EFFECTIVENESS MONITORING COMMITTEE (EMC)
Strategic Plan

Submitted to the California State Board of Forestry and Fire Protection

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Cover photos (clockwise from the top left): Class II-Large water temperature study site on LaTour Demonstration State Forest; Montana weir at a gaging station in the South Fork of Caspar Creek watershed, Jackson Demonstration State Forest; Automated bird recorder installed on Boggs Mountain Demonstration State Forest (BMDSF); and plot-scale sediment fence installed as part of the BMDSF post-fire runoff and erosion study.

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EXECUTIVE SUMMARY

The California State Board of Forestry and Fire Protection (Board) formed the Effectiveness Monitoring Committee (EMC) in 2014 to develop and implement a monitoring program to address both watershed and wildlife concerns and to provide a better active feedback loop to policymakers, managers, agencies, and the public. Effectiveness monitoring is necessary to assess whether management practices are achieving the various resource goals and objectives set forth in the California Forest Practice Rules (FPRs), and other natural resource protection statutes and laws, codes and regulations, (EMC 2013, MacDonald et al. 1991) and is a key component of adaptive management. Effectiveness monitoring is also a crucial component for complying with the "ecological performance" reporting requirements outlined in Assembly Bill 1492 (Committee on Budget, Chapter 289, Statutes of 2012).

Through the Strategic Plan process, the EMC and the Board developed a suite of critical monitoring questions based on input from a variety of stakeholders and organized them into groups of 11 individual themes. The EMC uses these themes and critical questions as guidance to solicit and evaluate specific monitoring projects. The goal is to develop a process-based understanding of the effectiveness of FPRs and associated regulations in maintaining and enhancing water quality, and aquatic and wildlife habitats.

In addition to laying out the critical monitoring questions, the Strategic Plan documents EMC ground rules, staffing and funding, connections to the AB 1492 Timber Regulation and Forest Restoration Program, an adaptive management framework, and processes for monitoring project solicitation and evaluation. The EMC will review and update the Strategic Plan every three years and present it to the Board for approval.

Serving as a companion to the Strategic Plan, the EMC Annual Report and Work Plan documents yearly accomplishments by the Committee, tracks changes in the Committee membership, documents the project selection process for the year, and provides updates on the status of previously funded monitoring projects. The work products and processes of the EMC include the following:

- Periodically update EMC Strategic Plan for Board consideration (approximately every three years).
- Prepare an Annual Report and Workplan for Board consideration.
- Regularly meet in open, webcast public meetings to conduct its work.
- Annual distribution of a Request for Proposal (RFP) soliciting monitoring project proposals. This distribution includes posting to the EMC website.
- Review and rank project proposals, and ultimately recommend certain projects for funding by February of each year. Funding of projects occurs from an annual allocation of $425,000 each fiscal year from the Timber Regulation and Forest Restoration Fund (TRFRF).
- Review Committee membership. A Call for Membership, if necessary, is widely distributed to encourage a broad spectrum of applicants that meet membership qualifications.

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LIST OF ABBREVIATIONS

ASP	Anadromous Salmonid Protection
BMPs	Best Management Practices
Board	California State Board of Forestry and Fire Protection
CAL FIRE	California Department of Forestry and Fire Protection
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CGS	California Geological Survey
CNRA	California Natural Resources Agency
DSF	Demonstration State Forest
EMC	Effectiveness Monitoring Committee
ESA	Endangered Species Act
EX-EM	Exemption and Emergency Notices
FGC	Fish and Game Code
FGCom	Fish and Game Commission
FORPRIEM	FPRs Implementation and Effectiveness Monitoring Program
FPA	Forest Practice Act
FPC	Board Forest Practice Committee
FPRs	California Forest Practice Rules
MC	Board Management Committee
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
Plans	Timber Harvesting Plans and all other harvest documents as defined under 14 CCR § 895.1
RPF	Registered Professional Forester
THP	Timber Harvesting Plan
TMDL	Total Maximum Daily Load
TRFR	Timber Regulation and Forest Restoration Program
USFS	U.S. Department of Agriculture, Forest Service
Water Boards	State and Regional Water Quality Control Boards
WLPZ	Watercourse and Lake Protection Zone
Working Groups	AB 1492 program Working Groups: Ecological Performance Measures, Data and Monitoring, Administrative Performance Measures, and Interagency Information Systems.
WQCP	Water Quality Control Plan, which is commonly referred to as Basin Plan.

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1.0 INTRODUCTION

The EMC was formed in 2014 to develop and implement a monitoring program to address both watershed and wildlife concerns and to provide a better active feedback loop to policymakers, managers, agencies, and the public. Effectiveness monitoring is necessary for assessing whether management practices are achieving the various resource goals and objectives set forth in the California Forest Practice Act (FPA) and Rules and other natural resource protection statutes and laws, codes and regulations (EMC 2013, MacDonald et al. 1991). The approach laid out here is a key component of adaptive management. Effectiveness monitoring is also a crucial component for complying with the "ecological performance" reporting requirements outlined in AB 1492. The types of monitoring potentially utilized by the EMC are briefly explained in Figure 1.

This Strategic Plan communicates the EMC's goals, actions necessary to achieve the goals, and critical components of the planning process. The EMC Strategic Plan will be updated approximately every three years. Section 1.0 of the document provides a brief background on forest practice-related monitoring in California, describes the membership of the EMC, the goals of the Committee, and ground rules for interaction among Committee members. Section 2.0 describes the overall strategic plan "road map," including the development of critical questions, identification of cumulative effects as an important issue, and consideration of ecological performance measures. Since monitoring is a key component for adaptive management, Section 3.0 describes the EMC and Board's role in an adaptive management framework. Section 4.0 describes important elements of the planning process, such as scale considerations for monitoring study design. Section 5.0 describes the process used by the EMC to solicit, select and fund projects. In addition to the EMC Strategic Plan, the EMC Annual Report and Workplan is updated annually to track progress on individual projects and document the Committee's ranking of proposed monitoring projects.

1.1 Background

Effectiveness monitoring is a key component of adaptive management. The EMC's work builds upon and expands previous monitoring work conducted in California. From 1992 through 2014 California's state and private forestlands implementation and limited short-term effectiveness monitoring focused primarily on water quality related issues (Tuttle 1995, Lee 1997, BOF 1999, Cafferata and Munn 2002, Brandow et al. 2006, Longstreth et al. 2008, BCTF 2011, Brandow and Cafferata 2014). Longer-term cooperative instream monitoring studies also have studied potential impacts from harvesting practices on water quality and aquatic habitats. These projects have included the Caspar Creek watershed study (Rice et al. 1979, Ziemer 1998, Lewis et al. 2001, Cafferata and Reid 2013), the Garcia River Instream Monitoring Project (Euphrat et al. 1998, Maahs and Barber 2001, Barber and Birkas 2006), the Little Creek Watershed Study (Skaugset et al. 2012, Loganbill 2013, Dietterick et al. 2015), the Judd Creek Watershed Study (MacDonald and James 2012), and the South Fork Wages Creek Watershed Study (RiverMetrics 2011). Existing monitoring approaches have had limited use for adaptive management, and have only addressed water quality and aquatic habitat concerns. As such, the EMC incorporates more comprehensive, rigorous and hierarchical forms of monitoring to aid in adaptive management.

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The EMC was formed in 2014 to develop and implement an effectiveness monitoring program to address both watershed and wildlife concerns, and to provide a better active feedback loop to policymakers, managers, agencies, and the public.

Figure 1. Monitoring types.

● Implementation	Assess whether management practices were conducted as designed and planned.
● Compliance	Monitoring used to determine whether specific rule, regulation, code or policy is being met.
● Effectiveness	Evaluation of whether a specific management practice had the desired effect.
● Project	Assesses the impact of a specific management activity or project; can be a subset of Effectiveness monitoring.
● Validation	Evaluation of existing data sets or both numerical and conceptual models including management models.
● Baseline	To identify temporal variability for planning and future comparison.
● Trend	Conducted at regular, well-spaced intervals to determine long-term trend to evaluate management practices or evaluate models.

(Adapted from MacDonald et al. 1991)

1.2 EMC Charter

The Board-approved charter directs the EMC to be a collaborative, transparent, and science-based monitoring effort. A goal of the EMC is to develop a process-based understanding of the effectiveness of the FPRs and other natural resource protection statutes and laws, codes and regulations, including the California Endangered Species Act (ESA), federal ESA, Porter-Cologne Water Quality Act, federal Clean Water Act, and Fish and Game Code (FGC) (Figure 2). We refer to these collectively as the FPRs and associated regulations in maintaining or enhancing water quality, aquatic habitat, and wildlife habitats. The EMC will emphasize addressing specific effectiveness monitoring requirements that are contained in the California Forest Practice Rules (FPRs) and statutes.

Figure 2. EMC charter goals.

(a) Provide a framework and support to comply with the reporting requirements of AB 1492 (Appendix A).

(b) Support an adaptive management process by providing feedback to the Board regarding effectiveness of the FPRs and associated regulations.

(c) Facilitate and recommend monitoring practices to evaluate how well current practices restore and maintain riparian, aquatic, and terrestrial habitat on private and state forestlands for state and federally listed species and priority species of concern (aquatic and terrestrial).

(d) Ensure that the process is consistent with the goals of the Clean Water Act for water quality on private and state forestlands.

(e) Ensure that the process is consistent with the goals of the Federal and State ESAs on private and state forestlands.

(f) Ensure that appropriate scientific methods and statistical evaluation, when necessary, are used to evaluate effectiveness of FPRs and associated regulations.

(g) Encourage dissemination of information through general public and scientific outlets.

(h) Promote use of State Demonstration Forests for effectiveness monitoring of FPRs, Water Quality laws and FGC, and other forestry-related laws and regulations.

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1.2.1 EMC Membership

In 2014, the Board appointed two Co-Chairs, 14 Committee members and identified five support staff. EMC members represent a wide range of natural resource expertise from academia, state and federal agencies, private and state forestland owners, and the public. Their expertise includes forest management, forest ecology, hydrology, geology, aquatic ecology, fisheries, wildlife management, and resource monitoring and sampling. Co-chairs facilitate meetings to ensure all actions and recommendations are made by consensus whenever possible. If failure to reach consensus occurs, the record (i.e., meeting notes) shall specify the key differences and the reasons consensus could not be reached. The Co-Chairs and Executive Officer of the Board establish each Committee member's respective term duration. Current membership is updated in the EMC Annual Report and Workplan.

1.2.2 EMC Ground Rules

As described in the EMC Charter, EMC meetings shall be publicly noticed and will be open to all interested parties, following the Bagley-Keene Open Meeting Act requirements. Meeting are webcast to the extent that technical resources allow. Board-appointed EMC members are encouraged to follow meeting "ground rules" to foster a collaborative scientific-based approach to achieving the stated goals and objectives of the EMC (adapted from WFPB 1987).
These ground rules include a commitment to:

(1) Attempt to reach consensus.
(2) Attend all scheduled meetings.
(3) Listen carefully and ask questions to better understand unclear issues.
(4) Have the EMC receive priority attention, staffing, and time.
(5) Have all EMC members clearly define the purposes and goals of their organizations.
(6) Have all EMC members recognize the legitimacy of the goals and differing perspectives of other EMC member organizations.

1.3 EMC Reporting

The EMC formally reports its activities in three ways. First, the EMC Co-Chair or Board staff give verbal updates at Board meetings. Second, the EMC updates its Annual Report and Workplan annually. The EMC Annual Report and Workplan update is approved and finalized by the Board. Third and last, the EMC is included in the Board's annual report to the Legislature. The EMC's portion of this report will be extracted from the EMC Annual Report and Workplan.

1.4 EMC Personnel and Funding

Dedicated staff and funding are necessary to achieve EMC goals and objectives, and support projects reviewed and recommended by the EMC. Public agencies and departments including CAL FIRE, California Department of Fish and Wildlife (CDFW), State and Regional Water Quality Control Boards (Water Boards), California Geological Survey (CGS), United States Forest Service (USFS), National Marine Fisheries Service (NMFS), and the California Natural Resources Agency (CNRA) have committed personnel to participate in the EMC discussions and meetings. Private landowners, conservation groups, and universities have also committed personnel. CAL FIRE provides specific personnel to provide technical support to the EMC. In fiscal year 2015/2016, the Board received the addition of one staff person funded by the Timber Regulation and Forest Restoration Fund to specifically support EMC efforts.

During development of the EMC Strategic Plan several critical needs for future personnel and funding were identified. These include

- Literature review by technical expert(s).
- Study design or statistical review.
- Specialized statistical analysis or modeling.

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- Sponsorship of graduate students or contribution to an existing university study(s).
- Ability to respond to and monitor rare and large events (see Section 4.3.1).
- EMC supported projects that require additional support for participation of university(s), specialized consulting or non-government organizations.
- Support for projects consistent with AB 1492 Working Groups. Also see Section 2.3 for more information related to the Timber Regulation Forest Restoration (TRFR) program.
- Funding to reimburse EMC members travel costs for meetings.
- Organizing and holding public outreach meetings to share EMC project information.
- Obtaining other sources of data or information for EMC sponsored projects (e.g., LiDAR, aerial photos).

Projects are funded from the TRFR fund. The allocation of funding is detailed in the EMC Annual Report and Workplan.

2.0 EMC STRATEGIC PLAN ROAD MAP

The EMC Strategic Plan road map guides how the Committee intends to achieve the EMC goals and objectives. The EMC Strategic Plan is a guidance document. The EMC Annual Report and Workplan is a living document that is updated annually to document the project selection process and the progress on selected projects. The EMC Strategic Plan is guided by seven primary objectives described in the EMC Charter which, for the purposes of developing critical monitoring questions, has been edited and summarized in Figure 3.

Figure 3. Primary objectives in developing critical monitoring questions.

- Seek, accept, and consider questions from stakeholders and the interested public.
- EMC members, in conjunction with the Board, should identify critical monitoring questions that address various EMC goals and objectives.
- Develop guidance for appropriate scientific methods and statistical evaluation used to evaluate effectiveness of FPRs and associated regulations.
- Increase understanding of the linkage between forest practices and the resource(s) of concern.
- Provide guidance for the acceptable level of scientific uncertainty across the broad spectrum of monitoring efforts from small-scale short-term monitoring to long-term replicated studies.
- Collaboratively develop methods to prioritize monitoring questions, and based on these methods, help select the highest priority projects to monitor.
- Promote collaborative fact-finding and understanding of scientific results at local, regional, and state levels.

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2.1 Development of Critical Monitoring Questions

As the first step in developing critical monitoring questions, the EMC sought and accepted priorities and monitoring questions from a wide variety of stakeholders including agency(s), department(s), board(s), and EMC members, and identified key areas of concern from the interested public. Development of critical monitoring questions is an open and transparent public process where inclusion of priorities and public comments can be followed on the EMC webpage (http://bofdata.fire.ca.gov/board_committees/effectiveness_monitoring_committee_/) and in Appendix C. The EMC reviewed the various proposed priorities and monitoring questions and developed critical monitoring questions to better understand whether management practices are achieving the various resource goals and objectives set forth in the FPRs and associated regulations.

The second step was to submit to the Board for review a final list of critical monitoring questions along with a draft Strategic Plan. The Board approved the list of critical monitoring questions with the Strategic Plan on December 6, 2017. Appendix C summarizes priorities and monitoring questions received from various stakeholders.

The third and final steps are an ongoing process. The third step is to evaluate specific monitoring projects, described in the EMC Annual Report and Workplan, that aim to address an EMC critical monitoring question(s). The final step is to initiate EMC sponsored projects.

2.2 Cumulative Effects

The Board identified cumulative effects during committee discussions as a priority in their Annual Report (Board 2014a). Cumulative impacts in the FPRs are defined as found in the California Environmental Quality Act (CEQA) guidelines (14 CCR § 15355). Since the EMC recognizes that management practices may produce either positive or negative cumulative impacts, the EMC will refer to cumulative effects and cumulative impacts as interchangeable terms. A focus on cumulative effects is consistent with the goals of the EMC, given that the proper implementation of best management practices (BMPs) is often cited as an approach for limiting cumulative effects from forest practice activities (Reid 2004). As such, it is necessary to evaluate the effectiveness of these practices at multiple spatial and temporal scales.

The EMC recognizes that cumulative effects encompass a broad spectrum of natural processes, resources of concern, and their linkages over time and space (MacDonald 2000, MacDonald et al. 2004, Reid 1993). Consequently, EMC projects implement an explicit strategy for monitoring and evaluating potential cumulative effects. The first element of the strategy is to monitor the causal linkages between FPRs and associated regulations and the resource(s) of concern at relatively small spatial and temporal scales, with special emphasis on understanding the management impacts on a particular resource and/or controlling natural process(es) (MacDonald and Coe 2007). The second element is to use a nested approach for monitoring to identify linkages at larger spatial and longer temporal scales (see Box 1). This approach would limit problems that have confounded many previous attempts to evaluate cumulative effects by monitoring discrete causal linkages between FPRs and associated regulations and resource(s) of concern (MacDonald 2000), and it can apply to cumulative effects in both aquatic and

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terrestrial systems. Section 4.3 provides more guidance on choosing the appropriate spatial and temporal scale for monitoring.

Box 1: Case Study of Cumulative Watershed Effects: The Caspar Creek Experimental Watershed Study

Monitoring programs that implement hierarchical and nested sample designs can focus on multiple study objectives in an integrated manner. Cumulative effects are the result of multiple localized impacts that manifest themselves at larger spatial and temporal scales. Nested study designs that characterize processes and linkages across multiple scales are best suited to address the multiscale complexities of cumulative effects (Ralph and Poole, 2001). The Caspar Creek Experimental Watershed Study provides a case study for illustrating these principles.

The Caspar Creek study is a cooperative project between CAL FIRE and the USFS Pacific Southwest Research Station located on Jackson Demonstration State Forest. It is the only research study with long-term records of streamflow and sediment from nested small watersheds in northern California. Caspar Creek has been the subject of three separate watershed studies, with the first experiment conducted in the South Fork starting in 1962. The second experiment began in 1985, with the goal of investigating cumulative watershed effects resulting from clear-cut harvesting primarily using cable yarding in the North Fork. The cumulative effects of logging and road construction on suspended sediment, storm runoff volume, and peak streamflow were documented using the modern FPRs in effect from 1989 to 1992. The extent of clearcutting in individual gaged tributaries ranged from 35% to nearly 100%, using a nested watershed design. The third experiment began in 2011 in the South Fork and is examining the influence of forest stand density reduction (25% to 75%) in gaged tributary watersheds on physical, chemical, and biological watershed processes. Six gaged sub-watersheds with varying levels of stand reduction will be harvested in 2018, with 2 sub-watersheds serving as controls and 3 monitoring stations located on the mainstem of the South Fork. The third experiment is nested from the individual tree all the way to the watershed scale.

Results produced from the first two experiments indicated that suspended sediment loads increased almost 3-fold from selection logging and road construction prior to implementation of the modern FPRs. Smaller, but statistically significant, increases in sediment were associated with clearcutting and road construction conducted under the FPRs in effect during the second experiment. The effects of multiple disturbances on suspended loads were found to be approximately additive, and downstream suspended load increases were no greater than would be expected from the proportion of area harvested. Runoff-induced gully initiation and rejuvenation in low order watercourses was found to be a major sediment source during periods without large landslides. Results to be produced from the third experiment in the South Fork will provide additional information on cumulative watershed effects with its innovative nested design.

2.3 Ecological Performance - Timber Regulation and Forest Restoration Program

The TRFR Program is directed by AB 1492 to develop ecological performance measures for state and private forestland management. Figure B-2 in Appendix A provides some context for the scale of these ecological performance measures. The TRFR Program has been making gradual progress in this work, with initial support from the University of California, Berkeley, to prepare a white paper on science, concepts, and potential approaches for ecological performance measures. A modified version of that white paper is currently under development by CNRA staff. The intent is that the white paper will provide a common basis of terms and concepts that the TRFR Program can use to engage agencies and the public in discussions toward the development of ecological performance measures for state and private forestland management. Completion of ecological performance measures is anticipated sometime in 2019. Ultimately, the ecological performance measures developed through this process will interconnect with the monitoring questions that the TRFR Program needs to answer.

Natural variability is an inherent characteristic of healthy ecosystems and plays a beneficial role in maintaining ecosystem functions and processes (Holling and Meffe 1996). This innate heterogeneity is an important measure of ecological performance; however, defining quantitative metrics for the natural range of variability is complex and not currently captured in the FPRs and associated regulations. For that reason, effectiveness monitoring projects are unlikely to address range of variability. Such concepts are more likely to fit under the aegis of the Ecological Performance Measures Working Group and will be discussed more thoroughly in the ecological performance measures white paper.

2.4 EMC Themes and Critical Monitoring Questions

EMC members, in conjunction with the Board, reviewed priorities and monitoring questions provided by a wide variety of stakeholders and how they may achieve various EMC goals and objectives (see Appendix C for more detail). The specific FPRs for each priority or monitoring question and associated regulations or policies are also described in Appendix C. The EMC has transformed the priorities into critical monitoring questions following a specific structure which is intended to improve understanding and allow better comparisons between multiple monitoring questions (Figure 4).

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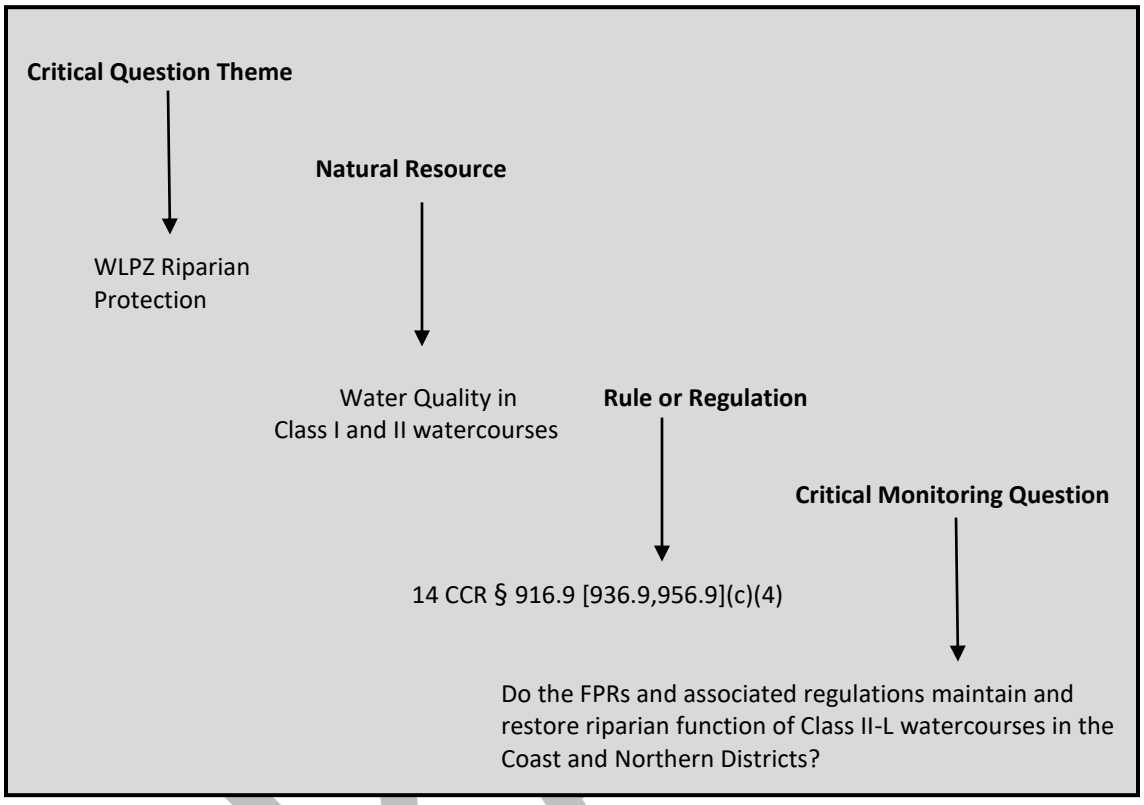
Figure 4. Example: EMC critical monitoring question structure.



During the development of critical monitoring questions the EMC summarized the questions by critical question themes. The monitoring questions were summarized into a total of eleven individual themes. The themes listed below are in no particular order. In addition to these descriptions, a full table of Priorities received from Boards, Departments, and Agencies including appropriate Forest Practice Rules, Regulations, and Policies is available on the board website under under the EMC section titled "Mission and Goals." (http://bof.fire.ca.gov/board_committees/effectiveness_monitoring_committee_/)

Theme 1: WLPZ Riparian Function

The FPRs have been 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, functions of riparian zones or result in an unauthorized take of listed aquatic species (14 CCR § 916 [936, 956]). The primary objective of the Watercourse and Lake Protection Zone (WLPZ) FPRs is to maintain or restore riparian and aquatic functions in classified watercourses. This can occur with both passive and active management approaches that may incorporate options ranging from protection (passive no touch) to active manipulation of stand structure and include timber harvest (14

CCR § 916.9 [936.9, 956.9](v)). Key functions of riparian zones include large wood recruitment, watercourse shading, sediment filtration, nutrient input, microclimate control, streambank/hillslope stability, and habitat for terrestrial wildlife species. The WLPZ FPRs can contribute toward meeting goals of Fish and Game Commission (FGCom) and/or FGCom and Board (Joint) policies, including: Endangered and Threatened Species Policy, Salmon Policy, Water Policy, and Joint Pacific Salmon and Anadromous Trout Policies. Riparian areas occur dynamically within watersheds adjusting to successional vegetation changes and annual hydrologic events and other disturbances (e.g., wildfires, wind, insect, diseases). In addition, the WLPZ FPRs may also contribute toward meeting Basin Plan objectives. Accordingly, the following critical questions should focus on the natural processes and function of WLPZs and have allowances for the dynamic nature of these management areas.

Critical Questions:

Are the FPRs and associated regulations effective in …

(a) maintaining and restoring canopy closure?
(b) maintaining and restoring stream water temperature?
(c) retaining predominant conifers in WLPZs and large woody debris input to watercourse channels?
(d) retaining conifer and deciduous species to maintain or restore riparian shade, water temperature, and primary productivity?
(e) maintaining and restoring input of organic matter to maintain or restore primary productivity as measured by macroinvertebrate assemblages?
(Note: Monitoring may also be appropriate for the AB1492 Working Groups).
(f) maintaining and restoring riparian function of Class II-L watercourses in the Coast District?
(g) maintaining and restoring riparian function of Class II-L watercourses in the Northern District?
(h) managing WLPZs to reduce or minimize potential fire behavior and rate of spread?
(i) filtering sediment that reaches WLPZs?

Theme 2: Watercourse Channel Sediment

Since the implementation of the modern FPRs in 1975, a primary goal of these regulations has been to limit the delivery of management-related sediment to watercourse channels in California. The amount of hillslope erosion and sediment delivery that occurs following timber operations depends on numerous factors, including the site conditions present (e.g., slope, soil type, vegetative cover), soil disturbance, level of proper FPR implementation, and intensity and number of large storm events following the completion of logging. The FPRs have been upgraded numerous times in the past 40 years to reduce management-related sediment delivery. Specifically, current silviculture practice regulations (14 CCR § 913 [933, 953]), harvesting practices and erosion control measures (14 CCR § 914 [934, 954]), watercourse and lake protection (14 CCR § 916 [936, 956]) and logging roads, landings and logging road watercourse crossings rules (14 CCR § 923 [943, 953]) provide measures to ensure timber operations meet the goals and intent of the FPRs by limiting sediment delivery to stream channels. These FPRs can contribute toward meeting goals of FGCom and/or FGCom and Board (Joint) policies that address protection of water quality and fish habitat, including the Endangered and Threatened Species, Salmon,

Water, and Joint Pacific Salmon and Anadromous Trout Policies. In addition, these FPRs may also contribute toward meeting Basin Plan objectives. The critical questions for Theme 2 address erosion and sediment monitoring at both the watershed (or sub-watershed) scale and Plan scale.

Critical Questions:

Are the FPRs and associated regulations effective in minimizing management-related sediment delivery from forest management activities to watercourse channels …

(a) at the watershed and sub-watershed level in managed watersheds?

(b) for individual Plans at the project level to evaluate channel response to forest management prescriptions and additional mitigation measures?

(Note: Monitoring may also be appropriate for the AB 1492 Working Groups)

(see Section 4.3 for discussion of appropriate scale(s)).

Theme 3: Road and WLPZ Sediment

Similar to Theme 2, the Road and WLPZ Sediment theme has been developed to answer critical questions regarding management-related hillslope erosion and sediment delivery to watercourse channels in forested watersheds. Theme 3 focuses on critical questions related to the effectiveness of FPR requirements included in the recently implemented Road Rules 2013 requirements (14 CCR § 923 [943, 953]). These FPRs also contribute toward meeting goals of FGCom and/or FGCom and Board (Joint) policies that address protection of water quality and fish habitat listed above. In addition, these FPRs may also contribute toward meeting Basin Plan objectives.

Critical Questions:

Are the FPRs and associated regulations effective in …

(a) reducing or minimizing management-related generation of sediment and delivery to watercourse channels?

(b) reducing generation and sediment delivery to watercourse channels when timber operations implement the Road Rules 2013 measures?

(c) reducing the effects of large storms on landslides as related to roads, watercourse crossings and landings?

(d) maintaining or improving fish passage through watercourse crossing structures?

(see Section 4.3 for discussion of appropriate scale(s))

Theme 4: Mass Wasting Sediment

To limit mass wasting sediment from anthropogenic sources, the FPRs require that timber operations be planned and conducted to provide mitigation measures to minimize sediment delivery from unstable geologic features (14 CCR § 923 [943, 953]). While considerable past monitoring efforts have addressed implementation and short-term effectiveness of FPRs designed to limit sediment entry related to surface erosion processes, less documentation has occurred on a statewide basis for success of the FPRs in preventing accelerated rates of management-related mass wasting features. This is particularly important in the California Coast Ranges and Klamath Mountains, where landslide features can be the primary sediment delivery mechanism. Achieving this goal is consistent with the goals of FGCom and/or

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FGCom and Board (Joint) policies, including the Endangered and Threatened Species, Salmon, Water, and Joint Pacific Salmon and Anadromous Trout Policies. In addition, these FPRs may also contribute toward meeting Basin Plan objectives. The critical questions for this theme address specific mass wasting-related topics to determine if the current rules and regulations are effective in avoiding and reducing management-induced landsliding.

Critical Questions:

Are the FPRs and associated regulations effective in minimizing sediment delivery to maintain water quality from …

(a) existing chronic unstable geologic features?
(b) mass wasting during episodic rare events and/or large storms *(see Section 4.3.1)*?
(c) mass wasting from high risk geologic features?

Theme 5: Fish Habitat

Numerous FPR regulations relate to the protection of fish habitat features in forested watersheds, particularly those found in the WLPZ rule section [14 CCR § 916 (936, 956)]. Specifically, these FPRs require that timber operations shall be planned and conducted to provide protection for water temperature control, streambed and flow modifications by large woody debris, filtration of organic and inorganic material, upslope stability, bank and channel stabilization, and spawning and rearing habitat for salmonids [14 CCR § 916.4 (936.4, 956.4) (b)]. As stated above for the other themes, these rule requirements contribute toward meeting the goals ofFGCom and/or FGCom and BOF (Joint) policies, including: Endangered and Threatened Species Policy, Salmon Policy, Water Policy, and Joint Pacific Salmon and Anadromous Trout Policy. In addition, these FPRs may also contribute toward meeting Basin Plan objectives. The critical questions included under this theme relate to maintaining and/or restoring the quality and connectivity of foraging, rearing, and spawning habitat.

Critical Questions:

Are FPRs and associated regulations effective in …

(a) describing and mapping the distribution of foraging, rearing and spawning habitat for anadromous salmonids?
(b) maintaining and restoring the distribution of foraging, rearing and spawning habitat for anadromous salmonids?

(Note: Monitoring may also be appropriate for the AB1492 Working Groups).

Theme 6: Wildfire Hazard

A goal of the FPRs is the production and maintenance of forests which are healthy and naturally diverse (14 CCR § 897). Numerous studies have shown that creating these types of forests reduces the risk of high severity wildfire (Safford et al. 2012, North et al. 2009, Omi and Martinson 2004, Martinson and Omi 2003). Several FPR sections address this wildfire hazard reduction theme, including minimum stocking standards (14 CCR § 912.7 [932.7, 952.7]), special silvicultural methods and stocking requirements (14 CCR § 961), silvicultural objectives and regeneration methods (14 CCR § 913 [933,

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953]), logging slash and hazard reduction (14 CCR § 917 [937, 957]), exemptions which facilitate removal of dead, dying or diseased trees (14 CCR § 1038), emergency notices which also facilitate removal of burned, dead, dying or diseased trees (14 CCR § 1052) and fuel hazard reduction (14 CCR § 1051). All of these rule sections provide measures to ensure timber operations meet the goals and intent of the FPRs. These FPRs appear to contribute toward meeting the goals of FGCom or Joint FGCom and Board policies, including: Endangered and Threatened Species Policy, Salmon Policy, Water Policy, Joint Pacific Salmon and Anadromous Trout Policy, and Interim Joint Policy on Pre, During and Post Fire Activities and Wildlife Habitat. In addition, these FPRs may also contribute toward meeting water quality standards. To date, little effectiveness monitoring related to this theme has occurred on a statewide basis. The following critical questions address specific topics related to wildfire hazard reduction. This theme has been further bolstered and brought to the forefront of immediate concerns, due to widespread and increasingly destructive nature of wildandfireswildand fires within the state. Governor Brown Jr. had decreed via executive order, for the formation of the California Forest Management Task Force[1] (formerly: Tree Mortality Task Force) whose foundation is built on guiding land management into creating healthier and more fire-resiliant landscapes.

Critical Questions:

Are the FPRs and associated regulations effective in …

(a) treating post-harvest slash and slash piles to modify fire behavior?
(b) treating post-harvest slash and retaining wildlife habitat structures, including snags and large woody debris?
(c) managing fuel loads, vegetation patterns and fuel breaks for fire hazard reduction?

Theme 7: Wildlife Habitat: Species and Nest Sites

The FPRs have a stated goal to maintain functional wildlife habitat in sufficient condition for continued use by the existing wildlife community within the planning watershed (14 CCR § 897). More specifically the FPRs require that timber operations shall be planned and conducted to maintain suitable habitat for wildlife species (14 CCR § 919 [939, 959]) and protection of nest sites (14 CCR § 919.2 [939.2, 959.2]). Reaching this goal appears consistent with the goals of FGCom or Joint FGCom and Board policies, including: Endangered and Threatened Species Policy and the Raptor Policy. Similar to Themes 4 and 6, extensive effectiveness monitoring on a statewide basis has not been conducted on non-federal timberlands for this or the following wildlife habitat themes. The critical questions that follow address wildlife habitat requirements related to species and nest sites.

Critical Questions:

Are the FPRs and associated regulations effective in protection of nest sites …

(a) following general protection measures in 14 CCR § 919.2 [939.2, 959.2](b)?

[1] Governor Edmund G. Brown, Jr. *Executive Order B-52-18*. State of California: Office of the Governor. May 10, 2018. https://www.gov.ca.gov/wp-content/uploads/2018/05/5.10.18-Forest-EO.pdf.

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(b) following species specific habitat and disturbance measures in 14 CCR § 919.3 [939.3, 959.3]?

Are the FPRs and associated regulations effective for the northern spotted owl in …

(a) ensuring take avoidance following 14 CCR § 919.9 [939.9] and 14 CCR § 919.10 [939.10]?
(b) ensuring take avoidance following 14 CCR § 919.9 [939.9](g)?
(c) maintaining adequate amounts of suitable habitat to protect and conserve owls?
(Note: Monitoring (c) may also be appropriate for the AB 1492 Working Groups).

Theme 8: Wildlife Habitat: Seral Stages

The Wildlife Habitat: Seral Stages theme has been developed to answer critical questions about the effectiveness of the FPRs in maintaining functional wildlife habitat [14 CCR §§ 897; 919 [939,959)], and in particular late seral stage retention. The FPRs require the Registered Professional Forester (RPF) to provide habitat structure information for late succession forest stands proposed for harvesting that will significantly reduce the amount and distribution of late succession forest stands or their functional wildlife habitat value so that it constitutes a significant adverse impact on the environment as defined in Section 895.1 (14 CCR § 919.16 [939.16, 959.16]). Additionally, Technical Rule Addendum No. 2 provides specific guidance that the assessment of biological habitat conditions should consider: snags and den trees, down, large woody debris, multistory canopy, road density, hardwood cover, late seral forest characteristics and late seral habitat continuity (14 CCR § 912.9 [932.9, 952.9]). These FPRs appear to contribute toward reaching the goals of FGCom policies, including: Endangered and Threatened Species Policy and Raptor Policy. The following critical questions address wildlife habitat requirements related to seral stages.

Critical Questions:

Are the FPRs and associated regulations effective in …

(a) retaining and recruiting late and diverse seral stage habitat components in WLPZs for wildlife?
(b) maintaining or increasing the amount and distribution of late succession forest stands for wildlife?
(c) maintaining or recruiting adequate amounts of early- and mid-seral habitats?
(Note: Monitoring may also be appropriate for the AB 1492 Working Groups)

Theme 9: Wildlife Habitat: Cumulative Impacts

Theme 9 has been included to specifically address cumulative impacts and wildlife habitat. The FPRs require that timber operations shall be planned and conducted to maintain suitable habitat for wildlife species (14 CCR § 919 [939, 959]). Also, the FPRs require a Cumulative Impacts Assessment (14 CCR § 898) to be completed that includes, but is not limited to, the overall biological habitat condition within both the plan and planning area. Technical Rule Addendum No. 2 provides specific guidance that the assessment of biological habitat conditions should consider: snags and den trees, down, large woody

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debris, multistory canopy, road density, hardwood cover, late seral forest characteristics and late seral habitat continuity (14 CCR § 912.9 [932.9, 952.9]). With respect to terrestrial species and their habitats, these FPRs appear to contribute toward reaching the goals of FGCom policies, including: Endangered and Threatened Species Policy and Raptor Policy. The critical questions that follow address cumulative biological resources-related questions.

Critical Questions:

Are the FPRs and associated regulations effective in …

(a) characterizing and describing terrestrial wildlife habitat and ecological processes?
(b) avoiding significant adverse impacts to terrestrial wildlife species?

(Note: Monitoring for (a) may also be appropriate for the AB 1492 Working Groups).

Theme 10: Wildlife Habitat: Structures

As stated for the other wildlife habitat themes above, a major goal of the FPRs is to maintain functional wildlife habitat in sufficient condition for continued use by the existing wildlife community within the planning watershed (14 CCR § 897). The FPRs require that timber operations shall be planned and conducted to maintain suitable habitat for wildlife species (14 CCR § 919 [939, 959]), and to encourage retention of structural elements or biological legacies through the implementation of Variable Retention (VR) silviculture (14 CCR § 913.4 [933.4, 953.4] (d). With respect to terrestrial species and their habitats, these FPRs appear to contribute toward reaching the goals of FGCom policies, including: Endangered and Threatened Species Policy and Raptor Policy. Critical questions have been developed to determine if the FPRs are effective in maintaining a proper level of structure required for wildlife habitat.

Critical Questions:

Is Variable Retention silviculture effective in meeting …

(a) ecological objectives including co-benefits?
(b) social objectives?
(c) geomorphic objectives?

Are the FPRs and associated regulations effective in retaining …

(a) a mix of stages of snag development that maintain properly functioning levels of wildlife habitat?
(b) native oaks where required to maintain wildlife habitat (14 CCR § 959.15)?

Theme 11: Hardwood Values

Hardwoods are valued as ecological, economic, and cultural resources. For the purposes of this Theme, the term hardwoods refers to trees within timberland that are not conifers, both Commercial Species and non-commercial species, including but not limited to: tanoak (*Notholithocarpus densiflorus*), true oaks (*Quercus* spp.), alders (*Alnus* spp.), Pacific madrone (*Arbutus menziesii*), California bay (*Umbellularia californica*), golden chinquapin (*Chrysolepsis chrysophylla)*, and aspen and cottonwoods (*Populus* spp.). The FPRs recognize hardwood ecological values in the Appendix to Technical Rule

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Addendum No. 2, wherein Hardwood Cover is recommended as a significant biological factor for a cumulative impacts assessment. More generally, the FPRs state that while growing trees for high quality timber, "the goal of forest management…shall be the production or maintenance of forests which are healthy and *naturally diverse,* with a *mixture of trees* and under-story plants [emphasis added]…" (14 CCR § 897 (b)(1)). The FPRs also have special prescriptions and exemptions from normal Plan preparation for the purposes of restoring hardwood stands (14 CCR § 913.4 [933.4, 953.4] (e), (f); § 1038 (l) [recently approved by the Board of Foresty]). Additionally, the FPRs identify hardwoods as an important component of riparian vegetation in the WLPZ (14 CCR 916 [936, 956]). With respect to hardwoods, these FPRs appear to contribute toward reaching the goal of the Joint FGCom and Board Policy on Hardwoods. Critical questions have been developed to determine if the FPRs are effective in maintaining and restoring hardwoods on timberland.

Critical Questions:

Are the FPRs and associated regulations effective in retaining…

(a) diverse forests with a mixture of tree species that includes hardwoods (14 CCR § 897 (b)(1))?
(b) native oaks where required to maintain wildlife habitat (14 CCR § 959.15)?
(c) aspen stands (14 CCR § 913.4 [933.4, 953.4] (e))?
(d) California black oak (*Quercus kelloggii*) and Oregon white oak (*Quercus garryana*) woodlands (14 CCR § 913.4 [933.4, 953.4] (f); § 1038 (l)?

2.5 Exemption and Emergency Notice Monitoring

While not a funded EMC project, Exemption and Emergency (EX-EM) Notice monitoring became an important task for the Review Team agencies beginning in 2016 with new statutory direction from the Legislature. EX-EM Notices are documents containing strict operational prohibitions and requirements for use in exchange for ministerial review and rapid approval. Notices of Exemption are presumed to be compliant with the California Environmental Quality Act (CEQA) and not subject to discretionary review by the Review Team agencies. Notices of Exemption are only exempt from the requirement for a Timber Harvesting Plan (THP). Emergency Notices are intended to give a landowner a head start on timber salvage operations following tree mortality events related to fire, insect, or disease outbreaks while a THP is in development. However, timber operations conducted under either Notice type must still adhere to the operational provisions of the FPRs and be compliant with all other relevant laws and regulations for protection of natural resources.

Though considerable information has been collected on THP FPRs compliance and effectiveness, virtually no effectiveness monitoring data have been collected on EX-EM Notices prior to 2018. With expanded use of EX-EM Notices due to the massive bark beetle tree mortality event in the interior part of California from 2012 to 2016 and numerous catastrophic timber fires in the last six years, concern by the Legislature and the public has risen regarding the level of EX-EM Notice compliance with the FPRs and their effectiveness in protection of resource values. Prompted in 2016 by Assembly Bills 1958 (Wood) and 2029 (Dahle), with additional direction from Senate Bill 92 in 2017, CAL FIRE and the Board initiated a long-term monitoring program for EX-EM Notices.

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Initial testing of a pilot monitoring protocol took place on Boggs Mountain Demonstration State Forest in the spring of 2018. Representatives from the California Department of Fish and Wildlife (CDFW), California Geological Survey (CGS), and both the Central Valley and North Coast Regional Water Quality Control Boards participated with CAL FIRE staff to complete pilot project monitoring during the summer of 2018. Small interagency teams evaluated 50 randomly selected EX-EM Notices that had experienced at least one winter period (six Notices were not harvested). Three types of EX-EM Notices were monitored in the field: Exemption Notices 1038(k)—drought mortality, 1038(j)—forest fire prevention pilot, and Emergency Notice 1052.1b—fire damage. Field data protocols focused on measuring residual stand structure, relative intensity of harvesting, fuel characteristics, wildlife habitat elements, road drainage and associated erosion features, watercourse crossing impacts, and watercourse protection.

An EX-EM Notice pilot project report will be written before the end of 2018 pursuant to deadlines initially imposed by AB 1958 and 2029, and later extended by SB 92. Senate Bill 901 from the 2018 Legislative Session further modified the reporting requirement to make it an annual undertaking of the Department and Board beginning December 31, 2019. SB 901 also directs the Department and Board to report on linear distance of road construction or reconstruction, Forest Practice Rule violations and enforcement actions, and the number of post-treatment site inspections completed by the respective Review Team agencies.

EX-EM Notice monitoring results are directly applicable to the goals and objectives of the EMC. EX-EM Notice monitoring supports adaptive management, providing a feedback loop to the public trust agencies, the public, and the Legislature regarding Forest Practice Rule compliance and effectiveness.

2.6 EMC Supported Monitoring Projects

Details on EMC supported projects are available online at:
http://bofdata.fire.ca.gov/board_committees/effectiveness_monitoring_committee_/
and in the EMC Annual Report and Workplan.

3.0 ADAPTIVE MANAGEMENT FRAMEWORK

The Board has previously discussed the benefits of implementing an Adaptive Management Framework (Board 2014b, EMC 2013). The Adaptive Management Framework is an overall strategy designed to consider scientific information provided by the EMC to better inform Board policy (Figure 5). Specifically, the Board will review results of EMC sponsored scientific studies to determine how effective the FPRs and associated regulations are in meeting their goals. In addition to results of scientific studies, the Board may consider the following four goals as part of the Adaptive Management Framework:

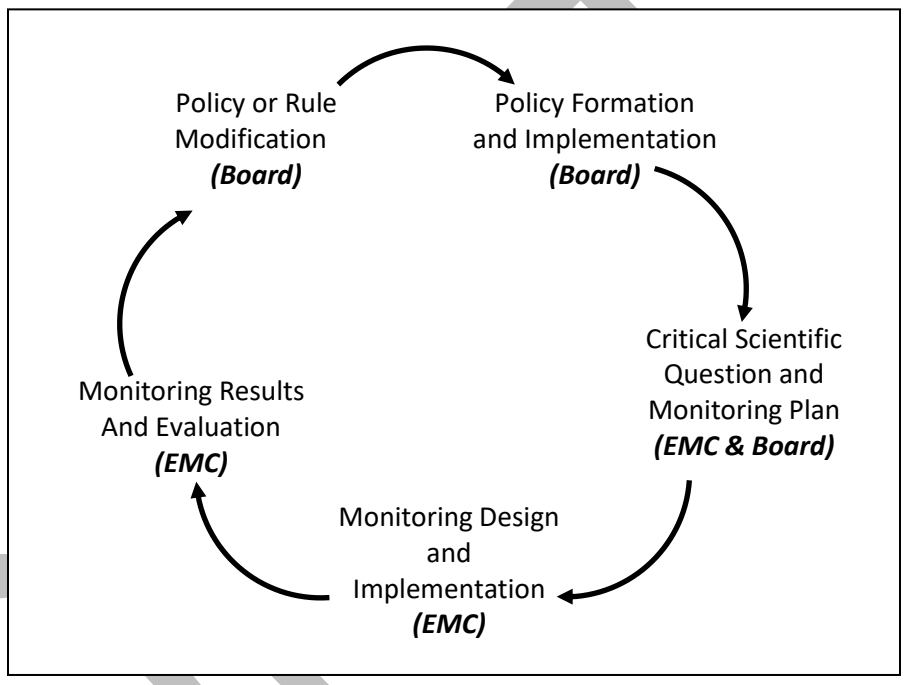
(1) To provide compliance with the state and federal ESAs for species found on state and private forestlands.

(2) To maintain and restore forest-dependent species on state and private forestlands.

(3) To meet the requirements of the federal Clean Water Act and Porter-Cologne Water Quality Control Act on state and private forestlands.

(4) To keep private forestlands economically viable in the State of CaliforniaAttempting to impart regulatory streamlining, while still enhancing California's timberland habitat, is a continuing goal and priority of the EMC.

Figure 5. The Adaptive Management Framework using EMC sponsored monitoring to better inform Board policy and regulations.



When the Board reviews scientific information from EMC sponsored studies it is important for Board members to understand the overall context and implications of the research. To achieve this objective the Board shall review information provided in the scientific report and additional information provided by the EMC that describe:

(1) The scientific or policy relevance of the study.

(2) The overall quality of the study design and results.

(3) Confidence in results explaining the effectiveness of the FPRs, Water Quality Objectives, FGC, or other regulations.

In addition, the Board has discussed the respective responsibilities of the EMC and the Board with regard to the scientific report. Appendix B contains a detailed list of these responsibilities. One portion

of the list refers to scientific questions appropriate for the EMC, while the Board portion of the list refers to more policy-based questions.

4.0 SCIENTIFIC METHODS

4.1 Resource Benefit

To allow Board members to better evaluate cost of implementing the existing FPRs and associated regulations, the Board has requested the EMC to evaluate the resource benefit of EMC-sponsored projects. As an example, the Board has requested that the FPRs Road Rules 2013 be evaluated for effectiveness in providing resource benefit and an economic cost of rule implementation. The EMC reviewed this request by the Board and determined that, if appropriate, relevant, and feasible, EMC sponsored projects should include an evaluation.

For each individual EMC sponsored project an evaluation may be completed of the resource benefit and economic cost of implementing the specific existing FPRs and associated regulation. This evaluation may be completed by the principal investigator or the EMC. The evaluation can be completed using the following guidance:

(1) The amount of detail should be tailored to the overall potential economic cost to landowners (e.g., higher potential economic cost requires more detail).
(2) If relevant, the evaluation should attempt to distinguish between land owner types; state vs. private and large vs. small landowners.
(3) If relevant, the evaluation should attempt to distinguish among Plan types: THP, Modified THP, Nonindustrial Timber Management Plan, Working Forest Management Plan; or Emergency or Exemption Notices.
(4) The evaluation should describe geographically by Region or County, if appropriate, where resource benefits and economic cost of the existing FPRs and associated regulations may be different.

In summary, the purpose of evaluating economic costs is to enable analysis of resource benefits within the context of resulting landowner economic burdens.

4.2 Study Design within an Adaptive Management Framework

The goal of any effectiveness monitoring study design is to determine if the FPRs and associated regulations related to natural resources management are maintaining and/or restoring desired ecological conditions. Monitoring studies in California will need to be able to detect changes in the environment from both individual and cumulative activities that are both spatially and temporally distributed on the landscape. Results will be used in an adaptive management framework to determine if existing policies and practices are working and confirm policies and practices are appropriate, or to

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craft new management practices, policies or regulations when the current ones are not achieving their desired result.

Because of the complexity and uncertainty surrounding natural resource management, study protocols will be embedded within an adaptive resource management model, summarized as:

(1) Defining the objectives and scope of management
(2) Developing operational plans to meet the objectives
(3) Implementing plans
(4) Collecting information about the impacts of the plans
(5) Evaluating the collected information in light of stated objectives
(6) Adjusting plans in light of new information

Adaptive management "provides a framework for making good decisions in the face of critical uncertainties, and a formal process for reducing uncertainties so that management performance can be improved over time." (Williams et al. 2009). Each of the steps of the adaptive management cycle, and its relevance for the EMC, is elaborated below.

Defining the objectives and scope of management – Studies considered by the EMC need to be designed to address: (1) existing or proposed forest management practices and; (2) objectives as defined through legislation (e.g., ESA, FPA), FPRs and associated regulations, and/or by stakeholders. Studies should state the management objectives that they are addressing, and include relevant answerable research questions. These research questions can include ecological, economic, and social considerations, as appropriate.

Developing operational plans to meet the objectives and implementing plans – The EMC will evaluate impacts from forest management activities planned and implemented by landowners, managers, and researchers. Research designs may be observational (testing existing management or conditions or analyzing existing datasets) or based on experimental designs. In either case, the anticipated outcomes of forest management and contribution toward achieving defined objectives will be stated upfront, based on a thorough literature review outlining existing knowledge and research gaps.

Monitoring studies must have valid designs, allowing for proper inferences about the phenomenon of interest. There are several broad potential approaches to designing effectiveness monitoring studies. One involves sampling populations, typically by comparing response variables from one set of treatments with another set of treatments (e.g., control-treatment). A second approach is through the use of experiments where treatments are deliberately prescribed and randomly assigned to experimental units. The advantage of the experimental approach is that the treatments may be of greater forest management intensity than the current FPRs allow and the results of an experiment can provide information that would not be available from a sample.

Studies will base their sampling design using previous literature or pilot tests to determine population variability, and to perform statistical power analysis for determining adequate sample sizes. The high natural variability commonly found in natural systems can make finding appropriate comparative groups

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(e.g., control and treatment) difficult, as the goal is to have these groups as similar to each other as possible to allow for the detection of differences.

Collecting information about the impacts of the plans – The EMC will rely on information collected through monitoring, which can take multiple forms, including baseline monitoring (measuring current conditions); trend monitoring (measuring attributes over time); effectiveness monitoring (measuring whether objectives of a project have been met); and validation monitoring (testing whether models are accurate).

Evaluating the collected information in light of stated objectives – The EMC will evaluate data for evidence of consistency with identified objectives. Evaluation will frequently take the form of statistical testing, using either frequentist or Bayesian statistical methods. However, data may take multiple forms and they will be analyzed according to the research questions posed. At times, analysis may need to rely on expert opinion especially when statistical analysis is inconclusive.

Adjusting plans in light of new information – Findings of the EMC should have means for integration into future forest management plans, through changed policy, landowner outreach, or other means. In addition, findings of the EMC should supplement existing and ongoing research conducted by other researchers.

Because of the multiple, competing objectives for forest lands in the state of California, the EMC will not be able to objectively state the "best" course of action for policy makers or managers. Rather, the EMC will collect as much information as possible to evaluate the impacts of forest policies and management decisions in light of identified management objectives. The adaptive management process facilitates learning "not by trial and error, but by a structured process," resulting in reduced uncertainty (Allen and Gunderson 2011).

4.3 Appropriate Temporal and Geographic Scale

This section provides guidance for selecting appropriate spatial and temporal scales when designing a monitoring study. Spatial scale defines the geographic area of a study such as a road segment, hillslope, or watershed. Temporal scale defines the time period of interest. In forest practice, this may be as short as one storm event or span several decades. Most FPR effectiveness monitoring studies conducted to date have focused on the site scale (e.g., road segment, harvest unit, stream reach) and are directed at prescription effectiveness over one- to four-year periods (e.g., Brandow and Cafferata 2014).

The selection of appropriate spatial and temporal scales for a monitoring study requires a review of current knowledge, understanding of the issue, and professional judgment. Scale selection must correspond to the specific study objectives, which should define the resource of concern (e.g., water quality), the controlling factors affecting the resource of concern, and the scale of those controlling processes (e.g., hillslope, reach or watershed scale). For time scales, controlling processes should be identified as deterministic or stochastic. Deterministic processes are finite and produce the same result for a given set of input variables whereas stochastic (probabilistic) processes are indeterminate – they produce a range of possible outcomes defined by a probability distribution. The temporal scale of a

study should be at least as long as the duration (including lag times) of controlling processes relevant to the study objectives. Temporal and spatial scales are not effortlessly separated, and knowledge of variability over time and space is necessary to effectively allocate monitoring efforts (Bunte and MacDonald 1999).

Typically, monitoring at large spatial or temporal scales increases the number and complexity of controlling processes, making it difficult to discern specific linkages between a controlling process and resource of concern. This can add uncertainty to study findings (MacDonald and Coe 2007). Consequently, monitoring projects should focus on the smallest spatial and temporal scales necessary to achieve the study objectives. Using an adaptive management framework, experience and refinements made from initial study phases can be used to adjust temporal and spatial scales so that study objectives are achieved. To address more complex study objectives, a monitoring plan framework of nested and cross-referenced monitoring studies at a range of scales can be applied (MacDonald 2000). Such a monitoring plan framework can be used to identify scale linkages and increase certainty in cause and effect relationships for complex studies, as well as save on costs and resources over the long-term (Cafferata and Reid 2013).

4.3.1 Rare or Large Event Monitoring

Monitoring in most forested areas is typically too short-lived to sample the variability of natural and disturbed hydrologic systems, and has a low probability of documenting environmentally significant episodic events such as large floods, landslides and debris flows. Dispersed monitoring seldom captures the linkages between large natural disturbance events and the transitory effects of forest practice activities (Dunne 2001). A comprehensive monitoring program should have a component that addresses the intersection of management and stressing events so that the effectiveness of forest practices can be evaluated across the widest range of environmental conditions. These events are not just hydrologic events, but can be from a variety of natural phenomena or may be from a combination of natural events such as those listed below:

(1) Rain-on-snow events that cause rapid increase in stormwater runoff, which can overwhelm drainage systems.
(2) A single storm or sequences of storms that saturate the soils that promotes conditions where landslides can deliver a variety of sizes of sediment and woody debris to streams.
(3) Earthquakes that can instantaneously trigger landsliding through ground shaking, or steepen slopes and/or weaken hillslope materials to where instability is triggered in subsequent rainfall events.
(4) Drought that can cause significant low flow that may compromise passage of aquatic organisms through estuaries and drainage structures, or can increase the likelihood of stream dewatering during water drafting operations.
(5) Drought that may lead to conditions where dense riparian areas can result in higher burn intensities within WLPZs and increased spread within watersheds.
(6) Large wildfires that affect large components of a bioregion or watershed, affecting significant numbers of aquatic and terrestrial organisms.

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(7) Episodic forest pest and/or disease-induced tree mortality exacerbated by prolonged periods of drought and/or higher than normal temperature regimes.
(8) Wind storm events causing loss of mature trees to windthrow across very large areas.

An effectiveness monitoring program that relies on annual measurements may not capture the information necessary to determine the effectiveness of these practices relative to larger events. Kirchner et al. (2001) found that catastrophic erosion events are infrequent and of short duration, but can control long-term sediment yield. They also noted that land use activities may alter the probability or magnitude of catastrophic events. Since these events are rare they should be proactively targeted for effectiveness monitoring.

Therefore, a different approach to standard monitoring is needed that will be able to respond to the large or rare events immediately following their occurrence and for some period of time after. This type of monitoring will require that a reserve of funds be set aside to respond immediately to the sites following the occurrence of a rare or large event to determine the effectiveness of the modern practices; an approach referred to as "post-mortem" monitoring (Stewart et al. 2013). Examples of past monitoring after large flood events include Furniss et al.'s (1998) evaluation of watercourse crossing performance in Washington, Oregon and northern California, and Robison et al.'s (1999) review of landslide impacts from large storms in western Oregon. In California, specific research questions can be addressed, such as (1) are unstable area prescriptions (e.g., canopy retention, leave areas within unstable landforms) effective for mitigating against mass wasting during high magnitude, low frequency storm events; or (2) are flows in culverts and their outlets meeting their minimum depth requirement for organism passage during low flows or do flows become hyporheic resulting in the culverts and their outlets becoming a barrier.

Effectiveness monitoring or research plans should be prepared in advance of these infrequent events. A critical component of any monitoring or research design is to identify the rare or large event that triggers "post-event" monitoring. Resources must be allocated prior to event occurrence so that resources can be deployed when a rare or large event occurs. The types of resources required will be determined by the pre-approved monitoring or research plan. Timing can be critical, as much of the forestry monitoring or research evidence can quickly fade away or be lost during restoration activities or other management activities. Once a rare or large event has occurred, the following procedure will be implemented:

(1) Determine that the rare event has occurred; the authority to make this determination will be the EMC.
(2) After review of the rare or large event, a pre-approved study plan will be reviewed and modified to best match the conditions that resulted from the rare or large event. Minor adjustments to the monitoring or research plan can be made and then executed without delay.

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4.3.2 Anadromous Fish Monitoring

Anadromous fish are those species that reside most of their adult life in the ocean and return to freshwater to spawn. However, juveniles and adults of some species may hold in freshwater for extended periods while others spend more of their life history in the ocean. Chinook and coho salmon and steelhead trout in California have complex life cycles, not only among the different species, but also among the different runs of species. Fisheries managers typically monitor adult escapement and juvenile outmigrants to determine the status and trends of fish populations. State, federal, and local agencies, tribes, and various private entities and landowners have collected and some are currently collecting fish population data in California. Available data varies from long-term and abundance data to data that are typically limited spatially and temporally. Determining impacts to fish populations requires intensive, multi-year monitoring, as trends may not be determined for many years due to high natural variability as well as the complexity of fish life cycles. Due to the complexity of fish life cycles, the quality and/or abundance of available data, and other confounding factors (such as climate change, ocean conditions, predator-prey dynamics, etc.), it may be difficult to make any correlations between timber harvesting impacts or restoration projects to fisheries populations, particularly at a reach or watershed scale.

Similarly, fishery biologists and other resource professionals monitor stream habitat parameters and indicators such as habitat typing, benthic macroinvertebrate assemblages, spawning substrate, stream temperature, suspended sediment, flow regimes, turbidity, and riparian vegetation to make inferences about project impacts to fish populations. As with monitoring fish populations, this type of monitoring is widely conducted across California by government agencies and private entities using accepted protocols. Habitat data are relatively easy to collect, less costly, and less intensive than fish population monitoring. It is also easy to document any changes, either positive or negative, from timber harvesting or restoration projects on a reach or watershed scale within a short time frame. Various types of stream habitat monitoring allow managers to make inferences on potential impacts to fish populations from timber operations. For these reasons, the EMC will focus primarily on stream habitat monitoring and, when available, will use fish population data as a basis to evaluate the effectiveness of specific FPRs and associated regulations.

4.4 Scientific Uncertainty

The Board recognizes there is overall scientific uncertainty concerning how forested ecosystems function within the framework of managed forestlands. There is also uncertainty in how various ecosystem components and processes might relate to one another. Therefore, the EMC and Board recognize that while we will attempt to increase our scientific understanding of ecosystem components or processes in managed state and private forestlands, we may never fully understand these processes. Even with these known uncertainties, the EMC and Board will pursue a better understanding of the effectiveness of FPRs and associated regulations.

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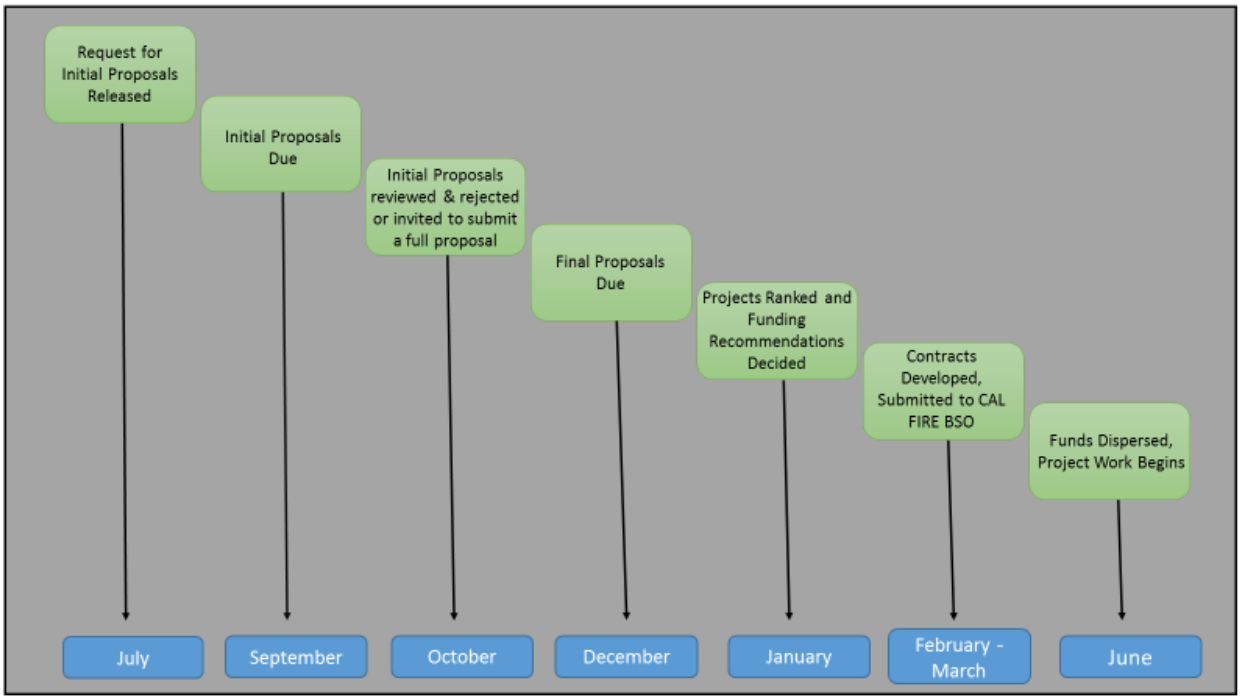
5.0 EMC Project Development and Management

Projects will be solicited through a once-a-year Request for Proposal (RFP) generated after the start of the fiscal year on July 1st. A RFP can be found on the EMC web site. Initial Concept Proposals will be solicited with a specified date and time by which submissions must be receieved by the Board. All proposals must be submitted on the standard form that the Committee has developed.

The EMC will conduct a preliminary technical review of all Initial Concept Proposals that are received by the due date (which is typically in September). This review will consider the completeness of the proposals and whether they are within the scope of the Themes and Critical Monitoring Questions elaborated in the Strategic Plan in Section 2.4. The EMC will work with Board staff to screen proposals for any conflicts of interest. The EMC may request the Principal Investigator to provide additional information within a reasonable period. When the EMC determines that an Initial Concept is complete and within scope, it will invite the Principal Investigator to submit a Full Project Proposal by a specified date (which is typically in December or January).

Figure 6. EMC Project Solicitation, Submission, Selection, and Funding Timeline.



Conflict of Interest

As an advisory committee under the oversight of the Board, members of the EMC may be perceived as quasi-public officials even though the committee lacks decision-making authority. As such, it is important that the members be aware of and avoid potential conflicts of interest, and even the possible perception of a conflict of interest. Generally, members must avoid participating in or influencing any decision in which they have a direct or indirect financial interest or other personal interest. The California conflict of interest rules that may apply to a particular member, or in a particular situation, can be very complex. If any questions or concerns arise regarding a potential conflict of interest, EMC members should seek guidance from the Board's legal counsel.

Project Ranking Method

The EMC will conduct thorough technical review of all Full Project Proposals that are received by the due date. This review will consider the completeness of the proposals and whether they are within the scope of the Themes and Critical Monitoring Questions elaborated in the Strategic Plan in Section 2.4. Principal Investigators will be invited to present and discuss their proposals at an EMC meeting. If needed, the EMC may request the Principal Investigator to provide additional information within a reasonable period. When a Full Project Proposal is deemed complete and ready for ranking, EMC members will rank the proposal according to the ranking process. EMC members will individually rank each project and the average ranking score will be calculated for each project. No specific minimum average ranking score is required for support; rather, individual project scores will be considered relative to other project scores.

Once all of the Full Project Proposals for the annual project cycle have been ranked, the EMC members will vote to make recommendations for allocation of available EMC funds to the Proposals, taking into consideration the project ranking score, how well the project tests the effectiveness of the FPRs, and the reasonableness of the requested budget. The EMC may decide to recommend funding a proposal in full, in part, or not at all. The Board will make the final funding decision.

It is the intent of the EMC to keep the ranking process transparent, with the ranking done in an easily trackable manner. The ranking will take place during regular, public meetings of the EMC. Subsequent to ranking actions, both written notes of the meeting and ranking results are published on the Board's website. Project Principal Investigators will be notified of their project ranking, and any comments regarding their project referred to them from the Committee. EMC members who are the Principal Investigator or Collaborator on a project will recuse themselves from ranking their proposal.

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Ranking Category Summaries

Critical Question
Projects that address multiple EMC critical themes and multiple critical questions within a given theme will be ranked higher than those that only address a single theme and critical question. Additionally, projects must describe appropriate study design and methods to adequately address the proposed critical question(s), and approximate time frame to conclude results that may be used by the Board to use an evidence-based approach in rule revision(s).

Scientific Uncertainty
Projects will be ranked higher when our current scientific understanding of forest practice effectiveness in the FPRs and associated regulations is incomplete. A goal is to promote projects that address large gaps in the knowledge of the effectiveness of the FPRs and associated statutes and regulations. Projects should propose to investigate high priority critical monitoring themes (Strategic Plan Section 2.4).

Geographic Application
Proposed projects that have broad application throughout California forestlands both public and private will be ranked higher than those with application limited to a specific geomorphic region or sub-region. Projects need not be physically located throughout California to produce findings that apply to multiple areas in the state.

Collaboration & Feasibility
Projects will receive higher ranking when they have a broad array of collaborative partners involved with substantive expertise in the proposed study. This is to encourage multidisciplinary approaches in the proposals. Project proponents are encouraged to collaborate with state and federal agencies, universities, private industry, NGOs, watershed groups, etc. Past performance in delivering timely, acceptable monitoring reports within available budgets will be considered.

EMC Funding Request
We report the amount of EMC funding requested for information; it is not a ranking criterion. The proposed monitoring projects need to describe existing collaboration and funding that will ensure achieving goals and objectives of monitoring. Also, the proposals need to clearly state funding requested from the EMC. Project proponents shall provide the information on the requested funding in proportion to the total project budget.

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RANKING OF PROPOSED EFFECTIVENESS MONITORING PROJECTS[2]

Project Number	Project Title	Critical Question	Scientific Uncertainty	Geographic Application	Collaboration & Feasibility	Overall Ranking	EMC Funding Request (not included in ranking score)
Example: EMC-15-001							

Ranking Method for Monitoring Projects

Critical Question: Proposed monitoring project addresses one or more EMC critical monitoring questions with appropriate study design and experimental methods.

Scientific Uncertainty: Current scientific understanding is not well-studied or validated. This ranking is weighed twice (2 times) the weight of other rankings.

Geographic Application: Critical question and proposed project has broad geographic application.

Collaboration & Feasibility: Number of active contributing collaborators relative to the monitoring subject. Consider the magnitude and expertise of the collaborators. Feasibility of monitoring project to meet stated goals and objectives within expected budget and timelines needed by the EMC, Board or stakeholders.

On a categorical scale of 1 to 5, reviewers should refer to the following guidance when reviewing any category:

1 = Does not meet any portion of the Ranking
2 = Does not meet key portions of the Ranking
3 = May meet some portions of the Ranking, either key or ancillary
4 = Meets key portions of the Ranking and does not address ancillary portions

[2] The metrics used for ranking EMC projects were modeled on the Cooperative, Monitoring, Evaluation and Research Committee (CEMR) (established by the State of Washington Forest Practices Board) general method for ranking projects. This was deemed prudent during the intial formation of the EMC as CEMR is roughly similar in scope and mission as the EMC, and is a well respected governmental advisory committee. (https://www.dnr.wa.gov/about/boards-and-councils/forest-practices-board/cooperative-monitoring-evaluation-and-research).

Project Management

Board, agency and EMC staff will work closely with Principal Investigators to manage the current and ongoing project workload. Staff will report out on progress at each EMC meeting. Co-chairs will brief the Board during EMC updates as needed.

Contract Development and Administration

Contracts will be developed by Board staff under the guidance of the CAL FIRE contracting staff. It is critical that project selection be completed as early as possible in the fiscal year to ensure that contract deadlines can be met and funds encumbered in the appropriate fiscal year.

Status and Progress Reports

Principal Investigators will provide yearly updates on status and progress. In person reports may be requested by the EMC at committee meetings.

EMC Scientific Reports

Members of the EMC or principal investigators conducting monitoring will synthesize the results into final reports for the EMC. The reports shall include descriptions of purpose and need, scientific methods, results and technical analysis, evaluation of implications for resources and forest management operations, and disclosure of any possible limitations of results and any scientific uncertainty. The reports shall not provide policy or regulatory recommendations, other than ideas for potential further refinement of study methods to address any significant limitations and remaining scientific uncertainty. All final reports will be made available to the public on the EMC webpage.

All reports shall discuss the statistical, physical and biological relevance of the monitoring and results. Due to relatively small sample sizes and lack of controls for both dependent and independent variables associated with “specific question” studies, statistically rigorous testing of water quality, aquatic habitat and wildlife resource questions is often difficult. However, well developed resource monitoring questions can improve scientific monitoring designs so that they limit spurious results and enhance the range of inference. Both statistical and biological relevance of the monitoring and the resulting acceptable level of scientific uncertainty should be clearly stated in each monitoring proposal and final report.

Development of possible rule language options based on results and findings of EMC reports, if necessary, shall be proposed by or brought before the Board’s Forest Practice Committee (FPC) for review and comment prior to submittal to the full Board.

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APPENDIX A: ORGANIZATIONAL FRAMEWORK OF AB 1492

Figure A-1.

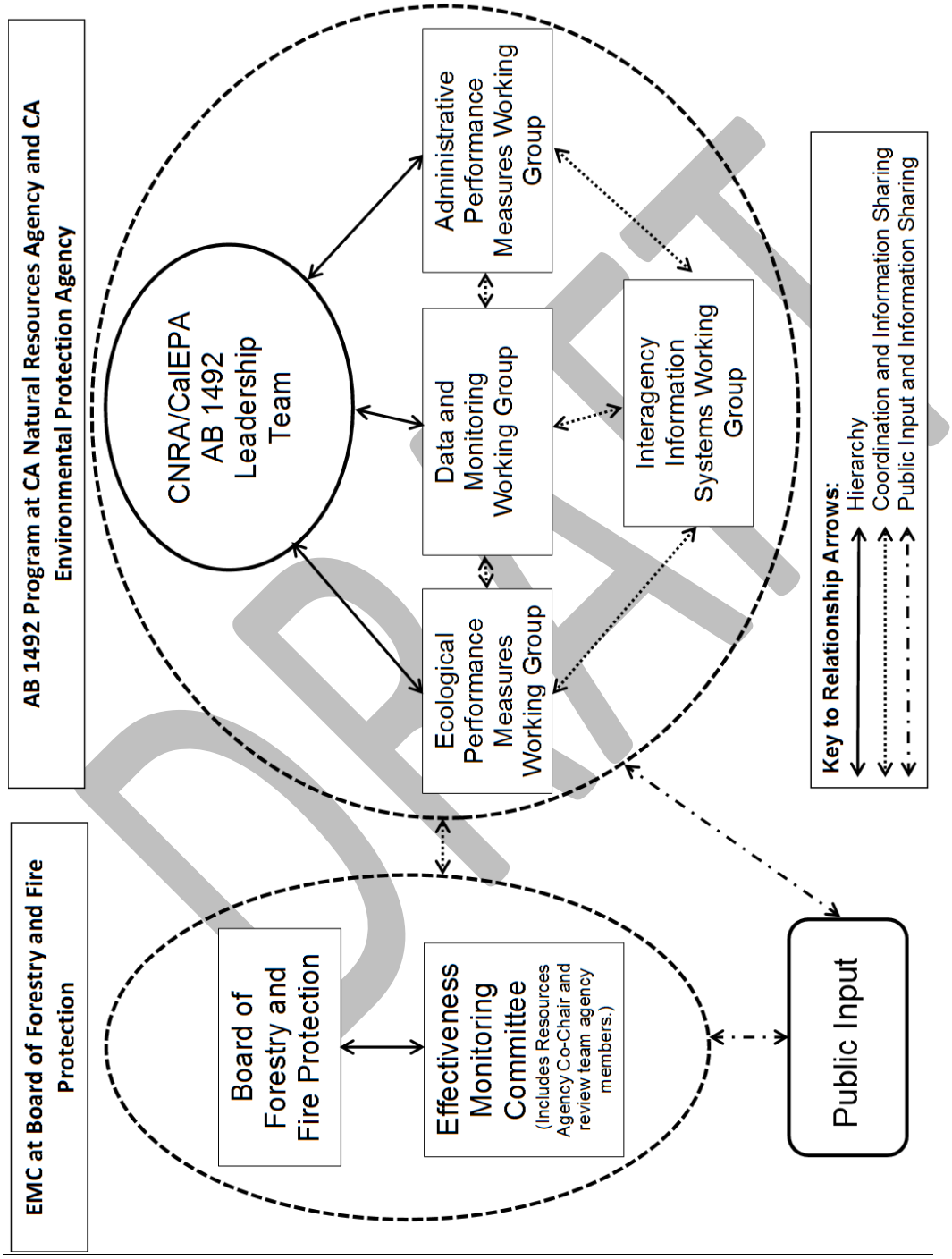

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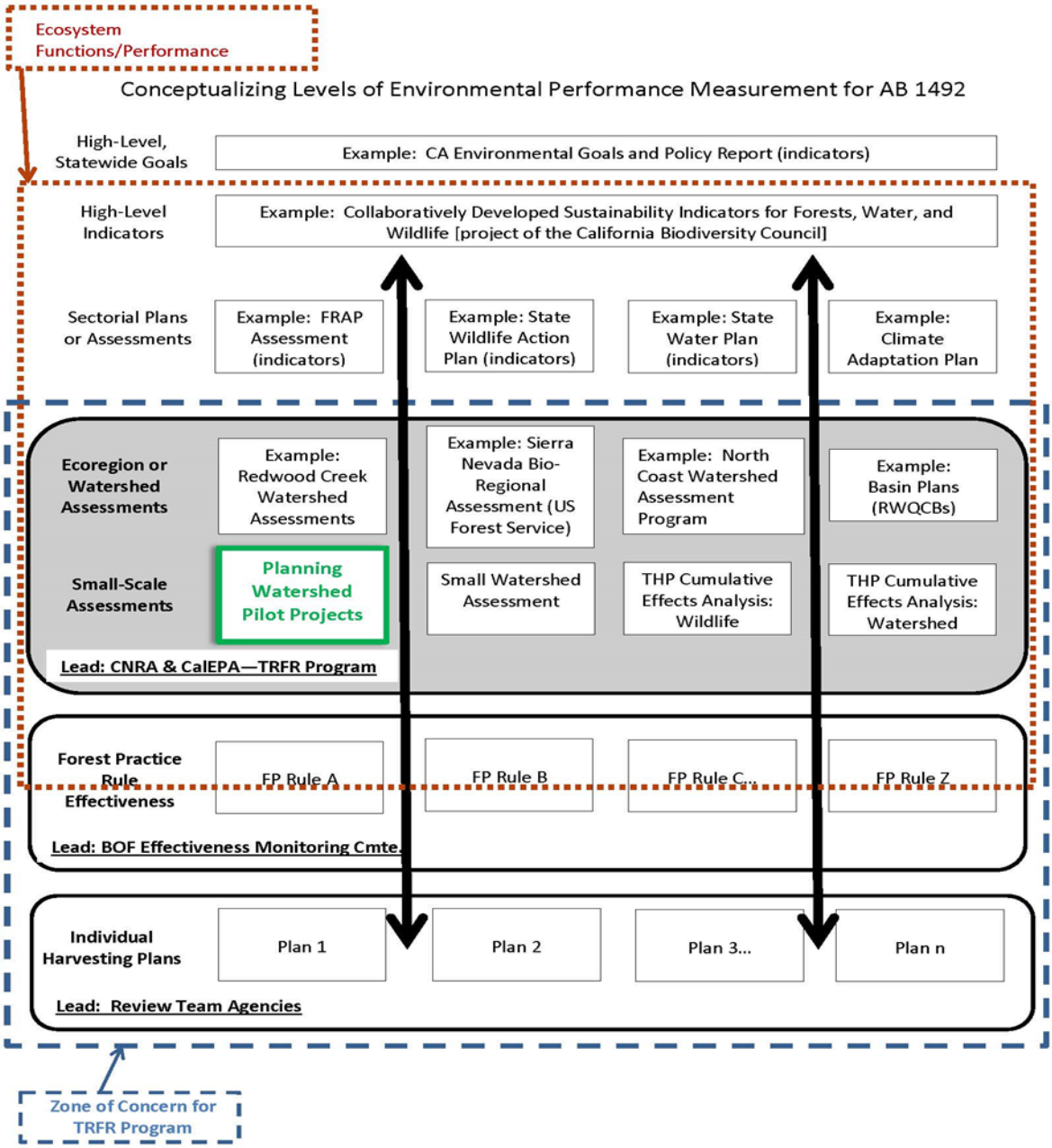
Figure A-2.


Ecosystem Functions/Performance
Conceptualizing Levels of Environmental Performance Measurement for AB 1492
High-Level, Statewide Goals
Example: CA Environmental Goals and Policy Report (indicators)
High-Level Indicators
Example: Collaboratively Developed Sustainability Indicators for Forests, Water, and Wildlife [project of the California Biodiversity Council]
Sectorial Plans or Assessments
Example: FRAP Assessment (indicators)
Example: State Wildlife Action Plan (indicators)
Example: State Water Plan (indicators)
Example: Climate Adaptation Plan
Ecoregion or Watershed Assessments
Example: Redwood Creek Watershed Assessments
Example: Sierra Nevada Bio-Regional Assessment (US Forest Service)
Example: North Coast Watershed Assessment Program
Example: Basin Plans (RWQCBs)
Small-Scale Assessments
Planning Watershed Pilot Projects
Small Watershed Assessment
THP Cumulative Effects Analysis: Wildlife
THP Cumulative Effects Analysis: Watershed
Lead: CNRA & CalEPA—TRFR Program
Forest Practice Rule Effectiveness
FP Rule A
FP Rule B
FP Rule C...
FP Rule Z
Lead: BOF Effectiveness Monitoring Cmte.
Individual Harvesting Plans
Plan 1
Plan 2
Plan 3...
Plan n
Lead: Review Team Agencies
Zone of Concern for TRFR Program

APPENDIX B: ADAPTIVE MANAGEMENT FRAMEWORK & RESPONSIBILITIES

Framework Responsibility	Adaptive Management Responsibilities
EMC	**Overall Scientific or Policy Relevance** 1. Does the study better inform understanding of effectiveness of FPRs? 2. Does the study better inform understanding of Water Quality Objectives and Fish and Wildlife Code or regulations? 3. Does the study contribute to understanding achievement of numeric or performance targets set by agencies or departments?
	Overall quality of the study design and results 1. Was the study design and analysis of results consistent with EMC recommendations? 2. Are study results scientifically relevant and significant?
	Confidence in results explaining effectiveness of FPRs 1. What is our previous scientific understanding and how have the results better informed our current scientific understanding? 2. What scientific uncertainty remains in our current understanding? 3. What is the relationship between this study and others that may be planned, underway or recently completed? 4. Feasibility of obtaining additional information to better inform policy and what will the additional information provide? 5. What will additional information or studies cost and timelines for completion?
BOARD	**Review scientific results and additional EMC information** 1. Develop appropriate management policy from information provided by EMC. 2. If management policy action is necessary, identify options and determine how feasible each option is from an operational and regulatory perspective. 3. If Board action is necessary, identify whether appropriate for Committee development or full Board review.

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APPENDIX C: PRIORITIES RECEIVED FROM BOARDS, AGENCIES AND STAKEHOLDERS

Board of Forestry and Fire Protection

The Board is required to develop and maintain a system of forest practice regulations applicable to timber management on state and private timberlands. Public Resource Code (PRC) § 4551 requires the Board to "…adopt district forest practice rules… to ensure the continuous growing and harvesting of commercial forest tree species and to protect the soil, air, fish, wildlife, and water resources…", while PRC § 4553 requires the Board to continuously review the rules in consultation with other interests and make appropriate revisions.

In order to assist the Board in the maintenance of its regulations, the Board annually distributes an Annual Call for Regulatory Review to the regulated public and agency representatives. This process allows the Board to accept written and oral comments from stakeholders on issues of interpretation, compliance, clarity, and inefficiency of the FPRs. The culmination of this process results in the Board's standing committees annually modifying their priorities depending on severity of issues and problems facing California's landscapes. For the most recent version of standing committee priorities, please see Appendix A of the Board Annual Report located here: http://www.bof.fire.ca.gov/

In addition to the FPRs, the Board has established several joint policies with the California FGCom that should be considered when setting monitoring priorities. These joint policies include Pacific Salmon and Anadromous Trout (FGCom 2009); Hardwoods (FGCom 1994[b]); and Pre, During and Post Fire Activities and Wildlife Habitat (FGCom 1994).

The EMC is a relatively new addition to the Board's structure. EMC funding is directed at projects that directly test the FPRs and can inform the Board on the efficacy of their existing regulations. It is the Board's vision that the findings of EMC funded projects will assist in the future development and maintenance of both policy and regulatory schemes to further the mission of the Board.

The Board understands that natural processes are complex and highly variable over time and space, and also that the current knowledge of these processes and their linkages are imperfect. However, it is also known that on-site control of potential impacts offers the most direct and rapid mitigation of potential impacts, and monitoring the effectiveness of these controls provides the best opportunity to increase our understanding of cause-and-effect relationships (i.e. linkages) between management and potential impacts to public trust resources. If potential adverse impacts are minimized at the local scale, there should be reduced potential cumulative effects at a larger scale (MacDonald 2000). To attempt to address cumulative effects the Board made three recommendations relevant to the EMC: (1) focus on effectiveness monitoring activities to support adaptive management approaches (MacDonald 2000), (2) research new computer modeling to improve analysis (Benda et al. 2007), and (3) improve collection of information from on-going analysis to create watershed databases for agencies and public use. The Board supports EMC efforts focusing upon project review, funding, tracking, and reporting to assist the Board in addressing Board and committee priorities.

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California Department of Fish and Wildlife

CDFW suggests a number of FPRs have long warranted monitoring for their effectiveness in ensuring timber operations do not cause or aggravate significant direct or cumulative effects on the environment and help to conserve public trust resources. In particular, there is a paucity of information collected on the FPRs effectiveness regarding direct and cumulative effects on terrestrial wildlife resources. These include FPRs intended to protect sensitive and other special-status species, maintain and recruit key habitat elements (e.g., snags), maintain late-succession forest stands, and avoid habitat fragmentation and/or maintain habitat connectivity. The effectiveness of the FPRs, individually and cumulatively should be effective in meeting the objectives stated under 14 CCR § 897 "Implementation of the Act Intent", including:

"(B) Maintain functional wildlife habitat in sufficient condition for continued use by the existing wildlife community within the planning watershed and, (C) Retain or recruit late and diverse seral stage habitat components for wildlife concentrated in the WLPZs and as appropriate to provide functional connectivity between habitats."

Additionally, many FGC statutes and FGCom policies apply to timber operations regulated by the FPRs. For example, FGC statutes that provide CDFW with authority over lake and streambed alterations (FGC § 1600 *et seq.*), over species designated as threatened or endangered under the California ESA (FGC § 2050 *et seq*.), and over pollution (FGC § 5650 *et seq*.) are commonly encountered during review of Plans. In addition, policies set forth by the FGCom, such as the Raptor Policy, guide CDFW activities and coincide with the intent of the FPRs (FGC § 703 et seq.). Overall, effective FPRs, FGC statutes, and FGCom policies related to fish and wildlife values should support forest ecosystem function, structure, and species composition within defined ranges that constitute properly functioning conditions.

State and Regional Water Quality Control Boards

The Water Boards' priorities are to participate in and support monitoring designed to increase our understanding of the effectiveness of FPRs and associated regulations in protecting the beneficial uses of water from existing and potential impacts of forest management. Monitoring studies should be designed to evaluate the effectiveness of specific FPRs and the associated regulations' effect on long-term watershed trends. Studies can also facilitate adaptive management to improve water quality protection provided by the FPRs and associated regulations.

While modern forestry practices have substantially improved since the passage of the Z'Berg-Nejedly FPA in 1973 (Board 2014b), the cumulative effects of past and ongoing land uses have degraded the ecological condtion of aquatic ecosystems and beneficial uses of water in forested watersheds throughout the state. In response, the Water Boards' priorities, as directed by the Porter Cologne Water Quality Control Act and policies such as the Anti-degratdation Policy (Resolution 68-16), are to restore impaired waterbodies and their watersheds and to protect those waterbodies that are not impaired.

To that end, it is necessary to evaluate the effectiveness of the FPRs and associated regulations in sustaining or improving aquatic ecosystem and watershed conditions, as measured through factors such as: preventing or minimizing sediment discharge; restoring impaired aquatic and riparian function; and

preserving and restoring cold water for beneficial uses through retaining and enhancing effective shade on watercourses. In order to meet these needs, the spatial and temporal scale of monitoring will vary from short-term site-specific or project-specific, to long-term watershed or regional scales. Additional studies and methods are needed to evaluate known or suspected water quality factors in timberland watersheds, such as fuel loading in WLPZs, changes to vegetation community diversity, effects of road system design alternatives and road density, effects of large scale canopy reduction on a catchment scale, fuel breaks encroaching into riparian zones, and management practices applied during and after timber harvest activities in wildfire-affected areas.

California Natural Resources Agency

The mission of CNRA is "To restore, protect and manage the state's natural, historical and cultural resources for current and future generations using creative approaches and solutions based on science, collaboration and respect for all the communities and interests involved." CNRA provides the primary leadership for the AB 1492 Timber Regulation and Forest Restoration Program, working in close collaboration with the timber harvest Review Team agencies and the California Environmental Protection Agency. Relevant to the functions of the EMC, AB 1492 includes:

- Legislative intent to "Promote transparency in regulatory costs and programs through the creation of performance measures and accountability for the state's forest practice regulatory program and simplify the collection and use of critical data to ensure consistency with other pertinent laws and regulations." [Public Resources Code § 4629.2(f)].
- A requirement for regular reporting to the Legislature that includes evaluating ecological performance. [Public Resources Code § 4629.9(a)(8)(F)]

Evaluation of the effectiveness of the Forest Practice Act (FPA) and Rules and other related timber harvesting statutes and regulations, the role of the EMC, is a very important element in achieving these directions from AB 1492. The EMC's creative, scientific, collaborative approach also is consistent with the CNRA mission statement.

California Geological Survey

CGS priorities focus on increasing our understanding of the FPRs effectiveness with regard to mass wasting, erosion, fluvial processes, and the construction techniques used for facilities such as roads, landings, and watercourse crossings. Management activities that affect these geologic processes have the potential to create local and cumulative effects to resources, and in some cases public safety. Due to the diverse geologic, topographic, and climatic conditions across the state, forest management activities also have the potential to result in different levels of impact in specific terrain (e.g., steep convergent slopes vs. gentle convex slopes), in different portions of the state (e.g., areas with high rainfall and weak geologic materials vs. areas with lower rainfall and strong geologic materials), as well as when the activities are conducted (e.g., during the winter vs. the summer), and what activities are conducted (e.g., tractor vs. cable harvesting; road construction vs. no road construction; or, selection vs. clearcut silviculture). Where and when forest management activities are conducted, as well as the practices employed, are critical to FPRs effectiveness. Monitoring activities that evaluate the geologic and construction practices above must take into account the geographic and temporal conditions where

they are employed, and recognize that stochastic events (such as significant storms, rain-on-snow events, large earthquakes, and large wildfires) often have profound effects on the landscape. These events will also have a significant effect on the results of monitoring activities (e.g., monitoring during a drought vs. monitoring following a 20-year recurrence interval storm). Effective FPRs will address forest management activities such that geologic-related impacts are reduced to less than significant. To achieve this, geologic-related monitoring studies must include the range of short-term to long-term, of site-specific to regional scales, as well as response to episodic rare or large events.

Beyond geologic focused monitoring, aquatic and terrestrial effectiveness monitoring should also identify what appropriate temporal scale or specific rare and large events which may need identification as part of effectiveness monitoring. Identifying the appropriate temporal scale will assist in separating effectiveness of current FPRs versus potential impacts from forest management legacies (see Section 4.3). Additionally, identifying rare and large events like landslides and floods or impacts from drought, disease or wildfire can assist in separating effectiveness of current FPRs and associated regulations. Most importantly, some specific FPRs may need to be evaluated for effectiveness following both forest management operations and rare or large events (see Section 4.3.1).

California Department of Forestry and Fire Protection

CAL FIRE monitoring priorities are to evaluate the implementation (i.e., compliance) and effectiveness of the FPRs. High priority topics include monitoring impacts to water quality, as has been undertaken since 1996, wildlife habitat for Board-listed sensitive species, and adequacy of fuel treatments for reducing fire spread and intensity.

Specifically, CAL FIRE encourages the EMC to undertake specific projects to determine the FPRs effectiveness related to Watercourse and Lake Protection Zone (WLPZ), road, and watercourse crossing requirements in maintaining acceptable sediment entry, water temperature regimes, and nutrient inputs. Monitoring of roads and watercourse crossings following large hydrologic events is needed to test the effectiveness of contemporary forest practices. Additionally, monitoring of unstable area identification and unstable area prescription effectiveness is required. The effectiveness of the current FPRs for meeting Basin Plan water quality objectives should also be an EMC priority.

Interactions between riparian conditions and in-stream nutrient dynamics must be better understood to appropriately manage riparian zones. Improved understanding is needed on how differences in riparian stand structure and composition affect seasonal light levels and nutrient availability, which influence primary production and thus salmonid production. On-going debate over appropriate levels of timber harvest in riparian zones make this a high priority research item for CAL FIRE. Factors affecting headwater stream temperatures also need to be better understood, particularly related to effectiveness of FPR protection measures for Class II watercourses.

Wildlife habitat effectiveness monitoring should also be a high priority for the EMC. CAL FIRE encourages the EMC to develop monitoring projects to determine the effectiveness of measures used to ensure take avoidance and prevention of significant adverse impacts for Board-listed sensitive and other important species. CAL FIRE will work through the EMC to collaborate with the other agencies on current wildlife monitoring efforts and to develop new monitoring approaches for sensitive species.

With the Governor's recent (2018) goal of doubling the total statewide rate of forest treatments within five years to at least 500,000 acres per year for improving forest health and resilience, monitoring of fuel treatment practice compliance and effectiveness has become a high priority for CAL FIRE. This includes monitoring both operations conducted with plans undergoing multi-agency review, and those undertaken with Exemption and Emergency (EX-EM) Notices. After leading a multi-agency EX-EM notice pilot monitoring project in 2018, CAL FIRE will develop an ongoing program to monitor the effectiveness of the resource protection provisions in the FPRs for EX-EM Notices.

USDA Forest Service

The USDA Forest Service Pacific Southwest Research Station (PSW) supports testing and monitoring the ability of the California FPRs to mitigate adverse effects on the environment from timber harvesting. As a world leader in natural resources research, PSW conducts and supports research in four key focus areas: (1) providing clean and reliable water resources, (2) enhancing benefits to urban communities from the natural environment, (3) sustaining ecological resources and services, and (4) creating landscapes that are resilient to disturbances such as timber harvesting and wildfire. Within an adaptive land management context, PSW supports EMC projects that evaluate if the FPRs are encouraging timber harvesting procedures that reduce post-harvest erosion, provide wildlife habitat for threatened and or endangered species including the Northern Spotted Owl, reduce adverse wildland fire behavior potential, and mitigate smoke emissions when harvest areas are burned by wildfire.

National Marine Fisheries Service

The National Marine Fisheries Service (NOAA Fisheries) supports the Board's EMC charter goal of ascertaining whether the FPRs and associated regulations maintain or enhance water quality and aquatic habitat, particularly habitat that supports salmon and steelhead listed under the federal ESA. NMFS also supports the overarching goal to create a unified effectiveness monitoring strategy to serve as a "road map" for focusing effort on the most urgent issues.

Seven species of salmon and steelhead are federally listed as threatened or endangered in California. Timber harvest is identified as a contributing factor that negatively impacts these listed species and their habitat. Recovery plans for these species recommend that the FPRs and associated regulations be evaluated and, if needed, modified to achieve sufficient habitat condition and population abundance necessary for recovery (NMFS 2012, NMFS 2014). NMFS encourages the Board to evaluate the effectiveness of FPRs and associated regulations addressing the rate of timber harvest and cumulative effects.

Examining a single FPR may not be the most effective approach in determining the effectiveness of regulating cumulative effects in all cases. Rather, examining a suite of FPRs and associated regulations which are intended, collectively, to contribute to controlling cumulative effects may be more informative. In addition, a proper examination of cumulative effects likely involves the study at site, watershed, and regional scales by tracking trends in important indicators of species population health and habitat condition. While cumulative effects may be avoided or minimized through site- or project-level controls (such as those found at FPRs within 14 CCR § 916 [936, 956]) validating whether such

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controls are effective at avoiding significant cumulative effects, or the degree to which they are minimized at various scales, is important for informed regulation of timber harvest in watersheds supporting listed salmonids.

Public Stakeholders

For the purposes of this Strategic Plan, public stakeholders include members of the general public, Native American tribes, private landowners, academics from universities, and a wide variety of interest groups. Because no one person or entity can speak on behalf of all public stakeholders, this summary is intended to describe input received to date from public stakeholders on the Strategic Plan. Since the EMC welcomes continued input from public stakeholders, this section will be revised when the Strategic Plan is updated approximately every three years.

One consistent comment received from multiple conservation groups and individuals is to have work on the EMC Strategic Plan, committee discussions, and public meetings as open and transparent as possible. To meet this public expectation, all EMC meetings are publicly noticed with meeting agendas, and previous meeting notes and other EMC documents are posted on the Board's website under the EMC webpage. In addition, all EMC meetings are broadcast live via webinar with the goal of continuing to improve internet broadcast of meetings and interaction with the public.

Members of the public have encouraged the EMC to promote monitoring tools or protocols for landowner-based project scale monitoring. Use of project scale photo point monitoring (e.g., CVRWQCB 2014) has been a useful tool for water quality monitoring (Board 2009) and may be appropriate for specific EMC critical questions. In addition, the EMC is encouraged to pursue development of easy-to-implement project-scale monitoring protocols to answer specific EMC critical monitoring questions when such protocols do not exist.

In general, public stakeholders support monitoring efforts that are well designed, advance our scientific understanding of natural processes, and are re-integrated through adaptive management into the FPRs and associated regulations. Accordingly, the EMC Strategic Plan places a strong emphasis on identifying well designed scientific studies (Section 4.0) that will be able to inform review of existing FPRs through an Adaptive Management Framework (Section 3.0).

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APPENDIX D: CAL FIRE AND BOARD MONITORING AND REPORTING REQUIREMENTS

The following is a list of the FPRs and current statutes with specific monitoring requirements to be conducted by CAL FIRE and/or the Board.

Class II Watercourses

14 CCR §§ 916.9 [936.9, 956.9] (g) (1) (C) The Department shall report to the Board at least once annually on the use and effectiveness of 14 CCR § 916.9 [936.9, 956.9] subsection (g) for as long as this rule section remains effective. This section has undergone the rulemaking process and pending approval by the Office of Administrative Law, the reporting requirement by the Department shall be struck from the regulation. This was done to allow pending and forthcoming scientific studies on the efficacy of the Class-II Large rules to come to fruition, to allow the Board decide whether to cancel or continue this rule sections when results show the relative efficacy of these rules. Additionally, this takes the burden off the Department that formerly required a yearly report to the Board, helping ease the heavy reporting requirement that the Department holds on Board actions.

Maintenance and Monitoring of Logging Roads and Landings

14 CCR §§ 923.7 [943.7, 963.7] (k) . . . The Department shall also conduct monitoring inspections at least once during the prescribed maintenance period to assess logging road and landing conditions.

Watercourse Crossings

14 CCR §§ 923.9 [943.9, 963.9] (u) . . . The Department shall also conduct monitoring inspections at least once during the prescribed maintenance period to assess watercourse crossing conditions.

Aspen, meadow and wet area restoration

14 CCR §§ 913.4 [933.4, 953.4] (e) (7) The Department shall review post-harvest field conditions of the portions of plans using the aspen, meadow and wet area restoration silvicultural prescription and prepare a monitoring report every five (5) years for the Board. The monitoring report shall summarize information on use of the prescription including:

- (i) The level of achievement of the measures of success as stated in the plan per 14 CCR §§ 913.4, 933.4, and 953.4, subsection (e)(5);
- (ii) (ii) Any post-harvest adverse environmental impacts resulting from use of the prescription;
- (iii) Any regulatory compliance issues; and
- (iv) Any other significant findings resulting from the review. The review shall include photo point records.

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Modified THP for Fuel Hazard Reduction

14 CCR § 1051.7 . . . The Department shall report to the Board at least once annually on the use and effectiveness of 14 CCR §§ 1051.3-1051.7 for as long as these rule sections remain effective.

Site-specific measures or nonstandard operational provisions

14 CCR §§ 916.9 [936.9, 956.9] (v) (10) Board staff and the Department shall work with agencies, stakeholders, and appropriate scientific participants (e.g., MSG, Technical Advisory Committee) in a transparent process to: (1) describe and implement two pilot projects, including monitored results, using site-specific or non-standard operational provisions; and (2) provide recommendations to the Board for consideration for adoption to provide detailed guidance for the application of site-specific or non-standard operational provisions. The pilot projects and guidance shall address cumulative and planning watershed impacts, and the guidance may address the appropriate standards the site-specific or non-operational provisions shall meet. A report on the progress of the pilot projects and implementation guidance shall be presented to the Board within 18 months of the effective date of this regulation.

Forest Fire Prevention Exemption Pilot Project

14 CCR § 1038(j) (15) At least one inspection conducted by the Director shall be made after completion of operations.

14 CCR § 1038(j) (17) The department shall maintain records regarding the use of the Forest Fire Prevention Exemption Pilot Project exemption in order to evaluate the impact of it on fuel reduction and natural resources in areas where it has been used.

PRC § 4584 (j) (11) (F) The department shall maintain records regarding the use of the exemption granted in this paragraph in order to evaluate the impact of the exemption on fuel reduction and natural resources in areas where the exemption has been used.

PRC § 4584 (j) (12) After the timber operations are complete, the department shall conduct an onsite inspection to determine compliance with this subdivision and whether appropriate enforcement action should be initiated.

Section 303(d) Listed Watersheds

14 CCR §§ 916.12 [936.12, 956.12] (a) The Department shall, in collaboration with the appropriate RWQCB and SWRCB, prioritize watersheds in which the following will be done: 1) conduct or participate in any further assessment or analysis of the watershed that may be needed, 2) participate in the development of TMDL problem assessment, source assessment, or load allocations related to timber operations, and 3) if existing rules are deemed not to be sufficient, develop recommendations for

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watershed-specific silvicultural implementation, enforcement and monitoring practices to be applied by the Department.

14 CCR §§ 916.12 [936.12, 956.12] (b) The Department shall prepare a report setting forth the Department's findings and recommendations from the activities identified pursuant to (a) above. The report shall be submitted to the Board and the appropriate RWQCB. The report shall be made available to the public upon request and placed on the Boards' website for a 90-day period.

Protection of Habitable Structures Exemption, 2015

14 CCR § 1038 (c) (6) (G) The Department shall evaluate the effects of the exemption allowed under 14 CCR 1038(c)(6) including frequency and state-wide distribution of use acres treated, compliance, professional judgment regarding post-treatment stand conditions observed relative to moderating fire behavior and actual performance in the event of a wildfire. The Department shall, annually report its findings based on this evaluation to the Board.

PRC § 4581 (i) (6) The department shall evaluate the effects of this paragraph and shall report its recommendations, before the paragraph becomes inoperative, to the Legislature based on that evaluation. The report shall be submitted in compliance with Section 9795 of the Government Code.

Drought Mortality Amendments, 2015

14 CCR § 1038 (k) (8) The Department shall monitor and report on the statewide use of the exemption, allowed under 14 CCR § 1038(k), including the number of harvest area acres, the areas of application and the degree of compliance. The Department shall, within 180 days of the date that these emergency regulations are filed with the Secretary of State, report its findings, to the Board.

Forest Fire Prevention Exemption

14 CCR § 1038(i) (14) At least one inspection conducted by the Director shall be made after completion of operations. (This provision will likely be revised upon Board promulgation of regulation pursuant to SB 901).

PRC § 4584 (j) (12) After the timber operations are complete, the department shall conduct an onsite inspection to determine compliance with this subdivision and whether appropriate enforcement action should be initiated. (This provision will likely be revised upon Board promulgation of regulation pursuant to SB 901).

Emergency Notice for Outbreaks of Sudden Oak Death Disease

14 CCR § 1052.5 The Department shall track the number of Emergency Notices for outbreaks of SOD, the acreage treated under the notices, and the WLPZ acreage treated under the notices, and report the results to the Board bi-annually.

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Conversion Exemptions

14 CCR § 1104.1 (7) The Department shall provide for inspections, as needed, to determine that the conversion was completed.

Exemptions and Emergency Notice Monitoring (PRC § 4589)

During the 2016 Legislative Session, Assembly Bills 1958 (Wood) and 2029 (Dahle) were signed into law creating two new types of Exemptions from the THP requirements of the FPA. Additionally, the two bills directed CAL FIRE and the Board, with participation by the CDFW, RWQCBs, and the public, to provide the Legislature with a report on the various Exemptions and Emergency Notice permitting options authorized by the FPA and Rules. In the 2017 Legislative Session, the reporting requirements of AB 1958 and AB 2029 were modified by a budget trailer bill, Senate Bill 92. This budget bill specified a new report due date of December 31, 2018, and added the requirement for, "…an analysis of exemption use, whether the exemptions are having the intended effect, any barriers for small forest owners presented by the exemptions, and measures that might be taken to make exemptions more accessible to small forest owners."

During the 2018 Legislative Session, Senate Bill 901(Dodd) again revised the reporting requirements under Public Resources Code § 4589. The reporting timeline was clarified to continue through December 32, 2025, with an initial submittal of the report occurring on December 31, 2019. The requirement for identifying barriers to small forest owners for use of exemptions and recommended measures to make exemptions more accessible to small forest owners was repealed. The report shall now include recommendations to improve the use of those exemptions and emergency notice provisions, information on the linear distance of road constructed or reconstructed under notices of exemption by individual ownerships, within a representative sample of planning watersheds from each forest practice district. The report shall also contain the number of post-treatment onsite inspections that occur and whether those inspections were attended by a representative of the Department of Fish and Wildlife and a representative of the State Water Resources Control Board and the number and type of violations and enforcement actions taken. The final report due December 31, 2025, shall also include recommendations necessary for revisions to diameter limits at stump heights of harvestable trees for Small Timberland Owner and Forest Fire Prevention Exemptions.

Currently, data is being assimilated, and initial revisions of this report is underway with the first submittal expected in December of 2018.

Required Inspections for Forest Fire Prevention Exemptions (Senate Bill 901, not yet in regulation)

PRC § 4584 (k) (11) After the timber operations are complete, CAL FIRE shall conduct an onsite inspection to determine compliance with the FPRs and whether enforcement action should be initiated. CAL FIRE shall notify the appropriate Regional Water Quality Control Board, the Department of Fish and Wildlife, and the California Geologic Survey seven days prior to conducting the onsite inspection. The Regional Water Quality Control Board, the Department of Fish and Wildlife, and the California Geologic Survey may conduct an inspection with CAL FIRE.