Holloway Fire Entrapment/Shelter Deployment

Accident Investigation Report

Bureau of Land Management
Winnemucca District
Vale District
Burns District

8/12/2012

Investigation Team
Holloway Fire Entrapment/Shelter Deployment

9/27/2012

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9.27.12

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Executive Summary

On August 12, 2012, at approximately 1800 hrs, a significant event occurred on the Holloway Incident in Division W. During a burnout operation, a crew member became separated from her crew and walked into an unburned area of the fire. The separation was partially due to a weather event resulting in a 180 degree wind switch along with high winds that spread fire outside of control lines and reduced visibility to near zero.

Realizing she was lost, with the fire gaining on her, physical and environmental factors were reducing her ability to stay ahead of the advancing fire. Unable to return to the safety zone, she was forced to deploy her fire shelter and was quickly overrun by the fire. She remained in the fire shelter for approximately 30 minutes and survived.

At approximately 1830 hrs she was located by her crew, transported to helibase for an initial assessment and medivaced to Humboldt General Hospital in Winnemucca, Nevada for a full evaluation. The following day she was flown to University of Utah Burn Center, evaluated and released.

Injuries consisted of several nickel to quarter size burns on her left arm, side and leg. She flew home on August 13, 2012.

Investigation Process

Following the fire entrapment/shelter deployment, the Incident Commander and Deputy Incident Commander notified all the Agency Administrators who notified their respective State Offices. Under a delegation of authority signed by both the Nevada and Oregon Associate State Directors, an accident investigation team was ordered on August 12, 2012, and the team assembled in Winnemucca, Nevada on August 13, 2012. The delegation required the team to identify and determine the key events, deficiencies, conditions, risk factors, and system failures that contributed to the entrapment/shelter deployment. The team's recommendations were to consist of improvements or preventative measures that could potentially prevent similar future accidents.

The investigation team consisted of the following:

- Chuck Schmidt, Investigation Team Lead, BLM New Mexico, Roswell Field Office Manager
- Kato Howard, Fire Behavior Analyst, BLM Alaska Fire Service, State Fuels Specialist
- Bradley Richardson, Documentation/Writer, BLM Nevada State Office, Management Assistant
- Chris Delaney, Operations, BLM Utah State Office, Deputy State FMO
- Kyle Cowan, Operations, BLM Colorado State Office, State Fire Operations Specialist

- Tony Petrilli, Shelter/PPE Specialist, USFS Missoula Development and Technology Center
- Duane Tewa, Bureau of Indian Affairs Representative, BIA Southwest Region, Assistant Regional FMO
- Tom Andrade, Oregon Department of Forestry Representative, Interface Fire Specialist

The team conducted interviews with parties involved. Site visits were conducted and all Personal Protective Equipment (PPE) and gear were inspected and evaluated for effectiveness. All witness statements, unit logs, dispatch logs, fire behavior runs and supporting documentation was collected and reviewed to assist in developing the findings and recommendations. Meteorological expertise was provided by the National Weather Service Office out of Elko, Nevada. GIS support was provided by the Nevada and Utah State Office.

Prologue

In the face of adversity the Interagency Hotshot Crew (IHC) member's equipment, training and the ability to think clearly, stay calm, and act decisively, prevented serious injury and saved her life.

Narrative

The following is a narrative of the events and actions that took place related to the Holloway fire shelter deployment. This narrative is based on site visits, technical evaluation of materials and equipment that remained on the site after the burnover. The team utilized fuel conditions, weather conditions, training records, equipment performance, and interviews with over thirty five individuals. Additional details, maps, photographs and technical reports relevant are contained in the appendices and findings sections of the report.

The Holloway fire was reported on August 5, 2012. The fire was burning the Bureau of Land Management (BLM) lands in Nevada south of the Oregon state line. Initial attack action was not successful and an Incident Management Team (IMT) was ordered based on a complexity analysis. On August 7, 2012, the Great Basin type 2 team took command and began suppression actions to contain the rapidly spreading fire.

Initially the terrain is flat to gentle rolling; the fire was burning in a north to northeast direction moving into the Trout Creek Mountains in Oregon. The fire was burning in grass at lower elevations and transitioned into heavier fuels as the fire moved into higher elevation.

Due to higher priority fires, critical resources ordered by the IMT such as crews, overhead and equipment were not filled.

The Zuni IHC's first shift on the Holloway Fire was on August 6, 2012. Two crew members were filling in for vacant positions, firefighter A was a fill in. Although she was a fill in, she had four years of firefighting experience and prior experience with Zuni IHC.

For the next several days, Zuni IHC worked multiple divisions on the south and east side of the fire. On the morning of August 12, 2012, overhead, equipment and crews were spiked at the Zimmerman Ranch and were briefed via radio. Although Zuni IHC had been assigned to the eastside of the fire from the beginning, they did not appear in the IAP on August 12, 2012. A quick tactical meeting occurred between Zuni IHC and Prescott IHC. The plan was to burn out from the intersection of the 15 Mile Rd. and White Horse Canyon Rd. (referred to as the 4-Way). The plan included the two IHCs and Engine 2619. The operation was delayed due to numerous factors; briefing location mix-up, vehicles issues, lengthy delays on VLAT drops. At 1500 hrs the two crews began a firing operation, Zuni IHC burning to the west along the White Horse Canyon Rd. and Prescott IHC burning to the south along 15 Mile Rd.

The Zuni IHC Superintendent, Prescott IHC Superintendent, and Task Force Leader (TFLD) A, noticed a group of personnel and equipment west of their location and moved to their location. When they arrived they found the Rangeland Fire Protection Associations working along the White Horse Canyon Rd. conducting firing and holding operations. The Rural Fire Protection Association (RFPA) were working with a BLM resource advisor (see map #6). The Zuni IHC Superintendent discussed their firing operation in an effort to coordinate tactics. Upon learning that Division W had a need for water handling support; the RFPA sent two type 6 engines to help Zuni IHC and Prescott IHC.

At approximately 1630 hrs, Zuni IHC suspends burning to refill drip torches. Weather observations observed by Zuni IHC were: dry bulb 83, wet bulb 57, RH 22, DP 40, winds 0-3 N to NE. The burnout was pulling directly into the main fire with a favorable N, NE wind.

While refilling the torches a separate squad of Zuni IHC continued further west and tied in with the RFPA. The Zuni Squad IHC, the RFPA engines and Engine 2619 started to burn back to the east towards the original Zuni IHC Squad that was burning west.

At approximately 1730 hrs the crew experienced a wind shift and began getting spots across the line. Firing is suspended as the squads begin lining spots. The Zuni IHC Superintendent instructs the assistant Superintendent to move the crew and truck back to the safety zone at the 4-way. Assistant Superintendent instructs Firefighter A to move the truck; however Firefighter A finds that another crew member is in the process of moving the truck. This switch becomes important as there is general belief that Firefighter A is in the truck. Ultimately, this slows down the process of realizing Firefighter A is missing. A few minutes later the crew observes a fire whirl crossing their holding line (see map #4 and #5.)

At approximately 1745 hrs, Air Attack notices a 1/10 acre spot fire in Division P and a five acre spot fire in the southern end of Division W near the Zimmerman Spike Camp. Air Attack and the Operations Section Chief prioritize the spot fire in Division W and assign helicopter 8PT to begin bucket work.

Firefighter A is trying to catch up with the rest of the crew, she is heading east down the line. As she begins catching up to the last two crew members near Engine 2619, the wind velocity increases to the point that smoke, dust, debris and embers limited visibility to near zero. She veers off into the green and moves directly into the path of the fire, passing the engine and crew members on the road. The fire is now increasing in rate of spread and intensity.

The fire continues moving northeast into a dense mahogany thicket. At 1759 hrs Firefighter A radios the Assistant Superintendent saying she has fire on both sides of her and can hear the fire approaching from the rear.

Firefighter A moves into the only opening she can see, (see photo appendix C) removes her pack, gloves, then removes the fire shelter, discards her fuel bottle, and attempts to remove the radio and water from pack. She has difficulty retrieving the radio due to the remote microphone cord being intertwined in the line pack webbing. Time is running out, she shakes open the shelter and deploys directly over her pack; she ensures the floor of the shelter is tucked under her. As the flame front hits, smoke and heat entered the shelter.

In the shelter she is having a difficult time breathing due to the heat and smoke and holding on to the shelter. Since she does not have gloves, she pulls her neck shroud from her hardhat and wraps her hands in it for protection. In order to get cooler air, she digs a hole in the dirt and breaths through her shroud. She moves the pack to her right side as she originally was lying on top of it. After repositioning she is forced to the left side of the shelter and is pressed against the shelter material. Conduction of heat through the shelter material causes several second degree burns.

She can hear her crew calling for her on the radio, but is unable to answer as she did not want to let go of the shelter.

Helicopter 8PT is diverted from bucket work to assist in locating Firefighter A.

After what is estimated to be ten minutes, the air in the shelter begins to cool and she is able to call on the radio and state she is alright. The Assistant Superintendent tells her to stay in the shelter and they would come and get her. Several Zuni IHC crewmembers move into the fire area and begin searching for her. The fire remained active; smoke and heat limited the crew’s ability to see and move quickly.

Using her compass, she is able to give direction to the crew to help locate her. As the crew continues to search, Firefighter A could feel the heat increase in the shelter and is hit by a second wave of heat and smoke. Once the fire subsided she again began communicating with the crew regarding her location. At 1830 hrs she is located by her crew and is walked to Engine 2619. She is then transported to a helispot and flown to the Denio helibase for an initial assessment and first aid. From there she is flown to Winnemucca for additional evaluation and medical treatment.

The following morning she is flown to the University of Utah Burn Center where she was evaluated and released. That afternoon she was flown home in an agency aircraft.

Timeline

8/12/2012

- 1350 hrs- TFLD A, Zuni IHC Superintendent, Prescott IHC Superintendent and Engine 2619 hrs meet at the 4-way and devised the operational plan to burnout.
- 1355-1450 hrs TFLD A heads west on White Horse Canyon Rd. from 15 Mile Canyon Rd. and runs into two RFPA engines.
- 1450 hrs -TFLD A, Zuni IHC, Prescott IHC, Engine 2619 and two RFPA engines brief at junction of White Horse Canyon Rd. and 15 Mile Canyon Rd (commonly referred to as the "4-way")
- 1500 hrs - Prescott IHC begins firing operations at the 4-way headed south along 15 Mile Canyon Rd.
- 1515 hrs - Zuni IHC begins firing operations at the 4-way headed west along the White Horse Canyon Rd.
- 1600 hrs - The IMET/LTAN noticed the subsidence layer of the smoke column capped between 8,000' 10,000' over the fire

- 1630 hrs - Zuni IHC had to stop the burn to refill drip torch fuel
- 1630 hrs - Weather is 83/57, RH 22, DP 40 and winds 0-3 N/NE
- 1730 hrs - Crew Superintendent instructs Assistant Crew Superintendent to have truck moved. Assistant Crew Superintendent instructs Firefighter A to move the Crew Superintendent truck east towards the 4-way (see map#3)
- 1730 hrs - Crew noticed change from favorable wind direction and began experiencing spot fires
- 1734 hrs - Fire whirl observed crossing control line by Zuni IHC
- 1734 hrs - Zuni IHC stopped firing operations
- 1745 hrs - Air Attack notices .10 acre spot fire in Division P and a 5 acre spot fire in the southern end of Division W
- 1747 hrs - Air Attack had discussion with OSC2 to prioritize spot fire in Division W.

- 1750 hrs - Helicopter 8PT was ordered by Air Attack to start bucket work on the spot fire in Division W near the Zimmerman Ranch Spike Camp
- 1753 hrs -Air Attack notices 180 degree wind shift from the south to the north
- 1755 hrs - Squad noticed Firefighter A is separated from squad
- 1759 hrs - Firefighter A calls on the radio that she is about to be overrun by fire and is going to deploy fire shelter
- 1800 hrs - Firefighter A deployed fire shelter
- 1806 hrs - Air Attack gets a call from DIVS W there has been a shelter deployment and is requesting bucket work
- 1810 hrs - Air Attack contacts 8PT to divert to Division W; assist with locating Firefighter A
- 1825 hrs - 8PT gets contacted on air-to-ground by Firefighter C trying to direct him to begin flying grid pattern near shelter deployment site. After attempting to locate Firefighter A 8PT leaves immediate area, due to poor visibility
- 1830 hrs - Firefighter A located by crew members. 8PT hears on air-to-ground "we have found her" " we are walking out"
- 1835 hrs - Firefighter A was loaded into Engine 2619 for transport to helispot
- 1840 hrs - 8PT dumps water for dust abatement on helispot
- 1845 hrs - 8PT lands, disconnects bucket and loads Firefighter A for medevac
- 1847 hrs - 8PT in bound, heading to Denio Helibase with Firefighter A and Crew Superintendent
- 1902 hrs - 8PT arrives at Helibase, Firefighter A evaluated by ICP medical personnel
- 1935 hrs - 8PT leaves helibase with Firefighter A inbound to Winnemucca
- 2011 hrs - 8PT lands Winnemucca Airport, Firefighter A is transferred to ground ambulance and transported to Humboldt General Hospital
- Firefighter A released from Humboldt General Hospital and RON in Winnemucca

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- 0830 hrs - DOI Burn Protocol was followed, for precautionary measures, Firefighter A was taken to University of Utah Burn Center via agency aircraft
- 1200 hrs - Firefighter A was assessed and released
- 1500 hrs - Firefighter A and Crew Superintendent interviewed by investigation team at Eastern Great Basin Coordination Center
- 1730 hrs - Firefighter A and Crew Superintendent transported to home unit via agency aircraft

Findings and Recommendations

The investigation team identified all the findings as being contributing factors to the shelter deployment rather than individually identifying each finding as being a direct or indirect cause.

Finding #1: The Zuni IHC Hotshot Crew lost crew member accountability. The Crew Superintendent, Assistant Crew Superintendent and Squad Boss had lost situational awareness of crew member location. Firefighter A lost situational awareness while enroute to the safety zone.

> **Discussion:** As the Zuni IHC burned west along the White Horse Canyon Rd. from the 15 Mile Canyon Rd., the Crew Superintendent asked the Assistant Superintendent to have someone move the Crew Superintendent truck back towards the 15 Mile Canyon Rd. The Assistant Crew Superintendent asked Squad Boss A to move the Crew Superintendent truck back towards the crews vehicles located in a safety zone at the 4-Way (See map #3.) Squad Boss A asked Firefighter B to move the vehicle, at the same time as that conversation was happening, Firefighter D told Firefighter A to move the same vehicle. As Firefighter A turned around and started to walk towards the vehicle, Firefighter A realized that Firefighter B had already started to move the vehicle. Firefighter A then turned around to resume in the same direction that the squad was told to go. This left several people thinking that Firefighter A was the person moving the vehicle. This put Firefighter A behind the rest of the Squad. Firefighter A hurried and caught up with Firefighter E but due to thick smoke and ash Firefighter A and Firefighter E became separated. Firefighter A tried to contact Firefighter D on the radio with no success. Firefighter A continued north up the hill attempting to find cleaner air (See map #4), she quickly found herself ahead of the advancing flame front. Firefighter A contacted the Assistant Crew Superintendent and notified him that she was exhausted and she was going to deploy her shelter.
>
> **Recommendation**: In cases where the crew utilizes escape routes and safety zones, crew member accountability needs to be continually evaluated. Anytime the crew stops, a head count needs to occur for accountability. Crews should evaluate pairing crew members up so that during emergency situations pairs of people are looking out for each other.

Finding #2: Firefighter dropped gloves prior to shelter deployment

> **Discussion:** During a dynamic deployment Firefighter A removed her pack, removed her gloves, and attempted to recover her radio and water bottle. When asked why she removed her gloves she replied “I do not know”.
>
> **Recommendation:** Stress during an emergency often results in individuals retreating to learned and practiced techniques accompanied by loss of fine motor skills with muscle memory serving as the means of accomplishing a critical task. Anytime fire shelter

deployment is practiced or taught; participants must wear gloves as they should during an actual deployment.

Finding #3: Shelter deployment training was not fully followed

Discussion: Firefighter A deviated from training by removing her gloves and taking her pack into the shelter.

Recommendation: Emphasis should be put on shelter deployment training to be conducted under wildland settings, using actual assigned fire gear. The need for radio communications and water is ancillary during shelter deployment.

Finding #4: Radio microphone cord was woven through line gear webbing which prevented firefighter from disconnecting radio and microphone from line gear during shelter deployment.

Discussion: Firefighter A tried to disconnect radio and microphone from line gear to take into shelter during deployment. The microphone cord was interwoven into drag loop of pack. When Firefighter A could not disconnect radio and microphone, she decided to take the pack into the shelter with her.

Recommendation: Firefighters using radio microphones should refrain from looping microphone cord through fireline pack webbing, allowing the cord to hang free and available to be removed quickly. During fire shelter deployment refreshers, firefighters should practice deployments with anticipated equipment and still meet timeframes of getting in the shelter.

Finding #5: Operational success and planning was hindered due to the lack of available resources within the Great Basin and resources loaned by Oregon BLM were only available until a new initial attack was reported.

Discussion: Due to the lack of available resources within the Great Basin, the Vale and Burns Districts loaned the Incident Management Team engines and dozers. It was understood these resources could be pulled anytime a new initial attack fire was reported. It made the Incident Management Team's planning extremely difficult because resource certainty was unknown. Additional resources were available in the Pacific Northwest Geographic Area, but because of a lack of cooperation/coordination between neighboring dispatch centers orders were not filled.

Recommendation: Neighboring dispatch centers need to work together to optimize the dispatching/ordering system that best supports the Incident Management teams ordered.

Finding #6: The IMT, the BLM, and Rangeland Fire Protection Association (RFPA) did not effectively communicate or coordinate.

Discussion: The complexity of the subject and the ability to recognize responsibilities and jurisdictions of local firefighting resources was a critical point to understand. Private land fire suppression responsibility in the State of Oregon is complex, in fact, some areas are unprotected. Organizing RFPA is a process the Oregon Board of Forestry and private landowners are utilizing to address this issue. Rangeland fire protection associations are nonprofit, locally governed and operated by landowner. They are organized to provide fire protection on rangeland areas of eastern Oregon, which are outside of both a forest protection district and a rural fire district. State statutes provide for the formation of these associations under the authority of the Board of Forestry.

In the Delegation of Authority to the type II team there is no inclusion of the state, county, RFPA or local official i.e. County Judge on the document.

Recommendation: All resources engaged with fire suppression activities should be directed by the Incident Commander after the delegation is signed and the management of the incident is officially transitioned.

Good communication between the IMT and agency administrators is important. Clear expectations and contact information for local resources would also be key information provided to IMTs. If the RFPA is not signatory to the Delegation of Authority, they should be included in developing the objectives in the delegation. They also should be included in transition briefings and incorporated into IAPs as part of the operation or as a cooperating agency where jurisdictions involve private lands protected by a RFPA.

Efforts should be made to bring agency administrators together sharing jurisdictional boundaries between Oregon and Nevada. A post fire season meeting would serve as a good venue to discuss the events of this season, and lead to lessons learned to be applied to the following fire season. Additionally a pre-season meeting with ODF, FS, BLM, RFPAs and local fire defense personnel to discuss operational protocols, any jurisdictional issues, share mobilization guides, update cooperator information prior to high fire activity levels should happen prior to fire season. Initial pre and post meetings will also serve as excellent platforms to discuss Oregon's RFPA program and to better understand local land ownership issues. Districts within BLM Oregon should ensure current cooperative agreements are in place with all RFPA within and/or adjacent to district boundaries.

Finding #7: Not all Resource Advisors supported the strategies and tactics of the Great Basin IMT.

Discussion: Resource Advisors were working independently with RFPAs and were openly critical of the IMT strategies and tactics. There was a lack of coordination and cooperation between resource advisors and the IMT.

Recommendation: Regardless of jurisdiction, Resource Advisors assigned to a team must develop a working relationship; assist, support agreed upon strategies, and resolve issues. In that environment all participants need to pull together to maximize efficiency, safety and team cohesion.

Finding #8: Lack of clarity within the IAP resulted in confusion in management oversight.

Discussion: Not all Division W resources, or overhead were documented in the IAP. Division breaks were not present on map. Accountability of all personnel on the fireline is the IMT's responsibility. Well documented chain of command is critical to firefighter safety.

Recommendation: Document all resources assigned to a fire. Update maps daily.

Finding #9: Several of the resources assigned to Division W were unclear as to who was the Division Supervisor.

Discussion: Prior to August 12th, most resources had been on Division Z; August 12th was their first day on Division W. Along with the resources, DIVS Z came onto Division W to scout fire progression and gather intelligence for the OSC2. Realizing there was a lack of mid-level supervisors; Division Z stayed on Division W and performed the role of TFLD.

Recommendation: As line overhead transition into different roles, it needs to be clearly articulated and communicated to all fireline personnel.

Finding #10: Local and accurate weather data for the north end of the fire was not available.

Discussion: Fire behavior and weather predictions depend on localized weather data. The fire is intersected in the middle with an east to west range of mountains. The closest weather data available to the IMT was on the southern end of the fire. This weather station is on the south facing slope, with a lower elevation than the north end of the fire. The IMT ordered a portable RAWS station to place in the northern end of the fire. As of August 15th, the team had not received the Remote Automotive Weather Station (RAWS).

Recommendation: GACCs should consider supporting teams with a portable RAWS for every assignment.

Finding#11: Dust devils are not commonly addressed in weather synopsis.

Discussion: Dust devils and fire whirls are not addressed in weather synopsis and are excluded from IAP discussions, because they are unpredictable and no standards or characteristics of developing situations are currently established.

The potential effect dust devils have on firefighting activity would have increased situational awareness of personnel in Division P and Division W.

Recommendations:
1. The fire behavior and weather communities should develop indicators and characteristics for dust devil and fire whirls to inform firefighters.
2. Standards for 'watches", "warnings" and "advisories" regarding dust devils and fire whirls should be created.
3. Definitions and language should be developed for Incident Meteorologist (IMET) and Fire Behavior Analyst (FBAN) to be included in briefings and IAPs.

Finding# 12: There was a loss of situational awareness of fuels, weather and fire behavior by personnel on the fire.

Discussion: There were many environmental indicators that individually were relatively minor indications of future fire control problems in Division P and Division W. In a global view with all the combined indicators firefighters may have been able to predict future control issues. Multiple Firefighting Orders and Watchout Situations address these concerns.

Standard Firefighting Orders	18 Watchout Situations
#2 Know what your fire is doing at all times.	#4 Unfamiliar with weather and local factors influencing fire behavior.
#3 Base all actions on current and expected behavior of the fire.	#14 Weather is getting hotter and drier.
	#15 Wind increases and/or changes direction.
	# 16 Getting frequent spot fires across line.

Personnel receive an annual safety and fireline refresher however fuels, weather and fire behavior are only discussed during significant trends not as a refresher for the basics. Firefighters receive training during S190, S290 and S390, but time frames between classes may be 3 to 4 years.

Recommendation:
Create an annual fireline refresher specific for fuels, weather and fire behavior.

Conclusions and Observations

On August 12, 2012, the Zuni IHC was performing suppression actions on Division W of the Holloway Fire. The incident was being managed by a Great Basin Type 2 IMT.

The Zuni IHC, TFLD A and Prescott IHC devised a plan to help contain the northeast side of the fire, which was a critical resource area identified by local District BLM administrators as valuable sage grouse habitat. All parties involved felt the plan of operation was safe and had a high probability of success. Zuni IHC and Prescott IHC began firing operations at 1500 hrs, with Prescott IHC proceeding south along the 15 Mile Canyon Rd. and Zuni IHC proceeding west along the Whitehorse Canyon Rd. All operations were going as anticipated. However, there were indicators early on that could have contributed to the outcome of the fire shelter deployment directly and indirectly.

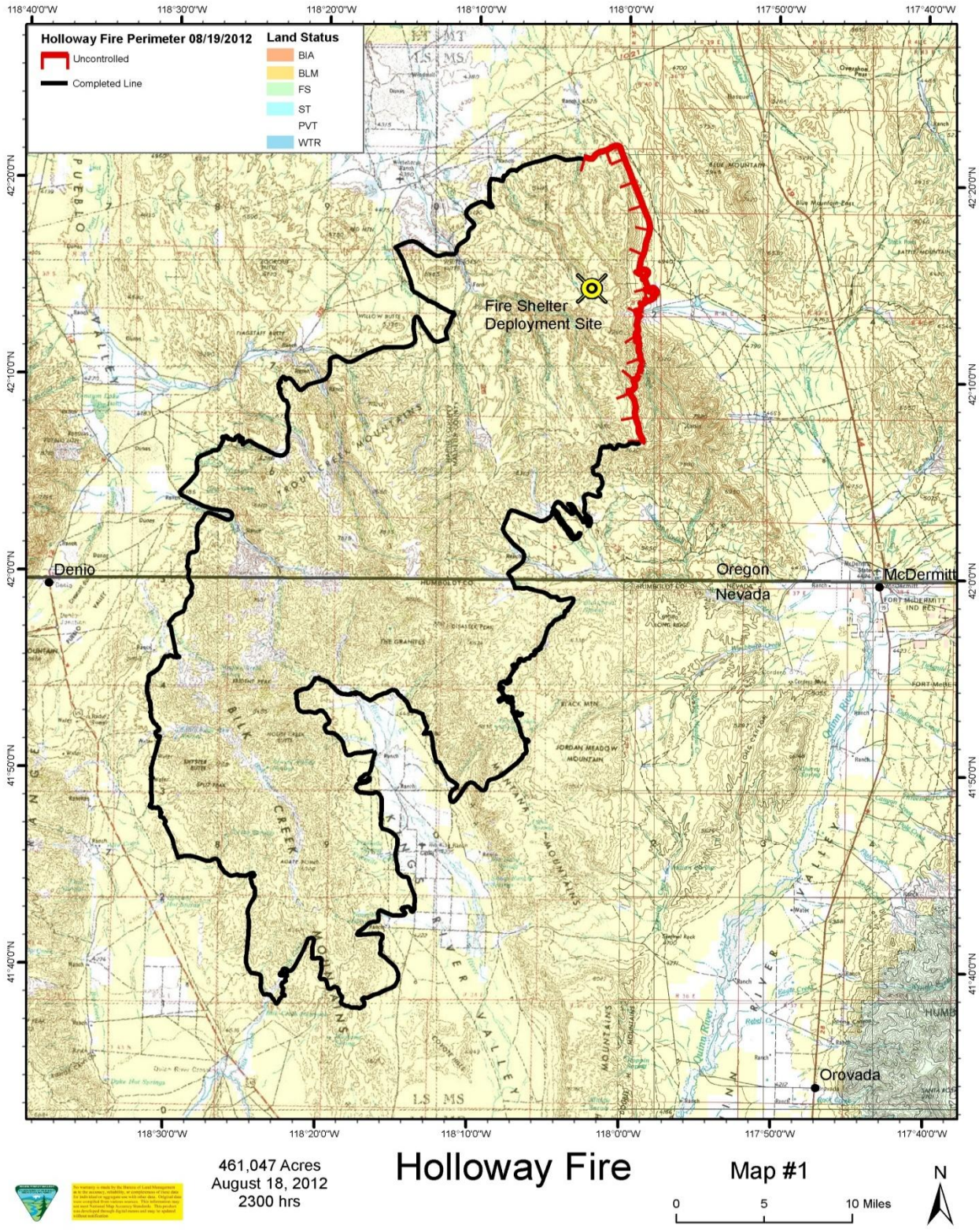
It was determined through interviews that during the shelter deployment Firefighter A deviated from proper training protocol for deploying a fire shelter; in addition there were some protocols identified that need to be re-emphasized during refresher training. The following Lessons Learned should serve as a reminder to all personnel:

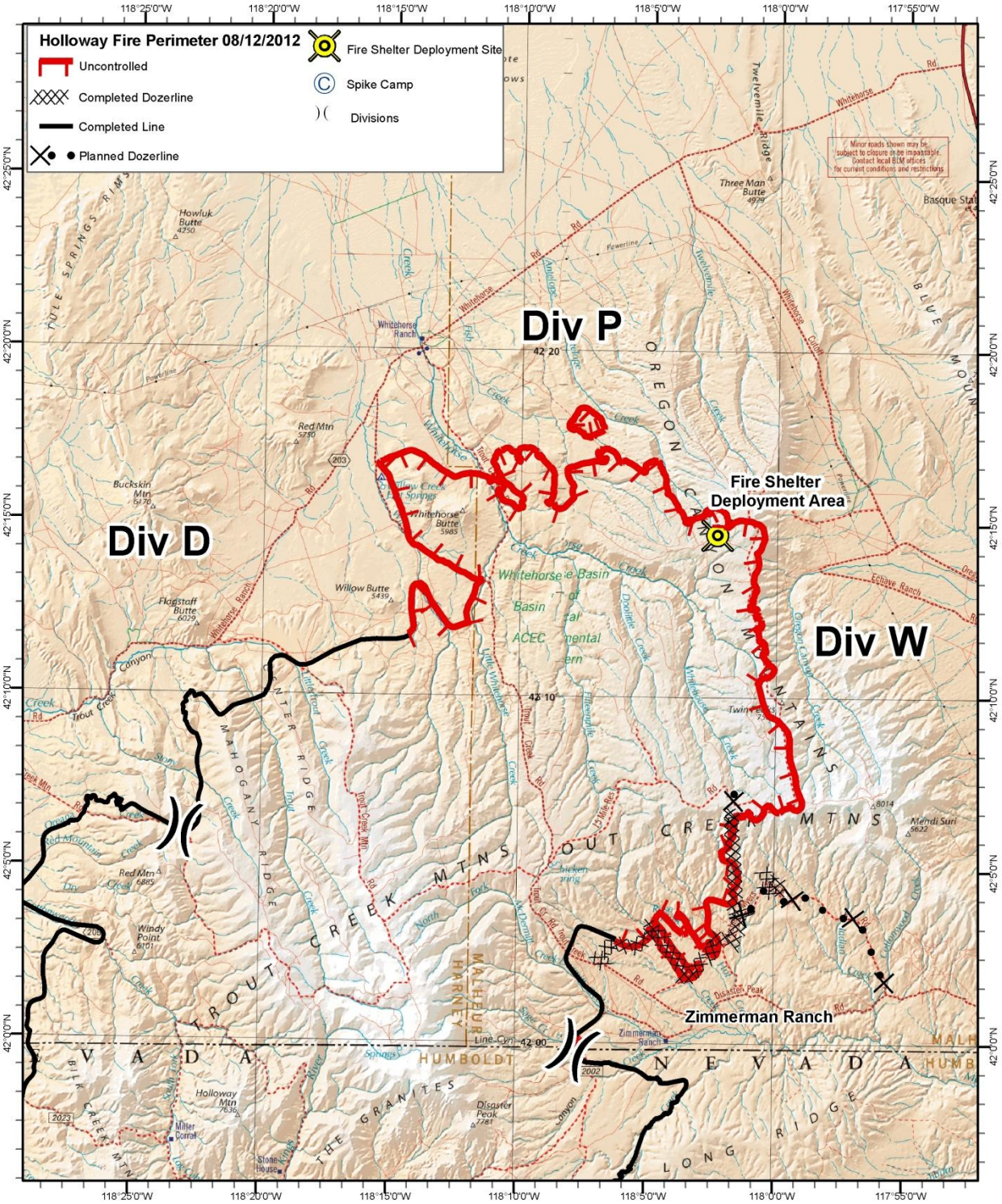
- Firefighters should practice deploying fire shelters with gloves.
- An accountability process should be established and implemented to ensure all firefighters maintain situational awareness.
- Ensure radios can be easily removed from packs.
- Practice identifying locations for deploying fire shelters having the highest probability of survival.
- Emphasis should be put on shelter deployment training to be conducted under wildland settings, using actual assigned fire gear.
- The need for radio communications and water is ancillary during shelter deployment.

Other notable observations include:

- During a 24 hour timeframe the IMT had multiple unplanned events occur. Other notable events include a lost firefighter, an electrical outage at ICP, UTV rollover, a cow being hit by an Engine, firefighter reporting chest pains, unaccounted for ranch workers and private fire resources. All of these incidents were managed with professionalism, and strong team work, resulting in a positive outcome.
- The WFDSS process is under powered. During the development stages for the Holloway fire the WFDSS program was taking 14 hrs to process. Many instances it would disconnect users from the program entirely.

Maps/Photos/Illustrations





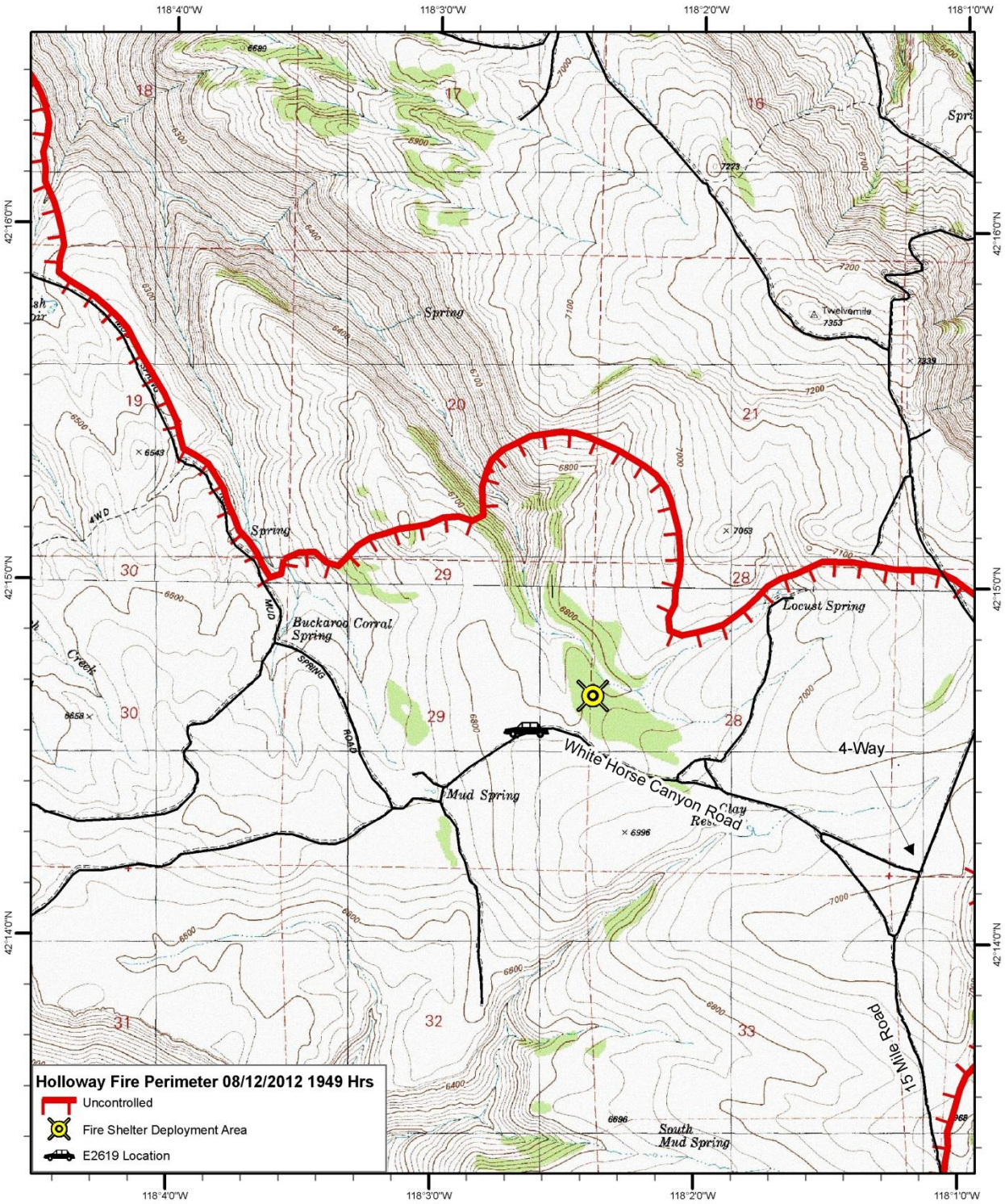
366,770 Acres
August 12, 2012
1949 Hrs

Holloway Fire

Map #2

0 5 10 Miles

N



366,770 Acres
August 12, 2012
1949 Hrs

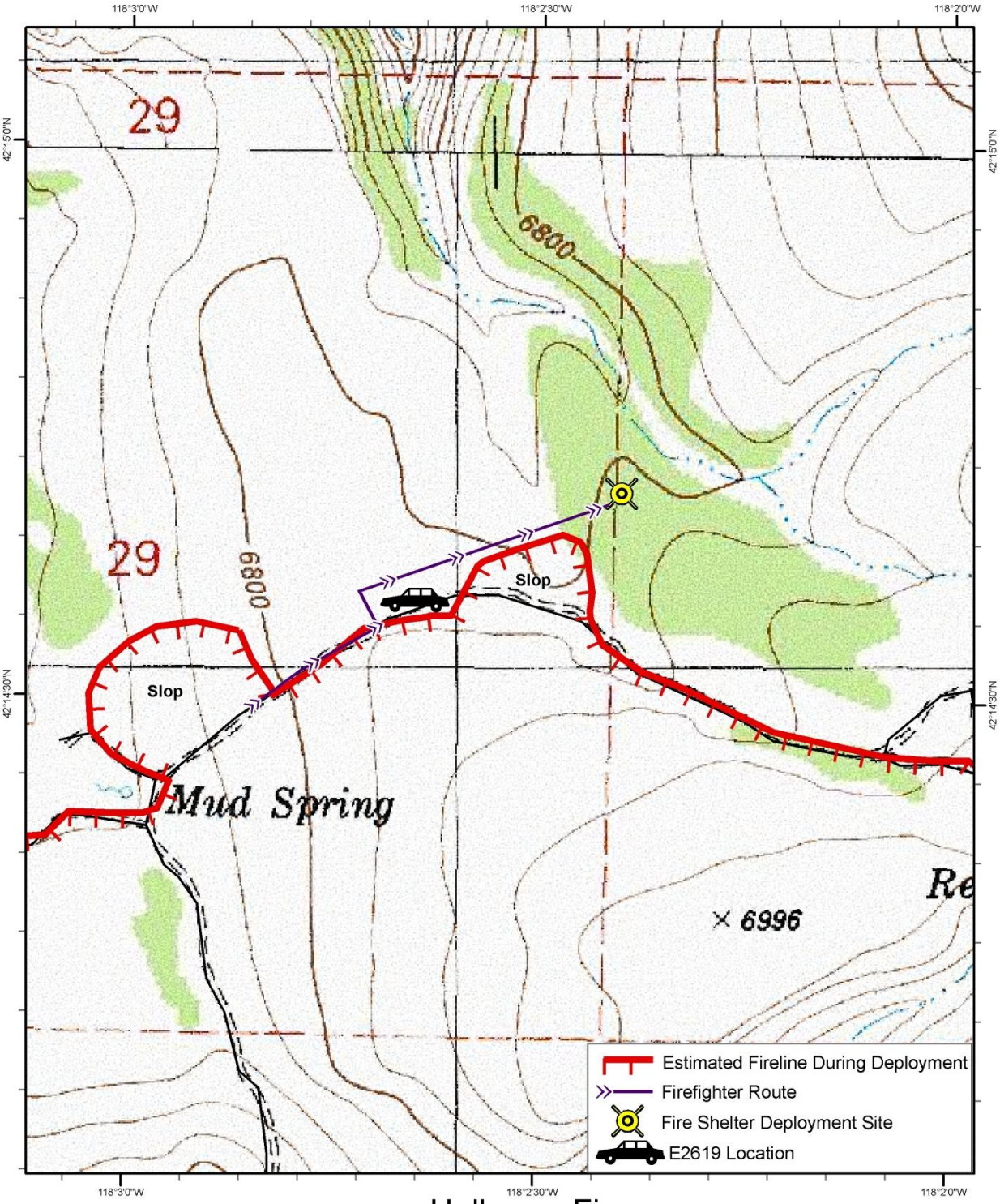
Holloway Fire

Fire Shelter Deployment Site
& Vehicle Location

Map #3

0 0.25 0.5 Miles

N



August 12, 2012
1759 Hrs

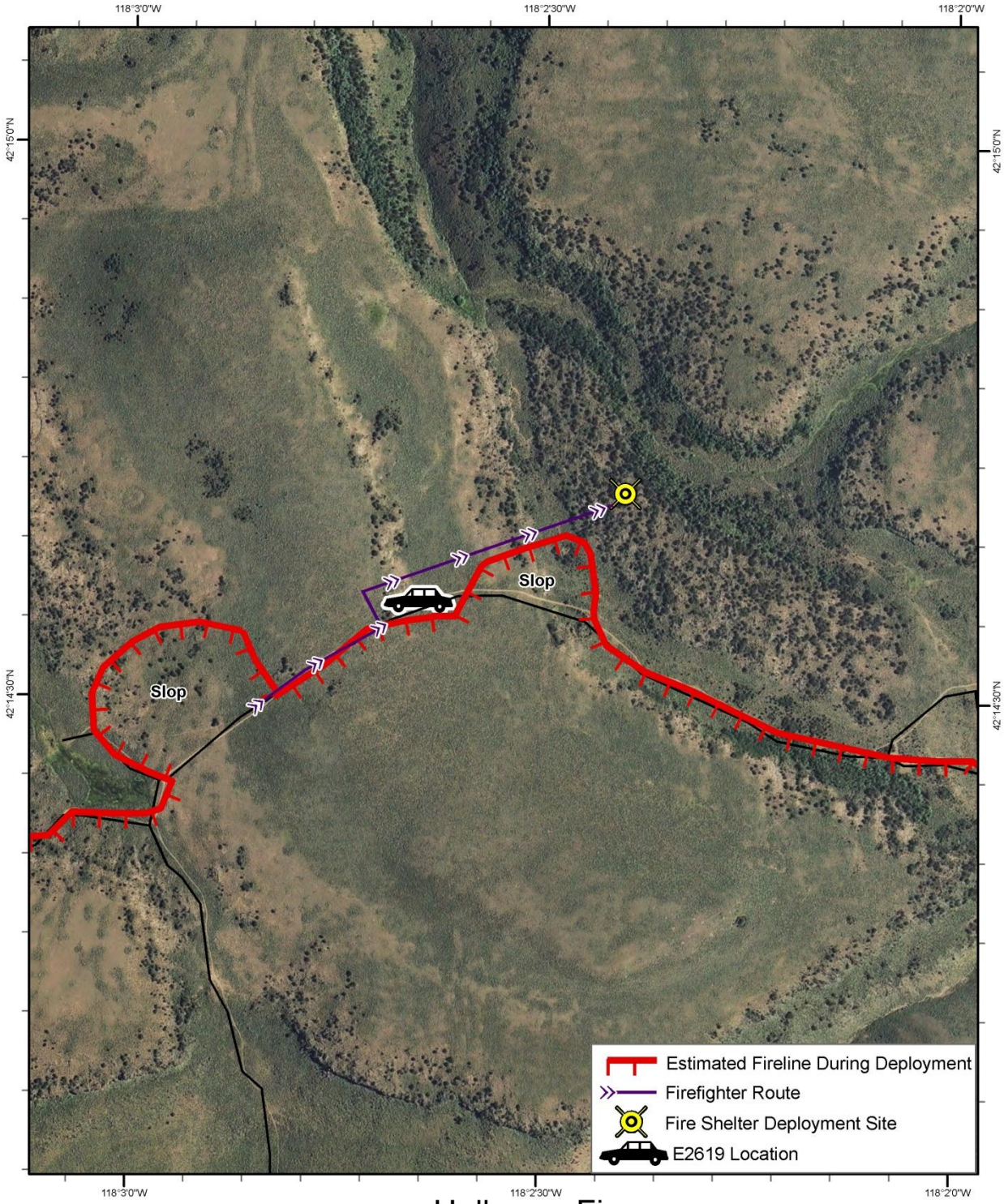
Holloway Fire

Fire Shelter Deployment Site
& Vehicle Location

Map #4

0 0.1 0.2 Miles

N



August 12, 2012
1759 Hrs

Holloway Fire

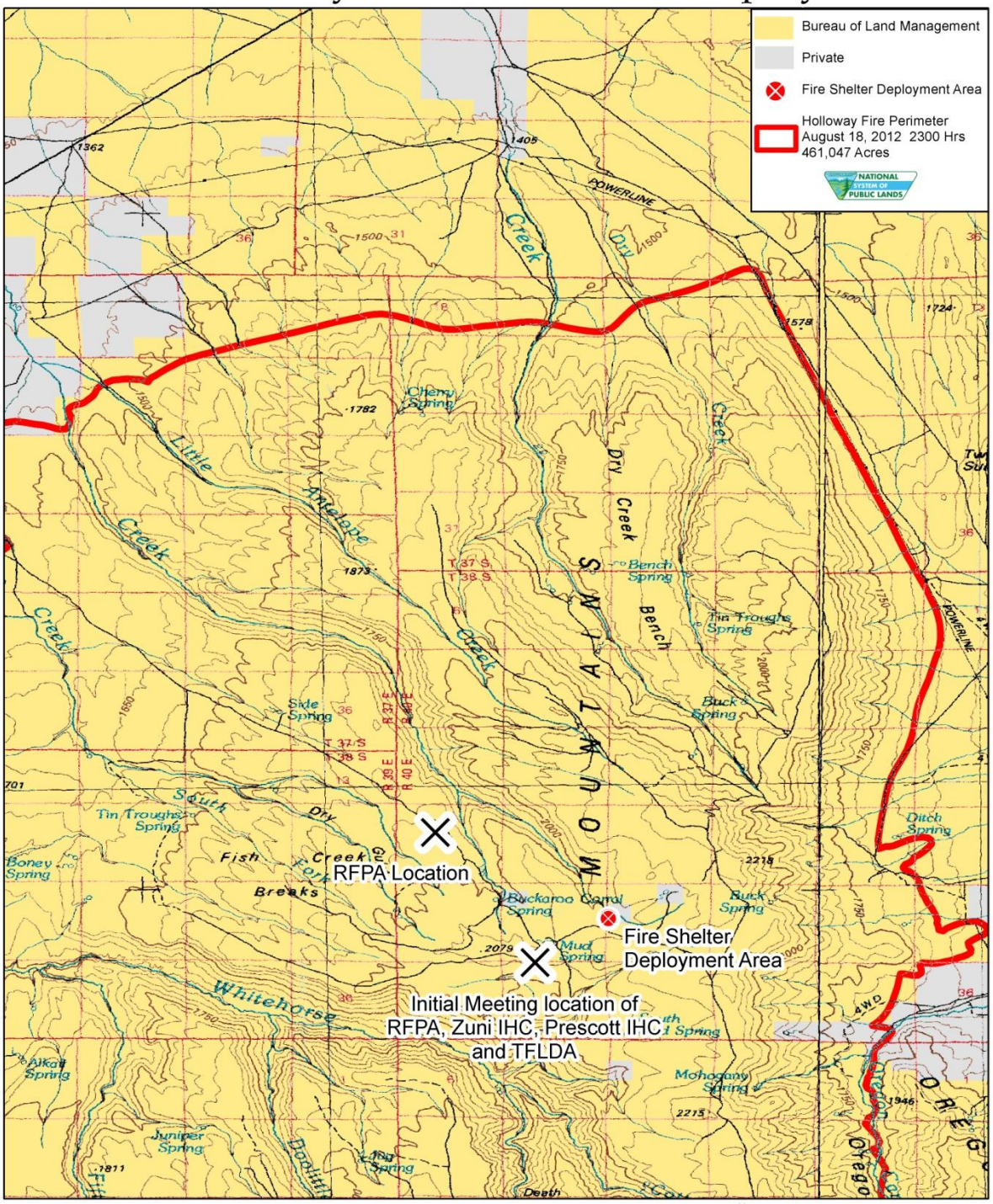
Fire Shelter Deployment Site
& Vehicle Location

Map #5

0 0.1 0.2 Miles

N

2012 Holloway Fire - Fire Shelter Deployment



Map #6

Illustration #1

Appendix A Fire Behavior and Weather Summary

The Trout Creek Mountain area of northern Nevada and southern Oregon has extreme fuel conditions. This area has been experiencing an extended period of drought conditions and high temperatures over the past two fire seasons. Dry conditions have persisted through the life cycle of this incident. Multiple fuel conditions have led to high/extreme fire behavior events and large fire growth. The factors contributing to fire behavior are:

- An outbreak of the Aroga Moth [*Aroga websteri*] infestation in this region began in the spring of 2012. The Aroga Moth is a sagebrush defoliator; estimates for sagebrush mortality in this area are 20% to 30%.
- Live fuel moistures for sagebrush in the fire area were estimated at 80%. Actual live fuel moistures from plot information within the burn area prior to the fire were 56%
- 10hr and 100hr fuel moistures were 2%, 1000hr fuel moisture was 3%

Fire behavior forecast for Division W abbreviated from the IAP;

Smokey with hazy sunshine early becoming partly cloudy late in the afternoon. With forecasted RHs (Minimum 6-9 percent valleys and 6-9 percent near 6500 ft.), temperatures (Highs 99-102 valleys and 89-93 near 6500 ft.),winds (Variable2-5 Gust 12 morning, SW 8-13 Gust 28 afternoon), and HAINES INDEX of 6 (late day).

Predictions for all areas of the fire
Fuel Model - 4 Sage
Rate of Spread (Ch./hr.) - Head Fire 95-100
Flame Length (ft) - Head Fire 10-12
Probability of Ignition - 100%
Spotting Distance - .1 Mile

Division W: Fire spread is expected to be mostly to the north and northeast. The most probable area of the fire to escape off of the Oregon Canyon Mountains towards the power lines north east of the Division will be through the area between your Division and Division P. This area has the least barriers to spread and most continuous fuels.

Fire weather summary for day shift summarized from IAP;

Weather: Smokey with hazy sunshine early becoming partly cloudy late in the afternoon.
Temperature: Highs 99-102 valleys and 89-93 near 6500 ft.
Humidity: Minimum 6-9 percent valleys and 6-9 percent near 6500 ft.
20 FT Winds:
Ridgetop - Variable at 2-5 mph with gusts to 12 mph until 11-1200 becoming southwest 8-13mph with gusts to 28 mph in the afternoon.
Slope/Valley - Down canyon/down slope 2 to 5 mph, by 1000 becoming upvalley/upslope at 4-8 mph gusts to 12 mph midday and southwest at 7-11 mph gusts to 20 mph in the afternoon.
Haines Index: 6 High.

Lightning Activity Level: 1.
STABILITY/INVERSION: Surface inversion top near 6000-6500 ft breaking around 1100 and the subsidence inversion top near 16000 likely to dissipate about 1400-1500.

Discussion:

Multiple indicators of extremely unstable air mass over that fire area when viewed individually are "notable" events that would contribute to increased fire behavior intensity, but went unnoticed as singular occurrences. When viewed as a chain of combined weather events, they are very good indicators of the probability for rapid increased fire behavior over the fire area.

- Subsidence layer capping thermal lift, with rapid increase in fire activity immediately after a breakdown. Subsidence - Air that rises in the atmosphere must be replaced by air that sinks and flows in beneath the rising air. Local heating often results in small-scale updrafts and downdrafts in the same vicinity. When the rising warm air and the sinking cold air reach neutral buoyancy a "layer or cap" is formed that does not allow vertical air column movement. Localized lower level occurrences of this are often called inversions. Upper level occurrences of this phenomenon are called *subsidence*.
- Daily upslope wind shift; through interviews and weather records @ 1500 to 1900, not correlated to a regular daily pattern of events by firefighters
- Development of a "Haboob" to the east and north of the division @ approximately 1730, indicating a major shift in stability and increased air mass movement. Haboob - is a type of intense dust storm carried on an atmospheric gravity current. Haboobs occur regularly in arid regions throughout the world, loose sand and particulates are lifted up from the desert floor, creating a wall of moving sediment. Although unseen by fire fighters in Division W. The occurrence was not communicated to IMET and disseminated to the field.
- Dust devil development at various times and location throughout the fire area

Conclusion:

Multiple factors aided in the increased fire behavior intensity leading to numerous spots across control lines and eventually the shelter deployment on Division W. **The primary cause of fast changing fire environment to the firefighters in Division W can be attributed primarily to a dust devil developed in the interior of the burnout and converted to a fire whirl when it intersected the flaming front of the burnout. This would have led to the localized rapid drop in visibility, increased fire behavior, increased erratic winds and numerous simultaneous occurrences of spot fires.**

Dust devils form when hot air near the surface rises quickly and if conditions are just right, the air may begin to rotate. As the air rapidly rises, the column of hot air is stretched vertically, causing intensification of the spinning. As more hot air moves into the developing vortex to replace the air that is rising, the rotation becomes amplified and self-sustaining. Often times dust devils are short lived, but occasionally some can last for over 10 minutes or generate a second

dust devil. Dust devils can carry particulate matter and embers both vertically and horizontally. In the summer months, dust devils are common place in northern Nevada and southern Oregon. The winds associated with dust devils can reach wind advisory criteria but are generally short lived and very localized. Although forecasters have the ability to forecast warm temperatures that would be conducive for dust devil development, meteorologists are unable to pin point where they will occur with precision. As such, the National Weather Service does not forecast or issue products for dust devils.

Throughout the operational period numerous dust devils were noticed by fire personnel in Division P and Division W, developing in the interior of the fire and outside the fire perimeter. Numerous interview statements from other fire personnel in ICP and local agency fire personnel also noted that the number and size of dust devils developing in the fire area was highly unusual.

The primary factors that facilitated in the development of a fire whirl that caused the embers to be transported across control line are:

- Haines Index – 6 , extremely unstable air mass over the fire area
- Topographical alignment of multiple drainage features vectored and funneled upslope winds increasing velocities
- Dust devil converted to fire whirl when it intersected flaming front

The secondary factors that contributed to the development of the fire whirls where:

- Venting of the subsidence layer increased thermal lift and convection
- Large sloped burned area increased surface temperature and thermal lift
- Multiple adjacent firing operations burn patterns facilitated dust devil/fire whirl development

Appendix B Personal Protection Equipment Report

Firefighter A Injuries

The burn injuries the firefighter received were on her left side while deployed inside the shelter. Since the fireline pack was on her right side, much of the left side of her body was pressed against the fire shelter. Heat transfers more easily due to conduction.

- 1 inch blister on left elbow
- ¾ inch blister on lower left leg
- ¾ inch blister on left torso

Deployment Site

- The deployment site was mostly dirt with sparse tufts of grass. There was a sage brush approximately 1 ½ - 2 feet tall adjacent to the left side of the shelter near the foot end. All grass and sage brush was consumed by the fire.
- There were 11 Mountain Mahogany trees (ranging size 10 to 15 feet in height) that were 15 to 30 feet from the shelter. Burnable leaves and limbs of the trees were consumed by fire.
- There were three rock mounds that bordered the deployment site on the west, southeast and northeast sides, 25 to 50 feet from the shelter.

Deployment Site looking north

Deployment Site looking west

Fire Shelter
New Generation Fire Shelter, Revision C
Date of Mfg: December 2004

The fire shelter was examined at the deployment site for signs of heat and other structural damage.

- The shelter showed signs of heat and direct flame contact.
    - Outer shell – Delamination of the aluminum foil and silica cloth occurred at the foot end and lower left side of the shelter. Some of the foil had burned away. The silica cloth remained intact throughout the outer shell.
    - Inner shell – Delamination of the aluminum foil and fiberglass occurred at the foot end. The fiberglass cloth remained intact throughout the inner shell.
    - Shake handles – Right Hand shake handle which was at the foot end burned away. The Left Hand shake handle showed some char.
- The hard plastic liner was found in the fire shelter sleeve of her fireline pack. The exposed edge of the liner was melted and deformed.
- The fire shelter PVC bag was found partially under the shelter. Part of the bag was melted.

Deployment Site

Foot end of fire shelter

Left Hand shake handle is charred

Right Hand shake handle is burned away

Exposed edge of plastic liner is melted

Delamination of inside shell at foot end

PPE

- Pants
- Shirt
- Face/Neck Shroud – found next to the fire shelter and showed no signs of high temperature.
- Hardhat – The hard hat was found under the fire shelter. It showed no signs of high temperature.
- Gloves – gloves were found outside the fire shelter. Due to exposure to flames and heat the gloves shrunk approximately 40 percent. Some finger tips were charred.

Burned gloves in comparison to gloves found inside firefighter's pack

Other Equipment

- Fireline pack: was inside shelter during deployment, found next to shelter, no signs of heat
- Radio: was inside shelter during deployment, found next to shelter, no signs of heat
- Compass: was inside shelter during deployment, found next to shelter, no signs of heat
- Water bottle: found inside shelter, no signs of heat
- Rhino tool: found outside shelter, tip of handle charred, exposed area of handle scorched
- Fuel bottle: found outside shelter, side of bottle 1 inch rupture

Material – Conditions and Corresponding Temperatures:

Aluminum Foil – Melt	1,220 degrees F
Fire Shelter Shake Handle (Kevlar) – char	970 degrees F
Wooden Tool Handle – char	700 degrees F
Leather Gloves – shrinkage 45 percent	600 degrees F
Foil/Shelter Cloth Bond – Delamination	500 degrees F
Fire Shelter PVC Bag – melt	280 degrees F
Fire Shelter Hard Plastic Liner – melt	270 degrees F
Human Skin – second degree burn	131 degrees F

Appendix C (acronym list)

8PT	Helicopter N498PT
AA	Air Attack
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
DIC	Deputy Incident Commander
DIVS	Division Group Supervisor
DOI	Department of Interior
DP	Dew Point
FBAN	Fire Behavior Analyst
FMO	Fire Management Officer
FOS	Fire Operation Supervisor
Hrs	Hour2
IAP	Incident Action Plan
IC	Incident Commander
ICP	Incident Command Post
IHC	Interagency Hotshot Crew
IMET	Incident Meteorologist
IMT	Incident Management Team
LTAN	Long Term Fire Analyst
NV	Nevada
ODF	Oregon Department of Forestry
OR	Oregon
P	Papa
PPE	Personal Protective Equipment
PVC	Polyvinyl Chloride
RAWS	Remote Automated Weather Station
Rd	Road
RFPA	Rangeland Fire Protection Association
RH	Relative Humidity
SUP	Superintendent
TLFD	Task Force Leader
USFS	United States Forest Service
VLAT	Very Large Air Tanker
W	Whiskey
WFDSS	Wildland Fire Decision Support System