

Applying the Wildland Fire Decision Support System (WFDSS) to Support Risk-informed Decision Making: The Gold Pan Fire, Bitterroot National Forest, Montana, USA

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Abstract—In response to federal wildfire policy changes, risk-informed decision-making by way of improved decision support, is increasingly becoming a component of managing wildfires. As fire incidents escalate in size and complexity, the Wildland Fire Decision Support System (WFDSS) provides support with different analytical tools as fire conditions change. We demonstrate the application of WFDSS information and tools to assess risk management cycle elements by using a case study wildfire from the 2013 fire season; the Gold Pan Fire, Bitterroot National Forest, Montana, USA. Examples of the scalability of the WFDSS, its ability to gain quick situational awareness, and an evaluation of fire behavior potential and burn probability with respect to Highly Valued Resources and Assets, is shown for the Gold Pan Fire as an emerging incident that evolved into a complex wildfire, supported with sophisticated analyses to assist decision-making.

Introduction

Documenting a deliberate, risk-informed decision is emphasized with recent national policy guidance (USDA-USDOJ 2009) regarding the management of wildfires on federal lands. Additionally, specific protocols for making risk-informed decisions on wildfires exists in the Forest Service 2014 Wildland Fire Risk Management Protocols (USDA Forest Service 2014). Decision-makers have traditionally used the Wildland Fire Decision Support System (WFDSS—Noonan-Wright and others 2011) to document a wildland fire decision since 2009, but there are numerous ways a user can engage with the WFDSS to inform the risk management cycle. We applied the risk management cycle as described by Taber and others 2013 (Figure 1) and demonstrated: (1) how the WFDSS was used to assess and inform risk throughout the life of the Gold Pan Fire, and (2) the adaptability of the WFDSS to respond to changing fire complexities.

Gaining Situational Awareness for an Emerging Fire

There are six parts to the risk management cycle: (1) situational awareness, (2) assessment, (3) risk control, (4) decision, (5) implementation, and (6) evaluation (Taber



Figure 1—The Risk Management Cycle. The six parts of the risk management cycle are not always followed in a linear fashion, but typically start with Situational Awareness (Taber and others 2013).

and others 2013). The completions of all parts are dependent upon each other and require iteration, deliberation, and the use of the best available science (Figure 1). Situational awareness requires decision makers to identify risks and opportunities for mitigation by defining the Highly Valued Resources and Assets (HVRAs), the hazard, and the probability those important values will be positively or negatively impacted by wildfire. A decision-maker gains situational awareness regarding values, hazard, and probability, to inform a preliminary risk assessment.

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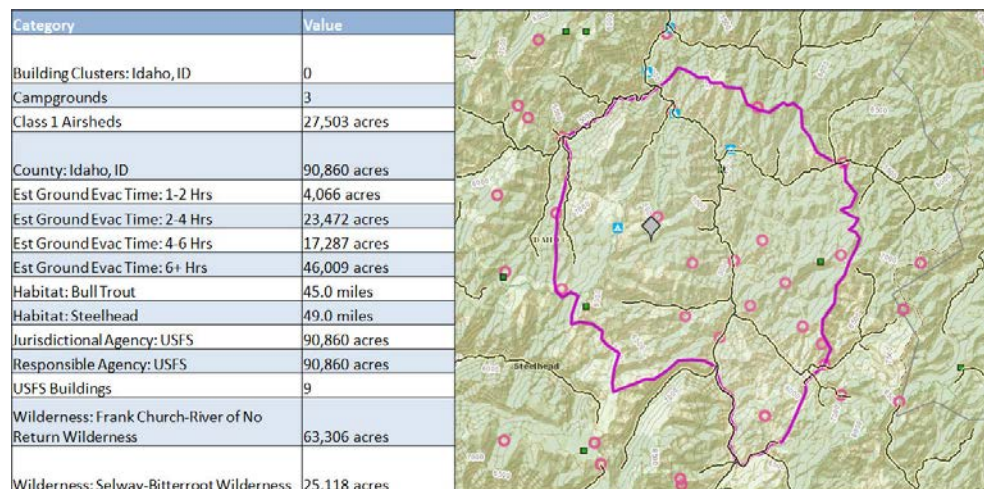


Figure 2—Planning Area Spatial Inventory Table and Planning Area. In WFDSS, the Incident >Situation tab is shown with Infrastructure (campgrounds—white tents/blue background; Forest Service buildings—green squares; and outfitter locations and camps—pink circles). Natural resource spatial data like bull trout habitat is displayed (linear yellow and black polygons on streams and rivers). The pink line delineates the planning area. The table summarizes spatial and non-spatial data, including highly valued resources and assets, which could support decision-making.

Identifying HVRAs (what infrastructure, natural and cultural values are adjacent to the location of the fire) helps decision-makers gain situational awareness to begin informing the preliminary risk assessment. In WFDSS, users draw a planning area polygon that will automatically populate a table of values, called a Planning Area Spatial Inventory (Figure 2). In addition, a user can manually click data sources on and off to isolate and identify specific values of interest or concern. For the Gold Pan Fire area, HVRAs included a cabin, a fire lookout tower, and a rural community east of the fire.

Hazard

During the initial phases of a risk assessment, decision-makers have a range of tools and data to evaluate hazard, including the continuity, amount, and configuration of surface and canopy fuels; fire behavior; and potential for fire growth. Fire danger graphs for the Bitterroot National Forest comparing current and historic Energy Release Component (ERC) trends were automatically generated for most Remote Automated Weather Stations (RAWS) and suggested that the ERC index was below the 90th percentile after the fire was detected. Fire history spatial data layers helped to quickly evaluate recently burned areas that could retard fire spread, and a large unburned area was noted between the Gold Pan Fire and the concentration of HVRAs to the east, suggesting greater hazard of unburned fuel in this area.

Probability

For a quick, qualitative risk assessment, probability refers to the likelihood of a fire becoming an active event with potential to reach HVRAs. Users address the potential for fire spread, barriers that would limit fire spread, and the current fire danger. For the Gold Pan Fire, much of the area had been historically managed to allow wildland fires to burn for enhancement of natural and cultural resources; subsequently there were old fire scars that could limit spread potential. Within the first few days of fire detection,

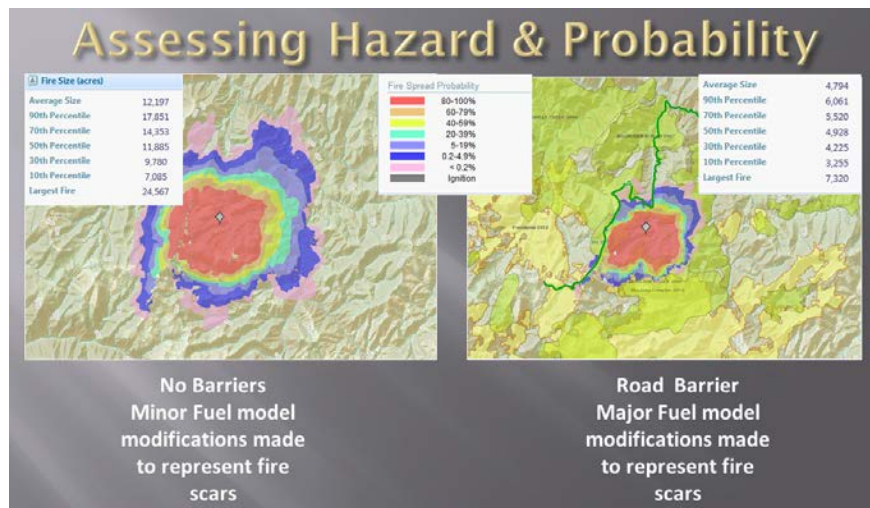
two Fire Spread Probability (FSPro) runs were used to simulate two-dimensional fire spread for 2,000 fires lasting 14 days, using historical weather and wind observations from the Hells Half Acre RAWS (No. 101019). The first simulation used minor modifications to surface and canopy fuels to represent less spread potential from historical fire scars, and the other simulation used barriers and fire scars to limit fire spread. To evaluate the probability of a fire becoming an active event, the mean fire size from the first run (12,000 acres) was compared to a mean fire size of 4,800 acres for the alternative run using the fire size table generated from each FSPro run (Figure 3). Displaying a range of outputs rather than one single analysis can be useful to address modeling uncertainty. Both outputs were considered and discussed with the decision makers during the preliminary situation awareness phase.

RISK Assessment for a High-Complexity Fire

Situational Awareness and Assessment

Within a few weeks of the detection of the fire, two significant spread events grew the Gold Pan Fire to 8,000 acres and an Incident Management Team (IMT) was called to manage the fire. WFDSS tools were used to reassess the Situational Awareness and Assessment phases of the risk management cycle. At that time, fire danger set a new record for maximum ERC (ERC=76), the peak of the season was still several weeks away, a season-ending event to naturally extinguish the fire was not expected until late September, and there were few barriers between the head of the fire and the HVRAs 12 miles northeast of the fire. An updated FSPro run with associated values helped the IMT gain some perspective on the fire's potential to burn outside of the Selway-Bitterroot wilderness area in the next two weeks, reinforcing the need for a long-term strategy that included consideration of both backcountry and front-country values.

Figure 3—Assessing Hazard and Probability Using FSPro. Fire spread potential was evaluated with two separate runs to understand the uncertainty associated with using FSPro when very little information is available. The first run shows a much larger average fire size (>12,000 ac) in the fire size table, when no barriers to surface fire spread were used as inputs to the model; and only minor fuel model modifications were made to represent less spread potential for historical fire scars. The second run is much smaller (<5,000 ac) when these modifications were fully implemented. Fire Spread Probability is represented spatially ranging from very low probability (<0.2 percent) to high probability (80-100 percent) that the location of a HVRA could be impacted sometime within the time frame of the model (in this case, 14 days).



Risk Control

Before the long-term plan was finalized, strategies and tactics were identified by the IMT to control risk and comply with incident objectives during the next operational period, including committing firefighters along a road to prepare for a burnout operation. However, the IMT reconsidered these actions after using the WFDSS Near-term fire behavior modeling tool to assess the potential fire behavior and fire spread over the next 72 hours. The analysis suggested that the safety of the firefighters was likely to be compromised before the work would be completed.

Bitterroot National Forest staff, local stakeholders, and a subset of the IMT were assembled to begin the long-term planning effort, assembling expertise in operations, policy, safety, and desired conditions. WFDSS outputs were used to focus efforts where fire was most likely to spread in the next several weeks and plan “Management Action Points” (MAPs) that, if breached, would initiate specific actions to be implemented. For example, MAP 11 was a north-south line between the fire and the urban interface that would consider home evacuations and a burnout operation if encountered by wildfire (Figure 4). Fifteen MAPs were developed over the life of the fire in the areas where the fire could potentially spread and impact values.

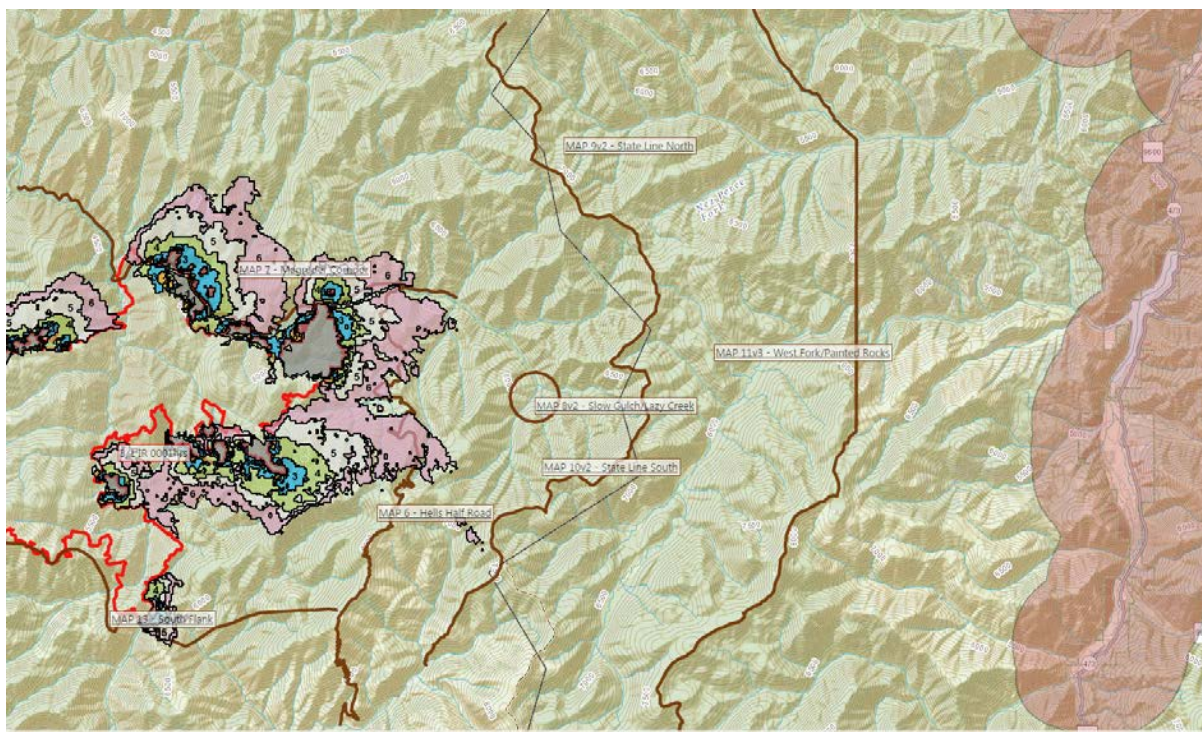


Figure 4—Six day simulated fire progression of the Gold Pan fire using Near-term Fire Behavior (NTFB). The Gold Pan Fire (perimeter in red) was modeled for a 6-day period (multi-colored polygons) to predict the fire progression given forecasted wind and weather and using the intense heat from the August 1st infrared and heat detection flight information as an ignition. Outputs display the potential for the fire to reach Management Action Points (brown lines). Management Action Points were developed in the long-term plan to protect highly valued resources and assets and the wildland urban interface (shown in pink).

Decision

Once the MAPs were identified and fire behavior was modeled, the risk management cycle moved to the Decision phase where the decision-makers validated the course of action (actions to manage the fire tiered from land management plan and the fire objectives) and acknowledged the risks. The tools in the WFDSS supported this phase by allowing the decision maker to easily see the products like fire danger rating graphs, season ending event graphs, and probabilistic fire spread. Additionally, a Near-term Fire Behavior output demonstrated expected fire behavior over the next several days. These graphics and descriptions, when assessed with the MAPs, gave the decision maker confidence in approving a sound course of action.

Implementation and Evaluation

The Implementation and Evaluation phases of the risk management cycle include carrying out the course of action and revising it as needed throughout the life of the fire. MAPs identified in the long-term plan along with daily reassessments of fire spread projections were used by the IMT and decision maker at daily planning meetings. The long-term analyst listed all MAPs that could be impacted in the next 24, 48 and 72 hours so the IMT could plan actions accordingly and implement the plan successfully. Additionally, a daily assessment for impacts to the planning area or closure area boundaries was made to ensure the planning area remained relevant and public safety was addressed. This daily reassessment using WFDSS fire behavior tools allowed the decision makers to continually evaluate the Decision to ensure it remained relevant.

Conclusion

The risk management cycle used for the Gold Pan Fire demonstrates how initial fire decision making can be quickly informed by geospatial information and analysis. As the fire's complexity escalated, an IMT was able to use WFDSS products to continually assess risk and inform the planning process. WFDSS is not just a place to document a decision that is compliant with National Fire Policy, but a powerful collection of data, tools and processes that can provide quick, scalable, relevant support to decision making at all levels of the Risk Management Cycle.

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