EFFECTIVENESS MONITORING COMMITTEE (EMC)
Strategic Plan

Submitted to the California Board of Forestry and Fire Protection

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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 AB 1492. 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 10 individual themes. The EMC uses these themes and critical questions as guidance to solicit and evaluate specific monitoring projects with a goal of developing a process-based understanding of the effectiveness of FPRs and associated regulations in maintaining and enhancing water quality, and aquatic and wildlife habitats. The following is a summary of the activities and progress made by the EMC in the past year:

- Updated EMC Strategic Plan.
- Reviewed the 2015 list of themes and critical questions in the EMC Strategic Plan and made no additions or alterations to the priorities in 2016.
- Added a detailed appendix in the Strategic Plan listing mandated monitoring and reporting requirements to ensure their completion.
- Refined and beta tested the EMC project ranking procedure included in the Strategic Plan.
- Provided detailed comments on the study plan for the third experiment at the Caspar Creek Experimental Watersheds, Jackson Demonstration State Forest, which will evaluate forest stand density reduction on watershed processes.
- Received an allocation of $425,000 each year for the 2016/2017 and 2017/2018 fiscal years from the Timber Regulation and Forest Restoration Fund. The money will be used to fund EMC-supported projects based on priority and availability of resources.
- Developed and posted a Request for Proposal (RFP) soliciting monitoring project proposals to the EMC website.
- Reviewed project proposals in April and October of 2016.
- Added two new members to fill vacancies on the EMC, and renewed the term for one existing member.
- Utilized the project ranking procedure included in the EMC Strategic Plan to select four proposed effectiveness monitoring projects to support (Table 1).

Table 1. 2016 EMC-Supported Effectiveness Monitoring Projects.

Project Number and Title	Summary	EMC Funding Recommended
EMC-2015-001: Class II-L monitoring	The primary objectives of this study are to: (1) investigate the variability of the relationship between drainage area, channel width, and the perennial flow extent across the geographic scope of the Anadromous Salmonid Protection (ASP) rules; (2) compare the relationships derived in (1) to the rule criteria for the Class II-L identification system in terms of both drainage area and channel width; and (3) conduct a pilot study to investigate the downstream propagation of water temperature from Class II-L systems in sites with contrasting lithology.	Awaiting revised study design and budget
EMC-2015-002: Forest Practice Implementation and Effectiveness Monitoring (FORPRIEM) ver. 2.0.	FORPRIEM (Forest Practice Rules Implementation and Effectiveness Monitoring) is CAL FIRE's only direct project monitoring of THPs and NTMPs, except for Forest Practice inspections. The objectives of FORPRIEM ver. 2.0. include (1) continuing to determine the implementation and short-term effectiveness of the FPRs implemented on the ground related to water quality, particularly related to watercourse and lake protection zones, watercourse crossings and roads; (2) utilizing multi-agency Review Team personnel to collect field data; and (3) using a stratified random sample of completed THPs and NTMP-NTOs to better test the FPRs on a larger percentage of higher erosion risk sites.	$28,000 recommended for statistical review
EMC-2015-004: Effectiveness of the Road Rules in reducing hydrologic connectivity and significant sediment discharge	This study will monitor changes in key indicators of forest road performance that result from the implementation of the "Road Rules, 2013 Rule Package." It will address how effective the Road Rules are at decreasing the magnitude of erosion, runoff, and sediment delivery at the road segment and plan scale. Specifically, data will be collected to answer: (1) has the length/area/percentage of roads draining to watercourses decreased after the implementation of the Road Rules (connectivity)?; and (2) have the road attributes affecting surface erosion for connected road segments improved since the implementation of the Road Rules?	$28,000 recommended for statistical review
EMC-2016-002: Post-fire effectiveness of the Forest Practice Rules in protecting water quality on Boggs Mountain Demonstration State Forest	This study is using established methods, when possible, to measure the effects of post-fire salvage logging and post-salvage site preparation techniques on runoff, erosion, carbon flux rates, and vegetative recovery on the Boggs Mountain Demonstration State Forest, which was burned during the 2015 Valley Fire. There are two main objectives to this project: (1) determine the effects of post-fire logging and site preparation on runoff, erosion, soil carbon, and vegetation recovery; (2) develop and demonstrate alternative BMPs for post-fire salvage operations.	No funding requested

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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
CFR	Code of Federal Regulations
CGS	California Geological Survey
CNRA	California Natural Resources Agency
DSF	Demonstration State Forests
EMC	Effectiveness Monitoring Committee
ESA	Endangered Species Act
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
HCP	Habitat Conservation Plan
HMP	Hillslope Monitoring Program
LTO	Licensed Timber Operator
LTSY	Long Term Sustained Yield
MC	Board Management Committee
MCR	Modified Completion Report Monitoring Program
MSG	Monitoring Study Group
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRV	Natural Range of Variability
Plans	Timber Harvesting Plans and all other harvest documents as defined under 14 CCR § 895.1
RPC	Board Resource Protection Committee
RPF	Registered Professional Forester
SWAMP	Surface Water Ambient Monitoring Program
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
WHR	Wildlife Habitat Relationship

WLPZ	Watercourse and Lake Protection Zone
Working Groups	AB1492 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.

1.0 INTRODUCTION

The following is the Strategic Plan for the Effectiveness Monitoring Committee (EMC) of the California State Board of Forestry and Fire Protection (Board). 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 if management practices are achieving the various resource goals and objectives set forth in the California Forest Practice Act and Rules (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 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. It is the intent to use the EMC Strategic Plan as a living document that will be updated annually. 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, monitoring priorities by entity/organization, critical questions organized by themes, and proposed monitoring projects for the current year. 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, and the importance of considering variability and stochastic events for strategic planning. Finally, the appendices contain a summary and listing of individual projects, along with the committee's ranking of the proposed monitoring projects.

1.1 Background

Effectiveness monitoring is a key component of adaptive management and the EMC proposes to build upon and expand on previous monitoring work. Over the past 20 years on California's state and private forestlands implementation and limited short-term effectiveness monitoring has focused primarily on water quality related issues (Tuttle 1995, Lee 1997, BOF 1999, Cafferata and Munn 2002, BCTF 2011, Brandow et al. 2006, Longstreth et al. 2008, BCTF 2011, Brandow and Cafferata 2014). Longer-term cooperative instream monitoring studies have also 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 2011), 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 proposes to incorporate more comprehensive, rigorous and hierarchical forms of monitoring to aid in adaptive management. 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. At a minimum, the California Forest Practice Rules (FPRs) and statutes that include effectiveness monitoring requirements related to the main themes identified in this plan will be addressed with EMC-supported monitoring projects (Appendix H).

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 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, federal Endangered Species Act, Porter-Cologne Water Quality Act, federal Clean Water Act, and Fish and Game Code (Figure 2). We refer to these collectively as the FPRs and associated regulations in maintaining or enhancing water quality, aquatic habitat, and wildlife habitats.

1.2.1 EMC Current Membership

In 2014, the Board of Forestry and Fire Protection (Board) appointed two Co-Chairs, 14 committee members (two current vacancies) and identified five support staff (Appendix A). The 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, hydrology,

geology, aquatic ecology, fisheries, wildlife management, and resource monitoring and sampling. The 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 established each committee member's respective term duration (Appendix A).

Figure 2 EMC charter goals.

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

(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 Endangered Species Acts 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 Fish and Game codes, and other forestry-related laws and regulations.

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. 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, one or both of the Co-Chairs gives verbal updates at Board meetings. These updates cover EMC activities that have not been covered at any earlier Board meetings. Second, the EMC updates its Strategic Plan annually. This annual update includes grammatical edits, substantial edits as needed, and an executive summary that outlines the year's milestones and accomplishments. The annual Strategic Plan 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 report to the Legislature documents Board and California Department of Forestry and Fire Protection (CAL FIRE) progress toward attainment of their previous goals and allows for public input on the direction of future Board goals. EMC's portion of this report will be extracted from the executive summary of the Strategic Plan.

1.4 EMC Personnel and Funding

The EMC has found that dedicated staff and funding are necessary to achieve some 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), U.S. 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 has also committed specific personnel to provide technical support to the EMC. Beginning in fiscal year 2015/2016, Board staff 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. Typically, these critical needs are necessary when EMC members and stakeholders cannot provide the necessary level of support or specialized technical expertise necessary to complete EMC sponsored projects. Critical needs identified include (not necessarily in order of importance):

- Literature review by technical expert(s).
- Study design or statistical review.
- Specialized statistical analysis or modeling.
- Sponsorship of graduate students or contribution to an existing university study(s).
- Ability to respond to and monitor rare and large events (see Section 4.2.2).
- 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 2.2 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 photo acquisition).

For Fiscal Years 16/17 and 17/18, the EMC has been allocated funding of $425,000 per fiscal year from the TRFR Fund. The Board will be working towards making this allocation permanent for subsequent fiscal years. Funding is intended to support EMC projects and will be granted through the normal Board/CAL FIRE contracting process. Projects will be funded based upon EMC priorities, as identified through ranking criteria provided in Appendix F.

2.0 EMC STRATEGIC PLAN ROAD MAP

The EMC Strategic Plan road map will guide how the Committee intends to achieve the EMC goals and objectives. It is the intent to use the EMC Strategic Plan as a living document that will be updated annually. The overall 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.

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/). 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. As part of their review the Board provided guidance and suggested changes to the draft Strategic Plan with the understanding that the Strategic Plan will be updated and reviewed by the Board annually. The Board approved the list of critical monitoring questions with the Strategic Plan on October 1, 2015. Appendix D summarizes priorities and monitoring questions received from various stakeholders.

The third and final steps are an on-going process. The third step is to evaluate specific monitoring projects, described in Appendix E, that aim to address an EMC critical monitoring question (detailed information on the project evaluation process is provided in Appendix F). The final step is to initiate EMC sponsored projects.

The following sections are a brief summary of the priorities and monitoring questions listed in Appendix D.

2.1.1 Board of Forestry and Fire Protection

For 2014, the Board's Forest Practice Committee and Management Committee provided a total of six and two priorities, respectively. Summarized, the Forest Practice Committee priorities focus, not necessarily in order of importance, on roads, cumulative effects, and slash treatment. The Management Committee priorities focus on WLPZ effectiveness emphasizing use of Demonstration State Forests as potential sites for monitoring. All Board committee topics are discussed in more detail in the priorities included in Appendix D. Detailed information on how the EMC intends to monitor cumulative effects is provided below.

The Board has established several joint policies with the California Fish and Game Commission 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). Where these joint policies overlap with FPRs and associated regulations the EMC has highlighted the policy.

The Board understands that natural processes are complex and highly variable over time and space. In addition, our understanding of these processes and linkages are imperfect. However, it is 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 aquatic and terrestrial resources of concern. Also, 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.

2.1.2 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 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.

The EMC recognizes that cumulative effects encompass a broad spectrum of natural processes and their linkages over time and space (MacDonald 2000, MacDonald et al. 2004, Reid 1993). The EMC also recognizes that management practices may have either positive or negative cumulative effects. Consequently, the EMC has developed a framework regarding how to monitor and evaluate potential cumulative effects. The first element of the framework 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, so that a hierarchy of information can be used to untangle the complexities that are inherent at larger spatial and longer temporal scales. Finally, improving study design to recognize appropriate spatial and temporal scales and identify potential variable interaction and indirect effects can greatly reduce spurious monitoring results. This approach would limit problems that have confounded many previous attempts to manage cumulative effects by monitoring discrete causal linkages between FPRs and associated regulations and resource(s) of concern (MacDonald 2000). Section 4.2 provides more guidance on choosing the appropriate spatial and temporal scale for monitoring.

While much of the emphasis to date has been placed on cumulative watershed effects, many terrestrial and aquatic public trust resources, including snags, dens, and nest trees for listed and other sensitive wildlife species are assumed to contribute to the overall health of timberlands, and the potential for cumulative effects to such resources are to be evaluated at multiple spatial scales per Technical Rule Addendum No. 2. For example, habitat elements like snags are an important component of wildlife habitat, providing nesting and denning substrate for numerous species and complexity to forest structure, thus contributing to biological diversity. The FPRs contain specific measures to maintain and recruit key habitat elements like snags at the individual logging area scale so that potential adverse cumulative effects can be avoided at the biological assessment area scale (e.g. planning watershed). However, the FPRs also include exceptions to snag retention requirements for fire hazard reduction, safety, and other reasons (14 CCR § 919.1 [939.1, 959.1]). In general, information regarding the FPRs effectiveness for snag retention is lacking, and is similarly lacking for other wildlife habitat components and characteristics, such as for protection of nest sites, retention and recruitment of large woody debris, hardwood cover, and late seral habitat connectivity. Thus, carefully designed and robust monitoring studies are needed to provide information on the effectiveness of Technical Rule Addendum No. 2 in identifying potential cumulative effects to wildlife habitat, and the opportunity for feedback and adaptive management. Due to the robust monitoring necessary and complexity of monitoring terrestrial resources across large, biologically relevant scales that typically include multiple public and private landowners, monitoring of these terrestrial resources may also be appropriate for the AB 1492 Working Groups.

2.1.3 California Department of Fish and Wildlife

The California Department of Fish and Wildlife (CDFW) suggests a number of FPRs have long warranted monitoring for their effectiveness in helping to ensure 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 has been 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 demonstrated as 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 watercourse and lake protection zones and as appropriate to provide functional connectivity between habitats."

Additionally, many Fish and Game Code (FGC) statutes and Fish and Game Commission (FGCom) policies apply to timber operations regulated by the FPRs. For example, Fish and Game Code 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 Endangered Species Act (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.

2.1.4 State and Regional Water Quality Control Boards

The Water Boards priorities are to participate in and support monitoring studies 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, and facilitate adaptive management to improve those FPRs and associated regulations, as necessary. While modern forestry practices have been 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 health and proper function of aquatic ecosystems and beneficial uses of water in forested watersheds throughout the state. The Water Boards priorities for impaired water bodies are to evaluate FPRs and associated regulations effectiveness to prevent or minimize sediment discharge and restore impaired aquatic and riparian function, and preserve and restore cold water for beneficial uses through effective shade on watercourses. The spatial and temporal scale of monitoring studies may vary from short-term site or project-specific to long-term watershed or regional scales. Additional monitoring studies are needed to evaluate fuel loading in WLPZs, restocking requirements, fuel breaks, and best management practices applied during and after timber harvest activities in wildfire-affected areas.

Monitoring studies should be designed to evaluate both the specific FPRs and associated regulations effectiveness and long-term watershed trends to help inform adaptive management of the FPRs and associated regulations, as they apply to all FPRs projects. Monitoring should be designed with clear objectives and goals, posing clear questions and using methods that can reasonably be expected to answer specific questions. An important component of the monitoring efforts should be a well-defined process for adaptive management based on study results. To establish reliability and enhance the confidence in the results, studies should use existing data collection standards or protocols linked to accessible data repositories appropriate for the type of data collected.

2.1.5 California Geological Survey

The California Geological Survey's (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, 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). Where and when 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 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 4.2) 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 and large events (see Section 4.2.2).

2.1.6 California Department of Forestry and Fire Protection

The California Department of Forestry and Fire Protection (CAL FIRE) monitoring priorities are to evaluate the implementation (i.e., compliance) and effectiveness of the FPRs in protecting water quality, as has been undertaken for the past 20 years (see Section 1.1), and also to evaluate the FPRs effectiveness in protecting wildlife habitat for Board-listed sensitive and other important species.

Based on the results of previous monitoring programs, CAL FIRE encourages the EMC to undertake specific projects to determine the FPRs effectiveness related to WLPZ, road, and watercourse crossing requirements in maintaining acceptable water temperatures and nutrient inputs, as well as reducing management-related sediment inputs. More rigorous and scientifically defensible tests of the effectiveness of individual practices are needed. For example, monitoring of unstable area identification and unstable area prescription effectiveness is needed. Monitoring specifically for roads and watercourse crossings following large hydrologic events (e.g. storm recurrence intervals exceeding 20 years covering a large hydrologic basin) is needed to test the effectiveness of contemporary forest

practices (see Section 4.2.2). The current FPRs effectiveness for meeting Basin Plan water quality objectives should also be an EMC priority. Further information is needed on chronic turbidity durations and spatial distributions at a watershed scale, and on their impacts to anadromous salmonid growth and survival.

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 debates 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. Additionally, the effectiveness of aquatic restoration projects needs more rigorous testing. Habitat restoration is critical for the survival of listed anadromous fish species in the Coast Ranges and CAL FIRE supports continued effectiveness monitoring of large wood enhancement projects undertaken to improve habitat for salmonids.

CAL FIRE believes that wildlife habitat effectiveness monitoring should be a high priority for the EMC. For example, CAL FIRE encourages the EMC to develop monitoring efforts to determine the effectiveness of measures used to ensure take avoidance and avoid significant adverse impact 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.

Finally, CAL FIRE supports effectiveness monitoring efforts in watersheds selected as pilot projects under AB 1492. CAL FIRE is beginning work with the other Review Team agencies to test a pilot approach for assembling available data on the planning watershed level to assess cumulative effects and identify opportunities for restoration of habitat for listed anadromous salmonids. Implementation of the 'Watershed Pilots Program' will be used to develop strategies for data assembly and sharing for consistent Timber Harvesting Plan preparation and review, to identify needs and opportunities for restoration, and to enable the development of forest practice ecological performance measures.

2.1.7 U.S. Forest Service

The U.S. Forest Service (USFS) has a mutual interest in supporting monitoring efforts that are well designed, advance our scientific understanding of natural processes and are re-integrated through adaptive management into the FPRs. Also, the USFS is embracing an "all-lands" approach working with adjacent landowners to reach common management goals. Several of the environmental factors that the USFS are required to monitor occur across administrative and ownership boundaries. The appropriate scale for monitoring will often include adjacent public and private lands. The EMC has an opportunity to develop shared monitoring between public and private lands.

In addition, the 2012 U.S. Forest Service Planning Rule (http://www.fs.usda.gov/planningrule) (36 CFR Part 219) requires the National Forests to create a monitoring program as part of new Land and Resource Management Plans. "…Each plan monitoring program must contain one or more monitoring questions and associated indicators addressing each of the following:

(i) The status of select watershed conditions.
(ii) The status of select ecological conditions including key characteristics of terrestrial and aquatic ecosystems.
(iii) The status of focal species to assess the ecological conditions required under § 219.9.
(iv) The status of a select set of the ecological conditions required under § 219.9 to contribute to the recovery of federally listed threatened and endangered species, conserve proposed and candidate species, and maintain a viable population of each species of conservation concern.
(v) The status of visitor use, visitor satisfaction, and progress toward meeting recreation objectives.
(vi) Measurable changes on the plan area related to climate change and other stressors that may be affecting the plan area.
(vii) Progress toward meeting the desired conditions and objectives in the plan, including for providing multiple use opportunities.
(viii) The effects of each management system to determine that they do not substantially and permanently impair the productivity of the land (16 U.S.C. 1604(g)(3)(C)…"

2.1.8 National Oceanic & Atmospheric Administration National Marine Fisheries Service

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) 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 Endangered Species Act. 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 impacts in all cases. Rather, examining a suite of FPRs and associated regulations which are intended, collectively, to contribute to controlling cumulative impacts may be more informative. In addition, a proper examination of cumulative impacts 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 impacts 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 controls are effective at avoiding significant cumulative impacts, or the degree to which they are minimized at various scales, is important for informed regulation of timber harvest in watersheds supporting listed salmonids.

2.1.9 Public Stakeholders

For the purposes of this Strategic Plan, public stakeholders include citizens, private landowners, universities and colleges, and a wide variety of interest groups. Because no one person or entity can speak on behalf of public stakeholders, this summary is intended to describe input received from public stakeholders during the development of the Strategic Plan. Since the EMC welcomes continued input from public stakeholders, the Strategic Plan will be updated annually.

One consistent comment received from multiple conservation groups and individuals is to have the EMC Strategic Plan development, 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, previous meeting notes, and all EMC documents 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).

2.2 Ecological Performance - Timber Regulation and Forest Restoration Program

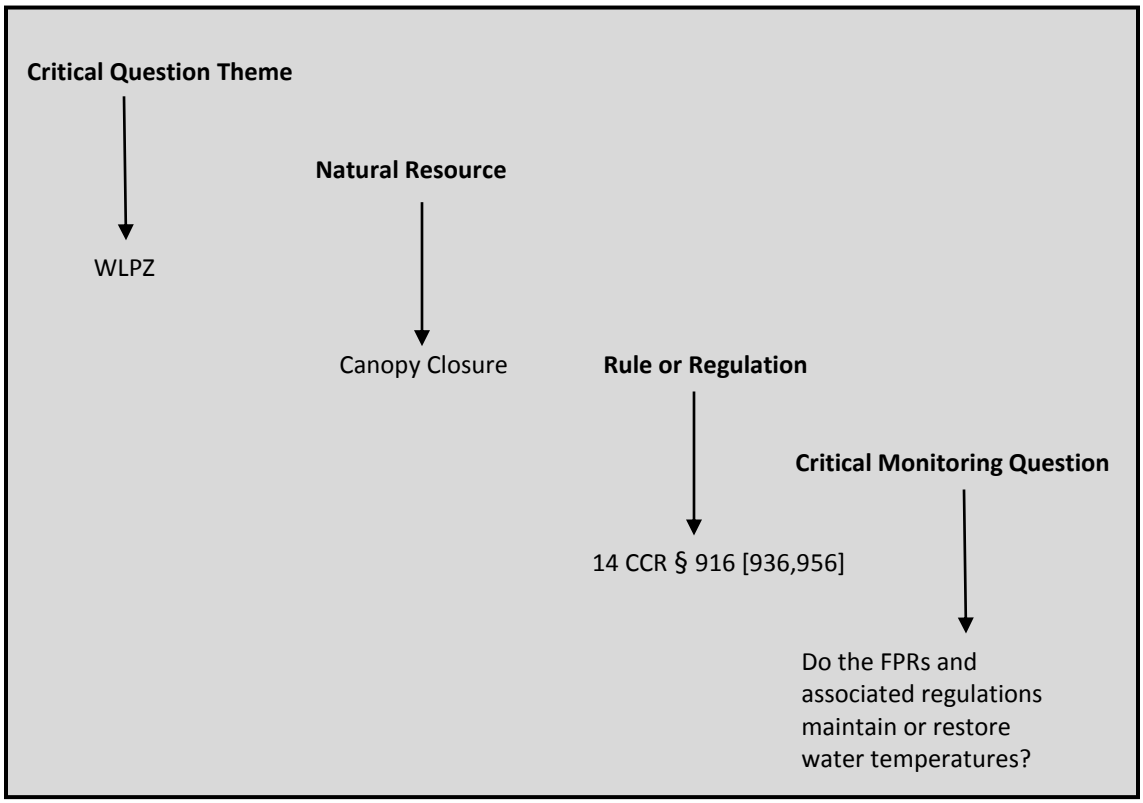
The Timber Regulation and Forest Restoration (TRFR) Program is directed by AB 1492 to develop ecological performance measures for state and private forestland management. The program is in its initial stages of this work, having completed charters in 2015 for several working groups, including the Ecological Performance Measures Working Group, the Data and Monitoring Working Group, the Administrative Performance Measures Working Group, and the Interagency Information Systems Working Group. Ultimately, the ecological performance measures will drive the monitoring questions that the TRFR Program needs to answer. In addition to relying on monitoring data currently being collected by a wide range of entities, the TRFR Program has been able to allocate resources from the TRFR Fund to the EMC to develop additional monitoring that is needed to support the ecological performance measures (see Section 1.4). Based on the Working Group charters, it will be some time in the future—2018—that the working set of ecological performance measures will be completed.

2.3 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 D for more detail). The specific FPRs for each priority or monitoring question and associated

regulations or policies are also described in Appendix D. 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).

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 ten individual themes. Also, to provide the Board and public with a better understanding of the EMC member discussions, the EMC then prioritized each of the ten individual themes. EMC members prioritized the themes based on their own individual professional judgment. This prioritization was intended to provide initial focus to High and Medium themes. Depending on funding opportunities, existing monitoring projects already underway (Appendix G), and other considerations, lower priority themes may also be EMC supported. The prioritization followed a general categorical scale of High, Medium or Low priority, and the themes were prioritized as follows:

High WLPZ Riparian Function, Watercourse Channel Sediment, Road and WLPZ Sediment, and Wildfire Hazard.

Medium	Mass Wasting Sediment, Fish Habitat, and Wildlife Habitat: Cumulative Effects.
Low	Wildlife Habitat: Species and Nest Sites, Wildlife Habitat: Seral Stages, and Wildlife Habitat: Structure.

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 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 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 *(Implementation and Compliance)*?
(b) maintaining and restoring stream water temperature?
(c) retaining predominant conifers in WLPZs (*Implementation and Compliance*) 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 4.2 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 4.2 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 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 4.2.2)*?
(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 (*Implementation and Compliance)*?

(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, 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.

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)?
(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 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 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)?

2.4 Catalog of Ongoing Cooperative and Individual Monitoring Projects

Numerous ongoing California watershed and wildlife-related monitoring projects and projects planned for implementation in the near future need to be considered by the EMC to avoid duplication and help focus priorities for critical monitoring questions. The catalog displayed in Appendix G builds on and updates the catalog developed by Coe (2009) for the Board's Monitoring Study Group titled "Water Quality Monitoring in the Forested Watersheds of California: Status and Future Directions." Only major studies being conducted on non-federal timberlands related to topics being considered by the EMC are included. The EMC may also review and consider studies conducted in mixed ownership landscapes or conducted on federal timberlands. General background/trend monitoring projects without specific objectives/hypotheses are omitted, as are Conditional Waiver/General Waste Discharge Requirements-related monitoring.

The catalog is divided into two sections. This first part lists cooperative studies being undertaken (i.e., those with participation from multiple monitoring entities). In this document, "cooperative" implies that significant resources (i.e., funding, staffing, and/or equipment) are provided by all the partners involved with the project. The second section lists monitoring projects being conducted primarily by individual entities. Projects listed are those that EMC members and staff were aware of as of December 2016. It is recognized that the catalog is incomplete and will change over time, since (1) a comprehensive survey of potential forest monitoring entities was not undertaken, and (2) land ownership changes will occur. The EMC Strategic Plan is considered a "living document" that we will update annually, including this monitoring catalog. Critical information necessary to update the catalog includes the monitoring entity(s) conducting the project, study title, general monitoring objectives/hypotheses being studied, principle investigator(s), and brief sources of additional information (e.g., website links, references).

2.5 EMC Supported Monitoring Projects – 2015 and 2016

EMC-2015-001 The sunset clause in the FPRs requires an assessment of of the effectiveness of the methods used for identifying Class II-L watercourses. Three monitoring questions will be addressed: (1) are the Class II-L identification methods resulting in conflicts between Review Team personnel and the regulated public?; (2) are the drainage area and width methods effective in identifying Class II-L watercourses?; and (3) are the identification methods effective in identifying watercourses that have the potential to translate thermal impacts to Class I watercourses?

EMC-2015-002: Forest Practice Implementation and Effectiveness Monitoring (FORPRIEM) ver. 2.0 - FORPRIEM (Forest Practice Rules Implementation and Effectiveness Monitoring) is CAL FIRE's only direct project monitoring of THPs and NTMPs, except for Forest Practice inspections. The objectives of FORPRIEM ver. 2.0. include (1) continuing to determine the implementation and short-term effectiveness of the FPRs implemented on the ground related to water quality, particularly related to watercourse and lake protection zones, watercourse crossings and roads;(2) utilizing multi-agency Review Team personnel to collect field data; and (3) using a stratified random sample of completed THPs and NTMP-NTOs to better test the FPRs on a larger percentage of higher erosion risk sites. The EMC has recommended this project for S28,000 in funding.

EMC-2015-004: This study will monitor changes in key indicators of forest road performance that result from the implementation of the "Road Rules, 2013 Rule Package." It will address how effective the Road Rules are at decreasing the magnitude of erosion, runoff, and sediment delivery at the road segment and plan scale. Specifically, data will be collected to answer: (1) has the length/area/percentage of roads draining to watercourses decreased after the implementation of the Road Rules (connectivity)?; and (2) have the road attributes affecting surface erosion for connected road segments improved since the implementation of the Road Rules?

EMC-2016-001: Post-fire effectiveness of the Forest Practice Rules in protecting water quality on Boggs Mountain Demonstration State Forest - This study is using established methods, when possible, to measure the effects of post-fire salvage logging and post-salvage site preparation techniques on runoff, erosion, carbon flux rates, and vegetative recovery on the Boggs Mountain Demonstration State Forest, which was burned during the 2015 Valley Fire. There are two main objectives to this project: (1) determine the effects of post-fire logging and site preparation on runoff, erosion, soil carbon, and vegetation recovery; (2) develop and demonstrate alternative BMPs for post-fire salvage operations. No funding was requested for this project.

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 and objectives (for information on the Washington State adaptive management program and its detailed decision-making process, see WFPB 2013). In addition to results of scientific studies, the Board will consider the following four goals as part of the Adaptive Management Framework:

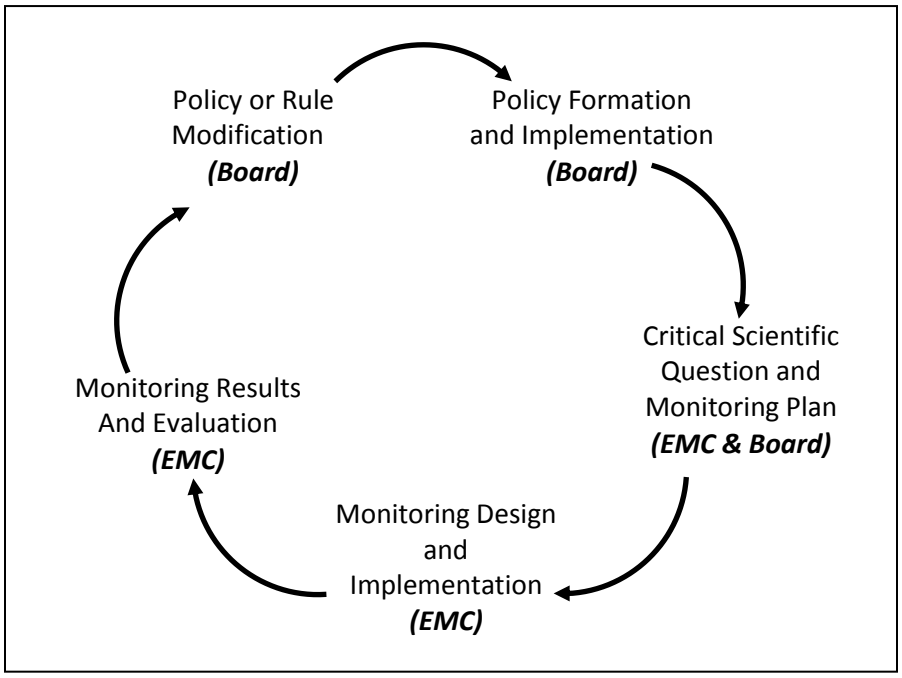
(1) To provide compliance with the state and federal Endangered Species Acts for species found on state and private forestlands.

(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 California.

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, or Fish and Game Code or regulations.

In addition, the Board has discussed the respective responsibilities of the EMC and the Board with regard to the scientific report. Appendix C 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 APPROPRIATE SCIENTIFIC METHODS AND REPORTS

4.1 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 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 (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 (see Appendix G).

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).

4.2 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).

4.2.1 Range of Variability

Natural variability is an inherent characteristic of healthy ecosystems and plays a beneficial role in maintaining ecosystem functions and processes (Holling and Meffe 1996). Natural variability is a product of:

(1) Ecosystem processes functioning at different spatial scales and differing rates and varying by several orders of magnitude

(2) The spatial attributes of ecosystems (e.g. productivity, species composition, seral stages), which are not constant and are scale dependent

(3) Ecosystems may display multiple stable states, instead of single equilibria, which maintain overall structure and diversity (Hollings and Meffe 1996)

(4) Disturbance regimes (including frequency, spatial arrangement and severity of disturbance)(Swanson et al. 1993)

Approaches and concepts used to characterize natural variability include historical range and variability (Keane et al. 2009), natural range of variability (Landres et al. 1999), and the use of properly functioning condition matrices (NMFS 1996, Marshall 2001) or assessments (Prichard 1998). All these approaches seek to acknowledge and quantify natural variability, with the goal of providing guidance and context

and direction for managing healthy and resilient ecosystems (Landres et al. 1999, Keane et al. 2009). In this section we use the term 'natural range of variability' (NRV) to characterize these concepts, but do not adhere to any particular approach expressed in the literature.

Characterizing NRV requires an understanding of how controlling ecosystem processes vary over time and space, and how these processes affect the ecosystem resource(s) of concern. As such, the concept of NRV can provide a basis for evaluating the feasibility of achieving desired management outcomes, the impacts and tradeoffs that might occur from different management alternatives, and may ultimately improve our capacity to manage dynamic ecosystems (Landres et al. 1999). In application, NRV assessments are often broad in scope and can be limited by available data, scale effects, assessment methodology, and study complexity (Keane et al., 2009). NRV assessments typically include an approach to optimize the use of available data, such as the identification of key indicator variables to quantify management impacts (Marshall 2001, Hillman and Giorgi 2002) or the use of a 'weight-of-evidence' approach (NCRWQCB, 2006). NRV assessments must be carefully tailored to temporal and spatial scales appropriate for the resource(s) of concern and controlling processes. Key indicator variables or PFCs may not be transferable over time and space. For example, in forest practice, anthropogenic effects caused by land development, fire suppression and climate change can significantly alter the historical NRV and affect study design for long-term (decade-scale) assessments.

Range of Variability and Effectiveness Monitoring

A primary goal of the EMC is to determine the effectiveness of the FPRs and associated regulations in achieving regulatory standards and possibly identify a need to modify the standards based on scientific, verifiable monitoring results. Many of these regulatory standards are based on a narrow range of values that represent an optimum or static resource condition, and are typically applied uniformly across large areas. Thus, the use of regulatory standards runs counter to the notion of natural variability, which emphasizes the dynamic character of ecosystems (Holling and Meffe 1996, Reeves et al. in press). Currently, the FPRs and associated regulations address NRV to only a limited extent by providing classifications that represent an average condition for a particular range of spatial and temporal variability. For example:

1. Productivity of the land is reflected in stocking rules such that less productive lands have lower stocking standards.

2. FPRs and associated regulations protecting watercourse zones vary, in part, based on Forest District, stream flow, presence of aquatic life, and domestic water use.

3. Geographic variability in climate and soil conditions is broadly represented by specific rules that apply to distinct forest districts (Coast, Northern and Southern).

4. FPRs do allow for site-specific conditions to determine appropriate riparian zone management practices under Section V (14 CCR § 916.9, [936.9, 956.9](v)).

It is recognized that monitoring the effectiveness of different forest practices in achieving a regulatory standard and consideration of whether those practices maintain the resource of concern within its natural range of variability are two fundamentally different questions that may be incompatible within a

monitoring study. For example, historical range of variability is best defined at spatial scales ranging from approximately 40 to 400 square miles (Keane et al. 2009); however, this scale of analysis may not be compatible or feasible within a monitoring study design that assesses management practice effectiveness at the hillslope or planning watershed scale. In some cases, incorporating NRV into a monitoring study may provide additional insight into the effectiveness of management practices in achieving desired resource goals and objectives.

A NRV analysis may also point out whether the regulatory standards being monitored fall within a biologically relevant range. Additionally, monitoring may show a practice fails to meet a regulatory standard, but the effect may be biologically insignificant as the outcome is within the NRV. All of these will potentially assist the Committee in reporting rule effectiveness to the Board.

If NRV is to be included in an effectiveness monitoring study, then its limitations must be considered, such as the frequent paucity of data to characterize NRV for ecosystem processes at a variety of scales (Keane et al. 2009).

Except as discussed above, due to the scope and scale of NRV in monitoring studies, it is not anticipated that effectiveness monitoring studies will address NRV unless data exist for the process or resource(s) of concern. If quantifying NRV for a given process or ecological condition becomes a high priority need, then a larger effort will likely be required with a specific study design at an appropriate scale to address the problem. Finally, if one is unable to define NRV, then a greater effort will need to be part of every project to describe biologically relevant changes.

4.2.2 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 events such as large floods, landslides and debris flows. Dispersed monitoring seldom captures the linkages between large natural disturbance events with 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 land sliding 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.
(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. These are examples of using infrequent events to determine the effectiveness of the FPRs and associated regulations related to natural resources. Categories of rare events need to be created so that, when they occur in California, a pre-approved effectiveness monitoring or research plan will be enacted to study the performance of the FPRs and associated regulations.

We recommend that effectiveness monitoring or research plans be prepared in advance of these 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. The goal is to immediately respond to the opportunities as they arise to maximize the ability to detect the performance of the FPRs and associated regulations during these rare or large events. 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) Notify the appropriate response team and deploy other necessary resources, (i.e., a road failure, a landslide, or a post-fire assessment will require specific sets of skills). These will be preselected and could be available on an on-call contractual basis.

(3) 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.

4.2.3 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 abundant 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. For example coho salmon typically have a three year life cycle so a minimum of nine years of population data would be required to capture a minimum three year trend for each cohort (NMFS 2012, NMFS 2014). Also 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. Sediment filling in pools and changes in stream temperature can rapidly document negative impacts from projects. Similarly, changes in pool-riffle ratios and macroinvertebrate assemblages can provide quick results to determine project success. Elevated stream turbidity can impact growth and survival of fish by reducing their ability to forage and affecting gill function and condition. Continuous turbidity monitoring provides information on the magnitude and duration of those values that can negatively impact fish. These various types of monitoring allow managers to make inferences on 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.

4.2.4 Resource Benefit

So Board members can better evaluate cost of implementing the existing FPRs and associated regulations, the Board has requested the EMC to also evaluate 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 also 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 could 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: Timber Harvesting Plan, Modified Timber Harvesting Plan, Nonindustrial Timber Management Plan, Program Timber Harvesting Plan, Working Forest Management Plan; or Emergency Notice or Exemptions.
(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.

4.3 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.

4.4 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 (see Section 3.0) based on results and findings of EMC reports, if necessary, shall be proposed by or brought before the Board's Forest Practice Committee for review and comment prior to submittal to the full Board.

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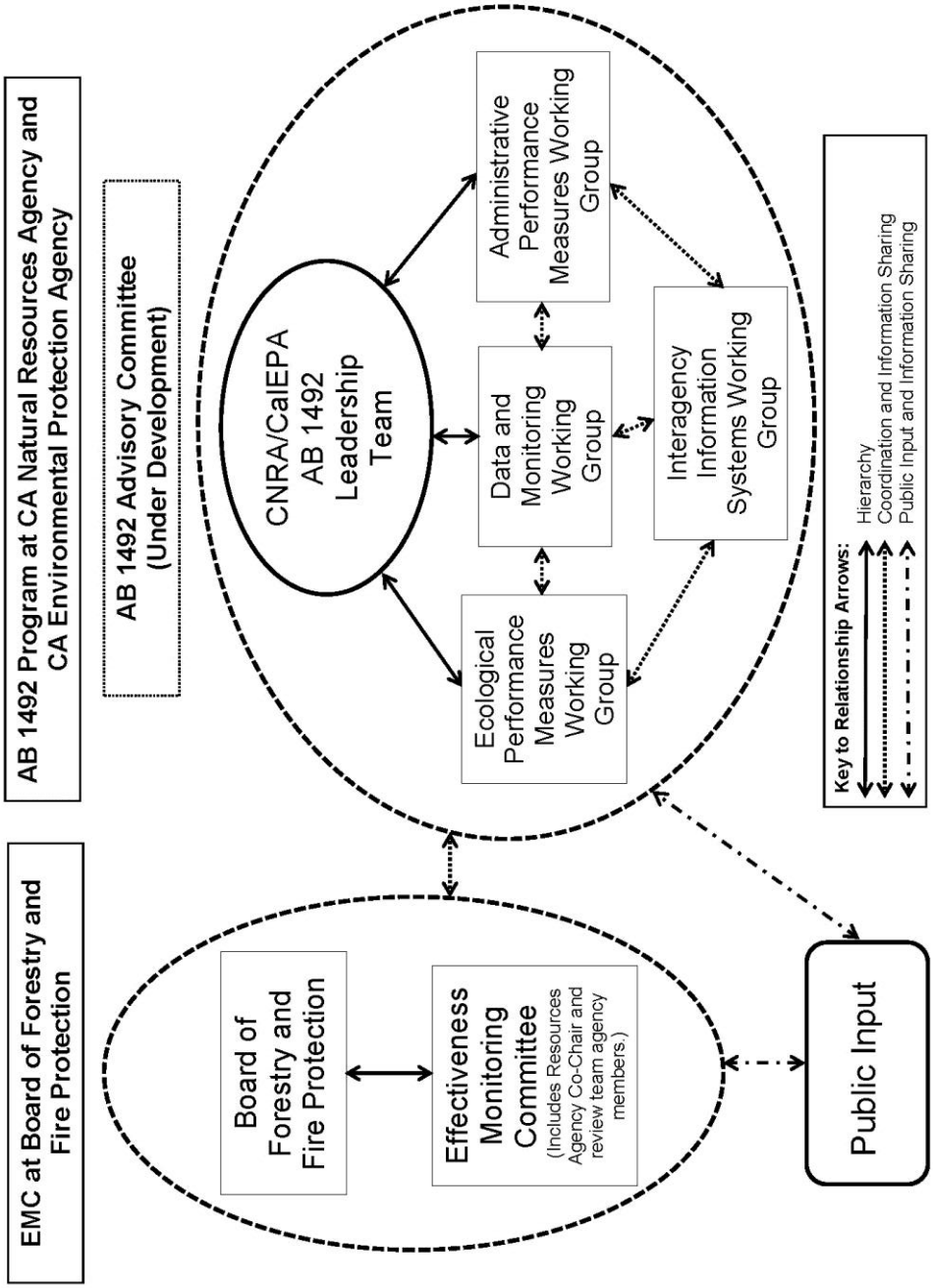
APPENDIX A: EMC APPOINTED MEMBERS AND STAFF

Name	Specialty	Affiliation	Term Expiration
Russ Henly	Co-Chair RPF 2560	California Natural Resources Agency	
Stuart Farber	Co-Chair RPF 2585	Board of Forestry and Fire Protection	
Agency Representatives			
Stacy Drury	Fire Ecology	USFS	
Bill Condon	Wildlife RPF 2461	CDFW	
Drew Coe	Hydrology/Forestry RPF 2981	CAL FIRE	
René Leclerc	Geology/Hydrology	Central Valley Regional Water Quality Control Board	
Clarence Hostler	Fisheries	NOAA/NMFS	
Ali Dunn	Water Quality	State Water Resources Control Board	
Bill Short	Geology/Watersheds	California Geological Survey	
Jim Burke	Geology/Water Quality	North Coast Regional Water Quality Control Board	
Monitoring Community			
Kevin Boston	Forestry/Engineering RPF 2370	Humboldt State University	7/1/2017
Erin Kelly	Forest Policy/Economics RPF 3001	Humboldt State University	7/1/2017
vacant	vacant	University affiliation	
Tom Engstrom	Wildlife/Botany RPF 1936	Sierra Pacific Industries	7/1/2018
Matt House	Hydrology/Fisheries	Green Diamond Resource Company	7/1/2017
Sal Chinnici	Wildlife	Humboldt Redwood Company	7/1/2017
Matt O'Connor	Geology/Geomorphology	Public	7/1/2018
Support Staff			
Matt Dias	Executive Officer RPF 2773	Board of Forestry and Fire Protection	
Pete Cafferata	Hydrology/Forestry RPF 2184	CAL FIRE	
Stacy Stanish	Biology/Fisheries RPF 3000	CAL FIRE	
Dave Fowler	Geology/Water Quality	North Coast Regional Water Quality Control Board	
Amanda Culpepper	Wildlife	CDFW	

APPENDIX B: ORGANIZATIONAL FRAMEWORK OF AB1492



APPENDIX C: 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.

APPENDIX D: PRIORITY RECEIVED FROM BOARDS, DEPARTMENTS & AGENCIES

(Priorities received have been grouped by critical question theme).

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
1	*1.1*	WLPZ Riparian Function	Canopy Closure	916.5 [936.5, 956.5] (e) G, I 916.9 [936.9, 956.9] (a)(7) 916.9 [936.9, 956.9] (f)(2)(A),(B),(C) 916.9 [936.9, 956.9] (f)(3)(A),(B),(C),(D),(F) 916.9 [936.9, 956.9] (f)(4)(A),(B),(C) 916.9 [936.9, 956.9] (g)(2(B)(1) 916.9 [936.9, 956.9] (g)(2)(B)(2)(iii)	WLPZ effectiveness in maintaining canopy closure and water temperature?	MSG (2009)	FGC § 1602(a) & 1603(a) FGCom T&E Species and Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Objectives for Temperature & Dissolved Oxygen
	1.2	WLPZ Riparian Function	Canopy Closure	916.5 [936.5, 956.5] (e) G, I 916.9 [936.9, 956.9] (a)(7) 916.9 [936.9, 956.9] (f)(2)(A),(B),(C) 916.9 [936.9, 956.9] (f)(3)(A),(B),(C),(D),(F) 916.9 [936.9, 956.9] (f)(4)(A),(B),(C) 916.9 [936.9, 956.9]	Evaluate adequacy of FPR canopy retention standard in preserving pre-harvest effective shade; in particular, whether the minimum canopy retention provided on Class I and II-L watercourses preserves or restores site specific potential effective shade.	Water Boards (2015)	FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
				(g)(2(B)(1) 916.9 [936.9, 956.9] (g)(2)(B)(2)(iii)			FGCom/Board Policy Salmon WQCP: Water Quality Objectives for Temperature & Dissolved Oxygen. North Coast: Temperature Policy (Basin specific amendment)
	1.3	WLPZ Riparian Function	Canopy closure	916.5 [936.5, 956.5] (e) G, I 916.9 [936.9, 956.9] (a)(7) 916.9 [936.9, 956.9] (f)(2)(A),(B),(C) 916.9 [936.9, 956.9] (f)(3)(A),(B),(C),(D),(F) 916.9 [936.9, 956.9] (f)(4)(A),(B),(C) 916.9 [936.9, 956.9] (g)(2(B)(1) 916.9 [936.9, 956.9] (g)(2)(B)(2)(iii)	FORPRIEM (revised) - Implementation and compliance of WLPZ canopy requirements	CAL FIRE (2014)	FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Objectives for Temperature

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							& Dissolved Oxygen.
	1.4	WLPZ Riparian Function	Canopy Closure	916.5 [936.5, 956.5] (e) G, I 916.9 [936.9, 956.9] (a)(7) 916.9 [936.9, 956.9] (f)(2)(A),(B),(C) 916.9 [936.9, 956.9] (f)(3)(A),(B),(C),(D),(F) 916.9 [936.9, 956.9] (f)(4)(A),(B),(C) 916.9 [936.9, 956.9] (g)(2(B)(1) 916.9 [936.9, 956.9] (g)(2)(B)(2)(iii)	Monitoring effectiveness of WLPZ canopy closure in Demonstration State Forests harvest plans.	MC (2014)	FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Objectives for Temperature & Dissolved Oxygen.
	1.5	WLPZ Riparian Function	Riparian Function	916.4 [936.3, 956.4] (a),(b)	The effectiveness of implementing Section 916.4 [936.4, 956.4](a) and Section 916.4[936.4, 956.4](b) in protecting, maintaining and/or restoring the functions set forth in Section 916.4[936.4, 956.4] (b).	CDFW (2015)	FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							Policy Salmon WQCP: Beneficial Uses Policy in Support of Restoration in the North Coast Region
	1.6	WLPZ Riparian Function	Riparian Function	916.9 [936.9, 956.9] (c)(4) 916.9 [936.9, 956.9] (g)	Effectiveness of Class II-L rules to protect, maintain and restore riparian function	FPC (2014)	FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Standards
	1.7	WLPZ Riparian Function	Riparian Function	916.9 [936.9, 956.9] (c)(4)	Evaluate how effectively the ASP Class II-L definition breaks out watercourses with summertime flow, i.e. how Class II S watercourses have water during summer months so that compliance with the Basin Plan temperature objective may be an issue.	MSG (2009) Water Boards (2015)	FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							Policy Salmon WQCP: Water Quality Standards
	1.8	WLPZ Riparian Function	Riparian Function	916.9 [936.9, 956.9] (c)(1)(2)(3)	WLPZ tree blowdown and potential impacts or benefits to water quality.	MSG (2009) EMC (2015)	FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Standards
	1.9	WLPZ Riparian Function	Riparian Function	916.9 [936.9, 956.9] (g)(2)(B)	Effectiveness of FPRs in retaining predominant conifers in all WLPZs as recommended in Section 916.9[936.9, 956.9](g)(2)(B), such as focusing practices on thinning from below and maintaining large woody debris input to streams.	CDFW (2015)	FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							Regional Water Board Basin Plan Water Quality Standards
	1.10	WLPZ Riparian Function	Riparian Function	916.5 [936.5, 956.5] (e) G, I 916.9 [936.9, 956.9] (a)(7) 916.9 [936.9, 956.9] (f)(2)(A),(B),(C) 916.9 [936.9, 956.9] (f)(3)(A),(B),(C),(D),(F) 916.9 [936.9, 956.9] (f)(4)(A),(B),(C) 916.9 [936.9, 956.9] (g)(2(B)(1) 916.9 [936.9, 956.9] (g)(2)(B)(2)(iii)	Effectiveness of FPRs in maintaining both conifer and deciduous species in WLPZs to maintain riparian shade and primary productivity.	EMC (2015)	FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Standards
	1.11	WLPZ Riparian Function	Riparian function	916.9 [936.9, 956.9] (c)(1)(2) 916.9 [936.9, 956.9] (f)(2)(A),(B) 916.9 [936.9, 956.9] (f)(3)(A),(B),(C) 916.9 [936.9, 956.9] (f)(4)(A),(B) 916.9 [936.9, 956.9] (g)(2(A),(B)	Effectiveness of FPRs in maintaining input of organic matter into watercourses to maintain primary productivity measured by distribution and abundance of macroinvertebrate assemblages.	EMC (2015)	FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							Quality Standards
	1.12	WLPZ Riparian Function	Slash Treatment	916.5 [936.5, 956.5] 916.9 [936.9, 956.9] (v)(6)	Effectiveness of WLPZ management to reduce potential fire behavior and spread under a variety of fuel matrix(s).	Water Boards and EMC (2015)	FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon FGCom/Board Fire & Wildlife Habitat Policy WQCP: Water Quality Standards
	1.13	WLPZ Riparian Function	Stand Structure	916.9 [936.9, 956.9] (s,)(t),(u) 1038, 1052.4	Effectiveness of flag and avoid rules on fire severity in the WLPZ	Water Boards (2015)	FGCom T&E Species Policy FGCom Salmon Policy FGC/Board Policy Salmon FGCom/Board Fire & Wildlife Habitat Policy

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							WQCP: Water Quality Standards
2	*2.1*	Watercourse Channel Sediment	Sediment	914 [934, 954] 915 [935, 955] 923 [943, 963] TRA#2 Appendix A(2)(a),(3)	Is excess sediment decreasing, on a regional basis, watershed or subwatershed basis?	Water Boards (2015)	FGC § 5650(a)(6) FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Objectives for sediment and turbidity
	2.2	Watercourse Channel Sediment	Sediment	914 [934, 954], 915 [935, 955] 923 [943, 963] TRA#2 Appendix A(2)(a),(3)	Is there a trend of recovery from excess sediment impairment occurring in managed watersheds?	Water Boards (2015)	FGC § 5650(a)(6) FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							WQCP: Water Quality Objectives for sediment and turbidity
	2.3	Watercourse Channel Sediment	Sediment	913 [933, 953] 914 [934, 954], 915 [935, 955] 923 [943, 963] TRA#2 Appendix A(2)(a),(3)	Effect of hillslope prescriptions on fluvial geomorphology, such as scour, down-cutting, and channel complexity.	CGS (2015)	FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Objectives for sediment and turbidity
3	*3.1*	Road and WLPZ Sediment	Sediment	916.1 [936.1, 956.1] 916.11 [936.11, 956.11] 916.9 [936.9, 956.9] (v)(3)(A)(7), (v)(5)(I)	Effectiveness of additional plan mitigation measures and in-lieu practices within WLPZs	MSG (2009)	FGC § 5650(a)(6) FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							Policy Salmon WQCP: Water Quality Standards
	3.2	Road and WLPZ Sediment	Sediment	923.1 [943.1] (e) 923.7 [943.7] (k) 923.9 [943.9] (u)	Erosion Control Plan effectiveness	MSG (2009)	FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Standards North Coast Erosion Control Plan
	3.3	Road and WLPZ Sediment	Sediment	FPA § 4551.9(b)	Comparison of the economic costs of implementing the Road Rules 2013 versus ecological benefit.	FPC (2014)	CWC § 13241(d)
	3.4	Road and WLPZ Sediment	Sediment	913 [933, 953] 914 [934, 954] 915 [935, 955] 923 [943, 963]	What extent are management practices under FPRs generating excess sediment (i.e., canopy removal, log skidding, and road construction and use) and delivering to watercourse channels.	Water Boards (2015) MSG (2009)	FGC § 5650(a)(6) FGC § 1602(a) & 1603(a) FGCom T&E

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Objectives for sediment and turbidity
	3.5	Roads and WLPZ Sediment	Sediment	913 [933, 953] 914 [934, 954], 915 [935, 955] 923 [943, 963]	To what extent can excess sediment generated from management practices be further minimized by improving those practices and to what extent is sediment production unavoidable (for example, does canopy removal always result in *some* increase in sediment production due to changes in peak flows)?	Water Boards (2015)	FGC § 5650(a)(6) FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Objectives for sediment and turbidity.

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							SWRCB: Flow Objectives
	3.6	Roads and WLPZ Sediment	Sediment	916.4 [936.4, 956.4] (b)(6)	Monitoring effectiveness of WLPZ surface erosion filtration on private forestlands and Demonstration State Forests harvest plans.	MC (2014)	FGC § 5650(a)(6) FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Standards
	3.7	Roads and WLPZ Sediment	Sediment	923 [943, 963] TRA#5	How effective are the Road Rules 2013 in preventing or minimizing sediment discharge?	Water Boards (2015)	FGC § 5650(a)(6) FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							Policy Salmon WQCP: Water Quality Standards
	3.8	Roads and WLPZ Sediment	Sediment	923.9 [943.9, 963.9] (c), (g),(n)	Effect of crossing structure design on fluvial geomorphology such as sediment routing and fish passage of all life stages.	CGS (2015)	FGC § 5650(a)(6) FGC § 1602(a) & 1603(a) FGC § 5901 FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Standards
	3.9	Roads and WLPZ Sediment	Sediment	923.2 [943.2, 963.2] (5), 923.4 [943.4, 963.4] (a), 923.5 [943.5, 963.5] (a), 923.7 [943.7, 963.7] (a), 923.9 [943.9, 963.9] (m)(2) TRA#5	Effectiveness of Road Rules 2013 to reduce hydrologic disconnection and sediment transport to a watercourse channel	FPC (2014) EMC (2015)	FGC § 5650(a)(6) FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							Policy FGCom/Board Policy Salmon WQCP: Water Quality Objectives for sediment and turbidity
	3.10	Roads and WLPZ Sediment	Sediment	923 [943, 963]	Effect of large storms on landslides (debris flows) and as related to roads, landings and crossings.	CGS (2015)	FGC § 5650(a)(6) FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Objectives for sediment and turbidity
	3.11	Roads and WPZ Sediment	Sediment	923.9 [943.9, 963.9] (c) 923 [943, 963]	FORPRIEM - watercourse crossings and fish passage of all life stages.	CAL FIRE (2014)	FGC § 1602(a) & 1603(a) FGC § 5901

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
							FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Objectives for sediment and turbidity
	3.12	Roads and WLPZ Sediment	Sediment	923.9 [943.9, 963.9] (f) 923.9 [943.9, 963.9] (o) TRA#5	Effectiveness of crossing construction practices with regard to long-term sustainability and resilience to episodic events.	CGS (2015)	FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Standards

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
	3.13	Roads and WLPZ	Sediment	923.1 [943.1, 963.1] 923.2 [943.2, 963.2] 923.4 [943.4, 963.4] 923.7 [943.7, 963.7]	Effectiveness of road and landing construction practices with regard to long-term sustainability and resilience to episodic events.	CGS (2015)	FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Standards
4	*4.1*	Mass Wasting Sediment	Sediment	923.1 [943.1, 963.1] (a)(5),(d) 923.2 [943.2, 963.2] (a)(2) 923.4 [943.4, 963.4] (d) 923.5 [943.5, 963.5] (d) 923.9 [943.9, 963.9] (m)(3) 1038 (b)(4) 1038 (f)(6) 1051 (a)(7) 1090.5 (s),(y) TRA#5	Effectiveness of plan mitigation measures to minimize sediment delivery from existing chronic unstable geologic features	MSG (2009) EMC (2015)	FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Objectives for sediment and turbidity
	4.2	Mass Wasting	Sediment	923.1 [943.1, 963.1] (a)(5), (d) 923.2 [943.2, 963.2] (a)(2)	Effectiveness of plan mitigation measures to minimize sediment delivery from potential	EMC (2015)	FGCom T&E Species Policy

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
		Sediment		923.4 [943.4, 963.4] (d) 923.5 [943.5, 963.5] (d) 923.9 [943.9, 963.9] (m)(3) 1038 (b)(4) 1038 (f)(6) 1051 (a)(7) 1090.5 (s), (y) TRA#5	episodic geologic events		FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Water Quality Objectives for sediment and turbidity
	4.3	Mass Wasting Sediment	Sediment	923.1 [943.1, 963.1] (a)(5),(d) 923.2 [943.2, 963.2] (a)(2) 923.4 [943.4, 963.4] (d) 923.5 [943.5, 963.5] (d) 923.9 [943.9, 963.9] (m)(3) 1038 (b)(4) 1038 (f)(6) 1051 (a)(7) 1090.5 (s),(y) TRA#5	Review of landslide dimension and causal relationships.	MSG (2009)	FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon
	4.4	Mass Wasting Sediment	Sediment	923.1 [943.1, 963.1] (a)(5),(d) 923.2 [943.2, 963.2] (a)(2) 923.4 [943.4, 963.4] (d) 923.5 [943.5, 963.5] (d) 923.9 [943.9, 963.9] (m)(3) 1038 (b)(4) 1038 (f)(6) 1051 (a)(7)	Effect of large storms on landslides as related to hillslope management prescriptions.	CGS (2015)	FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
				1090.5 (s),(y) TRA#5			
5	*5.1*	Fish Habitat	Habitat	916.4 [936.4, 956.4] (a)(2)	The FPRs effectiveness in describing and mapping distribution of foraging, rearing and spawning habitat for anadromous salmonids.	MSG (2009) EMC (2015)	FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Beneficial uses
	5.2	Fish Habitat	Habitat	916.4 [936.4, 956.4] (a)(2)	The FPRs effectiveness in maintaining a distribution of foraging, rearing and spawning habitat for anadromous salmonids.	EMC (2015)	FGC § 2081(b) FGC § 1602(a) & 1603(a) FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Beneficial Uses

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
	5.3	Fish Habitat	Habitat	916.4 [936.4, 956.4] (a)(2)	The FPRs effectiveness in maintaining a distribution of foraging, rearing and spawning habitat non-anadromous salmonids	EMC (2015)	FGCom T&E Species Policy FGCom T&E Species Policy FGCom Salmon Policy FGCom/Board Policy Salmon WQCP: Beneficial Uses
6	*6.1*	Wildfire Hazard	Slash Treatment	917 [937], 957 1038(c) 1038(i),(j) 1051.3,4 1052.4	Effectiveness of fuel treatment to reduce fire hazard reduction.	FPC (2014)	FGCom/Board Fire & Wildlife Habitat Policy
	6.2	Wildfire Hazard	Slash Treatment	917.5 [937.5, 957.5]	Effectiveness of residual slash pile treatment in comparison to fire hazard reduction or fire behavior	FPC (2014)	FGCom/Board Fire & Wildlife Habitat Policy
	6.3	Wildfire Hazard	Slash Treatment	915.2 [935.2, 955.2] (a) 919.1 [939.1, 959.1] 1052.4(e)	Effectiveness of treating post-harvest slash and retaining wildlife habitats structures including snags and large woody debris.	EMC (2015)	FGCom/Board Fire & Wildlife Habitat Policy
	6.4	Wildfire Hazard	Slash Treatment	917.5 [937.5, 957.5]	Effectiveness of treating post-harvest slash piles to reduce fire behavior to better understand ignition and spread using a	EMC (2015)	FGCom/Board Fire & Wildlife Habitat Policy

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
					variety of pile sizes.		
	6.5	Wildfire Hazard	Slash Treatment	913.4 [933.4, 953.4] (c)	Effectiveness of vegetation management and construction and maintenance of fuel breaks for fire hazard reduction.	EMC (2015)	FGCom/Board Fire & Wildlife Habitat Policy
	6.6	Wildfire Hazard	Slash Treatment	917.5 [937.5, 957.5]	Effectiveness of treating post-harvest slash piles to reduce fire behavior under a variety of slash pile locations within a stand and impacts to adjacent untreated stands.	EMC (2015)	FGCom/Board Fire & Wildlife Habitat Policy
	6.7	Wildfire Hazard	Slash Treatment	915.2 [935.2, 955.2] (b) 916.9 [936.9, 956.9] (q) 917.3, 937.3, 957.3	Effectiveness of treating post-harvest slash using control burning treatment versus chipping on soil dynamics and vegetation response.	EMC (2015)	FGCom/Board Fire & Wildlife Habitat Policy
	6.8	Wildfire Hazard	Invasive Plants	No applicable FPRs	The effectiveness of FPRs in reducing and/or treating invasive plants for both fire threat reduction and sensitive plant habitat protection and restoration.	CDFW (2015)	FGCom/Board Fire & Wildlife Habitat Policy Regional Board Waiver Requirements for Pesticide
	6.9	Wildfire Hazard	Stand Structure	912.7 [932.7, 952.7] 921.4, 961.4, 927.10 1071	The effectiveness of stocking requirements with respect to long-term forest management for fire suppression.	Water Boards (2015), CDFW (2015)	FGCom/Board Fire & Wildlife Habitat Policy WQCP: Water Quality Standards
	6.10	Wildfire Hazard	Sediment and Water	915.3 [935.3, 955.3] 915.4 [935.4, 955.4]	The effectiveness of the FPRs in protecting water quality with respect to silvicultural	Water Boards (2015)	FGCom Water Policy

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
			Temp-erature		herbicide application post-treatment ground cover.		Regional Board Waiver Requirements for Pesticide
7	*7.1*	Wildlife Habitat: Species and Nest Sites	Nest Sites	919.2 [939.2, 959.2]	The effectiveness of Section 919.2[939.2, 959.2], General Protection of Nest Sites, "…for the protection of Sensitive species…"	CDFW (2015)	FGC § 2081(b) FGC § 3511 FGC § 3513 FGC § 3503 FGC § 3503.5 FGCom T&E Species Policy FGCom Raptor Policy
	7.2	Wildlife Habitat: Species and Nest Sites	Nest Sites	919.3 [939.3, 959.3]	The effectiveness of Section 919.3[939.9], Specific requirements for Protection of Nest Sites.	CDFW (2015)	FGC § 2081(b) FGC § 3511 FGC § 3513 FGC § 3503 FGC § 3503.5 FGCom T&E Species Policy FGCom Raptor Policy

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
	7.3	Wildlife Habitat: Species and Nest Sites	Species	919.9 [939.9] (g)	The effectiveness of Section 919.9(g) in avoiding take of Northern Spotted Owls	CDFW (2015)	FGC § 2081(b) FGCom T&E Species Policy FGCom Raptor Policy
	7.4	Wildlife Habitat: Species and Nest Sites	Species	919.9 [939.9] 919.10 [939.10]	Effectiveness of Northern spotted owl rules and regulations in protecting and conserving the species	FPC (2014)	FGC § 2081(b) FGCom T&E Species Policy FGCom Raptor Policy
	7.5	Wildlife Habitat: Species and Nest Sites	Species	919.16 [939.16, 959.16]	Effectiveness of FPRs and guidance to ensure take avoidance of Townsend's big-eared bat.	CAL FIRE (2015)	FGC § 2081(b) FGCom T&E Species Policy
	7.6	Wildlife Habitat: Species and Nest Sites	Species	898.2(d)	Effectiveness of FPRs and guidance to ensure take avoidance of Sierra Nevada yellow-legged frog.	CAL FIRE (2015)	FGC § 2081(b) FGCom T&E Species Policy
8	*8.1*	Wildlife Habitat: Seral Stages	Seral Habitats	897(b)(1)(C)	The effectiveness of the Rules per Section 897, in retaining and recruiting late and diverse seral stage habitat components for wildlife in WLPZs and as appropriate to provide for functional connectivity; including individuals and patches of trees.	CDFW (2015)	FGC§2820 et seq. FGCom T&E Species Policy FGCom Raptor Policy

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
	8.2	Wildlife Habitat: Seral Stages	Seral Habitats	919.16 [939.16, 959.16]	The effectiveness of Section 919.16[939.16, 959.16], Late Succession Forest Stands, with respect to maintenance of the amount and distribution of late succession forest stands or their functional habitat values on forestland ownerships.	CDFW (2015)	FGC§2820 et seq. FGCom T&E Species Policy FGCom Raptor Policy
9	*9.1*	Wildlife Habitat: Seral Stages	Cumulative Effects	912,9 [932.9, 952.9] TRA#2 TRA#2 Appendix C	The effectiveness of Section 912.9 [939.9, 959.2]and Technical Rule Addendum No. 2 in characterizing and avoiding significant adverse impacts to terrestrial wildlife species, their habitats and ecological processes.	CDFW (2015)	FGCom T&E Species Policy FGCom Raptor Policy
	9.2	Wildlife Habitat: Seral Stages	Cumulative Effects	913.1 [933.1, 953.1] (a) (3) 912,9 [932.9, 952.9] TRA#2 TRA#2 Appendix C(4)(g)	The effectiveness of Section 913.1[933.1, 953.1](a)(3) in avoiding forest habitat fragmentation.	CDFW (2015)	FGCom T&E Species Policy FGCom Raptor Policy
10	*10.1*	Wildlife Habitat: Structures	Structures	913.4 [933.4, 953.4] (d)	The effectiveness of Section 913.4[933.4, 953.4](d), Variable Retention, in the retention of structural elements or biological legacies" …to achieve various ecological, social and geomorphic objectives."and other co-benefits.	CDFW (2015)	FGCom T&E Species Policy FGCom Raptor Policy
	10.2	Wildlife Habitat: Structures	Structures	919.1 [939.1, 959.1]	The effectiveness of Section 919.1[939.1, 959.1], Snag Retention, "…to provide wildlife habitat…." and to retain a mix of (decay) stages of snag development and restoring snag densities towards "properly functioning" levels.	CDFW (2015)	FGCom T&E Species Policy FGCom Raptor Policy

Theme	Sub-theme	Critical Question Theme	Natural Resource	Forest Practice Rule	Priority or Monitoring Question	Submitted by and Year	Associated Regulation, or Policy
	10.3	Wildlife Habitat: Structures	Structures	919 [939, 959] 912,9 [932.9, 952.9] TRA#2 TRA#2 Appendix C(4)(f)	The effectiveness of various Rules in retaining and recruiting late and diverse seral stage habitat components with characteristics such as basal hollows, broken tops, multiple tops, furrowed bark, large diameter, reiterative limbs, large platform limbs and others.	CDFW (2015)	FGCom T&E Species Policy FGCom Raptor Policy
	10.4	Wildlife Habitat: Structures	Structures	1052 1052.4(e) 1052.5(b)(4)(A) 1052.5(b)(4)(C)(i),(ii)	The effectiveness of Section 1052 Emergency Notice, with respect to retention of habitat structural elements and biological legacies.	CDFW (2015)	FGCom T&E Species Policy FGCom Raptor Policy
	10.5	Wildlife Habitat: Structures	Oak	959.15	The effectiveness of Section 959.15, Protection of Wildlife Habitat, in retaining and protecting 400 sq. ft. basal area of oak per 40 acres, "…on areas designated by DFG as deer migration corridors, holding areas, or key ranges when consistent with good forestry practices."	CDFW (2015)	FGCom T&E Species Policy FGCom Raptor Policy FGCom/Board Hardwoods Policy
	10.6	Wildlife Habitat: Structures	Aspen	913.4 [933.4, 953.4] (e)	The effectiveness of Section 913.4[933.4, 953.4](e), Aspen, meadow and wet area restoration,"….to restore, retain, or enhance…for ecological or range values."	CDFW (2015)	FGCom T&E Species Policy FGCom Raptor Policy FGCom/Board Hardwoods Policy

APPENDIX E: SUMMARY OF CURRENT LISTED PROJECTS AS OF DECEMBER 2016

The following summary table is a catalog of monitoring projects proposed to the Effectiveness Monitoring Committee. For individual Project Summary(s) and concept proposals that provide more detailed project information, visit the EMC website (bofdata.fire.ca.gov/board_committees/effectiveness_monitoring_committees_/) .

Project Number	Project Title	Current Status	Principal Investigator(s)
EMC-2015-001	Class II-L monitoring	Ranked (11/21/16)	D. Coe
EMC-2015-002	FORPRIEM (ver. 2.0) WLPZ, watercourse crossing, and road monitoring	Ranked (06/17/16)	P. Cafferata
EMC-2015-003	Road Rules effectiveness at reducing mass wasting	Awaiting concept proposal	D. Coe, B. Short
EMC-2015-004	Effectiveness of the Road Rules in reducing hydrologic connectivity and significant sediment discharge	Ranked (11/21/16)	D. Coe, B. Condon
EMC-2015-005	Effectiveness of Class II headwater WLPZ protection measures for water temperature, near stream humidity, and streamflow	Awaiting concept proposal	B. Condon, B. McFadin, Dave Fowler
EMC-2015-006	Post-harvest effectiveness of WLPZ measures to maintain or enhance coho salmon (*Oncorhynchus kisutch)* habitat in forested watersheds	Withdrawn; project incorporated in EMC-2015-007	B. McFadin
EMC-2015-007	Monitoring habitat of anadromous species in forested watersheds	Awaiting concept proposal	S. Stanish
EMC-2015-008	Landscape-level long-term water temperature monitoring of forested watersheds	Awaiting concept proposal	B. McFadin, D. Fowler
EMC-2015-009	Long-term trend monitoring of SWAMP sites	Withdrawn; NCRWQCB has suspended the Status and Trends monitoring program as of December 2013	R. Fadness, D. Fowler
EMC-2016-001	Post-fire Road Rules effectiveness monitoring	Awaiting concept proposal	B. Short, D. Lindsay, D. Coe, K. Boston, P. Cafferata
EMC-2016-002	Boggs Mountain Demonstration State Forest post-fire research and effectiveness monitoring	Ranked (06/17/16)	J. Wagenbrenner, D. Coe, and D. Lindsay

Project Number	Project Title	Current Status	Principal Investigator(s)
EMC-2016-003	Effectiveness of FPRs on unstable areas	Awaiting revised concept proposal	M. O'Connor
EMC-2016-004	General protection of nest sites—implementation and effectiveness of the Forest Practice Rules at protecting active nest sites	Awaiting concept proposal	TBD
EMC-2016-005	Snag retention—implementation and effectiveness of the Forest Practice Rules at maintaining functional wildlife habitat through snag retention	Awaiting concept proposal	TBD

APPENDIX F: RANKING OF PROPOSED EFFECTIVENESS MONITORING PROJECTS[1]

Project Number	Project Title	Critical Question	Scientific Uncertainty	Geographic Application	Collaboration & Feasibility	Overall Ranking	EMC Funding Request[2]
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
5 = Meets all portions of the Ranking

[1] Additional guidance for ranking criteria follows on the next page.
[2] The funding requested is not a ranking criterion.

Supplemental Information for Ranking Method

Project Ranking Method

EMC projects will be evaluated in April and October. A Request for Proposal (RFP) can be found on the EMC web site. The proposals received by 5 pm on March 15th will be reviewed in April and proposals received by 5 pm on September 15th will be reviewed in October. Ranking results will be posted on the EMC web site and project proponents will be notified of the results. All monitoring project proposals and the ranking results will be made publicly available on the EMC web site. If an EMC member is the principal investigator, the EMC member will recuse themselves from ranking their proposal. Projects may be reviewed and ranked at other times, as appropriate, to address the flow of proposals before the committee.

Project Ranking
EMC members will individually rank each project and then the EMC will evaluate the average scores to determine which studies the EMC supports. No absolute ranking score is required for support; rather, individual project scores will be considered relative to other project scores. The EMC will then consider whether to recommend funding of the project, taking into consideration both the project ranking and the requested budget

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).

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 2.3) related to maintaining or enhancing water quality, aquatic habitat, and wildlife habitats.

Geographic Application
Proposed projects that have broad application throughout California forestlands 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.

Summary of Reviewed and Ranked Monitoring Projects

Beginning on February 24th and concluding on November 21, 2016, the Effectiveness Monitoring Committee (EMC) of the Board of Forestry and Fire Protection (Board) reviewed and subsequently ranked proposed monitoring projects. The proposed monitoring projects are intended to address critical monitoring questions identified in EMC's Strategic Plan. The review and ranking process followed procedures described in Section 2.5 and Appendix E of the EMC's Strategic Plan.

The EMC received a total of four proposed monitoring projects from principal investigators (see below). Projects 2015-002 and 2016-002 were ranked at the June 17th meeting, while projects 2015-001 and 2015-004 were ranked at the November 21st meeting.

Project Number	Project Title	Critical Question	Scientific Uncertainty (2 times)	Geographic Application	Collaboration & Feasibility	Overall Ranking (Range)	EMC Funding
2015-001	Class II-L monitoring	**4.0**	**4.0**	**4.3**	**3.5**	**19.8 (16 to 21)**	**None**
2015-002	FORPRIEM ver. 2.0. (revised) WLPZ, watercourse crossing, and road monitoring	**4.6**	**3.4**	**5.0**	**4.4**	**20.8 (17 to 23)**	**$28,000**
2015-004	Effectiveness of the Road Rules in reducing hydrologic connectivity and significant sediment discharge	**4.7**	**3.6**	**4.4**	**4.0**	**20.3 (16 to 24)**	**$28,000**
2016-002	Post-fire effectiveness of the Forest Practice Rules in protecting water quality on Boggs Mountain Demonstration State Forest	**4.1**	**4.3**	**3.7**	**4.4**	**20.8 (17 to 24)**	**None**

In summary, based on the overall rankings, projects 2015-001, 2015-002, 2015-004, and 2016-002 have the full support of the EMC. The EMC will continue to support and work with the principal investigators as they develop the final study designs.

APPENDIX G: CATALOG OF ONGOING COOPERATIVE AND INDIVIDUAL MONITORING PROJECTS

#	Monitoring Entity	Study Title	General Monitoring Objectives/Hypothesis Being Investigated; Principle Investigator(s)	Geomorphic Province (CGS 2002)	Online Websites and Other Available Information
Cooperative Projects					
1	CAL FIRE (with assistance from CGS, CDFW, and Water Boards, and EMC)	Forest Practice Rules Implementation and Effectiveness Monitoring FORPRIEM (revised) [see EMC-2015-002]	Data on FPR implementation and effectiveness related to water quality (program to be revised in 2015 for new road rules, stratified random sampling, and to reflect input from the EMC). Clay Brandow was PI; Pete Cafferata and Drew Coe are leading revision work in 2016.	Coast Ranges, Klamath Mountains, Cascade Range, Modoc Plateau, Sierra Nevada	The FORPRIEM report with data from 2008-2013 with revision recommendations is available at: http://bofdata.fire.ca.gov/board_committees/monitoring_study_group/msg_monitoring_reports/forpriem_report_final_022715.pdf
2	CAL FIRE	Camera Station Monitoring	Extensive wildlife camera station monitoring across State's Demonstration State Forests. Stacy Stanish is the PI.	Coast Ranges, Sierra Nevada, Cascade Range	Not available at this time.
3	CAL FIRE and USFS PSW	Caspar Creek Experimental Watersheds—New 3rd Experiment (South Fork); 2nd Experiment (North Fork) Recovery	A study plan for the Third Experiment in the South Fork has been developed by Salli Dymond, USFS PSW. Hydrologic impacts of 3rd cycle logging using unevenaged management. North Fork (Second Experiment) recovery monitoring continues. Joe Wagenbrenner and Liz Keppeler are PIs.	Coast Ranges	Caspar Creek published papers are at: http://www.fs.fed.us/psw/topics/water/caspar/ The third experiment is discussed in the 50 year Caspar summary paper: http://calfire.ca.gov/resource_mgt/downloads/reports/California_Forestry_Report_5.pdf

#	Monitoring Entity	Study Title	General Monitoring Objectives/Hypothesis Being Investigated; Principle Investigator(s)	Geomorphic Province (CGS 2002)	Online Websites and Other Available Information
4	Cal Poly SLO and CAL FIRE, Oregon State University	Post-Harvest and Post-Fire Watershed Response in the Little Creek Watershed	Study documents NTMP harvest impacts (one winter period) and 2009 Lockheed Fire impacts (three winter periods) in the Little Creek watershed. Brian Dietterick is PI. Final report finished in July 2015.	Coast Ranges	The Little Creek watershed study is described at: http://spranch.calpoly.edu/research_watershed.ldml Several Little Creek MS theses available.
5	Cal Poly SLO and CAL FIRE	Predicting Instream Community Structure to Inform Spatially-Explicit Riparian Management Strategies	Study planned to be conducted in the Little Creek watershed, Swanton Pacific Ranch, documenting site-specific WLPZ management impacts using bioassessment methods; Brian Dietterick is PI.	Coast Ranges	Not available at this time.
6	Lyme Redwood Forest Company and CAL FIRE	South Fork Wages Creek Cooperative Instream Monitoring Project	THP-scale water quality effectiveness monitoring project began in 2004—expected completion in 2020. [sole source contract under development to allow the study to continue]	Coast Ranges	Data from the first year sampled at SF Wages Creek (2004-2005) are available at: http://bofdata.fire.ca.gov/board_committees/monitoring_study_group/msg_supported_reports/2005_supported_reports/31_-_gma_2005_sf_wages_wy2004-2005.pdf
7	Lyme Redwood Forest Company and CDFW	Pudding Creek Large Wood BACI Experiment	Treat 80% of Pudding Creek with large wood and determine if there is an increase in life stage specific abundance of juvenile salmonids. Sean Gallagher and Dave Wright are PIs.	Coast Ranges	See: Gallagher, S.P., S. Thompson, and D.W. Wright. 2011. Identifying factors limiting coho salmon to inform stream restoration in coastal Northern California. California Fish and Game 98(4):185-201.

#	Monitoring Entity	Study Title	General Monitoring Objectives/Hypothesis Being Investigated; Principle Investigator(s)	Geomorphic Province (CGS 2002)	Online Websites and Other Available Information
8	CDFW, USFWS	Fisher Translocation Project	The fisher (*Pekania pennanti*) translocation project has relocated individuals from their northern California extent above Shasta Lake to a northern Sierra, Stirling City location. DFW and USFWS have radio-collared most individuals and are tracking their habitat use and breeding success. They also have set camera stations in known denning areas. Rich Callas is PI.	Cascade Range, Sierra Nevada	See: www.wildlife.ca.gov/Regions/1/Fisher-Translocation
9	Green Diamond Resource Co., Oregon State University, USFS PSW and PNW	Riparian Canopy Experiment	Reach and watershed-scale experiment to test if thinning riparian areas to enhance light and nutrient input will improve salmonid production; pilot project implemented. Matt House and Lowell Diller are PIs.	Coast Ranges	http://bof.fire.ca.gov/board_committees/monitoring_study_group/msg_archived_documents/msg_archived_documents_/diller_bof_msg_canopy_density_experiment__12-10-13_.pdf
10	Green Diamond Resource Co., CSU, CAL FIRE	Quantifying Cumulative Watershed Effects Over Time in the Little River Watershed, Humboldt County	Water quality and fisheries data collected by GDRCo in the Little River watershed from 2004-2014 will be analyzed; project to be conducted from 2015-2017. Lee MacDonald and Phil Turk (CSU) are PIs.	Coast Ranges	Not available at this time.
11	Humboldt Redwood Company, HSU, CAL FIRE, and CGS	Railroad Gulch BMP Evaluation Project	Paired watershed study associated with the McCloud Shaw THP in the Elk River watershed; expected completion 2020. Andy Stubblefield, HSU, is PI.	Coast Ranges	See Michelle Haskins HSU MS project description at: http://www2.humboldt.edu/fwr/grad_students/detail/michelle_haskins
12	NCRWQCB and The Nature Conservancy	Garcia River Monitoring Program	EMAP/SWAMP physical habitat and biological monitoring to evaluate conditions and trends per the Garcia River TMDL. Jonathan Warmerdam and Jennifer Carah are PIs.	Coast Ranges	2012 Monitoring Plan is available at: http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/workplans/final_garcia_reg_one.pdf

#	Monitoring Entity	Study Title	General Monitoring Objectives/Hypothesis Being Investigated; Principle Investigator(s)	Geomorphic Province (CGS 2002)	Online Websites and Other Available Information
13	Sierra Pacific Industries and CAL FIRE	Judd Creek Cooperative Instream Monitoring Project	THP-scale effectiveness monitoring study to determine the impacts from the Engebretsen THP. Cajun James is PI; final report in progress.	Sierra Nevada	See abstract at: http://abstractsearch.agu.org/meetings/2012/FM/EP52C-08.html
14	UC Davis and CAL FIRE	Bedload Transport Regimes in Coarse Cobble-Bedded Streams	Field-based and flume experiments to study interactions between hydrograph shape and bedload transport. NF Caspar Creek field study site. Sarah Yarnell, UC Davis, and Lucas Siegfried (PhD student) are PIs.	Coast Ranges	https://watershed.ucdavis.edu/project/impacts-hydrograph-shape-sediment-transport
Individual Projects					
15	Lyme Redwood Forest Company	SF Ten Mile Streamflow and Sediment Monitoring	Sediment data collection to validate TMDL estimates.	Coast Ranges	Not available at this time.
16	DFW	Stream Temperature and Microclimate Study	Document changes in microclimate, air, and stream temperatures on JDSF and Russian Gulch SP; study established in 2001. Brad Valentine was PI for DFW.	Coast Ranges	http://www.academia.edu/8133134/A_Preliminary_Study_of_Streamside_Air_Temperatures_Within_the_Coast_Redwood_Zone_2001_to_20031
17	CDFW	Ecosystem Biodiversity Monitoring	Long-term monitoring (vegetation plots and camera stations) of terrestrial biodiversity at the ecoregion scale from the Cascades to the Central Sierra (DFW Regions 1 and 2). Karen Kovacs is Program Manager.	Klamath Mountains, Cascade Range, Modoc Plateau	www.wildlife.ca.gov/Regions/2/Eco-Regional-Biodiversity-Monitoring
18	CDFW	Great Gray Owl Nest/Meadow Monitoring	Targeted monitoring of exceptional great gray owl habitat (large meadows >20 acres and associated surrounding forest structure), including meadow searches for feathers and pellets, nighttime calling surveys. Joe Croteau and Andy Yarusso are PIs.	Sierra Nevada, Cascade Range, Modoc Plateau	See abstract at: http://www.wildlifeprofessional.org/western/tws_abstract_session_list.php?sessionID=48
19	Fruit Growers	Wildlife Camera Station	Extensive camera station monitoring across FGS	Klamath	Not available at this time.

#	Monitoring Entity	Study Title	General Monitoring Objectives/Hypothesis Being Investigated; Principle Investigator(s)	Geomorphic Province (CGS 2002)	Online Websites and Other Available Information
	Supply Company	Monitoring Project	ownership (more details to be provided).	Mountains	
20	Green Diamond Resource Co.	Aquatic HCP Monitoring Studies	Fisheries, sediment, water temperature, turbidity, amphibians, road erosion monitoring to validate HCP standards. Matt House is PI.	Coast Ranges	https://greendiamond.com/responsible-forestry/california/reports/4thBiennialReport_(Final_With_Appendices).pdf
21	Humboldt Redwood Company	Aquatic HCP Monitoring Studies	Fisheries, sediment, water temperature, turbidity, road erosion monitoring to validate HCP standards. Mike Miles is Program Manager.	Coast Ranges	HRC aquatic condition monitoring reports are available at: http://www.hrcllc.com/monitoring/aquatic-conditions/
22	Mattole Restoration Council	Mattole River Watershed Turbidity Monitoring	Monitor turbidity response to sediment reduction work in the Mattole River watershed. Sungnome Madrone is PI.	Coast Ranges	Not available at this time.
23	Mendocino Redwood Company	Turbidity and Suspended Sediment Monitoring in the SF Albion River Watershed	Study to determine if turbidity and suspended sediment improves with road upgrading work. Kirk Vodopals is PI.	Coast Ranges	See: http://bofdata.fire.ca.gov/board_committees/monitoring_study_group/msg_archived_documents/msg_archived_documents_/vodopals_2013_s._fork_albion_river_suspended_sediment_loads.pdf
24	Mendocino Redwood Company	Coastal Tailed Frog/Southern Torrent Salamander/Salmonid Abundance and Distribution Studies	Monitor population levels to assess effectiveness of HCP/NCCP measures	Coast Ranges	MRC fisheries monitoring reports are available at: http://www.hrcllc.com/monitoring/aquatic-conditions/
25	Mendocino Redwood Company	Road Surface Erosion Monitoring Project	Establish a watershed-scale suspended sediment load in SF Albion River watersheds from roads and compare with results of SEDMODL. Kirk Vodopals is PI.	Coast Ranges	The MRC road surface erosion study is described in the following PPT: http://ucanr.org/sites/forestry/files/145281.pdf

#	Monitoring Entity	Study Title	General Monitoring Objectives/Hypothesis Being Investigated; Principle Investigator(s)	Geomorphic Province (CGS 2002)	Online Websites and Other Available Information
26	Mendocino Redwood Company	Stream Temperature Monitoring Study	Monitor stream temperatures to assess effectiveness of HCP/NCCP measures. Kirk Vodopals is PI.	Coast Ranges	Not available at this time.
27	Roseburg Resource Company	Fisher Monitoring	Roseburg, in coordination with USFWS, is conducting camera station and track plate monitoring of fisher use in the Fountain Fire area near Burney.	Cascade Range	Not available at this time.
28	Salmon Forever	Freshwater and Elk River Water Quality Monitoring	Monitor to determine the adequacy of HRC AHCP standards and trends in water quality. Clark Fenton is PI; Jack Lewis is statistical consultant.	Coast Ranges	http://www.naturalresourcesservices.org/projects/elk-river-and-freshwater-creek-sediment-monitoring-project
29	Sierra Pacific Industries	Battle Creek Turbidity Monitoring Studies	Study to determine the impact of the logging, fire, and salvage logging on water quality parameters. Cajun James is PI.	Cascade Range	SPI's 2012 Battle Creek monitoring report is available at: http://www.spi-ind.com/research/JamesandMacDonaldGreaterBattleCreekWatershedUpdateAdditions_SPI.pdf
30	Sierra Pacific Industries	Upper San Antonio Creek Monitoring Study	Determine the impact of evenaged silviculture on water quality parameters. Cajun James is PI.	Sierra Nevada	See: CH2M Hill. 2001. Water quality data review. Technical memorandum prepared by John Gaston for Sierra Pacific Industries dated July 10, 2001. 3 p.
31	Sierra Pacific Industries	Millseat and Baily Creek Temperature and Microclimate Study	Determine the effect of 75 ft riparian buffers on water quality parameters. Cajun James is PI.	Cascade Range	See: http://ceshasta.ucanr.edu/files/137630.pdf
32	Sierra Pacific Industries	2-14-102-TEH (The LiNe THP) Monitoring Studies	Monitor the water temperature, canopy, and sediment impacts from a 28 mile shaded fuel break in Tehama County (2015-2017) crossing 7 Class I ASP watercourses. Clayton Code is RPF.	Sierra Nevada	Not available at this time.

#	Monitoring Entity	Study Title	General Monitoring Objectives/Hypothesis Being Investigated; Principle Investigator(s)	Geomorphic Province (CGS 2002)	Online Websites and Other Available Information
33	Sierra Pacific Industries	California Spotted Owl Monitoring	Extensive monitoring project with sites throughout the Sierra Nevada; Kevin Roberts is PI.	Sierra Nevada	See video at: https://www.youtube.com/watch?v=hCg6uYXd3tM
34	Sierra Pacific Industries	Camera Station Monitoring	Extensive wildlife camera station monitoring across SPI's ownership.	Sierra Nevada, Cascade & Coast Ranges Klamath Mtn	Not available at this time.
35	Sierra Pacific Industries	Botanical Species Monitoring	Extensive botany monitoring across SPI ownership in coordination with Dean Taylor (more details to be provided)	Sierra Nevada, Cascade & Coast Ranges Klamath Mtn	Not available at this time.

APPENDIX H: MONITORING AND REPORTING REQUIREMENTS

The following is a list of the 2016 FPRs and current statutes with specific monitoring requirements to be conducted by CAL FIRE and/or the Board. If these rule requirements fall within the monitoring themes identified in Section 2.3, the EMC will place emphasis on them through the ranking process (Appendix F), ensuring that they are addressed with EMC-supported monitoring projects. The EMC has reviewed the list and prioritized the FPR monitoring requirements into three categories or tiers. The highest priority tier directly relates to identified themes in this Strategic Plan; the moderate priority tier indirectly relates to identified themes, and the lowest priority tier was not judged to relate to identified themes.

Highest Priority Tier

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.

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.

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.

Moderate Priority Tier

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., Monitoring Study Group, 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.

Lowest Priority Tier

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 Total Maximum Daily Load (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 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.

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.

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.

Conversion Exemptions

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

Recent Legislation

In the 2016 legislative session Assembly Bills 2029 (Dahle) and 1958 (Wood) were signed into law, both providing the same overall direction to the Board of Forestry and Fire Protection and CAL FIRE, working with the Department of Fish and Wildlife and the Regional Water Control Boards, to conduct an overall review of trends in the use of, compliance with, and effectiveness of the expanding numbers of Emergency and Exemption process for timber harvest permitting:

PRC § 4589

(a) On or before December 31, 2017, the department and board shall review and submit a report to the Legislature on the trends in the use of, compliance with, and effectiveness of, the exemptions and emergency notice provisions described in Sections 4584 and 4592 of this code and Sections 1038 and 1052 of Title 14 of the California Code of Regulations. The report shall also include recommendations to improve the use of those exemptions and emergency notice provisions.

(b) The Department of Fish and Wildlife, regional water quality control boards, and the public shall be provided opportunities to participate in the review and the development of the report.

(c) The report shall be submitted pursuant to Section 9795 of the Government Code.

(d) If the report is not submitted to the Legislature on or before December 31, 2017, either the Senate Budget Subcommittee on Resources or the Senate Committee on Natural Resources shall hold a hearing in January 2018 to investigate why the report was not submitted.

(e) This section shall remain in effect only until January 1, 2019, and as of that date is repealed, unless a later enacted statute, that is enacted before January 1, 2019, deletes or extends that date.