RMA
Risk Management Assistance

# Risk Management Assistance (RMA) Products 2020

☐ Incident Timeline

☐ Resource Timeline

☐ Management Direction Alignment Table

☐ Trade-off Analysis & Risk Assessment Exercise (on-site or virtual)

☐ Aviation Use Summary

☐ Suppression Difficulty Index Map

☐ Potential Control Location Map

☐ Season-ending Analysis (not available in Alaska)

☐ Snag Hazard Map

☐ Ground Evacuation Map and Injury/Illness (not available in Alaska)

☐ Exceedance Probability Curves (available only if the geographic area has a quantitative wildfire risk assessment that can be combined with an accurate FSPro run)

- To request one of these analytics, contact Rick Stratton (richard.stratton@usda.gov)

# Incident Timeline

**Questions Answered**:

- Is there a way to display fire size, cost, personnel, percent containment, strategy, etc. on a single graph and look at the relationships? For example, can I compare the cost of the fire to the strategy over time in relation to threatened structures?

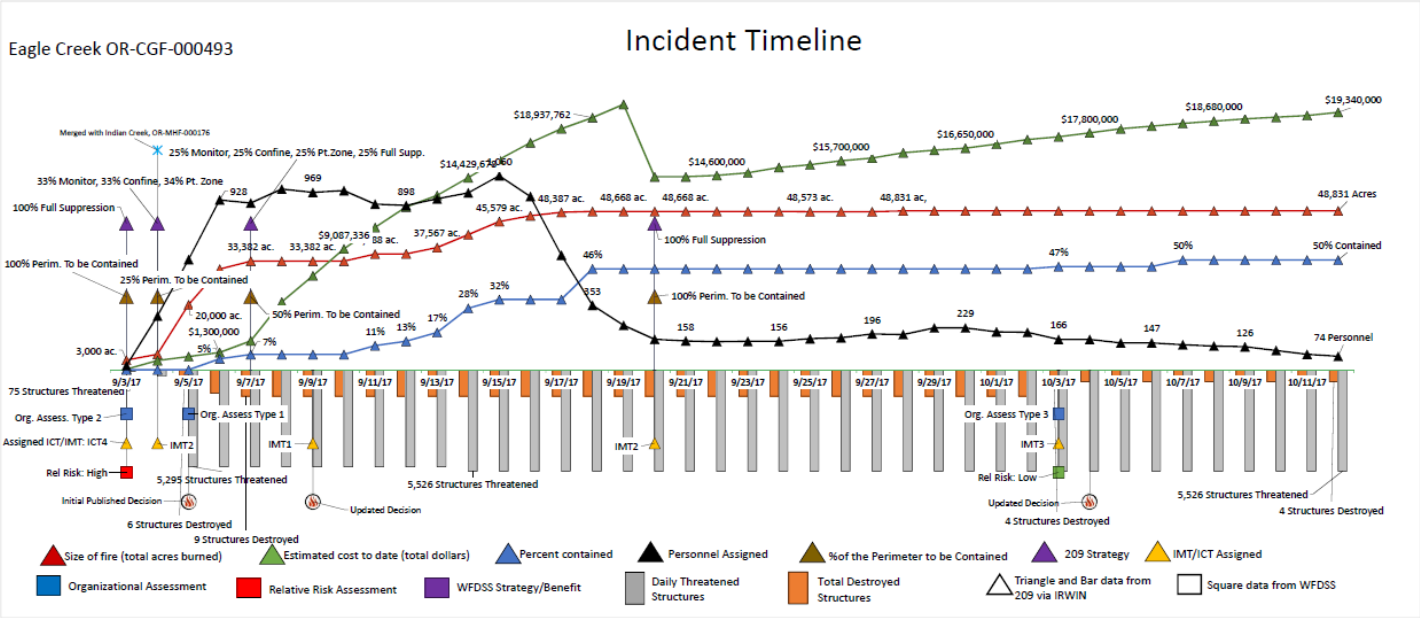
**Purpose**:

The incident timeline is a visual depiction of the history of a fire. The product can be used by incoming teams and resources to get a quick history of the incident and by the unit as a tracking mechanism of what has occurred on the fire. Data are acquired from the IRWIN Observer application and WFDSS. IRWIN ensures the Authoritative Data Source (ADS) is used for each data element.

Timeline Data Include:

- Size
- Cost
- Number of Personnel
- Percent Contained
- Directed Strategy
- Reported Strategy
- Percent of Perimeter to be Contained
- Relative Risk Assessment
- Organizational Needs Assessment
- Assigned Incident Management Team/IC
- Structures Threatened/Destroyed
- Decision Status

**Example** (Eagle Creek Fire, OR 2017):



# Resource Timeline

**Questions Answered**:

- How many resources are on the fire? What types of resources are on the fire? Has resource type changed with fire size or containment?

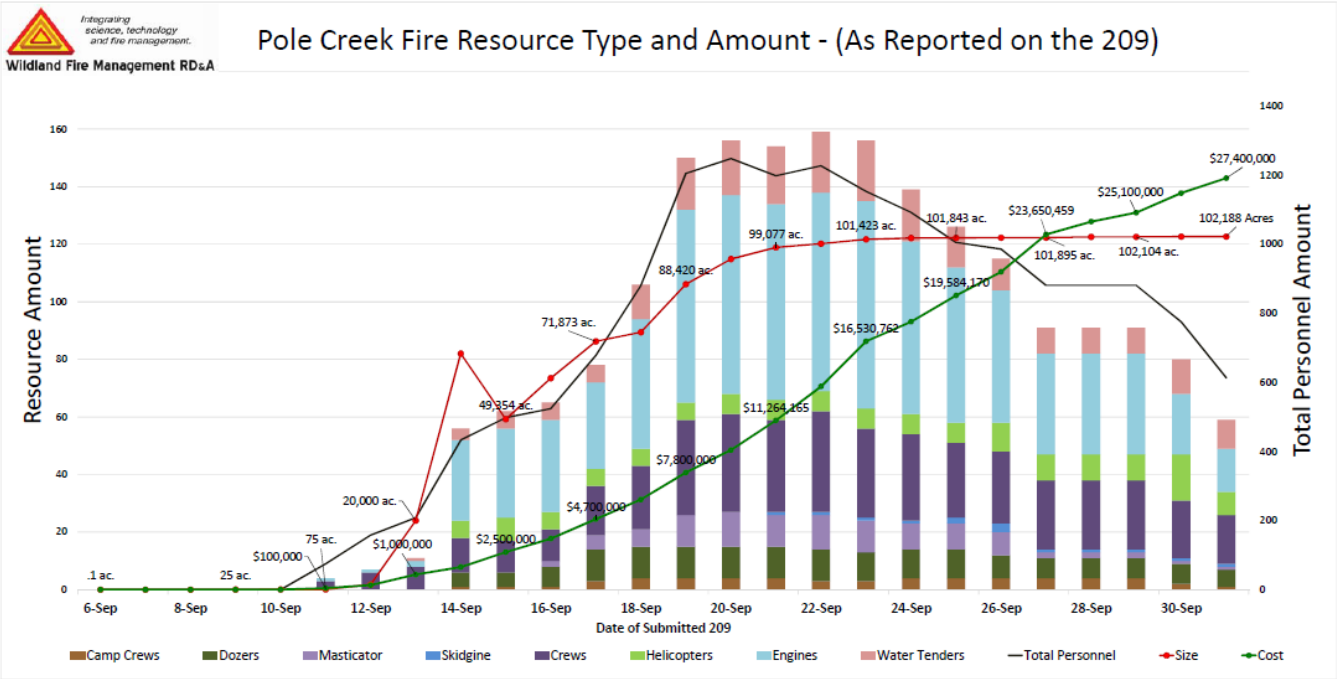
**Purpose**:

The resource timeline is similar to the incident timeline, but it visually depicts resource type by date. The product can be used by incoming teams and overhead to get a quick overview of the number and type of resources and how they trend with fire size, cost, etc. Data are acquired from the IRWIN Observer application and WFDSS. IRWIN ensures the Authoritative Data Source (ADS) is used for each data element.

<u>Timeline Data Include</u>:

- Size
- Cost
- Number of Personnel
- Resource Type
- Percent Contained

**Example** (Pole Creek Fire, UT 2018):



# Management Direction Alignment Table (MDAT)

**Questions Answered**:

- Are the strategic objectives (from the L/RMP), incident objectives, WFDSS course of action, leader's intent, and the incident action plan in alignment?
- Can I see a table that describes the L/RMP, WFDSS, and incident direction BY CATEGORY?
- How can I compare the verbal direction on this incident to direction given through written format? Are there inconsistencies or misalignment in direction that can be cleared up? Where is the direction clear?

**Purpose**:

The management direction alignment table compares the direction provided in the L/RMP via WFDSS Strategic Objectives and Management Requirements, Incident Objectives and Requirements in the WFDSS Decision, Delegation of Authority/Leader's Intent, Course of Action from WFDSS, and Incident Action Plan (IAP). Direction is grouped by general category, such as safety/Risk management, general fire management, cost/financial, WUI/infrastructure, air quality, cultural/historical, T&E species, Wilderness, PIO/PAO/Coop, riparian/water, weeds, and recreation. A summary page is also provided to the Line officer with areas of misalignment and/or or recommendations.

**Example** (1 category only shown out of 16; Frye Fire, AZ 2017):

| Category | LRMP Strategic Obj. | LRMP Mgt. Req. | WFDSS Incident Obj. & Req. | WFDSS Course of Action | DOA/Leaders Intent | Incident Action Plan (IAP) Obj./Req. |
|---|---|---|---|---|---|---|
| **Safety/Risk Management** | | **AZ-CNF: Unit Wide**<br>Firefighter and public safety shall be the first priority in all fire management activities.<br><br>**AZ-CNF: Unit Wide**<br>Wildland fire suppression responses shall minimize…risks to life and property. | | **Updated 6/21:**<br>Firefighter and public safety remains priority over all other incident objectives and requirements. The IMT will make reasonable and prudent risk-based decisions to accomplish the agency mission while minimizing exposure to hazards for firefighters and the public. | Firefighter safety and effectively managing risk are our primary concerns in addressing this incident. There are no resource or facility values that are worth the cost of human life. We do recognize that there are inherit risks that cannot be eliminated. Your task is to minimize those risks and limit our exposure to those risks. We are committed to the continuous management of risk. Ensure that all assigned firefighting personnel adhere to the work/rest guidelines. Ensure that the 10 standard orders are followed and adhered to by every firefighter, without compromise and that the 18 watch out situations will be continually evaluated and mitigated.<br><br>We on the Coronado continue to commit to our 2017 Life First Principles:<br>•We will make reasonable and prudent risk-based decisions to accomplish the agency mission while minimizing exposure to hazards for firefighters and the public.<br>•We will commit to work towards better integration and alignment between line officers and fire management personnel, to assure shared leadership of all incidents.<br>•Upper-level management will have an open-door policy.<br><br>Ensure all actions reflect a commitment to firefighter and public safety through the development of tactical operations commensurate with values at risk, probability of success and the use of the least number and types of firefighting resources necessary to successfully accomplish the mission.<br><br>Be creative, decisive and exercise good judgment in decision making to accomplish tasks and objectives under confusing, dangerous and ambiguous conditions. We are committed to the continuous management of risk. Make reasonable and prudent decisions to accomplish | Ensure the safety of emergency responders and the public by utilizing risk management processes and timely evacuations. |

# Trade-off Analysis and Risk Assessment Exercise

**Questions Answered**:

- What is the best strategy or course of action (COA) for management of this fire?
- Is there a better COA than the current strategy we are employing on this fire?

**Purpose**:

The trade-off analysis (TOA)/risk assessment exercise is a process that the RMAT, agency administrator(s), partners, and the incident management team participate in. It is in spreadsheet form and continues to be refined. The intent of the TOA is to develop a range of potential Strategies (i.e., Courses of Action) representing a broad spectrum of potential response options and rate them regarding how well they addressed (a) risk to vales such as residential and commercial development, infrastructure, ecological, and cultural, (b) firefighter risk, (c) public safety, and (d) partner/cooperator concerns, and (e) social/political/economic.

The process begins with an understanding of the current strategy and then proposes a range of alternative strategies along with estimates of the firefighting effort (ground & aerial resources) and incident duration needed to implement each strategy. The TOA utilizes a set of tables to provide a framework for trading-off risk among the elements highlighted above and weighs each strategy based on probability of success and consequences of failure. This exercise can be sent to a local unit or a small cadre of RMA reps can be ordered to help develop/facilitate the exercise.

**Example** (Decker Fire, CO, 2019):

| **Fire:** Decker Incident | **Area:** Rocky Mountain Region / Rio Grande National Forest | | | | **Date:** October 02, 2019 |
|---|---|---|---|---|---|
| | | | | | |
| **Strategic Alternatives** | | | | | |
| | | | | | |
| | **Strategy A:** | | **Strategy B: Preferred Option** | | **Strategy C:** |
| Description: | Conduct control operations on both the PSICC and RFG utilizing indirect lines consisting of roads, natural barriers, and fuel transitions to maximize fire activity benefits in wilderness areas and minimize growth on unfavorable wilderness areas. Full suppression on partner BLM lands on points that are favorable and minimize growth and deemed successful.<br>This strategy would allow fire to travel across the landscape for the greatest distance. | | Identify containment options for high probability of success and take suppression actions on PSICC, RGF, and BLM lands by using geographic features, favorable fuels conditions, existing roads, constructed hand lines, and trails.<br>This strategy would minimize fire travel across the landscape. | | Full perimeter suppression tactics using a mix of direct, in-direct, cold trailing to minimize perimeter growth and incident duration.<br>This strategy would stop fire growth at current size. |
| Resource Commitment: | Moderate during active control operations | | Moderate during active suppression operations | | High during active suppression operations |
| Duration: | Season ending event | | Season ending event or with unusual weather events such as frontal passage | | As soon as perimeter control is completed with interior smoke |
| Incident Complexity: | T2/T1 | | T2/T1 | | T2/T1 |
| **Risk to Values** | | | | | |
| **Prioritized Values** | **Risk** | *Comments* | **Risk** | *Comments* | **Risk** | *Comments* |
| **PVT Residential / Commercial Development** | | | | | | |
| Private inholding structures | Serious | Structures near proposed lines | Serious | Structures near proposed lines | Minor | No structures near proposed lines |
| Private land | Serious | Private lands outside proposed lines | Serious | Private lands outside proposed lines | Minor | Private lands outside proposed lines |
| Mining Claims | Minor | No mining claims | Minor | No mining claims | Minor | No mining claims |

# Aviation Use Summary

**Questions Answered**:

- Which aircraft are assigned to and working on this incident?
- What is the trend in aircraft assignments and use over time?
- Where are large airtankers and heavy helicopters being used on this incident?
- What is the exposure (accident expectation) related to this level of aviation engagement?
- How does this aircraft use align with the overall incident strategy?

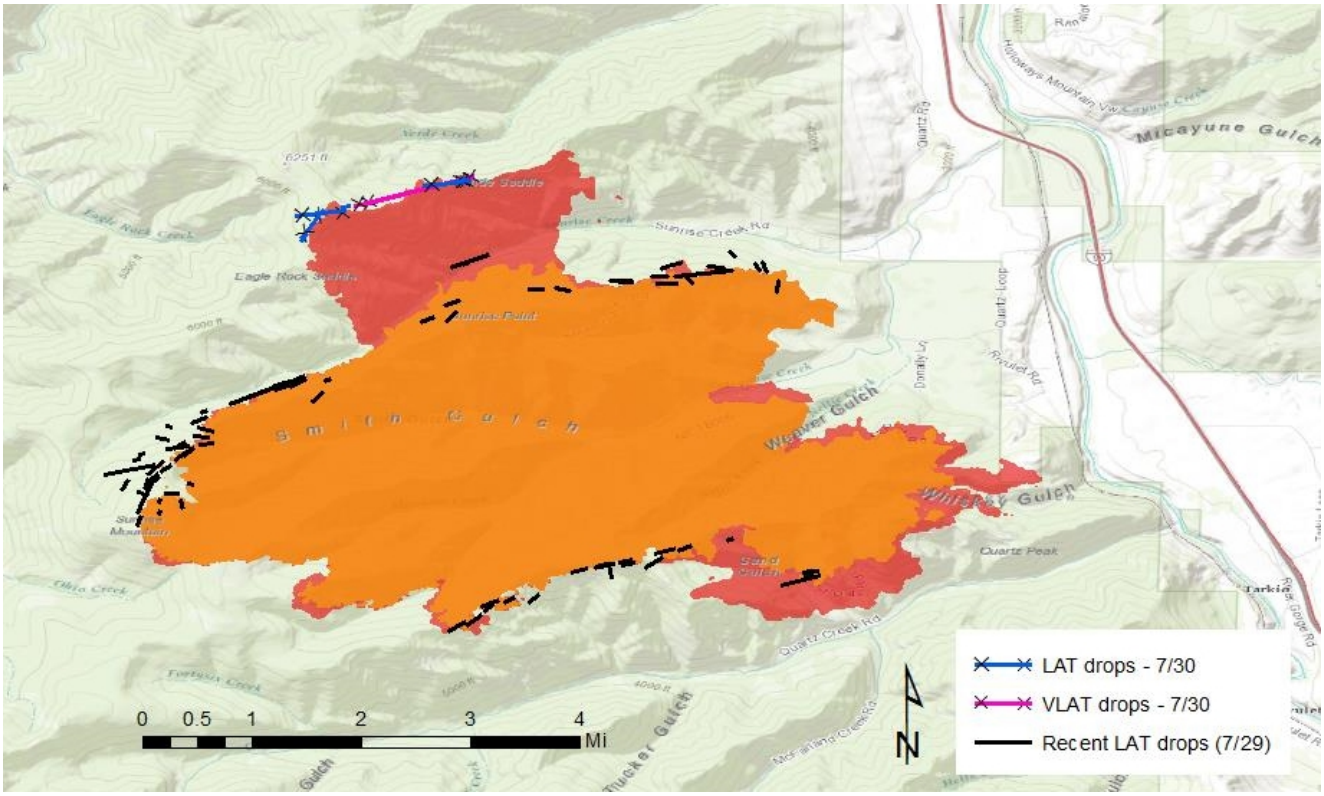
**Purpose**:

The RMAT utilizes emerging technologies and existing federal data systems to summarize and map aviation actions in fire suppression. Products included in the Aviation Use Summary are intended to enhance decision makers' abilities to quantify and track aviation exposure through time, including the ability to account for accident expectation associated with relatively minor levels of repeated aircraft use over a long duration incident. These products can initiate important conversations highlighting thoughtful consideration for the associated risk and intended benefit of every management decision that results in exposure to firefighters, whether they are ground or aerial based assets. These products can also be used to improve communication between different levels of fire management and to highlight potential areas of risk transference between ground and aviation.

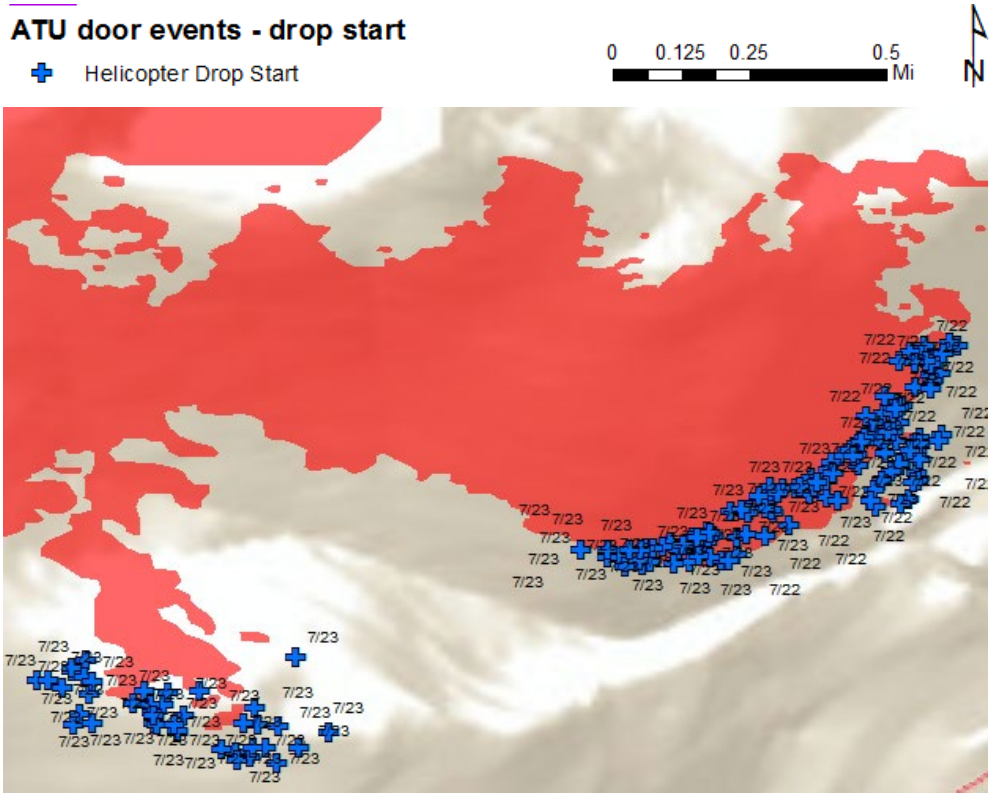
**Examples**:

<u>Mapping retardant and water delivery</u>

Federal LATs and tanked T1 helicopters under exclusive-use contracts with the USFS are required to equip aircraft with Additional Telemetry Units (ATU) that log the coordinates of door opening and closing events associated with retardant or water delivery (these data are also available from LATs operating under Call When Needed agreements). These data are available in real time, and the points and associated information can be converted in GIS to display drop lines. They are not widely used or accessed, and currently have cumbersome systems that preclude efficient data processing. Despite inefficiencies in the underlying systems, RMAT analysts have developed methods to pull, clean, and process door events in order to map and summarize aviation activities for incidents up through the end of the operational period the previous day. Helicopter data volume may necessitate display of helicopter drops as point door events, but this approach still enables fruitful discussions about total drop volume, level of engagement, and associated exposure.




- Sunrise Fire LAT/VLAT drop lines (ATU data) through 8/2

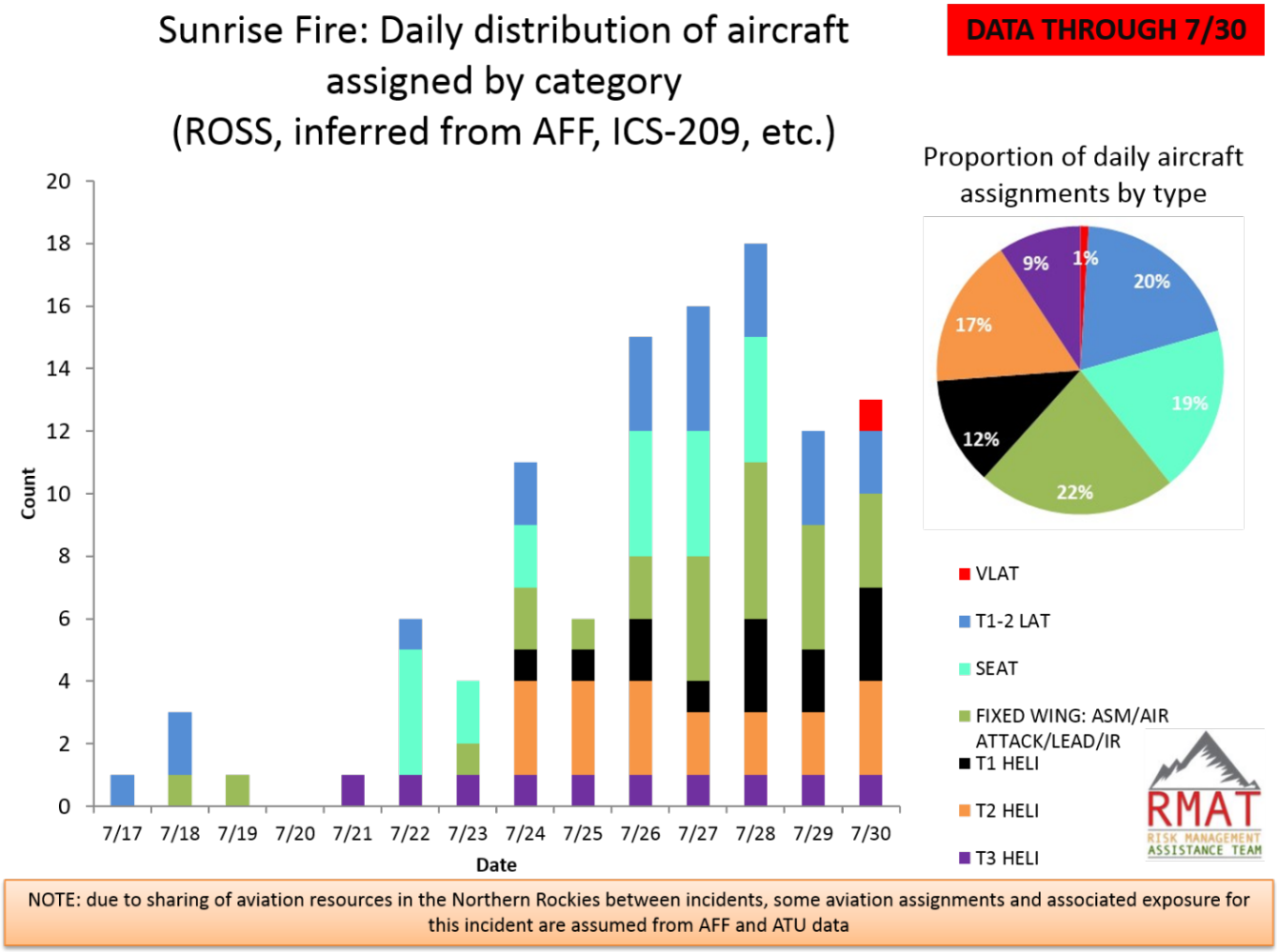



- Whetstone Fire helicopter drop door events (drop start only) for a single T1 tanked helicopter for two operational periods (7/22 – 7/23)

Not all aircraft consistently report ATU data and some aircraft are not required to provide data. Because the entire aviation picture may not be captured by a map of ATU data, tables or narrative summaries can provide information about the level of completeness of the mapped drops. Even for incidents where the majority of drop data cannot be mapped, a map showing just a portion of use can be very effective at initiating aviation strategy conversations and risk management decisions.

Incident level resource tracking

Plotting a time-series graph of the number and type of aviation assets assigned to a fire can highlight trends in use or a ramp up in aviation engagement. This, in turn, can initiate necessary conversations about the strategy behind these resource assignments and whether the associated exposure is in line with the expected benefits of the objectives associated with the aircraft.




- Sunrise fire aviation resource assignment time series graphic

# Suppression Difficulty Index (SDI)

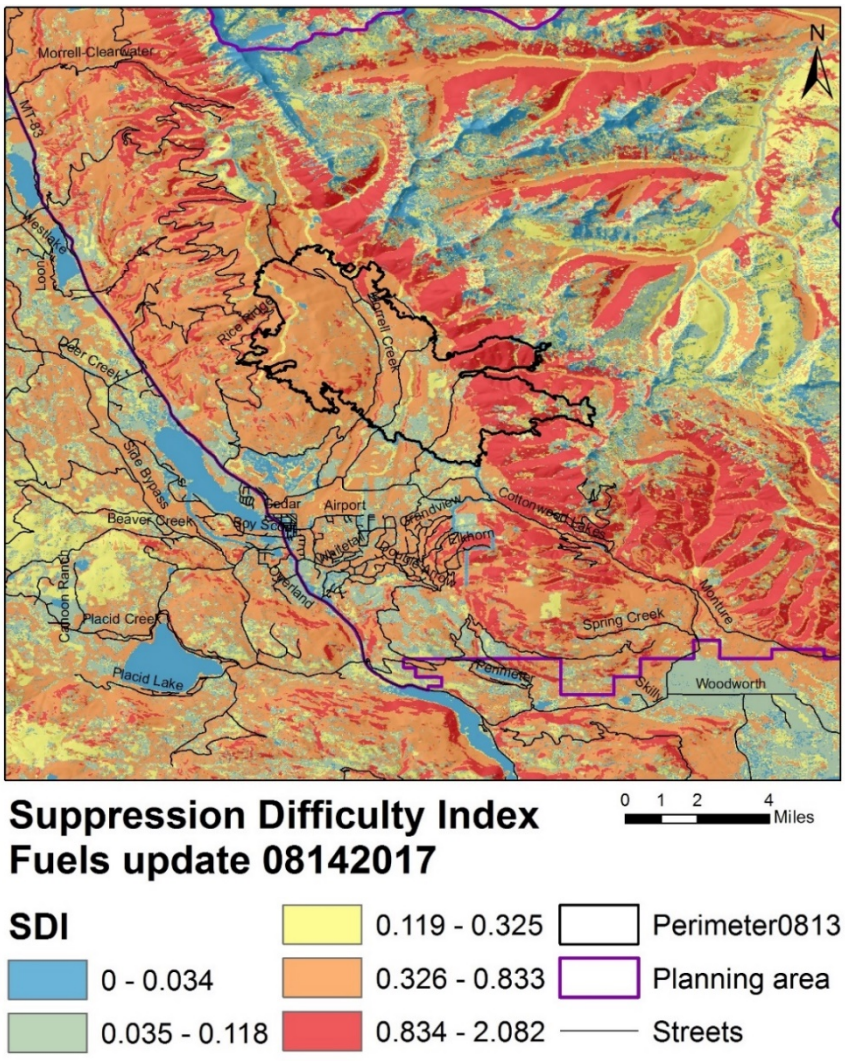
**Question Answered**:

- Where on the landscape do opportunities exist to mitigate hazards to fire responders?

**Purpose**:

Suppression Difficulty Index is a rating of relative difficulty in performing fire control work. It factors in topography, fuels, expected fire behavior under prevailing conditions, firefighter line production rates in various fuel types, and accessibility (distance from roads/trails). Red zones are “watch out” situations where engagement is likely to be very difficult given potential fire behavior, fuels, terrain, and lack of access. Blue zones indicate areas of higher likelihood of success due to low fire behavior as a result of gentle terrain, low to moderate fuel conditions, and better access. SDI does not account for standing snags or other non-fire hazards to firefighters, so it is not a firefighter hazard map. It is only showing in relative terms where it is harder or easier to perform work. High SDI indicates extreme difficulty, and low SDI indicates more reasonable conditions.

**Example** (Rice Ridge Fire, MT 2017):



# Potential Control Locations (PCL)

**Questions Answered**:

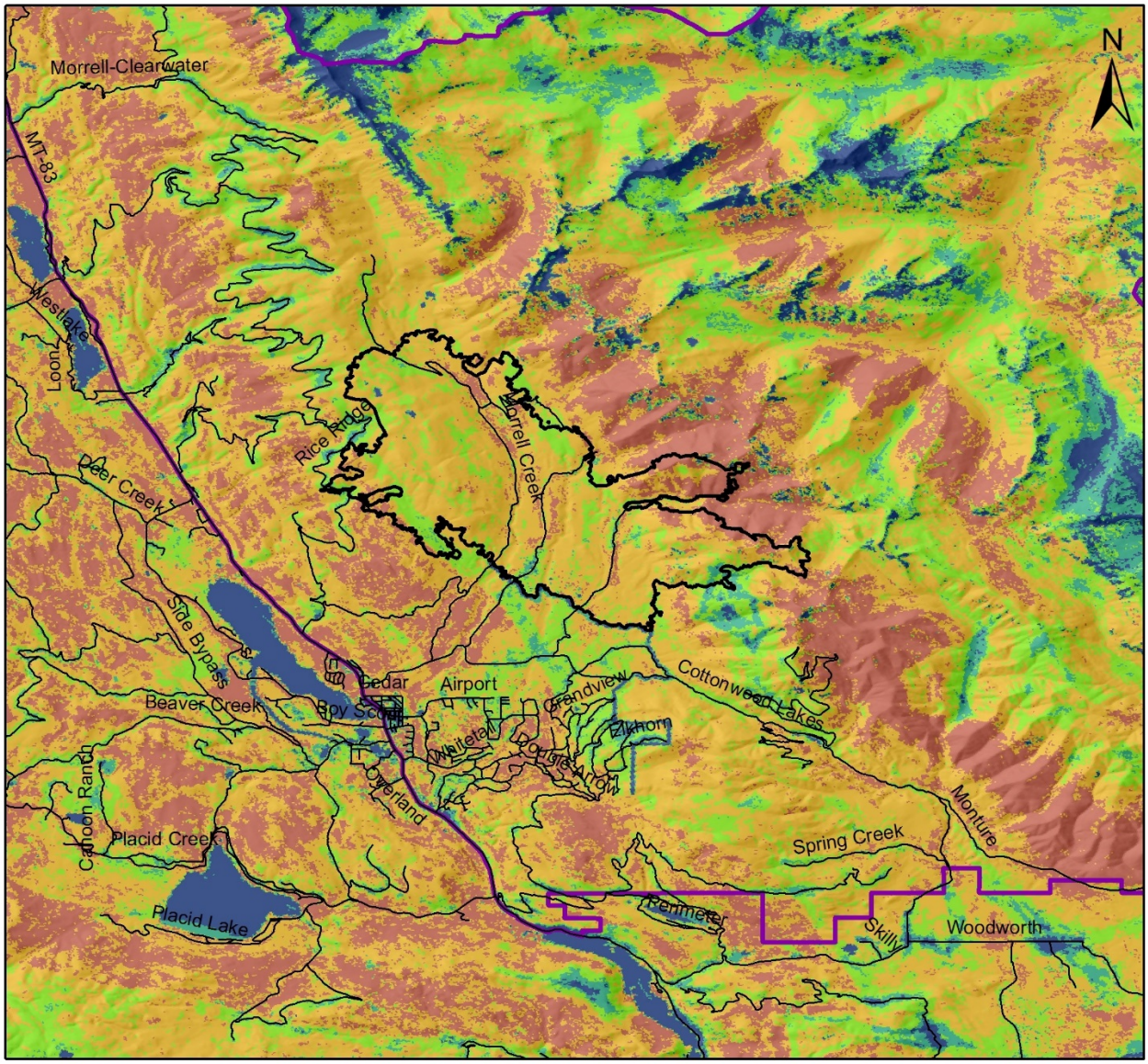
- Where on the landscape are fires most likely to be successfully contained under typical fire weather conditions and suppression effort?
- Where on the landscape are fires most likely to continue spreading under typical fire season weather and suppression effort?

**Purpose**:

The atlas of Potential Control Locations provides a summary of the historical fire containment probability. PCL is scaled from 0-100%, corresponding to conditions with low to high probability of containing a fire based on the past 20 years of fire behavior and fire management activity on a specific landscape. While it is not a map of actual containment probability (each fire occurs under a unique set of conditions), it provides a reasonable assessment of where suppression actions can leverage the natural conditions that have successfully slowed or stopped fires in the past. It does this by comparing historic fires with various characteristics of the landscape such as expected fire behavior, fuels transitions, roads and trails, topographic features, and suppression difficulty. Red zones can be considered wicks, where fires tend to spread into the entire zone. Blue zones in the PCL atlas are areas where fires tend to stall on the landscape due to some combination of site conditions[1].

[1] The scaling of PCL is from 0-100%; Higher % = best likelihood for forming a fire perimeter, Lower % = not likely according to the model that a fire perimeter would be established there, i.e. historically fires don't tend to stop in these places.

**Example** (Rice Ridge Fire, MT 2017):



# Season-ending Analysis

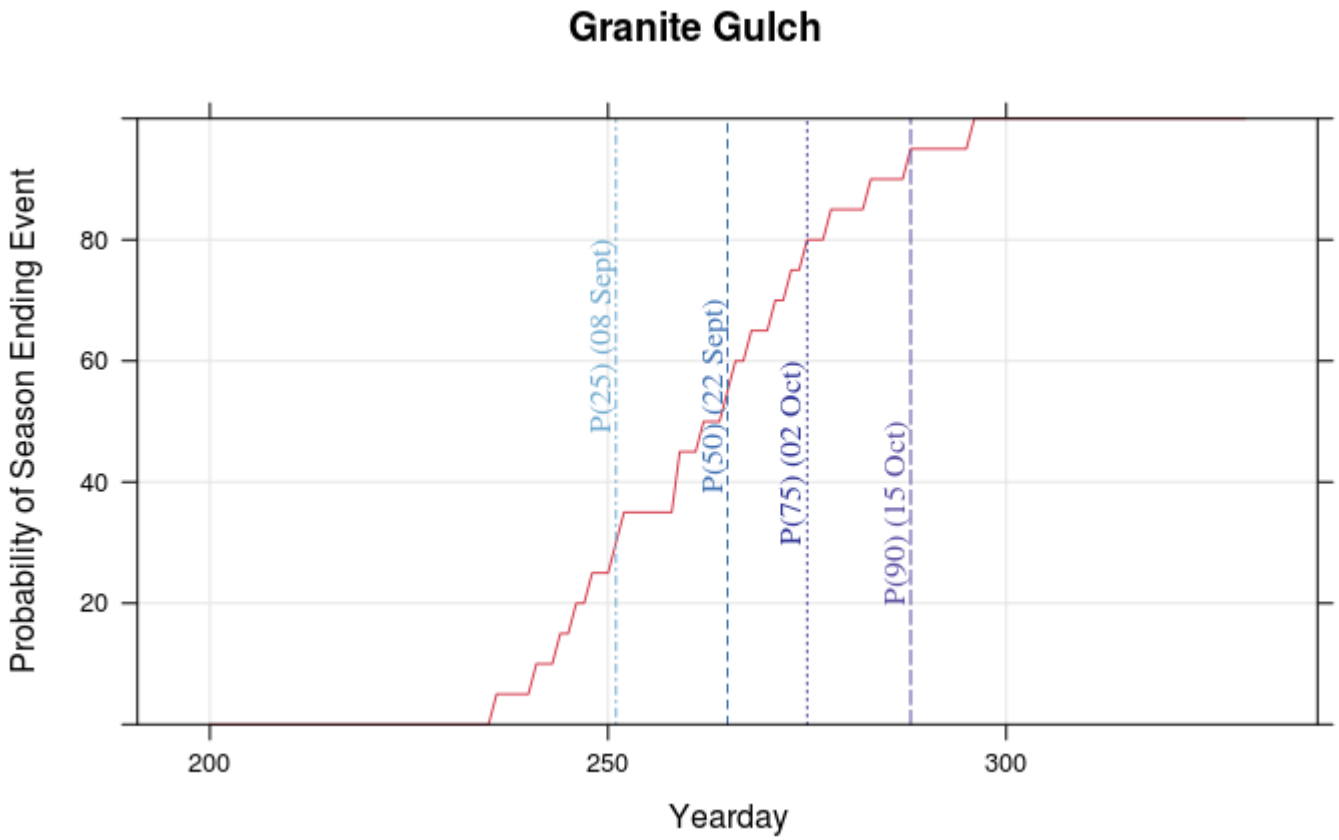
**Question Answered**:

- When will the fire season end?

**Purpose**:

A season-ending event consists of a fire-stopping—sometimes referred to as a fire-slowing event(s)—followed by a persistent combination of environmental factors that mark the end of the fire season. These factors can include subsequent pulses of rain or snow, lower temperatures, higher relative humidity, a lower sun angle, and a shorter photo period.

This product is in development by Dr. Matt Jolly of the Fire Sciences Lab, RMRS. It is based on 18 years of gridded weather data and instead of the nearest Remote Automated Weather Station (RAWS) or a grouping of RAWS (a SIG), it is based on the most recent fire perimeter. The criteria for choosing the term threshold is much less subjective than the traditional approach. A time series of ERC is extracted for each pixel in the fire perimeter. If the ERC drops below a RELATIVE ERC of 75 (data is scaled 0 to 100)—25% of the historic max—and remains below that threshold, the season-ending criteria is met. Below is a season-ending graph for the 2019 Granite Gulch Fire in the Eagle Cap Wilderness, WWF, OR.



# Snag Hazard Map

**Question Answered**:

- Where can firefighters safely mop up with the least amount of exposure from dead trees?

**Purpose**:

The Snag Hazard maps are intended to show areas of relative hazard from dead, standing trees. The maps are compiled from the National Treelist dataset (**Riley** et al 2016). ***This dataset was created for use in large scale modeling and has not been field verified.*** The dataset uses a mathematical relationship between actual FIA plot data and landscape characteristics to produce a wall-to-wall dataset of treelists at the 30 meter pixel level, suitable for use in FVS and other growth and yield models. From these treelists, dead trees are extracted and summarized by median height and density per hectare. We classified this data per **Dunn**, et. al (2019) to determine the snag hazard as follows:

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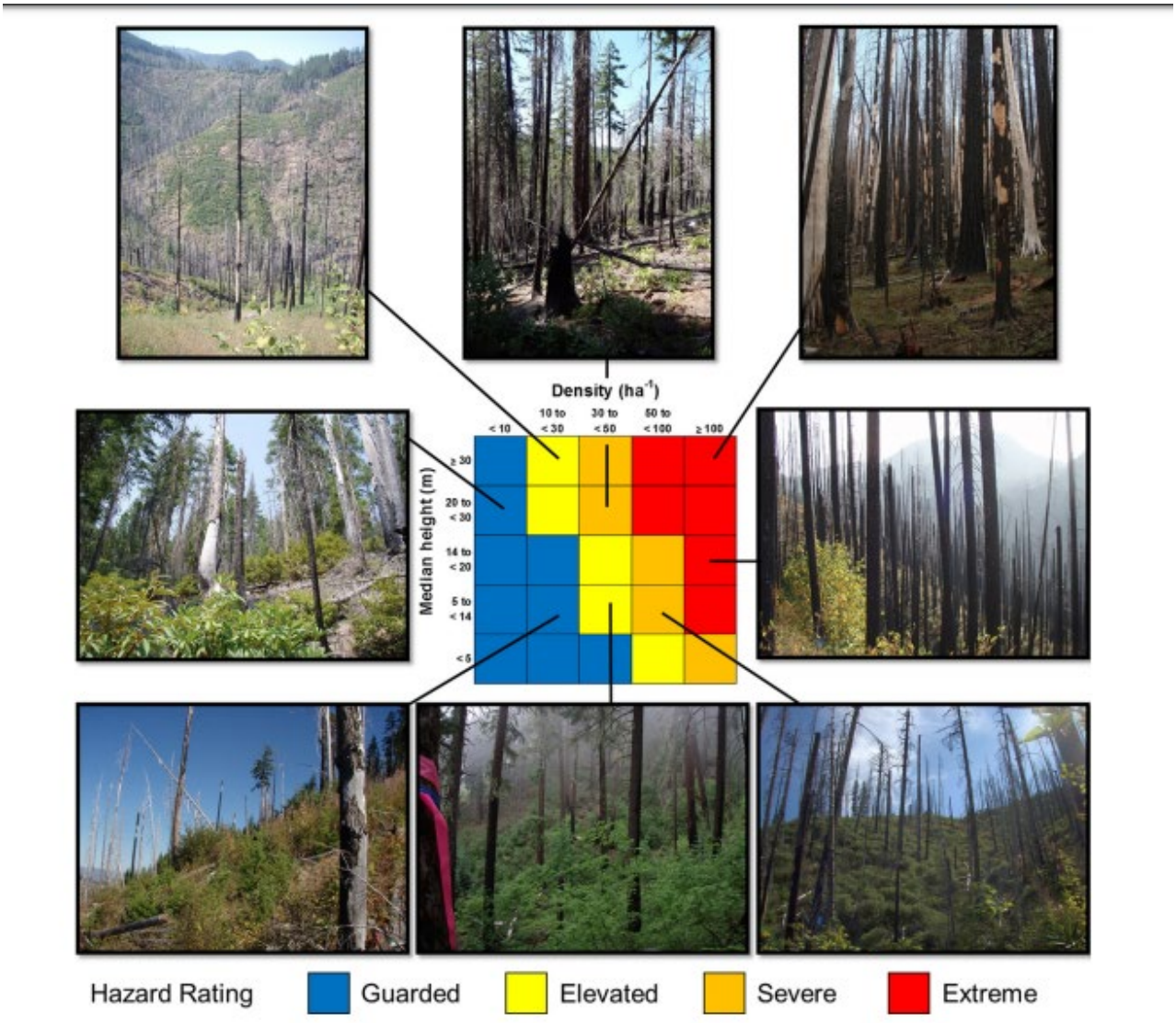


While the above pictures show snags from burnt forest, the national treelist identifies snags from all dead trees – burnt, insects, age, etc.

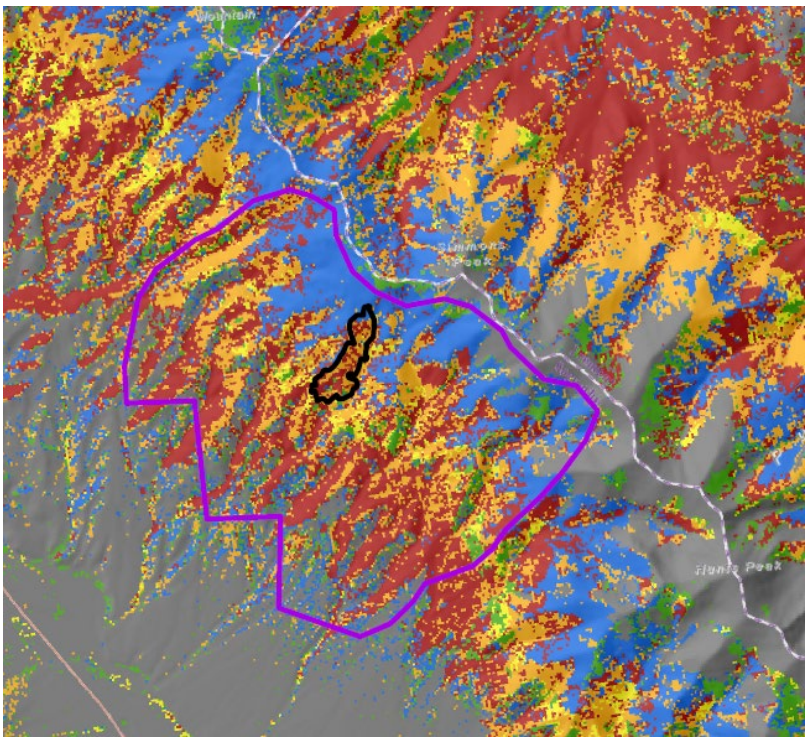
The national treelist dataset is representative of landscapes circa 2009. Since then, disturbances and age may have produced more snags in some areas, while snags in other areas may have fallen down. A temporal model of these dynamics is available, however it is not fully ready for production and is still considered a research tool.

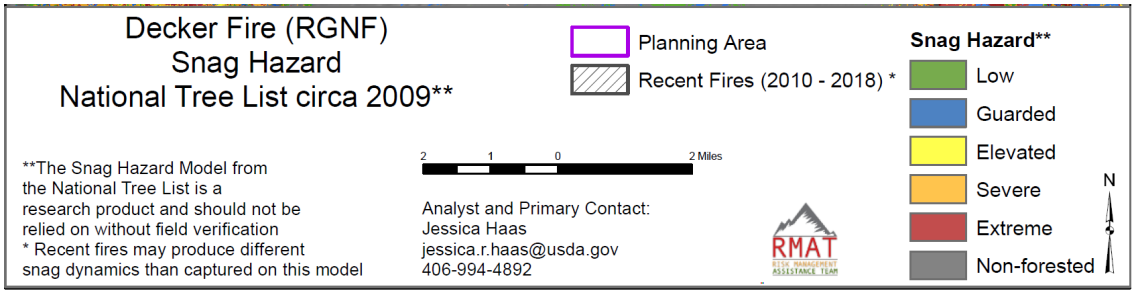
The snag hazard maps produced from the national treelist dataset are still a research tool, however they can provide real insight into the snag conditions on the ground. Any feedback and field verification of these products will be very useful and greatly appreciated.

**Riley**, et al (2016) Mapping forest vegetation for the western United States using modified random forests imputation of FIA forest plots. Ecosphere 7(10):e01472. 10.1002/ecs2.1472

**Dunn**, et al (2019) "Spatial and temporal assessment of responder exposure to snag hazards in post-fire environments" Forest Ecology and Management, 441(202-214) DOI10.1016

**Example** (Decker Fire, RGF, CO 2019):





# Ground Evacuation Map and Injury/Illness Information

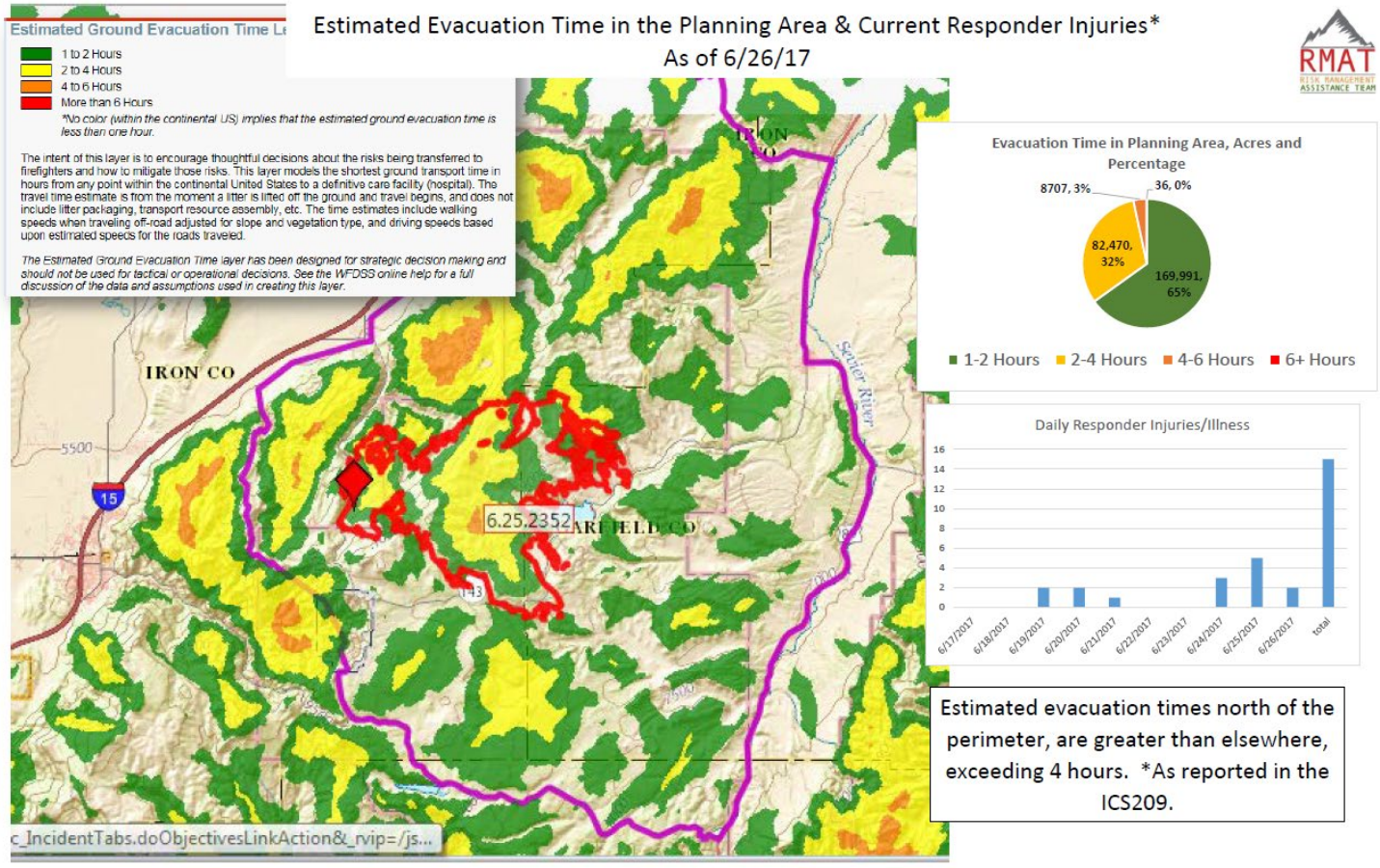
**Questions Answered**:

- What is the evacuation time to evacuate resources by ground to a hospital?
- What areas are more remote than others?

**Purpose**:

The Estimated Ground Evacuation Map has been designed for strategic decision making and should not be used for tactical or operational decisions. The ground evacuation layer can assist in identifying estimated ground transport time from different locations on a fire to a care facility. The time estimates include walking speeds when traveling off-road adjusted for slope and vegetation type, and driving speeds based upon estimated speeds for the roads traveled. The intent of this layer is to encourage thoughtful decisions about the risks being transferred to firefighters and how to mitigate those risks.

**Example** (Brian Head Fire, UT 2017):



# Exceedance Probability Curves

**Questions Answered**:

- Which fires in the next 7, 10, or 14 days have the highest likelihood of loss—exposure to resources and assets—and/or ecological benefits to fire?
- Is there a quantitative way for our Forest, area command, or geographic area to prioritize our limited resources based on values at risk?

**Purpose**:

Exceedance Probability (EP) Curves allow for the comparison of incidents relative to one another with regard to likely outcomes (i.e., positive vs. negative). Information to develop the curves comes from regional Quantitative Wildfire Risk Assessments (QWRA) (where available) and Fire Spread Probability (FSPro) output. Information about HVRAs (Highly Valued Resources and Assets), including their locations, are obtained from the QWRA. FSPro provides the probability of a fire reaching HVRAs within a given time. This product has been used by individual forests, multiple forests due to a lightning event, area commands, and Multi-Agency Coordinating (MAC) Groups to help inform prioritization. EP Curves can be developed based on based on multiple fires (Example 1) or HVRAs (Example 2).

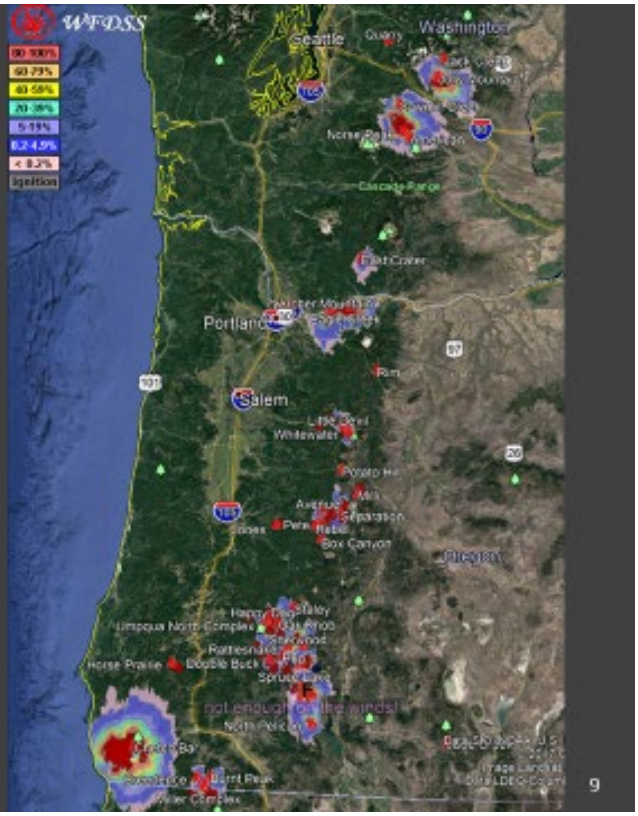
To learn more about EP Curves and there use, click on the webinar link below. This presentation was given Feb. 28, 2018 for the Advanced Fire Environment Learning Unit.
https://www.youtube.com/watch?v=etmVADt9URI

Reference:
Stratton, Richard D. 2018. Use of FSPro and a Quantitative Wildfire Risk Assessment (QWRA) to create Exceedance Probability Curves to Aid Incident Prioritization (S11.8). Presented at: The Fire Continuum Conference: Preparing for the Future of Wildland Fire. May 22, 2018; Missoula, MT.

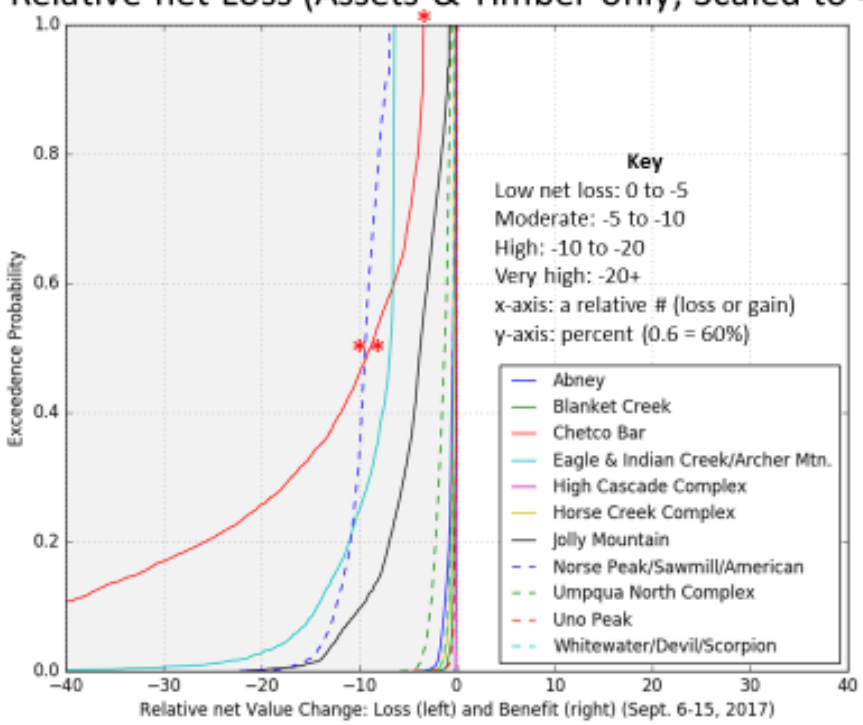
**Example #1** (PNW MAC, Sept. 2017):

## FSPro (Fire Spread Probability)

- 10-day run (Sept. 6-15)
- 4 days of forecast (includes the cooler temps, higher RHs, and possible precip)
- 3,000 fires modeled from last know position of the fire (from IR flight or satellite)
- 8 analysts
- ~25 fires simulated
- Includes previous fires & current containment lines
- For each of the 3K fires an overall cNVC is calculated for each ending perimeter and fire; then it is graphed.
- Assumes NO SUPPRESSION



## Relative net Loss (Assets & Timber only; Scaled to 40)




### How to interpret the curves

- First, a NET + response is on the right and a net negative is on the left. That does not mean there are some benefits on the fire—just that the OVERALL net outcome is negative. Since most assets and timber respond *negatively* to fire, all of the curves are on the left (a loss).
- Start here*, note Norse Peak and Eagle Creek have the highest immediate probability for loss. HOWEVER, see how Chetco exceeds both of these fires eventually and goes on to have a VERY negative let loss? (an example of a low probability, high consequence outcome). These tails are those blue and pink bands on the FSPro runs (i.e., the rare events).
- Chetco Bar is predicted to be 100% mildly negative, but the loss doubles at about 50% (-2.5 vs. -5)**—so the likelihood of Chetco exceeding a value of -10 is 50%, or saying it a different way, in the next 10-days there is a 50/50 chance Chetco will realize a high net loss.

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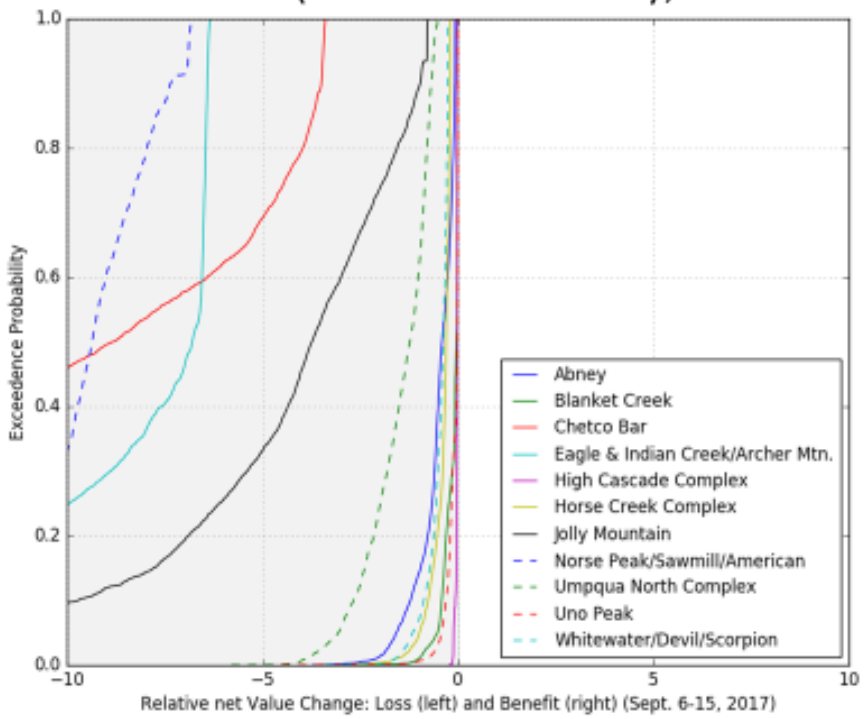
## Relative net Loss (Assets & Timber only; Scaled to 10)

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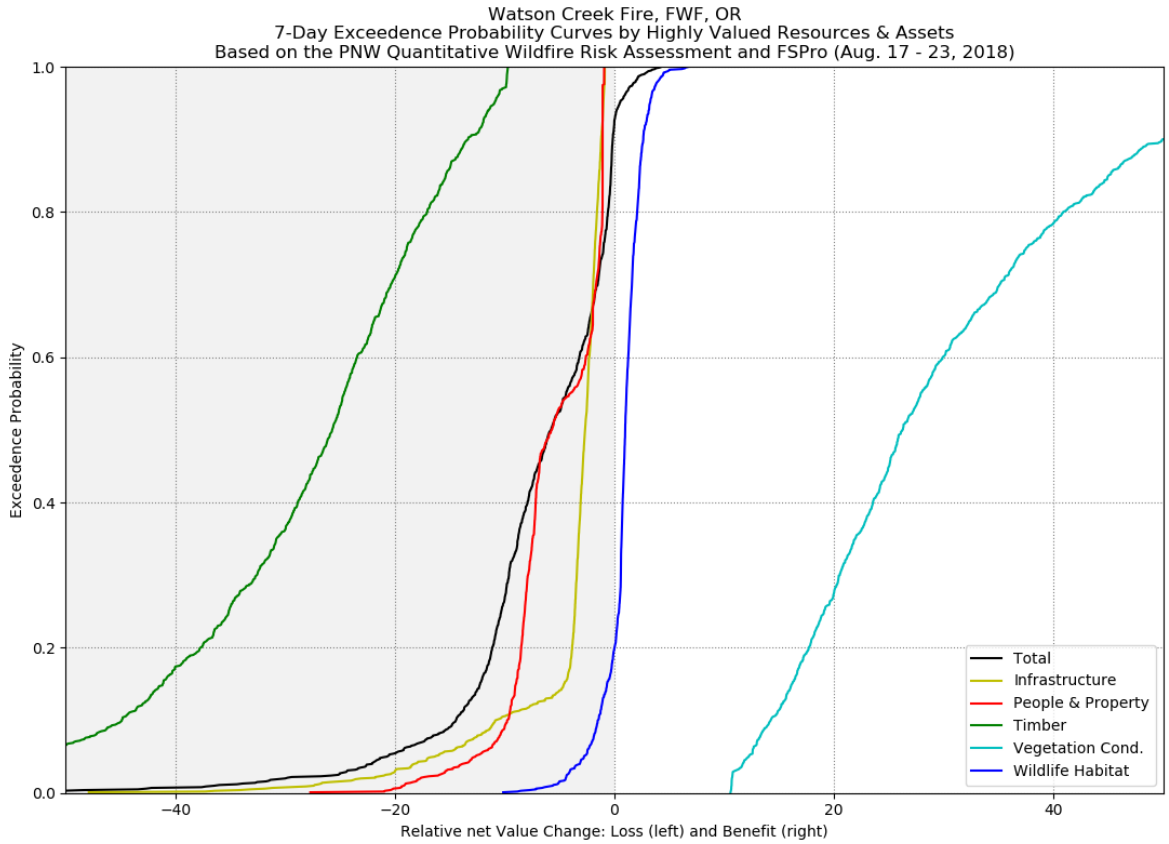
**Example #2** (SINGLE Fire [Watson Creek Fire, FWF, OR], Aug. 2018):


Watson Creek Fire, FWF, OR
7-Day Exceedence Probability Curves by Highly Valued Resources & Assets
Based on the PNW Quantitative Wildfire Risk Assessment and FSPro (Aug. 17 - 23, 2018)
Exceedence Probability
1.0
0.8
0.6
0.4
0.2
0.0
−40
−20
0
20
40
Relative net Value Change: Loss (left) and Benefit (right)
Total
Infrastructure
People & Property
Timber
Vegetation Cond.
Wildlife Habitat