Prioritizing Culvert Replacement Projects to Restore Habitat Connectivity in the Warner River Watershed

Kat Crowley, Ben Nugent, & Amy Villamagna

New Hampshire Water and Watershed Conference
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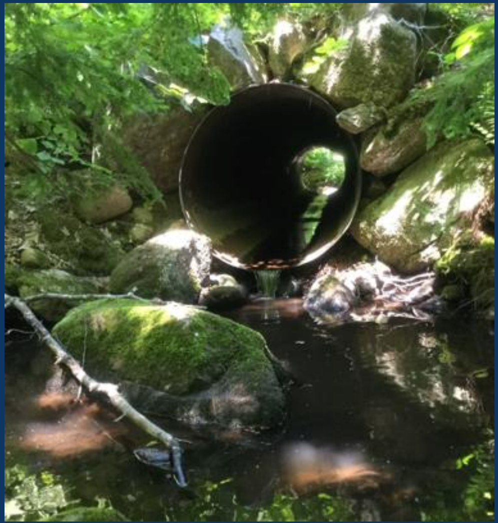
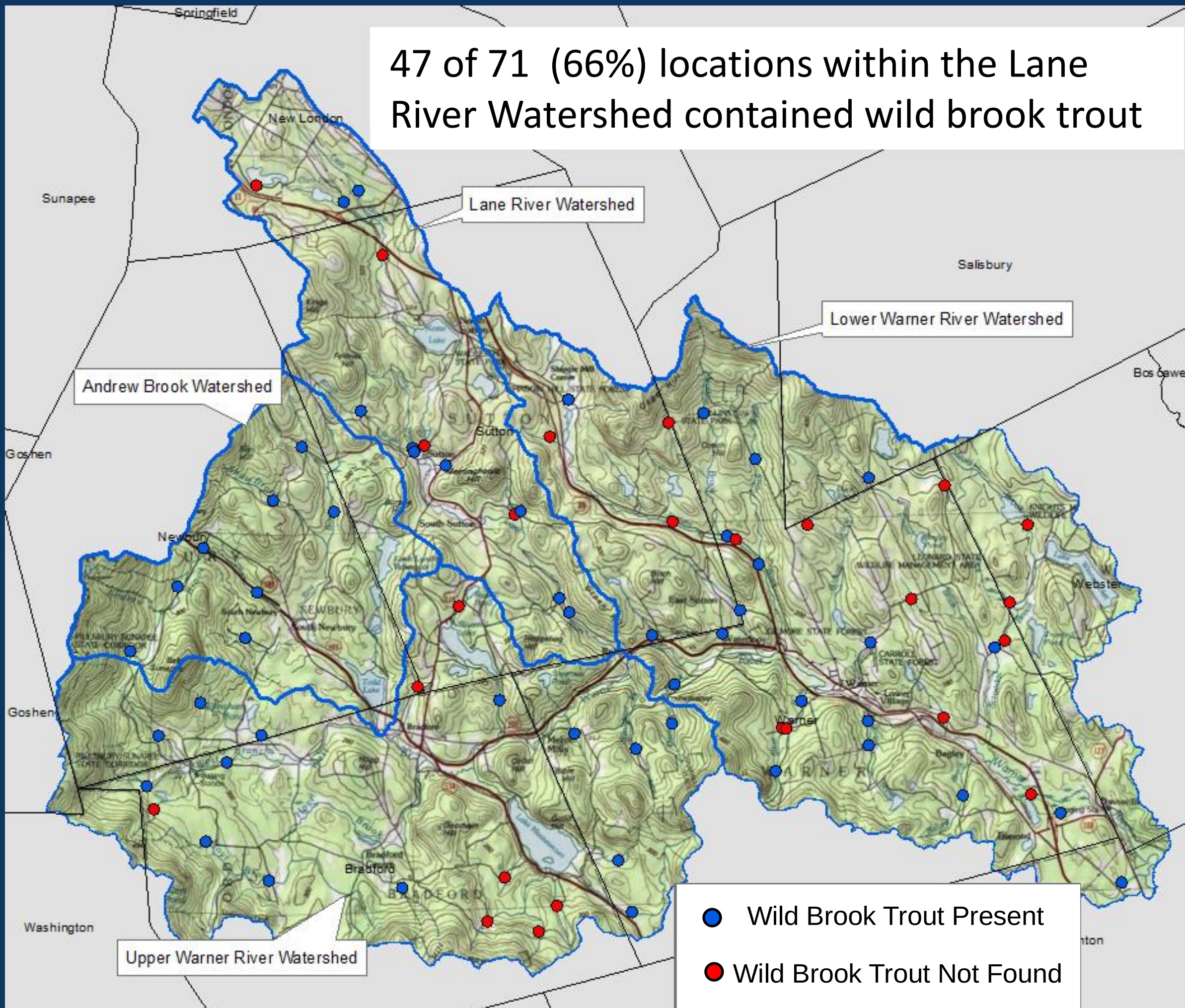


Overview

- Project Background
- Project Objectives
- Framework Development
- Prioritization Framework
- Applications
- Questions

Warner River Watershed Conservation Project

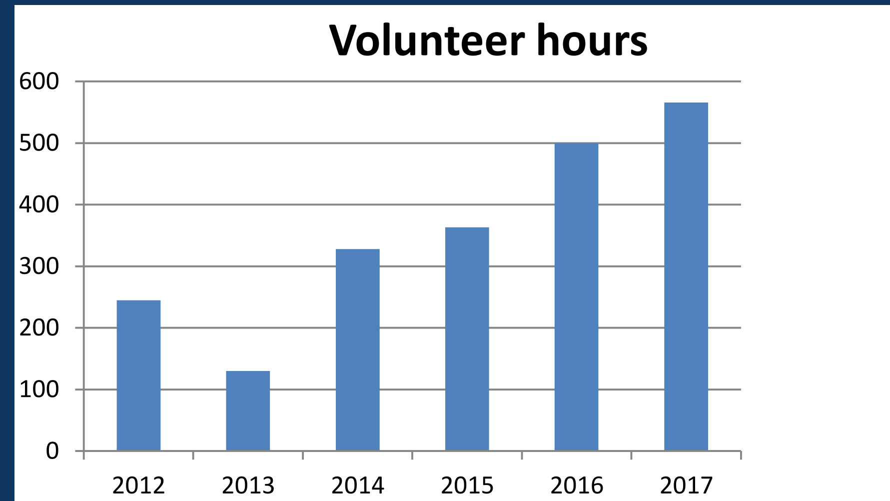


2012-partnership between NH Fish and Game and Basil Woods Trout Unlimited formed to assess watershed

Results:

- Watershed deserves attention
- Local residents were committed to support future efforts

Warner River Watershed Conservation Project- Progression after baseline assessments



Outreach/Education

Land Conservation

Volunteer River Assessment Program

Property specific site visits

Flood resiliency workshops

Warner River designation into NH Rivers Management and Protection Program

Watershed wide stream crossing assessment project

The Problems Associated with Undersized Stream Crossings

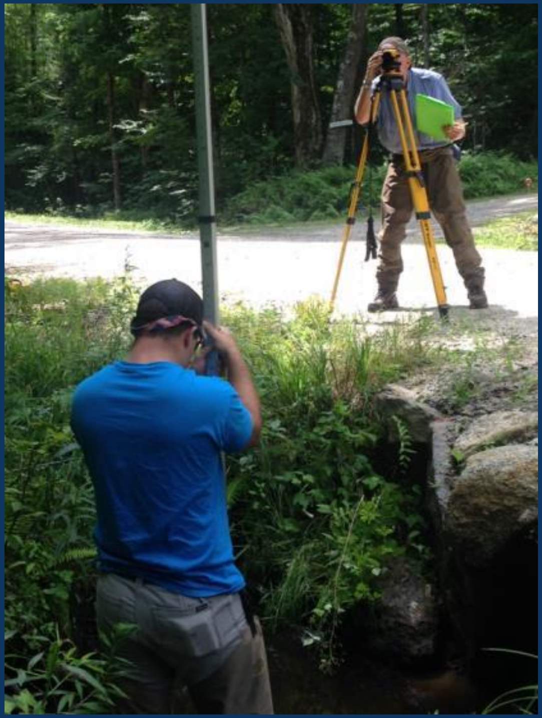



- Block fish and other aquatic species migration
- Reduce opportunities to (re)colonize areas
- Alter natural erosion and sedimentation rates of a stream
- Amplify velocity and energy during high flow events
- More susceptible to failure and washout

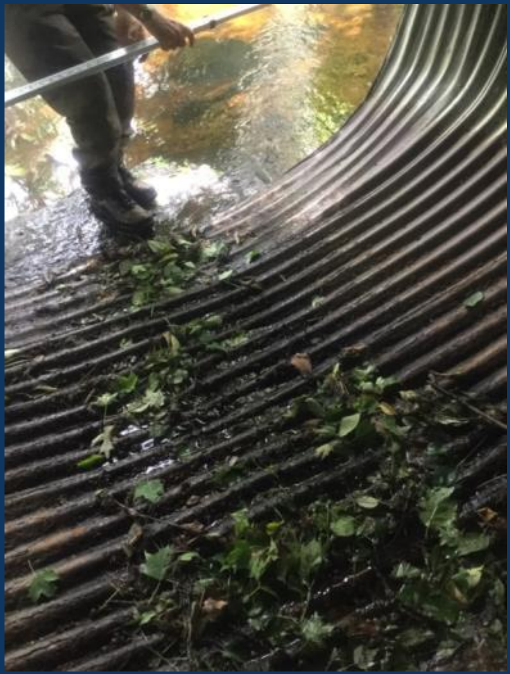
Close to half of the fish species of greatest conservation need to migrate to complete life cycles!

Stream Crossing Assessments (2014-2016)
208 crossings evaluated

- Structure Condition
- Aquatic Organism Passage Status
- Geomorphic Compatibility
- Hydraulic Capacity

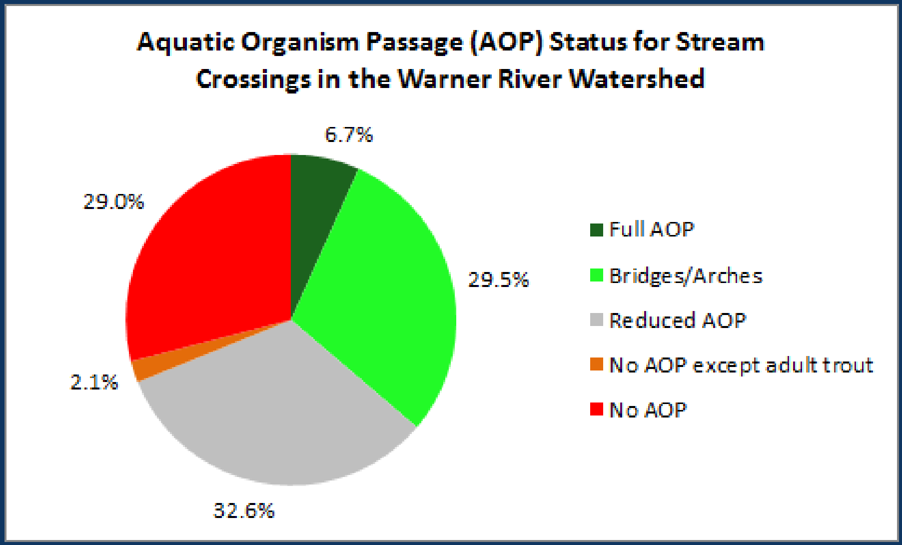


Stream Crossing Assessments Results



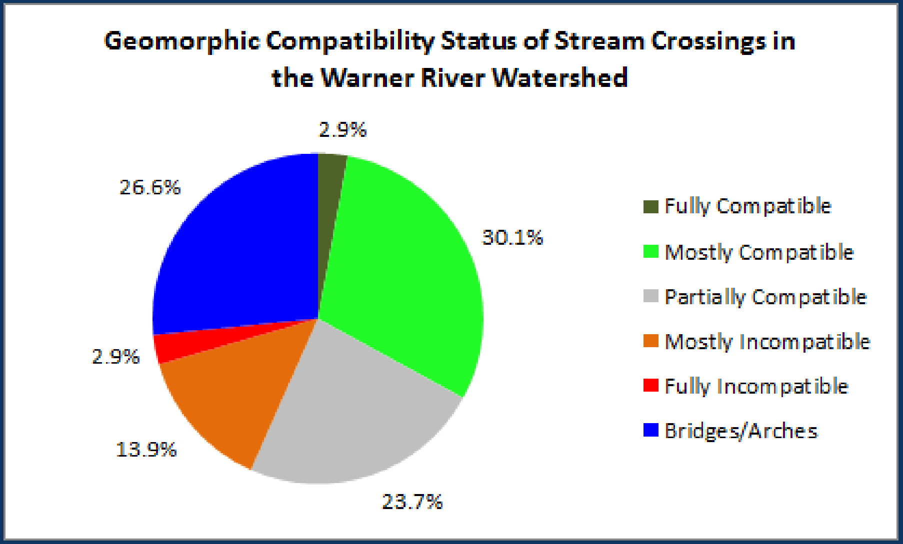
Structure Condition

Stream Crossing Assessments Results

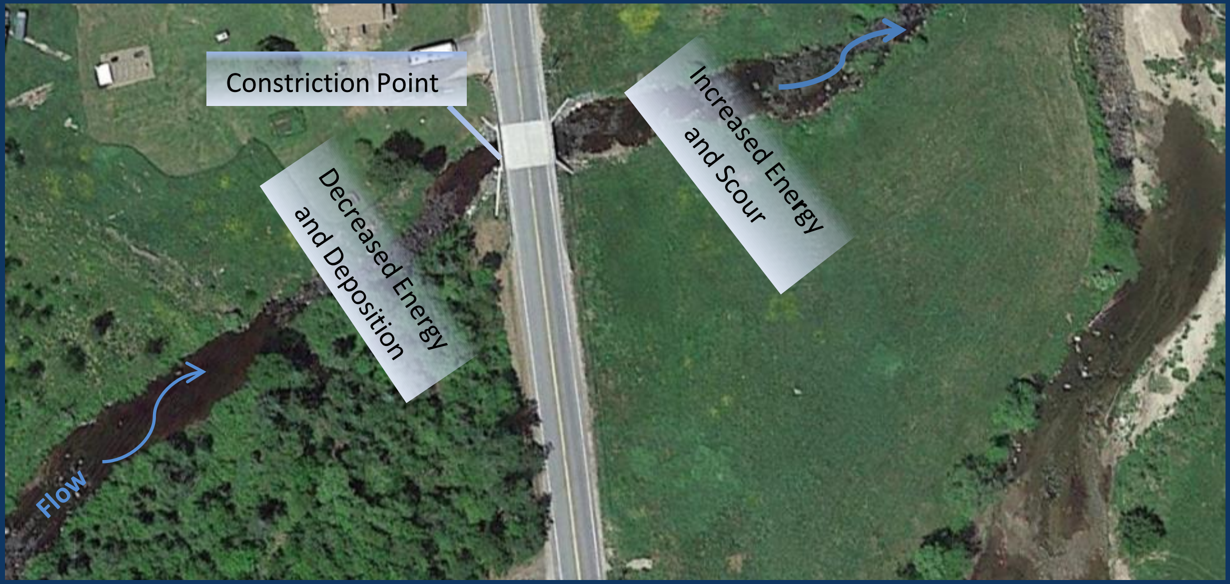


Aquatic Organism Passage Status

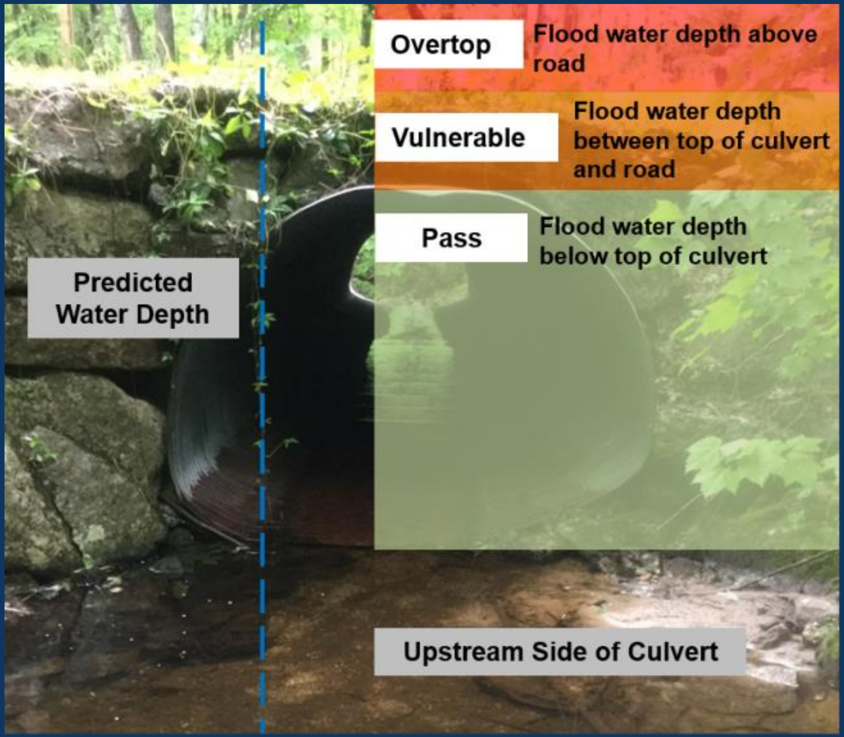
Stream Crossing Assessment Results



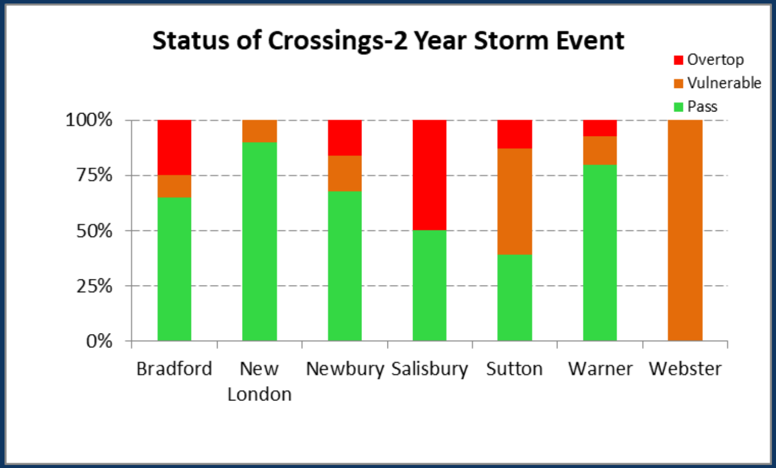
Geomorphic Compatibility

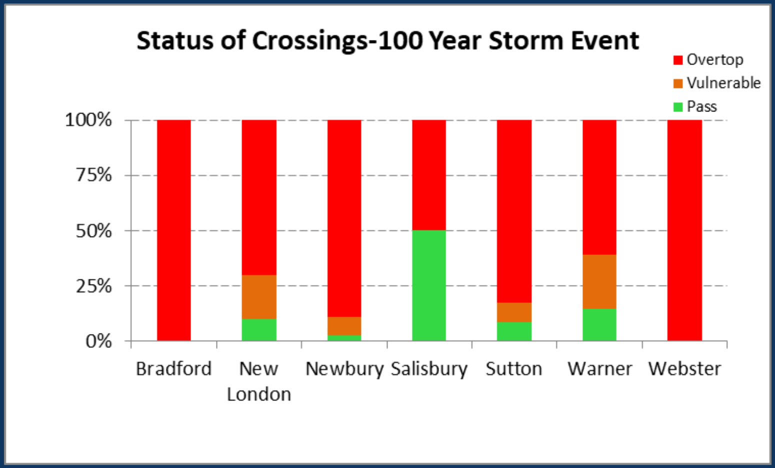


Stream Crossing Assessments Results

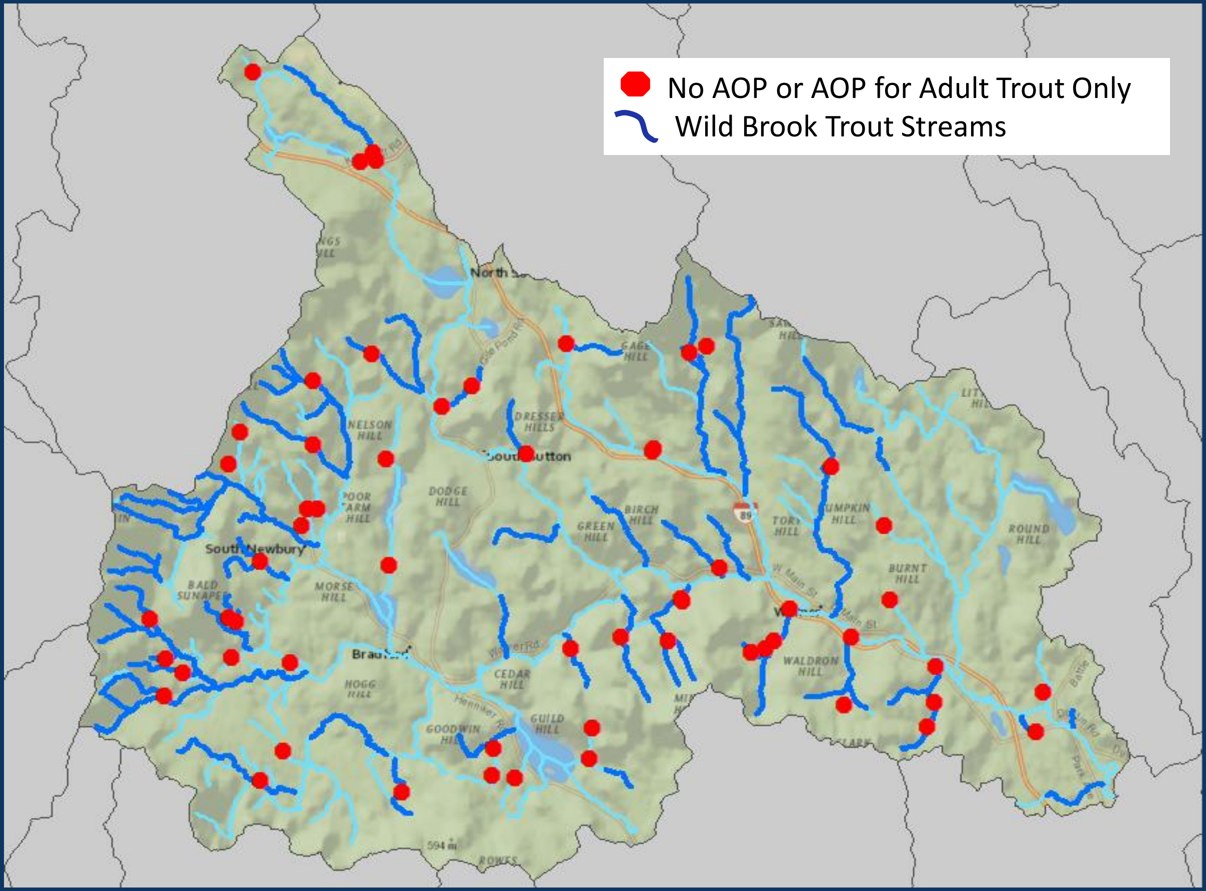


Hydraulic Capacity





Next step: An approach to prioritize restoring habitat connectivity was needed



Possible funding sources when natural resources are considered:

Eastern Brook Trout JOINT VENTURE A Fish Habitat Partnership

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

U.S. FISH & WILDLIFE SERVICE DEPARTMENT OF THE INTERIOR

NEW HAMPSHIRE CHARITABLE FOUNDATION

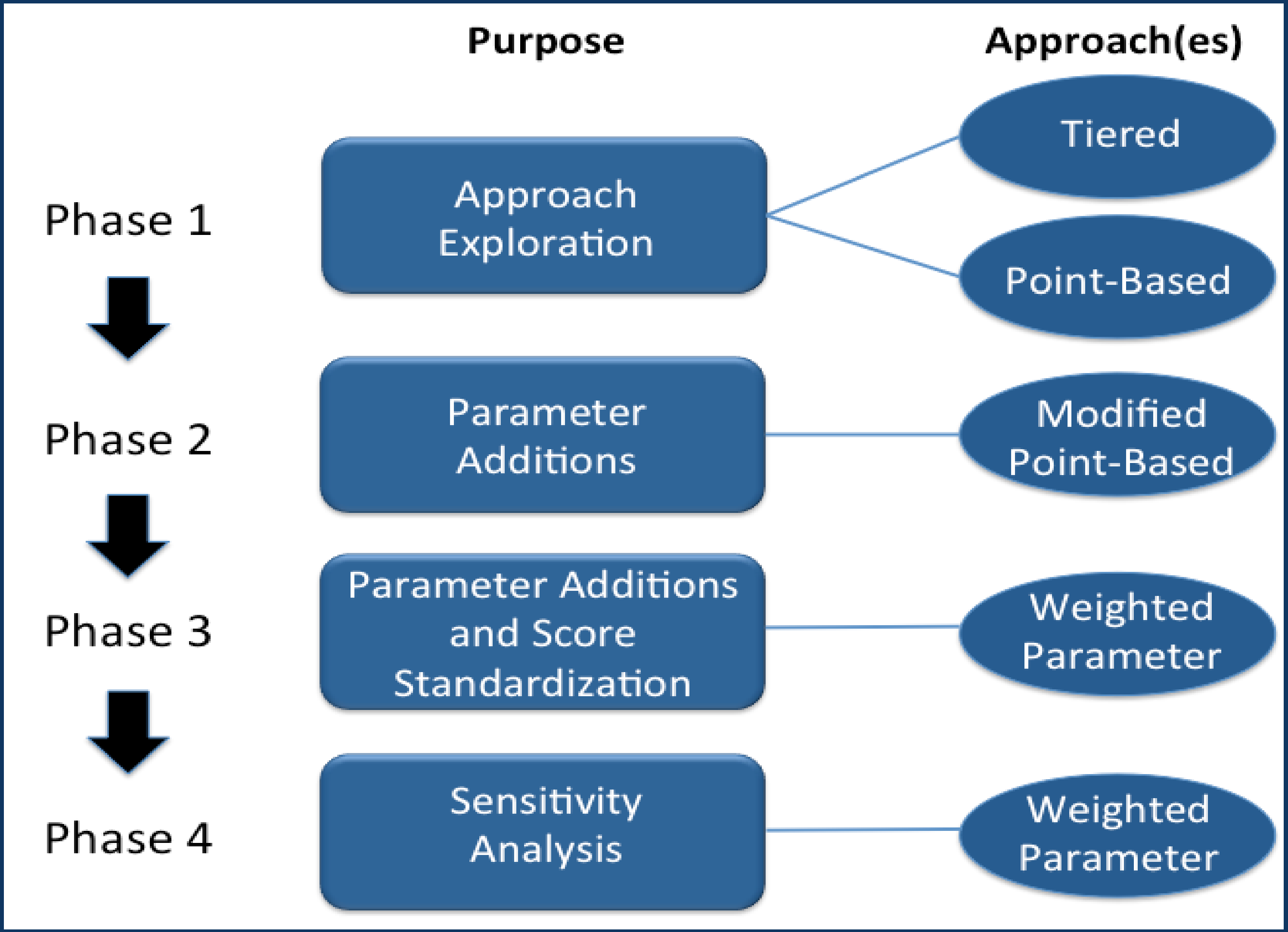
NRCS Natural Resources Conservation Service

STATE OF NEW HAMPSHIRE LIVE FREE OR DIE FISH AND GAME

Project Objectives

- Consolidate field data and GIS data
- Identify priority culverts
- Engage local communities

Framework Development



Weighted Parameter Approach

- Choose parameters
- Calculate parameter scores from raw data
- Assign weights to parameters and categories
- Sum weighted scores

Culvert Parameters	Population and Habitat Parameters	Landscape Characteristic Parameters
AOP Compatibility	Upstream Length	Percent Conserved Land
Geomorphic Compatibility	Downstream Length	Percent Impervious Surface
Flood Vulnerability Over Time	Brook Trout Density	Percent Agricultural Land
Structure Condition	Brook Trout Stream	Percent Forest Within 30m Stream Buffer
Openness	Brook Trout Young-of-the-Year Density	

Culvert Parameters

- Aquatic Organism Passage
- Geomorphic Compatibility
- Flood Vulnerability Over Time
- Structure Condition
- Openness

Habitat & Population Parameters

- Upstream Habitat Length
- Downstream Habitat Length
- Adult Brook Trout Density
- Young-of-the-Year Brook Trout Density
- Brook Trout Stream Classification

Landscape Characteristics Parameters

- Percent Impervious Cover
- Percent Agricultural Land
- Percent Conserved Land
- Percent Forest Cover within 30m Buffer

“Protect” Method

- Targeted culverts in high-quality streams with small amounts of adjacent impervious surfaces and agricultural land use
- Main issue brook trout face is impassable culverts

"Re-secure" Method

- Targeted culverts in poor-quality streams with high amounts of adjacent development and agricultural land
- Brook trout face many threats: stormwater runoff, lack of canopy cover, impassable culverts

Score Standardization

- Assigning scores based on the range of parameter values for all culverts within the watershed
- Each parameter receives a score between 0-1

For parameters where we prioritized high values (e.g. upstream length), we used this equation:

$$Parameter\ score = \frac{Observed\ Value - Minimum\ Value}{Maximum\ Value - Minimum\ Value}$$

For parameters where we targeted low values (e.g. % impervious cover), we used this equation:

$$Parameter\ score = \frac{Maximum\ Value - Observed\ Value}{Maximum\ Value - Minimum\ Value}$$

Assigning Weights

Culvert Parameters		Population and Habitat Parameters		Landscape Characteristic Parameters	
Category Weight:	**0.333**	**Category Weight:**	**0.334**	**Category Weight:**	**0.333**
Parameter:	**Weight:**	**Parameter:**	**Weight:**	**Parameter:**	**Weight:**
AOP Compatibility	0.20	Upstream Length	0.2	% Conserved Land	0.25
Geomorphic Compatibility	0.20	Downstream Length	0.2	% Impervious Surface	0.25
Flood Vulnerability Over Tir	0.20	Max Adult EBT Density	0.2	% Agriculture	0.25
Structure Condition	0.20	EBT Stream	0.2	% Forest Buffer	0.25
Openness	0.20	Max YOY EBT Density	0.2		

$$C1 = p1 \times w1 + p2 \times w2 + p3 \times w3 + p4 \times w4 + p5 \times w5$$

$$C2 = p6 \times w6 + p7 \times w7 + p8 \times w8 + p9 \times w9 + p10 \times w10$$

$$C3 = p11 \times w11 + p12 \times w12 + p13 \times w13 + p14 \times w14$$

$$CS = C1 \times W1 + C2 \times W2 + C3 \times W3$$

Tool Results

SADES_ID	Town	Culvert Category	Hab/Pop Category	Landscape Category	Overall Score	Watershed Tier	Town Tier
3158	Newbury	0.72	0.01	0.39	0.322		
5467	Newbury	0.77	0.11	0.39	0.376		
5468	Newbury	0.81	0.12	0.39	0.387		
5614	Newbury	0.66	0.10	0.39	0.343		
5615	Newbury	0.85	0.10	0.39	0.391		
5616	Newbury	0.43	0.17	0.38	0.308		
5772	Bradford	0.61	0.31	0.19	0.342		
5773	Bradford	0.68	0.04	0.20	0.255		
5805	Sutton	0.48	0.25	0.43	0.373		
5858	Newbury	0.46	0.22	0.37	0.331		
5859	Newbury	0.55	0.23	0.37	0.360		
5860	Newbury	0.60	0.22	0.37	0.368		
5904	Newbury	0.84	0.53	0.23	0.502		
5905	Newbury	0.83	0.53	0.23	0.502		
5906	Newbury	0.55	0.02	0.37	0.274		
5963	Newbury	0.61	0.02	0.41	0.307		
5964	Newbury	0.49	0.31	0.38	0.378		

Applications

- Flexible prioritization framework
- Freely available data:
  - NH GRANIT layers
  - USGS 2011 National Land Cover Dataset
- Score standardization method is transferable to other watersheds
- Potential use by municipalities to garner mitigation funds

Acknowledgements

- Support for this project was provided by the New Hampshire Fish and Game Department and Basil W. Woods, Jr. Chapter of Trout Unlimited volunteers
- Funding for this project was provided by New Hampshire Fish and Game Department, Plymouth State University's Center for the Environment, and the PSU Student Research and Creativity Fund

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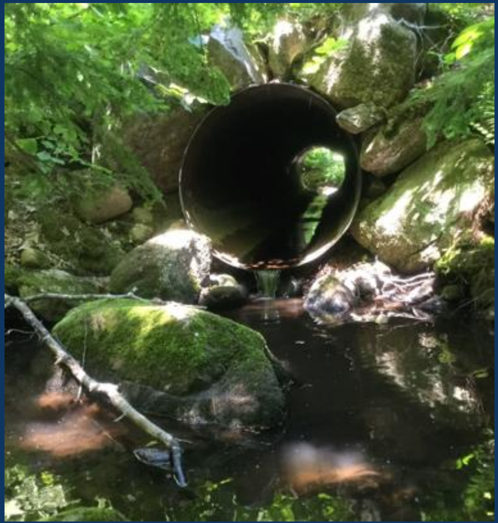

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