 48 above	48						0		
Field 49	**Current Percent Composition**. Enter the values from field 49 above	49								
Field 58	**S-Class Similarity.** Enter the smaller of fields 48 (reference) and 49 (current)	58						0		
Field 59	**Stratum Similarity.** Enter the sum of field 58 for all columns	59							59	%
Field 60	**S-Class Percent Difference**. If f49 < f48: diff = ([f49 - f48] / f48) * 100; If f49 ≥ f48: diff = ([f49 - f48] / f49) * 100	60						100 %		
Field 61	**S-Class Relative Amount**. "Trace" if field 60 is < -66, "Underrepresented" if f60 ≥ -66 to < -33%, "Similar" if f60 ≥ -33 to ≤ 5%, "Overrepresented" if f60 > 5 to ≤ 80%, "Abundant" if > 80%. (see Rel. Amt. scale below)	61						Abundant		
Field 62	**Stand Departure.** If f60 ≥ 0 enter f60 value, if f60 < 0 enter 0	62								
Field 63	**Stand Fire Regime Condition Class.** If f61 = Trace, Underrepresented or Similar, enter "1"; if f61 is Overrepresented, enter "2"; if Abundant, enter "3"	63								
Field 64	**Stratum Area of Vegetation Departure.** Field 6 * (f18 / 100) * ([f49 - f48] / 100)	64								
Field 65	**Stratum Vegetation Departure.** Subtract the value in field 59 from 100	65							65	%
Field 66	**Stratum Vegetation Condition Class.** "1" if field 65 is 0 - 33%, "2" if 34 - 66%, "3" if 67 - 100%	66							66	
Field 67	**Stratum Fire Frequency Departure.** Calculate: (1 - [(smaller of fields 19 and 20) / (larger of fields 19 & 20)]) * 100	67							67	%
Field 68	**Stratum Fire Severity Departure.** Calculate: (1 - [(smaller of fields 21 and 22) / (larger of fields 21 & 22)]) * 100	68							68	%
Field 69	**Stratum Regime Departure.** Calculate: (field 67 + field 68) / 2	69							69	%
Field 70	**Stratum Regime Condition Class.** "1" if field 69 is 0 - 33%, "2" if 34 - 66%, "3" if 67—100%	70							70	
Field 71	**Stratum Departure.** Calculate: (field 65 + field 69) / 2	71							71	%
Field 72	**Stratum Fire Regime Condition Class.** "1" if field 71 is 0 - 33%, "2" if 34 - 66%, "3" if 67—100%	72							72	



Fire Regime Condition Class Standard Landscape Method Field Form

Landscape Data (fields 1-15)

Registration Code	1	**Landscape Code**	2	**Characterization Date**	3 / /	**Examiner Code**	4
Landscape Name	5			**Landscape Area**	6	**acres / hectares** (circle one) (7)	

Georeferenced Landscape Position

Latitude	8	**Longitude**	9	**Datum**	10

Landscape Photos:		Photo Dates:	Comments:
Current	11	12 / /	
Reference	13	14 / /	15

Stratum Data (fields 16-46)

Stratum Num	16	**BpS Code**	17	BpS Lifeform	23	Indicator Species	24	25	26
Comp.	18	(% of landscape)		Landform	27	Avg Slope Class	28	Insolation Class	29
Reference Fire Freq.	19	**Current Fire Freq.**	20	Low Elevation	30	High Elevation	31		
Reference Fire Sev	21	**Current Fire Sev.**	22	Elevation Units	32 ft / m				
Georeferenced Stratum Position:	Latitude	33	Longitude	34	Datum	35			
Current Photo	36	Photo Date	37 / /	Ref % Comp Source	38	Curr % Comp Source	39		
Comments	46								

Unchar. S-Classes:	Code	Comments
1	40	41
2	42	43
3	44	45

Stratum Data: Succession Class (S-Class) Composition Data (fields 47-57)

Succession Class (47)	**Ref % Comp** (48)	**Curr % Comp** (49)	Upper Layer Lifeform (50)	Upper Layer Size Class (51)	Dominant Species 1 (52)	Dominant Species 2 (53)	Dominant Species 3 (54)	Dominant Species 4 (55)	Photo (filename/pathway) (56)	Photo Date (57)
A	%	%								/ /
B	%	%								/ /
C	%	%								/ /
D	%	%								/ /
E	%	%								/ /
U (all)	0 %	%								/ /

Stratum Data (fields 16-46)

Stratum Num	16	**BpS Code**	17	BpS Lifeform	23	Indicator Species	24	25	26
Comp.	18	(% of landscape)		Landform	27	Avg Slope Class	28	Insolation Class	29
Reference Fire Freq.	19	**Current Fire Freq.**	20	Low Elevation	30	High Elevation	31		
Reference Fire Sev	21	**Current Fire Sev.**	22	Elevation Units	32 ft / m				
Georeferenced Stratum Position:	Latitude	33	Longitude	34	Datum	35			
Current Photo	36	Photo Date	37 / /	Ref % Comp Source	38	Curr % Comp Source	39		
Comments	46								

Unchar. S-Classes:	Code	Comments
1	40	41
2	42	43
3	44	45

Stratum Data: Succession Class (S-Class) Composition Data (fields 47-57)

Succession Class (47)	**Ref % Comp** (48)	**Curr % Comp** (49)	Upper Layer Lifeform (50)	Upper Layer Size Class (51)	Dominant Species 1 (52)	Dominant Species 2 (53)	Dominant Species 3 (54)	Dominant Species 4 (55)	Photo (filename/pathway) (56)	Photo Date (57)
A	%	%								/ /
B	%	%								/ /
C	%	%								/ /
D	%	%								/ /
E	%	%								/ /
U (all)	0 %	%								/ /

Stratum Data (fields 16-46)

Stratum Num	16	**BpS Code**	17	BpS Lifeform	23	Indicator Species	24	25	26
Comp.	18	(% of landscape)		Landform	27	Avg Slope Class	28	Insolation Class	29
Reference Fire Freq.	19	**Current Fire Freq.**	20	Low Elevation	30	High Elevation	31	Unchar. S-Classes: Code	Comments
Reference Fire Sev.	21	**Current Fire Sev.**	22	Elevation Units	32 ft / m			1 40	41
Georeferenced Stratum Position:		Latitude	33	Longitude	34	Datum	35	2 42	43
Current Photo	36	Photo Date	37 / /	Ref % Comp Source	38	Curr % Comp Source	39	3 44	45
Comments	46								

Stratum Data: Succession Class (S-Class) Composition Data (fields 47-57)

Succession Class (47)	**Ref % Comp** (48)	**Curr % Comp** (49)	Upper Layer Lifeform (50)	Upper Layer Size Class (51)	Dominant Species 1 (52)	Dominant Species 2 (53)	Dominant Species 3 (54)	Dominant Species 4 (55)	Photo (filename/pathway) (56)	Photo Date (57)
A	%	%								/ /
B	%	%								/ /
C	%	%								/ /
D	%	%								/ /
E	%	%								/ /
U (all)	0 %	%								/ /

Stratum Data (fields 16-46)

Stratum Num	16	**BpS Code**	17	BpS Lifeform	23	Indicator Species	24	25	26
Comp.	18	(% of landscape)		Landform	27	Avg Slope Class	28	Insolation Class	29
Reference Fire Freq.	19	**Current Fire Freq.**	20	Low Elevation	30	High Elevation	31	Unchar. S-Classes: Code	Comments
Reference Fire Sev	21	**Current Fire Sev.**	22	Elevation Units	32 ft / m			1 40	41
Georeferenced Stratum Position:		Latitude	33	Longitude	34	Datum	35	2 42	43
Current Photo	36	Photo Date	37 / /	Ref % Comp Source	38	Curr % Comp Source	39	3 44	45
Comments	46								

Stratum Data: Succession Class (S-Class) Composition Data (fields 47-57)

Succession Class (47)	**Ref % Comp** (48)	**Curr % Comp** (49)	Upper Layer Lifeform (50)	Upper Layer Size Class (51)	Dominant Species 1 (52)	Dominant Species 2 (53)	Dominant Species 3 (54)	Dominant Species 4 (55)	Photo (filename/pathway) (56)	Photo Date (57)
A	%	%								/ /
B	%	%								/ /
C	%	%								/ /
D	%	%								/ /
E	%	%								/ /
U (all)	0 %	%								/ /

Fire Regime Condition Class Code Sheet

Stratum BpS Lifeform (23)

AQ	Aquatic
NV	Non-vegetated
CF	Coniferous upland forest
CW	Coniferous wetland or riparian forest
BF	Broadleaf upland forest
BW	Broadleaf wetland or riparian forest
SA	Shrub-dominated alpine
SU	Shrub-dominated upland
SW	Shrub-dominated wetland or riparian
HA	Herbaceous-dominated alpine
HU	Herbaceous-dominated upland
HW	Herbaceous-dominated wetland or riparian
ML	Moss or lichen dom. upland or wetland
WD	Woodland
OT	Other BpS vegetation lifeform

Stratum Landform (27)

GMF	Glaciated mountains-foothills
NMF	Non-glaciated mountains-foothills
BRK	Breaklands, river breaks, badlands
PLA	Plains, rolling plains, plains w/ breaks
VAL	Valleys, swales, draws
HIL	Hills, low ridges, benches

Average Slope Class (28)

GENTL	0 to ≤ 10%
MOD	> 10 to ≤ 30%
STEEP	> 30 to ≤ 50%
VSTEEP	> 50%

Insolation Class (29)

LOW	Northerly aspects / Cold air pockets
MOD	Flat to ≤ 10% slope
HIGH	Southerly aspects / Warm air upflows

Reference Condition S-Class Source (38)

N	Non-local expert estimate
D	Determined from literature review and modeling workshops
R	Regional / state default values from literature review & modeling workshops
L	Local expert estimate
T	Interdisciplinary team (IDT) consensus w/ local expert
M	Local expert estimate w/ lit. review & modeling workshop w/ local expert
B	IDT consensus from lit. review & modeling workshop w/ local expert
F	Intensive field study w/ lit. review & modeling workshops

Current S-Class Comp Source (39)

V	Visual estimate
R	Walk through with visual estimate
M	Mapped summary or other spatial data source

S-Class (47)

Codes for Characteristic S-Classes
(Typical [But Varies])

A	Early-seral; Post-replacement
B	Mid-seral; Closed
C	Mid-seral; Open
D	Late-seral; Open
E	Late-seral; Closed

Codes for Uncharacteristic S-Classes (40, 42, 44)

UINP	Invasive Plants
UTHV	Timber mgt. not mimicking natural regime
UGRZ	Grazing mgt. not mimicking natural regime
UFUS	Unnatural fuels accumulation and succession
UFEF	Fire effects are uncharacteristic
USHD	Unnatural soil disturbance
UIDS	Insects/Diseases: Exotic or unnaturally severe
UCLR	Cultural (e.g., tree plantations)
UPAT	Unnatural stand patches or landscape patterns
UOTH	Other (Describe in f. 41, 43, 45)

S-Class Upper Layer Lifeform (50)

CONT	Coniferous trees
BRDT	Broadleaf trees
SHRB	Shrubs
HERB	Herbaceous
MOSS	Moss or lichens
NVEG	Non-vegetated
NNNN	Does not fit any class

S-Class Upper Layer Size Class (51)

Coniferous and Broadleaf Trees:

SEED	Seedling - Trees < 4.5 feet tall
SAPL	Sapling - Trees ≥ 4.5 feet and < 5.0 inches DBH
POLE	Pole - Trees ≥ 5 inches DBH and < 9 inches DBH
MEDM	Medium - Trees ≥ 9 inches DBH and < 21 inches DBH
LARG	Large - Trees ≥ 21 inches DBH and < 33 inches DBH
VLAR	Very large - Trees ≥ 33 inches DBH

Shrubs

LOWS	Low - Shrubs ≤ 3 feet tall
MEDS	Medium - Shrubs > 3 feet tall and < 6.5 feet tall
TALS	Tall - Shrubs ≥ 6.5 feet tall

Herbaceous

LOWH	Low - Herbaceous ≤ 2 feet tall
TALH	Tall - Herbaceous > 2 feet tall

Other

MMLL	Moss, lichens, litter / duff
BARN	Barren, rock, gravel, soil
NNNN	Does not fit any category; unable to assess

Stratum S-Class Relative Amount (61)

Code	Rel. Amt. Class	Range
T	Trace	< -66% Departure
U	Underrepresented	≥ -66 to < -33%
S	Similar	≥ -33 to ≤ 5%
O	Overrepresented	> 5 to ≤ 80%
A	Abundant	> 80% and all U classes

FRCC Simple 7 Form

Landscape Code (Field 2)______________ Characterization Date (3) ___________________
Landscape Name (5) ___________________________ Landscape Area (6) _______________ Units (7) (circle one): acres / hectares
Latitude (8) _____________________ Longitude (9) ________________________ Datum (10) _______________________

Stratum Number (16) _____________ BpS Code (17) __________________ Composition (18) ______________%
Latitude (33) ____________________________ Longitude (34) ____________________________ Datum (35) _____________

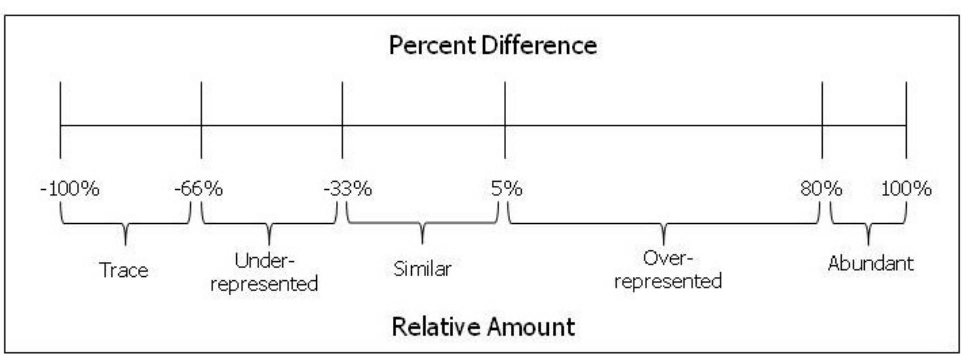
Regime Inputs	Reference	Current	Departure (1 - [smaller / larger]) * 100
Fire Frequency (yrs)	(19)	(20)	(67) %
Fire Severity (% Replacmt.)	(21)	(22)	(68) %
Regime Departure. (Frequency Dep. + Severity Dep.) / 2			(69) %
Regime Condition Class. (**1** = 0-33%; **2** = 34-66%; **3** = 67-100%)			(70)

Succession Class (S-Class) (47)	Reference % (48)	Current % (49)	Similarity (lower of Ref or Curr) (58)	Pct. Difference (60) If (curr<ref) Diff = ([curr-ref]/ref)*100 If (curr≥ref) Diff = ([curr-ref]/curr)*100	Relative Amount[1] (61)	Stand FRCC[2] (63)
A						
B						
C						
D						
E						
U	**0**		**0**	**100**	**A**	**3**
Sum	**100**	**100**				
Vegetation Departure. (100 minus the Similarity sum)						(65) %
Vegetation Cond. Class. (**1** = 0-33%; **2** = 34-66%; **3** = 67-100%)						(66)
Stratum Departure. (Regime Dep. + Veg. Dep.) / 2						(71)
Stratum FRCC. (**1** = 0-33%; **2** = 34-66%; **3** = 67-100%)						(72)

Comments (46)____
____
____
____
____
____

[1] **Relative Amount:**
(Based on Percent Difference)
T: Trace (<-66%)
U: Underrepresented (≥-66 to < -33%)
S: Similar (≥-33 to ≤5%)
O: Overrepresented (>5 to ≤80%)
A: Abundant (>80%, and all **U** classes)

[2]**Stand Fire Regime Condition Class:**
(Based on Relative Amount)
FRCC 1 = Trace, Underrep., Similar
FRCC 2 = Overrepresented
FRCC 3 = Abundant



Appendix B: List of New vs. Old Data Fields (Version 3.0 vs. Version 1.3)

Table B-1. List of Guidebook version 3.0 data fields versus those from earlier versions (dashes denote *not applicable*).

Field No.	Field Name	Prev. No.	Previous Name
1	Landscape Registration Code	1	Registration Code
2	Landscape Code	2	Project Code
3	Landscape Characterization Date	4	Characterization Date
4	Landscape Examiner Code	5	Examiner Code
5	Landscape Name	6	Project Name
6	Landscape Area	7	Project Area
7	Landscape Acres/Hectares	8	Acres/Hectares
8	Landscape Latitude	10	Latitude
9	Landscape Longitude	11	Longitude
10	Landscape Datum	15	Datum
11	Landscape Current Photo	16	Current Photo
12	Landscape Current Photo Date	17	Current Photo Date
13	Landscape Reference Condition Photo	18	Reference Condition Photo
14	Landscape Reference Condition Photo Date	19	Reference Condition Photo Date
15	Landscape Comments	20	Comments
16	Stratum Number	21	Stratum Number
17	Stratum Biophysical Setting Code	26	BpS Code
18	Stratum Composition Percent	41	Composition %
19	Stratum Reference Condition Fire Frequency	51	Ref. Cond. Fire Freq.
20	Stratum Current Fire Frequency	52	Current Fire Freq.
21	Stratum Reference Condition Fire Severity	53	Ref. Cond. Fire Sev.
22	Stratum Current Fire Severity	54	Current Fire Sev.
23	Stratum Biophysical Setting Lifeform	25	BpS Lifeform
24	Stratum Indicator Species 1	27	Indicator Species 1
25	Stratum Indicator Species 2	28	Indicator Species 2
26	Stratum Indicator Species 3	29	Indicator Species 3
27	Stratum Landform	32	Landform
28	Stratum Average Slope Class	34	Average Slope Class
29	Stratum Insolation Class	36	Insolation Class
30	Stratum Low Elevation	38	Low Elevation
31	Stratum High Elevation	39	High Elevation
32	Stratum Elevation Units	40	Elevation Units
33	Stratum Latitude	43	Latitude
34	Stratum Longitude	44	Longitude
35	Stratum Datum	48	Datum
36	Stratum Current Photo	49	Current Photo
37	Stratum Photo Date	50	Photo Date

38	Stratum Reference Percent Composition Source	55	Ref. % Comp. Source
39	Stratum Current Percent Composition Source	56	Current % Comp. Source
40	Stratum Uncharacteristic S-Class Code 1	-	-
41	Stratum Uncharacteristic S-Class Description 1	-	-
42	Stratum Uncharacteristic S-Class Code 2	-	-
43	Stratum Uncharacteristic S-Class Description 2	-	-
44	Stratum Uncharacteristic S-Class Code 3	-	-
45	Stratum Uncharacteristic S-Class Description 3	-	-
46	Stratum Comments	60	Comments
47	Succession Class Code	62	Succession Class
48	Succession Class Reference Percent Composition	72	Ref. % Comp.
49	Succession Class Current Percent Composition	73	Current % Comp.
50	Succession Class Upper Layer Lifeform	63	Upper Layer Lifeform
51	Succession Class Upper Layer Size Class	64	Upper Layer Size Class
52	Succession Class Dominant Species 1	66	Dominant Species 1
53	Succession Class Dominant Species 2	67	Dominant Species 2
54	Succession Class Dominant Species 3	68	Dominant Species 3
55	Succession Class Dominant Species 4	69	Dominant Species 4
56	Succession Class Photo	74	Photo
57	Succession Class Photo Date	75	Photo Date
58	Succession Class Similarity	77	S-Class Similarity
59	Stratum Similarity	78	Strata Similarity
60	Succession Class Percent Difference	79	S-Class % Difference
61	Succession Class Relative Amount	80	S-Class Relative Amount
62	Stand Departure	81	Stand Departure
63	Stand Fire Regime Condition Class	82	Stand FRCC
64	Stratum Area of Vegetation Departure	83	Stratum Area of S-Class Departure
65	Stratum Vegetation Departure	85	Stratum Current S-Class Departure
66	Stratum Vegetation Condition Class	86	Stratum S-Class FRCC
67	Stratum Fire Frequency Departure	87	Stratum Current Fire Frequency Departure
68	Stratum Fire Severity Departure	88	Stratum Current Fire Severity Departure
69	Stratum Regime Departure	89	Stratum Current Freq.-Sever. Departure
70	Stratum Regime Condition Class	90	Stratum Freq.-Sever. FRCC
71	Stratum Departure	-	-
72	Stratum Fire Regime Condition Class	91	Stratum Fire Regime Condition Class
73	Stratum Weighted Departure	99	Stratum Weighted Departure
74	Landscape Departure	100	Landscape Departure
75	Landscape Fire Regime Condition Class	104	Landscape Fire Regime Condition Class

Table B-2. Previous data fields that have been discontinued for Guidebook version 3.0.

Prev. Field No.	Previous Field Name
3	Project Number
22	Stratum Code
23	Stratum Number
24	Stratum Characterization Date
30	Indicator Species 4
31	Local BpS
57	Native American Burning
58	B/C Class Break
59	D/E Class Break
65	Upper Layer Canopy Closure
70	Anderson Fuel Model
93	Proj. Area Weighted Ref. Cond. Mean Fire Frequency
94	Proj. Area Weighted Ref. Cond. Mean Fire Freq. Class
96	Proj. Area Ref. Cond. Weighted Mean Fire Severity
97	Proj. Area Ref. Cond. Fire Sever. Class
98	Proj. Area Natural Fire Regime Group
101	Stratum Weighted Fire Freq.-Sever. Departure
102	Proj. Area Weighted Fire Freq.-Sever. Departure
103	Proj. Area S-Class or Fire Freq.-Sever. Weighted Mean Departure

Appendix C: Suitable Reasons for Replacing Default Reference Condition Values with Local Values

1. Reasons for Replacing Default Reference Condition Data with Locally Generated Data

2. Protocol for Developing Local Reference Condition Models

Reasons for Replacing Default Reference Condition Data with Locally Generated Data

There are five suitable reasons for replacing the default reference condition data with locally generated data. These include situations in which:

1) The area occupied by a given biophysical setting (BpS) in your Landscape is geographically much smaller than that simulated by the default models;

2) Local expert knowledge or results from formal studies in the area indicate a permanently altered BpS;

3) The BpS stratum is constrained by physical or land use barriers (property boundaries) that preclude the disturbance regime from operating naturally, such that any field data reflecting the current condition will likely be dissimilar to those generated by the reference condition modeling;

4) The current succession class (S-Class) composition of a given BpS has been drastically skewed in relation to the modeled reference condition as a result of a very large-scale disturbance, such as a climate-driven stand-replacing fire;

5) A local stratum or associated succession classes have been classified or mapped at a much finer resolution than that which was used to simulate default reference conditions during modeling.

The following section describes in more detail the five possible reasons for adjusting the default reference conditions for a given BpS. After reading this information carefully, please record in your Stratum comments field or elsewhere which scenario best supports your editing rationale.

1) The scale of the geographic extent of the BpS landscape is much finer than that which was used to simulate default reference conditions during modeling.

   This would commonly occur where a local administrative unit (such as a National Forest, National Park, or BLM Field Office) is refining FRCC inputs with enhanced input data and reference conditions. To support the investment in making these changes, local expert knowledge or results from studies, inventory, or monitoring of the BpS should indicate a difference in the default type or rate of natural state transitions. These differences include S-Class description, rates of change between succession classes, and disturbance probabilities or severities. Differences should be of an adequate level to change the departure value, FRCC, relative amount, or management implications.

2) Local expert knowledge or results from studies of the BpS indicate a permanently altered system that has changed the type or rate of natural state transitions. Alterations include:

   a) A BpS stratum that is substantially smaller than that which would support the natural diversity of S-Class patches and composition that is in harmony with the natural disturbance regime. Examples include a small fish and wildlife refuge, a small national monument, or a small patch of public land surrounded by private land not managed as wildland.

   b) A BpS stratum with exotic invasives that are more competitive than the dominant native species, thus changing the type or rate of natural state transitions.

   c) A BpS stratum in which a native species critical to S-Class composition and transitions has been extirpated, thus changing the type or rate of natural state transitions.

   d) A BpS stratum drastically altered as a result of climate change, soil loss or type change, or other permanent changes in BpS physical characteristics that heavily affect the type or rate of natural state transitions. An example would be unnatural erosion of a grass-dominated dark, loamy surface soil that leaves a rocky soil prone to shrub domination.

3) The BpS stratum is constrained in size by physical or land use barriers that preclude the functioning of the natural fire regime and resultant natural diversity of S-Class patches and composition.

An example would be a BpS stratum with an infrequent or rare replacement fire regime topographically restricted to the upper zone of an isolated mountain range, where just one or two states of vegetation development might be expected to dominate the entire BpS at any given time – unlike the scenario suggested by the coarser-scale default model. In such cases, the localized reference conditions can be adjusted to show up to 100 percent of the S-Class composition occurring in any one state. (Also note that the BpS in question can also be examined at a coarser scale to determine if the natural succession class diversity exists in the larger area beyond the Landscape boundaries).

4) The current S-Class composition is now drastically skewed in relation to the modeled reference condition as a result of a very large scale disturbance, such as a climate-driven stand-replacing fire or insect epidemic.

   Such scenarios reflect a temporal anomaly that can skew S-Class composition relative to that suggested by the default simulation modeling. In Alaska, for example, spruce beetle epidemics in the upland spruce hardwood and coastal boreal transition types can promote dominance by one forest age class (S-Class) for vast expanses far in excess of the scales suggested by default models.

5) Stratum or S-Class classification and/or mapping occurring at a much finer resolution than that simulated during the default reference condition modeling.

   An example would be a classification based on understory composition, fuels, terrain, soils, or other factors that subdivide BpS succession classes initially described by the default models.

   Note: A common question relates to changing reference conditions in landscapes where the management objective is for a state (S-Class) or disturbance composition that is not in harmony with the natural or permanently altered regime described by the default or localized reference conditions. *This is not a suitable reason for changing the default reference conditions.* From a management perspective, landscapes with these management objectives typically require a higher investment in order to convert or maintain a condition that is not in harmony with the natural regime. In addition, such management potentially jeopardizes the continued existence of native ecological components and processes. The general goal of FRCC assessment and monitoring is to determine to what extent current management is maintaining or restoring natural systems – that is, how well native ecological components and processes are being conserved. As a performance measure, therefore, FRCC should be used where the land management objectives involve sustainability of the natural fire regime, improvement of forest or rangeland health, and reduction of hazard to native ecological components or processes.

Protocol for Developing Local Reference Condition Models

Users can develop their own reference condition data for any given BpS by using the following FRCC modeling protocol. (Note that the reference condition variables typically needing adjustment include up to five succession classes, fire frequency, and fire severity):

1) Document which suitable reason from above justifies changing the reference condition from the default.

2) Document that the reference condition has been adjusted in combination with the above reference condition variables through use of the Vegetation Dynamics Development Tool (VDDT) or similar non-spatial model or through a companion spatial model such as Tool for Exploratory Landscape Analysis (TELSA), Landscape Succession Model (LANDSUM), or other similar spatial model.

3) Document the local expert or team making the adjustment and the associated literature and field reconnaissance methods that support the model refinement.

Appendix D: FRCC Frequently Asked Questions

1. Since FRCC metrics were emphasized in the 2001 National Fire Plan (NFP) and in other policy arenas, where does FRCC stand in terms of national importance in 2010?
2. Do I need to be an FRCC-certified user in order to conduct assessments?
3. What does the Registration Code (data field 1) on the Standard Landscape Worksheet represent?
4. What kinds of support are available to FRCC users?
5. What is NIFTT's response to a critic who says that the FRCC methodology is a relatively opaque process that generates simplistic metrics?
6. Is the FRCC methodology too esoteric / over-specialized for most managers? In other words, is it difficult to understand and use?
7. Who developed the default biophysical settings (BpS) reference condition models and how were they developed?
8. Have the default reference condition values been peer reviewed?
9. Can I develop my own reference condition models, or is such modeling too complex for the average user?
10. Why does the FRCC method use the historical range of variation (HRV) in calculating departure, since HRV reflects somewhat cooler climatic conditions that may never occur again?
11. Isn't the concept of an historical (or even current) range of variation becoming irrelevant since the climate is warming and ecosystems may change in ways that are unpredictable?
12. Shouldn't the historical (or natural) range of variation be used only for context when interpreting FRCC outcomes – and not for actual management targets?
13. Are the federal agencies required to convert all FRCC 3 and FRCC 2 lands back to FRCC 1?
14. Why do the reference condition models and FRCC assessments use stand-scale fire frequency for characterizing landscape-scale occurrence?

1. Question: **Since FRCC metrics were emphasized in the 2001 National Fire Plan (NFP) and in other policy arenas, where does FRCC stand in terms of national importance in 2010?**

Answer: Although FRCC assessments are not components of every management plan or project, FRCC data remain important for documenting and monitoring ecosystem health – which is a key concept in the NFP and other policy directives. First, the FRCC Guidebook provides a nationally consistent method and a comprehensive set of biophysical setting models that synthesize our knowledge of how fire regimes shape landscape structure and function. In addition to being useful for ecosystem-based management, FRCC data can contribute to planning for specific resource objectives, such as range, wildlife, fire, and timber management. Back to FAQs

***2. Question*:** **Do I need to be an FRCC-certified user in order to conduct assessments?**

***Answer*:** No, users of this methodology do not need to be certified. Note, however, that NIFTT offers a certification course that can greatly enhance your understanding and ability to conduct assessments. FRCC certification can also enhance one's professional resume. In addition, informal training courses have occasionally been offered within a given agency or through a collaborator such as The Nature Conservancy (contact ecologists in your region for information). And finally, users who have conducted previous FRCC assessments should update their skills by reading FRCC Guidebook version 3.0 to learn about new methods, data forms, and tools (See also next two FAQs.) Back to FAQs

***3. Question*:** **What does the Registration Code (data field 1) on the Standard Landscape Worksheet represent?**

Answer: The Registration Code can be any unique identifier that is meaningful to the user. For example, you might want to use the National Wildfire Coordination Group unit identifier (see www.nwcg.gov for more information). For example, "FBST" is the NWCG code for the Stevensville Ranger District on the Bitterroot National Forest. Or users can create their own custom codes, such as "BMDI" for the BLM's Battle Mountain District. In either case, we encourage the use of only one Registration Code per management unit, followed by unique Landscape Codes (field 2) for each assessment area. Back to FAQs

***4. Question*:** **What kinds of support are available to FRCC users?**

***Answer*:** NIFTT maintains a help desk that typically responds to users within 24 hours of initial contact. In addition, some of the FRCC software tools have user friendly, built-in Help functions. In addition, users can take the online course Fire Regime Condition Class, which introduces the participant to the theories and principles behind FRCC and also teaches the Standard Landscape Worksheet Method for assessing condition class on the landscape. Please visit www.frcc.gov to learn more. Back to FAQs

5. *Question*: What is NIFTT's response to a critic who says that the FRCC methodology is a relatively opaque process that generates simplistic metrics?

Answer: FRCC personnel and collaborators have made transparency a key guiding element during every step of the research and development process – from model development, to sensitivity testing and subsequent improvements to the methodology, to working with LANDFIRE personnel in their development of various FRCC-related GIS layers. Since inception in 2002, an additional guiding principle has been that the FRCC method would use only simple metrics that could be readily understood and implemented by a wide range of potential users, including resource managers and various specialists. Back to FAQs

6. *Question*: Is the FRCC methodology too esoteric / over-specialized for most managers? In other words, is it difficult to understand and use?

Answer: NIFTT believes that the FRCC methodology and associated forms and tools were designed to be user-friendly and relevant to management. For example, the FRCC methodology is not unlike other well established methods that evaluate watershed conditions, range conditions, and other resource specialties. In addition, note that the simple similarity and departure indices used by the FRCC method have existed in the realm of vegetation ecology since at least the 1950s. Back to FAQs

7. *Question:* Who developed the default biophysical settings (BpS) reference condition models and how were they developed?

Answer: The development of reference condition models for the various biophysical settings (BpS) (or Potential Natural Vegetation Groups [PNVG]) was a long and arduous process that took nearly a decade to complete. The goal was to thoroughly describe the disturbance-maintained plant communities that existed for thousands of years before EuroAmerican settlement. As described in Chapters 2, numerous workshops were held in which local ecologists used available literature and expert knowledge to model and summarize fire regimes, succession class structure and composition, and other biophysical traits for all major types in the U.S. (Also see related FAQ below.)
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8. *Question:* Have the default reference condition values been peer reviewed?

Answer: Yes. The model development process mentioned above included an extensive peer review process between 2003 and 2010. In addition, the models have been used for various research purposes that have been described in publications such as USDA

Forest Service General Technical Reports and peer-reviewed professional journals.
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9. *Question*: Can I develop my own reference condition models, or is such modeling too complex for the average user?

***Answer*:** Users can develop their own models under the formal protocol described in the FRCC Guidebook (see Chapter 2 and Appendix C). The modeling software used for this process is the Vegetation Dynamics Development Tool (VDDT; available at www.essa.com), which is relatively user-friendly and free. Also note that some federal agencies and The Nature Conservancy's Fire Learning Network have provided a number of VDDT training workshops to date. Some agencies also have experts who can assist with such modeling, which requires both local data and user background knowledge about vegetation structures, succession rates, fire regimes, and fire effects at all scales.
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10. *Question*: Why does the FRCC method use the historical range of variation (HRV) in calculating departure, since HRV reflects somewhat cooler climatic conditions that may never occur again?

***Answer*:** HRV is used because it is the best currently available information on sustainable landscapes. We fully realize this is not the same range of variation that could occur at this point in time. In response, some researchers are starting to model what the current (or future) range of variation will be, and as these results become available and peer-reviewed, we will incorporate them into the FRCC method. In addition, many ecosystems are now so altered from sustainable ranges that great accuracy in determining departure is not really necessary, and hence the relatively simple FRCC metrics will suffice. (Also see related FAQ below.) Back to FAQs

11. *Question*: Isn't the concept of an historical (or even current) range of variation becoming irrelevant since the climate is warming and ecosystems may change in ways that are unpredictable?

***Answer*:** No, because the historical range of variation is still a good measure of land capability and sustainability. Climate change will certainly have effects, but they will likely be gradual changes over time. NIFTT fully agrees, however, that the FRCC methodology must be revised in the future to reflect changing conditions and incorporate new estimates of the range of variation as such data become available.
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12. *Question*: Shouldn't the historical (or natural) range of variation be used only for context when interpreting FRCC outcomes – and not for actual management targets?

***Answer*:** NIFTT and its collaborators, such as The Nature Conservancy, consistently stress during trainings that HRV does not represent the desired future condition in every management situation. In other words, management objectives are constantly influenced and shaped by social, economic, and other resource concerns. (Also see related FAQ below.) Back to FAQs

***13. Question*: Are the federal agencies required to convert all FRCC 3 and FRCC 2 lands back to FRCC 1?**

***Answer*:** No. Restoring all federal lands to condition class 1 in order to emulate historical conditions is neither feasible nor universally desirable. For example, the scope of the problem in many areas is simply too large – especially in view of funding and human resource limitations. Also, management objectives (such as fire hazard mitigation) often do not include restoration and maintenance of natural conditions. Back to FAQs

***14. Question*: Why do the reference condition models and FRCC assessments use stand-scale fire frequency for characterizing landscape-scale occurrence?**

***Answer*:** Representative stand metrics, such as mean MFI, gathered from multiple sample sites (Barrett and others 1997), can be used for characterizing fire frequency at multiple scales. For example, stand MFIs can be used to determine a fire cycle metric (Heinselman 1973; Heinselman 1981; Brown and Smith 2000) for any given BpS regardless of landscape size (Brown and others 1994; Barrett and others 1997; Morgan and others 1998). In essence, the stand MFI metric serves as a lowest common denominator for characterizing fire frequency at multiple scales, which is useful for FRCC purposes because assessment landscapes can vary widely in size. Back to FAQs

***15. Question:* What are some examples of FRCC-related policy requirements in the various land management agencies?**

Answer: FRCC is applied by federal agencies at a number of scales. At the broadest scale, FRCC data serve as inputs for national allocation models such as the Ecosystem Management Decision Support System (EMDS). And, at finer scales, FRCC is required for accomplishment reporting across federal agencies, and in some agencies' planning processes. Currently, FRCC is a required reporting element for Department of Interior natural resource agencies in the National Fire Plan Operations and Reporting System (NFPORS). FRCC is also a required reporting element in the USDA Forest Service Activity Tracking System (FACTS). In both of those databases, pre-and post-treatment condition classes and fire regimes data are required for areas subject to fuel management treatments. The Bureau of Land Management requires FRCC summaries in Land Management Plans and Fire Management Plans. In those documents, condition class acres within each BpS and associated fire regime groups are required data elements. Back to FAQs

***16. Question:* The National Fire Plan Operations and Reporting System (NFPORS) requires FRCC data for stand-sized treatment units. Are stand-**

scale metrics meaningful? And if so, what specific metric should be used?

Answer: Yes, the stand-scale metrics are very useful for management purposes. In fact, the FRCC methods were developed, in large part, to address management needs and reporting requirements. Various FRCC metrics were designed to address basic user needs, such as: 1) determining the amount of each BpS succession class in relation to its estimated reference amount (Stand FRCC) and 2) documenting project accomplishments at various scales, such as for individual stands (Stand FRCC), for mid-scale units (Stratum FRCC), and for entire landscapes (Landscape FRCC). (*Note*: Please see Chapter 3 for detailed reporting examples). Back to FAQs

***17. Question*: Are FRCC metrics useful for evaluating fire hazard in wildland-urban interface (WUI) areas and elsewhere?**

***Answer*:** No, FRCC is strictly a measure of ecological departure from historical reference conditions. Although FRCC is not a fire hazard metric, indirect inferences about potential fire behavior or effects can sometimes be made when analyzing the condition class results for a given BpS. Back to FAQs

***18. Question:* How does FRCC Guidebook version 3.0 improve upon previous versions?**

Answer: Based upon user feedback, the FRCC working group has attempted to improve the FRCC assessment process in several ways. First, the number of fields used in both the forms and software tools has been reduced to lessen clutter and improve ease of use. Fields which were duplicative or unnecessary were deleted. Next, consistency in methodology between the Standard Landscape Worksheet and Standard Landscape Mapping methods was improved, including the incorporation of fire regimes data into the GIS mapping tool. Finally, the FRCC Software Application and FRCC Mapping Tool were improved to both produce summary reports of FRCC findings for watersheds, fire management units, and other assessment areas (see Chapter 4). NIFTT also considered user feedback and conducted sensitivity testing to develop new FRCC methods and calculations, as described in chapters 2 and 3. (Also see related FAQ below.) Back to FAQs

***19. Question*: Since version 3.0 contains two new algorithms, does that mean that previous FRCC assessments are no longer valid? And if not, how should re-assessments be conducted for those FRCC Landscapes?**

***Answer*:** Whether your previous FRCC outputs are still valid is up to you to decide based on management objectives, on landscape and stand conditions, and on other factors. Be aware, however, that your old output data might well differ substantially from any new data generated by the Guidebook version 3.0 algorithms. This is especially true of FRCC Mapping Tool outputs, because previous tool versions were unable to process fire frequency and severity data. Note that two options exist for conducting re-assessments: 1) use the version 3.0 methods and tools to re-analyze both

the original input data and any subsequently updated inputs (*recommended approach*); or 2) continue using the old FRCC methods and tools to conduct the re-assessment.
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20. *Question*: What is the difference between the "Stratum Regime Condition Class" (field 70) and the "Stratum Fire Regime Condition Class" (field 72)?

***Answer*:** As explained in Chapter 3, Stratum Regime Condition Class reflects the departure classification for the fire regime component only (that is, frequency departure + severity departure / 2). In contrast, Stratum Fire Regime Condition Class reflects the average of the vegetation and fire regime departures (vegetation departure + regime departure / 2), which is the endpoint diagnosis for the Stratum. Back to FAQs

21. *Question*: Are GIS-based FRCC assessments more accurate than field-based assessments?

***Answer*:** The spatial outputs generated by the FRCC Mapping Tool certainly can be more informative than the non-spatial data produced by field-based FRCC assessments, However, the tool does not always produce more accurate FRCC outputs. As discussed in Chapter 2, imagery-derived inputs have inherent limitations (Schmidt and others 2002; Menakis and others 2003; Menakis and others 2004; Rollins and others 2004; Provencher and others 2008; Blankenship and others 2009; Provencher and others 2009). Consequently, prospective users of the FRCC Mapping Tool should plan to validate their input and output data by using ground surveys, additional locally derived data (such as from stand exams), and local expert knowledge whenever possible.
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22. *Question*: Why is FRCC scale-dependent, and how does analysis scale affect FRCC Mapping Tool outputs?

***Answer*:** As described in chapters 2 and 3, stratum condition class outcomes can be greatly affected by the size of the reporting units that are used for summarizing the vegetation composition. That is, ecologically appropriate analysis scales should be used whenever possible. (A notable exception occurs with the LANDFIRE National FRCC layer, as described in the following FAQ.) For example, subwatershed-size units are likely appropriate for analyzing BpS types in Fire Regime Groups I and II, because associated fire and patch sizes are usually relatively small. Conversely, large summary units such as sub-basins should be used for analyzing BpS types in Fire Regime Group V, because fire and patch sizes are often quite large. Also be aware that the use of inappropriate analysis scales can produce substantially different and partially erroneous FRCC outcomes than might otherwise occur. For instance, user-induced error can occur when the summary units are too small to potentially exhibit the full range of S-Class compositions that occurred in the natural landscape. In such cases, the mapping tool would likely generate excessive amounts of condition class 3 – especially where

stand replacement fires have promoted large expanses of just one succession class.
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23. *Question*: How does the LANDFIRE National FRCC layer differ from the various FRCC layers produced by the FRCC Mapping Tool for local assessments?

***Answer*:** As described in Appendix E, the LANDFIRE FRCC layer that covers the entire U.S. is based on vegetation composition only, not also on fire regime inputs as occurs with locally based assessments. In addition, S-Class compositions for the many hundreds of BpS types across the U.S. were summarized according to very large areas (such as entire LANDFIRE mapping zones) because smaller summary units such as watersheds would have been impractical from a logistics standpoint. Given the above limitations, the LANDFIRE FRCC layer is useful mostly for regional to national-level planning, whereas for local planning purposes, the FRCC Mapping Tool can produce FRCC layers for three scales that range from stands to relatively large landscape units for a given assessment area. Back to FAQs

Appendix E: Overview of FRCC-related Geospatial LANDFIRE Layers

FRCC-related LANDFIRE Data Products

The LANDFIRE Project has produced a suite of GIS maps documenting FRCC, fire regimes, and other closely related themes across the U.S.

To date, the LANDFIRE Project (www.landfire.gov) has produced a Rapid Assessment phase (conducted between 2004 and 2005) and a subsequent National phase, which started in 2005 and concluded in 2009. And during the LANDFIRE National Refresh phase (2009 to 2011), the developers began updating and refining a number of FRCC-related data, such as the Refresh BpS layer, which represents an abbreviated set of models that might be useful for FRCC Mapping Tool assessments. To date, LANDFIRE has produced a number of downloadable FRCC-related GIS layers based on 30-meter pixel resolution across the entire U.S. Below is a brief description of some FRCC-related GIS layers produced by the LANDFIRE Rapid Assessment and LANDFIRE National phases.

Biophysical Settings (BpS) layer

The LANDFIRE National BpS layer (and the similarly themed Rapid Assessment PNVG layer that preceded it) shows the spatial occurrence of the reference (or historical) vegetation types in the U.S., as described in Chapter 2. Also note that the subsequent LANDFIRE National Refresh effort, which is scheduled to be completed in 2011, will not produce a set of comprehensive model descriptions or a separate BpS data layer. Rather, because the Refresh models reflect aggregated versions of the original LANDFIRE National BpS models, the Refresh models will simply be cross-referenced to the applicable National models and will be included as a separate attribute in the LANDFIRE National BpS layer. (For detailed information about the Refresh BpS layer, please visit www.landfire.gov.)

Succession Classes (S-Class) layer

This layer documents the spatial occurrence of the existing vegetation status according to as many as five succession classes as defined by the FRCC Guidebook (see Chapter 2). The layer documents the spatial array of succession classes A through E and up to two classes of the uncharacteristic class U for each BpS. Class UE represents uncharacteristic exotic vegetation, such as invasive weeds, and Class UN represents uncharacteristic situations created by native species, such as when grasslands experience unnatural tree encroachment. The succession classes layer, in combination with the BpS layer, thus provides a data set for evaluating the vegetation component of the FRCC algorithm. For example, in addition to documenting pre-settlement and existing vegetation across the U.S., the LANDFIRE S-Class and BpS layers can serve as required inputs for operating the FRCC Mapping Tool locally (see Chapter 4).

Also note that the subsequent LANDFIRE National Refresh effort will update the original S-Class layer to include the effects of recent (post-1999) disturbances that postdated the original mapping effort. Unlike the Refresh BpS products, a separate layer will be produced for the Refresh S-Classes. (Again, for detailed information about the Refresh S-Class layer, please visit www.landfire.gov.)

FRCC layers

The various LANDFIRE FRCC layers produced to date depict relatively coarse-scale estimates of FRCC across the U.S., using the departure algorithm and the three condition classes defined by the FRCC Guidebook (see Chapter 2). The layers were derived using two different methods: 1) the Rapid Assessment and Refresh phases analyzed current succession class composition relative to reference amounts as suggested by BpS (or PNVG) models, and 2) the National phase used the BpS and S-Class layers as inputs to conduct landscape simulation modeling as the primary basis for deriving reference conditions and fire regime layers (Rollins and Frame 2006; Keane and others 2007). In addition, LANDFIRE has produced an FRCC Departure Index layer during all three phases mentioned above, which shows departure from reference vegetation amounts based on a zero-to-100 percent departure scale.

Note that all of the FRCC outputs described above are based solely on vegetation departure across broad-scale units such as entire LANDFIRE mapping zones or ecological subsections. Therefore, the three available LANDFIRE FRCC layers are not as refined as the FRCC assessments that can be produced by local field assessments or by local FRCC Mapping Tool assessments (see chapters 3 and 4). In other words, although the LANDFIRE FRCC layers may be useful for national and regional-level analyses, those outputs should not be used for finer scale planning.

For more information about the various LANDFIRE FRCC layers and to read about four FRCC case studies conducted by LANDFIRE personnel, please visit the Documents > FRCC Documentation section of www.landfire.gov.

Fire Regime layers

The LANDFIRE Project has produced a number of data layers related to various aspects of natural (or reference) fire regimes. For instance, the fire regime groups layer documents the spatial occurrence of the five reference fire regime groups defined by the FRCC Guidebook (see Chapter 2). These layers were derived using two different methods: 1) the Rapid Assessment mapping phase was derived from the dominant fire regime assigned to each BpS model; and 2) the National phase for the conterminous U.S. used LANDSUM landscape simulation software (Keane and others 2007) to generate probability outputs for mean fire interval (MFI) and fire severity for each pixel and then applied a dominant-fire rule set (Table D-1; also note that regime mapping for Alaska and Hawaii was based on direct assignments from the BpS model descriptions, not on LANDSUM simulations).

Table D-1. Rule set for LANDFIRE National mapping of fire regime groups for conterminous U.S.

MFI (yr)	Replacement Fire Occurrence * (%)	Fire Regime Group
<35	<66	I
<35	≥66	II
35-200	<80	III
35-200	≥80	IV
>200	0-100	V

* Refers to proportion of time a given 30-meter pixel was affected by replacement fire in the simulation (*not* to percent top kill as detailed in the fire regime groups definition (see Chapter 2).

Similarly, the LANDSUM modeling outputs were used to produce the following regime-related layers for the contiguous U.S. only: 1) Mean Fire Return Interval, 2) Percent Low-severity Fire, 3) Percent Mixed-severity Fire, and 4) Percent Replacement-severity Fire.

In summary, the LANDFIRE data layers that describe various aspects of FRCC and natural fire regimes can be important contributors to restoration planning and can help fulfill various requirements as set forth by the Healthy Forest Restoration Act of 2003 and the National Fire Plan Operations and Reporting System (NFPORS). For more information, and to learn how to download the above layers, please visit www.landfire.gov.