Fire Analysis in Alaska: A Quick Reference

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A. Introduction

Alaska is faced with a unique fire management problem that has been handled in an interagency way for more than 30 years. The evolution of fire management has led to a different approach in interagency cooperation; weather data management; fire behavior and fire danger implementation; GIS management; and overall fire suppression strategies. **This guide is intended to provide standardized inputs for initial analysis; these are not hard and fast rules to be strictly followed throughout an incident.**

B. Alaska Fire Management

The Alaska Interagency Wildfire Management Plan outlines four management options which determine the default initial response to a wildfire. Options are selected by jurisdictional agencies based on legal mandates, policies, regulations, resource management objectives, and local conditions including, but not limited to, population density, fire occurrence, environmental factors, and identified values. Management options are assigned at a landscape scale and apply across jurisdictional boundaries. Ideally, boundaries are based on fuel types, access, topographic features, natural barriers, and fire regimes; are readily identifiable from both the air and ground; and can be feasibly defended. Management option designations are intended to be flexible. They may be changed with time to reflect long-term changes in land use patterns, values, resource objectives, or fuels. They may also be overridden with a non-standard response on a fire when local conditions or resource availability warrants.

Another unique aspect of Alaska fire management is the collaboration between a Jurisdictional FMO and a Protection FMO. The Jurisdictional FMO represents the agency or landowner and provides fire management direction to the Protection FMO. The Protection FMO is an Alaska Fire Service, State of Alaska, or U.S. Forest Service FMO who is tasked with managing fire operations in designated zones regardless of ownership. Either FMO may be the point of contact for analysis information and results. Contact the Protection FMO or designee for analysis information unless otherwise directed. Predictive Services staff can answer questions regarding the appropriate contact for a specific incident if not easily identifiable. Alaska fire management contacts can be found in Chapter 70 of the Alaska Mobilization Guide.

C. Weather and Fire Danger

Alaska began using the Canadian Forest Fire Danger Rating System (CFFDRS) in 1992 because its indices and indexes more closely represented fluctuations in fire season than its NFDRS equivalents. In 1994, after the adoption of CFFDRS, Alaska started compiling weather data outside of WIMS. Authoritative weather and fire danger information can be found at Alaska Fire and Fuels (AKFF). National products based on NFDRS are still used in Alaska, such as WFDSS and IFTDSS. Crosswalks from CFFDRS indices and fuel types are provided throughout this document to aid effective use of NFDRS based products. Additionally, many CONUS National Weather Service products are not available in Alaska. The AICC weather page has a comprehensive list of relevant Alaska weather information.

D. Incident GIS Information

Alaska has a reliable fire occurrence and perimeter history record dated back to 1940, but the most accurate records date back to 1987. This fire history is displayed in WFDSS, Alaska Wildland Fire Maps, and is also available as zipped shape files for use in WFDSS. Fire history can answer questions about validity of barriers, fuel models in old burns, general burn patterns and are commonly used as landscape masks to facilitate landscape edits.

Values at Risk located near fires are not all stored in WFDSS nor are they available on any public platform. You must request access to the Alaska Known Sites Database stored on the NIFC AGOL platform. This database contains information on sites in Alaska across all agency boundaries that may need protection.

A variety of satellite information is widely available and useful, but it is accessed in different ways. VIIRS data are updated on Alaska Wildland Fire Maps, and AKFF much faster than displayed on EGP or WFDSS. Satellite imagery, RGB GeoTIFFs and a variety of map services are available and serve in place of NIROPS IR on most incidents.

E. CFFDRS Related Fire Behaviour

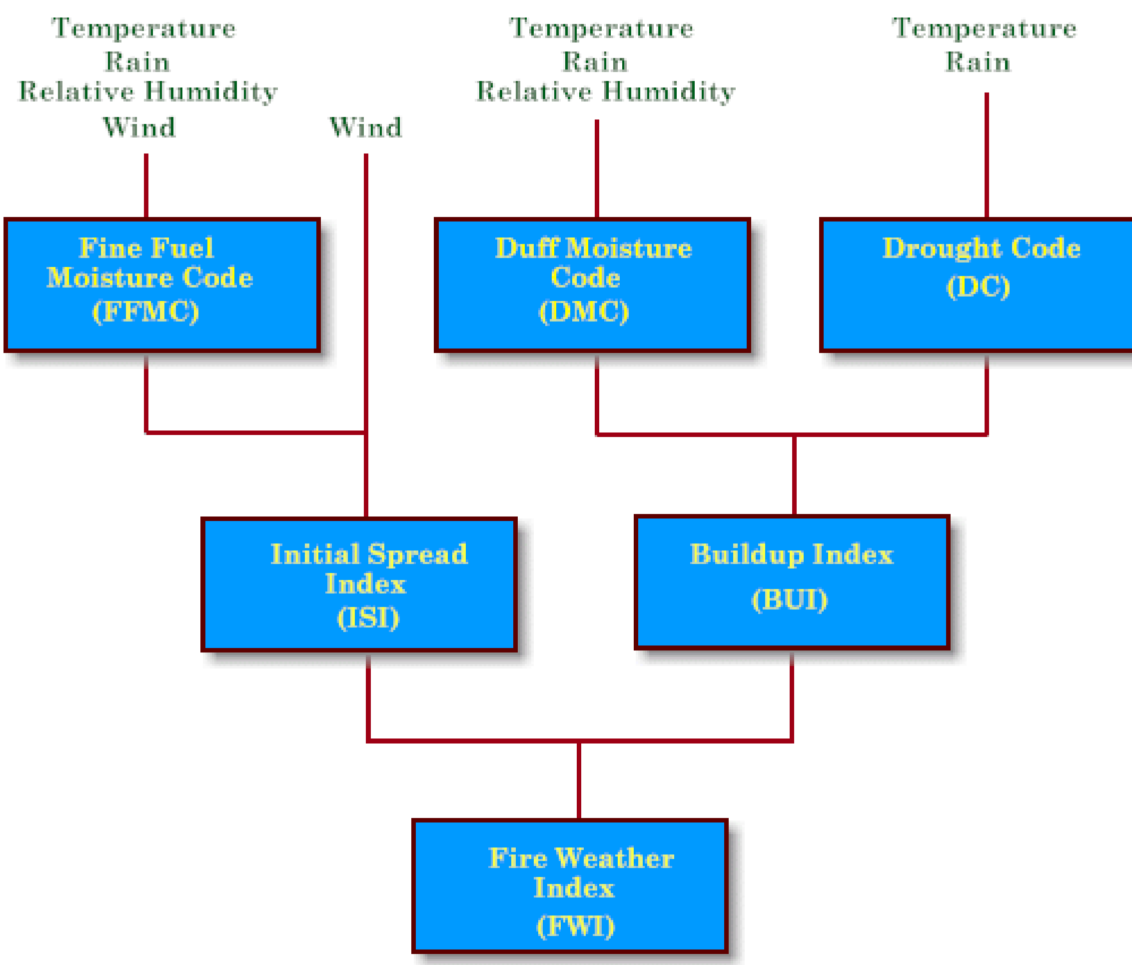


Figure 1: Fire Weather Index Flowchart

CFFDRS incorporates and integrates fire danger and fire behavior. The Fire Weather Index (FWI) system uses four daily weather inputs at 1400 AKDT (solar noon) and yesterday's fuel moisture codes to calculate today's fuel moisture codes and fire behavior indices. The Fire Behavior Prediction (FBP) system uses two of the values produced from the FWI and adds fuel type information to calculate fire behavior variables. These calculations can be done by hand using published field guides for FWI and FBP, with RedApp (standalone software that is the Canadian equivalent to BehavePlus), or the FBP calculator provided in AKFF. Using any of these calculators will aid validation of WFDSS analysis results.

F. Climatology for the Boreal Interior

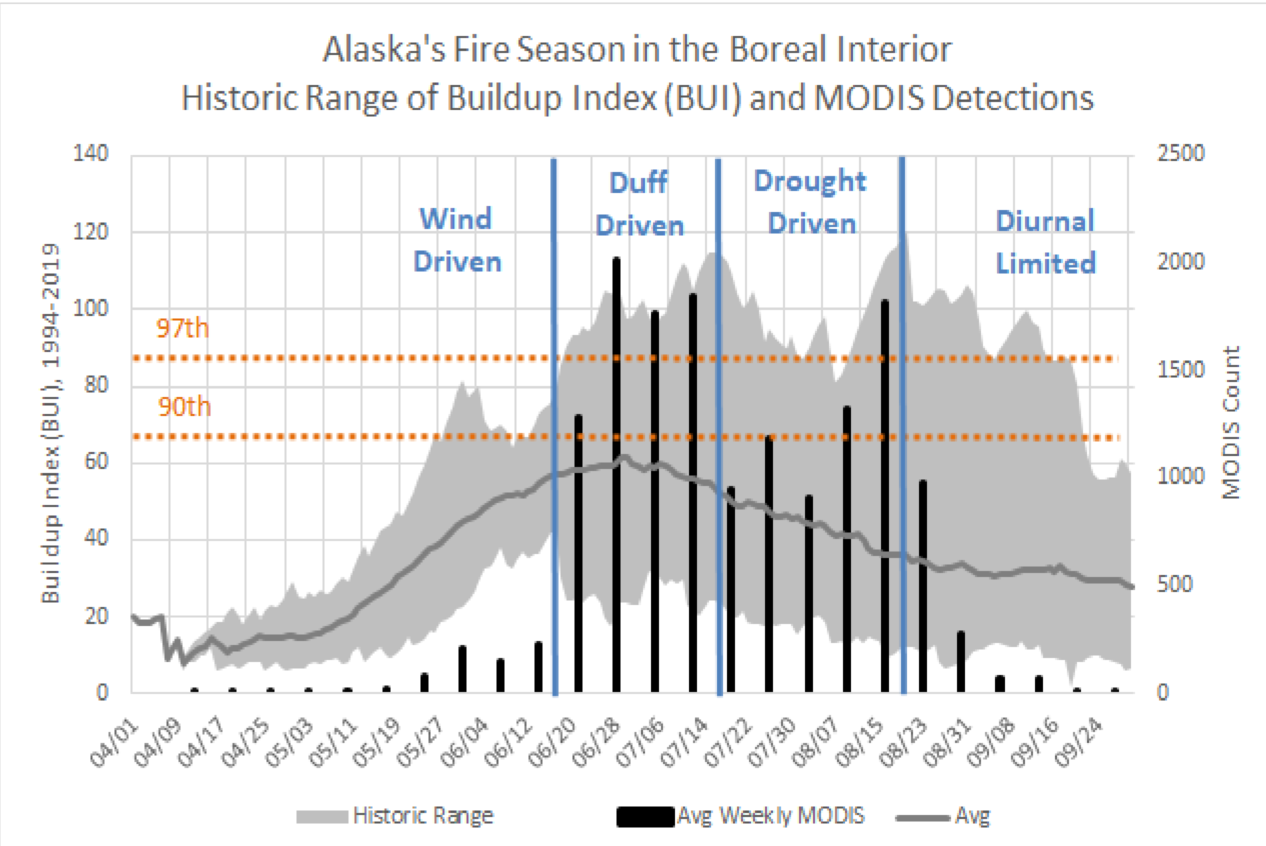


Figure 2: Alaska Fire Season as Described by the Buildup Index (BUI)

The Alaska fire season has been divided into four distinct stages:

- **Wind-Driven Stage** - begins in early April and corresponds generally to the period before full greenup when the soils are still cold, but dead grass and litter are flammable. Most fires are caused by human ignitions and are located along the road system. These are primarily smaller initial attack fires but incidents with rapid spread and growth can also occur.
- **Duff-Driven Stage** - begins in early to mid-June and generally coincides with longer days around the summer solstice that produce peak heating and rapid drying of surface and subsurface fuels. Fires occurring during this period are characterized by episodic growth events related to hot, dry sunny days, and can produce high flammability despite green fuelbeds. This is normally the peak of the Alaska fire season when fires can exhibit a high resistance to control.

- **Cumulative-Drought Stage -** begins in the middle of July and reflects less common later season fire growth potential and fewer additional lightning ignitions. This stage occurs in years where mid- and late-summer rains do not materialize sufficiently to reduce significant fire growth potential. Fires that burn late in the year may exhibit a high resistance to extinguishment. Severe drought indices can lead to fires that overwinter and reinitiate the following spring.
- **Diurnal Limited Stage** begins in mid-August and is influenced by rapidly shortening days with significant reduction in solar radiation and resultant moderation of daytime temperatures and relative humidity. Shortened burn periods and high overnight humidity recovery limit the spread potential of these fires. Significant fire activity during this period is unusual and has not occurred since 2004 and 2005. Late season fire activity in 2019 was limited to areas affected by a strong wind event in mid-August, and localized drought in the Susitna Valley and the Kenai Peninsula, not from widespread drought across the state.

G. Calibration and Validation

Fire behavior analysis is dependent on accurate and effective characterization of environmental inputs, user assumptions about the best models to apply, and model sensitivity to its inputs. In Alaska, the largest sources of error include the following:

- Accurate mapping of black spruce stands, deciduous forests, and burn scars in the analysis area.
- Forecast-driven characterization of day-to-day variation in burn period length and crown fire potential during the analysis period.
- Effective representation of fine dead and live fuel moistures as atmospheric conditions stress fuelbeds, usually informed by FWI codes and indices.
- Representative forecasts of wind speed and direction that influence fire spread and overall growth at the fire location.

This guide's recommendations for landscapes, seasonal severity, fuel moisture conditions, and wind factors is intended to inform analyses without the benefit of calibrating an initial analysis. Best calibration includes critique of recent analysis results, recognition of significant changes in landscape flammability, and assertive application of seasonal settings such as burn day frequency, burn period length, crown fire assumptions, and spotting probability.

II. CFFDRS Analysis

A. Alaska Fire & Fuels

AKFF is the warehouse for Alaska's weather and fire danger database. The website has multiple interfaces and functionality. An in-depth description can be found in the AKFF Users Guide. CFFDRS indices are calculated for many types of weather stations in addition to RAWS. The type of weather station you select may have data limitations. AICC Predictive Services staff can answer any questions you may have about weather stations.

Display options include the following.

- **Map display**- Gridded data are displayed in addition to data for each weather station. Additional layers are available to interpret data and provide context for the area of concern.
- **Tabular Displa**y – Data are available for the history of each weather station going back to 1994 or when the station was started.
- **Graphs** – Weather and CFFDRS indices can be displayed graphically. It is often useful to compare this year's information to past years.
- **CFFDRS Adjectives and Definitions** – A quick reference is provided for Adjectives used in Alaska and some basics of CFFDRS are also included.
- **Download data** – All data stored on AKFF is available to download in CSV form. A FireFamilyPlus 5 database that is updated weekly is also posted on the AICC website.
- **Tools** – Both FBP and FWI tools are provided to calculate options not shown on AKFF.

B. Buildup Index (BUI) Season Graphs

BUI is the CFFDRS equivalent to ERC. It is used to characterize seasonal severity across Alaska during fire season. It integrates the estimates of Duff Moisture Code (DMC) and Drought Code (DC). Early in the fire season, BUI is driven mainly by DMC. As fire season progresses into the Drought-Driven phase, DC becomes a major factor as the deeper duff layers support combustion. BUI graphs for all stations in a selected PSA are provided on the Fuels tab of the AICC webpage. Clicking the PSA label will graph the current year's BUI trend for each weather station in the PSA compared with historic maximums, minimums, and averages for the available climatology. Alaska does not use PocketCards for interpreting seasonal severity. Instead, this seasonal trend analysis is used to convey similar information using BUI plotted against a climatological range from data stored in AKFF.

C. Fire Weather Index (FWI) Codes and Indices

This table of thresholds was developed by Alexander and Cole in 2001 for weather and CFFDRS indices in Alaska. They are most applicable in Interior Alaska, where most fire activity occurs. However, even in tundra fuelbeds, they can be applied if validated.

Class	LOW	MOD	HIGH	VHIGH	EXT	Interpretation
Max Temp	<50°	50° to 59.9°	60° to 69.9°	70° to 79.9°	80°+	Fire intensity and crown fire potential
Min RH	51% to 100%	41% to 50%	31% to 40%	21% to 30%	<20%	Fine fuel moisture and ignition potential
FFMC	0 to 79.9	80 to 85.9	86 to 88.9	89 to 91.9	92+	Below 74, little chance of ignition or surface fire spread with an open flame. Active spread in light fuels at 80. Ignition potential high at 90 and extreme fire behavior expected at 92.
DMC	0 to 39.9	40 to 59.9	60 to 79.9	80 to 99.9	100+	Duff layer not involved below 20. Influence of duff on surface fire noticeably increases at 40. Extreme fire behavior becomes possible above 60.
DC	0 to 149.9	150 to 349.9	350 to 399.9	400 to 449.9	450+	Minimal significant ground fire below 300.
ISI	0 to 1.9	2 to 4.9	5 to 7.9	8 to 10.9	11+	Expected spread potential. Used in fire behavior predictions.
BUI	0 to 39.9	40 to 59.9	60 to 89.9	90 to 109.9	110+	Fuel availability and flammability. Seasonal severity. Used in Fire Behavior Predictions.
FWI	0 to 8.9	9 to 17.9	18 to 27.9	28 to 34.9	35+	Fire intensity and extreme fire potential.
Daily Severity Rating (DSR)						A transformation of the FWI that emphasizes its higher values. Can be cumulated through the season to represent overall conditions.

Figure 3: Fire Weather Index Codes and Indices

D. Canadian Fuel Types in Alaska

The first process in CFFDRS is to generate FWI outputs based on weather readings taken nominally at solar noon (1400 AKDT) and the previous day's fuel moisture codes. Once FWI indices are calculated, fuel types are integrated with these values to produce fire behavior predictions. The table below (Figure 4) is a summary of Canadian fuel descriptions and FBP classifications. More detailed descriptions and crosswalks to the standard 40 fuel models can be found later in the [Alaska's Landscape] and in the [2018 Alaska Fuels Guide].

Surface Fuels	Tree Canopy	Descriptions	FBP Fuel Type
Feather moss With shrubs and spruce reproduction	Black Spruce and / or White Spruce	Crowns to Ground	C-2
		Taller trees, crowns not to ground	C-3 (C-5 for riparian spruce)
	MixedWood with Aspen/Birch	Spruce Ladder Fuels	M-1, (spring) M-2 (summer)
	Bug Kill	When dead are down, may become slash type	M-3 (spring) M-4 (summer)
Needle Litter with sparse veg (e.g. equisetum)	Spruce	Crowns to Ground	C-2
	Spruce or another Conifer	Tall trees, crowns not to Ground	C-5
Leaf Litter with Herbaceous/shrub	Aspen and/or Birch	Open and closed stands	D1(spring) D2(summer)
Lichen	Woodland Spruce	Open spruce with some dense clumps	C-1
Shrub (Brush) & Tundra Or Fuel Breaks	Includes areas of sparse trees; woodland spruce	Tussock and Other Grasses	O-1b, 60%-90% curing Curing higher in spring /drought
		Primarily Shrub or Brush	O-1a, 50%-70% curing Curing higher in spring/drought
Grass (can be used for Tundra; grass-shrub with lower curing %)	Little, if any, canopy	Spring matted grasses	O-1a, 80%-100% curing for spring conditions
		Summer and drought-cured standing grass	O-1b, 40%-70% for active spread higher for extreme drought
Slash	heavier loading	Little if any canopy left. May not represent blowdown well.	S-1
	lighter loading		S-2
	Coastal		S-3

Figure 4: Canadian Fuel Types

E. Calculating Fire Behavior Outputs

Access to RedApp or [AKFF FBP Calculator] is essential for FBANs to be able to calculate fire behavior outputs and for LTANs to validate predicted spread in spatial models. The fire behavior prediction module in CFFDRS is quite accurate, requires little calibration, and produces results quickly. The main inputs are fuel type, ISI (FFMC and windspeed) and BUI from the nearest weather station. The AKFF FBP tool can automatically transfer weather and FWI inputs to the calculator for a given station. These same indices can be used in different fuel types to compare spread rates. This is the simplest and most effective way to validate fire spread predictions.

5/8/2020 Fire Behavior Prediction Calculator - Synoptic Labs Fire Services

CFFDRS Fire Behavior Prediction Calculator

```
COMMENT:
### CALCULATION INPUTS #########################################
Date/Time:  Date (Julian) ......... May 08 (128) 21:00 UTC
            Prediction Duration ... 60 mins
------------------------------------------------------------------------
Fuels:      FuelType ... C-2: Boreal spruce
            FFMC ....... 92    (given)
            BUI ........ 25.7  (KNAA2 8hr daily forecast)
            FMC ........ NaN (calculated)
            Fuel Modifiers:
                % Conifer ......... NaN   % Dead Fir ...... NaN
                Grs Curing Coef ... NaN   Grs Fuel Load ... 0    ton/acre
------------------------------------------------------------------------
Weather:    Wind Speed .......... 5 mph
            Wind Direction: ...undefined (NaN° / Azimuth = NaN°)
------------------------------------------------------------------------
Location:   Latitude: ......... NaN (N)   Longitude ...NaN (W)
            Elev ................ 0 ft    Slope ....... N/A% facing N/A
### EFFECTIVE PARAMETERS #######################################
ISI .................. ... 8.551
Spread Direction ..... undefined (NaN°)
Wind Speed ........... ....... 5 mph
### FIRE BEHAVIOR ##############################################
                         Head Fire     Flank Fire    Back Fire
                         -------------------------------------
Rate of Spread ......... 21.48 ....... 10.82 ....... 7.02      ch/hr
Rate of Spread at T .... 21.46 ....... 10.82 ....... 7.01      ch/hr
Flame Length ........... 9.74 ........ 7.1 ......... 5.82      ft
Fire Intensity ......... 799.1 ....... 402.7 ....... 261.03    BTU/ft/sec
Fire Type .............. S-Surface ... S-Surface ... S-Surface
Spread Distance ........ 18.37 ....... 9.26 ........ 6         ch
### FUEL CONSUMPTION ###########################################
Surface Fuel Consumption ... 5.71 ton/acre
------------------------------------------------------------------------
                         Head Fire     Flank Fire    Back Fire
                         -------------------------------------
Crown Fuel Cons. ....... 0 ........... 0 ........... 0         ton/acre
Total Fuel Cons. ....... 5.71 ........ 5.71 ........ 5.71      ton/acre
### FIRE SIZE AND SHAPE ########################################
Length-to-Breadth ................ 1.316
Length-to-Breadth at T ........... 1.316
Elliptical Fire Area ............. 35.45 Acres
Elliptical Fire Perimeter ........ 0.85 mi
Rate of Perimeter Growth ......... 79.06 ch/hr
```

Figure 5: FBP Calculator Outputs

F. Fire Behavior Forecasts using CFFDRS

These Alaska specific recommendations can help firefighters understand other tools and briefings provided to resources before and while in the field.

Description of Inputs and Outputs for a Fire Behavior Forecast
INPUTS
WEATHER SUMMARY: ○ Emphasis on any critical fire weather factors (high pressure, chinook winds, etc.) in discussion. ○ Highlight any critical thresholds in temperature and relative humidity from the FWI Interpretation table above.
OUTPUTS
FIRE BEHAVIOR-General: Fuels & Terrain: • Emphasize terminology for fuels commonly used here. Black spruce, white spruce, Mixedwood or mixed forest, hardwoods, shrub, and tussock tundra. • Reference burn scars as a separate fuel category, reference how old they are and what fuels (black and/or sparse, heavy dead and down, grassy, or shrubs) they contain. • You can identify fuel types or fuel models, but only in conjunction with more descriptive and identifiable distinctions in vegetation and fuel. • Reference live vegetation conditions related to normal conditions. Has the landscape greened up? Is it showing yellowing or other indicators of drought-stress? Fuel Moistures: • Recently observed and currently forecasted FFMC levels from several nearby stations in AKFF is valuable in evaluating relative value of persistence or highlighting changing predictions. • BUI (for forest) and DMC (for tundra) landscapes and how they have changed over the last week or so can help interpret overall flammability of the fire area. Graphs from other stations in the area from AKFF to help evaluate and report how current conditions compare to historic trends and extremes. • Use the FWI interpretation table above to help describe the current situation. • Reference Tactical Analysis interpretation after rainfall events. Fuels can become flammable very quickly after rain events. General Fire Behavior Descriptions and Predictions: • Emphasize daylength and how it affects the burn period for the current situation. Many firefighters from the lower 48 are unfamiliar with the influences of the midnight sun in current situation. • Rates of spread could be referenced in miles per hour for tundra, spruce, and Mixedwood. Feet per minute make more sense for deciduous and recent burn scars. • Flame lengths, in feet, are valuable descriptions and predictions. The fire type (surface, torching, and active crown fire) can be predicted and should be reported. • Include Probability of Ignition and Spotting Distance predictions with reference to past conditions.

Figure 6: Fire Behavior Forecast Suggestions

III. Alaska's Landscape

A. Vegetation and Fuels

Alaska's vegetation is quite varied. General categorization into broad ecoregions can help loosely classify the main vegetation that is found there.

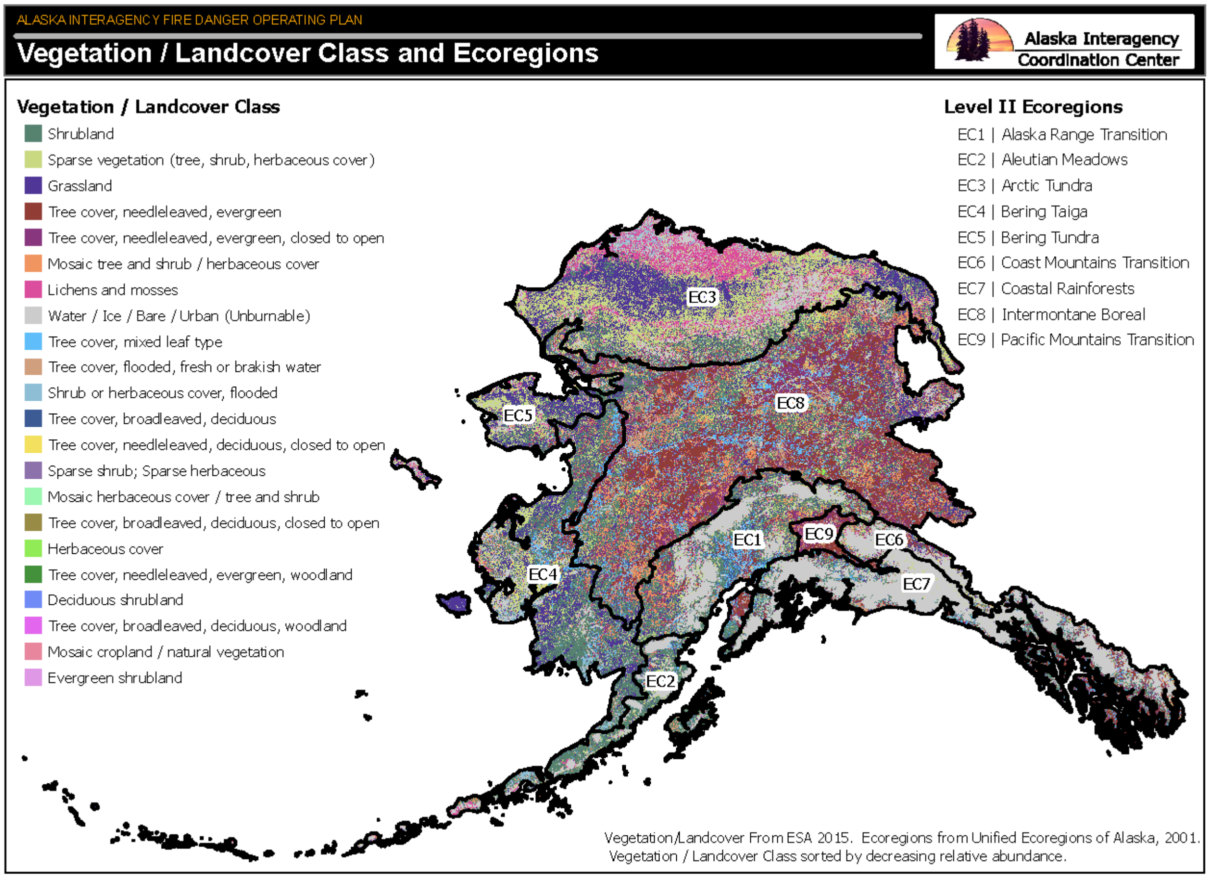


Figure 7: Alaska Unified Ecoregions and Vegetation Class

- **EC1 - Alaska Range Transition** – Much of this region is in the high elevations of the Alaska Range and Talkeetna Mountains. It contains mainly black spruce, standing dead white spruce due to a recent bark beetle infestation, and mixed hardwoods. Fire load on the Kenai Peninsula is significantly higher than in the Mat-Su valley. Since 2014, two fires large fires have burned over 350,000 acres on the Kenai Peninsula (Funny River 2014 and Swan Lake 2019).
- **EC2 - Aleutian Meadows** – Primarily tundra fuels with a low fire load.
- **EC3 - Arctic Tundra** – North Slope tundra that usually does not have weather conditions to support large fire growth. However, in 2007, the 250,000+ acre Anaktuvuk River fire burned late in the season and prompted fire managers to reassess the idea that the North Slope does not have large fires.
- **EC4/EC5 - Bering Taiga, Bering Tundra** – Low fire load, but fires do happen under favorable conditions. Mainly short lived as moisture frequently impacts the west coast.
- **EC6/EC7 - Coastal Mountain Transition/ Coastal Rainforest** – The area is normally quite wet, but fires can occur in the Panhandle under dry conditions, which may be becoming more frequent.

- **EC8 - Intermontane Boreal** – Most flammable region in Alaska. Black spruce and mixed hardwood are broken up by numerous large fire scars from a varied fire history.
- **EC9 - Pacific Mountains Transition** – Fire activity in the Copper River Basin is mainly restricted to valley floors and usually requires more severe conditions to sustain fire spread than the Interior.

B. Landscape Extent and Resolution in WFDSS

Spatial analysis in Alaska will often cover large areas and require limitations on the size of landscape analysis areas and resolutions defined for them. Follow these recommendations:

- 60m resolution if the analysis area is 10-20 miles on a side.
- 90m-120m resolution if analysis area is 20-30 miles on a side.
- 270m resolution if analysis area >30 miles on a side; start at 270m for the initial run, then consider 120m or 90m (minimum).
- If analysis area is greater than 30 miles on a side, consider modeling flanks in separate runs.

C. Common Landscape Edits

There have been numerous issues with the Alaska Landfire 2014. These issues are actively being addressed. Here is a list of common landscape edits that have proven effective in the past. For more detailed information, see the Fuel Model Guide to Alaska Vegetation.

- Black spruce is usually represented as TU3 (163), TU4 (164) and possibly TU5 (165). Converting all or some of these fuel models to SH5 (145) can match fire spread more accurately.
- Above 1000m is usually unburnable.
- During periods of drought or later in the summer, deciduous stands may not be an effective barrier to fire spread. TU1 (161) could be edited to a slightly faster moving fuel model if spread is occurring in deciduous stands.
- Tussocks represented as GR4 (104) and can exaggerate fire spread. Converting fuels to GS3 (123) or SH2 (142) may help temper spread if necessary.
- Beetle killed white spruce may not be captured in Landfire. TU1/TU2 (161/162) to SB2 (202) or TU5 (165) could help address recent beetle kill.
- Heavy dead and down beetle kill SB3 (203) unless a large grass component present.
- Burn scars 1-2 years post fire will not support fire spread and should be masked as TL1 (181).
- Burn scars with 3-5 years recovery can sometime support fire spread if conditions are severe enough. Convert scars that support fire spread to TU1 (161) .
- Burn scars 6+ years old can be represented as SH2 (142). Fire spread is variable in older burn scars and should be evaluated on an individual basis.
- 2004 and 2005 burn scars are prevalent on the landscape. They have become more flammable with time but still not displaying rapid rates of spread, except under extreme circumstances. Editing SH3 (143) to SH1 (141) or SH2 (142) may effectively slow down spread rates.
- Twice burned areas are becoming more common on the landscape, but still represent a small overall percentage of fuels. Fuels that are present will vary depending on previous burning conditions. SB1 (201) may represent areas that are mainly dead and down and might be appropriate based on the intensity of the previous fires. Reduce fire spread in brush dominant fuels by reducing canopy cover or crown bulk density.

D. Fuel Model Crosswalk

The Fuel Model Guide to Alaska Vegetation provides crosswalk tables and detailed descriptions of vegetation types that include fuel and fire behavior interpretations. Forest Crosswalk Table and Fuel Model Comparison

Form	Composition	Structure	Vegetation Type	40	13	FBP
Forest	**Conifer** (over 75% of tree cover contributed by needle leaf species)	Closed (60%+)	(1) Sitka Spruce – Hemlock Forest	TL1	8	C-5/C-7*
			(2) Closed White Spruce Forest	TU2/TU1	9	C-3
			(3) Closed Black Spruce Forest	TU3/TU4	9 adj	C-2
		Open (25-59%)	(1) Sitka Spruce – Hemlock Forest (see above)	TL1	8	C-5/C-7*
			(4) Open White Spruce Forest	TU5	10	C3
			(5) Coastal Boreal Transition–Open White/Lutz Spruce	TU1	8	D-1/D-2*
			(6) Black Spruce-Mixed Spruce Forest	TU4/TU3	9 adj	C-2
			(7) Black Spruce Peatland	TU2	10	C-1
		Woodland (<25%)	(7) Black Spruce Peatland (see above)	TU2	10	C-1
			(8) Coastal Woodland Rainforest	TL1	8	D1/D2*
			(9) White Spruce Woodland w/ Shrubs	SH2	10	M-1/M-2*
			(10) Black Spruce Woodland w/ Tussocks	GS2	5	C-1
			(11) Black Spruce Woodland w/ Lichen	TU4	9 adj	C-1
			(12) Black Spruce Woodland w/ Sphagnum Moss	TU2	10	C-1
	Deciduous (over 75% tree cover contributed by broadleaf species)	Closed (60%+)	(13) Black Cottonwood-Balsam Poplar/Red Alder	TL2	8	D-1/D-2
			(14) Paper Birch/Quaking Aspen Forest	TU1		
		Open (25-59%)	(15) Paper Birch Forest	TU1		
			(16) Quaking Aspen Forest	TU1	8	D-1/D-2
			(17) Balsam Poplar (Black Cottonwood) Forest	TL2		
		Woodland (<25%)	(18) Woodland Paper Birch/Balsam Poplar	SH1	8	O-1a/b*
	Mixed (25-75% admixtures of conifer & broadleaf)	Closed (60%+)	(19) Spruce-Paper Birch-Aspen	TU5	10	M-1/M-2*
			(20) White Spruce-Balsam Poplar-Paper Birch	TU1	8	
		Open (25-59%)	(19) White or Black Spruce w/ Paper Birch or Aspen	TU5	10	M-1/M-2*
			(20) White Spruce w/ Balsam Poplar and Paper Birch	TU1	8	
		Woodland (<25%)	None really described			

Figure 8: Forest Fuel Model Crosswalk

1. Black and White Spruce

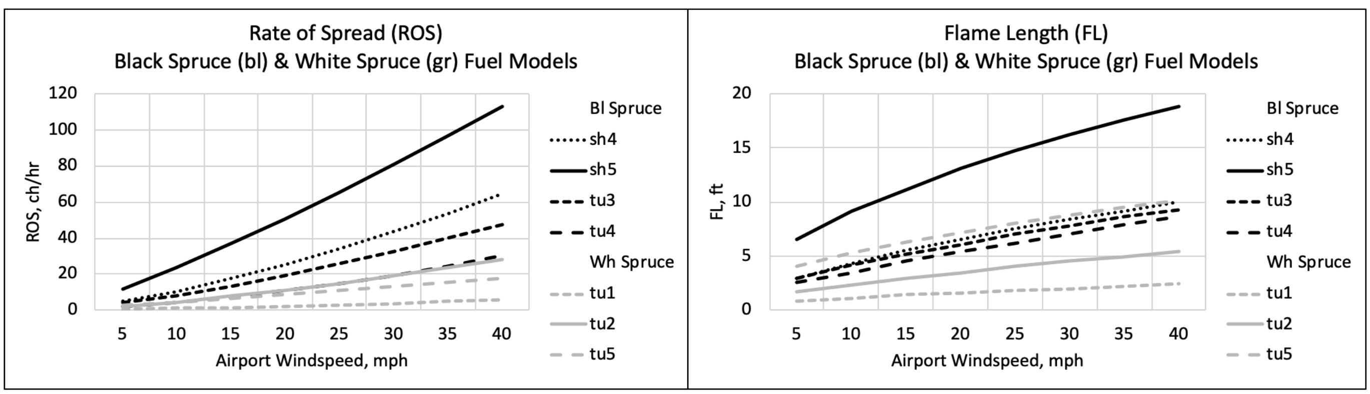


Figure 9: Black and White Spruce Fuel Model Comparison

These estimates reflect typical peak season (Duff-Driven) conditions for black spruce that burn as crown fires with the following inputs.

- Dead Fuel Moistures of 5% (1-hr), 6% (10-hr), and 7% (100-hr)
- Herbaceous Fuel Moisture of 90% is insignificant for most of these fuel types and Woody Fuel Moisture of 90% represents black spruce needle moisture content.
- Canopy Cover of 25%, Stand Height of 20ft, and Crown Ratio of 0.7. Canopy is necessary for spotting spread, but it reduces midflame wind speed. Taller white spruce would reduce spread & flames.

SH5 (145) produces spread rates approaching crown fire spread estimates. It would need spotting to approach spread rates for CFFBP Fuel Type C-2 with an ISI of 22 (FFMC 92, winds: airport 20/RAWS 15) and BUI 100.

For white spruce, TU5 (165) produces more spotting, but slower spread than TU2 (162). Active crown fire is not common in either fuel model.

2. Deciduous and Mixedwood

Fire behavior in deciduous forests is much more moderate than in conifer forests. There are important distinctions between primarily deciduous and Mixedwood forests. Pre-green conditions allow fire spread to be more wind influenced. After green/leaf-out, during the Duff-Driven season, fire spread is more subdued. If dry conditions persist into the drought-driven seasons, these fuel types are more likely to allow fire spread again.

- **Deciduous forests** TU1 (161) or TU2 (162) can have both high canopy cover (green) and very low canopy bulk density making the foliage much less flammable. Canopy base height is generally higher, producing very little spotting. Young, post-fire forest conditions may be better represented as shrub fuels until leaf/needle litter builds up.
- **Mixedwood forests** TU5 (165) or TL6 (186) includes both deciduous and conifer trees. Canopy cover is similarly high when deciduous trees are greened up. However, with the conifer component, canopy bulk density should be higher and canopy base height lower to promote spotting and possible crown fire behavior.

These fuel types are difficult to distinguish from satellite imagery, especially if the conifer is in the understory. Deciduous forests will produce significantly lower fire behavior than Mixedwood forests, with variable conifer admixtures.

Before greenup, forests are more open (partially sheltered) and litter fuelbeds are primarily dormant dead fuels and low live fuel moistures. Canopy cover should be lower, 30% or less to allow greater wind penetration. Live fuels moistures (herbaceous 30%, woody 60%) are very low in these graphed outputs.

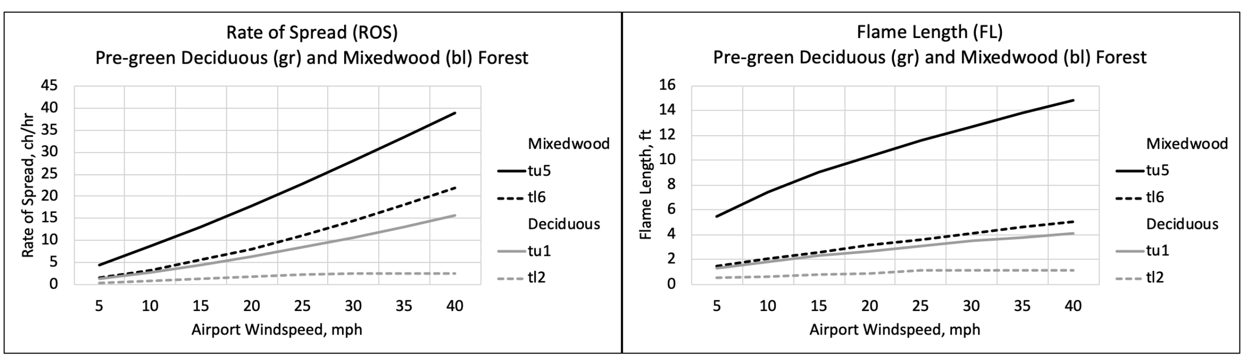


Figure 10: Pre-Greenup Deciduous and Mixedwood Fuel Model Comparison

After greenup, in mid- to late-May, wind sheltering, and live fuel heat sink tend to limit fire growth more in these fuels. Canopy cover should be much higher, as much as 70% to limit wind penetration to the surface. Live fuel moistures (herbaceous 90% and woody 100%) are much higher even during active fire periods.

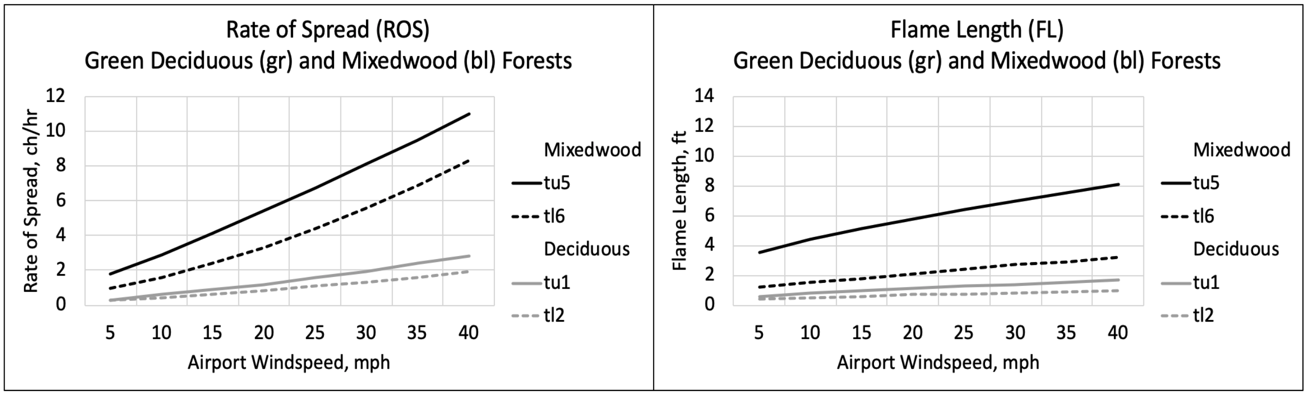


Figure 11: Post-Greenup Deciduous and Mixedwood Fuel Model Comparison

3. Shrub Crosswalk Table and Fuel Model Comparison

Form	Composition	Structure	Vegetation Type	40	13	FBP
Scrub	**Dwarf Tree Scrub** (10%+ dwarf trees cover)	Closed (60%+)	(21) Dwarf Tree Mountain Hemlock or Spruce Scrub	SH1	8	O-1a
		Open (25-59%)	(21) Dwarf Tree Mountain Hemlock or Spruce Scrub (22) Dwarf Tree Black Spruce Scrub	SH1 GS2	8 9	O-1a C-2
		Woodland (<25%)	(22) Dwarf Tree Black Spruce Scrub	GS1	9	C-1
	Tall Scrub (shrubs at least 1.5 m or 5 ft tall)	Closed (75%+)	(23) Closed Tall Alder-Willow Shrub (24) Closed Tall Birch Shrub (25) Tall Shrub Swamp	TL2 SH3 SH1	8 9 8	D-1/D-2* M-1/M-2 O-1a/b
		Open (25-74%)	(26) Open Tall Alder-Willow Shrub (27) Open Tall Birch/Birch-Willow Shrub	TU1 SH3	8 9	D-1/D-2 M-1/M-2
	Low Scrub (shrubs 20 cm to 1.5m)	Closed (75%+)	(28) Closed Low Birch/Birch-Willow/Ericaceous Shrub (29) Closed Low Willow/Alder-Willow Shrub	SH2 SH2	8 8	D-1/D-2 D-1/D-2
		Open (25-74%)	(30) Open Low Mixed Shrub-Sedge Tussock Tundra/Bog (31) Open Low Mesic Shrub Birch – Ericaceous Shrub (32) Open Low Birch Ericaceous Shrub Bog and Open Low Shrub Birch-Wilow Shrub (33) Open Low Willow/Sweetgale (34) Open Low Alder/Alder-Willow Shrub (36) Sagebrush-Grass	GR4 GR2 GS2 SH1 GS1 GR1	1 5 5 8 1 8	O-1a/b O-1a/b O-1a/b O-1a/b O-1a/b O-1a/b
	Dwarf Scrub	Dryas	(37) Dwarf Shrub Tundra	GS1	1	O-1a/b

Figure 12: Shrub Fuel Model Comparison

These fuels are normally found in:

- Coastal and arctic tundra of western and northern Alaska.
- High elevation krummholz.
- Wetlands limited by permafrost.
- Regrowth after fire disturbance.
- Grassy disturbed lands around communities, infrastructure improvements, and Kenai bug kill.

Dwarf Tree Scrub is at the poorest end of forest woodland classes above. Fire behavior is more dependent on the surface cover than the scattered trees. Spotting potential may be significant if tree density is higher.

Tall Scrub (SH fuels) does not persist on a widespread basis. Frequently found in wetlands and along water courses where willow & alder thickets usually produce minimal fire behavior. Also includes aspen and birch regeneration for a period after wildfire disturbance once they have grown tall and thick enough to be seen.

Low Scrub (GS fuels) more commonly produces mixtures of grasses and sedges alongside shrubs that can include more flammable birch and willow as well as burnable ericaceous shrubs among the ground cover. Spotting potential may be significant under strong winds.

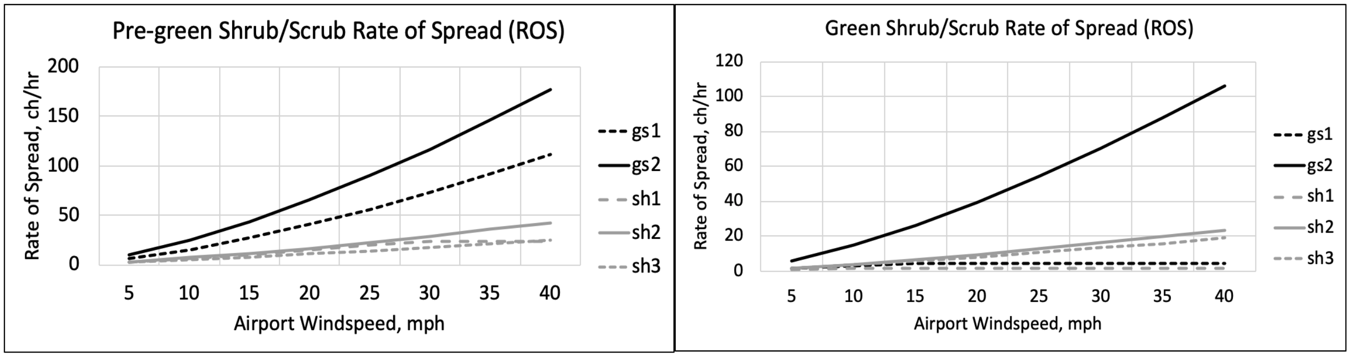


Figure 13: Pre-Greenup Vs. Post-Greenup Rate of Spread Comparison

Fire behavior inputs for the graphs here include very little if any canopy that might support long range spotting. Midflame wind reduction is 0.4. Dead fuel moistures of 5% (1-hr), 6% (10-hr), and 7% (100-hr) represent a dry surface fuelbed. **Pre-greenup** live fuel moistures of 30% for herbaceous and 60% for woody are an early spring extreme. **Post-greenup**, growing season fire behavior inputs include herbaceous fuel moisture of 80% and woody fuel moisture of 90%.

4. Herbaceous Crosswalk Table and Fuel Model Comparison

Herbaceous	**Graminoid**	Dry	(38) Elymus	GS2	5	O-1a/b
			(39) Grass-Shrub	SH2	5	O-1a/b
		Mesic	(41) Bluejoint (Calamagrostis)	GR4	2	O-1a/b
			(42) Bluejoint-Shrub/Herb	GR2	6	O-1a/b
			(43) Tussock Tundra	GR4	1	O-1a/b
			(44) Mesic Sedge-Grass-Herb Meadow Tundra	GS1	5	O-1a/b
			(45) Sedge Willow Dryas Tundra	GR1	1	O-1a
			(46) Sedge-Birch Tundra	GR2	6	O-1a/b
		Wet	(47) Wet Meadow Tundra	GR1	1	O-1a/b
			(48) Wet Sedge-Grass Meadow Marsh	GR1	1	O-1a
			(49) Wet Sedge Meadow-Bog-Shrub	GR1	9	O-1a
	Forbs	Mesic	(52) Mesic Forb Herbaceous	GR1	1	O-1a
	Bryoid	Lichens	(53) Foliose and Fruticose Lichen	GR1	2	O-1a/b
			(54) Crustose Lichen	NB9	99	N/A
	Aquatic	Wet	(55) Aquatic Herbaceous	NB8	98	N/A

Figure 14: Herbaceous Fuel Model Comparison

These fuel models are the most dynamic of all choices, with very wide ranges of fire behavior, based on ranges of herbaceous fuel moisture between 30% (DMC 130 in the growing season) and 120% (DMC 40 in the growing season).

This example uses 75% herbaceous fuel moisture to represent late spring conditions, transitioning from pre-green to greener growing season conditions as well as stressed growing season fuelbeds represented by DMCs of around 75.

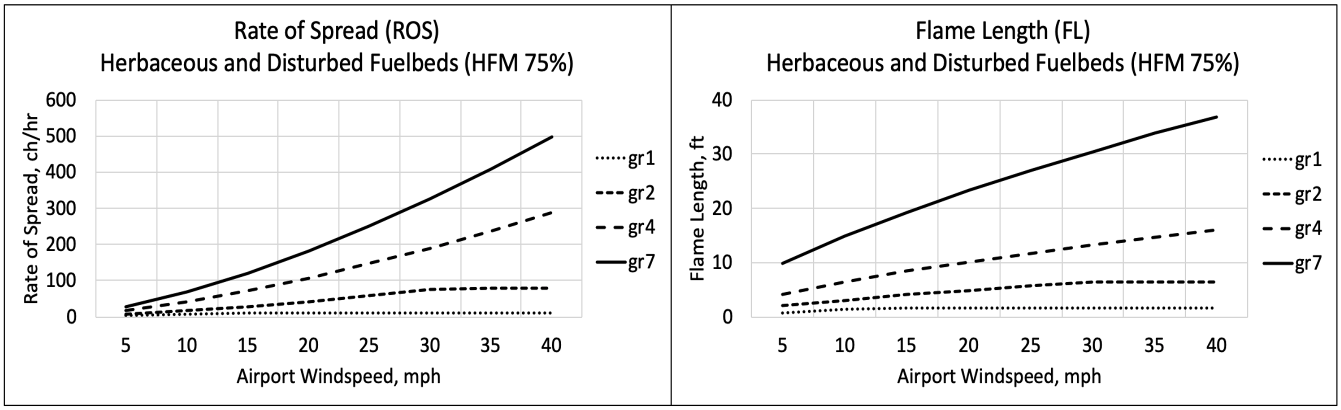


Figure 15: Herbaceous and Disturbed Fuels Rate of Spread Comparison

Tussock Tundra GS4 (124) can show very rapid rates of spread under drought conditions and can reburn as drought develops after early season fires. They have accumulations of dead fuels below that may be submerged or remain too wet to burn under most conditions.

Bluejoint grass GR4 (124) and GR7 (127), is commonly found on the southern Kenai Peninsula, and contains heavy dead fuel loads even when green.

5. Disturbed Area Crosswalk Table and Fuel Model Comparison

Disturbed Lands	Beetle-Kill Spruce		(56) Downed Beetle-killed Spruce (?) Standing Dead Beetle-kill Spruce Forest (?) Heavy Stem Breakage Downed/Jack-Straw Spruce (?) Closed Spruce/Mixed w/ Mod Downed Beetle-kill	SB1 SB2/SB3 SB3 TU5	11 12 13 10	M-3/M-4 M-3/M-4 C-3 M-3/M-4
	Post-Harvest		(?) Post-Harvest Bluejoint Grass & Logging Slash	GR7	3	O-1a/b
	Wildfire	1-2 yrs since burn	Little fine fuel, spread Rate negligible to very slow	TL1	8	D-2
		3-5 yrs since burn	Live fuels increasing, still inconsistent creeping spread	TU1	8	D-1/D-2
		6+ yrs since burn	Fine fuels increasing, low-moderate spread with wind	SH2	8	O-1a

Figure 16: Disturbed Areas Fuel Model Comparison

Disturbed areas cover a wide array of disturbances and should be evaluated on an individual basis. Beetle-kill spruce has become very widespread in South Central Alaska in recent years. The infestation began in the Kenai Peninsula and has worked its way north to the Alaska Range. A large grass component has become prevalent in areas once dominated by white spruce.

Logging activities are not that widespread in Alaska but may be an appropriate fuel classification in areas of blowdown or twice burned fuels. Twice burned fuels seem to be a more prevalent situation in Alaska and fuels need to be examined closely. Grass, shrub, or slash models may represent spread rates depending on current fuel conditions and previous burn severity.

Fire scars also need to be closely evaluated. Depending on current fuel conditions and previous burn severity, historic fire scars may or may not act as a barrier to spread.

IV. WFDSS Analysis

A. General Information

There are two main assumptions when modeling fire growth in Alaska that have been validated during many situations across fire seasons.

1. Rates of spread for black spruce, the most fire prone fuel in Alaska, is better modeled by SH5 (145), High Load, Dry Climate Shrub when active burning conditions are anticipated, requiring frequent landscape edits of TU3 (163) Moderate load, humid climate timber-grass-shrub and TU4 (164) Dwarf Conifer with Understory.
2. Fire growth in Alaska is episodic. When using SH5 (145) to represent black spruce or using Scott & Reinhardt crown fire settings for increasing crown fire more widely, burn day frequency in FSPro should be limited to 30-40%. Burn day frequency will often need to be adjusted, based on seasonality.
    - This is accomplished by adjusting the number of rows in the ERC table and editing the ERC stream and iteratively evaluating the burn day frequencies in FSPro results. The editing ERC table section has more detailed information.
    - It is common to adjust ERC values in the ERC Stream based on FFMC and BUI observations and forecasts. This is usually needed to capture peaks during fire season that may not be adequately represented by ERC. Figure 33, later in the guide, is used as a crosswalk for FFMC and BUI to ERC inputs in FSPro.
    - These two concepts are central to how analyses are conducted in Alaska, though other adjustments may be needed for exceptional scenarios. See Item 7 in this section, below, concerning Crown Fire Method and Section D, Special Situations for WFDSS Analysis.

1. Naming Convention

To easily differentiate between analyses, we use a defined naming convention of: Analysis-Start-Date Weather-Stream Number-of-Days Version Unique-Descriptor. For example:

- Short-Term - 0602 Calib 10hr Spot .15 S&R HFM30%
- Near-Term - 0602 Fcst 3day Finney BS to SH5
- FSPro - 0616 Outlk 14day 0616-0629

Please:

- **Do not include the incident name** in the analysis name. It is included automatically and does not need to be duplicated.
- **Do not include other items that appear in the analysis list**, such as the analysis type or the analyst's name or initials.

Order, content, and consistency in naming convention facilitates sorting and finding the analysis of interest:

- The first part of the name should be the **analysis start date**. The "Created" date does not provide any specific information about the analysis start date or the weather basis for the analysis. This is usually an important cue in search for an analysis.
- It is important to differentiate analyses that use climatology and/or weather forecasts from those that use past, observed, or speculative weather scenarios for the period of

analysis. Using “Calib”, “Fcst” or “Outlk” as the second item of each analysis name will segregate these analyses.

- Additional items that stay consistent for a series of analyses, such as the number of days for FSPro or NTFB analyses, and the number of hours for a STFB analysis, are useful identifiers.
- Including a version number, such as v1, v2, etc., as a separator between the “fixed” items that precede it and the “variable” features that follow, may facilitate sorting from the name field as well.
- Any following references is where description of the specific run can be included to highlight how it is unique and help identify which are preferred.

2. Start Date/Time

The start date and time are critical to analyzing fire behavior in relation to the peak burning period, forecast scenario used, and calibration scenarios.

Short-Term/Basic

- The best use is for analysis of significant weather events and calibration of model inputs to past events.
- Start date depends on the question to be answered. Forecast scenarios can include yesterday to incorporate a calibration day. Event scenarios may not depend on a specific forecast and can reference a comparable past event weather. Calibration scenarios are usually associated with past events with known perimeter changes.
- If you are using Short-Term to calibrate for FSPro, calibration should be using a known perimeter or VIIRS signatures.
- **Start time is important**. Peak of the burn period is around 1700 for worst case scenario. Fuel moistures from conditioning or initial fuel moistures default to values estimated for the start time. These are used for every hour of the analysis.

Near-Term

- The best use is for multiple day forecast scenario. Do not use Near-Term inputs to directly calibrate inputs for FSPro. It is best to use Short-Term since the processors are the same.
- Start and Stop Hours should reflect each day’s burn period and each day’s burnability.
- The same start and stop hour can be used for days when no growth anticipated. Do not accept default for all days to be the same, unless that is what you want.

FSPro

- Generally, set the start date as the next active burn period, today or tomorrow if a forecast period is to be included.

3. Duration

The duration of the run helps determines the processor to use.

Short-Term/Basic

- A single day’s burn period length or
- Two or three days if the forecast is expected to be persistent with significant wind speed.

Near-Term

- Two to three days, depending on forecast confidence.
- Longer durations are faced with forecast uncertainty, landscape inaccuracy, and suppression action impacts.

FSPro

- For Boreal analyses, when limiting Burn Days, use a 14-day duration.
- For pre-green, wind-driven season and in tundra landscapes, a 7-day duration without setting burnable day limits.
- Limit the forecast inputs to those days with very high forecast confidence, usually the first 2-3 days of the analysis period. Consider adding forecast days only if the extended forecast expresses very high confidence.
- Future scenarios will not have forecasts available and will depend entirely on climatology.

4. Burn Period

This graph of the Kanuti RAWS (AK03N Tanana Zone-North) Solar Radiation highlights the day length and solar radiation on sunny days that defines fire seasonality in Alaska. Solar radiation on sunny days is generally comparable among Wind-Driven, Duff-Driven, and Drought-Driven seasons. It is significantly lower only during the Diurnally Limited season.

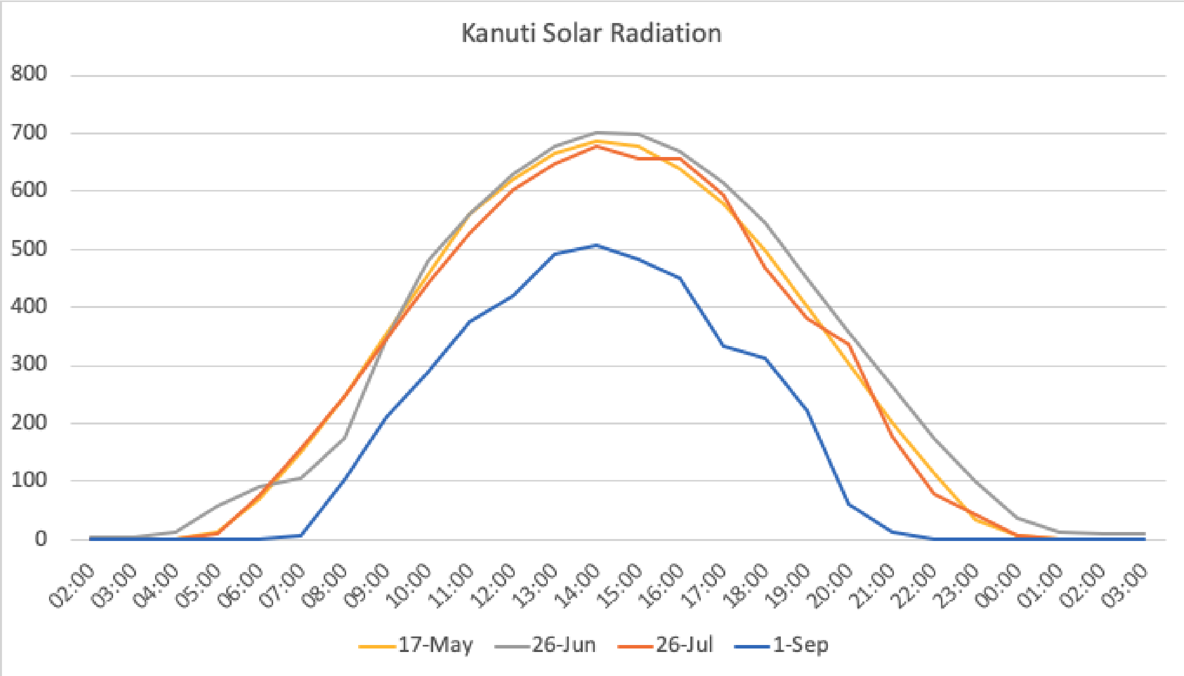


Figure 17: Kanuti RAWS Solar Radiation

The table below represents the burn period in minutes. It is useful for initial analysis and to help calibrate analysis based on seasonality.

- **Short-Term** – Choose a burn period based on expected weather and season for each day.

- **Near-Term** – Start and stop hours should include peak hours, 1600-1700. If no fire growth is expected, use a zero hour burn period.
- **FSPro** – Hot, dry, and unstable conditions represent the burn period for the top bin.

Season and ERC Table Row/Weather	Wind-Driven April 1- June 15	Duff-Driven June 15 - July 15	Drought-Driven July 15-Aug 15	Diurnal Limited Aug 15 and later
1st Row: Hot/Dry/Unstable	480	540-600	480	Should be based on which row the burn days fall into and how active the fire is expected to be in the analysis period. Less than 5 hours.
2nd Row: Hot/Dry	420	480	420	
3rd Row: Min RH 25% +	300	360	300	
4th Row: Clouds & Sun	180	240	180	
5th Row: Cloudy	60	120	60	

Figure 18: Burn Period Guidance

5. Conditioning Days

The Nelson fuel moisture model, especially as implemented in WFDSS conditioning methods, produces elevated fine dead fuel moistures in Alaska. This can have an adverse impact on your analysis.

Short-Term – Conditioning Days can be set to zero to turn off fuel moisture conditioning. Initial fuel moisture inputs are more important when you do. Forested landscapes can be assumed to be shaded, reducing the importance of conditioning. Tundra and open fuels are often level and conditioning is generally related to cloud cover, which can be set in the initial fuel moisture table.

Near-Term – You cannot turn off fuel conditioning in NTFB. Instead, you will have to edit weather streams for the conditioning and analysis periods. Shorten conditioning to no more than 1 to 2 days (generally) and set the analysis period to the very high confidence forecast days. This will minimize the weather stream edits you have to consider.

6. Foliar Moisture Content

A general recommendation is to set Foliar Moisture Content during the Duff-Driven and Drought-Driven part of the season to 90%. This will not have a significant impact on analysis results but coincides with the woody fuel moisture of black spruce during the peak of fire season. During the spring dip, black spruce needle moisture is lower than most conifers. Further recommendations and more information can be found in the fuel moisture section.

7. Crown Fire Method

The following recommendations are specific to Alaska crown fire potential. They are based on an understanding of landscape variation and season severity that translate into recommendations for both landscape edits and crown fire settings.

- **Finney and representing black spruce as SH5 (145)** - For most analyses during the Duff-Driven season or when DMC/BUI are not at extreme levels, this combination will focus crown fire in black spruce fuels.
  - Peak season (Duff-Driven) conditions commonly exhibit significant potential primarily in black spruce because of the live fuel heat sink in other fuel types. Significant spread events are mainly dependent on current severe weather. Growth events are intermittent and limited by changes in landscape, weather, and smoke conditions.
- **Scott & Reinhardt** is appropriate when drought severity increases, and DMC/BUI levels are at extreme levels. This expands crown fire potential to fuel models that would not normally be very flammable and useful during pre-green up conditions.
  - As dry periods extend over weeks or months, live fuels become less of a heat sink and eventually transition to become part of the fuel load (especially for Mixedwood and tundra fuels). Significant fire spread becomes more possible over a wider range of landscape conditions and torching/spotting from those areas can be considered more likely.
- These settings may be augmented by increasing burnable days under extreme scenarios.

8. STFB and FSPro Spotting Probability

The spotting probabilities in the table below are displayed as prospective inputs to the FSPro Analysis ERC Table. Any of the individual recommendations (combination of season and current weather) could be considered as a recommendation for a single STFB analysis scenario.

Season and ERC Table Row/Weather	Wind-Driven Before Greenup	Duff-Driven Greenup-July 15	Drought-Driven July 15-Aug 15	Diurnal Limited Aug 15 and later
1st Row: Hot/Dry/Unstable	.20	.20-.25	.15-.25	Should be based on which row the burn days fall into and how much crown fire & spotting expected on those days.
2nd Row: Hot/Dry	.15	.15-.20	.10-.20	
3rd Row: Min RH 25% +	.10	.10	.05-.15	
4th Row: Clouds & Sun	.05	.05	.01-.05	
5th Row: Cloudy	.01	.01	.00 to .01	

Figure 19: Short-Term and FSPro Spotting Probability Guidance

9. NTFB Spotting Probability

Near-Term uses a different processor than Short-Term or FSPro. Spotting needs to be scaled appropriately in Near-Term or processing time will increase significantly or fail to complete.

Season and ERC Table Row/Weather	Wind-Driven Before Greenup	Duff-Driven Greenup-July 15	Drought-Driven July 15-Aug 15	Diurnal Limited Aug 15 and later
1st Row: Hot/Dry/Unstable	.10	.10-.15	.07-.13	Should be based on which row the burn days fall into and how much crown fire & spotting expected on those days.
2ndRow: Hot/Dry	.07	.08	.05-.1	
3rd Row: Min RH 25% +	.05	.05	.03-.07	
4th Row: Clouds & Sun	.03	.03	.02	
5th Row: Cloudy	0	0	0	

Figure 20: Near-Term Spotting Probability Guidance

10. Ignition Files

Try to produce simplified (fewer) polygons for ignition files. The analysis will run faster, especially when the servers are busy.

- If an incident has NIROPS IR, use intense and scattered heat as the basis for the ignition.
- VIIRS RGB imagery can help highlight active or hotter areas of a perimeter.
- If neither option is available, areas of recent growth, favorable fuels or anecdotal intelligence and flight photos may provide insight.

11. Barrier Files

Apply barriers to the analysis if you expect that surface spread will be stopped and spotting spread will be necessary, even if the analysis resolution makes the barrier wider than you want. Black spruce produces prolific long-range spotting but major rivers like the Yukon are rarely breached. Fire history in an area can provide insight into what has been a viable barrier in the past.

12. Weather Station Selection

As shown here, AKFF (on the left) has many more stations available than the WIMS network (on the right). WFDSS analysis depends on the WIMS network as its data source, limiting station options in Alaska.

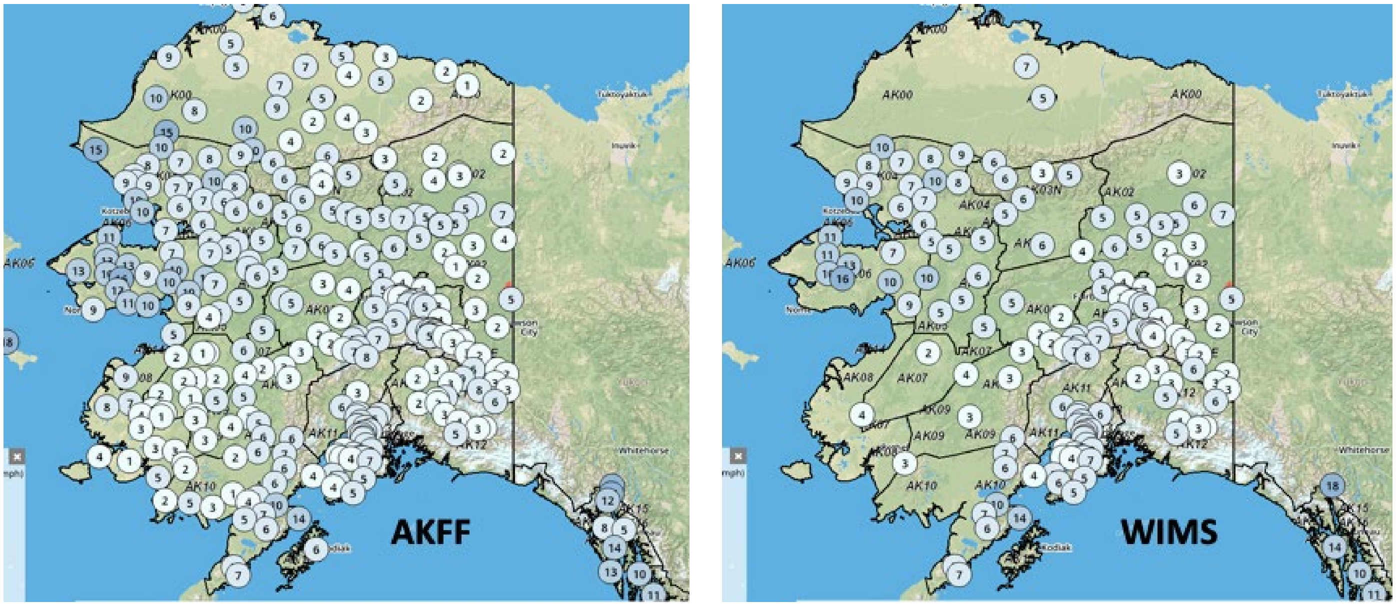


Figure 21: Weather Station Availability

It is not uncommon for WIMS based stations to be missing from the WFDSS analysis list of nearest stations, even if it was available for previous analyses and days. This is generally because the current WIMS record for that station is not up to date. Local dispatch offices may not have updated recent observations, or there may be a gap caused by data transmission error. Predictive Services is the point of contact to coordinate communication with the local dispatch office to request an update of the WIMS record to reactivate the station.

13. Weather Stations not in WFDSS

It is possible to use weather stations from AKFF to influence weather-based inputs in WFDSS analyses. Make a point of reviewing the stations surrounding the fire of interest on the AKFF map. Look at the following data.

- Recent observations and the 3-day forecast for temperature, relative humidity, wind speed, and precipitation amounts.
- Review FFMC, DMC, and BUI in the same observations and forecasts.
- Edit the weather streams and initial fuel moistures used in STFB and NTFB if necessary, based on information gleaned from surrounding stations.
- AKFF observations and forecasts for wind speed, GFMC, FFMC, DMC, and BUI are useful tools to edit ERC table moistures and ERC/Wind speed streams in FSPro. Review the fuel moisture guidelines in Section C, below.

B. Winds

Many RAWS report wind speeds that are lower than forecast estimates or those reported from nearby ASOS (Airport Automated Surface Observing Systems) stations. These RAWS wind speed measurements may produce underestimates of mid-flame wind speed used in fire behavior predictions.

This example from August 2019 compares estimates from the Palmer ASOS and Little Granite RAWS, using AKFF graphs to demonstrate the difference that can manifest between RAWS and ASOS measurements. A wind event caused rapid fire spread and extreme fire behavior in the area over two days, August 17 and 18.

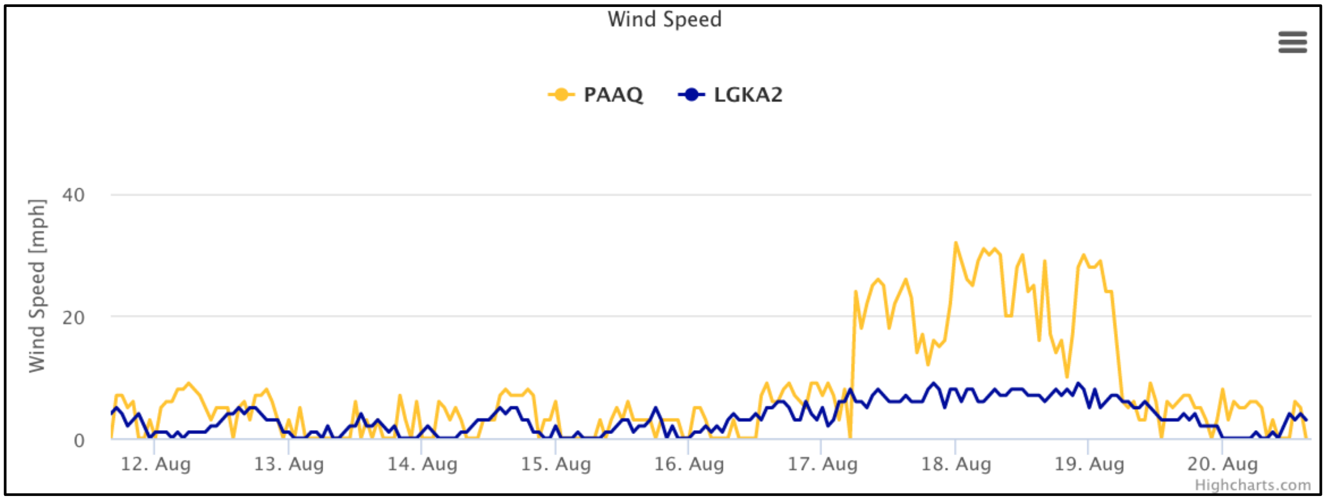


Figure 22: Wind speed Comparison

1. Wind Estimate Editing for STFB & NTFB

Calibration Analyses:

- Wind inputs for Alaska RAWS should be assumed to be low and generally **multiplied by 1.5** for STFB and NTFB retrospective analyses that use station observations in the analysis period.
- ASOS stations in the area should be examined for significant wind events as shown in the graph above.

Forecast Analyses:

- In most cases, forecast weather will be more analogous to ASOS than RAWS estimates. Multiplying by 1.5 may not be necessary in all cases when RAWS stations are used.
- Examine weather forecast for solar heating and surface instability. Consider how the Hot-Dry-Windy index views the forecast period for the grid cell including the fire area. Default forecasts may be low.

2. Wind Climatology in FSPro

The ASOS network wind climatology is generally not available for review in WIMS or WFDSS. It is however available on the Iowa Environmental Mesonet (IEM) site. Historic wind roses for Alaska ASOS network stations are available and should be consulted when selecting a station for wind climatology to be used in FSPro analyses.

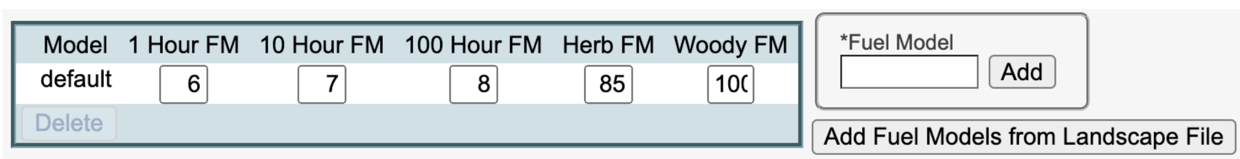
If the RAWS wind rose appears to show reduced wind speeds as compared to nearby ASOS stations, or if the RAWS is in a boreal forest setting, **using "Both" rather than "10-min average"** when creating the wind climatology for FSPro analyses to produce more accurate results.

C. Fuel Moisture

1. Initial Fuel Moistures (STFB and NTFB)

Short-Term

Without additional specific designations, the default fuel moisture table below will be applied to all fuel models including everything from tussock tundra represented by GR4 (104) with herbaceous fuel loads and full sun on the fuel bed to deciduous forest represented by TL5 (185) with no live fuels and heavy shade on surface fuels every day.

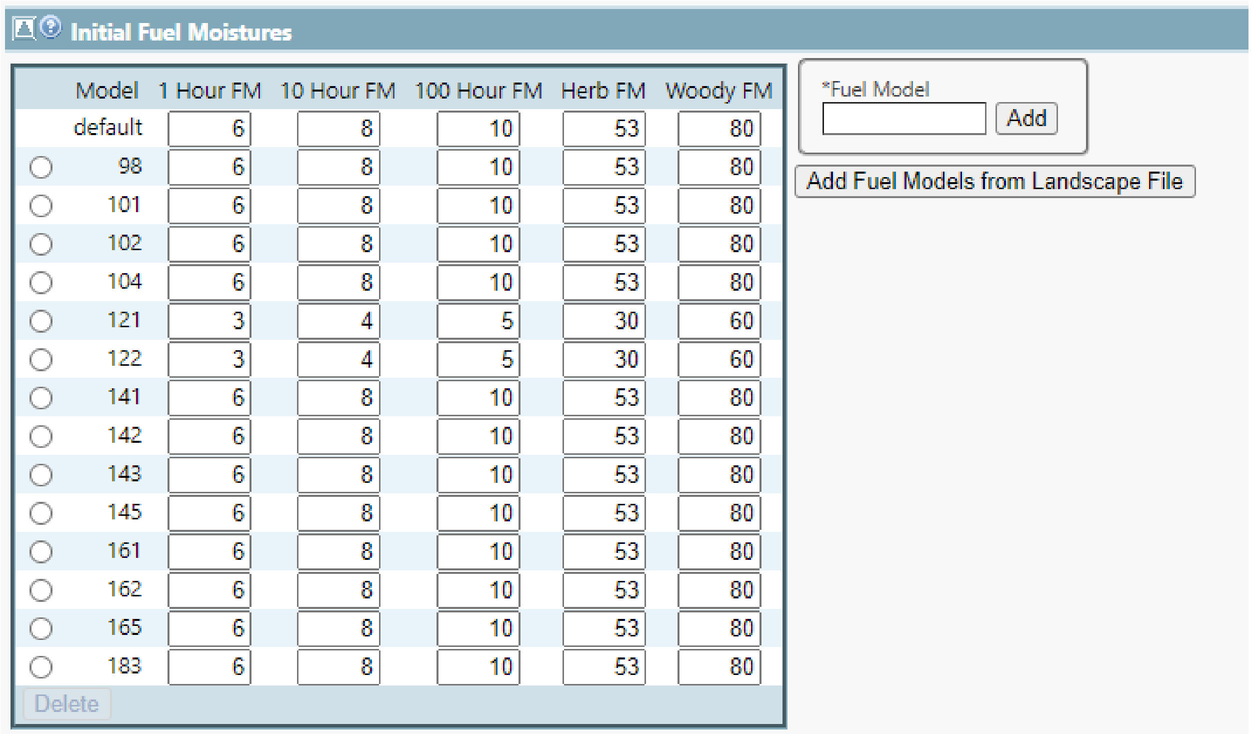


If zero conditioning days are chosen, the analyst is responsible for reflecting:

- different shading based on overstory and cloud cover. different herbaceous fuel moisture for specific fuel models that have different fire spread characteristics than herbaceous fuel loads.
- different woody fuel moistures in areas that are represented by different fuel models. For example, the difference between deciduous forest represented by TU1 with lingonberry or blueberry with live moisture at 140% as ground cover and black spruce represented by SH5 with needle moistures of less than 100%.

To represent these variations, it is recommended that:

1. the default initial fuel moisture row should represent the predominant cover based on whether the dead fine fuels are shaded or unshaded. For most of the boreal forest, the default should be shaded fine fuel moisture under tree or shrub canopy.
2. Additional rows for specific fuel models could represent important and sizeable areas that are not represented by the default condition, based on the fuel model designated in those areas. For example, in the boreal forest, open areas of tussock tundra could be considered unshaded and should reflect lower dead fine fuel moisture.
3. In most analyses, with black spruce represented by SH5, the default woody fuel moisture would be set low (around 90%) to reflect needle moisture in the shrub fuel. If there is significant area with willow or aspen reproduction in burn scars, that would be much too low there. Specific fuel model rows could be added to reflected unshaded dead fuel moistures and higher woody fuel moistures, as much as 30-50% higher.



Model	1 Hour FM	10 Hour FM	100 Hour FM	Herb FM	Woody FM
default	6	8	10	53	80
98	6	8	10	53	80
101	6	8	10	53	80
102	6	8	10	53	80
104	6	8	10	53	80
121	3	4	5	30	60
122	3	4	5	30	60
141	6	8	10	53	80
142	6	8	10	53	80
143	6	8	10	53	80
145	6	8	10	53	80
161	6	8	10	53	80
162	6	8	10	53	80
165	6	8	10	53	80
183	6	8	10	53	80

Figure 23: Editing Initial Fuel Moistures in STFB

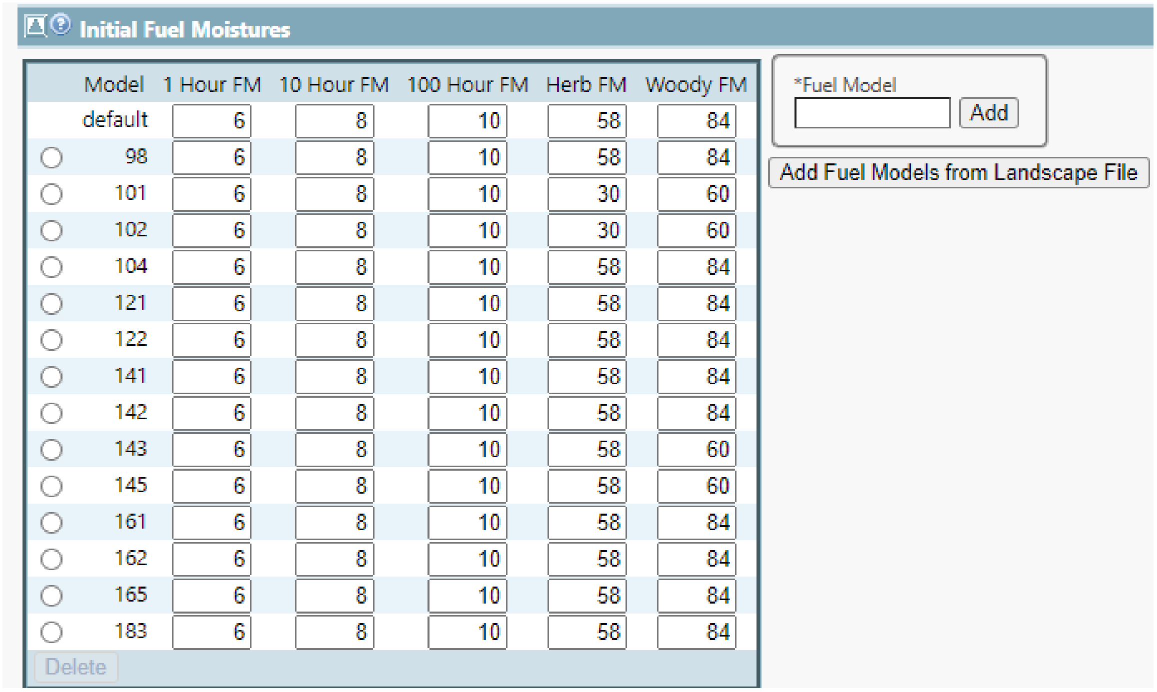
Default Fuel Model – In boreal settings, this fuel model will usually represent shaded dead fine fuels and spruce needle moisture as the woody fuel moisture. These values are used to represent the most widespread conditions on the landscape.

Additional individual Fuel Model rows – Providing representation for both shaded and unshaded find fuels requires at least two or more lines in the initial fuel moisture table.

- The 1-hr and 10-hr tables below can provide guidance for both shaded and unshaded values. You can use the default line for all or only one of them. If you use the default for forested (shaded), you must enumerate key unshaded fuel models on separate individual rows, or vice versa.
- Herbaceous fuel moisture can be derived from the DMC table below. That may not require a lot of input for different values, but woody fuel moisture is different if it represents spruce than if it represents deciduous species.
- Reference fuel moistures from comparable ERC table rows to set fuel moistures for the analysis.

Near-Term:

- Because 1-hr and 10-hr fuel moistures change hourly during conditioning and analysis periods, initial fuel moistures are of less importance than in Short-Term.
- Setting the live fuel moistures (both herbaceous and woody) are of primary importance here, as for STFB. There may be reason to individualize woody fuel moisture inputs for select fuel models based on differences from default row inputs.



Model	1 Hour FM	10 Hour FM	100 Hour FM	Herb FM	Woody FM
default	6	8	10	58	84
98	6	8	10	58	84
101	6	8	10	30	60
102	6	8	10	30	60
104	6	8	10	58	84
121	6	8	10	58	84
122	6	8	10	58	84
141	6	8	10	58	84
142	6	8	10	58	84
143	6	8	10	58	60
145	6	8	10	58	60
161	6	8	10	58	84
162	6	8	10	58	84
165	6	8	10	58	84
183	6	8	10	58	84

Figure 24: Initial Fuel Moistures in NTFB

2. Editing the Weather Summary

If you choose to use conditioning days, it is very important to edit the weather summary, or you could inadvertently have much higher dead fuels moistures than anticipated.

- Edit Precipitation amounts. If significant growth is anticipated, generally eliminate significant precipitation amounts in the conditioning and analysis periods if you anticipate significant growth. Precipitation amounts dramatically raise dead fuel moistures to values close to moisture of extinction and lower fire behavior predictions.
- Edit Cloud Cover to less than 50% for hours around and during the defined burn period if you expect active fire behavior.
- Edit overnight RH recovery to less than 50% if you anticipate active fire behavior in the assessment.

Weather Summary

Precip Amt	(Start hr	Last hr)	Min Temp	(@ hr)	Max Temp	(@ hr)	Min RH	Max RH	Max Wind	Wind Dir	(@ hr)
0.20	15	21	54	3	72	13	53	86	12	247	18

Hourly Records for 06/22/2020

Graph View | First Day | Previous Day | Next Day | Last Day | Save | Return

*A Record Type of *Forecast indicates that part of the hourly record is missing. Please review and edit these records before running the analysis.

Hour	Precip Amt	Temp	RH	Wind Speed	Wind Dir	Cloud Cover (%)	Record Type
0	0.00	56	78	6	251	66	RAWS
1	0.00	55	79	6	246	66	RAWS
2	0.00	55	77	6	255	66	RAWS
3	0.00	54	78	5	273	66	RAWS
4	0.00	55	76	5	273	66	RAWS
5	0.00	55	76	3	247	66	RAWS
6	0.00	58	73	2	239	66	RAWS
7	0.00	64	61	6	250	66	RAWS
8	0.00	67	57	6	261	66	RAWS
9	0.00	64	63	4	276	66	RAWS
10	0.00	70	54	4	261	66	RAWS
11	0.00	69	55	5	277	66	RAWS
12	0.00	70	54	3	270	66	RAWS
13	0.00	72	53	1	284	67	RAWS
14	0.00	69	56	3	288	83	RAWS
15	0.12	63	77	8	259	100	RAWS
16	0.00	58	82	10	259	100	RAWS
17	0.00	58	76	10	257	100	RAWS
18	0.00	59	77	12	247	100	RAWS
19	0.00	60	69	10	249	100	RAWS
20	0.00	59	71	10	240	100	RAWS
21	0.08	55	86	5	254	100	RAWS
22	0.00	55	83	6	243	97	RAWS
23	0.00	55	78	9	249	94	RAWS

Graph View | First Day | Previous Day | Next Day | Last Day | Save | Return

Figure 25: Editing Weather Stream in NTFB

3. 1-hr Fuel Moisture

Instead of the traditional fine fuel moisture tables provided in US modeling references, this table is more responsive to cloud cover and temperature differences but does not incorporate precipitation.

Grass Fuel Moisture

- Based on research done in savanna grasses in Ontario
- Table shows Equilibrium Moisture Content
- Assumes that atmosphere unchanged for 2-3 hours.

CFFDRS Grass Fuel Moisture		Relative Humidity (%)							
SOL_{ef}	**Temp**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**80%**	**100%**
Overcast Or Shaded	**41°F**	10	13	16	17	19	21	25	38
	50°F	9	12	14	16	17	19	23	37
	59°F	8	11	13	15	16	17	23	37
	68°F	7	10	12	13	15	17	21	34
	77°F	6	8	10	12	14	15	20	32
	86°F	5	7	9	11	12	14	19	32
Broken, Clouds > 50% of sky	**41°F**	7	10	12	14	15	16	19	21
	50°F	6	9	11	13	14	15	17	20
	59°F	6	8	10	11	13	14	16	19
	68°F	5	7	9	10	12	13	15	17
	77°F	4	6	8	9	10	11	14	17
	86°F	3	5	6	8	9	10	13	16
Scattered Clouds < 50% of sky	**41°F**	5	8	10	11	12	13	15	17
	50°F	5	7	9	10	11	12	14	15
	59°F	4	6	7	9	10	11	13	14
	68°F	4	5	6	8	9	10	11	13
	77°F	3	4	5	6	7	8	10	12
	86°F	2	3	4	5	6	7	9	11
Clear Skies	**41°F**	4	6	7	8	9	10	12	13
	50°F	3	5	6	7	8	9	11	12
	59°F	3	4	5	6	7	8	9	11
	68°F	3	4	4	5	6	7	8	10
	77°F	2	3	4	4	5	6	7	9
	86°F	2	2	3	3	4	5	6	7

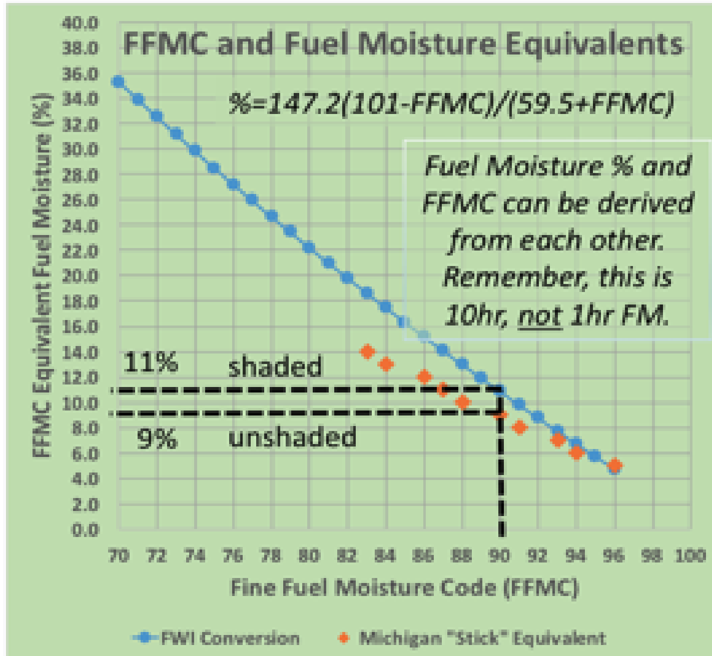
Figure 26: 1-hr Fuel Moisture Guidance

4. 10-hr Fuel Moisture

Using current and forecast estimates of FFMC can inform estimates for both shaded and unshaded estimates of 10-hr fuel moisture.

FFMC and Timelag Fuel Moisture

- FFMC represents shaded litter fuels with about a 10 hr timelag (5 to 16 hrs)
- An equivalent fuel moisture % can be estimated and used in predictions.



FFMC	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80
10h-Sh	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22
10h-Unsh	5		6	7		8	9		10	11	12		13	14		15	

Based on 20 years of daily estimates of FFMC values, its 10hr fuel moisture equivalent, and manual estimate of NFDRS unshaded 10hr "Sticks" in Michigan 1975-1995.

Figure 27: 10-hr Fuel Moisture Guidance

5. Herbaceous Fuel Moisture (HFM) and 100-hr Dead Fuel Moisture

Current and forecast DMC levels can be used to inform estimates of both herbaceous fuel moisture (left vertical axis) and 100-hr fuel moisture (right vertical axis; 360-hour TL). Before green-up occurs, these estimates for herbaceous fuel moisture may need to be lowered to account for the dryness in pre-greened fuels.

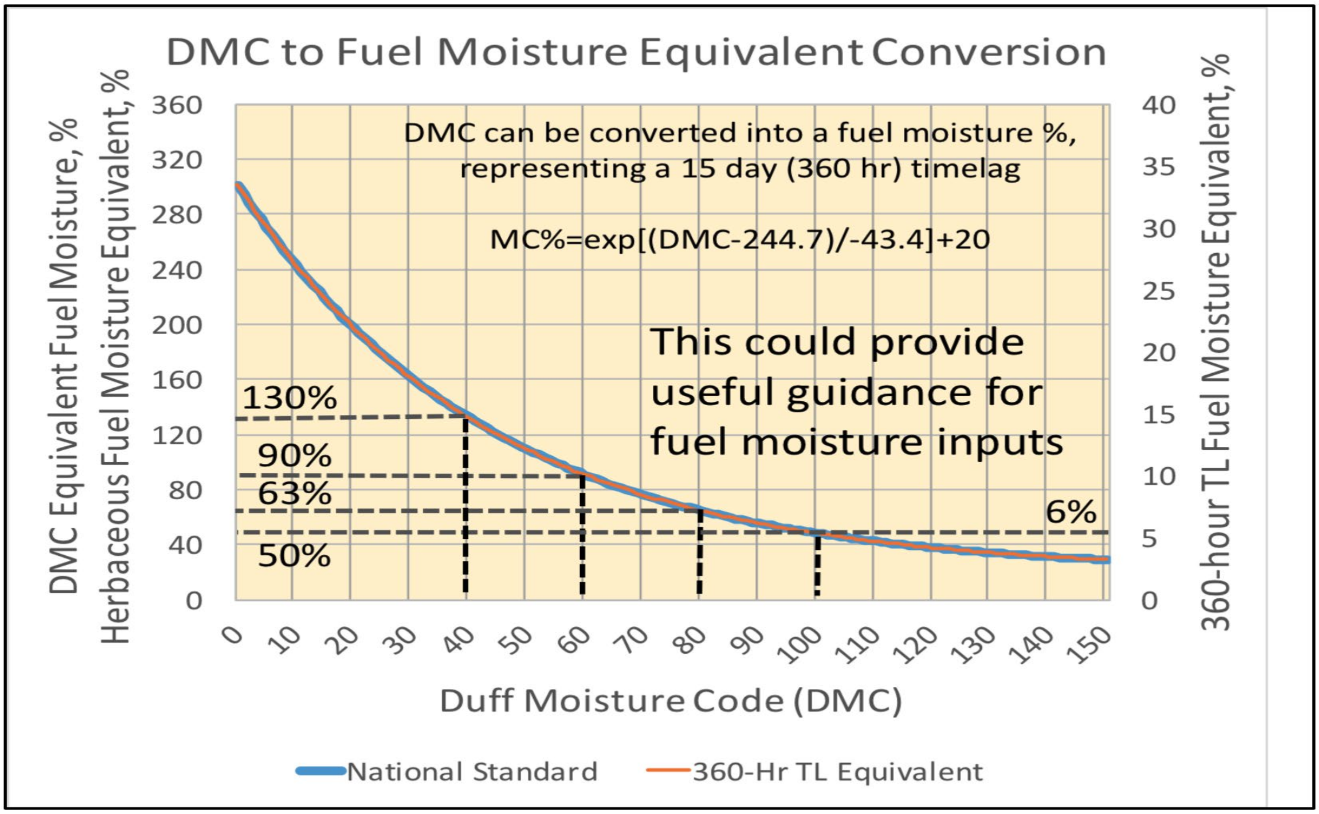


Figure 28: Herbaceous Fuel Moisture and 1-hr Fuel Moisture Guidance

6. Woody Fuel Moisture (WFM)

This graph of seasonal trend for live woody fuel moistures in Alaska, both in the Interior (Int.) and South Central (SC), is an overall average of boreal sampling locations from 2012-2018. Black spruce begins to burn readily when FFMC is greater than 88 and BUI is above 80. Under these conditions woody fuel moisture should be set to 90% and scaled when appropriate.

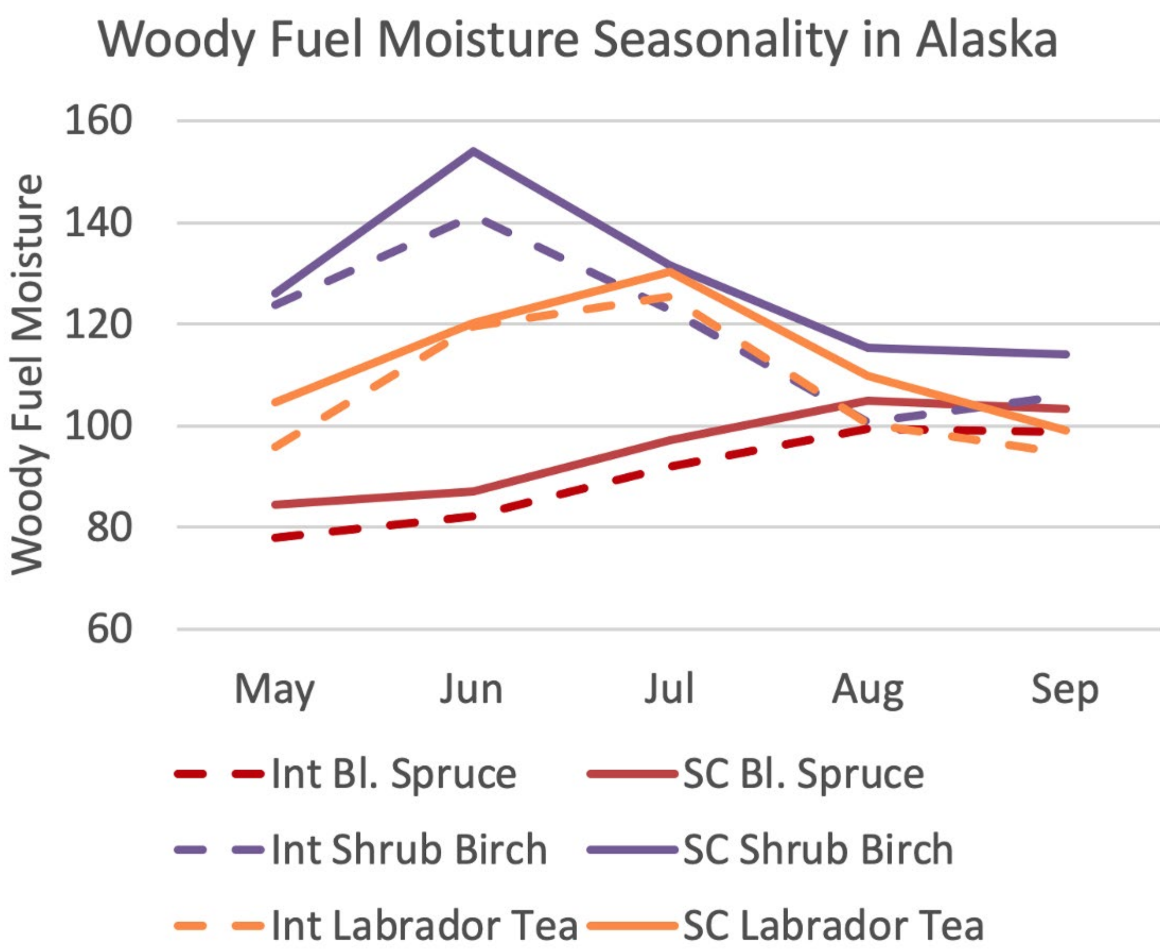


Figure 29: Woody Fuel Moisture Guidance.

7. ERC Table and Fuel Moisture Climatology (FSPro)

- Setting the date range for the ERC table will impact fuel moisture defaults.
- **There is normally no need to use any more than 20 years of climatology**. Earlier data might not be applicable to present day conditions.
- The traditional approach sets the date range to Jan 1-Dec 31. This will apply dormant day levels to extreme bins and produce extreme live fuel moistures in upper bins.
- Fire season (May 1-Sept 30) is the other common setting. Fewer dormant days in the sample will result in higher live fuel moisture levels, which maybe too high.
- Sub-season date range (Wind-Driven, Duff-Driven, Drought-Driven) will produce the best dead fuel moisture climatologies. Live fuel moistures will be much too high in Duff-Driven & Drought-Driven seasons.

Season and ERC Table Row/Weather	1-hr	10-hr	100-hr	Herbaceous	Woody
1st Row: Hot/Dry/Unstable	ERCg/y climatology tends to mute the observed variation in fine fuel moisture. Lowering 1-hr in the top two bins, possibly to 3% to 4% for extreme scenarios may help calibrate fire spread.	6-7%	8%	Current DMC estimates can convert to HFM. Use daily increase of 3-4-point increase in DMC over analysis period to suggest max DMC and convert to HFM.	Review NFMD records for Black Spruce needle moisture, generally <100%. Other shrubs generally higher during the growing season.
2nd Row: Hot/Dry		8%	9%		
3rd Row: Min RH 25% +		9%	10%		
4th Row: Clouds & Sun		12%	13%		
5th Row: Cloudy		15%	17%		

Figure 30: Fuel Moisture Guidance

Primary concerns for fuel moisture inputs when evaluating the default ERC table for a given weather station in FSPro analyses are:

- 1-hr fuel moisture may be too high in the top 2 bins. If they appear moderated, considering lowering them to what is possible under potential extreme weather. Review the fine fuel moisture table in the FBFRG or use the grass fuel moisture table above.
- Herbaceous fuel moisture estimates are unlikely to provide reasonable results in fire behavior analysis during the growing season. Use DMC equivalent fuel moisture and establish a range around where today fits in the ERC table based on ERC adjustments to obtain more reasonable values.
- Woody fuel moistures will also be generally too high. Consider setting WFM for today based on field estimates, calibration to observed fire behavior, or assumptions about current drought effect. Change WFM by 5% ranges per row in each direction from where the observed value fits in the ERC table row.

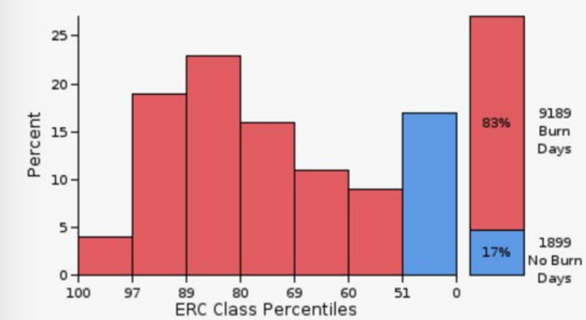
8. Editing the ERC Table and ERC Stream

In an FSPro analysis, the ERC Stream is displayed as a sequence of days in the recent past with the estimated ERC values for those days. A forecast stream, based on the National Digital Forecast Database (NDFD) weather forecast, can be included. After those days, climatology trending toward the average ERC trendline provides a range of ERC sequences further into the future for the analysis period.

Analysis suggests that **typical frequency of active fire spread is about 40% over 2 weeks** in active periods of significant fire seasons. For fire to spread in black spruce, weather factors need to align, which does not happen daily. ERC climatology is exaggerated during the peak (Duff-Driven) season and depressed in the later (Drought-Driven) season. In those cases, the prediction of days a fire spreads or burn days can be seriously over or underestimated.

Below is an example from June 30th (Duff-Driven); there are too many Burn Days, producing a very large 80-100 probability band, generally because ERC is at its climatological peak. Reducing the number of ERC table rows and adjusting estimates in the ERC stream are both necessary to reduce the number of burn days to generally less than 40%.

ERC Class Burn Days Summary



%ile	Min ERC	Burn Days	%
97	61	456	4
89	52	2121	19
80	46	2596	23
69	42	1817	16
60	39	1243	11
51	36	956	9
		9189	83

1899 No-Burn Days (17 %)
1008 fires X 11 non-forecast days = 11088 days
The summary does not include the 3 forecast days

An FSPro Histogram file does not exist.

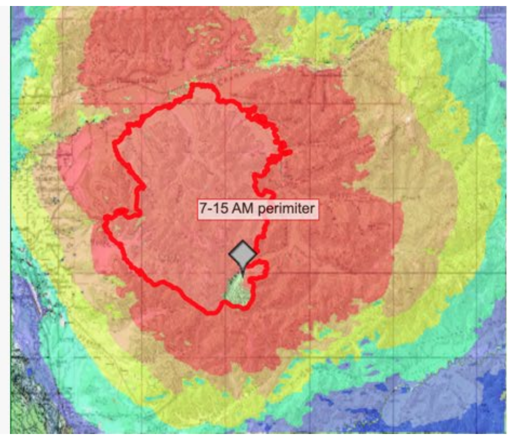


Figure 31: Overestimating Burn Day Results

In the example below, during the Drought-Driven part of fire season, the entire observed and forecast ERC stream falls below that threshold (ERC-G of 38), which reduces the number of burnable days to zero in the analysis period. The map shows the result, with a very low probability of any significant fire spread. This may accurately reflect observed and expected conditions. However, it may be due to ERC bias later in the season, and it may be necessary to increase the number of burn days by adding rows to the ERC Table or editing the ERC stream to values above the minimum value in the ERC table.

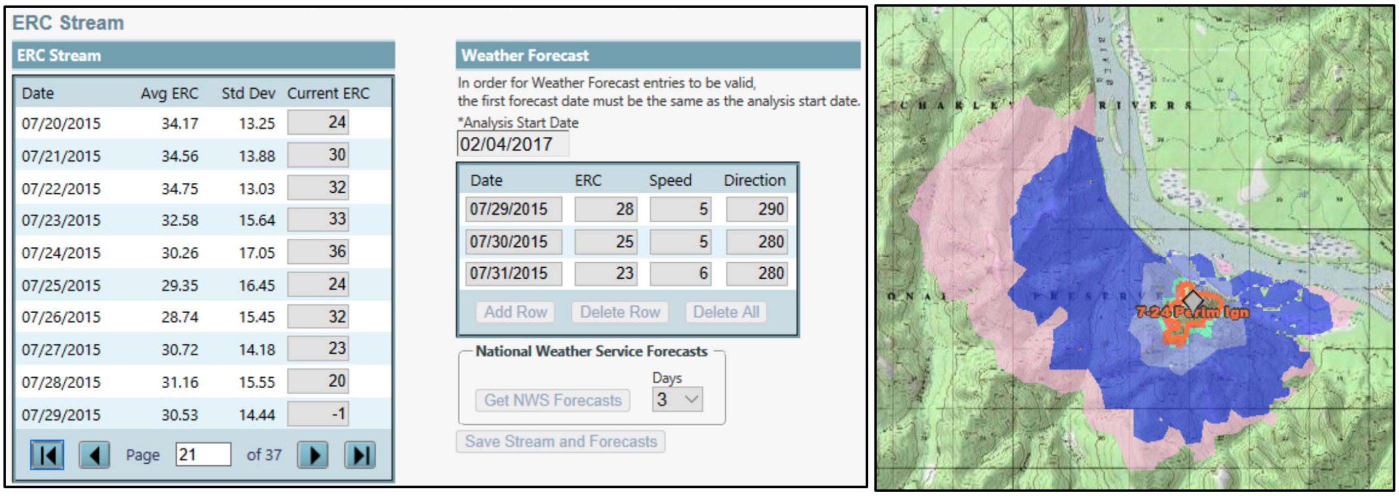


Figure 32: Underestimating Burn Day Results

Editing ERC Stream daily estimates: Using FFMC and BUI values obtained from the selected station in AKFF, this chart helps to identify daily severity and guide ERC levels for individual days in the ERC Stream.

Setting ERCg Levels for FSPro Analysis

80 to 82.9	83 to 85.9	86 to 88.9	89 to 91.9	92+	FFMC / BUI
5th Bin	*4th Bin*	*2nd Bin*	*2nd Bin*	*Top Bin*	**110+**
5th Bin	*4th Bin*	*2nd Bin*	*2nd Bin*	*Top Bin*	**90 to 109.9**
5th Bin	*4th Bin*	*3rd Bin*	*3rd Bin*	*2nd Bin*	**60 to 89.9**
5th Bin	*4th Bin*	*4th Bin*	*3rd Bin*	*3rd Bin*	**40 to 59.9**
5th Bin	*5th Bin*	*4th Bin*	*4th Bin*	*3rd Bin*	**< 40**

%ile		Min ERC
96	Top	61
89	2nd	54
76	3rd	49
67	4th	43
58	5th	38

Use FFMC and BUI to adjust/set ERC values in ERC stream, both observed & forecast

Figure 33: FFMC-BUI to ERC-G Crosswalk

Editing Herbaceous Fuel Moisture in the ERC Table and for STFB/NTFB analyses

The following table can be used to guide crosswalks from DMC inputs to herbaceous fuel moisture inputs; FFMC and BUI inputs to ERC stream values; and analysis period wind speed and direction for a few days of observed weather and up to 3 forecast days from AKFF for your analyses.

- Obtain DMC from AKFF using the best weather station. The HFM (%) in the ERC Table can be derived from DMC. See table in the fuel moisture section above. Current DMC values can also be used to guide HFM for STFB and NTFB analysis.
- Edit ERC values in ERC Stream using Observed and Forecast FFMC & BUI from AKFF, established ERC thresholds in ERC Table, and row/ "bin" assignments from table above.

For Example,

Date	DMC	Herbaceous Fuel Moisture %	FFMC	BUI	ERC	Wind speed/ Direction
6/21	80	63	92	90	62	7G14 SE
6/22	84	55	90	94	56	10G15 SE

9. Summary of ERC Table row modification under different climate conditions

When conducting an initial FSPro analysis, there may be no known prior growth events to calibrate with. The guidelines in this document can serve an initial FSPro analysis in the Boreal Interior, and inputs for specific ERC Table rows from those analyses can be used to calibrate inputs to initial Short-Term and Near-Term analyses.

Calibration in Short-Term can be helpful to FSPro analysis as well **if** landscape and weather inputs can be verified. If inputs used in Short-Term provide calibrated outputs to known fire spread, take note of the FFMC and BUI values for the day of your calibration. For example, a calibration run was completed on 6/10 that matched known fire spread. On 6/10 FFMC is 91 and BUI is 99. From the chart above, these values would translate to 2nd bin conditions. All the variables you used from your calibration run could populate the 90th percentile row in ERC bin page. The bins above your calibration row could be scaled to more severe values, and the ones below more moderate conditions.

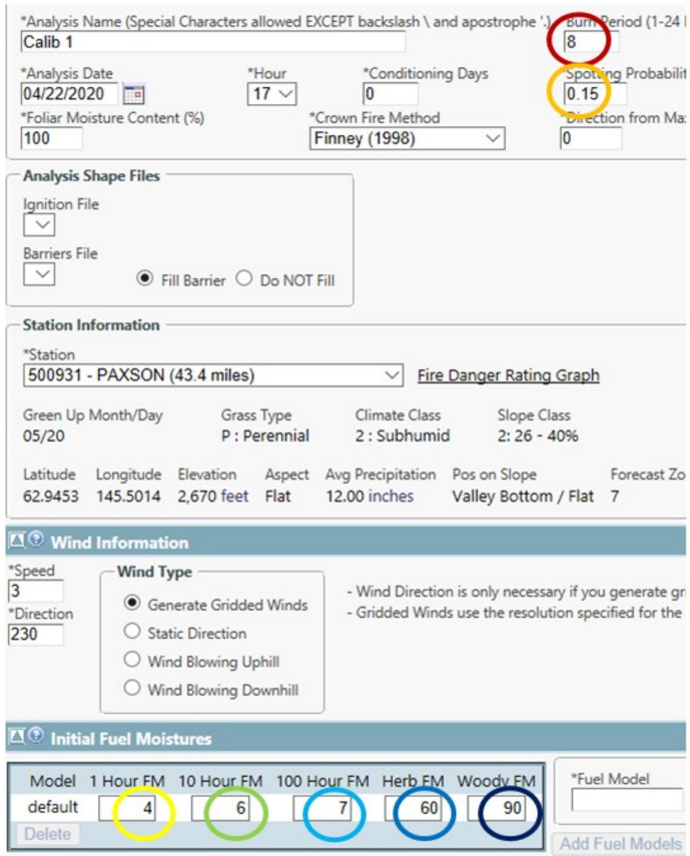


Figure 34: Short-Term Inputs

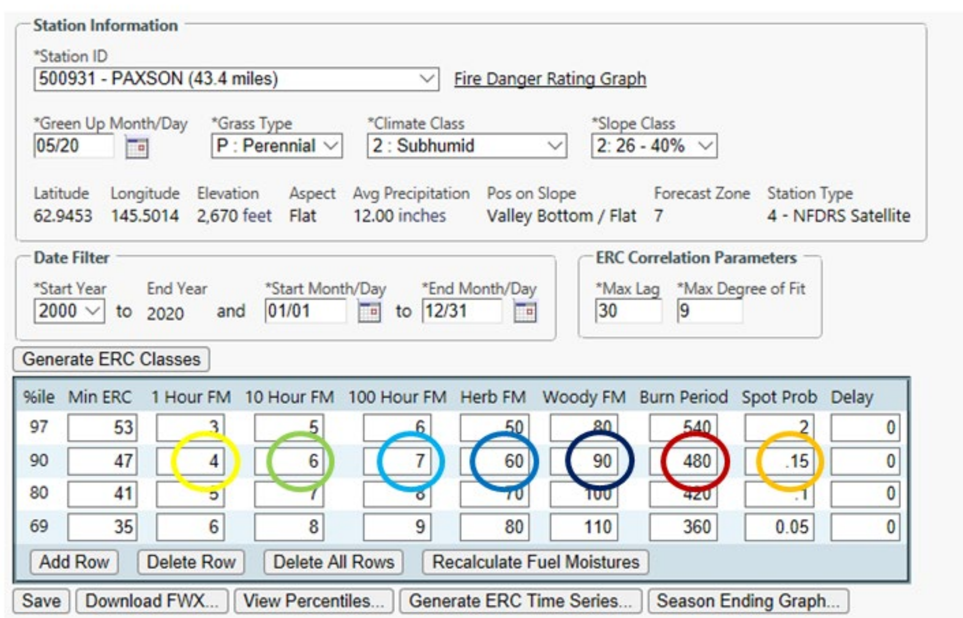


Figure 35: FSPro ERC Bin Calibration

D. Special Situations for WFDSS Analysis

1. Tundra Ecoregion Fires

- These fires are best carried by hot, dry, sunny weather that decrease fine dead fuel moisture and increase instability. When these conditions ease, fire spread slows significantly and stops with overnight humidity recovery.
- Tundra fuels can have high dead fuel loads, even after greenup. They are prone to reburn if drought conditions develop.
- They can have multiple distinct pothole water features that interrupt continuous spread.
- Significant streams can stop active spread if torching and spotting fuels are not available. Barriers are effective for modeling this in analyses.
- FSPro may not capture the frequency and duration of significant events over longer analysis periods. A seven-day analysis period is likely more useful than 14-day since tundra fires rarely burn for 14 days.
- Evaluate the need to reduce burnable days based on the extended forecast.
- NTFB analysis for forecast periods up to 5 or 6 days may produce better results compared to FSPro, depending on the confidence in the extended forecast with NTFB edited weather streams.
- Based on Grass and Grass-Shrub fuels, individual spread events may produce very rapid spread and large fire growth. Set STFB to use 0 days conditioning if strong winds are forecast.
- In areas of western and southwestern Alaska, weather stations are not common. Validate wind speed and direction from on scene resources is possible or from previous fire spread.

2. Wind-Driven (Pre-green) Season Fires

- These fires are characterized by a lack of, or reduced, live fuel heat sink that normally impedes fire spread under normal summer weather. Monitor this condition carefully and be prepared to transition to normal analysis guidance for burn days and live fuel moistures.
- There is less forest canopy, especially in Mixedwood and deciduous forests, to reduce wind speed on the surface fuels.
- The ground is usually still cold and damp, and shaded spruce forest fuelbeds will need more sun, heat, and wind for ignition and active spread.
- FSPro may not be able to capture frequency and duration of significant events over longer analysis periods. Keep analysis period (7 days) shorter and question the need to reduce burnable days based on the extended forecast.
- STFB is a key tool for analysis when strong winds are forecast.
- Dead fuel moistures in NTFB analysis are often affected by night-time humidity recovery. Review fuel moisture conditioning guidelines carefully.

3. Diurnal-Limited (After mid-August) Season Fires

- These are rare situations, and are generally dependent on extreme departures of drought, heat, sun, and wind. This combination of conditions rarely produces more than a few days of significant fire spread before the weather changes.
- Pay close attention to the Tactical (Fire Slowing) and Strategic (Season Ending) tools when deciding how to analyze expected fire growth.

- ERC climatology cannot represent these conditions, so FSPro is limited in its ability to represent anticipated fire spread.
- STFB is a key tool for analysis when strong winds are forecast.
- Dead fuel moistures in NTFB analysis are often affected by night-time humidity recovery. Review fuel moisture conditioning guidelines carefully.

4. Spatial Spotting Hazard Assessment: Testing Barrier Breach potential with FSPro

- Significant barriers to surface spread exist across the landscape. This novel application of FSPro analysis on the 2009 Chakina fire in the Copper River area can help inform the likelihood of breaches by spotting. See Analysis tools page on AFSC website.

E. WFDSS Analysis Interpretation, Disposition, Documentation

1. Review Status & Accepting or Rejecting Analysis

Analyses in review status cannot be seen by WFDSS authors, owners, or editors and cannot be included in WFDSS decisions either. Only fire behavior specialists can view analyses while they are in review status. Though analyses in review status do not require a final disposition, it is good practice to accept analyses that are used to support decisions and reject those that you do not want referenced.

When you click **"Accept" or "Reject"** from the Results tab, you get a dialogue box and an opportunity to explain your decision.

If you "Accept" the analysis, include notes to explain and justify the decision:

- This justification is for Agency Administrators and other decision makers. This is not the place to describe landscape edits, fuel moisture changes etc.; That belongs in the applicable analysis notes section.
- Describe the major assumptions and assertions about the situation referenced in the analysis.
- Interpret the results in the context of the question they are intended to answer.
- Identify your confidence in the results, outlining the primary uncertainties limiting the analysis.
- Explain the effective longevity of the analysis and criteria for considering a new one.
- If you have reason to think that users may not fully understand the results, verbally explain them.

If you "Reject" the run, include the reason it was rejected in a note. This can be brief but could explain what you will do in the next run.

There are reasons to keep analyses in review status. Calibration results may be useful to other analysts, however, without explanation or direction, they may be misunderstood and/or misused by those not familiar with their purpose. You can offer a general note for review analyses to explain useful examples.

2. Expiring and Invalidated Analyses

Analyses that have been accepted will remain that way in the permanent record. Over time, analyses will lose value and should no longer be used to support decisions. Some will become invalidated by the course of events, either weather factors or actual fire growth outcomes. Consider documenting disposition of accepted analyses as they expire or are invalidated.

- When accepted analyses have expired, consider documenting it in the analysis notes.
- Consider rejecting any invalidated analyses in review status, documenting reason in analysis name.

V. Other Analyses

A. Non-Spatial Spotting Hazard Assessment

- Probability of Ignition in the Fire Behavior Field Reference Guide.
- Spotting Distance from the Alaska FBP Field Guide or Fire Behavior Field Reference Guide.
- Spotting Threat Distance of Embers (mi) and Probability of Ignition (%) based on FFMC & Wind speed.

Wind speed, mph	FFMC 70-75 (Temps 50-80	FFMC 76-84 (Temps 50-80)	FFMC 82-85 (Temps 50-80)	FFMC 86-89 (Temps 50-80)	FFMC >90, (Temps 50-80)
10 mph	0.25 miles 20-23 %	0.25 miles 27-32 %	0.25 miles 37-42 %	0.25 miles 50-56 %	0.25 miles 67-74 %
15 mph	*0.4 miles 20-23 %*	*0.4 miles 27-32 %*	*0.4 miles 37-42 %*	**0.4 miles 50-56 %**	**0.4 miles 67-74 %**
20 mph	*0.5 miles 20-23 %*	*0.5 miles 27-32 %*	**0.5 miles 37-42 %**	**0.5 miles 50-56 %**	**0.5 miles 67-74 %**
25 mph	*0.7 miles 20-23 %*	0.7 miles 27-32 %	**0.7 miles 37-42 %**	**0.7 miles 50-56 %**	**0.7 miles 67-74 %**
30 mph	0.8 miles 20-23 %	0.8 miles 27-32 %	**0.8 miles 37-42 %**	**0.8 miles 50-56 %**	**0.8 miles 67-74 %**

Figure 36: Spotting Distance and Probability

B. Fire Stopping and Season Ending Criteria

1. Tactical Incident Analysis Tool (Fire Slowing Events)

Important questions surround the occurrence of significant precipitation events during active fire periods. They are often convective and produce uncertain/variable amounts that are hard to map spatially. Even if fuels in and around active fires are wetted, evaluating the duration of their mitigation benefits is a question. This tool can help guide your answers.

2. Seasonal Strategic Analysis Tool (Season End Climatology)

Until snow covers the ground, it is difficult to conclude that fires are out, and the season is over in Alaska. This tool provides insight, by Predictive Service Area, about how a decline in FWI flammability indicators relates to shortening days and lower risk of active fire spread.

VI. Alaska-specific Data Resources

A. Map and Feature Services from AICC

The Alaska Interagency Coordination Center (AICC) makes a wide variety of Alaska-specific data available as map and feature services including, but not limited to:

- CFFDRS, Alaska FBFM40, and LANDFIRE EVT raster layers.
- PSAs, Fire Weather Zones, and Alaska Weather Stations.
- Wildland Fire Jurisdictions, Fire Management Options, Protection Responsibilities, Current Fire Ownerships, and Alaska Fire Plots.
- Fire Heat Points, Fire History (points and polygons), current year Fire Locations (points) and Perimeters (polygons).
- Alaska Lightning (from the Alaska Lightning Detection System).

B. Zipped Fire Perimeters

Pre-zipped fire perimeters for all current and historic fires are available on the AICC webpage. The script is run daily during fire season. Any updated perimeters for current perimeters will be available each morning.

C. Near-real-time Satellite Imagery

VIIRS Land Cover, VIIRS Fire Temperature, VIIRS Fire Color, and other GeoTiffs are available from the University of Alaska - Geographic Information of Alaska (GINA) on the Wildand Fire Mapping site. These data products provide information related to fire activity, fire extent, and smoke movement.

D. Alaska Known Sites Database (AKSD)

AKSD identifies infrastructure, cultural and natural resource sites throughout AK that may be threatened by wildfire. FBANs and LTANs may find these data useful input to WFDSS as points of interest and/or incident objective shapes. Users must have a NIFC-AGOL account to access this information and will need to be added to the appropriate NIFC Org Groups. Users needing NIFC-AGOL accounts should fill out this form. After your NIFC-AGOL account is established, send an email to BLM_AK_AFS_GIS@blm.gov with “AKSD Access” in the subject line.

E. High Resolution Imagery

Copernicus Open Access Hub (Sentinel-2 data)

The European Space Agency’s Copernicus Program provides access to high-resolution imagery worldwide. Visit the Open Access Hub User Guide page to learn how to register for an account and access data. EarthExplorer for Landsat 7 & 8, and a limited selection of Sentinel-2 data.

F. Key Resources

1. Alaska Geographic Area Resources

- AICC Daily Fire Weather Briefing
- AICC Predictive Services, Situation Report, Assignment Logistics, and Fire Plans
- National Weather Service, Alaska Region Fire Weather
- Fuel Model Guide to Alaska Vegetation
- Alaska Fire Danger Operating Plan
- AWFCG Fire Modeling & Analysis Committee Resources

2. Geospatial Resources

- AFS Geospatial Information
- Alaska DOF Integrated Fire Management (IFM)
- ESRI Sentinel Imagery Living Atlas
- Satellite RGB Imagery GeoTIFFs
- NIFC ArcGIS Online
- AFS GeoPDF Repository
- Copernicus Open Access Hub (Sentinel-2 data)
- USGS EarthExplorer

3. CFFDRS Resources

- Alaska Fire and Fuels Fire Weather Index information (AKFF) & Users Guide
- Alaska FWI Field Guide & Alaska FBP Field Guide (hard copies available)
- Weather Guide for the Canadian Forest Fire Danger Rating System
- AKFF Firefamily Plus Database (do not use WIMS data)
- CFFDRS Online Course and YouTube Lesson Videos
- CFFDRS Compare Models Excel Workbook (windows only)
- RedAPP (CFFBP) Offline Software (windows and OSX)

4. US Fire Danger and Fire Behavior Resources

- Fire Behavior Field Reference Guide
- Compare Models Excel Workbook (windows only)
- Wildland Fire Decision Support System (WFDSS)
- Interagency Fuel Treatment Decision Support System (IFTDSS)
- Fire, Fuel, Smoke Applications (FLAMMAP, FireFamilyPlus, BehavePlus, etc.)

G. Short-Term Reference

1. Naming Convention

- 0602 Calib 10hr Spot .15 S&R HFM30%

2. Start Date and Time

- **Start Time is important**. Peak burning period is around 1700.

3. Duration

- Generally, a one day. Two to three days if the forecast is expected to be persistent with significant wind speed.

4. Burn Period

Season and ERC Table Row/Weather	Wind-Driven April 1- June 15	Duff-Driven June 15 - July 15	Drought-Driven July 15-Aug 15	Diurnal Limited Aug 15 and later
1st Row: Hot/Dry/Unstable	480	540-600	480	Should be based on which row the burn days fall into and how active the fire is expected to be in the analysis period. Less than 5 hours.
2nd Row: Hot/Dry	420	480	420	
3rd Row: Min RH 25% +	300	360	300	
4th Row: Clouds & Sun	180	240	180	
5th Row: Cloudy	60	120	60	

5. Conditioning Days

- Conditioning Days can be set to zero to turn off fuel moisture conditioning. Initial fuel moisture inputs are more important when you do. Forested landscapes can be assumed to be shaded, reducing the importance of conditioning. Tundra and open fuels are often level and conditioning is generally related to cloud cover, which can be set in the initial fuel moisture table.

6. STFB Spotting Probability

Season and ERC Table Row/Weather	Wind-Driven Before Greenup	Duff-Driven Greenup-July 15	Drought-Driven July 15-Aug 15	Diurnal Limited Aug 15 and later
1st Row: Hot/Dry/Unstable	.20	.20-.25	.15-.25	Should be based on which row the burn days fall into and how much crown fire & spotting expected on those days.
2nd Row: Hot/Dry	.15	.15-.20	.10-.20	
3rd Row: Min RH 25% +	.10	.10	.05-.15	
4th Row: Clouds & Sun	.05	.05	.01-.05	
5th Row: Cloudy	.01	.01	.00 to .01	

7. Wind Estimate Editing for STFB

- During calibration, wind inputs for Alaska RAWS should be assumed to be low and generally multiplied by 1.5.
- Forecast weather will be more analogous to ASOS than RAWS estimates. Multiplying by 1.5 may not be necessary in all cases when RAWS stations are used.

8. 1-hr Fuel Moisture

Grass Fuel Moisture

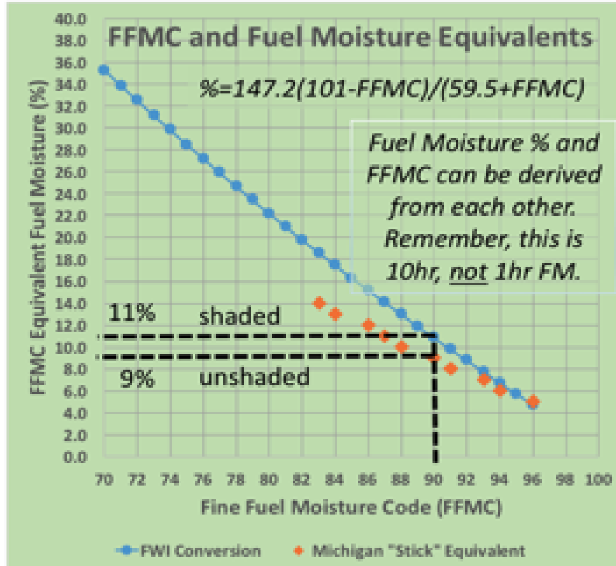
- Based on research done in savanna grasses in Ontario
- Table shows Equilibrium Moisture Content
- Assumes that atmosphere unchanged for 2-3 hours.

CFFDRS Grass Fuel Moisture		Relative Humidity (%)							
SOL_{ef}	**Temp**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**80%**	**100%**
Overcast Or Shaded	**41°F**	10	13	16	17	19	21	25	38
	50°F	9	12	14	16	17	19	23	37
	59°F	8	11	13	15	16	17	23	37
	68°F	7	10	12	13	15	17	21	34
	77°F	6	8	10	12	14	15	20	32
	86°F	5	7	9	11	12	14	19	32
Broken, Clouds > 50% of sky	**41°F**	7	10	12	14	15	16	19	21
	50°F	6	9	11	13	14	15	17	20
	59°F	6	8	10	11	13	14	16	19
	68°F	5	7	9	10	12	13	15	17
	77°F	4	6	8	9	10	11	14	17
	86°F	3	5	6	8	9	10	13	16
Scattered Clouds < 50% of sky	**41°F**	5	8	10	11	12	13	15	17
	50°F	5	7	9	10	11	12	14	15
	59°F	4	6	7	9	10	11	13	14
	68°F	4	5	6	8	9	10	11	13
	77°F	3	4	5	6	7	8	10	12
	86°F	2	3	4	5	6	7	9	11
Clear Skies	**41°F**	4	6	7	8	9	10	12	13
	50°F	3	5	6	7	8	9	11	12
	59°F	3	4	5	6	7	8	9	11
	68°F	3	4	4	5	6	7	8	10
	77°F	2	3	4	4	5	6	7	9
	86°F	2	2	3	3	4	5	6	7

9. 10-hr Fuel Moisture

FFMC and Timelag Fuel Moisture

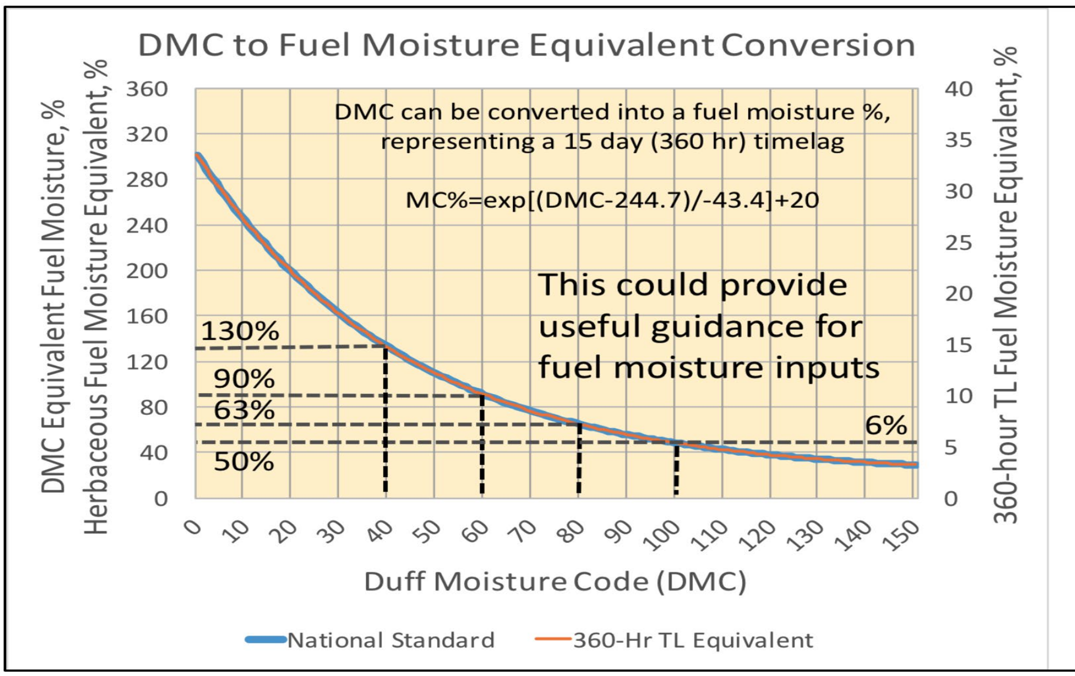
- FFMC represents shaded litter fuels with about a 10 hr timelag (5 to 16 hrs)
- An equivalent fuel moisture % can be estimated and used in predictions.



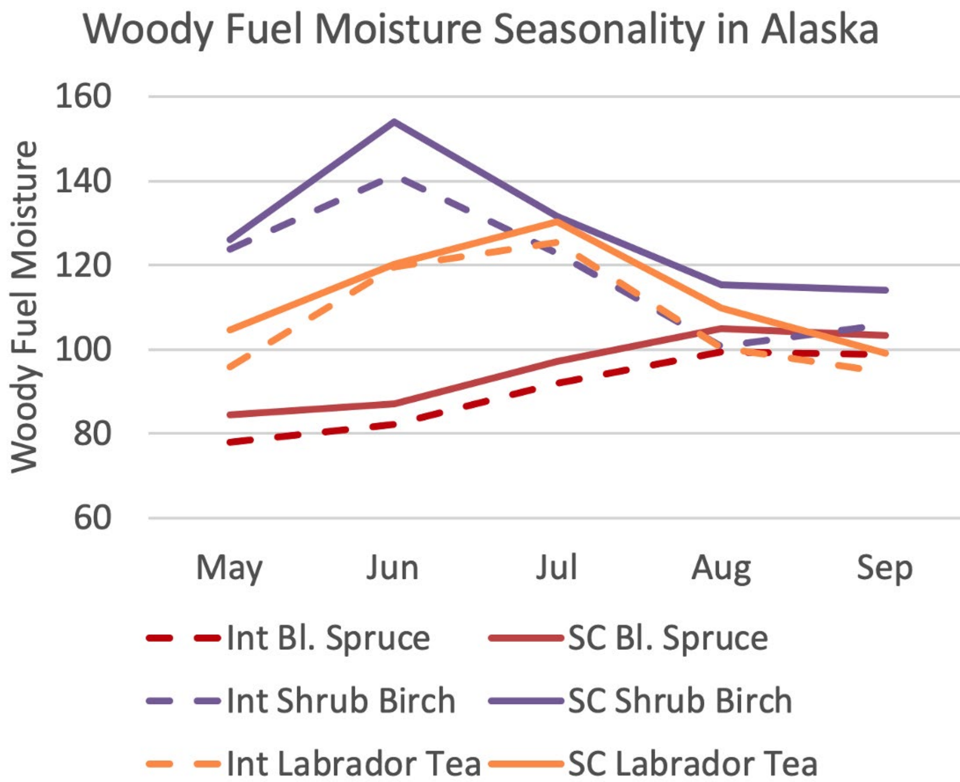
FFMC	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80
10h-Sh	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22
10h-Unsh	5		6	7		8	9		10	11	12		13	14		15	

Based on 20 years of daily estimates of FFMC values, its 10hr fuel moisture equivalent, and manual estimate of NFDRS unshaded 10hr "Sticks" in Michigan 1975-1995.

10. Herbaceous Fuel Moisture (HFM) and 100-hr Dead Fuel Moisture



11. Woody Fuel Moisture (WFM)



H. Near-Term Reference

1. Naming Convention

- 0602 Fcst 3day Finney BS to SH5

2. Start Date/Time

- **Start Time is important**. Peak burning period is around 1700.
- Do not use Near-Term inputs to directly calibrate inputs for FSPro.
- Start and Stop Hours should reflect each day's burn period and each day's burnability. Do not accept default to all days the same, unless that is what you want.
- When no growth is anticipated use the same start and stop hour.

3. Duration

- Generally, 2-3 days, depending on forecast confidence.
- Longer durations are faced with forecast uncertainty, landscape inaccuracy, and suppression action impacts.

4. Burn Period

Season and ERC Table Row/Weather	Wind-Driven April 1- June 15	Duff-Driven June 15 - July 15	Drought-Driven July 15-Aug 15	Diurnal Limited Aug 15 and later
1st Row: Hot/Dry/Unstable	480	540-600	480	Should be based on which row the burn days fall into and how active the fire is expected to be in the analysis period. Less than 5 hours.
2nd Row: Hot/Dry	420	480	420	
3rd Row: Min RH 25% +	300	360	300	
4th Row: Clouds & Sun	180	240	180	
5th Row: Cloudy	60	120	60	

5. Conditioning Days

- Shorten conditioning to no more than 1 to 2 days.
- Set the analysis period to the very high confidence forecast days.
- Edit weather streams for the conditioning and analysis periods if needed.

6. NTFB Spotting Probability

Season and ERC Table Row/Weather	Wind-Driven Before Greenup	Duff-Driven Greenup-July 15	Drought-Driven July 15-Aug 15	Diurnal Limited Aug 15 and later
1st Row: Hot/Dry/Unstable	.10	.10-.15	.07-.13	Should be based on which row the burn days fall into and how much crown fire & spotting expected on those days.
2nd Row: Hot/Dry	.07	.08	.05-.1	
3rd Row: Min RH 25% +	.05	.05	.03-.07	
4th Row: Clouds & Sun	.03	.03	.02	
5th Row: Cloudy	0	0	0	

7. Wind Estimate Editing for NTFB

- During calibration, wind inputs for Alaska RAWS should be assumed to be low and generally multiplied by 1.5.
- Forecast weather will be more analogous to ASOS than RAWS estimates. Multiplying by 1.5 may not be necessary in all cases when RAWS stations are used.

8. 1-hr Fuel Moisture

Grass Fuel Moisture

- Based on research done in savanna grasses in Ontario
- Table shows Equilibrium Moisture Content
- Assumes that atmosphere unchanged for 2-3 hours.

CFFDRS Grass Fuel Moisture		Relative Humidity (%)							
SOL_{ef}	Temp	10%	20%	30%	40%	50%	60%	80%	100%
Overcast Or Shaded	41°F	10	13	16	17	19	21	25	38
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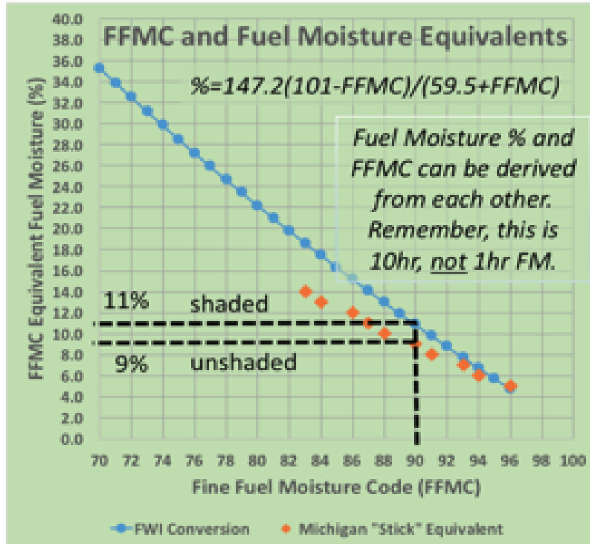
	59°F	8	11	13	15	16	17	23	37
	68°F	7	10	12	13	15	17	21	34
	77°F	6	8	10	12	14	15	20	32
	86°F	5	7	9	11	12	14	19	32
Broken, Clouds > 50% of sky	41°F	7	10	12	14	15	16	19	21
	50°F	6	9	11	13	14	15	17	20
	59°F	6	8	10	11	13	14	16	19
	68°F	5	7	9	10	12	13	15	17
	77°F	4	6	8	9	10	11	14	17
	86°F	3	5	6	8	9	10	13	16
Scattered Clouds < 50% of sky	41°F	5	8	10	11	12	13	15	17
	50°F	5	7	9	10	11	12	14	15
	59°F	4	6	7	9	10	11	13	14
	68°F	4	5	6	8	9	10	11	13
	77°F	3	4	5	6	7	8	10	12
	86°F	2	3	4	5	6	7	9	11
Clear Skies	41°F	4	6	7	8	9	10	12	13
	50°F	3	5	6	7	8	9	11	12
	59°F	3	4	5	6	7	8	9	11
	68°F	3	4	4	5	6	7	8	10
	77°F	2	3	4	4	5	6	7	9
	86°F	2	2	3	3	4	5	6	7

9. 10-hr Fuel Moisture

FFMC and Timelag Fuel Moisture

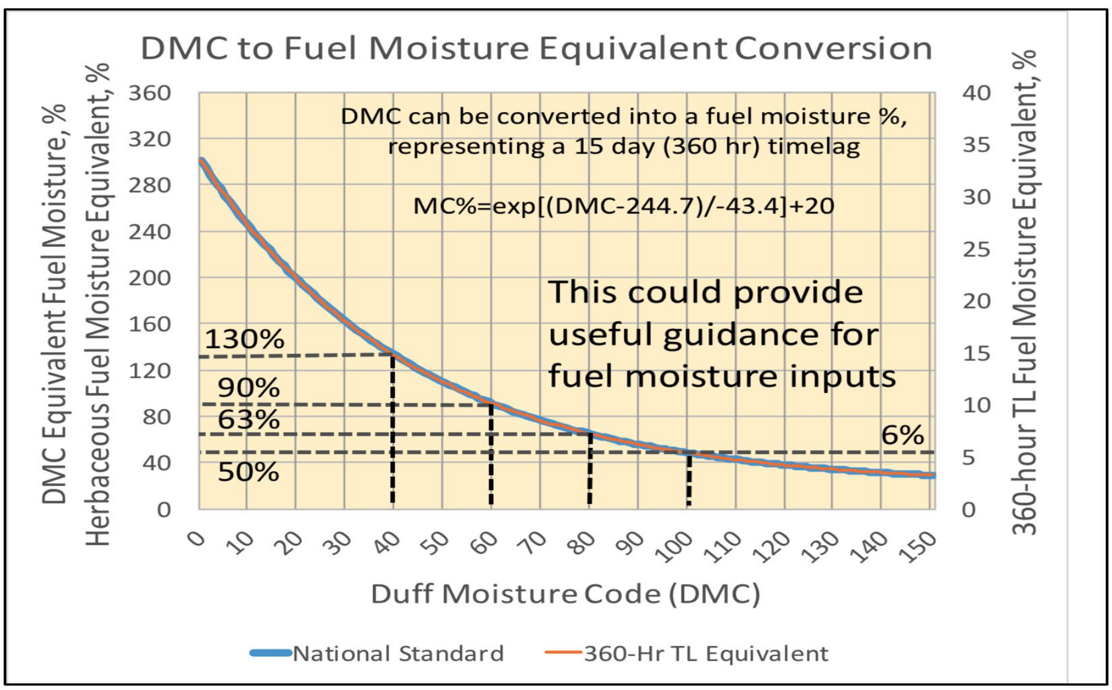
- FFMC represents shaded litter fuels with about a 10 hr timelag (5 to 16 hrs)
- An equivalent fuel moisture % can be estimated and used in predictions.



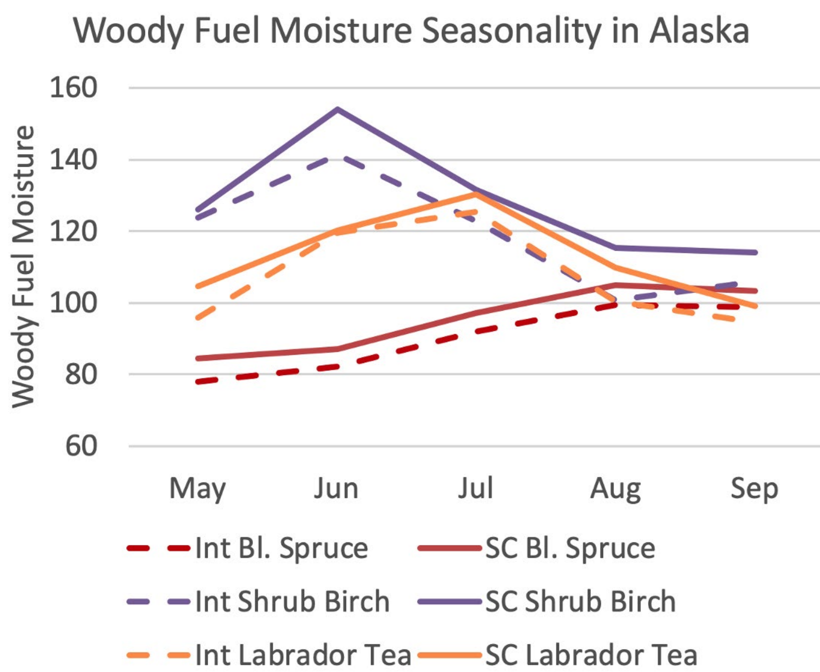
FFMC	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80
10h-Sh	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22
10h-Unsh	5		6	7		8	9		10	11	12		13	14		15	

Based on 20 years of daily estimates of FFMC values, its 10hr fuel moisture equivalent, and manual estimate of NFDRS unshaded 10hr "Sticks" in Michigan 1975-1995.

10. Herbaceous Fuel Moisture (HFM) and 100-hr Dead Fuel Moisture



11. Woody Fuel Moisture (WFM)



I. FSPro Reference

1. Naming Convention

0616 Outlk 14day 0616-0629

2. Start Date/Time

Generally, set start date as the next active burn period, today or tomorrow if a forecast period is to be included.

3. Duration

For Boreal analyses, when limiting Burn Days, use a longer (14 day) duration.

For pre-green, wind-driven season and in non-forest (tundra) landscapes, consider shorter (7-day) durations without setting burnable day limits.

Limit the forecast inputs to those days with very high forecast confidence, usually the first 2-3 days of the analysis period. Add additional forecast days only if there is very high confidence in the extended forecast.

Future scenarios will not have forecasts available and will depend entirely on climatology.

4. Burn Period

Season and ERC Table Row/Weather	Wind-Driven April 1- June 15	Duff-Driven June 15 - July 15	Drought-Driven July 15-Aug 15	Diurnal Limited Aug 15 and later
1st Row: Hot/Dry/Unstable	480	540-600	480	Should be based on which row the burn days fall into and how active the fire is expected to be in the analysis period. Less than 5 hours.
2nd Row: Hot/Dry	420	480	420	
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5. FSPro Spotting Probability

Season and ERC Table Row/Weather	Wind-Driven Before Greenup	Duff-Driven Greenup-July 15	Drought-Driven July 15-Aug 15	Diurnal Limited Aug 15 and later
1st Row: Hot/Dry/Unstable	.20	.20-.25	.15-.25	Should be based on which row the burn days fall into and how much crown fire & spotting expected on those days.
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3rd Row: Min RH 25% +	.10	.10	.05-.15	
4th Row: Clouds & Sun	.05	.05	.01-.05	
5th Row: Cloudy	.01	.01	.00 to .01	

6. Wind Climatology in FSPro

The ASOS network wind climatology is generally not available for review in WIMS or WFDSS. It is however available on the Iowa Environmental Mesonet (IEM) site. Historic wind roses for Alaska ASOS network stations are available and should be consulted when selecting a station for wind climatology to be used in FSPro analyses.

If the RAWS wind rose appears to show reduced wind speeds as compared to nearby ASOS stations, or if the RAWS is in a boreal forest setting, **using "Both" rather than "10-min average"** when creating the wind climatology for FSPro analyses to produce more accurate results.

7. 1-hr Fuel Moisture

Grass Fuel Moisture

- Based on research done in savanna grasses in Ontario
- Table shows Equilibrium Moisture Content
- Assumes that atmosphere unchanged for 2-3 hours.

CFFDRS Grass Fuel Moisture		Relative Humidity (%)							
SOL_{ef}	**Temp**	**10%**	**20%**	**30%**	**40%**	**50%**	**60%**	**80%**	**100%**
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	77°F	3	4	5	6	7	8	10	12
	86°F	2	3	4	5	6	7	9	11
Clear Skies	**41°F**	4	6	7	8	9	10	12	13
	50°F	3	5	6	7	8	9	11	12
	59°F	3	4	5	6	7	8	9	11
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	77°F	2	3	4	4	5	6	7	9
	86°F	2	2	3	3	4	5	6	7

8. 10-hr Fuel Moisture

FFMC and Timelag Fuel Moisture

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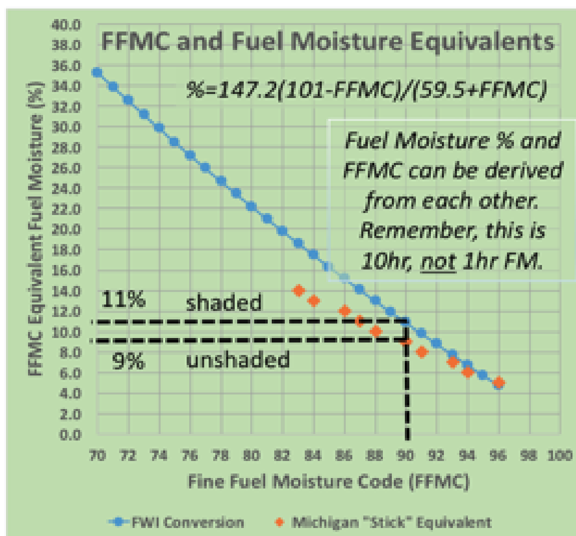
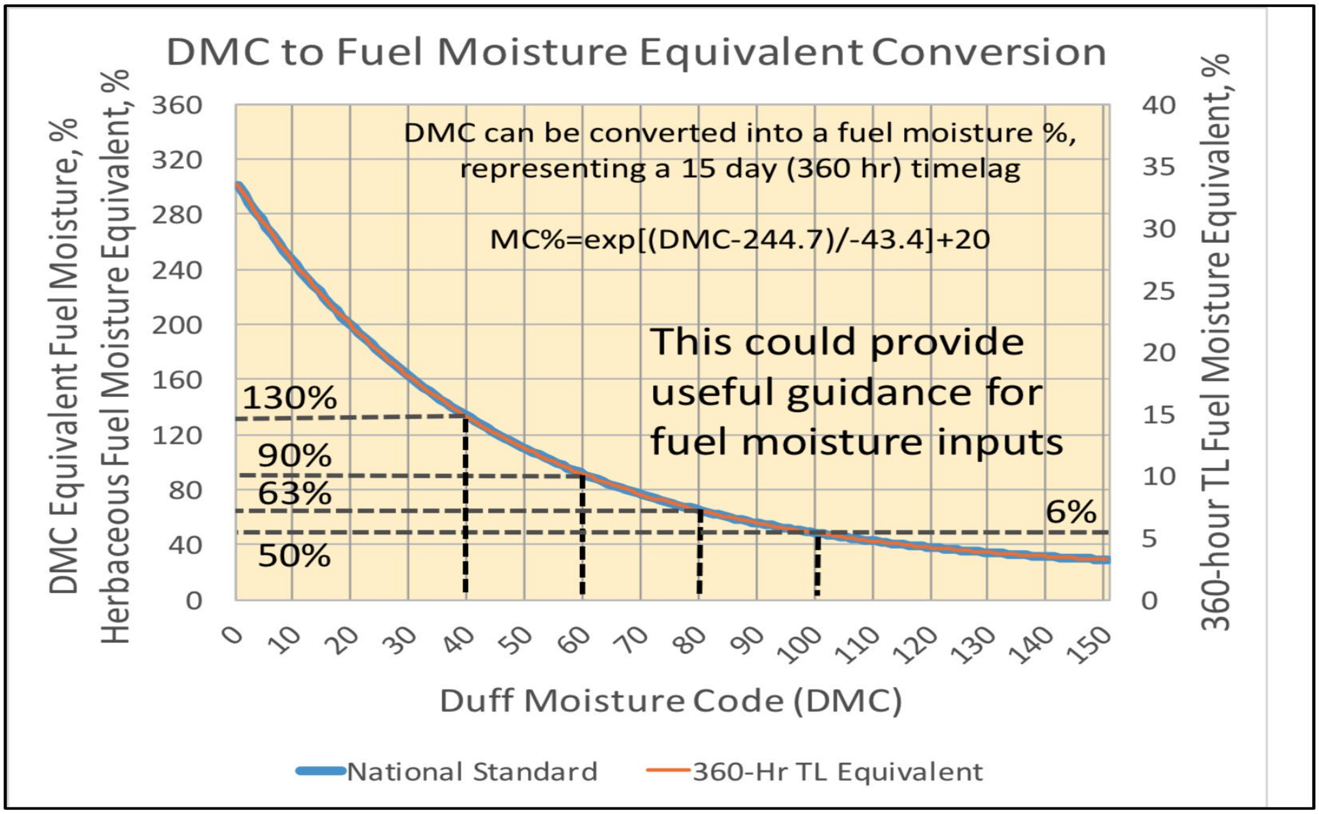
- An equivalent fuel moisture % can be estimated and used in predictions.



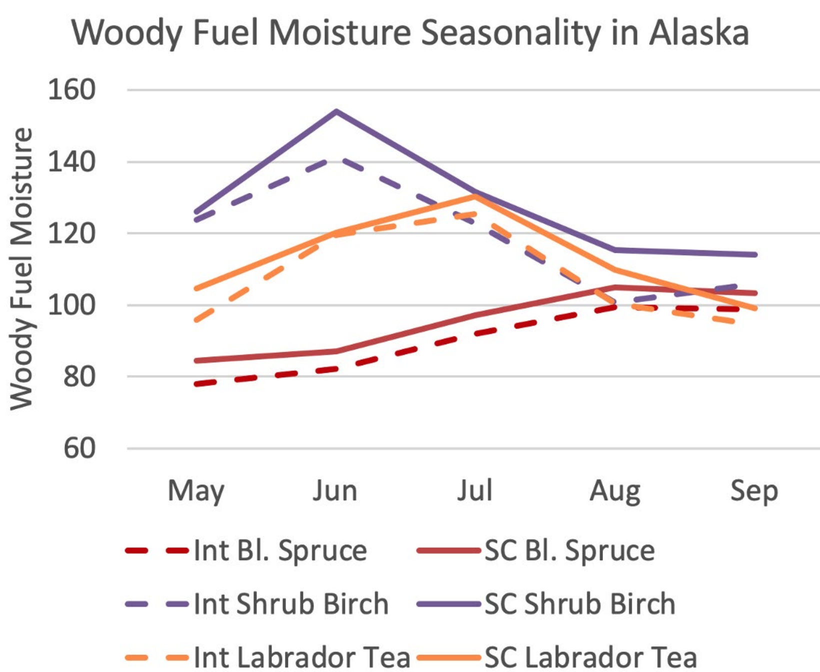
FFMC	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80
10h-Sh	5	6	7	8	9	10	11	12	13	14	15	16	17	19	20	21	22
10h-Unsh	5		6	7		8	9		10	11	12		13	14		15	

Based on 20 years of daily estimates of FFMC values, its 10hr fuel moisture equivalent, and manual estimate of NFDRS unshaded 10hr "Sticks" in Michigan 1975-1995.

9. Herbaceous Fuel Moisture (HFM) and 100-hr Dead Fuel Moisture



10. Woody Fuel Moisture (WFM)



11. ERC Table and Fuel Moisture Climatology (FSPro)

Season and ERC Table Row/Weather	1-hr	10-hr	100-hr	Herbaceous	Woody
1st Row: Hot/Dry/Unstable	ERCg/y climatology tends to mute the observed variation in fine fuel moisture. Lowering 1-hr in the top two bins, possibly to 3% to 4% for extreme scenarios may help calibrate fire spread.	6-7%	8%	Current DMC estimates can convert to HFM. Use daily increase of 3-4-point increase in DMC over analysis period to suggest max DMC and convert to HFM.	Review NFMD records for Black Spruce needle moisture, generally <100%. Other shrubs generally higher during the growing season.
2nd Row: Hot/Dry		8%	9%		
3rd Row: Min RH 25% +		9%	10%		
4th Row: Clouds & Sun		12%	13%		
5th Row: Cloudy		15%	17%		

12. Editing the ERC Table and ERC Stream

- **Typical frequency of active fire spread is about 40% over 2 weeks** in active periods of significant fire seasons. Check you results tab for burn day percentages.
- Use FFMC and BUI values from chosen weather station to identify daily severity and guide ERC levels for individual days in the ERC Stream.

Setting ERCg Levels for FSPro Analysis

80 to 82.9	83 to 85.9	86 to 88.9	89 to 91.9	92+	FFMC / BUI
5th Bin	4th Bin	2nd Bin	2nd Bin	Top Bin	110+
5th Bin	4th Bin	2nd Bin	2nd Bin	Top Bin	90 to 109.9
5th Bin	4th Bin	3rd Bin	3rd Bin	2nd Bin	60 to 89.9
5th Bin	4th Bin	4th Bin	3rd Bin	3rd Bin	40 to 59.9
5th Bin	5th Bin	4th Bin	4th Bin	3rd Bin	< 40

%ile		Min ERC
96	Top	61
89	2nd	54
76	3rd	49
67	4th	43
58	5th	38

Use FFMC and BUI to adjust/set ERC values in ERC stream, both observed & forecast

13. Calibration with Short-Term Results