Spatially-Discrete Modeling Approach to Prioritize Land Conservation for Water Supply

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Green Landscapes for Water Security: Measuring and Modeling Hydrologic Benefits

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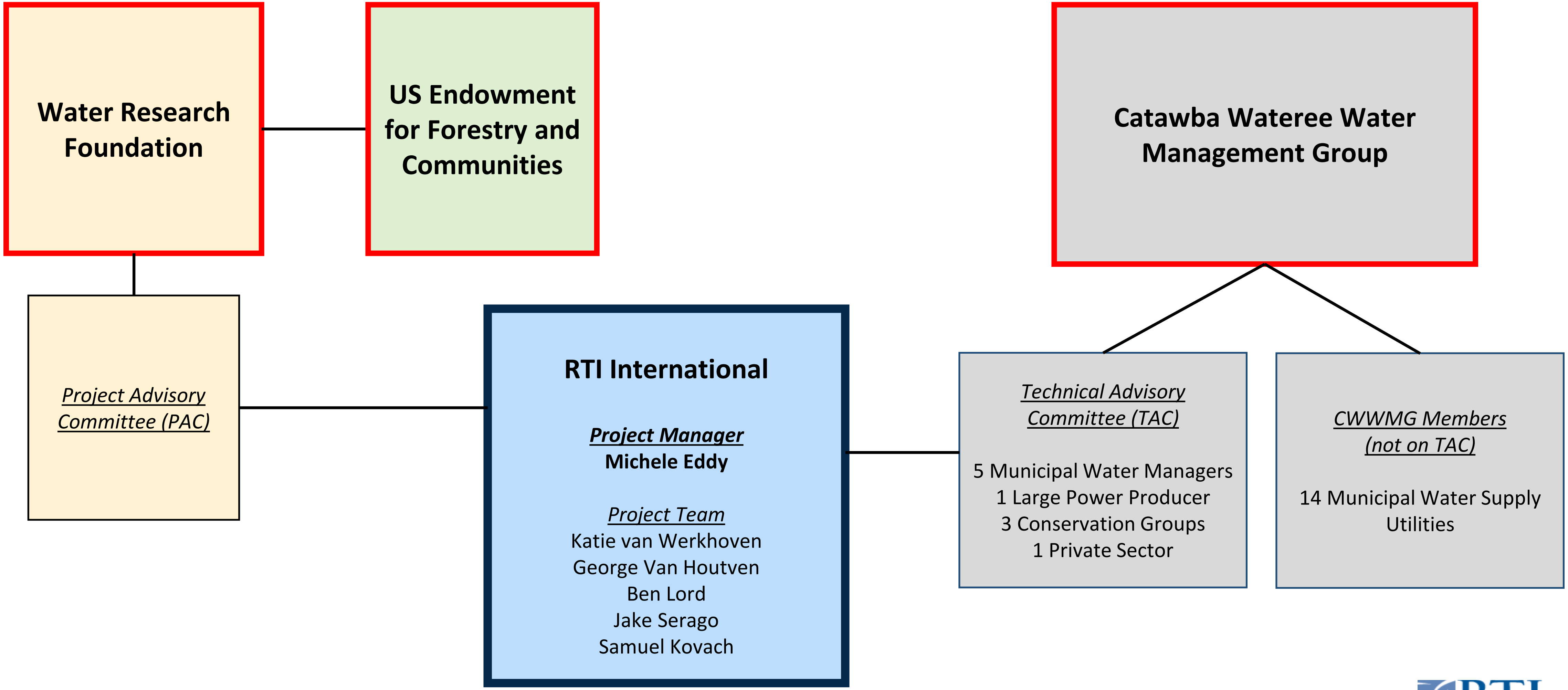
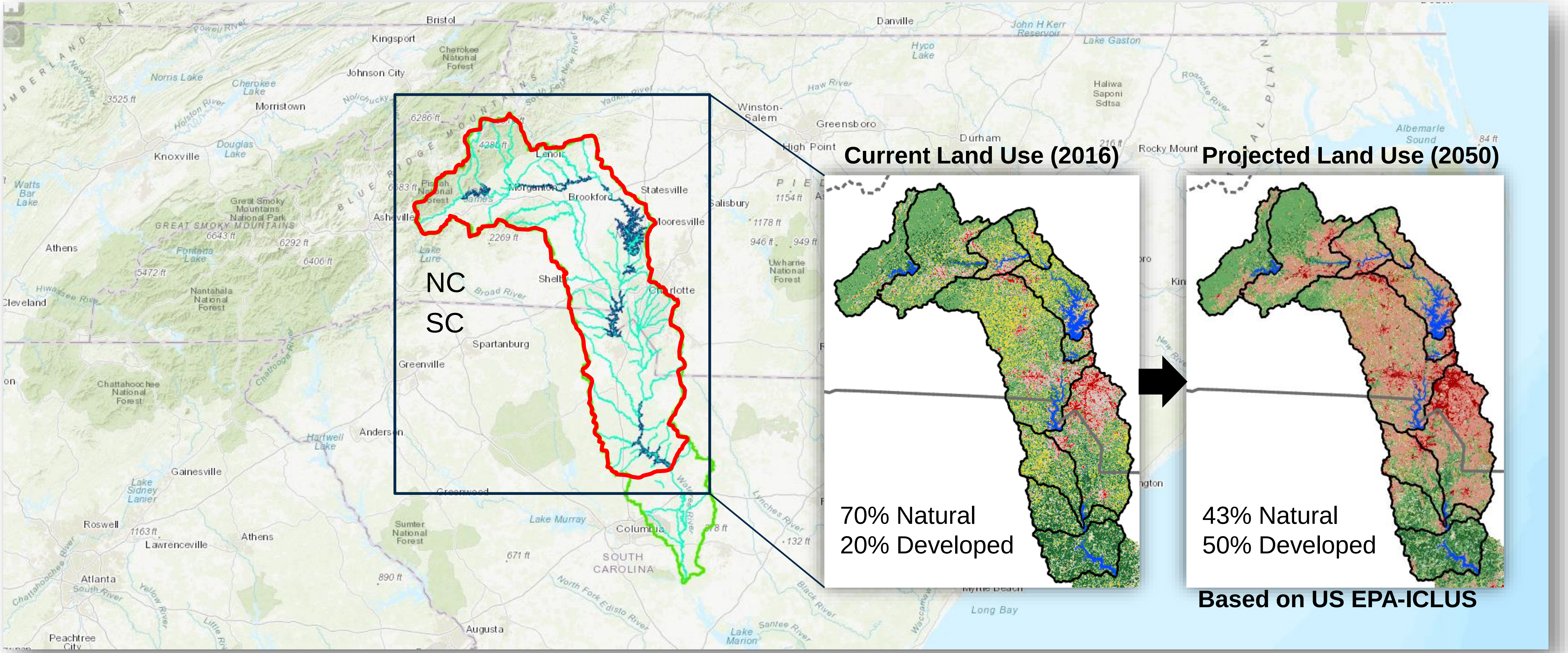
Project Funding and Organization

National-scale organizations

Local-level stakeholders



Location and Land Use



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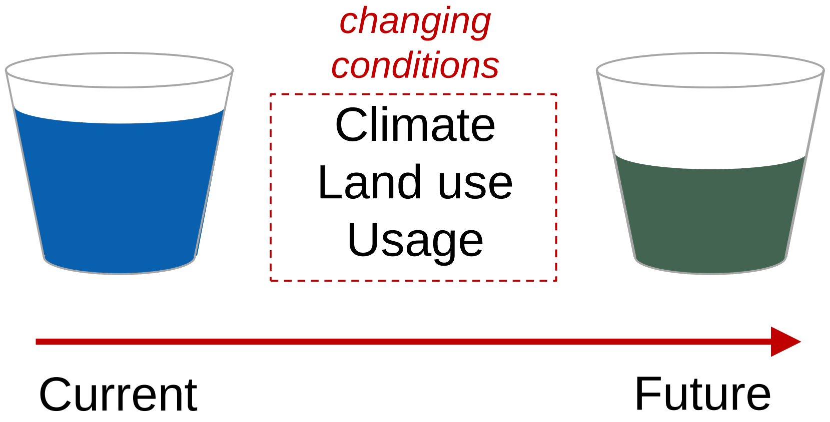
Project Goals

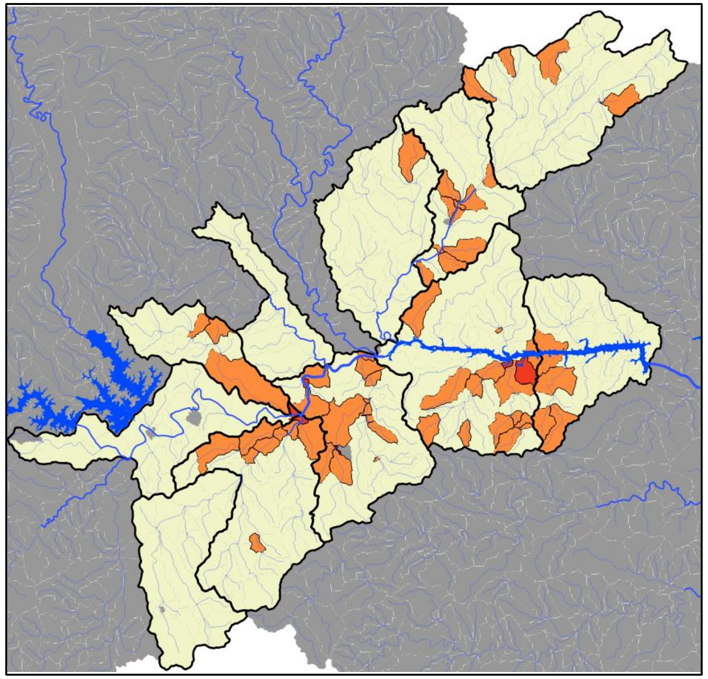
1

Project FUTURE CHANGE in hydrology and water quality



2

Identify HOT SPOTS



3

PRIORITIZE

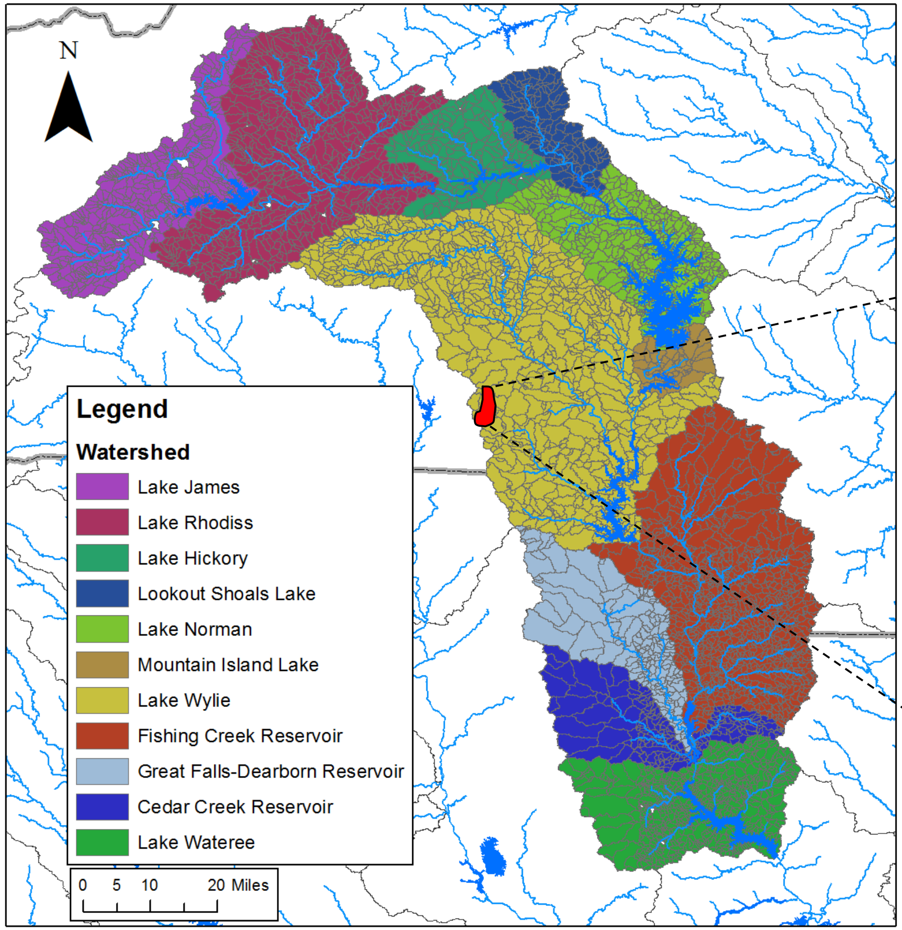
land conservation investments

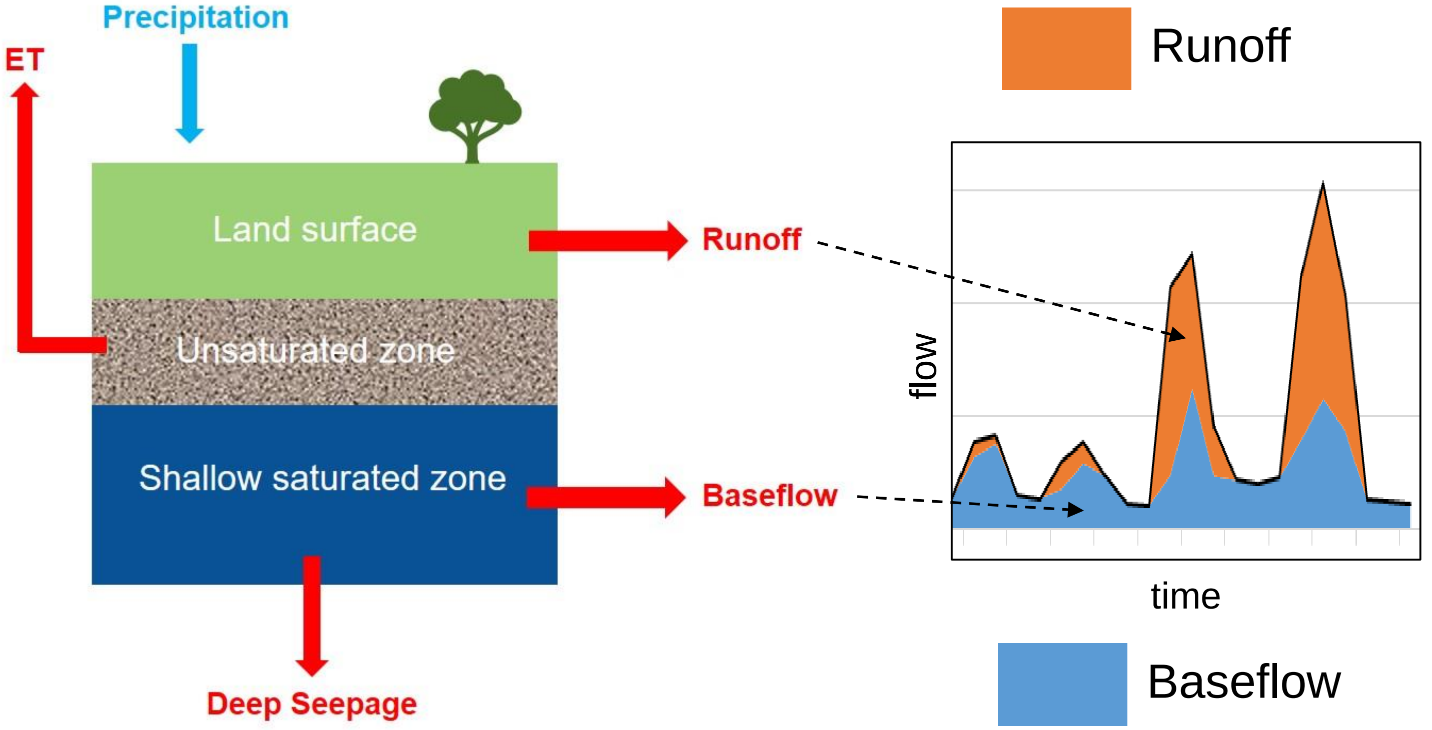
$

WaterFALL Model Overview

<u>Reservoir Subwatersheds</u>:
(colored areas)
11 divisions
Ave. ~1000 km^2

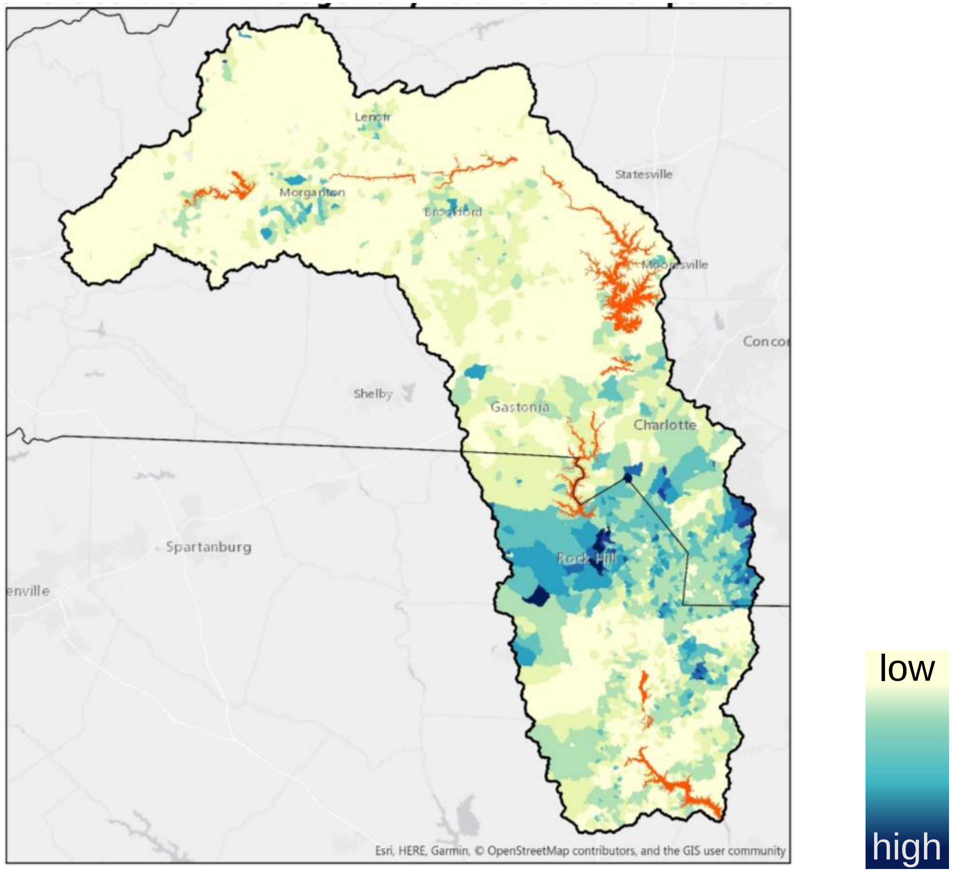
<u>Catchments:</u>
(gray boundaries)
5,811 divisions
Ave. ~2 km^2



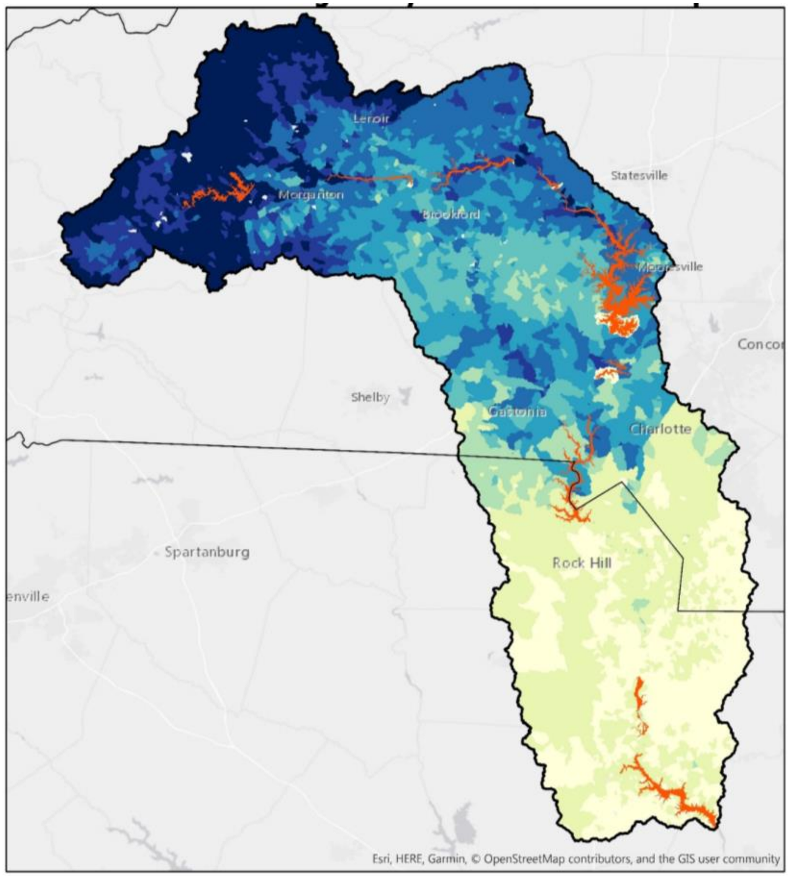


Example Model Outputs

e.g. Current average annual runoff and baseflow across the basin



Surface Runoff

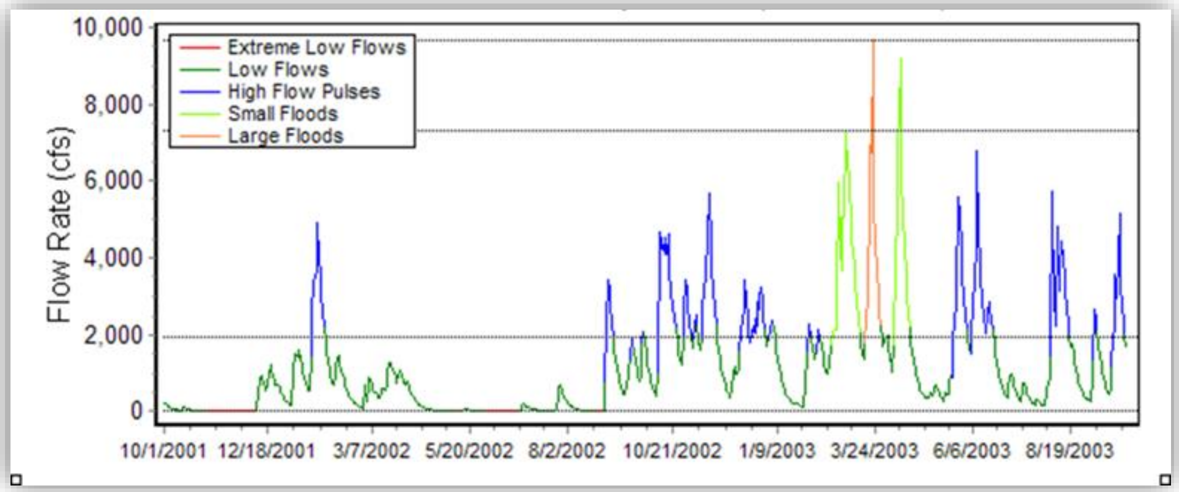


Baseflow

Source: Eddy et al., forthcoming

Evaluate Change with Multiple Metrics

- 30-year daily time step simulations
- Calculate metrics for each catchment
  - Hydrologic regime, e.g. volume, timing, frequency, duration, flashiness
  - Annual sediment load



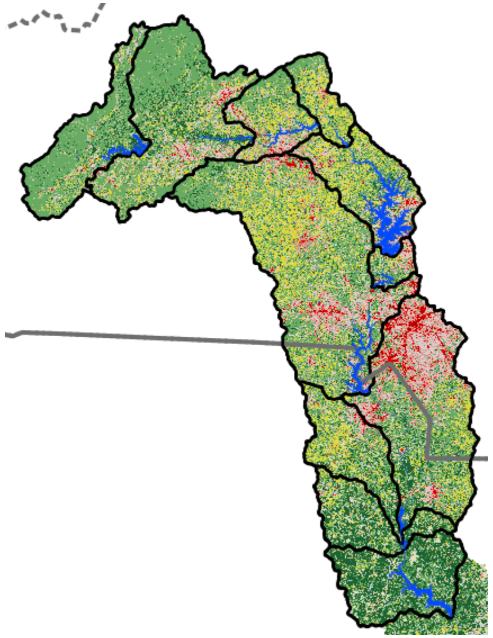
How does the regime change in the future?

Current Metrics ⟷ Future Metrics

Run Multiple Scenarios

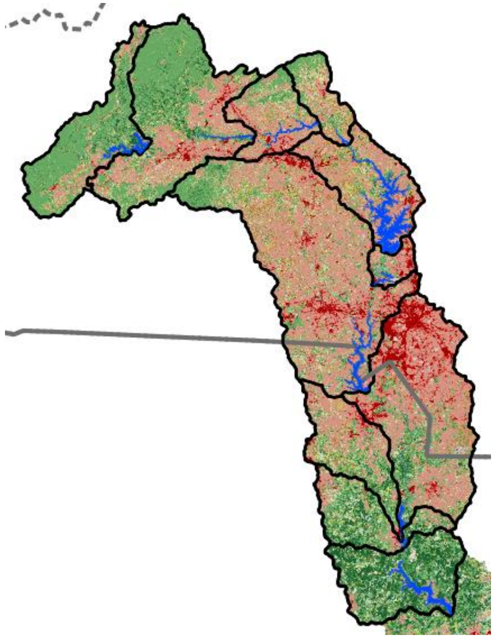
Run multiple scenarios to understand causes and (later) mitigation potential of change

CURRENT CONDITIONS



1) Current land use and current climate

FUTURE



1) Projected land use plus climate change
2) Land use change only
3) Climate change only

Change in all metrics

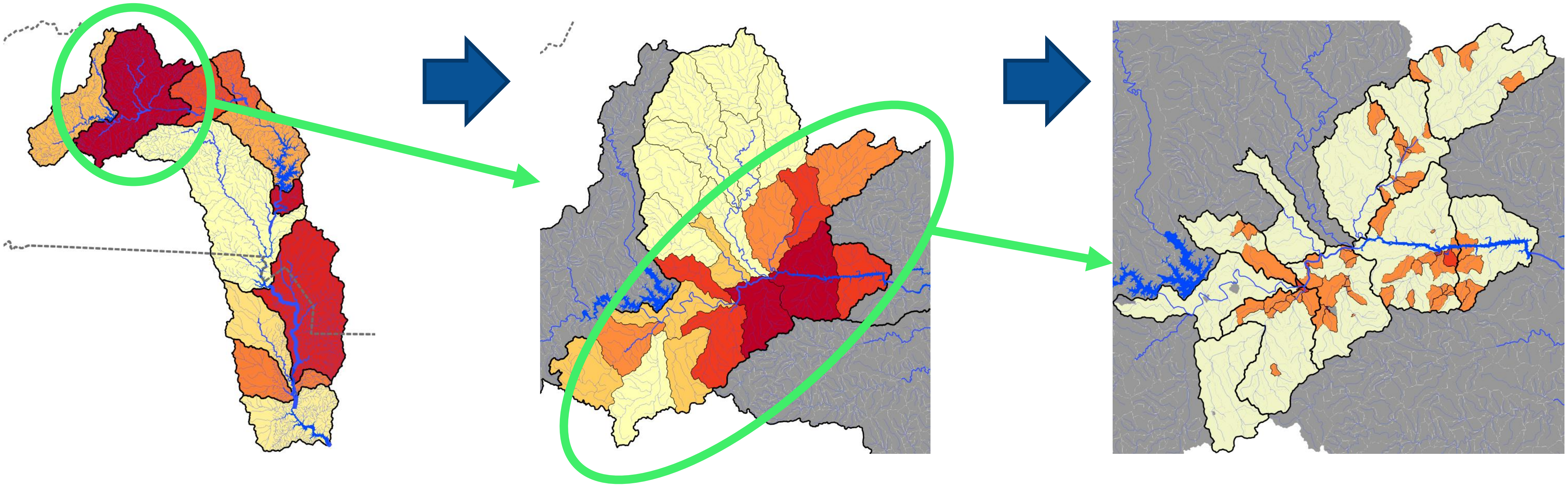
Composite metric for area & scale of interest

Apply a Scaled Screening Analysis

Reservoir-Scale Screening

HUC12-Scale Screening

Catchment-Scale Screening



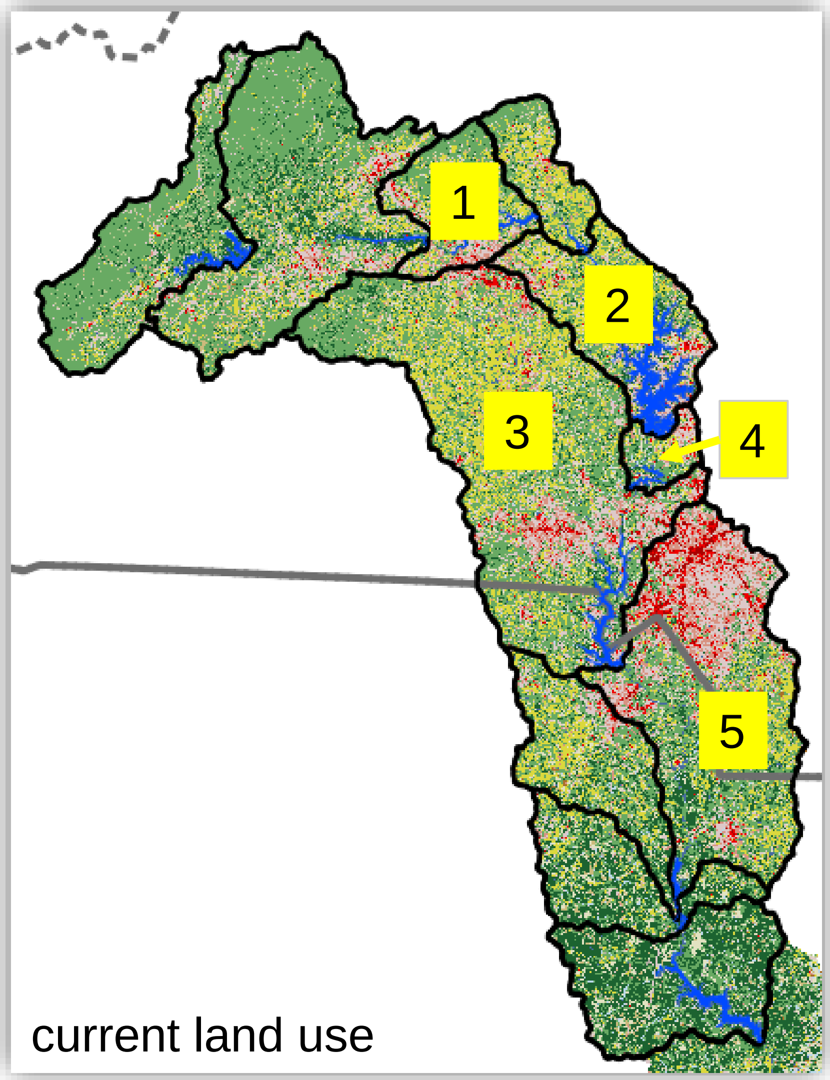
Reservoir scale screening also factors in:

- Mitigation potential – e.g. cause of change, amount of conservable land
- Usage – where are the important source areas

Source: Eddy et al., forthcoming

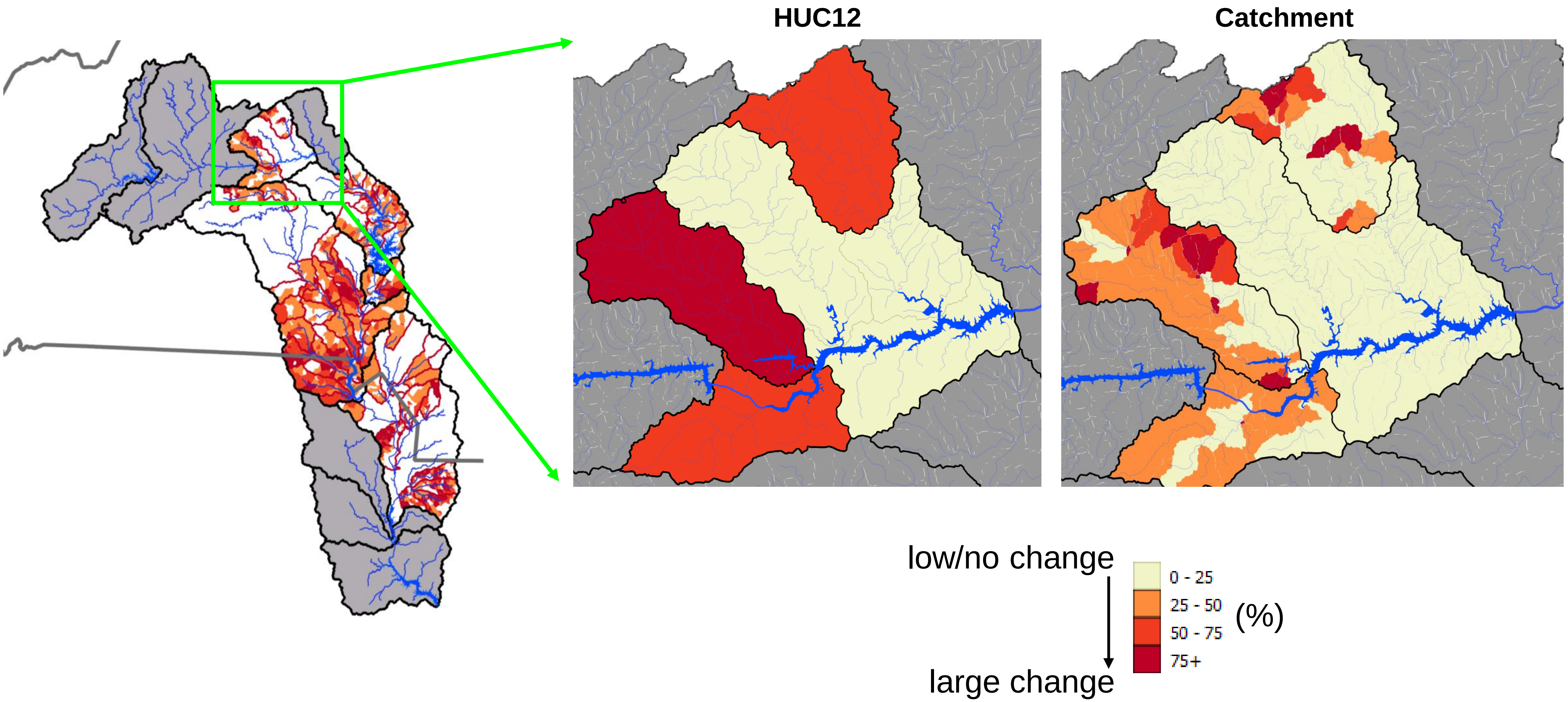
Identify Priority Subwatersheds

- 5 high priority reservoir subwatersheds
- Scoring incorporated:
  - Projected change in hydrology and sediment load
  - Mitigation potential via land conservation
  - Importance for water supply – i.e. volume of withdrawals
- Focus smaller scale analyses on these 5 subwatersheds



Draft findings. Do not cite.

Identify Hot Spots within Priority Areas



Color = composite metric capturing % change in hydrologic regime characteristics and sediment load

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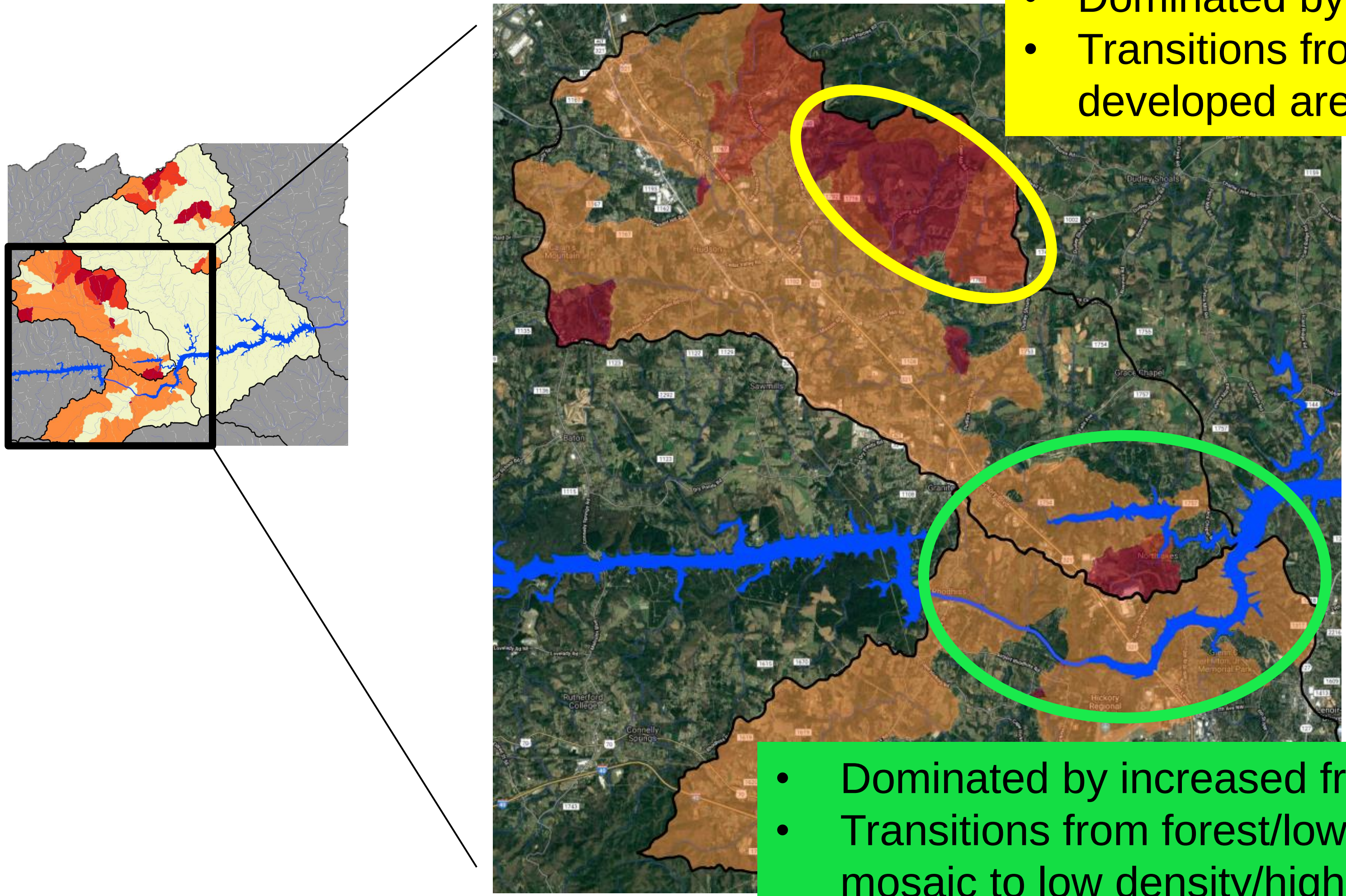
Source: Eddy et al., forthcoming

Evaluate Hot Spots in Detail

- What’s changing? What’s causing the change? What can be done about the change?

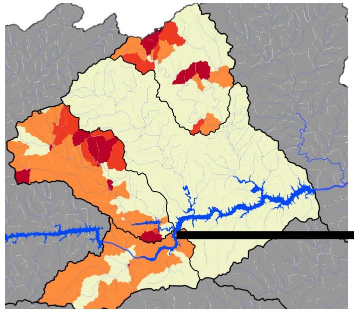


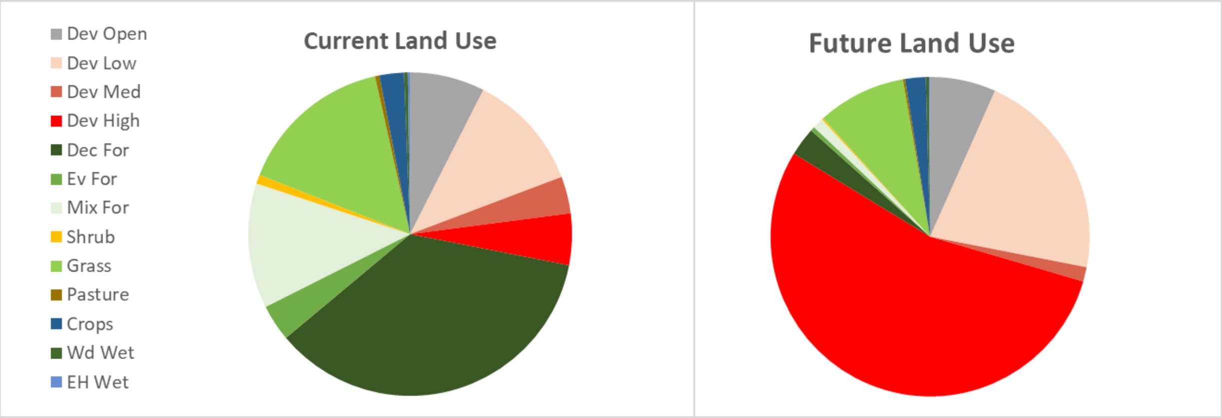
- Dominated by increased sediment loads.
- Transitions from mostly forest to low-density developed area

- Dominated by increased frequency of low flow
- Transitions from forest/low density developed mosaic to low density/high density mosaic

Source: Eddy et al., forthcoming

Lake Hickory in Detail

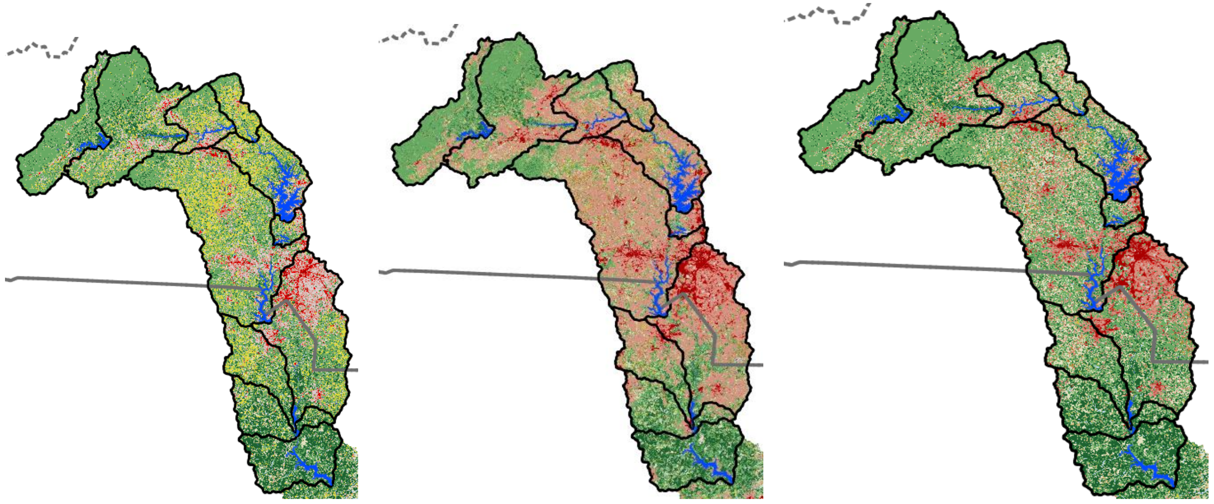




Source: Eddy et al., forthcoming

Evaluate the Benefit of Land Conservation

CURRENT **FUTURE** **MITIGATED FUTURE** → Hold all natural land cover at current levels



Hydrology: Qualitative (reduction in % change)

Potential hydrologic benefit, catchment A = Future change, catchment A - Mitigated future change, catchment A

Sediment: Net benefit (monetary)

Sediment Monetary Benefits:
-Drinking water treatment costs
-Lakeshore property values
-Recreation benefits
-Co-benefits of carbon storage and health

Costs:
-Natural land values
-Average cost per acre
-Based on tax value of parcels

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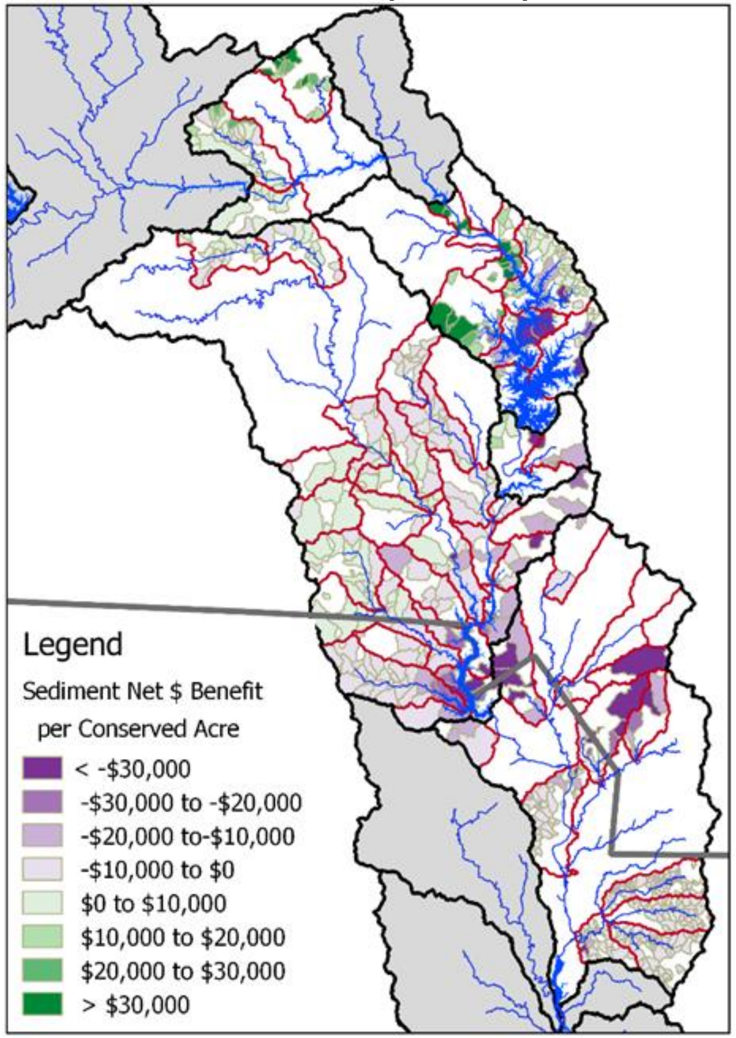
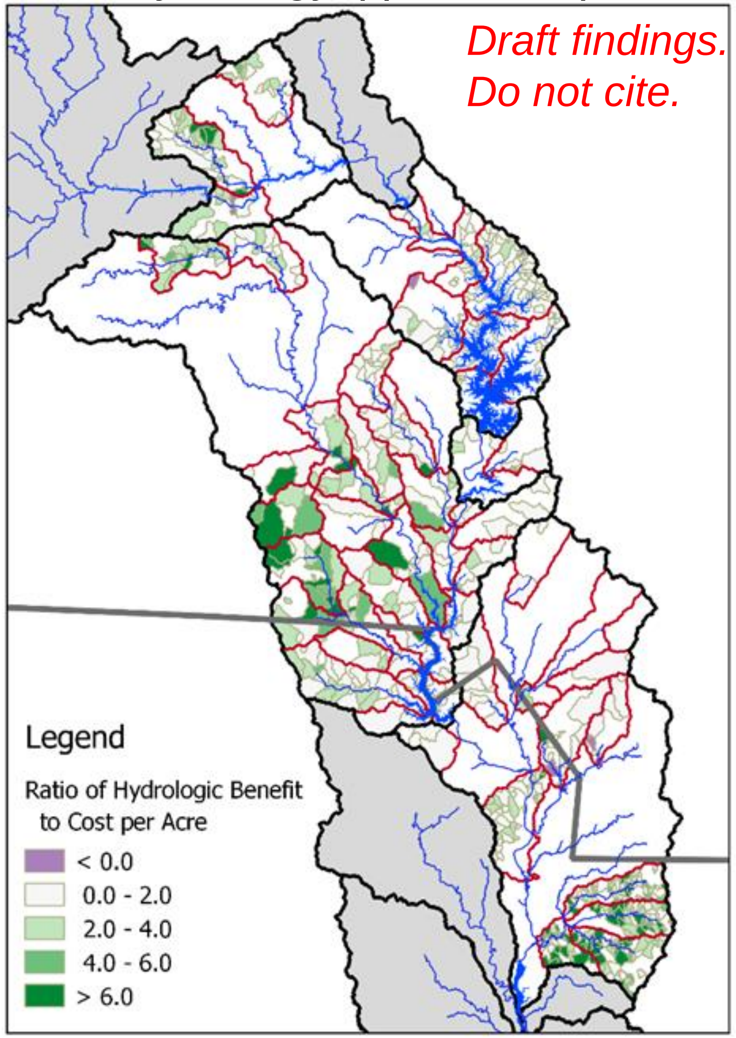
Calculate Benefit-Cost Ratings

Sediment ($ cost)



Hydrology (qualitative)



Source: Eddy et al., forthcoming

Thank You!

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Reference:

Eddy, M., K. van Werkhoven, B. Lord, S. Kovach, J. Serago, and G. Van Houtven. Forthcoming. Quantifying the Potential Benefits of Land Conservation on Water Supply to Optimize Return on Investments. Project #4702. Denver, CO: The Water Research Foundation.

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