



Comprehensive Watershed Assessment: Data Analysis Results

Part 2

Photo courtesy of LBD

Presentation Topics

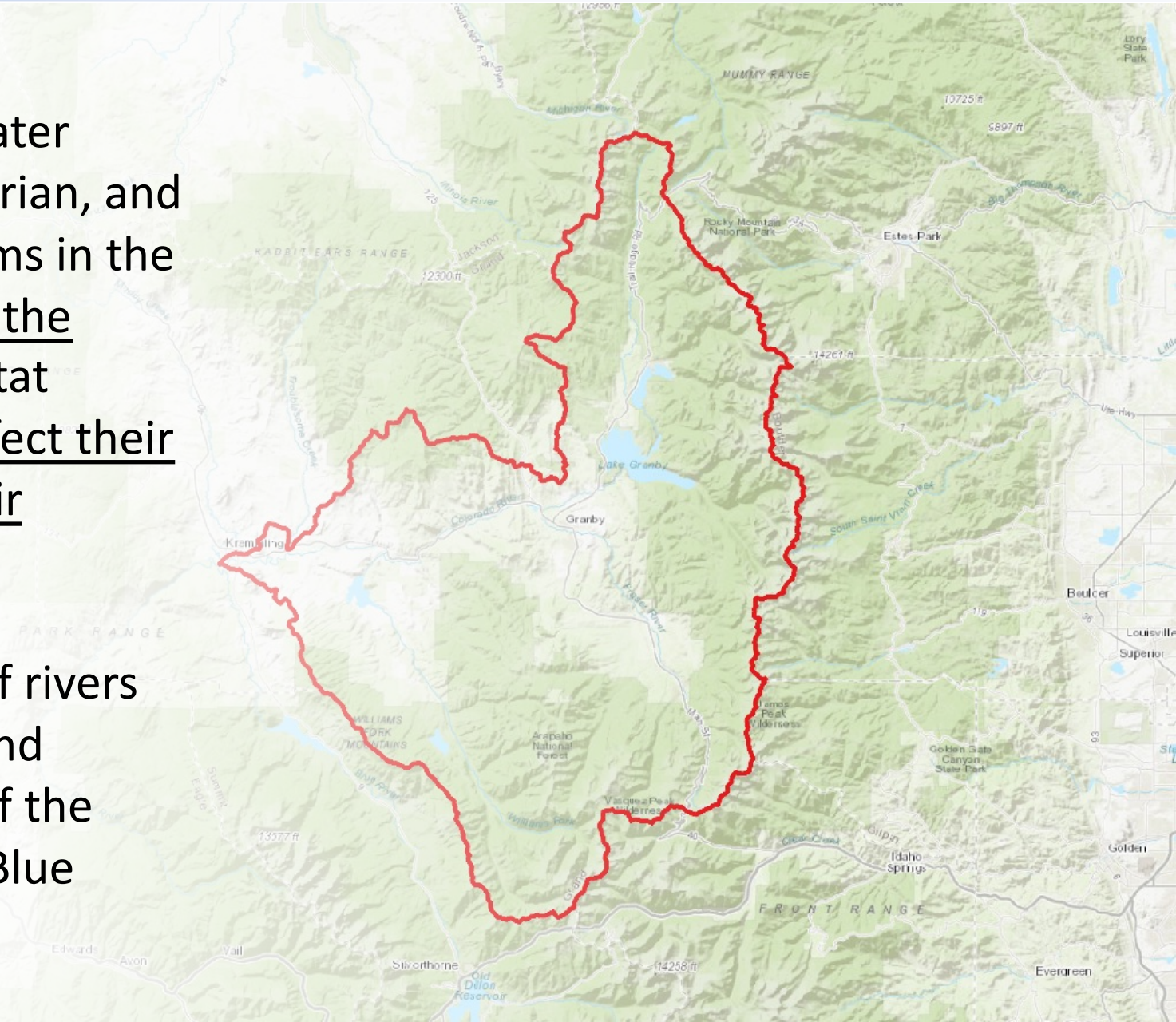
- Review Watershed Assessment Goals & Approach
- Geographic Reorientation to Stream Groups
- Review Key Aquatic Resource Concerns for the Watershed Assessment
- Present Primary Results for:
 - Geomorphic Condition
 - Riparian Assessment
 - Aquatic Biota

Question to keep in mind: How well do these quantitative assessment results align with your perspectives on watershed conditions?

Watershed Assessment Goal

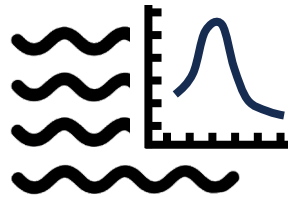
Watershed Assessment Goal: Assess hydrological regime characteristics, water rights, water quality, geomorphic, riparian, and biological data relevant to focus streams in the CEA for the purpose of understanding the condition of streams and aquatic habitat within the CEA and the factors that affect their preservation and, where possible, their improvement.

Cooperative Effort Area: >100 miles of rivers and streams in the Colorado, Fraser, and Williams Fork River Basins upstream of the Colorado River's confluence with the Blue River in Grand County

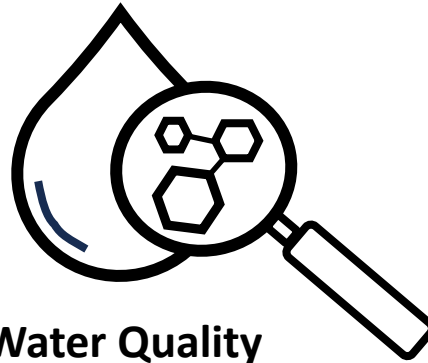


Watershed Assessment Topic Areas

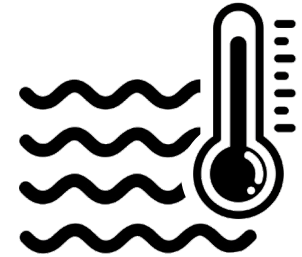
- Assessment activities arranged into 6 topic areas
- Topic areas align with the 2010 Grand County SMP



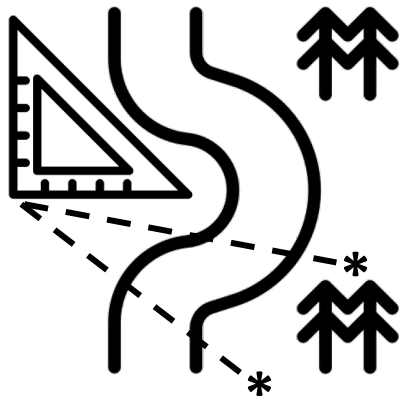
Hydrology



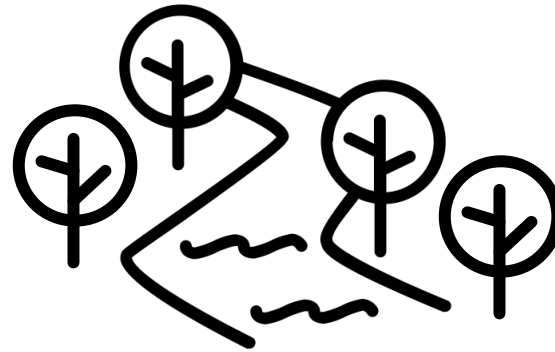
Water Quality



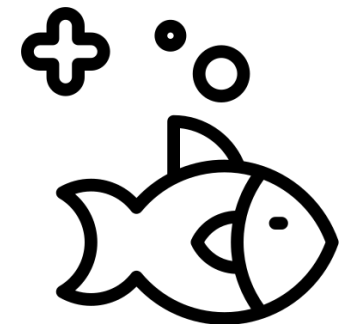
Water
Temperature



Geomorphic
Conditions



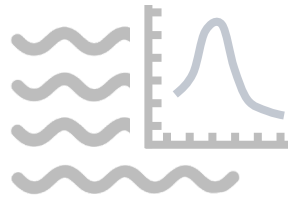
Riparian Areas



Aquatic Biota

Watershed Assessment Topic Areas

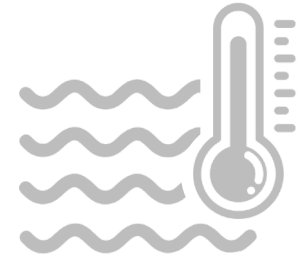
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Hydrology



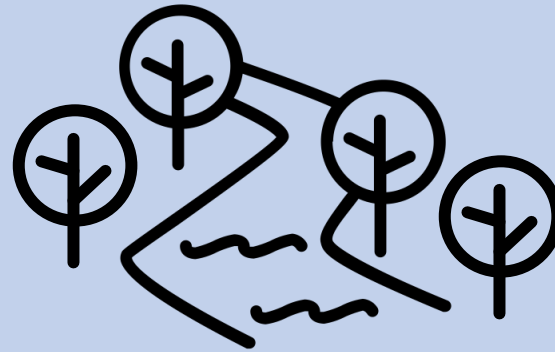
Water Quality



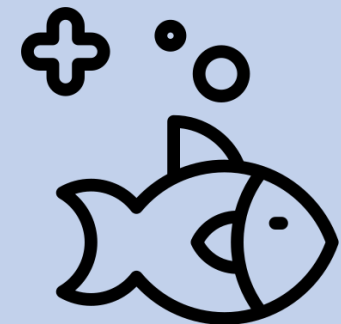
Water
Temperature



Geomorphic
Conditions



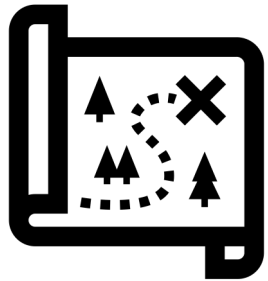
Riparian Areas



Aquatic Biota

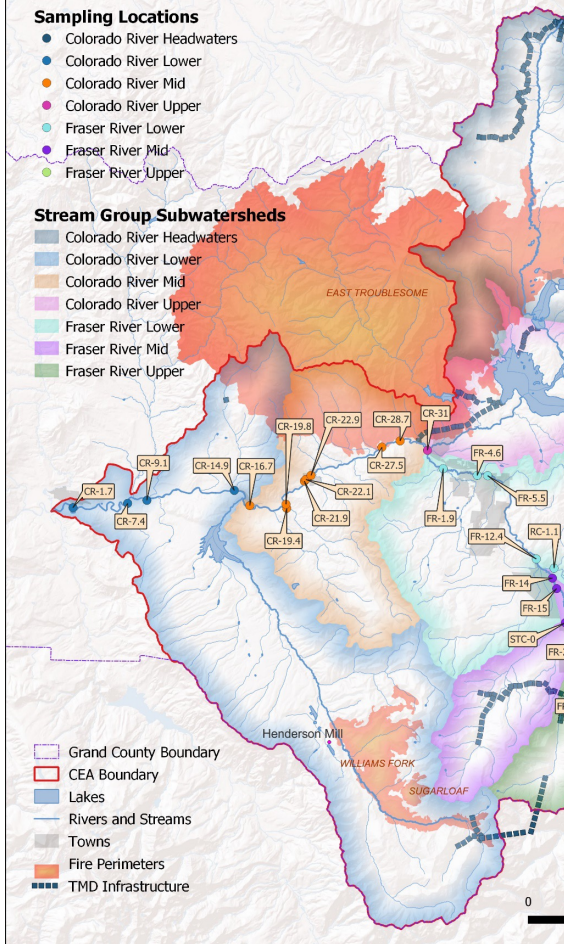
Geographic (Re)orientation

Reminder of the
organizational
strategy for results
presentation

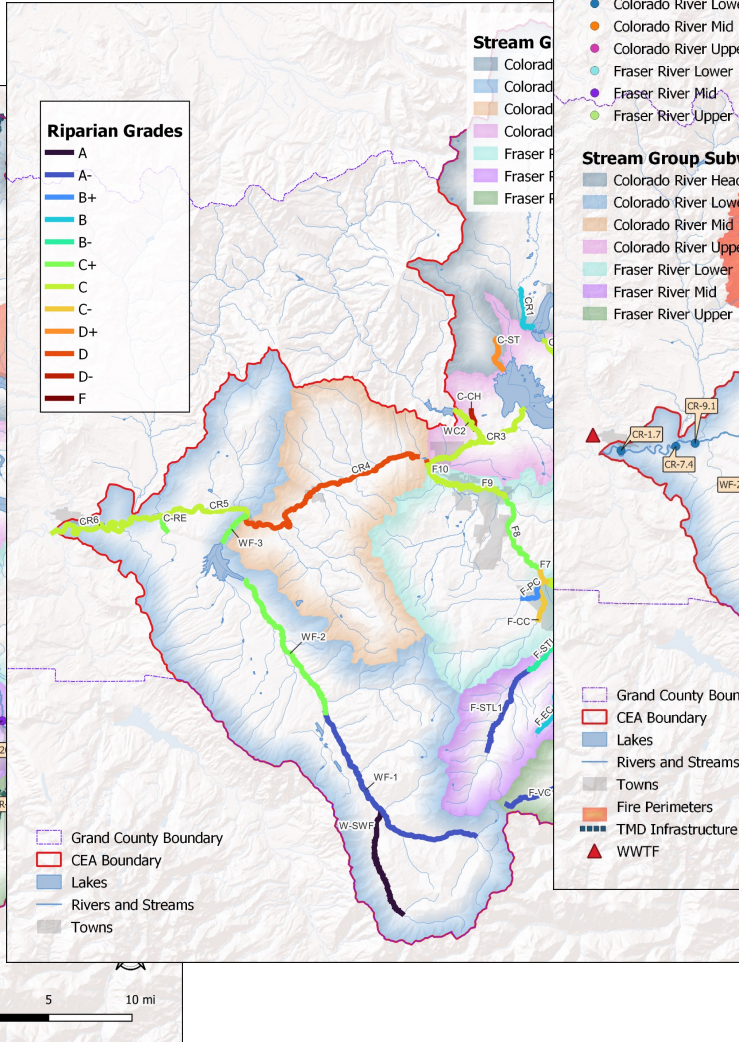


Supplementary Maps

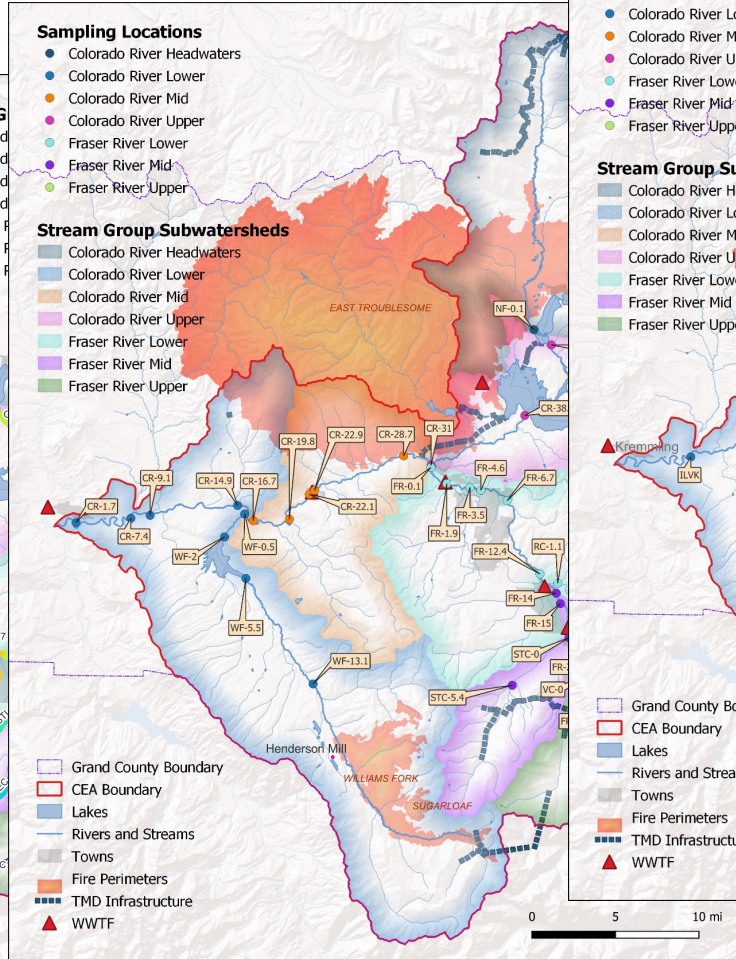
Sediment



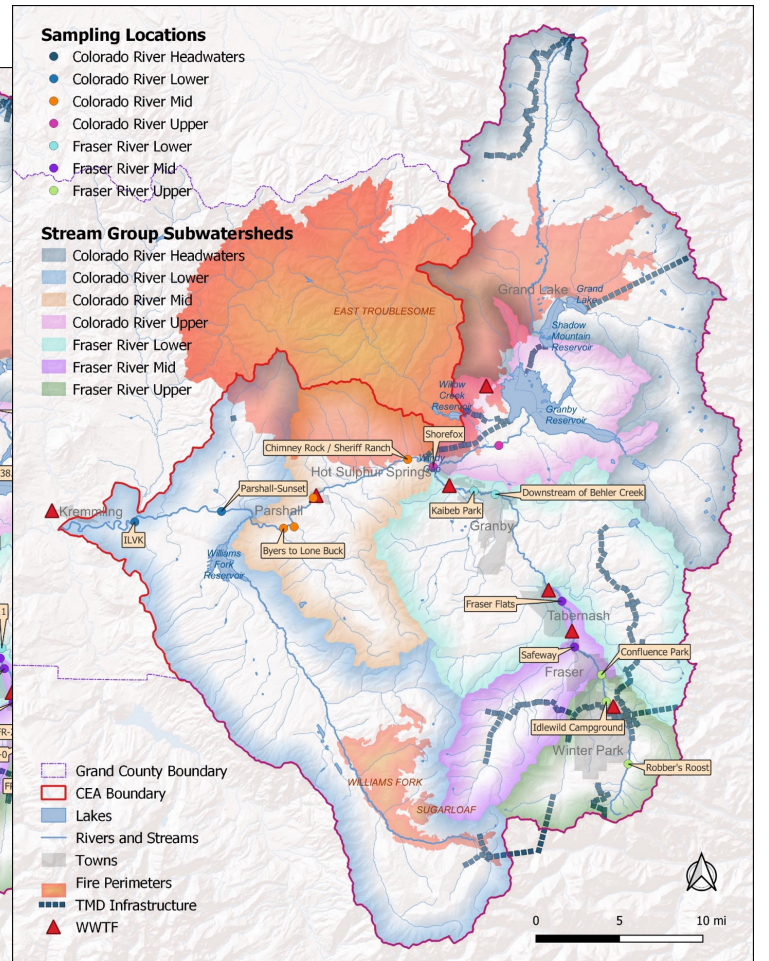
Riparian



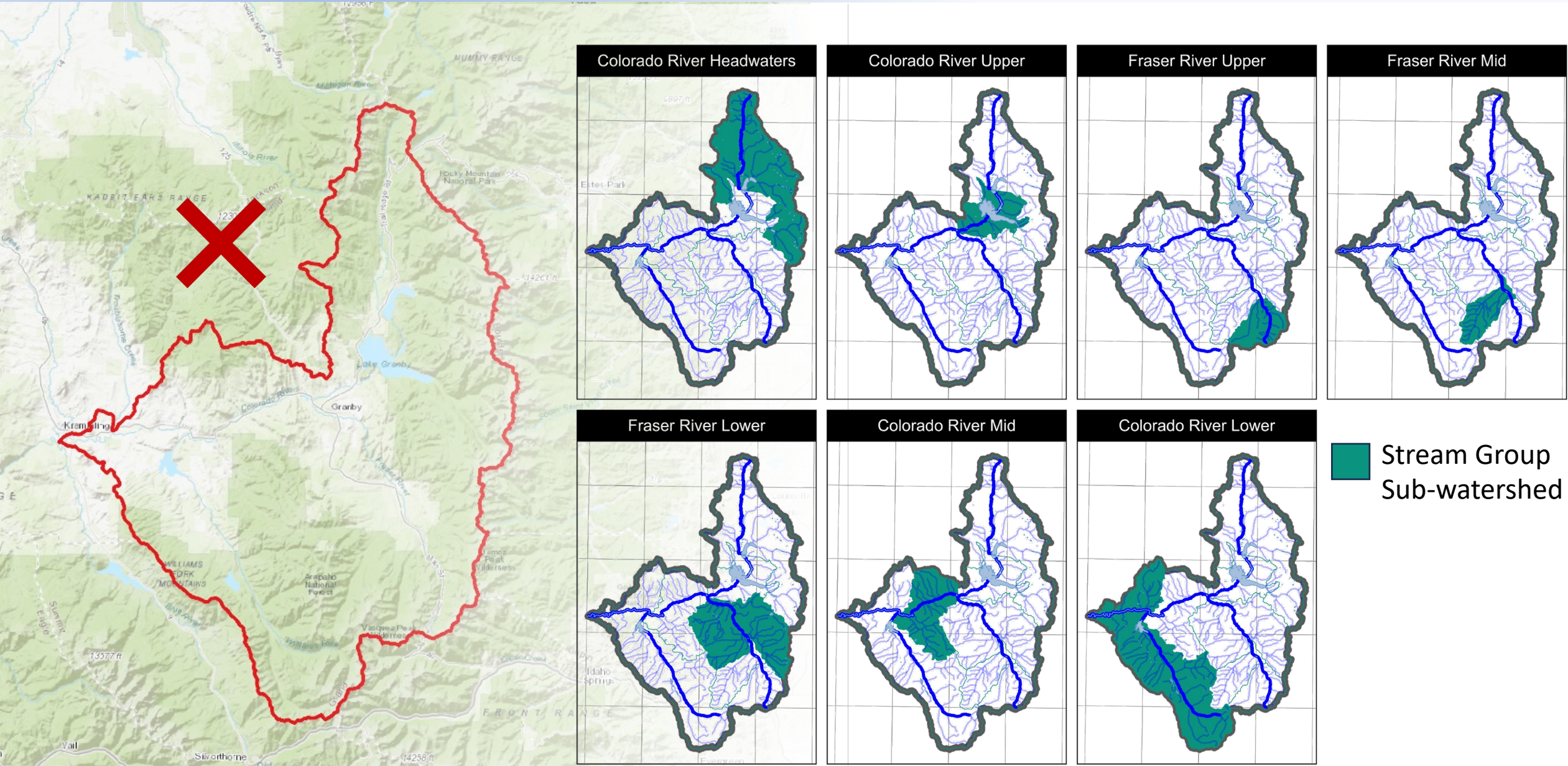
Macroinvertebrates



Fish



CEA and Stream Group Sub-Watersheds



Geomorphic Condition

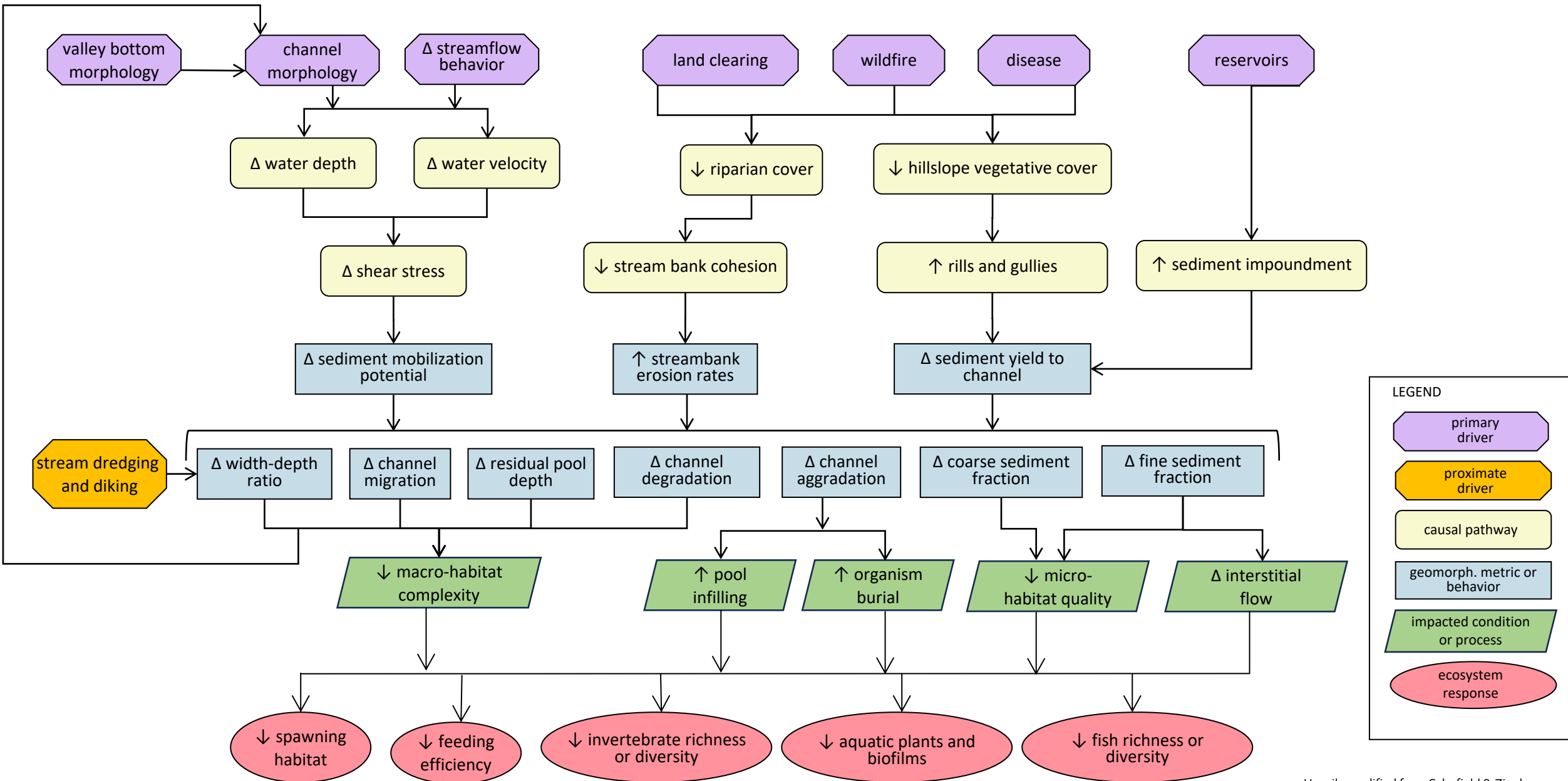
Summary of Findings



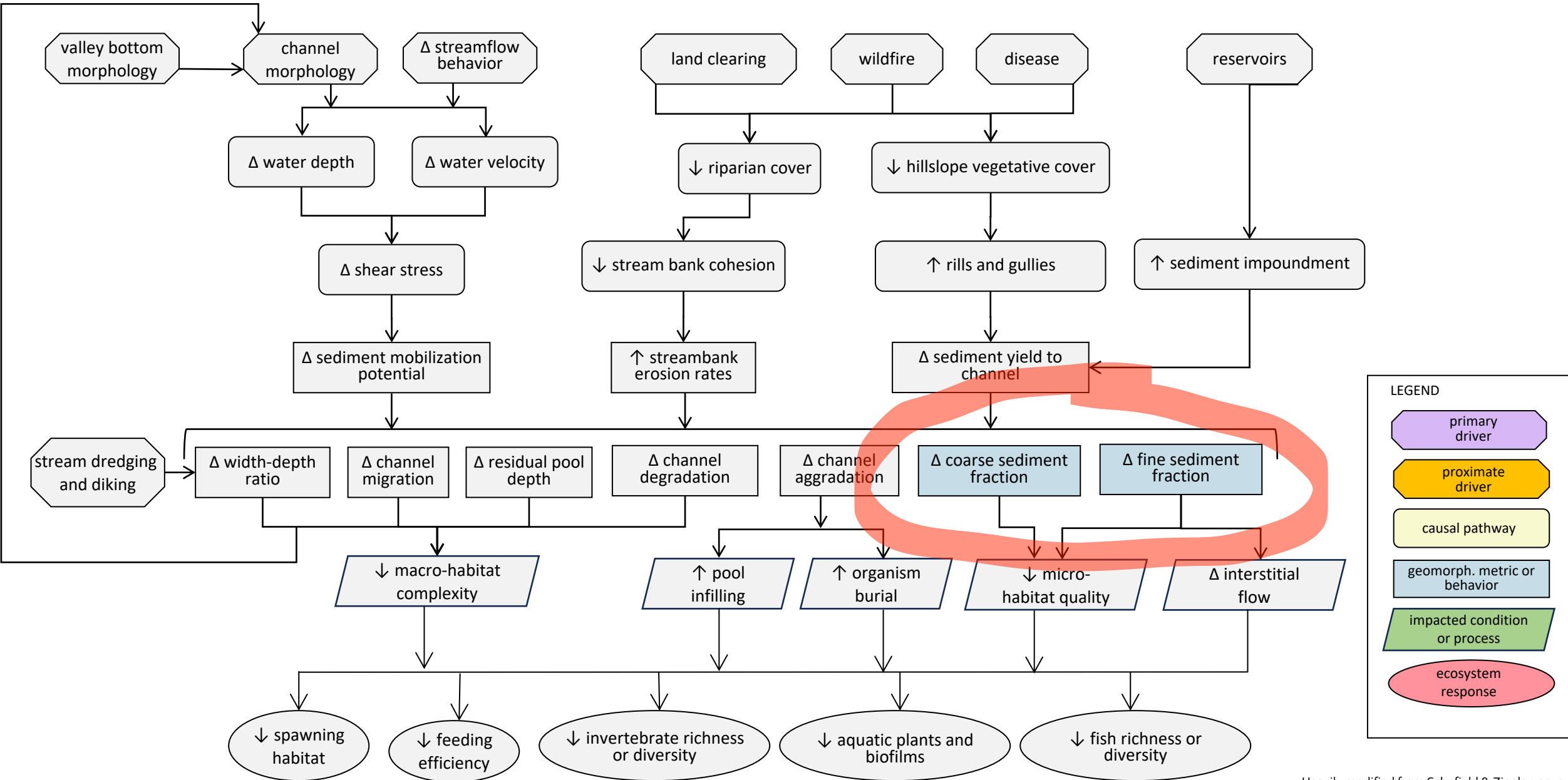
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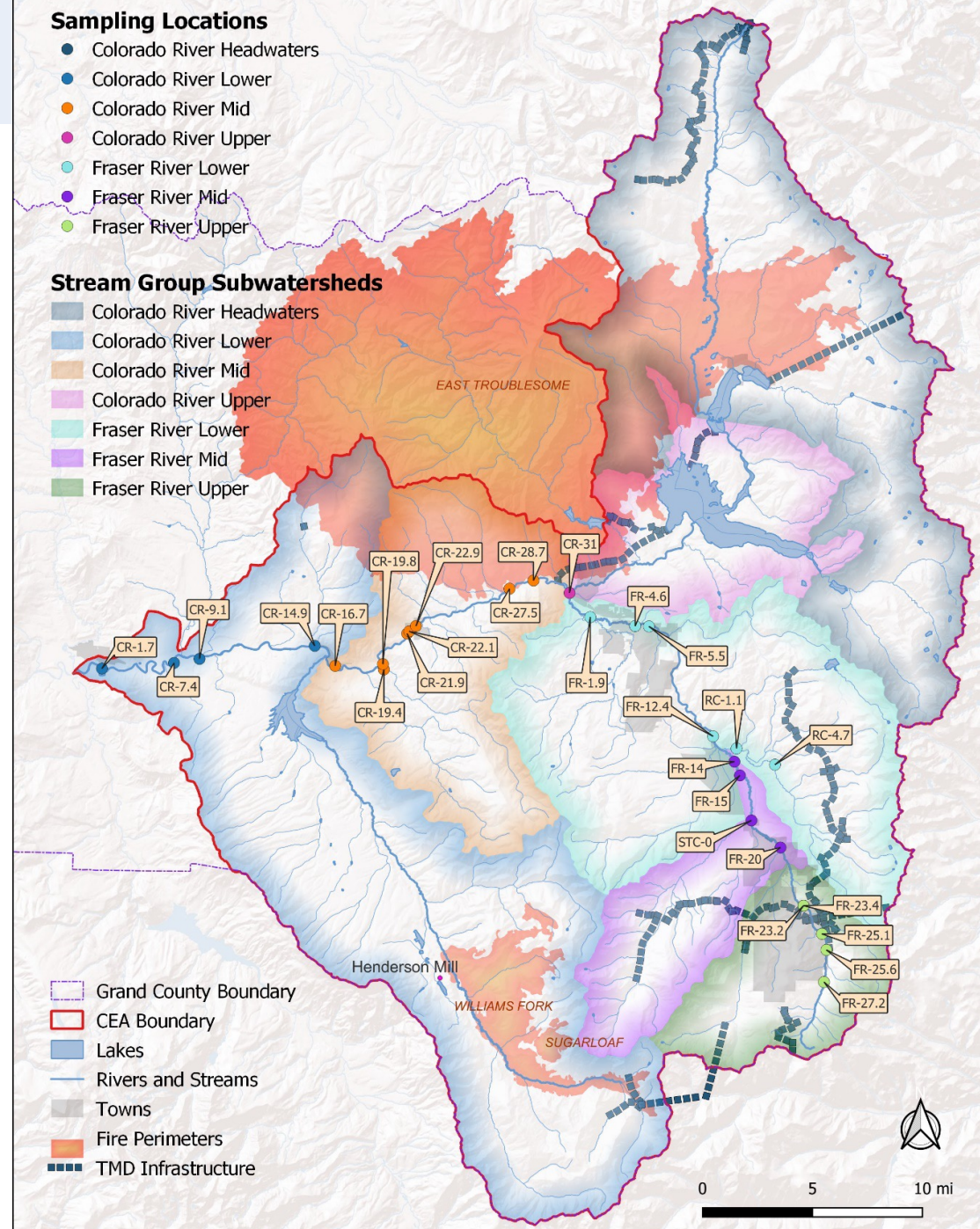
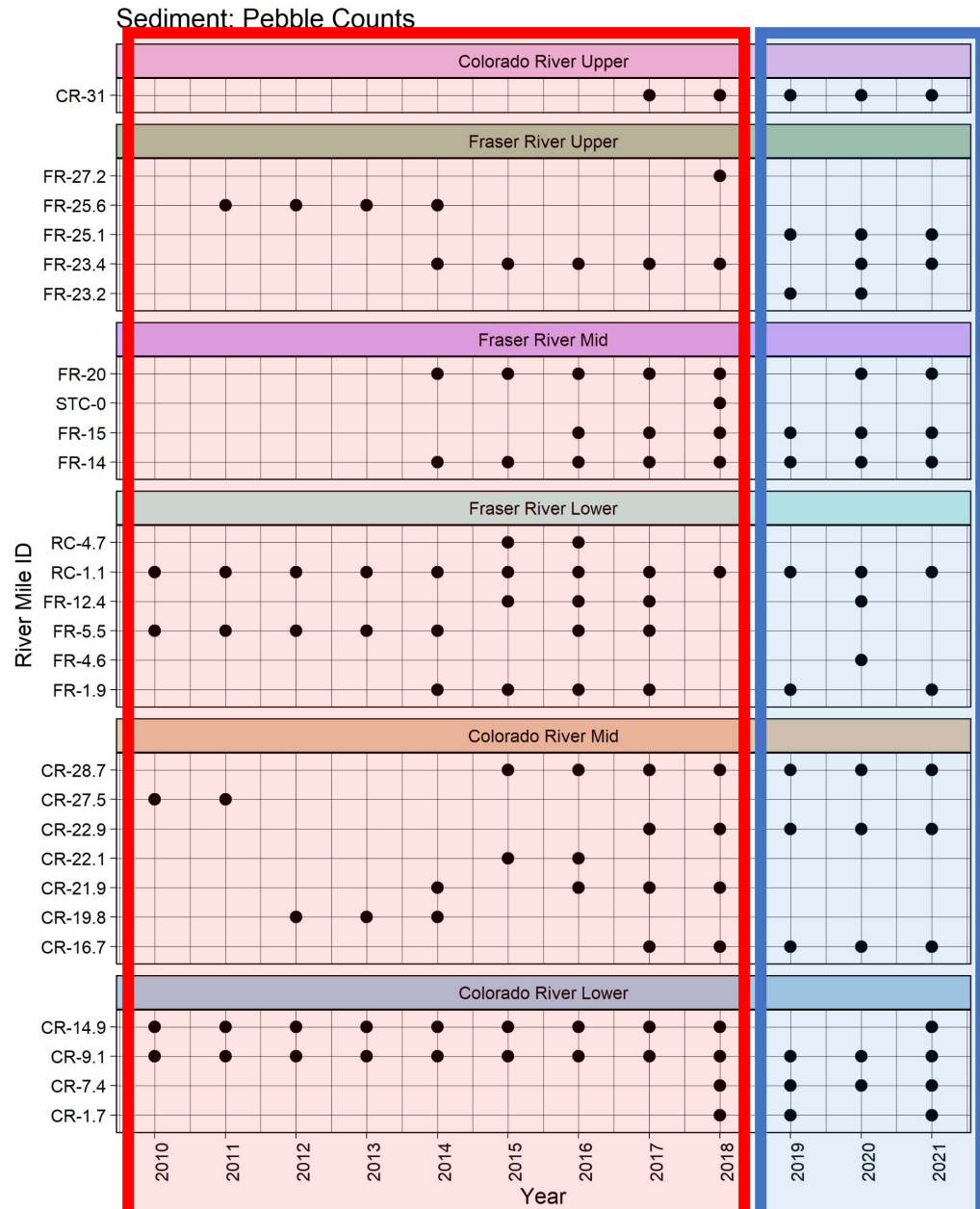
Geomorphology: Causal Pathway Conceptual Model



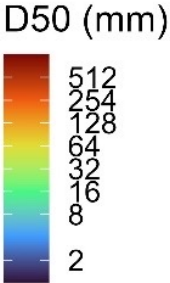
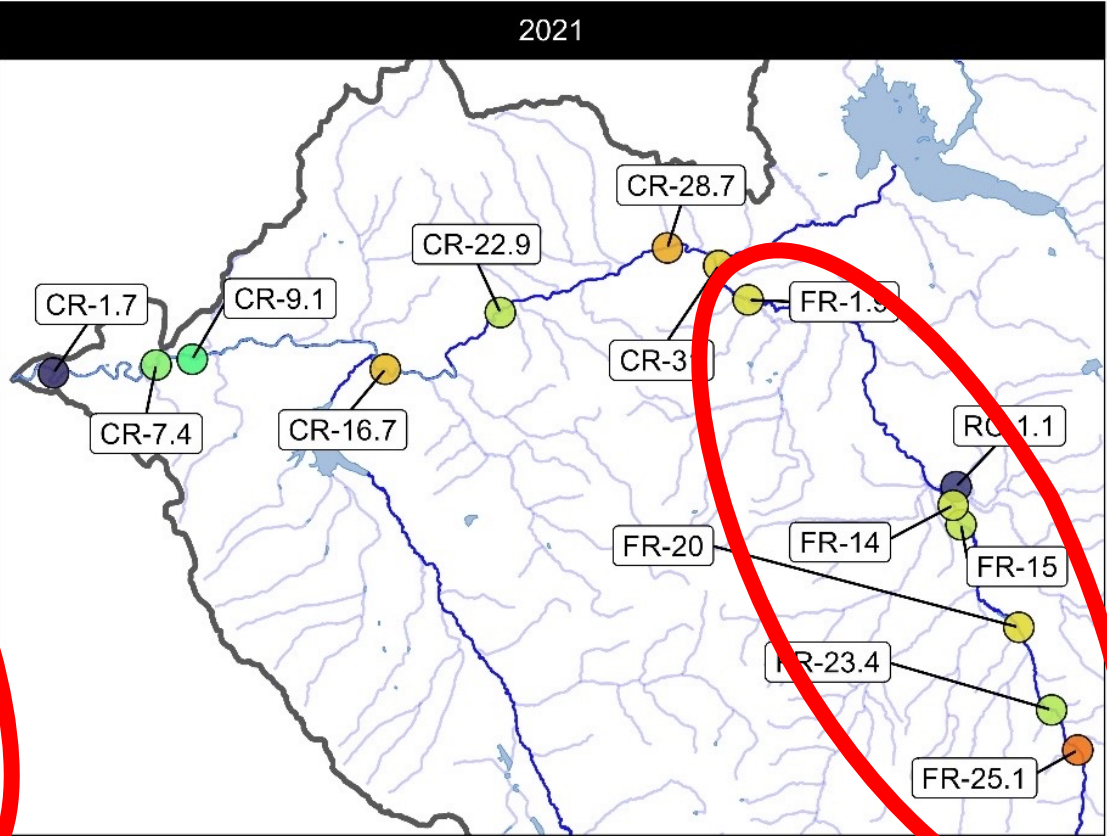
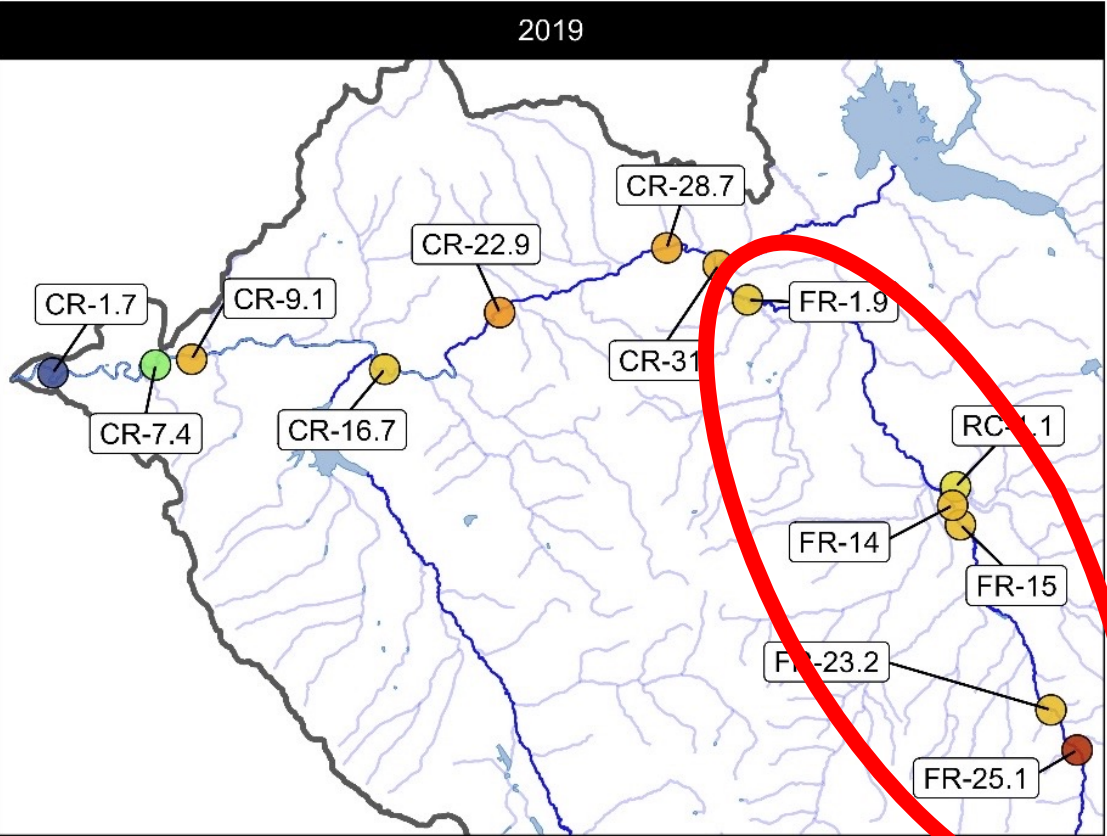
Geomorphology: Causal Pathway Conceptual Model



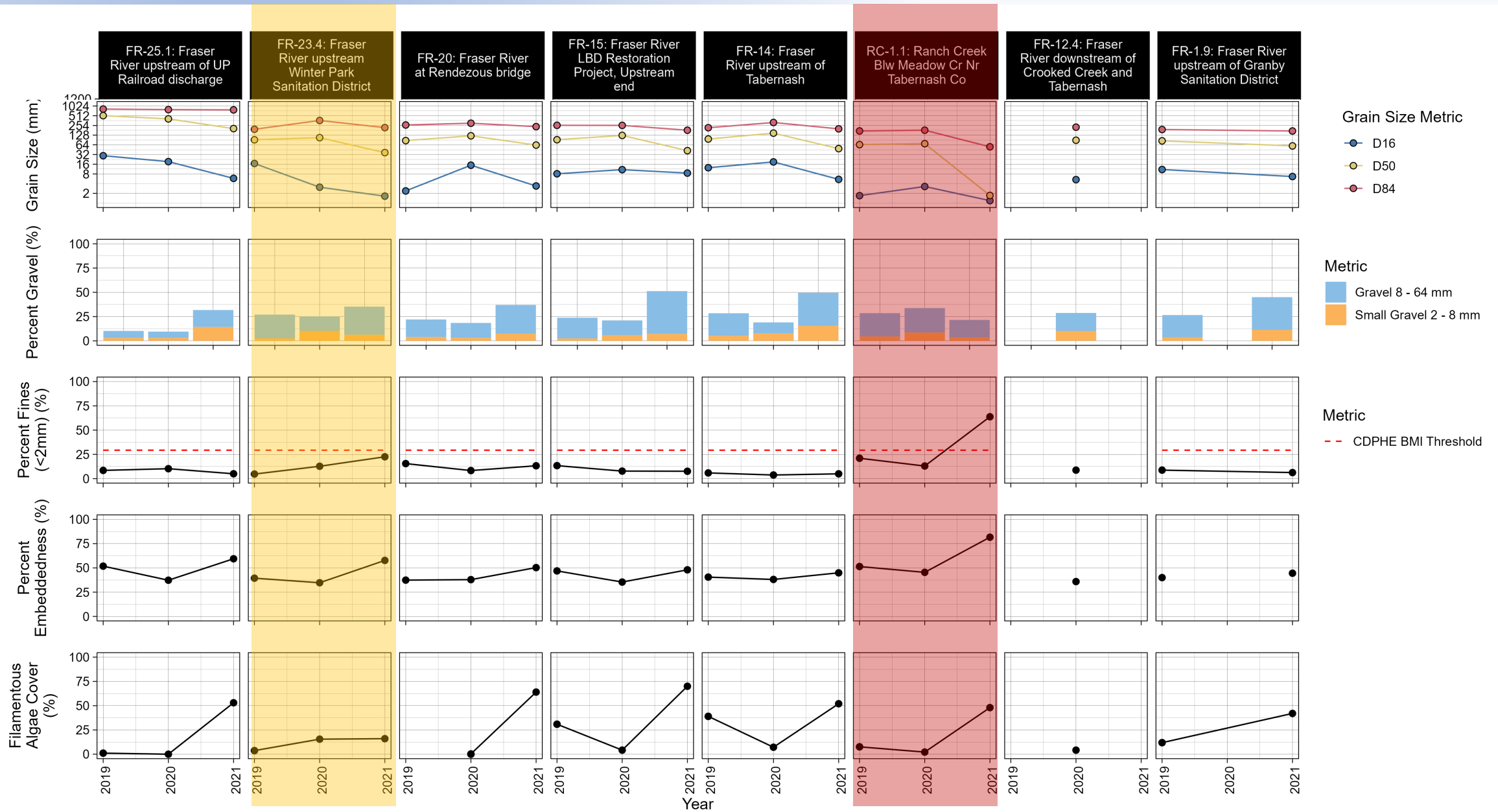
Sediment – Data Inventory



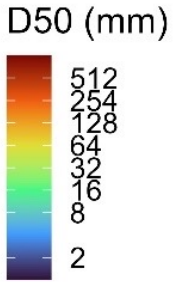
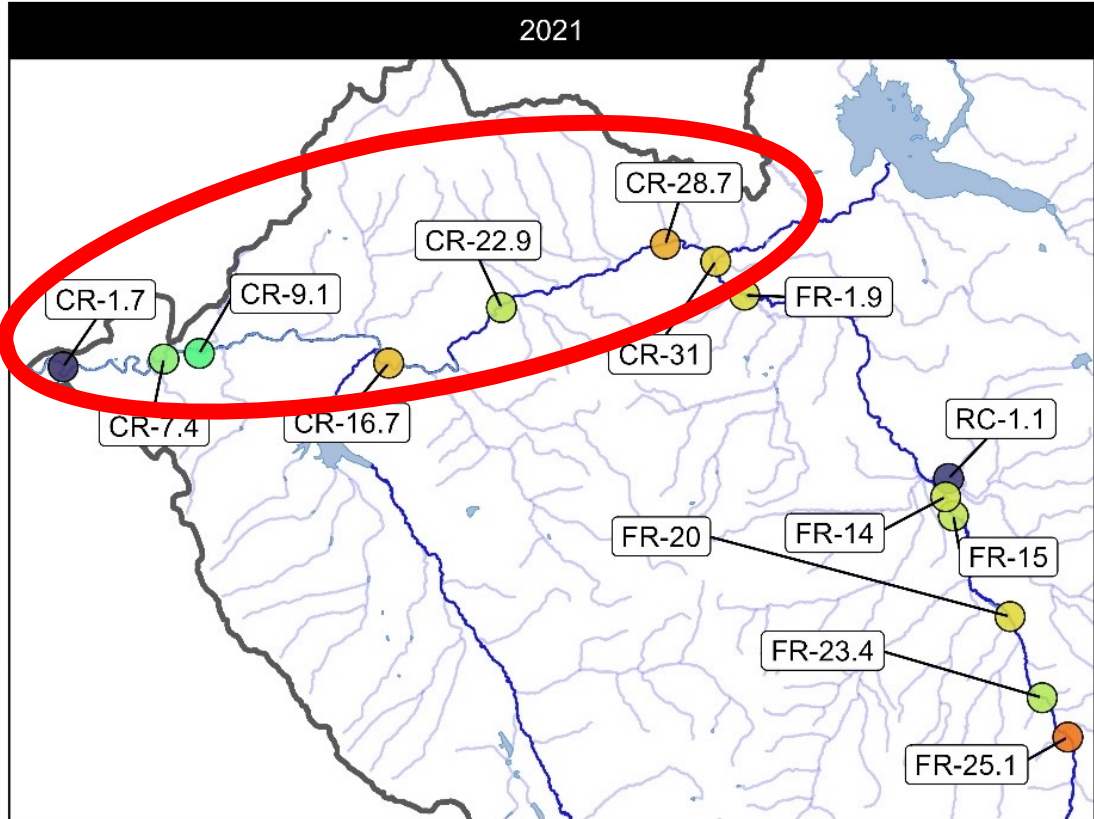
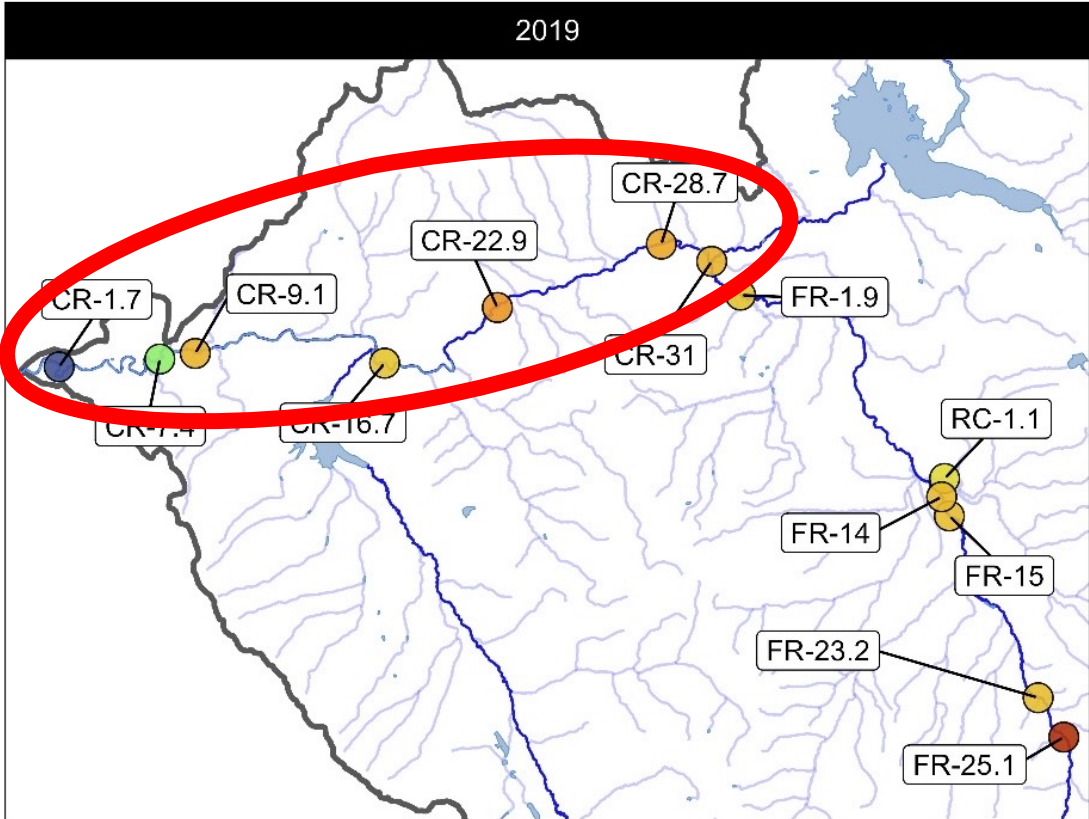
Channel Substrate– Spatial Patterns on Fraser



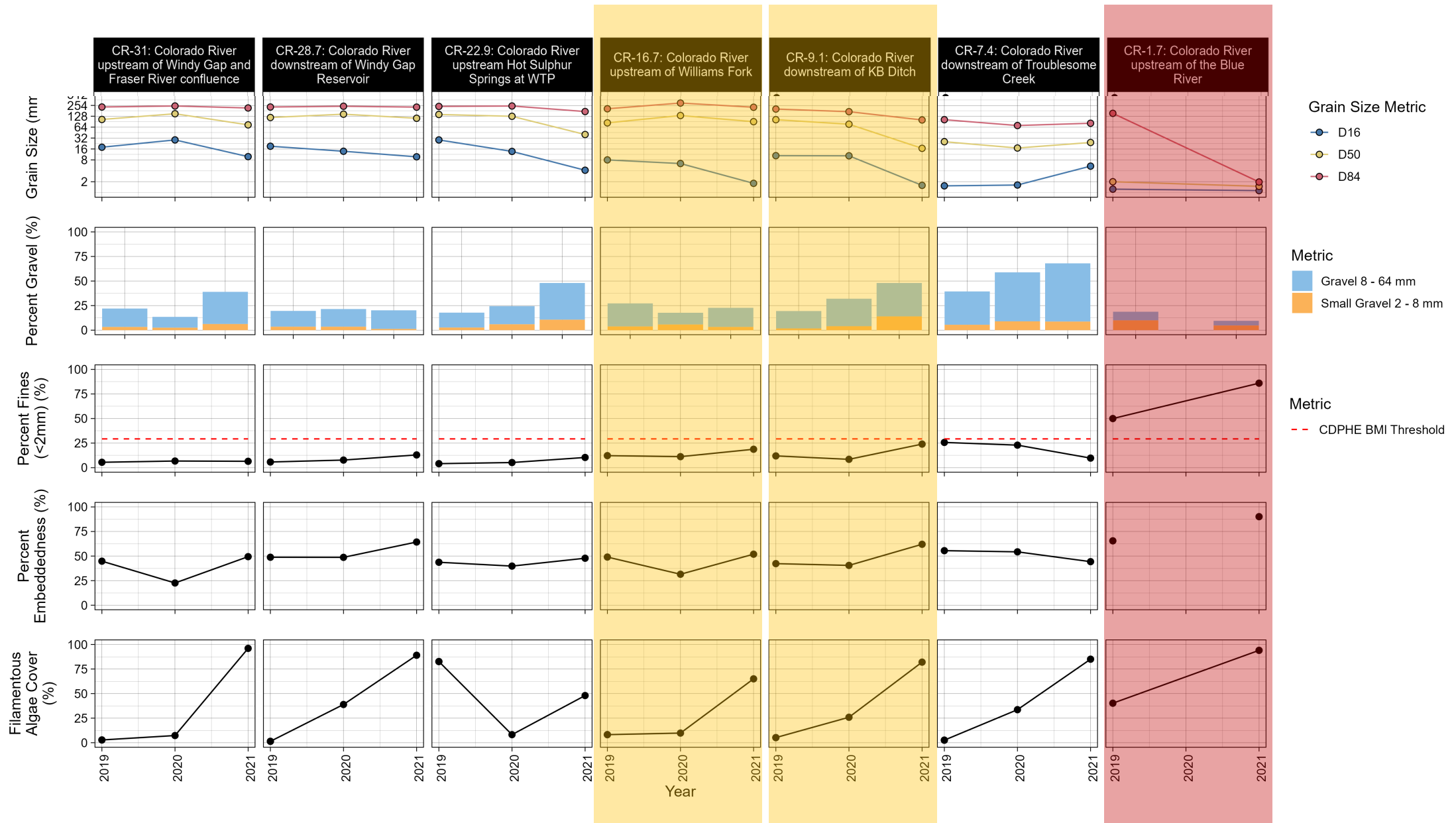
Sediment – Fraser River Channel Substrate Condition



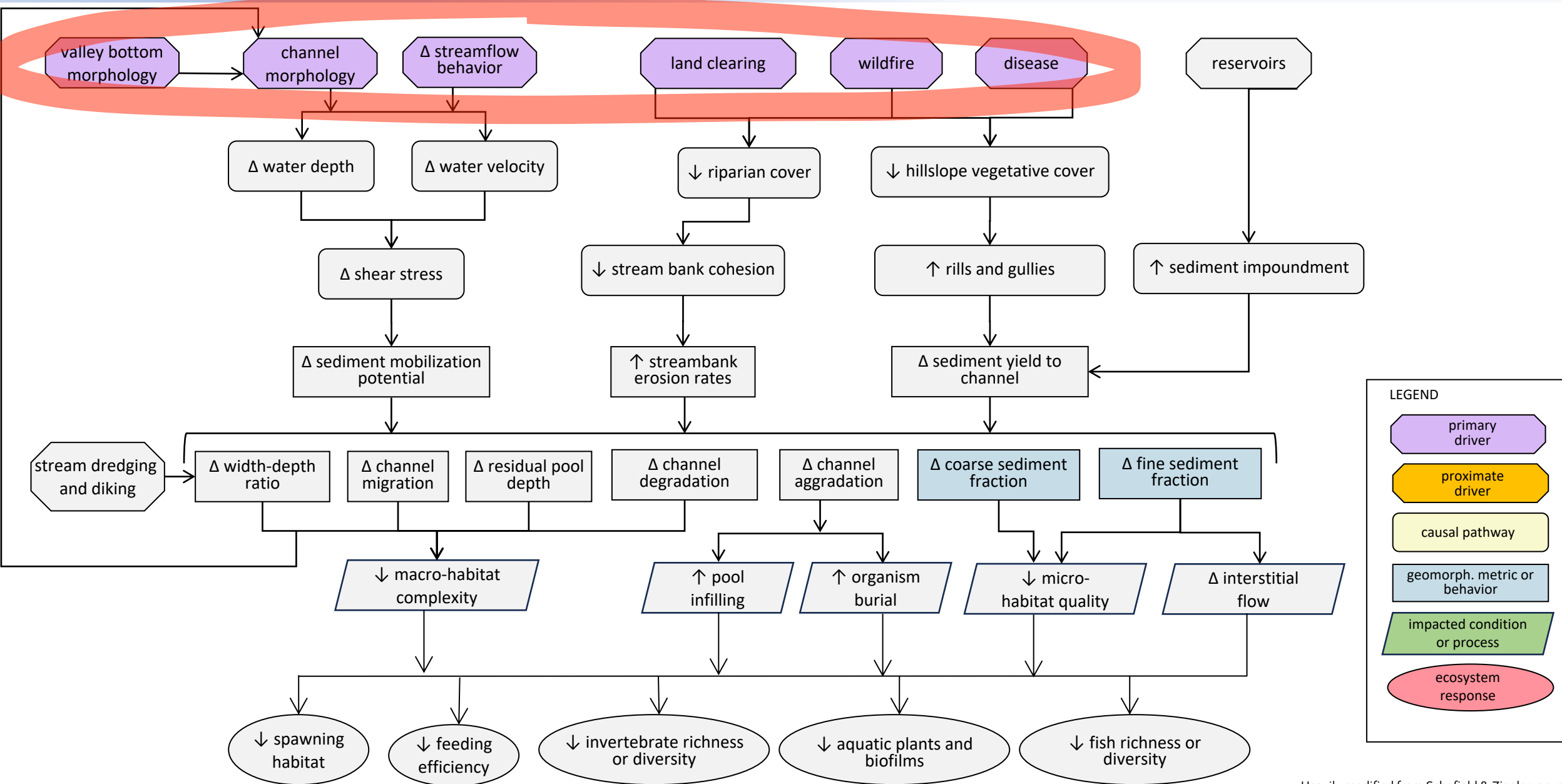
Channel Substrate– Spatial Patterns on the Colorado River



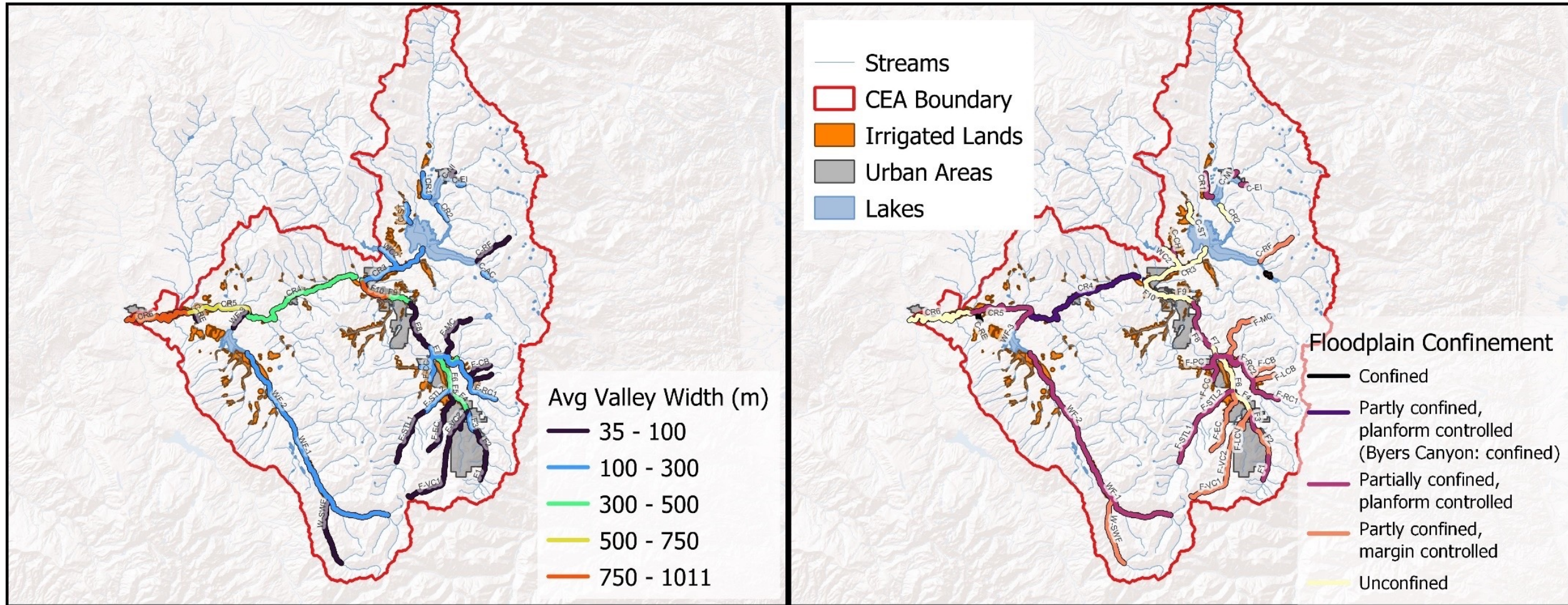
Sediment – Colorado Channel Substrate Condition



Geomorphology: Causal Pathway Conceptual Model

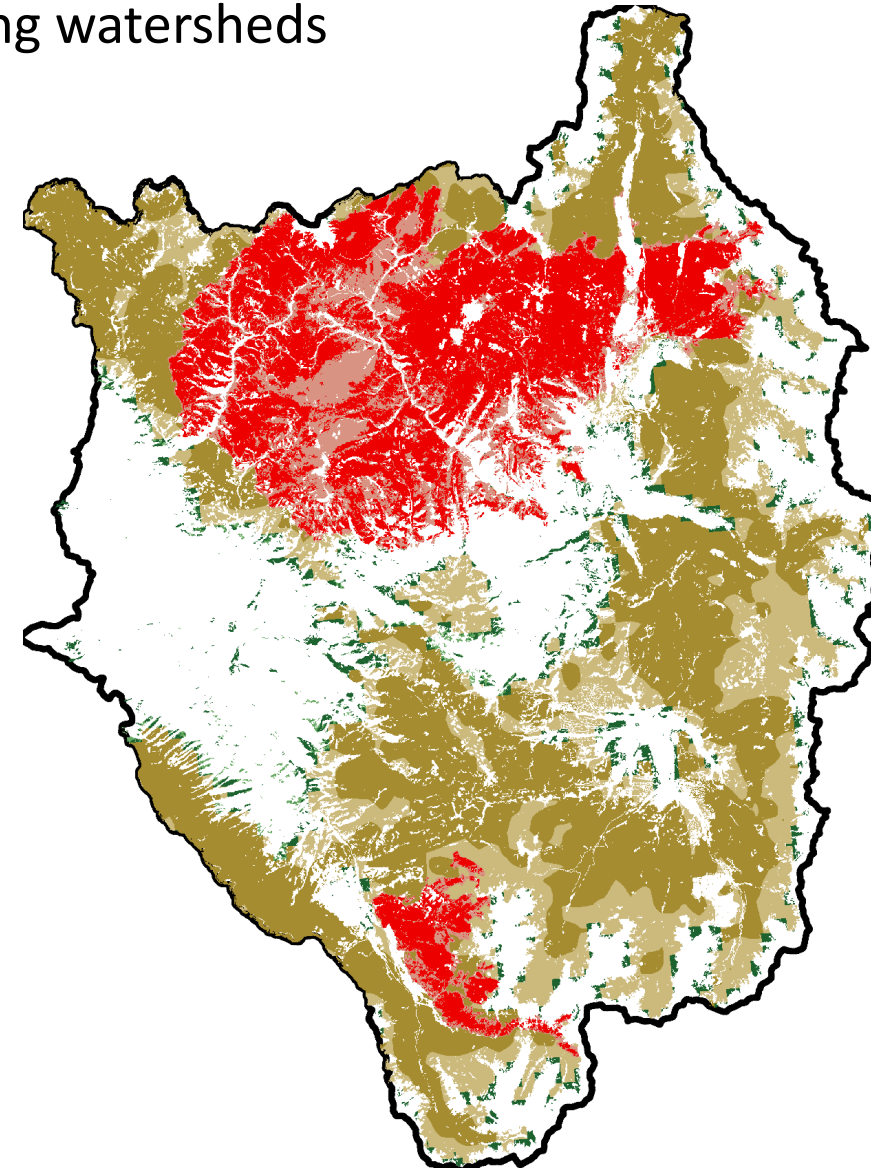
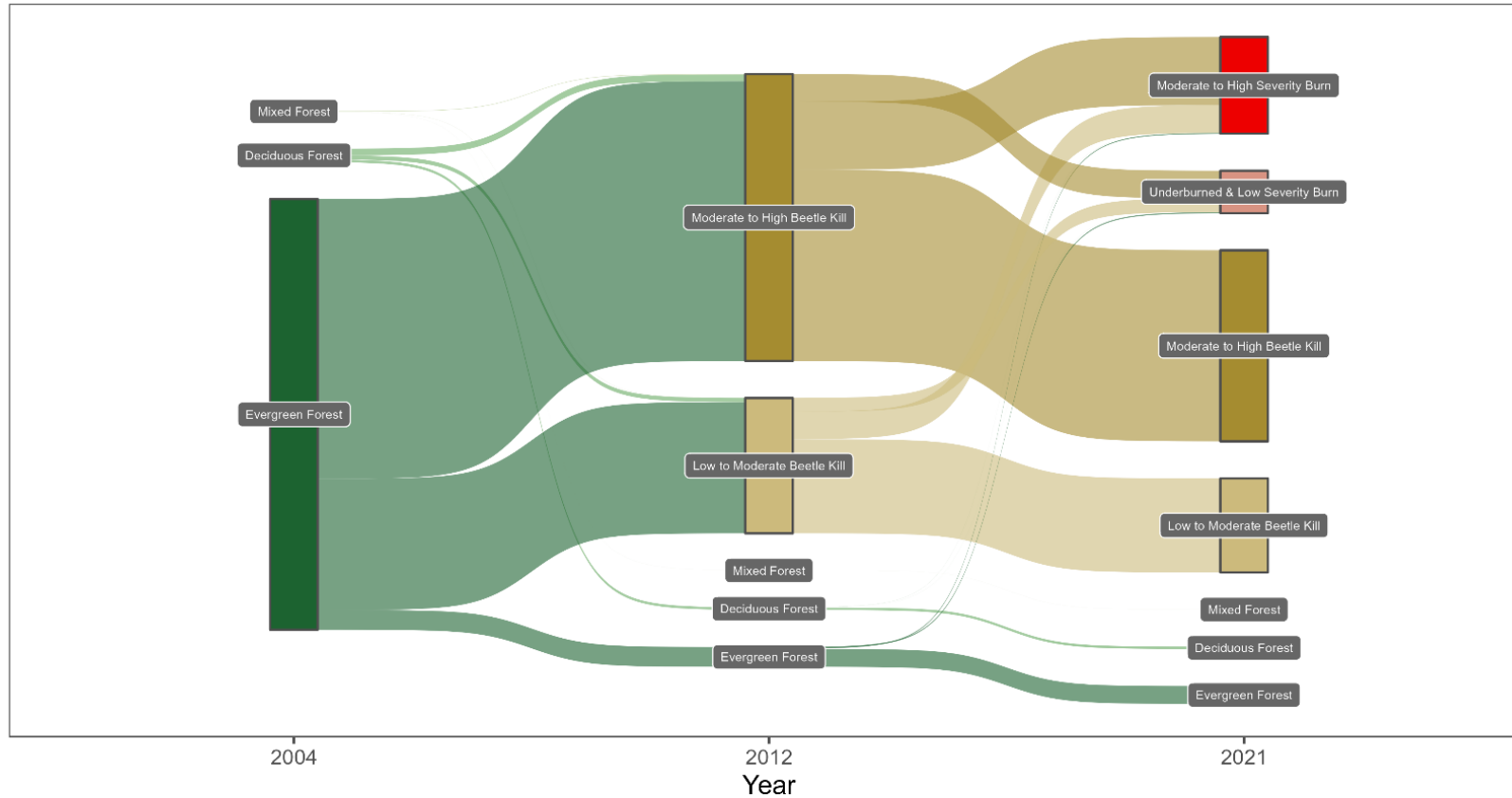


Drivers: Valley Bottom Morphology



Drivers: Forest Disturbance

- Evergreen forests constitute ~55% of landcover in CEA-contributing watersheds
- 95% of forest impacted by **pine beetle** between 2003-2012.
- 31.4% of forested area **burned** between 2018-2020



Drivers: Wildfire Impacts

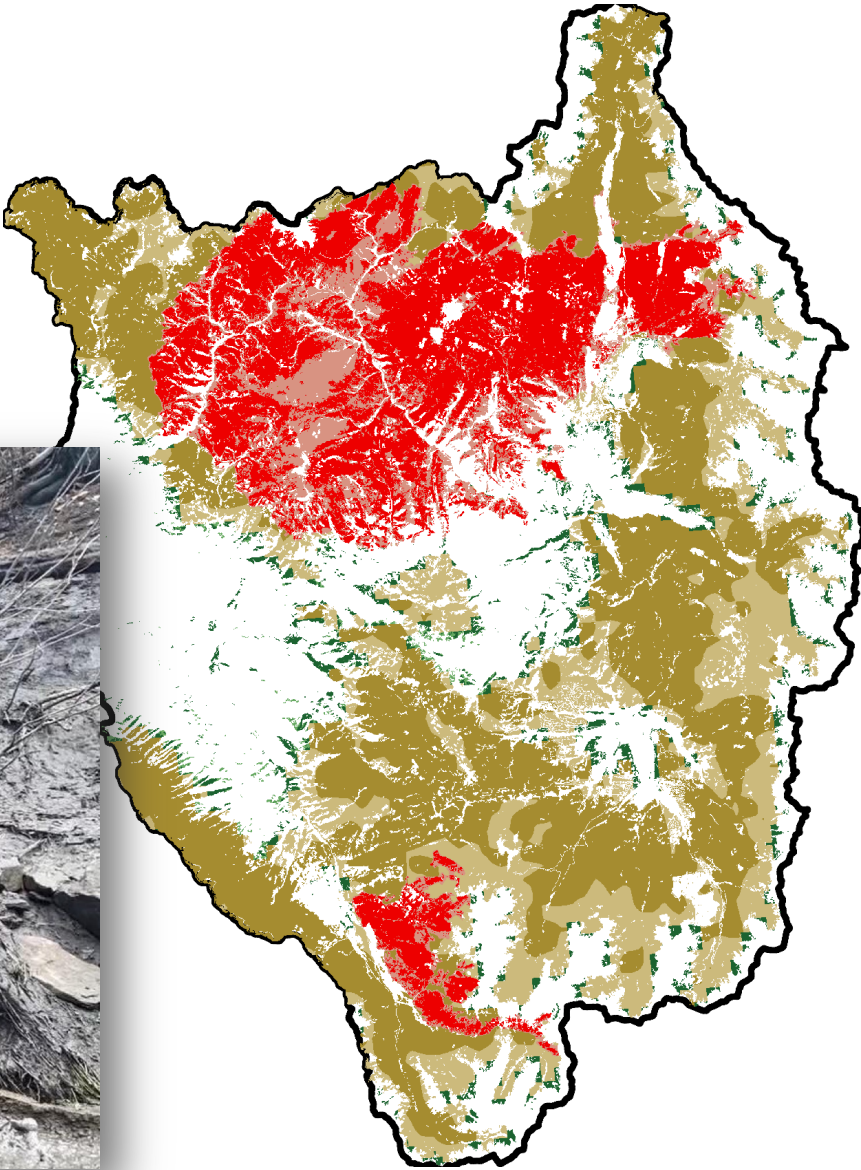


July 5, 2021

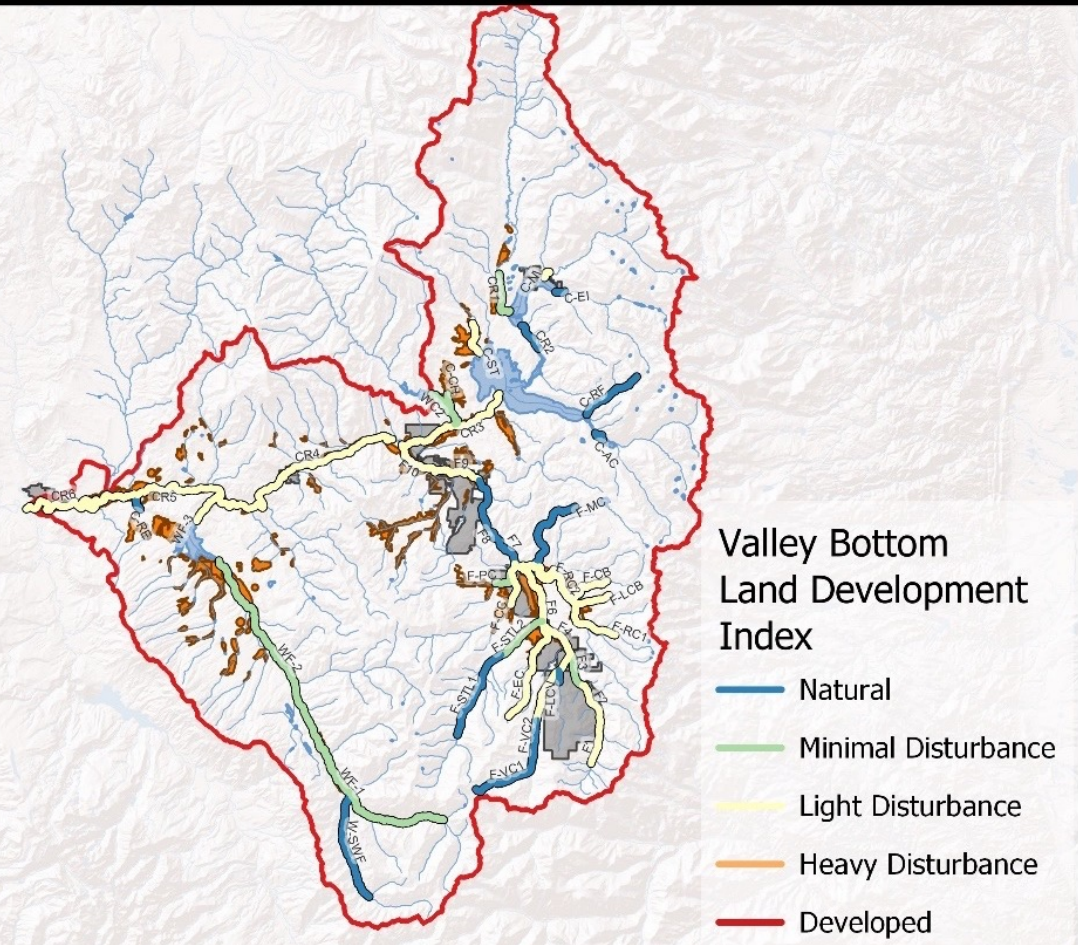
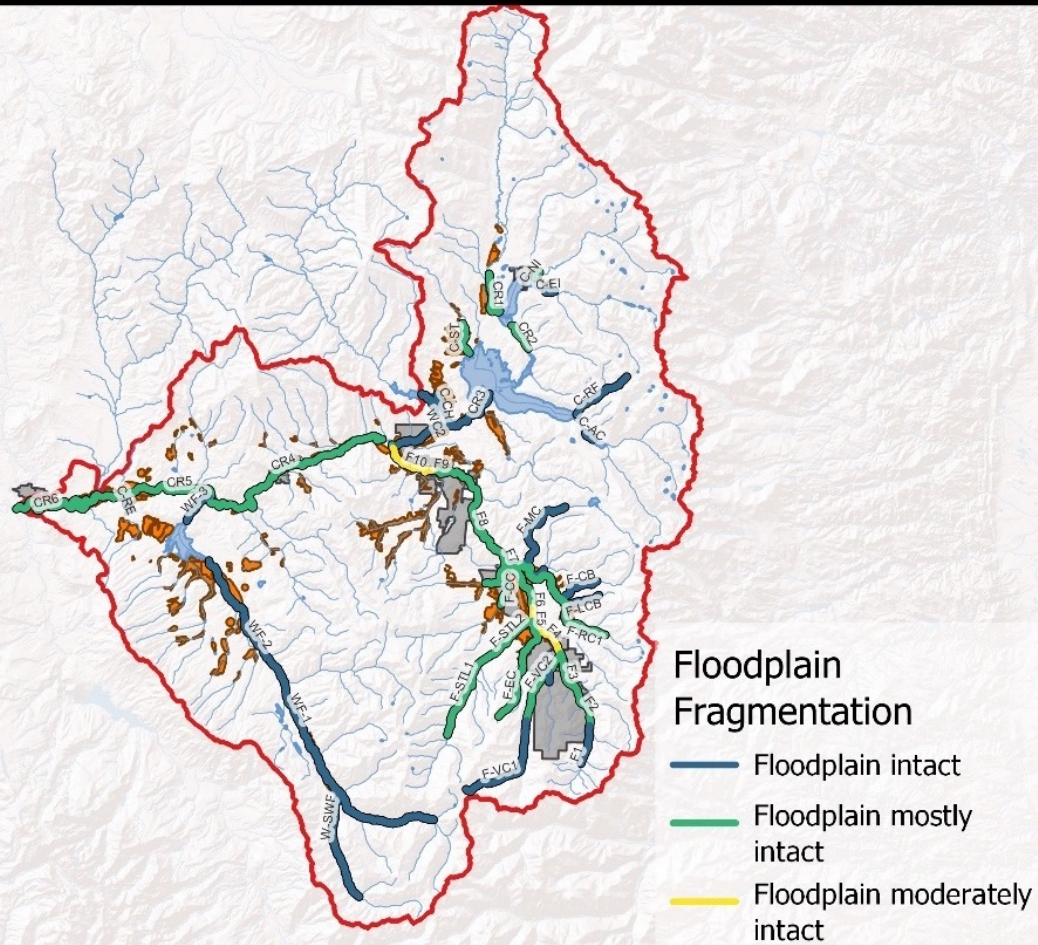
Source: Grand County Watershed Recovery



Jul 7, 2021 Hwy 125 - Mudslides



Drivers: Floodplain Condition

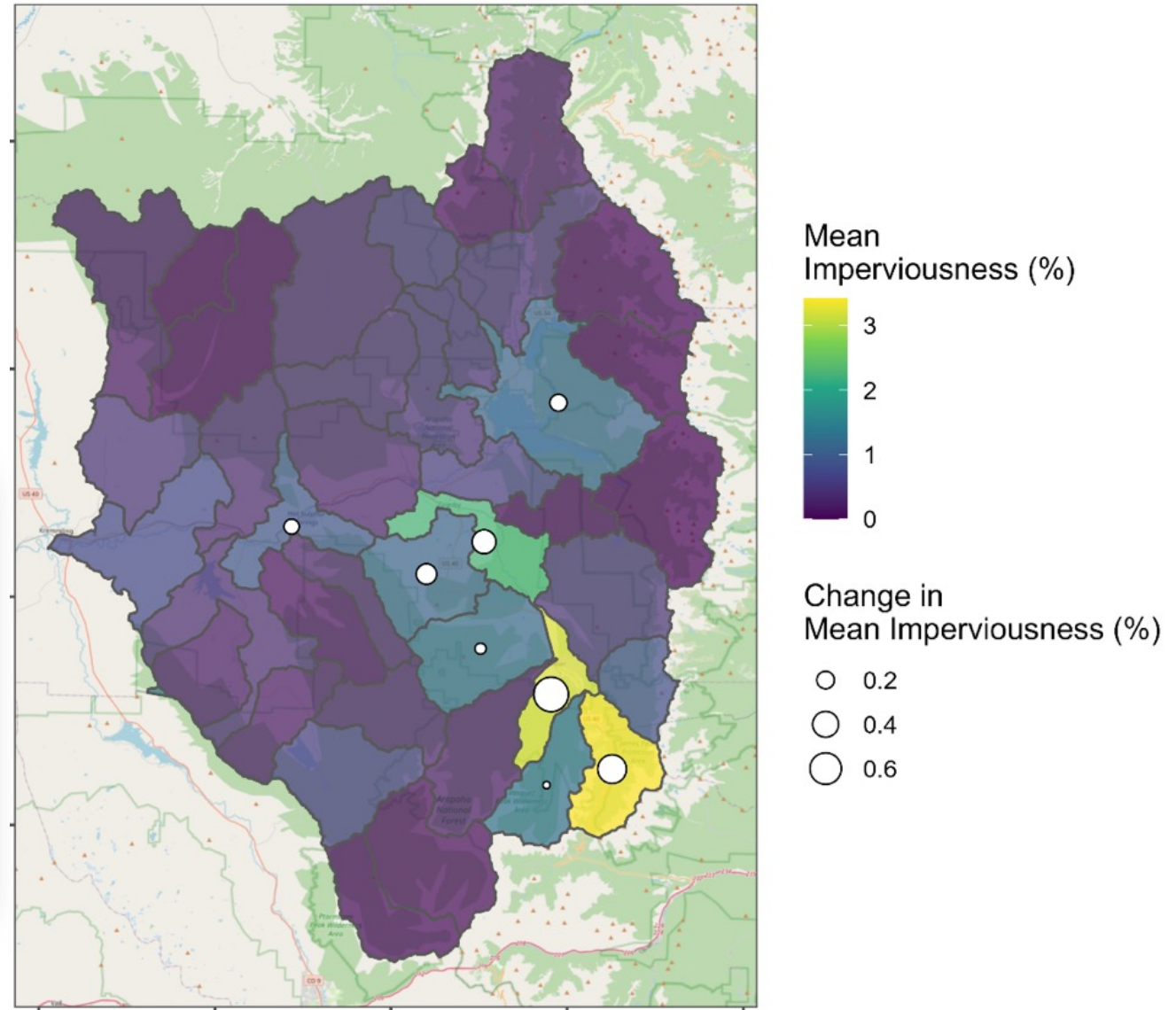


Drivers: Development Patterns

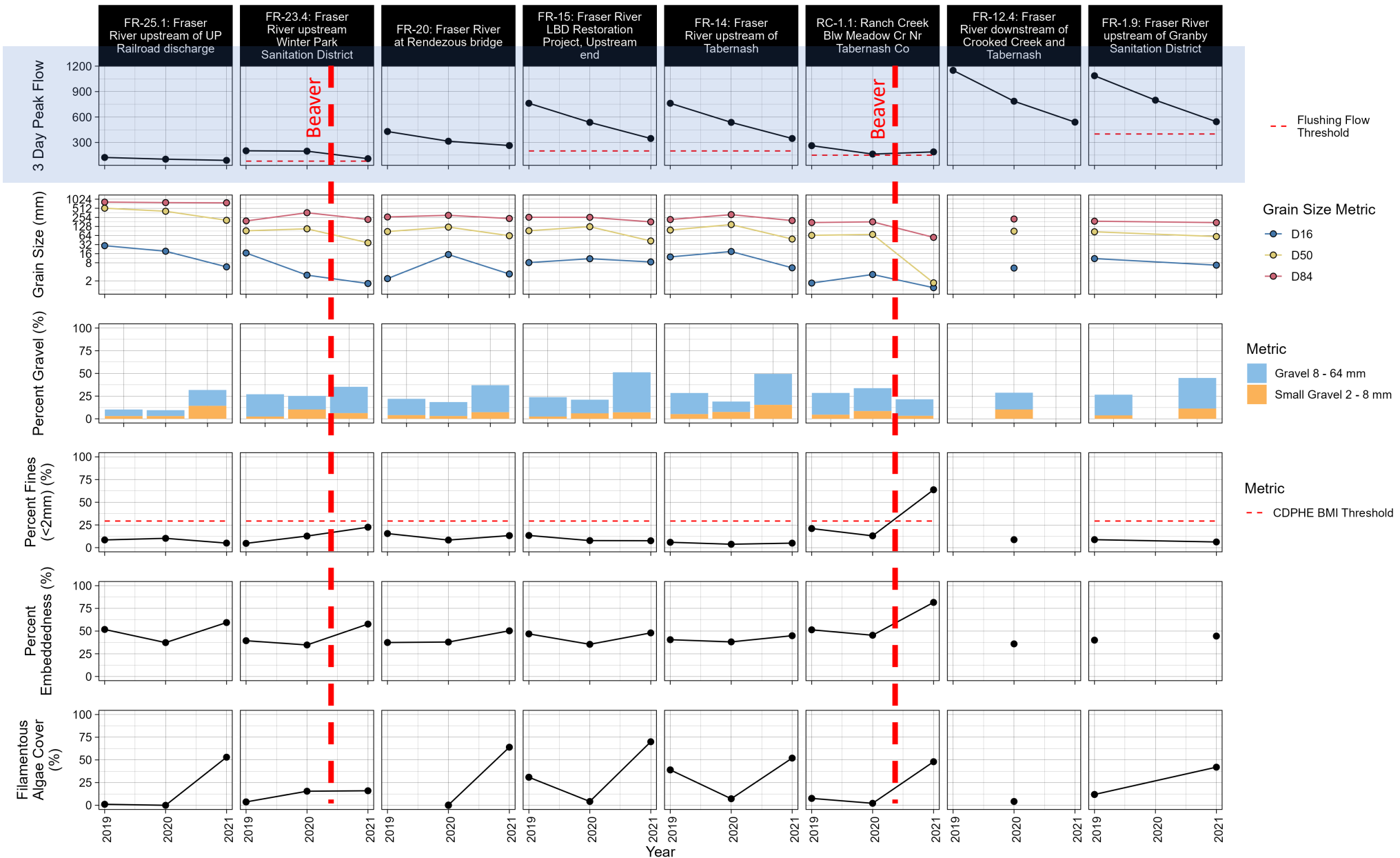
- Most development exists in the Fraser River valley and in the vicinity of Granby. This is reflected by relatively high levels of mapped impervious cover



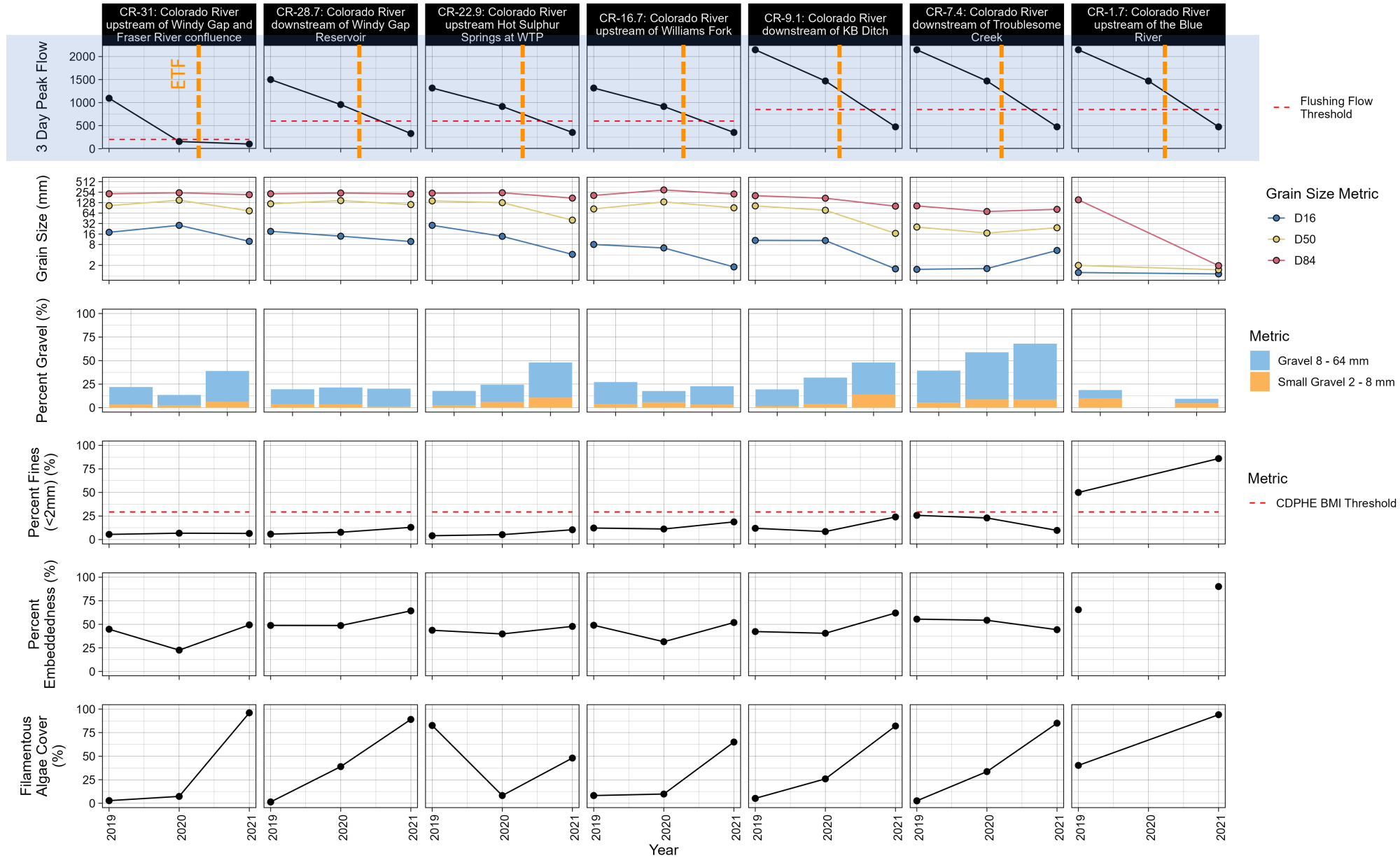
Source: Town of Winter Park



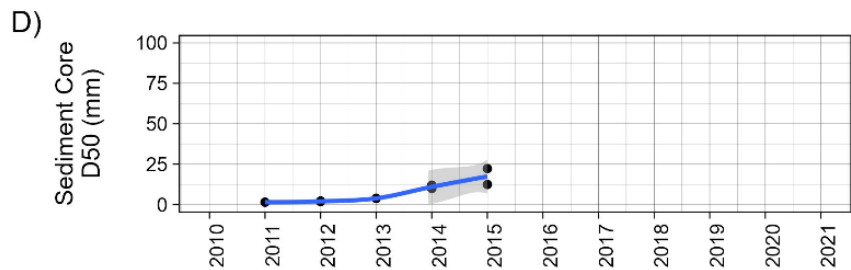
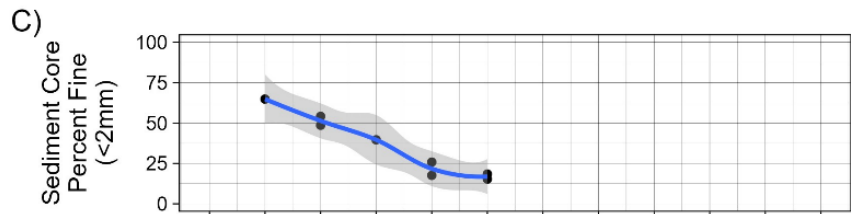
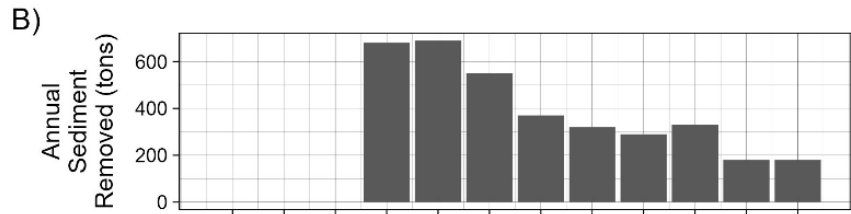
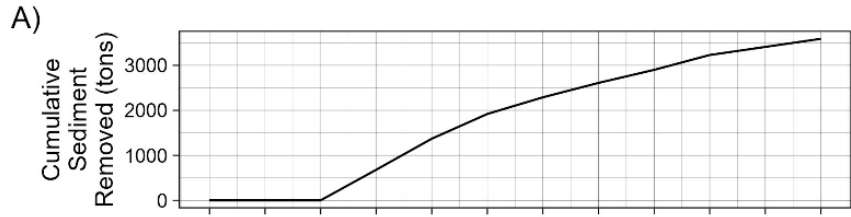
Correlations with Flow on the Fraser River



Correlations with Flow on the Colorado River



Project: Fraser River Sediment Pond



Source: Denver Water

Sampling Locations

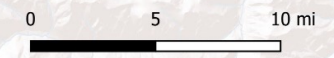
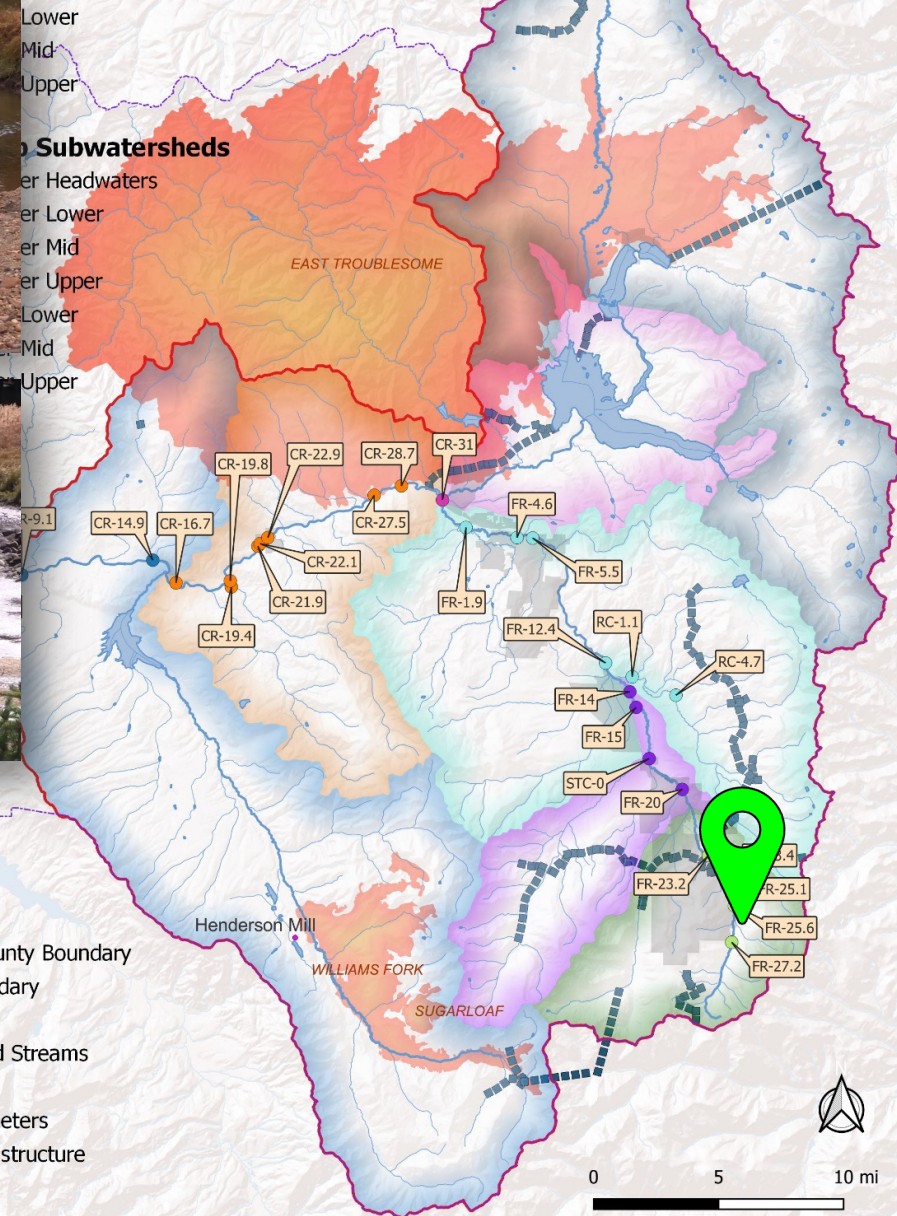
- Colorado River Headwaters
- Colorado River Lower
- Colorado River Mid
- Colorado River Upper

Lower
Mid
Upper

Subwatersheds

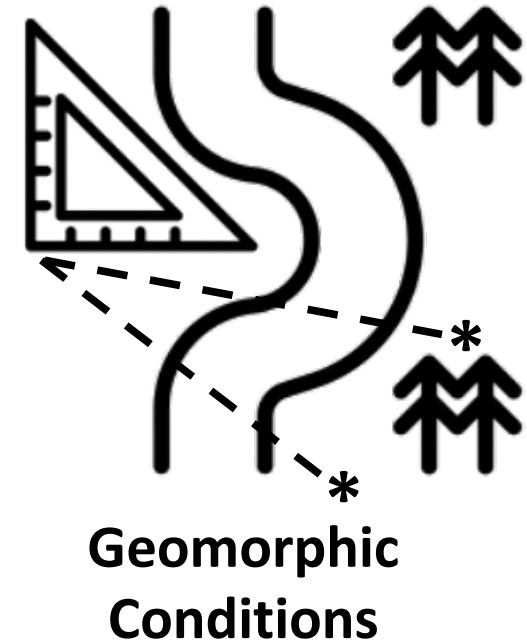
er Headwaters
er Lower
er Mid
er Upper
Lower
Mid
Upper

- Grand County Boundary
- CEA Boundary
- Lakes
- Rivers and Streams
- Towns
- Fire Perimeters
- TMD Infrastructure



Geomorphology: Key Findings

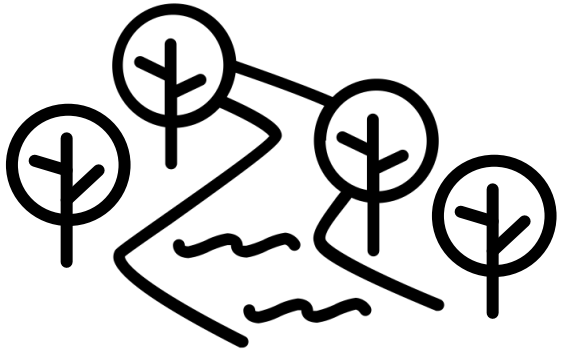
- Changes in data collection methodologies limit our ability to compare results across the entire period of interest.
- Recently collected data appears robust. Continued and consistent data collection is critical to understanding long-term trends and conditions.
- Fraser River Sediment Pond improved habitat quality on downstream reach.
- Observed recent fining of streambed sediments at some locations on Fraser and Colorado River.



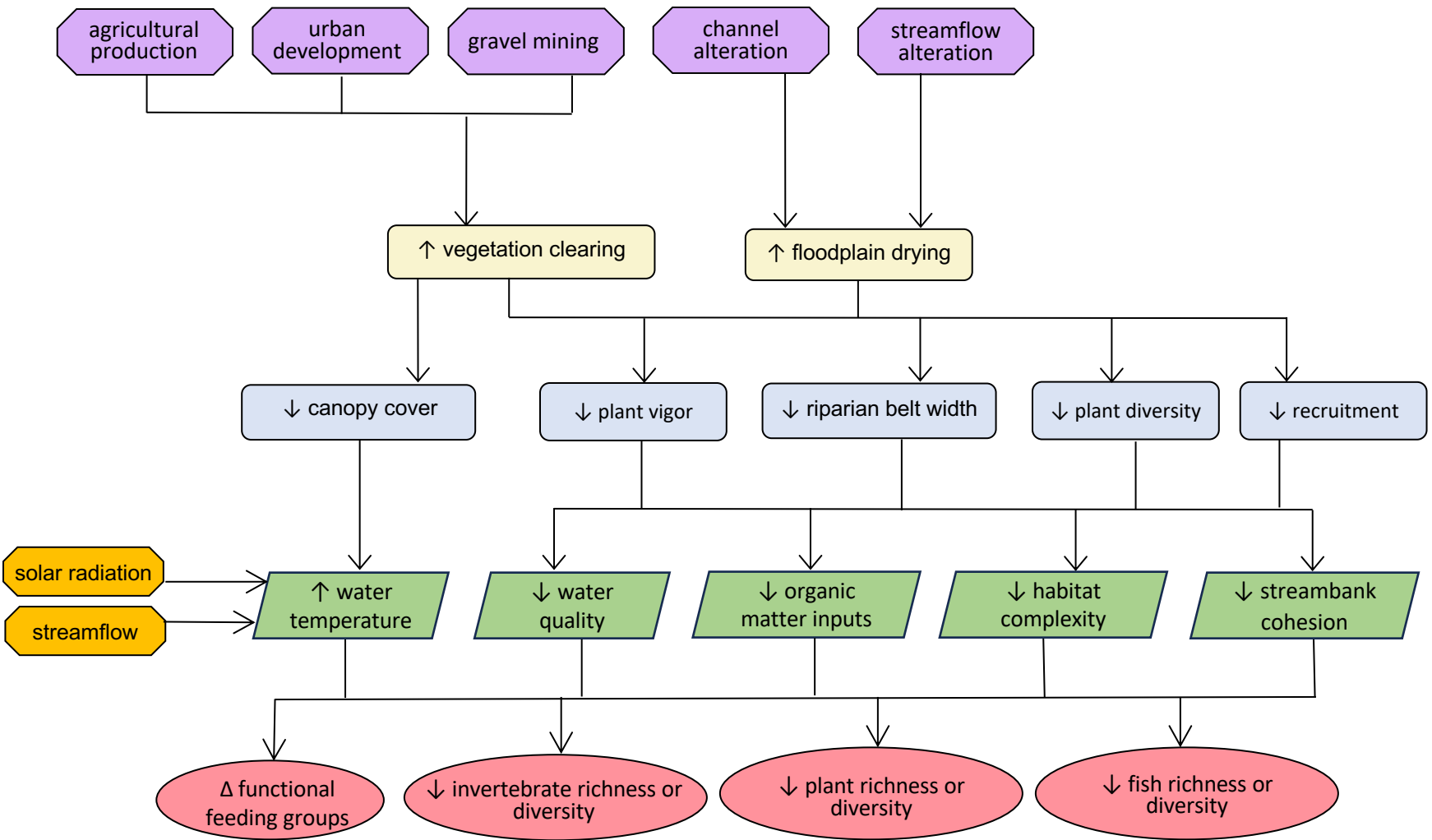


Riparian Areas

Summary of Findings



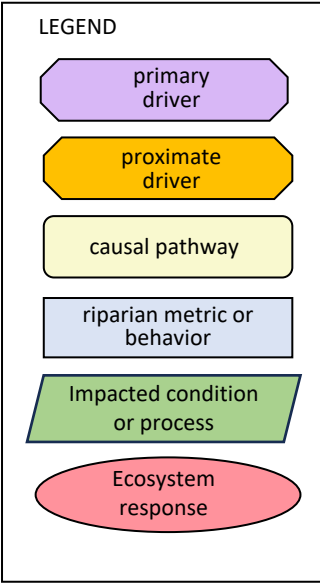
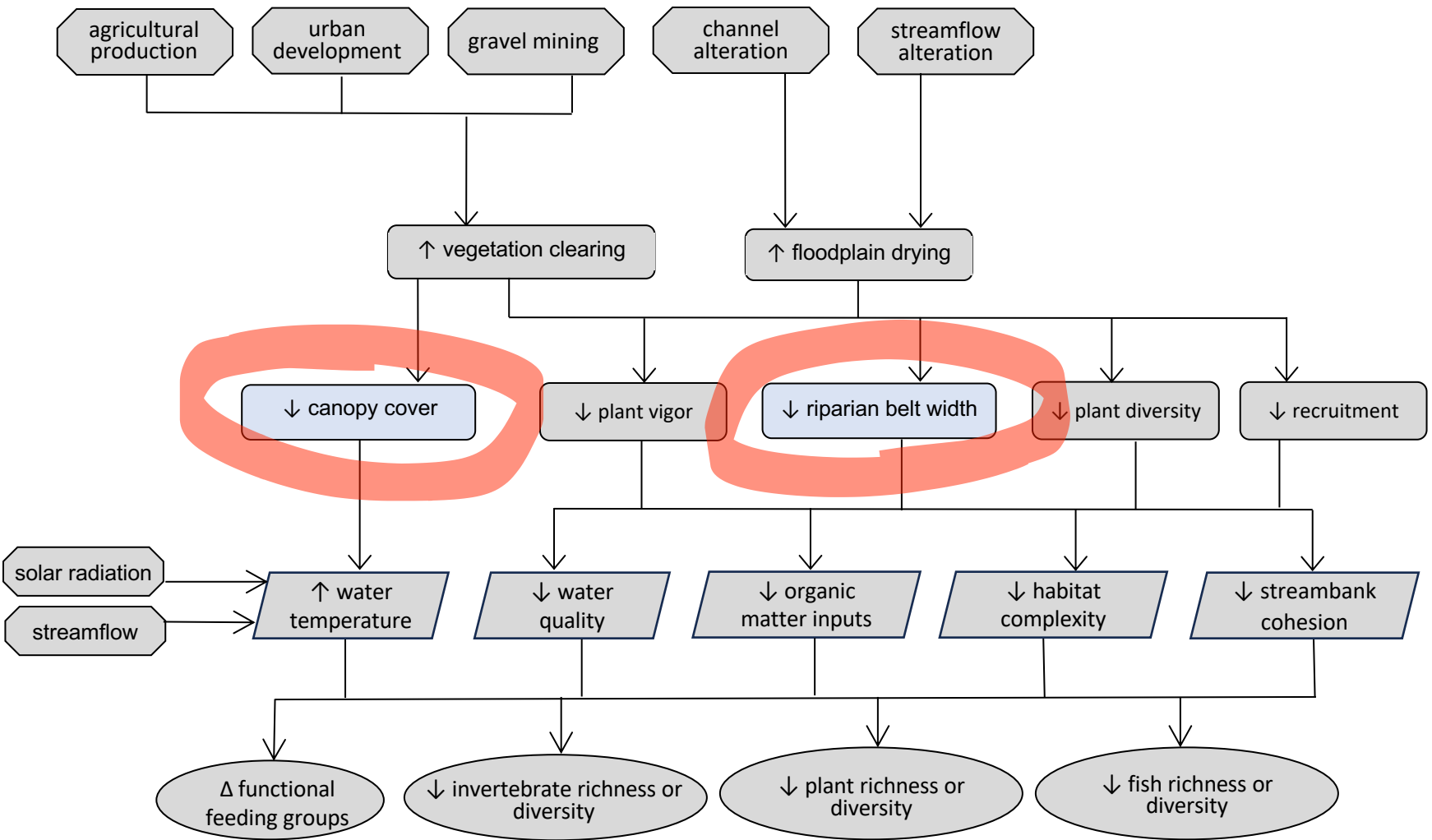
Riparian Areas: Causal Pathway Conceptual Model



LEGEND

- primary driver
- proximate driver
- causal pathway
- riparian metric or behavior
- impacted condition or process
- Ecosystem response

Riparian Areas: Causal Pathway Conceptual Model



Comprehensive Riparian Condition Mapping Methodology

1. Delineate area of interest

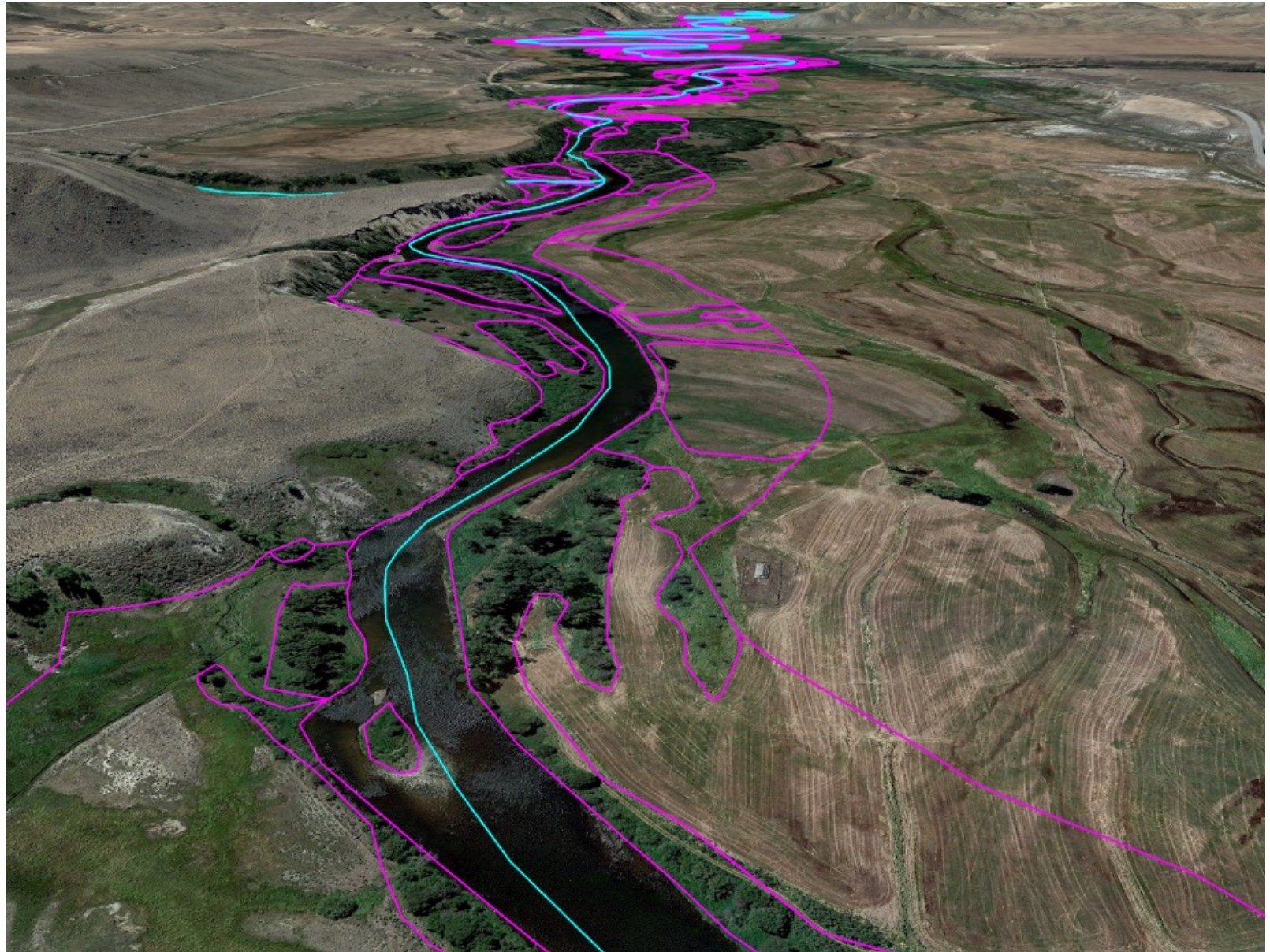
- 100 m for both banks or the natural floodplain, whichever is narrower.

2. Hand digitize land cover classifications

- Relied on 2019 and 2021 NAIP imagery

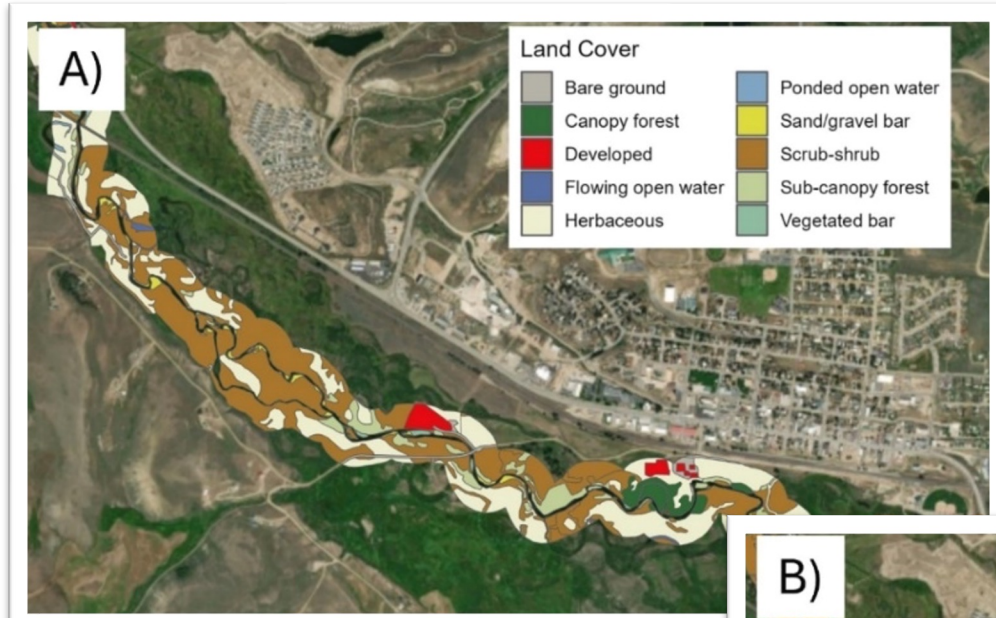
3. Assign conditional assessment values (i.e., grades)

- Grades reflect departure from natural/pristine conditions

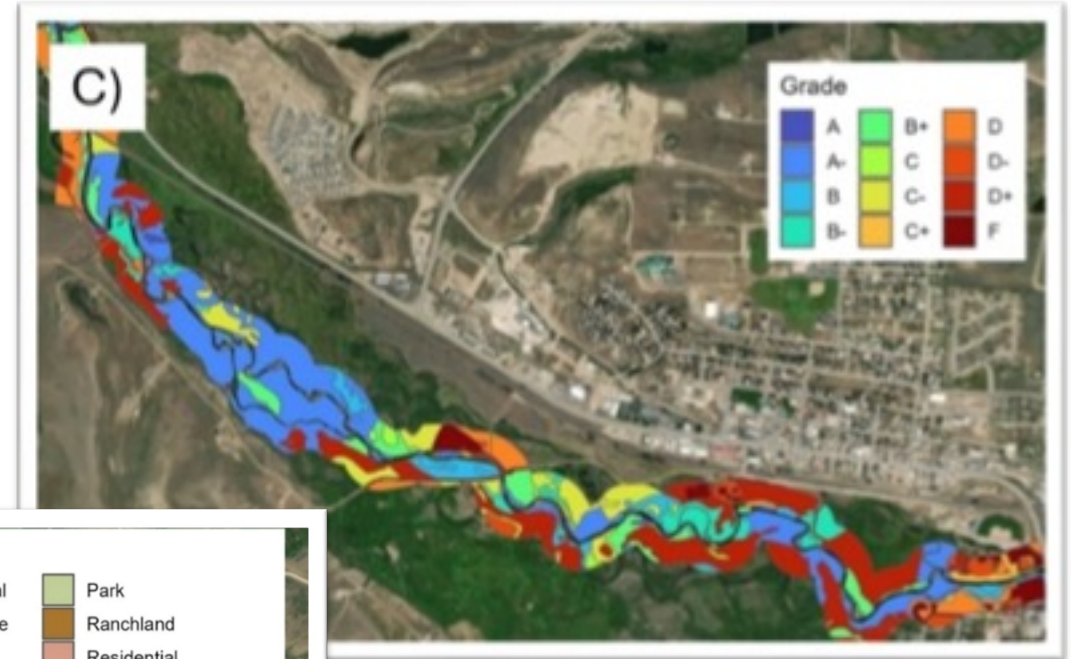


Riparian Condition Mapping Outputs

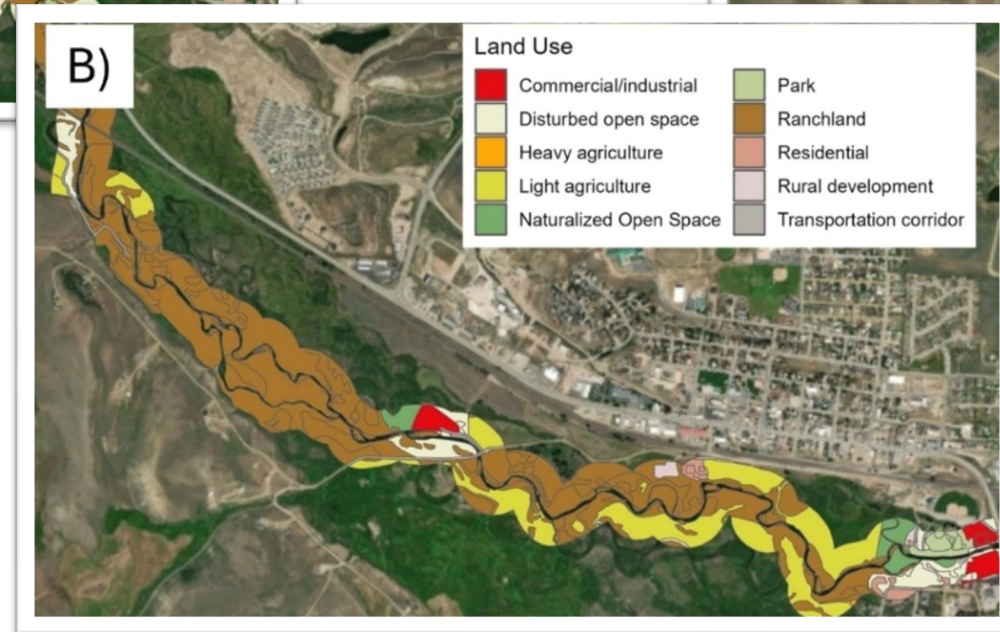
Dominant Cover



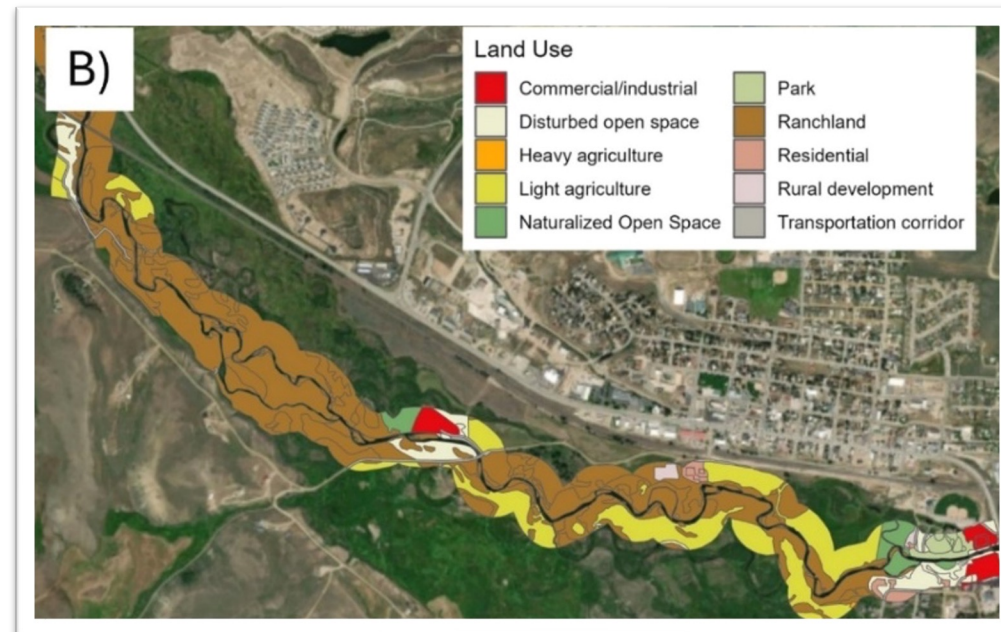
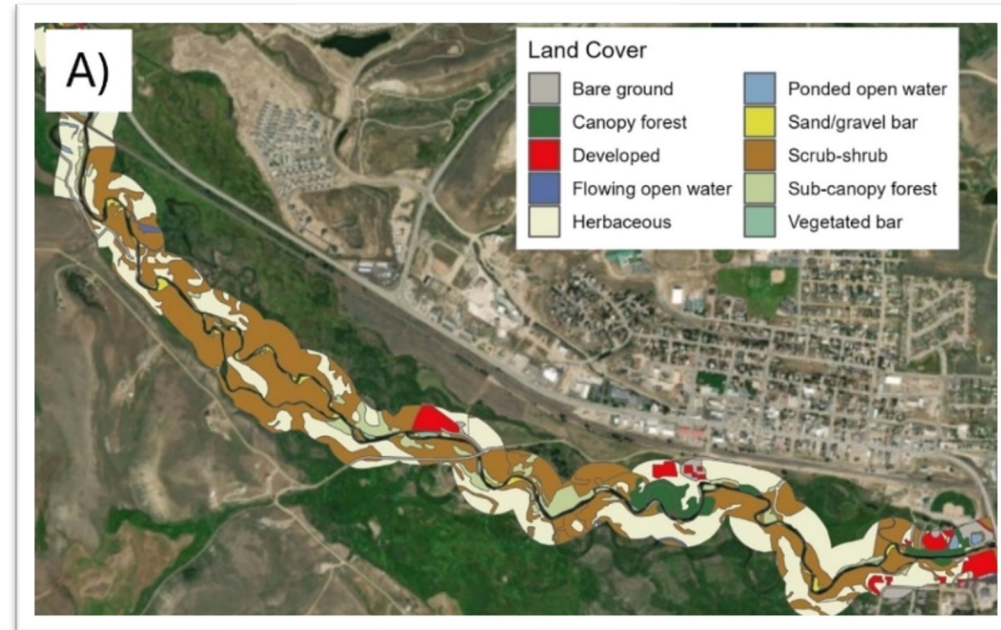
Current Condition



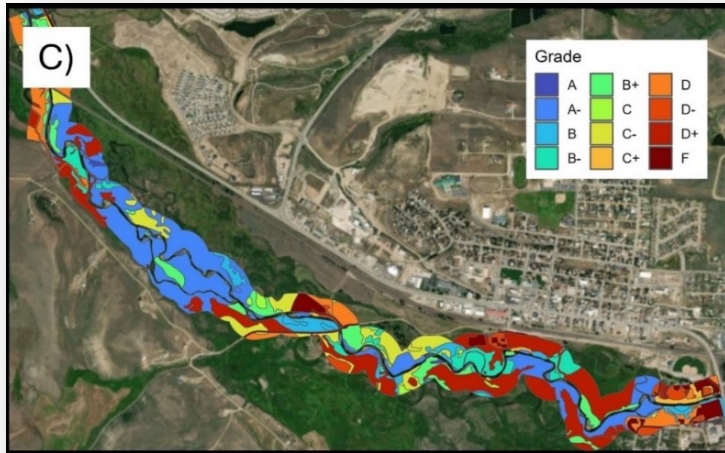
Land Use



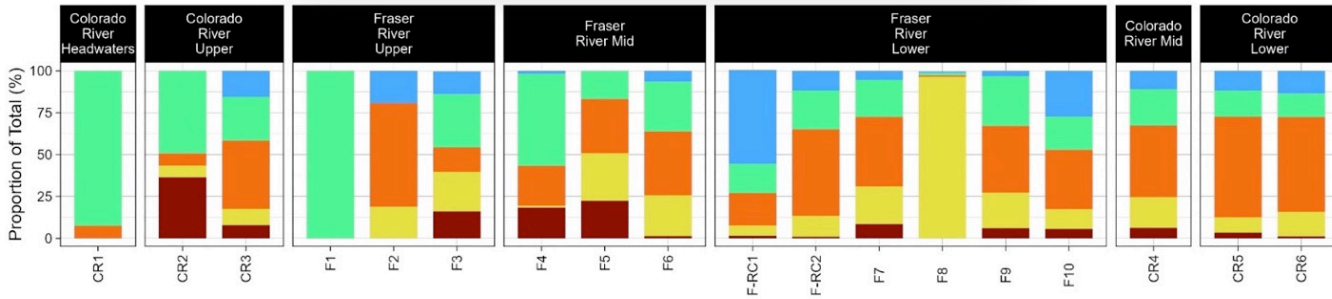
	Mainstem Rivers (Polygon Assessment)					
	Colorado River Upper	Fraser River Upper	Fraser River Mid	Fraser River Lower	Colorado River Mid	Colorado River Lower
Land Cover						
Alpine Forest	--	--	--	--	--	--
Bare Ground	5%	10%	2%	2%	3%	2%
Canopy forest	<1%	<1%	<1%	1%	19%	6%
Developed	3%	12%	9%	2%	4%	1%
Flowing open water	1%	--	<1%	<1%	<1%	<1%
Herbaceous	43%	17%	21%	39%	37%	63%
Ponded open water	2%	4%	6%	1%	<1%	1%
Montane Forest	--	--	--	--	--	--
Palustrine emergent wetland	<1%	--	--	<1%	--	<1%
Subalpine Forest	--	14%	--	3%	--	--
Sub-canopy forest	10%	1%	3%	3%	18%	10%
Scrub-shrub	34%	42%	59%	47%	19%	18%
Vegetated bar	<1%	--	<1%	<1%	<1%	--
Land Use						
Light agriculture	<1%	--	--	<1%	<1%	--
Heavy agriculture	31%	2%	1%	17%	27%	49%
Commercial/industrial	<1%	1%	4%	1%	2%	--
Dams/levees	1%	--	<1%	<1%	--	--
Disturbed open space	5%	10%	7%	3%	2%	1%
Infrastructure	2%	3%	3%	<1%	<1%	<1%
Naturalized Open Space	1%	26%	15%	6%	9%	3%
Park	--	--	1%	2%	1%	--
Ranchland	53%	14%	60%	65%	53%	44%
Residential	2%	12%	5%	1%	1%	<1%
Rural development	1%	3%	<1%	<1%	2%	1%
Transportation corridor	5%	6%	4%	3%	3%	2%
Wildland	<1%	24%	--	2%	--	--
Total Acreage	468	94	529	1074	740	1169



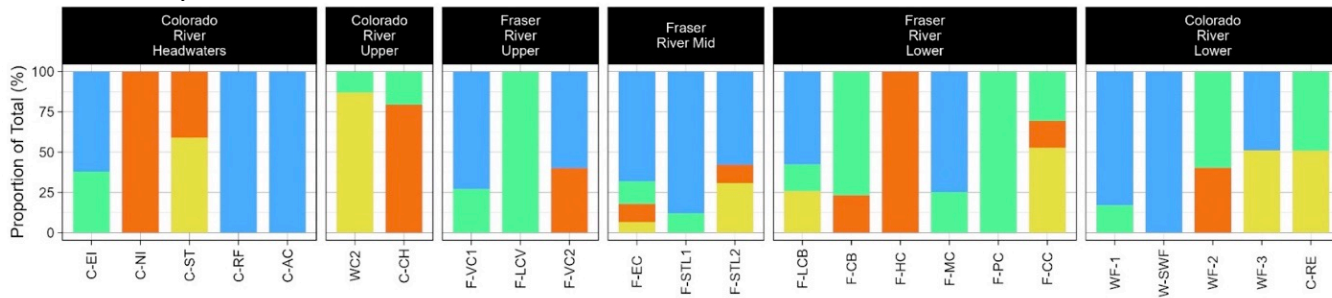
Riparian Condition Mapping Results



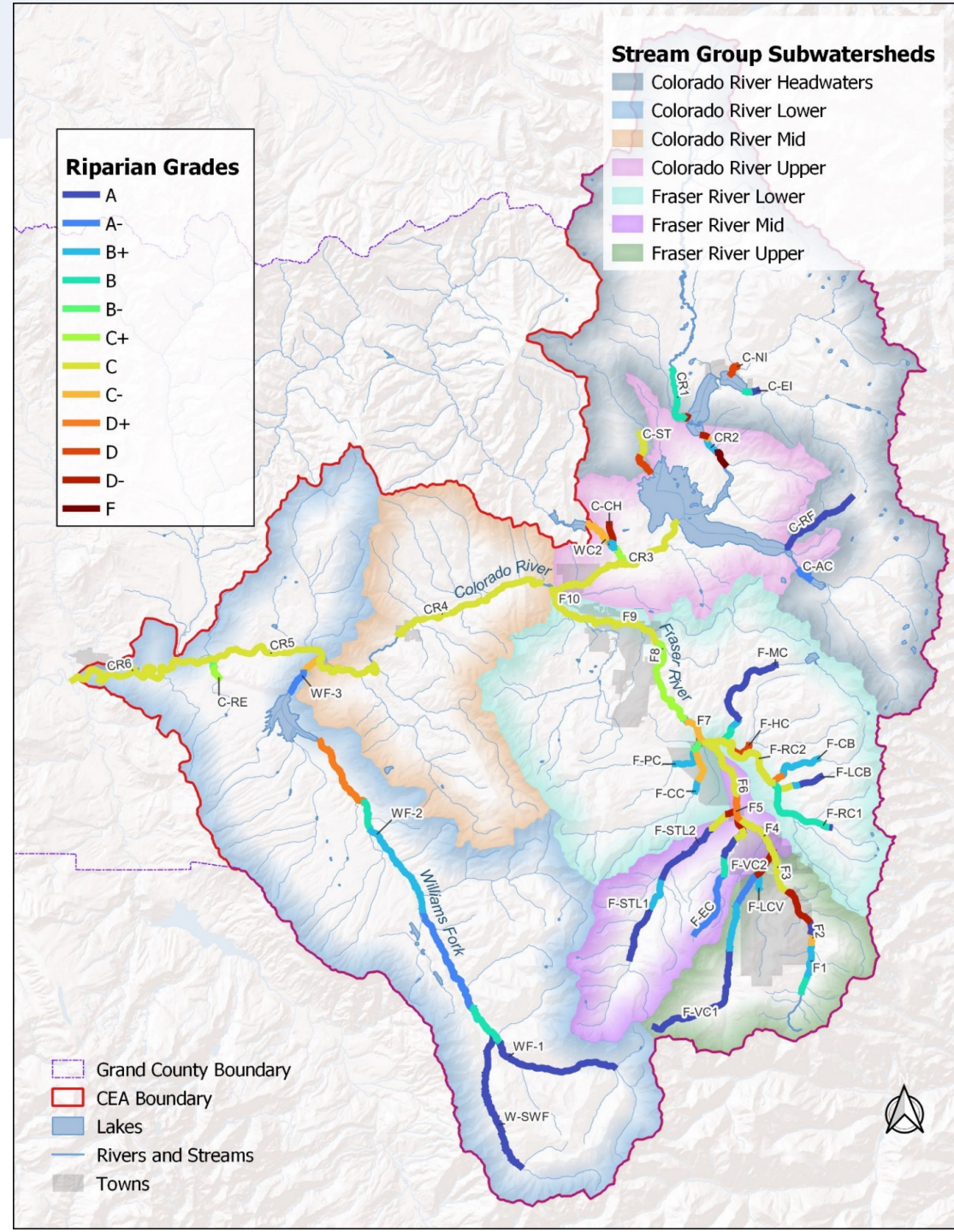
Mainstem



Tributary Reaches

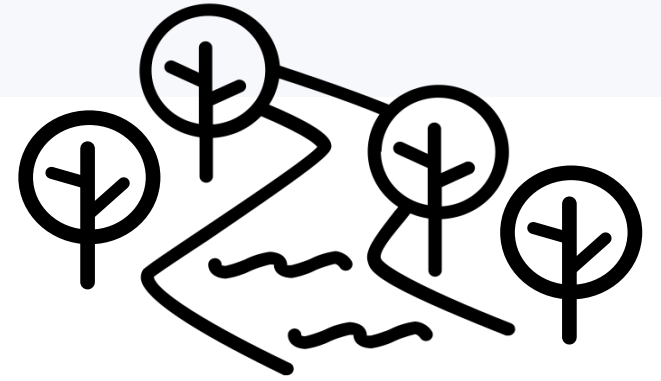


Grade A B C D F



Riparian Condition – Key Takeaways

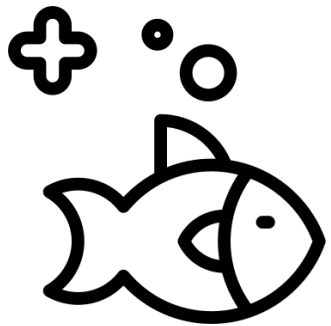
- Despite the rural character of CEA impacts to riparian areas are widespread, driven by:
 - Historical agricultural land uses
 - Water management
 - Development of resort towns and outdoor recreation amenities
- Impacts of **urbanization** are most pervasive in the Fraser River Valley
- Impacts of **agriculture** are most pervasive along the Colorado river between the Fraser river and Kremmling.
 - Clearing commonly runs all the way to the streambank
- Most headwater reaches remain in very good condition
 - Modest impacts from **water management** or **infrastructure**.



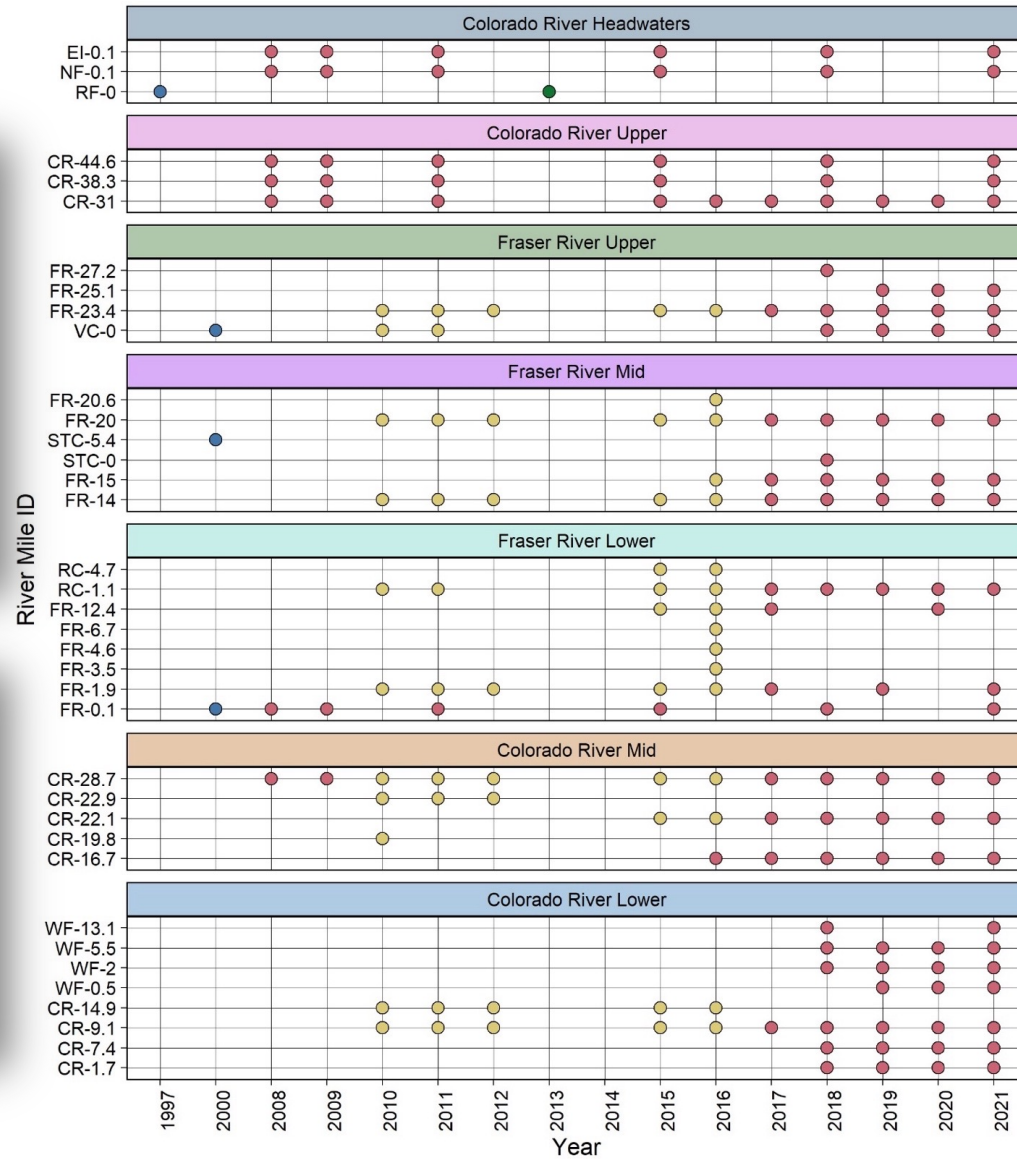


Aquatic Biota

Summary of Findings



Macroinvertebrates - Inventory



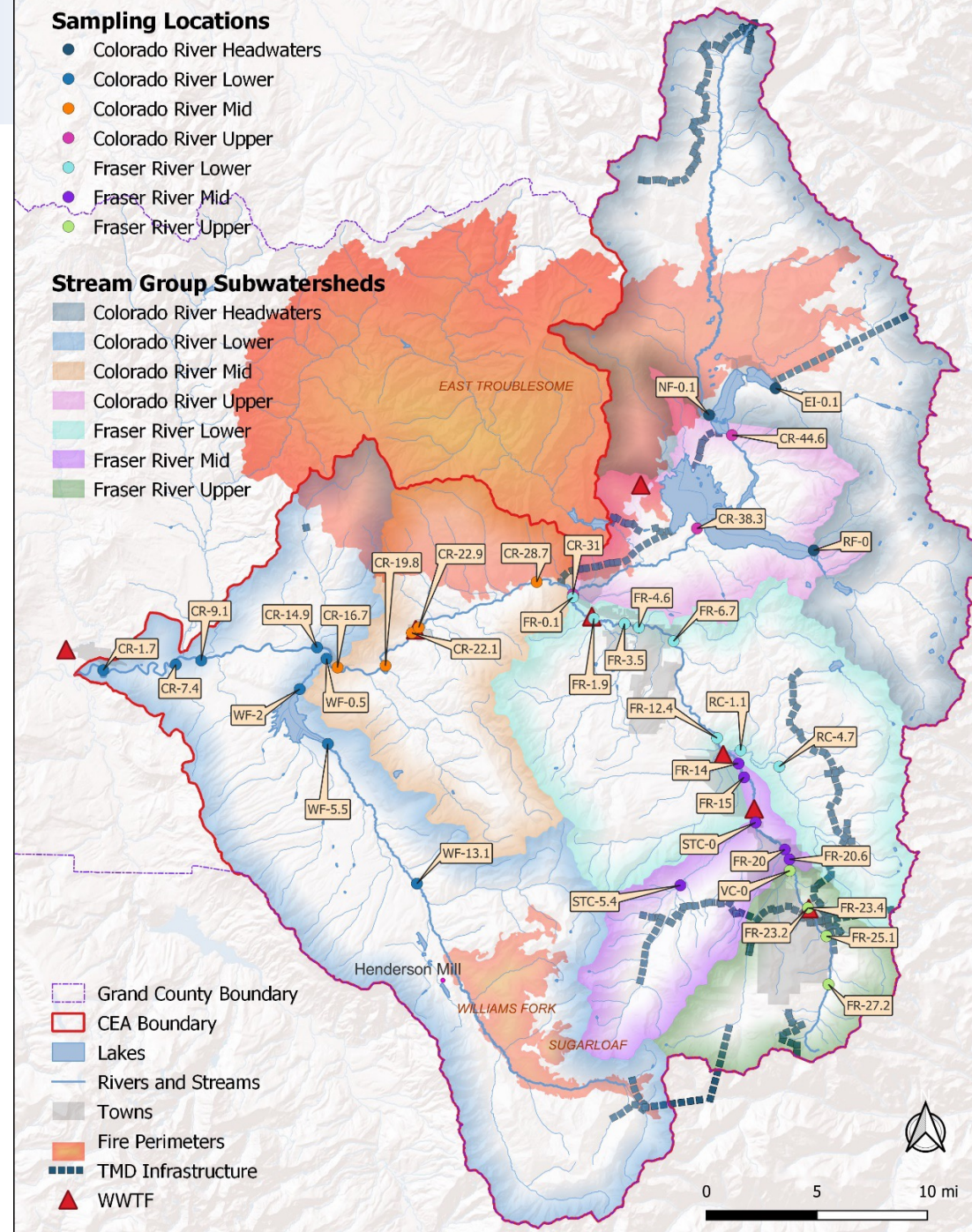
Sampling Entity ● CDPHE ● EPA ● GCWIN ● Timberline

Sampling Locations

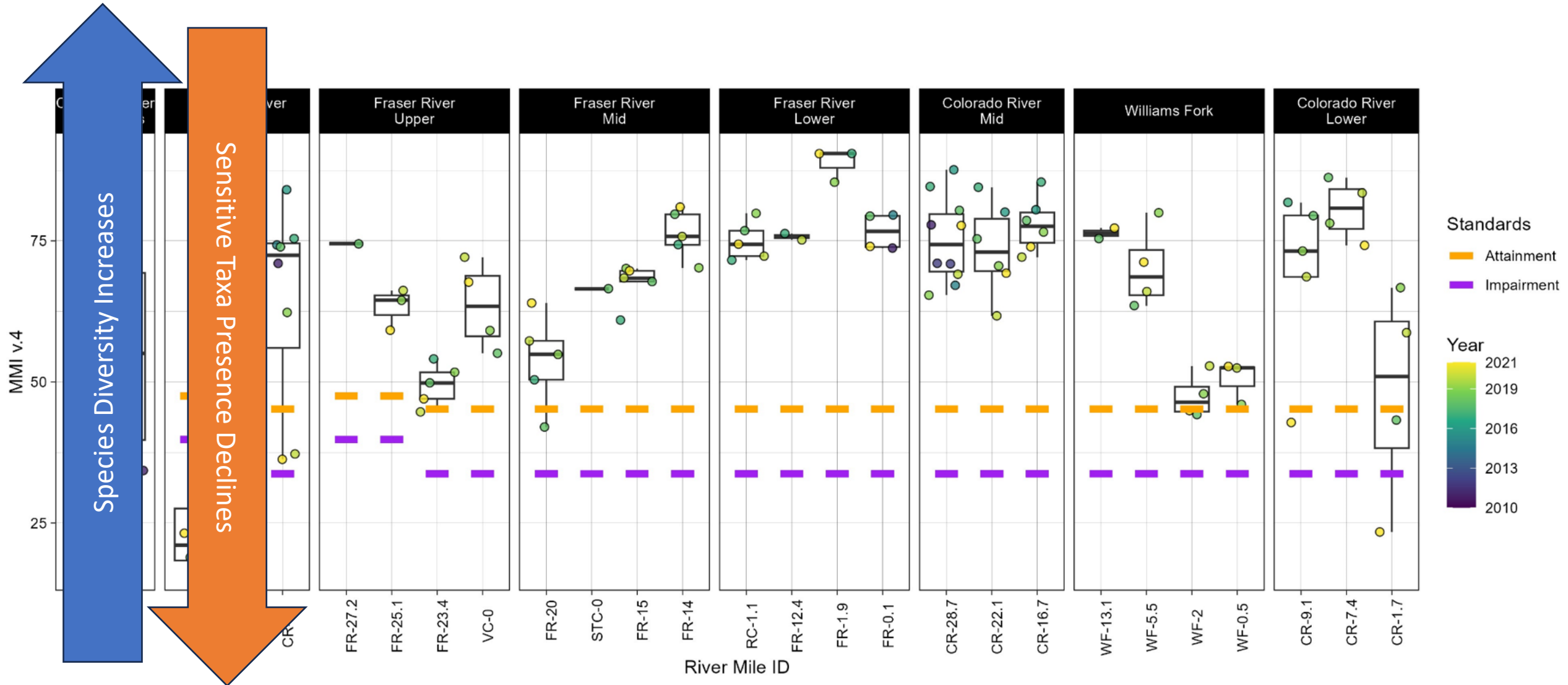
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- Colorado River Lower
- Colorado River Mid
- Colorado River Upper
- Fraser River Lower
- Fraser River Mid
- Fraser River Upper

Stream Group Subwatersheds

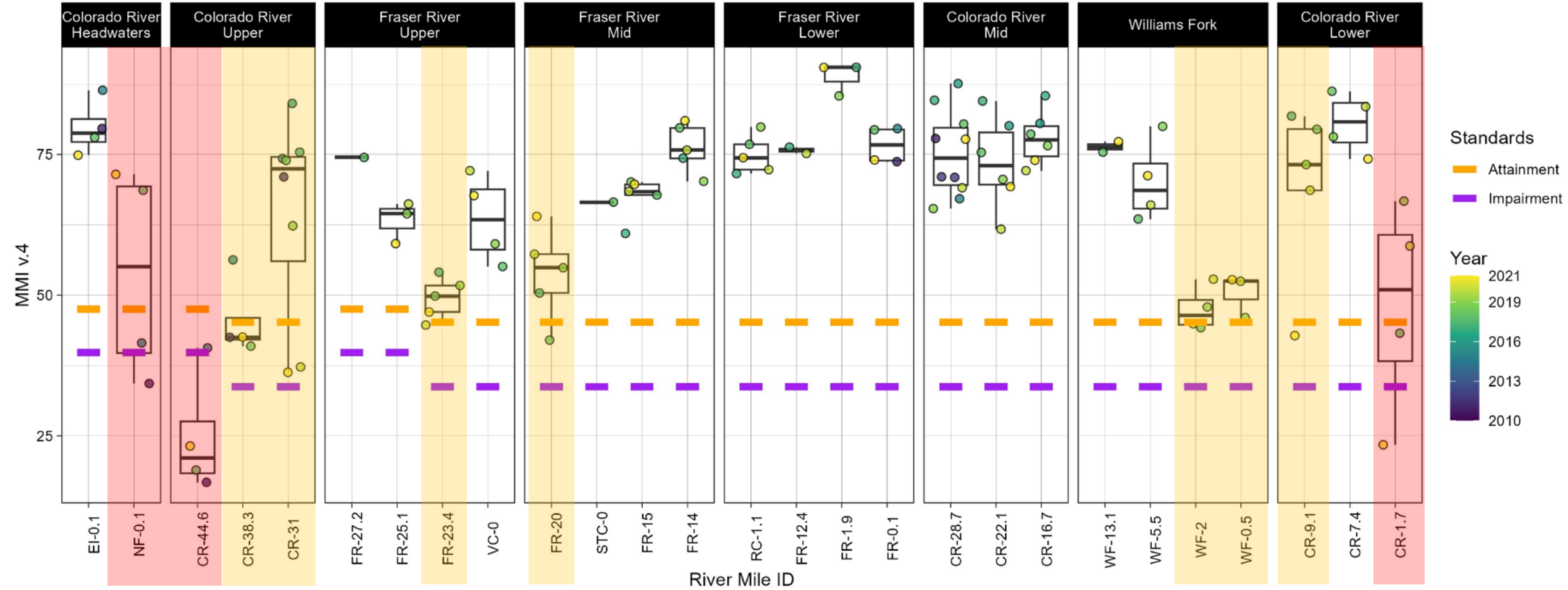
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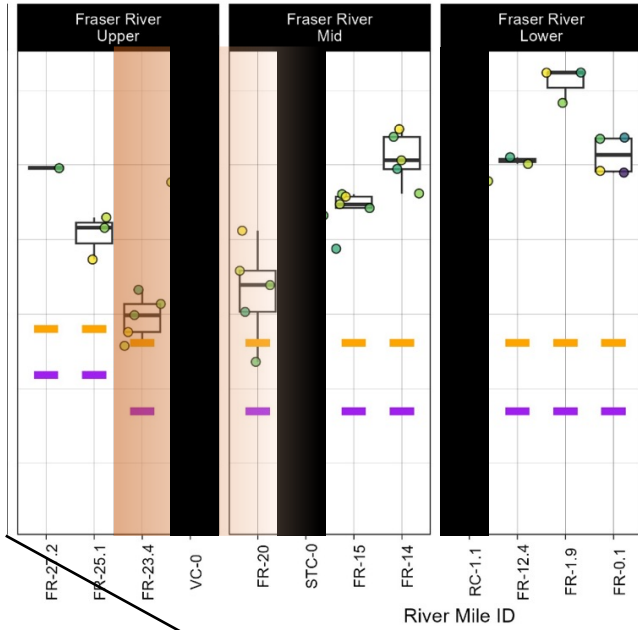
Macroinvertebrates – Aggregate Patterns



Macroinvertebrates – Aggregate Patterns

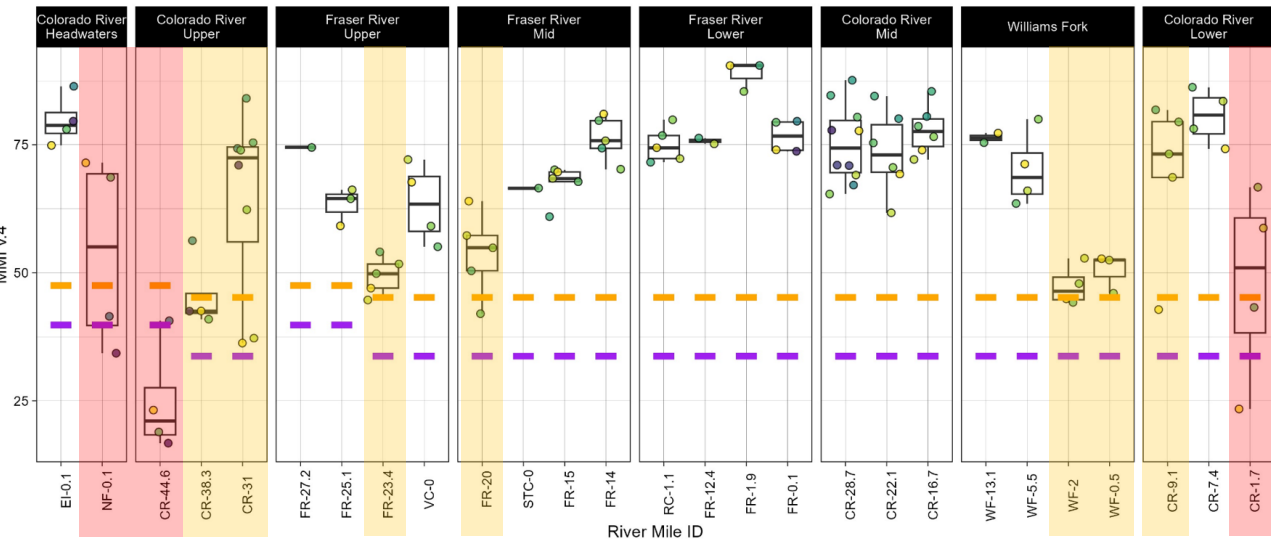


MMI – Fraser Spatial Patterns



Impacts on upper Fraser River driven by:

- Union Pacific Tunnel Discharge
- Highway Maintenance
- Resort Development

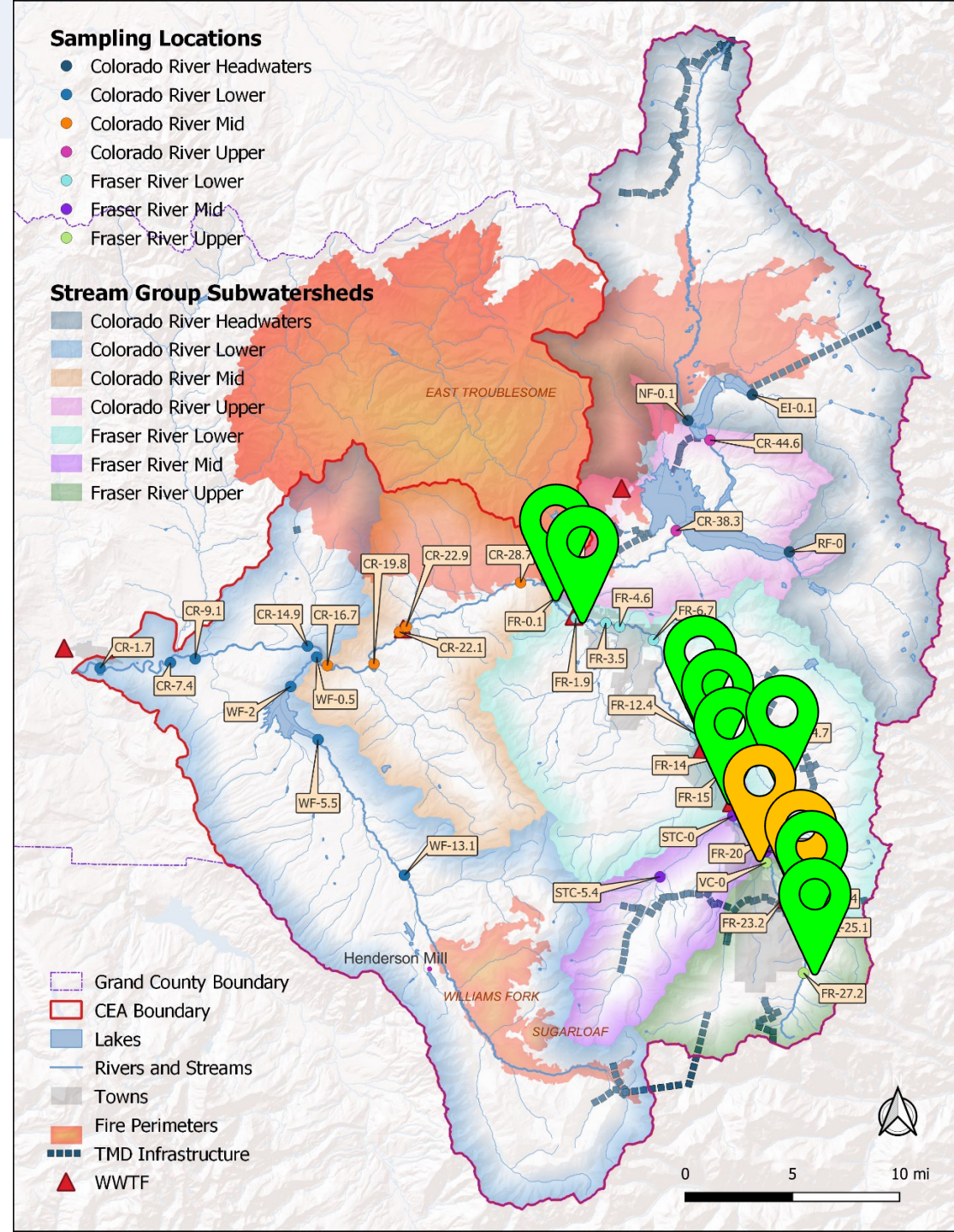


Sampling Locations

- Colorado River Headwaters
- Colorado River Lower
- Colorado River Mid
- Colorado River Upper
- Fraser River Lower
- Fraser River Mid
- Fraser River Upper

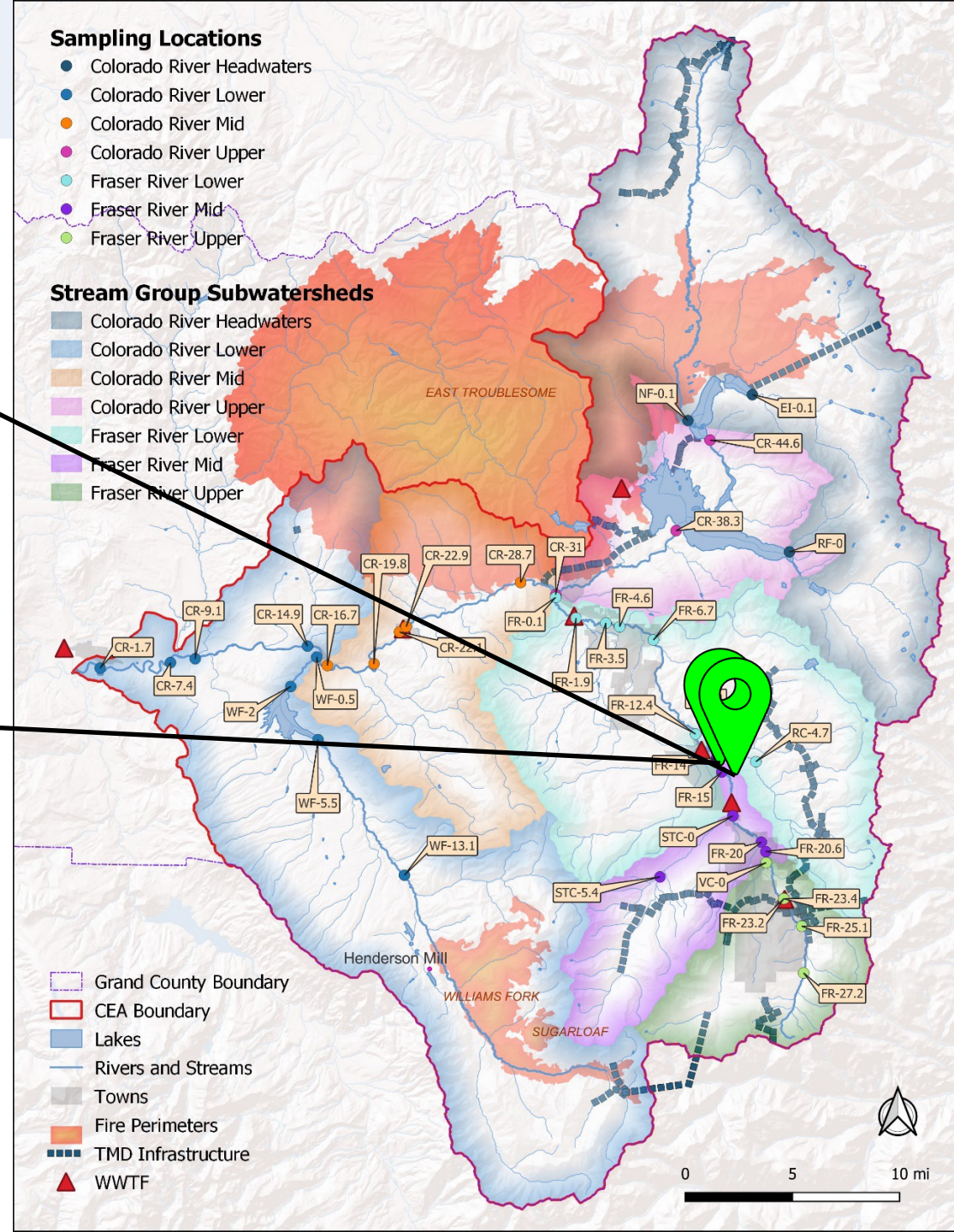
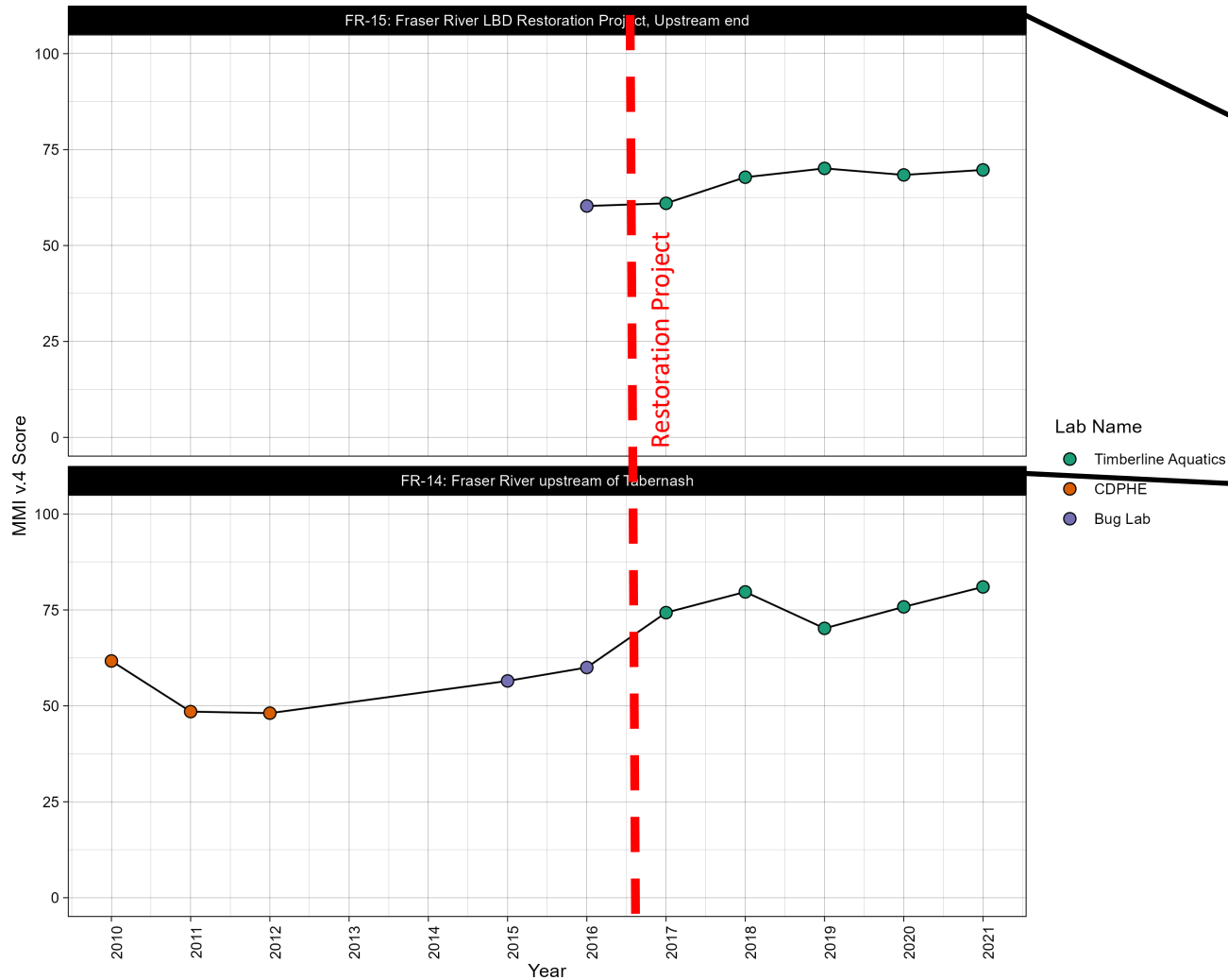
Stream Group Subwatersheds

- Colorado River Headwaters
- Colorado River Lower
- Colorado River Mid
- Colorado River Upper
- Fraser River Lower
- Fraser River Mid
- Fraser River Upper

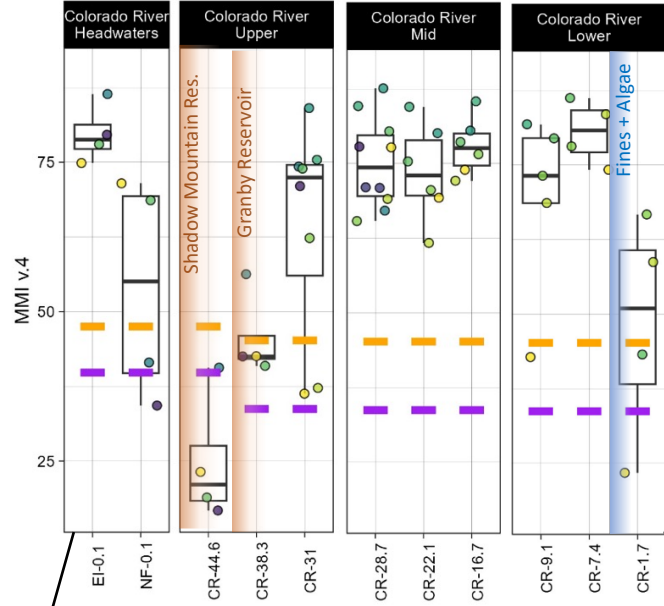


Project: Fraser Flats Restoration

Improving MMI Scores post-project

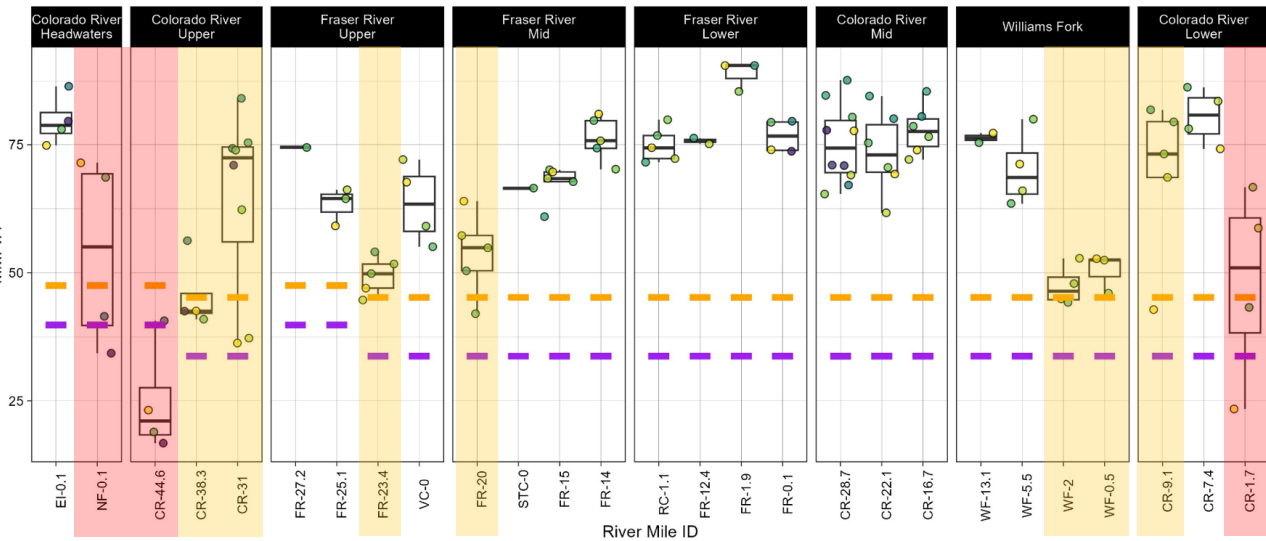


MMI – Colorado Spatial Patterns



Impacts on Colorado River driven by:

- Reservoir Operations
- Wildfire

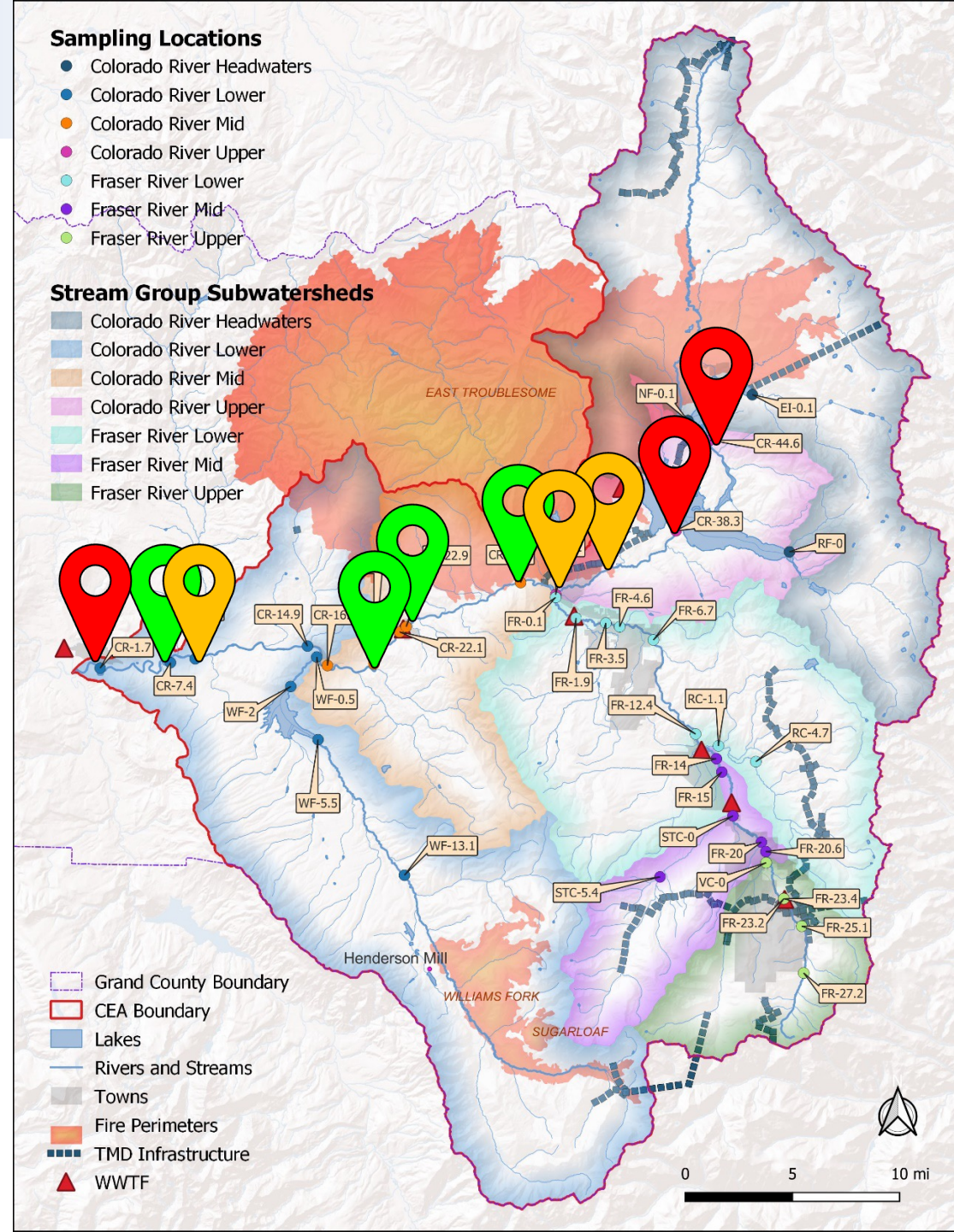


Sampling Locations

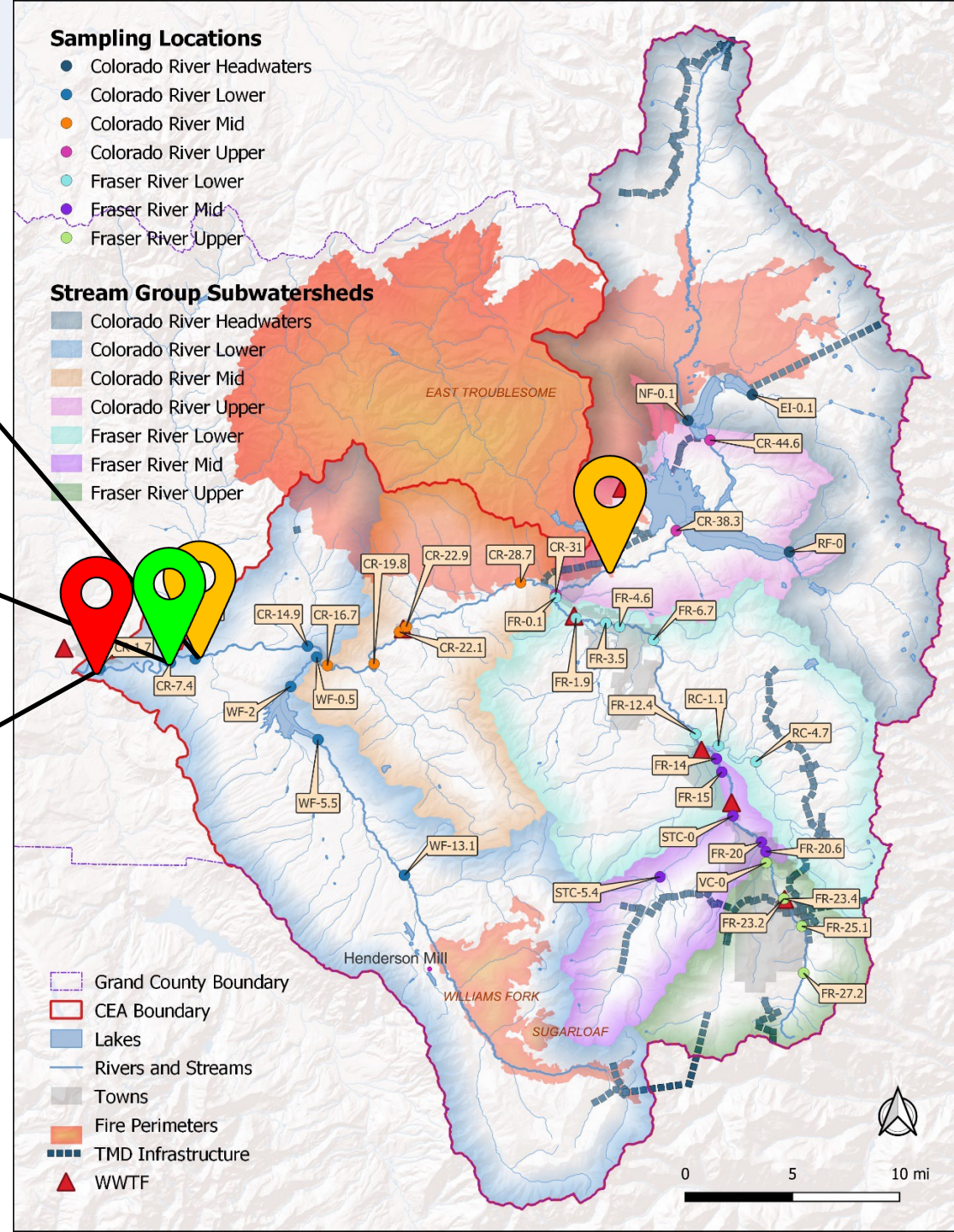
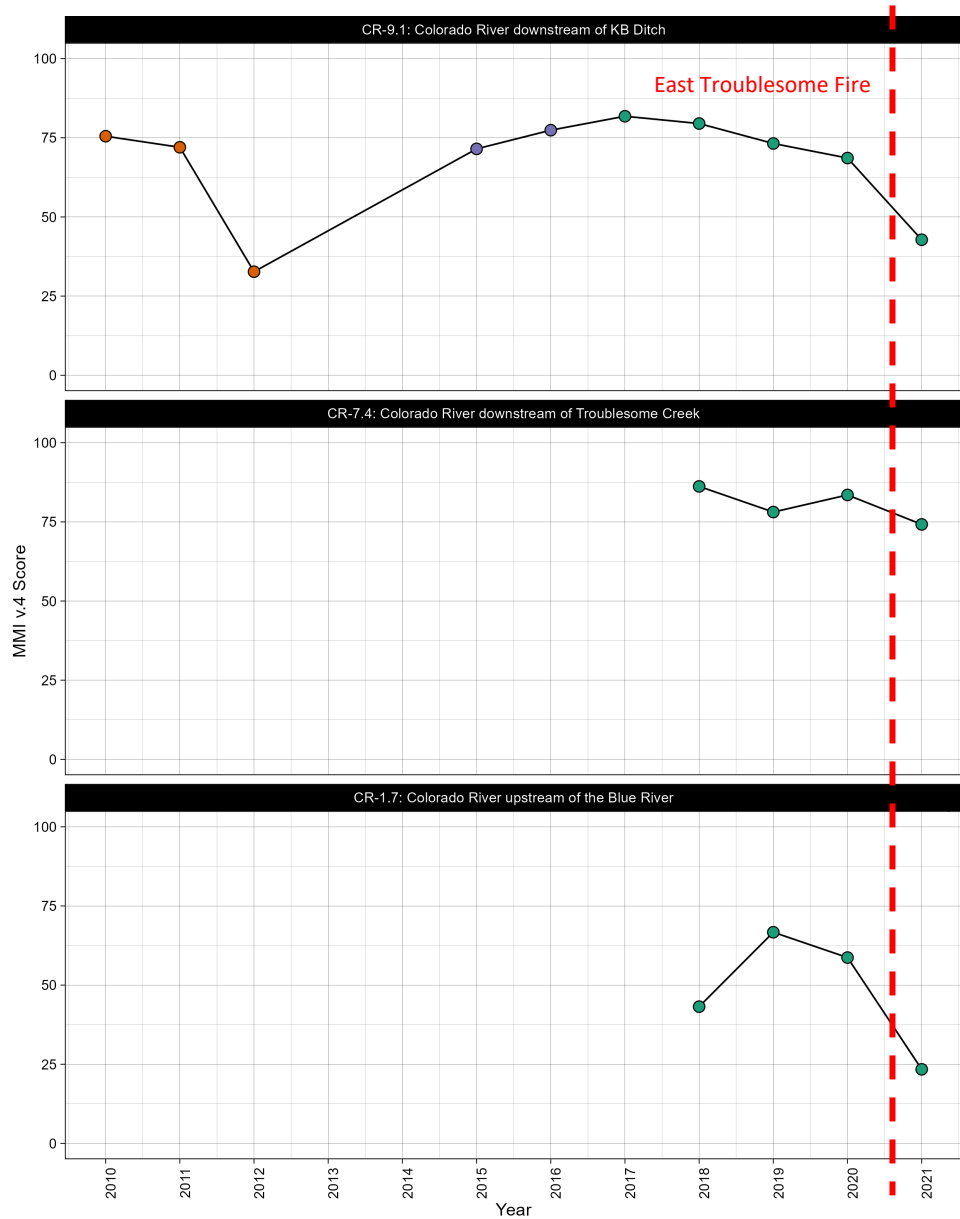
- Colorado River Headwaters
- Colorado River Lower
- Colorado River Mid
- Colorado River Upper
- Fraser River Lower
- Fraser River Mid
- Fraser River Upper

Stream Group Subwatersheds

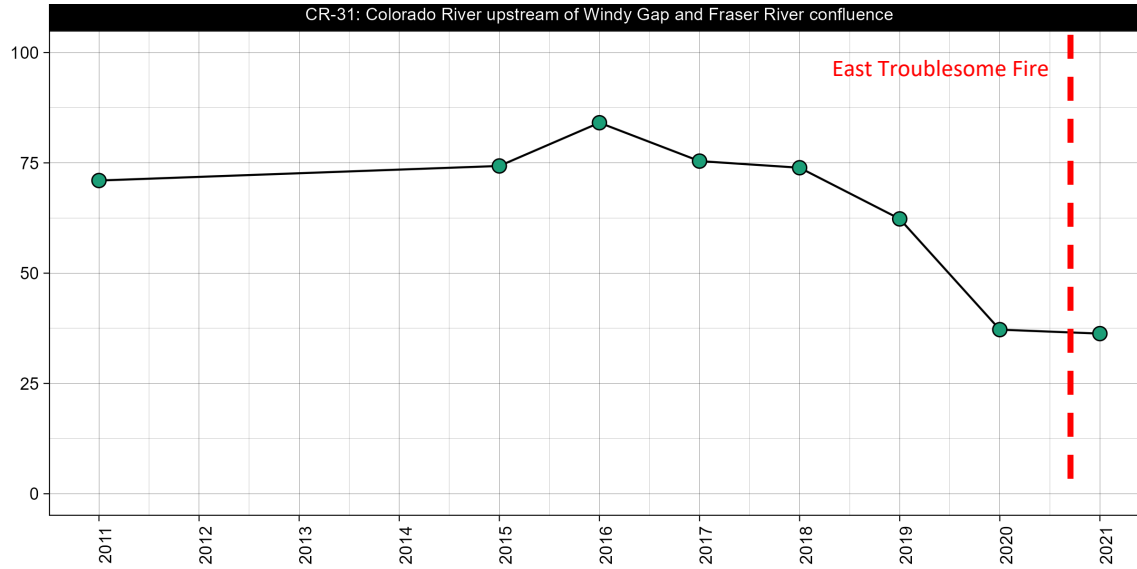
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- Fraser River Lower
- Fraser River Mid
- Fraser River Upper



Macroinvertebrates: Colorado River

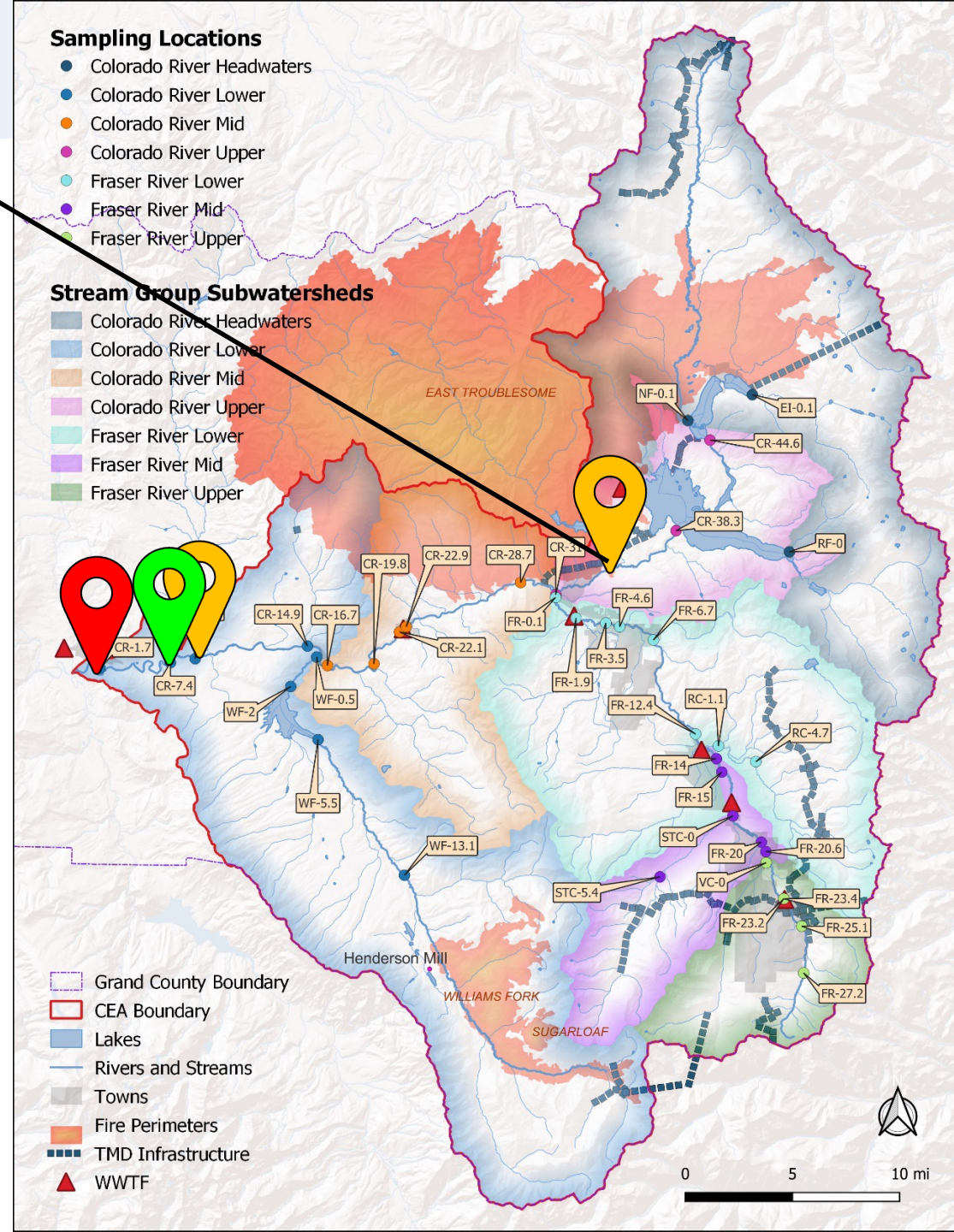


Macroinvertebrates: Colorado River



Declining MMI scores over time on Colorado River below Willow Creek confluence:

- Wildfire
- Fine sediments
- Algae
- Elevated Nutrients

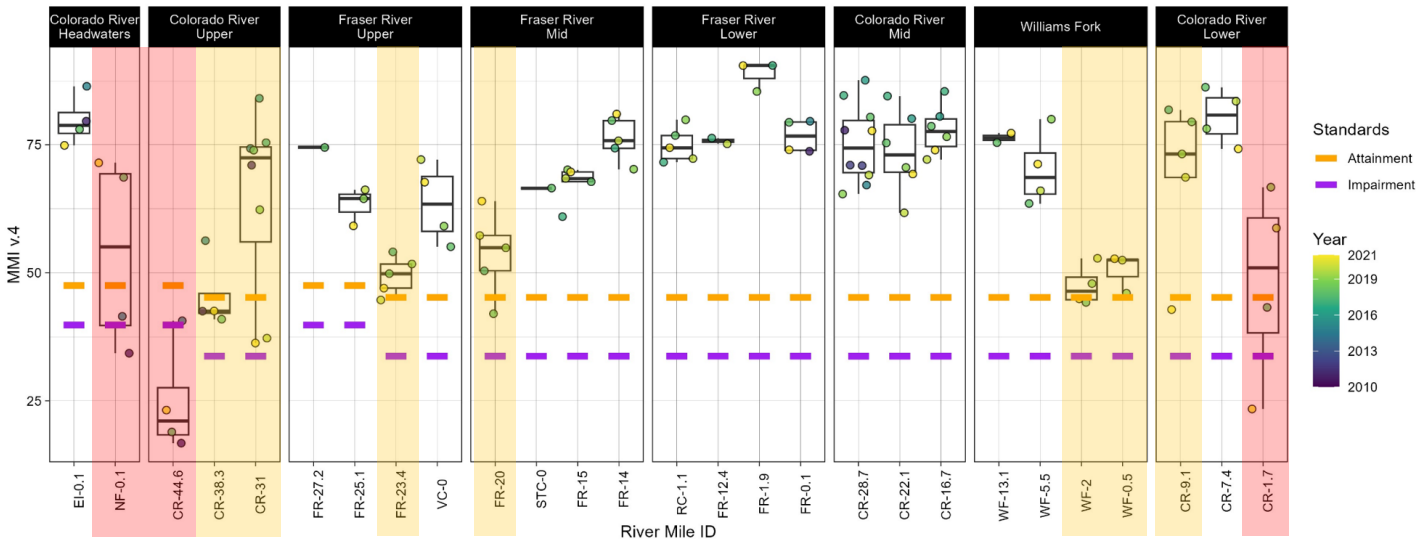
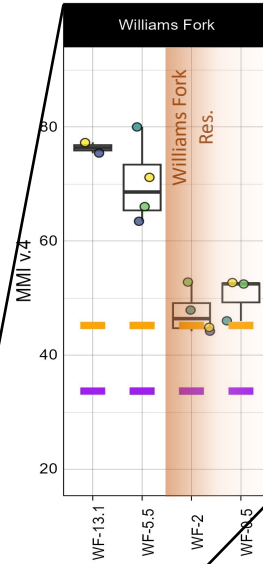


MMI – Colorado Spatial Patterns

Impacts on lower Williams Fork driven by:

Fork driven by:

- Reservoir Operations

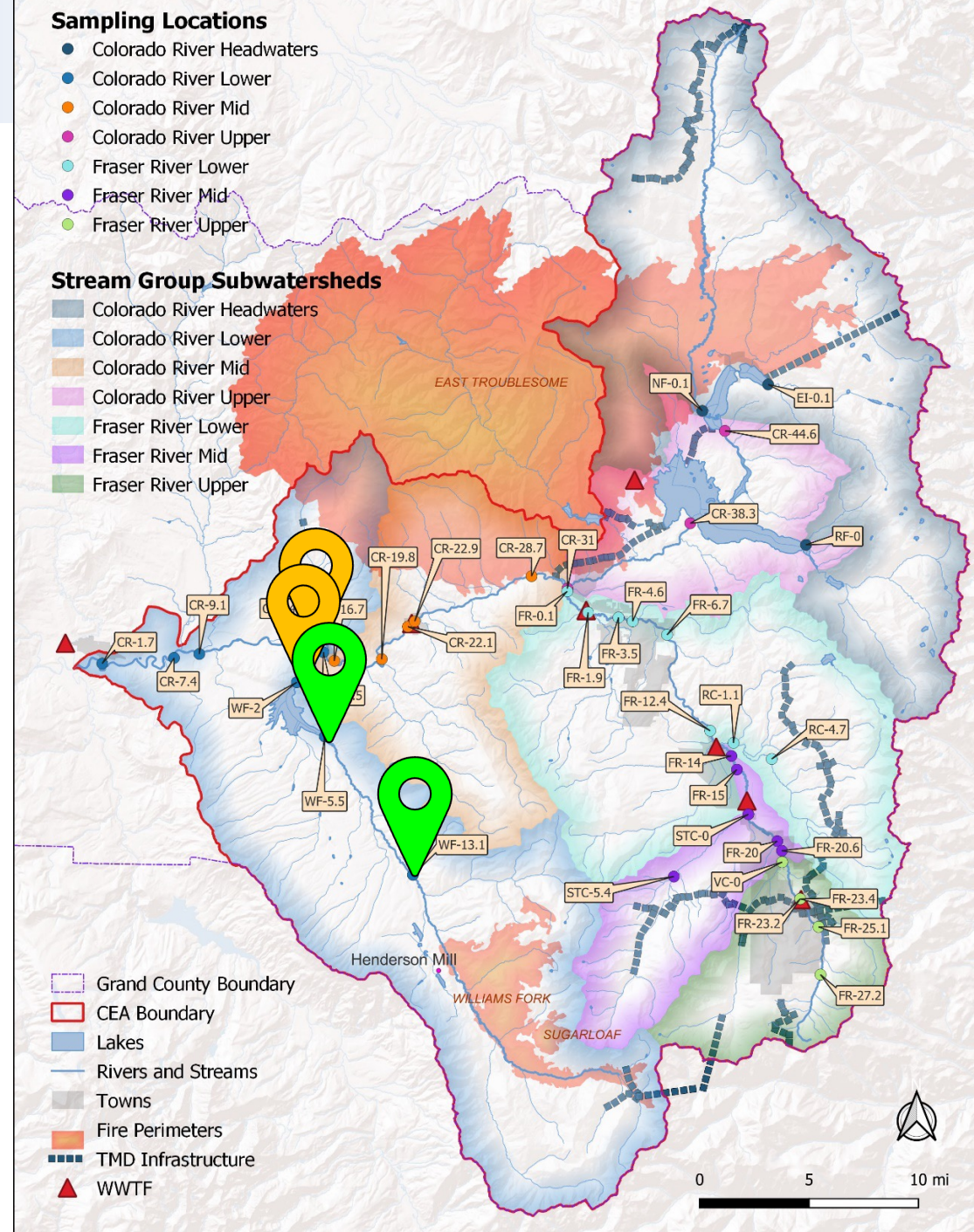


Sampling Locations

- Colorado River Headwaters
- Colorado River Lower
- Colorado River Mid
- Colorado River Upper
- Fraser River Lower
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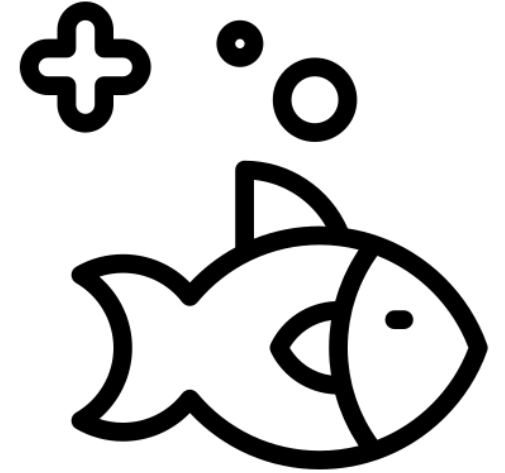
Stream Group Subwatersheds

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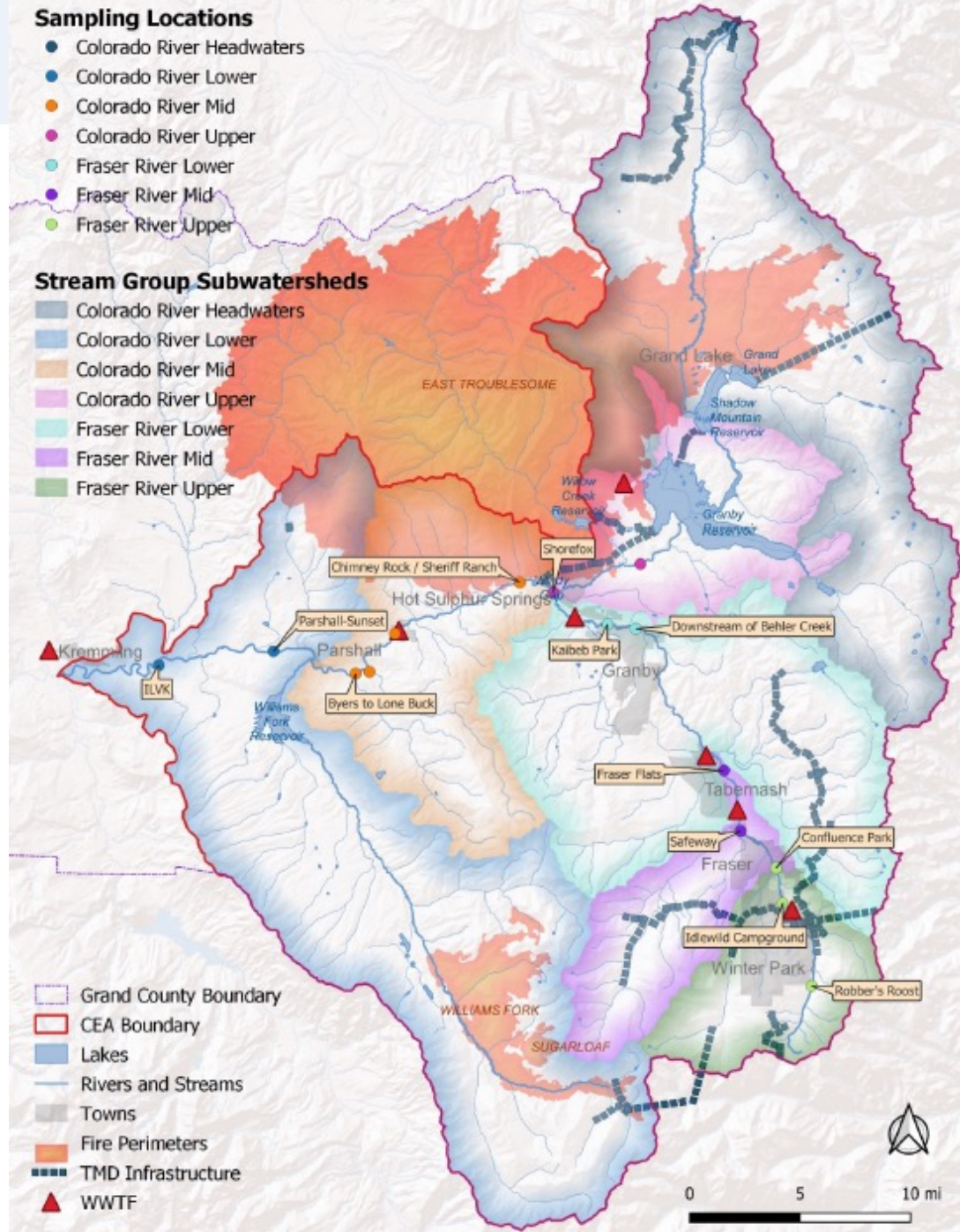
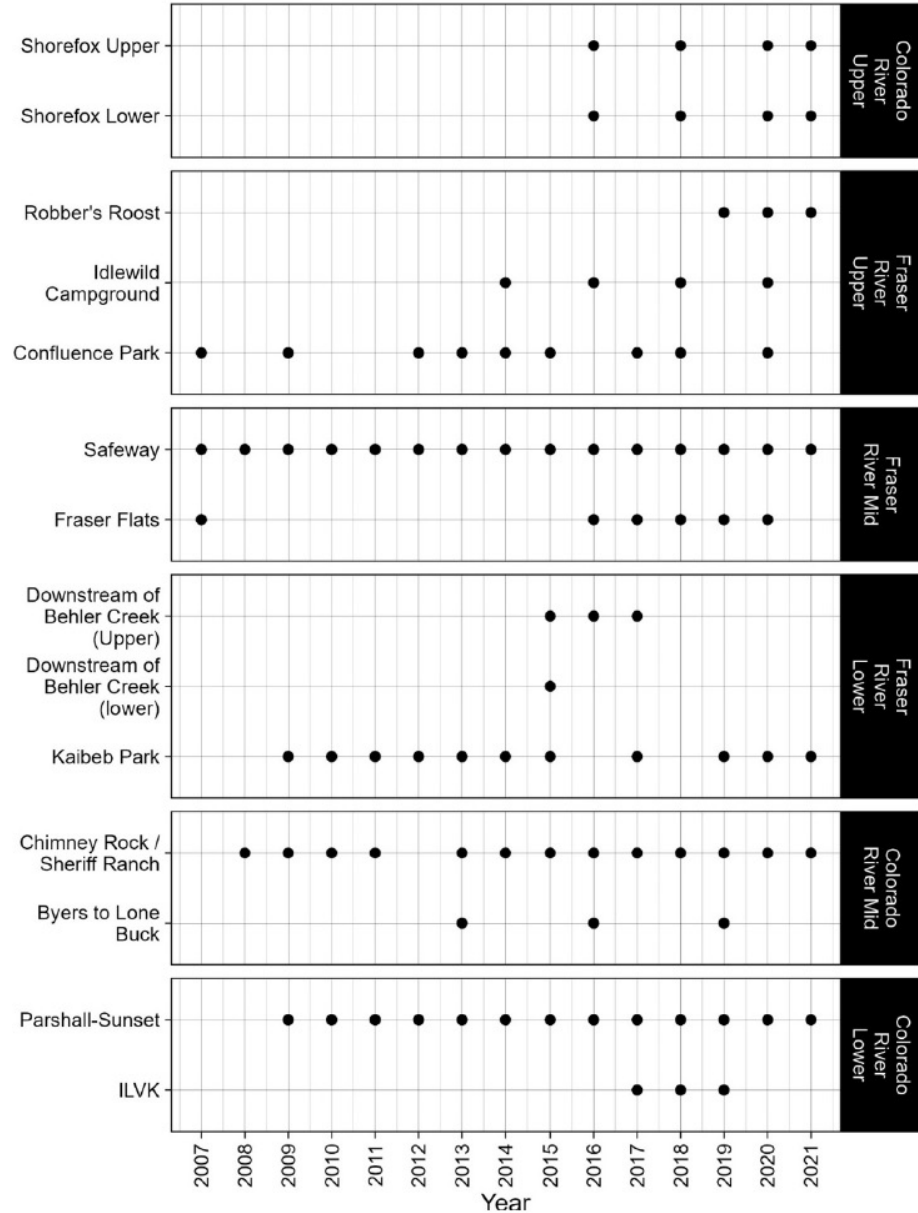


Macroinvertebrates Biota – Key Takeaways

- Healthy, relatively stable macroinvertebrate communities exist across a majority of CEA – indicative of good water quality.
- Concerns are localized, are likely driven by:
 - Reservoirs
 - Union Pacific Tunnel Discharge
 - Development
 - Habitat Degradation: Sediment / Algae / Nutrients
- Habitat restoration at Fraser Flats generated modest improvements in macroinvertebrate community health
- Recent downward trend (2018 – 2021) on some Colorado sites
 - Flows, wildfire, nutrients, algae, sediment.
 - Downward trend predates East Troublesome fire at some sites.

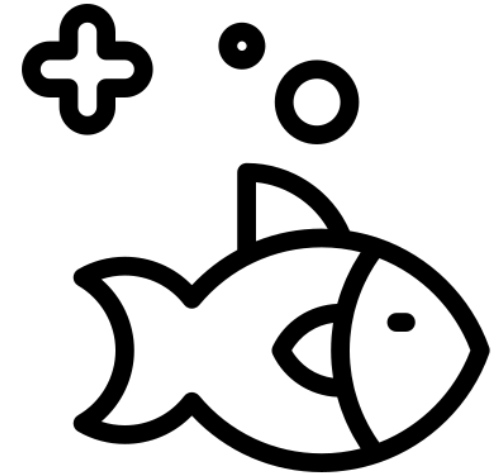


Fish: Inventory



2010 GC SMP Findings: Aquatic Biota

- Multiple stressors identified:
 - **habitat and water quality**
 - **angling** pressures
 - inter-annual **hydrological variability**
 - **disease**
 - inter-species **competition**
- Dramatic declines in rainbow trout fishery since the mid-1980s → **Whirling disease**.
- Colorado River cutthroat trout **range reduced** to ~6% of historic habitat in the upper Colorado River drainage.



Fish – Species Distribution

Native Fish:

- Cutthroat
- Sculpin



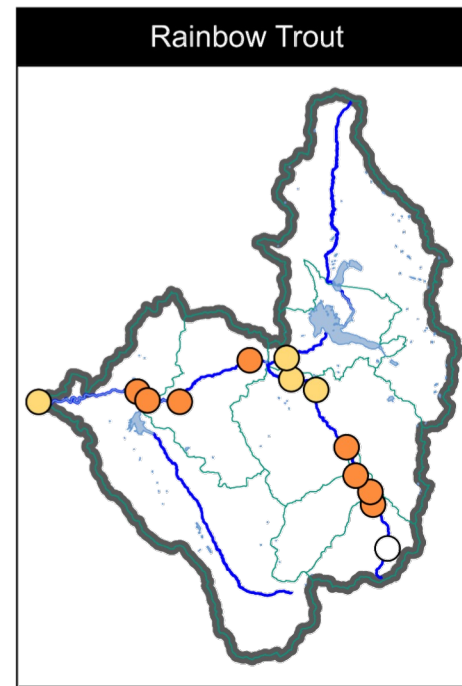
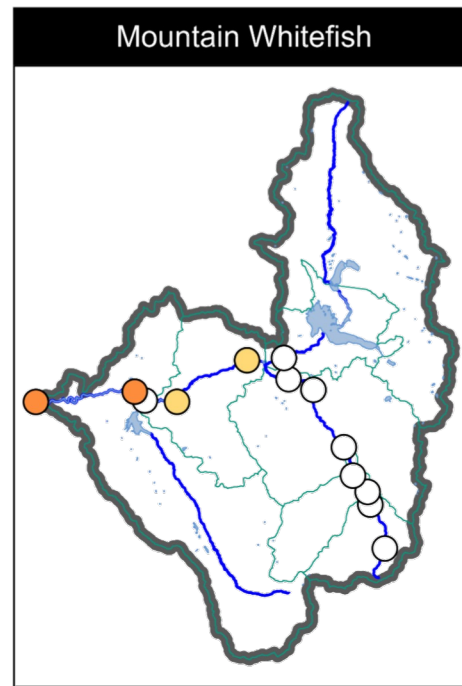
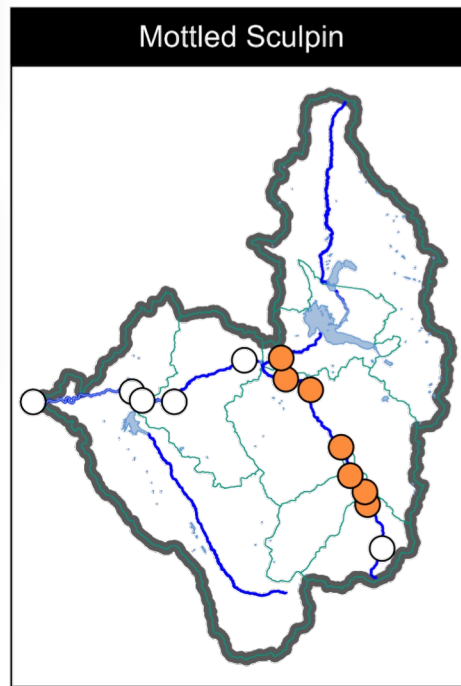
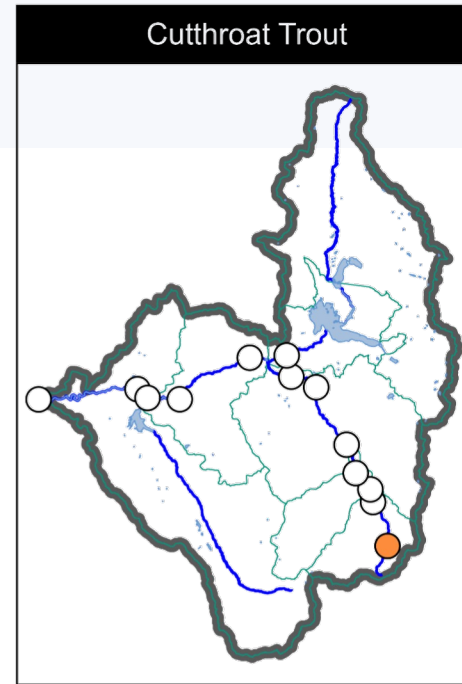
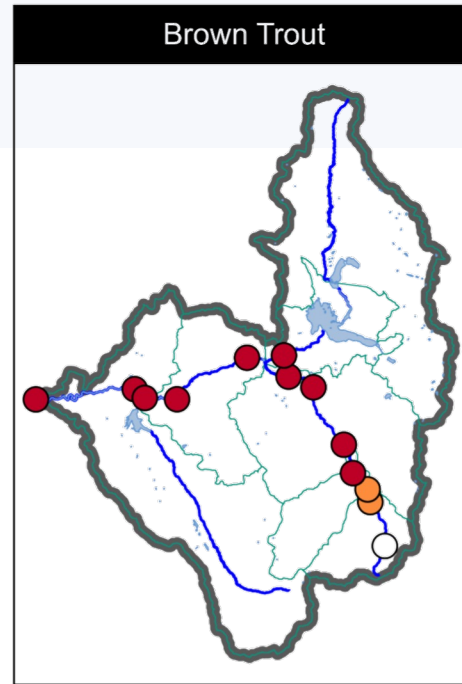
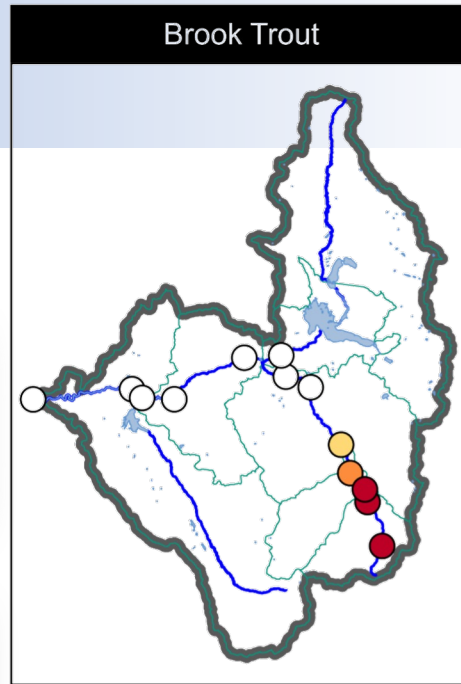
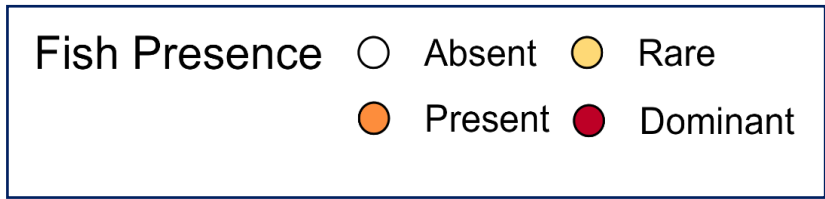
Non-Native Sport Fish:

- Brook Trout
- Brown Trout
- Rainbow Trout

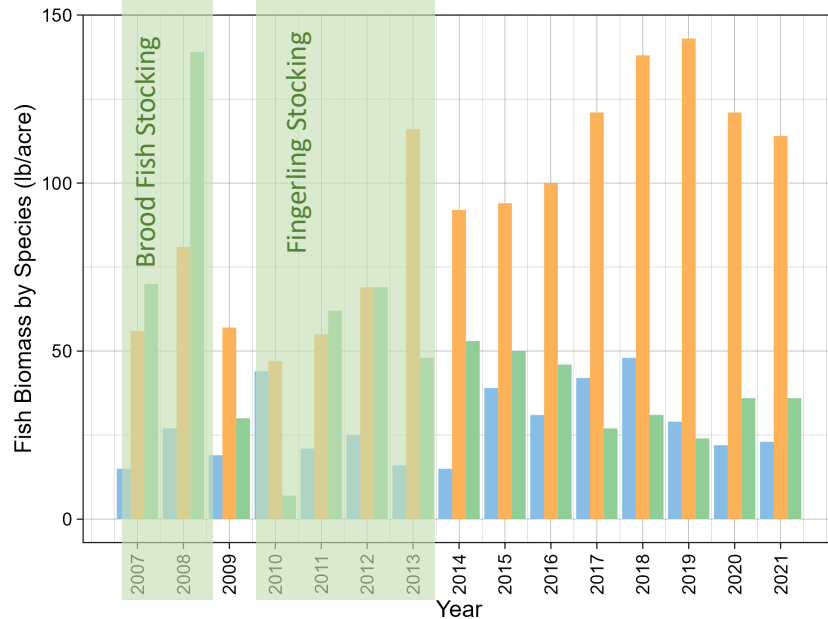
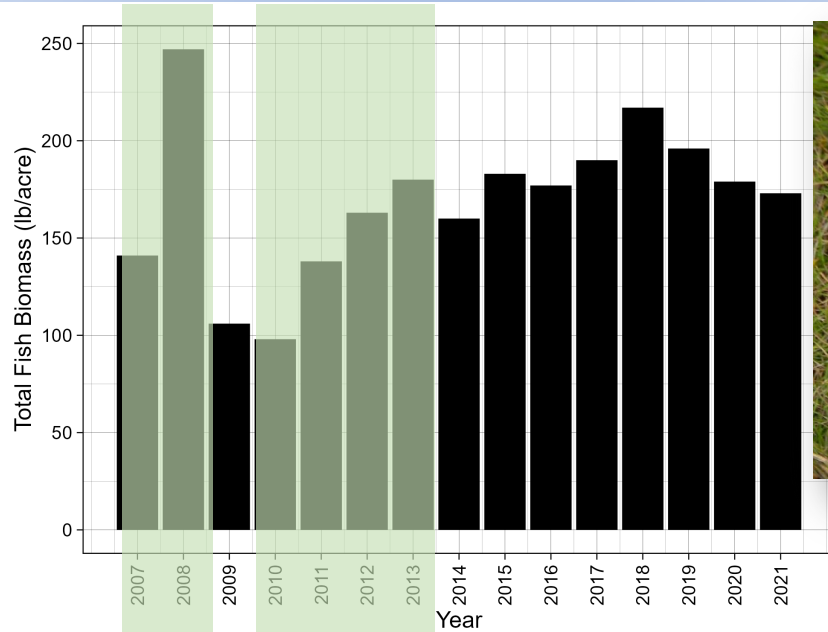


Other Non-Native

- Mountain Whitefish

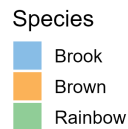


Sport Fish Biomass: Safeway



Source: CPW

- Most diverse location on Fraser River
- Browns starting to dominate

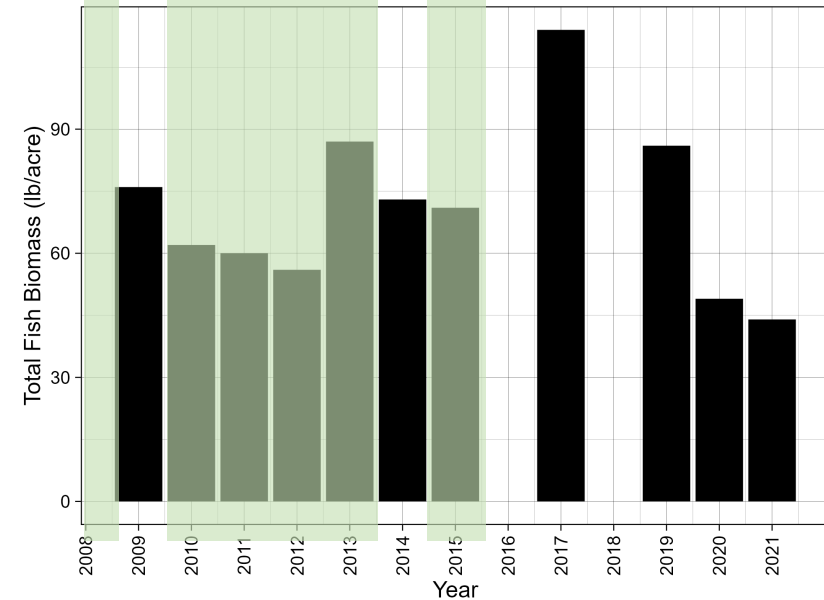
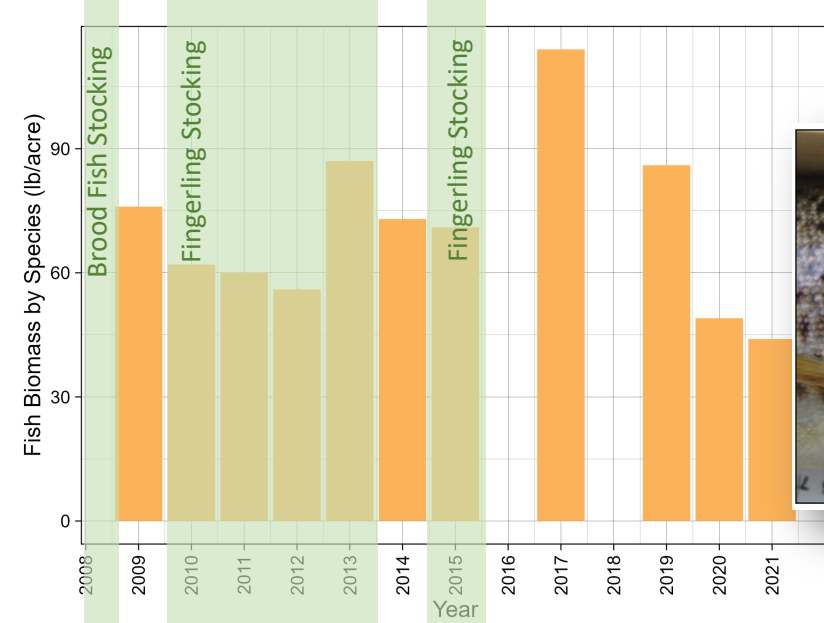


Sampling Locations

- Colorado River Headwaters
- Colorado River Lower
- Colorado River Mid
- Colorado River Upper



Sport Fish Biomass: Kaibab Park



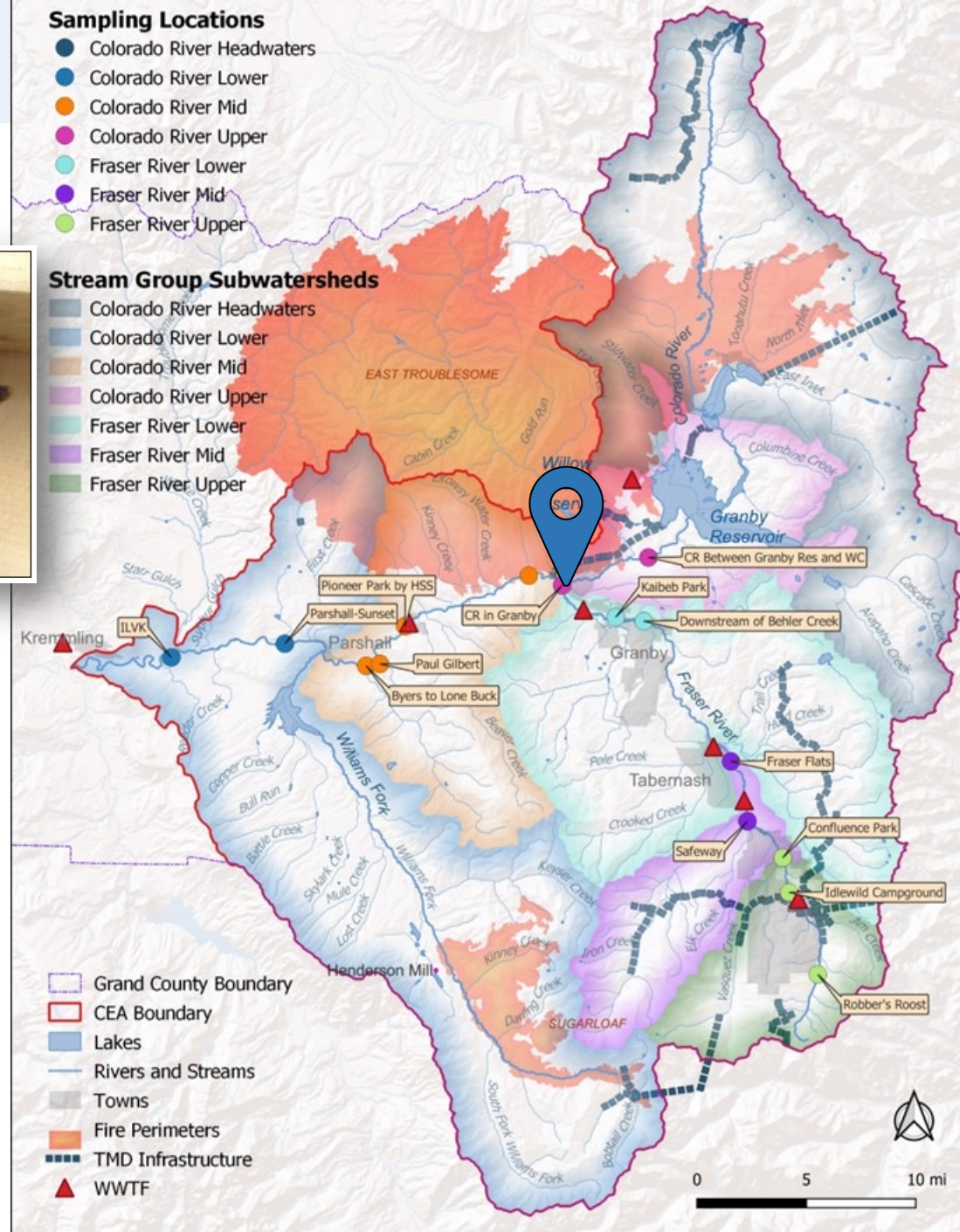
- Rainbows non-responsive to stocking
- Brown trout may be sensitive to low flow and peak flow years
- Recent declines following barrier removal

Sampling Locations

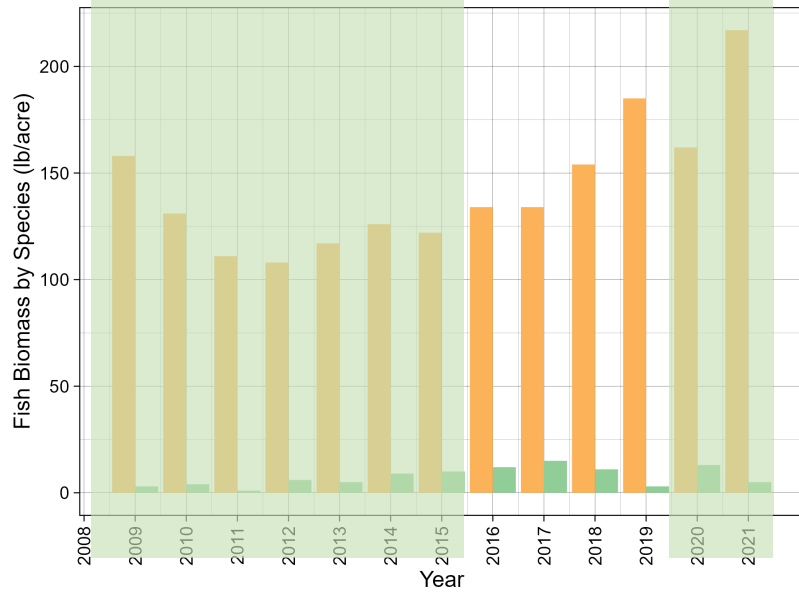
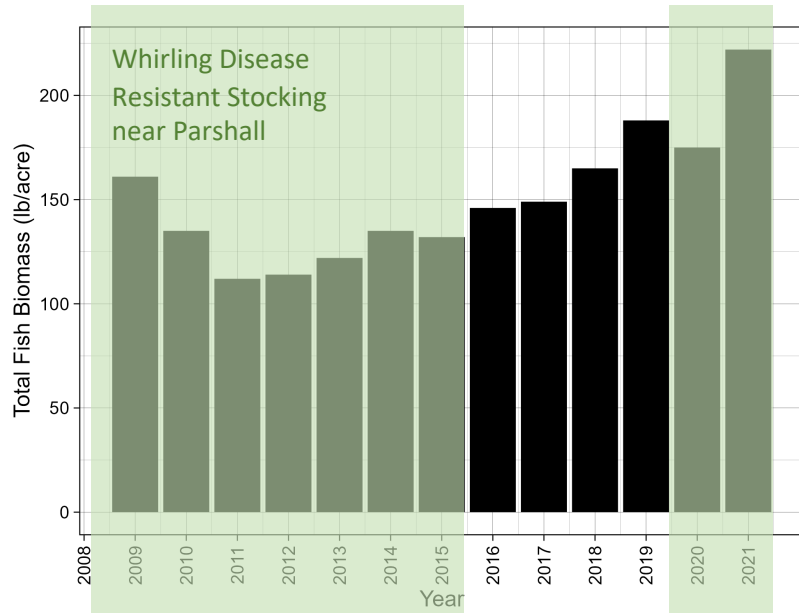
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Stream Group Subwatersheds

- Colorado River Headwaters
- Colorado River Lower
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- Fraser River Upper



Sport Fish Biomass: Parshall-Sunset



- Rainbows dependent on stocking
- Recent increases in adult brow trout:
 - Emigration from ETF impacted sites ?



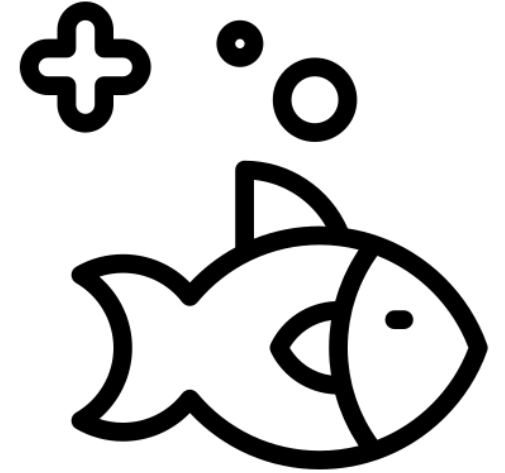
Source: CPW

- Species
- Brooks
 - Brown
 - Rainbow



Fishery – Key Takeaways

- Robust sport fisheries persist across many reaches
- Fishery is dominated by non-native species
- Rainbow stocking had only limited success.
 - Reproduction/recruitment observed on Fraser Middle/Upper and Colorado Middle/Lower but populations are **not** self-sustaining without additional stocking
 - Possibly related to higher water temperatures and predation by brown trout.
- Highly productive reaches maintained high-quality sport fishery across 2010-2021 period.
 - Relatively stable biomass in middle Fraser River between 2013- 2021
 - Increasing brown trout biomass at Parshall-Sunset since 2011.
- Impacts of wildfire are expected and may become more evident in future data sets
 - New data shows depressed recruitment in impacted reaches



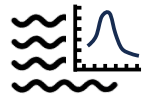


Wrap-Up

What comes Next?



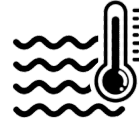
Next Steps



Hydrology



Water Quality



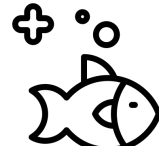
Water Temperature



Geomorphic Conditions

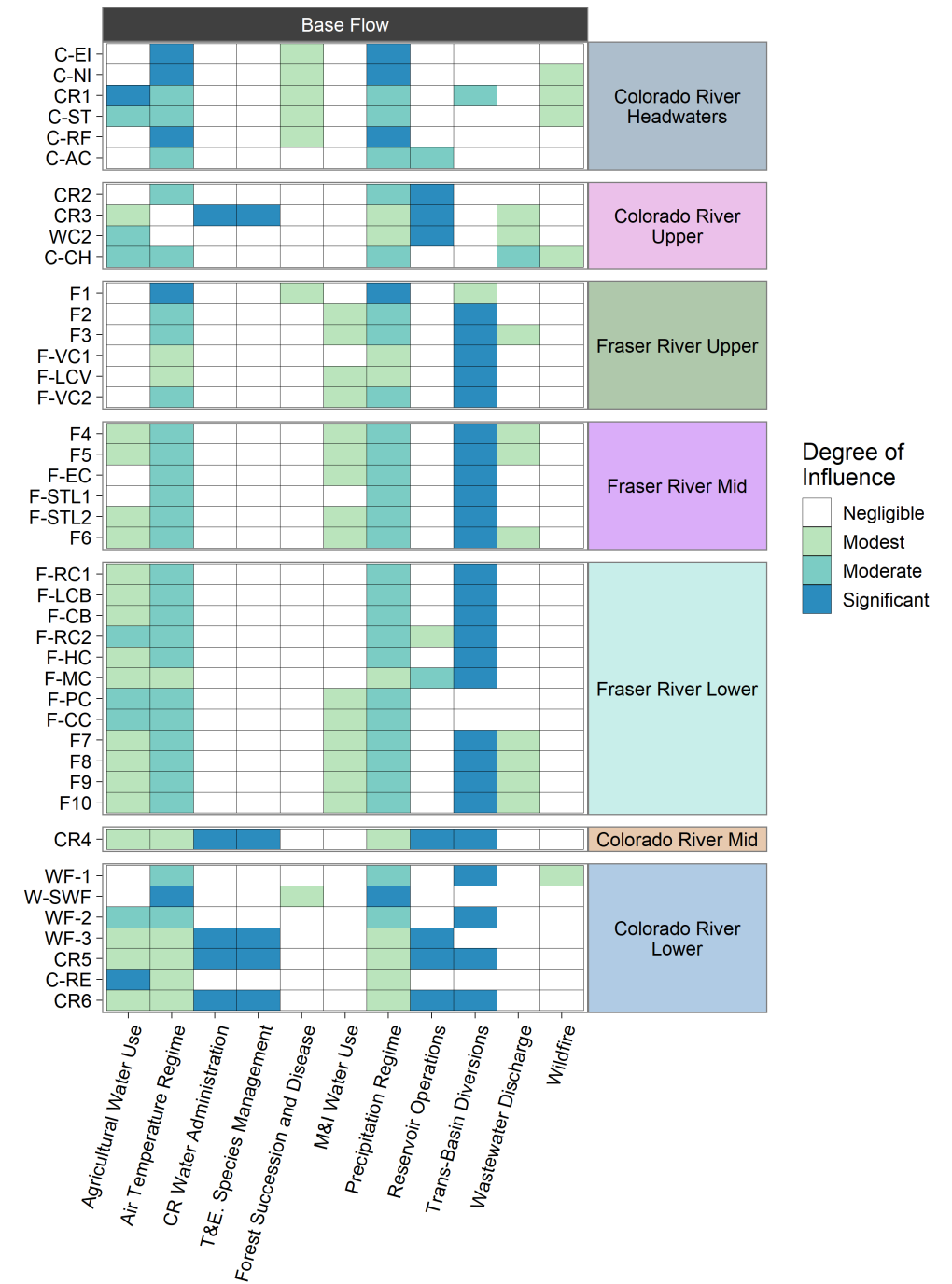


Riparian Areas



Aquatic Biota

- Draft report submitted to LBD for review
- Final report expected in March
- Distribution to stakeholders will follow and support Phase II





Questions?



Seth Mason
seth@lotichydrological.com
970-903-7561

