RTI FACT SHEET **#33**
Rural forest community issues

The LMS Fire Scoping Tool: Stand- and Landscape-level Fire Assessments using LMS

by Kevin Ceder

Past forest practices combined with fire suppression in the Western United States have resulted in overstocked forests with fuel buildups leading to wildfires burning at an increasingly large scale and with severe fire effects. To reduce fuel loadings towards moderating fire behavior and damage, stand treatments are needed. In order to maximize treatment effectiveness, planning must be done at the landscape level to prioritize stands most at risk. The Landscape Management System (LMS) with the Fire Scoping Tool and the Fire and Fuels Extension for the Forest Vegetation Simulator growth model (FFE-FVS) provides an easy-to-use platform for stand- and landscape-level simulations of stand growth with and without silvicultural treatments, fire effects and behavior estimation, assessment (scoping) of fire potentials, and analysis in support of fuel treatment planning.

The Colville Example portfolio, created with data from the South Deep watershed on the Colville National Forest, will be used to demonstrate the LMS Fire Scoping Tool (figure 1) now available with the LMS-FFE Add-on. Simulated landscape conditions are shown for the year 2000 (the initial inventory year) and for 2020 following management to reduce ACTIVE and PASSIVE Fire Type, or fire behavior, under wildfire conditions. Determination of which stands to treat was based on the Fire Type in 2000 and 2020. Stands with a Fire Type of ACTIVE in 2000 are treated in 2010 and any stands that would move into an ACTIVE Fire Type by 2020 are treated in 2020. The treatment prescribed for the stands is removal of all trees that are except Douglas-fir or western larch followed by a thinning from below of the Douglas-fir and larch to leave 45ft^2 of basal area.

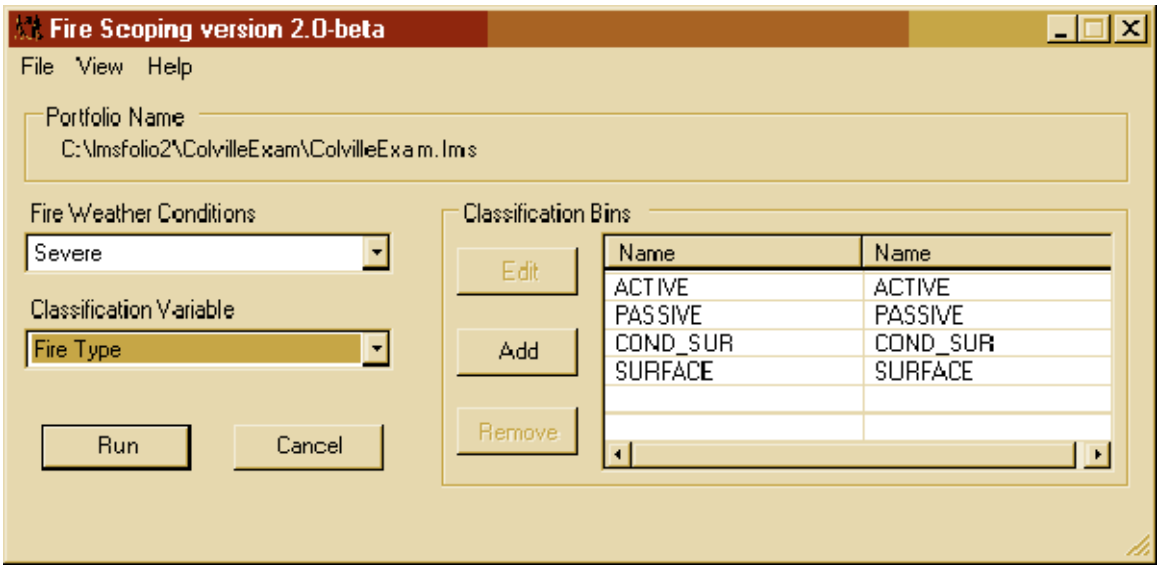

Figure 1: Fire Scoping Tool used for fire analyses in the Landscape Management System

Enabling an LMS portfolio to run FFE-FVS and set fire weather and fuel moisture conditions is accomplished with the LMS-FFE Configuration Tool (part of the LMS-FFE Add-on installation). When FFE-FVS is enabled for a portfolio, the Potential Fire Report, which contains information about fire behavior and effects for each stand if a fire was to burn in the stand under severe or moderate conditions, can be turned on to do landscape-level fire analyses with LMS. Default measures for wind speed, fuel moisture, and air temperature are provided for both extreme and moderate conditions or can be adjusted within the LMS-FFE Configuration Tool by the user to better replicate local fire conditions.

Once FFE-FVS options have been configured, the simulated forest landscape can be "grown" and stands "treated" in either 5- or 10-year cycles as selected by the user. FFE-FVS fire metrics are created within LMS for the initial condition and for each growth period simulation. Summaries of Potential Fire Report outputs, created by the LMS Fire Scoping Tool, are presented as acreage distribution charts in the Fire Scoping Report, a Microsoft Excel® template, and/or as maps in ESRI ArcView 3.x using one of five fire behavior and effects variables, selected by the user, as the summary variable:

1) Crowning Index: 20-foot wind speed needed to initiate and carry a crown fire (severe conditions only)
2) Torching Index: 20-foot wind speed need to torch individual trees (severs conditions only)
3) Fire Type: Description of fire behavior:
    a. ACTIVE: Crown fire;
    b. PASSIVE: Surface fire with torching of individual trees;
    c. COND_SUR: Conditional fire. Canopy conditions exist for crown fire but may lack ladder fuels or predicted flame length may be too short to ignite canopy. Crown fire may occur if flames reach canopy from ground or neighboring stand; or
    d. SURFACE: Ground fire
4) Flame Length
5) Percent Basal Area Mortality

When weather and moisture conditions and a classification variable have been selected, the range of the selected variable for all years in the simulation period is sorted automatically for classification into four equal-width bins, with one bin for each category. Using the full range of the data allows distributed classifications for comparability that are the same for all years. The number of bins, range of bins, and names of the bins, however, are also fully configurable by the user for maximum flexibility in the analysis capabilities. For example, high, moderate, and low fire risk can be estimated for each stand plot in the simulation dataset based on the Severe Crowning Index assessment from the Potential Fire Report produced by FFE. The estimated Crowning Index is the estimated wind speed in miles per hour (mph) at 20 feet off the ground that is needed to sustain a crown fire. The "High risk" bin might be for all stands <25 mph (in other words very little wind needed for a crown fire), the "Moderate" bin all stands 25 – 50 mph, and "Low" all stands with >50 mph estimated Crowning Index.

The FFE Variable Distribution Report from the LMS Fire Scoping Tool has been designed to assist in the selection of variables for the analysis. An examination of the distributions of the available classification variables can help with the determination of an appropriate number of bins and bin limits that fit the particular analysis need. All variables, other than Fire Type, are continuous, numeric variables where a range is set for each bin. Fire Type is a categorical variable and each bin represents a unique value. For this example, below, Fire Type with severe fire weather and fuel moisture conditions is used as the summary variable resulting in the graphs in the Fire Scoping Report (Figure 2) and maps in ArcView (Figure 4) of Fire Type.

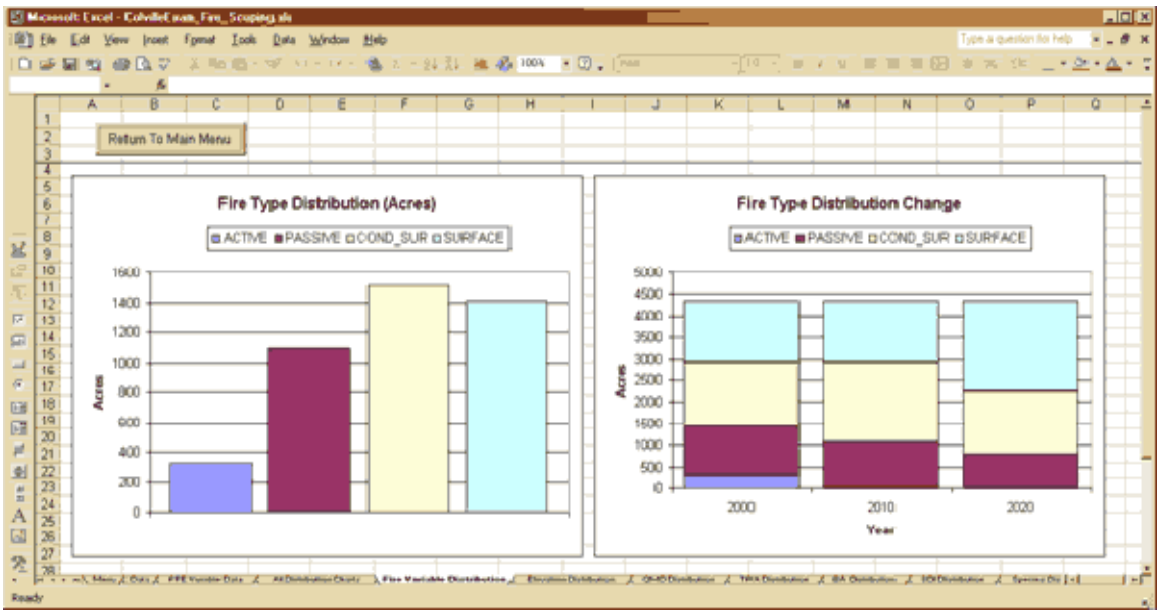

Figure 2: Fire Type distributions for the year 2000 and under 20 years of mangement for ColvilleExam portfolio in Fire Scoping Report created by the LMS Fire Scoping Tool

Distributions of the selected fire variable, Fire Type, for this analysis, shown in Figure 2, in the Fire Variable Distributions worksheet is just one of the pages of graphs automatically available from the Fire Scoping Report (Figure 3). In addition to the acreage distribution of the selected fire variable in the initial year (left, above) and each year of the simulation (right, above), distributions of elevation and stand structure variables, including quadratic mean diameter, trees per acre, basal area, Reineke's stand density index, dominant species, and canopy structure are available in other worksheet pages with each bar of the distribution chart classified by the fire variable. The classified charts can be used to quickly gain better understanding of the characteristics of stands across the landscape and the interrelation of stand structure variables in regards the fire variable of interest. Since stand changes are simulated in LMS to occur because of growth and treatment, changes in the fire variable distributions can be related to changes in stand structure for comparative assessment of the effectiveness of treatments in changing fire risk and behavior.

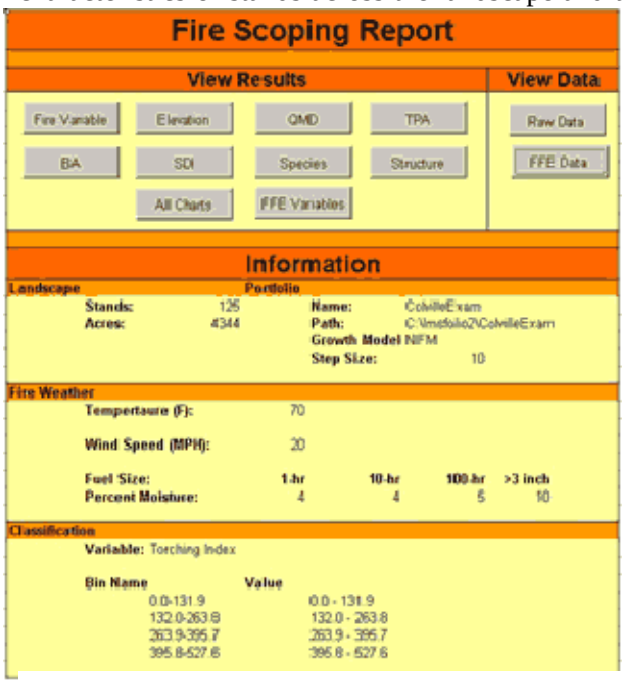

Figure 3: Fire Scoping Report User Interface

Spatial distributions of stand fire attributes across a landscape can have important implications for management planning and protection of homes, transportation, or critical habitats. Maps of the selected fire variable for each year of an LMS simulation are made quickly by using the LMS Fire Scoping Tool to display output attributes in ArcView. Stands automatically appear in gray-scale but the legends for each year can be modified, changing colors and classification limits and/or names to fit specific analyses. Further spatial analysis can be done by adding GIS layers to display stand attributes for additional years in the simulation period from the LMS Fire Scoping Tool (Figure 4).

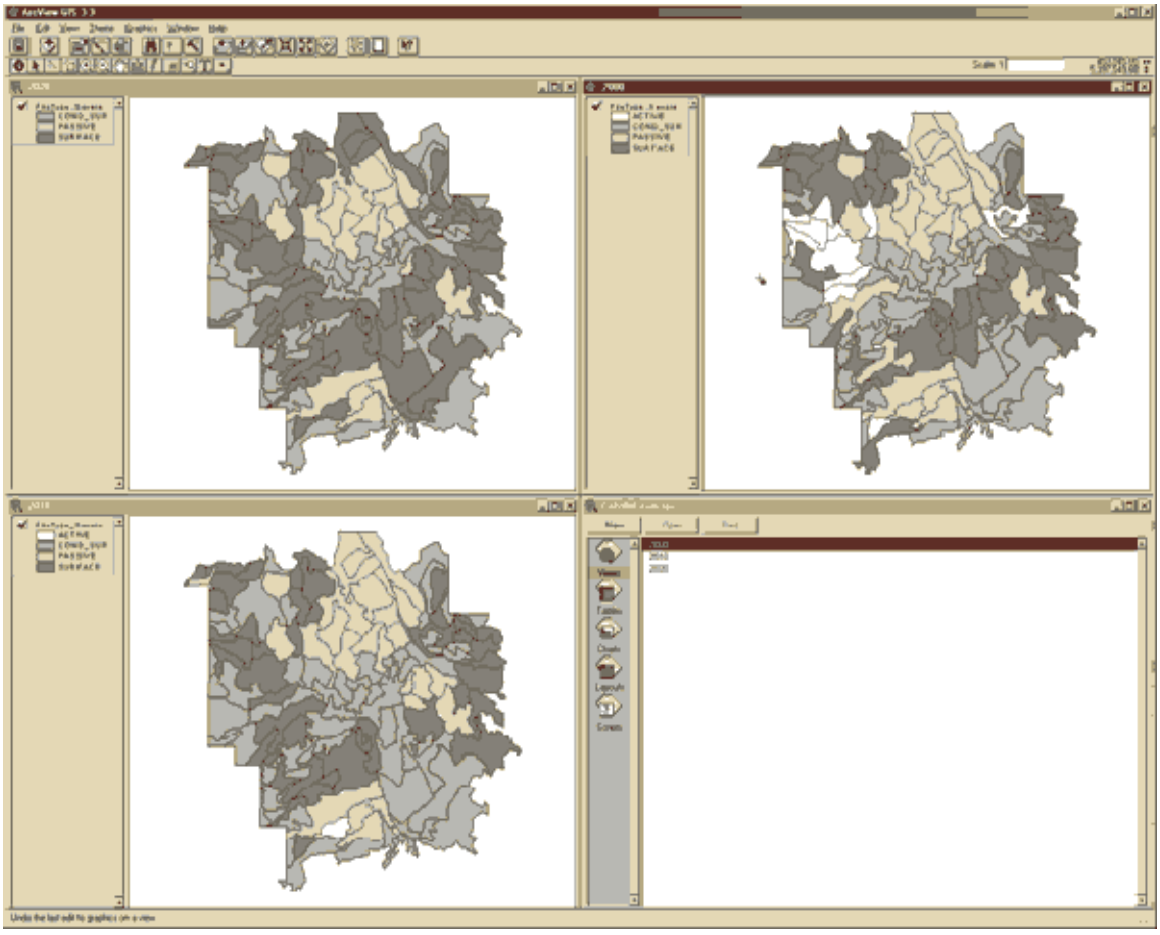

Figure 4: Maps of Fire Type in ESRI ArcView 3.3 created by the LMS Fire Scoping Tool

The addition of the Fire Scoping Tool and FFE-FVS expands the suite of analyses capabilities within LMS to include fire behavior and effects. Now an LMS portfolio of a landscape with actual forest inventory and topographic data can be used to quickly assess and compare fire effects and behavior under various management regimes. Designing effective stand fuel treatments for changing fire effects and behavior is assisted as well by other functionalities embedded within LMS such as inventory characteristics, economics, habitat indices, structure classes, visualizations, and more. Stand and map outputs from the LMS Fire Scoping Tool help guide fuel treatment planning by highlighting areas of most urgent need for prioritized fuel treatment scheduling.

For further information about LMS see CFR Fact Sheet #1 and the LMS web site:
http://lms.cfr.washington.edu/
For further information about FFE-FVS see the FFE-FVS web site:
http://forest.moscowfsl.wsu.edu/4155/ffe-fvs.html

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