Advising Fire Adapted Communities With Recent Fire Science

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Forest Products Laboratory

Observable Wildland Fire Hazards and Related Mitigations

- Effects Zone within county of wildfire – Resource protection & prescribed fires
- Smoke Zone within few miles of wildfire – Sensitive population must avoid smoke
- Embers Zone within 1 mile from wildfire – Firewise protected, evacuate, & suppress
- Radiant Zone within wildfire vision view – Managed landscape, evacuate, & suppress
- Flame Zone within wildfire perimeter – Shelter-in-place, and evacuation too risky

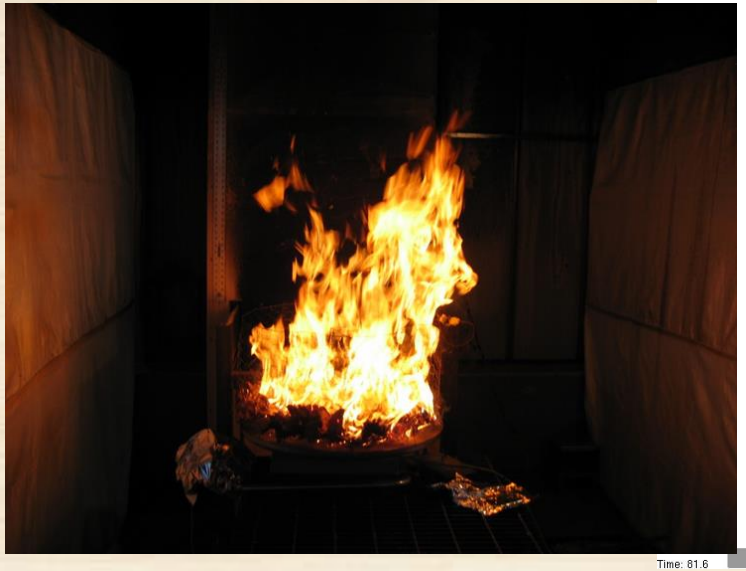
But Fuels is as "Hazard" in IWUIC

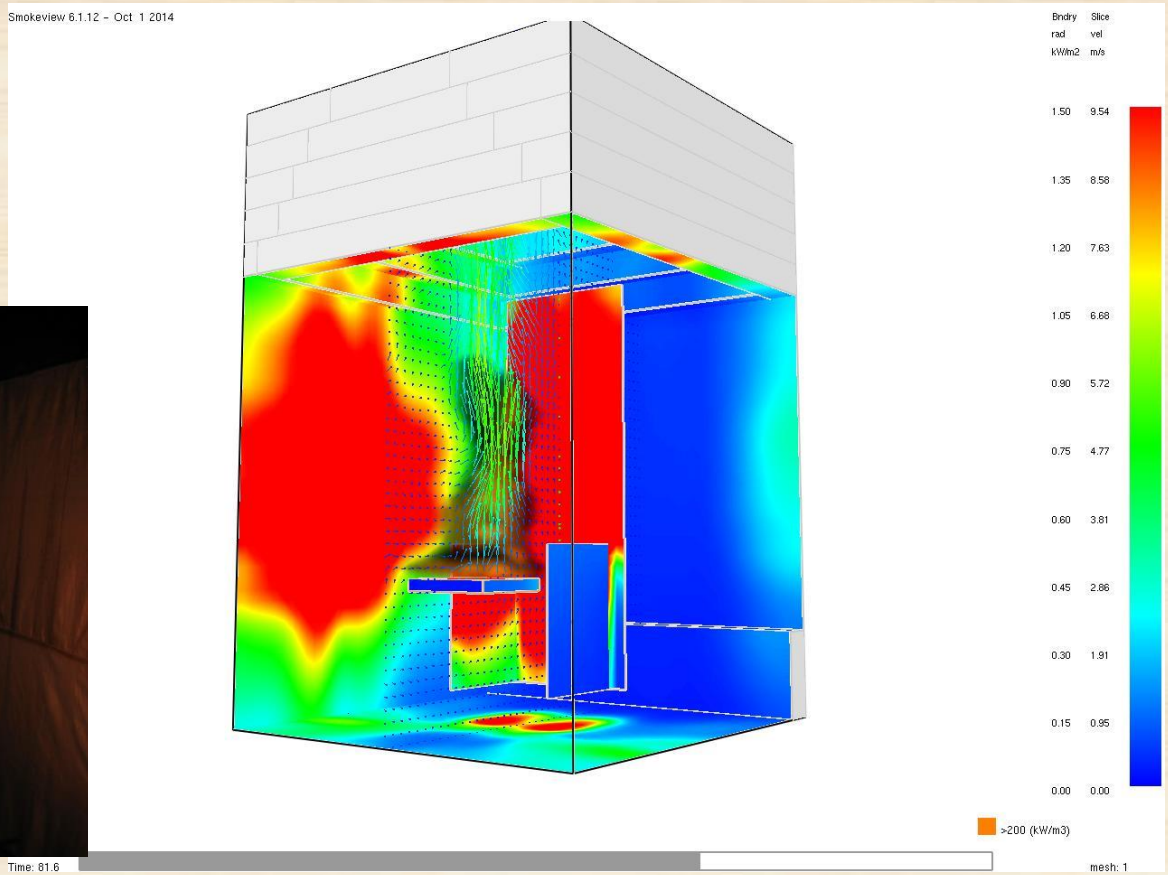
- Executive Order 13728—Wildland-Urban Interface Federal Risk Mitigation, May 18, 2016
- Federal buildings being built with 5000 sq. ft. or more, and is within the WUI zones, should be protected via IWUIC for moderate wildfire risk
- In 2015-IWUIC, fire severity levels are assigned as moderate, high, and severe from subjective evaluation of fuel load, terrain & fire intervals
- Fire severity levels are subjectively reduced with vegetation treatment on the property
- Research is needed to relate wildland fuels to fire hazards to targets-at-risk to risk mitigation

Fire Effects & Smoke Hazard

- "Fire Science Exchange Network" is good resource, and their collaborators
- Science-based tools for Prescribed Fires
  - 10 hour fuel moisture models
  - Meteorological forecasts
  - Smoke transport forecasts (using WDFSS)
  - Fire behavior (using BEHAVE primarily)
- Burn permits are difficult to obtain, and so still need better fire science tools
- FPL is on forefront with FS ecologists to model all stages of prescribed fires

Litter Burn under FPL's HRR Hood and FDS as example of FPL capabilities





Science of Wildfire Embers Hazard

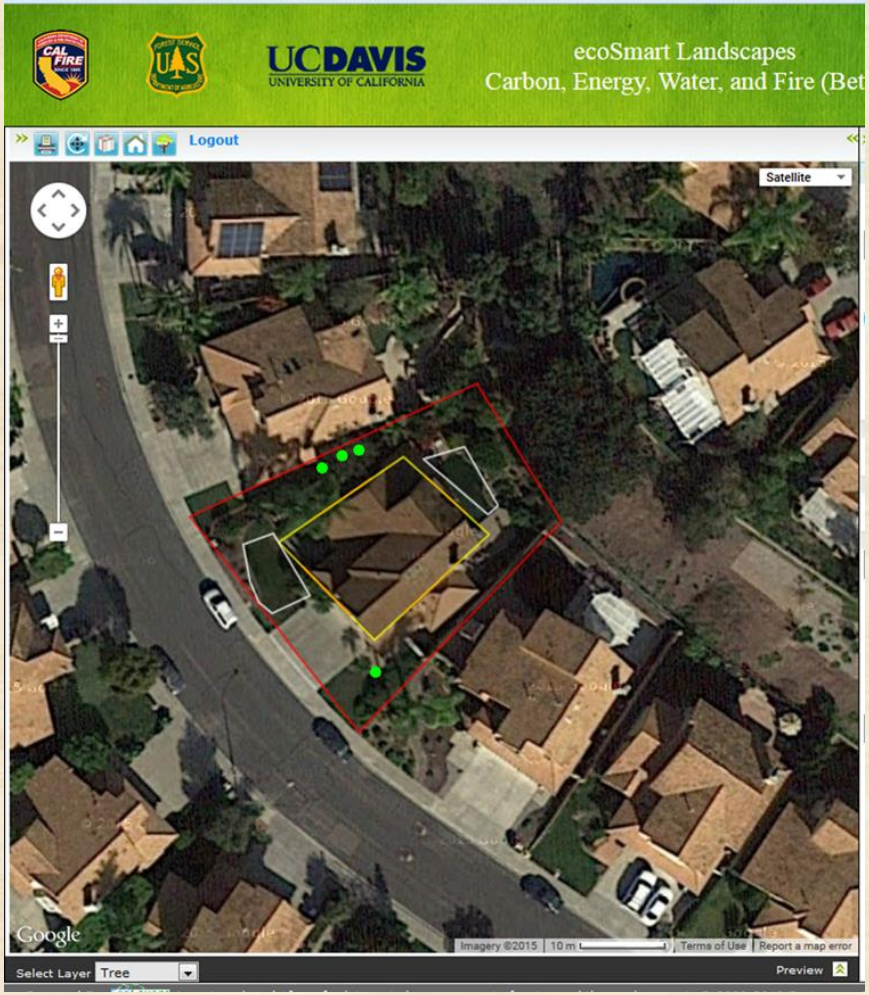
- "~80-90% of houses were destroyed in the absence of direct radiant heat and flame from the fire front" from Leonard (2005) describing Australian bushfires
- Avoidance of embers as a mitigation tool could then be achieved with very conservative fuel treatments
- NIST ember generator and embers target effects
- IBHS full scale work on whole houses exposed to typical ember showers determined effective structure modifications instead of fuel treatments
- FPL research on wood decking subjected to ember hazard indicate exterior walls need protection
- Results into NFPA 1144, IWUIC and Firewise USA

Science of Wildfire Radiation Hazard

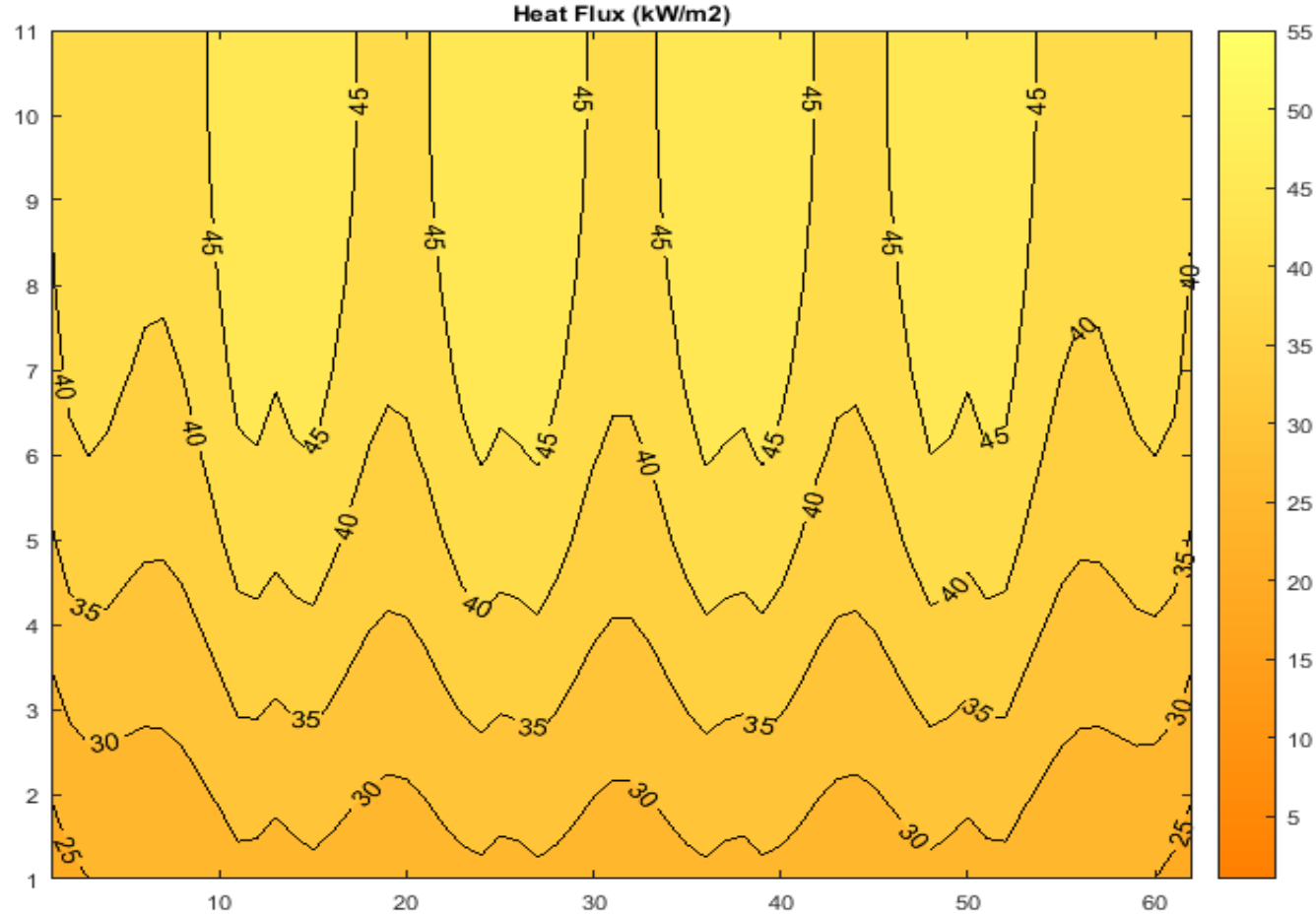
- NFPA 1144 - "Tree crowns within the structure ignition zone shall be spaced to prevent structure ignition from radiant heat"
- Structural Ignition Assessment Model (SIAM) – developed at FPL by Hao Tran & Jack Cohen in the 1980s, now outdated
- ecoSmart Fire Model – developed at FPL by Mark Dietenberger and Charles Boardman, superseding SIAM by calculating for discrete fuels, terrain, target response, and mitigation actions
- Wildland Fire Dynamic Simulator (WFDS) – Only useful to researchers and Mark Dietenberger is involved with vegetation combustion fundamentals

Many ecoSmart Fire Model Features

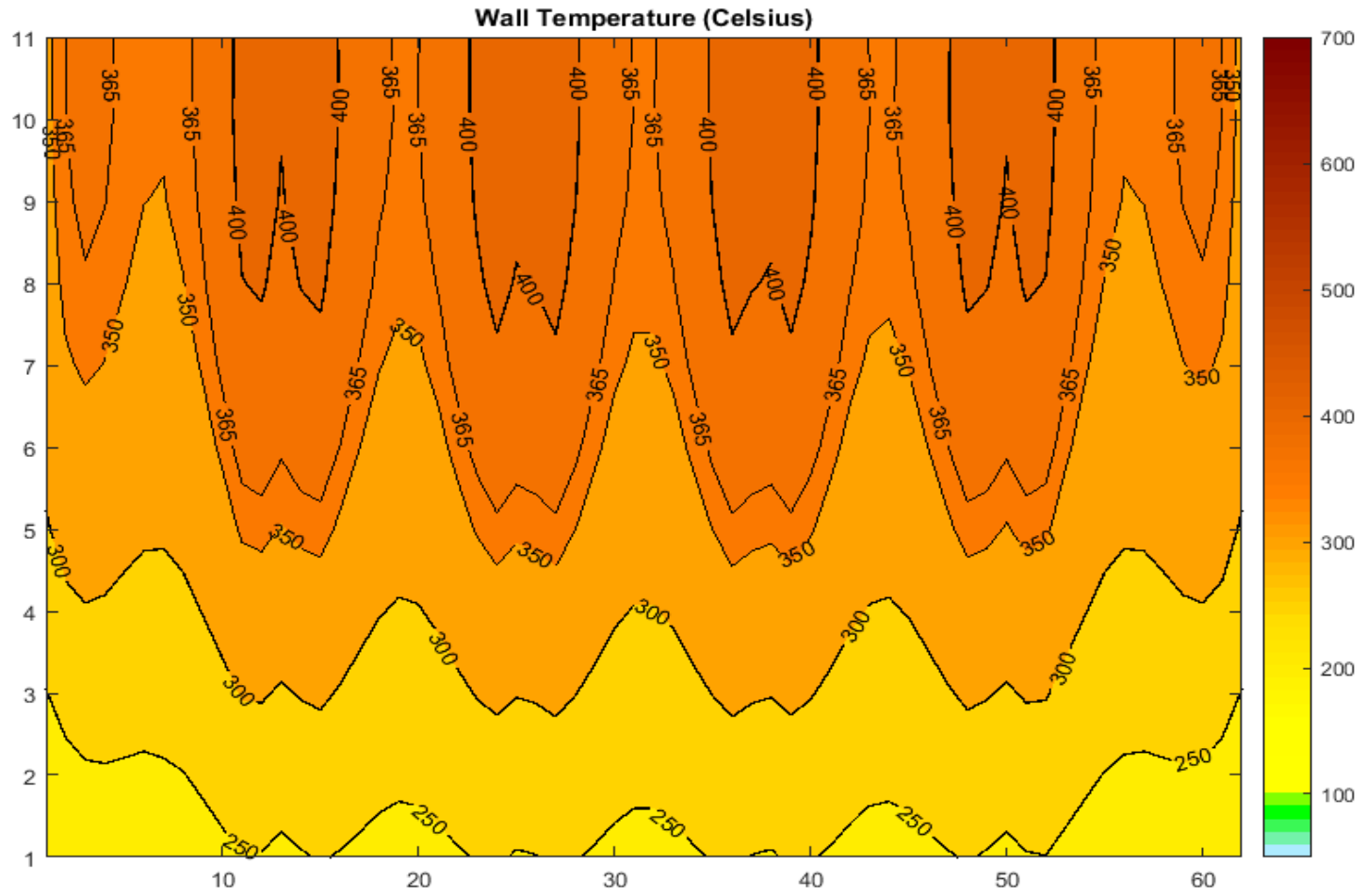
- Physical based model with many surface elements
- Landscaping with Google Earth Map
- Trees Positioning and Trimmings
- Fire Resistant Cladding
- Radiation Blocking with Fences
- Ground Coverings Radiation Reflections
- Flame Attenuation by Burning Trees



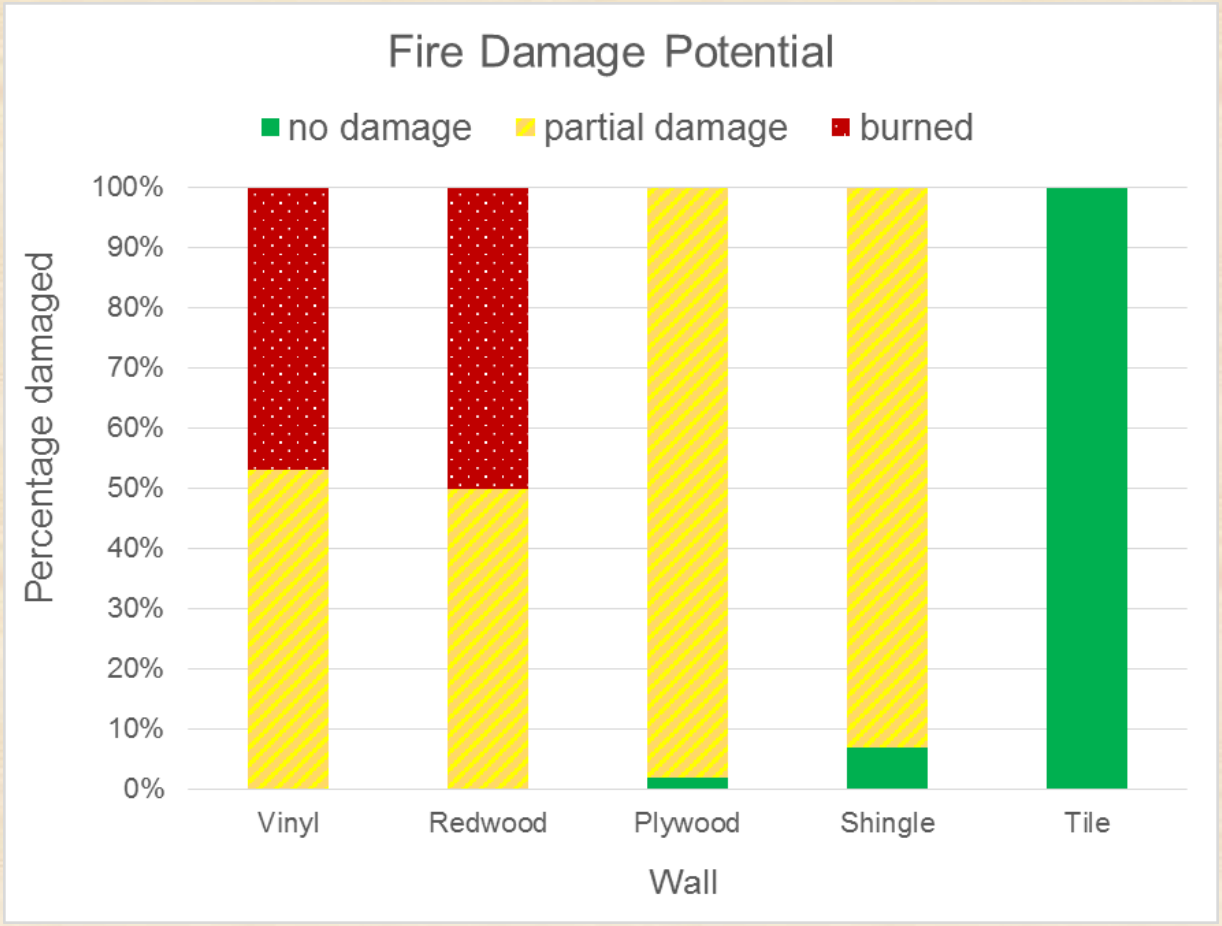
Fluxes of 6Tree Fires Along Wall #1 Using the ecoSmartFire on PC



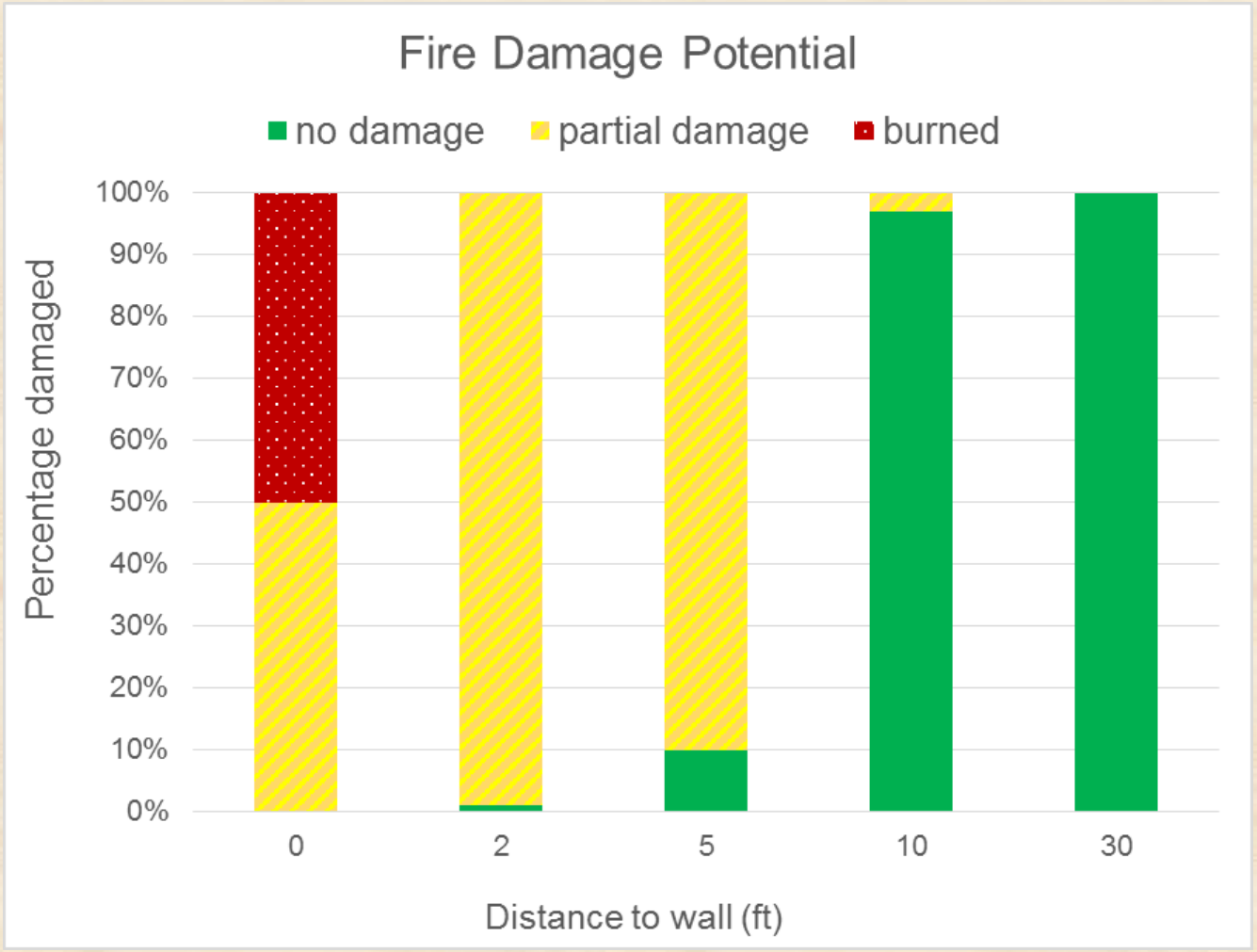
SurfaceTemperatures after 28 s Burn Time on Redwood Siding



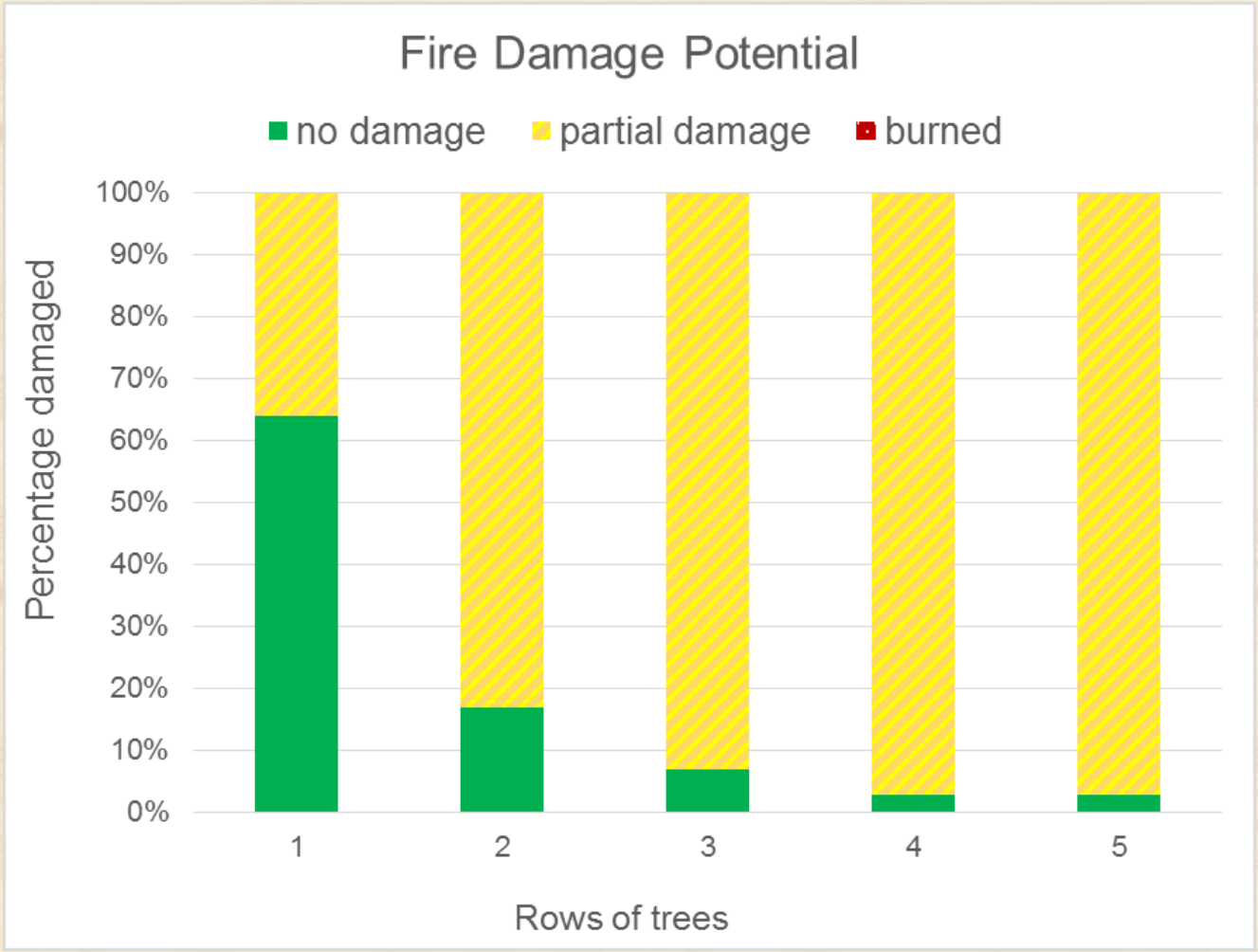
Summary for 5 Cladding Materials Responding to 6 Close-up Tree Fires



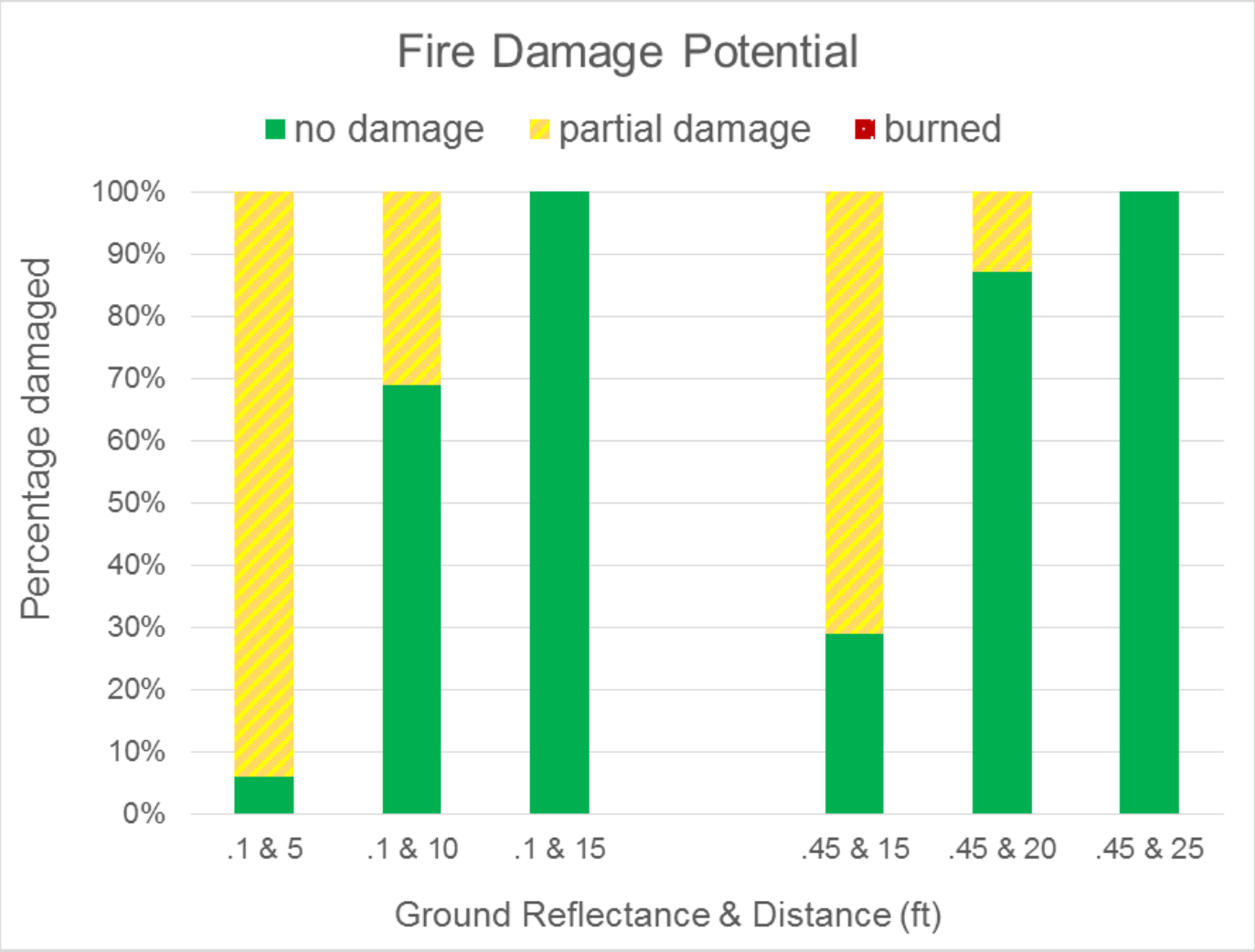
Improve Redwood Fire Damage Potential by Moving Fires Away From Wall #1



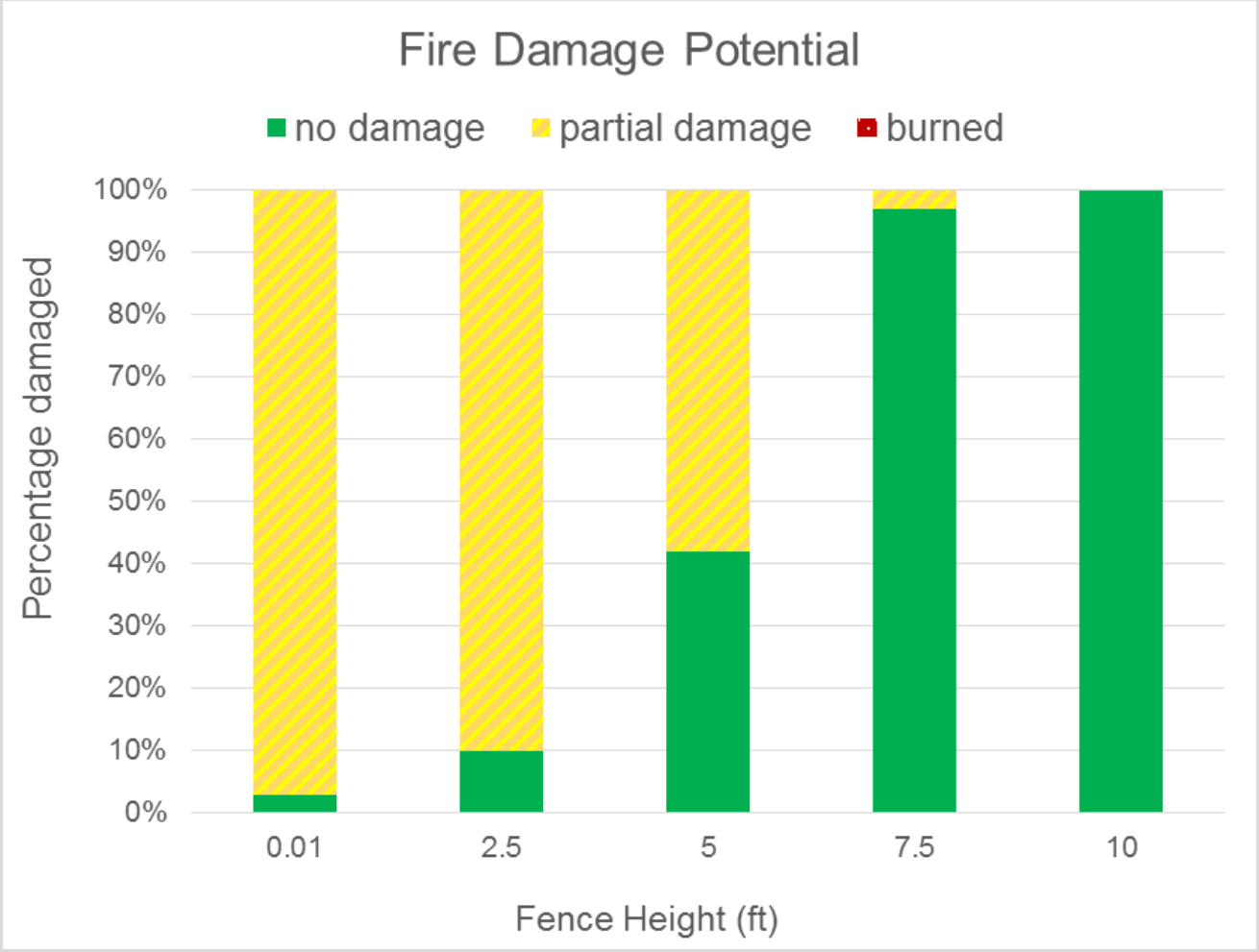
Worsening Damage with Number of Rows of Tree Fires at 10 ft from Wall #1



Effects of Ground Covering and of 30 Tree Fires Spacing on Wall Damage



Increasing Fence Heights for Reducing Damage on Wall #1 from 30 Tree Fires

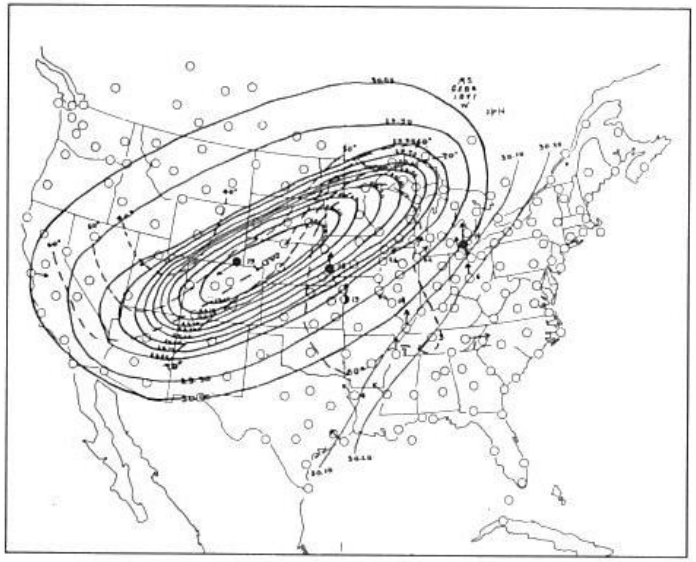


Fire Adapted Possibilities

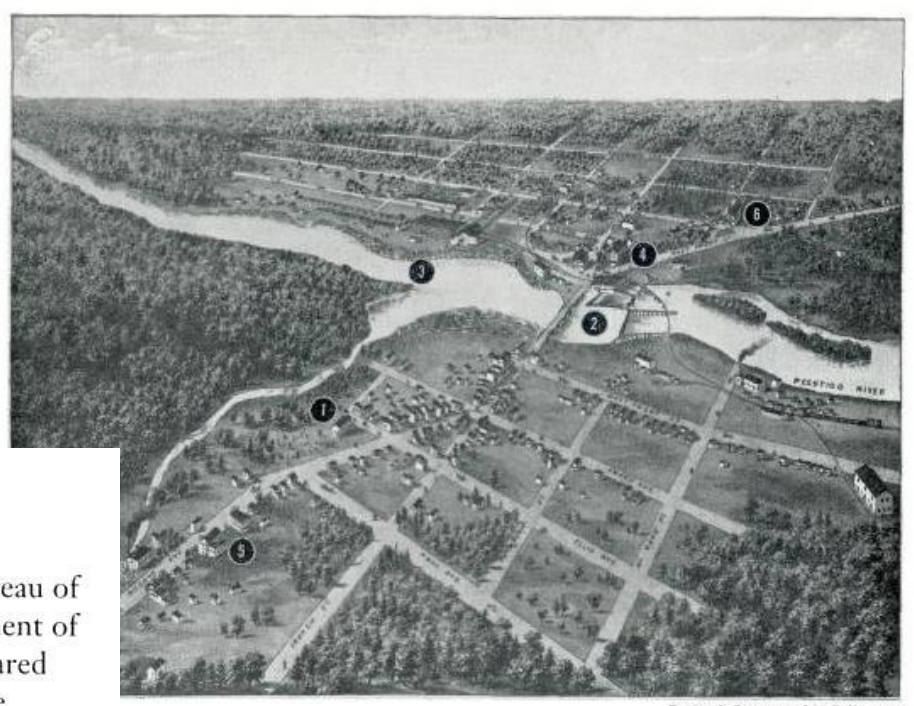
- Structure Protection is Only From Embers Threat (IBHS house tests)
- Amorphous Defense Zones is Possible
- Selections of Cladding is Possible
- Vegetation Spacing is Adjustable
- Fences and Ground Cover is Effective
- Any Vegetation Type is Workable
- More Features Added with CS Help

Science of Wildfire Flame Hazard – Peshtigo Firestorm 1871 Facts

- Drought & strong winds
- Many managed burns
- Good fuel clearance
- 1.2 million acre - Megafire



The Weather Bureau of the U.S. Department of Agriculture prepared this map using the reports made by U.S. Army Signal Corps observers at 5:35 P.M. Central Standard Time, October 8, 1871. (*Courtesy Wisconsin Historical Society*)



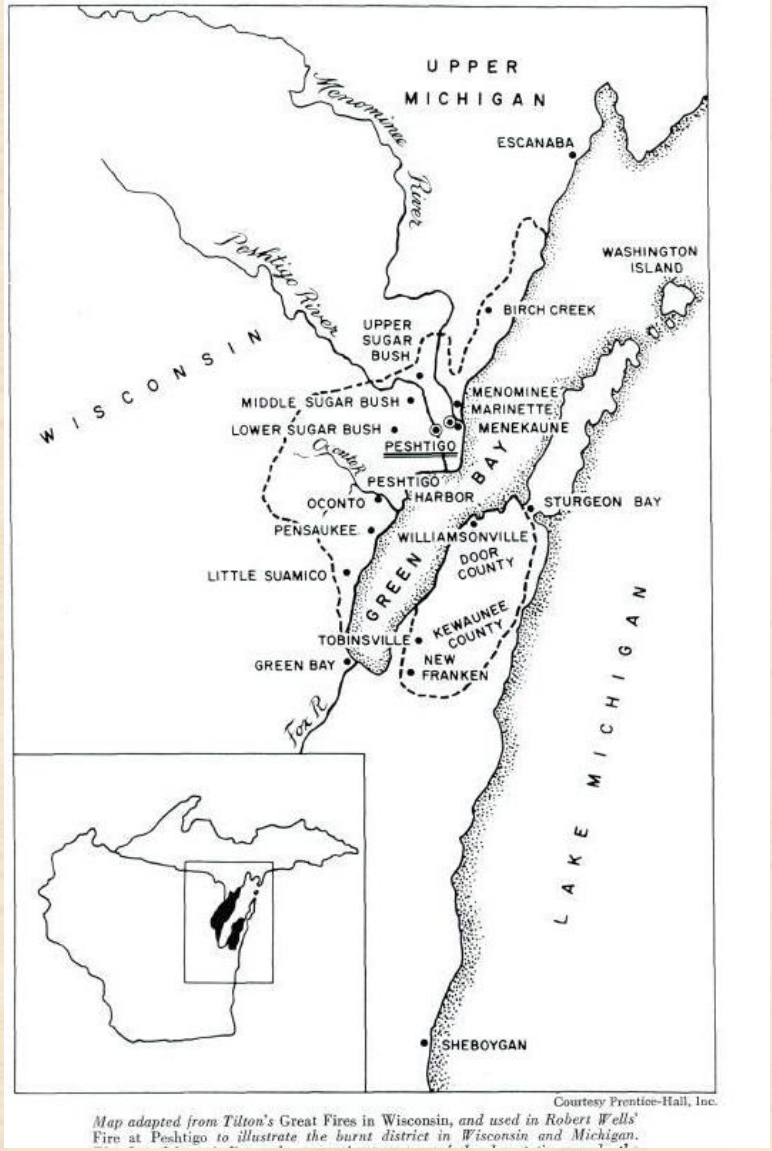
Society's Iconographic Collections

Bird's-eye view of Peshtigo as it appeared in 1871 shortly before its destruction.

"Firestorm at Peshtigo"
Gess & Lutz, 2002, NY

Educated Witnesses Fire Reports

- Fire tornado lifted home
- Embers exploded gas clouds
- Trees continued to burn after twigs and foliage burnt
- Large trees ignited interiorly from smoldering ground
- All houses burnt in village
- Suffocated in root cellars
- ~1200 died in Peshtigo alone
- Fire suppression overwhelmed
- ~ 1 billion trees destroyed

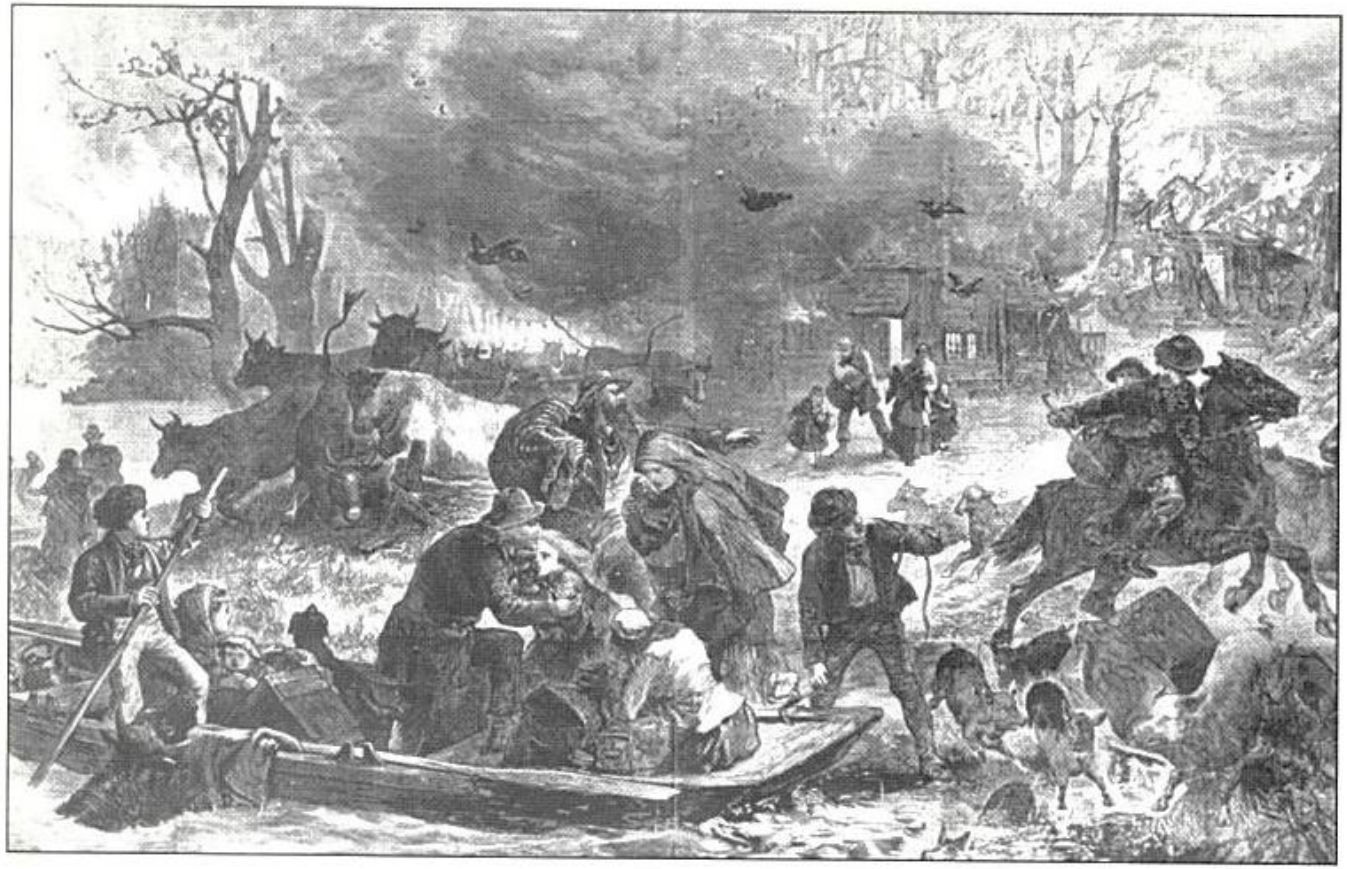


Courtesy Prentice-Hall, Inc.

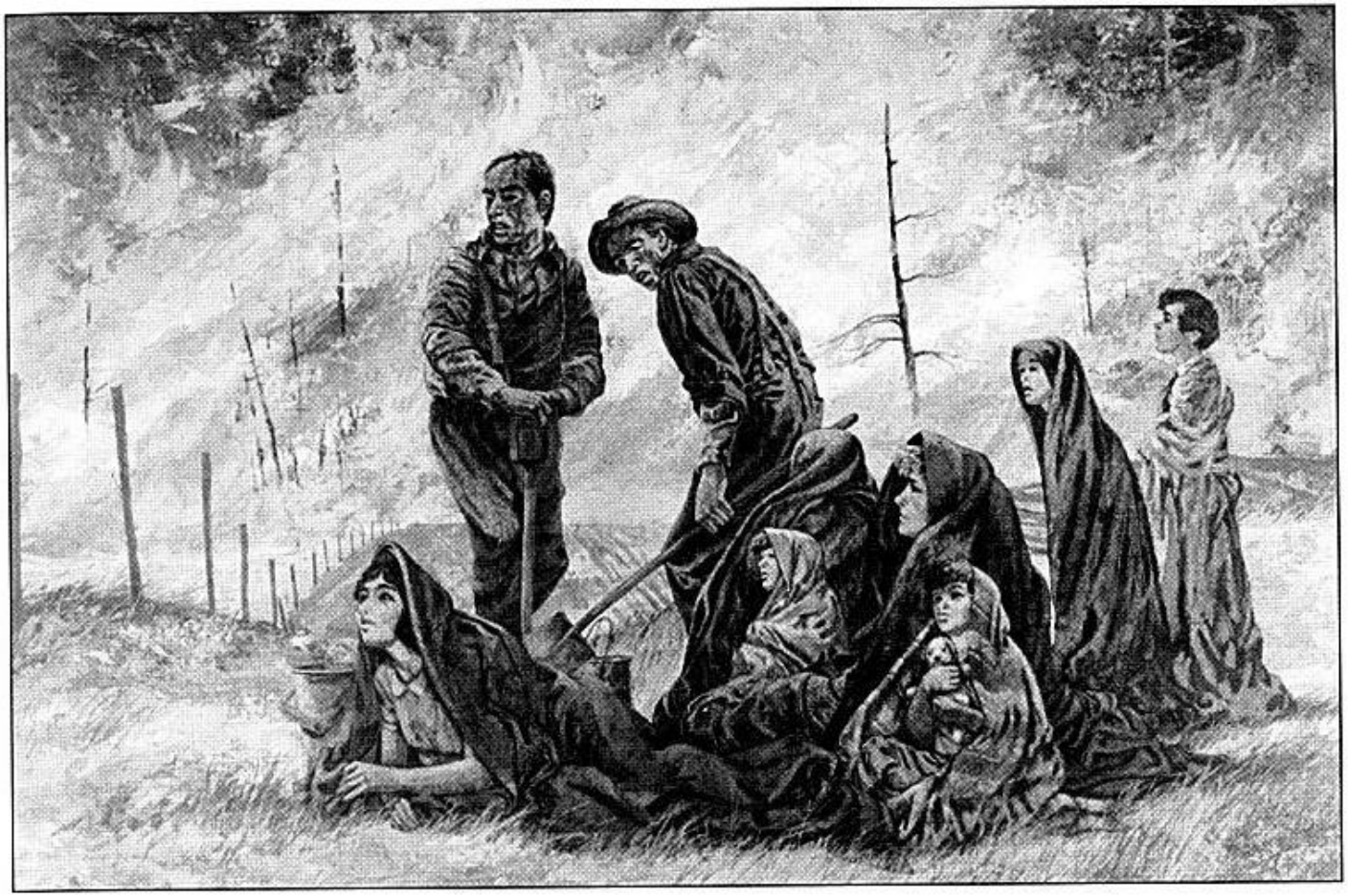
Map adapted from Tilton's Great Fires in Wisconsin, *and used in Robert Wells'* Fire at Peshtigo *to illustrate the burnt district in Wisconsin and Michigan.*

Some survived in Peshtigo River, but

This imaginative drawing of people fleeing to safety in the river appeared in the November 25, 1871, issue of *Harper's Weekly*. (*Courtesy Wisconsin Historical Society*)

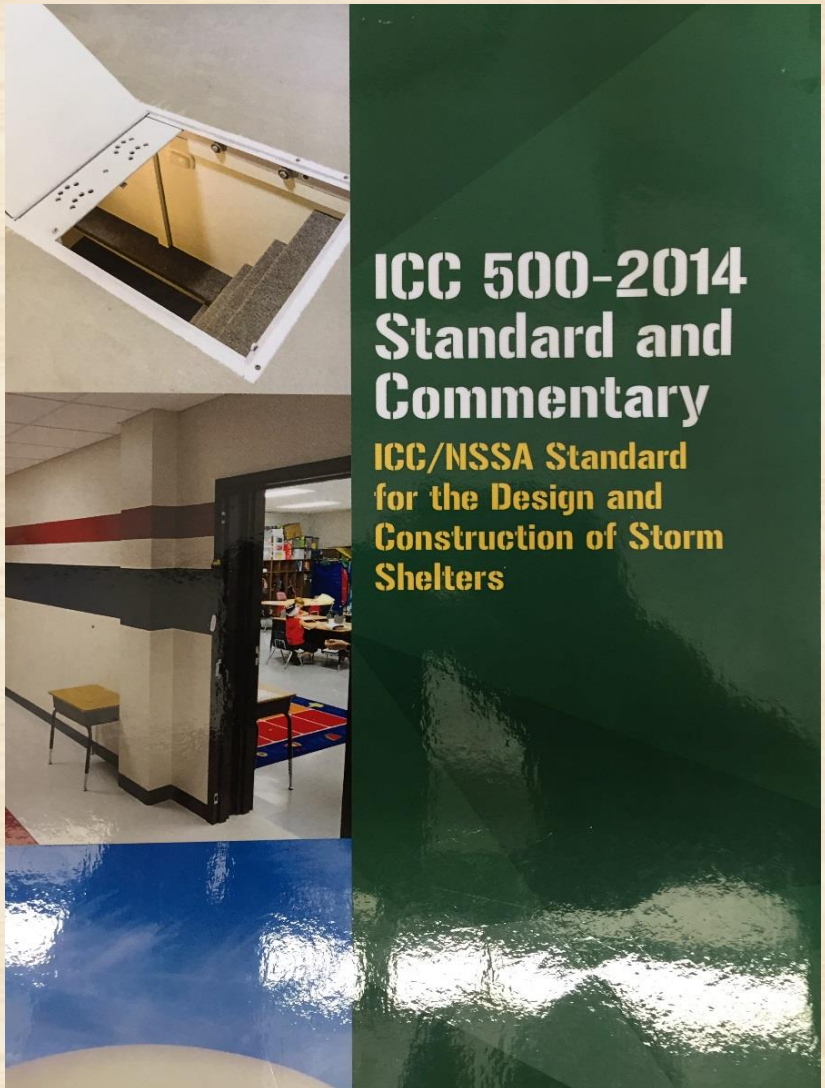


Most Perished in the Open Space…



Many families sought safety in clearings, but the fire was so intense most of them died where they stood. (*Courtesy Wisconsin Historical Society*)

DIY CLT Shelter Research at FPL - Ignition Resistant Construction Class 1 (IWUIC - Also Class A roof and sprinklers)

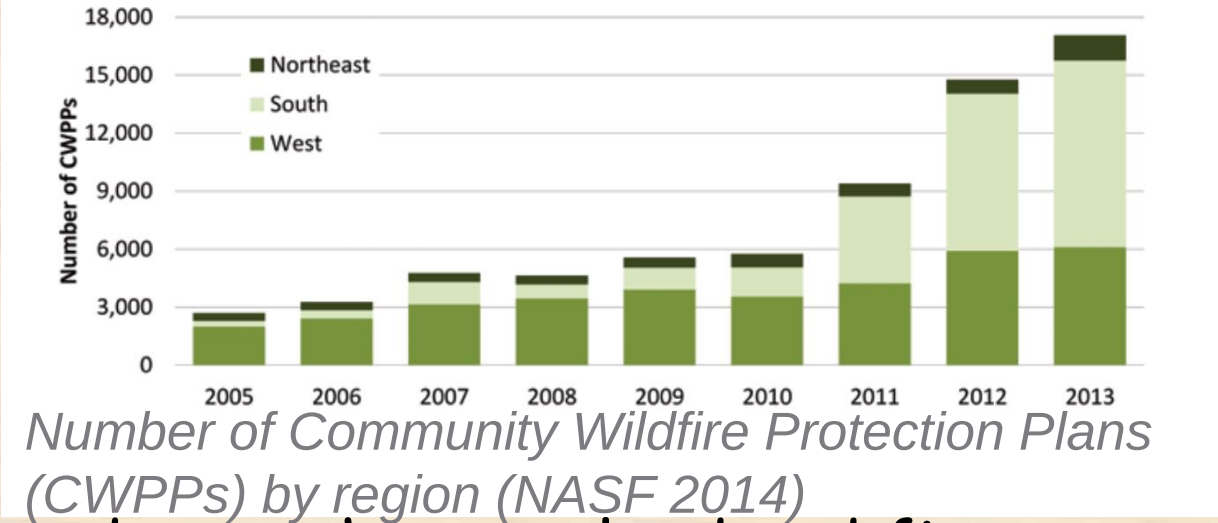


Transferring Science Knowledge

- FEMA provides 6 day training,

"Wildland Urban Interface: Fire-Adapted Communities R0614"

- Fire Adapted Communities Learning Network
- The Wildfire Research Center (WiRe)



Number of Community Wildfire Protection Plans (CWPPs) by region (NASF 2014)

"We need to anchor our land and fire management practices to the bedrock of solid science and research" by Richard McCrea in "Wildfire Magazine, Dec. 2017"

Thank You!

FPL website for publications:

https://www.fpl.fs.fed.us