2021 EFFECTIVENESS MONITORING COMMITTEE ANNUAL REPORT AND WORKPLAN

STATE BOARD OF FORESTRY AND FIRE PROTECTION

January 28, 2022

EXECUTIVE SUMMARY

The Effectiveness Monitoring Committee (EMC) Annual Report and Workplan (Report) is a living document which is updated and approved by the Board of Forestry and Fire Protection (Board) annually and is intended to catalogue the yearly accomplishments and status of ongoing EMC efforts. The Report summarizes EMC accomplishments, details EMC funding actions for the year, and provides an update of current EMC membership and staffing. For fiscal year (FY) 2021/2022, the EMC selected two proposed effectiveness monitoring projects to fund and support. Ongoing projects from prior years continued to be funded.

EMC PROCESS SUMMARY

The EMC was formed to develop and implement an effectiveness monitoring program to address both watershed and wildlife concerns, and to provide an active feedback loop to policymakers, managers, agencies, and the public to better assist in decision-making and adaptive management. As an advisory body to the Board, the EMC helps implement an effectiveness monitoring program by soliciting robust scientific research that addresses the effectiveness of these laws at meeting resource objectives and ecological performance measures related to AB 1492.[1]

Three formal documents guide the activities and goals of the EMC: (1) the EMC Charter,[2] (2) the EMC Strategic Plan,[3] which is updated approximately every three years, and (3) the EMC Annual Report and Work Plan[4] (i.e., this report), which is updated every calendar year. The longer, more static Strategic Plan and the shorter, more fluid Annual Report and Work Plan, is a linked process developed in response to Board member requests. The EMC reports on its activities in a variety of ways. The EMC Strategic Plan road map lays out how the Committee intends to achieve the EMC goals and objectives. This Annual Report and Workplan tracks progress on individual projects, documents the Committee's ranking and selection of proposed monitoring projects, and details other annual accomplishments and ongoing EMC efforts. The EMC conducts open meetings a minimum of four times per year (quarterly) to conduct EMC business, during which progress reports, final reports, or other presentations on EMC-funded projects or other related research may be provided. The EMC Co-Chair or Board staff also report on the EMC's activities via verbal updates at Board meetings throughout the year.

EMC projects are solicited through an annual Request for Proposals (RFP) which is released following the start of the new fiscal year (FY) (see Figure 1). The RFP, ranking, and selection process are detailed in the Strategic Plan.

[1] AB-1492 Forest resource management (2011-2012), Health & Safety Code 13009.2; see https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120AB1492

[2] https://bof.fire.ca.gov/media/10115/effectiveness-monitoring-committee-charter-7120_ada.pdf

[3] https://bof.fire.ca.gov/media/9122/2018-emc-strategic-plan-ada.pdf

[4] https://bof.fire.ca.gov/media/gijnn1q0/2020-emc-annual-report-and-workplan.pdf

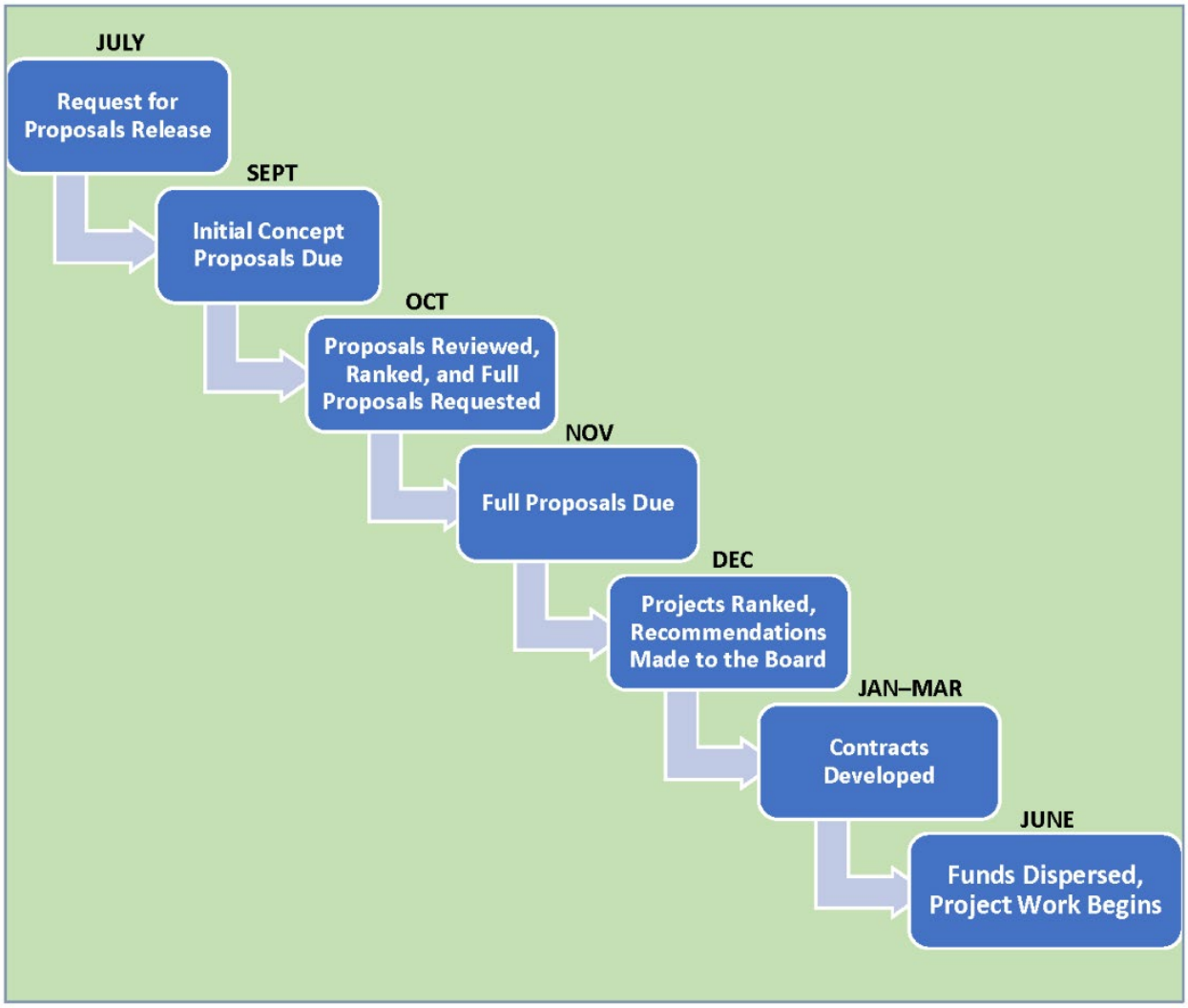

Figure 1. EMC Project Submission Timeline (approximate)

EMC FUNDING

For FY 2021/22, the EMC has been allocated ongoing funding of $425,000 from the Timber Regulation and Forest Restoration Fund (TRFRF),[5] established by AB 1492 (2012), of which $154,472 was allotted to support ongoing, previously awarded projects and $270,528 remains for projects to be funded starting in FY 2021/22. The EMC anticipates an allocation of $425,000 in FY 2022/23 and 2023/24 as well. This funding is allocated to projects through the Board/CAL FIRE contracting process.

[5] http://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120AB1492.

Table 1. Ongoing EMC Projects with Continued Funding and/or Activity (2021/2022)

Project #	Title	Primary Investigator(s)	Funding Status
EMC-2015-001	Class II Large Watercourse Study: Multiscale investigation of perennial flow and thermal influence of headwater streams into fish bearing systems	Kevin Bladon & Catalina Segura	Fully allocated
EMC-2016-002	Post-fire Effectiveness of the Forest Practice Rules in Protecting Water Quality on Boggs Mountain Demonstration State Forest	Joe Wagenbrenner, Kevin Bladon, Drew Coe, & Don Lindsay	Not applicable*
EMC-2016-003	Road Rules Effectiveness at Reducing Mass Wasting (Repeat LiDAR Surveys to Detect Landslides)	Bill Short & Matt O'Connor	Fully allocated
EMC-2017-001	Effects of Forest Stand Density Reduction on Nutrient Cycling and Nutrient Transport at the Caspar Creek Experimental Watershed	Helen Dahlke & Randy Dahlgren	Fully allocated
EMC-2017-002	Boggs Mountain Demonstration State Forest (BMDSF) Post-Fire Automated Bird Recorders Study	Stacy Stanish	Fully allocated
EMC-2017-006	Tradeoffs among Riparian Buffer Zones, Fire Hazard, and Species Composition in the Sierra Nevada	Rob York	Allocated
EMC-2017-007	The Life Cycle of Dead Trees and Implications for Management	John Battles	Fully allocated
EMC-2017-008	Do Forest Practice Rules Minimize Fir Mortality from Root Disease and Bark Beetle Interactions	Richard Cobb	Fully allocated
EMC-2018-003	Alternative Meadow Restoration	Christopher Surfleet	$23,230.85
EMC-2018-006	Effect of Forest Practice Rules on Restoring Canopy Closure, Water Temperature, & Primary Productivity	Kevin Bladon, Catalina Segura, Matthew House, & Drew Coe	$97,207.81
EMC-2019-002	Evaluating Treatment Longevity and Maintenance Needs for Fuel Reduction Projects Implemented in the Wildland Urban Interface of Plumas County	Brad Graevs & Jason Moghaddas	$4,386.74
EMC-2019-003	Fuel Treatments & Hydrologic Implications in the Sierra Nevada	Terri Hogue & Alicia Kinoshita	$97,637.64

Project #	Title	Primary Investigator(s)	Funding Status
EMC-2019-005	Sediment Monitoring and Fish Habitat – San Vicente Accelerated Wood Recruitment	Cheryl Hayhurst	$56,200.00

*EMC-supported, but not EMC-funded

EMC ACCOMPLISHMENTS

In 2021, the EMC accomplished the following:

- The EMC met five times virtually in open, webcast meetings to conduct business. The January meeting was delayed from December 2020.
- The EMC implemented a new communication system that was established in 2020, in which individual committee members were assigned as project liaisons to provide check-ins with EMC-funded Principal Investigators to ensure project progress and deliverables are on track for BOF acceptance. Project liaisons provided project updates, as appropriate, at regularly scheduled EMC meetings, and worked with Board staff to facilitate communications and plan receipt of deliverables to the EMC.
- Research priorities were selected from the established Priority Themes and Critical Monitoring Questions described in the Strategic Plan via anonymous vote of all EMC voting members. The top five critical monitoring questions were prioritized for funding in the 2021/22 FY, although not to the exclusion of projects focusing on the remaining critical monitoring questions.
- The EMC finalized a new framework for processing completed EMC-funded projects to better facilitate EMC reporting to the Board. This "Completed Research Assessment" (previously known as "Science to Policy Framework") provides a step-by-step approach to guide EMC members in verifying scientific integrity and validity of the research, and interprets the results of the scientific research as to the implications for management and policy. Two EMC members work with the Principal Investigator(s) of each project to complete the required form, which is then presented to the EMC and amended as necessary prior to presentation to the Board. This provides an easily understood narrative and synthesis for Board members to give context to study results.
- A Completed Research Assessment was prepared for project EMC-2015-001: Effectiveness of Class II Watercourse and Lake Protection Zone (WLPZ) Forest Practice Rules (FPRs) and Aquatic Habitat Conservation Plan (AHCP) Riparian Prescriptions at Maintaining or Restoring Canopy Closure, Stream Water Temperature, and Primary Productivity. The results and implications of this project were presented to the EMC and then forwarded to the Board for consideration by the Forest Practice Committee. Results from EMC-2015-001 were utilized to craft a draft rule revision related to the Anadromous Salmonid Rules. The draft plead is currently in the Forest Practice Committee.
- The EMC received an ongoing allocation of $433,000 from the Timber Regulation and Forest Restoration Fund, of which $154,472 was allocated to previously awarded projects (see Table 1), and the remaining $278,528 will be available to projects awarded in the 2021/22 fiscal year.

- The EMC reviewed three initial concept proposals and requested full concept proposals from two research teams. Upon review and discussion, the committee voted to fund both proposals:
    - EMC-2021-001: Aquatic Toxicity and Cumulative Watershed Effects of Pesticide Discharge Related to Post-Fire Reforestation
        - Following the ranking process, the organization withdrew the proposal due to the inability to meet the EMC's maximum indirect cost limit of 15%.
    - EMC-2021-003: Evaluating the Response of Native Pollinators to Fuel-Reduction Treatments in Managed Conifer Forests
- While not an EMC-funded project, a final project presentation on a project that is relevant to EMC-funded research (i.e., related to the FPRs and related regulations) was provided on the Railroad Gulch BMP Evaluation Study conducted in the Elk River watershed, Humboldt County.
- Brief project updates were provided by Principal Investigators and/or Project Liaisons at EMC meetings for the following projects: EMC-2015-001 (Class II Large Watercourse Study), EMC-2016-003 (Repeat LiDAR Surveys to Detect Landslides), EMC-2017-001 (Caspar Creek Experimental Watershed), EMC-2017-008 (Forest Practice Rules and Fir Mortality), EMC-2018-003 (Alternative Meadow Restoration), EMC-2018-006 (Effect of Forest Practice Rules), EMC-2019-002 (Treatment Longevity and Maintenance Needs for Fuel Reduction Projects), and EMC-2019-005 (San Vicente Accelerated Wood Recruitment).
- A Draft Strategic Plan was updated at the end of 2021 and will be finalized in early 2022. The EMC investigated a grant program as a means of distributing funding on future projects and will continues to evaluate the merits of instituting a grant program for implementation in FY 2022/23.

EMC SUPPORTED MONITORING PROJECTS – 2015 to 2021

The comprehensive list of EMC-supported monitoring projects can be found on the Board's EMC webpage (https://bof.fire.ca.gov/board-committees/effectiveness-monitoring-committee/).

EMC PRIORITIES

EMC priorities are developed by the Committee, but as an advisory body to the Board, the Board can also request prioritization of items by the EMC. The current EMC priorities are as follows:

- Support projects related to the EMC Themes and Critical Questions.
- Monitor progress on previously funded or supported EMC monitoring projects.
- Meet in the field at least once per year to observe active or proposed monitoring projects (this was not achieved in 2020 or 2021 due to the COVID-19 pandemic, although one virtual field tour was conducted and several comprehensive presentations were given during public meetings).

CURRENT APPOINTED EMC MEMBERS AND STAFF

For FY 2021/2022, the Committee has two Co-Chairs; up to 16 EMC members, including eight agency representatives and seven monitoring community members (two seats were vacated during 2021 and remain open); and five support staff positions (one seat was vacated in 2021, but filled within two months).

Table 2. Current EMC Membership and Support Staff

Name	Specialty	Affiliation	Term End Date
Co-Chairs			
Loretta Moreno	Co-Chair, Forest Ecology	California Natural Resources Agency	07/05/2023
Susan Husari	Co-Chair, Forestry and Fire Management	Board of Forestry and Fire Protection	11/06/2023
Monitoring Community			
OPEN SEAT Greg Giusti	Forestry, Registered Professional Forester (RPF) 2709	University of California Cooperative Extension Advisor Emeritus - Lake and Mendocino counties	Vacated 07/01/2021
Matt House	Hydrology and Fisheries	Green Diamond Resource Company	08/31/2024
Sal Chinnici	Wildlife	Humboldt and Mendocino Redwood Companies	07/01/2024
Matt O'Connor, Ph.D.	Geology and Geomorphology	Public	11/06/2023
OPEN SEAT Sarah Bisbing, Ph.D.	Forest Ecology and Forestry	Academic, University of Nevada, Reno	Resigned 09/08/2021
Leander Love-Anderegg, Ph.D.	Forest Ecology and Forestry	University of California, Santa Barbara	07/05/2023
Peter Freer-Smith, Ph.D.	Plant Ecology and Environmental Policy	Academic, University of California, Davis	07/05/2023
Agency Representatives			
Stacy Drury, Ph.D.	Fire Ecology	USDA Forest Service Pacific Southwest Research Station	n/a
Elliot Chasin (to 09/21/2021) Ben Waitman (from 09/22/2021)	Wildlife	California Department of Fish and Wildlife	n/a
Drew Coe	Hydrology/Forestry, RPF 2981	CAL FIRE	n/a

Name	Specialty	Affiliation	Term End Date
Jessica Leonard	Watershed Management	State Water Resources Control Board	n/a
Justin LaNier	Geology, Hydrology, and Water Quality	Central Valley Regional Water Quality Control Board	n/a
Clarence Hostler	Fisheries	National Oceanic & Atmospheric Administration National Marine Fisheries Service	n/a
Bill Short	Engineering Geology and Hydrogeology	California Geological Survey	n/a
Jim Burke	Geology and Water Quality	North Coast Regional Water Quality Control Board	n/a
Support Staff			
1. Matt Dias (to 07/01/2021) 2. Edith Hannigan (from 11/03/2021)	1. Forestry, RPF 2773 2. Forestry and Fire Protection	Board of Forestry and Fire Protection Executive Officer	n/a
1. Pete Cafferata (to 07/01/2021) 2. Andrew Lawhorn (from 12/14/2021)	1. Hydrology/Forestry, RPF 2184 2. Forestry and Fire Management	1. CAL FIRE 2. Board of Forestry and Fire Protection	n/a
Stacy Stanish	Biology and Fisheries, RPF 3000	CAL FIRE	n/a
Dave Fowler	Geology and Water Quality	North Coast Regional Water Quality Control Board	n/a
1. Katie Harrell (to 01/31/2021) 2. Kristina Wolf, Ph.D. (from 02/01/2021)	1. Forestry 2. Rangeland and Restoration Ecology	Board of Forestry and Fire Protection	n/a

EMC PROJECT UPDATES

The following section provides more information on reported project activities in 2021, or prior if applicable:

EMC-2015-001: Class II Large Watercourse Study: Multiscale investigation of perennial flow and thermal influence of headwater streams into fish bearing systems

At the January 13, 2021 EMC meeting, Member Drew Coe announced that OSU PhD student Austin Wissler had analyzed the thermistor data for this project as the first part of his dissertation research. This portion of his research was submitted for publication to the journal Hydrological Processes in January 2021. A paper

was accepted and published in the journal *Authorea* in January 2021 (Wissler et al. 2021). As part of a California Fire Science Seminar Series, Dr. Kevin Bladon provided a presentation titled "Wildfire and Post-Fire Management Effects on Water Resources" on April 13, 2021 (Bladon 2021).

At the April 21, 2021 EMC meeting, Member Coe presented on longitudinal trends in stream temperature from work conducted in the Caspar Creek Experimental Watersheds and on LaTour Demonstration State Forest (contrasting lithologies). Data were collected in five Caspar watersheds and three LaTour basins in 2017 and 2018. Drainage areas ranged from 57 to 773 acres. Air and stream temperatures tracked much more closely for the coastal basins compared to the inland LaTour basins. Input of coldwater springs decreased water temperature at entry points in the Cascade Range, providing cooling in a downstream direction, while four out of five Coast Ranges streams had a warming trend downstream. Spring inputs were found to lower the relationship between air and water temperatures. This study showed that not all streams meet the assumptions of uniform downstream warming utilized with the Class II-Large Anadromous Salmonid Protection (ASP) rules. The general pattern of complex instead of assumed asymptotic downstream warming makes implications for the California FPRs difficult. This conclusion validates the concepts included in the FPRs, 14 CCR § 916.9 [936.9, 956.8](v), allowing RPFs to develop site-specific riparian zone measures where they are appropriate.

Adam Pate's earlier work conducting a regional assessment of parameters for determining Class II flow permanence and network connectivity was also briefly described (Pate et al. 2020). Approximately 100 streams were studied, with channel characteristics and surface water conditions measured in mostly ASP watersheds. The most important variable for connectivity was winter precipitation. Drainage area was found to be more important than bankfull channel width, and width was found to work in the opposite direction than expected (decreased flow with wider channels). For connected streams, the rule requirement of 100 or 150 acres depending on forest practice district came reasonably close to the mid-values measured in this field study. The rule mandated drainage areas did not work as well for flow permanence, but they were still tracking appropriately (larger watersheds had more flow permanence). In general, this study provides evidence that channel width is not a good predictor for higher water temperatures being transmitted downstream, while drainage area is a good parameter for use in the CA FPRs.

Member Coe also reported that the manuscript previously submitted to the journal *Hydrological Processes* was rejected, and that modifications would be made to the discussion section and the paper would be resubmitted over the summer. Another new manuscript was recently accepted into *Hydrological Processes* with major revisions.

The EMC determined that the completed project EMC-2015-001 would provide a good beta test for the draft Science to Policy Framework (i.e., the precursor to the Completed Research Assessment). It was found that the study (1) did fulfill the funding requirements and informed a FPR; (2) was scientifically sound (one published paper to date); (3) scalable: clear differences in warming patterns were documented in different lithologies, with complex patterns observed in the Cascade Range; a key limitation was that only temperature was studied, while the ASP rules were also developed to address the transport of sediment, large wood, and nutrients; (4) additional research needed: it is appropriate to determine findings from EMC-2018-006 prior to initiating new research; and (5) scientific application: our understanding of controls for perennial/connectivity flow for headwater streams in California has been substantially increased.

At the July 21, 2021 EMC Meeting, Member Coe summarized the revised Completed Research Assessment that he and Member Matt House completed for this project. The project determined that drainage area is

considerably more important than the active channel width for determining both Class II flow connectivity and flow permanence. The document suggested that simplifying the FPRs by removing channel width as a criterion for classifying Class II-Large watercourses was merited. Revisions were suggested to the document prior to its presentation to the Board's Forest Practice Committee.

The final project results were presented to the Board by Member Coe on July 14, 2021. Final project results and a Completed Research Assessment were presented at the EMC meeting on July 21, 2021. The Completed Research Assessment was also presented to the Forest Practice Committee at the September 10, 2021 Board meeting, including potential implications for policy. In response, the Board proposed rule changes, and the item will be discussed at a future Board meeting. Updated presentations were given to the Board at the Forest Practice Committee meeting on November 3, 2021, and again on December 8, 2021.

EMC-2016-002: Post-fire Effectiveness of the Forest Practice Rules in Protecting Water Quality on Boggs Mountain Demonstration State Forest

At the January 13, 2021 EMC Meeting, Member Coe summarized a published poster presented online at the Fall 2020 AGU (American Geophysical Union) meeting titled "Alternative methods for reducing sediment delivery from skid trails used for post-fire logging" (Waggenbrenner 2020). This component of the study was included to develop and demonstrate alternative best management practices (BMPs) for post-fire salvage operations. Rainfall simulation was used to test post-fire treatments on skid trails in an area that burned with high severity in the 2015 Valley Fire. Runoff experiments were conducted to compare changes in runoff and sediment outputs among five mitigation techniques. The treatments were:

3. Control: standard waterbar spacing with the FPRs (100 feet with moderate EHR; 30-40% slopes).
4. Double-drainage: waterbar spacing set to ½ the prescribed FPR spacing (50 feet).
5. Slash-covered: skid trail covered with logging slash at a rate of 50%.
6. Slash-packed waterbar outlets: outlets covered with logging slash (70%) and machine packed.
7. Walked-in slash: both skid trail and waterbar outlet covered by slash (50% and 70%, respectively), and machine packed.

A licensed timber operator made four round trips on each skid trail. There were six plots randomly assigned for each treatment. Plot test sections were ½ the distance between waterbars and the full skid trail width. The application rate for the runoff simulator was 28 mm/hr (1.1 in/hr) for 30 minutes, which corresponded to the runoff rate from rainfall simulations with an applied rainfall rate of 71 mm/hr (>100-year recurrence interval). Variables included surface cover, surface roughness, runoff velocity (using a pulsed saline injection tracer), runoff rate, and sediment concentration. Results were as follows:

1. Cover: There was no difference in wood cover between the Control and Double-drainage plots or outlets. Plot wood cover was greater for the Slash-covered and Walked-in treatments, which included addition of wood on the skid trail surface. Outlet wood cover was greater for Slash-covered, slashpacked, and Walked-in treatments.
2. Surface roughness: Surface roughness showed no differences in the plots. Roughness in the outlets was more variable within each treatment than in the plots, and none of the treatments appeared to affect surface roughness.

3. Runoff velocity: The plot runoff velocities were lower for the treatments where slash was added to the skid trails (Slash-covered and Walked-in). All treatments had lower runoff velocities in the outlets than the Controls, particularly where slash was added to the waterbar outlets.
4. Runoff rate: Runoff rates across all treatments were highly variable. Runoff rates in the Double-drainage treatment were lower than the Controls because of the higher frequency of waterbars and shorter plot lengths. Runoff rates in the Slash-covered and Walked-in treatments were lower than the Controls.
5. Sediment concentration: Sediment concentrations were similar at the plot sample location across treatments except for the Slash-covered, which was slightly lower. At the outlets, there was no difference in sediment concentration between the Controls and Double-drainage treatments, and the Slash-covered, Slash-packed, and Walked-in treatments had lower concentrations. Sediment rating curves still need to be constructed to allow sediment yields to be calculated.

Additional characterizations of hydraulic roughness and erosion may also be generated using structure for motion photogrammetry. The main conclusions to date from this study are that (1) reducing the distance between waterbars has little effect on sediment delivery, and (2) the addition of slash to waterbar outlets has a greater influence on sediment delivery than slash added to the skid trails. The value of slash packing the outlets of skid trails following salvage logging operations validates the existing FPRs, which state that, "Where waterbreaks cannot effectively disperse surface runoff, including where waterbreaks on roads and skid trail cause surface runoff to be concentrated on downslopes, roads or skid trails, other erosion controls shall be installed as needed…(914.6 [934.6, 954.6](f))." Since roads and skid trails share similar properties and similar rule requirements (e.g., 914.6, 934.6, 954.6), results from this study may also apply to elements of the "Road Rules", specifically to elements of 923.5, 943.5, 963.5.

In related research, Dr. Joe Wagenbrenner provided a presentation titled, "Post-Fire Salvage Logging Effects on Soils, Runoff, and Sediment Production in Western Watersheds" (Wagenbrenner et al. 2021). The presentation was recorded on April 5, 2021 and was part of a Salvage Webinar series co-hosted by the Rocky Mountain Research Station, Northern Rockies Fire Science Network, Southern Rockies Fire Science Network, and the Northwest Fire Science Consortium. The primary investigators continue to analyze the data from this study and new papers are forthcoming.

EMC-2016-003: Road Rules Effectiveness at Reducing Mass Wasting (Repeat LiDAR Surveys to Detect Landslides)

The processing of the light detection and ranging (LiDAR) data by the USGS and its contractors was delayed due to COVID-19 response and by prioritizing processing of LiDAR data from areas affected by wildfires. At the April 21, 2021 meeting, Member Bill Short reported that LiDAR delivery from the USGS was still delayed. At the July 21, 2021 EMC meeting, Member Short informed the EMC that LiDAR data for Amador and El Dorado counties has been accepted, and that California Geological Survey (CGS) should be getting the data in the next few weeks, and would be uploaded to the national USGS site (https://www.usgs.gov/core-science-systems/ngp/tnm-delivery/gis-data-download).

At the Oct 21, 2021 EMC Meeting, Member Matt O'Connor and Member Short provided a project update. They reported that allocated project funds were expended in support of LiDAR acquisition to implement the project, and CGS was still awaiting the LiDAR data. Once received, CGS would implement an investigation of sequential LiDAR as a tool for identifying and tracking landslides; the analysis is expected to occur in early 2022.

EMC-2017-001: Effects of Forest Stand Density Reduction on Nutrient Cycling and Nutrient Transport at the Caspar Creek Experimental Watershed

At the April 21, 2021 meeting, Pete Cafferata reported that the pandemic imposed major restrictions on laboratory access for cation-anion analysis on 1,600 remaining water samples, but that Seanna McLaughlin's master's thesis was expected by June and a final report by the end of the calendar year. No project deliverables were provided in 2021.

In December 2021, principal investigator (PI) Dr. Helen Dahlke provided a project update via email. Dr. Dhalke reported that due to the pandemic university closures, non-essential laboratory research was not permitted. In addition, analysis of water samples for major cations and anions was reliant on a chromatograph for which access was not permitted until spring 2021, and additional repair and maintenance was then needed, preventing analysis at that time. Moreover, the MS student employed on the project left the university in 2021 without finishing her degree. The new plan is to train two other students on use of the analytical equipment sometime after January 2022 and draft a final report thereafter.

EMC-2017-002: Boggs Mountain Demonstration State Forest (BMDSF) Post-Fire Automated Bird Recorders Study

The third and final year of bird recordings were made in the late spring of 2019 and the bird call interpreter completed the recording analysis in January 2020. Member Stacy Stanish is working with a CDFW statistician to analyze the data. No project updates or deliverables were provided in 2021.

EMC-2017-006: Tradeoffs among Riparian Buffer Zones, Fire Hazard, and Species Composition in the Sierra Nevada

At the January 13, 2021 EMC Meeting, Katie Harrell, Board staff, reported that this project was significantly affected by COVID-19, and a contract amendment extended the project to June 30, 2022. Commercial harvests for the project were completed by end 2021. These harvests represent the first of a sequence of treatments applied as part of the experiment. The sequence includes:

1. **Commercial harvest** - A commercial harvest within WLPZ that have been designated as "experimental forestlands" by the Board. These harvests are one of three experimental treatments: 1) a "status quo" harvest of directional felling of large trees; 2) a thin from below to a target basal area; and 3) a thin from below plus small canopy gap creation.

2. **Activity fuel piling** - This occurs after the commercial harvest and consists of hand crews and low impact heavy equipment. The objective is to concentrate activity fuel from the harvest as well as precommercial trees into piles that can be burned.

3. **Burning of piles.** This represents the final treatment and can be a combination of discrete pile burning or pile burning plus broadcast burning (i.e. "pilecast" burns).

In 2021, phase 2 was completed for all study areas utilizing funds outside of the EMC contract. While the intent was to complete phase 3 in 2021, this did not occur in all study areas because a burn permit was not authorized to burn the piles when conditions were appropriate to meet defined objectives. By the time burning could be permitted in the fall time, conditions were very wet. Hand piles and small machine piles absorb a lot of moisture and do not stay dry within an interior core, as does occur with large machine piles.

High fuel moisture of hand piles is especially pronounced in riparian areas, which tend to be relatively wet and cold. Despite efforts to keep the piles dry with wax coated paper covers, the piles were very wet because of rain and snowfall. The perimeters of the piled areas were lined with a dozer and were prepped for burning during drier conditions, but the permitting challenges prohibited burning.

Despite the setback, piles have been burned whenever resources were available, and approximately 75% of the study areas have been burned. The burning, however, is time-intensive because of wet conditions. It is possible that burning will be completed in the spring of 2022, but this will depend on permitting. Seasonal crews will be available to help with burning in early June. In dry springs, Cal Fire has suspended all burn permits; thus, the completion of the treatments will depend on weather and the ability to obtain burn permits during times when burning is not constrained by wet conditions. In anticipation of these difficulties, most post treatment measurements were completed during summer 2021. This was not preferred because the measurements do not capture the fuel consumption that occurs after burning. To maximize the utility of the data, fuel transects were placed so that they did not overlap with piles. Hence, the measurement assumes that no fuel beyond the pile perimeters would be consumed during burning.

Several preliminary results have been reported for this project and related issues (Board of Forestry and Fire Protection 2019, York and Roughton 2019, York 2020, Ingram 2021). A progress report and results are expected in the late spring or summer of 2022.

EMC-2017-007: The Life Cycle of Dead Trees and Implications for Management

This project is in a 24-ha stand at Blodgett Forest (identified as Compartment 160) where snags have been tracked for almost four decades. Dr. John Battles developed a new annual snag tracking protocol at Blodgett Forest Research Station. The first annual inventory using the new monitoring protocol was completed in 2020. A retrospective study of log decay was also completed to complement the long-term study of downed wood decay rates. This project is complete, and results and a final presentation are expected in spring of 2022.

EMC-2017-008: Forest Practice Rules to Minimize Fir Mortality from Root Diseases

At the October 21, 2021 EMC Meeting, Richard Cobb reported that several publications were in development, recently submitted, or in review. A paper titled "Efficacy of Chemical and Biological Stump Treatments for the Control of *Heterobasidion occidentale* Infection of California *Abies concolor*" was published in October 2021 in the journal *Pathogens*. A final project presentation is anticipated for the April 2022 EMC meeting, and two additional publications are expected to be published in 2022.

EMC-2018-003: Alternative Meadow Restoration

At the April 21, 2021 meeting, Member O'Connor reported that due to extremely low winter precipitation, no meadow streamflow was recorded, greatly complicating measurement of treatment effects. Determination of water quality changes from the WLPZ removal treatment could not be explored due to lack of streamflow in spring and summer of 2021. It is anticipated that—given winter already has significant snowpack—there is a good likelihood of an average water year with spring runoff that would enable the PI to complete the water quality objective. However, it would be beneficial to extend the hydrologic measurements past the spring into the summer for more conclusive evaluation of treatment effects. Further, extending the project into the summer would allow vegetation surveys and soil compaction analysis following a, hopefully, more average winter. Therefore, the PI intends to submit a time extension on this contract, the term of which is currently set to expire on June 30, 2022.

Member O'Connor corresponded with the principal investigator (PI) on October 20, 2021 regarding effects of the Dixie Fire on the project field area, as all meadow sites were affected by the fire. The PI reported the loss of a few instruments, although the fire appeared to have benefitted the grasslands. The surrounding watershed was significantly altered by the fire, likely increasing water yield. This will likely affect previous assumptions regarding upslope drainage contributions to the meadow system. The biggest problem noted by the PI was that fire roads cut directly through the meadow restoration area, and it is currently unclear whether the areas will be restored.

The remaining funds were allocated in August of 2021, and analyses were ongoing and originally expected to be completed in spring 2022. Given the drought conditions and fire impacts, a project extension is merited, and will be submitted for an extension for a term end of October 1, 2022 for final reporting.

EMC-2018-006: Class II Watercourse and Lake Protection Zone

At the April 21, 2021 EMC meeting, Member Matt House announced that harvesting occurred in 2020, and 2021 post-harvest data were being collected. Green Diamond Resource Company staff had supplemented Oregon State University staff due to field limitations related to the pandemic. Austin Wissler scaled back his study to a master's project, and Drs. Bladon and Segura were pursuing a post-doc to continue the project.

At the July 21, 2021 EMC meeting, Dr. Bladon provided a recorded video (see the EMC webpage link: https://bof.fire.ca.gov/media/5uie1e1g/bladonsegura_emcupdate_2021-07-21.mp4) and progress presentation on this project being conducted on Green Diamond Resource Company (GDRC) timberlands in Humboldt County. There are 18 watersheds included in the study—six reference watersheds and four of each of the three riparian treatments. Treatment watersheds were all harvested in 2020 with one of the three treatments: (a) Coastal Anadromy Zone ASP Class II-L Prescription (30-ft core zone, 70-ft inner zone with 80% overstory canopy cover), (b) GDRC Habitat Conservation Plan Prescription (30-ft inner zone with 85% overstory canopy, 70-ft outer zone with 70% overstory canopy cover), or (c) an alternative prescription resembling pre-ASP (& Threatened or Impaired Watersheds (T/I) Rule Package) requirements (100-ft zone with 50% overstory canopy).

There are six circular 1/10 acre fixed-area plots in the riparian area of each watershed to quantify pre- and post-harvest tree condition, species, diameter at breast height (DBH), basal area, and canopy closure from hemispherical photographs. Stream discharge is being measured with salt solution gaging, and dissolved oxygen (DO) and photosynthetically active radiation (PAR) (radiation reaching the stream) data are also being recorded. Longitudinally along each of the 18 stream reaches (1,000 feet) there are four air temperature sensors and 12 stream temperature sensors (288 total sensors). Two centrally located meteorological stations are also maintained to quantify precipitation, air temperature, wind speed, soil moisture, and relative humidity. Additionally, 27 groundwater wells have been installed to document how water is routed to stream channels. All automated sensors have been set up to collect data at 15-minute intervals.

Pre-harvest mensuration data presented show that the three treatment sites and the controls are generally comparable when considering the mean number of trees per acre, basal area, canopy closure, and leaf area index (LAI). Annual precipitation was only approximately 50% of the long-term average during the winter of 2019–2020, but air temperatures were close to average. Stream discharge was similar in the reference and pre-ASP watersheds, but considerably lower in the ASP basins. Very limited flow response is expected due to the very low WLPZ harvest rates.

Preliminary stream temperature data show little evidence of discrete locations of groundwater discharge or spring inputs (i.e., stable temperature moving in a downstream direction). Plots of stream temperature for reference watersheds vs. ASP and HCP basins show no effect, while pre-ASP basins show a harvest effect, with increases of ~0.3˚C (0.5˚F). Photosynthetically active radiation data show no treatment differences, except for pre-ASP basins, where increases of 244% have been documented. Mean chlorophyll-a concentrations are slightly elevated for all the treatment basins and the reference watersheds. Monthly water chemistry grab samples for nitrogen, phosphorus, and dissolved organic carbon (DOC) do not reveal large changes to date. Next steps include continued data collection and sampling, application of Quality Assurance and Control protocols, post-harvest data analyses, and publishing a stream temperature paper in early 2022 (Wissler) and a streamflow response paper in late 2022 (Nicholas). Post-doctoral scholar Dr. Lorrayne Miralha started on the project in October 2021 to conduct longer term data analyses. Final results are expected in 2023.

EMC-2019-002: Evaluating Treatment Longevity and Maintenance Needs for Fuel Reduction Projects Implemented in the Wildland Urban Interface of Plumas County, CA

At the July 21, 2021 EMC Meeting, Member Stacy Drury provided a project update. Member Drury was in contact with the Feather River Resource Conservation District (RCD), which had moved forward with the project, COVID had put the project behind schedule. Some experimental sites burned in 2020, and fires in the summer had encroached on some of the plots, but the project was still on track to provide the contracted deliverables.

At the October 21, 2021 meeting, Member Drury provided an additional update, stating that the project was wrapping up. The Dixie Fire burned most of the experimental sites, and many could no longer be evaluated, resulting in a delay in the final report, so the project investigators would need to re-evaluate the next steps and timeline.

An additional update provided by Michael Hall with the Feather River District was also provided in December 2021. Mr. Hall reported that the North Complex Fire (2020) and Dixie Fire (2021) directly impacted several projects implemented by the Plumas County Fire Safe Council, including this one. This created an opportunity to assess how the treatments were utilized by firefighters as defensible space and how the treatments may have affected post fire mortality. Once the fire closures were lifted, several of these burned projects were visited and evaluated using ground and UAV based imagery. Additional analysis was ongoing as of December 29, 2021, and a final report was submitted to the EMC on December 31, 2021 (Moghaddas et al. 2021).

EMC-2019-003: Fuel Treatments and Hydrologic Implications in the Sierra Nevada

In December 2021, the PIs provided an update via email, reporting that in 2020, COVID-19 delayed the start date of the project by several months and ongoing impacts due to the pandemic impacted the proposed timeline. Further, Dr. Kinoshita was on maternity leave during Fall 2021. However, several site visits were conducted in 2021 to the Sagehen watershed for extensive spatial data collection, and work is ongoing on the statistical analysis of various data streams, and initial work was started on integrated hydrologic modeling for the Sagehen watershed. Streamflow data were acquired and reset in both June and October this year. These data are being quality controlled and added to the existing long-term dataset. An additional year of data were acquired for Leaf Area Index, Simplified Surface Energy Balance (SSEBoP) evapotranspiration (ET) and Moderate Resolution Imaging Spectroradiometer (MODIS) Fraction of Photosynthetically Active Radiation (FPAR) 4-day global datasets were acquired using Google Earth Engine

and analyzed. LiDAR data available for Sagehen was acquired for both 2014 and 2018 for the basin and canopy cover loss/gain was analyzed for the system. Streamflow data at the sub-basin scale and watershed outlet (USGS) have been analyzed and change detection methods applied.

Preliminary results indicate that at the watershed and sub-watershed scale, changes in runoff are explained by precipitation and ET is not an important part of the variability in observed runoff depth. Using 30-m satellite-based ET, there was less than a 15% change at the sub-basin scale. The relative change in forest density between 2014 and 2018 highlights the potential for high variability or monitoring hot spots for large changes in ET at the sub-basin scale. This demonstrates that ET and forest structure are linked; however, the scale of treatment is relatively minor at the watershed scale, and the impacts to basin-scale runoff are not discernable. Further scaling of "hot spot" behavior to the watershed scale, using integrated hydrologic modeling, will provide further insight on treatment impacts on ecohydrologic response and impact from regional treatments.

Initial results were presented in a talk titled "Hydrologic response to forest treatment practices for wildfire mitigation in a Sierra Nevada watershed" at a regional fire symposium workshop in Boulder, CO in October 2021 and at the AGU Fall National meeting in New Orleans, LA in December 2021.

The PIs intend to file a request for a contract time extension to complete the following tasks:

- Finalize physically-based hydrologic model parameterized for a range of spatially-varying fuel treatments;
- Further develop statistical tools and algorithms that integrate the monitoring data and satellite-based products and can further elucidate relationships between forest canopy change and hydrologic response;
- Create an integrated package, including models and statistical framework, that is downloadable and usable by stakeholders, resource managers and decision-makers; and,
- Produce scientific papers and reports.

EMC-2019-005: Sediment Monitoring and Fish Habitat – San Vicente Accelerated Wood Recruitment

At the April 21, 2021 EMC meeting, Member Short reported that the two watersheds to be studied in Santa Cruz County had burned in the CZU Lightning Complex and the Sempervirens Fund was not going to continue with the Timber Harvest Plan (THP). Project investigators met with Board staff to discuss alternatives that might be available, including changing the project to a post-fire large wood study. However, RPF Nadia Hamey was planning to go forward with the project. The California Geological Survey had installed monitoring equipment in the stream channels, and data were being collected. They observed significant sediment within the channels.

At the October 21, 2021 meeting, Member Short reported that a modified plan for the project would be submitted. At that time, the project was still on hold, but Member Short anticipated that the plan would go through as modified and work to fly the LiDAR for pre-project analyses was planned for winter, and some streamflow surveys had been conducted.

More recent communication with RPF Hamey indicates that trees have been remarked for the project and the THP and Section V Accelerated Wood Recruitment (AWR) documents are in the process of being revised and are planned to be submitted early in the new year. The AWR aspect of the project is intended to commence Summer 2022. Full baseline surveys are anticipated to be conducted during Spring 2022 and post-implementation surveys conducted Fall 2022.

EMC PROJECT RESULTS AND PRODUCTS

The following section provides more information on reported project deliverables in 2021, or prior if applicable:

EMC-2015-001: Class II Large Watercourse Study: Multiscale investigation of perennial flow and thermal influence of headwater streams into fish bearing systems

This project is complete, and additional publications and presentations are expected. One manuscript is being revised for submission to a different journal after rejection from the journal *Hydrological Processes*. Another new manuscript was recently accepted into *Hydrological Processes* with major revisions. Once published, final versions will be shared with the EMC. The following items were published or presented in 2021:

- An article titled, "Comparing headwater stream thermal sensitivity across two contrasting lithologies in Northern California" was published in January 2021 with the journal *Authorea* (Wissler et al. 2021).
- Member Coe provided a project update at the January 13, 2021 EMC meeting.
- As part of a virtual California Fire Science Seminar Series, Dr. Bladon provided a presentation titled "Wildfire and Post-Fire Management Effects on Water Resources" on April 13, 2021 (Bladon 2021).
- A final project presentation on results was given at the EMC meeting on April, 21, 2021.
- Co-Chair Husari provided the Board with a project update at the July 2, 2021 Board Meeting.
- Final project results and a Completed Research Assessment were presented to the Board at the Forest Practice Committee meeting on July 14, 2021, and at the EMC meeting on July 21, 2021. Following revisions, an additional presentation was given to the Board at the Forest Practice Committee meeting on September 10, 2021. A presentation on policy implications and an additional project update were presented to the Board at the Forest Practice Committee meeting on November 3, 2021, and again on December 8, 2021.

EMC-2016-002: Post-fire effectiveness of the Forest Practice Rules in protecting water quality on Boggs Mountain Demonstration State Forest

This project is complete, and additional publications and presentations are expected. The following items were published or presented in 2021:

- At the January 13, 2021 EMC meeting, Member Coe summarized a published poster that was presented online at the Fall 2020 AGU meeting titled "Alternative methods for reducing sediment delivery from skid trails used for post-fire logging" (Wagenbrenner et al. 2020).
- Dr. Joe Wagenbrenner gave a presentation titled, "Post-Fire Salvage Logging Effects on Soils, Runoff, and Sediment Production in Western Watersheds" (Wagenbrenner et al. 2021) on April 5,

2021 at the Salvage Webinar series co-hosted by the Rocky Mountain Research Station, Northern Rockies Fire Science Network, Southern Rockies Fire Science Network, and the Northwest Fire Science Consortium.

EMC-2016-003: Road Rules Effectiveness at Reducing Mass Wasting (Repeat LiDAR Surveys to Detect Landslides)

Project updates were provided at the April 21, July 21, and October 21, 2021 EMC meetings. Results for this project are expected in mid-2023, and as such, no publications or presentations occurred in 2021.

EMC-2017-001: Effects of Forest Stand Density Reduction on Nutrient Cycling and Nutrient Transport at the Caspar Creek Experimental Watershed

A project update was provided at the April 21, 2021 EMC meeting. Results for this project are expected in 2022, and as such, no publications or presentations occurred in 2021.

EMC-2017-002: Boggs Mountain Demonstration State Forest (BMDSF) Post-Fire Automated Bird Recorders Study

Results for this project are expected in spring 2022, and as such, no publications or presentations occurred in 2021.

EMC-2017-006: Tradeoffs among Riparian Buffer Zones, Fire Hazard, and Species Composition in the Sierra Nevada

Several extension products with preliminary results have been developed and are comprised as follows: a presentation was given at the California Licensed Foresters Association in 2019 (York and Roughton 2019); a field tour was given to the EMC in 2020 (York 2020); a white paper on partial harvests in the WLPZ (Board 2019); and a blog entitled "Fuels Management in Creeks and Streambeds" published with the University of California Agriculture and Natural Resources Forestry Research and Outreach Program (Ingram 2021). A project update was provided at the January 13, 2021 EMC meeting, and an email update was provided in September 2021. Results for this project are expected in late spring or summer of 2022, and as such, no publications or presentations occurred in 2021.

EMC-2017-007: The Life Cycle of Dead Trees and Implications for Management

A project update was provided at the January 13, 2021 EMC meeting. Results for this project are expected in spring 2022, and as such, no publications or presentations occurred in 2021.

EMC-2017-008: Forest Practice Rules to Minimize Fir Mortality from Root Diseases.

A project update was provided at the October 21, 2021 meeting. A final project presentation, including discussion of the Completed Research Assessment, is planned for the EMC's April 2022 meeting. In mid-2021, Mr. Cobb reported provided an email update with information on publication status of three articles as follows:

- An article titled, "Efficacy of Chemical and Biological Stump Treatments for the Control of *Heterobasidion occidentale* Infection of California *Abies concolor*" was published in October 2021 with the journal *Pathogens* (Poloni et al. 2021).
- A second article titled, "Heterobasidion effects on stand composition over fifty years of root disease in California fir and pine forests" will be submitted to a peer-reviewed journal soon.

- A third article titled, "Interactions between forest structure, host community, and pathogen identity during 50 years of Heterobasidion root disease in the Sierra Nevada - Southern Cascade Mountains" is being prepared.

EMC-2018-003: Alternative Meadow Restoration

A project update was provided at the April 21, 2021 meeting. It is expected that a presentation will be given to the EMC in spring of 2022. At least two theses are expected to be completed in 2022. Other anticipated deliverables include at least one peer reviewed journal manuscript to be prepared in 2022, and one presentation to be delivered at a professional forest science related conference. Due to the complicating effects of drought and fire on the project sites, the PI intends to submit a project extension request to allow for an additional four months to allow for supplementary data collection and time to complete analyses and produce final reports.

EMC-2018-006: Class II Watercourse and Lake Protection Zone

A project update was provided at the April 21, 2021 EMC meeting. A recorded project presentation, virtual field tour, and project status update were provided at the July 21, 2021 EMC meeting. Final results for this project are expected in 2023.

EMC-2019-002: Evaluating Treatment Longevity and Maintenance Needs for Fuel Reduction Projects Implemented in the Wildland Urban Interface of Plumas County, CA

Project updates were provided at the July 21 and October 21, 2021 EMC meetings, and a final report was submitted to the EMC on December 31, 2021 (Moghaddas et al. 2021). A final presentation and Completed Research Assessment are expected in 2022.

EMC-2019-003: Fuel Treatments and Hydrologic Implications in the Sierra Nevada

A project update was provided by email in December 2021, which included preliminary results, an adjusted timeline, and information on a talk titled "Hydrologic response to forest treatment practices for wildfire mitigation in a Sierra Nevada watershed" given at a regional fire symposium workshop in Boulder, CO in October 2021 and at the AGU Fall National meeting in New Orleans, LA in December 2021 (Bode et al. 2021). The PIs intend to file a request for a contract time extension to produce additional deliverables, including: (1) a hydrologic model parameterized for a range of spatially-varying fuel treatments; (2) statistical tools and algorithms integrating monitoring data and satellite-based products to explore relationships between forest canopy change and hydrologic response; (3) an integrated package, including models and statistical framework, that is downloadable and usable by stakeholders, resource managers and decision-makers; and (4) scientific papers and reports.

EMC-2019-005: Sediment Monitoring and Fish Habitat – San Vicente Accelerated Wood Recruitment

Results for this project are expected in 2022, and as such, no publications or presentations occurred in 2021. Project updates were provided at the April 21 and October 21, 2021 meetings.

POTENTIAL EMC PROJECT IMPACTS TO REGULATIONS

The EMC provides valuable insight to the Board on testing the effectiveness of their rules and regulations by way of science-based research projects. EMC-funded studies may show that regulatory modifications, either minor or major, need to occur to ensure the effectiveness of the FPRs (14 CCR § 895 et seq.). The EMC moved findings from EMC-2015-001 (Class II Large Watercourse Study) to the Board for consideration in

2021, and this will likely lead to rule revision in 2022. Th EMC expects to move findings from EMC-2016-003 (Repeat LiDAR Surveys to Detect Landslides), EMC-2017-006 (Tradeoffs among Riparian Buffer Zones, Fire Hazard, and Species Composition in the Sierra Nevada), and EMC-2017-008 (FPRs to Minimize Fir Mortality from Root Diseases) to the Board for consideration in 2022 or 2023.

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