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Southern California Firestorm 2003

Report for the Wildland Fire Lessons Learned Center

For:

Paula Nasiatka

Lessons Learned Center Manager

National Advanced Resource Technology Center

Pinal Air Park

Marana, Arizona 85653

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This report was prepared by two private consulting firms with the input of federal agency employees assisting the Wildland Fire Lessons Learned Center.

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Please direct any questions concerning this report, or any correspondence to:

Mark Smith
Mission-Centered Solutions, Inc.
P.O. Box 2102
Parker, CO 80134
(303) 355-0964
(303) 646-3720 (fax)
email: MSmith@MCSolutions.com

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Michael DeGrosky, CEO
Guidance Group, Inc.
715 Hillside Drive
Washburn, WI 54891
(715) 373-5466
(715) 373-5409 (fax)
email: mtd@centurytel.net

The following is an excerpt from the entire report. It is suggested that the reader also view the Introduction to the report to put this section into context.

Fire Behavior and Fuels

This section outlines lessons learned regarding fire behavior as described by interviewees.

Extreme Fire Behavior

> *I've seen a once-in-a-lifetime fire three times now.*
> **- 30 year Engine Company Captain**

Respondents felt it was important to communicate to the wildland community that the Southern California fires were much more than typical wind-driven events. The Santa Ana influence was typical, with winds rarely stronger that 30 to 40 mph. The extreme fire behavior during this event resulted from a convergence of extended drought, fuel conditions, hot and dry weather, and wind.

Similar fire-prone landscapes that set preconditions for extreme wildland fire can be found across the western U.S:

- rangelands and forests with high or overloaded fuel conditions
- extensive areas of tree mortality resulting from insect infestations
- extensive areas affected by persistent drought
- increasing human encroachment into fire-prone environments and relentless expansion of the wildland-urban interface (WUI)

After extending into the urban environment, these fires often split into multiple heads and spread along paths defined by the available fuel sources. Fires spread over and around barrier after barrier. Wind conditions contributed to extremely unpredictable fire behavior and erratic changes in fire direction and spread. On one fire, the flaming front extended 45 miles throughout the city.

The fires moved far more quickly than anyone had anticipated or prepared for. One fire grew from 500 to 31,000 acres in four hours. Sudden wind shifts and huge fire whirls threw embers and flaming debris far ahead of the main fire. Wildland fires nearing urban areas spotted ½ to ¾ of a mile past the interface and into the urban environment. One pilot reported encountered a 4' x 8' flaming sheet of plywood and rocks at an altitude of 1,500 feet.

The majority of respondents indicated that they did not recognize early on the need to significantly adapt strategy to the extreme fire behavior. The felt they pursued perimeter control strategies too long before shifting their thinking defensively and enacting appropriate tactics until the weather provided an opportunity to go back on the offensive. All indicated that when this mental shift occurred, they were more successful in saving neighborhoods. All indicated that if faced with a similar situation in the future, they would initially adopt a protect-and-defend strategy.

Summary of Lessons Learned—Extreme Fire Behavior

- The extreme fire behavior during this event resulted from a convergence of extended drought, fuel conditions, hot and dry weather, and wind. Respondents felt conditions that led to these fires are common in other areas throughout the western U.S.
- The extreme nature of the fire behavior surprised most firefighters. Most did not initially recognize the need to adapt strategy and tactics to the extreme fire behavior. They said adopting an initial protect-and-defend strategy before attempting perimeter control would have been more effective.

Transition to an Urban Conflagration

Normally we go after it. This time it went after us!
- City Battalion Chief

These fires burned beyond the wildland-urban interface into urban environs with little or no wildland fuels. In this environment, fires spread from structure to structure—an urban conflagration.

When fires initially entered urban zones, embers from the main fire ignited spot fires in the urban zones. There, ornamental vegetation, such as palms, ignited producing intense ember showers and more spotting. Winds often carried these ember showers into attic vents and eave spaces of neighboring houses. Consequently, unlike most structures destroyed by wildland fire, these urban houses burned from the inside out.

In some cases, the requirements of urban firefighting and the intense heat generated by multiple structure fires demanded that firefighters abandon traditional "bump and run tactics" in favor of flowing large quantities of water to involved structures that threatened whole blocks. The criteria for selecting the appropriate tactic are discussed in depth in the Strategy and Tactics section of this report. The extension of fire well into urban settings also required unified command between agencies that do not frequently come into operational contact.

Given the continuation of the conditions contributing to these fires and the persistent expansion of the wildland-urban interface, Respondents believed that similar fire events will occur in the future. Consequently, contingency planning for such fire events becomes increasingly necessary.

Summary of Lessons Learned—Transition to an Urban Conflagration

- Fires crossed the traditional interface into purely urban areas. Structures became another fuel type to carry the fire deeper into cities.
- Ornamental vegetation created an unpredictable and significant fuel source that blew into attic vents and eaves and spread through neighborhoods by torching, crowning, or throwing embers. Structures became involved from ember attack from the inside out rather than flame impingement.
- Firefighters found heat control the primary factor for preventing fire from spreading to other structures once fire entered denser urban areas.

- Respondents believed similar events will happen in the future and reiterated the need to put even more effort into pre-incident planning.

Fire Whirls

> *What we were expecting to see were fire whirls (4' to 6' tall), what we actually saw were true fire tornadoes. The fire researchers kept telling us what we were seeing was impossible and never seen before. After three days of discussion, the fire researchers started to understand that what they were expecting and what was happening was not jiving.*
> **-Division Supervisor**

Respondents reported unusual numbers of fire whirls that ranged from several yards wide up to a ½ mile wide. *Destructive fire whirls,* those causing structural damage unrelated to fire, also were reported.

In addition to appearing suddenly, large fire whirls, characterized by a jet engine noise, took in debris such as large tumbleweeds and bushes from the bottom and ejected flaming debris from top—raining embers and violently showering sparks as much as ¾ of a mile beyond the head of the fire. In one reported case, a fire whirl entered an area that had already burned clean down to three-inch stubble and whirled across several hundred feet of burned area into unburned fuel, carrying fire the whole way and igniting the unburned fuel. Another fire whirl crossed an eight-lane freeway. Small fire whirls merged into larger ones. Some reported fire whirls moving downhill.

Summary of Lessons Learned—Fire Whirls

- Observed fire whirl behavior was both unexpected and extreme in these fires, catching many firefighters by surprise and significantly contributing to spotting up to ¾ mile.
- 180-degree wind shifts proceeded fire whirls by 45 seconds to a minute. These wind shifts became a warning sign/trigger point to some firefighters, allowing time to pull crews out to a safer area.

Wind Shifts

> *It does not matter how much experience you have, the urban interface fire will surprise you. I never expected the fire to move so fast against the wind and wouldn’t have believed it if someone told me about it.*
> **- Municipal Department Fire Chief**

Wind shifts produced dangerous fire behavior, including fire whirls. Once recognized, crews developed contingency actions (including moving to safety zones) that they implemented when they detected sudden wind shifts. Strategically, the shifts from the easterly Santa Anas to the prevailing westerly winds offered opportunities to take the initiative and gain ground on perimeter control.

Summary of Lessons Learned—Wind Shifts

- Wind shifts were trigger points indicating the potential for fire whirls and other dangerous fire behavior. Leaders developed contingency plans to implement when wind shifts occurred.
- Larger predicted wind shifts were used to set strategic trigger points to take advantage of wind shifts as the opportunity to move from a defensive strategy to an offensive one.

Fuels

> *The fire hit us so hard; the houses became just another fuel type.*
> **- Engine Company Captain**

In higher elevations, extensive tree mortality resulting from pine beetle infestation provided abundant fuel to carry the fire. Light, flashy fuels, and decadent chaparral fueled the fire at lower elevations. Witnesses reported mass ignition in grassy fuels ahead of the fire—the result of dry winds, high temperatures, low humidity, and low fuel moistures.

As the fire transitioned from the traditional WUI into the urban environment, heat emanating from fully involved structures allowed the fire to spread to neighboring structures by direct flame impingement, radiant heat, and embers emanating from palm fronds and other ornamental foliage. In terms of radiant heat, municipal firefighters reported no difference between being outside these houses and being inside a fully involved structure.

Palm trees provided an unusual and significant fuel source, carrying the fire rapidly across streets and through neighborhoods both through torching and by fronds creating a spotting source.

Dense ornamental foliage proved a significant problem in older neighborhoods. Other highly flammable fuels included Eucalyptus (especially when in groves), olive trees, and Italian Cypress. Dense accumulations of Italian Cypress needles threw embers in all directions once ignited.

Belts of natural “open space” in WUI neighborhoods (versus greenbelts) helped spread the fire by carrying it along roads or helping fire to jump a road.

Summary of Lessons Learned—Fuels

- Fire moved very quickly through trees killed by bugs and chaparral. Mass ignitions were reported in light, grassy fuels.
- As a type of fuel, involved structures emanated intense radiant heat. Heat levels in the street were unusually high.
- Ornamental vegetation created an unpredictable and significant fuel source that blew into attic vents and eaves and spread through neighborhoods by torching, crowning, or throwing embers.

- Natural open space areas contributed to fire spread. Greenbelts were effective barriers.

Effects of Fuels Programs and Fuel Treatments

Respondents reported that fuel treatments resulting from quality hazard abatement programs influenced fire behavior—in some cases dramatically. Areas with more effective prevention and fuels hazard abatement programs fared better than those without.

Newer houses constructed of stucco and sealed eaves with reduced ladder fuels and cleared defensible space survived better than new homes in areas with less restrictive building codes (still allowing shake roofs or unsealed eaves, for example). In one area, over 90% of the homes lost (over 700) had wood shingle roofs. Older houses in urban neighborhoods with dense ornamental vegetation and palm trees were also at risk.

Respondents reported considerable differences between communities in how they had handled hazard abatement. Some had mandatory programs that were well enforced, with stiff penalties for non-compliance. Other communities had voluntary programs or didn't enforce their mandatory programs. The reported differences in how these communities fared was striking. Fewer homes were lost in communities where local government actively supported and enforced hazard abatement programs, and firefighter safety presented less of a concern. However, the normal 30' abatement limit was not sufficient in most cases to prevent flame impingement and ember-driven fires from starting. Some WUI areas had 100' abatement limits, and those were extremely effective.

In one of the areas with the 100' clearance requirement, many homes survived even though no fire resources were available to protect them. In this community, residents are required to create a 100' defensible space, and local firefighters divide the homes and go door-to-door to communicate with residents. If the resident does not comply with the defensible space requirements, a notice is issued with a deadline and a fine. Similar to some traffic tickets, the fine doubles then triples the longer the resident takes to comply. Eventually, the jurisdiction fines the resident $635, contracts the abatement work out, and adds the cost (about $300) to the fine. The whole amount is then billed to the resident's property taxes for the next year. Last year, this jurisdiction originally issued about 18,000 hazard abatement notices. They ended up having to contract out and bill residents for only 138 of those 18,000 parcels.

Local jurisdictions that took the responsibility of maintaining government-managed lands to very high standards were also successful. Greenbelts were highly effective, as were open spaces where fuels were abated or treated. In addition to reducing the fire hazard, these areas set an example for area residents.

In one successful example, a resident created a defensible space around their home by clearing several feet of native coastal sage scrub vegetation and replacing it with gravel and fire resistant plants including ice plant (non-native, but does well in this area) as ground covering, pencil bush, again a non-native but does well in the area (*Euphorbia trucalli*), lemonade berry, a native (*Rhus integrifolia*), Catalina cherry, a native (*Prunus lyonii),* California wax myrtle, a native (*Myrica californica),* and native oaks, (*Quercus agrifolia),* which are not only resistant to burning but grow naturally in Southern California. In contrast, costal sage was often burned beyond recognition.

In wildland areas, it proved critical for natural resource agencies to focus their limited resources on priority projects. The National Forests have hundreds of thousands of acres of dead trees and accumulated fuels. Treating the whole area is unrealistic given the resources available to the agencies. As one respondent put it, "Six or eight projects, 10 to 100 acres in size made a difference on this fire because they were in key areas. We need to focus on treating fuels around the structures. We can't treat the whole forest."

One successful project involved a school where middle and high school students provided defensive space clearance, trash, and brush removal. The local Fire Marshall had visited the school every month and helped them set up measures that saved not only the school but were credited with saving the whole town. Twice firefighters were able to beat back the flames from the deck of the school and the lodge next to it. The hotshot crew who had defended the structures wrote on a classroom blackboard, "Thanks for doing your work. Because of you we were able to save [your town]."

Areas burned by wildfires in the previous year did not necessarily stop fires because light, flashy fuels had grown in the burned areas. However, fuels treatments and prescribed burns conducted in the past 5 years were generally more successful. Using existing community fuel breaks and planned points (often old burn projects) worked effectively to keep fire out of the mountain communities.

Summary of Lessons Learned—Effects of Fuels Programs and Fuel Treatments

- Strict building codes and fuels abatement programs in the WUI were extremely effective compared to less aggressive programs in other areas. Shake shingled homes suffered very high loss rates compared with other types of roof construction.
- Greenbelts and open spaces where fuels had been treated or abated or both were effective as control points in the WUI. Native, fire resistant plants were effective in creating defensible space that was effective and still natural looking.
- In wildland areas, the quality and placement of fuel treatments—not gross acres treated—mattered most. In some cases, five acres treated in the right spot saved a community.