2013 Belle Fourche Prescribed Fire Review

Devils Tower National Monument

National Park Service, Intermountain Region

Executive Summary

The Belle Fourche Prescribed Fire unit is a 325 acre landscape-scale prescribed burn located within the boundaries of Devils Tower National Monument (DETO), designed to reduce the woody fuel load as well as maintain the native grass ecosystem. On May 7, 2013 the Great Plains Fire Management program, from Wind Cave National Park (WICA), which has wildland fire responsibilities for DETO, initiated ignitions on 300 acres of the unit. On May 8, 2013 the Belle Fourche prescribed burn was declared an escaped prescribed burn and converted to a wildfire. During the implementation phase of this prescribed fire, two separate incidents occurred which were contributory to the escaped prescribed burn. Early in the operational shift of May 7th, a UTV and rider were involved in a vehicle tip-over. Also on May 7th, a power line was a scorched and caused the loss of power to the National Monuments upper pumping station, which contributed to damaging the Monuments waterlines. This report will be focused solely on the escaped prescribed fire.

On May 7th, after ignition of a test fire, it was determined that environmental conditions and the effects of the test fire were within prescription parameters and would meet resource objectives. The Go/No Go Checklist was approved by the Burn Boss and ignition of the unit continued. After progressing a quarter mile, multiple spot fires occurred west of DP-8, outside of the planned unit. Firing operations were halted. During suppression efforts of these spots, the UTV Tip-over mishap occurred, which caused a temporary shortage of responding resources. Around 1400 hours, the spots at DP-8 were contained and ignitions resumed. Around 1600 hours, heat from a jackpot caused a power line coming from a transformer to a mid-slope pump house to sag to the ground. The power line was turned off by the power company and ignitions resumed. Around 1810 hours, a large ponderosa pine tree torched near DP-7. The ensuing ember shower resulted in several spot fires southwest of DP-7, outside of the unit. These spots were contained and ignitions were completed on the unit by 1900 hours.

On May 8th, fewer resources were assigned to the prescribed burn; the decision was made not to request the USFS resources that had assisted on the previous day. Through consultation with the Midwest Regional Fire Management Office, the decision was also made to conduct an After Action Review of the UTV Tip-over. Remaining resources were assigned to focus on securing the spots located at DP-8. At 1250 hours, fire activity was observed at the location of the spot fires near DP-7. By 1310 a direct attack operation with all available resources was in progress at DP-7. By 1330, the spot fire had established itself and was moving upslope through the timber. At 1342 the Belle Fourche Prescribed fire was declared escaped and put into wildfire status.

The Review Team determined the following:

- The Prescribed Fire Plan met policy.
- Coordination with management for implementation was signed off by the DETO Superintendent for implementation the day of the burn.
- Fine Dead Fuel Moisture levels during the heat of the day on both May 7th and May 8th fell to 3% which placed the burn out of the prescription parameters identified in the plan.
- The objectives identified for the prescribed burn are incomplete and do not adequately address mortality in the mature Ponderosa pines.

- There was a failure to identify the need for, establish, and utilize necessary Agreements and Memorandum of Understandings with interagency partners to provide the ability to pay for shared resources.
- The After Action Review for the UTV tip-over distracted firefighters and pulled resources from the prescribed fire mop-up operations.

The review of the Belle Fourche Prescribed Fire was conducted in accordance with direction provided in the Interagency Prescribed Fire Planning and Implementation Procedures Guide (Page 29); National Park Service, Reference Manual 18, chapters 7 and 17; Interagency Standards for Fire and Fire Aviation Operations, chapters 17 and 18; and principles of Operational Leadership.

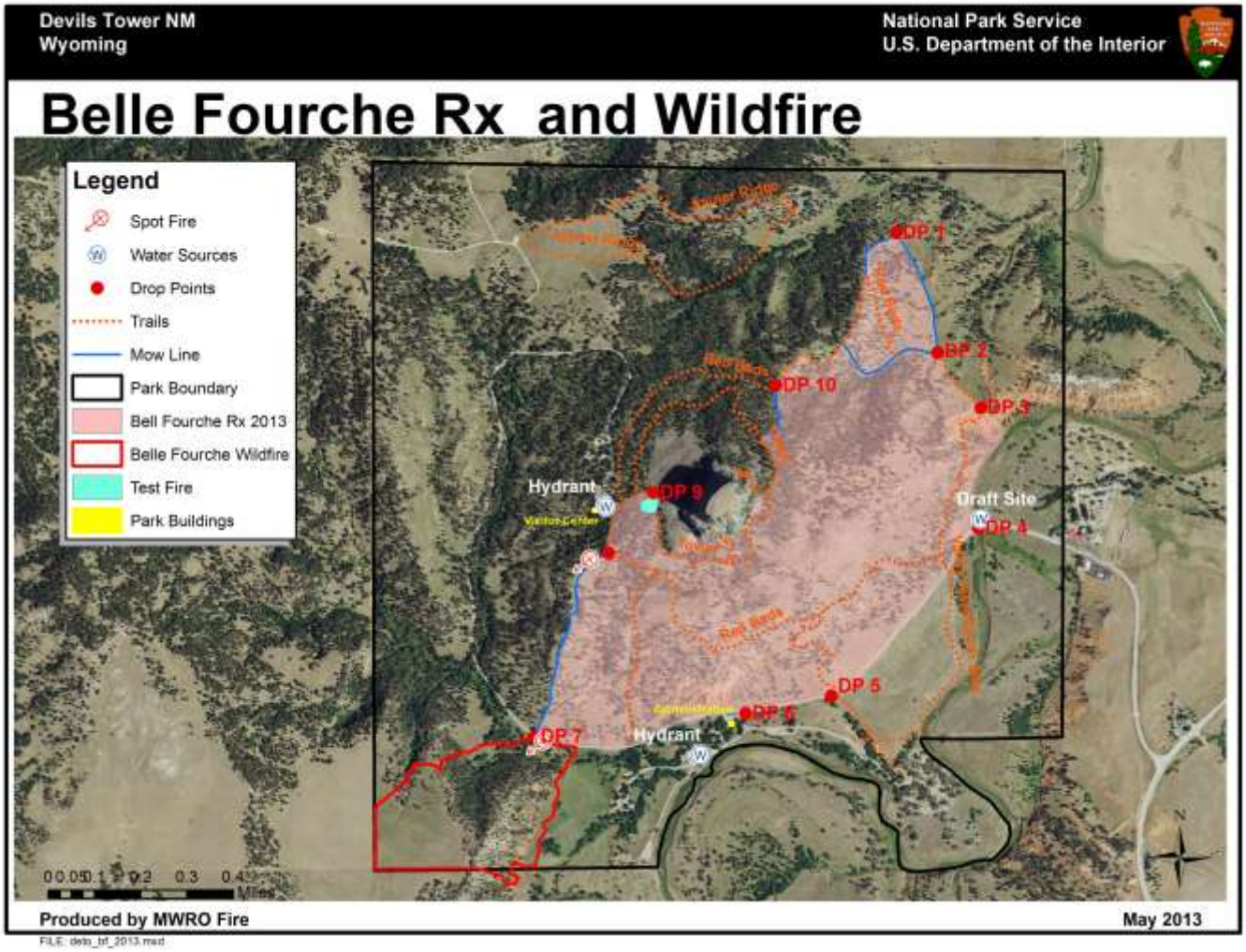


Figure 1: Belle Fourche Prescribed Fire Map.

Description of the Belle Fourche Prescribed Fire

The Belle Fourche Prescribed Fire unit is a 325 acre landscape scale prescribed burn located within the boundaries of DETO. The unit resides to the south and east of the Tower. The Belle Fourche treatment unit sits approximately three quarters of a mile west of Highway 24. Privately owned commercial development is located at the entrance to the Monument. National Park Service (NPS) administration and developments lie immediately adjacent to the south boundary of the burn unit. The Monuments Visitor Center is directly adjacent to the western boundary of the burn unit. The main entrance road to the Tower/Visitor center was utilized as the south control line and a portion of the main trail was also utilized as a control line along the northern boundary.

The Belle Fourche fuels treatment unit was previously burned in 1997, making this a second entry burn unit. The area of the escaped prescribed fire was burned in 2007 as part of the Southwest prescribed burn unit.

The fuels within the Belle Fourche Prescribed Fire unit consisted of predominantly a Short Grass (GR2) fuel model with open stands of Ponderosa pine. Areas adjacent to the burn unit also had pockets of a Moderate Load Timber Litter (TL-3) fuel model. Scattered throughout the unit there were also jackpots of dead and down fuels which were residual from the prescribed burn completed in 1997.

Visitor access to several trail systems during the implementation phase of the prescribed burn would be temporarily restricted. Politically, the local community had expressed a strong interest in the Monument's desire to treat this unit with prescribed fire. The view shed is a major attractor to visitation and the businesses nearby are concerned that an excessive number of dead trees will detract from the public's desire to visit the Monument.

As stated in the Belle Fourche Prescribed Fire Burn Plan, the following goals and objectives were identified for the burn on May 7th, 2013.

Goals and Objectives:

- Reduce the fuel loading in the woody fuels.
- Maintenance of the native grass ecosystem.

Resource management objectives:

- Reduce 50% of the 1-hour and 10-hour woody fuels.
- Reduce 20% of the 100-hour and 1000-hour woody fuels.
- Decrease non-native herbaceous density and relative cover by at least 20% 2 years post burn.
- Burn greater than 70% of the unit area to produce nutrient flush and encourage the growth of native prairie grasses and forbes.
- Reduce herbaceous fuel loading (thatch) in the native prairie by at least 50% immediately post burn.

Fire (Operational) Objectives*:*

- Educate Monument visitors and people in the local area as to the benefits of fire and its role in the natural ecosystem.
- Provide training opportunities for fire personnel.

Description of the Events

The planning process for Belle Fourche Prescribed Fire began in the spring of 2012; and compliance was completed in August of 2012. The project was input into PEPC (#47310) on May 5, 2013. Holding line preparations were started on May 2nd, and the Belle Fourche Burn Plan as well as the Agency Administrator Pre-ignition Approval Checklist was signed by the superintendent the morning of implementation, May 7th. As previously stated the Belle Fourche unit had been burned in 1997.

***Note: Time frames represented in this report reflect those reported in personal interviews as well as unit logs provided to the review team.

May 6th

Off-unit NPS resources arrived at DETO.

May 7th

The US Forest Service engines arrived. All resources were briefed on scene at 0830 hours. A key point addressed during the briefing was erratic wind behavior resulting from terrain influence. None of the resources expressed any concern for the weather or the fuel conditions. The overall consensus was that it was a good day for a prescribed fire on the unit.

At 1000 hours, a test fire was initiated in the northwest corner of the unit near DP-9, on the west side of and at the base of the rock formation known as the "Devils Tower". Resources were split into two teams: Task Force 1 (TF-1) which progressed from the test burn location east around the base of the tower towards DP-10; and Task Force 2 (TF-2) which progressed south and west from DP-9 towards DP-8.

Around 1200 hours, three spot fires occurred west and south of DP-8. While suppressing these spots, an NPS UTV tipped over on its side. No injuries occurred and the UTV sustained no damage. The UTV was temporarily out of commission and TF-2 requested resources from TF-1 to assist in suppressing the spot fires. One UTV and a few firefighters were diverted from TF-1 and assisted suppression efforts. All three spots burned together and were encircled as one spot fire. The spot fire was contained at .9 acres by 1400.

Both TF-1 and TF-2 resumed Ignition operations shortly after 1400 hours. Around 1440 hours, TF-1 consulted with the burn boss and determined that approximately 25 acres in the north east tip of the unit would be excluded due to the time of day and the current burning conditions. Based on that decision it was decided that the interior line between DP-10 and DP-2 which had been installed the previous week, would be utilized as the control line on the northeast portion of the unit. To facilitate

interior ignitions on the overall unit, as igniters from both TF-1 and TF-2 worked south on each side of the unit, they also sent interior burners in to bring fire evenly down towards the south side of the unit.

Analysis of actual weather readings from the on-site RAWS station show that between 1400 and 1600, the burn was out of prescription with fine dead fuel moisture readings at 3%. The burn organization was utilizing on-site observations collected from their Fire effects monitor (FEMO). Observations were then adjusted to a shaded Fine Dead Fuel Moisture due to the smoke column. Un-shaded observations from the FEMO would have also placed the Fine Dead Fuel Moisture at 3%.

Around 1600 hours midway between DP-8 and DP-7 and somewhat interior, a power line feeding an NPS pump house was burned and broken. The down power line supplied power to a relay station fed by the main pump below. At this location, the waterline empties into a storage tank, which is then pumped up to the Visitor Center which is located still higher up the hill. The burn boss trainee notified the Park Superintendent and Powder River Power Company. The power line was de-energized at 1730.

At 1800 hours, TF-1 tied into the road at DP-7. Ten minutes later, a large ponderosa pine close to the road torched, and erratic winds threw an ember shower south, over the road. Two spot fires resulted from the ember shower. NPS Engines E-627 and E-623 quickly responded and caught the two small spots. Firing then continued along the main road. Ignition was complete around 1900 hours, and an AAR was started at 1930 hours. All resources were off shift by 2230 hours.

May 8th

At 0730 hours a meeting with the prescribed fire overhead, the Park Superintendent, and the regional office (on speaker phone) discussed the UTV tip-over from the previous day. It was determined that an AAR should take place immediately and the Superintendent suggested a UTV stand down until 1200 hours. All were in agreement.

At 0800 hours, the onsite morning briefing took place. Resources had been reduced to only the NPS resources. The US Forest Service resources were not requested to help with mop-up and snagging the trails. Priority assignments were placed upon mopping up the spot near DP-8 and snagging the trail system so that it could be opened up to the public as soon as possible.

At 1100 hours most of the resources were pulled off of trail snagging and mop-up of the spot near DP-8 to attend the UTV tip-over AAR. The Burn Boss drove by the spot fire near DP-7 on his way to the AAR, and did not notice any smoke coming from the area they had worked the previous day.

At 1250 hours, E-627 which had been working the spot fire near DP-8, left to refill water and observed smoke coming from the area of the spots near DP-7. E-627 requested additional resources, which arrived quickly, and started direct attack of the fire. Although US Forest Service engines were not requested by the NPS to support mop-up operations, they were nearby and monitoring the radio traffic. US Forest Service engines were informed by their dispatch that a resource order was necessary to participate in the prescribed fire. The prescribed burn was converted to a wildfire at 1342 hours and the USFS resources were able to engage.

Figure 2: Early fire behavior (May 7th) as ignitions moved down towards DP-8.

Figure 3: Fire behavior and consumption during burn operations (May 7th).

Chronology of Events

Table 1

May 7, 2013	
0730	The Burn Boss and Burn Boss Trainee met with DETO Superintendent to discuss the prescribed fire, sign the Burn Plan, and sign the Agency Administrator Pre-ignition Approval Checklist.
0830	All resources on scene and present for the morning operational briefing. Prescribed Fire Burn Boss trainee conducts briefing with input from the Burn Boss, the Northern Great Plains Fire Ecologist, and DETO Superintendent.
0930	All personnel gather at the Visitor Center parking lot for the test fire which will occur near DP-9.
1000	Test fire is ignited by Task Force 2 (TF-2). Observed fire behavior consist of surface fire, active backing fire, and dead and down heavy jackpot consumption.
1015	Burn boss and key overhead determine that the Test Fire is meeting objectives, and the decision is made to continue with burning the unit.
1016	Task Force 1 (TF-1) starts firing south of DP-10, at a high point.
1030	The Burn Boss met with the Crook County Fire Warden at the Visitor Center parking lot.
1100	TF-1 firing has made it to DP-10, and starts burning east towards DP-2. TF-2 has ignited to the Visitor Center parking lot. FEMO weather observations place Fine Dead Fuel Moisture at 6% un-shaded (68 degrees, Rh 32)
1120	FEMO observation, smoke column moving off to NNW
1123	RAWS station readings place Fine dead fuel moisture at 4% un-shaded. (66 degrees F, Rh 23)
1155	TF-2 igniters establish communication with TF-1 igniters and complete a pass to the east, then begin another pass to the west back toward DP-8. All fire is kept above the Red Beds Trail.
1200	TF-1 is progressing well, and they are looking at including the north 25 acres. (Between DP-1, DP-2, and DP-10) TF-2 has several spot fires near DP-8. The NPS UTV tips over, near DP-8 on mow line, no injuries. TF-1 gives TF-2 both UTV's and igniters to assist with spot fires. FEMO weather observations place Fine Dead Fuel Moisture at 4% un-shaded (71 degrees, Rh 25)

1215	TF-1 resources arrive at DP-8 spot and begin assisting TF-2.
1223	RAWS station readings place Fine dead fuel moisture at 4% un-shaded. (68 degrees F, Rh 22)
1230	FEMO observation, smoke column moving off to NNW
1300	TF-1 burns an interior hill (SE of DP-10) to prevent slope reversal and keep up with fire edge. The Burn Boss updates Superintendent on spot fire near DP-8, and UTV tip over. FEMO weather observations place Fine Dead Fuel Moisture at 4% un-shaded (71 degrees, Rh 25)
1323	RAWS station readings place Fine dead fuel moisture at 4% un-shaded. (69 degrees F, Rh 20)
1400	Spot Fire at DP-8 is contained; firing begins again on west flank, using E-628 for support. FEMO weather observations place Fine Dead Fuel Moisture at 8% shaded (4% un-shaded) (69 degrees, Rh 23)
1408	Burn Boss contacts GPC dispatch, and informs them of the spot fire and that the burn was 25% complete. Communications with the FEMO while providing weather observations is poor. Resources from TF-1 borrowed by TF-2 have returned back to TF-1, minus US Forest Service UTV which stayed with TF-2. TF-1 now behind schedule, it is decided not to burn north 25 acres (DP-1).
1423	RAWS station readings place Fine Dead Fuel Moisture at 3% un-shaded. (71 degrees F, Rh 19)
1430	E-628 is having electrical problem, pump shuts off. FEMO observation, smoke column moving off to NNW
1440	The Burn Boss updates the Midwest Regional Office on the status of the prescribed fire.
1447	E-628 pump problem has been fixed.
1450	FFS UTV pump is not working. There is only 200 feet to rock face to tie off the burn near DP-7. TF-2 decides to complete the last portion without wet line due to sparse fuels.
1500	TF-1 Firing Boss ignites across unit from east to west and back. Forest Service holders coordinate and bring fire down between DP-2 to DP-3. TF-2 on the west line ties into rock face at the end of the ridge. The fire is backing towards the pump house, located between DP-7 and DP-8. TF-2 igniters use a ring fire pattern

	around the associated power polls and pump house. E-627 established a hose lay from DP-7 up to the rock face along the mow line. FEMO weather observations place Fine Dead Fuel Moisture at 7% shaded (3% un-shaded) (73 degrees, Rh 21)
1523	RAWS station readings place Fine Dead Fuel Moisture at 3% un-shaded. (72 degrees F, Rh 18)
1530	FEMO observation, smoke column moving off to NNW
1600	Heat from a jackpot of fuels located below and to the side of the power line causes the power line to sag. Power line from mainline to pump house is on the ground, the poles are unburned. The Burn Boss Trainee notifies DETO Superintendent, and calls the Power River Power Company notifying them of the power line situation and asks them to shut off the power. FEMO weather observations place Fine Dead Fuel Moisture at 7% shaded (3% un-shaded) (73 degrees, Rh 24)
1623	RAWS station readings place Fine Dead Fuel Moisture at 4% un-shaded. (73 degrees F, Rh 21)
1700	FEMO weather observations place Fine Dead Fuel Moisture at 7% shaded (3% un-shaded) (73 degrees, Rh 21)
1715	FEMO observation, smoke column moving off to NW
1723	RAWS station readings place Fine Dead Fuel Moisture at 4% un-shaded. (71 degrees F, Rh 20)
1730	Power River Power Company arrives on scene and the power line from the main line to the pump house is de-energized.
1750	Ignitions on final interior strip is completed, TF-2 is ready to burn from DP-7 to DP-6.
1800	TF-1 ties in burn to road near DP-3. TF-2 Firing held at corner DP-7. FEMO weather observations place Fine Dead Fuel Moisture at 9% shaded (71 degrees, Rh 28)
1810	Large Ponderosa Pine close to the road torches near DP-7, numerous embers are thrown across the road, E-627 and E-623 quickly respond, firing folks help staff engines and catch two spots.
1830	E-627 preps bollards (short poles) along road east of DP-7.
1834	The Burn Boss updates GPC; discuss a new wildfire at BADL – no resources are needed for

	the BADL wildfire.
1900	Firing operations complete, Ignition teams from TF-2 and TF-1 have tied in between DP-6, DP-5 and DP-4. FEMO weather observations place Fine Dead Fuel Moisture at 10% un-shaded (69 degrees, Rh 29) FEMO observation, smoke column moving off to SW
1916	Burn Boss updates the Midwest Regional Office.
1930	After Action review conducted on the days burn operation.
2015	E-623 assigned to patrol spot near DP-8.
2200	Hike out.
2230	Off shift @ Sundance
May 8, 2013	
0730	Burn Boss and trainee, Northern Great Plains FMO, and DETO Superintendent on a conference call with the Midwest Regional Office. Discuss the need for a UTV AAR and a UTV stand down till 1200 hours.
0800	Morning briefing with all Prescribed Fire personnel. The Forest Service resources are not requested for mop-up and trail snagging. The Black Hills Wildland Fire Module starts snagging paved trail so that it can be reopened. All other resources mopping-up spot fire near DP-8.
0846	Burn Boss trainee notified dispatch that there would be 14-15 personnel on scene reinforcing lines and mopping up.
0915	Operations normal.
0958	Burn Boss gives update to the Crook County Fire Warden. Not going to burn the extra 25 acres.
1100	Burn Boss patrols past the old spot fire near DP-7, no smoke showing. UTV on site AAR (near DP-8), attended by most resources.
1123	RAWS station readings place Fine Dead Fuel Moisture at 5% un-shaded. (72 degrees F, Rh 29)
1223	RAWS station readings place Fine Dead Fuel Moisture at 4% un-shaded. (74 degrees F, Rh 22)
1250	Spot fire near DP-7 noticed by E-627 when headed to refill water, onsite resources

	requested.
1254	Order placed for 4 type 6 engines and 1 hand crew; Unsure about payment method.
1256	The Burn Boss calls Crook County Fire Warden and updates him of new spot.
1259	USFS has resources available to support, but put on standby.
1310	The prescribed fire staff departs the Visitor Center parking lot in route to spot fire. Direct attack on fire with saw, hand tools, and bladder bags, anchor point established successfully. E-625 establishes a hose lay.
1330	UTV arrives on the spot, going direct on fire in meadow. Fire moves up hill.
1323	RAWS station readings place Fine Dead Fuel Moisture at 4% un-shaded. (74 degrees F, Rh 20)
1342	**Spot fire Converted to a wildfire, Type 3 IC assigned**
1355	Burn Boss updates the Midwest Regional Office on status.
1410	Estimate 45 acres involved in escape.
1423	RAWS station readings place Fine Dead Fuel Moisture at 3% un-shaded. (77 degrees F, Rh 18)

***Note: Time frames represented in this report reflect those reported in personal interviews as well as unit logs and the radio log from the Great Plains Interagency Dispatch Center which was provided to the review team.

Underlying Reasons for the Prescribed Fire Escape

Determine if the Prescribed Fire Plan was adequate for the project and complied with policy and guidance related to prescribe fire planning and implementation.

The prescribed fire plan met policy requirements, however it was not signed off on by the Park Superintendent until the morning the burn was planned to be implemented.

The Belle Fourche Prescribed Fire Plan complied with National Park Service policy found in Wildland Fire Management, Reference Manual 18 (National Park Service 2008). The Prescribed Fire Plan was developed in accordance with direction found in the Interagency Prescribed Fire Planning and Implementation Procedures Guide (USDA & USDI 2008). The Belle Fourche Prescribed Fire Plan was not signed off on by the Park unit's Superintendent until the morning of the prescribed fire.

Complexity Analysis: The complexity analysis portion of a burn plan provides managers with a relative ranking of the complexity of a specific prescribed fire project. The process can be used to identify special problems and concerns and develop mitigation activities to reduce risk and hazard.

The complexity analysis section for the Belle Fourche Prescribed Fire plan which deals with "*Potential for Escape*" adjusted the risk for a potential escape down from moderate to low. This was based upon the knowledge that the areas to the north and east had been recently burned. The area of escape on May 8th was to the south and west. During the planning process, this area does not appear to have been given adequate consideration.

The final Complexity Analysis Summary of the Belle Fourche Prescribed Fire Burn Plan ranked 12 of the 42 elements as "moderate", whereas the initial ranking had 23 of the 42 elements ranked as "moderate". The final summary complexity rating for the plan though remained "Moderate". The rationale in the complexity analysis for a moderate rating referenced the proximity to private lands and the public's interest. Historically the Monument has received input from the local community on their desire to minimize the impacts on the view shed as a result of burning.

Determine if the prescription, actions and procedures set forth in the Prescribed Fire Plan were followed.

The review team found that prescription, actions and procedures set forth in the Prescribed Fire Plan were not followed on two parts: number of resources needed and Fine Dead Fuel Moisture. Furthermore the prescription was inadequate in that the identified objectives failed to address mortality of mature trees which would directly impact the aesthetic concerns of the public.

Prescription Elements: A prescribed fire prescription is the measurable criteria used to define a range of conditions during which a prescribed fire may be ignited and held as a prescribed fire.

The Belle Fourche Prescribed Fire Plan utilized two environmental prescription parameters, wind speed 2-12 mph, and Fine Dead Fuel Moisture 4-10%. The plan also focused on only two fuel model types; Short Grass (GR2) and Moderate Load Timber Litter (TL3). Prior to ignition, resources on the burn calculated the Fine Dead Fuel Moisture based upon the spot weather forecast which they received. During the burn they utilized on site conditions recorded by the FEMO. Actual conditions recorded by the RAWS station located at the Monument showed that conditions were dryer than forecasted and that un-shaded Fine Dead Fuel Moistures for fuels located to the south and west of the unit dropped out of acceptable prescription parameters for two hours each day on May 7th and May 8th. The FEMO for the burn was utilizing shaded fuel conditions, based on the smoke column coverage. Although this was representative for the area directly under the smoke column it was not for the surrounding fuels. The smoke column was moving off to the northwest, thus all of the fuels to the south and east of the unit would have been experiencing un-shaded conditions. Using the on-site observations collected from the FEMO un-shaded Fine Dead Fuel Moistures between 1500 and 1700 would have been 3%. Resources on the burn underestimated the fact they were actually working on the extreme end of their prescription

and that the fuels on the south side would have been influenced by drier conditions than those to the north and west.

Contingency Resources: (Note: The Belle Fourche Prescribed Burn Plan does not directly address contingency resources, but does refer to additional resources.) Resources on site for the prescribed fire on May 7th met the requirements of the burn plan however; they did not for May 8th. The Adequate Holding Resources worksheet found in Appendix F of the Belle Fourche prescribed fire plan called for a minimum of 22 firefighters with a line production rate of 10 chains/hour/person, to catch a spot fire. As found in the Great Plains Interagency Dispatch Center radio log, there were only 14-15 personnel assigned to the prescribed fire on May 8th. This shortage of resources contributed to the inability to catch the spot once it was established. The decision to not use the USFS resources on May 8th contributed to the shortage of adequate resources to catch the spot.

Contingency resources listed in the plan (Element 17) stated that additional resources may be available from either Crook County or the USFS in Sundance. These resources were available; however there was no formal agreement in place to utilize their services, which became an issue when they were called upon when needed. As previously noted, the USFS resources contributed to the line construction capability calculations in the burn plan, showing that committed resources would be able to contain and control a spot fire should one occur.

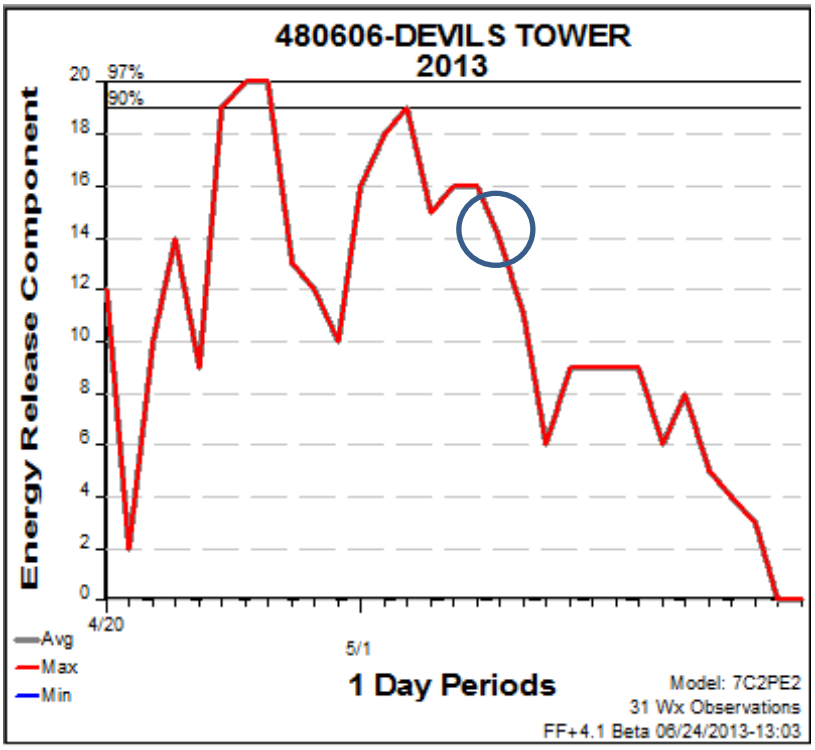
The escape resulted from a spot fire being missed or overlooked from an ember shower from a torching ponderosa pine which ignited a ready pocket of fuel, a miscalculation of the Fine Dead Fuel Moisture to the south and west, and an untimely distraction of firefighters (UTV AAR and trail opening) when conditions heated up enough for the spot to establish itself, and coupled with a shortage of adequate firefighters to catch the spot. These circumstances enabled the spot to establish itself and resulted in spread and fire behavior which the resources on hand on May 8th were not prepared to deal with.

There was a failure to identify the need for, establish, and utilize necessary Agreements and Memorandum of Understandings with interagency partners to provide the ability to pay for shared resources.

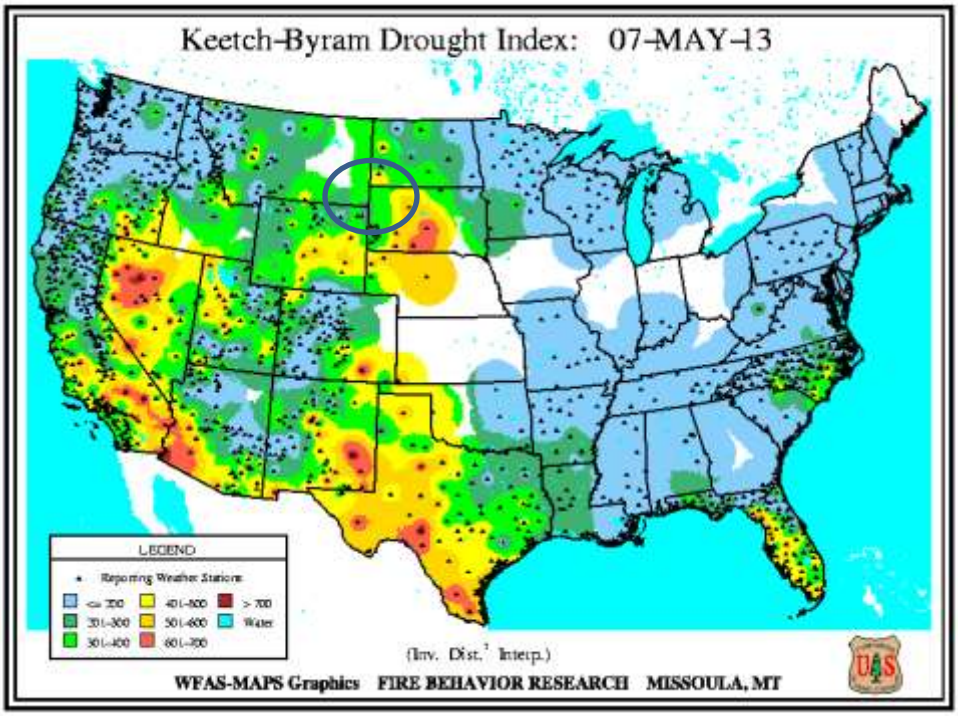
Element 17 of the Belle Fourche Prescribed Fire Burn Plan stated; “If unintended fire cannot be contained by the morning of the following day by the resources on hand, the Burn boss will convert the fire to a wildfire.” The Belle Fourche Prescribed Fire was declared a wildfire on May 8th, day 2 of the project. The plan itself called for two days of ignitions. A contributing factor to the decision to transition the Belle Fourche Prescribed Fire to an escaped wildland fire was an inability to pay for the USFS resources which responded to assist the burn organization when things got more intense than they had expected on May 8th. Devils Tower National Monument and the Great Plains Fire Management Group have no formal agreement or Memorandum of Understanding in place to support exchange of funds between agencies during a prescribed fire event. The burn overhead prematurely released the USFS resources from their organization which left them short when additional resources were needed on May 8th.

Analysis of seasonal severity, weather events, and on-site conditions leading up to the wildfire declaration:

The representative Energy Release Component (ERC) value for the prescribed fire area as represented by the Devils Tower RAWS station for the period of the prescribed burn was well within acceptable levels. For May 7th, the ERC value was roughly 12, which was well below the 90th percentile and was decreasing for the next several days.



The Keetch-Byram Drought Index (KBDI) values indicated that the area was experiencing typical late spring conditions; early growing season drought conditions (between 300 and 400). KBDI values ranging from 200-400 tend to see lower litter and duff layers dried out and contributing to fire intensity. (USFS-Wildland Fire Assessment System)



Drought Monitor, May 7, 2013

The Northern Great Plains Fire Management program did not take any fuel moisture samples to verify fuel moisture levels prior to ignition. During the month of April, the Monument received 2.18 inches of precipitation; however nothing was recorded from April 30th until the day of the burn.

The spot weather forecast for the burn day indicated that all prescription weather parameters at the planned ignition time would be met. The low relative humidity forecast of 21% with a maximum temperature of 73 degrees would have placed the Fine Dead Fuel Moisture at 4%, the high end of the prescription. According to the local RAWS actual conditions were dryer than forecasted with the relative humidity bottoming out at 18%. This placed the un-shaded Fine Dead Fuel Moisture at 3% which was outside the acceptable parameters identified in the burn plan.

The FEMO on site for the burn recorded that the Fine Dead Fuel Moisture (FDFM) never fell below 4% throughout the operational period on May 7th. While calculating the FDFM, a shaded factor was used, based upon the developed smoke column overhead. While this was representative of the fuels under the smoke column, it would have failed to account for those fuels which were not. The smoke column was moving off to the Northwest, thus the fuels to the Southwest, where the escape took place would not have been influenced by shading, and would have been drier and more receptive.

The prescription indicated that any wind direction was acceptable for burning; smoke sensitive receptors were identified in the burn plan and a plan was identified to deal with potential smoke impacts to any of the nearby road systems (park roads and State Highway 24).

Figure 5: ***Observed fire behavior during test fire.***

Analysis of the prescribed fire prescription and associated environmental parameters: The burn plan addressed all the required elements according to interagency policy. The burn plan was written as a general burn plan which included the entire 325 acres of the Belle Fourche Prescribed Fire unit.

Fuels associated with the Belle Fourche Prescribed Fire treatment unit consisted of open Ponderosa pine stands scattered with pockets of residual dead and down fuel concentrations from the prescribed fire conducted on the unit in 1997. The target objective identified by the Burn Plan was to remove the dead and down fuel concentrations found throughout the unit.

The Burn Plan described the fuels adjacent to the burn unit, specifically to the west as being Moderate Load Timber Litter (TL-3). The plan states that they had been treated with fire within 5 years, and would thus have greatly moderated fire behavior. The park did not have site specific fuel loading information for the unit and the plan was written and fire behavior modeled off of generic fuel loading numbers obtained from *Standard Fire Behavior Fuel Models: A comprehensive Set for Use with Rothermel's Surface Fire Spread Model, Scott/Burgan*.

Containment calculations in the Burn Plan indicated that under upper end prescription conditions, resources on hand on May 7th could contain one spot fire. On May 8th when the spot fire activity flared up the resources on hand were not enough to catch the spot as demonstrated in the Plans Adequate Holding Resources Worksheet. The decision to release the USFS resources prior to having the known spots sufficiently mopped up severely impacted the ability of resources on hand to catch a spot fire.

Determine if overall policy, guidance and procedures relating to prescribed fire operations were adequate.

Prescribed fire operations were adequate. The following are key discussion items related to local procedures and guidance.

Fuels, Weather, and Fire Behavior: The Parks Fire Management staff did not take any local fuel samples to compare with calculations being provided from the weather stations. Relative fire danger indices, fire behavior calculations, and fuel moisture values as they pertained to the Belle Fourche Prescribed Fire area were all based off of RAWS data (model calculations). For the Belle Fourche Prescribed Fire unit, the fire organization did have fire monitoring plots established by the Northern Great Plains Fire Ecology program to support fire management decision making. An established Remote Automated Weather Station (RAWS) is located just south of the unit and was utilized for weather data (Station ID 480606).

Multi-year Strategic Program of Work: The Northern Great Plains Fire Management group manages a year round, complex fire management program that has a long, successful history of wildland fire and fuels management project implementation at most of the eight park units which they have responsibility for. Annually the program attempts to maximize prescribed fire and fuels management opportunities, in addition to their wildfire workload. As evidenced by previous implementations and their Five Year Fuels Treatment Plan, there is a strong commitment from the Northern Great Plains Fire Management group to accomplish fuels treatments at Devils Tower National Monument.

Review of the approving line officers qualifications, experience, and involvement: The Superintendent for Devils Tower National Monument had assumed his Superintendent position at DETO in January, and was taking regular trips back to his previous work assignment location. The Northern Great Plains Fire Management Officer (FMO) has been in place since 2010, and due to budget restrictions is without a prescribed fire specialist. With this key vacancy, the FMO is attempting to cover the responsibilities for both positions. Although the planning portion for this burn was occurring for the better part of the year prior to the burn, the Fire management program did not sit down and go over the Agency Administrators Go/No-GO checklist for the burn with the DETO Superintendent until the morning of implementation. The Superintendent has not completed the Fire Management Leadership (FML) curriculum.

Review of the qualifications and experience of key personnel involved: All key personnel involved in the prescribed burn met qualifications and were experienced for their assigned positions. The Fire Management Officer, Burn Boss and trainee all assured and confirmed the qualifications and experience level of assigned personnel during the planning phase of the project. On May 7th and 8th the burn organization was utilizing several trainees in key positions such as Firing Boss and Holding Boss. Each of these positions had an appropriately qualified evaluator in the trainer position.

Determine the level of awareness and understanding of the personnel involved in regards to procedure and guidance.

Organizationally there was knowledge of the risks and hazard associated with the prescribed burn however there was a failure to recognize and an underestimation of the potential consequences associated with burning at the high or dry end of the prescription.

Program Management: The Northern Great Plains Fire organization had two key permanent staff vacancies on the date of the Belle Fourche Prescribed Fire. Their Prescribed Fire/Fuels Specialist and Engine Foreman positions were vacant; the program also had several seasonal monitor and firefighter positions vacant due to budget shortfalls. The key leadership positions and available firefighter positions being vacant in the fire management program impacted the planning as well as the implementation of the project.

Effective Communication: On the Belle Fourche Prescribed Fire communication amongst the resources was effective in coordination of firing patterns between the two task forces. Radio communications at time though were less than optimal. The use of local line-of-site channels was hindered by terrain and the proximity to the "Tower". This was best evidenced by the report that communications in regards to fire weather reports from the Fire Effects Monitor (FEMO) position were not equally copied by all resources.

Competing objectives: The objectives for the prescribed burn seemed to focus on removing the residual dead and down fuel concentrations from the previous prescribed burn in 1997. The plan did not address acceptable levels of tree mortality amongst the live Ponderosa pine trees. The impacts of visible dead trees were a high priority concern that the Park dealt with after the unit was first burned in 1997. Although Monument resource managers felt that they achieved their objectives, visual observations of the unit by the review team found a high percentage of mature Ponderosa pine mortality. Feedback provided to the review team from the Monuments Superintendent suggested that local neighbors were not pleased with the results from both the 1997 and this burn, and were looking to prevent the monument from burning that unit again in the future.

Lessons Learned

Table 2

Lesson Learned	Potential Method for Sustaining
Planning	
➢ ***Do not wait until the day of ignition to sign off on a burn plan. Provide adequate time prior to ignitions to allow management time to review and approve a burn plan.***	➢ *Prescribed burns are planned events; the planning process for a prescribed burn needs to take into account ample time so as to not have the Superintendent approve it the day ignition is to take place. In the future, ensure that the planning process for all fuels projects are approved and signed off by the appropriate land manager a minimum of 30 days prior to implementation.*

Lesson Learned	Potential Method for Sustaining
➢ ***To support interagency cooperation of fuels treatment projects, Interagency Agreements and Memorandum of Understandings need to be established and put in place to exchange resources and funds if necessary on fuels treatment projects. This is true of contingency resource planning as well.***	➢ *Schedule pre-season meetings with interagency partners to ensure that there is an understanding of what is expected and needed from all in regards to fuels treatment work for the upcoming year. If there is going to be a need to exchange funds ensure that there is a mechanism in place during the pre-season planning meeting.*
➢ ***If a prescribed burn plan calls for a specific number of resources, do not release below that number until all lines have been checked and spot fires are controlled.***	➢ *Do not operationally shrink your organization below what your plan calls for as a minimum, until after you have verified that all previously identified problem areas (spots) have been addressed. Consider creating an organizational Plan for the mop-up phase of implementation.*
➢ ***In the event that there is a mishap or incident within an incident which occurs on a prescribed burn (i.e. UTV tip-over), avoid rushing to conduct the After Action Review, until all operational threats associated with the project have been adequately taken care of.***	➢ *Identify the need and schedule AAR's for after all operational risks have been completely addressed.*
➢ ***Ensure that there is a clear understanding as to what is expected from all resources in regards to resuming normal park operations. If crews perceive a rush or priority to re-open a trail system, then management needs to take responsibility and the time to provide clear instructions and expectations.***	➢ *Before re-opening trails for public use, ensure that all control lines and spot fires have been adequately patrolled and secured.*
Prescription Elements	
➢ ***Prescription elements are supposed to be "a range of low to high limits" for the environmental (weather, topography, fuels, etc.) and fire behavior (flame length, rate of spread, spotting distance, etc.) parameters.***	➢ Establish prescription elements for prescribed burns based upon combined 'input/output" variables and not just "output" variables.
➢ ***When calculating Fine Dead Fuel Moisture values, and basing a shaded value upon the smoke column, keep in mind that fuels not directly under the smoke column will not be influenced by shading.***	➢ Provide both shaded and un-shaded values for Fine Dead Fuel Moisture values in the Burn Plan. Do not use shaded values in calculation if shade is solely from smoke/cloud cover.
➢ ***The Burn Plan did not adequately address all impacts to the environment from implementing the prescribed burn. Mortality of mature Ponderosa trees although referenced as local concerns were not***	➢ When developing prescription parameters, remember to take into account all concerns which could impact the burn program, such as mortality brought on by more intense fire behavior as a result of dead and down jackpots

Lesson Learned	Potential Method for Sustaining
addressed in the objectives or prescription.	of fuel.
Effective Communication ➢ ***All individuals involved in implementing a prescribed burn have a shared responsibility to voice concerns, hazards or issues when recognized at any point throughout the planning process or operational period.*** ➢ ***Critical fire weather was not clearly communicated to all on the prescribed burn, due to interference from topography***.	➢ Critical questions need to be asked such as: What could go wrong? What am I not seeing that you might be seeing? Who holds the "big picture" of what is going on? This "disconfirming process" could have helped detect or anticipate problems. Not all risks and hazards of a prescribed fire may be identified in the burn plan. The information needed to successfully plan and implement a project often lies with an individual person who spots a subtle problem. Therefore, an organizational cultural that encourages comprehensive communications is critical. ➢ Utilize a repeater system to ensure that all communications are copied by key positions on the burn. Establish a system which utilizes copy and repeat back verification from the FEMO to positions such as burn boss, ignitions and holding.

Lessons Learned: Operational Leadership

Operational Leadership identifies key risk factors that affect individual and team performance. It has been designed to provide a standardized approach that will assist employees in assessing and managing risk throughout the organization.

In Operational Leadership, the eight components of Effective Mission Analysis help employees identify those human factors in the workplace and provide tools for individuals and teams to use in assessing and mitigating risks. The primary intent is to examine the event details with consideration for the principles of operational leadership, to learn from the near misses as well as the successes.

Supervision: All positions on the burn were qualified and trainee's had appropriate mentors. Resources assigned were well within span of control measures. Although organization followed the burn plan, some questions remained from the organization after the operation in regards to their organization. (i.e. no specific holding boss was identified for the entire operation.)

Planning: An approved plan was completed and implemented. The plan itself was rushed for completion; being signed off by the Superintendent the day implementation took place. There was no formal mechanism (Agreement) put in place to reimburse USFS resources which were relied upon to support the prescribed burn.

Contingency Resources: Contingency resources were not specifically identified in the plan or the IAP; the language referencing them was vaguely written, rendering that portion of the plan as non-committal. During the review there was a general disconnect and misunderstanding as to what a contingency resource actually is.

Communication: On-site radio communication was established; however during operations the proximity to the Tower and topography prevented consistently good communications from one side of the burn to the other. Critical communications such as weather updates were only broadcast on local channels and at times were difficult to copy.

Team Selection: All personnel were qualified and experienced for their assigned prescribed fire positions. The organization for this prescribed burn was a highly qualified and competent group.

Team Fitness: Not all resources were familiar working together in a prescribed fire environment.

Environment: The prescribed fire was conducted at the high end of the prescription. The burn organization did not anticipate the ember showers associated with lighting fuel jackpots on the down slope side and letting fire carry into them. The time allotted to preparation of this unit was minimally adequate.

Complexity: All aspects of complexity were not properly addressed; aesthetics were addressed in the burn plan complexity analysis however, neither tree mortality nor scorch height was addressed in the plans objectives or implementation plans. The Monument continues to receive negative feedback from the surrounding community as a result of the last time this unit was burned in 1997.

Positive Factors

- During the implementation of this project, there were no injuries reported.
- Devils Tower National Monument and the Northern Great Plains Fire Management group are to be commended for their overall planning process and use of fire as a resource management tool.
- The Northern Great Plains Fire Management staff did an excellent job in safely reconfiguring from a prescribed fire mop-up situation to a suppression operation when the prescribed burn was converted to a wildfire.
- Interagency collaboration amongst the Monuments neighbors to support each other for wildland and prescribed fire operations is outstanding.
- The organization made good use of trainee opportunities at all levels.
- All of the identified Resource Management objectives for the burn were met or exceeded.

References

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Prescribed Fire Complexity Rating System Guide. January 2004. 43 pages.

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Belle Fourche Prescribed Fire Plan

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