Introduction

The LANDFIRE Total Fuel Change Tool, or LFTFC Tool, is an ArcGIS toolbar that links to a set of fuel rules stored in a Microsoft Access database. The fuel rules assign spatial areas to certain fuel attributes, such as Fire Behavior Fuel Models, based on vegetation characteristics and disturbance history specified in LANDFIRE data. Users can edit the rules and run the tool to see how changed assumptions about the fuel attributes of specific vegetation types will impact the output fuel attribute grids and the resultant fire behavior characteristics.

The tool quickly translates user-defined fuel rules into spatial layers, allowing for iterative changes to LANDFIRE fuels data. This can facilitate routine and recurring database management used in the progressive manipulation of fuel data for planning, fire incidents, and LANDFIRE fuel calibration.

The tool allows users to take expert knowledge of fire behavior and effects (including spatial distribution) from a wide range of specialists, combine it with information provided by LANDFIRE, and easily translate this knowledge into spatial layers for visualization and for use in fire behavior models. Spatial outputs adhere to landscape data file standards for use with FARSITE, FlamMap, WFDSS, FSPRO, and other fire behavior/fire effects programs.

The intent of this tutorial is to familiarize the user with basic LFTFC Toolbar functionality. It is the user's responsibility to determine whether LFTFC Tool fuel attribute outputs match the expected fire behavior characteristics, given values such as moisture content and wind conditions that best fit the analysis area. For further explanation of the LFTFC Tool's capabilities, refer to the LANDFIRE Total Fuel Change Tool User's Guide, located on www.niftt.gov. To best understand the LFTFC Tool's outputs listed below, the user should have a thorough knowledge of fuels and fire behavior for their areas of interest.

Surface Fuel Grids:	Canopy Fuel Grids:
Fire Behavior Fuel Model 13 (FBFM 13)*	Forest Canopy Cover (CC)
Fire Behavior Fuel Model 40 (FBFM 40)*	Forest Canopy Height (CH)
Fuel Loading Models (FLM)	Forest Canopy Bulk Density (CBD)
Fuel Characteristics Classification System (FCCS)	Forest Canopy Base Height (CBH)

*This tutorial references both Anderson's (1982) 13 fuel models and Scott and Burgan's (2005) 40 fuel models. All fuel models are referred to by number (1-13 for the Anderson models and 101-204 for the Scott and Burgan models).

It will be helpful for the user to have a working knowledge of the LANDFIRE vegetation and disturbance data, especially the layers listed below, which are used as inputs to the LFTFC Tool:

Biophysical Setting (BpS)
Existing Vegetation Type (EVT)
Existing Vegetation Cover (EVC)
Existing Vegetation Height (EVH)

Fuel Disturbance (FDist)

Descriptions of these layers can be found at http://www.landfire.gov/vegetation.php and http://www.landfire.gov/disturbance.php.

For this tutorial, imagine yourself tasked with fine-tuning the LANDFIRE fire behavior fuel model layers for your area of interest. The revised fuel layers that you produce will be used in fire behavior models in the upcoming fire season. Keep this objective in mind as you proceed through the tutorial.

Computer Requirements

Ensure the following programs are installed and functioning properly on your computer:

- ArcGIS 10 and current service pack
- Spatial Analyst extension of ArcGIS
- Microsoft Access (2000 or higher, current version preferred)

Although system requirements that are adequate to run ArcGIS will suffice to run tools created by the National Interagency Fuels Technology Transfer (NIFTT), at least 10 GB of free hard drive and 2 GB of RAM are recommended to run the LFTFC Tool. Generally, faster processors, more memory, and increased free hard drive space will improve performance. In addition, NIFTT tools were developed for Windows Operating Systems.

Section I. Installing the LFTFC Toolbar into ArcGIS

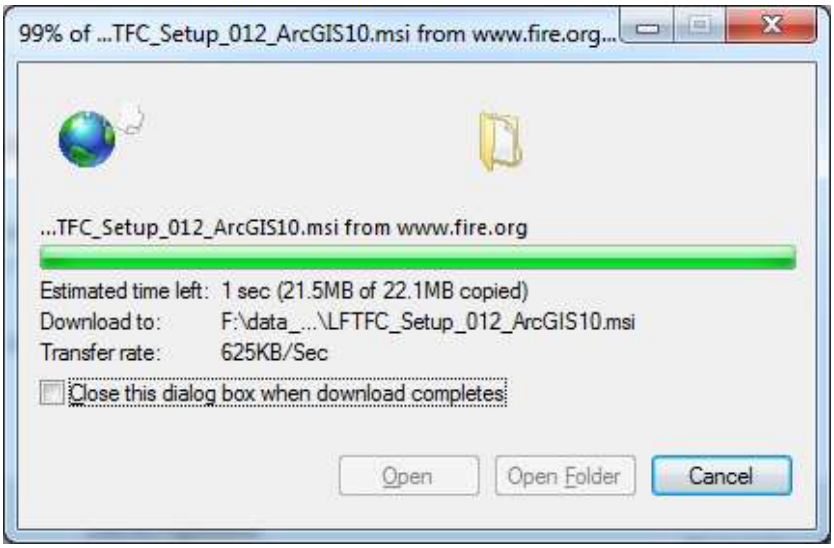
Follow these steps to install the LFTFC Toolbar. If you have a previous version of the LFTFC Toolbar installed on your computer, go to the Control Panel and select **Add/Remove Programs**. Uninstall any older versions of the LFTFC Tool. Refer to the LANDFIRE Total Fuel Change Tool User's Guide (www.niftt.gov) if you are prompted to install .NET.

□ Navigate to www.niftt.gov and click on **Current Tools & User Documents** located in the upper menu.

□ Under *Downloads*, select **LFTFC Tool**; click **Save** (or **OK**, depending on your browser) when the *File Download* dialog box appears and navigate to *C:*.

□ Right-click in the white space within the dialog box and select **New > Folder**. Name your new folder "Downloads." Note: If you already have a folder where you typically download programs, skip this step and use your existing folder.

□ Double-click on the *Downloads* folder and click **Save** in the *Save As* dialog box. A download progress dialog box appears like the one shown below. The download time will vary, depending on your Internet speed.



□ When the download is complete, the download progress dialog box will disappear if you've placed a check mark in the white box in the lower left side labeled *Close this dialog box when download completes*. Or, click **Close** when the download process ends. You are now ready to install the LFTFC Toolbar.

□ Navigate to the *C:\Downloads* folder containing the LFTFC Tool install file.

□ Double-click **LF TFC_Setup_012_ArcGIS10.msi** to initiate the installation process. (You may receive a security warning; select **Run** or **Yes** to run the software install.)

□ The *Setup Wizard* opens. Click **Next** three times and **Close** when the installation completes.

□ Open ArcMap and verify that the LFTFC Toolbar is present.

□ If the LFTFC Toolbar is not present, go to **Customize > Toolbars**. Make sure that the LFTFC Toolbar is checked and visible.

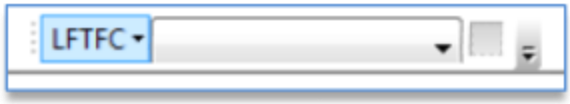
Once the tool is selected, the toolbar will appear in ArcMap. Also, check that the Spatial Analyst extension is activated under **Customize > Extensions**.

The LFTFC Toolbar should now be enabled and ready for use. If you have any further questions about installation, refer to the LANDFIRE Total Fuel Change Tool User's Guide (www.niftt.gov) or contact the helpdesk at helpdesk@niftt.gov.

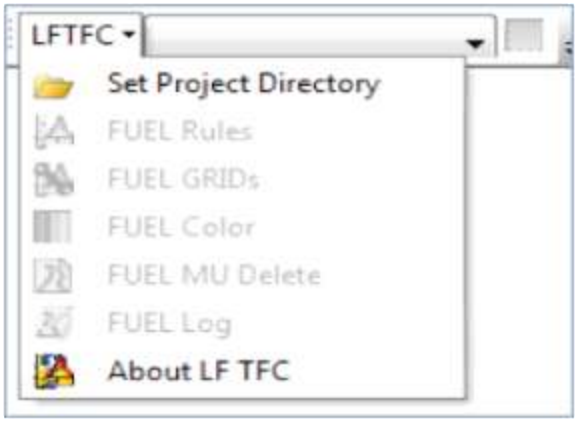
Section II. Tool Review and Setting up a LFTFC Toolbar Editing Session

The following section will familiarize you with the LFTFC Toolbar.

A. The LFTFC Toolbar

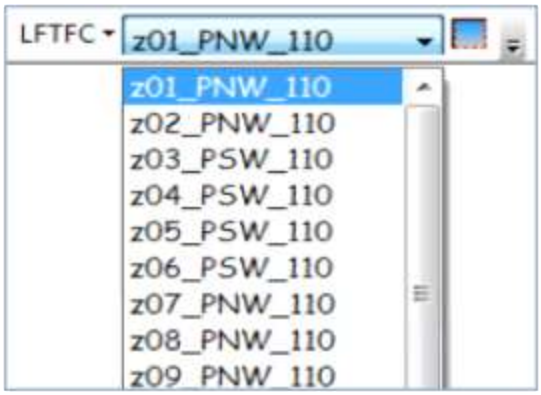


The first drop-down menu on the LFTFC Toolbar serves seven functions, as shown below:

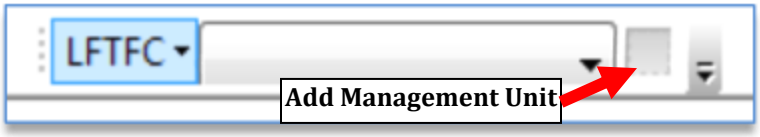


This menu allows you to set the project directory, create and revise rules, and build grids.

The second menu with the drop-down arrow allows you to specifiy the Management Unit for your area of interest, as shown below:



The last icon on the LF TFC Toolbar is *Add Management Unit*, shown below. This is where the area of interest is specified, either with a user-defined extent or the intersection of the grids used in your project.



B. Starting a LFTFC Toolbar Editing Session

If you have not already done so, begin by extracting the data file that came with this tutorial to your local drive (*C:\LFTFCT_Tutorial*). To begin your first LFTFC Toolbar session, you will add five LANDFIRE raster data layers, each in the same projection and geographic extent:

Layer name	Description
bps	Biophysical Setting
evt	Existing Vegetation Type
evc	Existing Vegetation Cover
evh	Existing Vegetation Height
fdist	Fuel Disturbance

□ Use the *Add Data* button to navigate to the **Wallow1_110EVT, Wallow1_110EVC, Wallow1_110EVH**, **Wallow1_110BPS**, and **Wallow1_FDIST2008** folders from *C:\LFTFCT_Tutorial\Wallow_Fire_Base_Files* and add the raster within each folder to your map. These raster layers will provide the input for the LFTFC Toolbar. Also add **20110617_Wallow_Progression_prj.shp** from *C:\LFTFCT_Tutorial\Wallow_Fire_Base_Files*.

□ If the *Create pyramids* dialog box appears, select **No** to speed up processing. If you do not want to see this box again, check the box in the lower left-hand corner to disable it.

EVT, EVC, EVH, BPS, and Disturbance are the required input layers for the LFTFC Tool. In addition, you will notice that there are several other grids included in the *Wallow1* folder. While they will not be used in the tutorial, it is good practice to download all necessary grids that will eventually be used in an .lcp file so that your data are in the same projection and extent. While you are going to edit only the fire behavior fuel model grids, you will still need the full landscape file data suite in order to run Farsite, FlamMap, and other fire behavior models.

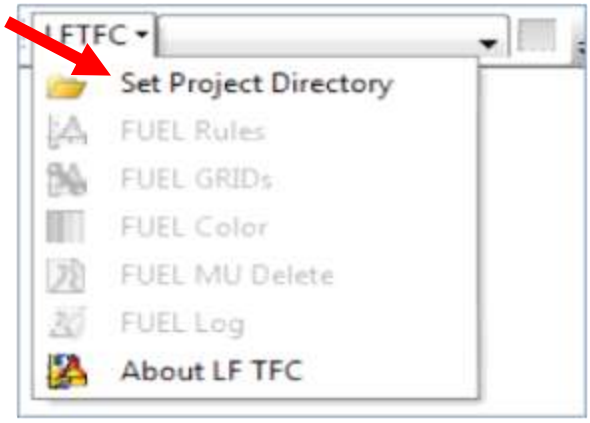
Section III. Conducting a LFTFC Toolbar Session

A. Set Project Directory and Management Unit

You will now set the project directory, specify the path to EVT, EVC, EVH, BPS, and FDIST grids, and specify the management unit. The management unit is the area that will be analyzed when the tool is run. There are two possible ways to specify the management unit: by drawing a rectangle in ArcMap, or by using the intersection of the required input grids. In this tutorial the grids provided are already clipped to the desired management unit to facilitate instruction. For this reason, we will use the intersection of the required grid function. This is the method you will want to use, for example, whenever LANDFIRE data are downloaded from the Data Distribution Site and analyzed by map zone. In contrast, if you need to analyze only a portion of previously downloaded LANDFIRE data, then you can use the Add Management Unit rectangle tool from

the toolbar to draw the Management Unit. In this case, the intersection of the required grid function will not be used (see below).

□ Click the down arrow on the LFTFC Toolbar and select **Set Project Directory**, as shown below:



□ Navigate to **C:\LFTFCT_Tutorial\LFTFC_Tool_projects** and click **OK**. (This folder was created when you unzipped the tutorial data.)

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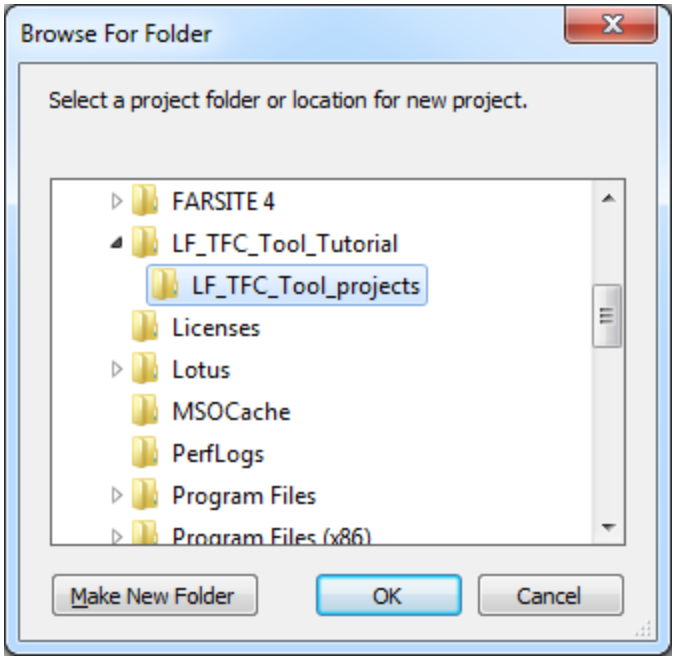
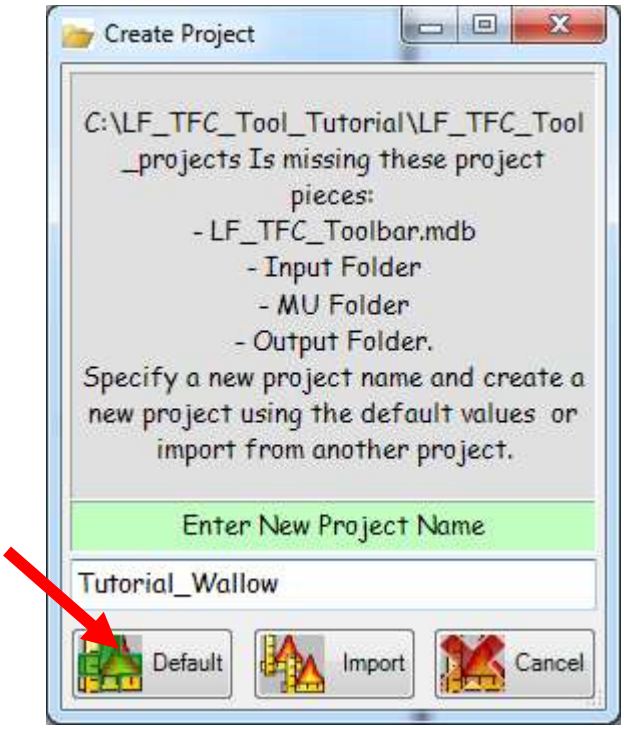
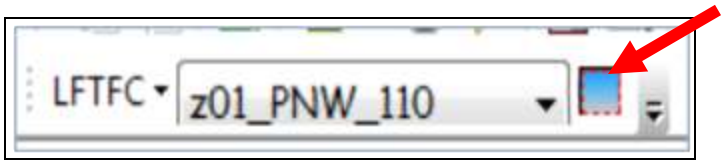


Tip: When creating a new project, the project directory should always be set to an empty folder. If anything goes wrong and you need to start the tutorial over, it may be easiest to create a new folder (for example, "LFTFCT_Tutorial_project2") and save the new project there. Alternatively, you can use ArcCatalog to delete any existing files from the LFTFC_Tool_projects folder before setting it as the project directory for your new project.

□ Enter "Tutorial_Wallow" into the *New Project Name* box and choose default. The tool loads the database and folders necessary to run the tool.

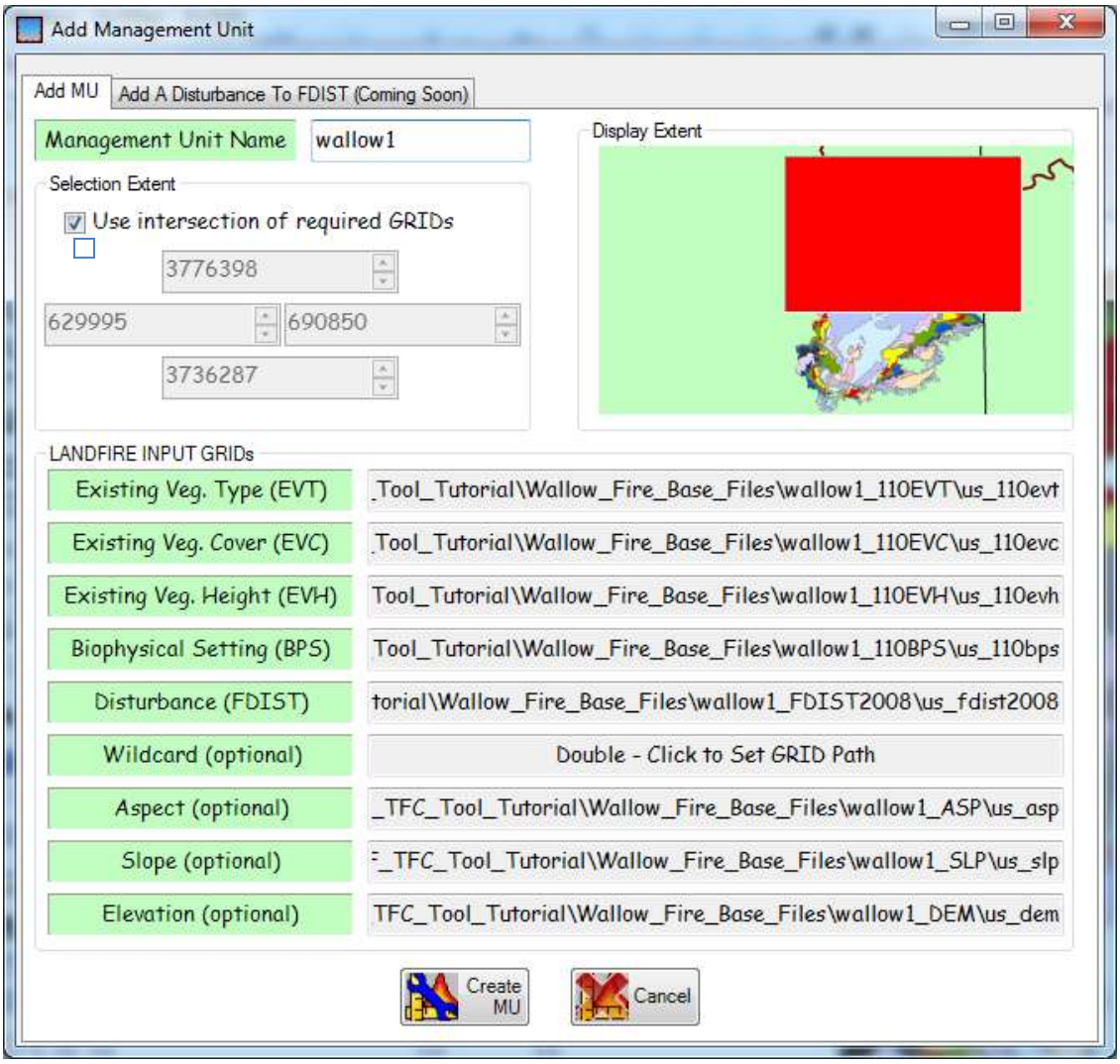


□ Once the database is loaded into your *Tutorial_Wallow* project folder, notice that the management unit list is populated. Click once on the **Add Management Unit** icon on the toolbar, as shown below:



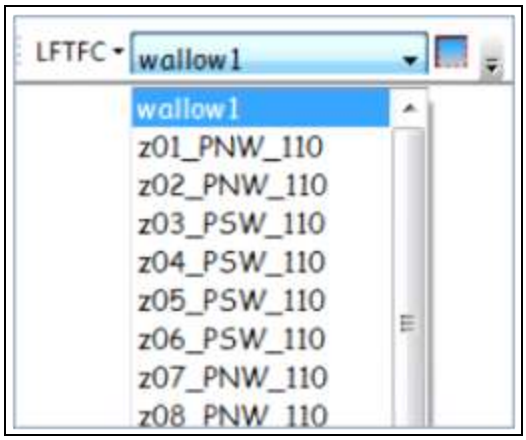
□ With your cursor, drag an extent rectangle over the layers in your ArcMap project across a portion of the Wallow Fire area. It is not important that your extent rectangle cover your entire dataset because you will not use this extent. As soon as your extent is drawn, a window appears.

□ Under *Management Unit Name*, type "Wallow1", check **Use intersection of required GRIDs** under *Selection Extent*, and navigate to each grid path (in the folder *LFTFCToolTutorial\ Wallow_Fire_Base_Files*), as shown below by double-clicking in each grid window.



□ Confirm that your window matches the one shown above and click **Create MU**.

Wallow1 will appear in the management unit list, as shown below. Management units are listed alphabetically and **wallow1** is at the top of the list. In addition, the combine grid **wallow1** with **EVT, EVH, EVC, BPS**, and **FDIST** appears in your Table of Contents.



You've defined your Management Unit and are now ready to import and edit fuel rules.

B. Import and Edit Fuel Rules

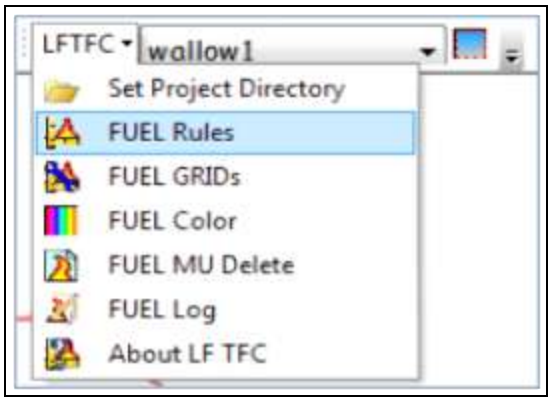
For this exercise, you are interested in an area of eastern Arizona and western New Mexico that was the site of the 2011 Wallow Fire. The default fuel rule sets provided by LANDFIRE for this area are not consistent with the actual fire behavior observed during the Wallow Fire. As a result, you have been tasked with editing the fuel rules to better match the observed fire behavior.

The rule sets that determine LANDFIRE fuel attributes are based primarily on EVT, EVC, EVH and FDIST by map zone. Your area of interest lies primarily in Zone 15 and extends into Zone 24. If you are not familiar with LANDFIRE map zones, you can refer to the supplemental information section in the metadata to determine in which zones your data lie.

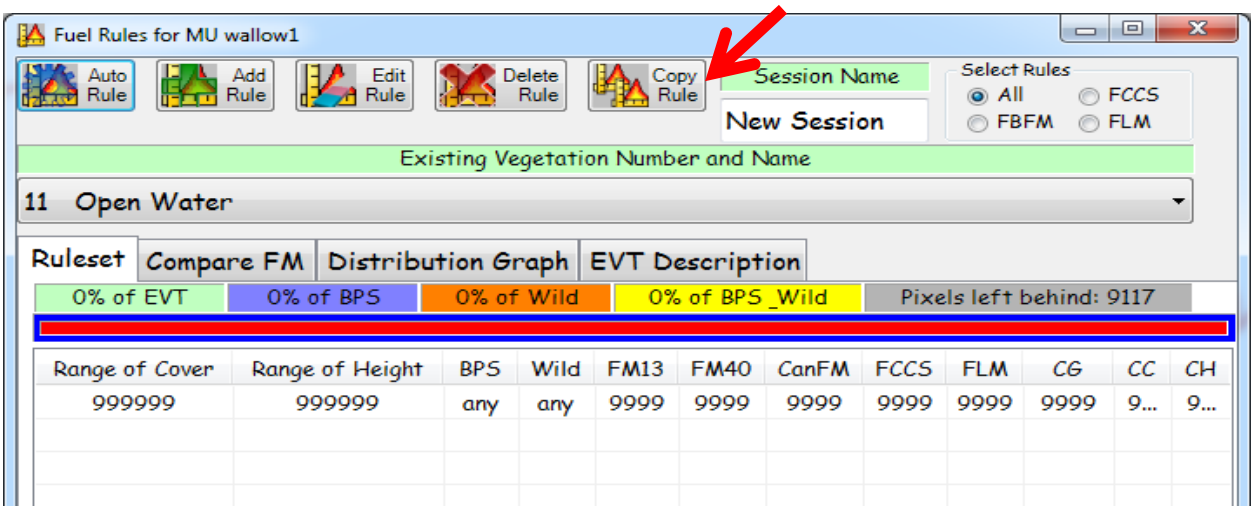
First, you will add fuel rules from the default set of rules (which you imported when you set your directory and clicked **default**) for each map zone in the LANDFIRE data. If the management unit had fallen entirely within Zone 15, you could have imported all of the necessary default rules from that zone. Instead you are interested in a subset of Zone 15 and a portion of Zone 24. As a result, you will first import the dominant Zone 15 fuel rules, then add any missing Zone 24 rules, and finally, delete any conflicting or extra rules.

Second, you will edit selected fuel rules to make them more consistent with the observed fire behavior. You are familiar with LANDFIRE's FBFM 13 and 40 grids for this area and ultimately want to increase fire behavior outcomes for EVT 205200, Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland. In the actual Wallow Fire, there was torching and spotting in this EVT, which the fire behavior models would not re-create with the surface fuel models in the LF data. You know that the fire behavior found in the FBFM 13 and 40 grids is mostly accurate, but want to increase fire behavior where there is moderate cover range: 40 to 59%. In the actual Wallow Fire incident, this cover range was hard to model because it was designated a fuel model 8 (Compact Timber Litter)/183 (Timber Litter or TL3).

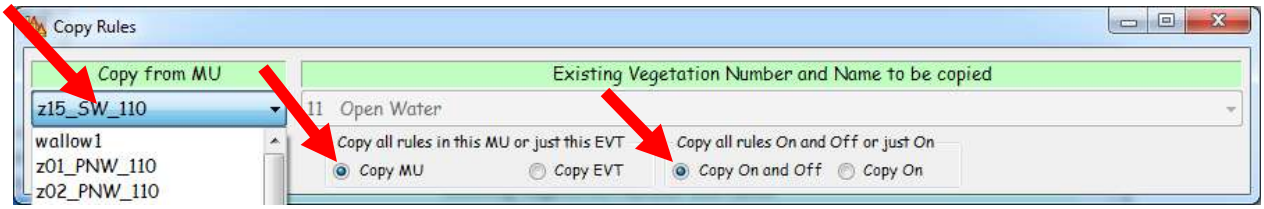
□ To import rules that fall within your management unit, click the down arrow on the LFTFC Toolbar and click on **FUEL Rules**, as shown below:



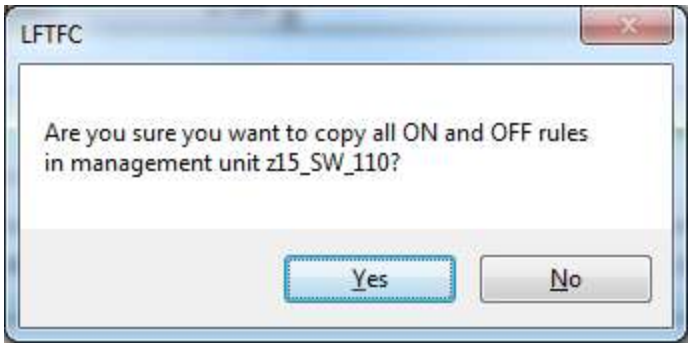
□ The *Fuel Rules for MU wallow1* window appears. All of the rules will be empty because the grid is a customized management unit. You can immediately tell the grid is empty from the red bar indicating that pixels in EVT 11 Open Water are not covered by rules. Click on the **Copy Rule** button, as shown below:



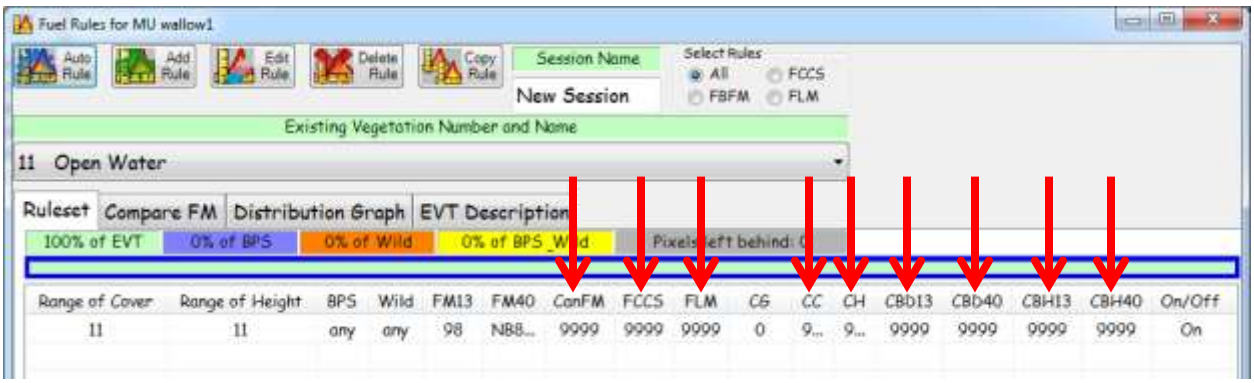
□ Click the down arrow in the *Copy from MU* area in the *Copy Rules* window and scroll down; click on **z15_SW_110**, as shown below. Confirm that both the *Copy MU* radio button and the *Copy On and Off* radio button are both selected, as shown below. Click **Copy Rules**.



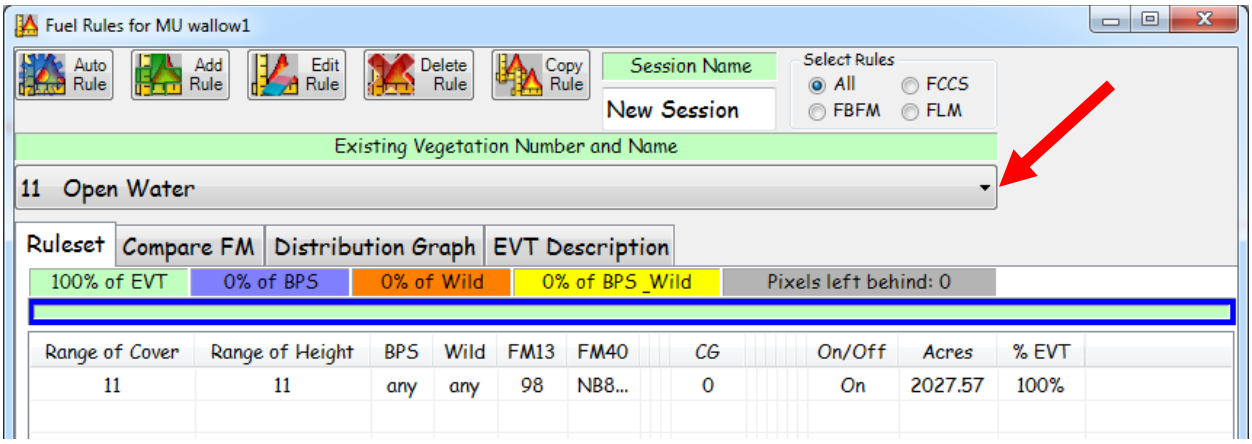
□ Click **Yes** when asked if you want to copy all ON and OFF rules for **z15_SW_110**. This means you will get all rules, whether they were used or not.



□ There are several headings in the *Fuel Rules* window that you do not need for this session. To make things easier to see, click once on *CanFM* heading (in the center) to hide it. Do this with FCCS, FLM, CC, CH, CBD13, CBD40, CBH13, and CBH40 (to unhide, you can click on the headings once again; to expand, you can double-click the margin of the field to match the attribute width).



The *Fuel Rules for MU wallow1* window will look like the one shown below:



Click on the *Existing Vegetation Number and Name* down-arrow and note that list of EVTs for Zone 15. With the inclusion of disturbances in LF 2008 Refresh data, the EVT list has been extended to include each combination of EVT, disturbance type, disturbance severity, and time since disturbance as a separate EVT. If a disturbance has occurred in an area between 1999 and

2008 and has been recorded in the LANDFIRE data, it will show up as an EVT, such that the original EVT is split into two or more new EVTs: an undisturbed type, and a separate disturbed EVT for each combination of disturbance type, severity, and time since the disturbance that occurred in the original EVT. With 11 Open Water highlighted blue, use your arrow up and down keys and click through all EVTs. Or, from the drop-down arrow, scroll down the EVT list and note that the EVTs are listed in a 2-digit sequence, and then for the "non-developed" EVTs, they transition to 6 digits. In the 6-digit codes used for non-developed EVTs, the first number in the code indicates whether the EVT is disturbed and the type of disturbance, as follows:

Non Disturbed	Fire Disturbance	Mechanical Add	Mechanical Remove	Wind	Insect and Disease
2xxxxx	3xxxxx	4xxxxx	5xxxxx	6xxxxx	7xxxxx

The next 3 numbers in the code indicate the original or undisturbed EVT, and the last 2 numbers represent the severity of the disturbance and the time since last disturbance, as follows.

Severity (the 5th digit in the number sequence) is described by:
Low = 1, Moderate = 2, and High =3.

Time Since disturbance (the 6th digit in the number sequence) is described by:
1 = one year since disturbance, 2 = 1 to 5 years since disturbance, and 3 = 5 to 10 years since disturbance.

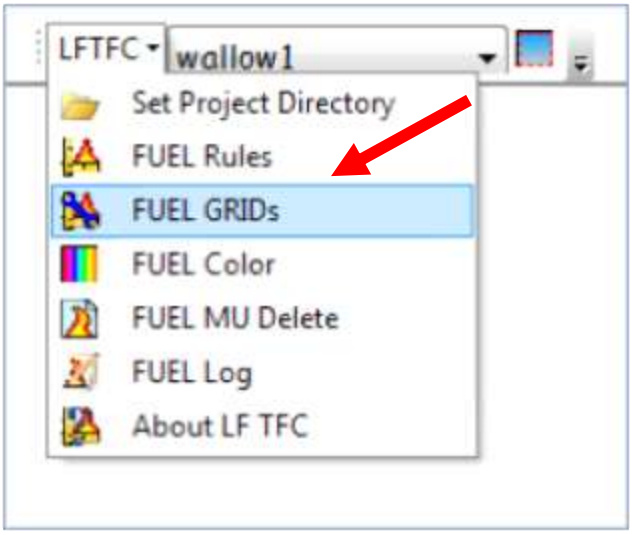
In the below example, an area with the code 311712 represents an area of EVT 211700 Southern Rocky Mountain Ponderosa Pine Savanna that had a fire disturbance of low severity between 1 and 5 years prior to the end of 2008.

Fire disturbance----from non-disturbed EVT----Severity----Time Since Disturbance

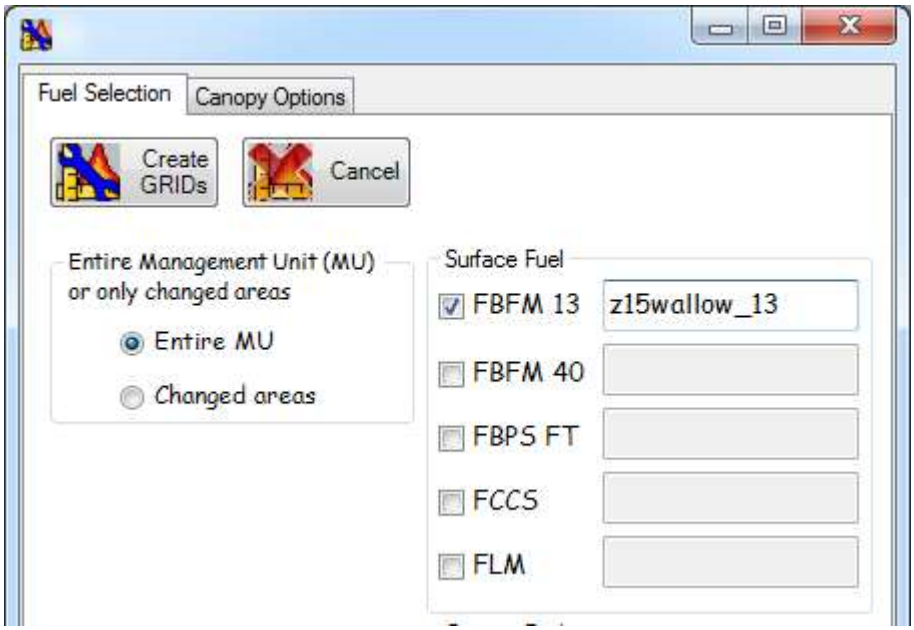
3	117	1	2

As you select an EVT from the drop-down list, the rules that were imported for that EVT will appear under the *Ruleset* tab. Since the MU Wallow1 stretches across LANDFIRE map zone boundaries, not all the rule sets for all the EVTs within the MU will be covered by what was copied in for Zone 15. As you scroll through the EVT list, you'll see that several have red in the indicator bar, showing that they have pixels not covered by the fuel rules. Others have less than 1% missing pixels, which will not be indicated in red on the bar. It's important to make note of the tab indicating *Pixels left behind* as well as the bar indicator. Scroll to EVT 215300 and 215500. The first is an example of an EVT with some pixels that aren't covered by the Zone 15 rules; the second is an example in which the rules cover all of the pixels. You can account for all pixels by adding rules or by importing the missing rules from Zone 24. With all the disturbed EVTs in the LF 2008 Refresh data, it's impractical to scroll through all EVTs to find the EVTs with pixels left behind. As an alternative method, attempting to make a fire behavior fuel model grid will list all of the EVTs with pixels left behind.

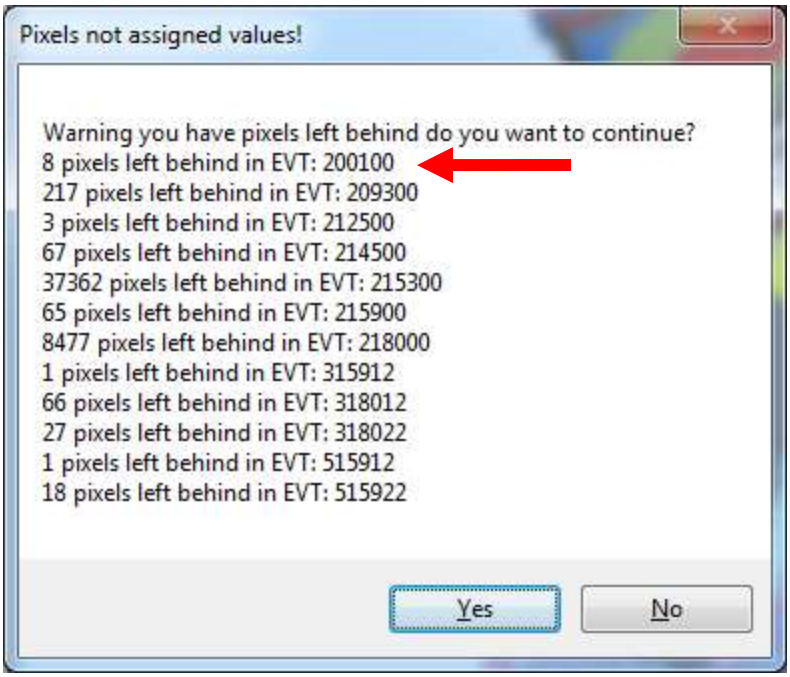
After reviewing some of the EVTs and the *Fuel Rules Page*, close the *Fuel Rules Page* (for now). Return to the LFTFC drop-down menu and select **FUEL GRIDs**.



An input screen will appear. Click the box for FBFM 13 under the *Fuel Selection* tab, enter a name, ensure the *Entire MU* radio button is selected, and click **Create GRIDs**.

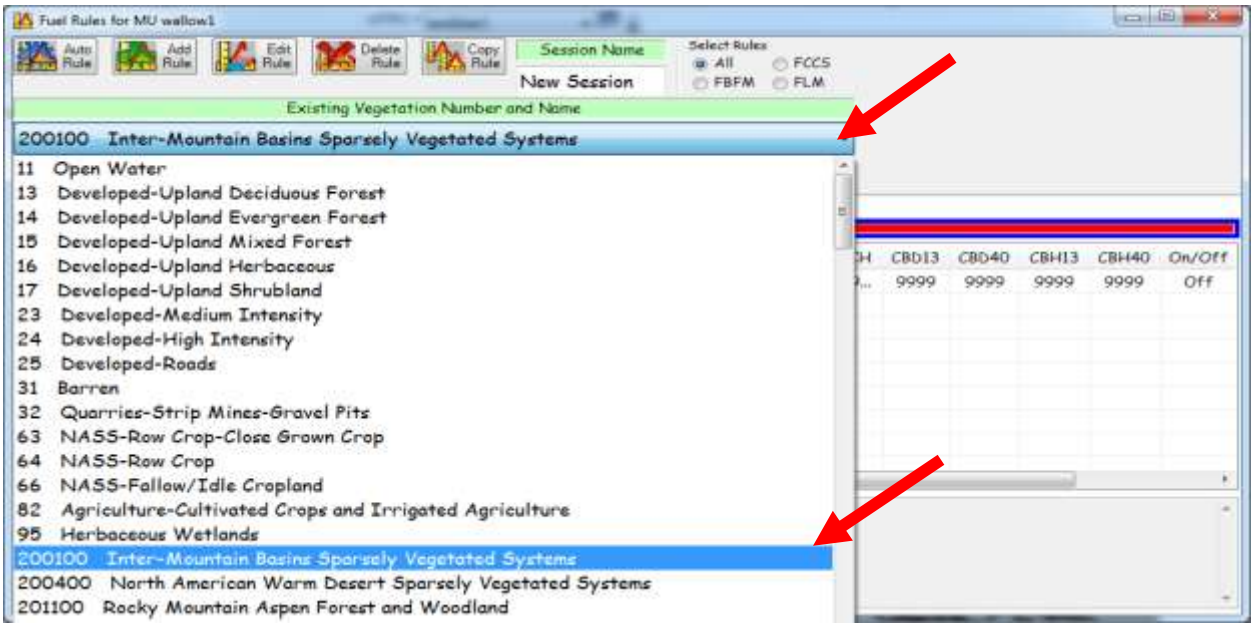


After LFTFC reads the input data from Zone 15 and attempts to make the FBFM13 GRID, the following window will appear with a list of EVTs, stating that some EVTs have missing pixels that are not completely covered by the existing rulesets.

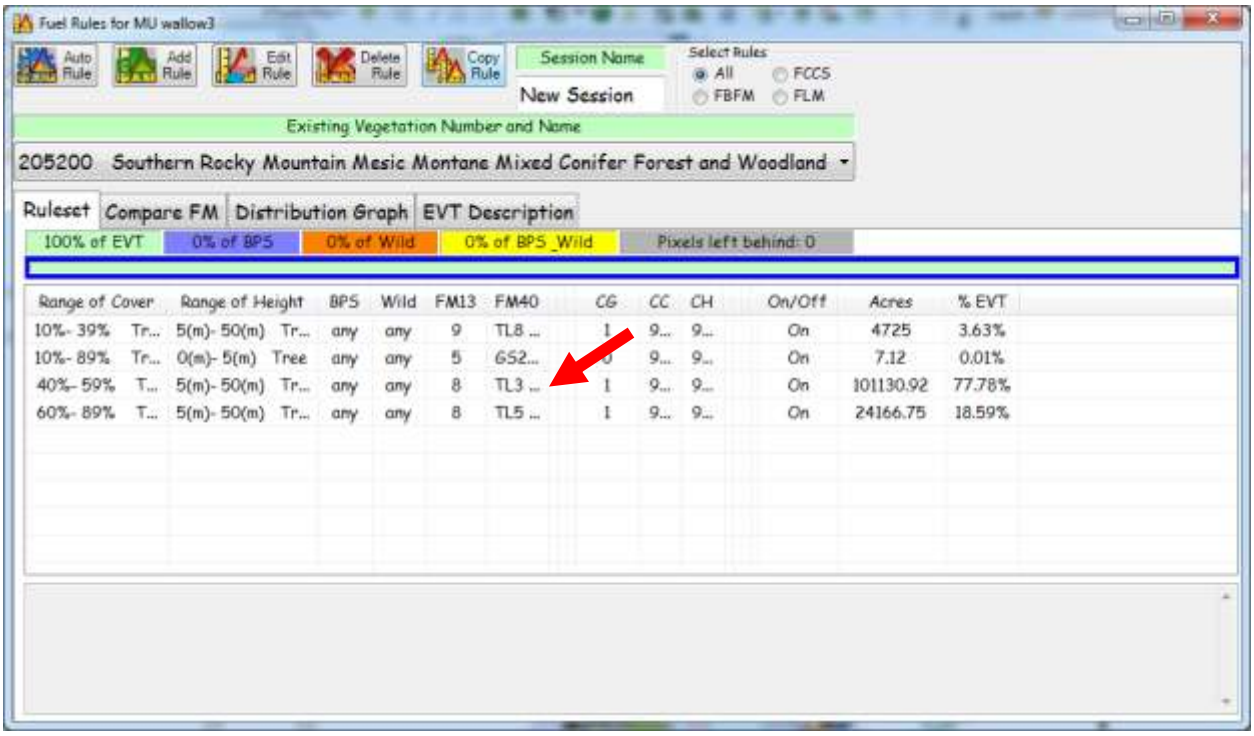


As you can see, 7 of the non disturbed EVTs (those with numerical codes beginning with “2”), 3 of the fire disturbed EVTs (315912, 318021, and 2), and 2 mechanical remove EVTs (515912 and 22) need additional rules to account for all the pixels in the MU (tip: make a sceen-capture of this for later use). Click **No** to abort the process.

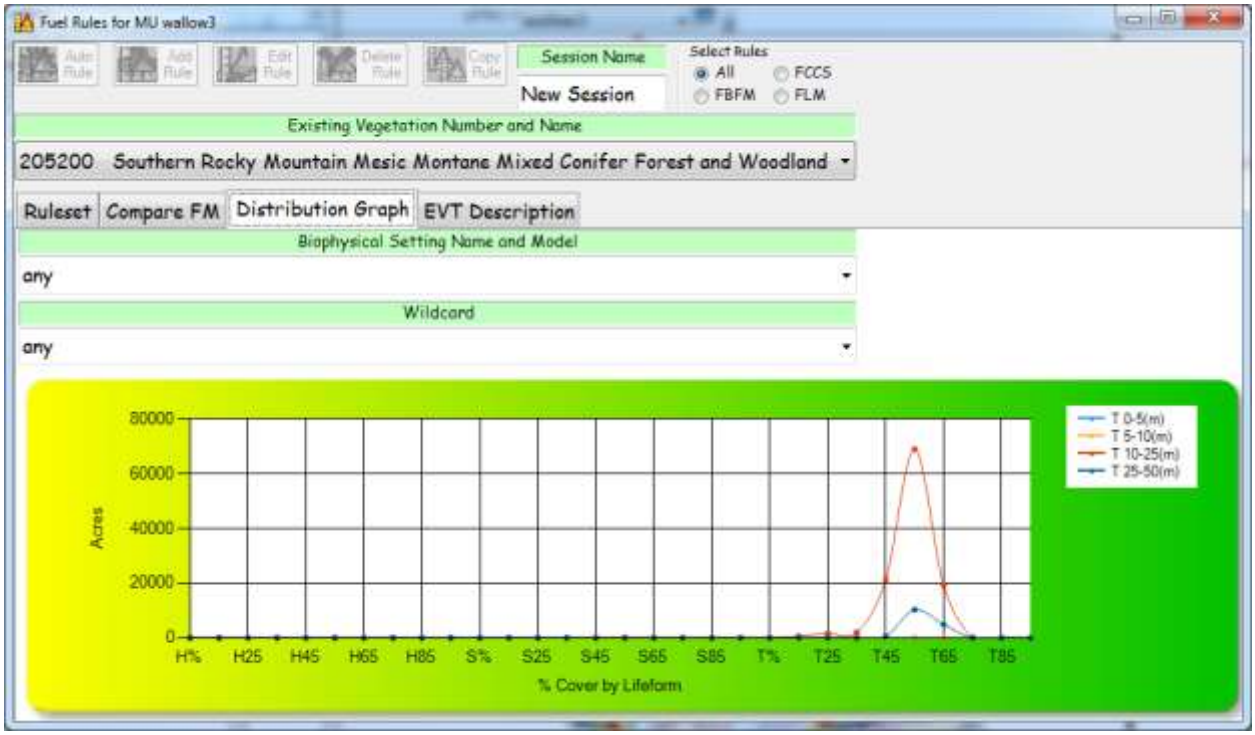
□ From the LFTFC drop–down menu, select **Fuel Rules** again, click the down-arrow on the *Existing Vegetation Number and Name* list, and select **200100 Inter-Mountain Basin Sparsely Vegetated Systems**, which is the first on the list of EVTs with pixels left behind (see figure above). Notice the indicator bar is entirely red; no fuel rules were imported for this EVT from Zone 15, and there are 8 missing pixels. The fuel rule for this EVT will be imported from the rule sets in Zone 24 later, but first let’s edit one of the fuel rules from Zone 15 that has been an issue.



During the Wallow Fire, modeling efforts to predict fire extent went well except for the fire behavior within one prominent EVT in Zone 15. In your current planning endeavors, it's important to calibrate the fuels layer with the spread events that occurred in the Wallow Fire, so editing the fuel rules in this EVT is important. Go to EVT 205200 in the *Existing Vegetation Number and Name* drop-down list and find Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland. Note that all the pixels are accounted for (indicated by the green bar); also notice that the fuel rule for 40 - 59% canopy cover and 5m - 50m height assigns these pixels to fuel model 8/183 (TL3). These pixels account for just over 101,000 acres in this Wallow1 MU alone. Also note that the Canopy Guide (CG) assignment is 1, indicating that this rule is available for crown fire activity, but with such a low intensity surface fuel model (8/183) it is very unlikely it would torch and crown. During the actual Wallow Fire event, this vegetation type was observed to crown quite readily in dry windy conditions.

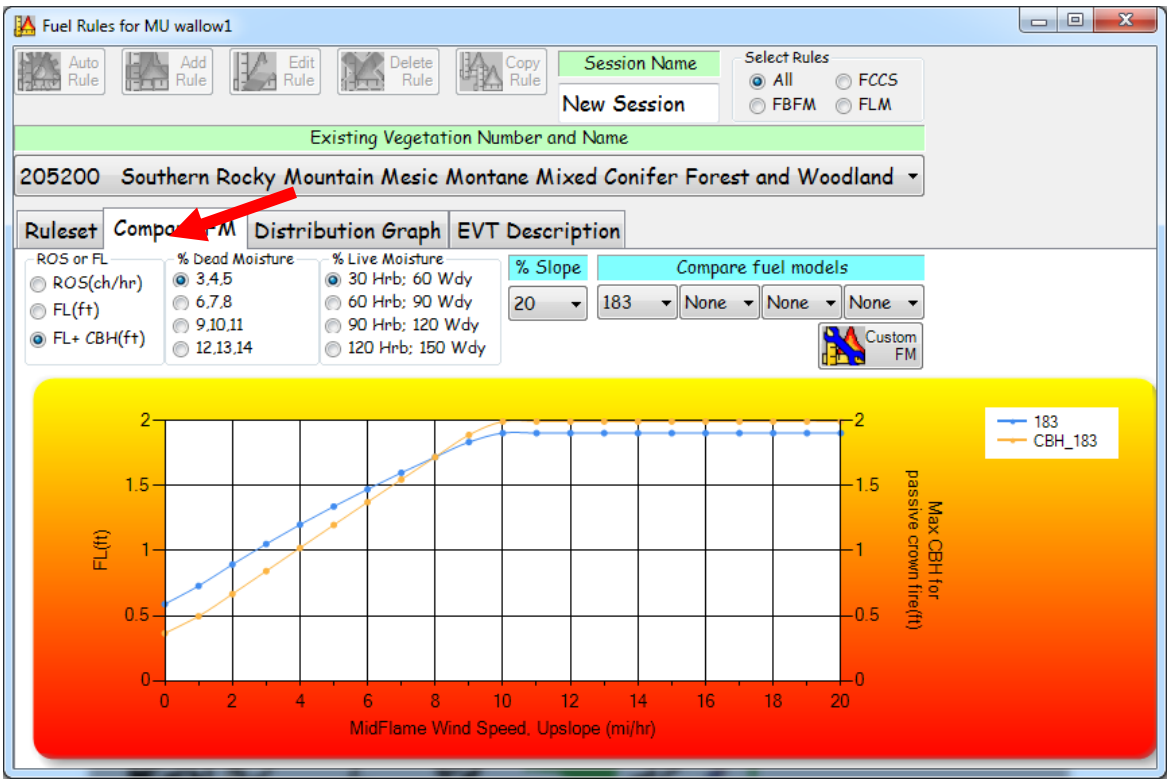


□ Click on the *Distribution Graph* tab to see the distribution of 205200 for cover and height, as shown below. Notice that 205200 includes pixels with percent cover Tree 15 - 85% with heights ranging from 0-5 m to 25-50 m.



Most of the acres in this EVT for the Wallow1 MU are in trees that are 35 to 65% cover and 10m to 25m in height. Many of these pixels are represented by the surface fuel model 183 (TL3).

□ Click again on the *Compare FM* tab, as shown in the image below, to view graphs that will help you compare the fire behavior characteristics associated with the current fuel models to those associated with other fuel models and assess which models may incite the expected crown fire activity.



□ On the *Compare FM Tab*, select the radio buttons for the following:

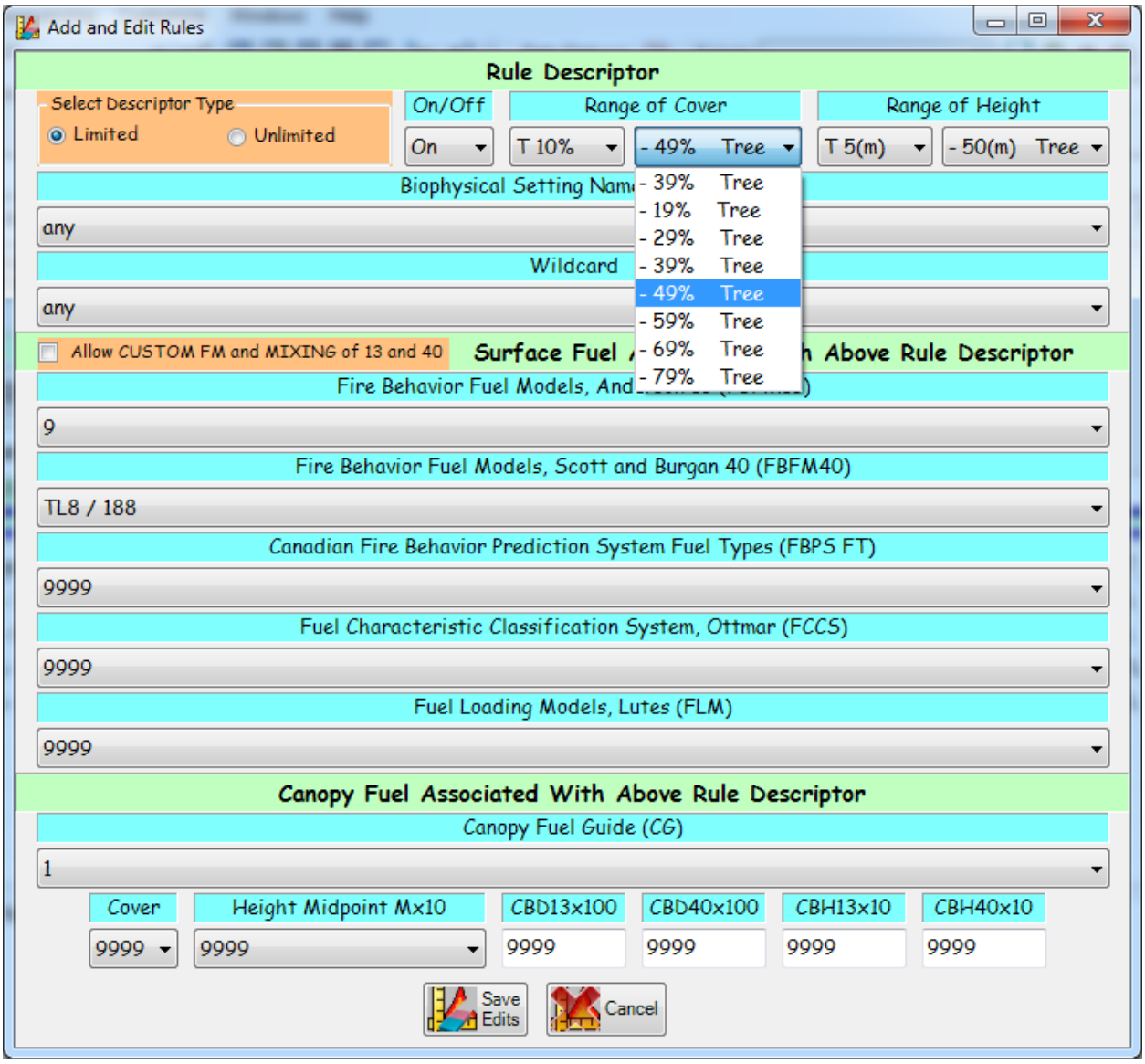
- under *ROS of FL*, select **FL+CBH(ft)**;
- under *% Dead Moisture*, select **3,4,5 Dead Moisture**; and
- under *% Live Moisture*, select **30 Herb: 60 Wdy**.

□Input 20% slope with the drop-down arrow and 183 from the first *Compare fuel models* drop-down arrow. The line labeled CBH_183 shows the canopy base height needed to create passive crown fire, or torching. As you can see, in fuel model 183, canopy base height (CBH) would have to be 2 feet or lower in order for torching to occur. In the actual Wallow Fire, torching occurred in many areas of this EVT where canopy base heights were much higher than that. The line labeled 183 shows the flame lengths expected in fuel model 183 under different wind speeds. Even at high wind speeds, flame lengths would not exceed 2 feet. Clearly, fuel model 183 would not permit the fire behavior experienced during the Wallow Fire since the canopy base height in the LANDFIRE data for most, if not all, of this area was greater than 2 feet.

□Replace 183 with 188 and 185 to see if a higher base height will torch for those fuel models. A fuel model 188 can have a CBH of 10ft at an 8 mph wind, and torching will occur. It would take an 18 mph wind to create torching in a 185 (TL5) fuel model with that same base height. Both of these fuel models would exhibit torching and possibly crowning with the environmental conditions that existed during some of the more extreme runs of the Wallow Fire.

□ Return to the *Ruleset Tab* where the rule set for EVT 205200 is located and edit the 40 - 59% cover, 5m to 50m Tree TL3 (183) rule. As discussed above, fuel model 183 is clearly inappropriate for this EVT. In collaboration with the local fuels specialist, you have decided to redistribute the cover range previously assigned to fuel model 183 by allocating half of this cover to 188 and half to 185. Then you will delete this rule, and fuel model 183 will no longer be represented for this EVT. This can be done in two ways:

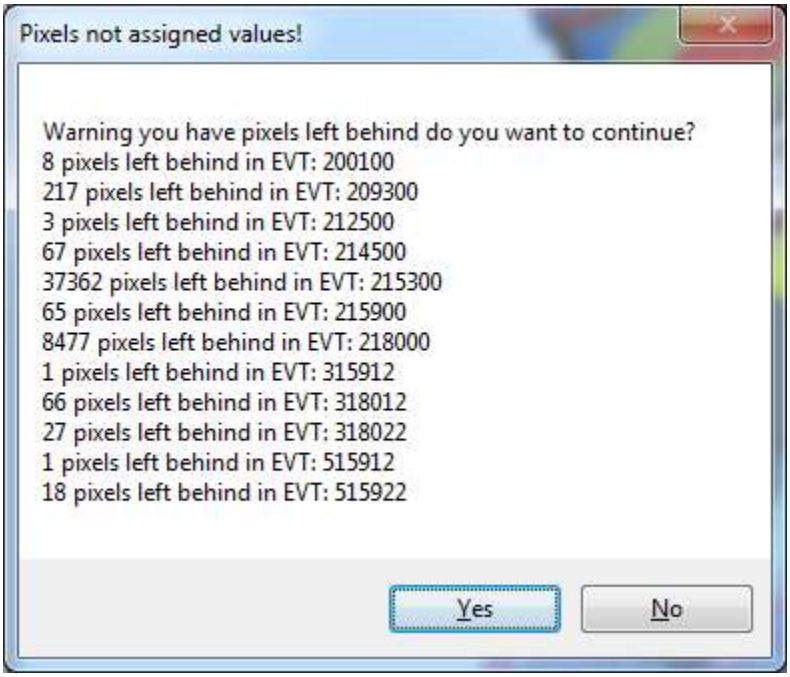
Option 1) Highlight the rule 10 - 39% cover, 5m to 50m trees 9/TL8 and click **Edit Rule** at the top of the *Fuel Rules* page. Increase the percent cover from 39 to 49%. Click **Save edits**. Highlight the 60- 89% cover, 5m- 50m 8/TL5 rule and click **Edit Rule**, decreasing the cover to 50%. Click **Save edits**. Then, highlight the 40 - 59% cover, 5m-50m 8/TL3 rule and use the **Delete Rule** button at the top of the *Fuel Rule* page to clear the duplicate rule.



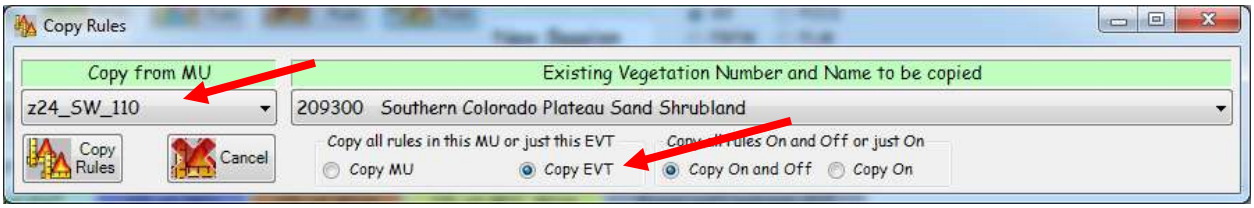
Option 2) You can also edit the rules by highlighting each cell of the rule set with a right mouse click. Right-click on the range of cover for the 10 -39%, 5m - 50m 9/TL8 rule and increase the cover (high side of range) to 49%. Right-click on the 60 - 89% cover, 5m - 50m 8/TL5 rule and reduce (low side of range) the cover to 50%. Use the **Delete Rule** button at the top of the page to clear the duplicate rule.

You identified in the distribution graph that areas of tree cover 35-65% between 10-25m tall were originally represented as fuel model 183 (TL3). With the edits you just completed, you've allocated this range of tree cover and height to be represented by fuel models 188 and 185, so 183 is no longer represented for this EVT. This fuel model change should help better represent the observed occurrence of passive crown fire.

□ Recall that on page 10 you imported rules only for LANDFIRE Zone 15; however, our management unit encompasses parts of both Zone 15 and Zone 24. Now you are going to add the missing rule sets for EVTs from Zone 24 that appear in MU Wallow1 and were not copied in with Zone 15. Use the list created earlier that identified missing pixels to find the EVTs that need to have rule sets imported from Zone 24. On the *Fuel Rules* page, scroll to 200100 – the first EVT on the list.



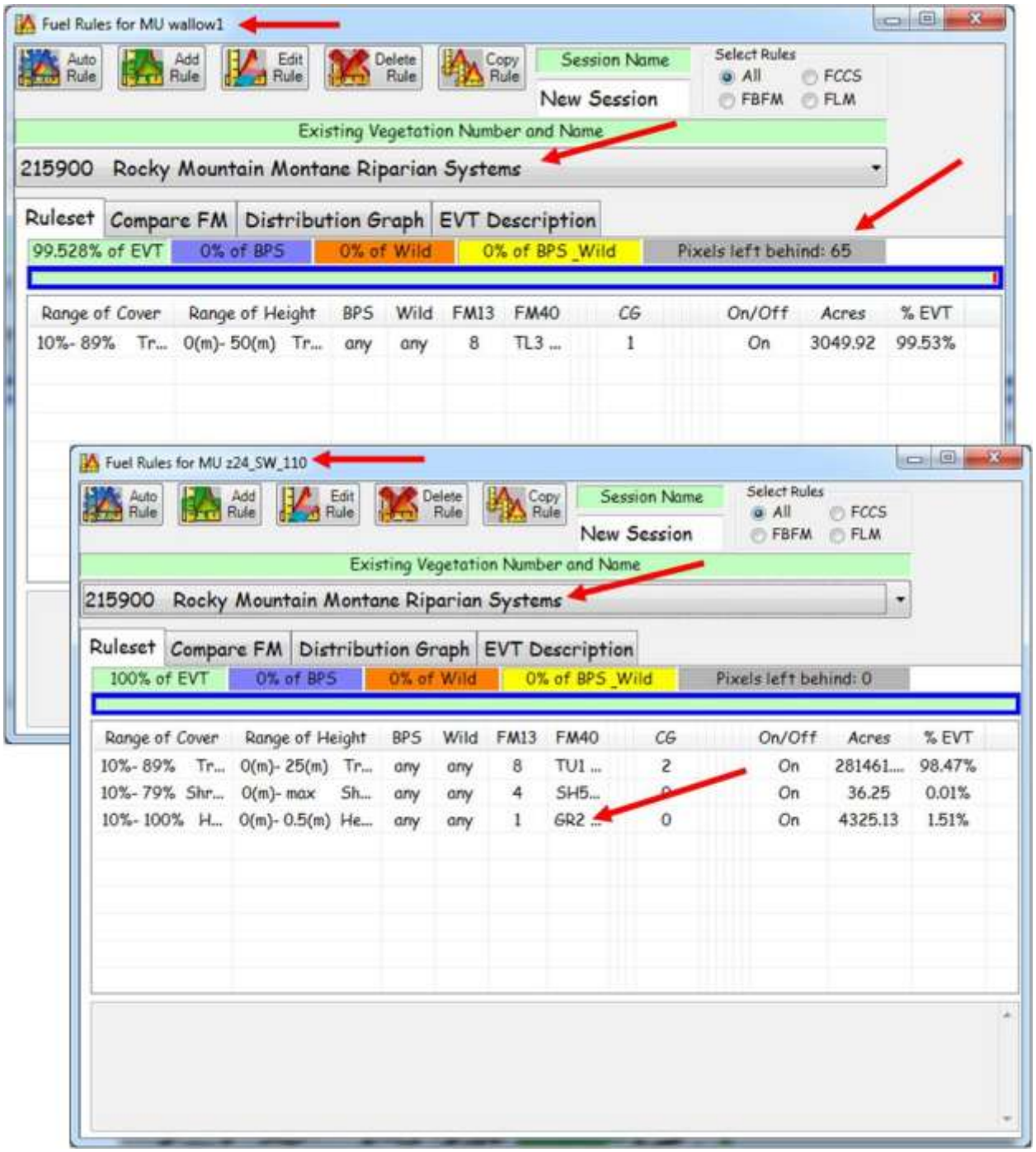
From the *Fuel Rules* page, click the **Copy Rule** button. In the *Copy Rules* dialog box, use the drop-down arrow on the *Copy from MU* menu to select **z24_SW-110**, as shown below. Check the **Copy EVT** radio button under the *Copy all rules in this MU or just this box* heading.



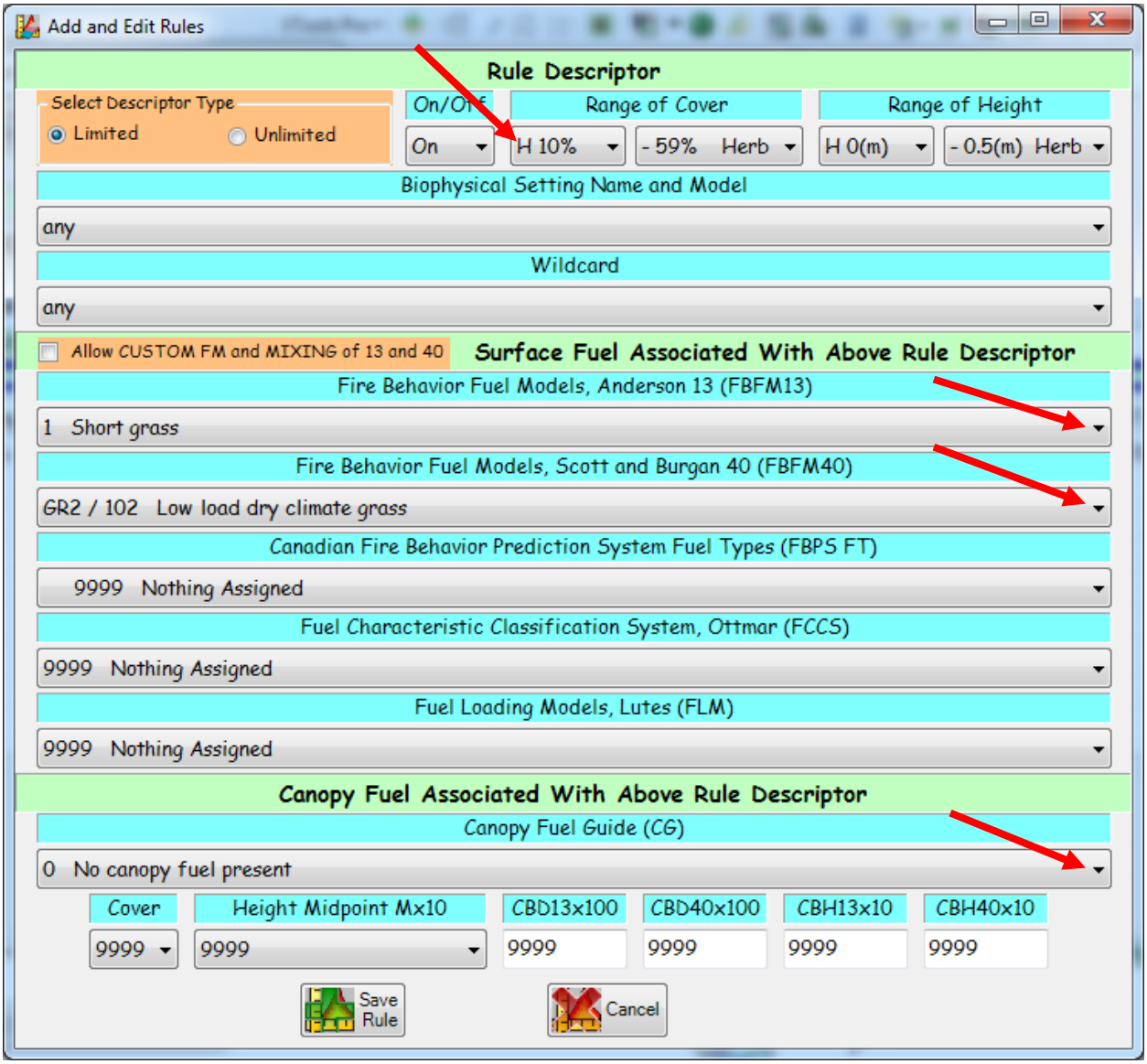
□ Click **Copy Rules**. Click **Yes** when asked if you want all rules, whether on or off. There is one rule associated with 200100, and cover values run from sparse to sparse. Notice that after you copy this rule, the indicator bar turns green, there are 0 pixels left behind, and 100% of the EVT is accounted for with Zone 24 rules. Continue to use this process to copy the rules from Zone 24 for the next 4 EVTs on your list: 209300, 212500, 214500, and 215300.

In EVT 215900, there is a treed EVT rule, but there are still 65 pixels not covered by the rules. When consulting the distribution graph, you see there are some herbaceous areas that the Zone 15 rules do not cover; they are from Zone 24. Go to the MU drop-down arrow on the main LFTFC Toolbar and select z24_SW_110. Then, go to the LFTFC drop-down list and select **Fuel**

Rules. In the Zone 24 *Fuel Rules* list, scroll down to 215900 and observe the fuel rule for the herbaceous areas (10 -100% H… 0-0.5(m) He…1/GR2).



Toggle back to the Wallow1 *Fuel Rules* page (note you can have several rules pages open at the same time) and ***Add Rule***. Input the information for an herbaceous rule with cover at **10 - 59%,** height at **0 - 0.5m**, FBFM13 **1**, FBFM40 **GR2/102**, and canopy guide of **0**. Click **Save Rule**.



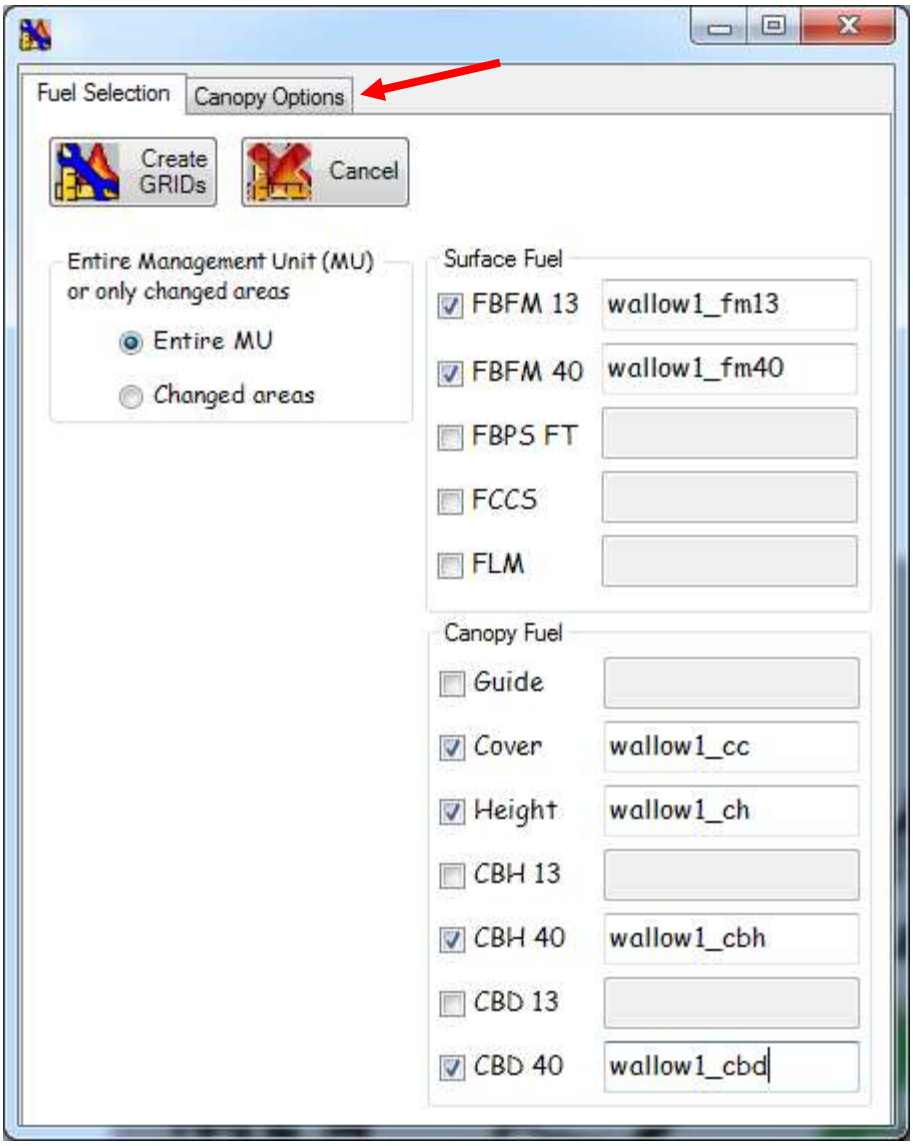
Alternatively, you could copy the Zone 24 rules into the Zone 15 *Fuel Rules* page for this EVT and then delete all the copied rules except the herbaceous rule.

Continue copying rules for the remainder of the EVTs indicated in the warning box on page 19. Note that in some cases, new rules will apply to the same fuels as existing rules. In these cases, use the *Delete Rule* button to delete the older version of the rule. For example, EVT 515922 has a duplicate rule: 10 - 89% Tree cover, 0 - 25m height 8//TL1 with a canopy guide of 2 and a rule

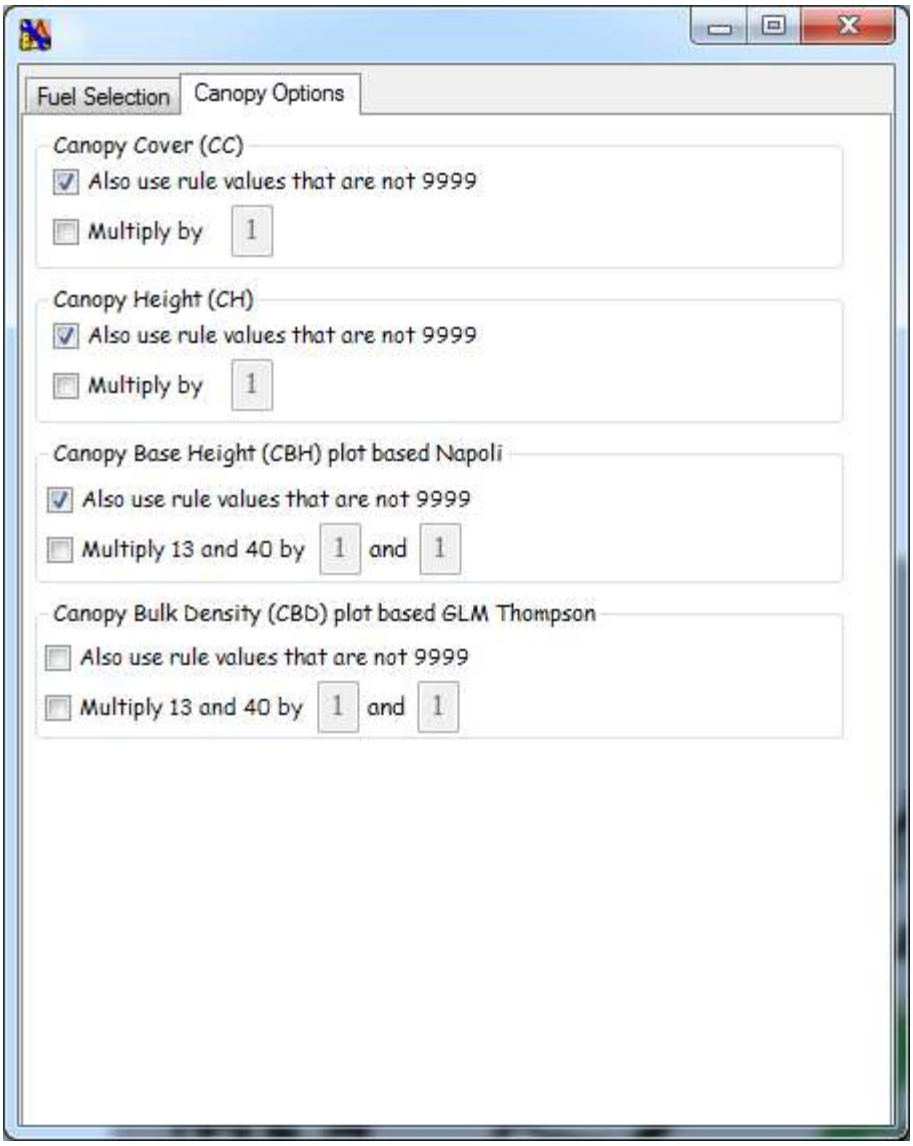
that states 10 - 89% cover, 0 -50% height 8/TL1 with a canopy guide of 2. The 0- 25m trees in this EVT are being counted twice, so one of these rules needs to be deleted. Delete the rule with 0-25m tree heights.

> Note: Be sure that when you have finished editing the rules, they address the entire range of cover, height, and lifeform present in the MU; otherwise, the grids will not be produced. If you are not sure which of two or more overlapping rules should be deleted, you can use trial and error to determine which rules you need in order to cover all pixels with no overlap. If there are still pixels left behind in an EVT after you have edited the rules, use the distribution graph to see which rules or lifeforms have been omitted. Then either add or edit the rules with range of cover, height, FBFM13, FBFM40, and the appropriate Canopy Guide (always add 0 for shrub and herbaceous and either 1 for crowning trees or 2 for non-crowning trees).
>
> For the purposes of this tutorial, any set of rules that covers the full range pixels with no overlap will suffice. In a real management scenario, you would use local knowledge of the relevant EVTs to decide which rules are most appropriate and whether any rules need to be edited for your project area.

Once all the EVTs in the list have been addressed and the edits have been made for fire behavior characteristics in EVT 205200, new fuel grids can be produced. Click the LFTFC down arrow and select **FUEL GRIDS**. A two tab input window appears with enty slots to name the new GRIDs. On the *Fuel Selection Tab*, for this exercise, make sure the *Entire MU* radio button is checked, check the box next to the fuels layers you need, and name them so that you'll remember them (note that GRID names are limited to 13 characters).



□ Since we will want canopy cover, canopy height, canopy base height, and canopy bulk density for our .lcp file, we will request these layers for our MU as well. Click the *Canopy Options Tab*, as indicated in the figure above, and select *Also use rule values that are not 9999* for canopy cover, canopy height, and canopy base height (the top box for the first three canopy categories). This is done because, in the LANDFIRE data, certain EVTs were manually assigned values for CC, CH, and CBH rather than having values calculated by the tool. Checking these three boxes tells the tool to use the manually assigned values when these grids are created. All values for CBD in LANDFIRE are calculated within the LFTCF Tool with a General Linear Model (Reeves and others 2009). Do not click either box for CBD.



□ Return to the *Fuel Selection Tab*, recheck the inputs, and click the **Create GRIDs** button. A processing window will appear for each GRID being produced to inform you of the progress.

The new fuels GRIDs will be stored in the Output folder under the project name you declared when **Setting Project Directory**. Note that, in this project directory, there are 3 folders and a database that are associated with the LF_TFC_Toolbar: Input, MU, and Output are the folders, and LF_TFC_Toolbar is the database. The *Output* folder should have all the GRIDS needed to construct the landscape file for Farsite and FlamMap clipped to the same extent as the rectangle drawn for the MU Wallow1.

Section IV. LFTFC Tool Summary

This tutorial introduced you to much of the LFTFC Tool's functionality. You were instructed on how to copy fuel rules for an area of interest that spans two mapping zones, how to edit one rule, and how to delete overlapping rules. You then created new grids for FBFM13 and FBFM40 that

reflected the edits made in the rule. Your edits better reflected the fire behavior that you would expect to see in your area.

After completing this tutorial, you are now prepared to create a landscape file (.lcp) for use in running fire behavior simulation models in your area. This information can be used to help formulate decisions about local projects, including prescribed burns, fuel treatments, and response to wildland fire.

Additional Help

Further information on the LFTFC Tool is provided in the LFTFC Tool User's Guide (www.niftt.gov). Note also that an on-line course is currently under development. Lastly, consulting the resources listed below will help you expand your knowledge and understanding of how to appropriately apply this tool. Please direct questions to the National Interagency Fuels Technology Team (NIFTT) through helpdesk@niftt.gov.

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References:

Anderson, H. E. 1982. Aids to determining fuel models for estimating fire behavior.Gen. Tech. Rep. INT-122. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 22 p.

Reeves, M., K. C. Ryan, M. G. Rollins, and T. Thompson. 2009. Spatial fuel data products of the LANDFIRE Project. International Journal of Wildland Fire 18:250-267.

Scott, J.H., and R.E Burgan. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. USDA Forest Service Rocky Mountain Research Station. General Technical Report RMRS-GTR-153.