DEPARTMENT OF NATURAL RESOURCES

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MEMORANDUM

May 1, 2020

TO: Forest Practices Board

FROM: Mark Hicks, Adaptive Management Program Administrator

SUBJECT: CMER strategy for completing Water Typing Study Designs

At the November 5, 2019 Washington Forest Practices Board (Board) meeting the following motion was passed:

> "Recommend the Cooperative Monitoring, Evaluation and Research Committee (CMER) to develop study designs for the PHB validation, physical characteristics, and map-based Lidar model studies. Design the studies for cost savings, including the phasing of the studies with eastern Washington to be initiated first, and the possibility and advisability of combining the PHB validation, physical characteristics and map based Lidar model studies, and then to report on the study designs to the Board by their May, 2020 meeting."

On April 28th the Cooperative Monitoring Evaluation and Research (CMER) committee approved a strategy for the In-stream process Science Advisory Group (ISAG) to complete study designs for the three projects identified by the Board: i) Potential Habitat Breaks, ii) Default Physicals, iii) LiDAR Model Map. The attached strategy is intended to serve as the requested May 2020 report to the Board.

To date ISAG has re-familiarized themselves with the draft study designs, cataloged outstanding comments, and met on a more frequent basis to assess how to efficiently move forward. The strategy provides a timeline for doing the actual work of updating the study designs in a way that will enable the projects to move forward effectively.

April 28, 2020

TO: **Mark Hicks (AMPA)**

FROM: **CMER**

SUBJECT: **CMER Water Typing Strategy Update**

At the November 5, 2019 Washington Forest Practices Board (Board) meeting the following motion was passed:

> *"Recommend the Cooperative Monitoring, Evaluation and Research Committee (CMER) to develop study designs for the PHB validation, physical characteristics, and map-based Lidar model studies. Design the studies for cost savings, including the phasing of the studies with eastern Washington to be initiated first, and the possibility and advisability of combining the PHB validation, physical characteristics and map based Lidar model studies, and then to report on the study designs to the Board by their May, 2020 meeting."*

In December 2019, CMER voted that the Instream Scientific Advisory Group (ISAG) should have the lead in drafting a response to the Board motion (above) by developing a Water Typing Strategy for CMER approval that addresses the Board's request. Consistent with the Board's motion, that strategy should include (but not be limited to) recommendations for how to proceed with the 'PHB Validation' (PHB), 'Default Physical Criteria (DPC)' and 'Map-based Lidar Model' (LiDAR Model) studies. In response to these directives, ISAG developed and/or compiled the following:

- **Recommendations (1-7) in response to the Board motion**
- **Proposed workplan and budget**
- **Appendix I –** Table comparing elements of three water typing approaches that are part of the CMER Water Typing Strategy. These elements provide a basis for the following recommendations.
- **Appendix II (Water Typing Strategy Project Summary) –** Includes the 'critical questions', 'timeline', 'current status', and 'project objectives' for the individual components of the CMER Water Typing Strategy, along with a summary of the current budget associated with the strategy.
- **Appendix III (Excerpt from CMER Protocol & Standards Manual, Section 7.8.8) –** Provides support for 'Recommendation 1'.

Prior to formulating specific Water Typing Strategy recommendations, ISAG developed the following water typing points in order to provide clarity on how to proceed with the strategy.

- The goal of the DNR water typing system is to accurately identify the upstream extent of fish habitat (see WAC 222-16-010 for definition of 'fish habitat').
- This goal (above) is the same for all three studies included in the Water Typing Strategy.
- While the goal is the same for each water typing approach, the different approaches will not (necessarily) result in identifying the same point on the landscape as the upstream extent of fish habitat.
- There is inherently a different level of error associated with each approach at the individual site scale (error here is defined as the difference between the **actual** upstream extent of fish habitat in a given watershed relative to where the individual approaches [DPC, PHB, and LiDAR Model] identify it).
- The intent of identifying the upstream extent of fish habitat relative to the location of the last/uppermost detected fish is, in part, to account for the spatial and temporal variability in fish distribution (fish move and detection locations can change between seasons and/or years).
- All three study approaches utilize physical channel/geomorphic features and temporal distribution patterns (i.e. season and annual variability) of fish to derive criteria for assessing/defining upstream extent of fish habitat.
- The CMER Water Typing Strategy should not necessarily be limited to an assessment of the three water typing approaches addressed in the Board's motion but may also capture additional elements identified within the CMER Workplan.

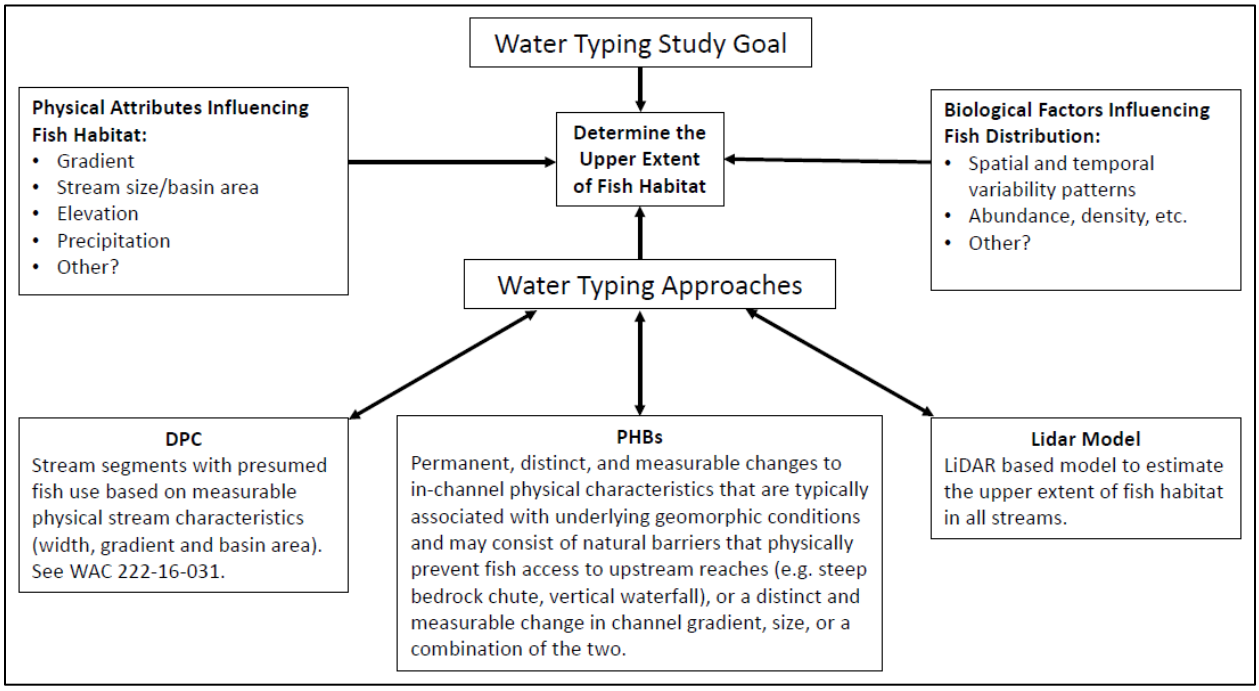

Figure 1. Conceptual diagram of the Water Typing Strategy.

Water Typing Strategy Recommendations

Recommendation 1 – Study design authors should incorporate 'Best Available Science' (BAS) and other steps outlined in the CMER Protocol and Standards Manual (PSM), Chapter 7, when developing study designs for the individual approaches that are part of the CMER Water Typing Strategy (see Appendix III).

Justification(s):

- The current drafts for DPC, PHB and LiDAR Model study designs occurred outside the CMER process, therefore, they did not follow the CMER PSM process for project scoping and study design development. The PHB Validation Study went through the Independent Scientific Peer Review (ISPR) process, but with limited involvement by CMER. The DPC and LiDAR Model study designs did not go through the ISPR review process.

Recommendation 2 – Collect initial data at a single set of unbiased and representative field sites to potentially inform at least some elements of all three studies.

Justification(s):

- Certain data (e.g. location of the uppermost detected fish in a given stream) are relevant to all three studies.
- Provide cost savings by improving implementation efficiencies.
- Enhance the ability to compare results from the different approaches.

Recommendation 3 – Coordinate implementation of the DPC and PHB studies to take advantage of their shared elements (e.g. sample sites, upstream extent of fish distribution information), but maintain separate study-specific elements (e.g. focused analysis) that are designed to accomplish study objectives and answer project related critical questions in the CMER work plan (2019 - 2020).

Justification(s):

- Same justifications as those presented for 'Recommendation 2'.

Recommendation 4 – Postpone implementation of the LiDAR Model study until after completion of the DPC and PHB studies and the development of a statewide LiDAR derived stream network.

Justification(s):

- The primary objective of developing a LiDAR model would be to identify PHB and DPC points as defined by the other two studies. Therefore, it is logical to wait until metrics associated with those approaches are permanently defined before developing a new model.
- LiDAR coverage of Washington is currently incomplete, and statewide coverage will be necessary for full implementation of the new LiDAR model map.

Recommendation 5 – There is potential for eDNA (Environmental DNA) to be included as an added element to the PHB and/or DPC studies, however, continued investigation of eDNA as a prospective water typing tool should not necessarily be limited to work within these other studies.

Justification(s):

- Potentially take advantage of efficiencies around study elements such as site selection as presented in justifications for 'Recommendations 2 & 3'.
- Potentially provide additional/alternative evidence of fish presence/absence to compliment electrofishing work.

Recommendation 6 – Structure the studies so that the eastside and westside portions of each study may function independently if needed.

Justification(s):

- The climate on the two sides of the Cascades is sufficiently different that the eastern and western WA sample sites do not need to be looked at simultaneously (i.e. during the same calendar, fiscal or water years).
- This approach will allow flexibility in implementing the studies.

Recommendation 7 – CMER should be tasked with development and approval of the final study designs for the individual approaches that are part of the CMER Water Typing Strategy.

Justification(s):

- Allow for modifications necessary to improve individual study designs and potentially combine appropriate aspects of these studies for efficiency and cost savings.

Workplan and Budget

The degree to which modifications are needed for each study design will largely dictate the timing for completion and budget estimates. CMER recommends conducting these tasks "in-house" to the extent practicable using existing human resources (CMER/SAG members, Project Managers, and CMER science staff). Doing so will push out budget needs past Fiscal Year '21, so the Board's budget line item will need to be modified accordingly. More accurate budget estimates for field implementation, site selection, data collection and analysis, and final report writing will be forthcoming pending completion of the study designs. However, the current budget amounts in the CMER Master Schedule for Fiscal Years '20 and '21 ($65,850 and $552,456, respectively) will not be expended, and the later phases of the projects once implemented will likely spread those costs out over several years.

	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27
PHB	**Study Design**							
			ISPR Review					
			Implementation Plan					
				Data Collection				
				QA/QC & Data Analysis				
							Report Writing	
PHB Budget	$0	$0	TBD	TBD	TBD	TBD	TBD	TBD
DPC	**Study Design**							
			ISPR Review					
			Implementation Plan					
				Data Collection				
				QA/QC & Data Analysis				
							Report Writing	
DPC Budget	$0	$0	TBD	TBD	TBD	TBD	TBD	TBD
LiDAR	**Postpone implementation of the LiDAR Model study until after completion of the DPC and PHB studies and the development of a statewide LiDAR derived stream network.**							
LiDAR Budget	$0	$0	$0	$0	$0	$0	$0	$0

Appendix I: Comparison of elements of three water typing approaches that are part of the water typing strategy.

	Default Physical Criteria (DPC)	Potential Habitat Breaks (PHBs)	Lidar Model
How is each water typing approach defined?	Stream segments with presumed fish use based on measurable physical stream characteristics (width, gradient and basin area). See WAC 222-16-031.	PHBs are defined as permanent, distinct, and measurable changes to in-channel physical characteristics. PHBs are typically associated with underlying geomorphic conditions and may consist of natural barriers that physically prevent fish access to upstream reaches (e.g. steep bedrock chute, vertical waterfall), or a distinct and measurable change in channel gradient, size, or a combination of the two.	LiDAR based model to estimate the upper extent of fish habitat in all streams.
What is the purpose of each approach?	To classify stream segments as 'F' or 'N' where fish use has not been determined using accepted protocol electrofishing survey (PES) methodology.	To identify the point (F/N break) that; 1) represents the upper extent of fish habitat, 2) is based on measurable physical stream characteristics, 3) is associated with a protocol electrofishing survey, and 4) is within the context of FHAM.	To generate a statewide water typing map identifying F/N break points and thereby classifying stream segments as 'F' or 'N' using LiDAR based model where fish habitat has not been determined using accepted protocol electrofishing survey methodology.
At what scale is each approach is implemented?	Segment/Point	Point	Landscape
Why is study needed on each approach?	To understand the extent to which current default physical criteria for Type-F waters accurately identify and/or encompass the upstream extent of (detected) fish presence (all species) and/or fish habitat considering potential geographic differences.	To identify specific PHB criteria that most accurately inform a consistent and systematic approach to water typing which recognizes and identifies "fish habitat" not just fish use. Once measurable metrics or threshold criteria are adopted, this approach to conducting protocol electrofishing surveys within the context of FHAM will meet DNR's objective of developing an alternative that is "repeatable, enforceable, and implementable".	To identify what, if any, potential opportunities exist to improve or replace the existing model using high resolution (LiDAR) topographic information.

Appendix II: Water Typing Strategy Project Summary **(prepared Jan. 2020, updated Apr. 2020)**

Project Name & Background	**Water Typing Strategy** At the November 5, 2019 WFPB Meeting the following motion was passed: *"Recommend the Cooperative Monitoring, Evaluation and Research Committee (CMER) to develop study designs for the PHB validation, physical characteristics, and map-based Lidar model studies. Design the studies for cost savings, including the phasing of the studies with eastern Washington to be initiated first, and the possibility and advisability of combining the PHB validation, physical characteristics and map based Lidar model studies, and then to report on the study designs to the Board by their May, 2020 meeting."* In December 2019 CMER voted that ISAG should have the lead in responding to the Forest Practices Board motion (above) and developing an overall CMER based Water Typing Strategy.
Strategy Elements	The CMER Water Typing Strategy will include (individually or in combination) the following elements: 1. Default Physical Criteria Assessment 2. Potential Habitat Breaks (PHB) 3. LiDAR Based Water Typing Model 4. Fish/Habitat Detection Using eDNA ISAG will consider whether, or if so how, to combine these elements (as directed by the WFPB), and to consider if/how additional elements may be added to the list.
Work Plan Critical Question Addressed	**(1) Default Physical Criteria Assessment** • To what extent do current default physical criteria for Type-F waters, considering potential geographic differences, accurately identify the upstream extent of (detected) fish presence (all species) and/or fish habitat? • Can alternative (to current) default physical criteria for Type-F waters, considering potential geographic differences, be identified that would more accurately and consistently identify the upstream extent of (detected) fish presence (all species) and/or fish habitat? • Are there sustained gradient or stream size thresholds alone that serve as default physical criteria? **(2) Potential Habitat Breaks (PHB)** • How can the line demarcating fish- and non-fish habitat waters be accurately identified? • To what extent does the current water typing survey window capture seasonal and annual variability in fish distribution considering potential geographic differences? • How do different fish species use seasonal habitats (timing, frequency, duration)? • How does the upstream extent of fish use at individual sites vary seasonally and annually? • How does the delineation of the upstream extent of fish habitat change seasonally?

	(3) LiDAR Based Water Typing Model • To what extent can LiDAR be used with the current fish habitat model to develop a new model for predicting the upstream extent of fish habitat sufficient to meet the requirements of the Forest and Fish Agreement? **(4) Fish/Habitat Detection Using eDNA** • How well and under what conditions does eDNA sampling accurately and consistently identify the upstream extent of fish presence, abundance, and/or fish habitat?
Responsible SAG & Project Manager	SAG: ISAG Project Manager: Eszter Munes
Project Team Members	TBD
Status/Phase	The overall CMER Water Typing Strategy is currently being developed within ISAG. The following provides specific details associated with each of the (4) active projects within the strategy: **(1) Default Physical Criteria Assessment** • The development of a study design to evaluate default physicals was initiated in 2016. • In March 2019 Cramer Fish Sciences presented a draft 'Physicals' study design to ISAG. During this presentation Cramer recommended combining this project with the PHB Validation Study. • Following the March 2019 presentation ISAG provided comments back to the authors on the draft 'Physicals' study design, however, no final/approved 'Physicals' study design was produced. • In November 2019 the Board recommended that CMER develop a 'Physicals' study design. • In December 2019 CMER voted that ISAG should have the lead in responding to this Board motion (above). ISAG is currently considering how the 'Physicals' project fits within the overall Water Typing Strategy and if it could be combined with other elements per the Board's motion. **(2) Potential Habitat Breaks (PHB)** • A PHB pilot project has been completed and a report was delivered to the Board in January 2016. • A 'PHB' study design was developed by the Board designated science panel and subsequently approved by ISPR in November 2018. • The study design was also reviewed by members of CMER/ISAG (informally, outside of the CMER process) and a comment matrix was provided to the authors in January 2019. • An updated (most recent) version of the 'PHB' study design was presented to the Board in May 2019. • The Board then created a special Water Typing Committee in June 2019 to provide recommendations on next steps back to the full Board in August 2019.

	• Per recommendation of the Water Typing Committee, in November 2019 the Board recommended that CMER develop a 'PHB' study design. • In December 2019 CMER voted that ISAG should have the lead in responding to this Board motion (above). ISAG is currently considering how the 'PHB' project fits within the overall Water Typing Strategy and if it could be combined with other elements per the Board's motion. **(3) LiDAR Based Water Typing Model** • The development of a study design RE a LiDAR based water typing model was initiated in 2016. • In May 2019 Cramer Fish Sciences delivered a draft 'LiDAR Model' study design to ISAG, however, no final/approved 'LiDAR Model' study design was produced. • In November 2019 the Board recommended that CMER develop a 'LiDAR Model' study design. • In December 2019 CMER voted that ISAG should have the lead in responding to this Board motion (above). ISAG is currently considering how the 'LiDAR Model' project fits within the overall Water Typing Strategy and if it could be combined with other elements per the Board's motion? **(4) Fish/Habitat Detection Using eDNA** • An eDNA pilot project has been completed (Brooke Penaluna – Principal Investigator) and a draft report was delivered for ISAG review in December 2019.
Project Timeline	ISAG will report on the 'Physicals', 'PHB', and 'LiDAR Model' study design(s) to the Board by May 2020. Project timelines thereafter will be based on recommendations developed at the May 2020 FP Board meeting. The following provides specific details on near-term tasks associated with each of the (4) active projects within the Water Typing Strategy: **(1) Default Physical Criteria Assessment** • ISAG will review the existing 'Physicals' study design and associated comments (from ISAG members in 2019) and develop options for how the existing study design could be modified and/or merged with other Water Typing Strategy elements moving forward. **(2) Potential Habitat Breaks (PHB)** • ISAG will review the existing 'PHB' study design, associated recommendations from the ISPR review, and associated comments (from ISAG/CMER members) and develop options for how the existing study design could be modified and/or merged with other Water Typing Strategy elements moving forward. **(3) LiDAR Based Water Typing Model** • ISAG member(s) will investigate other (ongoing/completed) LiDAR (fish) modeling studies to identify current knowledge gaps and assess whether further/new work on this subject is needed. An update on this topic will be provided at the February ISAG Meeting.

(4) Fish/Habitat Detection Using eDNA

- ISAG members reviewed the updated eDNA report and voted to have the P.I. make revisions based on consensus-based comments. Funding to make revisions ($5,500) was approved during the CMER meeting in February 2020. A draft with comments from concurrent, ISAG/CMER review will be submitted for CMER approval in April 2020.

Project Summary and Purpose

Summary: Refine study designs for the PHB validation, physical characteristics, and map-based LiDAR model studies in FY2020. Design the studies for cost savings, including the phasing of the studies in eastern Washington to be initiated first, and the possibility and advisability of combining the default physical criteria, PHB validation, and/or map-based LiDAR model studies.

Purpose: Inform a permanent water typing system that meets FFR objectives.

Project Objectives

Determine possibility/advisability of combining the 'Physicals', 'PHB', and/or 'LiDAR Model' studies. Project specific objectives are listed below:

(1) Default Physical Criteria Assessment

- Compare and quantify how the current default physical criteria correspond to the uppermost point of fish presence and potential fish habitat.
- Determine the physical characteristics of habitat likely to be used by fish.
- Determine if sustained gradient or stream size thresholds alone serve as sufficient default physical criteria.

(2) Potential Habitat Breaks (PHB)

- Test the proposed PHB criteria and evaluate if those criteria or some other criteria will allow for the identification of potential habitat breaks for use in water typing to accurately and consistently identify the upstream extend of fish presence and/or fish habitat when determining the F/N break.
- Determine which combinations of gradient, channel width, barriers to migration, and other physical habitat and geomorphic conditions of the Board identified PHB criteria best identifies last detected fish location in an objective and repeatable manner as applied in the FHAM.
- Provide insight into how last detected fish points, end of fish (EOF) habitat, and PHBs proposed by the Board may vary across ecoregions, seasons, and years.
- Identify PHB criteria that can be used to capture EOF habitat in forested streams across Washington; and better understand how PHBs may be influenced by seasonal and annual variability, and by location within Washington.

(3) LiDAR Based Water Typing Model

- Prepare 'LiDAR Model' study design to evaluate the effectiveness of a LiDAR based logistic regression model and identify and locate presumed fish habitat across the state.
- Develop a logistic regression model that predicts fish habitat across non-federal forestlands in Washington.
- Select the appropriate spatial scale for the study. Include analytical (validation) that may be necessary to validate the model.

(4) Fish/Habitat Detection Using eDNA

- Assess how eDNA sampling compares with electrofishing for overall effectiveness, costs, and accuracy for identifying fish presence.

Budget

- Board Approved August 14, 2019.
- Expenditures do not include CMER staff or ISPR review.

	PHB	DPC	LiDAR	eDNA
Expenditures to Date	$374,420.91	$115,132.94	$245,241.70	$59,512.47
FY 20 Budget	$0			$5,500
FY 21 Budget	$552,456.00			$0

Appendix III: Excerpt from CMER Protocol and Standards Manual, Section 7.8.8

Consider the following BAS elements in the alternatives analysis (BM22-9):

1. Information source
2. Spatial scale
3. Temporal scale
4. Study design
5. Methods
6. Data
7. Quantitative analyses
8. Context
9. References
10. Logical conclusions and reasonable inferences
11. Level of peer review