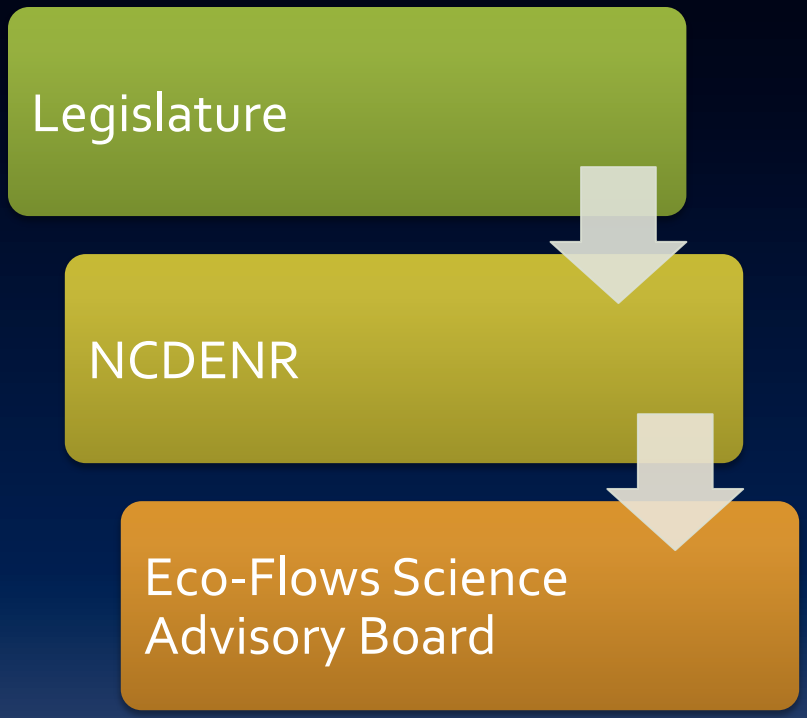
Ecological Flows Framework for North Carolina Coastal Streams

Coastal Ecological Flows Work Group

2013 Tidal Creeks Summit

December 17, 2013

Eco-Flows in NC



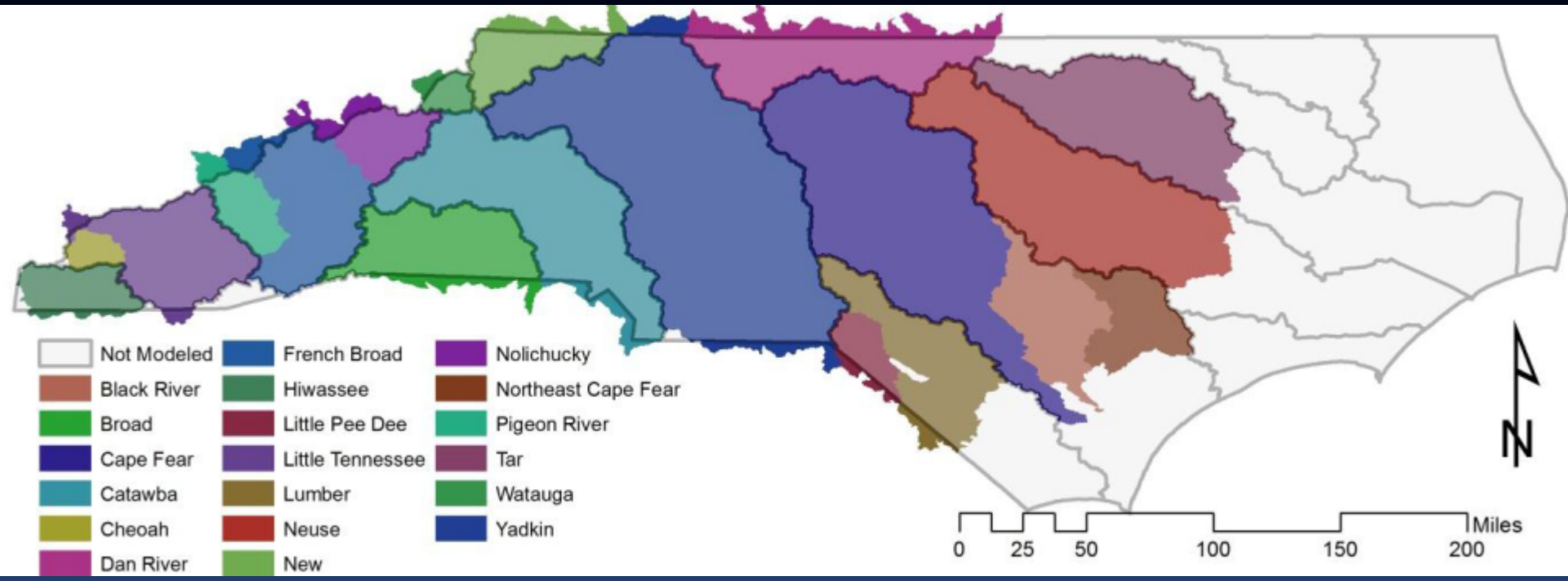
- SL2010-143

  'AN ACT TO DIRECT 'DENR' TO DEVELOP BASINWIDE HYDROLOGIC MODELS…'

  "The Department shall characterize the ecology in the different river basins and identify the flow necessary to maintain ecological integrity."

- Context of Future Withdrawals

EFSAB Hydrologic Modeling

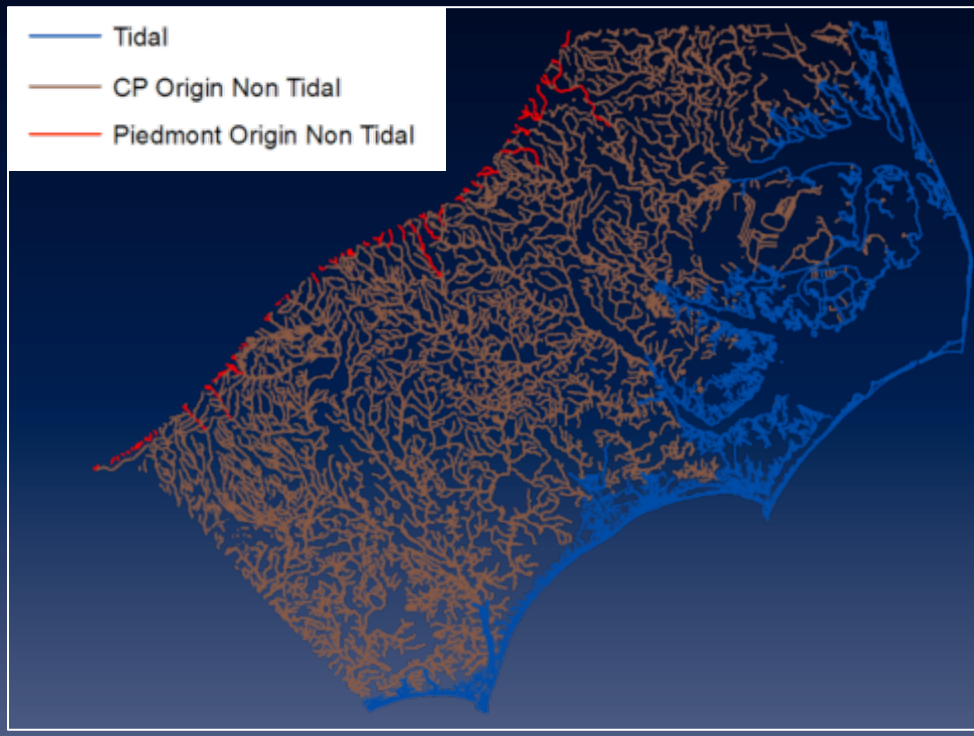


Availability of WaterFALL Hydrologic Data in NC by River Basin (EFSAB, 2013)

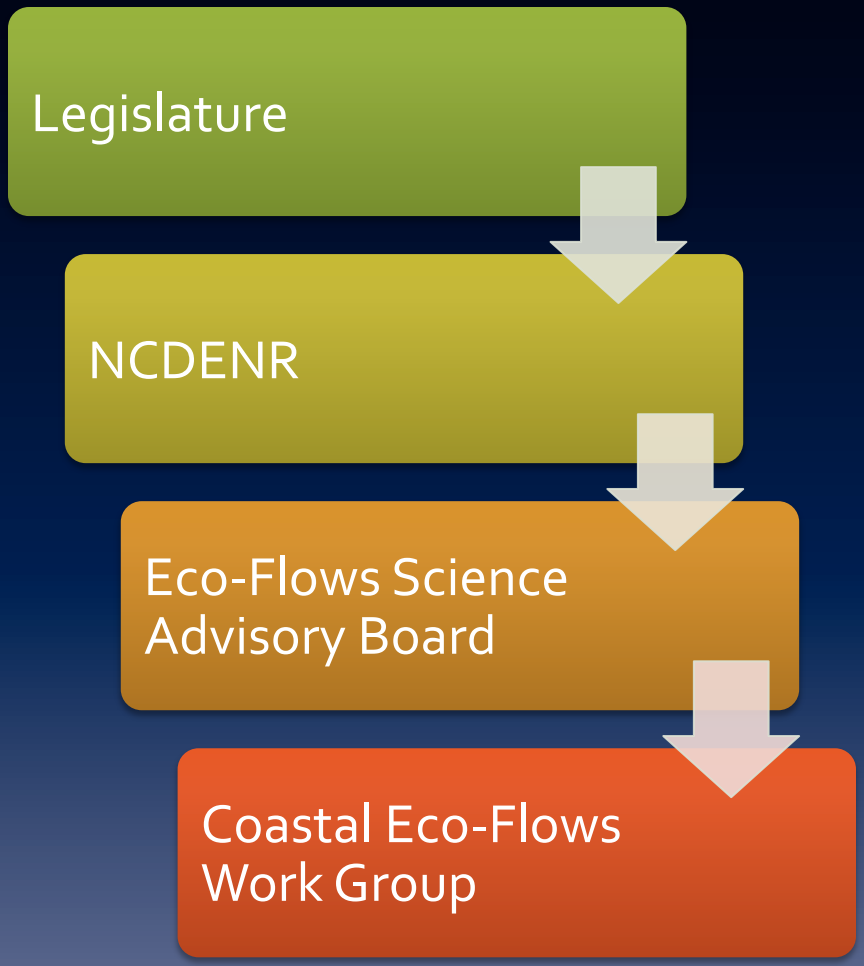
- Calibrated by long-term USGS gage records
- Lack of Biological Data in Coastal Plain

Coastal Plain Eco-Flows

- Flow & Water Quality Link
- Salinity and Dissolved Oxygen
- Tidal Influence
- Altered Hydrology
- Interconnection with Flood Plain and Groundwater
- Medium to Low Slopes



Eco-Flows in NC



CEFWG Objective:

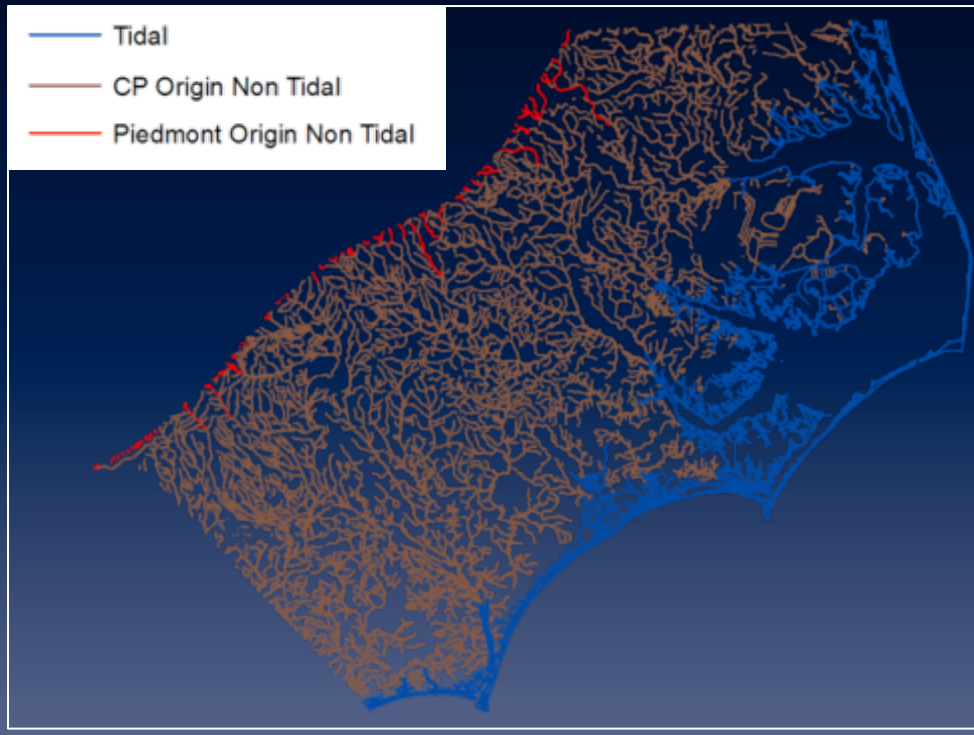
- Assess the general ability to establish an Eco-Flows approach for coastal streams

Coastal Ecological Flows Work Group

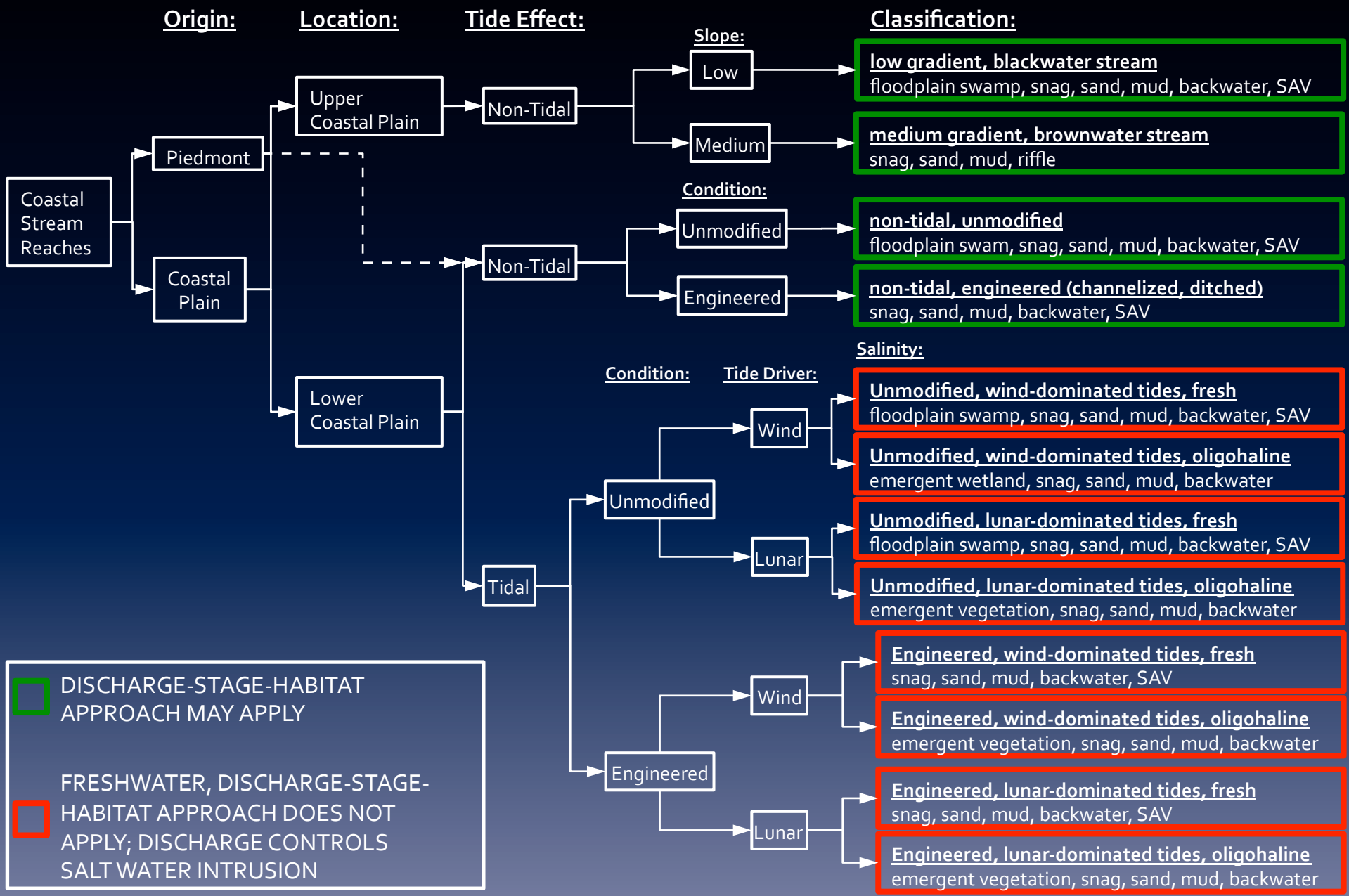
- Bob Christian, ECU, chair
- Eban Bean, ECU
- Dean Carpenter, APNEP
- Scott Ensign, AquACo
- Mike Griffin, ECU
- Kevin Hart, NC DMF
- Mike O'Driscoll, ECU
- Mike Piehler, UNC IMS
- Judy Ratcliffe, Natural Heritage
- Fritz Rohde, NOAA
- Bennett Wynne, NC Wildlife Resources

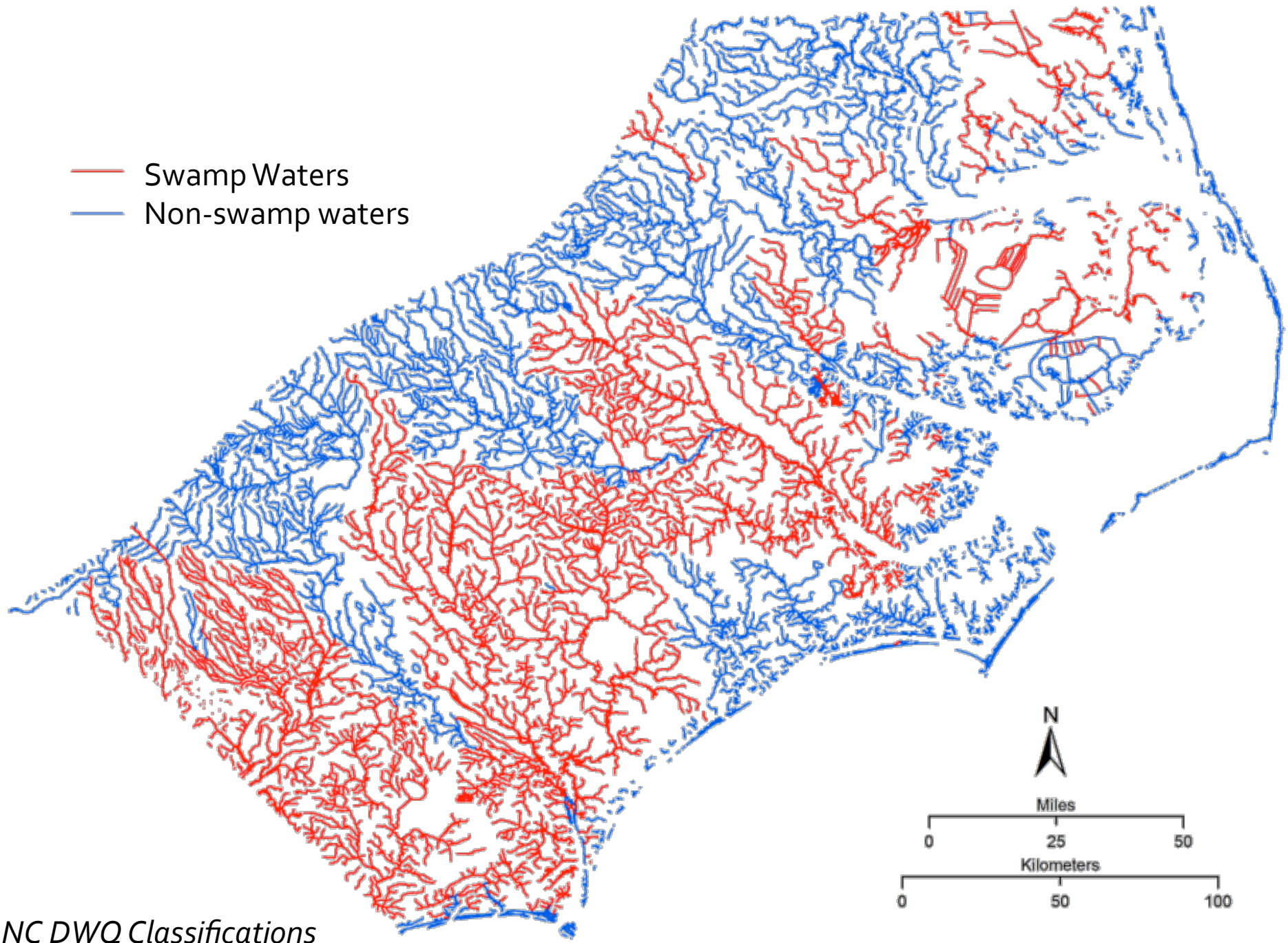
Coastal Plain Eco-Flows

- Flow & Water Quality Link
- Salinity and Dissolved Oxygen
- Tidal Influence
- Altered Hydrology
- Interconnection with Flood Plain and Groundwater
- Medium to Low Slopes

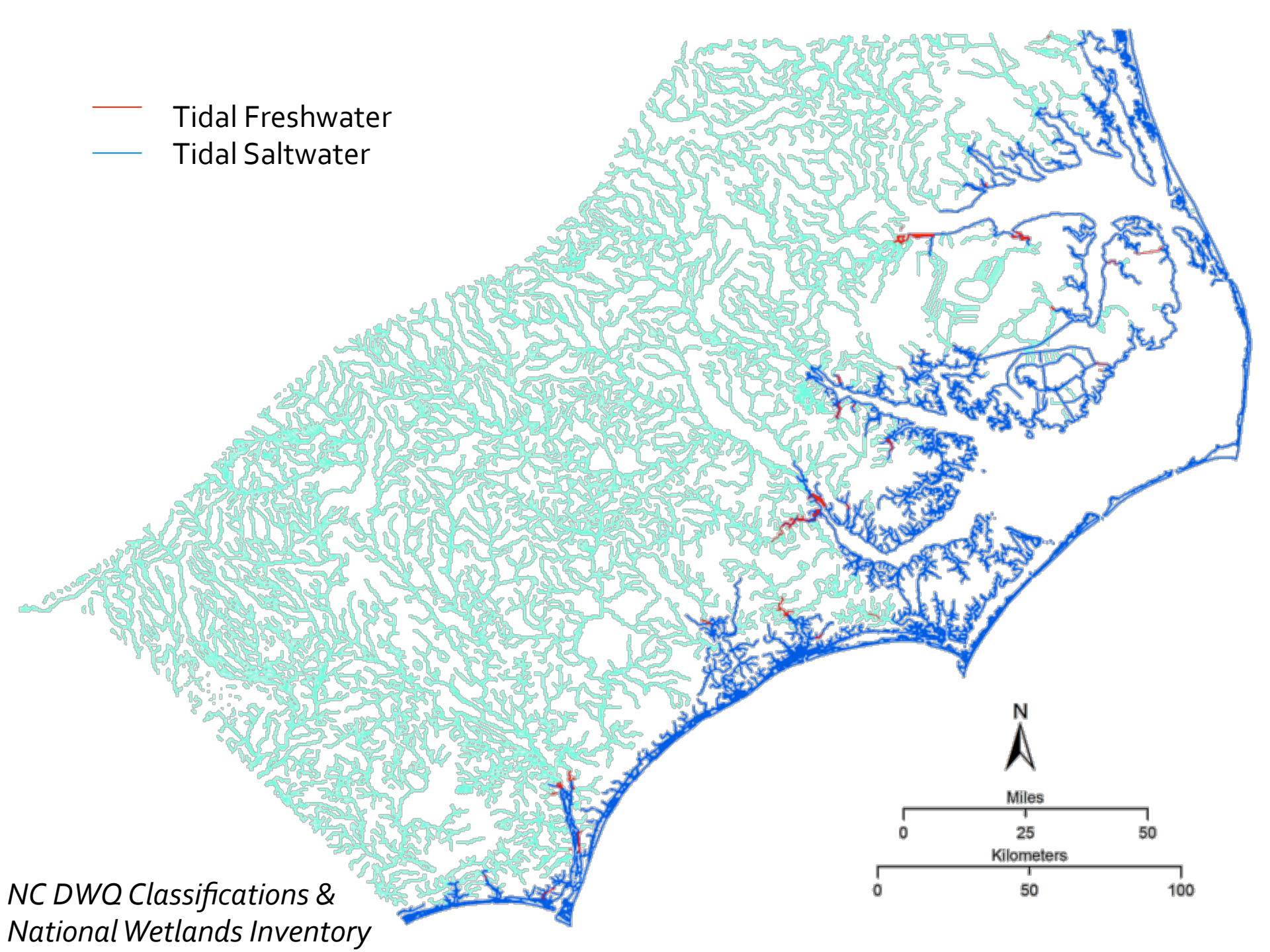


STREAM REACH TYPOLOGY AND IN-STREAM HABITATS

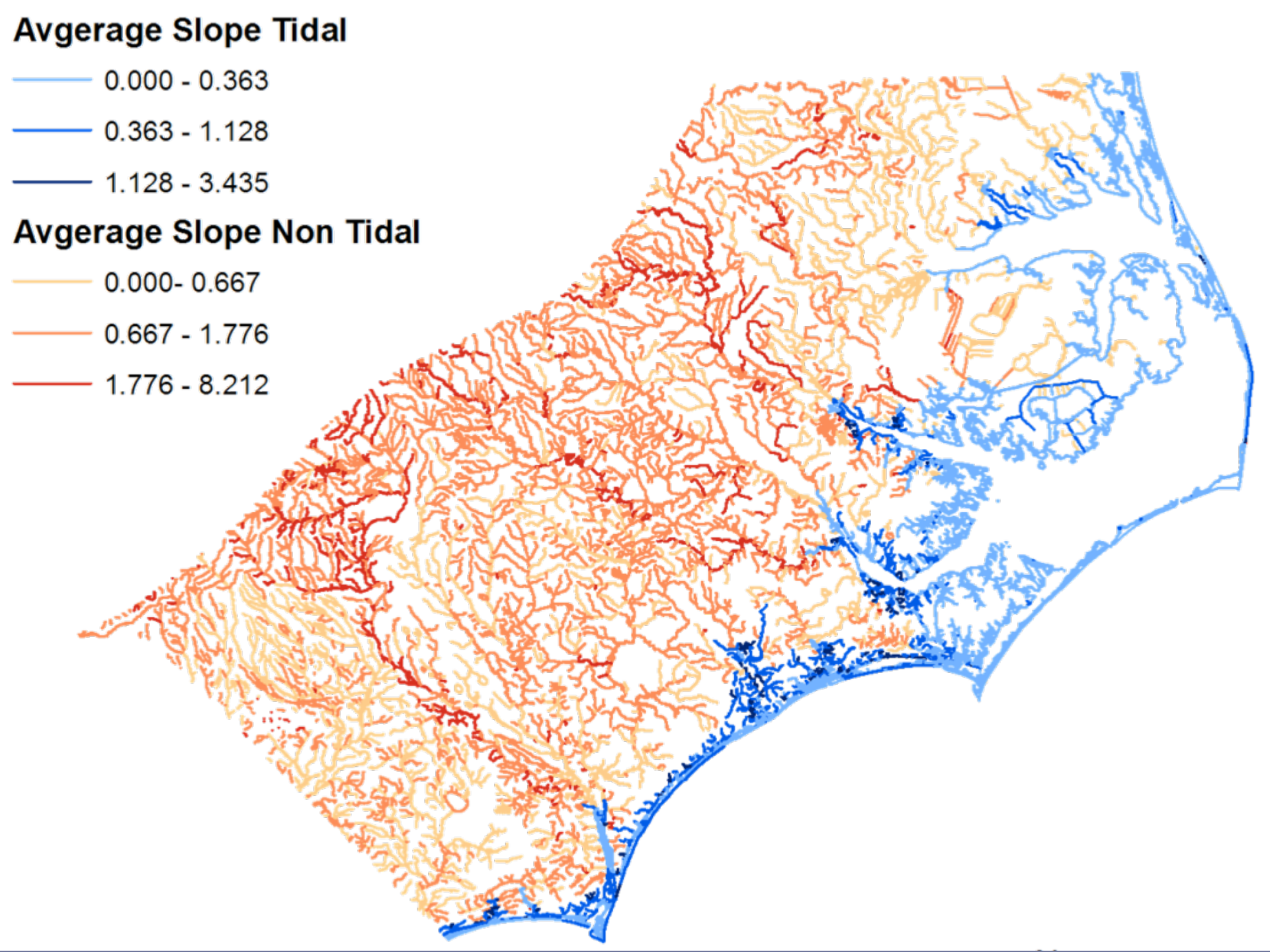


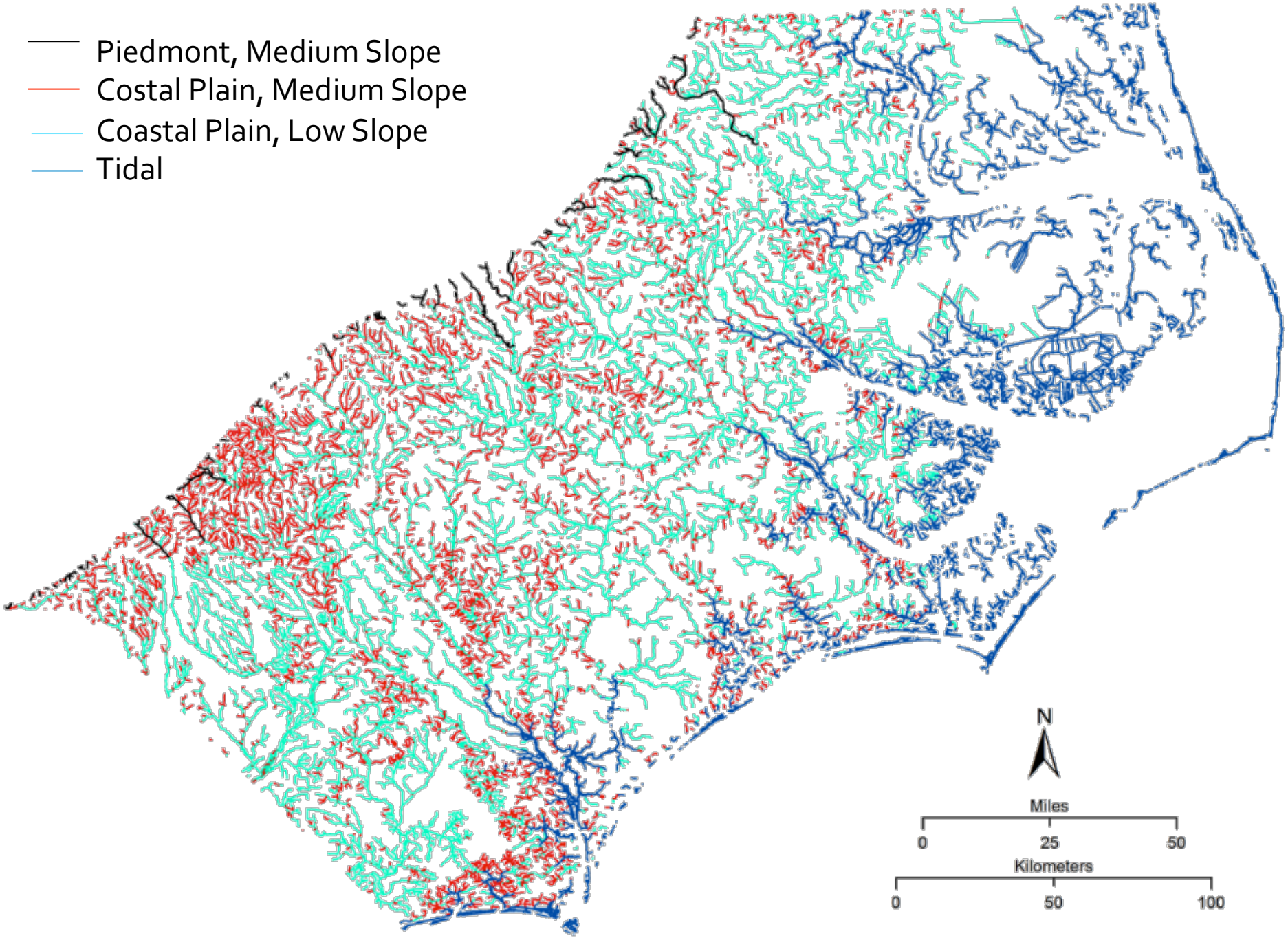


NC DWQ Classifications



NC DWQ Classifications &
National Wetlands Inventory


Avgerage Slope Tidal
0.000 - 0.363
0.363 - 1.128
1.128 - 3.435
Avgerage Slope Non Tidal
0.000- 0.667
0.667 - 1.776
1.776 - 8.212


Piedmont, Medium Slope
Costal Plain, Medium Slope
Coastal Plain, Low Slope
Tidal
N
Miles
0
25
50
Kilometers
0
50
100

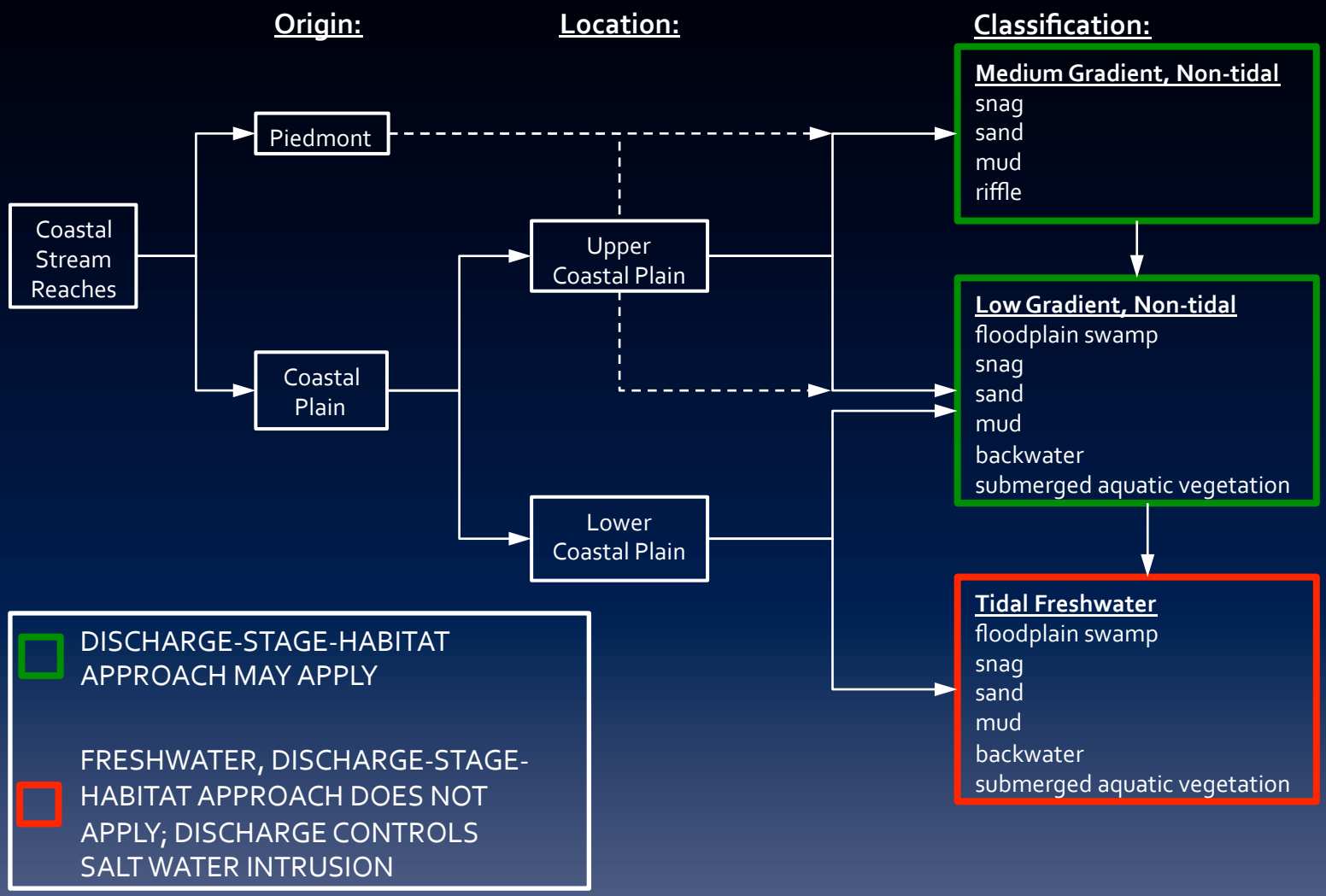
Assemblages and Anadromous Fish

Species	Salinity (ppt)		Temperature (C)		Dissolved Oxygen (mg/l)		Flow (cm/s)
	Adult	Spawn/Egg	Adult	Spawn/Egg	Adult	Spawn/Egg	Spawning
Alewife	[S] 0-5	[S] 0-5 [O] 0-2		[S] 11-28 [O] 17-21	[S] >3.6	[S] >4	[O] slow current
American shad	[S] 0-18	[S] 0-18	[S] 10-30	[S] 13.0-26	[S] >5		[S] 30-90
Blueback herring	[S] 0-5	[S] 0-22 [O] 0-2		[S] 14-26 [O] 20-24	[S] >5		[O] strong current
Striped bass	[S] 0-5	[S] 0.5-10	[S] 20-22	[S] 12-24 [O] ~18-22	[S] >5		[S] 30.5-500 [O] 100-200
Yellow perch	[S] 0-13	[S] 0-2	[S] 6-30		[S] >5		
White perch	[S] 5-18	[S] 0-2	[S] 10-30	[S] 12-20	[S] >5		
Sturgeon, Atlantic	[S] 0 to >30	[S] 0-5	[S] 0 to >30	[S] 11-20			
Sturgeon, Shortnose	[S] 0 to >30	[S] 0-5	[S] 0 to >30	[S] 5-15			
[S] = Suitable, and [O] = Optimum							

Physical Spawning (Adult) and Egg Development Requirements for Resident Freshwater and Anadromous Fishes Inhabiting Coastal North Carolina from the 2010 North Carolina Coastal Habitat Protection Plan (Deaton et al., 2010)

- Regional economic and ecological importance
- Wide geographic area over lifespan
- Many species reside in tidal waterways
- Available habitat suitability models
- Flow important for spawning & maturation.
- Roanoke River links habitat suitability to flow
- Resident fish and vegetation also considered

STREAM REACH TYPOLOGY AND IN-STREAM HABITATS



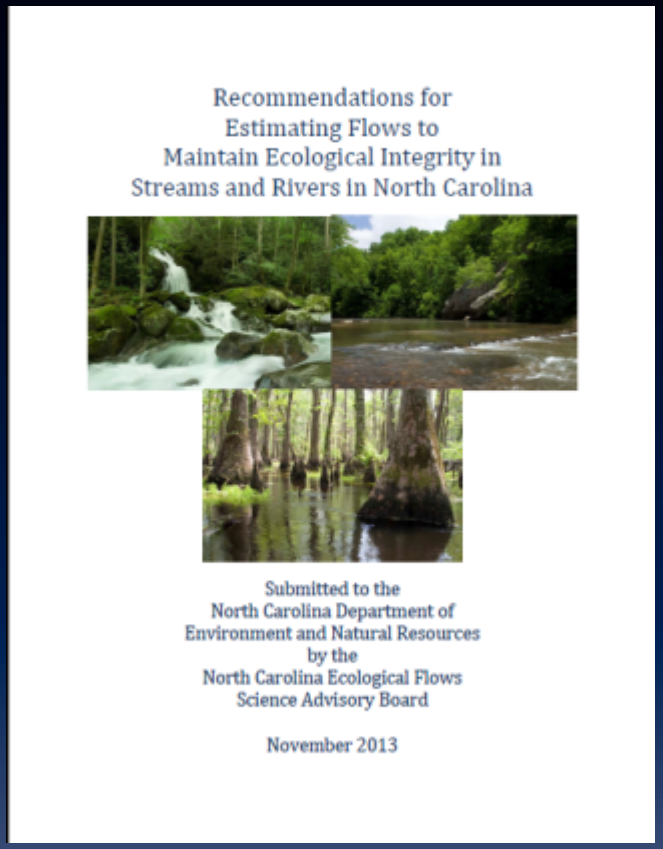
Determinants & Assemblages

Origin	Slope Gradient	Relevant EF Determinants				Assemblages for EF Assessment		
		EFSAB Extension	Discharge & Habitat	Downstream Salinity	Overbank Flow	Anadromous Fish	Resident Fish	Vegetation
Piedmont	Medium (≥ 0.25%)	X	X	X		X		
Upper Coastal Plain	Medium (> 0.25%)	X	X	X		X		
Upper Coastal Plain	Low (< 2.5 mm/m)		X	X	X	X		X
Lower Coastal Plain	Low (< 2.5 mm/m)		X	X	X	X		X
Lower Coastal Plain	Tidally Driven Flow			X	X		X	X

Research Needs

- Determine correspondence of known discharge patterns with nearby coastal plain stream flow patterns
- Determine the upper-most extent of tidal influence
- Evaluate juvenile abundance indices vs. flow and salinity/conductivity
- Map salinity distribution across coastal plain
- Quantify stream typology classes
- Evaluate Roanoke slabshell and other mussel distributions and abundance as informative of salinity and flow patterns.
- Determine hydrologic metrics and characteristics of coastal streams
- Determine reference flow regimes for each river basin
- Assess the balance of withdrawals and discharges

Questions?



http://ncwater.org/files/eflows/sab/EFSAB_Final_Report_to_NCDENR.pdf

Eban Bean
beaneb@ecu.edu