Lessons Learned Review

Firefighter Entrapment

Horseshoe 2 Fire

Location of the rocky chute that the two firefighters used as their escape route down to the rock buildings that are located behind the photographer.

Coronado National Forest
June 2011

Contents

"Seven years of fire refreshers paid off."

"Stick together—unity is huge."

"When you put fire down, you can't take it back."

Comments from Firefighters in this Lessons Learned Review

Review Readers

To help us to continue to learn from this "Lessons Learned Review" approach, please provide your feedback at the following link:

feedback

[Complete URL: https://spreadsheets.google.com/spreadsheet/viewform?hl=en_US&formkey=dHk1clFTaEtfU3gyeXlsbHVpemd5dlE6MQ#gid=0]

To download this entrapment incident's Google Earth companion file:

Near Miss Depiction

[Complete URL: https://sites.google.com/a/firenet.gov/geta-group/training/flag-library/Horseshoe2FireNearMissDepiction.kmz]

1. Leader's Intent

"As you proceed with the review, I ask that you consider that the firefighters involved in this incident are in a unique position to help the Forest Service learn to better manage future incidents and to develop and maintain a respectful learning culture. Your report should help us to understand what happened, why and when critical decisions were made, and what can be learned to help us prevent the reoccurrence of these types of incidents in the future."

Jim Upchurch, Forest Supervisor,
Coronado National Forest
From the June 10, 2011 Delegation of Authority
to the Horseshoe 2 Firefighter Entrapment Review Team

Delegation of Authority Outlines Objectives for Review Team

On June 11, 2011—three days after the firefighter entrapment incident on the Horseshoe 2 Fire—the Forest Supervisor of the Coronado National Forest signed a Delegation of Authority for the formation of a Review Team to pursue a "Lessons Learned Review" of this incident.

As outlined in this Delegation of Authority, the Review Team's objectives included:

- Identify facts of the event and develop a chronological narrative of the event.
- Identify underlying reasons for success or unintended outcomes.
- Identify what individuals learned and what they would do differently in the future.

Lessons Learned Review

"The purpose of a 'Lessons Learned Review' (LLR) is to focus on the near miss events or conditions in order to prevent potential serious incidents in the future. In order to continue to learn from our near misses and our successes, it is imperative to conduct an LLR in an open, non-punitive manner. LLRs are intended to provide educational opportunities that foster open and honest dialog and assist the wildland fire community in sharing lessons learned information. LLRs provide an outside perspective with appropriate technical experts assisting involved personnel in identifying root causes and sharing findings and recommendations."

From the *Interagency Standards for Fire and Aviation Operations* (Red Book), Chapter 18 – Non Serious Wildland Fire Accident Investigation Processes.

Document Environmental and Human Factors; Promote a Learning Culture

The Delegation of Authority also requested the Review Team to:

- Use mindful processes and protocols to identify and document factors (environmental, human, administrative, etc.) that contributed directly or indirectly to the entrapment.

- Promote a respectful learning culture. Create an environment and opportunity for learning that will benefit all wildland firefighters and line officers by facilitating a pro-active forum for positive discussion and documentation.


Phoenix
Coronado National Forest, Arizona
Tucson
Horseshoe 2 Fire
Image © 2011 DigitalGlobe
© 2011 INEGI
© 2011 Google
Image © 2011 GeoEye
Google


Heat Perimeter
Intense Heat
Scattered Heat
June 7th, 2011
Incident location
Elfrida
Image USDA Farm Service Agency
Google

Looking down canyon from the lookout site where the two "lookout" firefighters were originally positioned.

2. Narrative – Incident Chronology

Horseshoe 2 Fire Transitions to Type 1 IMT

The Horseshoe 2 fire starts May 8, 2011 on the Douglas Ranger District of the Coronado National Forest in Southeastern Arizona. The fire transitions to a Type 1 Incident Management Organization.

Type 2 IA Crew Assigned to Division Where Private Homes are Located

By early June, the Horseshoe 2 fire has grown to 140,000 acres. Early in the morning of June 7, incident managers assign a Type 2 Initial Attack (IA) crew to a Division on the western side of the fire in Turkey Creek drainage—where several ranches and vacation cabins are located. Overhead provide multiple detailed briefings to this crew before assigning them to be holding resources to support burnout operations. This is the crew's first operational shift on the fire.

When they arrive on their Division, the crew and the Division Supervisor (DIVS) discuss posting a lookout. Another crew already has a lookout posted. The DIVS agrees and suggests a location—based on previous operations where other Type 1 and Type 2 crews had posted lookouts. The Crew Boss assigns two crew members to this lookout position.

The Plan – This illustration shows the intended burnout operation plan that began at 1230 hours.

Critical Burnout Operation Starts – Red Flag Warning in Place

1230 Hours

The burn out operation starts. All resources understand that a Red Flag Warning is in place. Winds are out of the west, up canyon. Division resources recognize that this burnout operation is critical to holding the fire on the north side of Turkey Creek and protecting many of the structures located in the canyon. If no action is taken, the fire—influenced by wind and terrain—will cross to the south side of the drainage—potentially destroying ranch homes, cabins, and outbuildings.

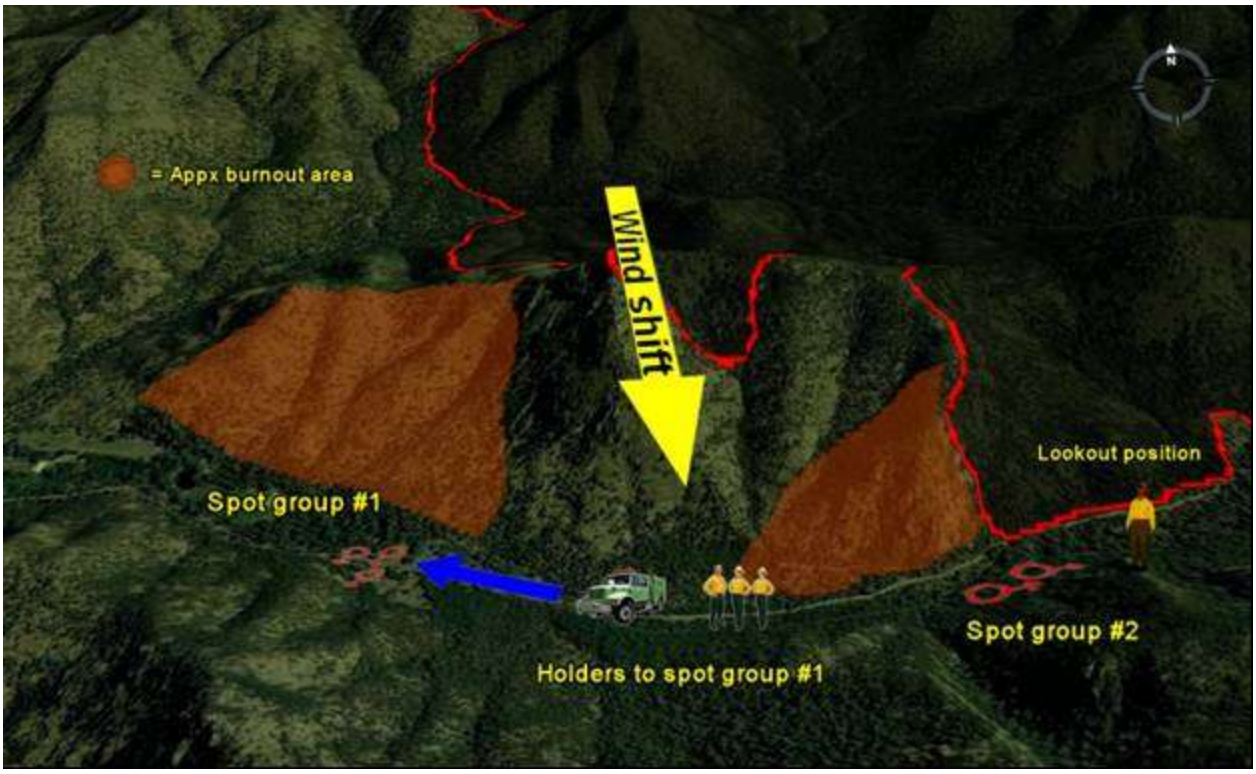
Winds Create Spot Fires

1300 Hours

Multiple spot fires are located and extinguished on the south side of Turkey Creek Road. A Type 1 helicopter, hand crews, and engines help contain these spots. Burning continues to keep up with the fire spread toward structures.

1430 Hours

The wind suddenly shifts from west to north—pushing smoke and fire brands across the road. Winds gust to greater than 30 mph during this time. Additional spot fires occur. Burn out operations stop.



Wind Shift – The sudden wind shift from the north pushes fire brands across Turkey Creek Road, creating spot fires that shut down the burn operation and eventually require all resources to pull out.

The DIVS requests all resources to respond and assist with these spots. Resources do excellent work to stop the spot fires from spreading. It appears the spots are going to be stopped when another large, active spot fire is reported up canyon.

All Resources Pull Out – Except the Two Lookouts

1500 Hours

The DIVS, recognizing that they have lost the line, orders all resources down canyon. To confirm that everyone is out and safe, the DIVS begins radio calls to all resources. All resources are accounted for at the safety zone, except the two lookouts posted by the incoming Type 2 IA hand crew.

The Two Lookouts Begin Rapid Retreat

From their lookout position, these two firefighters have adequate views up and down the canyon. However, as soon as the multiple spot fires occur, their visibility is impaired by smoke in the valley floor below them. The lookouts become apprehensive about their situation. They radio the Crew Boss Trainee (t) and ask if they should come down. The Crew Boss (t) informs them that they are in a good spot.

Immediately, the Crew Boss calls them on the radio: *"If you don't feel comfortable then leave."* At this time, all resources holding on the road move down canyon to assist with the growing spot fires.

1505 Hours

After a few minutes, the smoke in the valley floor lifts. The lookouts see two large, active spot fires below their position and immediately recognize the danger. They radio the Crew Boss to report that they are leaving the lookout site and moving to the safety zone.

The lookouts begin a rapid retreat down a rocky chute. Lookout 1 (LO1) loses his tool on the way down and bangs-up his legs on the rocks during this descent. He didn't take the time to put on his gloves, which were in his front pocket. Lookout 2 (LO2) and LO1 are both moving rapidly—believing that their lives are in danger. As they descend on the east side of the ridge, the fire makes a rapid uphill push on the west side that runs toward the lookout position that they had just abandoned.

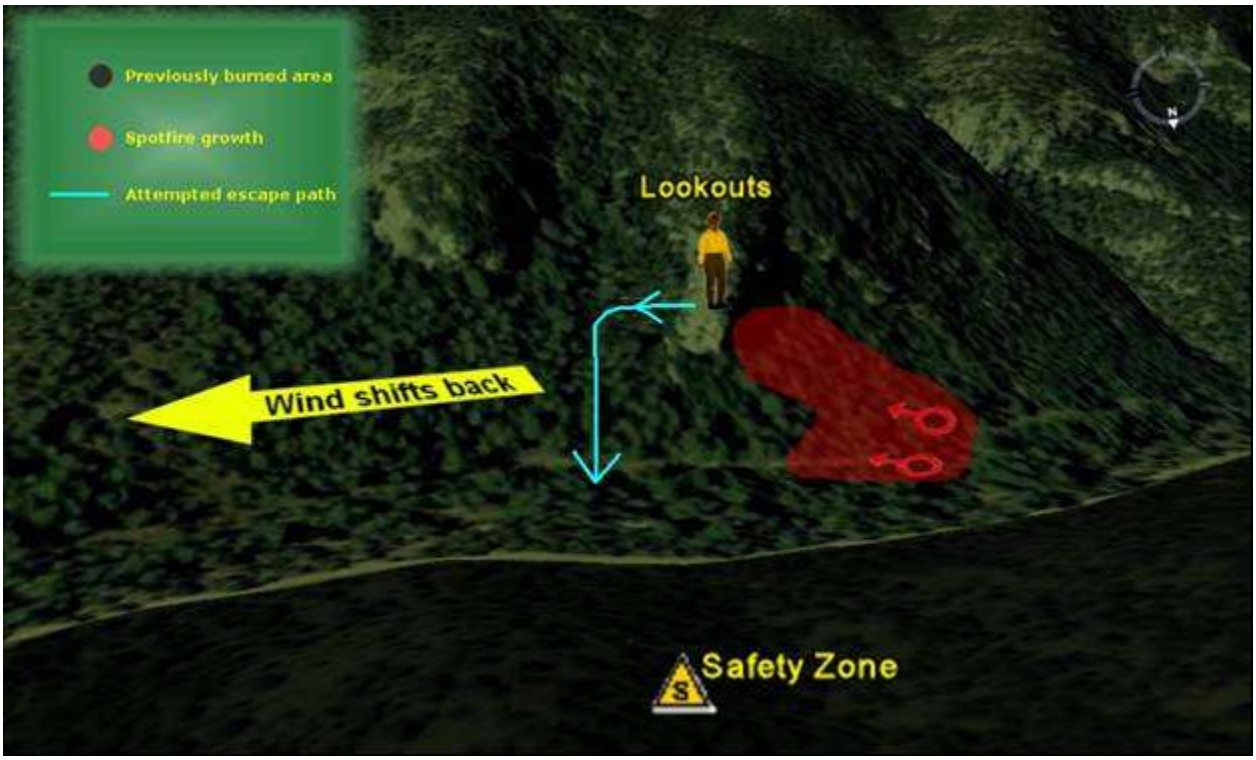


Illustration shows the route to the safety zone that the two lookouts intended to take—before the spot fire cuts off their access and ability to move to this safety zone location.

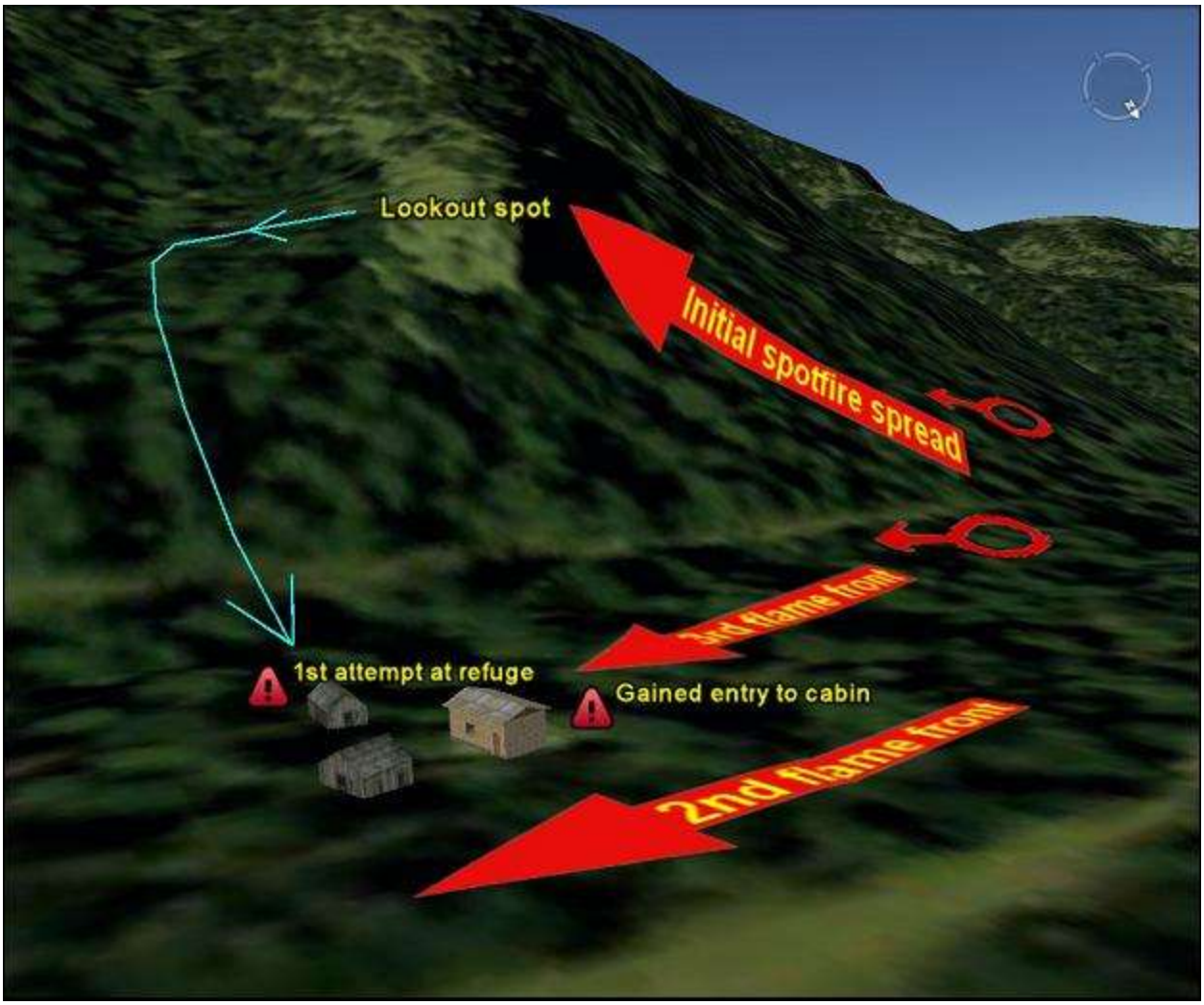


Illustration shows the route the two lookouts take to seek refuge in the rock house shelters. Note the initial spot fire spread, followed by the second flame front, and the third flame front that burns through their eventual position in their rock house shelter.

Spot Fire Cuts Off Access to Pre-Identified Safety Zone

1520 Hours

LO1 and LO2 arrive at the bottom of the chute and cross the dry Turkey Creek. They intend to get across the road and into the hard black on the north side of the road—inside a safety zone that had been identified in briefings. However, the spot fire below them has grown in size and intensity. It cuts off their intended route across the road.

From previous crew briefings, LO1 and LO2 also know that nearby rock houses can also be used as a last resort to shelter in place.

The two firefighters make it to one of these rock outbuildings and try to enter—but the door is locked. LO2 breaks the window with his shovel and tries to pry the window open, but cracks his shovel handle.

LO1 takes out his fire shelter and drops his pack.

For a brief moment, the smoke lifts. LO1 sees another rock building 20 feet away and—to seek refuge from the fast approaching fire—decides to try to gain access there. LO2 feels the intense heat on his neck as he starts scratching two deployment areas with the shovel—thinking they will have to ride out the flame front in their fire shelters.

LO1 tries the door at the next building. It is also locked. He punches-out the window located beside the door with his bare hand and uses his fire shelter to scrape out the remaining glass. LO1 then yells over to LO2: *"In here, now!"*

Windows that Lookout 2 breaks out with his shovel, then breaks shovel handle trying to pry window open.

The Two Firefighters Take Refuge Inside Building

They both enter the building and—to give themselves the best chance at survival—methodically begin removing window coverings and other combustibles away from the outer walls. They provide their Crew Boss an update on the radio, informing that they have taken refuge in a building.

The rock building in which the two lookouts seek refuge from the flame front. (To gain access, Lookout 1 breaks out window located to right of door—cutting his hand in the process.)

Photo taken by Lookout 2 as the flame front passes around and over them.

The flame front passes through—burning into, around, and over the house.

LO2 realizes that LO1 has cut his hands (on the glass when he broke the window). He helps wrap-up LO1's hands with a pillow case found inside the building.

DIVS Arrives at Their Location

At about this time, the DIVS calls them on the radio trying to determine their location. LO2 guides the DIVS to their location, where they load up and head down canyon.

The DIVS drops off LO1 with the Line Paramedic on the Division. LO1 is taken to spike camp for follow-up treatment. He eventually requires stitches for his injuries. LO2 is dropped off with his crew and they continue supporting operations for the remainder of the shift.

3. Circumstances and Factors that Contributed to the Entrapment

A. Contributing Circumstances

- **Predicted Fire Behavior**

  The morning of the incident, the fire had crossed the ridge to the west, where the previous day's burnout had been checked and was backing down the slope toward Turkey Creek. The DIVS and Task Force Leader (TFLD) had discussions on what the fire was going to do. They both believed that—with the predicted winds for that day—if no actions were taken to secure the line before the fire reached it, holding fire north of the road would be difficult. The fire was therefore forcing their hand to start burnout operations.

- **Fire More Active**

  All resources recognized the fire activity was more active the morning of the incident than it had been previous mornings.

- **Burnout Impacts Previous Lookout Location**

  Due to the burnout occurring down-canyon, the lookout location from previous days may not have been the best location for that particular day.

B. Contributing Factors

- **Wind Gusts Changing Direction**

  The localized winds in this area enter the canyon from the west, creating an eddying effect. On June 7—the day of the entrapment—the winds met Red Flag criteria and wind gusts were changing direction and coming out of the north. This wind effect caused the spot fires on the south side of Turkey Creek below the lookout position.

- **Lookout Location**

  The lookout location was up-canyon and down-wind of burnout operation, which put the two firefighters in a vulnerable position.

- **Decision Making and Training**

  Both individuals (LO1 and LO2) made good decisions to gain access into the rock house for shelter. In addition, their structure training provided them the knowledge to prep the structure for direct impingement from the flame front.

4. Lessons Learned by the Firefighters

A. Your 'Gut Feeling' Decision Making Process

- As conditions change, pay attention to your situational awareness apprehensions and perceptions—your "gut feelings." Do not second-guess your decision to leave and move to a safer area.
- *"Constantly reassess the situation—and act when recognizing change."*

Down-canyon view from the lookout site. The main fire is backing down ridgeline on June 7 before the firing operations start.

B. Trigger Points and Contingency Planning

- Early on in crew/overhead planning, set trigger points for actions to be taken—either leaving a lookout location or moving it to a safer position.
- Ensure that <u>all</u> personnel are made aware of—and understand—where trigger points are located—especially in relationship to the location of personnel.
- Always have contingency plans. Discuss these plans and understand the actions associated when trigger points are met.

C. Lookout Need and Location

- Assess the need for lookouts and strategically place them within the most advantageous and safe area.
- Do lookout positions have to be in an unburned area?
- <u>All</u> personnel need to know the location and position of the lookouts.
- If the lookout can't see because of smoke, it is time this person(s) comes down to tie-in with the crew.
- Consistently assess the lookout location in relationship to fire activity and conditions within the fire environment. Is the current lookout position the most advantageous—and safe—location?

D. Training, Training, Training

- Training helped in key decisions made by the two firefighters (LO1 and LO2) during their retreat to the rock house:
    - Reciting the Fire Orders, mainly "*Stay Alert, Keep Calm, Think Clearly, Act Decisively*". (LO1 learned the old version of the orders.)
    - LO2 said that the fire shelter video kept "playing in my mind" as he prepared a spot to deploy fire shelters.
    - Both individuals had received structure training, which they used as they prepared the inside of the rock house for the flame front. They both immediately pulled flammable blinds off the windows and pushed the furniture away from the walls.
    - *"Seven years of fire refreshers paid off."*
    - *"Good to know that our training isn't bogus."*
    - The importance of practicing all aspects of fire training was recognized along with the need to continue learning and improving proficiencies throughout the fire season.

E. Important Insights

- *"Stick together—unity is huge."* (In reference to the lookouts' retreat from their observation post to the rock house.)
- *"Emphasize physical fitness to get you out of a bad situation."*
- *"When you put fire down, you can't take it back."* (Referring to the burnout operation.)

Post Entrapment Incident – Firefighter points to shovel scrape marks where Lookout 2 had started to make a deployment site.

5. Recommendations

A. Recommendations by the Firefighters

1. Importance of Communication

- Everything ties back to communications.
    - Ensure all resources know the trigger points for different aspects of the operation (i.e. removing lookouts or resource disengagement).
    - Speak up if questions come up. (Case in point: Not everyone understood why a burning operation was being implemented on a Red Flag day.)

2. Use of Lookouts

- Discuss with personnel the need for more than one lookout in an area, especially on a Division where multiple resources are working in the same area. This reduces the number of people separated from their crew during periods of critical fire activity.
- Daily assess the location for the lookout. Just because the location was used on previous days, doesn't mean that particular location should be used for the current day.
- Assess the location of the lookout for quick egress to safety zone.

3. Understand Local Factors that Influence Fire Behavior

- Turkey Creek drainage faces west and catches the prevailing southwest wind in this region. The sudden wind switch from the north threw smoke and fire brands over the road—resulting in the entrapment. It is unclear how well these local factors that influenced fire behavior were understood by resources on the division.

4. Use of a Personnel Accountability Report (PAR) System for Wildland Fire

- The wildland fire community doesn't have a system in place to quickly determine personnel accountability in a speedy, timely manner. The "PAR System" used in structure fire does provide for this.
- When overhead announces "Checking for PAR," all structure resources understand to account for their personnel. When the Division calls each resource, a quick response confirms all accounted for—or reveals missing personnel. When time is of the essence, this process can be done very rapidly.

B. Recommendations by the Review Team

1. Understand How You React Under Stress

The lookouts (LO1 and LO2), knowing they were caught in a life-threatening event, rapidly evaluated their evolving situation and reacted quickly to save their lives. Understanding how firefighters mentally and physiologically react to stress may contribute to saving lives in the future. For example, LO1 was focused on getting to his safety zone and didn't consider putting on his gloves that were in his front pocket.

2. Clarify Conflicting Procedures Between Wildland and Structural Firefighter Training

Recognize and clarify potentially conflicting procedures between wildland and structural firefighter training for interior structure preparation. The current S215 guidance directs firefighters to close non-flammable window coverings. There is no guidance on what to do with flammable window coverings or moving furniture to the middle of a room away from the walls.

3. Understand Local Factors that Influence Fire Behavior

This incident highlights the importance of seeking and sharing local expertise on wind and terrain influences on fire behavior.

4. The Importance of Taking a Tactical Pause

When a new resource is assigned to a division with a high-tempo operation, provide extra consideration to the risk management process. For this new, incoming resource, there may not be enough time to gather sufficient situational awareness. This new resource might rely heavily on intelligence from briefings to make decisions about resource placement. When similar situations occur in the future, the Review Team recommends taking a tactical pause to reevaluate risk.

5. Safety Alert to Compare Common Factors

To share safety information with firefighters in a timely manner, the Horseshoe 2 Firefighter Entrapment Review Team recommends that the Coronado National Forest issue a safety alert that compares common factors between the recent Bull Fire Entrapment and this incident.

6. Commendations

- **Training**

  Both of the lookouts had structure fire training that appears to have helped them survive inside a rock house as the flame front passed through.

- **Decision Making**

  Both of the lookouts made quick, decisive decisions that prevented serious injuries or fatality.

- **Communications**

  The lookouts remained in constant contact with their Crew Boss during the entrapment. This constant contact allowed for a quick evacuation.

- **Line Leadership**

  Line leadership took quick action to locate, evacuate, and provide medical attention for the entrapped firefighters.

Driveway that leads to the rock structures where the firefighters sought refuge from the flame front.

7. Review Team

Bea Day, Team Leader
Forest Fire Management Officer, Cibola National Forest and Grasslands

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Training Specialist, National Advanced Fire and Resource Institute

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Wildland Fire Lessons Learned Center

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Lolo Hotshots/GETA Group

The Review Team would like to acknowledge the Coronado National Forest and Thomas's Rocky Basin Incident Management Team for their leadership and commitment to learning from this incident.

8. Appendices

Appendix A – Weather and Fire Behavior

A. Weather

On June 6, 2011, Southeast Arizona was under the influence of a southwesterly flow pattern, typical of the area during the month of June. In this pattern, ridge top areas can receive some very gusty southwesterly winds while the slope areas continue to experience typical diurnal up-valley winds during the daytime.

On June 7—the day of the entrapment—the official incident forecast from the Incident Meteorologist called for ridge top winds to be from the southwest with sustained speeds of 10 to 15 mph and gusts between 25 and 30 mph. Slope winds were forecasted to be up-valley in the afternoon with gusts between 25 and 30 mph. Along with these winds, hot and dry conditions were also forecast. At the ridge tops, the forecast called for minimum relative humidity between 10 and 15 percent, with temperatures in the 70s.

Based on the location of the event, the closest available observations were from Incident RAWS established on a ridge top at Monte Vista, located southeast of the incident at an elevation of 9,250 feet. (The incident occurred at 6,000 feet.) Observations on June 7 from this Monte Vista RAWS:

Time (MST)	Temperature	RH	Wind
1106	68	18%	W 8G20 MPH
1206	73	16%	SSW 10G25 MPH
1306	73	16%	SW 12G24 MPH
1406	72	18%	SW 13G31 MPH
1506	73	19%	SSW 12G30 MPH
1606	70	19%	SW 15G32 MPH

As a comparison, other observations in and around the fire reported the same type of conditions. An incident RAWS on the east side of the fire reported relative humidity between 11 and 13 percent with west-southwest winds gusting between 19 and 32 mph. A permanent RAWS at Rucker Canyon reported relative humidity between 9 and 12 percent with southwest wind gusts between 21 and 29 mph.

Richard Thompson, Incident Meteorologist
National Weather Service, Los Angeles/Oxnard

B. Fire Behavior

Fire and Fuels Outlook

On June 7, live fuels moistures for typical vegetation in the area of the Horseshoe 2 Fire:

Oak – 98 percent
Pine – 111 percent
Juniper – 92 percent
Mesquite – 62 percent

The Haines Index was predicted at 5, the Energy Release Component was 105 (97 percentile), and the Probability of Ignition was 100 percent. The 10-hour fuel moisture was predicted at 2 percent and the 100-hour fuels were 5 percent.

Turkey Creek Canyon

The Turkey Creek Canyon (TC) is a very large drainage that can act like a funnel and collects winds from a SW (210 degrees)/NW (300 degrees) direction. TC is a deep and steep canyon that is approximately eight miles long and as narrow as one-half mile, and as wide as 3½ miles at the confluence.

What Happened?

With general winds out of the Southwest predicted at 10-15 and gusts 25-30 heading across the flat desert landscape, the winds flowed unimpeded into the mouth of TC drainage.

As the winds entered the drainage, they flowed along the drainage and its east-west orientation. At the confluence of TC there are several smaller feeder drainages located about mid-way—as well as at the top of TC—that have a north-south orientation.

As the wind hit the back of the drainage, it then flowed through the path of least resistance and headed into the smaller drainages—instead of pushing up and out. The large amount of air forced into the smaller drainages increased in speed and changed direction. With this increased speed and volume of air, the general flow was overpowered and a northerly wind developed through the smaller canyons.

The rock houses and lookout site were located in-between two of these north-south oriented canyons that became overpowered by this effect. The wind in these locations will be extremely erratic and gusty depending on the wind speed.

Keith Hackbarth, Fire Behavior Analyst
Great Basin Team 1
Bitterroot National Forest