Effectiveness Monitoring Committee

Completed Research Assessment

Date: Jun 04, 2026

Prepared by: Marjan Ghotbizadeh (SWRCB) and Givonne Law (EBRPD)

Project Number: EMC-2023-002

Project Title: Assessing Fire Hazard, Risk, and Post Fire Recovery for Watercourse and Lake Protection Zones (WLPZ) and Riparian Areas of California

Principal Investigators: David Saah, PhD, and Jason Moghaddas, MS (Spatial Informatics Group)

Final Deliverables Received: December 18, 2025

1. Fulfills and addresses scientific question(s) posed in proposed research?

A. Does the study inform the intended rule, numeric target, performance target, or resource objective?

Yes, the study analyzes fire-effects and impacts on WLPZ and riparian areas that had a variety of past fire treatment, or none, and predicts future fire behavior in these areas. The results inform the Thermal Plan and Basin Plan temperature objectives set by the State and Regional Water Quality Control Boards and enforced through the Forest Practice Rules (FPRs). Specifically, it addresses the resource objective of maintaining cold-water temperatures through canopy shade.

The study found that these numeric targets are at extreme long-term risk if WLPZs are not managed for wildfire resilience, as high-severity fires lead to permanent loss of overstory shade.

B. Does the study inform the Forest Practices Rules?

The results provide a scientific basis for the following rules:

Rules informed:

General Watercourse and Lake Protection Rules (All Districts):

- **14 CCR §§ 916.2, 936.2, 956.2 [Protection of the Beneficial Uses of Water and Riparian Functions]:** The study informs these performance goals by proving that "no-touch" management can lead to high-severity fires that permanently destroy the overstory shade required for water temperature protection.
- **14 CCR §§ 916.4, 936.4, 956.4 [Watercourse and Lake Protection]:** The study informs the functional objectives of these rules by demonstrating the need to integrate "Wildfire Resilience" into riparian zone protections.
- **14 CCR §§ 916.5, 936.5, 956.5 [Procedure for Determining WLPZ Widths]:** The research provides data on how existing buffer widths perform under extreme fire conditions.

Silvicultural Standards (Specifically for the Northern District/Case Study area):

- **14 CCR § 933 [Silvicultural Objectives]:** The results inform the broader goals of forest stand management by emphasizing the trade-off between high-density stands and wildfire risk in sensitive watersheds.
- **14 CCR § 933.1 [Regeneration Methods for Evenaged Management]:** The study assessed how clearcutting and evenaged regeneration influenced fire outcomes within and adjacent to WLPZ boundaries.
- **14 CCR § 933.2 [Regeneration Methods for Unevenaged Management]:** The findings suggest that unevenaged systems, when used to maintain specific canopy levels, can support both ecological and fire-resilience goals.
- **14 CCR § 933.3 [Intermediate Treatments]:** This was a primary rule informed by the study. The model proved that **thinning and sanitation/salvage** are the most effective human-controlled factors in reducing burn severity and preventing "crown fires" from entering the WLPZ core.
- **14 CCR § 933.4 [Special Prescriptions]:** The study informs the use of site-specific management to address unique fire-hazard conditions in riparian corridors.
- **14 CCR § 933.5 [Stocking Status]:** The research on "Type Conversion" (forest turning to brush) provides a basis for re-evaluating post-fire restocking requirements to ensure long-term watershed recovery.

  The study successfully answers **CMQ 1(h)** (Managing WLPZs to reduce potential fire behavior) and **CMQ 12(a)** (Improving overall forest wildfire resilience). It indicates that

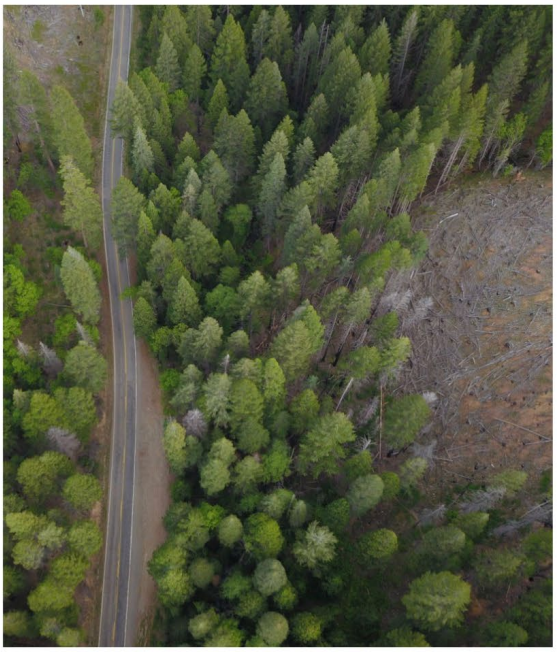
while fire weather and environmental settings are the primary determinants of burn severity, passive management frameworks can contribute to fuel accumulations that may increase risk in certain high-intensity conditions.

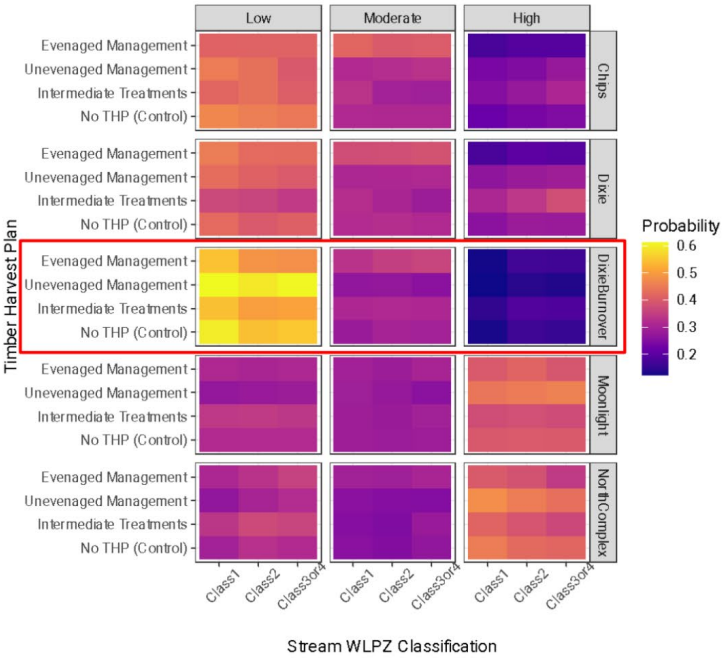
2. Scientifically sound?

This research project consisted of a state-wide analysis of WLPZ areas and a case study of Plumas County WLPZ areas. Both portions of the project viewed separately were scientifically sound. The study used rigorous scientific protocols and advanced data analysis:

- **Methodology:** For the state-wide analysis, various datasets had to be utilized for mapping and calculation of a comprehensive statewide hydrology layer and its associated buffers. Data parameters were put in place to map the various data sets with the TA83 nomenclature, such as prioritizing Class 1 stream classification when overlap occurred. Burn history and severity in WLPZ area were assessed for long term effects using another set of databases, such as Cal Fires Fire and Resource Assessment Program (FRAP 2023b) and U.S. Forest Service Rapid Assessment of Vegetation Condition after Wildfire (RAVG, 2012–2023; USFS 2023), amongst others. Fire Hazard and risk modeling for WLPZ area was assessed with data from Pyrologix 2021 using a selection of outputs. The Plumas County Case Study was done with the same methodology but with a more comprehensive and complete data set suite. An aggregate collection of the THP records for these areas was categorized and mapped spatially and temporally with burn severity and recovery data from major fires in the County that took place between 2000 and 2021, in addition to fire frequency in any one of the 30-meter patch pixel areas. This was followed up by a site-level visual assessment using an uncrewed aerial vehicle (UAV), Google Earth historical imagery and field observations. Multiple methods of analysis, including Random Forest Classification model (Machine Learning), were then used to analyze the interaction of fire weather, topography, land use history, and management.

Imagery





The first image shows a UAV captured photo of a forested area. The Second image shows burn severity based on comparison of THP categorized areas and WLPZ classifications.

3. Scalable?

What does the study tell us?

In the state-wide study, major differences in historical fire activity in WLPZs were partially attributed to the prevalence of discrepancies in stream classification systems, by county, used for analysis. These results are better analyzed by county via the online dashboard, a deliverable of the project. When complemented by the state-wide fire behavior models, the results showed consistently that burn outcomes in WLPZs are driven by fire events themselves, but environmental factors were the second greatest influence. The data analysis showed that common fire behavior predictors, such as aspect, landscape position and drought intensity, could be used the same to predict fire behavior in riparian areas and WLPZs as they can in other forested area. It can be assumed the same controls of fire intensity used outside riparian areas could be used inside riparian areas to similar effect.

However, the state-wide analysis also showed that riparian corridors, especially ones around Class I and Class II WLPZs, tended to moderate fire behavior and lessen effects the closer fire moved towards the waterway. Due to the data discrepancies by county, effects of forest treatment in riparian corridors on fire behavior were variable, and some were contradictory to the Plumas County Case Study.

In the case study, intermediate treatments showed limited but consistent tendency towards lower severity in higher-severity fires (Moonlight and North Complex). Some factors leading to trends included event-scale and land use/zoning (industrial vs non-industrial forests) and its associated canopy cover.

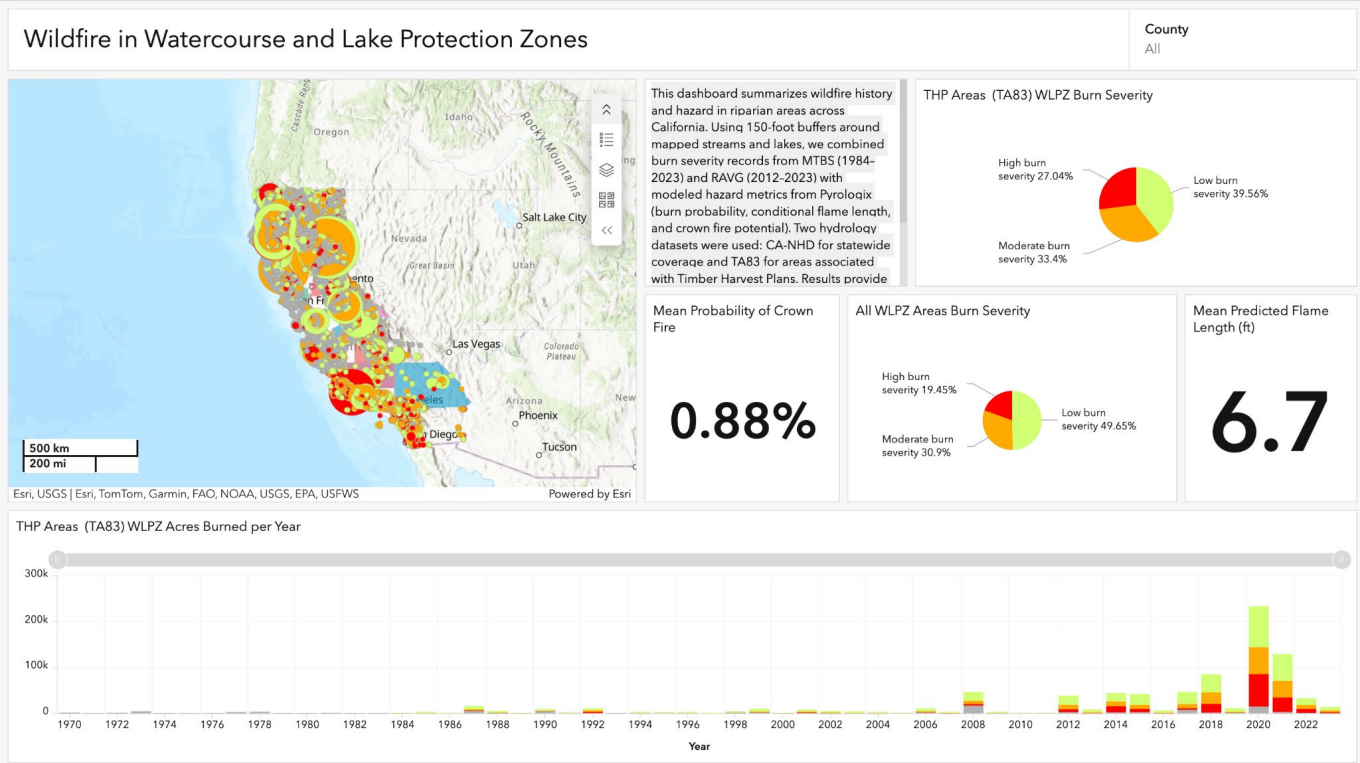
Post-fire data analysis showed a shift in vegetation type from predominantly evergreen forest cover to multiple other vegetation types. This showed a clear pattern of barren ground expanding immediately after fires in riparian areas, giving way to shrub and scrub vegetation in following years. The historical research showed that unsupported conversion of this type can shift the forested area back to early-seral stages and take hundreds of years to recover.

In conclusion, “This study shows that the wildfire event and environmental setting remain the strongest determinants of burn severity, but management still matters when applied strategically.” The study provides a new "proactive" management framework. The study proposes an adaptive 'Resilience Band' (150–300 feet from the water) as a conceptual planning framework. This zone can be used to reduce ladder fuels and crown continuity where site conditions support treatment, without weakening core WLPZ protections. The concept aligns with a broad body of research demonstrating that strategic thinning and fire treatments improve wildfire outcomes, and with past EMC recommendations (2023), which advocate adaptive, light-touch treatments in and near riparian zones. A proposed structure and implementation timing is available in the Final Report.

Do findings apply to other areas of the State?

Through the use of the provided dashboard and utilizing the methodology of the Plumas County Case Study, discrepancies and data gaps could be compensated for and the proposed

WLPZ/riparian area treatment could be assessed for applicability on a County-wide or smaller scale. The report states that the state-wide findings on fire behavior in riparian and WLPZ areas are generally applicable state-wide; however, the report identifies a specific anomaly in the Coast Forest District. Data there showed different patterns than the Plumas Case Study, suggesting that regional factors like coastal moisture and specific mapping discrepancies (TA83 vs CA-NHD) require targeted follow-up.



4. New EMC study recommended to advance research on this topic?

A. Literature review sufficient? Yes, the PIs conducted a thorough review of fuel treatment and riparian function literature. Spatial data analysis used throughout the methodology was also well reviewed.

B. Recommended further funding? Central Recommendation: There is a critical and immediate need for a unified, statewide, classified (Class I–IV) WLPZ dataset. Reconciling TA83 and CA-

NHD datasets is essential to make future policy evaluation and applied planning efficient and reproducible.

The PIs recommended further research in the areas of treatment timing and post-fire trajectories to further refine the proposed management for WLPZ areas. It is not clear that such funding should be provided by the EMC. The matter should be discussed by the committee.

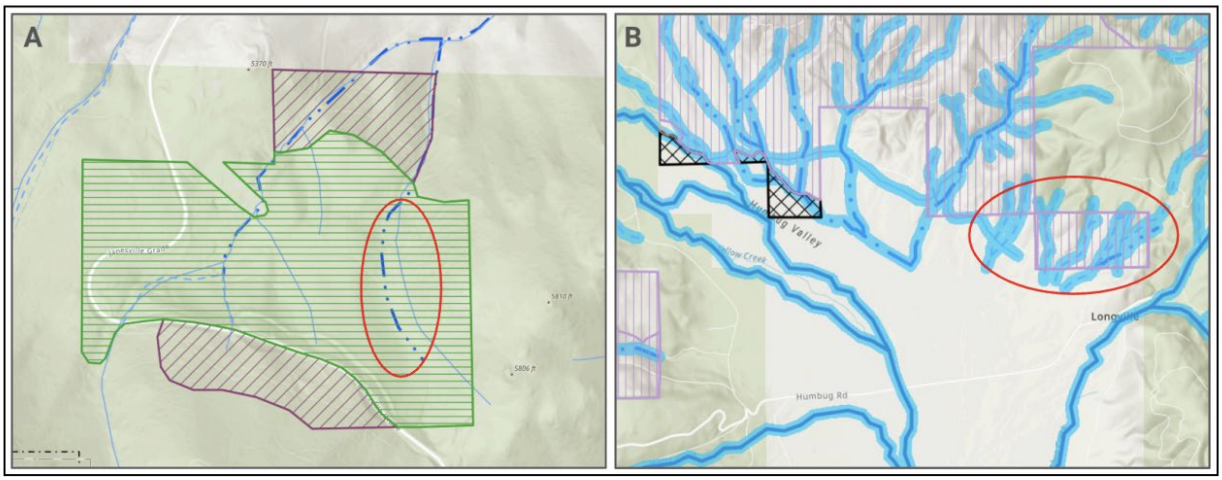


Image showing demonstration of spatial misalignment between CA-NHD and TA83 hydrology datasets, highlighting the need for a unified statewide classified WLPZ layer.

C. Relationship to other studies: This study builds directly upon Rob York's prior EMC work (2017) regarding fuel treatment alternatives in riparian zones. While York evaluated site-level treatments, this project extends that work into a statewide geospatial framework. It also complements EMC-2018-006, by explaining the wildfire conditions that threaten the canopy cover being monitored in that study. In addition, the EMC study 2015-001 showed how stream temperature responses differed based on site conditions such as groundwater inputs and elevation and forest conditions.

5. Scientific Applications

What is the scientific basis that underlies the rule? How much of an incremental gain in understanding do the study results represent?

Current WLPZ rules were adopted in 2009, and only a few studies have researched the effects of timber harvest suppression in these areas as it relates to wildfire prevention and the resulting hydrological impacts. This is a well-recognized area for further research, and the study set a framework and methodology for digitally assessing past fire effects in WLPZ area, as well as methodology to predict future fire effects as they relate to forest practices in and around riparian areas, at least on a regional or county scale.

This study did not look into forest treatment in WLPZ and riparian areas as specific as those analyzed in past EMC studies, but it did provide the first state-wide applicable methodology and suggests a prescription which could address the undesirable fire effects found in the analysis. Further, the study results from the case study suggested that various forest treatments may not result in differing fire effect outcomes but instead will be more ideal than no forest treatment occurring prior to a fire event, at least in analysis of that specific county.

The results of the study created a tool and proof case that will assist regulators and agencies increase understanding of management implications, as well as assess the efficacy of the current WLPZ rules. Loss of canopy cover in riparian areas and its resulting impacts on stream temperature and sedimentation are the basis of the Thermal Plan and Basin Plan that informs the WLPZ rules, and this study presents a methodology to challenge the importance of these effects when weighing the impact of various practices (or lack of practices) in the forested environment.