WRIA 9 Stormwater Retrofit Project:

Modeling cost-effective solutions to meet flow and water quality targets

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Salish Sea Ecosystem Conference

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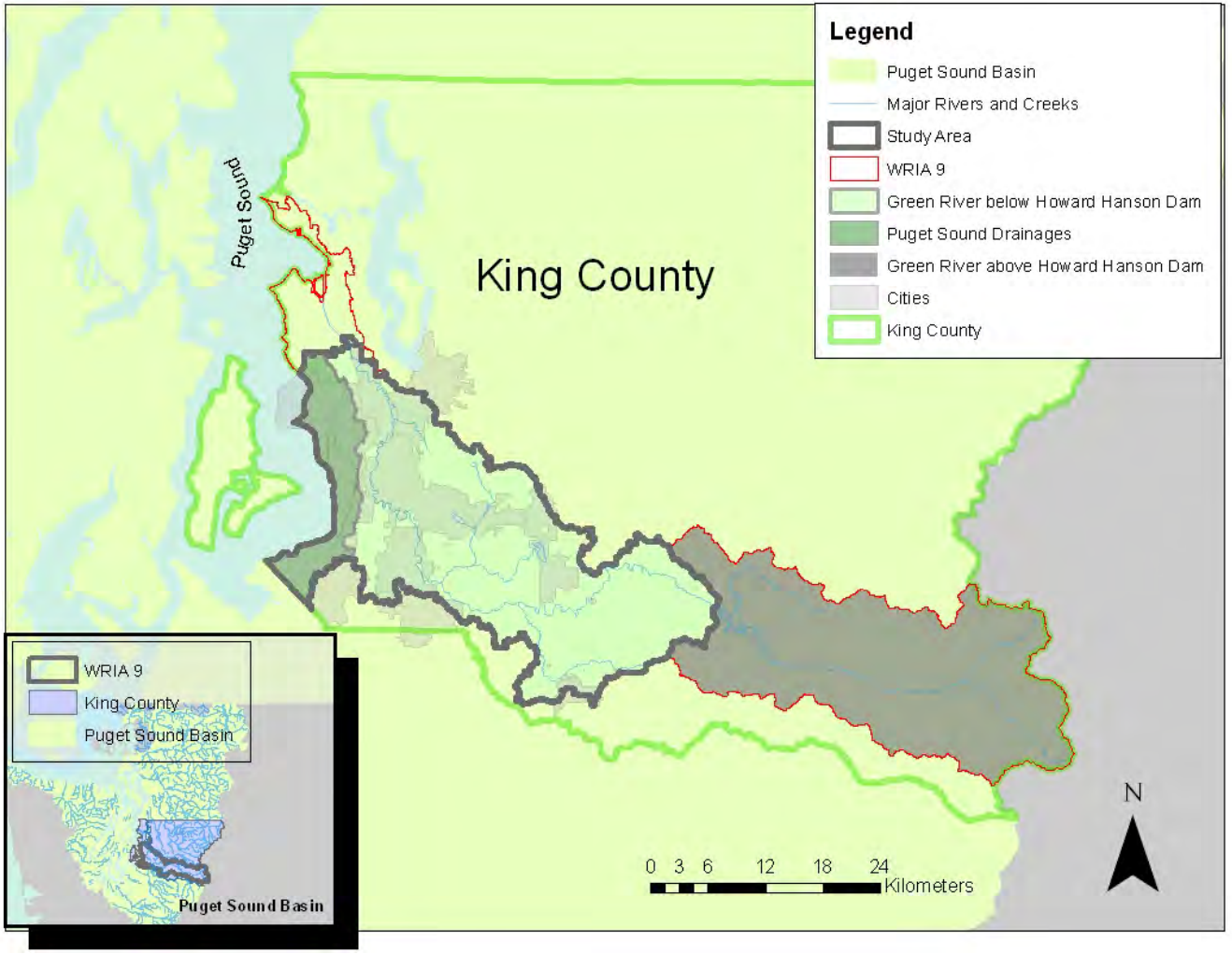
Objectives

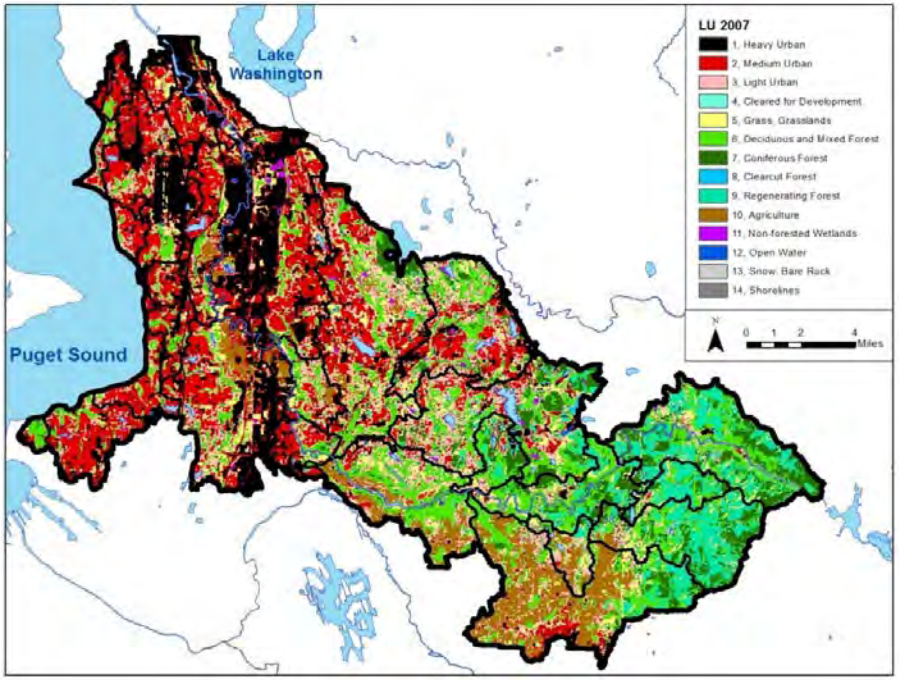
Estimate planning-level stormwater facility needs and costs for the future development in the WRIA 9 study area.

1. Model cost-effective combinations of BMPs to reach stormwater goals using the EPA SUSTAIN model.
2. Extrapolate model results to future (2040) developed conditions.

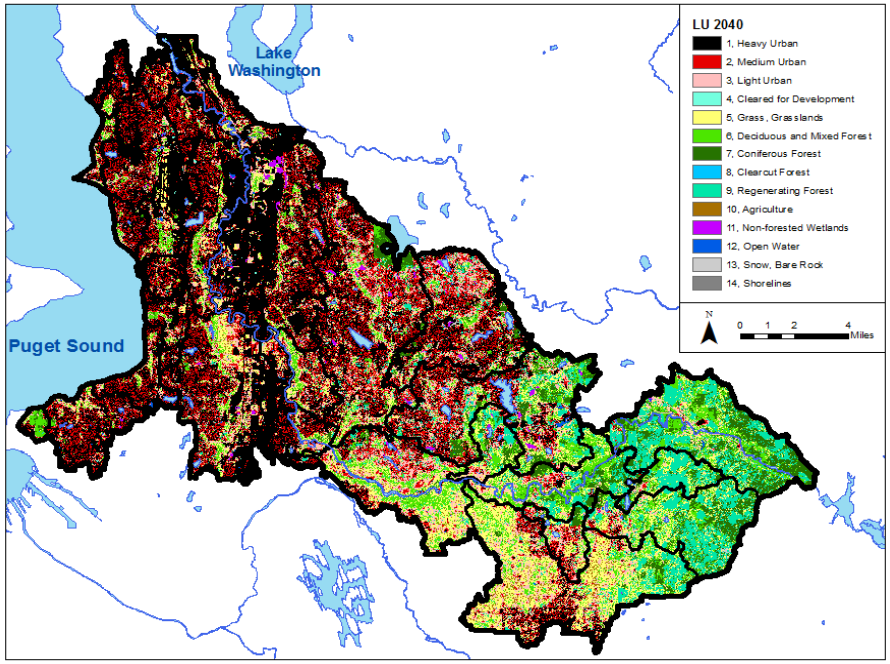
WRIA 9 Study Area



Future Development



2007 Satellite-derived Land Use (UW 2007)



Simulated 2040 Future Land Use (Alberti 2009)

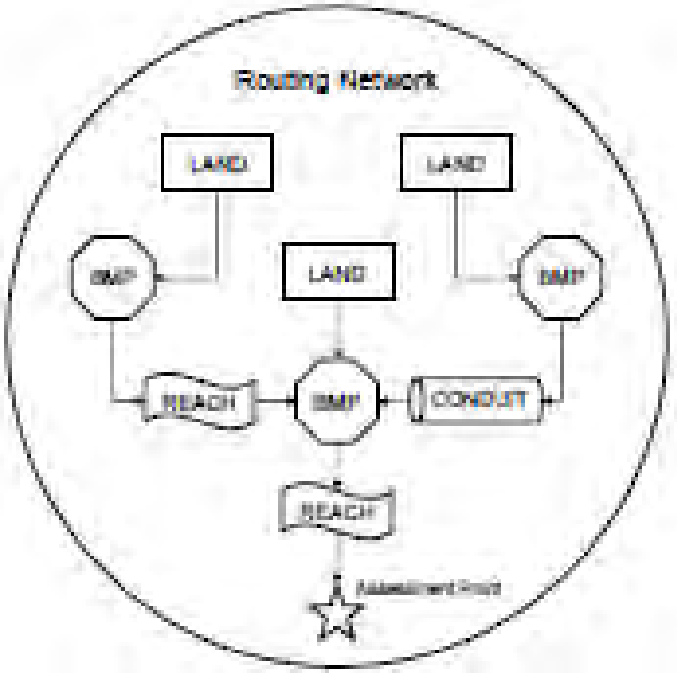
SUSTAIN: **S**ystem for **U**rban **S**tormwater **T**reatment and **A**nalysis **IN**tegration

Model Inputs:

BMP Design and Cost Assumptions

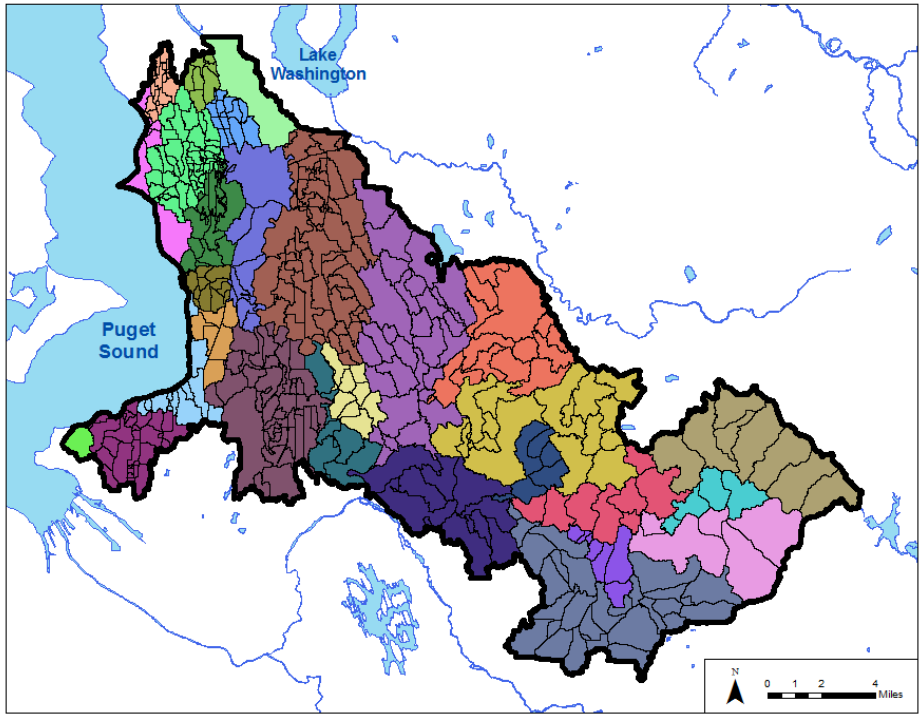
Flow or water quality goals

Decision variables

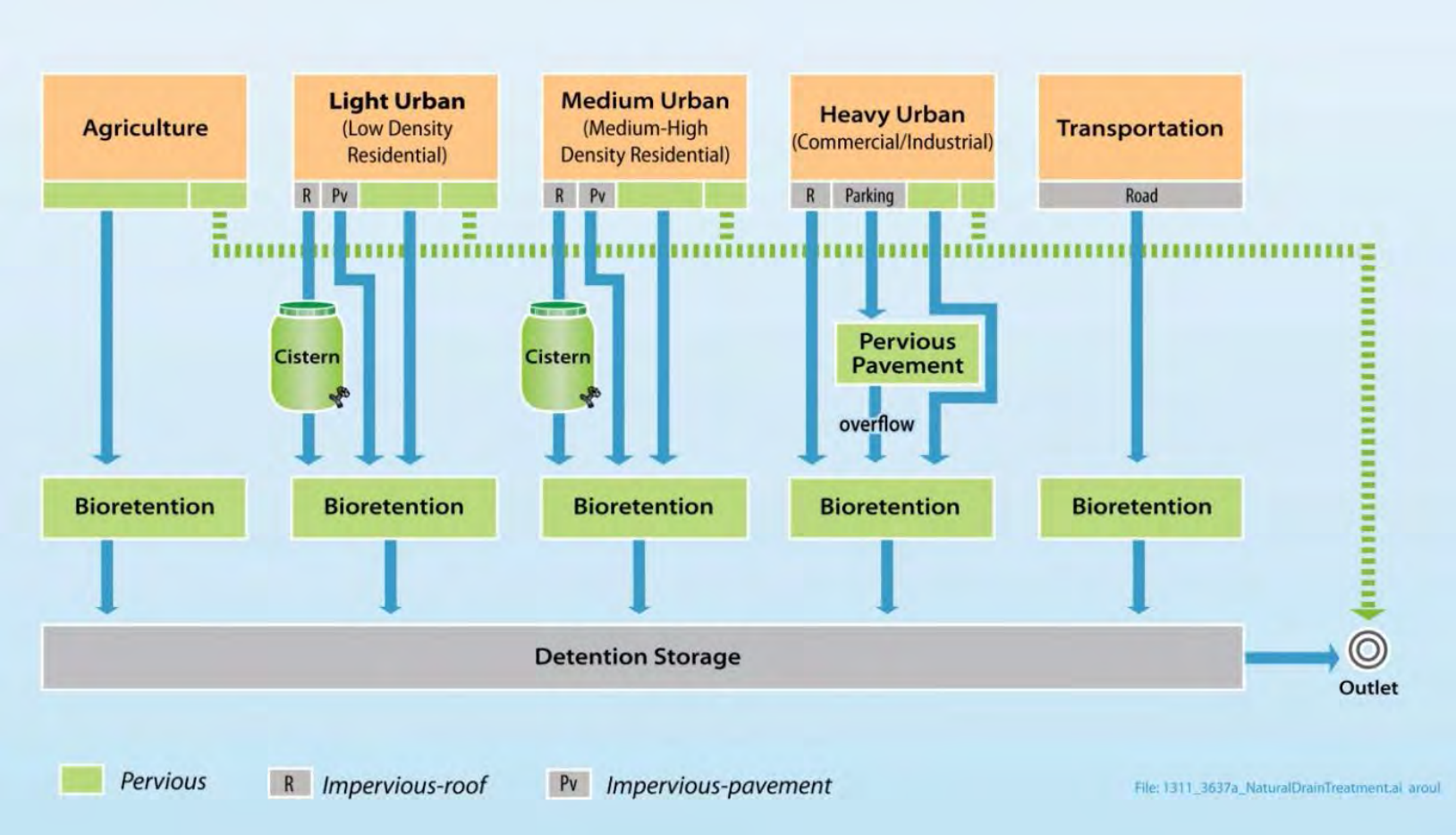


Modeling Approach

- Study area: 278 mi^2, 446 catchments
- Model 135 hypothetical 100-acre catchments representing combinations of:
  - **5 generic land uses**
  - **3 soil types**
  - **2 slopes**
  - **3 precipitation zones**
  - **2 land costs**



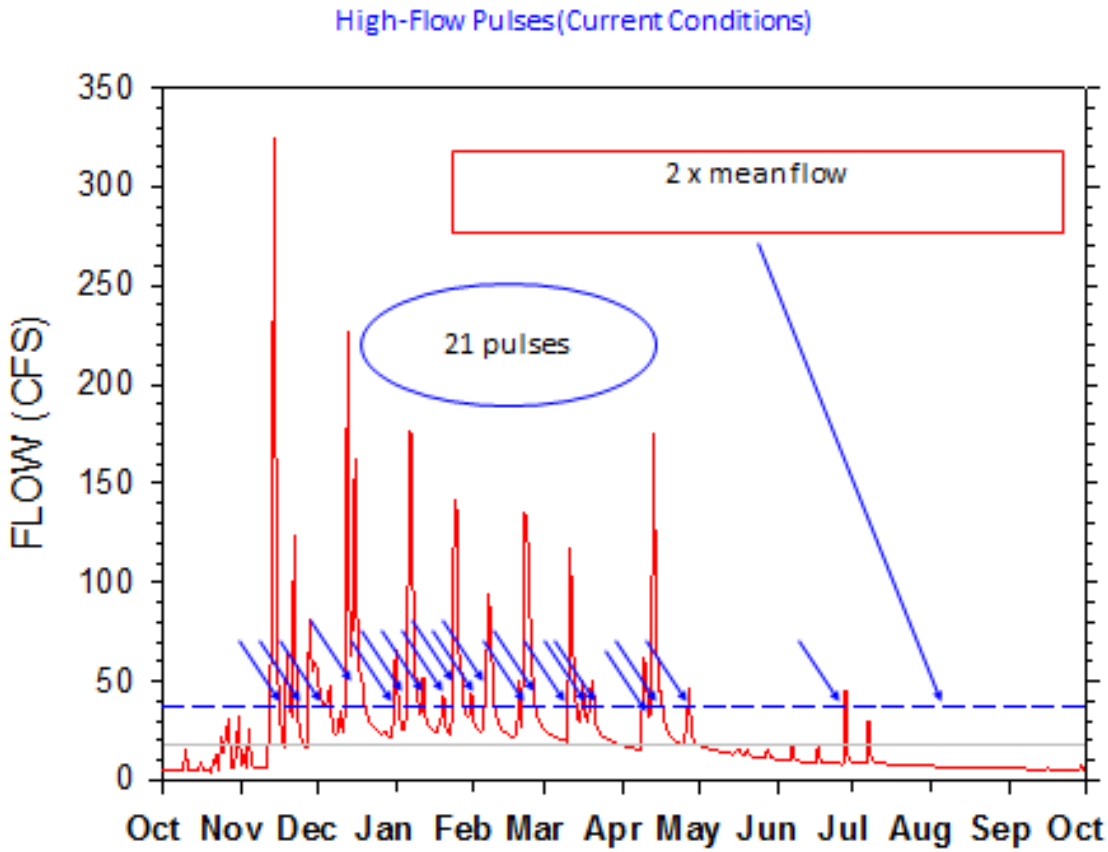
BMP Treatment Train



BMP Unit Design and Cost Assumptions

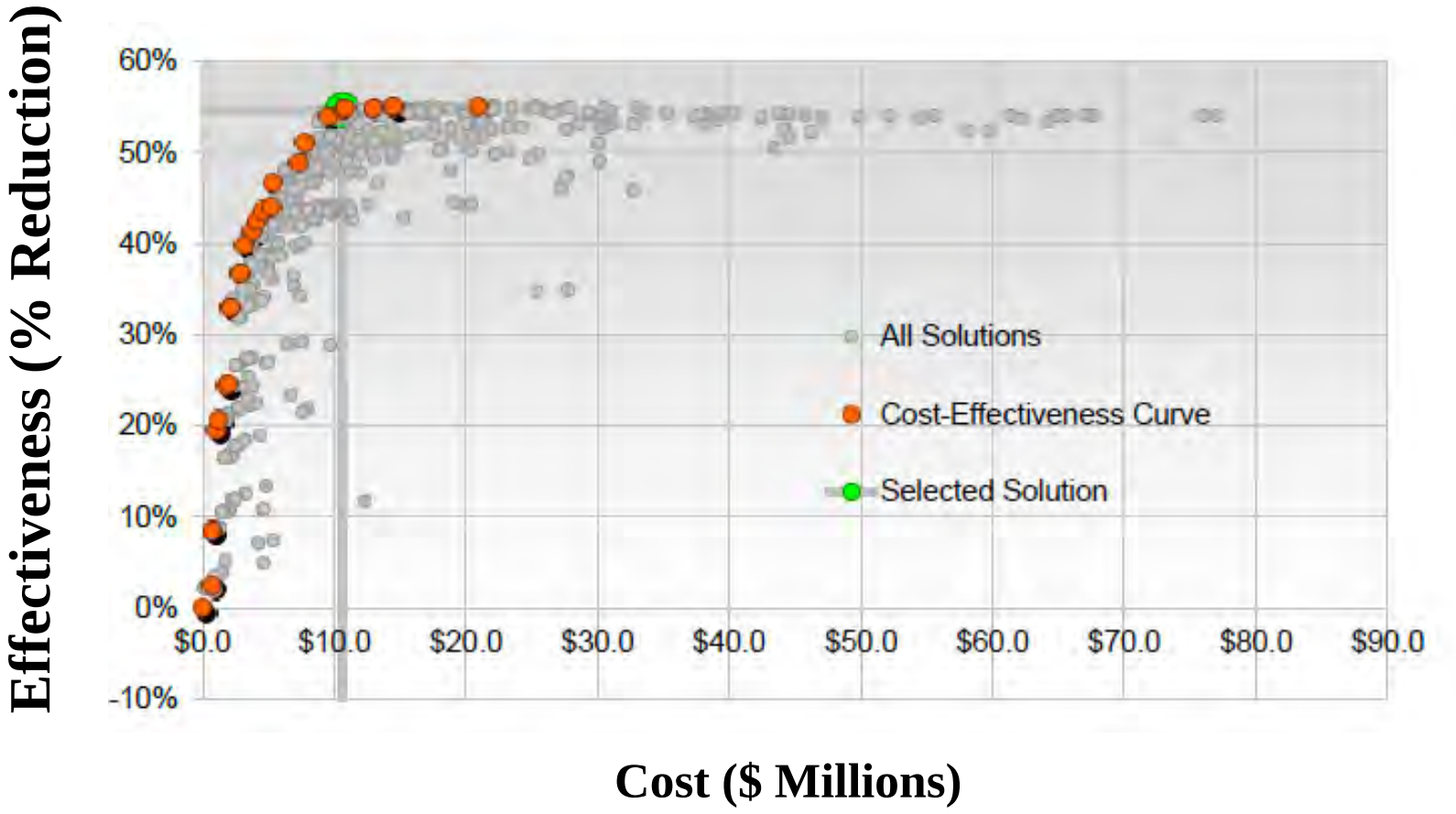
- Develop conceptual BMP unit designs
- Assume construction of modeled BMP units are distributed over the 30-year period.
- 30-year life cycle costs assuming 5% real discount rate:
  - **Capital** : design, permitting, and construction
  - **Operation and Maintenance** (O&M)
  - **Inspection and enforcement** (I&E)
  - **Land acquisition cost**

SUSTAIN Optimization Target:
Reduce Stream Flashiness



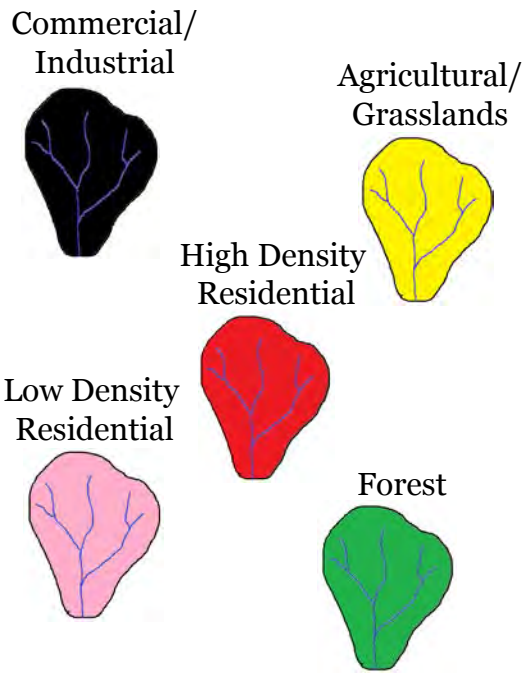
High Pulse Count: Number of times mean daily flows ≥ high-flow threshold set at 2 X long-term mean daily flow rate

SUSTAIN Output

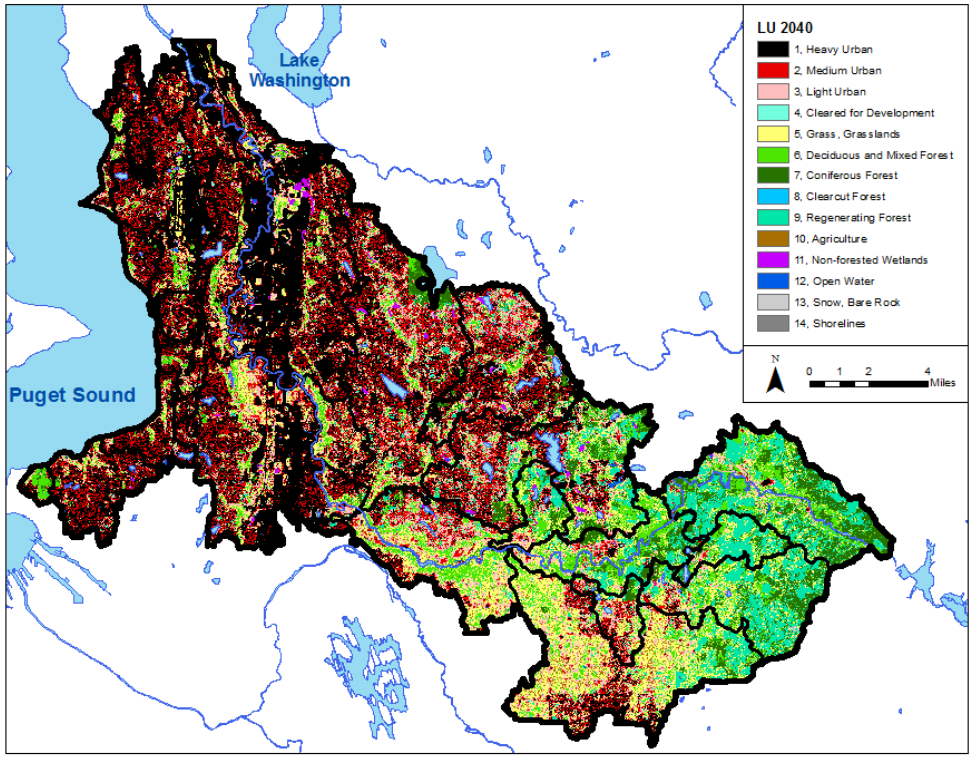


Scale to Future Land Use

SUSTAIN Modeled Hypothetical Catchments



Scale



Simulated 2040 Future Land Use (Alberti 2009)

Results: BMP Units and Storage

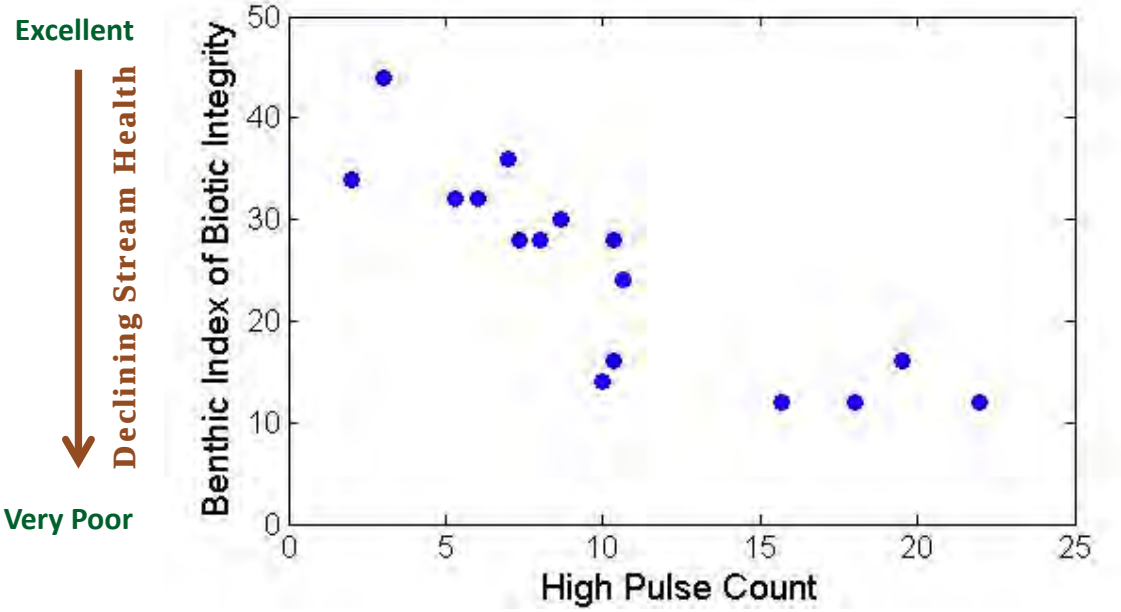
BMP Unit	#Units	Volume (acre-ft)	Storage (inches)
Cisterns	24,000	200	0.02
Rain Gardens	2,600,000	9,600	0.90
Roadside Bioretention	190,000	700	0.07
Detention Ponds	75,000	19,000	1.80

2.7 inches of flow control for future development in study area

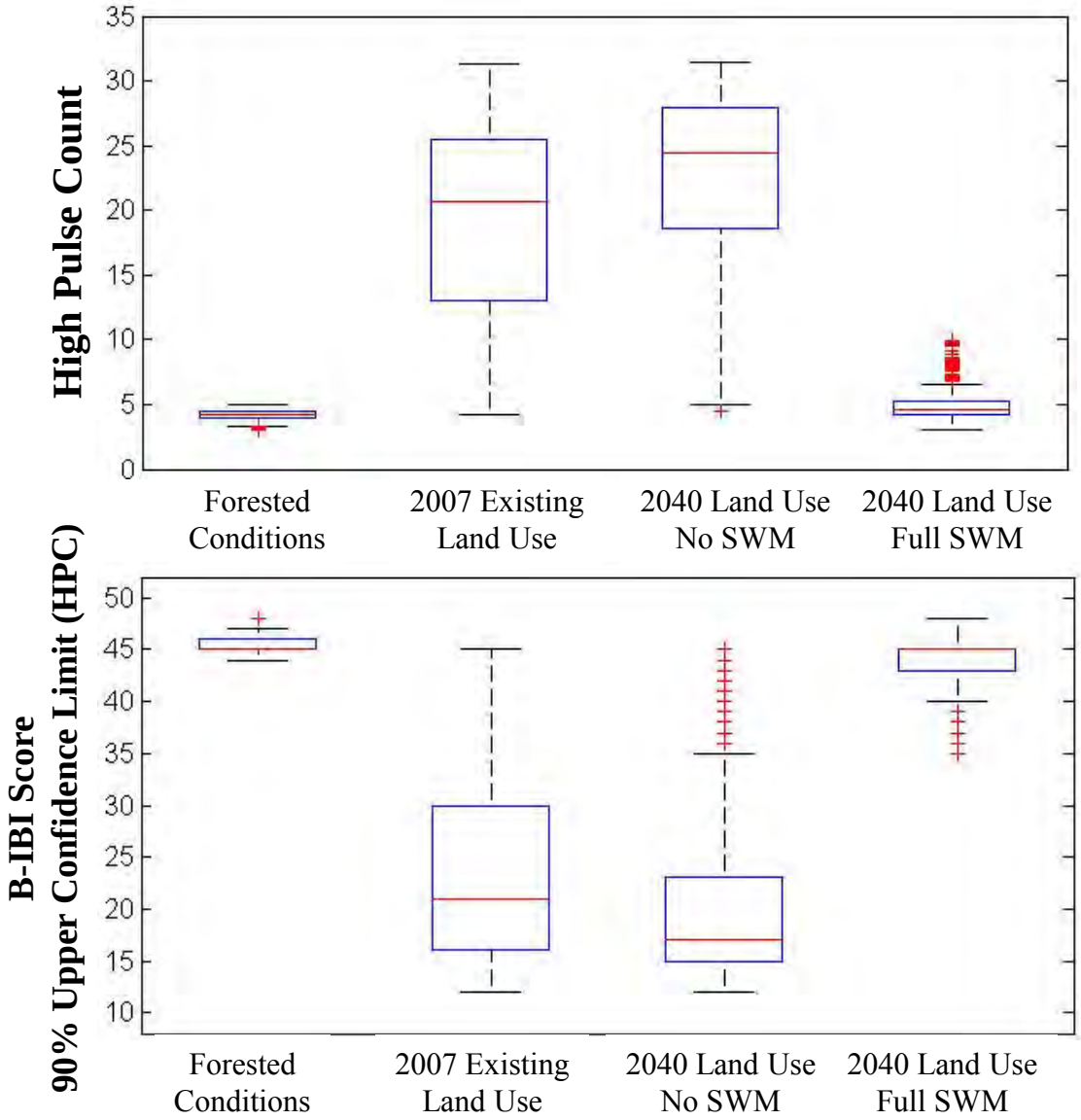
$$\text{storage} = \frac{\text{volume of facilities}}{\text{developed area}}$$

BMP Effectiveness:
Improvement in Biological Health

- King County data set from 16 flow and B-IBI stream stations (*DeGasperi et al. 2009*)
- Logarithmic-linear regression equation provide probabilistic estimates of improvement in B-IBI scores (*Horner 2013*)
- Predict improvement in B-IBI scores based on improvement in HPC



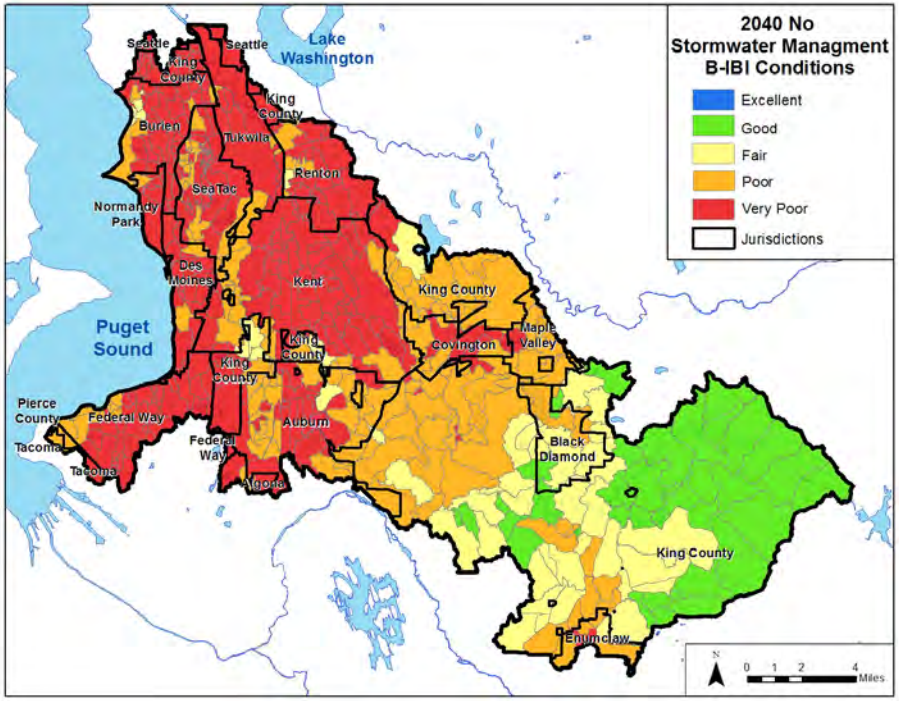
Potential Improvement in Hydrologic Indicators and B-IBI Scores



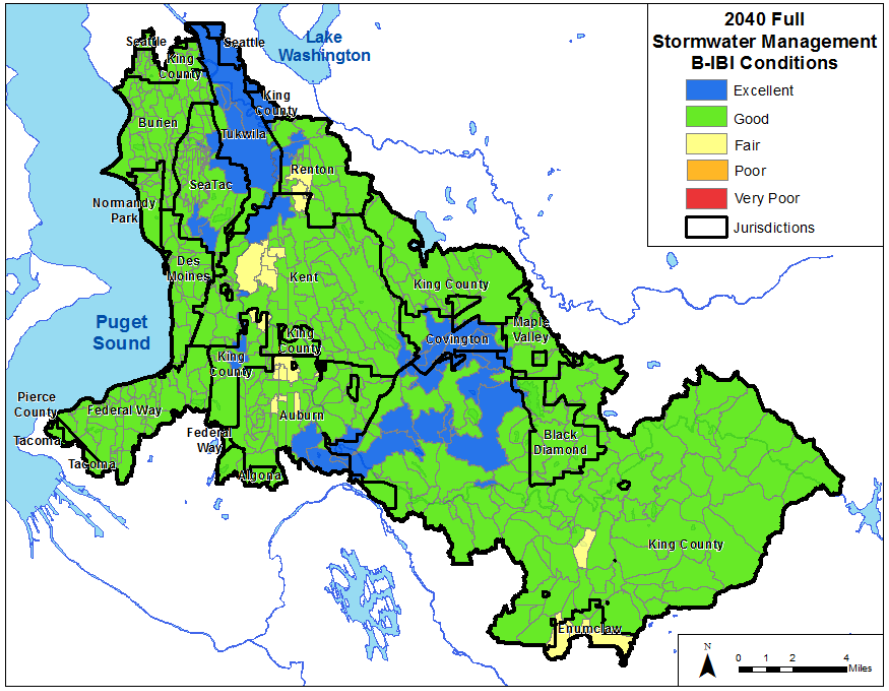
*Results for 446 catchments of study area

Potential B-IBI Improvement

2040 Land Use
No Stormwater Management



2040 Land Use
Full Stormwater Management



Biological Condition	B-IBI Range
Excellent	46 - 50
Good	38 - 44
Fair	28 - 36
Poor	18 - 26
Very Poor	10 - 16

Source: http://pugetsoundstreambenthos.org/

Next steps: Estimating Costs

- How will BMPs be implemented across the study area?
- Evaluate implementation strategies:
  - Identify existing facilities
  - Mitigation required with new and redevelopment
  - Potential public stormwater program

Questions?

For more details: King County's WRIA 9 Retrofit Project SUSTAIN Modeling Report

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