



Home Destruction During Extreme Wildfire Conditions

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**Cedar Fire
San Diego, CA 2003**

Principal Discussion Points:

- **How do residential fire disasters occur during extreme bushfire/wildfire conditions?**

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- **How do residential fire disasters occur during extreme bushfire/wildfire conditions?**
- **What opportunities do we have for preventing wildland/bushfire-interface (WUI) fire disasters?**

A photograph of a large residential house at night, completely engulfed in intense orange and yellow flames. The fire is very large, with thick smoke rising into the dark sky. In the foreground, there are silhouettes of trees and a fence. A semi-transparent dark rectangle with a grid pattern is overlaid in the center, containing the title text in white serif font.

Disastrous Residential Fire Destruction

An aerial photograph of a wildfire. In the foreground, a small, single-story house with a light-colored roof is visible, surrounded by dark, charred ground. To the right of the house, a large, intense fire is burning, with bright yellow and orange flames rising into the air. The background shows a vast area of land covered in dense vegetation, with a winding road or path visible. The overall scene is one of a major fire event in a rural or semi-rural area.

**How do WUI fire
disasters occur?**

How do wildland-urban fire disasters occur?

Extreme fire conditions

(Fuel+wx
+ topo)



Wildland fire

(Rapid spread +
high intensity)



Urban fire

(Simultaneous
home ignitions)



Fire protection resources

(Overwhelmed)



Fire Protection

(Reduced
effectiveness)



Many
totally
destroyed
homes

Wildfire suppression and structure protection comprise the primary approach to preventing WUI fire destruction.



How do wildland-urban fire disasters occur?

Extreme fire conditions

(Fuel+wx
+ topo)



~~Wildfire control~~

Urban fire

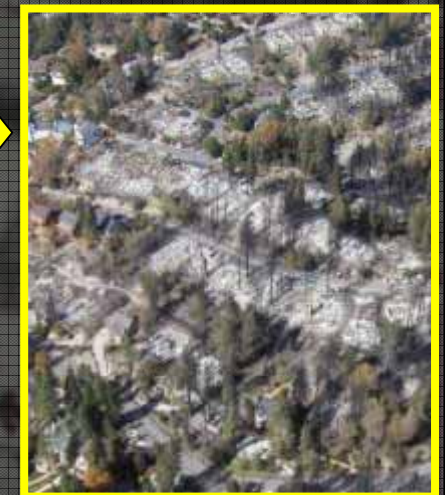
(Simultaneous
home ignitions)

Fire protection resources

(Overwhelmed)



~~Protection~~



During extreme wildfire behavior if firefighters cannot respond to homes then fire protection doesn't occur and the technology and logistics that support firefighters are not effective.

**And, if no one is present to
extinguish home ignitions,
any sustained home ignition
results in total destruction –
whether it happens in 20 mins
or 12 hrs.**



Tactical success...



Strategic failure!



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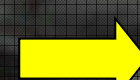
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If homes don't ignite,
homes don't burn!

**And, if homes don't burn,
the WUI fire problem
does not exist.**

**This suggests a WUI fire
approach principally in terms
of home ignition potential
rather than bushfire/wildfire
suppression and structure
protection.**



Opportunity for Preventing WUI Fire Destruction





Opportunity for Preventing WUI Fire Destruction

A Home Ignition Approach

**Define the wildfire/bushfire
residential fire destruction in
terms of how homes ignite.**



Defining WUI Fire Destruction as a Home Ignition Problem

In its simplest terms, a wildland-urban fire is where the fuel feeding a wildfire changes from wildland fuel to urban fuel.

For this to happen, wildland fire must be close enough for its flying brands and/or flames to contact the flammable parts of the structure.

Defining WUI Fire Destruction as a Home Ignition Problem

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Conceptually defines the relationship between home destruction and the flames and firebrands of extreme wildfire?



Research analyses,

- Computational analysis,**
- Crown fire experiments,**
- WUI fire examinations,**

**have provided specific insights on
how homes ignite during extreme
bushfire/wildfire behavior.**



Computational Analysis

**From how far away will crown fire
flames ignite a wood wall?**



Modeling Results

Making model assumptions to over-estimate the distance flame radiation can ignite wood:

Crown fire flames must be within 30 meters/100 feet before wood wall ignition will occur (radiant heating).

Crown Fire Experiments



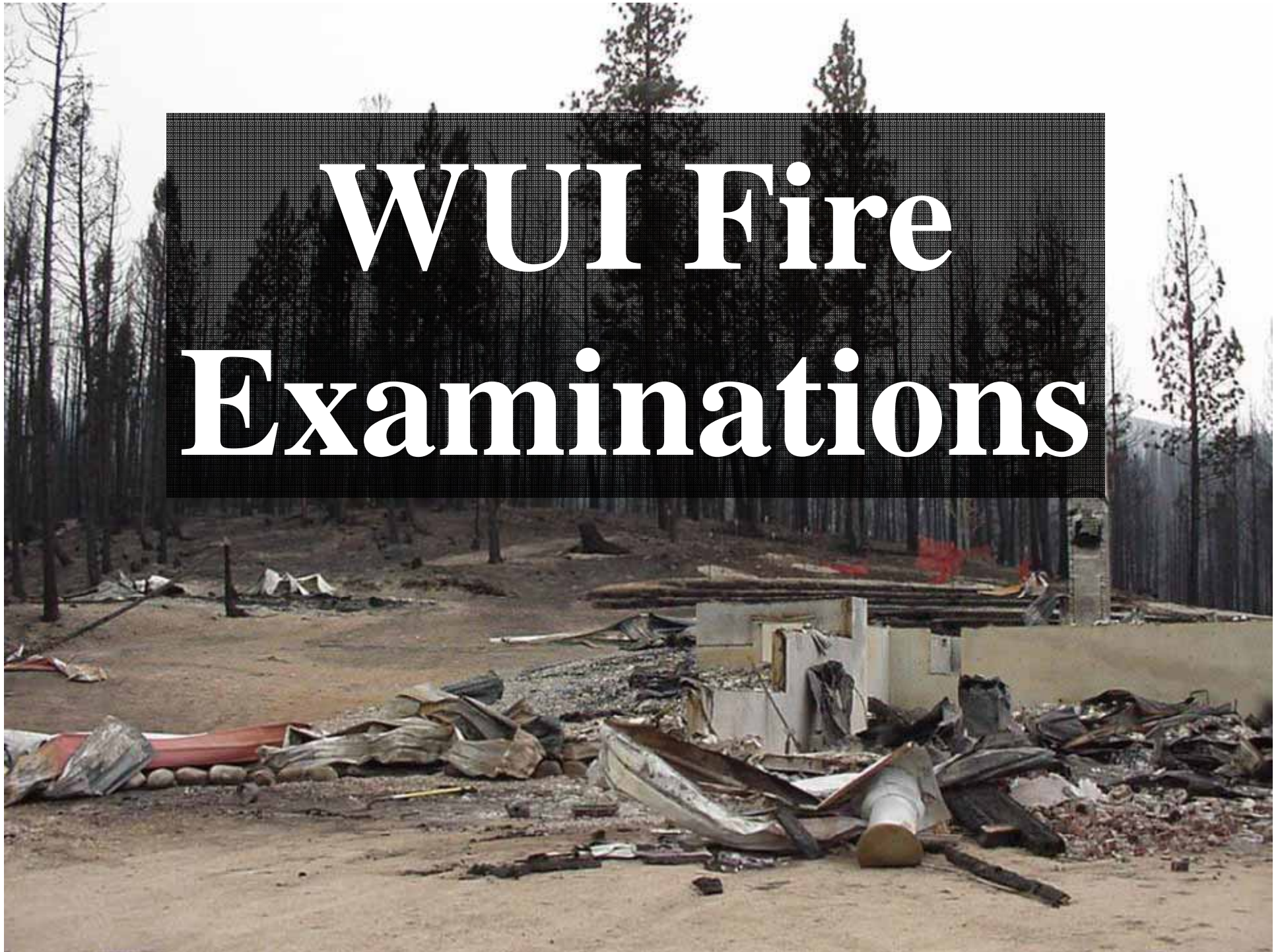
Crown Fire Experiments

Significant Results:

- Validated that the 30 m/100 ft computed distance over-estimated,
- Intense crown fire flames burnout at a location in less than 50 secs.



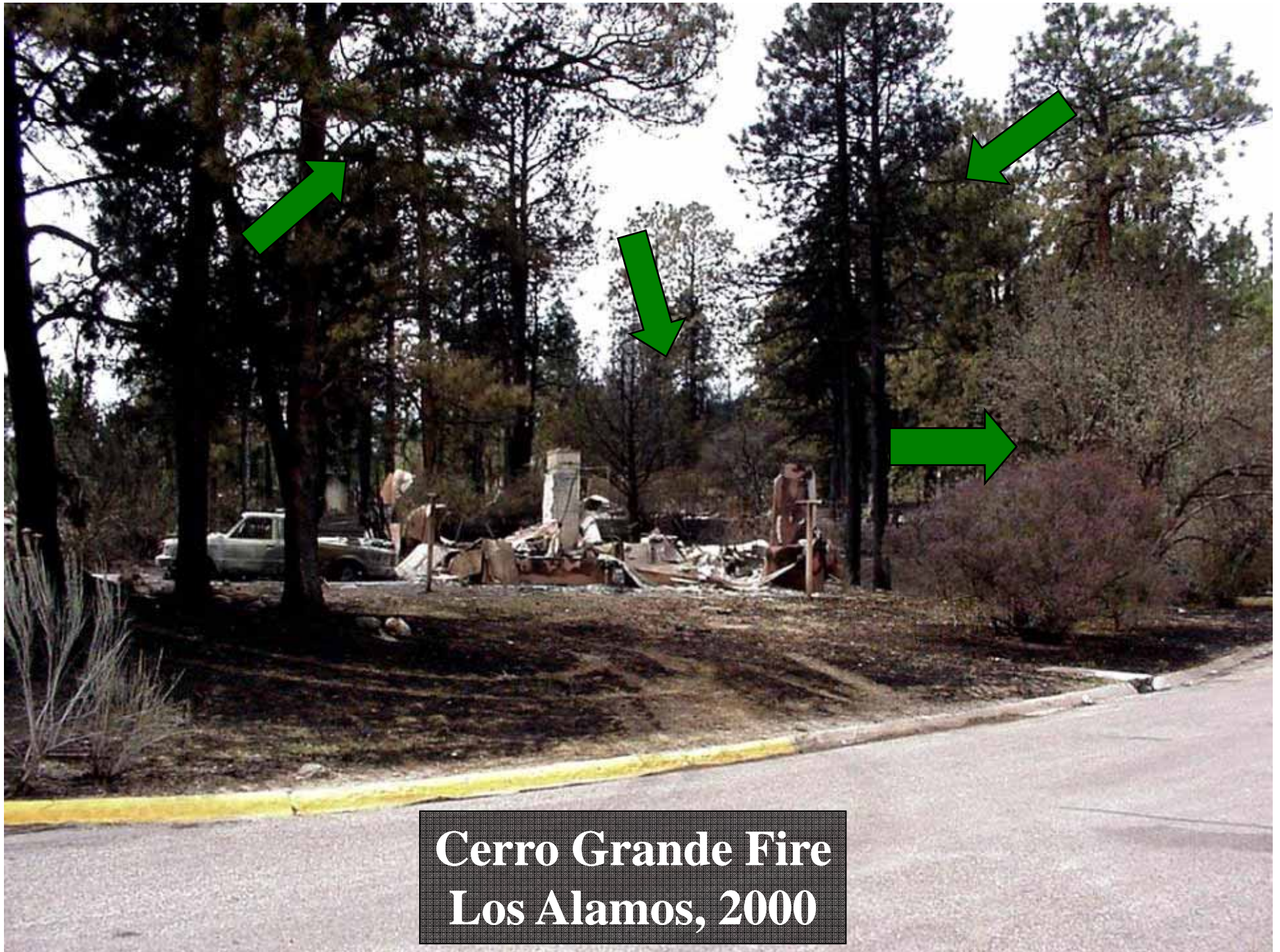
WUI Fire Examinations



Examination findings:

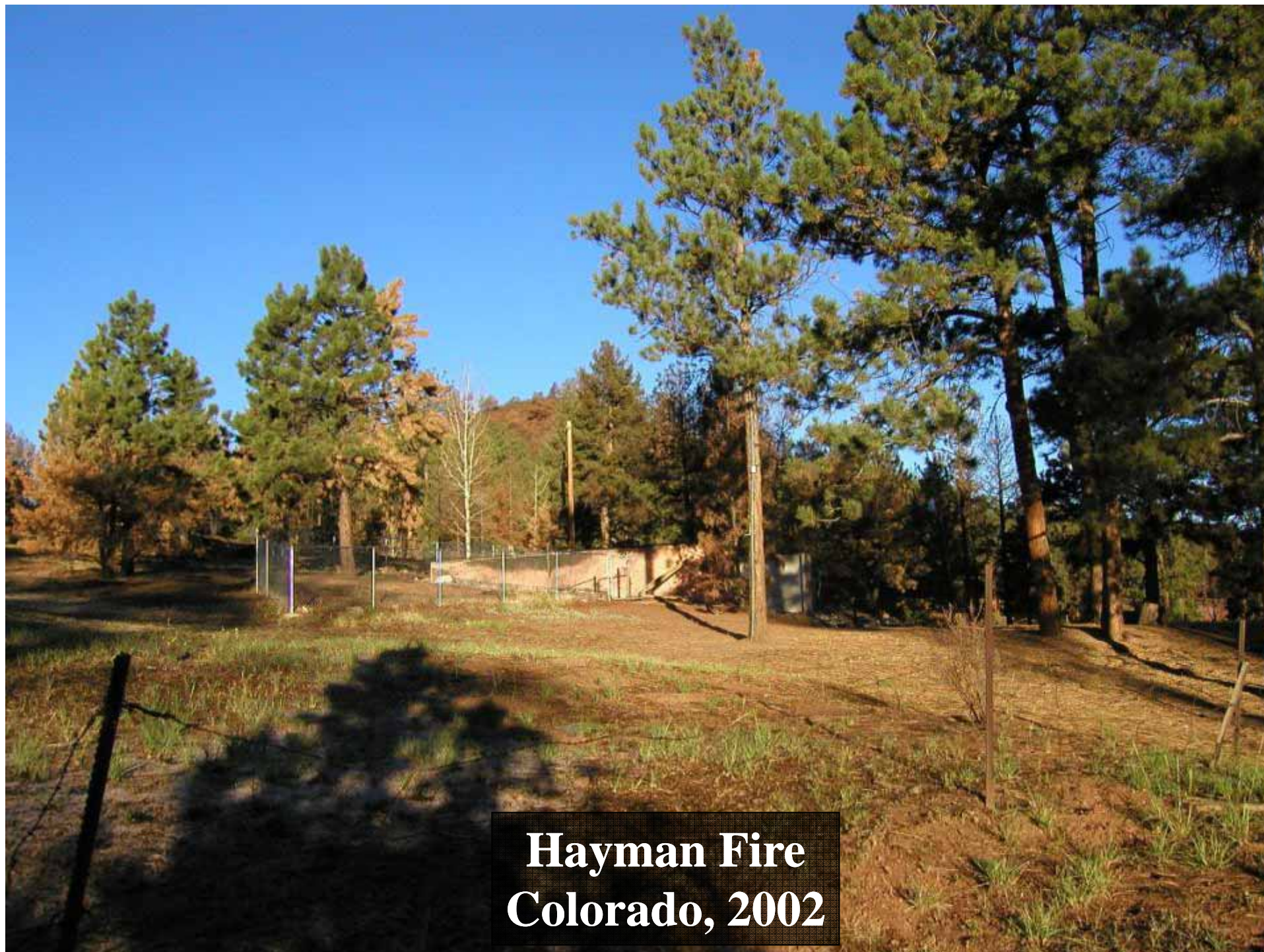
Most destroyed homes with adjacent unconsumed vegetation.

Ignitions occur from lesser intensity sources – surface fire and firebrands.



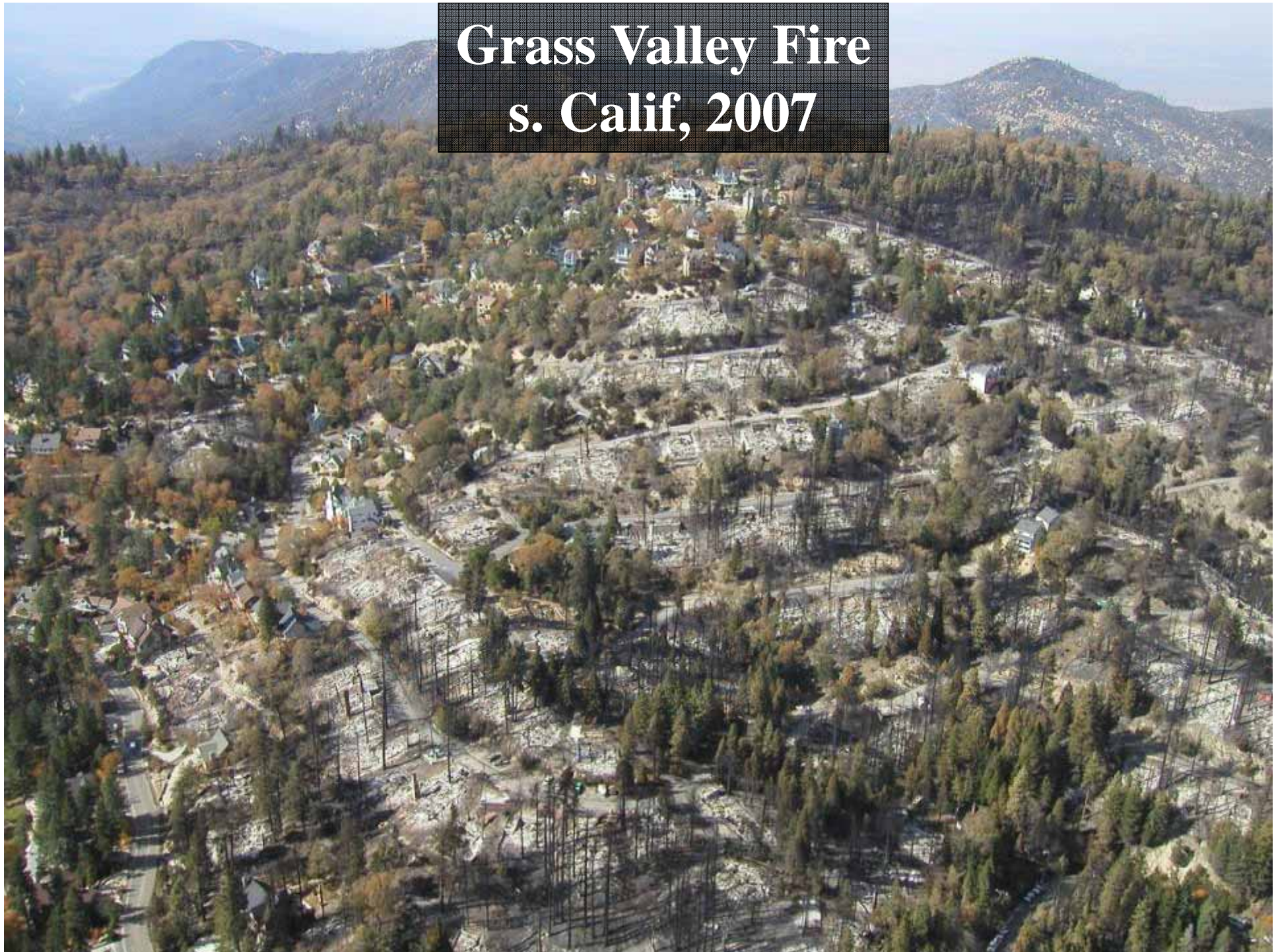
**Cerro Grande Fire
Los Alamos, 2000**

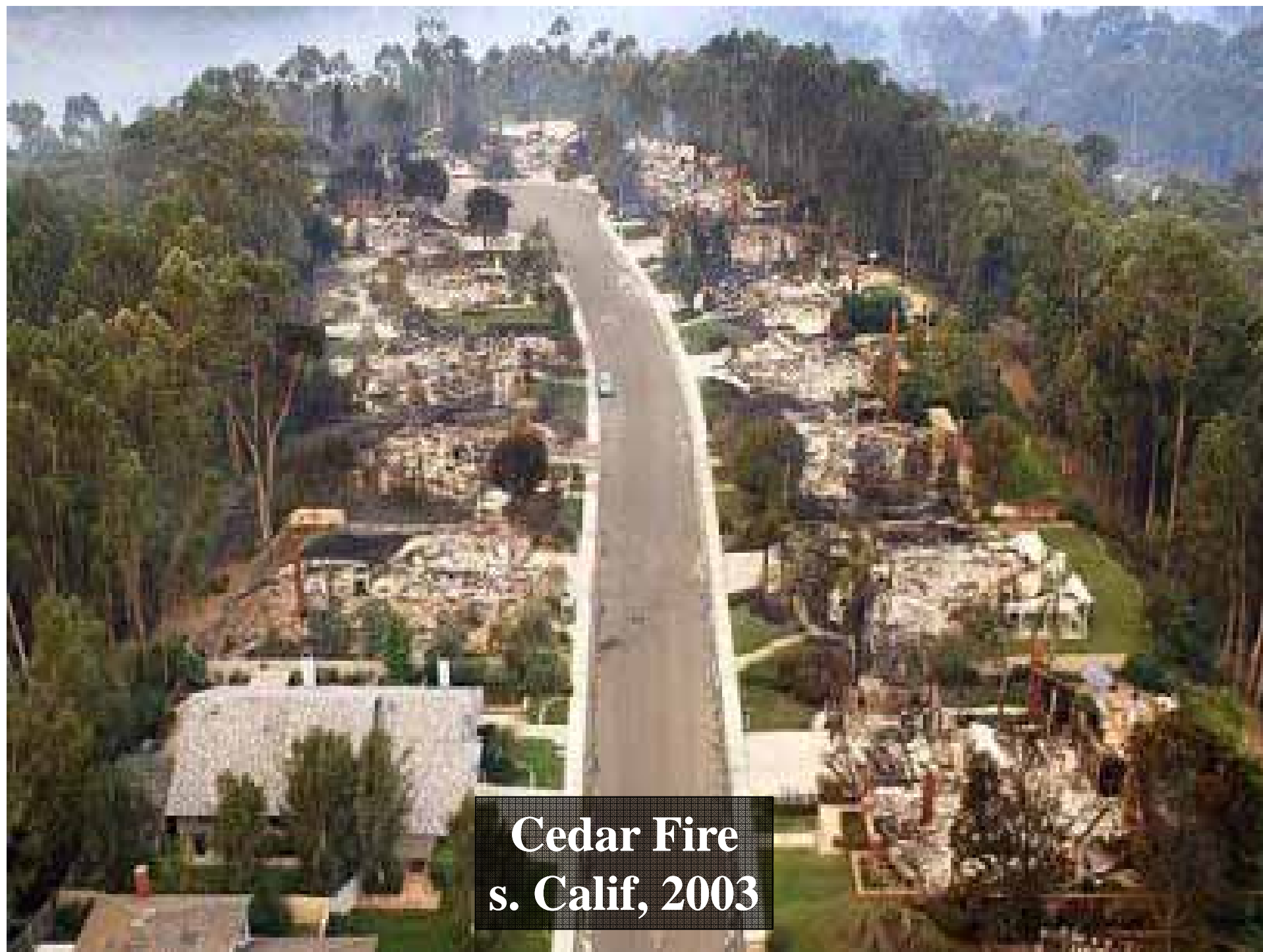




**Hayman Fire
Colorado, 2002**

Grass Valley Fire s. Calif, 2007





Cedar Fire
s. Calif, 2003

Kinglake, Victoria 2009



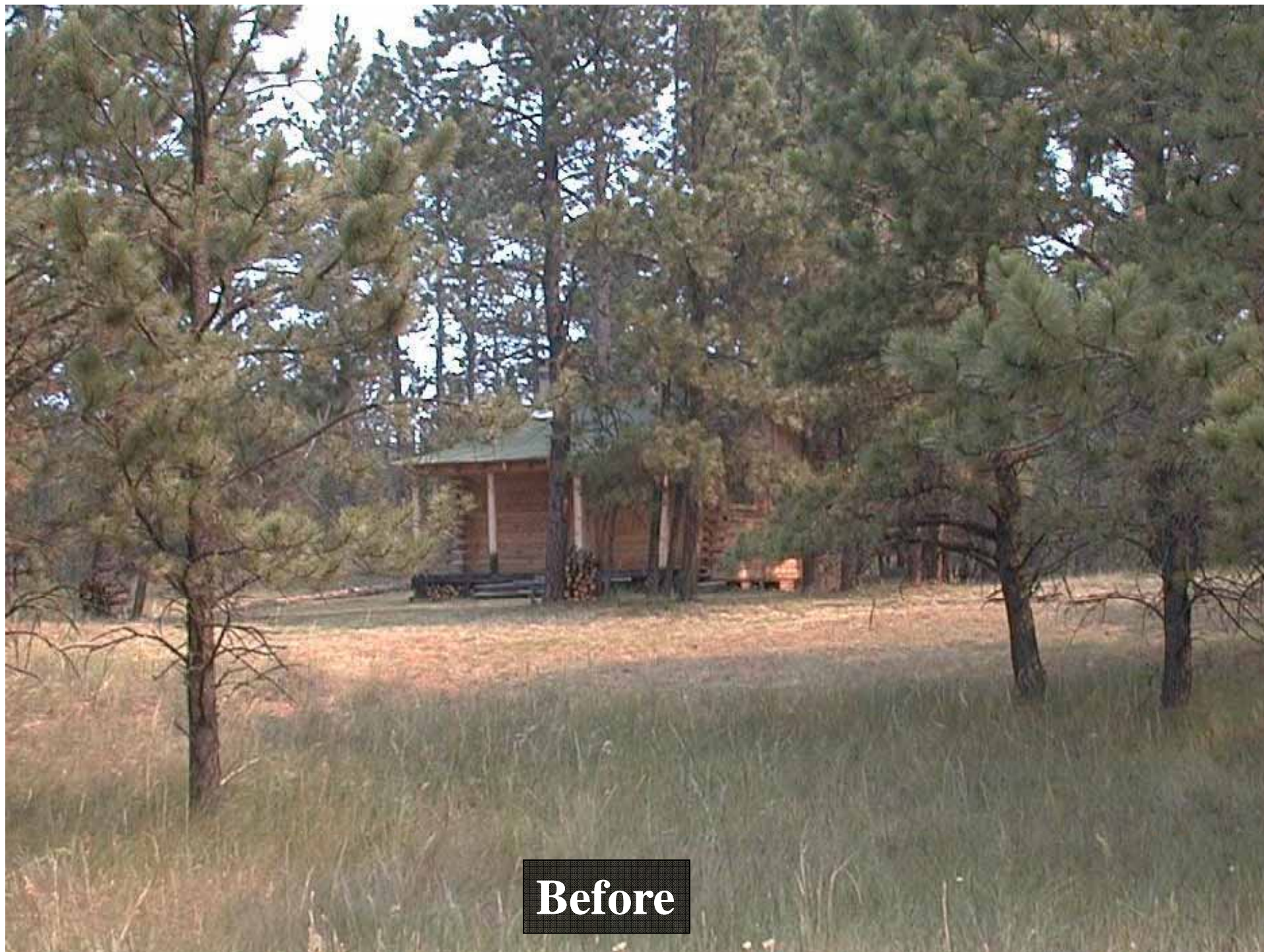
Examination findings:

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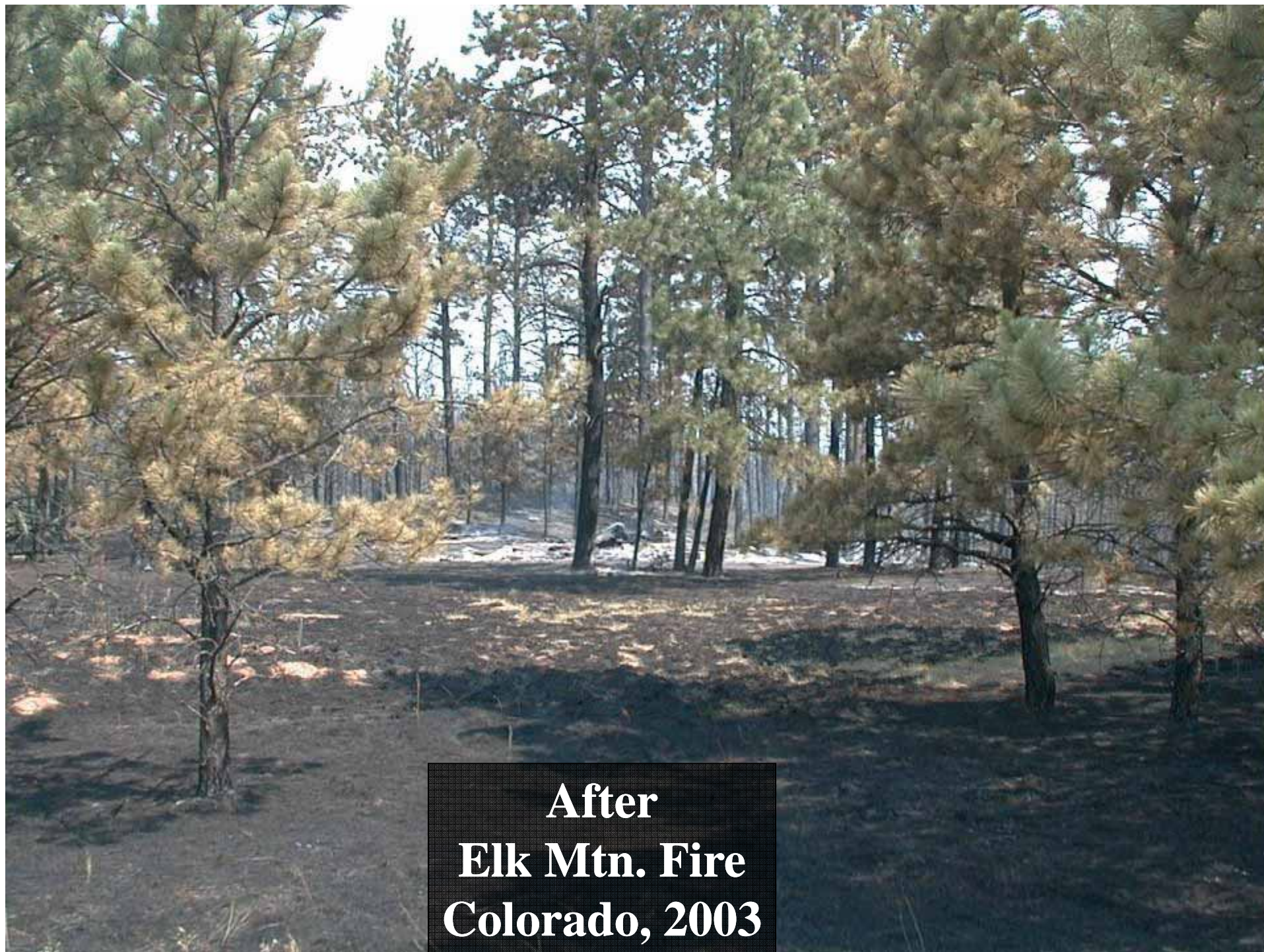
Ignitions occur from lesser intensity sources – surface fire and firebrands.



**Angora Fire
Lake Tahoe, CA 2007**



Before



**After
Elk Mtn. Fire
Colorado, 2003**





**Missionary Ridge Fire
Colorado, 2002**





Examination findings:

Homes commonly ignite and burn hours after the wildfire has ceased its extreme fire behavior;

Most homes destroyed are not directly ignited by extreme wildfire behavior.

An aerial photograph of a wildfire in a forested area. The image shows a dense forest of tall, thin trees, many of which are blackened and charred. Large patches of bright orange and yellow fire are visible, particularly in the upper left and center-right areas. Thick white and grey smoke rises from the fire, filling much of the sky and obscuring some of the trees. A yellow arrow points from the bottom left towards the center of the image.

**Photo time
1220**

**Wildfire @
930-1000**

**Grass Valley Fire
s. Calif, 2007**



**Photo time
1220**





**Photo time
1800**

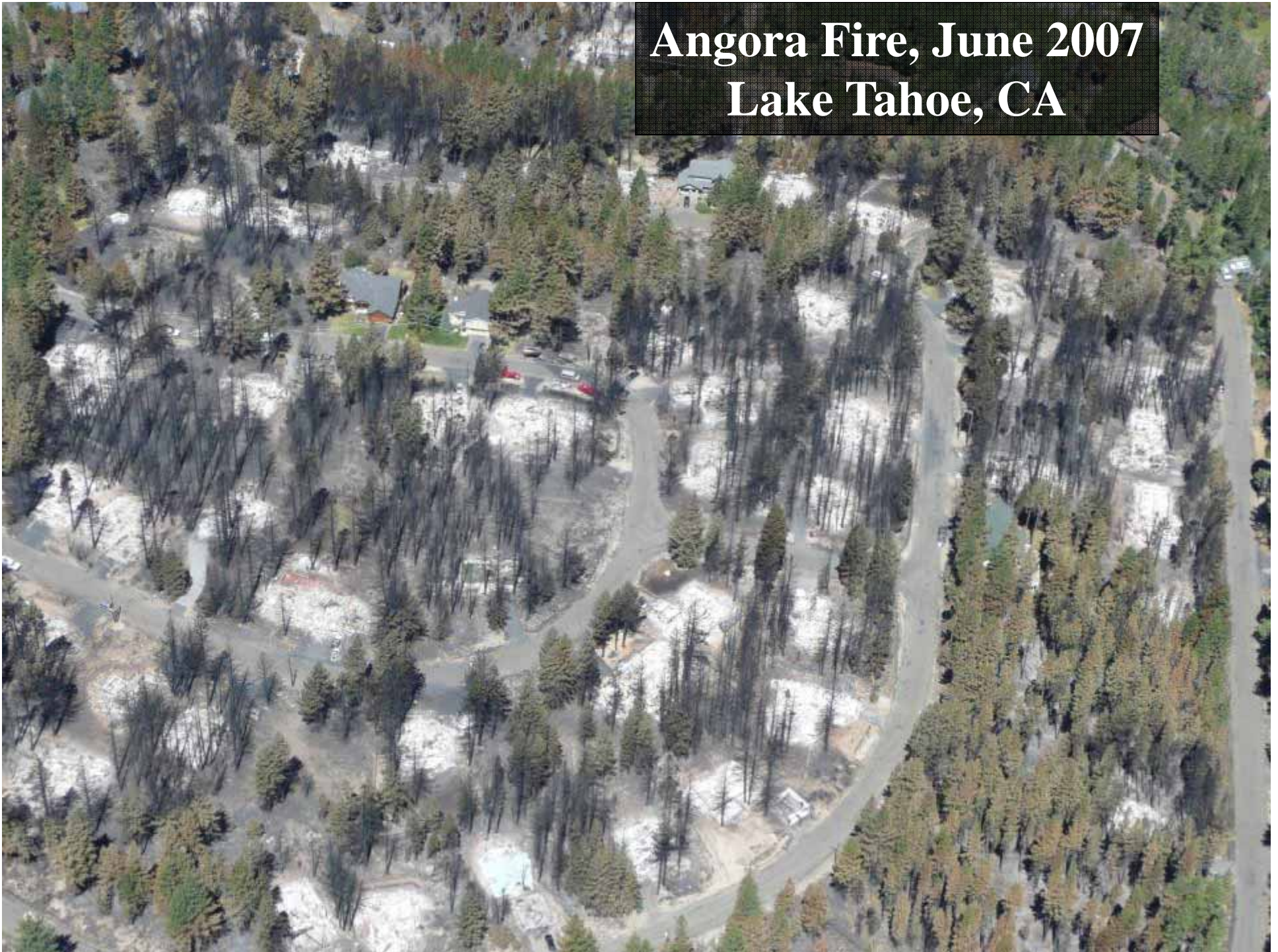


Los Alamos, 2000

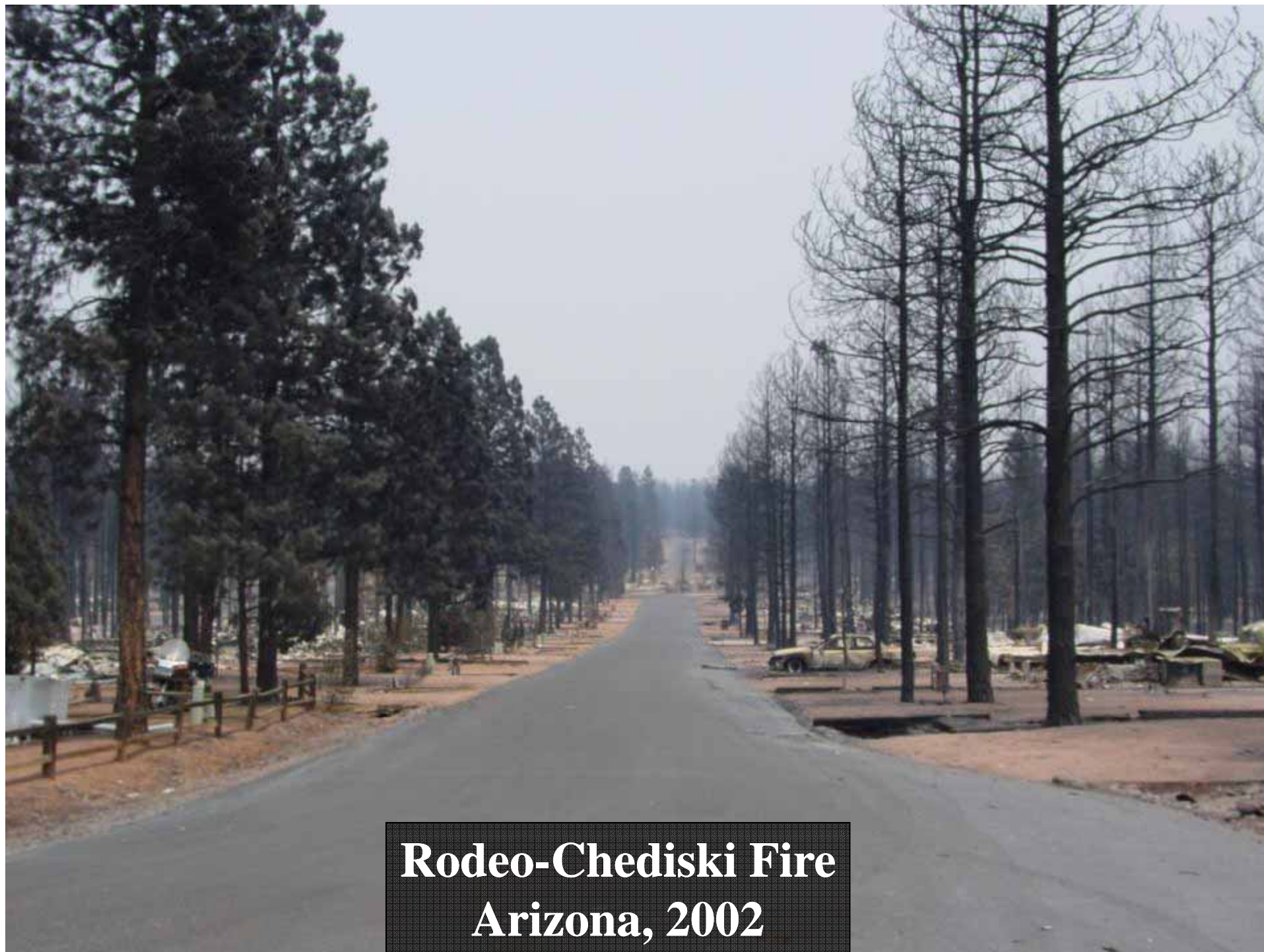
Examination findings:

High intensity wildfires typically do not continue spreading through residential developments.

Angora Fire, June 2007
Lake Tahoe, CA







**Rodeo-Chediski Fire
Arizona, 2002**

Research Indicates:

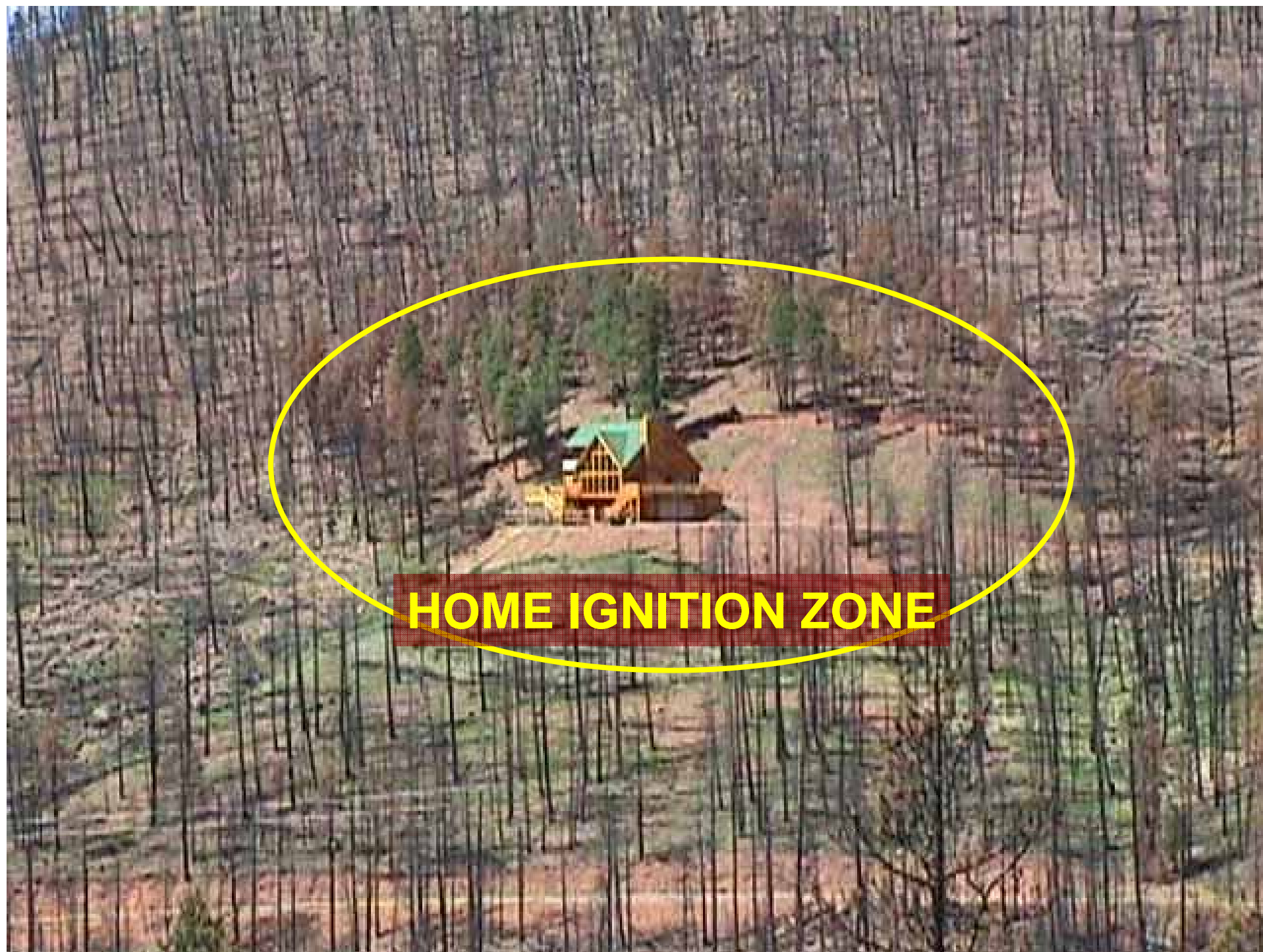
**Homes meet the requirements for
ignition based on local conditions.**

Research Indicates:

Given extreme wildfire behavior, the home characteristics in relation to the area surrounding the home within 30 m (100 ft) principally determine the potential for home ignitions. I call this the –

home ignition zone (HIZ).









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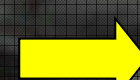
Fire protection resources

(Overwhelmed)



Fire Protection

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**Ignition
Resistant
Homes
(HIZs)**



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Ignition
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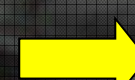
Fire protection resources

(Proportional)

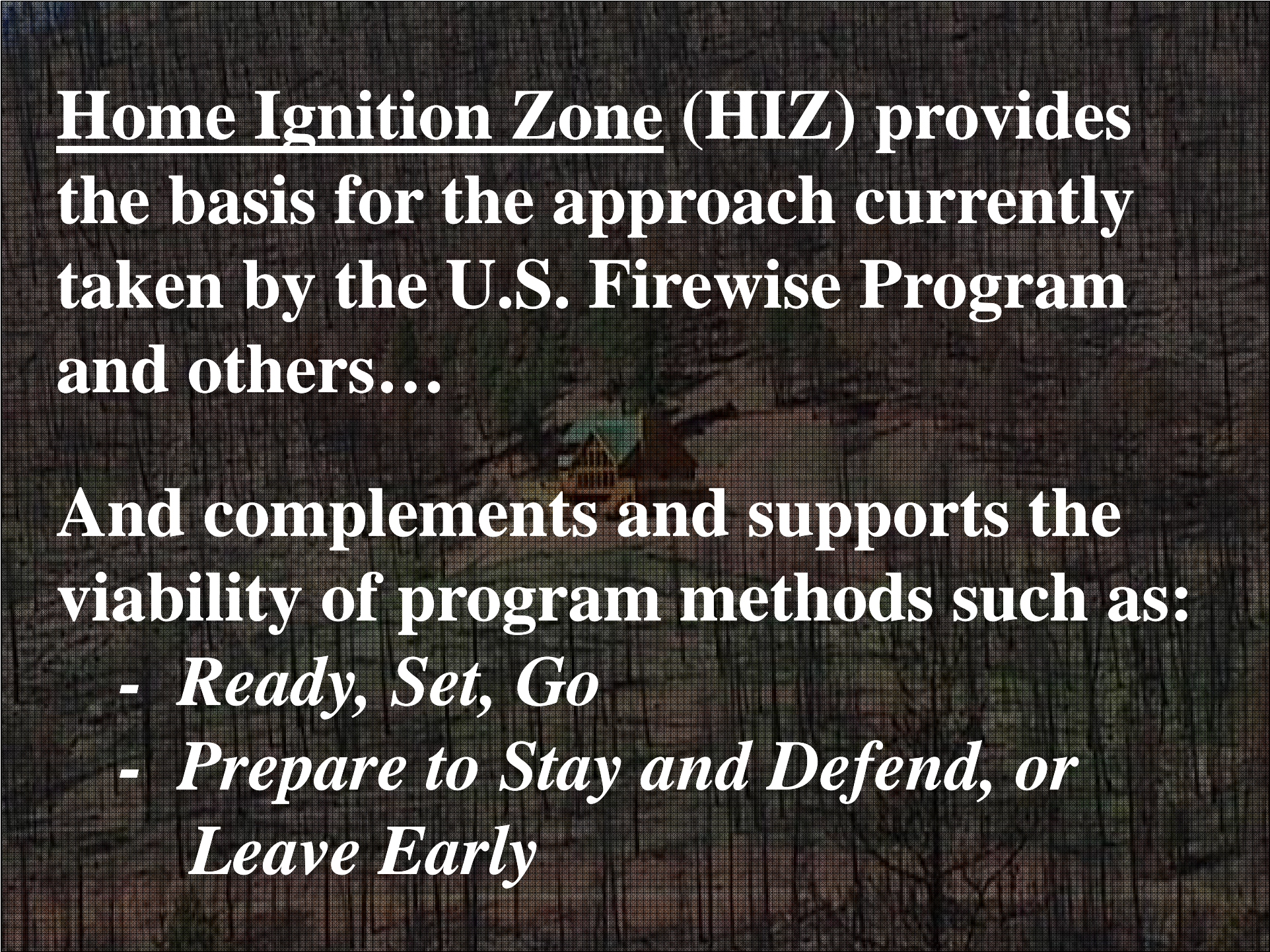


Fire Protection

(Enhanced
effectiveness)



Disaster
Prevented



Home Ignition Zone (HIZ) provides the basis for the approach currently taken by the U.S. Firewise Program and others...

And complements and supports the viability of program methods such as:

- *Ready, Set, Go***
- *Prepare to Stay and Defend, or Leave Early***

A night photograph of a forest with warm lights reflecting on a body of water. The scene is illuminated by several bright, warm yellow lights that create a soft glow and reflect on the calm water in the foreground. The background is filled with dark, silhouetted evergreen trees. The overall mood is serene and peaceful.

Thank you