City & County Engineers of Los Angeles
Resilient Infrastructure

Gean Na, P.E.
ACPA-CA State Director
gna@concretepipe.org

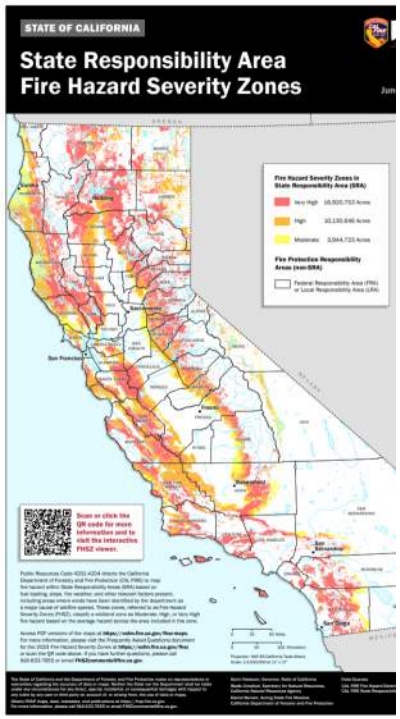
October 5, 2023

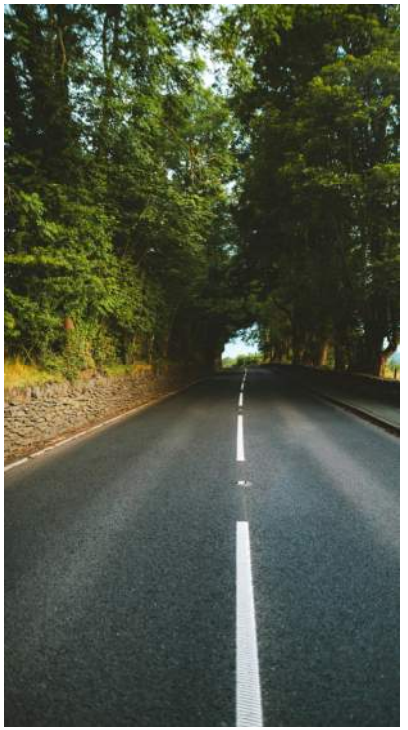
2023 California Wildfire Season

- Meteorologists which predict that in California, 400,000 to 1 million acres will burn.
- 10 Biggest Fires in California history have occurred since 2017
- 2023 Storm delayed the height of the fire season
- 2023 Expected to be similar to 2017 killed, 11,000 destroyed structures

Objective

- Roadways
- Lessons learned from California Wildfires
- Tools for Engineers to select proper material for storm drain infrastructure
- Where the industry is going





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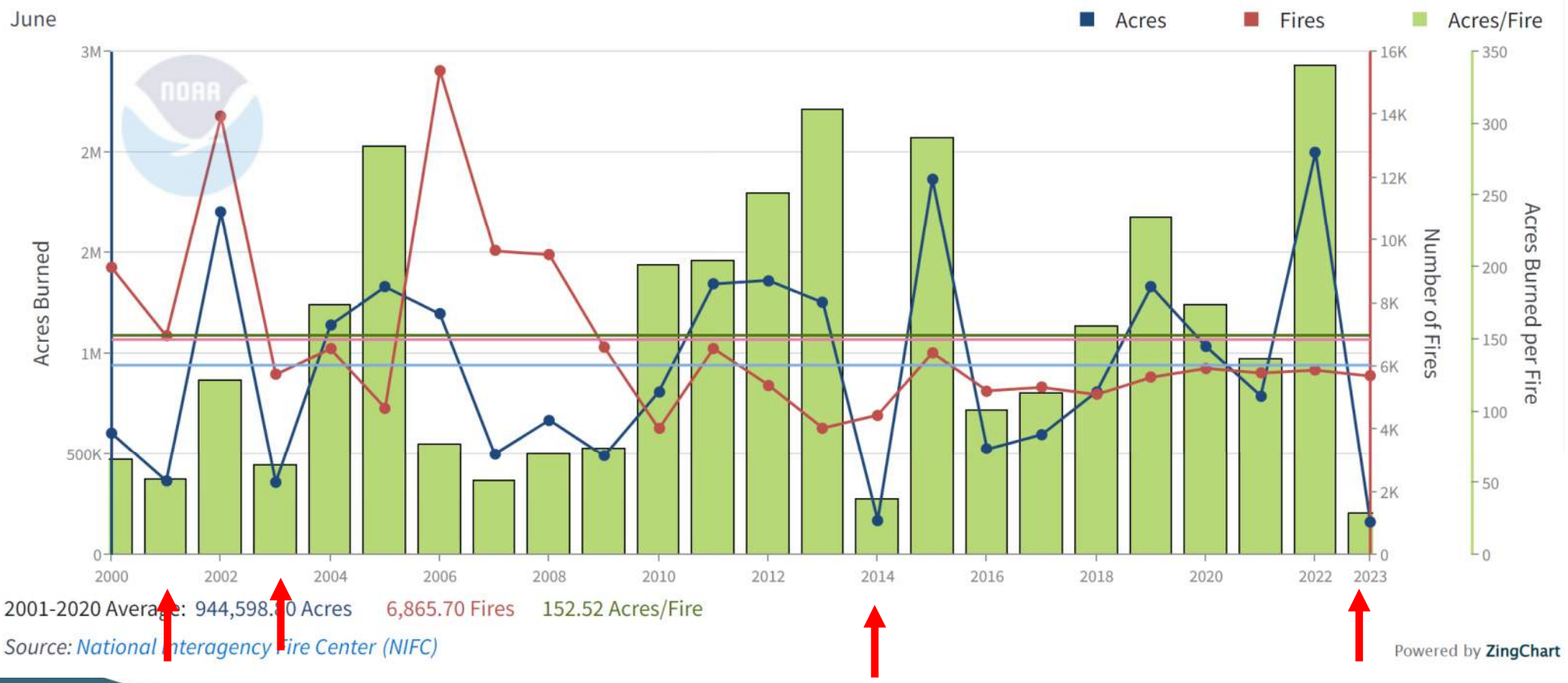
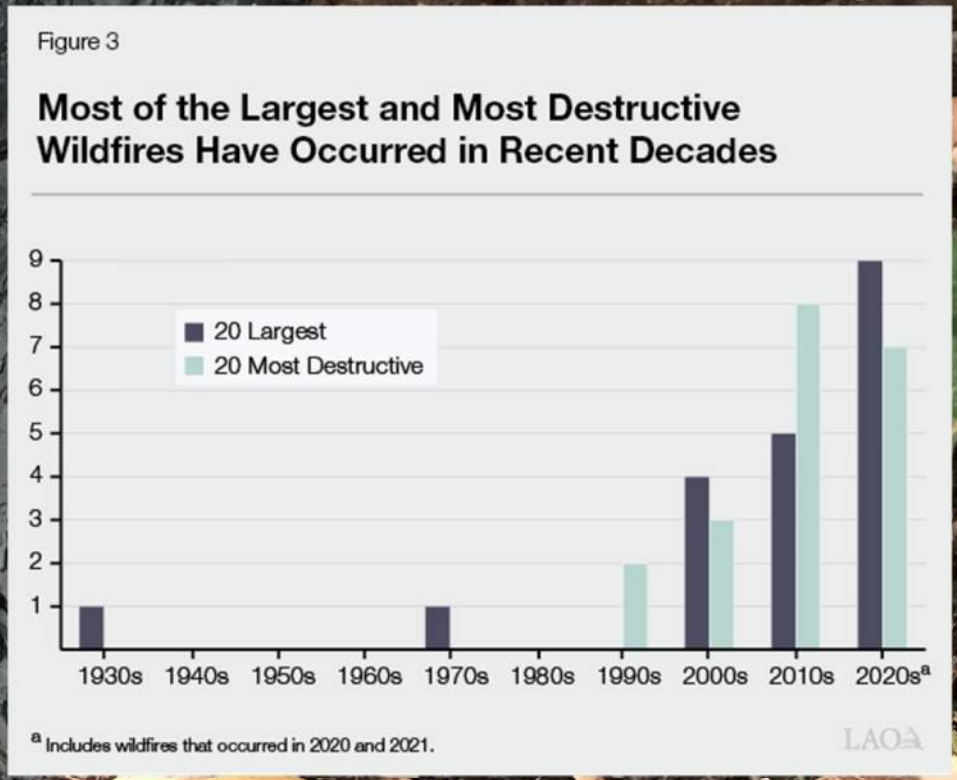
Burned storm drains in Santa Rosa create slide, sinkhole risk

US Wildfires Statistics



California Notable Fires

Notable Fires	Detail
August Complex	1st Largest
Dixie	2nd Largest
Mendocino Creek	3rd Largest
Camp Fire	1st Deadliest
Griffith	2nd Deadliest
Tunnel	3rd Deadliest
Tubs	2nd Destructive, 3rd Deadliest

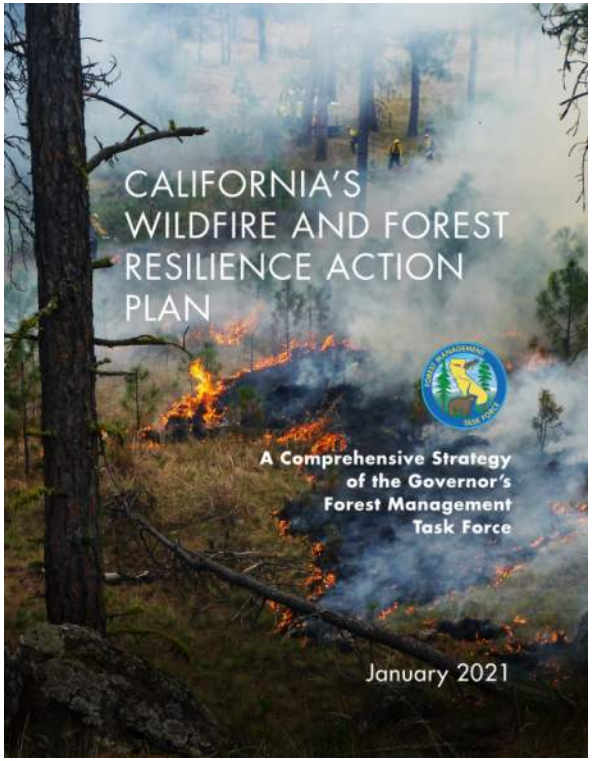


Source: CalFire

Climate Change is a ***Risk*** **Multiplier**

Santa Rosa, California, 2017

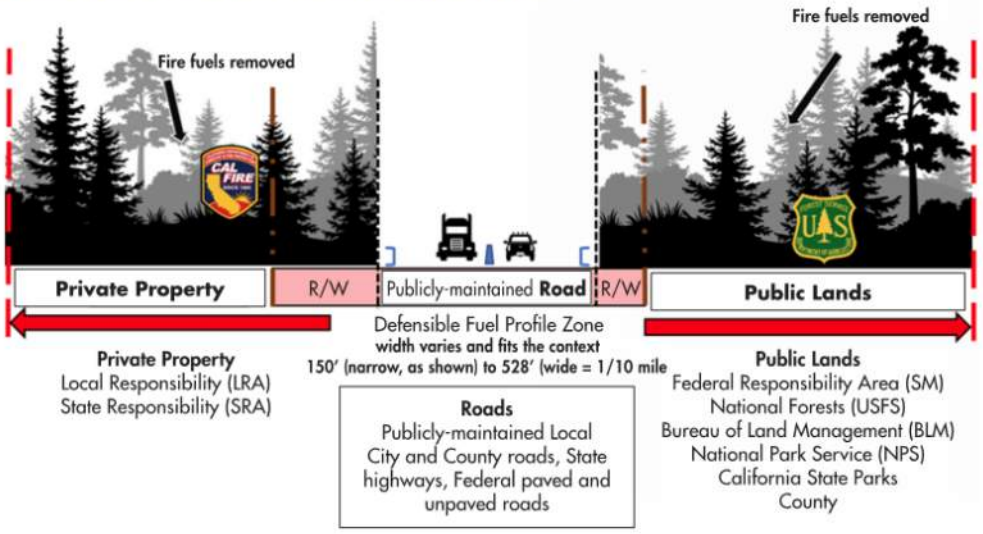
Create Fire-Safe Roadways



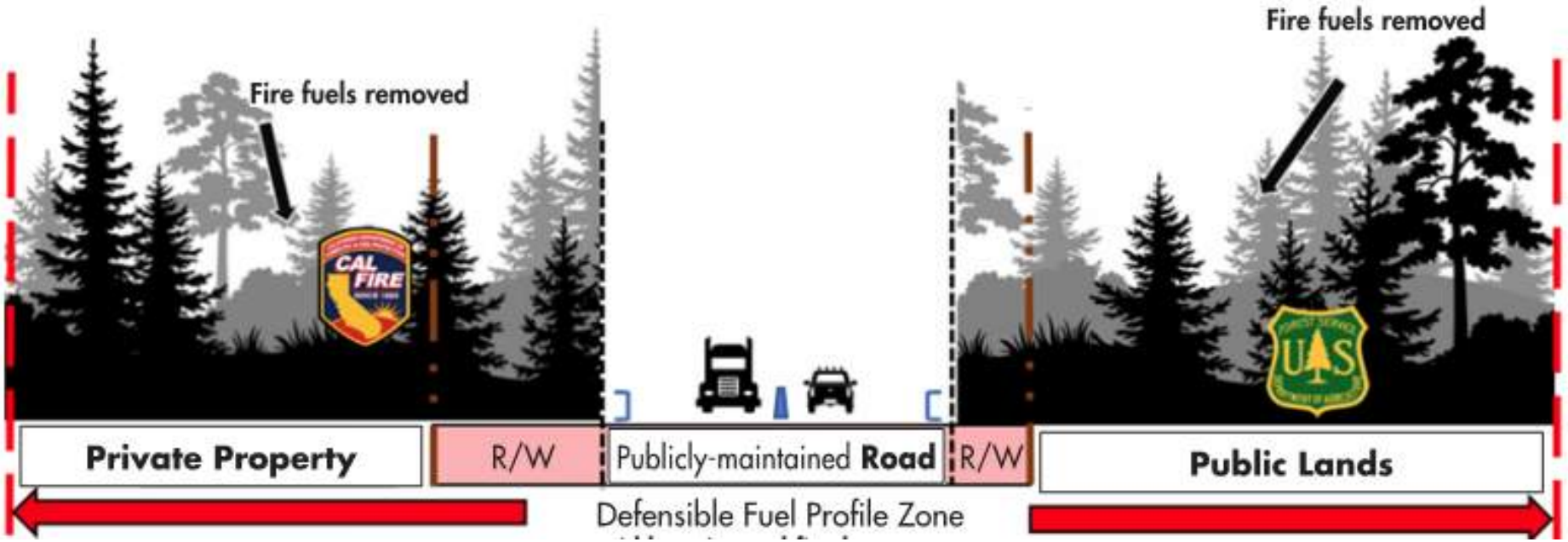
Create Fire-Safe Roadways

A fire-safe state highway system is vital to reducing wildfire ignitions and ensuring emergency evacuation routes. According to the California Department of Transportation (Caltrans), 2,600 centerline miles of California's highway system needs defensible space within and alongside the Caltrans-owned right of way.

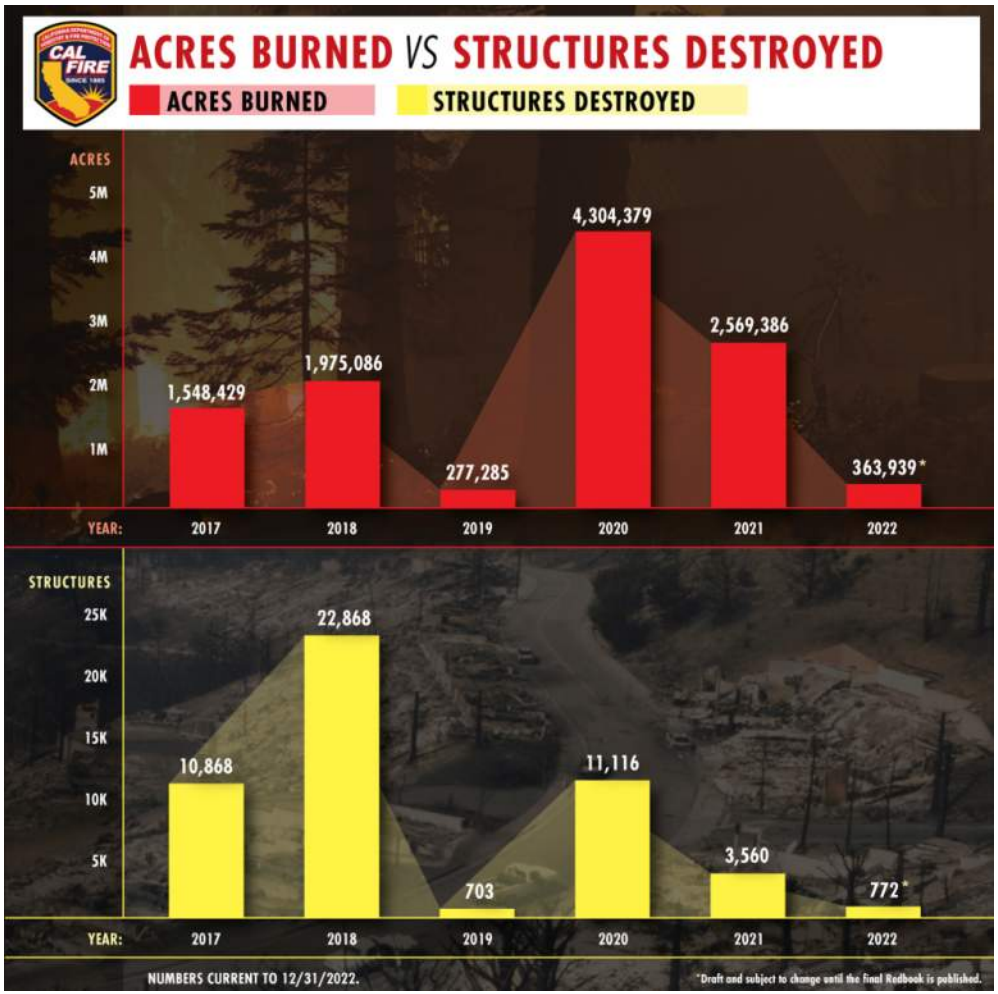
Figure 4: Public roads with "defensible fuel profile zone."



Create Fire-Safe Roadways

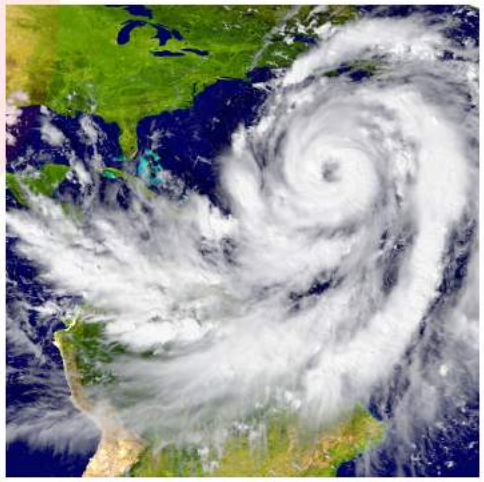


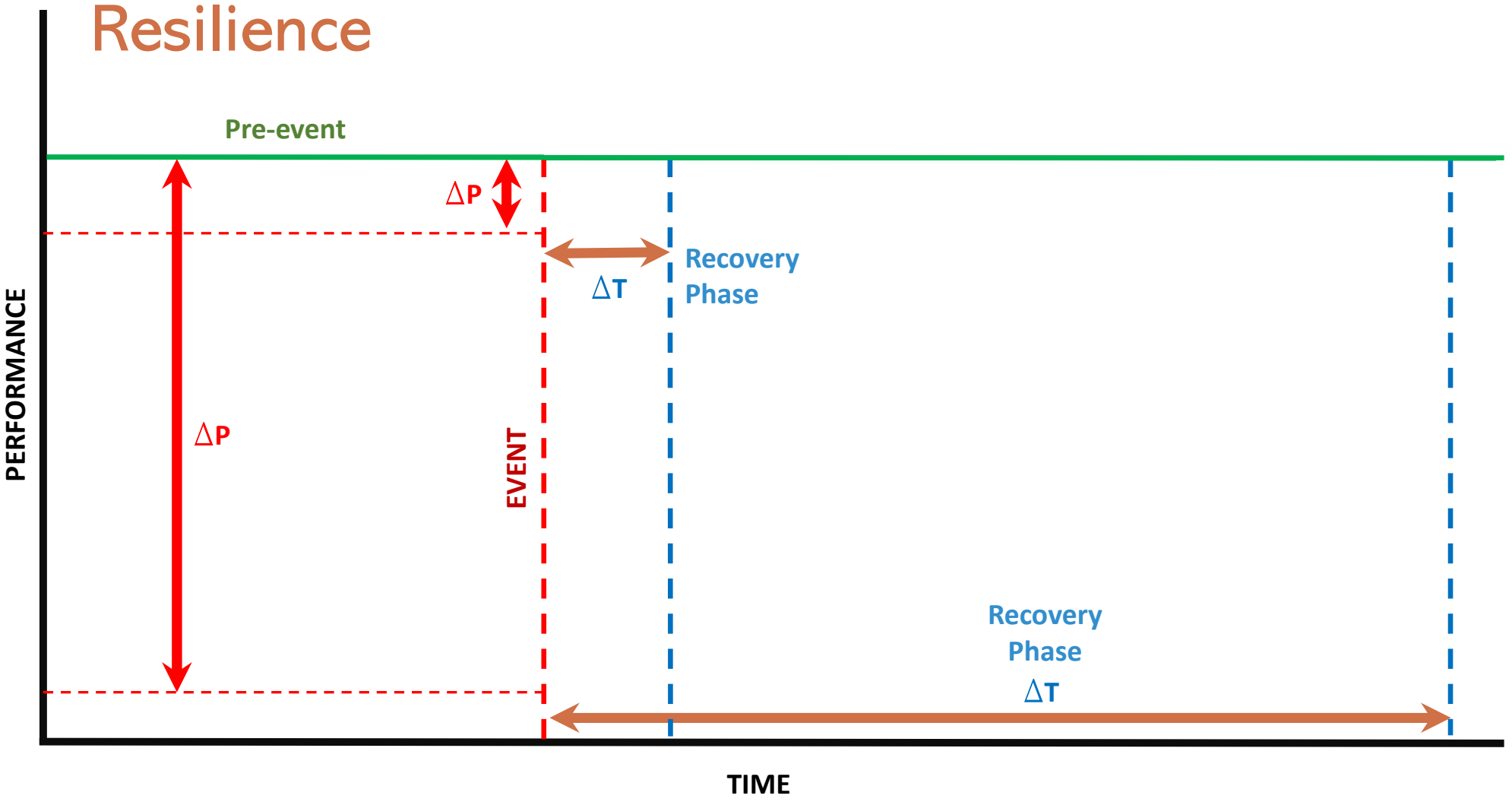
CalFire Acres Burned vs Structures Destroyed



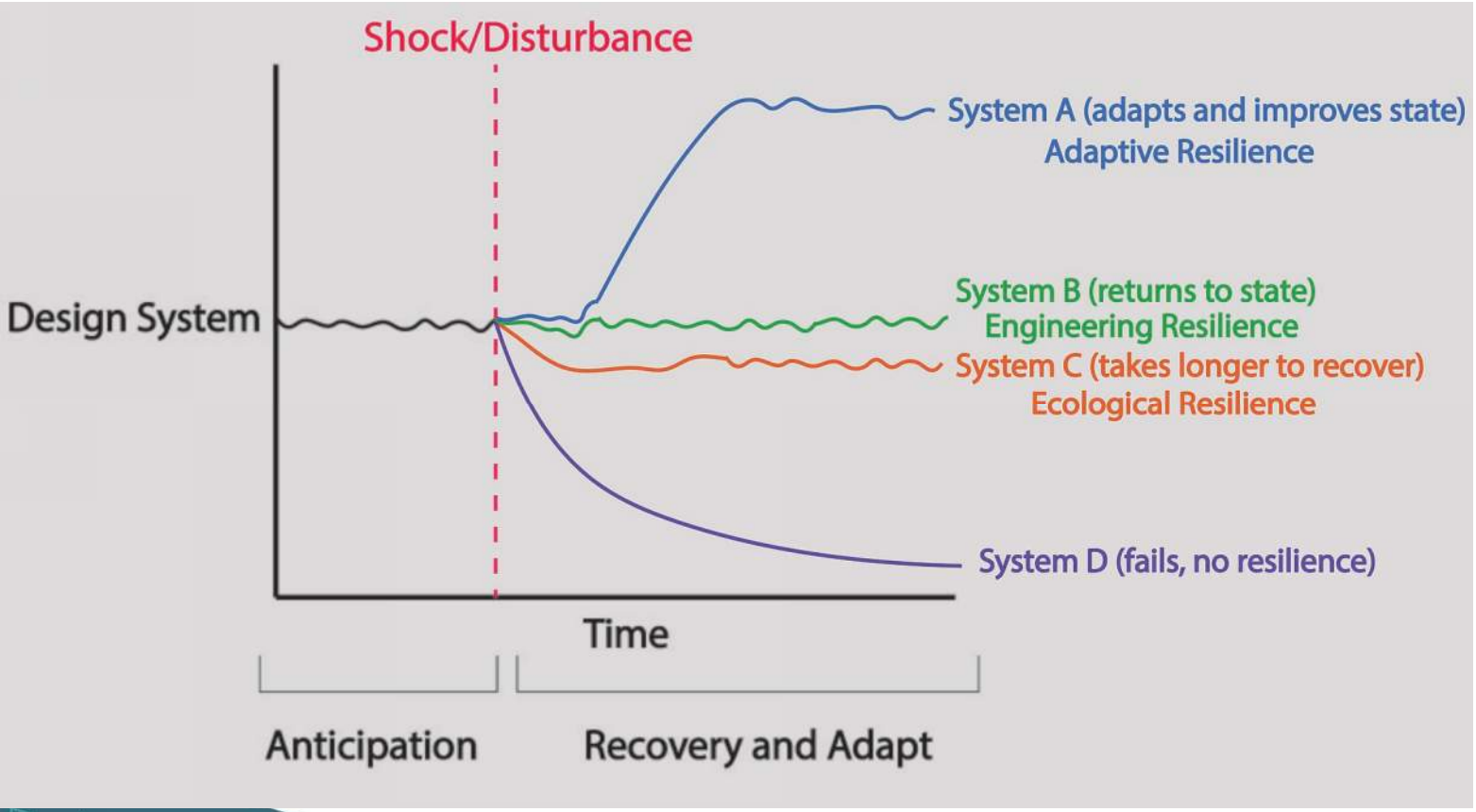
Resilience

ability to:
prepare, plan for, absorb, recover from, or more successfully adapt to adverse events




Resilience
Pre-event
ΔP
ΔT
Recovery
Phase
ΔP
EVENT
Recovery
Phase
ΔT
PERFORMANCE
TIME

Designing Resilience



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Lessons Learned

Saddleridge Fire (Porter Ranch Commercial Development)

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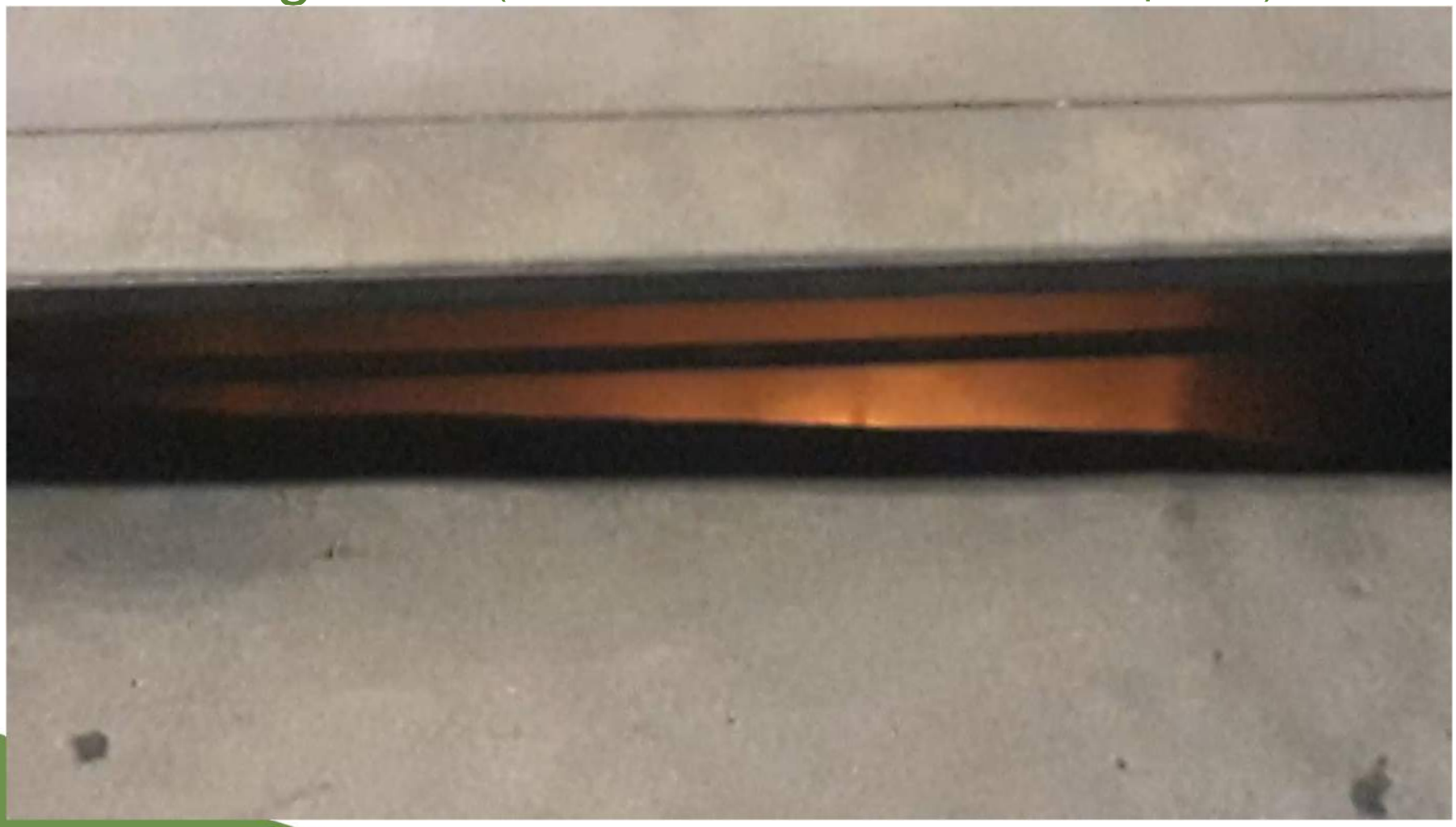

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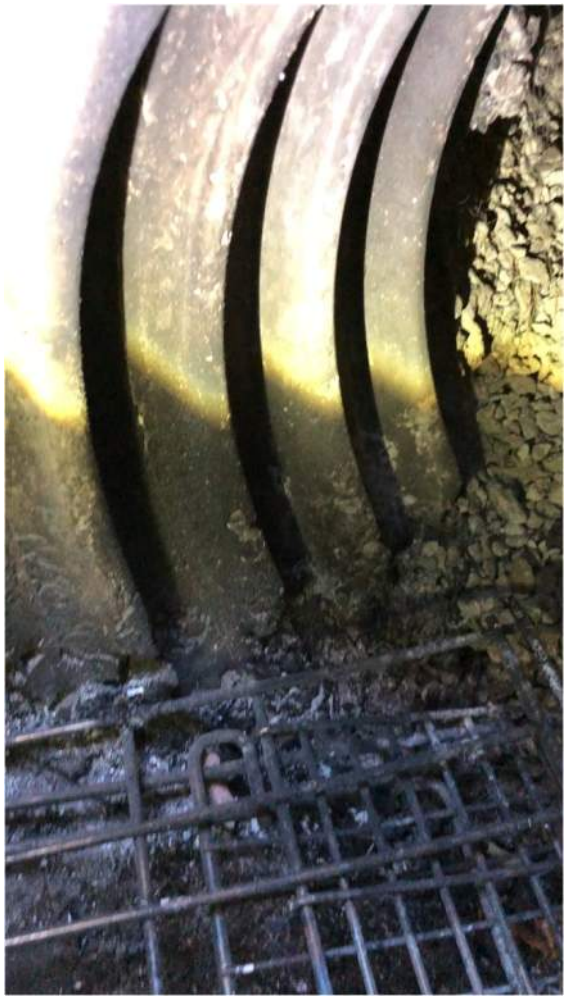
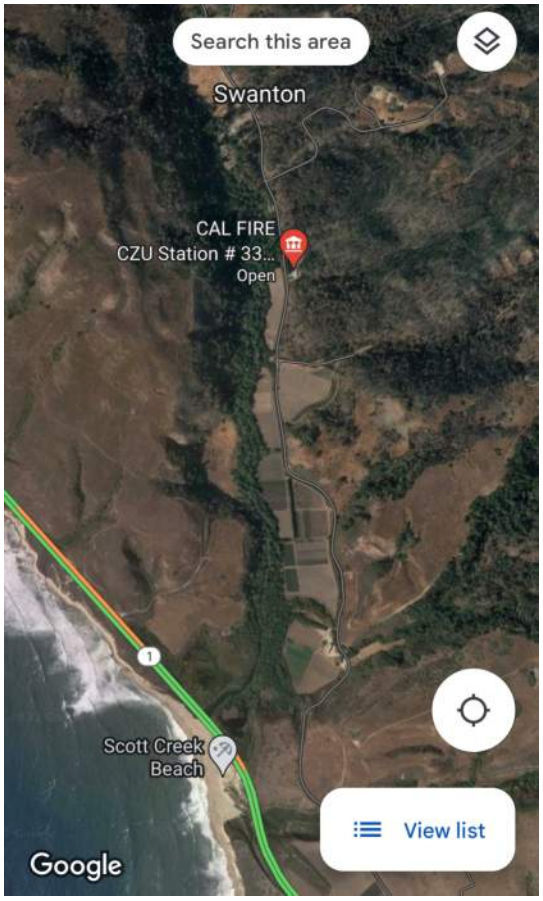


Saddleridge Fire (Porter Ranch Commercial Development)

Silverado Along I-241 (2020)

San Lorenzo Valley Water District

CZU Lightning Complex (Santa Cruz 2020)



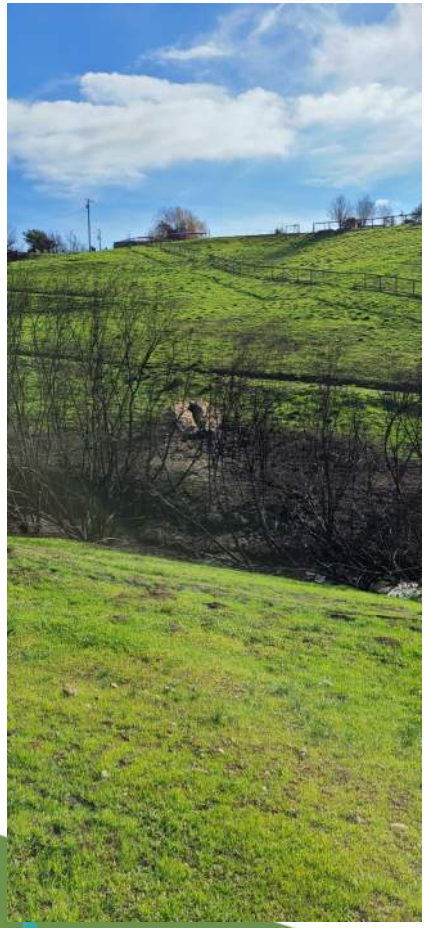
CZU Lightning Complex (Santa Cruz 2020)

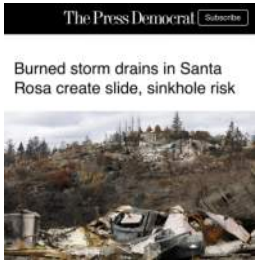
Santa Rosa (2017)

The Press Democrat Subscribe

Burned storm drains in Santa Rosa create slide, sinkhole risk

Santa Rosa (2017)…… 1 year Later





Town of Paradise

Town of Paradise

Town of Paradise

Town of Paradise – Rebuild 2023

[MATERIALS]
Tools for Engineers to select proper materials

Melting Temperature of Storm Drain Pipe

Average Wildfire Temperature: 1,472° F

Plastic Pipe

267º F

Metal Pipe

Steel 2,500 º F

Aluminum 1221 º F

(Bitumen at 400 º F)

Concrete Pipe

No Melting Point (but spalling could occur with continuous exposure)

Source: Plastic Solutions, Inc., Pacific Corrugated Pipe Company, LLC.

Plant Test – Concrete vs Plastic

Agency Recommendations

Caltrans
Highway Design Manual
Chapter 850 – Physical Stangards

City of Los Angeles
Structural Design
Manual Part-H

F. Storm Drains

The use of plastic pipe for storm drains present special considerations for the designer.

1. Plastic pipe is combustible and should be protected where fire is likely. Access to the pipe should be restricted with grates or bars to prevent vandalism and arson. Other devices include inlet/outlet structures of reinforced concrete which also extend several diameters into the pipe to protect the plastic pipe during brush fires.

extinguish if the source of the fire is eliminated (i.e., if the grass or brush is consumed or removed) while HDPE and PP can continue to burn as long as an adequate oxygen supply is present. Based on testing performed by Florida DOT, this rate of burning is fairly slow, and often self extinguished if the airflow was inhibited (i.e., pipe not aligned with prevailing wind or ends sheltered from air flow).

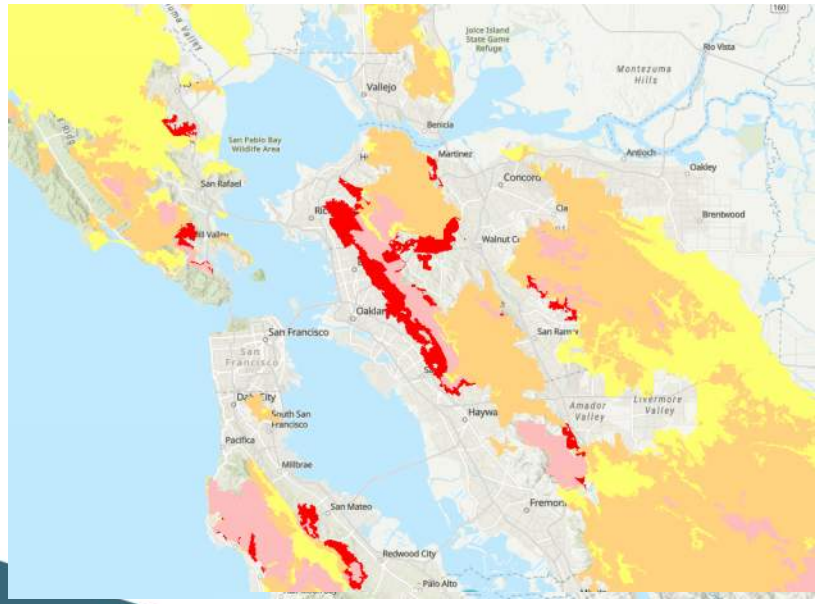
Due to the potential for fire damage, plastic pipe is not recommended for overside drain locations where there is high fire potential (large amounts of brush or grass or areas with a history of fire) and where the overside drain is placed or anchored on top of the slope.

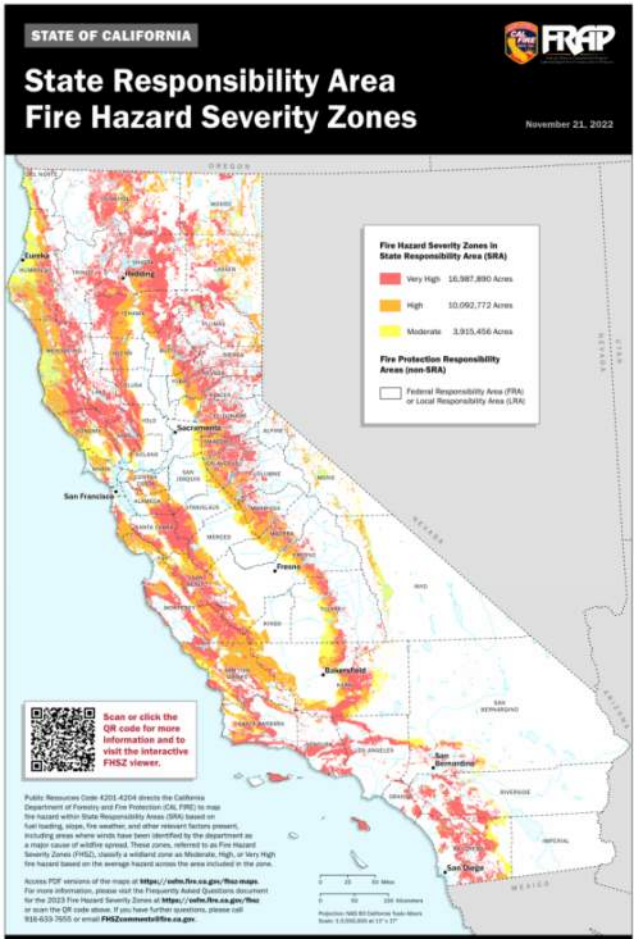
Where similar high fire potential conditions exist for cross culverts, the designer may consider limiting the allowable pipe materials indicated on the alternative pipe listing to non-flammable material types, use concrete endwalls that eliminate exposure of the pipe ends, or require that the end of flammable pipe types be replaced with a length of non-flammable pipe material.

Design Resources

Resources:

- CalFire Maps
- GIS Maps
  - Website: calfire-forestry.maps.arcgis.com





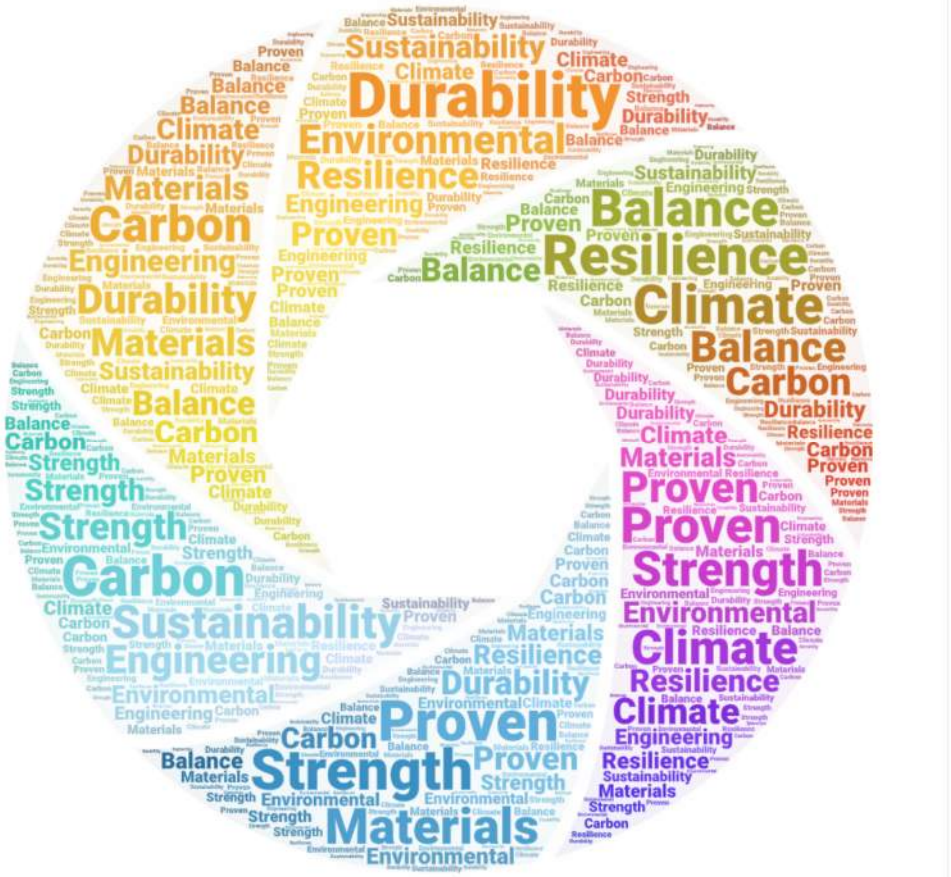
Resilience Based Design of Infrastructure - ASTM

1. The Guide for Climate Resiliency Planning and Strategy (E3032)
2. The Guide for Seismic Risk Assessment of Buildings (E2026)
3. The Practice for Probable Maximum Loss (PML) Evaluations for Earthquake Due-Diligence Assessments (E2557)
4. The Test Method for Water Immersion and Drying for Evaluation of Flood Damage Resistance (E3075)
5. The Practice for Infrastructure Management (E3210)

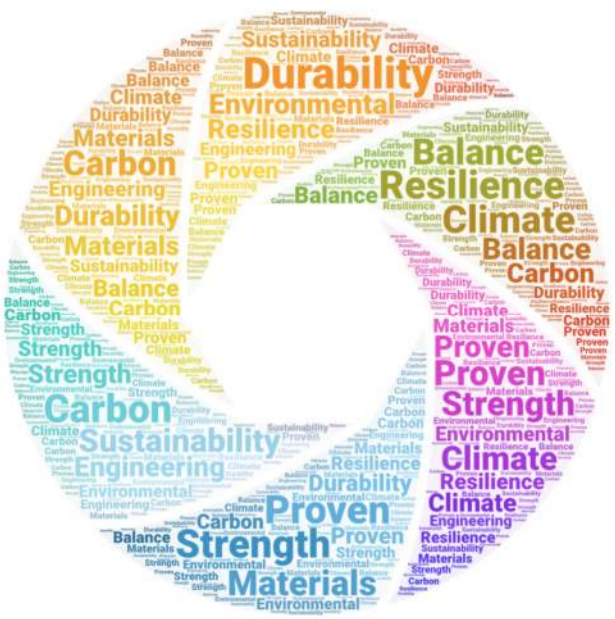
Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Federal Aid Program

PROTECT's purpose is to help make surface transportation more resilient to natural hazards, including climate change, sea level rise, flooding, extreme weather events, and other natural disasters through support of planning activities, resilience improvements, community resilience and evacuation routes, and at-risk coastal infrastructure.

Challenges


Sustainability
Durability
Environmental
Resilience
Balance
Climate
Carbon
Materials
Engineering
Proven
Strength

Thank You



Gean Na
gna@concretepipe.org
(714) 932-1663