United States
Department of
Agriculture

Forest Service

November 13, 2009

Fire and Aviation Management

Station Fire Initial Attack Review

Report of the Review Panel

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Executive Summary

On August 26, 2009, at 3:24 p.m., the Angeles National Forest (USDA Forest Service, Pacific Southwest Region) received a call for initial attack response to a fire that had ignited on the forest near the Angeles Crest Fire Station, on the Angeles Crest Highway. The terrain below the Angeles Crest Highway is rugged and steep. The slope percentage from the highway to the creek bottom ranges from 33 percent to 67 percent along the half mile section of the highway centered on the fire station. There are several narrow ravines facing east along this section of highway. The slopes below the highway range from 900 to 1,680 feet in length. The vegetation was mature mixed chaparral, standing six to eight feet tall, at least 50 years old, and extremely flammable. Ultimately, the fire grew in size to over 160,000 acres, leading to the loss of forest resources, private property, and human life. At the direction of the Chief of the USDA Forest Service, a review was undertaken for the period from initiation of initial attack on August 26 to August 28, 2009, at 2:00 p.m., when the fire was placed under the command of a Type I Incident Management Team.

A five-person review panel, guided by incident documentation and interviews conducted with initial attack incident commanders and Angeles Forest personnel, performed a review that reconstructed the initial attack phase of the Station Fire[1] from a foresight perspective. The review process focused on conditions at the time of the incident including terrain, weather, vegetation conditions, potential fire behavior, suppression resource effectiveness, and exposure of firefighters to the hazards of wildland fire. From this foresight perspective, decisions were reconstructed in terms of how they appeared to incident commanders at the time, given the information available and the uncertainties present in the management situation.

The primary objectives of the review were to:

- Determine if the Angeles National Forest preparedness actions before the Station Fire were in alignment with existing plans (staffing/ action guides, land and resource management plan, fire management plans) and cooperative agreements;

Terrain below the Angeles Crest Highway is extremely rugged and steep.

- Determine if the decision process and actions taken during initial attack including key decisions during the initial attack were reasonable and prudent in view of the known environment, current information, and other circumstances existing at the time of the event; and

- Examine the role of the agency administrator in providing leader's intent and input to strategic decisions for the incident initial attack.

The review panel found that:

- The Angeles National Forest had in place at the time of the incident an up-to-date staffing and action guide for initial attack.

- The actions taken by the Angeles National Forest and the Forest Supervisor with respect to overall incident objectives—controlling the fire at the smallest acreage practicable consistent with firefighter safety considerations, were consistent with the forest's land management plans.

- The origin of the Station Fire was in extremely rugged terrain with limited opportunities for safe suppression activities by ground-based suppression resources.

[1] For the purpose of this review the term "initial attack" encompasses the actions of the incident commanders from the initial dispatch on August 26, 2009, through to the transition of the fire to the Type 1 Incident Management Team on August 28, 2009, at 2:00 p.m.

- The dry, dense brush in the area of the fire was at high risk for potentially extreme fire activity and at a level that posed unacceptable risk to firefighters.

- Firefighters made cooperative efforts to engage the fire at critical points during the daylight phase of initial attack. Control of the incident was prevented because of a spot fire that occurred in an inaccessible location with limited visibility and thick, tall brush.

- The ordering and assignment of firefighting resources to initial attack was appropriate and consistent with accepted fire management practices. Additional ground tactical resources would not have improved the effectiveness of operations because they could not be safely deployed.

- Incident management decisions made during the review period were consistent with generally accepted incident management practices. Decisions made by initial attack incident commanders reflected sound judgment of the operational situation and were prudent with respect to firefighter effectiveness, safety, and suppression resource deployment.

- The review panel found no evidence or indication that initial attack incident commanders felt unduly constrained to inappropriately reduce direct suppression costs.

- In conclusion:

    - Incident managers during the initial attack phase of the Station Fire acted in a manner consistent with best professional practices as accepted by wildland firefighting agencies, and

    - Deployed suppression resources under conditions where firefighters would be safe and effective.

In light of the extremely challenging topography encountered during initial attack and the highly volatile fire and vegetation conditions, incident commanders were reasonable and prudent in not exposing firefighters to actions that would have been ineffective and compromised their safety.

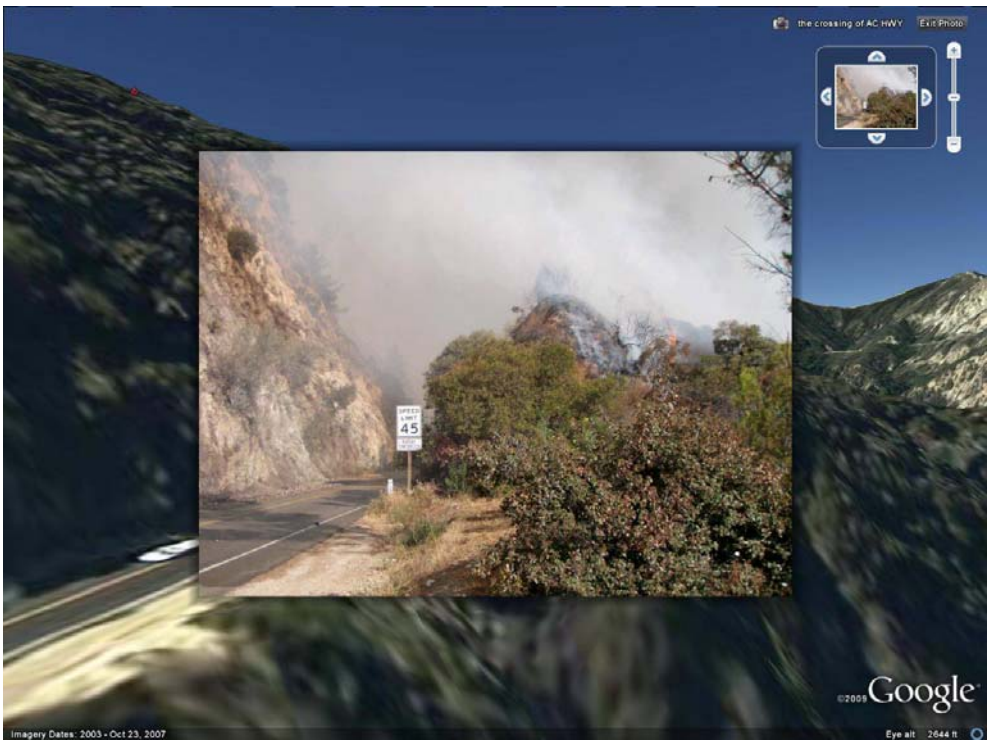
Active fire below the Angeles Crest Highway coupled with the topography make accessibility by ground crews impossible

Introduction

The safe, effective, and successful initial attack of wildland fire is vital. As an agency, the USDA Forest Service is successful in its initial attack of wildland fires nearly 98 percent of the time. The Angeles National Forest Land and Resource Management Plan mandates the forest take aggressive action on all unplanned ignitions. During the 2008-2009 fire season, the forest experienced only two escapes of the nearly 200 fires that occurred. The 160,500 acre Station Fire was one of the two fires to escape initial attack.

Initial attack is one of the most difficult, hazardous phases of fire management. Improving initial attack practices means not only improving effectiveness of suppression but also improving the management of risk to those who intervene as part of fire operations and are thereby exposed to the inherent risks of wildland fire. Each year, wildland firefighters die in the line of duty – approximately 20 annually. Incident managers have a responsibility to protect the public as well as firefighters from exposure to wildland fire that could prove hazardous and even fatal.

The Angeles National Forest has a long history of firefighter fatalities, especially those that occurred when fire came from below the firefighters, overrunning them, as was the case during the Canyon Fire (1968), the Loop Fire (1966), and the Glen Allen Fire (1993). Hot, dry weather, with very steep topography, and the vegetation conditions prone to this particular forest made firefighters on the Angeles National Forest acutely aware of the dangers of approaching a fire from above.



Angeles National Forest has long history of firefighter fatalities, especially those that occurred when fire came from below the firefighters

Scope and Focus of Review

This review is entirely focused on the period of time between discovery and report of the Station Fire on the afternoon of August 26, 2009, at 3:24 p.m., to transfer of command of the incident to a Type I Incident Management Team on August 28, 2009, at 2:00 p.m. The review addresses neither the performance of the Type I Incident Management Team nor the predisposing vegetative and societal factors that contributed to the Station Fire. This review does not address the performance of the non-federal assistors and cooperators who were also engaged in this incident.

The primary objectives of the review were to:

- Determine if the Angeles National Forest preparedness actions before the Station Fire were in alignment with existing plans and cooperative agreements;
- Determine if the decision processes and actions taken during initial attack, including key decisions during the initial attack, were reasonable and prudent in view of the known environment, current information, and other circumstances existing at the time of the event; and
- Examine the role of the agency administrator in providing leader's intent and input to strategic decisions for the incident initial attack.

Review Panel Composition

Review Panel was composed of the following individuals:

- James E. Hubbard, Team Leader, Deputy Chief, State and Private Forestry, USDA Forest Service
- Tom Harbour, Director, Fire and Aviation Management, USDA Forest Service
- John B. Tripp, Chief Deputy, Emergency Operations, Los Angeles County Fire Department
- Ken Pimlott, Deputy Director, Chief of Fire Protection, California Department of Forestry and Fire Protection (CAL FIRE)
- Donald G. MacGregor, Ph.D., Senior Scientist, MacGregor and Bates, Incorporated

Fire above and below Angeles Crest Highway on August 27 after spot fire occurred

Scope and Focus of Review (continued)

From discovery of the fire to approximately 1:10 p.m., on August 27, 2009, the Angeles National Forest personnel were entirely responsible for the management of the fire. During this period, the Station Fire was not under unified command, and suppression resources supplied by the California Department of Forestry and Fire Protection (CAL FIRE) and the Los Angeles County Fire Department (County) were provided solely in a role of assistance. Unified command was established with Los Angeles County Fire Department at approximately 1:10 p.m. on August 27, 2009. During this review, the role of the two review panel members from the Los Angeles County Fire Department and CAL FIRE organizations was to provide independent technical or subject matter expertise and to analyze the wildland firefighting strategies and tactics used during initial attack, from an outside perspective. Their input was based on the information provided by the Angeles National Forest and through interviews conducted with initial attack incident commanders and other forest personnel. Neither of these team members was in a role to evaluate conformance of initial attack actions with USDA Forest Service policies, directives, and/or guidelines.

Individuals Interviewed

Interviewee	Unit	Role on Incident
INT #1	Angeles NF	Fire Officer
INT #2	Angeles NF	Incident Commander (Type III)
INT #3	Angeles NF	Incident Commander (Type IV)
INT #4	Angeles NF	Incident Commander (Type III)
INT #5	Angeles NF	Incident Commander Trainee
INT #6	Angeles NF	Fire Investigator
INT #7	Angeles NF	Division Supervisor

Review Process

The general approach to this review is adapted from the "After Action Review" format described in the National Wildland Fire Coordinating Group (NWCG) Incident Response Pocket Guide (PMS #461). In addition, the review takes advantage of a risk science-based approach that recognizes the complexity and uncertainty in hazardous situations, and the need for incident managers to assess the likely effectiveness of suppression resources in a given situation, as well as to assess the risks to incident responders.[2, 3]

Wildland fire suppression is a hazardous undertaking, as such, wildland fire management decision making is always done under conditions of uncertainty. This means that a review of fire management decision making cannot take, as its reference or starting point, the outcome of an incident. To do so is misleading and lends to a hindsight-bias by which the outcomes can appear inevitable from preceding conditions and decisions. To avoid a hindsight bias, this review was focused on reconstructing the decision situation as it appeared to key decision makers at the time, during initial attack. A foresight perspective accounts for the uncertainty that is inherent in wildland fire incident command as well as the risks to which firefighters are exposed. From this perspective, the review is then appropriately focused on:

- Whether the decisions made on the incident were reasonable given the situational conditions, uncertainties present, and the information available at the time, and

- Whether similar individuals, with similar professional backgrounds, and experience, operating under similar circumstances would come to the same general conclusions about the best approach for dealing with the fire.

[2] Haimes, Y.Y. (1998). Risk modeling, assessment and management. New York: Wiley.
[3] National Research Council (2009). Science and decisions: Advancing risk assessment. Washington, D. C.: The National Academies Press

A key consideration given in the review process was to the exposure of firefighters to the inherent risk of wildland fire, the appropriateness of exposure given the environmental conditions (e.g., weather, terrain, vegetation, etc.), the fire behavior, consideration to the values imminently threatened and at risk, and ultimately the firefighters' ability to be effective in suppressing the fire. Fire management decisions are risk based and are a tradeoff between the damage a fire might do and the harm it might inflict to firefighters who intervene to mitigate those risks. For every firefighter assigned to take action on a fire incident, risk is transferred from the resource threatened to the firefighter. This review looked at if and when that transfer of risk was reasonable and appropriate during the initial attack phase of the Station Fire; and when it was not, did incident managers act prudently in making decisions that reduced firefighters' exposure to harm.

The review was initiated by collecting information and documentation directly pertaining to the incident including:

- Dispatch Logs or Run Cards
- Weather Data (predicted, observed, national fire danger ratings)
- Pre-attack Plans
- Decision Documentation (ICS-214 and Logs)
- Maps
- Briefing Packages
- Situation Reports (ICS-209)

This information was used as a guideline for interviewing incident managers in key decision-making roles during the review period. From those interviews, as well as appropriate incident documentation, incident decisions were reconstructed in terms of:

a. Environmental conditions that pertain to the fire and fire context (e.g., fire behavior, weather, vegetation), and

b. Management events that represent responses to the fire.

The incident reconstruction was used to develop the findings and recommendations presented in this report.

Incident Reconstruction

The incident reconstruction was based on a number of information sources including incident documentation, interviews with initial attack incident commanders, visits by members of the review panel to the site of the initial attack, and subsequent information requests made to the Angeles National Forest management and staff. In addition, the review panel requested a review of the conditions present at the site of initial attack relevant to factors that influenced the fire behavior associated with the spot fires below the Highway. This evaluation was completed by Dr. David Weise of the USDA Forest Service, Pacific Southwest Research Station in Riverside, California. (See Appendix A)

Highlights of the report are as follows:

General Setting and Terrain Conditions

The ignition occurred along the Angeles Crest Highway (Highway 2) at approximately milepost 29, near the Angeles Crest Fire Station (Lat 34° 15' 3.77"N; Long 118° 11' 41.51"W). The fire investigation placed the exact point of ignition adjacent to a roadside turnout and indicated it was human caused. The terrain above and below the Angeles Crest Highway at this location is rugged and steep. The slope percentage from the Highway to the creek bottom ranges from 33 percent to 67 percent. Appendix B shows photographs of the site of initial attack taken from several vantage points, including a point on Civilian Conservation Corps (CCC) Ridge looking toward the initial attack area. As the photographs indicate, topographical conditions in this area are extremely difficult, if not impossible, to traverse without a high degree of exposure to hazard. In addition to the hazards of rolling rocks and unstable footing, firefighters attempting to access points below the Highway would be in an upslope position with respect to fire below them and in brush conditions with extremely limited or no visibility. In these conditions, safety zones and escape routes could not be established.

Along Angeles Crest Highway at Turnout

Firefighters attempting to access points below the Highway would be in an upslope position with respect to fire below them—safety zones and escape routes could not be established

Weather Conditions

Weather conditions at the time of Initial attack and into the evening of August 26 tended to be warm and dry with relatively light winds. Weather observations at the Clear Creek weather station (approximately 3.2 miles away) indicated a temperature of 89 degrees Fahrenheit, a relative humidity of 11 percent, and wind speed of 10 mph. The spot weather forecast produced at 5:20 p.m., in the late afternoon and early evening, predicted night time temperatures around 74 degrees Fahrenheit, and a maximum relative humidity of 17 percent. Maximum observed relative humidity at the two weather stations in the area on the night of August 26 did not exceed 17 percent. At 8:40 a.m. on August 27, temperatures were 89 degrees Fahrenheit with relative humidity of 9 percent.

Vegetation Conditions

Vegetation conditions are a critical element in determining the hazardousness of exposing firefighters in incident operations. The observed afternoon vegetation moisture content was typical for this time of year. However, the fact that the relative humidity was not predicted to increase very much on the night of August 26 meant that the vegetation moisture would stay relatively low throughout the night and that fires would continue to burn actively through the night. Live vegetation moisture content was normal for this time of year based on long-term averages. However, the moisture content in chamise was approaching 60 percent, which is considered a critical level for fire behavior. Also of importance was the percentage of dead versus live vegetation. Dead vegetation is particularly volatile and can lead to extreme fire behavior. Percentage of dead vegetation in the area of initial attack ranged from 50 percent to 70 percent.

Potential Fire Behavior

Initial Attack on the Station Fire occurred in a context of highly volatile vegetation conditions with potentially extreme fire behavior. Guidelines for suppression activities that are appropriate for different levels of fire behavior have been developed over the years and are a basis for determining the risk associated with suppression operations. Flame length, rate of spread, and fire intensity are the fire behavior indicators typically used. In the case of the initial attack on the Station Fire, vegetation conditions were such that flame lengths in excess of 15 feet could be expected, accompanied by very high rates of spread. Under these conditions, fire behavior is extreme and not amenable to attack by hand crews or fire engines.

Vegetation conditions are a critical element in determining the hazardousness of exposing firefighters to incident operations

Incident Synopsis

The first initial attack dispatch on the Station Fire occurred at approximately 3:24 p.m., on August 26, 2009. Simultaneously Los Angeles County Fire Department and Angeles National Forest personnel responded,[4] with additional air resources provided by the nearby Morris Fire. On arrival, incident responders found the fire burning on the upslope side of the Angeles Crest Highway, adjacent to a roadside turnout, in hazardous conditions (see Appendix C for pictorial representation of IA site). The terrain at the site of initial attack was extremely rugged and steep. Firefighters engaged the fire with handcrews, engines, and aircraft. Operational decisions were based on where resources could be both safely and effectively positioned. Hose lines, aircraft, and handcrews were deployed on the fire. Ground-based resources (crews and engines), accompanied by air support, were able to make progress on the upslope portion of the fire throughout the afternoon. Only a portion of the resources on the incident could be used, however, due to limited opportunities for deployment posed by the hazardous terrain, brush conditions with extremely limited or no visibility, and potential fire behavior conditions. These undeployable resources were released once it was obvious to the incident commander that they could not be utilized safely and effectively.

Spot fires occurred on the down slope side of the Highway within minutes after responders arrived.

Operational decisions were based on where resources could be both safely and effectively deployed

Temperatures at this time of the day were reaching 100 degrees, and the relative humidity was less than 10 percent, making the probability of ignition on the down slope aspect almost certain and the potential fire behavior extreme. Engines, handcrews, and/or aircraft were able to attack some spot fires; however, there was at least one known spot fire which was inaccessible for attack. Air resources were unable to extinguish fires alone and would have required ground resources to assure effectiveness.

Map showing location of spot fire and inaccessible, rugged terrain below the Highway

[4] Resources that initially responded from Angeles National Forest and LA County Fire Department on August 26, 2009 included: Nine (9) handcrews of 20 members each, 2 Chief Officers from the Angeles National Forest and 2 from LA County Fire, 13 engines, 3 water tenders, 2 patrols, 2 medium helicopters, 1 heavy helicopter, 1 heavy Helitanker, and an Airco helicopter. Additionally, the Morris Fire sent 1 air attack, 2 Helitankers and 2 airtankers.

The upslope portion of the fire continued to respond to control efforts using the appropriate resources. Late in the evening of August 26, flying embers produced by the upslope fire ignited at least one significant spot fire below the Highway in an area inaccessible by ground resources. The on-scene assets, including engine crews, hand crews, and leadership, assessed the situation regarding the spot fires and determined that without appropriate anchoring and mitigation, approaching the fire from above was neither safe nor feasible. By 2:10 a.m. on the morning of August 27, 2009, several spot fires had occurred on the down slope side of the Highway. Due to the increased fire activity, orders were placed for additional air resources and ground resources with a reporting time of sunrise. Effective work continued on the upslope portion of the fire and assessment continued for the fires down slope of the highway. By 8:30 a.m. on the morning of August 27, the fire was exhibiting extreme fire behavior with fire burning both upslope and down slope of the Highway. At 11:00 a.m., firefighters were ordered off the line due to extreme fire behavior and the unsafe conditions. At approximately 1:10 p.m., the Angeles National Forest and Los Angeles County Fire Department entered into unified command. At 1:32 p.m. on the afternoon of the August 27, a Type I Incident Management Team was ordered. The Type I Incident Management Team assumed command of the fire on August 28, 2009, at 2:00 p.m.

Initial Attack on the Station Fire occurred in conditions that were extremely hazardous and in which there were limited opportunities to engage the fire operationally. The spot fires that occurred down slope of the Highway on the evening of August 26 required ground resources to assure suppression because air resources alone were insufficient to achieve control. The spot fire situation continued to worsen throughout the evening of August 26 and early morning of August 27. Sufficient fire resources were available to incident managers; however, the inaccessibility of the fire and excessive hazard created by the terrain and dry, dense brush conditions limited opportunities to affect fire spread down slope of the Highway. Conditions were not safe for ground crews to approach the fire from above.

Sufficient resources were available to incident managers; however, the inaccessibility of the fire and excessive hazards limited opportunity to affect fire spread

Findings of the Review Panel

The review panel was asked to determine whether the decision processes and actions taken during initial attack were reasonable and prudent in view of the known circumstances existing at the time of the event. Based on information obtained from incident documentation as well as interviews with incident managers, the review panel identified several key findings and found decisions were reasonable and prudent based on the following findings:

Preparedness Actions of the Angeles National Forest

At the time of the incident, the Angeles National Forest had in place an up-to-date staffing and action guide for initial attack. In addition, the forest had established preparedness plans with respect to readiness, communications, and interagency cooperation. The forest had coordinated actions in this area with the Los Angeles County Fire Department, who assisted in the initial attack. (See Appendix E, 2009 Fire Management Plan)

Management Direction and Objectives

The actions taken by the Angeles National Forest and the Forest Supervisor with respect to overall incident objectives, controlling the fire at the smallest acreage practicable consistent with firefighter safety considerations, were in concert with the Forest's land management plan. (See Appendix D, Angeles National Forest Land and Resource Management Plan)

Environmental Conditions

The origin of the Station Fire was in extremely rugged terrain with limited opportunities for safe, effective suppression activities. Weather at the time revealed high temperatures with low relative humidity and limited recovery of relative humidity during the evening, leading to unfavorable conditions with respect to the effectiveness of fire suppression. The dense, dry brush was easily ignitable.

Vegetation and Potential Fire Behavior Conditions

The vegetation characteristics in the area of the fire were at very high risk with respect to firefighting operations. Due to the ease of the ignition of the brush, the potential for extreme fire behavior posed unacceptable risk to firefighters. Brush stands were thick and above eye level, obscuring visibility, and making access to the fire difficult.

Weather, topography, and dense, dry brush conditions threatened the safety and effectiveness of firefighters the evening of August 27

Initial Attack Response

Firefighters made successful cooperative efforts to engage the fire at critical points during the daylight phase of Initial Attack and made progress toward containing the fire on the portion of the fire above the Angeles Crest Highway (Highway 2). Despite efforts with hose lines and engines, control of the incident was prevented because firefighters were unable to access spot fires that occurred below the Highway at night in steep terrain and in dry, dense brush.

Resource Ordering and Assignment

The ordering and assignment of firefighting resources to Initial Attack was appropriate and consistent with best management practices as accepted by wildland firefighting agencies. Additional resources during the evening of August 26 and morning of August 27 would not have improved the effectiveness of operations during that operational period and would have resulted in needless exposure of firefighters to the hazards of wildland fire. Opportunities to affect fire spread were limited on the down slope side of the Highway, not by the amount of suppression resources assigned to the incident, but by the inaccessibility of the fire, hazard of the terrain, and dry, dense brush conditions with extremely limited or no visibility.

Critical Event

On the evening of August 26, spot fires occurred below the Angeles Crest Highway, near the point of fire origin, and were not accessible by firefighters due to excessively steep terrain, limited visibility, and decadent, thick brush. Aircraft use, without subsequent engagement of ground forces, would have been ineffective.

Incident Management Decisions

Based on conditions and circumstances on the afternoon and evening of August 26, 2009, as well as those decisions made subsequently by initial attack incident commanders reflected sound judgment of the operational situation and were prudent with respect to firefighter safety and resource deployment. Their management actions exhibited a consistent awareness of the hazards of the incident and the recognition that engaging the fire below the Highway using ground-based resources would expose firefighters to unmitigated risk. Incident management decisions made during the review period were consistent with broadly accepted incident management practices, including the ordering and assignment of both ground-based and aviation suppression resources.

Conclusion

The purpose of this review was to determine if the Angeles National Forest preparedness actions before the Station Fire were in alignment with existing plans and cooperative agreements; if the decision process and actions taken during initial attack were reasonable and prudent; and to examine the role of the agency administrator in providing leader's intent and input into strategic decisions for the incident initial attack. This review examined only the initial attack phase of the Station Fire from the initial report of the incident on August 26, 2009, to the transition of the incident to the Type I Incident Management Team on August 28, 2009. The review panel concluded that during the initial attack phase of the Station Fire, incident managers on the Angeles National Forest acted in accordance with accepted wildland firefighting practices. They had clear leader's intent and deployed suppression resources only in those conditions where they would be safe and effective. In light of the extremely challenging topography encountered during initial attack, the highly volatile fire, and dense, dry brush, incident commanders were reasonable and prudent in their response and in not exposing firefighters to conditions that would have compromised their safety.

Members of the Review Panel

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Appendix A

Potential Fire Behavior

Station Fire
Afternoon/Evening of August 26, 2009

David R. Weise, Ph.D.
Supervisory Research Forester
USDA Forest Service
Pacific Southwest Research Station
Forest Fire Laboratory
Riverside, California

General Setting

The terrain below the Angeles Crest Highway near the Angeles Crest Fire Station on the Angeles National Forest is fairly rugged and steep. The slope percentage from the highway to the creek bottom ranges from 33 percent to 67 percent along a 0.5 mile section of the highway centered on the fire station. Several narrow ravines facing east occur along this section of the highway. The slopes below the highway range from 900 to 1,680 feet in length. The vegetation is mature mixed chaparral 6 to 8 feet tall and was at least 50 years old. In contrast, much of the chaparral vegetation on the 2006 Esperanza incident on the San Bernardino National Forest probably ranged from 4 to 6 feet in height. Live fuel moisture is routinely monitored on the Angeles National Forest and in Los Angeles County as a measure of fire danger. Observed live fuel moisture content measured 5 to 7 days prior was 63 percent for chamise, 67 percent for ceanothus, and 89 percent for manzanita. Weather observations at the Little Tujunga weather station (11.4 miles) for 1:00 p.m. included air temperature of 99 ° F, relative humidity of 7 percent, and wind speed of 8 mph. Weather observations at Clear Creek weather station (3.2 miles) included temperature of 89 °F, relative humidity of 11 percent, and wind speed equal to 10 mph. From these observations, predicted fuel moisture of the one hour time lag fuels (easily ignitable grasses, pine needles, small branches) was 1 percent. Moisture content of the larger 10 and 100 hour fuels were 2 and 6 percent, respectively. The spot weather forecast produced at 5:20 p.m., indicated night time temperatures around 74 °F and maximum relative humidity of 17 percent. Maximum observed relative humidity at the two weather stations on the night of August 26 did not exceed 17 percent.

Fuel Conditions

The observed afternoon fuel moisture contents were typical for this time of year; however, the fact that the humidity was not predicted to increase very much on the night of August 26 meant the fuel moistures would stay relatively low throughout the night and that fires would continue to burn actively through the night. Live fuel moisture content was normal for this time of year based on long term means measured by Los Angeles County Fire Department. However, the moisture content in chamise was approaching 60 percent which is considered a critical level for fire behavior. Based on the fire behavior tables found in Appendix B of the

[3] National Wildfire Coordinating Group (NWCG). 2006. NWCG Fireline Handbook, Appendix B; Fire behavior. PMS 410-2, NFES 2165. Boise, ID

Appendix A (continued)

Fireline Handbook[3], fuel moisture of the unshaded 1 hour fuels would increase to a maximum of 4 percent by 8:00 a.m. the next morning; however, the equilibrium moisture content associated with 17 percent relative humidity and 74 °F is only 2 percent. The very low moisture content of the fine fuels (1 percent) indicates that these fuels could be easily ignited. This ignition potential was indicated by the forecasted Ignition Component of 100 and the calculated probability of ignition of 1[4]. The fuel conditions described for the Station Fire are similar to conditions associated with the 1968 Canyon Fire fatalities which occurred on August 24, 1968[5]. These investigators hypothesized that a fire whirl occurred near a ridge top and cast a firebrand down slope into a narrow ravine. The resulting upslope fire run lasted 30 seconds and overtook the crew. The fuel age where these fatalities occurred was estimated to be 50 to 80 years.

Anticipated Fire Behavior

Several options are available to estimate the potential fire behavior that the initial attack firefighters would have experienced from a fire that started in the chaparral below the Angeles Crest highway. All of these options are based on the Rothermel fire spread model[6]. Most of the versions describe chaparral as 6 feet deep. Cohen developed a variant called FIRECAST[7] that contained fuel models specific to chamise and mixed chaparral of various heights and ages. I used FIRECAST to estimate the flame length, fireline intensity, and rate of spread for the forecasted night time conditions (dead fuel moistures: 1 hour equal to 1, 10 hour equal to 2, Slope equal to 50 percent, midflame wind speed of 6, 8, and 10 mph, live fuel moisture of 63 percent, and percentage of fuel bed that was dead of 30 and 50 percent). Predicted spread rates for these conditions ranged 0.75 to 1.5 mph, flame length ranged from 18 to 30 feet and fireline intensity ranged from 2,900 to 8,400 BTU/ft/s. The spread rates and flame lengths are similar to the fire behavior anticipated by the fire danger indices calculated for the Clear Creek and Little Tujunga stations using the weather data collected at 1:00 p.m., on August 26, 2009.

Terrain Effects

The area below the highway is relatively steep and thus difficult to walk up. The slopes in the 1948 Mann Gulch Fire[8] fatalities and the 1994 South Canyon Fire[9] fatalities were 44 to 76 percent and 55 to 80 percent, respectively. In the 1968 Canyon Fire which occurred 17 miles east of the Station Fire

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[4] Bradshaw, L.S.; Deeming, J.E.; Burgan, R.E.; Cohen, J.D., compilers. 1984. The 1978 National Fire Danger Rating System: technical documentation. Gen. Tech. Rep. INT-169. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 44 p.

[5] Countryman, C.M., McCutchan, M.H., Ryan, B.C. 1969. Fire weather and fire behavior at the 1968 Canyon Fire. Res. Pap. PSW-55. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station. 20 p.

[6] Rothermel, R.C. 1972. A mathematical model for predicting fire spread in wildland fuels. Res. Pap. INT-115, Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 40 p.

[7] Cohen, J. D. 1986. Estimating fire behavior with FIRECAST: user's manual. Gen. Tech. Rep. PSW-90. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station. 11 p.

[8] Rothermel, R. C. 1993. Mann Gulch fire: a race that couldn't be won. Gen. Tech. Rep. INT-299. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 10 p.

[9] Butler, B.W.; Bartlette, R.A.; Bradshaw, L.S.; Cohen, J.D.; Andrews, P.L.; Putnam, T.; Mangan, R. J. 1998. Fire behavior associated with the 1994 South Canyon Fire on Storm King Mountain, Colorado. Res. Pap. RMRS-RP-9. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 82 p.

Night Time Fire Behavior

The fire behavior predicted to occur during the evening and night was active primarily for one reason, no humidity recovery. Typically at night, temperatures drop and relative humidity increases resulting in an increase in fuel moisture. The increased fuel moisture causes fire behavior to moderate. However, relative humidity was not forecast to increase appreciably due to the nature of the air mass over the Station Fire. Fuel moistures stayed low and fire behavior did not moderate. Spot fires could have spread successfully at night since fine fuel moisture content was low.

Interpretation of Fire Behavior

Guidelines for suppression activities that are appropriate for different levels of fire behavior have been developed over the years. Flame length, rate of spread, and fire intensity are the fire behavior indicators typically used and can be displayed on a fire characteristics chart. The predicted fire behavior was plotted on the attached fire characteristics chart. Note that the total amount of energy released did not change as the spread rate changed. The * indicates that chaparral with 30 percent dead material and the * indicates chaparral with 50 percent dead material. Fireline intensity describes the rate at which the energy is released which has been correlated with flame length. Fireline intensities < 100 BTU/ft/s or flame lengths < 4 ft can be directly attacked by firefighters with hand tools. Flame lengths 5 to 8 feet generally require some sort of ground-based vehicle attack (engine, bulldozer). For the Station Fire, the predicted fire behavior far exceeds any kind of firefighting capabilities that ground-based resources might have.

Summary

Predicted fire behavior potentially encountered by initial attack forces on the Station Fire was typical for August. This fire behavior is extreme and not amenable to attack by hand crews or fire engines. Predicted fuel moisture conditions had a high probability of supporting easy ignition of fine fuels by spot fires, fast spread rates, and large flames. Terrain was very steep and difficult to traverse on foot, which has been typical of areas where firefighter fatalities have occurred.

[10] Andrews, P.L.; Rothermel, R. C. 1981. Charts for interpreting wildland fire behavior characteristics. Gen. Tech. Rep. INT-131. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 21 p.

[11] Byram, G.M. 1959. Forest fire behavior. Pp. 90-123 In: Forest fire: control and use. Edited by K.P. Davis. McGraw-Hill, New York.

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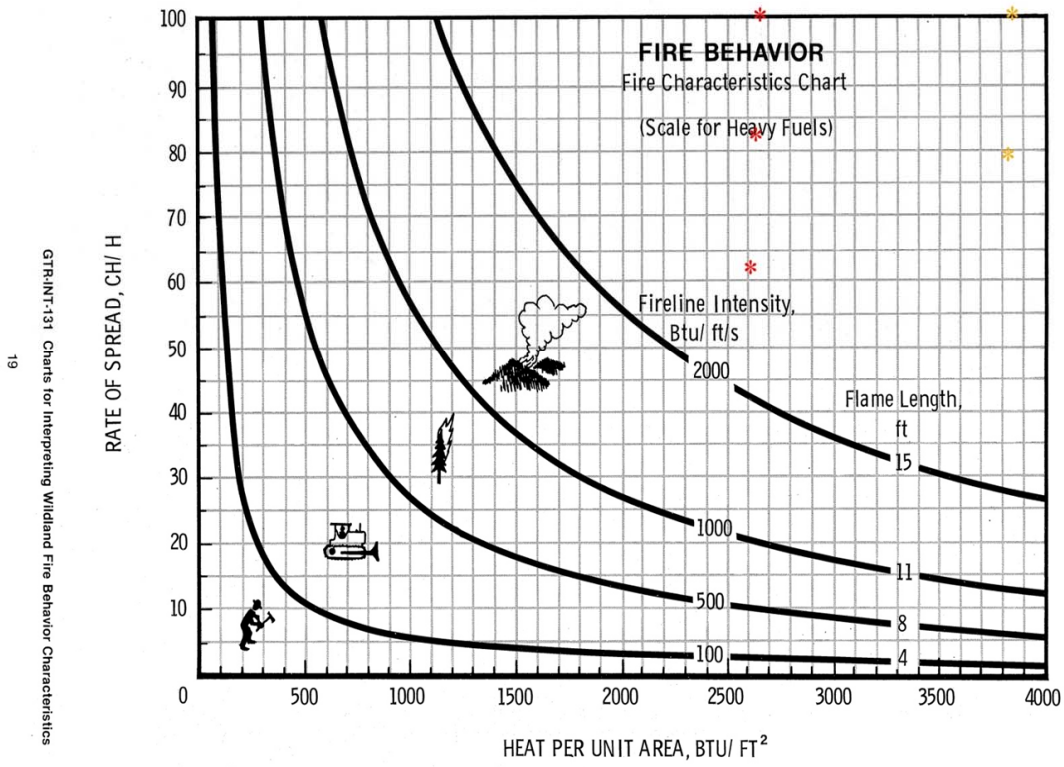
Appendix A—Interpretation of Fire Behavior



Predicted fire characteristics associated with potential spot fires occurring below the Angeles Crest Highway, near Angeles Crest Fire Station, August 26, 2009. Red stars are for fuel beds with 30 percent dead material, orange are for 50 percent dead materials

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Appendix B

Station Fire
Photographs of Area of Initial Attack

Photograph 1. Small, unnamed spur canyon (center) within Woodwardia Canyon, location of the initial perimeter of the Station Fire on August 26, 2009. Point-of-origin located near dirt turnout along Highway 2 in foreground. Photo taken from Civilian Conservation Corps Ridge, location of the original Incident Command Post, looking west-southwest. (Angeles National Forest, Los Angeles River Ranger District. Photo taken on October 21, 2009, after first significant post-fire rainfall. Strong red coloration from retardant somewhat diminished from upper canyon and side ridges.)

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Photograph 3. Looking north along S.R. 2 (Angeles Crest Highway). Southern edge of original Station Fire perimeter on ridge to left. During the early morning hours of August 27, 2009, down canyon winds carried embers from this ridge to unburned vegetation on the downhill (east) side of S.R. 2 to the right. Photo taken on October 21, 2009.

Photograph 4. Looking east-southeast across S.R. 2 (Angeles Crest Highway) from within the original Station Fire perimeter. From this location, down canyon winds carried embers across S.R. 2 (east) into the vegetation below. Photo taken on October 21, 2009.

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Photograph 5. Looking upslope to the west into the initial footprint of the Station Fire. Photo taken along S.R. 2 (Angeles Crest Highway) from turnout near where the fire began on August 26, 2009. Photo taken on October 21, 2009.

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Photograph 6. Steep slopes with nearly impenetrable chaparral vegetation within the initial footprint of the Station Fire. Photo taken looking west from along S.R. 2 (Angeles Crest Highway) near where the fire began on August 26, 2009. Photo taken on October 21, 2009.

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Appendix C

Station Fire Initial Attack
Area of Initial Attack and Fire Perimeter
(Google Earth Representation)
Station Fire—August 26, 2009

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Station Fire Initial Attack
Area of Initial Attack and Fire Perimeter
(Google Earth Representation)
Station Fire—August 26, 2009

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Station Fire Initial Attack
Area of Initial Attack, Fire Perimeter, and Point of Origin
(Google Earth Representation)
Station Fire—August 26, 2009

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Photograph 2. Small, unnamed spur canyon (center) within Woodwardia Canyon, location of the initial perimeter of the Station Fire on August 26, 2009. Area to lower-left of center (exposed highway cut) is where the Station Fire spotted east (down canyon) across Highway 2 during the early morning hours of August 27, 2009. Photo taken from Civilian Conservation Corps Ridge, location of the original Incident Command Post, looking west-southwest. (Angeles National Forest, Los Angeles River Ranger District. Note: Photo taken on October 21, 2009, after first significant post-fire rainfall. Strong red coloration from retardant somewhat diminished from upper canyon and side ridges.)

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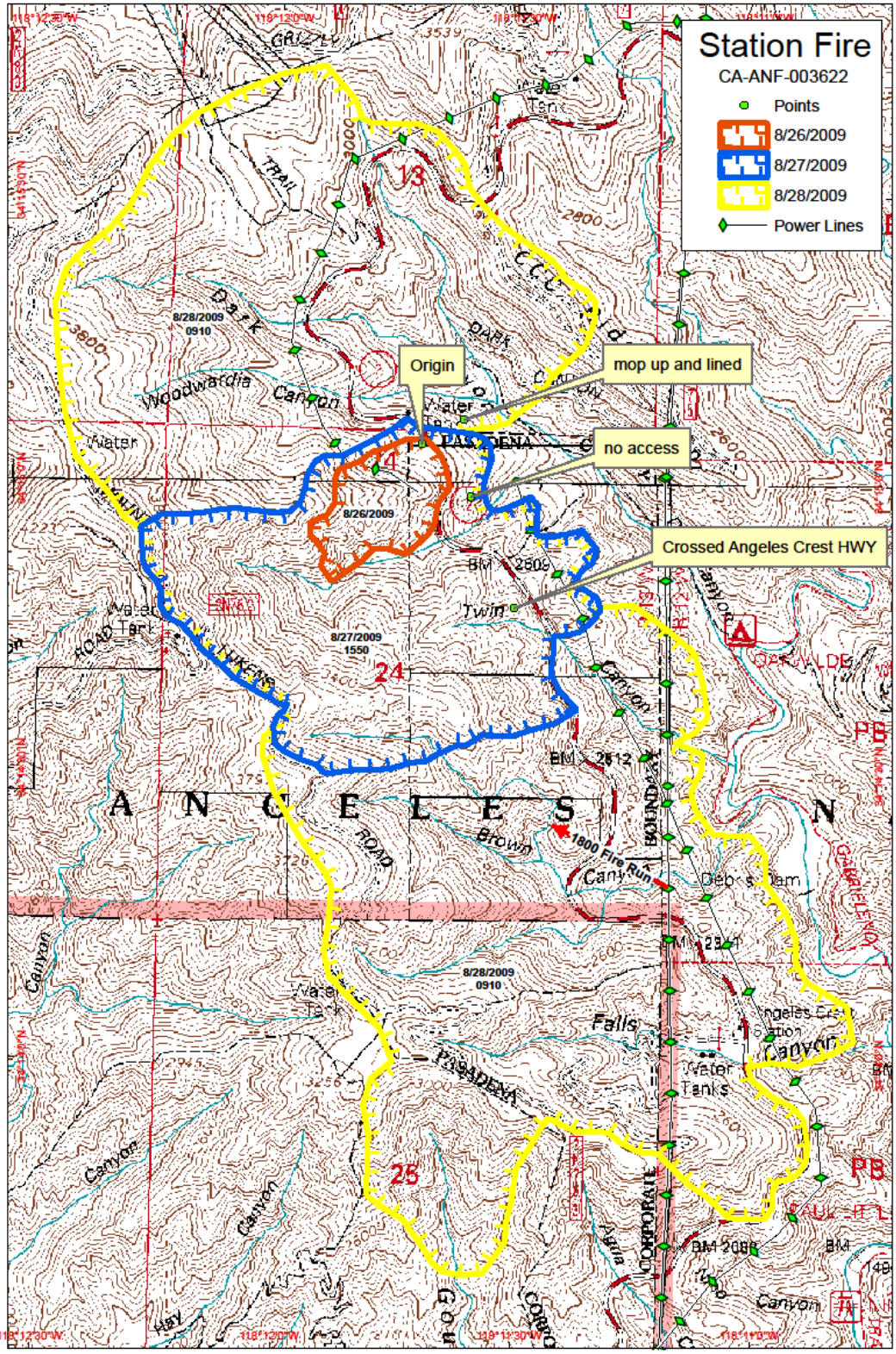
Station Fire Progression Map
August 26—August 28, 2009



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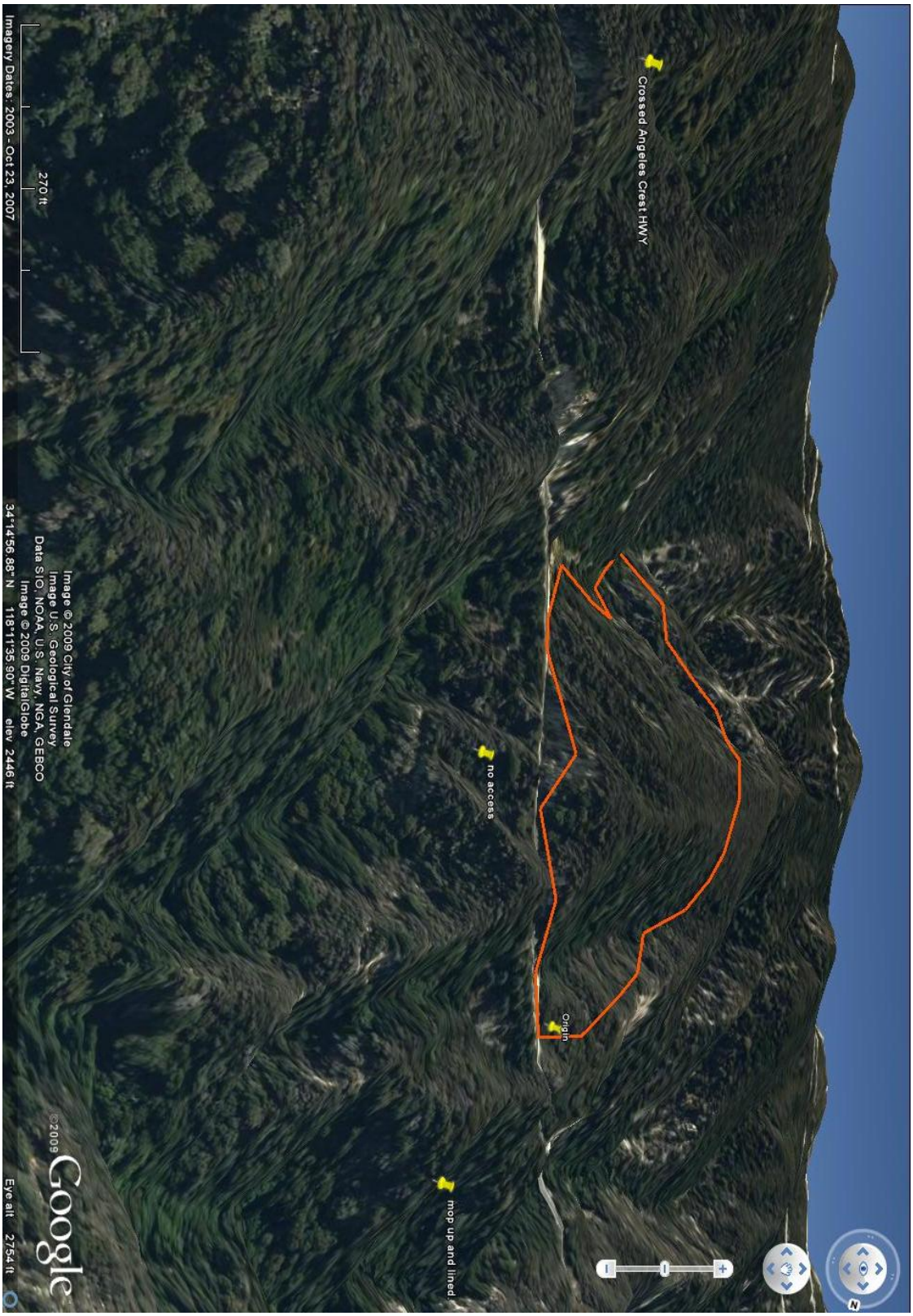

Google Earth map demonstrating where fire cross the Angeles Crest Highway, the spot fire below the road, point of origin and where fire was lined

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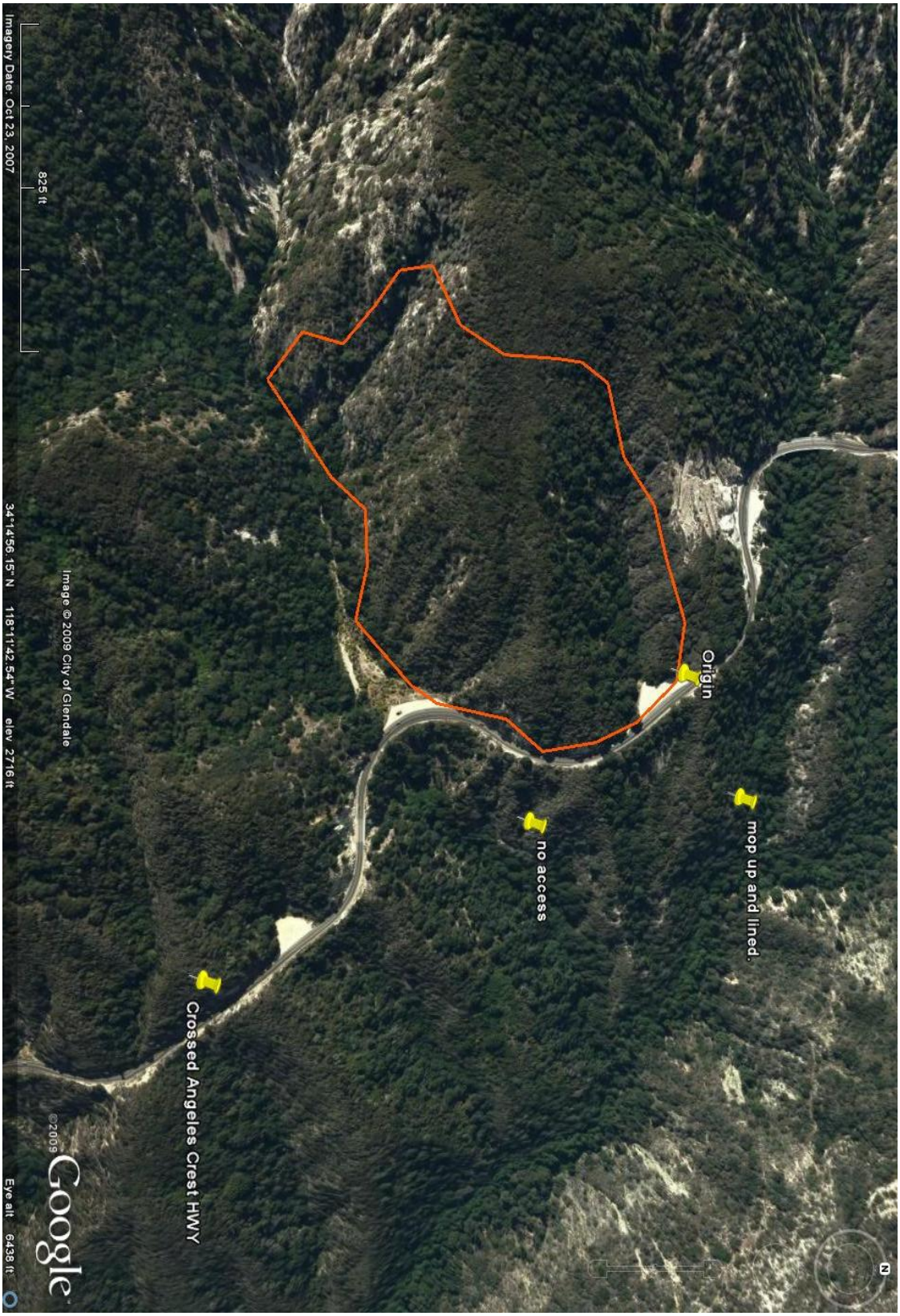

Alternate view of fire origin, spot fire and where the Station Fire crossed the Angeles Crest Highway

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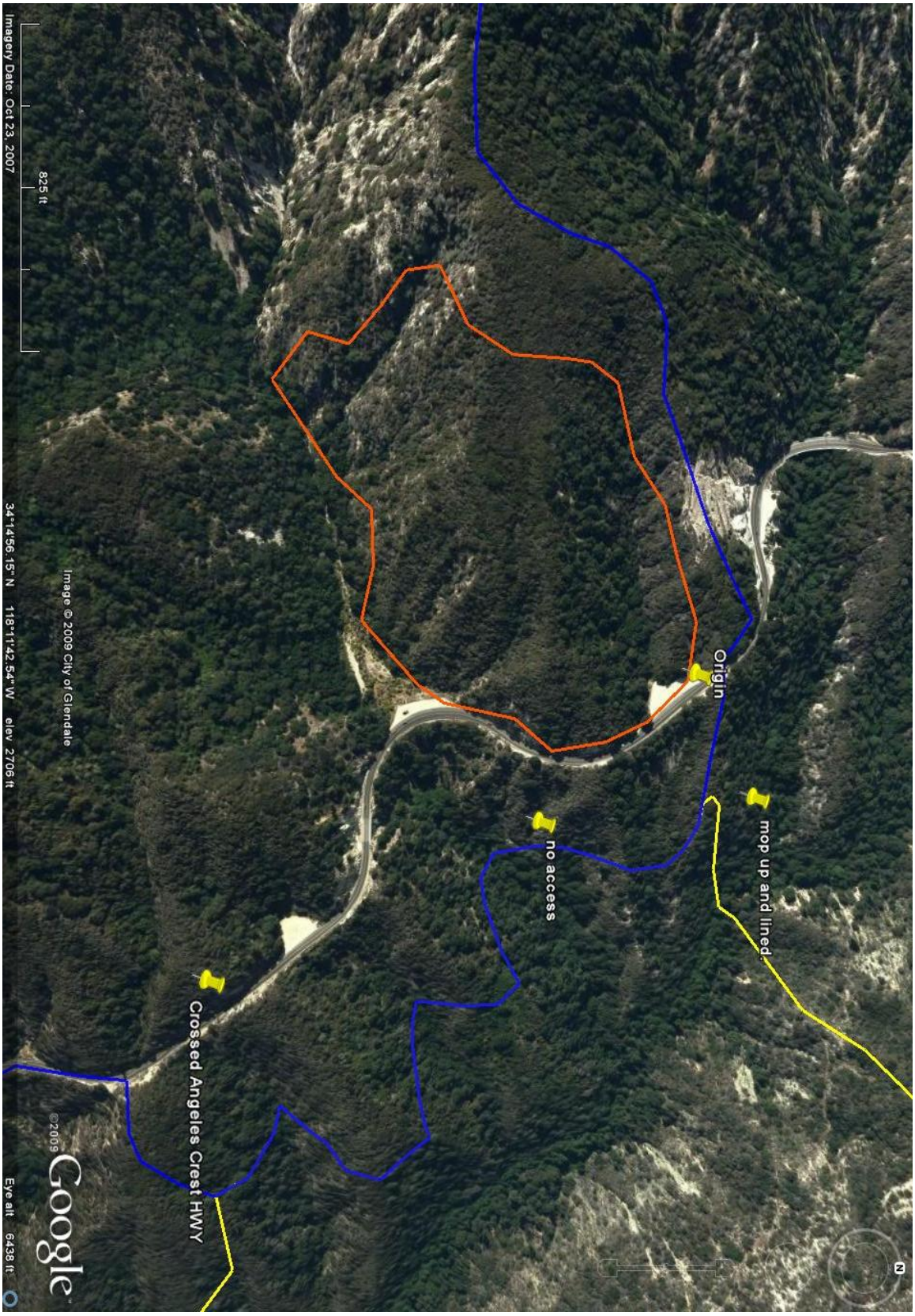

Alternate view of fire origin, spot fire and where the Station Fire crossed the Angeles Crest Highway with fire progression lines
Representing the fire perimeter August 26—28, 2009

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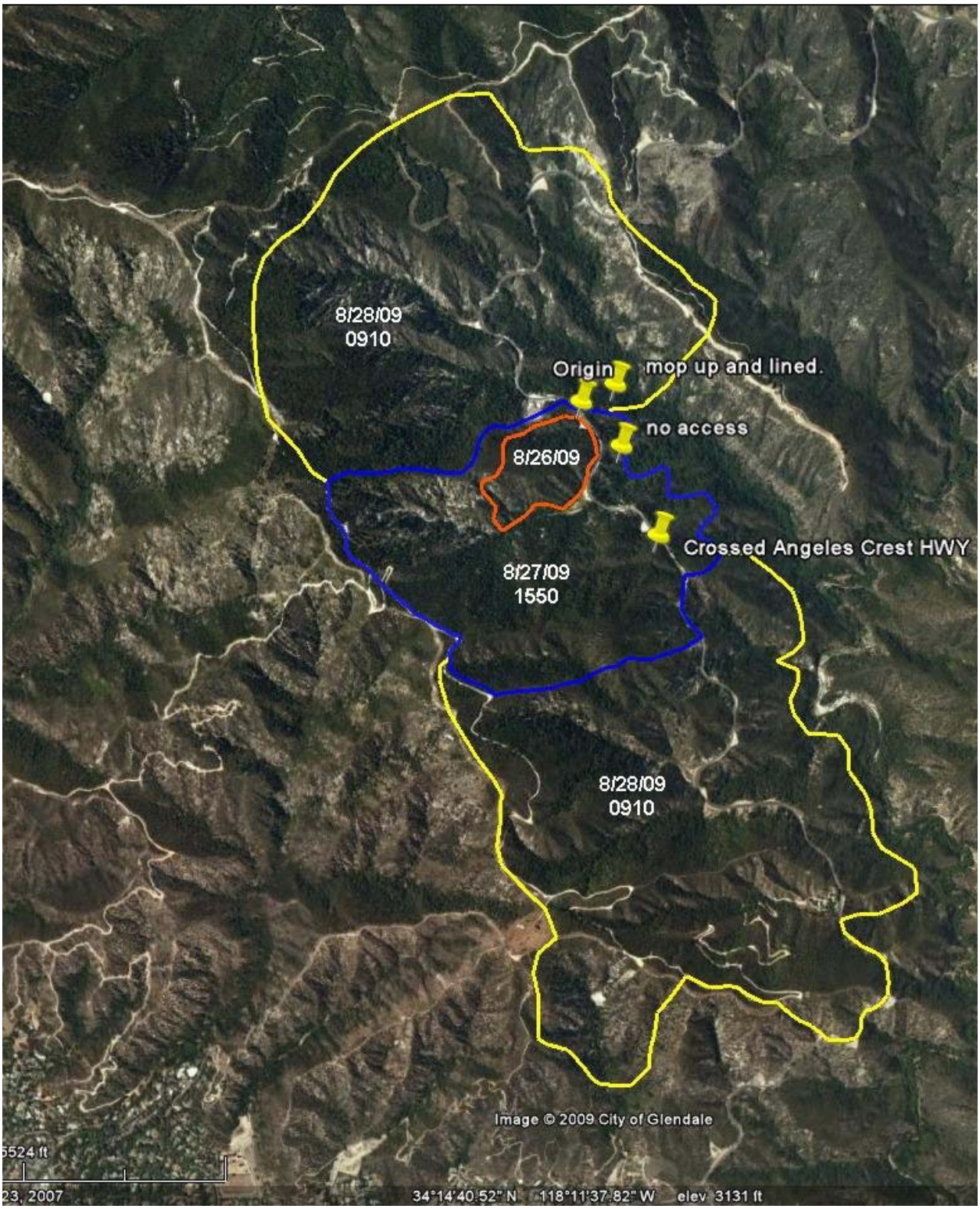

Fire Progression Map from August 26 through August 28, 2009, at 9:10 a.m.

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Appendix D

Excerpt from the Angeles National Forest
2005 Land Management Plan
Direction for Fire Management and Fire Suppression

USDA

United States Department of Agriculture

Forest Service

Pacific Southwest Region

R5-MB-076

September 2005

Land Management Plan

Part 2 Angeles National Forest Strategy

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Excerpts from
2005 Angeles National Forest Land Management Plan
Direction for Fire Management/Fire Suppression

Page 1, Angeles NF Forest Plan Revision Record of Decision

"This revised forest plan meets our legal obligations to the people of the United States and the national forest environment that surrounds them. The Forest Service understands its role or niche within the network of communities throughout southern California. The Angeles National Forest is a unique regional feature with important resources that must be sustained over time. I believe that my decision maximizes the net public benefit (sustainability of social, economic, and ecological processes) to meet current needs and to leave options for future generations to continue to enjoy sustainable recreation opportunities, healthy forest systems and appropriate community protection from wildland fire. These benefits are achieved through proven measures that protect, maintain, improve, and restore the health of the national forests and open lands; reduce risks from wildland fire, invasive species, insects, disease and other threats; provide wildlife habitat; protect and restore unique vegetation and terrain; and perhaps most importantly, to provide a diversity of recreation, environmental education opportunities, and monitoring requirements, that are the cornerstone of our program emphasis for the future."

Page 4, Angeles NF Forest Plan Revision Record of Decision

Chief's Four Threats

The revised forest plan is responsive to the Forest Service's 2004 National Strategic Plan and to the resolution of the four threats described by the Chief of the Forest Service (Publication Speech, 2003). These four threats include:

- **Fire and Fuels –** decades of fuel buildup, coupled with drought and disease, have created a situation that poses a real threat to the lives and property of people living in the communities of southern California. In southern California, fire is a fact; it is not a question if fires will burn, rather, it is a question of when and how intensive.

Page 6-7, Angeles NF Forest Plan Revision Record of Decision

Developed Area Interface: Much of the urban interface and concentrated use areas within the Forest boundary are included in the Developed Area Interface zone. Accordingly, much of our community defense work and fuels management activities in response to the National Fire Plan will be focused within this zone. The Developed Area Interface (DAI) zone includes the Wildland/Urban Interface (WUI) zone described in the National Fire Plan. Within the WUI zone there are two sub-zones called the WUI Defense zone and the WUI Threat zone. Areas beyond these zones can, under the right conditions, be included in the WUI zone and therefore are described

Page 6 Angeles NF Forest Plan Revision Record of Decision

As the WUI influence zone. The DAI zone is especially compatible with community defense work and already includes a significant amount of the National Forest System roads that enable access for community defense work or fire suppression. The zone is also compatible with the location of sites needed for a variety of special uses.

Page 13, Angeles NF Forest Plan Revision Record of Decision

Alternative 4a (Selected)

Alternative 4a adjusts the preferred alternatives by using selected elements from other alternatives, as well as making changes to the scheme of land use zones in response to public comment, tribal consultation, and internal review of the draft environmental impact statement (DEIS) and land management plans for the four southern California national forests.

Alternative 4a is focused on active management for the maintenance of healthy forests; community protection from wildland fire; managed, sustainable recreation settings and uses; and the management of threatened and endangered species. The alternative theme includes the opportunity for a low level of growth of recreation activities and the facilities to support increased use. Managed sustainable use of the national forests is compatible with the maintenance of long-term biological diversity and ecological integrity. The focus on community protection is complementary to the National Fire Management Policy.

Page 15, Angeles NF Forest Plan Revision Record of Decision

Given these criteria, I am identifying Alternative 4a as the environmentally preferred alternative. This Record of Decision has discussed the decision process and the rationale for the decision. Given the complexities of the management situation in southern California and the way Alternative 4a addresses the conservation and protection of plant and animal species and their habitat, the demand for human uses, and the critical need for community wildland fire protection, it just makes sense. The evaluation process that I have described in the previous section includes the evaluation of net public benefit, the key factors, and the attributes and advantages that cause Alternative 4a to stand out, in my mind, as environmentally preferable.

Pages 32-34 LMP Part 2: Angeles National Forest Strategy

Fire Management

Fire Management includes all activities involved with pre-fire preparation, fire hazard reduction such as brush removal, and public education concerning fire prevention and safety.

The Fire Management and Administration group formulates and administers fire management and safety plans, and oversees all fire management operations including budget and planning, general supervision, scheduling, and other administrative activities.

Wildland fire suppression 2005 encompasses all activities included in containing and mitigating the damages of wildland fires caused by either natural or human means. This program also includes national support of fire and disaster teams in other areas of the country. The primary responsibility is in supporting large suppression operations nationally; however, other types of assignments include assisting the Federal Emergency Management Agency (FEMA). Past assignments have included earthquakes, floods, hurricanes, 9/11 disaster support, and supervision of the Columbia Space Shuttle debris recovery.

Prevention is based on three primary categories: education, engineering and enforcement. Education includes Smokey Bear programs to instill a fire prevention ethic in school children and Firewise community programs that target civic and homeowner groups. Engineering includes abatement of fire hazard along roadways and in high-use areas using fire retardants and removal of flammable vegetation. Enforcement includes executing state fire law regarding hazard abatement around structures, for both public and private land in the national forest. This is also done along all electrical transmission and distribution systems, (placed by public utility agencies), across the national forest.

Hazardous fuel reduction is the set of activities associated with removing brush and vegetation from areas where they pose a significant threat to human life, property, and national forest resources, and where they interfere with the health of natural fire-adapted ecosystems. Fuel reduction involves direct management of vegetation using prescribed fire, mechanical, manual, or chemical methods. This is accomplished by a multidisciplinary planning approach using resource specialists, local governments, communities and contractors. The national forest Fuels Officer provides overall leadership for this program, which is then carried out by Fire Management personnel and local government.

Suppression of wildland fires is the first priority for program managers. All wildland fires on southern California national forests are considered to be a threat to communities. Aggressive fire suppression and prevention strategies will be implemented near communities to achieve the objectives to protect life and property from wildland fire, subsequent floods and debris flows. National Forest staff plan to maintain the suppression organization at 90 percent of the most efficient level or higher.

WUI Defense and Threat Zones around structures, fuelbreaks, and vegetation treatments to maintain or restore forest health within community protection areas are the next priority. Over the next three to five years, vegetative treatments will be strategically integrated to maximize community protection efforts and minimize wildland fire size, while considering habitat needs. Mortality removal will be integrated with thinning within the community protection areas. National Forest staff plan to complete approximately 40 percent of identified treatment needs (see Fire 1 – Fire Prevention; Fire 2 - Direct Community Protection; Fire 3 - Fire Suppression Emphasis; Fire 4 - Firefighter and Public Safety; Fire 5 - Fuelbreaks and Indirect Community Protection; and FH 3 - Restoration of Forest Health).

Pages 124-128, LMP Part 2: Angeles National Forest Strategy
Fire 1 - Fire Prevention

Reduce the number of human-caused wildland fires and associated human and environmental impacts. Focus fire prevention programs on the urban interface, threatened, endangered, proposed, candidate and sensitive species habitat, vegetative areas threatened with type conversion and areas of major recreation use:

Continue environmental and fire prevention classroom education in local schools to reach the diverse communities the Forest Service serves.

Implement Forest Fire Restrictions and Closure Plan as appropriate, including an internal/ external public communication plan.

Continue the activation and utilization of the National Fire Prevention and Education Teams as appropriate in order to augment local fire prevention resources.

Develop and implement a plan to expand structure hazard reduction from 30' zones to 100' zones of clearance.

Continue to refine the process of implementing partial or full national forest closure as appropriate in order to increase the margin of public and firefighter safety.

Linked to National Strategic Plan Goal 1- Reduce the risk from catastrophic wildland fire, objective 2.

Fire 2 - Direct Community Protection

Reduce the number of high risk/high value, and high and moderate risk acres using mechanical treatments, grazing, and prescribed fire. Identify and schedule for treatment the high risk and high value acres near communities and developed recreation sites, including the installation of Wildland/ Urban interface (WUI) Defense and Threat Zone vegetation treatments. Highest priority should be given to those areas with substantial drought and insect-killed vegetation that present a significant threat to life and property in entire communities:

Promote removal of tree mortality adjacent to structures as the first step in reducing threats to human life and investments.

When National Forest System lands are managed for direct community protection, consider the use of Memorandums of Understanding with Fire Safe Councils as a means of allowing residents to meet state fire law or county brush clearance ordinances on a combination of private and public lands.

Herbicides or the repetitive use of prescribed fire may be used in the WUI Defense zone on National Forest System land to avoid expensive treatments of resprouting chaparral species.

Linked to National Strategic Plan Goal 1- Reduce the risk from catastrophic wildland fire, objectives 1 and 3.

Fire 3 - Fire Suppression Emphasis

All fires either on the national forest or that threaten the national forest will be suppressed. Wildland fires that pose life safety threats, threaten communities, improvements or infrastructure will receive a management response commensurate with minimizing acres burned. An appropriate management response (including a full range of suppression strategies) may be used elsewhere on the national forest where natural and cultural resource impacts along with fire suppression costs are primary concerns.

Cross train with other fire agencies to improve suppression coordination and performance on fires burning in the Wildland/Urban Interface or developed area intermix.

Continue to expand mutual aid agreements with fire cooperators in order to ensure the coverage of key fire stations during periods of fire resource drawdown.

Continue the evaluation of current and future fire station locations with respect to strategic location, changing demographics, suitability and operating costs.

Implement a "Fireshed" analysis of the national forest to either validate or modify current fire management strategies and tactics.

Linked to National Strategic Plan Goal 1- Reduce the risk from catastrophic wildland fire, objective 2.

Fire 4 - Firefighter and Public Safety

Improving firefighter and public safety is the primary objective in fire management. All other activities are tiered to this core value. Integrate fire management activities with those of other government agencies that share a mutual interest or benefit in fire activities on the national forest. Conduct fire management activities in a cost effective manner:

Improve residential inspection capability to enhance the defensible space around structures.

In concert with other agencies and Fire Safe Councils develop evacuation and structure protection plans that will enhance both firefighter and public safety.

Maintain program reviews, training and qualification standards contained in the Fire Management Plan.

Coordinate meetings, training and workshops with employees and cooperating fire agencies to improve fire and emergency operations capability and preparedness.

Cooperate with local agencies to develop and build-out an inter-operable radio communications system for emergency response and incident management in southern California.

Linked to National Strategic Plan Goal 1- Reduce the risk from catastrophic wildland fire, objective 2.

Fire 5 - Fuelbreaks and Indirect Community Protection

Maintain the existing system of roadside fuelbreaks and fuelbreaks along watershed boundaries to minimize fire size and the number of communities threatened by both fires and floods. Consider constructing new fuelbreaks on land outside of wilderness or other special designations.

Consider an opportunistic approach to fuels management. Take advantage of previously burned or treated areas to link future fuels and vegetation management or wildlife habitat improvement projects when doing fuels planning.

Utilize fire landscape analysis to aid in the design of future fuelbreak systems, maintain multiple lines of community defense, and to minimize future wildland fire size.

Develop a plan to minimize the propagation of invasive nonnative species during fire suppression and fuels or vegetation management activities.

Linked to National Strategic Plan Goal 1- Reduce the risk from catastrophic wildland fire, objectives 1 and 3.

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Appendix E

Excerpts from the Angeles National Forest

2009 Fire Management Plan

Fire Management Unit 2

(Area of the Station Fire)

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ANGELES NATIONAL FOREST
2009 Fire Management Plan

Prepared by: _____ Date: _____
David Kerr
Adaptive Management Services

Reviewed by: _____ Date: _____
John Thomas
Deputy Chief, Fire and Aviation Mgmt.

Reviewed by: _____ Date: _____
David Conklin
Chief, Fire and Aviation Management

Approved by: _____ Date: _____
Jody Noiron
Forest Supervisor, Angeles National Forest

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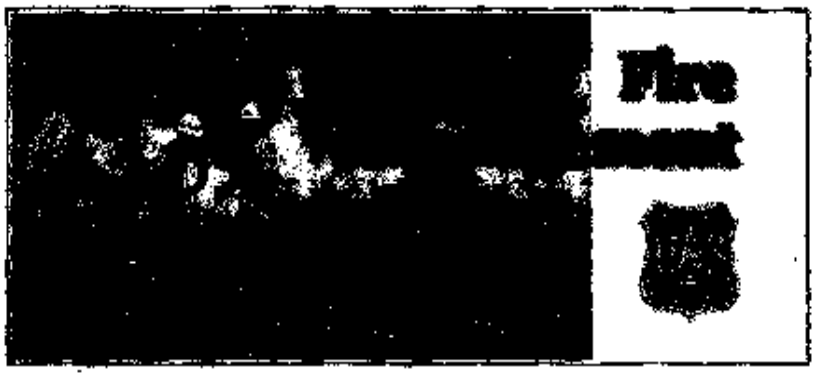
ANGELES NATIONAL FOREST
2009 Fire Management Plan



Prepared by: _____ Date: 6/1/09
David Kelly
Adaptive Management Services

Reviewed by: _____ Date: 6/1/2009
John Thomas
Deputy Chief, Fire and Aviation Mgmt.

Reviewed by: _____ Date: 6/8/09
David Conklin
Chief, Fire and Aviation Management

Approved by: _____ Date: 6/8/09
Jody Noiron
Forest Supervisor, Angeles National Forest

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Fire Management Unit – 2 – Mid-Elevation, Non-Wilderness

Fire Management Unit Characteristics

This Fire Management Unit is characterized by a mid-elevation shrubland system and includes limited in-holdings, reflecting a true wildland urban intermix fire environment. Scattered developments including Forest Service facilities, organizational camps, electronic sites and recreation developments add to the complexity of the fire situation. The density of fire suppression resources has decreased significantly from FUM 1, as cooperating resources no longer are available through automatic aid.

The FMU is best characterized by fuel type and fire behavior. The density of the fuelbed and canopy closure increases significant in this mid-elevation range. Grasslands sages fall out of the stand structure and a transition to woody chaparral vegetation occurs. Fuel loads increase to 16+ tons per acres (Weise and Regelbrugge, 1991) on many sites with an associated increase in fireline intensity and resistance to control. Aerial firefighting resources are less effective due to the closure of the canopy and increased fire intensity. Production rates decreases for crews and engines in this FMU as compared to FMU-1.

The standard initial attack dispatch to a report of a wildland fire is the same as FMU-1.

Topography and vegetation vary greatly within the FMU. Large portions of the FMU were burned during the Copper, San Fran, Bouquet, Williams and Curve fires of 2002. These fires were stand-replacing incidents and have modified the fuel component in major watersheds. The FMU includes the primary portions of the major watersheds for the Forest. These include San Gabriel Canyon (West, Middle and East Forks), Arroyo Seco Canyon, Big Tujunga Canyon, Little Tujunga Canyon, Pacoima Canyon, Bouquet Canyon, Lake Hughes Canyon and San Fransiquito Canyon. These primary watersheds and their heavily bisected nature represent the major topographic features that effect fire behavior and local weather patterns.

The lack of fire frequency in this mid-elevation range has left a plant community that is relatively intact, resilient and vigorous. While recent fires have affected large portions of the FMU, large expanses of continuous chaparral remain.

Aspect plays a major role in the distribution of chaparral species. North facing slopes include a live oak component that was missing from FMU-1. several species of Ceanothus begin to appear in the plant community and Manzanita also became a conspicuous element of the fueled. Chamise, lemonade berry, toyon and Laurel Sumac continue to be important species. Coulter pine at the upper elevation range of the FMY and Big-cone Douglas-fir are the coniferous species found. Big-cone Douglas-fir has been identified as a species of special concern in the *Southern California Mountains and Foothill Assessment*, since it has been identified as falling out of the ecosystem due to increasing fire intensity in and adjacent to the stands. This increase in intensity is associated with fire exclusion within the stands (Minnich, 1999).

Table 3.3. Acres by Land Use Zone in FMU 2.

FMU	BC	BCMUR	BCNM	CB	DAI	EF	EW	RW	Grand Total
2	91,677	26,563	124,151	2,023	39,621	14,368		10,011	296,682

The following is the Critical Biological (CB) Areas and the primary species protected (Land Management Plan Part 2, page 11):

- **Castaic** (367 acres) – Arroyo toad
- **Fish Canyon** (104 acres) – Arroyo toad
- **San Francisquito Canyon** (130 acres) - California red-legged frog, unarmored three-spine stickleback and Berberis nevinii (Nevin's Barberry)
- **South Fork Little Rock Creek** (12 acres) – Mountain yellow-legged frog
- **Upper Big Tujunga** (818 acres) – Arroyo toad, California red-legged frog
- **West Fork San Gabriel River** (506 acres) – Santa Ana sucker
- **Lower Little Rock Creek** (86 acres) – Arroyo toad

Incident managers need to be aware of the presence of these species and the potential effects of suppression operations on habitat areas. Direction issued from the United States Fish and Wildlife Service in 1995 indicates that firefighter and public safety will not be constrained in order to protect endangered species or their habitats.

In order to mitigate issues concerning TESPC species and other resource concerns, a Resource Advisor from the Forest will be ordered on all fires where aerial retardant use has or is likely to occur in water courses or in areas of modeled/occupied habitat for threatened and endangered species. The IC is also responsible for documenting actions that occurred within known occupied and modeled habitat areas so that appropriate mitigation actions can be initiated after the incident.

Historic and cultural resources are presence within the FMU and tend to be clustered adjacent to the broad valley bottoms, watercourses, Valley and Coast Live Oak clusters and saddles and ridgelines. The Forest archeologist maintains records of known artifact locations and can brief on-scene fire managers concerning these resources. The sensitive nature of the information related to heritage resources do not allow for full dissemination of this information to all module leaders on the Forest; however this information is maintained by the Chief Officers.

Real property abounds within the FMU and a comprehensive list of these properties is not useful. Pre-attach maps maintained by the Forest identify key facilities and communities within the FMU.

Strategies and Measurable Management Objectives

The resilience of the established shrub lands within the FMU make this Unit a target for the use of prescribed fire and other vegetation management treatments. Key suppression control features, such as the Santa Clara and Sierra Pelona fuelbreaks are located primarily within the boundary of the FMU. These features need to be maintained through the use of prescribed fire, mechanical or biological means.

Fire suppression will continue to focus on aggressive initial attack in attempts to minimize acres burned during wildfire. This strategy provides the best opportunity to protect resource management features such as Bigcone Douglas-fir and TESPC species habitat while protecting improvements and private in holdings aggressive suppression also helps prevent fire from burning out of the interior of the Forest into the adjacent wildland urban interface.

Fire prevention activities and mitigation work will assist in developing and maintaining defensible space around improvements, with prevention patrols focused on areas of high public use or clusters of historic enhance tactical fire suppression opportunities.

Objectives are:

- Provide an appropriate management response to reported wildland fires within the FMU. Maintain a minimum initial attack capability year round to assure an appropriate management response is provided.
- Assure a minimum of one qualified duty office is available for immediate dispatch to provide incident oversight on a year round basis. An on-call Chief Officer is identified for each Ranger District and a Forest Fire Staff Officer is available to respond to a reported incident 24-hour a day.
- Assure a Wildland Fire Situation Analysis is completed for all fires which are uncontrolled after the second burning period.
- Assure that wildland fires are evaluated for appropriate management oversight using the *IRPG and "Redbook" Complexity Analysis Guide*.
- Conduct prescribed fires within established prescription windows and with only fully qualified personnel.
- Coordinate prescribed fire activities with the appropriate air quality regulators.
- Complete fire hazard inspections for Forest Service facilities prior to June 15 annually.
- Complete fire hazard abatement work prior to July 1 for Forest Service facilities.

Management Constraints Affecting Operational Implementation

Management constraints in the area of fire suppression and fire prevention are minimal. Activities need to be closely coordinated with agency resource managers to assure that sensitive resources are protected to the greatest extent possibly without comprising firefighter and public safety or unduly placing private property at risk during fire events. The area of prescribed fire has identified operational constraints. These constraints include:

The South Coast Air Quality Management District is a severe non-attainment area under the National Ambient Air Quality Standards. The degraded nature of the air shed limits the number of allowable burn days constraining prescribed fire opportunities.

The presence of modeled and occupied habitat for TESPC species requires close coordination with the United States Fish and Wildlife Service to obtain an affects determination for proposed treatments. This coordination and any mitigation actions required constrain treatment areas and burn windows.

Historic Fire Occurrence

While this FMU has a relative low number fire starts annually, it has the potential for large fire development given the nature of the fuel structure and the completely of the terrain. Fires burning our of the wildland urban interface and into the Forest have heavily impacted the FMU. Flanking tactics utilized on fires starting in the lower elevations tends to push fire spread into this unit. Ignition patterns near transportation corridors. Lightning fires occur in the upper elevations of the FMU, however most lightning activity is concentrated in FMU-3 and FMU-4.

The Fire Management Situation

Weather patterns influencing fire behavior and historical weather analysis – The FMU has two unique weather patterns that influence fire behavior and activity. The desert side of the FMU as defined by Newhall Pass north through the Santa Clarita Valley and the Antelope Valley portion of the Unit. This area trails FMU-1 in supporting active fire spread and ignitions. The desert influenced areas experience strong winds in the late spring and summer as the thermal low develops over the Mojave Desert. The pressure gradient between cold marine air and the hot desert sets up strong circulation patterns that leads to gusty and highly variable winds. This desert-influenced portion of the FMU also shows the earliest curing of annual grasses and has the lowest average live fuel moistures.

While the same weather pattern impacts the front range of the FMU it is expressed differently, as the air mass still contains much of the moisture associated with the coastal zone. This can lead to low clouds and fog through the lower elevations, however this marine influence normally establishes itself below 3,500'. The fire environment above this inversion is significantly different. Fire behavior and suppression decisions can vary based on how deep the inversion has established. Drying trends for live and dead fuels as well as wind patterns are different based on this weather feature.

As the pressure gradient associated with the thermal low decreases during the summer, weather conditions between the desert influenced and front range portions of the FMU become more closely aligned.

Automated weather stations most reflective of the FMU are Tanbark, Warm Springs, Clear Creek and Camp 9. Camp 9 is operated by the Los Angeles County Fire Department.

Fire season determination – Fire activity in this FMU rotates around the Unit as the annual grasses cure and live fuel moisture drop. The annual grasses act as the wick to spread the ignition source into the live fuels. Curing dates vary annually, but can be as early as April 15, dependent on the amount and distribution of the winter rains.

Live fuel moisture sampling within the FMU occurs at Tanbark, Clear Creek, Little Tujunga and Coarse Gold. These samples are taken on a bi-weekly basis during the months of May through December. Monthly samples are taken the remainder of the year. This information is consolidated at the Angeles ECC and is available to Chief Officers as a decision making tool.

Fuel conditions likely to affect fire behavior – Some dieback of chaparral species occurred during the summer of 2002 as moisture stress impacted the vegetation. Manzanita is the dominant species impacted by the dieback, but some species of Ceanothus also display die back. This event is not wide spread and represents a localized change to the fire environment. Coulter pine, especially plantations at lower elevation display significant mortality.

From a fuels perspective fire behavior is a factor of live and dead fuel moisture, curing date and dead fuel loading. Cured fine fuels in this FMU are not generally continuous enough to cause fire spread at relatively high live fuels moistures. As the season progresses and live fuel moisture drops fire activity increases as the live fuels contribute energy into the fire environment.

Fire regime alteration – The fire regime associated with this vegetation type is high intensity, stand replacing in nature. The Fire Return Interval (FRI) is classified as 35 to 100 years. This return interval is contradicted by information found in Southern California Mountains and Foothills Assessment, which identifies the FRI as 50 to 80 years (Stevenson, Calcarone, 1999).

Overall the chaparral plant community is vigorous and resilient. Fire frequency is such that seed banks have been able to reestablish after fire and remain a viable source of recruitment for obligate seeding species. Spouting species continue to display viability after fire.

Control problems and dominate topographic features – Steep slopes and heavily bisected topography limit control opportunities within the FMU. Mechanized equipment is restricted in many areas to the primary ridge systems. Fires under typical weather patterns run to the ridge tops where changes in the alignment of the fire spread allow for successful suppression operations to be conducted. Lateral spread is a function of winds and fuel moistures. As live fuel moisture decreases, lateral spread increases in the chaparral fuel type, this lateral spread often allows a fire to reposition for rapid upslope fire runs.

The density of the chaparral fuels, especially fuel beds older than 20 years, reduces the effectiveness of aerial suppression actions as retardant and water is less efficient at penetrating the canopy and affecting the surface fuels.

Other elements of the fire environment affecting fire management – The wildland urban intermix consisting of private property, structures and federal facilities represent the greatest values to be protected. Resource values focus primarily on protection of riparian habitat, soil stabilization and water quality. Requirements for the protection of riparian habitats are found the LMP, Part 3, Appendix E and F.

The density of roads within this FMU decreases when compared to FMU-1. Lack of access is a limiting factor for fire control resources. The ability to maintain roads to *"provide safe and efficient routes for … fire protection equipment and other high clearance vehicles"* (LMPR, Part 2, Trans 1) is an important fire suppression requirement.