Wetland Conservation and Restoration in a warming climate: the role of beaver dams

By

Columbia Wetlands Stewardship Partners

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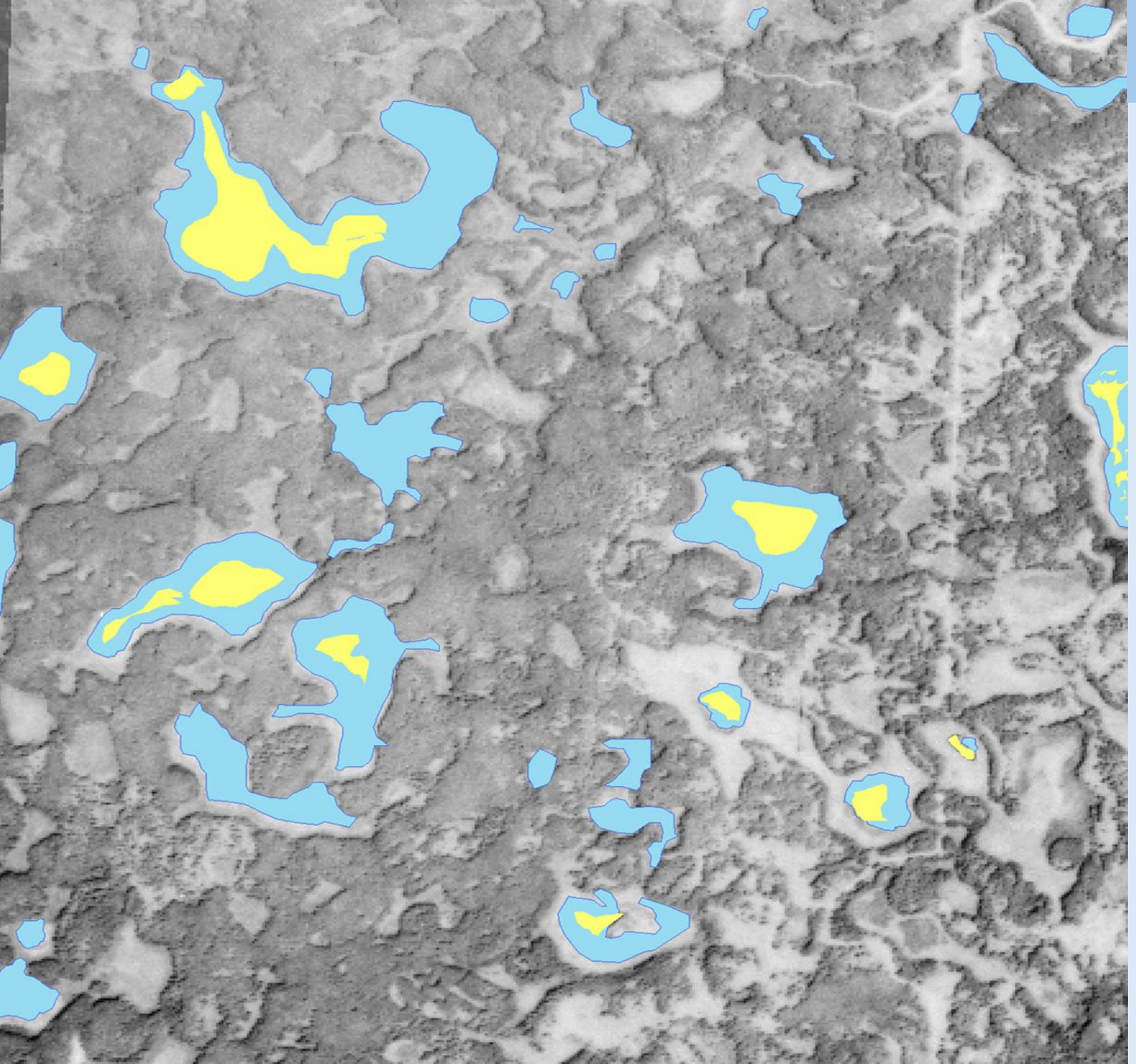
February 26, 2026

Beavers make dams which store water and create wetlands: mitigating climate warming

Beavers Create Open Water!



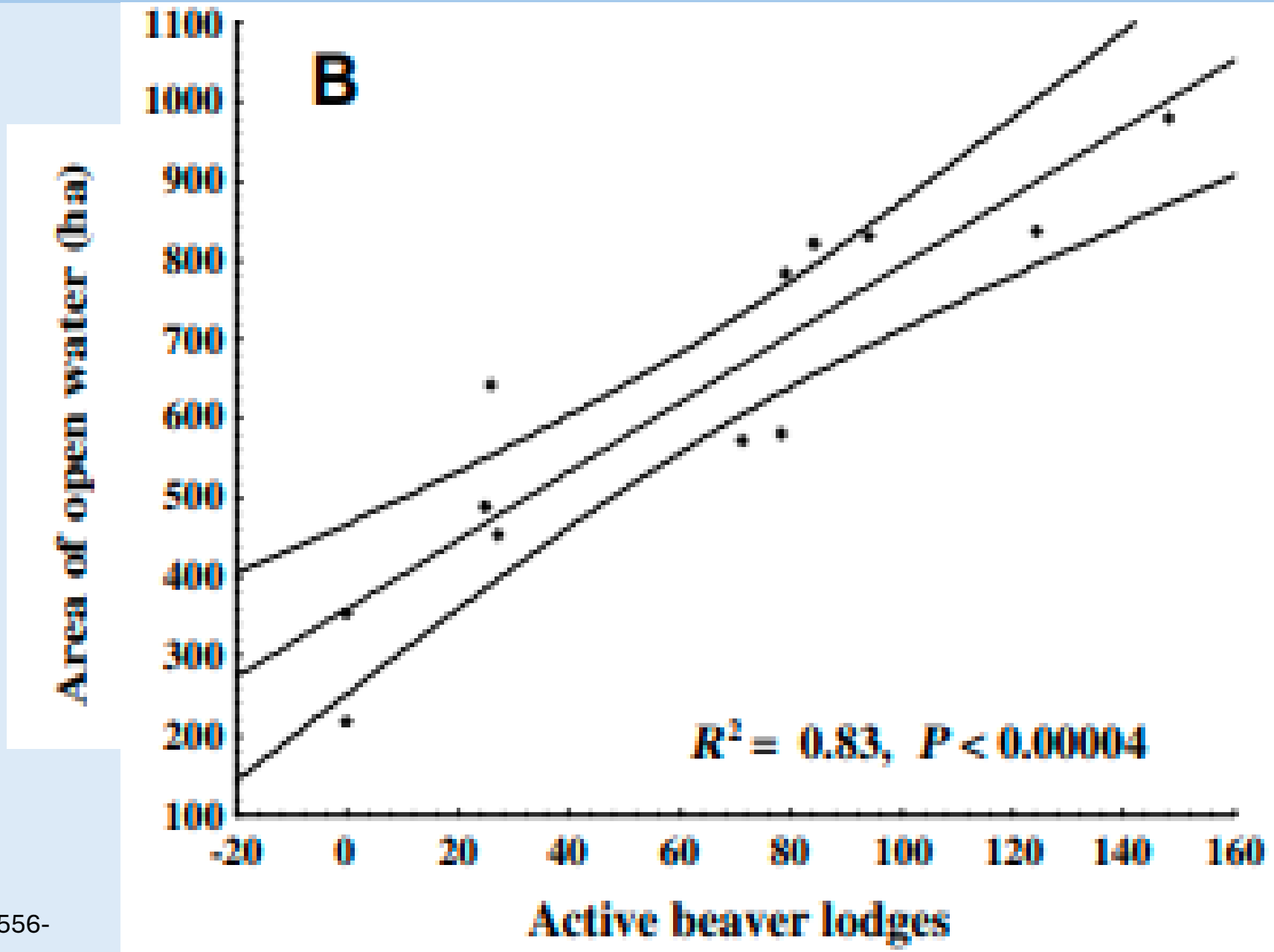
1950 Water Coverage
2002 Water Coverage

- 1950
  - 47% more precipitation than 2002
  - no beaver
  - less open water
- 2002
  - driest year on record
  - beaver well-established
  - 61% more open water than 1950

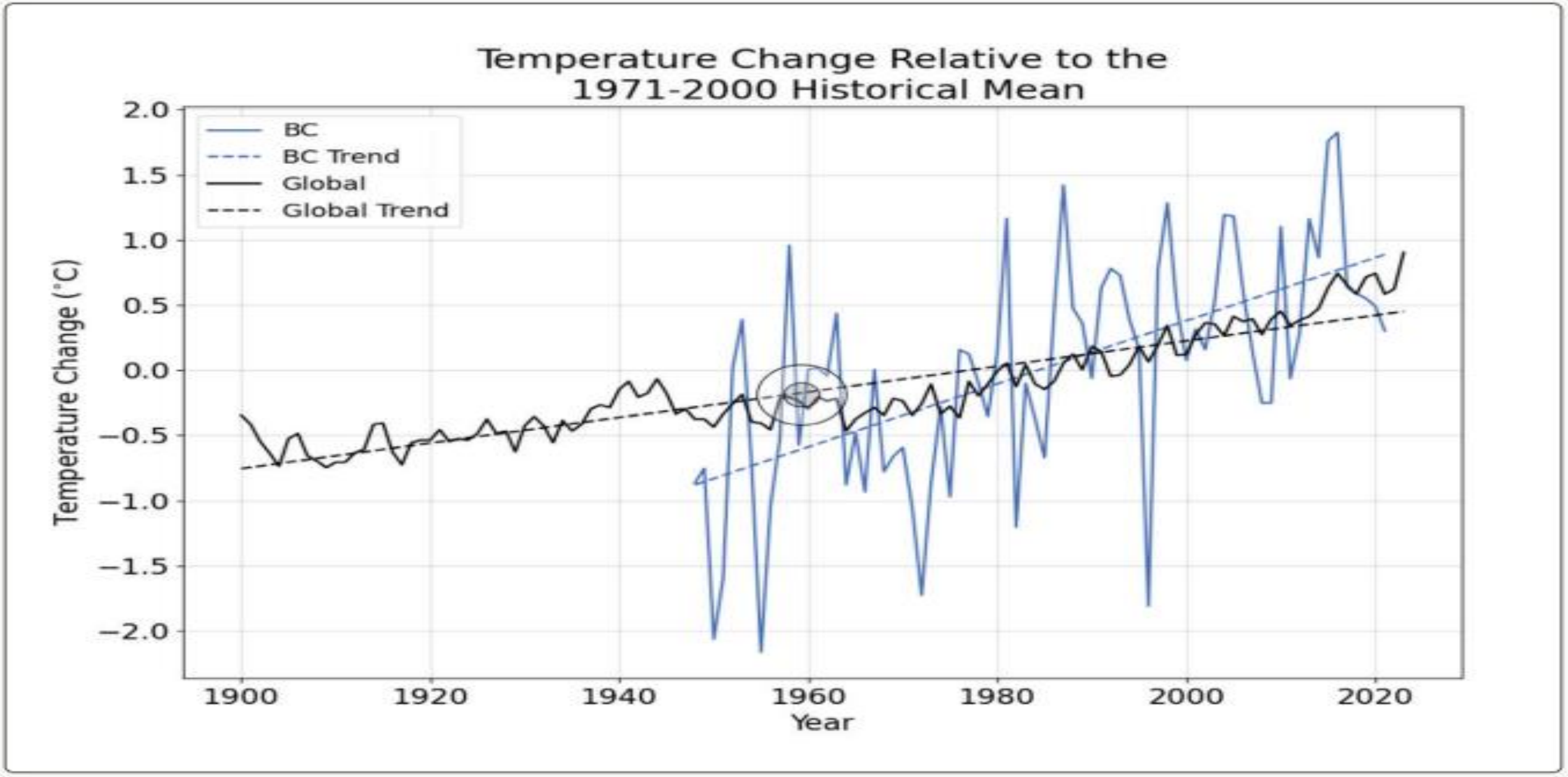
Hood & Bayley 2008 Biological Conservation 141:556-567

Beavers Create Open Water!

- Active beaver lodges = the single most important factor controlling the area of open water



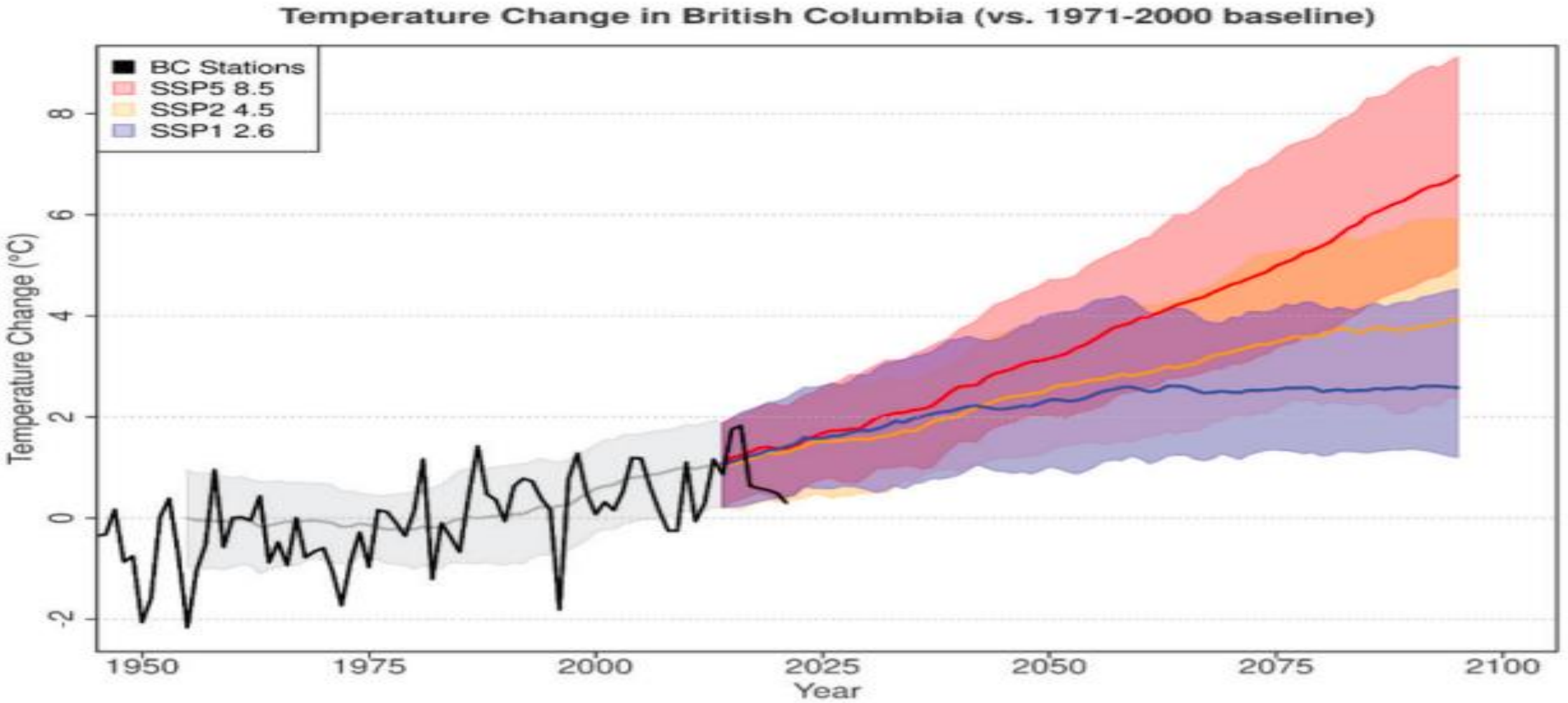
Hood & Bayley 2008 Biological Conservation 141:556-567


Temperature Change Relative to the
1971-2000 Historical Mean
BC
BC Trend
Global
Global Trend
Temperature Change (°C)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
1900
1920
1940
1960
1980
2000
2020
Year

B.C. data derived from PCIC's Provincial Climate Data Set (1948–2021)

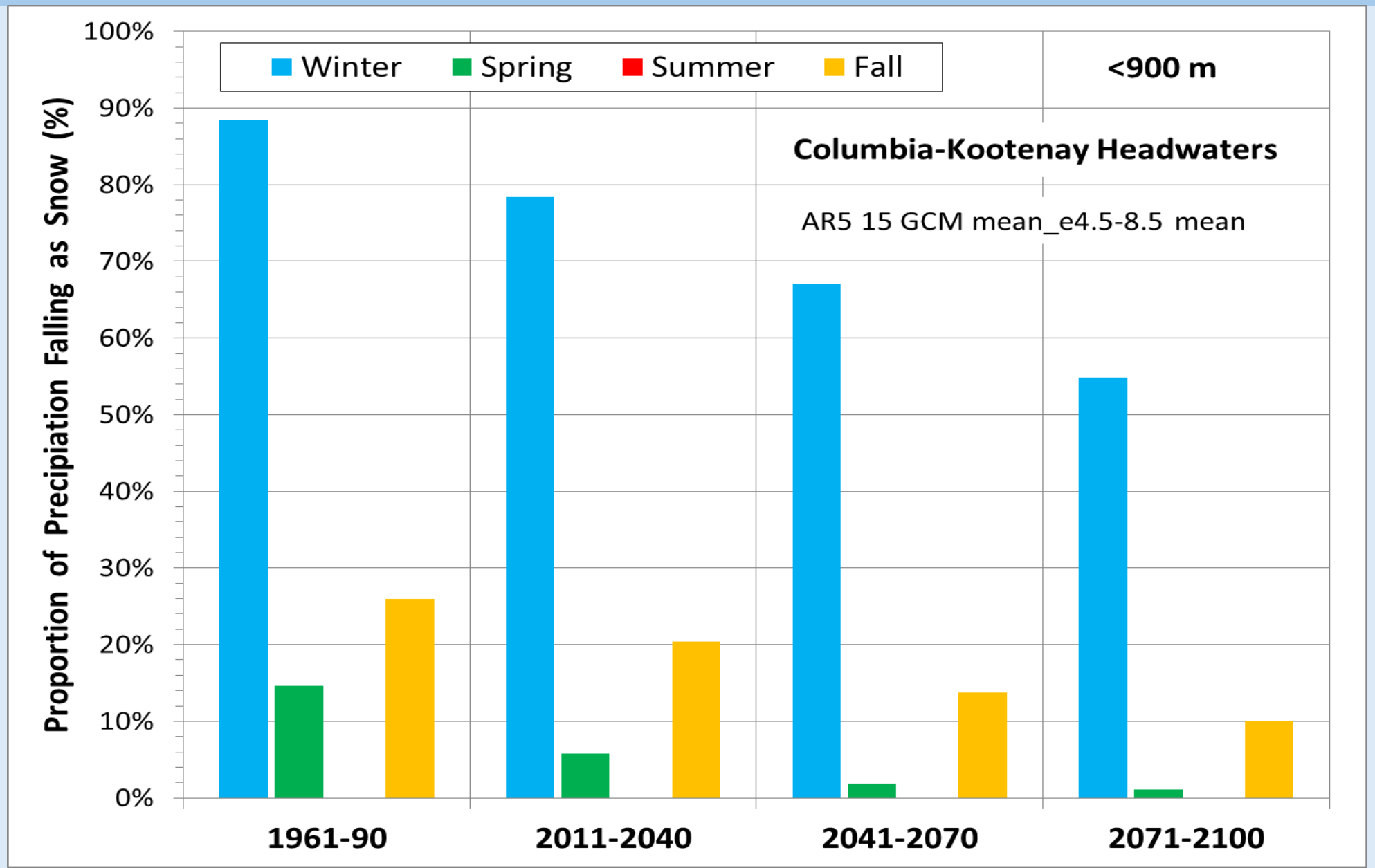
Region	Season	Mean temperature change (°c)
B.C.	Annual	+ 1.7
	Winter	+ 3.2
	Spring	+ 1.6
	Summer	+ 1.7
	Fall	(+ 0.83)

Projected temperature change for B.C. under three future emissions scenarios: low (blue), medium (yellow), and high (red).



British Columbia Disaster and Climate Risk and Resilience Assessment: Provincial Report 2025

Less snow in every season in future years

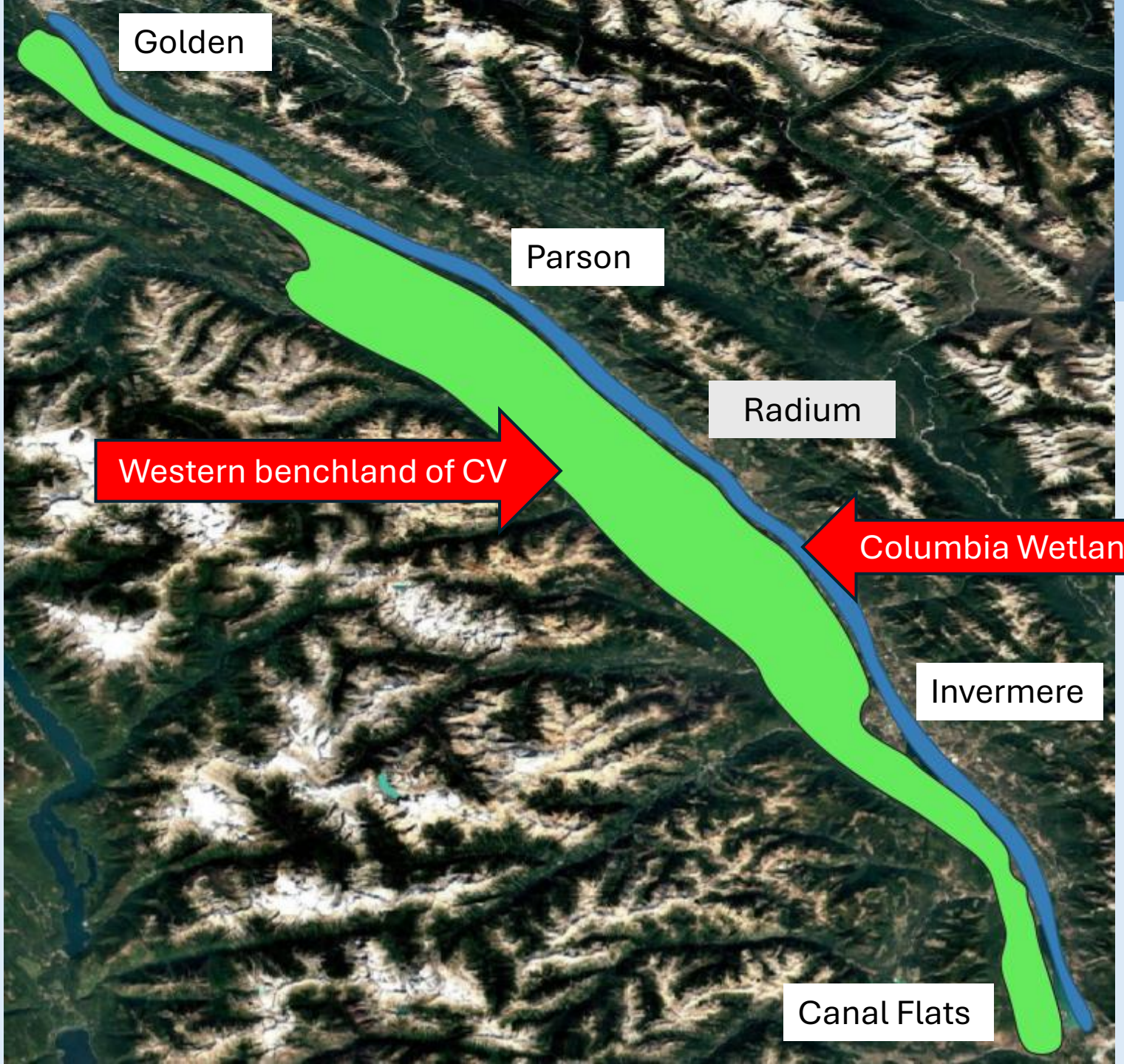


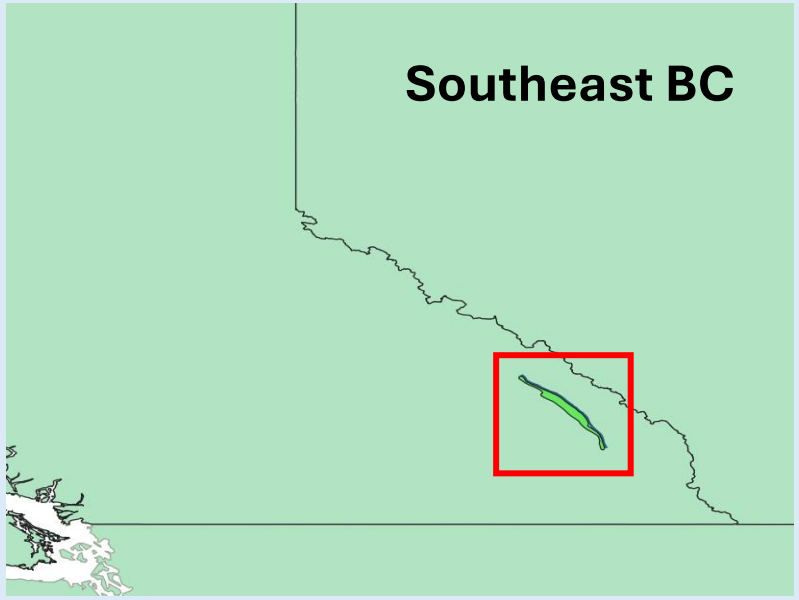
Carver & Utzig

Hydrologic implications of warming climate: the future is even more extreme

- Declining snowpack generally
- Less snow at lower elevations
- More precipitation coming as rain
- Lower spring flows
- Low summer flows
- Decreased summer soil moisture
- Occasional extreme events
- More semi permanent streams (fewer permanent streams)
- More agricultural demand

The Columbia Wetlands and Benchlands in the Columbia Valley

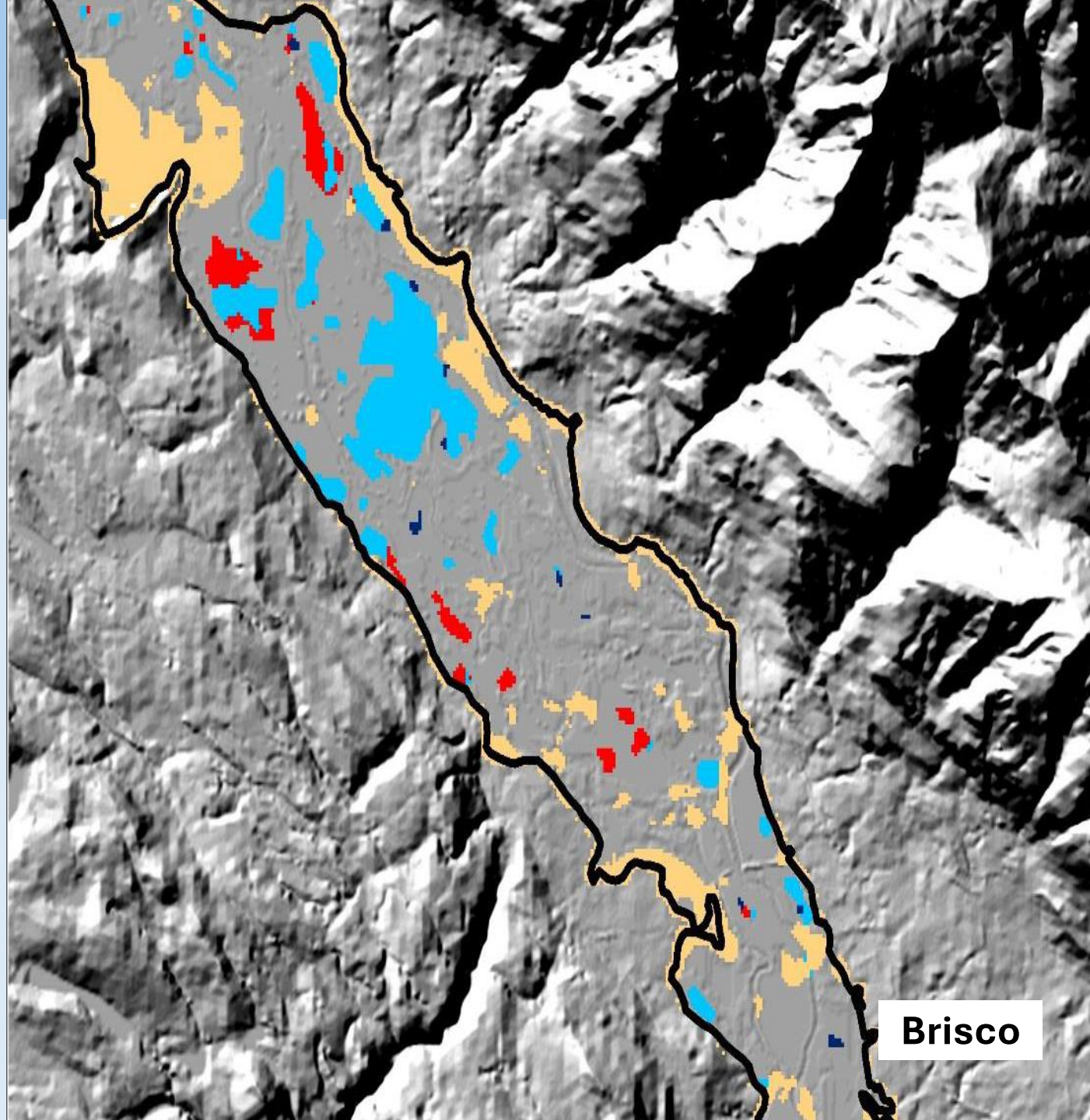




Effect of climate change on 188 km^2 Columbia Wetlands

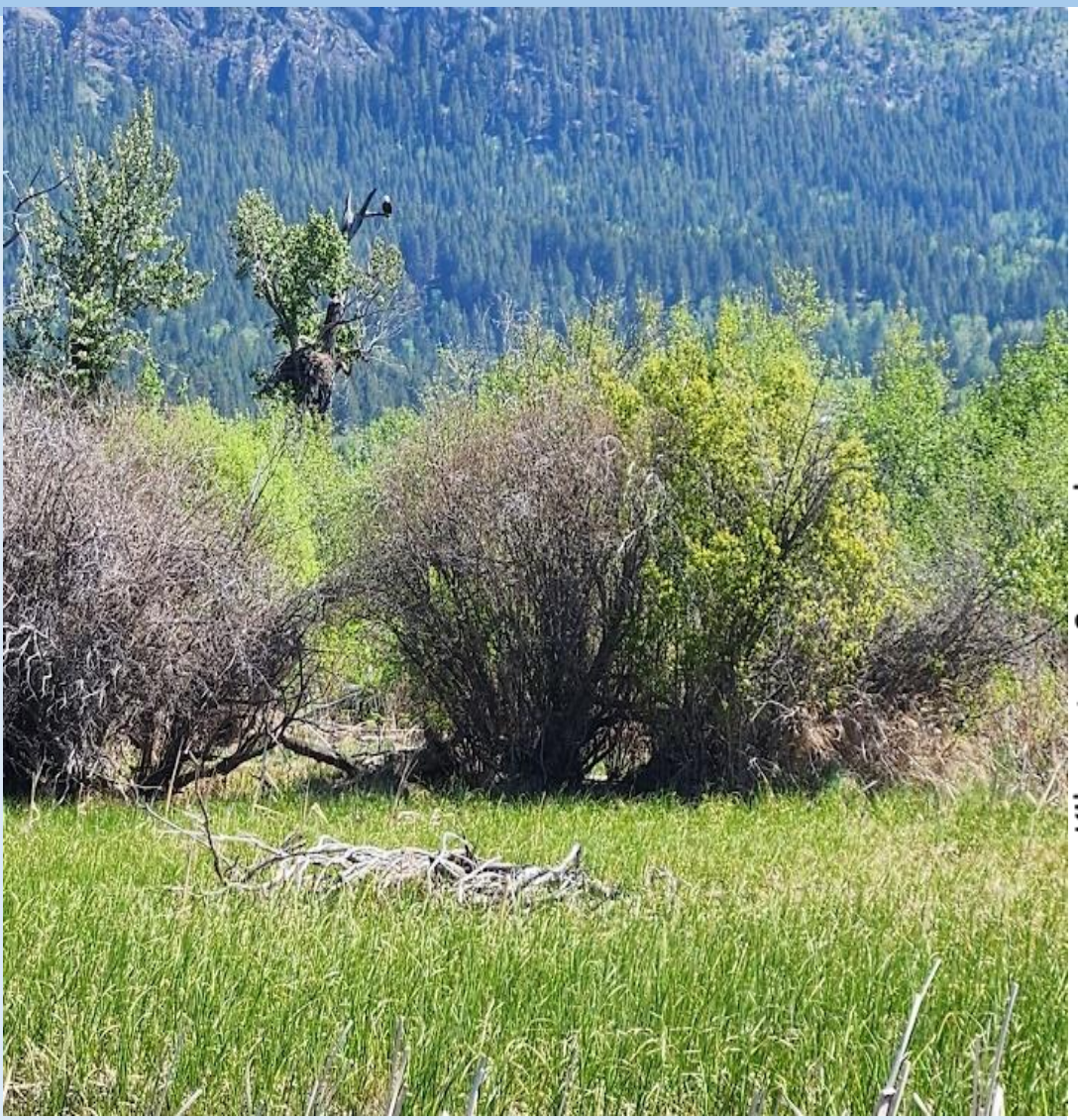
Watershed Scale Climate Impacts

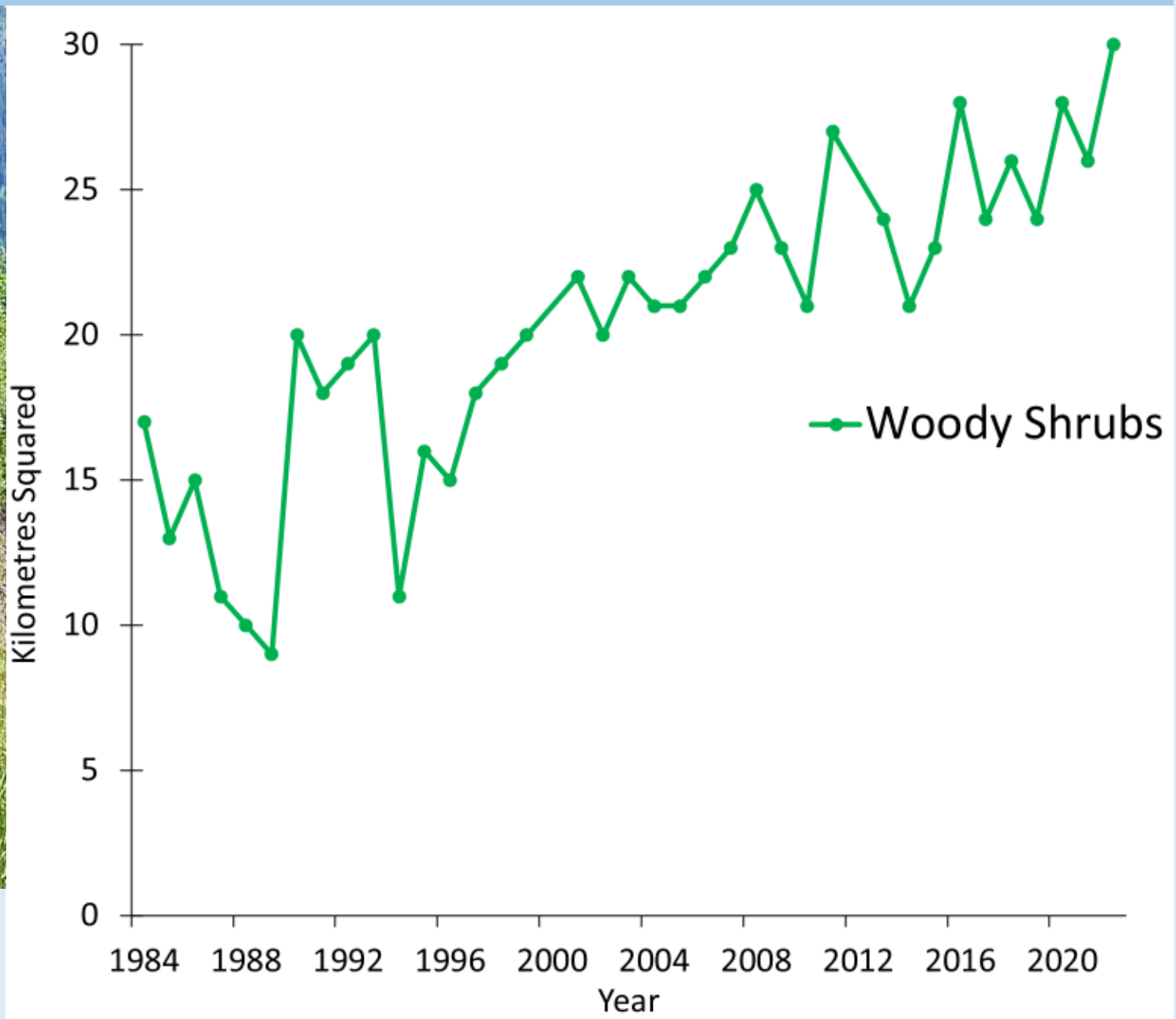
- Red patches= Loss of open water habitat
- 1984-2003 vs 2004-2019
- **CW has lost open water habitat in summer season**



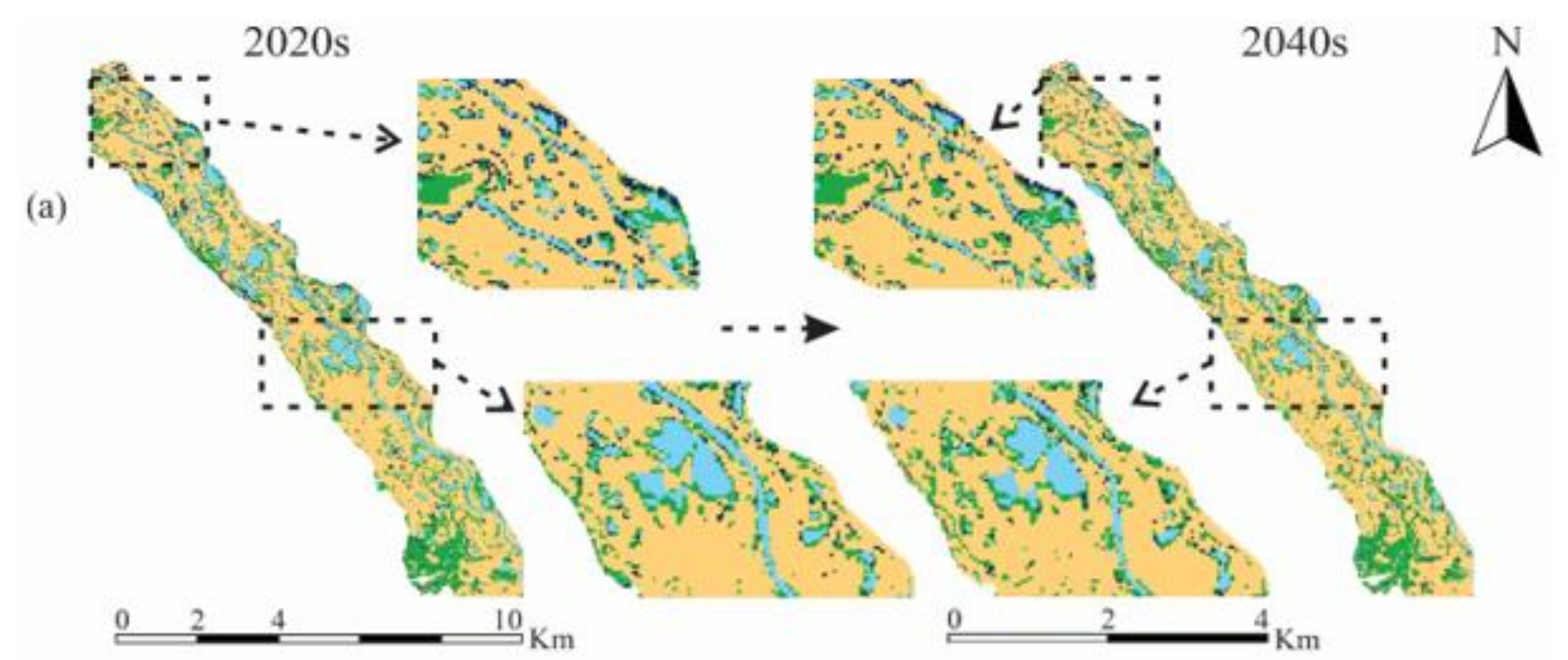
Hopkinson et al. 2020

Increasing Woody Shrubs





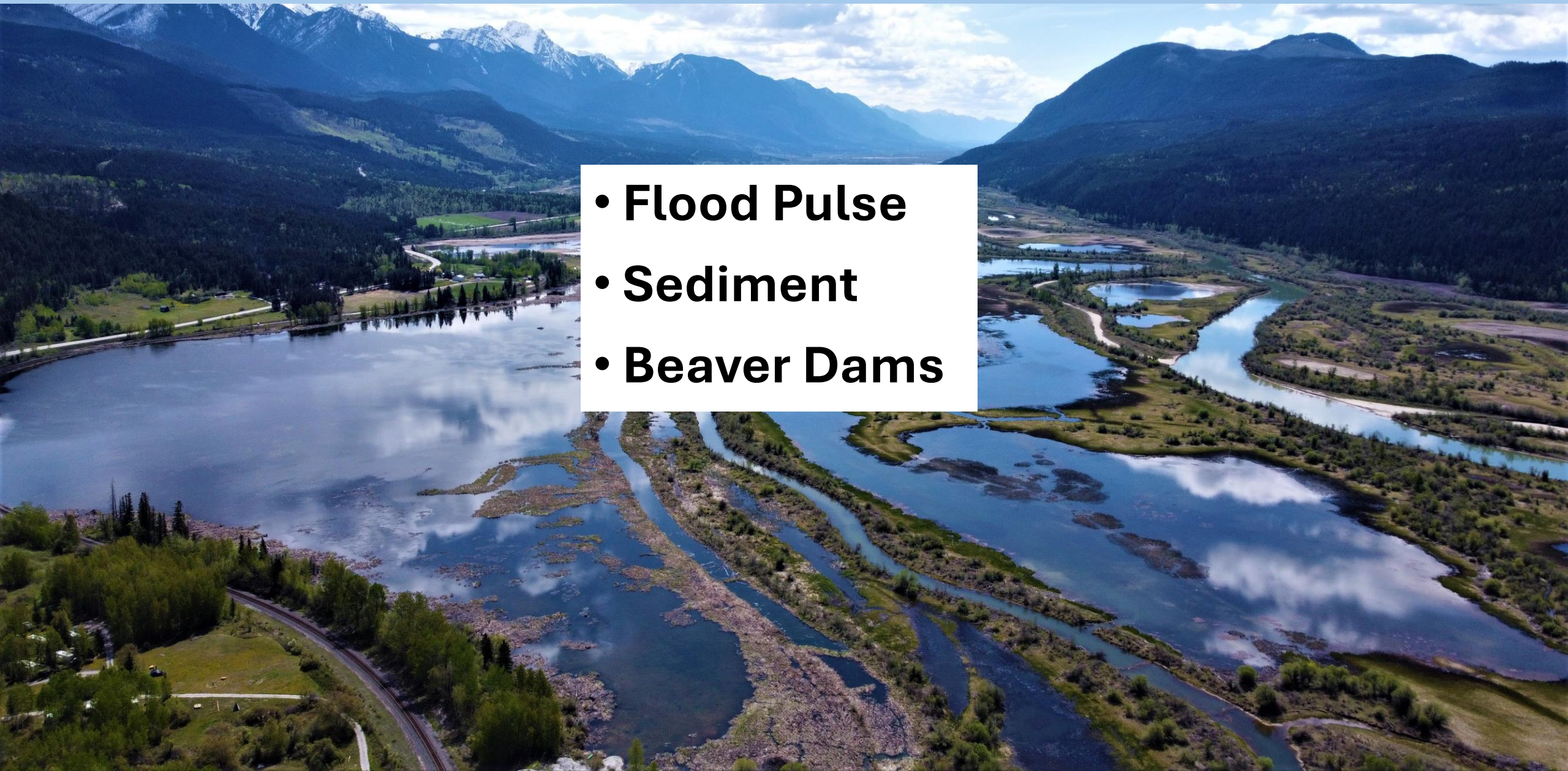
Areas of Open Water, Marsh, Wet Meadow decreased Woody Shrubs increased in Columbia Wetlands



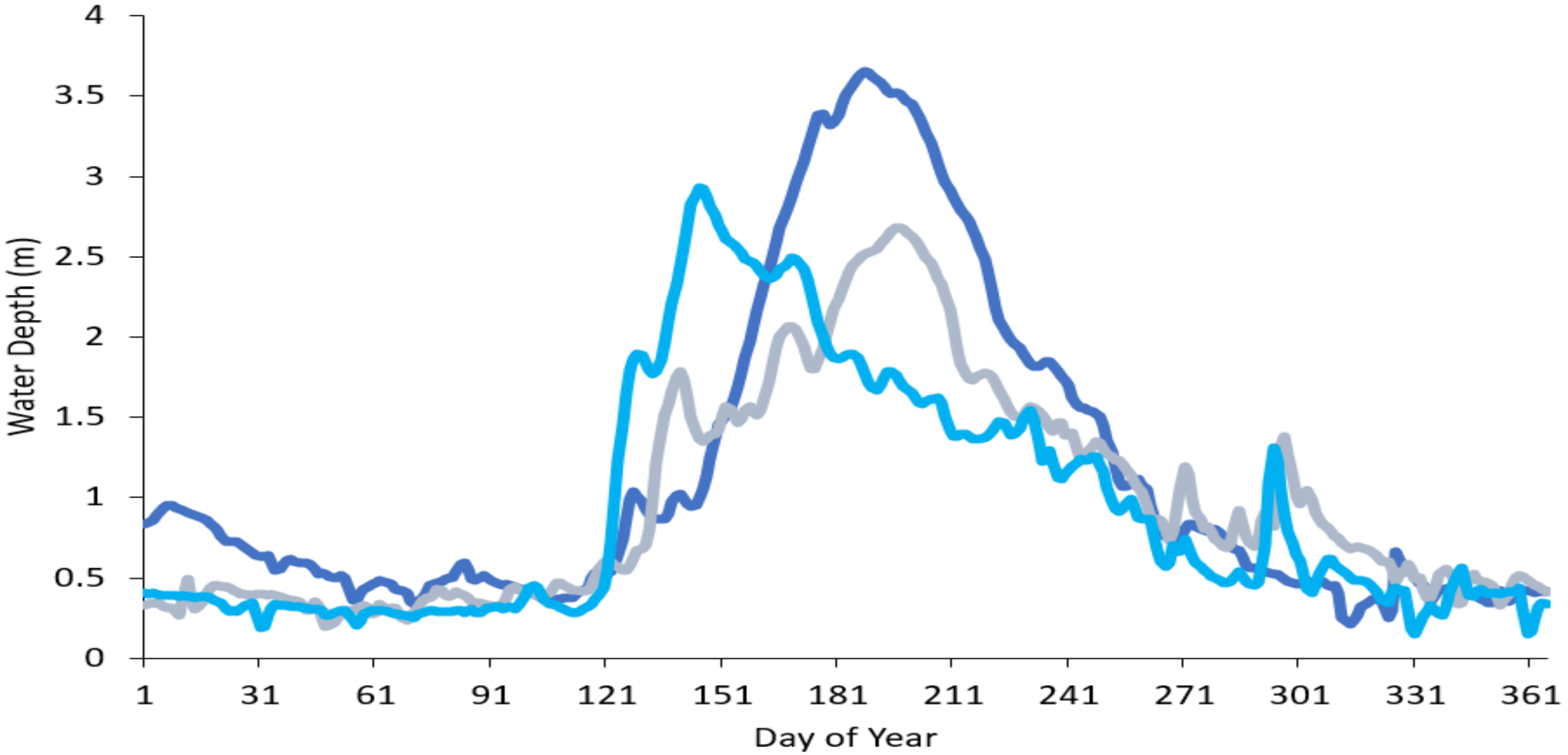
Rodrigues et al 2025 Science of the Total Environment

What role do beaver play in the Columbia Wetlands?

Three Things Drive The Columbia Wetlands



Flood Pulse of the Columbia River



Changes in Water Flows in Columbia River

- Peak water levels and volumes are declining
- Duration of flood pulse is getting shorter
- Summer water levels are getting lower
- Timing of peak flow is getting earlier

Sediment Forms Natural Levees Which Bound Wetlands

Sediment deposited on vegetation & levees in high water

Beaver Dams in the Columbia Wetlands

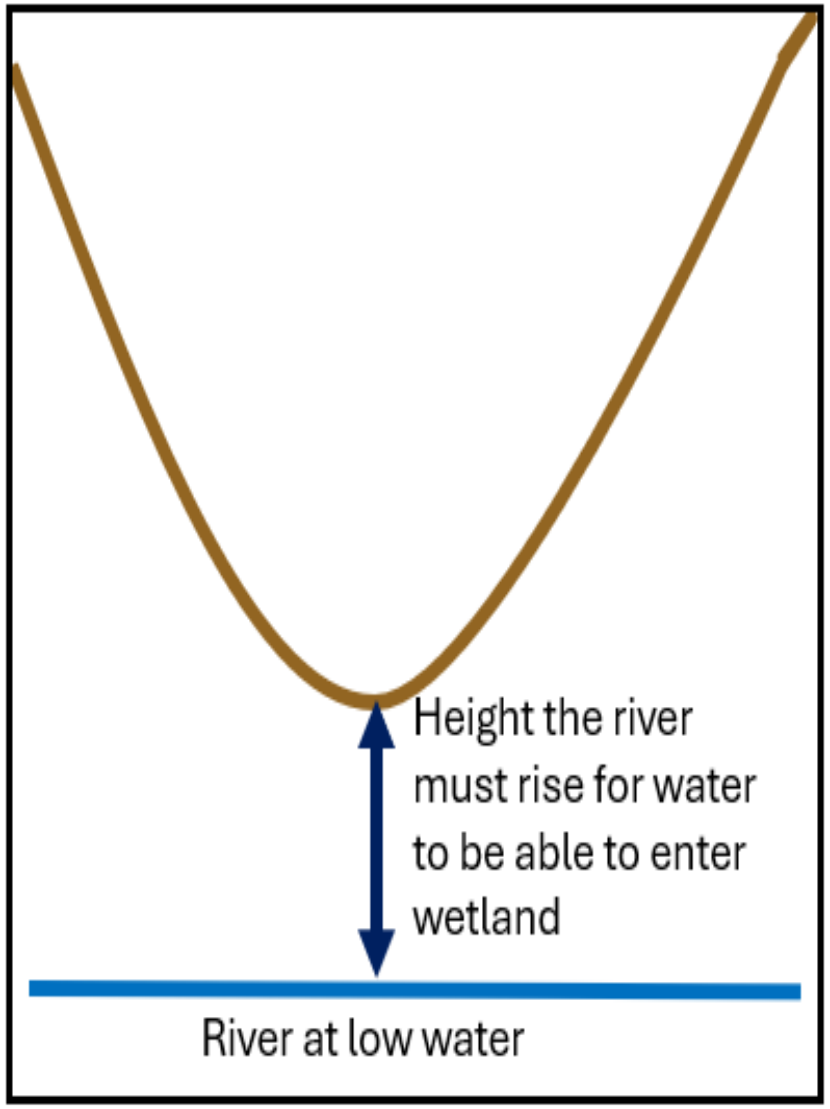
What kind of floodplain wetlands are in the Columbia Wetlands and how are they affected by drought and beavers?

Levee Gaps in the Columbia Wetlands

Levee Gaps in the Columbia Wetlands

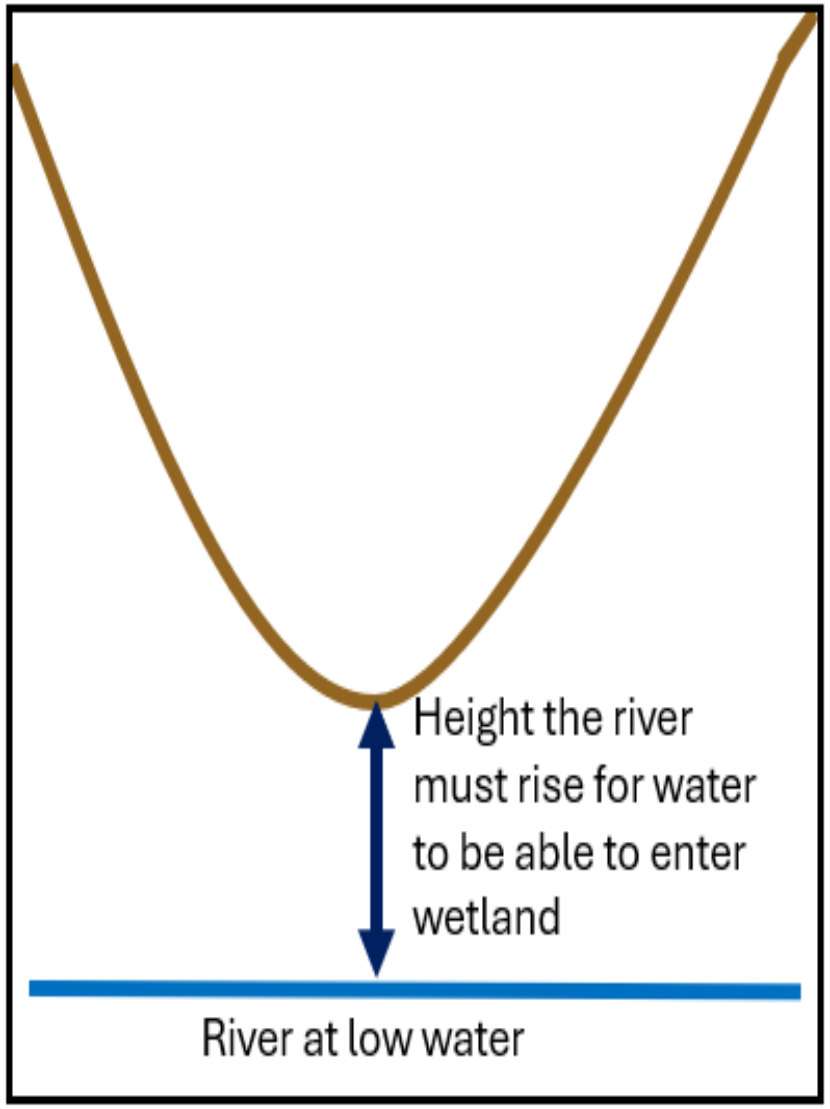
Levee Gaps and Beaver Dams

Scenario 1: Gap

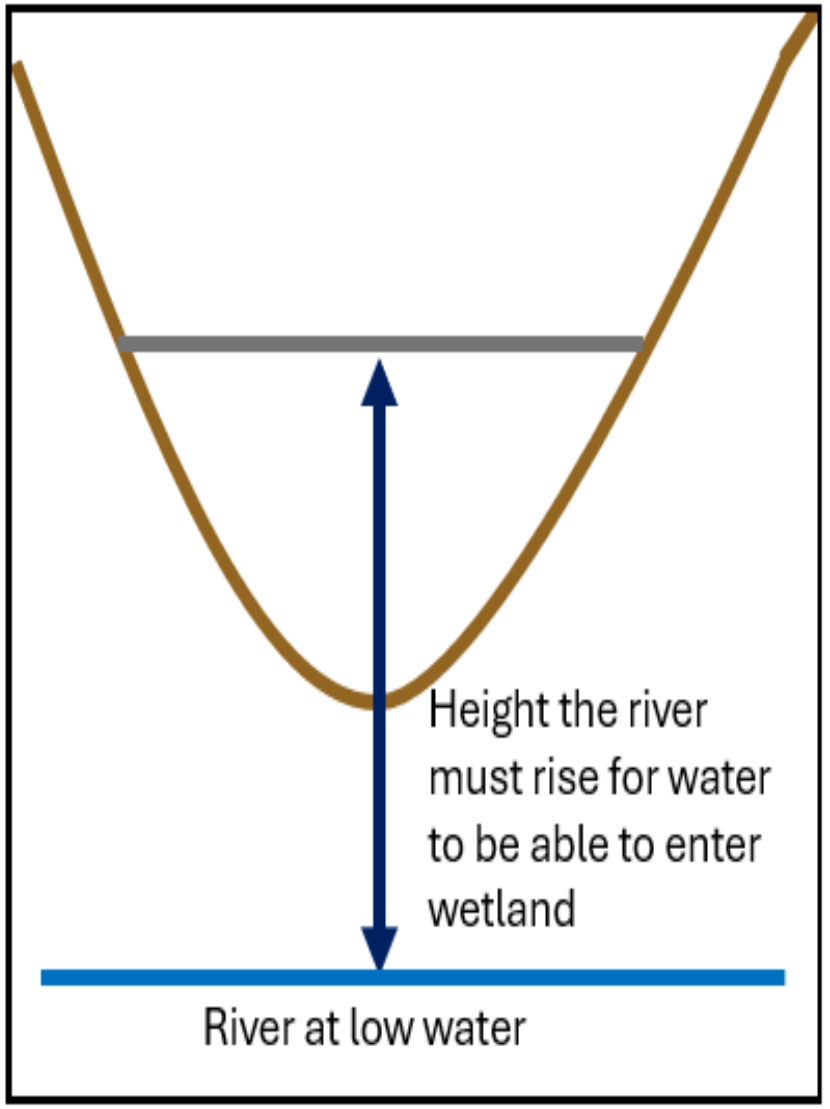


Levee Gaps and Beaver Dams

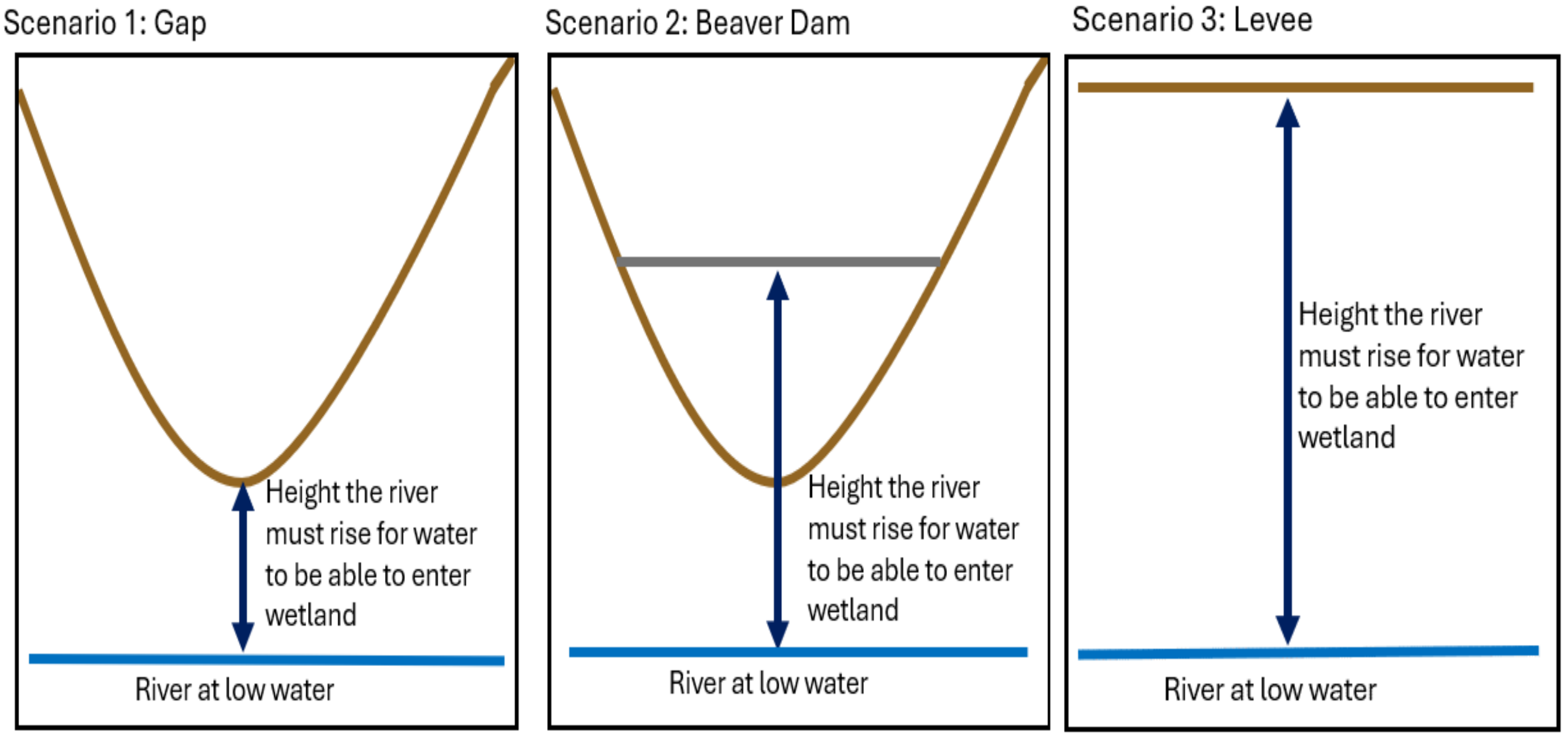
Scenario 1: Gap



Scenario 2: Beaver Dam



Levee Gaps and Beaver Dams



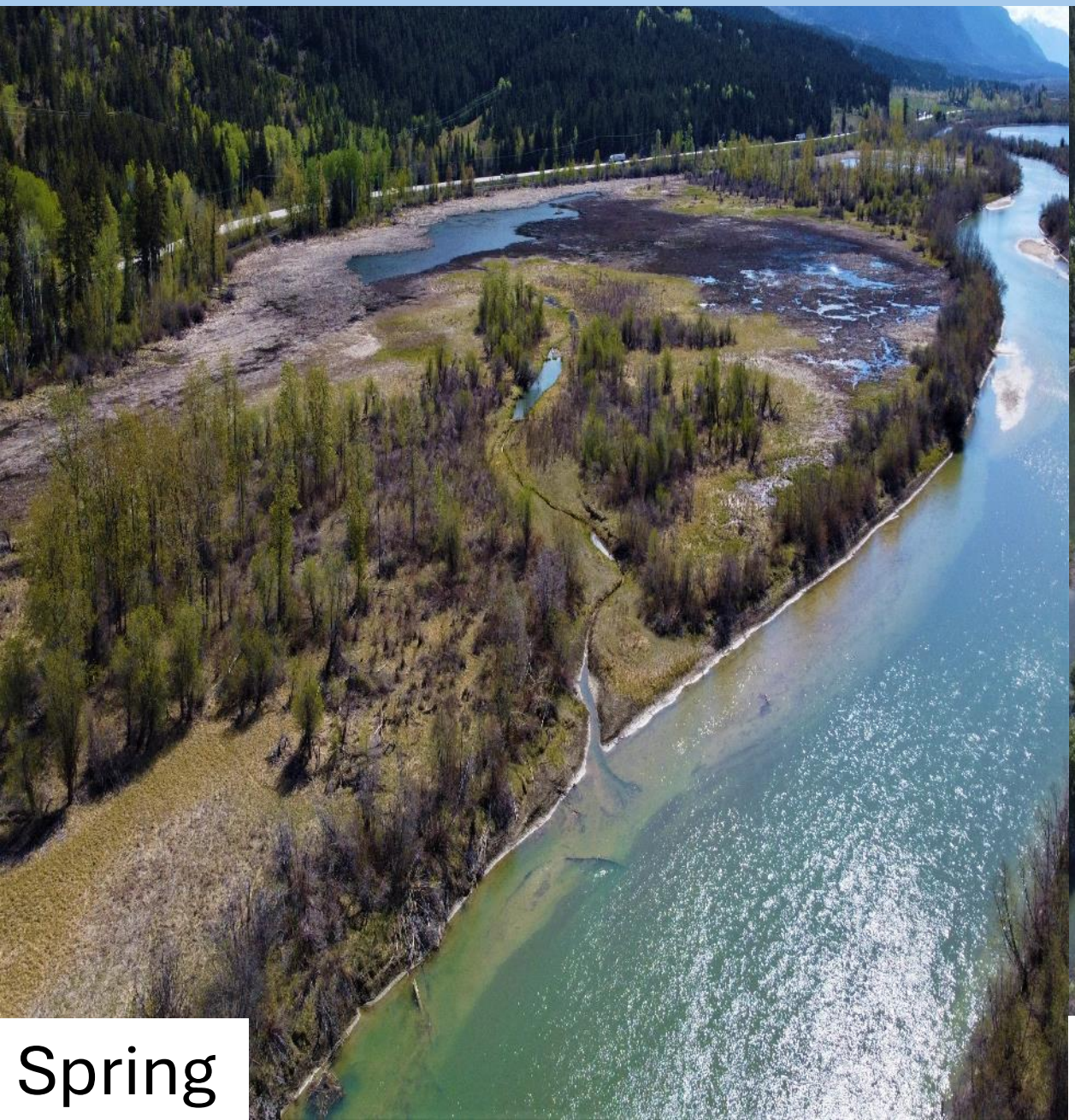
Three Types of Floodplain Wetlands

Most Connected Wetland

Spring

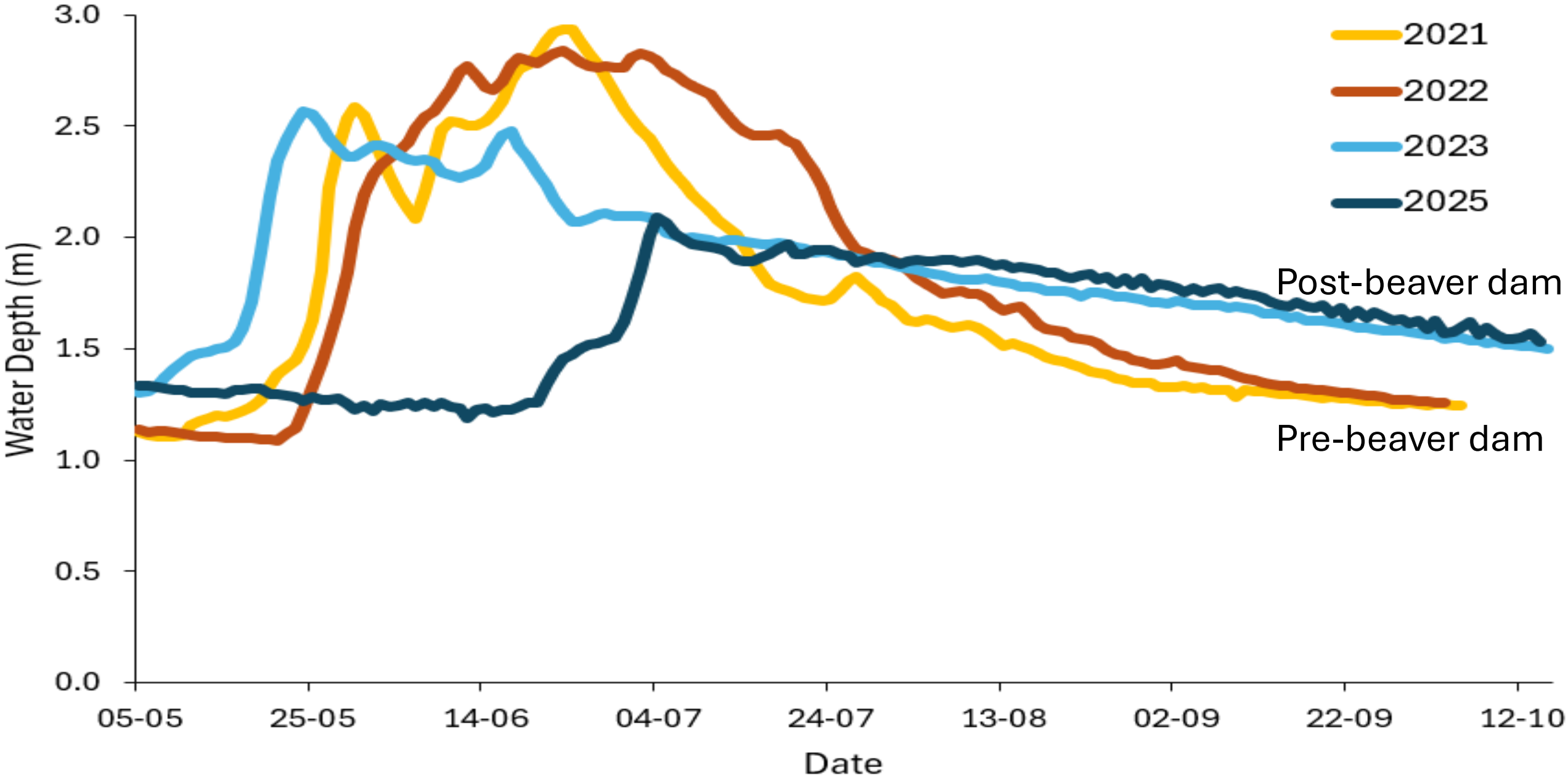
Summer

Partially Connected Wetland

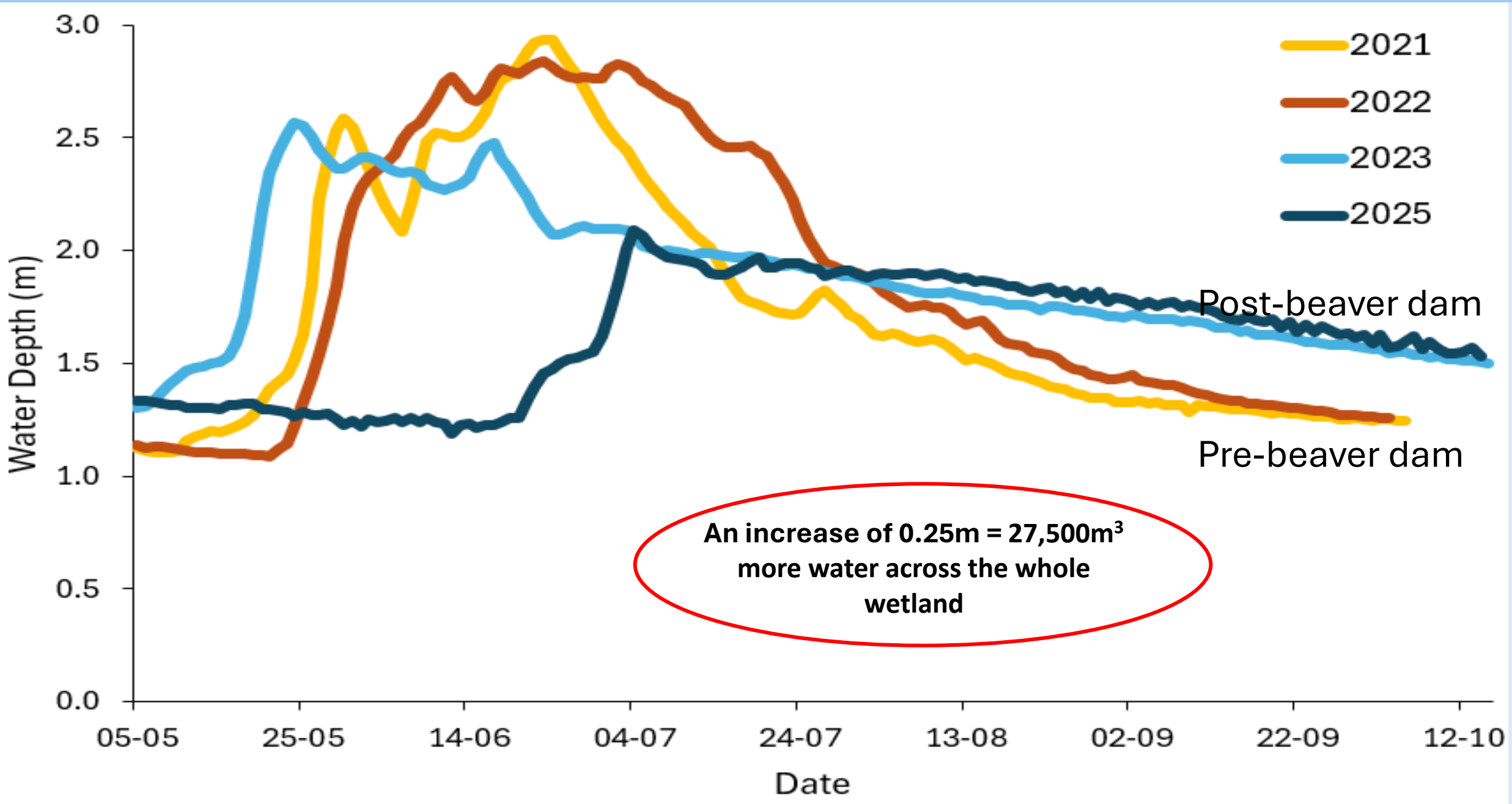


Least Connected Wetland

Site 71 pre- and post-beaver dams



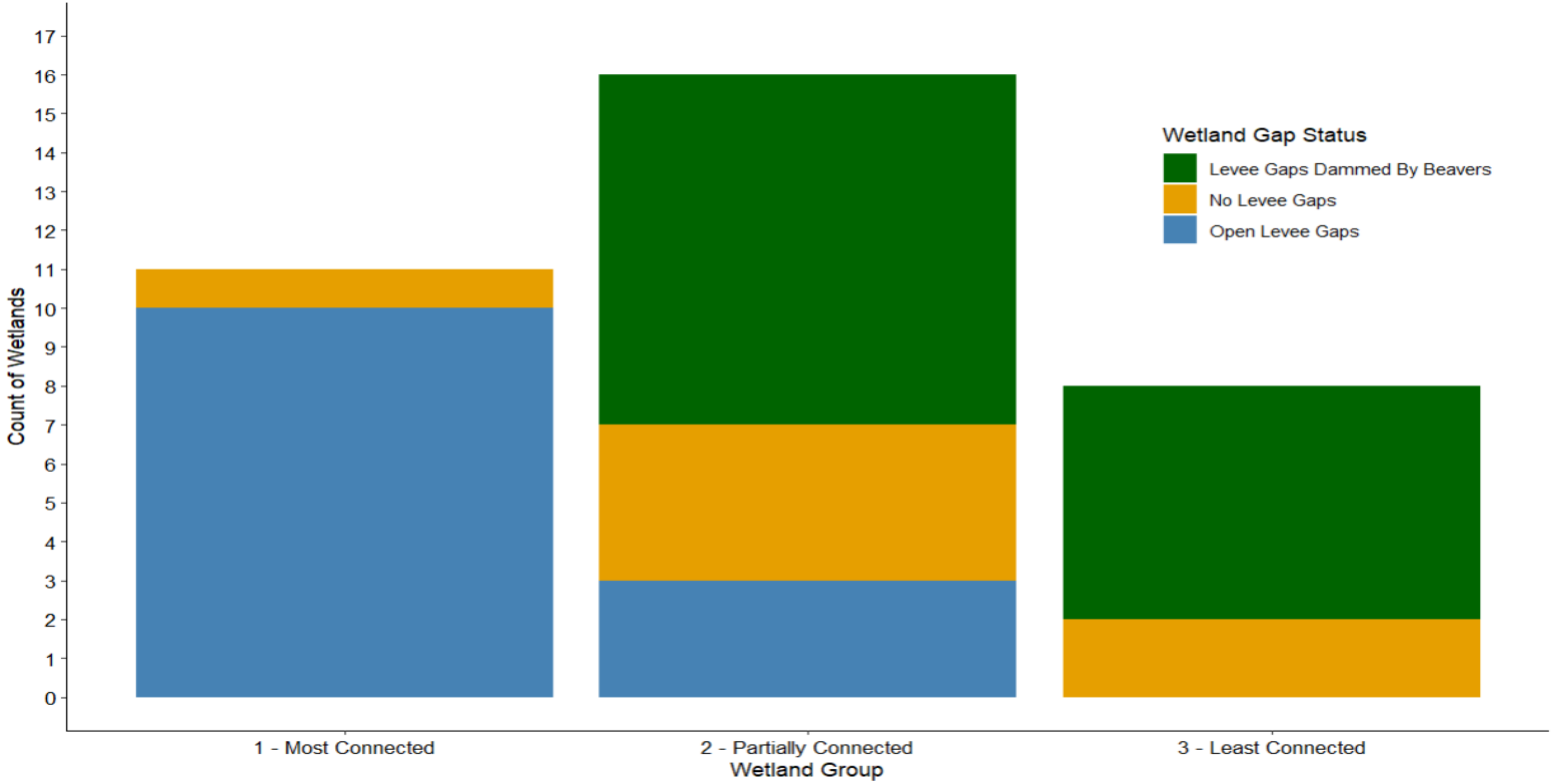
Beaver dams keep water high during the fall, winter and spring for wildlife



Beaver Dams Retain Water in Wetlands

- Most Connected Wetlands: 0% have beaver dams
- Partially Connected Wetlands: 56% have beaver dams
- Least Connected Wetlands: 88% have beaver dams

Beaver Dams Determine Wetland Groups

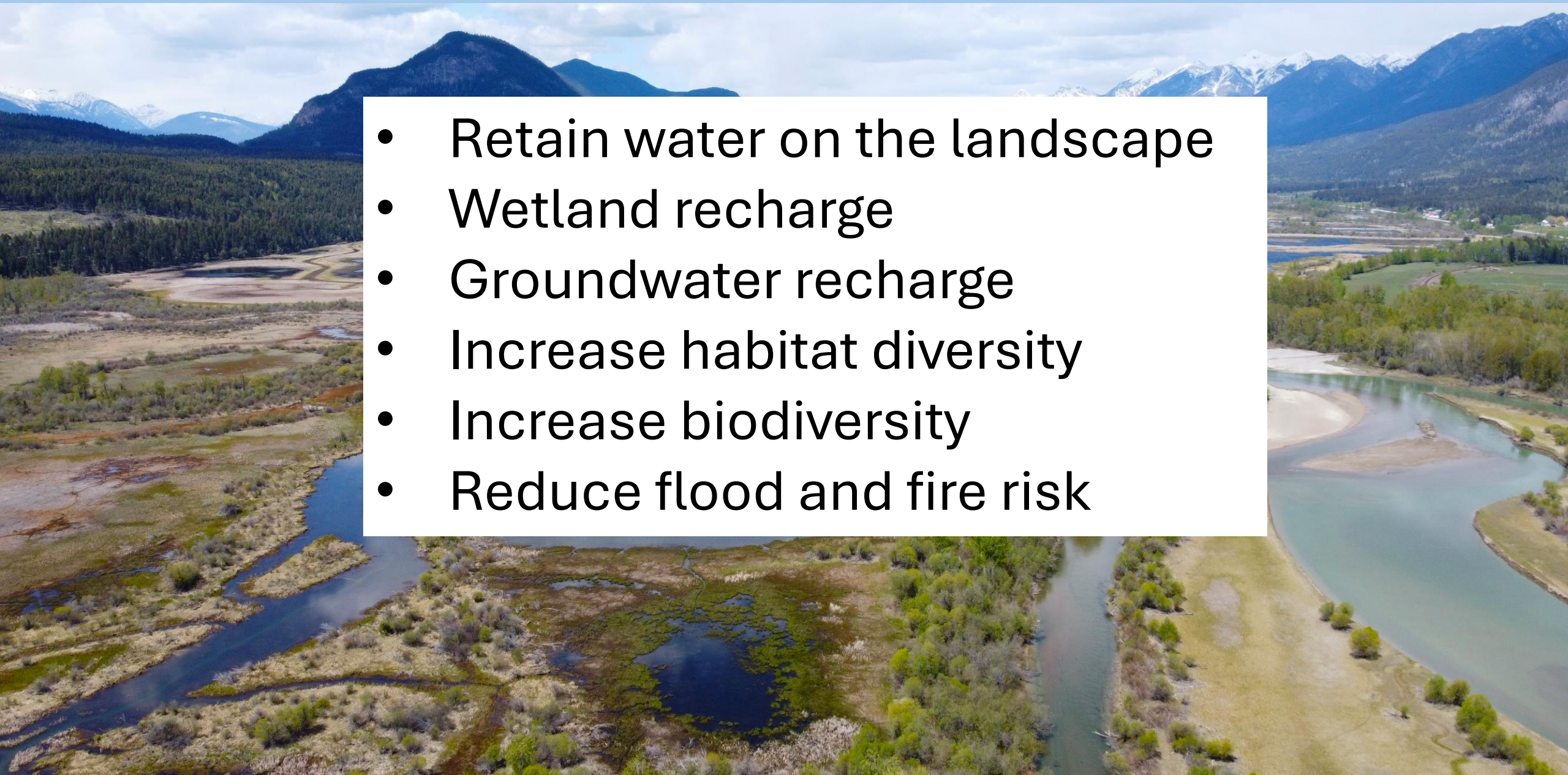


Levee Gaps and Beaver Dams Explain 60% of Variation in Hydrology in Study Wetlands

Beaver Dams at Spillimacheen – Sites 69 and 62

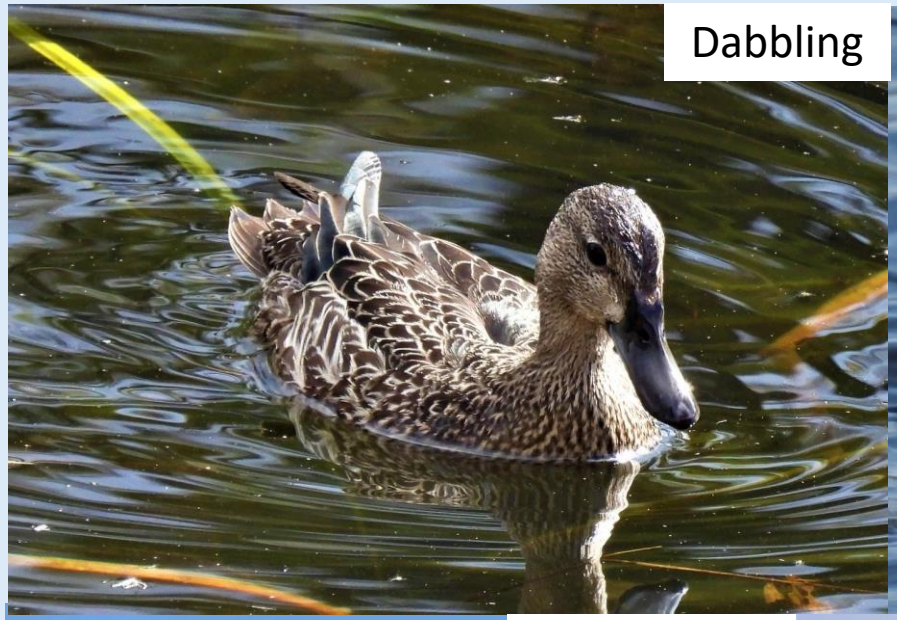
Natural Beaver Dams in the Columbia Wetlands

Why do we care about beaver dams?



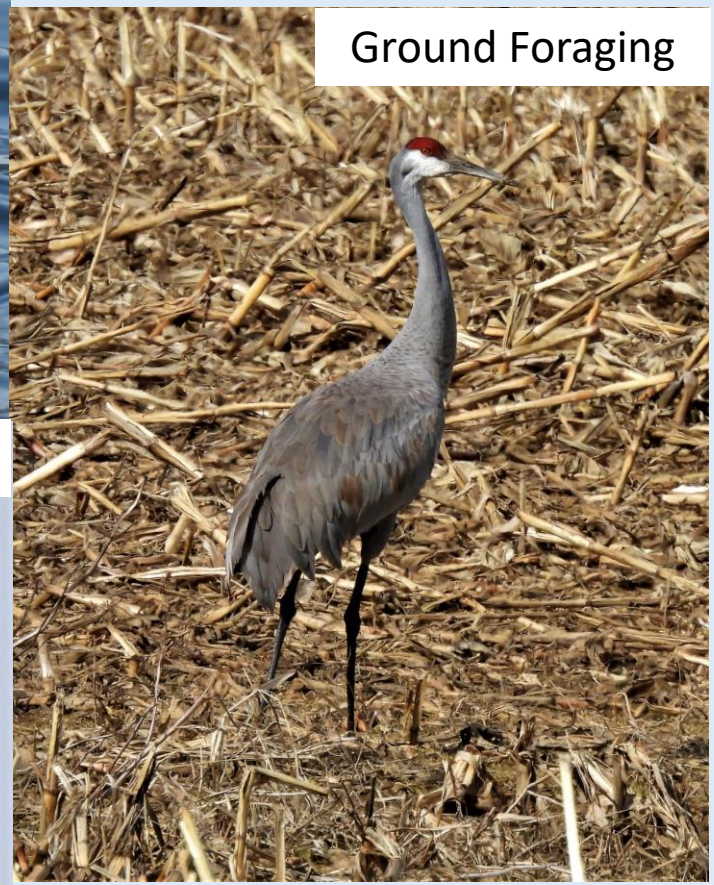
- Retain water on the landscape
- Wetland recharge
- Groundwater recharge
- Increase habitat diversity
- Increase biodiversity
- Reduce flood and fire risk

Different Types of Birds Use Different Water Depths



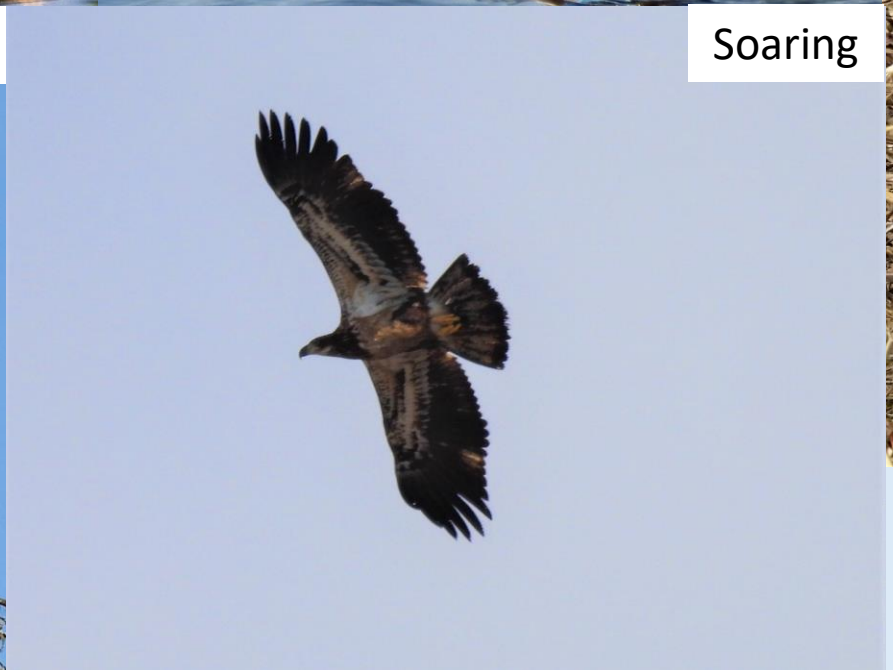
Dabbling

Diving



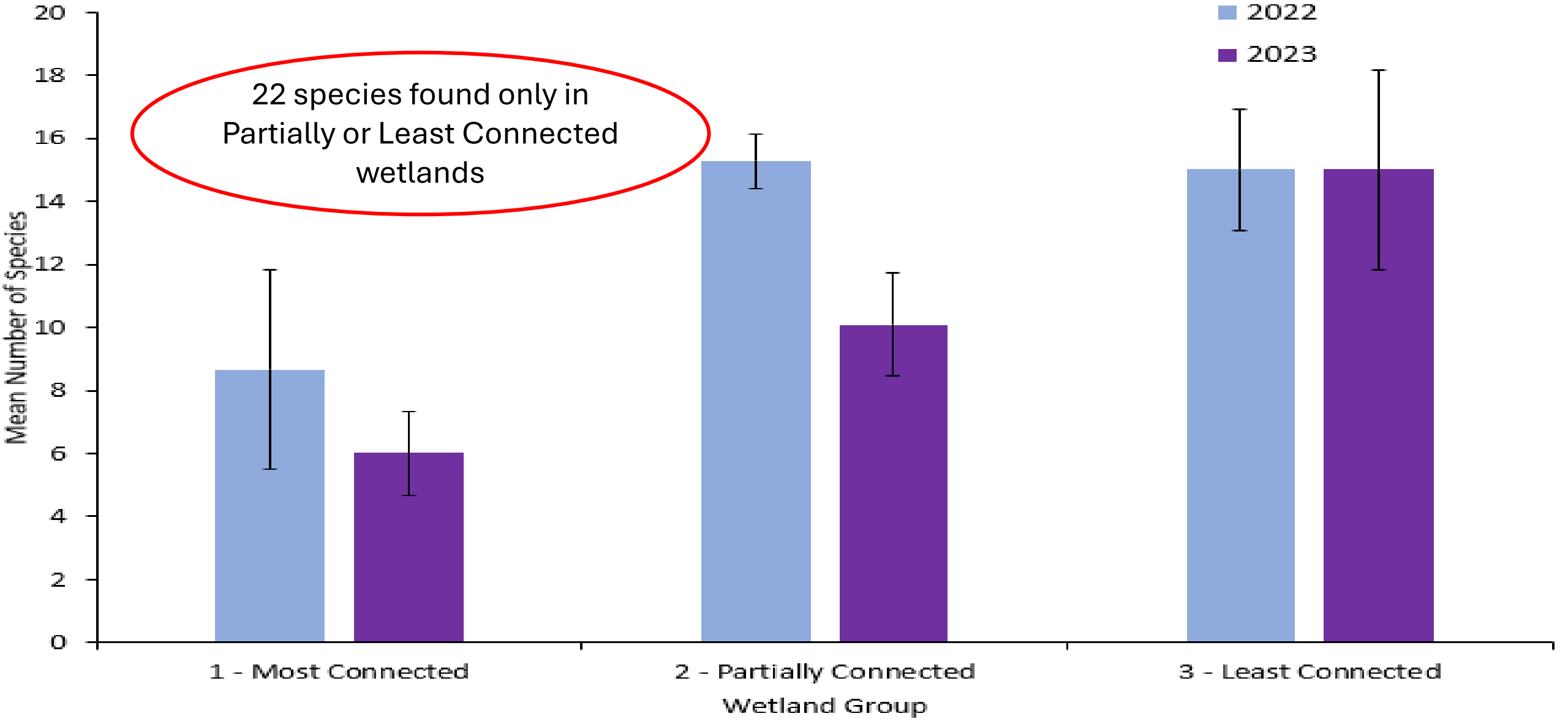
Ground Foraging

Aerial Diving



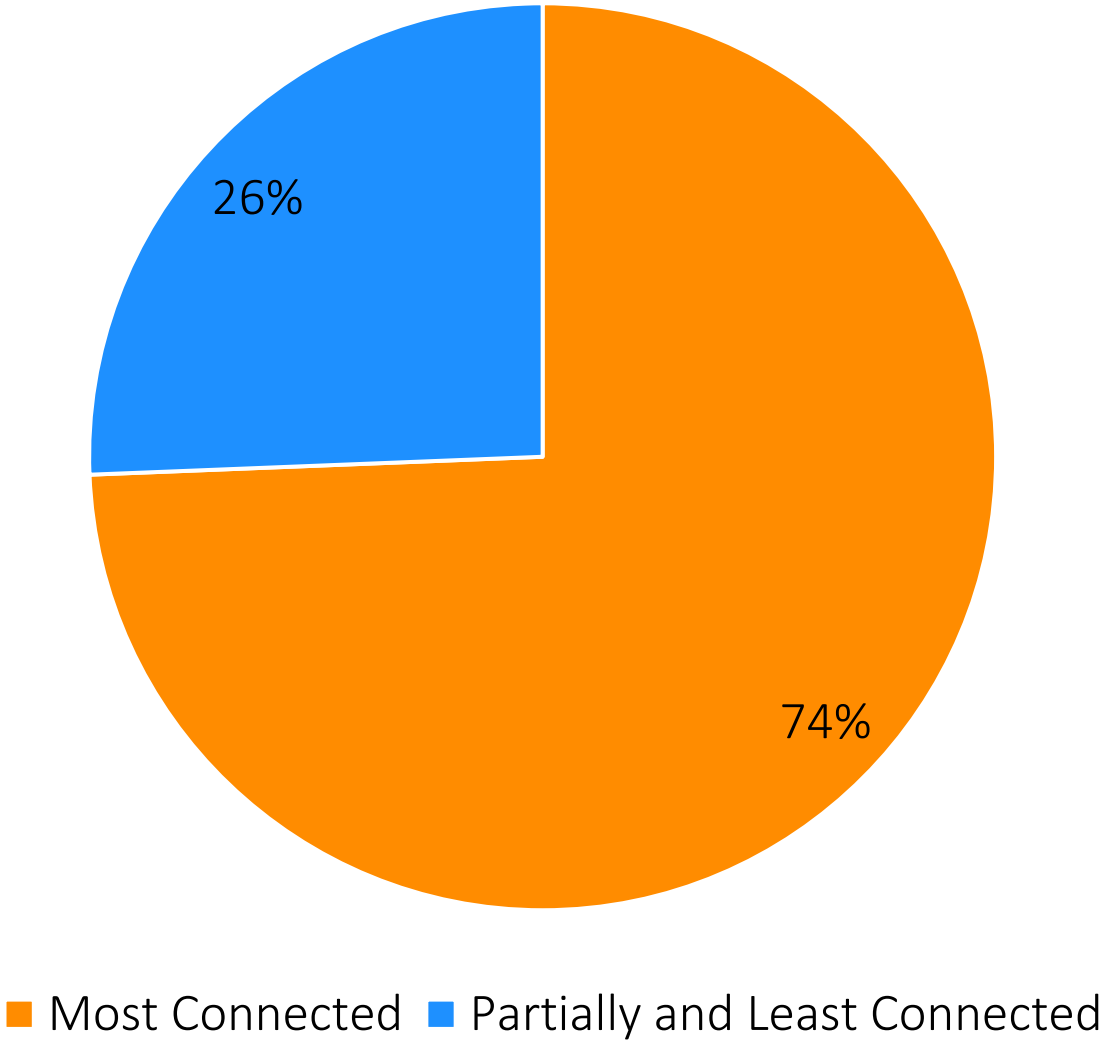
Soaring

Beaver Dams Provide Important Habitat for Spring Migratory Waterbirds

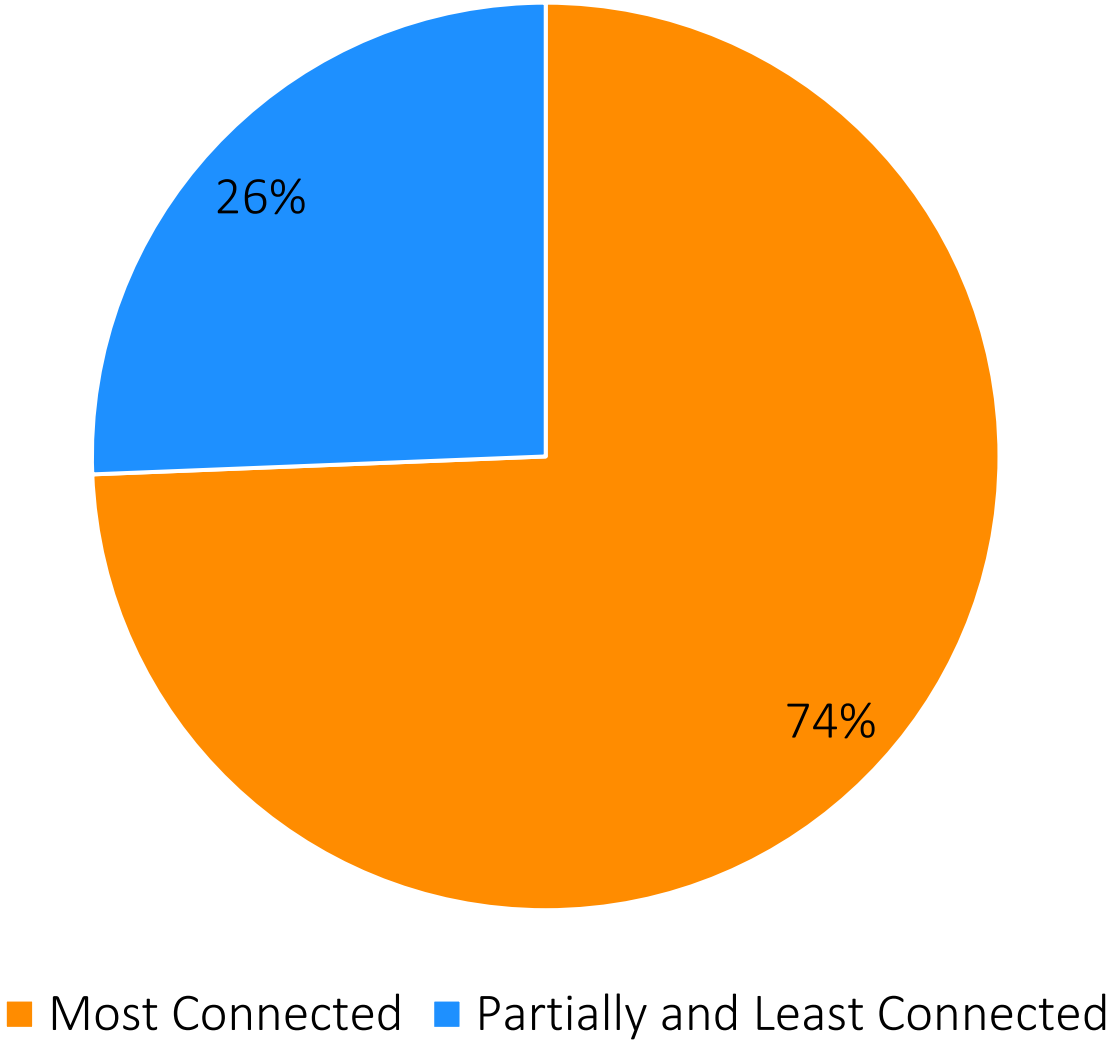


High biodiversity when have high habitat diversity

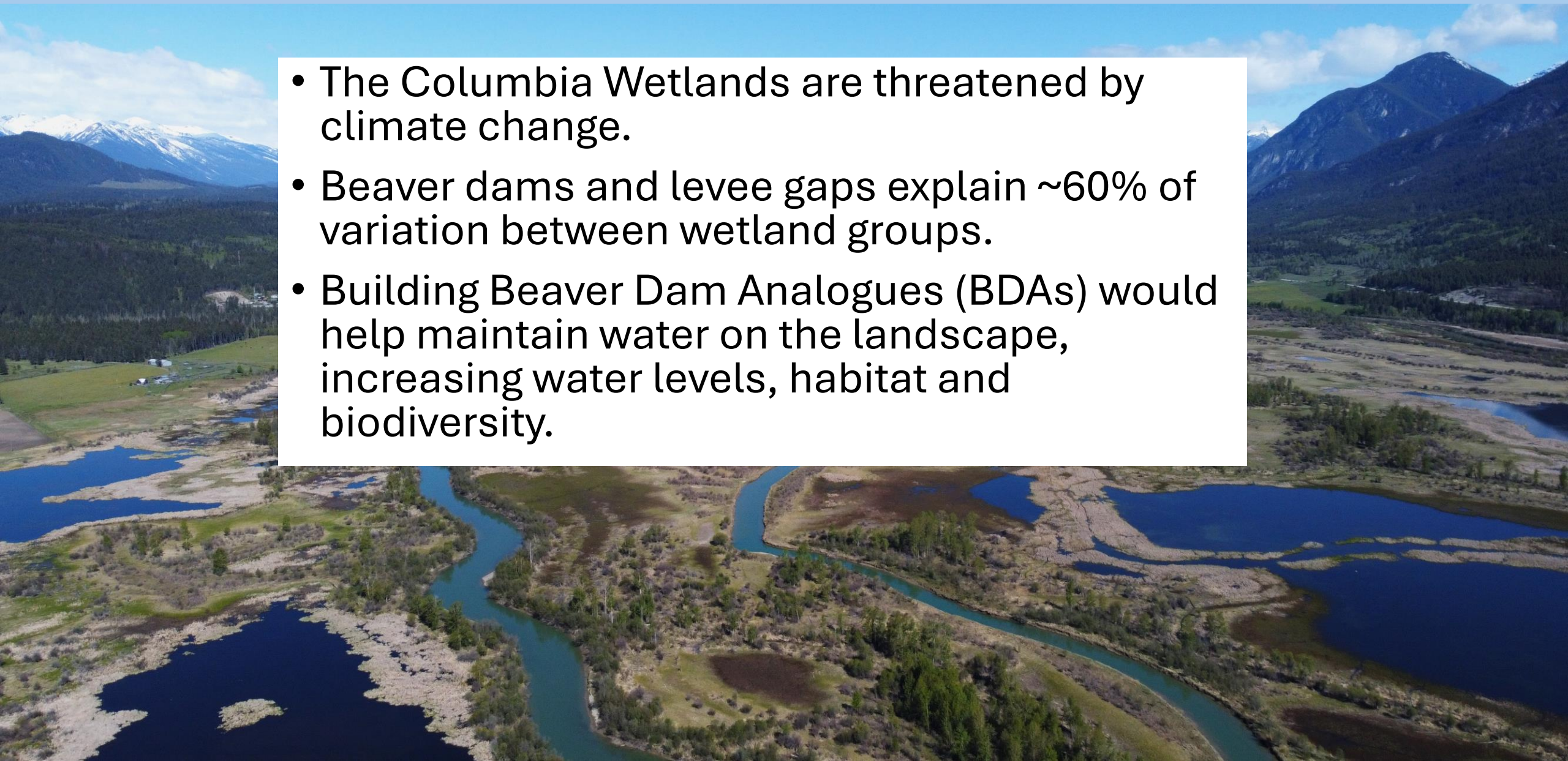
Most Connected Wetlands make up 74% of the Columbia Wetlands



Partially and Least Connected Wetlands Are 26% of the Columbia Wetlands



Key Takeaways



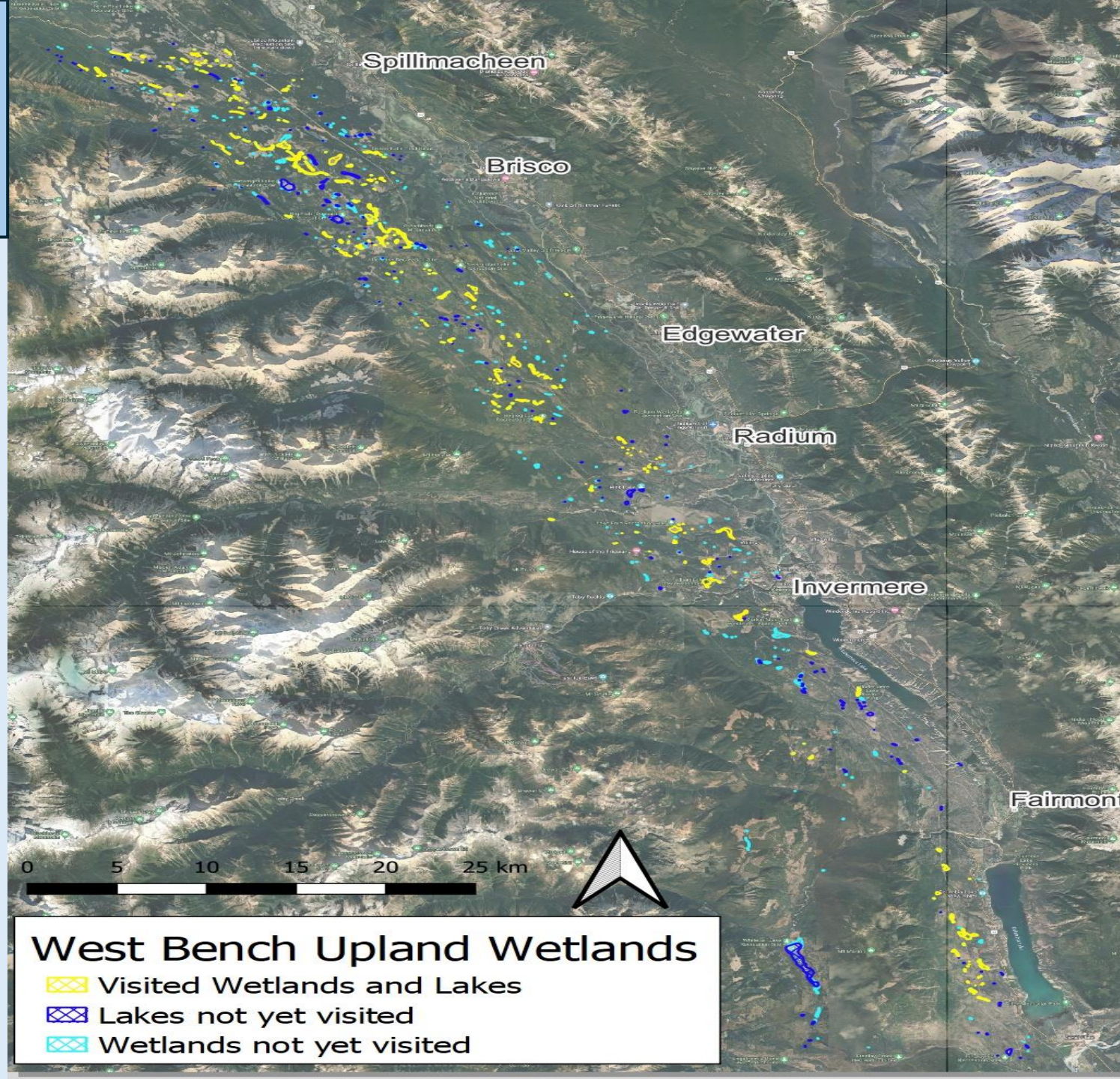
- The Columbia Wetlands are threatened by climate change.
- Beaver dams and levee gaps explain ~60% of variation between wetland groups.
- Building Beaver Dam Analogues (BDAs) would help maintain water on the landscape, increasing water levels, habitat and biodiversity.

What is the effect of climate change on small benchland wetlands of the Columbia Valley?

BC Freshwater Atlas lakes and wetlands on western benchlands of Columbia Valley

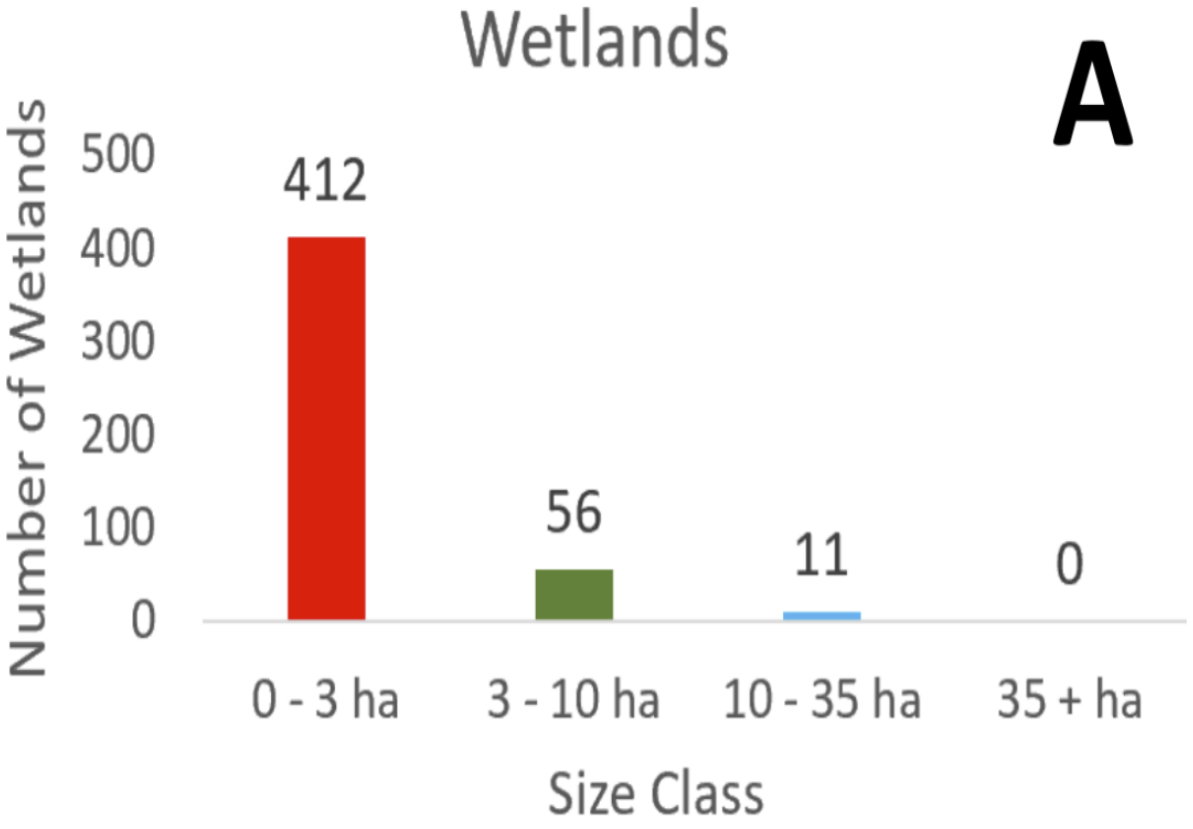
- We assessed 45% of the 828 lakes and wetlands between Spillimacheen and Canal Flats!

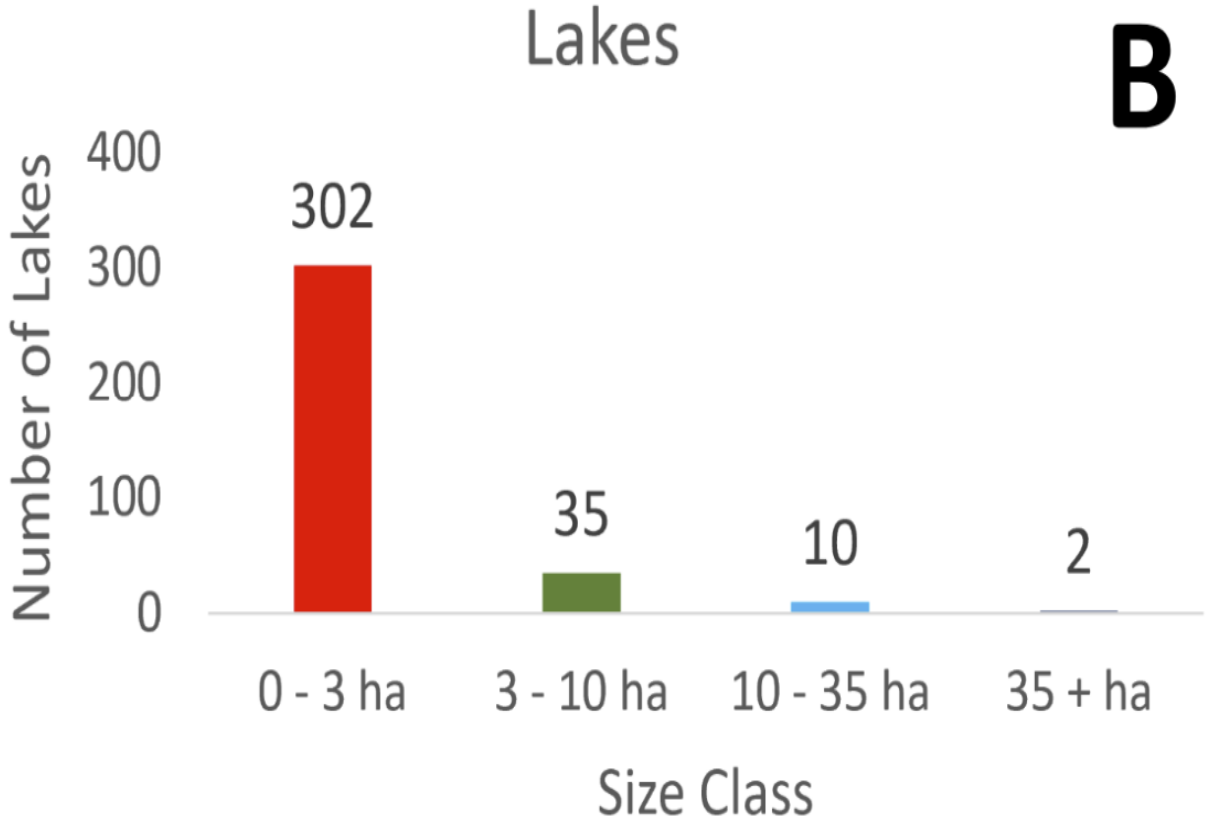
- Assessed 214 of the 479 FWA wetlands
- Assessed 136 of the 349 FWA lakes



Most wetlands and lakes in the Columbia Valley are small: less than 3 hectares

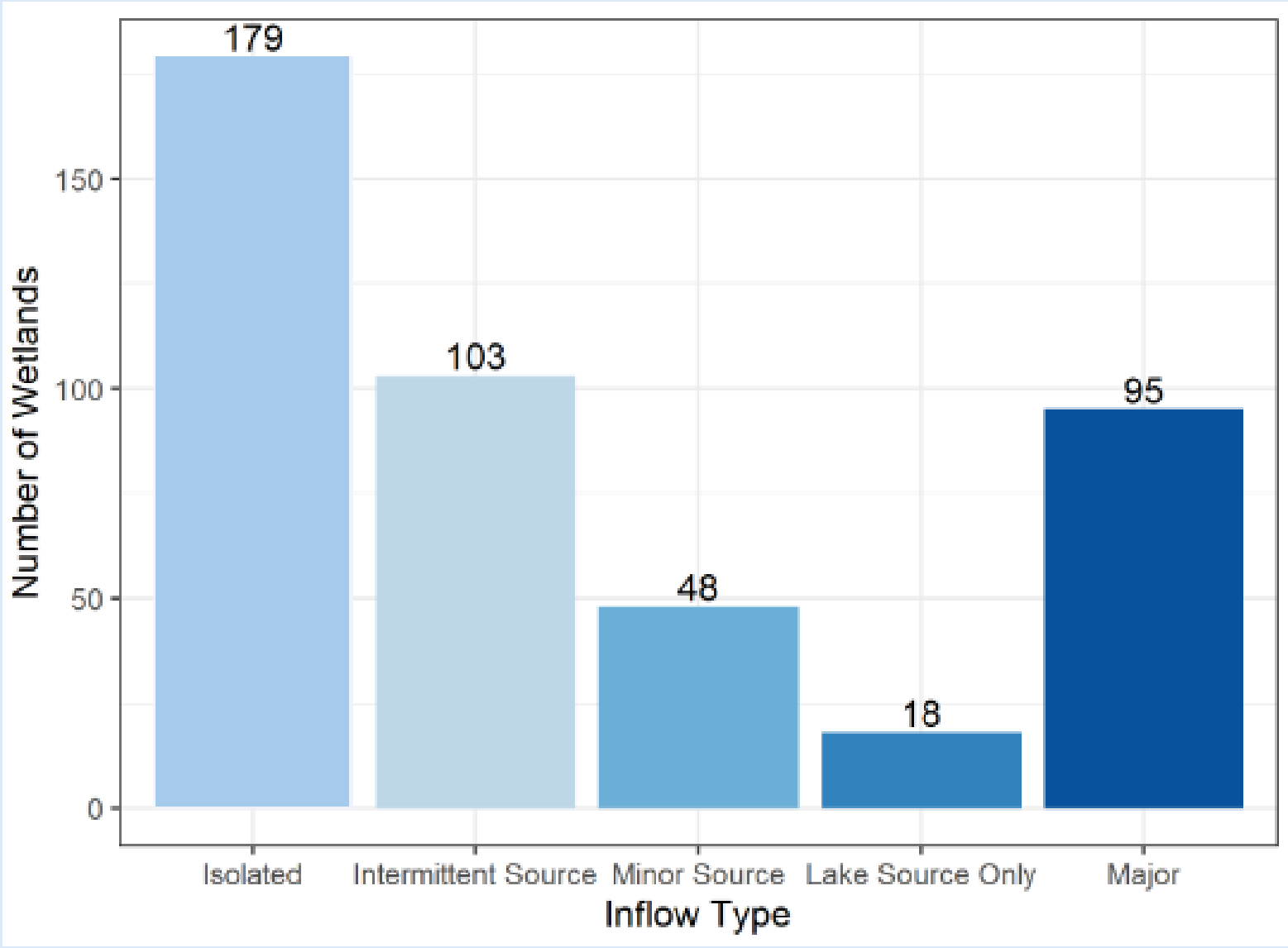
BC Freshwater Atlas (FWA) lakes and wetlands on the western upland bench of the Columbia Valley between Canal Flats and Spillimacheen. A= 479 wetlands; B=349 lakes.



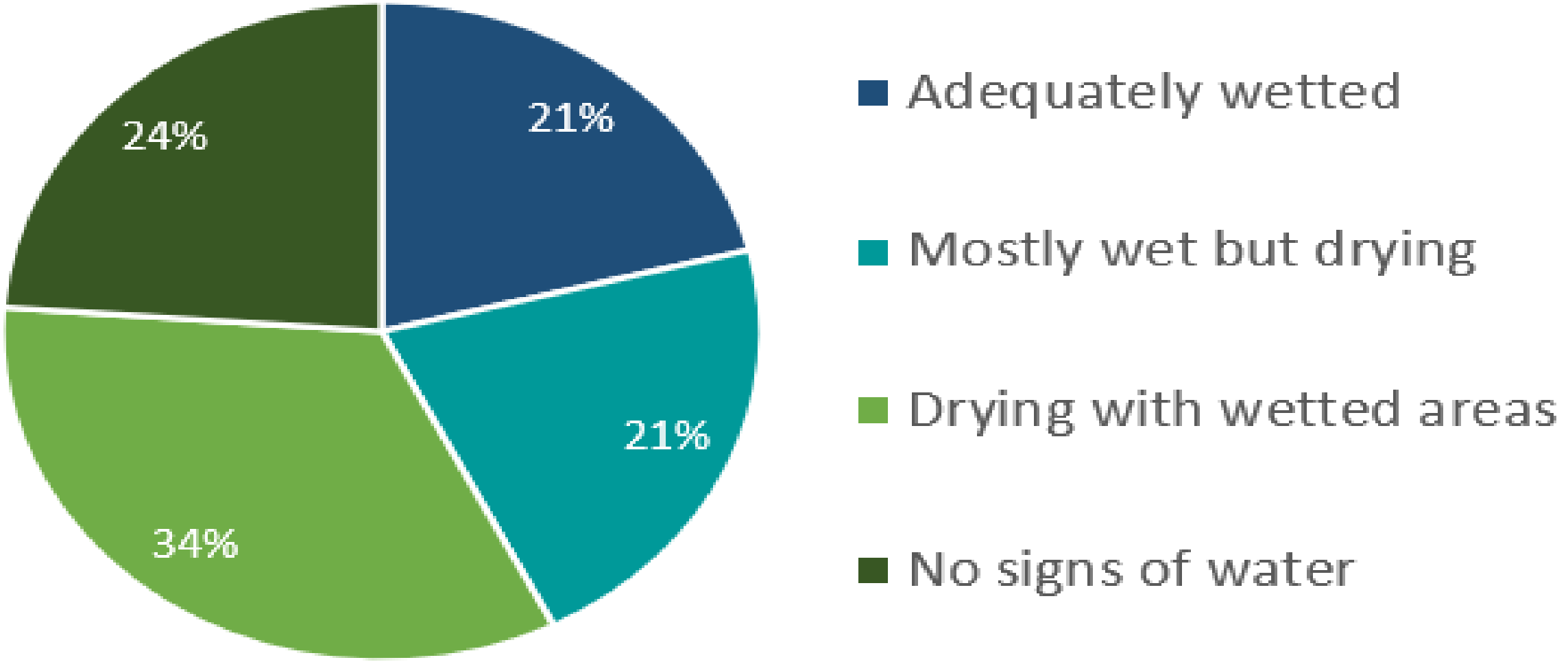


Wetland Water Sources

- Water source is crucial to current and future status of wetlands
- Many wetlands are isolated



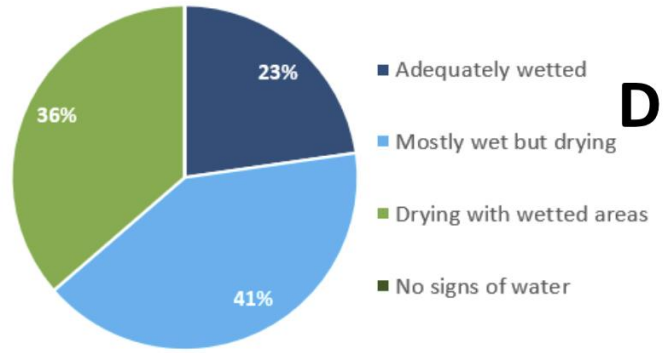
Are the benchland wetlands drying?
79% of 214 wetlands showed evidence of lack of water

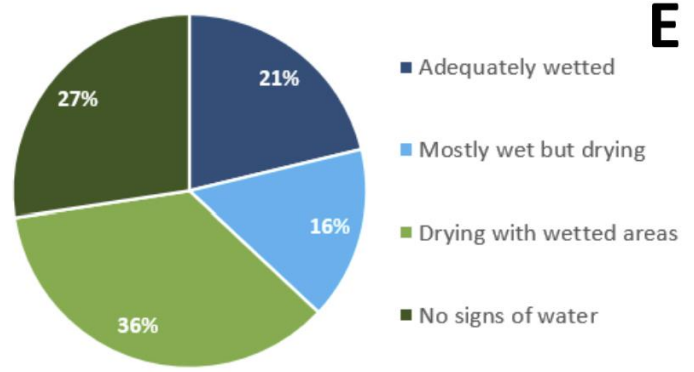


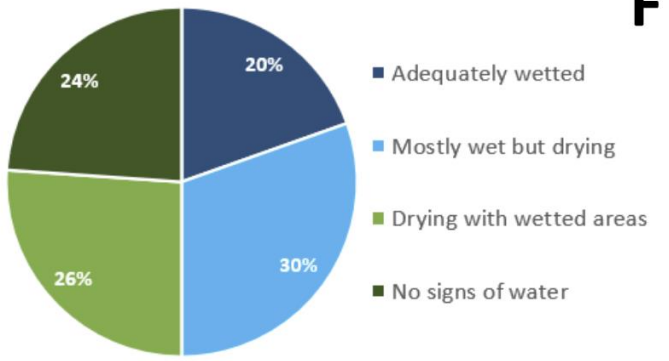
How does the Hydro Geographical location of wetlands affect them?

Wetlands can be:

- Adjacent to lakes
- Along streams and rivers
- Isolated from surface water source

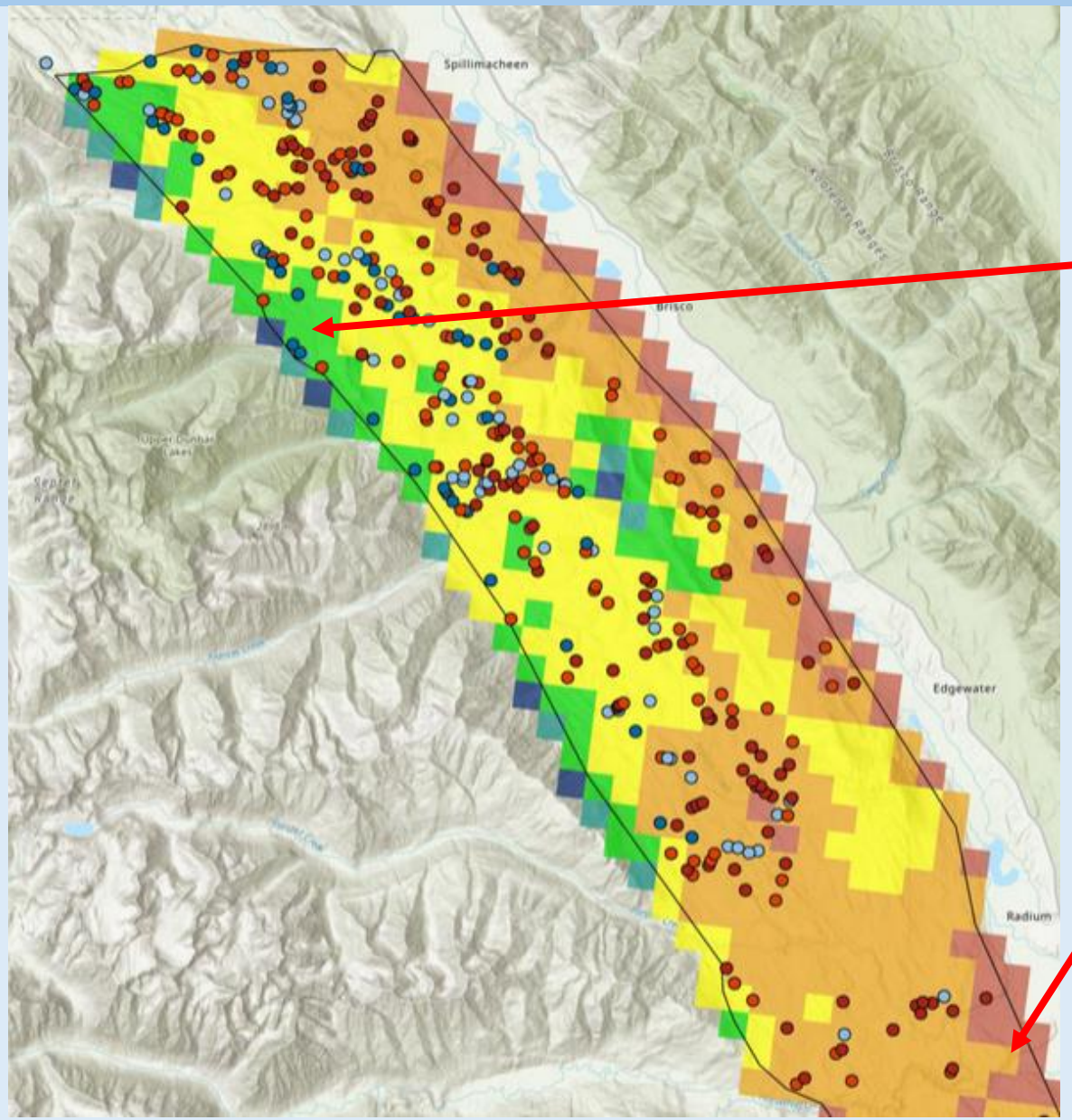






A Strong Climate Gradient: Drier In The South

- Whole area is dry!
- But further south is drier.



Blue/Green = Wetter

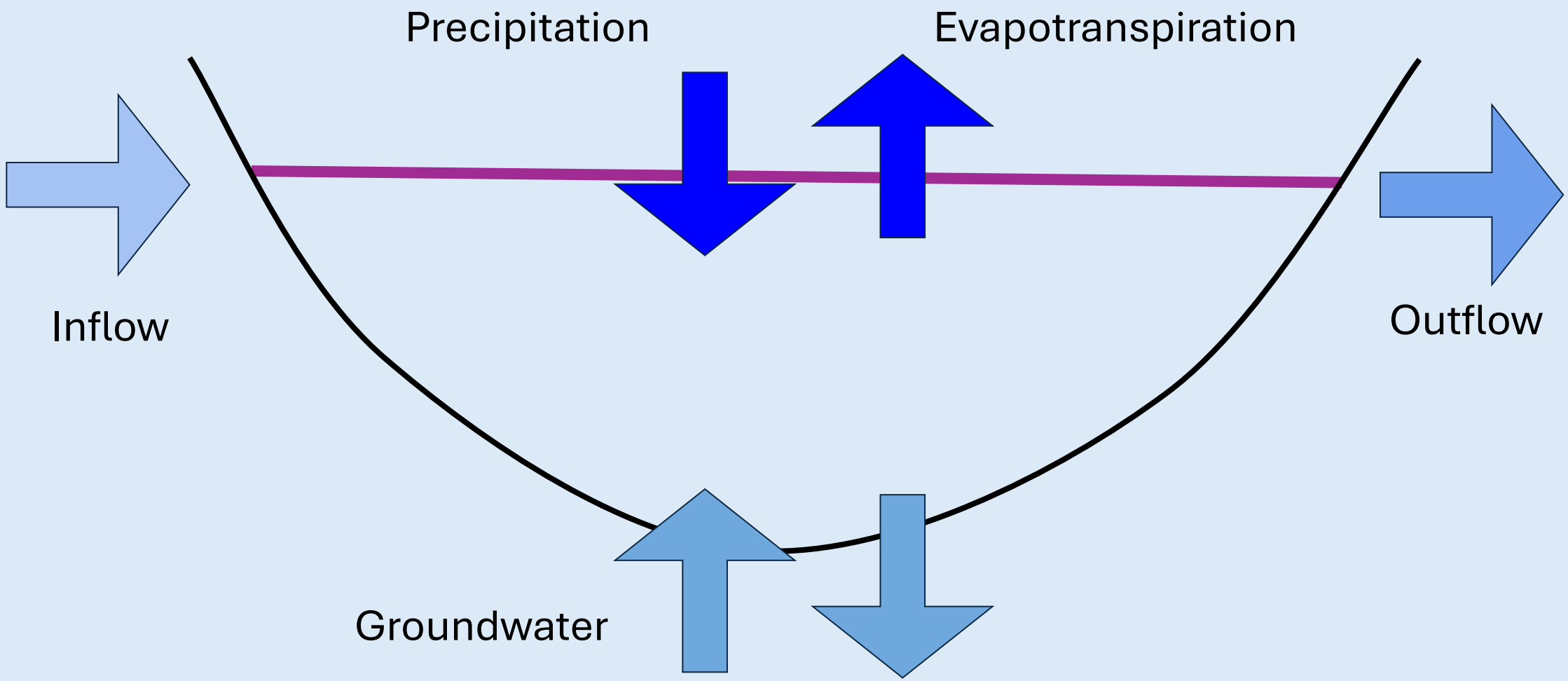
Orange/Red = Drier

Wetlands West of Columbia Lake are drying

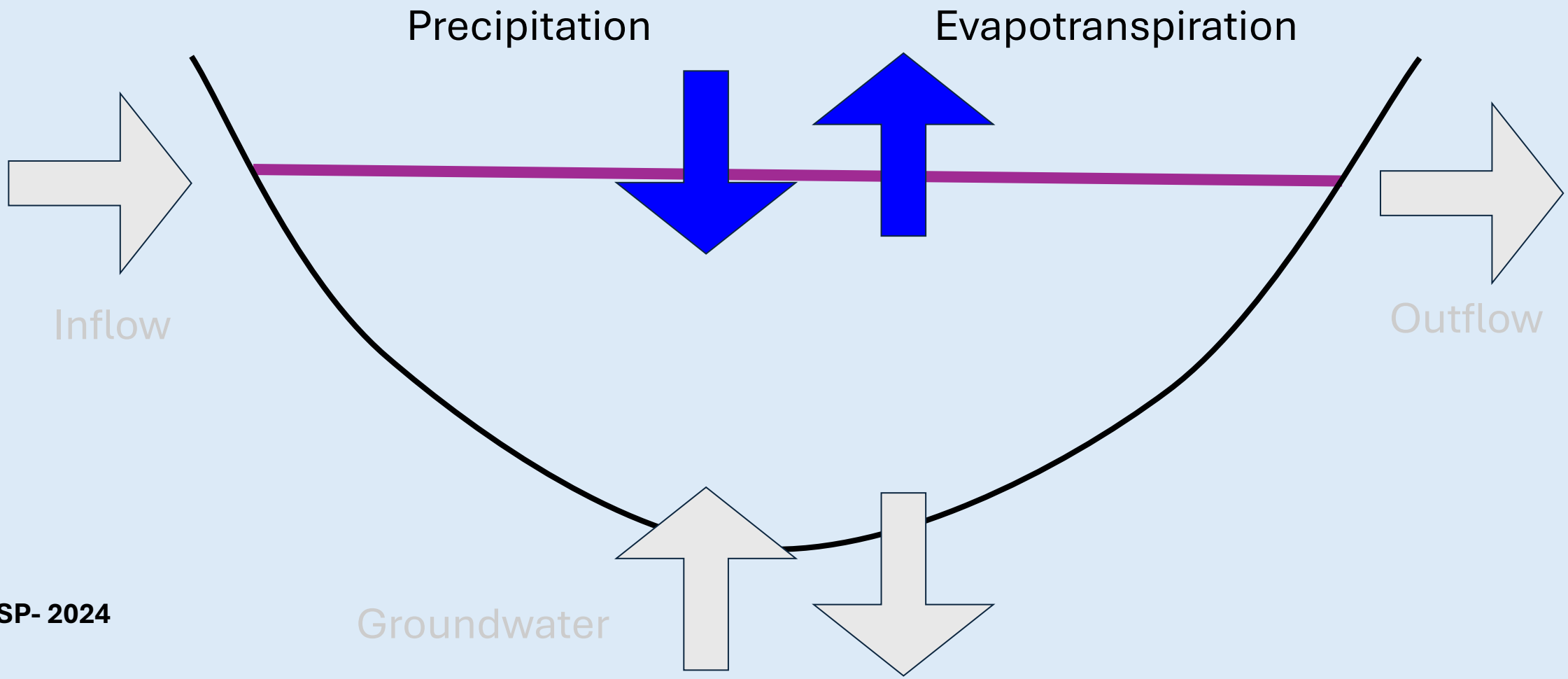
Wetlands West of Columbia Lake are drying

Sun Lake west of Columbia Lake is drying

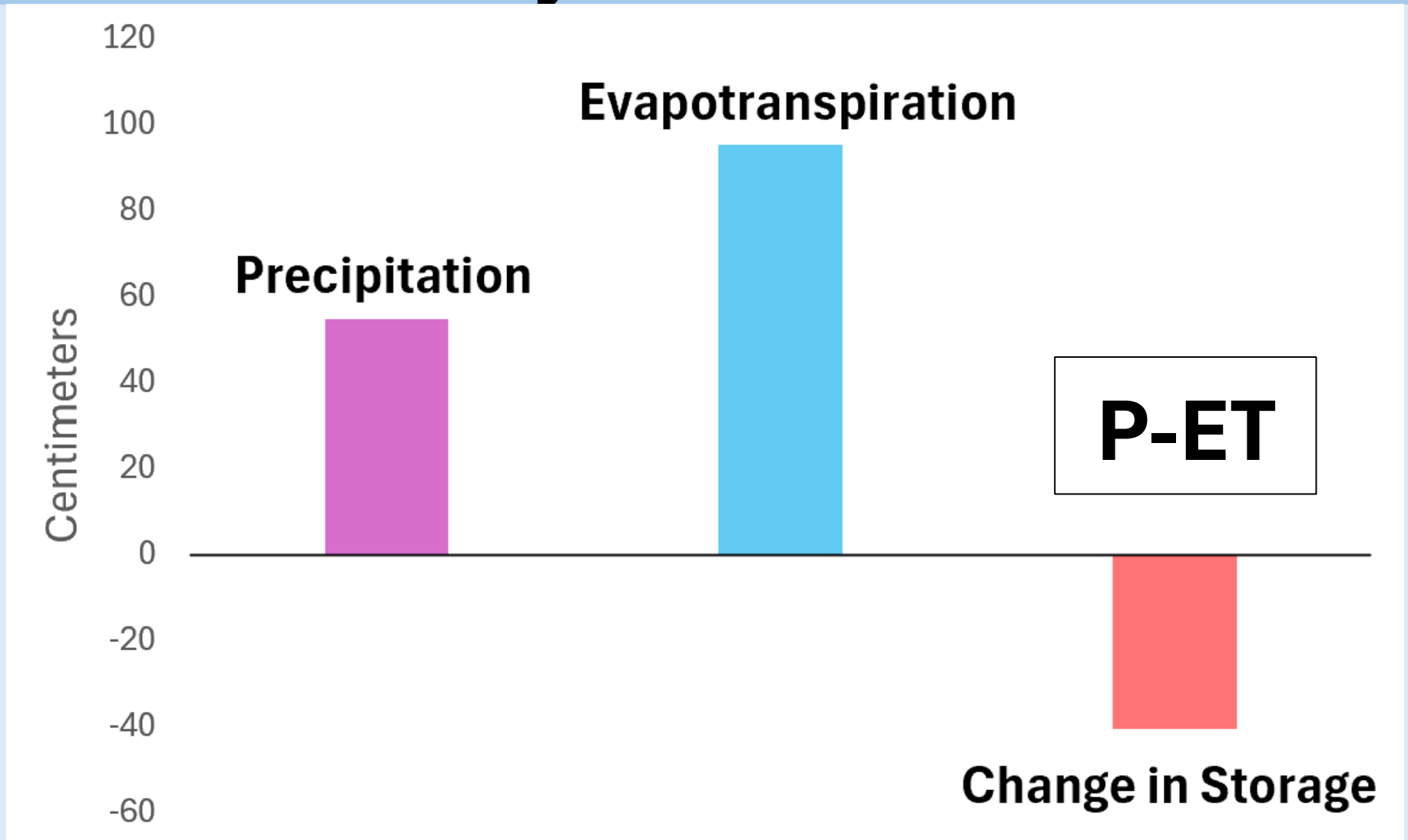
Water Balance of lakes and wetlands



Lakes & wetlands will dry up without surface or groundwater source

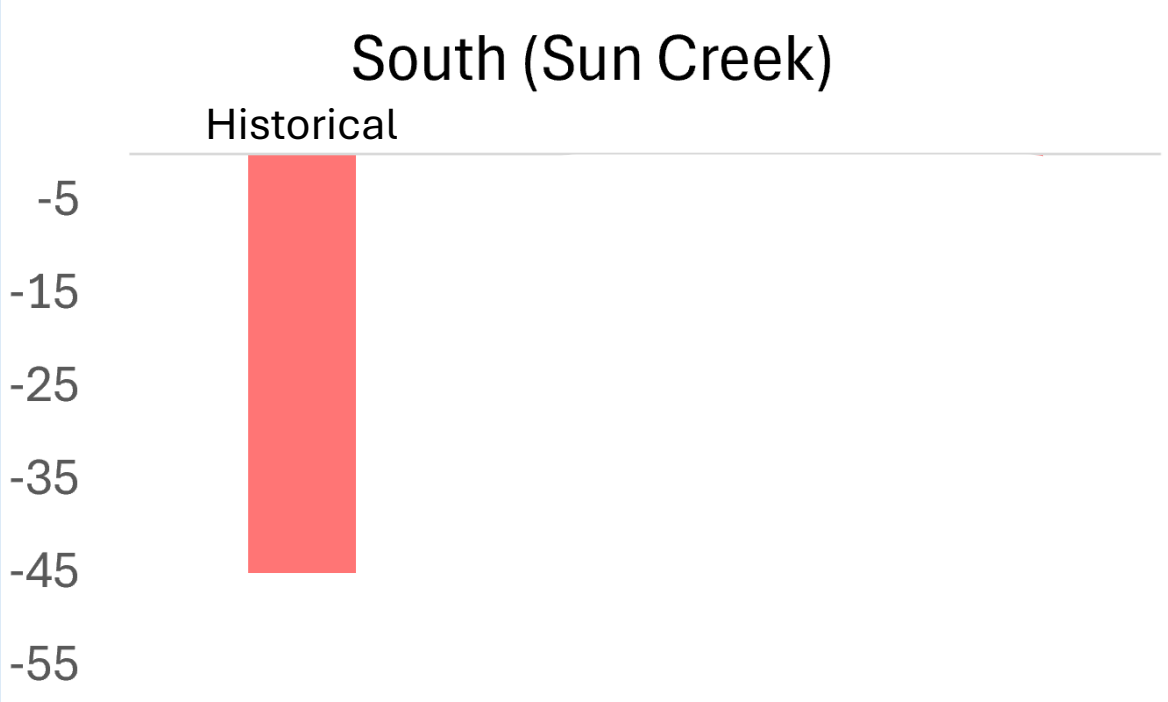


Moisture Deficit in East Kootenay
ET exceeds Precipitation by 20 – 40 cm each year *now*



Moisture Deficit in North and South of Study Area

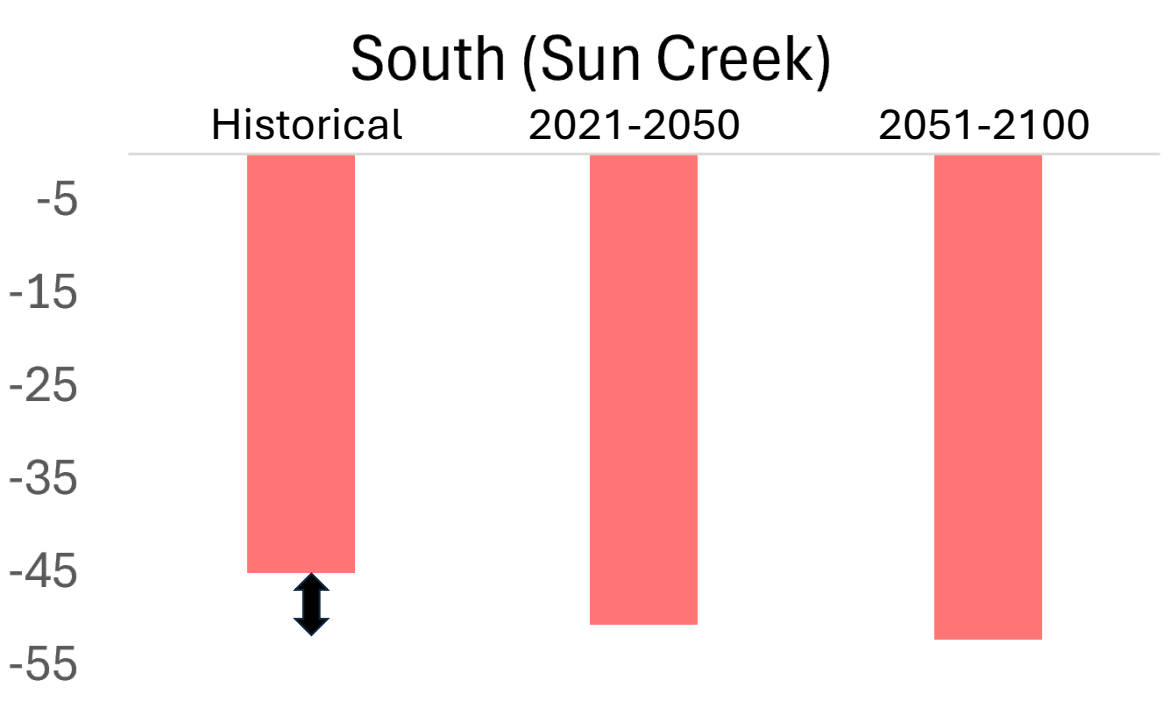
West of Columbia Lake area
~45 cm deficit now



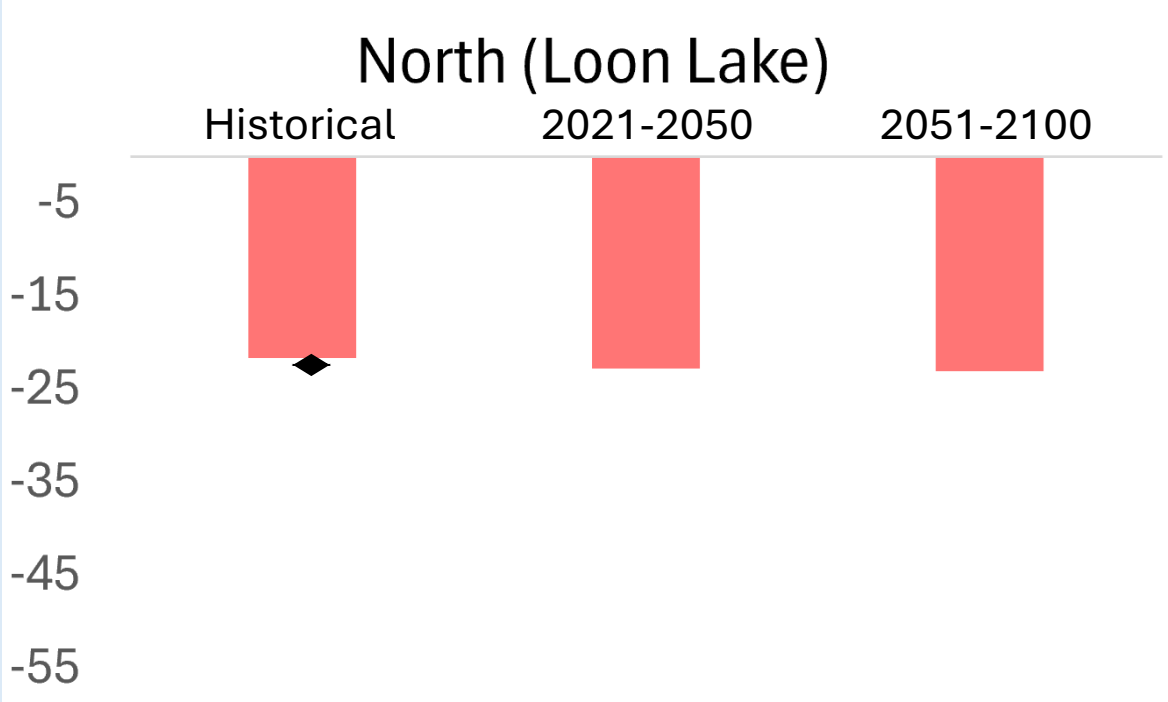
Brisco/Spillimacheen area
~21 cm deficit now

Moisture deficit with climate change by region

52 cm deficit by 2100



22 cm deficit by 2100

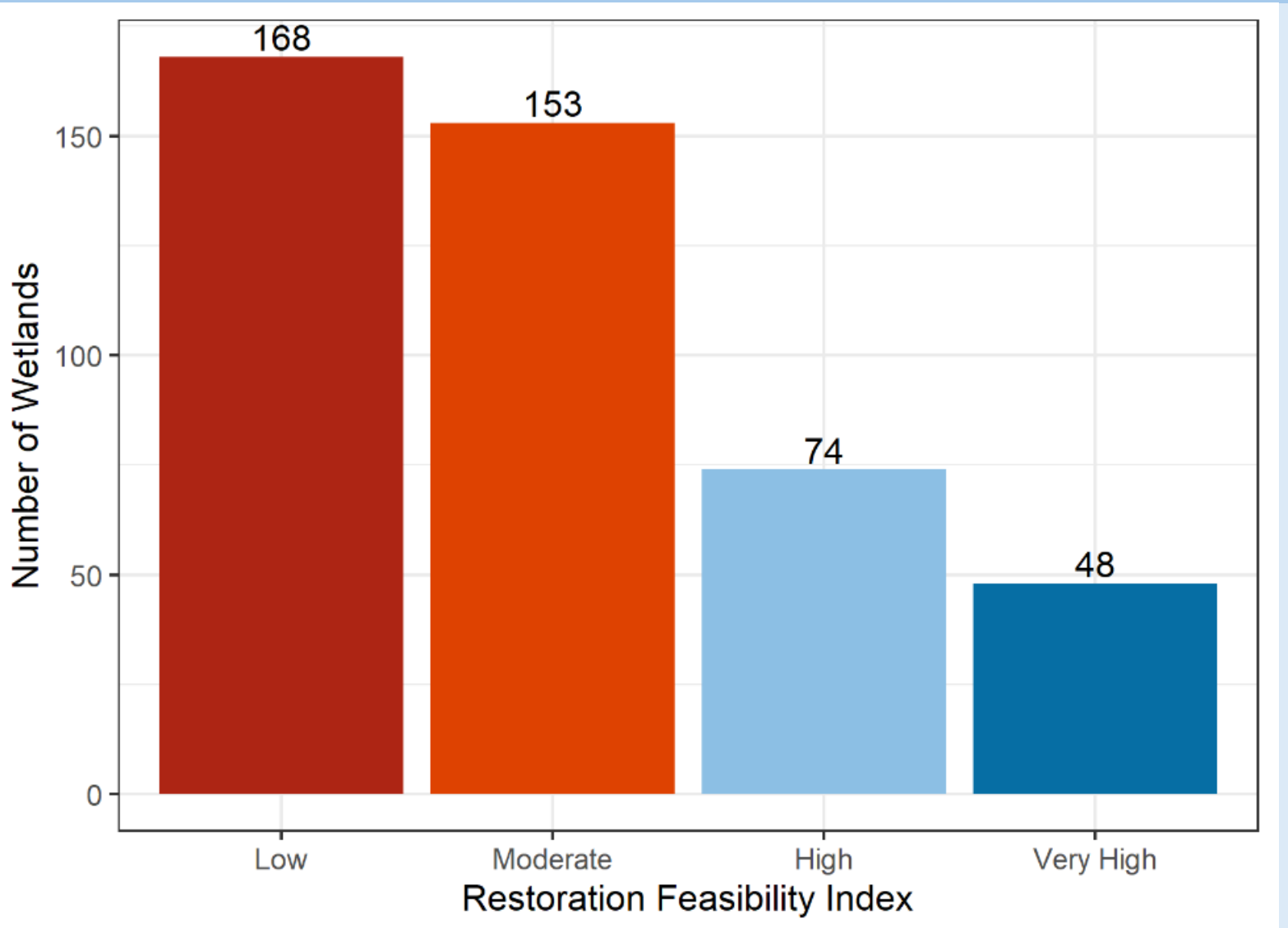


To restore wetlands, *must* have a surface water or groundwater source

CWSP, 2024

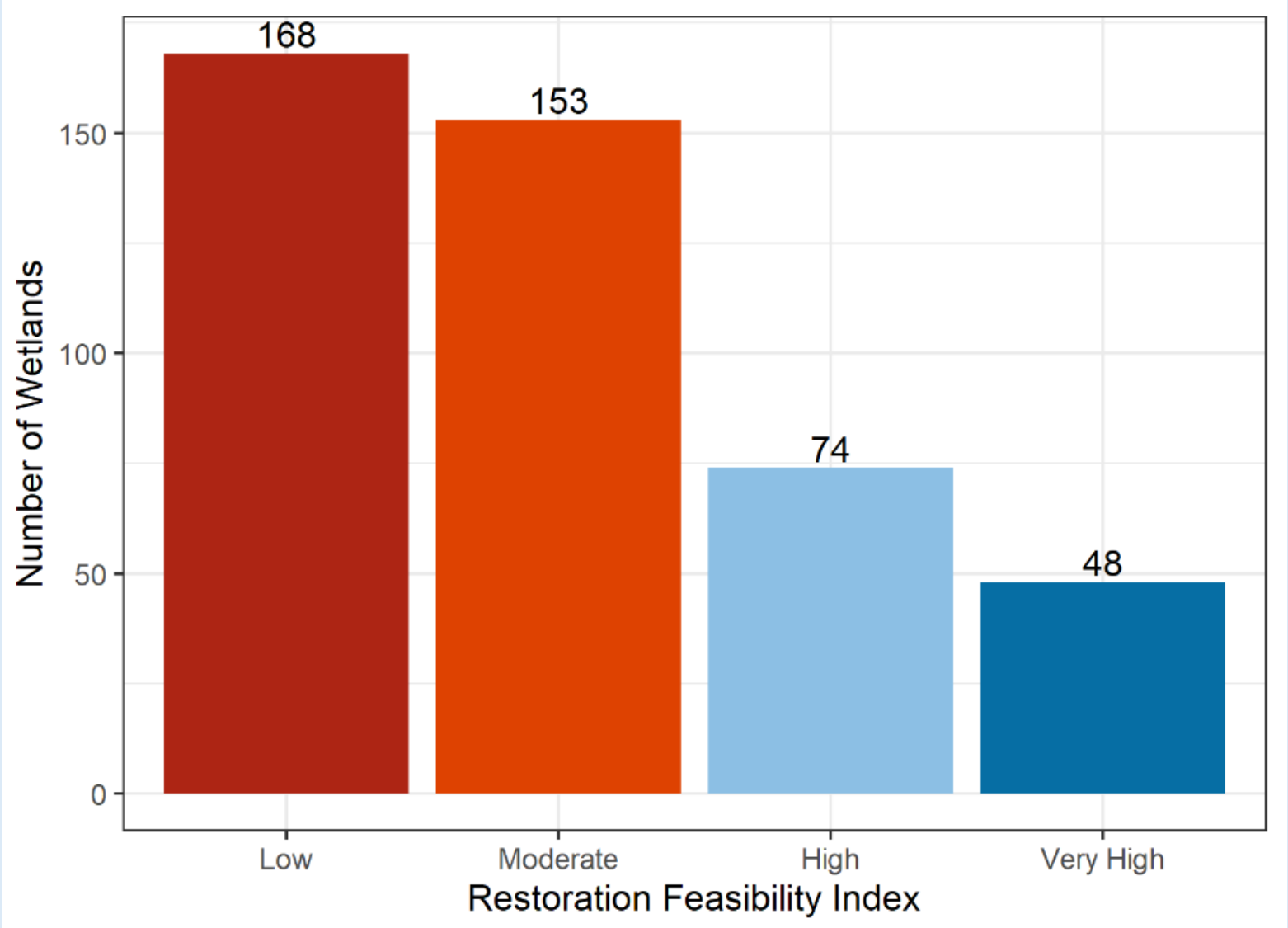
Wetland Restoration Feasibility Index

Can help determine if a wetland restoration will be successful.



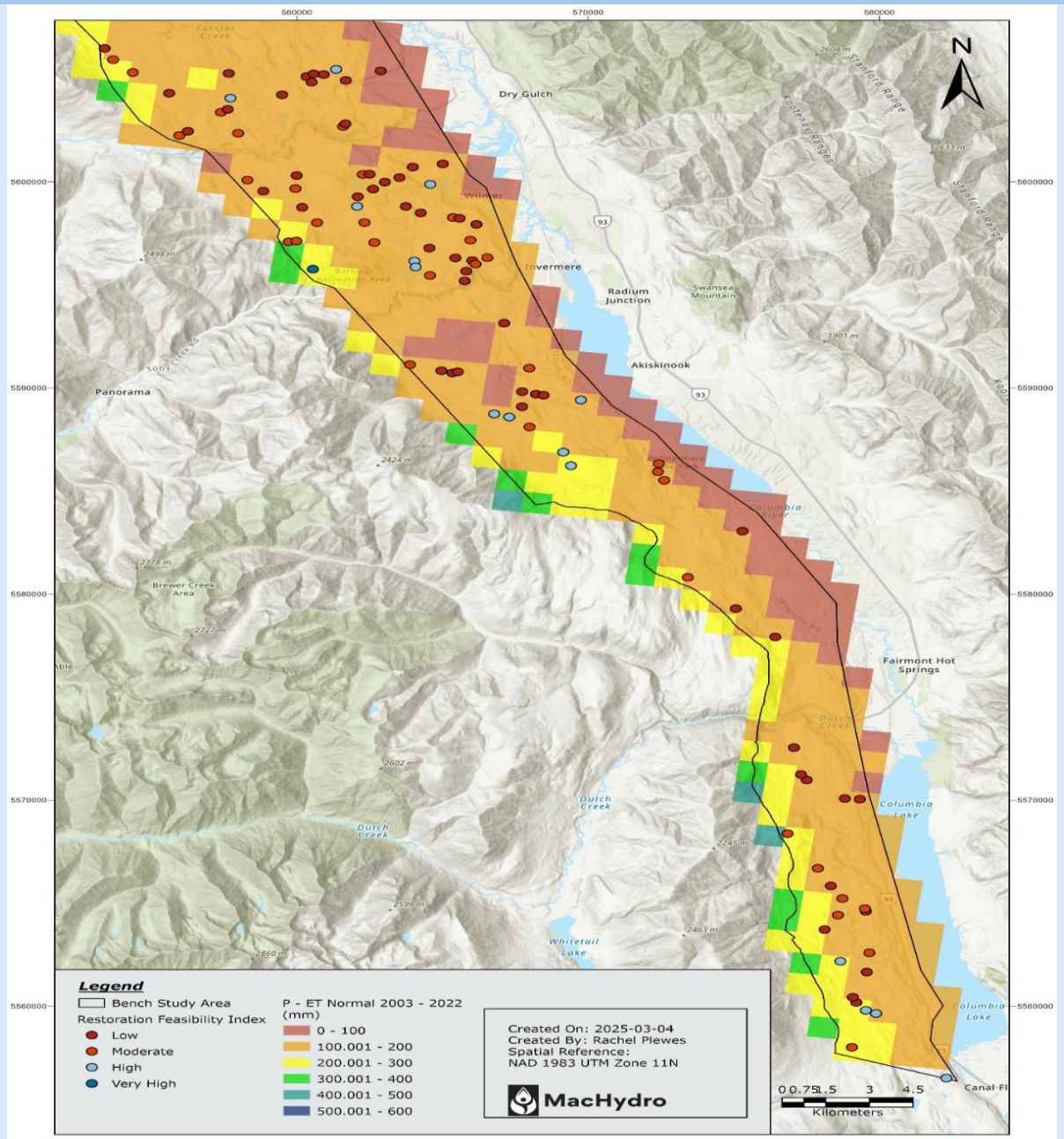
Wetland Restoration Feasibility Index

- Made from:
  - Wetness Index
  - Precipitation – Evapotranspiration
  - Inflow Source
- Indicates that many wetlands may be hard to restore
- Fieldwork in 2025 to verify this model.



Wetland Restoration Feasibility Index

Individual wetlands assessed with Restoration Feasibility Index and a heat map of the region.



Beaver dams may be able to modify water sources to create wetlands even in naturally dry areas

West of Columbia Lake – Marion Creek Wetland Complex

Key Message: Beaver Dams mitigate climate change by retaining water

West of Columbia Lake – Marion Creek Wetland Complex

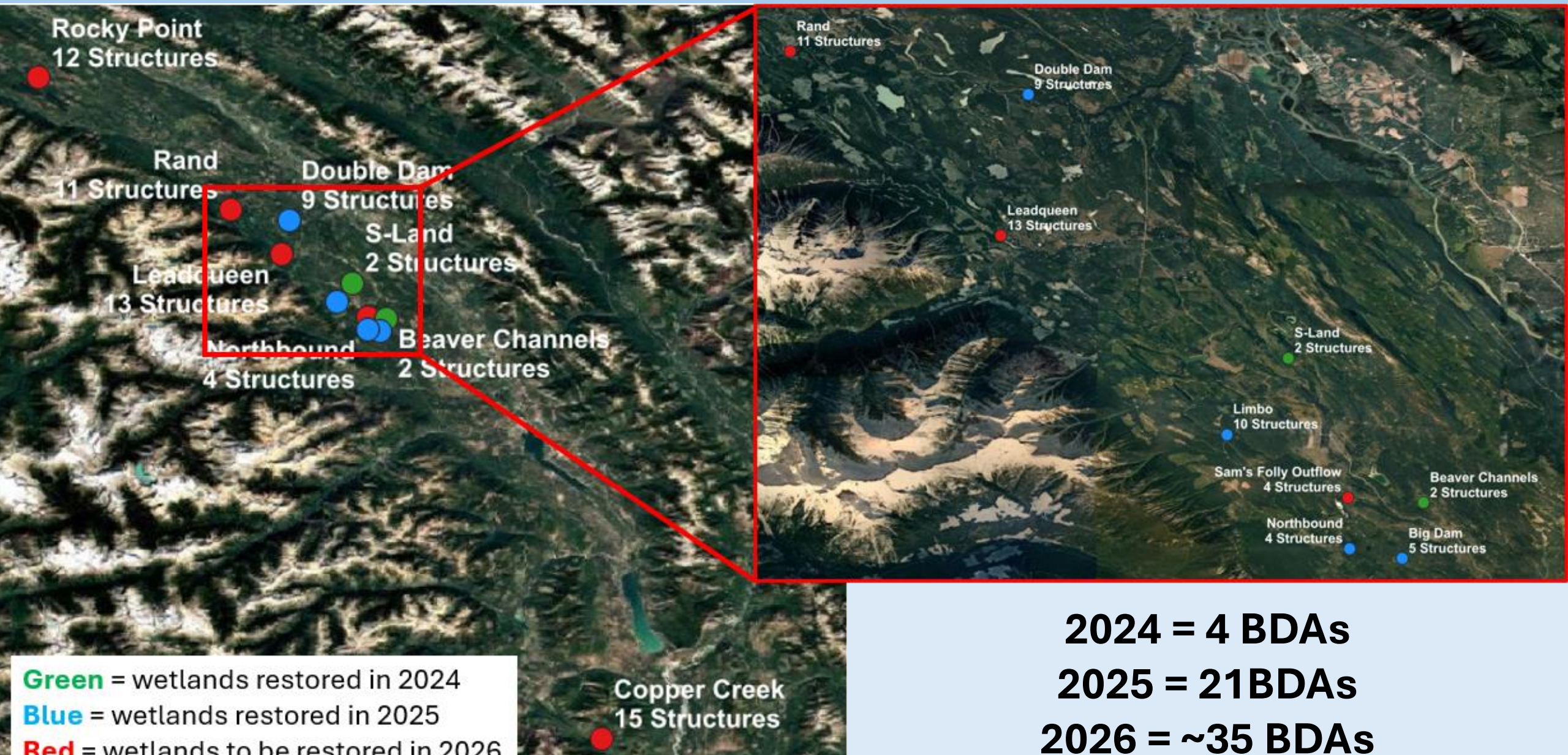
Beaver dams provide riparian habitat for wildlife corridors

West of Columbia Lake – Marion Creek Wetland Complex

Beaver Dam Analogues – Mimics Natural Beaver Dams

- Low-tech solution
- Made with natural materials
- Not necessary for beaver to return to site
- Stores water, reconnects floodplains
- Supplies ground water
- Creates wetland habitat for plants, wildlife and fish
- Provides riparian habitat for wildlife corridors
- Two approaches:
  - Repair old beaver dams
  - Create new dams

CWSP BDA sites



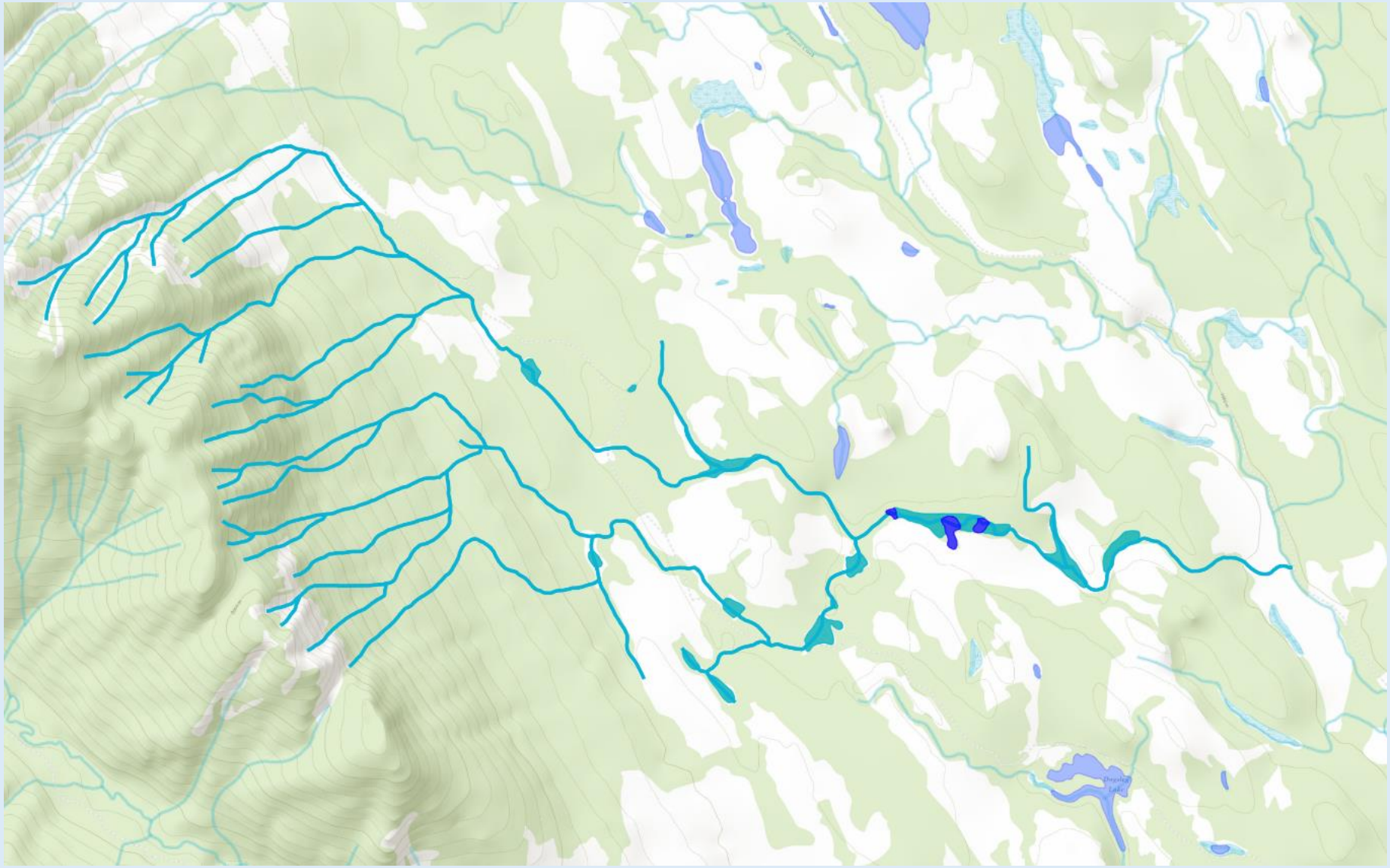
2024 = 4 BDAs

2025 = 21BDAs

2026 = ~35 BDAs

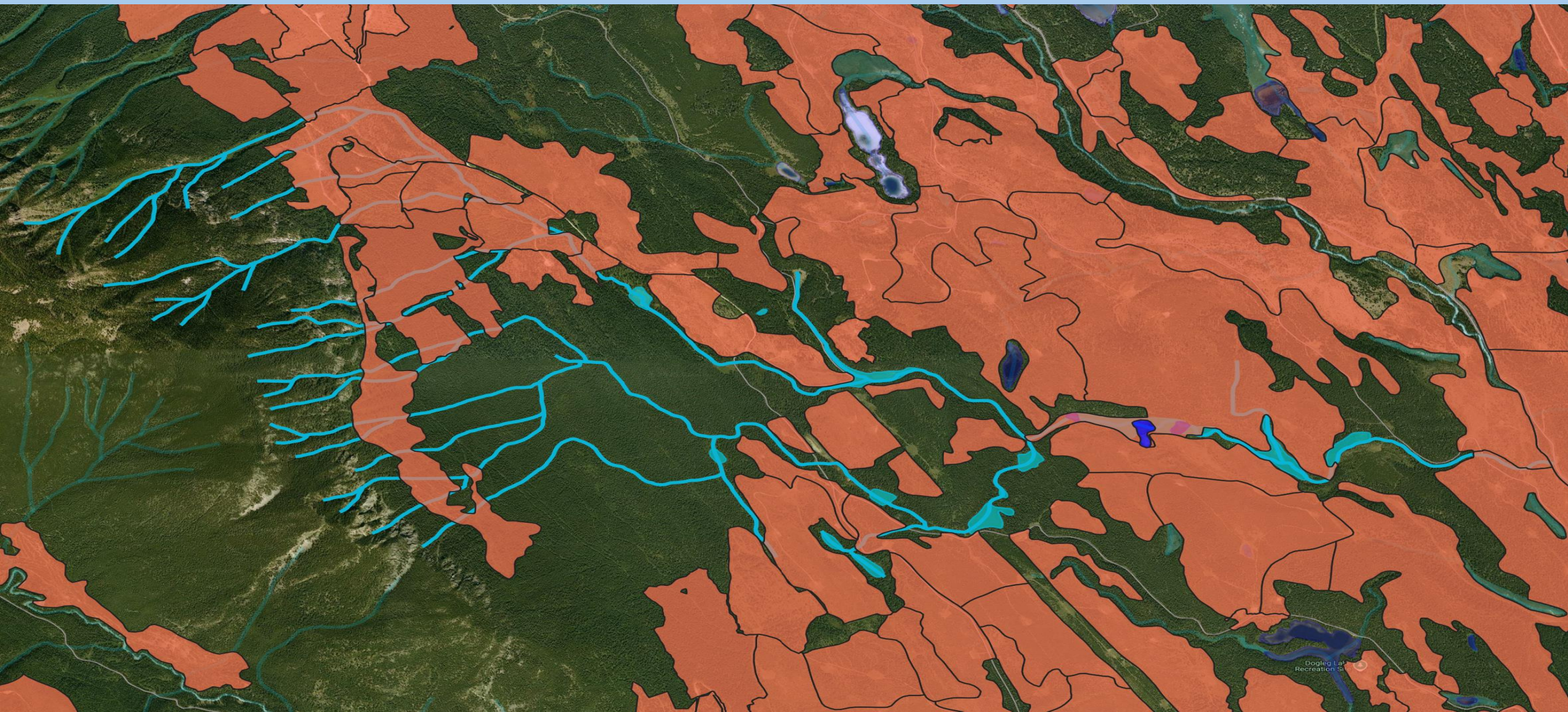
Riverscape Restoration Approach

- Many small wetlands along small streams



Site Selection for Riverscape Restoration

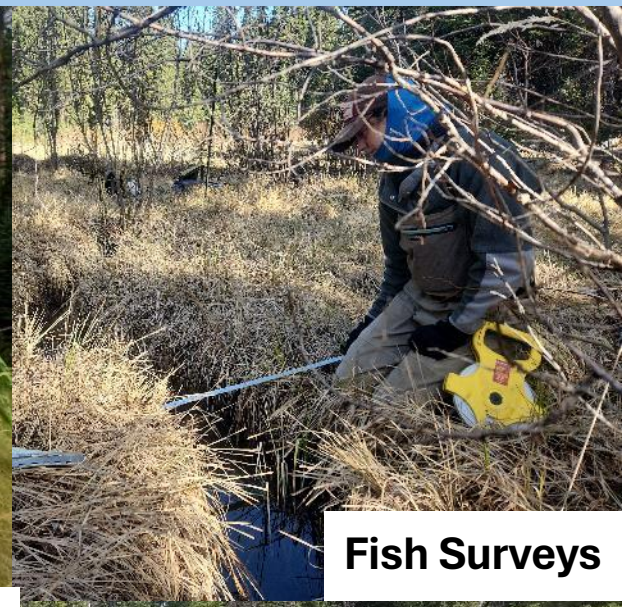
Logging and cut blocks occur throughout region:
unknown contribution to loss of water and loss of beaver



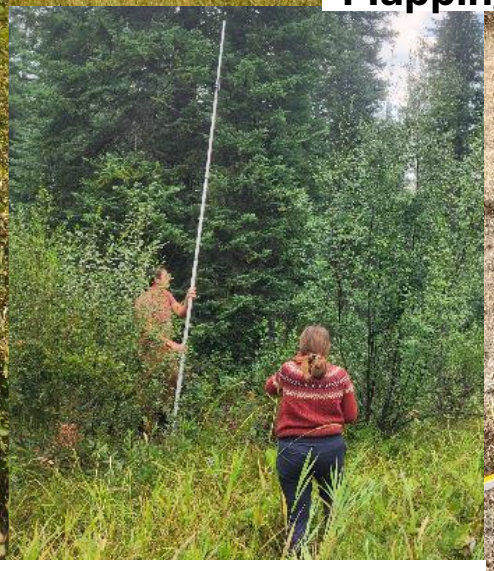
Logging and cut blocks occur throughout region:
unknown contribution to loss of water and loss of beaver

Beaver Dam Analogue Planning

Estimate Inundation Area & Mapping



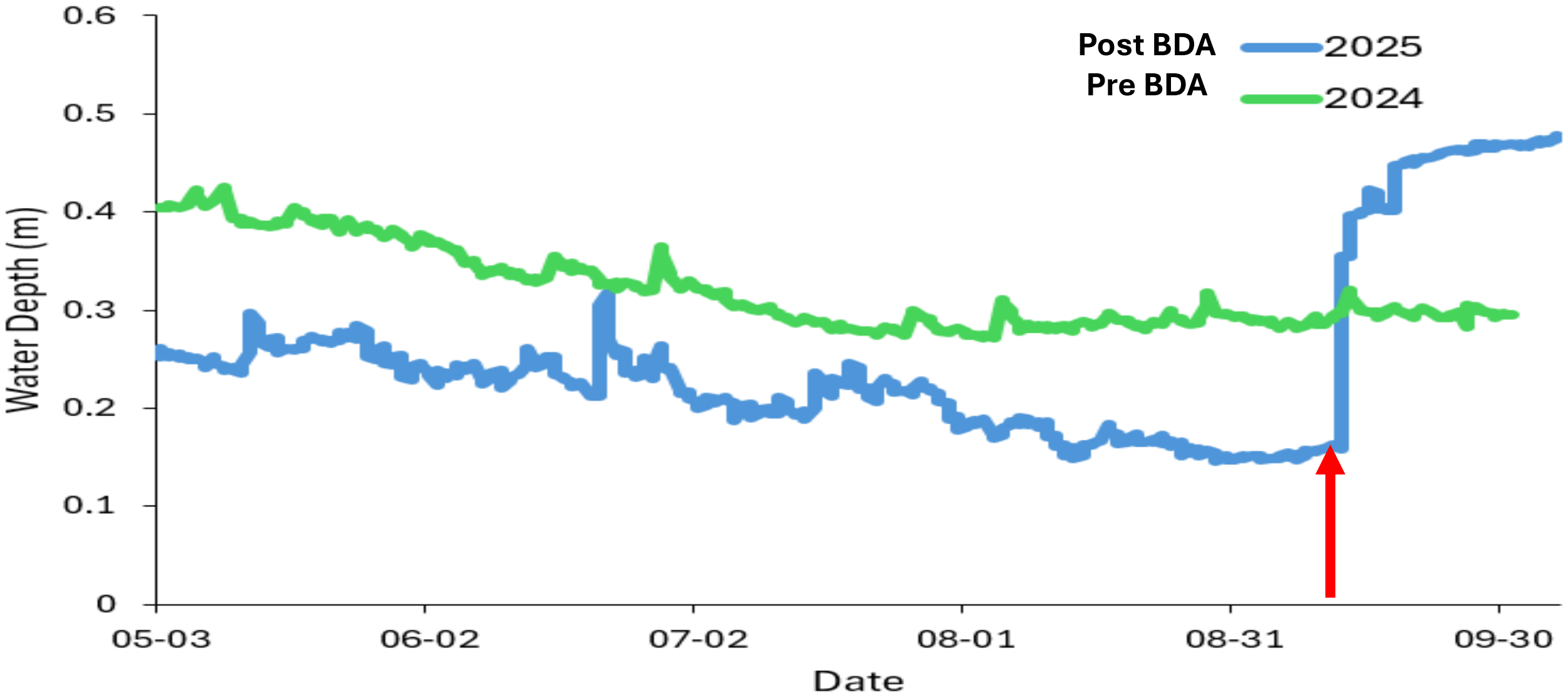
Fish Surveys



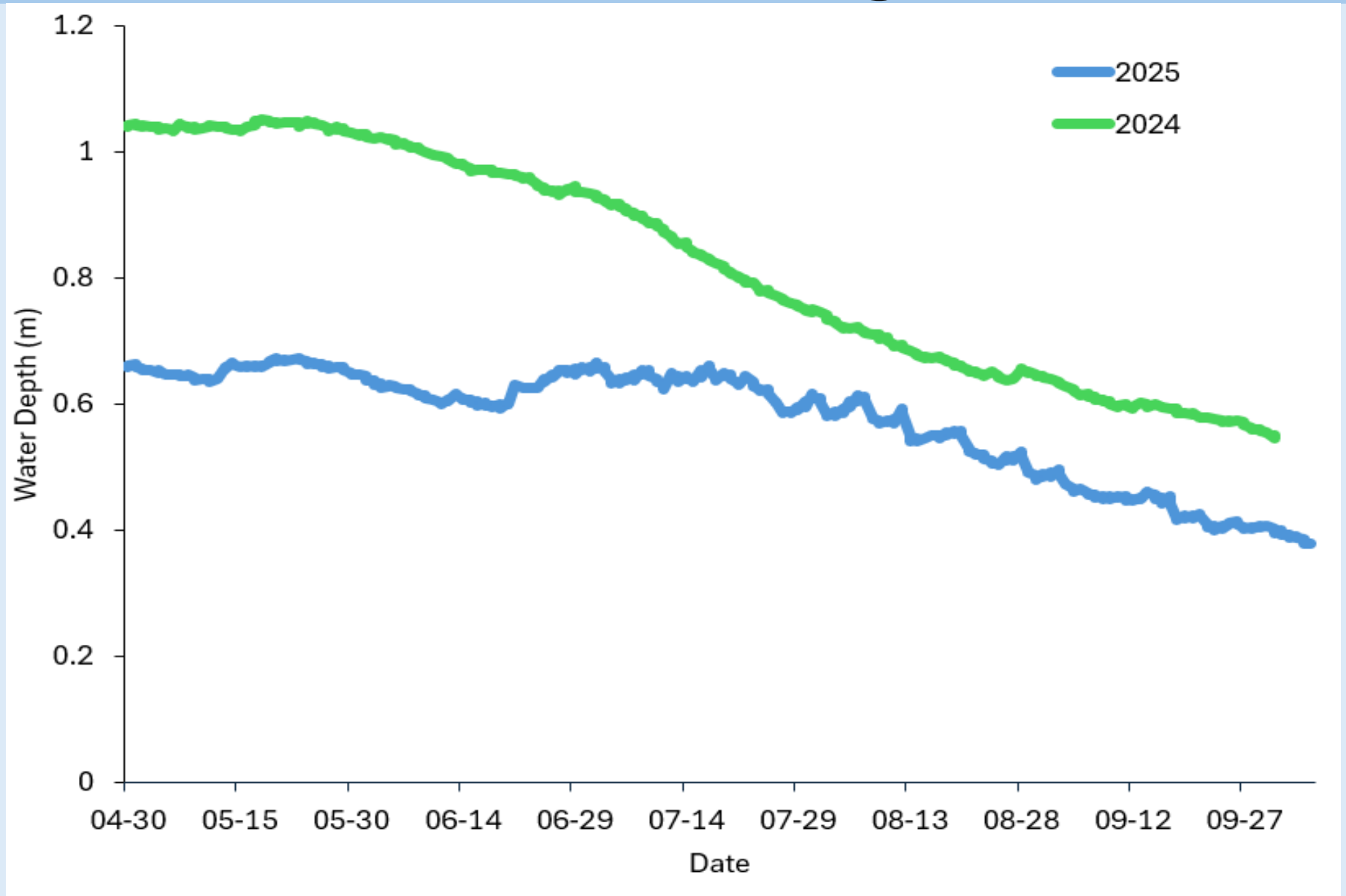
Survey Existing Beaver Dams

Survey Locations for New BDAs

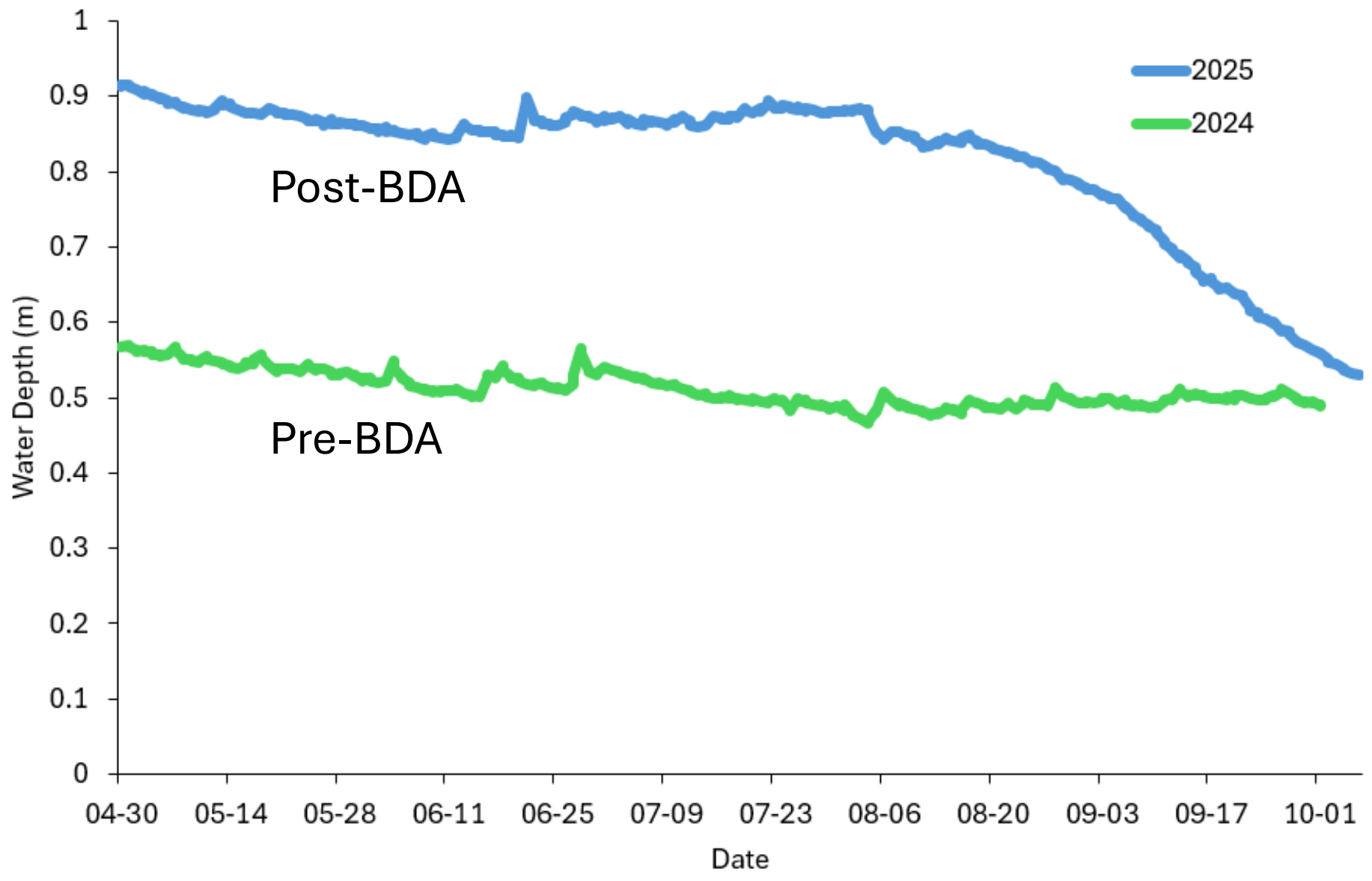
Water monitoring pre and post restoration: effects of drought and BDA



Uplands Reference Wetland 2024 vs 2025: effects of drought

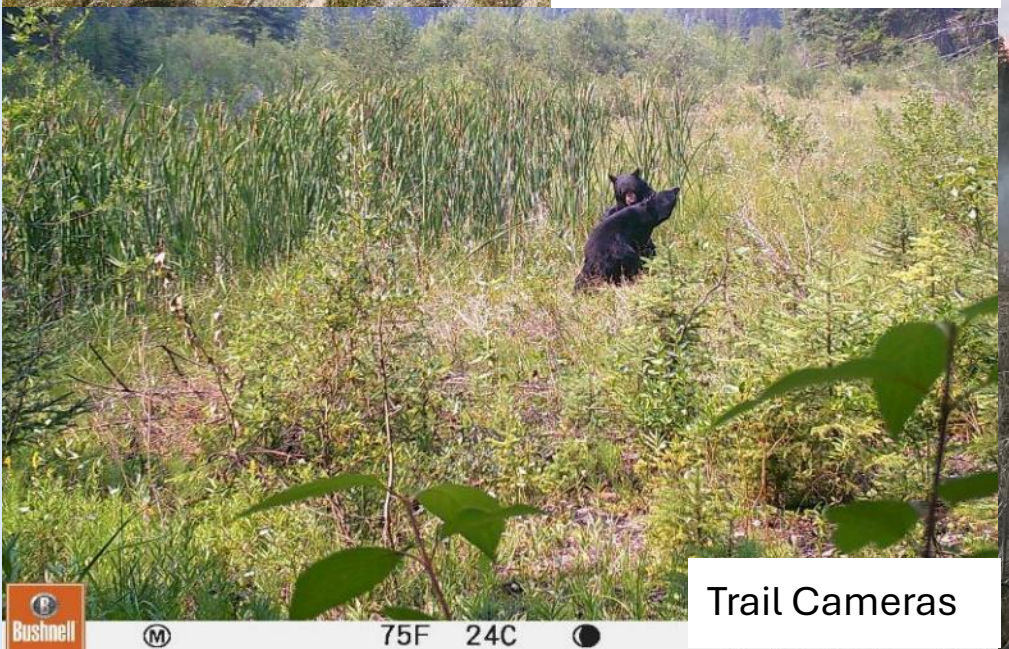


BDA could not mitigate the effects of the drought in 2025



Monitoring: Pre- and Post- Restoration

Vegetation Surveys



Trail Cameras

Breeding Bird Surveys

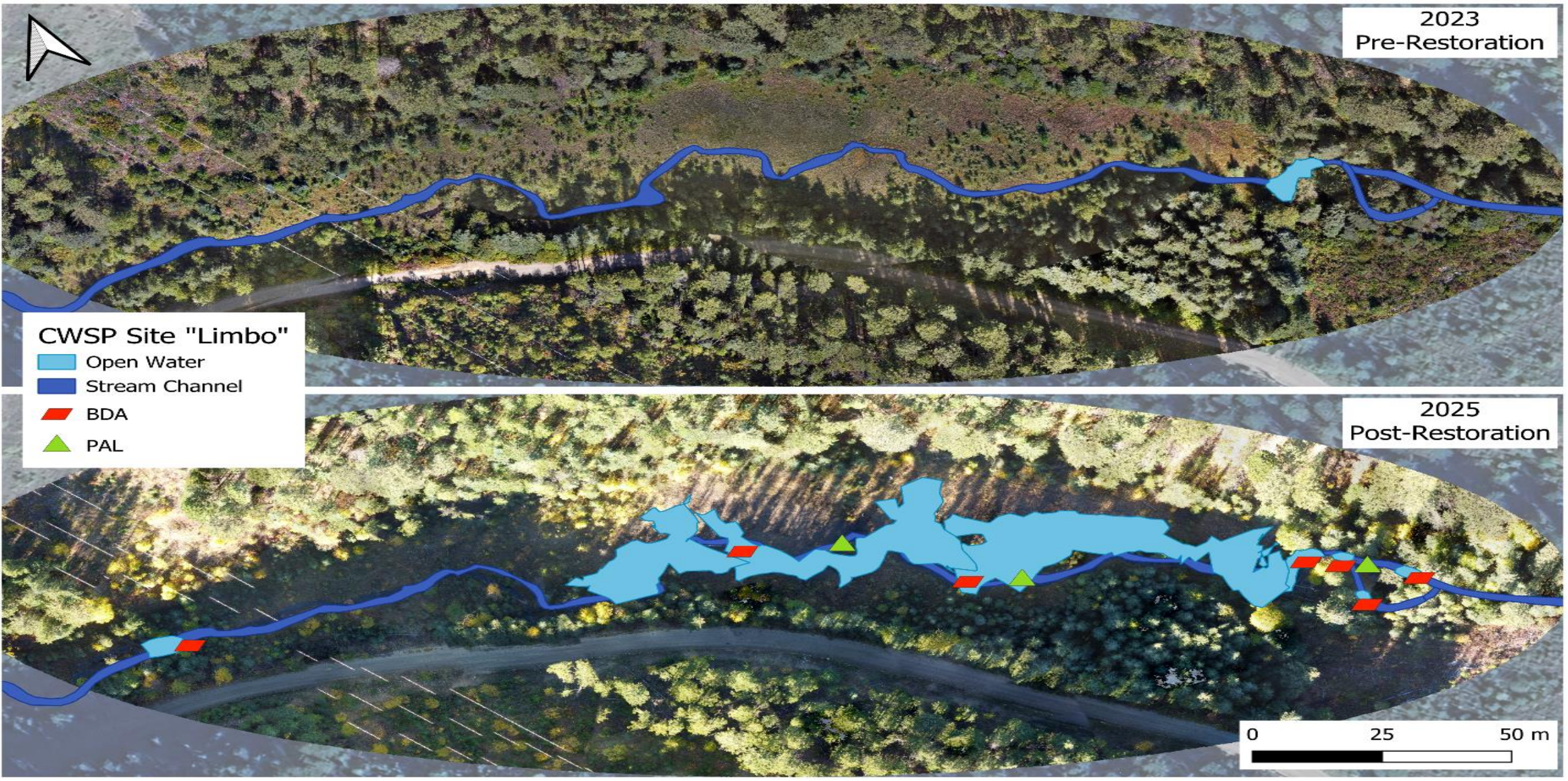
Water Quality

Soil Surveys

Monitoring: Post- Restoration Permitting Requirements

Assessments of built structures – water depth, water quality, dam status.

Pre- and post-BDA flooding at our Limbo site



In Summary

1. Despite everything we do, all wetlands are vulnerable to climate change
2. Beavers provide valuable services in maintaining wetlands.
3. Beaver in Columbia Wetlands maintain the water levels in spring & during droughts
4. Wetlands on the upland benches might be small, but they are important
5. In places without beavers, we can mimic their activities using beaver dam analogues.
6. Build BDAs where there is a surface water source
7. We are working on the Wetland Restoration Feasibility Index to guide wetland restoration efforts.
8. All of this is collaborative work!

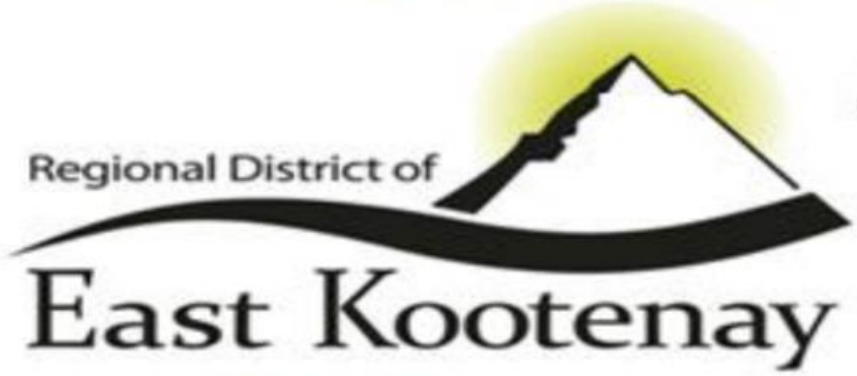
Challenges

- BDAs may not keep providing enough water to retain wetlands even with the best planning: long term sustainability of BDAs is uncertain.
- Province allows the killing & trapping of beavers: that is unwise given the impacts of climate change.
- Government permit requirements for BDAs are extreme; the Water Sustainability Act regulations have no special consideration for conservation projects in wetlands & streams.
- Provincial policy is not progressive enough to address the accelerating impact of the climate crisis.

In Conclusion

- Need better understanding of beavers, population & ecology
- Protect beavers: killing and trapping beavers in many cases is the same as destroying wetlands
- BDAs do not need to have beaver return to provide ecosystem services
- Drought will likely continue, but protecting wetlands and buffering them from climate warming is a way to conserve biodiversity and protect water resources across the landscape

Thank you to all our funders!



Environment and Climate Change Canada

Environnement et Changement climatique Canada

Go beavers!

Questions?

sbayley@ualberta.ca
catrionasleven@gmail.com

Go beavers!

Access the BC Disaster report https://climatereadybc.gov.bc.ca/pages/dcrra

- **British Columbia Disaster and Climate Risk and Resilience Assessment: Provincial Report 2025**

Wetland vegetation or open water dominated **42% of the 214 FWA wetland** polygons and 93% of the 136 FWA lake polygons

- **Adequately wet** - Dominant: Open Water/Wetland Vegetation, Subdominant: Open Water/Wetland Vegetation
- **Mostly wet, but drying** - Dominant: Open Water/Wetland Vegetation Dominant, Subdominant: Shrub, Conifer, Mudflat, Dryland=(hydrophobic veg)
- **Drying with wetted areas** - Dominant: Shrub, Conifer, Mudflat, Dryland (hydrophobic veg) and Open Water/Wetland Vegetation present
- **No signs of water –**all hydrophobic veg dominant: Shrub, Conifer, Mudflat, Dryland and Open Water/Wetland Vegetation Absent

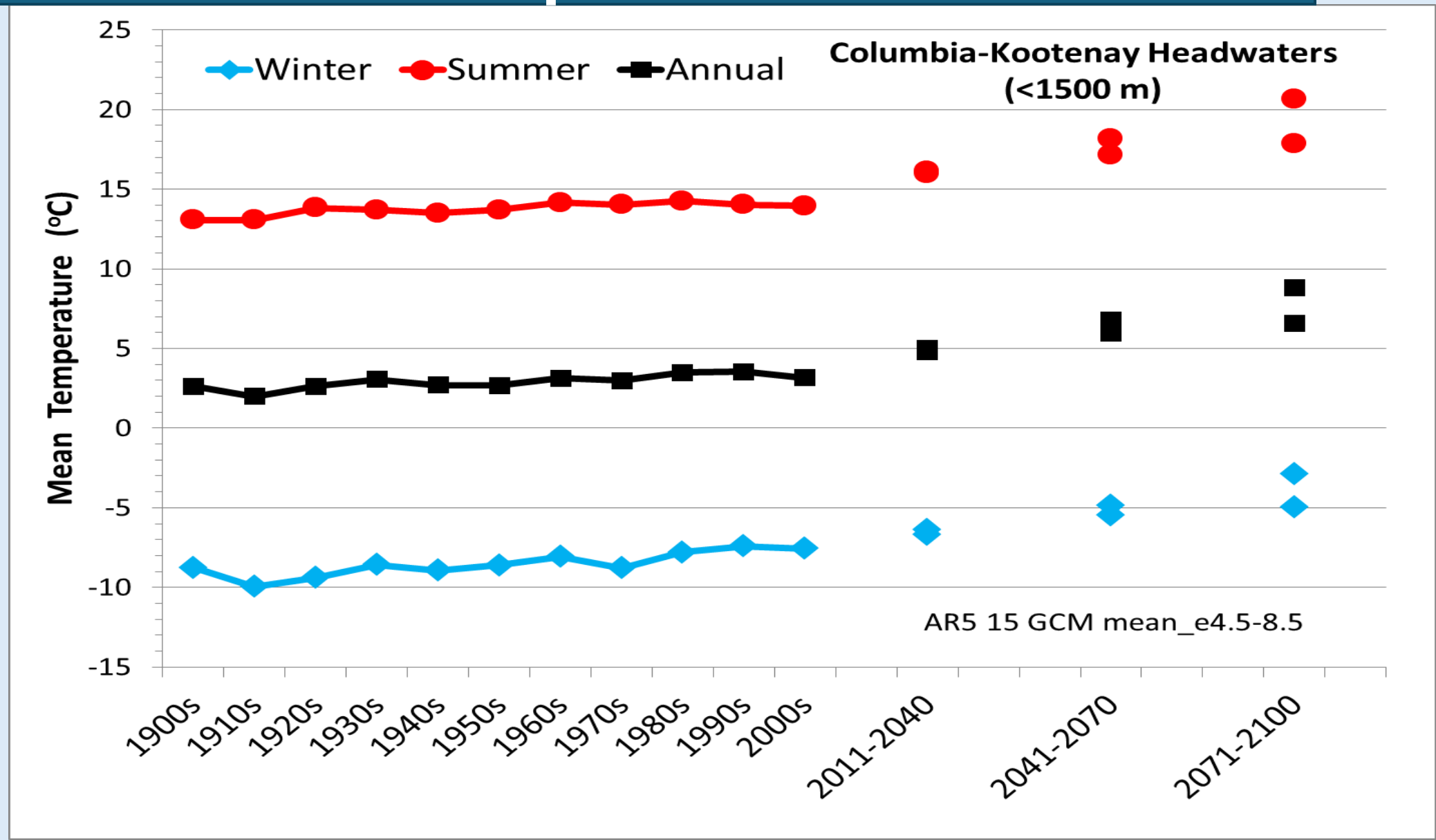
Flood Pulse

July 2022 (high water)

Historic & projected mean temperatures

Summer
+ 5° C

Winter
+ 3.5° C



Carver & Utzig

Flood Pulse

July 2022 (high water)

Values of the Columbia Wetlands

- CW 180 km only undammed part of the 2000km Columbia River
- Complex dynamic floodplain driven by mostly natural processes
- Still maintains most vulnerable top predators
- Corridor and habitat for abundant native fish, birds, mammals
- Provides habitat for over 260 species of biota (assuming is similar to Vermillion wetlands in Banff)
- Provides water resources and flood control
- Provides enjoyment and spiritual values for people
- Floodplain wetlands provide $150 Billion/yr ecosystem services, are very rare & are the most threatened type of wetland.

Natural levees create the different types of wetlands

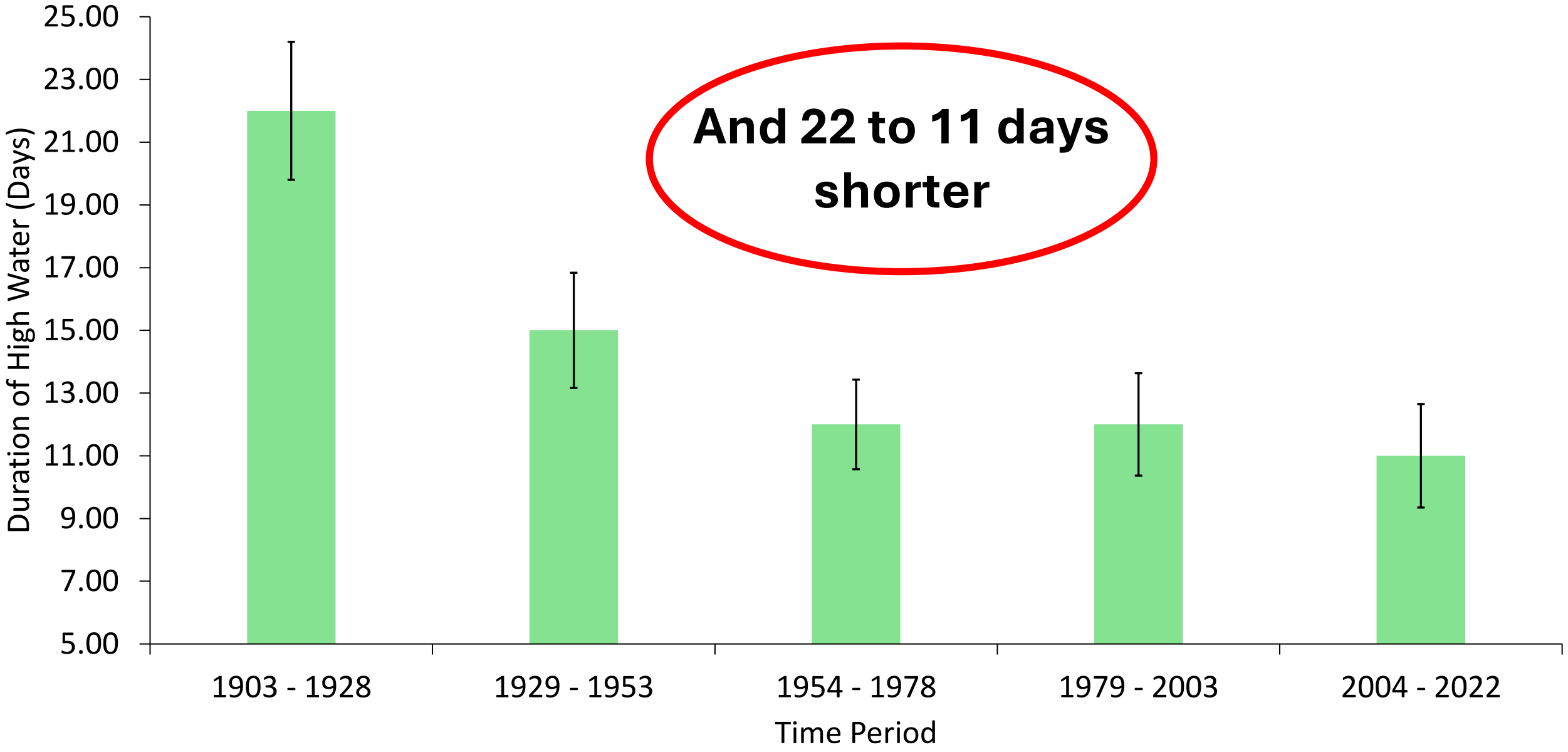
Wetlands West of Columbia Lake are drying

CWSP, 2024

Wetlands West of Columbia Lake are drying

CWSP, 2024

Changes In The Flood Pulse: Earlier in Spring



Beaver Dams in the levee gaps