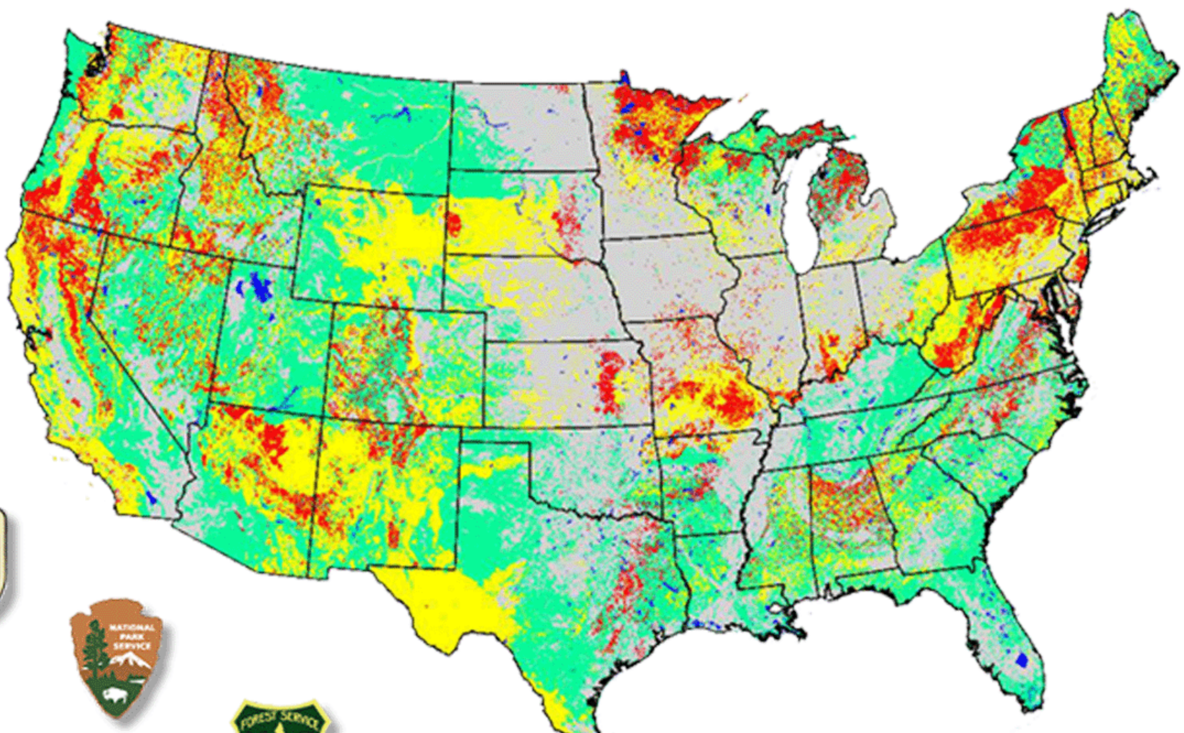
INTERAGENCY FIRE REGIME CONDITION CLASS GUIDEBOOK



VERSION 1.2

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Abstract

The Fire Regime Condition Class (FRCC) Standard Landscape Worksheet Method and Mapping Method provide tools for fire, vegetation, and fuels assessment and management at both the landscape and stand levels. These methods are used to describe general landscape fire regime and vegetation-fuel characteristics. Estimates of these characteristics are calculated for comparison with estimates of natural fire regime reference values and reference condition vegetation-fuel characteristics to index Fire Regime Condition Class (a classification of the amount current conditions have departed from those of historical reference conditions). Low departure (FRCC 1) describes fire regimes and vegetation-fuel conditions considered to be within the reference condition range of variability, while moderate and high departures (FRCC 2 and 3) characterize conditions outside of this reference condition range. The Fire Regime Condition Class Guidebook is a fine-scale version of the original FRCC concepts and definitions published in Hardy and others (2001), Hann and Bunnell (2001), and Schmidt and others (2002). FRCC worksheet and mapping methods were developed and implemented by an interagency working group teamed with The Nature Conservancy and managed by the Interagency Fuels Committee. The FRCC methods, software, website, and associated publications have been developed in association with the Fire Monitoring and Inventory System (FIREMON) and in parallel with the Rocky Mountain Research Station (RMRS) Rapid Assessment and LANDFIRE projects.

The FRCC Guidebook includes two procedures for determining FRCC: the FRCC Standard Landscape Worksheet Method and the FRCC Standard Landscape Mapping Method. FRCC Guidebook methods were designed to provide consistency and quantifiability from the landscape scale to the stand scale, and to allow for quick FRCC estimation assessments of those project areas similar to one previously assessed using the FRCC Standard Landscape Worksheet or Mapping Method. The FRCC worksheet and mapping methods also include procedures for assessing stands within the landscape.

The FRCC Guidebook FRCC Standard Landscape Worksheet Method and Mapping Method provide the user with “how-to” steps for determining fire regime and FRCC. The Standard Landscape Worksheet Method explains the steps for determining FRCC (using local field data) and can be used with the assessment medium that best suits the user’s needs (the Standard Landscape Worksheet, the Standard Landscape Worksheet Field Form, the Simple-7 Field Form, and/or the associated software – details on these mediums are provided at the beginning of Chapter 3). The Standard Landscape Mapping Method is designed to emulate the worksheet method with an added spatial dimension. The Mapping Tool produces a multitude of spatial layers that correspond to the attributes derived by the Standard Landscape Worksheet Method.

Data entry and reporting software can be downloaded and is available at www.frcc.gov, or contact your agency, TNC, or private FRCC coordinator. Please contact helpdesk@frcc.gov with any questions.

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Chapter 1

Introduction

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The Fire Regime Condition Class (FRCC) Standard Landscape Worksheet Method and Mapping Method provide tools for fire, vegetation, and fuels assessment and management at both the landscape and stand levels. These methods are used to describe general landscape fire regime and vegetation-fuel characteristics. Estimates of these characteristics are calculated for comparison with estimates of natural fire regime reference values and reference condition vegetation-fuel characteristics to index fire regime condition class (a classification of the amount current conditions have departed from those of historical reference conditions). The data collected through these methods describe the size of the area being assessed, its geographic location, biophysical conditions, and fire regime characteristics. These data can then be used to determine the current conditions' similarity to and departure from the reference conditions, the natural fire regimes, landscape-scale FRCC, and stand-scale FRCC (see Chapter 2 for further detail).

These variables can be determined at different scales, from the entire landscape down to individual stands or patches (note: although the term *patch* is used in conjunction with shrub and grasslands, the term *stand* will be used throughout the document to refer to these as well as to forest and woodlands). In FRCC methodology, a landscape is defined as the contiguous area within a delineation that is large enough to include the variation in vegetation-fuel conditions of the natural fire regimes. When a landscape is being assessed, it becomes a Project Area, which can be further divided into Strata, which are subdivisions of the landscape based on biophysical or management criteria such as fire regime or vegetation-fuel class conditions. FRCC worksheet and mapping methods were designed to provide consistency and quantifiability from the landscape scale to the stand scale and to allow for quick FRCC estimation assessments of those project areas similar to one previously assessed using the FRCC Standard Landscape

Worksheet Method or Mapping Method (guidelines regarding appropriate use of the Estimation Technique can be found in Chapter 3).

It is important to note that, before determining stand-level FRCC, landscapes must first be assessed using the Standard Landscape Worksheet Method (Chapter 3) or Mapping Method (Chapter 4). The Standard Landscape Methods (both quantitative approaches) provide the user with a background understanding of the processes used to determine landscape and stand FRCC. Furthermore, FRCC must first be determined at the landscape scale because outputs from the landscape-scale assessment serve as inputs to the stand-scale assessment; in other words, the "relative amount" (see Ch. 3) of each BpS's vegetation-fuel classes must be determined in order to determine stand FRCC.

The current fire regime and vegetation-fuel conditions are compared to those of the reference conditions (the seven reference conditions include the five vegetation-fuel classes, fire frequency, and fire severity) to determine the departure from reference conditions for determination of landscape FRCC, and to determine the current relative amount (a classification of the departure) compared with reference conditions for determination of stand FRCC. See Chapter 2 for a detailed discussion of reference conditions.

Both the FRCC worksheet and mapping methods have been developed and implemented by an interagency working group teamed with The Nature Conservancy (TNC). This working group is chartered and managed by the Interagency Fuels Committee. The FRCC worksheet method, mapping method, software, website, and associated publications have been developed in association with the Fire Monitoring and Inventory System (FIREMON) and in parallel with the Rocky Mountain Research Station (RMRS) Rapid Assessment and LANDFIRE projects (www.landfire.gov).

FRCC Objectives

Specific objectives established by the interagency working group (through the Interagency Fuels Committee) guided the development of the FRCC procedures:

1) Procedures will be designed to reflect the fire regimes and FRCC as defined and described by Hardy and others (2001) and Schmidt and others (2002) with the purpose to support multi-scale planning and monitoring and founded upon a broad-based vegetation and disturbance regime sustainability index (such as FRCC) as described by Hann and Bunnell (2001).

2) Methods will be developed and also emulated by mapping procedures in such a way that users would understand the applications of FRCC and associated measures.
3) Procedures will be based on simple calculations, classification, and commonly available data so that users can hand-calculate and classify in the field.
4) Standard, quantitative methods will be developed to be flexible in application, rapid yet detailed in determination of estimates, and to result in high confidence. A companion estimation technique will be developed for faster determinations that will emulate the outcome of the standard quantitative method.
5) Development of the procedures will follow similar concepts and terminology as those of other resource condition measures (for example, watershed, forest, and rangeland health) to facilitate interdisciplinary communication and support an integrated approach to multi-scale planning and monitoring.

This edition of the Standard Landscape Worksheet and Mapping Methods is a fine- to mid-scale version of the original coarse-scale FRCC concepts and definitions published in Hardy and others (2001), Hann and Bunnell (2001), and Schmidt and others (2002) and is the result of beta-testing and revisions that were initiated in 2000. We thank those who tested the FRCC Guidebook and provided recommendations and solutions. We also thank those who participated in the development of the Potential Natural Vegetation Groups, now termed (for FRCC purposes) Biophysical Settings (BpS's), used in the FRCC methodology. Descriptions of these can be found at www.frcc.gov. For more information on Biophysical Settings, see Chapter 2.

There will continue to be refinements in the BpS classifications and associated reference condition characteristics. Regional teams and the RMRS National Rapid Assessment will revise these values by geographic area through a nationally-consistent process. Contact the help-desk at helpdesk@frcc.gov with questions regarding this process. There will also continue to be improvements in the associated FRCC text descriptions, forms, code sheets, software, and website to improve functionality and incorporate updates. Update notices will be posted on our website. Visit www.frcc.gov, contact the help–desk, or contact your agency, TNC, or private FRCC coordinator to obtain the FRCC Guidebook version with the latest updates. We recommend printing the entire Guidebook and putting it into a three-ring binder, replacing old chapters with new ones as they are released. Note: certified users and trainers will be notified of updates by email. Users can inquire about becoming certified by contacting the FRCC help-desk or, for users without Internet access, contact your agency, TNC, or private FRCC coordinator.

A major revision of the FRCC Guidebook, Version 2, is scheduled for release in 2006. The FRCC Guidebook (version 2.0) will be revised based on recommendations from a broad science review, results from the National LANDFIRE Project, research focused on the FRCC methods and reference conditions, assessments of training and implementation tools, and user feedback.

Data Entry Resources

FRCC data entry and reporting software for both the worksheet and mapping methods can be downloaded and is available at www.frcc.gov. We recommend that all worksheet users with computer capability use Java-based data entry and reporting software (requires MS Access 2000 or a subsequent version) as this software provides an efficient system for storage, filing, data correction, sensitivity testing, and production of finished reports with graphics and photos.

If you do not have access to the Internet but do have computer capability, obtain the software by requesting a CD-ROM from your agency, TNC, or private FRCC coordinator.

An Internet-based data entry program will be available in the future to federal, state, and approved private agency personnel with Internet access. Private agency personnel can become approved for Internet-based access by submitting a request through a federal, state, or previously-approved private agency sponsor. This future Internet-based FRCC data entry option will be more sophisticated than the downloadable version and will, for example, allow for data communication with the National Fire Plan Operations and Reporting System (NFPORS) and the National LANDFIRE Project.

Quality Control

Quality control safeguards are being incorporated into the FRCC Standard Landscape Worksheet and Mapping Methods. The examiner code, for example, will link to a tracking database which contains information on each certified user or trainer that has participated in a formal FRCC training session, the interactive website training, the CD-ROM training, or an informal FRCC training that meets requirements, thereby limiting data entry capabilities to certified FRCC examiners only. The database will also record the last date of training and the associated version of methods and software. Additionally, this code will allow Internet data communication and automated data export to NFPORS and the National LANDFIRE Project. In the future, some federal agencies may choose to require entry of an examiner code into the NFPORS system for all data entry.

Users can ensure they meet the training requirements or inquire about becoming certified by contacting the FRCC help-desk (helpdesk@frcc.gov) or, for users without Internet access, by contacting their agency, TNC, or private FRCC coordinator.

Guidebook Structure

The FRCC Guidebook is arranged in four chapters: Chapter 1 is an introduction to and an overview of the FRCC process, Chapter 2 is a detailed discussion of the theory and principles behind FRCC, Chapter 3 is an FRCC worksheet procedure guide, and Chapter 4 is an FRCC mapping procedure guide. Chapter 3's Standard Landscape Worksheet Method facilitates the determination of FRCC using local field data and can be used with the assessment medium that best suits the user's needs (the Standard Landscape Worksheet, the Standard Landscape Field Form, the Simple-7 Field Form, and/or the associated software – details on these mediums are provided at the beginning of Chapter 3). Chapter 4's Standard Landscape Mapping Method is designed to emulate the worksheet method with an added spatial dimension. The Mapping Tool produces a multitude of spatial layers that correspond to the attributes derived by the Standard Landscape Worksheet Method.

Chapter 2

Fire Regime Condition Class Theory and Principles:

- **FRCC Definitions**
- **Biophysical Settings**
- **Reference Conditions**
- **Scale Issues and Landscape Stratification**

FRCC Definitions

Fire regimes and fire regime condition class (FRCC) were 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-scale FRCC mapping tests and demonstration projects, with substantial modifications based on subsequent informal workshops and field tests. FRCC can be applied to all wildland vegetation and fuel conditions or to wildland fire situations.

Fire Regime

A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention but including the influence of aboriginal burning (Agee 1993; Brown 1995). Coarse-scale definitions for natural fire regimes were developed by Hardy and others (2001) and Schmidt and others (2002) and interpreted for fire and fuels management by Hann and Bunnell (2001). The five natural fire regimes are classified based on the average number of years between fires (fire frequency or Mean Fire Interval [MFI]) combined with the severity of the fire (the amount of vegetation replacement) and its effect on the dominant overstory vegetation. These five natural fire regimes are as follows:

I – 0-35 year frequency and low severity (most commonly associated with surface fires) to mixed severity (in which less than 75 percent of the dominant overstory vegetation is replaced)

II – 0-35 year frequency and high severity (stand replacement: greater than 75 percent of the dominant overstory vegetation is replaced)

III – 35-200+ year frequency and mixed severity

IV – 35-200+ year frequency and high severity

V – 200+ year frequency and high severity

As the scale of application becomes finer, these five classes may be defined in greater detail or any one class may be split into finer classes; however, coarse-scale logic will be retained.

Fire Regime Condition Class

Fire regime condition classes measure the degree of departure from reference conditions, possibly resulting in changes to key ecosystem components, such as 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. Possible causes of this departure include (but are not limited to) fire suppression, timber harvesting, livestock grazing, introduction and establishment of exotic plant species, and introduced insects and disease (Schmidt and others 2002).

The three fire regime condition classes are based on no or low (FRCC 1), moderate (FRCC 2), and high (FRCC 3) departure from the central tendency of the reference conditions (Hann and Bunnell 2001; Hardy and others 2001; Schmidt and others 2002). This *central tendency* is a composite estimate of the reference condition vegetation characteristics; fuel composition; fire frequency, severity, and pattern; and other associated natural disturbances (see the *Reference Condition Modeling* section below for an explanation of central tendency). Low departure includes a range of plus or minus 33 percent deviation from the central tendency.

Characteristic vegetation and fuel conditions are considered to be those that occurred within the natural fire regime, such as those found in FRCC 1 (low departure). Uncharacteristic conditions are considered to be those that did not occur within the natural regime, such as are often found in FRCC 2 and 3 (moderate to high departure). These 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 repeated annual grazing that reduces grassy fuels across relatively large areas to levels that will not carry a surface fire.

In order to determine departure and assign fire regime condition class, reference condition characteristics have been identified and descriptions developed for the western U.S., eastern U.S., and Alaska concerning vegetation-fuel class composition, fire frequency, and fire severity for the biophysical settings (BpS’s) (formerly potential natural vegetation groups or PNVGs) used in the coarse-scale analysis by Schmidt and others (2002). The reference condition characteristics for each BpS can be found in a summary table of reference values extracted from each BpS’s description document. Description documents are comprehensive summaries of each BpS. Both the reference condition summary tables and the BpS description documents can be found on the FRCC website at www.frcc.gov. These values were developed through Vegetation Dynamics Development Tool (VDDT) modeling, literature review, field visits, and communication with regional experts (additional details on BpS's and reference conditions are provided below).

Refinement of reference condition models will be ongoing through 2009 via expert workshops and the national Rapid Assessment and LANDFIRE projects. In addition, through workshops, BpS's will be identified at finer resolutions and models will incorporate more expert input and peer-review. (Finer resolution reference condition models can be developed through regional or local efforts, but must be done using a standardized guidebook process – see Appendix B). For information on workshops or to ensure you have up-dated values, visit the FRCC website (www.frcc.gov) or contact the FRCC help-desk (helpdesk@frcc.gov). Users without internet access should contact their agency, The Nature Conservancy (TNC), or private FRCC coordinators.

Biophysical Settings (BpS's)

> →***Note****: In this FRCC Guidebook version 1.2, the term "biophysical settings" (BpS's) replaces "potential natural vegetation groups" (PNVGs) in FRCC nomenclature. This change has been incorporated to provide a common ground for the use of different potential vegetation concepts among agencies and to clarify the reasons for the use of ecosystem concepts in FRCC. These changes do not require any action on the part of the user.*

Biophysical settings (BpS's) are the primary environmental settings used in determining a landscape's natural fire regime(s) and fire regime condition class (FRCC). These settings incorporate both classification (taxonomic) and map unit concepts. Ecosystems can be classified based on a single attribute—vegetation, soils, or geomorphology, for example, or they can be classified based on integrated attributes, such as ecological types (Winthers and others 2004), ecological sites (NRCS 2003), or ecological systems (Comer and others 2003). The taxonomic units of these classifications can be considered biophysical classes. When these classes are mapped in organized, repeating map units, they become biophysical units.

These units are land delineations based on the geographic area, physical setting, and vegetation community that can occupy the setting. Physical characteristics include climate, geology, geomorphology, and soils. Vegetation includes the area's native species and associated successional stages – determined according to our best understanding of the historical or natural range of variation, including disturbances. In addition to these attributes, each biophysical setting also features characteristic ecological processes of fire frequency and severity and therefore provides a cogent, robust foundation for determining fire regime and fire regime condition class.

Other basic ecosystem processes of change found at smaller scales combine and affect the outcome of FRCC at the landscape scale. For example, plants photosynthesize to produce live biomass, and much of this live biomass becomes dead biomass in the form of litter, duff, and woody material. Much of the live and dead biomass may be changed in state by disturbances such as fire, wind, drought, herbivory, insect and disease. Growth and maturation processes also change the biomass and are reflected in changes in: live species composition, size and form, duff, litter, and standing and downed dead woody material. For FRCC, each state is called a vegetation-fuel class and characterized by a distinct description.

In FRCC, a visual dynamics model is used to characterize the pattern of transitional states in each BpS (figs. 2-1 and 2-2) in response to growth and maturation over time and changes resulting from disturbance. For any one stand, only one state can occur at any one time. Across a large BpS that contains many stands, all states may be represented at one time. This type of dynamics model has been developed for each BpS, and as new BpS's are determined, models are built for them. Existing models are reviewed and revised as necessary.

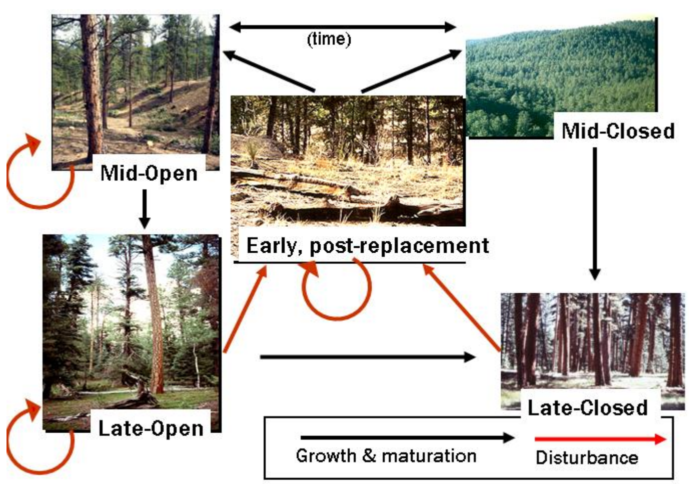


Figure 2-1 – Visual dynamics model (standard 5-box) for a forest ecosystem.

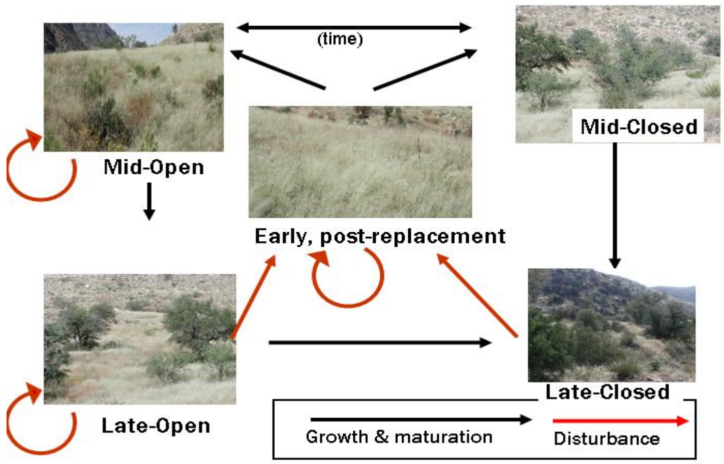


Figure 2-2 – Visual dynamics model (standard 5-box) for a rangeland ecosystem.

Vegetation as a Proxy for Biophysical Setting

Although biophysical settings represent the collective, integrated attributes of an environment, we use *vegetation* as a proxy to describe them. The BpS is typically identified by vegetation indicating the mix of fire severity and frequency across the landscape. For example, grand fir is often associated with a mixed-severity fire regime, and ponderosa pine with a frequent, low-intensity fire regime. However, it should be clearly understood that, for the purpose of assessing fire regime and fuel conditions, vegetation is a practical surrogate for the BpS but not a concise classification of vegetation or ecologically-integrated map units.

Vegetation for both forests and rangelands can be defined in *existing*, *potential, and historical* terms and can be classified and mapped at all scales (they are not limited to local plant associations).

Existing vegetation is the plant cover, or floristic composition and vegetation structure, occurring currently at a given location (Brohman and Bryant 2005). Existing vegetation's departure from that of the reference conditions is used to calculate FRCC.

The term *potential natural vegetation* (PNV) refers to vegetation that would become established if all successional sequences were completed and reflects the capability of an area to generate a characteristic set of ecosystem structure, function, and composition. Unfortunately, the term is often confusing because it has been defined in different ways with various nuances. Two basic concepts of PNV have emerged, one definition excluding disturbance and one including disturbance: 1) the successional sequence is constrained only by climate, meaning succession proceeds to a climax state limited only by the climatic regime affecting the area (Winthers and others 2004); and 2) succession proceeds until a characteristic disturbance (often fire) occurs and ends it (NRCS 2003).

Inclusion of disturbance in defining the vegetation component of the BpS is critical for FRCC determination since condition class is based on an estimate of departure from the reference condition of vegetation states and their interrelationships with fire frequency, fire severity, and other disturbances across landscapes. FRCC methodology therefore employs the concept of potential natural vegetation defined as that limited by disturbance, not climate. For FRCC purposes, ecological classifications that use climatically-constrained PNV require a crosswalk to relate those PNV types to the vegetation described in FRCC.

Many existing classifications of potential natural vegetation are in use, and although somewhat simplistic in presentation, table 2-1 is useful in comparing and understanding commonly used approaches to classifying potential natural vegetation.

Table 2-1 – Examples (and associated references) of potential natural vegetation classifications grouped according to whether natural disturbance is incorporated.

Vegetation classification approach	Classification examples	Reference
Excluding natural or historical disturbance (vegetation constrained only by climate)	Habitat type and climax plant association Potential vegetation type Potential natural vegetation	Daubenmire 1968 Keane and others 1996 Winthers and others 2004
Including natural or historical disturbance	Kuchler potential natural vegetation Ecological site classification Ecological systems	Kuchler 1964 USDA Natural Resource Conservation Service 2003 Comer and others 2003

Historical vegetation is the vegetation that existed during the reference period prior to Euro-American settlement and that was often affected by Native American burning. The starting point of Euro-American 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 the Interior Columbia Basin assessment, for example, a time frame of 400 years, from 1450 to 1850 (the latter being the approximate date of settlement) was used (Keane and others 1996; Quigley and Arbelbide 1997). For FRCC determinations, we use historical vegetation for reference conditions because we lack understanding regarding the way historical systems would currently operate under present climatic and edaphic conditions.

Use of the historical range of variation of pre-Euro-American settlement times to describe the reference condition vegetation of a BpS is often criticized by the scientific and management communities because this period was cooler than today's climate. For this reason, where data are available regarding the mix of successional stages without modern human interference in today's climate, these should be used. In many cases this information is lacking, however, and thus the historical range of variation usually provides our best understanding of functioning landscapes with the full array of ecosystem structure, composition, and processes. In short, these historical landscapes are what we know was functioning and sustainable—and FRCC estimates the current departure from those conditions. Moreover, using the current range of variation in ecosystems also has its weaknesses: until we improve our ability to predict near future (30-100 years from present) vegetation dynamics, this approach will remain largely speculative. Also, using current conditions as a baseline for determining reference conditions may inadvertently lead to a belief that current, degraded environments are acceptable.

Biophysical Settings Summary

- **BpS is the primary landscape delineation for FRCC and incorporates both classification and map unit concepts.**
- **Vegetation is used as the environmental expression of the land's capability—a proxy for describing the biophysical setting.**
- **FRCC uses a potential natural vegetation concept that incorporates natural disturbance; the incorporation of disturbance is critical in FRCC determination because FRCC is an estimate of the departure from the natural or historical range of disturbance.**
- **We recognize that the historical range often developed under a different climatic regime than that of today's; therefore, where data are available, we recommend use of the current (natural) range of variation given lack of modern human interference.**
- **Existing, potential, and historical vegetation concepts have all been used in developing FRCC methodology. Current conditions are described using existing**

vegetation. The concept of potential natural vegetation represents the environmental setting and the landscape's capability to generate the structure, function, and composition of ecosystems. This potential land capability, associated with an historical range of variation in disturbance, provides information on historical vegetation, which in turn provides a context for determination of the reference conditions used in FRCC assessments.

Reference Conditions

Reference conditions are defined as the composition of landscape vegetation and disturbance attributes that, to the best of our collective expert knowledge, can sustain current native ecological systems and reduce future hazards to native diversity – reference conditions should reflect characteristics that can be restored. These conditions are the baseline for determining departure from the natural or historical range. Reference conditions are determined by experts through synthesis of expert knowledge, published literature, and historical information using standardized computer modeling tools and processes. Each iteration of reference condition determination is reviewed and adjusted based on informal or formal peer review to maintain an adaptive approach to incorporating new expert knowledge, information, or modeling tools. Historical empirical data and historical modeling provide an important context for reference condition determination but are only a subset of the inputs for the identification of reference conditions. For example, in some highly altered landscape ecosystems - such as old field systems of the eastern U.S., exotic invasives of the western U.S., loss of whitebark pine to blister rust in the West, or loss of grassland soils in the Southwest - the historical context may be a minor factor in determination of reference conditions. For preliminary development of reference conditions, however, modeling of the historical may provide the most efficient means to an initial estimate.

Historical and Present Natural Range of Variability

As stated above, reference conditions reflect our best estimate of a sustainable environment. This sustainable environment does not exist as a fixed state, but rather occurs within a range of variation reflecting the intrinsic instability of landscape patterns (Pickett and White 1985).

Because fire regime condition class uses landscapes as an organizing principle, reference conditions are defined by the mix of vegetation states (vegetation-fuel classes) across the landscape combined with the fire severity characteristic of that landscape. This concept forms the spatial aspect of landscape ecology.

Time, however, is also a critical component affecting the way landscapes function: in addition to severity, the frequency of fires also defines reference conditions. A broad time scale (100 to hundreds of years, depending on Euro-American settlement) frames the reference conditions, and within this broad time frame, a range of variation of reference conditions emerges—a range limited by the climate, geology, geomorphology, soils, and vegetation of the landscape: the biophysical setting. Some biophysical settings generate frequent, low-intensity fires; others infrequent, high-intensity fires; and so on.

Therefore, reference conditions should be defined in terms of a range of conditions over space and time, rather than in terms of a fixed set of conditions. We see two main approaches for defining the range of variation: the *historical range of variation* and the *present natural range of variation*. Each approach has strengths and weaknesses (table 2-2).

In North America, the historical range of variation (HRV) is usually defined by the period prior to Euro-American settlement. (Note: the term *historical range of variation* can also be considered synonymous with *natural range of variation* (Landres and others 1999)). This period would occur prior to 1600 in New England, prior to 1800 in the Midwest, prior to 1850 in the Pacific Northwest, and so on. Typically, the time frame is set as several hundred years prior and up to the particular settlement date. The specific time frame should be carefully defined according to objectives, available data, and ecosystem characteristics (Landres and others 1999).

Using current and historical data (such as those from tree-ring analysis), modeling can estimate a landscape's range of variation in seral stages (vegetation-fuel classes), fire frequency, and fire severity. A strength of the historical range concept is that a "track record" exists in the form of historical data—albeit to varying degrees, depending on the landscape of interest-- to suggest that landscapes of this time period were, in fact, sustainable. On the other hand, a concern regarding the HRV concept is that the vegetation patterns developed during this time period reflect a climatic period that can be unlike the present, and unlikely to occur again. In the Pacific Northwest, for example, the time frame for the historic range of variation was much cooler than today's climate and is even referred to as *the little ice age*. Climate figures critically, because its effects can often override those of management actions (Veblen 2003).

The present natural range of variation (PNRV) is defined by a time period starting at the present and reaching into the future, with the future endpoint typically defined at 100 to 500 years and sometimes further. Because vegetation patterns are being modeled according to a climate we will likely experience, the PNRV concept may be more realistic than HRV. This concept also has drawbacks, however, notably in the inherent speculation on seral stage composition, fire frequency, and fire severity. Moreover, we are uncertain of what will be sustainable in the future.

Table 2-2 – Comparison of the Present Natural Range of Variation (PNRV) and Historical Range of Variation (HRV) approaches.

	Historical Range of Variation (HRV)	**Present Natural Range of Variation (PNRV)**
Time frame	Prior to Euro-American settlement (date varies). Must define the time period (such as 400 years prior and up to settlement).	Current and near future (approximately 100 years).
Climate	Historic climate.	Current climate and modeled future climatic trends.
Human influences	Includes the influence of Native American management activities on the affected landscape patterns. (Prescribed burns and wildfires indistinguishable from fire scar data.)	Incorporates the legacy of Native American activities because much of the current native plant diversity reflects those activities.
Strengths	Empirical data is available from dendrochronology, historic photos, historic surveys, and other historical ecology techniques.	May provide the most realistic baseline from which to assess landscape change and departure Modeling can integrate expert judgment and current/future simulations with historical empirical data.
Weaknesses	Reference conditions for landscape assessments would be based on a climate that no longer exists. Rapid warming as the Little Ice Age ended may have created short-lived fire regimes that cannot be confidently extrapolated either forward or backward in time. How do we know what was sustainable under past conditions? Even a 400-year pre-settlement period is shorter than the life span of many tree species.	Data are often lacking on vegetation state trends. It may be difficult to predict state mix on the landscape. Problem of "shifting baselines:" The possible trap of defining what is there today or what we desire as a baseline that may not represent natural or even functional conditions. Selecting reference areas can be difficult, particularly in landscapes highly altered by humans. How do we know what will be sustainable under future conditions? 100 years may be to short for some vegetation state changes to occur.
Possible refinements	Timeframe can vary and must be defined.	Option to include introduced organisms (such as cheatgrass, blister rust, chestnut blight, feral horses) that have naturalized. What if control methods are developed in the future?
Interpretive issues	HRV is based on at least some limited data about past conditions plus modeling. It therefore may be less speculative than NRV. HRV requires careful examination of the available data and comparison of past and present climates.	NRV is based primarily on modeling because we have no data on future conditions. It therefore may be more speculative than HRV. NRV requires careful examination of model assumptions and accurate knowledge of species dynamics.

When using HRV and PNRV concepts in practice, we must refine the approach to better address the specific situation being studied. For example, most modelers of the range of variation, both historical and present natural, consider Native American burning an inherent part of the ecosystem that influenced the landscapes we see today. Modelers must also define the numeric boundaries of the reference values to reduce the variation to a workable range; for example, in the Interior Columbia River Basin assessment, reference values were defined as conditions falling within +/- 25 percent of the historical mean value for an attribute (Hemstrom and others 2001).

Users of PNRV must also decide on two other important refinements: whether to include effects of invasive plants and animals (introduced by humans in the settlement and post-settlement period), and how much human-caused disturbance, resulting from development and agriculture, should be recognized in the reference conditions. We have to decide at what point we accept invasives as a part of ecosystems that cannot be changed. As mentioned in the *Biophysical Settings* section above, using current conditions as a baseline for determining reference conditions may inadvertently lead to a belief that current, degraded environments are acceptable. For example, the removal of cheatgrass from the western U.S. may seem daunting, but technology and methods may yet be developed that will make this possible. As a further example, the return of the American chestnut to Appalachian forests, based on advances in breeding disease resistance in the species, does not seem as hopeless as it once did.

We encourage use of PNRV in applying FRCC because it is realistic, having a basis on current conditions and on trends suggesting conditions to come – not on conditions gone forever (NCSSF 2005). Having said this, use of HRV to determine reference conditions must serve as a surrogate in many cases until better data and models are available (Landres and others 1999). Indeed, a review of the literature on the range of variation suggests that all approaches, whether relying on historical, current, or future time frames, are still working within the same basic concept. In other words, they all include elements of the variation in ecological processes and landscape structure defined within a time period prior to Euro-American settlement (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). The careful examination of a wide range of data on vegetation, disturbance, and climate, combined with documentation of all assumptions made, seems therefore preferable to persistent use of a dogmatic time frame and is likely to lead to the best product (Wong and Iverson 2004).

Our understanding of reference conditions is an approximation of reality, and some error will be generated in our condition class determinations for this reason. Nonetheless, the inherent assumptions made in landscape modeling have been well-documented (Hemstrom and others 2001). In addition, FRCC has proven to be a robust method of departure determination, in part because great precision is not necessary to determine that many of our ecosystems are clearly departed from a sustainable state.

Finally, it should be noted that the range of variation is not the same as the desired future condition. The latter incorporates the human social and economic contexts. Although consideration of these contexts is critical for true sustainability—active ecological restoration will not proceed without society's support—the desired future condition is determined by a statement of policy rather than a scientific principle.

Reference Condition Modeling

Current standardized FRCC methods for estimating reference conditions for a given BpS use a non-spatial vegetation and disturbance dynamics model called the Vegetation Dynamics Development Tool (VDDT) (Beukema and Kurz 2004). The model is calibrated through review of the literature, expert opinion, and field data, when available. The inputs to the model include: 1) estimates of transition (succession or growth and development) rates between vegetation-fuel classes (states, seral stage, or successional classes) and 2) probabilities (frequencies) of disturbance that maintain a vegetation-fuel class or cause transition from one class to another. This modeling approach is used to integrate empirical data with information from the literature and knowledge of regional or local experts. To describe reference conditions, we use the *central tendency estimate* rather than a range of variability, such as a minimum and maximum. The literature on historical vegetation and natural fire regimes is not consistent in reporting a range of variation, but is consistent in reporting a central tendency estimate – usually in terms of a mean, such as mean fire interval or mean vegetation condition.

Where spatial data are available, a companion spatial model can be used to determine if spatial variation in factors such as fire weather, fire spread, terrain, and climate may change the reference condition estimates. These companion spatial models include the Tool for Exploratory Landscape Analysis (TELSA) (Frid and Kurz 2004) and the Landscape Sucession Model (LANDSUM) (Keane and others 2003). However, although the topic has not been studied widely, initial results indicate that reference condition estimates may not be substantially different between simulations using only VDDT versus those including a spatial companion model (Shlisky and others 2004).

For this version 1.2 of the FRCC Guidebook, reference conditions were modeled for 500 years into the future (fig. 2-3). The simulation starts with an equal distribution of vegetation-fuel class composition, estimates for transition rates, and disturbance probabilities between vegetation-fuel classes. The transitions and probabilities of change between vegetation-fuel classes are based on historical evidence unless the current BpS's climate, soil, or plant species are known to be permanently altered. In cases of permanently altered BpS's, the reference conditions are first modeled using the historical evidence and then adjusted for altered changes in states and transitions.

Refer to the *Fire Regime Condition Class* section near the beginning of this chapter for details on 1) the reference conditions that have been modeled for various regions of the U.S., 2) where to find descriptions and summary tables of the reference conditions, 3) how these were identified and how they are being refined, and 4) how to ensure you have updated values. Methods for modeling FRCC reference conditions will change as results are delivered from the national LANDFIRE Project.

Reference Conditions Summary

- **Reference conditions are an estimate of the mix of vegetation-fuel classes (states or successional classes), fire frequency and severity across the BpS of interest.**
- **Reference conditions are the baseline for determining departure from the natural or historical range (i.e., condition class).**
- **Reference conditions are determined by experts through synthesis of expert knowledge, published literature, and historical information using standardized computer modeling tools and processes.**
- **We encourage use of PNRV in applying FRCC because it is realistic, having a basis on current conditions and on trends suggesting conditions to come; however, use of HRV to determine reference conditions must serve as a surrogate in many cases until better data and models are available.**
- **Current standardized FRCC methods for estimating reference conditions for a given BpS use a non-spatial vegetation and disturbance dynamics model called the Vegetation Dynamics Development Tool (VDDT).**
- **To describe reference conditions, we use the *central tendency estimate* rather than a range of variability, such as a minimum and maximum.**
- **Refer to the *Fire Regime Condition Class* section near the beginning of this chapter for further details on the reference conditions used in FRCC determination.**

Scale Issues and Landscape Stratification

A key element in accurately evaluating FRCC is an understanding of scale. Much of the work in the realm of natural resources takes place at the stand scale; activities such as slash disposal, noxious weed treatment, and biomass removal are all examples of stand-scale projects. Although it is possible to analyze individual stands using the FRCC Standard Landscape methods (details in Chapter 3), analysis must begin at the landscape level because fire regimes operate at a landscape scale. Landscapes, therefore, are the appropriate scale at which to evaluate fire regimes and ecological departure for FRCC determination.

In FRCC methodology, a landscape is defined as the contiguous area within a delineation that is large enough to include the variation of the natural fire regimes. Therefore, an initial estimation of landscape area size for FRCC determination can be based on the fire regime group. The frequent fire regimes typically have relatively fine-grained patch variation that can be encompassed by an area typically associated with the physical confines of the BpS polygon, which is substantially smaller than average historical fire size. This is also true for the infrequent, mixed regimes in steep and dissected terrain where the patch variation is driven by physical confines rather than fire size. The mixed regimes in flat to rolling terrain have larger patch variation that requires landscape areas one to two times the average historical fire size. The infrequent and rare replacement regimes in steep and dissected terrain require landscapes that are two to three times the historical fire size and in flat to rolling terrain, three to four times the historical fire size. The rare and mixed fire regimes require an area 10 to 50 times the average gap size, depending on amount of vegetation-fuel class diversity. These landscapes are often referred to as shifting mosaics, where small gaps are created by wind disturbance and fill over time. Examples include western hemlock in southeast Alaska and northern hardwood forests in the East. General guidelines on landscape size as it relates to fire regime groups can be found in table 2-3.

Table 2-3 – General guidelines on landscape size for FRCC determination.

	Terrain	
Natural fire regime group	**Flat to rolling**	**Steep and dissected**
I – Frequent, surface & mixed	50-2,000 acres	50-1,000 acres
II – Frequent, replacement	50-2,000 acres	50-1,000 acres
III – Infrequent, mixed & surface	500-2,000 acres	250-1,000 acres
IV – Infrequent, replacement	5,000-1,000,000 acres	2,000-250,000 acres
V – Rare, replacement	5,000-1,000,000 acres	2,000-250,000 acres
V – Rare, mixed	50-10,000 acres	50-10,000 acres

Although fire regimes can serve as general guidelines for estimating landscape size, the specific size of the landscape for determining FRCC must be carefully selected: if the area is too small, a false picture of fire severity, frequency, and size will emerge, and mistakes in planning will inevitably follow; if the area is too broad, on the other hand, the ability to discern small changes in FRCC will be lost. Fifth- or sixth-code hydrologic units (25,000 to 100,000 acres) serve as logical landscape sizes for FRCC evaluation. Eco-map subsection or land type association delineations may also be used instead of fifth- or sixth-code hydrologic units if that classification and mapping system more effectively aggregates the BpS polygons into a contiguous landscape area. For infrequent and rare replacement regimes, fifth- or sixth-code watersheds may not be of sufficient size, in which case a fourth-code sub-basin or eco-map section may be more appropriate. In contrast, a fifth- or sixth-code watershed may be much larger than that needed for a BpS in a frequent or mixed regime, in which case a seventh-code watershed or eco-map land type or land type association polygon may be used. For delineations that occur as scattered small polygons or types with limited area due to biophysical constraints, a very large area or an adjustment of reference conditions (see Appendix B) may be needed. Landscape sizes can be defined locally, as well; however, to avoid the aforementioned unsound management decisions and reduced ability to monitor accomplishments that result from improperly defined landscape, these local determinations should be made by expert teams serving a region or sub-region for the development of consistent landscape definitions.

Once landscapes are identified, they must then be subdivided according to dominant vegetation types, each subdivision having a distinct fire regime and unique structural characteristics. For FRCC purposes, we refer to these subdivisions as *strata*. In short, your landscape-scale FRCC assessment will involve one or more strata, depending on the number of dominant vegetation types present. As mentioned above, these vegetation types are referred to as biophysical settings (BpS's). Occasionally, landscapes composed of a single BpS may be stratified according to ecological condition so that the user can assess FRCC for treated versus untreated areas separately. In addition, landscapes may be stratified by ownership delineations or sub-watersheds and thus allowing differences in FRCC to be described accordingly. But even these alternative subunits will usually be organized according to the BpS's within. Overall, the project area will be stratified by dominant vegetation types in the majority of applications.

Scale Issues and Landscape Stratification Summary

- **FRCC can be defined at the stand scale; however, because fire regimes operate at a landscape scale, it is important to understand and evaluate FRCC at the landscape scale before assessing at the stand scale.**
- **In FRCC methodology, a landscape is defined as the contiguous area within a delineation that is large enough to include the variation of the natural fire regimes.**
- **To avoid defining your landscape incorrectly, a multidisciplinary approach should be used for determination of appropriate landscape size for FRCC assessment.**
- **Landscapes are further divided into *strata*, each having a distinct fire regime and structure. In FRCC, these strata are referred to as *biophysical settings* (BpS's).**

Chapter 3

FRCC Standard Landscape Worksheet Method

- Project Data
- Strata Data: General Information, Biophysical Settings, Natural and Current Fire Regimes
- Strata Data: Vegetation-fuel Class Composition Fields
- Similarity, Departure, Relative Amount, and FRCC Calculation Fields
- Standard Landscape Worksheet Graphs
- Estimation Technique
- Natural Fire Regime Groups (table)
- Coarse-scale Vegetation-fuel Class Codes and Descriptions (table)
- “Simple 7”

This chapter provides the “how-to” steps for determining the natural fire regime, landscape FRCC, and stand FRCC of a project area using the Standard Landscape Worksheet Method. The directions under each field number are divided according to different user needs. The *Worksheet* directions (for use in conjunction with the Standard Landscape Worksheet) apply to examiners determining FRCC using local field data and performing manual calculations. The *Field Form* directions (for use in conjunction with the Standard Landscape Worksheet Field Form) apply to examiners determining FRCC using local field data that will later be entered into the program for calculation. The *Software* directions apply to examiners entering local field data into the software program. (Note: the *Software User Guide* contains more detailed software instructions and can be accessed at www.frcc.gov.) Where these are not specified, the directions apply to all three.

The Standard Landscape Worksheet Method provides the background understanding of the processes used to determine the natural fire regime, landscape FRCC, and stand FRCC and therefore provides the validation for the Estimation Technique (see the *Estimation Technique for Determining Landscape FRCC and Stand FRCC* section near the end of this chapter). For this reason, examiners should first become proficient in using the Standard Landscape Worksheet Method before employing the Estimation Technique.

→Note: Most fields are numbered sequentially; numbers that appear to have been “skipped” are retained for use by the computer program. In addition, field titles in bold on the Worksheet and Field Form and in blue in the software signify *required* data.

<u>Project Data</u> (fields 1- 20)

Fields 1 to 20 are used to characterize the entire project area at the landscape scale. Fields 1 to 4 uniquely identify the project area.

→Software note: Since the database automatically opens with an example project entered, you will need to create a new project. Go to the menu bar at the top of form and select "Project," then select "New" from the drop-down menu to enter a new project. The Software User Guide at www.frcc.gov provides additional detailed instructions on using the software program.

Registration Code ID (field 1) – Required – Enter your 4-character code assigned by the FRCC help-desk based on your agency affiliation. Visit the FRCC website at www.frcc.gov (under "Documents") for an updated list or contact the help-desk at helpdesk@frcc.gov if your land management unit is not listed. For users that do not have internet access and for non-federal agency personnel, contact your agency, TNC, or private FRCC coordinator. We encourage non-federal agency users to use one Registration Code per management unit and then use different Project Codes for individual project areas.

Project Code (field 2) – Required – Enter a code used to identify the project area (you are not required to use all eight characters). Some examples of Project Codes follow:

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

You may want to use the same code you would use for the National Fire Plan Operations and Reporting System (NFPORS) or other non-federal reporting system.

Project Number (field 3) – Required – Assign and enter an integer value (for example, 1, 2, 3…) to serve as an identifier to distinguish this project area from others.

Project Characterization Date (field 4) – Required – Enter the date of examination that distinguishes this data from previous or subsequent characterizations. Enter as an 8-digit date in the MM/DD/YYYY format. For example, April 10, 2005 would be entered 04/10/2005.

If the same project area is being re-measured after treatment of one or more units or to update condition class following a period of succession or unplanned disturbance, keep the same Project Code and Project Number but change the Characterization Date. Strata within the project area that have *not* changed can be copied into the data entry program under the new date. Data for those strata that *have* changed must be entered as new data.

Examiner Code (field 5) – Required – The Examiner Code is the code assigned to you by the help-desk. For certified users, this is the user's email address (go to www.frcc.gov for details on becoming certified). For users who do not have an email address, simply enter your name.

Project Name (field 6) – Required – Enter the name of the project area (usually the area's major drainage or other prominent feature). You may want to cross-reference this with your NFPORS "Project" (or other non-federal reporting system project name).

Project Area Size (field 7) – Required – Enter the size of the project area in an integer value. The Project Area Size is the extent of the overall area where you will be applying the FRCC Standard Landscape Worksheet procedures. (See field 8 for measurement units.)

Project Area Units (field 8) – Required – Circle / select either acres or hectares as the measurement unit for the Project Area Size in field 7.

Recording a Georeferenced Project Position (fields 10 to 15)

The following fields provide georeferencing for your project area. These fields are required and are important for re-photographing locations, for placing the project into a Geographic Information System (GIS), and for cross-walking to the NFPORS database.

We recommend using a Global Positioning System (GPS) receiver to record latitude and longitude in decimal degrees rather than degrees, minutes, and seconds. Where possible, select a position somewhat central to the project area and with a panoramic view for the location (fields 10 and 11) and for the current photo (field 16). Record the GPS coordinates to the sixth decimal place.

If you do not have a GPS receiver, determine latitude and longitude using a USGS 1:24,000 topographic map.

If, for lack of resources, you cannot determine latitude and longitude, enter "0" into fields 10, 11, and 15 and enter a legal location description in the comments field (field 20).

Latitude (field 10) – **Required –** Enter the latitude of the project area in decimal degrees to the sixth decimal place (for example, 45.951234).

Longitude (field 11) –**Required –** Enter the longitude of the project area in decimal degrees to the sixth decimal place (for example, 95.951234).

Datum (field 15) –Required – Enter / select the datum used. Datum is a model used to represent map coordinates on the Earth's surface. If you are unsure, contact your local GIS coordinator to see which datum is preferred. If you are not using a GPS, leave this field as is.

You may want to use the same georeference position used in your NFPORS reporting system (or other non-federal reporting system). In NFPORS, this is the center point of your project area.

Documenting your Project Area with Current and Reference Condition (Historical) Photos (fields 16 to 19)

Digital photographs and scans are useful means by which to document your project area as they provide a unique opportunity to visually assess the project area or vegetation class in a database format for local, regional, and national use. Document the project area with a current landscape-view or aerial view photograph. If available, scan a reference condition picture of the project area taken from a similar viewpoint or a picture of a landscape with similar biophysical settings. Photos can be compared to determine important changes after project area treatment implementation or an unplanned fire or other disturbance event. In addition, previously established project areas can be located by orienting landmarks in the photos to visual cues in the field. Photos also serve as excellent communication tools for describing project rationale to the public and to fire and fuels personnel. Potentially the most important use of these photos lies in the development of a photo series for use in evaluating a treatment's effectiveness.

The Software User Guide (www.frcc.gov) provides detailed instruction on how to incorporate photos into your project data.

Current Photo (field 16) – Not Required

Worksheet or Field Form: Enter a name and location for the photo (a pathway on your computer or other location indicating where the photo will be filed for potential future exportation to the central database).

Software: Use the browser to navigate to the photo stored on your computer. The digital photo file will accompany the rest of the project data when exported to the central database.

Current Photo Date (field 17) – 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 18) – Not Required **–**

Worksheet or Field Form: Enter a name and location for the photo (a pathway on your computer or other location indicating where the photo will be filed for potential future exportation to central database).

Software: Use the browser to navigate to the photo stored on your computer. The digital photo file will accompany the rest of the project data when exported to the central database.

Reference Condition Photo Date (field 19) – Not Required **–** Enter the date the reference condition photo was taken as an 8-digit date in the MM/DD/YYYY format.

Entering Comments about the Project area (field20)

The Comments field is provided for the field examiner to record information about the project area that cannot be recorded elsewhere on the form. For example, you can record ecological conditions, dates of wildland fire or fire use occurrence, directions, historical information, or any other important attributes.

Comments (field 20) – Not Required **–** Briefly enter any relevant comments about the project area. Use abbreviations to save space (as long as comments are still understandable).

Strata Data: General Information, Biophysical Settings, Natural and Current Fire Regimes (fields 21- 60)

According to your management needs, delineate the project area into strata by:

- differences in biophysical settings (BpS's)
- differences in fire regime groups (see table 3-15, page 3-41),
- BpS life forms (table 3-1, page 3-10),
- differences in current conditions (physical and/or biological),

- treatment or non-treatment units, or
- other management or biological delineations

Delineate as many strata as you deem necessary, keeping in mind that the individual strata, when combined, must total 100 percent of the project area.

If you need to conduct an assessment in a short amount of time, we suggest you do not include stratum that make up less than 20 percent of the project area - unless the stratum has very important management implications. Keep it simple by delineating the project area into the dominant strata only (usually only 2 to 3 strata).

→**Important - For multiple strata:**

> ***Worksheet:*** use an additional *Stratum Data* page (p. 2 of the FRCC Standard Landscape Worksheet) to complete fields 21 to 60 for ***each*** of your stratum.
>
> ***Field Form:*** use the additional strata/vegetation-fuel data sections provided to complete fields 21 to 75 for ***each*** of your stratum.
>
> ***Software:*** The cursor will automatically tab to the Stratum Data block below the Project Data block. You will need to complete this and the Vegetation-fuel Class Data block for ***each*** of your stratum. Create blank Stratum Data and Vegetation-fuel Class blocks for each additional stratum by clicking on the "New" (New Stratum) button located to the right of the Stratum Number field at the top of the Stratum Data block.

Stratum Number (field 21) – **Required** –

Worksheet or Field Form: Number your strata on each of your stratum worksheets. Number each stratum incrementally, starting with 1 (1, 2, 3, etc.)

Software: This will be assigned for you by the program.

Stratum Code (field 22) – **Required** – Enter a code that may be used to crosswalk the stratum to your reporting system (for example, this can be linked to the "Treatment Unit Name" in NFPORS).

Stratum Name (field 23) – Not Required – Enter a name associated with the stratum for purpose of identification (for example, “North Turkey Creek” or “Grassland with Tree”).

Stratum Characterization Date (field 24) – **Required** – Enter the date the stratum data was collected in the MM/DD/YYYY format (the software program will default to the date entered in the Project Data block but can be changed if needed). This date can be different from the Project Characterization Date (because of a different date of sampling) but should characterize the stratum for the same *general* time period.

Identifying Life Form and Associated Biophysical Setting (BpS) (fields 25 and 26)

To correctly identify the life form and associated BpS (fields 25 and 26), first review the following terms:

Canopy cover – The percentage of ground covered by a vertical projection of the outermost perimeter of the natural spread of plant foliage. Small openings within the canopy are included (SRM 1989, NRCS 1997).

→*Note:* Users with foliar cover data should covert it to canopy cover using the best available data and local expertise. This conversion will reflect the species, vigor, and age of the vegetation.

Natural fire regime – A natural fire regime is a general classification of the role fire would play across a landscape in the absence of modern human mechanical intervention but including the influence of aboriginal burning (Agee 1993; Brown 1995)

Forest – Conifer or broadleaf trees with an average upper layer height of greater than 5 meters (approximately 17 feet) and with canopy cover of at least 25 percent during the late successional seral stage.

Woodland – Conifer or broadleaf trees with an average upper layer height of greater than 5 meters and with canopy cover ranging from 10 to 25 percent during the late seral stage of development.

Shrubland – Mature trees have a height of greater than 5 meters and shrub cover is at least 10 percent.

Grassland – None of the above conditions for forest, shrubland, or woodland met, and graminoid / herb cover is at least 5 percent.

You'll next be asked to identify the life form for the biophysical setting you will later identify in field 26. Note that **the most common error in determining potential natural life form** (for example, forest, woodland, or shrubland) **results from the selection of a life form simply because that is what currently exists on that landscape**. Verify your initial selection by reviewing reference condition photos (landscape or aerial view). Additional note: if most or all of the current life form is of one size class that began development since Euro-American settlement, the area was most likely not characterized by that life form historically.

Now use the following key to identify the life form for the biophysical setting you will later identify in field 26.

Key to Potential Natural Life Forms

→Note: "Life forms," as used in this key, refer to the physiognomic vegetation formations of the Federal Geographic Data Committee (FGDC) National Vegetation Classification (FGDC 1997).

1a. Canopy cover of trees ≥ 10% under the historical disturbance regime: **Go to 2**

1b. Canopy cover of trees < 10% under the historical disturbance regime: **Go to 3**

2a. Mature (late successional) height of trees ≥ 5 meters (16.5 ft) and canopy cover ≥ 25%: **Forest**

2b. Mature (late successional) height of trees ≥ 5 meters (16.5 ft) and canopy cover ≥ 10% and ≤ 25%: **Woodland**

→Note: "Woodland" is an unofficial subdivision of Forest and is not recognized in all vegetation classifications; however, data can be easily collapsed into the Forest group, if necessary.

2c. Mature (late successional) height of trees <5 meters: **Go to 4**

3a. Canopy cover of shrubs ≥ 10% (or foliar cover ≥ 5%): **Go to 4**

3b. Canopy cover of shrubs < 10% (or foliar cover < 5%): **Go to 5**

4a. Potential canopy cover of trees ≥ 10% (not currently present due to altering of the historical disturbance regime): **Shrubland w/ Trees**

4b. Potential canopy cover of trees < 10%, even with an altered disturbance regime: **Shrubland**

5a. Canopy cover of graminoids / herbs ≥ 5%: **Go to 6**

5b. Canopy cover of graminoids / herbs < 5%: **Barren**

6a. Non-forest; upper canopy life form primarily grasses: **Go to 7**

6b. Non-forest; upper canopy life form primarily forbs and / or sedges / rushes: **Herbaceous Meadows, Non-Forest Wetlands, Tundra**

7a. Canopy cover of trees ≥ 10% (not currently present due to altering of the historical disturbance regime): **Grassland w/ Trees**

7b. Potential canopy cover of trees < 10%, even with an altered disturbance regime: **Go to 8**

8a. Potential canopy cover of shrubs ≥ 10% (or foliar cover ≥ 5%) (not currently present due to altering of the historical disturbance regime): **Grassland w/ Shrubs**

8b. Potential canopy cover of shrubs < 10% (or foliar cover < 5%) even with an altered disturbance regime: **Grassland**

→NOTE: Be aware that what may appear to be forest or woodland may actually be a natural shrubland or grassland BpS that has been *influenced by tree or shrub*. Use the following interpretations:

Tree encroachment potential in shrubland or grassland:

Shrubland or grassland is the natural cover associated with the historical disturbance regime and:

1. Trees are currently present in the stratum or
2. Trees are not currently present, but there is potential and an available seed source (typically within a mile).

Shrub encroachment potential in grassland:

Grassland is the natural cover associated with the historical disturbance regime and:

1. Shrubs are currently present on the stratum land unit or
2. Shrubs are not currently present, but there is potential and an available seed source (typically within a mile).

→***Important note:***

Worksheet and Field Form: *All subsequent default fields (marked as "def") will later be automatically populated by the software with reference values correlating to your BpS selection for field 26 below; however, you may wish to complete these fields on the worksheet or field form in order to later compare default values with local data. In these cases, simply follow the "Worksheet" directions.*

Software: *All subsequent default fields will later be automatically populated with reference values correlating to your BpS selection in field 26 below; however, you may replace these default values with more accurate local data.*

Stratum BpS Life form (field 25) – Required – This field represents the dominant life form associated with the BpS you will later identify for field 26.

Worksheet or Field Form: Enter the 2-character code (from table 3-1 below) for the life form identified above in the *Key to Potential Natural Life Forms.*

Software: This field will be automatically populated according to your selection for field 26.

Table 3-1 – BpS life form codes.

Code	BpS life form
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 life form

Stratum BpS Code (field 26) – **Required** – Once you have determined and entered the correct BpS life form, go to www.frcc.gov and select the appropriate key (Western U.S., Eastern U.S., or Alaska) to identify the appropriate biophysical setting (BpS). Once you have keyed to what you think may be the correct BpS, read the associated BpS description document (at www.frcc.gov) to ensure that the geographic area, site description, species, and disturbance regime fits your landscape stratum. If these do not correspond, continue to determine the appropriate BpS using the key and reading other BpS descriptions. These description documents should be read thoroughly and used often throughout this process to ensure that you haven't identified the wrong BpS. ***The most common error in determining FRCC is selecting the wrong BpS.***

Worksheet or Field Form: Enter the 4 to 6 character code (from the reference condition summary tables at www.frcc.gov) for the BpS selected according to the above guidelines or according to local data*.

Software: Select the 4 to 6 character code (from the drop-down menu) for the BpS selected according to the above guidelines or according to local data*.

→***Important note:** When replacing default values with local values, enter "XXXX" in field 26 and return to field 25 to manually enter the appropriate life form code. Then, complete the following steps:

Adjust reference conditions (the seven reference conditions include the five vegetation-fuel classes, fire frequency, and fire severity) ONLY after meeting the following criteria:

1) Document which suitable reason from Appendix B justifies changing the reference conditions from the default.

2) Document that the reference condition has been adjusted in combination with the 6 other reference conditions 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. This process avoids an inconsistent combination of the 7 reference conditions.

3) Document the local expert or team making the adjustment and the associated literature and field reconnaissance that was used in support.

This documentation will support the use of your improved or finer-scale expert estimate and more localized literature and field reconnaissance.

Stratum BpS Indicator Species (fields 27 to 30)

An indicator species is usually the most dominant species found in a BpS under reference (historical) conditions. Uncharacteristic disturbance or succession can reduce or eliminate these species. To clarify, these species are not necessarily what is found *currently* in the stratum; indicator species are based on reference conditions (see the BpS description documents).

Worksheet or Field Form: For fields 27-30, write at least one and up to four species that are indicative of the type of site conditions and natural disturbance regimes typical of the BpS. We recommend that you later check against the NRCS plant species code (at www.frcc.gov) and, if different, change for consistency in communicating data.

Software: For fields 27-30, select (from the drop-down menus) at least one and up to four species (taken from the NRCS plant list) that are indicative of the type of site conditions and natural disturbance regimes typical of the BpS. Note the "Species" button to the left of the indicator species boxes (fields 27 – 30). This feature allows you to query the NRCS list of plant species. Further details on this feature can be found in the Software User Guide at www.frcc.gov.

Stratum Indicator Species 1 (field 27) – **Required** – See directions above.

Stratum Indicator Species 2 (field 28) – Not Required – See directions above.

Stratum Indicator Species 3 (field 29) – Not Required – See directions above.

Stratum Indicator Species 4 (field 30) – Not Required – See directions above.

Stratum Local BpS Code (field 31) – Not Required – Enter up to a 10-character alpha-numeric code for a local BpS if applicable (for example land type, habitat type, plant association, range site, ecological land unit, potential vegetation type, or group).

Stratum Landform (field 32) – Required – Enter / select a coarse-scale Landform Code from table 3-2 below (or from the software drop-down menu).

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 34) – Required – Enter / select a Slope Class from table 3-3 below (or from the software drop-down menu):

Table 3-3 – Slope percent class codes.

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

Stratum Insolation (Aspect) Class (field 36) – Required – Insolation is a relative classification of the amount of sun heating reception. This is typically related to the aspect of slopes and the influences of warm or cold airflow. Enter / select an Insolation Class from table 3-4 below (or from the software drop-down menu):

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 38) – Required – Enter an elevation that represents the *typical* lower elevation of the stratum (note: this is not the statistical minimum). If the elevation does not change within the stratum, enter the same elevation for low and high. (See field 40 for measurement units.)

Stratum High Elevation (field 39) – Required – Enter an elevation that represents the *typical* upper elevation of the stratum (note: this is not the statistical maximum). If the elevation does not change within the stratum, enter the same elevation for low and high. (See field 40 for measurement units.)

Stratum Elevation Units (field 40) – Required – Circle / select either feet or meters as the elevation measurement unit for fields 38 and 39.

Stratum Composition (field 41) – Required – Estimate the percentage of the total project area that falls within this stratum (for example, enter 20 for 20 percent; do not use a decimal). The sum of all strata for the project area must total 100 percent.

Recording a Georeferenced Project Position (fields 43-50)

The following fields provide georeferencing for your project area. These fields are required and are important for re-photographing locations, for placing the stratum into a Geographic Information System (GIS), and for cross-walking to the NFPORS database.

We recommend using a Global Positioning System (GPS) receiver to record latitude and longitude in decimal degrees rather than degrees, minutes, and seconds. Your selection for location of the stratum position is flexible. Select a point that is generally central to the stratum area or a point that provides a good visual perspective of the stratum. Select the location from which the stratum photo (field 49) is taken so that the photo can be repeated at a later date for monitoring purposes. Record the GPS coordinates to the sixth decimal place.

If you do not have a GPS then you can determine latitude and longitude using a USGS 1:24,000 quad map.

If you cannot determine latitude and longitude then enter “0” into the fields and enter a legal location description in the comments (field 60).

Stratum Latitude (field 43) –Required – Enter the latitude of the stratum center in decimal degrees to the sixth decimal place (for example, 45.951234).

Stratum Longitude (field 44) –Required – Enter the longitude of the stratum center in decimal degrees to the sixth decimal place (for example, 95.951234).

Datum (field 48) –Required – Enter / select the datum used. Datum is a model used to represent map coordinates on the Earth's surface. If you are unsure of which to use, contact your local GIS coordinator to see which datum is preferred. If you are not using a GPS, leave this field as is.

Current Stratum Photo (field 49) – Not Required **–**

Worksheet or Field Form: Enter a name and location for the photo (a pathway on your computer or other location indicating where the photo will be filed for potential future exportation to central database).

Software: Use the browser to navigate to the photo stored on your computer. The digital photo file will accompany the rest of the project data when exported to the central database.

Current Stratum Photo Date (field 50) – Not Required **–** Enter the date the stratum photo was taken as an 8-digit date in the MM/DD/YYYY format.

Fire Regime Data (Fields 51-54)

Fields 51 through 54 ask you for the *central tendency* or mean of the reference condition and current fire frequencies or severities. It is important to note that an exact average is not required; rather, your estimate of the central tendency is assumed to have plus or minus 33 percent variation (refer to the *Reference Condition Modeling* section in Chapter 2 for an explanation of *central tendency*).

To review information about the BpS descriptions and reference conditions, refer to the website at www.frcc.gov, contact the help-desk (helpdesk@frcc.gov), or, if you do not have internet access, contact your agency, TNC, or private FRCC coordinator.

Stratum Reference Condition Fire Frequency (field 51) – Required – This is the mean fire interval (MFI) for the Reference Condition Fire Frequency.

Worksheet: Obtain the MFI from the reference condition summary tables (*note*: pre-settlement Native American fire use has been included where appropriate), from regional values (such as local studies), or you can develop your own local estimates. For the latter approach, estimate a representative stand-scale 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:

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

Software or Field Form: The data entry program will automatically populate this field with values from the reference condition summary tables; again, you may replace this default value with local data, if desired.

→Note regarding using local data: Rather than conducting intensive fire history sampling, we encourage users to conduct a general field reconnaissance (see suggested methods in field 52 below), or, use literature searches and the “expert opinion” approach.

Estimating Current Fire Frequency (MFI) (field 52)

In field 52 below, you’ll be asked to estimate current fire frequency by conducting a thorough analysis of post-settlement fire activity. Analyze all substantially spreading fires (in other words, fires caused by lightning and humans, including prescribed burning) regardless of whether the severity was natural (Current Fire Severity is addressed in field 54). That is, assess all fires that had potential to influence the vegetation.

Whether to include comparatively small fires (such as size classes “B” and “C”) is up to the local user. Small fires can certainly be ecologically important, especially if they were part of the natural fire regime or if the stratum is limited in extent. In general, however, you probably wouldn’t want to include most “Class A” spot fires (in other words, ignitions that were quickly suppressed).

Following are three potential methods for estimating Current Fire Frequency, the first using *fire atlas record*s and the others using *field examinations.*

Below is a method for estimating Current Fire Frequency using **fire atlas records**.

> <u>Step 1</u> - 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).
>
> <u>Step 2</u> - Estimate 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 1935. Therefore, modern-day fires have burned an average of 50 acres per year (3,500 acres / 70 years = 50).

<u>Step 3</u> – 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 that conversion factor to determine current fire frequency and enter the result in field 52, Current Fire Frequency.

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

Next are two methods for estimating Current Fire Frequency (MFI) based on general **field examinations** (for *forest* BpS's only).

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, Barrett and Arno 1988). Estimate a representative MFI by dividing the number of years in the fire period by the number of fire intervals (total scars minus 1) (see fig. 3-1 below).

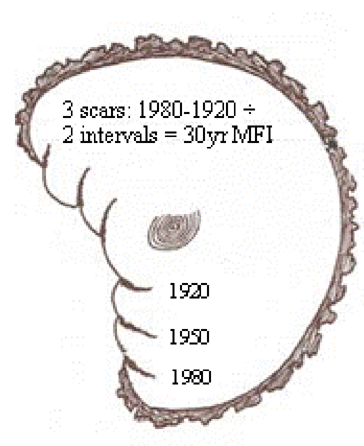
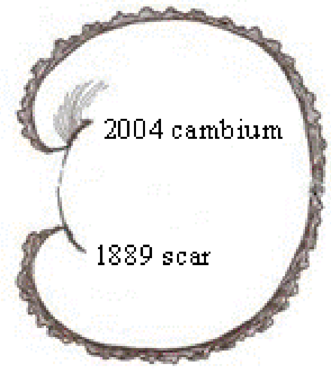


Figure 3-1 – Estimating current fire frequency (MFI) from stump with multiple fire scars.

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 fig. 3-2 below). For example, this value can be estimated by: 1) examining stumps with known logging dates, 2) by using an increment borer to estimate the date of the last fire scar on live trees, or 3) by estimating post-fire regeneration dates for even-aged stands (such as in lodgepole pine forests).

Figure 3-2 – Estimating the number of years since the last fire.



Stratum Current Fire Frequency (field 52) – Required – Estimate Current Fire Frequency (MFI) using one of the above methods. Note: If there is no evidence of fires occurring during the post-settlement era, enter 100 years as a default value.

Stratum Reference Condition Fire Severity (field 53) – Required – This metric refers to the proportion of stand replacement (defined as 75 to 100 percent upper-layer life form 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. Use your own estimate or the default values (estimates derived from simulation modeling) from the BpS summary tables.

Stratum Current Fire Severity (field 54) – Required – Estimate current stand replacement potential based on modern fire records 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.

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 substantially during the current period, simply re-enter the reference value (since, for example, in most stand-replacement regimes, fire severity potential has not changed since the historical reference period).

Stratum Metadata (fields 55-57)

Stratum Reference Condition Vegetation-fuel Class Percent Composition Source (field 55) – Required –

Worksheet: From table 3-5 below, enter the 1-character code representing the *source* from which you acquired the data that is to be entered below in fields 62 – 72 (Reference Condition Stratum Vegetation-fuel Class Composition).

Software or Field Form: The data entry program will automatically populate this field with the source code of "D," indicating data acquired from the reference condition summary tables; however, if you choose to replace the default values in fields 62-72 with more accurate local values, select the appropriate code from the drop-down menu (representing the source from which you acquired your data to be entered in fields 62 – 72).

The source selections are ordered from least to most rigorous regarding validity of the values obtained.

Table 3-5 – Reference condition vegetation-fuel 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 Vegetation-fuel Class Percent Composition Source (field 56) – Required –

Worksheet: From table 3-6 below, enter the 1-character code representing the source from which you acquired the data that is to be entered below in field 73 (Current Stratum Vegetation-fuel Class Composition).

Software or Field Form: The data entry program will automatically populate this field with the source code of "R," indicating data acquired from a walk through and visual estimate as this is the recommended method; however, if you choose to replace the default values in field 73 with a more accurate local value, select the appropriate code from the drop-down menu (representing the source from which you acquired your data to be entered in field 73).

The source selections are ordered from least to most rigorous regarding validity of the values obtained.

Table 3-6 – Current vegetation-fuel class composition source codes.

Code	**Source**
V	Visual estimate
R	Walk through with visual estimate
M	Mapped summary

Stratum Reference Condition Fire Frequency and Native American Burning (field 57) – Required –

Worksheet: From table 3-7 below, enter the 1-character code representing how you addressed the issue of inclusion of Native American burning in the reference conditions above for field 51.

Software or Field Form: The data entry program will automatically populate this field with the code of "C," indicating use of default reference condition value for field 51 (which includes influence of Native American burning); however, you may replace this default value with a more accurate code from the drop-down menu (representing how you addressed the issue of inclusion of Native American burning in the reference condition fire frequency above in field 51).

Refer to Barrett and Arno (1982) for a discussion of ecological implications.

Table 3-7 – Inclusion of Native American burning influence in reference condition fire frequency value for field 51.

Code	Inclusion of Native American burning influence
C	Used default reference condition summary tables
A	Substantial Native American burning influence included
D	Substantial Native American burning influence, but not included
W	Native American burning considered but not different than without
N	Native American burning influence not considered

Vegetation-fuel Class Breakpoints (fields 58-59)

Later, in fields 62-75, you'll be asked to define in detail the structure and composition of each of the vegetation-fuel classes existing within your project area's strata. The general characteristic vegetation-fuel classes are defined for FRCC purposes as A) early-seral, post-replacement (AESP), B) mid-seral, closed canopy (BMSC), C) mid-seral, open canopy (CMSO), D) late-seral, open canopy (DLSO), and E) late-seral, closed canopy (ELSC). Note that we commonly also use the shorthand codes A through E in referring to these characteristic vegetation-fuel classes. Table 3-16 provides descriptions of both characteristic and uncharacteristic vegetation-fuel classes.

Fields 58-59 below ask you to identify the canopy closure percentage breakpoints between *open* and *closed* canopies if canopy closure was used.

Stratum B to C Vegetation-fuel Class Breakpoint (field 58) – Not Required **–**

Worksheet or Field Form: Enter the canopy closure breakpoint percentage for differentiating between vegetation-fuel classes B (Mid seral, *closed* canopy) and C (Mid seral, *open* canopy). Use the following default values: **35 percent** canopy closure for forest, woodland, and herbland and **15 percent** for shrubland. Or, if you have a more accurate local value, enter this. Enter the percentage as an integer, not a decimal.

Software : The program will automatically populate this field with the default value; however, if you have a more accurate local value, replace the default value with this. Enter the percentage as an integer, not a decimal.

→**Note:** *If using a value other than canopy closure to determine the breakpoint*, leave the above default values but, in the “Comments” field (field 60), note which variable was used in its place.

Stratum D to E Vegetation-fuel Class Breakpoint (field 59) – Not Required **–**

Worksheet: Enter the canopy closure breakpoint percentage for differentiating between vegetation-fuel classes D (Late seral, *open* canopy) and E (Late seral, *closed* canopy). Use the following default values: **35 percent** canopy closure for forest, woodland, and herbland, and **15 percent** for shrubland. Or, if you have a more accurate local value, enter this. Enter the percentage as an integer, not a decimal. Remember, these are based on reference conditions so you may be able to extract this information from the description document for your BpS.

Software or Field Form: The program will automatically populate this field with the default value; however, if you have a more accurate local value, replace the default value with this. Enter the percentage as an integer, not a decimal.

→**Note:** *If using a value other than canopy closure to determine the breakpoint*, leave the above default values but, in the “Comments” field (field 60), note which variable was used in its place.

Stratum Comments (field 60) – Not Required **–** Briefly enter comments regarding the stratum. For example, describe situations in which you used the “other” code (OT) or could not complete a particular field. Use abbreviations to save space (as long as comments can be understood).

Strata Data: Vegetation-fuel Class Composition Fields (fields 62- 75)

Use the BpS description documents, reference condition summary tables, regional descriptions if available, or develop custom local descriptions of the characteristic (using *reference* conditions from the reference condition summary tables) and uncharacteristic vegetation-fuel classes. As mentioned above, table 3-16 provides a general description of the standardized vegetation-fuel classes for both characteristic and uncharacteristic classes. The BpS descriptions and reference values are in an on-going review and refinement process; to ensure you have up-dated values, visit the FRCC website (www.frcc.gov), contact the help desk (helpdesk@frcc.gov), or contact your agency, TNC, or private FRCC coordinator.

Reminder:

For fields 62-75, you will again need to complete these fields for *each* of your stratum on additional Stratum Data pages (p. 2 of the Standard Landscape Worksheet). Field Form users:

use the additional strata sections provided. Software users: enter into the Vegetation-fuel Class block for each Stratum you add.

→**Note:** For many BpS's, the characteristic vegetation fuel classes A through E do not always follow the general descriptions given in table 3-16. In many grasslands, for example, there may be only three classes: immediate post disturbance, open, and closed. Users therefore must always read the BpS description documents or summary tables to determine how each class is defined.

Stratum Vegetation-fuel Class Code (field 62) – Required – First, determine which of the 5 *characteristic* vegetation-fuel classes exist within the stratum, and for fields 63-75, leave blank those vegetation-fuel classes not found in the stratum.

Worksheet or Field Form: Then, beneath the characteristic classes, write the 4-character code (from table 3-16) for any *uncharacteristic* vegetation-fuel classes that exist within the stratum.

Software: Then, to add any *uncharacteristic* vegetation-fuel classes that exist within the stratum, click on the "New" button (to the left of the characteristic classes) and a row for an uncharacteristic class will appear below the characteristic classes. Click in the "Code" cell to select from the drop-down menu the uncharacteristic vegetation-fuel class existing within the stratum. Repeat the procedure for additional existing uncharacteristic classes (note: you may need to scroll down to view these).

→***Note: For fields 63 through 70,*** answers should be based on current conditions but should reflect the BpS reference descriptions for characteristic types. Follow these steps:

1) Read the BpS description document and study the descriptions of each vegetation fuel class.
2) Locate these vegetation fuel classes in your landscape.
3) Describe these vegetation fuel classes in fields 63 through 70.

Vegetation-fuel Class Upper Layer Life Form (field 63) – Required (for each veg-fuel class existing in the BpS) **–** Work sequentially through table 3-8 below (or software drop-down menu) until you find the determination criteria matching the stratum's upper layer life form; enter the 4-character code.

Table 3-8 – Upper layer life form codes.

Code	Life form	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	

Vegetation-fuel Class Upper Layer Size Class (field 64) – Required (for each veg-fuel class existing in the BpS) **–** From table 3-9 below (or software drop-down menu), select / enter the 4-character size class code for the stratum's dominant upper layer life form (from field 63).

Table 3-9 – Upper layer life form 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

Vegetation-fuel Class Upper Layer Canopy Closure (field 65) – Required (for each veg-fuel class existing in the BpS) **–** From table 3-10 below (or software drop-down menu), select / enter the code for the estimated canopy closure of the upper vegetation layer.

Table 3-10 – Upper layer canopy closure codes.

Code	Percent Canopy Closure
0	Zero percent
0.5	0-1 percent
3	2-5 percent
10	5-15 percent
20	15-25 percent
30	25-35 percent
40	35-45 percent
50	45-55 percent
60	55-65 percent
70	65-75 percent
80	75-85 percent
90	85-95 percent
98	95-100 percent
XX	Could not assess

Vegetation-fuel Class Dominant Species (fields 66 to 69)

These fields differ from fields 27-30 (the BpS Indicator Species) in that these represent the *dominant species* found in **each** vegetation-fuel class **within** the stratum. Often, however, the dominant species are the same as the indicator species.

Worksheet or Field Form: For fields 66-69, write at least one and up to four species that are dominant for each vegetation-fuel class found within the BpS. If you are not recording NRCS plant codes, we recommend that you later check against the NRCS plant species code (at www.frcc.gov) and, if different, change for consistency in communicating data.

Software: The program will automatically populate field 66 with a dominant species default value (the indicator species from field 27); however, if you have more accurate local values, use these. (Note: for uncharacteristic classes, you must choose from the drop-down menu.) See the Software User Guide (www.frcc.gov) for shortcuts in determining the Dominant Species.

Vegetation-fuel Class Dominant Species 1 (field 66) – Required (for each veg-fuel class existing in the BpS) **–** See directions above.

Vegetation-fuel Class Dominant Species 2 (field 67) – Not Required **–** See directions above.

Vegetation-fuel Class Dominant Species 3 (field 68) **–** Not Required **–** See directions above.

Vegetation-fuel Class Dominant Species 4 (field 69) – Not Required – See directions above.

Vegetation-fuel Class Fire Behavior Fuel Model (field 70) – Not Required **–** Select / enter the appropriate fire behavior fuel model from Anderson's 1982 publication *Aids for Determining Fuel Models for Estimating Fire Behavior* in table 3-11 (or software drop-down menu).

Table 3-11 – Anderson's (1982) 13 Standard Fire Behavior Fuel Models.

F M number		Vegetation types	Fire behavior	Fuels
0	--	Non-vegetated		
1	--	Perennial grasslands, annual grasslands, savannahs, grass-tundra, grass-shrub with < 1/3 shrub or timber	Rapidly-moving	Cured fine, porous herbaceous; .5 to .9 tons surface fuel-load per acre; .5- to 2-foot depth
2	--	Shrub, pine, oak, pinyon-juniper with < 2/3 shrub or timber cover	Moderate spread in herbaceous with added intensity from litter/wood and production of firebrands	Fine herbaceous surface cured or dead, litter, dead stem or limb wood; 1 to 4 tons surface fuel-load per acre; .5- to 2-foot depth
3	--	Tall grassland, prairie, and meadow	Fast-moving with wind, but not as fast as FM 1	Tall herbaceous surface with > 1/3 dead or cured; 2 to 4 tons fuel-load per acre; 2- to 3-foot depth
4	--	Coastal/sierra chaparral, pocosin shrub (fetterbrush, gallberry, bays), southern rough shrub, closed jack pine, pine barrens	Fast-moving and intense	Flammable foliage and small dead woody material with or w/o litter layer; 10 to 15 tons fuel-load per acre; 4-to 8-foot depth

5	--	Moist or cool shrub types (laurel, vine maple, alder, manzanita, chamise), forest/shrub, regeneration shrubfields after fire or harvest	Slow-moving and low to moderate intensity	Green foliage with or w/o litter; 3 to 5 tons per acre; 1- to 3-foot depth
6	--	Pinyon-juniper w/ shrubs, southern hardwood/ shrub w/ pine, frost-killed Gambel oak, pocosin shrub, chamise, chaparral, spruce-taiga, shrub-tundra, hardwood slash	Moderate spread and intensity, not as fast/ intense as FM 4, but faster than FM 5	Flammable foliage but shorter and more open than FM 4 w/ less dead, small wood and litter; 4 to 8 tons per acre; 2- to 4-foot depth
7	--	Palmetto-gallberry w/ or w/o pine overstory, black spruce/shrub, southern rough, slash pine/gallberry	Fast-moving, even at higher dead fuel moisture contents	Flammable foliage, even when green; 4 to 6 tons per acre; 2- to 3-foot depth
8	--	Closed-canopy short-needle conifer types, closed-canopy broadleaf or hardwood types	Typically slow-moving with low intensities; can move rapidly with high intensity with very low fuel moistures and hot/dry/windy	Usually low- to moderately-flammable foliage with litter or scattered vegetation understory; 4 to 6 tons per acre surface fuels; .1- to .5-foot depth
9	--	Long needle (ponderosa, jeffrey, red, southern) conifer types, oak-hickory and similar hardwood types	Fast-moving fires with moderate to high intensity depending on amount of surface fuel	Flammable foliage with needle or leaf litter and some dead, downed woody material; 3 to 4 tons per acre; .1- to .5-feet
10	--	Any forest type with > 3" dead, downed woody fuels	High fire intensity with low fuel-moisture and fast moving with wind	Dead, downed > 3" woody fuels and litter; 10 to 14 tons per acre of total surface fuel < 3"; .5- to 2-foot depth
11	--	Light-logging slash, partial-cut slash	Fast-moving and low to moderate intensity with wind	10 to 14 tons per acre; total fuel load < 3"; .5- to 2-foot depth
12	--	Moderate and continuous logging slash in clearcuts or heavy partial cuts and thinned areas	Fast-moving and moderate intensity fire	30 to 40 tons per acre; total fuel load < 3"; 2- to 3-foot depth
13	--	Heavy and continuous logging slash in clearcuts or heavy partial cuts and thinned areas	Fast-moving and high intensity fire	50 to 60 tons per acre; total fuel load > 3"; 2- to 4-foot depth

Vegetation-fuel Class Reference Percent Composition (field 72) – Required – Enter an estimate (central tendency) of the reference condition composition percentage (in an integer form, using no decimal) for each existing vegetation-fuel class within the stratum. (Uncharacteristic classes will always be "0".)

Worksheet: Refer to the reference condition summary tables, regional values, or local estimates.

Software or Field Form: The data entry program will automatically populate this field with the reference condition default value; you may replace this default value with more accurate local data.

> *→Note: In most cases the sum of entries for the five characteristic classes equals 100 percent. There are, however, rare cases in which the sum can equal more than 100 percent: 1) infrequent*

and rare interval (> 35 years) stand-replacing regimes that have an absence of mosaic effect due to lack of barriers to fire spread or where the BPS is restricted to a small contiguous area, such as on the top of a mountain; and 2) frequent interval (< 35 years) stand-replacing regimes, such as shrubland or grassland that tend to be dominated by one vegetation-fuel class, irrespective of the extent or presence/absence of barriers to fire spread. For example, in a long interval, stand-replacing regime with a large geographic extent that does not have barriers to fire spread, most of the area will be in one vegetation-fuel class at any one time period. The first year post–fire, there may be 100 percent in Class A; five years post-fire, there may be 100 percent in Class C; seven years post-fire there may be 100 percent in Class D; and so on. In this example, the reference percent composition sum would total 300 percent (or more, depending on if you have greater than zero percent in other classes). If you believe you have a system where this applies, see Appendix B: Suitable Reasons for Replacing Default Reference Condition Values with Local Values.

Vegetation-fuel Class Current Percent Composition (field 73) – Required – Enter an estimate (central tendency) of the current composition percentage (in an integer form, using no decimal) for each existing vegetation-fuel class within the stratum. Use local data such as aerial photographs, maps or walk-throughs. The sum of entries for the classes must total 100 percent.

→**Note:** You may associate any individual stand with *only one* vegetation-fuel class. For example, if uncharacteristic timber harvest (UTHV) has affected vegetation-fuel stands that make up 20 percent of the area, and those same stands have an uncharacteristic pattern (UPAT), you must select the primary cause which, in this case, would be UTHV.

Vegetation-fuel Class Representative Photo (field 74) – Not Required **–**

Worksheet or Field Form: Enter a name and location of photo (a pathway on your computer or other location indicating where the photo will be filed for potential future exportation to central database).

Software: Use the browser to navigate to the photo stored on your computer. The digital photo file will accompany the rest of the project data when exported to the central database.

Vegetation-fuel Class Representative Photo Date (field 75) – Not Required **–** Enter the date the Class Representative Photo was taken as an 8-digit date in the MM/DD/YYYY format.

Similarity, Departure, Relative Amount, and FRCC Calculation Fields (fields 77- 104)

→***Worksheet Note*** : Although the below fields are not labeled “required” or “not required,” worksheet users must complete each field below in order to determine FRCC (the program automatically calculates the values for software/field form users).

→***Field Form Note****:* At this point, you have entered all the necessary data for this stratum. Use the additional strata/vegetation-fuel data sections provided to for each additional stratum. When you have entered data for all strata, you can use the software program to complete the calculations. Go back to the beginning and follow the Software directions to enter your data into the program.

→***Software Note****:* At this point, you have entered all the necessary data for this stratum. Create blank Stratum Data blocks for each additional stratum by clicking on the “New” (New Stratum) button located to the right of the Stratum Number field at the top of the Stratum Data block. When you have entered data for all your strata, simply click on the “Report” button in the lower right corner and use the page up/down keys or the scroll bar at the right to view your full report.

Stratum Vegetation-fuel Class Similarity (field 77) – This percentage represents the similarity of the current amount of the five characteristic classes to the reference condition amount.

Worksheet: Enter the lesser value of fields 72 and 73.

Strata Similarity (field 78) – This is the total of all the vegetation-fuel class similarity values (field 77) for all the strata within your project area.

Worksheet: Total and enter the sum of field 77.

Stratum Vegetation-fuel Class Percent Difference (field 79) – This percentage represents the difference between the current amount and the reference condition amount of the five characteristic classes.

Worksheet: Use one of the following equations:

If (field 73 < field 72), difference = ((field 73 – field 72) / field 72) * 100

If (field 73 ≥ field 72), difference = ((field 73 – field 72) / field 73) * 100

Stratum Vegetation-fuel Class Relative Amount (field 80) – This classifies the amounts of reference condition vegetation-fuel classes that currently exist within the stratum relative to that which likely occurred historically. See fig. 3-3 below showing the Relative Amount classes on a continuum before completing field 81:

Worksheet: Enter the letter code from table 3-12 below. Compare the value from field 79 with the graph in fig. 3-3 to determine the Relative Amount Class.

Figure 3-3 – Amount of vegetation-fuel class (VFC) relative to that of the defined reference period.

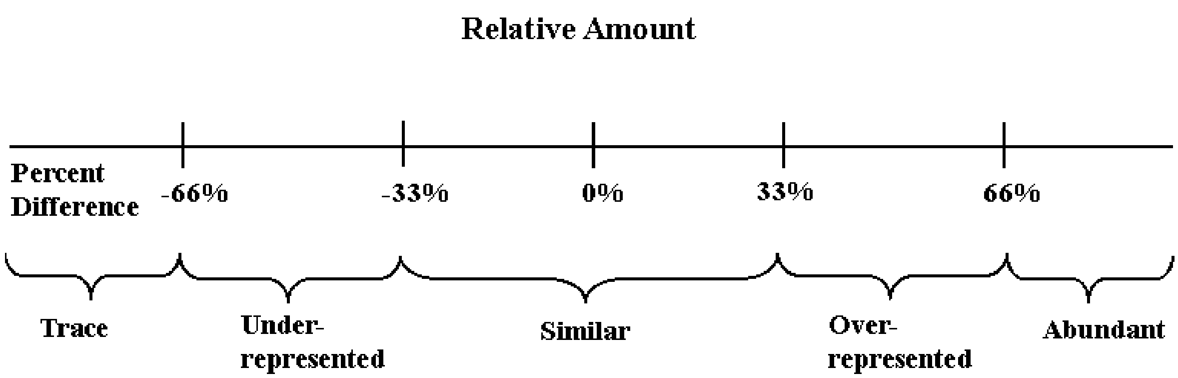


Table 3-12 – Relative Amount class codes.

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

Stand-scale Data (fields 81-82)

The stand-scale fields below (Stand Departure and Stand FRCC) determine FRCC at a patch, stand or small project area scale that does not meet the definition of a landscape or strata in terms of size. While these values are derived from the VFC, they apply to stands within the associated VFC, not the VFC itself.

Stand Departure (field 81) – This is the categorization that gives a stand its departure rating:

Worksheet: Use one of the following equations and enter the result:

If VFC Difference (field 79) ≥ 0, then Stand Departure = enter the value from field 79

If VFC Difference (field 79) < 0, then Stand Departure = enter 0

Stand FRCC (field 82) – For each stand that is a member of this vegetation-fuel class, compare the value from field 80 with table 3-13 below to determine the stand FRCC.

Table 3-13 –Stand FRCC determination and appropriate management response for improvement of landscape condition.

VFC Relative Amount Class (field 80)	Stand Departure (field 81)	Stand FRCC (field 82)	Improving stand condition if stand is:	Improving landscape condition if VFC is:
Trace	0	1	Maintained or protected	Recruited
Under-represented	0	1	Maintained or protected	Recruited
Similar	0	1	Maintained or protected	Maintained
Over-represented	VFC difference (value from field 79)	2	Reduced	Reduced
Abundant	VFC difference (value from field 79)	3	Reduced	Reduced

Interpretation of table 3-13:

At the stand scale, the management goal is to maintain stands residing in VFCs categorized as Trace, Under-represented, or Similar and reduce stands residing in VFCs categorized as Over-represented or Abundant. **At the landscape scale,** the management goal is to recruit VFCs categorized as Trace or Under-represented, maintain VFCs categorized as Similar, and reduce VFCs categorized as Over-represented or Abundant.

*→**Note:** A change of condition class in more than 1 percent of the stratum area may affect the Relative Amount Class (field 80) of the Vegetation-fuel Class (field 62) at the landscape scale. Consequently, after treatment or disturbance, the changed stratum vegetation-fuel class estimates will need to be monitored for recalculation of the departure and reclassification of the Relative Amount Class to determine a new Stand FRCC (field 82).*

Stratum Area of Vegetation-fuel Class Departure (field 83) – This field represents the area (in acres or hectares) that has departed from the reference condition vegetation-fuel class composition.

Worksheet: Use the following equation:

Field 7 * (field 41 / 100) * ((field 73 – field 72) / 100) = Area departed

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

Stratum Current Vegetation-fuel Departure (field 85) – This represents the deviation of the current vegetation-fuel class amount from the central tendency of the reference condition amount.

Worksheet: Subtract the value in field 78 from the integer 100.

Stratum Vegetation-fuel FRCC (field 86) – This field categorizes Vegetation-fuel Departure into an FRCC classification.

Worksheet: Categorize the Current Vegetation-fuel Departure value from field 85 into a condition class (1, 2, or 3) and enter that value:

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

Stratum Current Fire Frequency Departure (field 87) – This represents the deviation of the current Fire Frequency from the central tendency of that of the reference conditions.

Worksheet: Use the following equation: (1 – (lesser value of fields 51 and 52) / higher value of fields 51 and 52)) * 100.

Stratum Current Fire Severity Departure (field 88) – This represents the deviation of the **Current Fire Severity** from the central tendency of that of the reference conditions.

Worksheet: Use the following equation:

(1 – (lesser value of fields 53 and 54) / (higher value of fields 53 and 54)) * 100

Stratum Current Frequency-Severity Departure (field 89) – This represents the deviation of the current Fire Frequency-Severity from the central tendency of that of the reference conditions.

Worksheet: Use the following equation: ((field 87 + field 88) / 2).

Stratum Frequency-Severity FRCC (field 90) – This field categorizes Fire Frequency-Severity Departure into an FRCC classification.

Worksheet: Categorize the Current Frequency-Severity Departure value from field 89 into a condition class (1, 2, or 3) and enter that value:

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

Stratum Fire Regime Condition Class (field 91) – This is the FRCC rating for the individual stratum.

Worksheet: Enter the higher value of fields 86 and 90.

→***Worksheet note:*** *For the following, return to the Project Data Fields (p. 1 of the Standard Landscape Worksheet)*

Stratum Percent of Project Area (field 41). These boxes represent the percent of the project area occupied by each stratum.

Worksheet: Enter the data from the Strata Datum pages (field 41). The sum of your strata must total 100 percent.

Stratum Reference Condition Fire Frequency (field 51) – This is the mean fire interval (MFI) for the Reference Condition Fire Frequency.

Worksheet: Enter the reference condition fire frequency data for each stratum from your Strata Datum pages (field 51).

Stratum Weighted Reference Condition Fire Frequency (field 92) – This is the weighted fire frequency value for each stratum.

Worksheet: Refer to your Strata Datum pages. Calculate for each of your stratum using the following equation: (field 41 / 100) * field 51.

→Note: if the project area includes enough barren area or water to warrant adding either as a separate stratum (at least 20 percent), exclude that percentage from 100 to calculate the above formula. For example, if the project area has a lake in its boundary that occupies 30 percent of the total project area, the formula would be: (field 41 / 70) * field 51.

Project Area Weighted Reference Condition Mean Fire Frequency (field 93) – This is the mean sum of the weighted fire frequencies for all strata.

Worksheet: Add the values from field 92 and enter the total.

Project Area Reference Condition Fire Frequency Class (field 94) – This field categorizes the weighted mean fire frequency total of all strata into a fire frequency class.

Worksheet: Enter “Frequent” if field 93 is less than 35 years; enter “Infrequent” if it’s 36 to 200 years; enter “Rare” if it’s more than 200 years.

Stratum Weighted Reference Condition Fire Severity (field 95) – This is the weighted fire severity value for each stratum.

Worksheet: Refer to your Strata Datum pages. Calculate for each of your stratum using the following equation: (field 41 / 100) * field 53.

→Note: if the project area includes enough barren area or water to warrant adding either as a separate stratum (at least 20 percent), exclude that percentage from 100 to calculate the above formula. For example, if the project area has a lake in its boundary that occupies 30 percent of the total project area, the formula would be: (field 41 / 70) * field 53.

Project Area Reference Condition Weighted Mean Fire Severity (field 96) – This is the mean sum of the weighted fire severities for all strata.

Worksheet: Add the values from field 95 and enter the total.

Project Area Reference Condition Fire Severity Class (field 97) – This field categorizes the weighted mean fire severity total of all strata into a fire severity class.

Worksheet: Enter “Surface” if field 96 is less than 25 percent; enter “Mixed” if it’s 26 to 75 percent; enter “Replacement” if it’s more than 75 percent.

Project Area Natural Fire Regime Group (field 98) – This field categorizes the project area into a natural fire regime group.

Worksheet: Enter the numeral indicating the natural fire regime group based on the combination of values from fields 94 and 97:

- I – frequent, surface and mixed
- II – frequent, replacement
- III – infrequent, mixed
- IV – infrequent, replacement
- V – rare, replacement

Stratum Current Vegetation-fuel Departure (field 85) – Enter the current vegetation-fuel departure data from your Strata Datum pages (field 85).

Stratum Weighted Vegetation-fuel Departure (field 99) – This is the vegetation-fuel departure weighted average for each stratum.

Worksheet: Calculate for each of your stratum using the following equation and enter the values (write as an integer using no decimal): (field 41 / 100) * field 85.

→Note: if the project area includes enough barren area or water to warrant adding either as a separate stratum (at least 20 percent), exclude that percentage from 100 to calculate the above formula. For example, if the project area has a lake in its boundary that occupies 30 percent of the total project area, the formula would be: (field 41 / 70) * field 85.

Project Area Weighted Vegetation-fuel Departure (field 100) – This is the sum of the vegetation-fuel weighted departure for the project area.

Worksheet: Add the values from field 99 and enter the total.

Stratum Fire Frequency-Severity Departure (field 89) – Enter the values from field 89 of your Strata Datum pages.

Stratum Weighted Fire Frequency Severity Departure (field 101) – This is the fire frequency-severity departure weighted average for each stratum.

Worksheet: Calculate for each of your stratum using the following equation:

(field 41 / 100) * field 89.

→Note: if your project area includes enough barren area or water to warrant adding either as a separate stratum (at least 20 percent), exclude that percentage from 100 to calculate the above formula. For example, if your project area has a lake in its boundary that occupies 30 percent of the total project area, the formula would be: (field 41 / 70) * field 89.

Project Area Weighted Fire Frequency-Severity Departure (field 102) – This is the sum of the fire frequency-severity weighted departure for the project area.

Worksheet: Add the values from field 101 and enter the total.

Project Area Vegetation-fuel or Fire Frequency-Severity Weighted Mean Departure (field 103) – This field is the higher of the two departures (vegetation-fuel and fire frequency-severity).

Worksheet: Enter the higher value of fields 100 and 102

Project Area Fire Regime Condition Class (field 104) –

Worksheet: From field 103, categorize the departure value for your project area into a condition class:

1 = ≤ 33 percent (within the reference condition range of variability)

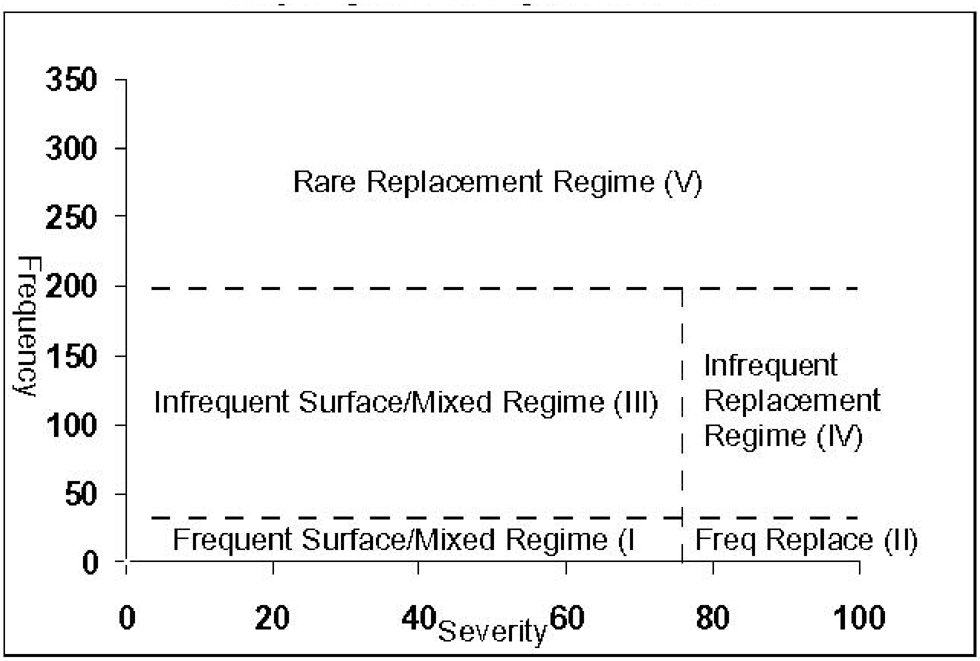
2 = > 33 percent to ≤ 66 percent (moderate departure)

3 = > 66 percent (high departure)

Completing the Standard Landscape Worksheet Graphs

Worksheet: Follow the procedures below to graph your results

Figure 3-4 – Fire regime classification graph.



Fire Regime Classification graph

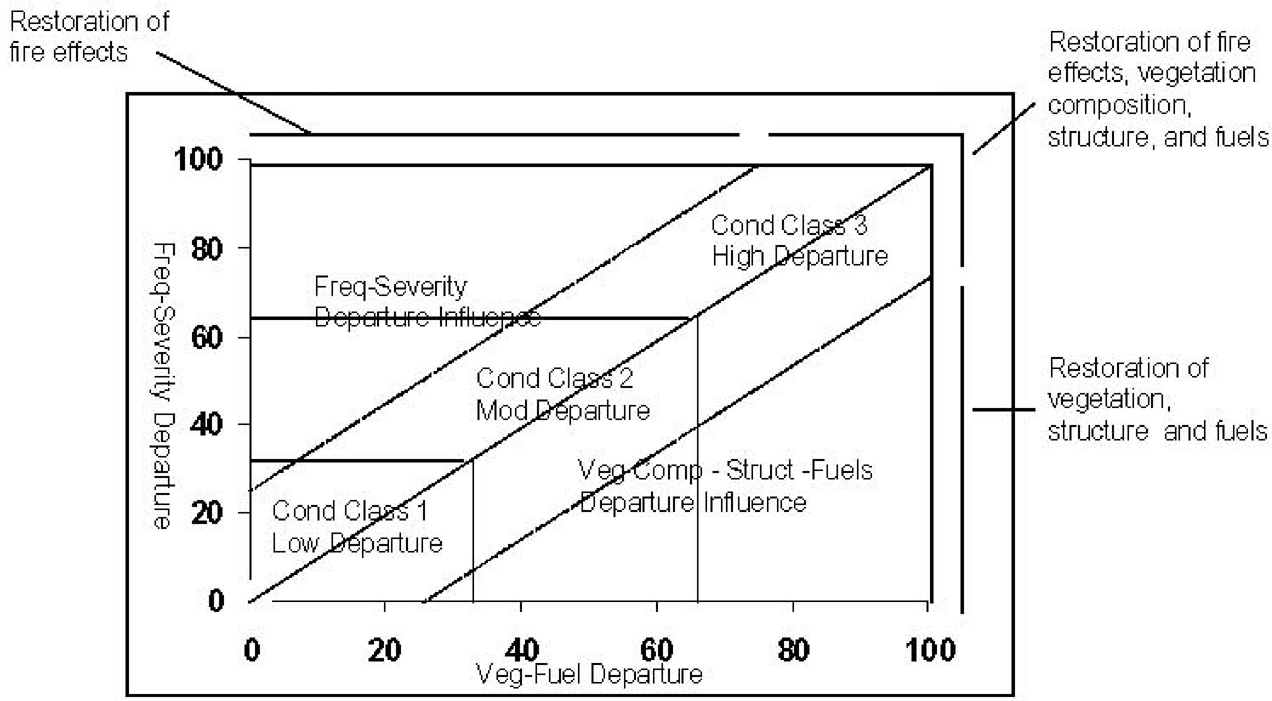
(Note: this graph can be used for individual stratum as well as for your overall project area.)

Step 1. On the Y-axis, place a mark representing your project area's Fire Frequency (from field 93).

Step 2. On the X-axis, mark your project area's Fire Severity (from field 96).

Step 3. Now simply integrate those two variables. That is, project the Y-axis value horizontally and project the X-axis value vertically. The intersection of those lines represents your project area's dominant fire regime.

Figure 3-5 -- FRCC graph with restoration context.



FRCC graph with restoration context

(Note: this graph can be used for individual stratum as well as for your overall project area.)

Step 1. On the Y-axis, place a mark representing your project area's Frequency-Severity Weighted Departure (from field 102).

Step 2. On the X-axis, mark your project area's Vegetation-fuel Weighted Departure (from field 100).

Step 3. Now integrate those two variables. Again, project the Y-axis value horizontally and project the X-axis value vertically. The intersection of the two lines represents your project area's FRCC.

FRCC graph note: The graph margins contain notes interpreting the restoration context. For example, if the lines intersect in the upper left-hand side of the graph, the notes in that portion of the graph suggest that restoring fire frequency and severity should have higher priority than vegetation restoration. Conversely, the notes in the lower right side of the graph suggest that vegetation restoration should be of high priority, and so on.

Tracking Post-treatment Progress toward Fire Regime Condition Class 1

(Note: this is neither a field on the worksheet nor in the software.
This is a manual, post-treatment calculation.)

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 103 – Post-treatment field 103) / (Pre-treatment field 103)) * 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 = $\leq$ - 10 percent difference
N – No change in FRCC = > - 10 percent difference and < + 10 percent difference
I – Improvement in FRCC = $\geq$ + 10 percent difference

For stand-scale treatments, use the following as a guideline for determining if treatments maintain or improve trend:

Table 3-14 – Management implications for the stand-scale fire regime condition class based on the vegetation-fuel class relative amount.

Veg-fuel class Relative Amount class	Stand FRCC	Improving condition if stand is:
Trace	1	Maintained
Underrepresented	1	Maintained
Similar	1	Maintained
Overrepresented	2	Reduced
Abundant	3	Reduced

Estimation Technique for Determining Landscape and Stand FRCC

There are situations in which landscape FRCC and stand FRCC may be estimated for a large number of project areas and treatment units in a short amount of time. However, the short time frame may not allow all of the FRCC assessments to be conducted at the appropriate landscape or stand scale. If you have an FRCC map that was developed following the FRCC Standard Landscape Mapping Method to map landscape and/or stand FRCC using nationally accepted reference conditions, you can use the map for pre-treatment estimation of FRCC.

If you do not have a map developed via the FRCC Guidebook process, we recommend that you strategically conduct the Standard Landscape Worksheet Method (SLWM) on at least one (ideally more) BpS strata that accounts for the majority of your project area. While conducting the landscape assessment, conduct the stand assessment on at least one (ideally more) of the typical treatment units. After completion of these assessments, it should then be possible to estimate landscape and/or stand FRCC for similar project areas and treatment units which have not been assessed using SLWM. FRCC estimation can be supplemented by additional project area and treatment unit information such as aerial photographs and orthoquads. As this estimation technique is based on documented FRCC assessment procedures, it may be adequate for non-controversial project areas and treatment units.

To organize a strategic assessment and subsequent estimation, we recommend use of an Excel spreadsheet. For the project areas and treatment units on which you've conducted assessments using the FRCC Guidebook process, use the spreadsheet to track key attributes of the BpS's. The landscape FRCC graph can also be used to record the departure and FRCC of landscapes in a visual format.

Table 3-15 – Natural fire regime groups for assessment of departure from reference condition range and variability at the landscape scale.

Fire regime group	Fire frequency (MFI)	Severity	Description
I	0 – 35+ years, frequent	Surface/ mixed	Open park-like, savannah grassland, or mosaic forest, woodland, or shrub structures maintained by frequent surface or mixed severity fires; surface fires typically burn through a forest understory removing fire intolerant species and small size classes and removing < 25% of the upper layer, thus maintaining an open single layer overstory of relatively large trees; mosaic fires create a mosaic of different age post-fire savannah forest, woodlands, or open shrub patches by leaving > 25% of the upper layer (generally < 40 hectares (100 acres)). Interval can range up to 50 years in systems with high variation in ignition frequency.
II	0 – 35+ years, frequent	Replace-ment	Shrub or grasslands maintained or cycled by frequent fire that removes > 75% of the upper layer; fires kill non-sprouting shrubs such as sagebrush which typically regenerate and become dominant within 10-15 years; fires remove tops of sprouting shrubs and grass, such as mesquite, chaparral, or bunchgrass, which typically resprout and dominate within 5 years; fires typically kill most tree regeneration such as juniper, pinyon pine, ponderosa pine, Douglas-fir, or lodgepole pine. Interval can range up to 50 years in systems with high variation in ignition frequency.
III	35 – 100+ years-, infrequent	Mixed	Mosaic of different age post-fire open forest, early to mid-seral forest structural stages, and shrub or herb dominated patches (generally < 40 hectares (100 acres)) maintained or cycled by infrequent fire that removes 25-75% of the upper layer. Interval can range up to 200 in systems with high temporal variability.
IV	35 – 100+ years, less infrequent	Replace-ment	Large patches (generally > 40 hectares (100 acres)) of similar age post-fire shrub or herb dominated structures or early to mid-seral forest cycled by infrequent fire that removes >75% of the upper layer. Interval can range up to 200 in systems with high temporal variability.
V	> 100-200 years, rare	Replace-ment	Large patches (generally > 40 hectares (100 acres)) of similar age post-fire shrub or herb dominated structures or early to mid to late seral forest cycled by infrequent fire that removes > 75% of the upper layer.

Table 3-16 – Coarse-scale vegetation-fuel class codes and descriptions.

Vegetation-fuel Class	Process	Forest & Woodland	Shrubland & Grassland
AESP-Characteristic; Early Seral	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
BMSC-Characteristic; Mid Seral Closed	Mid successional; mid age; competition stress	One to two upper layer size classes; > 35% canopy cover (crown closure estimate); standing dead & down; litter/duff; standing dead and down	Upper layer shrubs or grasses; < 15% canopy cover (line intercept)
CMSO-Characteristic; Mid Seral Open	Mid successional; 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
DLSO-Characteristic; Late Seral Open	Late successional; 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
ELSC-Characteristic; Late Seral Closed	Late successional; 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
UINP–Uncharacteristic; Invasive Plants	Invasive plants, such as annual grasses or knapweed; difficult to reverse with restoration if large and scattered infestations; most effective to prevent and contain	Commonly spread along roads and in harvest units with mechanical soil surface disturbance; more competitive than native grasses and forbs	Commonly spread along roads and by livestock; more competitive than native plants; usually associated with increase (annual grasses) or decrease (knapweed) in fire frequency
UTHV-Uncharacteristic Timber Mgt Not Mimicking Natural Regime	Timber harvest, stand improvement, and tree planting is not similar to natural regime; road density may be excessive; often lacks dead and down trees and logs; patterns are typically linear or uniform rather than irregular and random or clumped	Commonly involves cutting of large trees & leaving small trees; timber thinning to systematic single tree spacing rather than group trees with variable spacing; planting higher density or different species composition than reference conditions, or off-site stock; high density road system enhancing invasive plant spread, rerouting of water & sediment, and animal displacement/harassment	

Vegetation-fuel Class	Process	Forest & Woodland	Shrubland & Grassland
UGRZ-Uncharacteristic Grazing Mgt. Not Mimicking Natural Regime	Grazing season, frequency, and intensity is not similar to natural regime; pattern is often uniform vs. irregular utilization	Often associated with loss of shrub and grass understory; spread of invasive weeds	Decrease in desirable forage species; increase in less desirable and invasive species
UFUS–Uncharacteristic Fuels/Succession/Lack Fire Effects	Reference condition disturbance frequency is beyond maximum allowing fuel accumulation or structure that did not occur during that time period	Usually associated with change to larger patch size and loss of patch mosaic with more contiguous heavy fuels	Usually associated with change to larger patch size and loss of patch mosaic with more contiguous upper layer fuels
UFEF-Uncharacteristic; Post-fire Effects More Severe Than during reference condition time period	Effects of fire on plants, soil, water, and air more severe than in reference conditions because of higher or different fuel loads; difficult to reverse with restoration; most effective to restore classes I, H, G, and L before this occurs	Commonly occurs in areas with heavy contiguous fuels due to uncharacteristic succession, timber mgt., or insect-disease effects; loss of large trees, excessive smoke, soil erosion, increased water temperatures	Commonly occurs in areas with contiguous upper layer fuels due to uncharacteristic succession or invasive plants
USHD-Uncharacteristic; Soil/Hydrologic Disturbance More Severe	Changes or diversion of flow, channelization, loss of biota, sedimentation, or changes in evapotranspiraton. Increased soil erosion, compaction, or displacement.	In forest stream chanelization, changes in vegetation evapotranspiraton, and shift in flow amounts. In woodland, the loss of understory herbaceous cover of soil resulting in increased erosion. Increased vegetation evapotranspiraton reducing flow from springs. Loss of beaver and associated ponds & cutting.	Reduced width in wet riparian zones or drying that change fire behavior & effects. Loss of upland soil cover resulting in increased soil erosion. Increased vegetation evapotranspiraton reducing flow from springs. Loss of beaver and associated ponds & cutting allowing fires to spread across riparian zones.
UIDS-Uncharacteristic Insect-Disease Invasive or More Severe	Invasive insects or disease, such as blister rust; or epidemic or level of extent not similar to reference condition patterns	Commonly occurs following uncharacteristic timber harvest of large trees leaving small insect-disease susceptible trees	
UCLR-Uncharacteristic cultural treatments	Cultural treatments do not mimic the reference condition patterns	Timber stand improvements, burned area restoration, or road networks that preclude successional stages or patterns	Range improvements, burned area restoration, roads that preclude successional stages or patterns
UPAT- Uncharacteristic Patch dynamics	Alteration of disturbance regimes have changed the patch pattern	Harvest, fire exclusion, or uncharacteristic fires result In uncharacteristic patterns.	Grazing, fire exclusion, or uncharacteristic fires result in uncharacteristic patterns
UOTH – Uncharacteristic; other disturbances	Other human altered disturbance processes		

Simple 7 Instructions

The "Simple 7" form was developed for training purposes to show users the seven key variables that determine FRCC in an outline format of the Standard Landscape Worksheet. The variables include the five vegetation-fuel classes, fire frequency, and fire severity. The form is intended for both training purposes and for simple data collection of the seven key variables; however, it is not to be used alone. The Standard Landscape Worksheet fields must be completed after data collection with the form. In addition, it must be noted that the Simple 7 form was developed for data collection of one stratum only. If you have a project area with multiple strata, you will need to fill out one form for each stratum. When applicable, the field numbers on the Simple 7 form have been correlated to the field numbers on the Standard Landscape Worksheet.

Fields 2, 3, 4, 6, 7, 8, 10, 11, and 15 – Instructions are the same as for the Standard Landscape Worksheet Project Data.

Fields 21, 24, 25, 41, 43, 44, 48, 51, 52, 53, 54, 72, and 73 – Instructions are the same as for the Standard Landscape Worksheet Strata Data.

Fields 77, 78, 79, 80, 81, 82, 83, 86, 87, and 88 – Instructions are the same as for the Standard Landscape Worksheet Similarity, Departure, Relative Amount, and FRCC calculation fields.

Fire Frequency Similarity – Divide the lesser value of fields 51 and 52 by the greater of the two and multiply by 100.

Fire Severity Similarity – Divide the lesser value of fields 53 and 54 by the greater of the two and multiply by 100.

Fire Frequency Departure – Subtract the fire frequency similarity value from 100.

Fire Severity Departure – Subtract the fire severity similarity value from 100.

Comments – The comment field figures prominently when using the Simple 7 form. Record biophysical descriptions of the strata for completion of the Standard Landscape Worksheet, including (but not limited to) Standard Landscape Worksheet fields 27-39, 63-70, existing uncharacteristic types, and any photo information, as well.

Chapter 4

FRCC Standard Landscape Mapping Method

- **Overview**
- **Input Layers**
- **Output Layers**
- **Reports**
- **System Requirements**
- **Installing the Software**
- **Data Preparation**
- **Initializing the Mapping Tool**
- **Running the Mapping Tool**
- **Outputs**
- **Interpreting the Results**
- **Trouble-shooting**
- **Developing a Custom Reference Condition Table**

The purpose of this chapter is to describe the Fire Regime Condition Class (FRCC) Mapping Tool and to explain its function, inputs, and outputs. This chapter will also direct the user on the Mapping Tool's installation and use. In essence, the Mapping Tool produces a multitude of spatial layers that correspond to the attributes derived by the FRCC Standard Landscape Worksheet Method described in Chapter 3. Users of the Mapping Tool should be certified users of the FRCC Standard Landscape Worksheet Method (see Chapter 1 for information on becoming a certified user or trainer). In addition, users must have an understanding of geographic information systems (GIS) and experience using raster data and ArcMap. At this time, the Mapping Tool assesses only the departure of vegetation-fuel classes; it does *not* assess Fire Frequency-Severity Departure because we have not yet developed a methodology for mapping fire frequency-severity departures. Note that this chapter is in the beta-test stage, and your suggestions for improvement are welcomed (helpdesk@frcc.gov).

Overview

The Mapping Tool uses three input layers to produce seven output layers, shown in table 4-1 below. In addition, the Mapping Tool produces a report that indicates the amount of acres in each vegetation-fuel class that would need to be converted to some other vegetation-fuel class if the management objective were to match the reference conditions of a particular BpS.

Table 4-1 – FRCC Mapping Tool inputs and outputs.

Inputs	Outputs
Landscape reporting levels	Master Grid
Biophysical settings (BpS's)	Stratum Vegetation-fuel Class Percent Difference
Vegetation-fuel classes	Stratum Vegetation-fuel Class Relative Amount
	Vegetation-fuel FRCC: Stand Level
	Stratum Vegetation-fuel Class Departure
	Stratum Vegetation-fuel FRCC
	Landscape Departure

Input Layers

The Mapping Tool derives a suite of FRCC-related attributes from three existing input layers. Note that the sources of these input layers can range widely for the Mapping Tool, from coarse field-level data to relatively precise satellite data.

Landscape Reporting Levels - a hierarchy including three different levels of landscape sizes (for example, sub-watershed, watershed, and sub-basin) is used by the Mapping Tool to derive the composition of vegetation-fuel classes for each BpS. Although most users will typically use only one size of reporting level, the option to use varying landscape size levels is presented because different BpS's may be dominated by different fire regimes, which, in turn, vary by the size of their typical disturbances. Note: we recommend that the more advanced option of using multiple reporting levels be used only by the skilled user because doing so adds a level of complexity to the outputs.

Biophysical Settings (BpS's) – the term biophysical setting refers to the combination of soils, climate, and topography that dictates the composition of the resulting plant communities and natural disturbance regimes. The Mapping Tool requires a BpS layer as this provides the framework by which the reference conditions were derived and characterized.

Vegetation-fuel classes – these are the successional states that may occur within a BpS that is influenced by natural disturbance regimes. These can also be thought of as a combination of cover type (early-seral, mid-seral, and late-seral) and structural type (open or closed). The Mapping Tool compares the existing composition of vegetation-fuel classes for each BpS with the corresponding reference condition of each class.

The Mapping Tool combines these 3 input layers and then compares the resultant output to a set of reference conditions. The Mapping Tool stores the reference condition information in a reference condition data table (automatically loaded when the tool is installed) that contains three pieces of information:

- a list of BpS's associated with the particular analysis area,
- the BpSs' respective reference condition data (the historical composition of vegetation-fuel classes), and
- the appropriately-sized landscape reporting level within which to compare the existing composition of vegetation-fuel classes to the reference conditions.

Users can either use the reference condition default values within the Mapping Tool (derived from the reference condition summary tables found on the FRCC website at www.frcc.gov – see Chapter 2 for details on the development of these) or opt to develop a custom table of reference conditions (addressed later in this chapter) that may better address the historical range of variability specific to the local area.

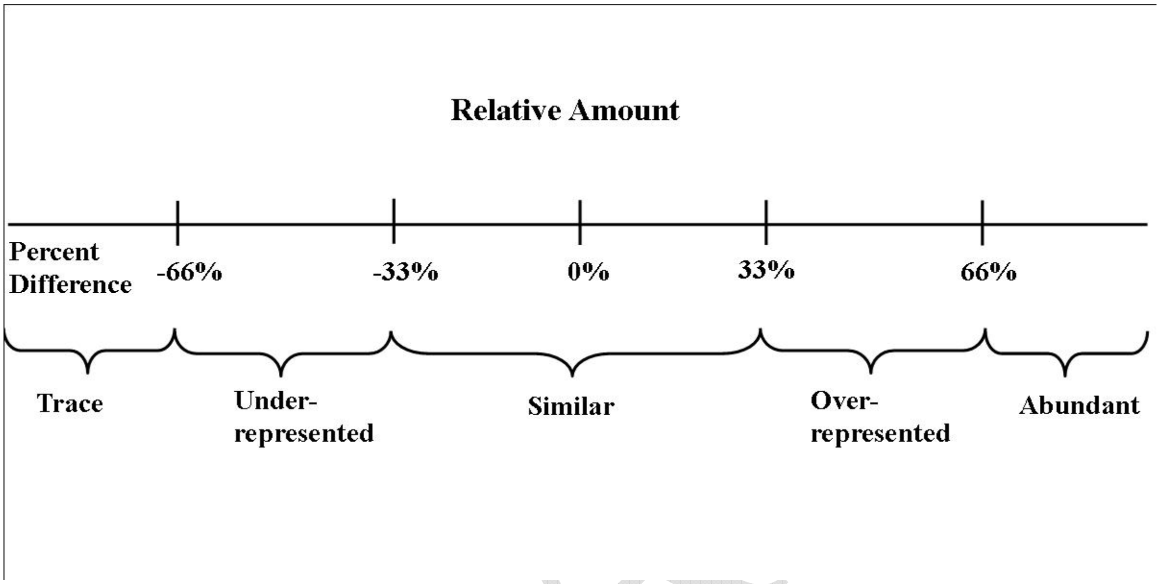
Output Layers

Master Grid -- The Master Grid contains all of the output data. Opening the attribute table of the Master Grid allows you to see all of your output data at once. In addition, within the Master Grid, the user can organize the fields and sort the data in any way deemed useful.

Stratum Vegetation-fuel Class Percent Difference – The Percent Difference represents the contrast between the existing condition of a vegetation-fuel class and the reference condition of that class. A positive value indicates that a particular vegetation-fuel class is over-represented on the landscape (compared to the reference condition amount) whereas a negative value signifies that the class is under-represented on the landscape. Of all the indices produced by the Mapping Tool, the Percent Difference output provides the most detailed information about the status of a vegetation-fuel class.

Stratum Vegetation-fuel Class Relative Amount -- This output also indicates whether the existing amount of a vegetation-fuel class is under- or over-represented on the landscape when compared to reference conditions. Unlike the more specific Percent Difference, however, Relative Amount classifies the Percent Difference into more general categories (see fig. 4-1 below). Although some information is lost when a continuous variable is classified into categories, classification reduces its complexity (for example, five classes can be much easier to deal with than a variable with values ranging from 0 to 100 percent).

Figure 4-1 – Amount of vegetation-fuel class (VFC) relative to that of the defined reference period.



Vegetation-Fuel FRCC: Stand Level – This output is yet another representation of the contrast between the existing condition of a vegetation-fuel class and the reference condition of that class and is also a further classification, categorizing Relative Amount into yet broader classes (see table 4-2). The primary purpose of the Stand-level Vegetation-fuel FRCC is to facilitate FRCC reporting for projects that target individual stands (areas not meeting the definition of an entire landscape).

Table 4-2 – Derivation of Stand-level Vegetation-fuel FRCC.

Stratum Veg-fuel Class Percent Difference (%)	Stratum Veg-fuel Class Relative Amount categories	Stand-level Veg-fuel FRCC
<33	Similar, under-represented, trace	1
≥33 percent and ≤66	Over-represented	2
>66	Abundant	3

Stratum Vegetation-Fuel Class Departure – This output also signifies the departure of the existing condition of the vegetation-fuel classes from that of the reference condition but across *all* vegetation-fuel classes within a BpS. It represents a continuous variable with values ranging between 0 (no departure) and 100 (completely departed).

Stratum Vegetation-Fuel FRCC – The Vegetation-fuel FRCC (table 4-3) is a classification of the more specific Vegetation-fuel Class Departure. The classes of 1, 2, and 3 represent a low, moderate, and high departure from reference conditions, respectively. Again, although some information is lost in the classification, the categories can simplify use. (Note: In Chapter 3, the Stratum Vegetation-Fuel FRCC represents one-half of the algorithm that derives FRCC, the other half being the Fire Frequency-Severity Departure.)

Table 4-3 – Derivation of Stratum Vegetation-fuel FRCC.

Stratum Veg-fuel Class Departure (%)	Stratum Veg-fuel FRCC
≤33	1
>33 to 66	2
>66	3

Landscape Departure – The Landscape Departure index is a depiction of the vegetation-fuel class departure from the reference conditions of *all* BpS's across the entire landscape or reporting level and is derived through an area-weighted average. In essence, it is a "big picture" view of the strata vegetation-fuel FRCCs combined. Note: this output is *not* included in Chapter 3.

Reports

The reporting function of the Mapping Tool was developed to assist land managers in identifying what would need to be accomplished if the objective were to match reference conditions. The Mapping Tool uses an algorithm that first computes the expected acreage of each vegetation-fuel class (in other words, the amount suggested by the associated reference models). The tool then subtracts the existing acreage of each vegetation-fuel class occurring on the landscape. The resulting value indicates the amount of change (expressed in acres) that would be necessary if the reference conditions were to be matched on the current landscape. *Positive* values indicate that a given vegetation-fuel class may be under-represented on the landscape, whereas *negative* values indicate that a given vegetation-fuel class likely is over-represented on the landscape.

System Requirements

- Platform: PC-Intel
- Processor: 800 MHz
- Memory: 256 MB RAM
- Space: 30 MB free disk space
- Microsoft Windows 2000 or Windows XP
- Microsoft Access and Excel (versions 2000 or newer)
- ArcMap 8.3 or newer, and Spatial Analyst

Installing the Software

1. Download the FRCC Mapping Tool from the FRCC website at www.frcc.gov (for users without Internet access, contact your agency, TNC, or private FRCC coordinator). The install file contains a Windows Installer Package (FRCCSetup.msi) that will automatically load the software programs "dotnetfx" and "mdac" (if they are not already loaded on your computer) and the Mapping Tool software.
2. Double click on FRCCSetup.msi to install the FRCC Mapping Tool software.
3. Launch ArcGIS ArcMap.
4. Open up an ArcMap document
5. Select "Tools" from the ArcMap menu
6. Select "Customize"
7. Select the "Commands" tab
8. Scroll down through the "Categories" and select "FRCC"
9. Click and drag the Mapping Tool icon (in the "Commands" window) up to the toolbar of your choice. This icon represents the shortcut to start the FRCC Mapping Tool.

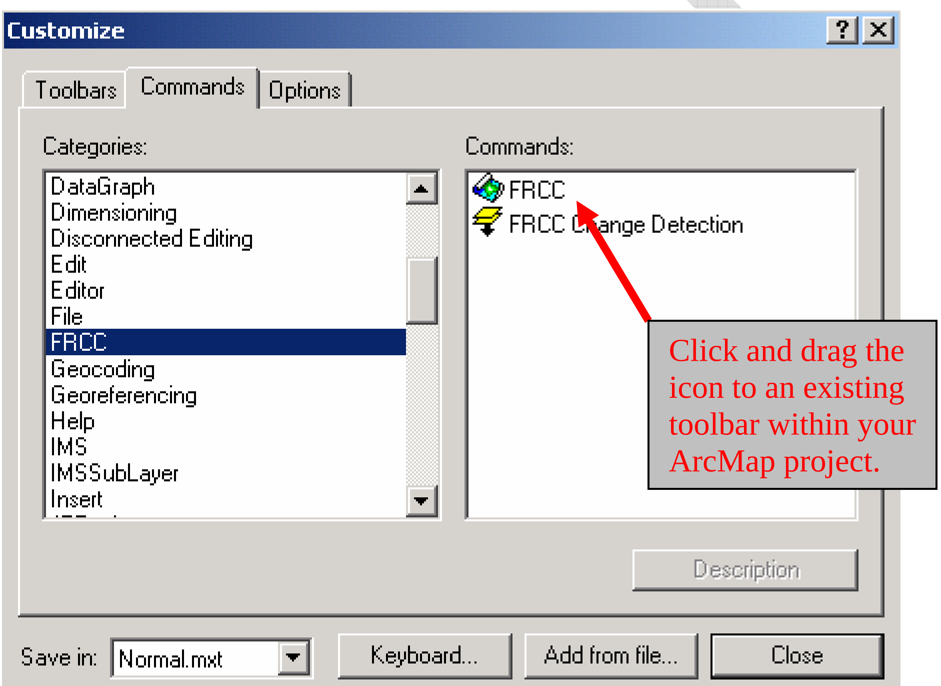
Data Preparation

As mentioned in the Overview, three raster data sets (in other words, Arc Grids) are required to run the Mapping Tool: a layer denoting the landscape size level (geographic unit) used for reporting purposes, a layer depicting biophysical settings (BpS's), and a layer depicting vegetation-fuel classes. The user has the option of inputting either three base layers OR one base layer containing all three attributes (the reporting levels for deriving composition, BpS's, and vegetation-fuel classes). As there are a myriad of methods and scales by which the base layers can be derived, this chapter will not teach users a process for developing the layers. Instead, this chapter will describe the steps necessary to format the data for use with the Mapping Tool.

There are three major requirements for the input data:

- The input layers must all be in an Arc Grid format.
- The input layers must all have the same projection.
- The input layers must all have the same geographic extent (they should be clipped to the analysis area using the same boundary file).

Figure 4-2 -- Loading the command icon to an ArcMap toolbar.

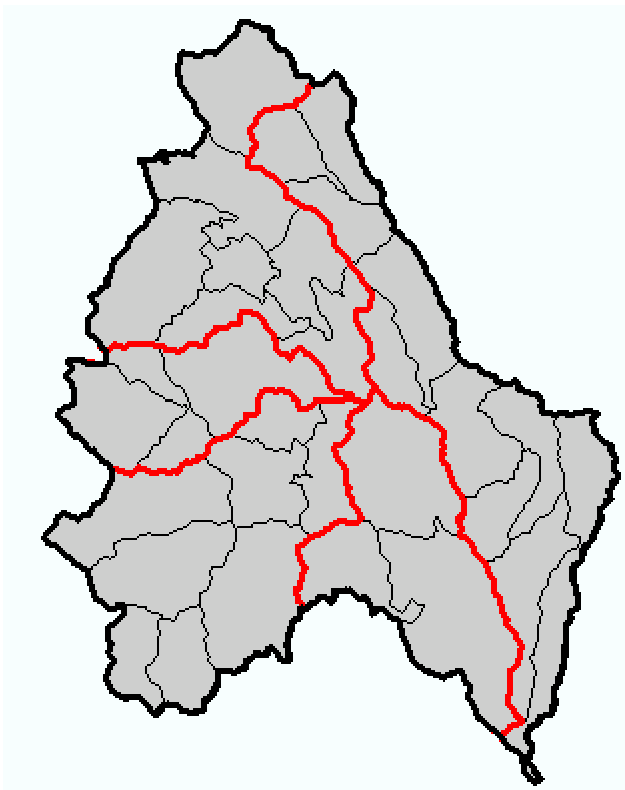


Landscape Reporting Levels

First, determine the appropriate size of the landscape for which FRCC is to be mapped; refer to Chapter 2: *Scale Issues and Landscape Stratification,* for direction. Next, determine the Mapping Tool landscape level that corresponds to the size of your analysis area.

A nested hierarchy of up to three landscape size levels (geographic units) is used by the Mapping Tool to derive the composition of vegetation-fuel classes for each BpS (fig. 4-3). Although the Mapping Tool can use up to three individual grids, one representing each level of the hierarchy, we recommend that all levels be contained within a *single* grid to ensure that the hierarchy levels are indeed nested.

Figure 4-3 – Example of a nested hierarchy of landscapes containing three levels of watersheds.



For some relatively small analysis areas, only a single landscape level may be necessary. In this case, the landscape layer would need to contain one attribute that would have a single value representing the landscape of interest. Further, the single landscape level might actually serve as the project boundary. For a small analysis area or for an analysis area dominated by frequent, low-severity fires (Fire Regime Group I), the landscape layer would again need to contain only one attribute; however, in this case, this one attribute could contain multiple values (such as multiple sub-watersheds).

A more complex analysis area involving a large geographic extent composed of a variety of fire regimes (such as fire regime groups I, III, IV, and V) requires a landscape layer with multiple attributes (in other words, a separate attribute for each landscape level) containing multiple values. For example, if a user wishes to use watershed delineations for the landscape, the landscape grid must then contain a separate item each for sub-watersheds (such as HUC6) for assessment of Fire Regime Group I, watersheds (such as HUC5) for assessment of Fire Regime Group III, and sub-basins (such as HUC4) for assessment of fire regime groups IV and V.

The user must also rank the order of the landscape levels from small to medium to large (for example, 1, 2, and 3, respectively). These values must correspond with the hierarchy values in the Mapping Tool's reference condition data table.

Figure 4-4 – Example of a value attribute table for an analysis area requiring multiple landscape levels.

Attributes of swanhucs

ObjectID	Value	Count	Huc6	Huc5	Huc4
22	630	7568	170102110101	1701021101	17010211
21	628	13391	170102110102	1701021101	17010211
20	607	6956	170102110103	1701021101	17010211
19	604	12321	170102110104	1701021101	17010211
18	581	5503	170102110105	1701021101	17010211
16	560	15276	170102110106	1701021101	17010211
17	570	8288	170102110201	1701021102	17010211
15	551	10718	170102110202	1701021102	17010211
14	544	6578	170102110203	1701021102	17010211
13	530	5979	170102110204	1701021102	17010211
12	525	14275	170102110205	1701021102	17010211
11	511	5752	170102110206	1701021102	17010211
10	498	10132	170102110207	1701021102	17010211

Biophysical Settings

First, the BpS codes used in your spatial layer must match those in the tool's reference condition data table. Departure indices will be derived only for those BpS's that are common to both the spatial layer and the tool's reference condition table. That is, the BpS codes used in the raster layer *must* match the BpS codes in the reference condition table if departure estimates are to be correctly calculated. Similarly, if the user opts to create a custom reference condition data table, the BpS codes must match the codes therein.

To aid the user in ensuring that the codes match, the Mapping Tool has an error-checking routine to verify that all BpS's represented in the spatial layer are also present in the reference condition table. The Mapping Tool will "error out" if the spatial layer contains a BpS that is not contained in the reference condition table. For example, some areas, such as agricultural or urban lands, are typically excluded from departure calculations. There may also be BpS's in your analysis area that do not currently have modeled reference conditions in the tool's reference condition data table, such as the Alpine and Riparian types. In such cases, the user must either omit those BpS's from the spatial layer or develop a custom reference condition table for the analysis area. Instructions for creating a custom reference condition table can be found in the last section of this chapter: *Developing a Custom Reference Condition Table.*

Figure 4-5 – Example of a value attribute table for a typical BpS grid.

Attributes of swanbps

ObjectID	Value	Count	Bps2
16	22	35965	WPWL
15	21	274	WPGF
14	20	75448	WLLPDF
12	18	15917	USAL1
9	15	45	PPIN1
8	14	15137	PPDF3
7	13	32	PICO1
3	9	29422	LSAL1
2	8	40173	GFDF2
1	6	53	DFIR3
0	5	511	DFIR2
4	10	781	
5	11	2247	
6	12	1137	
10	16	7841	
11	17	52	
13	19	4562	

Vegetation-fuel Classes

Because the vegetation-fuel class grid contains the successional state information for each BpS, each vegetation-fuel class must be nested within the appropriate BpS. Typically, vegetation-fuel class data must be derived from a combination of other vegetation spatial layers (such as dominance type/cover type, size class, and/or canopy cover). Therefore, to ensure that the vegetation-fuel classes are nested within the appropriate BpS's, we recommend that the user combine the BpS spatial layer with the appropriate vegetation layers prior to assigning vegetation-fuel classes. Another advantage to combining the BpS layer with the vegetation layers is that the user can conduct a final check for erroneous data (such as a tree size class appearing in a shrub BpS).

However the vegetation-fuel class layer is derived, it must have an attribute that contains the following values: “a”, “b”, “c”, “d”, “e”, and “u” (indicating early-seral, mid-seral closed, mid-seral open, late-seral open, late-seral closed, and uncharacteristic, respectively). **Note: Ensure that vegetation-fuel codes match those in the Mapping Tool’s reference condition table (**for example, some analysts use the shorthand code class “a” instead of the formal acronym “AESP.”) Review the previous section on BpS’s for specifics on matching codes.

Figure 4-6 – Example of a value attribute table for a typical vegetation-fuel grid.

Attributes of swanvgfl4

ObjectID	Value	Count	Vegfuel
0	1	58901	a
1	2	31593	b
2	3	57144	c
3	4	38397	d
4	5	26942	e
5	6	16620	

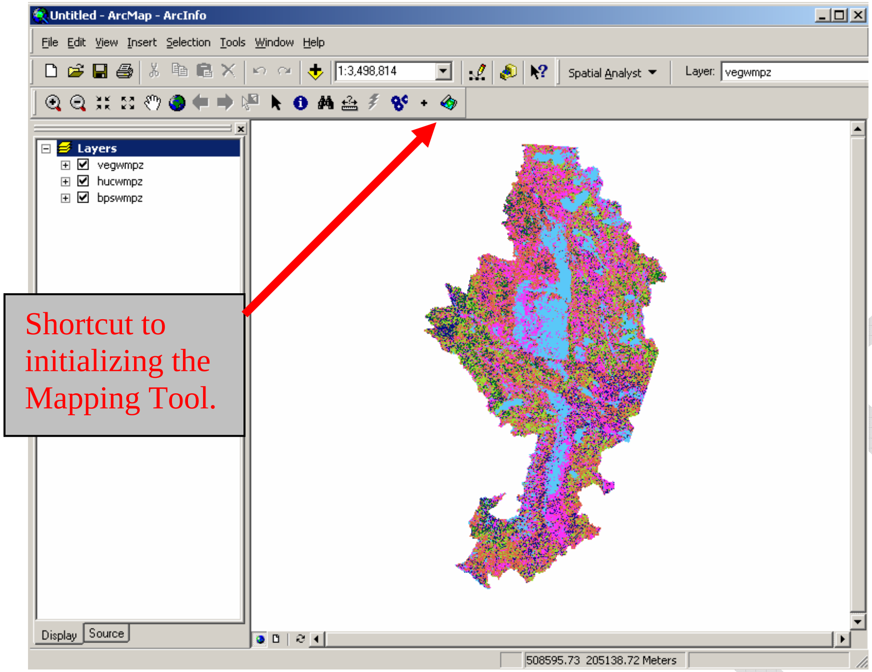
Initializing the Mapping Tool

1. Open up an ArcMap document

2. Load the input layers

3. Select the Mapping Tool button  (see fig. 4-7 below)

Figure 4-7 – Icon representing the shortcut to Mapping Tool initialization.



Running the Mapping Tool

Figure 4-8 below provides an example of the dialogue box that will appear after the Mapping Tool is initialized. In the dialogue box, the user must:

→**Select which data layers and which attributes of those data layers contain the information pertaining to:**

- the landscape reporting levels
- the BpS's
- the vegetation-fuel classes

→**Select:**

- the appropriate reference condition table
- an output pathway (location) where the output data is to be stored

- a file name by which to identify the data
- which output layers will be generated

These various steps are explained in detail below.

1. Select the Landscape Reporting Levels.

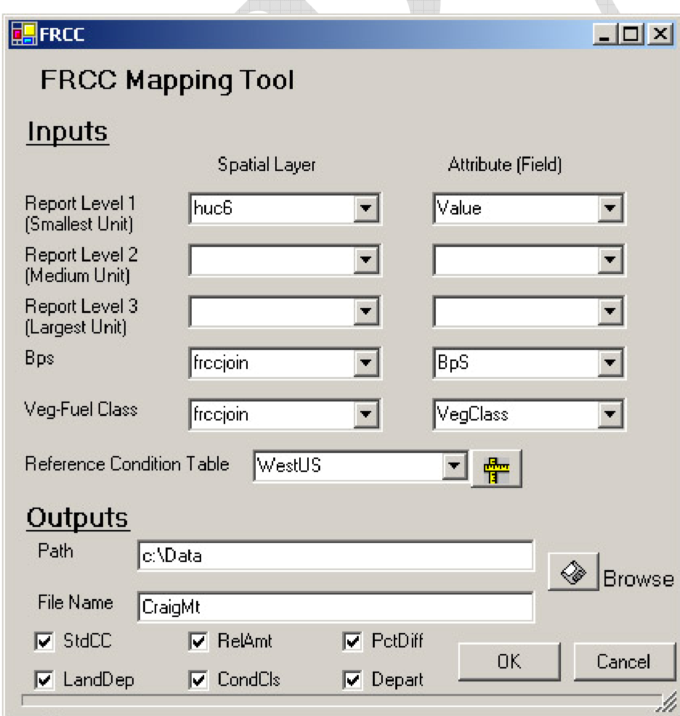
****Using only a single landscape level** as a reporting unit* (fig. 4-8 below):

a. The landscape reporting levels (“report levels” in fig. 4-8 below) correspond to the landscape level hierarchy and are numbered 1 through 3 (small to large geographic areas, respectively).

b. Select the spatial layer containing the landscape information. In this example, the landscape data is contained in a spatial layer called “huc6”.

c. Select the appropriate attribute from the spatial layer for which composition will be assessed. In this example the attribute is called “Value”.

Figure 4-8 – Example of Mapping Tool dialogue box when one landscape level is used.



**Using multiple landscape levels* as reporting units* (fig. 4-9 below):

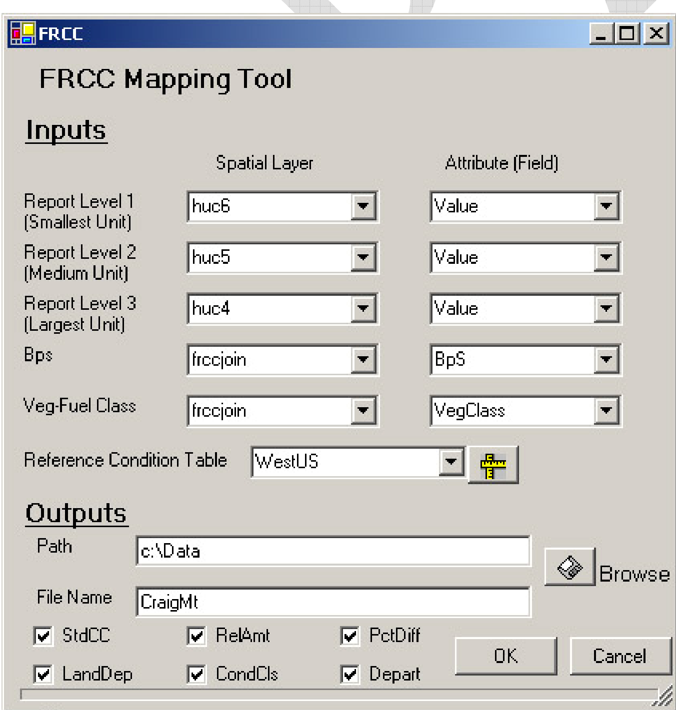
a. Assume that our example analysis area is relatively large and is comprised by Fire Regime Groups I, III, and IV. We therefore need to use three landscape levels to assess composition. Moreover, we want to use HUC6 data as our smallest units for assessing Fire Regime Group I, HUC5 data as our next largest units for assessing Fire Regime Group III, and HUC4 data as our largest reporting units for assessing Fire Regime Group IV. In this example, we have 3 landscape layers – one layer for each level of the hierarchy.

b. Select "Report Level 1". For this example, we select the spatial layer named "huc6" and the attribute called "Value" to represent the smallest level of the hierarchy.

Select "Report Level 2". For our example, we select the spatial layer named "huc5" and the attribute called "Value" to represent the middle level of the hierarchy.

Select "Report Level 3". For our example, we select the spatial layer named "huc4" and the attribute called "Value" to represent the largest level of the hierarchy.

Figure 4-9 – Example of Mapping Tool dialogue box when 3 landscape levels are used.



2. **Select the biophysical setting (BpS) information.**

   a. Select the BpS layer. In the above example, “frccjoin” is the spatial layer containing the BpS data.

   b. Select the appropriate attribute in the BpS layer. The attribute in the “frccjoin” layer that corresponds to the reference condition table is called “BpS”.

3. **Select the vegetation-fuel class information.**

   a. Select the vegetation-fuel class layer. In our example, “frccjoin” is the spatial layer that contains the vegetation-fuel data.

   b. Select the appropriate attribute in the vegetation-fuel layer. The attribute in the “frccjoin” layer that corresponds to the reference condition table is called “Vegclass”.

4. **Select the appropriate reference condition table from the drop-down menu.**

   Currently, there are four reference condition tables available in the Mapping Tool: “Alaska,” “WestUS,” “EastUS,” and “Custom”. In our example, we selected a reference condition table called “National Standard”. Refer to the last section of this chapter, *Developing a Custom Reference Condition Table,* for instructions on creating a custom reference condition table to better address the historical range of variability for your local area.

5. **Identify the pathway for storing the output data.**

   Type the desired pathway for the location where you wish to store the output data (in fig. 4-9 this is “c:\Data”).

6. **Select a file name.**

   The Mapping Tool will automatically create a folder identified by the name you enter in the “File Name” field (in fig. 4-9 the file name entered is “CraigMt”). This folder will be located within the pathway identified above in step 5. All output layers will be stored within this folder, including a spreadsheet, and a master grid identified by the name you assign to the file. The master grid contains all of the output data. With the exception of the master grid, all output grids have only one attribute besides the typical “value” and “count”. These attributes have the same name as their respective layers.

7. **Select the spatial outputs.**

By default, the Mapping Tool will output all spatial layers identified in table 4-4. However, the user can deselect (remove the check mark from) any layer that he/she does not wish to view. Note: deselecting unneeded outputs will speed up the processing time considerably.

Outputs:

The Mapping Tool can provide up to 7 spatial layers (table 4-4) as well as a final report (fig. 4-10).

Table 4-4 – Spatial outputs generated by the Mapping Tool.

Name	Description
<file name>	Master Grid
Pctdiff	Stratum Vegetation-fuel Classes Percent Difference
Relamt	Stratum Vegetation-fuel Class Relative Amount
Stdcc	Vegetation FRCC: Stand Level
Depart	Stratum Vegetation-fuel Class Departure
Condcls	Stratum Vegetation-fuel FRCC
Landdep	Landscape Departure

Interpreting the Results

One way to interpret the spatial outputs is to explore the Master Grid. As mentioned above, opening the attribute table of the Master Grid allows all of the data to be seen at once. Once the table of the master grid is opened, the fields can be organized and the data sorted in any way deemed useful. For example, to learn which BpS’s and which vegetation-fuel classes comprise the Relative Amount classes (in other words, those that are under-represented or those that are over-represented), sort the data by “relamt”, BpS, and vegetation-fuel class. Or, to simply learn which vegetation-fuel classes are most under-represented on the landscape (in other words, the vegetation-fuel classes most in need of protection or maintenance), sort by “pctdiff” (Percent Difference) in ascending order (refer to the *Stratum Vegetation-fuel Class Relative Amount* section in the Overview above).

Note: Even if multiple landscape levels were selected, each record in the table of the Master Grid will represent only the unique combination of the ***lowest level*** of the landscape hierarchy, the BpS, and the vegetation-fuel class.

In addition, the Mapping Tool produces a final report that indicates the amount of acres in each vegetation-fuel class that would need to be converted to some other vegetation-fuel class if the management objective were to match the reference conditions of a particular BpS (see fig. 4-10 below, last column). An interpretation of the example report in figure 4-10 suggests that this particular landscape has a shortage of vegetation-fuel classes “A” and “D” and an excess of all other vegetation-fuel classes (when compared with the reference conditions). The report generates an individual worksheet for each landscape level used in the analysis.

Figure 4-10 – Example of the Mapping Tool’s final report.

swan.xls

	A	B	C	D	E	F	G	H	I
1	RS	Bps	Vegfuel	BpS Count	Ref Cond (%)	Ref Count	Current Count	Current Count - Ref Count	Acre Conversion
2	1560	GF-WF	a	1981	10	198.1	16	-182.1	-364.481461
3	1560	GF-WF	b	1981	14	277.34	460	182.66	365.6023266
4	1560	GF-WF	c	1981	17	336.77	674	337.23	674.9812362
5	1560	GF-WF	d	1981	32	633.92	270	-363.92	-728.4024893
6	1560	GF-WF	e	1981	27	534.87	561	26.13	52.30038757
7	1560	GF-WF	U	1981	0	0	0	0	0

Trouble-shooting

Users may encounter problems viewing the ArcMap display when executing the Mapping Tool successively. The problem arises because the names of the outputs (table 4-4 above) will be the same in each run. When ArcMap is asked to display a spatial layer that has the same name as a layer that had been previously loaded, it “thinks” that you want to view the previous layer. Consequently, the display will show the previous layer, not the most recent layer that was generated.   Two ways to avoid this potential problem are to: 1) close ArcMap between executions, or 2) create a new ArcMap Project, then add the most recently generated layers to your data frame.

In addition, there are four main sources of error that can lead to unexpected results. Outputs that do not seem to represent actual conditions are most likely to occur when:

→errors exist in the raw data; in other words, the original data layers used to derive the BpS layer and the vegetation-fuel class layer do not accurately reflect conditions that occur on the ground.

Users should review all raw data sets to ensure they accurately represent conditions on the ground.

→errors exist in the way the raw data was classified to derive the Bps layer and the vegetation-fuel class layer. For example, certain cover types, size classes, and canopy cover classes can be assigned to the wrong vegetation-fuel class.

Users should review the Bps and vegetation-fuel class layers to evaluate whether they accurately reflect conditions on the ground.

→errors exist in the reference conditions that are used with the Mapping Tool. In other words, the Mapping Tool's reference condition tables might not accurately reflect the natural disturbance regimes or the expected mean composition of vegetation-fuel classes within the user's particular local BpS.

Users should review the Mapping Tool's default reference condition tables to ensure that one corresponds to the specific analysis area. If not, the user will need to create a custom reference condition table (see the last section of this chapter, *Developing a Custom Reference Condition Table*).

→inappropriate landscape reporting levels are used with the Mapping Tool.

To avoid errors in results, users should first determine the appropriate size of landscape for which FRCC is to be mapped (see Chapter 2: *Scale Issues and Landscape Stratification*), and, subsequently, select the appropriate Mapping Tool landscape level. For details, refer to the *Landscape Reporting Levels* section above.

Developing a Custom Reference Condition Table

Important note: *Prior to developing a custom reference condition table, refer to Appendix B: Suitable Reasons for Replacing Default Reference Condition Values with Local Values.*

Two options are available for those users that wish to develop a custom reference condition table that may better address the historical range of variability specific to the local analysis area:

To develop a custom table that is similar to one of the Mapping Tool's tables (if only a few records need to be changed):

a. Open the Reference Condition Database located in c:\frcc\MappingTool\refcon.mdb using Microsoft Access.

b. Identify the tool's reference condition table that you wish to modify to create a custom table: "Alaska," "WestUS," "EastUS," and "Custom".

c. In the "refcon:Database" dialog box in Microsoft Access, right click on the table then select *Copy*.

d. From the Microsoft Access "Edit" menu, select "Paste" and in the "Paste Table As" dialog box, enter a name for the new custom table (for example, "myBpS." Click "OK."

e. Open the new custom table by double clicking on it in the "refcon:Database" dialog box.

f. Edit the custom table as necessary to include BpS's more specific to your particular analysis area. Your custom table will be saved automatically when you close Access.

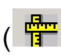
To create a table "from scratch" (if the Mapping Tool's table options contain conditions too different from those of your particular analysis area to be of use as a starting point):

a. Open the Reference Condition Database located in c:\frcc\MappingTool\refcon.mdb using Microsoft Access.

b. Open the “custombps” table by double-clicking on it in the *refcon:Database* dialog box.

c. Delete any unwanted example rows in the table.

d. Enter the desired BpS’s and reference condition values. Your custom table will be saved automatically when you close Access.

→**Note: For either option presented above, do not change the structure of the existing Custom table.** Users can make changes to the Custom table by either editing the table within Microsoft Access, as described in the steps above, or by editing it within the Mapping Tool. To edit the Custom table within the Mapping Tool, click on the editor icon to the right of the reference condition table drop-down menu () and open the Custom table. Edit the desired values and enter. Your changes will be automatically saved.

Appendix A
Standard Landscape Worksheet Forms and Graphs

- **FRCC Standard Landscape Worksheet**
- **Fire Regime and FRCC Worksheet Graphs**
- **FRCC Standard Landscape Worksheet Field Form**
- **Simple 7 Form**

Fire Regime and Condition Class Standard Landscape Worksheet Version 1.2 (project page)

Project Data (Fields 1-20)							
Registration Code	1	**Project Code**	2	**Project Number**	3	**Charact Date**	4 / /
Examiner Code	5	**Project Name**	6	**Project Area**	7	**acres / hectares (circle one)** (8)	
Georeferenced Project Position:							
Latitude	10	***Longitude***	11	**Datum**	15		
Photos:		Photo Dates:	comments 20				
Current	16	17 / /					
Reference Condition	18	19 / /					

Before completing the section below, complete one strata page for each stratum in the project landscape

Project Data: Landscape Totals (Fields 92-104)			Strata 1	2	3	4	5	Landscape Totals
Field 41	**Stratum % Area**. Enter the % of the landscape that each strata comprises. (field 41 on the strata page).	41						100%
Field 51	**Stratum Reference Condition Fire Frequency**. For each strata, enter field 51 from the strata's individual worksheet	51						
Field 92	**Stratum weighted RefCond Fire Freqency** - Multiply %Area/100 - Barren and Rock strata with Natural Fire Frequency [field 41 / (100% - % of Barren or Water BpS's)] * field 51	92						
Field 93	**Project Weighted Mean Fire Frequency** (years). Enter the sum of field 92 for columns 1 through 5	93						years
Field 94	**Project Weighted Mean Fire Frequency Class.** Enter "Frequent" if field 93 is 0-35 years, "Infrequent" if 36-200 years, "Rare" if more than 200 years.	94						
Field 53	**Stratum Reference Condition Fire Severity**. Enter the Ref Fire Severity from field 53 on the strata worksheet.	53						
Field 95	**Stratum weighted reference condition -** Multiply %Area/100 - Barren and Rock Strata with Natural Fire Severity [field 41 / (100% - % of Barren or Water BpS's)] * field 53]	95						
Field 96	**Project Reference Condition Fire Severity**. Enter the sum of field 95 for columns 1 through 5	96						%
Field 97	**Project Reference Condition Fire Severity Class**. Enter "Surface" if field 96 is 0-25%, "Mixed" if 26-75%, "Replacement" if greater than 75%.	97						
Field 98	**Project Natural Fire Regime Group**. Enter class based on the combination of field 94 and field 97: I - frequent, surface & mixed, II - frequent, replacement, III - infrequent, mixed IV - infrequent, replacement, V - rare, replacement	98						
Field 85	**Stratum current Veg-Fuel Departure**. Enter field 85 from the strata worksheet.	85						
Field 99	**Stratum weighted veg-fuel departure** Multiply %Area/100 - Barren and Rock Strata with Veg-Fuel Departure [field 41 / (100% - % of Barren or Water BpS's)]* field 85]	99						
Field 100	**Project Weighted Veg-Fuel Departure** Enter the sum of field 99 for columns 1 through 5	100						%
Field 89	**Stratum Fire Frequency-Severity Departure**. Enter field 89 from the strata worksheet.	89						
Field 101	**Stratum weighted Fire Freqency Severity Departure -** Multiply %Area/100 - Barren and Rock Strata with Freq-Sev Departure [field 41 / (100% - % of Barren or Water BpS's)] * field 89]	101						
Field 102	**Project Weighted Fire Frequency-Severity Departure**. Enter the sum of field 101 for columns 1 - 5	102						%
Field 103	Enter the greater of Veg-Fuel Weighted Departure and Fire Frequency-Severity Weighted Departure (higher of field 100 and 102.)	103						%
Field 104	**Project Fire Regime Condition Class**. Enter "1-Low" if field 103 is 0-33%, "2-Moderate" if 34-66%, "3-High" if 67-100%.	104						

Stratum Data: General Information/BpS/Reference and current Fire regimes (fields 21-60)

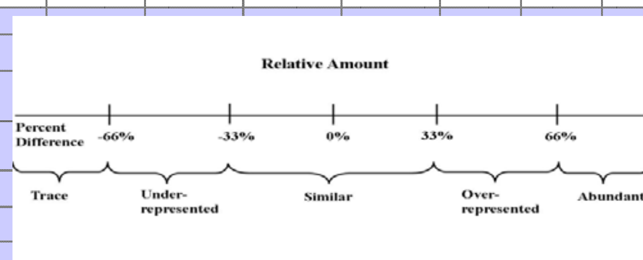
Stratum Num	21	Stratum Code	22	Stratum Name	23	Stratum CharDate	24 / /	BpS Lifeform	25 def
BpS Code	26								
Indicator Species	27		28		29		30	Local BpLU	31
Landform	32								
Avg Slope Class	34	Insolation Class	36	Low Elevation	38	High Elevation	39	Elevation Units	40 ft / M
Composition	41	% of Area							
Georeferenced Stratum Position:									
Latitude	43	Longitude	44	Datum	48				
Current Photo	49	Photo Date	50	Ref Cond Fire Freq	51 def	Current Fire Freq	52	Ref Cond Fire Sev	53 def
Current Fire Sev	54								
Ref V/F Comp Source	55 def	Cur V/F Comp Source	56 def	Native Amer Burning	57 def	B/C Class Break	58 def	D/E Class Break	59 def
Comment	60								

Stratum Data: Vegetation-Fuel (VFC)Class Composition Data (fields 62-75)

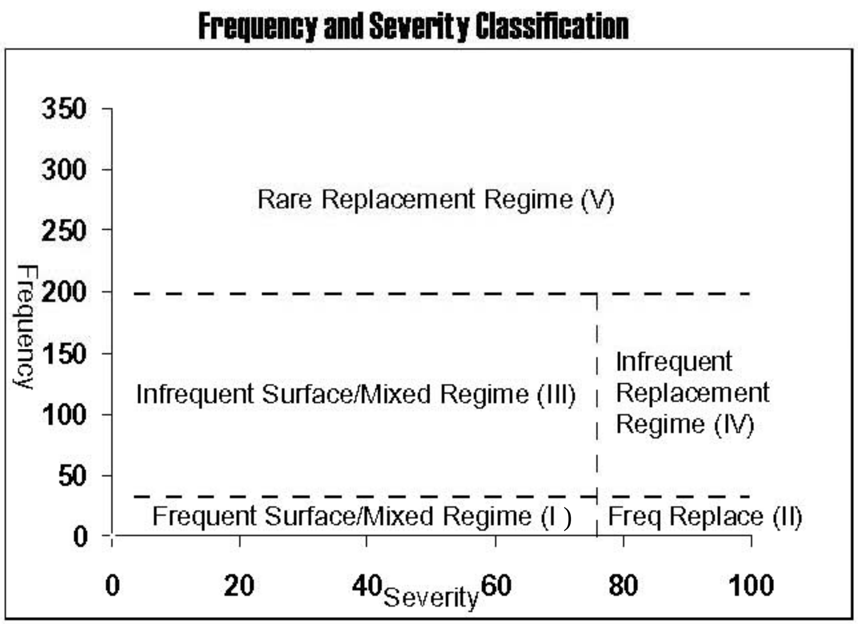
Vegeta-tion Fuel Class (62)	Uppr Layr Lifeform (63)	Uppr Layr Size Class (64)	Uppr Layr Canopy Closure (65)	Dominant Species 1 (def) (66)	Dominant Species 2 (def) (67)	Dominant Species 3 (def) (68)	Dominant Species 4 (def) (69)	Fuel Model (70)	Ref % Comp (def) (72)	Curr % Comp (73)	Photo (74)	Photo Date (75)
AESP									%	%		/ /
BMSC									%	%		/ /
CMSO									%	%		/ /
DLSO									%	%		/ /
ELSC									%	%		/ /
										%		/ /
										%		/ /
										%		/ /

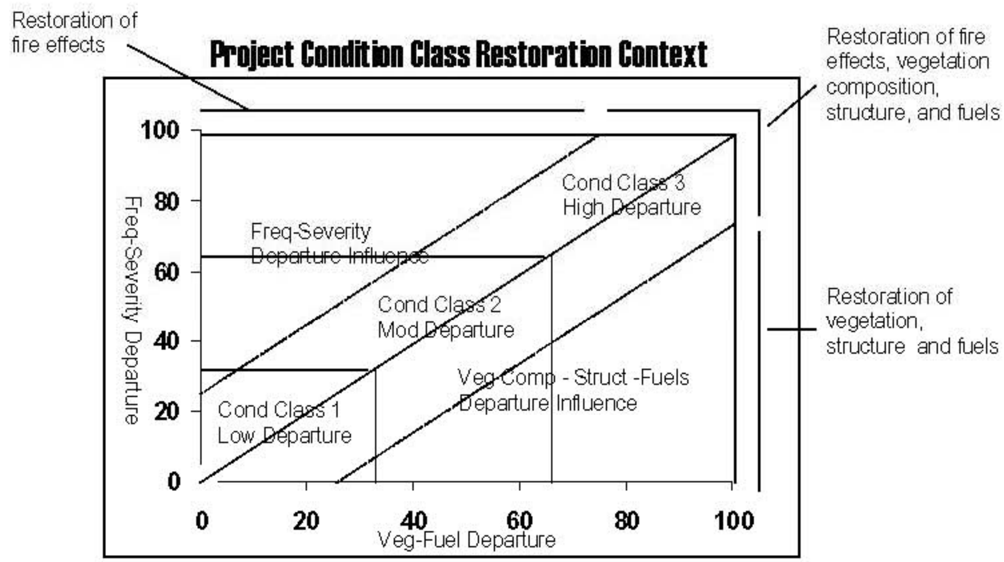
Stratum Data: Strata Totals (Fields 77-91)

			Veg-Fuel Types								Stratum Totals
Field 62	Veg-Fuel Class (rows above becomes columns here for fields 62, 72 and 73)	62	AESP	BMSC	CMSO	DLSO	ELSC	____	____	____	
Field 72	**Reference (Natural) Percent Composition.** Enter the values from field 72 above.	72						0	0	0	100%
Field 73	**Current Percent Composition.** Enter the values from field 73 above.	73									100%
Field 77	**Veg-Fuel Class Similarity**. Enter the smaller of field 72 (natural) and field 73 (current).	77									
Field 78	**Stratum Similarity**. Enter the sum of field 77 for all columns.	78									%
Field 79	**Veg-Fuel Class % Difference.** if (f73<f72) diff = ((f73-f72)/f72)*100 or if (f73 >or=f72) diff = ((f73-f72)/f73)*100	79						100	100	100	
Field 80	**Veg-Fuel Class Relative Amount.** "Trace" if field 79 is <-66, "Under-represented" if f79 >= -66 to < -33%, "Similar" if >=-33 to <=33%, "Over-represented" if f79 >33 to <=66 %, "abundant" if >66%.(see figure)	80						Abundant	Abundant	Abundant	
Field 81	**Stand Departure.** If f79 >= 0 enter f79 value, if f79 < 0 enter 0	81									
Field 82	**Stand FRCC.** If f80 = Trace, under-rep or similar enter an FRCC of 1, if f80 is over-rep enter FRCC 2 if Abundant enter FRCC 3.	82									
Field 83	**Area of VFC departed.** Field 7*(f41/100) * ((f73-f72)/100)	83									
Field 85	**Stratum Current Veg-Fuel Departure.** Subtract the value in field 78 from 100	85									%
Field 86	**Stratum Veg-Fuel Condition Class.** "1" if field 85 is <= 33%, "2" if 34-66%, "3" if 67-100%.	86									
Field 87	**Stratum Current Fire Frequency Departure**. Calculate: (1- (smaller of field 51& 52 / larger of field 51& 52)) * 100	87									%
Field 88	**Stratum Current Fire Severity Departure**. Calculate: (1- (smaller of field 53 & 54 / larger of field 53 & 54)) * 100	88									%
Field 89	**Stratum Current Frequency-Severity Departure**. Calculate: (field 87 + field 88) / 2	89									%
Field 90	**Stratum Frequency-Severity FRCC.** "1" if field 89 is <= 33%, "2" if 34-66%, "3" if 67-100%.	90									
Field 91	**Stratum Fire Regime Cond Class.** Enter the greater of field 86 and field 90	91									



Fire Regime and Condition Class
Worksheet Graphs





Fire Regime and Condition Class Standard Landscape Worksheet Field Form

Project Data (fields 1-20)

Registration Code	1	***Project Code***	2	***Project Number***	3	***Charact Date***	4 / /
Examiner Name	5	***Project Name***	6	***Project Area***	7	acres / hectares (circle one) (8)	

Georeferenced Project Position:

Latitude	10	Longitude	11	Datum	15

Photos: Photo Dates:

Current Photo	16	17 / /	Comments:
Reference Cond Photo	18	19 / /	20

Stratum Data (General Information/BpS/Reference and Current Fire Regimes (fields 21-60)

21 **Stratum Num** | **Stratum Code** 22 | **Stratum Name** 23 | **Stratum Char Date** 24 | **BpS Lifeform** 25 def | **BpS Code** 26

Indicator Species 27 | 28 | 29 | 30 | Local BpLU 31 | **Landform** 32

Average Slope 34 | **Insolation Class** 36 | **Low Elevation** 38 | **High Elevation** 39 | (feet/ meters) 40 | **Composition** 41 % of Area

Georeferenced Stratum Position:

Latitude 43 | **Longitude** 44 | **Datum** 48

Curr Photo 49 | Photo Date 50 | **Ref Cond Fire Freq** 51 def | **Current Fire Freq** 52 | **Ref Cond Fire Sev** 53 def | **Curr Fire Severity** 54

Ref Comp Source 55 def | **Curr Comp Src** 56 def | **Nat Amer Burn** 57 def | B/C Class Break 58 def | D/E Class Break 59 def | Comment 60

Stratum Data: Vegetation-Fuel Class (VFC) Composition Data (fields 62-75)

Vegetation Fuel Class Code (62)	**Uppr Layr Lifeform** (63)	**Uppr Layr Size Class** (64)	**Uppr Layr Canopy Closure** (65)	**Dominant Species 1 (def)** (66)	Dominant Species 2 (def) (67)	Dominant Species 3 (def) (68)	Dominant Species 4 (def) (69)	Fuel Model (70)	**Ref Comp (def)** (72)	**Curr Comp** (73)	Class Represent. Photo (74)	Class Represent. Photo Date (75)
AESP									%	%		/ /
BMSC									%	%		/ /
CMSO									%	%		/ /
DLSO									%	%		/ /
ELSC									%	%		/ /
										%		/ /
										%		/ /
										%		/ /

Stratum Data (General Information/BpS/Reference and Current Fire Regimes (fields 21-60)

21 **Stratum Num** | **Stratum Code** 22 | **Stratum Name** 23 | **Stratum Char Date** 24 | **BpS Lifeform** 25 def | **BpS Code** 26

Indicator Species 27 | 28 | 29 | 30 | Local BpLU 31 | **Landform** 32

Average Slope 34 | **Insolation Class** 36 | **Low Elevation** 38 | **High Elevation** 39 | (feet/ meters) 40 | **Composition** 41 % of Area

Georeferenced Stratum Position:

Latitude 43 | **Longitude** 44 | **Datum** 48

Curr Photo 49 | Photo Date 50 | **Ref Cond Fire Freq** 51 def | **Current Fire Freq** 52 | **Ref Cond Fire Sev** 53 def | **Curr Fire Severity** 54

Ref Comp Source 55 def | **Curr Comp Src** 56 def | **Nat Amer Burn** 57 def | B/C Class Break 58 def | D/E Class Break 59 def | Comment 60

Stratum Data: Vegetation-Fuel Class (VFC) Composition Data (fields 62-75)

Vegetation Fuel Class Code (62)	**Uppr Layr Lifeform** (63)	**Uppr Layr Size Class** (64)	**Uppr Layr Canopy Closure** (65)	**Dominant Species 1 (def)** (66)	Dominant Species 2 (def) (67)	Dominant Species 3 (def) (68)	Dominant Species 4 (def) (69)	Fuel Model (70)	**Ref Comp (def)** (72)	**Curr Comp** (73)	Class Represent. Photo (74)	Class Represent. Photo Date (75)
AESP									%	%		/ /
BMSC									%	%		/ /
CMSO									%	%		/ /
DLSO									%	%		/ /
ELSC									%	%		/ /
										%		/ /
										%		/ /
										%		/ /

Stratum Data (General Information/BpS/Reference and Current Fire Regimes (fields 21-60)

	21	**Stratum Num**		**Stratum Code**	22	**Stratum Name**	23	**Stratum Char Date**	24	**BpS Lifeform**	25 def
BpS Code	26										
Indicator Species	27		28		29		30	Local BpLU	31	**Landform**	32
Average Slope	34	**Insolation Class**	36	**Low Elevation**	38	**High Elevation**	39	(feet/ meters)	40	**Composition**	41 % of Area
Georeferenced Stratum Position:											
Latitude	43	**Longitude**	44	**Datum**	48						
Curr Photo	49	Photo Date	50	**Ref Cond Fire Freq**	51 def	**Current Fire Freq**	52	**Ref Cond Fire Sev**	53 def	**Curr Fire Severity**	54
Ref Comp Source	55 def	**Curr Comp Src**	56 def	**Nat Amer Burn**	57 def	B/C Class Break	58 def	D/E Class Break	59 def	Comment	60

Stratum Data: Vegetation-Fuel Class (VFC) Composition Data (fields 62-75)

Vegetation Fuel Class Code (62)	**Uppr Layr Lifeform** (63)	**Uppr Layr Size Class** (64)	**Uppr Layr Canopy Closure** (65)	**Dominant Species 1 (def)** (66)	Dominant Species 2 (def) (67)	Dominant Species 3 (def) (68)	Dominant Species 4 (def) (69)	Fuel Model (70)	**Ref Comp (def)** (72)	**Curr Comp** (73)	Class Represent. Photo (74)	Class Represent. Photo Date (75)
AESP									%	%		/ /
BMSC									%	%		/ /
CMSO									%	%		/ /
DLSO									%	%		/ /
ELSC									%	%		/ /
										%		/ /
										%		/ /
										%		/ /

Stratum Data (General Information/BpS/Reference and Current Fire Regimes (fields 21-60)

	21	**Stratum Num**		**Stratum Code**	22	**Stratum Name**	23	**Stratum Char Date**	24	**BpS Lifeform**	25 def
BpS Code	26										
Indicator Species	27		28		29		30	Local BpLU	31	**Landform**	32
Average Slope	34	**Insolation Class**	36	**Low Elevation**	38	**High Elevation**	39	(feet/ meters)	40	**Composition**	41 % of Area
Georeferenced Stratum Position:											
Latitude	43	**Longitude**	44	**Datum**	48						
Curr Photo	49	Photo Date	50	**Ref Cond Fire Freq**	51 def	**Current Fire Freq**	52	**Ref Cond Fire Sev**	53 def	**Curr Fire Severity**	54
Ref Comp Source	55 def	**Curr Comp Src**	56 def	**Nat Amer Burn**	57 def	B/C Class Break	58 def	D/E Class Break	59 def	Comment	60

Stratum Data: Vegetation-Fuel Class (VFC) Composition Data (fields 62-75)

Vegetation Fuel Class Code (62)	**Uppr Layr Lifeform** (63)	**Uppr Layr Size Class** (64)	**Uppr Layr Canopy Closure** (65)	**Dominant Species 1 (def)** (66)	Dominant Species 2 (def) (67)	Dominant Species 3 (def) (68)	Dominant Species 4 (def) (69)	Fuel Model (70)	**Ref Comp (def)** (72)	**Curr Comp** (73)	Class Represent. Photo (74)	Class Represent. Photo Date (75)
AESP									%	%		/ /
BMSC									%	%		/ /
CMSO									%	%		/ /
DLSO									%	%		/ /
ELSC									%	%		/ /
										%		/ /
										%		/ /
										%		/ /

“Simple 7” Training Form - Fire Regime Condition Class (FRCC)

Project Code *(Field 2)* __________ Project Number *(3)* ________ Project Char. Date *(4)* ___________
Project Name *(6)* ______________________ Size *(7)* _________ Units *(8)*: acres / hectares
Lat *(10)* _______________________ Long *(11)* _______________________ Datum *(15)* __________

Stratum *(21)* ________ Date *(24)* __________ BpS *(25)*:______________ Stratum Comp *(41)* _____%
Stratum Lat *(43)* __________________ Stratum Long *(44)* ___________________Stratum Datum *(48)* _______

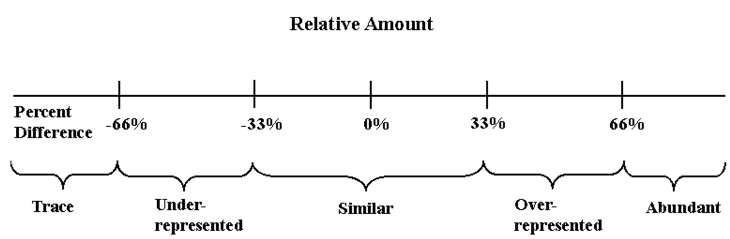
Fire Frequency-Severity	Reference *(51 & 53)*	Current *(52 & 54)*	Sim ((smaller/larger)*100)	Dep (100-Sim)
Fire Frequency (yrs) Sim = (smaller/larger)*100				
Fire Severity Sim = (smaller/larger)*100				
Fire Frequency-Severity Condition = (Frequency Dep + Severity Dep) / 2 *(87)*				
Fire Frequency-Severity Condition Class (0-33 = 1; 34-66 = 2; 67-100 = 3) *(88)*				

Vegetation-Fuel *(62)*	Reference % *(72)*	Current % *(73)*	Similarity (lower of Ref or Cur) *(77)*	Difference *(79)* if (cur<ref) diff = ((cur-ref)/ref)*100 if (cur ≥ref) diff = ((cur-ref)/cur)*100	Relative Amount[1] *(80)*	Stand Condition Class[2] *(82)*
A – Early						
B – Mid Closed						
C – Mid Open						
D – Late Open						
E – Late Closed						
U – Uncharacteristic	0		0	100 %	abundant	3
Sum	100	100				
Departure = (100%-Sum Similarity) *(83)*						
Vegetation-Fuel Condition Class (0-33 = 1; 34-66 = 2; 67-100 = 3) *(84)*						

Stratum Fire Regime Condition Class *(89)* = Higher of Vegetation-Fuel *(84)* or Frequency-Severity *(88)*	

Comments ________________________________ ____
____
____
____
____
____

[1]Amount based on Difference
T – TRACE (<or=-66% departure)
U –UNDER REPRESENTED (>-66% and <or= -33% departure)
S - SIMILAR (> -33% and < +33% departure)
O – OVER REPRESENTED (>or= +33% and <+66% departure)
A - ABUNDANT (>or= +66% departure or > 0% uncharacteristic classes)



[2] Determine Stand Condition Class (1, 2, or 3) Using the Following Rules:
If VFC Relative Amount (f80) is T, U or S enter 1 for Condition Class 1.
If VFC Relative Amount (f80) is O enter 2 for Condition Class 2.
If VFC Relative Amount (f80) is A enter 3 for Condition Class 3.

(#) = Field number corresponding to the FRCC Worksheet and Software.

Appendix B

Suitable Reasons for Replacing Default Reference Condition Values with Local Values

There are five suitable reasons for replacing the default reference condition values with local values. These include situations in which:

1) the scale of the extent of the area being assessed is geographically much smaller than that of the default;

2) local expert knowledge or results from studies indicate a permanently altered biophysical system;

3) the local landscape is constrained by physical or land use barriers that preclude the disturbance regime being in harmony with the vegetation-fuel class composition;

4) the composition at any one time period is driven by regional long-term cycles; and

5) if the BpS classification and mapping are at a much finer resolution than the coarse- or mid-scale defaults.

The following text provides expanded descriptions of these five reasons for adjusting and replacing coarse- or mid-scale default reference conditions. Determine which reason corresponds to your situation:

1) The scale of the geographic extent of the BpS (PNV) landscape is much smaller than the coarse- or mid-scale default. This would commonly occur where a local administrative unit (i.e. National Forest, National Park, BLM Field Office, etc.) 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 vegetation-fuel class description, rates of change between vegetation-fuel class, 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 landscape that is substantially smaller than that which would support the natural diversity of vegetation-fuel 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 landscape with an exotic invasive(s) that is more competitive than native species, thus changing the type or rate of natural state transitions.

c) A BpS landscape where a native species critical to state composition and transitions has been extirpated, thus changing the type or rate of natural state transitions.

d) A BpS landscape with climate change, soil loss or change, or other permanent changes in physical characteristics that changes the type or rate of natural state transitions. An example would be erosion loss of a dark, loamy surface soil where grasses are more competitive, resulting in a rocky soil where shrubs are more competitive.

3) The BpS landscape is constrained in size by physical or land use barriers that preclude development of the natural diversity of vegetation-fuel class patches and composition that is in harmony with the natural disturbance regime; an example would be a landscape BpS in an infrequent or rare replacement fire regime group that is limited to the upper zone of an isolated mountain range where one or two states of vegetation development dominate the whole landscape at any given period of time. The localized reference conditions for this case can allow up to 100 percent in any of the states at any given time period. In such cases, assessment and monitoring should be conducted at the province or section level to assure that the natural diversity of states can occur.

4) Composition at any one time period is driven by regional long-term cycles of disturbance and climate that result in a temporal composition rather than a spatial composition. For example, the spruce beetle in the upland spruce hardwood and coastal boreal transition types of Alaska results in dominance of one age and composition class at any one time period across the whole region.

5) Scale of the BpS classification is much finer than the FRCC Guidebook default classification. An example would be a BpS classification using understory composition, fuels, terrain, soils, or other factors to split the default BpS classes.

Note – a common question relates to changing reference conditions in landscapes where the management objective is for a state (vegetation-fuel) 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 implication perspective, landscapes with these management objectives typically require a higher investment in order to convert or maintain a condition that is not harmony with the natural regime. In addition, they potentially jeopardize native ecological components and processes. The general goal for assessment and monitoring of FRCC is to determine how in harmony we are with the natural system and how well we are conserving native ecological components and processes. As a performance measure, 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.

When replacing default values with local values:

Adjust reference conditions (the seven reference conditions include the five veg-fuel classes, fire frequency, and fire severity) ONLY after meeting the following criteria:

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 six other reference conditions 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. This process avoids an inconsistent combination of the seven reference conditions.

3) Document the local expert or team making the adjustment and the associated literature and field reconnaissance that was used in support.

This documentation will support the use of your improved or finer-scale expert estimate and more localized literature and field reconnaissance.

Appendix C

Science Review of FRCC Guidebook Version 1.0

A science review was conducted of the FRCC Guidebook version 1.0 methods (Morgan and others 2005, in prep). The following information is a brief summary of the purpose, process, and recommendations of the science review of the Fire Regime Condition Class (FRCC) concept, methods, and applications. Beginning in October of 2003, the group met multiple times, conducted communications, and developed written material. Membership of the science review team follows:

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A systematic process was used to solicit broad input, independent reviews, written documents, and submission of a draft manuscript for formal peer review. The management and policy context in which the methods were developed was recognized and comments were provided on the scientific appropriateness, strengths, and limitations of FRCC. The management objectives and political context surrounding FRCC provided the boundaries of the review. The team was particularly concerned about soliciting and incorporating review from a wide range of scientists and users. A draft manuscript will be ready for submission to a refereed journal in the spring of 2005. In the document, the team addresses the FRCC concept, methods and applications and focuses on its background, strengths, limitations, and recommendations. Throughout, the degree to which FRCC is science-based and scientifically reasonable is evaluated. The review recognizes and encourages the need to incorporate findings into the FRCC methods and applications as soon as possible. The review team is therefore aware that management has chosen to make improvements in the FRCC Guidebook.

The science team concluded that the concept of fire regime condition class is science-based, and that it appropriately tries to reflect changes in vegetation and fuel conditions as a result of changes in fire regimes, other disturbances, and land use. After evaluating both the qualitative and quantitative methods, the team recommended that the qualitative (scorecard) method be revised immediately and subjected to beta-testing, that the resulting quantitative and qualitative forms be identified as version 1.0, and that the Guidebook working group solicit and incorporate comments from scientists and users. The working group followed through and revised the qualitative scorecards, eventually developing an optional simpler format for the quantitative system called "Simple 7", which is part of this May, 2005 release. In this version, the qualitative scorecard methods have been eliminated and the stand scorecard has been replaced with a quantitative method that considers stand conditions in the context of landscape FRCC. The science review provided 11 recommendations listed below.

1. Provide guidance on FRCC science background and context for operational use.
2. Provide guidance on FRCC background theory and key concepts.
3. Clarify uncharacteristic classes.
4. Account for spatial pattern in FRCC.
5. Address the high uncertainty in assessing severity in reference conditions.
6. Use range of values for reference conditions and determination of current departure.
7. Clarify the difference between point and area fire frequency.
8. Clarify how to determine what vegetation type the user is assessing.
9. Revise and improve vegetation type reference condition descriptions.

10. Test repeatability and accuracy of field methods.
11. Assemble and develop new guidance for describing historical fire regimes.

The Interagency Guidebook Working Team has reviewed the recommendations and interacted with the science review team and has recommended the following responses to the Interagency Fuels Committee (IFC). The IFC has indicated that the FRCC Guidebook should be upgraded to meet the recommendations but that many of the items are subject to decisions by other entities, such as funding levels, Forest Service and Interior research, Joint Fire Sciences, and National Fire Plan research. The responses are summarized in table 2-3.

Table 2-3 – Listing of science review team recommendations and working group responses for changes and additions to FRCC Guidebook procedures and information.

1. Science background & context ◆ Explain scientific basis ◆ Credibility of process	**1. Response** ◆ Chapter 2 of revised guidebook will add scientific background ◆ Add chapter discussing management applications and integration
2. Background theory and concepts ◆ Synthesis of science background theory and key concepts is terse and needs expansion ◆ Address issues of scale & pattern in more depth	**2. Response** ◆ Chapter 2 of revised guidebook will add scientific background ◆ Add more on scale ◆ Add results from initial LANDFIRE research on scale ◆ Add additional training module
3. Clarify uncharacteristic class ◆ Lack of descriptions by vegetation type cause confusion and inconsistency ◆ Possibly only allow direct modern human-caused processes	**3. Response** ◆ LANDFIRE / Rapid Assessment modeling workshops enhancing descriptions ◆ Consider impact of not classifying uncharacteristic fire effects on soil, etc. These may preclude only allowing direct human-caused affects.
4. Science background & context ◆ Explicitly consider changes in pattern as well as composition because ecological processes are closely linked ◆ Uncharacteristic pattern does not capture its importance	**4. Response** ◆ LANDFIRE does not have methods for assessing pattern ◆ Lack of technology that is simple enough to implement consistently. This may preclude our ability to implement anything in the near future.
5. High uncertainty in assessing severity ◆ Severity definition in GTR-87 definition is limited to first-order effects on the upper layer ◆ Recommend broader definition ◆ Recognize the uncertainty in ability to model or empirically determine ◆ Include sources and degree of uncertainty in descriptions	**5. Response** ◆ Evaluate and possibly change the severity definition ◆ Clarify descriptions of severity by vegetation type ◆ Assess shift to broader definition and methods ◆ Possibly use Normalized Burn Ratio (NBR)/ Composite Burn Index (CBI) for recent & current mapping & FOFEM for modeling reference conditions.
6. Use range of variability instead of central tendency as reference ◆ Use range of values for reference conditions of 5 vegetation-fuel classes ◆ Use range for reference conditions of fire frequency and severity ◆ More in keeping with science of historical range of variability	**6. Response** ◆ Developed simple method of departure that uses a quantile of the maximum of the range (recommended by LANDFIRE statistician) ◆ Tested by reviewing literature in 6 different vegetation types ◆ Literature is inconsistent and incomplete on reporting range ◆ LANDFIRE agreed to provide simulated range with 90th quantile of maximum from simulations using LANDSUM
7. Clarify difference between point and area fire frequency	**7. Response**

◆ Fire frequency in a landscape reflects both how often fires occur and how large those fires are ◆ Because they are estimated from individual and small groups of fire-scarred trees, point estimates usually suggest that fires are more frequent ◆ Area frequency can be estimated from fire-scarred trees by excluding fire years that are only recorded by one or a few trees, but that requires good cross-dating ◆ For many locations, we lack data to do more than approximate historical fire regimes	◆ Want area frequency, but point frequency data are more commonly available ◆ Fire rotation method and guidebook rules may resolve this issue ◆ LANDFIRE can model area fire frequency reference conditions ◆ May be able to use NBR and CBI for assessing current area fire frequency, but this has not been tested
8. Clarify how to determine what vegetation type user is assessing ◆ Incorrect determination of Potential Natural Vegetation (PNV) or BioPhysical Setting (BPS) can cause major error in FRCC ◆ Explicitly address how to accommodate situations greatly altered by human disturbance	**8. Response** ◆ Developing keys to vegetation type by geographic areas ◆ Revising reference condition definition to what's restorable ◆ LANDFIRE has improved mapping rules based on indicator species and physical characteristics
9**. Revisions in vegetation type reference condition descriptions** ◆ Reference descriptions lack sufficient detail for users to understand which one is suited to their location, which others are similar, and where to go for additional information ◆ Descriptions must include the basis for and uncertainty in fire regime and vegetation abundance estimates ◆ Include more information on other disturbances ◆ To be defensible descriptions need to reflect synthesis of the literature and expert opinion, and to identify references used	**9. Response** ◆ Will expand descriptions in LANDFIRE Rapid Assessment and in LANDFIRE workshops ◆ LANDFIRE may produce uncertainty measures however we're not sure they will be useful to managers ◆ LANDFIRE workshops include other disturbances ◆ Current workshops and descriptions are improved but need more ◆ May need additional staff and contract work to produce higher quality descriptions
10. Need to test repeatability and accuracy of field methods ◆ A robust assessment of FRCC accuracy and replication is needed – how well do guidebook assessments and modeling agree with reality across vegetation gradients in landscapes where historical fire regimes are well characterized? ◆ This will inform development of a consistent methodology to defining reference conditions using dendrochronology, paired photos, and other retrospective techniques.	**10. Response** ◆ Robust assessment would be highly useful for improving FRCC definitions, methods and tools ◆ Moving forward on contract to test guidebook and LANDFIRE methods in Rincon Mountains of Arizona ◆ TNC has proposed testing in central US ◆ However, the research on reference conditions and assessment methods is sorely lacking
11. Assemble & develop new guidance for describing historical fire regimes ◆ Add links to existing fire history available from the IMPD ◆ Assemble and develop guidance on field procedures to standardize approaches to characterizing historical fire regimes (dendrochronology, charcoal and pollen; photographs and literature; modeling)	**11. Response** ◆ Possible Joint Fire Science project to expand and increase availability of fire history information ◆ Lack of funding and strategy for research to develop effective methods across all forest and rangeland types ◆ Consistent methods and their associated uncertainty should be provided in FIREMON ◆ Will require working closely with research

Appendix D

FRCC Version 2.0 Methods Using LANDFIRE Reference Conditions

Background

A science review was conducted of the FRCC Guidebook version 1.0 methods (Morgan and others 2005, in prep). The science review team recommended that the reference condition modeling determine not only the central tendency (mean and median), but also a range of variation. These statistics would come from the LANDFIRE-LANDSUM reference condition simulations. The team recommended that the range of variation be expressed as the minimum and maximum, adjusted to exclude outliers by excluding a percentile of the simulated values below a minimum percentile (such as 10^{th}) and above a maximum percentile (such as 90^{th}). The mean, median, minimum, and maximum would then be determined from this data set that excludes the outliers. These would be determined for each biophysical setting (BpS) for each LANDFIRE zone. These would become the Interagency Guidebook reference conditions for the Standard Landscape Worksheet Method and Standard Landscape Mapping Method, as well as the reference conditions for the LANDFIRE FRCC map.

The Interagency Fuels Committee (IFC) was concerned that the LANDFIRE FRCC map may differ from the FRCC Mapping Method map of a local area, given the same LANDFIRE current vegetation, BpS reference conditions, and summary grid (900 meter by 900 meter). In order to demonstrate consistency, as part of technology transfer training, the LANDFIRE current vegetation and BpS reference conditions common to both LANDFIRE and the FRCC Guidebook will be input to the FRCC Mapping Tool to show the same results on the 900 meter by 900 meter grid as produced in the LANDFIRE FRCC map. As recommended by the science review team, students will then be trained on how to report results at other scales, interpret the differences, and map and interpret the other Mapping Tool attributes of “Amount Class” and “Stand Condition.” LANDFIRE will not map these finer-scale interpretations.

The FRCC Working Group conducted a test in which they applied the same simple similarity method used in version 1.0 (see fig. 1) that compares the current to the central tendency, but compared the current to the adjusted maximum (see fig. 2). Then they changed the condition classification break points for departure from the 0-33, 33-66, and 66-100, used when comparing to the mean, to 0-5, 5-53, and 53-100. The procedure worked well and accounted for the adjusted minimum by using only the maximum because the current composition must sum to 100 percent of the landscape. A concern has been expressed that this simple similarity method does not address the minimum. However, members of the science review team and FRCC Working

Group indicated that the method may not account directly for the minimum but does account indirectly for the minimum by allowing only the current, which is less than the minimum, to contribute to the similarity.

The Working Group then conducted a test on modeling the range of variation using the VDDT model and literature review. They found that the literature was inconsistent in what type of variation was reported. It was difficult to determine if the range of variation was related to variation through time, size of geographic extent, or variation in biophysical and disturbance characteristics. The literature was also incomplete in reporting a range, but consistently reported a central tendency. The LANDFIRE scientists indicated they could consistently model the range of variation in reference conditions using the LANDSUM spatial model.

Version 1.0 – Departure Central Tendency Method

VFC	Ref Mean	Cur	Sim	Diff	Amt Class	Stand CC	Stand Dep
A	15	1	1	- 93	Trace	1	0
B	5	14	5	+ 64	Over Rep	2	64
C	25	5	5	-80	Trace	1	0
D	40	10	10	-75	Trace	1	0
E	15	50	15	+ 70	Over Rep	2	70
U	0	20	0	+100	Abundant	3	100
Sum	100	100	36				

Departure = (100-36) = 64; CC = 2 (1 – 0-33; 2 – 33-66; 3-66+)

Diff = If Ref >= Cur Then (Cur-Ref)/Ref; Else (Cur-Ref)/Cur
Stand CC = 1 (If < 33); 2 (If 33-66); 3 (If > 66)

Figure 1 – FRCC Guidebook version 1.0 method for fire regime condition class similarity, departure, and classification using the vegetation-fuel class composition data. The reference is the central tendency and sums to 100 percent. The current is current composition and sums to 100 percent. The lower of the two (reference or current) is taken for each class and summed for similarity. Departure is calculated by subtracting similarity from 100. Class 1 is assigned assuming there is plus or minus 33 percent standard variation around the central tendency. Classes 2 and 3 are even breaks.

The LANDSUM model uses the VDDT model for the biophysical setting (BpS) as a starting point for the transition rates between vegetation-fuel class states and transition paths for disturbances (see fig. 3). Disturbance probabilities vary in response to time, geographic extent, biophysical variation across the spatial extent, ignition and spread of fires, and climate. The model is executed many times for a 4000-5000 year simulated period, starting with even conditions and the reference model transition and disturbance probabilities. The results provide a data set that includes the range of variation for many simulations with varying outcomes.

Version 2.0 – Departure Range Method

VFC	Ref Min	Ref Max	Cur	Sim	Diff	Amt Class	Stand CC	Stand Dep
A	10	20	1	1	- 90	Trace	1	0
B	2	15	14	14	0	Similar	1	0
C	15	35	5	5	- 67	Trace	1	0
D	25	65	10	10	- 60	Trace	1	0
E	5	30	50	30	+ 40	Over Rep	2	40
U	0	0	20	0	+100	Abundant	3	100
Sum		100	100	60				

Departure = (100-60) = 40; CC = 2 (1 – 0-5; 2 – 5-53; 3-53+)

Diff = If Cur < Max & > Min Then = 0; If Cur > Max Then (Cur-Max)/Cur; If Cur < Min Then (Cur-Min)/Min

Amt Class; Similar = - 5 to + 5; Trace = < - 53; Under = - 53 to < -5; Over = + 5-53; Abundant = > 53

Figure 2 – FRCC Guidebook version 2.0 method for fire regime condition class similarity, departure, and classification using the vegetation-fuel class composition data. The reference is the adjusted maximum and sums to more than 100 percent. The current is current composition and sums to 100 percent. The lower of the two (reference adjusted maximum or current) is taken for each class and summed for similarity. Departure is calculated by subtracting similarity from 100. Class 1 is assigned assuming 0 departure between the minimum and maximum. Up to 5 percent departure outside the minimum and maximum is allowed to account for naturalized species and allow more variation. Classes 2 and 3 are even breaks between 5 and 100.

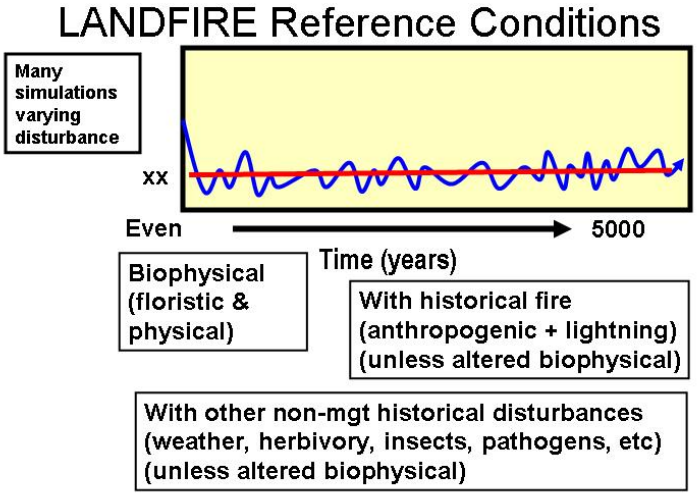

Figure 3 – LANDFIRE modeling of reference conditions using the LANDSUM spatial model. Disturbance probabilities are varied in response to time, geographic extent, and biophysical conditions. The model is executed many times for a 4000-5000 year simulation period, starting with even conditions and the reference model transition and disturbance probabilities. The results provide a data set that includes the range of variation for many simulations with varying outcomes.

Test Methods: FRCC Guidebook Version 2.0 and LANDFIRE Prototype Zones 16 and 19

After reviewing the data for Zone 16 (western Utah) the Working Group concluded that the 10th and 90th appeared to assure that the adjusted maximum values for each class added to well over 100 percent, which is desirable to allow a full range of variation. The 10th and 90th also appears to exclude most outliers that result from any erratic simulation behavior. The working group concluded that a condition class 1 (within natural range of variation) break point of 1 percent did not allow adequate variation outside the adjusted minimum and maximum. This added variation may be needed to account for alterations in the current biophysical or unexplained modeling behavior. However, the upper break point for condition class 1 could not be too large or it could allow inclusion of 5 percent or more of exotic vegetation states, which would be unacceptable from a management implications perspective. The decision for condition class 1 was to allow 0 to < 5 percent departure. Condition classes 2 and 3 evenly split so as not to bias the assignment, similar to the version 1.0 methods. The classification break point rules are shown in table 1.

Table 1 – Classification breakpoint rules for fire regime condition class using the vegetation-fuel class composition data.

Condition class	**Minimum departure (%)**	**Maximum departure**
Departure = (100-Similarity); Similarity = smaller of Current or Adjusted Maximum; Adjusted Maximum = 90th quantile of the maximum of the LANDSUM simulations for each class		
1	0	< 5%
2	> = 5	< 52.5
3	> = 52.5	100

For inclusion of reference condition statistics in the Interagency FRCC Guidebook, the LANDFIRE team will provide a spreadsheet of results by BpS for each zone with a format similar to that shown in table 2.

Table 2

Biophysical setting (BpS)	Veg-fuel class	Mean (%) of adjusted range	Median (%) of adjusted range	Adjusted maximum (%)	Adjusted minimum (%)
Name	Name	Value	Value	Value	Value
Name	Name	Value	Value	Value	Value
Name	Name	Value	Value	Value	Value
Name	Name	Value	Value	Value	Value

Special Considerations and Cautions

These analyses and decisions have been made in a very short time period in order to meet the deadlines for delivery of the LANDFIRE Prototype and for implementation of version 2.0 of the FRCC Interagency Guidebook. Additional analysis and upcoming ground truth by the LANDFIRE scientists, Technology Transfer Group, and FRCC Working Group of the Zone 16 and 19 areas, as well as each zone in the LANDFIRE National mapping, will likely provide much more insight in terms of the methods and rules for FRCC. Peter Brown and Tyson Swetnam will be conducting a study in Zone 16 of field reference conditions, reference simulation techniques, current conditions, and metrics for determining FRCC. Improved methods and reference conditions will likely be available for the next round of LANDFIRE FRCC mapping and implementation in the FRCC Guidebook. All these efforts will provide a solid foundation for evaluating need for change in future FRCC methods.

The Working Group and Interagency Fuels Committee (IFC) determined that both LANDFIRE FRCC mapping and Guidebook FRCC mapping should be consistent, given the same inputs and summary scale. Once the first zone is mapped for National LANDFIRE FRCC, the methods and scale must stay the same for determination of FRCC across all zones of the United States. Once one zone is mapped with a given method and scale, the rest of the zones must use the same method and scale for consistent determination of FRCC across the nation. To refine FRCC within local extents, a step-down process for local areas can adjust scale and type of summary. This step-down analysis would not be used for upward reporting of amount of condition class because it would not be consistent with other areas across the U.S. However, these local adjustments would be of considerable value to the local use of FRCC for prioritization, integrated assessments, and management treatment implications.

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Glossary of Terms
FRCC Guidebook Version 1.2

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

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

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

Class: The box model vegetation-fuel class within each BPS, based on successional (seral) stage, composition, and structure (see table below). Reference conditions for each BPS are based on the 5 characteristic classes (AESP, BMSC, CMSO, DLSO, ELSC); current conditions might have additional classes (called "uncharacteristic").

Seral Stage	**Composition & Structure**	
	Attribute (such as Open)	***Attribute (such as Closed)***
Post-Replacement	A (AESP)	
Mid-Development	C (CMSO)	B (BMSC)
Late-Development	D (DLSO)	E (ELSC)

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 vegetation-fuel classes B and E.

Coarse-Scale FRCC Mapping: Based on Schmidt et al., 2001. This document outlines the methodology used to map Fire Regime Condition Class and associated attributes at a coarse scale (1 km pixel resolution) for the conterminous 48 states. Available at: www.fs.fed.us/fire/fuelman/

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

Condition Class: In FRCC methodology, a synonym for Fire Regime Condition Class.

Default Reference Condition Characteristics: Derived from national, regional, or subregional modeling of BPS reference conditions using a five-box model within the Vegetation Dynamics Development Tool (VDDT) modeling software. These provide an average percentage estimate for each of the 5 characteristic vegetation-fuel classes that make up the landscape, 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.

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 condition class or the end state of succession for BPS; DFC may not be the same as reference conditions or FRCC 1 because of social and economic factors.

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

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 toward those of natural reference conditions.

Fire Frequency (Mean Fire Interval [MFI]): In FRCC methodology, this is the average number of years between fires. 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. In FRCC methodology frequency is years between all types of fires (replacement, surface, and mixed) that change the landscape mosaic of vegetation-fuel classes. A fire must affect 5 percent or more of the fire perimeter to be included.

Fire Regime: In FRCC methodology, this is the combination of fire frequency and fire severity. Natural or historical fire regimes may differ from current fire regimes, measured by Fire Regime Condition Class.

Fire Regime Condition Class: A classification of the amount of departure of conditions at a given time period (such as current or future) from the ecological reference conditions. Historical conditions are commonly used as a best estimate for the reference conditions. Native American or anthropogenic influences are commonly included. Fire Regime Condition Class is a relatively complete measure of the departure from the natural system.

Fire Regime Condition Class Characteristics: A measure of departure from natural or historical ecological reference 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	Fire regimes are within the natural or historical range and risk of losing key ecosystem components is low. Vegetation attributes (composition and structure) are intact and functioning.
2	Fire regimes have been moderately altered. Risk of losing key ecosystem components is moderate. Fire frequencies may have departed by one or more return intervals (either increased or decreased). This may result in moderate changes in fire and vegetation attributes.
3	Fire regimes have been substantially altered. Risk of losing key ecosystem components is high. Fire frequencies may have departed by multiple return intervals. This may result in dramatic changes in fire size, fire intensity and severity, and landscape patterns. Vegetation attributes have been substantially altered.

Fire Regime Condition Class Standard Landscape Mapping Tool: Designed for assessment, prioritization, and planning. These methods follow the same process as the worksheet procedures, but in a mapping environment. These methods do not map Fire Regimes or Departure from Fire Regimes

Fire Regime Condition Class Standard Landscape Worksheet Methods: These provide a landscape assessment tool for fire, vegetation, and fuels management planning. These methods are used to describe general landscape characteristics that are calculated together with estimates of historical fire regime reference values to index Fire Regime Condition Class. They can be conducted at two scales: **landscape-scale FRCC** for assessment of departure from reference conditions, and the **stand-scale FRCC** for assessment of FRCC in smaller areas in the context of landscape scale FRCC. The landscape- scale FRCC method must be conducted first in order to generate context inputs for the stand-scale FRCC method.

Fire Regime Group: A categorization of historical fire regimes to describe the frequency and intensity of fires (based on Heinselman1973). There are five fire regime groups:

Group	Frequency	Severity
I	0-35 years	Low and mixed
II	0-35 years	Replacement
III	35-200+ years	Low and mixed
IV	35-200+ years	Replacement
V	200+ years	Replacement and other fires occurring within this frequency range

Fire Severity: In FRCC methodology, this is the effect of fire within the fire perimeter in terms of replacement/removal of the upper layer vegetation and surface burning. Replacement/removal may or may not cause a lethal effect on the plants. For example, replacement fire in grassland removes the leaves, but leaves resprout from the basal crown, while replacement fire in most conifers causes mortality of the plant. A fire must affect 5 percent or more of the fire perimeter to be included.

Severity Class	Effects
No Fire Effects	< 5 percent replacement or surface
Surface or Low	≤ 25 percent replacement **Surface**: > 50 percent surface burned; **Low**: ≤ 50 percent surface burned
Mixed	≥ 5 percent replacement or surface and < 75 percent replacement
Replacement	≥ 75 percent replacement

Historical Conditions: See "Reference Conditions."

Historical Range of Variability (HRV): See "Natural Range of Variability" for discussion.
Historic Vegetation: The vegetation that developed during the pre-European-settlement era. Historic vegetation was a reflection of land potential and disturbance regime. Historic 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 Variability, Reference Conditions**.**

LANDFIRE: A multi-agency, inter-disciplinary mapping project designed to develop a consistent, mid-scale inventory of current vegetation and fuel conditions, and the associated natural or historical reference conditions, for forest and rangeland biophysical settings. LANDFIRE will develop fine resolution (30 m^2 pixels) geospatial data for the entire U.S., and will include a Fire Regime Condition Class layer. For more information, visit www.landfire.gov.

Late-Development: The stage in a BPS where vegetation is in late successional or mature stage for a given successional path. Ages will vary greatly depending on individual BPS. This is typically associated with vegetation-fuel classes D and E in FRCC methodology.

Map or Method Consistency/Accuracy:
Consistency for FRCC 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-Development: The stage in a BPS in which vegetation is in mid-successional or immature stage for a given successional path. Ages will vary greatly depending on individual PNVGs. This is typically associated with classes B and C in FRCC methodology.

Mixed-Severity Fire: Any fire that does not qualify as a replacement fire or a surface or low intensity fire. Mixed fires can open or maintain a vegetation-fuel class. This is a general category of fire severity that excludes surface and replacement fires, but includes mosaic and other fires that are intermediate in effects.

Mosaic Fire: Any landscape-scale mixed fire that has scattered patches across the fire perimeter, resulting in a mosaic of burned and unburned patches.

National Fire Plan Operations and Reporting System (NFPORS): NFPORS is 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.

Natural Conditions: See "Reference Conditions."

Natural Fire Regime: The fire regime of the natural system in absence of modern human interference. This is assumed to include native anthropogenic influences that may have contributed to development of native species fire adaptations.

Natural Range of Variability (NRV): 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 development of native species adaptations and natural disturbance regimes. Both the terms "Natural Range of Variability" and "Historic Range of Variability" are in common use (Landres et al. 1999), and are used to refer to a pre-European settlement timeframe. The critical items to include are the timeframe and the assumptions regarding disturbance. (See the "Reference Conditions" section of Chapter 2 for a more complete discussion.) Because historic climate no longer exists, development of a "present natural range of variation," 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 the historic period will be appropriate. FRCC methods use the historic range of variation concept while allowing the present natural range of variation. See also Historical Range of Variability, Present Natural Range of Variability.

Open: A structural characteristic in which the upper layer of vegetation canopy is relatively open. 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 the "open" vegetation-fuel classes B and E.

Patch: See “Stand.”

Post-Replacement: The BPS stage in which vegetation is in early-successional or a young stage. In forested and woodland BPS, this type will typically have less than 10 percent tree canopy cover and less than 5 percent canopy cover in shrubland BPS. Ages will vary greatly depending on individual BPS. This is typically class A in FRCC methodology.

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 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 2004), and includes the potential vegetation type concept.. Kuchler’s Potential Natural Vegetation (1964) is an example of the latter, as is the historic 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 PNV types for coarse-scale assessment. In FRCC this term is synonymous with Biophysical Setting (BpS).

Potential Vegetation Type (PVT): The potential of a land area to support one or more climax plant associations using a climatically constrained, rather than a disturbance-constrained, concept. This 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. (See PNV for a comparison with disturbance-constrained definitions).

Potential Vegetation Type Group (PVTG): A grouping of PVTs for coarse-scale assessment.

Present Natural Range of Variability (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 method therefore is predictive and somewhat speculative, but offers the advantage of a timeframe with the current and predicted climate, rather than an historical climate that no longer exists. If used, the timeframe 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 the historic period (the method currently used to determine reference conditions in FRCC) will be appropriate. See also Historical Range of Variability, Natural Range of Variability.

Project Area or Landscape: In FRCC methodology this area encompasses a minimum dynamic area adequate to sustain the natural vegetation mosaic and disturbance regime.

Reference Conditions: An estimate of the central tendency of vegetation-fuel class composition, fire frequency, and fire severity for a biophysical unit or landscape area. Reference conditions are the basis for calculating the ecological departure used to determine the Fire Regime Condition Class. A time frame for this variation is always involved and must be specified in models. Reference conditions can use the present natural range of variability (PNRV) for current or future conditions with the present/expected future climatic regime. Because data and models are generally lacking for this approach, however, we normally rely on use of the historical range of variability (HRV), determined for a specific historical time period and associated climatic regime. PNRV offers the advantage of using the current/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 variability (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-fuel classes A-E, Fire Frequency, and Fire Severity in FRCC methodology, although users may customize these values according to available local data.

Reference Condition Refinement: A consistent, systematic, on-going process of refinement of the BPS classifications and associated reference conditions. Area vegetation and fire ecology experts gather to participate in an initial workshop, review literature and area data, develop written descriptions of the BPS classes and disturbance regimes, test attributes and sensitivity using the “box model,” conduct informal peer reviews and reach consensus, and revise the reference conditions.

Reference Condition State/Transition Model: See "Box Model."

Replacement-Severity Fire: Any fire that causes greater than 75 percent top removal of a vegetation-fuel type, resulting in general replacement of existing vegetation. May or may not cause a lethal effect on the plants. For example, replacement fire in grassland removes the leaves, but leaves resprout from the basal crown, while replacement fire in most conifers causes mortality of the plant.

Scale: Scale can be seen through two perspectives: as used by geographers and as used by ecologists. With the perspective of geographers, there are two types of scale. **Scale of map:** pixels or polygons, ranging from coarse (at 1 square kilometer - 250 acres - or more) to fine (ranging from 30 meter by 30 meter - 900 square meters or .22 acres) to 1 meter by 1 meter (1 square meter or .0002 acres). **Scale of classification map legend**: Vegetation mapping, for example, can range from coarse-scale life forms to fine-scale plant community types. For fire regime condition class mapping, the determination of departure from reference conditions has a sliding scale that depends on the application. With ecologists, scale refers to extent on the landscape: "broad scale" for large areas and "fine scale" for local areas. Scale is critical to an understanding of landscape ecology.

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 the vegetation-fuel class composition across the landscape and for changes in fire frequency and fire severity. The method used to determine vegetation-fuel 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 in the field. (See "Departure" for comparison of difference).

Small Area: See "Stand."

Stand: A land area delineated too small to contain the natural variation of the vegetation-fuel mosaic and disturbance regime. It is often dominated by one vegetation-fuel class that can range in size from as little as 1 hectare (2 acres) to 100 hectares (250 acres) or more in size. "Stand" is associated with forest/woodland, while "patch" is associated with rangeland/grassland; the term "stand" is used for both throughout the Guidebook.

Stand Scale Assessment: Method for assigning Fire Regime Condition Class to a stand, patch, or small area based on its membership in a relative amount class of the landscape. A landscape FRCC assessment must first be performed before the stand scale can be assessed.

Stratum (Strata): A division of the landscape based on biophysical or management criteria.

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

State/Transition Model: See "Box Model."

Surface or Low Severity Fire: Any fire that causes less than 25 percent upper layer replacement/removal in a vegetation-fuel class, but burns 5 percent or more as replacement or surface within the fire perimeter. Surface and low-intensity fires can open or maintain a vegetation-fuel class. Surface fire burns more than 50 percent of the surface, while a low-intensity fire burns 50 percent or less of the surface.

Relative Amount Class: Vegetation-fuel class relative amount is the amount of current vegetation-fuels compared to the reference condition amounts. The estimate is classified into Trace, Under-Represented, Similar, Over-Represented and Abundant.

Uncharacteristic: A vegetation class that would not have been found within the natural or historical range of variability. Uncharacteristic classes include invasive plants, timber or grazing management that doesn't emulate the natural regime, and fire effects, soil disturbance, insects, or diseases that are more or less severe than in the natural regime.

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: In FRCC methodology, this is a standardized type classification based on descriptions of vegetation and fuel composition, structure, process, and pattern. Classes are grouped into those that are characteristic of the natural or historical conditions or and those that are uncharacteristic of these conditions.