WIMS Technote-2018-01

Fire and Aviation Management Staff

Date: **June 2018**

System: **WIMS**

Subject: **WIMS Version 5.0 Release, NFDRS2016**

Purpose: **Communicate Important Release Information**

Contact: **Interagency Incident Applications (IIA) Helpdesk**

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Scope: **WIMS update with new moisture models and reduced number of fuel models**

WIMS was updated June 8th to incorporate new live and dead fuel moisture models and 5 generalized fuel models. The updates are based on a proposal from the NWCG Fire Danger Subcommittee through the Fire Environment Committee (See Appendix A). It was approved by the NWCG Executive Board in September 2014 (See Appendix B). A synopsis of the updates follows.

#1: Growing Season Index (GSI) to compute all live fuel moisture values

- Provides a significantly better live fuel moisture model using elements from a standard fire weather observation.
- Requires no constant human intervention yet accurately reflects within season and season-to-season live fuel conditions. Eliminates herbaceous state sequencing, season codes and greenness factors.

#2: Nelson Dead Fuel Moisture Model to compute all dead fuel moisture values

- Provides a better dead fuel moisture model that accurately models diurnal and seasonal dead fuel moisture using elements from hourly fire weather observations.
- Requires no daily human intervention for state of weather and fuels wet entries

#3: Reduce fuel models to five fuel response types.

- Eliminates the ’78 vs. ’88 fuel model distinction/confusion; Changing from 40 to five NFDRS fuel models does not reduce model accuracy; it reduces model redundancy. Also removes climate class, shrub type and other ‘88 specific fuel model controls.
- Simplifying fuel models will increase the ability of field personnel to understand and apply fire danger information.

What is the implementation strategy?

NFDRS2016 models are now running in the background, using hourly observations from the existing RAWS network to generate a once-daily NFDR record (at the stations regularly scheduled (RS) time) for each new fuel model. This record type is being called type "N" and it supersedes existing type "N" records that have been being created existing fuel models. It will take about 30 days for the moisture models to calibrate to current weather. Users will need to "opt in" to start viewing and finally accepting NFDRS2016 as their operational NFDRS. **This phased in approach should have no immediate effect on the daily operations except for several areas as described below**.

Does NFDRS2016 work with my current weather station?

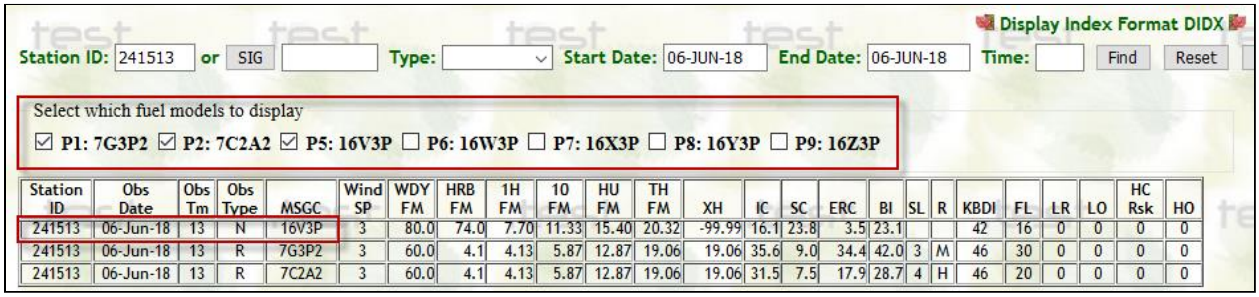
Yes, if your station is a RAWS station with solar radiation and is being ingested via the WIMS RAWS gateway. Developers are working to enable users of the WIMS Alternate Gateway to begin using NFDR2016 later this summer.

What do I need to do differently?

Right now nothing. Keep publishing observations while the 2016NFDRS is running in the background.

What is the first thing I will notice?

If you view your NFDRS outputs via DIDX/ DIDM/PLST you will find there are now decimal places in the moisture and index values.



Station ID	Obs Date	Obs Tm	Obs Type	MSGC	Wind SP	WDY FM	HRB FM	1H FM	10 FM	HU FM	TH FM	XH	IC	SC	ERC	BI	SL	R	KBDI	FL	LR	LO	HC Rsk	HO
241513	06-Jun-18	13	N	16V3P	3	80.0	74.0	7.70	11.33	15.40	20.32	-99.99	16.1	23.8	3.5	23.1			42	16	0	0	0	0
241513	06-Jun-18	13	R	7G3P2	3	60.0	4.1	4.13	5.87	12.87	19.06	19.06	35.6	9.0	34.4	42.0	3	M	46	30	0	0	0	0
241513	06-Jun-18	13	R	7C2A2	3	60.0	4.1	4.13	5.87	12.87	19.06	19.06	31.5	7.5	17.9	28.7	4	H	46	20	0	0	0	0

You will also notice a new line allowing you to select specific fuel models to display. From DIDX/DIDM you can select to display specific NFDRS2016 model rows via checkboxes in that line. Display selections made in DIDX/DIDM are only for your current session. They **do not** change default Active Models for the station being displayed. Currently the NFDRS2016 models are not displayed in the initial DIDX/DIDM screens. Management of which models are displayed in an initial DIDX/DIDM screen is in ENFDR module (see below).

> ***Note #1: If you are viewing NFDRS information for a SIG, the selection line is not valid. There is no way to organize multiple priority models and descriptions for stations in SIGS.***
>
> ***Note #2: If you view an NFDR2016 fuel model you will find the NFDRS ObsType is "N" which signifies the NFDR record is a NFDRS2016 output based on the new moisture and fuel models.***

What are the new models?

As part of the NFDRS2016 update, five new models were added to every RAWS station (type 4) as priority 5/6/7/8/9 fuel models. Their indexes are being computed daily at the Regular Scheduled (RS) time with the new moisture models via the RAWS Gateway process. **No user intervention is required!!**

The fuel models have generic names and are derived from the established Fire Behavior Prediction System models. They are denoted by the prefix "16."

Note: Non 2016 fuel models are now being termed "legacy fuel models."

NFDRS2016 Name	Description	Source
16V	Grass	Scott/Burgan GR2
16W	Grass/Shrub	Scott/Burgan S2
16X	Brush	Scott/Burgan SH9
16Y	Timber Litter	Scott/Burgan TL 1
16Z	Slash	Scott/Burgan SB1

Does NFDR2016 work with Forecast Weather?

Currently no. Developers are working now to use the existing 7-day NWS Fire weather forecasts for the 2016 moisture models. If you view a forecast for a 2016 fuel model, it will be populated with -99 values.

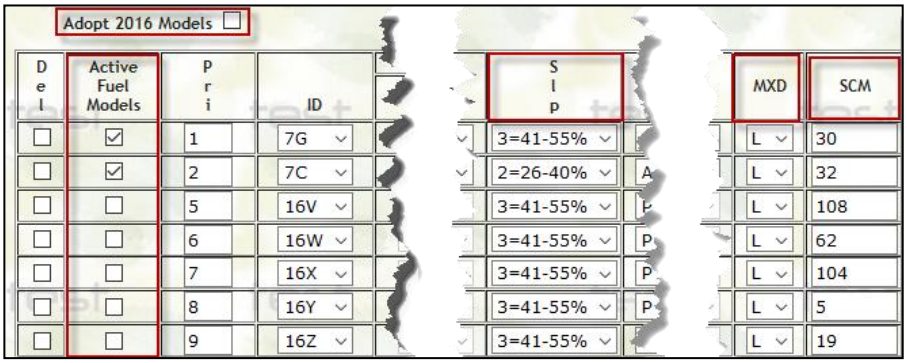
Station ID	Obs Date	Obs Tm	Obs Type	MSGC	Wind SP	WDY FM	HRB FM	1H FM	10 FM	HU FM	TH FM	XH	IC	SC	ERC	BI	SL	R	KBDI	FL	LR	LO	HC Rsk	HO
40309	10-Jun-18	13	F	7G1A2	12	122.0	51.4	7.11	15.07	12.64	15.49	12.49	22.9	11.4	37.1	48.6	3	M	43	34	0	0	0	0
40309	10-Jun-18	13	F	16Y1A	12	-999.0	-999.0	-99.00	-99.00	-99.00	-99.00	-99.00	-999.0	-999.0	-999.0	-999.0			43	-999	0	0	0	0

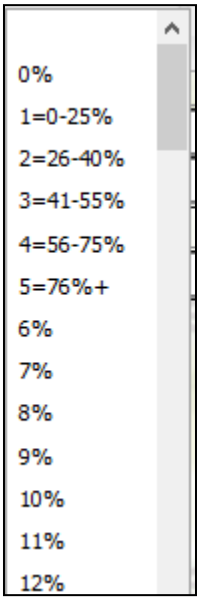
ENFDR Changes

There are five changes in ENFDR to support NFDRS2016 that the average user will see.

#1. A new column (Active Fuel Models) selects what fuel model are displayed on an initial DIDX or DIDM screen. As part of the update display of 2016 fuel models is disabled. Turning these models on and off can be done by the station owner or a person with ACL access to manage a station. Notice that the 2016 models are initially assigned priority 5 though 9. (This was done to make sure existing fuel models were not affected by adding the 2016 models.

#2. In preparation for WIMS to be able to ingest gridded data in the future, the 5 standard slope classes still exist but there is the ability to put in a specific slope from 6% to 250%.



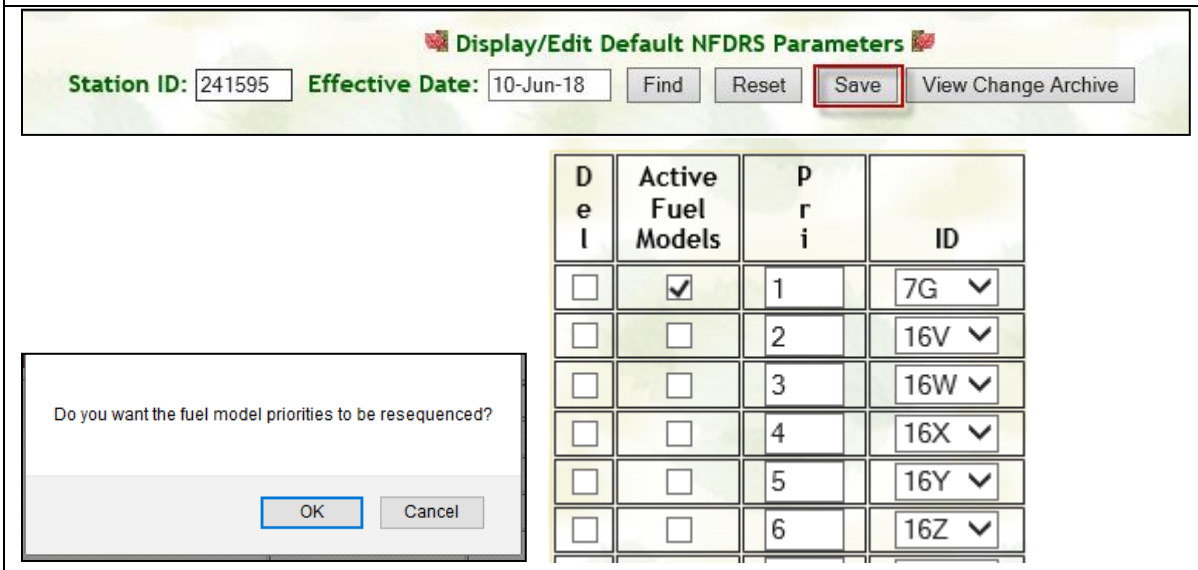


#3. You may also select for each fuel model to a fuel model default Moisture of Extinction (L = fuel model default value) or (H=40%) for more humid climates, usually east of the Mississippi River.

#4. You may enter a locally derived Maximum Spread Component (SCM) to improve the accuracy of the Ignition Component.

#5. A checkbox is present to signal to WIMS when you wish to abandon legacy fuel models and accept NFDRS2016 as your operational system. This will create a backup of all your legacy fuel models and their NFDR records and then delete them from the WIMS production database. More information on this is being developed.

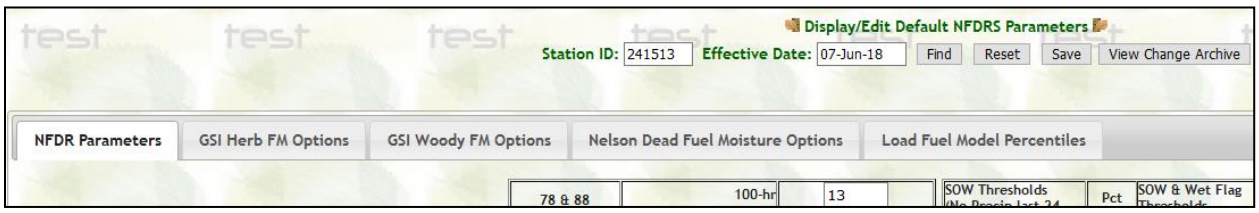
If you had less than four legacy fuel models and you make and save a change to a fuel model (i.e. Green Up) you will see a dialog asking if you want to re-sequence fuel models. If you click OK the fuel models will be re-sequence to remove any gaps in the priority as shown below. If you click Cancel your changes will be saved but the fuel models will remain as they were. You can select either option.



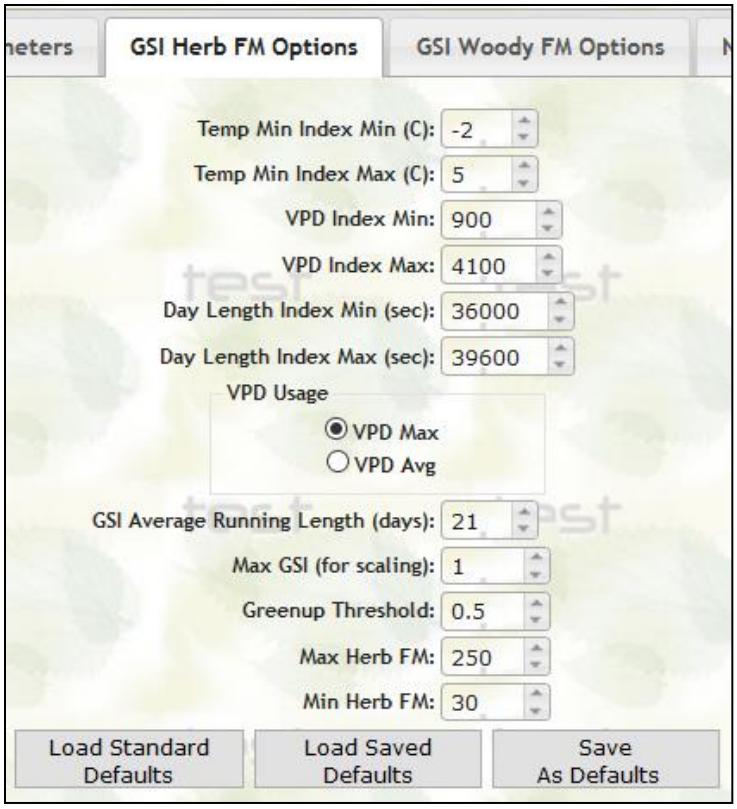
Model Manager Role

WIMS has added a new user role called Model Manager. If you are assigned this role, ENFDR will display additional tabs to actively manage the live and dead fuel moisture models. Guidelines are being developed on their use, but it will look like the following screens.

ENFDR Screen with Model Manager Role.

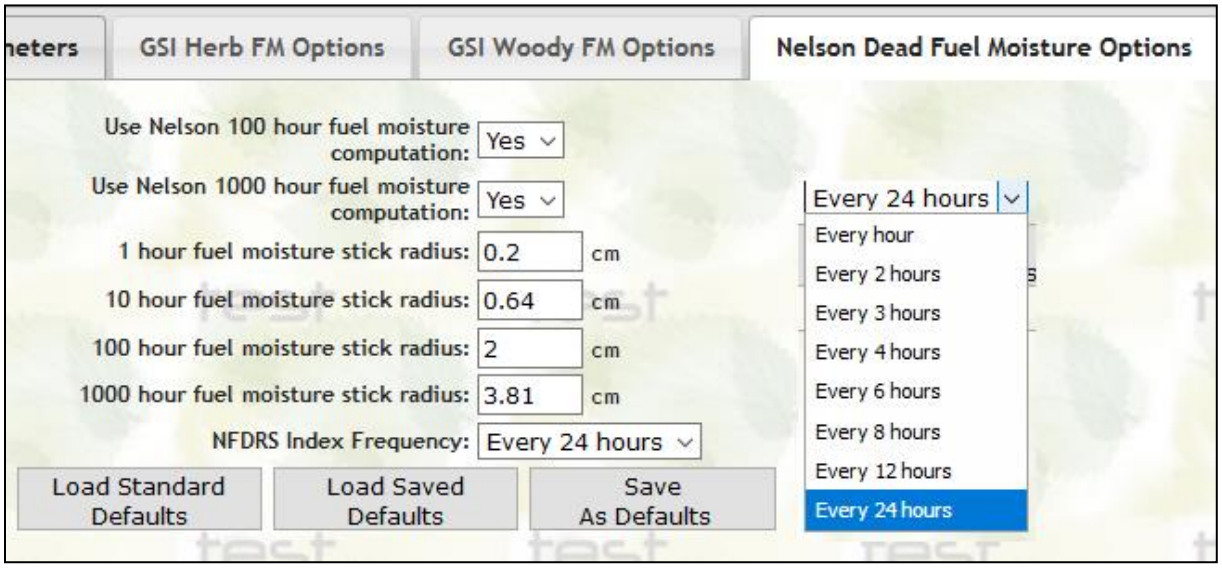


GSI FM Options. Those who may have been working with the Live Fuel Index in Fire FamilyPlus may have seen these parameters to fine tune the live fuel moisture response. These same parameters can be modified for a WIMS weather station for both the Herbaceous and Woody fuel moistures.



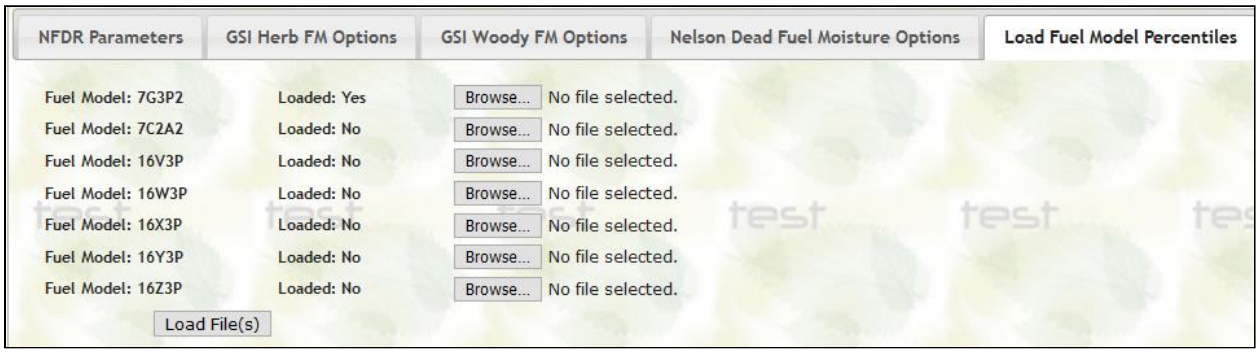
Nelson Dead Fuel Moisture Options. WIMS Model Managers have the ability modify several parameters for dead fuel moisture calculations, including whether to use the Nelson Model for the 100 and 1000 hour fuel moistures. You can also change the frequency that NFDRS indices are compute from once/day (at the RS hour) to other selected frequencies.

Note: Every 24 hours (once-daily at RS time) was set as the NFDR2016 for easier RS time to RS time comparison between models in the DIDX screens.



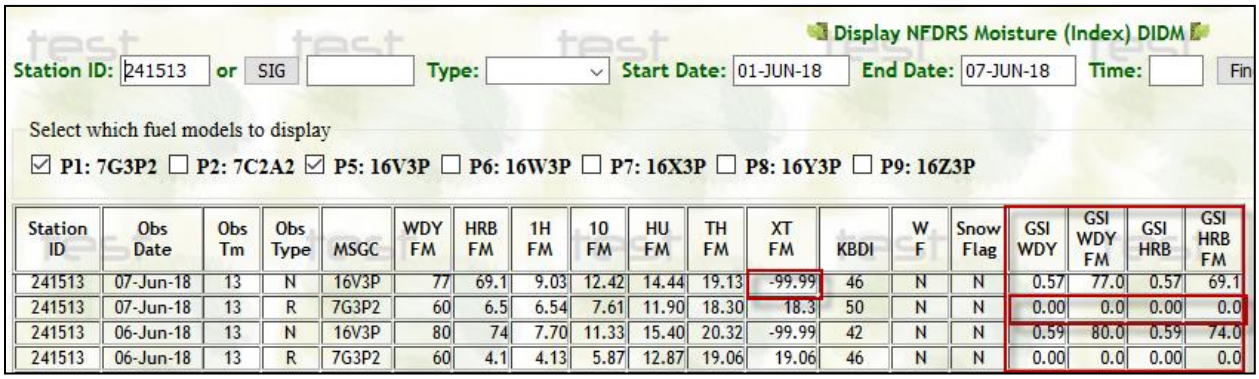
Load Fuel Model Percentiles. WIMS now has some basic ability work with percentiles and to graph indices and percentiles, somewhat like FireFamilyPlus. Currently percentile information for each fuel model must be computed in FireFamilyPlus and uploaded into WIMS (by a Model Manager). Work is underway to expand WIMS capacity to produce percentiles directly from within the WIMS database.

The graphical/tabular display of fuel moistures and indices is done in a new module Compare (**FastPath = COMP**) which is presented in the next section.



DIDM Changes

The DIDM screen has new columns that track the daily GSI values that drive the live fuel moisture calculations. These values will be zero for legacy fuel models. For the 2016 fuel models, the XTFM column will show -99.99 to indicate they are not used for the live fuel moisture calculation.



Display NFDRS Moisture (Index) DIDM

Station ID: 241513 or SIG Type: Start Date: 01-JUN-18 End Date: 07-JUN-18 Time: Fin

Select which fuel models to display

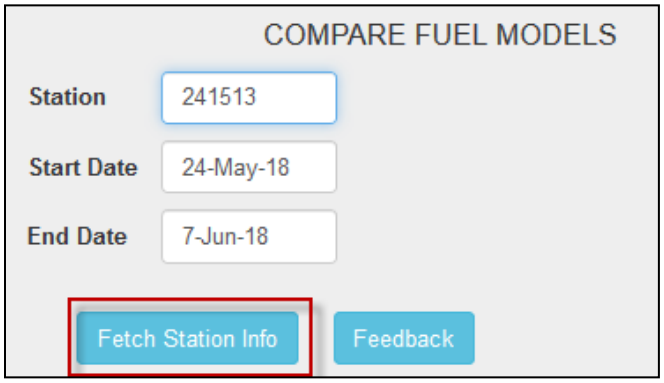
☑ P1: 7G3P2 ☐ P2: 7C2A2 ☑ P5: 16V3P ☐ P6: 16W3P ☐ P7: 16X3P ☐ P8: 16Y3P ☐ P9: 16Z3P

Station ID	Obs Date	Obs Tm	Obs Type	MSGC	WDY FM	HRB FM	1H FM	10 FM	HU FM	TH FM	XT FM	KBDI	W F	Snow Flag	GSI WDY	GSI WDY FM	GSI HRB	GSI HRB FM
241513	07-Jun-18	13	N	16V3P	77	69.1	9.03	12.42	14.44	19.13	-99.99	46	N	N	0.57	77.0	0.57	69.1
241513	07-Jun-18	13	R	7G3P2	60	6.5	6.54	7.61	11.90	18.30	18.3	50	N	N	0.00	0.0	0.00	0.0
241513	06-Jun-18	13	N	16V3P	80	74	7.70	11.33	15.40	20.32	-99.99	42	N	N	0.59	80.0	0.59	74.0
241513	06-Jun-18	13	R	7G3P2	60	4.1	4.13	5.87	12.87	19.06	19.06	46	N	N	0.00	0.0	0.00	0.0

New WIMS Module: COMPARE (FastPath = COMP)

The COMPARE screen is designed to allow you to compare outputs from two fuel models at one station. You do not need the Model Manager role to use COMPARE. The COMP screen has two or three horizontal panels. The top panel is the control section; the others are displays panels.

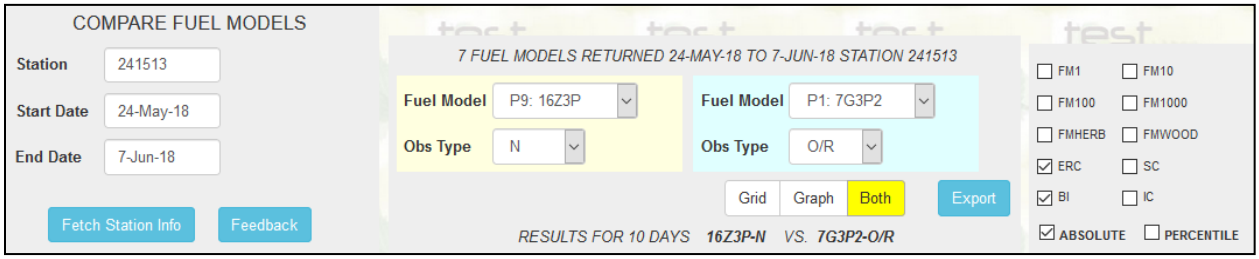
Running COMPARE is a two step process. The first step is to select the station and date range like any other WIMS screen. SIGS are not supported in COMP. Clicking the **Fetch Station Info** button retrieves all the NFDR records for all the fuel models for that station/date. The COMP function keeps these data in local memory so, once loaded, the graphing is very fast.

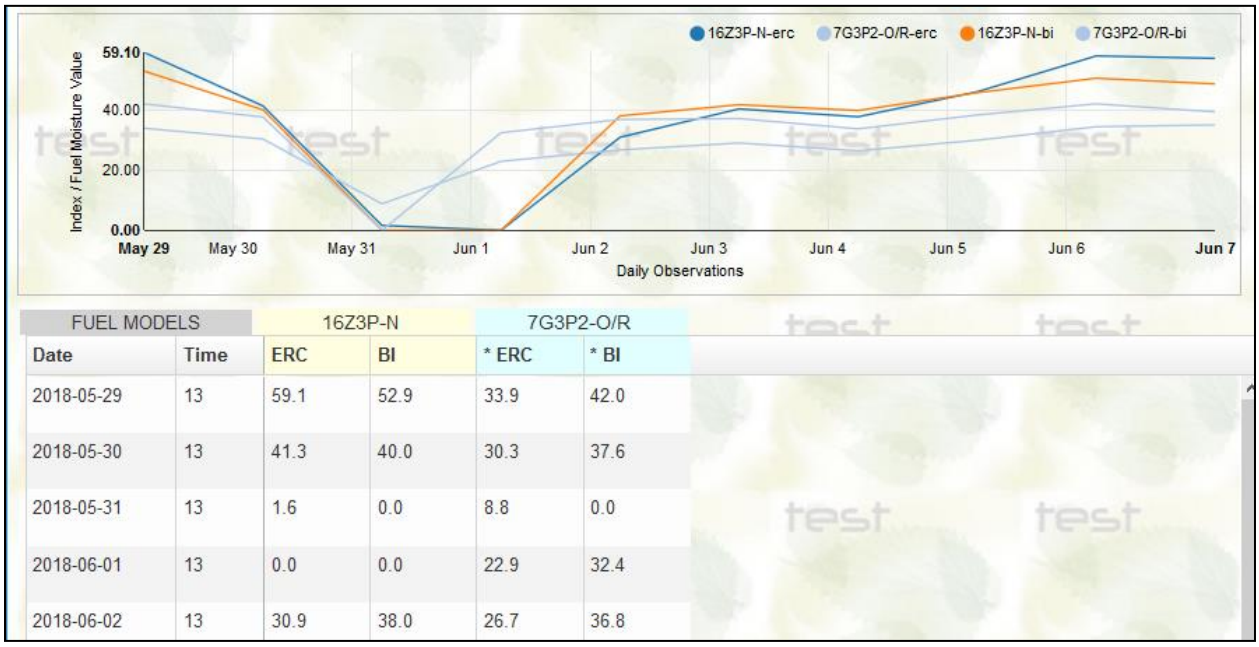


COMP then displays what was retrieved. Here you can select Fuel Model and Observation type. All 2016 fuel models are denoted by Obs Type = N. On the right side you can select which moisture and Index values you want to compare. You can also select to view actual daily values or the percentile of

the daily value. For Display can select Grid (table), graph or both. Both was the selection displayed below.

Note: Percentile Files need to have been loaded in ENFDR before you can view percentiles.





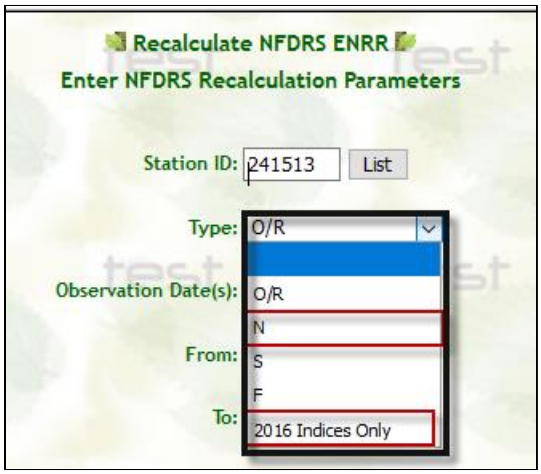
FUEL MODELS		16Z3P-N		7G3P2-O/R	
Date	Time	ERC	BI	* ERC	* BI
2018-05-29	13	59.1	52.9	33.9	42.0
2018-05-30	13	41.3	40.0	30.3	37.6
2018-05-31	13	1.6	0.0	8.8	0.0
2018-06-01	13	0.0	0.0	22.9	32.4
2018-06-02	13	30.9	38.0	26.7	36.8

Finally, the Export button in the control panel will download all the information from the “Fetch Station Info” to a CSV file that can be opened directly on your local computer.

ENRR Changes

If you have occasion to use ENRR to recalculate NFDRS values from past weather observations within WIM, you will see a new Type Selection called “2016 Indices Only.” The difference between type “N” and “2016 Indices Only” is that:

- Type “N” will fully re-compute live and dead fuel moistures from hourly observations along with NFDRS indices at the appropriate frequency. This can take about 10-minutes per year to complete. Type “N” should only be selected if parameter(s) in the GSI live fuel moisture or Nelson dead fuel moisture model were changed by a Model Manager.
- Type “2016 Indices Only” will use previously computed and stored moisture values to re-compute NFDRS indices. This should be used when a 2016 NFDRS fuel model component has changed such as slope class. MXD (moisture of extinction) , SCM (Maximum Spread Component), staffing index or percentile thresholds. This calculation takes about 5 minute/year.



Appendix A. Proposal to update NFDRS

The NWCG Fire Danger Sub-Committee and the NWCG Fire Environment Committee are recommending updates to the United States National Fire Danger Rating System. With over 40 years of data and experience with the existing system, new fuel moisture models allow for significant improvements while eliminating much of the daily interaction with the system. The following proposals were not developed overnight. They have been tested across the country and compared against the existing models for a number of years with good results.

Proposal #1: Incorporate the Growing Season Index (GSI) to compute live fuel moistures

The Growing Season Index is a meteorological based phenology model (Jolly, 2005) that predicts seasonal changes to live fuels. Increasing values of GSI indicate periods of increasing live fuel moisture and decreasing values indicate periods of moisture stress. GSI provides estimates that are closer to measured values than the current NFDRS calculations without the constant "care and feeding" required by the current model. It uses standard observation elements from the RAWS network.

The Wildland Fire Decision Support System (WFDSS) has been using the Growing Season Index (GSI) to model live fuels moisture for two years. GSI live fuel calculations, based on selected RAWS, are used in all WFDSS fire behavior models to populate the woody and herbaceous fuel moisture inputs. Lessons learned from WFDSS are being used to calibrate GSI parameters to a local RAWS for optimal model performance when the model is implemented in WIMS. GSI user interface and algorithms are now being tested in the WIMS Test system.

GSI will be used to replace the existing NFDRS live herbaceous and woody fuel moisture models. This will eliminate the need for managers to enter a green-up date each year because GSI predicts green-up of live fuels from weather observations. The live fuel moisture models in NFDRS have always been cited as the weakest component of the system and this change will significantly improve fire danger rating in areas where live fuels dominate. GSI will provide the improved live fuel modelling needed for the southeastern states to increase their confidence in fire danger outputs.

Highlights:

- **Provides a significantly better live fuel moisture model using elements from a standard fire weather observation.**
- **Requires no constant human intervention yet accurately reflects within season and season-to-season live fuel conditions.**

Proposal #2: Incorporate the Nelson Model to compute fine dead fuel moisture

Developed by Ralph Nelson (Nelson, 2000) it is a model designed to use frequent (hourly or less) weather observations that include temperature, relative humidity, solar radiation, and precipitation amount to compute fine (1 and 10 hour) dead fuel moisture (DFM). The current algorithms for fine DFM in the National Fire Danger Rating System (NFDRS) were originally developed by Mike Fosberg in the 1970s. They use once-a-day weather information and require manual entry of 'state-of-the-weather' and 'fuels wet' codes. These early algorithms were calibrated to estimate fine DFM for mid-afternoon conditions. Legacy DFM models are generally referred to as the "Fosberg" models.

Based upon extensive validation studies in cooperation with Oklahoma State University and the Oklahoma Mesonet (Carlson and others 2005, 2007), the Nelson model was extended from its original formulation of predicting 10-hour fuel moisture to being configurable for any diameter/time lag dead fuel. It constitutes a significant improvement over existing NFDRS DFM algorithms for the 1 and 10 hour fuel moistures. The ability of the Nelson model to predict diurnal fuel moisture and higher levels of fuel moisture than the Fosberg model (e.g. >30%) is useful.

Evaluation is still in progress for the performance of 100 and 1000 hour moistures in the Nelson model and we are not proposing to replace the easy to compute and highly reliable Fosberg solutions at this time.

In December 2010, the production version of WIMS started running the Nelson model, in a prototype mode, for all RAWS stations. It computes fine fuel moisture values and associated NFDRS indices four times per day, 365 days/year. These values are stored in the WIMS database separate from values from the operational Fosberg model to facilitate statistical comparisons.

Highlights:

- **Provides a better fine dead fuel moisture model that accurately models diurnal fine DFM using elements from hourly fire weather observations.**
- **Requires no daily human intervention for state of weather and fuels wet entries**

Proposal #3: Reduce the number of fuel models in the NFDRS.

The first National system (1972) contained 9 fuel models. John Deeming, the lead developer of the 1978 update lobbied for four fuel models, to clearly differentiate between the Fire Danger Rating and Fire Behavior Prediction systems, which were both under development in the mid 1970's. Other forces prevailed however and the 1978 NFDRS was released with 20 fuel models. Local fire management input from the Southeast identified that the 1978 version was not responsive to their fuels, particularly with respect to live fuel moisture. The 1988 update added extra parameters (i.e. drought fuel loads) and modified values (i.e. fuel loads) to the existing fuel models, creating in essence, 20 more fuel models. But it did not fundamentally change the live fuel moisture model; it only gave the user the opportunity (or burden) of manipulating the live fuel moisture model on a daily basis. A comprehensive fix for the live fuel moisture calculations is addressed in Proposal #2.

The demand for more fuel models stemmed from the thought that models with subtle differences would provide an increase in accuracy of outputs, but this was found to unrealistic considering the vast areas being assessed by the NFDRS. Using 10 years of weather data, and computing Energy Release Component distributions for each of the original 20 fuel models (same weather) a statistical similarity analysis shows that the outputs between the various models were highly correlated. In fact, the three slash models are perfectly correlated with each other. By cluster analysis of the correlations, outputs fall into three or four unique fuel model response groups: grass, brush, slash, and timber/litter.

It is proposed that the new system will have four fuel types that reflect the response time of fuels to weather conditions. These models are Short, Medium, Long, and Very Long. These four models correspond to the four Fire Behavior Fuel Model (FBFM) groups: grasses, brush, timber, and slash. These four FBFMs groups are also the fuel models used in WFDSS.

Highlights:

- **Eliminates the ’78 vs ’88 fuel model distinction/confusion.**
- **Changing from 40 to four NFDRS fuel models will not produce a reduction in model accuracy or outputs.**
- **Simplifying the fuel models used in NFDRS will increase the ability of field personnel to understand and apply fire danger information.**

Appendix B: NWCG Memorandum on NFDRS2016

NATIONAL WILDFIRE COORDINATING GROUP

Memorandum No. 16-019
Date: 7 September 2016

TO: NWCG Executive Board Members

FROM: John Glenn, Chair, NWCG Executive Board

SUBJECT: Update on revisions to the National Fire Danger Rating System

The purpose of this memorandum is to provide an update on revisions to the National Fire Danger Rating System.

In September of 2014, the NWCG Executive Board approved a revision to the US National Fire Danger Rating System (NFDRS). Completion of the updated system, NFDRS2016, is expected November 1, 2016. NFDRS2016 will include three significant changes:

- Replace Fosberg Dead Fuel Moisture Model with the Nelson Dead Fuel Moisture Model.
- Replace Burgan Live Fuel Moisture Model with the Growing Season Index-based live fuel moistures.
- Reduce the number of fuel models in the NFDRS from 40 down to 5.

Implementing these changes will result in a major simplification of the NFDRS. Many unused system components will be safely removed, while the core usefulness and functionality of the system will remain essentially unchanged. The NFDRS will be easier to use and understand.

The NFDRS2016 model development work is complete and is now being incorporated into the primary NFDRS processors: Weather Information Management System (WIMS) and Fire Family Plus (FFP). Technical documentation is 95% complete and waiting for case studies that require the use of the new FFP application to complete. For the latest information on the status of the NFDRS2016 implementation go to http://www.wfas.net/nfdrs2016.

The NWCG Fire Danger Curriculum Unit has been working on a revision to the S-491 Intermediate Fire Danger Rating course which will incorporate the NFDRS2016 into a scenario based format. The revised S-491 will be presented within the next two years. Until then the current S-491 class is still valid. Refresher training videos for employees who have previously completed S-491 are being developed, and will be available starting in March of 2017. The videos will focus on the key aspects and impacts of NFDRS2016. Videos will be accessible from the NWCG Fire Danger Subcommittee webpage at http://www.nwcg.gov/committees/fire-danger-subcommittee/resources.

Workshops to support the transition to NFDRS2016 are being arranged for each Geographic Area for winter 2016-spring 2017.

In 2017 and 2018, the field may use both versions and compare both the outputs and the decisions made. This will provide the Fire Danger Subcommittee feedback on how the NFDRS2016 compares to the older version at supporting sound decision making. The new WIMS contains a module where users will be able to compare models inside the program and provide feedback based on results. We encourage you to provide feedback thru the 2018 fire season.