Extended Monitoring Request Revised

Prospective Answers to the 6 Questions from the CMER / Policy Interaction Framework Document

May 14, 2024

Project Title: Eastside Type N Riparian Effectiveness Project (Lean Pilot)

Study Design Title: Eastside Type N Riparian Effectiveness Study Design

Background:

The project team proposes five years of additional monitoring (on top of the two years post-harvest) of a limited suite of variables for the Eastside Type N Riparian Effectiveness Project (ENREP) totaling seven years post-harvest monitoring of those variables. The current study design calls for two years of pre-harvest monitoring and two years of post-harvest monitoring among paired basins comprised of control and harvested sites. Since some of the prospective answers were unchanged from the original Prospective Answers to the 6 Questions Document, **information that pertains specifically to the Monitoring Extension proposal of an additional 5 years is indicated in blue text.**

1. Does the study inform a rule, numeric target, performance target, or resource objective (Yes/No)? If Yes, go to the next question. If No, provide a short explanation on the purpose of the study.)

Yes.

2. Does the study inform the Forest Practices Rules, the Forest Practices Board Manual guidelines, or Schedules L-1 or L-2?

Yes. ENREP will determine if, and to what extent, the prescriptions found in the Type N Riparian Prescriptions Rule Group are effective in achieving performance targets and water quality standards, particularly as they apply to sediment and stream temperature in eastern Washington.

3. Was the study carried out pursuant to CMER scientific protocols (i.e., study design, peer review)? (Provide short explanation. Be clear on use of ISPR.)

Yes. This exploratory study design was developed by a TWIG (Technical Writing and Implementation Group) under the LEAN process, and the design was reviewed and approved by CMER consistent with the Protocol and Standards Manual (2016), and successfully went through Independent Scientific Peer Review (ISPR). The only change is that the suite of variables monitored during the proposed five-year extension would be reduced to balance additional information with cost efficiency.

4. What does the study tell us? What does the study not tell us? (This is where the study and its relationship to rules, guidance, targets, etc are to be described in detail. Consider technical findings; study limitations; and implications to rules, guidance, resource objectives, functional objectives, and performance targets; in addition to other information.)

What the study will tell us:

As companion to the Type N Effectiveness “Hard Rock” and “Soft Rock” studies, this study will inform Policy of the quantitative changes in FPHCP covered resources, water quality and aquatic life coincident with forest harvest activities in eastern Washington.

To that end, the study specifically addresses the following critical questions:

1. What is the magnitude of change in water temperature, canopy closure, and stream cover of Type Np channels in the first two years after harvest?
2. What is the magnitude of change in stream flow and suspended sediment export from the Type Np basin in the first two years after harvest?
3. What is the relationship between aquatic life (and their supporting resources) and observed changes in hydrology, sediment, and temperature associated with forest management activity?

This study will use a hierarchical design that incorporates a blocked Multiple Before-After/Control-Impact (MBACI) design with reaches nested within basins to quantify the magnitude of change that occurs as a result of harvest activity. The MBACI design, which is replicated in space and time, controls for natural variability throughout the pre- and post-treatment periods and allows us to estimate the likelihood that observed effects are related to anthropogenic activity (Underwood, 1994; Downes et al. 2002).

By design, the ENREP sites encompass a range of ecological and hydrological conditions (hydroclimatic gradient). Preliminary results indicate that initial responses to harvest is similar to the pattern of Westside Type N Hard Rock and Soft Rock Effectiveness studies with all treatments eliciting reductions in shade and increases in stream temperatures in the first year after harvest (McIntyre et al. 2021, Ehinger et al. 2021). Responses in the ENREP sites varied in the second year post harvest with one site (Tripp’s Knob) exhibiting persistent shade reductions and temperature increases and the other (Springdale) exhibiting minimal shade changes and temperature decreases. Extending the post-harvest monitoring period from two to seven years will show whether and where responses to harvest are transient or persist longer than 2 years.

While two years is adequate to capture initial causal changes to streamflow, shade, water temperature, turbidity, suspended sediment concentration, large wood, and channel morphology, other aquatic life variables may not show a response for several years following several reproductive cycles (Leps et al. 2016). A BACI study in the Trask River Watershed in Oregon used four years of post-harvest monitoring and found that invertebrate densities were highly variable on annual basis, which limited their ability to detect a change due to harvest (Johnson et al. 2022). Finally, more than two years of monitoring will provide information on the changes to invertebrate community composition over time, which cannot be measured in only two years (Stone et al. 1998).

While the original ENREP study design will capture the immediate and direct effects of harvest, indirect effects of harvest are best characterized on longer time frames. For instance, increased light penetration to the stream post-harvest could decrease litterfall while increasing periphyton growth, which may influence invertebrate communities. Other indirect effects, such as windthrow or flooding, may also appear in subsequent years after harvest. One example is the Stuart-Takla Fisheries-Forestry Interaction Project, which showed that the loss of canopy cover to windthrow delayed thermal recovery in the first five years following harvest (Macdonald et al. 2003). Another scenario was found in the CMER Westside Type N Effectiveness Hard Rock Extended study where there was a stronger effect on stream temperatures in the first two years, then a weaker effect for the next 2-3 years, as vegetation recovered, followed by a strong effect in the final 2-3 years with the majority of sites never fully recovering to pre harvest stream temperatures following nine years of post-harvest monitoring (McIntyre et al. 2021). Like the Westside Type N Effectiveness Hard Rock Extended report, **extending the ENREP monitoring period to seven years will provide key insights into the direct and indirect effects of harvest as well as revealing the impacts of vegetation recovery.**

Finally, in cold regions, interannual variations in climate has been noted to mask snowpack and streamflow responses to forest disturbances (Goeking and Tarboton, 2020). In the snow-dominated ENREP watersheds, interannual variations related to the El Niño Southern Oscillation (ENSO) phases that commonly persist for 1 to 2 years are predicted to exert a strong response on the hydrological dynamics. While this can be partly assessed through the hydrometeorological monitoring that is included in the original study design, it is possible that treatment effects will interact with climate variations to produce distinct responses (e.g., producing more severe effects on water temperature and aquatic life in warmer and drier years with earlier freshet timing than in colder and wetter years with later runoff). The proposed extension will more effectively reveal how climatic variability, including potential variations related to ENSO cycles, interact with the documented landcover changes to affect the critical response variables.

The proposed extended monitoring would reduce potential influence of Type 1 (false positives) or Type 2 (false negatives) on the quality of the findings.

What the study will not tell us:

The study will not directly address alternate prescriptions. It will test a 50' Type Np buffer consistent with current rule. One of the design goals of the 'dry' study was to evaluate the effect of buffering or not-buffering dry reaches. In all the sites where we have over 1000' of stream that is predominately dry for more than 2 months (e.g., Springdale, BlueGrouse, and their eastern Cascade analogs), we will be working with landowners to clearcut harvest a portion of the dry stream network. This was always a design goal for the 'dry' component of the study that was communicated to landowners of those sites, but not well articulated in the approved study design document. We recognize that there was interest by certain members to also see clearcut harvest in perennially wet reaches, and this was discussed as an option in the March 23, 2018 CMER meeting. Clearcut harvest along perennially wet reaches has not been discussed with the landowners, and the decision on where and how perennial reaches are treated will need to be resolved at a later date with the involvement of landowners and their harvest implementation teams to ensure that experimental treatments both meet their scientific and management objectives and are practically feasible. Insights into alternate prescriptions are expected to occur through meta-analyses that incorporate the results of this study and the larger body of research on forestry effects.

The study is designed with only two-years of pre-treatment monitoring and at least two-years of post-treatment monitoring. Two-years is not enough time to capture the full range of effects, especially those that are likely to be episodic. Although the degree of inference will be limited by the relatively short pre and post-treatment phases, this has been shown to be adequate for quantifying the initial changes associated with harvest (e.g., McIntyre *et al.* 2018). Longer-term monitoring will be required to determine the overall trajectory of responses and to capture a broader range of climate conditions and greater potential for episodic changes with less-frequent recurrence intervals (e.g., temperature recovery, sediment export from processes that act over longer time-scales, changes associated with flood or drought events, and delayed response in aquatic communities).

By experimenting at the basin scale, we can examine reach-scale effects within the drainage basin, as well as cumulative exports to downstream fish-bearing waters, but we cannot directly address downstream effects. These sites are not appropriate for evaluating effects on fish and have limited utility for assessing even downstream effects on temperature given that the adjoining higher-order streams the study basins discharge to are influenced by land uses both upstream and immediately downstream of their confluences with the study streams.

The three site pairs identified for inclusion of the study span a gradient of precipitation and channel wetness in the northern Rockies ecoregion and we seek another three pairs in the eastern cascades across a similar gradient of precipitation. Small sample size, relative to observational studies, is an issue for most experimental studies and especially so for field-based studies like this. However, experimental studies are essential to testing the effectiveness of specific riparian prescriptions. Given our limited amount of basin-scale replication, the results of this study should not be viewed solely in isolation, but rather as a part of the larger body of research on forestry effects. Failure to obtain additional sites will reduce power of the study and level of inference, especially as they relate to CMER lands with higher levels of aquifer permeability.

In an ideal scenario, we could monitor each site as it fully recovers to answer the question, "How long does it take for riparian functions to fully recover from harvest?" Adding five additional years of post-harvest monitoring, for a total of seven years, will not accomplish this because all sites are not expected to fully recover to baseline conditions for at least ten years or longer. However, seven years of monitoring may be sufficient to assess whether and where changes are transient or persistent and may indicate the recovery trajectory for the complete suite of hydrological and aquatic life variables that are being monitored. However, we note that the recovery trajectory from the Westside Type N Hard Rock Effectiveness Extended report varied throughout the nine years of post-harvest monitoring making recovery trends less predictable and dependent of the length of post-harvest monitoring (McIntyre et al. 2021).

5. What is the relationship between this study and any others that may be planned, underway, or recently completed? Factors to consider in answering this question include, but are not limited to:

- **a. Feasibility of obtaining more information to better inform Policy about resource effects.**
- **b. Are other relevant studies planned, underway, or recently completed? (If yes, what are they?)**

ENREP is a companion to the two westside Type N Effectiveness studies ("Hardrock", "Softrock") and will provide information about how riparian processes and functions provided by Type Np buffers maintained at levels that meet FP HCP resource objectives and performance targets for shade, stream temperature, LWD recruitment, litter fall, and aquatic life in eastern Washington.

In addition, ENREP will address whether different types of Type N channels respond differently to forest practices. It will also address the effect of buffering or not buffering spatially intermittent stream reaches in Type Np streams. The results are likely to empirically inform the Eastside Np

Effectiveness Project, which is listed in the CMER workplan as a literature review related to Ns rule effectiveness.

ENREP is currently the only Type Np Effectives study planned or underway in eastern Washington.

The Westside Type N Buffer Characteristics, Integrity, and Function (BCIF) Project (Schuett-Hames et al., 2012) was a BACI study that employed sites where both sides of an Np stream were harvested. The study monitored riparian stand recovery, large woody debris, shade, and soil disturbance, for five years post-harvest. This study did not measure water quality or aquatic life. The BCIF study also re-sampled riparian vegetation, LWD recruitment, shade and other variables after 5 years of no post-harvest monitoring immediately following the first five years of monitoring. At year 10 monitoring resumed revealing changes in riparian mortality and ingrowth, windthrow, and shade from the first five years (Schuett-Hames and Steward 2019).

The CMER Extensive monitoring project recently prioritized by the Forest Practices Board could also be used for measuring recovery of riparian vegetation post-treatment. While by design, extensive monitoring does not show cause-effect relationships, it can be used to measure long-term trends and whether threshold values are being met (e.g., effective shade, long-term LWD recruitment, riparian stand structure, RSAG/CMER Extensive Monitoring memos to TFW Policy, 2014, 2019, 2022, 2023).

6. What is the scientific basis that underlies the rule, numeric target, performance target, or resource objective that the study informs? How much of an incremental gain in understanding do the study results represent?

The rules are based on multiple assumptions regarding the effectiveness of Np riparian buffers and protecting resource objectives. Some of these assumptions appear to hold while others appear questionable based on results from the Type N Experimental "Hard Rock" study in western Washington.

This is the only study that will specifically address Type Np rule effectiveness in eastern Washington, and how responses vary along a spatial, hydroclimatic gradient, and associated gradient of seasonal surface water presence. As such, it is expected to provide a substantial gain in information in the context of other Type Np and related forest research.

The incremental gain in understanding will increase proportional to the number of years of extended monitoring beyond the current ISPR approved study design. Unpredictable episodic events (e.g., windthrow, rain-on-snow flood) may contribute noise and uncertainty to the long-term treatment effect beyond the two years following harvest. Benthic communities may exhibit "lag effects" that do not show up in two years following treatment. Extending the post-harvest monitoring period from two to seven years will enable CMER to track not only the immediate impacts of harvest, but also the recovery of riparian vegetation and concomitant responses of flow, water quality, and aquatic ecological variables. Taken together, this represents a large incremental gain in understanding beyond the initial study plan.

By extending the post-harvest monitoring period to seven years, we expect a substantial gain in understanding of the long-term impacts of harvest and effectiveness of riparian buffers. For instance, the Westside Type N Effectiveness Hard Rock Phase II report (McIntyre et al. 2021) showed that water temperature response was strong in the first 2 years following harvest, followed by a weaker response in the next 2-3 years, and ending with a strong response in years six through nine. Indirect effects of harvest, such as windthrow or floods, could be missed in the first two years following the harvest and impact study results (McDonald et al. 2003).

Extending the post-harvest monitoring period from two to seven years will enable CMER to track not only the immediate impacts of harvest, but also the initial recovery of riparian vegetation and concomitant responses of flow, water quality, and aquatic ecological variables. While we may not be able to quantify the full recovery of each riparian function over seven years, we will be able to characterize the recovery trajectory that each site is on and assess whether trajectories are similar or different across sites. Taken together, quantifying harvest impacts as well as recovery represents a large incremental gain in understanding beyond the initial study plan.

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