

Wildfire Resilience Fundamentals

Frank Frievalt, Director, WUI FIRE Institute

August 2026

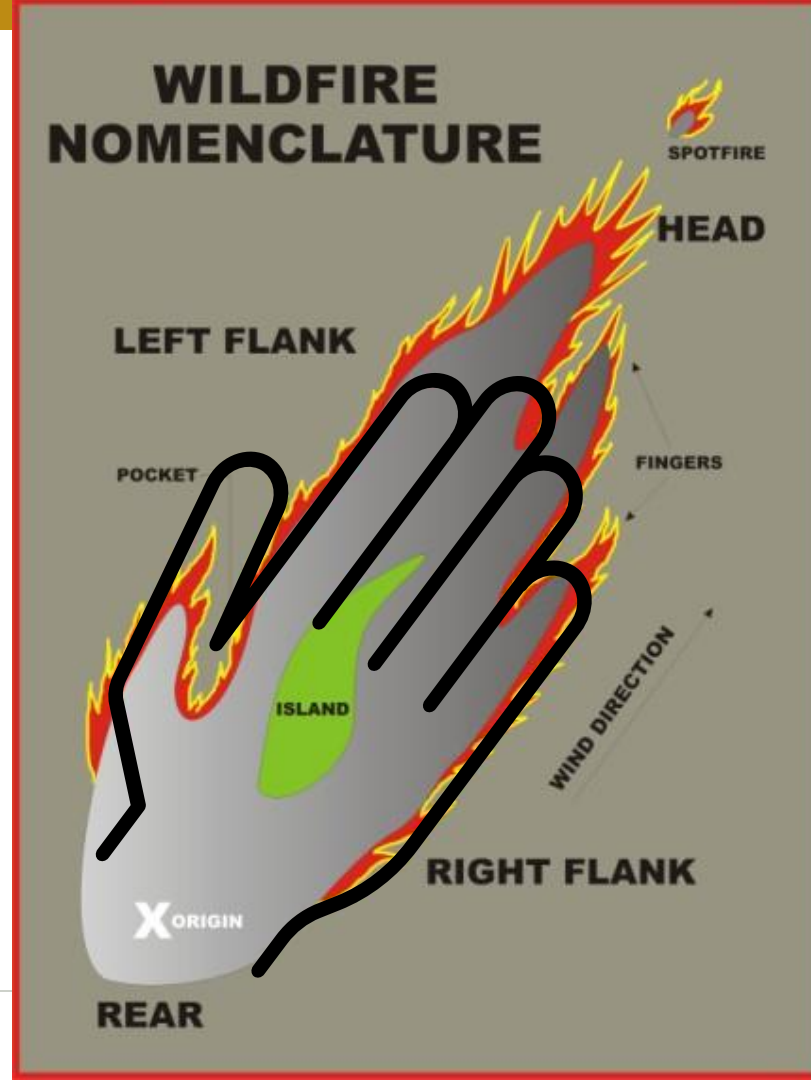


CAL POLY

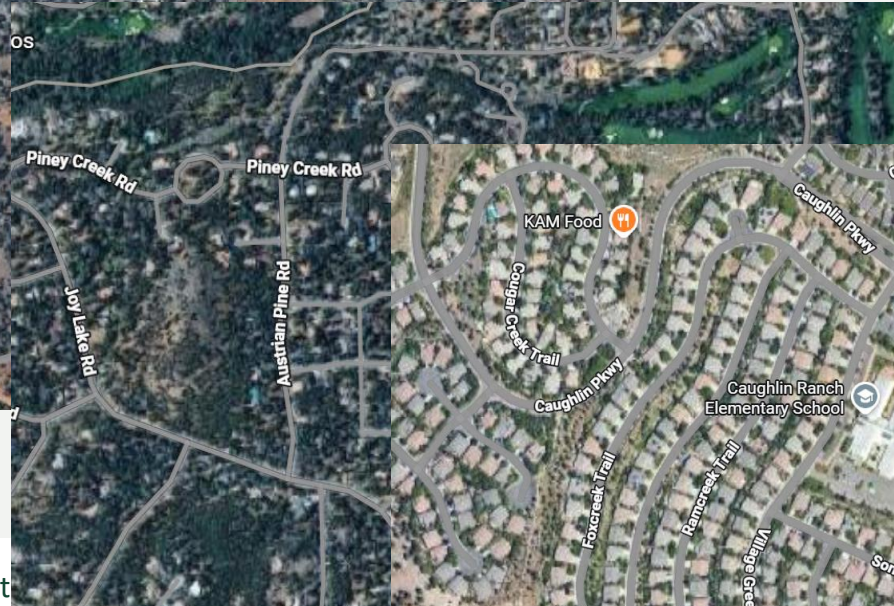
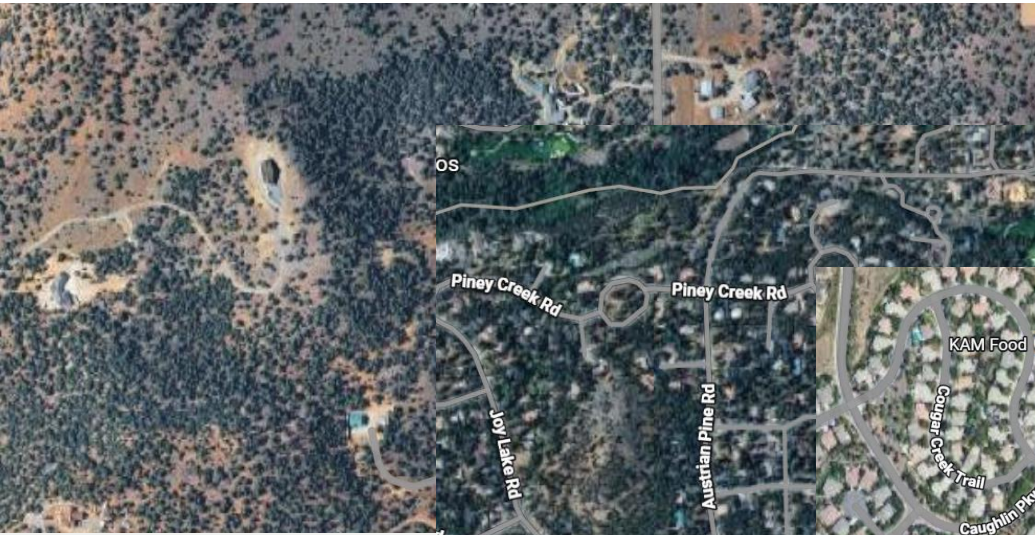


Anatomy of a Wildfire

- Rear/Heal
- Flanks
- Pockets
- Head
- Fingers
- Spotfire
- Islands



What is the WUI?



(WUI) is the geographical area where infrastructure, meets or

densities:

Source: <https://www.nist.gov>



“This area, called the home ignition zone (HIZ), defines wildland-urban (WU) fires as a home ignition problem and not a problem of controlling wildfires.”

(Cohen, Jack. 2019. “A More Effective Approach for Preventing Wildland-Urban Fire Disasters.” In *A New Direction for California Wildfire Policy—Working from the Home Outward*, compiled by Douglas Bevington, pp. 8–9. Leonardo DiCaprio Foundation, February 11, 2019.)

“By definition, wildland-urban interface fire disasters depend on homes igniting during wildfires.”

(Cohen, Jack. 2008. “The Wildland-Urban Interface Fire Problem: A Consequence of the Fire Exclusion Paradigm.” *Forest History Today*, Fall 2008: 20–26.)



Wildfire, or Something Else?



Structure outlines
overlaid on an infrared
image of the Eaton
Fire

Source: Infrared - Getty Images/MAXAR Technologies; Structure outlines – Caroline Kelleher



Tipping Point from Wildfire to Conflagration

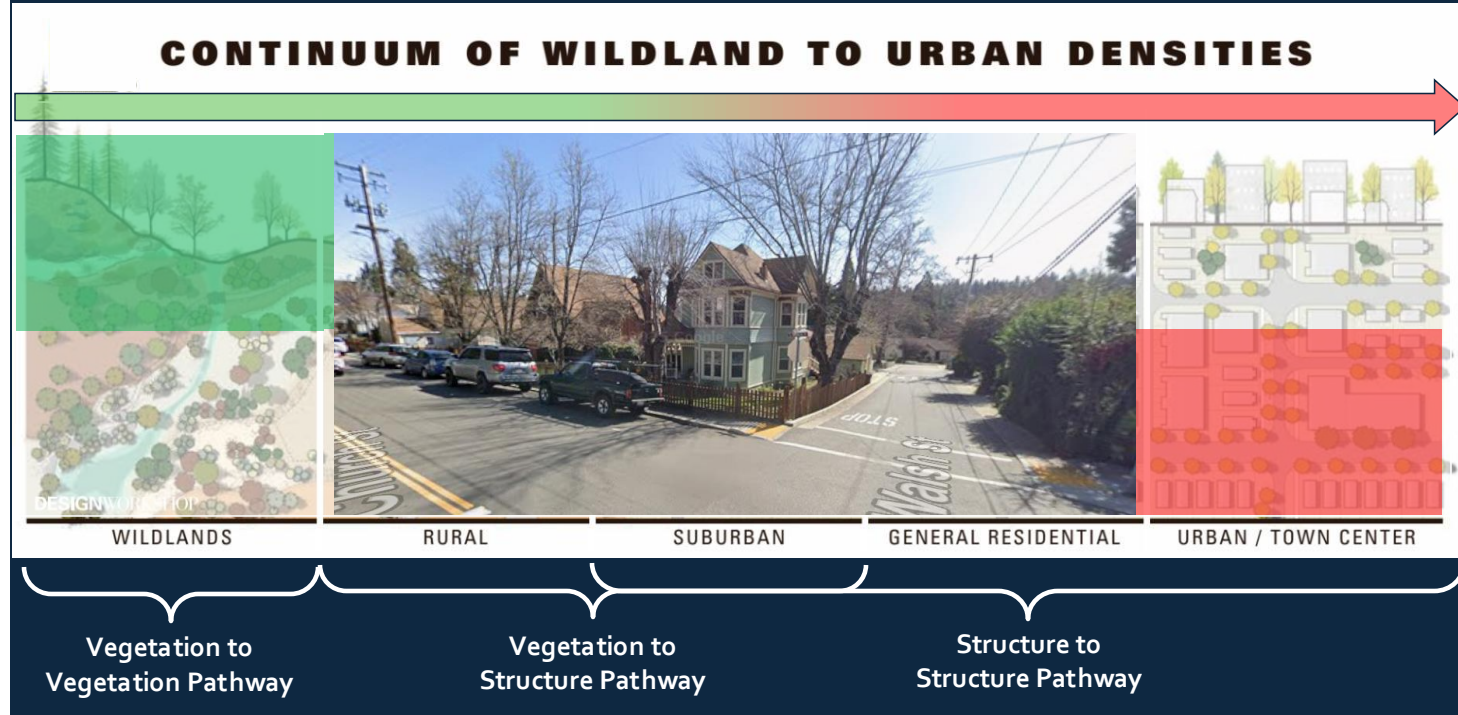
FIGURE 1. WILDLAND-URBAN INTERFACE FIRE SEQUENCE.

Source:
Cohen, Jack.
2010. The
wildland-
urban
interface fire
problem.
Fremontia.
38(2)-38(3):
16-22.



A WUI Approach to the Problem

Risk Reduction Strategies Vary by Fuel Type & Fire Pathway



Structure

Density

Fire risk to structures in California’s Wildland-Urban Interface

[Maryam Zamanialaei](#), [Daniel San Martin](#), [Maria Theodori](#), [Dwi Marhaendro Jati Purnomo](#), [Ali Tohidj](#), [Chris Lautenberger](#), [Yiren Qin](#), [Arnaud Trouvé](#) & [Michael Gollner](#) ✉

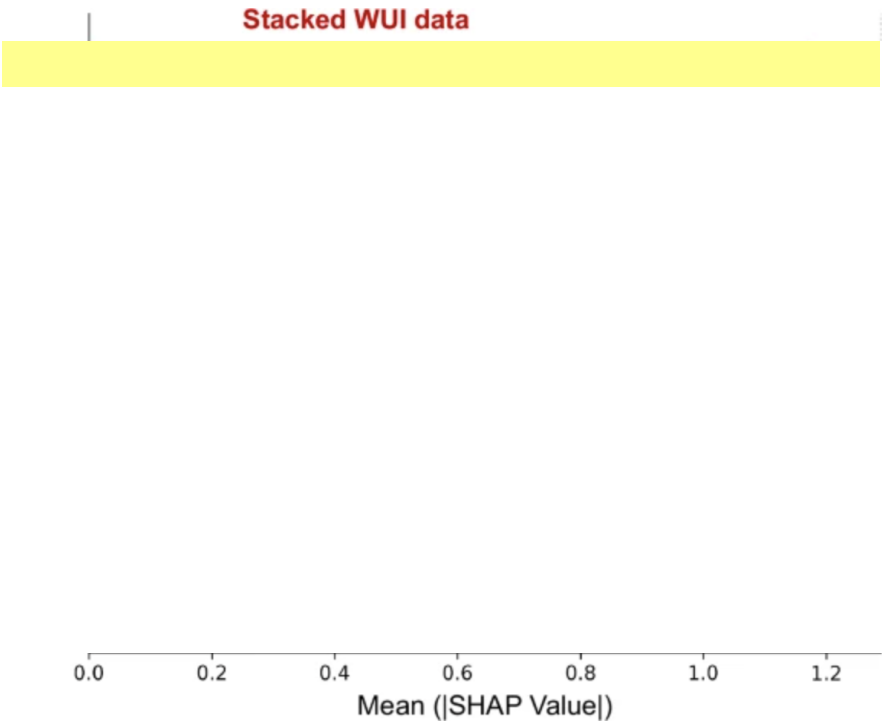
Nature Communications **16**, Article number: 8041 (2025) | [Cite this article](#)

26k Accesses | **9** Citations | **509** Altmetric | [Metrics](#)

"Collectively, these studies underscore that while defensible space is important, building features and surrounding vegetation, as well as proactive mitigation strategies, are critical to improving wildfire resilience."

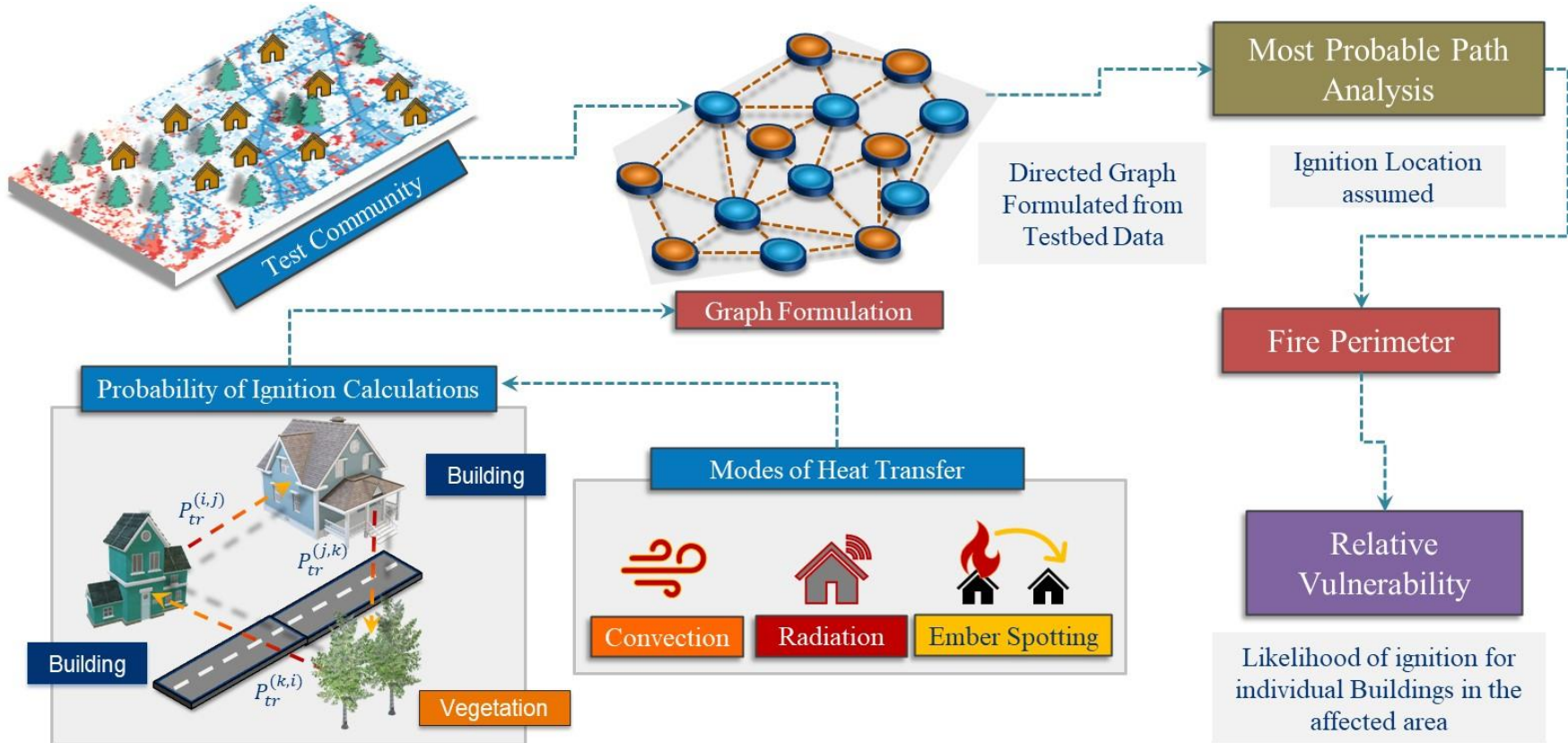
Zamanialaei et al. 2025

Fig. 4: SHAP aggregation results characterizing the contribution of features for the entire (stacked) WUI data from five fires.



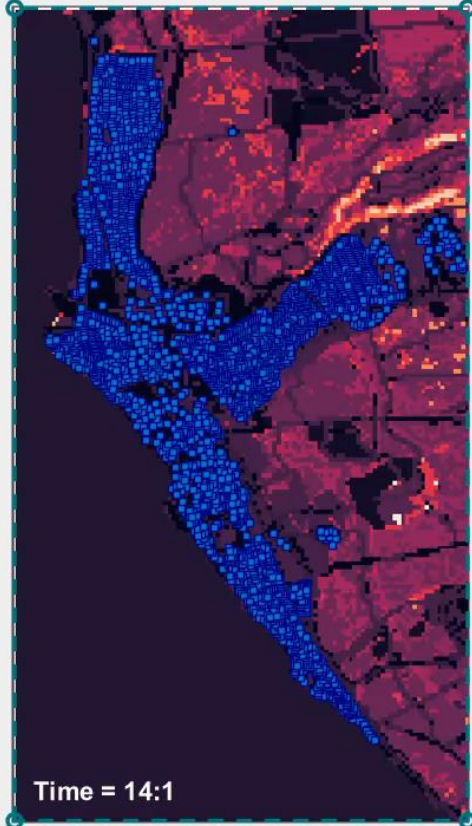
Mean absolute SHAP values from an XGBoost classifier ($n = 47,742$ structures) trained on merged WUI data from five fires. Bars show the average $|SHAP|$ for each predictor, ranked by contributions: structure separation distance (SSD), exterior siding, year built, flame length, ember deposition, roof

AGNI-NAR Framework



Propagation Comparison for Lahina

AGNI-NAR Model Simulation

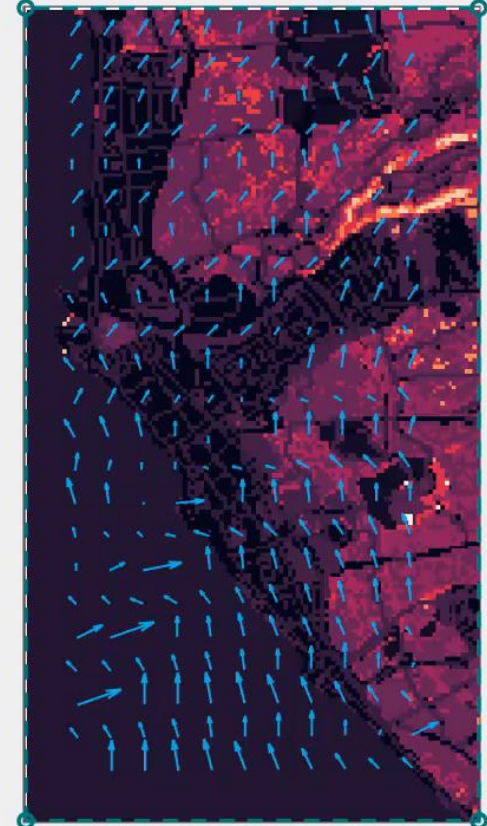


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FSRI Incident Data



Wind Simulation



Where to “Mitigate”



How to “Mitigate” a Structure



WILDFIRE PREPARED
— A PROGRAM OF IBHS —

wildfireprepared.org

ADDITIONAL REQUIREMENTS FOR PLUS

- ✓ Cover gutters.
- ✓ Enclose eaves.
- ✓ Install noncombustible siding.
- ✓ Upgrade windows & doors.
- ✓ Upgrade to a noncombustible deck.
- ✓ Move accessory structures at least 30 feet away.
- ✓ Remove parallel fencing.

BASE REQUIREMENTS

ROOF

- ✓ Ensure the roof covering is Class A fire-rated & maintained clear of debris.
- ✓ Choose noncombustible gutters & downspouts.

BUILDING FEATURES

- ✓ Install flame- and ember-resistant vents or 1/8-inch metal mesh over vents.
- ✓ Ensure 6-inch vertical noncombustible clearance at the base of exterior walls.
- ✓ Clear & maintain the underdeck area; enclose low-elevation decks.

0-5 FOOT NONCOMBUSTIBLE ZONE

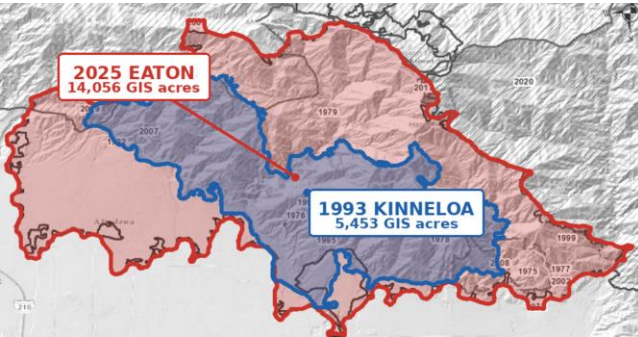
- ✓ Establish a **0-5 foot noncombustible zone** around the home and decks; remove overhanging branches; replace combustible fences within 5 feet.

5-30 FOOT DEFENSIBLE SPACE ZONE

- ✓ Maintain yard with spaced vegetation, structures, & other connective fuels; clear debris; remove firewood.
- ✓ Move structures at least 10 feet away & maintain a 0-5 foot noncombustible zone around them.



Past is Prologue Unless we Adapt...



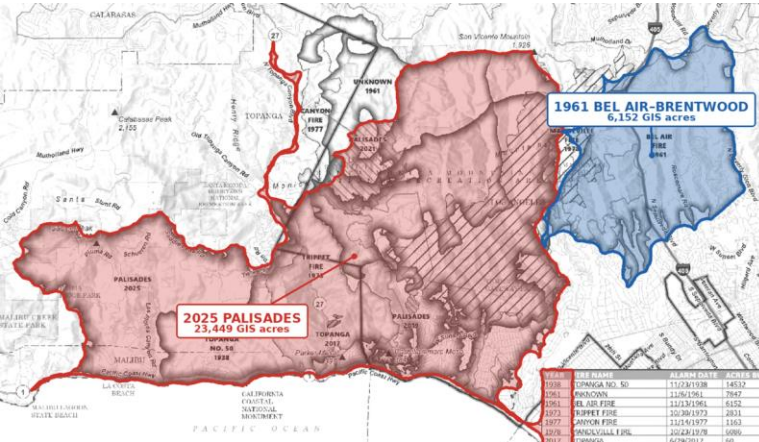
Perimeter locations and size are for relational comparison only.

Measure	1993 Kinneloa Fire	2025 Eaton Fire
Acres burned	5,485 acres (Board of Forestry and Fire Protection)	14,021 acres (CAL FIRE)
Structures destroyed	196 (LACounty Files)	9,419 residential, commercial and other structures (CAL FIRE)
Fatalities	1 direct fatality (Board of Forestry and Fire Protection)	19 civilian fatalities (CAL FIRE)
Duration	6 days — Oct. 27–Nov. 1, 1993 (Wikipedia)	24 days — Jan. 7–31, 2025 (CAL FIRE)
Reported loss, event-year dollars	≈\$58.5 million direct/sustained losses (1993); nearly another \$7 million was spent on suppression	\$8–10 billion (2025) modeled insured property loss (Verisk)
Approx. loss in July 2026 dollars	≈\$135.2 million direct losses	≈\$8.41–10.51 billion



CAL POLY

Past is Prologue Unless we Adapt...



Perimeter locations and size are for relational comparison only.

Measure	1961 Bel Air–Brentwood Fire	2025 Palisades Fire
Acres burned	6,090 acres (LA Fire)	23,448 acres (CAL FIRE)
Structures destroyed	505 — 484 residences + 21 other buildings (LA Fire)	6,845 residential, commercial and other structures (CAL FIRE)
Fatalities	0 (LA Fire)	12 civilian fatalities (CAL FIRE)
Duration	≈2 days — first alarm Nov. 6; containment/effective control by morning Nov. 8 (The Relief)	24 days — Jan. 7–31, 2025 (CAL FIRE)
Reported loss, event-year dollars	>\$30 million (1961) in a later LAFD historical account. The original official LAFD report cautioned that total material damage could not then be fully assessed. (The Relief)	\$20–25 billion (2025) modeled insured property loss (Verisk)
Approx. loss in July 2026 dollars	>\$335 million	\$21.0–26.3 billion



CAL POLY

We've Seen This Movie Before...



<https://www.youtube.com/watch?v=UxnC1WW95XE>



<https://www.pbs.org/video/weathered-after-the-la-firestorm-elfmgu/>

Let's Design “For Not Disaster; Weathering the Firestorm”

- **Next Webinar: Designing for Neighborhood Resilience**
 - Margot McDonald
 - Assistant Director & Faculty Fellow, Cal Poly WUI FIRE Institute
 - <https://fire.calpoly.edu/people/staff>

Questions?