Wildland Fire Decision Support System (WFDSS): Quantifying a Qualitative Relative Risk Assessment

Relative Risk Assessment

The 1995 publication, *Wildland Fire Use Implementation Procedures Reference Guide* (revised 2005) established the Relative Risk Assessment (RRA) process for use in wildland fire management. The definitions of individual RRA elements have further developed slightly over time, but the procedure's use of values, hazards, and probability elements remains the same as in the original 1995 document. Since 2008, the Wildland Fire Decisions Support System (WFDSS) application implements the principles of RRA in the decision making process.

Initially, the best available information for a qualitative assessment is based on the decision makers' and local specialists' professional judgment and experience combined with any preexisting planning information applicable to the situation. Information from the WFDSS Situation tab for the incident (Zone Weather Forecast, Fire Danger Rating graph, Designated Areas, Infrastructure, etc.) can be useful here. If you do not complete RRAs regularly, review the criteria for each element available at http://www.wfmrda.nwcg.gov/docs/NWCG042-2010_Attachment%20A_Organizational%20Needs%20Assessment%20-%20Process%20and%20Directions%20for%20Use_2010_12_06.pdf.

When using the RRA charts, document the methods and considerations that led to each of the ratings, specifically, capture the logic and basis for choosing each qualitative rating in a concise format. For example; if you looked at the Fire Danger Rating graph and used it as the basis for your rating of "Extreme" for the "Seasonal Severity" element, document that in the "Notes" section for the "Probability" chart. You should include local criteria in your notes and use this data about each element as a preplanning activity. For example, local areas may define specific dates for use in the "Time of Season" element.

Extended Risk Assessment

The relative risk rating characterizes the general magnitude of risks associated with implementing wildland fire management activities as a snapshot in time. This is not a one-time process; you will repeat RRA activities throughout the fire. As the duration of the incident increases, more detailed and quantitative information will be available to verify and re-evaluate the RRA components. It is this ongoing collection of information and analysis that forms the basis for the extended risk assessment. There is no established format for an extended risk assessment; use whatever format best represents the clear presentation and logical flow of the analyses used to support the decision. One option is to organize the extended risk assessment into three sections (Values, Hazard, and Probability), corresponding to the RRA. These sections can

be further subdivided into the three elements of each RRA component. Suggested analyses and products for each component and its three elements are covered in the following sections.

Values: What are the values at risk?

The Values assessment of the relative risk contains three elements: Natural/Cultural Resource and Infrastructure, Location of Fire to Values, Social/Political Concerns.

The values potentially affected by wildfire encompass a wide range of diverse economic and non-economic items, such as:

- Infrastructure such as homes and powerlines.
- Natural resources such as watersheds, and wildlife habitat.
- Cultural resources such as historic structures and archeological sites.
- Local economic drivers such as visitor attractions and commercial timber.
- Environmental values like air quality.

The established Planning Area defines the geographic area in which you create a values inventory. WFDSS gives you a head start on this by compiling a list of values present in the Planning Area based on the data layers available in the application. As you compile the list of values, you might find it useful to organize the inventory in a table format. There is no established format for the table; however, WFDSS uses this format:

Values List

Category	Value	Data Source	Currency	Coverage
Building Clusters: Lewis And Clark, MT	0	US Counties / FGDC Cadastral Subcomm.		Available counties
Building Clusters: Powell, MT	0	US Counties / FGDC Cadastral Subcomm.		Available counties
Class 1 Airsheds	72,472 acres	NPS Air Resources Division	Various	National
County: Lewis And Clark, MT	66,587 acres	HSIP 2011, US Census Bureau TIGER data	07/01/2010	National
County: Powell, MT	6,011 acres	HSIP 2011, US Census Bureau TIGER data	07/01/2010	National
Habitat: Canada Lynx	72,598 acres	FWS Geospatial Services	02/01/2012	National
Jurisdictional Agency: USFS	72,598 acres	Various	08/08/2011	National
Responsible Agency: C&L	1 acres	Various	07/13/2011	AK, CA, ID, MT, NM
Responsible Agency: USFS	72,598 acres	Various	07/13/2011	AK, CA, ID, MT, NM
Retardant Avoidance	54 acres	USFS Data Warehouse	12/2011	National (USFS Units only)
USFS Buildings	6	USFS-INFRA	02/23/2012	National
Wilderness: Scapegoat Wilderness	72,598 acres	Various	03/12/2012	National

It is critical to recognize that not all values of concern to decision makers are listed in the WFDSS Values Inventory. You must consult with local experts, decision makers, and other stakeholders to ensure you have captured each of the values to be evaluated in the risk assessment. Some of the specialists that may have information on the presence of specific values affected by the fire include:

- Wildlife biologists (especially for Threatened and Endangered Species)
- Hydrologists
- Silvaculturists
- Air Quality Specialists or Regulators
- Cultural Resource Specialists and Archaeologists

- Wilderness Management Specialists

Risk Assessment values are usually susceptible, or respond differently, to the range of possible fire behaviors. Knowing a value's response to fire helps develop potential protection strategies. You can find information about a value's response to fire from local specialists and prescribed fire project plans. Another source for information about specific plant and animal species is the Fire Effects Information System.

Putting the information gathered about values so far can be organized into a table like this:

Value Identifier	Value Type (Units)	Location	Ownership	Response to Fire
Lazy Acres Ranch	Structures (11); 3 historic	47 13 06 x 114 50 03	Private	Historic structures susceptible to fire damage; newer structures well-protected by landscaping and resistant building materials
XY Harvest Unit	Commercial Timber (96 acres)	47 26 56 x 114 36 30	Forest Service	Flame lengths less than 2 ft acceptable
Grayling habitat	16 miles	Grayling Creek watershed	Forest Service	Stand-replacing fire within 100' of Grayling Creek reduces population for 6 months following fire.

In addition to the inventory tables, you can create a map of the location of values of concern in the WFDSS application using the "Map Capture" tool in WFDSS. This map comprehensively shows the values of concern in relation to the fire perimeter and the predicted fire spread. Values listed in the WFDSS Values Inventory are generally available spatially in the Situation Map. You can add values (in addition to the WFDSS Values Inventory) to the incident map by using "Objectives Shapes." For technical information on creating shapes in the WFDSS application, see Managing Shapes.

If the "Social and Political Concerns" for the incident include air quality, tools for quantifying smoke can be found at http:/firesmoke.us/wfdss/. Displaying the boundaries of potentially affected jurisdictions compared to predicted fire spread may also be useful in quantifying specific political concerns; the "Boundaries" shapefiles in the WFDSS Situation Map can be used for this, again using the Map Capture tool.

Information on values developed for the extended risk assessment can be included on the "Values" content page of the Decision Editor. Some products may also be appropriate for the "Rationale" content page.

Hazard: What is the intensity of the fire?

The Hazard assessment of the relative risk contains three elements: Fire Behavior, Departure from Historic Conditions, and Potential Fire Size.

The Fire Behavior component of the RRA is a qualitative observation of the current fire behavior as described in the instructions. Digital photographs can document these observations. Dispatchers and incident owners without the Fire Behavior Specialist role in their profile can use the Automated Basic and Short-Term Fire Behavior tools in the WFDSS application to create quantified outputs of predicted fire behavior based on short-term weather predictions using default inputs to quantify short-term fire behavior.

An extended risk assessment should include quantified fire behavior predictions for short- and long-term fire behavior potential. In developing a more detailed analysis of the Fire Behavior element of the Risk Assessment, you should request that a Fire Behavior Specialist (a role in WFDSS) or Long Term Analyst/LTAN (an IQCS qualification) run more detailed models for the fire event. Fire Behavior Specialists can create more customized fire behavior outputs using the Analyst-Assisted Basic, Short-Term and Near-Term Fire Behavior tools. The Analyst-Assisted versions can be used to evaluate potential fire behavior with a given weather scenario based on local experience ("what if" weather events).

Other models that might be useful for addressing specific fire behavior concerns for the incident include:

- BehavePlus
- FlamMap
- FARSITE
- Wind Ninja

Specialized training or experience is needed to effectively use these stand-alone programs—LTANs, FBANs (Fire Behavior Analyst), and GSANs (GeoSpatial Analysts) are most commonly used to perform these analyses, but many experienced fuels specialists have skills in one or more of these programs.

Departure from Historic Conditions is loosely based on Fire Regime Condition Class (FRCC). Information about area fire return interval and departure from it to quantify this element can be obtained from local fuel specialists and/or area prescribed fire plans. It is important to realize that high levels of departure are not always correlated with increased hazard: Some vegetation types are hazardous to values even under their natural fire regime (lodgepole pine forests); other vegetation types may be highly departed, but present less hazard than their natural state (e.g., overly grazed woodlands). These anomalies can skew the results of the RRA, and should be carefully evaluated and explained as part of the extended risk assessment.

Information on the hazard elements developed for the extended risk assessment can be included on the "Situation" content page of the decision editor. Some products may also be appropriate for the "Rationale" content page.

Potential Fire Size may be evaluated with a Fire Spread Probability (FSPro) analysis, but the practical limitations of FSPro may limit the accurate analysis of fire spread to 14 days or less. Although "Current Time of Season" and "Barriers to Fire Spread" are components of the

"Probability" element, the analyses used to support these components may also be useful in evaluating Potential Fire Size.

Probability: What are the probabilities the value will be affected by the fire?

The Probability assessment of the relative risk contains three elements: Current Time of Season, Barriers to Fire Spread and Seasonal Severity.

Currently, the most effective quantitative analysis of a wildfire's probable spread is provided by the Fire Spread Probabilities (FSPro) analysis in the WFDSS application. This analysis must be performed by a trained specialist, such as a LTAN or other Fire Behavior Specialist. You can request a specialist to perform these runs from the WFDSS application. Correctly interpreting the FSPro results is a key skill for users. The Fire Behavior Specialist who generated the results can be a valuable resource for ensuring that it is interpreted correctly, and that the limitations of the modeled result are understood by the requestors. Most importantly, it is critical that users understand that maps displaying FSPro results are not progression maps. The different colors do not represent fire shapes or days of fire spread and act as a valuable resource for ensuring burn probability contours. Burn probability contours are the area (cells) on the landscape within each contour have that probability of burning at any time within the time period used by the FSPro analysis. FSPro simulates fire growth under hundreds or thousands of weather scenarios, and the probability is calculated by how many times a cell burned divided by the number of simulations. The burn probabilities offer no information about when or how any point on the map will burn. Any area in the probability output can be reached on the first day of the modeled period or the last day, and it could reach that point as a head, flanking, or backing fire. The probabilities are for the analysis time period (7, 14, days, etc.), not until a season-ending event.

In addition to using FSPro to quantify the Probability component, you may want to provide quantitative support for the three individual elements: Time of Season, Barriers to Fire Spread, and Seasonal Severity. As noted previously, these elements can also relate to Potential Fire Size. Time of Season can be analyzed in FireFamilyPlus using the Term function. This product, and the criteria defining a season-ending event for the local area, can be prepared pre-season. Barriers to Fire Spread can be supported by fuel treatment maps, recent fire history atlases, and fuels/vegetation maps. Much of this information is available in the WFDSS application, or can be added locally for display in the Situation map.

Seasonal Severity can be supported by many products available on the Internet; for example:

- U.S. Drought Monitor Forecasts (http://www.cpc.ncep.noaa.gov/)
- 30-90 Day Temperature and Precipitation Outlooks (http://www.cpc.ncep.noaa.gov/)
- 7 Day Fire Potential (http://psgeodata.fs.fed.us/staticmap.html or your GACC "Outlook" webpage; also available in WFDSS)
- Fire Season Outlook (http://www.predictiveservices.nifc.gov/outlooks/monthly_seasonal_outlook.pdf)

In addition, FireFamilyPlus provides tools to produce custom NFDRS graphs including comparisons with averages, maximum, and minimum values, and individual prior years. Screenshots of these products can be inserted into the WFDSS decision content.

Each of the products mentioned in this guide can be included in a published WFDSS decision, making it readily available for current and future decision making. Technical instructions for adding the results of these analyses to the WFDSS decision can be found in Incorporating Long Term Assessment Information in WFDSS:

Again, the extended risk assessment does not have an established format or required content; the format should facilitate the logical flow of information, and the content should address the management questions and concerns relevant to the situation. The extended risk assessment should NOT be an exhaustive compendium of every product and analyses available; you should use only those products that are needed to support the decision.

Information on the probability elements developed for the extended risk assessment can be included on the "Situation" content page of the decision editor. Some products may also be appropriate for the "Rationale" content page.

Reviewing and Updating the Risk Assessments

You should complete RRA activities ideally during every Periodic Assessment to ensure that the elements have not changed since the last Periodic Assessment. While the qualitative elements of the RRA may remain stable, most products in the extended risk assessment have a "shelf life:" FSPro outputs expire, outlooks are reissued monthly or weekly, the fire perimeter expands into new areas, and so forth. It is critical that the extended risk assessment is updated, often multiple times, during a long duration incident. You can UPDATE a WFDSS decision at any time by copying the previous decision and then updating the pertinent information. Reference these updates in the periodic assessment narrative to document that the approver has reviewed the updated information. The Reports tab in WFDSS should not be used to document anything relevant to a change in a decision or change the intent of the decision without publishing a new decision.

Throughout the process of reviewing and updating, make sure the RRA and the extended risk assessment are in alignment. For example, if an updated extended risk assessment contains products clearly showing that Seasonal Severity has moderated to a below-average condition, the RRA should likewise be updated to "Low."