



Accident Investigation Report

CDF HELITACK CREW 404 BURNOVER



Tuolumne Fire

CA-STF-2191

**Stanislaus National Forest
September 12, 2004**



**United States
Department of
Agriculture
Forest Service**



**California
Department
of Forestry and
Fire Protection**

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CDF Helitack Crew 404 Burnover Accident Investigation Report

■ Investigation team leaders:

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David Edgar, USFS Forest Safety Officer, San Bernardino National Forest

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■ Investigation technical consultants:

Brenda Graham, USFS Wildland Fire Meteorologist, Redding, CA
Dave Poucher, USFS Region 5 Health and Safety Program Manager
Chuck Lawshe, CDF (Retired) Scene Investigator

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■ Maps and Diagrams



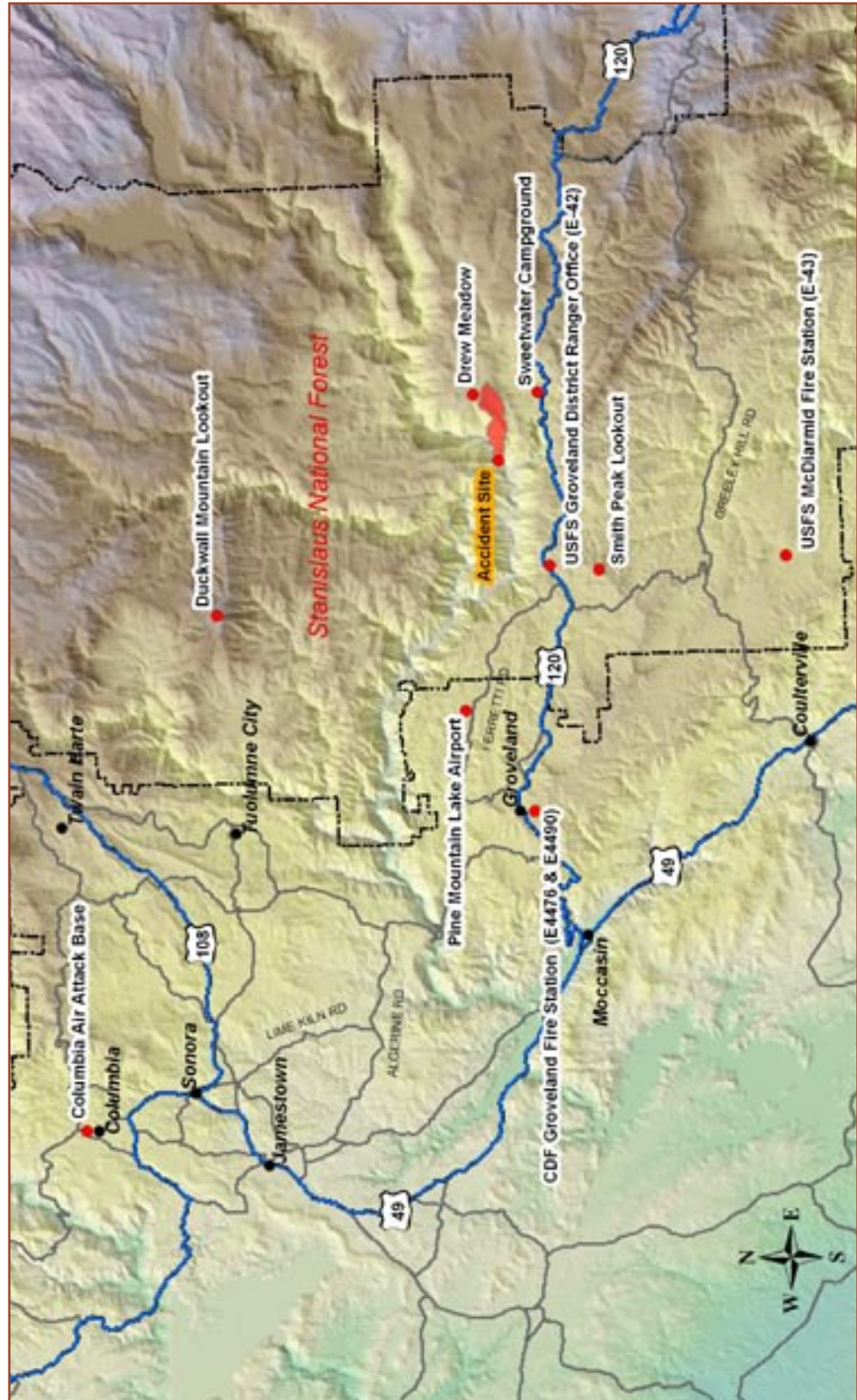
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CDF Helitack Crew 404 Burnover Vicinity Map



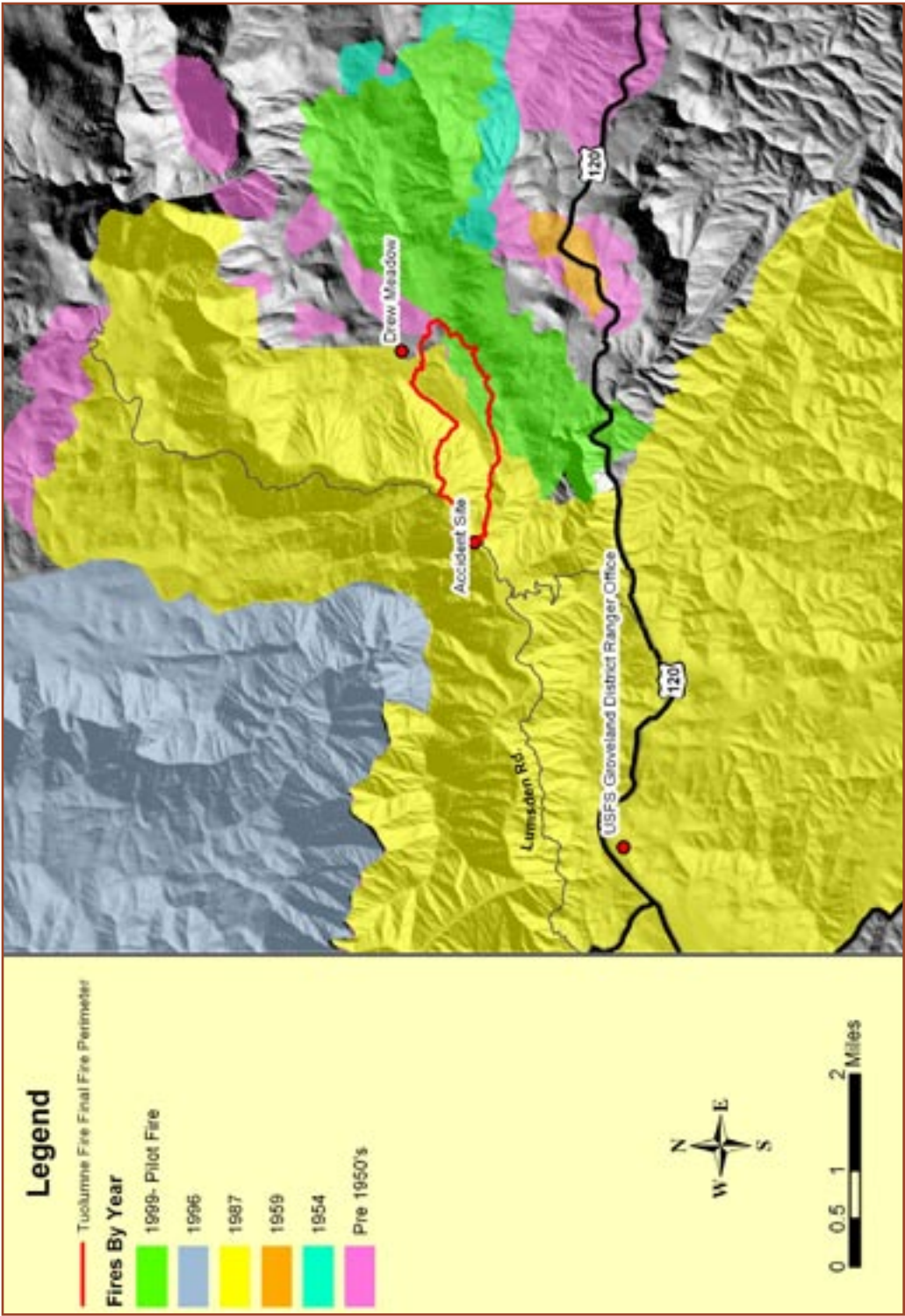
CDF Helitack Crew 404 Burnover Site Location Map



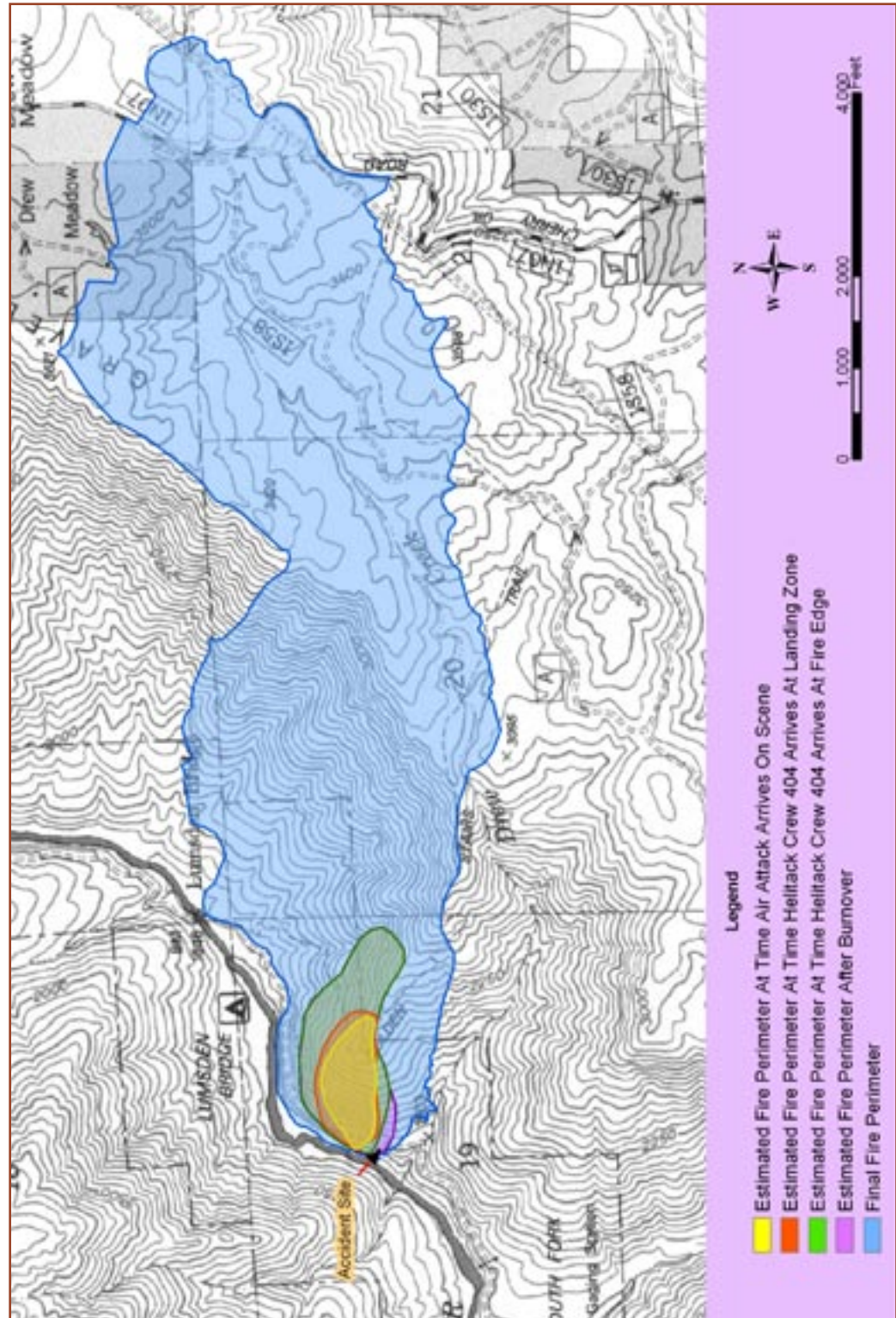
CDF Helitack Crew 404 Burnover
Travel Route Map



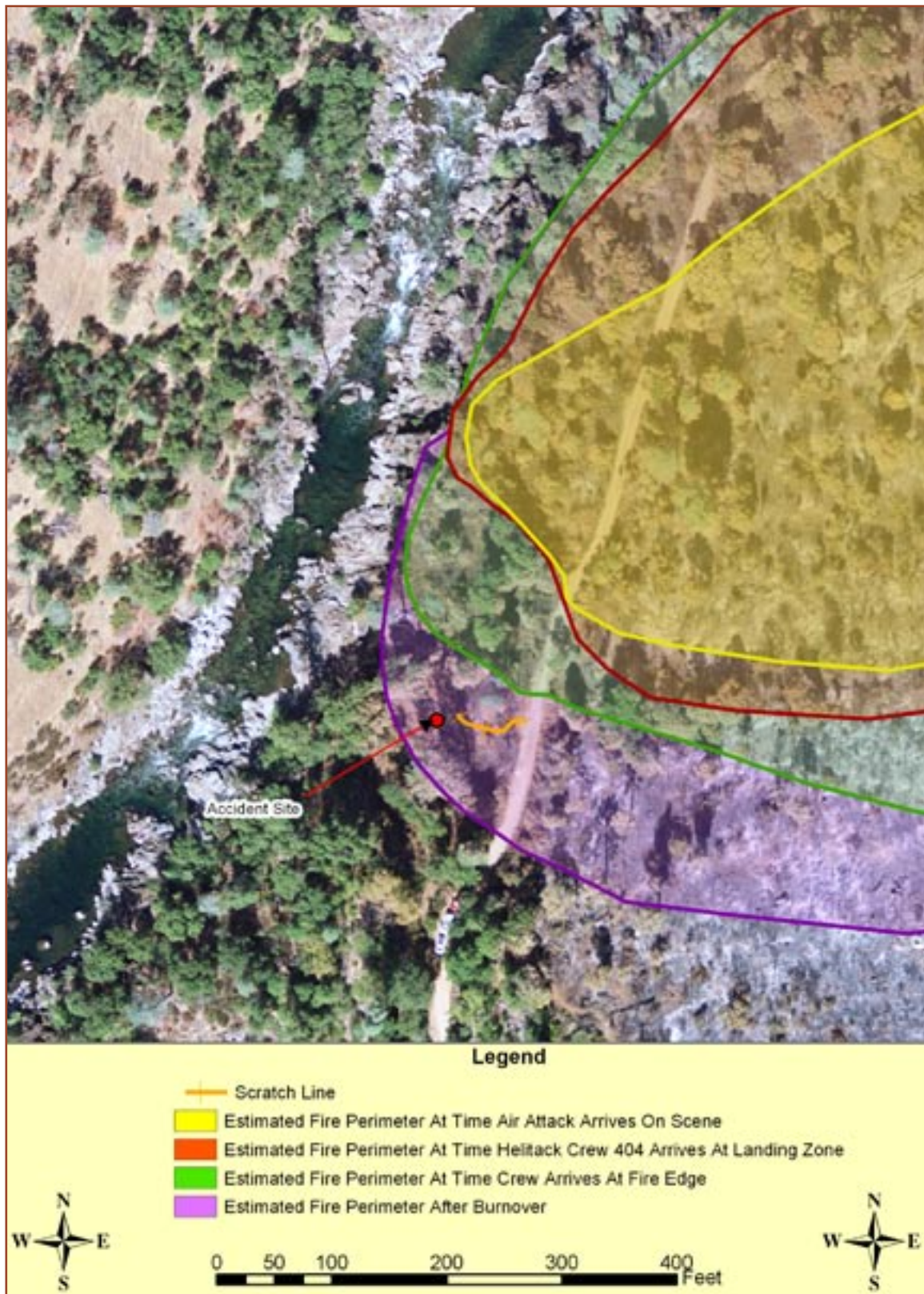
CDF Helitack Crew 404 Burnover
Fire History Map



CDF Helitack Crew 404 Burnover Fire Progression Map Overview



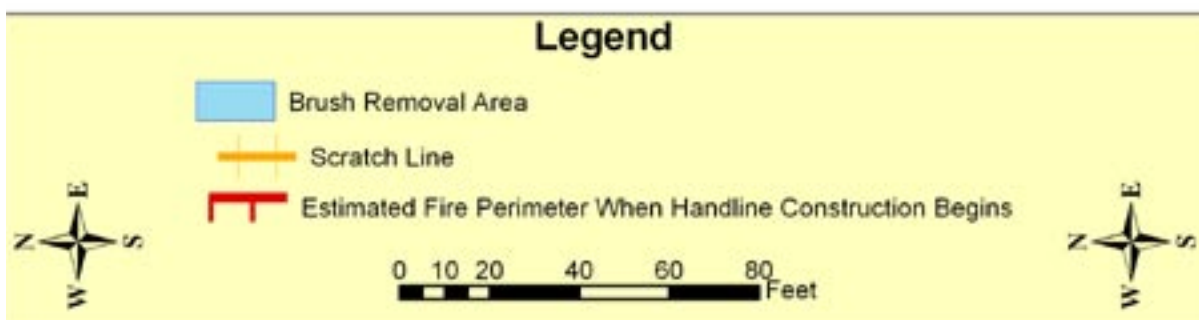
CDF Helitack Crew 404 Burnover Detailed Fire Progression



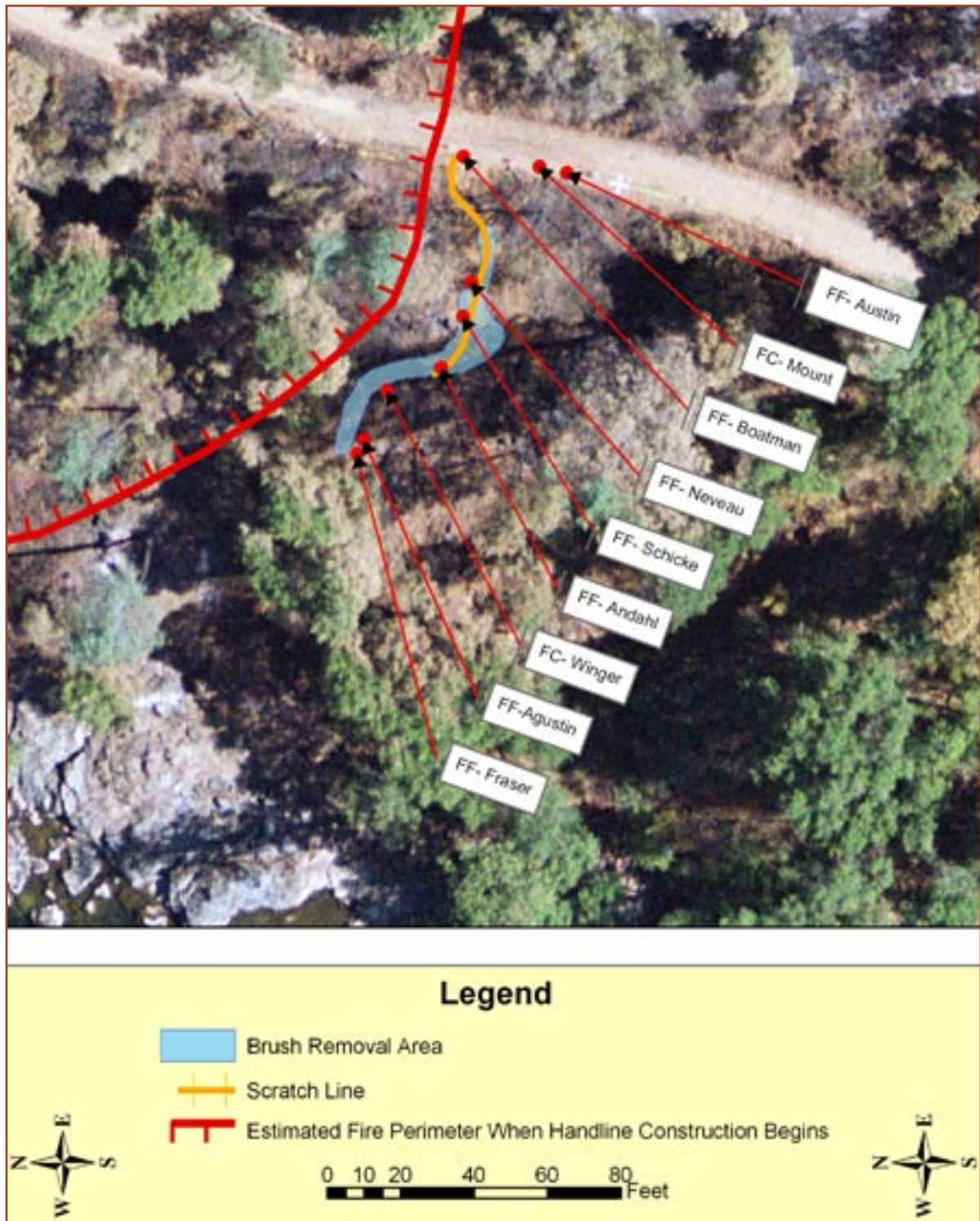
CDF Helitack Crew 404 Burnover Planned Fire Line Construction



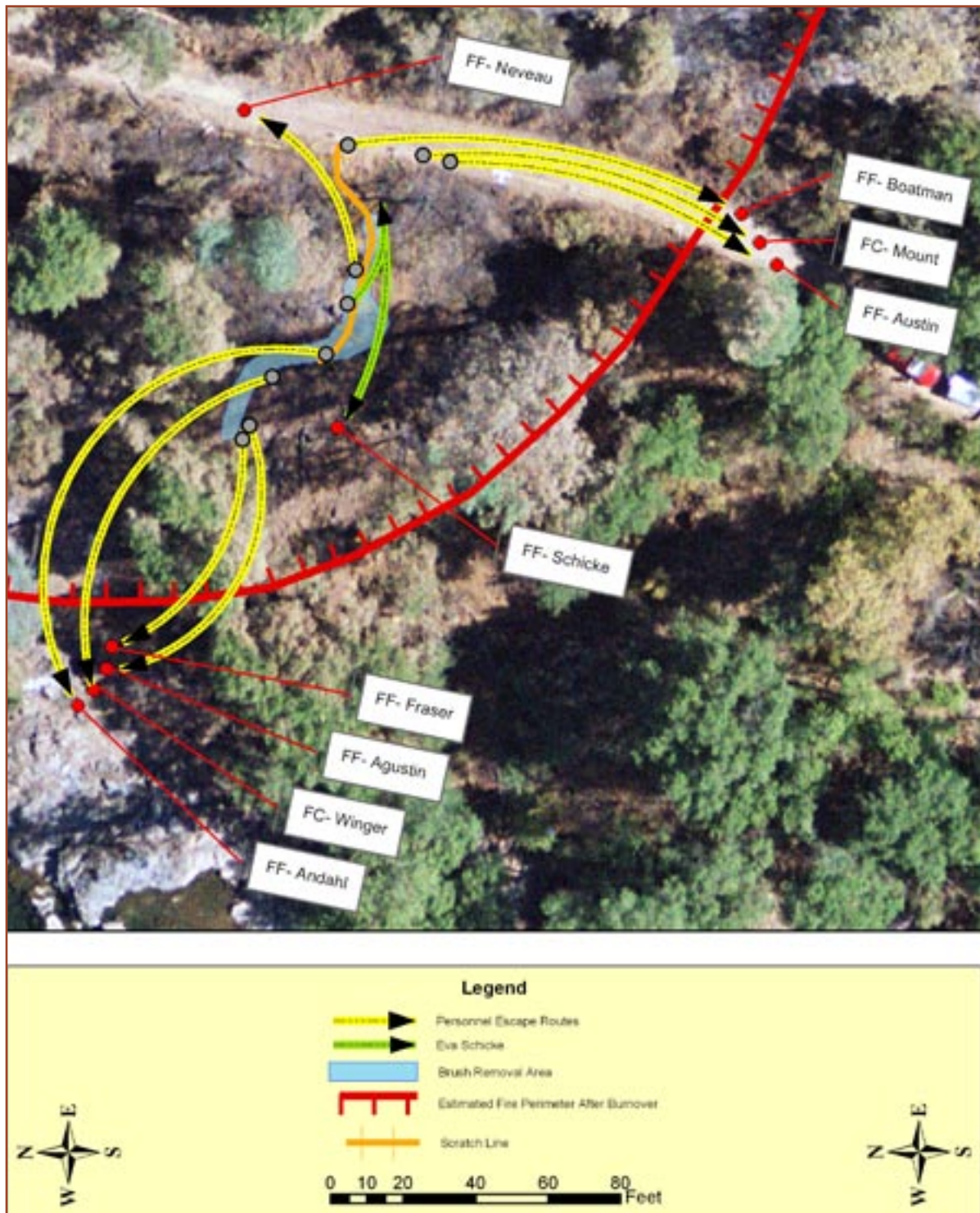
CDF Helitack Crew 404 Burnover **Fire Line Construction Prior to Flareup**



CDF Helitack Crew 404 Burnover Personnel Locations Prior to Flareup



CDF Helitack Crew 404 Burnover Post Flareup Personnel Locations



■ Site Photographs



Overview of
Tuolumne
River Canyon
looking East.
Fire and accident
site is in lower
center of photo.



Tuolumne River
Canyon looking South.
Fire and accident
site is in center of photo.



Tuolumne River, fire
origin, accident
site (red oval).
Lumsden Bridge
is at top of photo.



*Fire upon
arrival of Air
Attack 440.*



*Copter
404 (in red
circle) first
drop (above
Lumsden
Road).*



*Retardant
drops
(red/brown
streak on
hillside) on
right flank.*



*Wind and
smoke
drift prior
to flare-up.*



*Fire origin along
Lumsden Road
(parallel to the river).*



*Rocky river
bank and
steep slopes
below the road.*



*Right flank of fire.
Drew Canyon is at
bottom of photo.*



*The seven firefighters from Copter 404 hiked
to Lumsden road (black arrow shows walkout
route) after being dropped off on gravel bar
landing zone (red "x").*

*River bank immediately
upstream from copter LZ.*



Lumsden Road looking east from accident site.



Lumsden Road looking west from fireline anchor point. Line construction is to the right at the orange flagging.



Lumsden Road looking east. Fire line anchor point is at orange stake just past second sign. Constructed fireline is downhill from the road.



*Fireline construction area.
Lumsden Road is to right
of photo. Rock outcropping
is in center of photo.*

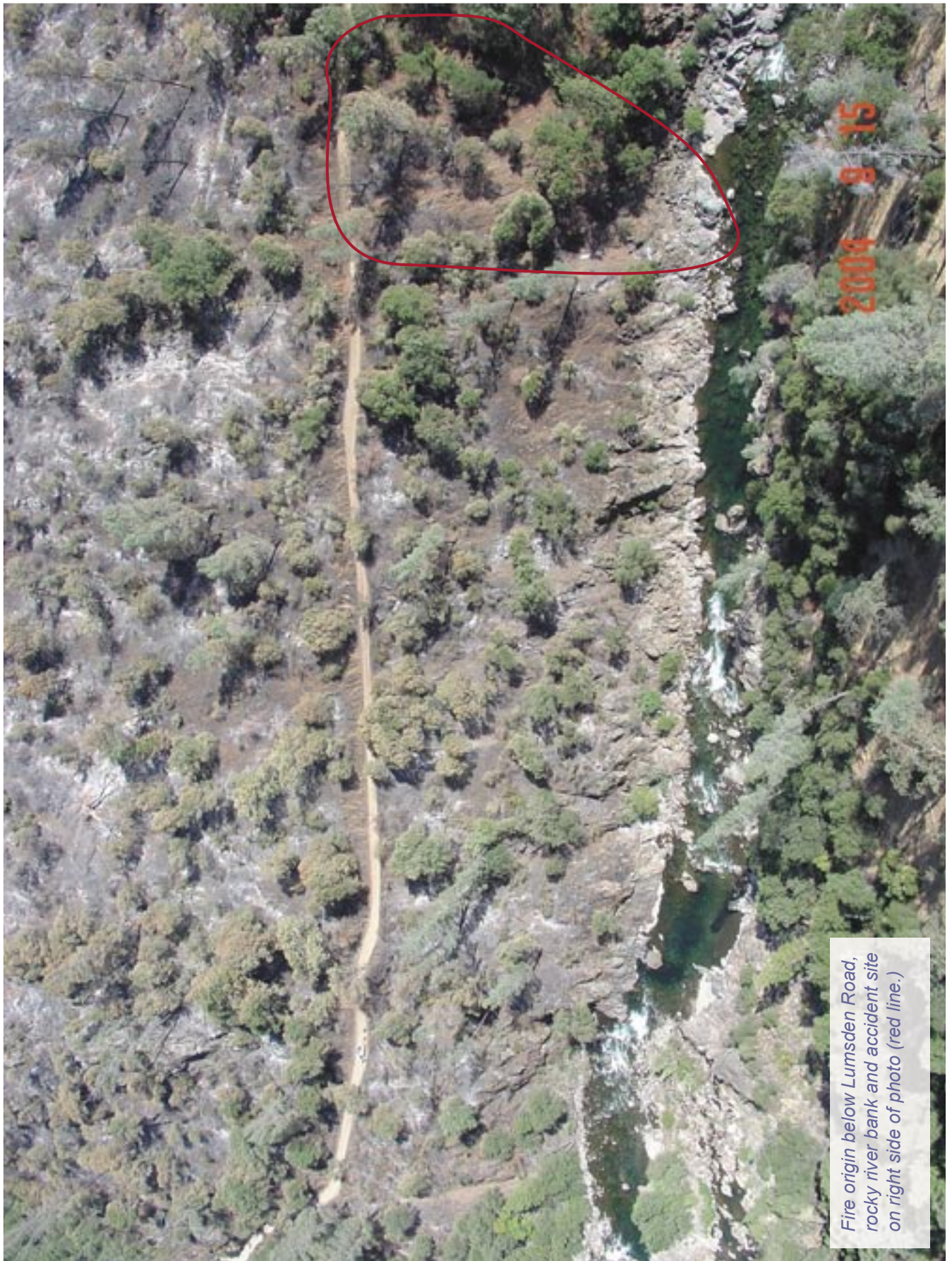


*Backpumps and
scraping tools
staged at
the road edge.*



*Bladder style back
pumps and "Rhyno"
scraping tools.*





■ Executive Summary



Executive Summary

On September 12, 2004 at approximately 1345 hours seven members of California Department of Forestry and Fire Protection (CDF) Columbia Helitack (Copter 404) crew had to take emergency action when a sudden wind shift and fire flareup overran their position. The helitack crew was constructing handline during the initial phases of a fire. The crew members saw the wind shift occurring and immediately utilized their escape routes to the identified safety zones. However, due to steepness of slope and rapid change in fire behavior, they did not all reach safety. Three firefighters suffered minor injuries and Firefighter Eva Schicke was entrapped and killed.

Situation

The fire was located at the bottom of the Tuolumne River Canyon on the Stanislaus National Forest (STF). The Tuolumne River Canyon is a major Sierra Nevada river drainage that has steep canyon sides and is 2,000 feet deep at the accident site. Slopes range from 80 to 120 percent. The fire was burning in predominately live oak leaf litter, light grass and mixed brush, with an oak overstory consistent with Fuel Model 2. One-hour fine dead fuel moisture was estimated at four to five percent and live fuel moistures were at critical stage.

Temperature: 89-94 F
Relative Humidity: 18-24%
Wind: Predominately steady up-canyon, estimated 3-5 mph.

No critical fire weather patterns (thunderstorms, frontal passage, etc.) were in place.

Fire Discovery and Dispatch

The Tuolumne Fire was first reported at 1233 hours. STF dispatched a standard wildland fire response that consisted of 2 chief officers, 6 engines, 1 water tender, 1 air attack, 2 air tankers and 1 helicopter. The air attack, air tankers and CDF Copter 404 responded from CDF-Columbia Air Attack Base, 22 miles northwest of the fire area. CDF Copter 404 is a UH-1H Super Huey (ICS type 2) helicopter with a crew of nine, staffed with a pilot, two Helitack Captains (HC) and six firefighters (FF). The Copter 404 crew personnel were:

Copter 404 Pilot Tom Eggleston
Copter 404 Captain Frank Podesta
Helitack Captain Jonah Winger
Firefighter Josh Agustin
Firefighter Jon Andahl
Firefighter Jeff Boatman
Firefighter T.J. Fraser
Firefighter Shane Neveau
Firefighter Eva Schicke

Initial Attack on the Fire

The fire was located just above the river in the bottom of the Tuolumne River Canyon near Lumsden Bridge. Lumsden Road runs parallel to the river. The fire was backing down-slope below the road and spreading rapidly above the road, up the south canyon face.

At 1259 hours Air Attack 440 (Battalion Chief Dan Ward and Pilot Colin Rogers) arrived at the scene. Ward was designated as Tuolumne Air Tactical Group Supervisor (ATGS). The fire had burned five to ten acres and was spreading up-slope and up-canyon pushed by a steady 3-5 mph up-canyon wind. ATGS Ward directed the two air tankers to make retardant drops on the right flank on the upper section of the fire. They were unable to get lower on the slope due to the canyon's steepness.

Copter 404 arrived at the scene at approximately 1305 hours. After waiting for the air tankers to clear, HC Winger and the six firefighters were dropped off by Copter 404 on a gravel bar at the confluence of the South Fork of the Tuolumne River and the Tuolumne River, approximately $\frac{3}{4}$ mile downstream of the fire. They walked from their landing zone to Lumsden Road near South Fork Campground and then toward the right flank of the fire. They were the first ground resources to take action on the fire.

ATGS Ward directed Copter 404 to make water drops on the right flank of the fire starting at the bottom. Copter 404 began their water drops at Lumsden Road and worked their way up the right flank. Copter 404 did not make any water drops on the fire below Lumsden Road (between the road and river).

■ Incident Commander's Actions

STF Division Chief Johnson was dispatched to the fire as the Incident Commander (IC) and responded down Lumsden Road from the Buck Meadows area. The IC drove past Helitack Crew 404 walking on Lumsden Road near South Fork Campground while he was en route to scout out the fire. He observed that the fire was both above and below Lumsden Road. The right flank of the fire below the road was backing very slowly into the wind. After observing the fire area near the right flank he returned to where the helitack crew was walking toward the fire. HC Winger met with IC Johnson. IC Johnson told HC Winger that he had just driven to the right flank and described the fire situation that he had observed. IC Johnson gave HC Winger the strategic assignment to size things up to see if there was some place they could anchor the fire to the river. HC Winger later stated that he understood his instructions to be to "anchor the fire on the right flank, from the road down to the river." No specific tactics were discussed. Following the briefing, HC Winger and the crew continued to walk along Lumsden Road to the right flank of the fire. The IC did not identify or discuss any overall strategy or priorities for the incident with the ATGS or the Helitack Captain.

After the briefing with Helitack Crew 404, IC Johnson initiated a discussion with the ATGS about using the copter to anchor the fire at the river. The ATGS said that his priority was further up the right flank and the IC concurred with this recommendation. HC Winger heard this discussion on the tactical net and realized that the priority for water drops from Copter 404 was going to be above the road.

■ CDF Helitack Crew 404 Initial Actions at the Right Flank

At approximately 1335 hours, upon reaching the right flank, FF Boatman and FF Neveau scouted further up Lumsden Road to see how far they were from Lumsden Bridge. They thought the bridge was another one to two miles further up river and would not work. Their intent was to determine if they could access the river and work their way into the bottom of the fire. The slope between the road and the river was very steep (80 to 120%) with smoke obscuring any access to the river through the burn.

HC Winger scouted out a grassy opening, through the green, in the oak overstory near the fire's right flank where he could see to the river. The fuel type was grass, leaf litter and scattered light brush under an oak and pine overstory. He scouted down the right flank (about 70 feet) to a point where he could see the route for line construction to the high water mark of the river. HC Winger estimated this would require 250 to 300 feet of fireline to be constructed from the road to the rocks above the river.

The right flank of the fire, below the road, was generally backing very slowly cross-slope into a steady, light up-canyon wind with surface flame lengths of 6 to 12 inches. The firefighters observed a surface fire burning underneath scattered brush without igniting the aerial portion of the brush.

■ **STF Engine 43 Actions**

While HC Winger and Helitack Crew 404 assessed their tactics for the right flank of the fire; STF Engine 43 (E-43) arrived at IC Johnson's location on Lumsden Road near South Fork Campground. STF E-43 Captain Mount received a briefing from IC Johnson and instructions to spot their engine at the Drew Creek crossing and support the helitack crew on the right flank. Neither IC Johnson, nor STF E-43 Captain Mount notified HC Winger that the engine was in the area or assigned to support them.

■ **Helitack Crew 404 Captain Winger's tactical briefing with crew**

HC Winger made the determination that constructing a scratch line from the road downhill to the river would be simple and quick to accomplish. His plan was to construct indirect line closely parallel to the fire edge and then cut off the underslung portion by dropping straight down to the river while firing out the intervening fuel from the road downhill as they constructed line.

The tactic was selected so that the crew could stay out of heat and smoke and take advantage of sparse fuel and natural barriers. Their five backpack pumps were staged on the edge of the road. The crew began to construct line downhill from the road to the rocks above the river (slope distance of 180 feet). The specific fireline construction assignment was to start with the chainsaw to take out the scattered brush, followed by anchoring at the road using scraping tools to cut a quick indirect scratch line, paralleling the fire's edge. They began to fire-out the intervening fuel as they went down the slope. All members of the helitack crew stated that they understood the assignment, had opportunity to comment, raise concerns, or even veto the assignment if they believed it to be unsafe. No one raised concerns.

HC Winger identified the escape routes and safety zones to all of the crew members.

HC Winger notified Copter 404 (on the assigned tactical net) they would be constructing downhill line on the right flank to tie into the river.

■ **Tool order and assignments**

FF Fraser - chainsaw
FF Agustin - pulling and swamping for the saw
HC Winger - scraping tool and portable radio
FF Andahl - scraping tool
FF Schicke - scraping tool
FF Boatman - scraping tool
FF Neveau - scraping tool, portable radio and fusees

■ **CDF Helitack Crew 404 Fireline Construction**

At approximately 1340 hours the crew members began building handline downhill. FF Fraser and FF Agustin had reached a point approximately 2/3 of the way down the slope (roughly 30 feet above the rocks at the high water level of the river) and were running out of brush to cut with the chainsaw. HC Winger and FF Andahl had cut a scratch line below a rocky outcropping, 80 to 100 feet down slope from the road. FF Schicke and FF Boatman were improving the scratch line and FF Neveau was using a fusee to burn out the intervening fuel starting at the road. FF Neveau had fired from the road to FF Schicke's position, 25 to 35 feet below the road. The firing operation was "pulling into the fire's edge nicely." Captain Winger addressed the three upper firefighters (Schicke, Neveau and Boatman) for one of them to return to the road, use a back pump to hold the anchor and be a lookout. FF Boatman volunteered to take this assignment and returned the 35 feet up the fireline to the road.

At approximately 1346 hours, as FF Boatman was preparing to don the back pump, STF E-43 Captain Mount and STF E-43 FF Austin walked up to his location and asked where his Captain was. FF Boatman indicated down the hill and STF E-43 Captain Mount saw HC Winger's red helmet and the crew building line. This was the first that anyone from the helitack crew knew there was other fire fighting resources in their area.

■ Flareup and Burnover Sequence

During the conversation between FF Boatman and Captain Mount, a sudden wind shift occurred causing the fire to change direction and spread up-slope toward the crew. The fire reacted to the directional wind shift and the backing fire became a spreading fire that turned up-slope with the wind. The fire rate of spread and flame lengths increased dramatically.

Three members of the helitack crew simultaneously shouted the alarm within seconds of the wind shift and everyone started toward their identified safety zones. The captain and three firefighters went down to the river; two firefighters went up toward Lumsden Road, FF Boatman was already on the road. The captain and three firefighters that went downhill reached their safety zone. Both FF Schicke and FF Neveau went uphill but only FF Neveau made it to the road. FF Schicke was last seen by FF Neveau immediately behind him approximately 5 feet from the road. FF Schicke was overrun by the flame front that was spreading uphill and was killed by inhalation of super heated air; she died within seconds. Her body slid down the slope and came to rest approximately 100 feet down-slope from the road. Firefighters at scene estimated the elapsed time from the wind shift to the burnover was less than 30 seconds with the total wind event lasting less than 2 minutes. Fire shelters were not deployed.

■ Post Entrapment

Immediately following the burnover and escape to the safety zones, HC Winger announced over the tactical net that Helitack Crew 404 had been burned over and there were injuries. HC Winger asked ATGS Ward for immediate assistance with water drops. HC Winger identified FF Agustin, FF Andahl and FF Fraser along the river and contacted FF Neveau by radio to do a crew accountability check. FF Neveau contacted HC Winger on portable radio and stated that FF Boatman and FF Neveau were accounted for but FF Schicke was missing.

Copter 404 Captain Podesta heard HC Winger's emergency announcement on the tactical net. Copter 404 was working a spot fire on the left flank at the time of the emergency call; they left the spot fire and proceeded towards Helitack Crew 404. En route they picked up a load of water from a dipping spot near Lumsden Bridge. They arrived at the crew's location within 1-2 minutes, but the fire had returned to a backing fire with minimal activity as observed earlier. They made water drops to cool off the area.

Searches for FF Schicke were started from the river up and from the road down. FF Boatman and FF Neveau located FF Schicke's body approximately 100 feet below the road. HC Winger, a licensed paramedic, determined that she was deceased.

CDF Engines 4490 (Captain Yount) and 4476 (Engineer Craddock) arrived at the accident site and assisted in treating the injured crew members, including bringing FF Andahl up from the river. IC Johnson transported the surviving members of the crew to South Fork Campground. They were transported by USFS helicopter to Pine Mountain Airport near Groveland. Two firefighters were then transported to hospitals via air ambulance. The remaining four firefighters were transported to hospitals via ground ambulance.

HC Winger and the four firefighters taken to Sonora Regional Medical Center were treated and released by 1830 hours, September 12.

FF Neveau was admitted to Doctor's Hospital in Modesto, held overnight and released on September 13.

■ Accident Investigation Team

Immediately after the accident was reported a joint CDF and USFS Major Accident Investigation Team was formed. The team convened in Sonora on September 13 and over the next several weeks did a comprehensive investigation into the facts and circumstances of the accident.

The team developed findings of fact. From those findings they determined the situations that were “Causal Factors” of the accident, those that were “Contributory Factors” and those that were “Non-related Safety Factors.”

■ Causal Factors

A causal factor is any behavior, condition, act or omission that starts or sustains an accident occurrence. There were five (5) causal factors identified by the Accident Investigation Team.

- 1) The wind shift changed the fire environment resulting in increased fire intensity and rate of spread.
- 2) Unburned fuel between the fireline and the fire’s edge did not allow for a sufficient margin of safety.
- 3) Escape routes were inadequate to allow sufficient time for the firefighters to reach safety zones.
- 4) The steepness of terrain and difficulty of travel influenced the tactical decisions to access and anchor the right flank.
 - a. The crew determined that safe access to the bottom of the fire was not possible via the river or down the slope either through the burn or the green. This conclusion influenced their decision to utilize the downhill line construction tactic in lieu of uphill line construction.
 - b. Inadequate consideration was given to the difficulty of travel back up the steep slope and the effect of degradation of surface traction caused by fire line construction and firefighters walking on the loose soils on the slope.
- 5) Helicopter water drops were available but not used. Fire engine hose-lay support was an option readily available but unknown to the helitack crew captain.

■ Contributory Factors

A contributory factor is any behavior, condition, act or omission that affected the occurrence or outcome but was not causal. Avoiding or eliminating the contributory factor would not necessarily prevent the occurrence. There were six (6) contributory factors identified by the Accident Investigation Team.

- 1) HC Winger had limited experience in indirect and downhill line construction.
- 2) Incident actions were based more on current fire behavior and less on expected fire behavior.
- 3) Downhill line construction has inherent dangers due to the nature of the tactic.
- 4) There were incident command and control shortfalls.
- 5) More thorough scouting prior to implementing downhill fireline construction could have led to utilization of a different tactic or withdrawal from the assignment.
- 6) The safety zone in the black was not accessible.

■ Non-Related Safety Factors

- 1) A lookout, with no collateral duties, should be posted when there is danger.
- 2) USFS and CDF downhill line construction guidelines differ.
- 3) The LCES Checklist differs between, and within, the two agencies, even in publications of the same year.

■ Accident Review Team Process



■ Accident Review Team Process

On September 12, 2004, as soon as it was known that a burnover of CDF Helitack Crew 404 had occurred and a firefighter had died on the Tuolumne Fire, an interagency accident investigation team was designated by the Regional Forester, USFS, Pacific Southwest Region and the Director, California Department of Forestry and Fire Protection. The team consisted of the following 15 members.

John Berry – Co-Team Leader, USFS

Dan Turner – Co-Team Leader, CDF

Mike Cole – Lead Investigator, CDF

Dave Edgar – Lead Investigator, USFS

Alan Carlson – Site Examination and Documentation, CDF

Jim Engel – Investigator and Sequence of Events, Interview team, CDF

Larry Hood – Fire Behavior Analyst, USFS

Craig Kincaid – Interviewer, CDF Firefighters Local 2881 Labor Representative

Ted Mathiesen – Interviewer, Helitack Subject Matter Expert, USFS

Rhonda Myers – Training Specialist, Human Factors Analysis, CDF

Denny O’Neil – Graphic Information Specialist, CDF

Lynda Philipp – Writer/Editor, USFS

Chuck Schoendienst – Interviewer, Fire Behavior Analyst, CDF

Peter Tolosano – Fire Safety and Human Factors Analysis, USFS

Rob Van Wormer – Helitack Technical Specialist, Training and Experience Records, Human Factors Analysis, CDF

■ Contributing Subject Matter Experts

Brenda Graham – Wildland Fire Meteorologist, USFS

Chuck Lawshe – Site Examination, CDF (Retired)

Dave Poucher – Safety/Investigations, USFS

■ Outside Agency Activity

Michele Grubbs, California OSHA, joined the team for site visits and first round of interviews, September 13, 14 and 15, 2004. A separate California OSHA report will be prepared based on her investigation and findings. (See Appendix O, page 176.)

Craig Endicott, USFS Special Agent was in charge of the cause and origin investigation. The cause is under investigation in cooperation with the Tuolumne County Sheriff.

Matt Gam, USDA Office of Investigator General, participated in a site visit on September 13 and met with the team leaders on September 14, 2004. He did not participate in the interviews or this investigation.

The National Institute of Occupational and Safety Health (NIOSH) initiated an independent review in November of 2004. NIOSH visited the accident site. This investigation team is providing information to NIOSH at their request. An independent report will be issued by them.

■ Investigative Team Authority

The team was given full authority as described under the Cooperative Fire Protection Agreement (the four party agreement, BLM/NPS/FS/CDF 7/25/01).

67. Accident Investigations

“Whenever an accident occurs involving the equipment or personnel of a supporting agency (CDF), the protecting agency (USFS) shall take immediate steps to notify the supporting agency that an accident has occurred. As soon as practical, the protecting agency shall conduct an investigation of the accident. A team made up of appropriate representatives from all the affected agencies shall conduct the investigation....

The sharing of information between agencies on accident investigations and their findings and probable causes is a valuable tool for safety and must be encouraged.”

The team had full authority to use whatever other technical support people were necessary to complete the accident investigation. The team was directed to do the following:

- Identify factual data associated with the circumstances relating to the incident.
- Accurately and objectively record the findings of its investigation.
- Analyze the findings to determine factors involved and their relationships.
- Recommend actions that should be immediately implemented to prevent similar future occurrences.
- Develop and submit a factual report and an investigative report to the Regional Forester, Pacific Southwest Region and the Director, California Department of Forestry and Fire Protection.

■ Team Chronology

September 13, 2004 — The team convened in the morning in Sonora, California. The team received an inbriefing by Stanislaus National Forest and CDF Tuolumne-Calaveras Unit personnel.

September 13, 2004 — The Tuolumne County Sheriff recovered the body in the morning and coordinated the autopsy and toxicology report. The team visited the accident site in the afternoon.

September 14–24, 2004 — Over the next two weeks, the team investigated the fire and fatality site and conducted a series of interviews with witnesses. In addition to interviews, written statements were taken. A detailed site examination was conducted including the gathering of physical evidence. Training and qualification records of all personnel directly involved in the accident from firefighters through the incident commander were assembled. The team gathered information and evidence about dispatch records, personal protective equipment, fire weather observations, policies, procedures and guidelines related to the incident actions for both agencies. In addition, the team met regularly to discuss progress, clarify assignments, plan their report and review their findings.

September 17, 2004 — The CDF Greensheet and USFS 72-hour Report was released by the CDF and USFS at 1700 hours. (See Appendix Q.)

September 20, 2004 — Eva Schicke’s Memorial Service was conducted at the Calaveras County Fairgrounds.

September 24, 2004 — With the initial interviews completed, the team adjourned. Individual members continued their specific assignments. The team leaders debriefed the CDF Tuolumne-Calaveras Unit Chief and Stanislaus Forest Supervisor on the status of the investigation prior to departing September 24.

October 26-28, 2004 — The team reconvened in Sonora, California. The team reviewed interview transcripts, conducted follow-up interviews and gathered additional physical evidence. The team assessed the accident information relative to the Ten Standard Firefighting Orders, 18 Watch Out Situations, LCES (Lookouts, Communications, Escape routes, Safety zones) Checklist, Downhill and Indirect Line Construction and Thirtymile Abatement Checklist. The team identified causal, contributing and non-related safety factors.

October 28, 2004 — Backpack pumps and tools were returned to the Columbia Helitack Base.

November 15-16, 2004 — A subset of the team and team leaders met in San Luis Obispo, California to finalize the causal, contributing and non-related safety factors and compile a rough draft report.

December 13-14, 2004 — The subset of the team met in San Luis Obispo, California, to complete the rough draft report.

January 10-11, 2005 — The entire team reconvened in Sacramento, California to review and finalize the draft report in preparation for the report's publication and presentation to a joint US Forest Service – California Department of Forestry and Fire Protection, Board of Review. Individual team members were released upon completion of their assigned tasks and reports.

March, 2005 — The team leaders submitted the final draft report to their respective agencies for presentation to a formal Board of Review.

May 11, 2005 — CDF/USFS Joint Agency Board of Review held. Report presented by Investigation Team Leaders and accepted by Board of Review.

Board of Review Team Members:

CDF

Mark Stanely, Chief Deputy Director
Jim Wright, Deputy Director
Tom Tisdale, Staff Chief
Don Posten, Unit Chief

USFS

Ken Connaughton, Asst. Regional Forester
Ray Quintanar, Fire and Aviation Staff Officer
Stanley Sylva, Forest Supervisor
Kent Swartzlander, Acting Fire Management Officer

■ Overview of the Accident



Overview of the Accident

On September 12, 2004 at approximately 1345 hours seven members of California Department of Forestry and Fire Protection (CDF) Columbia Helitack (Copter 404) crew had to take emergency action when a sudden wind shift and fire flareup overran their position. Three Firefighters suffered minor injuries and Firefighter Eva Schicke was entrapped and killed.

Situation

Location

The fire was located near the bottom of the Tuolumne River Canyon (1450' elevation) three miles east of Groveland, California on the Stanislaus National Forest (STF) in Tuolumne County. The Tuolumne River Canyon is a major Sierra Nevada river drainage that has steep canyon sides and is 2,000 feet deep at the accident site. The fire originated approximately ½ mile downstream of the Lumsden Bridge along Lumsden Road.



Topographic map of accident site.

Fuel

During the initial attack, the fire was burning in light, flashy surface fuels. The fuels were predominately live oak leaf litter, light grass and mixed brush, with an oak overstory consistent with Fuel Model 2. One-hour fine dead fuel moisture was estimated at four to five percent and live fuel moistures were at critical stage.

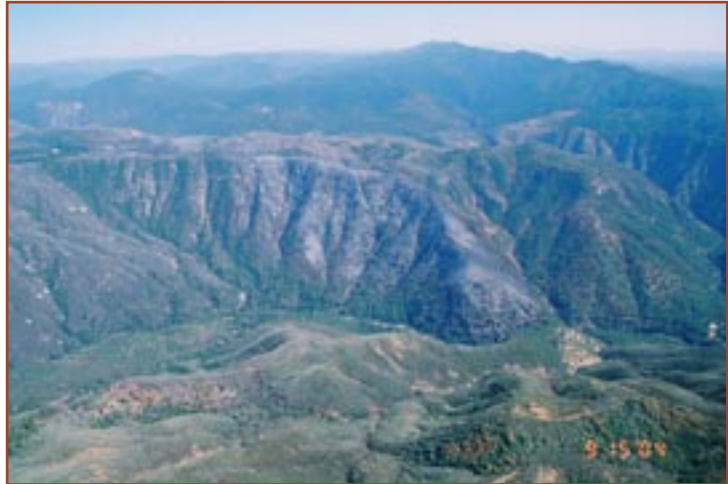
Topography

The Tuolumne River Canyon is a major Sierra Nevada river drainage characterized by a meandering river channel with numerous tributary canyons and ridges. Slopes range from 80 to 120 percent. Deep river drainages, such as the Tuolumne River, frequently experience wind shifts

and eddies. Local airflow is influenced by the physical shape of the terrain in the canyon causing wind eddies. Review of the Air Attack 440 video and post-incident observations on the ground indicate the first 75 to 100 vertical feet above the entrapment location may have been particularly sensitive to this occurring.

Variations in aspect and fuels create localized heating differences contributing to changeable air flow patterns. Local airflow is influenced by in-drafts into the fire above the road that are occasionally strong enough to briefly override the up-canyon wind, creating occasional wind shifts.

The fire started below Lumsden Road on the south side of the river.



*Tuolumne River Canyon looking South.
Fire and accident site is in center of photo.*

■ Weather

Temperature: 89-94 F

Relative Humidity: 18-24 %

Wind: Predominately steady up-canyon, estimated 3-5 mph.¹

No critical fire weather patterns (thunderstorms, frontal passage, etc.) were in place.

■ Fire Discovery and Dispatch

The Tuolumne Fire was reported by STF Duckwall Lookout at 1233 hours. The visible smoke column put the fire near the Sweetwater Campground, 5 miles east of Buck Meadows. At 1245 STF Smith Peak Lookout's cross on the smoke column put the fire in the bottom of the Tuolumne River canyon near South Fork Campground. STF dispatched a standard wildland fire response that consisted of:

- STF Division Chief, Division 4, Allen Johnson, (IC)
- CDF Battalion Chief Julie Henriques, Battalion 4416
- STF Engine 42, STF Buck Meadows Fire Station
- STF Water Tender 42, STF Buck Meadows Fire Station
- STF Engine 43 Captain Tammy Mount, STF McDiarmid Fire Station
- STF Engine 44, Cherry Lake Fire Station
- CDF Engine 4490 Captain John Yount, CDF Groveland Fire Station
- CDF Engine 4476 FAE Kevin Craddock, CDF Groveland Fire Station
- CDF Engine 4468, CDF Green Springs Fire Station
- CDF Air Attack 440, Battalion Chief Dan Ward (ATGS), Pilot Colin Rogers,
Columbia Air Attack Base
- Air Tanker 82, Columbia Air Attack Base
- Air Tanker 83, Columbia Air Attack Base
- CDF Copter 404, Columbia Air Attack Base

¹ Prior to the burnover numerous observers (Air Attack 440, Copter 404 pilot, IC and Helitack Crew 404) reported that the wind had remained light and steady flowing in an up-canyon direction.

At 1245 hours Copter 404 was dispatched, along with CDF Air Attack 440, Tanker 82 and Tanker 83 (S-2 T airtankers), from their home base in Columbia, California (22 miles northwest of the fire). Copter 404 is a UH-1H Super Huey (ICS type 2) helicopter with a crew of nine, consisting of a pilot, two Helitack Captains (HC) and six firefighters (FF).

The Copter 404 crew consisted of:

- Copter 404 Pilot Tom Eggleston
- Copter 404 Captain Frank Podesta
- Helitack Captain Jonah Winger
- Firefighter Josh Agustin
- Firefighter Jon Andahl
- Firefighter Jeff Boatman
- Firefighter T.J. Fraser
- Firefighter Shane Neveau
- Firefighter Eva Schicke

All members of the helitack crew met the training and experience requirements for their assignment and were well rested.

■ Initial Attack on the Fire

The fire was located east of Groveland in the Stanislaus National Forest. It burned on both sides of Lumsden Road in the bottom of the Tuolumne River Canyon near Lumsden Bridge. The fire was backing down-slope below the road and spreading rapidly above the road up the south canyon face. At this point in the canyon, the river course turns from east-west to north-south for a short distance. Thus the fire was on a slope that faced west.

At 1259 hours Air Attack 440 (Battalion Chief Dan Ward and Pilot Colin Rogers) arrived over the fire. Ward was designated as Tuolumne Air Tactical Group Supervisor (ATGS). The fire had burned five to ten acres and was spreading up-slope and up-canyon pushed by a steady 3-5 mph up-canyon wind. ATGS Ward directed the two air tankers to make retardant drops on the right flank on the upper section of the fire; they were unable to get lower on the slope due to the canyon's steepness.

Copter 404 arrived over the fire at approximately 1305 hours. After waiting for the air tankers to clear, HC Winger and the six firefighters were dropped off by Copter 404 on a gravel bar at the confluence of the South Fork of the Tuolumne River and the Tuolumne River, approximately $\frac{3}{4}$ mile downstream of the fire. They walked from their landing zone to Lumsden Road near South Fork Campground and then toward the right flank of the fire. They were the first ground resources to take action on the fire.

They had the following complement of tools:

- 5 Bladder style backpacks
- 5 Scraping tools (Rhyno style)
- 1 Chainsaw
- 1 Gas fuel pack for chainsaw
- 2 portable radios

On the assigned tactical frequency, ATGS Ward directed Copter 404 Captain Podesta to make water drops on the right flank. The instructions from ATGS Ward were to start at the bottom and work up the right flank. Copter 404 with Pilot Eggleston and Copter 404 Captain Podesta on board began making water drops on the right flank of the fire. They began their water drops at Lumsden Road and worked their way up the right flank towards the air tanker drops. Copter 404 did not make any water drops on the fire below Lumsden Road (between the road and river).



The seven firefighters from Copter 404 hiked to Lumsden road (black arrow shows walkout route) after being dropped off on gravel bar landing zone (red "x").

■ Incident Commander's Actions

STF Division Chief Johnson, was dispatched to the fire to be the Incident Commander (IC) and responded down Lumsden Road from the Buck Meadows area. The IC drove past the walking Helitack Crew 404 en route to scout out the fire. The fire had spread above and below Lumsden Road. The road paralleled the river and the right flank of the fire below the road was backing very slowly into the wind. After observing the fire area near the right flank, he returned to where the helitack crew was walking along Lumsden Road near South Fork campground.

The IC did not announce any overall strategy or priorities to the resources on the fire.

HC Winger met with IC Johnson on the road. Johnson did not identify himself as the IC, nor did Captain Winger inquire as to Johnson's role. IC Johnson told HC Winger that he had just driven to the right flank and described the fire situation that he had observed. IC Johnson said he gave HC Winger the strategic assignment to "size things up to see if there was some place they could safely anchor the fire and start doing some action." HC Winger stated that he understood his instructions to be to "anchor this fire on the right flank, the road down to the river." No specific tactics were discussed. Following the briefing, HC Winger and the crew continued to walk along Lumsden Road to the right flank of the fire. HC Winger still did not realize that Johnson was the IC.

After the briefing with Helitack Crew 404, IC Johnson initiated a discussion with ATGS Ward on the tactical net. IC Johnson asked ATGS Ward "as far as that helicopter goes, what do you think about using it to pick up that fire below the road so we can get that at least anchored up." ATGS Ward stated that he wasn't worried about the fire below the road and that the priority was further up the right flank. IC Johnson accepted ATGS Ward's recommendation that the fire below the road was not a priority and stated "the helitack crew is working their way up there; I think they are going to see if they can anchor that piece below the road." HC Winger heard this discussion on the tactical net, realized that Johnson was the IC and that the priority for Copter 404 was going to be above the road. Captain Winger said that he thought, "Oh, there goes our water drops."

Simultaneous to this portion of the discussion ATGS Ward's attention was distracted by the Air Attack 440 pilot on aircraft intercom about a new spot fire on the left flank and ATGS Ward did not hear the entire discussion about the helitack crew working below the road. ATGS Ward later stated that he thought Helitack Crew 404 was working above Lumsden Road.

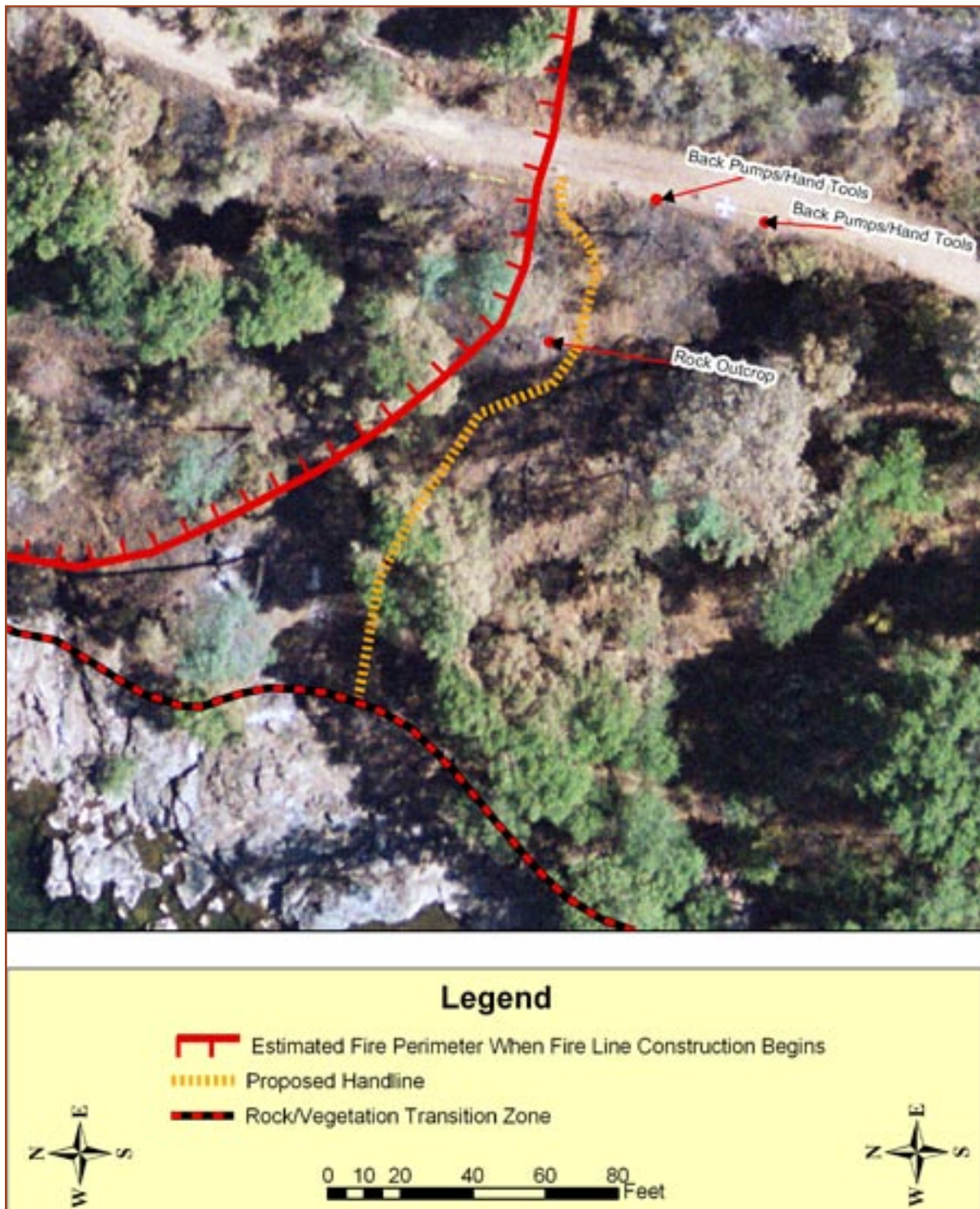
■ CDF Helitack Crew 404 Initial Actions at the Right Flank

At approximately 1335 hours, upon reaching the right flank, FF Boatman and FF Neveau scouted further up Lumsden Road to see how far they were from Lumsden Bridge. Their intent was to determine if they could access the river and work their way into the bottom of the fire. After their initial scouting they thought the bridge was another one to two miles further up river and would not work. The slope between the road and the river was very steep (80-120%). They observed that the further upstream they went, the steeper the slope to the river became. Smoke obscured visibility in the burn and they did not locate a way through the black to the river. They returned to the right flank of the fire and rejoined the crew.

HC Winger scouted out a grassy opening in the oak overstory near the fire's right flank where he could see to the river. The fuel type was grass, leaf litter and scattered light brush under an oak and pine overstory. He scouted down the right flank (about 70 feet) to a point where he could see the route for line construction to the high water mark of the river. HC Winger estimated this would require 250 to 300 feet of fireline to be constructed from the road to the rocks above the river.

The right flank of the fire, below the road, was generally backing slowly cross-slope into a steady, light up-canyon wind with surface flame lengths of 6 to 12 inches. The firefighters observed the fire burning underneath the scattered brush without igniting the aerial portion of the brush. *[Note: physical examination of the site indicated that scattered torching of individual brush had taken place.]* The fire edge did not go directly downhill; it angled down the slope and up the river and would

require constructing underslung line if they went direct. HC Winger made the determination that constructing a scratch line from the road downhill to the river would be simple and quick to accomplish. His plan was to construct indirect line parallel to the fire edge and then cut off the underslung portion by dropping straight down to the river and firing out the intervening fuel.



Planned fire line construction.

■ STF Engine 43 Actions

While HC Winger and Helitack Crew 404 scouted and assessed their tactics for the right flank of the fire; STF Engine 43 arrived at IC Johnson's location on Lumsden Road near South Fork Campground. STF E-43 Captain Mount received a briefing from IC Johnson and instructions to spot their engine at the Drew Creek crossing and support the helitack crew on the right flank. After the briefing, STF E-43 proceeded toward the right flank on Lumsden Road and parked at Drew Creek crossing. At 1342 hours, as Captain Mount started walking towards the right flank, STF E-43 broadcast "at scene" to STF Dispatch on Command Net. STF E-43 Captain Mount and STF E-43 FF Austin walked from the engine up Lumsden Road. Helitack Crew 404 was around a curve in the road and not visible from their parking spot. Neither IC Johnson, nor STF E-43 Captain Mount notified HC Winger that the engine was in the area or assigned to support them. HC Winger did not know an engine had been assigned to support his operation and that it was close.

■ Helitack Crew 404 Captain Winger's tactical briefing with crew

The tactic selected to establish the anchor at the river was indirect downhill fireline construction to stay out of heat and smoke and to take advantage of sparse fuel and natural barriers. The five backpack pumps were staged on the edge of the road. The crew began using one chainsaw and hand tools to construct line downhill from the road to the rocks above the river (slope distance of 180 feet). The specific fireline construction assignment was to start with the chainsaw to take out the scattered brush, followed by anchoring at the road using scraping tools to cut a quick indirect scratch line, paralleling the fire's edge 7 to 30 feet away. They began to fire-out the intervening fuel as they went down the slope. This parallel attack² was chosen in order to "stay out of the smoke and heat and take advantage of the grassy opening."

All members of the helitack crew stated that they understood the assignment, had an opportunity to comment, raise concerns, or even veto the assignment if they believed it to be unsafe. No one raised concerns.

HC Winger identified the escape routes and safety zones as:

- "downhill to the river"
- "up hill to the road, then up the road into the burn or down the road into the green"
- The standard safety zone of stepping into the burn was not specifically discussed, but crew members stated that they know it is always a primary option.

HC Winger notified Copter 404 Captain Podesta on the tactical net that they would be constructing downhill line on the right flank to tie into the river.

Tool order and assignments:

FF Fraser - chainsaw
 FF Agustin - pulling and swamping for the saw
 HC Winger - scraping tool and portable radio
 FF Andahl - scraping tool
 FF Schicke - scraping tool
 FF Boatman - scraping tool
 FF Neveau - scraping tool, portable radio and fuses

² CDF Manual section 4320.1 student information

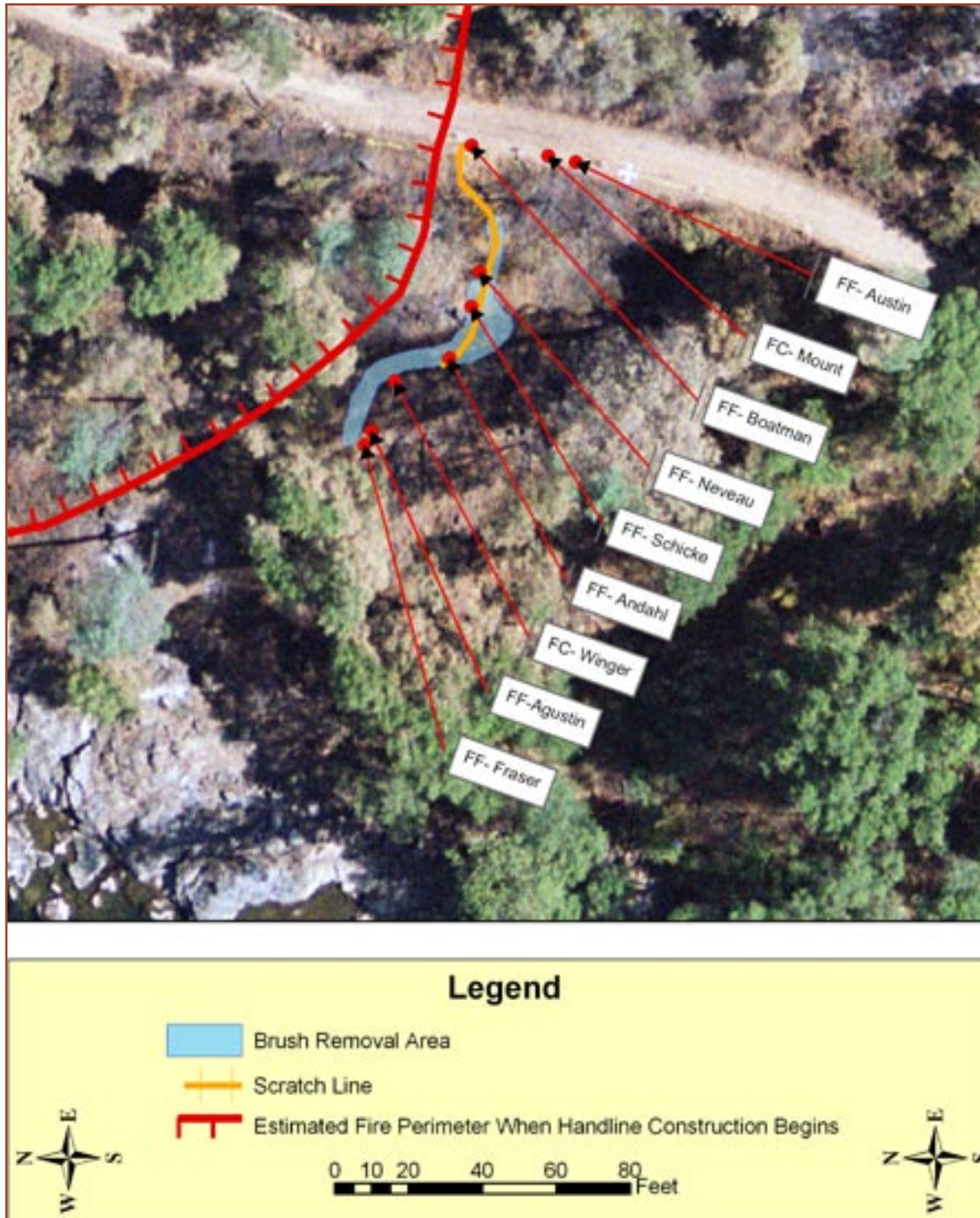
■ CDF Helitack Crew 404 Fireline Construction

At approximately 1340 hours the crew members began building handline downhill through a 30- to 50-foot wide “grassy opening” with scattered brush fuels under an oak and pine overstory. They used the chainsaw and hand tools. The fire was backing into a steady 3 to 5 mph up-canyon wind towards the crew. FF Fraser and FF Agustin had reached a point approximately 2/3 of the way down the slope (roughly 30 feet above the rocks at the high water level of the river) and were running out of brush to cut. They moved very quickly since there was only scattered brush. The cut brush was thrown into the green, creating a brush-free zone for line construction. HC Winger and FF Andahl had cut a scratch line below a rocky outcropping, 80 to 100 feet down-slope from the road. FF Schicke and FF Boatman were improving the scratch line and FF Neveau was using a fusee to burn out the intervening fuel starting at the road. FF Neveau had fired from the road to FF Schicke’s position, 25 to 35 feet below the road. According to their observations, the firing operation was “pulling into the fire’s edge nicely.”



Fire line construction prior to flareup.

Firefighters then observed what they described as a “minor” flutter in the wind. According to statements made to interviewers, Captain Winger addressed the three upper firefighters (Schicke, Neveau, Boatman) to “grab the back pump and just make sure that holds as you go down; look for spots as you go; lookout.” FF Boatman volunteered to take this assignment and returned up the fireline to the road, he did not hear HC Winger say to be a lookout.



Crew Location Prior to Flareup

■ Flareup and Burnover Sequence

At approximately 1346 hours, as FF Boatman was preparing to don the back pump, STF E-43 Captain Mount and STF E-43 FF Austin walked up to his location and asked where the Helitack Captain was. FF Boatman indicated down the hill and STF E-43 Captain Mount saw HC Winger's red helmet and the crew building line.

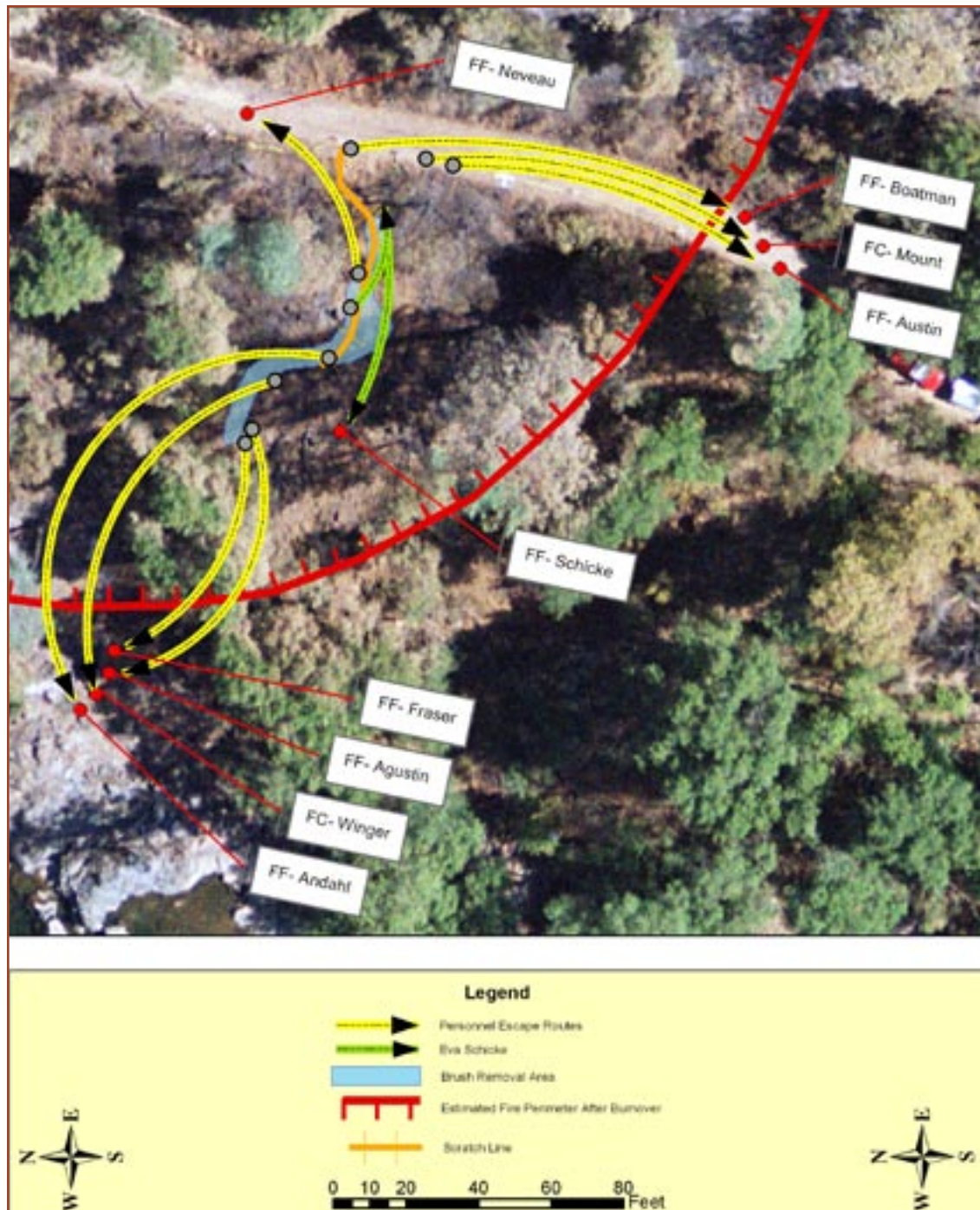
During this conversation, a sudden wind shift occurred causing the fire to change direction and spread up-slope into the crew. Three members of the helitack crew simultaneously shouted the alarm and everyone started toward their identified safety zones. Four members of the crew, including the captain, went down to the river; two went up toward Lumsden Road, FF Boatman was already on the road. The four firefighters that went downhill reached their safety zone. Of the two firefighters that went uphill, FF Schicke and FF Neveau, only FF Neveau made it to the road. FF Schicke was last seen by FF Neveau immediately behind him approximately 5 feet from the road. Firefighters at scene estimated the elapsed time from the wind shift to the burnover was less than 30 seconds with the total wind event lasting less than 2 minutes. There was no indication that the wind was going to change and dramatically as it did. It occurred suddenly without warning and the only action the crew could take was to react and seek safety zones. Fire shelters were not deployed.

[Note: the estimated elapsed time for this series of events to occur was the amount of time it took to read the preceding paragraph.]

■ The following actions occurred simultaneously

- The fire reacted to the directional wind shift and the backing fire became a spreading fire that turned up-slope with the wind. The fire rate-of-spread and flame lengths increased dramatically.
- FF Agustin saw the fire flareup "in a very small draw to the right of the oak tree we were cutting to and it sheeted up the draw in the grass." He yelled to FF Fraser (sawyer) to get down the hill; he and FF Fraser ran downhill towards the river safety zone. They skirted the flareup by running through the unburned fuels. They reached the river safely, without injury.
- HC Winger recognized the fire spreading toward the crew and yelled "emergency action."
- FF Neveau saw fire coming up the hill below him and yelled "wind shift;" fire began burning parallel to the fireline and his position.
- FF Andahl heard FF Neveau yell "wind shift" and saw fire below. FF Andahl was at the same location as Captain Winger; he and Captain Winger took separate routes side-hill through the flaming front. They both stated that it was very hot in the burn and did not believe they could stay there; both turned downhill towards the river. Due to the steepness of the slope their descent was almost uncontrolled; the last portion was almost vertical. FF Andahl bounced off of a tree, injured his ankle and received minor burns. Captain Winger suffered minor facial burns. Both made it to the river safety zone.
- While talking to FF Boatman, STF E-43 Captain Mount heard helitack crew members yelling and noticed a spot fire next to her on the cut bank on the uphill side of the road. STF E-43 Captain Mount started back towards STF E-43 and yelled for STF E-43 FF Austin to follow her. She observed the spot fire spreading parallel to Lumsden Road, down-canyon. The spot fire then turned up-slope. She felt a strong wind at her back as she "trotted" toward STF E-43.
- ATGS Ward observed an increase in fire intensity on the upper portion of the right flank (he estimated it to be at the 2,250 foot elevation) and a following flareup at the heel below the road. He gave an order over the tactical net for all crews to "get in the black, get to your safety zones." ATGS Ward believed Helitack Crew 404 was working above the road.
- FF Boatman saw the flareup below the crew and yelled at FF Neveau and FF Schicke to run uphill to the road. They were approximately 25 to 35 feet below the road. Both started up the fireline toward the road, hiking at first, then scrambling. They used their scraping tools, like a climbing tool, to help themselves up the slope.
- FF Boatman observed FF Schicke and FF Neveau scrambling up the hill towards him; then saw flame and felt intense heat coming up from just below the road. He was forced to back away from the edge and heard FF Schicke scream.

- FF Neveau scrambled up the fireline towards Lumsden Road. He looked over his shoulder and saw FF Schicke scrambling directly behind him. He felt intense heat coming from below and thought he was starting to burn. FF Neveau heard FF Schicke screaming. He last saw FF Schicke when they were within 5 to 10 feet of the road. This was the last time FF Schicke was seen alive.
- As the flames hit the road FF Neveau rolled over the lip of the road within the oncoming flame front and rolled across to the cut bank. FF Neveau moved up Lumsden Road into the black, out of the heat. He suffered smoke inhalation and thought he was burned.
- FF Boatman saw FF Neveau roll onto the road. He then lost visibility due to fire and smoke impinging on the road. He did not see FF Schicke come up onto the road and no longer heard her screaming. He moved down Lumsden Road into the green, out of the heat.



Post Flareup Personnel Locations

■ Post-Entrapment

Immediately following the flareup and escape to the safety zones, HC Winger announced over the tactical net that Helitack Crew 404 had been burned over and there were injuries. HC Winger asked ATGS Ward for immediate assistance with water drops.

- FF Boatman returned to FF Neveau's location and checked him for injuries.
- HC Winger identified FF Andahl, FF Agustin and FF Fraser along the river and contacted FF Neveau by radio to do a crew accountability check.
- FF Neveau contacted HC Winger on portable radio and stated that FF Boatman and FF Neveau were accounted for but FF Schicke was missing.
- FF Boatman walked back to the beginning of the fireline looking for FF Schicke but due to smoke couldn't see into the burn area.
- Copter 404 Captain Podesta heard HC Winger's emergency announcement on the tactical net. Copter 404 was working a spot fire on the left flank at the time of the emergency call; they left the spot fire and proceeded towards Helitack Crew 404. En route they picked up a load of water from a dipping spot near Lumsden Bridge. When they arrived at the crew's location, the fire had returned to a backing fire with minimal activity like they had seen earlier. They made water drops to cool off the area.
- At 1349 hours ATGS Ward requested two ground ambulances through STF Dispatch.
- HC Winger broadcast on the tactical net that there was a missing helitack crew member.
- At 1354 hours IC Johnson advised STF Dispatch there were injuries to firefighters on the line and one was missing
- Searches for FF Schicke were started from the river up and from the road down. Rolling rocks and other material in the burn hampered the search. There was concern that rolling rocks could injure the searchers near the river.
- FF Boatman and FF Neveau organized a grid search from the road with the assistance of STF Engine 43. FF Boatman and FF Neveau located FF Schicke's body approximately 80 feet below the road. HC Winger observed her body and determined that she was obviously deceased.
- HC Winger broadcast over the tactical net that the missing firefighter had been found. He did not say there was a fatality.
- At 1442 hours IC Johnson advised STF dispatch that the missing firefighter had been found.
- CDF Engines 4490 (Captain Yount) and 4476 (Engineer Craddock) arrived at the accident site and assisted in treating the injured crew members, including bringing FF Andahl up from the river. IC Johnson transported the surviving members of the crew to South Fork Campground. They were transported by Eldorado National Forest Copter 516 to Pine Mountain Airport near Groveland. FF Neveau was transported to Doctor's Hospital in Modesto via air ambulance. FF Andahl was transported to Sonora Regional Medical Center via air ambulance. The other crew members were transported to Sonora Regional Medical Center via ground ambulance.
- At 1500 hours initial attack IC Johnson transitioned incident command to Extended Attack IC Payne, STF Division Chief and met with STF Assistant Fire Management Officer (AFMO) McGowan. Initial Attack IC Johnson confirmed to STF AFMO McGowan that there was a fatality. STF AFMO McGowan called STF Fire Management Officer (FMO) Cones and confirmed the fatality.
- At 1615 hours STF AFMO McGowan and Initial Attack IC Johnson met with CDF Battalion Chief Henriques and CDF Fire Captain Jones to advise them of the fatal injuries to FF Schicke.
- At 1800 hours AFMO McGowan, Initial Attack IC Johnson and CDF Battalion Chief Henriques met with Tuolumne County Deputy Sheriff Crowe. Deputy Crowe advised that the recovery of FF Schicke's body would not take place until the next morning because of safety concerns for the recovery team.
- FF Neveau was admitted to Doctor's Hospital in Modesto, held overnight and released on September 13.

- HC Winger and the four firefighters taken to Sonora Regional Medical Center were treated and released by 1830 hours, September 12.
- Critical Incident Stress Debriefings occurred for personnel at Buck Meadows on September 12 and Sonora on September 13.



Detailed fire progression.

■ Personal Protective Equipment

All personnel had Personal Protective Equipment (PPE) that was proper for the assignment and the PPE performed as expected. PPE reduced the extent of injuries suffered and did not contribute to the accident.

■ Sequence of Events



Sequence of Events in Chronological Order

■ Pre-Incident:

■ September 12, 2004

0800 hrs

California Department of Forestry and Fire Protection (CDF) Battalion Chief (BC) Dan Ward reports for duty at the CDF Columbia Air Attack Base. BC Ward is working the last day of a four-day shift and has had an adequate work-rest cycle. Ward is assigned as the Air Tactical Group Supervisor (AGTS) on Air Attack 440 (Ward interview).

CDF Fire Captain (FC) Frank Podesta reports for duty at the CDF Columbia Air Attack Base. Copter 404 Captain Podesta is designated as the Copter 404 Captain. Copter 404 Captain Podesta is working the first day of a four-day shift and has had an adequate work-rest cycle (Podesta interview).

CDF Fire Captain (FC) Jonah Winger reports for duty at the CDF Columbia Air Attack Base. HC Winger is designated as the Helitack 404 Captain on Copter 404. HC Winger is working the first day of a four-day shift and has had an adequate work-rest cycle (Winger interview).

CDF Forestry Pilot (FP) Tom Eggleston reports for duty at the CDF Columbia Air Attack Base. FP Eggleston is assigned as the pilot for Copter 404. FP Eggleston is working the first day of his shift and has had an adequate work-rest cycle (Eggleston interview).

CDF Firefighter 1 (FF) Jeff Boatman reports for duty at the CDF Columbia Air Attack Base. FF Boatman is assigned as a crew member on Helitack crew 404. FF Boatman is working the first day of a four-day shift and has had an adequate work-rest cycle (Boatman interview).

CDF Firefighter 1 (FF) Shane Neveau reports for duty at the CDF Columbia Air Attack Base. FF Neveau is assigned as a crew member on Helitack Crew 404. FF Neveau is working the second day of a four-day shift and has had an adequate work-rest cycle (Neveau interview).

CDF Firefighter 1 (FF) Eva Schicke reports for duty at the CDF Columbia Air Attack Base. FF Schicke is assigned as a crew member on Helitack crew 404. FF Schicke is working the fourth day of a four-day shift and has had an adequate work-rest cycle (Ward 2nd interview).

CDF Firefighter 1 (FF) John Andahl reports for duty at the CDF Columbia Air Attack Base. FF Andahl is assigned as a crew member on Helitack crew 404. FF Andahl is working the fourth day of a four-day shift and has had an adequate work-rest cycle (Andahl interview).

CDF Firefighter 1 (FF) Josh Agustin reports for duty at the CDF Columbia Air Attack Base. FF Agustin is assigned as a crew member on Helitack Crew 404. FF Agustin is working the first day of a four-day shift and has had an adequate work-rest cycle (Agustin interview).

CDF Firefighter 1 (FF) T.J. Fraser reports for duty at the CDF Columbia Air Attack Base. FF Fraser is assigned as a crew member on Helitack Crew 404. FF Fraser is working the third day of a four-day shift and has had an adequate work-rest cycle (Fraser interview).

0900 hrs Copter 404 Captain Podesta, Helitack Captain (HC) Winger, FF Agustin, FF Andahl, FF Boatman, FF Fraser, FF Neveau and FF Schicke participate in physical fitness training at the Columbia Air Attack Base. No injuries are reported after this training (all crew interviews).

USFS Fire Management Officer (FMO) Allen Johnson reports for duty as the Groveland Ranger District Duty Officer. FMO Johnson, designated as STF Division 4, was off-duty the night before and slept all night (Johnson interview).

1030 hrs Copter 404 Captain Podesta, HC Winger, FF Andahl, FF Agustin, FF Boatman, FF Fraser, FF Neveau, FF Schicke eat breakfast (all crew interviews).

■ Incident:

1233 hrs Stanislaus National Forest (STF) Duckwall Lookout reports the Tuolumne Fire to Stanislaus Dispatch. The fire is originally reported near the Sweetwater Campground area, approximately 5 miles east of Buck Meadows. The fire is reported at Latitude 37 50.44.16 Longitude 120 1' 58.08. Section 19, Township 1S Range 18E. (Johnson interview & STF Computer Aided Dispatch [CAD] Report).

1245 hrs Stanislaus Dispatch initiates a wildland fire response and dispatches STF Division 4, CDF Battalion 4416, STF Engine 42 and Water Tender 42 from the Buck Meadows Fire Station, STF Engine 43 from the McDiarmid Fire Station, STF Engine 44 from the Cherry Lake Fire Station, CDF Engine 4490 and CDF Engine 4476 from the CDF Groveland Fire Station and E4468 from the CDF Green Springs Fire Station, Air Attack 440, Tanker 82, Tanker 83 and Helicopter 404 from Columbia Air Attack Base. (STF CAD report).

Copter 404, Air Attack 440, Air Tanker 82, Air Tanker 83 are dispatched to the fire from Columbia Air Attack Base. The interagency intercom is used to dispatch the Columbia aircraft. There is no communication between STF dispatch and the CDF air resources. (Tuolumne Calaveras Unit [TCU] MIRPS Report)

CDF Copter 404 responds to the Tuolumne Fire. On board are Forestry Pilot Tom Eggleston, Fire Captain Frank Podesta, Fire Captain Jonah Winger, Firefighter Josh Agustin, Firefighter John Andahl, Firefighter Jeff Boatman, Firefighter T.J. Fraser, Firefighter Shane Neveau, Firefighter Eva Schicke.

Air Attack 440 (AA440) responds to the Tuolumne Fire with Pilot Colin Rogers and CDF BC Dan Ward.

Airtanker (AT) 82 responds to the Tuolumne Fire with Pilot Duane Cornell.

Airtanker (AT) 83 responds to the Tuolumne Fire with Pilot Jim Dunn.

Smith Peak Lookout advises STF Division 4 Allen Johnson the fire looks closer to the confluence of the South Fork of the Tuolumne River and the main Tuolumne River.

1246 hrs STF Division 4 Johnson advises STF Dispatch on STF Forest Net the fire is in Tuolumne River Canyon, not the Sweetwater Campground Area. STF Division 4 Johnson begins his access down Lumsden Road toward the heel of the fire (Johnson interview, CAD report).

1255 hrs Copter 404 is flying toward the fire. The crew can see the fire is near the Tuolumne River. FF Boatman talks with the crew about Tuolumne River Canyon and his knowledge from river rafting the area. FF Boatman talks of the steep topography and long access times for vehicle traffic (Boatman interview).

- 1259 hrs** AA 440 with BC Ward and pilot Rogers are at scene (STF CAD Report).
- 1303 hrs** AA 440 BC Ward contacts STF Division 4 Johnson on STF Forest Net. ATGS Ward states the fire is burning 5-10 acres and the fire is on both sides of Lumsden Road (STF CAD report, AA 440 video).
- CDF Airtanker 82 and Airtanker 83 are at scene (AA440 video).
- 1304 hrs** Copter 404 arrives at scene and is directed by AA 440 to hold out of the area while the airtankers work the fire (AA440 video).
- 1305 hrs** STF E-43 starts down Lumsden Road from Ferretti Road.
- 1306 hrs** STF Division 4 Johnson assumes the role of Incident Commander (IC). IC Johnson directs CDF B4416 to have the CDF engines make access down Lumsden Road. IC Johnson orders an additional five type 3 engines, three additional helicopters and four additional airtankers (STF CAD report).
- 1310 hrs** AA 440 assigns Airtanker 82 and 83 to drop fire retardant on the upper portion of the right flank (Ward interview).
- First airtanker drop at lower portion of right flank, second drop working backwards up-slope (Cornell and Dunn interviews).
- IC Johnson parks at South Fork Campground on Lumsden Road, approximately 1 mile west of the right flank of the fire. Johnson is able to see an airtanker drop on right flank (Johnson interview).
- Copter 404 recons the fire and surrounding area for a safe landing zone (Podesta Interview).
- 1311 hrs** Copter 404 locates a landing zone along the river, downstream from the fire. The landing zone is near the South Fork campground at the confluence of the main fork and south fork of the Tuolumne River. (AA440 Video)
- Copter 404 lands at landing zone and deploys HC Winger, FF Agustin, FF Andahl, FF Boatman, FF Fraser, FF Neveau and FF Schicke. Copter 404 Captain Podesta and FP Eggleston remain in Copter 404. Copter 404 Captain Podesta and HC Winger discuss a plan to work Crew 404 on the right flank. HC Winger has a handi-talki and has it set to the designated tactical net (Forest Service Tac#2). HC Winger is also scanning CDF Air to Ground frequency. Crew 404 offloads five full five-gallon water backpack pumps, a chainsaw, a chainsaw support pack (including extra fuel and oil) and five scraping tools (Podesta and Winger interviews).
- 1312 hrs** Crew 404 gathers on Lumsden Road near the South Fork Campground after individually hiking from Copter 404's landing zone. Crew 404 begins walking toward the right flank fireline on Lumsden Road (all crew 404 interviews).
- AA 440 assigns Copter 404 to begin making water drops at the bottom of the right flank and work up toward the head of the fire.
- 1314 hrs** IC Johnson requests six additional handcrews from STF Dispatch.
- HC Winger uses his handi-talki to inform Copter 404 Captain Podesta that Crew 404 will work the right flank (Podesta and Winger interviews).

- 1316 hrs** Copter 404 makes first bucket drop on fire starting at the lower portion of the right flank, above Lumsden Road (AA440 video).
- Crew 404 is still hiking in (Podesta interview).
- 1319 hrs** Copter 404 makes second water drop on right flank above Lumsden Road (AA 440 video).
- 1320 hrs** IC Johnson arrives at scene on Lumsden Road. As IC Johnson drives past the South Fork Campground, he sees Crew 404 walking along Lumsden Road. IC Johnson is surprised to see the crew. Until this point IC Johnson thought he was the only resource on the ground. IC Johnson had not heard any radio traffic about Crew 404 or Copter 404 being at the scene. IC Johnson drives past Crew 404 while they are walking on Lumsden Road. IC Johnson drives to right flank to assess the fire (Johnson interview).
- 1322 hrs** AA 440 relays to IC Johnson that fire intensity is beginning to increase.
- 1323 hrs** Copter 404 makes 4th water drop on right flank above Lumsden Road (AA 440 Video).
- IC Johnson observes fire burning on both sides of Lumsden Road. IC Johnson observes smoke conditions and only a smoldering fire below Lumsden Road. IC Johnson continues driving the burn area to assess the left flank. IC Johnson becomes concerned about rolling material or snags falling on Lumsden Road behind him. IC Johnson turns his vehicle around and drives back out the way he came on Lumsden Road (Johnson interview).
- 1325 hrs** IC Johnson drives back downstream on Lumsden Road and meets with Crew 404. IC Johnson talks face-to-face with HC Winger and assigns crew 404 to the right flank. IC Johnson tells HC Winger the fire is burning in steep country, with fire on both sides of the road. IC Johnson instructs HC Winger to go in and size up the right flank and find a place to take action. IC Johnson does not instruct HC Winger to report back to him on his actions. IC Johnson drives to South Fork Campground to better view the fire (Johnson and Winger interviews).
- IC Johnson asks AA 440 about using Copter 404 to make water drops on the bottom of the right flank below the road to anchor it. ATGS Ward replies he isn't worried about the bottom of the right flank; it is holding it's own. IC Johnson states Crew 404 is going to try to anchor the fire below the road (AA440 video).
- AA 440 pilot sees spot on the left flank. Pilot Rogers and ATGS Ward have a discussion about the spot on the Air Attack 440 intercom. ATGS Ward tells IC Johnson about the spot. ATGS Ward focuses his attention to the spot fire on the left flank (AA 440 video).
- Crew 404 is still hiking (Winger interview).
- 1328 hrs** Copter 404 makes 5th bucket drop on right flank above Lumsden Road (AA440 video).
- 1330 hrs** Copter 404 makes 6th bucket drop on right flank above Lumsden Road (AA440 video).
- 1331 hrs** Airtanker drops on right flank (AA440 Video).
- Copter 404 offers to check out spot fire on left flank (Ward Interview).
- Crew 404 continues hiking on Lumsden Road toward right flank (Winger interviews).
- 1335 hrs** Crew 404 arrives at right flank. FF Boatman and FF Neveau scout further east on Lumsden Road to verify their position in relation to the Lumsden Bridge. FF Boatman also checks for access downhill from Lumsden Road to the river area (Boatman and Neveau interviews).

FF Boatman and FF Neveau do not locate an access point and return to where HC Winger and Crew 404 are positioned. HC Winger briefs crew on possibly constructing handline downhill to river from Lumsden Road. HC Winger scouts area by hiking downhill toward river. HC Winger estimates the distance to tie in the road to the river to be 300 feet. *[Actual measurement at the scene was 260'.]* HC Winger locates a break in the fuel bed estimated by him to be 7 to 15 feet from the fire's edge. HC Winger describes the fire as backing cross-slope, with low flame lengths (approximately 6 to 12 inches). HC Winger decides this is the best area to construct indirect handline to stay out of the heat and heavier brush. HC Winger identifies the safety zones as back up the hill to Lumsden Road then east along the road into the black, or down the hill to the river, where there is no fuel. HC Winger chooses this indirect tactic to stay out of the heat and smoke, take advantage of light fuels and to not have to deploy the heavy back pumps on a steep slope (Winger interview).

HC Winger finishes briefing crew on the assignment. All crew members are polled on any concerns over the assignment. No safety concerns are voiced. HC Winger directs Crew 404 to stage the full water back pumps along Lumsden Road. HC Winger does not deploy the back pumps because of the indirect tactic that he chose. The chainsaw and scraping tools are the only tools initially deployed for indirect handline construction. HC Winger employs the indirect tactic based on the break in the fuel bed, presence of a smoldering or backing fire and the fast time frame he expects to complete this assignment (all crew 404 interviews).

HC Winger advises Copter 404 that the Helitack Crew would be building downhill fireline from the road to the river on the right flank. Copter 404 Captain Podesta is the only person that hears this traffic. Copter 404 monitoring CDF Air to Ground and assigned tactical net (Eggleston interview).

IC Johnson does not hear this traffic (Johnson interview).

HC Winger's communication to Copter 404 was on tactical net (Podesta interview).

1340 hrs

STF E-43 arrives at the South Fork Campground and meets with IC Johnson. STF E-43 Captain Mount meets with IC Johnson. IC Johnson tells E-43 Captain Mount "Helitack Crew 404 is hiking in and should be at the fireline by now." IC Johnson states Crew 404 is assessing the fire to see if they can start flanking the fire. IC Johnson assigns E-43 to the right flank. The instructions from IC Johnson include, find a safe place to spot the engine, support Crew 404 and assess the right flank to see if there is anything the rest of the responding engines can do. IC Johnson specifically tells STF E-43 Captain Mount about the turnout along Lumsden Road at Drew Creek. This is the turnout STF E-43 Captain Mount decides to initially spot STF E-43 (Mount and Johnson interviews).

Crew 404 descends from Lumsden Road downhill in the following order:

- FF Fraser is assigned to begin constructing handline using a chainsaw to clear what little brush there was. FF Agustin is assigned to be the swamper for the saw. FF Fraser and FF Agustin begin line construction from Lumsden Road. FF Fraser and FF Agustin move fairly quickly due to the limited amount of brush (Winger interview).
- HC Winger begins constructing handline from Lumsden Road. Winger is working both as a scout and using a scraping tool (Winger interview).
- FF Andahl is assigned a scraping tool and begins constructing handline from Lumsden Road (Andahl interview).
- FF Schicke is assigned a scraping tool and begins constructing handline from Lumsden Road (Boatman interview).
- FF Boatman is assigned a scraping tool and begins constructing handline from Lumsden Road (Boatman interview).

- 1342 hrs** STF E-43 arrives at Lumsden Road at the turnout at Drew Creek, just west of where Crew 404 is working. E-43 stops at this location to allow E-43 Captain Mount to walk ahead and determine if there is a safe area for the engine to park in. E-43 advises STF Dispatch they are at scene (Mount interview).
- FF Neveau is assigned a scraping tool and a handi-talki monitoring the assigned tactical net. FF Neveau begins fireline construction from Lumsden Road. FF Neveau is monitoring the tactical net only. The bank that is selected does not allow FF Neveau to monitor air to ground (Neveau and Boatman interviews).
- 1344 hrs** HC Winger directs FF Neveau to burn-out the fuel between the fire's edge and the fireline the crew is constructing (Winger and Neveau interviews).
- FF Neveau begins firing from road using a fusee. Neveau fires down approximately 25 feet to FF Schicke. FF Neveau stops firing at FF Schicke's position (Neveau interview).
- STF E-43 Captain Mount and FF Austin walk up Lumsden Road to the area of the right flank (Mount interview).
- 1345 hrs** Fire intensity picks up on ridge at right flank above the road and above Crew 404. ATGS Ward noticed a flareup at the heel a few moments later (Ward interview #2).
- Crew 404 continues handline construction unaware of the change above the road. The area above the road was not visible from their location (Winger interview).
- HC Winger gives direction to FF Schicke, FF Boatman and FF Neveau to deploy a back pack pump to hold any slop over and to have a good visible perspective on the crew. FF Boatmen accepts this assignment and hikes up to Lumsden Road (Winger and Boatman interviews).
- FF Boatman arrives at the cache of backpumps.
- STF E-43 Captain Mount contacts FF Boatman and asks where his captain is. STF E-43 Captain Mount sees a crew person wearing a red helmet down the handline from Lumsden Road. STF E-43 Captain Mount discusses the line construction with FF Boatman. STF E-43 Captain Mount states to FF Austin she would not commit E-43 to that line because of the steepness (Austin statement).
- Simultaneously the members of Crew 404 notice the fire flareup below them (all Crew 404 interviews).
- 1346 hrs** FF Neveau sees flareup below him, at the bottom of the hill and yells "wind change." Wind begins blowing up-slope toward Crew 404 (FF Neveau interview).
- FF Agustin sees fire flareup below him. FF Agustin yells at FF Fraser to get down the hill (Agustin interview).
- FF Fraser hears FF Agustin and begins running downhill (Fraser interview).
- HC Winger recognizes the fire spreading toward Crew 404 from below and yells "Emergency Action" (Winger interview).
- STF E-43 Captain Mount hears Crew 404 begin yelling while talking to FF Boatman. STF E-43 Captain Mount turns toward the cut bank across Lumsden Road and sees a small circular spot of fire burning at the bottom of the cut bank (Mount interview).

FF Andahl hears FF Neveau yell “wind change” and sees fire below. FF Andahl is with HC Winger. FF Andahl begins running downhill. FF Andahl and HC Winger are approximately 80–100 feet below Lumsden Road at a rocky outcropping (Andahl interview).

HC Winger begins running downhill. HC Winger is cut off by the advancing head fire and changes direction to running across the slope into the burn. The burn is hot and HC Winger is exposed to heat and smoke (Winger interview).

FF Andahl is cut off by the advancing head fire and changes direction to across the slope. FF Andahl runs down an extremely steep slope. This causes him to fall and roll uncontrolled down the hill. FF Andahl stops when he lands on his back on the rocky edge of the river (Andahl interview).

STF E-43 Captain Mount starts walking back toward STF E-43. Mount yells for FF Austin to follow her. FF Austin is standing near FF Boatman. FC Mount observes the small spot spread parallel to Lumsden Road and down-canyon toward E-43’s location. The spot fire also increases in rate of spread and intensity (Mount interview).

1346 hrs

ATGS Ward observes an increase in fire intensity on the upper portion of the right flank, at approximately 2250’ elevation. ATGS Ward sees flareup at heel of right flank and gives the order over the tactical net for all crews to “get in the black, get to your safety zones.” ATGS Ward believes Crew 404 is working above Lumsden Road. (Ward interview #1 and #2).

CDF E4490 and E4476 are driving down Lumsden Road, west of the South Fork Campground. FC John Yount is driving E4490 and Fire Apparatus Engineer (FAE) Kevin Craddock is driving E4476. FAE Craddock hears the order from ATGS Ward to “get in your safety zones” on the radio. Craddock believes he is monitoring the assigned tactical frequency (Craddock interview).

FF Boatman sees flareup below Crew 404 and yells at FF Neveau and FF Schicke to run uphill to the road. FF Boatman observes FF Neveau and FF Schicke running uphill. Both FF Neveau and FF Schicke have their scraping tool in their right hand and still have their backpack/web gear on (Boatman interview).

FF Neveau sees fire coming uphill and begins running uphill with FF Schicke “right on my heels.” FF Neveau estimates they are less than 10 feet from Lumsden Road (Neveau interview).

FF Boatman sees fire coming up from below and backs up from road edge. FF Boatman hears FF Schicke scream (Boatman interview).

FF Neveau is running up the fireline toward Lumsden Road and, by looking over his shoulder, sees FF Schicke directly behind him. FF Neveau can feel heat coming from below. FF Neveau is screaming and can hear FF Schicke screaming. FF Neveau can see FF Schicke using her hand tool to assist her hiking up the hill. FF Schicke is last seen within five feet of Lumsden Road. The loud roar of the approaching fire makes hearing difficult. This is the last time FF Neveau hears FF Schicke screaming (Neveau interview).

FF Boatman sees FF Neveau roll up onto Lumsden Road. The fire is burning directly over FF Neveau. FF Neveau rolls across Lumsden Road to bottom of the cut bank. FF Boatman loses visibility because of fire and smoke. FF Boatman does not hear FF Schicke screaming anymore and doesn’t see her make it to the road (Boatman interview).

FF Boatman retreats down Lumsden Road toward STF E-43 with FF Austin (Boatman interview).

FF Agustin and FF Fraser escape down to river (Agustin and Fraser interview).

FF Andahl hikes down to river with minor burns, but during the run he thought he broke his ankle (Andahl interview).

HC Winger makes it to river with minor burns. HC Winger contacts ATGS Ward on the tactical frequency. HC Winger advises Crew 404 has been burned over and there are injuries. HC Winger asks for immediate assistance with water drops (Winger interview).

Copter 404 Captain Podesta hears HC Winger on tactical net requesting the water drops and assistance (Podesta interview).

1349 hrs AA440 orders two ground ambulances through Stanislaus Dispatch (CAD Report).

FF Boatman retreats west on Lumsden Road toward STF E-43 with FC Mount and FF Austin. E-43 is parked at the Drew Creek turn out, down stream from burnover site (Boatman and Austin interviews).

FF Neveau moves east on Lumsden Road into the previously burned area. FF Neveau suffers minor burns and smoke inhalation (Neveau interview).

Copter 404 leaves spot fire on left flank and proceeds toward Crew 404. The dipping site is upstream from Lumsden Bridge. Copter 404 has to pick up water before responding to site where Crew 404 is located (Eggleston, Ward and Podesta interviews).

FF Boatman returns to the burn area and meets with FF Neveau. FF Neveau asks FF Boatman, "Am I burned?" FF Boatman tells FF Neveau he is "a little red." FF Neveau contacts HC Winger by radio and completes a crew count. FF Neveau advises FF Schicke is missing (Boatman and Neveau interviews).

FF Boatman walks back to the fireline looking for FF Schicke. FF Boatman can't see into the burn area because of the smoke. FF Boatman and FF Neveau are yelling for FF Schicke (Boatman interview).

1353 hrs CDF E4490 and E4476 arrive at South Fork Campground and are assigned by IC Johnson to stage there (Johnson and Craddock interviews).

FF Agustin and FF Fraser assist FF Andahl to the edge of the river (Andahl interview).

Copter 404 fills its bucket at the river and arrives at the bottom of the right flank. Pilot Eggleston sees minimal fire activity at right heel. Copter 404 begins making water drops (Eggleston interview).

HC Winger broadcasts on the tactical net that there is a missing crew member (Winger interview).

ATGS Ward estimates flareup behavior lasts approximately 30 seconds (Ward interview #1).

The fire quickly returns to previous backing behavior (Ward interview #1).

FF Fraser estimates flareup lasts approximately 8 seconds (Fraser interview).

FF Neveau estimates the flareup lasts approximately 10 seconds (Neveau interview).

1354 hrs IC Johnson advises Stanislaus Dispatch there are injuries to firefighters on the fire and one firefighter is missing. Requests two ambulances to the Lumsden Bridge Area (STF Cad Report).

FF Agustin begins looking downstream, upstream and in the green for FF Schicke (Agustin interview).

FF Andahl is located near the river. FF Andahl begins feeling weak. FF Andahl tells FF Fraser “I think I’m going to pass out.” FF Fraser instructs FF Andahl to cool himself off with the river water (Andahl interview).

FF Fraser and HC Winger begin looking in the burn area at the bottom of the fire near the river for FF Schicke. Rolling rocks and other material hamper search (Winger and Fraser interviews).

HC Winger tells Copter 404 to drop in the burn area to cool it down (Winger and Podesta interviews).

HC Winger contacts AA440 and requests assistance to conduct grid search of area (Winger interview).

CDF E4490 and E4476 ask IC for permission to proceed into burnover area to assist with search. IC Johnson advises to proceed into the area if it is safe (Craddock interview).

E-43 Captain Mount instructs the driver of STF E-43 to back the engine into the burn area near the location of Crew 404’s handline construction start point (Mount interview).

FF Boatman walks down the handline looking for FF Schicke. FF Boatman locates FF Schicke’s handtool approximately 40’ down from the road. Boatman picks up the hand tool and uses it to assist himself back up the slope. FF Boatman does not see FF Schicke. Burn area is still hot and smoky (Boatman interview).

FF Fraser begins search uphill from river (Fraser interview).

FF Boatman begins to organize a grid search from the top, but delays because of the search coming up from the bottom. FF Boatman determines there is too much risk of increasing the amount of rolling material going down the hill. This would be dangerous for the firefighters coming up from the bottom (Boatman interview).

FF Fraser arrives at the top of the road and meets with FF Boatman and FF Neveau (Boatman interview).

FF Boatman organizes a grid search with STF Engine 43, FF Fraser and FF Neveau (Boatman interview).

FF Boatman and FF Neveau locate FF Schicke mid-slope from the road. FF Boatman points out FF Schicke to HC Winger, who has worked his way up from the bottom (Boatman, Neveau and Winger interviews).

HC Winger determines FF Schicke is obviously deceased (Winger interview).

HC Winger, FF Boatman, FF Fraser, FF Neveau and the crew from STF E-43 move back to road (Boatman interview).

HC Winger broadcasts over the radio that the missing firefighter has been found. HC Winger does not say there is a fatality (Winger interviews).

- 1442 hrs** IC Johnson advises Stanislaus Dispatch the missing firefighter has been found (CAD Report).
- E4490 and E4476 arrive at the accident scene. E4476 FAE Craddock assists FF Andahl up from the slope (Craddock interview).
- Crew 404 (HC Winger, FF Agustin, FF Andahl, FF Boatman, FF Fraser and FF Neveau) assemble on the road.
- FF Neveau begins having difficulty breathing (Boatman interview).
- HC Winger, FF Agustin, FF Andahl, FF Boatman, FF Fraser and FF Neveau and are transported by IC Johnson to South Fork Campground (Boatman, Neveau, Winger and Johnson interviews).
- 1500 hrs** STF Division 3, Jon Payne, arrives at scene. Payne is the Fire Management Officer from the Summit Ranger District. IC Johnson transitions command to Payne. Chief Payne responded to the fire as an additional chief officer (CAD Report).
- 1506 hrs** HC Winger, FF Agustin, FF Andahl, FF Boatman, FF Fraser and FF Neveau are transported by USFS Copter 516 to Pine Mountain Airport to meet the air ambulance (CAD Report).
- FF Neveau is transported by Air Ambulance to Doctors Hospital in Modesto (CAD Report).
- FF Andahl is transported by separate air ambulance to Sonora Regional Medical Center (CAD Report).
- HC Winger, FF Agustin, FF Boatman and FF Fraser are transported by ground ambulance to Sonora Regional Medical Center [SRMC] (CAD Report).
- 1515 hrs** Assistant Fire Management Officer Jerry McGowan meets with STF Division 4 Johnson. STF Division 4 Johnson confirms there is a fatality. McGowan calls STF Fire Management Officer Gary Cones and notifies him of the fatality (McGowan Statement).
- 1516 hrs** One ground ambulance transports HC Winger, FF Agustin, FF Boatman and FF Fraser to SRMC (TCSO CAD).
- 1611 hrs** Ground ambulance arrives at SRMC. (TCSO CAD).

■ Post Incident:

- 1615 hrs** STF AFMO McGowan and STF Div 4 Johnson meet with CDF Battalion Chief Julie Henriques and CDF Fire Captain Rommie Jones and confirm the fatality. All parties decide to drive down to the site of the flareup to confirm the fatality. AFMO McGowan meets up with USFS LEO Jim Moriarty. LEO Moriarty is coming from the accident site and also confirms a fatality has occurred (McGowan statement).
- 1630 hrs** CDF Safety Officer Kirk McBride arrived at Sonora Regional Medical Center. CDF Safety Officer McBride initiates a defusing process with Helitack Crew 404.
- 1718 hrs** FF Boatman is released from SRMC.
- 1724 hrs** FF Fraser is released from SRMC.
- 1730 hrs** FF Agustin is released from SRMC.

Sequence of Events in Chronological Order

- 1800 hrs** STF AFMO McGowan, STF Div 4 Johnson and CDF BC Henriques meet with Sheriff's Deputy Dan Crowe. Crowe advises the recovery of FF Schicke's body will not take place until the morning because of safety concerns.
- 1820 hrs** HC Winger is released from SRMC.
- 1830 hrs** FF Andahl is released from SRMC.
- 2100 hrs** STF AFMO McGowan takes STF Div 4 Johnson home to his residence. Johnson goes off duty.

■ **September 13, 2004**

- 0900 hrs** Critical Incident Stress Debriefing (CISD) process begins at the Best Western Sonora Oaks Hotel. CISD contacts continue for the duration of the investigation.
- 0900 hrs** A joint CDF/USFS accident investigation team convenes at the Stanislaus National Forest Supervisor's Office in Sonora.
- 1506 hrs** FF Neveau is released from Doctors Medical Center in Modesto.
- FF Schicke's body is recovered by TCSO search and rescue team. The body is transported to Sonora.
- 1600 hrs** Accident investigation team arrives at accident site. Team members examine the site and speak with the USFS investigators.

■ **September 14, 2004**

Accident investigation team commences investigation process.

Findings



Findings

This section presents the CDF Helitack 404 Crew Burnover Investigation Team's findings. A finding is a conclusion drawn from and supported by interviews, witness statements and physical evidence found elsewhere in the document.

Fire Behavior

Fuels

- Primary fuels burning at the accident site were light flashy surface fuels consisting of oak leaf and pine needle litter, sparse short discontinuous cured annual grass and mixed brush with an oak and pine overstory.
- Fuel remains and burn indicators in the area of the accident site are consistent with a low-intensity backing fire.
- One-hour fine dead fuel moisture was calculated at 4-5 percent for exposed fuels and 6-7 percent for shaded fuels.
- 1,000-hour fuel moisture was at a 33-year record minimum value of 7 percent at nearby Buck Meadows RAWS station.
- On-site live fuel moisture samples were taken on 9/17/04. The values recorded are for manzanita (71%) and chamise (61%).
- Energy release component (ERC) for 09/12/04 was at a record maximum value of 86.

*Photo 3.
Surface
fuels
similar to
those in
which the
fire was
burning.*



Weather

- Weather observations at the fire area were not recorded prior to the burnover.
- Estimated weather values were: temp. 89-94 F, relative humidity 18-24 percent, winds WSW 3-5 mph.
- A spot weather forecast had not been requested for the incident during the initial attack stages.
- There was a sudden and unanticipated wind shift of 90-120 degrees at the accident site.
- No unusual or critical fire weather patterns (thunderstorms, frontal passage, etc.) were in place or predicted for the fire area.

Topography

- At the time of initial attack, near the accident, the fire was backing laterally on a west aspect, with slopes ranging from 80-120 percent. The main fire was spreading to the southeast toward Drew Meadow.
- At the time of initial attack, the backing fire had not yet progressed completely down-slope to the Tuolumne River.
- When the wind shift occurred, the fire transitioned to 90 percent uphill slopes.



*Tuolumne River,
fire origin, accident site.
Lumsden Bridge is at
top of photo.*

Predicted Versus Observed Fire Behavior

Predicted:

- There was no unusual or critical fire weather predicted for the Tuolumne fire area on 09/12/04.
- Fire weather forecasts were available and were broadcast 09/12/04 on CDF and USFS networks.
- Predicted fire danger rating for 09/12/04 was Very High.
- Based on the fire danger rating for 09/12/04, the dispatch level was High.

Observed:

- Air Attack 440 (ATGS) was first at scene and estimated fire size to be at 5-10 acres.
- Fire was burning above and below Lumsden Road but had not backed completely down-slope to the Tuolumne River.
- Fire behavior for the entire right flank was backing fire; fire behavior for the entire left flank and the head was active head fire and some spotting. ATGS predicted the fire would go to the top of the ridge.

- Fire activity at the accident site was moving laterally cross-slope at 1-3 feet per minute, with flame lengths < 12 in.
- Fire above the road had established itself in a dead snag near the fire's edge and about forty feet up-slope from the road. The snag was burning about forty feet off the ground.
- Based on witness statements and supported by burn indicators, just seconds before the fire run or simultaneous to the fire run, but not connected to it, a spot fire was observed at the base of the cut bank almost directly across the road from where the line location went downhill.
- Witness statements indicate that during the burnover a sudden and unanticipated wind shift changed the fire spread from a cross-slope backing fire to an up-slope head fire for a period of approximately 30 seconds.
- The wind shift that occurred lasted approximately two minutes. After the two-minute wind shift, the wind changed back to its previous condition and did not change again during the burning period.

■ Environmental Factors

■ Wind

- Witness statements indicate that prior to the burnover, the observed wind was steady up-canyon, at WSW, 3 to 5 mph.
- A wind shift occurred that changed the fire spread from a cross-slope backing fire to an up-slope head fire that over ran the crew.
- Fire behavior modeling estimated wind velocity increased to approximately 7 mph and the direction changed to NNE during the burnover.
- After the burnover, the wind velocity and direction changed back to its previous condition and did not change again during the burning period.

■ Smoke/Visibility

- As shown on the ATGS video, while Crew 404 was conducting their size-up, smoke limited visibility below Lumsden Road which made it difficult to locate an accessible route to the river through the burn.
- Smoke was not a factor or hindrance to line construction prior to the burnover.
- Smoke during the burnover reduced visibility between the road and the river and initially hampered rescue efforts.

■ Temperature

- Temperatures in the area of the accident site were estimated at 89-94 F.

■ Terrain

- Slopes measured in the general fire area below Lumsden Road range from 80 to 120 percent.
- Slope measured at the accident site is 90 percent.
- Soils at the accident site are loose and gravelly making footing difficult.

■ Incident Management

■ Initial Fire Report

- Initial report of the smoke was from Duckwall Lookout at 1233 hours. Initial location report was at Sweetwater Campground.
- At approximately 1245 Smith Peak Lookout reported a cross azimuth on the smoke which corrected the location to Tuolumne River drainage.

■ Initial Resource Response

- The following resources were dispatched at the initial response: 2 Chief Officers, 6 Engines, 1 Water Tender, 1 Air Attack, 2 Air Tankers and 1 Helicopter.
- The STF Helicopter was not on base and available for initial attack to the Tuolumne Fire; it was assigned to another incident on an adjoining unit.

■ Objectives

- The STF has designated the Tuolumne River drainage in the area of the accident site as “full suppression;” all fires are to be fully suppressed.
- STF dispatched a standard wildland fire response to the reported incident.

■ Strategy

- No strategy was announced by the IC.
- Initial strategy, although not announced by IC, appeared to be to anchor the right flank below Lumsden Road with Helitack Crew 404 supported by STF Engine 43.
- When the ATGS was asked by the IC to make some drops on the heel to secure it, the ATGS stated, “I am not concerned about that area. My priority is further up the right flank.”
- Concurrent strategy was to provide structure protection as needed in the area of Drew Meadow with STF Engine 42.

■ Tactics Employed

- Direct attack with Airtankers and Copter 404 was initiated above Lumsden Road.
- Air drops were being effective at that location in minimizing fire spread.
- No aerial resources attacked the fire below Lumsden Road prior to the turnover.
- No ground resources other than the Helitack Crew 404 engaged the right flank of the fire prior to the turnover.
- The HC selected Downhill/Indirect line construction as the ground engagement tactic.
- Line construction began at Lumsden Road approximately 170 horizontal feet above the proposed end point at the high-water level of the Tuolumne River.
- Fireline construction was approximately 7 feet from the fire’s edge at the start point and widened to approximately 30 feet off the fire’s edge as line construction progressed downhill.
- Saw work extended to within 30 feet of the high water level of the river, approximately 140 horizontal feet downhill from Lumsden Road.
- Scraping of handline reached 80 to 100 feet downslope.
- A firing-out operation was conducted from Lumsden Road down the constructed handline just short of the position of Firefighter Schicke, approximately 25 feet from the road.
- The HC directed one firefighter to “lookout” in addition to donning a back pump, looking for spots, making sure the line holds and supporting the firing operation; Firefighter Boatman accepted this assignment and returned to Lumsden Road. He did not hear HC tell him to be a lookout.

■ Safety Briefings

- There was a face-to-face briefing between the Incident Commander (IC) and Helitack Captain (HC) prior to engagement of the fire. HC was unaware of IC’s identity.
- There was a face-to-face briefing between the IC and STF Engine Captain 43 prior to the turnover.
- The IC indicated to both the HC and STF Engine Captain 43 that there was “good black” at the fires edge with “minimal fire activity.”
- HC indicated to his crew that the designated safety zones were “the river and the road into the black or the green.”

- All crewmembers stated that using the “black” as a safety zone is always an option even if not specifically designated.
- The HC indicated that the escape routes to the safety zones were down the hill to the river, up the line to the road and then move into the green or black.
- After briefing by HC, the helitack crewmembers were invited to express their opinions about the tactical assignment; none expressed any concern or opposition.

■ Instructions Given

- The IC told HC on the ground to “size things up to see if there is some place that they could safely anchor the fire and start doing some action.”
- The HC on the ground understood from IC “anchor the fire from the road to the river bottom.”
- The ATGS stated to Copter 404 “secure the right flank up around the right shoulder and then down.”
- The IC assigned Captain 43 to scout the area and support Helitack Crew 404 if possible.
- The HC assigned specific tool order and work assignments to Helitack Crew.

■ Control Mechanisms

■ Span of Control

- No issues exceeding span of control guidelines were present.
- The IC had placed orders for additional resources and overhead before the turnover occurred.
- The 30-Mile Hazard Abatement Checklist was being considered/implemented at the time of the turnover.

■ Radio Communications

- Copter 404 was dispatched to the fire from Columbia airbase.
- Copter 404 received the assigned radio frequencies for the incident prior to departure (Tactical net, Air to Ground, Air to Air, Command net).
- Copter 404 received a tactical assignment from ATGS to drop off the crew and begin dropping water at the bottom of the right flank.
- There was no radio communication between Copter 404 and the IC.
- The HC monitored the assigned tactical frequency and overheard traffic between IC and ATGS.
- Helitack Crew 404 crew utilized two portable radios for communications.
- The IC had good communications with the ATGS over the incident, but “spotty” communications with STF dispatch while at the fire scene.

■ Ongoing Evaluations

- The IC drove to the right flank of the fire where it intersected Lumsden Road and evaluated this portion of the fire.
- The HC had a chance to observe the lower portion of the right flank of the fire from the copter as they were orbiting in preparation for landing.
- The HC personally scouted approximately 70 feet below Lumsden Road on the right flank before starting work. He visually observed the remainder of the right flank down to the river from that location.
- Two firefighters scouted along Lumsden Road toward the left flank looking for access to the lower portion of the fire.
- The assigned ATGS was evaluating and providing feedback to the IC while orbiting the fire.
- The ATGS had a video camera and filmed approximately 30 minutes of the fire. The turnover was not filmed.

■ Standard Firefighting Orders

Of the Standard Firefighting Orders the following were not fully followed:

3. Base all actions on current and expected behavior of fire:

Actions were based on the observed fire behavior up to the time of the wind shift. The wind shift was unanticipated by the HC, the IC and the ATGS. Incorporation of appropriate mitigation measures based on LCES and Watch Out Situations were addressed primarily for observed fire behavior and not expected behavior.

4. Identify escape routes and safety zones and make them known:

HC did identify escape routes and safety zones to his crew; the escape route to the road proved to be inadequate when the flareup occurred.

5. Post lookouts when there is possible danger:

A dedicated lookout was not posted that could observe the crew or fire behavior above and below the road. It was assumed by the HC that all crewmembers were lookouts in addition to their other duties. There is no evidence that a dedicated lookout would have given an earlier warning to the crew of the flareup occurring. The ATGS was in an orbit on the right flank and was observing the area at the time of the flareup.

7. Maintain prompt communications with your forces, your supervisor and adjoining forces:

After the initial briefing between the IC and HC, there was no further communication. There was no communication between HC and ATGS to advise of their location below road on right flank and no communication between the first at scene engine and HC.

8. Give clear instructions and ensure they are understood:

Instructions given by IC and instructions received by HC regarding line assignment were not jointly understood or discussed again. Instructions were given by ATGS to Copter 404 to start dropping water at the bottom of the right flank. Copter 404 started dropping water above Lumsden Road on the right flank.

9. Maintain control of your forces at all times:

IC did not identify himself as the IC to HC during initial briefing. IC did not follow up communication with HC regarding progress, situation, etc.

10. Fight fire aggressively, having provided for safety first:

Firefighting was aggressive, however all Standard Firefighting Orders and the Watch Out Situations were not considered adequately; an adequate margin of safety was not provided for.

■ 18 Watch Out Situations

Ten "Watch Out" Situations applied:

1. Fire not scouted and sized up:

The HC personally walked down the right flank approximately 70 feet below Lumsden Road before starting work. He visually observed the remainder of the right flank (approximately 170 horizontal feet) down to the river from that location. Two firefighters scouted up river approximately 300 feet along Lumsden Road looking for access to the fire but were unsuccessful in locating an access location. Complete scouting or walking the proposed fireline was not accomplished prior to engagement.

3. Safety zones and escape routes not identified:

HC did identify escape routes and safety zones to his crew; the escape route to the road proved to be inadequate when the flareup occurred.

5. Uninformed on strategy, tactics and hazards:

The IC described the current fire situation, with regard to the lower right flank, to HC. No overall strategy or priorities were announced by IC. Strategy of anchoring the fire at the right flank was discussed between the IC and HC, no discussion regarding downhill line construction or indirect tactics took place, no controls or restrictions prevented the use of these tactics. The IC did not know the tactics being utilized by the HC.

6. Instructions and assignments not clear:

Instructions given by IC and instructions received by HC regarding line assignment were not jointly understood or discussed again. Instructions were given by ATGS to Copter 404 to start dropping water at the bottom of the road and move up the right flank. Copter 404 started dropping water above Lumsden Road on the right flank.

8. Constructing fireline without a safe anchor point:

HC believed he had established an anchor point at the road for downhill/indirect line construction. The fire above the road continued to burn laterally and had the potential to outflank their position, however this did not occur. The goal of the HC was to “anchor to the river; that was going to be our real anchor.”

9. Building fireline downhill with fire below:

Helitack Crew 404 was building fireline downhill on a portion of line that had uncontrolled fire below their position. When the flareup occurred, the fire overran the crew. No mitigations to reduce the potential hazard of fire coming from below, such as water drops from the Helicopter, were utilized.

11. Unburned fuel between you and the fire:

Physical evidence indicates that the fireline being constructed varied between 7 and 30 feet from the fire's edge. Unburned fuel and the crew's location on the slope allowed the fire to overrun their position before they could utilize their escape routes. There had not been time to fire-out all unburned fuel between the main fire and the constructed fireline as was planned.

13. On a hillside where rolling material can ignite fuel below:

While no rolling burning materials were observed, the potential existed for this to occur and the result would be an uphill fire run that could overtake the position of the crew. No mitigations to reduce this hazard, such as water drops from the Helicopter, were utilized.

15. Wind increases and/or changes direction:

There was no advance warning or prediction that a wind change would occur, however wind changes in steep narrow canyons with confluence drainages are common and should be expected. Tiny fluctuations in wind were noted moments before the flareup.

17. Terrain and fuels make escape to safety zones slow and difficult:

Steep slopes and loose soils, were primary contributors to the difficulty of travel, which made the uphill escape route inadequate. Uphill fire rate of spread was more rapid than the firefighters travel time over the escape route to the upper safety zone.

■ Downhill Fireline Construction

The following statements describe whether or not a particular element of the CDF and/or USFS policy for downhill and indirect firefighting guidelines applied.

Downhill and Indirect Firefighting Guidelines (CDF)**1. Direct attack methods shall be used whenever possible.**

Fireline construction was approximately 7 feet off the fire's edge at the start point and widened to approximately 30 feet off the fire's edge as line construction progressed downhill.

2. Decision is made after thorough scouting.

The HC personally walked down the right flank approximately 70 feet below Lumsden Road before starting work. He visually observed the remainder of the right flank (approximately 170 feet) down to the river from that location. Two firefighters scouted up river approximately 300 feet along Lumsden Road looking for access to the fire but were unsuccessful in locating an access location. Complete scouting or walking of the entire proposed fireline was not accomplished prior to engagement.

3. A lookout will be posted where the fires behavior can be seen.

A dedicated lookout with no collateral duties was not designated; it was assumed all crewmembers were lookouts in addition to their other duties. All segments of the fireline below Lumsden Road were visible to the HC; no one was observing the fire above Lumsden Road. One firefighter was on Lumsden Road but did not have a radio. All crew members were within earshot.

4. Members will be able to rapidly reach a zone of safety from any point along the line if the fire unexpectedly crosses below them.

The fire overran one crewmember who attempted to run uphill to safety; two others had to escape through the flames downhill to safety.

5. A downhill line shall be securely anchored at the top.

Line construction began at a mid-slope road, potential was for the fire to outflank Helitack Crew 404's position above the road, however this did not happen.

6. Full compliance with "The Standard Fire Orders" is assured.

As described above, seven of the Standard Firefighting Orders were out of compliance.

Downhill Checklist (USFS)**1. Crew supervisor(s) and fireline overhead will discuss assignment prior to committing crew(s).**

Specific tactics were not discussed; no restrictions prevented the use of selected tactics. The IC did not know the tactics being utilized by the HC.

2. Proposed fireline has been scouted by supervisor(s) of involved crew(s).

The HC personally walked down the right flank approximately 70 feet below Lumsden Road before starting work. He visually observed the remainder of the right flank (approximately 170') down to the river from that location. Complete scouting or walking of the entire proposed fireline was not accomplished prior to engagement.

3. Crew Supervisor is in direct contact with lookout that can see the fire.

A dedicated lookout with no collateral duties was not designated; it was assumed all crewmembers were lookouts in addition to their other duties. All segments of the fireline below Lumsden Road were visible to the HC; no one was observing the fire above Lumsden Road. One firefighter was on Lumsden Road but did not have a radio.

4. Rapid access to safety zone(s) in case fire crosses below crew(s).

Steep slopes and loose soil were primary contributors to the difficulty of travel, which made the escape routes inadequate. Uphill fire rate of spread was faster than travel time over the escape route to the upper safety zone.

5. Direct attack will be used whenever possible.

Fireline construction was approximately 7 feet off the fires edge at the start point and widened to approximately 30 feet off the fires edge as line construction progressed downhill.

6. Starting point will be anchored for crew(s) building fireline down from top.

Line construction began at a mid-slope road, potential was for the fire to outflank Helitack Crew 404's position above the road, however this did not happen.

7. Bottom of fire will be monitored; if the potential exists for the fire to spread, action will be taken to secure the fire edge.

HC visually monitored the right flank of the fire as line construction progressed downhill. The fire had the potential to spread; no action, such as helicopter water drops, were taken to secure the fire edge.

■ LCES

LOOKOUTS: A dedicated lookout with no collateral duties was not designated; it was assumed all crewmembers were lookouts in addition to their other duties. All segments of the fireline below Lumsden Road were visible to the HC; no one on the crew was observing the fire above Lumsden Road. The HC believed “all” crewmembers had the responsibility to be a lookout. One firefighter was told to move up to Lumsden Road, retrieve a back pump, support the firing operation and “kind of be like a lookout”; this firefighter did not have radio communications with the HC.

COMMUNICATIONS: The HC and the IC did not discuss the tactics being employed or current fire situation status of the lower right flank. HC did establish communications with Copter 404 and advised them of selected tactics. There were two radios being used on the Helitack 404 Crew for intra crew communications. IC did not follow up communication with HC after the initial briefing.

ESCAPE ROUTES: The uphill escape route was compromised when the wind changed and the flareup occurred; of the two firefighters who used it, only one made it to safety. Steep slopes and loose soils, were primary contributors to the difficulty of travel, which made the uphill escape route inadequate. Uphill fire rate of spread was faster than travel time over the escape route to the upper safety zone. The lower or downhill escape route was also compromised for two firefighters as they had to escape through the flames to safety. Two other firefighters who used the lower escape route through the green, escaped unharmed.

SAFETY ZONES: There were three safety zones: the river, the road and the black. The river safety zone did protect the four fire personnel who reached it from any flame related injury. The firefighter who ran uphill to Lumsden Road had to immediately move east into the burn to escape the heat as the flareup was occurring. The firefighter standing on Lumsden Road moved west into the green to escape. The use of the black or burn safety zone lower on the slope was attempted initially by two firefighters, but was abandoned due to residual heat present.

■ Involved Personnel Profiles

■ Qualifications

- All Firefighters and overhead were qualified by their agency for the positions they held on the fire.

■ Training

- All personnel were certified by their agency as having received “refresher” or “beginning of season” training in fire behavior, safety and related subjects.
- There are no lesson plans in the CDF 4300 procedures handbook that address downhill/indirect line construction.
- Downhill/indirect firefighting guidelines are addressed in the CDF 7000 policy manual.
- The use of the “6 Minutes for Safety” program was used to train in downhill/indirect tactics.
- The HC based all his decisions on the observed fire behavior, not on potential fire behavior.

■ Operational Period Length/Fatigue

- This was the first operational period of an initial attack fire.
- All firefighters were within the work/rest guidelines established by their agency.
- Both HCs and two firefighters had returned from normal days off on 09/12/04.

■ Attitudes

- Several members of Helitack Crew 404 stated that their assignment on the Tuolumne Fire was “routine, it would take a short time to complete.”
- The HC statement indicates that “it’s standard Helitack procedure” in reference to building fireline downhill.

■ Leadership

- The IC was not formally designated by name from STF dispatch on either the tactical or command frequency.
- The IC did not identify himself to the HC as being the IC during their briefing.
- The IC used both the call sign “Tuolumne IC” and “Division 4” while communicating on the radio to STF dispatch and ATGS.
- The IC did not establish controls or conditional approval on tactics to the HC, or require situation updates.
- The IC ordered additional resources in preparation for an emerging fire.
- After the turnover the IC facilitated medivac efforts by ordering air ambulance services, notified Agency Administrator of the turnover and facilitated relieving involved individuals from fireline duties.
- The HC supervised his crew at the scene of action.
- The HC organized search efforts for the missing firefighter.

■ Equipment

■ Availability

- All personal protective equipment (PPE) was available to and used by involved individuals at the time of the turnover.
- PPE included; Nomex shirts and pants, hard hat with protective face shrouds, safety glasses and/or goggles, leather gloves and emergency fire shelters.

■ Performance/Non-Performance

- All personal protective equipment performed within design limitations.
- One firefighter received radiant heat burns through his Nomex. The Nomex did not melt or burn.
- No fire shelters were deployed.

■ Firefighting Equipment/Tools

- There were no non-performance issues with any of the firefighting equipment used by Helitack 404 Crew.
- All equipment was used for its intended purpose.
- Firefighting equipment used by Helitack 404 Crew included; one chainsaw, one chainsaw gas pack, five scraping tools (Rhyno type), five full (5 gallon) back pack pumps and two portable radios.

Causal Factors



Causal Factors

After analyzing the information and evidence available, the Accident Investigation Team determined that there were five (5) primary causal factors for this accident which are described below. Had any of these factors not occurred or been appropriately considered, it is probable that the accident would not have occurred.

CDF Definition:

A causal factor is any behavior, condition, act or omission that starts or sustains an accident occurrence. Avoiding or eliminating the factor would prevent the occurrence. Events which sustain the occurrence sequence but were normal to the situations as they developed are not causal factor(s). (CDF Serious Accident Investigation Guide)

USFS Definition:

A causal factor is any behavior or omission that starts or sustains an accident occurrence. (FS 0367-2808-MTDC)

■ Synopsis of incident

CDF Helitack Crew 404 was constructing fireline downhill from the road to the river using a chainsaw to cut brush and scraping tools to build fireline, followed by using a fusee to fire-out the unburned fuel.

The triggering event that caused this fatal accident was the wind shift and resultant critical increase in fire behavior. The change in wind direction was not anticipated by the helitack crew captain or crew members. This abrupt wind change created a flareup and running fire front that overran the position of the seven crew members.

A change in wind direction and speed occurred without warning. A wind change was not factored into the plan for the downhill line construction method the crew was using. Their mitigation measures did not account for the wind change and failed to work.

The wind change caused the increased fire behavior that entrapped the crew. Had other mitigations been in place or considered, it is probable that the entrapment would not have occurred.

“Expected” fire behavior should include the probable worst-case for the location and situation.

■ Five (5) causal factors identified by the Accident Investigation Team

- The wind shift changed the fire environment resulting in increased fire intensity and rate of spread.
- Unburned fuel between the fireline and the fire’s edge did not allow for a sufficient margin of safety.
- Escape routes were inadequate to allow sufficient time for the firefighters to reach safety zones.
- The steepness of terrain and difficulty of travel influenced the tactical decisions to access and anchor the right flank.
 - a. The crew determined that safe access to the bottom of the fire was not possible via the river or down the slope either through the burn or the green. This conclusion influenced their decision to utilize the downhill line construction tactic in lieu of uphill line construction.

- b. Inadequate consideration was given to the difficulty of travel back up the steep slope and the effect of degradation of surface traction caused by fire line construction and firefighters walking on the loose soils on the slope.
- Helicopter water drops were available but not used. Fire engine hose-lay support was an option readily available but unknown to the helitack crew captain.

■ The wind shift changed the fire environment resulting in increased fire intensity and rate of spread.

The primary cause of the flareup was a shift in wind direction, which changed a slow, backing cross-slope fire into a rapidly spreading up-slope fire. The flareup overran the helitack crew. The wind shift occurred without warning and lasted for only 1 to 2 minutes. The wind shift was not anticipated. However, wind shifts in steep narrow canyons with confluence drainages should be expected.

Deep river drainages, such as the Tuolumne River, frequently experience wind shifts and eddies. Local airflows are influenced by the physical shape of the terrain in the canyon causing wind eddies. This is common in steep sided river canyons with convoluted terrain like that in the Tuolumne River canyon. Review of the Air Attack 440 video and post-incident observations on the ground indicate the first 75 to 100 vertical feet above the entrapment location may be particularly sensitive to this occurring. Variations in aspect and fuels may have also created localized heating differences that could contribute to changeable air flow patterns. Local airflow may have also been influenced by indrafts into the fire above the road that were occasionally strong enough to briefly override the up-canyon wind, creating occasional changes in smoke drift.

- *The wind shift that occurred on this fire was not anticipated by the incident commander, the air tactical group supervisor, or the helitack crew.*
- *Since a steady up-canyon wind had been observed by all the parties, they based their actions on “current” fire behavior without giving adequate consideration to “expected” fire behavior. The sudden wind direction change was part of a localized weather pattern with unpredictable timing.*
- *Constant observation of the area for over thirty minutes prior to the flareup gave no advance warning that a wind shift was imminent. No similar wind shift was observed on this section of line the remainder of the day.*
- *The fire cause investigation team and the accident investigators were in the immediate area of the accident for the next several days. They observed steady gentle up-canyon winds like the day of the accident. They also experienced wind shifts of short duration, but none similar in direction to the one experienced by the helitack crew.*
- *An “unexpected” wind shift was a primary causal factor in this fatality. It has been identified as a common denominator in numerous previous fatal wildland fire accidents. Firefighters should anticipate wind shifts. Wind shifts should not be “unexpected;” tactics and mitigations must take wind shifts into consideration.*

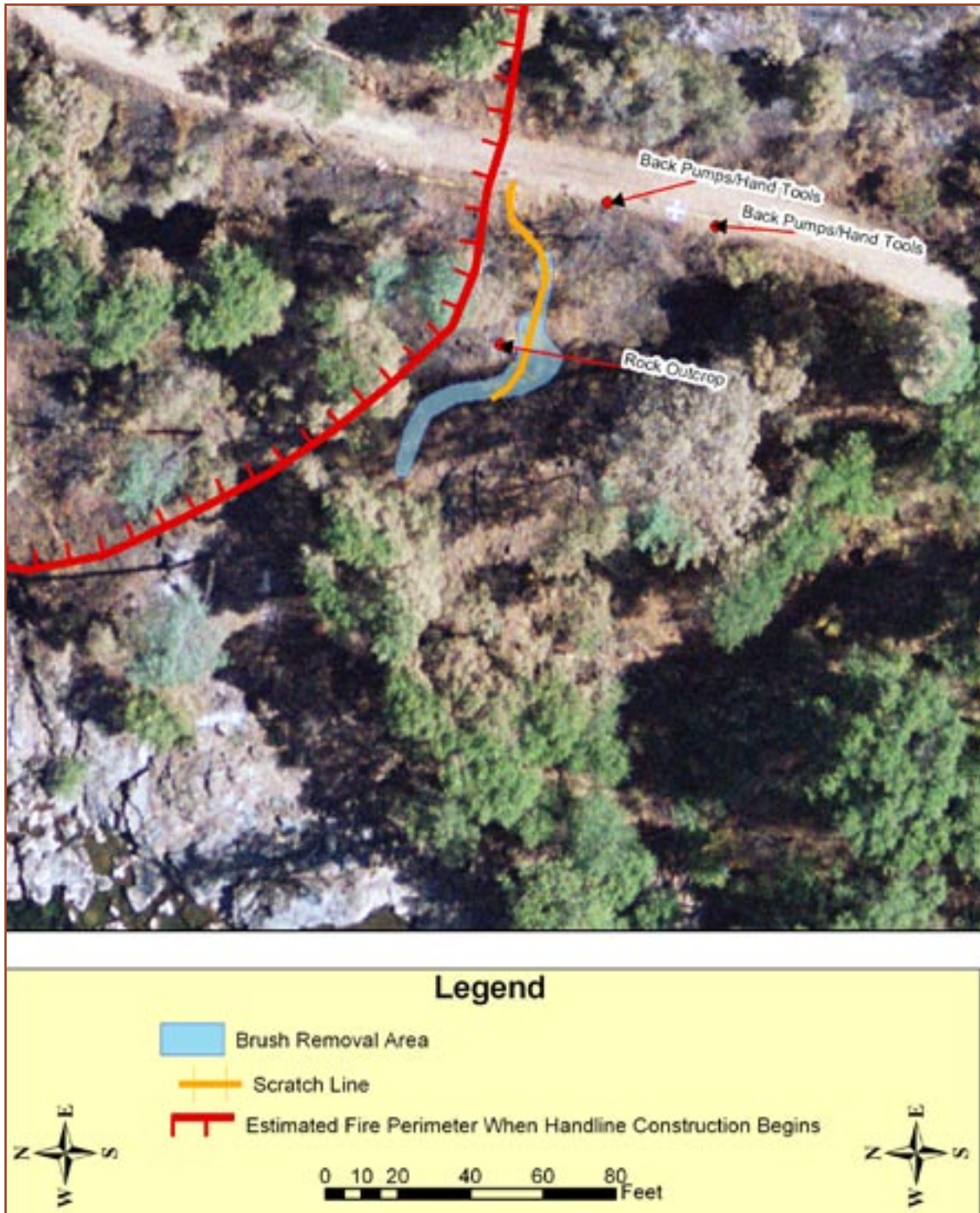
■ Unburned fuel between the fireline and the fire’s edge did not allow for a sufficient margin of safety.

The helitack crew was building fireline downhill from the road to the river using a chainsaw to cut brush and scraping tools to cut and improve line. The fireline was constructed parallel to the fire’s edge and only partially completed when the flareup occurred. They were using a fusee to create blackline by firing the fireline from the road.

- The tactic utilized was technically indirect line construction since there was unburned fuel between the fireline and the main fire. However it does not meet the classic definition of “Indirect Attack.” *Indirect attack by definition is line construction “a considerable distance” from the main fire.¹ This fireline was being built 7 to 30 feet from the main fire. The method is consistent with a tactic historically called “Parallel Attack.”*

¹ CDF Manual section 4320.1 Student Information

- The short distance of unburned fuel between the fire's edge and the fireline allowed the fire to overrun the crew before they could utilize their escape routes in time. In addition, the burning fuel (particularly the brushy area below the road which presented a physical barrier) prevented the crew members from crossing the fire's edge into the black.
- Firing out of the unburned fuel from the road down was not sufficient to provide a safe fireline because it was incomplete. While firing out is an appropriate technique, not enough had been completed to be effective.



Fire Line Construction Prior to Flareup

■ Escape routes were inadequate to allow sufficient time for the firefighters to reach safety zones.

Escape routes are the primary mitigation factor for indirect downhill line construction tactic in the event a dangerous condition develops. The escape routes were sufficient for the low-intensity flanking fire behavior observed prior to flareup but were not adequate for the fire behavior that developed after the wind shift.

When the wind shifted and the fire behavior changed, the crew members utilized the escape routes previously identified, “down to the river,” “up to the road” and the default “into the black.” However, two of the escape routes were too difficult to traverse.

~ *The “Down to the river” escape route was satisfactory for FF Fraser and FF Agustin.* They skirted around the edge of the advancing fire front in the green and made it to the river safety zone without injury.

~ *The “Up to the road” escape route was inadequate due to difficulty of travel because of steepness (80–120% slope), loose soil conditions and rocky terrain.* The rate of spread of the fire exceeded the speed of the escaping firefighters. FF Neveau barely made it to the safety zone. FF Schicke was right behind FF Neveau, but she was unable to reach the safety zone in time and was overrun by fire. She died from inhalation of superheated gases before reaching the road.

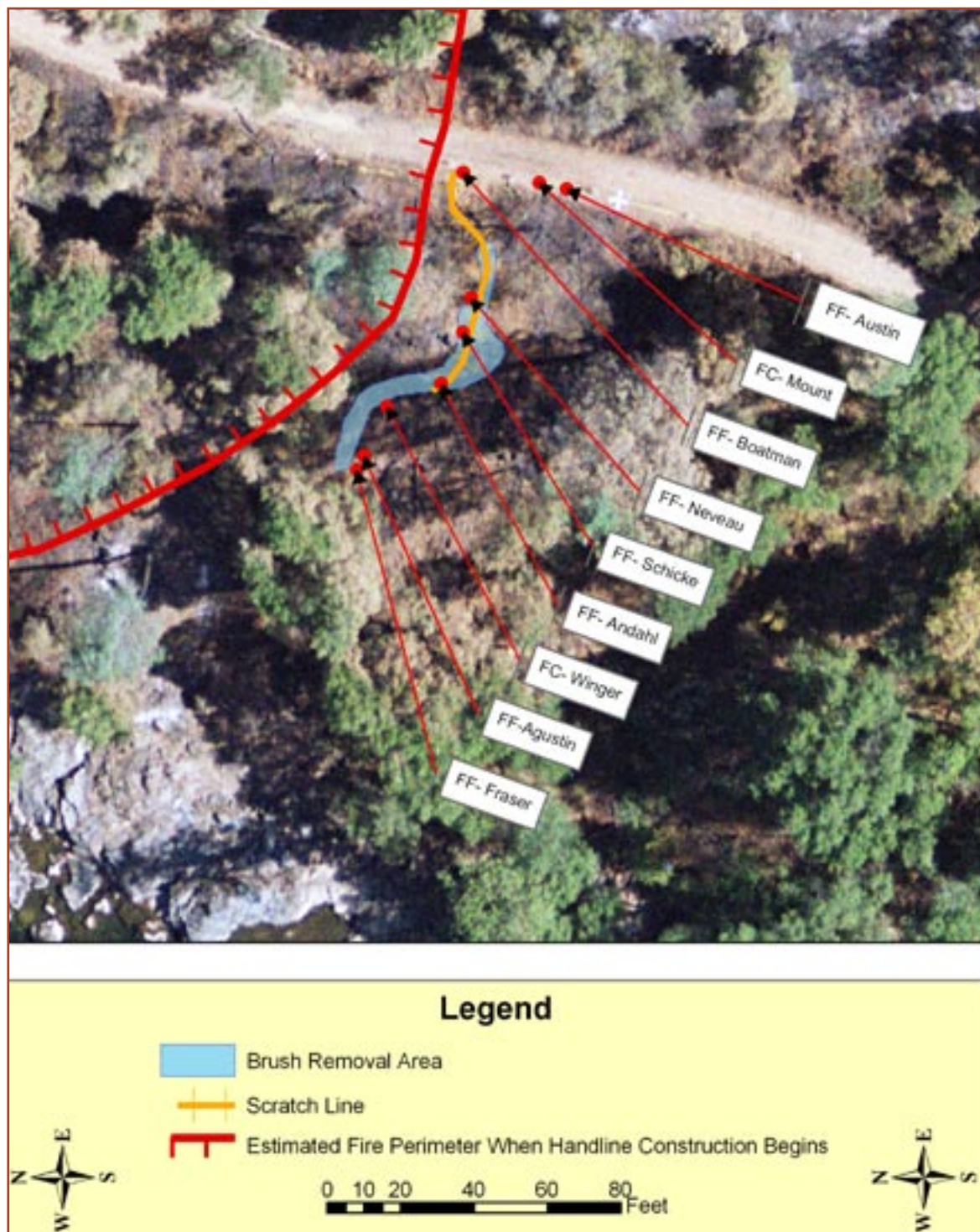
~ *The “Into the black” escape route utilized by Captain Winger and FF Andahl was marginally effective.* Although they made it to the safety zone at the river, both suffered injuries because of the heat, steepness of the slope and difficulty of terrain.

■ The steepness of terrain and difficulty of travel influenced the tactical decisions to access and anchor the right flank.

The terrain and difficulty of travel limited the options for approaching the fire and limited the tactical methods considered to complete the strategic objective of anchoring the right flank.

- a. The crew determined that safe access to the bottom of the fire was not possible via the river or down the slope either through the burn or the green. This conclusion influenced their decision to utilize the downhill line construction tactic in lieu of uphill line construction.
- b. Inadequate consideration was given to the difficulty of travel back up the steep slope and the effect of degradation of surface traction caused by fire line construction and firefighters walking on the loose soils on the slope.
 - *The river’s edge, consisting of cliffs, boulders and poor footing, precluded the crew from walking up the river from their landing zone (LZ) and building fireline uphill from the river.*
 - *There was no practical way for the crew to stay alongside the river from their LZ to the heel of the fire.* This would have required a walk of over one mile attempting to jump from boulder to boulder while carrying back packs, back pumps, hand tools, chainsaw and wearing firefighting boots. This would have been unsafe. There were physical barriers of rock outcrops and ledges immediately upstream and downstream of the fire that blocked access to the heel of the fire from the river.
 - *The crew used Lumsden Road from the LZ to the fire because it was the most expedient route.*
 - *The crew scouted for an access point from the road to the river in order to utilize an uphill line construction tactic. After preliminary scouting from the road near the fire edge, the crew determined there was no apparent usable access to the river.*
 - FF Boatman was familiar with the canyon and scouted up Lumsden Road past the right flank of the fire to see if access to the bottom could be made from the Lumsden Bridge. Similar to hiking in from the LZ, such an access would require an unsafe route along the river’s edge.
 - The firefighters did not see a safe route through the burn to the river.
 - The only other option to access the river would have been to go down through the green. The only place to do that quickly was the same opening they used to construct fireline.

- The steepness of the 80 to 120 percent slope combined with loose soil, rock out crops and drop offs made travel slow and difficult. This situation was a significant factor in the selection of the tactical options of downhill line construction.
- They did not consider withdrawing from the assignment.



Personnel Location Prior to Flareup

■ **Helicopter water drops were available but not used. Fire engine hose-lay support was an option readily available but unknown to the helitack crew captain.**

There were missed opportunities to utilize available water application tools. The tools included helicopter drops and fire engine support that were close by. If the tools had been used, the selected tactic would likely have changed and may have prevented the burnover of the crew.

Helicopter drops:

- Copter 404 was the first helicopter at the fire and had access to the bottom of the fire.
- There was an instruction from the ATGS to Copter 404 to drop on the right flank, starting from the bottom; Copter 404 understood the direction to be to start above the road and work up the right flank to support the air tanker drops.
- Copter 404 did make water drops on the right flank of the fire but began the drops above the road. Water drops above the road were effective in reducing the heat and slowing the fire spread. There were no physical barriers or other obstacles to preclude water drops below the road.
- The IC initiated a discussion with the ATGS on the tactical frequency regarding using the copter to anchor the right flank of the fire at the river, below the road. IC Johnson asked about using “the helicopter to anchor up the right flank below the road.” ATGS Ward stated that he didn’t think the area below the road was a problem and the higher priority was further up the right flank. The IC accepted the ATGS recommendation.

[Note: In post accident interviews the ATGS thought that the copter had already made drops in the area below the road and that the IC was referring to the use of the Helitack crew below the road. It was not clear to ATGS Ward where the crew was. At the time of the flareup, he thought that they were above the road.]

- Water drops could have been requested by the Helitack Captain to support their fireline construction below the road, but such a request did not occur.

Hose-lay or fire engine support:

- There was inadequate communication about the presence of an engine for hose-lay support. Any one of three individuals could have verified the proximity of engine support. The Helitack Captain could have monitored the command net or inquired as to the availability of engine support. The IC could have notified him that he had assigned STF E-43 to support their operation. STF E-43 captain could have notified the Helitack Captain that they were in the area to support their operation. HC Winger stated that if he had been aware of a fire engine close that could support his fireline construction, he may have utilized a different tactic.
- The assignment to tie in the fire from the road to the river was well suited to a fire engine hose-lay or hose stream. The fire engine crew could have put in a hose-lay direct on the fire edge, utilized hose streams from the roadway to wet down the unburned fuel and extinguish the fire edge or supported the firing operation. By being able to cool down the burned area, a direct line construction tactic would undoubtedly be used. It is likely that the indirect downhill fireline construction tactic would have been deferred for the hose-lay.

■ Contributory Factors



Contributory Factors

CDF Definition:

A contributory factor is any behavior, condition, act or omission that affected the occurrence or outcome but was not causal. Avoiding or eliminating the factor would not necessarily prevent the occurrence. (CDF Serious Accident Investigation Guide)

■ Six (6) contributory factors identified by the Accident Investigation Team.

- HC Winger had limited experience in indirect and downhill line construction.
- Incident actions were based more on current fire behavior and less on expected fire behavior.
- Downhill line construction has inherent dangers due to the nature of the tactic.
- There were incident command and control shortfalls.
- More thorough scouting prior to implementing downhill fireline construction could have led to utilization of a different tactic or withdrawal from the assignment.
- The safety zone in the black was not accessible.

■ HC Winger had limited experience in indirect and downhill line construction.

Experience is the application of training and knowledge. Through experience, people validate their training. They learn by doing and reinforce what works and what doesn't work. The more diverse experience an individual has, the greater the likelihood that they have "seen a similar situation" before. They remember the results and utilize that memory in their decision making process.

HC Winger met the minimum qualifications for his position and incident assignment. He had limited experience with indirect and downhill fireline construction. HC Winger's experience consisted of:

- CDF Helitack Captain for eight (8) weeks at Columbia Helitack, July 2004 through September 2004, CDF Tuolumne-Calaveras Unit. During this period HC Winger had 21 documented fire assignments totaling 10.3 hours.
- Type 1 CDF Fire Crew Captain at Pine Grove Camp for 2 years, July 2002 through July 2004, CDF Amador El Dorado Unit. During these 2 years he had 23 documented fire assignments.
- CDF Fire Apparatus Engineer-Paramedic (FAE-P) for 2 years, 2000-2002, CDF Amador-El Dorado Unit. Limited wildland fire experience and no handcrew experience.
- Firefighter - Paramedic with the Pioneer Fire Protection District for 2.5 years.
- Volunteer Firefighter with Pioneer Fire Protection District for 2.5 years.

■ Incident actions were based more on current fire behavior and less on expected fire behavior.

Underestimating potential fire behavior contributed to this accident. Wind shifts, fuel conditions and topography affected this fire's behavior. An innocuous backing fire suddenly changed to an uphill fire run with a rapid rate of spread. Personnel on the incident that had personally observed the fire burning in the area prior to the accident did not recognize this potential.

The fire was moving deceptively slowly and "almost out" along the right flank below the road. This condition lulled personnel into a false sense of security which caused them to underestimate potential fire behavior.

Base all action on current and expected behavior of the fire. (Ten Standard Fire Fighting Orders)

The transition from a slow spreading, low-intensity fire to a fast-moving, high intensity fire often occurs rapidly. This seems to surprise firefighters most often in live fuels, possibly because green vegetation is associated with reduced ignition risk. The exact mechanisms triggering these transitions are not fully understood by fire behavior analysts. However observations of past fire behavior indicate that such transitions often occur when there are changes in wind speed or direction, fire location (top of the slope versus base of the slope), or in the quantity of live and dead components in the vegetation canopy.

“Expected” fire behavior should include the probable worst-case for the location.

Wind conditions

The fire area was videotaped and observed by ATGS Ward for more than thirty minutes prior to the flareup. The smoke below the road, near the accident site, showed no obvious signs of varying from the steady, up-canyon wind direction. This is consistent with conditions reported by IC Johnson and HC Winger.

There were some indications just prior to the flareup that a wind shift might occur. Helitack firefighters observed flames “fluttering” on the fire edge moments before the flareup. The smoke column on another section of the right flank above the road shifted momentarily, then returned to up-canyon. None of these conditions, even though observed by very experienced firefighters, triggered any alarm that a wind shift of the type that occurred was imminent.

River drainages, such as the Tuolumne River, frequently experience wind shifts and eddies. Local airflow may have been influenced by the physical shape of the terrain in the canyon causing wind eddies. This is common in steep sided river canyons with convoluted terrain like that in the Tuolumne River canyon. Review of the Air Attack 440 video and post-incident observations on the ground indicate the first 75 to 100 vertical feet above the entrapment location may be particularly sensitive to this occurring. Variations in aspect and fuels may have also created localized heating differences that could contribute to changeable air flow patterns. Local airflow may have also been influenced by indrafts into the fire above the road that were occasionally strong enough to briefly override the up-canyon wind, creating occasional wind shifts.

The fire cause investigation team and the accident investigators were in the immediate area of the accident the next several days. They observed steady gentle up-canyon winds like the day of the accident. They also experienced wind shifts of short duration but none similar in direction to the one experienced by the helitack crew.

To be successful the actions and tactics taken depended on the observed wind pattern remaining constant.

Fuel conditions

Critical live fuel moisture values contributed significantly to the increased fire spread and intensity associated with the flareup. This reduced fuel moisture contributed to the rapid fire spread in the aerial fuels of the brush patch that was adjacent to FF Neveau and FF Schicke’s position below the road. Critically low live fuel moistures contributed to the rapidly spreading high intensity fire behavior observed during the flareup. Live fuel moistures sampled in close proximity to the accident site on September 17, 2004 were at critical levels for both chamise (61%) and manzanita (71%). Live fuel moistures for both chamise and manzanita were routinely sampled on the CDF Tuolumne-Calaveras Unit (approximately 20 miles northwest of the incident) and had been at critical levels since July 28, 2004.

Fire Season 2004 had record low fuel moistures throughout the Sierra Nevada. Live fuel moistures had dropped below critical stage by July 28 and continued to deteriorate. Firefighters on the initial attack of this fire had worked in similar fuel conditions on previous fires since July 28, 2004.

The critically dry fuels contributed to the rapid rate of spread when the wind shifted.

■ Downhill line construction has inherent dangers due to the nature of the tactic.

Downhill line construction has been central to several fatal and near miss fireline accidents. Heightened awareness and caution is necessary when using this tactic. When downhill line construction is necessary, mitigation factors must be considered. The **Ten Standard Fire Fighting Orders** must be followed and the **18 Situations That Shout Watch Out** should be addressed. There are guidelines for downhill line construction that add additional criteria to consider when using this tactic.

Avoiding downhill line construction is preferred, especially on large and complicated sections of line where escape routes are long or difficult to travel. Similar complications exist on short sections of line as is the case at this accident.

It is important to note that the CDF Guidelines and USFS Checklist for downhill and indirect fireline construction differ. Differences include: approval process, procedure for firing operations, protocol when fire is below starting point and required supervision. The two agencies' documents follow.

CDF Downhill and Indirect Firefighting Guidelines 7070.2

(October 2002)

Downhill/indirect line construction in steep terrain and fast burning fuels shall be done with extreme caution. Direct attack methods shall be used whenever possible.

The following guidelines shall be followed before firefighting commences:

- The decision to fight fire downhill is made by a competent firefighter after thorough scouting.
- Downhill line construction shall not be attempted when fire is present directly below the proposed starting point.
- The fire-line shall not lie in or adjacent to a chimney or chute that could burn out while members are in the vicinity.
- Communication is established between the members working downhill and members working uphill from below. When neither group can adequately observe the fire, communications will be established between the members and supervising overhead. At this time a lookout with communications will be posted where the fire's behavior can be seen.
- Members will be able to rapidly reach a zone of safety from any point along the line if the fire unexpectedly crosses below them.
- A downhill line shall be securely anchored at the top. Avoid under-slung line.
- Full compliance with "THE STANDARD FIRE ORDERS" is assured.

If possible line firing should be done as the line progresses, beginning from the anchor point at the top.

Reference: Section 7013.1.1
7070-5

USFS Downhill Checklist Fireline Handbook (NFES 0065)

Downhill fireline construction is hazardous in steep terrain, fast burning fuels, or rapidly changing weather. Downhill fireline construction should not be attempted unless there is no tactical alternative. When building downhill fireline, the following is required:

- Crews supervisor(s) and fireline overhead will discuss assignments prior to committing crew(s). Responsible overhead individual will stay with job until completed (TFLD or ICT4 qualified or higher).
- Decision will be made after proposed fireline has been scouted by supervisor(s) of involved crew(s).
- LCES will be coordinated for all personnel involved.
 - Crews Supervisor(s) is in direct contact with lookout that can see the fire.*
 - Communications is established between all crews*
 - Rapid access to safety zone(s) in case fire crosses below crew(s)*
- Direct attack will be used whenever possible; the fireline should be completed between anchor points before being fired out.
- Fireline will not lie in or adjacent to a chute or chimney.
- Starting point will be anchored for crew(s) building fireline down from top.
- Bottom of the fire will be monitored; if the potential exists for the fire to spread, action will be taken to secure the fire edge.

Helitack Crew 404 fireline tactical decision

The first tactic considered was to anchor at the river and build fireline uphill. Helitack Crew 404 did not find an access path to the river through the black or along the river bank. As FF Boatman and FF Neveau walked up Lumsden Road into the black, the slope between the road and the river became progressively steeper and smoky. The black was described as a “dirty burn.” Access along the river bank was blocked on both ends by rock outcroppings and boulders. The only readily available access to the river was to traverse the grassy opening in the green where they ultimately built their fireline. If they built fireline from the bottom up, in order to fire-out the completed line, they would have to make another trip down (firing) and back up. HC Winger decided this would take too much time. In addition, he was concerned about the steepness of the slope and the more times they traveled up and down the hillside the crew would be exposed to injury from rolling rocks. When HC Winger scouted down the proposed fireline he decided that since the soil was so loose and fuel so sparse their boots would practically dig the line as they went down the hill and line construction would be quick. By the time they got to the bottom they would have practically built a scratch line already with just their boots.

Another tactic available was building direct fireline downhill. HC Winger characterized the fire as a “dirty burn.” HC Winger said that his concern was staying out of the residual heat and smoke from the dirty burn and the crew members would not be able to work from the black. There was the potential of a re-burn in the brush ladder fuels that would present a similar hazard as indirect line. They would need to use the back pumps on the steep slope. HC Winger decided that this tactic would take too much time and effort.



Planned Fireline Construction

The tactic chosen was indirect downhill line construction parallel to the fire's edge. A reason given by HC Winger for going indirect was to keep the firefighters out of the heat and smoke of the dirty burn, take advantage of light fuels and they could fire it out as they went. They would not need to use the back pumps on the steep slope. He believed this method would allow them to build the fireline quickly.

The safety measures used were commensurate with the fire behavior he was observing. HC Winger did not ignore or disregard safety orders but put in place measures that were inadequate for the fire behavior that developed after the wind shift. He did not recognize the potential for severe fire behavior because he did not anticipate a significant wind shift. Consequently, when the wind shift and flareup occurred, all the crew members were not able to safely escape.

The following Watch-out Situations were not adequately mitigated (Eighteen Watch-out Situations):

• **Building fireline downhill with fire below.**

Constructing line downhill when there is fire below you can result in an uphill fire run that can overtake the position of the firefighters. Since the escape route is often uphill, planning for such an event is critical in mitigating the danger. Building downhill fireline using direct attack reduces the danger. The mitigation measures of using water to cool the fire and having escape routes into the black are available. The decision to use indirect downhill line construction compromised the use of these two mitigating measures.

The fire was not directly below the crew's position. However, with a wind shift and change in direction of spread, the potential of an uphill fire run must be considered and mitigated.

• **On a hillside where rolling material can ignite fuel below**

There is no evidence that rolling material ignited the fuel below the firefighters and caused the uphill fire run. The concern with rolling material played a part in the decision to build indirect line. The fire edge angled down-slope and up-river creating an underslung line situation.

Helitack Crew 404's intention was to build line straight downhill to avoid underslung line but the trade-off was indirect line and unburned fuel. The actual line construction as planned was not completed.

■ **There were incident command and control shortfalls.**

The command and control shortfalls that contributed to the accident were:

- confusing instructions
- IC's identity was unclear
- unclear priorities
- unclear objectives
- undisciplined communications.

Give clear instructions and ensure they are understood (Ten Standard Firefighting Orders):

There was confusion regarding actions to be taken and who was in charge.

– **IC Johnson to HC Winger:**

IC Johnson drove Lumsden Road to the right flank of the fire. On his way in he passed Helitack Crew 404 walking on the road near South Fork Campground. IC Johnson stated that this was the first he realized the helitack crew was at scene. [Note: ATGS Ward had advised IC earlier on tactical net that the copter was on the ground with the crew.]

IC Johnson continued to the right flank and observed the fire burning above and below Lumsden Road. The fire below the road had flame lengths of 6 to 12 inches and was backing very slowly against the up-canyon wind. He did not continue past the right flank for fear that he would get isolated on the other side of the fire if rolling material or a tree fell across the road. IC Johnson returned to Helitack Crew 404's location.

During a face-to-face discussion between IC Johnson and HC Winger, IC Johnson described what he had observed at the right flank. He discussed with HC Winger the need to anchor the fire between the river and the road. He told HC Winger to "size things up to see if there was some place they could safely anchor the fire and start doing some action." IC Johnson did not identify himself as the IC nor did HC Winger attempt to determine what Johnson's role was. [Note: HC Winger later deduced that Johnson was the IC from a tactical net radio conversation he heard between IC Johnson and ATGS Ward.]

IC Johnson believed the assignment he had given to HC Winger was to find a way to safely anchor the fire between the road and the river and report back. HC Winger thought the instruction was an action assignment to “anchor this fire on the right flank, the road down to the river,” not just scout it and report back.

– ***ATGS Ward to Copter 404 Captain Podesta:***

Copter 404 Captain Podesta asked ATGS Ward “do you want to start at the bottom of the right flank here and work our way up?” ATGS Ward replied “yes, lets see if we can secure that right flank, up around the right shoulder and then down...” [Note: *Initial discussions and instructions from ATGS Ward to Copter 404 from the air attack video*] Copter 404 began water drops on the right flank above the road. No drops were made below the road. ATGS Ward thought they would start at the river.

– ***Incident Commander Johnson to ATGS Ward:***

After the briefing with HC Winger and while the helitack crew was hiking to the right flank, IC Johnson asked ATGS Ward on the tactical net about “using the helicopter to anchor up the right flank below the road.” [Note: *from Air Attack video*] ATGS Ward stated he didn’t think the area below the road was a problem and the higher priority was further up the right flank.

IC Johnson accepted ATGS Ward’s recommendation and then stated that the helitack crew would be in at the right flank shortly. At the exact moment IC Johnson was describing that helitack would be anchoring the fire below the road, ATGS Ward was distracted by the Air Attack pilot on aircraft intercom about a new spot fire on the left flank. ATGS Ward did not hear IC Johnson’s remarks and did not acknowledge the IC’s assignment of Helitack Crew 404 below the road.

In post accident interviews ATGS Ward believed that Copter 404 had already made drops in the area below the road. At the time of the flareup ATGS Ward thought that Helitack Crew 404 was above the road. Air Attack pilot Rogers advised ATGS Ward that the helitack crew was below the road right after the flareup.

Confusion about priorities, strategy and tactics

- ***There was no announced overall strategy or priority for the incident.*** The IC and ATGS were starting to formulate one. It was clear that this fire was going to go into extended attack or major mode. The resources available were assigned to the right flank or the Drew Meadow area. By the actions taken and assignments made, the strategy appeared to be to anchor the right flank at the river, work up the right flank and across the head to keep the fire out of Drew Meadow. Firefighters on the right flank each identified their own tactic but there was no established priority to support the operation at the heel of the right flank.
- ***There was confusion about the assignment given to HC Winger by IC Johnson.***
- IC Johnson stated that he expected Winger to size-up the area and get back to him about the situation before he did anything. HC Winger understood the assignment was to anchor the fire from the road to the river. ***There were no explicit instructions given to check back with the IC, nor any effort by the IC to contact the Helitack Captain for an update. There was no effort by HC Winger to contact IC Johnson and report his findings or proposed tactical action.***
- ***IC Johnson and HC Winger did not discuss the tactics (direct, indirect, hose-lay, etc.) to be used to anchor the fire, just the strategy of doing so.*** Neither IC Johnson nor HC Winger discussed using downhill line construction as the tactic of completing the task. ***There were no restrictions about the tactic to be used.***

*Maintain prompt communication with your forces, your supervisor and adjoining forces
(Ten Standard Fire Fighting Orders)*

There were five missed opportunities for communications to occur that may have changed the outcome of this accident.

- ***IC Johnson did not establish any controls for HC Winger to report to him prior to initiating any tactical action.*** Had IC Johnson done so and HC Winger proposed the use of the Indirect Downhill Fireline Construction tactic, USFS protocol requires that additional consideration occur. This likely would have resulted in closer coordination by the IC or the assignment of support resources.
- ***HC Winger did not initiate a communication with IC Johnson that identified the indirect downhill line construction tactic.*** Had Captain Winger done so, USFS protocol requires that additional consideration occur. This likely would have resulted in closer coordination by the IC or the assignment of support resources.
- ***HC Winger did not notify Copter 404 Captain Podesta on the tactical net that the crew was going to construct downhill fireline from the road to the river. Had Copter 404 Captain Podesta notified the IC with this information, USFS protocol requires that additional consideration occur.*** This likely would have resulted in closer coordination by the IC or the assignment of support resources.
- ***IC Johnson did not inform HC Winger that STF Engine 43 was at scene and being assigned to support the helitack crew.*** HC Winger stated that “had he known that an engine was that close he would have waited and discussed the assignment with the engine captain.” Had IC Johnson notified HC Winger about STF-E43 it is probable that the indirect downhill line construction tactic would have been modified.
- ***STF Engine 43 Captain Mount did not contact HC Winger on tactical net advising that they were assigned to support the helitack crew.*** By contacting the helitack crew the engine captain could have determined if the engine could enter the area safely. HC Winger stated that “had he known that an engine was that close he would have waited and discussed the assignment with the engine captain.” Had Captain Mount contacted HC Winger it is probable the indirect downhill line construction tactic would have been modified.

■ **More thorough scouting prior to implementing downhill fireline construction could have led to utilization of a different tactic or withdrawal from the assignment.**

The strategic objective was to anchor the right flank of the fire at the river. HC Winger and other members of Helitack Crew 404 quickly scouted the area of the right flank to seek a path to the river for uphill line construction, to identify fireline construction route and to identify escape routes.

More thorough scouting of the situation may have identified alternate tactics or obstacles such as the drop off at the high water line of the escape route “down to the river.”

Situations determined by the helitack crew after scouting:

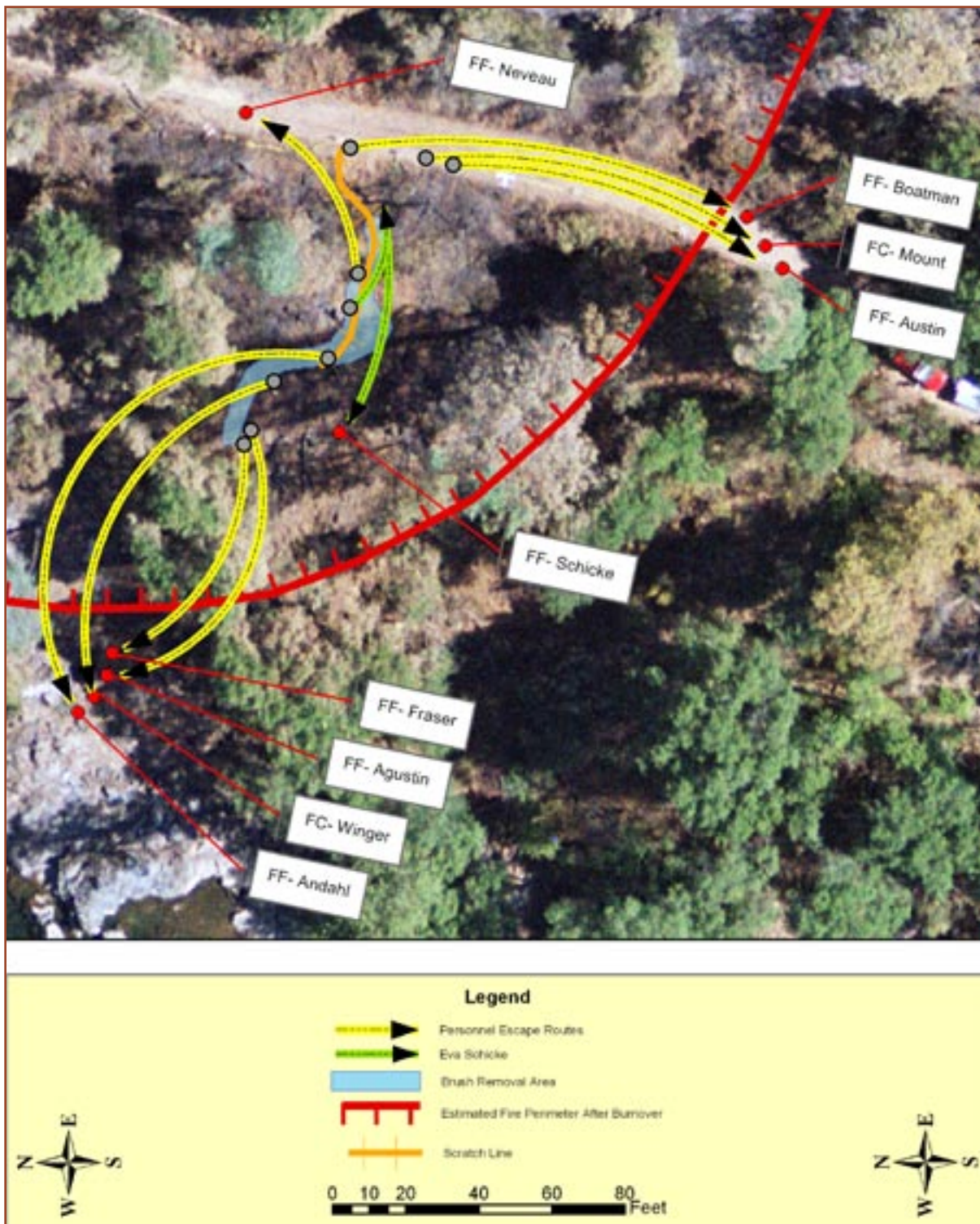
- ***They could not access the base of the right flank via the river.*** FF Boatman and FF Neveau scouted ahead to determine how close they were to the Lumsden Bridge in order to use the riverbank to access the bottom of the fire. They estimated that it was 1 to 2 miles further up the road and decided it was not feasible. Utilizing the river bank for access from the Helicopter LZ was not feasible because of rock outcroppings and boulders.
- ***They could not access the base of the right flank through the black.*** FF Boatman and FF Neveau observed the slope below the road as they scouted up Lumsden Road. The slope below the road became steeper the further up the road they went. Smoke conditions further prevented the crew from finding safe access to the river through the black.

- ***They determined it was more appropriate to construct downhill line than to access the river and build uphill line.*** To quickly access the base of the right flank through the green would have necessitated the crew walking in the grassy opening where they later started constructing fireline. Direct access to the river through the green would have required (1) moving a significant distance downstream and constructing indirect line at a considerable distance from the fire or (2) walking through the same grassy opening used for the fireline and constructing direct fireline from the river. Captain Winger concluded that it would be more efficient to construct indirect downhill fireline after observing the fire behavior below the road.
- ***An option not exercised was to withdraw from this assignment.*** An option available would have been to withdraw from fireline construction at this location and seek a safer strategic location to anchor the fire to the river.

■ The safety zone in the black was not accessible.

The definition and purpose of a safety zone is a place where no additional action other than being in the safety zone is necessary to prevent harm. The crew knew that in addition to the standard “into the black” safety zone, the Helitack Captain identified two other safety zones; (1) “down to the river” and (2) “up to the road and then move into the green or black.”

- ***The safety zone at the river was adequate.*** Once FF Fraser and FF Agustin reached the safety zone they were out of harm’s way. Shelters were not deployed nor necessary. No injuries resulted once they reached the safety zone.
- ***The safety zone at the road was adequate, but required moving on the road into the green or into the black.*** FF Neveau reached the road and moved into the black. FF Boatman was on the road and moved into the green. Shelters were not deployed nor were they necessary. No injuries resulted once they reached the safety zone.
- ***The safety zone into the black was inadequate.*** Typically going into the cooled black is a primary safety zone. However, in this instance the black below the road proved to be too hot to remain without suffering injury. HC Winger and FF Andahl ran through flaming front into the black but believed it was too hot to stay there and turned downhill to reach the safety zone at the river. They did not deploy shelters either in the “black” or at the “river” safety zones. No injuries resulted once they reached the safety zones. Because of the flaming front and unburned fuel, escape into the black was not accessible to FF Neveau and FF Schicke.



Post Burnover Crew Location

■ Non-related Safety Factors



■ Non-related Safety Factors

CDF Definition:

A non-related safety factor is an element discovered as part of the investigation that did not have a direct or indirect effect on the outcome of the accident but does deserve scrutiny.

■ Three (3) non-related safety factors were identified:

- A lookout should be posted, with no collateral duties, when there is danger.
- USFS and CDF downhill line construction guidelines differ.
- The LCES Checklist differs between, and within, the two agencies, even in publications of the same year.

■ Post a lookout with no collateral duties where there is danger.

The purpose of a lookout is to give early warning to firefighters to allow them to utilize their escape routes in time to reach the safety zones without injury. The lookout should be aware of the assignment, have the knowledge, skills and abilities to recognize a developing dangerous situation and the authority to sound an alarm. It is recommended that the lookout have no collateral duties, so the lookout can concentrate on the task of watching for danger.

Several helitack crew members and the ATGS observed the flareup almost simultaneously; they shouted warnings immediately.

– FF Boatman

Captain Winger recalled telling FF Boatman to go back up to the road, get a back pump to support the firing operation and be a lookout. FF Boatman did not hear a specific task to be a lookout, but he stated the assignment included “having a good visual perspective on the crew.” He did have the collateral duties of donning a backpack and holding the corner. However, once at the road FF Boatman’s attention was diverted to STF E-43 Captain Mount when she approached the fire edge looking for the captain of Helitack Crew 404. The flareup occurred in seconds while FF Boatman was talking with STF E-43 Captain Mount and not looking downhill.

– ATGS Ward

ATGS Ward in Air Attack 440 was above the right flank of the fire at the time of the flareup. He had a clear view of the entire right flank and did not observe any early indication of a wind shift. ATGS Ward saw the wind change almost simultaneously to the helitack crew and immediately broadcast a warning on the tactical net for crews to “get in the black, get to your safety zones.”

Alternate Lookout Location

There were no alternate sites that would have allowed a lookout to detect early indicators of a wind shift.

There is no evidence that a dedicated lookout at any location could have given an earlier warning of the wind shift.

■ USFS and CDF downhill line construction guidelines differ.

See the comparison below.

CDF Downhill and Indirect Firefighting Guidelines 7070.2

(October 2002)

Downhill/indirect line construction in steep terrain and fast burning fuels shall be done with extreme caution. Direct attack methods shall be used whenever possible.

The following guidelines shall be followed before firefighting commences:

- The decision to fight fire downhill is made by a competent firefighter after thorough scouting.
- Downhill line construction shall not be attempted when fire is present directly below the proposed starting point.
- The fire-line shall not lie in or adjacent to a chimney or chute that could burn out while members are in the vicinity.
- Communication is established between the members working downhill and members working uphill from below. When neither group can adequately observe the fire, communications will be established between the members and supervising overhead. At this time a lookout with communications will be posted where the fire's behavior can be seen.
- Members will be able to rapidly reach a zone of safety from any point along the line if the fire unexpectedly crosses below them.
- A downhill line shall be securely anchored at the top. Avoid under-slung line.
- Full compliance with "THE STANDARD FIRE ORDERS" is assured.

If possible line firing should be done as the line progresses, beginning from the anchor point at the top.

Reference: Section 7013.1.1
7070-5

USFS Downhill Checklist Fireline Handbook (NFES 0065)

Downhill fireline construction is hazardous in steep terrain, fast burning fuels, or rapidly changing weather. Downhill fireline construction should not be attempted unless there is no tactical alternative. When building downhill fireline, the following is required:

- Crews supervisor(s) and fireline overhead will discuss assignments prior to committing crew(s). Responsible overhead individual will stay with job until completed (TFLD or ICT4 qualified or higher).
- Decision will be made after proposed fireline has been scouted by supervisor(s) of involved crew(s).
- LCES will be coordinated for all personnel involved.
 - Crews Supervisor(s) is in direct contact with lookout that can see the fire.*
 - Communications is established between all crews*
 - Rapid access to safety zone(s) in case fire crosses below crew(s)*
- Direct attack will be used whenever possible; the fireline should be completed between anchor points before being fired out.
- Fireline will not lie in or adjacent to a chute or chimney.
- Starting point will be anchored for crew(s) building fireline down from top.
- Bottom of the fire will be monitored; if the potential exists for the fire to spread, action will be taken to secure the fire edge.

- The LCES Checklist differs between, and within, the two agencies, even in publications of the same year.

CDF L.C.E.S. 7070.1.3 (October 2002)

"LCES" stands for "Lookout(s), Communication(s), Escape route(s) and Safety zone(s)." These are the same items stressed in the "FIRE ORDERS" and "Watchout Situations." Each element should be evaluated independently and continuously. But of equal importance, these should also be evaluated as a system. For example, the best safety zone is of no value if your escape route does not offer timely access when needed.

The LCES system must be communicated to each firefighter prior to when it must be used. The nature of wildfire suppression dictates continuous evaluation of LCES and, when necessary, reestablishment of LCES as time and fire growth progress.

Lookouts

- Every firefighter has both the authority and responsibility to warn others when hazards become threats to safety.

Lookout(s) or scouts (roving lookouts) need to be in a position where both the hazard and the firefighter(s) can be seen. Lookouts must be trained to observe the wildland fire environment and to recognize and anticipate fire behavior changes. Each situation determines the number of lookouts that are needed. Due to terrain, cover and fire size, one lookout is normally not sufficient. When the hazard becomes a danger, the lookout relays the information to the firefighters so they may reposition to the safety zone.

Communications

- Must be able to tell other firefighters of an impending "problem"
- Must have communications

The crew must determine the method of communication(s) that will alert them of approaching hazards. Communications must be prompt and clear, whether by radio, verbal or hand signals.

Escape Routes

- Must have one and preferably two escape routes
- Must lead to safety zones

Escape routes are the paths the firefighter takes from his/her current threatened position to an area free from danger. Unlike the other components of the system, there must always be more than one escape route available as a single escape route may get cut off!

Escape routes are probably the most dynamic component of LCES as their effectiveness changes continuously. As the firefighter works along the perimeter, fatigue and spatial separation increases the time required to reach a safety zone. The most common escape route is the fireline. Be aware that on indirect or parallel fireline, problem situations can become magnified. Unless safety zones have been identified ahead as well as to the rear, firefighter retreat may not be possible.

Safety Zones

Safety zone(s) are locations where the threatened firefighter may find adequate refuge. Safety zones should be planned as a location where no shelter will be needed. This does not imply that a shelter should not be deployed if needed, only that if there is a deployment, that location is not a true safety zone. Fireline intensity and topographic location determine a safety zone's effectiveness.

USFS LCES Checklist Fireline Handbook NFES 0065

March 2004

In the wildland fire environment, Lookouts, Communications, Escape Routes, Safety Zones (LCES) is key to safe procedures for firefighters. The elements of LCES form a safety system used by firefighters to **PROTECT THEMSELVES AND WORK AS A TEAM WITH OTHERS**.

This system is put in place before fighting the fire: select a lookout or lookouts, set up a communication system, choose escape routes and select a safety zone or zones.

LCES IS A SELF-TRIGGERING MECHANISM. Lookouts assess and reassess the fire environment and communicate threats of safety to firefighters. Firefighters use escape routes to move to safety zones.

LCES is built on two basic guidelines:

1. Before safety is threatened, each firefighter must be informed how the LCES system will be used, and
2. The LCES system must be continuously re-evaluated as conditions change.

Lookouts

- Experienced/Competent/Trusted
- Enough lookouts at good vantage points
- Knowledge of crew location
- Knowledge of escape and safety locations
- Map/Weather Kit/Watch/IAP

Communications

- Radio frequencies confirmed
- Backup and check-ins established
- Update on any situation change
- Sound alarm early, not late

Escape Routes

- More than one escape route
- Avoid uphill escape routes
- Scouted: Loose soils/rocks/vegetation
- Timed: Slowest person/fatigue and temperature factors
- Marked: Flagged for day or night (NFES 0566)
- Evaluate: Escape time vs. rate of spread
- Vehicles parked for escape

Safety Zones

- Survivable without a fire shelter
- Back into clean burn
- Natural Features: Rock areas/water/meadows
- Constructed Sites: Clearcuts/roads/helispots
- Scouted for size and hazards
- Up-slope? = more heat impact = larger safety zone
- Downwind? = more heat impact = larger safety zone
- Heavy fuels? = more heat impact = larger safety zone

Escape time and safety zone size requirements will change as fire behavior changes.

USFS
Incident Response Pocket Guide NFES 1077
LCES Checklist

January 2004

LCES must be established and known to ALL firefighters BEFORE needed.

Lookout(s)

- Experienced / Competent / Trusted
- Enough lookouts at good vantage points
- Knowledge of crew locations
- Knowledge of escape and safety locations
- Knowledge of trigger points
- Map / Weather Kit / Watch / IAP

Communication(s)

- Radio frequencies confirmed
- Backup procedures and check-in times established
- Provide updates on any situation change
- Sound alarm early, not late

Escape Route(s)

- More than one escape route
- Avoid steep uphill escape routes
- Scouted: Loose soils / Rocks / Vegetation
- Timed: Slowest person / Fatigue & Temperature factors
- Marked: Flagged for day or night
- Evaluate: Escape time vs. Rate of spread
- Vehicles parked for escape

Safety Zone(s)

- Survivable without a fire shelter
- Back into clean burn
- Natural Features: Rock Areas / Water / Meadows
- Constructed Sites: Clearcuts / Roads / Helispots Scouted for size and hazards
- Up-slope? = More heat impact = Larger safety zone
- Downwind? = More heat impact = Larger safety zone
- Heavy Fuels? = More heat impact = Larger safety zone

Escape time and safety zone size requirements will change as fire behavior changes.

■ Appendices



■ Appendices

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Appendix A

Injuries



Appendix A—Injuries

The following information regarding injuries sustained by members of CDF Helitack Crew 404 was obtained from injury reports (CDF Form 3067), return to work forms (CDF Form 200), followup reports and the pathology/autopsy report.

■ **CDF Fire Captain Jonah Winger:**

Fire Captain Winger was medically evaluated at Sonora Regional Medical Center. He received several small (spots) second degree burns on his face. Fire Captain Winger was treated and released to full duty on September 12, 2004.

■ **CDF FF-I Joshua Agustin:**

Firefighter Agustin was medically evaluated at Sonora Regional Medical Center. He received no injuries and was released to full duty on September 12, 2004.

■ **CDF FF-I Jon Andahl:**

Firefighter Andahl was medically evaluated at Sonora Regional Medical Center. He received a small second degree burn on his left wrist (approximate size 1" x 2") and a small second degree burn on his nose ("dime" size). Initial emergency room x-rays indicated a possible fracture to his left ankle; however, additional x-rays indicated Firefighter Andahl's left ankle was not fractured. He was treated and released to modified work status September 12. Firefighter Andahl returned to full duty on October 6, 2004.

■ **CDF FF-I Jeff Boatman:**

Firefighter Boatman was medically evaluated at Sonora Regional Medical Center. He received no injuries and was released to full duty on September 12, 2004.

■ **CDF FF-I Thomas Fraser:**

Firefighter Fraser was medically evaluated at Sonora Regional Medical Center. He received no injuries and was released to full duty on September 12, 2004.

■ **CDF FF-I Shane Neveau:**

Firefighter Neveau was medically evaluated at Doctor's Medical Center in Modesto. He was admitted for smoke inhalation and received respiratory therapy and was released on September 13, 2004. There were initial concerns he received first and second degree burns to his backside; however, medical evaluation revealed no burn injuries. Firefighter Neveau was released to modified work status on September 14 and returned to full duty on September 20, 2004.

■ **CDF FF-I Eva Schicke:**

Firefighter Schicke received fatal injuries at the accident site. The pathology/autopsy report stated the following:

Cause of Death:

Inhalation of products of combustion.

Time frame: seconds.

Autopsy Findings:

1. Inhalation of products of combustion; desquamation and thermal change of mucosa of airway.
2. Inhalation of material consistent with soil. This material was non-occlusive in the airway.
3. Charring of the entire body, postmortem.
4. Postmortem fracture of the right tibia/fibula.
5. Postmortem fractures of the posterior left ribs.
6. Blood carboxyhemoglobin (COHb) saturation = 5%. (Toxic concentration = 15 to 50%, fatal concentration = greater than 50%.)

Additionally: Remnants of a tubular nylon/Velcro knee brace were found on the left knee. Firefighter Schicke experienced two reportable injuries to her left knee (Fire Season 2002, Fire Season 2003). Relative to the knee injuries, Firefighter Schicke received return to work orders (CDF Form 200) with no restrictions; the last Form 200 was dated May 1, 2004. Firefighter Schicke did not demonstrate, nor report, any physical performance limitations during her assignment between May 1 and September 12, 2004.

■ Personal Protective Equipment (PPE)



Appendix B—Personal Protective Equipment (PPE)

The Personal Protective Equipment (PPE) issued to firefighters of CDF Helitack Crew 404 consisted of the following items:

- Helmet with chin strap
- Goggles
- Nomex shroud
- Nomex shirt
- Nomex pants
- Gloves
- Chainsaw chaps
- Fire shelter

The PPE assigned to Fire Captain Winger and firefighters Agustin, Andahl, Boatman, Fraser and Neveau was inspected and photographed by investigation team member Battalion Chief Rob Van Wormer. With the exception of Firefighter Schicke's PPE, none of the PPE issued to Crew 404 was damaged or failed to function during the burnover. The burnover and subsequent residual burning destroyed Firefighter Schicke's PPE.

Additional items and supplies carried by the firefighters included the following items:

- Web gear
- Canteens
- Headlamp
- Fire tool
- Fusees
- Chainsaw with accessories (as assigned)
- First aid kit
- HT radio (as assigned)
- Personal items

The average weight of the PPE with web gear and complement was 40-45 pounds. Additional details regarding PPE are found in the supporting data section.

■ Experience, Training, Qualifications



Appendix C—Experience, Training and Qualifications

The following is a summary of experience, training and qualifications for the personnel involved in the turnover of CDF Helitack Crew 404 listed below. Individual training records may be found in the documentation section.

Title/Name	Experience	Qualifications/Training
Battalion Chief Dan Ward CDF	Air Attack 9 yrs. 3 mo. Forester 10 yrs. 6 mo. Captain 8 yrs. 8 mo. Engineer 1 yr. 10 mo.	Air Attack MGT I-271 Helibase MGR I-357 Air Support I-470 Air Ops I-420 Command and General Staff I-300 Intermediate ICS Type 1 Helicopter MGR I-430 Operations Section Chief Incident Management I, II & III S-290 Intermediate Fire Behavior S-490 Advanced Fire Behavior
Forestry Pilot Tom Eggleston CDF	Perm. 5 yrs LT 10 seasons	Air Attack MGT Type 1 Helicopter MGR I-300 Intermediate ICS CDF Short Haul Pilot and Rescuer
Fire Captain Frank Podesta CDF	Captain 11 yrs. Engineer 6 yrs. Hotshot Captain USFS, 10 yrs.	Air Attack MGT I-271 Helibase Manager I-374 Helicopter Coordinator I-375 Air Support Supervisor I-378 Air Attack Supervisor Military Helicopter Manager Type 1 Helicopter Manager CDF Short Haul Basic Crew Captain S-212 Wildfire Power Saw I-300 Intermediate ICS Incident Management 2 I-224 Field Observer Fire Management 2
Fire Captain Jonah Winger CDF	Helitack Captain 8 weeks Captain 2 yrs. 2 mo. Engineer Paramedic 2 yrs. FF/Para. 2.5 yrs. Pioneer Vol/FF 2.5 yrs. Pioneer	Fire Crew Captain Module 1 Fire Crew Captain Module 2 S-212 Wildfire Power Saw Incident Management I & II I-200 Basic ICS I-300 Intermediate ICS Driver Operator Module SFM Fire Officer S-290 Intermediate Fire Behavior

Firefighter Eva Schicke CDF	6 months Helitack 4 seasons Engine	CDF Firefighter I Basic CDF Advanced FFI CDF Basic Helitack S-212 Wildfire Power Saw
Firefighter John Andahl CDF	5 months Helitack 3 seasons Engine 1 season tanker base	CDF Firefighter I Basic I-100 Introduction to ICS S-212 Wildfire Power Saw
Firefighter Josh Agustin CDF	6 seasons Helitack 4 seasons Engine	CDF Firefighter I Basic CDF Basic Helitack CDF Advanced FFI I-100 Introduction to ICS I-272 Helispot Manager
Firefighter T.J. Fraser CDF	2 seasons Helitack 4 seasons Engine	CDF Firefighter I Basic Wildland Firefighter Survival S-190 Introduction to Fire Behavior S-212 Wildfire Power Saw
Firefighter Jeff Boatman CDF	2 seasons Helitack CDF 1 season Engine CDF 2 seasons Hot Shot USFS 1 season Crew USFS	CDF Firefighter I Basic S-212 Wildfire Power Saw S-234 Ignition Operations S-270 Basic Air Operations S-205 Fire Operations in Urban Interface S-200 Initial Attack Incident Commander S-230 Crew Boss Single Resource I-200 Basic ICS I-300 Intermediate ICS S-211 Portable Pumps and Water Use
Firefighter Shane Neveau CDF	1 season Helitack 3 seasons Engine	CDF Firefighter I Basic CDF Advanced FFI I-100 Introduction to ICS S-190 Introduction to Fire Behavior S-212 Wildfire Power Saw

Appendix C—Experience, Training, Qualifications

Division Chief Allen Johnson USFS	DFMO 1 yr. 6 mo. Asst. DFMO 15 yrs. 6 mo. Hotshot Fore/Supt. 3 yr. 2 mo. Captain 4 yrs. 10 mo. Fire Prev. Tech 1 yr. 4 mo. Engineer 1 yr. 6 mo. Firefighter 2 yrs.	Incident Commander Type 2 Operations Section Chief Type 2 Logs. Section Chief Type 2 Resource Unit Leader Staging Area Manager Firefighter 1 & 2 I-300 Intermediate ICS I-339 Division/Group Supervisor I-420 Incident Command & General Staff Interagency Aviation MGT & Safety S-390 Intro to Advanced Fire Behavior S-490 Advanced Fire Behavior Calcs
Fire Captain Tammy Mount USFS	Captain 7 yrs. Engineer 5 yrs. 11 mo. Firefighter 1 yr. 7 mo.	Crew Boss Engine Boss Helicopter Crew Member Strike Team Leader Engines Strike Team Leader Crews Incident Commander Type 4 Safety Officer Type 3 Task Force Leader Firefighter 1 & 2 I-300 Intermediate ICS S-390 Intro to Advance Fire Behavior

Fire Environment



Appendix D—Fire Environment

This section is a summary of the fire environment on the afternoon of September 12, 2004. It discusses the topography, condition of the vegetation or fuels in the area and the weather related factors that influenced the fire behavior.

■ Topography

The Tuolumne River is a major drainage in the Sierra Nevada range and flows westward from the crest toward the Central Valley. The canyon in the area of the accident site is topographically complex with steep, rugged, broken terrain. The canyon is 2,000' deep at the accident site with steep canyon sides and numerous intermittent and perennial tributary streams flowing into the Tuolumne River. The accident site was located at the bottom of the Tuolumne River Canyon at 1450 feet elevation. The slope was 90 percent at the accident site.



*Photo D-1: Tuolumne River Canyon looking northeast.
Tuolumne fire is located in the center of photo.
Accident site is obscured by ridge in foreground.*



Photo D-2: Tuolumne River Canyon looking downriver to the west. Photo was taken approximately 150' above accident site. Accident site is not visible in this photo.

Fuels

Vegetation in the general area is intermingled pine-oak woodland and chaparral brush. Tree species in the accident site area were primarily canyon live oak (*Quercus chrysolepis*) with an occasional gray pine (*Pinus sabiniana*) and California black oak (*Quercus kelloggii*). Shrub species in the accident site area was primarily toyon (*Heteromeles arbutifolia*) and interior live oak (*Quercus wislizeni*). Other brush species in the general area included manzanita (*Arctostaphylos spp.*), deerbrush, blueblossom (*Ceanothus spp.*), California buckeye (*Aesculus californica*) and chamise (*Adenostoma fasciculatum*). The surface fuel layer consisted of oak leaf and pine needle litter and sparse, short, discontinuous cured annual grasses less than 12 inches in height.

Fire history records indicate the fuels last burned in 1987 as part of either the Hamm 87 or Clavey 87 Complex. On-site evidence near the accident site indicates that the fire was of low to moderate intensity, as many larger diameter trees survived the fire.

The vertical continuity of the fuel in the accident site area is best described as a three-layered fuel bed. The surface fuel layer of sparse short grass, oak leaf and pine needle litter provided a light, flashy fuel bed. One-hour fine dead fuel moisture was calculated at four to five percent for exposed fuels and six to seven percent for shaded fuels. The intermediate fuel layer consisted of brush, predominately toyon and young live oaks that ranged in height from 4 to 10 feet. The upper fuels layer consisted of the larger diameter oak and pine trees that ranged in height from approximately 30 to 100 feet.

While there was natural variability in the three-layered fuel bed, it was significant in that it provided ladder fuels for a surface fire to spread to higher levels dependent upon site-specific vertical continuity, surface fire intensity and flame lengths. Critically low, live fuel moistures allowed the fire to transition from the surface fuels to the aerial brush fuels very quickly.

The following two photos show fuels west of the accident site on a similar aspect and elevation. The photos depict fuels similar to those in which the fire was burning in the area below the road. At the accident site there was a more natural opening with less brush present.

Photo D-3.
Surface
fuels
similar to
those in
which the
fire was
burning.



Photo D-4.
Unburned
fuels just west
of final fireline
below road.
Final right
flank fireline
is in the
foreground.
This was
approximately
100 feet south
of accident
site.



■ Live Fuel Moisture

The amount of live fuel moisture determines how readily brush will burn and if it will contribute significantly to fire spread and intensity. As the moisture in the living fuel declines throughout the growing season, more of the living fuel can become involved in a fire and the probability of rapid spreading high intensity fires increases. Experience has indicated that, in general, sustained, fast-spreading and high-intensity fires in chaparral are infrequent until the live fuel moisture has declined to about 60 percent in chamise and 80 percent in manzanita. These moisture levels are often designated as the “critical” fuel moistures for these fuels.

Live fuel moistures are sampled on a routine basis by both the CDF Tuolumne-Calaveras Unit and the Stanislaus National Forest to track seasonal fuel moisture trends in chamise and manzanita. Table 1 displays the most recent live fuel moisture samples taken by the Tuolumne-Calaveras Unit. The sampling location is 20888 Lyons-Bald Mtn. Road, Sonora, CA in Tuolumne County. The elevation is 2500 feet, south aspect, 30 percent slope.

Table 1: Recent Live Fuel Moistures

Date	Chamise (average)	Manzanita (average)
4/8/2004	119%	117%
4/22/2004	114%	122%
5/12/2004	104%	107%
6/2/2004	87%	104%
7/6/2004	66%	83%
7/28/2004	58%	77%
8/31/2004	54%	55%

Note: Bold numbers indicate critical fuel moisture values.

Table 2 displays on-site fuel moisture samples taken after the incident on September 17, 2004. Samples were taken on a similar aspect and elevation just south of the final perimeter of the Tuolumne fire below the road.

Table 2: On-site Fuel Moisture

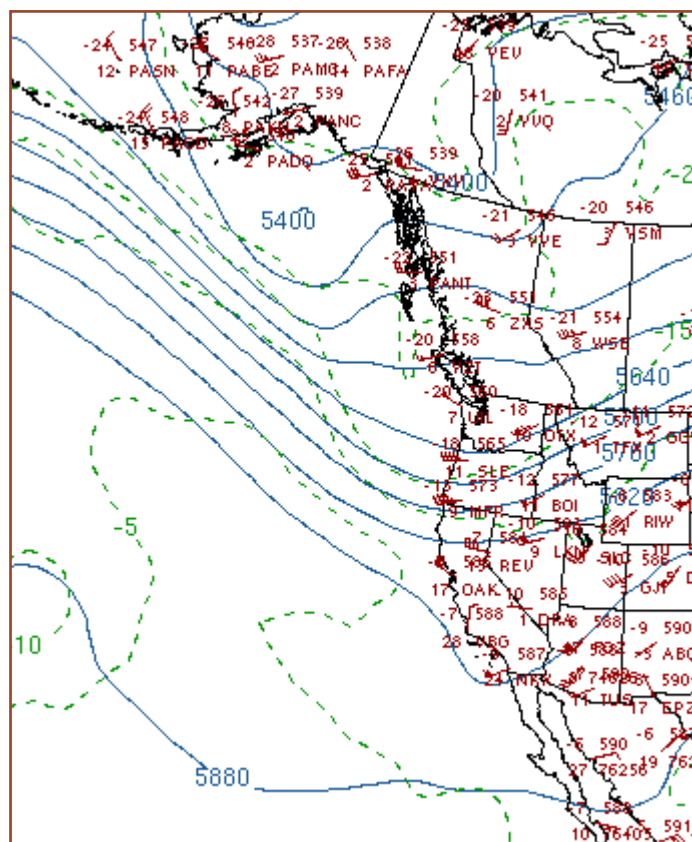
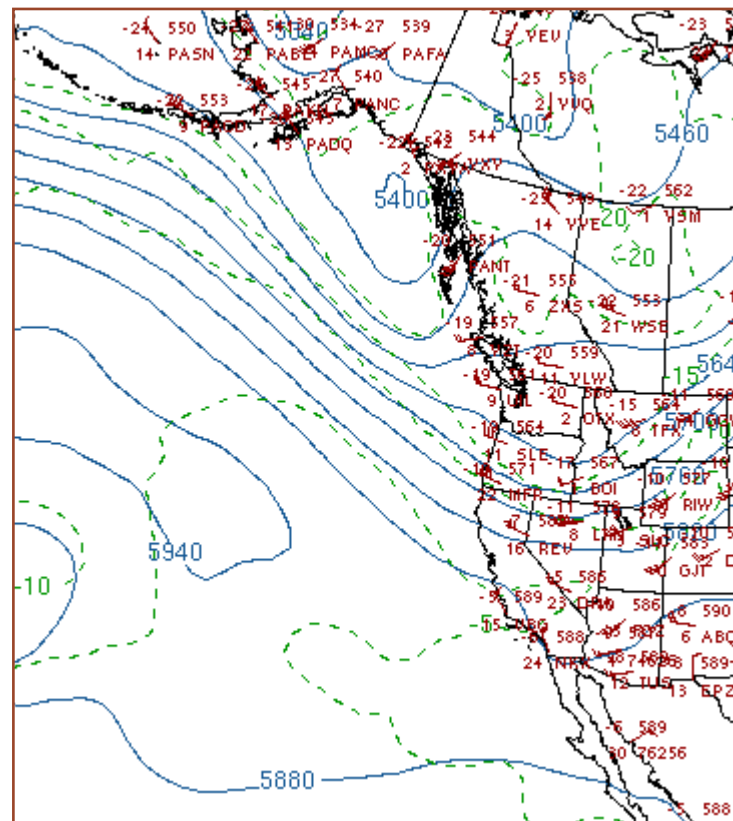
Date	Chamise (average)	Manzanita (average)	Toyon (average)
9/17/2004	61%	71%	74%

Note: Bold numbers indicate critical fuel moisture values. Chamise is considered as critical as it was only 1 percent above threshold value.

While toyon is not routinely sampled and critical fuel moisture thresholds have not been established for the species, it could be expected to follow similar patterns to indicate flammability. One sample of underburned, scorched toyon brush was taken 34 feet southwest of the body retrieval site, on a similar aspect and elevation (See photo 5). The moisture content was four percent. It is unknown what the moisture content was immediately after the flaming front passed through. However, the low moisture content at the time of sampling indicates that almost all the moisture in the plant had been driven off by the surface fire and was on the threshold of igniting and sustaining combustion. Any minor increase in surface fire intensity or flame length could be expected to ignite these aerial fuels.



*Photo D-5.
Underburned
toyon brush.*

Figure 3: 500 mb Chart 9/12/04 1100 PDT**Figure 4: 500 mb Chart 9/12/04 1700 PDT**

Weather forecast:

The most current general fire weather forecast for the incident area was done by the National Weather Service in Sacramento, CA, and adequately described the weather conditions for the area (Attachment 1, page 117). No site-specific (Spot) forecast had been requested at the time.

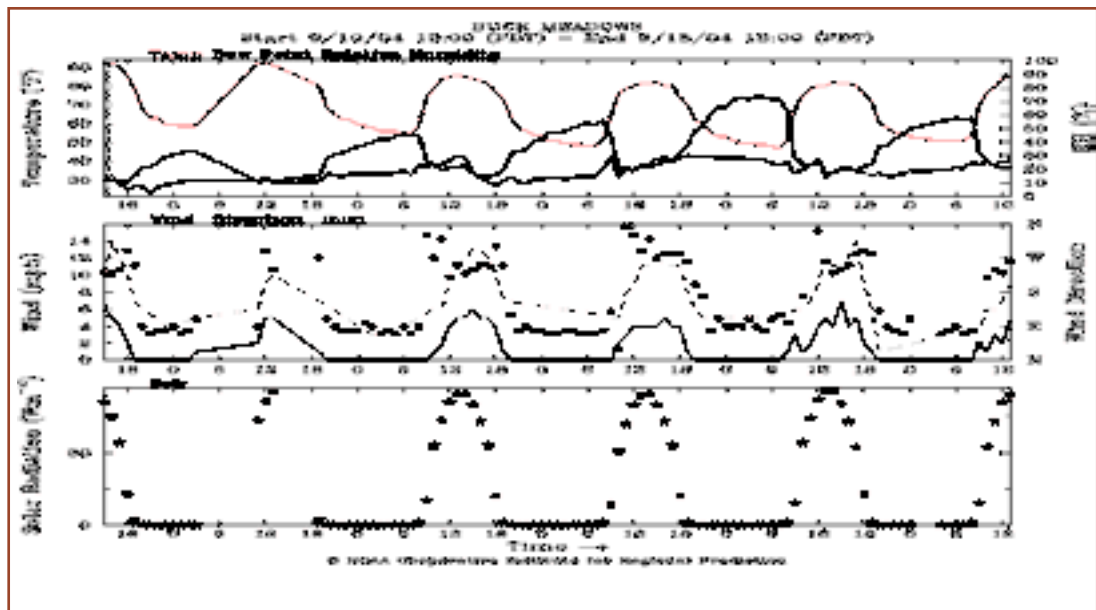
General comments:

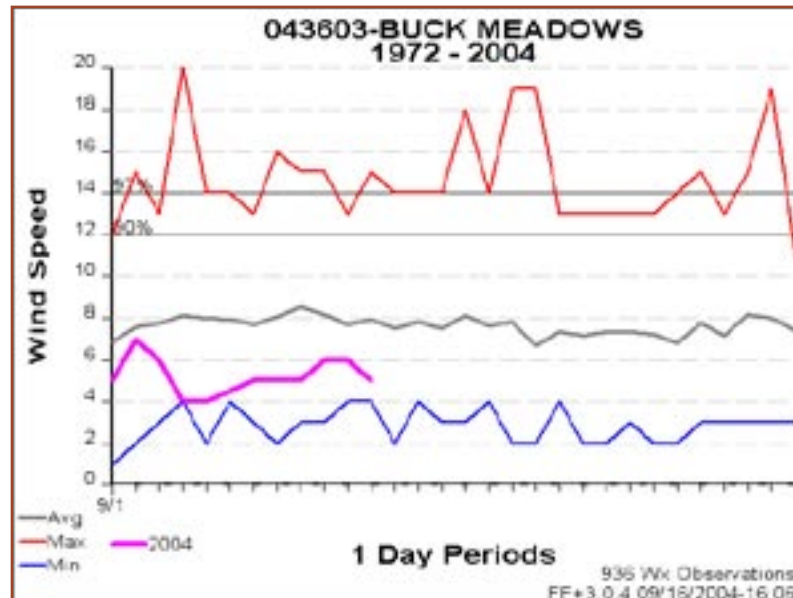
The analysis of fire weather conditions surrounding the time of the entrapment must remain speculative due to a lack of on-site measured data or a somewhat representative weather station nearby. The nearest Remote Automatic Weather Station (RAWS) is Buck Meadows, located at the Groveland District Office at Buck Meadows and is about 3.5 miles horizontal distance southwest from the incident site. This RAWS is at an elevation of about 3200 feet near the top edge of the Tuolumne River canyon while the entrapment site was near 1500 feet in the canyon bottom. However, the same data trends recorded at the Buck Meadows RAWS can likely be applied to any airmass changes that occurred in the river canyon as the low pressure trough went through the area.

Wind:

As a result of the low pressure trough passing through, wind speeds at the nearby Buck Meadows RAWS were 1 to 2 mph stronger during the day of the entrapment compared to surrounding days (Graph 1). While the general wind direction over the area (SW to WSW) was basically aligned with the Tuolumne River canyon, there is no indication this resulted in stronger than normal winds near the river from air being funneled through the canyon. Wind speeds at the Buck Meadows RAWS were actually below average for the time of year (Graph 2).

Graph 1: 5-day Weather Trends for Buck Meadow RAWS



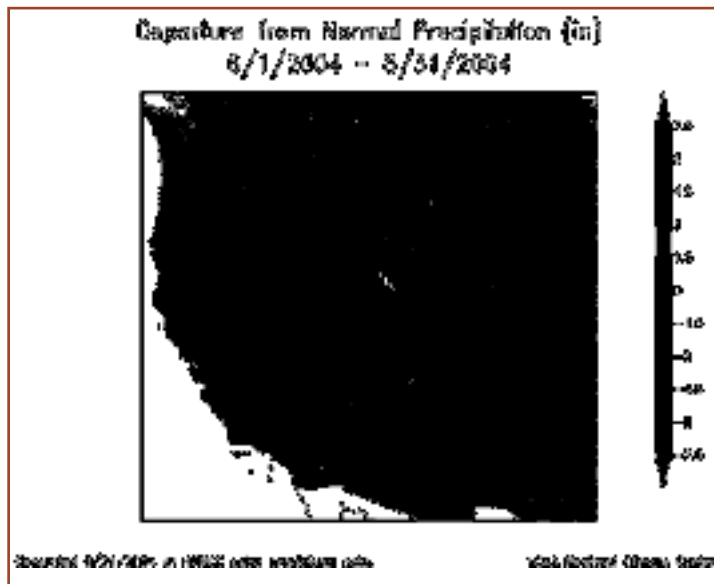
Graph 2: Buck Meadow RAWS September wind climatology

Qualitative reports from witness interviews indicate that the wind on-site prior to the entrapment was steady and up-canyon at three to five miles per hour. This appears very reasonable when watching the smoke drift as captured on the video taken overhead by Air Attack prior to the time of the incident. Witnesses stated there was a sudden change in the wind direction from up-canyon to up-slope (from the river toward the road) causing a flareup which led to the entrapment.

The smoke flow captured on the Air Attack video for the period before the entrapment showed some differences in air motion between sites above versus those below the road. The smoke originating from below the road was moving predominately up-canyon almost parallel to the river. However, it would occasionally flow up-slope (from the river to the road) for brief periods. The smoke flow from the portion of the fire above the road was consistently up-slope with some up-canyon wind influence on its drift.

Prior Conditions:

While a dry summer is common for the area, rainfall for the period June through August was 1.5 inches below normal (Figure 1). The last precipitation prior to the incident occurred on May 28th when RAWS sites in the general area recorded 0.10 to 0.60 inch that day.

Figure 1: Rainfall Departure from Normal June-Aug 2004**Temperatures:**

Based on the data from Buck Meadows RAWS, afternoon temperatures in the area were on the order of five to eight degrees cooler than the previous day (Table 3). Allowing for the elevation difference and a canyon bottom location compared to the RAWS site, the temperature is estimated to be somewhere between 89 and 94 degrees on-site at the time of the entrapment.

Relative Humidity:

For much of the day at Buck Meadows RAWS, relative humidities were seven to ten percent higher than the previous day (Table 3), and the afternoon minimum humidity was almost as dry as the day before. Allowing for the elevation difference and canyon bottom location compared to the RAWS site, relative humidity is estimated to be somewhere between 18 and 24 percent on-site at the time of the entrapment.

Table 3: 24 Hour Weather Trends

RAWS Name	Elev/Dist/Dir from Fire	Time	*Temp °F	% RH	Wind Direction	Wind Speed mph	Peak Wind Gust
Buck Meadows	3199 ft 4 mi WSW	16:00PDT	83/-9	16/+6	WSW/ W	5/0	13/0
		15:00PDT	84/-8	17/+7	WSW/ SW	6/+1	13/-1
		14:00PDT	85/-7	23/+12	SW/ W	5/-1	12/0
		13:00PDT	86/- 5	22/+ 11	WSW / W	5/+ 0	11/+ 1
		12:00PDT	85/- 7	21/+ 9	SW / SW	4/-1	10/+ 1
		11:00PDT	84/- 8	20/+ 9	NW / W	2/+0	6/+ 0
		10:00PDT	79/-10	23/+10	W/E	1/+1	6/-1
Mount Elizabeth	4934 ft 19 mi NW	16:00PDT	74/-8	22/+6	WSW/WSW	8/-2	18/0
		15:00PDT	76/-7	23/+8	SW/SW	11/0	18/-1
		14:00PDT	78/-5	23/+10	SW/SW	10/0	18/+1
		13:00PDT	78/- 7	29/+ 16	SW / SW	10/+ 1	17/+ 3
		12:00PDT	78/- 5	25/+ 11	SW / WSW	10/+ 2	15/+ 2
		11:00PDT	76/- 9	26/+ 12	S / SW	7/+ 2	13/+3
		10:00PDT	72/-10	27/+13	S/SW	7/+1	12/0

*Format: current reading/change from 24 hours ago

■ **Conclusions:**

The cause of the wind shift at the time of the entrapment is not apparent and does not appear to be an easily foreseeable event. Based on the air flow behavior in the area seen on the video taken for a period prior to the entrapment, it appears that while the predominant on-site wind flow was up-canyon, there were also occasional brief periods with up-slope winds. This strongly suggests the sudden wind direction change witnessed which caused the flareup was part of a localized weather pattern with unpredictable timing.

Local airflow may have been influenced by the physical shape of the terrain in the canyon causing wind eddies. This is common in steep-sided river canyons with convoluted terrain like that in the Tuolumne River canyon. The video suggests the first 75 to 100 vertical feet above the entrapment location may be particularly sensitive to this occurring. Variations in aspect and fuels may have also created localized heating differences that could contribute to changeable air flow patterns. Local airflow may have also been influenced by indrafts into the fire above the road that were occasionally strong enough to briefly override the up-canyon wind, creating occasional wind shifts.

■ Attachment 1 – National Weather Service Fire Weather Forecast

FIRE WEATHER PLANNING FORECAST FOR INTERIOR NORTHERN CALIFORNIA
NATIONAL WEATHER SERVICE SACRAMENTO CA
730 AM PDT SUN SEP 12 2004

.DISCUSSION...

A LARGE UPPER LEVEL TROF OF LOW PRESSURE WILL DEEPEN OVER THE PACIFIC NORTHWEST TODAY AS A WEAK FRONTAL SYSTEM MOVES THROUGH OREGON/WASHINGTON AND NORTHERN CALIFORNIA. THIS FRONTAL SYSTEM WILL BRING CLOUDINESS TO THE NORTHERN PART OF THE STATE AND SOME COOLING TO NEARLY ALL AREAS WITH AT LEAST SOME MODERATION IN THE VERY DRY HUMIDITIES THAT HAVE BEEN OBSERVED OVER THE LAST SEVERAL DAYS. HUMIDITY VALUES THIS MORNING ARE RUNNING A FEW TO SEVERAL PERCENT HIGHER THAN YESTERDAY MORNING. MORE MODERATE BUT OCCASIONALLY BREEZY CONDITIONS ARE EXPECTED THROUGH MID WEEK AS A SERIES OF WEAK FRONTAL SYSTEMS DIG THE UPPER LEVEL TROF INTO THE GREAT BASIN. ALTHOUGH MORE MODERATE CONDITIONS ARE EXPECTED... AT THIS TIME NO PRECIPITATION IS EXPECTED THROUGH THE EXTENDED PERIOD.

CAZ269-122230-
WESTERN TAHOE WESTERN ELDORADO AND STANISLAUS NF
FIRE WX ZONE 269
730 AM PDT SUN SEP 12 2004

.TODAY...

SKY/WEATHER.....MOSTLY SUNNY.
MAX TEMPERATURE.....76-84 LOWER ELEVS AND 64-69 UPPER SLOPES AND RIDGES.
24 HR TREND.....3-6 DEGREES COOLER.
MIN HUMIDITY.....15-25 PERCENT.
24 HR TREND.....7-12 PERCENT WETTER.
20-FOOT WINDS.....
VALLEYS/LWR SLOPES...SOUTHWEST WINDS 5 TO 12 MPH.
RIDGES/UPR SLOPES....SOUTHWEST WINDS 12 TO 18 MPH.
LAL.....1.
CWR (>0.10 IN).....0 PERCENT.

.TONIGHT...

SKY/WEATHER.....MOSTLY CLEAR.
MIN TEMPERATURE.....51-61 LOWER ELEVS AND 37-45 UPPER SLOPES AND RIDGES.
24 HR TREND.....2-4 DEGREES COOLER.
MAX HUMIDITY.....30-45 PERCENT.
24 HR TREND.....5 PERCENT WETTER.
20-FOOT WINDS.....
VALLEYS/LWR SLOPES...NORTHWEST WINDS TO 8 MPH.
RIDGES/UPR SLOPES....NORTHWEST WINDS 7 TO 15 MPH.
LAL.....1.
CWR (>0.10 IN).....0 PERCENT.

.MONDAY...

SKY/WEATHER.....MOSTLY SUNNY.
MAX TEMPERATURE.....73-81 LOWER ELEVS AND 61-66 UPPER SLOPES AND RIDGES.
MIN HUMIDITY.....18-28 PERCENT.
20-FOOT WINDS.....
VALLEYS/LWR SLOPES...NORTHWEST WINDS 5 TO 12 MPH.
RIDGES/UPR SLOPES....NORTHWEST WINDS 12 TO 18 MPH.
LAL.....1.
CWR (>0.10 IN).....0 PERCENT.

Appendix E

Fire Behavior



Appendix E—Fire Behavior as Described by Observers

The accident investigation panel members interviewed each of the major participants in the initial attack firefighting response for the Tuolumne Fire for the Copter 404 Burnover. Interviewees were requested to describe the events on September 12 and asked specific questions on tactics, communications and safety. The interview panel met with most of the participants on September 14 and 15, 2004 and conducted some follow-up interviews a few days later. During these interviews, the observers provided descriptions of fire behavior. Although their accounts of location, distance and time varied, the witnesses agree with each other fairly well. Since the witnesses participated in the firefight from different locations and were experiencing physical and emotional trauma it is reasonable to expect some variation in the narratives.

The following individuals contributed to this compiled description:

Dan Ward	AA440 ATGS
Colin Rogers	Air Attack 440 Pilot
Alan Johnson	Incident Commander
Tom Eggleston	Copter 404 Pilot
Frank Podesta	Copter 404 Captain
Jonah Winger	Crew 404 Helitack Captain
Josh Agustin	Copter 404 Firefighter
John Andahl	Copter 404 Firefighter
Jeff Boatman	Copter 404 Firefighter
T.J. Fraser	Copter 404 Firefighter
Shane Neveau	Copter 404 Firefighter
Tammy Mount	Engine 43 Captain
Brian Austin	Engine 43 Firefighter
Russell Looney	Air Tanker 81 Pilot
Crewmembers	Engine 4476 and Engine 4456
Duane Cornell	Air Tanker 82 Pilot
Jim Dunn	Air Tanker 83 Pilot

Observed fire behavior will be summarized before, during and after the flareup event. Since Lumsden Road is an access route that provides a reference point for observers, fire behavior above and below the road will be presented sequentially.

■ Before the flareup below Lumsden Road as described

Upon arrival of the initial attack resources, the fire was backing down-canyon (toward the southwest) against an up-canyon wind. Flame lengths were described as less than 1 foot by the Incident Commander (IC) who drove to the right flank a few minutes before Helitack Crew 404 reached the line. Upon arrival, Helitack Captain (HC) Winger checked the lower right flank below Lumsden Road. The fire contoured down-slope but bent up-canyon toward the northeast. The fire below the road was aligned fairly closely with its extension above the road. The fire was creeping slowly down-canyon.

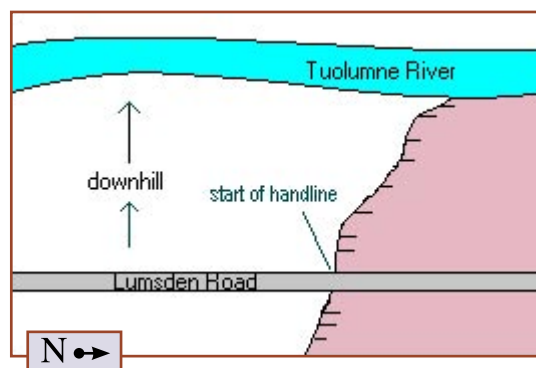


Figure 1: Fire alignment at time of initial ground attack. Pink area represents burn.

During this same period, aerial videos showed smoke originating from below the road to be spreading up-canyon, parallel to the river.

Copter 404 made no bucket drops below the road.

As the fire appeared to be spreading favorably, Helitack Crew 404 prepared to construct handline on the downhill portion of the fire. Crewmembers described the flames as being one foot or shorter.

As the first 100 feet of the cut line extended down-slope, the fire continued to back down-canyon toward the crew working on the handline. Cut materials were thrown to the left of the handline (into the green). When the scrape had extended about 60 feet down-slope to a dogleg, crewmembers used a fusee to burn out the fuel between the handline and fire. Fire was extended about 20 feet down the line to the base of a large pine.

HC Winger and crewmembers assert that the constructed handline was about 10 feet from the backing fire edge. HC Winger advised that the sawyer cut line below the dogleg was not the same as his planned handline. The sawyer had cut too far to the south from where he intended to proceed. From the dogleg he intended to angle to the right toward the fire on somewhat of a contour.

The interviewed members from Helitack Crew 404 and aerial observers from Copter 404, AA440 and the air tankers were consistent in reporting benign backing behavior with short flame lengths along the lower right flank during the entire observed period prior to the flareup.

■ Before the flareup above Lumsden Road as described

ATGS Ward observed that the fire above the road had crested the ridge and had dropped onto the (north-facing) lee of the hill. Here the fire exhibited lessening intensity and speed. The air tankers and Copter 404 appeared to be effectively holding the right flank above Lumsden Road. The copter made 6 to 7 bucket drops.

As the fire spread higher in the canyon (toward Cherry Road) it appeared to catch more of the upper gradient winds. About one hour into the fire (estimated around 1328 hrs), a spot fire was sighted mid-slope off the left flank at about 2400 feet elevation. Copter 404 responded and was effectually limiting this spot with two to three water drops. Later, additional spotting activity was observed higher up the slope.

The head of the fire began moving southeast toward the top of the canyon. IC Johnson and ATGS Ward discussed their plan for expanding the suppression forces responding to the incident. They ordered additional aircraft, ground resources and overhead personnel and then directed incoming resources toward the area of Cherry Road and Drew Meadow.

The right flank was smooth and appeared to be backing evenly.

Smoke was spreading up-slope and up-canyon. The up-slope vector was more observable on upper elevations and was more notable during the short runs that occurred. Smoke originating near the heel tended to spread up-canyon rather than up-slope. Spotting activity was never observed on the right flank of the fire.

■ The flareup below the road as described

Helitack Crew 404 was spread out along their handline that was under construction. The lowest cut was 100 feet below the road but the scraped portion had extended about 50 feet. The captain of Engine 43 approached the top of the handline and observed Helitack Crew 404 working. The fireline immediately above the road appeared to be inactive.

As E-43 Captain Mount arrived near the top of the handline, she observed a spot fire on the road cut-bank across from the top of the handline. The spot fire spread southward along the cut bank about 35 feet and then to the slope above. Within an estimated 10 to 15 seconds, the fire from the vicinity of Helitack Crew 404 was blowing across the road near the head of the handline.

From the crew's perspective, as per their testimony, the following events progressed from the bottom of the proposed handline up toward the road. Each testimony reflects the witness' observations from his own location on the line.

FF Jeff Boatman advised that the backing fire had been underburning some of the brush and that their handline placement took advantage of a natural break in the ladder fuels. After the crew was working, he noted a small wind shift and some parallel fire. He was told to get the backpack. Somebody yelled and he saw a wind shift and crewmembers scattering with the fire coming up the hill. He yelled and backed from the road edge. He heard Schicke scream and saw Neveau arrive at the top as the fire hit the road. (Boatman was 1st from the top).

FF Shane Neveau had been firing-out the area between the fire and the new handline. He bumped up against Schicke so he threw away his fusee. He saw a tiny "flicker" of wind change and then a major wind change with torching below him. He yelled "Wind Change!" and "Get Out!" He turned and ran uphill and felt heat at his back. He rolled into the cut bank and tried to deploy his shelter while on the ground but he got up and ran to the black instead. He asserted that the firing-out operation was not related to the flareup. (Neveau was 2nd from the top).

FF Eva Schicke was 3rd from the top. During her escape attempt, she may have reached within 5 feet of the road.

FF John Andahl heard Neveau yell "wind change!" and saw fire racing up from below. He saw a hole in the flame height and ran through it, downhill to the right. The hole disappeared as he was in it. He ran through blindly, hit a tree and then landed on the rocks. He received burns on the left side of his face and other mechanical injuries. (Andahl was 4th from the top).

HC Jonah Winger saw a giant wind shift and saw fire spreading up the flank toward Helitack Crew 404 from below. The fire was somewhat in the canopy. He yelled "Emergency Action!" He ran down through the fire. In a subsequent interview HC Winger provided a diagram showing approximate site conditions. (Winger was 5th from the top).

FF Josh Agustin was the brush puller and he estimated that he was 4-5 feet from the black. The fire was backing, underburning and not consuming the brush. The flame length was about one foot. Agustin saw a wind shift and fire sheeting up below him in the grass and then it died slightly. (There was not much brush in the vicinity.) He yelled to FF Fraser. The fire sheeted up a second time and was spreading into his piled brush. He jumped downhill, eventually landing on top of Fraser on the riverbed. He described the sheeting action as fire about 8 to 12 inches tall and 10 to 15 feet deep, spreading (left) 10 to 15 feet into the green with intense heat. (Agustin was 6th from the top).

FF T.J. Fraser was the saw operator. He dumped his cut material to the left (toward the green). Brush near the bottom of the cut was very sparse. He saw a wind shift and heard yelling. He set his saw brake and ran past the flames. He did not take any heat or smoke as he escaped. As he looked back uphill, he could see the fire running uphill and could see Winger and Andahl come down. (Fraser was 7th from the top).

The various crewmembers described the fire event as taking 8 to 30 seconds. From the air, the event appeared to take 15 to 20 seconds, (max 30 sec as per ATGS440).

■ The flareup above the road as described

From the air, increased intensity was observed on the southwest-facing portion of the right flank above Drew Creek. This fire run was headed up-slope but moving slightly down-canyon. Smoke from the run, however, still appeared to be moving up-canyon. Aerial observers did not perceive a directional change in the smoke that indicated a wind change with a southeastern component. The right flank of the fire was still close to the ridge.

Aerial observers give somewhat differing accounts of fire activity on the right flank at the time of the flareup. According to ATGS440, after increased behavior on the upper slope was noted, increased intensity was then seen near the lower right flank at Lumsden Road. The fire near the road appeared to be unconnected from the increased behavior on the upper slope and delayed somewhat behind it (30 seconds as per ATGS). The lower fire appeared to start from below the road then carry slightly above the road. It was this fire activity near the heel that triggered ATGS Ward's command for crewmembers to get into the black (especially since he believed them to be working above the road at the time). ATGS Ward commented that the fire did not appear to spread much above the road. According to the pilot of Airtanker 81 however, fire spread was progressive from the bottom to the top.

The fire run progressed in a narrow band along the right flank of the fire.

From Engineer Craddock's perspective in E4476 approaching South Fork Campground from the west, the fire buildup high on the ridge appeared to occur before the increase near the heel.

From the air, the fire below the road appeared to have moved in a narrow wedge about 15 yards down-canyon. The right flank near the road was aligned more vertically from the pre-flareup condition. Down in the new black, crewmembers estimated that fire had spread about 50 feet south of the handline.

■ Post-flareup above the road as described

As Engines 4490 and 4476 approached the rocky turnaround from the southwest, they could see the chamise burning above them. They had concerns about their engine safety close to the draw. By the time they got to the right flank to assist with the search, the fire behavior immediately above them had died down.

The pilot of AT 81 observed that the entire fire run moving up the right flank took 4 to 5 minutes. The Hollister airtankers made their first drop (using jel) after the flareup and after Copter 404 began making rescue drops during the search for FF Schicke. The jel drops are clearly visible in post-fire photos and mark the fire's edge soon after the flareup.

On the upper slopes after the initial run, the fire began backing down the ridge toward Drew Creek. The right flank above the road backed somewhat south of the below-road segment. Later, Deadwood crews extend a handline up the right flank, which then paralleled Drew Creek.

■ Post-flareup below the road as described

After the captain of E-43 felt that the fire was not likely to take another run, she backed her engine toward the black to assist. E4490 and E4476 also responded.

After the flareup, the fire returned almost immediately to the previous backing behavior.

When responding to the call for bucket drops the copter pilot and captain observed few specific targets for bucket drops. Aerially visibility was described as fairly good but ground observers who were searching for the missing firefighter were hampered by heat and smoke.

Bucket drops began to put water on concentrations of heat. The fire's spread to the west was stopped. Later, crewmembers from E-43 and other firefighters constructed a handline and extended a hose-lay from the road down to the river.

■ Fire Behavior Modeling



Appendix F—Fire Behavior Modeling On the 9/12/04 Tuolumne Fire

Fire behavior modeling is an appropriate part of a turnover investigation. Modeling can help describe and explain the fire behavior observed and demonstrate the extent to which the behavior was predictable. Fire behavior modeling can also identify where site conditions are more hazardous or less hazardous, thus providing guidance in setting safer firefighting tactics.

Even though BEHAVE and other fire modeling programs have documented assumptions and limitations they can be used to demonstrate relative fire behavior between differing small sites.

■ Modeling Assumptions on the Tuolumne Fire

■ Live Woody Moisture

CDF Units and USDA National Forests conduct live fuel moisture monitoring. Usually only chamise (*Adenostoma fasciculatum*) and manzanita (*Arctostaphylos spp.*) are tracked. These plants are suitable because they are common throughout the state and often impact the burning conditions encountered by wildland firefighting agencies. Other shrub species also burn and contribute to fire behavior. Their own live fuel moisture and flammability parallel those of chamise and manzanita, responding to the same soil moisture and weather conditions.

Chamise and manzanita were both present within the Tuolumne Fire. In the immediate area of the accident however, chamise was not present and only a small component of manzanita contributed to the fire behavior. Toyon and live-oak shrubs were the predominate brush species. Nevertheless, chamise and manzanita provide an indicator of flammability for other brush species that were present. The overall live fuel moisture can be inferred. The most recent live fuel moisture readings from the Tuolumne Calaveras Unit were 54% for chamise and 55% for manzanita (8/31/04). These readings are in line with numbers coming from adjacent CDF units and National Forests. They reflect the seasonal low-point and indicate potential critical fire behavior. For modeling purposes, Live Woody Moisture of 50 percent was used.

■ Fuel Models

Fire behavior analysts choose a fuel model that best represents how a fire burns under specified weather conditions. Although fuel models are classified by vegetative characteristics, they are selected for fuel characteristics that best represent their burning behavior. In the area of the accident, fine dead fuels (1-hour) drive the fire's rate of spread. Cured grasses and dry oak leaves provided the fine fuels that contributed most to the fire spread. Fire modeling in this exercise will use FM2, reflecting a grass and leaf surface layer with an overstory of oak and pine. The brush component around the accident site contributed to the flame length and intensity and provided a ladder effect, supplying loft to embers and heat. This brush component is less represented in FM2 and may be better modeled with a different fuel model. Alternative fuel models are explored in the following analysis.

Site Weather Conditions

Accident site weather conditions are based on fire weather analysis prepared by Brenda Graham, USFS Meteorologist:

Temperature: 90 degrees Fahrenheit
 Relative Humidity: 20 percent
 Midflame Wind Speed: 4 mph

Time-lag Dead Fuel Moisture

Calculation of 1-hour fuel moisture: Table A factor + Table C correction

(Rothermel, Fire Behavior Field Reference Guide)

Table A fuel moisture: 3 %

Table C correction (exposed fuel, 1200 hrs, L= +/- 1000 feet, aspect: West, 31+%): 2 %

1-hour Fuel Moisture = 3 + 2 = 5 percent

10-hour Fuel Moisture = 1-hr FM + 1% = 6 percent

100-hour Fuel Moisture = 10-hr FM + 1% = 7 percent

Topography Factors

Aspect at accident site WNW: use 290 degrees (azimuth from north).

Wind direction: Up-canyon originating from SSW; use 200 degrees (from north)

Slope: 90 percent

BEHAVE Modeling Predictions

Inputs

Fuel Model 2

1-hour 5%

10-hour 6%

100-hour 7%

Live fuel moisture 50%

Midflame Wind Speed (MWS) 4 mph

Outputs

Fuel Model 2

Fire Description	ROS (ch/hr)	FL (feet)	Spread Direction degrees	Spread Direction description
Backing Fire, steady wind	3.7	2.3	200	downcanyon-lateral, SSW
Head Fire, steady wind	66.4	8.6	84	upcanyon-upslope, East
Upcanyon spread	8.7	3.4	20	upcanyon-lateral NNE

ROS – predicted rate of fire spread in chains per hour. A chain is 66 feet.

One chain per hour is 1.1 feet per minute.

FL – predicted flame length in feet.

Spread Direction – predicted in degrees from north.

The predicted behavior of a head fire compared to that of a backing fire has nearly 4x the flame length and 20x the rate of spread. Firefighters on the Tuolumne Fire reported that the flame length of the backing fire below Lumsden Road was about 1 foot. There are no ground-based fire behavior observations for head-fire near or the Lumsden Road however. At the time of arrival of line personnel, the head was burning on the ridge in chamise and chaparral, a substantially different fuel type than near the burnover site or fire origin. The FM2 predictions appear reasonable and compare favorably with observed conditions near Lumsden Road during the period before the flareup.

Witnesses described a wind shift at the time of the accident. If a wind shift is modeled from upcanyon to up-slope, the wind source changes from SSW to WNW (200 degrees shifted to 290 degrees). Even without a change in wind speed, (4 mph) the expected increase in fire behavior would be:

ROS (ch/hr)	FL (feet)	Spread Direction (degrees)
87.8	9.8	110 directly up-slope

This is a 24x increase in rate of spread [87.7 ch/hr = 96 feet/minute] and a 4x increase in flame length shifting from backing behavior to head fire behavior for the site where Helitack Crew 404 was building a handline.

In mountainous terrain, temporary shifts in wind direction are often accompanied by gusts. A moderate wind increase (gusts to 7 mph) added to the change in direction provides the following projected fire behavior:

ROS (ch/hr)	FL (feet)	Spread Direction (degrees)
137.0	12.0	110

Fire behavior becomes notably more intense. [137.3 ch/hr = 151 feet/minute]

Under a common shift in wind direction or one that includes a modest gust, predicted fire behavior would be notably more intense than of a backing fire. These predictions compare favorably with the flareup behavior observed by Tuolumne Fire line firefighters.

Alternative fuel models

Fuel Model FM2 may not fully describe the fire behavior because of model limitations and fuel variation at the site. Comparisons with FM6, FM4 and FM9 were explored during behavior modeling.

Fuel Model 6

Description	ROS (ch/hr)	FL (feet)	Spread Direction (degrees)
light brush, 4 mph wind	72.0	8.9	110
light brush, 7 mph wind	101.1	10.4	110

This FM6 predicted behavior for a head fire is not much different than the FM2 above, but has a significantly different fuel description.

Fuel Model 4

Description	ROS (ch/hr)	FL (feet)	Spread Direction (degrees)
heavy brush, 4 mph wind	250.6	36.0	110
heavy brush, 7 mph wind	356.3	42.3	110

This calculation is an extreme jump in predicted behavior for a head fire and does not compare well with observed behavior. The FM4 model is probably too heavy for the incident site, in spite of cut vegetation that may have contributed to the flareup.

Investigating the use of FM9-Hardwood-litter might be appropriate because the accident site's oak leaves and sparse grass are similar to the vegetation description identifying this model. A backing fire (spreading down-canyon toward the WSW) has the following predicted characteristics.

Fuel Model 9

Description	ROS (ch/hr)	FL (feet)	Spread Direction (degrees)
light hardwood, 4 mph (backing)	.8	1.0	200 (down-canyon)
hardwood-litter, 4 mph (head)	18.6	4.3	110 up-slope

This predicted slow backing fire with short flame length is very similar to the observed behavior before and immediately after the flareup. However, for the up-slope wind change using the same FM9, fire behavior is not very significant. This model does not appear to model observed fire behavior except under low-intensity conditions.

■ Analysis Summary

- In August 2004, fuel moisture for live chaparral fuel was at a seasonal low point throughout the Sierra. Fire behavior can be expected to be extreme when live fuel moisture is below the critical level.
- Fire behavior modeling can be useful in demonstrating relative fire intensity for specific small sites. Fuel Model 2 best predicts overall fire behavior at the accident site.
- A change in wind direction from up-canyon to up-slope on extremely steep slopes will cause a large increase in fire behavior.
- Extremely steep ground by itself can lead to intense fire behavior. It also creates hindrances to fire control efforts and should have a multiplier effect on safety considerations.

■ References

- Albini, 1976. *Estimating Wildfire Behavior and Effects*. USDA Forest Service. General Technical Report INT-30.
- Anderson, Hal E. 1982. *Aids to Determining Fuel Models for Estimating Fire Behavior*. USDA Forest Service. General Technical Report INT-122. April 1982.
- Rothermel, Richard C. *How to Predict the Spread and Intensity of Forest and Range Fires*. USDA Forest Service. General Technical Report INT-143
- BEHAVE Fire Behavior Prediction and Fuel Modeling System*. [Developed in Missoula, Montana by the Forest Service Intermountain Research Station. BEHAVE is supported by USDA Forest Service, Washington Office, Fire and Aviation Management.]

■ Fire Behavior Conclusions



■ Appendix G—Fire Behavior Conclusions

The fire behavior and flareup on the Tuolumne fire associated with the entrapment on the afternoon of September 12, 2004, was a direct consequence of the combination of fuel, weather and topographical factors. The alignments of fire environment factors and the resulting fire behavior were normal and predictable.

■ **Current and past fire behavior often does not indicate the potential fire behavior that could occur.**

Maximum possible fire spread and flame lengths are estimated by comparing present fuels, weather, topography and the current fire behavior with predicted or anticipated changes in fuels, weather and topography and past experience of extreme fire behavior on other fires. Previous experience and observations of fast spreading, high intensity fire behavior and training in fire environment assessment are tools that should be used to anticipate potential fire behavior.

The fire behavior exhibited on the Tuolumne fire below the road prior to the flareup consisted of low intensity, lateral flanking fire spread which was moving cross-slope at 1 to 3 feet per minute with flame lengths of one foot or less. Initial attack responders described and the air attack video confirmed, a consistent backing fire on the lower right flank prior to the flareup. During this period, there were no wind shifts or indicators of increased fire behavior where Crew 404 chose to construct fireline. The observed low intensity fire behavior may have given firefighters a false sense of security, even though existing conditions of fuel, weather and topography were critical.

■ **The transition from a slow spreading, low-intensity fire to a fast-moving, high intensity fire often occurs rapidly.**

This seems to surprise firefighters most often in live fuels, possibly because green vegetation is associated with reduced ignition risk. We do not fully understand the exact mechanisms triggering these transitions. However observations of past fire behavior indicate that such transitions often occur when there are changes in wind speed or direction, fire location (top of the slope versus base of the slope), or in the quantity of live and dead components in the vegetation canopy. Live green vegetation can support and even promote high-intensity, fast spreading fire behavior. Assessment of the position of the fire relative to the alignment of wind, slope and live and dead fuels can assist firefighters in recognizing potentially hazardous fire behavior.

■ **Complex interactions between fuels, topography, weather and the fire can dramatically influence the local wind patterns.**

Local airflow and small-scale winds may have been influenced by topography (physical shape of the terrain), variations in aspect and fuels and indrafts into the fire above the road. The complex interaction of these influences most likely caused the change in wind direction witnessed on the fire.

■ **Critical live fuel moisture values contributed significantly to the increased fire spread and intensity associated with the flareup.**

Critically low live fuel moistures contributed to the rapidly spreading high intensity fire behavior observed during the flareup. Live fuel moistures sampled in close proximity to the accident site on September 17, 2004 were at critical levels for both chamise and manzanita. Live fuel moistures for both chamise and manzanita were routinely sampled on the Tuolumne-Calaveras Ranger Unit (approximately 20 miles northwest of the incident) and had been at critical levels since July 28, 2004.

■ **Predicted fire danger indicated critical environmental conditions.**


The forecasted weather for September 12, 2004 could be characterized as fairly normal for a mid-September day. However, the National Fire Danger Rating System (NFDRS) indices tracking seasonal trends indicated extreme fire behavior. Energy Release Component (ERC) was at a record maximum value (86) and 1000-hour fuel moisture was at a record minimum value (7%) for a 33 year period at the nearby Buck Meadows RAWS station.

■ **Escape route travel time is related to topography, route length and potential fire behavior.**

Escape routes should be considered in relation to potential maximum-intensity fire behavior rather than past or present fire behavior. The ideal escape route includes a downhill direction over the shortest possible distance to the safety zone, thereby maximizing firefighter travel rates toward areas with minimum fire spread. Escape routes uphill to the road were sufficient for the low intensity flanking fire behavior observed prior to the flareup but were not adequate for the fire behavior experienced during the flareup.

■ Site Examination



	SUPPLEMENTARY INVESTIGATION REPORT					ORIGINATORS CASE NUMBER		
	STATE OF CALIFORNIA DEPARTMENT OF FORESTRY AND FIRE PROTECTION (LE-71)					Site Examination Report		
CASE TITLE	MONTH	DATE	YEAR	COUNTY	REG	RU	INCIDENT #	
Tuolumne Fire Accident	Sept.	12	2004	TUO.	CSR	STF	CACSR000116	

CDF Helitack Crew 404 Burnover Site Examination

■ Summary

On September 13, 2004 at 10:00 a.m. I reported for assignment to the Tuolumne Fire Serious Accident Investigation in Sonora, California. During the initial meeting of the accident investigation team I was assigned by lead investigator Mike Cole the responsibility of conducting the on-site investigation of the accident scene. On the afternoon of September 13, 2004, I accompanied the investigation team to the accident site and conducted a general overview of the accident site without leaving Lumsden Road, which is located at the top of the general accident site.

During the following week and a half, I conducted almost daily examinations of the accident scene, which included identifying, protecting, documenting and collecting physical evidence. I also conducted an evaluation of burn pattern indicators to determine the spread of the fire through and near the accident site.

During this same period of time, I coordinated the surveying of the general accident area site by licensed contract surveyors. The task of the surveyors was to accurately document the topography of the site and placement of key physical evidence items. CDF Fire Captain Denny O'Neil assisted me in this task. The surveying company also took high-resolution aerial photographs.

Review showed that the original spread of the fire was primarily up-canyon and up-slope to the northeast. Backing and lateral indicators on the right flank of the original fire spread indicate a slow to moderately burning fire that spread cross-slope into an up-canyon wind towards the accident site to the south. Occasional moderate runs and torching are evident where surface fuels and brush were mixed and fire spread into the brush from below. These areas were small in size and mixed among the total burn area.

Below the road, between the right flank of the fire and the accident site, evidence indicates that rock outcrops and dirt chimneys restricted the cross-slope fire spread against the wind and towards the accident site at scattered locations. Burn indicators show that an area of backing fire worked its way across the slope and entered the general accident site near the lower quarter of the slope (between the road and river). Fuel remains and burn indicators in the area just up stream of the accident site are consistent with a low intensity ground fire burning in light grass and leaf litter.

At the same time that the fire was backing across the hill towards the accident site below the road, fire on the uphill side of Lumsden Road further to the north was backing across the slope to the south at a much more rapid pace in more consistent fuels. Just prior to the accident, the fire above the road was about 10-30 feet behind or to the north of the fire below the road with indications that further up the slope it was even further to the south. This fire above the road was burning in heavier fuels and was burning faster across-slope and hotter than below the road as indicated by heavy white ash deposits above the road. Fire just above the road had established itself in a dead snag near the fire's edge and about forty feet up-slope from the road. The snag was burning about forty feet off the ground.

Physical evidence on the ground in the form of cut brush, supports statements by Helitack 404 crewmembers that they were constructing indirect fireline from the road downhill. Saw work had

continued to within thirty feet of the high water level of the river as indicated by the lowest saw cut on the hill. The crew was spread out along the line from the road to this location. Burn indicators near the top of the line show a moderately hot fire burning in the area just inside the line and up to the road with lateral and backing indicators, both into the fire and downhill from that location to about twenty-five feet below the road, consistent with statements of the crew firing-out in this area.

Witness statements indicate that a small spot fire established itself at the base of the cut bank on the inside edge of the road. This spot fire was located across from the top of the line location and burning out operation of Helitack Crew 404. It was also downhill and to the south about thirty feet from the snag, which was on fire above the road. Burn indicators support witness statements that this spot fire spread rapidly across the face of the cut bank to the south for about thirty feet and then turned up-slope.

Burn indicators support statements by HC Winger and other witnesses that almost simultaneous to the spot fire taking off on the cut bank, a fire front came across the slope towards the position of the lower four members of Helitack Crew 404. Burn indicators show that this fire front was burning moderately hot in the surface fuels with some individual torching of brush. There was no indication of fire spreading to the crowns in this area or large-scale fire in the brush.

Witness statements indicate, and burn indicators show, that this cross-slope fire picked up speed and intensity as it turned up-slope near the location of the line construction. Ground fire indicators show the fire burned under the scattered brush until it reached a location below a continuous stand of brush at which time it gained intensity and began to be carried in the brush itself. Burn indicators show this run in the brush to have been rapid and sustained for about forty-five feet up the hill and about thirty feet wide inside the line. As this fire neared the area fired-out by the crew, about twenty-five feet below the road, it subsided on the left shoulder of the run while the right shoulder continued as an advancing fire and crossed over the line and ran up toward a large oak tree just below the road.

Burn indicators show that an additional spread of this fire from below made its way around the end of the cleared handline and burned up-slope in light grass, leaves and cut brush, toward the road. This fire fingered out to the south in a narrow, but short, run. The heat from this additional burning combined with the fire burning across the line in the brush and followed it up-slope to the road where the spot fire had already turned up-slope and burned beyond.

Physical evidence recovered from the scene along with witness statements indicate that the victim and one other firefighter were above and in the area of this fire front at the time it ran across the line and to the road. Witness statements and burn indicators show that the fire hit the road and quickly subsided.

Investigation of the area above the road shows that about fifty feet above the road and to the north of where the spot fire had turned up-slope, an advancing fire front had established itself and was burning extremely hot in grass, leaf litter and brush over an area about one-quarter acre in size. Burn indicators show that this fire was burning with the wind (opposite the direction of burning below the road prior to the fire run) and with the slope in a southeasterly direction. This fire was joined by the spot fire from the cut bank and together they continued a short but hot run over the ridge which separated the west aspect slope of the accident scene and the south aspect slope facing Drew Creek to the southeast. This fire then turned up ridge and up-slope, burning in nearly continuous chamise brush fuel and made a narrow run toward the main fire activity further up this ridge.

During the investigation, consistent up-canyon or down-slope winds were witnessed below the road at the accident site. Up-slope or down-canyon winds were never witnessed on the accident site during the week and a half of daytime on the ground investigations by four investigators. Above the road, wind direction was repeatedly observed to change from up-canyon to down-canyon and from up-slope to down-slope over short periods of time in the afternoon. Gusts of wind were observed flowing down-canyon and wrapping around the ridge line separating the west aspect of the accident site and the south aspect in Drew Creek drainage.

■ Conditions

The accident site is located at the 1450 feet elevation near the bottom of the Tuolumne River canyon. While the Tuolumne River generally runs east to west, at the accident site the river canyon turns and runs nearly north to south. This turn in the river is formed by a ridge, which juts into the river course from the northwest, just downstream and west of the accident site. This ridgeline affects the up-canyon airflow. Granite rock outcrops in many places form the canyon sides just above the river bottom itself. Slopes near the bottom of the canyon at the accident site run from 80 to 120 percent with vertical drops in some locations near the river edge.

Drew Creek is a tributary of the Tuolumne River and flows into main river canyon just south (downstream) of the accident site. Drew Creek flows generally from the east; its south facing slope, on the fire side of the drainage, is covered primarily with chamise brush less than 17 years old.

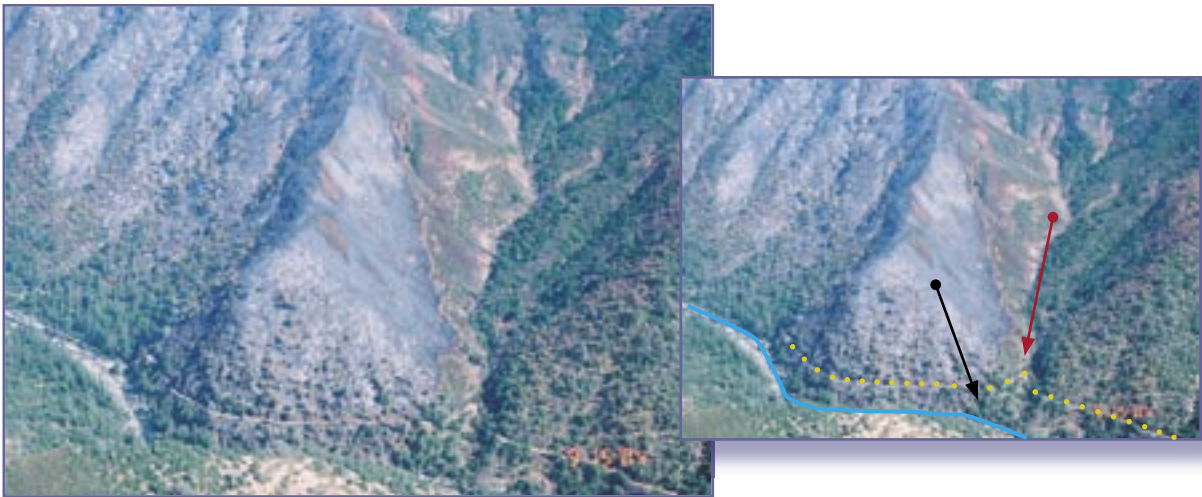


Photo H-1. View of lower fire area and accident scene. Tuolumne River (blue line) runs from lower left side (upstream) to lower right of photo (down stream) with north to the left of the photo and south to the right. Photo taken generally from west to east. Drew Creek (red arrow) is visible to the right of burned area. Lumsden Road (yellow dotted line) runs above the river on the southeast side and is visible near the bottom of photo. Accident site (black arrow) is located on the slope below the road and just above the river, just inside the right flank.

The lower end of the fire and accident site are reached by a dirt forest road named Lumsden Road, which comes from the southwest rim of the canyon about six miles away. As Lumsden Road approaches the accident site it drops to near the bottom of the canyon and passes Lumsden campground, crossing several side drainages, the last one before the fire being Drew Creek. At the accident site, the road is about 260 feet above the river bottom and is a one-lane dirt roadway with steep cuts in the hillside. Lumsden Road continues up-canyon for about another three-quarters of a mile where it crosses Lumsden Bridge.

The general accident site is on a primarily west aspect below Lumsden Road. Multiple shallow chimneys running from above the road to the river bottom bisect the slope near and at the accident site. These shallow chimneys have increased slopes and loose soil with sparse fuels in them. Rock outcrops are scattered across the slope in pockets and along minor ridgelines. A shallow chimney runs from the top to the bottom of the accident site and forms a portion of a debris channel, which collects rolling or sliding debris from the top of the fire line (at the road). Debris is funneled down this channel to a rock outcrop about mid-slope within the accident site. This natural debris channel continues over the rock outcrop and down the slope until it nears rock cliffs near the river. At this point the debris channel turns slightly to the left (looking downhill) and drops to the river rocks below.

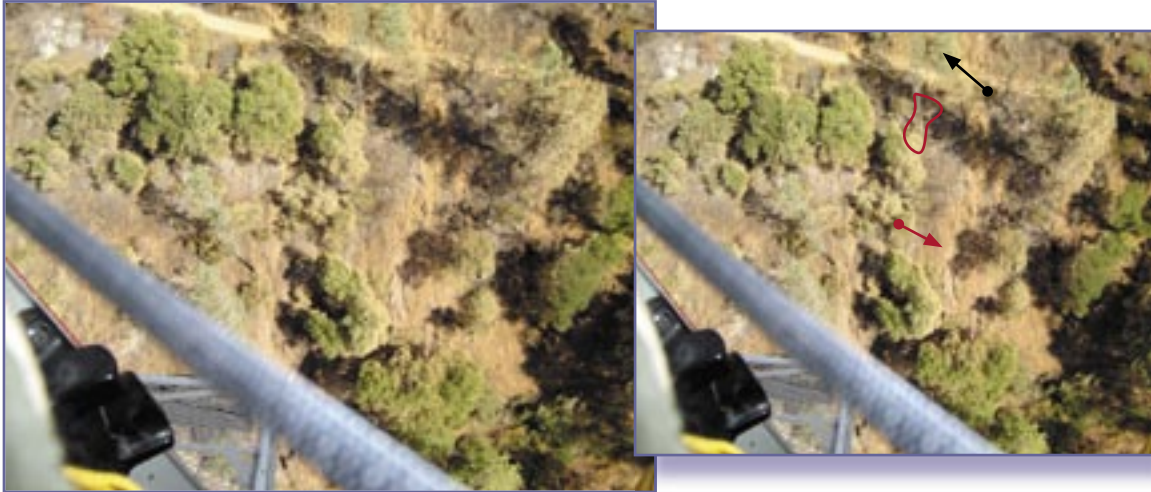


Photo H-2. Photo of accident site with Lumsden Road visible in upper photo. Line construction left the road between gray pine and large oak below the road (black arrow) in upper right corner of photo. Dark ash area (red line) below and to the left of gray pine is remains of brush patch. Line construction came around right edge of this burned area and underneath it prior to turning down-slope again. Victim's body recovered in shadow located to right of center (red arrow), right and above burnt logs on hillside.

The west-aspect slope of the general accident site continues up-slope above the road about 400 feet to a ridge which separates it from the generally south-facing slope on the northeast side of Drew Creek. Slopes above the road moderate to less than 100 percent except where isolated rock outcrops exist. Surface fuels at the general accident site below the road consist of leaf cover and sparse short grass about one foot tall. Scattered brush and brush patches are intermixed with small openings of dry grass and oak trees. Gray pines are scattered sparsely across the slope. The south-facing slope in the Drew Creek drainage is covered almost entirely by continuous chamise brush with light grass underneath. The slope above the road and above the accident site has more consistent ground fuel consisting of leaves and grass along with more dead and down brush and oak fuels as indicated by ash residue.

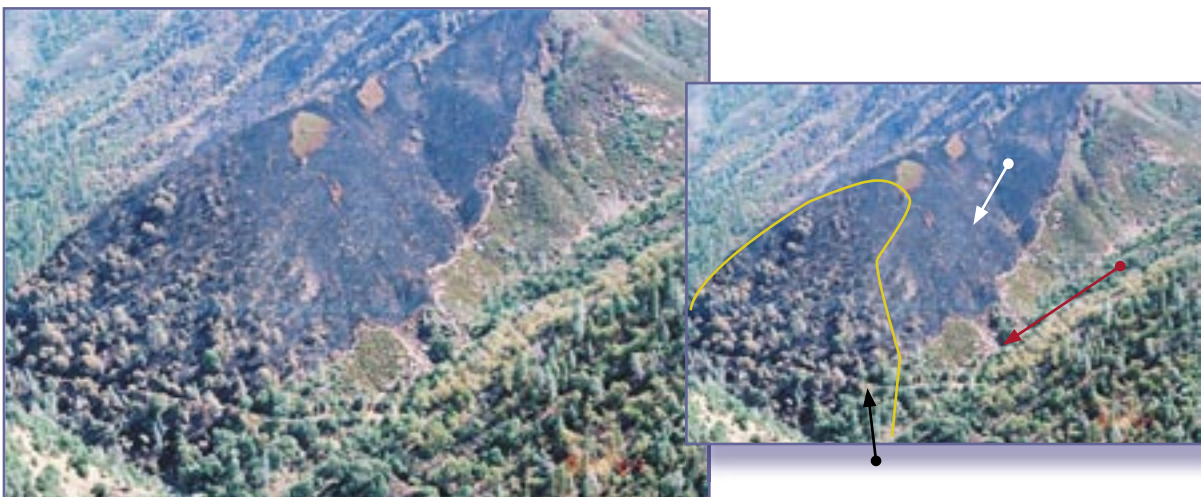


Photo H-3. View of west aspect slope (yellow line) shown in lower left corner. Drew Creek in right of photo (red arrow). South aspect (white arrow) above Drew Creek visible above it. Ridge and fuel transition from west aspect to south aspect visible just left of center. Accident site (black arrow) below road along right flank near bottom of photo.

The original fire spread, below Lumsden Road, included up-canyon advancing fire and a backing fire down-canyon and down-slope into a generally up-canyon light wind. Burn indicators above the road show that the fire here burned hotter and faster than the fire below the road.

Burn indicators support reports by the crew of Copter 404 that at the time of their arrival at the general accident site, the right flank of the fire below the road was backing into an up-canyon wind. The right flank of the fire above the road was about 10 to 30 feet north of (past) the fire's edge below the road. Witnesses indicate that burning conditions included a slow burning backing fire with flame lengths of about one foot. Burn indicators show that short up-slope runs of fire in surface fuels partially torched occasional scattered brush.

While specific wind conditions prior to the fire above the road are unknown, during the course of one and a half weeks of on-site investigation certain wind conditions were noted. Winds below Lumsden Road were noted to begin a general up-canyon flow at about 11:30 a.m., with a steady light to moderate up-canyon flow by 12:00 noon. At the general accident site, down-slope winds were frequently observed mixing with the up-canyon flow. At no time were down-canyon or up-slope winds observed during the hours between 10:00 a.m. and 5:00 p.m. Winds above Lumsden Road and above the general accident site were noted to be variable and included changes from down-slope to up-slope and from up-canyon to down-canyon. Gusts of wind were noted that came down-canyon and wrapped over the ridge dividing the west aspect of the accident site and the south aspect of Drew Creek.

■ Specific Fire Spread

A review of macro and micro burn indicators showed that the spread of the fire was primarily up-canyon and up-slope to the northeast. Backing and lateral burn indicators on the right flank (the flank closest to the general accident site) below the road show a slow, to moderately burning, fire spreading across and up-slope against an up-canyon wind and toward the accident site to the south. Occasional moderate up-slope runs of 10 to 20 feet and individual torching of low brush are evident where surface fuels and brush were mixed, continuous and the fire spread into the brush from below. These areas were small in size and scattered among the total burn area. No evidence of re-burning was observed.

Photo H-4. Area up-canyon of accident site looking north and up-slope showing the terrain and fuels where the fire was burning prior to entering the accident site. Accident site is out of photo to the right about 200 feet. Typical light surface fuels of short grass and leaves on poor soil site with rocks.



Macro burn indicators above the road, including degree of burn indicators, ash deposits and the relatively close alignment of the right flank above and below the road at the time of the accident indicate that the fire above the road moved up-slope and toward the south at a faster pace and burned hotter than below the road. This increased lateral spread indicates that fuel continuity and variations in the winds played a greater role in the spread of the fire above the road on the west aspect. This is consistent with wind conditions noted during the week and a half after the fire (see conditions section), smoke conditions noted during the final frames of the air attack video taken about 15 minutes prior to the accident and comments from the air attack expressing concern about the fire hooking below the retardant line on the right flank. Based on post-incident wind observations, this increased fire spread to the south would be expected to increase higher up on the slope.

Photo H-5. View of west slope showing heavy deposits of white ash above the road consistent with hotter burning and higher fuel loads in this area. Below the road only isolated small patches of white ash are present with the decrease even greater near and at the accident site.



Increased physical barriers such as rock outcrops and chimneys with sparse fuels also restricted fire spreading across the slope below the road. Burn indicators on the right flank below the road are consistent with restricted lateral spread due to topographic and geologic features. Lower on the slope, near the river, burn indicators show that the right flank of the fire was originally backing slowly in sparse grass and leaf surface fuels and into a light wind. As this lateral spread continued across the slope, burning debris rolled down-slope into the chutes formed by the rock formations below. In some cases evidence of large burning logs and limbs was observed to have rolled down-slope to the river area. Most of this rolling debris occurred after the fire front had moved through the area.

Photo H-6. View just up-canyon from accident site. View shows fuels and topography where fire was backing into wind toward accident site at right out of photo.



Burn indicators including cupping on low lying brush, protection indicators on and around rocks, degree of burn and leaf freeze showed that on the lower one quarter of the slope below the road, a slow burning backing fire continued to burn cross-slope towards the accident site. Burned fuels indicated that prior to reaching the general accident site the backing fire moved into a stand of low oak trees and brush with openings covered by more continuous leaf litter and pine needles. This increased continuity in fuels from sparse grass to leaf litter allowed the fire lower on the slope to continue its spread south.

*Photo H-7.
View from
mid-slope, up-
canyon of the
fireline.
This is the
area into
which Helitack
Captain Winger
and Firefighter
Andahl ran
before turning
downhill. Ash
remains show
increased fuel
loading in the
area.*



Reports from the members of Helitack Crew 404 indicate that they chose the line location at the general accident site to take advantage of a break in the brushy fuels. This is consistent with the ash and burned stem remains at the site that indicates a decrease in brushy fuels in this area. During examination of the accident site, several locations were found where the surface fuels had been protected by moving objects. In these locations, the surface fuels consisted of sparse grass and a thin layer of leaf debris.

Near the lower one-quarter of the slope and outside of the proposed line location but within the accident site, the remains of a moderate sized downed oak tree with three trunks was lying up and down the slope. Near the top of the line location on the fire side, the ground appeared to have moderate leaf litter fuels with some dead and down brush and tree branches. About 25 feet below the road and on the fire side of the line was a mature gray pine. Next to this gray pine, toward the fire side and slightly downhill, was a single toyon bush.



Photo H-8. View from road at top of line construction (black arrow) down-slope towards gray pine (red arrow) and toyon bush (yellow arrow) which are located at bottom edge of fired out area and at upper edge of brush patch which sustained fire run.

Below the toyon bush and gray pine and inside the proposed line location was a moderately heavy patch of mixed toyon and live oak brush which covered an area about 45 feet up and down the hill and 28 to 30 feet across the hillside. Below this brush patch the undergrowth turns to scattered live oak brush, toyon and oak trees with leaf litter and some downed limbs. Below this initial transition from the brush patch, the area opens up to patchy brush, oaks and leaf litter.



Photo H-9. View of lower end of brush patch showing beginning of run (red arrow) in brush up-slope. Constructed handline (yellow arrow) located in right lower corner.



Photo H-10. View of brush patch (red line) which burned off just inside line location directing convective heat towards the upper end of the line near the road.

Burn indicators show that the fire spread into this lower area of patchy brush, oak and leaf litter across the slope from the sparse grass and leaf fuels. This fire burned across the lower quarter of the slope and against the wind, starting from the sparse grass to the north and leading into the leaf litter and brush. Indications support the fire crew observations that the fire just below the road was within 10 feet of their proposed line location when they began their firing-out operation. Burn indicators show that in the area below the gray pine and toyon bush, unburned ground and brush fuels existed between the line location and the fire's edge for 30 feet or more prior to the accident.

At the same time the fire was spreading cross-slope below the road, fire had established itself above the road and spread into a standing snag about 80 feet tall. The snag was located about 30 feet to the north of the proposed line location, about 40 feet up-slope of the road. This snag was observed just prior to the accident by a member of Engine 43 to have been burning about 40 feet up.



Photo H-11. View of area above the road and above accident site. Green trees visible to the left edge of photo above road is area of possible helicopter water drops (blue line). In center of photo is area which burned hot (red line) and rapidly (spread direction shown in red arrows) prior to and during accident events. Burning snag (yellow arrow) was located below and to the left of bright green tree above road in lower left corner of photo.

The slope above the road and accident site was more open than below the road. The steep cut bank and initial fuels along the top edge of the cut bank restricted visibility from the road up-slope. Several members of the Helitack crew and crewmembers of Engine 43 confirmed this restricted visibility.



Photo H-12. View from south to north along Lumsden Road, above accident site, showing steepness of cut bank above road and area burned by spot fire (red line) on cut bank.

On the up-slope side of the road and toward the north, a line of low, burned fuels indicates the location of possible helicopter water drops made by Copter 404 (See Photo H-11, page 140). A number of burn patterns are present to indicate that a low-intensity fire burned cross-slope and through this area in several locations. Side-slope and to the south of this area the fire established itself in a pocket of heavy brush and surface fuels. The source of the spread of this fire could not be conclusively determined but strong evidence indicated it to be lateral spread across the slope from the north. A possible spot fire generated by a hot ember dropping from the burning snag nearby cannot be supported due to the distance and noted wind speeds but cannot be ruled out as a result of rotor wash.



Photo H-13. Area above the road in which the fire had established itself prior to accident events. Fire spread indicators show fire coming from right of photo and burning hot in upper right corner of photo before moving up-slope toward where photo is taken (red arrow). Spot fire from cut bank spread up-slope (yellow arrow) and joined this fire from lower left of photo.

Based on witness statements and supported by burn indicators, just seconds before the fire run and/or simultaneous to the fire run but not connected to it, a spot fire was observed at the base of the cut bank almost directly across the road from where the line location went downhill. These witness statements by Engine 43 Captain Tammy Mount and Firefighter Brian Austin indicate that the spot fire spread rapidly across the face of the cut bank and to the south, burning opposite the direction that the wind had been blowing up to this time. Statements by the two and burn indicators show that this spot fire turned up-slope about 30 feet south of its origin. Burn indicators show that this fire then spread in a narrow front, about 20 feet wide, up-slope where it joined the existing fire burning above the road.

Macro and micro burn indicators show that in the area above the road and to the north of where the spot fire had turned up-slope, an advancing fire front had already established itself from the fire that had burned cross-slope. This fire was extremely hot and spread in grass, leaf litter and brush over an area about one-quarter acre in size. Scorch heights on gray pines were observed to be 80 feet and higher along with consistent needle freeze above that level. Brush consumption in this area was more complete than in most other areas on the west aspect. Burn indicators in this area show that this fire was burning with a wind that was opposite the direction that the winds had been burning below the road prior to the fire run and with the slope in a southeasterly direction. The lateral spread of this fire was joined by the spot fire from the cut bank above the location where Captain Mount observed the spot fire to turn uphill. This fire spread from the west aspect above the road up-slope to the southeast towards the lower levels of the south slope in Drew Creek. Burn indicators show that this fire rounded the ridge dividing the west aspect above the accident site and the south aspect in Drew Creek and turned up-slope to the east.



Photo H-14. View from north to south along Lumsden Road above the accident site from next to the top of the line construction and near the reported location where the spot fire was located. Spot fire spread along slope (red arrows) away from camera and then turned up-slope.



Photo H-15. Gray pine located along dividing ridge between Drew Creek south aspect and accident site west aspect slopes. Needle freeze (black arrow) and scorch height on pines indicates severe burning activity and wind directions curling from the west aspect up-slope and east, turning up-slope and to the north on the south aspect. Photo taken looking generally west to east.



Photo H-16. Photo is taken near ridge separating west slope and north slope above the road and accident site. Photo shows route that fire traveled (red arrow) and the degree of burn.



Photo H-17. Photo taken from ridge above road and accident site, which separates the west slope and the south slope. View is up-slope with west slope to left and south slope to right. Photo shows path where fire turned up-slope/ridge (red arrows) and degree of burn. Pine tree in upper left corner shows needle freeze indicators of fire coming up-slope from this location towards it. Fuels changed in this location from leaf and needle litter with patches of brush to consistent chamise brush field to right of photo.

At the same time as the fire activity on the cut bank above the road, the fire below the road, which had been backing cross-slope and into the wind on the lower quarter of the slope, made a rapid run cross-slope to the south and up-slope. This fire spread directly toward the lower four members of the Helitack 404 crew. Burn indicators show that this fire spread remained initially in the surface fuels and moved rapidly under the brush present in scattered locations in this area.



Photo H-18. View from lower third of slope below the road at accident site looking from south to north cross-slope towards the direction where Helitack Captain Winger indicated the fire run had come from (red arrows). Chain saw work visible on right edge of photo and near center of photo (blue arrow).

The timing of the spot fire spread and fire spread below the road are simultaneous, or nearly so, as supported by witness statements of Captain Mount. Captain Mount stated that she saw an approximately one-foot diameter spot fire spread to the south, run along the side of the cut bank and spread for about 30 feet. Captain Mount stated that she jogged alongside this spreading fire for about 30 feet and then felt the wind to her back for the first time. She said that she turned and looked below the road and observed fire spreading up from the lower levels of the slope below the road while the spot fire above the road turned up-slope.

As the fire on the lower one-quarter of the slope below the road reached the bottom of the mixed brush patch of toyon and live oak approximately 28 feet inside the line location, burn indicators show that intensity, slope and fuel continuity (both surface and brush) provided enough heat to lift the fire into the brush itself. The consistent up-slope, and slightly to the south (right), burn pattern shows a rapid and hot torching run of this brush patch (45 feet up-slope) with most of the heat vectoring up-slope to the right and across the upper portions of the line construction where two members of the Helitack 404 crew were attempting to escape up-slope to the road.



Photo H-19. View from line location down-slope with brush patch visible to center and right of photo. Fire spread up-slope (red arrow) toward the location from which the photograph was taken and from the downhill right center of photo.

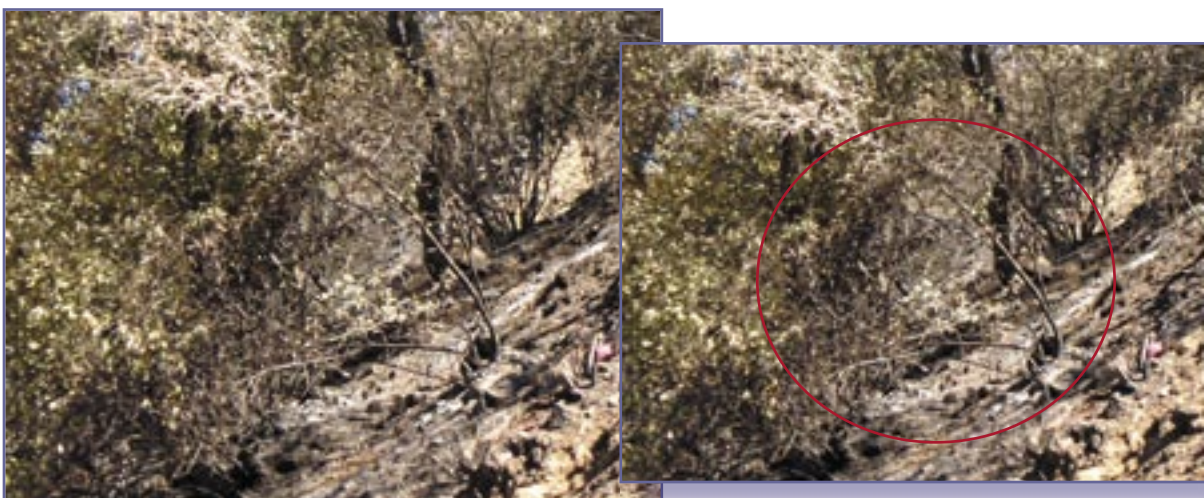


Photo H-20. View from mid-slope below road in accident scene looking from south to north cross-slope towards bottom of brush patch showing transition area (red circle) from surface fire to brush fuel fire.

As the left shoulder of this torching brush run reached the gray pine and single toyon bush up-slope of the brush patch and interfaced with the area fired-out and without surface fuels, the degree of burn indicators show the fire reduced in intensity leaving leaves unconsumed on the lower edge of the toyon bush. The right shoulder of the fire continued to the right of the gray pine, across the line and to the road above. Degree of burn indicators on the lower right heel of this run, near the lower line location, shows lateral spread of the fire consistent with beginnings of the run in the brush.

While the advancing fire moved through the brush patch just inside the line, burn indicators show that the lower flank continued to move cross-slope to the south and reached the leaf litter and cut brush from the line construction in that area. This fire then turned up-slope and, influenced by the primary run in the brush patch, continued up-slope on the other side of the line location. Burn indicators show that this narrow run on the other side of the line split about one-third of the way below the road with a narrow, advancing front turning to the south and an up-slope front joining the fire from the brush patch.

A large oak tree just below the road and about 30 feet across the slope from the line location (south) shows leaf freeze indicating substantial convective heat directly in this area where the two fire fronts have joined and reach the road. This location is also directly aligned with the location across the road on the cut bank where the spot fire had turned and rapidly spread up-slope. The fire front below the road subsided when it reached the road barrier and the already burned area across the road.



Photo H-21. View of oak tree with leaf freeze indicators (red arrow) showing fire spreading up-slope to road in accident site. Oak is located about 30 feet south of where line left road. Gray pine (yellow arrow) about 25 feet below top of constructed fire line is seen behind the oak tree.

Protection indicators located during the site examination indicate that the area where the victim's body was found, side-slope to the south of the lower line location and below the major rock outcrop, burned after the arrival of the body at that location. Burn indicators show a lateral fire of low to moderate intensity crossed this lower slope some time shortly after the advancing fire turned up-slope. The burning of the heavy downed oak tree in this area added to the intensity and long duration of heat in this area once it began to burn.

Photo H-22. Photo of fire shelter recovered about 14 feet up-slope from body recovery site. Unburned vegetation attached to and protected by underside of shelter indicates that this area had not burned at the time the shelter reached this location.



Photo H-23. Photo of unburned vegetation located under loose rock about 2.5 feet up-slope from body recovery site, indicating that this area was not burned at time rock slid to this location.



Burn indicators, including degree of burn, cupping and protection indicators, show that about 40 feet across the slope to the south from the line location the fire transitioned into a backing fire again with low rate of spread and intensity. The fire was contained later at that location.

■ On-Site Interviews

During the final days of on-site investigations, two members of Helitack Crew 404 were taken to the accident site and interviewed. During that interview, I took part and spoke with both Helitack Captain Jonah Winger and Firefighter Jeff Boatman.

Captain Winger and I also climbed down to the top of the major rock outcrop where the line location had gone through it. Captain Winger told me he had gone to this location when he scouted the proposed line route. Captain Winger pointed out to me the location down-slope and to the right where he said the flaming front came from. This area was consistent with the burn indicators I had already found and consistent with fire spread into the bottom of the brush patch just inside the line near where we were standing.

Captain Winger described for me the fire behavior he saw when the fire spread across and up-slope towards him and his crew. He stated that the fire “crowned” below him while it spread in his direction. I observed and commented to Captain Winger that there were no burn indicators that suggested or supported a “crown” fire in that location. Captain Winger agreed. I then asked him if what he termed a “crown” fire could have been the torching of cut brush from the line construction and he stated that it could have been.

Captain Winger told me that when he saw the fire below him he shouted the alarm and then ran into the flaming front in an attempt to reach the interior of the burn where it was cooler. He stated that after running about 20 feet into the burn through burning brush, he was still getting burned and he turned down-slope in an effort to reach the river below. When I asked Captain Winger how he had run through 20 feet of fire with the brush burning, which I found inconsistent with the reported damage to his Nomex, he told me that there was only scattered brush burning where he had run.

Captain Winger told me that at some time during his escape through the flames, he crossed paths with Firefighter Agustin who was headed down-slope. He also told me that immediately after he shouted the alarm, he saw the two-person saw team escape down-slope and to the left (south).

I asked Captain Winger if he knew that Firefighter Schicke wore a knee brace. He told me that about one month prior, he had noticed her doing her physical fitness with a knee brace on. Captain Winger stated that he asked Firefighter Schicke if her knee was bothering her and she answered “yes.” Captain Winger stated that he had also heard about Firefighter Schicke going to a medical examination some time in the past, which he thought was associated with her knee. Captain Winger did not know if she had a brace on the day of the accident.

I spoke with Firefighter Boatman who told me that he had originally scouted the road to the north when the crew first arrived because he was familiar with the area. He said that when he returned, he went down the line with Firefighters Schicke and Neveau. He told me that he had given instructions for the crew below the rock outcrop to cut back to the north, towards the fire, so that rocks loosened by the other crew members would not roll down on them. He said that at one point instructions were passed to get a back pump and he went back up the slope to get one.

Firefighter Boatman stated that the burning-out operation was going well, with low-intensity fire burning back towards the fire’s edge about 10 feet away. He said at one point he noticed the flames “waver” and turn back towards the line. Firefighter Boatman said that immediately after that the fire activity below took off. Firefighter Boatman stated that he looked down the hill and saw the fire coming up from below. He said that he shouted, “get out of there” to the crewmembers below the road. He said that he could see Firefighters Schicke and Neveau.

Firefighter Boatman said that he retreated to the south along the road to near the bend in the road. He said that he turned back and saw Firefighter Neveau on the road just above the line location and that the worst of the fire coming up the hill was also in that same area. Firefighter Boatman made no mention of the spot fire on the cut bank.

The next day an on-site interview was conducted with the supervisor of Engine 43, Captain Mount. Captain Mount told us that when she got the instructions to go down into the canyon she was concerned and that she asked the IC if he was sure he wanted her engine to go down into the canyon. She proceeded with her engine down into the canyon and met with the IC near the Lumsden campground. She said her engine continued towards the fire where she had a conversation with the IC. She had her engine stop short of the right flank where the road crossed Drew Creek.

Captain Mount stated that she walked along the road with Firefighter Austin towards the right flank in an effort to determine if it was safe to proceed with her engine and to make a face-to-face contact with the captain of the helitack crew. Captain Mount said that when she rounded the corner and could see the right flank, she saw one firefighter on the road that she later identified as Firefighter Boatman. She stated that they walked up to Firefighter Boatman and as they began a conversation, she noticed a spot fire about one foot in diameter at the base of the cut bank across from the line location.

Captain Mount said that the spot fire spread too rapidly for them to do anything about it. She stated that as she began to “trot” to the south along the road, she was just keeping up with the side slope spread on the cut bank. She stated that after about 30 feet the spot fire turned and ran up-slope. Captain Mount said that it was then that she first felt the wind change at her back as she ran away. Captain Mount told us that it was about then that she looked over the downhill side of the road and saw fire spreading up from below.

Captain Mount stated that she yelled at her firefighter to follow her and that after some hesitation he did so. She said that the two of them then took Firefighter Boatman to the engine. Captain Mount said that when she returned, she ordered her engine to turn around to prepare to leave the area if need be.

On Tuesday, September 21, 2004 I met with Firefighter Austin near the fire site. He told me that on the day of the accident he had walked from the engine to the right flank with Captain Mount. He said that when they approached they saw one firefighter on the road that he determined to be Firefighter Boatman.

Firefighter Austin volunteered that when he approached he did not see any fusee, smell a fusee, or see any slag. He explained that he thought the spot on the cut bank was from the burning taking place just below the road and next to the line. He stated that he did not see an ember land there but did observe smoke drifting across the road from that location.

Firefighter Austin said that prior to the spot fire taking off, he noticed a burning snag above the road and just inside the right flank of the fire. He showed me the stump of the tree that had been cut down since. Firefighter Austin estimated that the snag had been burning about 40 feet up.

■ Physical Evidence

On September 16, 2004 I began the identification, documentation and collection of physical evidence on the accident site. I was assisted by retired CDF Investigator Chuck Lawshe. During the collection of the items I took photographs of the items as they lay on the ground, and in some cases during the collection process, to document the damage to each.

During the collection of the physical evidence, several observations were made. Most of the debris believed to be associated with Firefighter Eva Schicke was located along a debris channel formed by the natural slope of the hill towards a shallow chimney running up and down the accident site. This debris channel began at the top of the line location and followed it down to the mid-slope rock outcrop. At this location, the line turned to the right and the debris channel veered to the left, over a drop-off formed by the rock outcrop and down-slope near the final right flank.

Debris collected on the hillside consisted of burnt Nomex cloth remains, melted plastic, fire shelter remains, web gear remains and aluminum food packets as well as unidentified manmade objects. The items found highest on the slope, believed to be associated with Firefighter Schicke, were on the line construction about 23 feet from the road. These items were a burnt segment of cloth and melted plastic around a 12" long oak limb, which was lying on the ground. These items were near the top of the debris channel.



Photo H-24. Burned debris associated with Firefighter Schicke highest on slope located in lower left corner of photo (blue arrow). Road (red arrow) shown 23 feet above at end of dirt slope.

Additional associated aluminum fragments and remains thought to be those of food packets were located along the line below 23 feet from the road but above the rock outcrop in and along the edges of the debris channel. At the point where the line cut to the right and the debris channel continued down-slope and to the left, at the top of the rock outcrop, plastic remains were found on the right side of the line in a cluster of cut brush stobs. This melted plastic appeared to be the remains of a standard issue wildland firefighter one-quart canteen. This debris was located to the north side of the debris channel.

Up-slope about 8 feet from the plastic and to the north of the line about 6 feet was located the remains of what could be a chinstrap and assembly for a hard hat. This was the item located furthest inside the fire line and out of the debris channel.

At the base of the rock outcrop along the debris channel I located the remains of a forest fire shelter. This item was partially buried by dirt debris, which had slid down-slope in the debris channel. During recovery of this item it was noted that the ground under and protected by the fire shelter had unburned and partially burned leaf litter. Additional unburned leaf litter was located attached to the underside of the shelter itself. In addition to the aluminum shelter, a fire shelter case snap and cloth remnants were located. These remains were located about 14 feet up-slope of the final body recovery site. (See Photo H-22, page 147.)

At about the same level on the slope, across the slope to the south about 12 feet was located a small particle of melted metal that could not be identified. This was the item found furthest to the south outside the debris channel.

At the body recovery site I collected numerous particles of burned Nomex cloth, web gear utility clips, aluminum fragments, boot eyelets and hooks. Under one of the larger burned Nomex fragments I observed partially burned leaf and grass, debris that had been protected by the Nomex. About 2 feet above the body recovery site I observed burn indicators on and around a loose rock and an embedded rock above it which indicated that the body had lodged at that location and burned for some time prior to sliding to the recovery location. Once the loose rock was turned over and removed it was observed that the ground below it was covered with unburned leaf and grass debris along with partially burned vegetative debris around the edge of the rock



Photo H-25. Body recovery site (pink flags) below rock outcrop and side slope from heavy fuels.



Photo H-26. Body recovery site (pink flags) from line location at rock outcrop looking down and side slope. Fire shelter recovered near center left edge of photo.



Photo H-27. View up-slope and from line location showing rock outcrop, located above body recovery site that line passed over.

Along the road itself we recovered five back pumps with various degrees of burning and five “Rhyno” tools. One of these tools was modified with a “Combie” tool head on it. This tool was the only tool with evidence of high heat damage to the handle. This tool is believed to have belonged to Firefighter Schicke. One other tool handle had several burn spots on it.

■ Conclusions

Physical burn indicators support the spread of a backing fire towards the accident site from the up-canyon direction. Evidence of sparse grassy fuels near the lower slope along with a gentle up-canyon wind restricted the lateral and backing spread of the fire initially towards the site.

Fire above the road to the north of the accident site burned in more consistent fuels and under shifting wind directions, allowing it to progress to the south at a faster pace than below the road. This is supported by post-accident wind observations above and below the road as stated in this report and by the greater degree of burn indicators above the road than below it. It is also supported by the witness statements, which put the two fire segments of the right flank nearly even at the road at the time of the accident.

Burn indicators, as discussed in this report, support the fact that the fire above the road established itself above the accident site independently of the fire below the road and independently of the spot fire on the cut bank. Degree of burn indicators, needle freeze and ash residue show that this fire above the road and accident site burned hotter in a concentrated area than seen anywhere else near the accident site. This burn activity spread quickly to the southeast and onto the chamise covered south-facing slope of Drew Creek where it turned up-slope again and made a significant run to the upper ridgeline.

Segments of the last moments of the air attack video, statements from the at scene air tanker pilot and physical burn indicators on the ground above the road, show that wind direction above the road was shifting and being drawn to the northeast prior to the accident.

Post-accident wind observations do not identify any wind pattern below the road which would duplicate the wind reversal as experienced at the time of the accident. The burn events above the road, including the intensity, fuel changes and wind shifts noted during post-accident observations support a finding that the wind and fire below the road at the accident site was directly influenced for a short period of time by the intense fire run which occurred above the road. The physical evidence supports a drawing of the fire below the road and the spot fire on the cut bank, indeed the entire lower right flank towards and into the fire making a substantial run above the road.

Physical evidence supports the fact that at the time of the accident, as much as 30 feet of unburned fuel existed between the line location where Firefighter Schicke stood and the fire's edge. This is supported by the fact that the fire climbed into the toyon brush next to the line at that location but could not sustain its run in the brush when it reached the area already burned out by the firing operation, as witnessed by the leaves remaining on the brush at that location. Lateral burn indicators may sustain an even wider distance in that area.

This is further supported by statements made by Captain Winger who stated that he turned and ran into the oncoming fire for about 20 feet before he realized it was too hot and he turned downhill. Under the pre-accident descriptions of fire behavior given by Captain Winger and other members of the crew, one-foot flame lengths backing into the wind, residual flame fronts should have been narrow and short lived. His description of at least 20 feet of depth of hot and intense burning fire indicates a recent spread of fire over that entire distance plus any distance he ran prior to entering the flaming front.

Physical burn indicators on the ground show that the fire that spread into the bottom of the brush patch came from this fire front Captain Winger described and first transitioned from the ground to the brush fuels 28 feet from the nearest line construction evidence.

Physical evidence associated to Firefighter Schicke support the fact that she progressed during the fire run to at least within 23 feet of the road and probably further. No evidence was located which would not support the claim by a fellow firefighter that she was last seen within 5 feet of the road. Physical evidence associated with Firefighter Schicke recovered along the debris chute indicates that above 23 feet from the road, her equipment was degrading to the point that segments of her Nomex uniform were coming off. This indicates that Firefighter Schicke was exposed to the fire front which burned through the brush patch, down-slope from this location and just within the line. Burn indicators show that additional heat sources contacted the body from the cut brush outside the line and surface fuels that were burning.

Evidence of unburned vegetation under the fire shelter, a rock which slid down the debris chute and under the body of Firefighter Schicke support the fact that at the time her body reached the recovery site, that location had not yet fully burned. This would indicate that her body reached that location within a short period.

While the position of her body on its back with legs bent may suggest to some that she was still alive at the recovery site, this is not supported by the fact that the area was not burned, the fact that she was within the debris chute (indicating a slide of the body from higher up) and finally the presence of body remains higher on the slope above the final recovery area prove that she was dead prior to arriving at the final body recovery site.

COPIES TO					INVESTIGATION STATUS		
RU	REG	HQ	DA	AG	OTHER	CLOSED	CONTINUING OTHER
PRINTED NAME OR REPORTING OFFICER				SIGNATURE OF REPORTING OFFICER		OFFICER'S TITLE	DATE OF REPORT
Alan W. Carlson Badge 1632						Investigator	1-12-05

Downhill Line Construction Review



Appendix I—Downhill and Indirect Line Construction

CDF Firefighting Guidelines 7070.2

(October 2002)

Downhill/indirect line construction in steep terrain and fast burning fuels shall be done with extreme caution. Direct attack methods shall be used whenever possible.

Direct attack was possible but indirect attack was selected because the Helitack Captain considered it more expedient.

The following guidelines shall be followed before firefighting commences:

- The decision to fight fire downhill is made by a competent firefighter after thorough scouting.
Helitack Captain and Firefighters had received training in downhill line construction. Thorough scouting was not completed –walked upper part of line to be constructed only, visually observed the lower portion.
- Downhill line construction shall not be attempted when fire is present directly below the proposed starting point.
When downhill line construction began fire was below the road but not directly below crew.
- The fire-line shall not lie in or adjacent to a chimney or chute that could burn out while members are in the vicinity.
No chutes or chimneys present but slope was very steep.
- Communication is established between the members working downhill and members working uphill from below. When neither group can adequately observe the fire, communications will be established between the members and supervising overhead. At this time a lookout with communications will be posted where the fire's behavior can be seen.
Not applicable.
- Members will be able to rapidly reach a zone of safety from any point along the line if the fire unexpectedly crosses below them.
Steep slopes, loose soil and brush/young oaks were primary contributors to unsuccessful escape. Very steep. Uphill route was fireline with loose soil and poor footing. Two downhill routes were used – (1) very steep to almost vertical near river (2) steep dirt chute.
- A downhill line shall be securely anchored at the top. Avoid under-slung line.
Line was anchored at road on right flank above the heel of the fire at the only place they could anchor for downhill line construction. The anchor point was less than optimal.
The scraped portion of the line that had been completed down from the road was not under-slung.
- Full compliance with "The Standard Fire Orders" is assured.
See discussion under "Ten Standard Fire Orders"

If possible line firing should be done as the line progresses, beginning from the anchor point at the top.

Crew was in the process of line firing when flareup occurred.

Reference: Section 7013.1.1

7070-5

Downhill Line Construction Checklist USFS Fireline Handbook (NFES 0065)

Downhill fireline construction is hazardous in steep terrain, fast burning fuels, or rapidly changing weather. Downhill fireline construction should not be attempted unless there is no tactical alternative.

The tactical alternatives were to go direct with water support from copter or engine hose-lay or to withdraw from this assignment at this location.

When building downhill fireline, the following is required:

- Crews, supervisor(s) and fireline overhead will discuss assignments prior to committing crew(s).
The IC and Helitack Captain discussed the assignment to anchor the right flank. (What was said and what was heard may have been different; there was no follow up with each other on action initiated.)
- Responsible overhead individual will stay with job until completed (TFLD or ICT4 qualified or higher).
The Incident Commander was qualified ICT3 but not present during the downhill line construction and may not have been aware that it was occurring. Captain Winger was Type 1 Fire Crew Captain qualified.
- Decision will be made after proposed fireline has been scouted by supervisor(s) of involved crew(s).
Helitack Captain and Firefighters had received training in downhill line construction. Thorough scouting was not completed –Helitack Captain walked upper part of line only, visually observed the lower section.
- LCES will be coordinated for all personnel involved.
Crews Supervisor(s) is in direct contact with lookout that can see the fire.
Everyone on the helitack crew could see the entire section of the fire they were working on and considered themselves to always be each others lookout. (A dedicated lookout was not posted prior to initiation of line construction.)
Communications is established between all crews.
Not applicable
- Rapid access to safety zone(s) in case fire crosses below crew(s)
Steep slopes, loose soil and brush/young oaks were primary contributors to unsuccessful escape. Very steep, uphill route was fireline with loose soil and poor footing. Two downhill routes were used – (1) very steep to almost vertical near river (2) steep dirt chute.
- Direct attack will be used whenever possible; the fireline should be completed between anchor points before being fired out.
Direct attack was possible but indirect attack was selected because the Helitack Captain considered it more expedient and wanted to keep the crew out of the smoke and heat. Crew was in the process of line firing when flareup occurred.
- Fireline will not lie in or adjacent to a chute or chimney.
No chutes or chimneys were present but slope was very steep.
- Starting point will be anchored for crew(s) building fireline down from top.
Line was anchored at road on right flank above the heel of the fire at the only place they could anchor for downhill line construction. The anchor point was less than optimal.
- Bottom of the fire will be monitored; if the potential exists for the fire to spread, action will be taken to secure the fire edge.
The bottom of the fire was observable by the crew and not being monitored by anyone else except periodically by air attack. The potential for the fire to spread existed but no action was taken to secure fire edge.

10 Standard Firefighting Orders



■ Standard Firefighting Orders ■

Standard	In Compliance	Non-compliance	Not Applicable	Notes	Causative	Contributory	Non-Contributory	Unrelated safety issue
FIRE BEHAVIOR								
1. Keep informed on fire weather conditions and forecasts	H404			General weather yes.	✓			
	IC				✓			
	AA440						✓	
	E43						✓	
2. Know what your fire is doing at all times.	H404			Visual observation in work area. In contact with AA440.			✓	
	IC			Moving to better vantage point			✓	
	AA440						✓	
	E43						✓	
3. Base all actions on current and expected fire behavior.	H404					✓		
	IC			Most knowledge/ history of fires in canyon		✓		
	AA440			9 years experience at Columbia				
	E43			Cautious about fire in bottom of canyon because of limited turn-arounds, long route out.			✓	

Standard	Compliance In	Non-compliance	Not Applicable	Notes	Causative	Contributory	Non-Contributory	Unrelated safety issue
FIRELINE SAFETY								
4. Identify escape routes and safety zones, and make them known.	H404			Up line to road, down to river, the black. (escape route to road was compromised by flare-up; escape route of Andahl & Winger was through fire to river)	✓			
			IC				✓	
			E43				✓	
			AA440				✓	
5. Post a lookout when there is possible danger.	H404			Everyone considered themselves to be lookouts, and Winger gave instructions to Boatman to get backpack pump at road, hold the line, & watch the crew. (Lookout not Boatman's primary duty. Lookout not posted prior to initiation of line construction.)			✓	
	IC			Relies on AA440			✓	
			AA440				✓	
			E43	Not engaged			✓	
6. Be alert. Keep calm. Think clearly. Act decisively.	H404						✓	
	IC						✓	
	AA440						✓	
	E43						✓	

Standard	In Compliance	Non-compliance	Not Applicable	Notes	Causative	Contributory	Non-Contributory	Unrelated safety issue
ORGANIZATIONAL CONTROL								
7. Maintain prompt communication with your forces, your supervisor, and adjoining forces.	H404			During line construction communicated with crew but did not communicate with supervisor that line construction was downhill or indirect. Not aware of adjoining forces. There was a face-to-face briefing with IC (Div. 4) prior to engagement. No attempts or failures of communication capability noted.		✓		
	IC			There was a face-to-face briefing with Captain Winger and E43 prior to engagement. No additional communication to Captain. Constant communication with AA440.		✓		
	AA440			In frequent communication with IC, operational aircraft, & E42.			✓	
	E43			Had face-to-face with IC prior to engagement; chose to make face-to-face communication with helicopter crew rather than radio. Did not contact adjoining force and advise of presence.		✓		
	Dispatch			(It is not clear that all resources responding were aware of other resources responding. Check-ins with dispatch not verifiable with information				✓

Standard	Compliance In	Non-compliance	Not Applicable	Notes	Causative	Contributory	Non-Contributory	Unrelated safety issue
8. Give clear instructions and insure they are understood.	H404			Crew understood instructions from Captain regarding line construction objectives. (Boatman not clear on lookout portion of his assignment.)		✓		
	IC			IC believes his direction to H404 was to size-up & safely anchor/take action (Winger believed assignment was to anchor from road to river.) IC directed E43 to support helitack crew & scout heel		✓		
	E43			Direction to "Support HC Crew" was not clear.		✓		
			AA440	Anchoring instructions to copter 404 on initial water drops was not clear.		✓		
9. Maintain control of your forces at all times.	H404							
	IC			(Did not identify self as IC to helitack crew. Did no follow-up communication with HC regarding progress, situation, etc.)		✓		
	AA440						✓	
	E43						✓	
IF YOU CONSIDER 1-9, then								
10. Fight fire aggressively, having provided for safety first.	H404			(All Standards were not considered adequately)		✓		
	IC					✓		
	AA440					✓		
	E43					✓		

18 Situations that Shout “Watch Out”



Appendix K—18 Situations that Shout “Watch Out”

Situation	Notes	Causative	Contributory	Non-Contributory	Unrelated Safety Issue
1. Fire not scouted & sized up.	IC sized up fire & Captain scouted line.		✓		
2. In country not seen in daylight.	Not applicable			✓	
3. Safety zones & escape routes not identified.	Inadequate safety zones & escape routes identified.		✓		
4. Unfamiliar with weather & local factors influencing fire behavior.	Helitack crew not familiar with local weather factors in the canyon.		✓		
5. Uninformed on strategy, tactics, & hazards.	Unclear statements on strategy, tactics, and priorities.		✓		
6. Instructions & assignments not clear.	Instructions between IC and helitack captain not jointly understood.		✓		
7. No communications link with crew.	Not applicable.			✓	
8. Constructing fireline without a safe anchor point.	Line was anchored at road on right flank above the heel of the fire at the only place they could anchor for downhill line construction. The anchor point was marginal/less than optimal.			✓	
9. Building fireline downhill with fire below you.	When downhill line construction began fire was below the road but not directly below crew.		✓		
10. Attempting a frontal assault on the fire.	Not applicable.			✓	
11. Unburned fuel between you and the fire.	Indirect line construction was selected tactic. Physical evidence indicates the width of unburned fuel was 7 to 30 feet. Oak and brush presented additional hazards (flare-up of aerial fuels in brush/oak).	✓			

Situation	Notes	Causative	Contributory	Non-Contributory	Unrelated Safety Issue
12. Cannot see the main fire, not in contact with anyone who can.	Not applicable.			✓	
13. On a hillside where rolling material can ignite fuel below you.	Steep slopes, rolling debris potential (rolling rocks observed).			✓	
14. Weather is getting hotter and drier.	Not present.			✓	
15. Wind increases and/or changes directions.	No significant change in direction or speed of wind observed in 45 minutes before flare-up event. Sudden, unanticipated shift in wind direction caused flare up.	✓			
16. Getting frequent spot fires across the line.	Frequent spotting at head; spot on left flank; none on right flank until flare up event.			✓	
17. Terrain & fuels make escape to safety zones slow & difficult.	Steep slopes, loose soil, and brush/young oaks were primary contributors to unsuccessful escape.	✓			
18. Taking a nap near the fireline.	Not present.			✓	

LCES Review



■ LCES Checklist Summary ■

Item	Compliance In	Non-compliance	Not Applicable	Notes	Causative	Contributory	Non-Contributory	Unrelated safety issue
LOOKOUTS								
Competent & trusted individual(s)?	H404			Boatman qualified; not clear he knew he was assigned. No lookout formally designated.				✓
Watch/ weather kit/IAP?			H404				✓	
Good vantage and safe location?	H404						✓	
Knowledge of escape and safety locations?	H404			Lack of clarity on lower escape route.		✓		
Knowledge of crew(s) location or division?			IC	Did not know when crew was below road.		✓		
Fire fighter has both authority and responsibility to warn others?			ATGS	Thought Helitack crew was above road.		✓		
	H404						✓	
COMMUNICATIONS								
Radio and Frequencies?	IC & ATGS			IC & AA440 communicated on ground tactical 168.200. VHF was used from air-to-air. (potential traffic clutter)				✓
Map & communication plan?			H404				✓	
Sound alarm early, not late?	H404						✓	
Must be able to tell other firefighters of an impending problem.	H404						✓	

Item	In Compliance	Non-compliance	Not Applicable	Notes	Causative	Contributory	Non-Contributory	Unrelated safety issue
ESCAPE ROUTES								
Scouted?		H404		Captain walked upper escape route to road; visually assessed lower escape route (may not have been able to see last drop-off to river.) Did not walk lower escape route; did not reassess escape routes.		✓		
Walkable?		H404		Very steep. Uphill route was fireline with loose soil & poor footing. Two downhill routes were used – (1) very steep to almost vertical near river (2) steep dirt chute.	✓			
Close enough? Anticipated ROS		H404		A rate of spread faster than escape time was not anticipated.	✓			
Timed?		H404		Based on interviews there is no indication of discussion regarding timing of escape routes	✓			
Marked?			H404				✓	
Away from fire head?			H404				✓	
SAFETY ZONES (no shelters needed)								
Clean burn / Natural/ Man-made / Vehicles.	H404			Road was adequate safety zone once continued into the clean black. River bottom was an adequate natural safety zone.				✓
Scouted?	H404			Captain scouted safety zone – road [SEE CDF 7070.1.3D for definition]; visually assessed lower safety zone but not on site.				✓
Large enough? Consider number of people, fuels, flame length.	H404			Upper safety zone was large enough. Lower safety zone was large enough.			✓	
Terrain? Avoid saddles, chutes, box canyons.	H404						✓	
Snags or rolling rocks?	H404			Upper and lower safety zones had rolling material into safety zones; snag above the road				✓
All personnel need to be informed.	H404						✓	
Update throughout the shift.	H404						✓	

California OSHA Investigation Findings



Appendix M—California OSHA Investigation Findings

STATE OF CALIFORNIA
DEPARTMENT OF INDUSTRIAL RELATIONS
DIVISION OF OCCUPATIONAL SAFETY AND HEALTH

Office: Cal/OSHA
1209 Woodrow, Suite C-4
Modesto, CA 95350
(209) 576-6260

NOTICE OF NO ACCIDENT-RELATED VIOLATION AFTER INVESTIGATION

Calif. Dept. of Forestry
635 N. Santa Rosa
San Luis Obispo, CA 93405



Page 1 of 1

An investigation of an industrial accident or occupational illness was conducted by Michele Grubbs at a place of employment located at Stanislaus Nat'l Forest, Lumsden Rd., Groveland on 09/13/2004.

DESCRIBE THE CONDITION INSPECTED:

Incident on 9/12/04. Injury Illness Prevention Program.

It has been determined that no standard, rule, order or regulation set forth in Title 8, California Code of Regulations, and Division 5 of the California Labor Code, has been violated in connection with the above described industrial accident and/or occupational illness.

Signature Michele Grubbs
Safety Engineer/Industrial Hygienist

Signature [Signature]
District Manager

Date of issuance 03-03-05 Date investigation completed 01/12/2005

This notice is provided to the employer in accordance with the provisions of California Labor Code Section 6318(a). The employer is required to post this notice for three working days.

This notice relates solely and exclusively to the investigation of the industrial accident(s) and/or occupational illness(es) described above. It does not relate to any other conduct, condition or activity existing at the above-described place of employment either on the date of the investigation or presently.

2	4	P9871	11-05	120141221
Region	District	SETH Identification No.	Optional Report No.	CAL/OSHA Form 1 Report No. CAL/OSHA-1708 (08-07/98)

CDF Blue Sheet/USFS 24-hour Report





Wildland Fire Fatality and Entrapment INITIAL REPORT

Complete this report for fire-related entrapment and/or fatalities. Timely reporting of wildland-related entrapments or fatalities is necessary for the rapid dissemination of accurate information to the fire management community. It will also allow fire safety and equipment specialists to quickly respond to these events as appropriate. This initial report does not replace agency reporting or investigative responsibilities, policies, or procedures. Immediately notify the National Interagency Coordination Center (NICC). Submit this written report within 24 hours—even if some data are missing—to the address given below.

NICC—National Interagency Fire Center
3833 South Development Ave.
Boise, ID 83705-5354

Phone: 208-387-5400
Fax: 208-387-5414

NICC Intelligence Section
E-mail: nicc_intel@nifc.blm.gov

Submitted by: John Berry and Dan Turner
Agency: US Forest Service/CDF
Phone: 209-533-6981

Position: Accident Investigation Team Leaders
Location: Sonora, California
E-mail: jberry@fs.fed.us
dan.turner@fire.ca.gov

1. General Information

- Date of event 09/12/2004 Time 1345 • Fire name, location, agency, etc.
Tuolumne Incident, Groveland Ranger District,
Stanislaus National Forest, California
- Number of persons involved 7
- Number of: Injuries 6 Fatalities 1

2. Fatalities

- Type of accident:
 - ☐ Aircraft ☐ Vehicle
 - ☐ Natural (lightning, drowning, etc.) ☐ Smoke
 - ☐ Medical (heart, stroke, heat, etc.) ☒ Entrapment
 - ☐ Struck by falling object ☐ Other
- Employing agency CDF
- Unit name: Tuolumne/Calaveras Ranger Unit
- Address 785 Mt. Ranch Rd.
San Andreas, CA 95249
- For further information, contact Fred McVay
Phone 209-754-3831
- Where fatality/entrapment occurred:
 - ☒ Fire site ☐ In transit
 - ☐ Incident base ☐ Other

Note: In the event of fatality(s), do not release names until next of kin are notified.

3. Fire-Related Information

- Fuel model G
- Incident management type at the time of the incident/accident: (circle one) 4
- Temperature 85 RH 23 Wind 12 mph
- Urban/wildland intermix? ☐ yes ☒ no
- Topography Steep slopes Slope 100%
- Cause of fire: ☐ Natural ☐ Incendiary
- Fire size at the time of the incident/accident 15 acres
- ☐ Accidental ☒ Unknown

4. Entrapment

A situation where personnel are unexpectedly caught in a fire-behavior-related, life-threatening position where escape routes or safety zones are absent, inadequate, or have been compromised. An entrapment may or may not include deployment of a fire shelter. Note: Engine and dozer burnovers also constitute entrapments.

• Brief description of the accident : September 12, 2004, Stanislaus National Forest, Goveland Ranger District, A nine person CDF helitack crew was part of an initial attack force responding to the Tuolumne fire around 12:30 PM. Fire was approximately 15 acres in steep terrain with slopes in excess of 100%. Seven crew members were in the process of cutting line when the fire flared up, over running the crew. One fire fighter was killed and 6 others injured. No fire shelters were deployed.

A major accident investigation team made up of California Department of Forestry and Fire Protection(CDF) and US Forest Service is onsite. Dan Turner, Chief, CDF- San Luis Obispo, and John Berry, Eldorado National Forest Supervisor are the Team Leaders for the joint investigation.

The Investigation Team will be gathering facts from the site, weather and other fire behavior information, personal interviews, and other background information. The Team plans on having one report for the two agencies.

JOHN BERRY
Team Leader

DAN TURNER
Team Leader

Entrapment Description

- Person trapped ☒ With fire shelter ☐ Without fire shelter
- Burns/smoke injuries incurred while in fire shelter ☐ Yes ☐ No
- Burns/smoke injuries incurred while escaping entrapment ☒ Yes ☐ No
- Burns/smoke injuries incurred while fighting fire ☐ Yes ☒ No
- Fire shelter performed satisfactorily ☐ Yes ☐ No
- Fire shelter was available, but not used ☒ Yes ☐ No

Personal Protective Equipment Used

- Fire shelter ☐ Yes ☒ No
- Gloves ☒ Yes ☐ No
- Protective pants ☒ Yes ☐ No
- Boots ☒ Yes ☐ No
- Protective shirt ☒ Yes ☐ No
- Goggles ☐ Yes ☐ No
- Face/neck protection ☐ Yes ☐ No
- Hardhad ☒ Yes ☐ No

NFES No. 0869

(Revised 2/01)

PMS No. 405-1



United States
Department of
Agriculture

Forest
Service

Washington
Office

14th and Independence Ave. SW.
P.O. Box 96090
Washington, DC 20090-6090

File code: 6730

Date: September 14, 2004

Route to:

Subject: Preliminary (24-Hour) Briefing

To: Regional Forester

THE FOLLOWING INFORMATION IS PRELIMINARY AND SUBJECT TO CHANGE

Location: Stanislaus National Forest

Date of occurrence: September 12, 2004

Time of occurrence: 1345, Fire reported 1233

Team leader: John Berry and Dan Turner

Mission: Initial Attack

Activity: Fire Suppression

Number injured: 6

Number of fatalities: 1

Property damage (such as to vessels, equipment, and structures): none

Narrative: September 12, 2004, Stanislaus National Forest, Gaveland Ranger District, A nine person CDF helitack crew was part of an initial attack force responding to the Tuolumne fire around 12:30 PM. Fire was approximately 15 acres in steep terrain with slopes in excess of 100%. Seven crew members were in the process of cutting line when the fire flared up, over running the crew. One fire fighter was killed and 6 others injured. No shelters were deployed.

A major accident investigation Team made up of California Department of Forestry and Fire Protection (CDF) and US Forest Service is onsite. Dan Turner, Chief, CDF- San Luis Obispo, and John Berry Eldorado National Forest Supervisor are the Team Leaders for the joint investigation.

The Investigation Team will be gathering facts from the site, weather and other fire behavior information, personal interviews, and other background information. The Team plans on having one report for the two agencies.

JOHN BERRY
Team Leader

DAN TURNER
Team Leader

cc:
Safety Manager Shannon Martinez, Dick King, Larry Crabtree



Caring for the Land and Serving People

CDF Green Sheet/USFS 72-hour Report



**CDF Green Sheet
and
USFS 72 Hour Report**

**California Department of Forestry and Fire Protection
USDA Forest Service**



CDF HELITACK 404 CREW BURNOVER

September 12, 2004

**TUOLUMNE FIRE
CA-STF--2191
STANISLAUS NATIONAL FOREST**

**PACIFIC SOUTHWEST REGION
USDA-FOREST SERVICE**

Lookouts Communications Escape Routes Safety Zones

A Board of Review has not approved this Summary Report. It is intended as a safety and training tool, an aid to preventing future occurrences, and to inform interested parties. Because it is published on a short time frame, the information contained herein is subject to revision as further investigation is conducted and additional information is developed.

SUMMARY

On September 12, 2004 at approximately 1345 hours seven members of CDF Columbia Helitack (Helicopter 404) crew were burned over while constructing fireline from Lumsden Road downhill to the Tuolumne River on a steep slope (80-120%). The fire was located near Lumsden Bridge in the bottom of the Tuolumne River Canyon. The crew had been dropped off by Copter 404 on a gravel bar in the river approximately mile downstream from the fire. The crew met the incident commander (IC) on Lumsden Road before reaching the fire. The helitack captain (HC) received a strategy briefing to establish an anchor point on the right flank. He walked to the fire's edge and assessed the area below the road.

After discussing the assignment and safety issues, the crew members began constructing indirect handline (7 to 30 feet from the fire's edge) downhill using a chainsaw and hand tools in an oak overstory with brush fuels. The fire was backing into an up-canyon wind. A wind shift occurred causing the fire to change direction and spread upslope into the crew. Three members of the crew simultaneously shouted the alarm. All members of the crew ran toward identified safety zones. Four members of the crew, including the captain, went down to the river; three went up toward Lumsden road. The four firefighters (FF) that went downhill reached their safety zone. Of the three firefighters that went uphill, FF#1 and FF#2 made it to the road. FF#3 was last seen by FF#2 immediately behind him approximately 5 feet from the road. FF#3 did not reach the road. Firefighters on-scene estimated the elapsed time from the wind shift to the burn-over was less than 30 seconds with the total wind event lasting less than 2 minutes. Fire shelters were not deployed.

After reaching the safety zones a crew count determined that FF#3 was missing; an immediate search was begun. FF#3 was located; she was obviously deceased.

The other helitack firefighters received minor to moderate injuries. They received immediate assistance at the scene and were transported to medical facilities in Modesto and Sonora.

CONDITIONS

The fire location is in Tuolumne County at the bottom of the Tuolumne River Canyon (1450' elevation) about three (3) miles east of Groveland, California. The Tuolumne River Canyon is a major Sierra Nevada river drainage that has very steep canyon sides and is 2,000 feet

deep at the accident site. The fire originated near the river _ mile downstream of the Lumsden Bridge.

The fire was first reported by The Stanislaus National Forest (STF) Duckwall Lookout at 1233 hours. STF dispatched a standard wildland fire response. Copter 404 was dispatched to the fire at 1245 hours from their home base in Columbia, California (22 miles northwest of the fire). CDF Air Attack 440, 2 airtankers, and the IC were already at the scene upon the arrival of Copter 404 at approximately 1305 hours. Copter 404 is a UH-1H Super Huey (type 2) helicopter with a crew of nine, consisting of a pilot, two helitack captains, and six firefighters. After dropping off one helitack captain and six firefighters at a landing zone (LZ) about _ mile southwest of the fire, the pilot and one helitack captain remained with the copter and began making water drops up the right flank. At the time of the burn over Copter 404 was working a spot fire off the left flank of the fire.

The crew walked along the road from the LZ to the right flank of the fire (the fire was burning above and below the road). The helitack captain met the IC at Lumsden Road near South Fork Campground and received a briefing on fire conditions and proposed strategy to anchor the right flank. The crew continued up the road to the right flank, evaluated the situation and the proposed assignment to anchor the right flank at the river.

Lumsden road parallels the river. The slope distance is approximately 260 feet from the road down to the river at the accident site. The fire was burning upslope from the river with minimal lateral spread on the right flank. The right flank was backing into a light up-canyon wind with flame lengths of less than 12 inches.

FUEL

During the initial attack, the fire was spreading in light, flashy surface fuels. The fuels were predominately live oak leaf litter, light grass, and mixed brush, with an oak overstory consistent with Fuel Model 2. One-hour fine dead fuel moisture was estimated at 4-5%. Live fuel moisture values at the accident site were unavailable and no representative values were available at the time of this report.

TOPOGRAPHY

The Tuolumne River Canyon is characterized by a meandering river channel with numerous tributary canyons and ridges with slopes ranging from 80-120%. The fire started below Lumsden Road on the south side of the river (north facing slope).

WEATHER

Temperature:	89-94 F
Relative Humidity:	18-24 %
Wind:	Predominately steady up-canyon, estimated 3-5 mph (generally WSW). Prior to the burn-over numerous observers (AA, C404 pilot, IC, crew 404) reported that the wind had remained light and steady flowing in an up-canyon direction.

No critical fire weather patterns (thunderstorms, frontal passage, etc.) were in place.

SEQUENCE OF EVENTS

The tactic selected to establish the anchor at the river was indirect line construction to take advantage of sparse fuel and natural barriers. Five backpack pumps were staged on the edge of the road. The crew began using one chainsaw and handtools to construct line downhill from the road to the end of the vegetation (slope distance of 180 feet). The fire was backing into an up-canyon wind. The initial point of the handline was approximately 7 feet from the fire's edge at the road; as the handline progressed, the distance from the edge of the fire widened to approximately 30 feet. After line construction began the firing out operation started. At approximately 1345 hours an abrupt wind shift occurred. The 90-120 degree windshift changed the fire spread from a cross-slope backing fire to an upslope head fire. The wind event triggering the flare-up lasted less than 2 minutes and the actual flare-up lasted approximately 30 seconds; then fire behavior returned to a backing fire influenced by the up-canyon wind.

The crew's tool order consisted of FF#6 (chainsaw), FF#5 (swamper), helitack captain (HC) with scraping tool, FF#4 (scraping tool), FF#3 (scraping tool), FF#2 (scraping tool, fusee, and handie talkie), and FF#1 (back pump). The chain saw cut line extended approximately 120 feet and the scraped portion extended approximately 40 feet. At this point FF #2 had fired out approximately 10 feet of line. The HC directed FF#1 to retrieve a backpack pump to support the

firing operation. FF#1 returned to the road to put on the backpack pump. FF#2 stopped firing and was standing next to FF#3. STF Engine 43 had arrived at a turn-around on Lumsden Road down canyon _ mile from the accident site. The captain and a firefighter from Engine 43 walked the road from the turnaround to the right flank and arrived seconds prior to the burn over.

FF#5 noticed a wind shift and saw a sheet of fire coming upslope toward him and yelled to FF#6 to go downhill. Simultaneously FF#2 warned of the wind shift and turned uphill along with FF#3 and began escaping up to the road (approximately 20 to 30 feet away). HC yelled a warning; FF#4 saw a hole in the flames and ran downhill through the fire followed by the HC. FF#1 heard yelling and turned to face the hand line. He saw a run of fire heading up the hand line and yelled for the crew to get out of there. FF#1 saw the lower crew members scattering downhill. FF#2 rolled over the lip of the road within the oncoming flame front as the fire hit the road. Although FF#2 and FF#3 were together within 5 feet of the road, FF#3 did not arrive at the road.

FF#1 ended up on the road to the southwest toward STF Engine 43; FF#2 rolled into the inside cutbank of the road, jumped up and ran into the black staying on the road. After going through the flames, FF#4 rolled down the steep rocky embankment toward the river. HC, FF#5, and FF#6 ended up in the safety area at the river. During this event the STF engine 43 captain and firefighter backed off toward the turn-around.

HC identified FF#4, FF#5, and FF#6 along the river and contacted FF#2 by radio. The two separate groups did a crew count and discovered that FF#1 and FF#2 were accounted for and FF#3 was missing. They began an immediate search and called for bucket drops and assistance in the search. Copter 404 responded from the spot fire on the left flank, refilled the bucket near Lumsden Bridge, and flew _ mile west to the accident site. When Copter 404 arrived, the fire behavior had subsided to its previous backing condition. Copter 404 began making bucket drops to cool the area so the search could proceed. As the heat and smoke conditions subsided HC, FF#1, FF#2, FF#5, and FF#6 began a grid search. Engine 43 arrived at the right flank to assist in the search. As the smoke cleared and bucket drops cooled the area, the searchers discovered the body of FF#3 located in the newly burned area approximately 100 feet below the road.

Injuries

- HC had minor burns to the head and face.
- FF#1 had no reported physical injuries.
- FF#2 was treated for smoke inhalation and minor burns.
- FF#3 was deceased.
- FF#4 was treated for one fractured ankle and one broken rib; one twisted ankle, and abrasions.
- FF#5 had no reported physical injuries.
- FF#6 had no reported physical injuries.
- All surviving crew members were transported to hospitals for observation and treatment.

Safety Issues for Review

- 10 Standard Orders
- 18 Situations that Shout Watch Out
- LCES
- Downhill Line Construction Guidelines.

