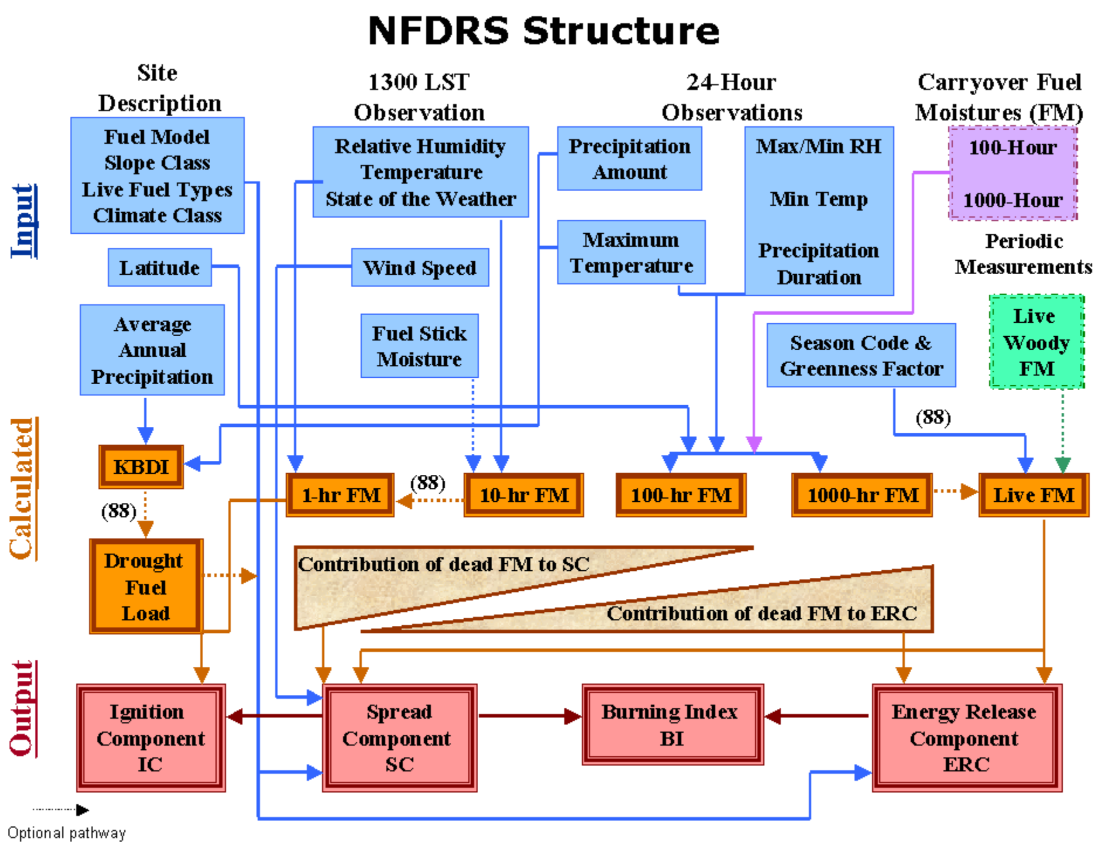
Appendix E. NFDRS technical reference

Use this appendix as a reference for National Fire-Danger Rating System (NFDRS) technical information. Topics in this appendix include:

- U. S. NFDRS structure ¨ NFDRS weighted averages
- Adjective (Public) Fire Danger -Rating Staffing Level
- Lightning Activity Levels recalculating NFDRS indices
- Live fuels NFDRS climate classes
- Standard Shef code descriptions.

U. S. NFDRS structure

The diagram below shows the NFDRS structure for both the 1978 and 1988 fuel models.



The shaded wedges show the contribution of dead fuel moisture to Spread Component (SC) and Energy Release Component (ERC). Based on either the 1978 or 1988 fuel model, the dashed lines show optional paths through the NFDRS system.

NFDRS technical reference

The NFDRS weighted averages function combines data from selected fire weather stations and produces an integrated fire danger rating for a geographic area. The fire manager must:

- Select each station to represent the area
- Determine the station-weighting factor (the influence of each station on the weighted area fire danger).

The weighting factors of the stations within the area must total 100 percent.

The station weighting factor is based on the fire manager's local experience, including:

- Percent of the total area represented by each station
- Resource values
- Historic fire occurrence
- Public use patterns.

Based on the Create Default NFDRS Parameters form, WIMS uses the Priority 1 fuel model for weighting factors. To change to a different fuel model, you must first select it by entering that fuel model's assigned priority using the Display/ Edit Default NFDRS Parameters form.

A fuel model must appear in the station catalog before you can use it to calculate weighted average values for a SIG.

How WIMS redistributes NFDRS weight assignments

To compensate for stations missing NFDRS indices, WIMS redistributes the related weight assignments to the stations that have those NFDRS indices.

Remember, the Edit Weighted Averages (EAVG) report is used to assign weights to stations within any SIG you own.

For example, the station numbers listed below have the following NFDRS weight assignments:

Station Number	Weight Factor %
505091	10
505092	15

505093	25
505094	30
505095	20
	100%

If station " 505092" is missing data, WIMS redistributes the weight assignments to the remaining stations as follows:

505091 = 100 * (10 / (10 + 25 + 30 + 20)) = 12

505093 = 100 * (25 / (10 + 25 + 30 + 20)) = 29

505094 = 100 * (30 / (10 + 25 + 30 + 20)) = 35

505095 = 100 * (20 / (10 + 25 + 30 + 20)) = 24

100 %

If stations " 505093" and " 505094" are missing data, WIMS redistributes the weight assignments to the remaining stations as follows:

505091 = 100 * (10 / (10 + 15 + 20)) = 22

505092 = 100 * (15 / (10 + 15 + 20)) = 33

505095 = 100 * (20 / (10 + 15 + 20)) = 45

100 %

How WIMS determines IFPL calculations for USFS Region 6

USFS Region 6 uses the Industrial Fire Precaution Level (IFPL) system to regulate activities to minimize risks associated with industrial operations. Industrial operation restrictions increase as IFPL values increase. WIMS calculates daily Precaution Values (PV) using one of the equations below:

West of the Cascades (assumes Fuel Model G)

$$PV = \left(ERC/22 \right) + \left((IC-5)/20 \right)$$

If PV > 3, then

$$PV = 3.0 + 2\left(PV - 3.0\right)$$

East of the Cascades (assumes Fuel Model C)

$$PV = \left(\frac{ERC}{4} \right) + \left(\frac{(IC-45)}{10} \right)$$

Southwest Oregon, Siskiyou Mountains (assumes Fuel Model F)

$$PV = \left(\frac{ERC}{6} \right) + \left(\frac{(IC-45)}{10} \right)$$

These IFPL equations are based on NFDRS parameters associated with historic industrial fire occurrence in the Pacific Northwest and have no applicability outside this area.

IFPL Class	Corresponding Precaution Value
1	At or below 1.999
2	2.000 -2.9999
3	3.000 -3.9999
4	4.000 and above

How WIMS handles weighted variables, components, indices, and values

The NFDRS weighted averages function calculates a weighted arithmetic average for:

- Wind Speed (WS)
- Woody Fuel Moisture (WDY)
- Herbaceous Fuel Moisture (Herb FM)
- One-hour Timelag Fuel Moisture (1H)
- 10-hour Timelag Fuel Moisture (10)
- 100-hour Timelag Fuel Moisture (HU)
- 1000-hour Timelag Fuel Moisture (TH)
- Ignition Component (IC)
- Spread Component (SC)
- Energy Release Component (EC)
- Burning Index (BI)
- Fire Load Index (FL)
- Keetch-Byram Drought Index (KBDI).

To obtain a weighted Ignition Component (IC) for stations A, B, and C -an example

The example below shows sample weighting factors for stations A, B, and C.

Station Weighting	Factor (W)	IC (W)	(IC)/ 100 AVG IC
A	22	38	8.36
B	44	47	20.68
C	34	58	19.72
	100		48.76 round 49

When averaging different fuel models, do not attempt to use the weighted average Energy Release Component (EC), Burning Index (BI), and Fire Load Index (FL). These values should be expressed as a range of values using the specific fuel model values found in the related NFDRS reports.

How WIMS determines the weighted staffing level

Before WIMS calculates the weighted Staffing Level, the staffing class must be determined using the nine-class system. WIMS identifies the breakpoint percentiles that drive the staffing class calculations for each fuel model in the station catalog. Using the outputs from different fuel models, WIMS then generates a weighted staffing level from the different fuel models and WIMS assigns a class factor according to the schedule below:

Staffing class	**(x)**	**Class factor (m)***
0	0	0
1-	1.25	1.19
1+	1.75	1.68
2-	2.25	2.37
2+	2.75	3.36
3-	3.25	4.76
3+	3.75	6.73
4-	4.25	9.51
4+	4.75	13.43
5	5.25	19.03

*Ln m= (x) Ln2

The example below shows how WIMS determines the weighted staffing level (SL):

Station	Wt. Factor (w)	Staff. Class	Class Factor (m)	(m) (w)/ 100
A	22	2-	2.37	.52
B	44	3+	6.73	2.96
C	34	4-	9.51	3.23
	100			6.71

As shown below, the shaded area shows how the 6.71 value translates to a weighted staffing class:

Staffing class	**(m) (w)/ 100**
0	0-0.99
1-	1.00-1.40
1+	1.41-1.99
2-	2.00-2.82
2+	2.83-3.99
3-	4.00-5.65
3+	5.66-7.99
4-	8.00-11.30
4+	11.31-15.99
5	Greater or equal to 16.00

The weighted staffing class is 3+ (3 high). The actual staffing level (SL field) on the Display NFDRS Weighted Averages form is then based on the number of display classes (DC) identified in the station catalog. If the station catalog shows " 5" display classes (staffing levels), a " 3" would display in the SL field. If the station catalog shows " 6" display classes, a " 3+ " would display in the SL field.

WIMS displays only the nine point Staffing classes, from 1-to 5. WIMS does not display the weighted staffing class " 0".

Adjective (Public) Fire-Danger Rating

In March 1974, Forest Service, BLM, and State Forestry representatives established a standard fire-danger rating for public information.

Most fire protection organizations use this adjective class only for public information. Staffing level (SL) is used for in-house fire readiness and dispatch information.

Using the weighted average IC, the weighted SL, and the adjective fire-danger matrix, WIMS determines the weighted adjective fire-danger rating

(R) for public use within a geographic area. Adjective fire-danger is expressed as one of five levels:

- Low (L)
- Moderate (M)
- High (H)
- Very High (V)
- Extreme (E).

The table below shows the adjective fire-danger for IC and SL:

Staffing level (SL)	**Adjective fire-danger (R)**				
0	0	0	0	0	0
1-, 1, 1+	L	L	L	M	M
2-, 2, 2+	L	M	M	M	H
3-, 3, 3+	M	M	H	H	V
4-, 4, 4+	M	H	V	V	E
5	H	V	V	E	E
Ignition component (IC)	0-20	21-45	46-65	66-80	81-100

The zero value is shown to address those cases where a staffing level of " 0" is calculated by WIMS. This occurs when the wet fuels flag (WF) is set to " Y" during an Observed (Type= O), Special (Type= S), or Forecast (Type= F) observation.

To determine the historic occurrence of the adjective fire-danger

Using the Fire Family Plus program, analyze the historic weather data housed in the NIFMID database.

The following table contains the narrative descriptions and color-codes for the five adjective fire-danger classes:

Fire-Danger Class	Color code Description
Low Green	Fuels do not ignite readily from small firebrands, although a more intense heat source, such as lightning, may start many fires in duff or punky wood. Fires in open cured grassland may burn freely a few hours after rain, but woods fires spread slowly by

	creeping or smoldering, and burn in irregular fingers. There is little danger of spotting.
Moderate Blue	Fires can start from most accidental causes, but with the exception of lightning fires in some areas, the number of starts is generally low. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel, especially draped fuel, may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious, and control is relatively easy.
High Yellow	All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High-intensity burning may develop on slopes, or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small Very High
Orange	Fires start easily from all causes, and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics; such as long-distance spotting and fire whirlwinds, when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.
Extreme Red	Fires start quickly, spread furiously, and burn intensely. All fires are potentially serious.

	Development into high-intensity burning will usually be faster and occur from smaller fires than in the very high danger class. Direct attack is rarely possible, and may be dangerous except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks until the weather changes or the fuel supply lessons.

Remember, adjective fire-danger is for public information only. It has no direct connection to fire behavior.

Staffing Level

Staffing Level is the bottom line of fire-danger rating. Using a specified staffing index, WIMS determines the staffing class or readiness level of the suppression organization. The SI field on the Create NFDRS Parameters form allows you to specify which of those eight staffing indices WIMS must use to calculate the fire-danger rating:

Staffing index	Name
BI	Burning Index
EC	Energy Release Component
FL	Fire Load Index
IC	Ignition Component
KB	Keetch-Byram Drought Index
LO	Lightning-caused Occurrence
MO	Human-caused Occurrence
SC	Spread Component

The Forest Service presently uses the 90th (SI-low) percentile and 97th (SI-high) percentile values for each station's fuel models to determine the staffing class. The Bureau of Land Management uses the 80th and 95th percentile values. FIREFAMILY PLUS, WIMS is used to determine these percentile values from a statistical analysis of historical fire weather observations, and provides criteria for ranking the relative severity of the fire danger on a given day.

WIMS generates a table of test values of SI-low percentile and SI-high percentile values that are identified in the station catalog to compare the Staffing Index for each model. There are always ten such test values, corresponding to the nine-class system (nine classes plus zero).

The actual number of staffing classes used by an administrative unit may be any value from 3 to 9. For this reason, WIMS always computes the staffing class based on the nine-class system, but displays the staffing class based on the completed DC field (number of display classes) in the station catalog.

Breakpoints for the staffing class in the nine-class system are listed below:

Computed class level	**Upper value for class**
0	SI = 0
1	SI-low¤8
2	SI-low¤4
3	SI-low¤(3/ 8)
4	SI-low¤2
5	SI-low¤(3/4)
6	SI-low
7	(SI-low + SI-high) ¤2
8	SI-high
9	More than SI-high

To determine which nine-class staffing class designator appears for a specific staffing class

Desired number of staffing level classes	**Displayed staffing class**									
3	0	1	1	1	1	1	1	4	4	5
4	0	1	1	1	1	3	3	4	4	5
5	0	1	1	2	2	3	3	4	4	5
6	0	1	1	2	2	3-	3+	4	4	5
7	0	1	1	2	2	3-	3+	4-	4+	5
8	0	1	1	2-	2+	3-	3+	4-	4+	5
9	0	1-	1+	2-	2+	3-	3+	4-	4+	5
Staffing class designator	0	1	2	3	4	5	6	7	8	9

1 In the first column, locate the Desired number of staffing level classes that your administrative unit employs, a value from 3 to 9.

2 Follow that row across to the Displayed staffing class for the corresponding Staffing class designator.

Lightning Occurrence Index

Lightning Occurrence (LO) is meant to account for fires set by lightning on the day being rated and for fires set the previous day not yet discovered that must be considered in the rated day's fire business (holdover fires).

Three Lightning Occurrence Indices are calculated each day:

- Yesterday's Lightning Occurrence Index uses the LO from two days ago, yesterday's Ignition Component, and the Lightning Activity Level reported today to characterize the lightning situation that occurred yesterday (from midnight to midnight).
- Today's Lightning Occurrence Index uses yesterday's recalculated LO, today's predicted Lightning Activity Level, and observed Ignition Component.
- Tomorrow's Lightning Occurrence Index uses today's preliminary LO and tomorrow's predicted Lightning Activity Level and Ignition Component.

Several Lightning Activity Levels (LALs) are reported from the Create Observation or Edit Observation form, or are included by the fire weather forecaster in point or trend forecasts. Lightning Risk (LR) is calculated from the appropriate LAL and the lightning risk scaling factor identified in the station catalog.

How WIMS obtains yesterday's lightning risk

The YL field (yesterday's lightning) on the Create Observation and the Edit Observation forms best describes the lightning occurrence from midnight to midnight the previous day. YL replaces the LAL used to calculate yesterday's preliminary LO in yesterday's fire weather record, and eventually becomes part of the archived weather data in NIFMID and used by FIRDAT.

How WIMS obtains today's Lightning Risk (LAL)

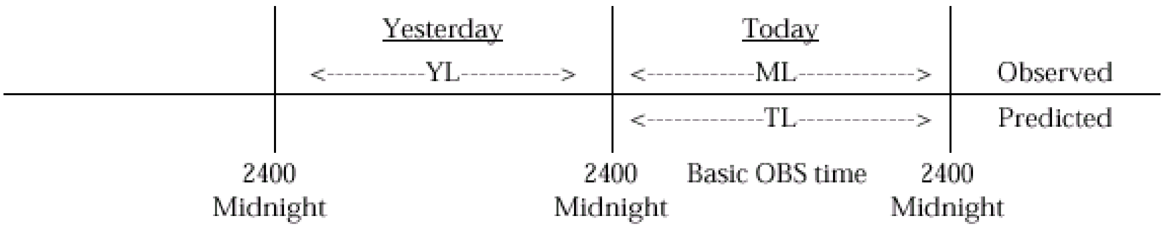
To estimate today's Lightning Activity Level, WIMS uses LAL to determine the current day's lightning risk during the processing of this afternoon's fire weather observation. During the basic observation time (1300 local standard time) two LALs are available:

1 The LAL predicted on yesterday's fire weather forecast for today is called Tomorrow's Lightning (TL).

2 The LAL that describes the Lightning Occurrence experiences between midnight last night and the basic observation time today is reported in the

ML field (Morning's Lighting) of the Create Observation and the Edit Observation forms.

WIMS chooses the higher of these two LALs. This value is replaced in the fire weather record by Yesterday's Lightning (YL) that will be reported tomorrow.



Where:

- YL is the observed LAL for yesterday.
- ML is the observed LAL today since midnight.
- TL is the LAL predicted yesterday for all of today.

How WIMS obtains today's lightning risk for predicting tomorrow's Fire Load Index

After the current day's fire weather observation becomes available, WIMS makes a second estimate of the LAL for the current day and selects the higher of:

- The ML reported in the fire weather observation
- The LAL predicted for the period from midnight of the current day and the basic observation time.

This second estimate is called the Afternoon's Lightning (AL). To recalculate the Lightning Occurrence Index for today, WIMS uses AL, the Ignition Component (IC) from the observation, and the Lightning Occurrence Index (LOI) from yesterday. This updated LOI is used to predict tomorrow's LOI.

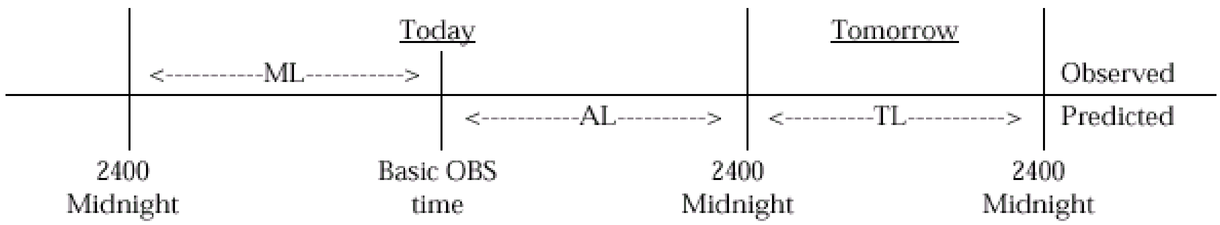
How WIMS obtains tomorrow's lightning risk for predicting tomorrow's Fire Load Index

The WIMS danger rating processor uses the value in the TL field on the Point or Trend Forecast form to determine tomorrow's lightning risk.

1 The LAL predicted on yesterday's fire weather forecast for today is called tomorrow's lightning (TL).

2 The LAL that describes the lightning occurrence experiences between midnight last night and the basic observation time today is reported in the

ML field (morning's lightning) of the Create Observation and Edit Observation forms.



where:

- ML is the observed LAL today since midnight.
- AL is the predicted LAL for the remainder of today (basic
- Observation time to midnight) for today's forecast.
- TL is the LAL predicted yesterday for all of today.

For more information, refer to Deeming, John E, Robert E. Burgan, and Jack D. Cohen. 1978. " The National Fire-Danger Rating System. "

More about recalculating NFDRS indices

The recalculate function in WIMS allows you to recalculate NFDRS indices day-by-day, for any range of dates you specify. You should recalculate NFDRS indices any time you add new information into the station catalog and/ or enter or edit observation data.

When adding missing weather observations or changing NFDRS parameters to existing observations, you should understand the affect of this new information on today's NFDRS index values:

- New information that is less than seven days old will have the greatest effect on today's NFDRS index values.
- New information older than seven days will not generally affect these values.
- If you add a significant number of missing observations within the last 45 days, be sure to recalculate the NFDRS indices.

Exception: The 1000-hour timelag fuel moisture content value may be affected by some changes for up to 55 days. Calculation of the 1000-hour timelag fuel moisture value is greatly affected by long durations of precipitation.

To handle missing data

1 Enter the missing weather observations using the Create Observation from (FASTPATH: NOBS).

2 Using the procedure outlined in "Recalculating NFDRS indices" in Chapter 5, " Beyond the basics, " recalculate the NFDRS indices from the date of the oldest entered observation to the current day.

To handle an NFDRS parameter change

Use this procedure to adjust herbaceous conditions codes, and 100-hour and 1000-hour and the X-1000 timelag fuel moisture contents.

1 Using the Edit NFDRS Parameters form (FASTPATH: ENFDR), edit the appropriate NFDRS parameters as outlined in "Editing NFDRS parameters" in Chapter 9, "Working with NFDRS."

2 Using the procedure outlined in "Recalculating NFDRS indices" in Chapter 5, "Beyond the basics," recalculate the NFDRS indices.

Live fuels

The moisture content of living fuels is controlled by the physiological processes of the plant. The two live fuels that make up the 1978 NFDRS fuel classes include:

- Herbaceous plants
- Woody shrubs.

Herbaceous plants

Herbaceous plants do not develop persistent woody tissues and include grasses, forbs, and ferns. Herbaceous plants are divided into annual and perennial types. When the live fuel moisture falls below 30 percent, herbaceous plants are considered cured and the moisture content defaults to that of the 1-hour timelag fuels.

For 1978 NFDRS fuel classes, the maximum herbaceous fuel moisture content is 250 percent.

Woody shrubs

During the growing season, perennial woody shrubs are allowed a maximum moisture content of 200 percent. The woody shrub fuel moisture model does not allow the estimated shrub moisture content to fall so low that the shrubs must be considered dead. These plants are considered dormant when the moisture content falls to the default woody fuel moisture set by the climate class.

For the 1978 NFDRS fuel model, the maximum woody fuel moisture content is 200 percent.

Live fuel moisture models

Live fuels act as either a heat sink or heat source. Live fuels become a heat source when their moisture content drops enough to allow desiccation and ignition during dead fuel combustion. If their moisture content remains above a critical level, live fuels act as a heat sink.

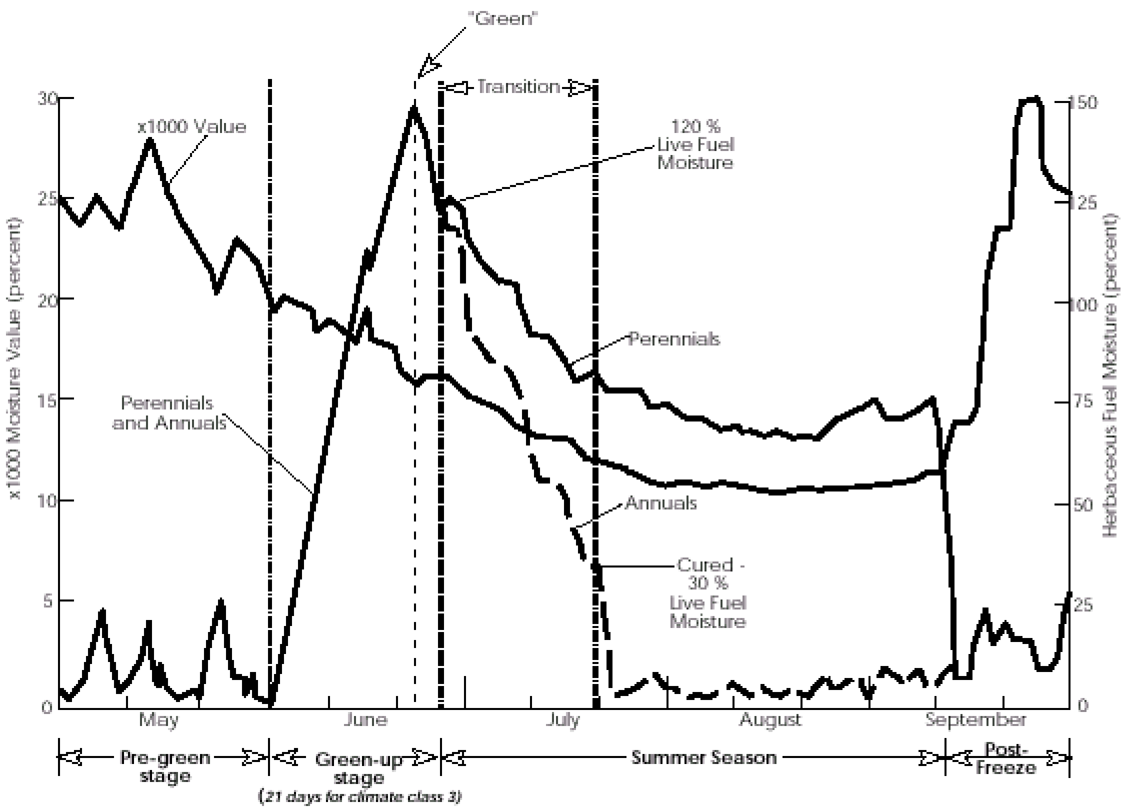
The live fuel model broadly approximates the moisture content of living herbaceous plants and the leaves and twigs of small woody shrubs. Maximum live fuel moistures at 25 percent 1000-hour timelag fuel moisture are 250 percent for herbaceous fuels and 200 percent for live woody shrubs.

Herbaceous plants are considered cured at 30 percent moisture content, while woody plants are considered dormant if their moisture content drops to 50 percent.

A dynamic live fuel moisture algorithm simulates greening and curing of herbaceous fuels by transferring fuel load between the live herbaceous class and the 1-hour timelag class as the herbaceous fuel moisture levels occur between 30 and 120 percent during the growing season.

x1000, Annual, and Perennial herbaceous fuel moisture models

The diagram below shows the relationship between the x1000 value and the annual and perennial herbaceous moisture models.



As shown above, when the greenup date is set for a station there is a dramatic change in the Perennial and Annual herbaceous fuel moisture models. During the first part of this Transition period, the Annual and Perennial herbaceous fuel moisture models lose moisture at the same rate until they reach 120 percent. From 120 to 30 percent, the Annual herbaceous fuel moisture decreases faster than Perennial herbaceous fuel moisture.

Greeness factors during dry periods

The table below shows some suggested greenness factors in relation to KBDI values:

KBDI value	Greenness Factor	KBDI value	Greenness Factor
0-200	20	401-420	9
201-220	19	421-440	8
221-240	18	441-460	7
241-260	17	461-480	6
261-280	16	481-500	5
281-300	15	501-520	4
301-320	14	521-540	3
321-340	13	541-560	2
341-360	12	561-580	1
361-380	11	581+	0
381-400	10		

Setting the Greenup date for a station

The stage of herbaceous vegetation controls two sets of fuel moistures:

- Herbaceous fuel moisture is affected by transition (H S field = T) and cured (H S field= C) stages. Unless frozen, perennial herbaceous fuels can recover from a cured stage after receiving moisture.
- Woody fuel moisture is affected by a frozen (H S field = F) state. Woody fuels must be frozen prior to Greenup.

The Greenup Date field on the Display/ Edit Default NFDRS Parameters form (FASTPATH: ENFDR) identifies the date at the start of Greenup. The Herb Date field reflects the date the last change was made to the H S field (herbaceous vegetation stage code). Determine the value of the HS field on the Display/ Edit Default NFDRS Parameters form, and then follow the procedure on the next page.

For more information about editing NFDRS parameters, see "Editing NFDRS parameters" in Chapter 6, " Working with Station Information."

To "Greenup" a station

From the Display/ Edit Default NFDRS Parameters form (FASTPATH: ENFDR):

- If the herbaceous vegetation is still cured from last year (HS field= C), change it to pregreen (HS field= P) or frozen (HS field= F) for at least one day. After at least one day, change it to green (HS field= G).

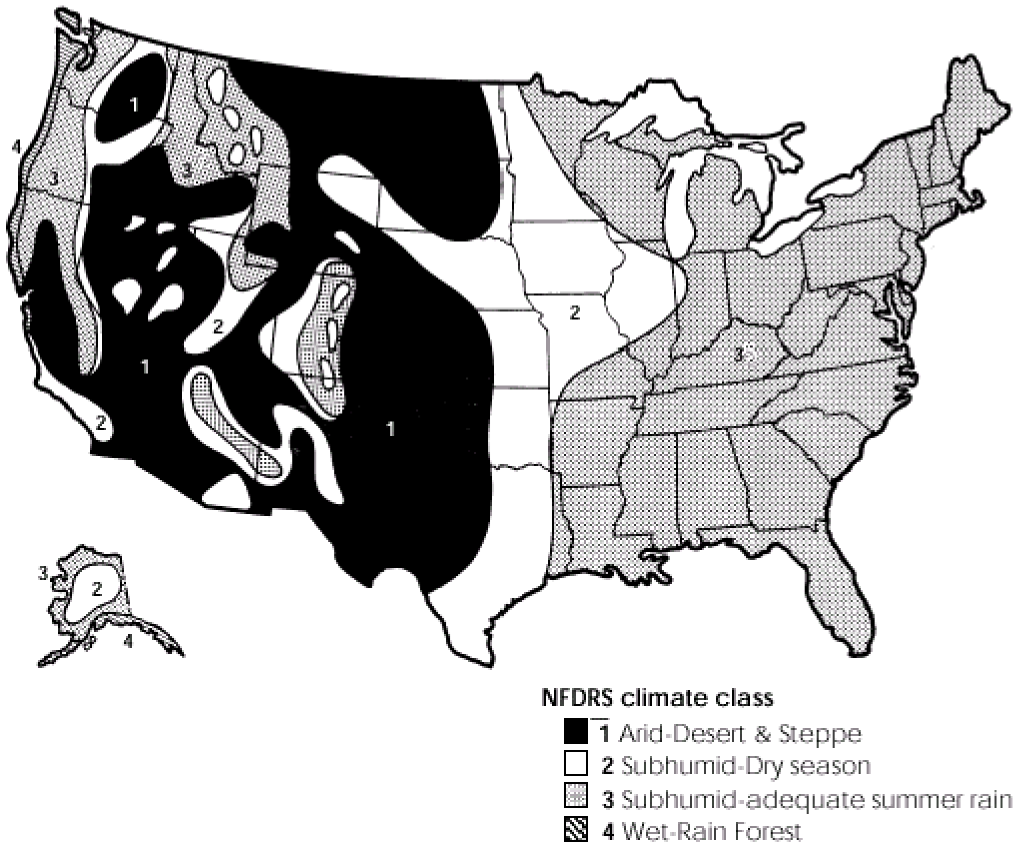
Changing the H S field to pregreen helps you work with the NFDRS model and prepare the weather station for the upcoming season.

- If the herbaceous vegetation is frozen (HS field= F), change it to green (HS field= G).
- If the herbaceous vegetation is in transition (HS field= T), you need to green (HS field= G), change it to pregreen (HS field= P), or frozen (HS field= F) for at least one day, and then change it to green (HS field= G).
- In the Herb Date field, enter the date of Greenup; the Greenup date, herb date and effective date must be the same. When you save this WIMS copies the date in the Herb Date field to the Greenup Date field. To force another greenup, you must reset the HS field to "G"

Changing the herbaceous vegetation to pregreen (HS field= P) resets the x1000 live fuel moisture recovery value to the current 1000-hour fuel timelag fuel moisture. Changing it to pregreen (HS field= P) is recommended, but optional.

NFDRS climate classes

The map of the United States below depicts the general locations of the NFDRS climate classes.



Climate class is valid for NFDRS stations (type 2, type 4, and type 6), and accounts for different plant adaptability to different moisture regimes and their response to rainfall anomalies. During a period without rain, plants adapted to a wet climate lose moisture faster than plants adapted to a dry climate.

Climate class affects several NFDRS parameters that influence live fuel moisture, including:

- Beginning 1000-hour fuel moisture
- Minimum live woody moisture
- Curing rate of herbaceous plants, for moistures between 120 and 30 percent
- Days in Greenup period, for 1978 NFDRS.

Standard Shef codes

The eight codes listed in the shaded area are standard measurements taken by every RAWS station. Do not enter any of these standard eight Shef codes as additional sensors. For more information, see "Entering RAWS station information" in Chapter 6, "Working with Station Information."

Shef code	Sensor description
PC	Precipitation, accumulation
US	Wind speed
UD	Wind direction
TA	Atmospheric temperature (dry bulb)
MT	Fuel temperature (wood probe)
XR	Relative humidity
VB	Battery voltage
PA	Atmospheric pressure
MF	Fuel moisture
UX	Wind direction, peak gust
UG	Wind speed, peak gust
TX	Atmospheric temperature maximum
TN	Atmospheric temperature minimum
XS	relative humidity maximum
XQ	relative humidity minimum
AF	surface frost intensity
AH	soil heat
AM	surface dew intensity
AW	air quality
AS	soil deformation
AT	time below critical temperature (25 DF, -3.9 DC)
AU	time below critical temperature (32 DF, 0 DC)
AQ	leaf wetness
CB	volcano fault creep
CE	volcano seismic data
CG	Volcanic gases
CH	Volcanic helium
CM	volcano crustal magnetic field
CP	volcano core pressure
CQ	earthquake prediction
CS	volcano crustal strain

CT	volcano crustal tilt
CU	volcano crustal uplift
CV	volcano geomagnetic field variations
CW	volcano soil tension
CX	glaciological data
DD	data motion (non-physical elements)
DE	data environmental (non-physical elements)
DT	data turbulence (non-physical elements)
DY	data activity (non-physical elements)
EA	evapotranspiration potential
EC	evaporation, event counter
ED	evaporation, pan depth
EM	evapotranspiration amount
ER	evaporation rate
ET	evapotranspiration total
EV	evaporation, lake (computed)
GD	frost depth, depth of frost penetration
GR	frost report, structure
GS	ground state
GT	frost, depth of surface frost thawed
HO	paroscientic (press trans)
H1	water log (press trans)
H2	Druck (press trans)
H3	Travis (press trans)
H4	Thomas (shaft enc)
H5	Valcom (shaft enc)
H6	Handar (shaft enc)
H7	Sutron (shaft enc)
H8	Affra (accoustic)
H9	Stevens (pulse gen)
HA	(V) height of reading
HB	depth of reading below surface
HC	height, ceiling
HD	height, head
HE (V)	height, regulating gate
HF	elevation, project powerhouse forebay
HG	height, river stage

HH (V)	height, of reading
HI	stage trend indicator
HJ (V)	height, spillway gate
HK	height, lake above a specified datum
HL	elevation, natural lake
HM	height of tide
HN	height river stage (daily min.)
HP	elevation, pool
HQ	river, stream, canal flow velocity
HR	elevation, lake or reservoir rule curve
HS	elevation, spillway forebay
HT	elevation, project tailwater stage
HU	gage height
HV	discharge flow
HW	height, spillway tailwater
HX (S)	height, river stage
HY (S)	height, river stage at 7 am
HZ	elevation, freezing level
IC	ice cover, river
IE	extent of ice from reporting area
IF	Freezing ice (ref. by voltage)
IG	icing rate
IM	ice movement
IO	extent of open water from reporting area
IR	ice report
IS	ice stress
IT	ice thickness
LA	lake surface area
LC	lake storage volume change
LS	lake storage (volume)
LV	liquid water vapor prof sensed by radiom
MC	condensation nuclei
MI	Moisture, soil index or API
ML	Moisture, lower zone storage
MM	fuel moisture, wood
MO	soil conductivity

MS (V)	Moisture, soil (amount)
MU	Moisture, upper zone storage
MW	Moisture, soil, percent by weight
MX	fuel mixture -10 hour
NG	total of gate openings (DAM)
NN	(V) number of spillway gates reported
NO	size OG gate opening (DAM)
PP	precipitation, actual increment
PR	precipitation rate
PT	precipitation, type
PY (S)	precipitation, increment end at 7 am
QA	discharge, adjust storag e @ project only
QB	discharge, instantaneous (REFS)
QC	runoff volume
QD	discharge, canal diversion
QG	discharge from power generation
QI	discharge, inflow
QL	discharge, rule curve
QM	discharge, preproject conditions in basn
QN (S)	discharge, minimum flow
QP	discharge, pumping
QR	discharge, river
QS	discharge, spillway
QT	discharge, computed total project outflow
QU	discharge, controlled by regulating outl
QV	cumulative volume increment
QX (S)	discharge, maximum flow
QY	discharge, river at 7 am
RA	radiation, albedo
RC	radiation, total sky cover

RD	radiation, direct beam solar radiation
RG	radiation, gamma
RI	radiation, accumulated incoming solar
RL	radiation, longwave
RM	radiation, electron density in ionosphere
RO	radiation, outgoing solar
RP	radiation, sunshine percent of possible
RR	radiation, partial flow rate
RS	radiation, sky
RT	radiation, sunshine hours
RV	radiation, flow rate air
RZ	radiation, global
SA	snow, areal extend of basin snow cover
SD	snow, depth
SE	snow, pillow ground temperature
SF	snow, depth (new snowfall)
SG	snow, pillow temperature underground
SI	snow, water content in inches of water
SL	snow, elevation of snow line
SR	snow, snow report
SS	snow, density
ST	snow, temperature
SW	snow, water equivalent
TB	temperature, delta
TC	temperature, degree days of cooling
TD	temperature, dew point
TE	temperature, sea water
TF	temperature, degree days of freezing
TG	temperature, underground
TH	temperature, degree days of heating
TM	temperature, air (wet bulb)
TO	temperature, observed ATT temp in degrees F
TP	temperature, pan water

TR	temperature, mean
TS	temperature, bare soil
TW	temperature, water
TY	temperature, surface
UA	wind, average wind speed
UC	wind, accumulated wind travel
UE	wind, average wind direction
UI	wind, run in accumulated miles
UL	wind, travel length accumulated over duration
UM	wind, speed min. (mi. hr. m/ sec)
UP	wind, speed (peak)
UR	wind, reference for wind direction
UT	wind, sigma theta dir. measured in degs
UW	wind, general
VC	generation, surplus cap of units on line
VE	generation, energy total
VG	generation, pumped water, power produced
VH	generation, time
VJ	generation, energy prod. from pumped water
VK	generation, energy store in reservoir
VL	generation, storage (natural flow only)
VM	generation, losses due to spill & other
VP	generation, pumping use, power used
VQ	generation, pumping use, total energy used
VR	generation, stored in reserve flow
VS	generation, station load, energy used
VT	generation, power total
VU	generation, status
VW	generation, station load, power used
WA	water, dissolved nitrogen & argon
WB	water, oxidation reduction potential
WC	water, conductance
WD	water, percentage of dissolved oxygen
WE	water, sea level
WG	water, dissolved total gases, pressure
WH	water, dissolved hydrogen sulfide
WI	water, depth of inst. BLW water level

WL	water, suspended sediment
WO	water, dissolved oxygen
WP	water, pH
WQ	water, quality
WS	water, salinity
WT	water, turbidity
WV	water, velocity
WW	water, Wwll level
WX	water, percentage of saturation
XA	upper air meteorological data
XC	total sky cover
XF	Fog
XG	lightning, number of strikes per grid box
XL	lightning, point strike
XM	Carbon monoxide
XO	ozone measurements
XP	weather, past
XT	tropopause
XU	humidity, absolute
XV	weather, visibility
XW	weather, present
XX	WMO code FM13 IX ship
XY	hurricane radar data
YA	instrument testing
YB	pressure readings from Weirs
YD	dust flux
YI	instrument temperature
YK	strain temperature
YL	transmissonmeters
YM	magnetosphere measurements
YU	DCP serial number
YW	soil heat flux
YY	DCP status (internal params of DCP)
ZA	Test DCP (test purposes only)
ZF	forward radiated power (DCP)
ZR	reflected radiated power (DCP)
ZS	DCP status number

ZT	internal temperature (DCP)
ZL	error log
ZZ	WMO code FMM63 IX bathy