Type N Experimental Buffer Treatment Project in Hard Rock Lithologies – Report to Policy on Wood Recruitment and Loading (Chapter 6)

11 December 2017 – For CMER Review

Study Report

The results from this study are found in the following Study Report:

McIntyre, A.P., M.P. Hayes, W.J. Ehinger, D. Schuett-Hames, S.M. Estrella, G. Stewart, R.E. Bilby, E.M. Lund, J. Walter, J.E. Jones, R. Ojala-Barbour, F.T. Waterstrat, C.R. Milling, A.J. Kroll, B.R. Fransen, J. Giovanini, S.D. Duke, G. Mackenzie, R. Tarosky, J.G. MacCracken, J. Thronton and T. Quinn. 2017. Effectiveness of Experimental Riparian Buffers on Perennial Non-fish-bearing Streams on Competent Lithologies in Western Washington. Cooperative Monitoring Evaluation and Research Report CMER XX-XXX, Washington State Forest Practices Adaptive Management Program, Washington Department of Natural Resources, Olympia, WA.

CMER/Policy Interaction Framework Six Questions

1. **Does the study inform a rule, numeric target, Performance Target, or Resource Objective?** Yes.

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

The objective of the Type N Experimental Buffer Treatment Project in Hard Rock Lithologies (Hard Rock Study) was to evaluate the effectiveness of the current westside riparian management zone (RMZ) prescriptions for Type N (non-fish-bearing) Waters in maintaining key aquatic conditions and processes affected by Forest Practices. Specifically, we evaluated whether the riparian buffer prescription for Type N streams met the following overall Performance Goals, namely: (1) to support the long-term viability of stream-associated amphibians, and (2) to meet or exceed water quality standards. As part of this evaluation, we assessed the Forest Practices Resource Objectives (defined as a series of Functional Objectives and corresponding Performance Targets in Schedule L-1) for heat/water temperature, large wood/organic inputs, and hydrology.

The overall study design addressed the following CMER Work Plan Critical Questions:

- Are riparian processes and functions provided by Type N buffers maintained at levels that meet Forest Practices (FP) Habitat Conservation Plan (HCP) Resource Objectives and Performance Targets for shade, stream temperature, large wood recruitment, litterfall, and amphibians?
- How do other buffers compare with the FP Type N prescriptions in meeting Resource Objectives?
- How do Type N riparian prescriptions affect water quality delivered to downstream Type F/S waters?

3. **Was the study carried out pursuant to CMER scientific protocols?**

Yes. The study design was carried out according to the CMER and Independent Scientific Peer Review (ISPR) approved study design (including sampling methodologies, statistical methods, and study limitations). SAGs (RSAG and LWAG), CMER, and ISPR reviewed all of the study chapters and their associated findings, and CMER approved the entire final report in September 2017.

4. **A. What does the study tell us?**

In the two years following harvest, we observed a significant post-harvest increase in in-channel wood loading in all buffer treatments. We observed the greatest increase, especially of small wood, in the clearcut RMZs of the FP and 0% treatments, where slash related to harvest of the streamside riparian stand accumulated. Tree fall rates in FP buffered RMZ were significantly greater than rates in the 100% treatment and unharvested reference RMZs, while rates in both FP and 100% treatment PIPs were greater than in reference PIPs, primarily due to windthrow. LW recruitment rates were greater in both the FP and 100% treatment than in the reference RMZs and PIPs, but most comparisons were not significant. As a result, we observed increased large wood recruitment and loading in streams with buffers. Future large wood recruitment will depend on several factors, including existing recruitment potential (the density and size of the current stand), ingrowth of new trees, future silvicultural activities, and the magnitude and frequency of disturbances, such as wind, that cause tree mortality and wood input. Future wood loading will depend on rates of wood recruitment as well as decay and transport of in-channel wood downstream.

Wood Recruitment and Loading

The LWD/Organic Inputs Resource Objective addresses wood recruitment and loading. The study reduces uncertainty for instream wood through an evaluation of wood recruitment and loading in the two years following harvest.

Functional Objective: Develop riparian conditions that provide complex habitats for recruiting large woody debris and litter.

Performance Targets: There are no Performance Targets specific to wood recruitment and loading for Type N Waters.

Wood Recruitment Results:

- Two year post-harvest tree fall rates, as a percentage of standing stems, in the FP buffer RMZs and PIPs were >5 ($P = 0.02$) and 12 ($P = 0.01$) times greater than the comparable unharvested reference rates. Tree fall rates in the 100% treatment PIPs were 7 times ($P = 0.03$) greater than in reference PIPs; however, no significant difference existed between tree fall rates in the 100% treatment and reference RMZs.
- In the two years following harvest, in-channel wood recruitment experienced the greatest change in the clearcut RMZs and PIPs, with little additional wood recruitment to the stream because trees were removed as part of the harvest treatments.
- Two year post-harvest large wood recruitment rates (volume) from RMZs in the FP buffer and 100% treatment were somewhat greater than for reference RMZs (1.1 and 1.6 times, respectively), but the differences were not statistically significant.

- Large wood recruitment volume in the FP and 100% treatment PIP buffers was substantially greater than in the reference PIPs (12 and 19 times, respectively) and the differences were statistically significant (P = 0.08 and 0.04, respectively).
- Riparian buffers prevented input of logging slash into the stream from upland clearcut harvest. In these buffers, wood input was mostly due to windthrow.
- Ninety percent of trees recruited during the two year post-harvest period were suspended over the stream channel.

Wood Loading Results:

- The post-treatment change in the number of in-channel large wood pieces (>10 cm [4 in] diameter) differed between the reference and riparian buffer treatments (P <0.01). We estimated a between-treatment average increase of 60% (P <0.001), 40% (P = 0.03) and 50% (P = 0.01) in the number of large wood pieces per stream meter in the 100%, FP and 0% treatments, respectively. The pattern for functional large wood (i.e., contributing to step formation, bank stability, or hydraulic roughness) was similar to that for total large wood (P <0.01).
- The post-treatment change in the number of in-channel small wood pieces differed between the reference and riparian buffer treatments (P <0.01). We estimated a between-treatment average increase of 60% (P = 0.05), 70% (P = 0.07) and 170% (P <0.0001) in the number of small wood pieces per stream meter in the 100%, FP and 0% treatments, respectively. The pattern for functional small wood was similar to that for total small wood (P <0.01).
- The only significant difference in numbers of wood pieces among the three buffer treatments was for total small wood, which had a greater post-harvest increase in the 0% than in the 100% (P = 0.01) and FP (P = 0.08) treatments. The increase in total small wood in the 0% treatment was 70% greater than in the 100% treatment and 60% greater than in the FP treatment.
- Greater than 75% of all wood pieces were classified as small. Small wood played a functional instream role in all sites, with approximately 50% of small wood pieces contributing to instream function, regardless of treatment.
- When in-channel windthrow and slash were considered in combination, the channel length covered (hereafter "wood-obstructed reaches") differed significantly among treatments (P = 0.001). In the first post-harvest year, wood-obstructed reach length in the 100%, FP and 0% treatments was estimated to be 3, 8, and 9 times greater than in the reference, and the FP and 0% treatments were significantly greater than in the reference (P <0.01).
- The proportion of wood-obstructed reaches in the post-harvest period increased with a decrease in the length of buffered RMZ, ranging from 8 to 25% in the FP treatment and 0 to 61% in the 0% treatment.
- We observed up to 5 times more large wood and up to 15 times more small wood in wood-obstructed reaches than in reaches that were not obstructed by wood. Ninety-

one percent (91%) of all wood pieces in wood-obstructed reaches were classified as small wood (≤10 cm [4 in] diameter).

- Large wood pieces most frequently contributed to bank stability in both the pre- and post-harvest periods, except in wood-obstructed reaches in the post-harvest period where the predominant function was hydraulic roughness. Large wood in wood-obstructed reaches also spanned the channel more frequently than in reaches that were not obstructed by wood.
- Small wood was generally loose in the stream (e.g., not anchored in the stream and easily moved downstream during periods of higher flow) in both the pre- and post-harvest periods. In the post-harvest period, the proportion of small wood pieces that were loose declined, while the proportion of pieces that contributed to hydraulic roughness increased. The proportion of pieces contributing to hydraulic roughness or spanning the channel was greater in wood-obstructed reaches.

Conclusions:

- Streams with buffers (FP buffered and 100% treatments) had increases in wood recruitment and loading over the two year post-harvest period.
- For streams with buffers, differences in wood recruitment were associated with levels of disturbance (mostly windthrow), including frequency and severity, regardless of treatment. Variability in stand structure associated with differences in post-harvest mortality has implications for future wood input and loading in the buffered streams, creating uncertainty about the ability of disturbed buffers to supply wood over the long-term.
- Future large wood recruitment from buffered RMZs and PIPs will depend on several factors, including existing recruitment potential (the density and size of the current stand), ingrowth of new trees, future silvicultural activities, and the magnitude and frequency of disturbances, such as wind, that cause tree mortality and wood input. In buffered RMZs without extensive mortality, future recruitment potential is good. For the sub-set of buffers with substantial wind mortality, wood recruitment rates were higher during the first two years after harvest, but the number of trees remaining in the stand were depleted. Uncertainty remains about the ability of these stands to regenerate and supply instream wood over the long-term.
- Future large wood recruitment from unbuffered (clearcut) RMZs in the FP and 0% treatments will require the establishment and development of a new forest stand. Over time, wood loading is likely to decrease as logging slash decays; however, these channels are likely to receive another pulse of logging slash during the next harvest. This process will result in an episodic wood input regime and changes in wood loading through time.
- We observed the greatest post-harvest increase in wood loading, especially small wood related to harvest of the streamside riparian stand (i.e., slash), as a result of harvest activity in the clearcut RMZs. In these reaches, equipment limitation zones (ELZs), in combination with additional rules intended to minimize wood input during harvest, did not prevent recruitment of logging slash to streams. However, our study

streams had substantially less slash input than streams in some similar studies (e.g., Jackson *et al.* 2001).

- In clearcut stream reaches, there was very little additional large wood recruitment during the two years after harvest. Harvest of streamside trees eliminates potential future wood recruitment for an extended period, which will likely result in smaller and lower wood loading levels over longer periods (e.g., a harvest rotation). Uncertainty remains about the fate and persistence of logging slash, especially small wood, which decays at a much faster rate than, and does not provide the same opportunity for instream sediment storage as, large wood. In Type N basins with clearcut RMZs, replacement of large wood with smaller pieces will likely reduce long-term sediment storage capacity.
- We cannot evaluate whether this wood input regime meets the Functional Objective of providing complex habitats and developing riparian conditions for recruiting large wood through time with only two years of post-harvest study.
- Wood pieces suspended above the stream channel provides shade and cover and are expected to provide in-channel functions eventually as they decay and are recruited to the stream. Uncertainty remains about the timeframe for suspended pieces to fall into the channel.

B. What does the study not tell us?

One should consider a number of study limitations when interpreting and generalizing the results.

Spatial Scope of Inference: The spatial scope of inference is limited to Type N basins dominated by competent lithologies, which comprise approximately 29% of western Washington Forests and Fish-regulated lands (P. Pringle, personal communication, September 2005). One should not assume that the results apply equally to other lithologies. Additional considerations include the fact that sites were located in second-growth forests and ranged from approximately 12 to 53 ha (30 to 130 ac). See McIntyre and colleagues (2009) for a summary of the site selection process.

Temporal Scope of Inference: The temporal scope of inference can only be made to the two year post-harvest interval. Do not assume that the results are applicable over a longer period. One can only understand the scope of potential long-term response with longer-term monitoring. For example, there will be opportunities for continued windthrow from riparian buffers, recruitment of spanning large wood, as well as the decay and downstream transport of wood currently in the channel, especially the small wood that contributed most to the increased wood load we observed in the clearcut RMZs of the FP and 0% treatments.

Riparian Buffering/BMPs: Application of clearcut timber harvest included buffers for sensitive sites and unstable slopes, and followed other best management practices (BMPs), ultimately, influencing the level of buffering in the FP treatment sites. CMER did not design this study to examine directly the influence of specific rules or BMPs, but rather to evaluate the overall influence of the FP buffer strategy as it is applied under real world circumstances. We do not know if the results for the FP buffers would have been different if only the minimum riparian buffers had been applied. We also do not know how frequently more than the minimum buffer length is applied across the managed landscape. Since the proportion of the stream length buffered in FP treatment sites was more than the minimum required under Forest Practice's rules, some consistent results between the 100% and FP treatments may reflect the fact that the stream length buffered was more similar between these treatments than between the FP and 0% treatments.

Pre-harvest Windthrow Event: Interpretation of results, especially for riparian vegetation and wood, required consideration of the timing and severity of a windthrow event that occurred 1-4 December 2007. During this time, a series of storms caused extensive windthrow throughout western Washington. The storms resulted in extensive damage to forestlands along the Washington coast, leading us to add an additional, third year, of pre-treatment sampling for some response variables. We found that study sites assigned to all treatments were impacted, including references and riparian buffer treatments. Since we had the opportunity to collect additional pre-harvest data, our data reflect the broad range of disturbances that occur throughout the managed forestlands of western Washington.

5. **What is the relationship between this study and any others that may be planned, underway, or recently completed?**

The results from the Hard Rock Study, BCIF Study, Soft Rock Study, Shade Study, and Amphibian Recovery Project in combination are expected to provide a thorough assessment of riparian prescription effectiveness for westside Type N Waters. They will generate data that can be used to determine if the resource objectives for heat/water temperature, LWD/organic inputs, sediment, hydrology and stream-associated amphibians (with the exception of terrestrial Dunn's and Van Dyke's Salamanders) are being met.

- Westside Type N Buffer Characteristics, Integrity, and Function Project [BCIF Study, completed]: The BCIF Study evaluated the magnitude of change in riparian stand conditions, tree mortality, shade and LWD recruitment when prescriptions were applied on a reach-scale at sites selected from a random sample of forest practice applications. The Hard Rock Study expanded on the knowledge gained in the BCIF Study, supplementing the results from the latter by increasing the sample of clearcut, 50-ft buffer and PIP buffer RMZ reaches. These results are particularly helpful in reducing the level of uncertainty in PIP buffer response, increasing the sample size and providing PIP reference data. Additionally, the Hard Rock Study included responses that were not incorporated in the BCIF study, including riparian-related wood inputs. Findings through five years post-harvest are reported on in Schuett-Hames and colleagues (2011). A report on findings through 10 years post-harvest is in development.

- Type N Experimental Buffer Treatment Project in Soft Rock Lithologies [Soft Rock Study, underway]: The Soft Rock Study will expand on the knowledge gained from the Hard Rock Study by evaluating the post-harvest changes in riparian stand conditions, buffer tree mortality, large wood recruitment, shade and stream temperature, and nutrient and sediment export from westside Type N basins with sedimentary lithologies. This study differs from the Hard Rock study in that it includes only study basins underlain with sedimentary lithologies, and includes only one riparian buffer treatment (equivalent to the Hard Rock Study FP treatment; no alternative buffers are tested). Both the Hard and Soft Rock studies use a manipulative experimental design to compare effectiveness of riparian buffers with unharvested controls. Like the Hard Rock Study, the Soft Rock Study is limited to western Washington. The Soft Rock Study will provide important confirmation of the effect of forest practices prescriptions on more erodible substrates that were not included in the Hard Rock Study.

- Amphibian Recovery Project [completed]: This project evaluated the effects of three buffer treatments on headwater streams throughout coastal western Washington. Riparian buffer treatments in this study differed from those included in the Hard Rock Study and included: (1) unthinned riparian buffers, (2) partial buffer, (3) buffer of non-merchantable trees, and (4) clearcut to the channel edge. The study included an evaluation of stream channel characteristics, wood loading, stream temperature, sediment, macroinvertebrates and stream-associated amphibians. One year of pre-harvest and three years (immediately post-harvest and two additional years beyond that) of post-harvest data were collected; not all metrics were evaluated in every post-harvest year. The study included 15 study sites. Since the treatments in the Amphibian Recovery Project were not designed to evaluate the current Forest Practices prescriptions for Type N streams, direct comparisons of results between this and the Hard Rock Study are only available for what we call the 0% treatment (their clearcut RMZ treatment). See Jackson and colleagues (2001; 2007) and Haggerty and colleagues (2004).

These studies will not address the effectiveness of the riparian prescriptions for eastside Type N Waters, for which CMER needs to complete the ENREP Study (underway), Eastside Np Effectiveness Project (planned).

- Eastside Type N Riparian Effectiveness Project [ENREP Study, underway]: The ENREP study will determine if, and to what extent, the eastside riparian prescriptions are effective in achieving Performance Targets and water quality standards, particularly as they apply to sediment and stream temperature. Study objectives include: (1) quantify the magnitude of change in stream flow, canopy closure, water temperature, suspended sediment transport and wood loading within eastern Washington RMZs following harvesting, and (2) evaluate the effects of these changes on downstream waters where possible. This study complements the Hard Rock Study by evaluating Type N prescription effectiveness in eastern Washington.
- Eastside Np Effectiveness Project [planned]: The Eastside Np Effectiveness Project will determine if and to what extent the riparian prescriptions for eastside Ns streams (non-fish-bearing seasonally dry) maintain Performance Targets and water quality with a particular focus on effects in downstream typed waters. A literature review will inform a field study to examine the effect of riparian prescriptions on Ns streams on downstream Type Np and F Waters. Responses will include in-channel wood loading, channel stability, and downstream water quality (temperature, turbidity, and sediment) and quantity, stream channel stability and magnitude and frequency of scour. This study complements the Hard Rock Study by evaluating Type N prescription effectiveness in eastern Washington.

- ***Feasibility of obtaining more information to better inform Policy about resource effects.***

Opportunities exist to inform Policy with data that have already been collected for the Hard Rock Study through eight years post-harvest (through 2016). The CMER budget for the current biennium includes funding for analyses of these data and report writing. Future and continued data collection is possible if interest exists. However, some reference sites have been or will be harvested for timber in the near future, making them unsuitable for use as references in the study. Opportunity may exist to establish new reference sites or to use nearby references from the Soft Rock study in lieu of harvested references for selected response variables. This is a unique long-term data set evaluating applicable riparian buffer treatments in a BACI-designed study. Value exists in continued monitoring of treated sites for interpretation of the longer-term trajectory of change. To date, two reference sites have been harvested and two are expected to be harvested during calendar year 2019. Due to regulatory constraints, it is unlikely that the remaining two reference sites would ever be harvested.

- ***What are the costs associated with additional studies?***

Analysis and report development through eight years post-harvest are a part of the current CMER 2017-2019 biennium budget. Costs estimates associated with additional study beyond eight years post-harvest are variable and dependent on which responses interest Policy. Budget placeholders exist in the CMER Master Schedule. We estimate that another round of sampling for riparian vegetation, wood recruitment and loading, and stream-associated amphibian demographics would be an additional $897,000. Modifying the specific responses included, as well as the number and timing of future sampling, affects budget estimates.

- ***What will additional studies help us learn?***

Results from the extended study period through eight years post-harvest will provide additional information for understanding the effectiveness of the current Forest Practices rules and buffer alternatives. Additional long-term monitoring will provide a unique opportunity to evaluate the longer-term response of variables of interest to forest practices. Originally, the Hard Rock Study was proposed to cover an entire harvest rotation (i.e., 30 to 40 years in western Washington). Future monitoring would allow us to evaluate wood recruitment and loading over an extended period. We also see enormous value in continuing to monitor more than one or two variables, as continued data collection for multiple covariates may be useful in better understanding the mechanisms of potential change. For example, the Functional Objective for large wood and organic inputs is to develop riparian conditions that provide complex habitats for recruiting large wood and litter. Therefore, to address rule effectiveness it would be best to continue monitoring of stand conditions, large wood recruitment, in-channel wood loading and litter inputs simultaneously.

- ***When will these additional studies be completed (i.e., when will we learn the information)?***

CMER anticipates development and approval of reports from the extended period (through eight years post-harvest) during the current biennium (2017-2019) and beginning of the following biennium (2019-2021), with transmission to Policy estimated for the 2019-2021 biennium. Timing of dissemination of findings to Policy for any future sampling would depend on the number of responses for which Policy is interested in continuing to monitor and the timing of that effort. We highly encourage Policy to consider the benefits of continued or future monitoring throughout an entire harvest rotation.

- ***Will additional information from these other studies reduce uncertainty?***

Future monitoring beyond eight years post-harvest will reduce uncertainty associated with trajectories of potential changes in wood recruitment and loading. Only longer-term study can provide guidance on the effectiveness of the current Forest Practices rules and their ability to meet Functional Objectives over the long-term.

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 management approach for westside Type N riparian prescriptions employs a patch-cut strategy, where a portion of the riparian stand in a Type N basin RMZ may be clearcut, providing that sensitive sites and at least 50% of the perennial stream length is buffered. CMER intended this study, along with BCIF and Soft Rock Studies, to evaluate the effectiveness of this strategy.

This study provides a substantial gain for wood recruitment and loading. While previous studies may have evaluated many of the metrics we included in this study as they relate to forestry practices, the Hard Rock Study provides results in context of the specific forest practices rules for riparian prescriptions required on Type N streams in western Washington.

The BACI study design provides a more precise estimate of the response to forest harvest. The inclusion of variable buffer treatments, both more restrictive and less restrictive than the current rules, was established to provide a response curve along a gradient of buffer length.

We expanded on the knowledge gained from other CMER studies, for example by supplementing the findings from the BCIF study by increasing the sample of riparian vegetation and wood recruitment clearcut, 50-ft buffer and PIP buffer RMZ reaches.

While most previous studies have focused on large wood (≥10 cm [4 in] diameter), small wood (<10 cm [4 in] diameter) is frequently abundant in smaller channels, where stream power is typically too low to transport wood downstream. Small wood in headwater provides functional roles (e.g., sediment storage) and influences channel morphology. Our study is among a few that addresses the prevalence, characteristics and function of small wood in headwater streams.

We are more confident in many of our findings because we were able to utilize new technology and sampling techniques that were not previously available, because of the duration and/or intensity of sampling, and because we were able to take advantage of more recent statistical methods.

<u>Technical Implications and Recommendations:</u>

Research/monitoring suggestions.

To better understand whether the current FP rules for Type N Waters meet the Functional Objective for large wood and organic inputs (i.e., to develop riparian conditions that provide complex habitats for recruiting large wood and litter), we highly encourage Policy to consider the benefits of extended monitoring of wood recruitment and loading response to treatments over time. This study covered only the first two years after harvest, which is not enough time to evaluate fully the duration of harvest effects and the long-term trajectory of response. To understand completely the impacts of the treatments on the managed landscape one would have to monitor the response for a longer period. Substantial amounts of time and money have been invested in this study to date. Currently we have collected data through eight years post-harvest, and a report outlining those findings is in development. Data collection at existing study sites over a longer time will reduce scientific uncertainty about the duration of disturbance and the progress of recovery in Type N riparian buffers and clearcuts. Considering the amount of time and money that would be required to re-initiate a similar study from the beginning, the best opportunity for evaluating long-term recovery is with continued monitoring in the existing study. Additional data collection may be especially important for evaluating the continued effects of windthrow and tree mortality in riparian buffers, in-channel wood recruitment and loading, and decay and transport of wood pieces downstream. Continued study for this and other related studies (see **What is the relationship between this study and any others that may be planned, underway, or recently completed**?) would result in a more confident assessment of prescription effectiveness as we monitor response to treatments over time.

Specifically, we propose two areas for potential future studies:

Analysis of Existing Data

- Buffered versus unbuffered Np reach-scale effectiveness: An evaluation of within-stream variability and characteristics between buffered and unbuffered reaches and between wood-obstructed and unobstructed reaches may prove informative for understanding the effects of alternative riparian buffer prescriptions. For example, based largely on retrospective studies, stream-associated amphibians were thought to be mostly absent from areas lacking overstory canopy and covered with dense matrices of wood and stored sediment; however, we found all focal amphibians, and even evidence of reproduction in the form of egg masses, in wood-obstructed reaches filled with fines and organic debris. CMER could address reach-scale effectiveness, at least in part, with existing data from the Hard Rock Study. We recommend an evaluation of reach-scale variability with existing data from this study, which could inform the utility of continued monitoring and/or future projects.

New Field Study

- Investigation of wood loading and amphibian use through time: Even with Forest Practices rules intended to minimize slash input into streams, we observed heavy slash loading in some stream reaches. In the two years immediately following harvest, we observed amphibian use of, and evidence of reproduction (i.e., egg masses) in, these reaches. Future evaluations could assess persistence of these wood-obstructed reaches, including overall stream coverage as a function of time since harvest. We could also address trends in amphibian density in wood-obstructed reaches through time.

Suggested changes to rules/board manual.

- A review and evaluation of the Performance Targets for westside and eastside Type N streams, both in context of the results of these studies and other current scientific research, by CMER and the Timber, Fish and Wildlife (TFW) Policy Committee would be appropriate once the studies outlined under #5 are completed. The Functional Objective for large wood and organic inputs is to provide complex habitats for recruiting large woody debris and litter. However, there are no Performance Targets specified for riparian conditions and in-stream large wood for Type N Waters. If Policy is interested in an evaluation of the effectiveness of FP rules for Type N Waters in maintaining Functional Objectives for large wood and organic inputs, they should consider the development of measurable Performance Targets.

References

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