Effectiveness Monitoring Committee 2026 Concept Proposal

a. Date submitted: May 18, 2026
b. Project Title (proposed): Process Based Restoration of Headwater Streams: Beneficial Reuse of Forest Biomass for Wildfire Resilience
c. Project #
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- Mia von Docto, Trout Unlimited
- Jeremy Kobor, O'Connor Environmental, Inc.
- Jessica Pollitz, Sonoma Resource Conservation District

j. Project Description

i) Project Duration

Approximately 31 months assuming grant contract in place Dec. 2026 extending to June 2029.

ii) Background and Justification

Process Based Restoration (PBR) treatments applied to headwater streams have manifold objectives that are broadly restorative with respect to watershed headwater ecosystems. These treatments are intended for headwater streams subject to gully erosion processes characterized by headcuts, channel incision, and bank erosion (https://sonomarcd.org/wp-content/uploads/2025/06/Low-Tech-Process-Based-Restoration-for-Upper-Watersheds-compressed.pdf). The PBR treatments utilize trees and shrubs from fuel-load management

and slash obtained primarily from adjacent Water and Lake Protection Zones (WLPZ) that is placed and compacted by hand labor crews. These green and woody materials are oriented either parallel or perpendicular to flow depending on local channel geometry (i.e. width, depth, slope) and local geomorphic conditions (e.g. substrate of channel bed and banks, erosion and sedimentation conditions). Such treatments have the potential to significantly reduce erosion and promote deposition of sediment in headwater channels providing associated watershed water quality benefits. The organic materials used reduce fuel-loads consistent with objectives of fire resiliency and forest health projects (e.g. Cal VTP projects). Many observers believe that prescribed fires affecting headwater WLPZ's often burn too hot, negatively affect ground cover where it is critically needed to intercept sediment and detain surface runoff. In addition to water quality benefits, secondary benefits of PBR treatment potentially include increased water detention in forest soils that benefit forest vegetation, enhanced groundwater recharge, attenuation of stormwater runoff, and reduced greenhouse gas emissions relative to combusting or exporting organic materials produced by fuel reduction treatments. PBR treatments are also expected to enhance aquatic habitat both onsite and downstream.

From the perspective of higher-level land management, this PBR treatment approach provides an additional option for beneficial disposal of biomass from forest fuel management and could accelerate adoption of "good fire" strategies. From a permitting perspective, low impact PBR treatment in headwater streams requires consultation with both Regional Water Board and Department of Fish and Wildlife to determine whether permits are required. A number of permits for these projects have been secured over the past 5 years, both on private and public lands. Personnel representing these regulatory agencies that have direct experience with these projects have expressed support for this work in the North Coast region. Whether such PBR treatments are consistent with Forest Practice Rules for Class II and III streams and WLPZ management may require evaluation.

While PBR techniques have been widely applied for decades by many diverse practitioners, fundamental research to evaluate the effectiveness of these treatments in Class II and III streams is warranted. This innovative PBR treatment approach offers potential for significant water quality and watershed benefits and the potential for widespread implementation in California's forested watersheds. This evaluation of effectiveness is needed to better demonstrate the potential benefits of this PBR treatments in headwater streams.

iii) Objectives and Scope

The primary goal of this project is to develop detailed and consistent observations of PBR treatments in headwater streams providing data to evaluate their effectiveness in terms of benefits to water quality across a geographic range of site conditions. The secondary goal is to evaluate potential long-term watershed-scale hydrologic benefits in terms of modeled effects on runoff attenuation, groundwater recharge, and soil moisture storage.

The proposed research systematically describe implemented treatments including forest and geomorphic setting of approximately 45 existing or planned PBR treatment sites in Sonoma and Mendocino Counties ranging in age from 1 to 20 years. Research sites include typical regional forest types: coastal redwood/Douglas-fir, mixed conifer/hardwood, and oak woodland. Data from monitoring of hydrologic and geomorphic processes in treated and control headwater streams over at least two winter seasons will be used to evaluate short-term effectiveness of these treatments with respect to stability of organic material comprising the treatments and the effects of treatment on erosion and sedimentation processes.

Modeling of the PBR treatments on hydrologic processes will utilize a physically-based, spatially-explicit integrated model code (MIKE SHE) in selected headwater tributaries. The tributary model will be nested in an existing watershed-scale model; this provides modeling efficiencies and the ability to evaluate watershed-scale hydrologic effects encompassing variable climate conditions over at least 10 years. Two such existing watershed models coincide with PBR treatment sites in redwood/Douglas-fir and mixed conifer/hardwood forest types (one example can be reviewed on this link- https://www.coastrangewater.org/_files/ugd/128aec_2751071fafb54a4f88cd128b41cbd3d2.pdf). PBR treatments on headwater streams will be modeled within one of two available model domains and will provide quantitative estimates of treatment effects on runoff, groundwater recharge and soil moisture storage.

iv) Research Methods

This research will establish methods to describe PBR treatments focused on stability of treatment materials and the effect of the treatments on hydrologic and geomorphic processes. Owing to the novelty of this field-based research, no data are available to develop a statistically robust study design that would enable formal hypothesis testing in a predictable manner. A mixture of qualitative data and quantitative data will be collected; appropriate statistical tests will be performed on selected data sets to determine the statistical significance of any differences observed. Future studies could potentially use sample data from this study to estimate sample sizes required to attain desired statistical power for formal hypothesis testing.

The study design will include comparisons between treatment and control sites within clusters of sites with various sample sizes. There will also be monitoring components of the study comparing conditions upstream and downstream from treatments at selected individual sites. It is likely that there will be a cluster of sites where channels can be evaluated before and after treatment implementation. Analyses and interpretation of qualitative and quantitative data with descriptive statistics rather than inferential statistical tests will provide the basis for assessments of effectiveness of the PBR treatments.

Core data describing each site will be documented in a map format. A survey protocol will document conditions at treated, control, and planned treatment. Basemaps will be derived from LiDAR topographic data. Measurements of channel width, depth, and slope

will be collected at regular intervals located on the base map. Geomorphic characteristics will be classified and mapped focusing on bed and bank materials, evidence of erosion and sedimentation, and other features of interest. Generalized descriptions of the geomorphic characteristics of each site including adjacent upstream and downstream areas will be included; Representative hillslope angles and valley width will be documented. Forest type, typical understory and shrub species, and ground cover will be documented. PBR treatments will be classified and mapped based on observations supplemented by available design plans. Treatment materials will be inspected to determine relative stability and evidence of sediment deposition or erosion. A longitudinal video survey of the mapped reach will also be collected.

Primary data pertaining to effectiveness will be obtained from repeated annual surveys as described above supplemented by quantitative data. The degree of stability versus the degree of disruption/entrainment of organic treatment materials will be a primary criterion for effectiveness. Potential erosion caused by treatments (either stable or disrupted) will also be evaluated. Deposition of sediment within or on the surface of treatment material will likely be a criterion for effectiveness with respect to water quality. Point measurements of depth and surface area of sediment deposits will provide quantitative data regarding sediment deposition. Some samples of sediment deposits will be analyzed for particle size distribution. Beneficial effects on erosion processes (i.e. preventing erosion of channel bed and/or banks within treatments) will also be observed and documented.

At a selected set of sites, the same survey protocol will be used following significant storm events. These winter surveys will provide insights regarding differential effects of peak flows of different magnitudes. Changes in sedimentation within treatment materials may occur with successive peak flow events that would not be detected by annual surveys. These data will be informative regarding the dynamics of peak-flow driven sedimentation processes in treatment materials. The effect of treatments on water quality will also be investigated using quantitative data from limited grab sampling for turbidity and/or suspended solids in streamflow above and below treatment sites during periods of storm runoff. Owing to a small sample size and typically high sample variability of these water quality parameters, these data are not expected to be conclusive but may be indicative of sediment retention within treatment materials. Stream discharge will also be measured during winter site visits.

The effects of treatments on hydraulics of flow in headwater streams will be investigated using quantitative data at selected sites using stream-stage data from pressure transducers installed within treatments and by comparison with stream stage data from control sites and upstream and/or downstream sites. These data will provide insights regarding the degree to which stream flow occurs within the matrix of organic treatment material and how the flow interacts with the treatment material with potential implications for sediment detention mechanisms. Stream stage data may also be expected to correlate with episodes of peak runoff that cause disruption or entrainment of the treatment material.

Effects of treatments on local shallow groundwater and overbank flow at atypical segments of headwater streams will also be investigated at a limited number of sites using pressure transducers in piezometers or shallow monitoring wells paired with in-stream stage data. Instances of such overbank flows may also be observed in annual and/or post-storm surveys.

Finally, to better understand the long-term fate of biomass forming the PBR treatment material and the degree to which the biomass degrades (similar to composting), the quantity of inorganic material (sediment) that is deposited within the treatment, and the quantity/extent of intrusion by roots of terrestrial riparian plants, small portions of a few treatment sites will be trenched using hand tools. This effort will include sites installed about 5 years ago and one site installed about 20 years ago. The trenches will be logged using geotechnical descriptive methods and some soil samples will be collected and analyzed to determine organic content, inorganic content and size distribution of inorganic material.

Hydrologic modeling simulating the effects of PBR treatments in selected tributary streams will provide estimates of changes in hydrologic process rates by comparison of treated conditions with existing condition model scenarios. Detailed topographic surveys of headwater channels to be incorporated in the hydrologic models will be conducted using Total Station survey equipment. LiDAR topographic data is often not sufficiently accurate to describe headwater stream channels in these forest environments.

Water balance parameters (runoff, interflow, groundwater recharge, soil moisture storage) for annual and seasonal periods in dry, average and wet water years will provide the basis for interpretation of long-term hydrologic effects of PBR treatments at the subwatershed scale defined by treated Class III tributaries and downstream Class II streams. The potential watershed scale effects of PBR treatments will be evaluated by extrapolating subwatershed effects.

v) Scientific Uncertainty and Geographic Application

There is significant scientific uncertainty regarding the effectiveness of PBR treatments in headwater streams. As observed to-date, treatments primarily in Class III streams have generally remained stable and observations generally support the expectation of beneficial effects on erosion and sedimentation that would improve water quality. Sonoma County Regional Parks instituted a monitoring program to document observations to comply with Regional Board permit terms. The monitoring protocol provides systematic qualitative observations collected annually including photo points to track changed conditions with relatively limited spatial detail. None of the sites have been surveyed to describe geomorphic features or channel geometry in detail. Sonoma RCD prepared a hydrologic and hydraulic analysis that estimated flows and velocities for 2-year and 10-year recurrence peak flows to evaluate stability of treated channels using stability thresholds for

biotechnical stabilization of stream banks. Use of this approach for stability evaluation and design work has not been validated.

Geographic applicability of this study certainly includes forest of the Coast Ranges and should be at least substantially applicable in forested areas throughout the state.

vi) Collaborations and Project Feasibility

Core collaborators have all participated in implementation and/or planning for PBR treatments of headwater streams. Sonoma County Regional Parks has implemented projects in three parks and is funded to implement additional work in a fourth park beginning in 2026 in partnership with Sonoma RCD. OAEC has pioneered these PBR treatments and has supervised implementation of most of the existing sites to date and has implemented treatment on private lands beginning in 2021/22 including some earlier treatments. These land managers are implementing PBR treatments and will provide all required access to over 40 existing or planned treatment sites to conduct this study. Trout Unlimited (TU) implemented treatments at sites in Mendocino County in 2021/22 including hydrologic monitoring and is preparing an evaluation of that project. These collaborators have existing working relationships surrounding PBR treatments. Sonoma RCD, TU and OAEC previously collaborated in a 10-year project to evaluate and enhance coho salmon habitat in the lower Russian River.

k. Critical Question Theme and Forest Practice Rules or Regulations Addressed.
This proposal addresses two of the six priority critical monitoring questions (CMQs) for the FY 2026/27 grant solicitation.

Are the FPRs and related regulations effective in…
2) … minimizing management-related sediment delivery from forest management activities to watercourse channels at the watershed and sub-watershed level in managed watersheds? ***(Question 2a)***
6)… improving overall forest wildfire resilience and the ability of forests to respond to climate change (e.g., in response to drought or bark beetle; reducing plant water stress) and variability, and extreme weather events (evaluate ecosystem functional response to fuel reduction and forest health treatments)? ***(Question 12a)***

This proposal provides scientific perspective on broad goals and objectives of the Forest Practice Rules for Watershed and Lake Protection Zones described under EMC Research Theme 1. Emphasis is added to Theme 1 language reproduced below to highlight specific objectives of WLPZ management relevant to this proposal.

WLPZ FPRs were developed to *ensure that timber operations do not potentially cause significant adverse site-specific and cumulative adverse impacts to the beneficial uses of water*, native aquatic and riparian-associated species, or functions of riparian zones, or result in an unauthorized take of listed aquatic species (14 California Code of Regulations [CCR] § 916 [936, 956]). A primary objective of the FPRs is to *maintain or restore riparian and aquatic functions in classified watercourses*. Both passive and active management

approaches may accomplish these objectives by incorporating options ranging from protection (passive, no touch) to active manipulation of stand structure (e.g., timber harvest) (14 CCR § 916.9 [936.9, 956.9](v)).

The WLPZ FPRs can contribute toward meeting goals of the Fish and Game Commission (FGCom) and/or Joint FGCom and Board policies, including those described in the Endangered and Threatened Species Policy, Salmon Policy, Water Policy, and Joint Pacific Salmon and Anadromous Trout Policies. In addition, the WLPZ FPRs may also contribute to maintaining sufficient shade and *supporting beneficial uses contained in Water Quality Control Plans (Basin Plan) for applicable Regional Water Quality Control Boards*. Key functions of riparian zones include recruitment of large woody debris, watercourse shading, *sediment filtration*, nutrient input, microclimate control, *streambank/hillslope stability*, and habitat for terrestrial wildlife species. Riparian areas occur dynamically within watersheds adjusting to successional vegetation changes, annual hydrologic events, and other disturbances (e.g., wildfires, wind, insect damage, and diseases). The following critical monitoring questions focus on the *natural processes and function of WLPZs and allow for the dynamic nature of these management areas*.

Specific aspects of stream channel/riparian function and WLPZ mitigation measures described in 14 CCR Section 916.4 (b) that PBR treatments may affect include streambed and flow modification by large woody debris, filtration of organic and inorganic material, bank and channel stabilization, and spawning and rearing habitat for salmonids. The proposed PBR treatments could be appropriate in coordination with Timber Harvest Plans but to-date, treatments have been restorative in landscapes with varying degrees of historic logging. PBR treatments in Class III streams may be inconsistent with Section 916.4 (c) (3) stating that "Soil deposited during Timber Operations in a Class III Watercourse other than at a temporary crossing shall be removed and *debris deposited during Timber Operations shall be removed or stabilized* before the conclusion of Timber Operations…"

l. Requested Funding
FY 2026/27: $200k
FY 2027/28: $250k
FY 2028/29: $325k

Depending on timing of a notice to proceed for Year 1(FY 26/27), funds would be expended on primary site surveys (initial conditions) beginning after the rainy season with some winter season monitoring planned to test methods. Year 2 (FY 27/28) would include primary site surveys (monitoring) and rainy season monitoring and hydrologic model set-up. Year 3 (FY 28/29) would continue primary site surveys (monitoring) and rainy season monitoring, analysis of data, hydrologic modeling and report/manuscript preparation.