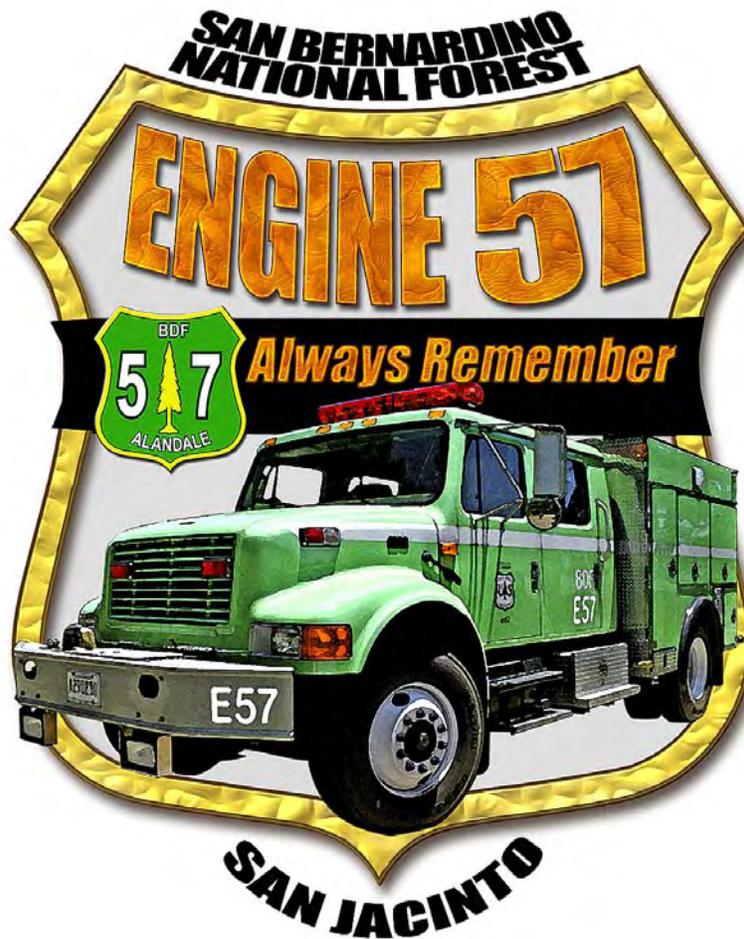




Esperanza Fire  
Accident Investigation  
Factual Report

Riverside County, California  
October 26, 2006



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# Esperanza Investigation Team

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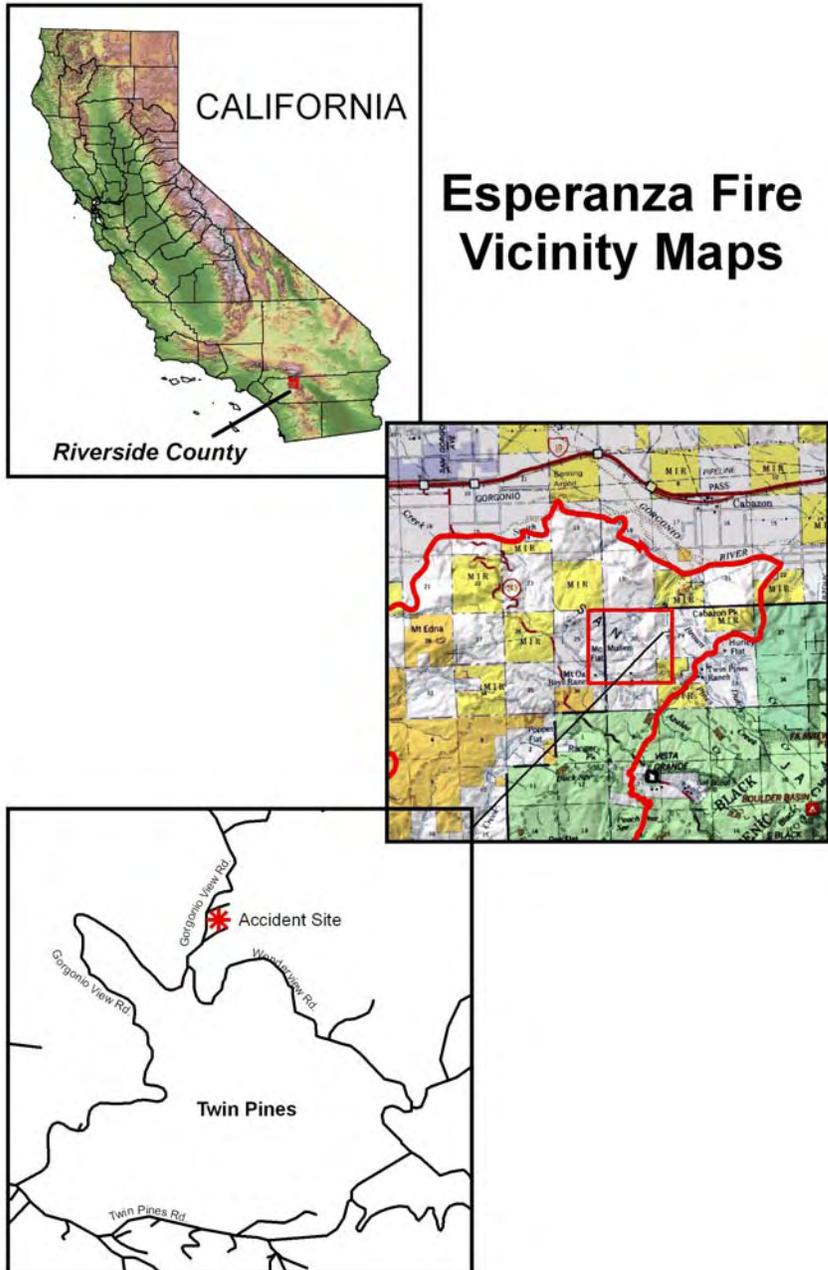


Figure 1. Esperanza Fire Vicinity Maps

## Executive Summary

The Esperanza Fire was reported on October 26, 2006 at 1:11 a.m. Pacific Daylight Time (PDT) in Cabazon, California, within the jurisdiction of the California Department of Forestry and Fire Protection (CAL FIRE). At approximately 7:15 a.m., five wildland firefighters from Forest Service Fire Engine 57 were overrun by the fire, while they were positioned near an isolated, vacant residential structure. All five firefighters were fatally burned by a sudden, intense fire run up a steep drainage below their location.

The fatalities occurred in the rural mountain community of Twin Pines, which is located in the San Jacinto Mountains approximately four miles southwest of Cabazon. Twin Pines is an identified wildland urban intermix with a recognized “extreme threat” rating for potential destructive impacts from wildfires.

Engine 57 and four other Forest Service fire engines from the San Bernardino National Forest, San Jacinto Ranger District were dispatched to the Esperanza Fire based on an Interagency Cooperative Fire Protection Agreement. All five Forest Service Type III fire engines and a March Air Force Base fire engine were performing structure protection in close proximity to each other when the fatalities occurred.

At the time of the burnover, the fire was several hundred acres in size burning rapidly in dry/dense chaparral/Manzanita, at the head of a steep drainage, and under the influence of Santa Ana winds.



Exhibit 1. Fire looking south from Cabazon area at approximately 4:00 a.m. PDT

## Narrative

The Esperanza Fire started in Cabazon, California in Riverside County. Cabazon is located on the valley floor on the northern side of the San Jacinto Mountains. The mountains rise dramatically in elevation from the desert floor at 1,700 feet to 4,000 feet in elevation to the rural mountain community of Twin Pines approximately four miles to the southwest. Twin Pines is a wildland urban intermix of dispersed residences on private land nestled at the head of a canyon. Lower portions of Twin Pines are accessible by narrow, winding, unpaved roads. The Twin Pines area is surrounded by the San Bernardino National Forest to the east and south. (See Figure 9, page 15, USFS and CAL FIRE Direct Protection Area Map)

The Twin Pines community is identified in the Mountain Area Safety Taskforce (MAST) Report as a very high to extreme threat area for potential destructive impacts from wildland fire due to physical orientation, surrounding dense chaparral/Manzanita, exposure to upslope winds, and alignment with potential Santa Ana winds. (See Figure 12, Page 18, Fire Threat and Fuel Rank Map for the Twin Pines area.)

The Esperanza Fire was first reported on Thursday, October 26, 2006, at 1:11 a.m. Pacific Daylight Time (PDT) burning at the base of the hill in the town of Cabazon. A red flag warning had been identified and was in effect. The probability for large fire growth was likely if the fire escaped initial attack given forecast conditions for high temperatures, low humidity, and Santa Ana winds.

Initial attack resources were promptly dispatched from the California Department of Forestry and Fire Protection (CAL FIRE) and the first fire engine, RVC Medic Engine 24, arrived on scene at 1:18 a.m. Initially, the fire was approximately two acres in size and located on the base of the hillside. At 1:24 a.m., the first arriving Battalion Chief (BC) from CAL FIRE reported the fire had grown to approximately ten acres with a rapid rate of spread, and had crossed the road east of the main drainage at a location called "Hallis Grade". (See Figure 8, Page 14, Esperanza Fire Progression Map) The BC concluded if the fire advanced into the drainage this would be a trigger point for the evacuation of residences in Twin Pines. The BC contacted the Perris Emergency Command Center (ECC) and advised personnel that the fire may have entered a designated Forest Service Direct Fire Protection Area (DPA) and requested the pre-planned response of five single resource Type III fire engines from the San Bernardino National Forest (BDF).

At approximately 1:32 a.m., the Battalion Chief assumed the role of Incident Commander (IC) and informed ECC that this fire was a "major, wind-driven [fire], with an uncontrolled perimeter due to fire behavior and fire intensity." He estimated the fire could potentially grow in excess of 25,000 acres and characterized the fire behavior as abnormal compared to his experience with previous fires in the same general location. Several fires had occurred in previous months; these fires had typically burned from east to west, skirting along the north aspect of the mountain. This fire was different because it

was influenced by a northeast wind, was burning uphill, and advancing into steeper drainages. At 1:43 a.m., BDF dispatch requests Forest Service Fire Engines 51, 52, 54, 56, and 57 respond to the fire.

At 1:53 a.m., the Esperanza Incident Commander directed more suppression resources into the Twin Pines area due to the perception of the growing fire heading towards the community. He also anticipated the need for air support and requested eight Type II helicopters, two Type I helicopters, and six air tankers to be available at sunrise.

At 3:07 a.m., the Esperanza Incident Commander duties were transferred to a CAL FIRE Division Chief. By this time, the fire was approximately 500 acres and had progressed up and over nearby Cabazon Peak (4,520 foot elevation).

Between 3:30 a.m. and 4:02 a.m., Forest Service Fire Engines 51, 52, 54, 56, and 57 responded from the San Jacinto Ranger District and reported to the Incident Command Post (ICP) located in Cabazon. At 4:02 a.m., when they arrived at the ICP, instructions were given to travel to the Twin Pines area to assist with structure protection. At 4:00 a.m., the evacuation of Twin Pines was ordered by the Esperanza Incident Commander. All five engines left the ICP heading towards a staging area at the junction of Twin Pines Road and Highway 243 at 4:18 a.m. While en route, Engine 51 reported a new fire start alongside Interstate 10 and was diverted to suppress this fire. The other four engines continued traveling towards the staging area. (See Figure 5, Page 11 – Branch II Map)

The four engines encountered people fleeing in vehicles down the highway which added to the emerging chaotic conditions. Engine personnel reported the road was obstructed with numerous civilian vehicles, motor homes, horses, and livestock. Due to the traffic congestion, the four fire engines became separated therefore Engines 52 and 57 arrived at the staging area first. Supervisors working in the Twin Pines area were CAL FIRE personnel, who included an Operations Section Chief, Branch Director II (Branch II), and a Structure Protection Group Supervisor.

Fire Engine 52 and 57 Captains met with the CAL FIRE Battalion Chief

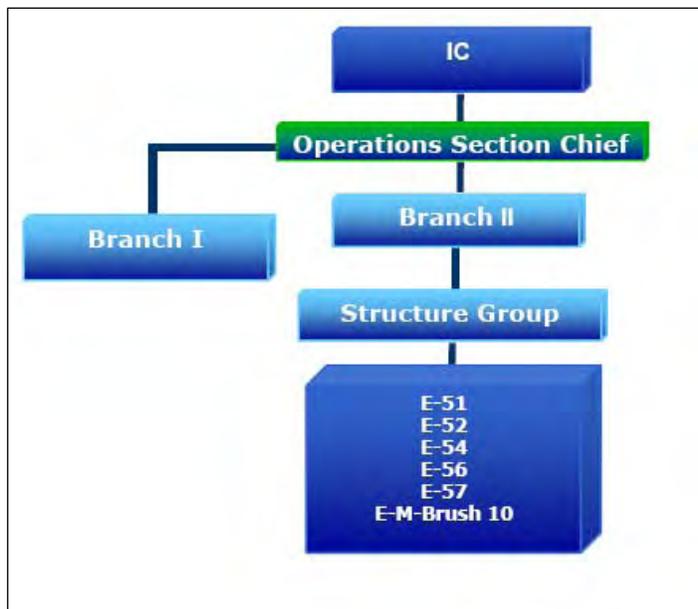


Figure 2. Unified Incident Command System Organization Chart at the time of the accident

who had assumed the duties of the Branch II Director (Branch II). He instructed the engine captains to drive down the unpaved Wonderview and Gorgonio View Roads into the lower Twin Pines basin area to triage houses and “see what they could do.”

At approximately 4:50 a.m., Engines 54 and 56 arrived at the staging area; however, due to the roadway being blocked by civilian vehicles, they were forced to drive further down the road. Engine 56 Captain walked back to meet with the CAL FIRE Battalion Chief who was designated as the Twin Pines Structure Protection Group Supervisor and he gave Engine 56 Captain an assignment to “go down Wonderview Road and perform structure triage.” Engine 56 Captain then returned to his engine and met with Engine 54 Captain to relay the instructions. Engine 54 and 56 Captains then met with Engine 52 and 57 Captains to talk about the mission.

Between 5:15 a.m. and 5:30 a.m., Engines 52 and 57 traveled down Wonderview Road. Engines 54 and 56 were instructed by the Twin Pines Structure Protection Group Supervisor to wait along Twin Pines Road to meet with an incoming March Air Force Base – Brush 10 Fire Engine (MB-10). At 5:30 a.m. Engine 52 stopped at 16600 Wonderview Road and found a resident who did not want to leave their home. Engine 57 continued alone traveling down the road approximately  $\frac{1}{4}$  of a mile and stopped at a house under construction at the junction of 49550 Venison Road (Tile House). Engine 57 Captain sized-up the Tile House and the rest of Venison Road then turned around and continued traveling down Wonderview Road. He then radioed Engine 52 Captain and advised that the Tile House had “room enough for two engines,” and that he would continue on down and look for other buildings. Engines 52 and 57 maintained ongoing communications using a Forest Service tactical radio frequency not assigned to the fire during this time.

While Engine 57 was triaging houses along Wonderview Road, Branch II met up with Engine 52. Engine 52 Captain told Branch II they could not convince the resident to leave. At 5:44 a.m., Branch II requested law enforcement assistance with the evacuation. Branch II then left this location, after instructing Engine 52 Captain to remain there until the resident had been evacuated.

At approximately 6:00 a.m., Branch II reported a dramatic increase in fire activity. The fire had reached the upper end of Hallis Grade and was progressing farther up the drainage. He noticed the fire was mostly a slope/fuel driven run and estimated the fire had spread approximately  $\frac{1}{2}$  to  $\frac{3}{4}$  of a mile in 15 minutes. He radioed the Operations Section Chief and advised him that the fire had crossed Wonderview Road and was moving rapidly towards Twin Pines Road. Branch II then continued down Wonderview Road checking on conditions.

Between 5:45 a.m. and 6:00 a.m., Engine 52 completed the evacuation and continued traveling down Wonderview Road to set up position at the Tile House, 49550 Venison Road. Engine 52 Captain contacted Engine 57 Captain to tell him that they were set up and concurred there was room for two engines. Engine 57 Captain responded that he was

at a “good location,” there was a pool for a water supply and he intended to remain at this location, which was 15400 Gorgonio View Road (Octagon House, See Figure 5, Page 11).

Engine 51 was released from the second fire along Interstate 10 and arrived at the staging area at approximately 5:45 a.m. He was instructed by the Twin Pines Structure Protection Group Supervisor to join Engines 54, 56, and MB-10 to perform structure triage along Wonderview Road. Engines 54, 56, and MB-10 attempted to drive down Wonderview Road but found that it was inaccessible because the fire had crossed the road. During this same time frame, the main fire reached the area of Engine 52 at the Tile House. Engine 52 personnel took defensive actions and retreated to the fire engine during the peak of fire activity. At 5:53 a.m., Engines 54, 56, and MB-10 drove back to Twin Pines Road where they meet up with Engine 51. They were then assigned to drive down Gorgonio View Road to continue structure protection and arrived at a doublewide mobile home (Doublewide).

While traveling along Gorgonio View Road, Engine 51, 54, and 56 Captains communicated using a Forest Service tactical radio frequency not assigned to the fire about concerns regarding the exit behind them being cut off by the fire, and the fact they were driving down “into a bowl.” The roadway was described as being narrow and surrounded by a lot of vegetation. They encountered a person in a motor home fleeing the area driving in an erratic manner.

At approximately 6:20 a.m., Engines 51, 54, 56 and MB-10 met Branch II along Gorgonio View Road and were directed to stay at 15975 Gorgonio View Road (Doublewide) where they now began to quickly size-up the structure and make defensive plans. (See Figure 6, Page 12 – Fire engine locations at the Esperanza Fire Accident Site Map)

At this time, Branch II noticed lights at a location approximately ¼ mile below the Doublewide, so he drove down the road and found Engine 57 parked at the Octagon House, which was built on a flat promontory. Branch II contacted firefighters standing next to the engine and instructed them to put on their line packs, including personnel protective equipment (PPE). He then had a conversation with Engine 57 Captain about PPE, the fire environment, and a lookout opportunity at this location. Not far from the engine, they stood at the edge of the property where they could see the “unnamed creek drainage”<sup>1</sup> that dropped sharply off below them. The fire was still up on the ridge to the east and progressing south toward Twin Pines Road.

Branch II finished his meeting with Engine 57 Captain at approximately 6:30 a.m. and drove back up Gorgonio View Road, briefly stopping at the Doublewide to inform

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<sup>1</sup> “unnamed creek drainage”: Is aligned northeast to southeast below the accident site. It is 1.5 miles long and is approximately ¼ mile wide with an average slope at 25 percent. The run of the slope is at average 50 percent. The United States Geological Survey Map, USDA Forest Service, Cabazon Quadrangle California-Riverside County, 7.5 – Minute Series and site visit was used to describe the topographic features of the accident site.

Engine 51 Captain of Engine 57's location before driving back to Twin Pines. At approximately 6:40 a.m., Branch II contacted the Operations Section Chief and Twin Pines Structure Protection Group Supervisor and advised them of the extreme fire activity heading upslope toward Twin Pines Road, and he recommended the evacuation of the Poppet Flats area, south of Twin Pines. At 6:45 a.m., he met with Twin Pines Structure Protection Group Supervisor and they agreed on their overall triage and structural triage plan of action along Twin Pines Road and down Gorgonio View and Wonderview Roads.

Sometime between 6:30 a.m. when Branch II left the area, and 7:15 a.m., Engine 57 set up a portable pump in the swimming pool at the Octagon House. Connected to the pump was a 100 foot section of 1½ inch hose extending to the east side of the residence with a 1½ inch nozzle attached. The pump was later found in the running position at full throttle. There was also a 1½ inch hose attached to the rear discharge of the engine without a nozzle. Meanwhile, firefighters at the Doublewide continued to deploy hose and prepared the area for a burnout operation, which needed to be accomplished before the advancing fire front reached their location. All five Forest Service Engine Captains continued to maintain frequent communications with each other using a Forest Service tactical radio frequency not assigned to the fire and not monitored by Esperanza Incident Command staff.

Between approximately 6:45 and 6:50 a.m., Engine 52 Captain informed Engine 56 Captain that the fire is "boiling up at the bottom down below." Then Engine 57 Captain contacted Engine 51 Captain and advised to "begin firing now." After unsuccessful attempts using assigned fire radio frequencies to contact Branch II to inform him of the burnout operations, the burnout was performed by Engines 51, 54, 56, and MB-10 around the Doublewide. Following notable holding/suppression actions, all firefighters at the Doublewide took refuge in the fire engines during the peak of ember showers, smoke, and the passage of the main fire front at approximately 7:15 a.m.

Attempts by Engine 52 to contact Engine 57 went unanswered at approximately 7:15 a.m. At approximately 7:57 a.m., the heat and smoke had diminished enough for Engine 51 and 52 Captains to work their way into Engine 57's location to discover the burnover. Immediate attempts by Engine 52 Captain to make an emergency call for assistance on the assigned fire command channel were unsuccessful, so he switched over to a Forest Service radio frequency and made contact with the Federal Interagency Communications Center (FICC). Following some initial confusion at the ICP over what was happening and where, the first agency medevac mission was activated with United States Forest Service Helicopter 535. Due to its Type III status and high winds, Helicopter 535 was unable to meet the mission. CAL FIRE Helicopter 301, a Type II, was able to land near the accident site at 8:22 a.m. to transport one burn victim. A second Type II helicopter, CAL FIRE Helicopter 305, then transported the second burn victim at 8:35 a.m. The bodies of the three deceased firefighters were removed from the site at approximately 7:09 p.m. PDT. (See Figure 7, Page 13, Fire Engine 57 personnel travel paths)

The Esperanza Fire quickly transitioned to a Type I Incident Management Team. During the first operational period, many residents were safely evacuated. After several days, the Esperanza Fire ultimately consumed approximately 41,173 acres and destroyed 34 residences and 20 outbuildings. The fire also forced the closure of Highway 243.

# Maps



Figure 3. Esperanza Fire Accident Site looking southwest.  
Google Satellite Image, © 2006 Europa Technologies

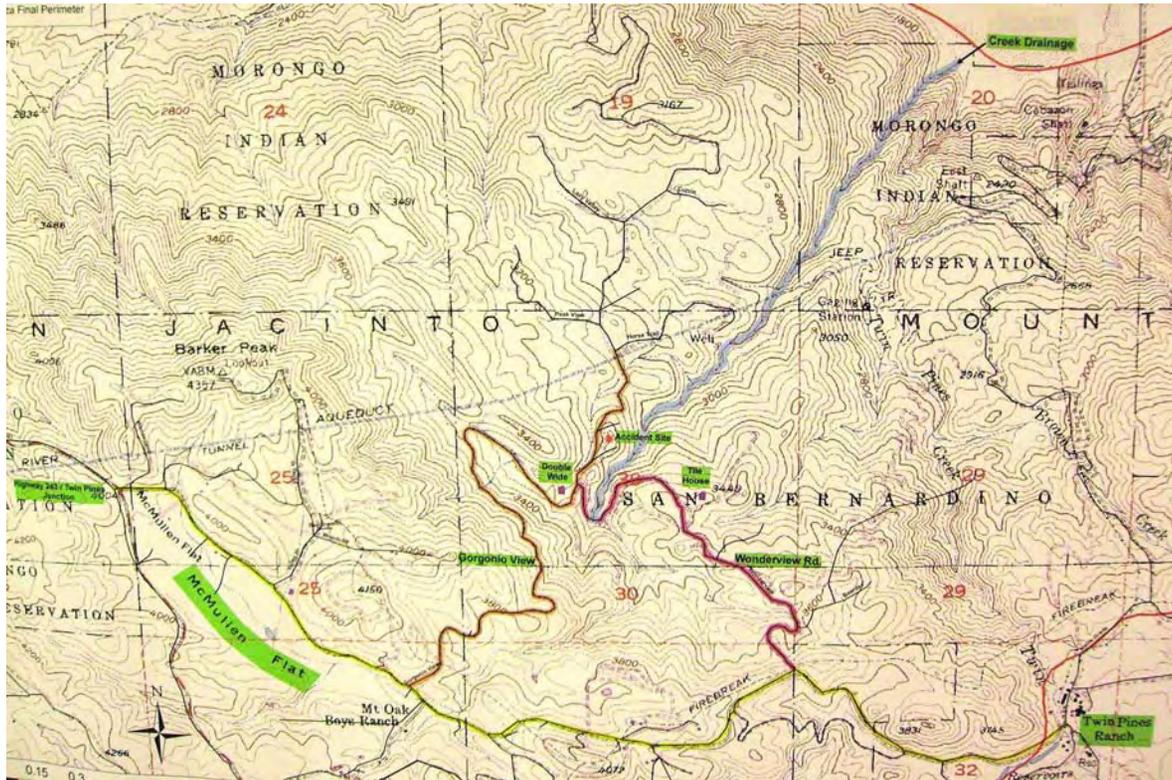


Figure 4. Topographic Map showing locations of the Accident Site, Tile House, Doublewide, Wonderview Road, and Gorgonio View Road.

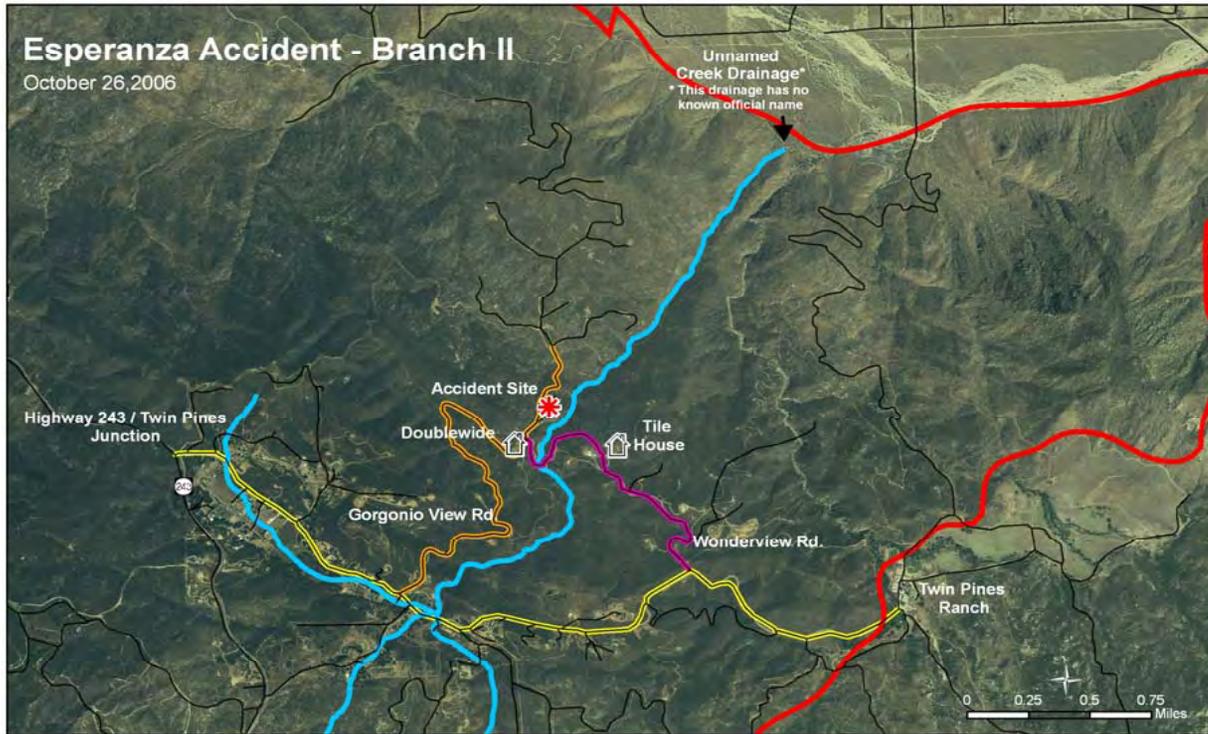


Figure 5. Branch II Map

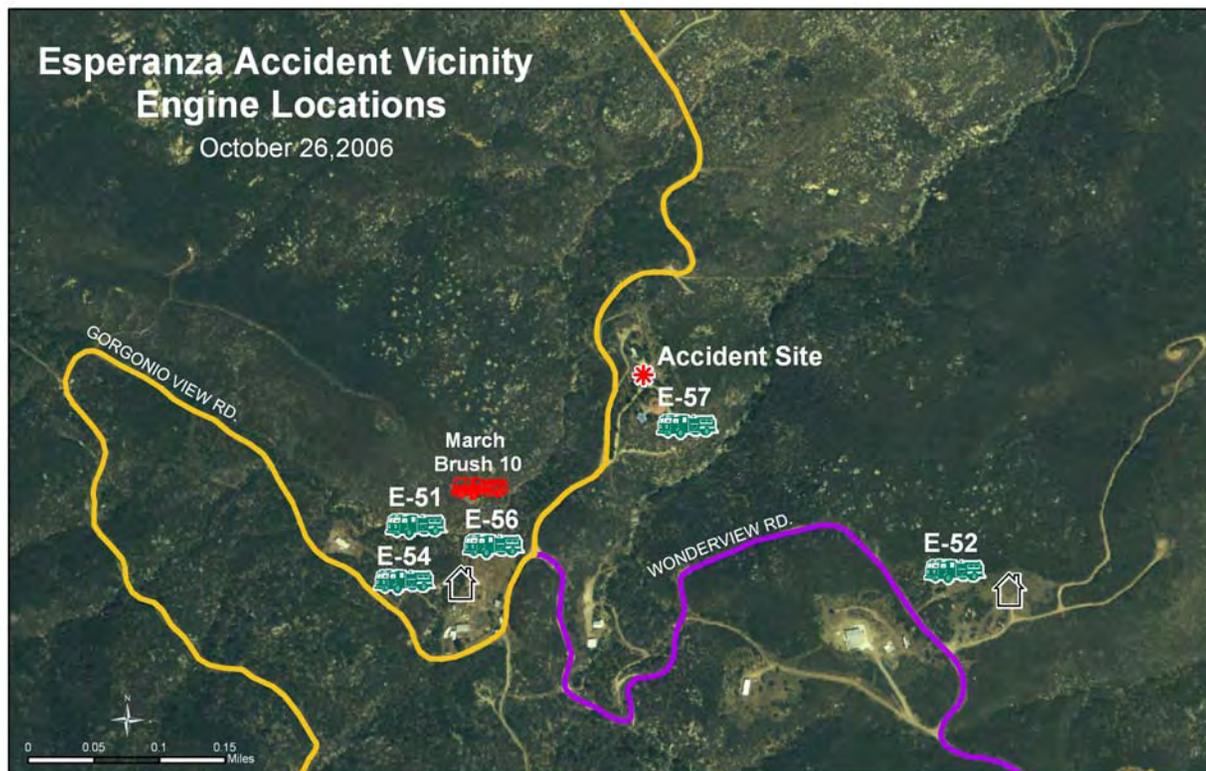


Figure 6. Fire engine locations at the Esperanza Fire Accident Site Map

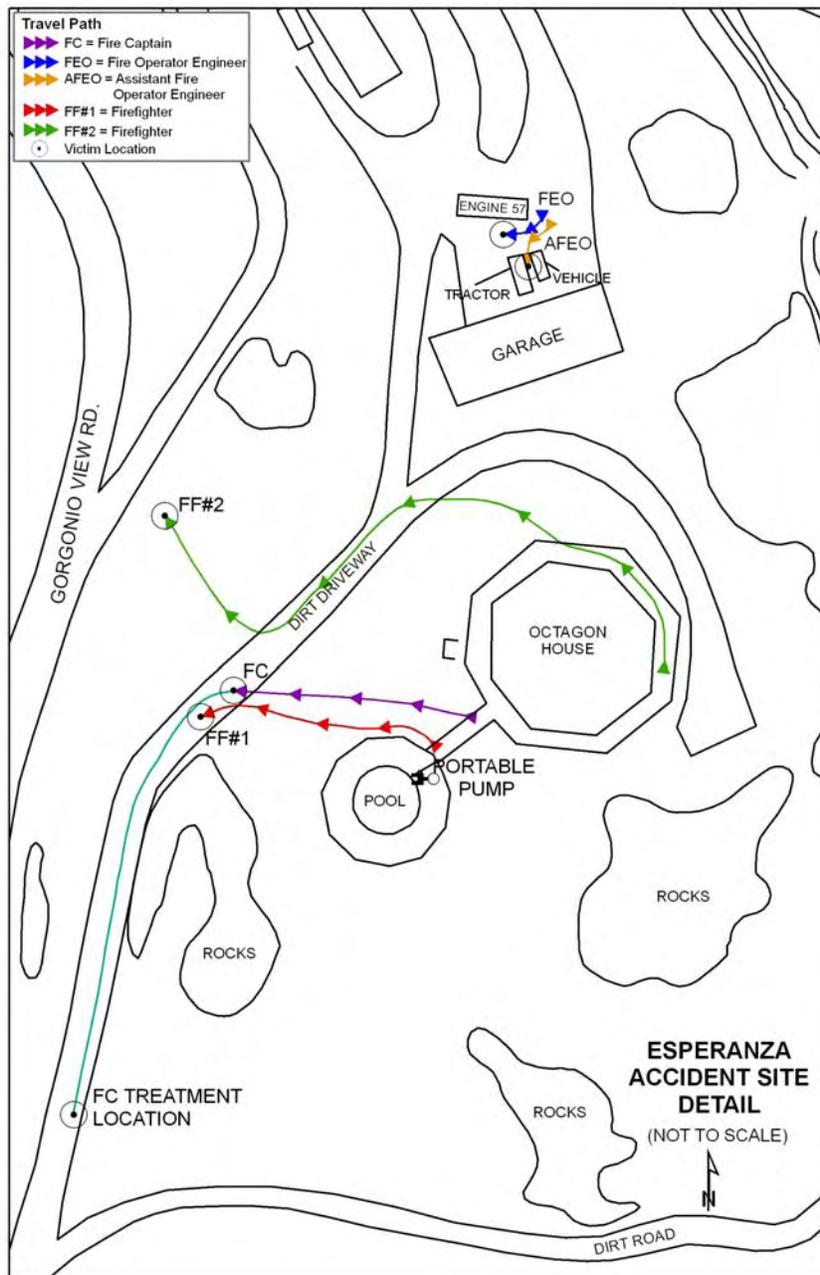


Figure 7. Fire Engine 57 personnel travel paths.

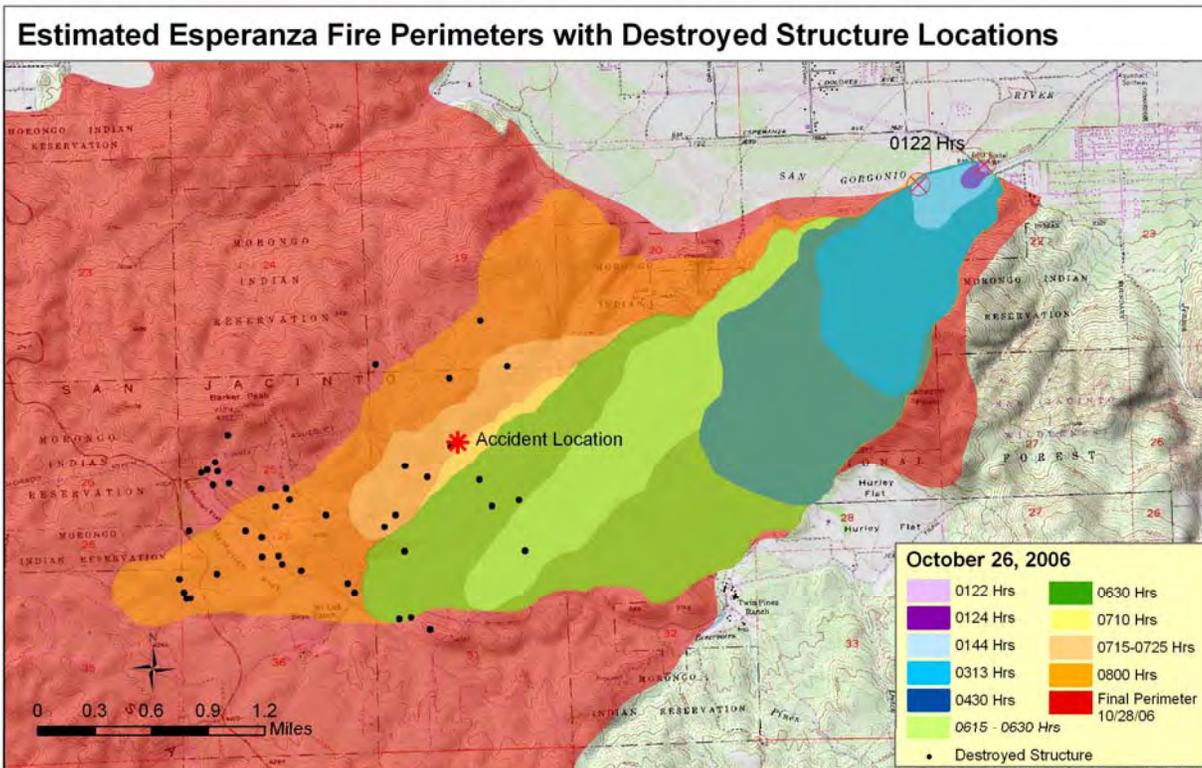


Figure 8. Esperanza Fire Progression Map

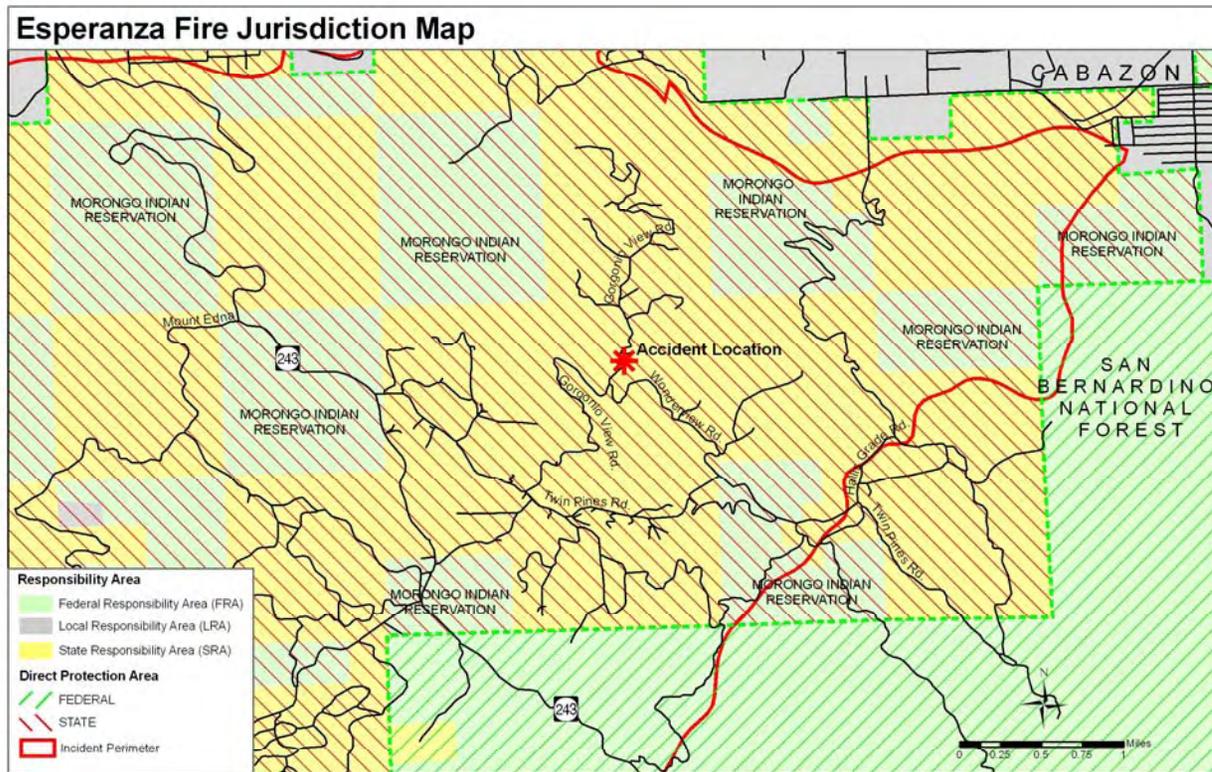


Figure 9. USFS and CAL FIRE Direct Protection Area Map.

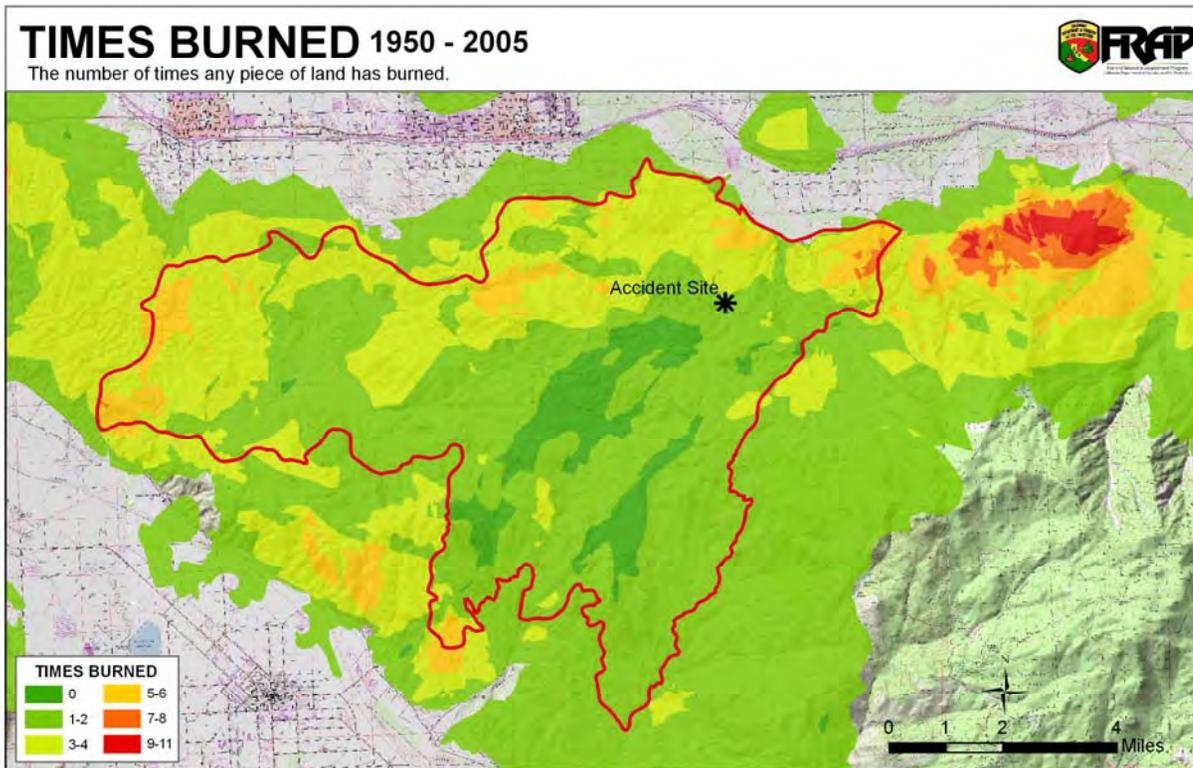


Figure 10. Fire Frequency Map.

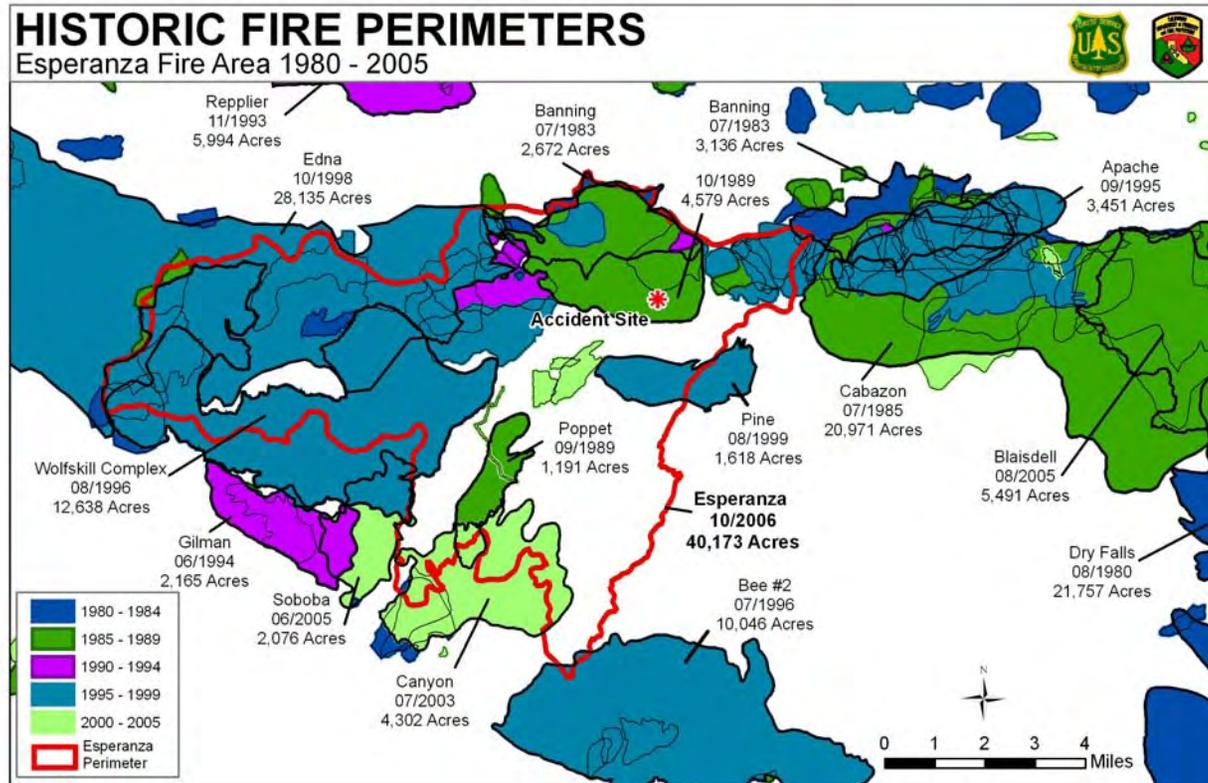


Figure 11. Historic Fire Perimeters

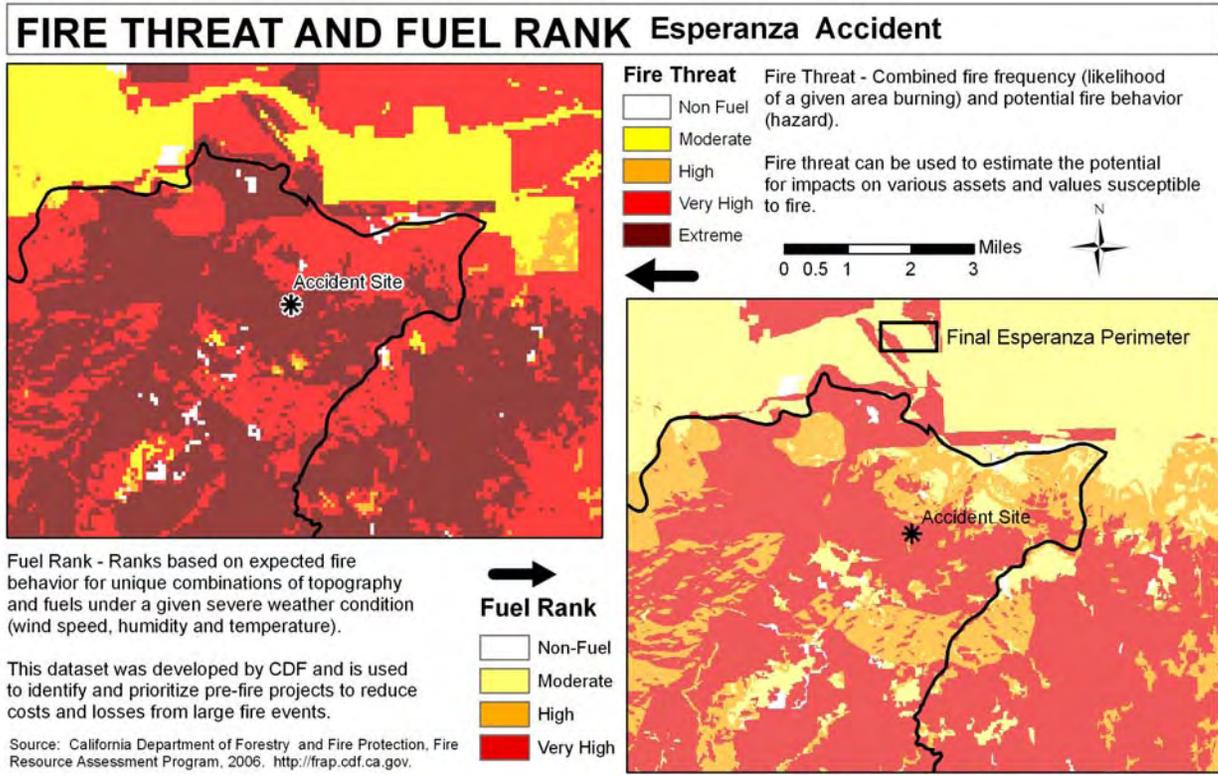


Figure 12. Fire Threat and Fuel Rank Map for the Twin Pines Area.

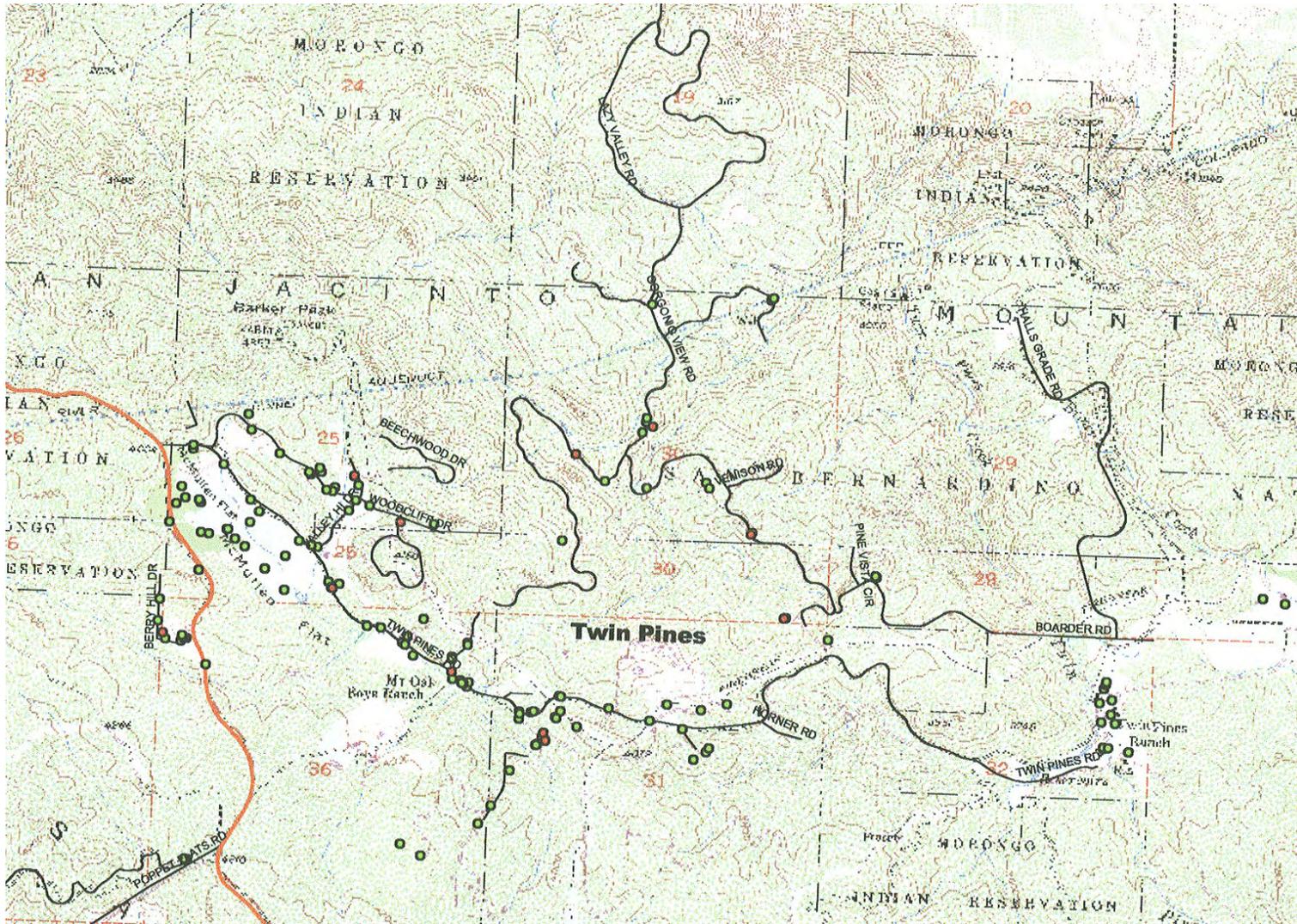


Figure 13. 10/2/2002 Poppet Flats, Pine Cove, and Idyllwild Contingency Study

● Structures Inspected

● Structures were Non-Defensible

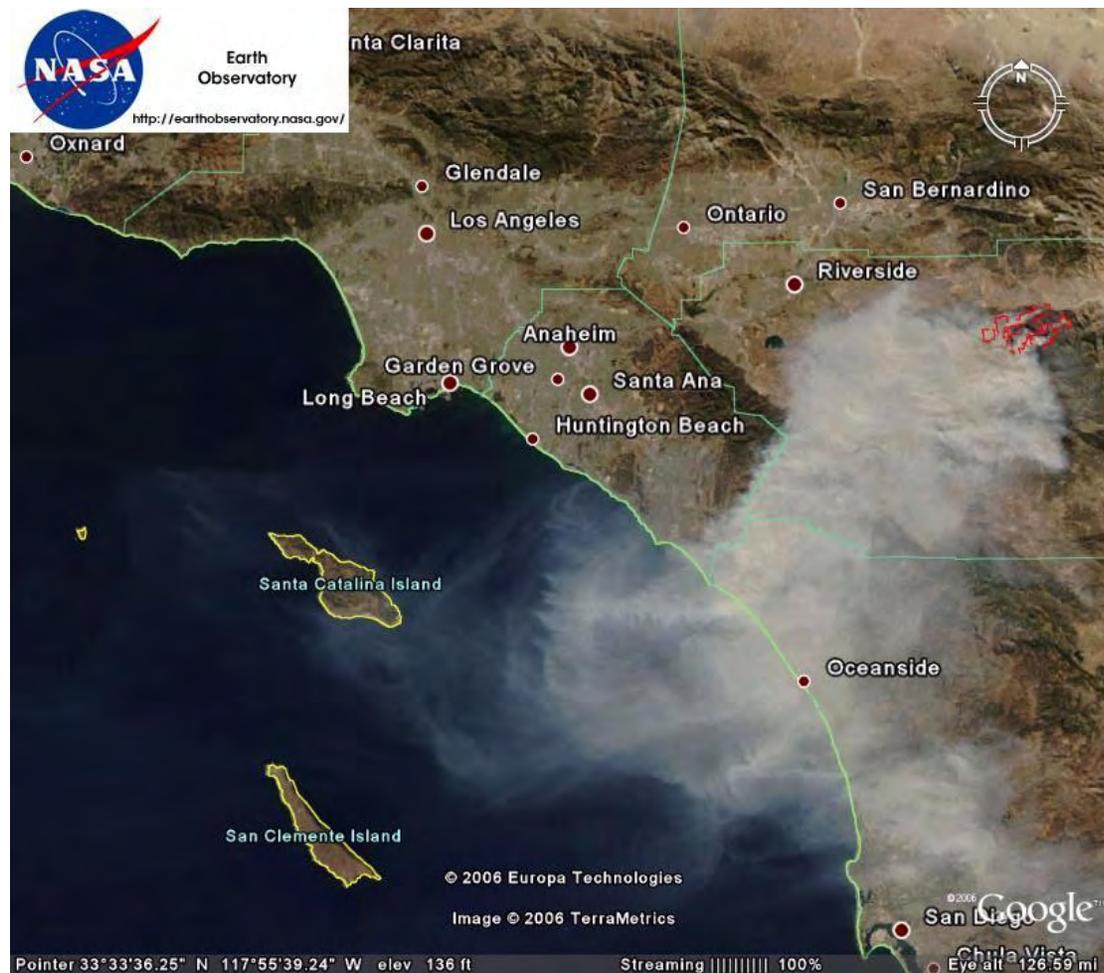


Figure 14. NASA satellite photo of smoke from the Esperanza Fire.  
© 2006 Europa Technologies.

## Photographs



Exhibit 2. Fire breaking through the inversion at 7:30 a.m. PDT  
*Courtesy of Guy McCarthy/The Sun, San Bernardino County Newspaper*



Exhibit 3. Aerial view of spot fires below the Accident Site  
at approximately 7:10 a.m. PDT



Exhibit 4. Aerial view of the fire run at approximately 7:14 a.m. PDT



Exhibit 5. Accident Site; looking north from Wonderview Road between the Tile House and Accident Site.

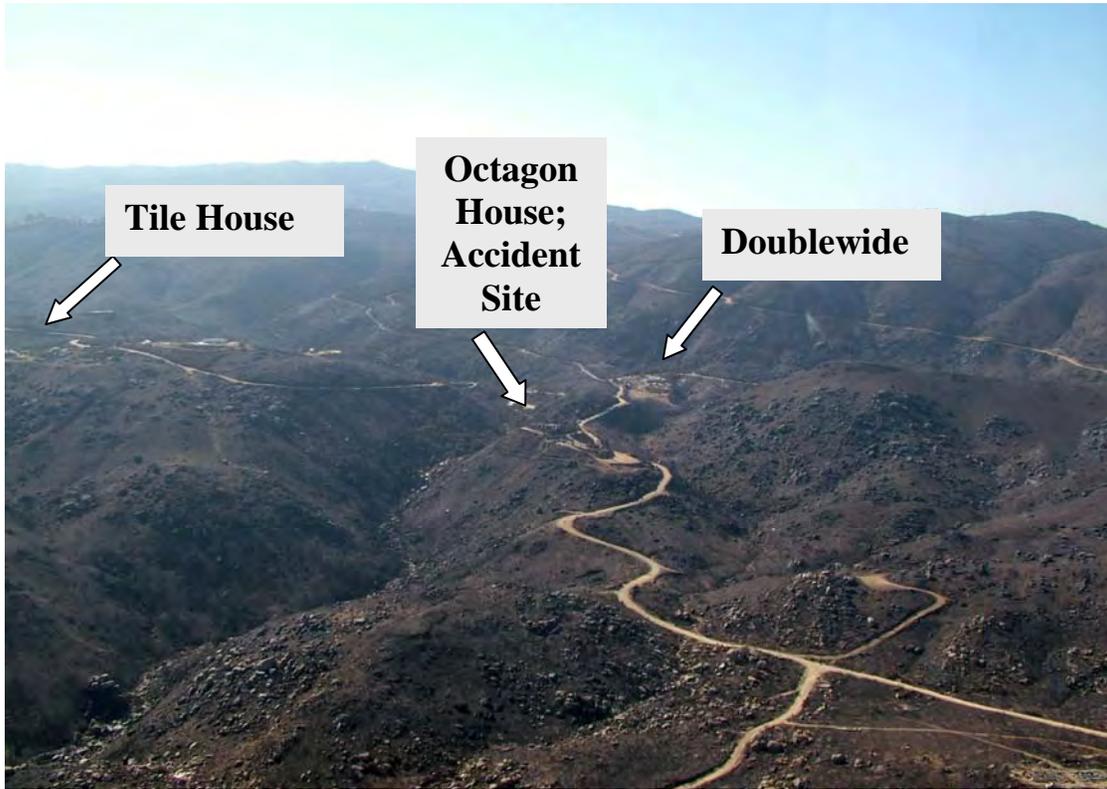


Exhibit 6. Complete area overview (Tile House/Doublewide/Accident Site) looking southwest.



Exhibit 7. Doublewide and Accident Site looking northeast.



Exhibit 8. Tile House looking northwest to the Accident Site.



Exhibit 9. "Unnamed creek drainage" looking south to the Accident Site.



Exhibit 10. Accident Site overview.



Exhibit 11. Overview from Accident Site looking north to Cabazon.



Exhibit 12. Fire run looking towards the Accident Site from the Tile House.



Exhibit 13. Fire run looking just above the Accident Site from the Tile House.

## **Timeline**

The development of an accurate timeline requires a multiple of sources including: dispatch logs; radio transmission voiceprints; individual statements; and interviews. In some situations, time estimations were necessary because personal observations and radio transmissions were made without a time record/reference or source time references conflicted. When a specific time could not be determined, a best estimate of time was provided. Events that occurred some time between established time references are indicated by asterisks (\*).

### ***October 26, 2006 – All times are listed as Pacific Daylight Time***

#### **1:11 a.m.**

- Vegetation fire reported in the vicinity of Elm Street and Bonita Avenue in Cabazon, California

#### **1:18 a.m.**

- Initial Attack Incident Commander (Riverside County Medic Engine 24) provides initial size-up and estimates fire at two acres located on the hillside

#### **1:24 a.m.**

- CAL FIRE Battalion Chief estimates the fire at 10 acres with a rapid rate of spread and possibly burning into the San Bernardino National Forest (BDF) land
- Request for five single resource Type III engines sent to BDF as an immediate need

#### **1:32 a.m.**

- CAL FIRE Battalion Chief 3113 assumes Incident Commander (IC) role
- Fire is spotting 500 feet ahead of itself
- Five acre spot is reported

#### **1:43 a.m.**

- BDF dispatch requests Forest Service Fire Engines 51, 52, 54, 56, and 57 to respond to the fire

**1:44 a.m.**

- Fire is estimated at 75 acres with a rapid rate of spread

**1:53 a.m.**

- Structure threat in Twin Pines area is reported
- Additional firefighting resources are requested

**3:07 a.m.**

- CAL FIRE Division Chief 3106 assumes Incident Commander (IC) role
- Fire is approximately 500 acres and has burned up and over Cabazon Peak

**4:00 a.m.**

- Evacuation of Twin Pines area ordered by Esperanza Incident Commander

**4:02 a.m.**

- Forest Service Engines 51, 52, 54, 56 and 57 arrive at the Incident Command Post (ICP) in Cabazon
- Initial briefing takes place at ICP  
(*Witness Statements # 11.6; 12.4; 13.1; and 16*)

**4:18 a.m.**

- Forest Service Engines 51, 52, 54, 56, and 57 are en route to the staging area at Twin Pines Road and Highway 243  
(*Witness Statements #11.6; 12.4; 13.1; and 16*)

**4:19 a.m.**

- Engine 51 reports new fire start along Interstate 10 and is diverted to suppress the fire
- Engines 52, 54, 56, and 57 continue traveling to the staging area at the junction of Twin Pines Road and Highway 243

\* Residents are evacuating Twin Pines area. The road is congested with vehicles and motor homes

**4:50 a.m.**

- Engines 52, 54, 56 and 57 arrive at the staging area and are assigned to drive down on Wonderview Road to triage and assist with evacuations

**5:15 a.m.**

- Engines 52 and 57 begin traveling down Wonderview Road  
(*Witness Statement # U12.4*)

\* Engines 54 and 56 are loading up and programming radios. They are advised by the Structure Protection Group Supervisor (CAL FIRE Battalion Chief 3114) to wait on Twin Pines Road for March Air Force Base - Brush 10 Fire Engine (MB-10)  
(*Witness Statements #13.1 and 16*)

**5:16 a.m.**

- Engine 51 is released from the fire along Interstate 10 and proceeds to the staging area

\* Engines 52 and 57 continue to travel down Wonderview Road  
(*Witness Statement #12.4*)

**5:30 a.m.**

- Engine 52 turns into the driveway at 16600 Wonderview Road and encounters a resident who refuses to leave. Engine 52 remains to assist in evacuation.

\* Engine 57 then continues to alone travel down Wonderview Road and stopped at a house under construction at the junction of 49550 Venison Road (Tile House). Engine 57 Captain sized-up the Tile House and the rest of Venison Road then turned around and continued traveling down Wonderview Road. He then radioed Engine 52 Captain and advised that the Tile House had “room enough for two engines,” and that he would continue on down and look for other buildings.  
(*Witness Statement #12.4*)

**5:40 a.m.**

- Engines 54, 56, and MB-10 leave the staging area to travel down Wonderview Road. The road is cut off by the fire, so the engines turn around and drive back up to Twin Pines Road.  
(*Witness Statements #11.6, 13.1, and 15.1*)

**5:44 a.m.**

- Branch II arrives at Engine 52’s location and directs Engine 52 to remain in place until the resident at 16600 Wonderview Road is evacuated

**5:45 a.m.**

- Evacuation of resident at 16600 Wonderview Road is completed

\* Engine 52 resumes travel down Wonderview Road and arrives at 49550 Venison Drive (Tile House) and prepares for structure protection

**5:53 a.m.**

- Engines 54, 56, and MB-10 meet with Engine 51 on Twin Pines Road and begin traveling down Gorgonio View Road together  
(*Witness Statements #13.1, 15.1, and 16*)

**6:00 a.m.**

\*Engine 57 arrives at 15400 Gorgonio View Road (Octagon House)  
(*Witness Statement #12.4*)

**6:15 a.m. – 6:20 a.m.**

- Engines 51, 54, 56, and MB-10 continue down Gorgonio View Road and can see the main fire  
(*Witness Statements #11.6; 13.1; 15.1; and 16*)
- Branch II meets with Engines 51, 54, 56, and MB-10

**6:20 a.m. – 6:30 a.m.**

- Branch II meets with Engine 57 Captain at the Octagon House  
(*Witness Statement #U-6*)

\*Engines 51, 54, 56 and MB-10 arrive at 15975 Gorgonio View Drive (Doublewide) and begin structure protection measures and prepare for a burnout operation to create a safety zone  
(*Witness Statement #U11.6*)

**6:30 a.m.**

- Branch II stops back at the Doublewide on his way back up to Twin Pines Road and informs Engines 51, 54, 56, and MB-10 of Engine 57's location  
(*Witness Statements #U-6 and U-11.6*)

**6:40 a.m.**

- Branch II advises that the fire has crossed Twin Pines Road and “fire behavior is extreme”
- The fire makes a second run by Engine 52 at the Tile House

**6:45 a.m.**

- Branch II meets with Twin Pines Structure Protection Group Supervisor on Twin Pines Road to discuss plan
- \* Engine 52 Captain contacts Engine 56 Captain via radio on a Forest Service tactical radio frequency not assigned to the fire and advises that the fire is “boiling up at the bottom down below”  
(*Witness Statement # U12.4 and 16*)
- \* Engine 57 Captain contacts Engine 51 Captain and recommends they “begin firing now”  
(*Witness Statements #U11.6 and U-19*)
- \*Engines 51, 54, 56, and MB-10 implement burnout just prior to fire front hitting

**7:00 a.m.**

- Intense holding action of burnout operation with spotting from the fire

**7:04 a.m.**

- Air Attack arrives over the fire

**7:10 a.m.**

- Winds increase
- Significant smoke is present
- Visibility impairment is five to 10 feet

**7:15 a.m.**

- All personnel at the Doublewide take refuge in Engines  
(*Witness Statement #U-11.6*)
- Radio calls from Engine 52 to Engine 57 go unanswered  
(*Witness Statements #U11.6 and U16*)

**7:57 a.m.**

- Engine 51 and 52 Captains access the driveway of the Octagon House and they find one seriously burned firefighter  
*(Witness Statement # U-16)*
- Engine 52 Captain contacts BDF and reports the burnover incident. He informs Federal Interagency Communications Center (FICC) that there are two firefighters with severe injuries and three firefighters are missing
- Incident Commander (Division Chief 3106) hears notification of burn victims through the Forest Net Radio channel [a station radio system already in place at the Cabazon Fire Station]  
*(Witness Statement #U-7)*

**7:58 a.m.**

- Engine 52 Captain requests two ambulances

**7:59 a.m.**

- Engine 52 Captain increases request to four ambulances

**8:00 a.m.**

- Two surviving victims receive initial medical treatment from the on-scene firefighters  
*(Witness Statement #U-11.6)*

**8:04 a.m.**

- Three deceased firefighters are found
- Engine 54 Captain requests a coroner

**8:22 a.m.**

- CAL FIRE Helicopter 301 lands at the accident site and the first burned firefighter is loaded and transported to the Arrowhead Regional Burn Center  
*(Witness Statement #U-8)*

**8:35 a.m.**

- CAL FIRE Helicopter 305 transports the second burned firefighter to the Arrowhead Regional Burn Center  
*(Witness Statement #U-8)*

**9:09 a.m.**

- CAL FIRE Helicopter 301 lands at Arrowhead Regional Burn Center  
(*Witness Statement #U-18*)

**7:09 p.m.**

- The bodies of the three deceased firefighters are removed from the accident site

## Investigation Process Summary

An Interagency Serious Accident Investigation Team (SAIT) was mobilized on the afternoon of October 26, 2006 for the Esperanza Entrapment/Fatality that occurred in the early morning of October 26, 2006 near Cabazon, California. The Team Co-Leaders were contacted on October 26, 2006 between 12:00 to 1:00 p.m. Pacific Daylight Time (PDT). When assembled, the SAIT team consisted of 18 primary interagency members and 14 technical specialist personnel.

### ***Investigative Team Authority***

The team was given full authority as described under the Cooperative Fire Protection Agreement (an agreement between the Bureau of Land Management; National Park Service; U.S. Forest Service; and California Department of Forestry and Fire Protection - 7/25/01 version), that states:

#### *“67. Accident Investigations*

*Whenever an accident occurs involving the equipment or personnel of a supporting agency (USFS), the protecting agency (CAL FIRE) 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 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 utilize technical support personnel necessary to complete the accident investigation. The team was directed to do the following:

- Identify factual data associated with the circumstances relating to the accident.
- Accurately and objectively record the findings of this investigation.
- Analyze the findings to determine factors involved and their relationship.
- Recommend actions that should be immediately implemented to prevent similar future occurrences.
- Develop and submit a Factual Report and Management Evaluation Report to the Chief of the Forest Service and the Director for the California Department of Forestry and Fire Protection.

Randy Moore received his Delegation of Authority from Hank Kashdan, Deputy Chief for Business Operations/Designated Agency Safety and Health Official for the United States Forest Service (USFS). Brad Harris received Delegation of Authority from Ken McLean, Deputy Director of Fire Operations for the California Department of Forestry and Fire Protection (CAL FIRE).

## ***Investigation Process***

A crosswalk was developed and used to ensure objectives established in the current USFS Serious Accident Investigation Guide (2005) and draft CAL FIRE Serious Accident Investigation Guide were met. The investigation process involved the use of the organizational structure of the Unified Command, Incident Command System (ICS) to manage team assignments, investigation protocols, briefings, witness interviews, and collection of evidence. A collaborative interagency effort was used to develop report findings, causal and contributing factors, and recommendations. Team expectations were that direction provided in the USFS 2005 Serious Accident Investigation Guide section “Report Use” would apply:

*“Report Use - Information collected and developed during the course of an accident investigation is to be used only for accident prevention. It shall not be used for purposes such as:*

- *Making any determination affecting the interest of an individual giving a statement*
- *Evidence (or to obtain evidence) to determine the misconduct of agency personnel*
- *Evidence to determine the disciplinary responsibility of agency personnel*
- *Evidence to assert affirmative claims on behalf of the Government*
- *Evidence to determine the liability of the Government for property damage, injuries, or death*
- *Evidence before administrative bodies*
- *Punitive or administrative action taken by agencies of the United States”*

## ***Team Chronology***

At 8:00 a.m. PDT on October 27, 2006, California Department of Forestry and Fire Protection (CAL FIRE) team members met at Beaumont CAL FIRE Fire Station. CAL FIRE SAIT members took custody of the site from the Riverside Operation Unit, as the USFS SAIT members were traveling to the area.

At 8:30 a.m. on October 28, 2006, the entire SAIT members met at the Cabazon Community Center. Also present were investigators from the Office of Inspector General (OIG) and Federal Occupational Safety and Health Administration (OSHA). The purpose of the SAIT, as stated by the co-leads, is to provide management with

information for accident prevention. Due to the interagency involvement at the time of the accident, the SAIT was selected to reflect the interagency cooperation.

A site tour was conducted by the CAL FIRE Chief Investigator, on October 28, 2006 at 12:00 p.m. All SAIT members, along with investigators from OIG and OSHA, were present. The purpose for the tour was to allow the SAIT members to have a visual understanding and familiarization of the accident site. SAIT members responsible for evidence collection and scene processing remained at the accident site after the tour.

The scene was secured by law enforcement personnel until November 3, 2006 at 6:00 p.m. This was the day that Fire Engine 57 was removed and scene processing was completed.

The San Bernardino National Forest issued a press release in lieu of the 24-hour report on October 28, 2006.

The CAL FIRE Blue Sheet (a preliminary 24-hour report) was prepared and submitted to the CAL FIRE Assistant Region Chief for review on October 28, 2006. It was approved and released that same day.

The USFS 72-hour report was prepared and submitted to the Chief of the Forest Service on October 30, 2006.

The CAL FIRE Green Sheet (a more detailed and comprehensive report than the Blue Sheet) was prepared and submitted to the CAL FIRE Assistant Region Chief for review on November 7, 2006. It was released on November 9, 2006.

The SAIT completed the evidence collection and processing, interviews, and document and information gathering on November 9, 2006. All SAIT staff returned to their respective home units.

On December 4, 2006, a Core Group of SAIT members met at the California Southern Operations Center in Riverside, California. The purpose of the meeting was to complete the Factual Report for both agencies. On January 17, 2007, an additional meeting was held in Auburn, California to finalize the Factual Report. The report was completed for final review by the team leaders on March 5, 2007.

## Human Findings – People and Management

These are the conclusions of the Interagency Safety Accident Investigation Team based on the chronology of events and factual data, weight of evidence, interviews, and professional judgment. Findings are grouped into the following categories: people, management, environmental, and material/equipment.

### **People**

#### **Finding 1.**

All Forest Service firefighters assigned to the Esperanza Fire on October 26, 2006 met or exceeded current agency qualifications and training requirements for fire positions held.

*(References: FS Red card documentation and training records)*

#### **Finding 2.**

The California Department of Forestry and Fire Protection (CAL FIRE) initial attack Incident Management Team (Incident Commander, Agency Administrator, Operations Section Chief, and Branch Directors) were all trained, qualified, experienced, and met or exceeded the minimum agency required qualifications for fire positions held.

*(References: employee training certifications, Employee incident assignment evaluations, F-1, F-2, F-3, F-4, F-5, F-49, and F-50)*

#### **Finding 3.**

Engine 57 Captain was based in Idyllwild and had at least 16 years of working experience at the San Jacinto Ranger District.

*(References: Employee personnel records and G-3)*

#### **Finding 4.**

Engine 57's Captain training history, including all position prerequisites including: L180 – Human Factors; L-280 – Followership to Leadership; L-380-Fireline Leadership; N9019 - ICT3 Simulation – Time Pressured Simulation Assessment; and S-215 – Fire Operations in the Wildland Urban Interface.

*(Reference: Employee training certifications)*

#### **Finding 5.**

All Forest Service firefighters assigned to the incident were within established work/rest guidelines.

*(Reference: Station log books, Employee time and attendance records, H-1, H-3 through H-6, H-8, and work/rest guidelines from 2006 - Interagency Standards for Fire and Fire Aviation Operations)*

## **Management**

### **Finding 6.**

The Esperanza Fire started on land under the jurisdiction by the CAL FIRE.  
(References: CAL FIRE RRU and USFS BDF tape/transcript, C-1, and F-1)

### **Finding 7.**

Unified command between CAL FIRE and the USFS, was announced over the Command Net at 03:10hrs.  
(References: A-2, A-6, O-5, F-1, and O-6)

### **Finding 8.**

Five Forest Service Type III fire engines were ordered by RRU and dispatched by BDF as single resources per initial attack (closest available forces) Cooperative Fire Protection Agreement - 01/01/2002, and the associated 2005 Draft Operating Plan (pre-planned response) for this affected Direct Protection Area.  
(References: CAL FIRE RRU and USFS BDF tape/transcript, CFPA A1-9, and Q-1)

### **Finding 9.**

The protection priorities expressed in the Cooperative Fire Protection Agreement includes the clear expectation and agreed objective for aggressive fire suppression when structures are involved.  
(References: Q-1: #3, 23, 29, and 31)

### **Finding 10.**

The Riverside County Mountain Area Safety Taskforce (MAST), San Jacinto Mountains Community, Wildfire Protection Plan – Draft Final (March 2006) identified/mapped the Twin Pines areas as Extreme to Very High Fire Threat Rating.  
(Reference: (MAST): <http://www.calmast.org/mast/public/index.html>)

### **Finding 11.**

A structure protection contingency map was developed by CAL FIRE in October 2002 identifying structure location and defensibility rating which covered the lower Twin Pines basin area. Octagon house at 15400 Gorgonio View Road was identified as non-defensible.  
(Reference: C-4)

### **Finding 12.**

No strike team or task force/group leader was working with the five Forest Service engines and March Air Force Base - Brush 10 engine on this assignment.  
(References: A-3, O-1, and O-7)

**Finding 13.**

The five Forest Service engines and March Air Force Base - Brush 10 engine were working under the supervision of CAL FIRE Branch Chief (Branch II) at the time of entrapment directed to do triage and evacuation.

*(References: A-3, and F-5)*

**Finding 14.**

Type III engines were assigned to the lower Twin Pines basin area because of their inherent capability to operate on narrow, steep, or unimproved roads.

*(Reference: A-4, O-1, and Agreement between the Office of Emergency Services/CAL FIRE/USFS/BLM/NPS/F&WS - dated 04/17/2003)*

**Finding 15.**

Branch II had a face-to-face meeting with Engine 57 Captain at the Octagon House just prior to driving back up to the Twin Pines Road area.

*(References: F-4 and F-5)*

## ***Environmental***

**Finding 16.**

Fire behavior – The rapid rate of fire spread and growth, common in this fire environment, was observed early in the morning by all firefighters involved in the entrapment.

*(References: A-3, Witness statements, and photos)*

**Finding 17.**

Fire behavior – Multiple spot fires created area ignition as the fire established within the “unnamed creek drainage” came into slope and wind alignment.

*(References: SAIT-FBAN analysis, witness statements, and photos)*

**Finding 18.**

Fuels – Conditions were at the critical stages of live fuel moisture and identified as a critical factor for large fire potential.

*(References: SAIT-FBAN analysis, San Bernardino Pocket Card, and San Jacinto Mountain Community Protection Plan/MAST)*

**Finding 19.**

Weather - National Weather Service Fire Weather Watch was issued for the area on Tuesday, October 24, 2006 at 2:15 p.m. PDT (40 hours prior to the accident).

*(References: M-12 and Weather Specialist report)*

**Finding 20.**

Weather - National Weather Service issued a Red Flag Warning for the area on Wednesday, October 25 2006 at 10:34 a.m. PDT (20 hours prior to the accident).  
(References: M-9 and Weather Specialist report)

**Finding 21.**

Topography – The “unnamed creek drainage” was in alignment with predicted northeast winds.  
(References – On-site observation, on-site photos, and Witness statement U-6)

**Finding 22.**

Topography – The “unnamed creek drainage” is similar to other steep drainages or chutes associated with past wildland firefighter entrapments.  
(References: Site visit, and site photos)

**Finding 23.**

Topography – The terrain at the entrapment site is an elevated knob providing a view of the “unnamed creek drainage” from the edge of the slope break.  
(References: Site visit, and site photos)

**Finding 24.**

Topography - Type III fire engines were specifically assigned because of capabilities to access steep, narrow, dirt roads with adverse grades down into the area of the entrapment.  
(References: On-site observation, and incident resource requests)

**Finding 25.**

Topography - All suppression personnel and resources that accessed the lower Twin Pines basin area via Gorgonio View Road and Wonderview Road did so in the dark.  
(References: O-1, and witness statements)

**Finding 26.**

Structure – The shape of the Octagon House combined with topographical features at the accident site contributed to a wind/fire eddy effect and was also unsuitable to serve as an area of refuge due to the conditions.  
(Reference: On-site observations, and Photo)

**Finding 27.**

Structures/Lives – There were approximately 20 structures in the proximity of Gorgonio View and Wonderview Roads. There was also the evacuation of one civilian at 16600 Wonderview Road.  
(References: On-site observations, and Map C-4)

## **Material/Equipment**

### **Finding 28.**

Personal Protective Equipment (PPE) - All five firefighters on Engine 57 had agency required PPE which was subjected to high temperatures and significant direct flame exposure, conditions that far exceed the design limitations of these products.

*(References: Photos and PPE specialist report)*

### **Finding 29.**

PPE – All five firefighters had New Generation fire shelters in their possession. None were deployed.

*(References: Photos and PPE specialist report)*

### **Finding 30.**

Engine 57 - Maintenance records were complete and indicate the engine was in good condition and fully operable to Region 5 Model 62 Engine standards.

*(References: Photos and equipment engine specialist report)*

### **Finding 31.**

Engine 57 - All indications are the engine was operating with the pump engaged at the time of the turnover.

*(References: Photos and equipment engine specialist report)*

### **Finding 32.**

Communications- There was no radio communications between Branch II and the engines in the vicinity of Gorgonio View Road following the last face-to-face meeting with an engine captain at the Doublewide at approximately 6:30 a.m.

*(References: Witness statements and O-1)*

### **Finding 33.**

Communication - Radio communication on the incident was impacted by notable traffic demands on assigned frequencies (one command and two tactical).

*(References: Witness statements, A-3, and O-3)*

### **Finding 34.**

Communication – While monitoring the incident assigned frequencies, all five Forest Service engines maintained radio communications with each other on Forest Service tactical radio frequency not assigned to the fire.

*(References: Witness statements)*

**Finding 35.**

Communication - Initial attempts by Forest Service personnel to contact Incident Command Post to report a medical emergency were unsuccessful over assigned fire command and tactical frequencies.

*(References: Witness statements and A-3, and A-4)*

**Finding 36.**

Communication - Radio contact was established with the FICC dispatch radio frequency to report the turnover and medical response was initiated.

*(References: Witness statements and A-3, A-4, O-1, O-3)*

## **Causal and Contributing Factors**

The human elements are critical factors in the evaluation of this investigation. A risky decision or a series of risky decisions appear to have contributed to this dangerous situation from which there was no room for error.

***Causal Factors are any behavior, omission, or deficiency that if corrected, eliminated, or avoided probably would have prevented the fatality.***

### **Causal Factor 1.**

There was a loss of situational awareness concerning the dangers associated with potential fire behavior and fire environment while in a complex wildland urban interface situation.

*(Findings #12, #16, #18, #19,#20, #21,#22,#23, #25, #26, #32, and #33)*

### **Causal Factor 2.**

The decision by command officers and engine supervisors to attempt structure protection at the head of a rapidly developing fire either underestimated, accepted, and/or misjudged the risk to firefighter safety.

*(Findings #9, #10,#11, # 16, #17, #18, #19, #20, #22, #24, and #26)*

***Contributing Factors are any behavior, omission, or deficiency that sets the stage for an accident, or increases the severity of injuries.***

### **Contributing Factor 1.**

Organizational culture - The public (social and political) and firefighting communities expect and tolerate firefighters accepting a notably higher risk for structure protection on wildland fires, than when other resources/values are threatened by wildfire.

*(Findings #8 and #9)*

### **Contributing Factor 2.**

Fire environment - Santa Ana winds came into alignment with the “unnamed creek drainage” and the inversion was penetrated by the thermal uplifting from a fire run which contributed to extreme fire behavior and area ignition.

*(Findings #15, #19, #20, and #21)*

### **Contributing Factor 3.**

Fire environment - The fire burned in rugged terrain and the burnover occurred in the upper end of a steep drainage with fuel loads at seasonal low fuel moisture levels.

*(Findings #18, #22, and #23)*

**Contributing Factor 4.**

Fire environment – The terrain and road system limited access to Type III or smaller fire engines.

*(Findings #14 and #24)*

**Contributing Factor 5.**

Span of control – The five Forest Service fire engines and March Air Force Base 10 fire engine were not supervised by a strike team/task force leader. This contributed to increased complexity and span of control.

*(Findings #8, and #12)*

**Contributing Factor 6.**

Communications – The five Forest Service engines used a Forest Service tactical radio frequency not assigned to the fire for tactical discussions. Effective communication controls were not in effect prior to the incident.

*(Findings #32, #33, and #34)*

**Contributing Factor 7.**

Leader's intent – Communications between Branch II and Engine 57 Captain at the Octagon House were not clear or understood.

*(Finding #15)*

**Contributing Factor 8.**

A contingency map developed in 2002 for the area that identified structure location/defensibility and Mountain Area Safety Taskforce Interface Protection Plan information was not used for strategic or tactical risk assessments or plans.

*(Finding #10)*

# Appendix 1 - Fire Behavior Analysis Summary

## *Fire Behavior Overview*

A wildland fire was reported along Esperanza Road in the town of Cabazon, California on Thursday, October 26, 2006 at approximately 1:11 a.m. Pacific Daylight Time (PDT). The fire was initially burning in light, flashy fuels and soon became established in steep, rocky terrain. It burned up hill, influenced by very steep slopes, to Cabazon Peak and spread to the west and southwest. Within the first few hours, the fire behavior exceeded direct attack capabilities of the first on-scene initial attack fire suppression resources. The fire was now estimated at approximately 500 acres.

During this initial run, fire behavior was primarily influenced by steep slope, seasonally dry annual grass, and chaparral fuels. The developing Santa Ana Winds were still fairly weak with sustained winds out of the east at less than 10 mph.

As the Santa Ana condition continued to develop, the winds maintained a steady speed at lower elevations while steadily increasing at the higher elevations. By 3:00 a.m. PDT, as the fire reached the upper elevations on the northern aspect of Cabazon Peak, wind speeds ranged from 6 mph gusting to 20 mph out of the east through Banning Pass while northeast winds were increasing in strength at the top of Cabazon Peak. These winds were now pushing the fire in a southwest direction toward the Hurley Flat area. Fire brands were carried to the west of Cabazon Peak and spot fires developed. Additionally, the fuel type transitioned from annual grasses and chaparral to heavier mixed mature chaparral intermixed with Manzanita, Mountain Mahogany, and Sage.

Between 4:00 a.m. and 5:00 a.m. PDT, the wind speeds increased to 10 mph with gusts to 23 mph. Relative humidity was recorded at 6 percent. The fire made significant progress to the west towards the Hurley Flats and the Twin Pines Ranch area. Acreage was estimated between 900 to 1,500 acres. Extreme fire behavior with sustained head fire runs and spotting was observed.

As the fire moved around the west side of Hurley Flat and into Twin Pines Creek, the terrain sheltered the wind which, essentially, slowed the progress of the fire. As the fire burned to the west of Twin Pines Creek drainage it began a significant up slope run as the fire came under the influence of the northeast Santa Ana wind. Spot fires were reported ½ mile ahead of the main fire front at this time.

Between 5:30 a.m. through 6:30 a.m. PDT, the fire made a significant, sustained head run to the southwest that was influenced by channeling winds up Twin Pines Creek and its many tributaries. This run reached Twin Pines Road at a point about 1 mile directly south of the accident site. Relative humidity was holding between 5 percent and 6 percent and the north/north east winds had now increased to 13 mph, gusting to 31 mph. Public evacuations were implemented in the Twin Pines community, and residents in the

Poppet Flat area were initially ordered to shelter in place, then evacuate as the fire threat passed and road conditions were declared safe. Additionally, engine personnel assigned to structure protection on Wonderview Road took defensive positions inside their engines as the fire front passed them. Fire size at this time was estimated around 2,200 acres.

As the fire progressed to the south/southwest during the 5:30 a.m. to 6:30 a.m. run, it established on a ridge immediately east of the accident site. This fire was observed by engine personnel assigned to structure protection along Wonderview Road and Gorgonio View Road.

Around 7:00 a.m. PDT, several factors came together to cause a rapid increase in northeast winds that directly influenced the fire behavior.

- A temperature inversion formed at the 6,000 foot level. This temperature inversion channeled the winds near the ground and restricted upward air movement. This temperature inversion registered on the Mercury, Nevada upper air sounding and was confirmed by pilots flying over the area on the morning of October 26.
- About 1 mile directly south of the accident site, the fire had generated enough heat for a convective plume to penetrate the 6,000 foot temperature inversion. This plume rose between 18,000 feet and 24,000 feet during the timeframe of 7:00 a.m. and 8:00 a.m. PDT.
- The fire established in the “unnamed creek drainage” down canyon of the accident site at a point in time when air feeding into the plume was being driven by the increasing northeast Santa Ana Winds.
- The orientation of the “unnamed creek drainage” was directly in line with the northeast winds which allowed the winds to increase with minimal resistance from terrain.

The fire reached the fatality site sometime between 7:00 a.m. and 7:30 a.m. PDT. The combination of strong surface wind speeds and the influence of the rising smoke plume, slopes, and heavy fuels along with significant spot fires burning together created an area ignition event. Firefighters assigned to structure protection on Gorgonio View Road and Wonderview Road observed the area ignition occur. They noted a topographical “bowl” about ¼ square mile in size became fully engulfed in flames in less than five minutes.

The accident site was located at the top of the “unnamed creek drainage” on a round prominent knoll, with drainages on both sides that are tributaries of the “unnamed creek drainage”. The “unnamed creek drainage” is oriented northeast to southwest, in nearly exact alignment with the winds observed on the morning of October 26. The winds were channeled from the northeast directly up slope, up drainage to the accident site, which included the Octagon House. The weather factors came into alignment with the advancing fire front at a point in time to pull the fire front rapidly through the accident

site. Firefighters located approximately 1,500 feet to the south of the accident site on Gorgonio View Road, estimated wind speeds between 50 and 70 mph in the local area. The wind direction and topographic shape of the accident site channeled the wind and flame directly at the Octagon House and Engine 57. As the flame front moved over and around the Octagon House, the shape of the house enabled the flame front to wrap around both sides of the house meeting on the downwind side.

## ***Fire History***

There is a notable history of wildfire occurrence in the geographical area of the Esperanza Fire documented in the California Interagency Historical Fire Perimeter Database. An analysis of records from 1950 through 2005 indicates that 11 fires have burned within the Esperanza Fire perimeter or vicinity during these 55 years.

The presence of fire in the landscape is evidenced by existing fire scarred trees, and the current age classes of trees and shrubs. In the case of the Esperanza Fire, the age class of the shrubs and chaparral are consistent with the historical records from the database. This finding supports the commonality of fuel loading and fire frequency in the Esperanza Fire area. The age of the chaparral is representative of a fire return interval of 9 to 18 years. The following historical fires selected from the records confirm the established fire return interval.

- |             |           |      |                                 |
|-------------|-----------|------|---------------------------------|
| • Edna      | August    | 1998 | Involved the accident site      |
| • Peach     | September | 1995 | Esperanza Fire point of origin  |
| • Wolfskill | August    | 1996 | Just north of the accident site |
| • Orange    | August    | 1996 | Northeast of the accident site  |

Of historic note, three previous fatality fires occurred in the vicinity of the Esperanza Fire.

- |           |           |      |                        |
|-----------|-----------|------|------------------------|
| • Bailiff | October   | 1967 | 1 firefighter fatality |
| • Mack 2  | September | 1971 | 1 firefighter fatality |
| • Edna    | August    | 1998 | Airtanker crash        |

## ***Fire Environment***

### **Fuels**

The predominant fuels represented in the area are common California Chaparral. Specifically, fuels were Manzanita, Mountain Mahogany, Sage, Chamise, and annual grasses. Fire Behavior Prediction System, (FBPS) fuel models 1 (grass) and 4 (Chaparral)

were used to model surface fire behavior. Fire Resource Assessment Program (FRAP) categorizes the fire area as an extreme fire threat with a very high fuel rank.

Fuels in the area historically average a growth density of 1 to 1.5 acre tons per year. The age class of fuel in the area was 17 years which is considered mature vegetation. The fuel loading is estimated to be 20 to 25 tons per acre. The average fuel height was five feet with areas of 8 foot intermix of Manzanita and Mountain Mahogany throughout. Overall, fuels were very volatile and had latent potential for significant energy release due to age and tons per area.

Fuel moisture content was influenced by the normal summer season lows which occur between the months of September and December. Fuels had become increasingly dry and flammable. The old growth plants had developed fine to larger dead branches within which were kindling dry and able to promote rapid and large fire growth. Live fuel moistures were estimated at <60 percent in Chamise and Sage Brush. Manzanita and Mountain Mahogany which are larger broadleaf shrubs held a slightly higher value of <75 percent. The dead fuel moisture contents in the 1 and 10 hour timelag fuels were at an equal value of 3 percent at the time of the fire start. Based on on-site and predicted weather, the probability of ignition given these fuel moistures is between 80 percent and 100 percent. Fire consumption in 1, 10, and 100 hour fuels would achieve 100 percent and consumption in the live fuels would average 90 percent.



Fire Behavior Analysis Figure 1. Fuel loading before Esperanza Fire



Fire Behavior Analysis Figure 2. Fuel loading after Esperanza Fire

## Weather

A Red Flag Warning had been issued on Wednesday, October 25, 2006 at 10:34 a.m. PDT. The Red Flag Warning called for northeast winds 20 to 30 mph with gusts to 40 mph with relative humidity's below 10 percent. At the Beaumont Remote Automatic Weather Station (RAWS) 9 miles west of the fire origination point, winds increased out of the east with gusts to 25 mph and relative humidity's decreased below 10 percent shortly after 12:00 a.m. PDT on October 26. As reported by the Beaumont RAWS (the only reliable weather reporting site near the Esperanza Fire), winds continued to increase through the morning hours of October 26 with peak gusts reaching 39 mph at 10 a.m. Humidity remained at or below 10 percent during the entire day of October 26.

Weather factors that significantly affected fire behavior on the morning of October 26 were:

- 1) the low relative humidity's
- 2) the wind strength and direction being in alignment with terrain
- 3) winds being capped by the inversion near 6,000 feet
- 4) the plume punching through the inversion directly downwind of the accident site shortly before the turnover

When the Santa Ana Winds began shortly before 12:00 a.m. PDT on October 26, they brought very dry air with relative humidity at or below 10 percent through Banning Pass. The winds through Banning Pass along the valley floor remained out of the east through all of October 26. Once the Santa Ana Winds began, they increased in strength through the morning hours of October 26. While winds in Banning Pass were out of the east,

winds over the terrain to the south, including the accident site, were primarily out of the northeast. These northeast winds were in alignment with the slope (blowing directly uphill) in some areas, and were blowing across the slope in other areas. Where the wind and slope were in alignment, fire behavior became extreme. This was observed by several firefighters who were located at different sections of the Esperanza Fire.

The inversion played a critical role in holding the strong northeast winds near the ground. In the absence of the inversion, the northeast winds would have expanded upward with a net reduction in wind speed near the ground. With the inversion in place, the air movement was confined between the ground and the inversion. As the air moves southwest from the Banning Pass area across the steadily rising terrain, the space between the ground and the inversion decreases. The inversion also rises as the air moves over the higher terrain but at an amount less than the ground is rising. The result is there is less space for the air to move through, as the air moves southwest over the higher terrain. In this situation, the wind speed increases as the air rises over the terrain. Highest wind speeds occur along ridgelines that are perpendicular to the wind direction. The final factor that proved critical in how fast the fire front moved through the accident site was the inversion being penetrated by the smoke plume rising approximately 2 miles southwest of the accident site shortly before the turnover.

As discussed in the weather section, this plume rose to between 18,000 feet and 24,000 feet at a location directly downwind of the accident site. When this plume penetrated the inversion, it acted as a relief valve on the resistance of the wind trying to blow between the inversion and the terrain. With the plume in place, air could rise upward into the plume as well as move downstream under the inversion. This allowed wind speeds to increase rapidly just as the fire front was moving up the “unnamed creek drainage” toward the accident site. The plume acted as a chimney draft pulling the air upward. The only place this air could come from was through the “unnamed creek drainage” past the accident site.

## **Topography**

The topographic features throughout the area can be described as steep, very broken terrain with many branching drainages and narrow canyons. The accident site has a north to northeast aspect and the “unnamed creek drainage” below the accident site is aligned northeast to southwest. The “unnamed creek drainage” is 1.5 miles long and is approximately ¼ mile wide with average slope at 25 percent. The run of the slope is at average of 50 percent. These features will cause winds to channel, compress, increase in speed, and become erratic.

The United States Geological Survey Map, USDA Forest Service, Cabazon Quadrangle California-Riverside County, 7.5- Minute Series and site visit was used to describe the topographic features of the accident site.

## ***FIRE BEHAVIOR***

The fire consumed an estimated 500 acres within the first 2 hours as it ran to the southwest up Cabazon Peak. Numerous spot fires, including one greater than ½ mile ahead of the fire front were reported by firefighters on scene. During the first five hours of the fire, flame lengths were 30 to 60 feet with head fire alignment and the rate of spread (ROS) was approximately 60 chains an hour (ch/hr).

The fire's westerly travel direction and rate of spread was influenced by the following variables:

- The fire spread was primarily dominated by wind.
- The fire's greatest rate of spread was when the wind and slope came into alignment.
- Fire spread at times was dominated by topography when the terrain sheltered the wind.
- The fire displayed slower spread and less intensity when out of slope and wind alignment.

The fire traveled in a southerly direction during the initial run due to topographic influences. When the fire reached the upper ridgelines, the easterly wind drove the fire in a westerly direction. Fire alignment created differences in spread rates depending if the fire was backing, flanking, or a running head fire. Several significant head fire runs developed prior to the burnover; two traveled ¼ mile in less than 3 minutes. The fire was realigning and intermittently traveling at 800 to 1200 Ch/hr or 10 to 15 mph in full alignment. The intermittent fire runs would travel 40 to 120 chains or ½ to 1 ½ miles at a time. The fire was in full alignment with wind and slope at the time of the accident.

Extreme fire behavior was encountered intermittently within the fire environment prior to the reaching the Octagon House and Engine 57. The fire drastically increased in velocity due to the converging of synoptic scale winds out of the northeast and terrain influences. These conditions aided and intensified the developing head fire run to the southwest to the ridgeline.

As the fire increased in size, spotting became more prevalent with air and fuel temperatures rising from the influence of this dynamic. Multiple spot fires created area ignition as the fire established within the "unnamed creek drainage" came into slope and wind alignment.

At the same time, a developing convection column was standing up within the strong wind field. The fire environment dominated the atmosphere with area ignition surrounding the accident site and a convection column rising between 18,000 feet and 24,000 feet.

On-site accounts and scientific modeling confirmed a head fire run in excess of 30 miles an hour and winds exceeded 50 mph at the accident site. Burn indicators found in the trees at the accident site indicate the flame height remained within 15 feet of the ground.

This is indicative of the wind remaining parallel with the ground and increasing in speed near the ground as the wind climbed the slope extending to the ridgeline.

See Exhibits 2, 3, 4, 12, 13 for photos references of this section.



Fire Behavior Analysis Figure 3. Scorch Height

## **Appendix 2 – Fire Operations Analysis Summary**

On October 26, 2006, at approximately 1:11 a.m. (Pacific Daylight Time) a fire was reported at the base of San Gorgonio Peak immediately southeast of the town of Cabazon in Riverside County, California. The fire was initially burning in light, flashy fuels and soon became established in steep, rocky terrain. It quickly spread to the west and southwest up very steep slopes to Cabazon Peak, driven by northeast Santa Ana winds.

The first on-scene engine was Medic Engine 24. Fire Captain 24 was identified as the Esperanza Fire Incident Commander. Upon arrival, Battalion Chief 3113 (BC 3113) assumed command from Fire Captain 24.

Fire potential was estimated at 25,000 acres. Multiple resource orders were placed based on the fire potential. The initial span of control was set up with two divisions, A (east flank) and Z (west flank). Battalion Chief 3116 (BC 3116) was assigned as the Operations Section Chief for oversight of division assignments.

The Riverside Sheriff's Office was engaged early on concerning the possible threat of evacuations. The fire was estimated at approximately 100 acres and burning up slope on Cabazon Peak. The Esperanza Incident Command Post (ICP) was at Station 24 in Cabazon and later expanded to the Community Center, located next to the CAL FIRE Riverside County Fire Department Station 24.

At 1:15 a.m. Division Chief 3106 was notified of the fire and responded from home. Division Chief 3106 (DC 3106) arrived at the Esperanza ICP at approximately 2:00 a.m. DC 3106 met with BC 3113 and was briefed on the situation and confirmed resource orders that had been submitted. DC 3106 assumed the Esperanza Fire Incident Commander (IC) role from BC 3113. Esperanza IC directed BC 3113 and BC 3116 (Operations) to review and organize all resource orders currently in the system.

Between 3:00 a.m. and 4:00 a.m., the fire activity increased and significant fire spread was observed from the ICP. The fire size was estimated to be between 500 to 800 acres. The decision was made to expand the organization from two Divisions into two Operational Branches with a structure group in the Twin Pines area. The north side or bottom portion was designated Branch I and the south portion, and at the top on Twin Pines was Branch II.

BC 3113 was assigned as Branch I. During this time period, BC 19 and BC 3114 arrived each with an engine strike team. BC 19 was re-assigned as Branch II and BC 3114 was assigned as Twin Pines Structure Protection Group Supervisor under the command of Branch II.

During this timeframe, there was a significant amount of fire activity, resource orders being placed, resources checking-in and being assigned and a tremendous amount of

radio traffic, coordination and decision making regarding the fire potential at sunrise and discussions of evacuations in the Twin Pines area.

At 4:00 a.m., the decision was made to evacuate the Twin Pines area. Five BDF Type III engines arrived at the ICP as five single resource engines. They received an assignment to proceed to the Twin Pines area for structure protection. As the five BDF engines were leaving the ICP, they identified a new fire start along Interstate 10. One BDF engine pulled off to suppress the new fire start, containing it at ½ acre. The remaining four BDF engines continued on to Twin Pines and arrived around 4:50 a.m.

### ***Timeframe Highlights (1:00 a.m. to 5:00 a.m. PDT)***

- Fire activity was clearly visible to firefighters traveling to and from the ICP.
- The forecasted Red Flag Warning for Santa Ana winds was reportedly known by all.
- Existing detailed maps of the area were not used/made available to brief the engines when they checked in at the ICP.
- Instructions were passed on from one engine captain to the other.
- The engines were assigned as single resources without a strike team/task force leader.
- One engine was temporarily delayed in meeting up with the rest in the Twin Pines area due to a reported second fire along Interstate 10.
- Several other command staff and suppression resources also reported to the fire, including: a Forest Service Agency Representative/Battalion Chief; Forest Service Division Chief; CAL FIRE Deputy Chief; San Bernardino Forest Fire Chief/Duty Officer; and several CAL FIRE engines; water tender; and dozer.
- Two CAL FIRE command officer's responded each with an engine strike team. One was reassigned as Branch II and one was reassigned as Twin Pines Structure Group.
- An order was placed for an Incident Management Team.

At approximately 5:00 a.m., Forest Service engines started to arrive in the Twin Pines Road area. Engines 57 and 52 were the first engines to drive down Wonderview Road to perform structural triage and assist with an evacuation. Engine 57 took the lead and initially stopped at the Tile House before finally taking up position at the Octagon House. Following the completion of an evacuation assignment, Engine 52 selected the Tile House to defend. The remaining other 3 Forest Service engines and a March Air Force Base - Brush 10 fire engine (MB-10) attempted to travel down Wonderview road. They discovered the road was cut-off by the fire so they were redirected by Branch II to travel down Gorgonio View Road and locate a defensible structure.

## ***Timeframe Highlights (5:00 a.m. to 6:30 a.m. PDT)***

- The fire had reached the lower areas of the dispersed Twins Pine community, had crossed one of two access roads, and extreme fire behavior was observed by all.
- Fireline supervisors directing operations in the Twin Pines area included a CAL FIRE Operations Section Chief, Structure Protection Group Supervisor, and Branch II Director.
- Briefings were given to a few individual engine captains, some information was passed on from captain to captain, and some instructions were relayed from other overhead or over the radio.
- Branch II traveled down into the lower portions of Wonderview and Gorgonio View Roads and had sized up the areas.
- Five Forest Service engines and a March Air Force Base – Brush 10 fire engine (27 firefighters collectively) were assigned a structure protection mission that required them to travel nearly 2 miles down (500 foot drop in elevation) a steep (12 percent grade) winding dirt road — in the dark.
- A wide range of buildings and property were scattered throughout the area, including: single family homes, double/single wide manufactured homes, travel trailers/motor homes, outbuildings, vehicles, and equipment.
- Approximately 20 structures were dispersed along poorly marked roads and many were not defensible even under “normal” conditions
- The area surrounding the Octagon House included a notable amount of ornamental fuel loading, outbuildings, vehicles, and other scattered property.
- The assignment involved a defensive position at the head of an advancing 500 plus acre fire burning in heavy brush and exhibiting extreme fire behavior in and adjacent to a long steep drainage (chimney) with Santa Ana winds forecasted to arrive at dawn.

Engines 51, 54, 56, and MB-10 arrived at the Doublewide and immediately took action to defend their position. Branch II met with one of the engine captains at the Doublewide. Shortly after, Branch II discovered the location of Engine 57 at the Octagon House, located approximately 1,500 feet down the road from the Doublewide. Branch II and Engine 57 Captain met at the Octagon House and discussed the situation. Branch II then drove up Gorgonio View Road and briefly met with one of the BDF Captains at the Doublewide and advised them of Engine 57’s location. Branch II drove back up to the Twin Pines Road at approximately 6:30 a.m. Between 6:30 a.m. and 7:30 a.m. resources at the Doublewide and Octagon House were overrun by the fire.

The fire passed by Engine 52’s location at the Tile House first. Engine 52 was positioned in the most defensible location, but eventually took refuge in the engine during peak fire activity, smoke blanketing, and ember showers. After the smoke cleared, firefighters at the Tile House observed the fire blow up the upper reach of the “unnamed creek drainage” and overrun the Octagon House and Doublewide engine positions.

The firefighters at the Doublewide took vigorous protection measures to defend the structure and secure an area of refuge, including a critically timed burnout just prior to

the fire front hitting. Attempts to contact Branch II on assigned command frequency prior to the burnout were unsuccessful. Some fire hose and incidental property were burned by the fire, but the main building survived following an aggressive fire fight. Before it was over, all the firefighters withdrew to the safety of the engines.

Engine 57 Captain made several radio contacts on a Forest Service radio tactical frequency not assigned to the fire with the firefighters at the Tile House and Doublewide prior to the burnover. Reports by those who talked to Captain 57 during this time indicate that he was secure at his location. He informed others that he had a good water source available. A portable pump was set up in the swimming pool. Its ignition switch was on and in a full throttle position. A 1½ inch hose was connected to the pump and extended to the east side of the building with a 1 ½ inch combination nozzle attached in the closed position. A 1½ inch hose, attached to the engine's rear discharge, was also found partially unfolded on the ground.

When no radio contact could be made with Engine 57 following the passage of a fire run that hit the Octagon House, a search began by fire personnel from both the Tile House and Doublewide. Initial attempts to contact command to report the medical emergency were unsuccessful on the assigned fire radio frequency. However, radio contact was promptly established with the San Bernardino National Forest Dispatch and an evacuation response was initiated.

### ***Timeframe Highlights (6:30 a.m. to 8:00 a.m. PDT)***

- Refer to Appendix 3 for LCES Summary Analysis
- Santa Ana winds surfaced at precisely the (Red Flag) forecasted time, location, and strength.
- Within the first seven hours of the initial operational period, the Esperanza Fire was out of the box. Almost all resources, including other engines along Highway 243 and in the Twin Pines Road/McMullen Flats area, were overrun by the fire.

At 8:05 a.m., during a conference call with California Southern Operations Center (South Ops), CAL FIRE Agency Administrator is notified about a possible engine burnover. South Ops advise they heard this information from the BDF intercom. The IC overheard radio traffic on an outside speaker at the ICP on BDF Forest Net regarding an engine burnover. Branch II notifies IC on a cell phone and confirms a BDF engine was burned over and at this time there were two burn victims and three firefighters missing. D3104 was assigned as IC to manage the incident within the incident. Rescue attempts began and two burned firefighters were transported by helicopter to Banning Airport. Branch II was relieved and replaced by a CAL FIRE command officer.

All BDF and MB-10 engines are released from the fire and relocate to the USFS station at Vista Grande.

## Appendix 3 – LCES Analysis Summary

<b>Lookouts, Communications, Escape Routes, Safety Zones (LCES) Analysis</b>			
Critical components associated with LCES safety system application - Engine 57			
E = Established	NE = Not established	IP = In place	NP = Not in place
DW = Doublewide	TH = Tile House	LO = Lookout	
<b>LOOKOUTS</b>		<b>Remarks</b>	
<b>Trained/Qualified</b> – Experienced with authority to take action?	IP		Engine 57 Captain was trained, qualified, and experienced to serve as a tactical lookout. There were no strategic lookouts assigned at other locations with a big picture view of the operation.
<b>Equipped</b> - Map, weather kit, binoculars?	IP		Local area map (topo w/roads) may not have been used or available.
<b>Location</b> – Good vantage point in safe spot?	IP		Entrapment/burnover confirms that location was not safe. LO had to remain in position at lip/edge of chute to have a complete/clear view into the bottom of the drainage below the structure.
<b>Escape Routes/Safety Zones</b> – Knowledge of locations?	IP		LO location was not survivable given the fire environment and conditions.
<b>Adjoining forces</b> – Knowledge of locations?	IP		Engine 57 was aware of the other engine’s locations at the DW and TH, and did provide them with some information on the fire activity and operations.
<b>COMMUNICATIONS</b>		<b>Remarks</b>	
<b>Effective (face-to-face) briefings:</b> <ul style="list-style-type: none"> <li>▪ LCES?</li> <li>▪ Fire Environment?</li> <li>▪ Hazards/Risks?</li> <li>▪ Strategy/tactics?</li> </ul>	IP		Branch II had a face-to-face meeting with Engine 57 Captain at the accident site just prior to the burnover.
<b>Radios</b> – Established communications with known frequencies?	IP		Engine 57 used a Forest Service radio tactical frequency not assigned to the fire to maintain communications with other FS engines at the DW and TH.
<b>Adjoining forces</b> – Informed of LO location/role?	IP		Engine 57 was aware of location of the fire engines located at the TH and DW.
<b>Status checks</b> – Updates/warnings/trigger points?	IP		Available trigger points were not effectively used.
<b>Clear</b> – radio discipline, chain of command, important info?	IP		Engine 57 used a Forest Service radio tactical frequency not assigned to the fire.

<b>ESCAPE ROUTES</b>			<b>Remarks:</b>
<b>Planned/Scouted?</b>	NP		Engine 57 did not scout out alternative escape routes in the area of refuge at the DW. Both roads up and out to Twin Pines Road were compromised by fire early on.
<b>Flagged/ID?</b>	NE		
<b>Timed/distance?</b>	NE		The distance to the DW area of refuge was approximately 1,500 feet from the accident site.
<b>Barriers?</b>	NE		Smoke and heat at the DW area of refuge once the burnout started.
<b>More than one?</b>	NE		
<b>Traffic control?</b>	NE		Both access roads/routes were cut off by fire.
<b>Monitored?</b>	NE		No strategic command oversight of operation.
<b>SAFETY ZONES</b>			<b>Remarks:</b>
<b>Clean burn, natural, developed vehicle?</b>	NP		Engine 57 Captain communicated to others on the radio that he felt secure at his location. Location/structure included heavy fuels and a notable accumulation of flammable property items on the ground, including several out buildings and vehicles.
<b>Planned/Scouted?</b>	NP		Secondary safety zone at DW was not scouted.
<b>Large enough?</b> – Factors: people, equipment, fire environment	NP		Primary safety zone was not large enough and a potential identified secondary safety zone at the DW required precision burnout/holding to serve as a marginal area of refuge.
<b>Terrain</b> - Saddles, chutes, canyons avoided?	NP		Accident site is located at the top of a long, steep drainage (chute).
<b>Location</b> - known by all?	NP		
<b>Hazards ID?</b> – Snags, power lines, hazmat?	NP		The round shape of the Octagon House contributed to a fire eddy effect and negated the opportunity for firefighters to use the house as a refuge.

## Appendix 4 – Standards for Fire Operations Analysis Summary

### *Issue*

Different expectations, operational standards, and unclear leader's intent regarding firefighter safety while actively engaged in a complex interagency wildland interface fire environment can complicate and potentially compromise firefighter safety.

### *Discussion*

The Esperanza Fire was managed under a Cooperating Fire Protection Agreement (CFPA) signed on 01/01/2002 between the Bureau of Land Management (BLM), National Park Service (NPS), U.S. Forest Service (USFS), and California Department of Forestry and Fire Protection (CAL FIRE). The following is a notable excerpt from this agreement:

#### “RECITALS

- 3. The State and Federal agencies acknowledge that differences exist between agency missions, but that each will represent the other agency's interests and must possess the recognition, knowledge and understanding of each other's mission objectives, authorities and policies. To the extent that “incident” objectives allow, each agency agrees to honor and aggressively pursue remedies to emergency fire situations that are consistent with what the other agency would have done had it been present. In “unified command” incidents, Incident Commanders must recognize each agency's mission objectives, authorities, and policies and agree as to how they will operate in compliance with same.”*

This CFPA permits cooperating agencies to provide fire management services on other agency's jurisdictional lands. All authority for fire management activities, however, is retained by the jurisdictional agency administrator. Agency administrators do not have the authority to accept different operating standards of the other agencies except for qualification standards. This cooperative agreement does not specify that the standards of the jurisdictional agency prevail, and thus jurisdictional authority and standards dictate the rules of engagement. The complexity of this situation is compounded when a fire is as challenging and dynamic as the Esperanza Fire.

## **Issue**

There are few, but nevertheless notable differences between the Forest Service's and CAL FIRE's missions, objectives, authorities, and policies concerning firefighter safety.

On initial and extended attack incidents, agencies use cooperating agreements and a supplemental Annual Operating Plan to enable rapid response and avoid being encumbered by different agency specific administrative/documentation requirements. The Annual Operating Plan does not address how the host agency will apply critical safety standards; rather, they rely on each agency to comply with their own safety procedures. A pitfall in this approach is that important safety requirements and mitigation could be overlooked or neglected by agency administrators, command officers, and firefighters due the overwhelming urgency and demands created during operational periods for fire in the wildland urban interface during initial attack, extended attack, and transition.

## **Summary**

The clear intent expressed as a guiding principle in the CFPA is “aggressive fire suppression”. The word “aggressive” is used seven times in the document while the doctrine of “firefighter safety first” is mentioned only once. Existing safety rules and risk aversion did not notably influence decisions to aggressively engage in the Esperanza Fire, while aggressive risk management and anchoring to foundational wildland firefighting safety principles was less than apparent.

Excerpt from the CFPA:

### *“31. Protection Priorities*

*The State and Federal Agencies agree that they mutually share technical responsibilities for all values at risk from wildfire within their respective DPAs. Further, each agency agrees that incident management objectives will provide for firefighter safety first and recognize the following priorities:*

- 1. Threat to human life.*
- 2. Threat to property (e.g., structures, improvements, and communities) and natural /cultural resources.*

*To the extent that incident objectives allow, the State and Federal Agencies agree to honor and aggressively pursue remedies to emergency fire situations that are consistent with what the other agencies would have done had they been present. **Specifically, the State and Federal Agencies acknowledge the necessity of demonstrating aggressive diligence in protecting structures and improvements from wildfire and protecting wildland and watershed from structure and improvement fires.**”*

The following is some additional points of note related to the CFPA:

*“14. Operating Plan*

*An Operating Plan will be mutually prepared and approved by each Bureau Field Office, National Park Service Unit, or National Forest and the appropriate State Unit. The Operating Plan will be a local working document that is developed between the various Bureau Field Offices, National Forests, National Park Service Units and the appropriate State Units, and shall be an attachment to the Cooperative Fire Protection Agreement. It shall be forwarded to the CAL FIRE Director and the BLM State Director, NPS Regional Director, or FS Regional Forester by May 15, following approval by the designated State representative and the Bureau Line Officer, Park Superintendent or Forest Supervisor.”*

- Records were unavailable to determine if the draft 2005 “Operating Plan” as required under the Cooperative Fire Protection Agreement was annually reviewed and approved; signed jointly.
- The draft “Operating Plan” encourages but does not require interagency training activities at the local level.
- The annual “Training Operating Plan” that is required by the CFPA has not been developed. However, a major interface zone training exercise involving 40 engine companies and 20 fire officers was conducted in the San Bernardino and San Jacinto Mountains on June 15, 2005.
- The duration of the existing CFPA shall continue through December 31, 2006.

## **Appendix 5 – Compliance Analysis Summary**

### **Thirtymile Hazard Abatement – Monitoring Checklist**

Not a standard for other wildland fire agencies, Forest Service specific.

Summary: Unclear direction in the Cooperative Fire Protection Agreement regarding how/if/when this standard should apply.

### **Cramer Fire Accident Prevention Plan**

Not a standard for other wildland fire agencies, Forest Service specific.

Summary: Unclear direction in the Cooperative Fire Protection Agreement regarding how/if/when this standard should apply.

### **Complexity Analysis**

Not a standard for other wildland fire agencies, Forest Service specific.

Summary: Unclear direction in the Cooperative Fire Protection Agreement how/if/when this standard should apply (roles/responsibilities).

### **Personnel Medical Surveillance Folders**

Employee medical surveillance records were reviewed.

Summary: Written Respiratory Protection Program for Self-Contained Breathing Apparatus (SCBA) was in place and to agency standards.

### **Employee IQCS Qualifications**

IQCS qualifications for employees were reviewed.

Summary: All met IQCS standards.

## **Leadership Training**

Engine 57 Captain's training history, including all position prerequisites, included: L180 – Human Factors; L-280 – Followership to Leadership; L-380-Fireline Leadership; N9019 - ICT3 Simulation – Time Pressured Simulation Assessment; and S-215 – Fire Operations in the Wildland Urban Interface.

Leadership training standards for CAL FIRE firefighters differ from USDA Forest Service.

Summary: The outcome of this fire demonstrates the challenge in assessing the effectiveness of recent advancements and individual accomplishments in training. It does support the notion that training alone should not be the default proposed solution to achieve desired safety performance, especially given our understanding of the critical role human factors play in a dynamic fire environment.

The S-215 – Fire Operations in the Wildland Urban Interface was recently revised and improved. However, some questions remain about some of the practices/tactics taught that could conceivably make it more difficult for an engine to make a quick retreat.

## **Weather Forecast**

A spot weather forecast was requested and received by the Incident Commander early on in the incident, prior to the accident. The spot forecast confirmed the Red Flag Warning. A Fire Weather Watch was issued for the area 2 days prior to the accident. A Red Flag Warning was issued the day before the accident. Witnesses' statements and weather reports confirm "Red Flag Warnings" were in effect for the early morning of the incident. Refer to the Esperanza Fire Weather Summary for additional details on compliance.

Summary: The reported awareness by most firefighters about the Red Flag Warning for Santa Ana wind conditions did not seem to influence the strategy of engagement or temper the tactical decisions made in any discernable way.

## **Engine 57**

Based on a site analysis and review of maintenances records, Vehicle 6652 Engine 57 was in good condition and fully operable for a Region 5 standard Model 62 (Type III) Engine.

## **Fire Shelter**

Missoula Technology Development Center (MTDC) Equipment Specialist determined the fire shelters in the possession of firefighters were to standard.

## **Written Plans/Policies**

A review of Agency Fire Management Plans show progress in the integration of interagency objectives and policies, but many important differences still exist.

Summary: Written direction for the management of fires is numerous, confusing, and in some cases, contradictory. There are separate or additional requirements that relate specifically to the agency responsible for managing the fire. Some agency protocols such as fire transitions (Type III to Type II/ I) documentation are generally the same, but lack consistency regarding safety. For example, CAL FIRE Incident Command Team Transition Briefing and Debriefing Form (7700) do not include a risk management or safety component.

The Cooperative Fire Protection Agreement, in place for the past several years and up for renewal, has resulted in a better understanding of the differences and strengths of each agency. An opportunity for improvement based on lessons learned is evident, particularly in the vital area of firefighter safety.

## **Appendix 6 – Fire Weather Analysis Summary**

On Wednesday, October 25, 2006, a winter storm moved from Idaho through Utah into Colorado. Behind this winter storm high pressure was building southward into Nevada. The combination of high pressure building into Nevada from the north and low pressure off the California coast caused a moderate Santa Ana Wind event over Southern California from late Wednesday evening through late Saturday evening — October 25 through 28, 2006.

This weather pattern is a classic setup for a Santa Ana wind episode. The National Weather Service Forecast Office (NWSFO) in San Diego (which has forecast responsibility for the area surrounding the Esperanza Fire) first mentioned the possibility of Santa Ana Wind conditions on Saturday, October 21 at 1:45 p.m. Pacific Daylight Time (PDT) in an issuance of the Fire Weather Planning Forecast. On Tuesday, October 24 at 2:15 p.m., NWSFO San Diego issued a Fire Weather Watch for the area which included the San Jacinto Mountains. On the morning of Wednesday, October 25, 2006, during the daily conference call between NWSFO San Diego, NWSFO Oxnard, and the South Area Operations Center Geographical Area Coordination Center (South Ops GACC), there was unanimous agreement that a Red Flag Warning was warranted for the area beginning Wednesday night. NWSFO San Diego issued a Red Flag Warning for the area the morning of Wednesday, October 25 at 10:34 a.m. PDT. It is NWSFO San Diego policy to fax all Red Flag warnings to the dispatch centers affected by the warning. This Red Flag Warning was faxed to the CAL FIRE Riverside Unit (RRU) Dispatch Center at 10:51 a.m. and to the San Bernardino National Forecast Dispatch center at 10:59 a.m. At 4 p.m. PDT on Wednesday, October 25, the San Bernardino National Forest dispatch center broadcast the Red Flag Warning information on their radio network.

All forecasts of this Santa Ana Wind episode issued by NWSFO San Diego were consistent from the Tuesday issuance of the Fire Weather Watch to the Wednesday afternoon issuance of the Fire Weather Planning Forecast. These forecasts called for Santa Ana Wind conditions to begin late Wednesday night (October 25, 2006) with the strongest winds expected Thursday morning after sunrise. Peak wind speeds were forecast to reach 40 miles per hour (mph) with gusts to 60 mph possible in mountain passes. Relative humidity was also forecast to fall to be at or below 10 percent during the entire time the Santa Ana wind was blowing.

At roughly 2:30 a.m. on Thursday, October 26, 2006, the forecaster at NWSFO San Diego noticed a hot spot (indicating a possible fire) near San Geronimo Pass on infra-red satellite imagery. At 3:13 a.m. PDT on Thursday, October 26, the RRU dispatch center received a request for a spot weather forecast for the Esperanza Fire from commanders in the field. This spot request was entered into the NWS computer system at 3:16 a.m. PDT. According to NWS computer records, an identical spot request was entered at 3:33 a.m. PDT. The request as entered into the computer system contained a latitude/longitude that was approximately 70 miles southwest of the Esperanza Fire. The NWS forecaster in San Diego, who was responsible for generating the spot forecast,

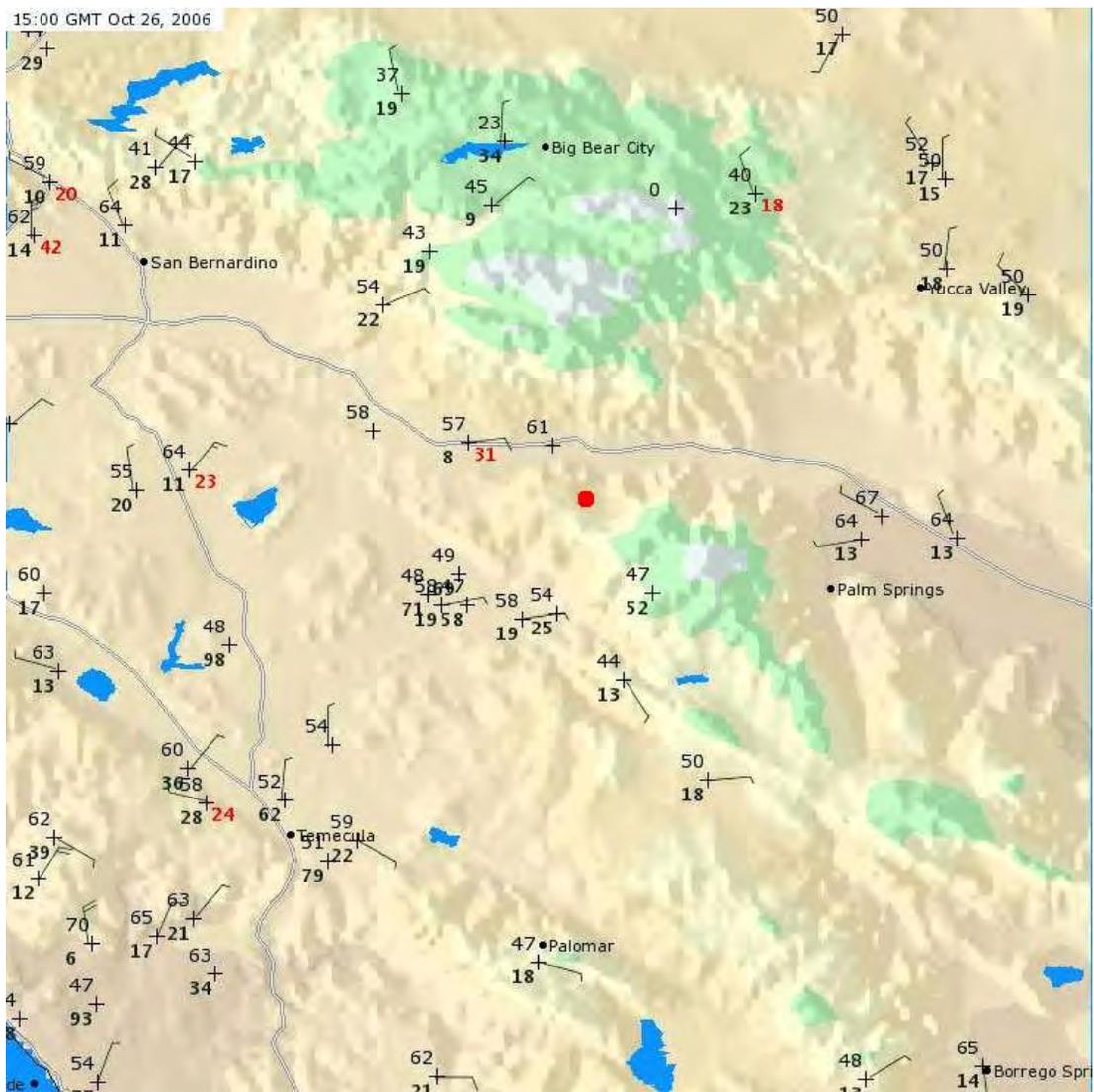
recognized a disconnect between the latitude/longitude (San Diego County), the dispatch center (RRU) call back number, and the hot spot noticed about an hour earlier. The forecaster generated a forecast for the San Gorgonio Pass area based on the hot spot and the RRU call back number, ignoring the latitude/longitude coordinates on the spot request which were in San Diego County. The forecast was completed at 4:00 a.m. PDT. Upon completion of the forecast, the forecaster called the emergency call back number on the spot request to discuss the discrepancy in latitude/longitude, but there was no answer at the call back number. The NWS faxed the spot forecast to RRU at 4:10 a.m. PDT. The CAL FIRE Riverside Unit Dispatch Center (RRU) distributed the spot forecast on their email system at 5:25 a.m. PDT to local, state and federal fire dispatch offices within the Southern California Geographical Area (which includes Riverside, San Bernardino, and San Diego). The information in the spot forecast generated by NWSFO San Diego was unchanged from the Fire Weather Planning Forecast and from the Red Flag Warning both of which were last sent around 2:00 pm PDT on Wednesday afternoon.

The Santa Ana Winds were observed by the Beaumont Remote Automatic Weather Station (RAWS) that is located in Beaumont, California just west of the San Gorgonio Pass as shown in Fire Weather Table 1. This observation data covers the period from Wednesday afternoon October 25 through Thursday afternoon October 26, 2006. On the evening of October 25, prior to the onset of the Santa Ana Winds, humidity values were in the 30 percent to 75 percent range, winds were out of the southwest, and pressure was fairly steady. Beginning at 9:10 p.m. on Wednesday, October 25, winds switched to an easterly direction, pressure began a slow rise, and humidity values dropped rapidly. The wind speed at Beaumont steadily increased from 6 mph to gusting 16 mph at 10:10 p.m. PDT Wednesday to 19 mph to gusting 39 mph at 10:10 am PDT Thursday. Humidity values also saw a sharp drop from 75 percent at 9:00 p.m. on Wednesday, to 7 percent shortly after midnight early Thursday morning. Humidity values at the Beaumont RAWS remained below 20 percent with winds ranging from 15 to 40 mph through 7:00 p.m. on Saturday, October 28, 2006.

It should be noted that twice on October 26, the Beaumont RAWS reported wind gusts of exactly 100 mph. These wind gusts were deemed an error due to lack of corroborating evidence such as damage that would accompany 100 mph winds in a populated area that exists near the Beaumont RAWS. Also, a wind gust value of 100 is a RAWS error code. This error occurs at random times due to a software defect with certain versions of the firmware in RAWS units.

The Santa Ana Winds develop due to the cooler air over the Mohave Desert having higher pressure than the warmer air to the west over the greater Los Angeles basin. Fire Weather Figure 1 shows the terrain and surface weather data over southern California at 7:00 a.m. PDT on October 26. This map shows how cold air pooling over the Mohave Desert is blocked by the San Bernardino and San Jacinto Mountains. San Gorgonio Pass is aligned east-west constraining the winds to blow only east or west. At 7:00 a.m., the Santa Ana Winds have driven westward through most, but not all of the greater Los Angeles basin. A few RAWS in the lower left portion of the map still show high relative humidities indicating the dry Santa Ana air has not penetrated into those areas. Also

evident on this map are the terrain aligned winds north and northwest of San Bernardino. In these areas, the wind is rushing through the lowest elevation passes from the north into the Los Angeles Basin. Some of the temperature differences in the “cool” air to the east are warmer than locations to the west. This difference is due to the elevation differences in the stations. Areas near Palm Springs (elevation near 500 feet) are lower in elevation than sites southwest of the accident site in the San Jacinto Mountains that are near 2,000 feet. For reference, San Gorgonio Pass has an elevation of 2,600 feet; the accident site is near 3,300 feet; the San Jacinto Mountains rise to over 10,000 feet; and the San Bernardino Mountains rise to over 11,000 feet.

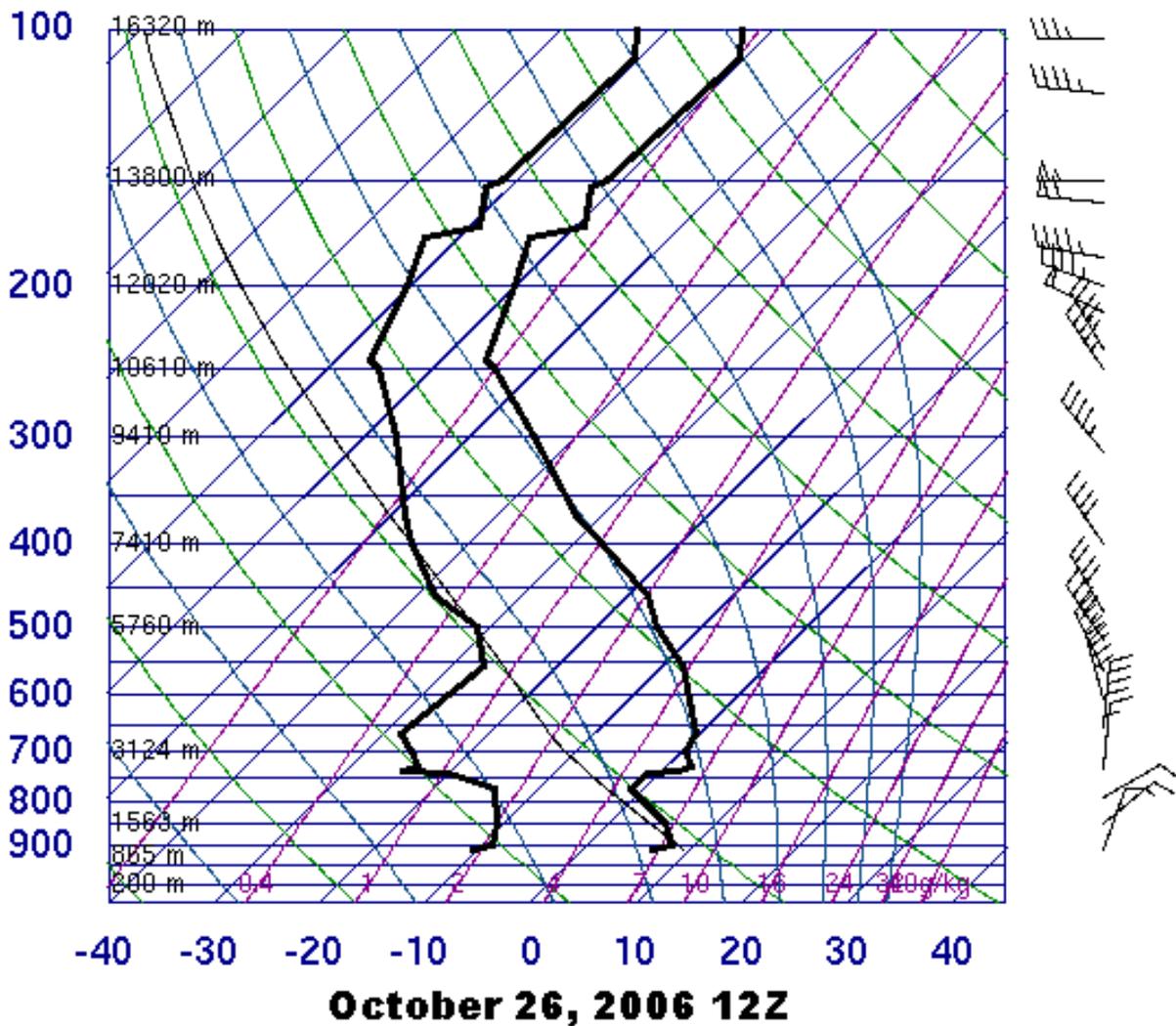


**Fire Weather Figure 1 - 15Z October 26 (7:00 am PDT) Surface data over southern California showing Temperature, Relative Humidity, wind direction and speed, and wind gusts in red. The accident site is near the red dot in the middle of the map. The Beaumont RAWS is located northwest of the accident site showing a temperature of 57, Relative Humidity of 8 percent and a wind gust of 31 mph out of the east.**

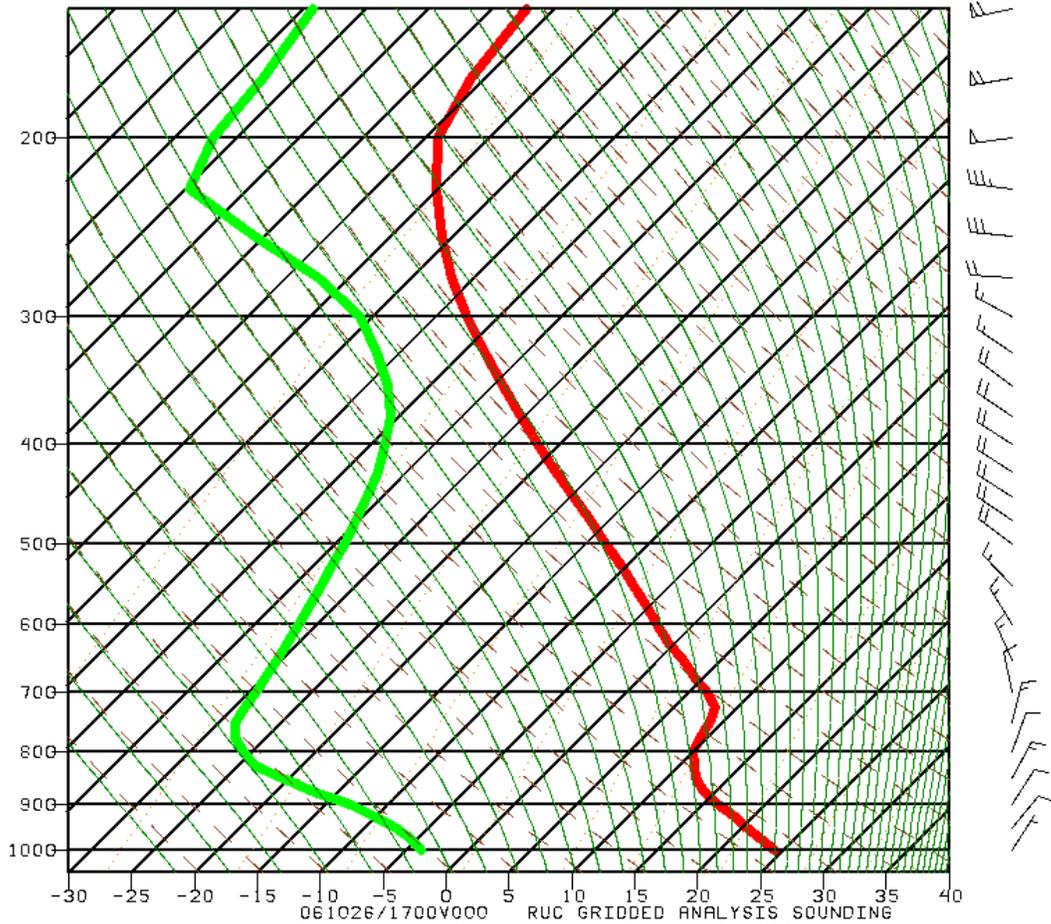
As the cool air pools over the Mohave Desert, a temperature inversion develops as warmer air aloft moves over the area. As the Santa Ana Winds push the cooler air to the west at low levels, the temperature inversion also migrates west into the greater Los Angeles basin. On October 26, this temperature inversion formed near the 6,000 feet Mean Sea Level (MSL). This level was observed on the Mercury, Nevada upper air sounding at 12Z October 26 shown in Fire Weather Figure 2. As the cooler air over the Mohave Desert pushed west into the greater Los Angeles basin the temperature inversion moved west as well. This is shown in the Rapid Update Cycle (RUC) model sounding shown in Fire Weather Figure 3. This sounding shows a model forecast at 17Z October 26, 2006, or 9:00 a.m. PDT, at the grid point closest to the accident site. On the morning of October 26, this inversion was observed in the smoke behavior over the Esperanza Fire and pilots flying over the area confirmed the inversion height was near the 6,000 foot level.

The progression of the Santa Ana winds is not uniform through the area. The cooler air over the Mohave Desert spills through lower passes first, then as the depth of the cool air increases, the air spills from the Mohave Desert to the west through progressively higher elevations. Mountain barriers significantly effect the wind direction on a local level, however over the Esperanza Fire location, the dominant wind flow in this situation was from the northeast. The wind deviating only slightly from this direction as the terrain dictates. The northeast wind at elevations below 6,000 feet MSL can be seen in the Mercury sounding shown in Figure 2 and in the model sounding shown in figure 3.

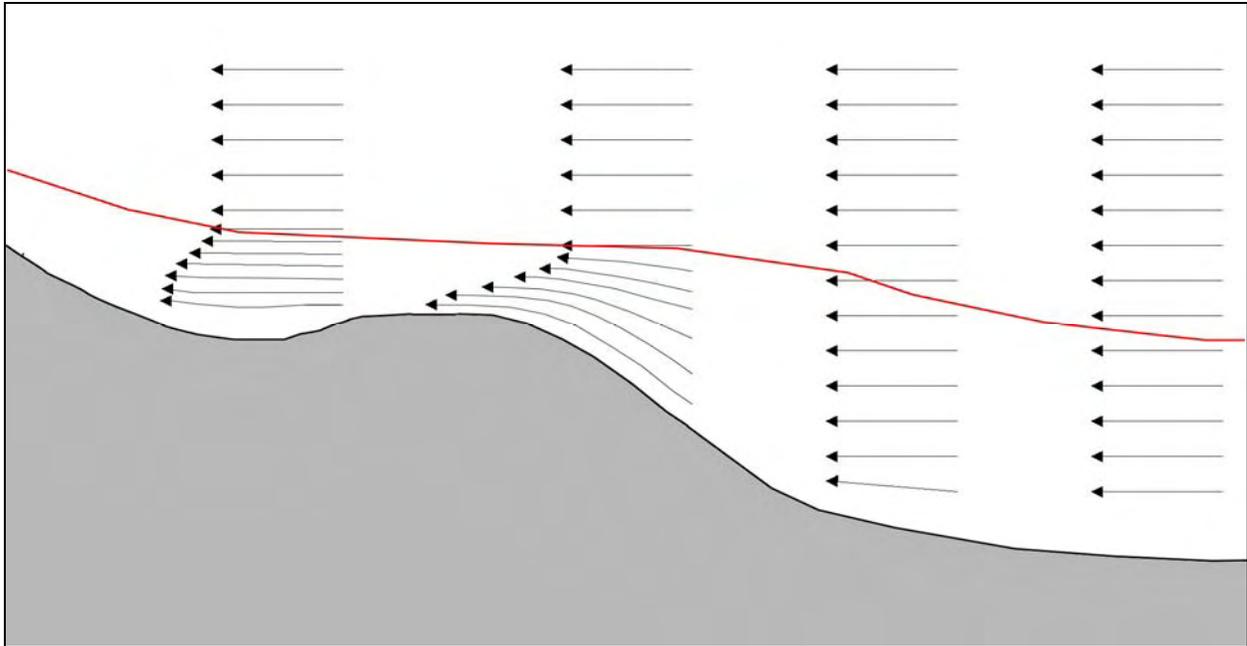
## 72387 DRA Mercury



Fire Weather Figure 2 – Mercury, NV 12Z October 26 (7:00 am PDT Oct 26) observed sounding plotted on a Skew-T diagram. Height shown on far left is millibars with height above MSL in meters shown inside the chart on the left, temperature along the bottom is in degrees C with temperature lines slanted to the right. Solid thick black lines are temperature and dew point. Wind barbs on right show wind speed in knots.



**Fire Weather Figure 3 - RUC model sounding at 17Z on October 26, 2006 at a grid point close to the accident site plotted on a Skew-T diagram. Height shown on left in millibars, temperature along the bottom is shown in degrees C. Red line is the temperature, green line is the dew point. Wind barbs on right show wind speed in knots.**



**Fire Weather Figure 4 - Wind flow up hill with a capping inversion. The length of the arrows indicates relative wind speed. The red line indicates the inversion height.**

The inversion over the area played a critical role in fire behavior. This includes channeling winds near the ground and preventing full ventilation of the fire under the stable atmospheric conditions present at this point in time as shown by the upper air soundings shown in Fire Weather Figures 2 and 3. The inversion was not at a constant height over the area. Over the San Gorgonio Pass area, the inversion height was between 5,000 and 6,000 feet MSL. The height of this inversion was forecast by the RUC computer model, and the height was confirmed near this level through observations and photos taken of the smoke plume over the fire at approximately 9:00 am by the Air Operations Supervisor. The inversion height slopes upward over higher terrain, but it does not stay at a constant height above the terrain. Fire Weather Figure 4 displays how winds follow the contours of a sloping land surface under inversion conditions described above. The free air above the inversion is minimally affected by the terrain. However under the inversion, wind speeds will increase as the distance between the ground and inversion decrease. The winds will increase the greatest closest to the ground where the slope has the greatest steepness.

Shortly before 7:00 a.m. on Thursday, October 26, the fire plume was able to generate enough heat to cause the air and smoke column to begin rising above the inversion layer. The location where the plume broke through the inversion layer was approximately 2 miles southwest of the accident site, in the upper reaches of the “unnamed creek drainage”. Once this plume rose above the inversion layer it acted as a relief valve giving the area better ventilation. Because air was no longer constrained to flow between the ground and the inversion but could also now rise above the inversion in the developing plume, wind speeds on the upwind side of the plume, near the accident site, increased.

At approximately 7:00 a.m. on Thursday, October 26 several factors came together to cause a rapid increase in northeast winds in the vicinity of the accident site. The Santa Ana Winds were increasing their influence on the area as evident by the steady increase in sustained and peak wind speeds at Beaumont in the early morning hours (see Fire Weather Table 1). The orientation of the “unnamed creek drainage” next to the accident site is aligned from northeast to southwest, the same direction as the Santa Ana winds in this area as observed by firefighters in the area. Fire had also burned into the upper reaches of the “unnamed creek drainage” (south of Twin Pines Road and southwest of the accident site) where it developed a plume that had penetrated the inversion. This plume, according to the National Weather Service 88D Radar rose to between 18,000 feet and 24,000 feet MSL between 7:00 a.m. and 8:00 a.m. PDT. Feeding this plume required a large quantity of air moving up the valley then rising in the vertical column.

When the burnover occurred, the following factors contributed to create extreme fire behavior:

1. Fire had spread into the upper reaches of the “unnamed creek drainage” (southwest of and downwind from the accident site).
2. The fire in the upper reaches of the “unnamed creek drainage” had created a plume at least 18,000 feet high punching through the inversion.
3. The “unnamed creek drainage” is oriented northeast to southwest, coincident with the synoptic scale winds.
4. Spot fires were heating the local environment in the vicinity of the Doublewide trailer just upstream from the accident site.

When the above conditions developed at roughly 7:10 a.m., the winds carried the flame front through the accident site very rapidly. The topographic shape of the accident site channeled the winds and flame directly at Engine 57. Burn patterns in the trees near Engine 57 indicate the flame height remained within 15 feet of the ground. This is consistent with the wind remaining parallel with the ground and increasing in speed near the ground as the wind climbed the slope immediately northeast of Engine 57, overran Engine 57, then ran southwest around the Octagon House. The nearly round shape of the house influenced the flow pattern of the wind and flame around the house. Because the house had a nearly round shape, the wind carried the flame around both sides of the house, wrapping around the house on the downwind side, with the flame front from each side meeting on the downwind side. This effectively makes for no safe place to escape the flames near this house.

The exact wind speed when the fire front moved through the accident site is unknown. Interviews with firefighters that were located at the Doublewide immediately southwest of the accident site indicate wind speeds at eye level were approximately 40 mph during and shortly after the fire front moved through their location. It is not unrealistic to expect that wind gusts at the Doublewide were near 50 mph. At the accident site, wind speeds are greatly influenced by the terrain. For northeast winds that were present on the morning of the accident, the steep slope immediately upwind (northeast) of the accident site causes a strong acceleration in wind speed as the wind climbs the slope. With the

reported conditions by firefighters at the relatively protected Doublewide site, it is not unrealistic to expect winds near Engine 57 to have been 50 to 70 mph as the fire front moved through the area. Fifteen to 30 minutes after the fire front had gone through the Doublewide area, firefighters who walked from the Doublewide to the accident site reported very strong winds with blowing dust and sand as they approached the accident site.

When Engine 57 first arrived at the Octagon House, the view to the northeast down the “unnamed draining” was un-obscured by the smoke. Reports indicate the valley floor near Cabazon was visible and the fire front was well to the east. The fire was casting enough light into the “unnamed creek drainage” such that the shape of the drainage was visible. In the early morning hours, prior to 7:00 a.m. PDT the fire progressed westward into the “unnamed creek drainage” below and northeast of the accident site. As fire got into the “unnamed creek drainage”, the northeast winds carried the smoke southwest over the accident site. At first the smoke density would have been light becoming thicker as the fire front approached. At the Doublewide, smoke densities became so thick that it caused some firefighters to lay on the ground to find cleaner air. All firefighters at the Doublewide sought refuge in their engines for protection from smoke and blowing embers. Conditions at the accident site were likely similar or worse due to the high fuel load on the steep slope immediately upwind of the accident site.

Beaumont, California RAWS 33.93N 116.939W - Elevation: 2680 ft								
	Time PDT	Temp	Dew Pt	RH	Wind			Pressure Altimeter Setting
					Speed (MPH)	Peak Speed	Direction	
	18:10	64.0	1.5	8	11	30	E	30.24
	17:10	65.0	-0.6	7	12	33	E	30.23
	16:10	69.0	-0.9	6	15	34	E	30.23
	15:10	69.0	-0.9	6	15	100*	E	30.22
	14:10	70.0	-0.2	6	17	35	NNW	30.23
	13:10	70.0	-0.2	6	17	34	E	30.22
	12:10	68.0	1.6	7	16	34	E	30.24
	11:10	66.0	3.0	8	18	39	E	30.24
	10:10	64.0	4.1	9	19	39	E	30.24
	9:10	62.0	4.8	10	16	33	E	30.22
	8:10	59.0	2.5	10	15	100*	E	30.20
	7:10	57.0	-3.7	8	13	31	E	30.18
	6:10	60.0	-4.2	7	13	26	E	30.16
	5:10	59.0	-8.1	6	10	23	ENE	30.15
	4:10	59.0	-5.0	7	9	22	ENE	30.14
	3:10	60.0	-7.4	6	8	20	ENE	30.13
	2:10	59.0	-11.8	5	7	22	ENE	30.12
	1:10	60.0	-11.1	5	8	21	ENE	30.10
	0:10	61.0	-3.5	7	7	25	ENE	30.09
	<b>Thursday October 26, 2006</b>							
	23:10	62.0	8.8	12	9	21	ENE	30.08
	22:10	62.0	40.4	45	6	15	E	30.06
	21:10	55.0	47.2	75	1	5	ENE	30.04
	20:10	60.0	49.8	69	1	9	SE	30.02
	19:10	62.0	48.8	62	4	11	SW	30.00
	18:10	67.0	47.7	50	3	10	NNE	29.99
	17:10	71.0	42.7	36	4	15	WNW	29.98
	16:10	78.0	41.3	27	5	14	NE	29.97
	15:10	81.0	44.8	28	5	15	SSW	29.96
	14:10	79.0	47.4	33	5	16	WNW	29.96
	13:10	75.0	46.2	36	7	15	WSW	29.97
	12:10	75.0	45.5	35	6	18	WSW	29.99
	11:10	72.0	47.6	42	6	13	SW	30.00
	10:10	69.0	53.1	57	6	13	SW	30.01
	<b>Wednesday October 25, 2006</b>							
	* Wind error code							

Fire Weather Table 1 - Beaumont RAWS weather from 10:10 am PDT October 25 through 6:10 pm PDT October 26.

## ***Weather Dissemination Standard Operating Procedures***

### **National Weather Service (NWS)**

The National Weather Service uses multiple methods to transmit all forecast information. This includes routine forecasts and special forecasts for warnings such as Red Flag Warnings and Spot Forecast Requests. First, all official NWS forecasts are sent via high speed circuits to the Family Of Services (FOS) computer system in Silver Spring, Maryland. Some products are displayed on the Web (internet), and some products are faxed directly to customers. The following table lists the dissemination methods used by the NWS for various products used by fire fighting and land management agencies.

<b>Product Name</b>	<b>Product ID</b>	<b>FOS</b>	<b>FAX</b>	<b>WEB</b>
Red Flag warning	RFWSGX	X	X	X
Spot Weather Forecast	SWFSGX	X	X	X
Fire Weather Planning Forecast	FWFSGX	X		X
Fire Weather Forecast for Riverside ECC	ECC034	X		X

**RFW – Red Flag Warning and Fire Weather Watch** - Issued as needed according to the criteria below.

Criteria for the area which covers the Esperanza Fire are as follows:

Either Relative Humidity  $\leq$  15 percent with sustained winds  $\geq$  25 mph and/or frequent gusts  $\geq$  35 mph for a period of 6 hours or more.

Or

Relative Humidity  $\leq$  10 percent (duration of 10 hours or more) regardless of wind speed.

### **CAL FIRE Riverside Unit (RRU)**

Weather forecasts are collected at approximately 8:00 a.m. each day from the web forecast placed on the web by NWS San Diego. They transfer information from the ECC product into an email that is transmitted to all area stations and chief officers. Weather forecasts are not read over the radio on a routine basis, but can be relayed on the radio if a request is received from a commander in the field.

### **San Bernardino National Forest (BDF)**

Weather is collected through a number of resources. Weather arrives in WIMS (Weather Information Management System), on the internet through the Forest Service Wildcad system, and on the internet at either the GACC web site or the NWS web site. Routine broadcasts of weather are performed daily at 11:00 a.m. and 4:00 p.m. All broadcasts begin with a discussion of any Red Flag Warnings or Fire Weather Watches in effect for any portion of the San Bernardino National Forest area. Unscheduled weather updates, such as a Red Flag Warning issued between the standard broadcast times are broadcast at the dispatchers discretion based on workload at the time and the severity of the forecast contained in the warning or watch.

## ***Findings and Facts gleaned from interviews and documents***

- All weather forecasts issued for the accident site and Esperanza Fire came from the National Weather Service (NWS) Forecast office in San Diego, California (WFO SGX).
- National Weather Service's first mention of Santa Ana Wind conditions is on Saturday, October 21 at 1:45 p.m. PDT in an issuance of the Fire Weather Planning Forecast (five days prior to the accident)
- National Weather Service Fire Weather Watch was issued for the area on Tuesday, October 24 at 2:15 p.m. PDT (40 hours prior to the accident).
- The National Weather Service (San Diego and Oxnard) and the South Area Ops Center Geographical Area Coordination Center held a conference call at 8:30 a.m. on Wednesday morning. All agreed that Santa Ana Wind conditions would develop Wednesday night and a Red Flag Warning would be needed.
- National Weather Service issued a Red Flag Warning for the area on Wednesday, October 25 at 10:34 a.m. PDT (20 hours prior to the accident). The NWS faxed the Red Flag Warning to the RRU Dispatch Center at 10:50 a.m. PDT. RRU did not send the Red Flag Warning via an email to area stations and chief officers.
- National Weather Service issued a High Wind Warning for the area on Wednesday, October 25 at 10:46 a.m. PDT (20 hours prior to the accident)
- The National Weather Service updated the Red Flag Warning at 2:00 p.m. PDT. RRU did not send the Red Flag Warning via an email to area stations and chief officers.
- On Thursday, October 26 at 3:13 a.m. PDT, a request for a spot weather forecast is received at the RRU.
- On Thursday, October 26 at 3:16 a.m. PDT, this request is entered into the computer system and transmitted to the NWS office in San Diego. At 3:33 a.m. PDT, this same spot request is entered a second time. The request as entered into the computer system contained a latitude/longitude that was approximately 70 miles southwest of the Esperanza Fire site. The NWS forecaster recognized a disconnect between the latitude/longitude (San Diego County) and the dispatch center (RRU). The forecaster also had seen a hot spot on satellite infrared imagery between 2 and 3 a.m. northwest of Palm Springs, indicating a likely fire just south of the San Gorgonio Pass area. The forecaster generated a forecast for the San Gorgonio Pass area, ignoring the latitude/longitude coordinates on the spot request which were in San Diego County. The forecast was completed at 4:00 a.m. and faxed to RRU. The forecaster called the emergency call back

number on the spot request to discuss the discrepancy in the latitude/longitude but there was no answer on the call back number.

- The NWS faxed the Spot Forecast to RRU at 4:10 a.m. PDT. RRU sent the Spot Forecast on their email system at 5:25 a.m. PDT. The information in the Spot Forecast was unchanged from the Fire Weather Planning Forecast and from the Red Flag Warning both of which were sent around 2:00 p.m. PDT on Wednesday afternoon.
- The National Weather Service in San Diego generates a compilation of fire weather zone forecasts from the NWS in Phoenix, Oxnard, and San Diego into one product which is displayed on the web for use by the RRU dispatch center. This compilation is generated so that the dispatch centers in southern California have one product to read instead of several. The compilation forecast is available on the web by 9:45 a.m. and 4:00 p.m. Pacific Standard or Daylight time depending on the season. The RRU dispatch center includes the morning fire information in their morning briefing package sent throughout the organization at 8:00 a.m. each day. Updates to the weather are sent via email only if the information is critical and differs from the information contained in the morning briefing package.
- When the NWS issues a Fire Weather Watch or a Red Flag Warning, these forecasts are faxed to the dispatch centers that are affected by the watch or warning. The Forest Service, San Bernardino Dispatch center reads these products on their radios as soon as traffic allows, and includes the watch and warning information in their 9:00 a.m. and 4:00 p.m. weather broadcast. The RRU dispatch center sends these updates in an email only if the information is critical and differs from information contained in the morning briefing package.
- Spot weather forecasts issued by the NWS are faxed to the dispatch center that is managing the area covered by the spot forecast. At the forecaster discretion, a call back will be made to the emergency number listed on the spot request to confirm receipt of the spot forecast.
- RRU sends a "Morning Report" via email to every fire station and chief officer in the district. This report includes a weather forecast taken from the National Weather Service San Diego web page. The 8 a.m. report sent on October 25, 2006, included the forecast issued at 2:30 p.m. PDT Tuesday evening by the NWS. This report also included the Fire Weather Watch valid Wednesday night and Thursday. The weather included in the 8 a.m. morning report did not include a weather section for Thursday.
- The NWS generated an updated Fire Weather Planning Forecast at 5:49 a.m. PDT on Wednesday. This updated report was not sent via email to area fire stations and chief officers

## Appendix 7 – Human Factors Accident and Incident Analysis Checklist Summary

USDA Forest Service Serious Accident Investigation Guide (2005)

It is widely published and recognized that the adverse effects of human error on decision making and risk perception are primary causes or contributors to serious accidents. Unsafe acts and human error associated with a majority of accidents also involve powerful latent preconditions and influences involving supervision and organization. Current safety investigation processes and prescribed interview protocols should not be expected to provide a “full and frank” revelation and analysis of the complex underlying psychological and physiological human factors that can compromise safe decisions and behavior. However, the following human factors analysis checklist provides a subjective, unweighed glance at the scope and complexity of human factors likely involved in the Esperanza incident. A ✓ mark means that the condition was present by some or all personnel assigned to the incident.

### Sensory and Perceptual Factors

- Misjudgment of distance, clearance, speed, and so forth
- False perception caused by visual illusion. Conditions that impair visual performance:
  - Featureless terrain (such as a desert, dry lake, water, snow).
  - ✓ Darkness and poor visibility.
  - ✓ Smoke and changing smoke patterns.
  - ✓ Mountainous terrain or sloping runway.
  
  - Anomalous light effect that cause flicker vertigo.
  - Low contrast of objects to background or poor illumination.
  - View into bright sunlight or moonlight.
  - Shadows.
  - Whiteout snow conditions.
- Spatial disorientation and vertigo. Conditions that affect sense of body position:
  - Loss of visual cues.
  - Adverse medical condition or physiological condition (alcohol and drug effects, hangover, dehydration, fatigue, and so forth).
  - ✓ Moving head up and down, looking in and out to change radios, answering or using cell phones.

- Loss of situational awareness. Types:
  - ✓ Geographic disorientation (such as deviation from route, loss of position awareness).
  - ✓ General loss of situational awareness (such as failure to perceive hazardous condition).
  - ✓ Erroneous situational assessment (misinterpretation of situation or condition).
  - ✓ Failure to predict or anticipate changing conditions.
  - ✓ False hypothesis confirmation bias (persistent false perception or misconception of situation).
  
- Attention failure (such as failure to monitor or respond when correct information is available). Types:
  - Failure to visually scan outside the vehicle or equipment for hazards.
  - ✓ Omission of checklist items.
  - Failure to respond to communication or warning.
  - Control-action error:
    - Failure to set, move, or reset control switch (lapse).
    - Unintentional activation of control switch (slip).
    - Control-substitution error (slip).
    - Control-reversal error (slip).
    - Control-adjustment or precision error (slip).
  
- Conditions that affect attention and situational awareness:
  - Inattention (focus on information unrelated to tasks).
  - ✓ Channelization, fixation (psychological narrowing of perception).
  - ✓ Distraction (preoccupation with internal [mental] event or with external event).
  - ✓ Task overload due to systems (such as communications).
  - Task overload due to equipment systems assignment factors.
  - Cognitive workload (problem-solving concentration or information overload).
  - Habit influence or interference.
  - Excessive crew stress or fatigue.
  - Excessive workload or tasking.

- ✓ Inadequate briefing or preparation.
- Inadequate training or experience for assignment.
- Negative learning transfer (such as during transition to new assignment).
- ✓ Adverse meteorological conditions.
- Tactical-situation overload or display-information overload.
- ✓ Inadequate crew vigilance.
- Inadequate equipment design.

### **Medical and Physiological Factors**

- Carbon monoxide poisoning.
- Self-medication (without medical advice or against medical advice).
- Motion sickness.
- Incompatible physical capabilities.
- Overexertion while off duty.
- Influence of drugs or alcohol.
- Cold or flu (or other known illness).
- Excessive personal stress or fatigue.
- Inadequate nutrition (such as omitted meals).
- Hypoxia.
- Heat.
- Cold.
- ✓ Stress induced by heightened state of alertness.
- Affects of smoke.
- Dehydration.
- Other medical or physiological condition.
  - Assignment tasking or job fatigue (such as being on duty more than 14 hours, late-night or early-morning operations).
  - Cumulative fatigue (such as excessive physical or mental workload, circadian disruption, or sleep loss).
  - Cumulative effects of personal or occupational stress (beyond stress-coping limit).
- ✓ Emergency condition or workload transition (from normal operation to emergency operation).

- Medical or physiological preconditions (health and fitness, hangover, dehydration, and so forth).

## Knowledge and Skill Factors

- Inadequate knowledge of systems, procedures, and so forth (knowledge-based errors). Types:
  - Knowledge-based.
  - Inadequate knowledge of systems, procedures.
  - ✓ Used improper procedure.
  - ✓ Ill-structured decisions.
  - Failure in problem solving.
- Inadequate equipment control, or inadequate accuracy and precision of equipment maneuvering (skill-based error). Types:
  - Breakdown in visual scan.
  - Failure to see and avoid.
  - Over or under reacting.
  - Over or under controlling.
  - Inadequate experience for complexity of assignment.
- Misuse of procedures or incorrect performance tasks (rule-based error), such as:
  - ✓ Failure to perform required procedure.
  - ✓ Use of wrong procedure or rule(s).
  - ✓ Failure to conduct step(s) in prescribed sequence.
- Conditions that lead to inadequate operational performance:
  - ✓ Lack or variation of standards.
  - ✓ Loss of situational awareness in varying environment.
  - Demonstration of performance below required proficiency standards or current standards.
  - Demonstration of inadequate performance or documented deficiencies.
  - Inadequate essential training for specific task(s).
  - Inadequate recent experience or inadequate experience.
  - Lack of sensory input.
  - ✓ Limited reaction time.

## Assignment Factors

- Failure of dispatch to provide correct critical information (such as frequencies, location, other equipment, or resources).
- ✓ Poor communication with other assets (such as ground or aircraft).
- ✓ Inadequate or faulty supervision from ground or tactical aircraft.
- ✓ Lack or variation of standards.
- Non-participant or non-communicative equipment or resources at the scene.
- ✓ Loss of situational awareness in varying environment.
- Changing plans or tactics (change of teams on incidents).
- ✓ Unanticipated change of radio frequencies.
- ✓ Intentional deviation from procedures.
- ✓ Unintentional deviation from procedures.
- Demonstration of performance below required proficiency standards or current standards.
- Demonstration of inadequate performance or documented deficiencies.
- Inadequate essential training for specific task(s).
- Inadequate recent experience or inadequate experience for assignment.
- Transition (learning new equipment or operational systems).
- ✓ Inadequate knowledge of tactical situation.
- Lack of sensory input.
- ✓ Limited reaction time.
- Conditions that lead to inadequate assignment performance.
  - ✓ Smoke.
  - ✓ Wind shifts.
  - ✓ Changes in fire behavior.
  - ✓ Low visibility.
- Unexpected equipment, resources, or aircraft.
- ✓ Assignment intensity.

- Assignment creep.
- ✓ Assignment urgency.
- ✓ Failure to recognize deteriorating conditions.
- ✓ Time compression.
- Diverts to new incidents.
- ✓ Excessive communication demands.
- ✓ Past assignment success based on high-risk behavior.

## **Personality and Safety Attitude**

- ✓ Overconfidence.
- ✓ Excessive motivation to achieve assignment.
- Reckless operation.
- Anger or frustration on the job.
- Stress-coping failure (such as anger).
- Overly assertive or nonassertive.
- Inadequate confidence to perform tasks or activities.
- ✓ Acquiescence to social pressure (from organization or peers) to operate in hazardous situation or condition.
- Failure to report or act upon incidents of misconduct.
- Toleration of unsafe acts and behaviors.
- Poor equipment or assignment preparation.

## **Judgment and Risk Decision**

- ✓ Acceptance of a high-risk situation or assignment.
- ✓ Misjudgment of assignment risks (complacency).
- ✓ Failure to monitor assignment progress or conditions (complacency).
- ✓ Use of incorrect task priorities.
- ✓ Intentional deviation from safe procedure (imprudence).
- Intentional violation of standard operating procedure or regulation. Types:
  - ✓ Violation of orders, regulations, standard operating procedures (SOP).
  - Crew rest requirements.
  - Inadequate training.
  - Violated agency policy or contract.
  - Failed to comply with agency manuals.
  - Supervisor knowingly accepted unqualified crew.

- Failed to obtain current weather brief.
- ✓ Accepted unnecessary hazard.
- Lacks adequate of up-to-date qualifications for assignment.
- Intentional disregard of warnings.
- Noncompliance with personal limits.
- Noncompliance with published equipment limits.
- Noncompliance with prescribed assignment parameters.
- ✓ Acquiescence to social pressure (from organization or peers).
- Conditions leading to poor safety attitude and risky judgment:
  - History of taking high risks (personality-driven).
  - Pattern of overconfidence.
  - Personal denial of wrongdoing.
  - Documented history of marginal performance or failure.
  - Excessive motivation (did not know limits).
  - Reputation as a reckless individual.
  - Failure to cope with life stress (anger or frustration).
  - Overly assertive or nonassertive (interpersonal style).
- ✓ Influenced by inadequate organizational climate or safety culture (such as high risk taking).

## **Communication and Crew Coordination**

- ✓ Inadequate assignment plan or brief.
- Inadequate or wrong assignment information conveyed to crew (dispatch or supervisor errors).
- Failure to communicate plan or intentions.
- Failure to use standard or accepted terminology.
- Failure to work as a team.
- ✓ Inability or failure to contact and coordinate with ground or aviation personnel.
- Inadequate understanding of communication or failure to acknowledge communication.
- Interpersonal conflict or crew argument during assignment.
- Conditions leading to inadequate communication or coordination:
  - Inadequate training in communication or crew coordination.

- ✓ Inadequate standard operating procedures for use of crew resources.
- ✓ Inadequate support from organization for crew coordination doctrine.
- ✓ Failure of organizational safety culture to support crew resource management.

## **System Design and Operation Factors**

- Use of wrong switch, lever, or control.
  - Misinterpretation of instrument indication.
  - Inability to reach or see control.
  - Inability to see or interpret instrument or indicator.
  - Failure to respond to warning.
  - Selection or use of incorrect system-operating mode (mode confusion).
  - Overreliance on automated system (automation complacency).
- Conditions that contribute to design-induced crew errors:
    - Inadequate primary equipment control or display arrangement.
    - Inadequate primary display data or data format.
    - Inadequate hazard advisory or warning display.
    - Inadequate system instructions or documentation.
    - Inadequate system support or facilities.
    - Inappropriate type or level of automation, or excessive mode complexity.

## **Supervisory and Organizational Factors**

- ✓ Not adhering to rules and regulations.
  - ✓ Inappropriate scheduling or crew assignment.
- Failure to monitor crew rest or duty requirements.
  - Failure to establish adequate standards.
- ✓ Failure to provide adequate briefing for assignment.
- Failure to provide proper training.
  - Lack of professional guidance.
  - Undermining or failure to support crews.
- ✓ Failure to monitor compliance with standards.
- Failure to monitor crew training or qualifications.
  - Failure to identify or remove a known high-risk employee.
  - Failure to correct inappropriate behavior.
- ✓ Failure to correct a safety hazard.

- Failure to establish or monitor quality standards.
  - ✓ Failure of standards, either poorly written, highly interpretable, or conflicting.
  - ✓ Risk outweighs benefit.
  
- Poor crew pairing.
  - ✓ Excessive assignment tasking or workload.
  - ✓ Inadequate assignment briefing or supervision.
  
- Intentional violation of a standard or regulation.
  
- Failure to perceive or to assess (correctly) assignment risks, with respect to:
  - ✓ Unseen or unrecognized hazards.
  - ✓ Environmental hazards or operating conditions.
  - ✓ Assignment tasking and crew skill level.
  - ✓ Equipment limitations.
  
- Conditions leading to supervisory failures:
  - ✓ Excessive operations or organizational workload (imposed by the organization or imposed by organizational chain).
  - ✓ Inadequate organizational safety culture.
  - ✓ Supervisor is over-tasked.
  
  - Supervisor is untrained.
  
  - ✓ Inattention to safety management (inadequate safety supervision).
  
  - Inadequate work standards or low performance expectations.
  - Inadequate or poor example set by supervisors.
  
  - ✓ Inadequate safety commitment or emphasis by supervisors.
  - ✓ Organization lacks an adequate system for monitoring and correcting hazardous conditions.
  - ✓ Supervisors fail to promote and reward safe behavior or quickly correct unsafe behavior.
  - ✓ Organization lacks adequate policies and procedures to ensure safe work performance.
  
  - Organization lacks adequate job-qualification standards or training program.
  - Organization lacks adequate internal communication.
  - Organization had no system or an inadequate system for management of high-risk employees.

- ✓ Organization lacks adequate process or procedures for operational risk management.
- Organization fails to provide adequate human factors training.
- Organization fails to ensure sufficient involvement of medical and occupational health specialists.
- Organization fails to establish or enforce acceptable medical or health standards.

## Written Plans, Direction, and Documentation

- Procedures.
  - Unwritten.
  - ✓ Unclear, undefined, or vague.
  - Not followed.
- Records.
  - Discrepancies entered but not deferred or cleared.
  - Entries not recorded or not recorded in correct book(s).
  - Improper entries or unauthorized signature or number.
  - Falsification of entries.
- Publications, manuals, guides.
  - ✓ Not current.
  - ✓ Were unused for the procedure.
  - Incorrect manual or guide used for procedure.
  - ✓ Not available.
- Training.
  - Not trained on procedure.
  - Training not documented.
  - Falsified.
  - Not current.
- Personnel.
  - Not properly licensed.
  - Insufficient (staffing).

- Improper or insufficient oversight.
  - Not properly rested.
- Management.
  - Nonexistent.
  - Ineffective.
  - Understaffed.
  - Ineffective organization of assigned personnel.
  - Insufficiently trained.
- Quality assurance.
  - Nonexistent.
  - Insufficiently trained.
  - Ineffective.
  - Not used when available.
- Inspection guides.
  - Unavailable.
  - Procedures not followed.
  - Insufficient.
  - Not current.
  - Not approved.
  - Not signed off.
  - Falsified.
  - Unapproved signature or number.
- Tools or equipment.
  - Improper use or procedure.
  - Uncalibrated.
  - Used improperly.
  - Not trained for the special equipment or tool.
  - Not used.
  - No tool control program.

## **Appendix 8 – Personal Protective Equipment Analysis Summary**

This report is based on witness statements, examination of the entrapment site, and the examination of the equipment found at the entrapment site from October 28 to October 30, 2006.

Based on a witness statement and the examination of the limited amount of clothing available, it appears the victims were wearing appropriate and required personal protective clothing and equipment (PPE). Although much of the PPE was severely damaged in the fire, there is no indication that the PPE was not serviceable prior to the turnover. It appears that the PPE was subjected to high temperatures and significant direct flame exposure, conditions that far exceed the design limitations of the clothing.

Five New Generation (M-2002) fire shelters were found, one in the vicinity of each victim. An additional New Generation fire shelter was found in a storage compartment of Engine 57. None of the shelters were deployed.

### ***Engine Site:***

Two victims were found at this site. This site was exposed to high intensity, long duration heat produced by the vegetative flame front and the ensuing vehicle fire. Vehicles involved at the site were Fire Engine 57, a small car, and a small tractor. Two fire shelters were found on the ground, one near each victim.

One of the shelters was accordion folded in the same shape in which it was packaged. Much of the aluminum foil of the shelter had melted away. Aluminum melts when it reaches 1220 degrees Fahrenheit. Much of the fiberglass in the shelter was brittle indicating temperatures of at least 1350 degrees Fahrenheit (F).

The second fire shelter that was next to the engine was slightly unfolded. Some of the silica cloth was brittle and some of the fiberglass of the shelter had melted away indicating temperatures of at least 1610 degrees F.

The fire shelter present in the engine's driver side storage compartment was folded in the same shape in which it was packaged. Much of the silica cloth was brittle and much of the fiberglass of the shelter melted away indicating temperatures at least 1610 degrees F.

### ***Road Site:***

Two victims were found at this site. Some line pack items were found above the road indicating the firefighters may have moved from above the road to this site.

Three fire shelters were found at this site. The first shelter was found in its polyvinyl chloride (PVC) bag and hard plastic liner with no pack; the second shelter was found adjacent to a line pack in its PVC bag and hard plastic liner; and the third shelter was found within a melted mass of a line pack. A radio inside the melted pack was still functioning when examined.

The equipment found at the Road Site showed signs of high heat exposure. The line packs found at this site were mostly melted into a mass. Nylon material used in packs melts at 410 degrees F. The hard hat found at the site was a melted mass. Hard hats melt at 450 degrees F. The two leather gloves found had shrunken significantly and stiffened, shrinkage occurs at about 600 degrees F. Only a small amount of Nomex clothing was found, it appears much of the victims' clothing was burned away. Nomex chars at 824 degrees F.

***Below Road Site:***

Another victim was found just below the Road Site. Little evidence was present at this site. Much of the clothing and line pack was burned away indicating a temperature exposure of at least 824 degrees F.

## **Appendix 9 – Equipment Engine 57 Analysis Summary**

### ***Engine 57, Vehicle 6652***

#### **Documented History of Vehicle 6652 Maintenance History:**

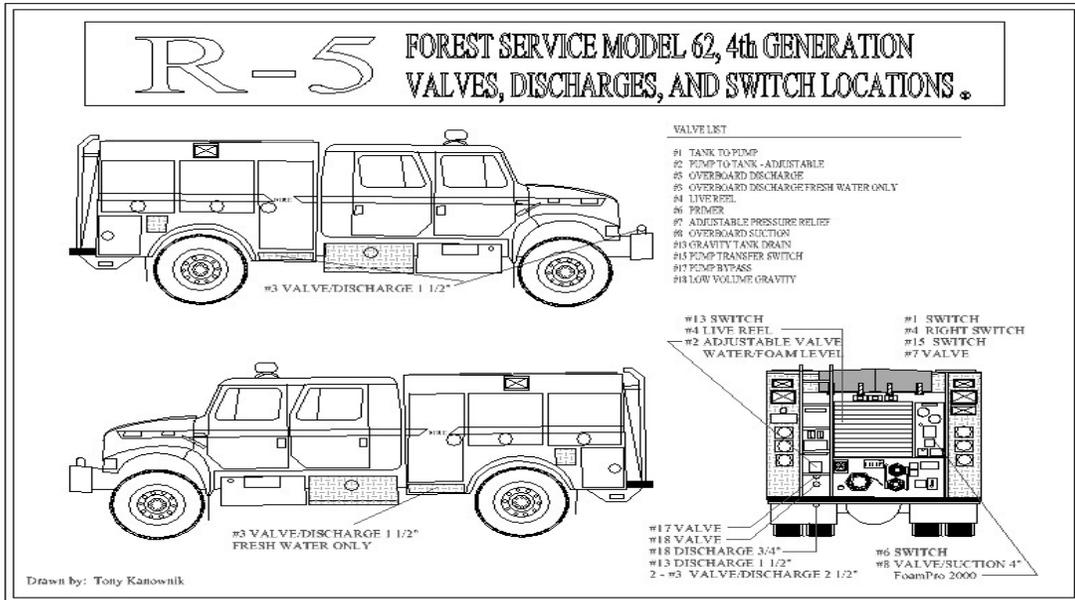
From Vehicle History Files and Fleet Management Vehicle Maintenance Data Base:

#### **General Information:**

- Forest Service Equipment number 6652, Class 949, Model 62, BDF Engine 57
- 2001 International Model 4900 4X2 Crew Cab
- In service October 29, 2001
- VIN 1HTSDADN21H393451
- License Plate number A290230
- DT-530 300 Horsepower Turbocharged Diesel Engine
- 6-Speed Allison Automatic Transmission with Auxillary Brake Retarder
- GVWR 33,000
- Capitalized Value: \$158,482.
- Current Documented Mileage 34,156 (10/22/2006)
- Fire apparatus built on a Government provided chassis by Boise Mobile Equipment, Boise Idaho.

#### ***Region 5 Standard Fire Engine Information***

- Model 62 Fire Engine
- Equipped with 1 each 500 gallon water tank, 2 each 20 gallon Class A foam reservoir
- Dual Foam System, Foam Pro 2001
- Darley JMP-500 2-stage pump



**Equipment Engine Figure 1. ..**

**Acquisition and Maintenance History:**

- 09/28/2000 Engine ordered as part Region 5 fire equipment expansion
- 03/30/2001 International Cab and Chassis delivered to Boise Mobile Eq. in Boise ID.
- 10/06/2001 Engine accepted and driven to San Bernardino. (1601 miles)
- 10/09/2001 Vehicle engine coolant change to meet compliance in Southern California
- 10/12/2001 3 Hoses repaired
- 10/29/2001 Engine is placed in service as BDF E-57
- 02/28/2002 Installed Door Pockets
- 04/17/2002 Modified Exhaust System for more ground clearance
- 05/20/2002 Transmission service (4558 miles)
- 06/24/2002 New Engine Status readout for rear panel
- 10/08/2002 Driving Lamps and brake parts purchased
- 10/17/2002 Filters purchased
- 01/29/2003 Annual inspection, valve and lighting work. (13,567 miles)
- 01/30/2003 Replaced a Hypro Flow Sensor
- 02/06/2003 Replaced paddle wheel sensor
- 03/03/2003 Towed to Dietrich International Dealership (13,648 miles)
- 03/11/2003 Repairs to cooling system at Dietrich International. (13,648 miles)
- 04/09/2003 Tubing purchased
- 07/25/2003 Engine status center and pump primer motor replaced
- 09/29/2003 Replaced 2 tires
- 12/03/2003 Engine Status readout replaced
- 02/24/2004 Annual inspection, LOF, pump work and tire replacement (18600 miles)
- 06/28/2004 Electrical Work at IHC dealership
- 10/14/2004 Replaced alternator

01/11/2005 Annual inspection, LOF, Trans Service, repaired panel lights (23,161 miles)

01/20/2005 AC repair and misc repair as part of the Annual inspection

01/24/2005 Opacity Test, smoke test (23,207)

03/22/2005 Safety Check by Maintenance Contractor Serco (23,396 miles)

04/26/2005 Repair windshield washer (24,304 miles)

06/01/2005 Repaired headlights (24366 miles)

06/08/2005 Adjust pump packing (24485 miles)

01/09/2006 Annual, LOF (27892 miles)

01/10/2006 Repaired lights, Repair Retarder, (27895 miles)

04/04/2006 Cancelled work order, truck not available to vendor (28,711 miles)

04/07/2006 DOT Level 1 inspections (28,833 miles)

04/11/2006 Service call to repair fuel lines a LA County Station 129

04/20/2006 Service call to Fox Field to repair an axle flange leak.

04/21/2006 Perform DOT Level inspection (29,053 miles) Inspection failed - due to driver's seat cracked.

04/24/2006 Repair front drivers seat base (29,175 miles)

06/02/2006 Perform DOT level 1 inspection.

06/02/2006 DOT level 1 inspection

06/09/2006 Repair Charging System, replace voltage regulator, and replace 1 ½ inch Akron ball valve. (29,350 miles)

**Facts:**

1. Vehicle 6652 E-57 was in service for 59 months prior to the Esperanza incident. All records kept in the vehicle were destroyed as a result of the vehicle fire. Records used to support vehicle Acquisition and Maintenance history were obtained from the San Bernardino National Forest Fleet Management Office.
2. Maintenance records were complete and indicate that Vehicle 6652 E-57 was in good condition and fully operable as a R5 standard Model 62 Engine. Model 62 engines built since 2001 were equipped with a single hose reel located in the rear compartment. During our inspection of Engine 57, we could not locate the hose reel. The hose reel cabinet was used to store hose packs at the time of the incident.
3. Vehicle 6652 E-57 last recorded odometer reading was taken from the Voyager Fleet Credit Database. On October 22, 2006 at 2235 hours the vehicle's current mileage was entered as 34,156 miles. A total 22.8 gallons of diesel fuel was purchased in Banning at G&M Oil, LLC #25 030.
4. 6652 E-57 was parked on-scene with the front of the vehicle pointed west.

## ***Condition of Vehicle as we joined the Investigation Team on 10/28/2006 at 4:00 p.m.***

James Little and I, Mike Arias arrived at the site and noted the following facts about the condition of 6652, Engine 57.

6652, Engine 57 was a total loss as a result of a secondary vehicle fire.

All six tires were completely burned with only the steel cords remaining. This allowed the vehicle to settle on its wheels, front axle and rear step bumper.

The high heat also caused distortion in the leaf springs assemblies causing the vehicles suspension to settle further.

### **Rear Control Panel**

Both 2 ½ inch discharge valves were reduced to accept 1 ½ inch fittings and hose. The bottom discharge valve was found open and connected to one hose comprised of two lengths that were partially burned. There was some water remaining in the two lengths of hose.

The rear compartment roll up door appeared to be in the closed position. Contents of the rear compartment appeared to be 1 ½ inch and 1 inch hose packs. Charred fittings sleeves and nozzles were found in the cabinet, as well as, the bottom area below this cabinet and directly behind the lower control panel.

The upper suction hose storage bins contained two lengths of suction hose, one in the lower left side and one in the lower right. The upper left and right storage bins were used to store a 1 ½ inch hose lays. The hose lay stored in the upper right bin was removed and connected to the bottom discharge at the rear of the engine panel. The hose lay stored in the upper right bin was still stored with the bin door closed.

The upper hose storage deck was completely burned and melted as result of the vehicle fire. The large storage compartment doors were burned. The left side was partially melted and missing while the right storage door was still complete.

The area directly below the top hose storage is where a water and foam tank is positioned on the truck and connected to the plumbing. The water tank is designed to hold approximately 510 gallons of water and within that tank there is also two separate 20 gallon compartments designed to store two types of foam concentrate. The tanks are constructed of polypropylene material. As designed complete sump and fill towers this tank weighed 475 lbs empty. This much poly propylene material once ignited and burning caused extensive heat.

The right rear lower compartment was found with a door. A military ammo can was found in the bottom of this compartment and appeared to contain fuses. A second military ammo can was found on the ground near the truck with two unburned ignition devices. Two empty drip torches were found adjacent to the ammo cans. One drip torch was found with the top separated while the other drip torch was complete.

The upper right rear compartment was severely damaged. The compartment panel was distorted and ripped open from what appears to be an explosion. The door to this compartment was found in two pieces. The outer door panel was found several yards away from the Engine. The inner panel was found adjacent to a tin building that has also burned. Sections of this door frame approximately 150 feet away from the Engine. The interior shelf was partially in place resting on a tool box in the forward end of the cabinet. In this cabinet there were also the remains of a case of Gatorade drinks. Caps and lids were melted off with some liquid still remaining in the plastic bottles. The compartment shelf had the remains of a large medical kit which contained the exploded oxygen bottle found several yards from the truck where the outer door panel was found.

The right side chock block compartment was found with its door in the open position. The chock block was found still in the compartment.

The right middle compartment was found without a door. The compartment door was found on the ground next to the burned wheels. The contents of this cabinet could not be identified, all that remained was melted aluminum and ash.

The right front compartment still had sections of its door frame in place. The inner outer door panels were burned and partially melted. All contents were burned with only the metal components of the tools remaining. Items found were flat files, pry bar, bolt cutters, shovel heads, and Pulaski tool heads.

The front bulkhead of the body was completely burned with all the aluminum panels melted away. On this bulkhead, the lower front of the Engine body a 1 ½ discharge valve was found mounted in the closed position and still capped. The hose from the pump to this valve was burned.

On the left side of the bulkhead behind the cab, there were remains of a 1 ½ discharge valve. The valve body was completely melted away. We could only find an inner valve handle collar. The two brackets that support this valve were still in place. There were no remnants of hose found near this side of the Engine.

A small hose lay compartment is located directly below the left front compartment. The door constructed of aluminum appeared to be melted away. No contents found except metal components from hose.

The left front compartment was found without its door. The door was found on the ground. Contents of this cabinet were completely destroyed. The identified contents were five each one gallon water canteen frames. The inner wall of this compartment was

distorted inward to the center of the cabinet. Two fire shelters were found. One shelter was found in the compartment and the other on the ground just below this compartment. Both were where charred and not in their yellow storage bags.

The left center compartment was found without its door. The door was found on the ground under ash and debris. There were some hose fittings remaining in the cabinet. Both shelves were destroyed.

The left rear compartment was found without its door. The door was found on the ground under ash and debris. The contents included a metal bracket and burned turnout gear, helmet and boots.

The left side chock block compartment was found empty. The left side chock block was most likely deployed and melted in the vehicle fire. Chock block was not detected in the melted aluminum material found in the front and rear of the left rear dual wheels.

The left rear lower compartment was found open without its door. There were remains of a metal bracket, ash and debris.

The upper left side boxes accessible from the top we found burned nomex pants. The right side we found a storage box with a tow chain. Other items included a breaker bar, lug wrench, and hydraulic jack.

The area just below the upper storage area was found completely destroyed and collapsed into the area below where the water tank had been. We found two chain saw bars that were stored in the upper storage area. One chain saw motor was found under the truck almost completely melted.

The intense heat of the tank material burning caused the back walls of all left side cabinets to deflect into the cabinet area toward the cabinet doors.

## **Truck Cab**

The 4-door truck cab was found completely burned. The left rear door was found unlatched. All other doors were in the latched position and had to be forced open to investigate the cab area.

All door glass was found shattered and melted in the floor of the cab front and rear.

The back seats were found completely destroyed with the remains of one Self Contained Breathing Apparatus (SCBA) bottle. The only remaining components of the bottles were the fiber material still in its cylindrical shape but reduced to ash. The valves for these bottles were found on the rear seating area floor. The cab roof directly above the rear seats was torn from the cab structure as a result the rear SCBA bottles exploding. The torn section of sheet metal was found on-site approximately 10 yards to the right of the vehicle.

Remains of what appeared to be day packs with personal items were found on the floor of the back seat area. Coins, keys and charred remains of two cell phones.

The front seat area was also completely destroyed. All controls on the dash and radio console were destroyed. The ignition keys were found on the floor between layers of melted window glass.

The truck fuel tank is located on the right side. The 70 gallon diesel fuel tank was still in place approximately 50 percent full. The fuel cap vented as designed.

A SCBA spare bottle storage compartment on the left side directly behind the fuel tank and below the rear cab door was partially burned. This cabinet stores four bottles. One bottle stored at the rear of this compartment was completely destroyed and melted with only the bottle valve remaining. The remaining three bottles were destroyed and still in place.

The left step area below the driver's door was completely burned. Just below the cab is the battery compartment designed to store three batteries. All three batteries were completely destroyed. Just behind the battery storage box an air tank was found with all fittings and hoses burned off. This tank was part of the vehicles air brake system.

The storage box on the left side of the truck just below the left rear door was found completely destroyed and melted. This storage box was designed to house the foam system pump and electric motor. These components were completely destroyed and found in the melted aluminum material on the ground just below the cab.

### **Engine Compartment**

The entire compartment was also destroyed. The only remaining material was fibers that had been reduced to ash from the intense heat. The entire hood and fender assembly was made of fiberglass material except for its mounting hardware and latches.

The vehicle was powered by a six cylinder turbocharged diesel engine. The air cleaner was mounted on the right side in a plastic and metal housing. All that remained of the air cleaner assembly was the metal screens from the air cleaner itself and the metal end caps. A metal ring which is designed as part of an ember separator was found. The screen material attached to this metal ring was not found.

The metal tubing used to deliver air from the air cleaner and air cooler to the turbocharger was found laying on the engine. The rubber connectors were burned and melted. The hose clamps were still in place on the cooler and the turbocharger. These lines were found clean with only a light trace of ash inside.

The turbocharger intake did not seem to be damaged from debris. The turbo shaft turned freely when examined.

The left side on the engine is where an on board Electronic Control Unit (ECU) was mounted. This ECU controls all fuel and electrical functions of the diesel engine. There was only wiring and metal connectors remaining. All circuit boards were destroyed.

The diesel fuel injector pump is also mounted on the left side of the diesel engine. The fuel lines and fuel filter body assembly were severely damaged from the intense heat. The front timing cover on the engine was melted away exposing timing gears. The valve cover on top the engine was burned and melted through exposing the rocker arms and valve train.

We found the engine oil level still at an operational level.

The front radiator, air conditioner condenser and air cooler were destroyed with all hoses and connections burned or melted. The transmission cooler housed in the same area was destroyed.

The automatic transmission was mostly in place however, due to high heat the brake retarder assembly was melted and found on the ground with other melted aluminum.

There was no oil found in the automation transmission. This was a result of the severe meltdown that occurred at the rear of the transmission assembly. The Power Take Off (PTO) gear box is mounted directly to the left side of the transmission. This gear box was still attached to a driveline and would not turn. We removed the PTO driveline and found the PTO engaged indicating the pump was engaged at the time the engine stopped running. The Darley water pump powered by this PTO was found resting on the ground as a result of the entire vehicle settling from the fire.

After we disconnect the pump drive line, we could turn the input shaft of the Darley pump.

The driveline from the rear of the automatic transmission attached to the rear differential was found completely ruptured as a result of high heat.

The rear differential was found resting directly on the ground due to all four tires being burned. The rear springs were collapsed due to the intense heat. This collapse of the rear spring assemblies allowed the truck body to settle down closer to the ground.

## **Conclusion**

All indications are that the truck engine was operating with the pump engaged at the time of the incident.

Based on the condition of all components the truck engine could have shut down due to the following reasons:

1. Interruption of electrical power:  
When the left side battery box and wiring to the ECU were burned.  
High heat causing extensive damage to the operators control panel affecting throttle and water valve controls.
2. Interruption of fuel delivery:  
Burning of fuel lines from the fuel tank and to the left side of the engine where fuel filter assembly and injector pump are located.
3. Interruption of air supply to the diesel engine.

As we inspected the damage to the chassis and the Engine body caused by the vehicle fire, we found evidence that the water tank was near full and that there was some undetermined amount of foam concentrate in the tanks. The polypropylene tank could have been damaged when an oxygen bottle stored in the right side storage compartment exploded. The sheet metal around this cabinet was extremely damaged from the explosion and may have ruptured the tank causing it to drain its contents on the ground. The intense fire burning below the tank caused damage to plumbing connected to the tank sump that is the lowest point of the tank. The area on the right side of Engine 57 showed signs of water flowing on the ground towards the right front of the vehicle then to the right driveway leading to a metal shed. This was observed on Sunday, October 29, 2006 and we could still find damp soil in this area.

On Friday, November 3, 2006, the day we removed Fire Engine 57 we noticed the area directly below the tank to still be damp. Once we removed the melted aluminum and debris from that area the soil was damp and not dry and compacted as it was all around the burned vehicle.

In all Government vehicle disposals it is standard procedure to remove any accountable property. We found that the front license plate had been removed sometime between 4:00 pm on November 2 and 9:00 a.m. on November 3 when we removed the vehicle. We did remove the remains of the rear plate and have it with the vehicle records.

We removed Fire Engine 57, Vehicle 6652 with use of a commercial wrecker and transport truck. We were able to install new wheels and tires on the front axle and tow it to a lower road and load it on the transport. Once loaded, we covered the entire engine with a tarp and towed it to a California Highway Patrol approved impound yard in Indio, California and will hold the vehicle there pending final decisions on disposal of the engine.

## Appendix 10 - Video Documentation

<b><i>Time</i></b>	<b><i>Videographer</i></b>	<b><i>Location of Videographer</i></b>	<b><i>Description of Video Scene</i></b>
(1) 4:00 a.m. PDT	San Bernardino National Forest (BDF), Fire Engine 52	At Cabazon	Fire looking south from Cabazon area
(2) During the fire	BDF Engine 52	At the Tile House	View of the first fire run
(3) During the fire	BDF Engine 52	Sitting inside Engine 52	Fire run at the Tile House
(4) During the fire	BDF Engine 54	Sitting inside Engine 54	Engine 54 traveling down Wonderview Road
(5) During the fire	RVC Engine 23	On Twin Pines Road	Fire crossing Twin Pines Road prior to turnover
(6) During the fire	BDF Engine 51	At the Doublewide	Burnout operation at the Doublewide
(7) During the fire	BDF Engine 52	At the Tile House	Fire run after daylight from the Tile House looking towards the accident site at approximate time of the accident
(8) Post fire	Created by a GIS Specialist		3-D image of the Accident Site.

## Appendix 11 – Glossary and Acronyms

**Agency/Area Coordination Center:** A facility which serves as a central point for one or more agencies to use in processing information and resource requests. It may also serve as a dispatch center for one of the agencies.

**Agency Administrator:** Managing officer of an agency, division thereof, or jurisdiction having statutory responsibility for incident mitigation and management. Examples: NPS Park Superintendent, BIA Agency Superintendent, USFS Forest Supervisor, BLM District Manager, FWS Refuge Manager, State Forest Officer, Fire Chief, Police Chief.

**Air attack:** The deployment of fixed-wing or rotary aircraft on a wildland fire, to drop retardant or extinguishing agents, shuttle and deploy crews and supplies, or perform aerial reconnaissance of the overall fire situation.

**Air tanker:** Fixed-wing aircraft certified by FAA as being capable of transport and delivery of fire retardant solutions.

**Area ignition:** Ignition of several individual fires throughout an area, either simultaneously or in rapid succession, and so spaced that they add to and influence the main body of the fire to produce a hot, fast-spreading fire condition. Also called simultaneous ignition.

**Blow up:** Sudden increase in fireline intensity or rate of spread of a fire sufficient to preclude direct control or to upset existing suppression plans. Often accompanied by violent convection and may have other characteristics of a fire storm.

**Branch:** The organizational level having functional or geographical responsibility for major parts of incident operations. The branch level is organizationally between section and division/group in the operations section, and between section and unit in the logistics section. Branches are identified by roman numerals or by functional name (e.g. service, support).

**Burnout:** Setting fire inside a control line to consume fuel between the edge of the fire and the control line.

**Burnover:** A situation where personnel or equipment is caught in an advancing flame front.

**California Interagency Historical Fire Perimeter Database:** CAL FIRE/FRAP, the USDA Forest Service Region 5 Remote Sensing Lab, the Bureau of Land Management, and the National Park Service are jointly developing the comprehensive fire perimeter GIS layer for public and private lands throughout California.

**Chain:** Unit of measure in land survey, equal to 66 feet (20 M) (80 chains equal 1 mile). Commonly used to report fire perimeters and other fireline distances, this unit is popular in fire management because of its convenience in calculating acreage (e.g., 10 square chains equal one acre).

**Check-in:** The process whereby resources first report to an incident. Check-in locations include incident command post (ICP), base or camps, staging areas, helibases, or direct to a tactical assignment.

**Chief:** The ICS title for individuals responsible for command of functional sections: Operations, Planning, Logistics, and Finance/Administration.

**Cooperative Fire Protection Agreement:** an agreement between the Bureau of Land Management; National Park Service; U.S. Forest Service, and California Department of Forestry and Fire Protection – version 7/25/01

**Dead Fuels:** Fuels with no living tissue in which moisture content is governed almost entirely by absorption or evaporation of atmospheric moisture (relative humidity and precipitation).

**Delegation of Authority:** A statement provided to the incident commander by the agency executive delegating authority and assigning responsibility. The delegation of authority can include objectives, priorities, expectations, constraints and other considerations or guidelines as needed. Many agencies require written delegation of authority to be given to incident commanders prior to their assuming command on larger incidents.

**Direct Protection Area:** That area for which a particular fire protection organization has the primary responsibility for attacking an uncontrolled fire and for directing the suppression action. Such responsibility may develop through law, contract, or personal interest of the firefighting agent (e.g., a lumber operator). Several agencies or entities may have some basic responsibilities (e.g., private owner) without being known as the fire organization having direct protection responsibility.

**Director:** The ICS title for an individual responsible for supervision of a branch.

**Division:** The ICS organization level between the branch and the task force/strike team. Divisions are used to divide an incident into geographical areas of operation. Divisions are established when the number of resources exceeds the span-of-control of the operations chief.

**Division/Group Supervisor:** The ICS position responsible for supervising equipment and personnel assigned to a division or group. Reports to a Branch Director or Operations Section Chief.

**[fire] Eddy Effect:** A circular-like flow of a fluid (such as air or water) drawing its energy from a flow of much larger scale, and brought about by pressure irregularities as in the downwind (lee) side of a solid obstacle. For example, wind conditions may be erratic and may eddy on the downwind side of large rock outcroppings, buildings, etc.

**Energy Release Component:** The computed total heat release per unit area (British thermal units per square foot) within the flaming front at the head of a moving fire.

**Entrapment:** A situation where personnel are unexpectedly caught in a fire behavior-related, life-threatening position where planned escape routes or safety zones are absent, inadequate, or compromised. An entrapment may or may not include deployment of a fire shelter for its intended purpose. These situations may or may not result in injury. They include "near misses."

**Escape Route:** A preplanned and understood route firefighters take to move to a safety zone or other low-risk area. When escape routes deviate from a defined physical path, they should be clearly marked (flagged).

**Extended Attack:** Suppression activity for a wildfire that has not been contained or controlled by initial attack or contingency forces and for which more firefighting resources are arriving, en route, or being ordered by the initial attack incident commander.

**Extended Attack Incident:** A wildland fire that has not been contained or controlled by initial attack forces and for which more firefighting resources are arriving, en route, or being ordered by the initial attack incident commander. Extended attack implies that the complexity level of the incident will increase beyond the capabilities of initial attack incident command.

**Extreme Fire Behavior:** "Extreme" implies a level of fire behavior characteristics that ordinarily precludes methods of direct control action. One or more of the following is usually involved: high rate of spread, prolific crowning and/or spotting, presence of fire whirls, strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously.

**Fire:** Rapid oxidation, usually with the evolution of heat and light; heat fuel, oxygen and interaction of the three.

**Fire Behavior:** The manner in which a fire reacts to the influences of fuel, weather, and topography.

**Fire Behavior Prediction System:** A system that uses a set of mathematical equations to predict certain aspects of fire behavior in wildland fuels when provided with data on fuel and environmental conditions.

**Firebrand:** Any source of heat, natural or human made, capable of igniting wildland fuels. Flaming or glowing fuel particles that can be carried naturally by wind, convection currents, or by gravity into unburned fuels.

**Fire Engine:** see Wildland Fire Engine

**Fire Environment:** The surrounding conditions, influences, and modifying forces of topography, fuel, and weather that determine fire behavior.

**Firefighting Forces:** Qualified firefighters, together with their equipment and material, used to suppress wildland fires.

**Fire Frequency:** A general term referring to the recurrence of fire in a given area over time.

**Fire Front:** The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified, the fire front is assumed to be the leading edge of the fire perimeter. In ground fires, the fire front may be mainly smoldering combustion.

**Fire Interval:** The number of years between two successive fire events for a given area; also referred to as fire-free interval or fire-return interval.

**Fire Pack:** A one-person unit of fire tools, equipment, and supplies prepared in advance for carrying on the back.

**Fire Progression:** The progress of the fire outwards from the point of origin.

**Fire Qualifications:** Computerized interagency summary of fire suppression qualifications of listed personnel. Available information includes fire training record, fire experience record, and physical fitness testing score for each individual.

**Fire Resources:** All personnel and equipment available or potentially available for assignment to incidents.

**Firefighting Resources:** see Fire Resources

**Fire Shelter:** An aluminized tent offering protection by means of reflecting radiant heat and providing a volume of breathable air in a fire entrapment situation. Fire shelters should only be used in life threatening situations, as a last resort.

**Fire Shelter Deployment:** The removing of a fire shelter from its case and using it as protection against fire.

**Fire Weather:** Weather conditions which influence fire ignition, behavior, and suppression.

**Fire Weather Forecast:** A weather prediction specially prepared for use in wildland fire operations and prescribed fire.

**Fire Weather Watch:** A Fire Weather Watch is issued to advise of conditions which could result in extensive wildland fire occurrence or extreme fire behavior, which are expected to develop in the next 12 to 48 hours, but not more than 72 hours. In cases of dry lightning, a Fire Weather Watch may be issued for the next 12 hours. Also see Red Flag Warning

**Flame Height:** The average maximum vertical extension of flames at the leading edge of the fire front. Occasional flashes that rise above the general level of flames are not considered. This distance is less than the flame length if flames are tilted due to wind or slope.

**Flame Length:** The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface), an indicator of fire intensity.

**Foehn Wind:** A warm, dry and strong general wind that flows down into the valleys when stable, high pressure air is forced across and then down the lee slopes of a mountain range. The descending air is warmed and dried due to adiabatic compression producing critical fire weather conditions. Locally called by various names such as Santa Ana winds, Devil winds, North winds, Mono winds, etc.

**Forest Net Radio Channel:** a station radio system already in place at the Cabazon Fire Station

**FRAP:** The California Department of Forestry and Fire Protection's Fire and Resource Assessment Program (FRAP). Assesses the amount and extent of California's forests and rangelands, analyzes their conditions and identifies alternative management and policy guidelines.

**Fuel:** Any combustible material, especially petroleum-based products and wildland fuels.

**Fuel Class:** Part of the National Fire Danger Rating System (NFDRS). Group of fuels possessing common characteristics. Dead fuels are grouped according to 1-, 10-, 100-, and 1000-hour timelag, and living fuels are grouped as herbaceous (annual or perennial) or woody.

**Fuel Loading:** The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area. This may be available fuel (consumable fuel) or total fuel and is usually dry weight.

**Fuel Model:** Simulated fuel complex for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.

**Fuel Moisture Content:** The quantity of moisture in fuel expressed as a percentage of the weight when thoroughly dried at 212 degrees F.

**Fuel Size Class:** A category used to describe the diameter of down dead woody fuels. Fuels within the same size class are assumed to have similar wetting and drying properties, and to preheat and ignite at similar rates during the combustion process.

**General Fire Weather Forecast:** A forecast, issued daily during the regular fire season to resource management agencies, that is intended for planning of daily fire management activities, including daily staffing levels, prevention programs, and initial attack on wildfires. Also called presuppression forecast.

**Geographic Area Coordination Center:** The physical location of an interagency, regional operation center for the effective coordination, mobilization and demobilization of emergency management resources. Listings of geographic coordination centers and their respective geographic coordinating areas can be found within the National Interagency Mobilization Guide, Chapter 20, Section 21.1

**Head Fire:** A fire spreading or set to spread with the wind.

**Holding actions:** All actions taken to stop the spread of fire.

**Incident Commander:** This ICS position is responsible for overall management of the incident and reports to the Agency Administrator for the agency having incident jurisdiction. This position may have one or more deputies assigned from the same agency or from an assisting agency(s).

**Incident Command Post:** Location at which primary command functions are executed. The ICP may be collocated with the incident base or other incident facilities.

**Incident Command System:** A standardized on-scene emergency management concept specifically designed to allow its user(s) to adopt an integrated organizational structure equal to the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries.

**Incident Management Team:** The incident commander and appropriate general and command staff personnel assigned to an incident.

**Initial attack:** A planned response to a wildfire given the wildfire's potential fire behavior. The objective of initial attack is to stop the spread of the fire and put it out at least cost. An aggressive suppression action consistent with firefighter and public safety and values to be protected.

**Inversion:** Atmospheric inversion. The departure from the usual increase or decrease with altitude of the value of an atmospheric property. In fire management usage, nearly always refers to an increase in temperature with increasing height. Also, the layer through which this departure occurs (also called inversion layer). The lowest altitude at which the departure is found is called the base of the inversion.

**I-Zone:** An area that, in relation to wildland/urban fire, has a set of conditions that provides the opportunity for fire to burn from wildland vegetation to the home/structure ignition zone.

**Jurisdiction:** The range or sphere of authority. Public agencies have jurisdiction at an incident related to their legal responsibilities and authority for incident mitigation. Jurisdictional authority at an incident can be political/geographical (e.g., city, county, state or federal boundary lines), or functional (e.g., police department, health department, etc.).

**Line Pack:** see Fire Pack

**Live Fuel Moisture Content:** Ratio of the amount of water to the amount of dry plant material in living plants.

**Live Fuels:** Living plants, such as trees, grasses, and shrubs, in which the seasonal moisture content cycle is controlled largely by internal physiological mechanisms, rather than by external weather influences.

**Lookout:** (1) A person designated to detect and report fires from a vantage point; (2) A location from which fires can be detected and reported; (3) A fire crew member assigned to observe the fire and warn the crew when there is danger of becoming trapped.

**Lookout(s), Communication(s), Escape Route(s), and Safety Zone(s) (LCES):** Elements of a safety system used by fire fighters to routinely assess their current situation with respect to wildland firefighting hazards.

**Management Action Points:** Geographic points on the ground or specific points in time where an escalation or alternative of management actions is warranted. These points are defined and the management actions to be taken are clearly described in an approved Wildland Fire Implementation Plan (WFIP) or Prescribed Fire Plan. Timely implementation of the actions when the fire reaches the action point is generally critical to successful accomplishment of the objectives. Also called Trigger Points.

**MAST:** The Riverside County Mountain Area Safety Taskforce (MAST), San Jacinto Mountains Community, Wildfire Protection Plan – Draft Final (March 2006)

**Mean Sea Level (MSL):** Average height of the surface of the sea for all stages of the tide over a 19-year period. NOTE: when the abbreviation MSL is used in conjunction with a number of feet, it implies altitude above sea level (e.g., 1000 feet MSL).

**Nomex ®:** Trade name for a fire resistant synthetic material used in the manufacturing of flight suits and pants and shirts used by firefighters. Aramid is the generic name.

**Operations Section:** The section responsible for all tactical operations at the incident. Includes branches, divisions and/or groups, task forces, strike teams, single resources and staging areas.

**Operations Section Chief:** This ICS position is responsible for supervising the Operations Section. Reports to the Incident Commander and is a member of the General Staff. This position may have one or more deputies assigned.

**Personal Protective Equipment:** That equipment and clothing required to mitigate the risk of injury from or exposure to hazardous conditions encountered during the performance of duty. PPE includes but is not limited to: fire resistant clothing, hard hat, flight helmets, shroud, goggles, gloves, respirators, hearing protection, chainsaw chaps, and shelter.

**Pre-ignition combustion phase:** Thermal or chemical decomposition of fuel at an elevated temperature. This is the pre-combustion stage of burning during which distillation and pyrolysis predominate. Heat energy is absorbed by the fuel which, in turn, gives off water vapor and flammable tars, pitches, and gases. These ignite when mixed with oxygen to initiate the flaming combustion phase.

**Probability of Ignition:** The chance that a firebrand will cause an ignition when it lands on receptive fuels.

**Pyrolysis:** The thermal or chemical decomposition of fuel at an elevated temperature. This is the Pre-ignition combustion phase of burning during which heat energy is absorbed by the fuel which, in turn, gives off flammable tars, pitches, and gases.

**Rate of spread:** The relative activity of a fire in extending its horizontal dimensions. It is expressed as rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Usually it is expressed in chains or acres per hour for a specific period in the fire's history.

**Red Flag Warning:** Term used by fire weather forecasters to alert forecast users to an ongoing or imminent critical fire weather pattern – normally to occur within 24 hours.

**Relative Humidity:** The ratio of the amount of moisture in the air, to the maximum amount of moisture that air would contain if it were saturated. The ratio of the actual vapor pressure to the saturated vapor pressure.

**Remote Automatic Weather Station:** A GEOS telemetered weather station that transmits hourly observations 24 times per day. These observations are automatically delivered through ASCADS to WIMS.

**Run (Of a Fire):** Rapid advance of the head of a fire, characterized by a marked transition in fireline intensity and rate of spread with respect to that noted before and after the advance.

**Safety Zone:** An area cleared of flammable materials used for escape in the event the line is outflanked or in case a spot fire causes fuels outside the control line to render the line unsafe. In firing operations, crews progress so as to maintain a safety zone close at hand allowing the fuels inside the control line to be consumed before going ahead. Safety zones may also be constructed as integral parts of fuelbreaks; they are greatly enlarged areas which can be used with relative safety by firefighters and their equipment in the event of blowup in the vicinity.

**Santa Ana Wind:** see Foehn Wind

**Self-Contained Breathing Apparatus (SCBA):** Portable air (not oxygen) tanks with regulators which allow firefighters to breathe while in toxic smoke conditions. Usually rated for 30 minutes of service. Used primarily on fires involving structures or hazardous materials.

**Situational awareness (SA):** The perception of what the fire is doing and what you are doing in relation to the fire and your goals. It involves an awareness of fire behavior and terrain and the ability to predict where the fire and you will be in the future. This skill depends both on individual perception and sharing it with the rest of the team. Human Factors Workshop - 1995 part 2. SA is knowing and understanding what is going on around you and predicting how things will change, or, in other words, "being coupled to the dynamics of your environment" (Moray, 2004). In the simplest form, SA describes how well someone's perception matches reality. On the fireline, especially under extreme conditions, it's critical for perceptions of the changing fire potential to reflect what's actually happening (Close, 2005). "Mindfulness" is one way of understanding situational awareness – "...coming to an understanding of yourself and your environment, maintaining an on-going scrutiny of expectations, continuous refinement and differentiation of expectations based on newer experiences, and a willingness and capacity to invent new expectations" (Weick and Sutcliffe, 2001).

**Single resource:** An individual, a piece of equipment and its personnel complement, or a crew or team of individuals with an identified work supervisor that can be used on an incident.

**Sounding (Upper Air Sounding):** A sampling of upper air conditions made by means of instruments and a small radio transmitter on a free balloon. Automatic radio signals originated by action of weather instruments are sent to a ground receiver. These signals are interpreted for use in analyzing and predicting upper air conditions over a wide area of the earth. Weather elements determined at a number of altitude points as the balloon rises are temperature, atmospheric moisture, pressure, wind direction and speed. Similar soundings may be made using fixed balloons or tether sondes.

**Span of Control:** The supervisory ratio of from three-to-seven individuals, with five-to-one being established as optimum.

**Spot Fire:** Fire ignited outside the perimeter of the main fire by a firebrand.

**Spot Weather Forecast:** A special forecast issued to fit the time, topography, and weather of a specific incident. These forecasts are issued upon request of the user agency and are more detailed, timely, and specific than zone forecasts. Usually, on-site weather observations or a close, representative observation is required for a forecast to be issued.

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

**Staging Area:** Locations set up at an incident where resources can be placed while awaiting a tactical assignment on a three (3) minute available basis. Staging Areas are managed by the Operations Section.

**Strike Team:** Specified combinations of the same kind and type of resources, with common communications, and a leader.

**Strike Team Leader:** The ICS position responsible for supervising a strike team. Reports to a Division/Group Supervisor or Operations Section Chief. This position may supervise a strike team of engines (STEN), crews (STCR), dozers (STDZ), or tractor/plows (STPL).

**Structural Fire Protection:** The protection of homes or other structures from wildland fire.

**Structural Triage:** Process of inspecting and classifying structures according to their defensibility/indensibility based on their situation, their construction, and the immediately adjacent fuels.

**Supervisor:** The ICS title for individuals responsible for command of a division or group.

**Suppression:** All the work of extinguishing or confining a fire beginning with its discovery.

**Synoptic:** Literally, at one time. Thus, in meteorological usage, the weather conditions over a large area at a given point in time.

**Synoptic Chart:** In meteorology, any chart or map on which data and analyses are presented that describe the state of the atmosphere over a large area at a given moment in time.

**Task Force:** Any combination of single resources assembled for a particular tactical need, with common communications and a leader. A Task Force may be pre-established and sent to an incident, or formed at an incident.

**Task Force Leader (TFLD):** The ICS position responsible for supervising a task force. Reports to a Division/Group Supervisor or Operations Section Chief.

**Technical Specialists:** Personnel with special skills that can be used anywhere within the ICS organization. These personnel may perform the same duties during an incident that they perform in their everyday job.

**Triage:** see Structure Triage

**Trigger Points:** see Management Action Points

**Type III Fire Engine:** A wildland fire engine that has a 500 gallon capacity, has a 500 at 150 psi (pounds per square inch) gallons per minute capability, and is able to transport a minimum of 3 crew members.

**Type II helicopter specification listed in the Interagency Helicopter Operations Guide - March 2006:** *Allowable Payload at 59° Fahrenheit at Sea Level: 2500; Passenger Seats: 9 to 14; Retardant or Water Carrying Capability (Gallons): 300; Maximum Gross Takeoff/Landing Weight (Lbs): 6,000 -12,500*

**Type III Helicopter specification listed in the Interagency Helicopter Operations Guide - March 2006 :** *Allowable Payload at 59° Fahrenheit at Sea Level: 1200; Passenger Seats: 4 to 8; Retardant or Water Carrying Capability (Gallons): 100; Maximum Gross Takeoff/Landing Weight (Lbs): up to 6,000*

**“Unnamed creek drainage”:** Is aligned northeast to southwest below the accident site. It is 1.5 miles long and is approximately ¼ mile wide with average slope at 25 percent. The run of the slope is at average of 50 percent. The United States Geological Survey Map, USDA Forest Service, Cabazon Quadrangle California-Riverside County, 7.5-Minute Series and site visit was used to describe the topographic features of the accident site.

**Unified Command:** In ICS, unified command is a unified team effort which allows all agencies with jurisdictional responsibility for the incident, either geographical or functional, to manage an incident by establishing a common set of incident objectives and strategies. This is accomplished without losing or abdicating authority, responsibility, or accountability.

**Upper Air Sounding:** see Sounding

**Weather Information Management System (WIMS):** A centralized weather data processing system at which daily fire danger ratings are produced.

**Wildland:** An area in which development is essentially non-existent, except for roads, railroads, powerlines, and similar transportation facilities. Structures, if any, are widely scattered.

**Wildland Fire Engine:** A unique vehicle that is specifically designed for the wildland environment. These fire engines are equipped with four wheel drive, rugged suspension and high wheel clearance for mountainous dirt road conditions. Fire engines are placed into category types that are used in the Incident Command System.

**Wildland Fire:** Any non-structure fire that occurs in the wildland. Three distinct types of wildland fire have been defined and include wildfire, wildland fire use, and prescribed fire.

**Wildfire Suppression:** An appropriate management response to wildfire, escaped wildland fire use or prescribed fire that results in curtailment of fire spread and eliminates all identified threats from the particular fire.

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

**Weather Information Management System (WIMS):** A centralized weather data processing system at which daily fire danger ratings are produced.

**Work/Rest Ratio:** An expression of the amount of rest that is required for each hour an individual is in work status. Current NWCG guidelines require one hour of rest for every two hours in work status.

## Acronyms

<b>BC</b>	Battalion Chief
<b>BDF</b>	San Bernardino National Forest
<b>BLM</b>	Bureau of Land Management
<b>CAL FIRE</b>	California Department of Forestry and Fire Protection
<b>CDF</b>	California Department of Forestry and Fire Protection
<b>CFPA</b>	Cooperative Fire Protection Agreement
<b>CH/HR</b>	Chains per hour
<b>DC</b>	Division Chief
<b>DW</b>	Doublewide
<b>DPA</b>	Direct Fire Protection Area
<b>ECC</b>	Emergency Command Center
<b>ERC</b>	Energy Release Component
<b>FBAN</b>	Fire Behavior
<b>FICC</b>	Federal Interagency Communications Center
<b>FRAP</b>	CAL FIRE's Fire Resource Assessment Program
<b>FW&amp;S</b>	Fish & Wildlife Services
<b>GACC</b>	Geographic Area Coordination Center
<b>IC</b>	Incident Commander
<b>ICP</b>	Incident Command Post
<b>ICS</b>	Incident Command System
<b>I – Zone</b>	Interface zone same as Wildland Urban Interface
<b>IMT</b>	Incident Management Team
<b>MAST</b>	Mountain Area Safety Taskforce
<b>MB-10</b>	March Air Force Base – Brush 10 Fire Engine
<b>MPH</b>	Miles per Hour
<b>MSL</b>	Mean Sea Level
<b>NPS</b>	National Park Service
<b>NWSFO</b>	National Weather Service Forecast Office
<b>NWS</b>	National Weather Service
<b>OIG</b>	Office of Inspector General
<b>OSHA</b>	Federal Occupational Safety and Health Administration
<b>PDT</b>	Pacific Daylight Time
<b>PPE</b>	Personal Protective Equipment
<b>RAWS</b>	Remote Automatic Weather Station
<b>RH</b>	Relative Humidity
<b>RFW</b>	Red flag warning
<b>ROS</b>	Rate of Spread
<b>RRU</b>	CAL FIRE Riverside Unit
<b>RUC</b>	Rapid Update Cycle
<b>RVC</b>	Riverside County
<b>SAIT</b>	Serious Accident Investigation Team
<b>SCBA</b>	Self Contained Breathing Apparatus
<b>South Ops</b>	California Southern Operations Center

**RAWS**  
**TH**  
**USFS**  
**WIMS**

Remote Automated Weather System  
Tile House  
United States Forest Service  
Weather Information Management System