
Foss Lake Escaped Prescribed Fire Facilitated Learning Analysis



Superior National Forest, Region 9

June 2016

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This review takes into consideration the fundamental character of complex systems and is not a critique of ability or performance.

1. Introduction

This Facilitated Learning Analysis (FLA) report is about a prescribed fire project that was declared a wildfire shortly after ignition began. The FLA Team was delegated to conduct a declared wildfire outcome review utilizing the Facilitated Learning Analysis approach. To learn and understand from events like this, decisions, actions, and events must be viewed in the context of the complex environment in which they occurred. In any complex environment, error and uncertainty persist despite our best efforts to eliminate them. This review takes into consideration the fundamental character of complex systems and is not a critique of ability or performance.

Our traditional response to unexpected outcomes is to attempt to discover if errors were made so that we do not repeat them the next time. This approach is limited, mainly because complex systems rarely deliver the same conditions again. Successful complex systems are not fixated on creating an error-free system, but in creating an *error tolerant system*. Error tolerant systems provide room for error and uncertainty to exist without consequence.

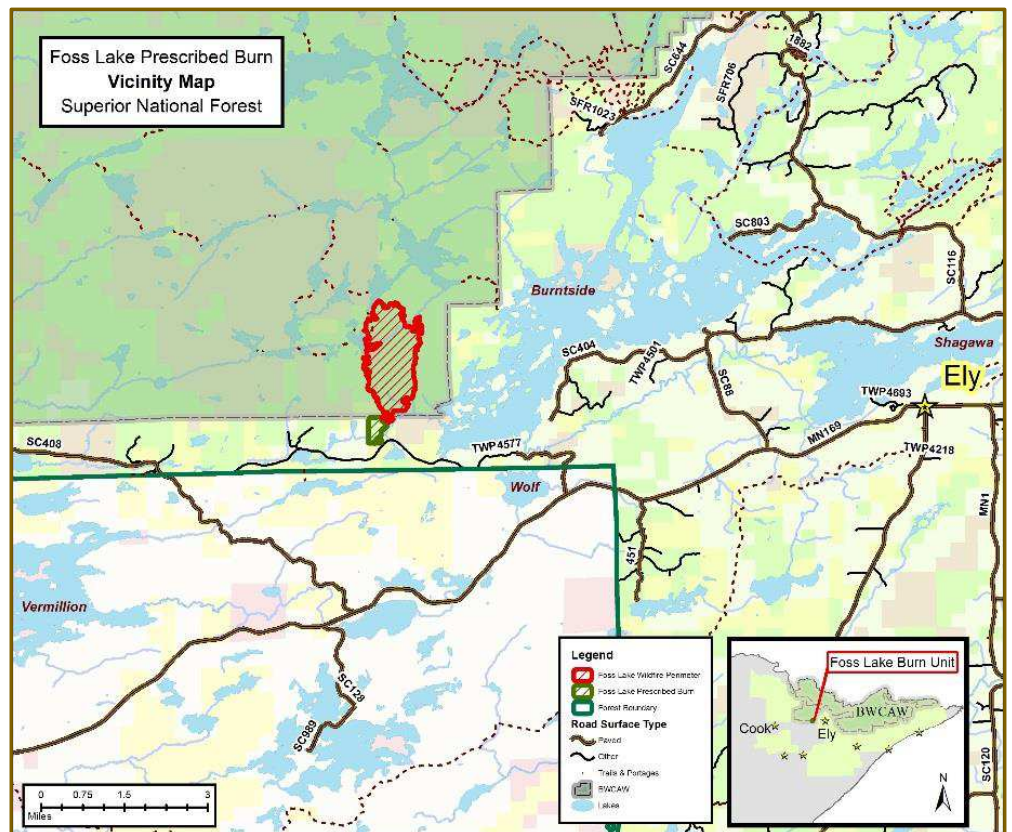
We are not suggesting that we focus solely on building room for error/uncertainty and forgo opportunities to learn to reduce the amount of error (perform better). We should focus on both. Learning from this event provides us an opportunity to learn how to perform better and how to build a more error tolerant system. This FLA is designed with that key concept in mind.

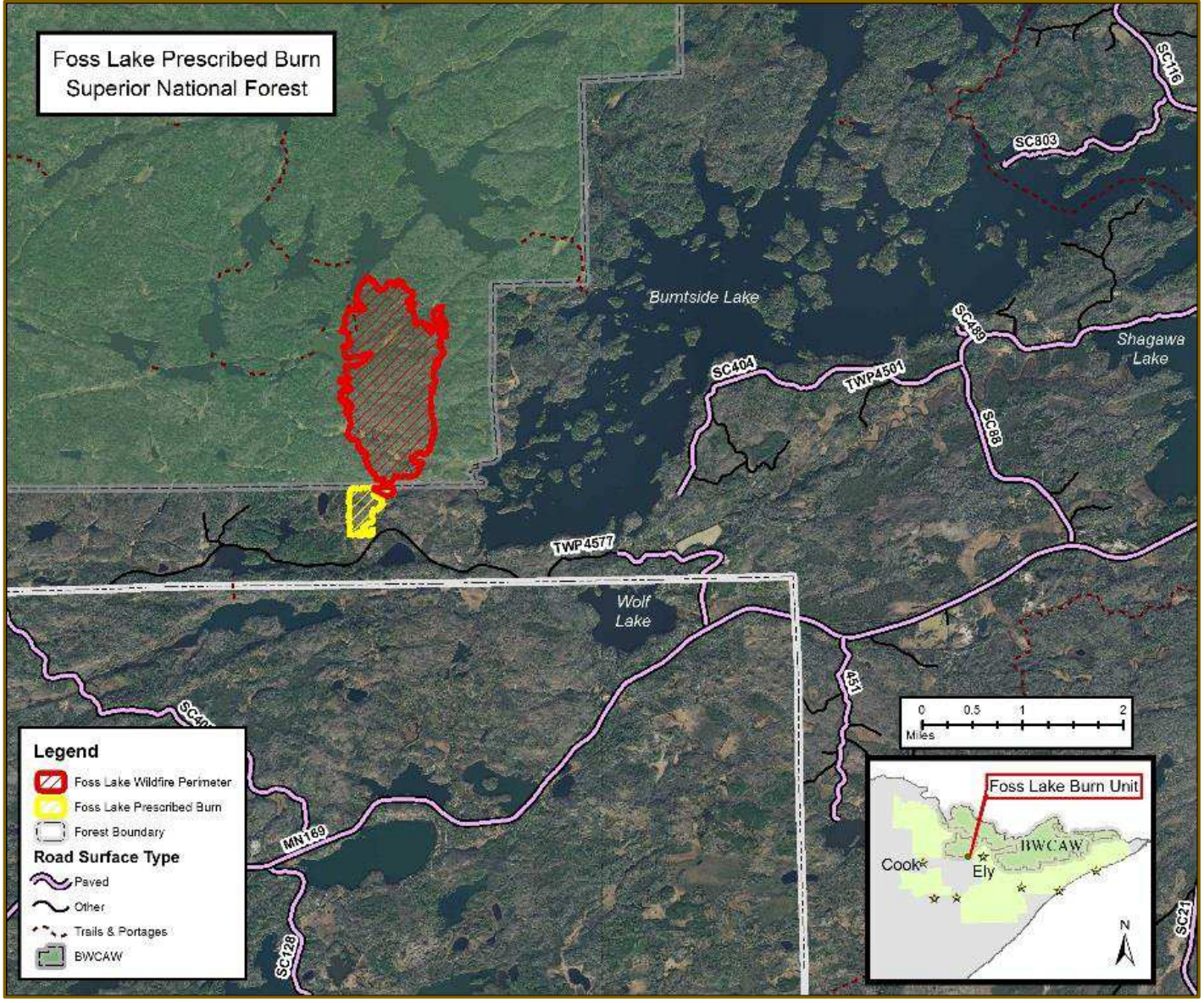
A. Vicinity Map

The Foss Lake Prescribed Fire unit is located on the La Croix Ranger District, within the Superior National Forest, which is approximately 10 miles west of Ely, Minnesota.

The burn unit is located about one mile west of the southwest end of Burntside Lake, outside the southern edge of the Boundary Waters Canoe Area Wilderness (BWCAN).

Foss Lake is a smaller lake located directly to the southeast of the burn unit.





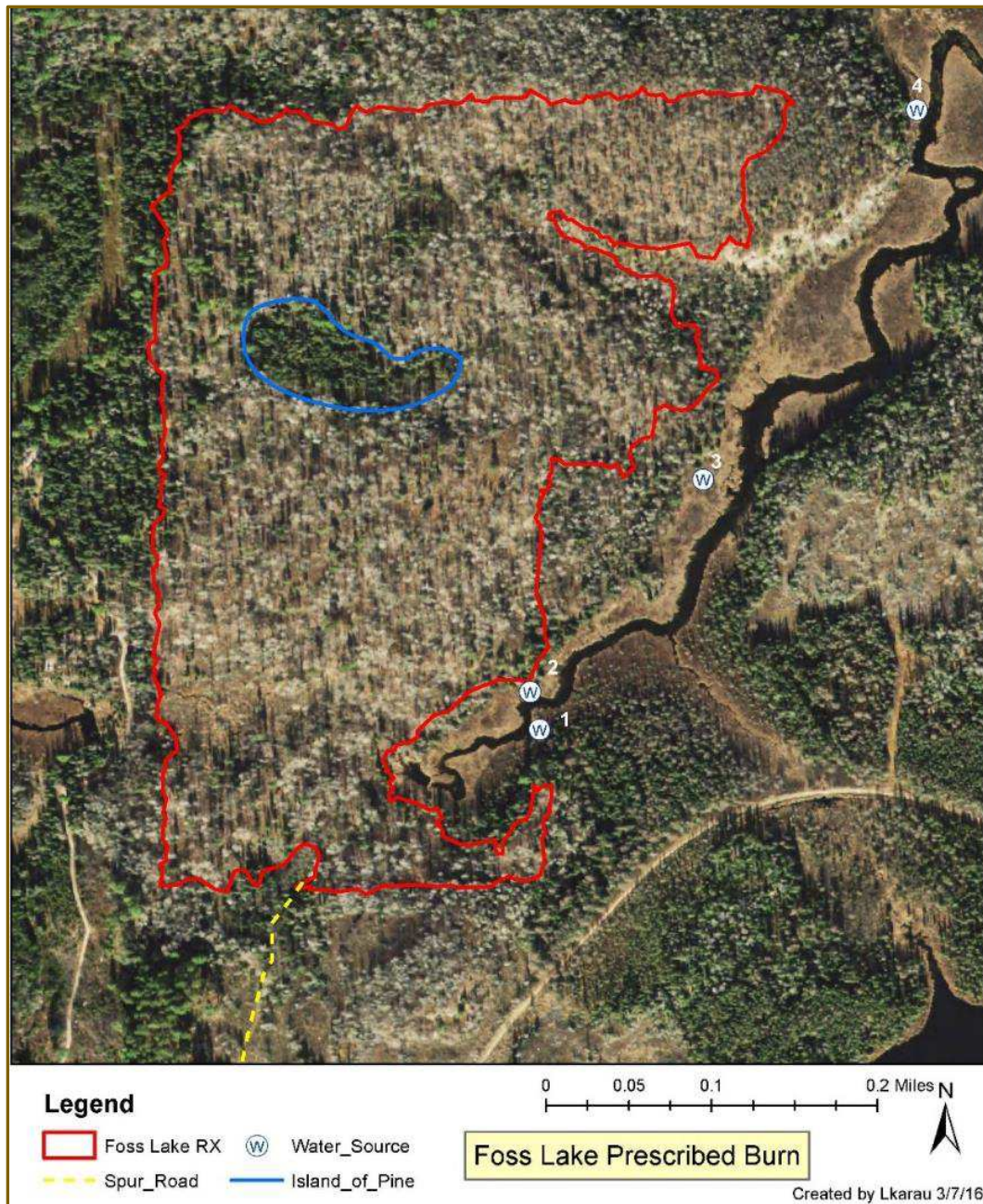


Figure 1 – Vicinity map, unit map, and close up image of Foss Lake Prescribed Fire burn unit.

2. Background

In 1999, the Superior National Forest was hit with a large-scale, high-wind event that caused substantial blowdown of trees and subsequent heavy dead and down fuel loadings across wide areas, including the Foss Lake area. The 93,000-acre Pagami Creek Fire in 2011, among other fires, emphasized the need for an increased pace and scale of hazardous fuels management, especially where blowdown and Wildland-Urban Interface (WUI) are adjacent.



The Foss Lake prescribed burn was part of the North Arm Fuels Reduction Project. The objectives of this project were to treat hazardous fuels in high-risk areas within the Ely and Vermilion Basin Wildland-Urban Interface areas outside the wilderness that are adjacent to public lands, and to improve wildlife habitat on approximately 1,658 acres of federal land.

In this land of many lakes it is important to understand that, as stated in the



Figure 2 – Two views (top and bottom above) show the Wildland-Urban Interface along the south and east shore and on the islands of Burntside Lake.

Superior National Forest pocket card: *“Under extreme conditions fire can spot ¼ to ½ mile, making all but the largest lakes ineffective at stopping fire spread.”*

This factor, among others, emphasizes the need for the hazardous fuels reduction aspects of the North Arm Fuels Reduction Project. The Decision Memo for the project was signed on August 16, 2013.

Project Objectives

Mechanical and prescribed fire treatments in the North Arm Fuels Reduction Project were used to reduce the balsam fir seed source and understory ladder fuels, setting back aspen, and enhancing oak and blueberry habitat.

Balsam fir is the “torch and spot” problem fuel that is similar to subalpine fir in the western United States.

The project was to mechanically treat approximately 106 acres in the Foss Lake burn unit by masticating all suspended woody debris, dead and dying balsam fir, and paper birch—to be followed by a prescribed fire. (The bark of paper birch is also a source of airborne firebrands and spotting.) The area was masticated in October 2014.

The Foss Lake unit was the last unit to be burned within the overall North Arm project. A prescribed fire plan was prepared and approved.

Environmental Conditions

In general, during 2015/2016, the Superior National Forest experienced a warmer than normal fall and winter. Precipitation was near normal, or slightly above normal. However, the warmer temperatures eroded the annual snowpack earlier and more often than normal.

The warmer than normal temperatures were forecasted to continue into April and May. This led to predictions of an above normal significant wildland fire potential for April and May on the Forest. In fact, due to the short term drought conditions, a fuels and fire behavior advisory was issued for northern Minnesota and northwestern Wisconsin. During periods of warmer, drier weather, the fire danger gradually increased. While this provided conditions for potential implementation of prescribed fire projects, it also provided normal to above normal fire behavior from ignitions, regardless of source.

3. What was Planned?

There was a strong need to complete the Foss Lake burn this spring (2016) as it was the last preparatory burn before the Crab Lake burn that is planned for the fall.

Prescribed fire implementation activities for the Foss Lake project were planned to begin on the morning of Thursday, May 19, 2016. During the previous days and weeks, the unit was prepared for



Figure 3 – Post mastication fuels two days prior to the prescribed burn.

burning with saw line, hose lays, pumps, canoes, and the setting up of a portable Remote Automated Weather Station (RAWS) just to the south of the unit. In addition, off-Forest resources were utilized for minor preparation work the day before ignition to enable these people to gain familiarity with the unit. Other resources to be utilized were notified and mobilized.

Resources and Assignments

Resources for this moderate complexity burn included a Line Officer, Burn Boss Type 2, Interagency Hotshot Crew, Firing Boss, Holding Boss, and one Type 6 Engine with crew, for a total burn organization of 36 personnel.

Holding resources were to patrol the line and handle any spot fires that may occur during and after ignition. Holding resources had pumps and hose lays around the entire unit to assist with holding operations. Two onsite Type 6 Engines with personnel and water delivery aircraft were assigned as contingency resources to quickly assist with any event that may arise.

Public Safety

The safety of the public was to be ensured throughout all burn operations with prior notification to surrounding landowners, business owners, and interested publics occurring prior to ignition of the burn. Specific safety issues for the public were addressed in the pre-ignition briefing along with signage of roads and trails. Ignition operations would cease if smoke became a hazard.

Briefing

A briefing was planned at the Ranger District office in Ely that morning. All prescribed fire resources were to be in attendance. Coordination with the Duty Officer was to occur to balance the prescribed fire needs and the initial attack needs for the day.

The plan for the day was to ignite the unit from north to south, into the wind. With the private property adjacent to the west side of the burn unit, ignition patterns were to be adjusted to reduce the risk of a slop-over or spot fire to the west.

Ignition was planned for one to two days, depending on the rate of ignition. It was acknowledged that there was a need to burn this unit at the hot end of the prescription in order to successfully set back the aspen in favor of longer lived pine species. A test fire was planned to give the Burn Boss enough of an indicator to proceed or not proceed with the burn.

4. What Happened?

The “Go/No Go” checklist was reviewed by the Burn Boss.

The current and predicted weather was analyzed from onsite observations and a spot weather forecast from earlier in the morning. It was determined that the conditions were, in fact, at the hot end of the prescription and conditions in the afternoon may go out of prescription for a period where ignition may need to be paused. Onsite weather observations were planned to continue to be taken hourly throughout the day.

The test fire was ignited at 1140 on Thursday morning as planned. Based on the test fire results, the Burn Boss made the determination to continue with the ignition.

Between 1220 and 1230, two small spot fires along the northern holding line were easily caught with the holding crew utilizing the hose lay. At 1250, firing was on hold due a spot fire about 100 yards north

of the test fire area, located in the wilderness, that was detected by crew personnel patrolling in a canoe on the northeast corner of the burn. This spot fire was ¼ to ½ acre at the time of detection.

Saw teams from the Hotshot Crew were sent to implement a saw line around the spot while other holding resources worked to get a hose lay into the spot. Initially, the hose lay was to be charged with a float pump. However, the crews could not successfully start the pump. A Mark 3 pump was then retrieved from another location, put in place, and attempts were made to start it. Crews could not successfully start the second pump for a critical period of time. At 1247, the Beaver Floatplane was requested with its 130-gallon water dropping and aerial observation capability. The Burn Boss believed the hose lays and the Beaver aircraft water drops would be adequate.

Difficulty Catching Spot Fire – Prescribed Burn Declared a Wildfire

Meanwhile, there were noticeable increases in wind speeds and subsequent fire behavior. At 1345, it was reported that fire crews were having a difficult time catching the spot fire. They were asked if they needed heavy aircraft. A Type 3 Helicopter with bucket was requested. Dispatch indicated a Type 1 Helicopter was available if needed. It was declined as not needed. Approximately 20 minutes later, the Type 1 Helicopter was requested along with an Air Attack.

At 1407, the Burn Boss declared the prescribed burn a wildfire and began shutting down the prescribed burn portion to keep it at the smallest possible size. He indicated that the Zone Fire Management Officer (ZFMO) would be the Incident Commander (IC) for the escaped fire portion and he would remain as the Burn Boss for the prescribed fire portion.

Over the next ½ hour, requests were placed for two additional Hotshot Crews, a CL-415 Scooper Air Tanker, and two Heavy Air Tankers, as well as Line Officer approval for dropping fire retardant in the wilderness. The fire was 10-15 acres and fire behavior continued to increase with increasing winds.

At approximately 1426, the Forest Fire Management Officer (FFMO) relayed a message from the Regional Fire Director that a wildfire declaration was not necessary for up to 24 hours. The ZFMO and Line Officer on scene discussed this briefly while at the pump site and while the Type 3 helicopter was dipping nearby. With both individuals on the telephone—and significant background noise—a miscommunication occurred. Thus, at approximately 1430, the ZFMO erroneously notified Dispatch that, per the Line Officer on scene, the wildfire was no longer a “declared wildfire.” This caused confusion in the Dispatch Center in tracking resources and incidents. The Dispatch Center Manager made a decision to continue with the initial call of a declared wildfire which cleared up the confusion in the Dispatch Center.

Type 2 IMT Ordered

As the fire continued to grow, the Line Officer made a request to the IC to have the Beaver Floatplane sweep the lake areas in front of the fire for paddlers and campers to ensure public safety. The IC assigned the Beaver to the mission. The area swept was found to be clear of public personnel.

At approximately 1700, a conference call occurred with Line Officers and key Forest staff that resulted in a decision to order a Type 2 Incident Management Team for the escaped wildfire, which was now several hundred acres in size.

By 1715, the prescribed burn portion of the fire had been tied into the creek to the east and a perimeter hose lay was in place. The Burn Boss reported to Dispatch that the prescribed burn portion was about 10 acres and was holding. Many of his resources had been released to engage the wildfire portion, with minimal staffing remaining on the prescribed burn.

5. Chronology of Events

Project Timeline

- 1999** Wind event in the Boundary Waters Canoe Area Wilderness (BWCAW) results in large areas of blown-down trees, including the area of the Foss Lake Prescribed Fire.
- 2001** R9 Regional Office recommends an Environmental Impact Statement (EIS) for BWCAW Prescribed Burn Project that includes burning in the wilderness.
- 2011** Pagami Creek Fire burns 93,000 acres, much of it in blowdown.
- Aug. 2013** North Arm Fuels Reduction Project Decision Memo/NEPA completed—which focused outside the wilderness.
- Oct. 2014** 106 acres of Foss Lake (Wolf Lake Road) Project is masticated.
- 2016** BWCAW Prescribed Burn Project Supplemental Impact Report (SIR) is completed.
- Spring 2016** Foss Lake Prescribed Burn Unit preparation work occurs.
- May 2016** Foss Lake Prescribed Burn Project Implemented.
- May 6, 2016** Fuels and Fire Behavior Advisory issued by Predictive Services for the northwestern third of the Great Lakes States, including the northern half of Minnesota.

Burn Day Timeline

Day 1

Wednesday, May 18, 2016 – Pre-Burn Day

This day was used for off-Forest resources to become familiar with the unit and finish minor prep work for the burn. The engine modules were taken to the structures on the west side of the burn. The hotshots did a reconnaissance of the unit and helped the local fire personnel set-up equipment including pumps, extra hoses, and fuel for the burn.

Fire personnel also did some minor prep work and water-charged all of the hoses. Almost the entire unit was plumbed. This effort ensured that the pumps were working properly and that they had adequate water throughout the burn unit.

Day 2

Thursday, May 19 – Burn Day

- 0900** The Foss Lake briefing was conducted at the ranger station due to its proximity to the Foss Lake prescribed burn unit. The briefing covered all of the main elements of the Burn Plan which included important points, such as burn objectives, weather, prescription, ignition and holding assignments, contingency resources, values-at-risk (such as the structures located west of the burn), and the location of the pumps and canoes. After the briefing, personnel involved in the burn headed to the burn unit.
- 0930-1000** All resources were in route to the Foss Lake burn unit: 1 Hotshot Crew, 3 Type 6 Engines, 1 Smokejumper Squad, Line Officer, overhead and miscellaneous burn personnel. The number of personnel on the burn exceeded the minimum number of 17 that the Burn Plan called for. There was a total of 36 personnel onsite during the commencement of the burn.
- 1116** All resources arrived on scene to get ready to start test burn.
- 1133** The Zone Fire Management Officer arrived on scene.
- 1140** With all personnel in place, the Burn Boss gave the order to start the test burn. The burn's Firing Boss was a Squad Leader from the Hotshot Crew. The Firing Boss mentioned that an objective for the burn was that the unit needed to be dry because the ground fuel was slash and masticated vegetation.
- As the test fire continued, both the Holding Boss and Firing Boss felt comfortable with how the test fire was developing. They were going slow and were getting good fuel consumption and depth.
- The Holding Boss was working with the non-local folks on how to utilize an endless supply of water on the burn. The technique that was used was to wet the saw line in front of the lighters and have the lighters ignite right at the edge of the wet line. The holding personnel, besides wetting the saw line, also sprayed the green side of the burn to minimize spotting potential next to the line. This technique was used because, for most of the burns on the Forest, no hand line is constructed, control lines consist of an 8-10-foot saw line, and the whole—or critical parts—of the unit is plumbed with a hose lay.

Once again, the Holding Boss checked with the holding personnel on the line. Everyone felt comfortable, including the Firing Boss.

- 1151** The Burn Boss notified Dispatch that the test fire was going well and ignition operations continued. Even though a few spot fires occurred adjacent to the line, both the Firing Boss and Holding Boss were comfortable with the how the burn was proceeding. The spot fires had been successfully suppressed and caused no issues.
- The Firing Boss instructed the lighters to slow down their ignitions to minimize the spotting potential. As the burn progressed, personnel who were staffing a canoe along the creek along the east flank advised the Holding Boss that they were going to go down the creek in a southerly direction to get a better view of the area north of the burn and check for any possible spotting. At this time, the burn was going well—progressing

slowly east toward Pump 4 on the creek. Once again, the Holding Boss checked with the holding personnel on the line. Everyone felt comfortable, including the Firing Boss.

The Firing Boss began to notice that even though the burn was progressing well, the wind was picking up and was very squirrely at times. With this in mind, he slowed down the ignitions to minimize the spotting potential. When he proceeded down the hill toward the creek, he also noticed that the winds behind him and higher on the slope seemed to be stronger than what he was experiencing lower on the slope.

Spot Fire Located 100 Yards North of Main Burn

The fire personnel on the canoe radioed the Holding Boss and advised him that there was a spot fire located about 100 yards north of the main burn and in the Boundary Waters Canoe Area Wilderness. The Holding Boss walked toward the spot. When he arrived, he observed that this spot fire was approximately $\frac{1}{4}$ to $\frac{1}{2}$ acre in size. He quickly sized it up and directed the personnel on the canoe to set-up the float pump and lay hose up to the spot fire.

Water Pumps Won't Start

As this activity was happening, two saw teams from the Hotshot Crew arrived and started cutting saw line in an attempt to help contain the spot fire. Meanwhile, the hose lay was put in from the river to the spot fire, but the crew could not get the float pump started. Multiple attempts were unsuccessful.

The fire personnel then went to the Pump 4 site and retrieved the Mark 3 pump and hooked it into the hose lay. They could not get this pump to start—even though it had been running when it was hooked up to the other hose lay. Once again, multiple attempts to get the pump to start were also unsuccessful.

Winds Picking Up; Fire Becoming More Active

Without water on the spot fire, containing the spot would be difficult to accomplish. Around this time, the Holding Boss walked toward the creek to check on the status of the pumps and to talk with the Zone Fire Management Officer to determine what the plan was. He noticed that the winds were now picking up and the fire was getting more active.

- 1247** The ZFMO called into Dispatch to report a spot fire in the wilderness and requested that the Beaver Floatplane Pilot go to the hanger and standby. During this time, the spot fire was getting active and the ignition operations were being terminated.
- 1253** The Beaver Floatplane with the tank for water drops was requested by the ZFMO. This Beaver aircraft has the capability of dropping 130 gallons of water.
- 1304** The ZFMO requested a Type 3 Helicopter for assistance suppressing the spot fire.
- 1313** The Forest FMO notified Dispatch, the Forest Integrated Resources Staff Officer, and the Forest Supervisor of the wilderness spot fire.
- 1339** Dispatch notified the Burn Boss that the Type 1 Helicopter had been cancelled from an initial attack fire. If needed, it was available.
- 1341** ZFMO replied that there was no need for the Type 1 Helicopter at that time.

- 1345** The Burn Boss asked the Holding Boss if he has a need for “heavy aircraft”. The Holding Boss responded that “with the Beaver drops and hose lay, we should be OK.”
- 1359** Eighteen minutes later, the ZFMO requested the Type 1 Helicopter and an Air Attack.
- 1407** The Burn Boss called Dispatch and declared the Foss Lake prescribed burn a wildfire. He also notified Dispatch that the ZFMO would be the IC for the escape burn and he would continue to be the Burn Boss for the prescribed burn. In addition, he requested a 20-Person Crew.
- 1411-1426** The escaped fire IC requested two 20-Person Crews—preferably Hotshot Crews, one CL-415 Scooper Air Tanker, and two Large Air Tankers. He also asked the Line Officer for—and received permission to—drop fire retardant in the wilderness.
- At this time, the fire was approximately 10 to 15 acres in size. A request was also made to another Forest Burn Boss, who was implementing a different prescribed burn, if he could release the Hotshot Crew that he had on his burn to respond to the Foss Lake burn. Because this other Burn Boss was in a very critical part of his burn and needed the crew to remain on the burn, he denied the request.
- Another Hotshot Crew was also requested and denied due to that crew also being committed to another project. They finally found a Hotshot Crew from another location.
- 1426** The FFMO notified the Line Officer on scene that the Regional Fire Director has indicated that a wildfire declaration was not necessary for up to 24 hours. Significant background noise and concurrent phone conversations lead to confusion over the Line Officer’s decision to continue with the wildfire declaration.
- 1431** The IC notified Dispatch that, according to the Line Officer, the Foss Lake prescribed fire was no longer a “declared wildfire”. This caused a great amount of confusion in the Dispatch Office. They did not know which incident to use to assign resources as they were being ordered. The Dispatch Center Manager made the decision to go with the initial call that the Foss Lake burn was an escaped prescribed fire.
- 1503** The Line Officer and Assistant Line Officer requested that the Beaver Floatplane Pilot sweep the wildfire area to ensure public safety and to locate any paddlers over Clark Lake, Saca, and Meat lakes, as well as the southern end of Crab Lake. This request was cleared with the Foss Lake IC.
- 1825** The Burn Boss notified Dispatch that approximately 10 acres of the prescribed burn were “consumed” and the majority of prescribed burn personnel were released to engage the wildfire portion with minimum crew remaining on the prescribed burn unit.
- 2207** All of the resources were released from both incidents and were in route to Ely.
- 2309** All resources arrived in Ely and went out-of-service.

6. Findings, Lessons Learned, and Recommendations

A. Human Factors

“We were trying to stay ahead of when green-up would occur or we would lose the chance for the summer. And the District wanted to be set up for the fall burn window to complete the Crab Lake burn.”

Burn Boss

Findings

Prescribed fire units had been completed throughout the spring burn window. The Foss Lake burn was the last burn that needed to be completed to set the District up for larger burns that would be burned during the fall window.

While pressure to complete the unit was desired and recognized, this was not an overwhelming consideration for the Fire Management Officer, District Rangers, or implementation resources.

Lessons Learned

Successful implementation of prescribed fires throughout the spring burn window may have contributed to an attitude that normalized the risk associated with an increase in wildfire activity while still actively engaged in prescribed fire implementation.

Continually assessing area wildfire activity, pressure to accomplish program goals, and workforce fatigue may alleviate the tendency for mission results to override situational awareness.

Be aware that real or perceived pressure—self or externally manifested—can cause one to downplay instincts, sometimes referred to as “gut checks,” and ignore the “hair on the back of the neck” in favor of completing the “mission.”

B. Communication

Findings

The availability of multiple communication mediums reduces congestion regarding radio traffic. However, not every resource hears decisions or conversations that occur via text or cell phone conversation.

Lessons Learned

Communication that occurs using methods other than broadcasting across the radio (text, cell phone calls, face-to-face) that contains information that will affect safety, operations, and decisions needs to be relayed to affected resources. This requires a conscious effort, particularly when operations are hectic and multiple incidents and decisions are competing for immediate attention.

C. Contingency Planning

“This is something to consider as a Burn Boss. If your air resources are dispatched to an initial attack, it may be time to re-evaluate.”

Burn Boss

Findings

Resources identified in the Burn Plan as contingency resources were also understood by the Duty Officer on the day of the burn to be initial attack resources. This created a situation in which identified contingency resources may be pulled for either smoke checks or to new fires for initial response. This, in fact, did happen on the Foss Lake Prescribed Burn project when contingency aircraft were dispatched to a new start. On the day of the Foss Lake escape, the Forest had two prescribed burns and responded to two new wildfire starts.

Lessons Learned

Relying on national resources for prescribed fire contingency resources can be a gamble. If a firm commitment is not in place and widely understood, these resources can be pulled at any time.

Maintaining a “global” picture of activity on the Forest and the Geographic Area is a challenge when committed to the implementation of a prescribed fire. This awareness requires an increased due diligence, which may include assigning someone the specific task of Prescribed Fire Manager being careful not to make the task a collateral duty. The Prescribed Fire Manager and the Duty Officer should work hand-in-hand to manage this global picture.

D. Consistency/Continuity

“Sometimes I have way too many bosses.”

Fire Management Officer

Findings

The fire program on the Forest has had issues with consistency and continuity in direction, management, and oversight due to several apparent factors, including:

- ❖ High turnover rate in key fire leadership, pilot, and ranger positions.
- ❖ Extended vacancies and barriers, including human resource delays, challenges with the reorganization process, and a lack of applicant interest for vacant positions, all contributed to an inability to fill key fire leadership and aviation positions, especially at the Forest level.

These factors are challenging to Zone/District fire organizations as they must assume more roles that normally would be handled at the Forest level to meet the priorities of a highly reliable and productive fire program.

Despite these long-term vacancies in key leadership positions, the Forest has operated successfully. Consistent leadership provides continuity in direction, standard operating procedures, and maintaining a “big picture view”—bridging gaps between program areas.

Lessons Learned

Staffing and maintaining key leadership and aviation positions in the context of responder exposure, risk to values, and the probability of success in strategies and tactics, helps to ensure that these priorities can be consistently managed with appropriate oversight.

E. Current and Predicted Conditions/Situational Awareness

“The forecasts have not been accurate. Our weather forecasts have been under-predicting weather all season.”

West Zone FMO

Findings

On this Forest, fire personnel utilize both the National Fire Danger Rating System (NFDRS) and the Canadian Forest Fire Danger Rating System (CFFDRS) in both fire preparedness and prescribed fire decision support. Seasonal fire danger appears to be reflected well using the NFDRS Energy Release Component (ERC) index. However, several of the Canadian indices were mentioned during this FLA review and are utilized for various aspects of fire management and fire effects.

The fire danger index for ERC was setting 20-year maximums for the period analyzed. The ERC values for the time of the Foss Lake burn were well above the values during three recent large fire events: Ham Lake, Cavity Lake, and Pagami Creek. ERC is only part of the story as it relates only to the dryness of live and dead fuels, while wind and fine fuel moistures, combined, account for the potential ease of fire spread.

The Fuels and Fire Behavior Advisory, issued May 6, 2016, summarized the conditions and potential implications the area was facing due to the short term drought. Indications of potential rapid fire spread during periods of dry and windy conditions, and heavier fuel involvement where 1000 and 100 hours fuels had dropped to critical levels.

Unit Burned at Hot End of Prescription to Meet Objectives

Indications that the unit was to be burned at the hot end of the prescription (lower fine fuel moistures and higher winds) in order to meet objectives were voiced to the FLA Team during interviews with burn personnel.

Based on an analysis of weather, fuels, and fire danger—information that was available to zone personnel prior to ignition—the conditions were, in fact, at the hot end of the prescription. In some cases, the indicated or forecasted conditions were outside the prescription—or would become outside prescription parameters later in the day. Specifically, low fine fuel moisture and higher winds, especially gusts, would contribute to conditions being outside of burn parameters. Thus, the burn leadership personnel discussed that they may need to halt ignition for a period in the afternoon due to predicted low relative humidity.

Onsite observations and the spot weather forecast were utilized to make the decision to burn. It appears that observations from the portable RAWFS, just to the south of the unit, were not used by

burn personnel. Observations from the RAWs were used by the National Weather Service for the spot weather forecasts.

While no fire behavior observations were documented, through information gathered via FLA Team interviews, fire behavior appeared to be consistent with that predicted in the Burn Plan under the conditions. Spotting did occur within predicted parameters and, ultimately, one of the farther spot fires, at about 100 yards or so, became established and gained momentum under drier and windier conditions than that forecasted in the spot forecast.

Lessons Learned

Weather forecasts can be wrong. Through FLA Team interviews, it was mentioned that forecasts had shown a trend of under-predicting the actual weather that has occurred so far during this 2016 season.

Utilizing the RAWs observations, which indicated more severe conditions, may have provided more foresight in the weather prediction and could have therefore led to different discussions and decisions on burning that day.

With a trend observed in the forecasts and actual weather being more severe, it would appear that this trend was not fully considered the day of the burn. It also appears the fire danger indices, trends and the Fuels and Fire Behavior Advisory described conditions were not fully utilized in the decision to burn.

Recommendations

It is recommended on the day of the burn to utilize all available weather, fuels and fire danger data to predict and anticipate likely fire behavior at the peak of the burn period. With that knowledge, it is recommended to:

1. Game out the “what if” scenarios of more severe weather conditions—in this case, lower relative humidity and higher winds—and adjust the plan to burn, including contingency resource production capability and the actual decision to burn or not.
2. Work closely with the local National Weather Service office to discuss observations that are not in line with forecasts in order to better calibrate future forecasts.
3. Describe resource and prescribed fire objectives to be as specific as possible to assist the Burn Boss and other Burn Plan readers to understand the intent of the burn and the tie-in with the prescription parameters.
4. Utilize a fire effects monitor (FEMO) on prescribed burns to document actual fire behavior from the burn.
5. Also utilize the FEMO position for the pre- and post-burn monitoring. A best practice would be to use the same personnel, when possible, for pre-, during, and post-fire monitoring to help ensure that the connection of fuels, fire behavior, and fire effects can be better understood and learned.
6. Continue to utilize both NFDRS and CFFDRS indices and work to further refine which codes and indices are indicative of the various fire management and fire effects parameters.

F. Internal Constraints

Findings

The Forest has experienced some internal functional implementation constraints regarding project-level decisions and analysis.

Lessons Learned

Foster frequent and early communication with the Regional Office and Supervisor's Officer to capitalize on available outside Forest technical expertise. Utilization of Forest and Regional level expertise may expand management opportunities and further leverage Forest capabilities.

Line Officers need to ensure that they are aware of their complete decision space, particularly when basing decisions on recommendations from resource areas that will constrain project implementation.

G. Communications: Unintended Audience

Findings

During the initial phases of deciding whether to declare a wildfire, and once declared, leadership of the prescribed burn became aware of some of the discussions occurring at the Forest and Regional levels. These discussions, which are expected and appropriate during events such as this, involved learning and communicating about the facts of the incident, reviewing and clarifying policy, and weighing options and risk regarding courses of action and recommendations.

One item mentioned was a discussion to not declare the wildfire until the end of the next burn period and to suppress the spot fire with hazardous fuels funding. Another item was the timing of the requested Incident Management Team (IMT) to transition with the current incident command and from where it was coming from, whether from local sources within the local area or from out-of-Region.

As prescribed burn leadership became aware of portions of these discussions, there was introduction of doubt, confusion and frustration over the status of the burn and what resources were available, specifically aircraft, which lead to perceived or actual delays in response. Additional stress was felt regarding the perceived delay in response of an out-of-Region IMT versus a local IMT and the potential that the local resources, already fatigued from a long day, would be managing this wildfire longer before the transition to an IMT.

Lessons Learned

While the discussions mentioned above are appropriate and customary in a situations like this, the contents of these discussions can fall on unintended ears and cause unintended consequences.

Recommendation

Use care in keeping pre-decisional discussions within their appropriate audience in order to not adversely affect operations on-the-ground.

Consider simulations to practice for these types of incidents to help foster recognition-primed decision making and familiarity of policies among Zone, Forest, and Regional leadership. Practice often, especially as the players change over time.

Foster frequent communication across all levels of leadership to ensure trust-based relationships are built and maintained.

Clarify IMT dispatch protocols and rotations at the Forest, State, and Geographic Area to ensure rapid and efficient mobilization of an IMT when ordered.

7. Commendations

A. Forest Management

The Forest is to be commended for managing a complex and expanding workload while maintaining a highly reliable and safe fire and aviation program.

Example 1

The Superior National Forest, among others in Region 9, normally conducts prescribed burning during its spring and fall fire seasons. In-season burning takes a delicate balance of suppression and prescribed fire operations in order to be successful at both.

Complexity is further compounded due to the logistical challenges of the character of the land base being: heavily vegetated, remote wilderness, large blowdown areas, and significant coverage in lakes and other wetland areas.

The Zone fire leadership appears to manage this delicate balance very well with the appropriate focus on responder exposure, protection of values at risk, and engaging where the probability of success is high.

Example 2

Zone fire personnel appear to have a very good understanding of what prescribed fire parameters are needed to meet specific objectives in the various fuel types and seasons within their Zone. This was verbalized during FLA Team interviews with key personnel.

The burn unit needed to be burned on the hotter end of the prescription to set back the aspen to promote initiation and growth of longer-lived conifer species. In addition, moderate wind was needed to assist fire carrying through the masticated balsam fir slash fuels.

The fire Zone proactively set up a portable RAWS near the burn unit in order to track weather for the planned prescribed burn.

8. Appendices – Interagency Prescribed Fire Guide: Declared Wildfire Review

Appendix 1 – The Prescribed Fire Analysis Review

From the Interagency Prescribed Fire Planning and Implementation Procedures Guide, the need to review the following five questions was necessitated.

1. An analysis of the seasonal severity, weather events, and onsite conditions leading up to the wildfire declaration:

FIRE DANGER – In general, the the Superior National Forest experienced a warmer than normal fall and winter. Precipitation was near normal or slightly above normal, however, the warmer temperatures eroded the annual snowpack earlier and more often than normal. The warmer than normal temperatures were forecasted to continue into April and May. This led to predictions of an above normal significant wildland fire potential for April and May on the Forest (see Figure 4).

On May 6, 2016, Predictive Services issued a Fuels and Fire Behavior Advisory that covered the north half of Minnesota (see Figure 5). This advisory discussed fuel conditions and the elevated significant fire potential due to the development of short term drought conditions.

Fire danger for the spring fire season based on the energy release component (ERC) at the Ely, MN remote Automated Weather Station (Ely RAWS) has been running above to well above average (see Figure 6). This is consistent with statements from District/Zone personnel about fire conditions.

Using Canadian indices, which are also used to advise fire program decisions, the build-up index (BUI) was below normal until the first week of May, when it rose above normal (see Figure 7).



Figure 4 – Significant wildland fire outlook for April and May 2016 from the National Interagency Fire Center (NIFC) Predictive Services.

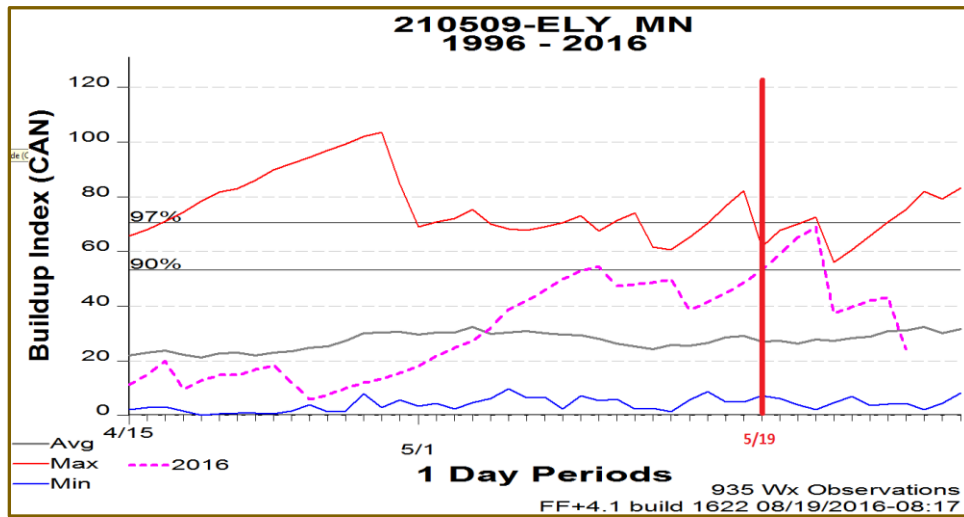


Figure 7 – Buildup Index (BUI - CFFDRS) graph for Ely, MN RAWS covering 2016 from April 15 to June 1—compared to 20 years of data.

During May 5 through May 10, the ERC indices peaked above the 97th percentile (for the time period shown) and were setting 20-year maximums for several days during the period.

The 973-acre Skibo Fire occurred on May 6 near Hoyt Lakes, approximately 30 miles southwest of Ely. Rainfall was received at the Ely RAWS on May 10 (0.1 inch) and May 15 (0.17 inch) which reduced fire danger, but ERC was still near the 90th percentile.

After the rain on May 15, the ERC began to rise. The ERC began setting 20-year maximums on May 17 and rose above the 97% percentile on May 19. The ERC continued to set 20-year maximum values until May 24.

Drought conditions were not present before or at the time of the burn. The U.S. Drought Monitor classified the area as “abnormally dry” with their May 24 release, after the burn, where it was “none” in previous releases going back to January 1.

The prescribed fire plan mentions ranges for three Canadian fire danger indices “for reference only” in the prescription (see Figure 8).

Canadian Fire Danger Indices		
	Burn Plan Range*	May 19th
FFMC	80-92	93
BUI	10-50	53
DMC	5-40	54
* For reference only.		

Figure 8 – Canadian Forest Fire Danger indices from the Burn Plan and actual values on May 19.



Figure 9 – Superior #2 portable Remote Automated Weather Station (RAWS) located approximately 1/2 mile south of the burn unit.

WEATHER – The weather parameter, along with 1-hour fuel moisture addressed below, used to determine if the burn unit was within prescription is 20-foot wind speed. The prescription range was from 0 to 15 mph wind. Using an adjustment factor of 0.4 for unsheltered fuels (as used in the Burn Plan), the mid-flame prescription wind speed would be 0 to 6 mph.

In addition, an east wind direction was specified as not acceptable due to private lands and structures located to the west of the unit.

Weather on the burn unit was monitored via portable RAWS (Superior #2) about ½ mile south of the burn unit (Figure 9). Additionally, hourly weather was taken onsite by burn personnel from 1100 to 1700 on the day of ignition (May 19). A spot weather forecast was acquired by burn personnel that was issued by Duluth, MN WFO at 0657 on May 19. It contained hourly forecast parameters from 1000 to 1700.

Wind direction observed onsite and at Superior #2 RAWS were generally consistent.

In the morning, prior to ignition, winds were SW to ESE. After ignition, winds were mostly SSW. (See Figure 10.)

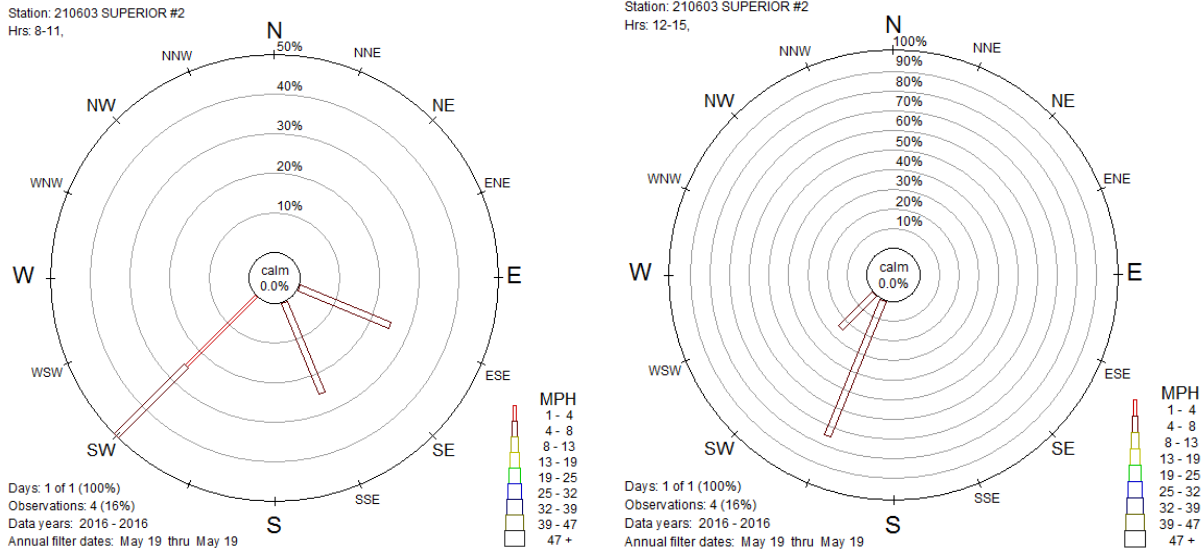
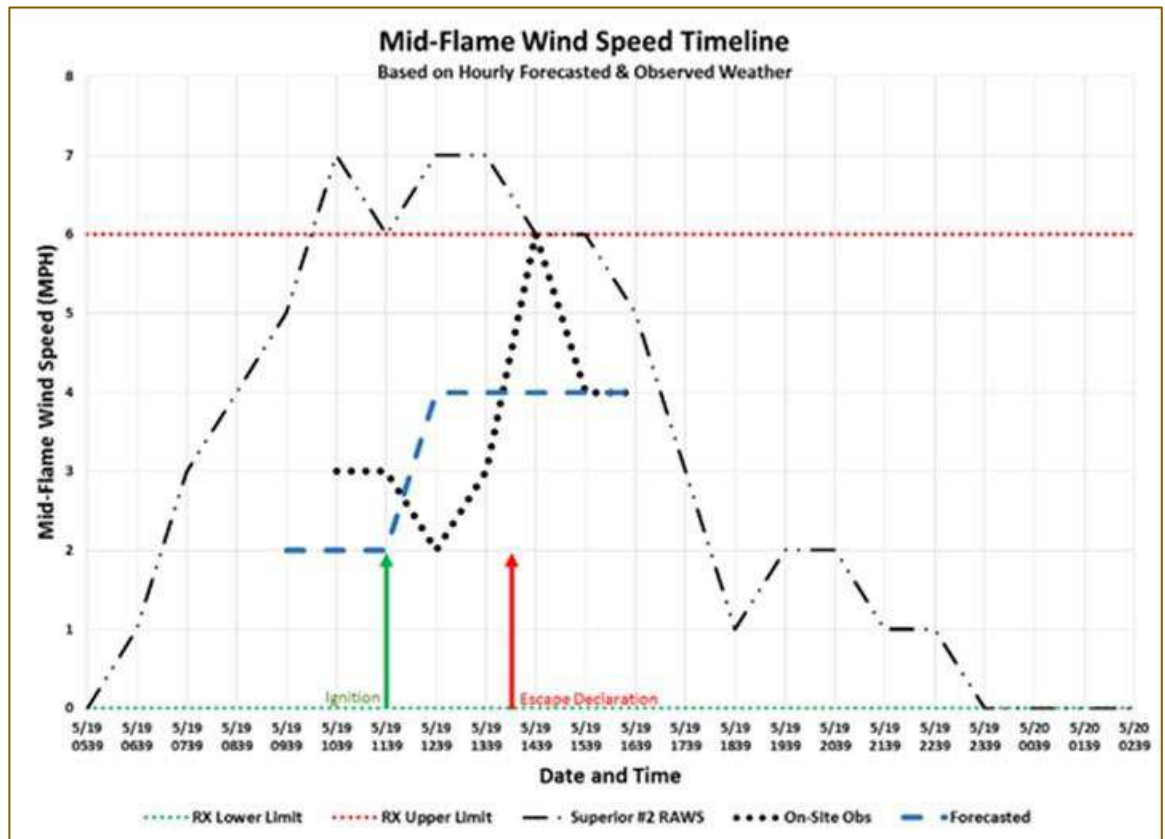


Figure 10 – Wind roses indicating wind direction and speed distribution at the Superior #2 RAWs for the morning period 0800-1100 and the afternoon period 1200-1500 on May 19, 2016.

Wind speeds, excluding gusts, at the Superior #2 RAWs were slightly above the prescription limit both before and after ignition began. Onsite observations and forecasted wind speed (excluding gusts) were within prescription parameters (see Figure 11). Wind gusts at Superior #2 RAWs were well above the prescription limit at time of ignition, while forecasted gusts were near or at the prescription limit (see Figure 12). Gusts were not indicated in the onsite weather observation data.

Figure 11 – Mid-flame wind speeds forecasted and observed. 20-foot winds from spot forecast were adjusted down to mid-flame using a factor of 0.4 (unsheltered).



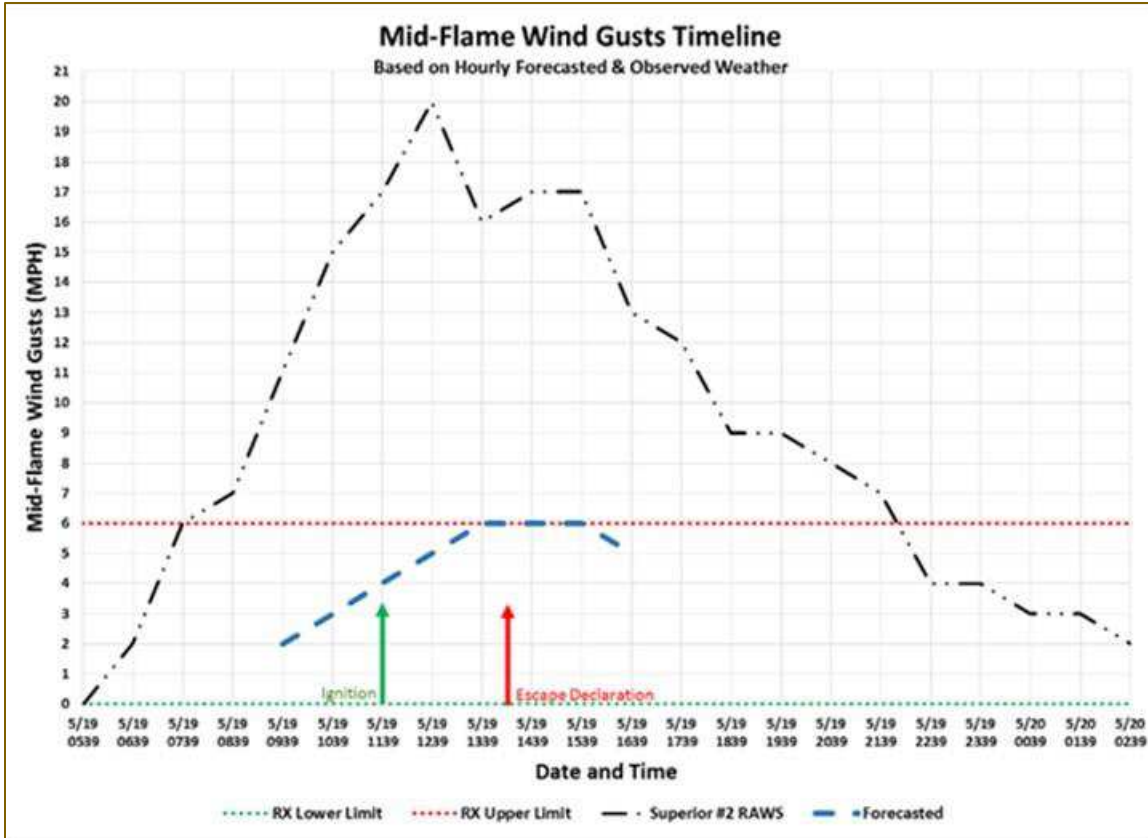


Figure 12 – Mid-flame wind speed gusts forecasted and observed. 20-foot wind gusts from spot forecast were adjusted down to mid-flame using a factor of 0.4 (unsheltered).

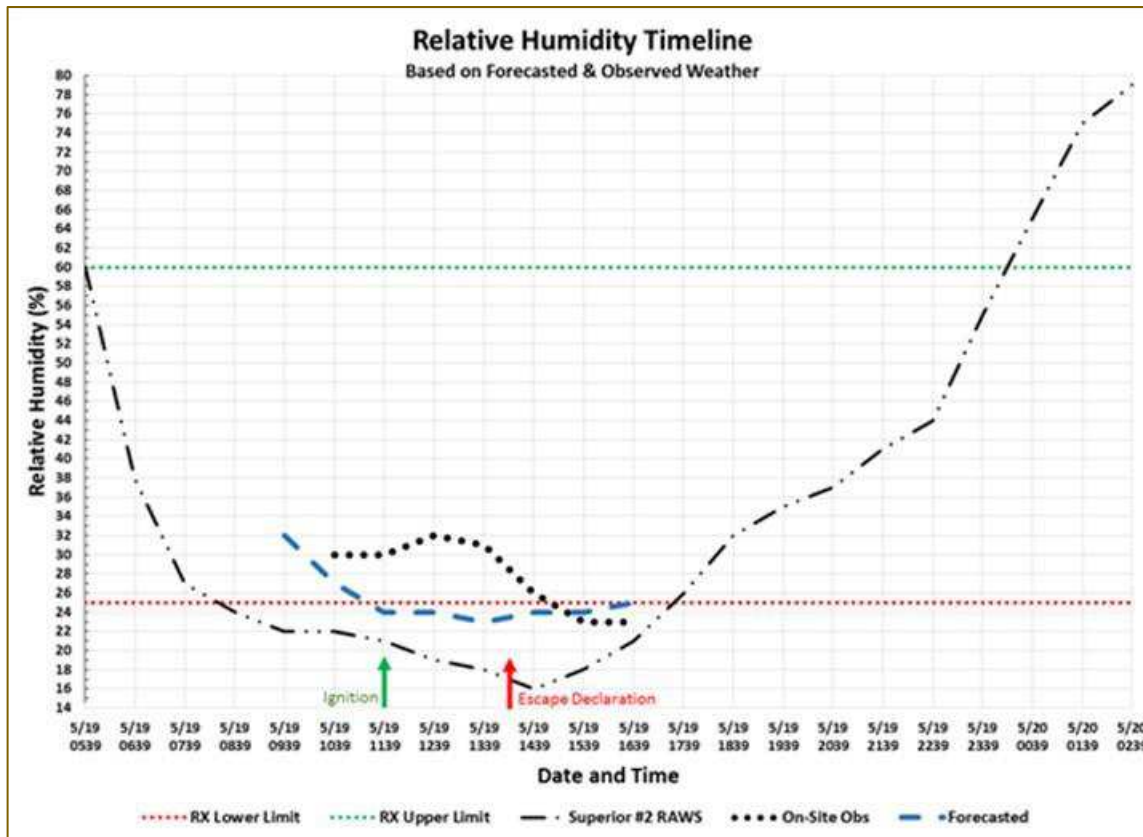


Figure 13 – Relative humidity (RH) forecasted (via NWS spot forecast), Superior #2 RAWS observations, onsite observations (via belt weather kit), and lower limit of burn prescription.

Relative humidity was referenced in the prescription to be between 25-60%. However, RH was not identified as a Go/No-Go parameter to burn. Minimum relative humidity (RH) was forecasted, via spot forecast, to be 21-26% for the day of ignition. At the time of ignition (1140), RH at the Superior #2 RAWS was 22% while onsite RH was measured at 30% (see Figure 13).

FUELS – The primary species in the burn unit can be best described as a mix of hardwoods such as aspen, oak, maple and paper birch with balsam fir. Previous heavy dead and down timber in the unit was a result of wind throw from one or more high-wind storm events over the past decade or two that affected widespread areas in the fire zone. The unit was masticated for hazardous fuels reduction targeting the dead and down and balsam fir, resulting in slash fuels dominating.

Fire behavior predictions in the Burn Plan were based on NFFL models 1, 3, 5 and 11. Fuel model 11—light logging slash—is the primary represented fuel in the burn unit (see Figure 14).



Figure 14 – Pictures of onsite fuels in the burn unit.

The fuels parameter used to determine whether the unit is in prescription is 1-hour fuel moisture (FFM). The prescription indicates FFM range of 4 to 14% to be within the prescription. The FFM at the time of ignition was 5% with onsite observations. FFM calculated from the Superior #2 RAWS were at 3% and FFM calculated from the spot forecast values indicated 3% as well (see Figure 15).

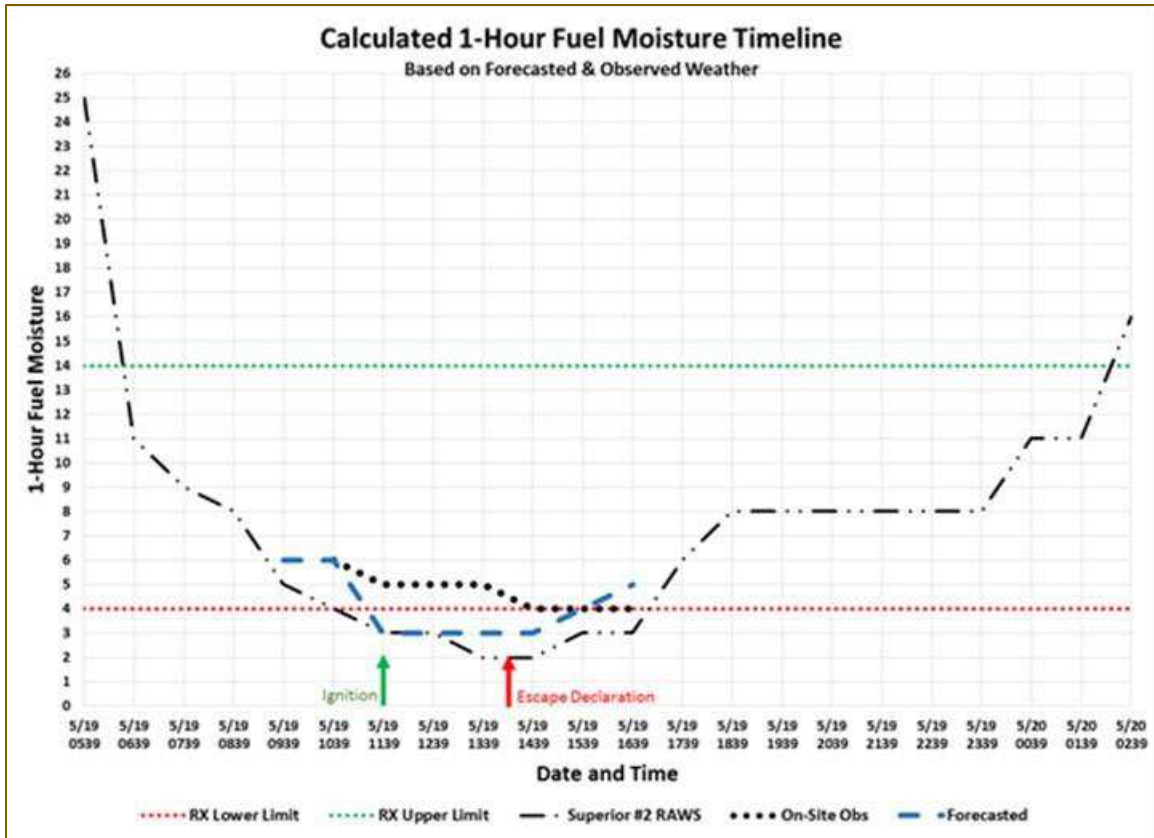


Figure 15 – Calculated fine fuel (1-hour) moisture based on Superior #2 RAWs, onsite weather observations, and spot forecast hourly values.

2. An analysis of the prescribed fire plan for consistency with agency policy and guidance related to prescribed fire planning and implementation:

A review of the Foss Lake Prescribed Fire Burn Plan was conducted and found that all elements were consistent with agency policy and guidance as outlined in the Interagency Prescribed Fire Planning and Implementation Procedures (April 2014).

The Burn Plan was signed by the preparer on April 7, 2016; the technical reviewer on April 8, 2016; and the Agency Administrator on April 27, 2016.

The Burn Plan template used for the preparation of the Foss Lake Burn Plan is the current national template. The Burn Plan also had the current Agency Administrator Pre-ignition Approval Checklist and Agency Administrator Ignition Authorization.

There were no amendments to the Burn Plan and the complexity analysis was well thought out and commensurate with the burn.

3. An analysis of prescribed fire implementation for consistency with the prescription, actions, and procedures in the prescribed fire plan:

Overall, the preparation work on the Foss Lake burn unit was consistent with what the Burn Plan had outlined in Element 9. The unit had been previously masticated, a saw line constructed around the unit on the identified control line, and the unit plumbed prior to ignitions. All pumps placed to support the burn were tested to ensure they were operational, and all of the hose lays were charged the day before the burn.

Under Element 11, Organization and Equipment, the Burn Plan met and exceeded the element. The Burn Plan called for a minimum of 17 personnel, to be on site the day of ignitions, and there were 36 personnel. Equipment on site also exceeded what was written in Element 11. They had extra hoses, pumps, canoes, and other extra equipment.

In Element 7, Prescription, it was evident that they would be burning at the hot end of the prescription. The spot weather forecast that morning had the RH at 21-26%, the low RH for the burn was set at 25%. The calculated fine fuel moisture (FFM) level from the onsite calculations was 5%, the low FFM level on the Burn Plan was 4%. The maximum spotting potential identified in the Burn Plan was calculated at 0.4 miles.

Overall, the Elements within the Burn Plan were adhered to, everything was in prescription at the start of the test burn when they started ignition and probably up to the time the troublesome spot fire was discovered.

4. An analysis of the prescribed fire plan for consistency with implementation was conducted and resulted in the following findings:

After reviewing the Burn Plan and reviewing the prescribed burning operations, it was determined that, overall, the elements within the Burn Plan were adhered to. The burn unit was properly staffed. The Burn Plan called for a minimum of 17 personnel. On the day of the burn there were 36 personnel on site. The pre-burn work was completed, the saw line was in, the burn unit was mostly plumbed with hose and they had an ample supply of water. All equipment was in place. In fact, they went beyond the equipment stated in the Burn Plan. The contingency resources were identified and available if needed.

Under Element 7 – Prescription. It appears that throughout the burning operation, they were within prescription. The spot weather forecast received that morning forecasted the minimum relative humidity to be 21-26%, where the Burn Plan minimum RH was at 26%. Before and during the burn, the wind speeds were within the prescription parameters. The BEHAVE output for spotting distance was 0.4 miles. It is determined that the Foss Lake prescribed burn was implemented at the high end of the prescription.

Under Element 17 – Contingency Plan. The Burn Plan addressed aerial contingency aircraft as “Water Delivery Aircraft – consider CL4 415/Fire Boss/Helicopter”. The IAP for the burn addressed it as “Water Delivery Aircraft”—not specific for the kind of water delivery aircraft that would be needed. During the time when the spot fire occurred, there was some confusion on the aircraft that was needed and what was available.

Recommendations

- When a spot weather forecast is received and the forecasted weather exceeds the prescription, Stop, Think, Talk and then Act. Reevaluate and consider not igniting.
- For Water Delivery Aircraft, the Burn Plan needs to: 1) Be more specific on what is available and ensure that it is available to the burn operation; 2) Advise Dispatch that when a contingency has been committed to an Initial Response; and 3) Notify the Burn Boss. Also, a caution with using a National Resource Aircraft as a contingency resource, for they can be pulled away at any time.

5. The approving agency administrator's qualifications, experience and involvement:

The Agency Administrator was qualified at the working level and has delegated authority to authorize low and moderate complexity burns. He has experience supporting and managing fire suppression and prescribed fire programs for more than 10 years. The Agency Administrator was involved from the review and approval of the Burn Plan, signing the Administrator Pre-Ignition Approval Checklist and Ignition Authorization through the moment the fire was declared a wildfire.

The qualifications and experience of all key personnel involved:

All key fire personnel were qualified in the positions for which they were assigned according to current IQCS records. All other assigned personnel also appeared to have been qualified in their respective positions.

FOSS LAKE RX BURN -- KEY BURN STAFF QUALS

ASSIGNED POSITION	QUALIFIED YES/NO
Agency Administrator (AADM)	Yes/Current
RXB2	Yes/Current
FIRB	Yes/Current
DIVS (Holding Boss)	Yes/Current

Appendix 2 – The Technical Fire Review

Foss Lake Prescribed Burn Plan

Technical Review

06/10/2016

Overall:

- Element 1 Signature page:** Good.
- Element 2 Go/No-Go Checklists:** Good.
- Element 3 Complexity Analysis Summary:** Good rational. The rational does mention that Fire Behavior inside the unit is expected to be low to moderate.
- Element 4 Description of RX Fire area:** Good. Good job in describing the fuel models within and adjacent to the burn unit.
- Element 5 Objectives:** The resource objectives are in line with the decision memo. For the Prescribed Fire, objectives need to follow the intent of the guide a little bit more, by making the objectives “SMART” specific, measurable, attainable, realistic, and time sensitive. Refer to Element 5 of the Prescribed Fire Guide.
- Element 6 Cost:** OK.
- Element 7 Prescription:** Many times the Environmental Prescription is developed through experience and knowledge of the area’s weather. There is a need to include the wind conversion factor in the Burn Plan. The Canadian Indices are a good reference, but for only those that are familiar with them. Burn personnel need to be very careful and identify which indices you are using and ensure they correlate with each other.
- Element 8 Scheduling:** OK.
- Element 9 Pre-Burn Considerations:** Good.
- Element 10 Briefing:** Ensure that all Burn Plan Elements are covered. After every briefing, make sure everyone signs the “sign it sheet” to document that they were at the briefing in case something happens.
- Element 11 Organization and Equipment:** Good. Able to understand and follow it.
- Element 12 Communications:** Good. Good communications plan.
- Element 13 Public, Personnel Safety and Medical:** Good.
- Element 14 Test Fire:** Good.
- Element 15 Ignition Plan:** OK. One thing that needs to be looked at closely: Plastic Sphere Dispenser (PSD) was mentioned as devices needed. If that is the case, then you need to show aerial ignition personnel in your organization chart, mention it in your ignition plan, and have an aerial plan signed and in place. It is a very small unit, would you really drop ping pong balls in it?
- Element 16 Holding Plan:** Good.
- Element 17 Contingency Plan:** Good. Good job on addressing your critical areas with Management Action Points (MAPs) and addressing different contingency actions for medical, communications and smoke. As for contingency resources, ensure that you do have one of the mentioned aircraft available at all times. I caution on using a National Resource aircraft because they can be pulled away at any time and the Beaver aircraft was never mentioned as a contingency resource.
- Element 18 Wildfire Conversion:** Good.
- Element 19 Smoke Management:** Good.
- Element 20 Monitoring:** Good.
- Element 21 Post Fire Activity:** Good

Other: Make sure you have good maps during your burn, update your organizational chart. These all need to be saved as documentation, and ensure that everyone signs the briefing sheet.

XX Recommended for Approval

Not Recommended for Approval

/s/ Robert Morales

RXB1__(Y)

June 10, 2016

Technical Reviewer

Qualification and currency (Y/N)

Date

Robert Morales: Santa Fe Fire Staff Office: 505-438-5630, or Cell: 505-660-1787
