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Washington Department of Natural Resources
Forest Practices Water Typing Criteria:

Synthetic Stream Development, Comparison of Alternatives, and Buffer Analysis

Methods Meeting

August 14, 2024

OVERVIEW

- Introduction: Background and Study Goals
- Methods
- Key Results
- Questions and Discussion

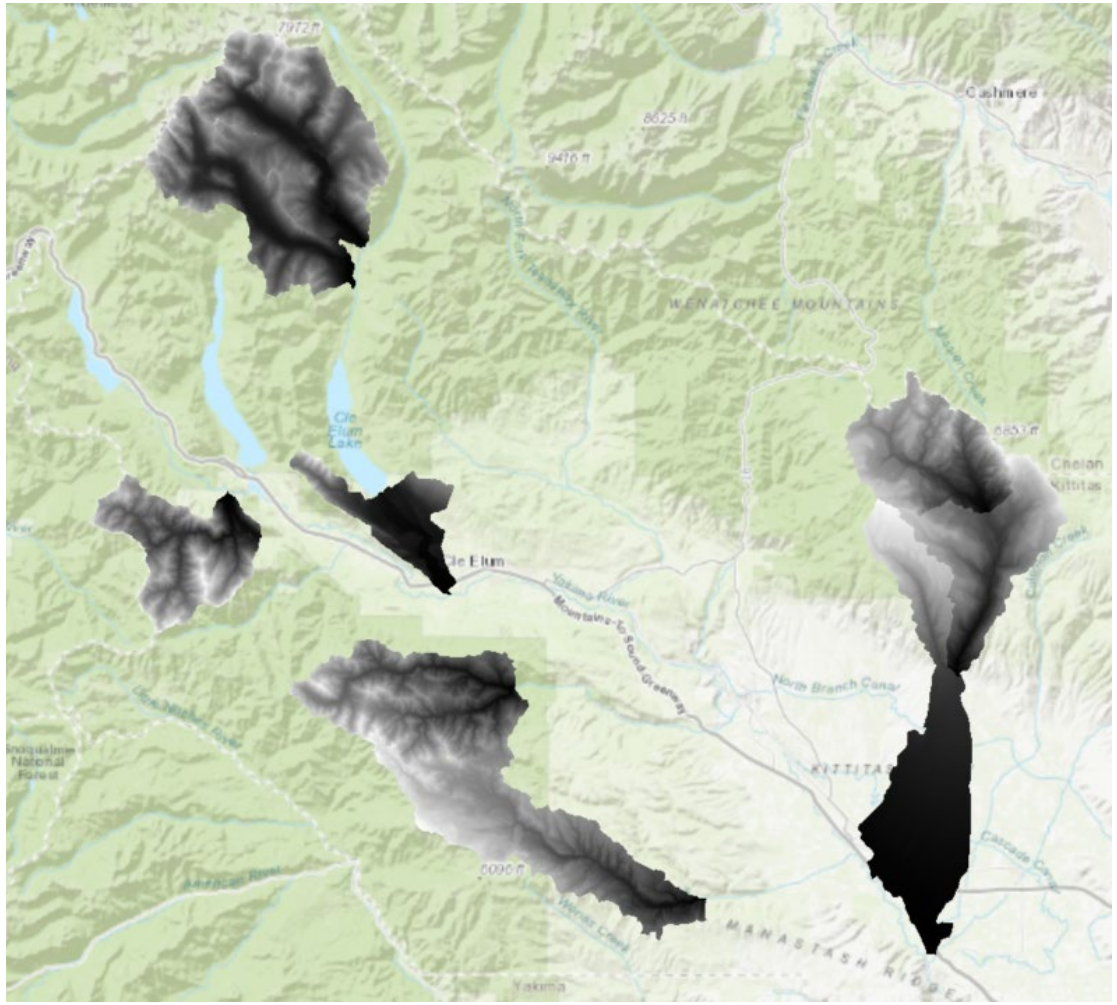
INTRODUCTION

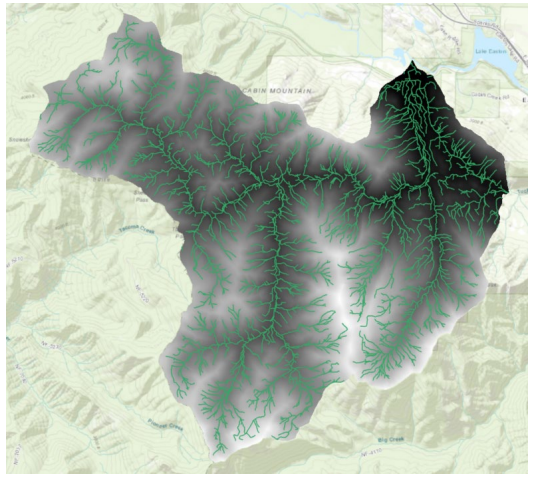
- Regulatory context
  - Permanent water typing system rule (“Water Typing Rule”) to replace interim rule
- Study goals and objectives
  - Build synthetic hydrographic stream networks
  - Identify key locations
    - DNR-concurred Fish/No Fish (F/N) Break
    - Observation of Last Fish (LF) during water typing field survey
    - Potential Habitat Breaks (PHBs): three options
    - Anadromous Fish Floor (AFF): two options
    - Default Physical Characteristics (DPC) of presumed Type 3 Waters
  - Calculate distance between key locations
  - Calculate change in Buffer Area and estimate associated change in Timber Volume

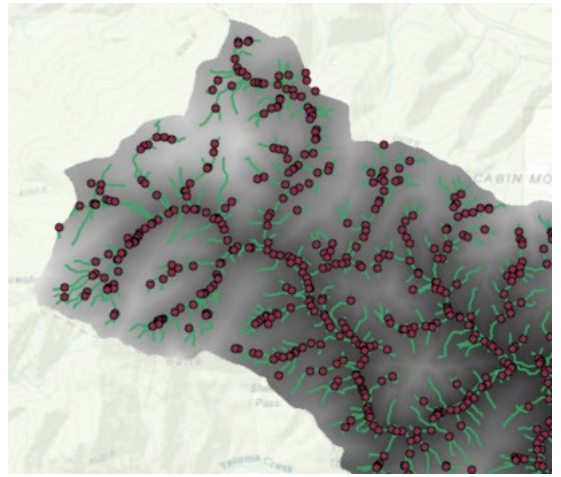
METHODS OVERVIEW

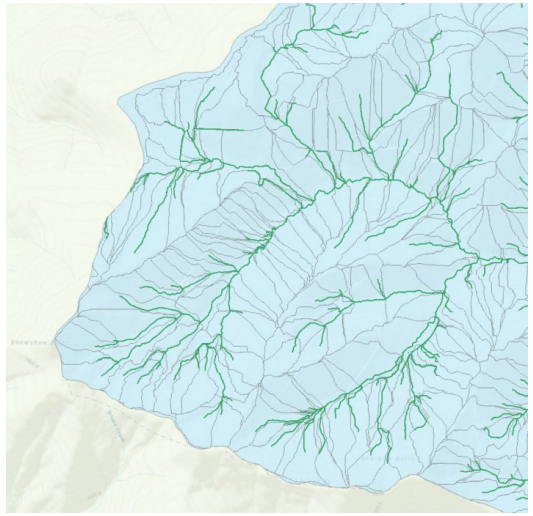
A. Create Synthetic Stream Networks (SSNs) using LiDAR-derived digital terrain models and Washington Department of Natural Resources (DNR)-provided concurred break and Last Fish datasets
B. Calculate PHB, AFF, and DPC locations and extents for each network
C. Compare the extents of waters in each network meeting the criteria for Type F (for each PHB option), AFF (for each option), and DPC
D. Compare the changes in riparian buffer acreage and timber volume for water type buffers around SSNs

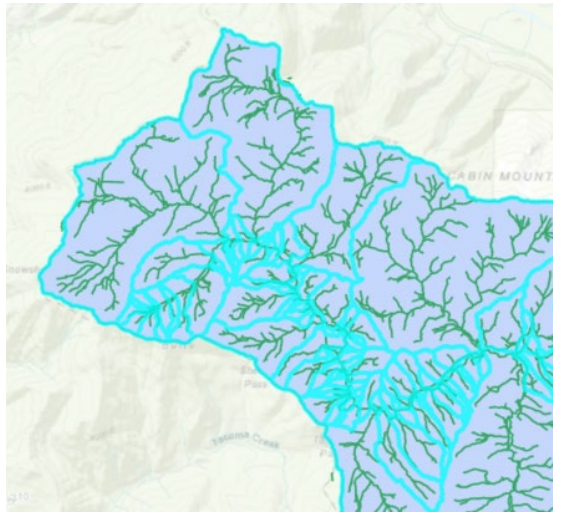
DOWNLOAD AND PROCESS RASTERS, CREATE STREAM LAYERS











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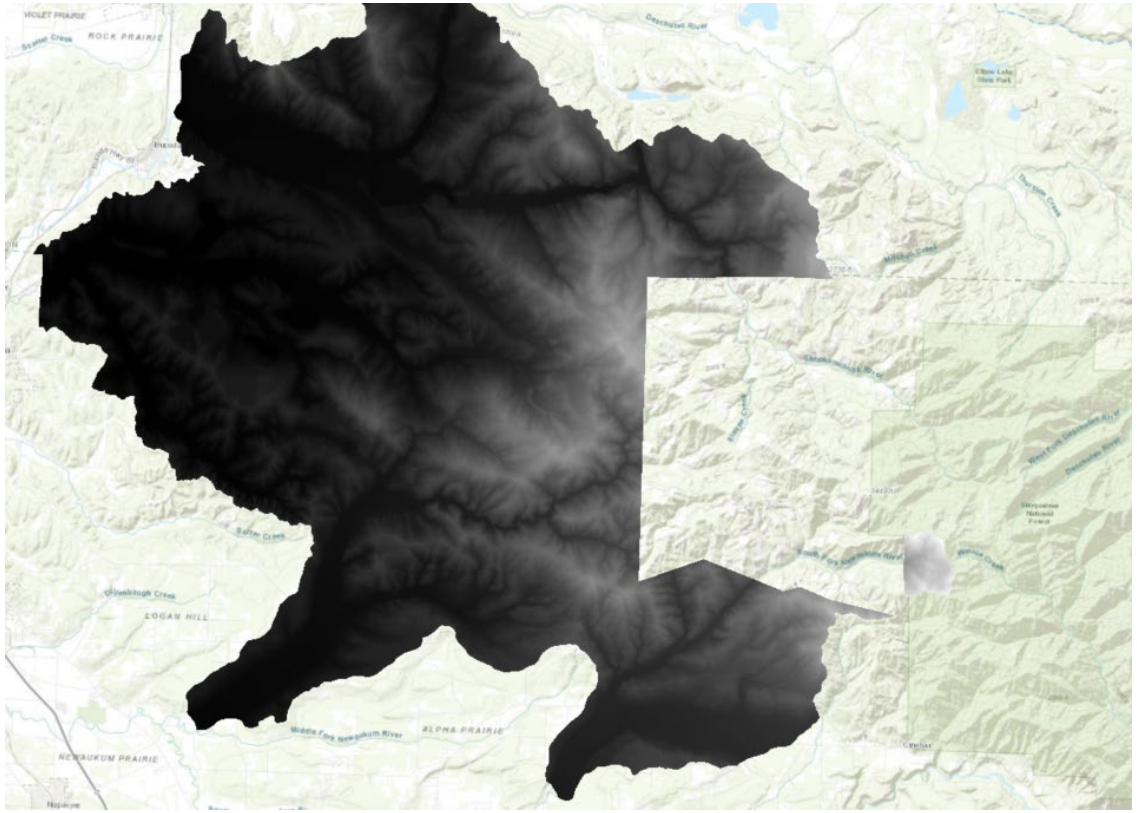
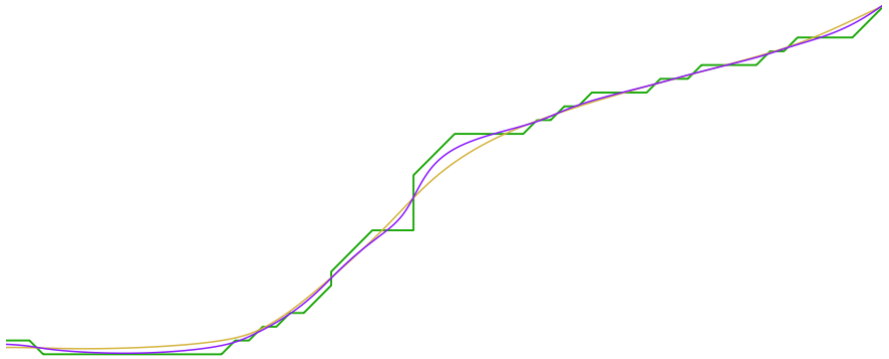
QUALITY ASSURANCE/ QUALITY CONTROL RAW STREAM LAYERS

Quality Assurance/Quality Control

- Raster gaps
- Streamline density vs. aerial, wchydro
- Roads or other diversions impacting F/N points

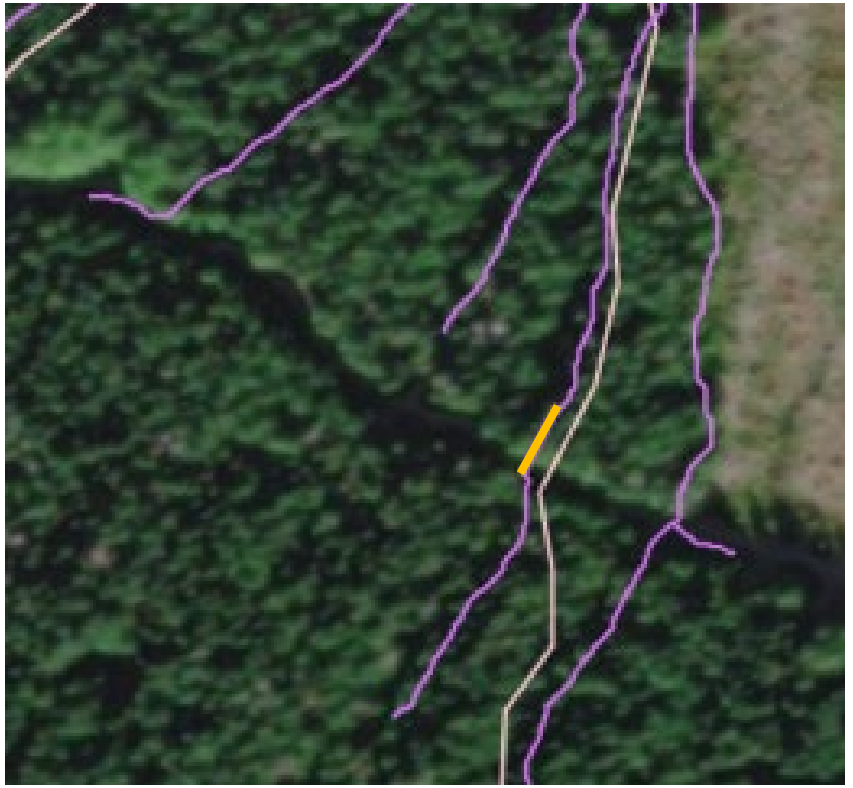


CREATE AND PROCESS SYNTHETIC STREAMS



QUALITY ASSURANCE/ QUALITY CONTROL

- Snapped F/N breaks to SSNs
- Stream formation thresholds
- Culverts



ADD ATTRIBUTES

- Basin statistics for each stream segment
  - Area, precipitation, canopy cover, etc.
- Segment statistics
  - F/N break
    - From DNR-concurred breakpoint
  - Anadromy
    - Presumed/documented anadromy from Statewide Washington Integrated Fish Distribution (SWIFD)
  - Perennial/seasonal
    - Perennial/seasonal data from wchydro
  - Bankfull Width (BFW)
    - Modeled using Beechie and Imaki (2014) formula

METHODS OVERVIEW

A. Create SSNs using LiDAR-derived digital terrain models and DNR-provided concurred break and Last Fish datasets

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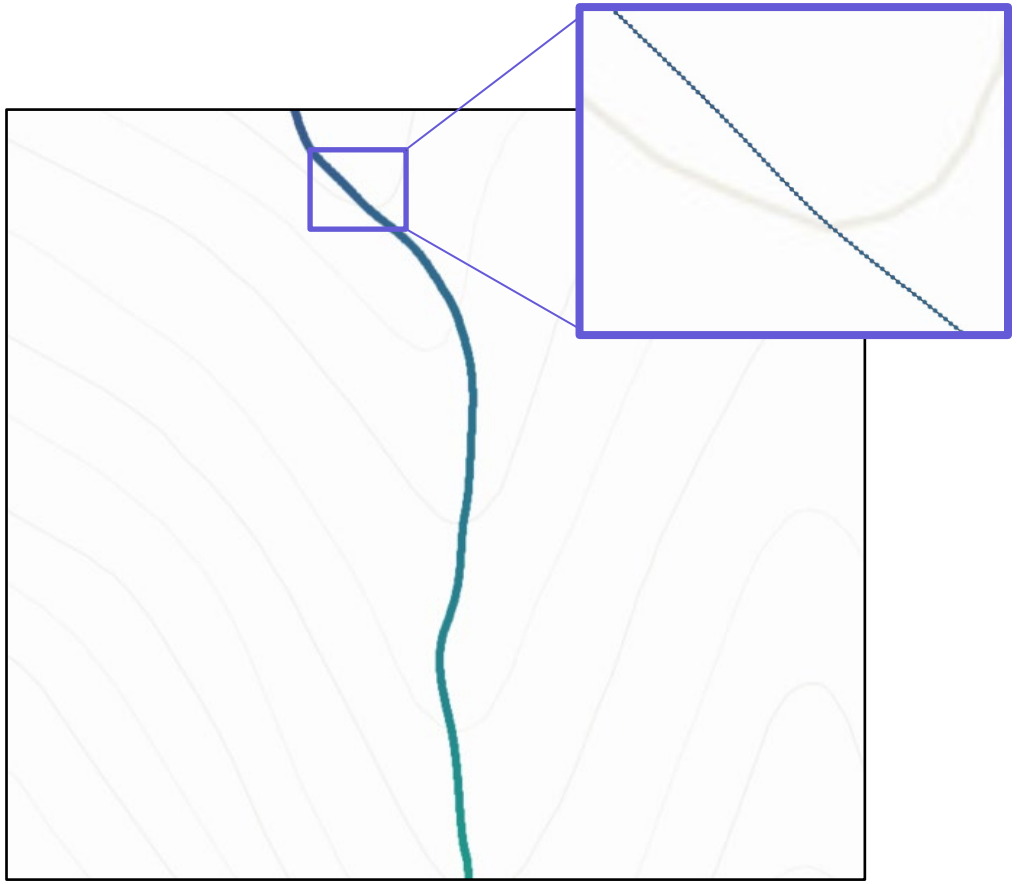
D. Compare the changes in riparian buffer acreage and timber volume for water type buffers around SSNs

METHODS: POINT DATASET

- Created points along streamlines at 1-foot intervals
- Combined segment-level attributes (SWIFD, seasonality, BFW) with point-level elevation data → high-resolution gradient information
- Calculated upstream gradients



METHODS: POTENTIAL HABITAT BREAK CRITERIA

Option	Regional Application	BFW or BFF	Gradient	Permanent Obstacle
A	W. Washington	≤2 ft*	↑≥5%*	Vertical: ≥BFW & ≥3 ft
B	Statewide	≤2 ft*	↑≥10%*	Vertical: ≥BFW & ≥3 ft Non-vertical: ≥20% & Δ elevation > US BFW
C	Statewide	↓ ≥20% flow†	↑≥5%	Vertical: ≥3 ft Non-vertical: ≥20% & Δ elevation > US BFW

Notes:

* As measured over a reach with length 5x BFW (20x BFW also calculated)
† As measured at the tributary junction
↓ Reduction
↑ Increase
Δ Change
US Upstream

Flow-based PHB exists where:

$$\frac{FLOW_{downstream} - FLOW_{upstream}}{FLOW_{downstream}} \geq 0.2$$

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DEFAULT PHYSICAL CHARACTERISTICS

State Side	BFW Threshold	Gradient Threshold
Eastern Washington	≥ 3 ft	≤ 16% (≤ 20% if basin > 175 acres)
Western Washington	≥ 2 ft	≤ 16% (≤ 20% if basin > 50 acres)

- Assessed point dataset for DPC
- Identified break points: the upstream-most point of a consecutive string of DPC locations

ANADROMOUS FISH FLOOR

Alternative	Criteria	Permanent Natural Barrier
A4 (7%)	Waters connected to saltwater or presumed/ documented anadromous fish use in SWIFD AND Below a sustained† channel gradient of 7% or a permanent natural barrier	~~Sustained† gradient of 20% for 100*, 250**, or 525*** ft~~ OR Near vertical drop ≥ 5*, 8**, or 12*** ft
D	Tributaries directly upstream of presumed/ observed anadromous fish use in GIS databases (i.e., SWIFD and StreamNet) WITHOUT A 5% gradient change or permanent natural barrier at the junction	A near-instantaneous vertical step ≥ BFW and ≥ 3 ft OR A step pool ≥ 20% gradient with elevation increase ≥ upstream BFW

Notes:

* BFW ≤ 5 ft

** BFW 5 to 10 ft

*** BFW > 10 ft

† Gradient must meet threshold for all 5 ft intervals within distance

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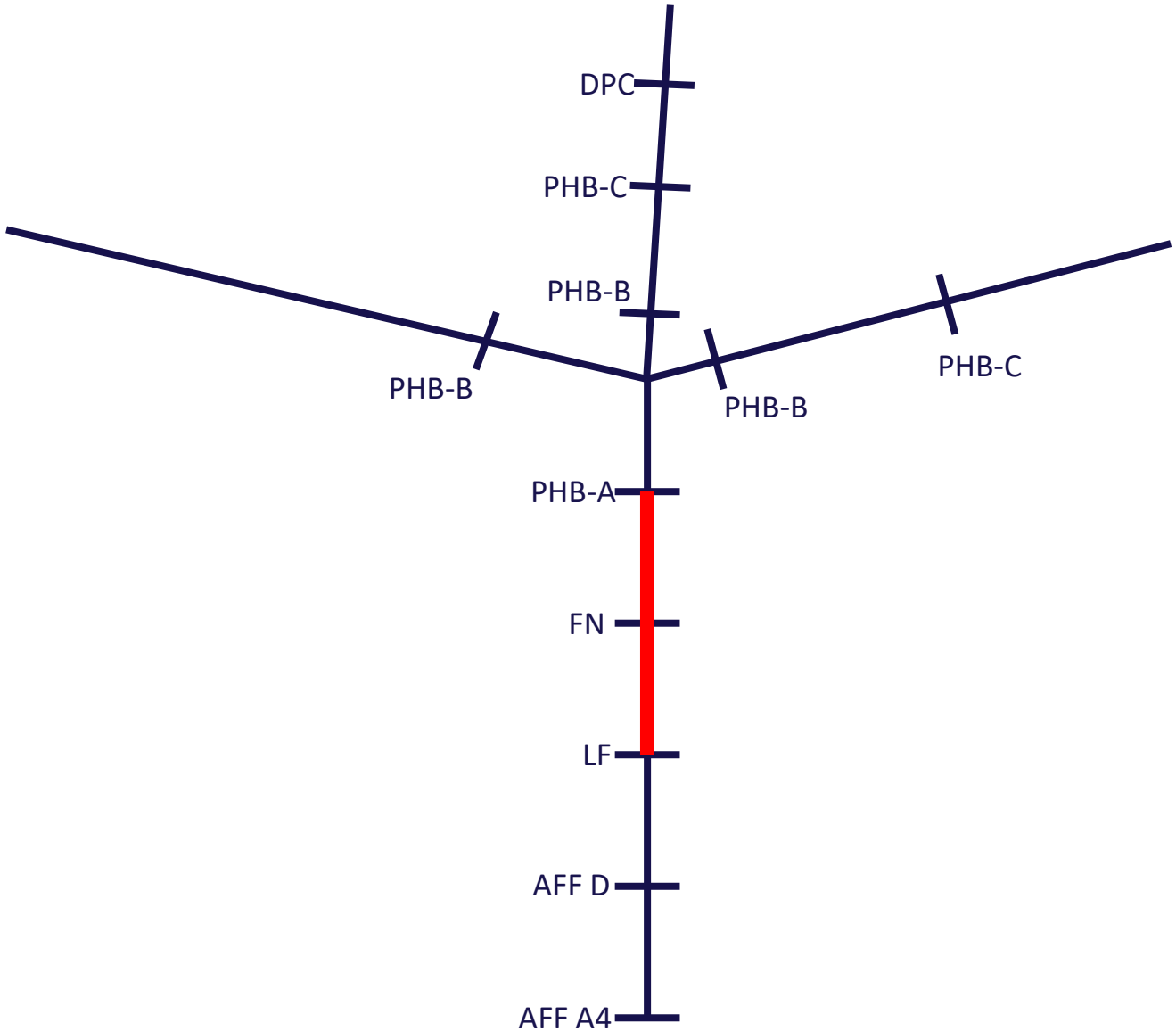
DISTANCE CALCULATION: LINEAR



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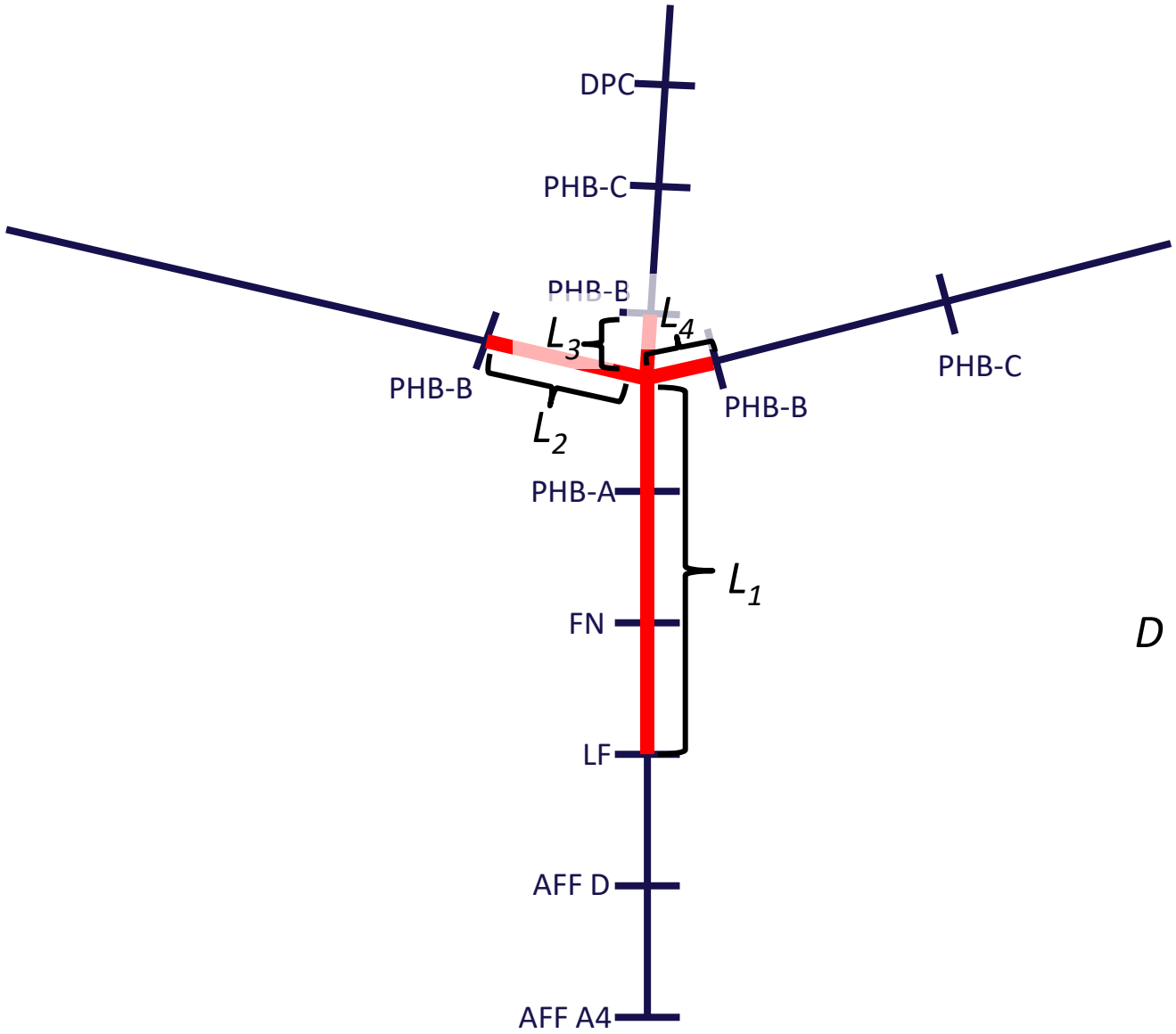
DISTANCE CALCULATION: MULTIPLE BRANCHES



$$D = L_1 + L_2 + L_3 + L_4$$

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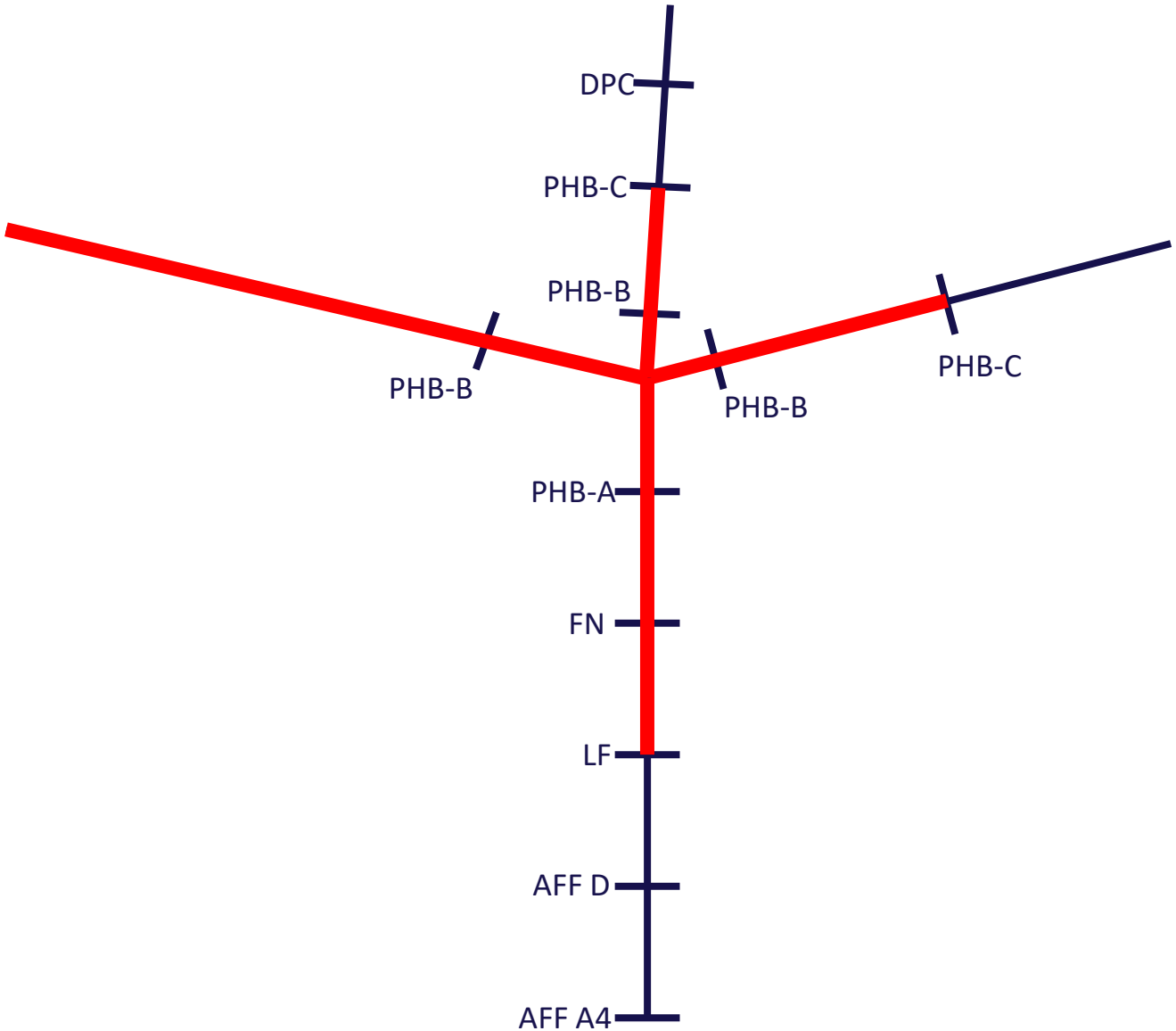
DISTANCE CALCULATION: MULTIPLE BRANCHES



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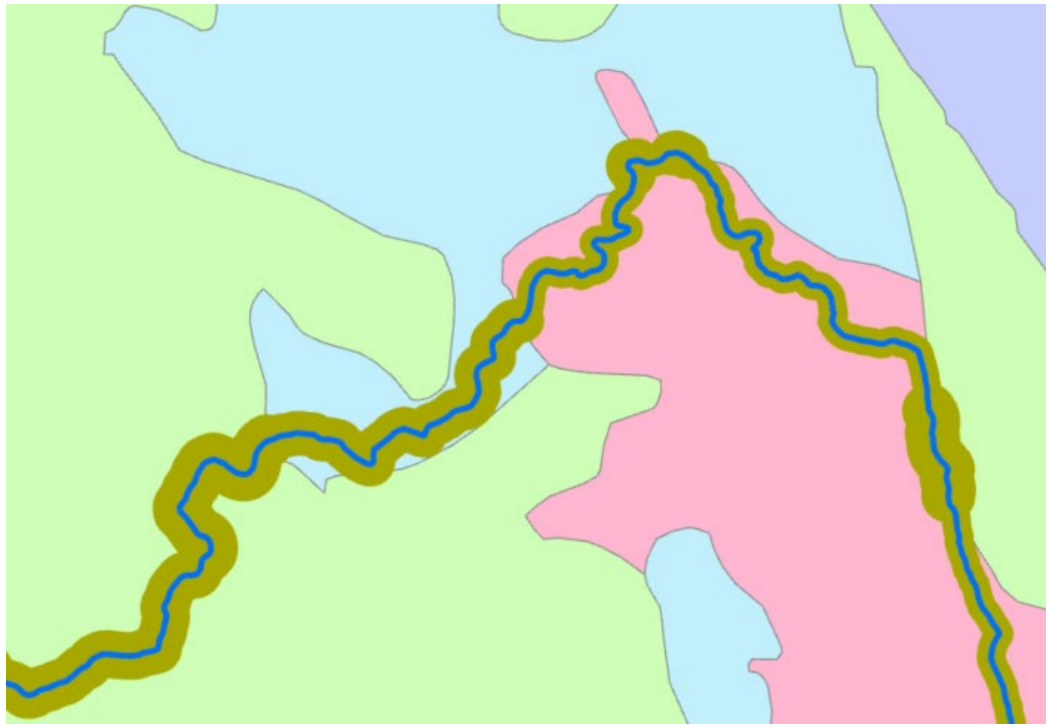
    a) Current Water Type Rule: Compare proposed PHB-based breaks with field-based concurred breaks for full riparian buffers (Type F and Type Np)

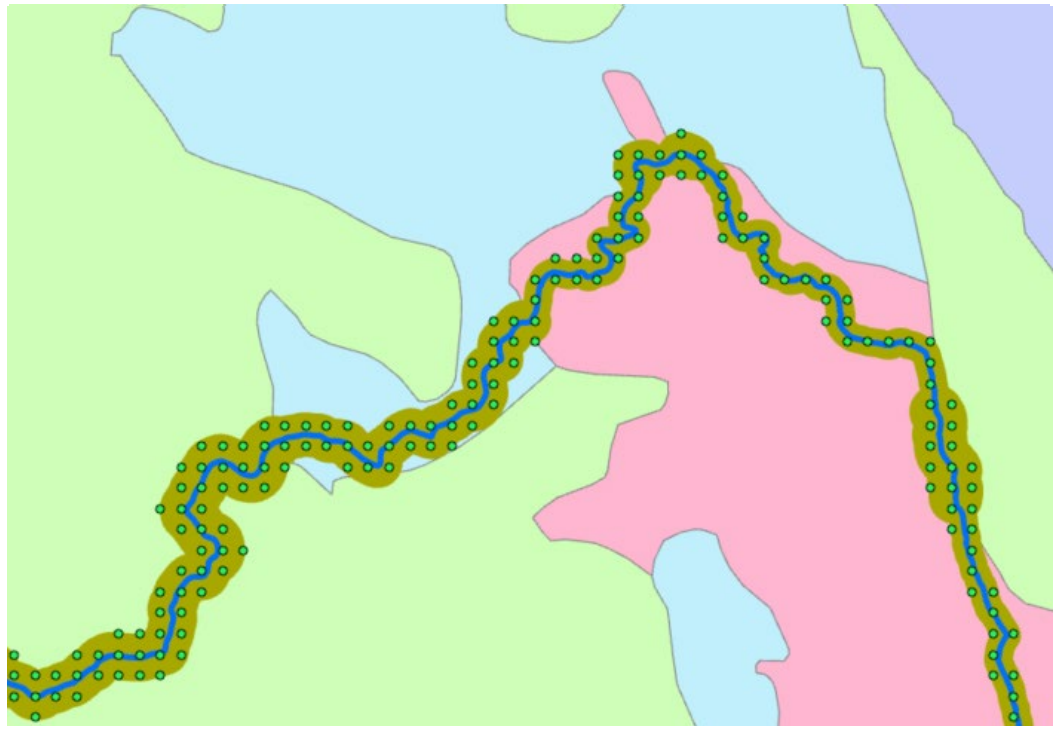
BUFFERS: CURRENT RULE, WATER BREAK COMPARISON



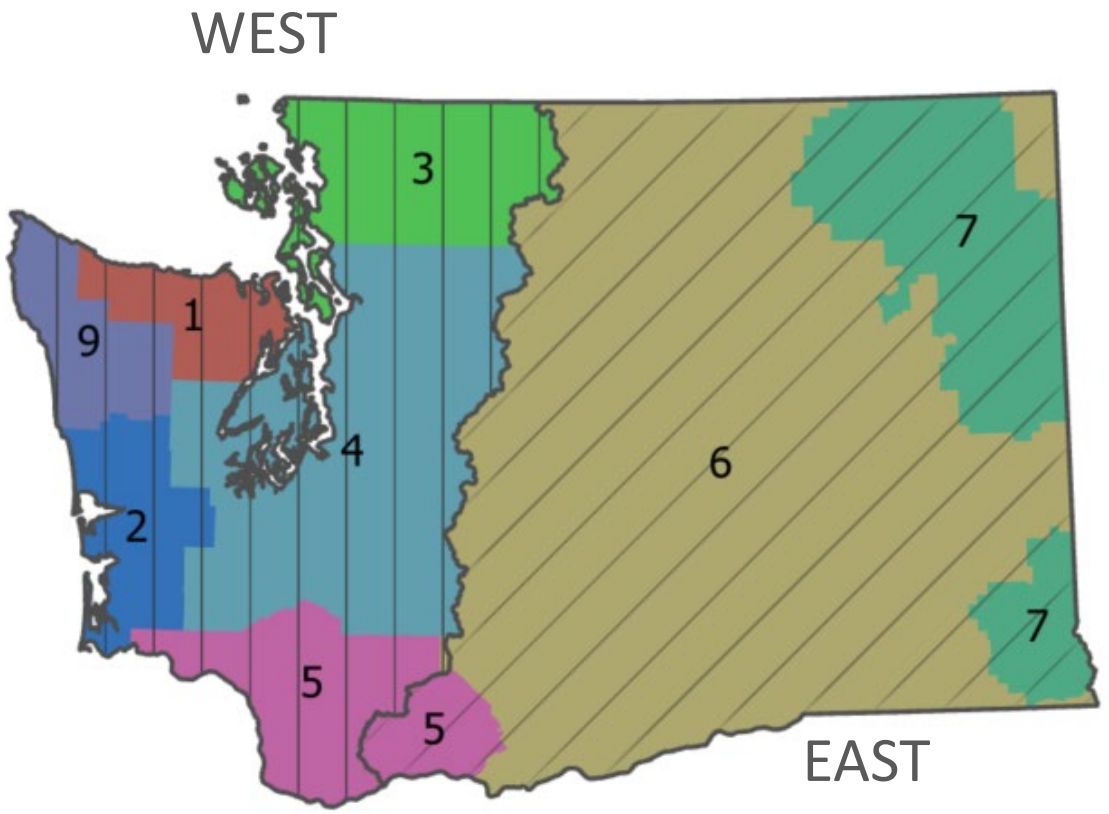
Type F Buffer Varied by Site Class (west side) and BFW

Type Np Buffer: 50-ft Buffer of 50% of Type Np Waters

BUFFERS: CURRENT RULE, WATER BREAK COMPARISON

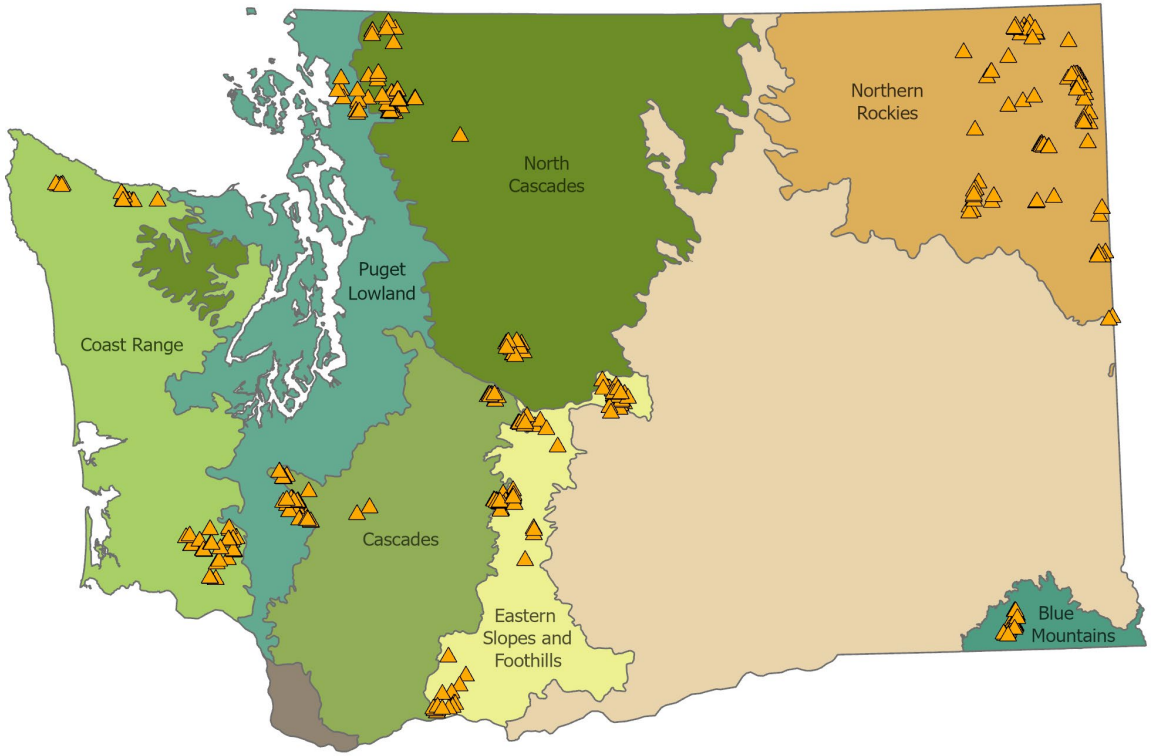


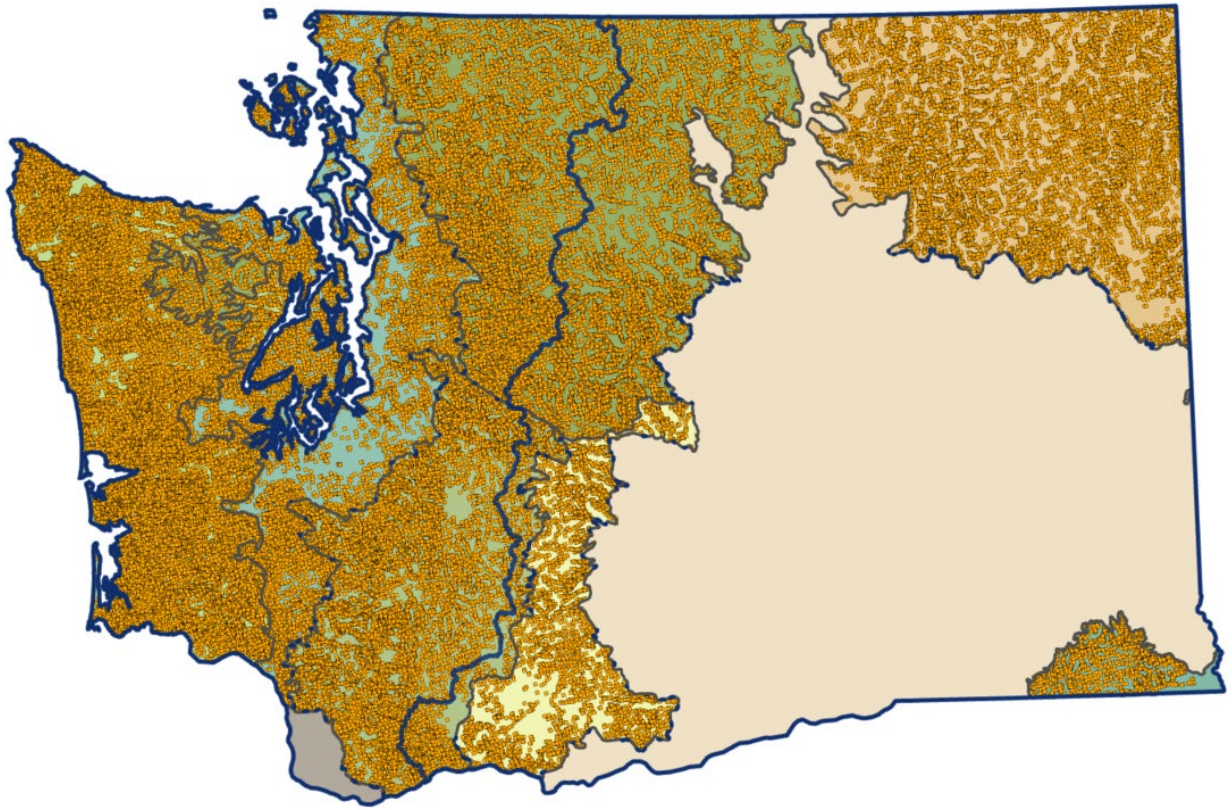
GNN Points Within Buffers



Stumpage Value Areas

ECOREGION AVERAGES AND N-WEIGHTED AVERAGES





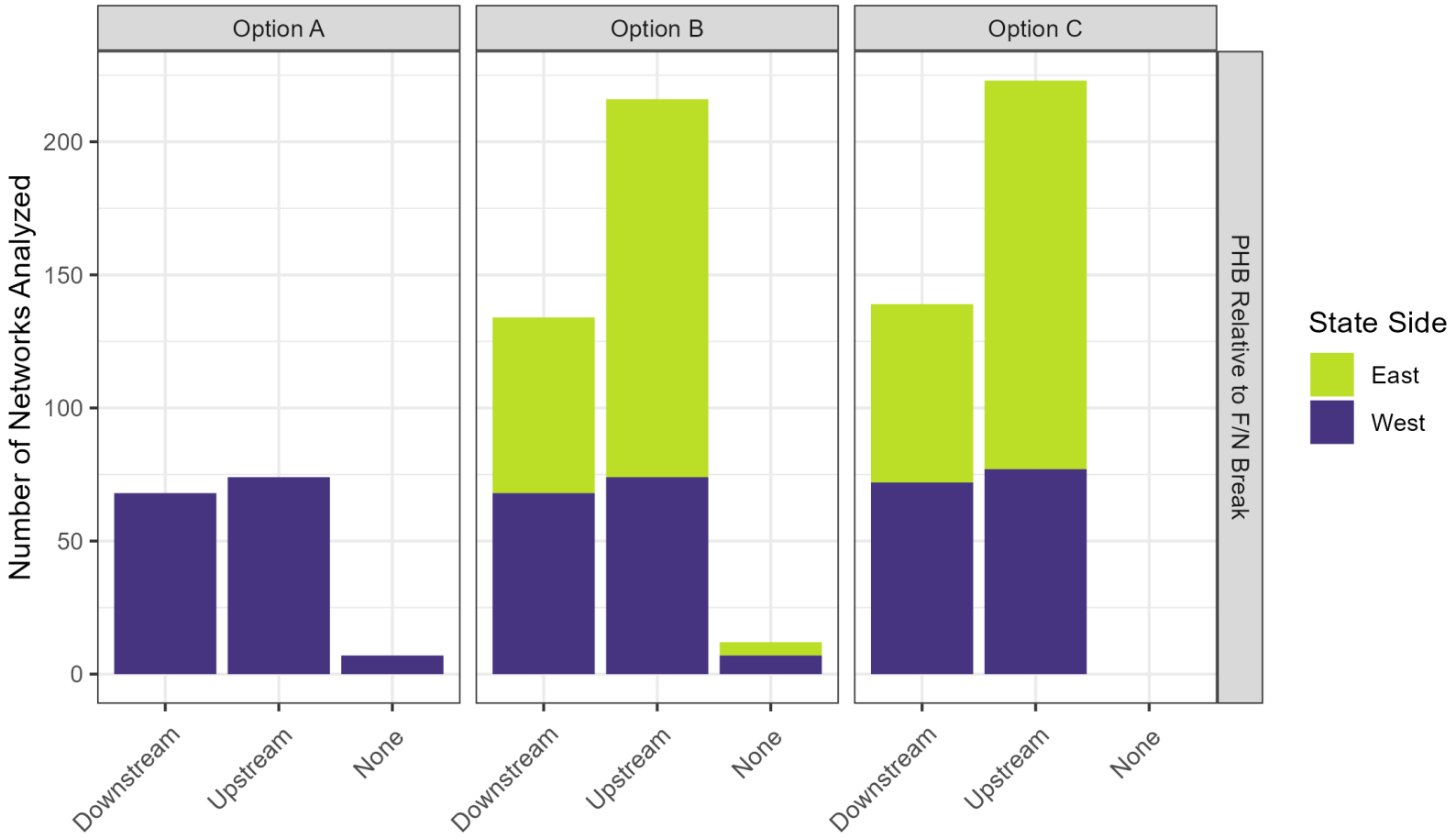
KNOWN DATA/ METHOD CAVEATS

- LiDAR: resolution, terrestrial (not water-penetrating)
- Manual editing needed to represent culverts through road berms
- Limited field verification for stream density, BFW, Bankfull Flow
- BFW model limitations: at the stream segment scale (one value between each junction)

RESULTS: OVERVIEW

- Comparisons of the relative location of
  - F/N break under existing Water Typing Rule,
  - Field observations of “last fish,”
  - Alternative PHBs under proposed Water Typing Rule options,
  - End of DPC, and
  - End of AFF
- Comparisons of the extent of
  - Type F waters under existing and proposed Water Typing Rule options,
  - Waters meeting DPC, and
  - Waters meeting alternative proposed AFF criteria
- Change in area of Type F and Type Np buffers
- Change in Volume of Timber contained within riparian buffers

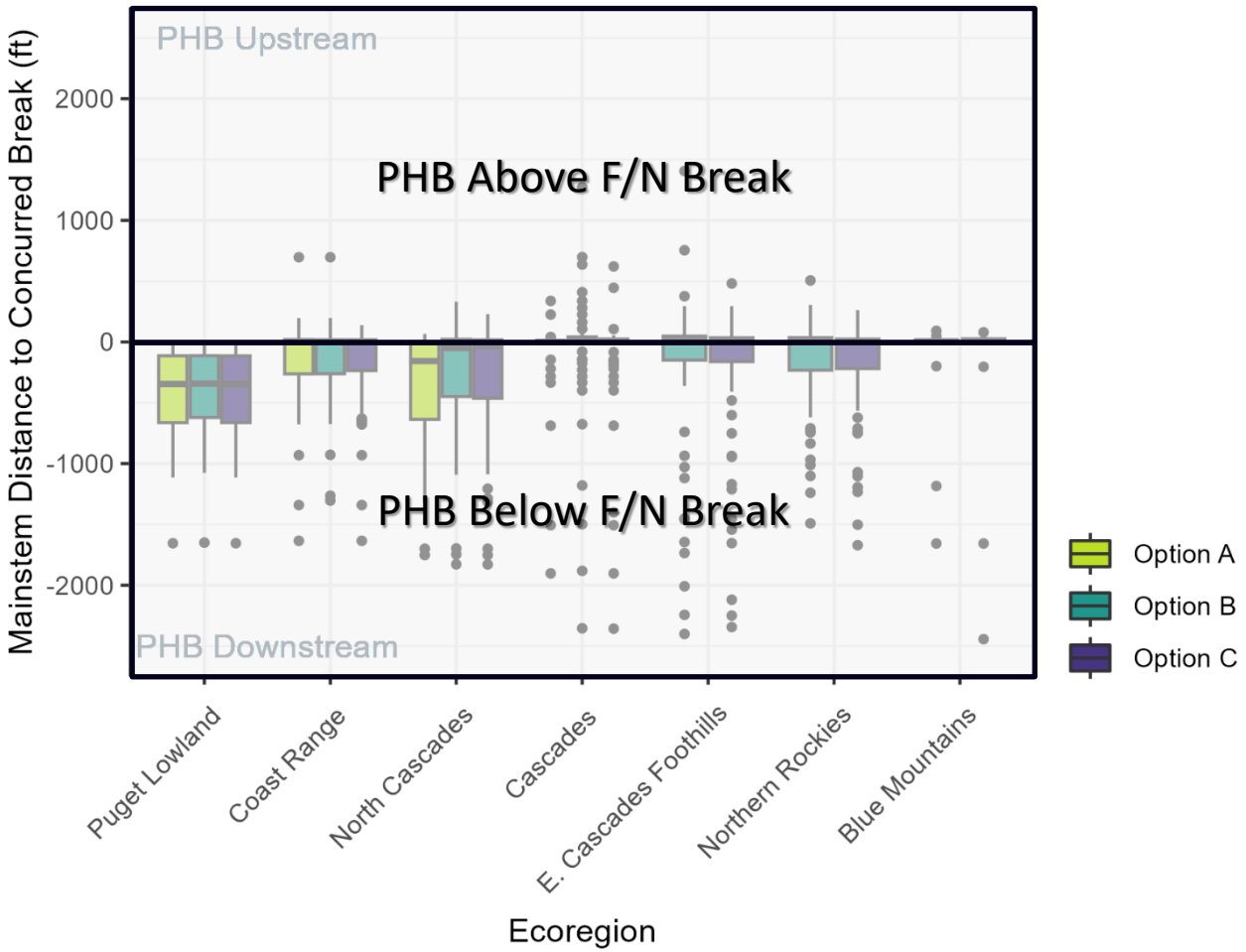
PHB COMPARED TO CONCURRED F/N BREAK



Number of networks in which the first PHB above last fish is downstream of or upstream of the DNR-concurred F/N break point

LOCATION OF PHB COMPARED TO F/N BREAK

- First PHB above last fish was generally tens to a few hundred feet below the concurred F/N break; in very few cases the first PHB was located above the DNR-concurred break
- In the field, this would simply be the next place to begin e-fishing
- For our analysis, we assumed this would be the end of fish under FHAM

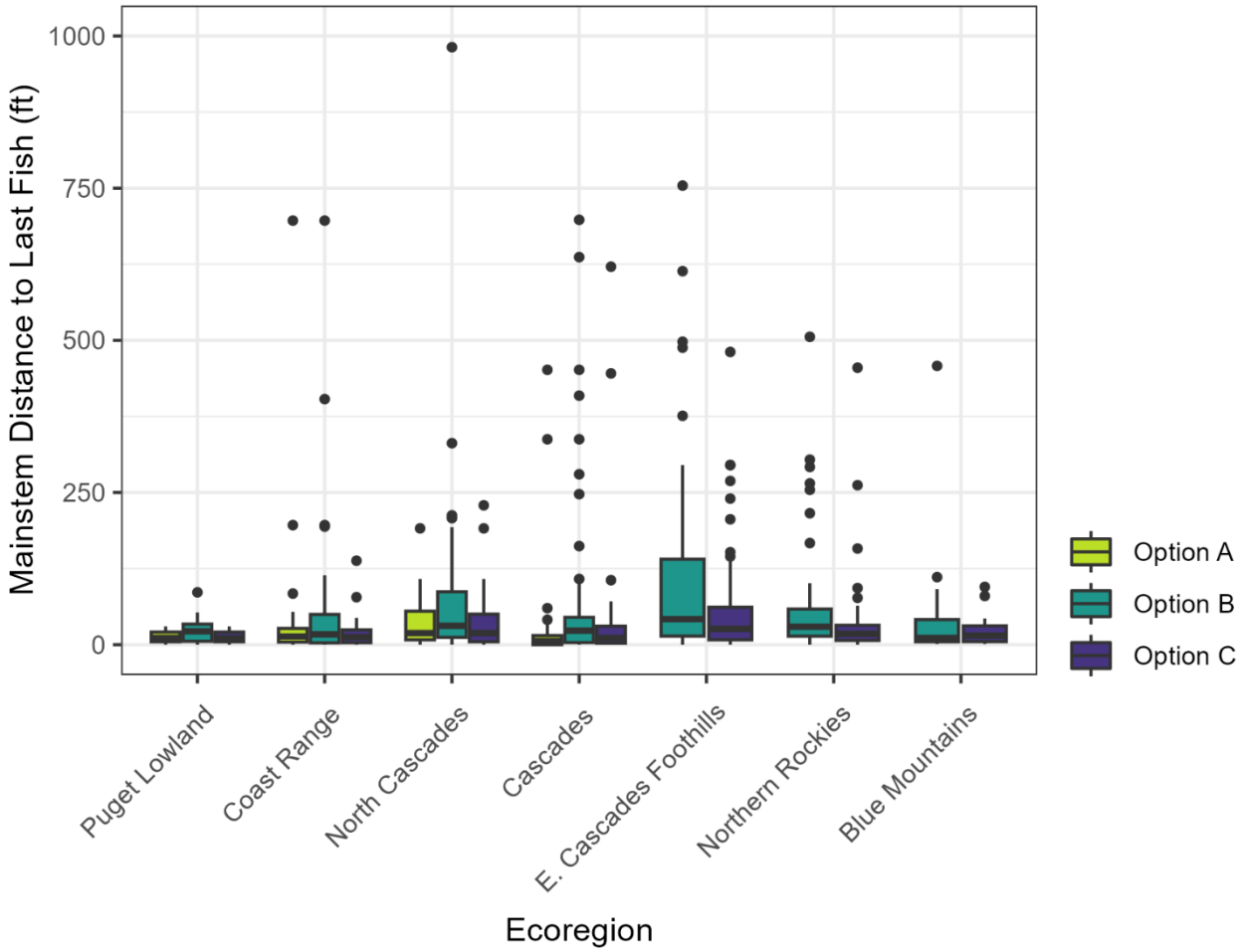


Distance between

- **the first PHB on the mainstem upstream of last fish and**
- **the DNR-concurred F/N break**

LOCATION OF PHB COMPARED TO LAST FISH

- First PHB above the last fish observed during a water typing survey (last fish) was generally less than 100 feet above the location of last fish In a very few cases, the first PHB above last fish was hundreds of feet above

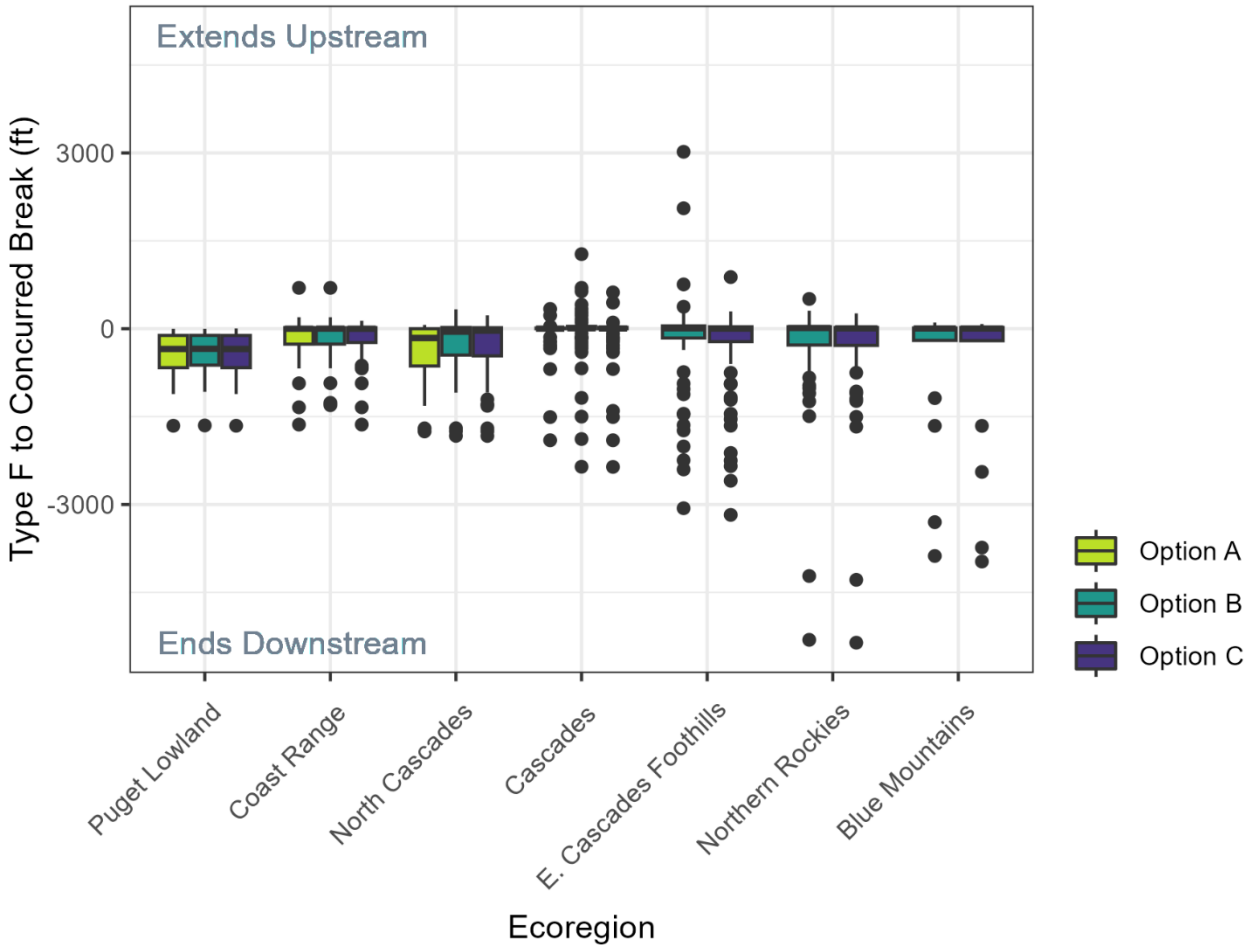


Distance between

- **the first PHB upstream of the last fish on the mainstem and**
- **the location of the last fish**

EXTENT OF TYPE F WATERS

- Nonetheless, the extent of Type F waters under FHAM was similar to that under existing rule, with a few notable exceptions



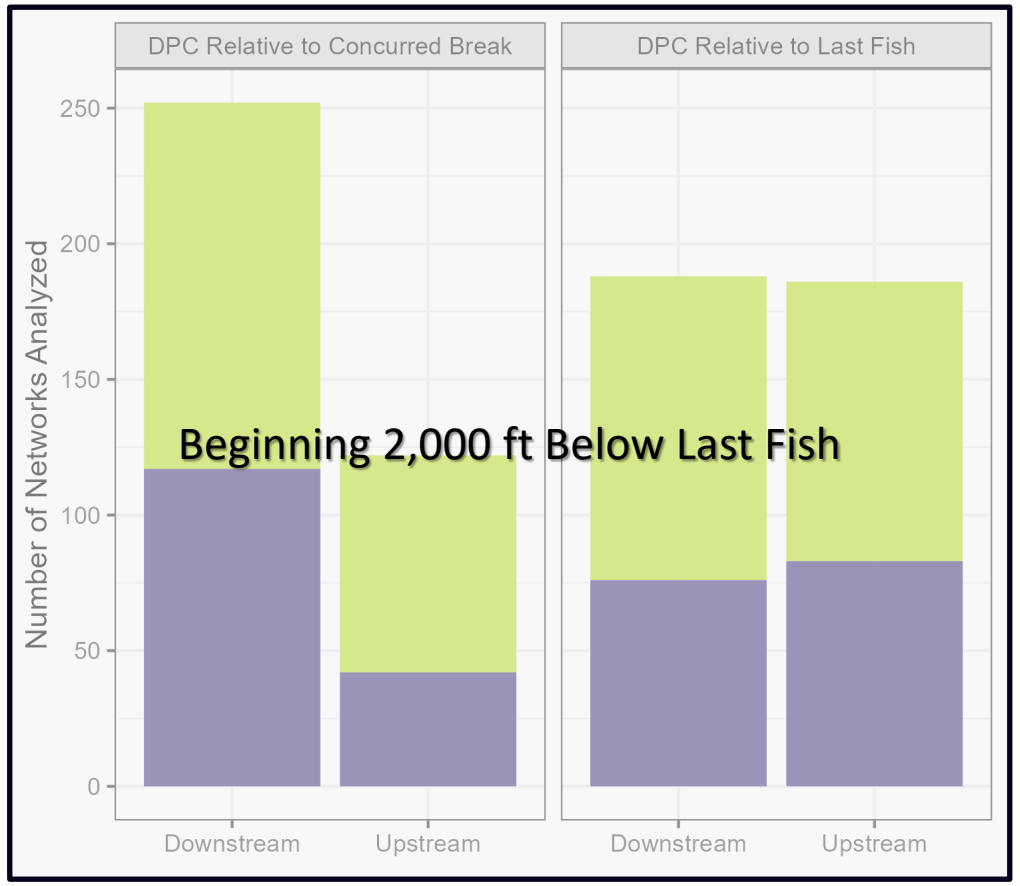
Total extent upstream of, or distance downstream to,

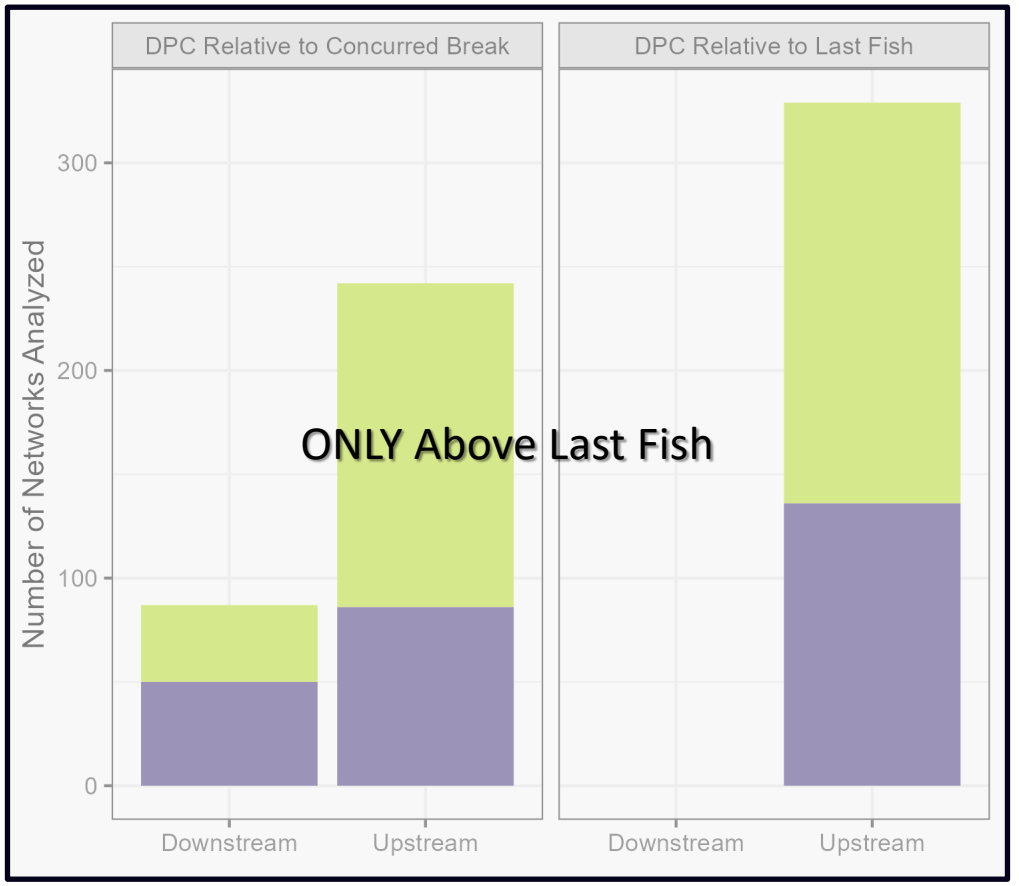
- **upper extent of Type F waters under FHAM**

from

- **DNR-concurred break**

FIRST BREAK IN WATERS MEETING DPC CRITERIA





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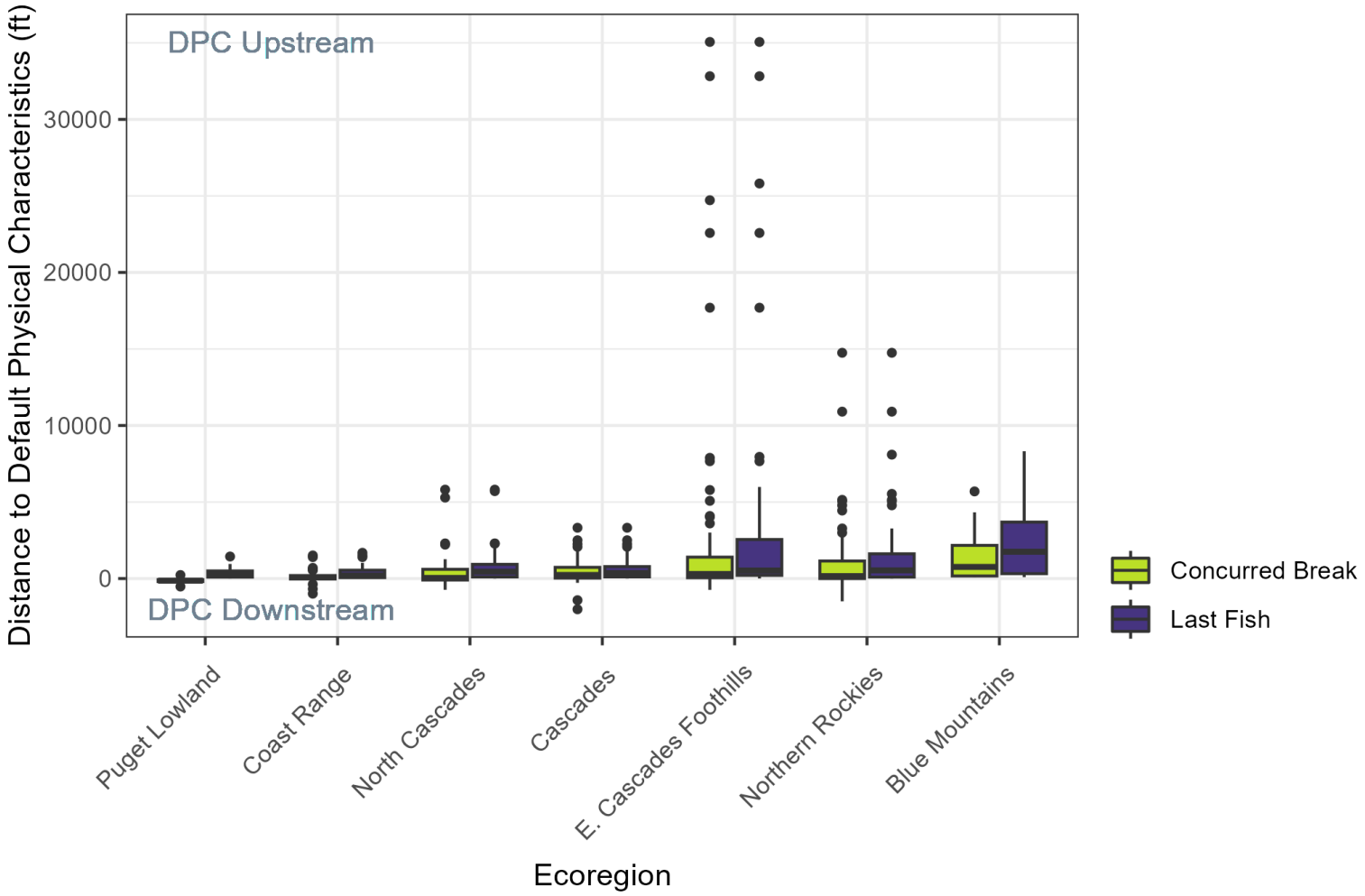
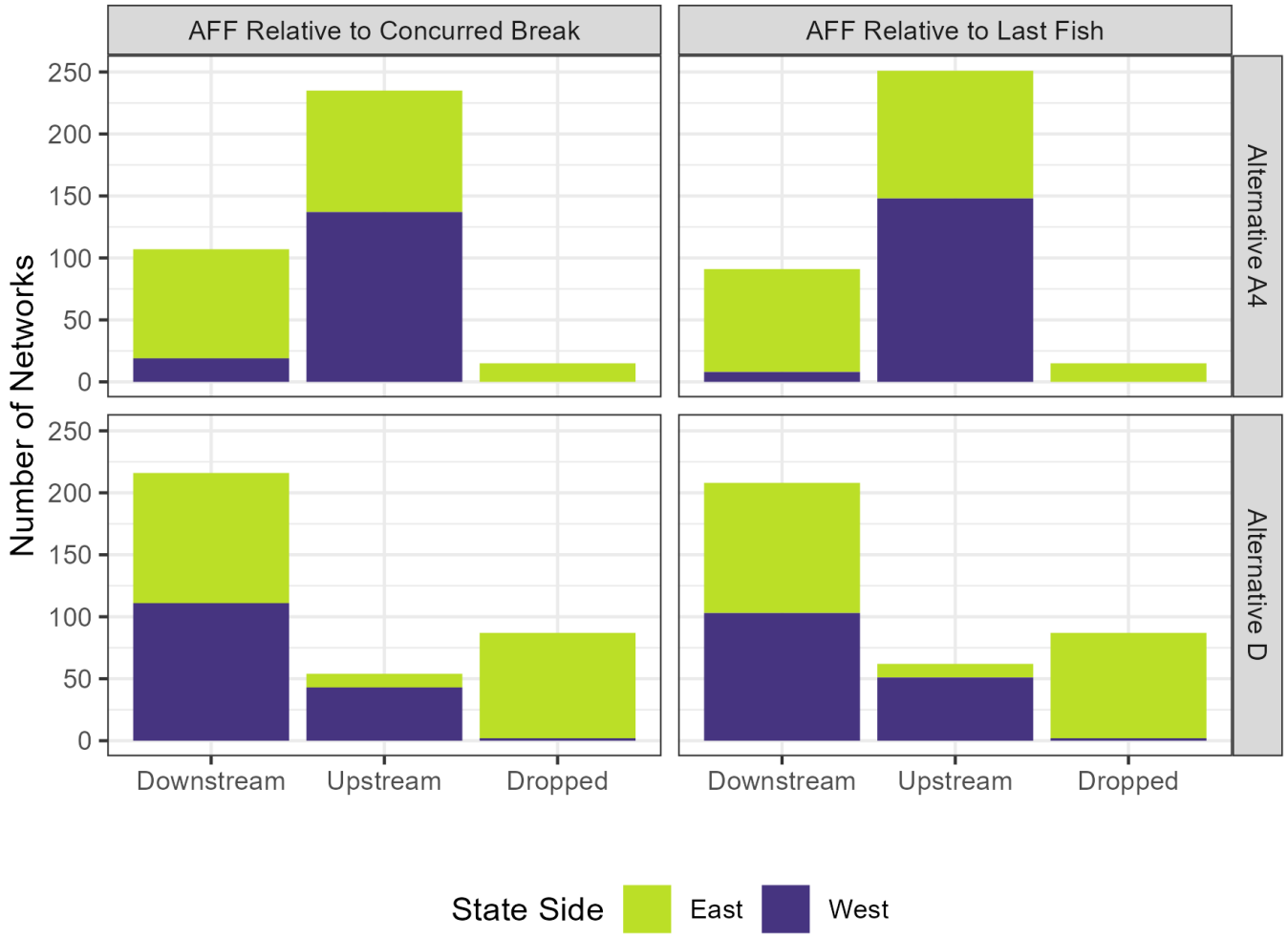
EXTENT OF WATERS BELOW FIRST DPC BREAK

- DPC generally extends above last fish and DNR-concurred F/N break
- DPC break is generally closer to F/N break than last fish

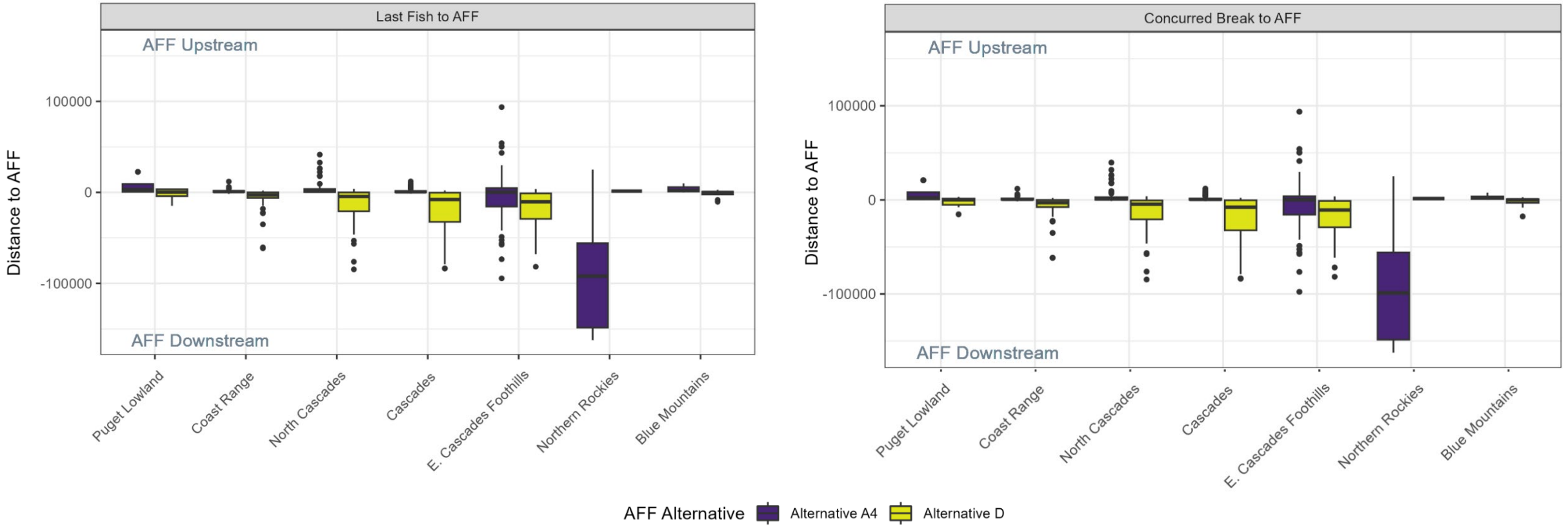


AFF EXTENT COMPARED TO CONCURRED F/N BREAK

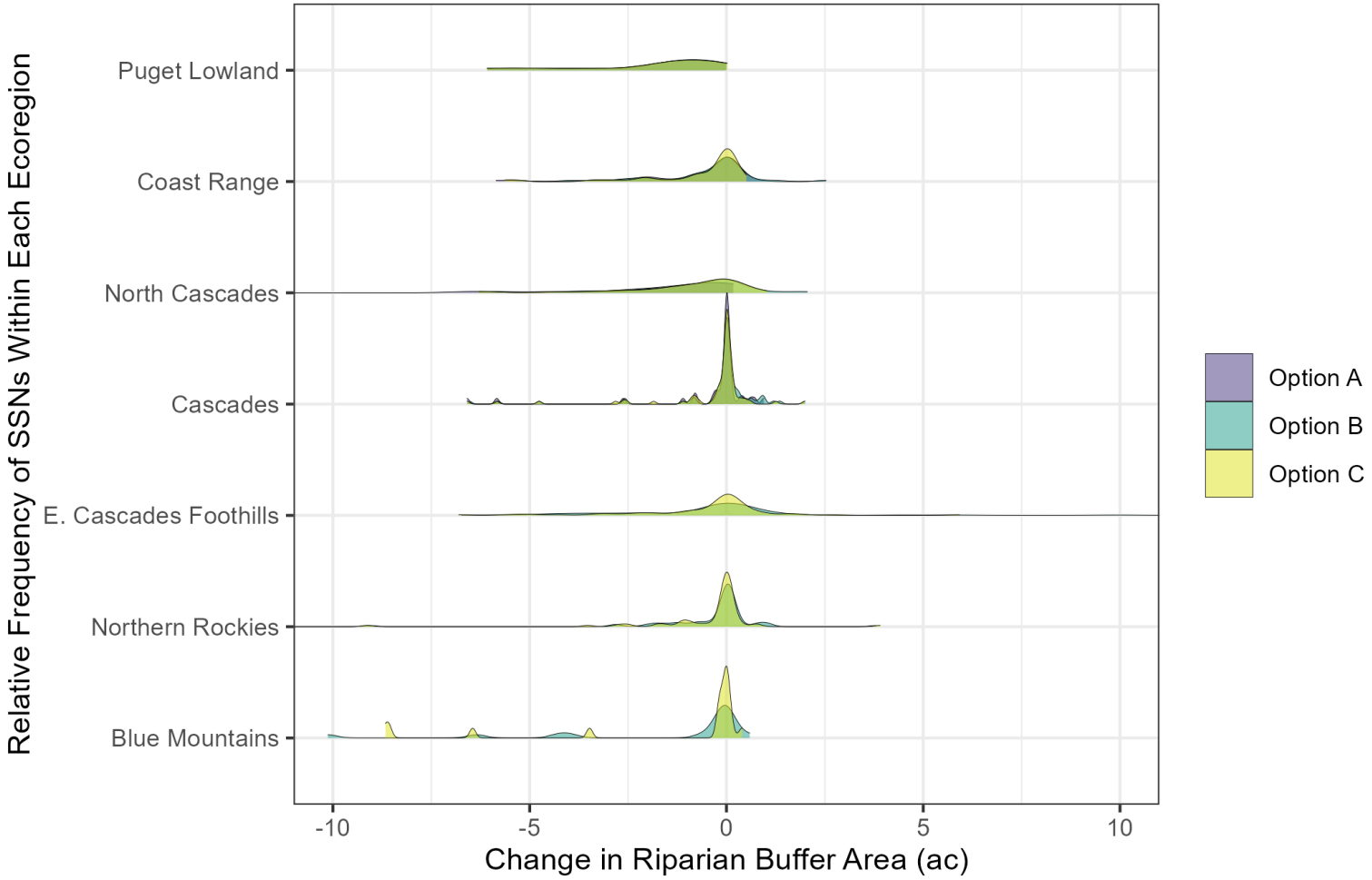


Number of networks in which AFF either ends downstream of or extends upstream above the last fish and DNR-concurred F/N break points

AFF EXTENT COMPARED TO LAST FISH AND F/ N BREAK

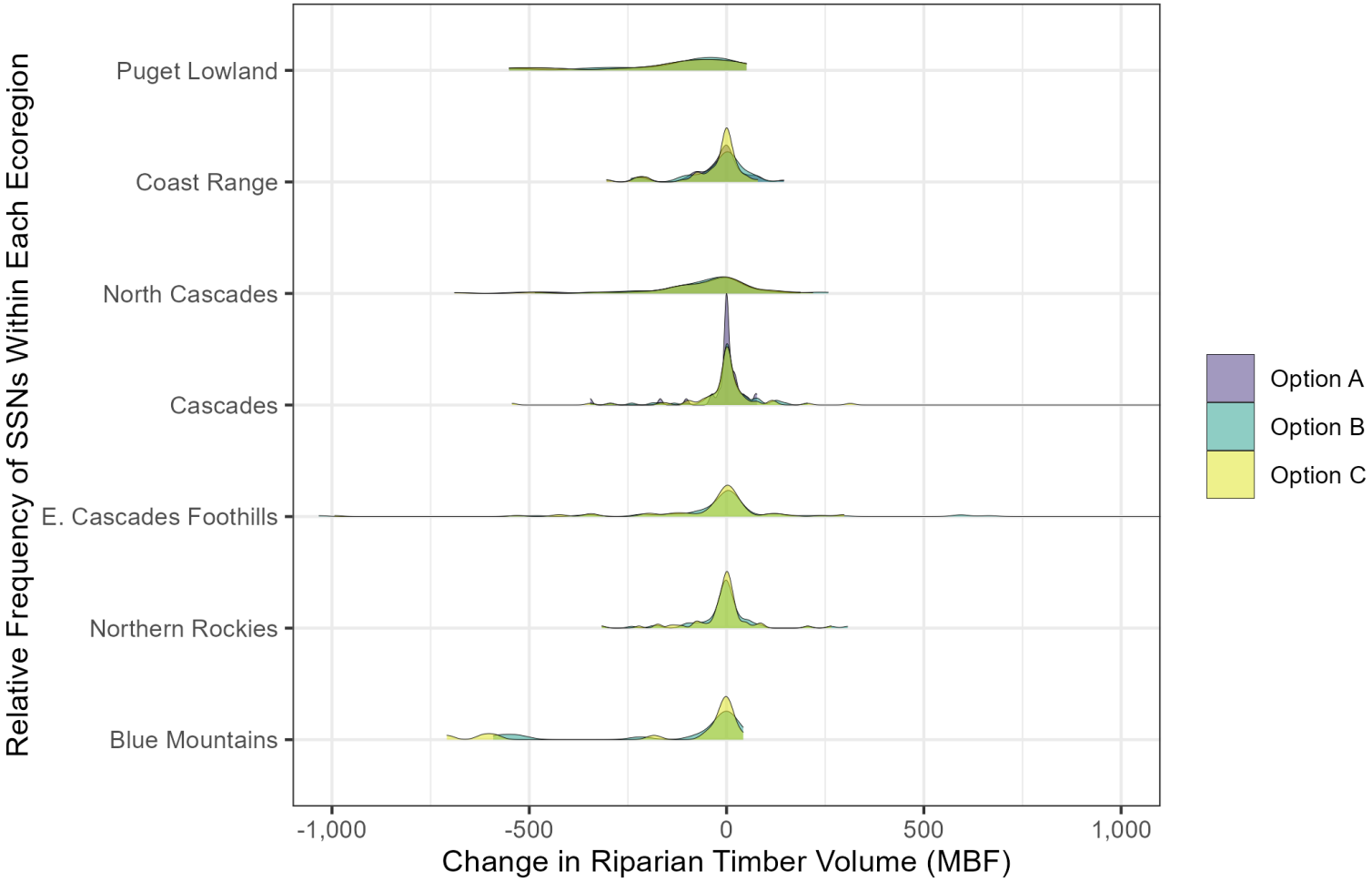


RESULTS: CHANGE IN BUFFER AREA



Ecoregion	Mean Change (Std Error)		
	A	B	C
Puget Lowland	-1.9 (0.6)	-1.8 (0.5)	-1.9 (0.6)
Coast Range	-0.7 (0.2)	-0.6 (0.2)	-0.7 (0.2)
North Cascades	-1.7 (0.4)	-0.9 (0.2)	-1.1 (0.2)
Cascades	-0.4 (0.2)	-0.2 (0.2)	-0.4 (0.2)
E. Cascades Foothills		0.2 (0.6)	-0.5 (0.2)
Northern Rockies		-0.5 (0.2)	-0.6 (0.2)
Blue Mountains		-1.5 (0.7)	-1.6 (0.8)

RESULTS: CHANGE IN BUFFERED TIMBER VOLUME



Ecoregion	Mean Change (Std Error)		
	A	B	C
Puget Lowland	-138 (55)	-128 (50)	-138 (55)
Coast Range	-29 (12)	-23 (11)	-29 (10)
North Cascades	-85 (28)	-55 (18)	-67 (21)
Cascades	-8 (11)	-5 (10)	5 (20)
E. Cascades Foothills		0 (33)	-45 (21)
Northern Rockies		-6 (11)	-12 (10)
Blue Mountains		-116 (53)	-127 (60)

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