USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Sinking Creek Prescribed Fire-Huckleberry Knob Declared Wildfire Review

Southern Region

George Washington and Jefferson National Forests

Eastern Divide Ranger District

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Executive Summary

On April 23, 2024, the Eastern Divide Ranger District (EDRD) of the George Washington & Jefferson National Forests (GWJ) initiated a prescribed burn (RX) on Unit Two of the Sinking Creek RX Project. The goals of this first entry 737-acre unit included enhancement of wildlife habitat and vegetative diversity, promotion of oak and yellow pine regeneration, and hazardous fuels reduction in the understory, midstory, and overstory.

In Region 8 RX, exceptions to weather and environmental condition parameters are granted on a case-by-case basis in what is termed a variance. Parameters for relative humidity (RH) specify that RHs below 30% require variances from the Forest Supervisor, while those below 25% require regional-level approval. In this case, both Forest and regional-level variances for RH were obtained the morning of the burn due to the spot weather forecast's prediction of 22% RH.

As ignitions began that morning, fire effects were consistent with the plan's objectives. Relative humidity on the fire decreased rapidly, however, and by afternoon the fire began to spot outside of its containment lines. While firefighters chased these spots, ignitions continued in order to secure the edge of the unit. Three significant spot fires occurred between 1400 and 1520, the third of which escaped the project area, burned 139 acres of NFS land, crossed the Appalachian Trail, and burned 1/10 acre of private land.

At 2150 the entire burned acreage, including the project area, was declared a wildfire. The subsequent examination of the event by an Incident Meteorologist (IMET) from the National Weather Service (NWS) revealed that an anomalous weather event that would have been "extremely difficult to predict" had occurred on the unit, causing a precipitous drop in RH to a low of 11%. Despite this unpredicted weather event, firefighters were able to contain the fire with minimal impacts to private land and no injuries or equipment lost.

Lessons learned are categorized into four groups: Weather, Unmanned Aircraft System (UAS), Communication, and First Entry Burn. Chief takeaways from these lessons include:

- The foresight to provide sufficient staffing to handle contingencies on this first entry burn was essential in minimizing its escape.
- There is a need for more robust relationships with the National Weather Service (NWS) and stronger practices for onsite weather observations and spot weather forecasts.
- Better use of UAS infrared to monitor the escape could have been beneficial.
- The Eastern Divide Portable RAWS could have provided valuable information, but:
    - the National Weather Service was unaware of its existence.
    - firefighters could not access the portable RAWS data because the tone select was disabled on their new BK radios.

Introduction

On Tuesday, April 23, 2024, the EDRD conducted a prescribed fire on Unit Two of the Sinking Creek RX Project. That afternoon, an outlier weather event occurred, causing the RH to drop significantly below what was forecast for the day. Three spot fires ensued, two of which were contained in the adjacent burn unit to the north. The third and largest spot burned 139 acres of NFS land outside the unit boundaries, crossed over the Appalachian Trail, and burned 1/10 acre onto private land. A wildfire was declared at 2150 that evening.

According to FSM 5140, Forest Supervisors are responsible for conducting reviews of any prescribed fire converted to wildfire that does not result in significant damage or cost. The September of 2022 National RX Program Review provides updated guidance on this policy in near term consideration #2 (pg 19-20), requiring that "a declared wildfire review will be the standard approach whenever a prescribed fire has been declared a wildfire. The review will be delegated by the Regional Forester or the Chief."

The declared wildfire review team consisting of RX subject matter experts (SMEs) convened on April 28, 2024, to review the Sinking Creek burn plan and execution along with the burn participants' qualifications and experience. The team conducted interviews with those involved and reviewed supporting documents to develop a narrative that included events and the logic behind actions the participants took before, during, and immediately following the RX burn and subsequent escape/wildfire declaration. The review team also visited the burn site with EDRD personnel, including the

District Ranger/Agency Administrator (DR/AA) and the Burn Boss (RXB2). This review includes lessons learned from which others involved in prescribed burning and wildland fire may benefit.

National Setting

In January 2022, United States Secretary of Agriculture Tom Vilsack worked with Forest Service Chief Randy Moore and others to introduce a strategy called "Confronting the Wildfire Crisis: A Strategy for Protecting Communities and Improving Resilience in America's Forests." The Strategy has many aims; however, one key factor is fuels treatments on the forest landscape through the use of prescribed fire. Through this reinvigorated effort, the Forest Service anticipates increased fuels treatments in cooperation with partners and other federal agencies while using the best science and knowledge available.

In May of 2022, a series of large-scale prescribed fire escapes led to a 90-day pause in prescribed burning until the Chief's Prescribed Fire Program Review was released in September of 2022. This Review provides tactical approaches the Forest Service can use, while recognizing that risks cannot be fully removed from this land management activity. As a result of this Review and as a learning organization, the agency now performs a declared wildfire review whenever a prescribed fire has been converted to a wildfire.

Regional Setting

Over the past ten years, regional fuels' accomplishments have been on an upward trend. At the same time, the region has significantly increased the fire workforce. However, the vacancy rate is, on average, 30%. Regionally, aerial ignitions utilizing UAS have increased from 15,000 acres in 2020 to 134,000 acres in 2024. Year-to-date, the region has treated 1.2 million acres and responded to 297 fires for 38,361 acres. Over the past 2 years the region has been challenged with multiple coordination centers experiencing radio outages. Specifically, the forests in the southern Appalachians have had significant radio issues that led to a safety standdown on all RX projects for nearly two weeks in 2023. There have been several equipment failures that led to limited availability of engines and dozers. On March 28th, 2024, the Grindstone RX Fire on the Bankhead National Forest in Alabama was declared a wildfire (the 109B wildfire). The Declared Wildfire Review for the Grindstone RX/109B Wildfire has been completed and is currently under regional review.

Forest Setting

The George Washington and Jefferson National Forests include 8 Ranger Districts covering 34 counties in the mountains of Virginia, West Virginia, and Kentucky. The two forests cover nearly 1.8 million acres, representing one of the largest blocks of public land in the eastern United States. The forests are combined and supervised as one; however, each has its own land management plan. Fire management is divided into four zones: the North Zone includes the Lee and North River Ranger Districts, the Central Zone includes the Glenwood Pedler and James River Warm Springs Ranger Districts, the Eastern Divide Zone includes the Eastern Divide Ranger District, and the South Zone includes the Mount Rodgers NRA and the Clinch Ranger District.

In the past two years, the forest has lost over 150 years of combined fire experience. All four district/zone fire management officers (ZFMO) and the forest fire management officer (FFMO) retired or moved to other positions. Of the seven district rangers, four are new to the position, and three are working as RX Moderate Agency Administrator (RXA2) trainees. On April 22nd, the EDRD District Ranger, who is a fully qualified RXA2, started a detail as a staff officer, and on the same day a new detailed EDRD District Ranger started.

Forest resources support RX and wildfire (WF) operations in the southern half of the region typically between January and March. Historically Virginia does not come into a consistent window conducive to prescribed fire operations until late March or early April. Because of the late season window, it can be difficult to find resources, specifically engines, suppression/fuels modules, and unmanned aircraft systems (UAS) modules. As of April 23rd, the forest has conducted 24 prescribed burns for 19,000+ acres and responded to 25 fires for 21,687 acres this calendar year (over half the regional WF acres). Since Spring 2023, the EDRD had attempted to burn the Sinking Creek unit on two occasions before April 23rd. The Virginia Interagency Coordination Center (VICC) has dealt with multiple outages, resulting in roughly 10 days with limited or no radio communications between Charlottesville Dispatch and the field. This has led to increased use of cell and satellite phones and a widespread lack of confidence in the reliability of the radio system.

Project Area Location and Description

With 70 years of fire exclusion, forest structure and composition both have and continue to change. Oak-dominated forests are being replaced by more shade-tolerant species, such as white pine (*Pinus strobus*), red maple (*Acer rubrum*), and striped maple (*Acer pensylvanicum*). Table Mountain pine (*Pinus pungens*), pitch pine (*Pinus rigida*), and oak (all fire-adapted and/or fire-maintained species) are in decline over most of their natural range. In the continued absence of disturbance, shade-tolerant trees could become more dominant than fire adapted species, such as oaks and hickories, in future stand composition since most oaks in our area are intolerant to continuous shade and are unable to compete with shade tolerant species. Rhododendron (*Rhododendron maximum*), which should be located in moist north-facing drainages, is now encroaching onto upper, drier slopes. Research has shown that frequent fires are initially essential for ecological restoration in areas where fire has been excluded for long periods of time to develop woodland flora and reduce the shrub and tree cover in the mid and understory layers.

Eastern Divide Ranger District Description

The Eastern Divide Ranger district office is in Blacksburg, Virginia. The Ranger District covers approximately 405,000 acres of the George Washington and Jefferson National Forest and spans 12 counties in southwest Virginia and West Virginia. With a staff of 38 employees, the district has an active program to enhance wildlife habitat and reduce hazardous fuels through prescribed fire and timber management, as well as a recreation program managing nearly 400 miles of trails (including 150 miles of the Appalachian National Scenic Trail), 27 recreation sites including 8 campgrounds, 10 wilderness areas, and approximately 500 miles of roads.

Sinking Creek Prescribed Fire Project Description

The Sinking Creek RX Project is 1,946 acres, divided into two units: Unit One is 1,209 acres, and Unit Two is 737 acres. The burn plan allows each unit to be ignited individually or as a complete block, treating the entire project area.

The Sinking Creek project runs on the south aspect of the Sinking Creek Mountain Ridge. The general topography of the area consists of long, narrow ridges running from southeast to northwest with intermittent drainage features. The project is characterized by a mix of yellow pines and hardwoods in the overstory and mountain laurel, blueberry, and huckleberry in the understory. Pine species include pitch, Virginia, table mountain, and shortleaf pine. Deciduous hardwood species include scarlet, chestnut, white and black oak, red maple and pignut hickory. The north end of the burn area is the Appalachian Trail, which experiences moderate recreational use during the spring burn season.

Sinking Creek Prescribed Fire Objectives (Burn Plan Element 5)

The Sinking Creek RX units are described in detail within the Sinking Creek Burn Plan. Element 5 of the burn plan lists several objectives that cover both units. The prescribed fire objectives are identified as the following:

- Provide for 50 to 70% scorch mortality in above-ground tree and shrubby vegetation.
- Reduce leaf litter layer by 60 to 70%.
- Reduce forest floor fuels in the 10 and 100-hour fuel classes by 30 to 50%.
- Maintain prescribed fire application on a 3 to 10-year cycle.

Vegetation Description

The Jefferson National Forest (JNF) is located in the Blue Ridge, Central Ridge and Valley, and Cumberland Plateau physiographic provinces, and is a part of the Appalachian Hardwood Forest, located within the Eastern Deciduous Forest Province. There are over 60 tree species represented on the National Forest. Hardwood-dominated forest types comprise over 70 percent of the acreage. Primary forest community types across the JNF include Dry-Mesic Oak Forest, Dry and Dry-Mesic Oak-Pine Forest, and Dry and Xeric Oak Forest, Woodland, and Savannah.

These community types are even more dominant on the Eastern Divide Ranger District. The Mixed Mesophytic community type also occurs to an important degree across the district, with substantial components of upland hardwoods and eastern white pine. The Dry-Mesic Oak Forests and Dry and Xeric Oak Forests, Woodlands, and Savannas community types vary widely in their species composition due to their wide distribution, but the major species include chestnut oak (Quercus montana), northern red oak (Q. rubra), black oak (Q. velutina), white oak (Q. alba), and scarlet oak (Q. coccinea). The dry and dry-mesic oak-pine forests considered here are oak-dominated forests containing a significant pine component. Predominant pine species found in these Forests and across the District include white pine (Pinus strobus), shortleaf pine (P. echinata), Virginia pine (P. virginiana), and loblolly pine (P. taeda).

Prescribed Fire Prescription (Burn Plan Element 7)

The prescription can be found in this document in Appendix A #3: *An analysis of prescribed fire implementation for consistency with the prescription, actions, and procedures in the prescribed fire plan,* table #2, page 40.

Prescribed Fire Outcomes

Accounts during interviews stated that the fire behavior observed seemed appropriate to meet objectives. Determining if objectives are achieved is not measurable immediately after the burn is completed. The monitoring activity will take place in June and July after green up is completed.

Wildfire Declaration

A prescribed fire, or a portion, or segment of a prescribed fire, must be declared a wildfire by those identified in the plan with the authority to do so, when either or both of the following criteria are met:

- Prescription parameters are exceeded and holding, and contingency actions cannot secure the fire by the end of the next burning period, or,
- The fire has spread outside the project area or is likely to do so, and the associated contingency actions have failed or are likely to fail and the fire cannot be contained by the end of the next burning period.

A prescribed fire can be declared a wildfire for reasons other than those identified above if events cannot be mitigated as determined by the Burn Boss and Agency Administrator.

Official Forest Service Title	Prescribed Fire Title	Declared Wildfire Title	FFs
Forest Supervisor	Overhead	Overhead	1
GWJ Fire Management Officer	Overhead **FFMO**	Overhead **FFMO**	1
GWJ Assistant Fire Management Officer	Forest Fire Duty Officer **FDO**	Forest Duty Officer **FDO**	1
District Fire Management Officer	Burn Boss **RXB2**	**ICT4**	1
Zone Assistant Fire Management Officer	Zone Assistant Fire Management Officer **ZAFMO**	**ZAFMO**	1
Equipment operator	**Holding Boss/DZIA/UTV**	**DZIA**	1
Swamper	**DZIA**	**DZIA**	1
District Ranger (Detailed into Staff Officer)	Agency Administrator **RXA2/AA**	Agency Administrator **WFA3/AA**	1
Interagency Hotshot Crew Member	Firing Boss A **FIRB A**		1
District Resource Specialist	Firing Boss B **FIRB B**		1
District Module Assistant	Firing Boss C **FIRB C**		1
Fire Engine Operator	Firing Boss B Trainee **FIRB(T) B**		1
UAS Module lead	**UAS Pilot**		1
Engine (2 total)	**Engine**	**Engine**	6
District Militia	Firefighter Type 2 **FFT2**		3
Interagency Hotshot Crew	Hotshots **IHC**		20
TNC crew	**TNC**		5
BIA Module with ATV	**Mod**		5
JOB CORPS Module	**Mod**		8
District Firefighter	**UTV (WITH FIRING A)**		1

Figure 1. Sinking Creek RX and 109B Declared Wildfire participant titles.

Seasonal Prescribed Fire Planning

In late 2022, following the Chief's Review and as part of normal prescribed fire management activities, the Eastern Divide Ranger District prepared an off-zone review of the Sinking Creek Burn Plan. The Burn Plan was written by the zone AFMO (ZAFMO) after the 2022 USFS National Prescribed Fire Review and incorporated comments from the off-district technical review, completed by an off-zone FMO on December 8, 2022. The district conducted its annual leadership team project review and priority meeting in the Fall of 2023. The EDRD District Ranger, as the Agency Administrator for the burn plan review, signed the burn plan on March 15, 2023, and then once again on February 15, 2024.

Preparations for the prescribed fire season began late summer to early fall with the district's interdisciplinary team meeting to discuss upcoming fiscal year projects and priorities. Weather during the 2023-2024 fall season had been fairly typical except for some abnormally dry periods from late November to early January for the EDRD.

The zone FMO preferred to use local fire staff and auxiliary firefighters to conduct prescribed firing operations. The culture is to allow district specialists with fire knowledge to drive firing operations for resource benefit and alignment with land management goals. There were high hopes to get this first entry burn completed this year to start moving this landscape towards LRMP Management Area objectives.

Events Preceding the Week of the Huckleberry Knob Fire

It was recognized early on that this burn was complex; the DR/AA had worked closely with fire managers in the planning process and had recently met with the Forest Supervisor to discuss the project. Firefighters intended to burn only the southern 737-acre Unit Two of the project area.

The popular Appalachian Trail that bounds Unit One on the north was busy with "thru hikers" this time of year, adding an additional layer of complexity, even though they were not planning to burn Unit One at this time. Firefighters were entering the end of the seasonal spring burn window when they could effectively put fire on the ground. Said the RXB2 "it was the third time we were all lined up to do this burn." Last year they had all mobilized to initiate the burn, but the fire behavior was so intense when they lit the test fire that the burn was cancelled. Winds shut them down the second time.

Significantly, this would be a "first entry" burn—which means an area where the Forest had not previously introduced fire. These burns can be difficult to conduct due to fuel loading and increased smoke production, but they are a valuable first step in restoring fire's role in the fire-adapted ecosystem. "This is the one I wanted to show...that we can come into these large units and be successful without putting holes in the canopy...[and] that we can get good fire effects" noted the RXB2.

Coordinating the Plan

The Forest AFMO assumed the role of Forest Duty Officer (FDO) on April 23, 2024. He was familiar with the burn and the variance request process. He stated that "it wasn't anything out of the norm. We knew that we were going to be overstaffing them. We were making sure we had everything right for the burn." The zone AFMO (ZAFMO) similarly assumed the role of Zone Fire Duty Officer. Aware that there were often wildfires on the same day as prescribed fires, he had checked the available resources in the area and asked what could be released to the district in the event of a wildfire. "We'd been discussing this [Sinking Creek Project] for weeks, waiting to burn" he remarked. It was one of the easier units to hold, since it is mostly surrounded by roads. The RH, he noted, had been consistently lower than what was predicted in recent weeks. A week ago, on a nearby burn, the RH was predicted at 50 but dropped as low as 33.

A portable Remote Automatic Weather Station (Eastern Divide RAWS) was set up on the south boundary of the unit, east of drop point 20. A spot weather request was submitted, to be completed by 0500. The RXB2 informed the F-AFMO the prior evening that the burn would need a variance for relative humidity.

Prescribed Burning Operations and Wildfire Response

On the morning of Tuesday, April 23rd, the Blacksburg NWS delivered a spot weather forecast at 0318 to EDRD. Because the NWS did not know that the Eastern Divide Portable RAWS was in place, the spot was prepared using Craig Valley, the next closest RAWS. Before crews left for the field, the RXB2 and AA discussed the plan, concluding that they would move forward with the RH variance request. A regional variance was subsequently approved at 0845 with a lower limit of 22 RH.

Crews gathered at the Blacksburg work center and then traveled to the unit. A total of 49 firefighters were present, more than double the minimum staffing of 23 prescribed in the burn plan. They briefed and all Go/No-Go lists were completed near drop point 16, on the northeast corner of the unit, at 0936. Crews were informed that the weather for the day was going to be "borderline." At 0959 the test fire was successfully completed and ignitions continued. FIRB A set up with the other 20 members of the IHC and a UTV operator on the steep handline that forms the east boundary of Unit Two, starting at drop point 16. FIRB B, along with a FIRB B (T) and 2 UAS pilots, were located just off the mid-slope road that bisects Units One and Two of the project area. FIRB C also positioned on the north boundary of unit 2. The remaining firefighters were concentrated along the north boundary of Unit Two with FIRB C. Resources included 2 engines, 2 district FFT2s, a TNC 5-person crew, a BIA 8-person module with a UTV, a holding boss plus 1 district FFT2 (both DZIA qualified), and a Job Corps 5-person module.

Figure 2. Map of Firing A & C's progression on the unit.

The plan was to introduce low intensity backing fire so as not to scorch the old growth trees within the unit. As ignitions began, the FIRBs noted that fire behavior was accomplishing what they intended. FIRB C broke his resources into three groups along the road, traveling west from drop point 16 with crews leapfrogging each other in order to proceed efficiently. "We were getting really good backing fire" he said. Those who weren't lighting were assisting with holding. Noted FIRB C "If you don't have a drip torch in your hand, you're holding." The burning proceeded well. "We were getting 1-2 foot backing fire, exactly what we wanted," he explained. The holding boss positioned the Job Corps module and the district engine up front with the lead lighters since they were the units who were most familiar with the area.

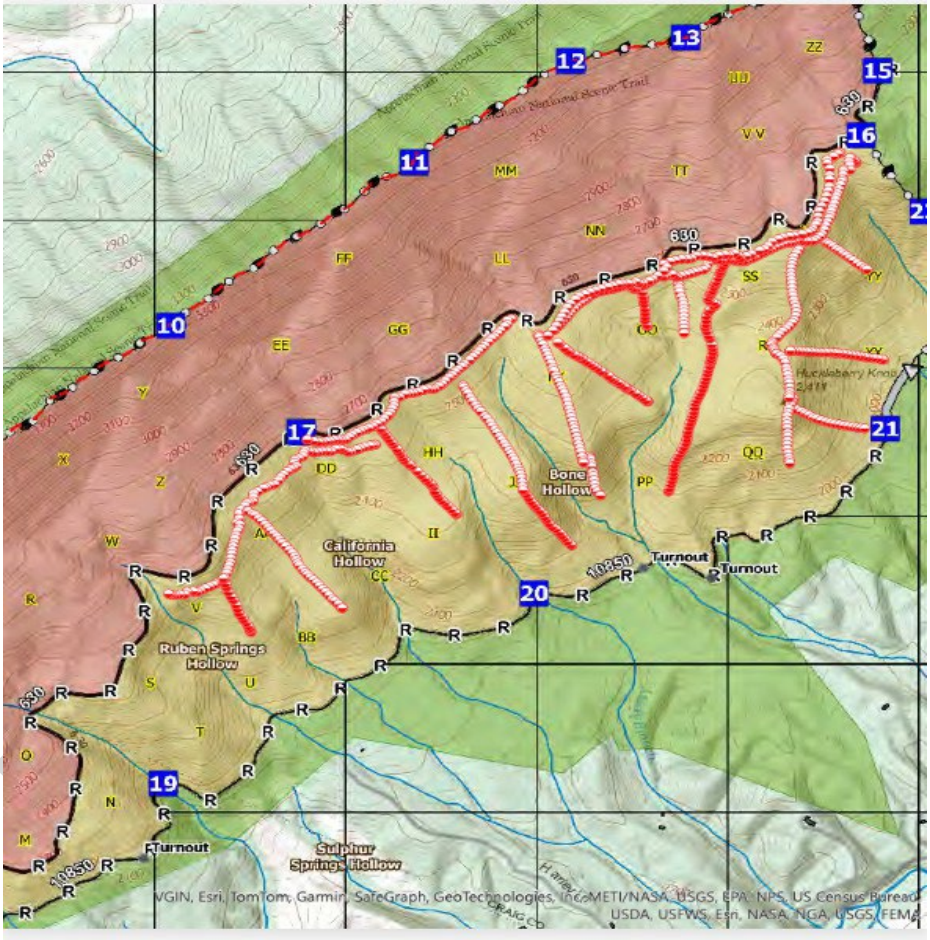


Figure 3. Map of Firing B (UAS) progression on the Unit.

The UAS group, including FIRB B and FIRB B (T), positioned just north of Bone Hollow in a pullout south of the road. Aerial ignition with the UAS began sometime between 1040 and 1057. "Our goal was to pull fire down some ridges and light out the road…I thought things were going good…any time [RH is] below 30%, we get spots. But we put them down" stated FIRB B. FIRB A and the rest of the IHC began blacklining downhill along the steep east side of the unit from drop point 16. Initial firing went as planned. As the crew worked, they stopped to let Firing B build depth on their lines with the UAS. They did not want fire to back down, cross the adjacent drainage, and create head fire that could scorch fuels and cause holding problems.

At 1200 Firing A reported to the RXB2 that they were getting frequent spots in the holding line duff. They didn't have any water, so they found themselves kicking out helmet-sized spots in the duff. A squad leader requested an engine to assist, but when the engine arrived it did not have enough hose to reach down the fireline where the duff was burning in the holding line. Extinguishing the spots without water became increasingly time-consuming and difficult.

At around 1300, communication issues on the radio began to emerge. First, there was an open mic that lasted for over ten minutes. The RXB2 traveled the line, checking each person until he found the culprit. He moved communications from the Region 8 Tactical Channel over to a different tactical channel during this time. As fire activity increased, traffic on the one channel became constant, with the noise of leaf blowers creating distracting background noise.

Spotting activity continued to increase on the east handline. At 1340 the Holding Boss sent the Job Corps module and the district engine over to provide additional support in this area. He noted that at this time he had lost the holding resources on his line who were most familiar with the area.

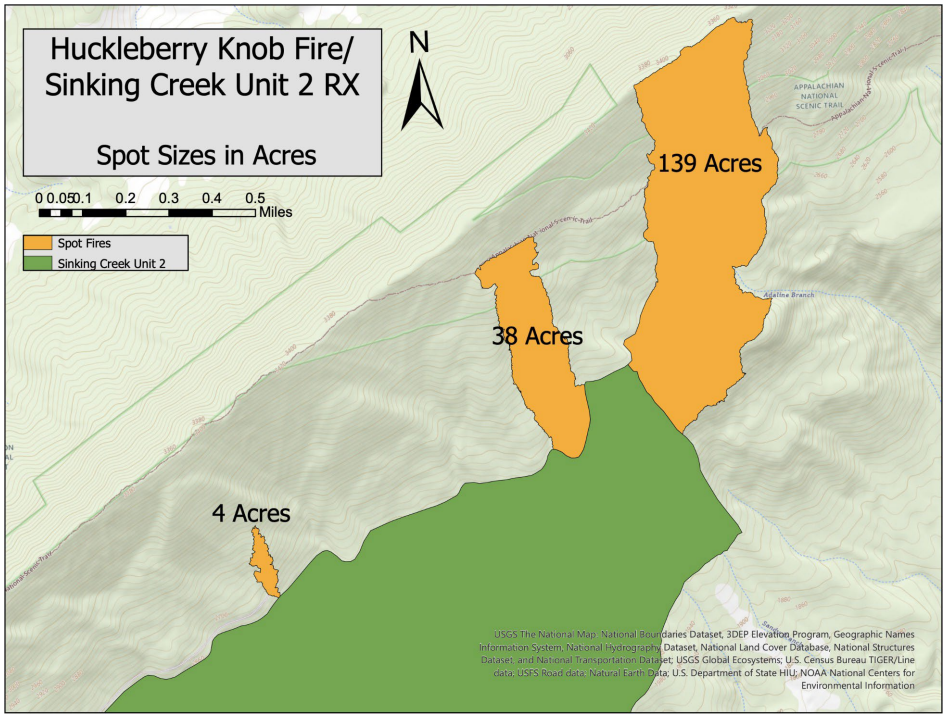


Figure 4. Map of spot fires on Sinking Creek RX. Spot Fire 1 was contained at 4 acres, Spot Fire 2 at 38 acres, and Spot Fire 3 at 139 acres.

At 1400, the first spot fire was detected just to the north of the fireline, about one mile to the southwest of drop point (DP) 16 (see Figure 4, above). Firefighters were able to fall a snag and make good progress on this first spot. Noted the UAS pilot, “after the initial spot, I started seeing dark smoke. I could definitely tell that fire activity was picking up.” The UAS lead continued to finish the lines he was pulling down from Huckleberry Knob. After this time, he set the drone down and awaited further direction.

At 1422, the RXB2 requested the contingency-identified Type 3 helicopter for bucket work and notified the FDO and the AA. That day the helibase manager (HEBM) was 30 minutes away on other business but remained in contact with the RXB2. The helibase at the Blacksburg airport was staffed with two fully qualified detailing helicopter managers (HMGB), a trainee helicopter manager (HMGB-T), and a helicopter crewmember (HECM). The RXB2 contacted the HEBM to request the helicopter and the HEBM directed his resources at the airport to “treat this as an IA” [initial attack]. While he was aware that there was a prescribed burn happening, he did not have maps for the unit to give to the responding resources. He requested electronic maps from the RXB2 but did not receive them the first time they were sent. At 1429, the helicopter got the "kneeboard" with the appropriate coordinates from dispatch.

At 1445 the RXB2 requested a dozer, type 6 engine, and a module to assist with the spot fire. A dozer, module, and type 3 IC were mobilized to respond. At 1452 the T3 helicopter launched from the airport in Blacksburg. It did not yet have the maps for the area, and by the time the HMGB was able to forward them, the crew on the helicopter had lost cell service. The RXB2 said he could “walk” the helicopter in. Notably, the UAS pilot did not receive notification that the helicopter was inbound, but had his own ADSB receiver and could see that it was coming. He established contact with the helicopter on an air-to-ground channel.

At 1500 the last hourly ground weather report for the day was read over the radio. The kestrel at the drone site read 15% RH at this time. The Eastern Divide Portable RAWS showed an RH of 17%.

The Type 3 helicopter was over the fire at approximately 1511. The pilot declined the dip site that was identified for him due to its proximity to homes. He circled the project area, which was increasingly obscured by smoke, and attempted to reach firefighters below before he departed the fire and set down in nearby Caldwell Fields at 1545.

In the meantime, the second and third spot fires were discovered at approximately 1520. Crews who had just finished suppressing the first spot responded to the second spot north of the north fireline about ¼ mile southwest of DP 16. The area was steep and heavily vegetated. Firefighters were on their hands and knees with blowers on their backs climbing under Mountain Laurel. Said the holding boss/DZIA, a highly experienced firefighter who has worked in this local area for three years, “we went from zero to 100…for me, [there was] no indication that this was coming.”

The DZIA attempted to employ the dozer, but it threw an error code and had to be taken out of service. Even in the best of circumstances, it's difficult to use dozers in this terrain. The DZIA noted that you have to pick out "spur ridges"-- areas that aren't quite as steep--but that in this terrain "you know you are going to get rocked out." Spot fire 2 was ultimately contained at 38 acres at 1953. The third spot fire proved to be harder to control.

Spot fire 3, which was detected at roughly the same time as Spot Fire 2, blew outside the north end of the east handline and burned uphill in steep, rugged, roadless terrain. As crews worked to contain it, a member of the IHC hiked up to the Appalachian Trail and cleared hikers on the western side of the trail. Another firefighter drove around to the east side of the trail to an access point and hiked in to clear hikers from the east side.

At 1613, the Eastern Divide RAWS showed an RH of 11%, its lowest reading of the day.

Having spoken with dispatch and the RXB2 about other possible dip sites, the type 3 helicopter was back up and over the fire at 1630. After some confusion reaching ground crews, the helicopter was able to do some bucket work on the second spot fire before returning to Caldwell Fields.

At 1713, the Eastern Divide RAWS showed an RH of 15%.

At 1723 the type 3 helicopter was up again and was able to dip from a private pond and returned to the fire but was unable to deliver the water due to smoke issues.

At 1733 the ZAFMO sent a request for a spot forecast to NWS Blacksburg. No observations were included, but remarks said, "please use nearest RAWS for current observations." Significantly, NWS Blacksburg still was unaware of the of the Eastern Divide Portable RAWS.

In the meantime, the AA and the FFMO were speaking to the RXB2 by cell and Starlink phone. They in turn discussed the situation with the Forest Supervisor, Assistant Director of R8 Fire and Aviation Management (FAM), and FDO. The concerns included: closing the Appalachian Trail and making notifications, private land at the top of the ridge that could be impacted, costs, resource availability, and the need to plan for additional operational periods.

At 1800 dispatch contacted the Type 1 helicopter stationed in Roanoke to check on its availability. At 1830 it was formally requested to respond. The ship was able to reposition to Blacksburg, but it was not available to fly the fire that night due to the impending sunset.

At 1832 the Craig Valley RAWS reported an RH of 10%, while the Eastern Divide Portable RAWS reported an RH of 24% (up 9% from the previous hour.) This is significant because later analysis showed that the Craig Valley RAWS was more closely aligned with the conditions on the upper elevations of the project area, where spot fire 3 was now burning.

Fire crossed the Appalachian Trail and burned across the Forest boundary onto private land at 1846. At this point, conflicting reports about the fire's behavior and incursion onto private land were reaching leadership. Much of the communication was taking place on phones, which allowed for different understandings of the situation.

At 1850 the ZAFMO called the Blacksburg NWS to report the discrepancy between the day's forecast and the actual RH. He also asked about the weather forecast for the next seven days. At 2100 there was an open conversation between the AA, FDO, FFMO, and field staff. There was a feeling that the fire would be caught that night, but ongoing concerns that additional resources would be needed for the next day and beyond. The process of declaring the fire was unclear from the line perspective. Said the AA, "when it came time to declare, I realized I didn't exactly know how to do it. I mean, I know we declare, but we had never really worked through the specific steps of a declaration. I remember asking how do we do it and the response I got was –'it's in the burn plan'---I remember thinking, I know that, but I never thought about the actual process and the conversations to do a declaration."

With the expectation that the area was going to be declared a wildfire, the FDO began to put together resources for the following day shift. At 2150, the RXB2 declared the Sinking Creek RX a Wildfire. Its name was changed to the Huckleberry Knob and the RXB2 transitioned from RXB2 to Incident Commander, Type 4 (ICT4). The Huckleberry Knob fire was declared contained on May 9, 2024, controlled on May 15, 2024, and out on June 3, 2024. In all, 181 acres burned outside of the planned Unit Two. 42 of those total acres were within the project area, in the adjacent Unit One. The majority of the additional 139 acres that burned outside of the project area were on NFS lands, with 1/10 acre burned on adjacent private property.

Lessons Learned

1) Weather and Fuels/Fire Environment

a. Weather

Having the Eastern Divide RAWS in place added the ability to receive accurate weather readings for the lower part of the prescribed fire. This review relies on critical weather readings from the Eastern Divide RAWS to analyze the weather event that led to the fire's escape. Other considerations for future burns include:

- Providing notification to the NWS office that a portable RAWS was in place near the RX Unit would have helped increase forecaster situational awareness before, during, and after the burn/escape.
- Including recent nearby weather observations or the name of a nearby RAWS to use for obtaining observations in the spot weather forecast requests could have given the NWS forecasters a better starting point for constructing the forecasts.
- Calling the NWS with a heads up about a spot forecast request or including more information in the remarks section of the request would have given the forecasters an opportunity to learn what times and weather parameters were most important to the burn operations.
- Sharing a map of the burn unit with the NWS would have been helpful to enhance the situational awareness of the forecasters issuing the spot weather forecasts.
- Remaining consistent with taking local weather observations each hour throughout the burn timeline and broadcasting those over the radio would have allowed ground forces to remain aware of the critically dry RH.
- Calling the NWS to request an updated spot forecast with ground truth observations as soon as possible after the forecast begins to differ substantially from those ground truth observations may have allowed a more accurate forecast through the afternoon to become available although the conditions observed were found to be extreme outlier/anomalous compared to climatology, recently observed weather, and weather model guidance.
- During peak fire season when prescribed fire is being considered on multiple Forest zones, in addition to wildfire, consider ordering an IMET to be detailed at the Supervisor's Office or VICC to provide fire weather support. This individual would provide the spot forecasts to meet the needs of the entire Forest in addition to working with the Forest FMO on Variance Requests and other assigned duties such as daily weather briefings, long-term planning, after action reviews, etc. This person would also act as the liaison between the Forest and the NWS field offices affected.
- In dry/sunny weather patterns, observed temperatures outpacing forecasted temperatures will likely result in lower relative humidity.
- When a burn unit varies more than 1000 feet in elevation change, an effort should be made to obtain weather observations from both a higher elevation and a lower elevation. This information would be very helpful for fire crew situational awareness and for aiding forecasters with the spot weather forecast.

b. Fuels/Fire Environment

- “Blow lines” on the Sinking Creek Rx, areas where fuels were cleared with leaf blowers, were thoroughly prepped multiple times prior to the burn. While not a likely contributing factor in the escape, holding

blow lines with duff accumulation under dry conditions and during spring green-up may require adjustment in holding tactics, consideration of hose lays, and increased patrols to mitigate fire creeping into and across them. Duff in blow lines under dry conditions and during spring green-up may dry rapidly due to longer day lengths, higher temperatures, and increased evapotranspiration of moisture out of the duff and soil. This rapid drying, which can be compounded by the increased exposure of duff related to prepping blow lines multiple times, may allow duff fires to become established, smolder, and creep across blow lines.

- Thresholds for NFDRS indices should be made clear in the burn plan and prescription. A number of NFDRS indices were at or above the 90th percentile when compared to the climatological average on the day of the burn (ERC, BI, 100-hr fuel moisture, and KBDI – see Appendix A. Analysis of seasonal severity, weather events, and on-site conditions), and all of the local trigger points listed in Element 16 of the burn plan were met or exceeded (Appendix A. Figure 18. GWJeff Fire – Local Trigger Points). However, it was unclear from both the burn plan and IAP that NFDRS indices and thresholds were considered in deciding whether the burn was within prescription, making the go/no go decision, and implementing strategy and tactics (See Appendix A. Table 2. Burn plan prescription, inputs, and source used for implementation of the Grindstone RX)
- The Fine Dead Fuel Moisture tool in BehavePlus or the FDFM tables in PMS 437 Fire Behavior Field Reference Manual should be used to estimate 1-hr and 100-hr fuel moistures for input into BehavePlus fire behavior modeling runs instead of using 1-hr and 100-hr fuel moisture values taken from NFDRS observations and forecasts to ensure accurate fire behavior model outputs (flame length, rate of spread, probability of ignition) (See Appendix A. Fuel Moistures and Fire Behavior Modeling).
- Maximum or full range of slope steepness values should be used in BehavePlus CONTAIN model runs to predict accurate line production rates and to aid in determining holding and contingency resources requirements and planning (See Appendix A. Table 1)

2) UAS

The use of UAS resources has been invaluable. The rapid orientation that this review team gained by watching real time firing pattern progressions from the UAS was unprecedented. Other benefits of having a UAS on this fire included:

• Using the UAS as an aerial ignition platform allowed firing operations to be conducted with intentional sphere placement and appropriate timing.

• Risk Reduction: not having to put people interior to light is safer and provides more resources for holding.

• Using both the visual and infrared capabilities of the Alta X platform provided a source for detection and quick size up of fire outside of containment lines. This supported good decision making by providing real time situational awareness for the Burn Boss and could be shared with the off-site AA.

• The data captured by the UAS provided a source to outline the timeline of events associated with the prescribed burn.

Some areas of improvement in UAS operations were noted in the review of the Sinking Creek RX related to the following topics:

- Policy

  UAS operations at night are common practice on large fires. These large fires are often covered by a temporary flight restriction (TFR) set up by the incident, and access to the airspace is prohibited without approval from the controlling authority. This provides for a safe working environment for the UAS and other manned aircraft. While not covered by a TFR, agency UAS operations are most commonly performed under the Federal Aviation Administration (FAA) regulations defined in 14 CFR Part 107 or under a Certificate of Authorization (COA) from the FAA which includes special provisions for flying beyond visual line of sight. A mission aviation safety plan (MASP) is a required agency policy document that must be completed and approved yearly for UAS operations on prescribed fire. The MASP outlines the type of mission the UAS will be performing, risks associated with performing the mission, and mitigations for those risks. At a minimum, a prescribed fire MASP must be approved by a qualified UAS Pilot, Forest Level fire personnel, Forest Aviation Officer, Regional Aviation Safety Manager, Regional Aviation Officer, and Forest Level Line Officer.

  Although covered under Part 107, the risks and mitigations associated with night operations are not addressed in the current MASP for the GWJ and therefore UAS night operations are prohibited for RX fire. Having a MASP that covered UAS night operations would have given managers the option of overflying the escaped fire after dark in order to gain critical situational awareness.

- Airspace Deconfliction

  "Please advise any aircraft ordered or enroute to the incident" is a phrase used in UAS standard operating procedures. This phrase is used when communicating with a dispatch center to ensure airspace deconfliction at the beginning of any UAS incident operation. The UAS pilot in this case did not receive notification from dispatch that the helicopter was incoming. Ensuring this communication occurs is critical for the safety of manned aircraft and ground resources.

3) Communications

Access to the Starlink system provided strong backup communication capability, although the convenience of communicating via phone can compromise information sharing and the overall situational awareness that radio broadcasts provide. Communication gaps are almost always a consideration in the review of unintended outcomes. That said, the following items merit further examination in the future:

- Fire size up information broadcast over the radio as opposed to phone would have provided a single chain-of-command report of the fire escape. Reliance on phone calls and texts is disrupting the definitive messaging that radio broadcasts provide.
- Handheld radios that are programmed with the capability to access local RAWS would have given firefighters more accurate information about changing weather conditions.
- A clear set of standard operating procedures (SOPs) for wildfire declaration would have streamlined operations for leadership. Consolidating this policy, publishing it in one place, and keeping it updated would help.
- There is outdated and conflicting information in the Forest 5140 that conflicts with regional and national directives.

4) First Entry Burn

This was the first entry for this block. With no fire history, the fuels are at the farthest departure from the desired condition for the project. There is no history from previous burns describing challenges or lessons learned and no local knowledge or experience on challenges from past entries.

Given the challenge of the first entry and the predicted RH of 22%, the RXB2 decided to double the number of resources specified in the burn plan. This proactive measure proved instrumental when the RH unexpectedly dropped to 12%, effectively allowing the resources to contain the slopover in the same operational period. The RXB2 stated that the resources engaged in suppressing the slopovers made a tremendous effort to contain them.

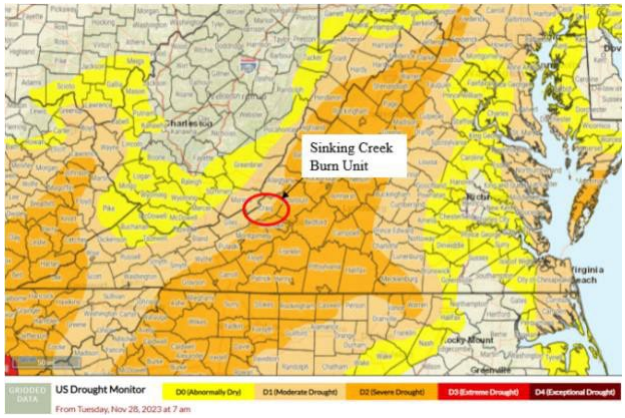
Conclusion

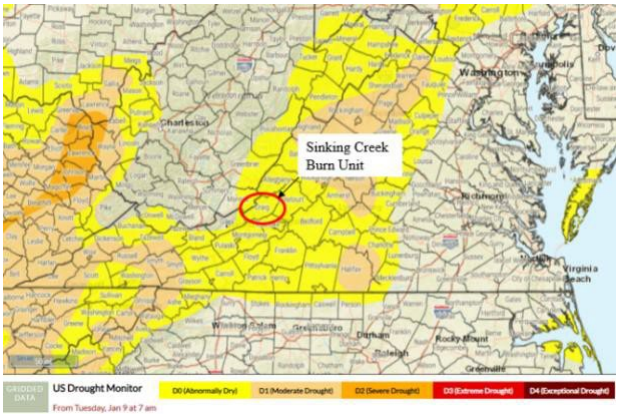
Prescribed fire is an essential tool for ecological and fuels management. Its use is subject to many different variables that are difficult to predict precisely. The precipitous drop in relative humidity experienced on the Sinking Creek RX is one such example. The escape occurred without injury or significant property damage and its prompt containment was due in large part to the competent planning and response of fire managers and their personnel. Improvements to coordination with the NWS, UAS operations, and communications as outlined in this review can assist future prescribed fire operations.

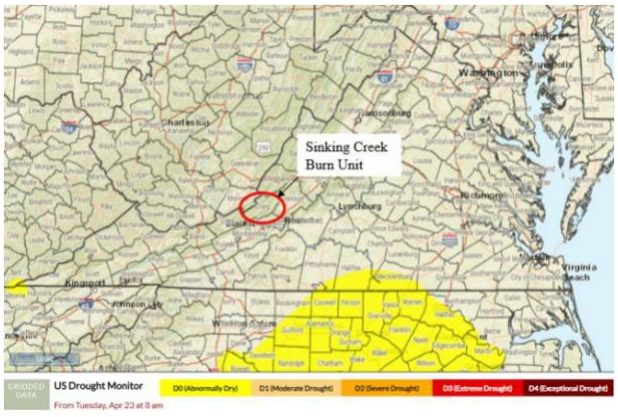
Appendices

Appendix A: Analyses and Assessments

#1: Analysis of seasonal severity, weather events, and on-site conditions







Figures 5 (Nov 28th), 6 (Jan 9th), 7 (Apr 23), from top to bottom. Seasonal drought conditions in the Sinking Creek RX area based on the US Drought Monitor.

The EDRD experienced severe drought in Fall 2023, but frequent precipitation events in Winter 2023/2024 improved drought conditions by January, and by April alleviated drought conditions for all of Virginia (Figures 5-7). By the time of ignitions on the Sinking Creek prescribed fire, the EDRD was no longer showing any drought conditions according to the U.S. Drought Monitor. A spring wildfire risk assessment was published for the Southern Area on March 11, 2024. This assessment projected normal to below normal wildland fire risk across the Southern Area, primarily due to a forecast for continued precipitation events through at least April 2024. On March 20, 2024, there was a wildfire outbreak on the Lee Ranger District of the GW-Jefferson NF compounded by a wind event that produced wind gusts in excess of 50+ mph, and which triggered mobilization of the Gold and Red IMTs to Virginia.

During the 30 days prior the burn, rainfall totals were between 80-120% of normal at the burn site (Figure 8).

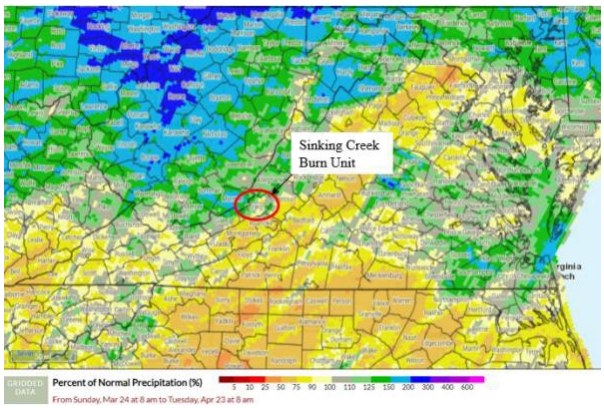


Figure 8. Departure (%) from historic average (normal) precipitation from Mar 24 – Apr 23 at the Sinking Creek Burn Unit

The Craig Valley RAWS was the closest RAWS to the burn site. It received 1.2 inches of rain 12 days before the burn and 0.10 inches 3 days before the burn (Figure 9). Craig Valley RAWS was used for the precipitation trend, since the portable RAWS was set up the day after the 1.2 inch precipitation event.

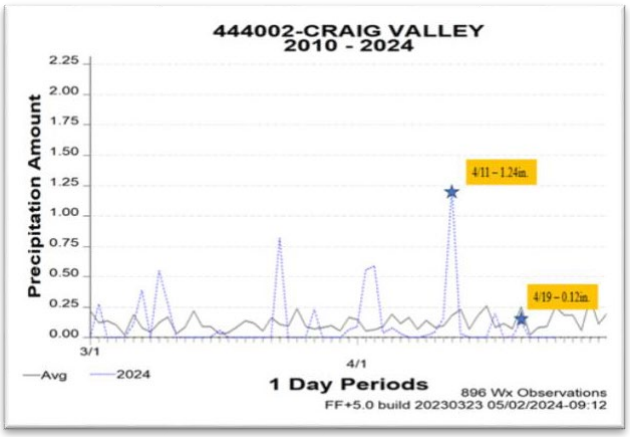


Figure 9. Description. Precipitation amounts at Craig Valley RAWS between Mar 1 and May 2, 2024. Stars indicate two recent precipitation events leading up to the Sinking Creek Rx burn.

The Energy Release Component (ERC) is a calculated output of the National Fire Danger Rating System (NFDRS). The ERC is a number related to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire. The ERC is considered a composite fuel moisture index as it reflects the contribution of fuels to potential fire intensity. The ERC has memory. Each daily calculation considers the past 7 days in calculating the new number. Daily variations of the ERC are relatively small as wind is not part of the calculation.

100-Hour Fuel Moisture (100-hr FM) represents the modeled moisture content in dead fuels in the 1-to-3-inch diameter class.

Burning Index (BI) - A measure of fire intensity. BI combines the Spread Component and Energy Release Component to relate to the contribution of fire behavior to the effort of containing a fire.

The Keetch-Byram drought index (KBDI) is a continuous reference scale for estimating the dryness of the soil and duff layers. The index increases for each day without rain (the amount of increase depends on the daily high temperature) and decreases when it rains. The scale ranges from 0 (no moisture deficit) to 800. The range of the index is determined by assuming that there is 8 inches of moisture in a saturated soil that is readily available to the vegetation.

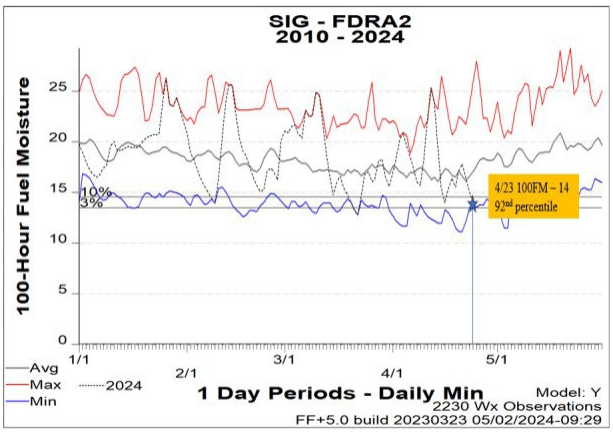


Figure 10. 100-hour fuel moisture. See below.

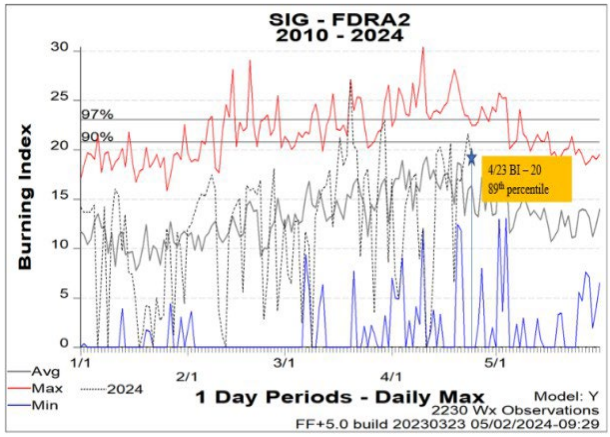


Figure 11. Burning index. See below.

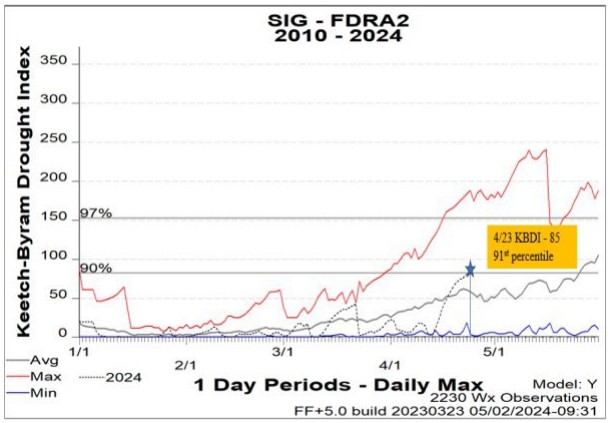


Figure 12.

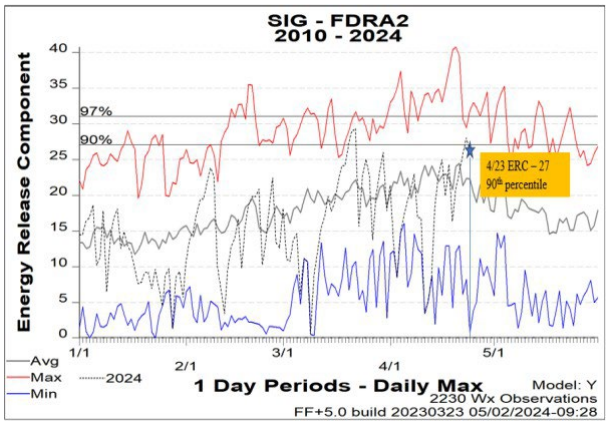


Figure 13.

Figures 10, 11, 12, 13 . Climatology graphs depicting daily average, maximum, and minimum trends in 100-hour fuel moisture (Figure 10, top left), Burning Index (Figure 11, top right), Keetch-Byram Drought Index (Figure 12, bottom left), and Energy Release Component (Figure 13, bottom right) from 2010 - 2024. Each graph also shows the trend for 2024, and the blue star illustrates the value for each of these indices on April 23rd.

The graphs above indicate conditions that were trending towards the 90th percentile for all indices in the week leading up to the Sinking Creek RX burn. This means for all weather observations analyzed from January 1 – May 31 in the referenced years, only 10% of observations exceed this value. Conditions on the day of the burn fell within one or two percentiles of the 90th percentile. Values around this percentile, although high, may facilitate the desired conditions for implementing prescribed burns depending on prescribed fire objectives.

Additionally, comments were made about the area having an earlier than usual green-up that could have potentially contributed to more rapid drying of the fuel bed. The Growing Season Index is a simple metric of plant physiological limits to photosynthesis. It is highly correlated to the seasonal changes in both the amount and activity of plant canopies. It predicts the green-up and senescence of live fuels and the influence of water stress events on vegetation. Increasing values of GSI indicate periods of improving conditions for live fuels and decreasing values indicate periods of detrimental weather conditions. GSI is calculated as a function of the three indicators of important weather factors that regulate plant

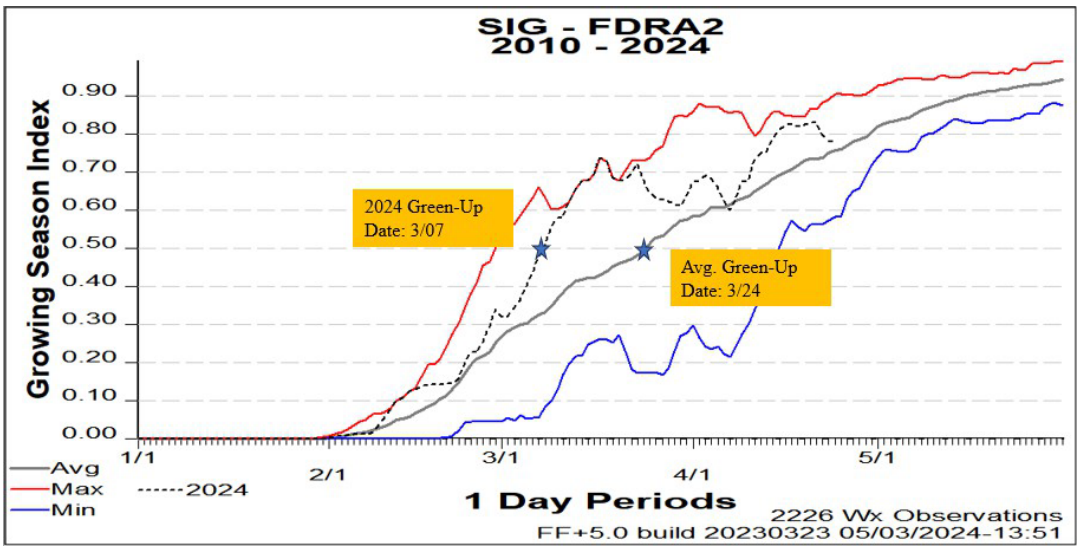


Figure 14. Climatology graph of Growing Season Index (GSI) for Fire Danger Rating Area 2 from the Virginia Fire Danger Operating Plan depicting maximum, minimum, and average GSI trends for Jan 1 – May 31st based on RAWS data from 2010-2024. The dashed line is the GSI trend line for 2024. GSI > 0.5 indicates green-up, so it appears green-up was approximately 17 days early in 2024.

functions. These indicators are combined into a single indicator that integrates the limiting effects of temperature, water and light deficiencies. Figure 14 below indicates that green-up started to occur as much as two weeks earlier than the time period average.

GW-Jefferson Fire Business Calculator

The Forest uses a combination of ERC and BI to determine their Fire Danger Adjective and Staffing Level for Fire Danger Rating Area (FDRA) 2 as described in the current Virginia FDOP. The results of the calculations are then distributed by the Virginia Interagency Dispatch Center to personnel on the GW-Jeff every morning and afternoon. The following figures follow those indices from the afternoon before the burn through the afternoon after the burn (Figures 15-17).

Date/Time:	VICC FDOP Fire Business Calculator - Today's Observations			
04/22/2024 15:41	FDRA1: Clinch	FDRA2: CZ/ED	FDRA3: NRA	FDRA4: North
ERC	22.1	24.7	23.3	26.5
100-hr	17.0	16.5	17.0	16.0
BI	18.0	18.6	17.8	22.8
1000-hr	19.1	18.1	18.8	17.4
KBDI	93	83	74	85
14+ Days Since Rain	No	No	No	No
Significant Activity	No	No	No	No
Fire Danger	Moderate	Moderate	High	High
Staffing Level	Staffing Level 2	Staffing Level 2	Staffing Level 3	Staffing Level 3
Planning Level	PL 1	PL 1	PL 2	PL 2

Figure 15. VICC Fire Business Calculator for afternoon observations on April 22, 2023.

Date/Time:	VICC FDOP Fire Business Calculator - AM Forecast			
04/23/2024 7:37	FDRA1: Clinch	FDRA2: CZ/ED	FDRA3: NRA	FDRA4: North
ERC	23.1	25.8	24.5	26.8
100-hr	15.9	15.3	15.7	15.0
BI	21.3	19.7	20.5	22.2
1000-hr	18.6	17.9	18.4	17.3
KBDI	93	83	74	85
14+ Days Since Rain	No	No	No	No
Significant Activity	No	No	No	No
Fire Danger	High	High	High	High
Staffing Level	Staffing Level 3	Staffing Level 3	Staffing Level 3	Staffing Level 3
Planning Level	PL 2	PL 2	PL 2	PL 2

Figure 16. VICC Fire Business Calculator for AM forecast on April 23, 2024 .

Date/Time:	VICC FDOP Fire Business Calculator - Today's Observations			
04/23/2024 15:50	FDRA1: Clinch	FDRA2: CZ/ED	FDRA3: NRA	FDRA4: North
ERC	24.1	26.9	25.7	28.5
100-hr	16.0	15.4	15.7	15.1
BI	21.0	20.8	21.7	24.6
1000-hr	18.6	17.9	18.4	17.3
KBDI	97	88	78	90
14+ Days Since Rain	No	No	No	No
Significant Activity	Yes	Yes	Yes	Yes
Fire Danger	High	High	High	High
Staffing Level	Staffing Level 3	Staffing Level 3	Staffing Level 3	Staffing Level 3
Planning Level	PL 3	PL 3	PL 3	PL 3

Figure 17. VICC Fire Business Calculator for afternoon observations on April 23, 2024.

The GW-Jefferson National Forests reference local trigger points when addressing the "Critical Weather Step Up Plan" in Element 16 of the Sinking Creek RX Plan. While the actions required by these triggers were addressed, it is worth noting that all of the trigger points listed were met or exceeded as shown in Figure 18. These forecasted values were pulled from the VA-VICC Fire Business calculator forecasted for April 23, 2024. The Sinking Creek spot weather forecast and on-site observations were used as well.

GWJEFF Fire : Local Trigger Points													
Season	Date	RH		FM10		FM100		Temp		ERC		BI	
		Trigger Point	Forecasted	Trigger Point	Observed	Trigger Point	Forecasted	Trigger Point	Forecasted	Trigger Point	Forecasted	Trigger Point	Forecasted
Spring	2/15 – 5/1	<30%	22%	<10%	10%	<15%	15.3%	>60	70	>20	25.9	>16	19.7

Figure18. GWJ Local Trigger Points for "Critical Weather Step up Plan."

Weather Events

Weather Forecasts and Warnings

Weather forecasts and warnings for the area of the Eastern Divide Ranger District are provided by the National Weather Service Weather Forecast Office in Blacksburg, Virginia on the south side of the Virginia Tech Montgomery Executive Airport, located less than two miles from the Ranger Office. NWS Blacksburg has forecast and warning responsibility for 40 counties across parts of southeast West Virginia, southwest Virginia, and northwest North Carolina. Spot forecasts for prescribed burns are also available at any time for federal and state agencies.

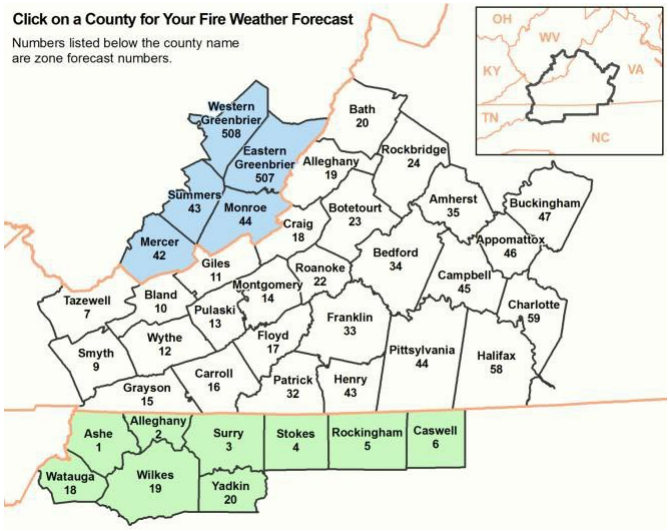


Figure 19. NWS Fire Weather Forecast by County Map.

Eastern Divide Portable Remote Automated Weather Station (RAWS TT386)

RAWS TT386 was set up on the south side of Forest Service Rd 19850 on the southern edge of Sinking Creek Unit 2 near Drop Point 20 (Figure 20 below) at an elevation of 2000 feet and began recording weather on April 12, 2024. Since the site has such a short record of weather, a climatology for the burn area was built using FireFamily Plus from the Craig Valley RAWS (CGVV2) located about 15 miles to the northeast at an elevation of 2702 feet, which is a similar elevation to the northern edge of Sinking Creek Unit 2. The normal high temperature for April 23 during the period 2010-2024 is 67, normal low temperature is 44, and normal minimum relative humidity is 35%. The average wind speed is 3.1 mph and the average gust is 9.7 mph.

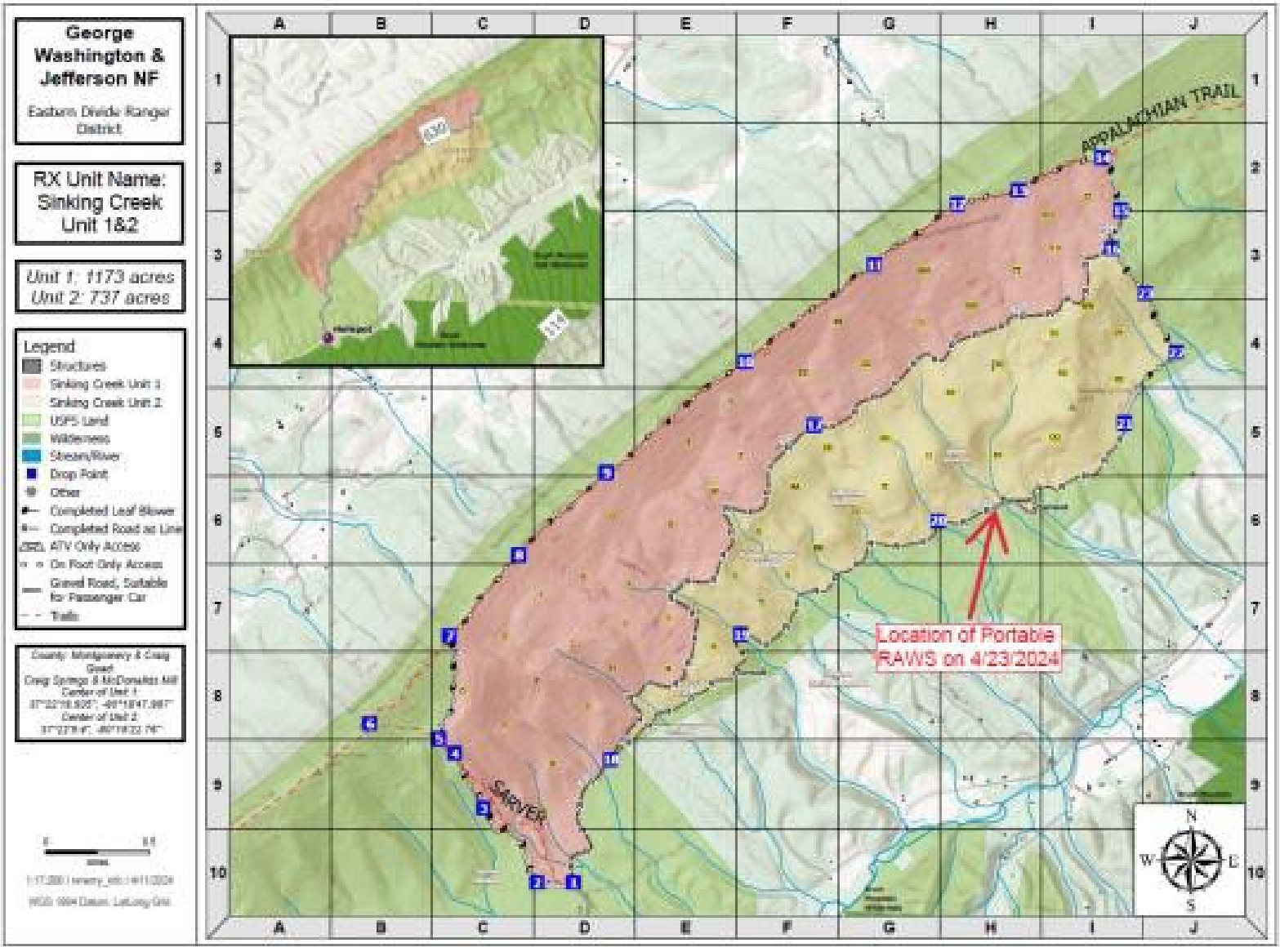


Figure 20. Map of the Eastern Divide Portable RAWS TT386 location on the Sinking Creek RX.

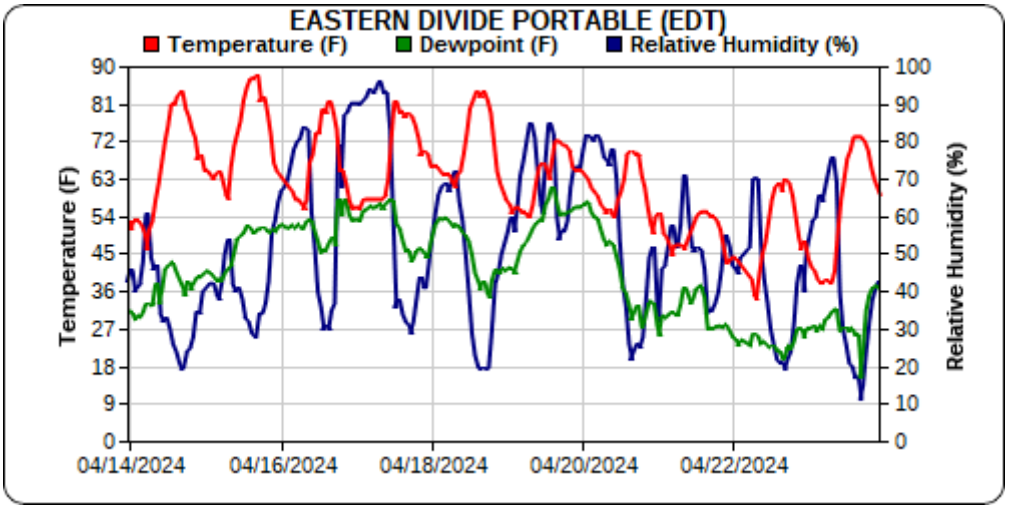
Figure 21. Photograph of the Eastern Divide Portable RAWS TT386 on the Sinking Creek RX.

Interviews with the National Weather Service staff indicated that no notification was made to the office that RAWS TT386 was set up and reporting to NIFC. Since this site is portable and can be put up or taken down anytime, it is not part of the regular ingest of RAWS data on the office Advanced Weather Interactive Processing System (AWIPS), but forecasts could have accessed the data via the MesoWest website. It is recommended that USFS notify the local NWS office anytime a portable RAWS is set up to include recent weather observations and the name of the station in spot forecast requests.

Weather Preceding the Huckleberry Knob Fire

The weather the week leading up to the burn featured above normal temperatures and dry conditions from April 14 to April 18 with high temperatures in the 80s and minimum relative humidity dipping into the 20-30% range. During this time only 0.01 inches of rainfall was measured at RAWS TT386 on April 16 from showers and nearby thunderstorms along a passing warm front. On April 19, a cold front brought

some rain showers which measured 0.03 inches, followed by a transition back to near to below normal temperatures with daily high temperatures mainly reaching into the 60s and 70s except mid 50s on April 21. The day before the burn was a dry day with relative humidity bottoming out at 19%, the lowest since RAWS TT386 was set up, with a high temperature of 63. There were no periods of significant winds although some afternoons saw wind gusts reaching into the 10-20 mph range.



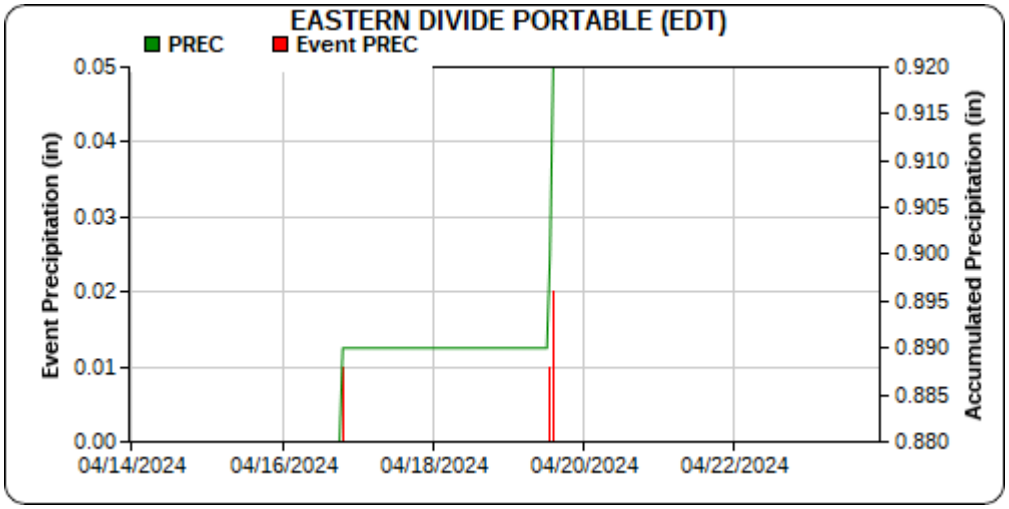


Figure 22 (top) is a graphical display of temperature, dewpoint, and relative humidity for the Eastern Divide Portable RAWS TT386 from April 14 through April 23, 2024, from https://mesowest.utah.edu/ and Figure 23 (bottom) is a graphical display of event precipitation and accumulated calendar year precipitation for the same period also from https://mesowest.utah.edu/

Weather on the day of the Huckleberry Knob Fire

High pressure was in place over the fire area on the day of the Sinking Creek Unit 2 prescribed burn and Huckleberry Knob Fire. This promoted dry and warm weather. Minimum relative humidity was forecast to range from 20 to 30% with some improvement late afternoon into the night as southwest winds between 5 and 15 mph brought in increased moisture.

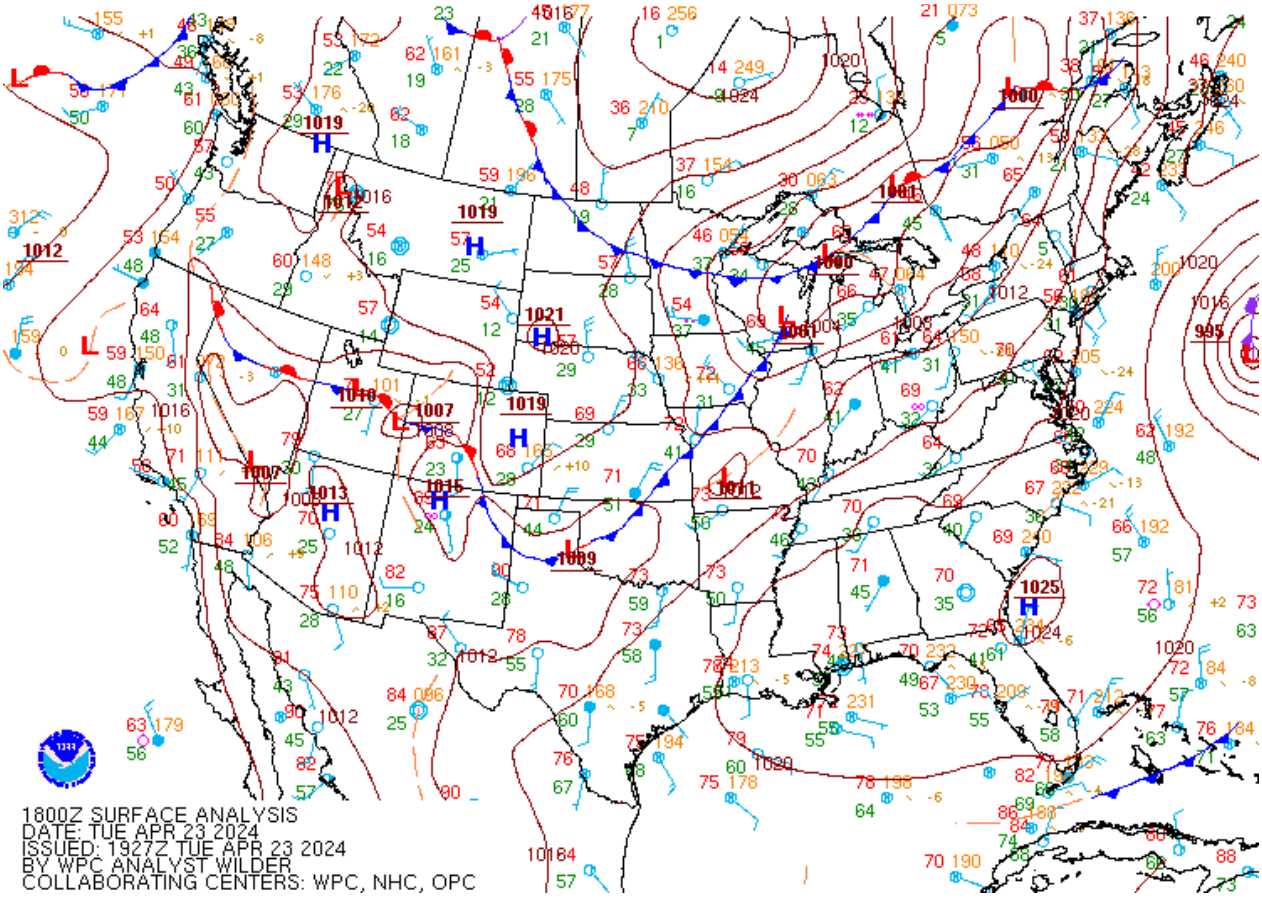


Figure24. Surface weather map analysis at 1400 on April 23 completed by the NWS Weather Prediction Center.

Surface Weather Observations

Hourly weather observations reported on RAWS TT386 the morning of the burn indicated good morning relative humidity recovery with a maximum humidity of 76% at 0713. In comparison, poor humidity recovery was observed on the Craig Valley RAWS (CGVV2). Hourly weather observations from this permanent station indicated a value no higher than 45% the morning before the burn. This station is 700 feet higher in elevation than TT386 and is a better representation of the observed relative humidity for the mid-upper slopes of the Sinking Creek Unit where the fire escaped containment. TT386 is located within the valley and is subject to influence from Craig Creek. The good humidity recovery observed on TT386 only influenced the lower part of the burn unit. Due to these noted differences in humidity recovery, when a burn unit varies by more than 1000 feet in elevation change, an effort should be made to obtain weather observations from a higher elevation and a lower elevation. This information would be very helpful for fire crew situational awareness and aiding forecasters making the spot forecast. A morning inversion broke around 0900 with steady, and in some periods, sharp drops in humidity through the mid to late morning and into the afternoon. The largest drop was between 0800 and 0900 when the relative humidity fell 29% as mixing began under southerly winds. The relative humidity bottomed out at an incredible 11% for a single hour at 1613 with a high temperature of 73F. This minimum relative humidity was the lowest since RAWS TT386 was set up and 8% lower than the day before. From 1700 into the evening, temperature steadily slid into the upper 50s while relative humidity rose to the low 40% range. In comparison, the Craig Valley RAWS also reported a very low relative humidity, bottoming out at 10% for a single hour at 1832, so the extremely low humidity was not a local effect or single observation.

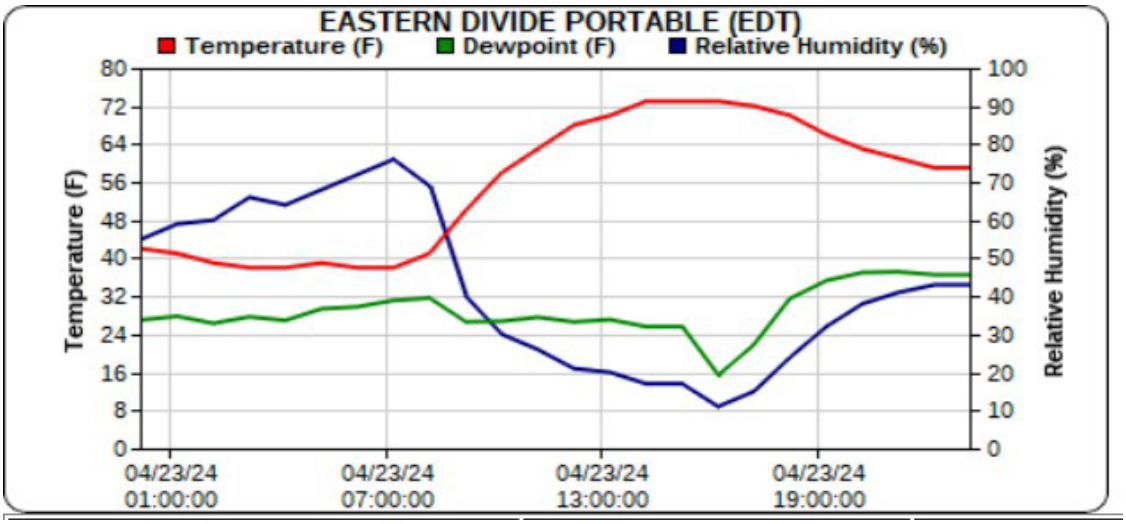


Figure 25. This a graphical display of hourly temperature, dewpoint, and relative humidity for the Eastern Divide Portable RAWS TT386 for April 23, 2024 from https://mesowest.utah.edu/

Upper Air Observation

The National Weather Service office in Blacksburg, Virginia is one of 92 stations across North America and the Pacific Islands that releases twice-daily weather balloons with attached radiosondes which collect upper-air weather data that are essential for weather forecasts. On the day of the burn, a weather balloon was released from the Blacksburg office, approximately 14 miles southwest of the burn area, at 0724. While it takes approximately two hours to complete, the most notable information gleaned from this with respect to fire weather is a region of very dry air in the lower atmosphere above the inversion. The surface air temperature that morning was 36, with the surface dewpoint of 34 resulting in relative humidity in Blacksburg of 92%. A good measure of the amount of moisture or lack thereof is precipitable water, which is the depth of water in a column of the atmosphere. This was measured at 0.24 inches, which was drier than 90% of the climatology for the day dating back to 1996. The mean precipitable water for the date is 0.53 inches. The region of the driest air was sampled between 1000-19000 feet AGL and is a source for dry air to mix down to the surface into the afternoon.

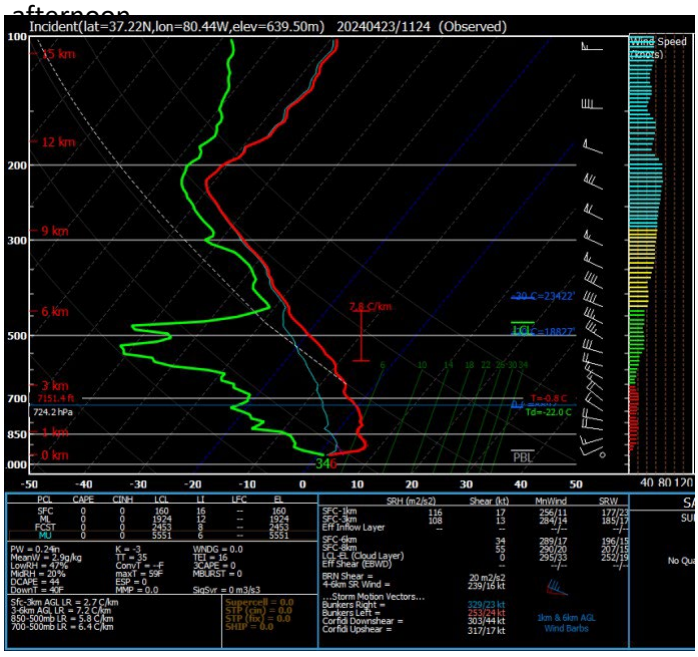


Figure 26 (left). This is a Skew-T Log-P diagram showing the observed temperature, dewpoint, wind speed, and wind direction from the surface through the entire atmosphere collected from the 0724 April 23, 2024 release of the weather balloon from the NWS Blacksburg office. A temperature inversion can be observed just above the surface with a large area of very dry air above this temperature inversion. This approximately represents the state of the atmosphere over the Sinking Creek RX. The software used to display this data is called SHARPpy.

The warmer the air temperature can get, the deeper the atmosphere can mix into the dry air. In order for the relative humidity to reach 22%, the temperature would have to rise to 69 and the dewpoint would have to fall to 28. With those temperatures, the atmosphere would mix up to around 7000ft AGL per modifying the output data.

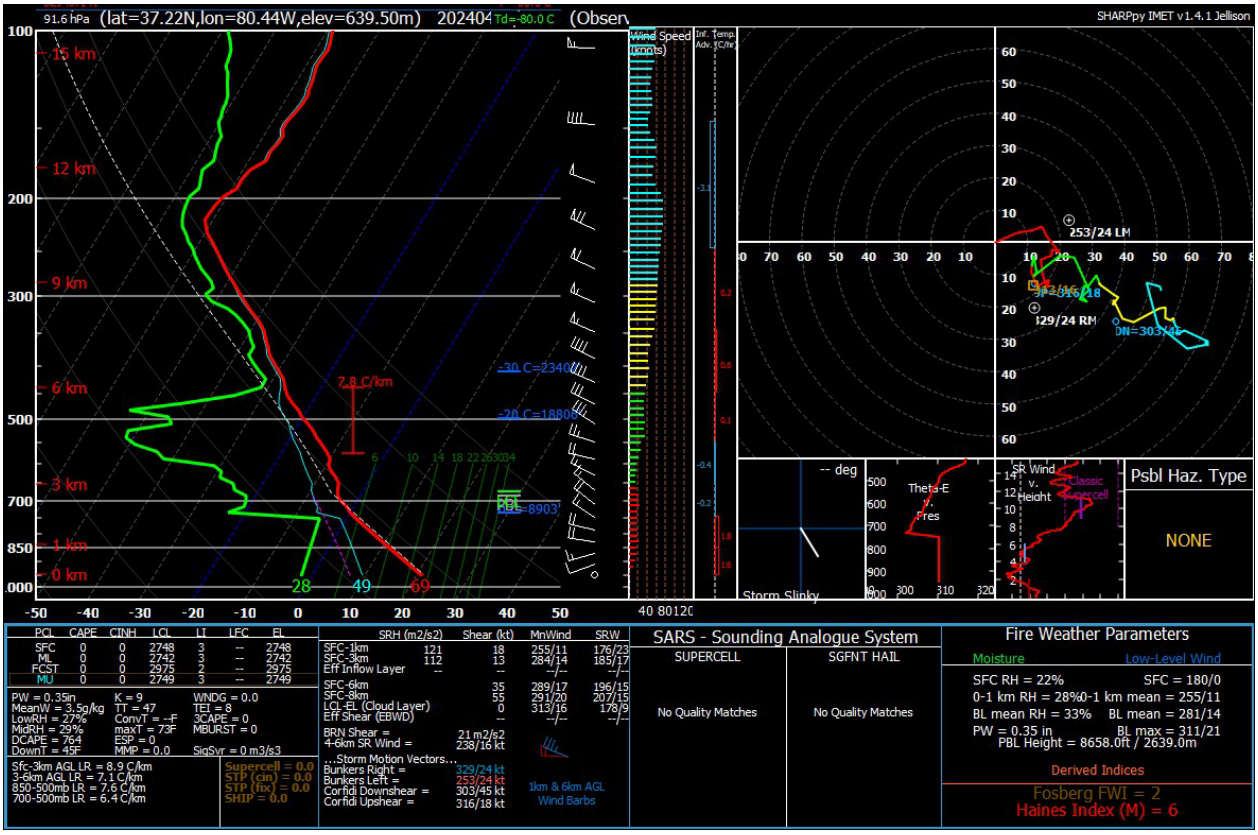


Figure 27. Using the SHARPpy software, the data can be modified by entering a forecasted temperature and dewpoint from the spot forecast for 1600 on April 23, 2024, to show a representation of what the atmosphere might look like during the afternoon with heating and mixing. This shows the atmosphere would be able to mix up to 7000ft AGL and tap into the region of dry air aloft resulting in drier air reaching the surface during the afternoon.

Warming the surface temperature to 73 with the dewpoint slipping back to 15, such as RAWS TT386 observed, yields a surface relative humidity of 11%.

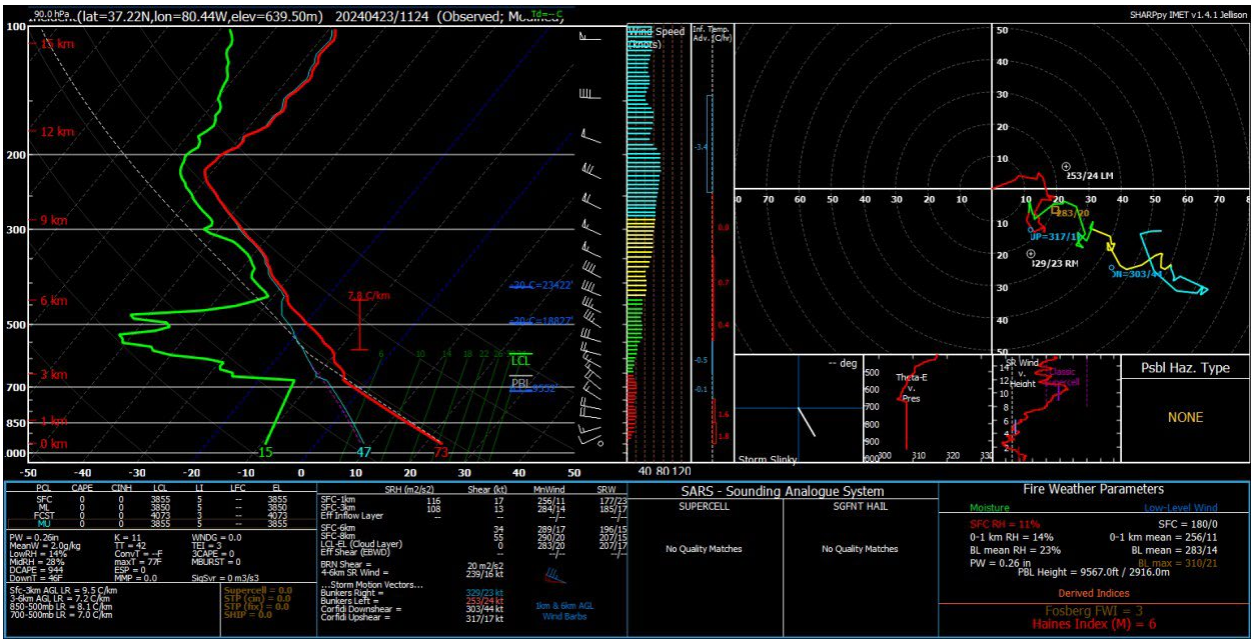


Figure 28. Event post-analysis using the SHARPpy software, the data was modified by entering the observed temperature and dewpoint recorded by RAWS TT386 at 1600 on April 23, 2024, which was not known by forecasters at the time the forecast was issued. This shows the atmosphere was actually able to mix even higher than 7000ft AGL, tapping deeper into the region of dry air aloft and resulting in even drier air reaching the surface during the afternoon, which likely contributed to the extremely low dewpoint and associated relative humidity. The temperature exceeded the forecast, further contributing to this deeper mixing.

So, one of the big questions to the forecast puzzle was how warm the surface temperatures would get on burn day and how deep will the atmosphere mix?

Four Spot Weather Forecasts

A planning spot forecast was requested from NWS Blacksburg at 0703 on April 22 for Sinking Creek Unit 2 with the forecast starting at 0800 on April 22. The request did not include recent observations, nor did it include any remarks. NWS Blacksburg provided the spot forecast at 0707 with a forecasted maximum temperature on April 23 at 1600 of 70, minimum relative humidity of 26%, southwest winds 8 mph gusting to 16 mph, and a mixing height of 5000 feet.

A second spot forecast was requested at 0908 on April 22 with a start time of 1500 and similarly did not include observations or remarks. NWS Blacksburg provided the spot forecast at 1309 with no change to the 1600 forecast for April 23.

A third spot forecast was requested for Sinking Creek Unit 2 at 2308 on April 22 with a delivery time of 0500 on April 23. Again, the request did not include recent observations, nor did it include any remarks. NWS Blacksburg provided the spot forecast at 0318 with a forecasted maximum temperature at 1600 of 69, minimum relative humidity of 22%, southwest winds 9 mph gusting to 13 mph, and a mixing height of 6500 feet. The trend between spot forecasts was that minimum relative humidity was expected to be lower and mixing heights higher for the afternoon of April 23.

Sinking Creek Unit 2

National Weather Service Blacksburg

2024-04-23 3:18 AM EDT

Spot Forecast for Sinking Creek Unit 2...USFS
National Weather Service Blacksburg VA
318 AM EDT Tue Apr 23 2024

Forecast is based on ignition time of 0500 EDT on April 23.
If conditions become unrepresentative, contact the National Weather Service.

.DISCUSSION...
High pressure remains over the area today bringing with dry and warm weather. Minimum RH values today will range from 20 to 30 percent, with slightly higher values near the ridges of the southern Blue Ridge. RH values begin to improve late afternoon into tonight as SW winds bring in some moisture. SW winds between 5 and 15 mph are expected this afternoon into tonight.

A cold front crosses our region on Wednesday with scattered showers mainly across the western mountains. Temperatures remain a few degrees either side of normal through the week with high pressure returning behind the front.

.TODAY...

Sky/weather.....Partly sunny (50-60 percent) then becoming sunny (5-15 percent).
CWR (0.01 in).....0 percent.
Max temperature.....Around 70.
Min humidity.....22 percent.
Wind (20 ft).....Light winds becoming southwest 5 to 9 mph in the late morning and afternoon.
Mixing height.....6500 ft AGL.
Mixing winds.....West 2 to 8 mph shifting to the southwest 12 to 16 mph late in the morning.
Smoke dispersal.....Poor (700 knot-ft) early in the morning increasing to excellent (96100 knot-ft) in the afternoon.
LVORI.....2.
ADI.....2 early in the morning increasing to 80 in the afternoon.
Haines Index.....5 or moderate potential for large plume dominated fire growth.

TIME (EDT)	6 AM	8 AM	10 AM	NOON	2 PM	4 PM
Sky (%)	63	65	16	3	4	13
Weather cov.						
Weather type	NONE	NONE	NONE	NONE	NONE	NONE
Tstm cov.						
CWR	0	0	0	0	0	0
Temp	39	44	53	60	66	69
RH	54	49	41	32	25	22
20 ft wind	W 4	W 4	SW 5	SW 6	SW 7	SW 9
20 ft wind gust	6	6	6	8	10	13
Mix hgt (ft)	400	400	2800	4300	5600	6500
Mixing wind	W 2	W 2	W 8	W 13	SW 13	SW 16
LVORI	2	2	1	1	1	1
ADI	2	2	30	63	80	75
Haines index	5	5	5	5	5	5
VRate mph-ft/1K	1	1	23	53	71	105

.TONIGHT...

Sky/weather.....Partly cloudy (30-40 percent) then becoming mostly cloudy (60-70 percent). Slight chance of rain showers early in the morning.
CWR (0.01 in).....10 percent early in the morning.
Min temperature.....Around 52.
Max humidity.....62 percent.
Wind (20 ft).....Southwest winds 6 to 12 mph.
Mixing height.....600 ft AGL.
Mixing winds.....Southwest 9 to 16 mph.
Smoke dispersal.....Excellent (84600 knot-ft) early in the evening decreasing to poor (5400 knot-ft) late in the night.
LVORI.....2.
ADI.....74 early in the evening decreasing to 7 late in the night.
Haines Index.....4 to 5 or low to moderate potential for large plume dominated fire growth.

TIME (EDT)	6 PM	8 PM	10 PM	MIDNGT	2 AM	4 AM
Sky (%)	20	36	36	30	47	70
Weather cov.						
Weather type	NONE	NONE	NONE	NONE	NONE	NONE
Tstm cov.						
CWR	0	0	0	0	0	10
Temp	66	62	58	55	53	52
RH	26	37	44	51	55	62
20 ft wind	SW 10	SW 6	SW 7	SW 7	W 9	W 9
20 ft wind gust	14	10	10	10	12	13
Mix hgt (ft)	5800	700	600	600	800	1100
Mixing wind	SW 16	SW 14	SW 13	SW 10	SW 9	W 13
LVORI	1	2	2	2	2	2
ADI	74	9	8	7	8	11
Haines index	5	5	4	4	4	4
VRate mph-ft/1K	97	10	7	6	7	14

Figure 29. Spot Weather Forecast for the Sinking Creek RX issued at 0318 on April 23, 2024 by NWS Blacksburg.

A fourth spot forecast was requested for Sinking Creek Unit 2 at 2133 on April 23 with no recent observations included, but this time it included the remark “Please use nearest RAWS for current observations” although the name of the nearest (portable) RAWS was not indicated. This spot forecast was requested before the fire was declared as a wildfire with the incident name of Huckleberry Knob. This indicated a minimum temperature of 50, a maximum humidity of 77%, west winds 7-10 mph and fair to poor smoke dispersal.

At 1850 NWS Blacksburg received its first call from the Sinking Creek prescribed burn reporting that the spot forecast issued early that morning had a minimum relative humidity of 22%, but fire crews measured “teens to single digit readings on site.” They also asked about the forecast for the next seven days.

Spot forecast requests should include recent weather observations to assist forecasters with a good starting point. Remarks can also be helpful if certain weather parameters critical to RX burn plans or further details are requested in the narrative. The Fire Weather Services for Virginia Operating Plan section titled “Procedures for Requesting a Spot Forecast” guideline #2 states “Provide as much on-site or near-site weather information as possible. At a minimum, the user should provide at least one observation within an hour of the request.” Guideline #4 states “as much as possible, specify the weather elements of most importance for which a forecast is needed, and/or critical values of these elements” and guideline #7 reads “natural resource agency personnel should contact the NWS forecast office for a spot update if the forecast conditions appear unrepresentative of the actual weather conditions. Whenever possible, users should provide feedback, positive or negative, to the NWS forecast office concerning the performance of the spot forecast during or shortly after an event.”

Forecast Models

NWS meteorologists use forecast models along with remote sensing to assist with producing weather forecasts. Relative humidity is a calculated value based on forecasted air temperature and dewpoint temperature. Looking back at the NWS NBM (National Blend of Models) model run for 2100 on April 22 at the forecast point for the Craig Valley RAWS showed a 0% probability that the air temperature would reach higher than or equal to 71 (observed) out of 44 models in the blend. This same model showed a 0% probability that the dewpoint temperature would reach less than or equal to 9 (observed) out of 44 models in the blend. The observed values were extreme outliers for the available model guidance and the previous day's observations, including the minimum relative humidity of 19% on April 22, suggested the model guidance and issued spot was a good forecast based on all information available. The graphic below shows the forecasted values (solid lines) of air temperature, dewpoint temperature, and relative humidity for Craig Valley RAWS on April 23 along with the observed values (dots) to show how far the observed values differed from model guidance.

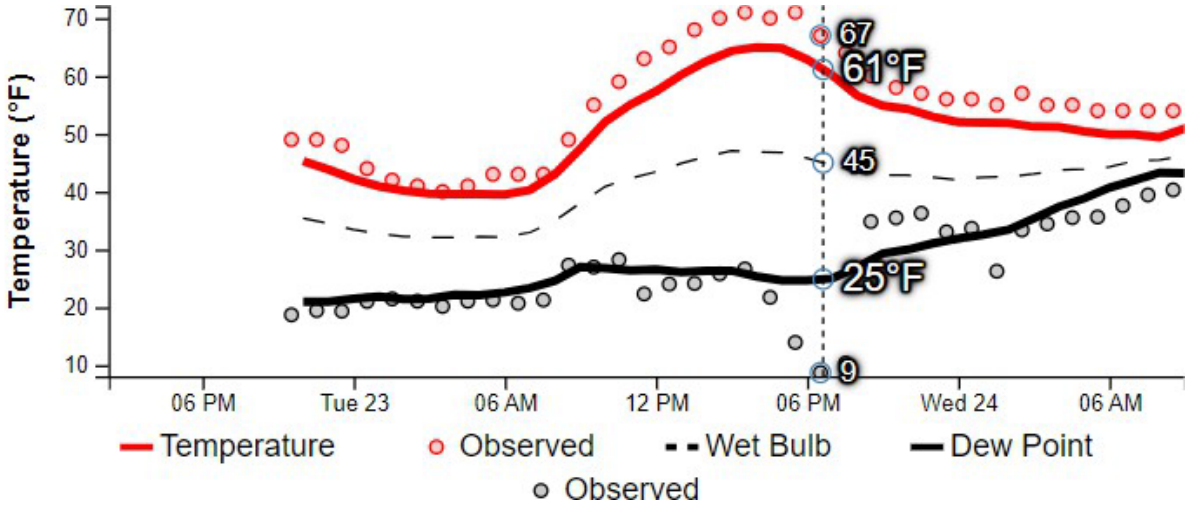


Figure 30. Observed vs Forecast Air Temperature and Dewpoint for the Craig Valley RAWS forecast point from the 2100 April 22, 2024 run of the NWS National Blend of Models (NBM) at 1900 on April 23, 2024. Note the spread between the forecast and observed values at 1900.

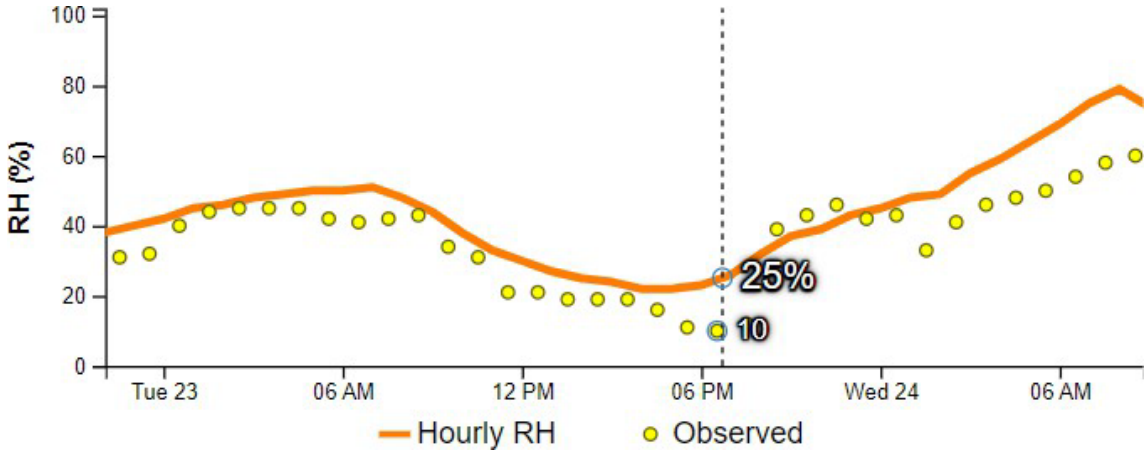


Figure 31. Observed vs Forecast Relative Humidity for the Craig Valley RAWS forecast point from the 2100 April 22, 2024 run of the NWS National Blend of Models (NBM) at 1900 April 23, 2024. Note the spread between the forecast and observed values at 1900.

The Special Weather Statement

NWS Blacksburg issued a Special Weather Statement for "Increased Fire Danger This Afternoon" at 0858 on April 23 for all Virginia and West Virginia counties in the forecast area. These statements are a coordinated effort between the NWS, Federal, and State land management partners to alert the media and general public to weather conditions favorable for rapid rates of spread if a wildfire were to occur. A call was made to the Virginia Interagency Coordination Center (VICC) prior to the issuance of this statement. The local RXB2 was made aware of the special weather statement as well.

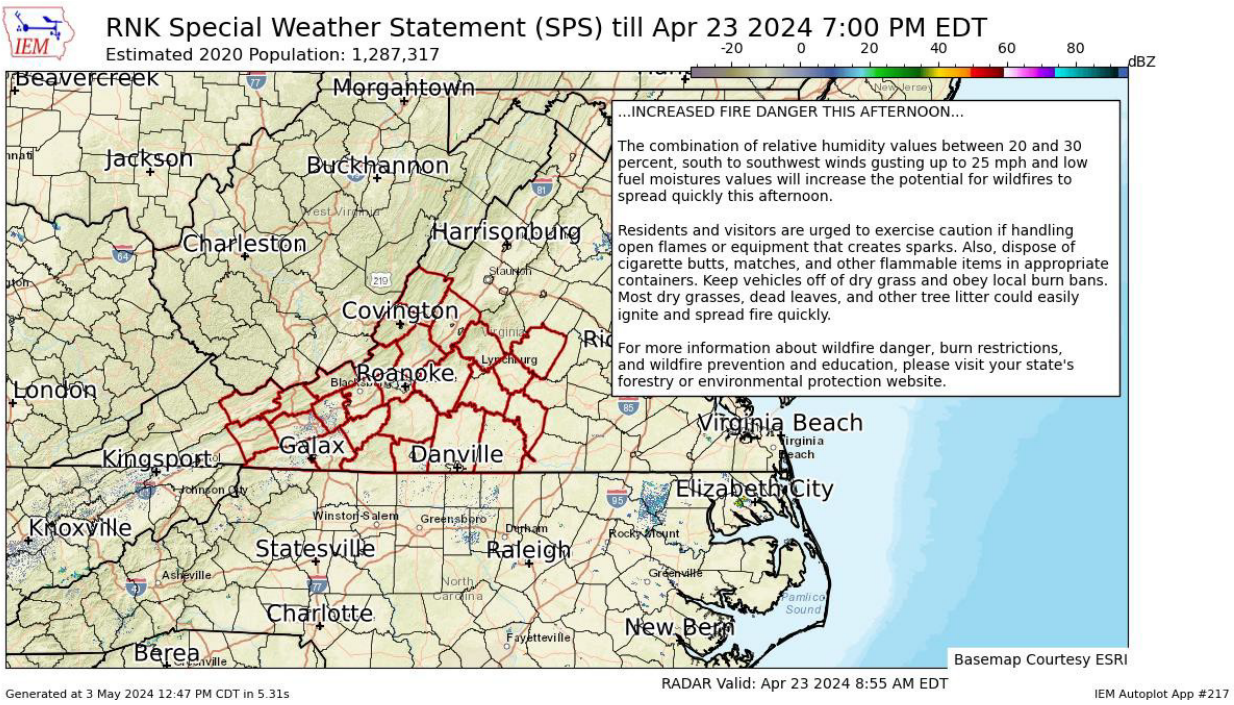


Figure 32. NWS Special Weather Statement issued for "INCREASED FIRE DANGER THIS AFTERNOON" at 0858 on April 23, 2024.

Weather Following the Huckleberry Knob Fire

The weather following the burn featured seasonable temperatures through April 27 before warming above normal for the end of April and into early May. Fair humidity recovery occurred the night following the burn/escape with maximum relative humidity only reaching 55% before daily relative humidity reading returned to seasonably dry levels. Minimum relative humidity dipped into the 20% and 30% range and maximums rose to the 70-90% range most days. No periods of significant winds have been observed since the burn/escape. A weak cold front passing through the southeast U.S. brought some rain showers on the evening of April 30 to Roanoke (0.08 in) and Blacksburg (0.01 in) but RAWS TT386 did not show any measurable rainfall.

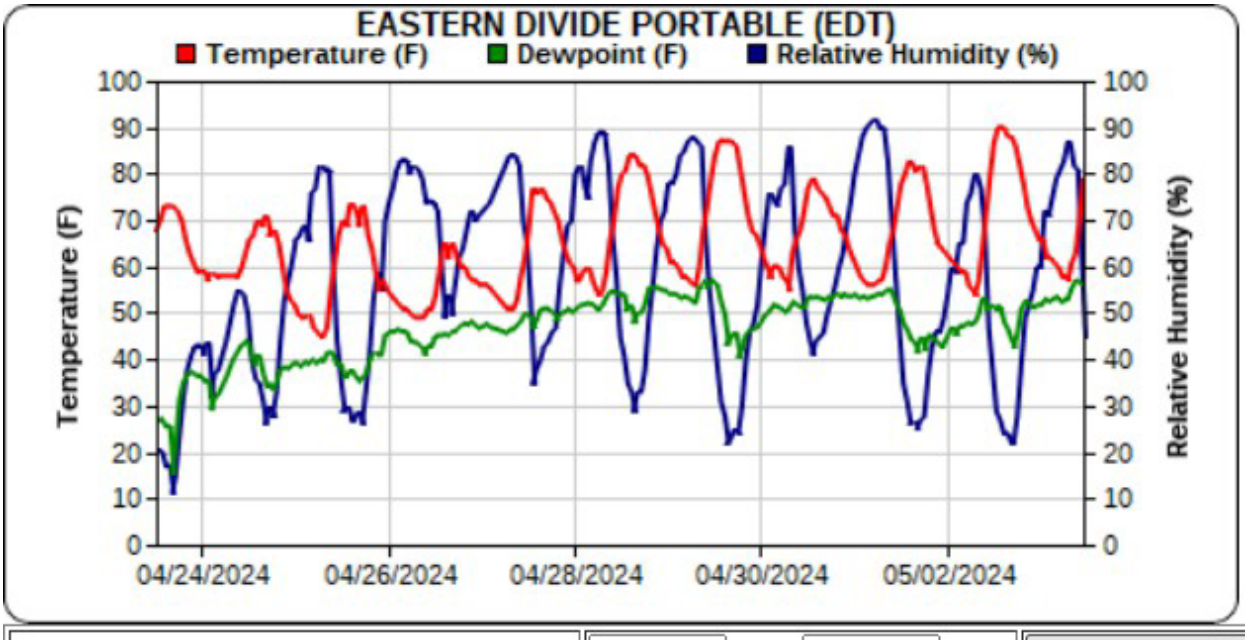


Figure 33. This a graphical display of temperature, dewpoint, and relative humidity for the Eastern Divide Portable RAWS TT386 from April 24 through May 4, 2024 from https://mesowest.utah.edu/

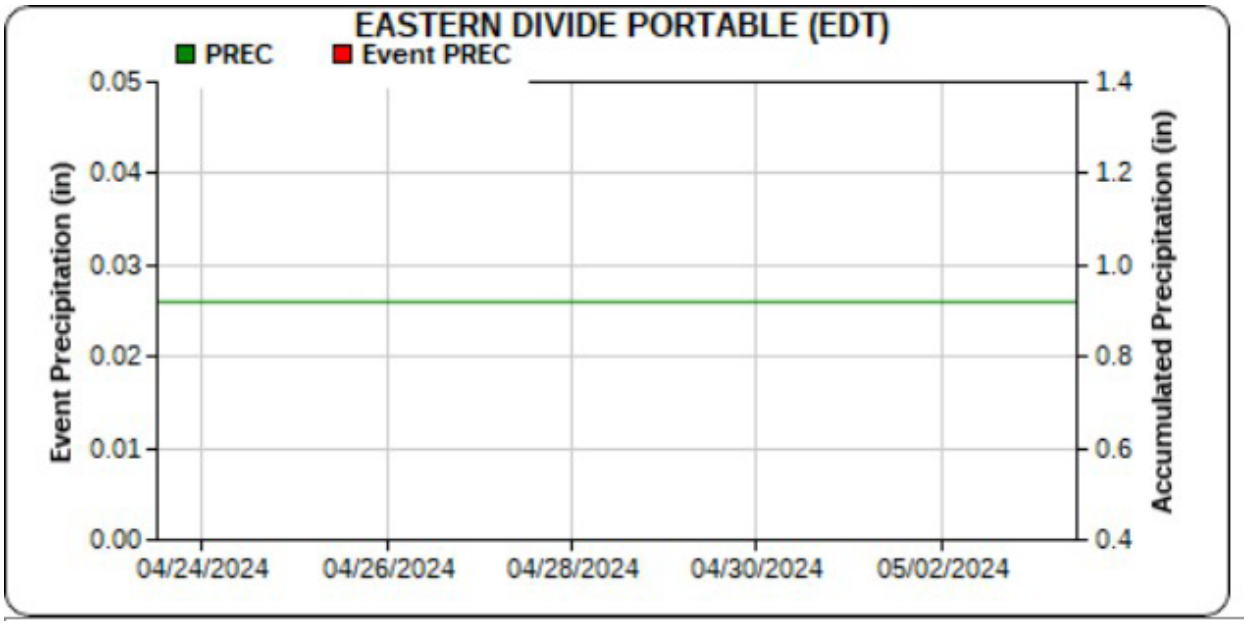


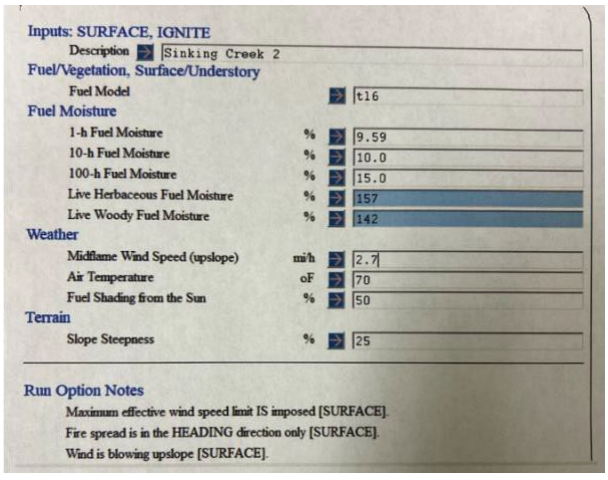
Figure 34. This a graphical display of event precipitation (none observed) and accumulated calendar year precipitation for the same period also from https://mesowest.utah.edu/

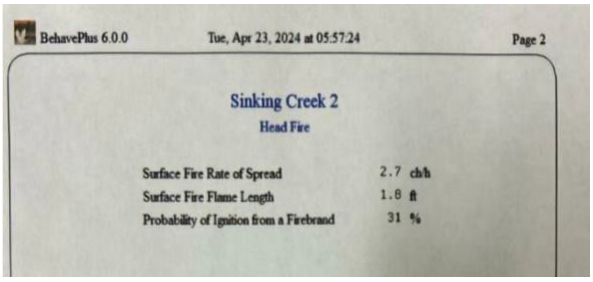
Ordering An IMET

During peak fire season when prescribed fire is being considered on multiple forest zones, in addition to wildfire, order an IMET to be detailed at the Supervisor's Office or VICC to provide fire weather support. This individual would provide the spot forecasts to meet the needs of the entire forest in addition to working with the Forest FMO on Variance Requests and other assigned duties such as daily weather briefings, long-term planning, after action reviews, etc. This person would also act as the liaison between the Forest and the NWS field offices affected.

Fuel Moisture and Fire Behavior Modeling

At 0557 on April 23rd, the EDRD AFMO conducted a fire behavior modeling run using BehavePlus 6.0.0 to predict rates of spread and flame lengths expected within the burn unit. TL6 (Moderate Load Broadleaf Litter) was chosen as the fuel model in alignment with the Vegetation/Fuels description in Element 4





Figures 35 (left) and 36 (right). Pre-burn BehavePlus model run and outputs for predicted rate of spread, flame length, and probability of ignition from a head fire.

and Prescription Parameters within Element 7 of the burn plan. Fuel moistures (FM) used as inputs into BehavePlus appear to have been derived from a combination of the April 22, 2024 VICC NFDRS forecast (1-hr and 100-hr) for the following day and on-site fuel sticks for 10-hr FM measured on the afternoon of April 22, 2024. According to the VA-VIC NFDRS forecast for the following day on April 22, 2024, the 1-hr FM (fine dead fuel moisture - FDFM) was predicted to be 9.59% at 1300 on the day of the burn, and the 100-hr FM was predicted to be 15.79%. From measurements of the on-site fuel sticks on the afternoon prior to the burn, 10-hr FM was reported at 10%, and the same value was used to predict 10-hr FM on the day of the burn (Figure 35).

Live herbaceous and live woody fuel moisture values were also taken directly from the dispatch NFDRS forecast. Midflame wind speed and air temperature inputs for the fire behavior model run were taken from the morning spot weather request. Midflame wind speed was calculated by taking the maximum forecast 20-ft wind speed (9 mph) from the spot weather and applying a wind adjustment factor of 0.3 to obtain a midflame wind speed of 2.7 mph. Slope steepness appears to have been determined by either analysis of topo maps or knowledge of the unit. Based on the above inputs, the BehavePlus model run predicted rate of spread to be 2.7 chain/hr, flame lengths of 1.8 ft, and probability of ignition from a firebrand of 31% (See Figure 36 – above).

From "Region 8 Fire and Aviation Bulletin 3.10.23 NFDRS Issues and Solutions": the previous model for estimating 1- and 10-hour fuel moistures known as the Fosberg model was integrated into Rothermel's tools and methods for surface fire behavior predictions (used in BehavePlus) in 1983. The current model being used in WIMS known as the Nelson model produces a more dynamic estimate that better reflects changes in precipitation, humidity, and solar radiation, making Nelson a better input for fire danger ratings such as ERC and BI. However, the two fuel moisture models can produce very different values for the same day with the Nelson model frequently predicting much higher fuel moistures than Fosberg's model. Since the BehavePlus fire modeling system is calibrated to the Fosberg model, using Nelson outputs will drastically underestimate fire behavior. (See Fuel Moisture: Dead Fuel Moisture Content | NWCG). Accordingly dead moisture values used as inputs in BehavePlus should be estimated using one of the following methods:

1. PMS 437 Fire Behavior Field Reference Guide 1-Hr Fuel Estimation Method
2. Fuel moisture estimations in the field using fuel moisture sticks and scales
   Fuel Moisture Scale Ten-Hour Moisture Sticks
   https://www.forestry-suppliers.com/Search?stext=fuel+sticks
   Pesola Medio – Line Spring Scales
   https://www.forestry-suppliers.com/p/93013/63951/pesola-medio-line-spring-scales
   Novalynx Instruction Manual for Fuel Moisture Sticks
   https://novalynx.com/manuals/225-7917-7918-7919-manual.pdf
   Evaluation of Instruments used to Measure Fuel Moisture
   https://www.fs.usda.gov/t-d/pubs/htmlpubs/htm05512347/index.htm
3. BehavePlus 6.0.0 Fine Dead Fuel Moisture Tool

10-hr fuel moisture inputs into BehavePlus were taken from on-site weighed fuel moisture sticks the day prior to the burn. This is one of the appropriate methods described above to determine 10-hr fuel moisture for fire behavior modeling. As reported above, the 1-hr and 100-hr fuel moisture values used

as inputs into BehavePlus on the morning of the burn were taken from the dispatch NFDRS forecast from the previous afternoon. Fuel moisture (FM) values within the dispatch NFDRS forecast are calculated using the Nelson model, which can overpredict 1-hr FM values for BehavePlus input. In the future, it is recommended that 1-hr FM inputs to BehavePlus come from one of the sources above using the spot weather forecast for the burn to ensure accurate fire behavior modeling. Using the Fine Dead Fuel Moisture Tool in BehavePlus and inputs from the Sinking Creek RX spot weather forecast results in a 1-hr FM of 6%. A 1-hr FM of 6% would produce greater flame lengths and rates of spread than a 1-hr FM of 9.59%. Similarly, 1-hr FM is used to calculate probability of ignition, so the predicted probability of ignition would have been significantly higher using a 1-hr FM of 6% instead of 9.59%.

#2: Analysis of the prescribed fire plan for consistency with agency policy

The Sinking Creek Prescribed Fire Plan is a Moderate Complexity Plan composed of two units – Unit One (1,209 acres) and Unit Two (737 acres). The Sinking Creek Prescribed Fire Plan is maintained in a project folder with ignition unit maps, complexity analysis, fire modeling documentation, and a job hazard analysis (JHA). The George Washington and Jefferson National Forest uses an Incident Action Plan (IAP) for burn day documentation. The IAP includes information copied from the RX burn plan to build a daily briefing packet.

- The packet for the Sinking Creek RX project IAP contained the following:
- Eastern Divide Communication Plan
- Incident Objectives (Element 5)
- Organizational Chart with assignments
- Medical Plan/ ICS 206
- ICS 214 (blank)
- Spot weather forecast
- Project area map

An ignition unit map was distributed to RX personnel that identified the number of acres being burned, control lines, designated DPs, and unique features.

Table 1: Analysis of Sinking Creek Prescribed Fire Plan Elements for consistency with policy and whether the element may have been a contributing factor to the outcome.

Prescribed Fire Plan Elements	Policy Consistent (NWCG)	Policy Consistent (USFS)	Comments	Contributing Factor?
Element 1: Signature Page	Yes	Yes	Electronic Signature can help with time stamp/date. AA signed the annual review.	No
Element 2A: AA Ignition Authorization	Yes	Yes	NWCG PMS 484 recommends documentation of AA key discussion points.	No
Element 2B: Go/No Go Checklist	Yes	Yes		No
Element 3: Complexity Analysis Summary and Final Complexity	Yes	Yes		No
Element 4: Description of Prescribed Fire Area	Yes	Yes	Slope used in Element 4 = 15-20%. Behave runs used for Element 7 Prescription Parameters = 10% and Behave day of runs = 25%. Although Behave outputs are similar in this case, maintain consistency in slope values throughout the burn plan elements.	No
Element 5: Objectives	Yes	Yes	Prescribed fire objectives are specific and quantitative but lack a time component. Consider adding desirable fire behavior parameters (FL, ROS, etc.) which would meet objectives to the existing objectives to improve burn personnel awareness and understanding.	No
Element 6: Funding	Yes	Yes		No

Prescribed Fire Plan Elements	Policy Consistent (NWCG)	Policy Consistent (USFS)	Comments	Contributing Factor?
Element 7: Prescription Parameters	Yes	Yes	• Reference R8 5140 variance process in table or one of the footnotes. Currently, the only requirements stated for exceeding wind and RH limits are either Forest Supervisor or Regional Forester approval. • For 20-ft winds, consider increasing maximum allowable wind speed to the regional limit of 20 mph to provide full flexibility and reduce potential need for plan amendment. • Ensure prescription parameters are representative of BehavePlus model runs. BehavePlus SURFACE model runs used a low temperature limit of 50 degrees, but the prescription parameters in Element 7 shows a low temperature limit of 40 degrees. • Consider utilizing a different NFDRS Parameter (ERC, BI, etc.) than PL 4 for prescription parameters, since PL4 is not a NFDRS parameter and is covered in Nat'l or Reg'l Planning Level.	No
Element 8: Scheduling	Yes	Yes		No
Element 9: Pre-burn Considerations and Weather	Yes	Yes	Consider adding how seasonal climatic conditions (NFDRS indices, 100-hr fuel moisture, etc.) leading up to the burn may affect fire behavior to this element.	No
Element 9 B: Method and Frequency of Weather and Smoke Management	Yes	Yes	Consider adding verbiage about documenting the AQI from AirNow on the day of the burn (either daily the AQI value or a printout from AirNow).	No
Element 10: Briefing Checklist	Yes	Yes		No
Element 11: Organization and Equipment	Yes	Yes	Great job of being specific and thorough with organization and equipment requirements.	No

Prescribed Fire Plan Elements	Policy Consistent (NWCG)	Policy Consistent (USFS)	Comments	Contributing Factor?
Element 12: Communications	Yes	Yes		No
Element 13: Public and Personnel Safety, Medical	Yes	Yes		No
Element 14: Test Fire	Yes	Yes		No
Element 15: Ignition Plan	Yes	Yes	A thorough narrative was included for firing devices and aerial firing devices.	No
Element 16: Holding Plan	Yes	Yes	May consider adding critical holding areas for the handline for both units DP14 to DP22. Consider adding verbiage on handline considerations during dry periods and growing season (rapid duff drying, potential need for hoselay, etc.).	No
Element 17: Contingency Plan	Yes	Yes	Consider adding clearer charts for line production rates for resources.	No
Element 18: Wildfire Declaration	Yes	Yes	The burn plan states that the prescribed fire can be declared a wildfire by the Burn Boss, FMO, **or** AA. Consider adding a statement to this element that the decision to declare should include input from the Burn Boss and be based on a group discussion amongst the Burn Boss, FMO, and AA to promote group decision-making.	No
Element 19: Smoke Management/Air Quality	Yes	Yes		No
Element 20: Monitoring	Yes	Yes		No
Element 21: Post-burn Activities	Yes	Yes	Use clear language. No acronyms	No
Appendix A: Vicinity, Project (Ignition Units)	Yes	Yes		No
Appendix B: Technical Review Checklist	Yes	Yes		No
Appendix C: Complexity Analysis	Yes	Yes		No

Prescribed Fire Plan Elements	Policy Consistent (NWCG)	Policy Consistent (USFS)	Comments	Contributing Factor?
Appendix D: JHA Risk Assessment	Yes	No	Signature missing from JHA. Add smoke exposure language to JHA - R8 5142.2 requires smoke exposure language be included in the JHA	No
Appendix E: Fire Behavior Modeling Documentation	Yes	Yes	BehavePlus SURFACE and CONTAIN runs in Appendix E used 10% as the only value for slope steepness. Consider using either maximum slope or a range of slope steepness values both inside and adjacent to the burn unit for CONTAIN runs.	No
Appendix F: Smoke Management Plan and Smoke Modeling Documentation (optional)	Yes	Yes	The IAP did not contain any smoke modeling runs (Hysplit, V-Smoke, etc.).	No
Appendix H: Post-Burn Evaluation	Yes	Yes	Not completed due to Wildfire Declaration	No
Overall Comments: The burn plan met policy requirements overall. There are some minor suggestions that can be considered for future plan updates. (1) Prescribed Fire Name and Ignition Unit Name in the USFS template is required at the top of each burn-plan page. The plan only has the RX fire name and ignition unit name in Element 1 and the supplement cover page. Note or address the variance process in Element 7. Developing language that addresses climatic conditions like drought in Element 9. Consider splitting out critical holding areas for sub-units 1 and 2 in Element 16 in case they are burned separately and add handline on eastern boundary as additional critical holding area if it is.				

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

The table below illustrates the burn plan prescription, inputs, and source used for implementation of the Sinking Creek RX. Forecasted values indicate that all prescription parameters were met except for RH below the Forest standard (<30%) and regional standard (<25%) and wind gusts <= 12 mph which was the maximum wind speed prescribed in this specific burn plan. The low relative humidity was forecast to be 22% at 1600 according to the spot weather forecast. Consistent with Region 8 policy, the RXB2 requested and received approval for both the Forest and regional variance. Element 7 of the burn plan has a maximum 20-ft wind speed of 12 mph, yet the spot weather forecast predicted gusts to 13 mph at 1600 and 14 mph at 1800. The highest actual wind gust reported by the on-site portable RAWS was 9 mph, but this portable RAWS was sited at the base of the burn unit and was not likely representative of wind speeds at higher elevations. Craig Valley RAWS, which is 15 miles away from the burn unit but at a similar elevation, reported winds gusts as high as 15 mph at 12:32 EDT.

Table 2. Burn plan prescription, inputs, and source used for implementation of the Sinking Creek RX.

Environmental Parameters of Prescription	Regional or Forest Standard	RX Prescription	Forecast	Source
Date/Time			4/23/2024	
Fuel Models (FBPS)		TL6/TU3	TL6/TU3	Burn Plan
1-HR Fuels %		N/A	9.59 *1/*	Dispatch Observation/ Forecast
10-HR Fuels %	≥6% open ≥8% closed	6% High 15% Low	10	On-Site Measurement
*Live Fuel Moisture (Herb) %		n/a	159	Dispatch Observation/ Forecast
*Live Fuel Moisture (Woody) %		n/a	144	Dispatch Observation/ Forecast
Temperature (F)	≤90 Forest	80 High 40 Low	70	Spot WX FX
Relative Humidity %	≥30% Forest ≥25% Region	20% High 40% Low	22%	Spot WX FX
20-Ft Wind (mph)	≤20 MPH	4-12 MPH High 1-4 MPH Low	5-9 MPH G13 (2/)	Spot WX FX
20-Ft Wind Direction		Any direction	SW	Spot WX FX
Midflame Wind Speed (MPH)	≤8 MPH	8 MPH High 1 MPH Low	2.7	BehavePlus
Midflame Wind Speed Direction	N/A	N/A	SW	Spot WX FX
Transport Wind Speed (MPH)	> 7 MPH	None	8 MPH @ 10AM	Spot WX FX
Transport W/S Direction		S SW WSW SE Preferred	W/SW	Spot WX FX
Mixing Height (Min)	≥1640ft/500m	>1640ft	6500 ft @ 4PM	Spot WX FX
Ventilation Factor	>2000	>2000	23,000 @ 10AM	Spot WX FX
NFDRS Parameter (PL)	ERC ≤ PL4	≤PL4	PL3	Fire Business Calculator
Probability of Ignition (%)	≤60	55 High 20 Low	31	BehavePlus
KBDI	≤350	≤350	83	Fire Business Calculator
Firing Technique		Backing, Flanking,	Backing,	RX Briefing

Environmental Parameters of Prescription	Regional or Forest Standard	RX Prescription	Forecast	Source
		Heading, Dotting	Flanking, Heading, Dotting	
Ignition Method		Ground/Aerial	Ground/Aerial	RX Briefing
Days Since Rain		N/A	2	BehavePlus
National or Regional PL	<PL4		PL2	Variance Request
LVORI	<8 nighttime		2	Spot WX FX
Flame Length (Ft)			1.8ft	BehavePlus
Rate Of Spread (Chs/Hr)			2.7ch/h	BehavePlus
1/ There is a discrepancy here on which Fuel Moisture values should be used. The value in this table was derived from WIMS and is based on the Nelson model. A FDFM calculator or PMS 437 Fire Behavior Field Reference Guide should be used to obtain this value to prevent errors in fire modeling. 2/20-ft wind speed prescription parameter <=12 mph includes gusts, but spot weather forecasted wind gusts as high as 14 mph. 3/PL4 should be defined (Preparedness Level and not Planning Level)				

Overall, implementation of the Sinking Creek RX Project was largely consistent with the prescriptions, actions, and procedures outlined throughout the 21 elements and appendices within the Sinking Creek Prescribed Fire Plan. However, the review team found two discrepancies between the burn plan and implementation and one oversight in estimating 1-hr fuel moisture (FDFM):

- Region 8 5142.3 Weather Forecast Requirements and the GWJ 5140.42 (2015) both require on-site weather observations at least every two hours throughout a burn. Element 20 of the Sinking Creek Prescribed Fire Plan states that the interval between recording of weather observations should not exceed one hour, Element 16D states that the burn boss will continue to monitor fire weather forecasts during the duration of the project, and Element 8B states that weather will be taken hourly until firing is complete or until the burn boss decides observations are no longer needed. These observations should be recorded and communicated to the crew according to Element 8B as well. A portable RAWS was recording on-site observations throughout the burn project, but observations were not communicated to burn personnel. However, no weather observations were taken or recorded manually by the burn crew after 1300 on the burn.
- Element 7 Prescription Parameters table has a 20-ft wind limit of 12 mph with a footnote that states that wind gusts are included in overall wind speeds (footnote 3). The spot weather forecast from the morning of the burn predicted gusts to 13 mph at 1600 and gusts to 14 mph at 1800. Forecast wind gusts over 12 mph should have triggered a plan amendment if the decision was made to continue with the burn.
- While not an inconsistency in plan implementation, the 1-hr and 100-hr fuel moisture values selected for fire behavior modeling were taken from the VICC NFDRS (Nelson fuel moisture model) forecast from 1300 the day prior to the burn instead of the 1-hr fuel moisture estimated from PMS 437 Fire Behavior Field Reference Guide or the BehavePlus Fine Dead Fuel Moisture Calculator (Fosberg fuel moisture model). The NFDRS 1-hr fuel moisture forecast was 9.59%, while the 1-hr fuel moisture estimated from the Fine Dead Fuel Moisture Calculator would have been 6%. This discrepancy resulted in significantly lower output values of flame length, rate of spread, and probability of ignition in BehavePlus on the morning of the burn than would have been estimated if the correct source for 1-hr fuel moisture was used.

The EDRD should use the FDFM Calculator in BehavePlus or PMS 437 Fire Behavior Field Reference Guide fine dead fuel moisture estimation tables to determine 1-hr fuel moisture for fire modeling runs in the future.

#4: The approving agency administrator's qualifications, experience, and involvement

The Agency Administrator is qualified as RXA2 and WFA2 and has completed all required training and refreshers. Qualification as RXA2 was attained on December 31st, 2022, and the RXA2 had served as RXA2 on 10+ moderate complexity prescribed burns. The AA was involved in the planning process, complexity determination, and signed the plan as the qualified RXA2. The AA was on unit and involved in the day of decision to implement the burn, signed the go/no go and agreed with requesting a variance. The AA was in communication with the RXB2, FDO and FFMO throughout the day and during the declaration discussions.

#5: The qualifications and experience of key personnel involved

- FDO- Qualified and current on all refreshers and training as TFLD, RXB2 and ICT3. Involved in supporting operations with resources for RX operations as well as suppression efforts.
- RXB2- Qualified and current on all refreshers and trainings as RXB2. Involved in the planning and implementation of the burn, took over as ICT4 after declaration.
- FIRB Alpha- Qualified and current on all refreshers and trainings as FIRB. Provided leadership to the firing operations from DP-16 to the south along the handline.
- FIRB Bravo- Qualified and current on all refreshers and trainings as FIRB. Provided leadership to the UAS ignitions.
- FIRB Charlie- Qualified and current on all refreshers and trainings as FIRB. Provided leadership to firing operations from DP-16 to the west along the holding road.
- Holding Boss- Qualified and current on all refreshers and trainings as CRWB, FIRB.
- UAS pilots-Qualified and current on all refreshers and trainings. Provided UAS firing operations and aerial scouting.

Appendix B: Sinking Creek Prescribed Fire Units Map

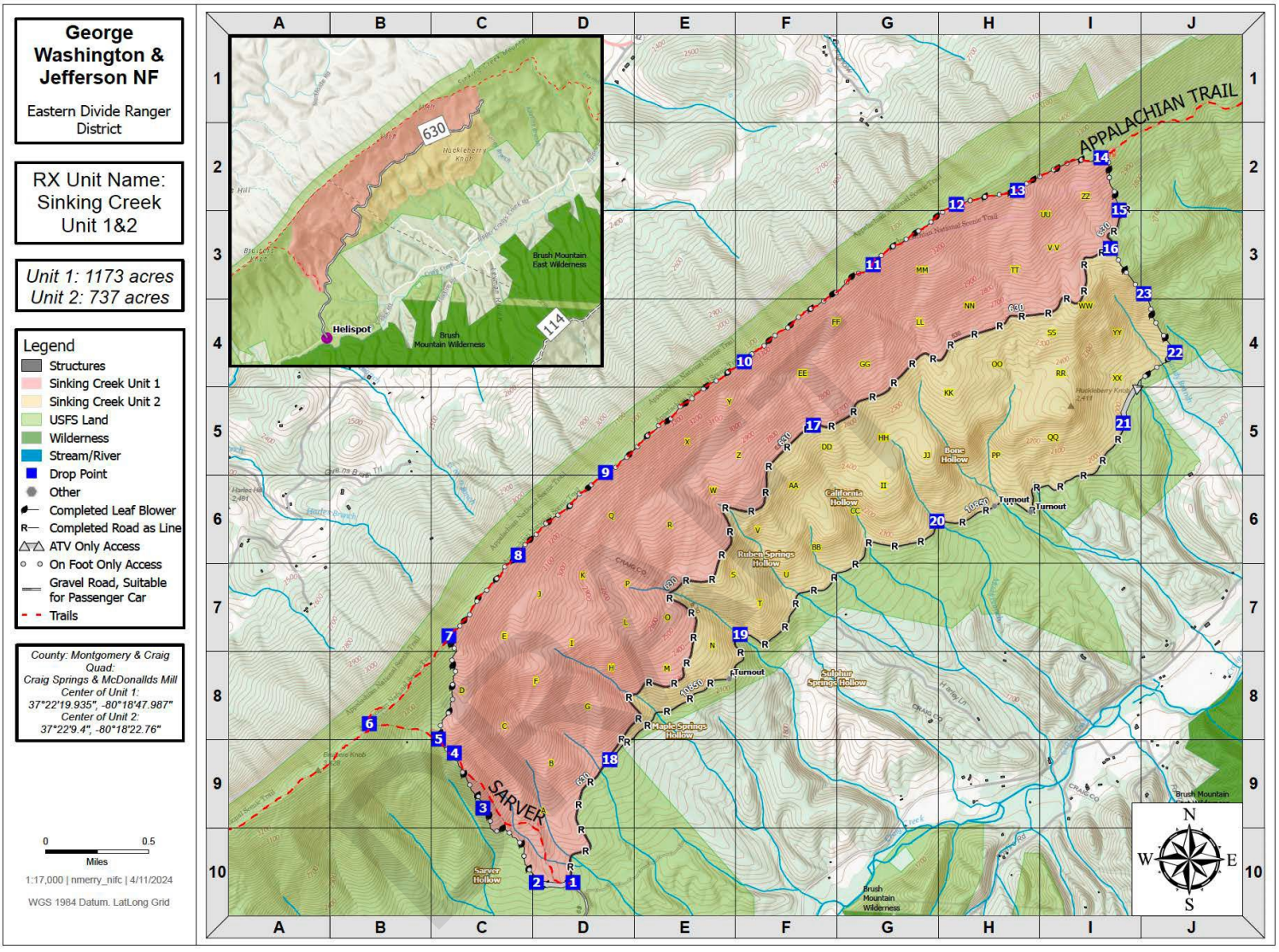


Figure 37. This is a map of the Sinking Creek RX Project Area. Drop Points were marked both on the map and on the ground.

Appendix C: Contributing Factors or Conditions

Table 3. Contributing Factors to RX Escape.

Category	Contributing Factor or Condition	Mark "X" If Observed
Planning	Burn area boundaries not aligned with favorable locations for fire containment.	
	Interdisciplinary team coordination lacking during design and planning of the treatment.	
	Lack of proficiency using fire behavior and related modeling tools.	
	Insufficient holding plan.	
	Insufficient ignition plan.	
	Insufficient mop-up and patrol plan.	
	Insufficient contingency plan.	
	Insufficient technical review.	
	Complexity rating did not adequately reflect the conditions actually experienced.	
Operations	Burn could not be completed and secured before forecasted worsening weather arrived.	
	Test fire did not provide accurate representation of fire potential.	
	Actions taken inconsistent with those described in the burn plan.	
	Insufficient patrol after burn boss transfers control to local unit.	
Communications	Unit boundaries or special features not communicated or identified accurately.	
	Instructions not given or well understood.	
Equipment	Malfunction or breakdown	
	Equipment not set-up and tested prior to need.	
Fire Environment	Extended fire persistence – 2 weeks or more in patrol status.	
	Actual weather experienced was outside what was forecast.	X
	Severe drought conditions contributing to unusually dry fuels.	
Fuels	Higher than typical fuel quantity/loadings.	X
	Large machine piles.	
	Hand piles.	
Human Factors	External influences or distractions.	
	Internal stress or fatigue.	

Appendix D: Delegation of Authority

Forest Service **Southern Region** **1720 Peachtree Road, NW**
Atlanta, GA 30309
FAX: 404-347-4448

File Code: 5140 **Date:** April 28, 2024
Route To:

Subject: Delegation of Authority – Sinking Creek Rx Burn / Huckleberry Knob Declared Wildfire Review

To: Cavan Fitzsimmons and Dan Martin–Review Team Co-Leaders

This letter formalizes your appointment as Review Team Leader to complete a Complex Declared Wildfire Review for the Sinking Creek Prescribed Fire (Rx) initiated on April 23rd, 2024 that resulted in the Huckleberry Knob Wildfire on the Eastern Divide District of the George Washington and Jefferson National Forests. To ensure an objective and insightful review, I have approved your review team roster that includes diverse subject matter expertise.

As Team Leaders, you have the authority of my office to execute and complete a thorough review as described in the enclosed Expectations document. Your Point of Contact for assistance and coordination with Southern Region Fire and Aviation Management is Michael Ward, Regional Fuels Program Manager 470-446-2247 michael.d.ward@usda.gov. Your Point of Contact with the National Forest is Colten Moor, Forest Fire Management Officer, 276-706-7729 colten.moor@usda.gov.

For necessary travel, equipment, salary or other costs related to this review use the charge code P8RV7R424 with override code 0808.

Your authority includes, but is not limited to:

- Controlling, organizing, managing, and directing the review
- Maintaining the confidentiality of the process
- Protecting and managing the integrity of documents, media or other artifacts collected.
- Authorizing requests for additional personnel, including technical specialists, to support the Team and releasing them upon completion of assigned duties.
- Authorizing and coordinating the expenditure of funds.
- Coordinating all media releases about the review with Forest PAO Megan Cirullo (megan.cirullo@usda.gov).
- Issuance of Safety Alerts, if warranted, in coordination with Forest Safety Officer Peter Roginski (peter.roginski@usda.gov)
- Providing myself or my designee with status updates as the situation dictates.

As clarified in the attached expectations from your team, it is my intention that no punitive actions, such as removal or termination from their position, will be taken by the Forest Service against any employee as a result of information provided to any member of your team. Information provided to your team may however be used by individual supervisors at their discretion to inform discussions with employees pertaining to their individual performance.

I want to thank you for your willingness to lead this important review. Please contact Kashima Gresham at 404-347-4177 or kashima.gresham@usda.gov to schedule meetings or status updates.

Approved By:

Digitally signed by Edward Hunter
Date: 2024.04.29 15:13:50 -04'00'

Edward Hunter, Deputy Regional Forester

Accepted By:

/s/ CAVAN FITZSIMMONS Digitally signed by CAVAN FITZSIMMONS
Date: 2024.04.29 16:01:50 -04'00'

Cavan Fitzsimmons, Co-Team Lead

/s/ DANIEL MARTIN Digitally signed by DANIEL MARTIN
Date: 2024.04.30 09:08:06 -04'00'

Dan Martin, Co-Team Lead

Enclosures: Expectations for Conduct of Sinking Creek Rx / Huckleberry Knob Declared Wildfire Review

cc: Joby Timm, Colton Moor, Shardul Raval, Andrew Baker, Michael Ward

Appendix E: Chronology of Events

Sinking Creek RX Burn/Huckelberry Knob Wildfire Timeline 4/23/2024

0300 – 0359

- 0318 Spot forecast delivered to EDRD for 0500 ignition of Sinking Creek Rx Burn

0500 – 0559

- 0513 Eastern Divide Portable RAWS reported RH of 68% (Up 4%). NWS Forecast reported RH of 49%

0600 – 0659

- 0613 Eastern Divide Portable RAWS reported RH of 72% (Up 4%). NWS Forecast reported RH of 54%

0700 – 0759

- 0713 Eastern Divide Portable RAWS reported RH of 76% (Up 4%)
- 0724 NWS Blacksburg releases daily morning weather balloon. Results show that the precipitable water (depth of water in a column of the atmosphere) measured was drier than 90% of climatology for the day dating back to 1996
- AFMO met with Forest Supervisor, got the forest approval and uploaded all documents in the regional queue

0800 – 0859

- 0813 Eastern Divide Portable RAWS reported RH of 69% (Down 7%). NWS Forecast RH of 49%
- 0815 VICC completed the burn notifications for Sinking Creek RX
- 0837 RXB2 on scene of Sinking Creek RX
- 0845 Regional Variance Approved and RXB2 Notified
- 0858 NWS Blacksburg issues a Special Weather Statement for Increase Fire Danger This Afternoon

0900 – 0959

- 0913 Eastern Divide Portable RAWS reported RH of 40% (**Down 29%**)
- 0949 All Resources arrived and briefed, all go/no go lists have been completed and, RXB2 notified and Test Fire starting
- 0959 Test fire Successful, continuing with burn

1000 – 1059

- 1010 NWS Blacksburg issues an Area Forecast Discussion with "Ample mixing today will drop relative humidity into the 20 percent range. Low humidity combined with warmer temperatures and breezy winds will be favorable for quickly spreading wild/brushfires"
- 1013 Eastern Divide Portable RAWS reported RH of 30% (**Down 10%)**. NWS Forecast RH of 41%
- 1040 UAS Aerial Ignition starting with UMR

1100 – 1159

- 1105 Burn Boss reports continuing with firing operations, establishing base line and continuing ignitions with UAS
- 1113 Eastern Divide Portable RAWS reported RH of 26% (Down 4%)

1200 – 1259

- 1213 Eastern Divide Portable RAWS reported RH of 21% (Down 5%), NWS Forecast RH of 32%

1300 – 1359

- 1300 weather taken onsite by kestrel loses 11% from 1200 reading
- Around 1300, hot mic from burn personnel that took 10+ minutes to clear
- 1313 Eastern Divide Portable RAWS reported RH of 20% (Down 1%)
- 1340 Job Corps Module pulled off north line to help suppress duff fires on eastern handline
- 1341 RXB2 reports continuing ignitions, 90% complete with baseline across top of unit, UAS ignitions continue

1400 – 1459

- 1400 First spot fire detected. RXB2 requested a Type 3 helicopter and called the FDO and the AA
- 1413 Eastern Divide Portable RAWS RH 17% (Down 3%). NWS Forecast RH of 25%
- 1429 Type 3 helicopter gets knee board from Dispatch
- 1445, RXB2 asked for a dozer, T6 engine, and a module a to help contain spot fire. A dozer, suppression module and type 3 IC were sent.
- 1452 T3 helicopter launches from airport in Blacksburg

1500 – 1559

- 1500 kestrel at drone site showed 15% RH
- 1500 last onsite weather of the day was broadcast over the radio
- 1511-1545 T3 helicopter was up over the fire. The pilot rejected the identified dip site and looked unsuccessfully for another dip site before departing fire and landing at Caldwell fields at 1545
- 1513 Eastern Divide Portable RAWS RH 17% (No Change)

- 1520 Both 38-acre and 139-acre spot fires reported and suppression efforts initiated

1600 – 1659

- 1603-1617 conversation took place between RXB2/Dispatch/T3 helicopter about dip site locations
- 1613 Eastern Divide Portable RAWS reported RH of 11% (Down 6%). NWS Forecast RH of 22%
- 1630 T3 helicopter lifted off from Caldwell Fields and was over the fire and dropped water on spot fire 2
- 1632 Craig Valley RAWS reported RH of 16% (Down 3%)
- 1649 T3 helicopter left fire and landed at Caldwell Fields

1700 – 1759

- 1700, FFMO worked on closing the Appalachian Trail, requesting additional resources
- 1700 the FFMO and FAFMO informed the AA and Forest Supervisor that there could be a wildfire declaration. They also spoke with the regional office about the situation
- 1700 T3 helicopter was over the fire again
- 1713 Eastern Divide Portable RAWS reported RH of 15% (Up 4%)
- 1723 T3 helicopter grabbed a bucket from a private pond but was unable to drop due to smoke issues on the fire
- 1732 Craig Valley RAWS reported RH of 11% (Down 5%)
- ZAFMO sent request for spot forecast to NWS Blacksburg. Contact info was included. No Observations but a Remark said “Please use nearest RAWS for current observations.” NWS Blacksburg still did not know about Eastern Divide RAWS
- 1742 Spot forecast was issued by NWS Blacksburg for Sinking Creek Unit 2

1800 – 1859

- 1800 the district Module started bringing fire along the north road, later tying it into drop point 18 to complete ignitions right around sunset
- 1800 call from dispatch on availability of T1 helicopter that evening. The helicopter was in the middle of pilot swap on that day
- 1805 T3 helicopter was back in the air
- 1813 Eastern Divide Portable RAWS reported RH of 24% (Up 9%). NWS Forecast RH of 26%
- 1830 T1 helicopter got call to launch for Sinking Creek RX
- 1832 Craig Valley RAWS reported RH of 10% (Down 1%)
- 1846 fire crossed Appalachian Trail and impacted private land
- 1850 T1 helicopter was enroute to Blacksburg. With 60-minute flight to Blacksburg, it arrived with only 20 minutes until sunset, so it did not fly the fire

- 1850 FDO called to NWS Blacksburg to report that the spot forecast issued early this morning had a min RH of 22% but they had teens to single digit readings on site of the RX burn. He also asked about the forecast for the next 7 days

1900 – 1959

- 1913 Eastern Divide Portable RAWS reported RH of 32% (Up 8%)
- 1928 NWS Blacksburg released daily evening weather balloon. Results show that the precipitable water (depth of water in a column of the atmosphere) measured was drier than 76-90% of climatology for the day dating back to 1996
- 1932 Craig Valley RAWS reported RH of 12% (Up 2%)

2000 – 2059

- 2013 Eastern Divide Portable RAWS reported RH of 38% (Up 6%) | NWS Forecast RH 37%
- 2032 Craig Valley RAWS reported RH of 39% (Up 27%)

2100 – 2159

- At 2100, the AA, FDO, FFMO and RXB2 discussed the possibility of declaring the RX a wildfire
- 2100 UAS Mod released
- 2113 Eastern Divide Portable RAWS reported RH of 41% (Up 3%)
- 2150 per the RXB2, there was a "box" around the fire. Additional resources would still be needed in the morning
- The Sinking Creek RX was declared a wildfire, its name changed to Huckleberry Knob and the RXB2 transitioned to ICT4

2200 – 2259

- 2200 AFMO built up the resources for the following day shift – a type 3 IC, contract crew and hotshot crew
- 2213 Eastern Divide Portable RAWS reported RH of 43% (Up 2%). NWS Forecast RH of 44%
- FIRB C released in order to come back in the morning as an IC if needed.

2300 – 2359

- 2230 AFMO left the incident to prepare for the next burn period and direct incoming resources as zone Duty Officer

Appendix F: Glossary of Key Terms

The main reference glossary for this guide is the National Wildfire Coordinating Group (NWCG) Glossary, which is updated periodically: http://www.nwcg.gov/.

AA – Agency Administrator.

AAR – After Action Review.

AD – Administratively Determined.

BehavePlus – The BehavePlus fire modeling system is a Windows®-based computer program that can be used for any fire management application that needs to calculate fire behavior. It uses specified fuel and moisture conditions to simulate surface and crown fire rate of fire spread and intensity, probability of ignition, fire size, spotting distance, and tree mortality.

BI – Burning Index.

Blackline/Blacklining – Preburning of fuels adjacent to and within a control line before igniting a prescribed burn. Blacklining is done prior to main ignitions to reduce heat on holding crews and lessen chances for spotting across control line.

Broadcast Prescribed Burning – Prescribed burning activity where fire is applied generally to most or all of an area within defined boundaries for reduction of fuel hazard, as a resource management treatment, or both.

Burn Boss (RXB2) – Person responsible for supervising a prescribed fire from ignition through mop-up. The Burn Boss is responsible for writing prescribed fire plans, determining when the prescribed fire is in prescription, obtaining smoke clearance and weather forecasts, notifying officials of the upcoming fire, and obtaining all qualified personnel and equipment needed to conduct and patrol the area. The Burn Boss must also ensure all operations are conducted in a safe manner and consider personnel and public safety during and after the prescribed fire.

Burning Season (In-Season Burning) – The number of days available each year for prescribed fire implementation is constrained by weather variables such as temperature, wind speed and relative humidity. In many areas, the season for prescribed fire implementation is late winter to early spring. Often, a narrow window of weather parameters is required due to safety issues, policy, and regulation, which will reduce the number of available days.

Chain – Unit of measure equaling 66 feet.

Chains Per Hour – The rate of fire spread is measured in “chains per hour.” A chain is 66 feet.

Chief’s Review – Chief’s 90-Day Prescribed Fire Program Review.

CIO – Chief Information Office.

COOP – Continuity of Operations.

Crown Fire – A fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as “running” or “dependent” to distinguish the degree of independence from the surface fire.

CRWB (Crew Boss) – A person in supervisory charge of usually 16 to 21 firefighters and responsible for their performance, safety, and welfare.

Declared Wildfire Review – Per Forest Service Manual (FSM) 5140, all prescribed fires that result in a wildfire declaration must be reviewed according to the procedures found in the NWCG Standards for Prescribed Fire Planning and Implementation, PMS 484.

Dozer – DZIA

DR – District Ranger, specifically the EDRD District Ranger (who was newly-detailed into a staff officer position).

Drop Point – A previously agreed upon rendezvous or supply location noted on situational maps.

Dry Bulb Temperature – The ambient air temperature that is measured by a thermometer.

Duty Officer (DO) – Individual working for a jurisdiction or agency responsible for coordinating that agency (Wildland Fire Response) on a given day.

EA (Environmental Assessment) – A requirement of National Environmental Policy Act (NEPA), an EA evaluates the potential impacts of proposed actions, such as a prescribed fire, on the environment and suggests alternatives, or mitigations, to reduce or eliminate these impacts.

EIS – Environmental Impact Statement.

ERC (Energy Release Component) – Index of the National Fire Danger Rating System (NFDRS) relating to the available energy (BTU) per unit area (square foot) within the flaming front at the head of a fire. It is a cumulative or “build-up” type of index and is an indicator of potential fire intensity.

Escaped Prescribed Fire – A prescribed fire that has exceeded or is expected to exceed prescription parameters or otherwise meets the criteria for conversion to wildfire. Criteria are specified in “Interagency Prescribed Fire – Planning and Implementation Procedures Reference Guide.”

FDFM (Fine Dead Fuel Moisture) – The moisture content of dead organic fuels, expressed as a percentage of the oven dry weight of the sample, that is controlled entirely by exposure to environmental conditions.

FDRA – Central Fire Danger Rating Area.

FEMO (Fire Effects Monitor) – The Fire Effects Monitor is responsible for collecting the on-site weather, fire behavior, and fire effects information needed to assess whether the fire is achieving established resource management objectives.

FEMS – Fire Environment Mapping System.

FFMO – Forest Fire Management Officer.

FFPv5 (Fire Family Plus) – Software for summarizing and analyzing daily weather observations and computing Fire Danger indices based on the U.S. National Fire Danger Rating System

FFT1 (Firefighter) – A working leader of a small group (usually not more than seven members), who is responsible for their performance, safety, and welfare.

FFT2 (Firefighter) – Firefighter Type 2.

Fine Fuels – Fast-drying dead or live fuels, generally characterized by a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a time lag of one hour or less. These fuels (grass, leaves, needles, etc.) ignite readily and are consumed rapidly by fire when dry.

FIRB (Firing Boss) – The Firing Boss reports to the Prescribed Fire Burn Boss and is responsible for supervising and directing ground and/or aerial ignition operations according to established standards in the Prescribed Fire Plan.

Fireline – The part of a containment or control line that is scraped or dug to mineral soil.

FLA (Facilitated Learning Analysis) – A non-punitive accident review process that seeks to

understand the events of an accident through the process of "sensemaking." The FLA process seeks to understand "how" it made sense to those involved, rather than "how" it makes sense in hindsight.

FlamMap (Fire Behavior Mapping and Analysis Program) – A fire behavior mapping and analysis program that computes potential fire behavior characteristics (spread rate, flame length, fireline intensity, etc.).

Flash Fuels – Highly combustible fine fuels such as grass, leaves, draped pine needles, fern, tree moss and some kinds of slash that ignite readily and are consumed rapidly when dry.

FM – Fuel Moisture.

FOBS (Field Observer)—this position is responsible for collecting and reporting situation information for an incident.

Foliar Moisture – The moisture content of the conifer needles in tree crowns. It is used along with surface fire intensity and crown base height as input to the crown fire initiation model.

FS – Forest Supervisor.

FSR – Forest System Road.

Fuel Loading – The amount of flammable material that surrounds a fire. Fuel load is measured by the amount of available fuel per unit area, usually tons per acre. A small fuel load will cause a fire to burn and spread slowly, with a low intensity.

FVS (Forest Vegetation Simulator) – The FVS is a forest growth simulation model that simulates forest vegetation change in response to natural succession, disturbances, and management.

GACC – National Geographic Area Coordination Center.

GWJ or GWJeff – George Washington and Jefferson National Forests.

IAP – Incident Action Plan.

IC – Incident Commander.

ICS – Incident Command System.

IDT – Interdisciplinary Team.

IHC – Interagency Hotshot Crew.

IMET – Incident Meteorologist.

Incident – An occurrence either human-caused or natural phenomenon, that requires action or support by emergency service personnel to prevent or minimize loss of life or damage to property and/or natural resources.

KBDI – Keetch-Byram Drought Index.

Kestrel – The brand name of an electronic, handheld instrument used to measure weather

observation elements including temperature, wind and humidity.

Kneeboard – Keeps flight-pertinent information close at hand, literally at the knee. It may have charts and other critical flight information for a helicopter.

LANDFIRE – A data management program that delivers spatial data related to vegetation, fuel, disturbance, and fire regimes. Designed to be used at a landscape-scale to support strategic vegetation, fire and fuels management planning to evaluate management alternatives across boundaries and facilitate national- and regional-level strategic planning and reporting of wildland fire management activities.

LMR – Land Mobile Radio.

LRMP – Land and Resource Management Plan.

National Wildfire Coordinating Group (NWCG) – An operational group designed to coordinate programs of the participating wildfire management agencies.

NFSE – National Forest Salary and Expense

NFDRS – National Fire Danger Rating System.

NFS – National Forest System.

NWS – National Weather Service.

PL – Preparedness level.

PMS – Publications Management System.

POI – Probability of Ignition.

Prescribed Fire Burn Boss – Type 2 (RXB2) – Person responsible for supervising a prescribed fire from ignition through mop-up. See definition for “Type” below.

Prescribed Fire Plan – A plan required for each fire application ignited by management. It must be prepared by qualified personnel and approved by the appropriate Agency Administrator prior to implementation. Each plan will follow specific direction and must include critical elements and how to mitigate each element.

Prescription Guidelines – Guidelines used to show upper and lower reaches of a prescription.

Rapid Lesson Sharing (RLS) – A process for field personnel to quickly share lessons with others. RLS can be used to document and share lessons learned as a result of close calls, minor accidents, successes, efficient ways of performing work, adaptations, or anything from which wildland fire personnel can learn.

RAWS (Remote Automatic Weather Station) – A weather station that transmits weather observations via GOES satellite to the Wildland Fire Management Information system.

RD – Ranger District.

RO – Regional Office (specifically Region 8).

ROS – Rate of Spread.

RX – Prescribed Fire.

RXA2 – Prescribed Fire Agency Administrator-Moderate Compexity.

RXB2 – Burn Boss.

SFDI (Severe Fire Danger Index) – A Fire Danger index developed by Dr. Matt Jolly that combines two separate Fire Danger indices: Energy Release Component (ERC) and Burning Index (BI).

SME – Subject Matter Expert.

SO – Forest Supervisors Office.
SOP – Standard Operating Procedure.
Spot Fire – Fire ignited outside the perimeter of the main fire by a firebrand.

Spot Weather Forecast (NWS) – A site-specific forecast issued by the National Weather Service (NWS) to fit the time, topography, and weather of a specific incident. These forecasts are issued upon request of the user agency and are more detailed, timely and specific than zone forecasts. On-site weather observations or a close, representative observation is required for a forecast to be issued.

Spotting – Behavior of a fire producing sparks or embers that are carried by the wind and start new fires beyond the zone of direct ignition by the main fire.

Slopover – A fire edge that crosses a control line or natural barrier intended to confine the fire.

Stream Wet Bulb Temperature – Dry bulb and wet bulb are used to calculate relative humidity. Wet bulb temperature is measured by sling psychrometers within a belt weather kit using thermometers that are wrapped in wetted wicks. The higher the difference between the dry bulb and wet bulb temperatures
(called the depression), the greater the felt effect is on the discharge air temperature.

Type 1/2/3 – Refers to resource capability. Resource typing provides managers with additional information in selecting the best resource for the task.

UAS – Unmanned Aircraft System.

USDA Forest Service – United States Department of Agriculture Forest Service.

USGS – United States Geological Survey.

UTV – Utility Task Vehicle.

Variance – Exceptions to prescribed fire parameters outlined in Forest Service Manual (FSM) 5140 that are granted on a case-by-case basis. Depending on the deviation from the established parameter, approval may be required at the Forest or the regional level.

VICC – Virginia Interagency Coordination Center.

WF – Wildfire.

WFA2 – Wildfire Agency Administrator Type 2.

WFDSS (Wildland Fire Decision Support System) – Map-based application that displays information to agency administrators, line officers, fire managers, and analysts as they move through the risk-informed decision process for wildland fire. Combines desktop applications for fire modeling into a web-based system.

WFSE – Wildland Fire Salary and Expense.

WildCAD-E – A Commercial Off the Shelf (COTS) Computer Aided Dispatch (CAD) system

developed by Bighorn Information Systems for wildland fire agencies.

Wildfire – An unwanted wildland fire.

Wildland Fire – Any nonstructural fire, other than prescribed fire, that occurs in the wildland. This term encompasses fires previously called both wildfires and prescribed natural fires.

Wildland Urban Interface (WUI) – The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetation fuels.

WIMS – The Weather Information Management System (WIMS) is a comprehensive system that helps users manage weather information. WIMS serves as the host for the National Fire Danger Rating System (NFDRS), incorporating both the 1978 and 1988 fuel models.

ZFMO – Zone Fire Management Officer.

Appendix G: Declared Wildfire Review Team

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