# Anadromous Fish Floor (AFF) Policy Memo

Prepared for

The Water Typing Rule Committee of the Washington State Forest Practices Board

By

Anadromous Fish Floor Project Team

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**Executive Summary**

This memo presents the policy recommendations to the Water Typing Rule Committee from the five TFW Policy Committee members of the Anadromous Fish Floor Workgroup (AFF Workgroup); see the names of the Policy members listed above. The AFF Workgroup was established in response to a request by Washington's Forest Practices Board (Board) for stakeholders engaged in the state's forest practices adaptive management program to collaboratively analyze and evaluate physical stream characteristics downstream from which all streams can be presumed to have anadromous fish habitat. Per the Board-approved Anadromous Fish Floor Charter, the 'anadromous fish floor' (AFF) is defined as measurable physical stream characteristics downstream from which anadromous fish habitat is presumed [1/]; in the permanent forest practices water typing system rule, the AFF would establish the location upstream of which protocol fish surveys to determine water type may begin under the Fish Habitat Assessment Methodology (being developed concurrently), thereby reducing electrofishing in waters that are presumed to have anadromous fish habitat.

The AFF Workgroup developed a general approach for evaluating model "success" and identifying relative performance of the various AFF alternatives.

That approach was to assemble a database of existing known and presumed fish occurrence data to serve as reference points for comparing AFF alternatives. This method of model comparison against independent field data is a standard approach used in the physical and biological sciences. It allows for evaluation of model "success" as judged in comparison with the data. Relative performance may be judged by the distances between the model prediction and the fish data. Specific to the AFF analysis, this means model "error" may be evaluated by tallying the length of stream where modeled AFF alternatives fall short of or extend beyond the fish distribution data. How the fish reference data were generated and what species they represent all influence the interpretation of the model performance.

**AFF Policy Recommendations for an Anadromous Fish Floor**

Based upon the AFF Findings Report, the Policy members of the AFF Workgroup are in consensus recommending no further consideration by the Board Committee and Board of AFF Alternatives A, C5%, C7%, C10%, E5%, E7%, E10%, and A3 to establish the location where protocol fish surveys to determine water type may begin.

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[1/] At their September 24, 2019 meeting, members of the Board's Water Typing Rule Committee (Board Committee) discussed their objective for an anadromous fish floor, as well as whether the definition of AFF is to be based on "presumed" or "likely" habitat, but did not finalize their discussion with a motion or vote. In their discussion captured in their meeting summary, the Board Committee generally agreed that "presumed" more accurately reflects what they were looking for, comes from the present situation where there is anadromy all of the time and where there is no need to electrofish.

The Policy members of the AFF Workgroup have a shared belief that there is limited possibility for consensus for the alternatives listed above, and a greater possibility for consensus by continuing to keep for consideration Alternatives D and A4, while adding for consideration two new alternatives, described below, which will require further spatial analyses.

The Policy members of the AFF Workgroup have not yet reached consensus AFF recommendation for a single AFF alternative to establish the location where protocol fish surveys utilizing FHAM may begin. We have however reached consensus on a recommendation to the Board Committee and Board for:

- continued consideration of Alternative D and A4 (10%), and
- consideration of two new AFF alternatives, Alternative A4 (7%) and Alternative A4 (5%); the general outline of these two new AFF alternatives are as follows:

**Alternative A4 (7%)** as waters within anadromous fish floor as defined:

- All waters included in the SWIFD GIS database of documented (observed) and presumed anadromy, plus upstream associated waters occurring below a sustained gradient of **7%** or a permanent natural barrier, whichever comes first. For the purposes of Alternative A4 (**7%)**, permanent natural barrier as defined using the barrier definition (below); and
- All waters connected to saltwater and extending upstream to a sustained **7%** gradient or a permanent natural barrier as defined using the barrier definition (below) within streams with no anadromous fish data.

**Alternative A4 (5%)** as waters within anadromous fish floor as defined:

- All waters included in the SWIFD GIS database of documented (observed) and presumed anadromy, plus upstream associated waters occurring below a sustained gradient of **5**% or a permanent natural barrier, whichever comes first. For the purposes of Alternative A4 (**5**%), a permanent natural barrier is defined using the barrier definition (below); and
- All waters connected to saltwater and extending upstream to a sustained **5**% gradient or a permanent natural barrier as defined using the barrier definition (below) within streams with no anadromous fish data.

Both of the A4 (7%) and A4 (5%) alternatives share the same barrier definitions, as follows:
Non-vertical Barrier:

- Channels < 5 feet in width: sustained gradient ≥ 20% for ≥ 100 feet (30 meters) without resting areas.
- Channels 5 – 10 feet in width: sustained gradient ≥ 20% for ≥ 250 feet (76 meters) without resting areas.
- Channels > 10 feet in width: sustained gradient ≥ 20% for ≥ 515 feet (160 meters) without resting areas.

Vertical Barrier (permanent natural features):

- Channels < 5 feet in width: near vertical drop ≥ 5 feet in height (1.5 meters)
- Channels 5 – 10 feet in width: near vertical drop ≥ 8 feet in height (2.5 meters)
- Channels > 10 feet in width: near vertical drop ≥ 12 feet in height (3.7 meters)

- The Policy members of the AFF Workgroup also request from the Board Committee / Board that additional time be allowed for the AFF Workgroup to have performed by TerrainWorks appropriate spatial analyses (defined in a Scope of Work) of these two new alternatives, and have maps of the sample watersheds produced showing all components of all alternatives for the purpose of informing a workshop with the Board Committee and full Board.

**Administrative and field-based considerations for AFF implementation**

- If the Board adopts any of the four alternatives recommended for continued consideration in the water typing rule process, DNR will need to update their Forest Practices Application Mapping Tool, or other formats (digital GIS layers, shape files, etc.) with the discrete locations and any narrative information associated with documented (observed) and presumed SWIFD points and make the data available to the public. DNR may choose to incorporate SWIFD points directly into their current hydro layer or a National Hydrography Dataset (NHD)-derived upgrade of the current hydro layer.
- DNR would need to develop a mechanism of updating the hydro layer with new data on anadromous distribution in SWIFD, similar to how water types are updated through the water type modification process.
- Statewide high resolution LiDAR coverage will be necessary for development of a statewide map identifying the first occurrence of gradient thresholds upstream from SWIFD points, the location of permanent natural barriers, or for full field implementation of any statewide gradient threshold-based AFF.
- No geographically widespread database of sustained gradient threshold features currently exist for the gradients stated in all of the gradient threshold-based alternatives, and no such statewide database is anticipated to exist for quite some time, due to statewide high resolution LiDAR coverage being incomplete.
- In areas with SWIFD, field implementation of Alternative D will involve initiating FHAM field surveys at or upstream from the mapped location of a SWIFD point and associated tributaries downstream of a SWIFD points would require field identification of the absence of a 5% gradient increase or permanent natural obstacle at the junction with the main stem, in order to presume anadromy up to the next Potential Habitat Break (PHB), where a FHAM survey may commence.
- In areas with SWIFD, field implementation of Alternatives A4 (10%), A4 (7%), and A4 (5%) will require initiating a search for a sustained gradient or permanent natural barrier at or upstream of a SWIFD point before initiating FHAM.
- **In areas without fish data, a method of field implementation of Alternative D, if adopted by the Board, will need to be developed.**

- **In areas without fish data nor LiDAR for Alternatives A4 (10%), A4 (7%), and A4 (5%)** assume there are no permanent natural barriers downstream and/or channel gradients downstream that are lower than the gradient at the downstream edge of the property line.

**AFF Policy Recommendations for potential future field studies**

As anticipated, the findings of the AFF Workgroup would have benefited from a field-based anadromous distribution dataset against which the alternatives could have been compared for a more direct assessment of performance.

There are other shortcomings and uncertainty issues associated with the process that could be addressed with and form the basis for development of several action items and potential future field studies:

- a literature review of anadromous fish distribution relationships with physical stream characteristics
- a field-based validation study to address the following uncertainties:
  - lack of field validation of fish points and modeled channel attributes, including gradient and barrier feature, PHBs.
  - channel gradients: Modeled gradients are likely extending each alternative higher in the stream networks than they would be if the gradients were measured in the field.
  - stream lengths: Estimates of absolute stream lengths are not reliable, resulting in greater confidence in the relative distances computed for each alternative and less confidence that the absolute distances would be the same as would be implemented in an eventual rule.

The Policy members of the AFF Workgroup also support the "Future Field Studies" recommendations included in the AFF Findings Report, as follows:

- Potential future field studies could be designed to validate the GIS analysis, improve our understanding of anadromous fish distribution and their habitat associations, and validate the criteria used to define the AFF. Specifically, validation of the GIS analysis could include field surveys of stream gradient, channel width, and barrier / obstacle locations to compare against estimates produced by the TerrainWorks GIS model.
- Research could be designed to address gaps in our understanding of anadromous fish presence / absence. For example, interannual and seasonal variability in the distribution of anadromous fish could be addressed through eDNA surveys or targeted electrofishing. Importantly, physical habitat surveys should be combined with fish observations to form a complete picture of anadromous fish associations with habitat characteristics. Similarly, validation of the criteria identified in an AFF rule could be accomplished by the addition of fields on the WTMF for surveyors to identify the locations where anadromous fish are observed and the associated habitat characteristics.
- Regardless of the AFF alternative selected, these ideas could be a future focus of adaptive management to validate the results found using the opportunistic data included in this report.

There is no agreement among the Policy members about whether an independent scientific peer review should be conducted on the technical report. That decision is ultimately up to the Board Committee.

**Policy Context and Assumptions pertinent to AFF**

**Policy Context**

In February 2018, the Board decided to consider an anadromous fish floor as part of its permanent water typing system rule efforts. Subsequently, at a June 4, 2019 Special Forest Practices Board (SFPB) Meeting, the Board passed a motion for a Board Committee to "work with stakeholders to resolve any outstanding issues regarding the anadromous fish floor." In addition, at the June 4th SFPB meeting, the Board directed TFW Policy to recommend whether an anadromous floor should be part of the water typing system rule. At the August 2019 Forest Practices Board meeting, the TFW Policy co-chairs reported to the Board that TFW Policy had recommended that the Board Committee consider an anadromous floor as a component for the water typing rule, but no Board motion on an anadromous fish floor was considered at that meeting. The Board Committee's subsequently approved charter reiterated the Board's approval to develop a new water typing system rule goal of shifting from the interim water typing system rule based on fish presence to one that relies on fish habitat (WAC 222-16-010) as the guiding principle for delineating the break between Type F and N waters. The Board Committee's charter further tasks the committee to "gather and analyze data for inclusion in any recommendations on an anadromous fish floor."

At their November 19, 2019 Regular Board Meeting, the Board accepted by motion several Board Committee's recommendations, including the Anadromous Fish Floor Workgroup Charter, dated October 7, 2019. The Board further tasked the Board Committee to:

- Provide guidance and oversight to the Workgroup
- Facilitate discussions with the entire Board and facilitate delivery of a final anadromous fish floor recommendations or minority/majority report

The AFF Workgroup's efforts were to:

- Assemble and analyze data from a sample of western Washington watersheds to evaluate suitability of metrics to inform the development of an anadromous fish floor; the analyses were to include assessment of the performance of the metric(s).
- Focus on all current Board motions that define anadromous fish floor alternatives (Tribal proposal, landowner proposal)
- Further refine the definition of anadromous fish habitat end points (e.g. stream width/gradient, swale, undefined channels, etc.) within draft rule language,
- Make, to the extent possible, consensus recommendations on an anadromous fish floor; and
- Recommend potential future field studies, as needed, to address technical uncertainties.

The Workgroup committed to producing two documents:

- The first is a technical report that describes how physical stream characteristics relate to anadromous fish habitat distributions in a sample of western Washington watersheds. The "Anadromous Fish Floor Spatial Analysis Findings Report", dated December 3, 2021, (hereafter referred to as the AFF Findings Report) is intended to satisfy this first report request.
- The second document is a report with metric/metric combinations and associated performances for determining the anadromous fish floor. The document will include conceptual frameworks on how an anadromous fish floor can be identified and applied in the field in a repeatable manner. If consensus is not reached, the report will identify the differing conclusions and perspectives based on the results of the analyses.

  This "Anadromous Fish Floor (AFF) Policy Memo", dated December 8, 2021, is intended to satisfy this second report request.

  The Principal Investigators and technical members of the AFF Workgroup focused on conducting the analyses to compare the AFF alternatives; the balance of risk between underestimating known anadromous stream length and overshooting the fish-non-fish habitat break point location is the subject of the associated AFF Policy Memo, prepared by the Policy members of the AFF Workgroup.

The AFF alternatives evaluated by the Workgroup consisted of two primary approaches to establishing an anadromous fish floor:

1) approaches that rely on gradient thresholds or barriers (whichever is encountered first) upstream from saltwater; and
2) approaches that rely on changes in channel characteristics identified upstream from an "anadromous core" defined by existing datasets (such as SWIFD).

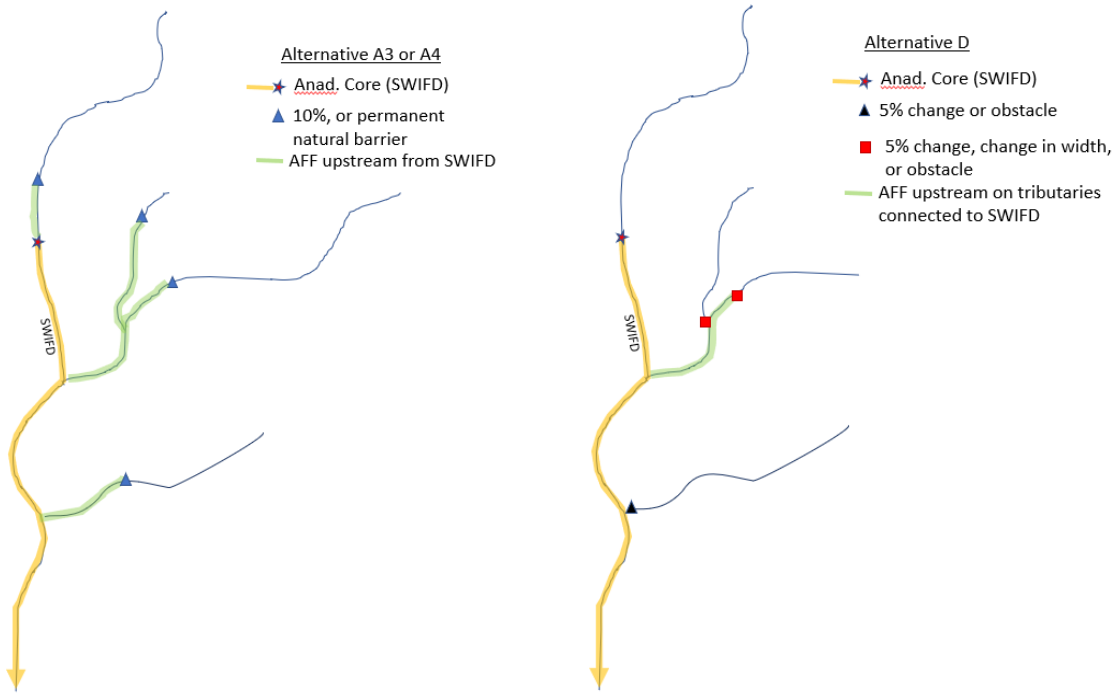
Alternatives A and E fall into the first category. Alternative A is defined by a sustained gradient threshold (10%) and WDFW-defined permanent natural barriers. Alternative E is based solely on thresholds of sustained gradient (5%, 7% or 10%) that form the "anadromous core" and extend into tributaries.

Alternative D falls into the second approach: it is defined by data on known and presumed anadromous fish occurrence, plus extensions of the AFF into tributaries using a modified potential habitat breaks (PHB) framework (ignoring the channel width-based PHB at the core stream-tributary confluence). For Alternative D, the modified PHB framework does not extend beyond the terminal "anadromous core" data point as it does on tributaries connected to the core.

Several alternatives act as combinations of the two primary approaches. Alternative C is a mix of the sustained gradient and "anadromous core" approaches; it uses sustained gradient thresholds (5%, 7%

or 10%) to establish the "anadromous core", and the modified PHB scheme from Alternative D to extend beyond the "core" on connected tributaries.
As the Workgroup conducted its spatial analyses, it decided to evaluate two new alternatives, A3 and A4, that also combine the two primary approaches. Alternatives A3 and A4 use data on known and presumed anadromy to form the "anadromous core" (as in Alternative D) but extend into connected tributaries and above the terminal anadromous data point on trunk streams until a threshold of sustained gradient (10%) or permanent natural barrier is reached.

While the Policy members of the AFF Workgroup have not yet reached consensus AFF recommendation(s), the Policy members are requesting additional time for spatial analyses of two new AFF alternatives under consideration by the AFF Workgroup, Alternative A4 (7%) and Alternative A4 (5%). See Figure A1 below, a schematic illustrating the conceptual differences between an AFF alternative such as Alternatives A3 / A4 and Alternative D.




**(A)** **(B)**

Figure A1. This stream schematic is provided to illustrate the difference between Alternatives A3 or A4 **(A)**, and Alternative D **(B)**, as to AFF upstream from SWIFD and AFF upstream on tributaries connected to SWIFD.

**Policy Assumptions**

The AFF Workgroup Policy members developed this Policy Memo, based on several assumptions as follows:

- The Department of Natural Resources (DNR) currently maintains (and intends to maintain) a statewide water type map depicting stream layers and water type break points. The points on the map are derived from a GIS-based model or have been digitized onto the map by DNR based on field surveys. The map provides a starting point to help identify streams types and locations.
- Landowners are required to verify whether the stream locations and the associated water types depicted on the water type map are correct prior to conducting forest practices activities. No additional assessment is necessary where a previous field survey or an interdisciplinary team (ID team) determined the appropriate water type through a concurrence review.
- One of the primary goals of the DNR water typing system is to accurately identify the upstream extent of fish habitat.
- "Fish habitat" means habitat, which is used by fish at any life stage at any time of the year including potential habitat likely to be used by fish, which could be recovered by restoration or management and includes off-channel habitat.
- Currently, the delineation of break between Type F (fish habitat) and Type N (non-fish habitat) waters (F/N break) can be accomplished in the following ways (which may change under the Board's Water Typing System Rule recommendations):
    - Perform a protocol fish survey to establish the upstream extent of fish use and fish habitat. The results of the survey are used for proposing changes to the water type map. If the proposed water type change is concurred by DNR, these points become the concurred water type break. 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 / temporal variability in fish distribution (fish move and detection locations can change between seasons and/or years). The Fish Habitat Assessment Methodology is intended to replace the current protocol fish survey for identifying the F/N water type break.
    - Apply default physical stream criteria. The default physical stream criteria are used to determine the water type for specific activities associated with an FPA, but is not used for proposing changes to the water type map.
    - Interdisciplinary teams can assist with determining fish habitat or review plans for conducting surveys in unique situations. The results of an ID team can be used to make changes to the water type map.

- Concurred fish / non-fish (F/N) break points incorporate the upper extent of fish occurrence as determined in a protocol survey, and in many cases also include presumed habitat extensions upstream based on best professional judgement and variable requirements for regulatory acceptance.
- In the permanent forest practices water typing system rule, the AFF would establish the location upstream of which protocol fish surveys to determine water type may begin under the Fish Habitat Assessment Methodology, thereby reducing electrofishing in waters that are presumed to have anadromous fish habitat. Note again Footnote 1/ on Page 2.

- As a clarification, the Policy members of the AFF Workgroup continue to assume that the intent of the AFF is to establish where protocol fish surveys to determine water type may begin under the Fish Habitat Assessment Methodology (being developed concurrently), rather than establish the upper extent of anadromy.
- Subject to future Board action, an anadromous fish floor is assumed to be part of a state-wide (for both western and eastern Washington) permanent forest practices water typing rule.
- This Policy Memo focuses on the four AFF alternatives approved by the Board for evaluation by the Workgroup (see Table 1 in the AFF Findings Report), as well as Alternatives A3 and A4, recommended in the AFF Findings Report to be formally adopted by the Board Committee as AFF alternatives for consideration along with the four previously-approved alternatives.

## Policy Relative Performance Questions used to evaluate AFF alternatives

Not having received clear guidance from the Forest Practices Board describing the specific performance expectations they have for the AFF alternatives, leading to a lack of context with which to interpret traditional statistical results, the Workgroup developed a general approach for evaluating model "success" and identifying relative performance of the various AFF alternatives.

Per the AFF Findings Report, "The general approach was to assemble a database of existing known and presumed fish occurrence data to serve as reference points for comparing our AFF alternatives. This method of model comparison against independent field data is a standard approach used in the physical and biological sciences. It allows for evaluation of model "success" as judged in comparison with the data. Relative performance may be judged by the distances between the model prediction and the fish data. Specific to the AFF analysis, this means model "error" may be evaluated by tallying the length of stream where modeled AFF alternatives fall short of or extend beyond the fish distribution data. How the fish reference data were generated and what species they represent all influence the interpretation of the model performance."

Policy members of the Workgroup prepared a set of Policy Relative Performance Questions to assist in evaluating the AFF alternatives and help develop potential recommendations for the Board and Board Committee, as follows:

- What are the total lengths of stream channels covered by each AFF alternative?
- What are the total lengths of streams with no fish data for each alternative?
- What is the relative performance of each alternative in minimizing AFF length above concurred F/N (overshoots)?
- What is the relative performance of each alternative in minimizing AFF length below observed or presumed anadromy (undershoots)?
- What is the relative performance of each alternative in extending modelled AFF length upstream or downstream of SWIFD?

Findings from the AFF Findings Report provide much of the information needed to answer these Policy questions.

Two additional Policy Questions are raised and answered in a subsequent section, titled “Policy Questions and AFF Policy Findings”, of this AFF Policy Memo.

The Policy members of the AFF Workgroup used the answers to all of these Policy questions to assess the relative performance of the full list of Board-approved and other AFF alternatives (A3 and A4) and to eventually reach their consensus recommendations to the Board Committee and Board. The following section is provided in its entirety to provide context and the rationale for those Policy consensus recommendations.

## Pertinent findings from AFF Spatial Analysis Findings Report

- What are the total lengths of stream channels covered by each AFF alternative?
    - Compare the length of kilometers shown on the “Total AFF Length” line of Table 2.
    - The total lengths of stream channels covered by each AFF alternative varied in predictable ways, but clearly, important differences exist between the alternatives that cause them to extend varying distances into the watersheds.
    - Alternatives (A, A3, A4, C10%, E10%) that used the highest gradient thresholds (10%) to terminate the AFF tended to extend farthest upstream (greater than 7380 kilometers for C10% or E10%, greater than 6370 kilometers for A, A3, or A4); alternatives that used lower gradient thresholds (C5%, E5%) and (C7%), E7%) tended to end the AFF lower in watersheds (greater than 5495 kilometers for C5% or E5%, greater 6375 kilometers for C7% or E7%).
    - The alternative (D) that did not use a gradient threshold but instead incorporated known and presumed anadromous data and extensions based on a lack of gradient changes or obstacles at tributary junctions ended lowest in the modelled watersheds and had the shortest overall AFF length (3527 kilometers).

**Table 1**. Cumulative channel lengths (kilometers) for each AFF alternative and stream categories.[1]

| | AFF Alternative | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Stream category** | **A** | **C5%** | **C7%** | **C10%** | **D** | **E5%** | **E7%** | **E10%** | **A3** | **A4** |
| Total AFF length | 6468 | 5568 | 6378 | 7381 | 3527 | 5495 | 6356 | 7391 | 6455 | 6371 |
| AFF in streams with no fish data | 5014 | 4241 | 4935 | 5831 | 2451 | 4169 | 4913 | 5842 | 5189 | 5125 |
| **AFF overlap with fish data** | | | | | | | | | | |
| Overlap of AFF and all anadromy | 2151 | 2119 | 2168 | 2191 | NA | 2119 | 2168 | 2191 | NA | NA |
| Overlap of AFF and SWIFD | 2081 | 2053 | 2099 | 2120 | NA | 2052 | 2099 | 2121 | NA | NA |
| Overlap of AFF and other anadromy | 1053 | 1040 | 1051 | 1054 | 1028 | 1040 | 1050 | 1054 | 1053 | 1053 |
| **AFF ends downstream of highest fish points** | | | | | | | | | | |
| AFF ends downstream of all anadromy | -62 | -94 | -45 | -22 | NA | -94 | -45 | -22 | NA | NA |
| AFF ends downstream of SWIFD | -62 | -89 | -43 | -22 | NA | -90 | -43 | -21 | NA | NA |
| AFF ends downstream of other anadromy | -0.88 | -14 | -3.39 | -0.75 | -26.79 | -14.69 | -4.26 | -0.72 | -1.41 | -1.40 |
| AFF ends downstream of other fish | -81 | -104 | -53 | -28 | -133 | -105 | -53 | -27 | -30 | -30 |
| **AFF ends upstream of highest fish points** | | | | | | | | | | |
| AFF ends upstream of all anadromy | 4078 | 3256 | 3993 | 4948 | 1340 | 3182 | 3970 | 4957 | 4242 | 4158 |
| AFF ends upstream of SWIFD | 4138 | 3314 | 4053 | 5008 | 1384 | 3240 | 4029 | 5017 | 4311 | 4228 |
| AFF ends upstream of other anadromy | 4312 | 3631 | 4256 | 5054 | 2047 | 3582 | 4237 | 5062 | 4492 | 4441 |
| AFF ends upstream of other fish | 3778 | 3025 | 3668 | 4543 | 1262 | 2954 | 3647 | 4553 | 3897 | 3832 |
| **Relation of AFF with F/N Break points** | | | | | | | | | | |
| AFF ends below F/N break | -52 | -99 | -38 | -12 | -157 | -101 | -39 | -12 | -23 | -28 |
| AFF ends above F/N break | 55 | 19 | 53 | 106 | 6 | 19 | 52 | 104 | 62 | 48 |

[1] All lengths given in kilometers. Results should be compared between alternatives (within rows), not between stream categories (within columns) because the stream categories use reference fish occurrence data with different sample sizes.

- What are the total lengths of streams with no fish data for each alternative?
  - Compare the length of kilometers shown on the "AFF in streams with no fish data" line of Table 2.
  - The distance the modeled AFF alternatives extended into streams with no fish data followed the same pattern as the other results.
  - Alternatives with larger gradient thresholds extended farther into these streams.
  - Alternative D and alternatives with smaller gradient thresholds extended less far into these streams.
  - Except for the lower gradient thresholds (5% and 7%), all alternatives with 10% gradient thresholds have at least twice the stream lengths with no fish data than does Alternative D.
  - Incorporating smaller barriers on smaller channels (as is done in Alternative A4) further reduced the total modeled AFF length

- What is the relative performance of each alternative in minimizing AFF length above concurred F/N (overshoots)?
  - Data from Water Type Modification Forms (WTMF) provided regulatory water type breaks between F/N water types in the analyzed watersheds. These data represent our best

approximation of the end of fish habitat used by any species of fish. There are 2 anadromous and 447 resident fish reference points in this dataset.

- Compare the length of kilometers shown on the "AFF ends above F/N break" line of Table 2.
- All of the AFF alternatives extended above some proportion of the F/N break point locations, but the portions of modelled AFF that "overshot" the F/N water type break data were small compared to the overall length of each modelled AFF.
- Alternatives that used a 10% gradient threshold tended to overshoot F/N break point locations more often and over greater distances than those that used lower gradient thresholds or changes in gradient.
- Alternatives that used lower gradient thresholds (C5% and E5%) or changes in gradient tended to overshoot the F/N water type break locations for shorter distances.
- See Figures 4 and 5 for visual examples from a portion of the Stillman Creek basin (Figure 4) and a portion of the Kalama watershed (Figure 5) of several alternatives where the AFF ends above F/N break points.
- Alternative D ends the least distance above F/N break points (6 kilometers); Alternative D did not extend AFF classification above known and presumed anadromy in mainstem (terminal) channels.
- Alternatives A, A3 and A4 extended at least eight times as far above F/N as did Alternative D.
- Incorporating smaller barriers on smaller channels (as is done in Alternative A4) further reduced the total distance of modelled AFF above the F/N break points.

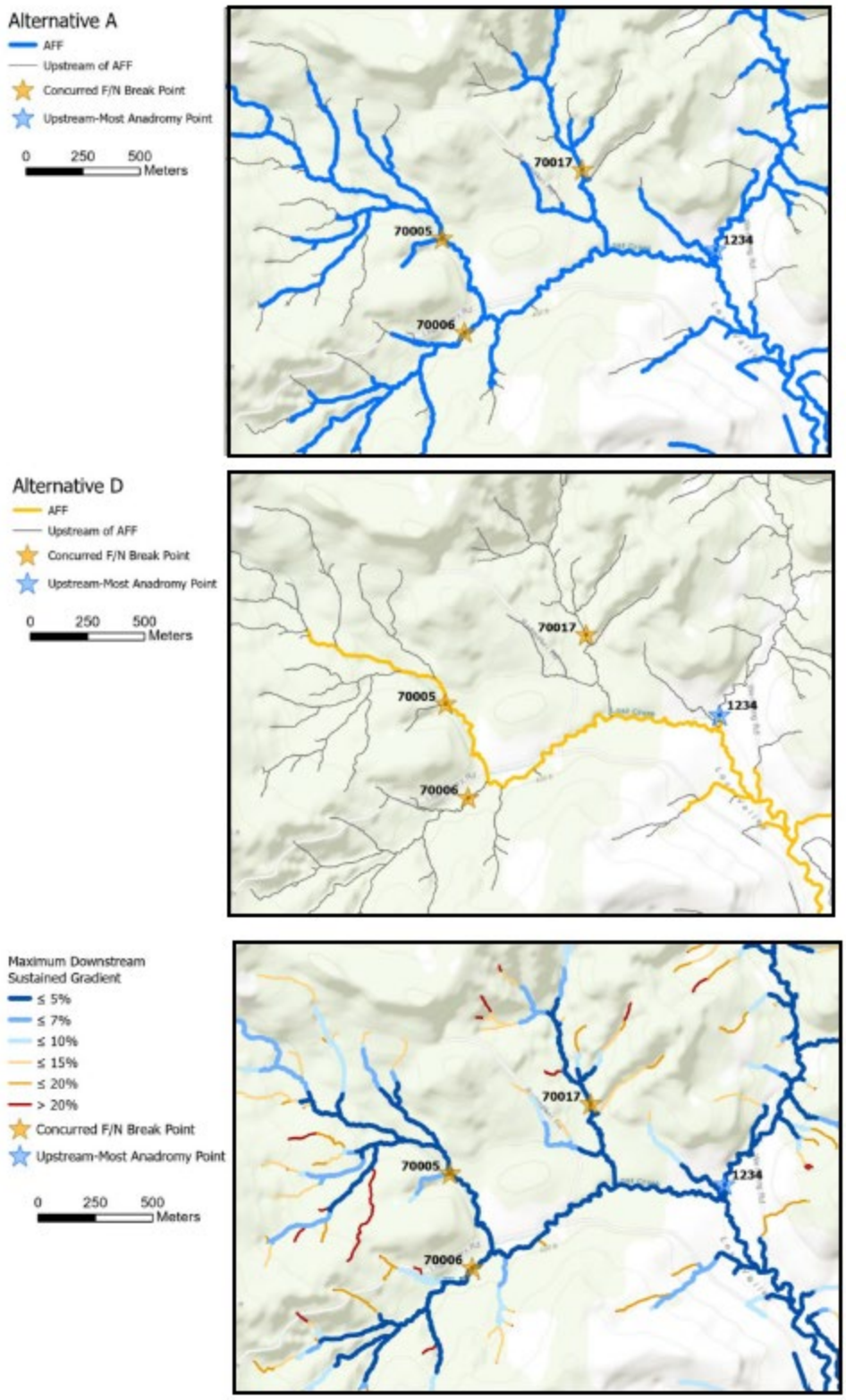



Figure 1. Example maps from a portion of the Stillman Creek basin in southwestern Washington. The top panel shows modeled Alternative A; the middle panel shows modeled Alternative D; the bottom panel shows the maximum downstream sustained gradients.

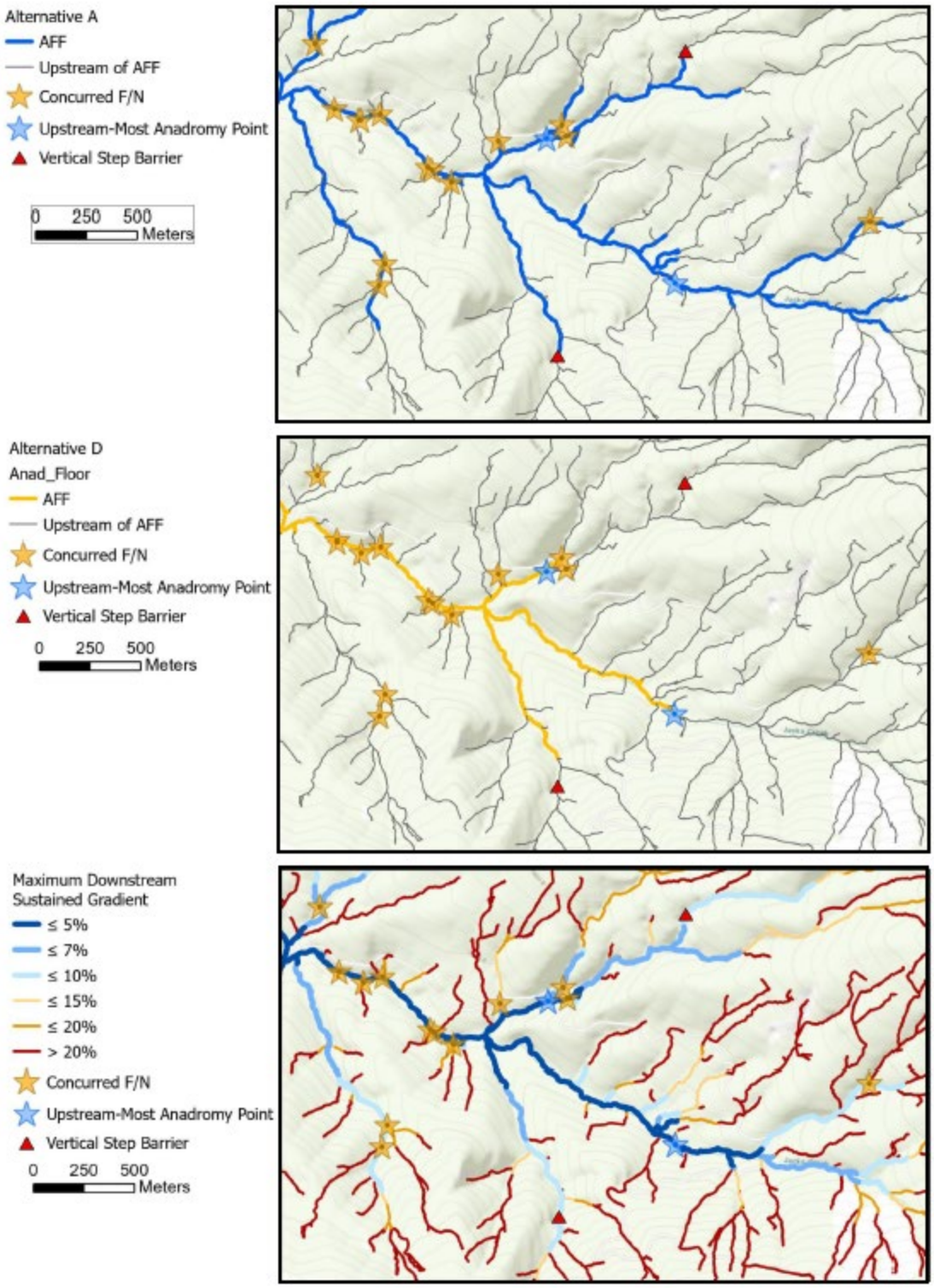



Figure 2. Example maps from a portion of the Kalama watershed in southwestern Washington. The top panel shows modeled Alternative A; the middle panel shows modeled Alternative D; the bottom panel shows the maximum downstream sustained gradients.

- What is the relative performance of each alternative in minimizing the length of reaches within known or presumed anadromy but upstream of the modelled end of AFF (undershoots)?
  - Compare the length of kilometers shown on the "AFF ends downstream of other anadromy" line of Table 2.
  - Alternatives that used a 10% gradient threshold tended to encompass a higher percentage of anadromous fish data and extend a greater distance upstream of those points than alternatives that used lower gradient thresholds (e.g. 5%) or that used a 5% change in gradient.
  - Alternatives that used lower gradient thresholds or that used a 5% change in gradient tended to fall short of the anadromous points more often and by greater distances than alternatives that used larger gradient thresholds.
  - Alternative D undershoots "Other anadromy" nineteen times more distance than does Alternative A4.

- What is the relative performance of each alternative in extending modelled AFF length upstream and downstream of SWIFD?
  - Compare the length of kilometers shown on the "AFF ends upstream of SWIFD" line of Table 2.
  - Alternatives C10% and E10% extended AFF the furthest above SWIFD, with Alternatives A, A3 and A4 still extending significant distances above SWIFD locations more often and over greater distances than the alternatives that used lower gradient thresholds.
  - By including associated tributaries lacking a 5% gradient increase or permanent natural obstacle at the junction with the main stem, Alternative D extends modelled AFF length 1384 kilometers above SWIFD.
  - Including an anadromous core in the alternative also prevented the AFF from terminating below waters already identified as anadromous in SWIFD.

Other findings from the AFF Findings Report pertinent to relative performance of the AFF alternatives:

Relation of the AFF alternatives to Anadromy

Relation of the AFF alternatives to Anadromy

- Alternatives that used a 10% gradient threshold tended to encompass a higher percentage of anadromous fish data and extend a greater distance upstream of those points than alternatives that used lower gradient thresholds (e.g. 5%) or that used a 5% change in gradient.
- Alternatives that used lower gradient thresholds or that used a 5% change in gradient tended to fall short of the anadromous points more often and by greater distances than alternatives that used larger gradient thresholds.
- Many of the overall observed anadromous fish data points were located in low gradient streams (<2% gradient). ~90% of the anadromous data points had downstream sustained gradients of 10% or less. ~60% of the anadromous data points had downstream sustained gradients of 5% or less.

Relations of the AFF alternatives to barriers

- The inclusion of natural barriers as AFF termination points reduced the overall lengths of the AFF when compared to similar alternatives that relied solely on gradient thresholds.
- The inclusion of barriers in Alternatives A, A3 and A4 reduced the cumulative channel length of those alternatives so they became similar to Alternatives C7% and E7%

Sustained gradients downstream from documented or presumed fish data

- 63% of the anadromous occurrence points have a maximum downstream gradient of 5% or less (mean 4.7%, median 3.7%); 75% have maximum downstream gradient values of 7% or less; and 88% have maximum downstream gradient values of 10% or less.
- 28% of the F/N occurrence points have a maximum downstream gradient of 5% or less; 60% have maximum downstream gradient values of 7% or less; and 68% have maximum downstream gradient values of 10% or less (mean 8.4%, median 7.5%).
- It is important to consider the following when interpreting the steepest downstream gradient results: as discussed above, the documented and presumed anadromy points used in this analysis do not necessarily represent the upstream extent of anadromy (anadromy likely extends further upstream, and above steeper sustained gradients) and may not capture the full range of anadromy.
- Similarly, many anadromous data points may be located in floodplain channels that never reach gradients higher than a few percent (i.e. the reason for the end of anadromous habitat is a factor not related to gradient such as the end of the channel, or an obstacle or barrier to upstream movement, not a steep gradient).
- Therefore, while the steepest downstream gradient results provide some context for the likely range in gradients within anadromous habitat, the true form of the distribution remains unknown.

## Policy Questions and AFF Policy Findings

### Policy Questions

- What is or should be the balance between selecting an AFF alternative which extends AFF further upstream in watersheds without fish data (thereby reducing electrofishing and determining water type (F/N break) in a subset of streams) and selecting an AFF alternative with a lower probability of overshooting likely F/N breaks if electrofishing were allowed?
    - Patterns seen in the watersheds with fish data where the performance of the alternatives were spatially analyzed may be inferrable to watersheds that currently do not have any fish data, but absent field validation is unknown.
    - While there remains uncertainty over the absolute stream lengths that would be affected by each alternative, we have confidence that the results of the spatial analysis allow for reliable comparison of the relative performance of the alternative to each other.
    - From a regulatory perspective, the AFF will determine where FHAM begins and electrofishing will be allowed.
    - Depending on the alternative selected by the Board, the AFF alternative selected by the Board essentially becomes the water typing system for some unknown proportion of stream miles in streams with no fish data or that have not been water typed.

- If the unknown fish use streams exhibit similar patterns as the streams for which we have fish occurrence data, we can assume that Alternatives A, A3 and A4 will extend beyond the regulatory water type break (F/N) that would have been found under the current interim water typing rule in a greater number of cases and for greater lengths of channel. Conversely, we can assume that Alternative D would allow for electrofishing in a greater length of channel that may host anadromous fish.
- In streams where there is currently no fish data or have yet to be water typed, applying Alternative D results in the most amount of stream length open to future protocol surveying by FHAM. Under Alternatives A, A3 or A4, more than twice the stream length would be presumed anadromous and not open to protocol fish surveying than Alternative D.
- As noted above in the "Pertinent findings from AFF Spatial Analysis Findings Report" section of this AFF Policy Memo, Alternative D ends the least distance above F/N break points (6 kilometers).

- How easily can the anadromous fish floor be identified and applied in the field in a repeatable manner, using each alternative? This question, others like it and the responses to those questions fall into the category of implementation issues.

**Implementation**

- Simply stated, discrete SWIFD location points already exist within digital-format datasets jointly managed by the western Washington treaty tribes and WDFW, the location of which points can be fairly accurately transferred onto and found on the ground, with relatively simple mapping tools and field orientation skills; no geographically widespread database of sustained gradient threshold features currently exist for the gradients stated in all of the gradient threshold-based alternatives, and no such statewide database is anticipated to exist for quite some time, due to statewide high resolution LiDAR coverage being incomplete. Statewide high resolution LiDAR coverage will be necessary for development of a statewide map identifying the first occurrence of gradient thresholds upstream from saltwater, the location of permanent natural barriers, or for full field implementation of any statewide gradient threshold-based AFF.
- Alternatives A, C and E require searching for AFF criteria above or below the location where a protocol survey is contemplated. This could be implemented in at least two ways:
  (1) Develop a statewide map identifying the (a) first occurrence of gradient thresholds upstream from saltwater and (b) the location of permanent natural barriers. This map likely would need to be created based on a modeling exercise similar to the work done on this project. Actual final placement of the AFF would be based on field verification as part of the FHAM process. High resolution LiDAR (sub-meter or better resolution) would likely be required state-wide to develop the synthetic stream network required to produce reliable maps to implement Alternatives A, C and E.
    - Given that all of the AFF alternatives extended above some proportion of the F/N break point locations, there will likely be site-specific situations (in streams where there is currently no fish data or have yet to be water typed) where landowners will question a sustained gradient AFF as the appropriate starting

point for an FHAM survey. In such situations, a field procedure will need to be developed to allow landowners and / or protocol fish surveyors to initiate an FHAM survey downstream of a sustained gradient AFF without going through a field ID team process.

(2) Make the assumption, absent any other information or access to downstream reaches, there are no permanent natural barriers downstream and/or channel gradients downstream that are lower than the gradient at the downstream edge of the property line. Field identification of the AFF would then proceed upstream from that downstream property line.

- As noted above, high resolution LiDAR would likely be required state-wide to produce reliable maps to implement Alternatives A, C and E, as well as Alternatives A3 and A4 which also utilize gradient thresholds. Development of a statewide LiDAR-derived stream network is not anticipated for many (but an unknown number of) years.
- Assuming the assumption articulated in (2) above, would require development of a field-based implementation protocol to field identify of the AFF (appropriate sustained gradient threshold or a permanent natural barrier defined by the selected AFF alternative) that is upstream of a downstream property line, in order to initiate FHAM.

- Alternatives incorporating SWIFD (A3, A4, and D) implementation involve initiating FHAM field surveys (in the case of Alternative D) at or upstream from the mapped location of a SWIFD point or (in the case of Alternatives A3 or A4) initiating the search for a 10% sustained gradient or permanent natural barrier at or upstream of a SWIFD point before initiating FHAM. Associated tributaries downstream of a SWIFD points would require field identification of the absence of a 5% gradient increase or permanent natural obstacle at the junction with the main stem, in order to presume anadromy up to the next Potential Habitat Break (PHB), where a FHAM survey may commence. FHAM surveys verify the absence of fish upstream from the sustained gradient, obstacle, stream junction size change (except for junctions with a SWIFD stream), barrier features, or PHB as defined in each alternative.
- Alternative A3, A4, and D rely on formally incorporating SWIFD into the Forest Practices water typing process. If any of these alternatives are adopted into the water typing process, DNR will need to update their Forest Practices Application Mapping Tool, or other formats (digital GIS layers, shapefiles, etc.) with the discrete locations and any narrative information associated with known and presumed SWIFD points and make the data available to the public. DNR may choose to incorporate SWIFD points directly into their current hydro layer or a National Hydrography Dataset (NHD)-derived upgrade of the current hydro layer. Substantial work will be required to complete such an update and will likely be subject to potential errors resulting from the data transfer process. Similarly, formally updating SWIFD with new data or information on fish distribution has proven in the past to be a difficult and time-consuming process. In the interim, a field-based implementation protocol will need to be developed, and DNR would need to develop a

mechanism of updating the 'anadromous core' with new data on anadromous distribution, similar to how water types are updated through the water type modification process. Consideration of challenges to map-based AFF implementation should be weighed against the difficulty of consistently identifying channel features such as barriers or obstacles and measuring gradient and channel width using a consistent method in the field.

- Whichever AFF alternative may be adopted into rule, there will be some situations where ID Teams will be appropriate to address site-specific conditions.
- Finally, no matter which AFF alternative is eventually selected by the Board, guidance will need to be developed (preferably in Board Manual Section 23) to deal with the inevitable situation where an AFF endpoint is shown on a map as located on land owned by another party, to which a protocol fish surveyor has no legal access or where no AFF gradient threshold map exists and the surveyor is required to locate the AFF in the field in an area of mixed ownership. The guidance should include protocols to be followed where these and other implementation issues present themselves.

## AFF Policy Recommendations

- In the water typing system, concurred F/N break points should take precedence over where an AFF overshoots or undershoots a concurred F/N break. There should be no need to apply AFF or FHAM in these locations.
- If adopted into rule, include an AFF alternative as part of the water typing Fish Habitat Assessment Methodology (FHAM) currently under rule consideration by the FP Board, with implementation to be covered in Board Manual section 23.
- Locations where the AFF extends into streams where no fish data exists may preclude a fish habitat survey using FHAM downstream of the AFF. These are the remaining streams statewide where the water typing needs to be completed. Given that large number of streams, the many miles of streams where water typing has not yet been verified in the field, and the uncertainty in AFF reliability, careful consideration should be given to the how these streams should be classified.
- Given the uncertainty with this modelling exercise, and the time necessary to complete a validation study, site specific challenges through ID team consultation will be available

**AFF Policy Recommendations for an Anadromous Fish Floor**

Based upon the AFF Findings Report, the Policy members of the AFF Workgroup are in consensus recommending no further consideration by the Board Committee and Board of AFF Alternatives A, C5%, C7%, C10%, E5%, E7%, E10%, and A3 to establish the location where protocol fish surveys to determine water type may begin. The Policy members of the AFF Workgroup have a shared belief that there is limited possibility for consensus for the alternatives listed above, and a greater possibility for consensus by continuing to keep for consideration Alternatives D and A4, while adding for consideration two new alternatives, described below, which will require further spatial analyses.

The Policy members of the AFF Workgroup have not yet reached consensus AFF recommendation for a single AFF alternative to establish the location where protocol fish surveys utilizing FHAM may begin. We have however reached consensus on a recommendation to the Board Committee and Board for:

- continued consideration of Alternative D and A4 (10%), and
- consideration of two new AFF alternatives, Alternative A4 (7%) and Alternative A4 (5%); the general outline of these two new AFF alternatives is as follows:

**Alternative A4 (7%)** as waters within anadromous fish floor as defined:

- All waters included in the SWIFD GIS database of documented (observed) and presumed anadromy, plus upstream associated waters occurring below a sustained gradient of **7%** or a permanent natural barrier, whichever comes first. For the purposes of Alternative A4 (**7%)**, permanent natural barrier as defined using the barrier definition (below); and
- All waters connected to saltwater and extending upstream to a sustained **7%** gradient or a permanent natural barrier as defined using the barrier definition (below) within streams with no anadromous fish data.

**Alternative A4 (5%)** as waters within anadromous fish floor as defined:

- All waters included in the SWIFD GIS database of documented (observed) and presumed anadromy, plus upstream associated waters occurring below a sustained gradient of **5**% or a permanent natural barrier, whichever comes first. For the purposes of Alternative A4 (**5**%), a permanent natural barrier is defined using the barrier definition (below); and
- All waters connected to saltwater and extending upstream to a sustained **5**% gradient or a permanent natural barrier as defined using the barrier definition (below) within streams with no anadromous fish data.

Both of the A4 (7%) and A4 (5%) alternatives share the same barrier definitions, as follows:
Non-vertical Barrier:

- Channels < 5 feet in width: sustained gradient ≥ 20% for ≥ 100 feet (30 meters) without resting areas.
- Channels 5 – 10 feet in width: sustained gradient ≥ 20% for ≥ 250 feet (76 meters) without resting areas.
- Channels > 10 feet in width: sustained gradient ≥ 20% for ≥ 515 feet (160 meters) without resting areas.

Vertical Barrier (permanent natural features):

- Channels < 5 feet in width: near vertical drop ≥ 5 feet in height (1.5 meters)
- Channels 5 – 10 feet in width: near vertical drop ≥ 8 feet in height (2.5 meters)
- Channels > 10 feet in width: near vertical drop ≥ 12 feet in height (3.7 meters)

- The Policy members of the AFF Workgroup also request from the Board Committee / Board that additional time be allowed for the AFF Workgroup to have performed by TerrainWorks appropriate spatial analyses (defined in a Scope of Work) of these two new alternatives, and

have maps of the sample watersheds produced showing all components of all alternatives for the purpose of informing a workshop with the Board Committee and full Board.

While Alternative D minimizes the extension of modelled AFF the least distance above concurred F/N break points (and only on lateral / tributary streams, not terminal channels), new Alternatives A4 (7%) and A4 (5%) may reduce extensions of modelled AFF above concurred F/N break points to potentially acceptable distances, as well as reducing, in the absence of statewide high resolution LiDAR coverage, the extent of field time required to locate sustained gradient thresholds above SWIFD points, to initiate FHAM protocol fish surveys.

On the other hand, Alternative D also has the greatest undershoot of 'other anadromy' where Alternative A has the least. It will be informative to see the results of the analysis of A4 (7%) and A4 (5%) as this is the area of anadromous fish use that may be subjected to electrofishing.

**AFF Policy Recommendations for potential future field studies**

As anticipated, the findings of the AFF Workgroup would have benefited from a field-based anadromous distribution dataset against which the alternatives could have been compared for a more direct assessment of performance.

There are other shortcomings and uncertainty issues associated with the process that could be addressed with and form the basis for development of several action items and potential future field studies:

- a literature review of anadromous fish distribution relationships with physical stream characteristics
- a field-based validation study to address the following uncertainties:
  - lack of field validation of fish points and modeled channel attributes, including gradient and barrier feature, PHBs.
  - channel gradients: Modeled gradients are likely extending each alternative higher in the stream networks than they would be if the gradients were measured in the field.
  - stream lengths: Estimates of absolute stream lengths are not reliable, resulting in greater confidence in the relative distances computed for each alternative and less confidence that the absolute distances would be the same as would be implemented in an eventual rule.

The Policy members of the AFF Workgroup also support the "Future Field Studies" recommendations included in the AFF Findings Report, as follows:

- Potential future field studies could be designed to validate the GIS analysis, improve our understanding of anadromous fish distribution and their habitat associations, and validate the criteria used to define the AFF. Specifically, validation of the GIS analysis could include field surveys of stream gradient, channel width, and barrier / obstacle locations to compare against estimates produced by the TerrainWorks GIS model.

- Research could be designed to address gaps in our understanding of anadromous fish presence / absence. For example, interannual and seasonal variability in the distribution of anadromous fish could be addressed through eDNA surveys or targeted electrofishing. Importantly, physical habitat surveys should be combined with fish observations to form a complete picture of anadromous fish associations with habitat characteristics. Similarly, validation of the criteria identified in an AFF rule could be accomplished by the addition of fields on the WTMF for surveyors to identify the locations where anadromous fish are observed and the associated habitat characteristics.
- Regardless of the AFF alternative selected, these ideas could be a future focus of adaptive management to validate the results found using the opportunistic data included in this report.

Subject to Board action to include an anadromous fish floor as part of a permanent forest practices water typing system rule, the Policy members of the AFF Workgroup recommend that the Compliance Monitoring Program evaluate whether the Program should include compliance monitoring of implementation of an anadromous fish floor rule as part of their standard or special emphasis sampling.