Special Board Meeting (Field Tour) – November 13, 2018
Natural Resources Building, Room 172, Olympia

Please note: The field tour provides the opportunity for Board members to learn about ongoing and future topics. The field tour will not be recorded. **No public comment will be taken and no Board action will occur during the tour.**

DRAFT AGENDA

12:30 p.m. – 12:40 p.m.	**Welcome and Introductions**
12:40 p.m. – 1:15 p.m.	**Overview of Field Tour** **Description of an Alternate Plan and an Alternate Plan Template** – Marc Ratcliff, Department of Natural Resources (DNR) • Existing Rule and Board Manual Guidance including description of two approved templates in Board Manual Section 21 **Update on TFW Policy Committee's Work** – Marc Engel, DNR Status of Review of: • Proposal Initiation; and • Existing draft Conifer Restoration and Conifer Thinning Templates **Description of Site Demonstration** – Ken Miller, landowner and Marc Engel, DNR
1:30 p.m.	**Depart Natural Resources Building P-1 Visitor Parking Lot** Visit proposed small forest landowner template field demonstration on Ken Miller's property.
5:00 p.m.	Return to Natural Resources Building

Notice to Public: Members of the public who wish to attend the field tour are encouraged to make a reservation by calling Patricia Anderson at 360-902-1413 by **November 9, 2018**.

Carpools and driving appropriate vehicles for terrain are encouraged. Public attendees are responsible for their own transportation, hard hat and safety vest. A hard hat will be **required** to walk through the forested environment, safety vest is optional. A tour map will be available on the morning of the tour.

Regular Board Meeting – November 14, 2018
Natural Resources Building, Room 172, Olympia

Please note: All times are estimates to assist in scheduling and may be changed subject to the business of the day and at the Chair's discretion. The meeting will be recorded.

DRAFT AGENDA

9:00 a.m.	**Welcome and Introductions** Safety Briefing – Patricia Anderson, Department of Natural Resources (DNR)
9:10 a.m. – 9:30 a.m.	**Report from Chair**
9:30 a.m. – 9:45 a.m.	**Public Comment** – This time is for public comment on general Board topics.
9:45 a.m. – 9:55 a.m.	**Approval of Minutes** *Action: Consider approval of August 8, 2018 meeting minutes.*
9:55 a.m. – 10:25 a.m.	**Field Tour Debrief**
10:25 a.m. – 10:35 a.m.	**Northern Spotted Owl Conservation Advisory Group** – Marc Engel, DNR
10:35 a.m. – 10:45 a.m.	**Public Comment on NSO Conservation Advisory Group**
10:45 a.m. – 10:55 a.m.	**Northern Spotted Owl Conservation Advisory Group** – Marc Engel, DNR *Action: Consider retaining NSO Conservation Advisory Group.*
10:55 a.m. – 11:05 a.m.	**Break**
11:05 a.m. – 11:20 a.m.	**Water Typing System Rule Update** – Marc Engel, DNR
11:20 a.m. – 11:35 a.m.	**Potential Habitat Break Pilot Study Results**– Hans Berge, AMPA
11:35 a.m. – 11:50 a.m.	**Potential Habitat Break Validation Study Design and Budget** – Hans Berge, AMPA
11:50 a.m. – 12:00 p.m.	**Public Comment on Potential Habitat Break Validation Study Design and Budget**
12:00 p.m. – 1:00 p.m.	**Lunch**
1:00 p.m. – 1:30 p.m.	**Potential Habitat Break Validation Study Design -** Hans Berge, AMPA *Action: Consider accepting study design and directing CMER to begin work*
1:30 p.m. – 1:45 p.m.	**Public Comment** – This time is for public comment on general Board topics for those who could not comment in the morning.
1:45 p.m. – 2:30 p.m.	**Addendum to January 2018 Science Panel report listing science used for PHB recommendations on tributary streams** – Science Panel
2:30 p.m. – 3:00 p.m.	**Recommendations for 2019 Stream Survey Protocol –** Dave Herrera and Jeff Davis, Board Members
3:00 p.m. - 3:15 min	**Update of Board Committee on Efficiency and Effectiveness Improvements for the Adaptive Management Program** – Lisa Janicki, Board Committee Chair
3:15 p.m. – 3:30 p.m.	**Break**
3:30 p.m. – 4:10 p.m.	**Compliance Monitoring 2016-2017 Biennial Report** – Garren Andrews

Future FPB Meetings

4:10 p.m. – 4:25 p.m.	**Staff Reports** A. **Adaptive Management Update** – Hans Berge, AMPA B. **Compliance Monitoring –** Garren Andrews, DNR C. **Small Forest Landowner Office Update -**Tami Miketa, DNR D. **Upland Wildlife Update –** Gary Bell, Washington Department of Fish and Wildlife
4:25 p.m. – 4:50 p.m.	**2019 Work Planning -** Marc Engel, DNR
	Executive Session To discuss anticipated litigation, pending litigation, or any other matter suitable for Executive Session under RCW 42.30.11.

FOREST PRACTICES BOARD
Regular Board Meeting
August 8, 2018
Natural Resources Building, Room 172
Olympia, Washington

Members Present
Stephen Bernath, Chair, Department of Natural Resources
Ben Serr, Designee for Director, Department of Commerce
Bob Guenther, General Public Member/Small Forest Landowner
Brent Davies, General Public Member
Carmen Smith, General Public Member/Independent Logging Contractor
Dave Herrera, General Public Member
Jeff Davis, Designee for Director, Department of Fish and Wildlife
Lisa Janicki, Elected County Official
Noel Willet, Timber Products Union Representative
Patrick Capper, Designee for Director, Department of Agriculture
Paula Swedeen, General Public Member
Tom Laurie, Designee for Director, Department of Ecology
Tom Nelson, General Public Member

Staff
Joe Shramek, Forest Practices Division Manager
Marc Engel, Forest Practices Assistant Division Manager
Patricia Anderson, Rules Coordinator
Phil Ferester, Senior Counsel

WELCOME AND INTRODUCTIONS
Chair Bernath called the Forest Practices Board (Board) meeting to order at 9:00 a.m.

REPORT FROM CHAIR
Chair Bernath acknowledged and thanked Scott Swanson for his leadership as the Timber, Fish
and Wildlife (TFW) Policy Committee (Policy) co-chair from February 2017 to July 2018. He
then introduced the new co-chairs, Curt Veldhuisen, Skagit River Cooperative and Terra Rentz,
Department of Fish and Wildlife. He also recognized Mary Scurlock's role as the Conservation
Caucus representative at Policy and introduced Alec Brown as her replacement.

He provided an update on the status of the facilitated tribal cultural resources process, reporting
that a policy-level cultural resources meeting is scheduled for September between the tribes,
forest landowners and the state, with the goal of reaching an agreement for next steps to be
presented to the Board in November.

He said to date, DNR has responded to 958 fire starts, burning approximately 145,000 acres.
Many forest practices staff participate in fire suppression activities and if conditions continue as
forecasted, he may consider requesting landowners temporarily delay submitting forest practices
applications in light of short staffing.

1   He then reported that once DNR has developed the details of a proposed 2019/2020 biennium
2   budget, he plans to solicit stakeholder support for programs such as the Forestry Riparian
3   Easement Program and the Family Forest Fish Passage Program.
4
5   **PUBLIC COMMENT (AM)**
6   Jim Peters, Northwest Indian Fisheries Commission (NWIFC), said the Clean Water Act (CWA)
7   assurances have always been a high priority for the western Washington tribes. The tribes
8   recognize the Department of Ecology (Ecology) and the federal Environmental Protection
9   Agency as leaders on water quality projects and, as co-managers; the tribes support their
10 continued work and funding on water quality issues.
11
12 Ray Entz, Kalispel Tribe, suggested that an emphasis on wildfire impacts be a priority for Policy.
13 Entz also shared his concerns with the report from the Board's committee on Adaptive
14 Management Program (AMP) improvements. He appreciated the candid comments captured in
15 the report prepared for the committee providing an understanding of how folks felt about the
16 AMP, however he was shocked to read the personal attacks toward the Adaptive Management
17 Program Administrator (AMPA). He applauded Hans Berge for his work in the program and his
18 desire to maintain integrity through the science process. He said the Board has the authority to
19 implement change and does not believe the Board needs the principals to implement program
20 changes.
21
22 **APPROVAL OF MINUTES**
23 MOTION: Tom Nelson moved the Forest Practices Board approve the May 9, 2018
24   meeting minutes.
25
26 SECONDED: Jeff Davis
27
28 Board Discussion:
29 None.
30
31 ACTION: Motion passed. 12 Support / 1 Abstention (Serr).
32
33 **TFW POLICY COMMITTEE'S 2019 PRIORITIES**
34 Curt Veldhuisen and Terra Rentz, Co-chairs, reviewed the 2019 priorities outlined in their report.
35 This includes work on Type F, the small forest landowner riparian template, the unstable slopes
36 proposal initiation, continued budget review discussions and considering the Type N study
37 findings.
38
39 Rentz said they will be working to reestablish trust within Policy and will focus on the proposed
40 improvements from the AMP review. She mentioned two proposed recommendations –
41 incorporating potential impacts of climate change into scientific project planning and improving
42 relationships between Policy and the Cooperative Monitoring, Evaluation, and Research
43 Committee (CMER).
44
45 Chair Bernath asked about the timing for the Hard Rock Type N study.
46

1   Rentz said Policy voted to accept the findings and report at their July meeting and by August 23,
2   they hope to determine alternatives. Policy will then have 60 days to develop a suite of potential
3   recommendations and then an additional 45 days to develop a single set of recommendation(s) to
4   present to the Board.
5
6   Veldhuisen emphasized that the Hard Rock Type N study involves a lot of material. He said
7   current conversations are focused on the forest practices program commitments to clean water
8   requirements. He said the study focused on temperature responses resulting from different
9   riparian prescriptions along Type N waters.
10
11 Rentz confirmed Policy's commitment to keep the volume of information understandable and
12 transparent. She invited Board members to visit an upcoming Policy meeting to observe the
13 committee in action.
14
15 Phil Ferester, Board Counsel, reminded Board members to coordinate with Patricia Anderson in
16 advance of attending or participating in a Policy meeting to ensure the meeting is posted if there
17 is a potential for a Board quorum to materialize at such a meeting.
18
19 Board Member Laurie asked if January 2019 was the month Policy plans to send
20 recommendations to the Board in advance of the February 2019 meeting.
21
22 Veldhuisen said the clock started in early July and following the 180-day schedule indicates that
23 January is the target month for providing recommendations to the Board.
24
25 **CLEAN WATER ACT ASSURANCES ANNUAL REPORT**
26 Mark Hicks, Ecology, updated the Board on the status of the CWA milestones. Since his update
27 to the Board in February 2018, one milestone has been completed – the Eastside Type N
28 Experimental Treatment Study. He provided a brief history on how the CWA assurances came
29 about and the establishment of various milestones after Ecology granted a 10-year extension in
30 2009 for meeting the assurances. He said several milestones remain off track due to limited
31 project funding, disagreement amongst stakeholders and competing priorities.
32
33 He said that Ecology believes the AMP is not working as intended in the Forests and Fish
34 legislation. Ecology has not yet made a determination to offer programmatic CWA assurances or
35 an extension of the milestones after the 2019 deadline. He said although Ecology has not seen
36 the results they had expected, they still see a high intrinsic value to the program and is
37 encouraged with the Board's commitment for program improvements. He said Ecology is
38 optimistic the Board will continue to support CMER projects, which will help complete the
39 outstanding milestones.
40
41 Board Member Swedeen asked why the Type N Effectiveness study took nine years to complete
42 and if the subcommittee is on track for meeting the CWA milestones.
43
44 Hicks said the reasons are complex and diverse. He said changing priorities, inconsistent
45 decision-making or lack of commitment by caucuses have created the most difficulties. He said

1   the solution might be in getting folks at the table who understand the science, are willing to
2   follow the process and are willing to share each other's issues.
3
4   **UPDATE ON PHB PILOT STUDY AND VALIDATION STUDY DESIGN**
5   Hans Berge, AMPA, and Dr. Phil Roni, science panel member, provided an update on the
6   Potential Habitat Break (PHB) Pilot Study and Validation Study design. Berge said they plan to
7   present the final study design and the results of the pilot to the Board at the November 2018
8   meeting. The design of the validation study calls for the sampling of streams during three
9   seasons each year over a three-year timeframe. He said the design calls for the completion of the
10 final report in 2023 following the process to bring a study through the AMP as outlined in Board
11 Manual Section 22.
12
13 Berge said the original study design was provided to stakeholders for review. The science panel
14 received comments from stakeholders and from an independent science team. The revised study
15 design is currently under a formal independent science peer review (ISPR). The panel expects to
16 receive the results of ISPR review in September and will present the final validation study design
17 to the Board in November.
18
19 Dr. Roni provided a brief update on the pilot study. He reported it is underway and when
20 completed it will help inform how to effectively conduct the validation study. He said
21 approximately 15 sites have been identified for western Washington and six sites have been
22 sampled to date. He said they are currently evaluating sites for eastern Washington. The
23 sampling is expected to be completed by the end of August and the science panel plans to
24 provide the results to the Board in November.
25
26 He said the stream survey methodology begins at the 'end of fish' point identified on an
27 approved water type modification form. From that point, the survey team will measure and
28 record detailed PHB data. The data collected will include bankfull width and wetted width data
29 on downed wood and a description of the stream's substrate. He said getting to some sites is
30 proving problematic due to increased fire risk, closed gates and difficult stream access.
31
32 Berge clarified that the validation study will be focused on those physical characteristics that
33 would define a PHB and is not focused on the anadromous zone.
34
35 Dr. Roni explained that the data collection process is extensive. He provided one preliminary
36 example for how extensive the data sampling is for one of the streams they have recently
37 surveyed.
38
39 Board Member Nelson thought it would be beneficial for Board members to see one of these
40 sites on the ground to gain a perspective for identifying PHBs.
41
42 Dr. Roni explained that most sites are near the Vail Tree Farm and some have adequate access.
43
44 **CMER MASTER PROJECT SCHEDULE**
45 Chair Bernath outlined the CMER budget approval process. He said the Board would be asked to
46 approve a proposed CMER Master Project Schedule budget for submittal to the Governor's

1   office. DNR will then put the request in the biennial legislative budget and, based on the funding
2   level actually allocated by the Legislature, Policy will fine-tune the CMER Master Project
3   Schedule and associated budget for Board consideration and approval next summer for the
4   CMER FY 2020-2021 budget.
5
6   Hans Berge, AMPA, discussed the process used by Policy to recommend a balanced budget. He
7   said the challenging part was to arrive at consensus regarding priorities. The budget presented
8   today is for the 2020-2021 biennial calendar. He further explained why some zeros occur within
9   the budget, contingency funding for future studies and adjustments that may occur to the
10 $250,000 set aside for Type N extended monitoring.
11
12 Berge explained several of the 'below the line' (not currently recommended for funding)
13 projects. He said these projects may be candidates for funding and if so, Policy would come up
14 with the structure for arriving at funding. These projects used to be above the line, but moved
15 below due to prioritization.
16
17 **PUBLIC COMMENT ON CMER MASTER PROJECT SCHEDULE**
18 Alec Brown, Conservation Caucus, described why his caucus voted sideways on the budget.
19 They are concerned with how extended monitoring projects have been approved and funded. He
20 said their caucus is appreciative of how the budget came together, but would like to see a
21 formalized adaptive management process to evaluate the need to implement and fund future
22 extended monitoring projects.
23
24 Ray Entz, Kalispel Tribe and representing Upper Columbia United Tribes, said he appreciates
25 the effort by Policy to balance the budget. He has concerns with 'add-on' projects because it may
26 set a precedent for how such projects are funded in the future. They would like to see the AMP
27 move forward on rule effectiveness studies and not focus on extended monitoring projects.
28
29 Karen Terwilleger, Washington Forest Protection Association (WFPA), acknowledged the
30 considerable time Policy spent on the budget. She said that unfunded projects on the Master
31 Project Schedule (MPS) shown as "below the line projects" allows Policy to decide if they are
32 appropriate to remain on the MPS budget and allows new projects to come forward when
33 funding becomes available. The goal of the MPS process used by Policy is to provide a more
34 rational thought behind the prioritization of the AMP work. She said WFPA is in support of
35 extended monitoring, but does not want it to delay other water quality related projects.
36
37 **CMER MASTER PROJECT SCHEDULE**
38 Hans Berge, AMPA, referring to the budget spreadsheet, said line 38 (Type N Buffer Treatment
39 Project Extended Monitoring through FY 2021) did not go through the normal CMER process.
40 He said it is a placeholder, if needed, for extended monitoring. He said it would be helpful if
41 CMER came up with criteria for determining when extended monitoring is warranted. He
42 clarified that the eastside scientist position is scheduled to begin in December 2018.
43
44 Nelson suggested Board members be in support of securing other funding sources to cover these
45 projects since the Business and Occupation Tax surcharge funding the Forests and Fish account
46 is set to expire in 2024.

1

2 Swedeen said extended monitoring should be a placeholder, not an expectation. She asked that
3 discussions occur to arrive at the feasibility and appropriateness to include extended monitoring.
4
5 Chair Bernath asked Veldhuisen and Rentz if discussions could occur regarding extended
6 monitoring evaluations.
7
8 Rentz said she believes so but thought it should be coordinated with CMER. Veldhuisen added
9 that the Policy budget subcommittee will be continuing their discussions and may take up this
10 issue. He said it is a fair request and believes it could happen.
11
12 Chair Bernath confirmed that the group would bring back clarity on when projects would need
13 extended monitoring.
14
15 MOTION: Patrick Capper moved the Forest Practices Board approve the 2019-2021 Master
16   Project Schedule. The Forest Practices Board also finds that the program is in
17   substantial compliance with the 2017-2019 CMER master project schedule.
18
19 SECONDED: Bob Guenther
20
21 Board Discussion:
22 None.
23
24 ACTION: Motion passed unanimously.
25
26 **WATER TYPING SYSTEM RULE MAKING & GUIDANCE UPDATE**
27 Marc Engel, DNR, said staff is working to incorporate the Board-accepted items for a permanent
28 rule and board manual guidance. Four rule development meetings have occurred to review the
29 draft language. The working draft includes combining elements of WAC 222-16-030 and -031,
30 new definition for off-channel habitat and the two ways to establish the Type F/N break –
31 retaining the physical characteristics currently in -031 and the new fish habitat assessment
32 methodology (FHAM).
33
34 He said that board manual development includes guidance for how to conduct the FHAM,
35 updated best management practices for protocol electrofishing surveys and how to delineate off-
36 channel habitat. Three field visits have occurred to assess the feasibility for finding the PHBs on
37 the ground identified in the three Board approved options for consideration. Staff is also working
38 with stakeholders to create language for consistently measuring stream gradient, bankfull width
39 and the obstacles for each PHB option. He said additional field days would be scheduled for next
40 spring to further test and refine the process.
41
42 He said the rule proposal, per the Administrative Procedures Act, Regulatory Fairness Act and
43 SEPA, would include an economic and environmental analyses. DNR has convened an advisory
44 group of economists to help identify the elements for consideration to assess the costs of the
45 rulemaking to the landowners and the benefits of the rulemaking to fish. The group includes

1 economists from DNR, Ecology, WFPA and the small forest landowner community as well as
2 tribal participation.
3
4 The economist advisory workgroup is tasked with the review of the cost benefit analysis (CBA)
5 and, when completed, advise on the need for the small business economic impact statement
6 (SBEIS). DNR is currently soliciting economist services to prepare the CBA and, if needed, the
7 SBEIS. He said that the solicitation period closed on July 31 and DNR received two qualified
8 bids. It is anticipated that the contract will be awarded by September 14.
9
10 Engel described how draft rule language and board manual guidance is being developed based on
11 Board motions and decisions recorded in meeting minutes. He discussed the need to gain
12 additional Board direction regarding clarification on the three PHB options under consideration;
13 specifically, how the proposed PHBs will be applied to lateral streams within the anadromous
14 floor.
15
16 Nelson said he liked the process for the economic analysis, and asked if members from the
17 eastside tribes were included in the economic stakeholder process since one of the PHB
18 alternatives is from that caucus. He also suggested DNR contact each caucus that provided a
19 PHB alternative to ensure that there is a clear understanding of each alternative.
20
21 Engel acknowledged that DNR could reach out to the eastside tribes during the economic
22 analysis review. He also acknowledged that DNR could reach out to each pertinent caucus to
23 ensure there is clarity about their specific PHB alternative.
24
25 **PUBLIC COMMENT (PM)**
26 Ken Miller, Washington Farm Forestry Association (WFFA), thanked the Board for continued
27 discussions on the small forest landowner riparian template. He asked the Board to include
28 riparian template updates at the next two Board meetings. He also asked the Board to consider a
29 site visit to his tree farm for a visual of the proposed template applied on the ground.
30
31 Board Members Guenther and Nelson encouraged the Board to consider Miller's invitation to
32 visit his tree farm.
33
34 **CLARIFICATION OF PHB ALTERNATIVES**
35 Chair Bernath indicated that this is an opportunity for those who submitted PHB alternatives to
36 clarify their alternatives in order for staff to capture the alternative in draft rule language.
37
38 Ray Entz, Kalispel Tribe and representing Upper Columbia United Tribes, said their PHB
39 proposal has not changed from the one originally presented. Their alternative is from the science
40 panel's report and they believe it is the best fit. He said that they added the anadromous floor
41 idea to capture small low elevation, low gradient streams. He said that the anadromous floor is
42 separate from the PHB evaluation and added that their alternative is for statewide application.
43
44 Jim Peters, NWIFC and representing Westside Washington tribes, said that their PHB proposal
45 had not changed from what was presented. He said interdisciplinary teams are still an integral
46 part of their alternative. A proponent could propose a stream survey within the 10% anadromous

1 floor that would be revaluated by an interdisciplinary team. He added that their proposal is for
2 statewide application.
3
4 He clarified that for streams in geographic areas above the anadromous floor, the FHAM
5 evaluation would begin at a tributary junction. A bankfull width reduction at a tributary junction
6 by itself would not necessarily be a PHB.
7
8 Karen Terwilleger, WFPA, referenced a memo and accompanying materials sent to the Board by
9 Jim Lynch. She said the documents the Board received for today's meeting are identical to those
10 provided in February 2018 and that their original PHB alternative has not changed. She said
11 although the details of their alternative were not extensively discussed, they felt that their
12 alternative was properly presented to, and approved by the Board.
13
14 She said they developed their alternative based on the data in the science panel's report and built
15 their alternative to address the criteria to assess accuracy, equity and risk allocation within the
16 Forests and Fish Report and Forest Practices Habitat Conservation Plan (FPHCP). She clarified
17 two points: (1) they envisioned that technical stakeholders would develop the anadromous layer
18 details and that it would not necessarily be based on a 5, 7, or 10% gradient threshold and, (2) for
19 streams located outside the anadromous overlay, tributary junctions would be used as a PHB if
20 they met the criteria for gradient, size or obstacles.
21
22 Board Member Davies asked Terwilleger if the WFPA alternative is to evaluate tributary
23 junctions as PHBs, and if so, to explain how their caucus' evaluation came from the science
24 panel's report.
25
26 Terwilleger said that their tributary concept comes from the data used in the analysis and the
27 literature citied in the report, not from the panel's recommendation regarding tributaries. She
28 reminded the Board that the science panel did not reach consensus for how tributaries would be
29 treated and that the request to provide a minority report was denied.
30
31 Board Member Davies referred to the science panels' recommendation, which suggested a PHB
32 assessment begins at the most downstream end of a tributary and any assessment for PHB
33 criteria is measured from the tributary junction. She asked if Dr. Roni could address the tributary
34 issue and lack of agreement within the report Terwilleger mentioned.
35
36 Nelson said he did not think the Board needed to look at the technical merits of each PHB
37 alternative. The idea was to analyze all alternatives for benefits to fish and costs. He suggested
38 that a work group be convened to arrive at language for each PHB alternative.
39
40 Sweeden took issue with the comment that Board "voted on" the full landowner proposal. She
41 reminded Terwilleger that some of the WFPA documents they received at February's meeting
42 came as Board members were actively considering options. She said that she did not believe
43 Board members had time to fully digest and understand the landowner's alternative. She
44 acknowledged that the Board did not fully discuss and address tributary streams during the
45 February meeting, but the Board voted on what they felt was an accurate representation of the
46 alternatives.

1
2 Nelson said the Board is not being asked to approve these alternatives, but rather asked Board
3 staff to analyze them.
4
5 Swedeen said her interpretation of the science panel's recommendation for using channel size as
6 a PHB criteria at tributaries results in false negatives and she did not think a size-based PHB at a
7 tributary junction would protect all fish at all live stages. She acknowledged that the science
8 panel did not reach consensus, but the majority—seven to one—recommended not using
9 tributary junctions as PHBs. She stated the Board's analysis would need to assess biological
10 benefits and whether the rule is meeting the obligations of the FPHCP.
11
12 Chair Bernath asked Engel if he felt staff had a full understanding of each alternative.
13
14 Engel said he believed DNR had enough information given today's Board discussion, staff's
15 prior meeting with WFPA representatives, and the information contained in the WFPA memos.
16 He said staff would meet with the three separate caucuses to ensure clarity about the respective
17 alternatives.
18
19 Engel said staff could meet with the three caucuses to clarify their PHB alternatives. He said the
20 Board, in considering rule, will need to assess the costs, the benefits and the biological impacts
21 to get a complete packet. The Board will make a determination of the best overall alternative for
22 the rule in regards to the definition of fish habitat in WAC 222-16-010.
23
24 Engel clarified that the environmental analysis will start with a SEPA checklist which will
25 inform whether an environmental impact statement is needed.
26
27 Swedeen acknowledged that the analysis will assess costs, but questioned if the analysis will be
28 rigorous enough to assess the risk and impacts to fish and fish habitat in being under protective
29 in regards to tributary junctions. She suggested that if one proposal does not protect fish
30 adequately, the analysis should potentially arrive at that conclusion.
31
32 Nelson said it would be beneficial for Board members, once the draft rule language is ready, to
33 view how these PHB proposals work on the ground.
34
35 Engel said a spring field tour for the Board could include visiting stream sites for the purpose
36 requested by Board Member Nelson.
37
38 Chair Bernath said discussions for feasibility of a field trip could occur later in the agenda. He
39 said the decision to hold a field tour could occur next February.
40
41 Board Member Herrera said he is struggling to understand what the benefits to fish might be
42 under the three PHB alternatives and if the Board is meeting the obligations under the FPHCP.
43 He said he would be interested in hearing the federal agencies' opinion on whether these
44 proposed alternatives meet the intent of the FPHCP in protecting fish habitat. He suggested
45 hearing from the federal agencies at the November 2018 meeting. He said it seems like we're
46 chipping away at fish and fish habitat.

1
2 Chair Bernath said that an invitation would be extended to the federal agencies regarding their
3 evaluation of the PHB proposals in relationship to the FPHCP.
4
5 **PUBLIC COMMENT ON CLARIFICATION OF PHB ALTERNATIVES**
6 Vic Musselman, WFFA, said small forest landowners prefer using physical parameters when
7 typing waters. He said they would benefit most from a LiDAR-based water typing model.
8
9 Jamie Glasgow, Conservation Caucus, indicated that the WFPA clarification is a big deal to their
10 caucus because their biggest concern is false negatives from fish surveys.
11
12 Chair Bernath asked him to explain false negatives.
13
14 Glasgow indicated that this refers to a stream typing survey for fish detection based on one day.
15 For context, he shared conclusions from a Snoqualmie watershed study where 9 of 29 previous
16 Type N confirmations through water type modifications showed fish presence after utilizing
17 eDNA. He said he believed that the Board did not accept PHB criteria for tributaries based on
18 size alone and said the science panel recommended against a size determination for tributaries.
19 He referred to Chair Bernath's statement made at the February 2018 Board meeting, which
20 directed staff not to use tributaries as a width change PHB in their cost benefit analysis. He noted
21 that the science panel was convened to meet the Board's best available science requirements. He
22 concluded by saying that the Conservation Caucus supports the motion passed at the February
23 2018 Board meeting.
24
25 Kevin Godbout, Weyerhaeuser, said his company would be happy to host the Board to visually
26 understand the PHB alternatives. He said they are motivated to move this process along and
27 asked the Board to accept the PHBs as presented and urged DNR staff to bring forward the costs
28 and benefits of the PHB alternatives. He said the Cole study done by CMER is part of the
29 science that supports the landowner proposal.
30
31 Peter Goldman, Washington Forest Law Center, said he has concerns about embarking on a
32 process that was not voted on by the Board. He would like the Board to hear from Dr. Roni on
33 how WFPA's PHB alternatives is at odds with the science panel's recommendation. He said if
34 the Board keeps this process grounded in science, it needs to consider the fish habitat definition
35 under 222-16-010.
36
37 Scott Swanson, Washington State Association of Counties, said he is surprised to hear that the
38 Board is further deliberating on the PHB alternatives. He thought the alternatives were very clear
39 and asked the Board to analyze all three alternatives as they were brought forward.
40
41 **FOREST PRACTICES BOARD DISCUSSION**
42 Board Member Smith, addressing earlier public comments, shared three observations:
43 • She felt that the new fish assessment process, given the potential to find or not find fish, will
44   arrive at a 50/50 shared risk split;
45 • She felt that applying a size-based PHB to tributaries is appropriate since the new process
46   will require an evaluation for fish above the tributary PHB; and

1   • The Board did not endorse any one specific PHB proposal, but asked staff to evaluate them
2   all.
3
4   Chair Bernath he said he thought there was a general need to move forward with the analysis and
5   wanted to ensure transparency in the process. He acknowledged the concern to answer questions
6   around the science regarding tributaries, and the need for appropriate staff reports to the Board.
7
8   MOTION: Tom Nelson moved the Forest Practices Board direct staff to work with each of
9   the proponents to clarify each alternative, including PHB's as they relate to above
10   and within the anadromous floor.
11
12   The Board further directs staff to work with stakeholders to ensure the analysis
13   process is transparent to all caucuses.
14
15   The Board further directs the AMPA to convene the authors of the January 2018
16   report from the science panel to update the report to reflect all perspectives and
17   supporting science regarding tributaries.
18
19   And further requests the staff to provide updates at the November 2018 and
20   February 2019 Board meetings including recommendations regarding a Board
21   field trip on the alternatives.
22
23 SECONDED: Noel Willet
24
25 Board Discussion:
26 Chair Bernath asked if Board members wanted to provide input or had reflections on the motion.
27 He said the goal of this motion is to provide further clarification to staff for continued rule-
28 related analysis and to keep the process moving forward.
29
30 Board Members Willet, Janicki, Herrera, Laurie, Serr, Davis, Guenther, Smith, Capper and
31 Nelson said they support the motion.
32
33 Board Members Swedeen and Davies said they do not support the motion. Swedeen said she
34 feels like the Board is moving forward with an analysis that does not support fish habitat. She
35 wanted the science panel to go into more depth regarding their recommendation behind tributary
36 junctions. Davies believed that the landowner proposal is different from what was discussed in
37 February.
38
39 Chair Bernath asked Engel if he understood the direction provided through the motion. Engel
40 stated that he did.
41
42 Chair Bernath asked Berge and Dr. Roni if they understood the direction provide through the
43 motion. Berge and Dr. Roni offered their thoughts to provide an update to the original expert
44 panel report. They felt a few page report or addendum to the original report was doable. Dr. Roni
45 said that a report could be completed within a few months.
46

RECOMMENDATIONS FOR 2019 FISH USE STREAM SURVEY PROTOCOL
Board Member Herrera provided a brief overview on why the co-managers were tasked with coming up with recommendations for a 2019 stream survey protocol.

He said that Board Member Davis and he have not met but said their staff have met to brainstorm potential ideas. They will be discussing their staff's recommended options once those are finalized. He concluded by saying that any recommendation brought to the Board would need to align with DNR's administrative structure.

BOARD COMMITTEE ON EFFICIENCY AND EFFECTIVENESS IMPROVEMENTS FOR THE ADAPTIVE MANAGEMENT PROGRAM
Board Member Janicki, Committee Chair, said the last meeting was held July 27 and a summary of the interviews was provided to the group. She acknowledged that some of the comments were raw, but said that the candid remarks were appropriate if issues are to be understood and acted upon. She said most of those interviewed indicated that they are really focused on making the AMP work.

She said the committee believes the best path forward is getting the sense of commitment re-invigorated within the group in order to demonstrate stronger leadership and clarify roles and responsibilities. The committee recommends three meetings involving caucus principals over the course of the year, including having a refresher course – an "AMP 101" in a sense. She said that the first meeting is scheduled for October 2018, followed by another in January 2019, with a wrap-up meeting in June.

Davis acknowledged that some of the root causes have to be addressed at the principals meeting and cannot be solved at the science panel level, through the AMPA, or within CMER. He said he hopes to be part of the principal-level conversation when that occurs.

Herrera stated his belief is that the real issues are not at the level of PHBs or anadromous zone discussions, but should focus on addressing how folks are going to share risk.

Swedeen acknowledged that honesty and creativity will be needed to get at the core issues. She agreed that root causes include disagreements for the fundamental obligations for protecting resources balanced with a viable timber industry.

Board Member Guenther thanked the committee for its work thus far. He felt that acknowledging the accomplishments done by the program and all caucuses is valuable for the program's legacy.

Janicki acknowledged Berge for his leadership and commitment to the program and willingness see this through.

Davies said she is looking forward to the gathering in October. She agreed that historical knowledge is important and that shared knowledge will be helpful to solve some of the issues.

1   Nelson said he agreed with the recommendations thus far. He encouraged Board members to
2   attend a Policy meeting to see where some of these problems exist.
3
4   Laurie said he hoped Board members would be able to see some of the products coming out of
5   the group—plans or agendas—so that Board members could provide helpful input.
6
7   Janicki said that an upcoming committee meeting is scheduled for August 23. She said Ms.
8   Lewis is very familiar with convening groups around environmental issues. Any content coming
9   from that meeting including how to incorporate a root-cause analysis could be forwarded to
10 Board members. She said the committee is potentially considering two-day meetings in order to
11 reestablish relationships among the principals.
12
13 **STAFF REPORTS**
14 Taylor's Checkerspot Butterfly
15 Marc Engel, DNR, presented a staff recommendation to implement a two-year reporting
16 schedule rather than an annual report. He said the agencies are committed to alerting the Board
17 should any forest practices application protection issue occur.
18
19 Chris Conklin, WDFW, clarified that the two-year reporting was a recommendation from
20 WDFW staff given the current protection approach used today. He said that in the future, the
21 agencies may assess the need to shift to a five-year reporting period. There were no objections to
22 this recommendation.
23
24 There were no questions on other staff reports.
25
26 **OCTOBER 2018 FIELD TOUR PLANNING**
27 Marc Engel, DNR, presented potential field topics that might come before the Board in the next
28 calendar year. He suggested a field tour to occur in southwest Washington. Site visits could
29 include PHBs, tethered logging, discussing the dry season protocol for the upper most point of
30 perennial flow, marbled murrelet management and northern spotted owl habitat.
31
32 He suggested the Board conduct a field tour in the spring to avoid a potential conflict with the
33 principals meeting scheduled for October 2018.
34
35 Swedeen suggested an alternative—conduct a half-day field tour on November 13 to visit Ken
36 Miller's tree farm for discussing the small forest landowner alternate plan template. This would
37 occur prior to the regular Board meeting on November 14.
38
39 Engel briefly discussed the timing for the small landowner alternate template and mentioned that
40 November would be appropriate timing to discuss the template and see how the proposal works
41 on the ground.
42
43 **2018 WORK PLAN REVIEW**
44 Marc Engel, DNR, reviewed the changes to the work plan as a result from the last meeting and
45 today's decisions.
46

1   MOTION: Lisa Janicki moved the Forest Practices Board approve the 2018 Work Plan as
2   amended today.
3
4   SECONDED: Bob Guenther
5
6   Discussion:
7   None.
8
9   ACTION: Motion passed unanimously.
10
11 **Executive Session**
12 None.
13
14 Meeting adjourned at 4:15 p.m.
15
16

DEPARTMENT OF
NATURAL RESOURCES

Forest Practices Division
1111 Washington St SE
Olympia, WA 98504

360-902-1400
WWW.DNR.WA.GOV

October 23, 2018

TO: Forest Practices Board

FROM: Marc Engel, Assistant Division Manager, Policy and Services
            Forest Practices

SUBJECT: Spotted Owl Conservation Advisory Group Update

Each year, per WAC 222-16-010, the Board evaluates the need to maintain the Spotted Owl
Conservation Advisory Group. This group would be convened to conduct habitat evaluations
when the Washington Department of Fish and Wildlife approves surveys demonstrating the
absence of spotted owls within the suitable habitat supporting an owl site center.

The Board has maintained the Spotted Owl Conservation Advisory Group to evaluate the need,
based on available habitat, to maintain NSO site centers while the Board completes its evaluation
of rules affecting the owl.

Within the last year there were no northern spotted owl surveys submitted to the Department of
Fish and Wildlife for review and approval for the absence of spotted owls; as such, the group did
not meet.

I will be requesting you confirm the Board's support of the Spotted Owl Conservation Advisory
Group at the upcoming November meeting.

Should you have any questions please feel free to contact me at 360-902-1309 or
marc.engel@dnr.wa.gov.

ME

MEMORANDUM

October 26, 2018

TO: Forest Practices Board

FROM: Hans Berge, Adaptive Management Program Administrator

SUBJECT: Potential Habitat Break (PHB) Pilot Study Final Report

The Forest Practices Board (Board) directed the implementation of a study to evaluate potential habitat breaks (PHBs) used in the fish habitat assessment methodology as part of an updated water typing process. The purpose of the study is to test PHBs selected by the Board. While the Board is considering different options, it is clear that the PHBs will focus on stream gradient, size, and the presence of obstacles (barriers) that impede upstream migration of fishes. A proposed pilot study was implemented in August 2018 with the intent of testing proposed methods to determine whether or not the methods would be able to identify PHBs reliably across multiple streams where water typing has been applied.

The pilot study included 27 sites on private, state, and federal forest lands in western and eastern Washington. Data were collected on gradient, bankfull and wetted widths, depth, stream bed elevation, habitat type, presence of large wood, dominant substrate, and steps or migration obstacles. The analysis of the data collected in the surveys demonstrated that all PHBs currently being considered by the Board could easily be evaluated with the methods contained in the study design. Additional observations of the amount of effort to collect these data are crucial to refining the budget associated with the full study. Other lessons learned in the pilot study include the necessity for developing a field manual with clear protocols for selecting sites, field methods including equipment use, and details for analytical procedures. As a result of the pilot study the budget for the validation study has been refined. For fiscal year 2019, it will cost an additional $143k, for a total cost of $869k (which includes $125k for the pilot study).

With the implementation of improvements identified in the pilot study and the originally proposed project schedule approved by the Board, the validation study has begun and field sampling will start in the spring of 2019. Progress reports will be delivered to the Board regularly over the course of the study. The final results of the study are expected to be in front of the Board in 2023 after going through the Adaptive Management Program.

POTENTIAL HABITAT BREAK (PHB) PILOT STUDY FINAL REPORT

Phil Roni, Kai Ross, Hans Berge, Pete Bisson, Jeff Kershner, Joe Maroney, Pat Trotter, and Jason Walter

Prepared for:

Washington Department of Natural Resources

Olympia, Washington

October 12, 2018

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EXECUTIVE SUMMARY

The Washington Forest Practices Board (Board) tasked the Forest Practices Adaptive Management Program to develop a comprehensive validation study to evaluate criteria used to describe potential habitat breaks (PHBs) applied in a fish habitat assessment method (FHAM) to differentiate fish and non-fish bearing waters across the state. PHB criteria evaluated include gradient, channel width, obstacles to migration, and other physical habitat and geomorphic conditions. We implemented a pilot study to evaluate the suitability of proposed sampling methodologies and gather additional information necessary for implementing the larger PHB validation study. This included conducting a longitudinal thalweg profile survey upstream and downstream of known end-of-fish (EOF) points at 27 sites on private, state, and federal forest lands in western and eastern Washington. The longitudinal profile provides a continuous characterization of the stream that allows for the determination of gradient and average bankfull width (BFW) at variable distances. Using a laser range finder and target, crews conducted longitudinal profile surveys 100 m downstream and 200 m upstream from EOF points, collecting data on gradient, bankfull and wetted widths, depth, stream bed elevation, habitat type, presence of large wood, substrate, and any steps or potential fish migration obstacles. The longitudinal profile data were analyzed to determine their feasibility at identifying PHBs based on gradient, BFW, and obstacles currently being considered by the Board. The analysis of longitudinal survey data demonstrated that PHBs based on gradient, BFW, and obstacles could be easily determined from the survey data. The field surveys helped us identify several modifications to the initial proposed protocol that are needed to assure the proposed and other potential PHBs can be easily identified (e.g., spacing of the survey points, habitat types, minimum habitat length, and substrate categories). It was also clear that considerable time is needed to identify suitable study sites, allow for access to the site from the nearest road, and prepare the site for survey (e.g., clearing vegetation prior to survey). These observations highlighted the necessity for developing a field manual with clear protocols for selecting sites, field methods including training and equipment use, and details for all analytical procedures. Lastly, based on the experience gained from the pilot study, it is expected that it will take a two-person field crew one and half days to sample each site.

BACKGROUND

Fish habitat in forested watersheds is influenced by many factors including, but not limited to, gradient, channel size, channel condition, nutrients, flow, barriers to migration, and history of anthropogenic and natural disturbance. The Washington Forest Practices Board is considering criteria to be used in determining potential habitat breaks (PHBs) between fish and non-fish bearing waters across the state. These criteria are based upon data collected during a single Washington Department of Natural Resources (DNR) protocol electrofishing survey and consider gradient, bankfull width (BFW), and vertical and non-vertical obstacles that impede upstream migration. To evaluate which physical criteria, alone or in combination, best define the end of fish (EOF) habitat (stream segments that are actually or likely to be inhabited by fish at any time of the year), detailed information is needed on the physical characteristics of the uppermost fish location and associated habitat in streams across Washington State. While some data on habitat conditions at EOF are available (e.g., from existing water type modification forms submitted to DNR), these data were found to be insufficient to determine PHBs that defined EOF locations and habitat for the purposes of this study.

DNR is developing a comprehensive validation study to determine combinations of gradient, channel width, obstacles to migration, and/or other physical habitat and geomorphic conditions that could be used to determine appropriate criteria to define PHBs and EOF habitat across Washington State. Additionally, this study intends to provide insight into how EOF habitat and PHBs may vary across ecoregions, seasons, and years. The full validation study will include sampling up to 350 sites across three seasons annually for three years. Fish distribution limits (i.e., EOF) will be determined during each season at each site following DNR protocols for electrofishing surveys. Once the uppermost fish is located during each sample event, the EOF location will be flagged, GPS coordinates recorded, and a longitudinal profile habitat survey that includes all potential PHB criteria will be conducted to characterize habitat and geomorphic conditions downstream and upstream of the EOF location.

The purpose of the pilot study was to determine if the proposed sampling methodologies provided the data and information necessary for implementing a larger PHB validation study. Part of our approach was to have field crews implement the sampling protocol in a variety of complex field situations to understand what challenges can be expected in the full validation study and to refine and select the most effective sampling strategy to efficiently gather data and identify PHBs. Additional objectives of the pilot study include confirming the time and effort needed to complete surveys, identifying recommendations for site selection, fine tuning field forms for computer tablets (iPad or similar), and data analysis. For the pilot phase, 20 to 30 sites were selected (10-15 eastern Washington, 10-15 western Washington) that represented a range of stream gradient (low to high) and passage obstacles to provide context of the natural variability expected to be observed in the study implementation phase. The goal was to have crews sample 10 to 15 sites in western Washington and 10 to 15 sites in eastern Washington where EOF had previously been identified. This report describes the methods and results of the pilot study and closes with recommendations for implementing the full validation study.
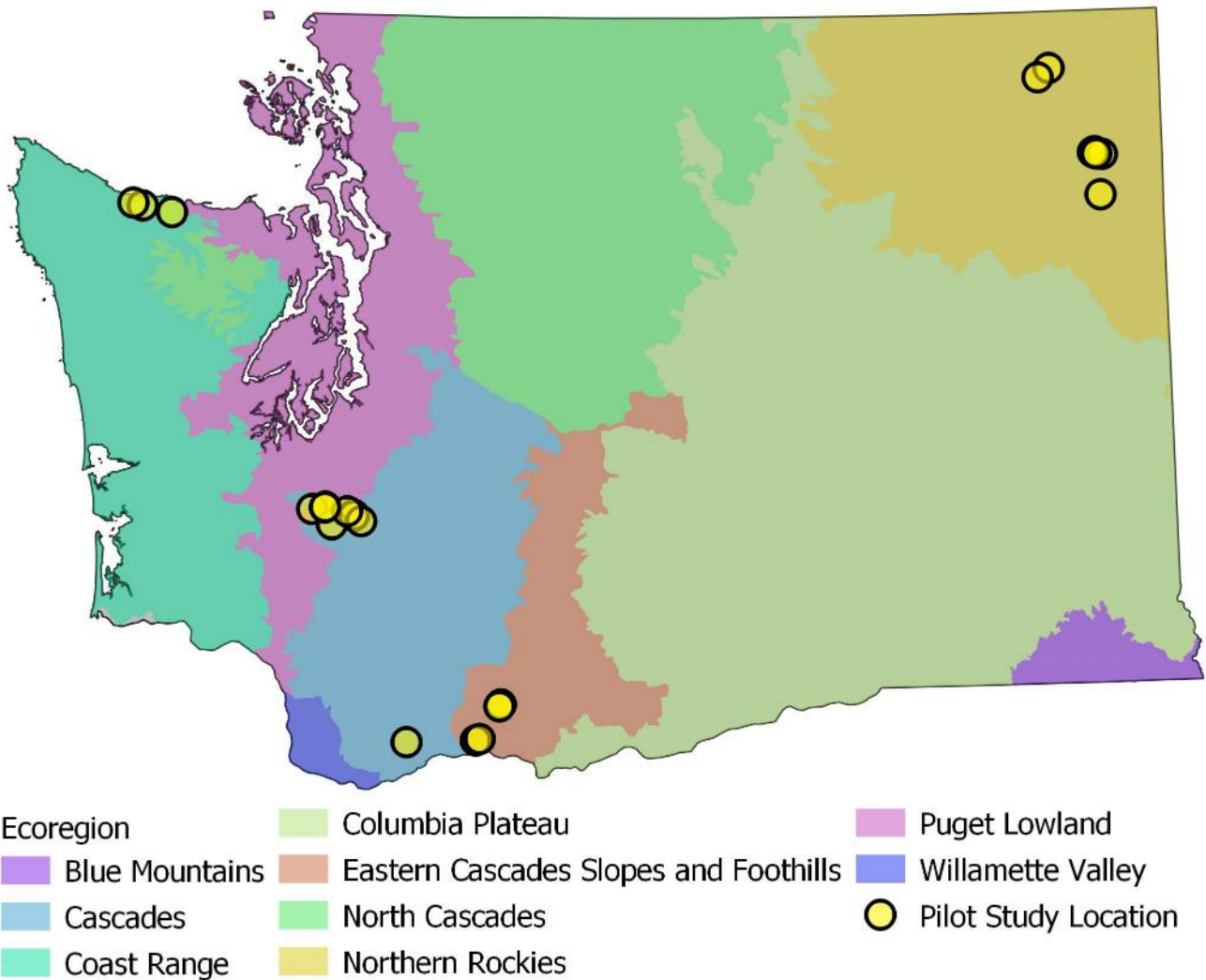
Figure 1. Location of study sites sampled in August 2018 as part of the PHB Pilot Study. See Table 1 for details on site characteristics.

METHODS

Site Selection and Identification

The goal was to select and sample 20 to 30 sites for the pilot study where EOF had previously been identified. Given time constraints to complete the field data collection (roughly 1 month), we worked with partners (DNR, Weyerhaeuser, Hancock Forest Management, SDS Lumber Company, Stimson Lumber Company, and the Kalispel Tribe) to identify sites that represented the range of complexity and natural variability expected in the full validation study. To assure this, sites were non-randomly selected that ranged from low to high gradient and contained fish passage obstacles (barriers) due to gradient or other channel features. We initially identified more than 30 sites, though some sites were not accessible due to road closures, fire, or other access issues. In the end, a total of 27 sites were sampled including 12 sites in western Washington and 15 in eastern Washington (Table 1; Figure 1). The sites were located on a mix of private (17), federal (7), and state lands (3) (Table 1).

Table 1. Characteristics and location of PHB Pilot Study sites including county, ownership, elevation, number of points surveyed, total length, average bankfull width (BFW), elevation change from top to bottom of survey, and overall stream gradient (elevation change divided by survey length). USFS = United States Forest Service.

Site No.	County	Ownership	Elevation (m)	No. points surveyed	Total length (m)	BFW (m)	Elevation change (m)	Overall Gradient
1	Klickitat	Private	643	74	308	2.55	7.25	2.4%
2	Klickitat	Private	675	68	261	2.62	9.94	3.8%
3	Klickitat	Private	676	69	304	2.39	10.59	3.5%
4	Skamania	Private	349	63	302	3.72	51.31	17.0%
5	Skamania	Private	568	82	319	2.80	20.46	9.6%
6	Pend Oreille	Private	986	71	327	2.51	47.13	14.4%
7	Stevens	Private	1087	80	312	2.70	13.08	5.1%
8	Stevens	USFS	1047	77	319	3.06	32.06	10.0%
9	Pend Oreille	USFS	1175	53	315	2.28	36.05	11.4%
10	Pend Oreille	USFS	1270	70	303	3.77	50.32	16.6%
11	Pend Oreille	USFS	1269	66	306	3.58	35.98	11.7%
12	Pend Oreille	USFS	1311	80	328	2.97	36.72	12.1%
13	Pend Oreille	USFS	1003	67	301	2.17	57.96	19.3%
14	Pend Oreille	USFS	1316	82	302	2.58	37.08	12.3%
15	Clallam	DNR	317	58	228	3.41	32.69	26.0%
16	Clallam	DNR	194	165	428	3.92	51.06	11.9%
17	Clallam	DNR	240	57	224	2.34	31.15	13.9%
18	Skamania	Private	425	74	319	3.97	22.94	7.2%
19	Thurston	Private	314	79	302	1.35	24.76	8.2%
20	Thurston	Private	337	68	301	1.94	20.91	7.0%
21	Lewis	Private	378	43	223	2.43	26.6	13.9%
22	Thurston	Private	386	98	306	2.33	30.73	10.0%
23	Thurston	Private	465	84	268	2.69	37.09	13.8%
24	Thurston	Private	162	89	301	3.35	42.29	14.1%
25	Lewis	Private	508	96	341	4.86	35.26	10.4%
26	Thurston	Private	266	83	298	1.69	20.29	6.8%
27	Thurston	Private	231	103	316	1.82	11.75	3.7%

Survey Methods

A longitudinal thalweg profile survey was used to survey gradient, bankfull and wetted width, depth, stream bed elevation, habitat type, presence of large wood, substrate, and any steps or potential fish migration obstacles 100 m downstream and 200 m upstream from EOF points. This approach involves surveying the streambed elevation along the deepest portion of the stream (the thalweg), yielding a two-dimensional longitudinal profile of streambed elevation. This methodology has been shown to be a reliable and consistent method for measuring change in stream morphology and fish habitat independent of flow (Mossop and Bradford 2006). The survey was designed to capture changes in bed topography and habitat types by surveying more points in reaches with more variable bed morphology, rather than fixed distances. Inflection points in topography were surveyed to capture changes in thalweg topography and gradient. A

laser range finder[1] mounted on a monopod and a target on a second monopod were used to collect distance and elevation data at each survey point (Figure 2). All data were entered into a computer tablet in the field. Measurements at each survey point included depth, wetted width, BFW, substrate size classification (i.e., boulder, cobble, gravel, sand, or less than sand), and habitat type (i.e., pool or riffle/cascade). Wetted width and BFW at each survey point were measured with a graduated stadia rod. Dominant substrate type was visually determined using a modified Wentworth scales following Cummins (1962). The electronic field form was programmed to identify points that met the criteria the Board is considering as PHBs. Steps and potential migration obstacles were categorized whether they were formed by wood, bedrock, or another substrate. The presence of wood was particularly important because wood-formed obstacles were considered deformable (non-permanent) and are not PHBs. The initial length upstream (200 m) and downstream (100) of EOF was determined by walking the stream and measuring the thalweg length with a laser range finder. Upstream and downstream photos were initially taken at the bottom (100 m downstream from EOF), EOF, and top (200 m upstream of EOF) of the survey reach. After reviewing the protocol for photo documentation, it was determined that photos should be taken of any of obstacles that met PHB criteria and every 25 m to capture general characteristics of the site. Originally electrofishing surveys were proposed as part of the pilot study, but due to the compressed time schedule for completing the pilot no electrofishing surveys were conducted for the following reasons: EOF locations had been previously identified at the sites we surveyed and electrofishing survey protocols are well accepted. Finally, in cases where a larger tributary contributed more than 1/3 of the flow upstream of EOF, the crews surveyed both branches of the stream.

Figure 2. Photos of crew using laser range finder and target mounted on monopods to survey longitudinal profile and stream characteristics for PHB Pilot Study.

Initial data quality assurance and validation occurred in the field during data entry. To ensure consistency, the electronic field form used drop down menus to prompt for required information and highlighted

---

[1] A Laser Technology TruPulse 200X was used for surveys.

missing data fields that were needed before the data entry moved forward. Once completed, each survey was visually inspected to highlight any outliers or erroneous measurements. All data processing and analysis was conducted using R statistical methods (R Core Team 2018).

Analysis of Data

PHB Identification

We considered three recommended sets of PHB criteria for the pilot study (Table 2). These PHBs relied upon measures of gradient and BFW. The longitudinal profile provides a continuous characterization of the stream that allows for the determination of gradient and average BFW at variable distances. This allows for the post-hoc test of any PHB recommendations that specify distances for their calculation (e.g., gradient should be calculated over a distance equal to 20 times the BFW at the point).

To identify and locate PHBs based on criteria in Table 2, we developed scripts in R to see if each point in the long profile survey met the criteria for any of the recommended PHB definitions. At each point, the up- and downstream gradient was calculated, as well as the up- and downstream average BFW, to identify PHBs based on thresholds, differences, and ratios of gradient and/or BFW. Calculated up- and downstream elevation differences were used to test the recommended non-vertical obstacle definitions. Gradient and BFW PHBs were identified along the entire survey reach using a rolling average equal to 20 times BFW. Obstacle definitions included both criteria for slope and height in the case of vertical obstacles. Most identified "vertical obstacles" had slopes of less than 90 degrees, therefore we used a threshold of 150% gradient to identify a vertical obstacle. In some cases, there was not adequate distance (20 times BFW) downstream or upstream of a survey point to calculate gradient or BFW over 20 times BFW. In those instances, we calculated the metric using the available portion of the survey and flagged them to indicate that the PHBs were identified using less than the required distance of 20 times BFW. Once each point was analyzed and PHBs identified, the data for each study site (stream) were output to a spreadsheet and visualized on top of the longitudinal profile.

To account for streams where the flow was divided between two tributaries, the data for each site were analyzed twice; once with each tributary attached at the junction point (Figure 4).
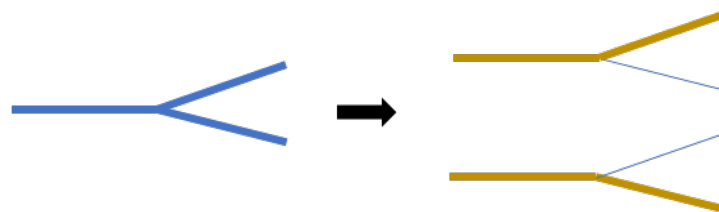

Figure 4. Schematic example of how a survey with tributary junctions is processed multiple times, once for each tributary.

Table 2. Three different combinations of PHB criteria being examined by Forest Practices Board and used to test data collected in PHB Pilot Study. For each proposed group of criteria there are criteria for barriers, gradient, and bankfull width (BFW).

PHB Set	Type	Description
1	Barrier	Gradient >20%, and barrier elevation difference is greater than BFW
	Gradient	10% gradient threshold (upstream gradient >10% and downstream gradient <10%)
	Width	2 ft upstream threshold (upstream BFW <2ft)
2	Barrier	Gradient >30%, and barrier elevation difference is greater than twice BFW
	Gradient	Gradient difference >= 5% (upstream gradient minus downstream gradient >=5) and downstream gradient >10%
	Width	2 ft upstream threshold (upstream BFW <2ft)
3	Barrier	Gradient >20%, and barrier elevation difference is greater than BFW
	Gradient	Gradient difference >= 5% (upstream gradient minus downstream gradient >=5).
	Width	20% decrease in width. Upstream to downstream width ratio <=.8

RESULTS

Implementation of PHB Protocol

Longitudinal profile surveys have been widely used on larger streams, but not extensively in small headwater streams to our knowledge. Surveys at the first few sites indicated that some minor modifications to the protocol were needed to complete the pilot study in a reasonable amount of time. First, collecting multiple points in each habitat unit (e.g., pool) resulted in points being surveyed every meter or less in some cases. This resulted in the first few surveys taking more than one day (8 to 10 hrs.) per site to complete the longitudinal profile. Thus, it was determined that the protocol should focus on measuring top and bottom of each habitat unit and that habitat units needed to be at least one-meter long. Similarly, classifying habitat units into pools, glides, riffles, and cascades was not needed, as the distinction between the later three was often flow dependent. Moreover, the data collected in the longitudinal profile can be used to objectively classify habitat post-hoc. Therefore, habitat types were reduced to pools and riffle/cascades. However, for pools the crew surveyed not only the top and bottom, but the deepest point of the pool as well. If there was a plunge pool or waterfall, a point was surveyed in the pool at the base of the waterfall and again at the top to get the full height of the potential obstacle. In addition, while we originally proposed to survey 100 m downstream and upstream from known EOF points, we were asked to survey 200 m upstream and 200 m downstream from EOF. Survey times at the first few sites took more than a day (8 to 10 hrs.) to survey 400 m in each stream, so we returned to our original proposed survey length of 100 m downstream and 200 m upstream from the EOF points. An additional unforeseen factor

was the time needed to clear vegetation so that the longitudinal profile survey could be completed. In many cases one to three hours were needed to clear overhanging vegetation to gain line of sight to use the laser range finder and survey equipment (Figure 3). Despite these minor modifications, the field crew was able to collect high quality and detailed field data (Table 3).

Table 3. Example of data collected at each site including station, distance, total (cumulative) distance, elevation, total (cumulative) elevation, depth, wetted width (WW), bankfull width (BFW), substrate (fines, sand, gravel, cobble, boulder, bedrock, wood), habitat type (riffle, pool, dry), comments (deformable obstacle or other comments). Note only first 30 points measured are reported in table.

| Station	Distance (m)	Total distance (m)	Elevation (m)	Total elevation (m)	Depth (m)	WW (m)	BFW (m)	Substrate	Habitat Type	Comments
0	0	0	0	0	0.15	1	1.5	Gravel	Riffle	
1	4.68	4.68	0.6	0.6	0.1	1.3	2.3	Cobble	Riffle	
2	4.88	9.56	0.2	0.8	0.17	1.1	1.9	Gravel	Riffle	
3	3.33	12.89	0.56	1.36	0.07	1.8	2.9	Gravel	Riffle	
4	4.66	17.55	0.55	1.91	0.1	1.8	3	Gravel	Riffle	
5	3.41	20.96	0.42	2.33	0.1	1.4	2.9	Gravel	Riffle	
6	8.21	29.17	1.11	3.44	0.05	1.6	3.3	Sand	Riffle	
7	2.56	31.73	0.59	4.03	0.12	1.3	2.9	Gravel	Riffle	
8	4.85	36.58	0.34	4.37	0.03	1.2	3.2	Gravel	Riffle	
9	3.49	40.07	0.34	4.71	0.11	1.8	3	Gravel	Riffle	
10	4.86	44.93	0.59	5.3	0.06	1.6	2.5	Gravel	Riffle	
11	5.57	50.5	0.45	5.75	0.09	1.6	3.1	Gravel	Riffle	
12	5.88	56.38	0.67	6.42	0.07	1.4	3.1	Cobble	Riffle	
13	6.76	63.14	0.67	7.09	0.1	1.8	2.4	Gravel	Riffle	
14	5.85	68.99	0.32	7.41	0.09	2	2.9	Fines	Riffle	
15	6.08	75.07	0.65	8.06	0.1	1.7	3	Fines	Riffle	
16	1.87	76.94	0.53	8.59	0.09	1.05	2.9	Sand	Riffle	
17	3.94	80.88	0.05	8.64	0.1	2.9	3.8	Sand	Riffle	
18	7.69	88.57	0.56	9.2	0.14	1.1	2.4	Fines	Riffle	
19	13.11	101.68	2.54	11.74	0.1	1.3	3	Gravel	Riffle	
20	1.84	103.52	0.01	11.75	0.09	1.3	2.6	Gravel	Riffle	
21	5.78	109.3	0.75	12.5	0.11	1.2	2.2	Gravel	Riffle	
22	4.27	113.57	0.94	13.44	0.03	1.1	2.8	Gravel	Riffle	
23	1.2	114.77	-0.26	13.18	0.3	0.9	2.2	Fines	Pool	
24	4.74	119.51	1.17	14.35	0.12	1.5	2.8	Sand	Riffle	
25	1.38	120.89	0.88	15.23	0.11	1	2.9	Fines	Riffle	Deformable
26	3.5	124.39	0.19	15.42	0.03	1.4	2.7	Gravel	Riffle	
27	3.59	127.98	0.59	16.01	0.09	1.2	2.5	Sand	Riffle	
28	3.64	131.62	0.39	16.4	0.15	1.1	1.9	Gravel	Riffle	

Figure 3. Photos of sites in western and eastern Washington showing some of streams and conditions encountered during PHB Pilot study.

Ability to Detect PHBs

We tested the data collected to determine the feasibility of identifying and locating various PHB combinations being reviewed by the board. The data can easily identify any of the combinations of PHBs being examined by the board or other PHBs that might be identified based on gradient, BFW, or obstacles (Figure 5 and Figure 6). Graphs for all 27 sites are provided in Appendix A.

A.
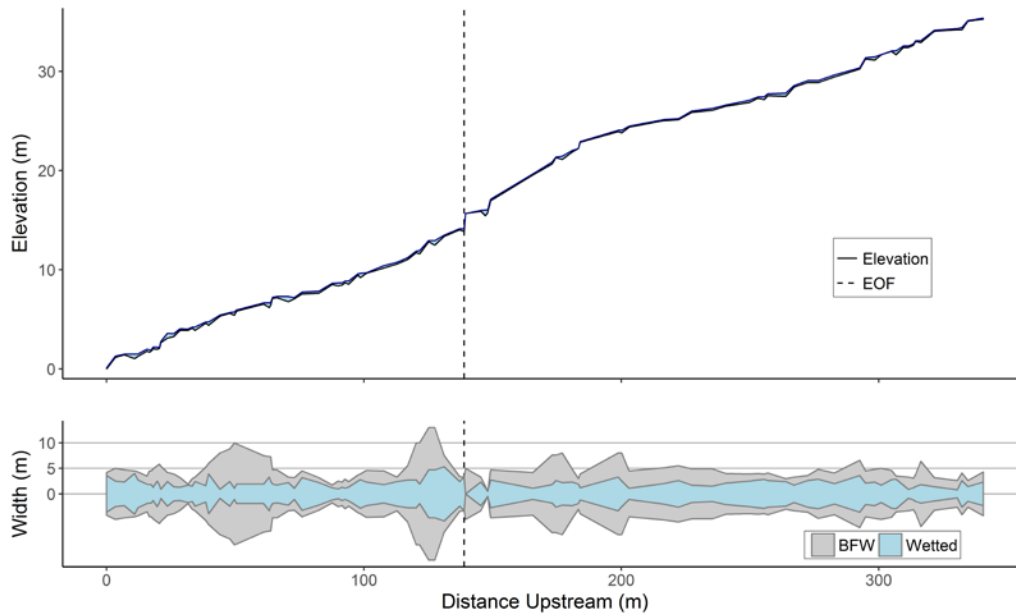
B.
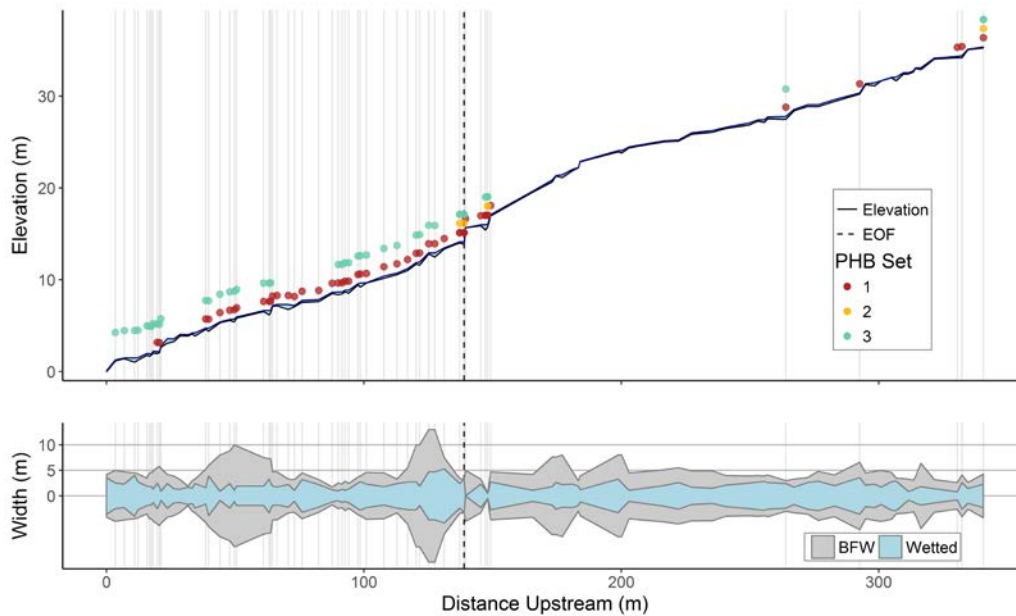
Figure 5. A. Example of long-profile from a western Washington PHB Pilot Study site showing stream bed elevation, water surface elevation, bankfull width (BFW), and wetted width (lower panel of each figure) along the surveyed stream thalweg. B. The same long-profile with the location of three different sets of PHBs identified.
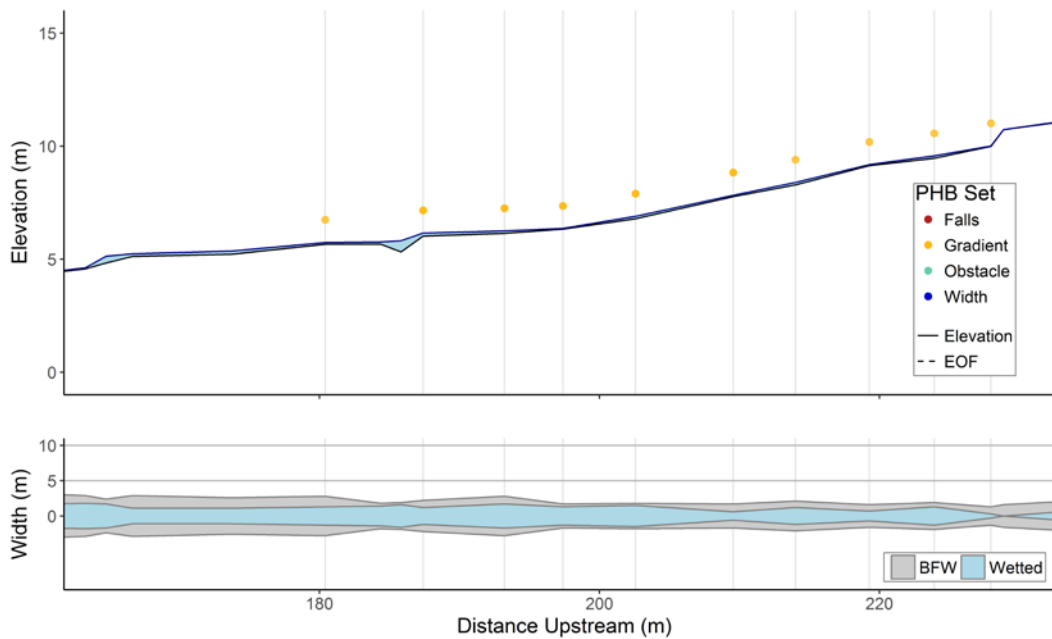
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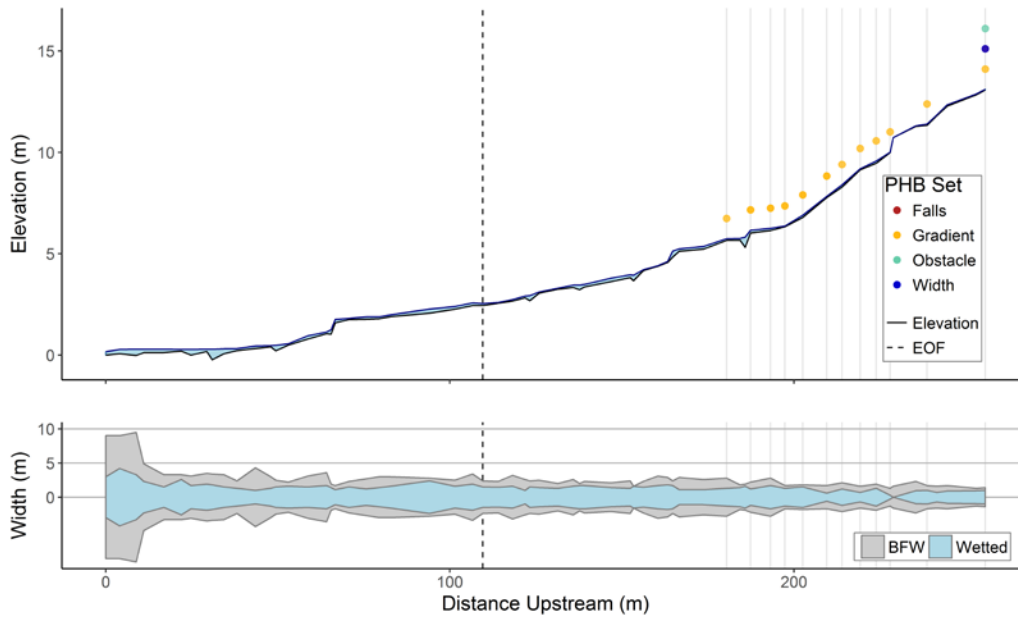
B.

Figure 6. A. Example of long-profile in an eastern Washington PHB Pilot Study site showing stream bed elevation, water surface elevation, bankfull width (BFW), wetted width (lower panel of each figure) and location of different PHBs based on gradient, barriers (obstacles), and BFW. B. Zoom in on area near 200 m showing PHBs. "Falls" represents a vertical or near vertical obstacle.

RECOMMENDATIONS

The PHB pilot study demonstrated that the proposed longitudinal thalweg profile survey is well suited for identifying various combinations of PHBs based on gradient, channel width, and potential obstacle. The combination of the field survey and the analysis of the resulting data resulted in several minor recommended adjustments for the proposed PHB validation study including important modifications to the field protocol, revised estimates for sampling time to complete surveys, the need for a detailed field manual to train field crews, and the importance of site reconnaissance and site selection prior to field crews arriving on site.

The field data collection effort of the pilot study demonstrated that considerable time is needed to identify and access sites (obtain access and keys for locked gates on both private and public lands) prior to the survey. This includes sites with previously monumented EOF. In addition, many sites required clearing vegetation (e.g., devils club, salmonberry, willow, vine maple) before the survey could be conducted. Anywhere from 30 minutes to 3 hours was needed at most sites to clear brush and prepare for the survey. Once cleared, it took crews anywhere from 2 to 12 hours to complete a longitudinal profile survey. Again, this does not include time to drive or walk to the site. Therefore, we expect the first visit for the full study to take, on average, a full day to access the site and complete a longitudinal profile. When coupled with a protocol electrofishing survey, which should take anywhere from half a day to a full day, we recommend budgeting for 1.5 to 2 full days (8 to 10-hour days) for the first site visit during the full study. Seasonal revisits should be able to be completed within one day on average.

Second, there are a handful of minor modifications needed to the initially proposed protocol. These include the spacing of the survey points, habitat types, minimum habitat length, and substrate categories. As noted in the results section, surveying points less than every few meters and trying to capture minor changes in topography in habitat unit needlessly lengthens the survey. Therefore, the survey should focus on capturing changes in topography greater than 30 cm and the beginning and ending of habitat units. For pools, the pool tailout, maximum pool depth, and top of the pool habitat should be surveyed. Habitat units should be simply classified as pools (slow water) and riffles (fast water) as the longitudinal profile can be used to objectively classify units based on residual depth and gradient. Moreover, making decisions on habitat classification in small streams is extremely subjective. Based on our experience, the minimum habitat unit size should be one meter along the thalweg unless there is clearly a noticeable change in depth and gradient. An additional substrate category that should be added would be clay or hardpan; a dominant substrate type at many sites that is not captured by the current substrate categories. We initially assumed that the wood substrate classification at obstacles would capture whether it was deformable or not. However, we added a drop-down menu to flag whether the obstacle was deformable or not.

In addition, there are several decisions that crews need to make in the field that could affect results if not done consistently. For example, what to do when they encounter a side tributary as they are surveying. Should they survey both the mainstem and tributary? For the pilot survey, we had crews survey both branches of the tributary assuming the tributary was at least 1/3 of the flow. While some of this can be dealt with in training, a detailed field manual will be needed to assure that crews conduct the surveys consistently. This should include not only how to set up the site and conduct the longitudinal profile, but how to deal with any unusual situations or problems in the field. A major component of the field manual should be site reconnaissance and selection. Many sites that appear to be accessible on paper, GIS maps, or based on information provided by land management organizations, may be inaccessible due to locked gates, road failures, or unforeseen circumstances. For the pilot study, we tried to select sites with relatively easy access from nearby roads (half-hour walk from road), though time needed to walk into a site ranged from ten minutes to two hours. This highlights the need for a set of clear criteria for selecting sites (e.g.,

EOF within 1 hr. walk of the nearest road) and the importance of prior reconnaissance before field crews access the sites.
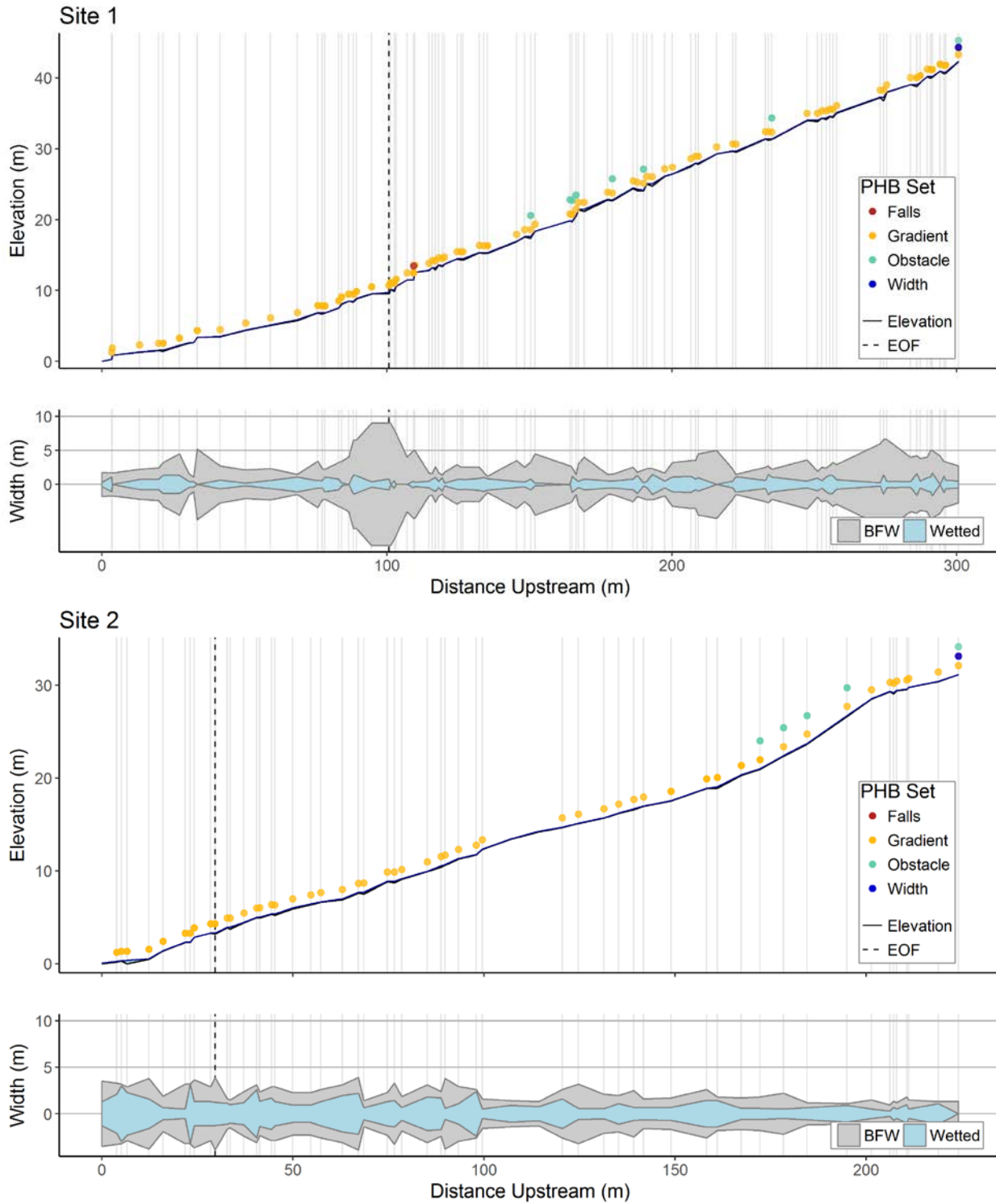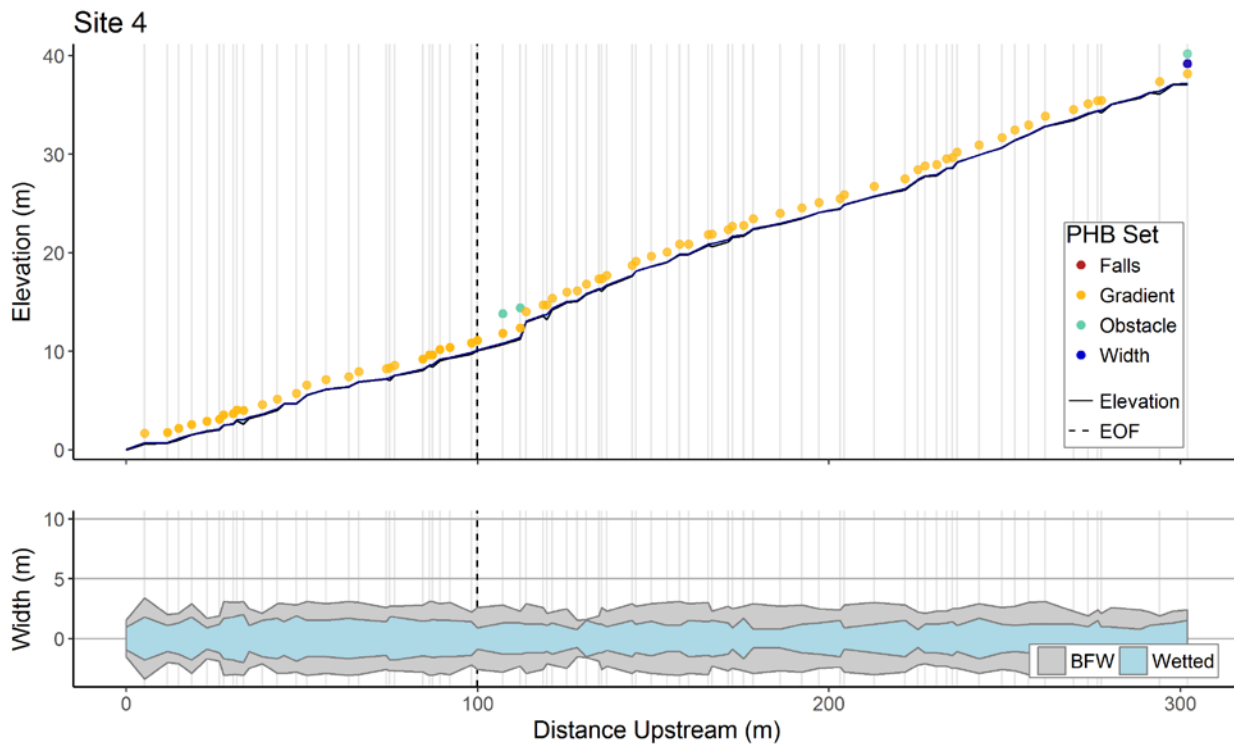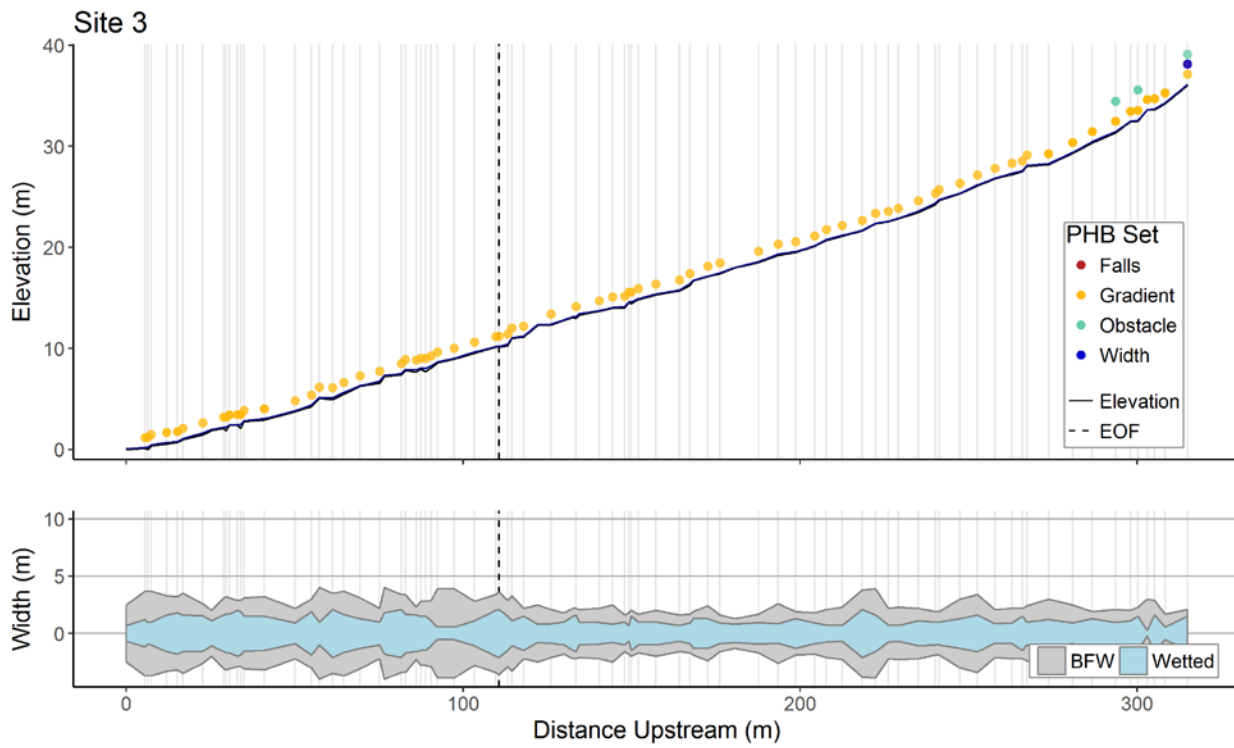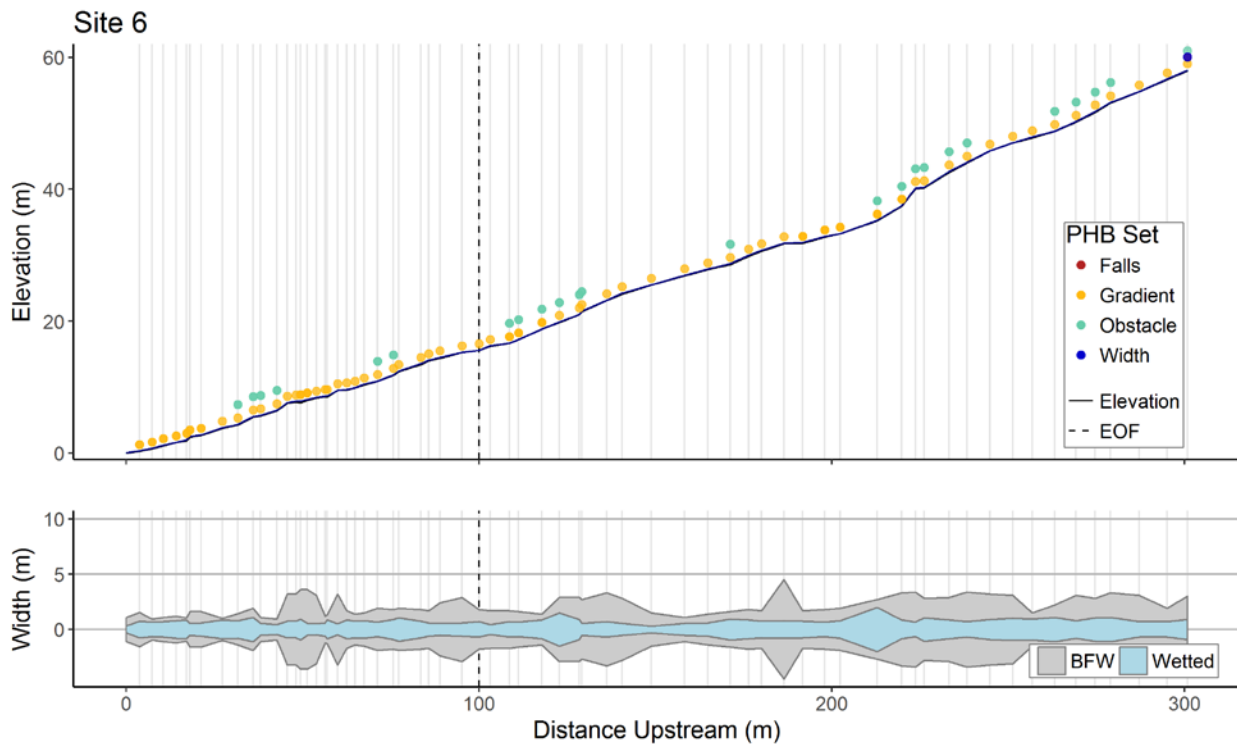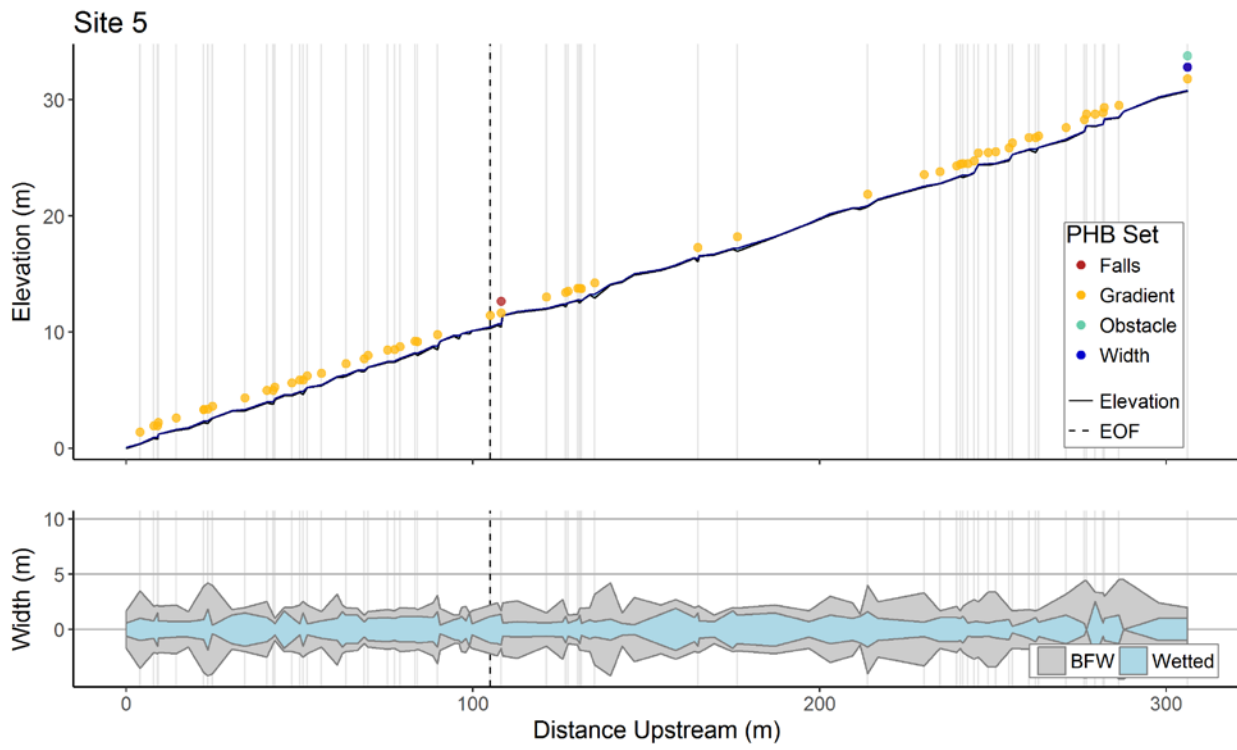
ACKNOWLEDGEMENTS

REFERENCES CITED

Mossop, B., and M. J. Bradford. 2006. Using thalweg profiling to assess and monitor juvenile salmon (*Oncorhynchus* spp.) habitat in small streams. Canadian Journal of Fisheries and Aquatic Sciences 63(7):1515-1525.

PHB Science Panel. 2018. Evaluation of physical features that define fish habitat in forested landscapes across Washington State. Draft study plan prepared for Washington Department of Natural Resources, Olympia, Washington. (August 4, 2018 Draft).

R Core Team 2018. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-project.org/.

Cummins, K.W. 1962. An evaluation of some techniques for the collection and analysis of benthic samples with special emphasis on lotic waters. American Midland Naturalist 67:477-504.

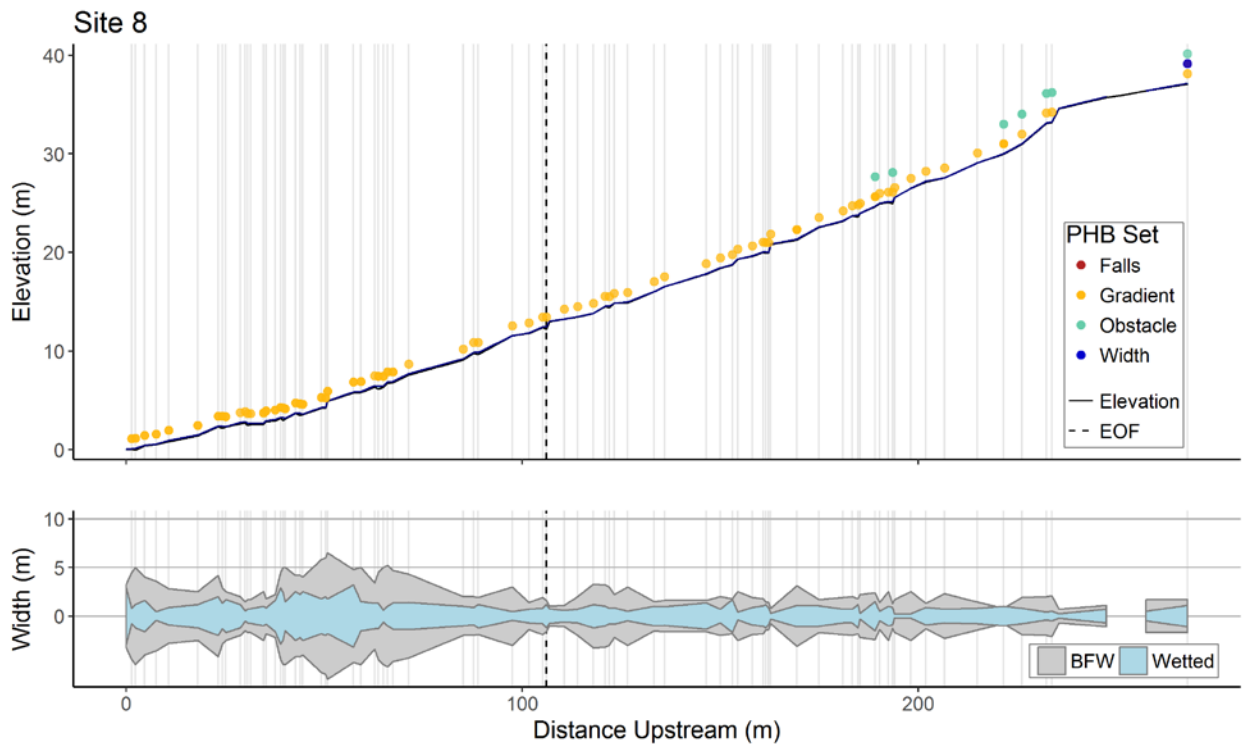Zar, J. H. 2009. Biostatistical analysis. Prentice Hall, Upper Saddle River, New Jersey.
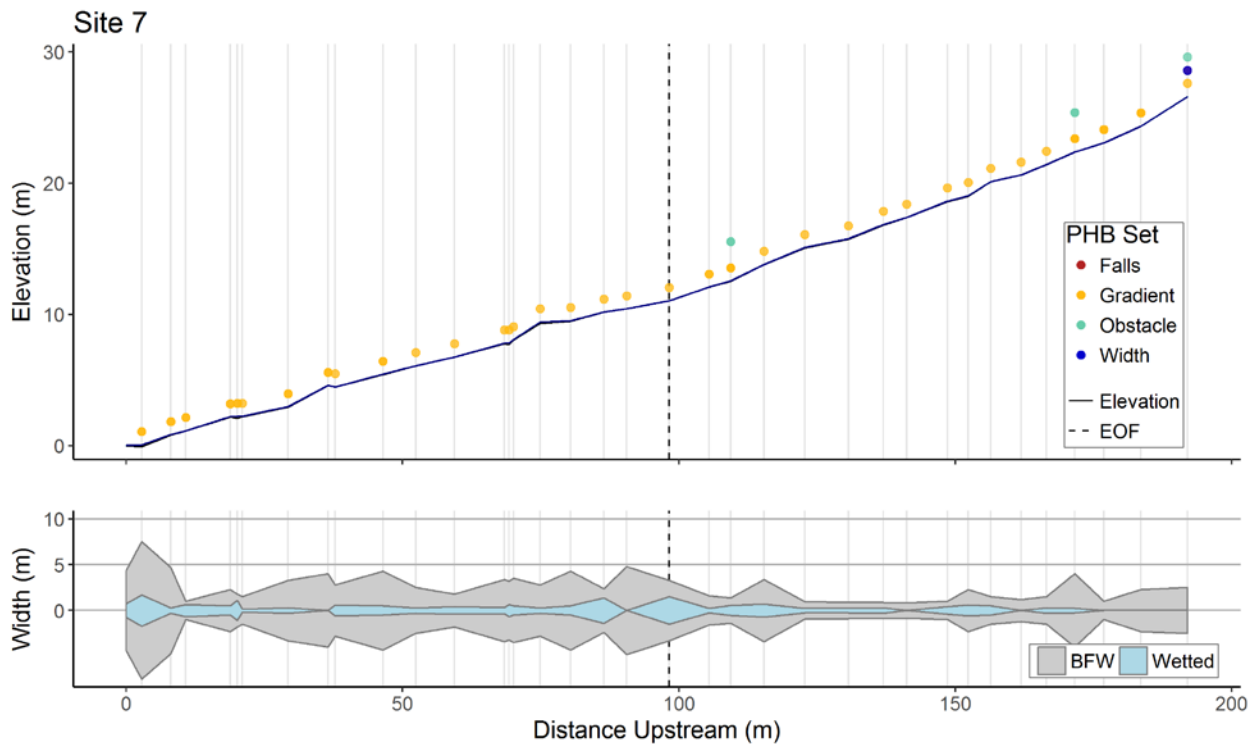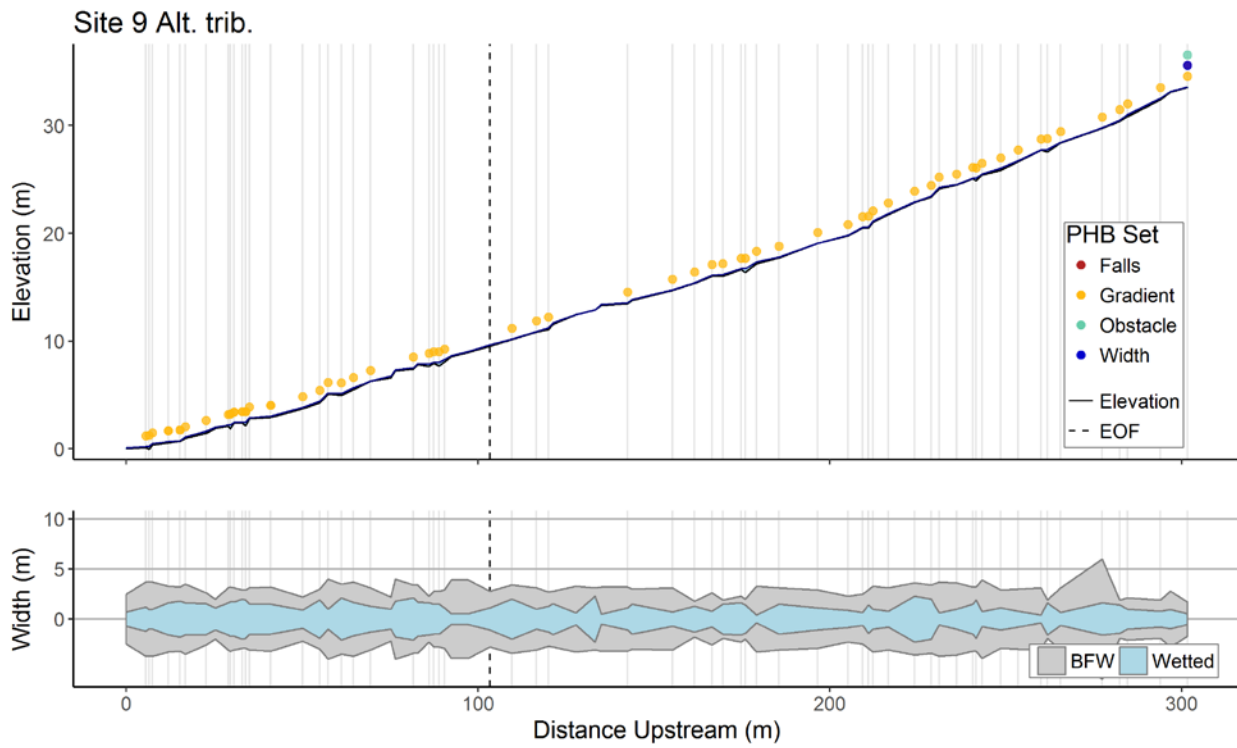
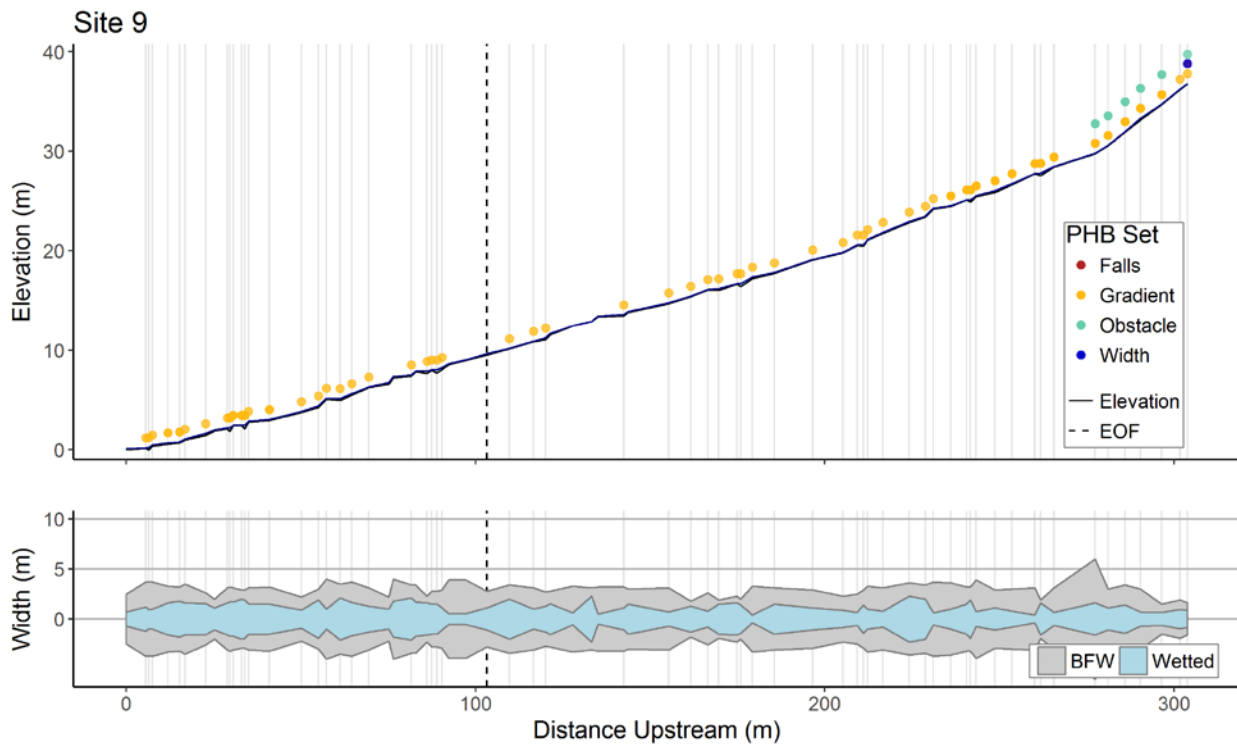# APPENDIX A: LONG-PROFILE AND PHBS AT ALL SITES

Table 1 provides a list of site characteristics for each of 27 sites.

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Site 9 Alt. trib.
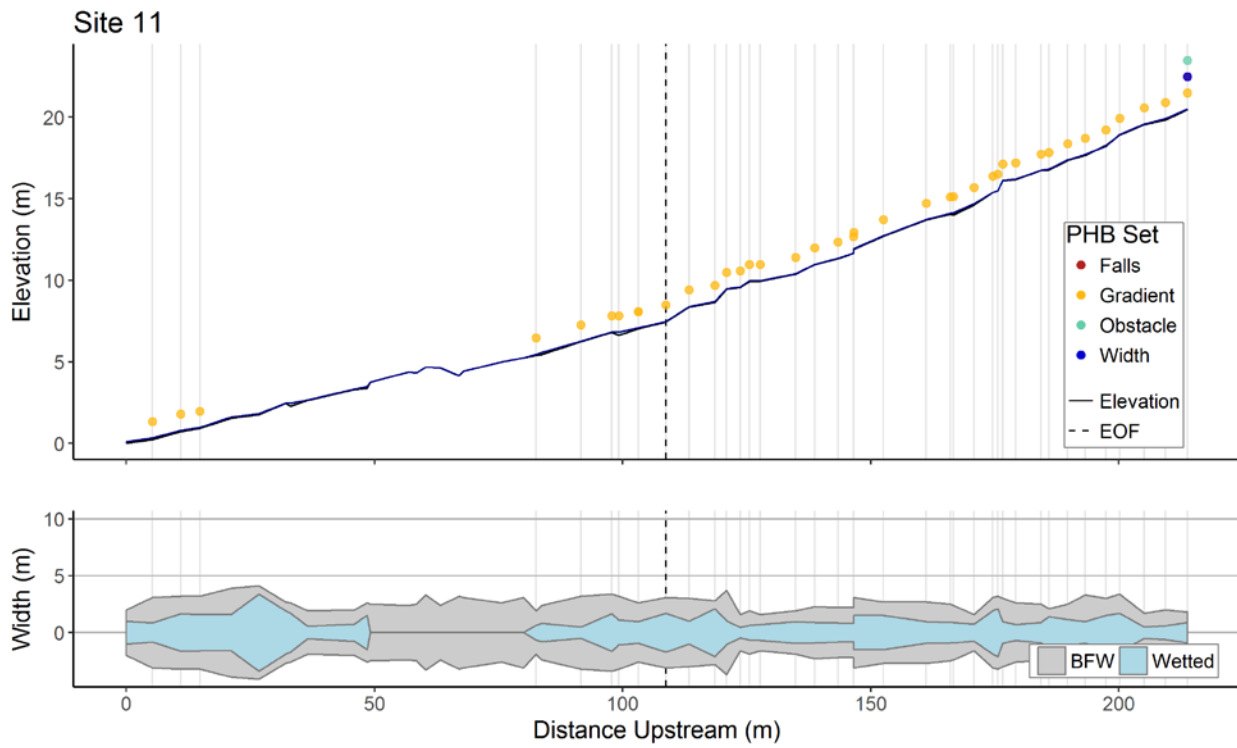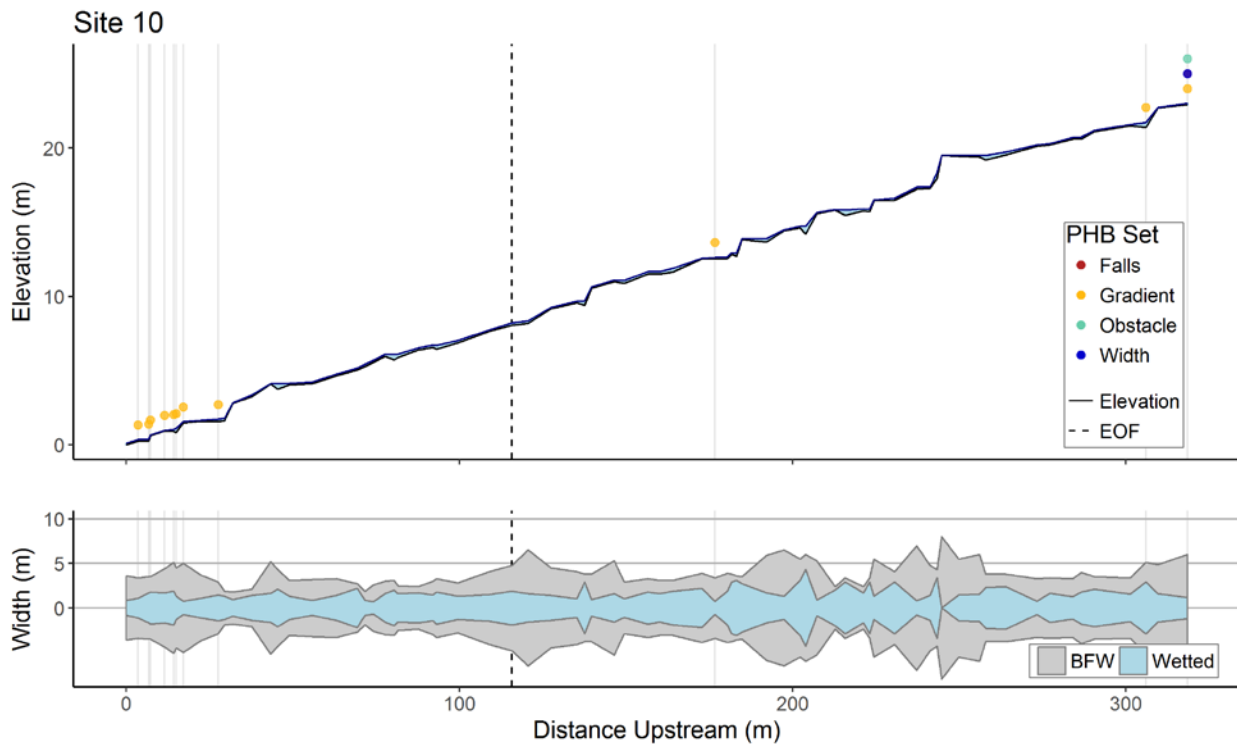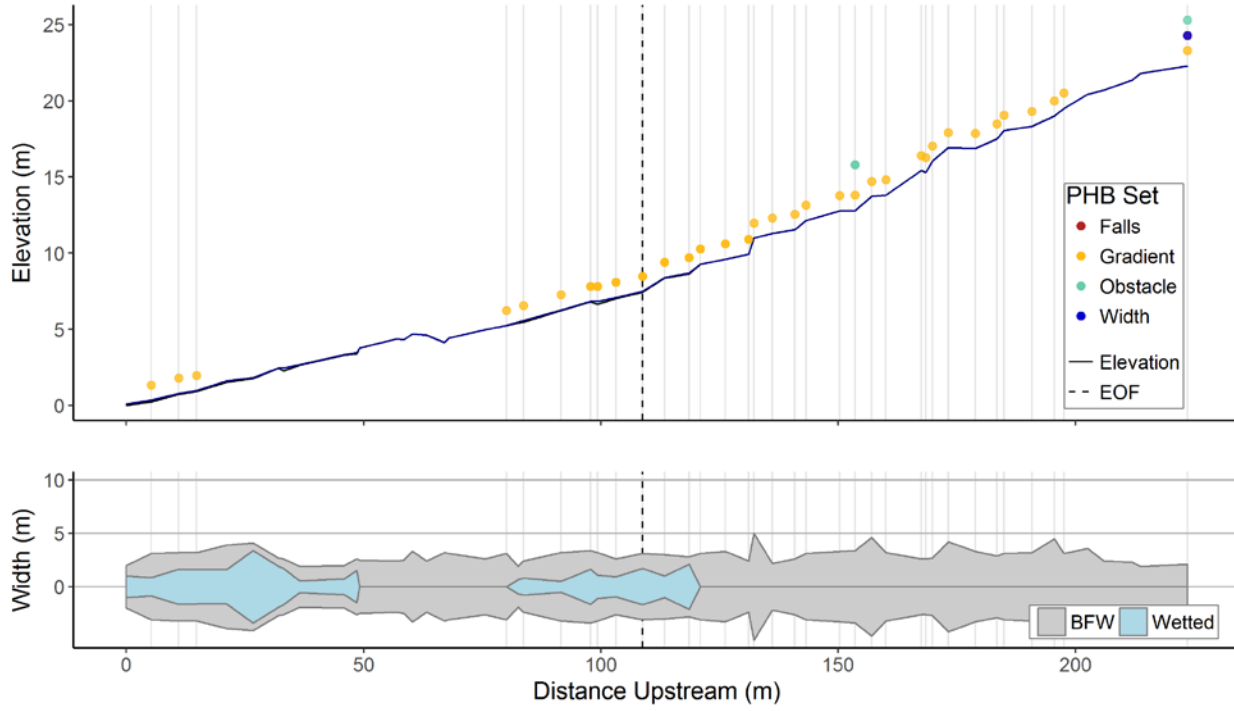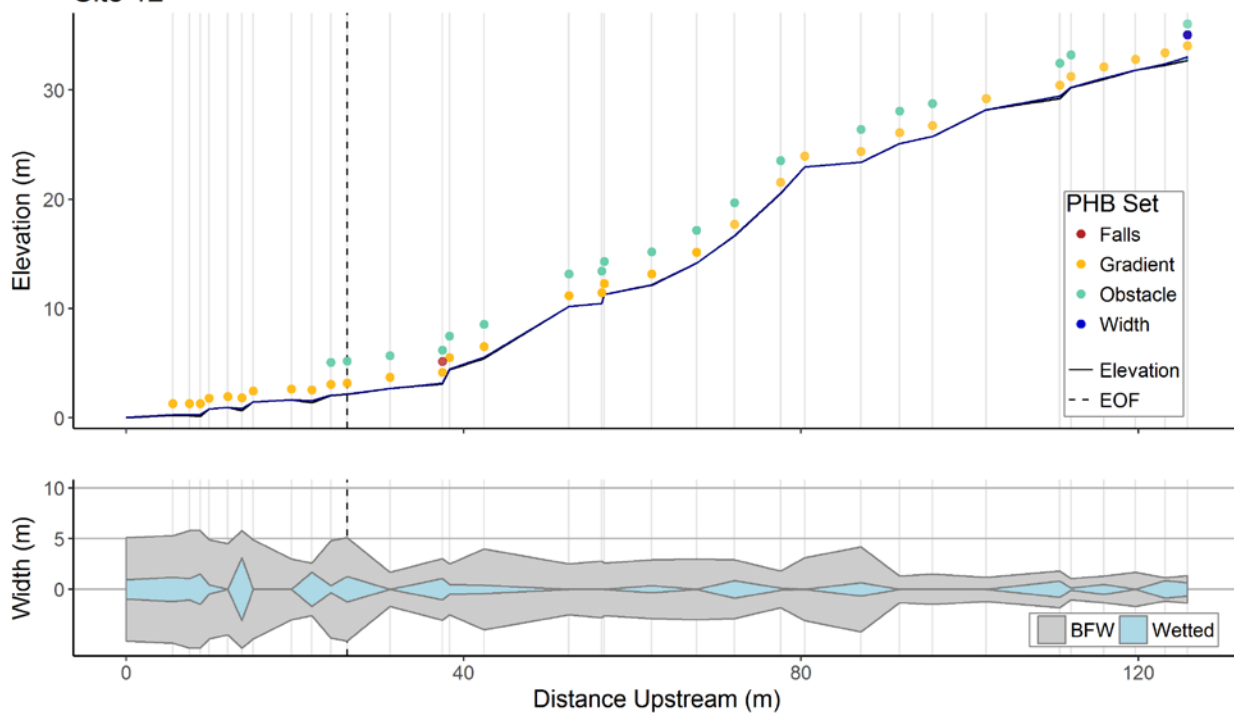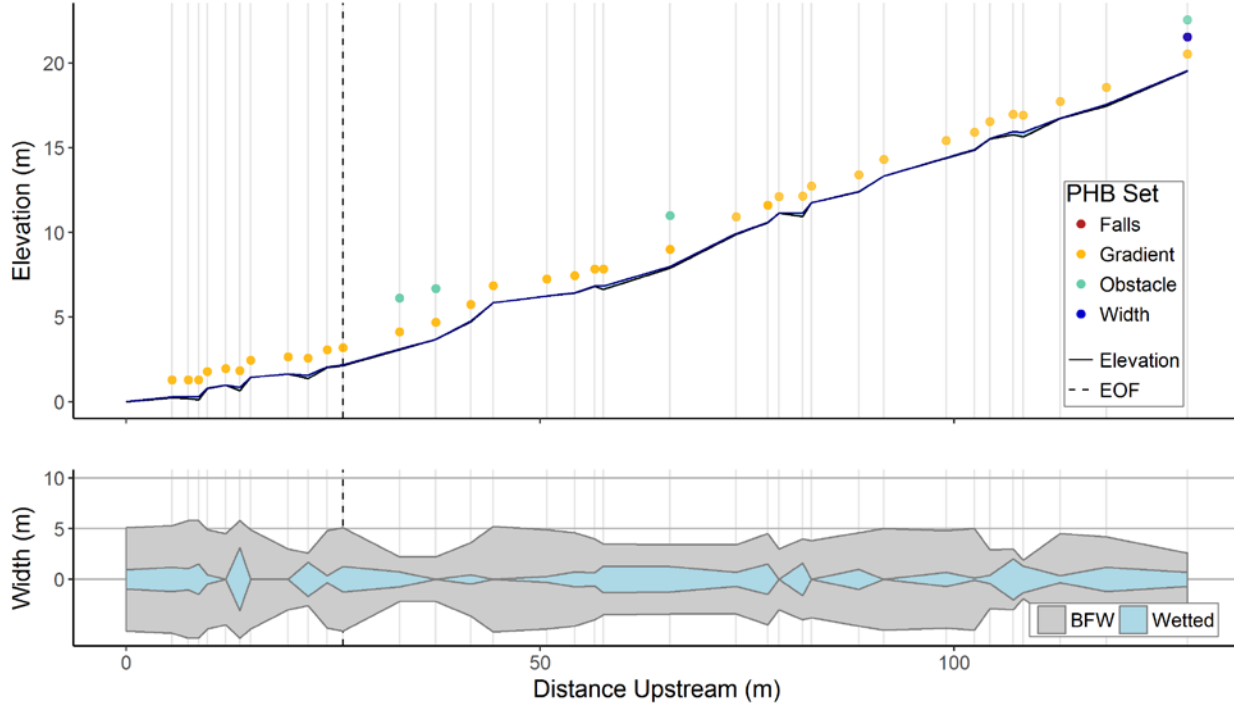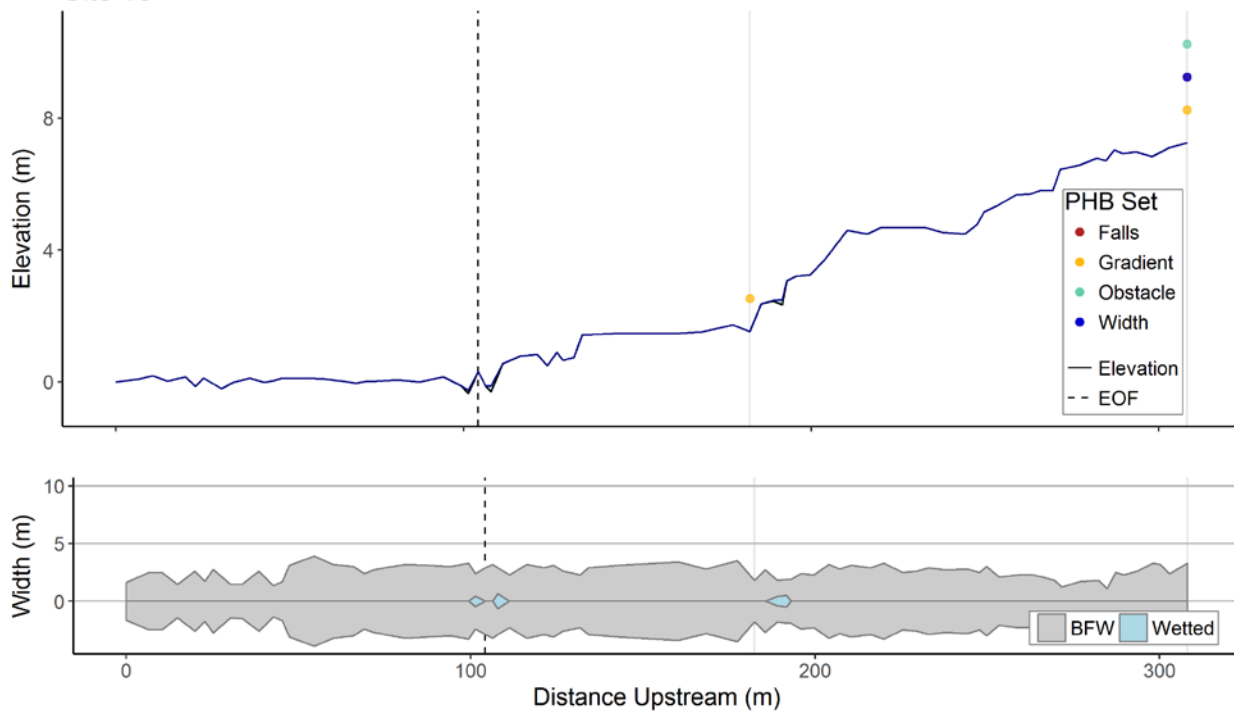
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Site 11

Site 11 Alt. trib.

Site 12

Site 12 Alt. trib.

Site 13

Site 14

Site 15

Site 18

Site 19
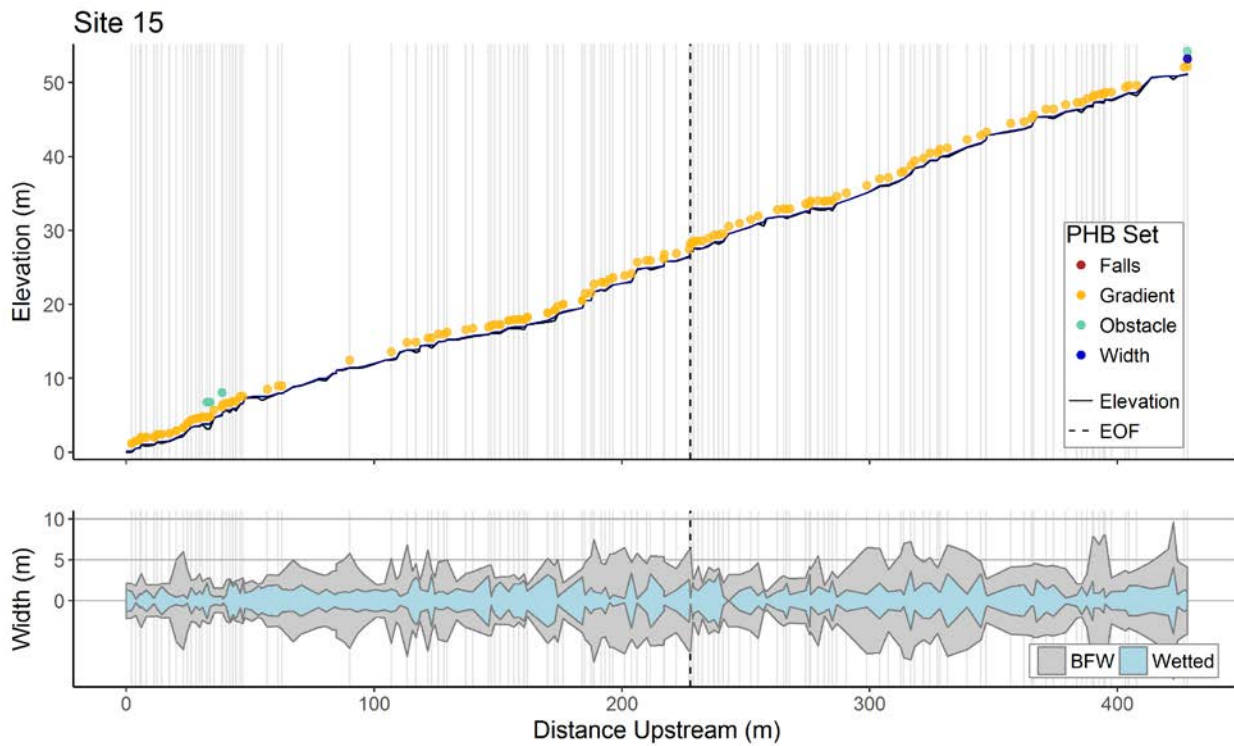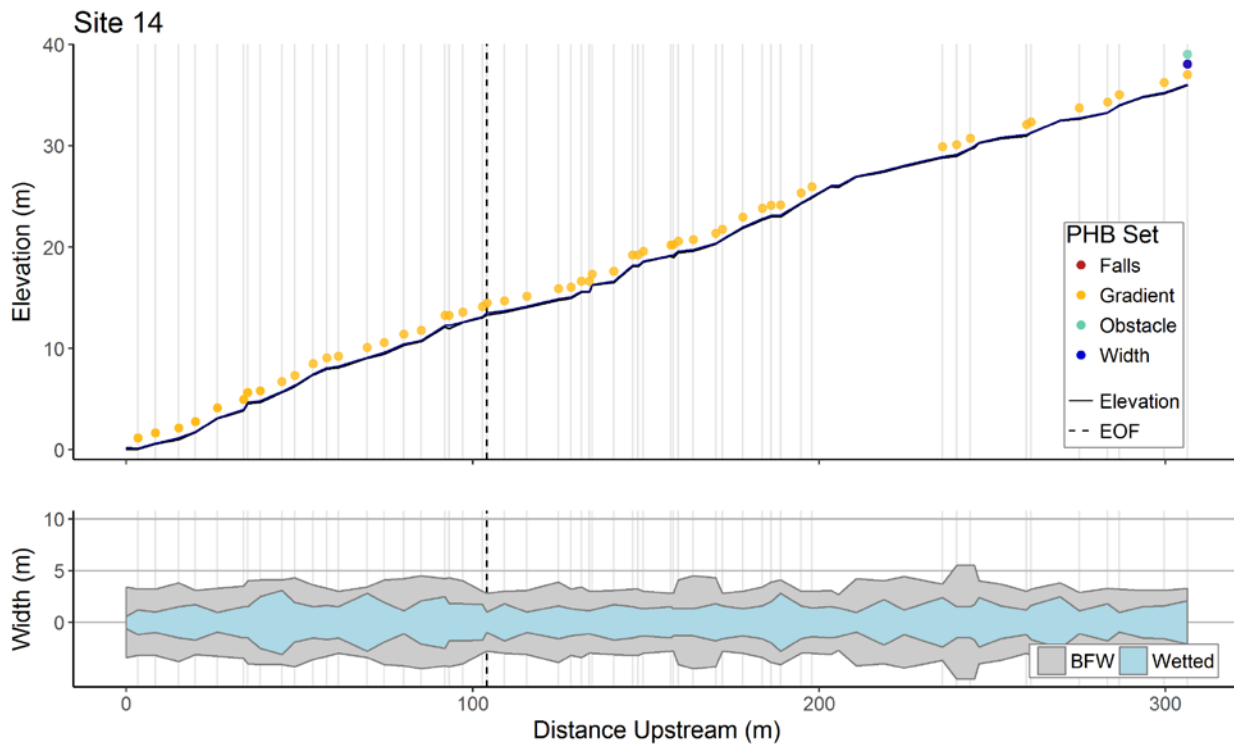
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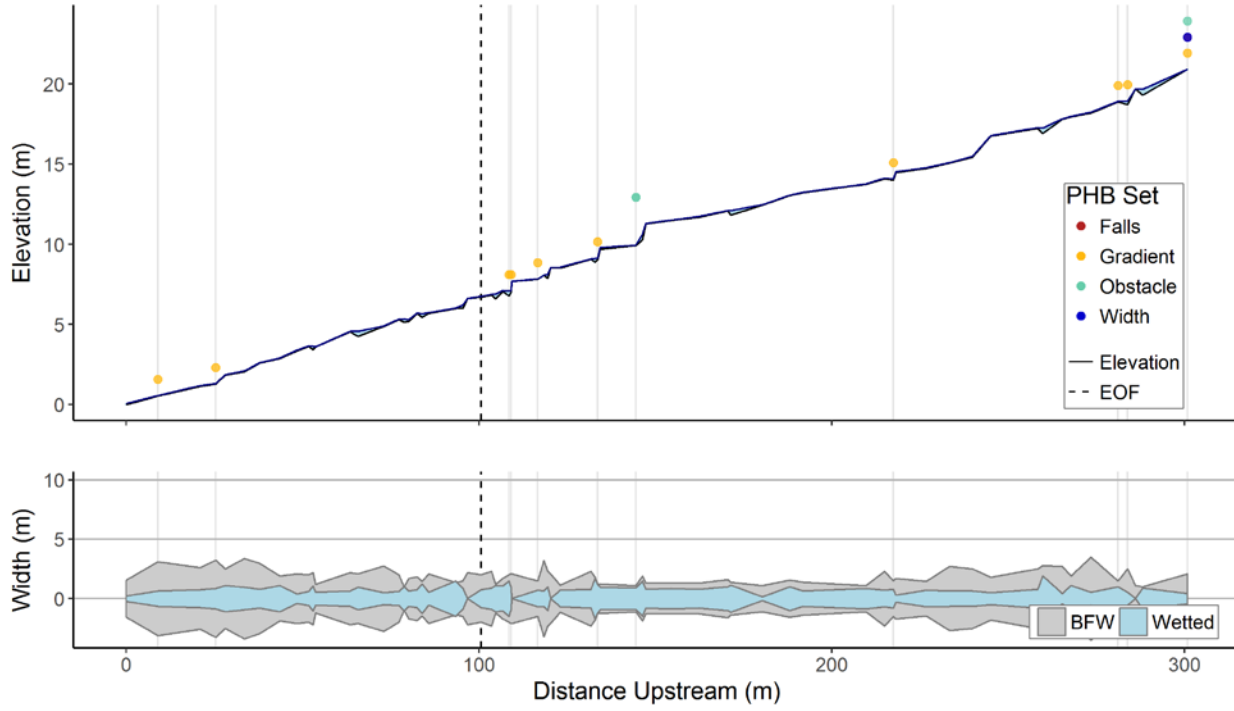
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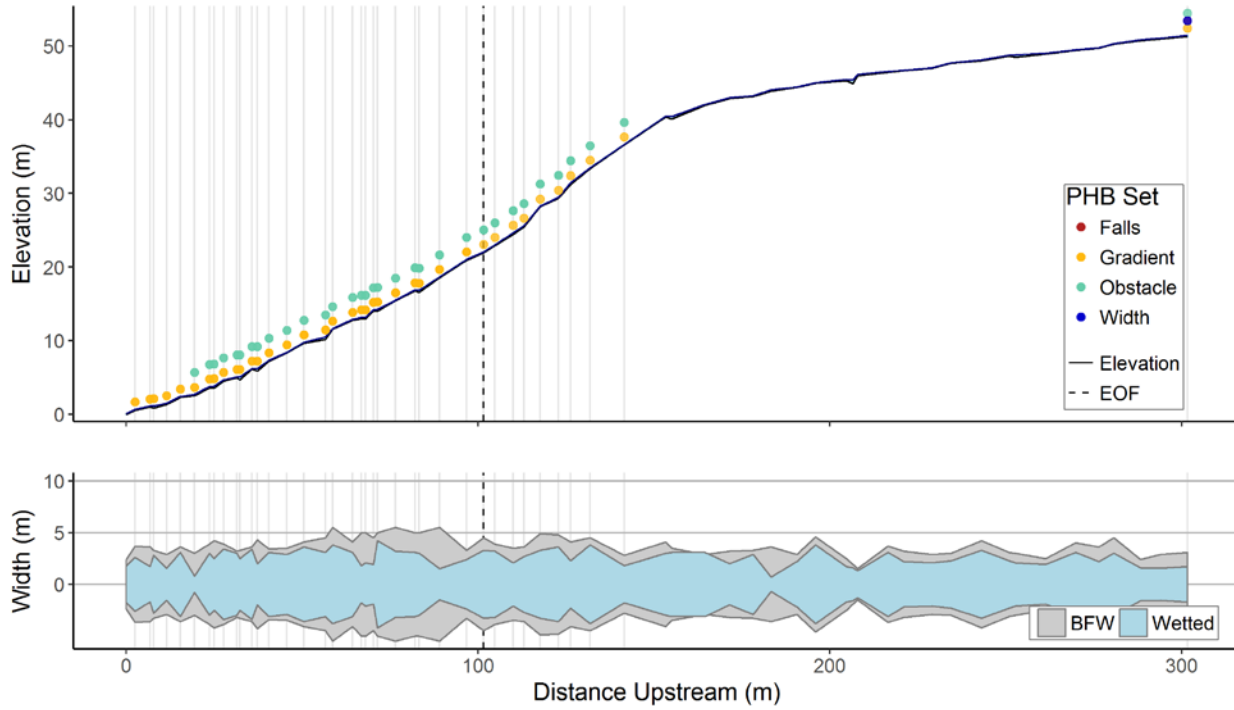
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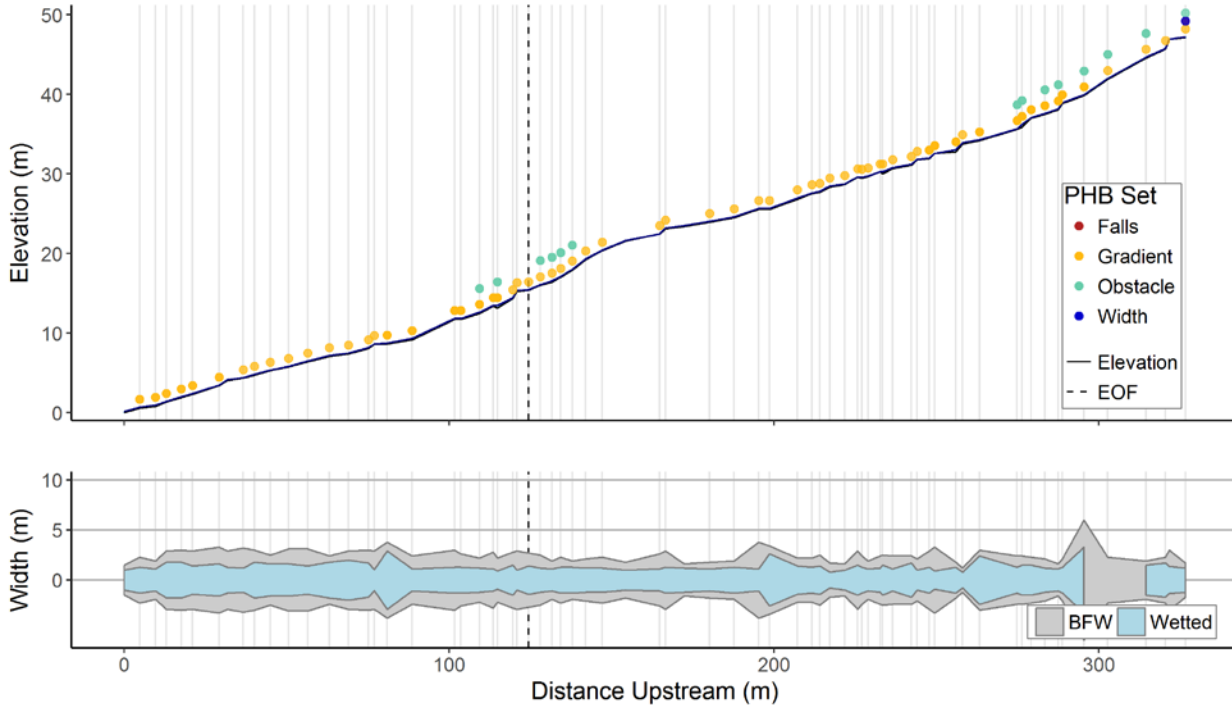
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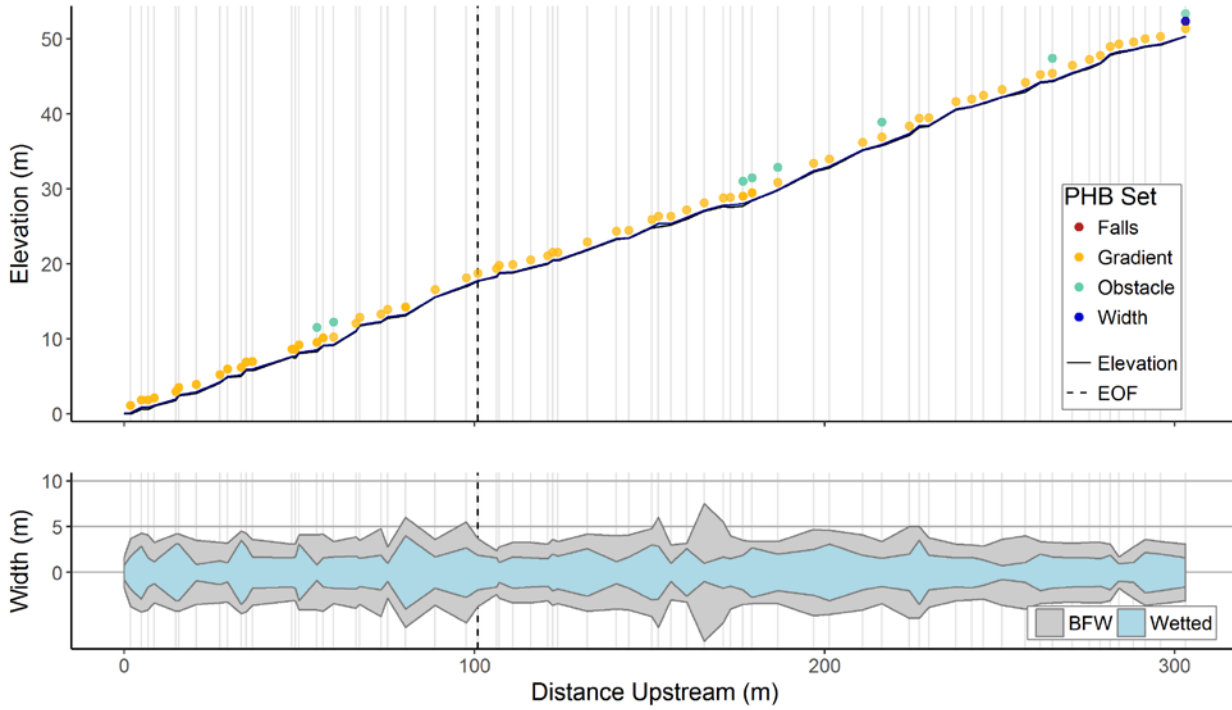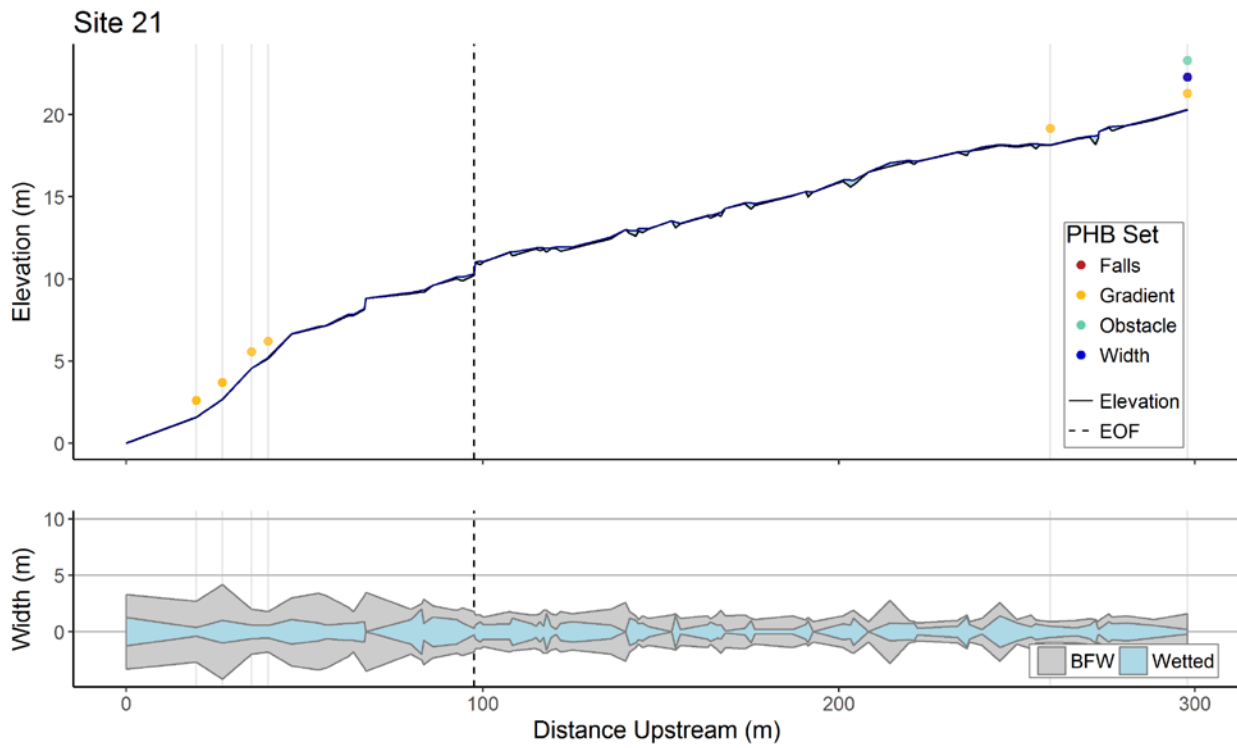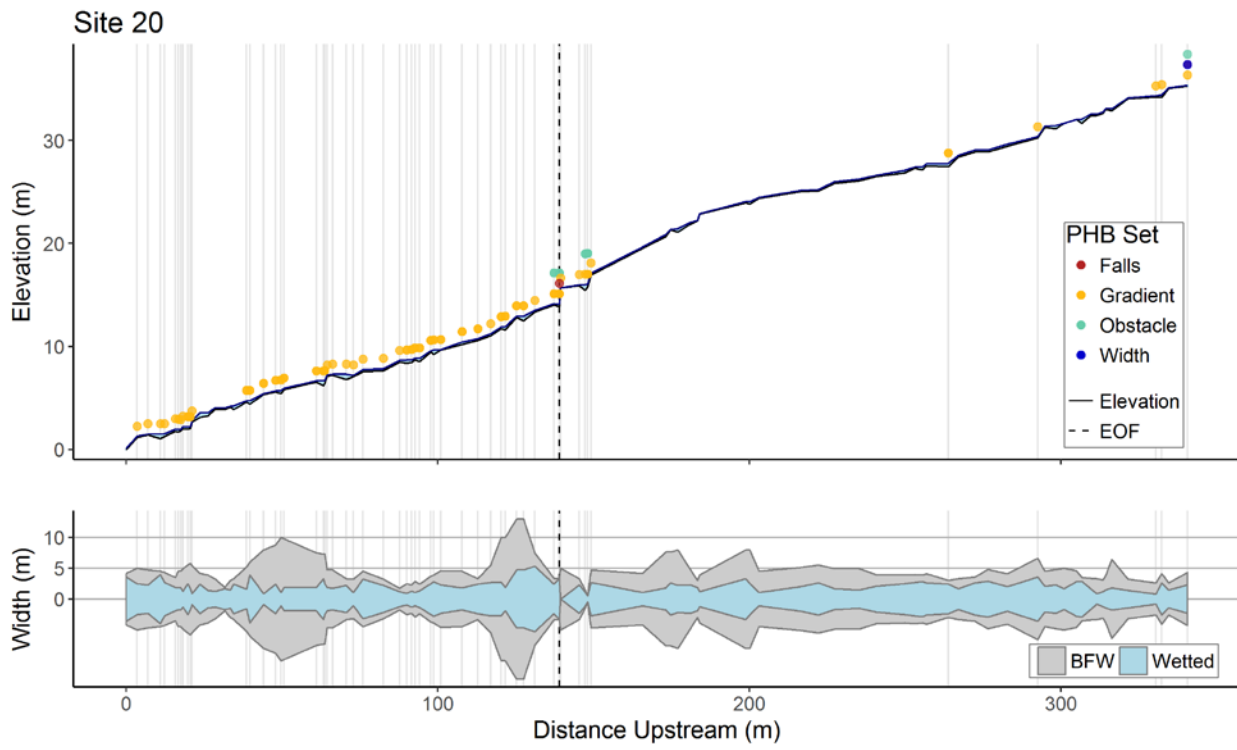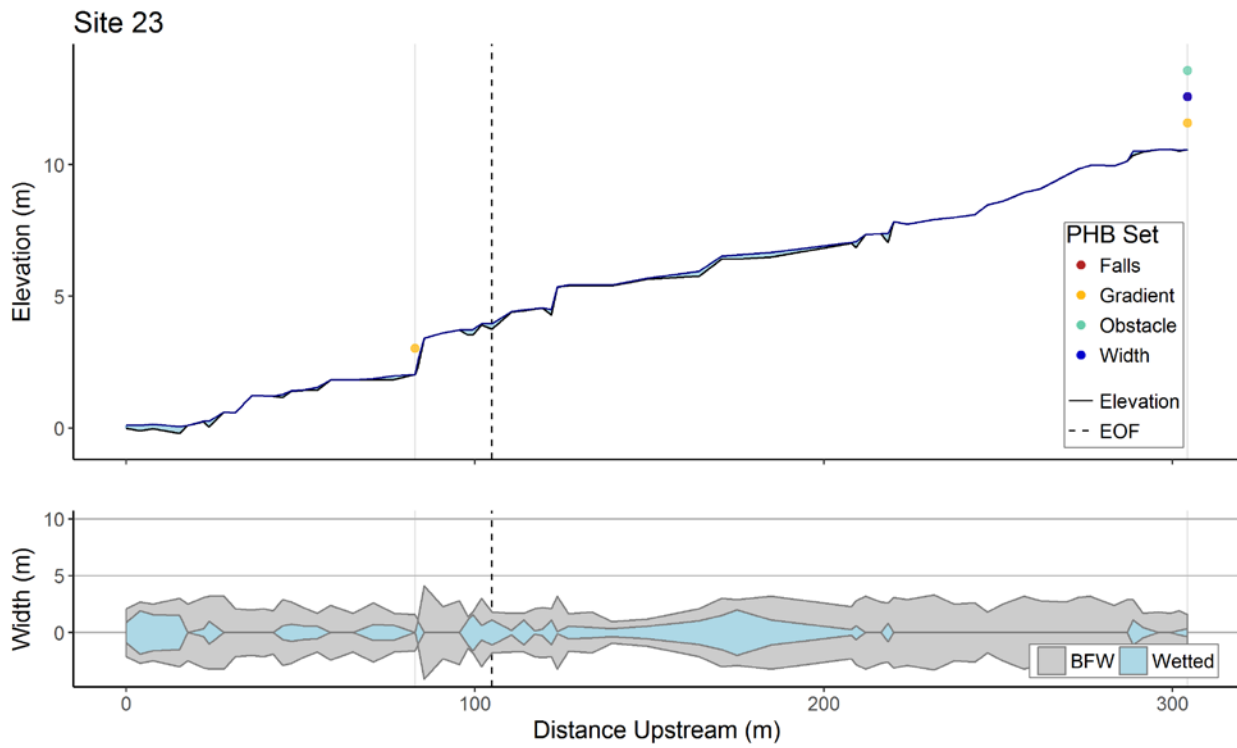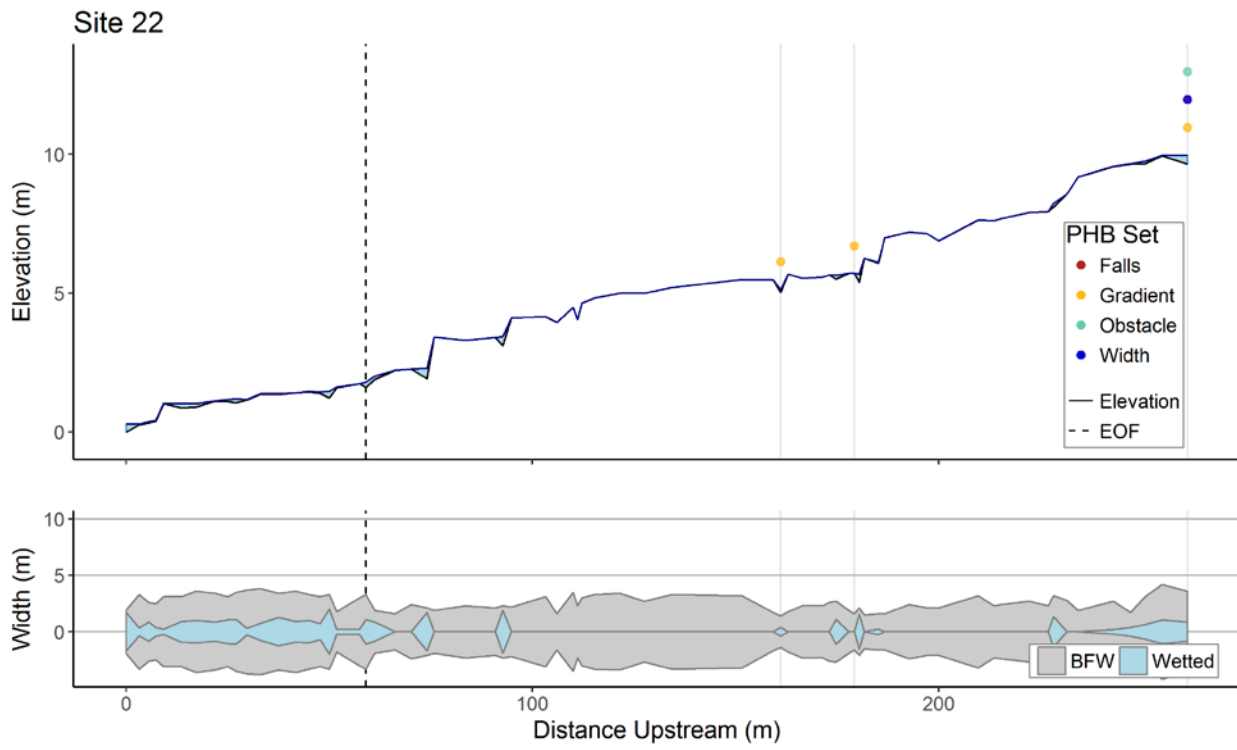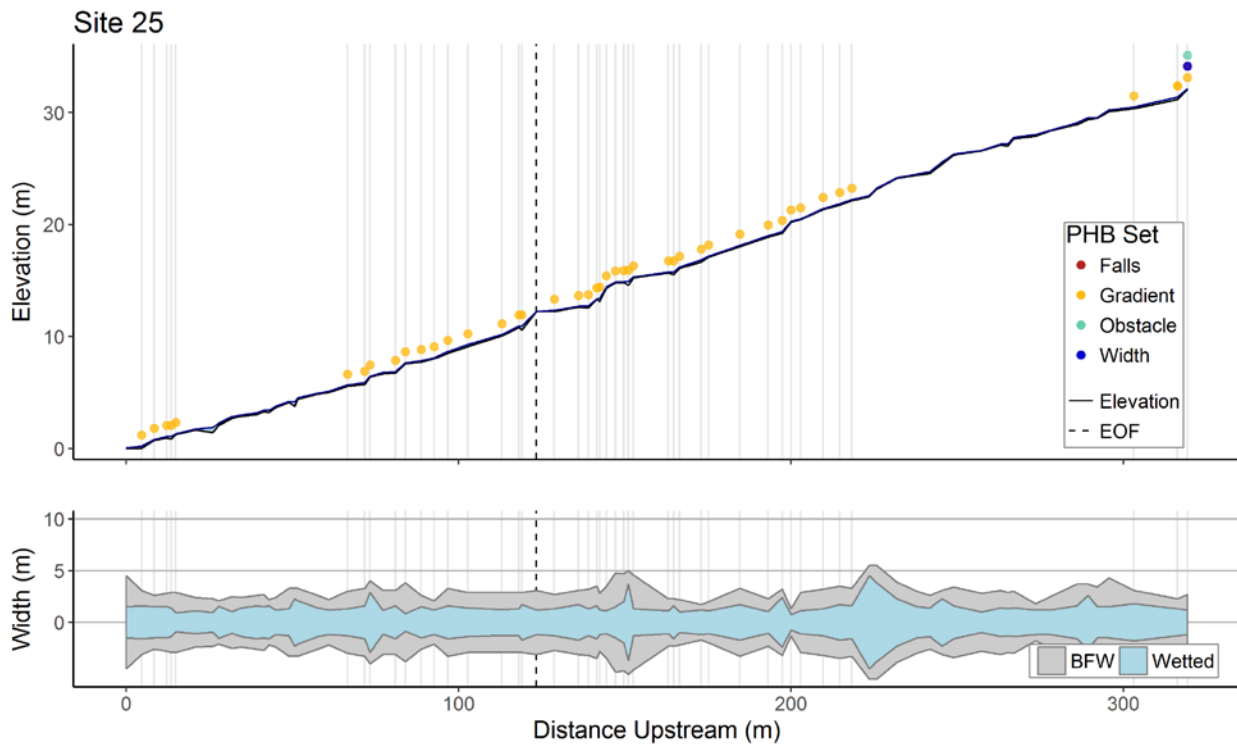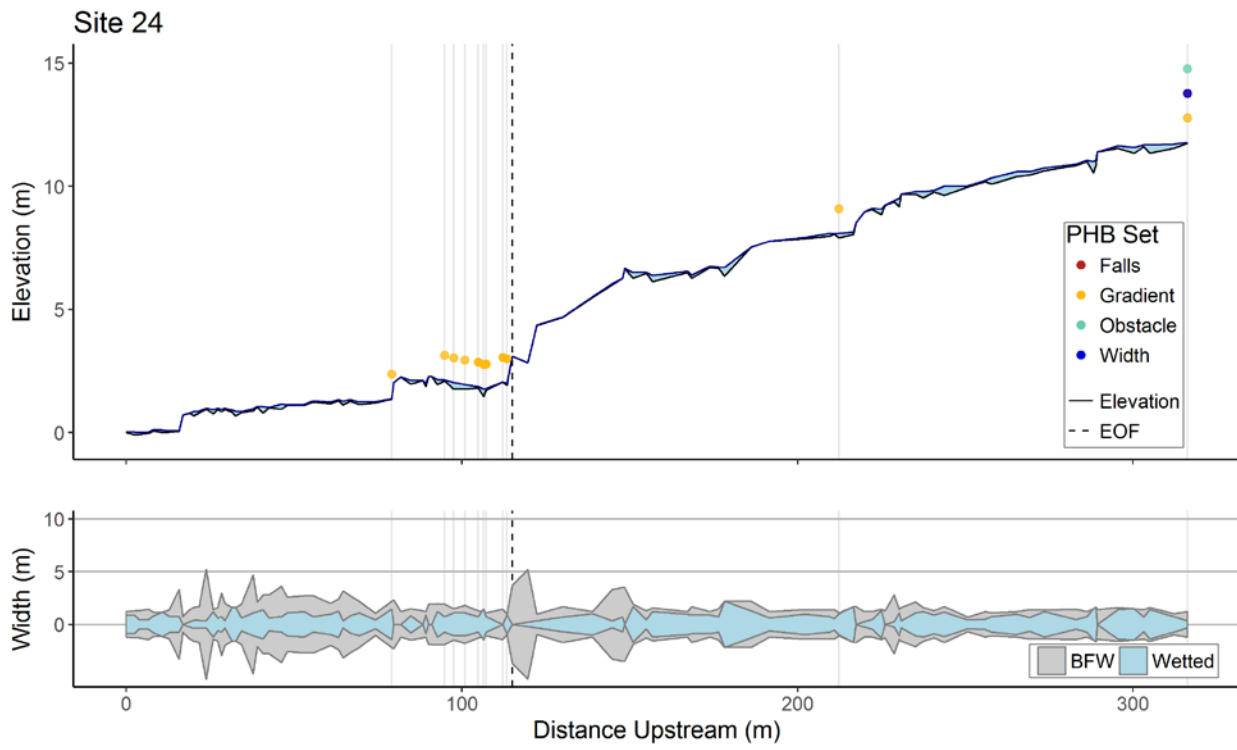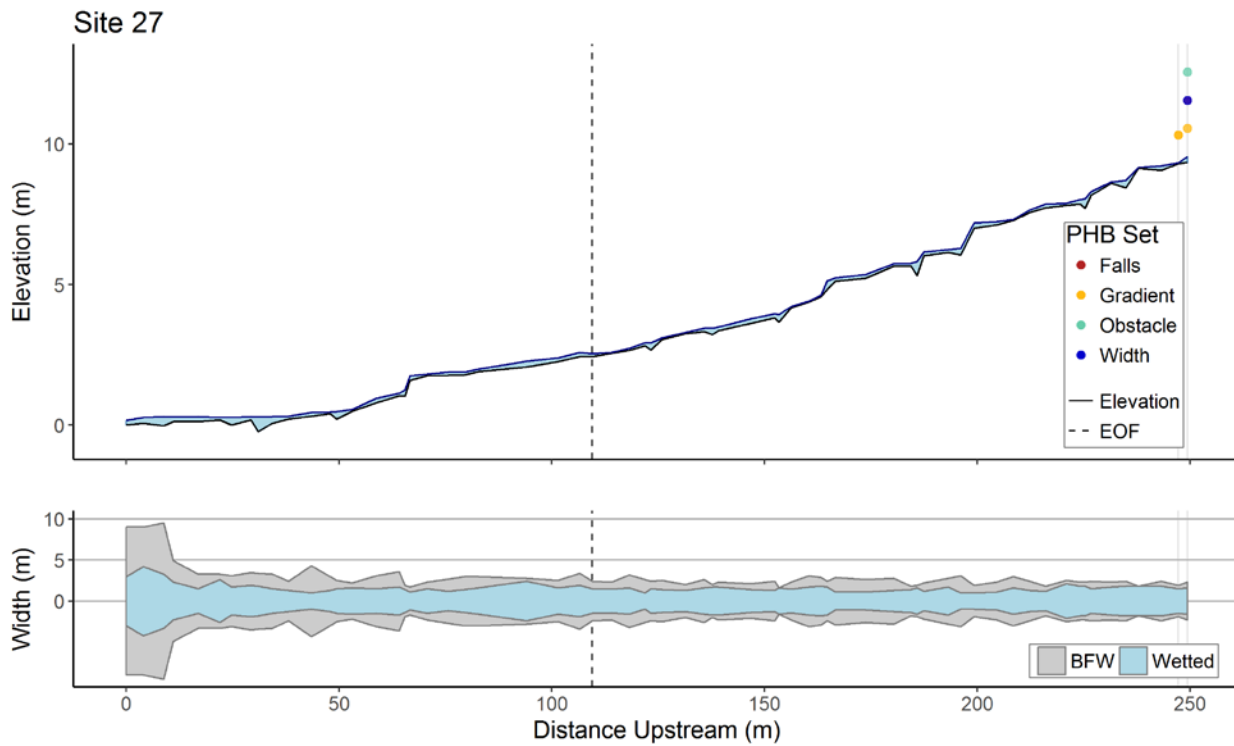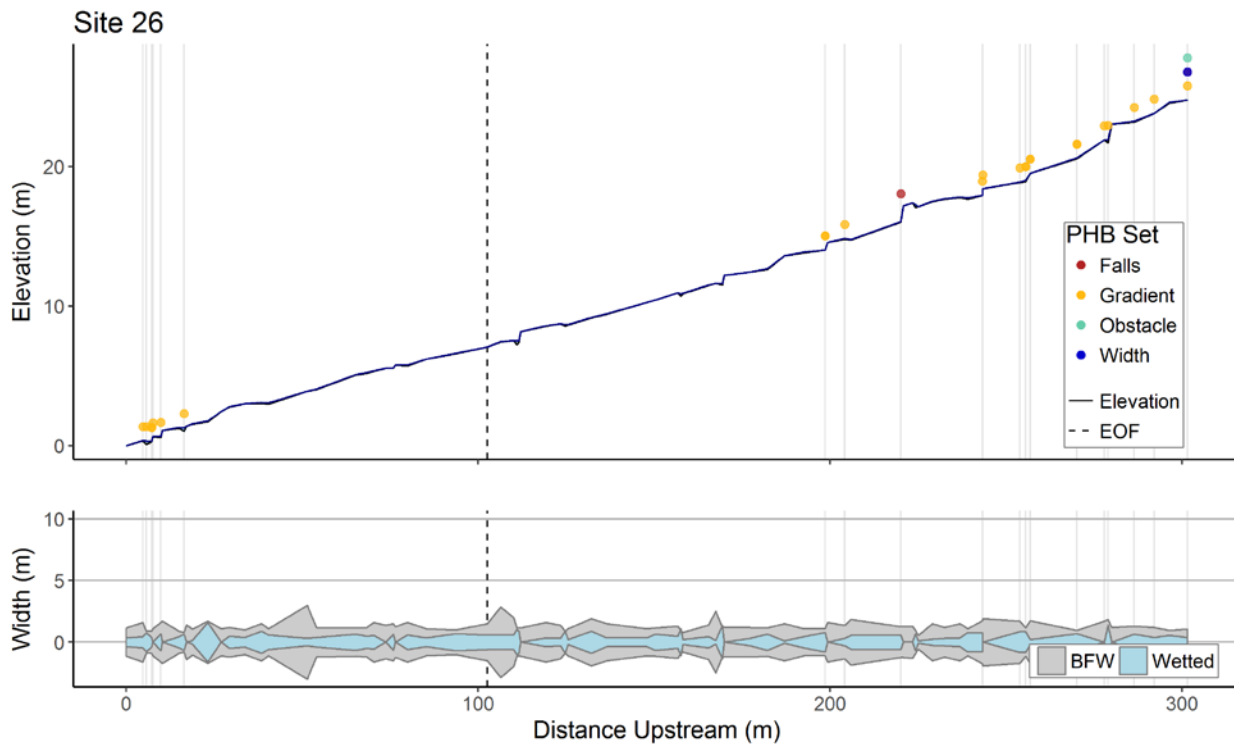
Site 26

Site 27

Site 27 Alt. trib.
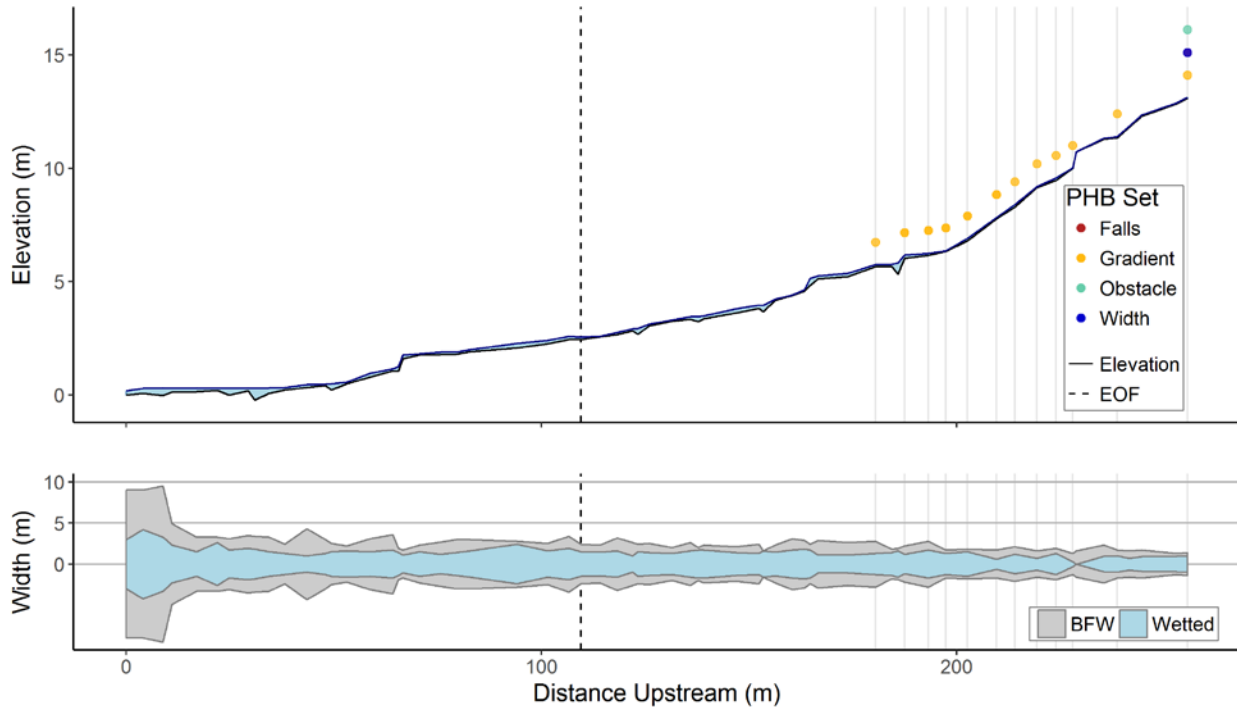
MEMORANDUM

October 26, 2018

TO: Marc Engel, ADM Policy and Services, Forest Practices Division

FROM: Hans Berge, Adaptive Management Program Administrator

SUBJECT: Science regarding tributaries

At the August 2018 meeting, the Forest Practices Board directed the Adaptive Management Program Administrator (AMPA) to develop supporting scientific documentation that reflects the state of the science pertaining to the use of small tributary streams by fish. The language from the motion is as follows:

" I move the Forest Practices Board directs staff to work with each of the proponents to clarify each alternative, including PHB's as they relate to above and within the anadromous floor. The Board further directs staff to work with stakeholders to ensure the analysis process is transparent to all caucuses. <u>The Board further directs the AMPA to convene the authors of the January 2018 report from the science panel to update the report to reflect all perspectives and supporting science regarding tributaries.</u>"

The attached document is an attempt to address this charge. You will see that the attached document is signed by 8 of 9 coauthors of the January 2018 report referenced in the Board's motion, and a minority report will be provided to you next week with the perspective of the dissenting coauthor to satisfy the requirement that "all perspectives…" are reflected.

Each coauthor sought to create a single document for you and efforts were made over the past several weeks to do so. Regrettably, we were not able to reach a consensus position on this document, although we were close. It is important to note that the focus was on the scientific evidence around the role of small streams in providing habitat for salmonid fishes, and not a reanalysis of the data in the January 2018 report. This summary is focused around the scientific literature and does not supplant any analyses that were included in the previous report. The interpretation of the broadly written motion was approached in the context of the discussion at the Board meeting in which I and the chair of the Science Panel, Dr. Phil Roni, were asked by Board members about completing this additional task.

If you have any questions or comments, please let me know.

A Review of the Role of Small Tributary Streams as Salmonid Habitat

Background and Purpose

At the August 2018 meeting, the Forest Practices Board directed the Adaptive Management Program Administrator (AMPA) to develop supporting scientific documentation that reflects the state of the science pertaining to the use of small tributary streams by fish. The language from the motion is as follows:

" I move the Forest Practices Board directs staff to work with each of the proponents to clarify each alternative, including PHB's as they relate to above and within the anadromous floor. The Board further directs staff to work with stakeholders to ensure the analysis process is transparent to all caucuses. <u>The Board further directs the AMPA to convene the authors of the January 2018 report from the science panel to update the report to reflect all perspectives and supporting science regarding tributaries.</u>"

The purpose of this document is to review the scientific literature that pertains to the use of tributary streams by both resident and anadromous salmonids and provide the Board with a comprehensive summary of the scientific literature on the role of small tributary streams as salmonid habitat. In this document, we refer to small tributary streams as streams that are 1st -3rd order streams generally less than 2m wide and consistent with the Washington Forest Practices Act (WAC 2013) definition for fish habitat, we define small tributary streams as streams that enter a larger stream in which resident and/or anadromous fishes may use during some part of their life cycles if this habitat is accessible. They may or may not contain perennial flowing surface water and their connection to a larger stream may be year-round or seasonal.

Case Studies of Small Streams as Fish Habitat

For resident trout and char and for anadromous salmonids that spend more than a few months of their lives in fresh water, the availability of aquatic habitat suitable for survival and growth is critical for successful freshwater rearing. Salmonids exhibit a variety of movements to different parts of a watershed in response to their life history requirements (Northcote 1978) and it is common for a variety of directed movements to be expressed within a single species (Quinn 2018) as a way of "spreading the risk" within the population and ensuring that a portion of

individuals will survive in an environment prone to multiple types of disturbance. Movements can be upstream, downstream, or laterally into small tributaries in which fish are not normally found. Transitional occupancy of temporarily suitable habitats is an important adaptation by salmonid fishes to living in unpredictable stream ecosystems (Schlosser and Angermeier 1995). In the Pacific Northwest, tributary streams (<2m bankfull width) are important habitat for many salmonids and may constitute a significant proportion of the habitat available to them (Rosenfeld et al. 2002). Small streams play an important role in the life history of anadromous fish by providing important spawning and rearing habitat for various life stages of salmon *Oncorhynchus spp.*, Steelhead *O. mykiss* and anadromous Cutthroat Trout *Oncorhynchus clarkii*. Coho Salmon *O. kisutch*, Steelhead and anadromous Cutthroat Trout are often found in streams ranging from small tributaries to mainstem rivers where they spawn and rear before migrating to the ocean (Cederholm and Scarlett 1981; Hartman and Brown 1987; Brown and Hartman 1988). Small tributaries have been shown to provide important overwintering habitat for both Steelhead (Cederholm and Scarlett 1981; Bramblett et al. 2002) and Coho Salmon (Bustard and Narver 1975; Peterson 1982; Brown and Hartman 1988; Nickleson et al. 1992), and Cutthroat Trout (Bustard and Narver 1975b) in a variety of Northwest streams.

Similarly, small streams are also important habitat for many resident trout and char *Salvelinus spp.* Resident trout show diverse life history strategies that often include spending considerable time in headwater streams (Fausch et al. 2002). Many of these fish may move relatively small distances that span less than a kilometer and move primarily between habitat units for feeding (Hilderbrand and Kershner 2000a; Schrank and Rahel 2004) while other fish are more migratory, using small tributaries for rearing as young of year and juveniles and eventually moving downstream into lake systems or move into larger rivers (Gowan and Fausch 1996, Dunham and Rieman 1999, Colyer et al. 2005, Muhlfeld and Marotz 2005). Small tributaries may provide important refugia for young trout where they can avoid larger predators and competition with older year classes (Louison and Stelzer 2016). For example, Louison and Stelzer (2016) observed that young-of-the-year Brown Trout *Salmo trutta* were able to use perennial first order streams for the first several months and likely immigrated into these streams from spawning areas.

Small tributary streams may support high densities of juvenile Cutthroat Trout in a watershed (Murphy et al. 1986, Rosenfeld et al. 2000). Stream habitat in these smaller streams is influenced by a number of factors. In a study of Cascade Mountain streams in Washington, fish use of these small tributaries was constrained by limited pool habitat, decreasing channel width, and sharp increases in channel gradient, but Cutthroat and Rainbow Trout *O. mykiss* did access streams with gradients up to 22% and were common where gradients exceeded 10% (Latterell et al 2000). Steep channels that contained abundant pools were more likely to contain fish, and pools provided a jumping point to access upstream habitat (Adams et al. 2000). In small streams in southeast Alaska, Coho Salmon, steelhead and Cutthroat Trout were found in accessible habitats above 15% gradients and ,while Coho Salmon did not appear to spawn in these high gradient reaches, spawning Dolly Varden char *Salvelinus malma* did occur (Bryant et al. 2004, Wissmar et al. 2010). In Washington State streams, fish have been observed in headwater stream segments with overall slopes as steep as 35% (J. Silver, Hoh Indian Tribe, Forks, WA, 1996, unpublished data; D. Collins, Washington DNR, Olympia, 2006, unpublished data), and in stream segments of 25% and steeper in Oregon (Connolly and Hall 1999).

The use of small, headwater tributaries often has a seasonal component related to flow availability and freshet timing. During seasonal runoff, fish may move into small tributaries to spawn or may use these tributaries as refugia from high flows (Bramblett et al 2002, Bryant et al. 2004). Other movements into small streams during these periods may be related to exploratory movements where fish look for new and possibly unoccupied habitats (Dolloff 1983, Decker and Erman 1992). For example, during times of low flows in southeast Alaska streams, juvenile Steelhead left small tributaries for larger streams while young Dolly Varden were year-round residents (Bramblett et al. 2002). In Carnation Creek, British Columbia Coho Salmon and trout (steelhead/cutthroat) used small tributaries in different ways during different seasons (Hartman and Brown 1987). Both young Coho and trout entered tributaries more in autumn and early winter. In contrast, Coho tended to leave tributaries more in late winter and early spring while the numbers of trout entering and leaving were about the same. Spawning trout entered tributaries from March to May. Depending on the species, salmonids may leave smaller tributary streams for downstream habitats with more water or in some cases be stranded in deeper pool habitats until fall or until seasonal rains arrive (Wiggington et al. 2006, Ebersole et al. 2006).

There are ontogenetic differences in preferred habitats of Cutthroat Trout. Moore and Gregory (1988) found that Cutthroat Trout fry were more commonly associated with low-velocity stream margins in the Cascades, while larger (older) Cutthroat Trout were more associated with pool habitat (Bisson et al. 1988; Rosenfeld 2002).

While seasonal use of habitats may occur in some small tributaries, the movements of trout to the most upstream portions of the drainages may not change dramatically unless changes in physical habitat or stream flows occur. Cole et al. (2006) found that most fish distribution boundaries did not change significantly in eastern Washington streams during the summer months over two years and most changes that did occur were less than 50 meters. Streamflow regimes for the two years surveyed were similar and reflected lower than average discharge at these locations. Higher winter and summer stream flows may influence the location of these boundaries when fish are able to move upstream during favorable physical conditions. Transient barriers that consist primarily of large woody debris are destroyed and reformed during high stream flow events and may influence fish movement. Seasonal variation in stream flow may potentially cause shifts in fish distribution and have yet to be adequately measured (Cole et al. 2006). For example, in a recent survey of Falls Creek, Washington (Deschutes River tributary) by Weyerhauser Company personnel, surveyors noted fish above a potential barrier in a seasonally flowing tributary stream during spring sampling (Figure 1). Observations of inaccessible habitat and diminished streamflow suggest these fish were most likely forced to move to more favorable locations immediately downstream in Falls Creek (Figure 2).

Figure 1. Confluence of a tributary of Falls Creek on the Vail Tree Farm, August 29, 2018. In a recent survey, fish were found 30 m upstream of this location (Jason Walter, Weyerhaeuser Company, personal communication).

Figure 2. Falls Creek (Type F) immediately adjacent to tributary in Figure 1 (above).

Intermittently flowing tributary streams during summer can provide important habitat opportunities for salmonids during periods of the year when discharge increases. Rainbow Trout preferentially spawned in Kilm Meadow Creek, an intermittent tributary of Sagehen Creek, California, during the spring and young trout were able to emerge and emigrate out of the stream before summer low flows caused the stream to become intermittent (Erman and Hawthorn 1976). Juvenile Coho that used intermittent tributaries in Oregon streams had higher overwinter survival than Coho from perennial tributaries (Wigington et al. 2006). Residual pools that remained available during the summer months were able to sustain young Coho when streams became intermittent. As streamflows resumed in the fall, other Coho from the mainstem moved into these streams. Similarly, Ebersole et al. (2006) observed that young Coho utilizing intermittent streams had higher growth rates and migrated as larger smolts in tributaries of the West Fork Smith River. Environmental conditions related to rainfall also may influence how successful each

cohort of young fish may be. Drought conditions during the summer low flow period may cause many stream habitats to dry up that may be available in wetter water years (Hwan et al. 2017). Age 0 Coho and Steelhead did better in wetter precipitation years in small intermittent tributaries in California and Coho had slightly higher survival.

An often-overlooked role of small tributary streams is their importance in providing cold water refugia and as a source or recruitment after catastrophic events such as debris flows or wildfires. Lamberti et al. (1991) documented the recolonization of stream habitat by cutthroat trout after a debris flow occurred in Quartz Creek, Oregon. They found that while local densities of trout were severely impacted by the debris flow, the presence of trout in small tributaries (unimpacted by the debris flow) contributed to the recovery of Cutthroat Trout the following year. In a review on the effects of wildfire on stream fish, Gresswell (1999) found that recolonization of streams after high severity fires is often rapid where fish populations outside these basins are in proximity to these watersheds and movement among streams is not limited.

The connections of these smaller tributaries to large streams may be particularly important where small stream habitat provides higher quality habitat than adjacent streams that have been significantly altered by disturbance (Tschaplinski and Harman 1983, Ebersole et al. 2006). For example, some tributaries of Type F waters may not used by fish during any season of the year due to a blockage at the tributary mouth or to unfavorable physical conditions (e.g., gradient, lack of rearing habitat and seasonal flow) in the tributary channel. However, over time accessibility factors or channel habitat can change in such a way that what were previously uninhabitable streams provide conditions that are favorable to fish occupancy, and conversely, tributaries that can be used by fish at present may experience changes that render them unfavorable in the future. Changes that determine whether small tributaries can be used by fish are typically related to disturbances such as exceptionally high flows associated with catastrophic flood events such as rain on snow floods, debris flows from landslides or wildfires, and windstorms. Such episodic disturbances are erratic and can occur infrequently (decades to centuries), but their overall effect in drainage systems is to create a mosaic of streams suitable for fish that changes in response to local disturbance regimes. This is illustrated conceptually in the Figure 3 adapted from Penaluna et al. (2018).
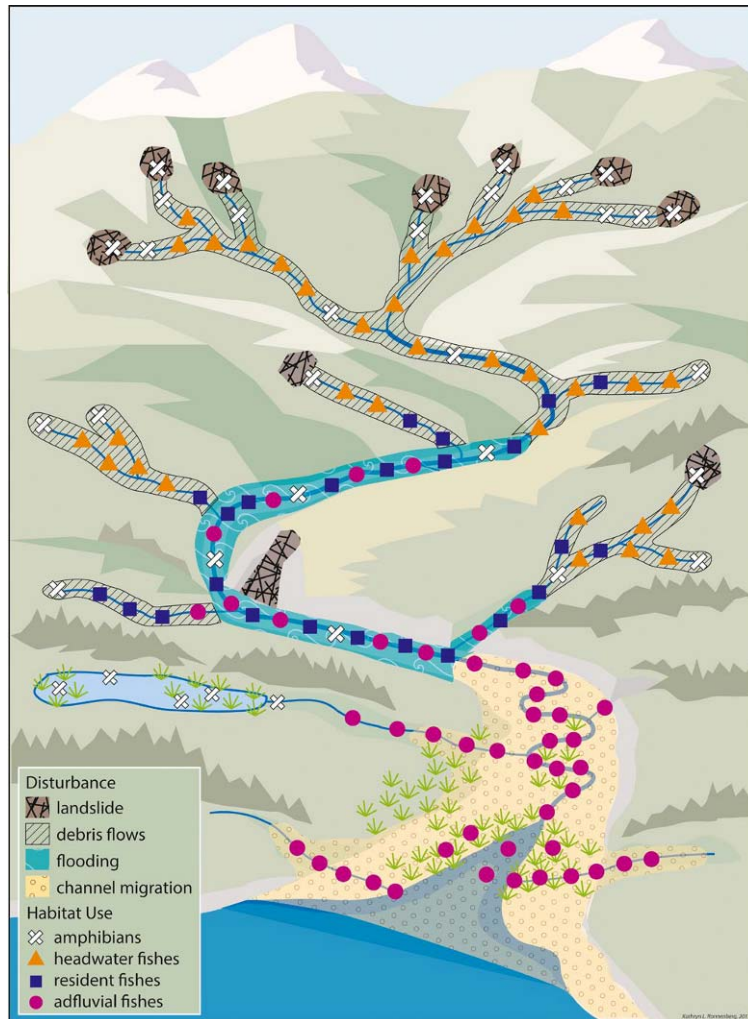
Figure 3. (From Penaluna et al. 2018) Generalized natural disturbances in a river network (modified from Montgomery 1999). Overlaid are types of aquatic species that are generally adapted to each area. The actual occurrence of a disturbance event depends on local conditions, including topography and soil type, and the legacy of past natural and human disturbances, such as the extent to which best management practices have been implemented regarding riparian buffers, conservation tillage, and culvert upgrades.

Conclusion

Small tributary streams can provide important habitat for stream-dwelling salmonids if they are accessible at some point during the hydrologic year. Anadromous fish may use small tributaries for spawning and rearing habitat, even in some cases when those streams are seasonally

intermittent. Small tributary streams are also important habitat for resident and migratory trout and serve similar functions as spawning, rearing, and overwintering habitat. An important role of small tributaries is their being part of well-connected drainage networks that allow for the passage of fish among rivers and tributaries. Connectivity facilitates rapid recolonization of streams by salmonids following large disturbances and provides access to refugia by fish during the disturbance events themselves. While differences in the upstream extent of population distribution may be limited by barriers caused by gradient, waterfalls or stream size, fish will continually explore new habitats when they become available and colonize suitable habitats when accessible. This includes small tributaries that may not be inhabited by fish during typical stream survey periods (spring or summer), but may constitute important habitats at other times of the year. Management strategies that take the dynamic nature of headwater tributaries into account are likely to be more robust to future changes than those that consider existing conditions to be permanent.

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Literature Cited

Adams, S. B., C. A. Frissell, , and B. E. Rieman. 2000. Movements of nonnative brook trout in relation to stream channel slope: Transactions of the American Fisheries Society 129:623-638.

Bisson, P. A., K. Sullivan, K., and J. L. Nielsen. 1988. Channel hydraulics, habitat use, and body form of juvenile coho salmon, steelhead, and cutthroat trout. Transactions of the American Fisheries Society 117: 262–273.

Bramblett, R. G., M. D. Bryant, B. E. Wright, and R. G. White. 2002. Seasonal use of small tributary and main-stem habitats by juvenile steelhead, coho salmon, and Dolly Varden in a Southeastern Alaska Drainage basin. Transactions of the American Fisheries Society 131: 498-506.

Bryant, M. D., N. D. Zymonas,, and B. E. Wright. 2004. Salmonids on the fringe: abundance,species composition, and habitat use of salmonids in high-gradient headwater streams, southeast Alaska: Transactions of the American Fisheries Society 133:1529-1538.

Bryant, M. D., M. D. Lukey, J. P. McDonell,, R. A. Gubernick, and R. S. Aho. 2009. Seasonal movement of Dolly Varden and cutthroat trout with respect to stream discharge in a second-order stream in Southeast Alaska. North American Journal of Fisheries Management 29: 1728-1742.

Bustard, D. R., and D. W. Narver. 1975a. Aspects of the winter ecology of juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*). Journal of the Fisheries Research Board of Canada 32:667-680.

Bustard, D. R., and D. W. Narver. 1975b. Preferences of juvenile coho salmon (*Oncorhynchus kisutch*) and cutthroat trout (*Salmo clarki*) relative to similated alteration of winter habitat. Journal of the Fisheries Research Board of Canada 32: 681-687.

Cederholm, C. J., and W. J. Scarlett. 1982. Seasonal immigrations of juvenile salmonids into four small tributaties of the Clearwater River, Washington, 1977-1981. Pages 98-110 in E. L. Brannon and E. O. Salo, editors. Salmon and trout migratory behavior symposium. Fisheries Research Institute, University of Washington, Seattle.

Cole, M. B., D. M. Price, D. M., and B. R. Fransen2006. Change in the upper extent of fish distributions in eastern Washington streams between 2001 and 2002: Transactions of the American Fisheries Society 135:634-642.

Colyer, W. T., J. L. Kershner, and R. H. Hilderbrand. 2005. Movements of fluvial Bonneville cutthroat trout in the Thomas Fork of the Bear River, Idaho-Wyoming: North American Journal of Fisheries management 25:954-963.

Connolly, P. J. and J. D. Hall. 1999. Biomass of Coastal Cutthroat Trout in unlogged and previously clear-cut basins in the central Coast Range of Oregon. Transactions of the American Fisheries Society 128: 890-899.

Dingle, H., 1996 Migration: The biology of life on the move.New York, New York, England, Oxford University Press, p. 474.

Decker, L. M., and D. C. Erman.1992. Short-term seasonal changes in composition and abundance of fish in Sagehen Creek, California. Transactions of the American Fisheries Society 121: 297-306.

Dolloff, C. A. 1983. The relationships of wood debris to juvenile salmonid production and microhabitat selection in small southeast Alaska streams. Ph.D. thesis, Montana State University, Bozeman, Montana. 100 pp.

Ebersole, J. L., P. J. Wigington, J. P. Baker, M. A. Cairns, M. R. Church, J. E. Compton, S. G. Leibowitz, B. Miller, and B. Hansen. 2006. Juvenile coho salmon growth and survival across stream network seasonal habitats. Transactions of the American Fisheries Society 135:1681-1697.

Erman, D.C. and V.M. Hawthorne. 1976. The quantitative importance of an intermittent stream in the spawning of rainbow trout. Transactions of the American Fisheries Society 105:675-681.

Fausch, K. D., C. E. Torgerson, C. V. Baxter, and H. W. Li. 2002. Landscapes to riverscapes: bridging the gap between research and conservation of stream fishes. BioScience 52(6): 1-16.

Gowan, C., and K. D. Fausch1996. Mobile brook trout in two high-elevation Colorado streams: reevaluating the concept of restricted movement. Canadian Journal of Fisheries and Aquatic Sciences 53: 1370-1381.

Gresswell, R.E. 1999. Fire and aquatic ecosystems in forested biomes of North America. Transactions of the American Fisheries Society128(2):193-221.

Hartman, G. E, and T. G. Brown. 1987. Use of small, temporary, floodplain tributaries by juvenile salmonids in a west coast rain-forest drainage basin, Carnation Creek, British Co lumbia. Canadian Journal of Fisheries and Aquatic Sciences 44:262-270.

Heggenes, J., Northcote, T.G., and A. Peter. 1991. Spatial stability of cutthroat trout (*Oncorhynchus clarki*) in a small, coastal stream. Canadian Journal of Fisheries and Aquatic Sciences 48: 757-762.

Hilderbrand, R. H., and J. L. Kershner. 2000a, Movement patterns of stream-resident cutthroat trout in Beaver Creek, Idaho-Utah. Transactions of the American Fisheries Society 129:1160-1170.

Hoffman R. and J. Dunham. 2007. Fish movement ecology in high gradient headwater streams: its relevance to fish passage restoration through stream culvert barriers. U.S. Geological Survey, OFR 2007-1140, 40 pp.

Hwan, J., A. Fernandez-Chacon, M. Buoro and S. M. Carlson. 2018. Dry-season survival of juvenile salmonids in an intermittent coastal stream. Canadian Journal of Fisheries and Aquatic Sciences 75: 746-758.

Lamberti, G. A., S. V. Gregory, L. R. Ashkenas, R. C. Wildman and K. M. S. Moore. 1991. Stream ecosystem recovery following a catastrophic debris flow. Canadian Journal of Fisheries and Aquatic Sciences 48:196-208.

Latterell, J. J., R. J. Naiman, B. R. Fransen, and P. A. Bisson. 2003. Physical constraints on trout (*Oncorhynchus spp.*) distribution in the Cascade Mountains: a comparison of logged and unlogged streams. Canadian Journal of Fisheries and Aquatic Sciences 60:1007-1017.

Louison, M. J. and R. S. Stelzer.2016. Use of first‐order tributaries by brown trout (*Salmo trutta*) as nursery habitat in a cold water stream network. Ecology of Freshwater Fish 25:133-140.

Milner, A. M., A. L. Robertson, K. A. Monaghan, A. J. Veal, and E. A. Flory. 2008. Colonization and development of an Alaskan stream community over 28 years. Frontiers in Ecology and Environment 2008 6(8): 413–419.

Montgomery, D. R. 1999. Process domains and the river continuum. Journal of the American Water Resources Association 35(2):397–410.

Moore, K. M. S. and S. V. Gregory. 1988. Summer habitat utilization and ecology of cutthroat trout fry in Cascade Mountain streams. Canadian Journal of Fisheries and Aquatic Sciences 45: 1921-1930.

Muhlfeld, C. C., and B. Marotz. 2005. Seasonal movement and habitat use by subadult bull trout in the Upper Flathead River system, Montana.North American Journal of Fisheries Management 25:797-810.

Murphy, M. L., J. F. Thedinga, K V. Koski, and G. B. Grette. 1984. A stream ecosystem in an old-growth forest in southeast Alaska: Part V: Seasonal changes in habitat utilization by juvenile salmonids. Pages 89-98 in W. R. Meehan, T. R. Merrell, Jr., and T. A. Hanley, editors. Fish and wildlife relationships in old-growth forests. American Institute of Fisheries Research Biolologists, Juneau, Alaska.

Nickelson, T., J. Rodgers, M. F. Solazzi, and S. Johnson. 1992. Seasonal changes in habitat use by juvenile coho salmon (*Oncorhynchus kisutch*) in Oregon coastal streams. Canadian Journal of Fisheries and Aquatic Sciences 49:783–789.

Northcote, T. G. 1978. Migratory strategies and production in freshwater fishes. Pages 326-359 in S. D. Gerking, editor. Ecology of freshwater fish production. Blackwell Scientific Publications, Oxford, England.

Penaluna, B. E., G. H. Reeves, C. Z. Barnett, P. A. Bisson, J. M. Buffington, C. A. Dolloff, R. L. Flitcroft, C. H. Luce, K. H. Nislow, J. D. Rothlisberger, M. L. Warren. 2018. Using natural disturbance and portfolio concepts to guide aquatic–riparian ecosystem management. Fisheries 43(9):406-422.

Quinn, T. P. 2018. The behavior and ecology of Pacific salmon and trout. University of Washington Press, Seattle, Washington. 562 pp.

Rosenfeld, J. S., S. MacDonald, D. Foster, S. Amehein, B. Bales, T. Williams, F. Race, and T. Livingstone. 2002. Importance of small streams as rearing habitat for coastal cutthroat trout: North American Journal of Fisheries Management 22:177-513.

Schlosser, I. J, and P. L. Angermeier. 1995. Spatial variation in demographic processes of lotic fishes: conceptual models, empirical evidence, and implications for conservation. American Fisheries Society Symposium 17:392-401.

Schrank, A. J., and F. J. Rahel. 2004. Movement patterns in inland cutthroat trout (*Onchorhynchus clarkii utah*): management and conservation implications. Canadian Journal of Fisheries and Aquatic Sciences 61:1528-1537.

Washington Forest Practices Act. 2013. Washington Administrative Code 222-16-010.

Wiggington, P. J. and 13 co-authors. 2006. Coho salmon dependence on intermittent streams. Frontiers in Ecology and the Environment 4:513-518.

Wissmar, R.C.**,** R. K. Timm**,** and M. D. Bryant. 2010. Radar-Derived Digital Elevation Models and Field-Surveyed Variables to Predict Distributions of Juvenile Coho Salmon and Dolly Varden in Remote Streams of Alaska. Transactions of the American Fisheries Society. 139 (1): 288-302.

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M E M O R A N D U M

DATE: **22** October 2018

TO: Forest Practices Board

FROM: Garren Andrews, Compliance Monitoring Program Manager

SUBJECT: Compliance Monitoring Program 2016-2017 Biennial Report

Attached is the 2016-2017 Forest Practices Compliance Monitoring biennial report, and Independent Scientific Peer Review synthesis and assessment.

The 2016-2017 Compliance Monitoring Program biennial report contains data analysis and interpretation, and trend analysis of the nine standard sample prescriptions, and Unstable Slopes for the 2016-2017 sampling window. Trend analysis was conducted to detect compliance trends on data collected from 2010-2017.

2016-2017 Biennium Forest Practices Compliance Monitoring Report

September 2018

WASHINGTON STATE DEPARTMENT OF
NATURAL RESOURCES
HILARY S. FRANZ | COMMISSIONER OF PUBLIC LANDS

2016-2017 Biennium Forest Practices Compliance Monitoring Report

Table of Contents

1. Acknowledgments

2. Executive Summary

The Compliance Monitoring Program (CMP) is a key component of the Washington State Department of Natural Resources' (DNR's) Forest Practices Program (FP Program). Compliance monitoring is linked to DNR's responsibility to ensure that operators and landowners follow forest practices administrative rules (FP rules) when they conduct forest practice activities. Through monitoring, the CMP provides feedback to the FP Program regarding the degree to which specific FP rules are being implemented correctly and highlights where there is a need for focus, training, guidance, or clarity.

The CMP reports on real-world, on-the-ground rule compliance. The FP rules direct DNR to provide "statistically sound, biennial compliance audits and monitoring reports to the [Forest Practices] Board for consideration and support of rule and guidance analysis" (WAC 222-08-160[4]). The CMP does not report on *effectiveness* of the rules: that responsibility lies with the Adaptive Management Program's Cooperative, Monitoring, Evaluation, and Research (CMER) committee.

This biennial CMP report covers data samples collected during the calendar year 2016 and 2017 field seasons. Two years are needed to obtain enough data to attain the desired level of statistical precision. The data from the 2016 and 2017 field seasons have been combined to satisfy the desired precision for statistical estimates.

The CMP evaluates compliance with prioritized FP rules considered to have the greatest potential impact on public resources (defined in RCW 76.09.020(25) as water, fish, wildlife, and capital improvements of the state and its political subdivisions). The evaluated rule groupings pertain to riparian and wetland areas and to road construction and maintenance.

Sample Design and Methodology

For the purposes of monitoring and appropriate statistical sampling, individual FP rules are grouped into categories of similar rules called "prescriptions." Separate samples are chosen for each prescription type monitored. The overall sampling population for compliance include forest practices applications (FPAs) that include forest practices activities, such as timber harvest or road construction. The sampling population for each prescription type consists of the subset of FPAs that contain the prescription. The prescriptions monitored in the 2016-2017 biennium include (numbers in parentheses indicate the estimated population of FPAs with the prescription in the 2016-2017 sample): Roads (2,275), Type A&B Wetlands (313), Forested Wetlands (463), No Inner Zone Harvest (NIZH) (1,408), Desired Future Condition Option 1 (DFC1) (86), Desired Future Condition Option 2 (DFC2) (331), Non-Fish-Bearing Perennial Waters (Np) (1,776), and Non-Fish-Bearing Seasonal Waters (Ns) (1,868).

For this report, 198 standard prescriptions were sampled from a total of 135 FPAs. The number of samples chosen for each prescription were those required to attain the desired precision based on preliminary statistical estimates of prescription population size, cluster size, and variance. Prescription sample sizes for the 2016-2017 biennium were as follows: Roads (15), Type A & B Wetlands (43), Forested Wetlands (17), No Inner Zone Harvest (24), Desired Future Condition

Option 1 (20), Desired Future Condition Option 2 (13), Non-Fish-Bearing Perennial Waters (35), and Non-Fish-Bearing Seasonal Waters (31).

FP rules monitored annually are referred to as the Standard Sample. In addition, certain rule groups are monitored periodically and are referred to as Emphasis Samples.

The Standard Sample monitors the following rules:

- Riparian protection (WAC 222-16-030, 222-30-021 and 022)
- Wetland protection (WAC 222-16-030, 222-30-020[6] and [7] and WAC 222-24-015)
- Road construction, maintenance, and abandonment (WAC 222-24)
- Haul routes for sediment delivery (WAC 222-24)

In addition, the physical parameters of waters (e.g., stream width, stream gradient, etc.) are observed to estimate the number of occurrences in which water types recorded on FPAs are different than what is observed on the ground (WAC 222-16-031).

Study Design

The CMP modified the compliance study design beginning with the 2014-2015 biennium in order to increase precision in statistical estimates for each prescription type observed. Previously, compliance rates were estimated by dividing fully-compliant samples by the total number of samples for each prescription type. The study design divides the number of compliant rules by the number of total sampled rules within each prescription type, resulting in an average compliance rate. This changes the interpretation of compliance, increases statistical precision in results, and provides more information to help determine causes of noncompliance associated with rule interpretation and implementation. The added precision helps discern changes in compliance rates over time. The study design also creates flexibility for future sampling to add or remove different prescription types from the sample as needed, while still providing the desired confidence intervals for each prescription type. In addition, as a result of rule overlap, the No Inner Zone Harvest and No Outer Zone Harvest prescriptions have been combined.

The estimated rate of compliance for a prescription is the proportion of sampled rules that were compliant. Compliance rates have been adjusted for bias per Independent Scientific Peer Review recommendations. These adjustments were insignificant (0.0029% - 0.0997%), but in some cases result in a change in the whole number percentage. Additional information is located in Appendix D.

Trend analysis is used to assess trends in prescription and individual rule compliance over time. Data collected from 2010-2013 for the standard prescription types were converted to be consistent with current data collection and analytical protocols. Weighted least squares linear regression analysis was used to predict general trends in average prescription compliance through time.

Notable Aspects of CMP Samples

- FPAs are randomly selected.
- Conclusions about average compliance are based on a two-year period, with approximately half the samples observed in the first year and half in the second. Two years are needed to obtain enough data to attain the desired level of statistical precision.
- Sample sizes are selected to achieve +/– 6% compliance estimates[1] at the 95% confidence interval.
- Results are reported for all the landowners combined.
- The Compliant percentages reported for all sampled prescriptions, except the Haul Route prescription, reflect average compliance for the prescription. Compliance with individual rules within the prescription are summed to calculate the percentage of prescription compliance rates. See Section 4 for additional information.
- The Haul Route prescription type follows a different sample design. The Compliant percentages reported for the Haul Routes prescription are overall rates of compliance with FP rules for haul routes (instead of the percentage of the sample compliant). See Section 4 for more information.
- A rule application assessed as compliant is rated either Compliant or Exceeds Rule Requirements. The latter is used when a landowner has implemented higher protection standards than required by FP rules.
- When a prescription is assessed as a deviation, it is rated either Low, Moderate, High or Indeterminate to provide the degree of deviation from rule or FPA requirements.
- Compliance is determined both for compliance of the forest practices activity implementation with FP rules, called "rule compliance," and for compliance of the forest practices activity implementation with what was stated on the FPA, called "FPA compliance."

Independent Scientific Peer Review

An Independent Scientific Peer Review (ISPR) was conducted on the 2014-2015 Compliance Monitoring biennial report, with a focus on sample selection and analytical methodology. The review concluded that current form of the ratio estimator for average compliance is valid. The review made two recommendations for improvement: to implement a jackknifed form of the ratio estimator; and, to integrate descriptions of population development and sample selection into the statistical analysis appendix. Both changes were made for this report. Additional information is located in Section 5.

Findings

The 2016-17 rule prescription compliance rates range from 87-100%, indicating generally high compliance with the forest practice rules selected for monitoring. Findings from the 2016-2017 sampling season are reported in Sections 6 and 7 of this report.

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[1] A 95% confidence internal of +/– 6% means that if the sample was repeated 20 times, one would expect the population mean (the "true" compliance rate) to fall within the confidence interval 19 out of 20 times.

Water Typing

Differences between observed and FPA-reported water types were observed for 16% of the waters observed; approximately the same number was under-classified as was over-classified (Table 3). Supplemental Water Information Forms (SWIFs) were completed for 29 samples due to observed water typing differences between water type documentation on FPAs and on-the-ground physical features.
- Fourteen waters were underclassified; 1 Ns, 6 Np, 2 A wetlands, and 5 B wetlands.
- Twelve waters were overclassified; 1 F water, 4 Ns, 2 A wetlands, and 5 B wetlands.
- Three waters were indeterminate, 2 B wetlands, and 1 A wetland.

Additional relevant data and results for water typing are located in Section 6.

Riparian Management Zones

RMZ compliance rates ranged from 87% to 100%. The DFC1 rate of rule compliance for the 2016-2017 sample period was 92%, 128 of the 139 sampled rules were compliant. The DFC2 rate of rule compliance was 95%; 86 of the 91 sampled rules were compliant. The NIZH rate of rule compliance was 95%, 112 of the 118 sampled rules were compliant. The Np activity rate of rule compliance was 87% (biased corrected, see appendix D), 96 of the 111 sampled rules were compliant. The Ns activity rate of rule compliance was 100%; all 31 sampled rules were compliant. Additional relevant data and results for compliance estimates are located in Section 6.

Wetland Management Zones

Wetland management zone compliance ranged from 92% - 100% (Table 5). The Type A&B Wetlands rate of rule compliance for the 2016-2017 sample period was 92%; 101 of the 110 sampled rules were compliant. The Forested Wetlands rate of rule compliance was 100%; all 34 sampled rules were compliant. Additional relevant data and results for wetland management zones are located in Section 6.

Roads

Roads-related compliance ranged from 90-95% (Tables 16 and 17). The Roads rate of rule compliance for the 2016-2017 sample period was 95%, and that for the Haul Route prescription was 90%. Additional relevant data and results for roads are provided in Section 7.

Trend Analysis

Trends of improving compliance were observed for three prescription groups and there are no trends showing declining compliance. Statistically significant trends were not observed for most of the prescription groups. Trends of year-to-year increasing prescription compliance rates (significant at a two-tailed alpha-level of 0.10) were observed for DFC2 (compliance rates rose from 92% during 2010/2011 to 95% during 2016/2017)), NIZH (compliance rates rose from 90% during 2010/2011 to 95% during 2016/2017), and Ns (compliance rates rose from 96% during 2010/2011 to 100% during 2016/2017). No statistically significant trends of decreasing

prescription compliance were observed. Additional relevant data and results for trend analysis are located in Section 8.

Unstable Slopes

The Unstable Slopes Emphasis sample was implemented in 2017 after a successful pilot study was conducted during the Fall of 2016. The pilot study tested methodologies for population development, field data collection, and data analysis. Revisions to the study design were instituted based on the results of the pilot study. The Unstable Slopes Emphasis Sample resulted in a compliance rate of 92%. Additional relevant data and results for unstable slopes are located in Section 10.

Changes Made Based on CMP Feedback

A primary goal of the CMP is to provide objective information about the degree of rule compliance to the forest practices program about where emphasis, including training and education, should be placed to bring about improved compliance with FP rules. The following are some recent and on-going forest practices program adjustments aimed at addressing issues identified through compliance monitoring results:

- Forest Practices Board Manual modifications are currently being considered for guidance about leave tree, DFC, and RMZ length.
- Updates to the Forest Practices Application form and instructions will be implemented October2018.
- Rule and Board Manual change recommendations have been incorporated into the Forest Practices Board work plan.

3.   Introduction

Photo by: Garren Andrews

Compliance monitoring is a component of the Washington State Forest Practices Program. Section 1 gives a brief history leading to the development of the Compliance Monitoring Program and explains key factors and concepts regarding compliance monitoring and the forest practices rules that are monitored.

3.1   History and Context

The 1974 Forest Practices Act (FP Act) declared, "forest land resources are among the most valuable of all resources in the state" (Revised Code of Washington [RCW], Title 76.09). This law and its corresponding forest practices rules (FP rules) (Washington Administrative Code [WAC], Title 222) regulate forestry activities on state and private lands in Washington State and are designed to both protect public resources on forestland and ensure that Washington continues to support a viable forest products industry. (WAC 222-16-010 [Public Resources]) Public resources are defined as water, fish, wildlife, and capital improvements of the state or its political subdivisions. The FP Act created the Forest Practices Board (the Board), an independent state agency with 13 members. The Board, working with the public, stakeholder groups, and DNR, adopts FP rules and approves technical guidance (Forest Practices Board Manual) that assists

landowners in implementing FP rules. The FP rules are administered by DNR (with input and consultation from other entities where directed by rule).

A flexible Forest Practices Program (FP Program) was developed to implement the FP Act and rules, because knowledge and understanding of natural systems evolves and natural systems change over time. A flexible FP Program is essential for meeting the intent of the FP Act in an arena where change is expected and ongoing. Components that provide systematic feedback and facilitate change when needed have been intentionally designed and incorporated into the FP Program. These components include the Compliance Monitoring Program (CMP), the Adaptive Management Program (AMP), and the Forest Practices Training Program (FPTP). Other FP Program components that provide critical functions for implementing the FP Act and rules and that provide information to improve the FP Program include Forest Practices Application (FPA) review and FPA compliance and enforcement. When these components provide feedback suggesting that change is needed to better meet the goals of the FP Act and rules, the Board can adopt new FP rules, modify existing ones, and adopt board manual technical guidance. Additionally, the FP Program may adjust its operational practices, within the bounds of the FP Act and rules, to create some of the desired changes. Since promulgation of the FP Act in 1974, the FP Program's flexible design has facilitated many changes to the FP rules to the Board Manual, and to the FP Program.

One such change was the incorporation of the Compliance Monitoring Program into the FP Program. The CMP was not part of the original FP Program established in 1974. The CMP was first formally proposed as an essential element in the 1999 Forests and Fish Report, a multi-stakeholder agreement that delineated acceptable measures to protect water quality and habitat for federally listed aquatic species and other riparian dependent species on private and state forestlands in Washington. The legislature enacted the Forests and Fish Report protection measures into law in 1999 based upon best available science. As a result, compliance monitoring for forest practices became a legal requirement. The CMP was promulgated as part of the FP rules in 2001 when the Board adopted FP rules that reflected the protection measures in the Forests and Fish law.

Regarding compliance monitoring, WAC 222-08-160(4) states: "The department shall conduct compliance monitoring that addresses the following key question: 'Are forest practices being conducted in compliance with the rules?' The department shall provide statistically sound, biennial compliance audits and monitoring reports to the board for consideration and support of rule and guidance analysis. Compliance monitoring shall determine whether forest practices rules are being implemented on the ground. An infrastructure to support compliance will include adequate compliance monitoring, enforcement, training, education and budget."

When funding for the CMP was allocated by the legislature in 2006, DNR, with input from other stakeholders, developed a compliance monitoring program design and implemented an initial sampling effort in the spring of that year. The CMP has completed annual compliance monitoring sampling every year since 2006. Additionally, the program has produced biennial reports starting with the 2006–2007 CMP Biennium Report showing results of field reviews, as directed by WAC 222-08-160(4), for consideration and support of rule and guidance analysis. All completed reports can be found on the CMP website: http://www.dnr.wa.gov/programs-and-

services/forest-practices/rule-implementation. The CMP is a key component of a feedback loop intended to improve compliance with the FP rules that protect public resources and maintain a viable forestry industry in Washington State. When sampling results provide sufficient information regarding a need for change, CMP reports include suggestions for potential changes that could help the FP Program better achieve the goals of the FP Act and rules. See Section 9 for a list of recent changes that resulted from CMP feedback.

3.2 Compliance Monitoring Program

Program Staffing

The DNR Forest Practices Assistant Division Manager for Operations directs the Compliance Monitoring Program. The program staff includes a program manager and a field coordinator, along with funded participation of one full-time staff person each from the Department of Ecology and Department of Fish and Wildlife. As of September 2017, the Department of Fish and Wildlife have ceased Compliance Monitoring field participation because of budgetary issues. Additional assistance is provided by tribal biologists and other forest practices staff.

Reports

Field sampling of completed FPAs occurs annually and findings are presented in a biennial report as required by WAC 222-08-160(4). In 2011, the FP Program began producing annual reports in the years that a biennial report was not required but ceased annual reporting in 2016 This present report is a biennial CMP report and covers data samples collected during the 2016 and 2017 field seasons. The data from the 2016–2017 field seasons has been combined to produce the desired precision for statistical estimates and resulting comprehensive findings, conclusions, and recommendations that are detailed in this biennial report.

Forest Practices Activities and Prescriptions

Forest practices activities are operations such as timber harvest and forest road construction that are subject to FP rules. Prescriptions are groupings of similar rules that apply to a forest practices activity. FP rules are divided and grouped by like topic/application for monitoring purposes. For example, forest practices activity types such as road construction and timber harvest are evaluated based on options available for implementing a particular activity, such as the many options available for harvest in the riparian management zone (DFC1, DFC2, etc.); and forest practices activity types are evaluated based on the function/feature being protected, such as water quality. In CMP reports, these rule groupings are called "prescription types." The CMP obtains data from samples and reports compliance monitoring findings by prescription type.

These prescription types allow for statistical estimation of compliance with specific rule groups rather than an overall forest practices compliance rate. This enhances the ability to determine where additional training, education, or FP compliance efforts might be needed to increase landowner understanding and compliance with FP rules. The CMP, with stakeholder input, determines which FP rule prescription types will be sampled each year and then estimates the number of samples required for statistical precision of prescription compliance rates. This

number of samples is then visited by the compliance monitoring field team for each of the FP rule prescription types.

Compliance

Each FPA is observed for compliance with 2 elements: first, how well the conditions on the ground — after completion of forest management activities — meet FP rules; and second, how well the conditions on the ground — after completion of forest management activities — meet what the applicant stated on the FPA. The first is called "rule compliance" and the second is called "FPA compliance." The compliance monitoring field team has found that deviation on a particular FPA can occur in one of the following 3 ways:

1) The conditions on the ground are in compliance with FP rules but not with the FPA. For example, a landowner/applicant states on the FPA that he or she will leave an RMZ along the entire 1000-foot length of the Np waters in the harvest area, but upon completion of harvest the landowner leaves a buffer along 700 feet of the stream length. The 700-foot RMZ buffer is still in compliance with FP rules because the FP rules do not require the entire length of an Np waters to be buffered. However, the 700-foot buffer is not in compliance with what the landowner stated would be done on the FPA.
2) The conditions on the ground are in compliance with the FPA but deviate from the FP rules. For example, a landowner/applicant incorrectly measures the width of the stream in the FPA area and states on the FPA that the stream falls into a smaller (incorrect) width category that requires less protection. Subsequently, if the landowner implements the forest practices activity using the incorrect protection measures, the forest practice has deviated from FP rules but is in compliance with what the landowner stated on the FPA.
3) The conditions on the ground deviate from both the FP rules and the FPA.

The primary intent of the CMP is to determine on-the-ground compliance with FP rules, or "rule compliance." However, understanding deviation from the FPA, or "FPA compliance," can help DNR determine whether improvements should be made in FPA forms, FPA application instructions, or other methods of landowner outreach and education. Information regarding the type of deviation helps to inform the efforts of the FP Program to improve on the ground compliance with FP rules.

Compliance Monitoring Scope Limitations

Compliance monitoring is limited by mandate, and budget, which results in a focused program with a well-defined yet limited scope. Compliance monitoring does not involve the following:

- Focus on individual landowners and compliance specific to those landowners, but rather focuses on 2 overall groups: small and large forest landowners.
- Focus on individual regions and compliance specific to that region, but rather focuses on statewide FP rules and FPAs.
- Track FP rule violations. When field reviewers encounter rule violations, the appropriate DNR regional staff is notified for further review.

- Modify water types. Field reviewers' record observed differences between water type documentation on FPAs and on-the-ground physical features. See Section 6.1.

3.3   Forest Practices Rules

Overall, FP rules provide protection for many riparian and upland species and their forest habitat, as well as protection for water quality. Currently, compliance monitoring focuses on rules that protect aquatic and riparian species habitat. FP rules that help protect aquatic and riparian species habitat include rules regarding the following:

- Riparian protection
- Wetland protection
- Water typing
- Road construction, maintenance, and abandonment near water
- Harvest or road construction on unstable slopes

Budget and staffing preclude the ability to monitor with statistical precision all FP rules that might affect aquatic and riparian species habitat, as well those that apply to upland habitat. The CMP prioritizes rule sampling based on a forest practices activity's potential to impact public resources.

The following are the CMP's prioritized rules chosen for sampling during the 2016-2017 field seasons.

Standard Sample

Certain specific FP rule groups are sampled every year and are considered part of the CMP Standard Sample. These include the following:

- Riparian rules — Western Washington and Eastern Washington RMZ rules (WAC 222-16-030, 222-30-021 and 022)
- Road construction and maintenance rules (WAC 222-24)
- Wetland rules (WAC 222-16-030, 222-30-020[6] and [7]; and WAC 222-24-015)
- Haul routes (WAC 222-24) for sediment delivery

Trend Analysis

For 2010-2017 data, rule compliance was carefully tracked to make sure that the compliance determination was consistently applied in all years. Data were converted to ensure consistent application of compliance determinations across the dataset (i.e. 2010 – 2013 data). If compliance for a particular rule was not assessed in accordance with current protocols, were incomplete, or un-convertible, the rule was not included in the trend analysis dataset. Data for rules were combined and compared through time within each corresponding prescription type. Trends in average compliance within prescriptions and individual rule compliance are tracked based on current methods.

Emphasis Sample

Other FP rule groups are sampled, as necessary, and are considered Emphasis Samples. These other FP rule groups govern activities utilized less often than the rules sampled in the Standard Sample. The smaller population size usually leads to the CMP sampling a higher proportion of the total emphasis population than is sampled in Standard Samples.

During the 2016-2017 sampling period, two pilot studies were conducted. During the 2016, sampling window a pilot study was developed and executed for Unstable Slopes that focused on FPA compliance. Additionally, the Compliance Monitoring Program developed and commenced a Forest Practices Hydraulic Projects pilot study that solely focused on FPA compliance.

4. Compliance Monitoring Design and Methodology

Photo by: Chris Briggs

The Compliance monitoring study design was developed to be a consistent and repeatable field-based method to determine if forest practices are conducted in compliance with forest practices rules (FP rules). Compliance monitoring design details are found in the document *Washington State Department of Natural Resources Forest Practices Compliance Monitoring Program Design and Compliance Monitoring Protocols*. Section 2 explains key design and methodology concepts used in the forest practices Compliance Monitoring Program.

4.1 Population and Sample Selection

The population designated for sampling consists of the forest practices applications (FPAs) that have completed forest practices activities and expire April 1, 2017, through March 31, 2019. Each FPA states all of the forest practices activities that the landowner intends to implement. This information allows the compliance monitoring field team to locate FPAs that list the particular FP rule prescriptions sampled in a given year. The sample population for each prescription type is the subset of FPAs that contain the prescriptions being monitored that year.

Landowner Reporting Groups

Compliance Monitoring Program (CMP) reports provide riparian and road compliance findings separately for small forest landowners and large forest landowners, in addition to findings for all landowners combined. To date, sample sizes for small forest landowners have been too small to achieve sufficient statistical precision for conclusions regarding small forest landowners as a separate landowner group. Confidence intervals are only calculated for all landowners combined.

Sample Selection

Populations are grouped by prescriptions (DFC1, DFC2, NIZH, etc.) that have been identified on completed individual FPAs for sample selection. Therefore, population sizes are determined by the frequency of prescriptions that occur as part of completed FPAs.

There are thousands of active (not yet expired) FPAs every year, because the majority of FPAs have 3 years in which to be completed. Each FPA has an expiration date. For the current report, to ensure that all active FPAs had an opportunity to be selected, the populations to be sampled are those FPAs that expire between April 1 of the preceding year and March 31 of the sampling year. For the 2016-17 sample, this included 2,114 FPAs in 2016, and 2,194 FPAs in 2017 (including forest practices notifications; see Glossary). Using the April 1 to March 31 window improves the likelihood that the forest practices operations are complete prior to the primary compliance monitoring sampling months (February through November), and that the compliance monitoring field team attempts to visit the site before the FPA expires.

To provide a random selection of FPAs from the sampling population, the FPAs that expire between April 1 and March 31 are assigned a random number as a decimal fraction between 0 and 1 and then are ordered from the smallest to the largest number. The selection methodology involves reviewing the FPAs in this random order. Each FPA is reviewed to determine the sample FP rule prescription types it includes. This selection process continues through the ordered list of FPAs until the target population/sample size is reached for each prescription type.

All FPAs in the population are ordered by the assigned generated random number and categorized by region. Division staff review FPAs in the random order assigned for monitored activities that are completed. Region staff determine if the activities identified in the FPA have been completed. FPAs that do not contain monitored activities and FPAs that are not complete are discarded from the population. Sample sizes are applied in proportion to region population size for each prescription type.

For each riparian prescription, the population to be sampled consists of FPAs that included that prescription. In some cases, a single FPA contains multiple implementations of the same riparian prescription type. If this is the case, 1 prescription implementation is randomly selected for assessment. Table 1 lists the Standard Sample prescriptions monitored in 2016 and 2017.

For roads prescriptions, compliance with a single rule on a single FPA is the percentage of applications of that road rule that were compliant. Thus, for road rules only, compliance with a single rule can be a number between 0 and 1. For example, if a single rule is applied 6 times on

one FPA and is compliant 5 out of 6 times, the compliance is 0.833 instead of 0 or 1 for that road rule on that FPA. The remaining analysis is the same as for riparian prescriptions.

Table 1. 2016-2017 Standard Sample Prescriptions Monitored

		Statewide	**Western WA Only**	**Eastern WA Only**
Roads		Road Construction and Abandonment		
		Haul Routes		
Harvest		RMZ — Type Ns Prescriptions		
		RMZ — Type Np Prescriptions		
		Wetlands (Type A&B and Forested)	RMZ — Type S or F Inner Zone Harvest DFC1	
		RMZ — Type S or F No Inner Zone Harvest	RMZ — Type S or F Inner Zone Harvest DFC2	RMZ – Type S or F Inner Zone Harvest EWa

To be efficient with staff time and funding, haul routes were sampled on a subset of FPAs that were selected for other prescription compliance sampling, rather than from a separately randomized list.

Sample Size and Confidence Values

Standard Sample

In the biennial compliance monitoring design used by the CMP, the Standard Sample uses a significance level of 95%. The CMP set a desired half-width of the 95% confidence interval (CI) at 6%. A 95% CI at +/– 6% means that if the sample was repeated 20 times, one would expect the population mean (the "true" compliance rate) to lie within the confidence interval 19 out of 20 times. The CMP sets the sample size to provide an approximate +/– 6% CI for the average compliance rate of each prescription type sampled for the biennium. This sample size is an estimate based on assuming that the observed variance in compliance rates and average number of applicable rules within each prescription will be similar to historical observations. Estimates for population variance are updated after each biennium, and increases in these estimates will lead to increased sample sizes in the following year. The population of FPAs in any given year is finite. Therefore, the size of the population affects the variance of compliance rates and, by extension, the width of CIs and the estimated sample sizes. Thus, infrequent prescriptions may need fewer samples to attain the desired precision levels. Estimated population sizes for each prescription are used in the sample size estimation to estimate a "finite population correction factor." This means that a smaller sample is required than would be for an infinite population.

Variance and cluster size (mean number of rules per prescription) were estimated based on the sample values from 6 years of data (2010–2015) prior to the 2016 sampling, and from 7 years of data (2010-2016) for the 2017 sample. Based on these data and the estimated FPA population size for the biennium, sample sizes were set for the biennium, and 50% of this sample size was

applied to 2016. The remaining 50% of the biennial sample was completed in 2017, after any adjustments for updated variance estimates. The sample sizes were set based on an estimate of the sample sizes required to attain a width of +/– 6% for a 95% CI for the combined 2016–2017 sample. The CI for this estimation was formed by assuming an approximate normal distribution for the average compliance ratio, so the half-width of a 95% CI is the estimated standard error multiplied by an appropriate t-statistic (approximately 2).

To provide closer adherence to the +/– 6% standard for the 95% CI, the CMP updated sample size estimates prior to 2017 sampling to include 2016 results in the variance and cluster size estimates. This 2-year approach assumes that there is no change in compliance between the 2 years, so that no bias is introduced by having unbalanced population sampling between the 2 years.

To estimate appropriate sample sizes, finite population sizes for each prescription type are estimated based on the proportion of the entire population viewed (Table 2). Total population sizes for prescription types are estimated. See Appendix A for more information regarding statistical methods.

Table 2. 2016-2017 Standard Sample Count by Prescription Type

Geographic Region	Prescription Type	Sample Count	Estimated Population Size of FPAs with the Prescription
Statewide	Road Construction and Abandonment	15	2275
	Haul Routes	12	n/a*
	RMZ — Type Ns Prescriptions	31	1868
	RMZ — Type Np Prescriptions	35	1776
	Type A & B Wetlands	43	313
	Forested Wetlands	17	463
	RMZ — Type S or F No Inner Zone Harvest	24	1408
Western WA	RMZ — Type S or F Inner Zone Harvest DFC1	20	86
	RMZ — Type S or F Inner Zone Harvest DFC2	13	331
Eastern WA	RMZ – Type S or F Inner Zone Harvest EWaIZ**	7	7

*The Haul Routes prescription does not have an estimated population.
**Eastern Washington Inner Zone prescription were sampled as a census

The sample size for haul routes is not set based on statistical precision.

Pilot and Emphasis Samples

Unstable Slopes Pilot Study

In the biennial compliance monitoring design used by the CMP, the Unstable Slopes uses a significance level of 90%. The CMP set a desired half-width of the 90% confidence interval (CI) at 6%. A 90% CI at +/– 6% means that if the sample was repeated 20 times, one would expect the population mean (the "true" compliance rate) to lie within the confidence interval 18 out of 20 times. The CMP sets the sample size to provide an approximate +/– 6% CI for the average compliance rate of each prescription type sampled for the study year.

Table 3. 2016-2017 Pilot and Sample Prescriptions Monitored

Year	Statewide
2016	Unstable Slopes Pilot Study
2017	Forest Practices Hydraulic Projects Pilot Study
2017	Unstable Slopes Study

Table 4. 2016-2017 Pilot and Emphasis Sample Count by Prescription Type

Prescription Type	Sample Count	Estimated Population Size of FPAs with the Prescription
2016 Unstable Slopes Pilot Study	9	978
2017 Unstable Slopes Study	43*	960
2017 Forest Practices Hydraulic Projects Pilot Study	15	562

*Sample size were calculated based off a 90% C.I.

4.2   Field Review and Data Collection

The compliance monitoring field team uses two primary data collection methods, field observations and field measurements. These two methods determine whether the landowner/applicant met the requirements of FP rules while implementing forest practices activities. Field observations are visual assessments that help provide answers to the questions asked on CMP Field Forms Specific measurements are taken to determine attributes such as tree/stump counts, RMZ length, RMZ width, and bankfull width. Examples of types of field observations and field measurements follow.

Riparian Harvest

- Observations:
    - Presence of alluvial fans, headwall seeps, and springs
    - Location of uppermost point of perennial flow
    - Presence of unstable slopes

- Measurements:
  - Bankfull width (BFW) — Measured for Type S, F, and N waters, except where the waters obviously exceeds or is below a threshold width (i.e., under or over 10 feet in Western Washington; under or over 15 feet in Eastern Washington). The channel width is measured (using a tape measure) at even intervals along the stream reach within the boundaries of the FPA. The goal is to obtain a minimum of 10 evenly spaced measurements.
  - Stream length — Measured using a hip chain. The length is used to determine the stationing for BFW measurements and RMZ width measurements.
  - RMZ and WMZ widths — RMZ widths (and the 3 zones within the RMZ) and WMZ widths are measured using a laser hypsometer to ensure accurate horizontal distances. Lasers with reflectors (held in place) are used to ensure measurement precision. RMZ widths are marked with flagging for visual reference.

Road Construction and Abandonment and Haul Route Assessment

The assessment of road construction and abandonment is based on answering a series of questions found on the CMP Roads Field Form. The questions address observed site conditions based on the required management practices in FP rules (WAC 222-24-010, 020, 030, and 040). The assessment of haul routes is based on observation of fulfillment of road rule requirements and on professional judgment from CMP participants, used to rate sediment delivery levels resulting from each haul route. Haul Route compliance is calculated by distance. Whereas, the compliance rate is the distance compliant divided by the distance sampled.

4.3   Compliance Assessment and Ratings

The CMP utilizes average compliance for a prescription among FPAs rather than the proportion of completely compliant FPAs. Each FPA is analyzed as a cluster of rules within each prescription. FPAs are then grouped according to relevant riparian prescriptions or road activities. Haul Routes, Roads, No Inner Zone Harvest (NIZH), Desired Future Condition Option 1 (DFC1), Desired Future Condition Option 2 (DFC2), Non-Fish-Bearing Perennial Waters, Non-Fish-Bearing Seasonal Waters, Type A&B Wetlands, and Forested Wetlands comprise the evaluated prescriptions. Compliance with individual rules is given a Bernoulli 0/1 result; the prescription compliance is the sum of compliant rules divided by the sum of all rules applied across all FPAs. For example, If a prescription has 17 rules that apply to it (across all sampled FPAs), and 16 of those rules are implemented per rule requirements, then the average compliance for that prescription is 94% (16 compliant rules $\div$ 17 total rules = 94%). As a result of the ISPR review, this average compliance rate is then adjusted for potential bias using a jackknife estimation process (see Appendix D for further explanation). In some cases, the bias adjustment is large enough to change the compliance rate by up to one percentage point (e.g., 86% is adjusted to 87%).

Haul Routes

Because haul routes were not sampled in proportion to regional population sizes, a stratified mean ratio compliance estimate was used to estimate statewide compliance. The stratified mean

ratio is the ratio of the stratified mean length of compliant haul routes divided by the stratified mean length of total haul routes sampled. The sample size for haul routes is not set based on statistical precision. Because the sampling has not generally been done in a strictly random manner, there is potential for bias in the final estimate. Therefore, limiting potential conclusions based on statistical analysis of the Haul Route prescription is recommended. Conclusions may be fallaciously attributed to a phenomenon rather than to the method of sampling.

Compliant/Deviation Determination

Compliance percentages disseminated in CMP reports do not necessarily represent the complete picture of compliance with FP rules because there are varying levels of compliance that are difficult to quantify. The terminology describing compliance was changed to better acknowledge and respond to this issue. In past CMP reports, prescriptions have been described as Compliant or Noncompliant. Beginning with the 2012 report, prescriptions were considered Compliant with or a Deviation from FP rules. The former Noncompliant category has been relabeled Deviation to more accurately acknowledge that while a prescription as a whole may deviate from FP rules, several of the FP rules that comprise a prescription may be compliant. Section 4.1 of this report explains that a prescription is a grouping of FP rules. These groups were constructed by the CMP for the purposes of estimating compliance. The following example illustrates this concept.

The DFC2 prescription type (leaving trees closest to Type S or F water in Western Washington) is not a single FP rule but rather a grouping of several rules, some of which are listed below (WAC 22-30-021):

- Core zone — "No timber harvest or construction is allowed in the core zone."
- Inner zone — "Forest practices in the inner zone must be conducted in such a way as to meet or exceed stand requirements" (see Glossary). "Trees are selected for harvest starting from the outer most portion of the inner zone first."
- Outer zone — "Timber harvest in the outer zone must leave twenty riparian leave trees per acre." "Dispersal strategy-riparian leave trees, which means conifer species with a diameter measured at breast height (DBH) of twelve inches (12") or greater, must be left dispersed approximately evenly throughout the outer zone."

These examples are only a few of the FP rules that are part of the DFC2 prescription type. When the DFC2 prescription in a CMP report is shown with a compliance of 98%, this refers to the average compliance of the sampled relevant rules within the DFC2 prescription. The corresponding Deviation category includes any FPAs that are a part of the DFC2 sample that deviated from compliance on at least 1 of the FP rules included in the prescription type.

It is important for readers to understand the meaning and severity of deviation from FP rules. To aid in this understanding, compliant and deviation assessments are assigned a compliance rating. Compliant prescriptions are rated either Compliant or Exceeds Rule Requirements. Prescriptions that deviate from FP rules are rated either Low, Moderate, or High. When the compliance monitoring field team, due to a variety of circumstances, cannot determine the degree of deviation, it is rated Indeterminate. These ratings help to convey the relative magnitude of deviation from what was required by the relevant rule.

Compliance Ratings and Reasons Descriptions

This section describes five compliance ratings and three reasons for deviation that are applied after the Compliant/Deviation assessment is made, as well as the Indeterminate rating. There are two categories for a Compliant assessment: Compliant and Exceeds Rule Requirements. There are three ratings for a Deviation assessment — Low, Moderate, High — as well as the Indeterminate rating. There are three reasons for a Deviation assessment — Layout, Operational, and Administrative.

Compliant Rating Determinations

The Compliant rating means that an activity meets the requirements of the individual FP rule that is relevant to that activity. By signing and submitting an FPA, a landowner conveys the intention to conduct specific forest practices activities on lands with specific site characteristics as described on the FPA. The landowner's signature on the FPA acknowledges that the landowner understands that FP activities must comply with the FP Act and rules.

Implementing this system requires the following assumptions:

- All participants acknowledge that this process relies on professional judgment and does not represent determinations of rule effectiveness.
- There will be no statistical analysis beyond the narrow scope intended.

Compliant Ratings Definitions

- Compliant rating — The activity is compliant with the FP rule.
- Exceeds Rule Requirements (or Exceeds) rating — While implementing their forest practices activities, landowners/applicants chooses to provide more protection than required by FP rules.

Deviation Rating Determinations

The Deviation rating means that an activity does not meet the requirements of the individual FP rule that is relevant to that activity. In order to gauge the magnitude of the deviation and where DNR might focus training efforts to improve compliance, the compliance monitoring field team uses professional judgment to rate deviations. It is important to note that these deviation ratings employ professional judgment and should not be used to excuse activities that violate FP rules or approved FPAs. There are three Deviation categories — Low, Moderate, High — as well as an Indeterminate rating. The following guidelines are used to assist professional judgment when rating the impact of deviation in the field:

- Low Deviation — Minor deviation from requirements of the rule. Examples include:
  - Outer zone has less than the required number of leave trees after harvest.

- Moderate Deviation — Moderate deviation from requirements of the rule. Examples include:
    - Trees harvested from the inner zone are larger than allowed by the Desired Future Condition harvest strategy.
- High Deviation — Major deviation from requirements of the rule. Examples include:
    - No leave trees left in the outer zone.
- Indeterminate — The rule is out of compliance, but the compliance monitoring field team cannot determine the degree of deviation.

Deviation Reasons Determinations

The Deviation reason assessment is determination made by the field team as to a potential cause for non-compliance. It is important to note that these deviation reasons employ professional judgment. There are three Deviation categories — Layout, Operational, and Administrative. The following guidelines are used to assist professional judgment when rating the impact of deviation in the field:

- Layout — The arrangement of the harvest unit did not meet the specifications of the rule. Examples include:
    - A stream meander is unaccounted for in the layout of an RMZ.
- Operational — The timber harvest and related activities process did not follow the arrangement of the harvest unit or associated activity. Examples include:
    - Designated leave trees harvested within a no-cut inner zone.
- Administrative — Information and/or data provided on the Forest Practices Application and associated documents deviates from the conditions observed on the ground. Examples include:
    - An incorrect site class is recorded on an FPA.

Note: Deviation ratings and determinations are not assessed for site characteristic rules (i.e. water type, site class, dominant overstory tree species). These data points are also not recorded when the field team cannot make an accurate assessment of the rating or determination.

The following examples of deviations from FP rules illustrate that there can be a level of compliance for many of the rules included in a prescription type, even when they are assessed as a Deviation. The examples show the process of assigning ratings to the deviation.

Figure 1 illustrates a riparian harvest adjacent to Type F water assessed as a Deviation and rated as Low. A riparian zone harvest is subject to a number of complex FP rules. In this example, the landowner/applicant followed multiple FP rules by typing the waters accurately; measuring the stream width correctly; correctly measuring the core, inner, and outer zone widths; and leaving the core zone intact.

Figure 1. Inner Zone Harvest with Deviation Rated as Low
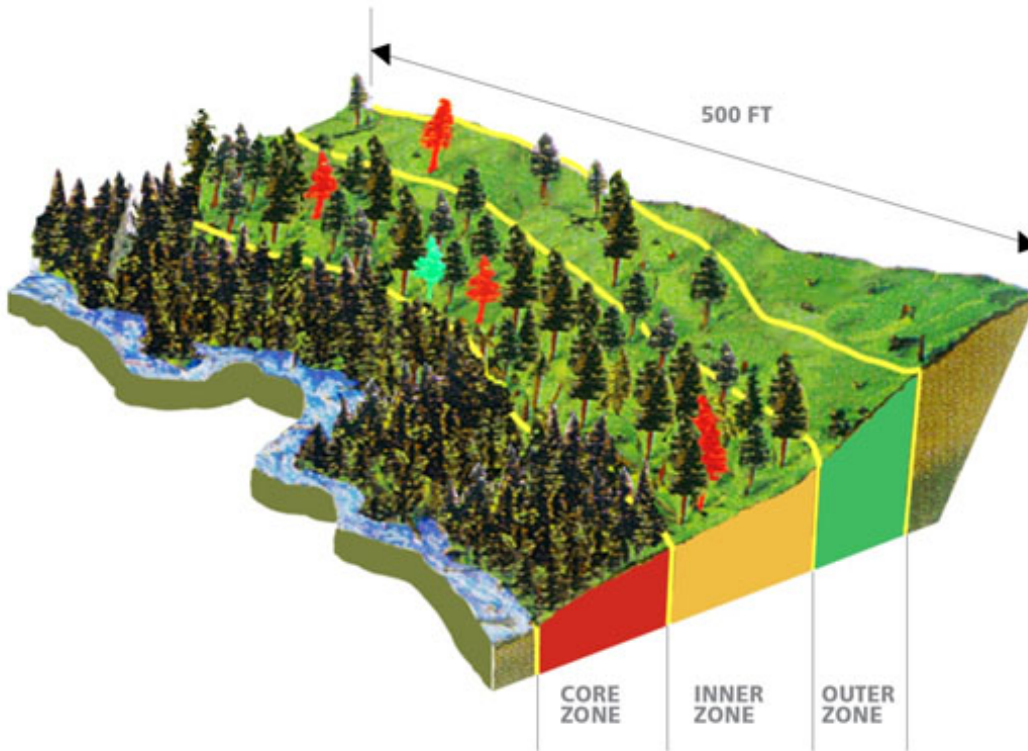
The red trees in the image represent trees that were required by rule to be left but were harvested. An offsetting factor in representing the average number of trees per acre required is that 1 tree per 500 feet was taken out of the outer zone, 3 trees too many were harvested from the inner zone, and an additional tree that had *not* been required to be left was left in the inner zone (represented in Figure 1 by the lime green tree outline).

In contrast, Figure 2 illustrates an example of inner zone harvest assessed as a Deviation and rated as High, on fish-bearing waters. In this scenario, the landowner/applicant planned a riparian zone harvest and followed the same FP rules as in the example above, except that harvest rules were not followed completely in any of the 3 zones. Each zone would be assessed for individual rule compliance. In this example, core zone trees were harvested, as were many inner zone trees and outer zone trees that were required to be left.

Figure 2. Inner Zone Harvest with Deviation Rated as High
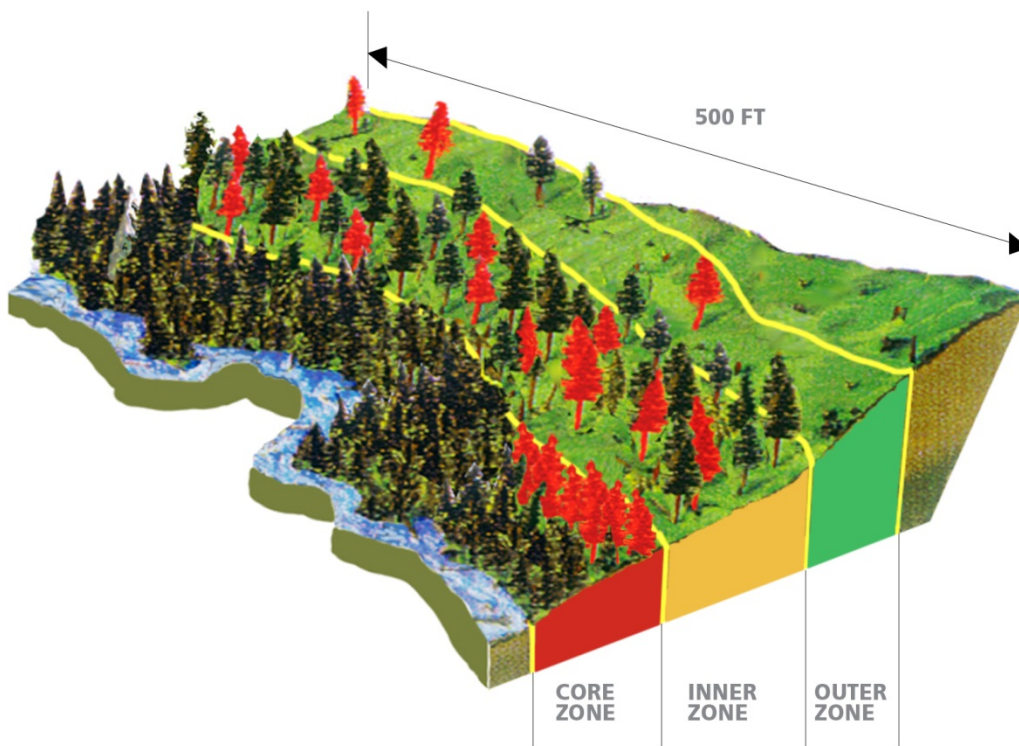
In Figure 2, 11 trees are missing per 500 feet of the inner zone and 3 trees are missing per 500 feet of the outer zone. Additionally, some harvest occurred in the core zone.

The expectation is for landowners to follow all relevant FP rules. However, there is more to evaluating compliance with FP rules than estimating average compliance for prescription types. The CMP continues to work toward finding better ways to explain a more complete picture of compliance in the reports.

4.4   Evaluation of Rule Compliance

The CMP utilizes cluster sampling. There are 2 levels of sampling units: the prescriptions and the rule application. The prescriptions are clusters of rule applications. In the previous method, only 1 assessment was made for each prescription per FPA, so the FPAs were all clusters of size 0 or 1, and the zeros dropped out of the population for the prescription. The current sampling design evaluates multiple applications of rules on single FPAs (i.e., the number of rules under prescription A on a single FPA = 0, 1, 2 … up to the total number of rules under prescription), so the FPAs are treated as clusters.

The CMP estimates the *average* compliance for a prescription or rule group among FPAs rather than the proportion of completely compliant activities among FPAs. As discussed above, each FPA is a cluster of rule prescriptions, which can be grouped in various ways (prescription or rule group) or evaluated individually. If a single rule is of interest, the compliance proportion for that rule is a simple binomial proportion — FPAs that do not apply the rule drop out of the population. When groups of rules (or prescriptions) are of interest, all FPAs that contain at least 1 of the rules are part of the population (from a random sample). Multiple implementations of a rule on a single FPA are not independent, the FPA is a cluster sample, and each has a different number of rules. The mean or average compliance and the variance of the mean are calculated according to the rules of estimation for cluster samples (Cochran 1963; Scheaffer et al. 1990). If there are many rules in a prescription, bad performance on a single rule will have little effect on overall average compliance. Compliance for each individual rule can be evaluated and tracked separately, although precision is not be controlled for individual rule compliance.

4.5   Compliance Monitoring Challenges

Challenges are not uncommon for any complex assessment program. This section reviews current challenges for the CMP.

Sample and Measurement Error

Sampling error occurs when rule or Board Manual guidance specifies that average values are to be used during the layout of a specific prescription type. This is because averages vary depending on where measurements are taken. It is unlikely that the compliance monitoring field team can duplicate the exact same ten measurements made along a stream reach for calculating stream width as were measured by a landowner. The result is that the compliance monitoring field team's average stream width value is likely different from the landowner's average stream width value. The CMP resolves the inability to determine statistical variability for average values by assigning an absolute 5% measurement error tolerance. This measurement error tolerance applies for 3 specific measurements: when determining 1) leave tree to edge of bankfull width; 2) buffer widths and lengths or floors within RMZs 3) bankfull width of N and F/S waterss. When a landowner's average value is within 5% of the compliance monitoring field team's average value, the landowner's values are considered accurate. If the landowner's average value falls outside the 5% error tolerance, the compliance monitoring field team value is assumed to be correct and the landowner's average value incorrect.

Variation in Natural Conditions

Natural systems such as forests are highly variable and difficult to measure with precision. Forest practices rules require precise measurements to implement forest practices activities. Applying precise measurements becomes difficult for forest practice activity implementation as well as for FPA compliance and compliance monitoring. When precise measurements required in the FP rules are confounded by variable site conditions, the CMP follows the most protective interpretation of the FP rules to determine compliance.

A frequent example of precise FP rules conflicting with imprecise on-site conditions occurs when a stream reach has FP rule–defined characteristics of both a Type Np water and a Type F water. Type Np waters are defined as waters that are perennial non-fish habitat waters. Type F waters are defined as having a gradient equal to or less than 20%. When a stream reach meets the physical criteria for a Type F water, and lies upstream of a portion of a stream reach that has a gradient greater than 20%, the water is considered Type F. The only exception is when an approved Water Type Modification Form or supporting Interdisciplinary Team documentation has been submitted endorsing the change of the water type.

5.   Independent Scientific Peer Review

As part of the 2014 redesign of the Compliance Monitoring data analysis methods, an Independent Scientific Peer Review was conducted on the new methodology, and the 2014-2015 data analysis and results.

A peer review was conducted through the Independent Scientific Peer Review Committee (ISPR) of the University of Washington (UW) of the 2014-2015 Biennium Forest Practices Compliance Monitoring Report for Washington State's Department of Natural Resources and for the Cooperative Monitoring, Evaluation and Research (CMER) Committee in spring 2017. The Forest Practices Board established the independent scientific peer review process to determine if the scientific studies that address program issues are scientifically sound and technically reliable. The review team consisted of three peer reviewers and the Associate Editor (AE). Reviewers were selected by the AE in consultation with the Managing Editor (ME) of ISPR. In addition to reviewing the document, the Review Team met with the ME and DNR personnel (including an outside consultant for the DNR Compliance Program) in April 2017 to obtain further information and clarification on issues such as the sample selection procedure, the process for creating the database, and estimation of compliance rates.

The AE and the three reviewers are recognized scientists with combined expertise in statistics, quantitative ecology and resource management, forest biometry, and silviculture.

The List of Review Questions

Each reviewer were asked to specifically address the following twelve peer-review questions and sub questions from CMER:

1. Are rigorous, transparent and sound research and statistical methods followed?
    a. Is the estimator used to estimate average compliance a proper statistical estimator?
    b. If the answer to a) is no, what estimator would you propose as an alternative estimate of average compliance for a prescription?
2. Is the statistical design (using the described estimator) a sound method for determining compliance with forest practices rules?
3. Is there sufficient detail in the document to reproduce the study?
4. Were data reasonably interpreted?
5. Do the literature citations include the latest applicable information and represent the current state of scientific understanding on this topic?
6. Are uncertainties and limitations of the work stated and described adequately?
7. Are assumptions stated and described adequately?
8. Is the information presented in an accurate, clear, complete, and unbiased manner and in a proper context?
9. Currently, there are several rules included in compliance calculations that are based on the proper classification of a site rather than on compliance with the rules specific to a particular classification. Thus, if an FPA is non-compliant for site class, the other rules are not applicable,

so the FPA cluster has a size of one, with compliance = 0%. Because these FPAs have only one rule applied, they are not given high weight in the ratio estimate of
average compliance. Specific questions:

      a. Does this amount to a bias in the estimate of average compliance for a
      prescription?

      b. If the answer to a) is yes, what would be the best way to remove this bias:

            i. Separate the compliance estimates into classification versus operational
            rules for those affected prescriptions

            ii. Change the method for estimating average compliance

10. Should compliance be calculated separately for administrative (site characteristics) versus layout and operational (on the ground) rule applications?

11. Recognizing there is a relationship between cost and sampling precision objectives, do you have suggestions for narrowing sampling statistic confidence intervals without significantly increasing the biennial sample size in order to improve the ability to discern trends over time?

12. What suggestions do you have for improving the clarity of the report narrative for an audience with general understanding of natural resources management: (1) the results of the report's two-year data; and (2) the description of trends?

Overview of results

The statistical approach regarding the sampling procedure and construction of the ratio estimator for compliance was determined to be generally sound. The Review Team and the Associate Editor recommended that a more thorough Appendix A containing the technical details of the sample selection procedure be included in the biennial report. The expansion of Appendix A will improve the reproducibility of the study and improve understanding surrounding the sampling selection and data analysis process. The updated Appendix A, could allow the entire compliance assessment process, from creation of the samples to obtaining the estimates, to be reproduced in another part of the country where FPAs and prescriptions are used.

It was strongly recommended that use of a "jackknifed" form of the ratio estimator be incorporated into data analysis. By using a jackknifed form of the ratio estimator, bias may be reduced yielding a more accurate variance estimate. This will require additional lines of coding in the data analysis, but will not change the sample selection procedure. A jackknifed ratio estimator can also be applied to older data sets.

Jackknife analysis would require recalculation of ratio estimates leaving out one sample each time. For example, if there were 13 samples being used to estimate DFC1 compliance, 13 ratio estimates would be calculated from the data, using 12 samples per estimate. The 13 estimates are then averaged to come up with a less biased estimate of DFC1 compliance. Estimator variance may increase for the jackknifed ratio, but only on the order of $1/n^2$ (Cochran 1977). Use of the jackknife would not necessarily reduce any bias to zero. However, jackknife ratio estimates can be compared to original ratio estimates to determine the sample size at which the difference between the two becomes negligible.

6. Forest Practices Rule Compliance for Water Types and Riparian, Wetland, and Equipment Limitation Zones

Forest practices rules (FP rules) are designed to protect aquatic resources and related habitat adjacent to typed waters and wetlands when forest practices activities are carried out. Riparian and wetland areas provide fish, amphibian, and wildlife habitat and protect water quality. A riparian management zone (RMZ) is the area adjacent to Types S, F or Np waters (see definitions below) where trees are retained to provide functions required by aquatic and riparian species, maintain water quality, as well as for protection from disturbance. A wetland management zone (WMZ) is the area located around the perimeter of a wetland where trees are left to provide protection from disturbance, maintain hydrologic functions as well as shade and nutrients for the wetland. Both RMZ and WMZ buffers filter runoff to minimize sediment entering water; provide long-term large woody debris recruitment and organic material crucial for fish and amphibian habitat; maintain shade to help regulate water temperatures; and provide amphibian and wildlife habitat. Protection on Type Np and Ns waters also includes an equipment limitation zone (ELZ). This is a 30-foot-wide zone adjacent to Type Np and Ns waters. There are limitations on

equipment use within the ELZ, and on-site mitigation measures are required if activities expose the soil on more than 10% of the zone.

FP rule protection measures that guide timber harvest options within RMZs depend on the water type (Type S, F, Np, Ns), width of the water (bankfull width), and the site class (I, II, III, IV, V) of the RMZ. Wetland protection depends on the type and size of the wetland.

Section 6.1 through 6.4 provides FP rule and on-site review descriptions and compliance monitoring findings for the following within the Standard Sample:

- Water type observations
- Western Washington RMZs
- Eastern Washington RMZs
- Statewide wetlands

While maintaining adequate shade is an important part of riparian prescriptions, the forest practices shade rules are not yet part of the FP rules being monitored by CMP. Consequently, the riparian descriptions throughout the remainder of this report do not include shade, even though shade is integral to the overall protection provided in riparian areas. The CMP will initiate sampling for shade compliance after the program has adopted methods suitable to produce relevant information.

6.1 Statewide Water Type Observations

In the initial years of compliance monitoring, compliance monitoring field team observations indicated that at times water types observed on the ground did not match water type classifications provided on submitted and approved forest practices applications (FPAs). This led to a focus on consistency and accuracy of water type information on FPAs, because the width and length of riparian buffers required under FP rules are directly linked to water type. In the FP rules, water is classified in specific categories, or "types," based on several factors (WAC 222-16-030, 031, and 035). Water type classification is a fundamental aspect of determining which FP rules apply to forest management activities taking place adjacent to typed water. Specific FP rules apply to specific water types because different water types fulfill unique and cumulative functions for aquatic and riparian species and water quality. Waters of the state were initially classified by type using local knowledge and orthophotos and were represented on a set of water type maps. Currently, the public can find information about the water type assigned to a particular water on the FPARS mapping site: http://www.dnr.wa.gov/programs-and-services/forest-practices/forest-practices-application-review-system-fpars. Because waters depicted on DNR water type maps were originally typed without a field visit, the maps can display incorrect water types and must be field verified by landowners prior to FPA approval.

FP Rules for Water Type

Forest practices water typing rules define 4 types of streams (S, F, Np, and Ns) and three types of wetlands (forested, nonforested Type A [including bogs], and nonforested Type B). The four types of streams are classified hierarchically based on stream function and level of protection required for the stream. The following are the water types in hierarchical order starting with the highest level (requiring the most protection):

- Type S waters — The highest level of classification, "Shorelines" of the state as designated by the Department of Ecology.
- Type F waters — The second highest level of classification, with fish, specifically defined human uses, or both.
- Type Np waters — The next lowest classification in the water hierarchy, these are non-fish-bearing waters that have a perennial flow of water during a normal rainfall year and include intermittent dry portions of the perennial channel.
- Type Ns waters — The lowest level of classified waters, seasonal non-fish-bearing waters where surface flow is not present year-round.

Wetlands are classified into two broad categories: Forested and Nonforested. Nonforested Wetlands are further divided into Type A and Type B.

- Forested Wetlands — Wetlands that have a crown closure of 30% or more (see Glossary).
- Nonforested Wetlands — Wetlands that have a crown closure of less than 30%.
  - Type A Wetlands — Greater than 0.5 acre in size and associated with at least 0.5 acre of ponded or standing open water present for at least 7 consecutive days between April 1 and October 1, and all bogs greater than 0.25 acre.
  - Type B Wetlands — All other nonforested wetlands greater than 0.25 acre.

On-site Review for Statewide Water Types

Field observations sometimes indicate that water types depicted on water type maps are incorrect. Landowners may use existing DNR water type maps as a starting point for information as they prepare their FPA for submittal to DNR, but must verify water types located within the areas proposed for forest management activities and indicate the correct water types on the FPA. Correct and accurate water typing is critical. When water is incorrectly underclassified, inadequate riparian protection measures may be applied, which may ultimately impact public resources; conversely, if a water is overclassified, excessive protection may be provided to the detriment of the proponent's objectives for the forest practice activity. Water type verification occurs through measurement of the water's physical characteristics as defined in WAC 222-16-031 and 035, or through a protocol (fish) survey (to confirm fish presence/absence) as guided by Forest Practices Board Manual, Section 13. Applicants are encouraged but not required to complete water type classification worksheets or document protocol surveys on water type modification forms and submit them with their FPA as supporting documentation for the water types indicated on the FPA.

Changes to DNR water type maps can be made when data from field observations indicate that the water type on the water type map is incorrect and/or if a water is found on the ground in a different location than depicted on the map or not at all. To propose a permanent water type change from the water type indicated on the DNR water type map, an individual submits a [Water Type Modification Form](#) to DNR. The Water Type Modification Form goes through a concurrence process that provides opportunity for review by all TFW stakeholder groups.

The compliance monitoring field team observes physical criteria (such as stream width, stream gradient, etc.) to determine if there appear to be differences between water types recorded on FPAs and what is observed on the ground. These observations are made on the same stream reaches and wetlands that have been randomly selected for compliance monitoring for other rules that year. The compliance monitoring field team evaluates only the stream reach or wetland within the proposed boundary shown on the FPA; therefore, the information is not sufficiently comprehensive to determine all water types, depending on the length and location of the water within the FPA. Water types can sometimes only be determined by continuing to observe and measure upstream or downstream of the FPA harvest unit boundary.

The CMP developed the Supplemental Water Information Form (SWIF) to be used specifically for recording potential water type and other water related discrepancies. A SWIF is completed when potential inconsistencies are found by the compliance monitoring field team between on-the-ground measurements and observations and what is described in the FPA. The information is reported in the compliance monitoring report. If an FP rule violation occurred because of the water type inaccuracy observed (i.e., the water did not receive enough riparian protection — buffer width and length), then the information relating to the violation is sent to the appropriate DNR region for follow up. The intent of using SWIFs is to obtain a sense of both the overall magnitude of possible water typing discrepancies on the landscape and the potential incorrect implementation of riparian buffers designed to protect aquatic resources. The compliance monitoring field team does not engage in formal water typing (e.g., fish protocol surveys) with the intent of changing water types, because that action has a defined process beyond the scope of the compliance review. The responsibility is on the landowner to ensure that the water types on the FPA have in fact been field validated.

Findings for Statewide Water Types

Water types recorded on a SWIF are further broken down into waters correctly classified, underclassified, overclassified, and indeterminate. The latter three categories are defined as follows:

- Underclassified — Physical characteristics indicate that the water should have been typed on the FPA and protected on the ground at a higher level of the hierarchical water typing system. For example, the FPA depicts a Type Np water that after observation is found to have Type F physical characteristics or observed fish.
- Overclassified — Physical characteristics indicate that the water should have been typed on the FPA and protected on the ground at a lower level of the hierarchical water-typing continuum. For example, the FPA inaccurately depicts a Type Ns water that after observation is found to be an untyped water.

- Indeterminate — Waters for which the compliance monitoring field team determines there is not enough information to make a water typing determination. For example, when the compliance monitoring field team visits a site in the wettest part of the year (winter) and cannot determine if the water would flow in the driest part of the year (summer), the compliance monitoring field team cannot determine with certainty if the water is a Type Np (perennial) or Ns (seasonal).

Table 3. 2016-2017 Water Typing Observation Information

Water Type on FPA	# Waters in Standard Sample	# Waters Recorded on SWIF	SWIF # Waters Underclassified	SWIF # Waters Overclassified	SWIF # Waters Indeterminate
F or S	57	1	*	1	0
Ns	31	5	1	4	0
Np	35	6	6	0	0
Type A Wetlands	14	5	2	2	1
Type B Wetlands	29	12	5	5	2
Forested Wetlands	17	0	0	0	0
Total	183	29	14	12	3

*Compliance Monitoring field protocols stipulate that F or S waters are not to be evaluated for underclassification, as there is no higher order water.

Water typing observations from 2016 and 2017:

Of the 183 sampled waters in 2016 and 2017, 29 samples called for SWIFs due to water typing discrepancies.
Fourteen samples were underclassified, resulting in an underclassification rate of roughly 8%. No approved Water Type Modification forms (protocol surveys) were contained within the paper records for the FPAs with underclassified waters. Of the 14 underclassified segments, fish were observed in one of the sampled segments, the other 13 non-compliant segments met fish physical characteristics with no supporting water type modification form or Interdisciplinary Team documentation to support lower order hierarchal water typing, resulting in the underclassification of the respective sampled segments. Of those, 7 were wetlands, where either fish presence was observed or the waters were associated with F waters. Six Np waters and 1 Ns water met fish habitat physical characteristics.
Ten samples were overclassified, resulting in an overclassification rate of 5%. Four Ns waters were determined to be wet swales or channels with no connectivity to higher order waters. Two type A wetlands were determined to be type B wetlands, and were measured to be smaller in area than what was reported on their respective FPAs. Of the 5 overclassified type B wetlands; 3 were determined to be forested wetlands, and 2 were determined to be non-typed wetlands. A large F

water was determined to be overclassified after bankfull width measurements revealed that the segment was a small F water.

Three samples were indeterminate. All 3 of the indeterminate observations were for A and B wetlands. The field team were unable determine the acreage of a Type A wetland at low water. An A wetland was unable to be located after debris flows post wildfire destroyed the selected wetland. Additionally, a B wetland could not be adequately delineated (Table 3).

6.2   Statewide Summary for FP Rule Compliance for RMZs, WMZs, and ELZs

Section 6.2 provides 2 summary tables: Table 4 lists the RMZ, WMZ, and ELZ prescriptions sampled in 2016 and 2017; Table 5 shows statewide results for compliance with RMZ and WMZ FP rules. The data and findings for each prescription are discussed in Section 6.3 and 6.4 (Western Washington RMZs) and Section 6.5 (Statewide RMZs, WMZs, and ELZs).

Table 4. RMZ, WMZ, and ELZ Prescriptions Sampled in 2016 & 2017

Western WA	Eastern WA	Statewide
RMZ — Option 1, Thinning from Below RMZ — Option 2, Leaving Trees Closest to Water	RMZ – Inner Zone Harvest, Thinning from Below	WMZ — Wetlands RMZ — No Inner Zone Harvest ELZ — Type Ns & Np Activities RMZ — Type Np

Each prescription has a unique set of timber harvest requirements and includes the use of a corresponding set of protocols and questions to determine compliance status for the individual rules that comprise the prescription. FP rule prescriptions for Type F and N waters can have different rules for Eastern and Western Washington. However, samples were not separated by Eastern and Western Washington. Wetland rules are the same for Eastern and Western Washington.

The small proportion of small forest landowner FPAs in Table 5 reflects the small proportion of total small forest landowner FPAs within the total FPA population containing the prescriptions assessed.

Table 5. 2016-2017 Compliance with FP Rules for Riparian, Wetlands and Roads Prescriptions

	Status of Compliance	Western WA		Statewide						Eastern WA
		DFC1	DFC2	No Inner Zone Harvest	Np Activities	Ns Activities	Type A&B Wetlands	Forested Wetlands	Roads	Inner Zone Harvest
Small Forest Landowners	# Compliant Rules	4	n/a	13	6	0	19	6	27.5	12
	# with Deviation	3	n/a	1	3	0	1	0	4.5	2
	% of Sample Compliant	57%	n/a	93%	74%	n/a	96%	100%	82%	86%
	Prescriptions Assessed	1	0	3	4	0	9	3	3	2
Large Forest Landowners	# Compliant Rules	124	86	99	90	26	82	28	98	37
	# with Deviation	8	5	5	12	0	8	0	2.0	0
	% of Sample Compliant	94%	95%	95%	86%	100%	91%	100%	98%	100%
	Prescriptions Assessed	19	13	21	31	26	34	14	12	5
All Landowners	# Compliant	128	86	112	96	31	101	34	125.5	49
	# with Deviation	11	5	6	15	0	9	0	6.5	2
	% of Sample Compliant	92%	95%	95%	87%*	100%	92%	100%	95%	96%
	Confidence Interval	(87, 97)	(89, 100)	(90, 99)	(79, 94)	n/a	(87, 97)	n/a	(88, 100)	n/a
	Prescriptions Assessed	20	13	24	35	31	43	17	15	7

* Jackknife biased corrected, see appendix D

6.3   Western Washington RMZs

6.3.1 Western WA Type S and F Waters

Section 6.3.1 addresses Type S and F riparian prescriptions: DFC1, Thinning from Below; and DFC2, Leaving Trees Closest to the Water.

On-site Review for Western WA Type S and F Waters

During the compliance monitoring field review, there are questions on the Western Washington Riparian Field Forms common to all riparian harvest options for Type S and F waters, including the following:

- Is there any harvest within the core, inner, and outer zones?
- Is the site class (variable in determining inner zone width) consistent with DNR site class maps?
- Is the stream width (variable in determining inner zone width) the same as stated on the FPA? If not, does it affect the inner zone width?

In addition to common questions relevant to all Type S and F water riparian prescriptions, specific Western Washington riparian prescription questions are asked on the Western Washington Riparian Field Forms that assess the unique rules directed at individual harvest options.

6.3.1.1 Western WA Type S and F Waters — DFC1, Thinning from Below

Desired Future Condition Option 1 is available if DFC growth modeling results show an available surplus basal area that allows harvest to take place in the inner zone. DFC calculations indicate if a forest stand meets basal area requirements (that is, if the stand is on a trajectory to meet the DFC of 325 square feet of basal area per acre at a stand age of 140 years) then harvest is allowed. When DFC

calculations indicate harvest is allowed because the model projects more basal area is available than needed to meet the target basal area in the FP rule, then the smallest diameter trees are allowed to be harvested, followed by the harvest of progressively larger trees until the surplus basal area limit has been reached (also referred to as "thinning from below"). This selection process is intended to establish a forest environment where the leave trees in the inner zone can grow larger in a shorter time and meet desired large wood, fish habitat, and water quality requirements faster. The widths of the inner zone and outer zone vary depending on the bankfull width of the water and the site class. A minimum of 57 conifer trees per acre must be left in the inner zone. A minimum of 20 conifer trees per acre greater than 12 inches (12") diameter at breast height (DBH) must be retained in the outer zone. The leave trees in the outer zone may be dispersed evenly or clumped around sensitive features such as seeps, springs, and forested wetlands.

Findings for Western WA Type S and F Waters — DFC1, Thinning from Below

Desired Future Condition Option 1 is the most complex Type F prescription to implement in terms of the number of requirements to be met. It occurs relatively rarely in the population of FPAs. In the 2016-17 sample, 20 FPAs were selected for review with DFC1 chosen as the harvest option from a total population of 86 FPAs. The resulting DFC1 prescription sample size was 20, and a total of 139 rules were evaluated.

Table 6. 2016-17 Compliance Ratings for Western WA Type S and F Waters — DFC1, Thinning from Below

RMZ Prescription	FP Rule Compliance Ratings						
	Compliant Ratings		Deviation Ratings				
	Exceeds (part of Compliant)	Compliant	Low	Moderate	High	No Assessed Deviation Rating	Indeterminate
DFC1 (%)	5%	92%	2%	1%	2%	3%	1%
DFC1 (Rule Count)	7	128	3	1	3	4	1

Sample size = 20

One hundred thirty one of the sampled 139 rules were compliant for the DFC1 prescription sample, resulting in a 92% compliance rate +/- 5%. Of the 20 sites sampled, 12 were 100% compliant and 8 showed deviation from at least 1 FP rule in the prescription type.

Field observations from 2016 and 2017 accounted for 11 non-compliance determinations across 8 sample sites. There were 3 non-compliant determinations for incorrect dominant overstory tree species. Douglas-fir was selected as the dominant overstory tree species per the DFC worksheet, however, Western Hemlock was observed as the dominant overstory tree species at all 3 sites. The reason for non-compliance was determined to be administrative for all 3 non-compliant determinations. No deviation severity rating is assigned for non-compliant site characteristic rules.

A single non-compliant determination was recorded for an incorrect stream size. The CMP field team calculated BFW exceeded 10 feet; the segment was recorded as a small type F water in the FPA. The reason for non-compliance was determined to be administrative, and deviation severity ratings are not assigned for non-compliant site characteristic rules.

There were 3 non-compliant determinations for observation of harvest of trees larger than allowed by the selected DFC harvest strategy. For 2 of the non-compliant determinations the reason for non-compliance was determined to be layout, resulting in a low deviation rating for both determinations. The third non-compliant determination was a result of the 6 largest required leave trees missing from the final inner zone tally. The CMP field team could not make a final determination between administrative or layout as the reason for non-compliance. A high deviation rating was assessed for the non-compliant observation.

A single non-compliant determination was recorded for less than the required 57 residual trees per acre remaining in the inner zone. The CMP field team could not make a final determination between administrative or layout as the reason for non-compliance. A high deviation rating was assessed for the non-compliant observation.

There were 3 non-compliant determinations for the outer zone retaining less than 20 trees per acre per rules. The reason for non-compliance was determined to be layout for all 3 non-compliant observations. One non-compliant observation was assessed a low deviation rating for 1 missing outer zone leave tree. One non-compliant observation was assessed a moderate deviation rating for 11 missing outer zone leave trees. One non-compliant observation had no observed outer zone leave trees, resulting in a high deviation rating. (See table 6.)

Exceeds ratings were assigned where extra Outer Zone leave trees were observed for 7 samples.

6.3.1.2 Western WA Type S and F Waters — DFC2, Leaving Trees Closest to the Water

Desired Future Condition Option 2 only applies to RMZs in site classes I, II, and III along waters that are less than or equal to 10 feet wide and to RMZs in site classes I and II for waters greater than 10 feet wide. For this option, DFC growth modeling results show an available surplus basal area that allows harvest to take place in the inner zone. Trees are selected for harvest starting from the outermost portion of the inner zone first and then progressively closer to the water. Twenty conifer trees per acre with a minimum DBH of 12 inches must be left in the harvested area of the inner zone. The widths of the inner zone and outer zone vary depending on the bankfull width of the water and the site class. For site classes I, II, and III on waters less than or equal to 10 feet, there is a 30-foot no-harvest extension beginning at the outer edge of the core zone. For site classes I and II on waters greater than 10 feet, there is a 50-foot no-harvest extension beginning at the outer edge of the core zone. Twenty conifer trees per acre greater than 12 inches DBH must be retained after harvest in the outer zone, unless a large woody debris in-channel placement strategy is selected. Leave trees in the outer zone may be evenly dispersed or clumped around sensitive features.

Findings for Western WA Type S and F Waters — DFC2, Leaving Trees Closest to the Water

Desired Future Condition Option 2 harvest is less complex to implement and is selected more frequently by proponents than DFC1. In the 2016-17 sample, 13 DFC2 prescriptions were sampled from an estimated population of 331. A total of 91 rules were evaluated.

Table 7. 2016-17 Compliance Ratings for Type S and F Waters in Western WA — DFC2, Leaving Trees Closest to the Water

RMZ Prescription	FP Rule Compliance Ratings						
	Compliant Ratings		Deviation Ratings				
	Exceeds (part of Compliant)	Compliant	Low	Moderate	High	No Assessed Deviation Rating	Indeterminate
DFC2 (%)	9%	95%	1%	1%	0%	2%	1%
DFC2 (Rule Count)	8	86	1	1	0	2	1

Sample size = 13

Eighty-six of the sampled 91 rules were compliant for the DFC2 prescription, resulting in a 95% compliance rate +/- 5.5%. Of the 13 sites sampled, 9 were 100% compliant and 4 showed deviation from at least 1 FP rule in the prescription type.

Field observations from 2016 and 2017 accounted for 5 non-compliance rule determinations. A single non-compliant determination was recorded for an incorrect stream size. The CMP field team calculated BFW exceeded 10feet; the segment was recorded as a small type F water in the FPA. The reason for non-compliance was determined to be layout, and deviation severity ratings are not assigned for non-compliant site characteristic rules.

There were 4 non-compliance determinations for observed harvest within the no-cut inner zone floor. The reason for non-compliance was determined to be layout for 3 of the non-compliant observations. The reason for the fourth non-compliant determination was determined to be operational. For each of the 4 non-compliant rule determinations a different deviation rating was assessed. For one of the non-compliant determinations, a low deviation rating was assessed for 3 cut-stumps in the inner zone floor. The second non-compliant determination was assessed a moderate deviation rating for 12 cut-stumps in the inner zone floor. The third non-compliance determination the deviation rating was indeterminate. The fourth non-compliant determination was not assessed a deviation rating. (Table 7.)

Exceeds ratings were assessed for leaving more than the required number of inner zone floor leave trees in 5 samples. Additionally, exceeds ratings were assessed for excess outer zone leave trees in 3 samples.

6.4 Eastern Washington RMZs

6.4.1 Eastern WA Type S and F Waters

Section 6.4.1 addresses Type S and F riparian prescriptions: Eastern Washington Inner Zone Harvest, thinning from below.

On-site Review for Eastern WA Type S and F Waters

During the compliance monitoring field review, there are questions on the [Eastern Washington Riparian Field Forms](#) common to all riparian harvest options for Type S and F waters, including the following:

- Is there any harvest within the core, inner, and outer zones?
- Is the site class (variable in determining inner zone width) consistent with DNR site class maps?
- Is the water width (variable in determining inner zone width) the same as stated on the FPA? If not, does it affect the inner zone width?

In addition to common questions relevant to all Type S and F water riparian prescriptions, specific Eastern Washington Inner Zone Harvest riparian prescription questions were evaluated for the unique rules that comprise the prescription type.

6.4.1.1 Eastern WA Type S and F Waters — EWaIZH, Thinning from Below

Eastern Washington Inner zone harvest is permitted if the calculated inner zone basal area per acre exceeds the basal area requirement for the requisite site index, elevation, and timber habitat type. Inner zone leave tree and basal area requirements are segregated by site index (low, medium, and high), elevation (below 2,500', 2,500'-5,000', and above 5,000'), and timber habitat type (Ponderosa pine, Mixed conifer, and High elevation). For the high elevation timber habitat type, Western Washington type S and F rules apply. When harvest is allowed because the calculations project more basal area is available than required to meet the target basal area in the FP rule, then the smallest diameter trees are allowed to be harvested, followed by the harvest of progressively larger trees until the surplus basal area limit has been reached (also referred to as "thinning from below"). This selective harvest process is intended to establish a forest environment where the leave trees in the inner zone can grow larger in a shorter time and meet desired large wood, fish habitat, and water quality requirements faster. The widths of the inner zone and outer zone vary depending on the bankfull width of the water and the site class. A minimum of 20 conifer trees per acre greater than 12 inches (12") diameter breast height (DBH) must be retained in the outer zone. The leave trees in the outer zone may be dispersed evenly or clumped around sensitive features such as seeps, springs, and forested wetlands.

Findings for Eastern WA Type S and F Waters — Inner Zone Harvest, Thinning from below

Eastern Washington Inner Zone Harvests are infrequently implemented. As a result, the Compliance Monitoring Program conducted a census study on Eastern Washington Inner Zone Harvests. In the 2016-17 census, all 7 identified EWaIZH prescriptions were evaluated. A total of 51 rules were evaluated.

Table 8. 2016-17 Compliance Ratings for Type S and F Waters in Eastern WA — Inner Zone Harvest, Thinning from below

RMZ Prescription	FP Rule Compliance Ratings						
	Compliant Ratings		**Deviation Ratings**				
	Exceeds (part of Compliant)	**Compliant**	**Low**	**Moderate**	**High**	**No Assessed Deviation Rating**	**Indeterminate**
EWaIZH (%)	8%	96%	0%	0%	0%	4%	0%
EWaIZH (Rule Count)	4	49	0	0	0	2	0

Census Population = 7

Field observations from 2016 and 2017 accounted for 2 non-compliance rule determinations. Both non-compliant determinations were recorded for incorrect site class. The CMP field team did not assess a reason for non-compliance or assign a deviation rating.

6.5 Statewide RMZs, WMZs, and ELZs

6.5.1 Statewide Typed Waters

Protection measures adjacent to typed water in the state of Washington include protecting channel migration zones (CMZs); establishing riparian management zones (RMZs) along the full length of fish-bearing waters and along a portion of the length of perennial non-fish-bearing waters; retaining no-harvest buffers adjacent to sensitive sites; and establishing equipment limitation zones (ELZs), where equipment is limited along non-fish-bearing waters. RMZs adjacent to fish-bearing waters include a core zone, inner zone, and outer zone; with differing prescriptions delineated in FP rules for inner and outer zones (see Figure 3).

In Western Washington, no timber harvest or road construction is allowed in the 50-foot core zone on fish-bearing waters (zone closest to the water), except for the construction and maintenance of road crossings and the creation and use of yarding corridors. The inner zone (middle zone, not including core zone) ranges from 10 to 100 feet, depending on width of the water and the site class (see Glossary) of the forested stand. Timber harvest of excess trees in the inner zone is only allowed if predetermined stand requirements are met, which are intended to result in a mature riparian forest stand at 140 years of age (called "desired future condition," or DFC). Timber harvest is allowed in the outer zone (adjacent to and outside the inner zone); with 20 riparian leave trees per acre retained following harvest.

Figure 3. Type S and F Water RMZs
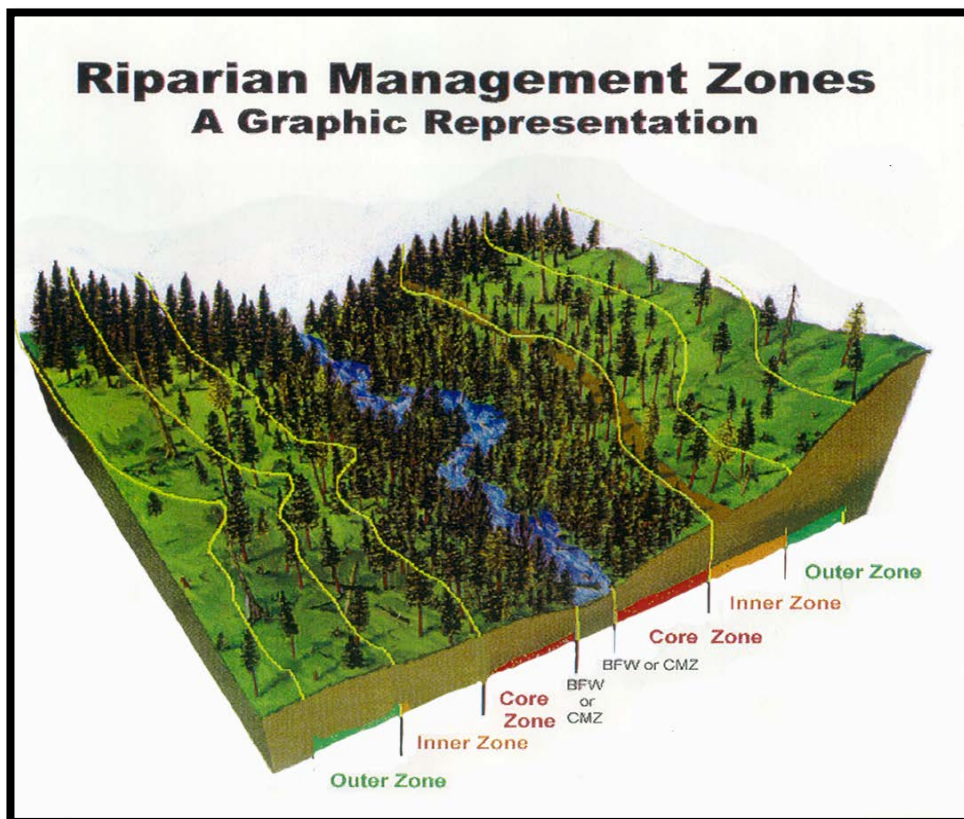
Protection along non-fish-bearing waters in Western Washington includes RMZs along at least 50% of the length of Type Np waters and around sensitive sites, and the establishment of ELZs for both Np and

Ns waters. An ELZ is a 30-foot-wide area where equipment use is restricted in order to minimize ground and soil disturbance. The ELZ protects stream bank integrity and helps minimize sediment delivery to non-fish-bearing waters that could potentially be routed farther downstream to fish-bearing waters.

In Eastern Washington, riparian management is intended to result in stand conditions that vary over time. Management is designed to mimic local disturbance (such as wildfire) regimes in a way that protects riparian function conditions and maintains general forest health. Harvest adjacent to a Type S, F, or Np water is based on the DNR site class map, timber habitat type, basal area, and shade requirements needed to protect the water. Habitat types include Ponderosa Pine, Mixed Conifer, and High Elevation. The no harvest core zone along type S and F waters is 30 feet. Harvest units within the Bull Trout Habitat Overlay must leave all available shade within 75 feet of the bankfull width or CMZ, depending on which is greater. Np and Ns waters have an ELZ of 30 feet.

6.5.1.1 Statewide Type S and F Waters — No Inner Zone Harvest

For the No Inner Zone Harvest (NIZH) option, DFC results show that existing stands in the combined core and inner zone do not meet stand requirements in western Washington. Therefore, inner zone harvest cannot take place, or sometimes the landowner elects not to harvest in the inner zone for operational or other reasons.

Findings for Statewide Type S and F Water — No Inner Zone Harvest

No Inner Zone Harvest is the most frequently selected harvest strategy adjacent to fish-bearing waters. This harvest strategy occurred on an estimated 1408 FPAs in the 2016-17 population. The resulting NIZH prescription sample size was 24, and a total of 118 rules were evaluated.

Table 9. 2016-17 Compliance Ratings for Statewide Type S and F Waters — No Inner Zone Harvest

RMZ Prescription	FP Rule Compliance Ratings						
	Compliant Ratings		**Deviation Ratings**				
	Exceeds (part of Compliant)	**Compliant**	**Low**	**Moderate**	**High**	**No Assessed Deviation Rating**	**Indeterminate**
No Inner Zone Harvest (%)	8%	95%	3%	2%	0%	1%	0%
No Inner Zone Harvest (Rule Count)	9	112	3	2	0	1	0

Sample size = 24

One hundred twelve of the sampled 118 rules were compliant for the NIZH prescription sample, resulting in a 95% compliance rate +/- 5%. Of the 24 sites sampled, 19 were 100% compliant and 8 showed deviation from at least 1 FP rule in the prescription type.

A single non-compliant determination was recorded for an incorrect stream size. The CMP field team calculated BFW exceeded 10', the segment was recorded as a small type F water in the FPA. The

reason for non-compliance was determined to be administrative, and deviation severity ratings are not assigned for non-compliant site characteristic rules.

Three non-compliant determinations were recorded for observed harvest within the no-cut inner zone. The reason for all 3 non-compliant observations was determined to be layout. A deviation rating of low was assessed for 2 non-compliant observations as a result of 8, and 13 observed cut stumps, respectively. A deviation rating of moderate was assessed for the third non-compliant observation as a result of 16 cut-stumps observed within the no-cut inner zone.

Two non-compliant determinations were recorded for observed less than 20 trees per acre remaining in the outer zone. For the first determination, 3 required outer zone leave trees were missing resulting in a deviation rating of moderate and the reason for non-compliance was determined to be layout. For the second non-compliance determination for less than 20 trees per acre in the outer zone a deviation rating of low was assessed, and the reason for non-compliance was determined to be layout. (Table 9.)

Exceeds ratings were assessed for excess outer zone leave trees on 9 samples. Additional outer zone leave trees were remaining beyond what was required by rule.

6.5.1.2 Statewide Type Np Waters

Type Np waters and sensitive sites contribute to the quality of water and fish habitat in downstream Type S and/or F waters. They also provide habitat for aquatic wildlife.

Fifty-foot-wide RMZs are required along portions (and specified locations) of Type Np waters. For example, a 50-foot-wide no-harvest RMZ is required where Type Np waters join a Type S or F water.

In western Washington, the total distance of the 50-foot buffer required along a Type Np water varies and depends on the length of the Type Np water from the confluence with the Type S or F water. Buffers on both sides of the water (2-sided buffers) must protect at least 50% of a Type Np water's length. If the Type Np water on the FPA is located more than 500 feet upstream from the confluence of a Type S or F water, and if the Type Np water is more than 1,000 feet in length, then the minimum percentage of the length of Type Np water to be buffered varies per the table in WAC 222-30-021(2) (b) (vii).

Sensitive sites associated with Type Np waters must also be protected with buffers or harvest restrictions. These include headwater springs or the uppermost point of perennial flow; the intersection of 2 or more Type Np waters; perennially saturated side-slope seeps; perennially saturated headwall seeps; and alluvial fans. No harvest is allowed within alluvial fans.

In eastern Washington, within fifty horizontal feet of the outer edge of bankfull width of the water, the landowner must identify either a no cut, partial cut and/or clearcut strategy for each unit to be harvested. For partial cut strategies, basal area requirements must be met that are specified for the timber habitat type. For clearcut strategies, a two-sided no-harvest fifty-foot buffer along the stream reach must be left that is equal in total length to the clearcut portion and meets the upper end of basal area requirements for the respective timber habitat type (WAC 222-30-022(2)(b)(i)&(ii)).

Type Np waters also require a 30-foot-wide ELZ. Equipment use and other forest practices are specifically limited, and mitigation is required if activities expose more than 10% the soil within the ELZ.

On-site Review for Statewide Type Np Waters

Questions asked on the Field Form for Type Np waters differ from those for Type S and F fish-bearing waters. Examples include the following:

- Is there evidence of equipment entry into the 30-foot ELZ? If so, was less than 10% of the soil within the ELZ exposed due to activities?
- Was the appropriate length of 50-foot no-harvest zone left on the given water segment?

Findings for Statewide Type Np Waters

Type Np waters were commonly encountered with an estimated 1776 FPAs having 1 or more Np waters within their harvest boundaries. The resulting Np prescription sample size was 35, and a total of 111 rules were evaluated.

Table 10. 2016-17 Compliance Ratings for Statewide Type Np Waters

RMZ Prescription	FP Rule Compliance Ratings						
	Compliant Ratings		**Deviation Ratings**				
	Exceeds (part of Compliant)	**Compliant**	**Low**	**Moderate**	**High**	**No Assessed Deviation Rating**	**Indeterminate**
Np Water (%)	1%	87%*	5%	0%	0%	9%	0%
Np Water (Rule Count)	1	96	6	0	0	10	0

Sample size = 35
* Jackknife biased corrected, see appendix D

Ninety-six of the sampled 111 rules were compliant for the Type Np prescription sample, resulting in an 87% compliance rate +/- 8%. Of the 35 sites sampled, 26 were 100% compliant and 9 showed deviation from at least 1 FP rule in the prescription type.

Field observations from 2016 and 2017 accounted for 15 non-compliance determinations.

Six non-compliant determinations were recorded for incorrect water type. Fish were observed in one of the sampled segments, the other 5 non-compliant segments met fish physical characteristics with no supporting water type modification form or Interdisciplinary Team documentation for Np determination, resulting in the mistyping of the respective sampled segments. The reason for non-compliance was determined to be administrative, and no deviation rating is assessed for non-compliant site characteristic rules.

One non-compliant determination was recorded for inadequate no-cut buffer length. The sample segment was missing 125' of required no-cut buffer. The reason for non-compliance was determined to be administrative as a result of an incorrectly identified F/N break. A deviation rating was unable to be determined for the non-compliant observation.

Five non-compliant determinations were recorded for observed harvest within the 50-foot no-cut harvest buffer. The reason for non-compliance for 3 of the observations was operational, while layout

was determined to be the reason for non-compliance for the other 2 observations. A deviation rating of low was assessed for 3 of the observations; no deviation rating was able to be determined for the other 2 observations.

Three non-compliant determinations were recorded for observed harvest within the 56-foot Upper Most Point of Perennial Flow no-cut buffer. For 2 of the observations the reason for non-compliance was determined to be layout. For the third observation, the reason for non-compliance was determined to be operational. All three sampled segments were assessed a deviation rating of low. (Table 10.)

6.5.1.3 Statewide Type Ns Waters

Buffers are not required for Type Ns waters. There is a 30-foot ELZ requirement, and mitigation measures are required if more than 10% of the soil in the ELZ is exposed.

Findings for Statewide Type Ns Waters

Type Ns waters are common, occurring in an estimated 1,868 FPAs in the statewide population for the 2016-17 sample. The resulting Ns prescription sample size was 31, and a total of 31 rules were evaluated.

Table 11. 2016-17 Compliance Ratings for Statewide Type Ns Waters

RMZ Prescription	Forest Practices Rule Compliance Ratings						
	Compliant Ratings		Deviation Ratings				
	Exceeds (part of Compliant)	Compliant	Low	Moderate	High	No Assessed Deviation Rating	Indeterminate
Ns Water (%)	0%	100%	0%	0%	0%	0%	0%
Ns Water (Rule Count)	0	31	0	0	0	0	0

Sample size = 31

All 31 of the sampled rules were compliant for the Ns prescription sample, resulting in a 100% compliance rate. There were zero observations of rule non-compliance for the Ns prescription type. However, only one rule is consistently evaluated as part of the Ns prescription type. (Table 11.)

6.5.2 Statewide Wetland Management Zones

Forest practices wetland rules are the same for Western and Eastern Washington. Wetland management Zones (WMZs) have variable widths based on the size and type of wetland. Type A Wetlands greater than 5 acres have a minimum 50-foot WMZ width, and an average 100-foot WMZ width. Type A Wetlands of 0.5 to 5 acres have a minimum 25-foot WMZ width and an average 50-foot WMZ width. Type B Wetlands of 0.5 to 5 acres have a minimum 25-foot WMZ width, and Type B Wetlands less than 0.5 acre along with Forested Wetlands require no WMZ. Leave trees are required (by size and number) within the WMZ. Bogs, both forested and non-forested, are treated as Type A wetlands when they are 0.25 acre or larger. There are no leave tree requirements for the Forested Wetlands prescription. Restrictions also apply regarding the maximum width of openings created by harvesting

within the WMZ. Additionally, ground-based harvesting systems shall not be used within the minimum WMZ width without written approval from DNR.

On-site Review for Statewide Wetlands

Protection measures for wetlands depend on the size and type of wetland. The information collected by the compliance monitoring field team varies depending on the type of wetland. Only one of the questions answered by the team is applicable to all wetlands:

- Were the wetlands typed, sized appropriately on the ground, and consistent with the FPA?

In addition, for Type A&B Wetlands, the compliance monitoring field team evaluates the following:

- Leave trees in the WMZ for species, number, and size
- Is the variable buffer width appropriate relative to the WMZ table in the rules?
- If operations were conducted within the WMZ, were the openings less than 100 feet wide?
- If operations were conducted within the WMZ, were the openings no closer than 200 feet from each other?
- Approval by DNR for use of ground-based harvesting systems within the minimum WMZ and for any timber that was felled into or cable yarded across the wetland
- Protections applied when a WMZ overlaps an RMZ
- For particular leave tree requirements, if the harvest within the WMZ is greater than or less than 10%

If harvest occurs within a forested wetland, the compliance monitoring field team determines whether the harvest method is limited to low impact harvest or cable systems; and whether the wetland boundaries (if greater than 3 acres within the harvest unit) are delineated correctly and shown on the activity map by the landowner/applicant.

6.5.2.1 Statewide Type A&B WMZs

Findings for Type A&B WMZs Statewide

Type A&B Wetlands are estimated to occur on 313 FPAs statewide in the 2016-17 population. The resulting Type A&B Wetlands prescription sample size was 43 and a total of 110 rules were evaluated.

Table 12. 2016-17 Compliance Ratings for Statewide Type A&B WMZs

WMZ Prescription	FP Rule Compliance Ratings						
	Compliant Ratings		**Deviation Ratings**				
	Exceeds (Part of Compliant)	**Compliant**	**Low**	**Moderate**	**High**	**No Assessed Deviation Rating**	**Indeterminate**
Type A&B (%)	2%	92%	0%	0%	0%	8%	0%
Type A&B (Rule Count)	2	101	0	0	0	9	0

Sample Size = 43

One hundred one of the sampled 110 rules were compliant for the Type A&B WMZ sample, resulting in a 92% compliance rate +/- 5%. Of the 43 sites sampled, 34 were 100% compliant and 9 showed deviation from at least 1 FP rule in the prescription type.

Field observations from 2016 and 2017 resulted in 9 non-compliance determinations. All were for incorrectly typed and sized A and B wetlands. Seven typed B wetland segments were determined to be associated with type F waters. Two typed A wetland segments were determined to be associated with type F waters. Non-compliance on 3 of the sampled segments was determined to be administrative; no reason for non-compliance was determined for the other 6 segments. No deviation rating is assessed for non-compliant site characteristic rules. (Table 12)

6.5.2.2 Statewide Forested Wetlands

Findings for Statewide Forested Wetlands

Approximately 463 FPAs statewide contained Forested Wetlands in the 2016-17 sample population. The resulting Forested Wetlands prescription sample size was 17 and a total of 34 rules were evaluated.

Table 13. 2016-17 Compliance Ratings for Statewide Forested Wetlands

Wetland Prescription	FP Rule Compliance Ratings						
	Compliant Ratings		Deviation Ratings				
	Exceeds (Part of Compliant)	Compliant	Low	Moderate	High	No Assessed Deviation Rating	Indeterminate
Forested (%)	0%	100%	0%	0%	0%	0%	0%
Forested (Rule Count)	0	34	0	0	0	0	0

Sample size = 34

All 31 sampled rules were compliant for the Forested Wetlands sample, resulting in a 100% compliance rate. There were zero observations of rule non-compliance for the Forested wetland prescription type. (Table 13.)

7.   Forest Practices Rule Compliance for Roads and Haul Routes

Section 7 provides rule and on-site review descriptions and compliance monitoring findings regarding the Standard Sample for roads and haul routes statewide.

Although, Roads prescription sampling follows the same design as riparian sampling, Haul Routes prescription sampling is designed differently. Haul Routes sampling assesses each 0.1 mile segment of forest road for correct design and for construction or maintenance of roads to protect typed waters from sediment delivery. This strategy enables determination of the rate of compliance for the entire haul route specified on the FPA.

A well-designed, located, constructed, and maintained system of forest roads is essential to both forest management and protection of public resources as well as public safety. Washington State forest practices rules — including those for road construction, maintenance, and abandonment and for "best management practices" — are some of the most, if not the most, stringent in the country. The FP rules are designed to help ensure that forest roads are constructed, maintained, and abandoned to do the following:
- Provide for fish passage
- Prevent mass wasting
- Limit delivery of sediment and surface runoff to all typed waters
- Avoid capture and redirection of surface water or groundwater
- Divert road runoff to the forest floor
- Provide for the passage of some woody debris
- Protect stream bank stability
- Minimize construction of new roads

- Assure no net loss of wetland function

FP rules accomplish these goals through ensuring the proper location, design, construction, maintenance, and abandonment of forest roads, landings, and water crossings.

The CMP collects data annually on sites where one or more of the following exists:

- Road construction
- Landing construction
- Type N water road crossing construction, including fords
- Road abandonment
- Haul routes (forest roads used to truck timber to market)

FP Rules for Statewide Roads and Haul Routes

FP rules for road construction, landing construction, Type F and N water road crossings, road abandonment, and haul routes are explained below.

Forest Road Construction

Road construction is composed of 3 components: road location, road design, and actual construction. The road rules require specific standards for road location, design, and construction, which are reflected in the questions found in the compliance monitoring Roads Field Form (defined in the on-site review section, below).

1) Road location — FP rules require that roads be located to fit the topography to minimize alteration of natural features (WAC 222-24-020). Examples of FP rule requirements related to road location are the requirement that the landowner/applicant minimize the number of water crossings and not locate roads in bogs or within natural drainage channels (except for crossings).
2) Road design — FP rules include road design standards that address construction techniques and water management (WAC 222-24-020). For example, new road construction on side slopes exceeding 60% that have the potential to deliver sediment to any typed water or wetland need to utilize full bench construction techniques (WAC 222-24-020[8]).
3) Road construction — Road construction requirements focus on maintaining stable road prisms and water crossing structures, and on minimizing sediment delivery to surface waters and wetlands (WAC 222-24-030). For example, road construction requires that erodible soil disturbed during road construction needs to be located where it could not reasonably be expected to enter the stream network or needs to be seeded with noninvasive plant species.

Landing Location and Construction

Landings are subject to several FP rules. Landings must not be located within specific areas such as natural drainage channels, RMZs, or WMZs. Landings must be constructed so that they are sloped to minimize accumulation of water on the landing. Excavation material shall not be sidecast where there is high potential for material to enter WMZs or within the bankfull width of any water or the 100-year flood level of any typed water (WAC 222-24-035).

Type N Stream Crossings

Installation, maintenance, and removal of bridges, culverts, and temporary water crossings must follow several FP rules (with technical guidance provided in Forest Practices Board Manual Chapter Section 5). For example, culvert placement must be designed so that the alignment and slope of the culvert parallels the natural flow of the stream and so that placement does not cause scouring of the streambed and erosion of the stream banks in the vicinity of the project. Additionally, bridges must not constrict clearly defined channels, and temporary water crossings must be constructed to facilitate abandonment (WAC 222-24-040).

Road Abandonment

Landowners have the option to abandon forest roads, with the exception that in some watersheds landowners are required to abandon roads to keep the road ratio at a certain level. When a landowner chooses to abandon a forest road, specific standards delineated in the FP rules must be followed (with additional technical guidance provided in Board Manual Chapter Section 3). For example, abandoned roads must be out-sloped, water barred, or otherwise left in a condition suitable to control erosion and maintain water movement within wetlands and natural drainages. An abandoned road must be blocked so that four-wheeled highway vehicles cannot pass the point of closure at the time of abandonment, and water crossing structures must be removed (WAC 222-24-052[3]).

Haul Routes

FP rules state that roads currently used or proposed to be used for timber hauling must be maintained in a condition that prevents potential or actual damage to public resources (WAC 222-24-051[12]). The compliance monitoring field team observes and records observations for haul routes regarding level of sediment delivery.

On-site Review for Statewide Roads and Haul Routes

In order to determine road compliance, the compliance monitoring field team visited FPA sites where forest road construction, landing construction, Type N water road crossings, abandoned roads, and haul routes are present. The compliance monitoring field team used the Roads Field Form and the Haul Route Field Form to record information on site. The compliance monitoring field team does not confirm water tying during road assessments. The data recorded on the Roads Field Form and the Haul Route Field Form helped the team determine road compliance for each FPA sampled.

Roads Field Form

The compliance monitoring field team used the Roads Field Form to record data observed for forest road construction, landing construction, Type N water road crossings, and abandoned roads. The initial series of questions on the Roads Field Form helped guide systematic assessment of road surface conditions, drainage structure placement and stabilization, routing of drainage water to the forest floor, and potential delivery of sidecast. Water crossing questions helped guide systematic water crossing placement, frequency, culvert sizing, positioning, and stabilization. Other questions were used to address wetland crossings, road location, wetland replacement, abandonment and stabilization of temporary roads, road abandonment, and proper construction and drainage for forest road landings.

The following are examples of questions found on the Roads Field Form:

- Road location — "Does new road construction minimize stream crossings?" (WAC 222-24-020[5])
- Road design — "Where the potential for sediment delivery existed, was full bench construction utilized for roads built on slopes greater than 60%?" (WAC 222-24-020[8])
- Road construction — "Were erodible soils disturbed during construction stabilized to prevent the potential to deliver to typed waters?" (WAC 222-24-030[4])
- Road landing location and construction — "Was the landing sloped to minimize accumulation of water on the landing?" (WAC 222-24-035)
- Type N water crossings — "Are the alignment and slope of all culverts on grade with the natural streambed? (WAC 222-24-040[2], [3], [4], and [5])
- Road abandonment — "Was the road blocked so that four-wheel highway vehicles cannot pass the point of closure at the time of abandonment?" (WAC 222-24-052)

Haul Route Field Form

The compliance monitoring field team uses the Haul Route Field Form to guide the systematic assessment of haul routes. The sampling method provides information for reporting the proportion of compliance/deviance, the level of sediment delivery (Table 14), and the cause of the noncompliance (Table 15).

There are five recorded levels of sediment delivery (No Delivery, De Minimis, Low, Medium, and High) used by the team for rating levels of sediment delivery, as well as one decision type (No Consensus). (Table 14.)

Table 14. Haul Route Sediment Delivery Level Categories

Delivery Level	Delivery Level Description
No Delivery	Complete disconnection of sediment delivery to typed water. Considered compliant.
De Minimis	Overland flow from roads reaches typed waters, but sediment delivery is indeterminable from background levels of turbidity. Considered compliant.
Low	Low chronic or temporary delivery. Effects are observable at the site of entry (distance downstream less than 1 channel width) only are and not expected to magnify over time given the existing activity.
Medium	Measurable but noncritical levels of delivery. Visual plume at the reach scale.
High	Extensive or critical levels of delivery. Substantial violations of turbidity criteria or significant visual plumes that occupy the channel and go beyond the reach scale (for example, around multiple bends in a stream).
No Consensus	The observers do not agree on the classification. Comments are essential to determine the scope of the difference, recording each observer's classification and the basis of disagreement.

It is helpful to determine, where possible, causes for sediment delivery. The compliance monitoring field team observes and records both primary and secondary causes of sediment delivery. (See Table 15.)

Table 15. Potential Causes of Sediment Delivery

Potential Causes	Cause Description
Faulty cross drainage	Inadequate frequency of or nonfunctioning drainage structures that carry road prism runoff or seepage, allowing sediment delivery to typed water
Inadequate water crossing structures	Absence of or nonfunctioning structures designed to pass typed water across a forest road, resulting in sediment delivery
Obstructed or bermed ditch line	Features of the road surface or ditch that divert water normally serviced by the ditch, causing sedimentation of typed water
Intercepted water	Water intercepted by road features and diverted to a channel other than its channel of origin prior to the road construction
Contaminated ditchwater	Ditchwater containing suspended sediment that flows into typed water
Ruts/inadequate crown	Perturbations of the road surface contributing sediments to runoff that reaches typed water
Driving in ditch line	Vehicular disturbance of stabilized ditches, resulting in sediment reaching typed water
Haul on native surface or inadequate rock	Road haul on a running surface containing fine particles that are captured by runoff and contributed as sediment to typed water
Water channeled to eroded/failing slopes	Water flow or runoff across unstabilized road features that contributes sediment to typed water
Road fill failure	Sediment resulting from the effects of gravity on the fill (slumps, raveling, etc.) being deposited in or carried by runoff to typed water
Cut slope failure	Sediment resulting from the effects of gravity on the cut slope (slumps, raveling, etc.) being carried by ditch flow to typed water

Findings for Statewide Roads and Haul Routes

This section summarizes data from both the Roads Field Forms and Haul Route Field Forms.

Roads Findings

Road construction or abandonment occurred on an estimated 1349 FPAs in the 2016-17 sample. The resulting Roads prescription sample size was 15 and a total of 132 rules were evaluated.

Table 16. FP Rule Compliance for 2016-2017 Road Activities

Statewide Road Activities for 2016 & 2017		
	Status of Compliance	**Road Activities Rule Compliance**
All Landowner Types	# of Rules Sampled	132
	# Compliant Rules	125.5
	# with Deviation	6.5
	Compliance %	95%
	95% Confidence Interval	CI (88, 100)

Sample size = 15

One hundred twenty five point five of the sampled 132 rules were compliant for the Roads prescription sample, resulting in a 95% compliance rate +/- 6%. Of the 15 sites sampled, 13 were 100% compliant and 2 showed deviation from at least 1 FP rule in the prescription type.

Field observations from 2016 and 2017 accounted for 6.5 non-compliance determinations across 2 sites. Two non-compliant observations were recorded for failure to stabilize disturbed soils during road construction. The reason for non-compliance was determined to be operational, and deviation rating of low was assessed for both observations.

A single non-compliant observation was recorded for inadequate drainage structures installed on a road with potential to deliver sediment to an adjacent type N water. The reason for non-compliance was determined to be operational, and a deviation rating of low was assessed for the observation.

A single non-compliant observation was recorded for failure to install rock armoring on a water crossing inlet. The CMP field team did not make a final determination between layout/operational as the reason for non-compliance. A deviation rating of low was assessed for the observation.

A single non-compliant determination was recorded for an installed culvert less than 24 inches in diameter on an Np typed water. The CMP field team did not determine the reason for non-compliance, and the assessed deviation rating was low.

A single non-compliant observation was recorded for an inadequate catch basin for an installed culvert. The reason for non-compliance was determined to be operational, and a deviation rating of low was assessed for the observation.

A non-compliant observation was recorded for a water bar that was impeding ditch line flow. Two separate road segments had the same rule evaluated on the FPA; at the second segment, the rule was observed to be compliant. For the non-compliant observation, no reason for non-compliance was determined, and deviation rating of low was assessed. (Table 16.)

Haul Routes Findings

The Haul Route prescription sample included an inspection of haul routes along forest roads from the farthest points in the FPA to public access roads. In each sample, the entire road was observed if it was less than 5 miles long. If the entire route was over 5 miles, ten 0.5-mile-long road segments were observed. Within each 0.5 mile, every 0.1-mile segment was observed as to its actual or potential delivery of sediment to typed water; and the primary and secondary causes for the delivery (see Table 17) were recorded. The compliance monitoring field team recorded compliance information for haul routes in general and for haul routes categorized by side slopes less than or greater than 60%. The data for side-slope percentage provide information needed to fulfill requirements for Clean Water Act assurances. (For more information, see *2009 Clean Water Act Assurances Review of Washington's Forest Practices Program.*)

Table 17. Haul Route Compliance Summary

Compliant		Deviation		
92% (75, 100) CI*		8.0% (0, 28) CI		
No Delivery	**De Minimis**	**Low**	**Medium**	**High**
89%	2.7%	4.1%	1.9%	2.1%

*CI is confidence interval at the 95% confidence level

Table 18. Haul Route Deviation by Cause

Primary Cause	% Deviation with This Primary Cause
Inadequate water crossing structures	19%
Cutslope failure	5%
Other (described in comments)	29%
Faulty cross drainage	14%
Stream or Spring Intercepted	5%
Rutting/inadequate crown	5%
Sediment from stream adjacent parallel road	5%
Wetland intercepted water	5%
Water channeled to eroding slopes	10%

For 26.1 miles of the 28.2 miles of haul routes evaluated, no delivery or de minimus sediment delivery were observed, resulting in a compliance rate of 92% (Table 17). The 29% or 0.6 miles that aggregates the "other" category is comprised of non-point-source sediment delivery and blocked drainage structures as the largest primary cause of sediment delivery (Table 18). Inadequate water crossing structures accounted for 19% or 0.4 miles of the observed deviation mileage. Faulty cross drainage

accounted for 14% or 0.3 miles of the deviation mileage. Water channeled on to eroding slopes accounted for 10% or 0.2 miles of the observed deviation mileage. All other primary cause categories accounted for 0.1 miles of deviation each, respectively. For efficiency, haul routes were observed on FPAs that had been selected for one of the standard sampled prescriptions.

8.   Forest Practices Rule Trend Analysis

FPA rule compliance has been monitored since 2006. In that time, there have been multiple changes to the methods for monitoring compliance. The current monitoring methods include tracking compliance with individual rules, while sampling the rule applications in clusters (FPAs). One of the goals of the current analytical methodology is to detect trends in prescription, and individual rule compliance over time. To accomplish this, data from before 2014 have been converted to be consistent with current analytical protocols.

The sample size for each year is set based on accomplishing a specific precision level (+/- 6%) for average compliance within a set of rules (a prescription) over a two-year period. Because the population of FPAs available in any given year is finite and varying, the sample size necessary to achieve a specific precision level also varies by year. Differing priorities and compliance estimation methods have caused differences in precision levels attainable by the samples collected in different years. In addition, methods for determining compliance with some individual rules have changed since 2006. While these differences create challenges in evaluating trends through time, this report includes an analysis aimed at seeking to discern statistically-meaningful patterns of changes in compliance rates measured over time.

Methods

For the 2010-2017 dataset, rule compliance was carefully tracked to make sure that the compliance determination was consistently applied in all years. Results were reviewed to ensure consistent application of compliance determinations across the dataset. Where data were not collected in accordance with current field protocols, were incomplete, or rules are no longer included in compliance estimates, the data were removed from the trend analysis dataset. Data for rules were combined and compared through time within each corresponding prescription type. The 2016-17 results used for trend analysis were calculated using the jackknifed form of the ratio estimator. Trends in average compliance with prescriptions and individual rule compliance are tracked to maintain consistency with current methods.

Linear regression analysis was used to predict general trends in average compliance through time. However, because of the varying precision levels among years, the regression assumption of homogeneous variance in average compliance was not satisfied. In general, higher sample sizes as a proportion of the population result in lower variance. Because average compliance is a ratio, the standard error of the average is a function of the proportion of the population sampled in each year and the number of rules within the prescription applied on each FPA. Weighted least squares linear regression, where the average compliance is weighted by the inverse of the estimated mean standard error for each year, was employed, to correct for the nonhomogeneous variance. In this way, years with better estimates of average compliance receive more weight in the regression, which compensates statistically for unequal variance. Statistical significance was determined with $\alpha = 0.10$. Residuals from regressions were tested for approximate normality using Shapiro-Wilks test with alpha = 0.05. P-values for significance of regressions were calculated, as well as 95% confidence intervals for linear regression coefficients for the weighted regression.

Since no individual rules are measured or tracked for Haul Routes, trend analysis was not conducted for the Haul Route prescription type.

Results

Desired Future Condition 1

Trend analysis results for the DFC1 prescription type revealed varying compliance rates for the prescription, and the individual rules, from year to year. Prescription compliance rates varied from 82% to 95% over the course of the evaluation period. As a result of the oscillating prescription compliance rate, no significant trend results (weighted $p = 0.41$) were observed for the weighted DFC1 prescription type. (Figure 4.)

Figure 4. Annual rule compliance for the DFC1 prescription with a weighted linear regression line overlaid. The point sizes reflect the relative weights given to each point in the regression based on variance differences among years.

Desired Future Condition 2

Trend analysis results for the DFC2 prescription type showed increasing compliance rates for the prescription, and the associated FP rules from year to year. Prescription compliance rates varied from 88% to 98% over the course of the evaluation period. As a result of the increasing prescription compliance rate, significant trend results (weighted $p = 0.094$) were observed for the weighted DFC2 prescription. A year over year increase of 0.94% for the overall prescription compliance rate was observed. (Figure 5.)

Figure 5. Annual rule compliance for the DFC2 prescription with a weighted linear regression line overlaid. The point sizes reflect the relative weights given to each point in the regression based on variance differences among years.

No Inner Zone Harvest

Trend analysis results for the NIZH prescription type revealed relatively consistently increasing compliance rates for the prescription, and the associated FP rules from year to year. Prescription compliance rates varied from 89% to 99% over the course of the evaluation period. As a result of the increasing prescription compliance rate, significant trend results (weighted $p = 0.099$) were observed for the weighted NIZH prescription. A year over year increase of 0.77% of the overall prescription compliance rate was observed. (Figure 6.)

Figure 6. Annual rule compliance for the NIZH prescription with a weighted linear regression line overlaid. The point sizes reflect the relative weights given to each point in the regression based on variance differences among years.

Non-fish Bearing Perennial Waters

As a result of data conversion issues, Np data collected from 2010 and 2011 were excluded from current trend analysis results. Trend analysis results for the Np prescription type revealed varying compliance rates for the prescription, and the associated FP rules from year to year. Prescription compliance rates varied from 77% to 98% over the course of the evaluation period. As a result of the oscillating prescription compliance rate no significant trend results (weighted $p = 0.50$) were observed for the weighted Np prescription type. (Figure 7.)

Figure 7. Annual rule compliance for the Np prescription with a weighted linear regression line overlaid. The point sizes reflect the relative weights given to each point in the regression based on variance differences among years.

Non-fish Bearing Seasonal Waters

Trend analysis results for the Ns prescription type revealed increasing compliance rates for the prescription, and the associated FP rules from 2010 to 2012 and a decrease in compliance rates from 2013 to 2015. Prescription compliance rates varied from 95% to 100% over the course of the evaluation period. As a result of the recently increasing compliance rates significant trend results (weighted $p = 0.10$) were observed for the weighted Ns prescription type. A year-to-year increase of 0.55% of the overall prescription compliance rate was observed. (Figure 8.)
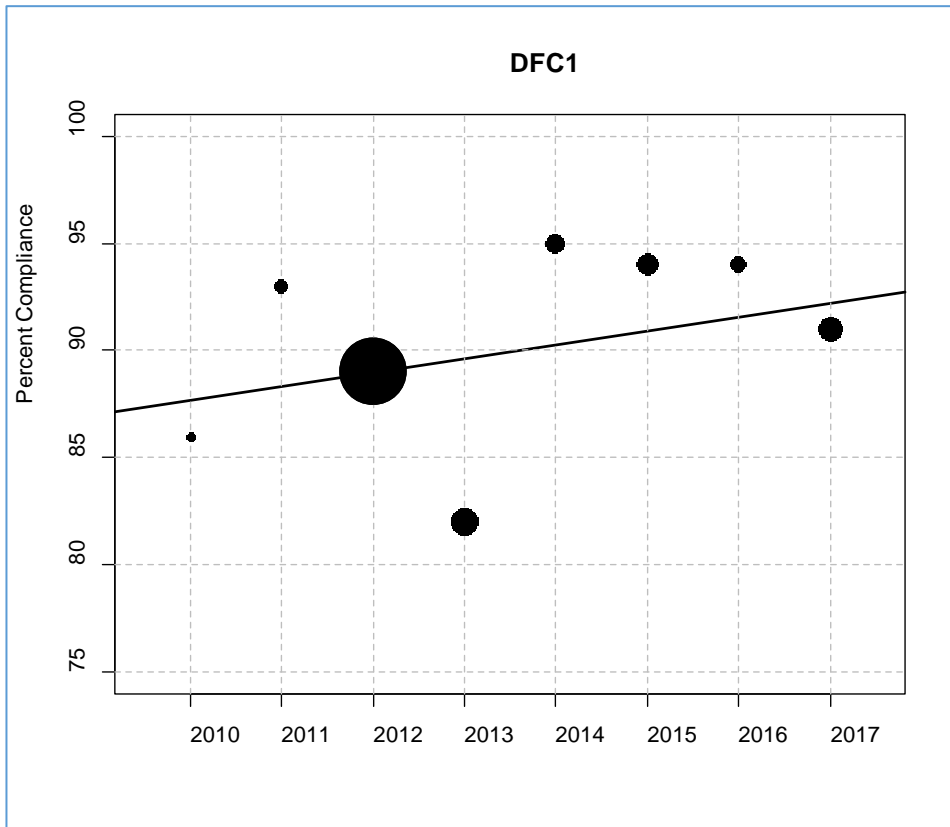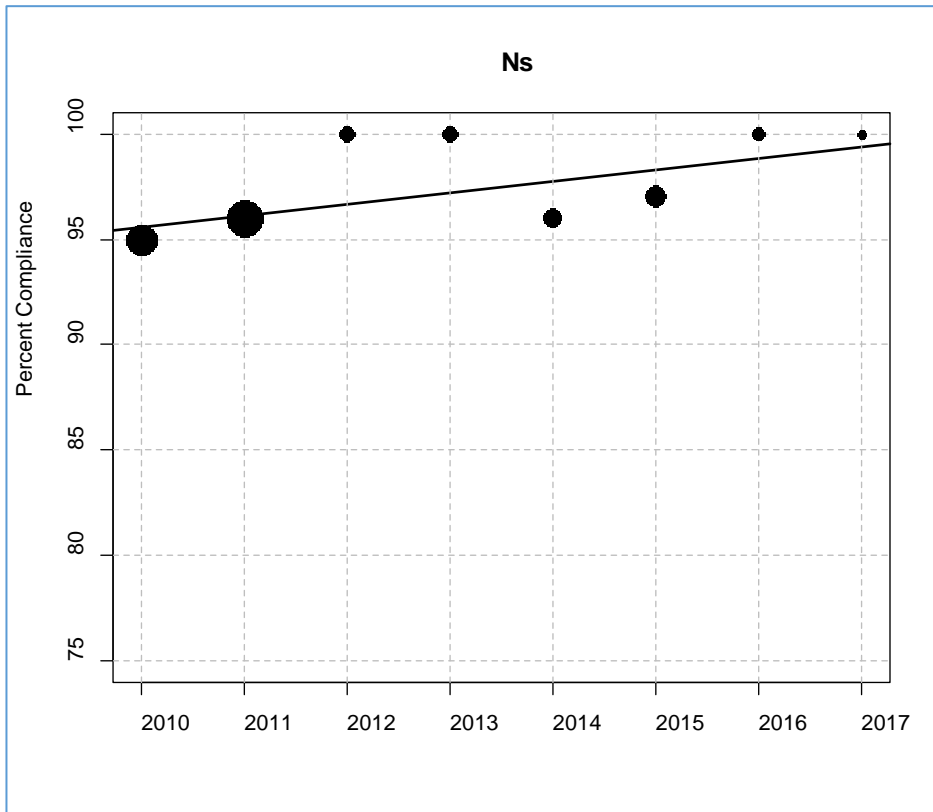

Figure 8. Annual rule compliance for the Ns prescription with a weighted linear regression line overlaid. The point sizes reflect the relative weights given to each point in the regression based on variance differences among years.

Trend analysis results for the A & B Wetlands prescription type revealed varying compliance rates for the prescription, and the associated FP rules from year to year. Prescription compliance rates varied from 89% to 100% over the course of the evaluation period. As a result of the oscillating prescription compliance rate no significant trend results (weighted $p = 0.54$) were detected for the weighted A & B Wetlands prescription type. (Figure 9.)
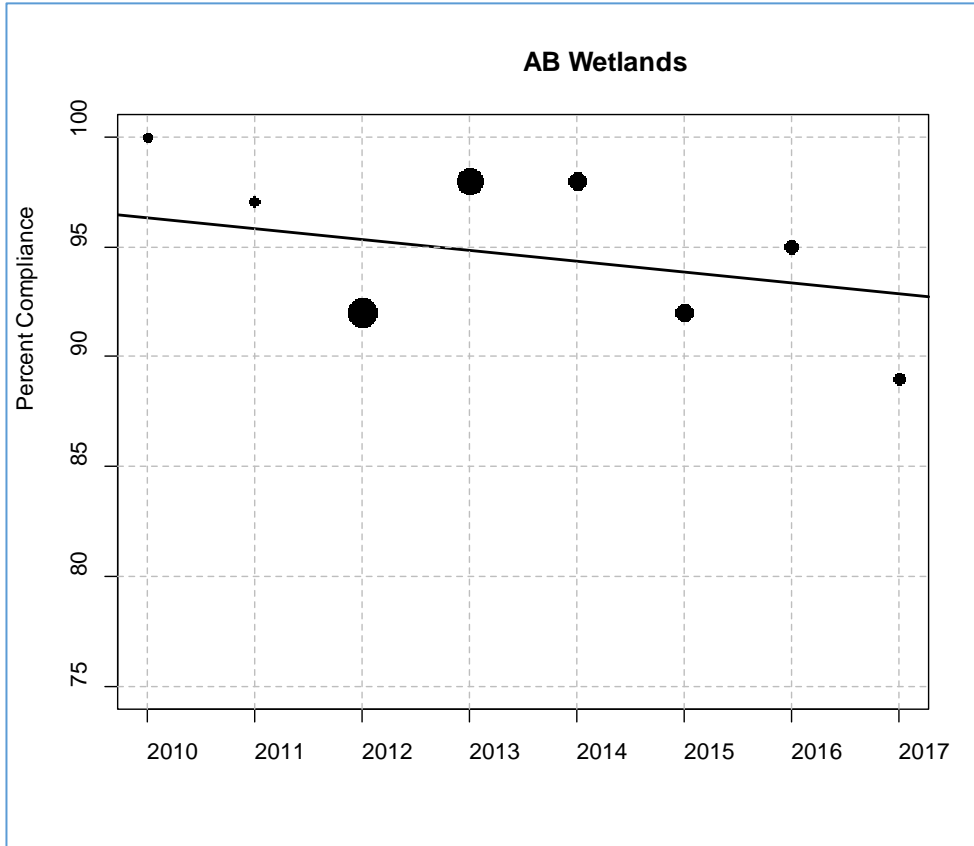
Figure 9. Annual rule compliance for the A&B Wetlands prescription with a weighted linear regression line overlaid. The point sizes reflect the relative weights given to each point in the regression based on variance differences among years.

Forested Wetlands

Trend analysis results for the Forested Wetlands prescription type revealed 100% compliance rates for the prescription, and the associated FP rules from 2010 to 2012, and varying compliance rates from 2013 to 2015. Prescription compliance rates varied from 94% to 100% over the course of the evaluation period. As a result of the oscillating prescription compliance rate no significant trend results (weighted $p = 0.99$) were observed for the weighted Forested Wetlands prescription type. A flat trend line for prescription compliance was observed. (Figure 10.)
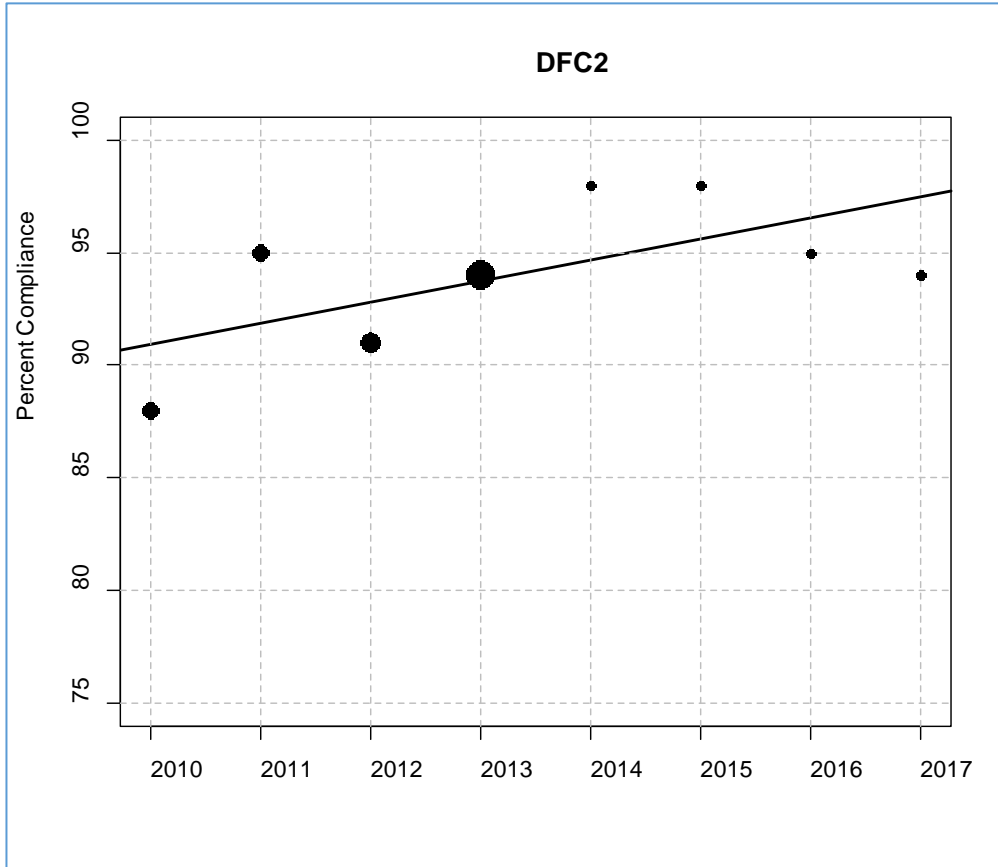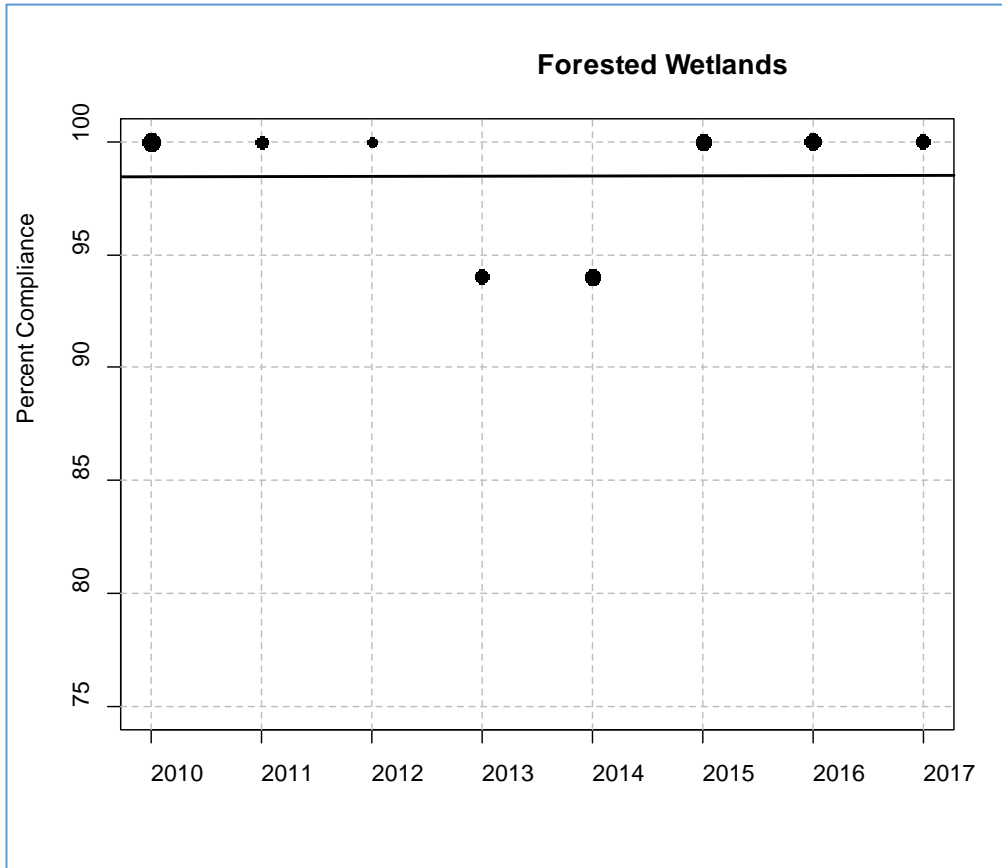

Figure 10. Annual rule compliance for the Forested Wetlands prescription with a weighted linear regression line overlaid. The point sizes reflect the relative weights given to each point in the regression based on variance differences among years.

Roads

Due to the large number of individual rules that comprise the Roads prescription (42), only prescription compliance is visually represented in the report. Trend analysis results for the Roads prescription type showed oscillating prescription compliance, and varying compliance for individual rules from year to year. Prescription compliance rates varied from 92% to 100% over the course of the evaluation period. No significant trend results for weighted regression analysis ($p = 0.34$) rate were observed for the Roads prescription type. (Figure 11.)
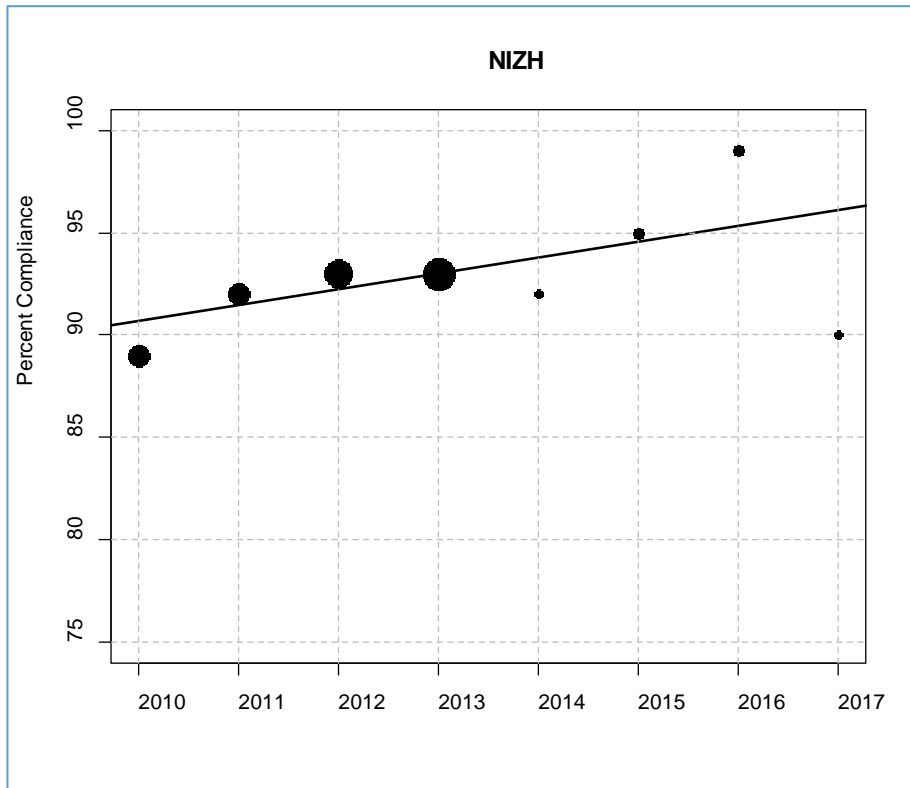

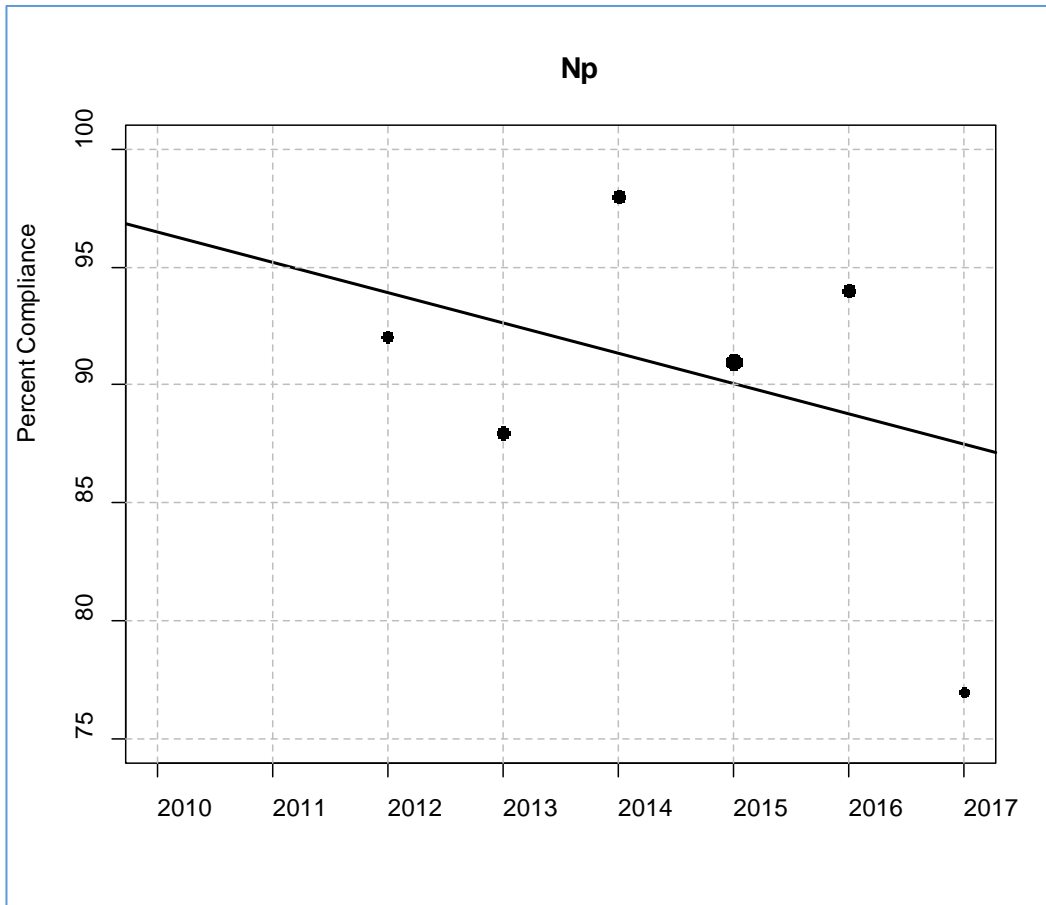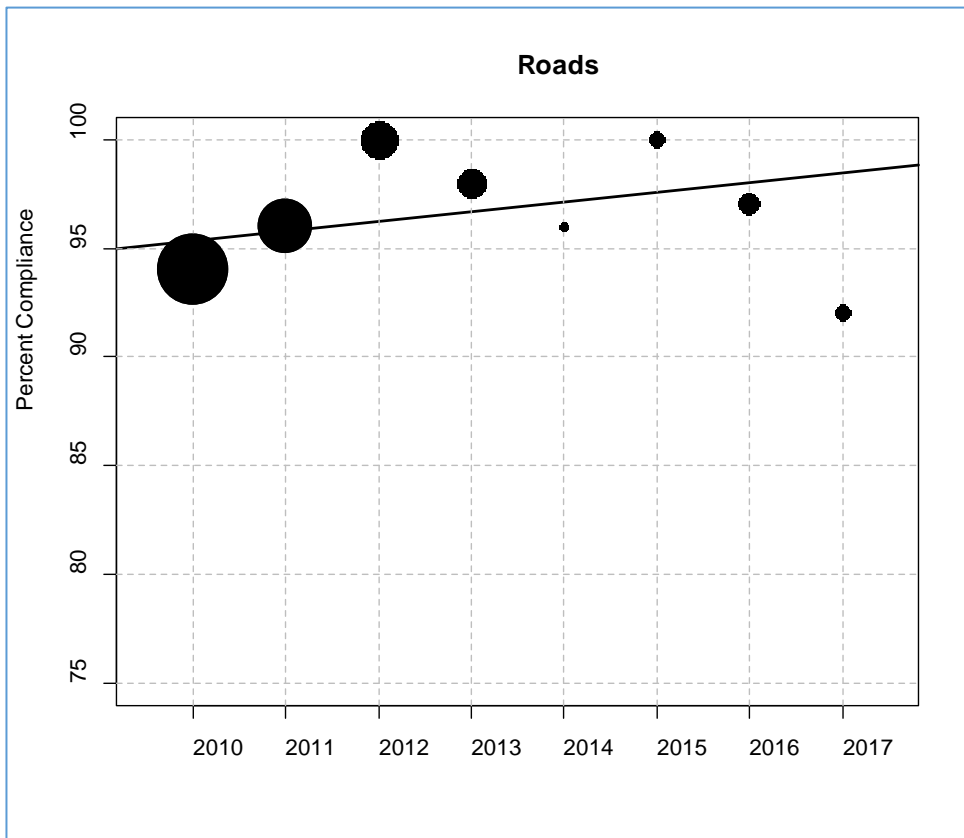**Figure 11.** Annual rule compliance for the Roads prescription with a weighted linear regression line overlaid. The point sizes reflect the relative weights given to each point in the regression based on variance differences among years.

Additional results that depict the relationship between individual rules and the prescription types they comprise can be found in Appendix C.

9.   Forest Practices Application Compliance

Section 9 addresses compliance with the forest practices application (FPA).

Overall FPA compliance generally mirrors FP rule compliance on individual FPAs; however, occasionally one may be compliant while the other is not. When the prescription deviates from the FP rules but is compliant with the FPA, per professional opinion the deviation is a result of the timber harvest design layout and/or approval process. When the FPA is compliant with FP rules but deviates from the landowner's stated protections on the FPA, typically what the landowner proposed, and committed to, conduct activities that were more conservative than what was implemented. Future prescription samples sizes are not based on FPA compliance variance estimates, and cluster size. (Table 19.)

Table 19. 2016-17 Compliance with FPAs for Riparian and Wetland Prescriptions

	Status of Compliance	Western WA		Statewide						Eastern WA
		DFC1	DFC2	No Inner Zone Harvest	Np Activities	Ns Activities	Type A&B Wetlands	Forested Wetlands	Roads	IZH (census)
Small Forest Landowners	# Compliant Rules	1	n/a	8	8	n/a	16	3	27.5	5
	# with Deviation	3	n/a	0	3	n/a	0	0	4.5	0
	% of Sample Compliant	25%	n/a	100%	74%	n/a	100%	100%	82%	100%
	Confidence Interval	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Prescriptions Assessed	1	0	3	5	n/a	5	2	3	1
Large Forest Landowners	# Compliant Rules	75	50	57	70	n/a	74	14	98	30
	# with Deviation	3	3	5	8	n/a	2	0	2.0	1
	% of Sample Compliant	96%	94%	92%	90%	n/a	97%	100%	98%	97%
	Confidence Interval	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	Prescriptions Assessed	19	13	21	30	n/a	24	12	11	6
All Landowners	# Compliant Rules	76	50	65	78	n/a	90	17	125.5	35
	# with Deviation	6	3	5	11	n/a	2	0	6.5	1
	% of Sample Compliant	93%	94%	93%	88%	n/a	98%	100%	95%	97%
	Confidence Interval	(85, 100)	(88, 100)	(86, 100)	(80, 96)	n/a	(85, 100)	n/a	(87, 100)	n/a
	Prescriptions Assessed	20	13	24	35	n/a	29	14	14	7

Note: No rules within Ns prescription type are evaluated for FPA compliance.

Table 20. 2016-2017 Comparison between FPA and Rule Compliance Assessments by Count

	RMZ Prescription	Total Prescriptions Sampled	FPA and Rule Compliance the Same	Deviation from FPA and Rule Compliant	FPA Compliant and Deviation from Rule	Deviation from Rule and FPA Indeterminate	FPA Compliant / Rule Indeterminate
Statewide	RMZ — No Inner Zone Harvest	24	24	0	0	0	0
	RMZ — Type Np Prescriptions	35	30	2	1	0	2
	ELZ - Type Ns Prescriptions	31	31	0	0	0	0
	WMZ — Type A&B Wetlands	43	40	1	0	0	2
	Forested Wetlands	17	17	0	0	0	0
	Roads	14	14	0	0	0	0
Western WA	RMZ — Type S or F Inner Zone Harvest DFC1	20	19	0	1	0	0
	RMZ — Type S or F Inner Zone Harvest DFC2	13	13	0	1	0	0
Eastern WA	RMZ – Type S or F Inner Zone Harvest EWaIZ (census)	7	6	1	0	0	0

Findings for FPA/FP Rule Compliance Differences

There are few differences between FPA compliance and FP rule compliance for the 2016-2017 sample. Differences were found in the DFC1, DFC2, EWaIZH, Type Np waters, and Type A&B Wetlands prescription samples. (Table 20.)

2016 and 2017 field observations resulted in the following differences between FPA compliance and FP rule compliance:

Within the DFC option 1 prescription, the difference occurred as a deviation from the Rule/FPA compliant, where the proponent incorrectly identified and treated the segment as a small type F water, but it was determined to be a large type F water by the CMP field staff. The outer zone had a sufficient number of leave trees per the FPA. However, with a large F water the outer zone extended into the harvested area, leaving the outer zone 11 leave trees short of satisfying the requirements of the rule.

Within the DFC option 2 prescription, the difference occurred as a deviation from the Rule/FPA compliant, where the proponent incorrectly identified and treated the segment as a small type F water, but it was determined to be a large type F water by the CMP field staff. After re-running the DFC software with the correct stream size, it was revealed the no-cut inner zone floor was wider than the previously selected strategy. With harvest observed within the no-cut portion of the inner zone floor the requirements for rule were not met.

Within the Eastern Washington Inner Zone Harvest prescription, the difference occurred as a deviation from the FPA/Rule compliant, where the proponent reported a longer stream length than was measured by the CMP field team for the sampled segment. Resulting, in fewer than the required 21 largest trees per acre remaining in the inner zone per the proponent's stream length measurements. However, using the shorter segment length reported by the CMP field team the requirements of rule were met.

Within the Np prescription, 5 samples deviated from the FPA, Rule, or were indeterminate. For the first sample, the proponent reported a longer 50-foot no-cut buffer than was required. Harvest was observed within the proponent's no-cut buffer. However, no harvest was observed within the required no-cut buffer by rule. The sample was compliant with the rule but deviated from the FPA. For the second sample, the proponent underreported the required length of the 50 foot no cut buffer. Per CMP field team stream length measurements, the proponent needed an additional 125 feet of no-cut buffer. The sample was compliant with the FPA but deviated from the requirement of the rule. For the third sample, because of the underreported 50-foot no-cut buffer length, harvest occurred within the required 50-foot no-cut buffer. The sample was complaint with the FPA but deviated from the requirement of the rule. For the fourth sample, the proponent over reported the required 50 foot no-cut buffer length. The CMP field team observed harvest within 50 feet of the water in the additional no-cut buffer. The sample was compliant with the rule but deviated from the FPA. For the fifth sample, the proponent treated the water as an Np but it was determined to be an F by the CMP field staff. Region FP staff received neither a Water Type Modification Form nor related Interdisciplinary Team documentation noting a water type change. During the compliance monitoring field visit, the water met the criteria of a Type F water (> 2' wide and < 16% gradient), and fish were visually observed. The sample was determined to be compliant with the wording on the FPA, and non-compliant with the rule.

Within the Type A&B Wetlands prescription, 3 samples deviated from either rule or application compliance. For the first sample, the proponent declared that the selected wetland was Type A. However, during the compliance monitoring field review, it was determined that the wetland was a Type B wetland, resulting in an incorrect no-cut buffer width per the FPA. The sample was determined to be compliant with the rule but deviated from the FPA. For the second sample, the CMP field team was unable to determine the appropriate water type. Resulting, in an indeterminate rule assessment for the no-cut buffer with. The sample was determined to be compliant with the FPA but indeterminate for the rule. For the third sample, because of the CMP field team being unable to determine water type, the appropriate number of leave trees per acre was indeterminate. The sample was determined to be compliant with the FPA but indeterminate for the rule.

10. Potentially Unstable Slopes Emphasis Study

The potentially unstable slopes emphasis study was developed in accordance with governance of the program to evaluate compliance with forest practices rules and the FPA. Forest Practices Applications (FPA) containing potentially unstable rule identified landforms (RILs) were assessed for the unstable slopes emphasis study. The design objective was to evaluate how well on-ground results related to avoiding and/or mitigating potential adverse impacts from forest practices on RILs were carried out compared to what was required by the subject FPA. The focus of the unstable slopes emphasis study was to evaluate overall FPA compliance as opposed to individual rule compliance. Thus, the unstable slopes prescription was comprised of FPA compliance only questions. This change of focus from typical compliance monitoring analyses was due to the lack of field measurable rules within the rule identified landform prescription type.

The population sampled for Unstable Slopes consisted of FPAs containing RILs or had them immediately adjacent. As defined in WAC 222-16-50(d)(i)), RILs include Inner Gorges, Convergent Headwalls, Bedrock Hollows, Toes of Deep-seated Landslides, ground water recharge areas for glacial deep-seated landslides, outer edges of meander bends along valley walls or high terraces of an unconfined meandering stream, and any areas containing landforms indicating the presence of potential slope instability which cumulatively indicate the presence of unstable slopes. Initial screening of FPAs eligible for sampling consisted of those with a checked 'Unstable Slopes' box located under the Resource Review section on the 'Office Checklist Page 1'. Following initial screening, FPAs that contained RILs or had RILs bounded out of the FPA footprint were assigned a randomly generated number. Compliance Monitoring and Science Team staff reviewed these FPAs for completeness, based on the random order assigned. The Science Team consists of forest practices regulatory licensed engineering geologists (Qualified Expert) who evaluate landowner proposals and provide advice to FP foresters who make decisions about FPA approval or disapproval. FPAs that did not contain the RIL prescription, and/or FPAs where forest practices harvest or road construction activities had not been completed, were removed from the sample population. In some cases, the FPA contained multiple instances of the Unstable Slopes prescription type. If multiple occurrences of the same prescription type are contained on a single FPA, only one occurrence is selected, at random, and assessed through a CMP field review.

To qualify overall FPA compliance for unstable slopes prescriptions, yes/no determinations were produced by a DNR Qualified Expert (WAC 222-10-030(5)) when answering the following questions related to FPA RIL compliance:

- Did the landowner identify all potentially rule identified unstable landforms in/around the harvest area?

- Did the landowner apply mitigation for all potentially unstable rule identified landforms as identified on their FPA (Question 31)?

- Did harvest occur within the no harvest mitigation area associated with potentially rule identified unstable landforms?

- If a Geotechnical memo, letter or report prepared by a QE was submitted as part of the FPA, was the mitigation, as identified in their report, implemented by the landowner?

A **Yes/No** or **N/A** determination was assessed for each individual question that makes up the Unstable Slopes prescription. These questions were answered during the Qualified Expert's field assessment, following a complete and thorough office review of the selected FPA. Questions were determined to be **compliant** when the QE confirmed all applicable rule identified landforms had been identified by the proponent and the completed harvest was observed to have correctly followed the approved FPA (for FPA compliance).

The **Exceeds** rating was not utilized.

The **deviation from compliance** determination means that implementation of the avoidance/mitigation actions in the approved FPA were not followed. As with the compliant determination, this determination was made for each individual question included in the Unstable Slopes prescription sample. If an answer to a question illustrated a deviation from compliance, then the proponent either did not identify all applicable rule identified landforms, or did not execute the stipulations stated in the FPA (for FPA non-compliance).

Deviation ratings (Low, Moderate, and High) were not utilized for the Unstable Slopes sample.

Findings for Unstable Slopes Emphasis Study

In the 2017 Unstable Slopes sample, 43 FPAs were selected for review from a total population of 978 FPAs. Three samples had no answerable questions and were excluded from analysis. The resulting sample size was 40, and a total of 119 questions were evaluated (Table 21).

Table 21. 2017 Statewide Unstable Slopes Emphasis Study Compliance Results

Unstable Slopes	
Sample Size	40
Mean Cluster Size	3.0
Questions Evaluated	119
Questions 'yes'	109
Mean 'yes'	91.6%
95% Confidence Interval	(85%, 98%)

One hundred nine of the sampled 119 questions were answered 'yes' for the Unstable Slopes prescription sample, resulting in a 92% compliance rate +/- 6.5%. Of the 40 sites sampled, 34 had 'yes' answers for all questions and 6 had 'no' answers for at least 1 question in the prescription type.

Field observations from 2017 included for 10 deviation observations.
- Four deviations were recorded for identifying all potentially rule identified unstable landforms in or around the harvest area.
- Two deviations were observed where avoidance/mitigation was not applied for all potentially rule identified unstable landforms.
- Four deviations were observed where harvest occurred within the no harvest mitigation area associated with potentially unstable rule identified landforms.

- No deviations were observed where a Geotechnical memo, letter or report prepared by a QE was submitted as part of the FPA, were the landowner, as identified in their report, did not implement the mitigation.

11. Report Discussion

The 2016-17 rule prescription compliance rates range from 87-100%, indicating high compliance with forest practice rules. The uncertainty bounds maintain the half-width 95% confidence interval target of +/-6% except for the Np prescription, which had lower compliance and higher variance than expected based on historic estimates. The Np sample size, relative to the expected population size, will be adjusted for the next biennia to reflect these disparities. Note that the jackknife-based confidence intervals are not symmetric. In addition, sample size estimates will continue to be determined using conventional ratio variance estimates.

Riparian and Wetland Compliance Proportioned across the Population

Tables that describe 2016-2017 riparian and wetland findings are in Sections 6.2, 6.3, 6.4, and 6.5 for individual prescription types. Section 6 also provides estimates of the population sizes for each prescription type. Table 22 (below) summarizes FP rule compliance according to these estimated populations. The sampling methodology employed provides desired precision for a biennial sample but does not support an unbiased approach to combine rates and weight by their proportion in the population. Therefore, CMP cannot offer, for example, an overall compliance rate for fish-bearing waters.

Table 22. 2016-17 Estimated Population Size and Associated FP Rule Compliance

Prescription Type	Estimated Population of FPAs with the Prescription	Compliance Percentage
RMZ — Type Np Prescriptions	1,776	87%
RMZ — Type Ns Prescriptions	1,868	100%
RMZ — Type S or F No Inner Zone Harvest	1,408	95%
Forested Wetlands	463	100%
Type A&B Wetlands	313	92%
Western WA RMZ — Type S or F Inner Zone Harvest DFC2	331	95%
Western WA RMZ — Type S or F Inner Zone Harvest DFC1	86	92%
Roads	1,349	95%
Haul Routes	NA*	92%

*The Haul Routes prescription does not have an estimated population.

Comparison between Ratio Estimates and Jackknife Estimates

The ratio estimator used for the previous biennia (2014-15) is a biased estimator, but the bias has been disregarded in previous biennia, and assumed very small. The jackknife estimates were compared to the biased ratio estimates for the past three biennia to evaluate the consequences that using the biased estimator may have had on interpretation of compliance results in the past.

The differences are generally negligible. The maximum difference in average compliance for the 2016-2017 biennium is a 0.22% reduction in compliance for roads, paired with a similar 0.16% increase in compliance for A&B Wetlands. For A&B Wetlands, average compliance using the jackknife estimator is 91.98%, whereas average compliance with the biased estimator would be 91.82%. The confidence intervals for the A&B Wetlands prescription shifted by a similar amount, indicating that the bias in the standard error estimate was minimal. The confidence interval is slightly (0.007%) narrower. For the roads prescription, the jackknife estimate is 94.85%, versus 95.08% for the biased estimator. The upper confidence interval is at 100% for both methods, but the lower confidence interval is lower by 0.8% for the jackknife interval, indicating the small downward bias in the original standard error estimate. Additional information and analysis concerning ISPR is located in Appendix D.

Table 23. Comparison of 2016-2017 rule compliance and confidence intervals using the standard ratio estimate method applied in previous biennia compared to the current jackknife method.

	Western Washington		Statewide					
	DFC1	DFC2	No Inner Zone Harvest	Np Activities	Ns Activities	Type A & B Wetlands	Forested Wetlands	Roads
Prescriptions Assessed	20	13	24	35	31	43	17	15
# Rules Compliant[1]	128	86	112	96	31	101	34	125.5
# Rules with Deviation[1]	11	5	6	15	0	9	0	6.50
Standard Ratio Compliance Estimate	92.086%	94.505%	94.915%	86.49%	100%	91.82%	100%	95.08%
90% Confidence Interval — Lower Bound	87.17%	89.00%	90.40%	78.84%	n/a	86.50%	n/a	88.30%
90% Confidence Interval — Upper Bound	97.00%	100%	99.43%	94.13%	n/a	97.14%	n/a	100%
Jackknife Compliance Estimate	92.093%	94.507%	94.913%	86.60%	100%	91.98%	100%	94.85%
90% Confidence Interval — Lower Bound	87.18%	89.00%	90.40%	78.95%	n/a	86.66%	n/a	87.51%
90% Confidence Interval — Upper Bound	97.01%	100%	99.43%	94.25%	n/a	97.30%	n/a	100%
Jackknife - Standard Ratio Compliance	0.0069%	0.0016%	-0.0025%	0.1100%	0%	0.1590%	0%	-0.2231%
Jackknife Half-width of CI - Standard Ratio Half-width of CI	0.0013%	0.0013%	0.0030%	0.0044%	n/a	-0.0034%	n/a	0.5652%

Compliance Monitoring Program Challenges

Representation of Complete Compliance

The expectation is for landowners to follow all FP rules. In most scenarios where there is deviation from at least one FP rule within a specific prescription, there is compliance with the remaining FP rules in that prescription. In fact, it is not unusual for prescriptions rated a minor deviation to also exceed rule requirements for some other FP rules in that prescription. For example, with DFC prescriptions, if there

were too few outer zone trees, there were often also more tree than required left in the inner zone, where trees have greater riparian benefits to streams. In this example, although letter of the rule was not met, more trees remained within the RMZ than the minimum required by rule.

Sample and Measurement Error

The CMP resolves the inability to determine statistical variability for average values by assigning a standard absolute 5% measurement error tolerance. This measurement error tolerance applies for only 3 specific measurements: when determining 1) stream bankfull width; 2) leave tree to edge of bankfull width; and 3) buffer widths and lengths or floors within RMZs. When a landowner's buffer is within 5% of the compliance monitoring field team's measured buffer, the values are considered the same. If the landowner's buffer value falls outside the 5% error tolerance, the compliance monitoring field team's measured buffer is assumed to be correct and the landowner's buffer incorrect.

Variation in Natural Conditions

Because natural features are variable, on-site conditions sometimes do not fit neatly into FP rule categories. When this occurs, review team members may opt to record the compliance as Indeterminate. The challenge is to improve understanding of the conditions and rule to minimize and ultimately eliminate indeterminate determinations. This may involve revisiting rule interpretation and how to apply the rules in imprecise situations or developing suggested changes to make clarification in FP rules and/or board manual guidance to better resolve questions associated with the variability in the natural environment.

Compliance vs. Resource Protection

The CMP study design has been developed to determine the how well actual on-ground results comply with specific sampled Forest Practices rules. The CMP does not evaluate effectiveness of the rules, nor the adequacy of the resource protection provided by the proponent's implementation of the Forest Practices rules.

12. Forest Practices Program/Forest Practices Rule Changes Based on Compliance Monitoring Feedback

Several rule and Board Manual updates are currently in process because of the 2014-2015 CMP biennium report. Leave tree, DFC, and RMZ length rule and Board Manual clarifications are currently under review and have been scheduled in the 2017 and 2018 Forest Practices Board work plan. Rule and Board Manual clarifications were presented at the May 2015 and 2016 Forest Practices Board meeting. As a direct result of Compliance Monitoring fieldwork, options are being considered to update the Forest Practices Application form and/or instructions for Wetland Management Zones to accurately reflect rule interpretation. The updated FPA form will be available July 16th 2018.

13. Glossary

Bankfull width (BFW).
  a) **For waters** — the measurement of the lateral extent of the water surface elevation perpendicular to the channel at bankfull depth. In cases where multiple channels exist, bankfull width is the sum of the individual channel widths along the cross section (see Board Manual, Section 2).
  b) **For lakes, ponds, and impoundments** — the line of mean high water.
  c) **For tidal water** — the line of mean high tide.
  d) **For periodically inundated areas of associated wetlands** — The line of periodic inundation, found by examining the edge of inundation to ascertain where the presence and action of waters are so common and usual, and of so long a duration in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland.

Basal area. The area in square feet of the cross section of a tree bole measured at 4.5 feet above the ground.

Bull Trout Habitat Overlay. Those portions of Eastern Washington streams containing bull trout habitat as identified by the Department of Fish and Wildlife's bull trout map.

Channel migration zone (CMZ). The area within which the active channel of a stream is prone to move, resulting in a potential near-term loss of riparian function and associated habitat adjacent to the stream, except as modified by a permanent levee or dike. For this purpose, "near-term" means the time scale required to grow a mature forest. (See Board Manual, section 2, for descriptions and illustrations of CMZs and delineation guidelines.)

Clear-cut. A harvest method in which the entire stand of trees is removed in 1 timber harvesting operation (except for trees required by rule or law to be left uncut).

Confidence interval. A type of interval estimate of a population parameter, used to indicate the reliability of an estimate. Confidence intervals consist of a range of values (interval) that act as good estimates of the unknown population parameter.

Crown closure. The percentage of canopy overlying the forest floor.

Desired future condition (DFC). The stand conditions of a mature riparian forest at 140 years of age, the midpoint between 80 and 200 years. Where basal area is the only stand attribute used to describe 140-year-old stands, these are referred to as the "target basal area." The DFC is a reference point on a pathway and not an endpoint for forest stands.

Diameter breast height (DBH). The diameter of a tree at 4.5 feet above the ground measured from the uphill side.

Dominant and co-dominant trees.
  a) **Dominant** — Trees or shrubs with crowns receiving full light from above and partly from the side. Typically larger than the average trees or shrubs in the stand, with crowns that extend above the general level of the canopy and are well developed but possibly somewhat crowded on the sides.

b) **Co-dominant** — a tree that extends its crown into the canopy and receives direct sunlight from above and limited sunlight from the sides. The crowns of dominant trees crowd one or more sides of a co-dominant tree.

Equipment limitation zone (ELZ). A 30-foot-wide zone measured horizontally from the outer edge of the bankfull width of Type Np or Ns waters. ELZ rules apply to all perennial and seasonal non-fish-bearing waters.

End hauling. The removal and transportation of excavated material, pit or quarry overburden, or landing or road cut material from the excavation site to a deposit site not adjacent to the point of removal.

Finite population correction factor. A formula frequently used in statistics and probability that allows adjustment to a population from larger to smaller or to indicate no change in the population. The result of the formula's calculation is called the "z-factor."

Forest practices application or notification (FPA or FPN). The DNR form used by forest landowners to apply for approval of a class III or IV forest practice or to notify DNR that they are conducting a class II forest practice.
a) **FPA** — an application for a permit to conduct a class III or IV forest practice. Class III and IV forest practices have a higher potential to impact a public resource than does a class II forest practice.
b) **FPN** — a notification to DNR that a class II forest practice will take place. Class II forest practices have less than ordinary potential to damage a public resource.

Forest road. Since 1974, lanes, roads, or driveways on forestland used for forest practices. "Forest road" does not include skid trails, highways, or local government roads except where the local governmental entity is a forest landowner. For road maintenance and abandonment planning purposes only, "forest road" does not include forest roads used exclusively for residential access located on a small forest landowner's forestland.

Full bench road. A road constructed across a slope without using any of the material removed from the hillside as part of the road. This construction technique is usually used on steep or unstable slopes.

Jackknife analysis. A resampling technique for variance and bias estimation. Each observation is systematically left out of the dataset and the ratio estimate is recalculated, then the mean is determined from the recalculations.

Laser hypsometer. An instrument that measures the distance to the top and bottom of an object and that measures the angle between the lines from the observer to each top and bottom to calculate height of the object.

100-year flood level. A "100-year" event means a calculated flood event flow based on an engineering computation of flood magnitude that has a 1% chance of occurring in any given year.

Partial cut strategy. The removal of a portion of the merchantable volume in a stand of timber to leave an uneven-aged stand of well-distributed residual, healthy trees that will reasonably utilize the productivity of the soil.

Prescription. A grouping of similar rules by forest practices activity type (e.g., No Inner Zone Harvest, Desired Future Condition Option 1, Desired Future Condition Option 2, Non-Fish-Bearing Perennial Water, Non-Fish Bearing Seasonal Water, Type A&B Wetlands, Forested Wetlands, Roads, and Haul Routes).

Public resources. Water, fish, and wildlife; also, capital improvements of the state or its political subdivisions.

Riparian function. Includes bank stability, the recruitment of woody debris, leaf litter fall, nutrients, sediment filtering, shade, and other riparian features important to both riparian forest and aquatic system conditions.

Riparian management zone (RMZ). The area located on each side of a Type S, F, or N water, where trees are left to provide protection from disturbance when forest practices activities such as timber harvest are conducted.

Rule Identified Landforms (RILs). Inner Gorges, Convergent Headwalls, Bedrock Hollows, Toes of Deep-seated Landslides, ground water recharge areas for glacial deep-seated landslides, outer edges of meander bends along valley walls or high terraces of an unconfined meandering stream, and any areas containing landforms indicating the presence of potential slope instability which cumulatively indicate the presence of unstable slopes

Sensitive sites. Areas near or adjacent to Type Np water and that have one or more of the following:
   a) **Headwall seep** — a seep located at the toe of a cliff or other steep topographical feature and at the head of Type Np water, connecting to the stream channel network via overland flow and characterized by loose substrate and/or fractured bedrock with perennial water at or near the surface throughout the year.
   b) **side-slope seep** — a seep within 100 feet of Type Np water located on side slopes with grades greater than 20%, connected to the stream channel network via overland flow and characterized by loose substrate and fractured bedrock, excluding muck with perennial water at or near the surface throughout the year. Water delivery to the Type Np channel is visible by someone standing in or near the stream.
   c) **Type Np intersection** — the intersection of 2 or more Type Np waters.
   d) **Headwater spring** — A permanent spring at the head of a perennial channel. Where a headwater spring can be found, it will coincide with the uppermost extent of Type Np water.
   E) **Alluvial fan** — a depositional landform consisting of a cone-shaped deposit of waterborne, often coarse-sized sediments.

Sidecast. The act of moving excavated material to the side and depositing such material within the limits of construction or dumping it over the downhill side and outside the limits of construction.

Significance level. A fixed probability of wrongly rejecting the null hypothesis H0, when the hypothesis is in fact true. The smaller the significance level, the better the protection for the null hypothesis. Including a significance level prevents the investigator, as far as possible, from inadvertently making false claims.

Site class. A growth potential rating for trees within a given area based on soil surveys. The designated site class along Type S or F waters will determine the width of the RMZ.

Site index. An index based on ranges of site classes. For example:

50-year site index range (state soil survey)

Site class	Years
I	137+
II	119–136
III	97–118
IV	76–96
V	< 75

Stand requirement. The number of trees per acre, the basal area, and the proportion of conifers in the combined core and inner zone such that the growth of the trees would meet the desired future condition.

Stream adjacent parallel roads. Roads (including associated right-of-way clearing) in an RMZ on a property that have an alignment parallel to the general alignment of the stream, including roads used by others under easements or cooperative road agreements. Also included are water crossings where the alignment of the road continues to parallel the stream for more than 250 feet on either side of the water. Not included are federal, state, county, or municipal roads not subject to forest practices rules, or roads of another adjacent landowner.

Temporary road. A forest road constructed and intended for use during the life of an approved FPA or FPN.

Uppermost point of perennial flow (UMPPF). The point in the stream where water begins to flow perennially (year-round) downstream.

Wetland management zone (WMZ). The area located around the perimeter of a wetland where trees are left to provide protection from disturbance, as well as shade and nutrients for the wetland.

Yarding corridor. A narrow, linear path through an RMZ to allow suspended cables necessary to support cable logging methods, or to allow suspended or partially suspended logs to be transported through these areas by cable logging methods.

14. Appendix A: Sampling and Sample Size Estimation

SAMPLING STRATEGY

Quantitative objectives

The primary quantitative objective of the Compliance Monitoring Program is to estimate the statewide average compliance of forest practices activities with applicable forest practices rules within each biennium, with an error rate of +/-6%. A secondary objective is to compare changes in compliance through time.

Population description

The population designated for sampling consists of the total number of each prescription type identified on forest practices applications that have completed forest practices activities and expire April 1, through March 31 of the following year. The program uses these dates as the timeframe for each successive year of compliance monitoring. This consistent annual sampling period ensures that no FPAs are excluded from selection due to submittal date.

FPAs for annual field assessments include *completed* Class II, Class III, and Class IV-Special and Class IV –General non-conversion FPAs expiring within a one-year period that contain a monitored standard prescription. Each application states all the forest practices activities that the landowner intends to implement. This information allows the compliance monitoring field team to locate forest practices applications (FPAs) that list the particular FP rule prescriptions being sampled in a given year. Sample selections for each prescription type are produced from the FPAs that contain the prescriptions being monitored that year.

Desired Future Condition Option 1, Desired Future Condition Option 2, Eastern Washington Inner Zone Harvest, No Inner Zone Harvest, Non-fish Bearing Perennial Waters, Non-fish Bearing Seasonal Waters, Type A & B Wetlands, Forested Wetlands, Roads, and Haul Routes comprise the annual standard sample prescriptions. The overall prescription population size is often not known, but can be estimated based on the number of FPAs that were reviewed and were found to be part of the population containing the given prescription. The CMP estimates N for an individual prescription as follows:

$$\widehat{N} = \frac{n_1 \times F_1}{f_1},$$

where
F_1 = the total number of FPAs approved in Year 1,
f_1 = the number of FPAs evaluated for membership in the population ("opened") in Year 1, and
n_1 = the number of FPAs opened that contained completed activities in Year 1.

The finite population correction factor (FPCF):

$$1 - \frac{n}{\hat{N}}.$$

Sample Selection methods

Each FPA is assigned an expiration date upon approval. There are thousands of active (not yet expired) FPAs every year, because the majority of FPAs have 3 years in which to be completed. Populations are grouped by prescriptions (DFC1, DFC2, NIZH, etc.) that have been identified by completed individual FPAs to more accurately analyze the collected field data. Therefore, populations are determined by the frequency of prescriptions that occur as part of completed FPAs.

To ensure all active completed FPAs have an opportunity to be selected, the populations to be sampled are FPAs that expire between April 1 of the preceding year and March 31 of the sampling year. The April 1 to March 31 window improves the likelihood that the forest practices operations will be completed prior to the primary compliance monitoring sampling months, February through November, and that the compliance monitoring field team attempts to conduct data collection before the FPA expires.

To ensure a random selection of FPAs from the sampling population, FPAs are assigned a random number as a decimal fraction between 0 and 1, and then are ordered from the smallest to the largest number. The selection methodology consists of reviewing the FPAs in this random order. Each FPA is reviewed to determine the sample FP rule prescription types, which can be sampled. This selection process continues through the ordered list of FPAs until the target sample size is reached for each sampled prescription type.

All FPAs in the population are ordered by the assigned generated random number and categorized by region. FPAs that do not contain monitored activities and FPAs that are not complete are removed from the population. Sample sizes are applied in proportion to statewide population size for each prescription type.

For each riparian prescription, the population to be sampled consists of FPAs containing that prescription. In some cases, a single FPA contains multiple implementations of the same riparian prescription type. If this is the case, 1 prescription implementation is randomly selected for assessment. If multiple instances of the same prescription type are contained on a single FPA, one instance is randomly selected and assessed for the purposes of Compliance Monitoring field reviews.
The figure below displays a flow chart that illustrates how activities are selected for field assessment.

Figure Flow Chart of FPA selection for Compliance Monitoring field reviews.

Select a populaton of submitted & approved Class II renewals, Class III, and Class IV-S FPAs.

Choose a time frame such that FPA activities are complete.

Determine proportion of prescription occurrances per Region.

For Example:
OLY=14%
SPS=12%
NE=15%
PC=38%
NW=15%
SE=6%

Use a random number generator to order the FPAs.

Stratify FPAs by Region and confirm selection criteria.

For example:
Does the FPA contain RMZs, WMZs or Roads?

Determine if FPAs are complete-- Call or field verify.

yes

Delete FPA from population. Select replacement from random sample.

no

For each FPA, determine activity types to be reviewed for compliance.

Any single activity type with mulitple stream segments?

yes

Select Random segment for field review.

no

CM Field Coordinator contact ECY, WDFW, and tribes to set up field visits on completed FPAs.

Sample size and allocation

The stated objective is to estimate compliance for each prescription with a precision of +/- 6% with a 95% confidence interval. We use data from previous biennia for each prescription to estimate compliance variance, the average number of rules among FPAs, and the expected population sizes (overall and within each region). Because these population values can vary widely among biennia, it is important to update the estimates after one year of sampling for the biennium is completed. This 2-year approach assumes that there is no change in compliance between the two years, so that no bias is introduced by having unbalanced sampling among the two years.

The estimated population values for variance, cluster size, and population size are used to estimate the sample sizes required to attain a width of +/- 6% for a 95% confidence interval using an iterative process based on a t-distribution confidence interval on average prescription compliance:

$$\hat{p} = \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i},$$

Where n is the number of FPAs sampled for the prescription, x_i is the number of rules applied on the ith FPA in the sample, and y_i is the number of rules that were complied with on the ith FPA.

A 95 percent confidence interval for the proportion compliant is formed as follows:

$$\hat{p} \pm t_{.025,(n-1)} \cdot SE(\hat{p})),$$

where $t_{.025,(n-1)}$ is the 97.5th percentile of the student-t distribution with (n-1) degrees of freedom,

$$SE(\hat{p}) = \frac{\sqrt{n \cdot (1 - \frac{n}{N}) \cdot \sum_{i=1}^{n} (y_i - \hat{p}x_i)^2}}{\sqrt{(n-1)} \cdot \sum_{i=1}^{n} x_i} \quad \text{(Cochran, 1977)},$$

and N is the estimated population size for the prescription.

Compliance and Variance Calculation Methods

In previous biennia, the average compliance was calculated according to the rules of estimation for cluster samples (See, for example, Cochran, 1977; Schaeffer et al., 1990). The mean compliance for a prescription was estimated by the ratio of the number of compliant rules divided by the total number of rules sampled across all FPAs in the prescription:

$$\hat{R} = \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i},$$

where n is the number of FPAs sampled for the prescription, x_i is the number of rules applied on the ith FPA in the sample, and y_i is the number of rules complied with on the ith FPA.

A 95 percent confidence interval for the proportion compliant was then formed as follows:

$$\hat{R} \pm t_{.025,(n-1)} \cdot \widehat{SE(\hat{R})},$$

where

$t_{.025,(n-1)}$ is the 97.5[th] percentile of the student-t distribution with (n-1) degrees of freedom,

$$\widehat{SE(\hat{R})} = \frac{\sqrt{n \cdot (1 - \frac{n}{N}) \cdot \sum_{i=1}^{n} (y_i - \hat{R}x_i)^2}}{\sqrt{(n-1)} \cdot \sum_{i=1}^{n} x_i} \text{ (Cochran, 1977),}$$

and N is the estimated population size for the prescription (i.e., total number of FPAs containing the prescription).

The ISPR review found that this was a proper statistical estimation process. However, the review drew attention to the bias on the order of 1/n that is present in the ratio estimator, and recommended that the jackknife estimation procedure described by Cochran (1977) and Gregoire (1984) be applied to help reduce or eliminate any potential bias in the estimates. Therefore, beginning with the 2016-2017 biennium, average compliance for each prescription is now estimated using a jackknife ratio estimator and associated confidence interval, as recommended by the ISPR review. For the jackknife estimator, each FPA was removed from the prescription sample in turn, and a ratio estimate of compliance was estimated on this reduced sample ($\widehat{R_{-J}}$). The jackknife estimator for average compliance in a finite population is (Cochran, 1977, eqn 6.82):

$$\widehat{R_{JK}} = w \cdot \hat{R} - (w-1) \cdot \widehat{R_-}$$

where

$w = n\left[1 - \frac{(n-1)}{N}\right]$ is a finite population correction factor, and

$\widehat{R_-}$ is the average of the n quantities $\widehat{R_{-J}}$.

An estimate of variance is also given by Cochran (1977, eqn 6.86):

$$var(\widehat{R_{JK}}) = \left(1 - \frac{n}{N}\right) \cdot \frac{(n-1)}{n} \cdot \sum_{j=1}^{n} (\widehat{R_{-J}} - \widehat{R_-})^2$$

$$var(\widehat{R_{JK}}) = \left(1 - \frac{n}{N}\right) \cdot \frac{(n-1)^2}{n} \cdot var(\widehat{R_{-J}})$$

$$\widehat{SE(R_{JK})} = \sqrt{var(\widehat{R_{JK}})}$$

An approximate 95 percent confidence interval for the jackknife estimate was then formed as follows:

$$\widehat{R_{JK}} \pm t_{.025,(n-1)} \cdot \widehat{SE(R_{JK})},$$

where $t_{.025,(n-1)}$ is the 97.5th percentile of the student-t distribution with $(n-1)$ degrees of freedom, and N in the formulas above is replaced by $\hat{N}$.

15. Appendix B: 2016-2017 Biennium Individual Rule Compliance by Prescription

Table column headers may not reflect actual field form question wording

Desired Future Condition Option 1

DFC1 (n=20)	Overstory Tree Species match DFC worksheet (222-30-021(ii)(B)(I))	Site Class (222-16-010)	Stream Size (222-16-031(2)(3))	No harvest in Core Zone 222-30-021(a)	Inner Zone meets diameter leave tree strategy (222-30-021(ii)(B)(I))	Largest 57 TPA left in Inner Zone (222-03-021(ii)(B)(I)	CMZ not recorded on FPA 222-30-020(13)	Correct # Outer Zone leave trees (222-30-021(iii)(c))
Compliance	17	19	19	20	16	19	1	17
Assessed	20	19	20	20	19	20	1	20
% compliant	85%	100%	95%	100%	84%	95%	100%	85%
95% CI	(65, 91)	(84, 100)	(77, 95)	(85, 100)	(63, 91)	(77, 95)	(8, 100)	(65, 91)

Desired Future Condition Option 2

DFC2 (n=13)	Overstory Tree Species match DFC (222-30-021(ii)(B)(II))	Site Class (222-16-010)	Stream Size (222-16-031(2)(3))	No harvest in Core Zone (222-30-021(a))	No harvest in floor Zone (222-30-021(ii)(B)(II)	20 conifer TPA in outer portion of IZ (222-30-021(ii)(B)(II))	CMZ not recorded on FPA 222-30-020(13)	Correct # Outer Zone leave trees (222-30-021(iii)(c))
Compliance	12	13	12	13	9	13	1	13
Assessed	12	13	13	13	13	13	1	13
% compliant	100%	100%	92%	100%	69%	100%	100%	100%
95% CI	(74, 100)	(76, 100)	(64, 100)	(76, 100)	(39, 91)	(76, 100)	(3, 100)	(76, 100)

No Inner Zone Harvest

NIZH (n=24)	Stream Size (222-16-031(2)(3))	Site Class (222-16-010)	No harvest in Core Zone (222-30-021(a))	No harvest in Inner Zone (222-30-021(b)	Correct # Outer Zone leave trees (222-30-021(iii)(c))	Observed CMZ 222-30-020(13)
Compliance	23	24	24	21	19	1
Assessed	24	24	24	24	21	1
% compliant	96%	100%	100%	88%	90%	100%
95% CI	(79, 100)	(86, 100)	(86, 100)	(68, 97)	(70, 99)	(3, 100)

Non-Fish Bearing Perennial Waters

Np (n=35)	Np stream size (222-16-031(4))	Is ≤ 10% of ELZ exposed (222-30-021(2)(a))	Appropriate Length of 50 foot buffer (222-30-021(2)(b)(vii))	No harvest within required 50 foot buffer (222-30-021(2)(b)(i))	No harvest 50 feet from headwall seeps & springs (222-30-021(2)(b)(ii)(iii))	56ft PIP/UMPPF & Confluence buffer (222-30-021(2)(b)(iv)(v))	No harvest on Alluvial fans
Compliance	26	5	23	21	3	17	1
Assessed	32	6	24	25	3	20	1
% compliant	81%	83%	96%	84%	100%	85%	100%
95% CI	(64, 93)	(36, 100)	(79, 100)	(64, 95)	(30, 100)	(62, 97)	(3, 100)

Non-Fish Bearing Seasonal Waters

Ns (n=31)	Ns stream size (222-16-031(5))	Is ≤ 10% of ELZ exposed (222-30-021(2)(a))
Compliance	31	0
Assessed	31	0
% compliant	100%	N/A
95% CI	(89, 100)	N/A

Forested Wetlands

Forested Wetlands (n=17)	Wetlands type & size consistent (222-06-035(2))	If harvest occurred, low impact used (222-30-020(7))	If greater than 3 acres, was it mapped (222-16-036(3))
Compliance	17	11	6
Assessed	17	11	5
% compliant	100%	100%	100%
95% CI	(81, 100)	(72, 100)	(55, 100)

A & B Wetlands

A&B Wetlands (n=43)	Wetlands type & size (222-16-035(1)(a) &(b))	Variable buffer width appropriate (222-30-020(8)(a))	Openings less than 100' wide (222-30-020(8)(d)	Openings less than 200' wide	Leave trees species represent pre-harvest (222-30-020(6))	Ground based in min WMZ had approval (222-30-020(8)(e))	WMZ-RMZ overlap-best protection used (222-30-020(8)	38 TPA GT 6in WW (4in EW) (222-30-020(8)(b))	13 TPA GT 12in,where they exist (222-30-020(8)(b))	75 TPA GT 6in, where they exist	25 TPA GT 12in, where they exist	3 TPA GT 20in, where they exist	5 TPA GT 20in, where they exist (222-30-020(8)(b))
Compliance	32	21	1	1	19	2	5	1	1	6	6	1	5
Assessed	41	21	1	1	19	2	5	1	1	6	6	1	5
% compliant	78%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
95% CI	(63, 89)	(85, 100)	(6, 100)	(6, 100)	(83, 100)	(20, 100)	(51, 100)	(6, 100)	(6, 100)	(57, 100)	(57, 100)	(6, 100)	(51, 100)

16. Appendix C: Trends of Individual Rules

Desired Future Condition 1
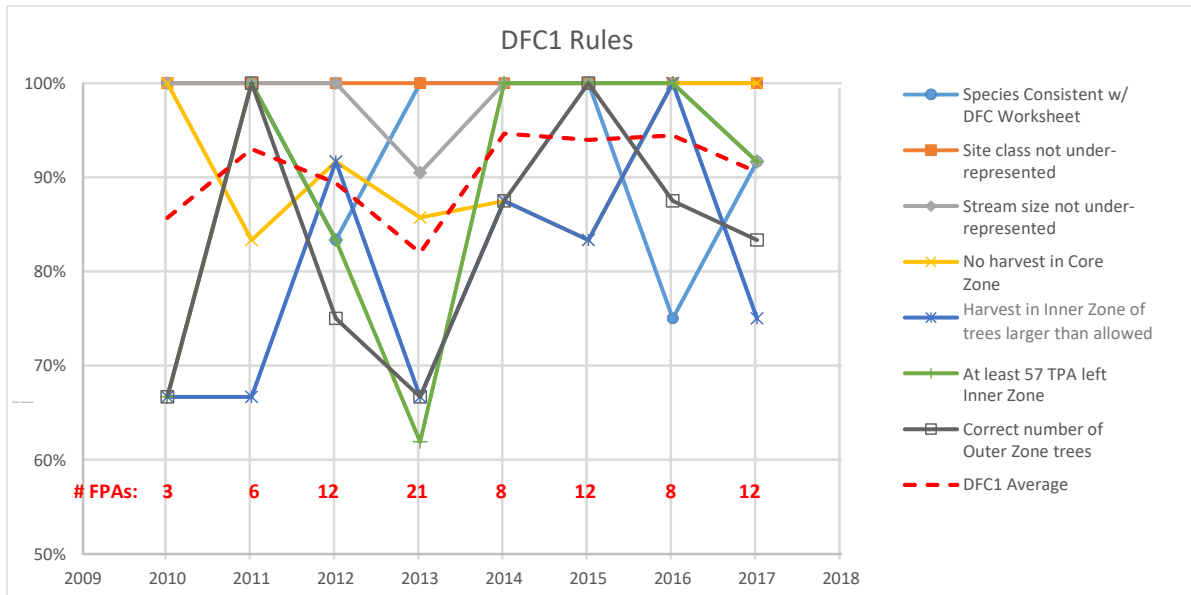
Desired Future Condition 2

No Inner Zone Harvest

Non-Fish Bearing Perennial Waters

91
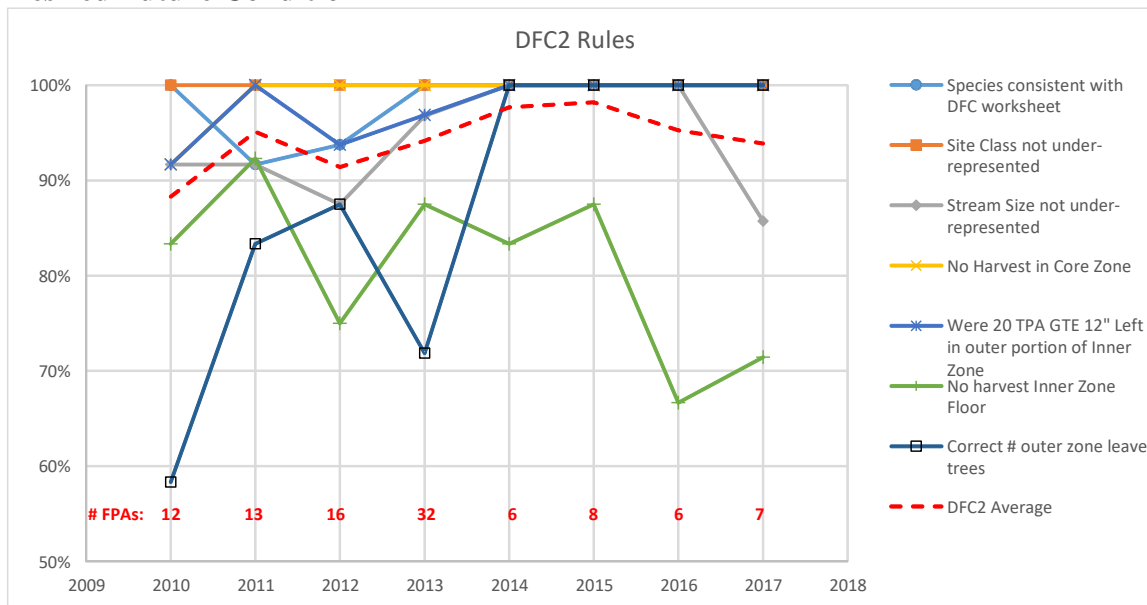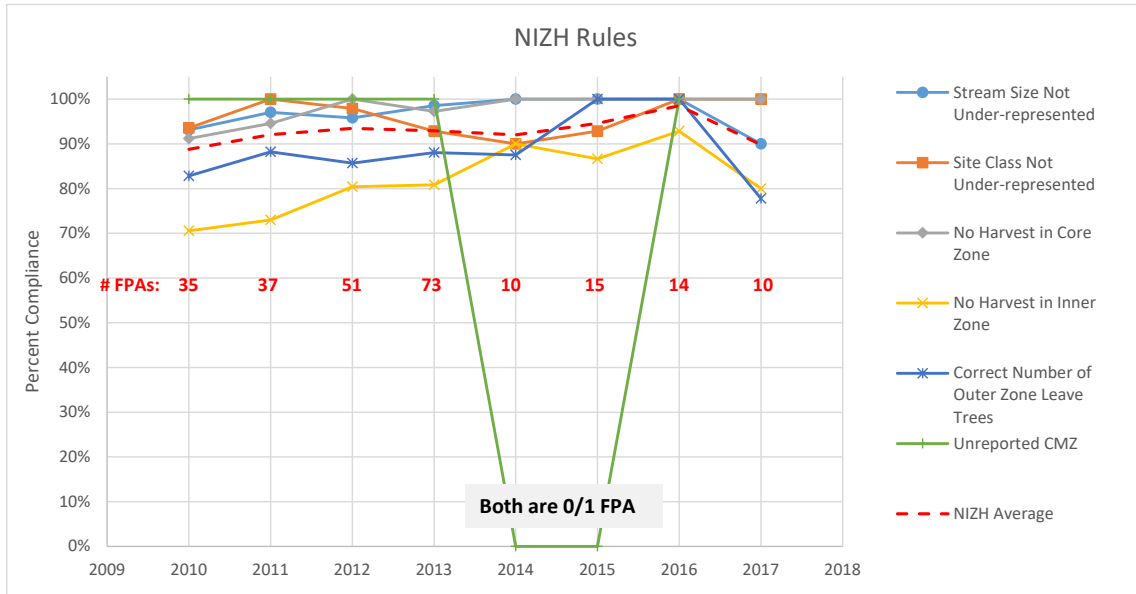
Non-Fish Bearing Seasonal Waters

A & B Wetlands

Forested Wetlands

Forested Wetlands

Legend:
- Were Wetlands Typed and Sized Appropriately
- Low impact harvest systems
- FW Greater than 3 acres, was it mapped
- Forested Wetlands Average

FPAs: 10   7   8   9   9   14   10   7
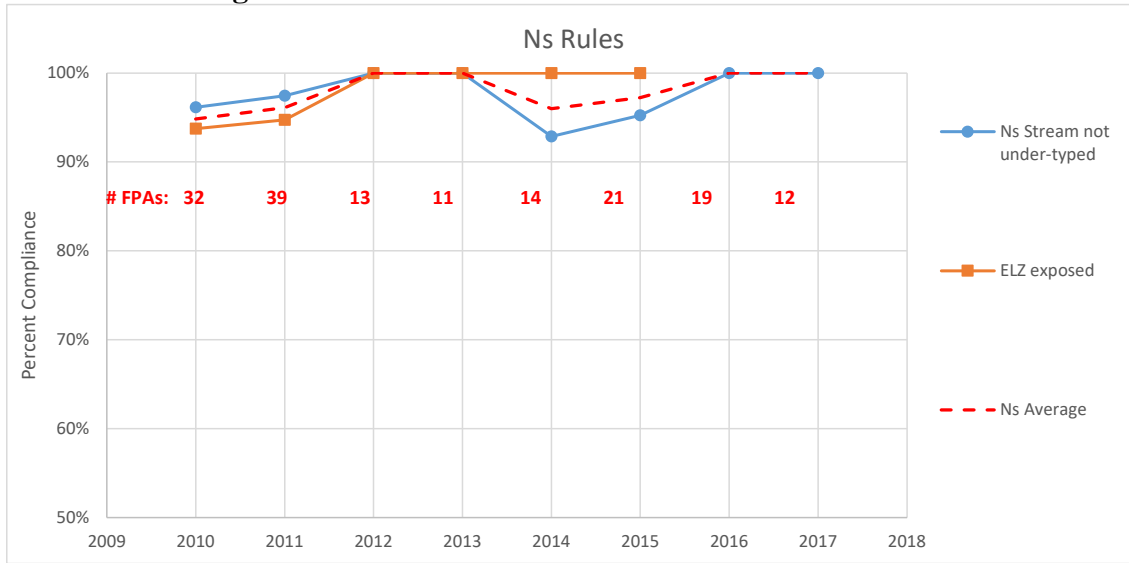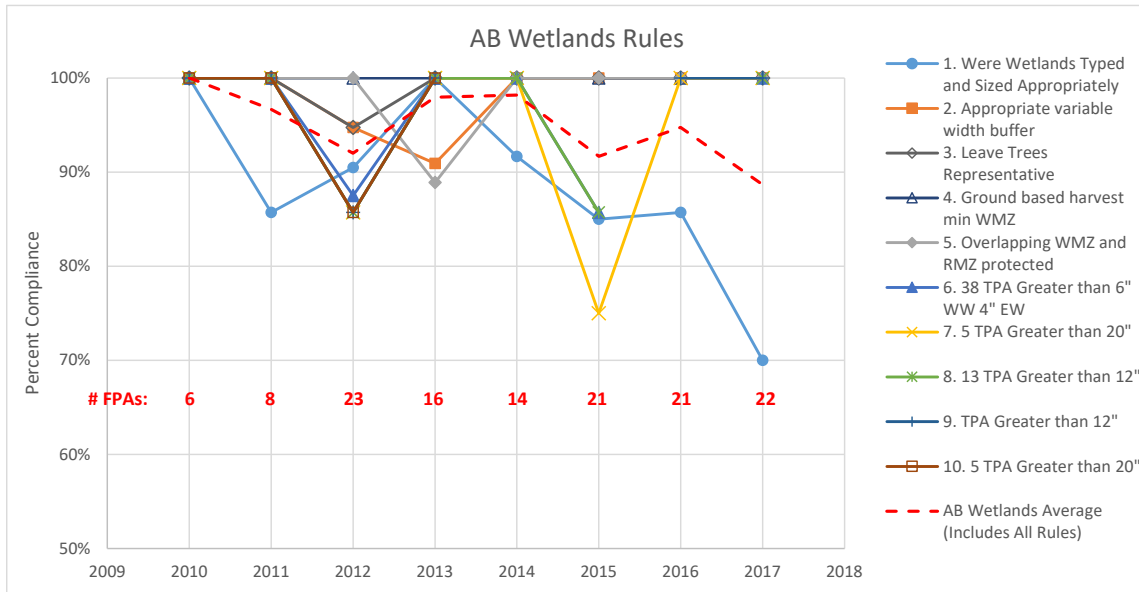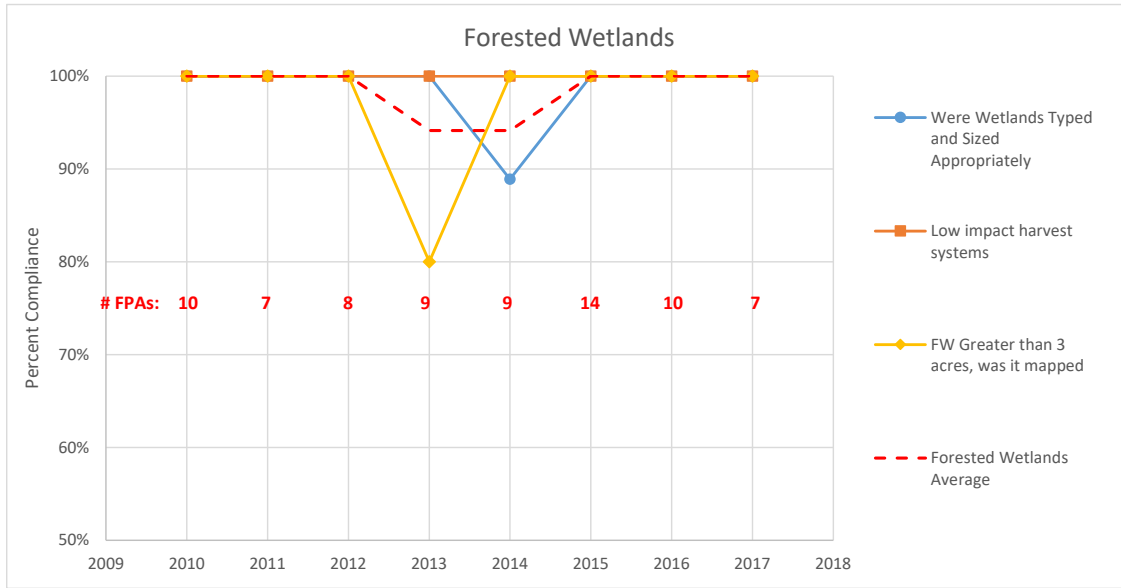
17. Appendix D: Technical Report on Jackknife Estimation Revisions and Trend Analysis

INTRODUCTION

The 2014-2015 Forest Practices Compliance Monitoring Biennial Report was reviewed by an Independent Scientific Peer Review (ISPR) Panel from the University of Washington in 2017. One recommendation from the ISPR was to alter the method 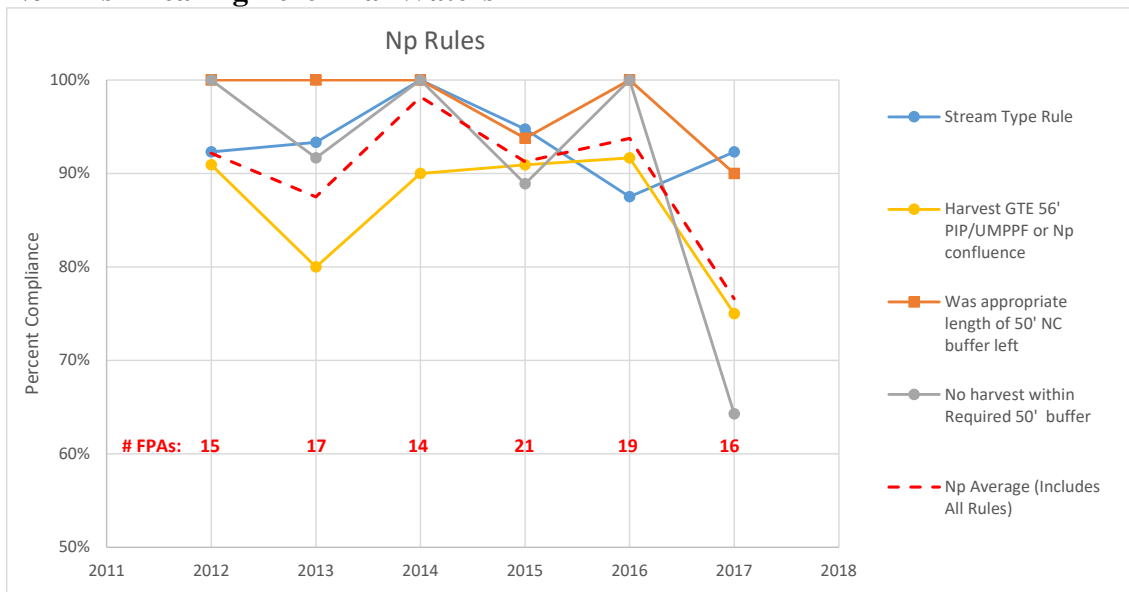for estimating the biennial compliance statistic and the uncertainty around that estimate to correct for the known bias present in a ratio estimator. The recommendation was to use a jackknife estimator rather than the conventional estimator of a ratio. The jackknife estimator was therefore used to estimate compliance for the 2016-2017 Biennial Report. This technical appendix provides the details of the methods revisions, including a summary of the compliance results, a comparison between compliance using the previous method and the new method for the past two biennia, and an assessment of linear trends in compliance through time.

METHODS

2016-2017 BIENNIUM

In previous biennia, the average compliance was calculated according to the rules of estimation for cluster samples (See, for example, Cochran, 1977; Schaeffer et al., 1990). The mean compliance for a prescription was estimated by the ratio of the number of compliant rules divided by the total number of rules sampled across all FPAs in the prescription:

$$\hat{R} = \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i},$$

where *n* is the number of FPAs sampled for the prescription, x_i is the number of rules applied on the *i*th FPA in the sample, and y_i is the number of rules complied with on the *i*th FPA.

A 95 percent confidence interval for the proportion compliant was then formed as follows:

$$\hat{R} \pm t_{.025,(n-1)} \cdot \widehat{SE(\hat{R})},$$

where $t_{.025,(n-1)}$ is the 97.5th percentile of the student-*t* distribution with (n-1) degrees of freedom,

$$SE(\hat{R}) = \frac{\sqrt{n \cdot (1 - \frac{n}{N}) \cdot \sum_{i=1}^{n} (y_i - \hat{R}x_i)^2}}{\sqrt{(n-1) \cdot \sum_{i=1}^{n} x_i}} \text{ (Cochran, 1977), and}$$

N is the estimated population size for the prescription (i.e., total number of FPAs containing the prescription).

The ISPR review found that this was a proper statistical estimation process. However, the review drew attention to the bias on the order of 1/n that is present in the ratio estimator, and recommended that the jackknife estimation procedure described by Cochran (1977) and Gregoire (1984) be applied to help reduce or eliminate any potential bias in the estimates. Therefore, beginning with the 2016-2017 biennium, average compliance for each prescription is now estimated using a jackknife ratio estimator and associated confidence interval, as recommended by the ISPR review. For the jackknife estimator, each FPA was removed from the prescription sample in turn, and a ratio estimate of compliance was estimated on this reduced sample ($\widehat{R_{-J}}$). The jackknife estimator for average compliance in a finite population is (Cochran, 1977, eqn 6.82):

$$\widehat{R_{JK}} = w \cdot \hat{R} - (w - 1) \cdot \widehat{R_-}$$

where

$w = n \left[1 - \frac{(n-1)}{N}\right]$ is a finite population correction factor, and

$\widehat{R_-}$ is the average of the n quantities $\widehat{R_{-J}}$.

An estimate of variance is also given by Cochran (1977, eqn 6.86):

$$var(\widehat{R_{JK}}) = \left(1 - \frac{n}{N}\right) \cdot \frac{(n-1)}{n} \cdot \sum_{j=1}^{n} \left(\widehat{R_{-J}} - \widehat{R_-}\right)^2$$

$$var(\widehat{R_{JK}}) = \left(1 - \frac{n}{N}\right) \cdot \frac{(n-1)^2}{n} \cdot var(\widehat{R_{-J}})$$

$$SE(\widehat{R_{JK}}) = \sqrt{var(\widehat{R_{JK}})}$$

An approximate 95 percent confidence interval for the jackknife estimate was then formed as follows:

$$\widehat{R_{JK}} \pm t_{.025,(n-1)} \cdot \widehat{SE(\widehat{R_{JK}})},$$

where $t_{.025,(n-1)}$ is the 97.5th percentile of the student-t distribution with *(n-1)* degrees of freedom, and *N* in the formulas above is replaced by $\widehat{N}$.

COMPARISON BETWEEN RATIO ESTIMATES AND JACKKNIFE ESTIMATES

The ratio estimator used for previous biennia is a biased estimator, but has been ignored in previous biennia, and assumed to be very small. We compare the jackknife estimates to the biased ratio estimates for the past three biennia to evaluate the consequences that using the biased estimator may have had on interpretation of compliance results in the past.

COMPLIANCE TRENDS

FPA compliance has been monitored since 2006. In that time, there have been multiple changes (documented elsewhere) to the methods for monitoring compliance. The current compliance monitoring methods include tracking compliance with individual rules within prescriptions, while sampling the rule applications in clusters (FPAs) for convenience of sampling. The sample size for each year is set based on maintaining a set precision level for average compliance within a set of rules (a prescription) over a two-year period. Because the population of FPAs available in any given year is finite and varying, the number or samples necessary to reach a given precision level also varies by year. Differing priorities and compliance estimation methods have caused differences in precision levels attainable by the samples collected in different years. In addition, methods for determining compliance with some individual rules has changed since 2006. These differences cause some difficulty in estimating trends through time. However, the rules that have been consistently monitored since 2010 can be and have been compared through time in this report. The compliance data from 2006-2009 have not yet been matched to current rules, although these data may be included in future reports.

For the 2010-2017 data, each rule was reviewed to make sure that the compliance determination was consistently applied in all years. For example, in the earlier time periods, some rules did not have a possibility of being recorded as non-compliant: if they existed on the application, then they were compliant. Rules such as this are not currently included in the rule compliance estimates for prescriptions, and were therefore not included in the trend analysis. In addition, the label or compliance question for some rules may have changed over time, potentially causing inconsistencies in the application of compliance determination. These issues were carefully considered and resolved before the final set of rules to be tested for trend was selected for each prescription.

For this biennium, 2016-2017, the method for estimating compliance and uncertainty around the compliance estimate has been changed to the jackknife method, to less biased estimator. The comparison between the jackknife estimates and the conventional ratio estimates for 2016-17 and

2014-15 compliance showed minor differences. The trends in compliance are therefore unlikely to be impacted by the choice of estimator. The jackknife estimators have been applied for annual compliance estimates for 2014-2017 at this point, and previous years with the conventional estimators.

Linear least-squares regression can be used to estimate general trends in average compliance through time. However, there are varying precision levels among years due to differences in sample sizes (proportion of population sampled) and in average cluster size (number of rules per FPA). In this case, the linear regression assumption of homogeneous variance is violated, which can cause biased estimates of trend. To adjust for this bias, we use weighted regression analysis, with the result in each year weighted by a relative variance estimate. In this way, years with more precise estimates of average compliance receive more weight in the regression, which compensates statistically for unequal variances. The trend estimates and significance level for both unweighted and weighted linear regression are supplied, with a 90% confidence interval for the annual trend (slope) for the weighted regression. Residuals from regressions are tested for approximate normality using Shapiro-Wilks test with alpha = 0.05.

RESULTS

2016-2017 BIENNIUM RESULTS
The jackknife estimates of compliance with FPAs and with Rules are displayed in Tables 1 and 2, respectively. The prescription compliance rates range from 87-100% indicated high compliance with forest practice rules. The uncertainty bounds maintain the target +/-6% width with the exception of the Np prescription, which had lower compliance and higher variance than expected based on historic estimates. The sample size relative to the expected population size will be adjusted for the next biennia to reflect these differences. Note that the jackknife-based confidence intervals are not symmetric. Also, sample size estimates will continue to be based on conventional ratio variance estimates.

COMPARISON BETWEEN RATIO ESTIMATES AND JACKKNIFE ESTIMATES
The standard ratio estimates and associated confidence intervals for rule compliance are compared for 2016-2017 biennium in Table 3, and for the 2014-2015 biennium in Table 4. The differences are generally very small. The maximum difference in average compliance for the 2016-2017 biennium is a 0.22% reduction in compliance for roads, paired with a similar 0.16% increase in compliance for AB Wetlands. For AB Wetlands, average compliance using the jackknife estimator is 91.98%, whereas average compliance with the biased estimator would be 91.82%. The confidence intervals for the AB Wetlands prescription are shifted up by a similar amount, indicating that the bias in the standard error estimate was minimal. The confidence interval is slightly (0.007%) narrower. For the roads prescription, the jackknife estimate is 94.85%, versus 95.08% for the biased estimator. The upper confidence interval is at 100% for both methods, but the lower confidence interval is lower by 0.8% for the jackknife interval, indicating the small downward bias in the original standard error estimate.

For the 2014-2015 biennium, the largest difference in compliance rate was for the roads rules, which had a compliance rate of 98.44% using the standard method, but a compliance rate of 98.54% using the jackknife method (a difference of 0.1%). The DFC2 prescription had the largest downwards shift, going from 98.00% to 97.99% using the jackknife estimator, a difference of -0.01%. The width of the confidence intervals grew or shrank by similar amounts depending on bias in the standard error estimates. The largest increase in confidence interval width was for AB Wetlands, which went from 10.47% wide to 10.61% wide, an increase of by 0.13%. In contrast, the confidence interval width for roads decreased by 0.19%.

COMPLIANCE TRENDS

Change in annual rule compliance through time is displayed in Figure 1 and Figure 2, and trend statistics are given in Table 5. The relative weights used for weighted linear regression were used to size the points in the regression plots – larger points were weighted heavier in the regression based on variance estimates. For example, a higher proportion of the population sampled or a larger cluster size (i.e., more rules per FPA) in any given year reduces the variance and results in a heavier weight for the regression analysis. Slope estimates (i.e., average change in compliance per year) are given for weighted and unweighted regressions with p-values for significance tests, and a 90% confidence interval for the weighted regression slope. There is some evidence for increasing trends in compliance for Western Washington DFC2 prescriptions, and statewide NIZH and Ns prescriptions, with estimated average increases from 0.5 to 1% per year. Note that the residuals from the forested wetlands weighed regression displayed non-normal characteristics (Shapiro-Wilks test p-value 0.00006), but no further tests were conducted due to the obvious lack of trend displayed in Figure 2.

DISCUSSION

The compliance with Forest Practices rules and applications remains high for the 2016-2017 biennium. The change to the jackknife estimator for compliance and uncertainty around compliance estimates has resulted in minor changes that do not affect the interpretation of compliance for this program, either for this biennium or historically.

There are some apparent increases in compliance since 2010 for some prescriptions, and no apparent decreases. Several caveats to these conclusions are needed: first, these methods are only testing for linear trends, and second, the 2010-2013 data have not yet been adjusted for the jackknife estimation method. The jackknife adjustments to earlier biennia are unlikely to result in large changes, but the annual trends observed are also small.

Table 1: 2016-2017 Compliance with Forest Practices Applications for Riparian and Wetland Harvest Prescriptions

	Status of Compliance	Western Washington		Statewide					Eastern WA
		DFC1	DFC2	No Inner Zone Harvest	Np Activities	Type A & B Wetlands	Forested Wetland	Roads	IZH (Census)
Small Forest Landowners	# Compliant Rules	1	n/a	8	8	16	3	27.5	5
	# with Deviation	3	n/a	0	3	0	0	4.5	0
	% of Sample Compliant	25%	n/a	100%	74%	100%	100%	82%	100%
	Prescriptions Assessed	1	0	3	5	5	2	3	1
Industrial Landowners	# Compliant Rules	75	50	57	70	74	14	98	30
	# with Deviation	3	3	5	8	2	0	2.0	1
	% of Sample Compliant	96%	94%	92%	90%	97%	100%	98%	97%
	Prescriptions Assessed	19	13	21	30	24	12	11	6
All Landowners	# Compliant[1]	76	50	65	78	90	17	125.5	35
	# with Deviation[1]	6	3	5	11	2	0	6.5	1
	% of Sample Compliant	93%	94%	93%	88%	98%	100%	95%	97%
	Confidence Interval	(85,100)	(88,100)	(86,100)	(80,96)	(95,100)	n/a	(87,100)	n/a
	Prescriptions Assessed	20	13	24	35	29	14	14	7

Table 2: 2016-2017 Compliance with Forest Practices Rules for Riparian and Wetland Harvest Prescriptions

	Status of Compliance	Western Washington		Statewide						Eastern WA
		DFC1	DFC2	No Inner Zone Harvest	Np Activities	Ns Activities	Type A & B Wetlands	Forested Wetland	Roads	IZH (Census)
Small Forest Landowners	# Compliant Rules	4	n/a	13	6	0	19	6	27.5	12
	# with Deviation	3	n/a	1	3	0	1	0	4.5	2
	% of Sample Compliant	57%	n/a	93%	74%	0%	96%	100%	82%	86%
	Prescriptions Assessed	1	0	3	4	0	9	3	3	2
Industrial Landowners	# Compliant Rules	124	86	99	90	26	82	28	98	37
	# with Deviation	8	5	5	12	0	8	0	2.0	0
	% of Sample Compliant	94%	95%	95%	88%	100%	91%	100%	98%	100%
	Prescriptions Assessed	19	13	21	31	26	34	14	12	5
All Landowners	# Compliant[1]	128	86	112	96	31	101	34	125.5	49
	# with Deviation[1]	11	5	6	15	0	9	0	6.5	2
	% of Sample Compliant	92%	95%	95%	87%	100%	92%	100%	95%	96%
	Confidence Interval	(87,97)	(89,100)	(90,99)	(79,94)	n/a	(87,97)	n/a	(88,100)	n/a
	Prescriptions Assessed	20	13	24	35	31	43	17	15	7

Table 3. Comparison of 2016-2017 rule compliance and confidence intervals using the standard ratio estimate method applied in previous biennia compared to the current jackknife method.

	Western Washington		Statewide					
	DFC1	DFC2	No Inner Zone Harvest	Np Activities	Ns Activities	Type A & B Wetlands	Forested Wetland	Roads
Prescriptions Assessed	20	13	24	35	31	43	17	15
# Rules Compliant[1]	128	86	112	96	31	101	34	125.5
# Rules with Deviation[1]	11	5	6	15	0	9	0	6.50
Standard Ratio Compliance Estimate	92.086%	94.505%	94.915%	86.49%	100%	91.82%	100%	95.08%
90% Confidence Interval — Lower Bound	87.17%	89.00%	90.40%	78.84%	n/a	86.50%	n/a	88.30%
90% Confidence Interval — Upper Bound	97.00%	100%	99.43%	94.13%	n/a	97.14%	n/a	100%
Jackknife Compliance Estimate	92.093%	94.507%	94.913%	86.60%	100%	91.98%	100%	94.85%
90% Confidence Interval — Lower Bound	87.18%	89.00%	90.40%	78.95%	n/a	86.66%	n/a	87.51%
90% Confidence Interval — Upper Bound	97.01%	100%	99.43%	94.25%	n/a	97.30%	n/a	100%
Jackknife - Standard Ratio Compliance	0.0069%	0.0016%	-0.0025%	0.1100%	0%	0.1590%	0%	-0.2231%
Jackknife Half-width of CI - Standard Ratio Half-width of CI	0.0013%	0.0013%	0.0030%	0.0044%	n/a	-0.0034%	n/a	0.5652%

Table 4. Comparison of 2014-2015 rule compliance and confidence intervals using the standard ratio estimate method applied in previous biennia compared to the current jackknife method.

		Western Washington		Statewide					
		DFC1	DFC2	No Inner Zone Harvest	Np Activities	Ns Activities	Type A & B Wetlands	Forested Wetland	Roads
Prescriptions Assessed		20	14	25	35	35	35	23	13
# Rules Compliant		131	98	116	128	59	120	38	81.7
# Rules with Deviation		8	2	8	8	2	7	1	1.29
Standard Ratio Compliance Estimate		94.24%	98.00%	93.55%	94.118%	96.72%	94.49%	97.44%	98.44%
90% Confidence Interval	Lower Bound	91.01%	95.22%	87.46%	89.40%	92.04%	89.25%	92.21%	95.30%
	Upper Bound	97.48%	100%	99.64%	98.84%	100.00%	99.73%	100.00%	100.00%
Jackknife Compliance Estimate		94.25%	97.99%	93.54%	94.122%	96.77%	94.55%	97.49%	98.54%
90% Confidence Interval	Lower Bound	91.02%	95.21%	87.45%	89.38%	92.13%	89.24%	92.35%	95.49%
	Upper Bound	97.48%	100.0%	99.64%	98.86%	100.00%	99.85%	100.00%	100.00%
Jackknife - Standard Ratio Compliance		0.0029%	-0.0070%	-0.0053%	0.0046%	0.0443%	0.0575%	0.0555%	0.0997%
Jackknife Width of CI - Standard Ratio Width of CI		-0.0026%	0.0156%	0.0072%	0.0444%	-0.0980%	0.1330%	-0.1443%	-0.1868%

Table 5. Results of analysis of linear trend through time on rule compliance

	Estimate of Annual Change (% per year)	Unweighted Regression	Weighted Regression	90% Confidence Interval on Slope of Weighted Regression
DFC1	Estimate	0.80%	0.65%	(-0.078, 2.1)
	p-value	0.29	0.41	
DFC2	Estimate	0.76%	0.94%	(0.022,1.8)
	p-value	0.13	0.094	
NIZH	Estimate	0.50%	0.77%	(0.004,1.5)
	p-value	0.32	0.099	
Np	Estimate	-1.8%	-1.3%	(-5.0, 2.4)
	p-value	0.34	0.50	
Ns	Estimate	0.50%	0.55%	(0.004,1.1)
	p-value	0.15	0.102	
A&B Wetlands	Estimate	-1.0%	-0.49%	(-1.95, 0.96)
	p-value	0.08	0.54	
Forested Wetlands	Estimate	0.0%	0.0078%	(-0.87, 0.88)
	p-value	1.00	0.99	
Roads	Estimate	-0.19%	0.45%	(-0.39, 1.3)
	p-value	0.70	0.34	

Figure 1. Annual rule compliance for four prescriptions with weighted linear regression line overlaid. The point sizes reflect the relative weights given to each point in the regression based on variance differences among years.
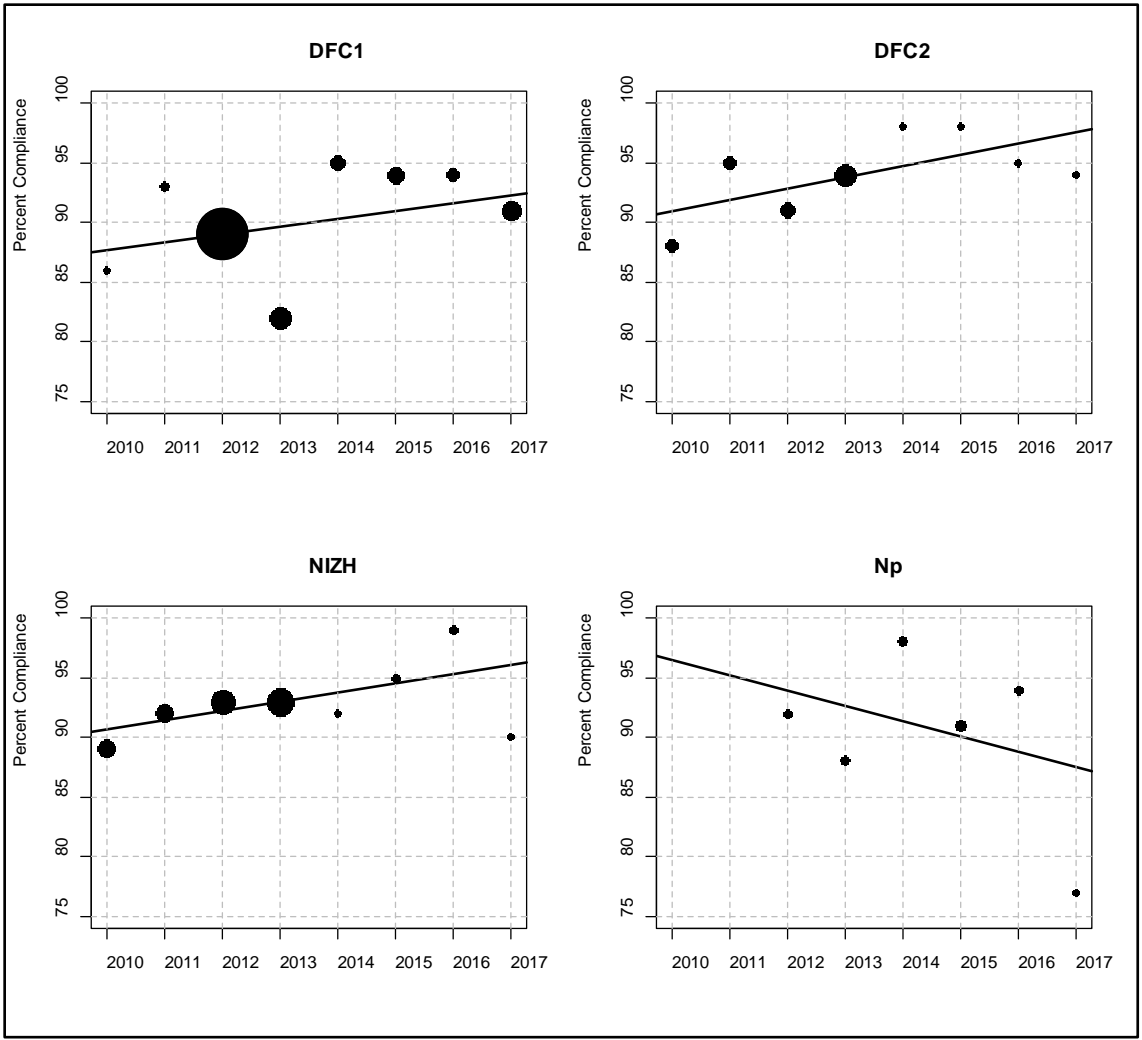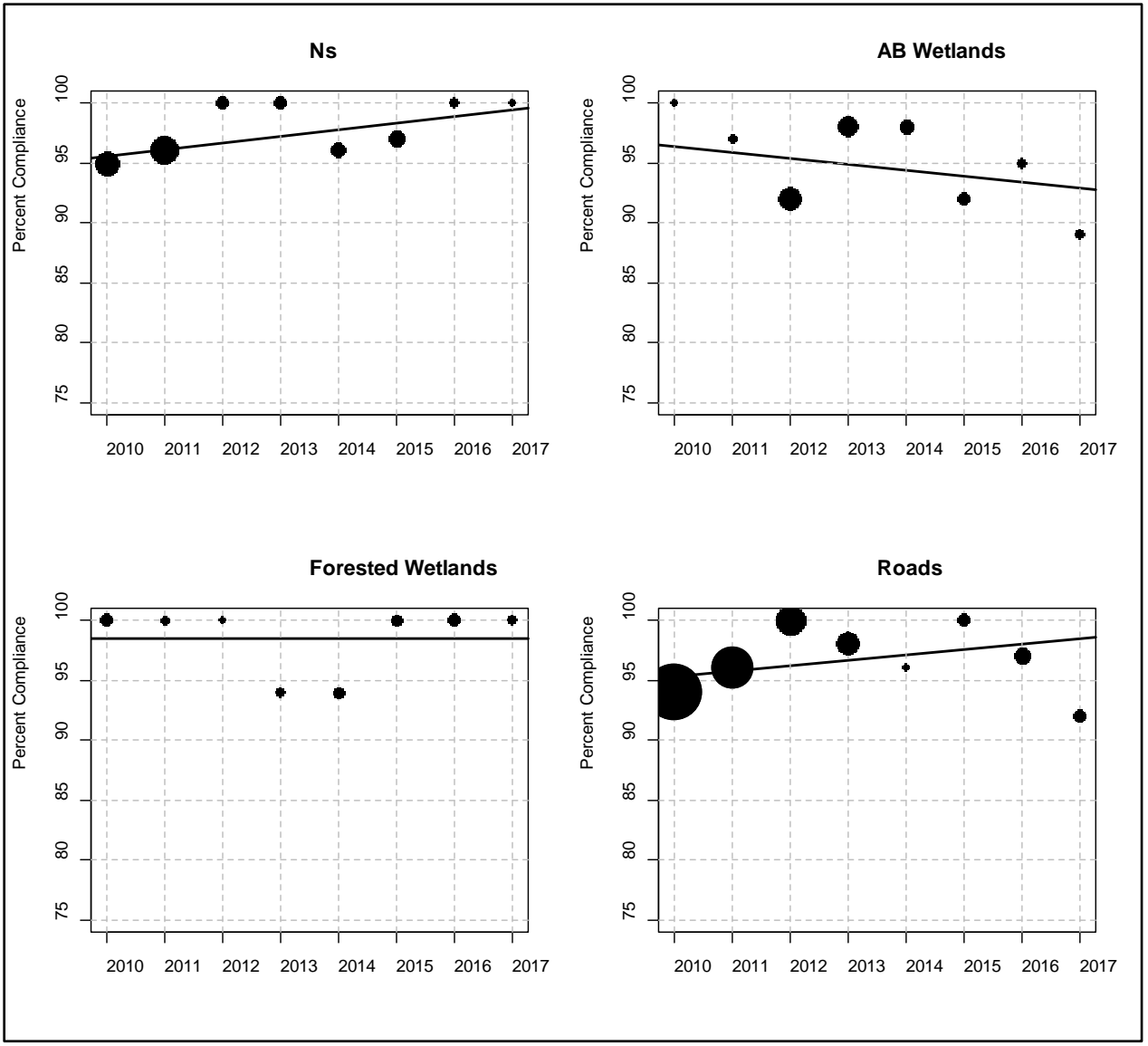
Figure 2. Annual rule compliance for four prescriptions with weighted linear regression line overlaid. The point sizes reflect the relative weights given to each point in the regression based on variance differences among years.

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18. References

Cochran WG. 1977. Sampling techniques. New York: John Wiley & Sons.

Cochran WG. 1963. Sampling techniques. 2nd ed. New York: John Wiley & Sons.

Efron B. 1987. Better bootstrap confidence intervals. Journal of the American Statistical Association 82(397):171–85.

Gregoire TG. 1984. The jackknife: an introduction with application in forest data analysis. Canadian Journal of Forest Research 14(4): 493-97.

Scheaffer RL, Mendenhall W, Ott L. 1990. Elementary survey sampling. 4th ed. Boston: PWS-Kent.

Zar JH. 1996. Biostatistical analysis. 3rd ed. Upper Saddle River New Jersey.

MEMORANDUM

October 26, 2018

TO: Forest Practices Board

FROM: Hans Berge, Adaptive Management Program Administrator

SUBJECT: Adaptive Management Program Quarterly Staff Report

This memo provides an update on important activities in the Adaptive Management Program since the last Board meeting in August 2018.

Budget
Following the end of fiscal year 2018, there was a positive variance of approximately $1.07M in the Forests and Fish Support Account for use in the Adaptive Management Program. As you may recall, the budget approved in May 2018 for fiscal year 2019 included an expectation that we would have an additional $722k in positive variance to spend on research projects. Given that expectation, and the actual expenditures, we have an additional $354k available for fiscal year 2019.

There are several projects that need additional funds in fiscal year 2019, including the Road Prescription-Scale Effectiveness Monitoring ($150k) for needs related to the Public Works process, Potential Habitat Break Study ($142k), the Forested Wetlands Effectiveness Study ($55k), the Wetlands Mapping Tool Validation ($25k) and the Type F Riparian Effectiveness Project ($50k). Policy will be discussing the allocation of available funds for fiscal year 2019 over the next several weeks, but for now the need exceeds the funds available by $68k.

Proposed Alternate Plan Template
The Policy subcommittee (workgroup) working on evaluating the proposed alternate plan template has made progress. The technical analysis of the scientific merit of the proposed alternate plan template is anticipated to be submitted to ISPR by the time of your November 14th meeting. While the review at ISPR is in process, the workgroup will continue to discuss how portions of the template may fit within the definitions in the WAC.

Type N Hard Rock Report
Policy continues to discuss different alternative recommendations for the Board following the results of the Type N Hard Rock study and subsequent findings report. The expectation is to have a recommendation for the Board at your February 2019 meeting.

MEMORANDUM

TO: Forest Practices Board

FROM: Garren Andrews, Compliance Monitoring Program Manager

SUBJECT: Current status of the Compliance Monitoring Program

2018 Compliance Monitoring standard sample field data collection completed October 2018.

2016/17 Compliance Monitoring biennial report writing complete. The biennial report was published September 2018.

If you have any questions please contact me at (360) 902-1366 or garren.andrews@dnr.wa.gov

GA/

October 4, 2018

TO: Forest Practices Board

FROM: Tami Miketa, Manager, Small Forest Landowner Office – Forest Practices

SUBJECT: Small Forest Landowner Office and Advisory Committee

Small Forest Landowner Office Advisory Committee
Since my last report, the Small Forest Landowner Office Advisory Committee held meetings on July 18 and September 19, 2018. Discussions focused on the following topics:

- Introduction of the new FREP Specialist, Brandon Austin
- Identify criteria for defining the term "relatively low impact on aquatic resources" regarding small forest landowner alternate management plans or alternate harvest restrictions.
- Update of SFLAC Action Plan

SFLO Program Updates
In the FY17-19 Biennium, with the $3.5 million allotted, staff in the Forestry Riparian Easement Program are working to purchase approximately 40 easements. With the $5 million allotted, staff in the Family Forest Fish Passage Program are working to correct a total of 38 fish barriers. With the $1 million allotted, the Rivers and Habitat Open Space Program will purchase two easements, one in a channel migration zone, and one in critical habitat for state threatened or endangered species.

Long Term Applications (LTA)
There are now a total of 264 approved long term applications, which is an increase of 5 approved applications since the end of the last reporting period (07/03/2018).

LTA Applications	LTA Phase 1	LTA Phase 2	TOTAL
Under Review	6	1	**7**
Approved	3	264	**267**
TOTAL	**9**	**265**	**274**

Upcoming Landowner Events

Ties To The Land Succession Planning
Ties To The Land Succession Planning, the human side of estate planning, focuses on ways to maintain family ties to the land from generation to generation, building awareness of key challenges facing family businesses, and motivating families to address those challenges.

- Ties to the Land, Succession Planning for Family Forest Owners – Spokane
  Friday, December 14, 2018

Other Landowner Events
- Forest Health and Wildfire Hazard Workshop and Hands-On Demonstration – White Salmon
  November 10, 2018

Forest Stewardship Coached Planning –
WSU's flagship class teaches landowners how to assess their trees, avoid insect and disease problems, attract wildlife, and take practical steps to keep their forest on track to provide enjoyment and even income for years to come. In this class landowners will develop their own Forest Stewardship Plan, which brings state recognition as a Stewardship Forest and eligibility for cost-share assistance, and may also qualify them for significant property tax reductions. For more information on these courses go to http://forestry.wsu.edu/

- Online Coached Planning Course
  Thursdays starting January 24th, 2019

For more information regarding these events go to
http://forestry.wsu.edu/

Please contact me at (360) 902-1415 or tamara.miketa@dnr.wa.gov if you have questions.
TM/

State of Washington
DEPARTMENT OF FISH AND WILDLIFE
Mailing Address: P.O. Box 43200, Olympia, WA 98504-3200 • (360) 902-2200 • TDD (360) 902-2207
Main Office Location: Natural Resources Building, 1111 Washington Street SE, Olympia, WA

November 14, 2018

M E M O R A N D U M

To: **Forest Practices Board**

From: **Gary Bell, Wildlife Biologist, Forest Habitats Section**

Subject: **Upland Wildlife Update**

The following provides a brief status update for ongoing or pending actions pertaining to priority wildlife species in forested habitats:

Marbled Murrelet
1992:   Federally listed as Threatened
1993:   State listed as Threatened
1996:   Federal critical habitat designated by USFWS
1997:   FPB enacted State Forest Practices Rules
2017:   State up-listed to Endangered

The up-listing of the marbled murrelet from state threatened to endangered became effective February 4, 2017. With an observed 4.4% annual population decline since 2001 the status of the marbled murrelet in Washington has not improved since state listing in 1993. WDNR, in consultation with WDFW, recommended that the Forest Practices Board (Board) support WDFW's initiation of a marbled murrelet rule assessment involving a diverse group of stakeholders, which was planned to be convened in early 2018. Due to several factors, initiation of the assessment was delayed. WDFW has since established a Marbled Murrelet Wildlife Working Group (WWG), which includes interested stakeholders, to evaluate rule effectiveness in protecting murrelet habitat, identify weaknesses in rule language and on-the-ground implementation, consider potential habitat conservation incentives, and bring consensus recommendations to the Board. The WWG held its initial meeting September 14, 2018. The WWG's 2nd meeting takes place October 30, 2018 (after due date for this memo), to continue work on a charter, develop a timeline for the assessment process, begin evaluating updated science on murrelets, and start reviewing rule content and language.

WDFW and partners are continuing to monitor murrelet populations on the water as part of the Northwest Forest Plan monitoring effort. During May-July of 2018, surveys were completed for the Puget Sound and Strait of Juan de Fuca (Zone 1), and new population estimates and trends are expected in the next couple of months. In addition, fall and winter surveys are being conducted in the Puget Sound region (now 5 years of data) as part of a Navy funded effort. Work is also underway to examine the diet of marbled murrelets during the non-breeding season, which involves capturing murrelets on the water, hopefully obtaining a fecal sample, and then using DNA sequencing techniques to reconstruct diet from the feces. Also of note,

the USFWS is in the process of producing a species status assessment for the distinct population segment in Washington, Oregon, and California.

Canada Lynx

1993:   State listed as Threatened
1994:   FPB enacted voluntary management approach
2000:   Federally listed as Threatened
2017:   State up-listed to Endangered

Up-listing of the lynx from state threatened to endangered became effective on February 4, 2017. In November 2017 USFWS published a proposed rule to remove lynx from the federal list of threatened and endangered species. Their species status assessment determined that regulatory improvements addressed the threat that led to the listing. Final rule to delist is expected November 2018. Despite reported status improvements in other portions of the US range, current information indicates that the historical distribution of lynx in Washington has contracted significantly and the only remaining resident lynx population is in Okanogan County. Threats to lynx include loss and fragmentation of habitat, small population size, and the potential effects of climate change. Most habitat changes have been due to large wildfires within the last 12 years. Based on estimates of available habitat, the population size is projected to be approximately 54 individuals. There are no indications that the conservation status of Washington's lynx population has improved since it was state listed.

At the time of the state up-listing, WDFW recommended to WDNR (and WDNR recommended to the Board) that no action be taken at this time to add Canada lynx to the forest practices rule designation for critical habitats (state). WDFW also recommended maintaining the voluntary protection approach for lynx while efforts are underway to evaluate existing protection mechanisms and identify the best conservation alternatives in collaboration with landowners, Canadian federal and provincial entities, US Fish & Wildlife Service, US Forest Service, conservation organizations, tribes and academic partners. The goal is to refine recovery actions that can be implemented in the near- and long-term to benefit lynx conservation.

In addition to screening forest practices, WDFW has coordinated with the USFS, USFWS and WDNR, and our conservation partners, to increase awareness and develop strategies that emphasize the heightened importance of protecting habitat in the face of wildfire threats that may affect lynx habitat. As a partner, WDFW has been actively participating in the *Transboundary Lynx Work Group*, which has been exploring additional conservation strategies including a feasibility assessment for translocating lynx into the Kettle Lynx Management Zone, and coordinating with southern British Columbia conservation partners concerning the importance of demographic support for Washington's transboundary lynx population.

Northern Spotted Owl

1988:   State listed as Endangered
1990:   Federally listed as Threatened
1996:   FPB enacted State Forest Practices Rules
2012:   USFWS designation of revised critical habitat
2016:   State retention of Endangered status

Recognized as a state endangered species, the Northern Spotted Owl population has continued to decline in recent years primarily due to ongoing competitive interactions with Barred Owls, as well as habitat changes from timber harvest and wildfires. The Northern Spotted Owl Implementation Team (NSOIT) continues working to develop a Safe Harbor Agreement (SHA) for forest landowners that will provide federal assurances while protecting existing habitat and recruiting new habitat. The group is also exploring other opportunities for landowner incentives.

Fisher

1998: State listed as Endangered
2016: Federal status: Final decision for west coast DPS - not warranted for listing (April 2016)
2018: Northern District Court of California ruling on 2017 USFWS fisher ESA listing withdrawal

The fisher, a member of the weasel family, continues to be re-introduced to Washington after disappearing from its forestlands during the last century. To date, WDFW and partners have successfully relocated 159 fishers from British Columbia to the Olympic National Park and other federal lands within the southern Cascade Mountains. Sixty-nine (69) fishers have been released at Mount Rainier National Park and the Gifford Pinchot National Forest since December 2015.

Unfortunately, due to extensive 2017 wildfires in British Columbia (BC) affecting habitat and the source population of fishers, BC decided they could no longer provide animals to Washington. This resulted in postponement of reintroductions into the Cascades during the winter of 2017/2018. WDFW and the National Park Service have subsequently developed a new partnership with the Calgary Zoo and Alberta Environment and Parks, Canada, to source fishers from Alberta for reintroduction into the north Cascades in the fall and winter of 2018-2019.

Combined with the Candidate Conservation Agreement with Assurances (CCAA) program administered by WDFW, the reintroductions are assisting the species return to the state. Non-federal landowners can continue to enroll in the CCAA and receive federal regulatory assurances in the event that the fisher becomes listed under the ESA in the future. By signing on to the CCAA, landowners agree to follow basic conservation measures that protect fishers that may use private lands. To date, 49 landowners and almost 3 million acres of non-federal forest lands are enrolled in the CCAA.

In September 2018, the Northern District Court for California ruled that the 2017 USFWS decision to withdraw their proposed rule to list fishers under the ESA was arbitrary and capricious. The result is that the fisher is once again a candidate for listing under ESA and USFWS is required to review their decision and publish findings by March 22, 2019.

Future Updates to the Board
The forest practices rules require that when a species is listed by the Washington Fish and Wildlife Commission and/or the U.S. Secretary of the Interior or Commerce, DNR consults with WDFW and makes a recommendation to the Forest Practices Board as to whether protection is needed under the Critical Habitat (State) rule (WAC 222-16-080). WDFW and DNR continue to coordinate to anticipate federal actions and to respond to changes in the status of any given species.

cc: Hannah Anderson (WDFW)
        Taylor Cotten (WDFW)
        Terra Rentz (WDFW)
        Chris Conklin (WDFW)
        Marc Engel (DNR)
        Sherri Felix (DNR)
        Joseph Shramek (DNR)

**DEPARTMENT OF
NATURAL RESOURCES**

Forest Practices Division
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Olympia, WA 98504

360-902-1400
WWW.DNR.WA.GOV

October 25, 2018

TO: Forest Practices Board

FROM: Marc Engel, Assistant Division Manager, Policy and Services
             Forest Practices

SUBJECT: 2019 Work Plan

At your November 14th meeting, I will present the staff recommended priorities for the Board's 2019
Work Plan (attached). The Work Plan incorporates TFW Policy Committee priorities,
recommendations from the Adaptive Management Program, and recommendations for rule making
and board manual development. The Work Plan also includes standing agenda items and/or tasks of
the Board. Upon your approval, this Work Plan will establish the Board's priorities for completion of
work by the Adaptive Management Program and Board staff in calendar year 2019.

The meeting dates for 2019 are February 13, May 8, August 14, and November 13, which occur on
the 2nd Wednesday of those months. It is anticipated a March/April field tour would occur to review
the potential habitat breaks in the field. Once these dates are scheduled, staff will notify the Office of
the Code Reviser for publication in the Washington State Register.

Also attached for your review is the work accomplished this past year.

Should you have any questions please feel free to contact me at 360-902-1309 or
marc.engel@dnr.wa.gov.

ME

FOREST PRACTICES BOARD
2019 DRAFT WORK PLAN

TASK	COMPLETION DATE/STATUS
Adaptive Management Program	
• Buffer/Shade Effectiveness Study (amphibian response)	February
• CMER Master Project Schedule Review*	May
• CMER Master Project Schedule Compliance Review*	August
• Hardwood Conversion Study	May
• TFW Policy Committee Progress Report on Unstable Slopes Recommendations from the Board approved Proposal Initiation	As needed
• Small Forest Landowner Western Washington Low Impact Template: TFW Policy Recommended Review Process & Timeline*****	May
• Hard Rock Study	February
• Extended Monitoring and Reporting*	February
Annual Reports	
• WAC 222-08-160 Continuing review of FP rules (Annual Evaluations), *by tradition the Board has received an annual evaluation of the implementation of cultural resources protections*	August
• Clean Water Act Assurances	August
• Compliance Monitoring 2016-2018 Biennial Report	August
• Northern Spotted Owl Conservation Advisory Group	August
• TFW Policy Committee Priorities*	August
• Western Gray Squirrel	May
Board Manual Development	
• Section 12 Forest Chemicals	November
• Section 23 (Part 1) Field Protocol to Locate Mapped Divisions Between Stream Types*	August
• Section 23 (Part 2) Perennial Stream Identification*	November
CMER Membership	As needed
Critical Habitat - State/federal species listings and critical habitat designations	As needed
Field Tour	March-April
Rule Making	
• Water Typing System – CR103	August
• Water Typing System – CR102	May
Committee Recommendations on AMP Efficiency & Improvements	On-going
Cultural Resources Recommendations from Facilitated Process (progress reports)	On-going
Quarterly Reports	
• Adaptive Management Program*	Each regular meeting
• Board Manual Development	Each regular meeting
• Compliance Monitoring	Each regular meeting
• Clean Water Act Assurances	February
• Legislative Activity	February & May
• NSO Implementation Team	Each regular meeting

Italics = proposed changes   *November 2018*
*= TFW Policy Committee

FOREST PRACTICES BOARD
2019 DRAFT WORK PLAN

TASK	COMPLETION DATE/STATUS
• Rule Making Activities	Each regular meeting
• Small Forest Landowner Advisory Committee & Office	Each regular meeting
• TFW Cultural Resources Roundtable	*To be determined*
• TFW Policy Committee Work Plan Accomplishments & Priorities*	Each regular meeting
• Upland Wildlife Working Group	Each regular meeting
Work Planning for 2020	November

FOREST PRACTICES BOARD
2018 WORK PLAN

TASK	COMPLETION DATE/STATUS
Adaptive Management Program	
• Buffer/Shade Effectiveness Study (amphibian response)	2019
• CMER Master Project Schedule Review*	May-COMPLETED
• CMER Master Project Schedule Compliance Review*	August
• Hardwood Conversion Study	2019
• PHB recommendation from science/technical experts	February-COMPLETED
• TFW Policy Committee Progress Report on Unstable Slopes Recommendations from the Board approved Proposal Initiation	As needed
• Small Forest Landowner Western Washington Low Impact Template: TFW Policy Recommended Review Process & Timeline*	May 2019
• TFW Policy subgroup & SFL Report on template alternatives and methodologies	February-COMPLETED
• Hard Rock Study	2019
• Validation Study Design Approval	November
• Validation Study Pilot	November
Annual Reports	
• WAC 222-08-160 Continuing review of FP rules (Annual Evaluations), *by tradition the Board has received an annual evaluation of the implementation of cultural resources protections*	August
• Clean Water Act Assurances	August-COMPLETED
• Compliance Monitoring 2014-2015 Biennial Report (w/ISPR Review)	May-COMPLETED
• Compliance Monitoring 2016-2017 Biennial Report	November
• Northern Spotted Owl Conservation Advisory Group	November
• Taylor's Checkerspot Butterfly Report	August-COMPLETED
• TFW Policy Committee Priorities*	August-COMPLETED
• Western Gray Squirrel	May-COMPLETED
Board Manual Development	Ongoing
CMER Membership	As needed
Critical Habitat - State/federal species listings and critical habitat designations	As needed
Field Tour	November
Forest Health and Wildfire Recommendations for Process & Timing	February-COMPLETED
Washington Geologic Survey Presentation	February-COMPLETED
Rule Making	
• Electronic FPA/N, Signature and Payment	February-COMPLETED
• Public Records Fee Schedule	February-COMPLETED
Committee on AMP Efficiency & Improvements	On-going
Cultural Resources Recommendations from Facilitated Process (progress reports)	On-going
Recommendation for 2019 Fish Use Survey Protocol	November

Italics = proposed changes
*= TFW Policy Committee

Updated August 2018

FOREST PRACTICES BOARD
2018 WORK PLAN

TASK	COMPLETION DATE/STATUS
Quarterly Reports	
• Adaptive Management Program*	Each regular meeting
• Board Manual Development	Each regular meeting
• Compliance Monitoring	Each regular meeting
• Clean Water Act Assurances	February
• Legislative Activity	February & May
• NSO Implementation Team	Each regular meeting
• Rule Making Activities	Each regular meeting
• Small Forest Landowner Advisory Committee & Office	Each regular meeting
• TFW Cultural Resources Roundtable	*To be determined*
• TFW Policy Committee Work Plan Accomplishments & Priorities*	Each regular meeting
• Upland Wildlife Working Group	Each regular meeting
Work Planning for 2019	November

Italics = proposed changes
*= TFW Policy Committee

Updated August 2018