Project Number: EMC-2015-002

Project Name: FORPRIEM ver. 2.0

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1.0. Background Information

FORPRIEM ver. 2.0 is a continuation of the FORPRIEM (Forest Practice Rules Implementation and Effectiveness Monitoring) program began in 2008 (Brandow and Cafferata 2014), which itself was a continuation of earlier BOF/CAL FIRE monitoring programs (Modified Completion Report (MCR) monitoring—Brandow et al. 2006, and the Hillslope Monitoring Program (HMP)—Cafferata and Munn 2002). All of these programs were used to determine the adequacy of the implementation and short-term effectiveness of California's Forest Practice Rules developed to protect water quality and riparian/aquatic habitats.

These state-sponsored monitoring programs have yielded considerable data during the past two decades: HMP--1996 through 2001, MCR--2001 through 2004, and FORPRIEM—2008 through 2013. The results from these studies, using comparable data collection and sampling methods, have been generally similar. They have found that (1) individual practices required by the California Forest Practice Rules (FPRs) are usually effective in preventing hillslope erosion features when properly implemented, and (2) overall rule implementation rates are high (approximately 90% or higher depending on the rule section). For example, only approximately 5% of the forest road drainage structures located on randomly located road segments have been found to have a FPR deviation or an associated erosion feature.

Road drainage, including at watercourse crossing approaches, has been found to need improvement, as has watercourse crossing design, construction, maintenance, and abandonment. The data from these monitoring programs suggest that there may be improvement over time for both watercourse crossing rule implementation and effectiveness, as well as for Class I WLPZ total canopy (Brandow and Cafferata 2014). The expectation is that with the implementation of the Road Rules, 2013 and Anadromous Salmonid Protection (ASP) rule packages, these trends will continue, and improvement in road drainage at watercourse crossing approaches will be observed. FORPRIEM ver. 2.0 will provide important data to the Board's Effectiveness Monitoring Committee (EMC) to determine if these improvements are indeed observed, if further refinements in the FPRs are required, and/or if better enforcement of the FRPs is needed.

The original mandate for FPR implementation and effectiveness monitoring related to water quality came from the desire to have the California Forest Practice Rules certified by US EPA as Best Management Practices (BMPs) under Section 208 of the Federal Clean Water Act. While that has not happened to date, the expectation to continue monitoring is high—particularly due to state and federal anadromous salmonid species listings, listing of waterbodies as impaired under Section 303(d) of the Federal Clean Water Act, and stakeholder concerns voiced to the Board of Forestry and Fire Protection (BOF). FORPRIEM monitoring is CAL FIRE's only direct 'project monitoring'

of THPs and NTMPs, except for Forest Practice inspections, and remains a very high priority for the Department.

2.0. Relationship to the Effectiveness Monitoring Committee and EMC Strategic Plan

Gathering input from the BOF's Effectiveness Monitoring Committee on revisions to FORPRIEM and making an attempt to better utilize all Review Team agencies to collect field data are key components of FORPRIEM ver. 2.0. Primary collaborating agencies, in addition to CAL FIRE, are RWQCBs, CGS, and CDFW. Data collected as part of FORPRIEM ver. 2.0 will complement data collected for other EMC monitoring projects (e.g., EMC-2015-004).

EMC critical monitoring questions to be addressed with FORPRIEM ver. 2.0 include:

- Theme 1—WLPZ riparian function

Are the FPRs and associated regulations effective in: (a) maintaining and restoring canopy closure (Implementation and Compliance); (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, maintaining or restoring water temperature, and maintaining or restoring primary productivity; (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 watercourse in the Northern District; and (i) filtering sediment that reaches WLPZs.

- Theme 2—Watercourse channel sediment

Are the FPRs and associated regulations effective in minimizing management-related sediment delivery from forest management activities to watercourse channels: (b) for individual plans at the project level to evaluate channel response to forest management prescriptions and additional mitigation measures

- Theme 3—Road and WLPZ sediment

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

- Theme 4—Mass wasting sediment

Are the FPRs and associated regulations effective in minimizing sediment delivery from: (b) mass wasting during episodic rare events and/or large storms to maintain water quality.

It is the EMC's intent that if FPR monitoring requirements are consistent with the monitoring themes identified in Section 2.3 of its Strategic Plan, the EMC will place significant emphasis on them, ensuring that they are addressed with EMC-supported

monitoring projects. The Road Rules, 2013 rule package includes the following two monitoring requirements that will be partially addressed with FORPRIEM ver. 2.0:

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.

3.0. Types of Monitoring to be Used

FORPRIEM ver. 2.0 will rely on the following types of monitoring—implementation, compliance, and effectiveness. Brief descriptions of these monitoring types follow (see Figure 1 in the EMC Strategic Plan).

> Implementation monitoring assesses whether management practices were conducted as designed and planned.
>
> Compliance Monitoring is used to determine whether specific rule, regulation, code or policy is being met.
>
> Effectiveness monitoring is an evaluation of whether a specific management practice had the desired effect.

This study will utilize the implementation/effectiveness approach used in the BCTF (2011) report. Where an erosional problem is documented, monitoring personnel will determine if the appropriate FPR(s) were properly implemented (admittedly a biased approach—see Lewis and Baldwin 1997).[1] We will document if there is a problem and the rule was correctly implemented, or if there is a problem and the rule was not properly implemented (Figure 1 from Tuttle 1995).

[1] Lewis and Baldwin (1997) stated that evaluating the level of implementation prior to stressing storm events is critical. If this is not done and site damage is observed, it might be much more likely that a rater would judge that a rule was not properly implemented. This is particularly true for many of the rules that are defined in terms of their erosional outcome. They recommended that, in spite of increased costs, the implementation assessment be done prior to any stressing events.

	No Problem*	Problem
Rule Properly Implemented	Case 1	Case 2
Rule Not Properly Implemented	Case 3	Case 4

Figure 1. Forest Practice Rule matrix (from Tuttle 1995).

4.0. Draft Study Design Components

FORPRIEM ver. 2.0. will continue to monitor the existing main topic areas (WLPZs, roads, and watercourse crossings) used in the original FORPRIEM study (Brandow and Cafferata 2014). This will allow for data continuity and uninterrupted determination of changes over time.

Specific Monitoring Questions for Three Main Monitoring Topics[2]

1. **WLPZs**
    a. Are Class I, II-L, II-S, and III watercourse rules being properly implemented, including overstory, understory, and total canopy requirements, ground cover requirements, WLPZ widths, etc.?
    b. Are Class I WLPZ post-harvest canopy levels continuing to improve over time?
    c. Are there erosion features within Class I or II WLPZs, and Class III ELZs that are related to the current timber harvesting operations?
    d. Are THP/NTMP mitigation measures specified for WLPZs beyond the standard FPRs properly implemented and effective in preventing erosion and sediment delivery?

2. **Roads**
    a. Are the Road Rule, 2013 rule package requirements being properly implemented, including hydrologic disconnection?

[2] WLPZs, road segments, and watercourse crossings will continue to be randomly located within plans, as has occurred with past monitoring programs. Plans will also be randomly selected, based on a stratified random selection process described in Section 5.1. Short-term effectiveness will continue to be evaluated following at least one over wintering period. Documentation of plan type will occur (e.g., industrial, nonindustrial, HCP, non-HCP). We will continue to sample NTMPs with NTOs that were operated on with overwintering periods,

b. Are road drainage structures and facilities constructed and maintained at proper spacing, sufficient to prevent road erosion features on the road surface and fill slopes?
c. Are road erosion features delivering sediment beyond the toe of the fill, to the WLPZ, or to the high water channel? If so, were the road FPRs properly implemented at this site?
d. Are THP/NTMP mitigation measures specified for roads beyond the standard FPRs properly implemented and effective in preventing erosion and sediment delivery?

3. <u>Watercourse Crossings</u>

a. Are watercourse crossings (including culverts, fords, and bridges) designed, constructed, maintained, and abandoned as per requirements in the Road Rules, 2013 rule package?
b. Are the Road Rule, 2013 rule requirements for watercourse crossings effective in protecting water quality (short-term effectiveness)?
c. Are watercourse crossing effectiveness categories (e.g., diversion potential, plugging, alignment) improving over time compared to results from prior monitoring programs?
d. Are THP/NTMP mitigation measures specified for watercourse crossings beyond the standard FPRs properly implemented and effective in preventing erosion and sediment delivery?

Watercourse and Lake Protection Zones (WLPZs) will be evaluated with a randomly located **200 foot transect** along a Class I, Class II-S, or Class II-L watercourse. For plans located within the Anadromous Salmonid Protection (ASP) rule area, sampling will include the core zone, inner zone, and outer zones (when present). In Class I and Class II-L WLPZs, total and overstory canopy cover will be measured with a sighting tube, an unbiased instrument (Robards et al. 2000). For Class II (standard) watercourses, only total canopy will be measured. Additionally, WLPZ erosion features related to timber operations from the current plan will be recorded and described, and WLPZ zone widths will be documented.

Road segments to be evaluated will be 600 feet in length in each direction from a randomly located Class I, II, or III watercourse crossing (**1200 feet total**). If no watercourse crossings are available in the plan, a straight random draw of a 1200 foot road segment will be made. As in past work, information will be recorded on road drainage structures and road erosion features where they are encountered along the 1200 road segment. Hydrologic disconnection will be documented in both directions from the watercourse crossing.

In total, two random watercourse crossings will be monitored when they are available in the plan area (including abandoned crossings). FPR implementation/ compliance and short-term effectiveness will be documented, using the effectiveness categories used for the joint CAL FIRE/NCRWQCB crossing monitoring work conducted on NTMP-NTOs in 2011 (Brandow and Cafferata 2014).

Mass wasting events will be documented where they are encountered in the plan during the normal sampling procedure (similar to the process used in the HMP). Road-related mass wasting events (not in-unit features) are to be the primary focus.

For WLPZs, roads, watercourse crossings, and mass wasting features encountered, monitoring personnel will utilize the following sediment delivery categories used in the BCTF (2011) report (Figure 2); sediment delivery categories are <1 yd^3, 1≤5 yd^3, 5<10 yd^3, and >10 yd^3. The sediment delivery "checklist" questions shown in Figure 2 will be designed in conjunction with the relative probability of sediment delivery criteria described below.

Sediment Delivery					
Has sediment delivered?	☐ Yes	☐ No	☐ Maybe	☐ Deliv. through buffer	☐ ft. Buffer dist.
Receiving Watercourse Type?	☐ Class I	☐ Class II	☐ Class III	☐ Class IV	
Associated with timber operations?	☐ Yes	☐ No	☐ Maybe		
Provide range of estimated volume delivered:	☐ ≤1 cy	☐ 1≤5 cy	☐ 5≤10 cy	☐ >10 cy	☐ cy^3

Figure 2. Sediment delivery questions and categories used in the BCTF (2011) report.

A system will be included to assign the relative probability of sediment delivery based upon simple field criteria. Field criteria includes distance to stream and the characteristics of sediment transport below road drainage points (i.e., magnitude of erosion; flow path characteristics, etc.). One possible approach to start from is shown in Table 1 (Raines et al. 2005). Simple information on the likely sediment source will also be documented, noting that sediment sources should be related to the current harvesting plan (not legacy or older plan) (Figure 3).

Table 1. Classification scheme for field evaluated road connectivity (Table 4 in Raines et al. 2005).

Table 4. Revised WARSEM classification scheme for field evaluated road connectivity.

Connectivity Class	Visible Geomorphological Impact	Sediment Delivery Potential	Percent of Sediment Delivering
0	No signs of connectivity below culvert outfall with or without evidence of sediment transport below outfall	None	0
1	Drains directly into stream channel at a road crossing	High	100
2	Direct delivery from ditch but some sediment trapped in functioning and maintained ditch out or designed sediment trap; or Evidence of diffuse sediment plume to stream below drainage outlet that is within 100 feet of a stream	Low/ Moderate	35
3	Evidence of diffuse sediment plume to stream below drainage outlet that is between 100 and 200 feet from a stream	Low	10
4	Direct delivery below drainage outfall; is connected to bankfull edge of stream channel via gully or landslide scar	High	100

Erosion Source				
Surface Erosion	Fluvial Erosion	Mass Wasting		Other
☐ Sheet wash	☐ Gully (>6"x6")	☐ Rotational	☐ Debris slide	☐ w/ explanation
☐ Rill (≤ 6"x6")	☐ Bank failure	☐ Translational	☐ Debris torrent/flow	

Explanation: _____

Relative age of source: ☐ ≤1 yr ☐ 1≤5 yr ☐ 5≤10 yr ☐ >10 yr ☐ Continuous

Figure 3. Simple erosion source information form component from the BTCF (2011) report.

In order to address topics not covered in previous work, plans (both THPs and NTMP-NTOs) will be selected for ***sub-sampling*** and visited a second time (i.e., plans "flagged" during the initial FORPRIEM 2.0. evaluation—not random plan selection):

- Mechanical, chemical, and broadcast burn **site preparation** (sediment delivery or no apparent delivery, using the categories displayed above in Figure 2 and Table 1). This will include walking the interfaces between units and watercourses to look for sediment "breakthroughs", similar to the approach used in the BCTF (2011) report and by Litschert and MacDonald (2009).[3]

- **Winter storm data collection**—utilize photo monitoring to document winter impacts (no water grab samples are to be taken).

Regional information on **storm recurrence intervals** during monitoring period (likely to be generated with discharge data from USGS gaging stations) will be documented and included in reports written for the project. Regional information on storm recurrence intervals will be used to document large events (e.g., 1997 New Year's Day storm), and corresponding field response to that level of event.

5.0. Monitoring Process Information

The monitoring process to be utilized is equally as important as the study design components. Attributes of successful monitoring programs are listed by Reid (1994), including "there is a clear tie between results and user needs; results will provide useful information." For FORPRIEM ver. 2.0 to be successful, it is critical to have an appropriately conceived and developed monitoring process that adequately addresses the issues/questions determined in advance to be important to key stakeholders. To provide a higher level of confidence in the success of FORPRIEM ver. 2.0., we will include the monitoring process components described that follow.

[3] Site preparation associated with fire salvage logging operations (often Emergency Notices) are to be addressed in a separate study.

5.1. Development of a Stratified Random Sampling Approach

A methodology for a stratified random sample of completed THPs and NTMP-NTOs to better test the FPRs on a larger percentage of higher erosion risk sites is under development by the CAL FIRE GIS Program in Santa Rosa (Program Manager Suzanne Lang). The following ArcGIS layers are being beta tested to assess relative erosion risk:

- 10 m DEM slope (index for shallow landsliding)
- Deep seated landslide susceptibility layer (Wills et al. 2011)
- E-EHR (surface erosion hazard) [note incomplete soil survey data in Calaveras and Humboldt counties at this time] (program currently available from CAL FIRE GIS Program, Santa Rosa)
- Drainage density (National Hydrology Dataset)

An algorithm is being tested to combine these parameters for a composite score (Table 2), similar to that used by McKittrick (1994) to rate erosion potential for super planning watersheds in California. When the CAL FIRE group working on this step is satisfied with the algorithm and the modeling results it produces, it will be vetted through the EMC to the Review Team agencies and the public. After a stratification scheme is developed for higher risk plans, the ArcGIS THP layer and a randomization scheme will be used to select the appropriate number of plans in each risk category (high, medium, and low)—allowing an adequate relationship to the total plan population to be generated.

Table 2. Draft rating scheme for determining high risk plans.

Category	High	Moderate	Low
Slope (%)	>60 (3)	30-59 (2)	<30 (1)
Erosion Hazard Rating	>66 (3)	50-65 (2)	<50 (1)
Deep-Seated Landslide Rating	8 to 10 (3)	5 to 7 (2)	0 to 3 (1)
Drainage Density (mi/mi^2)	>1.7 (3)	1.1 to 1.7 (2)	<1.1 (1)
	High	**Moderate**	**Low**
Planning Watershed Rating	10 to 12	6 to 9	4 to 5

5.2. Multi-Agency Review Team Personnel to Collect Field Data

The public and other resource agencies have expressed skepticism about monitoring conclusions generated by CAL FIRE in the past, largely due to the monitoring methods used (including random site selection) and lack of direct participation in data collection (Longstreth et al. 2008). The IMMP and BCTF monitoring efforts have shown the benefits of using multi-agency teams to collect field data (Longstreth et al. 2008, BCTF 2011). They demonstrated that the Review Team agencies can work together cooperatively and achieve consensus, with a greater

appreciation for each agency's concerns and objectives related to the impacts from timber harvesting.

The main advantage of a multi-agency monitoring approach is that provides for a balance of interests and strengthens public confidence in the monitoring results. The goal of using multi-agency teams is to have trained, designated staff that can provide dependable participation, continuity, and expertise (Tuttle 1995). The main disadvantage is the cost, but funding from the TRFR fund has allowed agency staffing to significantly increase over the past three years, making this a viable option. While this approach was a goal of the original FORPRIEM study, inadequate funding and staff time was available, resulting in only CAL FIRE personnel evaluating the randomly selected plans. Creating real incentives for agency personnel in addition to CAL FIRE to help collect data is needed and requires further discussion by the EMC.

5.3. Training Program and Public Involvement

Public involvement has largely been lacking in past CAL FIRE monitoring programs, reducing confidence in the monitoring results (as stated above). To address this problem, we propose to invite the public/watershed groups, NGOs, environmental groups, etc. to **participate in field training workshops** to promote information exchange, stakeholder involvement, and increase the potential buy-in on the monitoring approach. Citizen participation in actual data collection is not included, however, due to landowner liability issues. This limited involvement approach may create interest among some groups suspicious of CAL FIRE monitoring results and/or lacking knowledge regarding the FORPRIEM process. It would invest some local groups in the outcome of the findings, and could give them a sense of ownership in the project.

5.4. Quality Assurance/Quality Control (QA/QC) Protocols

Quality assurance consists of actions to ensure adherence to data collection and analysis procedures, while quality control is associated with actions to maintain data collection and analysis consistent with study goals through checks of accuracy and precision.

Primary components of the QA/QC program will include (1) developing a detailed training/protocol manual, (2) having trained agency personnel collect the data, (3) using check audits by project leaders to enhance consistency among the data collectors, and (4) utilizing a qualified contractor to collect independent, third party QA/QC data on a random subset of the FORPRIEM ver. 2.0 plans.

6.0. Adaptive Management

Data collected with FORPRIEM ver. 2.0. will provide CAL FIRE Forest Practice Inspectors and Review Team agency personnel with visual evidence of what works and what does not work in the field—potentially improving PHI recommendations in the future. It is anticipated that PHI mitigation recommendations can be compared to monitoring results for those recommendations, providing an adaptive management

opportunity that can be developed from this project. FORPRIEM ver. 2.0 will also provide data to BOF members and other decision makers regarding needed improvements in the FPRs, including the use of non-standard practices.

7.0. Resource Benefit

The relative benefits of the FPRs evaluated for FORPRIEM ver. 2.0 vs. their economic costs to landowners will also be considered when possible. In particular, this study will provide an opportunity to consider road and watercourse crossing improvement costs, likely collected as self-reported data on the sections found where roads and crossings were upgraded to comply with the Road Rules package requirements. Costs could be collected per unit (e.g., mile, crossing) and then benefits assessed with the costs. While several different variables exist, it would be useful to look at the range of costs and the relationships between cost and effectiveness.

8.0. FORPRIEM ver. 2.0 Tasks to be Completed

- Redesign the FORPRIEM field forms to collect data meaningful to all the agencies, as well as addressing the newer BOF rule package requirements (ASP rules, Road Rules, 2013, etc.).
- Investigate methods for electronic field data entry—using smart phones and Survey 123 or similar applications, and/or tablets.
- Investigate and potentially develop procedures to select monitoring sites by hillslope position (i.e., toe, midslope, ridgetop).
- Develop a spatially explicit database for data storage.
- Develop a methodology manual and training program.
- Develop a detailed QA/QC program simultaneously with the main plan sampling program.

9.0. Updated Timeline

The goal is to finish the draft methods document in summer 2016, beta test the revised procedures in late summer 2016, schedule training sessions in spring 2017 and implement the program by the summer of 2017. Data collection is anticipated to occur for a minimum of 3-5 years.

10.0. Funding

No additional funding is required from the EMC; CAL FIRE will provide staff to collect data. It is anticipated that with AB 1492 funded positions in place, the other Review Team agencies will assist in field data collection, as well as other aspects of the project (see Section 5.2 above).

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