



# Using Ecosystem Service Indicators to Prioritize Land Conservation: An Application for the Taunton River Watershed



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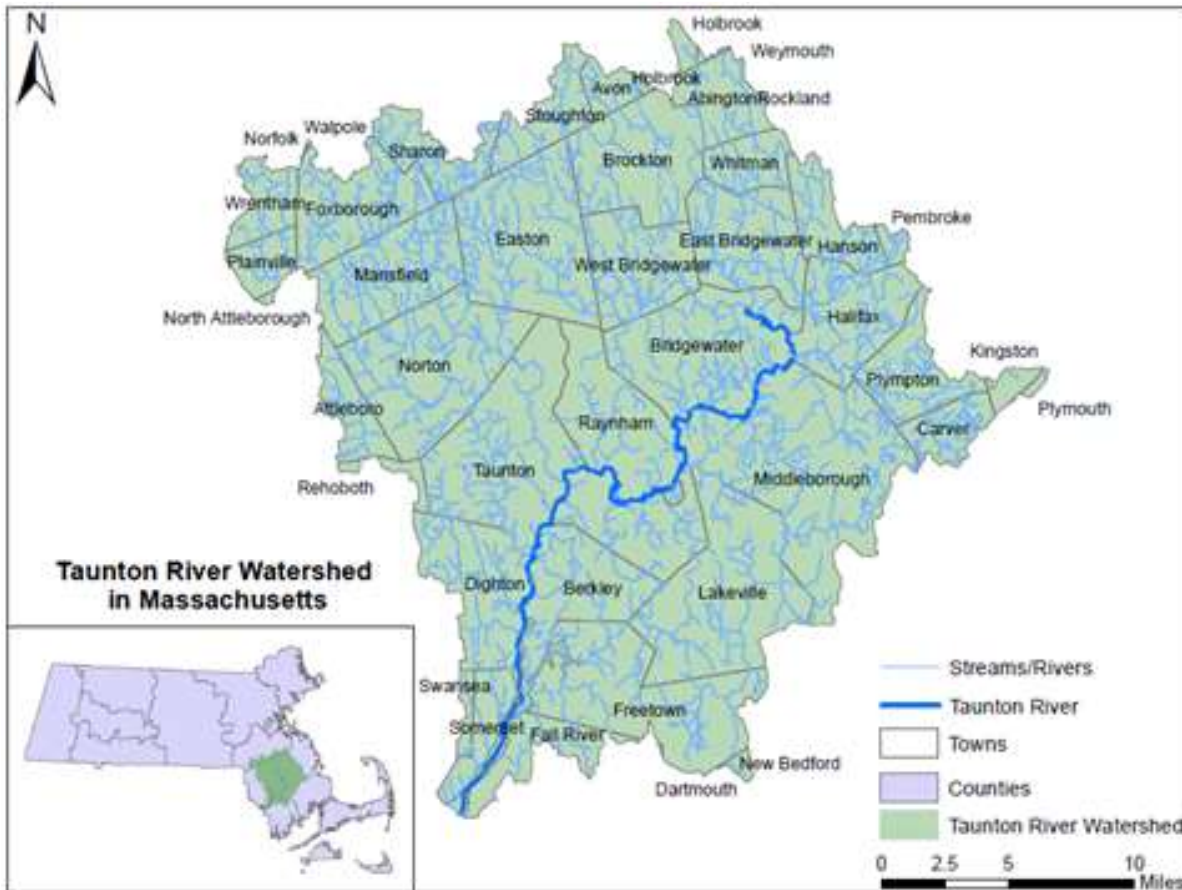
# Acknowledgments

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# Objectives

- Support efforts to strengthen resilience and protect ecosystem services in the Taunton River Watershed
  - Project funded by EPA's Healthy Watershed's Program
- Develop an **assessment framework** for identifying and prioritizing natural areas for conservation
- Develop a screening-level **decision support tool** that local stakeholders and analysts can use to help them identify and rank areas for protection

# Taunton River Watershed



- ✓ 2<sup>nd</sup> largest watershed in MA (560 square mile)
- ✓ 40-mile Taunton River is the longest undammed tidal river in New England
- ✓ Vulnerable to threats from climate change

# Assessment Framework

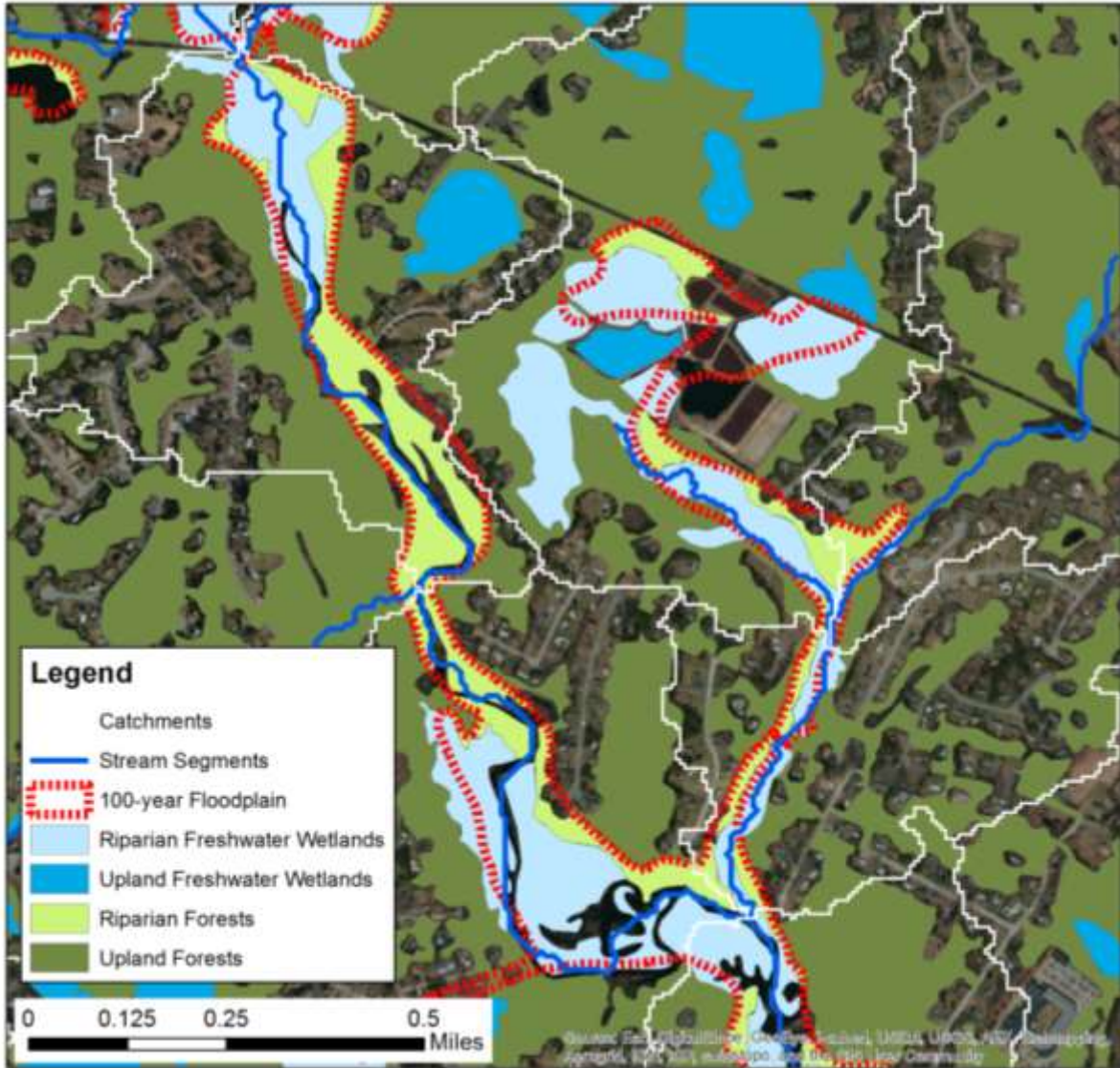
- Define types of areas to be protected
  - Focus Areas (FA)
- Identify specific units in each FA group that are candidates for protection
  - FA units
- Define the main types of ecosystem services (ES) provided FAs
- Define measurable indicators of these ES
  - ES factors
- Assign scores for each ES factor at each FA unit
  - ES factor scores
- Generate combined scores for each FA unit
  - Total ES score (for each ES category)
  - Overall score (all ES together)
- Rank FA units according to scores

## Focus Areas (FA)

- Natural Lands (currently unprotected)
  - Wetlands
    - Freshwater riparian
    - Freshwater upland
    - Saltwater riparian
  - Forests
    - Riparian
    - Upland
- Instream Network
  - Stream segments



# Illustration of Focus Areas Delineations



# Ecosystem Service (ES) Categories

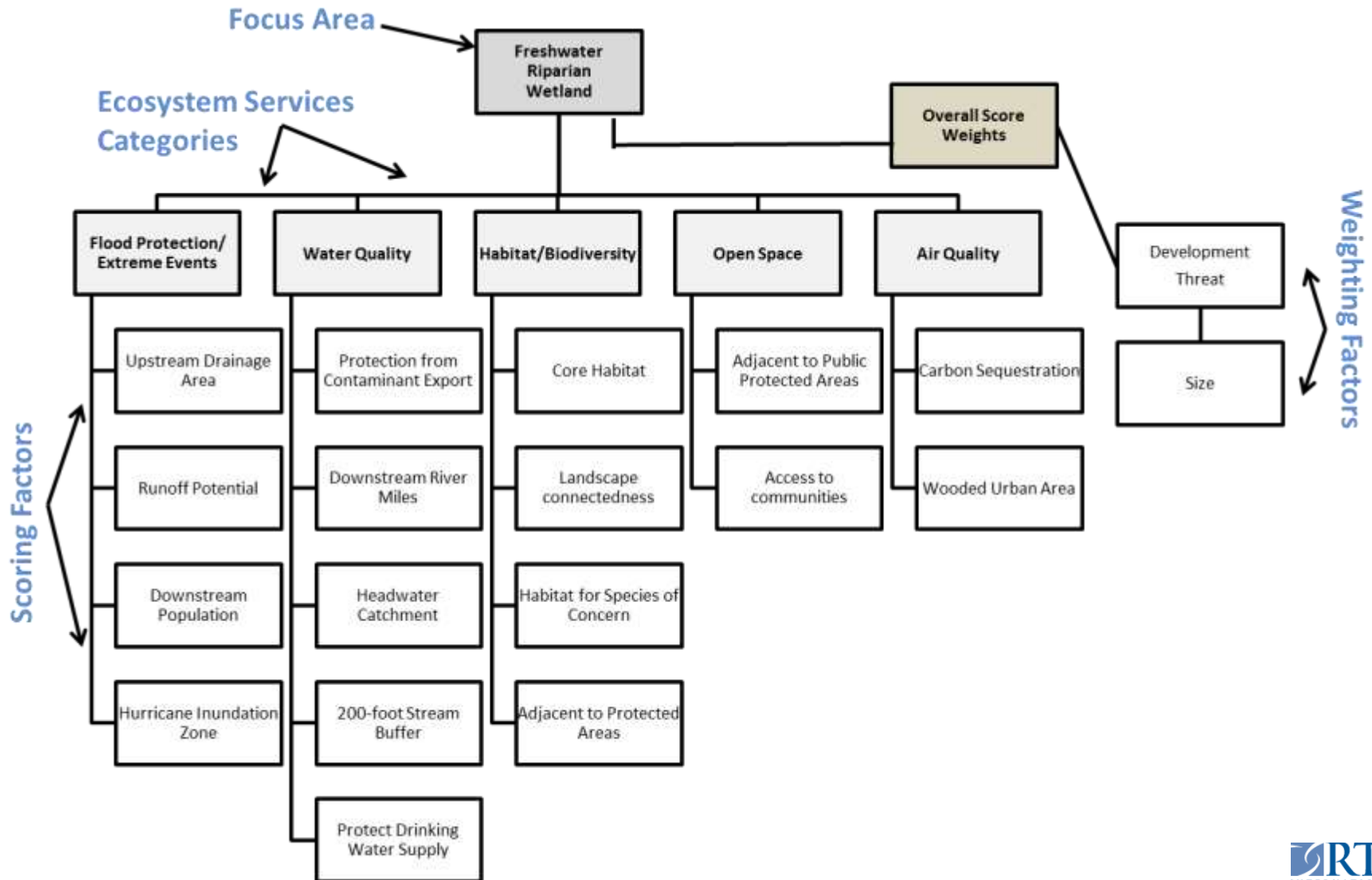
- Flood/Extreme Event Protection
  - Flood control; storm surge attenuation
- Water Quantity Protection
  - Maintenance of instream flow; groundwater recharge
- Water Quality Protection
  - Water filtration/purification; sediment retention
- Habitat/Biodiversity Protection
- Open Space Preservation
  - Maintenance of natural beauty and outdoor recreation areas
- Air Quality
  - Air pollutant filtration; carbon sequestration



## ES Factors

- **Measurable indicators** reflecting the amount of each ES currently provided by each FA unit
- Example ES factors for water quality protection by freshwater riparian wetlands
  - Percent non-natural land cover upstream
  - Number of downstream river miles to estuary
  - Located in headwater catchment?
  - Located upstream from surface or groundwater protection area?
  - Located within 200 ft of stream?

# Example of ES Scoring Components



# Example ES Scoring:

## Water Quality Scores for Riparian Freshwater Wetlands

Unit ID	ES Factor Scores						Total ES Score with Equal Weighting of Factors
	% Non-natural Land Use Upstream	Number of Downstream River Miles	Headwater Catchment	Surface Water Protection Area	Groundwater Protection Area	Part of 200-ft Stream Buffer	
12201	3	3	3	3	3	3	3
408	2	1	3	0	0	3	1.5
6453	1	2	0	0	0	0	0.5

# Example ES Scoring:

## Water Quality Scores for Riparian Freshwater Wetlands

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	% Non-natural Land Use Upstream	Number of Downstream River Miles	Headwater Catchment	Surface Water Protection Area	Groundwater Protection Area	Part of 200-ft Stream Buffer	
12201	<b>3</b> (>53% Altered)	<b>3</b> (>49 downstream miles)	<b>3</b> (within a headwater catchment)	<b>3</b> (SWP within 12 miles downstream)	<b>3</b> (GWP within 12 miles downstream)	<b>3</b> (within 200 ft of stream segment)	<b>3</b>
408	<b>2</b> (<53% and >24% altered)	<b>1</b> (<28 downstream miles)	<b>3</b> (within a headwater catchment)	<b>0</b> (no SWP within 12 miles downstream)	<b>0</b> (no GWP within 12 miles downstream)	<b>3</b> (within 200 ft of stream segment)	<b>1.5</b>
6453	<b>1</b> (<24% altered)	<b>2</b> (<49 and >28 downstream miles)	<b>0</b> (not within a headwater catchment)	<b>0</b> (no SWP within 12 miles downstream)	<b>0</b> (no GWP within 12 miles downstream)	<b>0</b> (not within 200 ft of stream segment)	<b>0.5</b>

# Decision Support Tool

- Allows users to apply the assessment framework for conducting screening-level analyses
- **Input**: User specifies:
  - the types of units to examine and prioritize (i.e., saltwater wetlands or upland forests)
  - The level of interest/importance attached to different ES categories and/or ES factors
- **Output**: Tool generates list of highest scoring units, based on user-defined inputs
  - Table organized by Unique ID, lat-long coordinates, township, scores
  - Spatial layer identifies polygons for each unit
  - Table and spatial layer can be linked by Unique ID, which allows units and scores to be displayed in maps

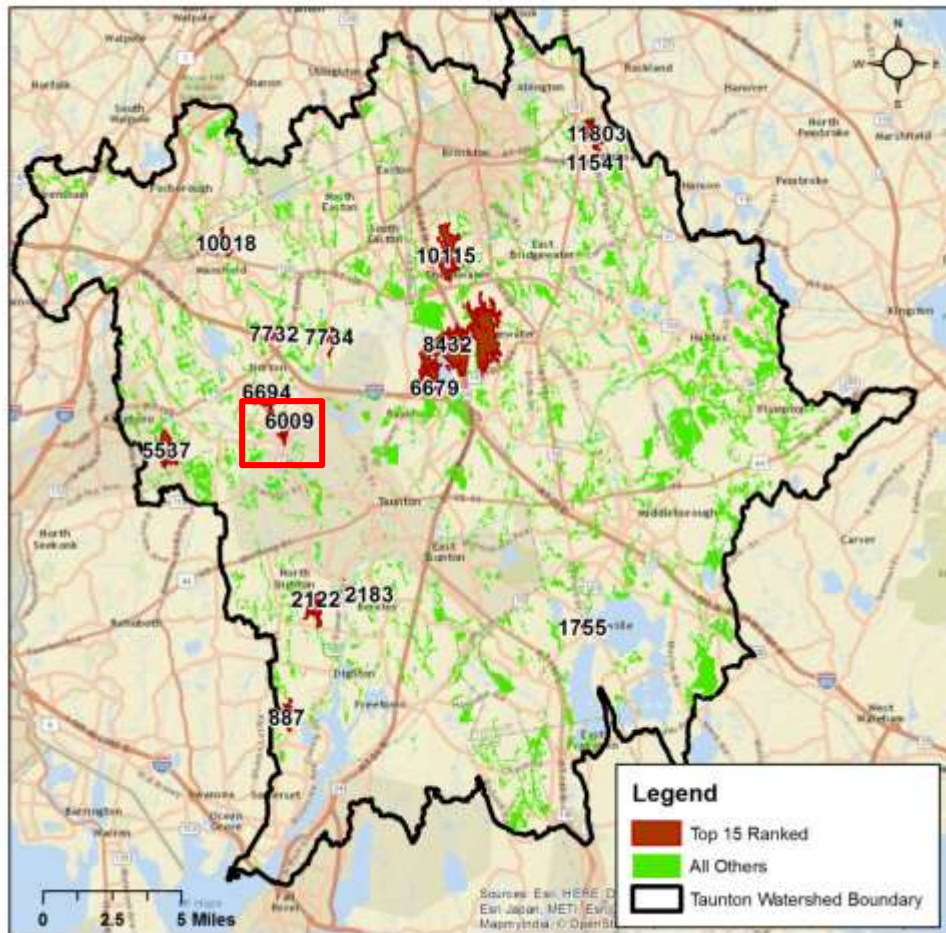
# Example Tabular Results – Freshwater Riparian Wetlands

- By individual Focus Area units
  - Numerical results for an Overall Combined Ecosystem Service score
  - Numerical results for each individual Ecosystem Service
  - All scores normalized between 1 (high) and 0 (low)

Rank	UniqueID	Latitude	Longitude	Town	Area (Acres)	Final ES Score	Water Quality	Flooding	Habitat	Open Space	Air Quality
1	8432	41.98	-71.02	Bridgewater	2072.39	1	0.6111	0.6429	1	1	1
2	7732	41.99	-71.16	Norton	21.07	<b>0.91417</b>	0.5556	0.6429	0.8571	0.8333	1
3	2122	41.84	-71.13	Dighton	159.79	<b>0.91041</b>	0.6111	0.8571	0.5714	0.8333	1
4	6694	41.95	-71.16	Norton	131.09	<b>0.9011</b>	0.5	0.6429	0.8571	0.8333	1
5	10115	42.03	-71.03	West Bridgewater	437.04	<b>0.89365</b>	0.6111	0.6429	0.7143	0.8333	1
6	887	41.79	-71.15	Dighton	61.19	<b>0.88992</b>	0.6667	0.7143	0.5714	0.8333	1
7	2183	41.85	-71.10	Berkley	22.25	<b>0.87313</b>	0.3333	1	0.7143	0.6667	1
8	10018	42.03	-71.19	Mansfield	80.57	<b>0.86939</b>	0.5556	0.5714	0.5714	1	1
9	11803	42.09	-70.93	Whitman	212.9	<b>0.86194</b>	0.6667	0.5714	0.4286	1	1
10	11541	42.08	-70.93	Whitman	14.05	<b>0.86194</b>	0.6667	0.5714	0.4286	1	1
11	6009	41.94	-71.15	Norton	153.49	<b>0.86192</b>	0.3333	0.6429	0.8571	0.8333	1
12	5537	41.93	-71.23	Attleboro	259.97	<b>0.85635</b>	0.5	0.4286	0.7143	1	1
13	6679	41.96	-71.04	Bridgewater	4.21	<b>0.85447</b>	0.7778	0.5	0.8571	0.8333	0.6667
14	1755	41.83	-70.94	Lakeville	19.26	<b>0.85447</b>	0.9444	0.4286	0.4286	0.8333	1
15	7734	41.98	-71.12	Norton	87.28	<b>0.84325</b>	0.6111	0.5714	0.5714	0.8333	1

\*\*Showing only first 15 results due to space limitations\*\*

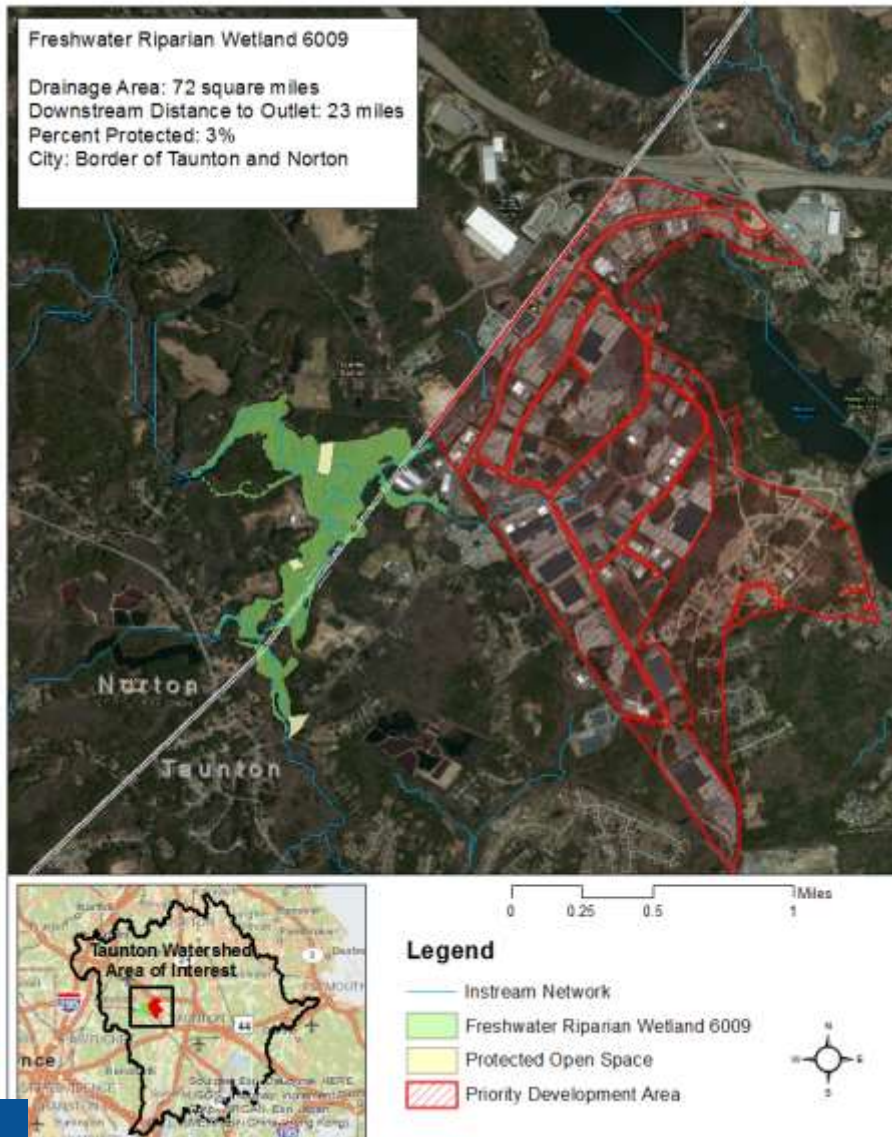
# Exporting Results to GIS (Example 1: Watershed Scale)



- Highlighting Top 15 in the Overall Ecosystem Service Scores
- Labeled by Unique ID
- Shows top wetlands throughout the watershed that provide the greatest combined ecosystem services
- Local stakeholders can then focus into any one of these areas



# Exporting Results to GIS (Example 2: Local Scale)



- Wetland ID 6009
- Ranked #11 Overall
- Highly ranked for air quality, habitat, and open space services
- Moderately ranked for flooding and water quality
- Possible Actions:
  - Currently 3% protected – have easements put into place
  - Adjacent to PDA – require new development to include green infrastructure to reduce runoff