Riparian Characteristics and Shade Response Experimental Research Study Draft Scoping Document

The Riparian Science Advisory Committee (RSAG)

July 12, 2018

Genesis for Study

RSAG recognized:

1. Protecting stream temperature is a priority of the forest practices rules,
2. Managing shade is how the rules protect stream temperature, and
3. That the strong relationship between shade and stream temperature provides the AMP with an opportunity:

- It is substantially quicker and less costly to test how riparian prescriptions affect stream shade then stream temperature.
- We can compare prescriptions against each other, *and* against levels of shade having known temperature effects.

Issue/Problem Statement (*simplified*)

Washington's forest practices regulations include no-harvest buffers of varying width that are used alone or applied in combination with adjacent zones where thinning is allowed.

No study has been identified which examines a well replicated range of riparian harvest treatments on stream shade across a broad range of forest types applicable to Washington State.

Field research is particularly limited examining how changing the width of no-cut buffers along streams effects the ability to thin the adjacent riparian stands without detrimentally affecting stream shade...

Purpose

The purpose of this study is to quantify how stream shade responds to a continuum of buffer management treatments of varying intensity across a range of stand types (or geo-physiographic regions) common to commercial forestlands covered under the FPHCP.

The results would strengthen the ability of the AMP to interpret and respond to ongoing and future effectiveness monitoring studies that directly test both shade and temperature.

(*Continued*)

Purpose - ***Continued***

The data collected on buffer and stand characteristics would also be used to test and make improvements to Ecology's SHADE.xls model.

This would further expand our ability to estimate the response of shade to an even broader range of treatment prescriptions, including alternative prescriptions, over a broader range of riparian forest types and conditions than what we can test directly.

Objectives

1. To determine the effect of varying buffer width and the intensity of management (i.e., thinning) within the buffer on shade provided to adjacent streams.
2. To determine relationships between stream shade and common forest-stand metrics (*e.g., mean canopy height, crown ratio, relative density, trees per acre, basal area per acre*).
3. To refine and calibrate Ecology's stream shade *(SHADE.xls)* model to improve application across the range of buffer configurations and timber stand types common to commercial forestlands in Washington.

Critical Questions

Two questions focus on the direct response to shade:

1. How does stream shade change in response to a range of no-cut and thinned buffer zones used alone and in combination?

2. How does the shade provided by the tested buffer configurations vary by stand type (*e.g., Douglass fir, hemlock-spruce, Ponderosa pine*)?

(*Continued*)

Critical Questions - *Continued*

Two additional questions focus on underlying processes and modeling:

3. What stand metrics (*e.g., stand height, relative density, trees per acre, basal area, and crown ratio*) alone or in combination, are the best predictor of shade and light attenuation; and how do these predictor variables vary by stand type?

4. What parameter input values and/or changes in the Ecology SHADE.xls model (*e.g., canopy density, light extinction, stream overhang*) would improve prediction accuracy for timber stand types common to commercial forestlands?

Alternative Study Designs - Overview

Alternative 1: Least costly option that **meets all the study objectives**.

Alternative 2: Same as alternative 1, except it includes more exploratory analysis and includes making any warranted changes to the shade model.

Alternative 3: Is a two-phased study focused on model refinement.

Alternative 4: Is a basic buffer shade study that uses only as-found buffer widths.

**CMER did not provide a recommended option, but support was only voiced for Alternatives 1 and 2 since they meet all objectives - also the reason why they are the focus of this presentation and scoping document.*

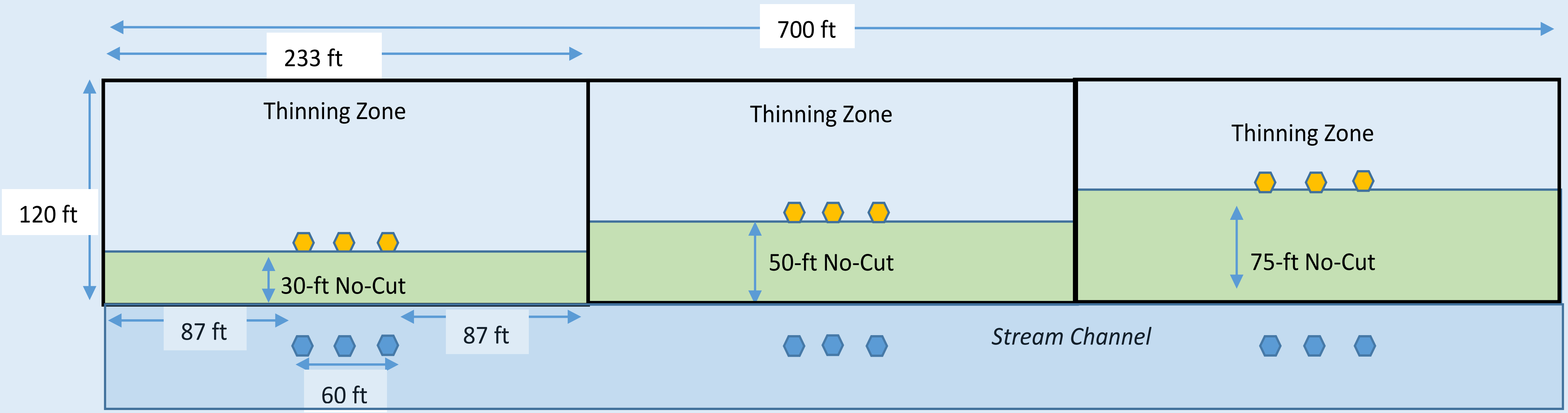
Alternative Study Designs

Alternative 1: Uses a well-controlled and replicated field study to firmly establish relationships between stream shade and the use of no-cut buffers of widths common to the rules when applied both alone and in combination with adjacent stand-thinning harvests of varying intensity.

Alternative 2: Uses the same field study design as Alternative 1 but includes more direct measurements of canopy density and light extinction along with a broader range of descriptive stand metrics affecting canopy density. It also includes the task of making changes to the SHADE.xls model.

Alternative 3: Is a two-phased study in which the first phase (described herein) is focused on identifying and making refinements to the shade model using data from existing RMZ's representing a range of forest types and harvest conditions, and the second phase (un-scoped) would test the validity of the model and any specific prescriptions of policy interest.

Alternative 4: Use a rigorous field study to firmly establish relationships between stream effective shade and existing no-cut buffers widths across a range of forest types.



Alternatives 1,2 use the same study frame:

- Five sites in each of four different stand types (*or physiographic regions*).
- Within each of these 20 sites, three study plots will be established. Within each plot, two thinning treatments and a clear-cut treatment will be applied sequentially.
- Design tests three stream adjacent no cut buffers, and up to two plot width buffers
- With shade monitoring both at the stream as well as the edge of the no-cut buffer a total of 16 prescription variants can be assessed at each site.

No-cut zones:

- **30 ft** – Eastside Core zone, common in research, BAS suggests allows more thinning
- **50 ft** – Westside Core zone, Type Np RMZ's statewide, common in research
- **75 ft** – Eastside small Type F (Inner + Core), BTO all available shade zone, shade rule

- **Maximum Plot Widths** (*still a critical study design decision*):
  - **100 ft** - Eastside large Type F and large Westside floor, common in research
  - **120 ft** – Typical Westside post-harvest packed buffers are less

Considered thinning to the stream, and using a 25 foot no-cut to create even no-cut intervals (25-50-75-100) – but higher project cost, less connection to rules, and less support in BAS.

Final decisions made in the study design phase and after consultation with Policy.

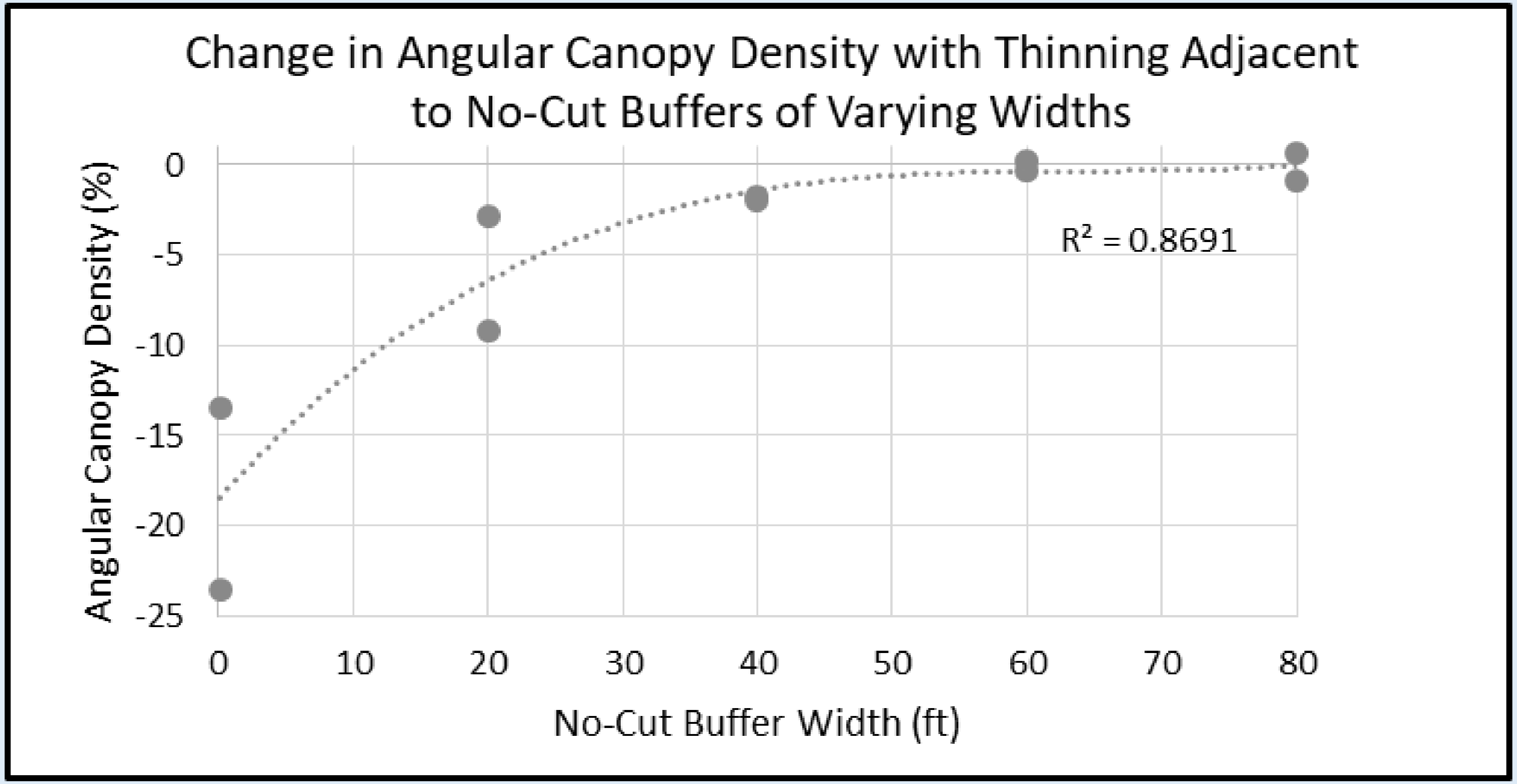
Thinning Treatments:

Light – 100 TPA or 100 ft^2/ac BA

Moderate – 50-57 TPA or 70 ft^2/ac BA

Clear cut – 100% removal (to test shade from the no-cut zones)

Figure 2. Example of the type of empirical results provided by Alternative 1 and Alternative 2. Figure shows how shade changes with alterations in the width of a no-cut buffer left along a stream adjacent to an overstocked riparian forest after thinning it to a target condition (adapted from Park et al. 2008).



Note: This type of graphical analysis would be further supported by statistical analyses comparing individual prescription variants between blocks and stand types as well as comparing the response curves for each thinning treatment.

Benefits of both Alternative 1 and Alternative 2 include:

(Benefits, limitations, and project risks are described in the scoping document for all four Alternatives)

- **Informative**:
  - Directly tests shade for a range of no-cut buffer widths in rule.
  - Informs policy makers on the consistency of the shade response to riparian management across stand types and geographic regions in Washington.
  - Produces a series of tables and associated predictive equations within which current rule effectiveness for shade preservation can be generally assessed across a range of prescriptions.
  - Tests the accuracy of the SHADE model for forest lands in Washington.
  - Examines a range of stand characteristics by stand-type to identify potential improvements to the SHADE model.
  - Produces stand-type-specific characterization data that can be used to more accurately parameterize shade models.

Benefits - *continued*

- **Flexible:**
  - Can be done on one-sided no-entry RMZs left after an upland harvest.
  - Small footprint and few site screening criteria increases candidate sites.
  - Treatments can be spaced out across years to fit budget and logistic limits.

- **Timely/Efficient:**
  - A block of three plots can be completed in a five-day period.
  - Sites can be marked for the entire sequential harvest in advance; allowing site marking and harvesting/sampling (field work) to proceed separately.
  - A contract harvester could work in tandem with the monitoring crew(s).
  - The straight forward dataset would streamline analysis and report writing.

Benefits - *continued*

- Minimal Landowner Commitment/Cost:
  - Does not require landowners to alter harvest plans, set aside control sites, or provide long-term access.
  - Landowners can market the treatment-trees harvested in the study.

Additional benefits of Alternative 2:

- Examines a greater range of stand characteristics and stand-model relationships for refining the SHADE model.
- Makes any refinements identified to the SHADE.xls model.

Some limitations of Alternative 1 and 2 include:

- The standardized experimental design would result in some sites having prescriptions applied that do not match what would otherwise be required in WAC 222-30.
- The study only examines shade in relation to changing harvest conditions, and thus informs only one of the five riparian functions, and not how shade changes over time.
- Alternative 1 may have less potential to inform model improvements then Alternative 2 by excluding stand vertical structural assessments and not directly measuring light energy extinction.
- Attempts to develop statistical models (relationships) between stand structures and conditions may not be successful.

Characteristics	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Stream & Topography	• Topographic shade angle • Bank full width • Bank slope & incision • Disturbance zone • RMZ hill slope • Azimuth and elevation	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1
Riparian Vegetation	• TPA • BA • RD • QMD • Height • Live canopy ratio • Stand structure • Dominant Species	• Same as Alternative 1	• Same as Alternative 1	• Dominant Species • Height • Coarse structure (visual assessment)
Shade & Cover	• Effective Shade (stream) • Overhead canopy cover and canopy closure (stream and riparian) • Leaf area index	• Same as Alternative 1 plus: • Direct measurement of solar energy extinction (radiometric) • Ground, mid layer, and upper canopy overhead cover and solar energy.	• Same as Alternative 2	• Effective Shade (stream)

Characteristics	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Outcome Products	• Empirically derived stream shade values associated with a range of no-cut buffers widths and RMZ thinning intensities (presented in tabular and equation form). • An evaluation of differences in stream shade by stand type across region. • Identification of key vegetation parameters affecting shade • Field derived values of overhead closure and cover by zone (including stream overhang) and tree height that can be used to more accurately parameterize the existing SHADE.xls model by stand type. • LAI measured by stand type, and converted to estimates of light extinction coefficient to use in refining the SHADE.xls model.	• Same as Alternative 1	• Refined SHADE model and/or model application guidance. • Prescription set and revised SHADE.xls model to validate in a follow-up field study.	• Empirically derived effective shade values associated with a range of no-cut buffer widths as implemented by landowners with assessment of affect that stream width, orientation, and stand type.

Characteristics	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Pre-harvest Monitoring	Yes	Yes	No	No
Prescriptions Replication	Yes	Yes	No	No
Empirical analysis of prescriptions	Yes	Yes	No	No
Extent of model improvement	Moderately High	High	Moderate	Low

Characteristics	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Stand types (S.T.)	4	4	4	4
Samples/S.T.	50	50	10	20
Prescription variants tested	10 - 16	10 - 16	NA	NA
Samples/ prescription	20	20	NA	NA
Total samples	200 - 380	200 - 380	40	80
Field Time	2 years	2 years	2 years	2 years
Meets <u>all</u> objectives & CQs	Yes	Yes	No	No
Cost Statewide Cost Eastside	$433,125 $258,875	$621,055 $344,500	$436,777[1] NA	$237,000 $142,750