WASHINGTON FARM FORESTRY ASSOCIATION DISPUTE RESOLUTION POSITION STAEMENT REGARDING THE INDEPENDENT FUNCTION EVALUTATION COMPONENT OF THE CRAMER FISH SCEINCE ASSESSMENT OF THE SCIENTIFIC JUSTIFICATION FOR THE ALTERNATE PLAN TEMPLATE PRESCRIPTIONS

November 1, 2021

The Washington Farm Forestry Association is deeply aggrieved at the novel interpretation of the CMER dispute resolution protocol that dismissed the mediation stage of our dispute. Many CMER members and agency scientists made it clear that they did not have the time to do a thorough technical review of either the Scientific Justification for the proposed prescriptions or the Cramer Fish Sciences Assessment of the Scientific Justification. We believe that many of the technical issues could have been resolved—and still can be with a deeper technical review.

Position Statement by CMER members recognizing that the **Independent Function Evaluation** (IFE) component of Cramer Fish Sciences' *Small Forest landowner Alternate Plan Template Review (September 30, 2018)* as completed, and is quality science. Our answers to the Six Questions follow our justification for this position.

It is our position that the Cramer Fish Sciences (CFS) review of the Scientific Justification (SJ) for the WFFA Small Forest Landowner Alternate Plan Template Proposal Initiation represents complete and quality science. The CFS review made use of Best Available Science (BAS) to inform the **Independent Functions Evaluation** specific to the proposed alternative riparian management prescriptions for small, non-industrial forest landowners of western Washington. The independent scientific peer review (ISPR) of the CFS review provides sufficient discussion of the strengths, limitations, and uncertainties presented in the Independent Function Evaluation section of the CFS review. We focus our answers to the Six Questions on the IFE rather than the SJ because it used more current literature, did not use a model for shade evaluations, considered wind throw, and received a rigorous ISPR from a panel of four highly qualified scientists with relevant expertise. The ISPR review of the CFS was at least as thorough and comprehensive as a CMER review. We note that the authors of the CFS were not asked to revise the CFS following comments received from the ISPR however, the reviewers spoke highly of the Independent Functions Evaluation approach and had no fatal (red per CMER protocol) comments that necessarily required document revision.

While a thorough methodology has not been developed within CMER for providing a quality review of science completed outside the CMER process, guidance for evaluation of non-CMER generated reports and proposals can be found in the CMER document "Use of non CMER Science in the Forest Practices Adaptive Management Program" (approved by consensus in 2013). Under the "Quality Assessment of Scientific Information (Evaluating Best Available Science)", pages 5 - 6, it states "…where non CMER science is being considered to inform

adaptive management program processes, CMER should evaluate if the protocols used in obtaining or generating the data are at least as rigorous as those expected for use by CMER in its research."

A universal definition of what constitutes good science is difficult to find, however a multidisciplinary panel of scientists undertook such an exercise as reported in Mårtensson *et al.* (2016). They provide a concept hierarchy consisting of four main areas to determine the quality of research. These main areas are labelled as: *Credible, Contributory, Communicable,* and *Conforming.* These concept areas are similarly addressed within CMER's Best Available Science guidance document. We evaluated the works of the SJ and the CFS review using these criteria and find both representative of "quality" science. Members of the TFW Policy Committee and the Forest Practices Board are additionally advised that the Independent Functions Evaluation presented by both the SJ and the CFS review are specific comparisons of estimated responses to the proposed riparian management prescriptions with existing rule prescriptions; e.g., relative effectiveness.

Credibility: Research that is Coherent, Consistent, Rigorous and Transparent

Both the SJ and CFS review meet this definition of *credible* as well as that defined in CMER's Best Available Science guidance; both are coherent and clearly present the methods, results and conclusions reported. The determination of quality science generally also includes peer review. Peer review does not explicitly demand an author's response but serves to evaluate, with neutrality, the strength of the methods used to fulfill the stated purpose of the work.

The purpose of the Cramer Fish Sciences (CFS) review was to evaluate the quantitative estimates within the SJ of the relative effectiveness (risk) of the proposed prescriptions "by determining:

1. If the function analysis is supported by Best Available Science (BAS), and
2. If the function analysis followed credible scientific/statistical protocols, and
3. The scientific strength of the findings."

The CFS noted that the SJ's "use of, and agreement with, science varies function to function, affecting the strength of [its] findings." Thus, providing peer review and critique of the SJ.

The "Assessment and Synthesis of ISPR Review (ISPR 18-19-04) dated February 11, 2019 provides evidence of the credibility of the CFS review.

Although the review panel raised concern that neither work provides adequate contextual information for reaching the "equal protection" threshold (regarding where and when the proposed management prescriptions may occur on the landscape) the ISPR panel found the CFS review to be technically sound and unbiased. We note that neither the SJ, nor the CFS were intended to assess "equal protection." Their focus was to characterize the relative differences in function between the proposed prescriptions and the existing forest practices

rules. We also note that neither the SJ nor the CFS were intended to assess whether the prescriptions or the rules meet FFR or Habitat Conservation Plan standards.

A comparison of works cited and source data used between the SJ and the CFS review revealed that:

- Twenty-nine works were cited by both the SJ and the CFS review, thirty-six references were cited by only SJ and fifty references were cited only in the CFS review, and
- Only one citation listed in the CFS review was a more recent publication (as of 2019); it was a literature synthesis published in a peer reviewed journal published by a professional society in 2016.

Notably, both authors cite data from multiple CMER studies including chapters from the "Hard Rock 2 year study for the CFS that evaluated the effectiveness of current forest practices rules on non-fish bearing headwater streams in western Washington. In the systematic evidence-based review Martin *et al.* (2021) identified only 9 studies that met full inclusion criteria providing empirical evidence concerning the effectiveness of buffering headwaters to maintain stream temperature; of those only one paper (Reiter et al. 2020) was published after 2018. We have also identified the most recently published report by Roon et al. (2021) which uses empirical data to better understand shade, light, and temperature response to riparian thinning treatments in second growth forests of northern California and several publications concerning the dynamics of large wood contributions to small streams in the western Cascades of Oregon (Gregory *et al.* 2003, Meleason *et al.* 2002, and Meleason *et al.* 2013). (Meleason *et al.*, 2002; Meleason *et al.*, 2013). Data extracted from Reiter et al. (2020) and Roon *et al.* (2021) do not contradict CFS shade estimates. The assertion that 90% of the large wood (LW or LWD) contribution for conifer dominated riparian forests less than 200 years old occurs from within the first 30m (33% from within 6m and 50% of the total from within 10m) is supported by source distance models reported by Meleason *et al.* (2013) and McDade *et al.* (1990). This not only reinforces the credibility of the CFS review based on the criteria of rigorous use of best available science regarding headwater riparian buffers in the Pacific Northwest up to 2019 but demonstrates that more recent reports do not contradict the independent functions analysis with the CFS

Contributory: Research that is Original, Relevant and Generalizable

The contributory nature of the independent function evaluations within both the SJ and CFS review is captured within the narrative of the WFFA Proposal Initiation. The evaluations are relevant for policy makers specifically for considering the potential impact to public resources from various riparian buffer management prescriptions. The findings by both authors demonstrate where knowledge gaps exist that contribute to qualitative assignment of "greater than" or "less than" estimated riparian function potential of the proposed management prescriptions when compared to the existing rule prescriptions. Thus, these works can help

TFW Policy prioritize research that addresses some of the remaining uncertainties. For example, prioritizing extensive monitoring is key to giving these and any new proposed management prescriptions the appropriate CONTEXT for understanding how CMER and non-CMER science is being applied to TFW landscapes. The Riparian Characteristics and Shade study specifically aims to clarify how much shade results from a range of stream buffer widths across a range of forest conditions—some of the buffer widths would be specific to the proposed prescriptions if RSAG and CMER include the "add-on" treatments currently in discussion. The 'Smart Buffer" exploratory study being implemented by WFPA members will inform how alternate stream buffers on Np stream could be located for maximum shade benefits relative to reach specific geology and stream aspect.

Communicable: Research that is consumable – structured, understandable and readable

Both the SJ and the CFS review are of high quality in terms of structure and readability. Additionally, the Assessment and Synthesis of the ISPR Review provides a thorough examination of CFS review within the responses to 11 questions. The SJ and the CFS review both provide clear and concise tables summarizing the estimated responses, with explanations of qualitative judgements, for each of the proposed riparian management prescriptions relative to current rule.

Conforming: Research that is Regulatory Aligned, Ethical and Sustainable

Research within the Adaptive Management Program, in general, can be considered adhering to the concept of Conforming. The overarching goal of the SJ and the CFS are to evaluate estimated riparian function to proposed alternate riparian management prescriptions.

Shortcomings

The Independent Functions Evaluation provides a glimpse of the estimated response to the proposed riparian treatments on a function-by-function basis. There is uncertainty around the degree with which the "greater than" qualification by the CFS differs from the "less than" qualification of the SJ (and vise versa) for any given assigned relative response. These assignments appear to be based on the authors' own expertise, judgement, or level of cautiousness specifically based on limited data for 25-foot buffers. These estimates are also difficult to quantify because the hypothesis driving the analysis of function response is based on "relative" not "absolute" effectiveness. We agree that "relative" is an appropriate measure given the very nature of the dynamic system under investigation however, the overall impact of the proposed alternate prescriptions with respect to current Forest Practices rule analogs is impossible to determine without a more thorough understanding of the spatial and temporal application of the alternate management strategies on the landscape.

The data presented within both the SJ and the CFS can be considered generated through quality process using BAS, however as clearly expressed by the CFS and ISPR, additional data and analyses would be necessary to determine if the prescriptions meet the standard of "equal protection." As suggested by ISPR this would involve both an evaluation of how the smaller harvest sizes of SFLO's effect functions and the spatial distribution of SFLO harvests. See further discussion under question 4b.

Answers to Six Questions from **the** CMER / Policy Interaction Framework Document

November 1, 2021

1. **Does the study inform a rule, numeric target, Performance Target, or Resource Objective?** Yes. The Independent Functions Evaluation (IFE) within the Cramer Fish Sciences review of the Scientific Justification of WFFA's proposed alternate riparian forest prescriptions presents the prospective functional performance of the prescriptions relative to the existing forest practices rules.

2. **Does the study inform the Forest Practices Rules, the Forest Practices Board Manual guidelines, or Schedules L-1 or L-2**? Yes. The IFE informs the "at least equal in overall effectiveness" requirement of alternative rules in RCW 76.09.370(3) & WAC 222-12-0401(6).

3. **Was the study carried out pursuant to CMER scientific protocols (i.e., study design, peer review)?**
   The study process was different but at least equivalent. The IFE did not originate from CMER or a Scientific Advisory Group within CMER however, the Cramer Fish Sciences (CFS) review of the Scientific Justification (SJ) for the WFFA Small Forest Landowner Alternate Plan Template Proposal Initiation represents complete and quality science. The CFS review made use of Best Available Science (BAS) to inform the Independent Functions Evaluation specific to the proposed alternative riparian management prescriptions for small, non-industrial forest landowners of western Washington. The independent scientific peer review (ISPR) of the CFS review provides sufficient discussion of the strengths, limitations, and uncertainties presented in the Independent Functions Evaluation section of the CFS review.
   The CFS has a clearly defined purpose and makes use of appropriate methodology to attain the reported results.

4a. What will the study tell us?

Both the SJ and CFS noted that some of the prescriptions (**Table 8** below) resulted in slightly reduced effectiveness due to fewer trees in the RMZ's than required by existing rules, and some prescriptions provide relatively larger increases in effectiveness due to additional RMZ trees along stream reaches that have no existing rule requirements. The ISPR, without considering the typically smaller harvests by SFLO's, indicates that the proposed prescriptions meet the threshold of "pretty close to equal protection." Presumably, the additional near stream buffer trees along the upper Np reaches, where the rules have no buffer tree requirements, generally mitigate for any perceived reduced protection that results from the fewer and more distant trees along type F streams. Also, as stated in the ISPR, the response curves start to flatten beyond 50'. We note, however, that "pretty close" is not the "equal in overall effectiveness" standard in RCW 76.09.370(3) & WAC 222-12-0401(6)—but it may meet that standard when the smaller small landowner harvests are considered. Additionally, ISPR noted that the standard of "equal protection" cannot be shown without additional analysis of the time and space distribution of small landowner (smaller) timber harvest unites.

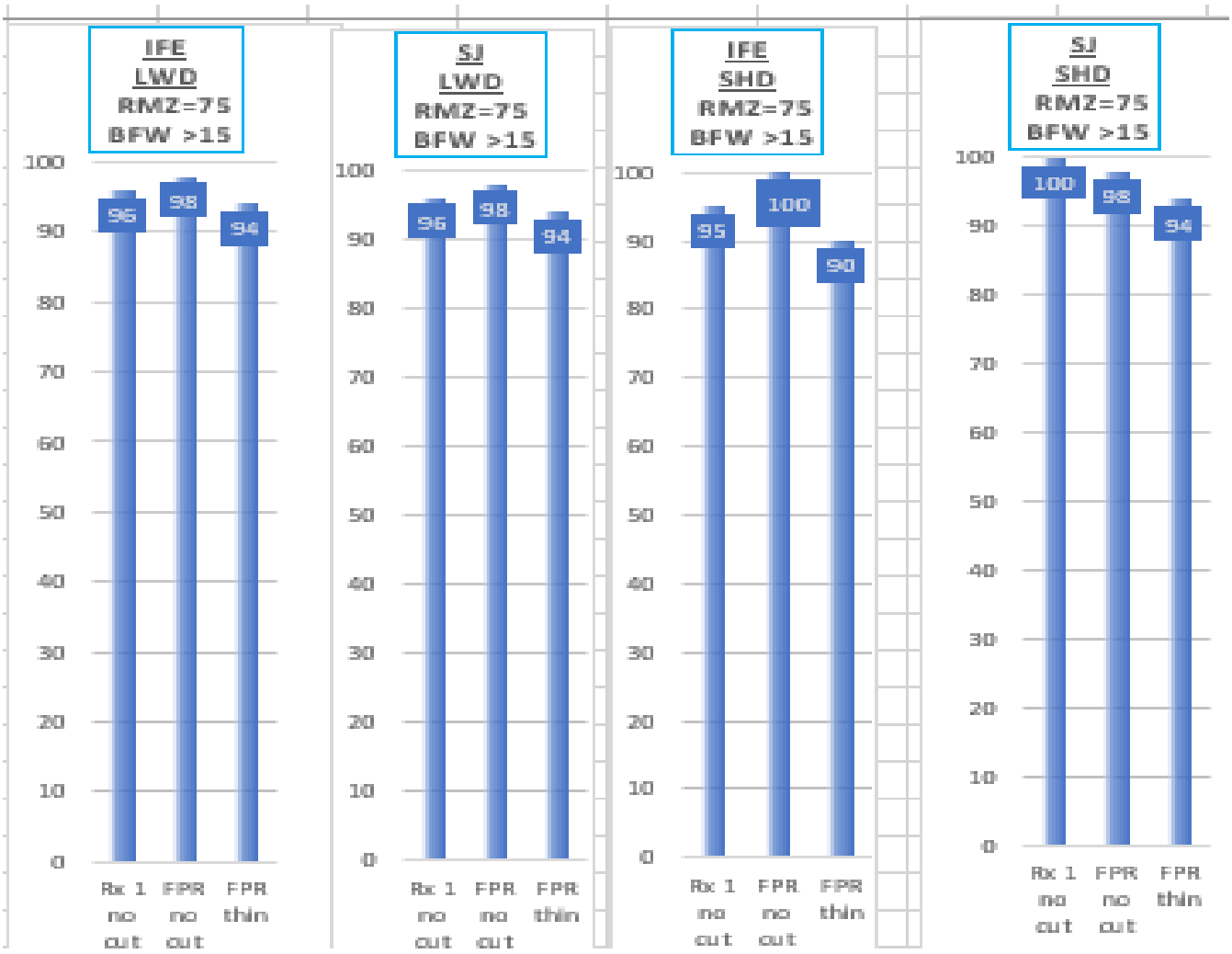
Type F Streams

According to **Table 8** (from CFS and presented below), all prescriptions for fish-bearing streams—WFFA and FPR analogs—would provide less than maximum riparian function. Function provided by WFFA prescriptions would most often be lower than that provided by their FPR analog, but to varying degree distinguished by whether the WFFA prescription uses a 25-ft fixed-width no-harvest buffer.

The following series of charts present the data from Table 8 of the Independent Functions Evaluation (IFE) and Table 3 of the Scientific Justification (SJ) that show the Large Woody Debris and Shade relative differences between the SFLO prescriptions (Rx) and the existing rules (FPR).

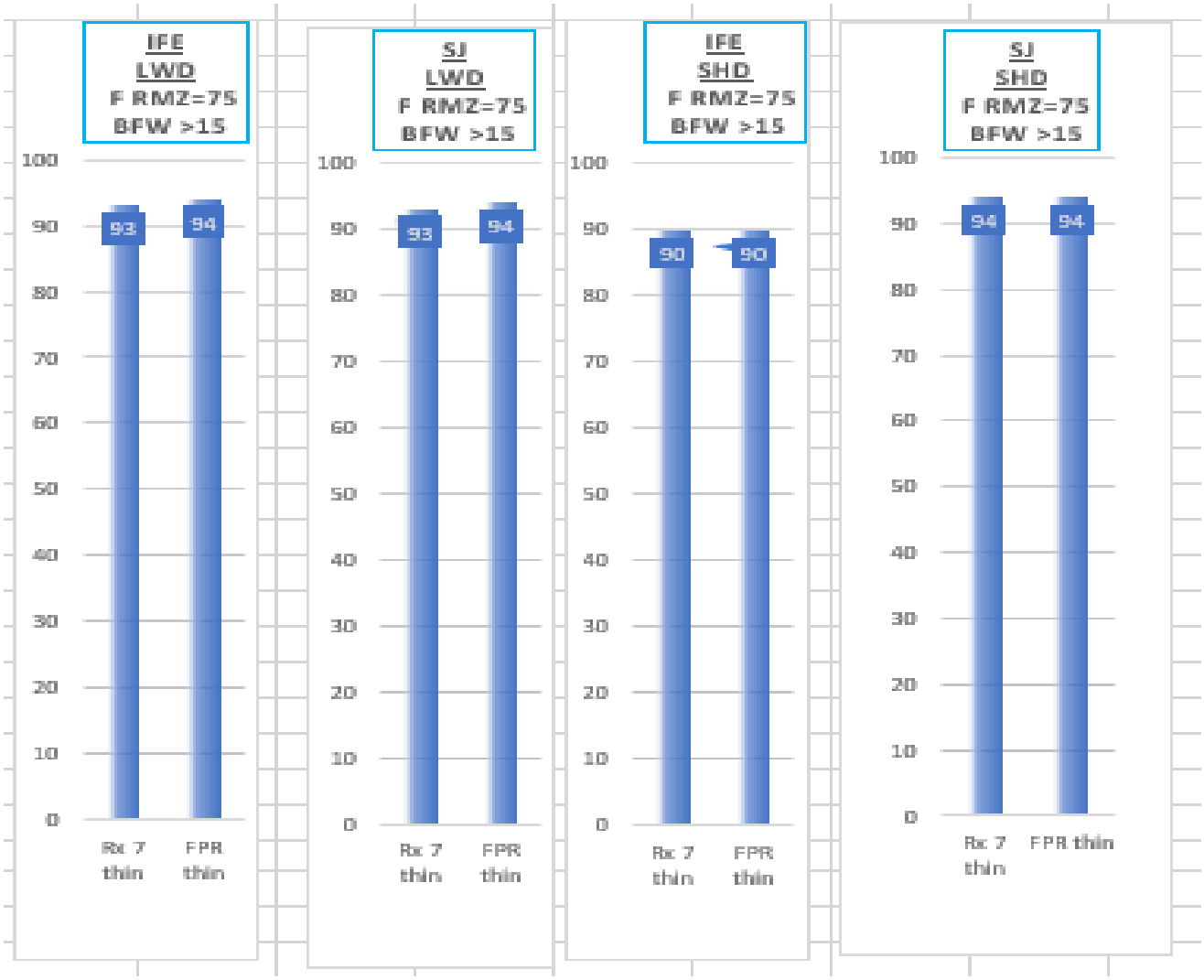
Large Woody Debris and Shade for 75' no cut and forest practices thinned buffers.

Rx1 BFW >15



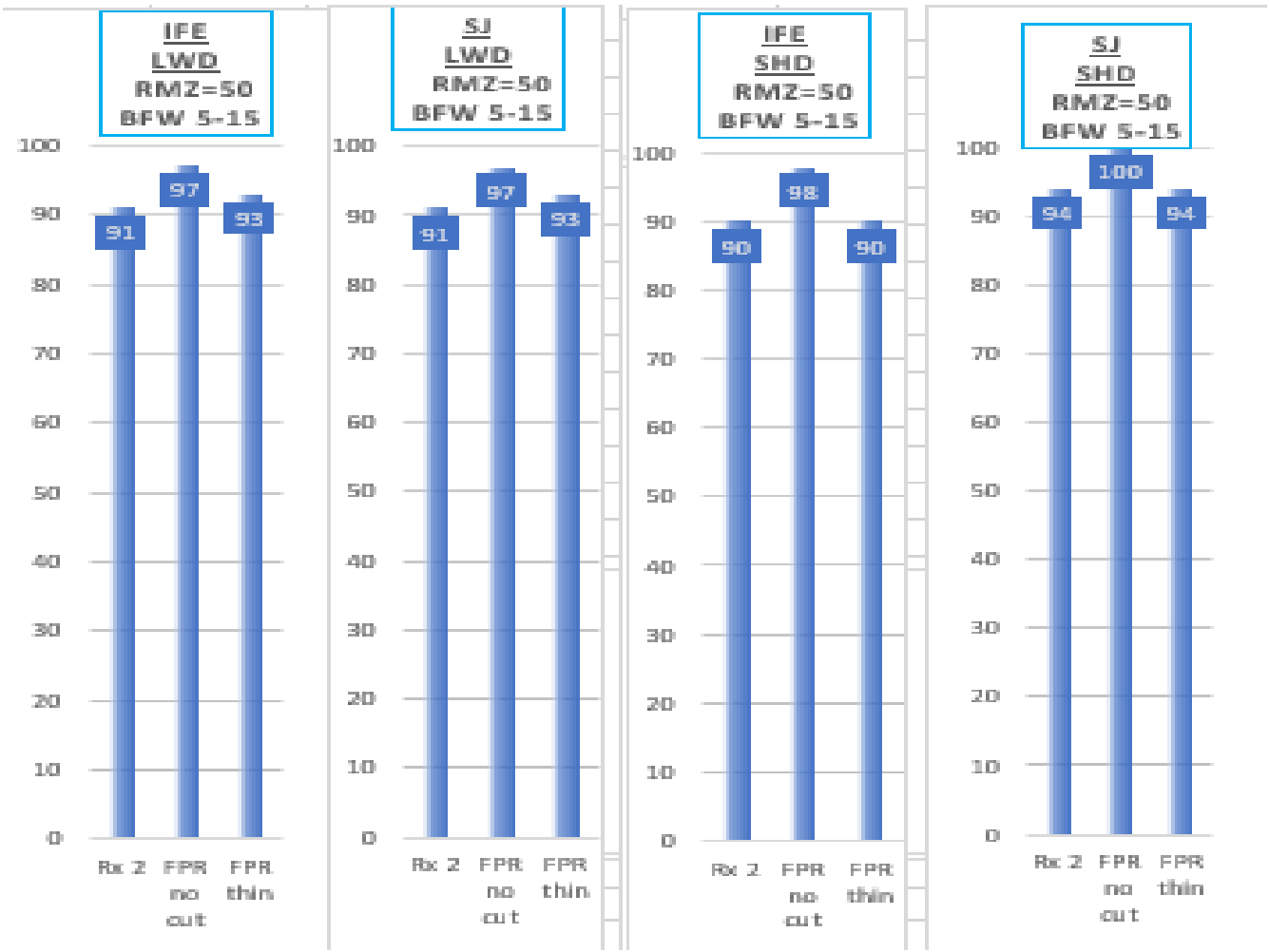
Large Woody Debris and Shade for 75' no cut and prescription thinned buffers.

Rx7 BFW>15



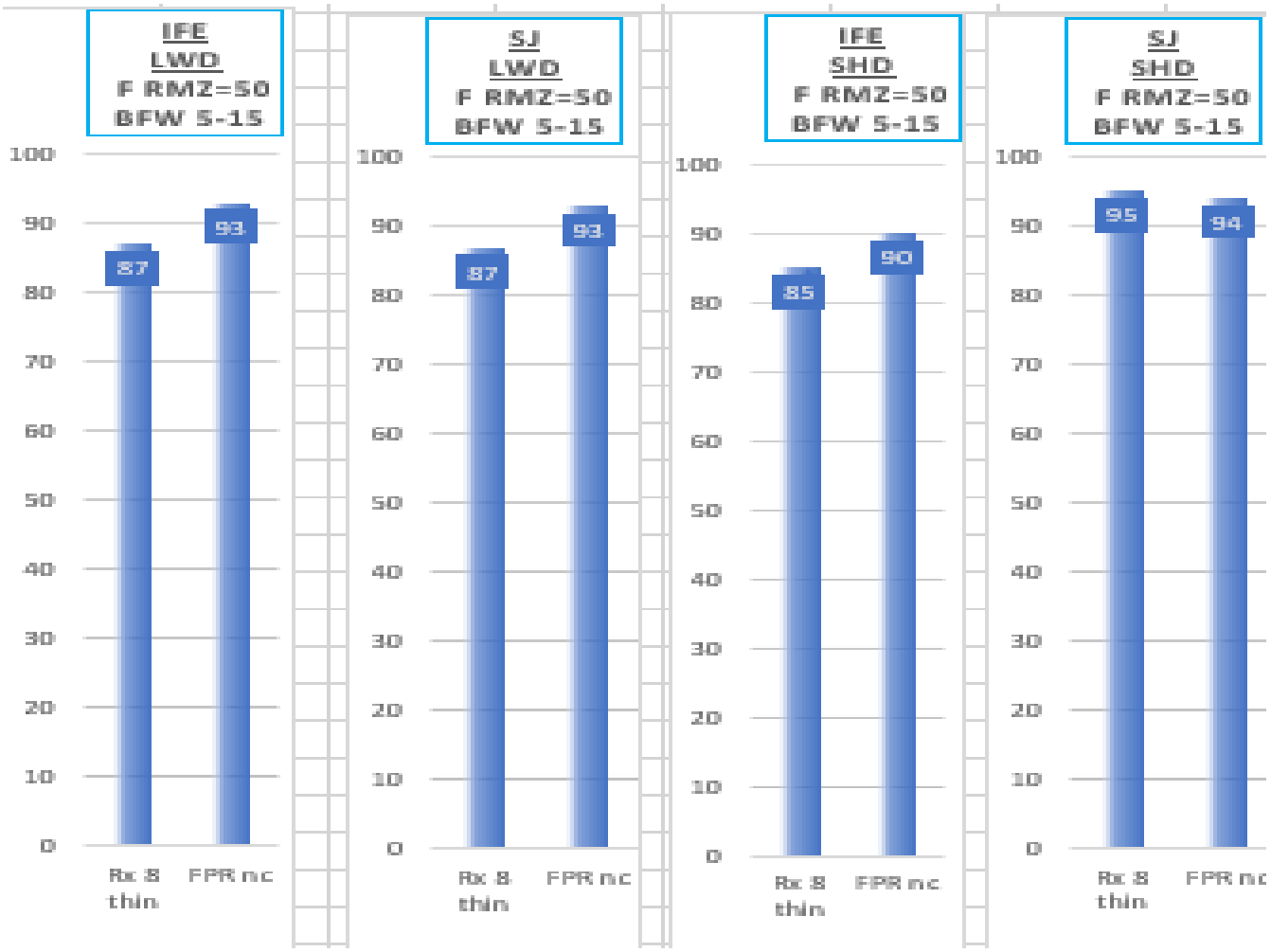
Large Woody Debris and Shade for 50’ no cut and forest practices rule thinned buffers.

Rx2 BFW 5-15’

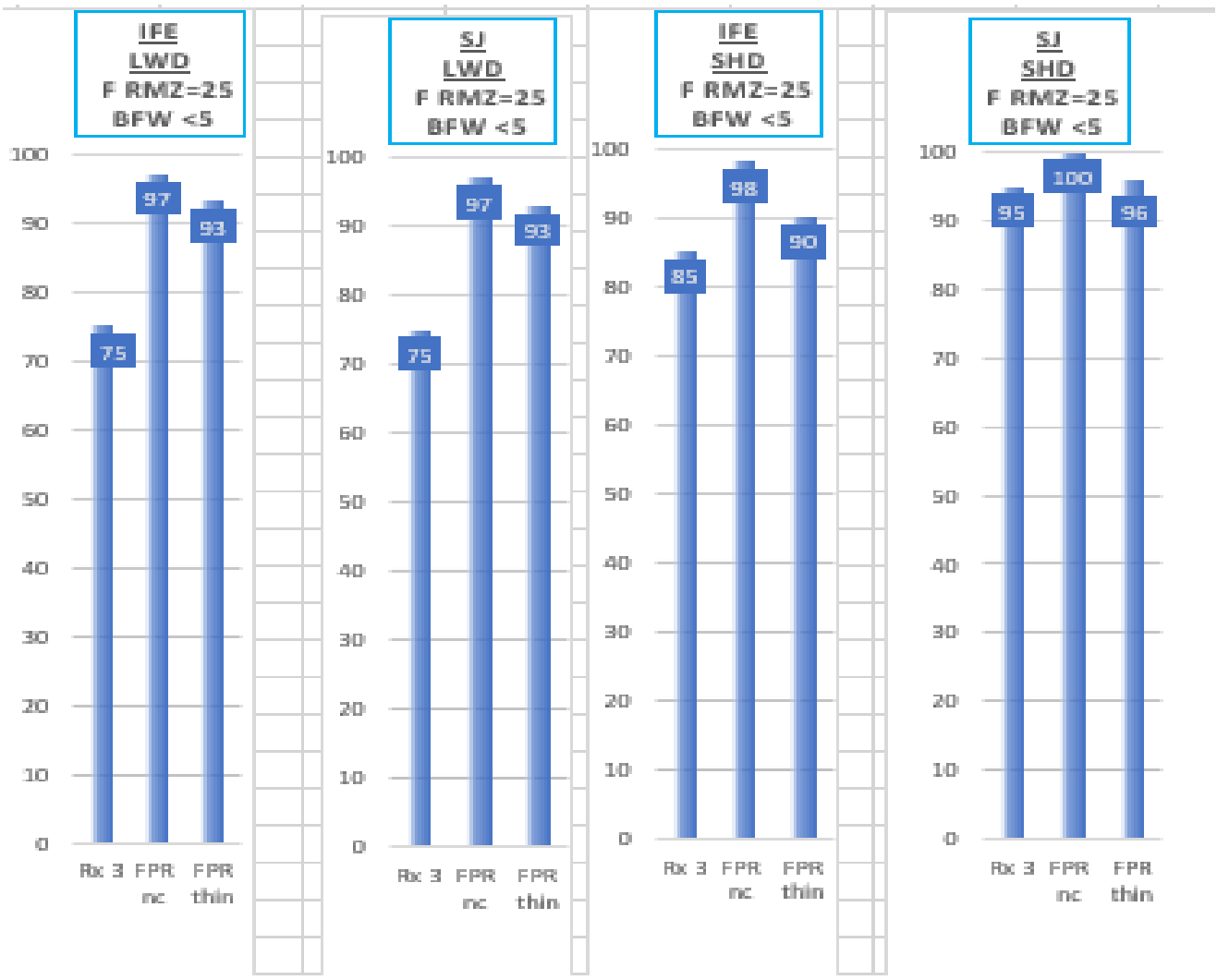


Large Woody Debris and Shade for 50’ prescription thinned buffers.

Rx8 BFW 5-15’



Large Woody Debris and Shade for Type F 25' no cut and forest practices rule thinned buffers Rx 3 BFW<5'

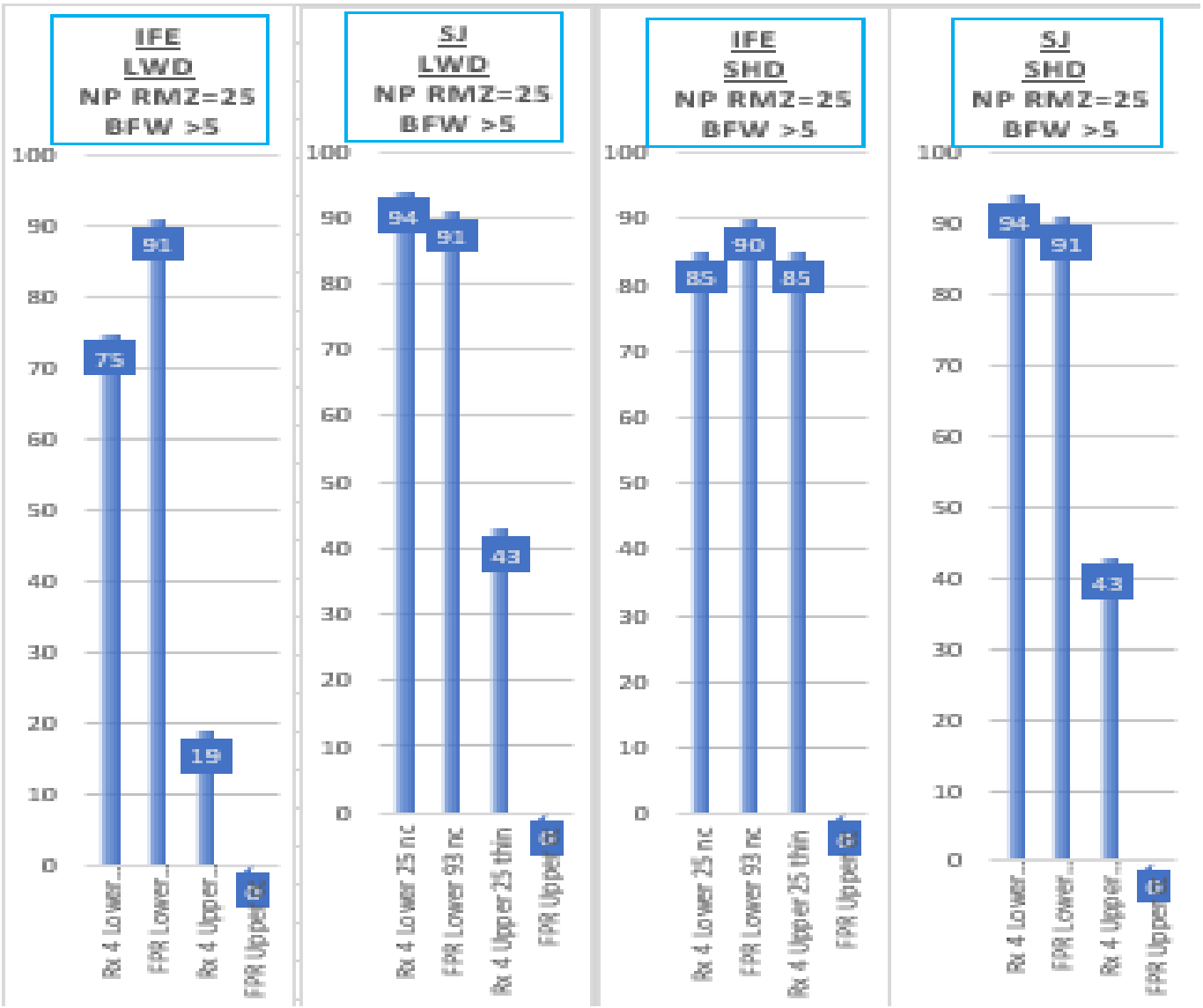


Type Np Streams

According to **Table 8**, all prescriptions that apply to perennial non-fish-bearing streams—both the WFFA and the FPR analogs—would provide less than maximum riparian function. Comparisons between the sets of prescriptions are mixed depending on the use of fixed-width buffers: when buffers are employed by the FPR prescriptions, they provide greater function than the buffers proposed by WFFA, but when buffers are not employed by the FPR prescriptions, they provide near zero function while the WFFA prescriptions provides some.

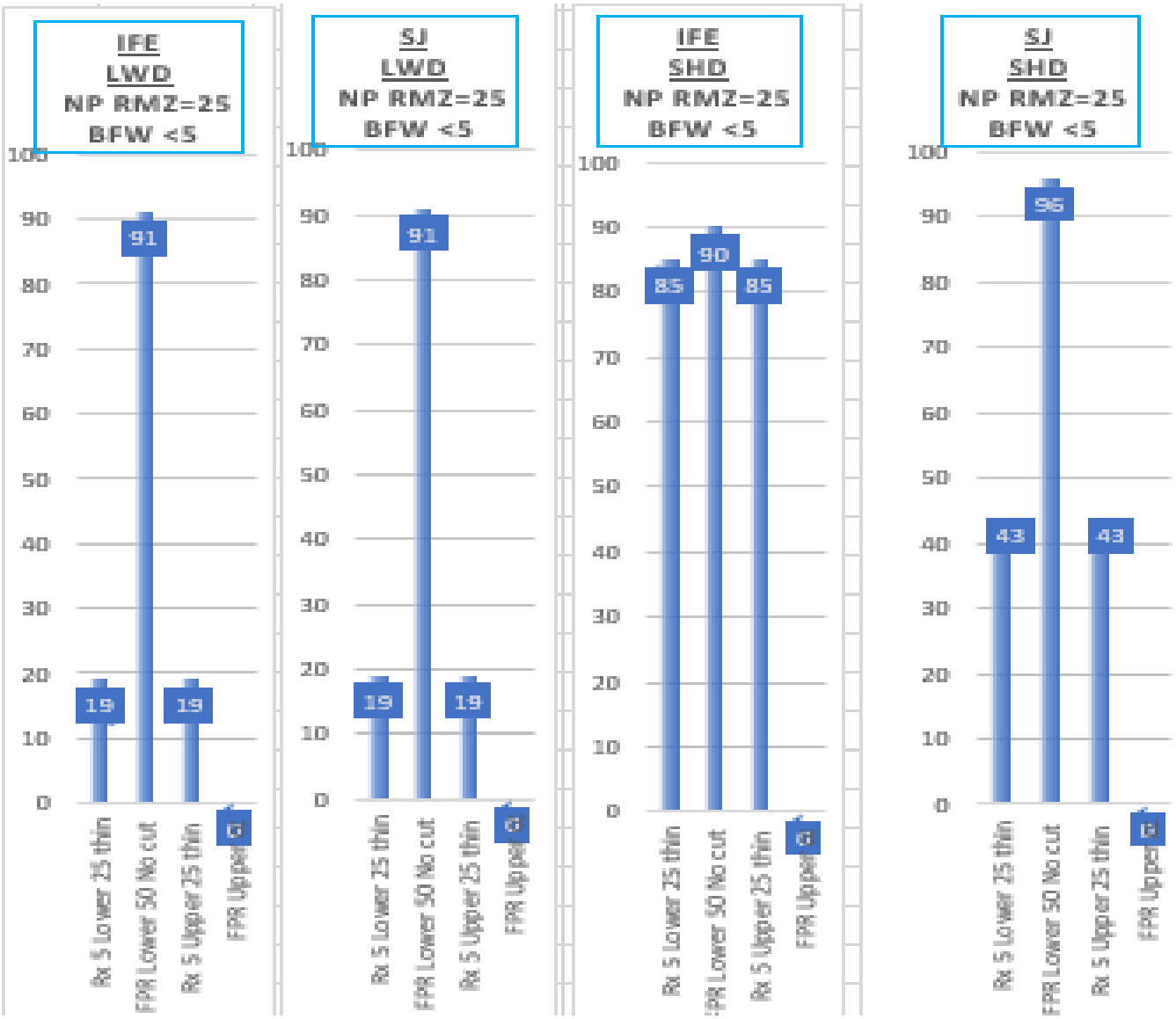
Large Woody Debris and Shade for Type Np 25' no cut and thinned buffers.

Rx4 BFW>5'



Large Woody Debris and Shade for Type Np 25' no cut and thinned buffers.

Rx5 BFW<5'



Type Ns Streams

Riparian function provided by the WFFA prescription for Type Ns streams (Rx No. 6) would be comparable to that provided by the Forest Practices rules, but both prescriptions provide no LWD recruitment, very little shade, very little leaf and litterfall, very little sediment filtration, significantly greater sediment delivery than buffered treatments, and little protection of streambank stability. This overall finding does not differ from the WFFA function evaluation.

Shown below are Table 8 from the Cramer Independent Functions Evaluation and Table 3 from the Scientific Justification.

Where the estimates are the same or similar, we are confident that they are accurate. Where they differ, we favor the IFE estimates in table 8. This is because the IFE used more studies, more current studies, did not use a model for shade estimates, considered windthrow, and had a robust ISPR.

Table 8: Comparison of riparian function potential predicted from WFFA template prescriptions to Forest Practices rule prescriptions based on findings of the independent function evaluations in the Review section. See "WFFA Template Proposal – Scientific Justification" for a complete explanation of WFFA and Forest Practices rules prescriptions. (Copied from page 47, Small Forest Landowner Alternate Plan Template Review, 2019)

Rx No.	Stream Type	WFFA Riparian Function					FPR Riparian Function				
		LWD	SHD	LIT_1	SED_2	SB_3	LWD	SHD	LIT_1	SED_2	SB_3
1	F	<96%	95%	a	b	a	<94% - <98%	90% - 100%	a	a - a/c	a
2	F	<91%	90%	a	c	a	<93% - <97%	90% 98%	a	b - b/c	a
3	F	<75%	85%	b	d	b	<93% - <97%	90% 98%	a	b - b/c	a
4	Np	<75% /<19%	85% / 85%	b	d	b	<91% / 0%	90% / 0%	a/c	c/e	a/c
5	Np	<19%	85%	b	d	b	<91% / 0%	90% / 0%	a/c	c/e	a/c
6	Ns	>0%	>0%	c	e	c	>0%	>0%	c	e	c
7	F	<93%	90% / 95%	a	b/c	a	<94%	90% / 100%	a	a/c	a
8	F	<87%	85% / 90%	a/b	c/d	a/b	<93%	90% / 98%	a	b/c	a

Notes:

1- Leaf and litterfall:

a. would likely be greater than or equal to that from unharvested stands
b. has not been observed for buffers smaller than 10 m
c. would be measurable, but less than that from 10 m buffers

2- Sediment:

a. filtration would generally be 80 percent and delivery would likely be zero
b. filtration would generally be less than 80 percent and delivery would likely be zero
c. filtration would be less than that from a 75-ft buffer and the buffer would likely have very low soil disturbance
d. filtration or delivery effectiveness has not been observed for 25-ft buffers
e. filtration would be less than that provided by a 25-ft buffer and delivery would be significantly greater than that from buffered treatments

3- Streambank stability:

a. is likely protected with fixed-width buffers 50 feet and wider
b. has not been observed with use of 25-ft fixed-width buffers
c. would likely have no protection as deep-penetrating roots decay

Table 3. Comparison of riparian function potential between proposed and Forest Practices Rule (FPR) prescriptions. In FPR type F streams, function effectiveness is evaluated for both the "no inner zone" and "thin from below" options for Site Class 3, respectively. See Table 2 caption for description of prescription codes.

		Riparian function potential									Riparian function potential							
Prescription No.	Stream Type	BFW (ft)	RMZ (ft)	Prescript.	Shade	LW	Sed.	Litter	Invert	Long. Cont.	BFW (ft)	Prescript.	Shade	LW	Sed.	Litter	Invert	Long. Cont.
		Standard Prescription									FPR Prescriptions							
1	F	>15	75	75/nc	max	> 96%	H	H	L	Y	>10	105/nc[c]	max	> 98%	H	H	L	Y
											>10	50/nc, 105/hth	> 94%	> 94%	H	H	L	Y
2	F	5-15	50	50/nc	> 94%	> 91%	H	H	L	Y	<10	93/nc	max	> 97%	H	H	L	Y
											<10	50/nc, 93/hth	> 94%	> 93%	H	H	L	Y
3	F	<5	25	25/nc	> 95%	> 75%	H	H	L	Y	<10	93/nc	max	> 97%	H	H	L	Y
											<10	50/nc, 93/hth	> 96%	> 93%	H	H	L	Y
4	Np	>5 ft	25	25x300/nc 25/tha	> 94% 43%[a]	> 75% > 19%[b]	H H	H H	L H	Y Y	NA	50x50%/nc 50%/cc	> 94% >0	> 91% slash	H M	H L	L M	Y N
5	Np	<5 ft	25	25/tha	43%[a]	> 19%	H	H	H	Y	NA	50x50%/nc 50%/cc	> 96% 59%[d]	> 91% slash	H M	H L	L M	Y N
6	Ns	NA	0	30/elz	>0	slash	M	L	M	N	NA	30/elz	>0	slash	M	L	M	N
		Thinning Prescription									FPR Prescriptions							
7	F	>15	75	50/nc, 75/hth	> 94%	> 93%	H	H	L	Y	>10	50/nc, 105/hth	> 94%	> 94%	H	H	L	Y
8	F	5-15	50	25/nc, 50/mth	> 95%	> 87%	H	H	L	Y	<10	50/nc, 93/hth	> 94%	> 93%	H	H	L	Y

[a]Shade in upper portion of Np reach based on cms stands (i.e., 25% density)

[b]Assume 75% supply potential for a 25-ft buffer which is reduced by 25% stand density (i.e., 0.25 x 0.75 = 0.19)

[c]Top and bottom cell Rx's are no-inner-zone-harvest and thin-from-below, respectively

[d]Base on mean canopy cover for headwater streams with slash (see Appendix A).

4b. What will the study not tell us?

While RCW 76.13.100(2) acknowledges that SFLO's have smaller harvest units, neither the IFE nor the SJ provide any documentation regarding the size of small landowner timber harvest units.

Neither the SJ, CFA, IFE, nor the ISPR show that the prescriptions meet the RCW/WAC standard of "equal in overall effectiveness" unless the smaller SFLO harvests are demonstrated or assumed "as hypothesized in RCW 76.13.100(2)".

Neither the IFE nor the ISPR demonstrated "equal protection" because the space and time distribution of SFLO harvests has not been done.

While the IFE considers windthrow there is still much uncertainty regarding the extent of wind impacts on RMZ trees through time and space. The Type N Hard Rock had the unfortunate experience of a near record windstorm so the responses to the forest practices treatments may differ from normal wind patterns. The studies included in question 5 suggest that windthrow impacts, while they do exist, my be much less of a concern than suggested in the Hard and Soft Rock studies.

The Cramer Fish Sciences (CFS) review provided a technical assessment of the SJ through conducting an independent Best Available Science (BAS) review and evaluation of the proposed riparian prescriptions. The CFS Review critique of the SJ was itself reviewed through an ISPR process. Common criticism given by ISPR as expressed by Reviewer 3 is that neither the SJ nor the CFS review specifically address the context of "where and when on the landscape these timber harvest might occur." Though the SJ does attempt to provide spatial context through a comparison of "the prescription width categories to channel width data from the CMER extensive temperature studies (Peter and Engeness 2014);" a more detailed inventory of small forest landowner units eligible for the proposed prescriptions is necessary to gain an understanding of the potential impacts of the proposed prescriptions on the landscape over time.

The purpose of the WFFA proposed alternate prescriptions is to provide landowners with options that are "equal in overall effectiveness." This concept is not well defined in the documents reviewed by CMER in this effort.

The concept of equal in overall effectiveness is arguably a POLICY matter determined after careful analysis and consideration of the combined impacts to the independent riparian functions. The combined effects are not addressed in either the CFS or the SJ. Further, the comparison is presented as "relative" not absolute. The ISPR panelists address this concept indicating that even with the spatial and temporal activities of the small forest landowners defined, comparing this to the general managed landscape is problematic and likely to not

reveal any statistically or discernable differences in response to different riparian management prescriptions.

5. Other Completed Relevant Studies.

We recognize the findings of the Independent Functions Evaluation (within the CFS review) to be supported by BAS given recent research reporting on empirical data published since 2018. The referenced studies presented here, do not provide findings that explicitly contradict the estimations presented by the CFS in Table 8. Several of these studies were considered in the IFE. We include them here because they are several of the most important studies regarding LWD source distances.

Roon, et.al. 2021. "Shade, light, and stream temperature responses to riparian thinning in second growth redwood forests of northern California."

This study used a Before-After-Control-Impact (BACI) design with one year pretreatment and one year post treatment measurements. The riparian forests were 40 to 60-year-old natural regenerated second growth. Three headwater stream sites were commercially thinned to remove either 40% or 50% basal area. Riparian shade, solar radiation and stream temperatures were measured.

While the 50% thinning showed significant temperature increases within and downstream, the 40% thinning showed no stream temperature responses in thinned or downstream reaches.

The up to 40% basal area removal by thinning to the stream edge is a heavier RMZ harvest than all of the proposed prescriptions except the 25' thinned RMZs on the upper reaches of prescriptions 4 and 5. This suggests that the shade reductions resulting from the SFLO prescriptions are not likely to result in a measurable water temperature response. We recognize that the additional trees along the upper reaches of Np streams in prescriptions 4 and 5 are effectively a heavier thinning than the 40% tested in this study. We note, however, that these additional trees are along the upper Np reaches that currently have no leave tree requirements under the current rules.

Johnson, et. al. 2001. "Mechanisms and source distances for the input of large woody debris to forested streams in British Columbia, Canada." This was a synoptic survey of 51 randomly selected stream reaches in undisturbed mature or old growth forests in central British Columbia. Figure 2 indicates that windthrow provides little to no LWD depending on stream size and channel morphology. We note that all trees from all distances were included. Figure 4 indicates more than 90 % of LWD for each source originates from about 20 meters ground distance. Also, there is a continuous, but very small, LWD contribution from windthrow as the windthrow source curve nears to 100%.

Fig. 4. Cumulative distributions of source distances for the input of large woody debris pieces to all 51 stream reaches differed among input mechanisms. The distance axis has been truncated at 40 m; a few pieces of large woody debris originated at distances up to 65 m in our samples. The rank ordering of the median source distances was (left to right) bank erosion < tree mortality < stem breakage < windthrow < landslides.

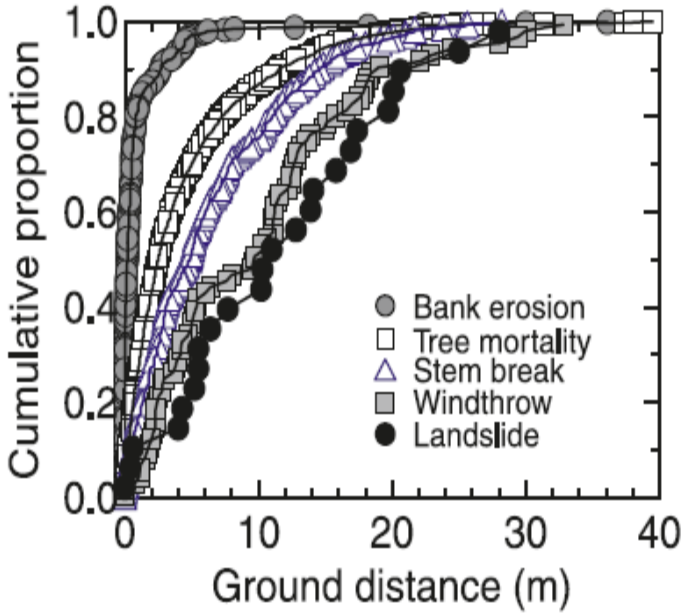
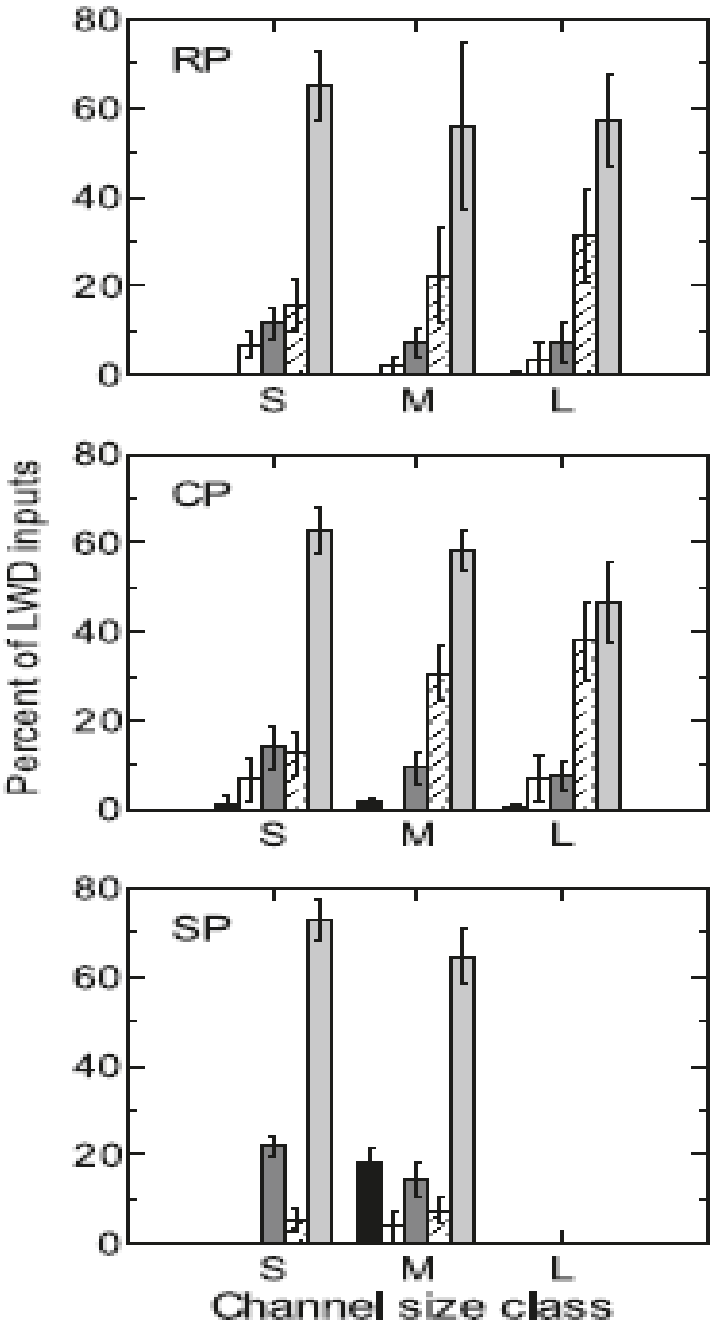


Fig. 2. Mean (±1 SE) percent of large woody debris (LWD) pieces by input mechanism and channel size category for riffle-pool (RP), cascade-pool (CP), and step-pool (SP) channel types. Input mechanisms (from left to right): landslides (black), windthrow (white), stem breakage (dark grey), bank erosion (cross-hatched), and standing dead fall (light grey). Channel categories: <3.3 m (small (S)), 3.3–10 m (medium (M)), and >10 m (large (L)) bankfull width.



Benda and Bigelow 2013. "On Patterns and processes of wood in northern California streams."
This study finds that the distances to sources of stream wood are controlled by recruitment processes and tree height. Figure 6 (D) of that report indicates, similar to Johnston Figure 4, that approximately 90% of wood volumes for managed Cascades conifer forests originates from about 10 meters and nearly 100% from about 15 meters source distance. Volumes for coastal watersheds are measurably less. However, "Average wood storage volumes in coastal streams are 5 to 20 times greater than inland sites primarily from higher riparian forest biomass and growth rates (productivity), with some influence by longer residence time of wood in streams and more wood from land sliding and logging sources."

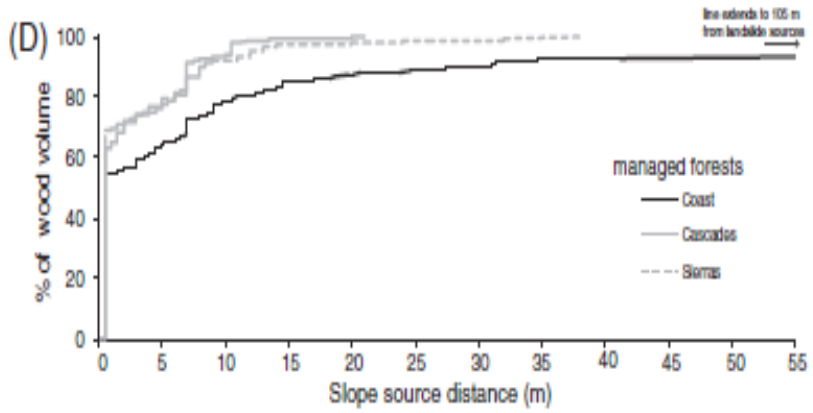


Fig. 6. (A) Conceptual planform of wood recruitment zones based on source distances for reaches dominated by various recruitment processes. The varying source distances have implications for the design on streamside protection areas. (B) Distances to sources of stream wood in Sierra reaches with different dominant recruitment processes (bank erosion, mortality, landsliding, and forest management). (C) Distances to sources of stream wood in less-managed and unmanaged forests. (D) Source distance in managed forests of the coast, Cascade, and Sierra regions. Data includes all recruitment processes including mortality, bank erosion and landsliding; landsliding occurs in coast unmanaged, coast less-managed, Klamath less-managed, and coast and Sierra managed groups.

CMER Hard Rock. We note that CFS considered the two-year results of the Hard Rock study. Here we report the results of the study post 8 and 9 years from harvest. This study used a BACI study design to evaluate the response to the existing forest practices rule for Np streams in western Washington. Three non-random sites were paired with matching reference sites. The study focused on average responses across all sites and did not report on differences between sites. Additionally, it experienced a highly unusual wind event that likely caused similarly unusual windthrow and subsequent shade windthrow measurements. *

Canopy closure decreased by 32% 3 years after timber harvest and had recovered to 27% by nine years after timber harvest. Cumulative mortality at year 8 was over 50%. In-channel large wood, predominately from windthrow, continued to increase through year 8. While discharge increased in all treatments after harvest, suspended sediment export events were episodic, poorly correlated with discharge, and not synchronized across all sites, suggesting they were unrelated to harvest. For many metrics, the magnitude of harvest-related change observed for a given treatment diminished over time.

**We note from Wikipedia "The Great Coastal Storm of 2007 was a series of three powerful Pacific storms that affected the U.S. states of Oregon and Washington and the Canadian province of British Columbia between December 1, 2007 and December 4, 2007. The storms on December 2 and 3 produced an extremely long-duration wind event with hurricane-force wind gusts of up to 137 mph (220 km/h) at Holy Cross, Washington on the Washington Coast, and 129 mph (208 km/h) at Bay City, Oregon on the Oregon Coast.[1][2] The storm also brought heavy rains and produced widespread record flooding throughout the region, and was blamed for at least 18 deaths.[3][4]*

CMER Soft Rock. This study had the same fundamental design as the Hard Rock study. Seven treatment sites and three references sites were located in the Willapa Hills region of southwest Washington. These sites were not randomly selected. One or two years pre and two or three years post-harvest measurements were completed.

The mean pre harvest canopy closure across all test sites was 96%. At post three it was 77% with a range of 38% to 97% reflecting the proportions of each site that were buffered and unbuffered per the Type N rule. Cumulative tree mortality basal area across all sites was 28.5 relative to 3.3 on the reference sites. Tree mortality was attributed to wind. This study also included the following table comparing the mortality (tree count not basal area) with other studies.

As expected, suspended sediment export was greater in the Soft Rock Study than in the Hard Rock Study owing to the different lithologies, but increased discharge and a more erodible lithology did not translate into greater post-harvest sediment export in the two treatment sites relative to export in the two reference sites

Martin, et.al. 2021. "An evidence-based review of the effectiveness of riparian buffers to maintain stream temperature and stream-associated amphibian populations in the Pacific Northwest of Canada and the United States." This study employed a systematic evidence review to evaluate empirical scientific evidence for the effectiveness of buffering headwater (typically non-fish-bearing) streams to maintain stream temperature and stream-associated amphibian populations in the Pacific Northwest of Canada and the United States. To address our synthesis objective, we identified thirteen temperature, seven amphibian, and two temperature/amphibian primary research studies that met objective inclusion criteria.

The evidence also indicated that variation in temperature response among studies may be associated with multiple factors (geology, hydrology, topography, latitude, and stream azimuth) that influence thermal sensitivity of streams to shade loss. Collectively, our results indicate that evidence is weak to address questions most relevant to policy discussions concerning effectiveness of alternative riparian management schemes.

Additional Studies That Could be Completed

As recommended by ISPR, a GIS analysis of the distribution of small landowner harvests could inform the "equal protection" issue.

An analysis of the DNR Forest Practices Database could very easily inform the size of small landowner timber harvests that would inform the "equal in overall effectiveness" (RCW 76.09.370(3) and (WAC 222-12-040(1) & (6)) and "relatively low impact" (RCW76.13.100(2) and (WAC 222-12-040(2) issues.

Both the CMER Hard Rock and Soft Rock studies have additional years of temperature data that is awaiting analysis and reporting. These data will tell if the temperature recovery trends in these two studies continue.

The CMER Riparian Characteristics and Shade study, currently working through the CMER process, will inform our understanding of between site variability of shade and water temperature.

A CMER 'state-wide' extensive monitoring program could inform the frequency, size and distribution of RMZ windthrow events.

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?

This question doesn't apply here because the focus of the IFE is on the relative to the existing rules functions of the proposed prescriptions. If the rules change then the results reported here may no longer be valid.

If not already done so within the answers to the six questions above, provide the technical implications/recommendations resulting from the study.

An important issue, not discussed very well in the SJ, by CFS, the IFE or ISPR, are the stream miles distances that would receive the various prescriptions. Since headwater streams, that would have RMZ trees that are not in the current rules, are much more abundant than lower watershed reaches, that have prescriptions for fewer RMZ trees, the overall results may meet the standard of "equal in overall effectiveness."

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