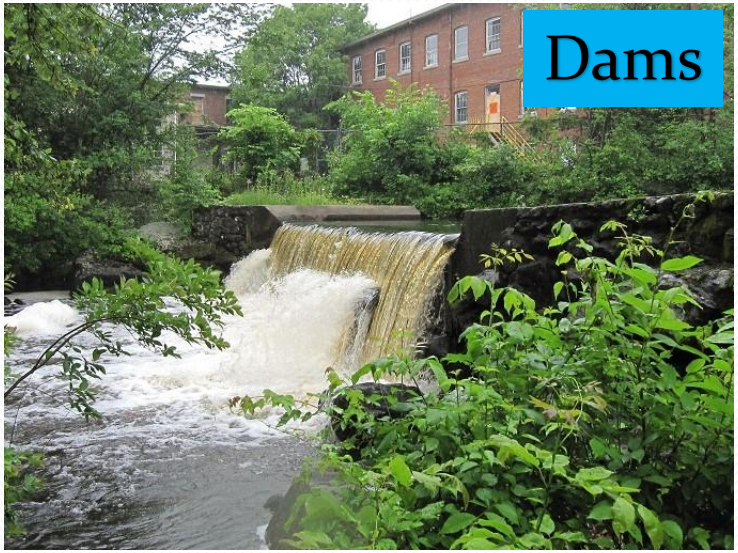
Evaluating Aquatic Barriers to Prioritize Restoration

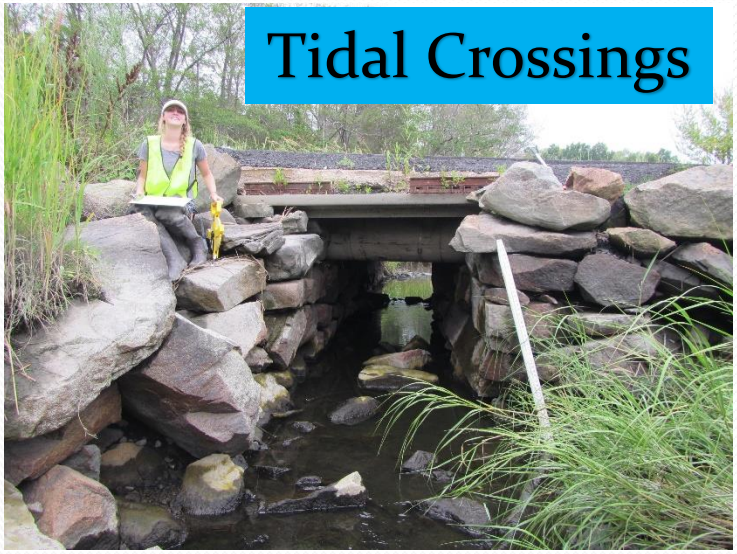
Regional inventory, assessment and prioritization of structures that may impede flow, fluvial and coastal processes

IPSWICH RIVER WATERSHED ASSOCIATION

Brian Kelder
Restoration Program Manager
Ipswich River Watershed Association

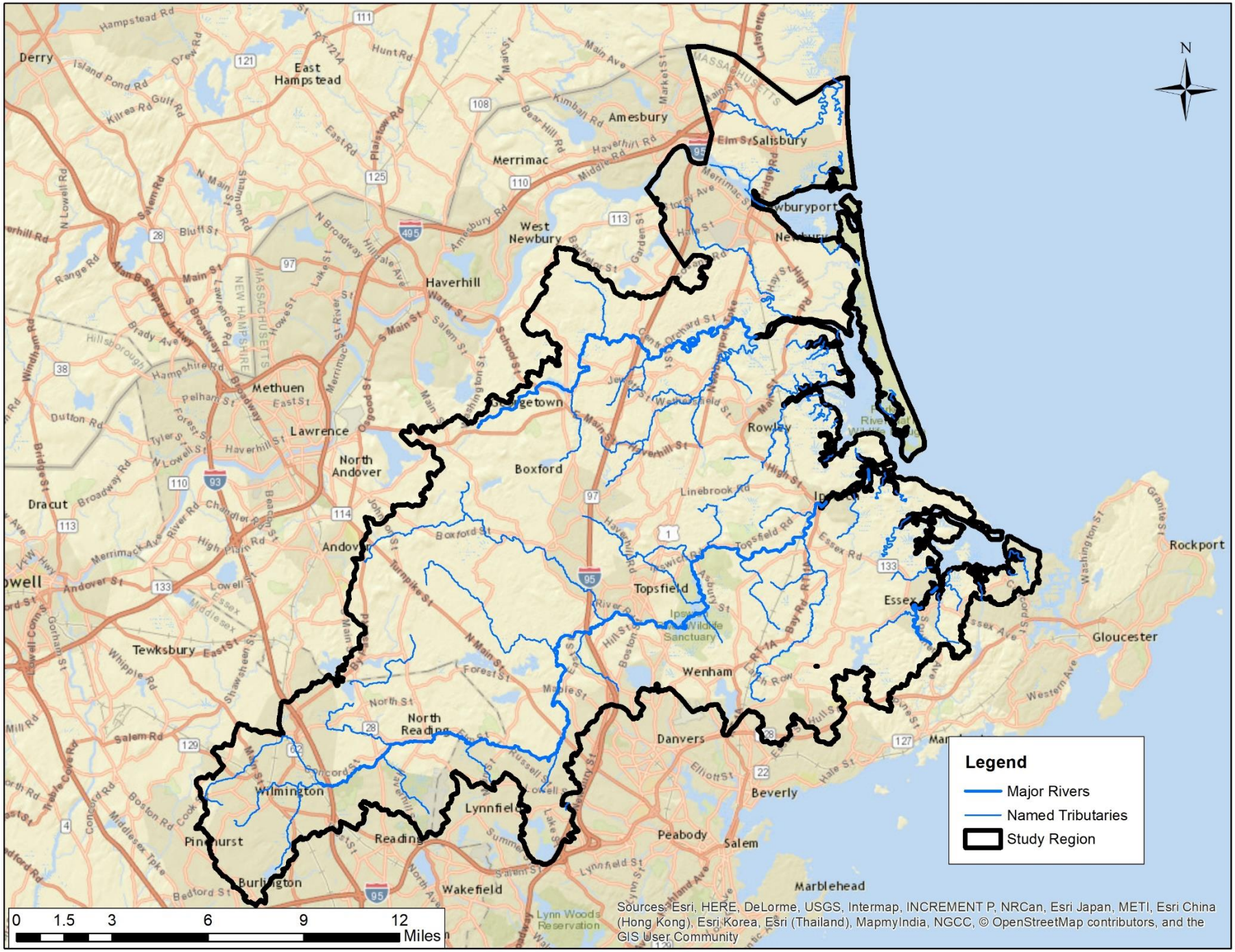
Barrier Types





Why the concern?

- Infrastructure Risk
  - Storms
  - Seal level rise
  - Aging structures
- Ecological Impacts
  - Habitat fragmentation
  - Altered flow
  - Water chemistry/oxygen
  - Sediment transport


N
Legend
Major Rivers
Named Tributaries
Study Region
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Miles
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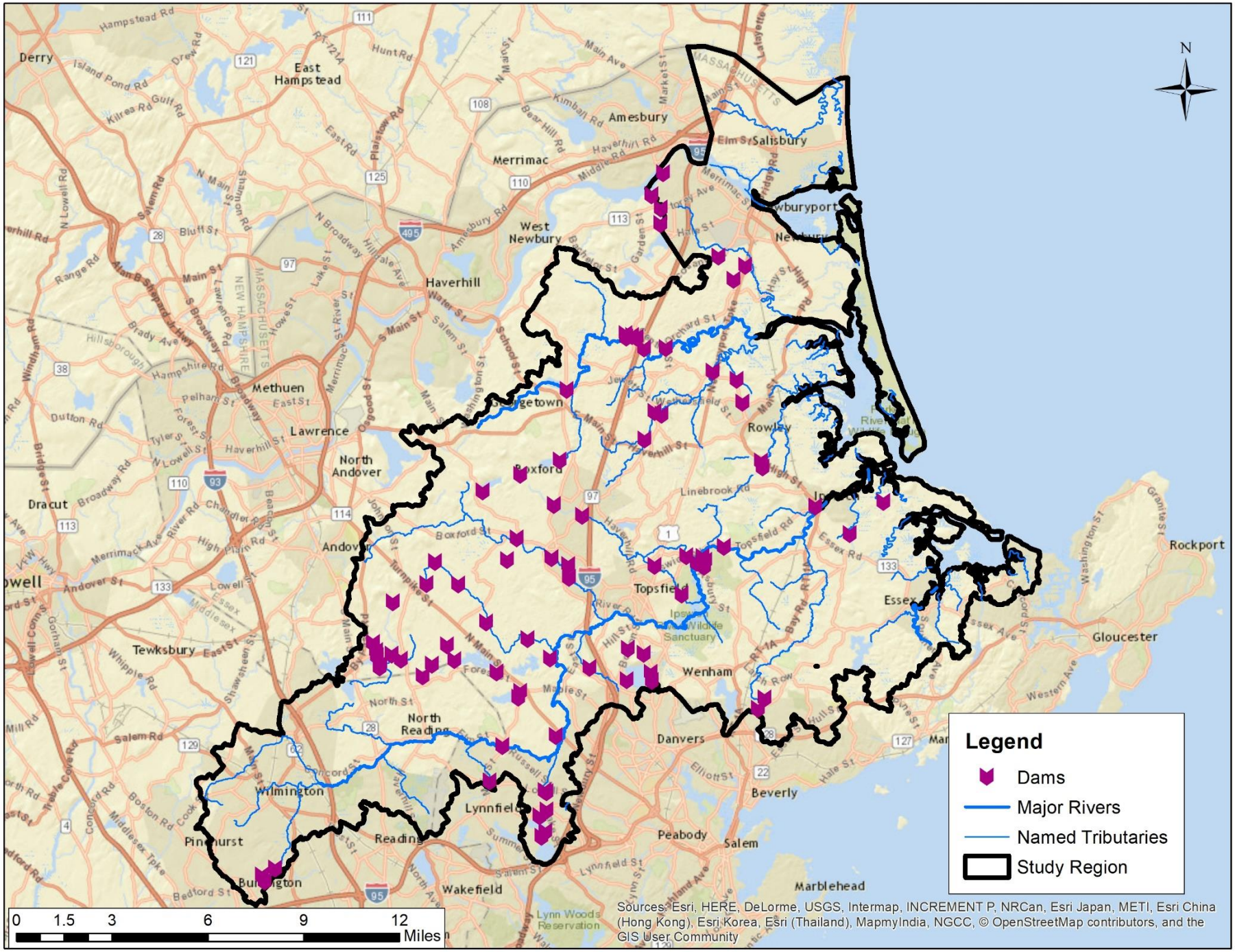
Methuen
Lawrence
North Andover
Boxford
Rowley
Dracut
Andover
Topsfield
Essex
Rockport
Gloucester
Tewksbury
Wenham
North Reading
Danvers
Wilmington
Lynnfield
Beverly
Peabody
Salem
Reading
Pinehurst
Burlington
Wakefield
Marblehead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Dams
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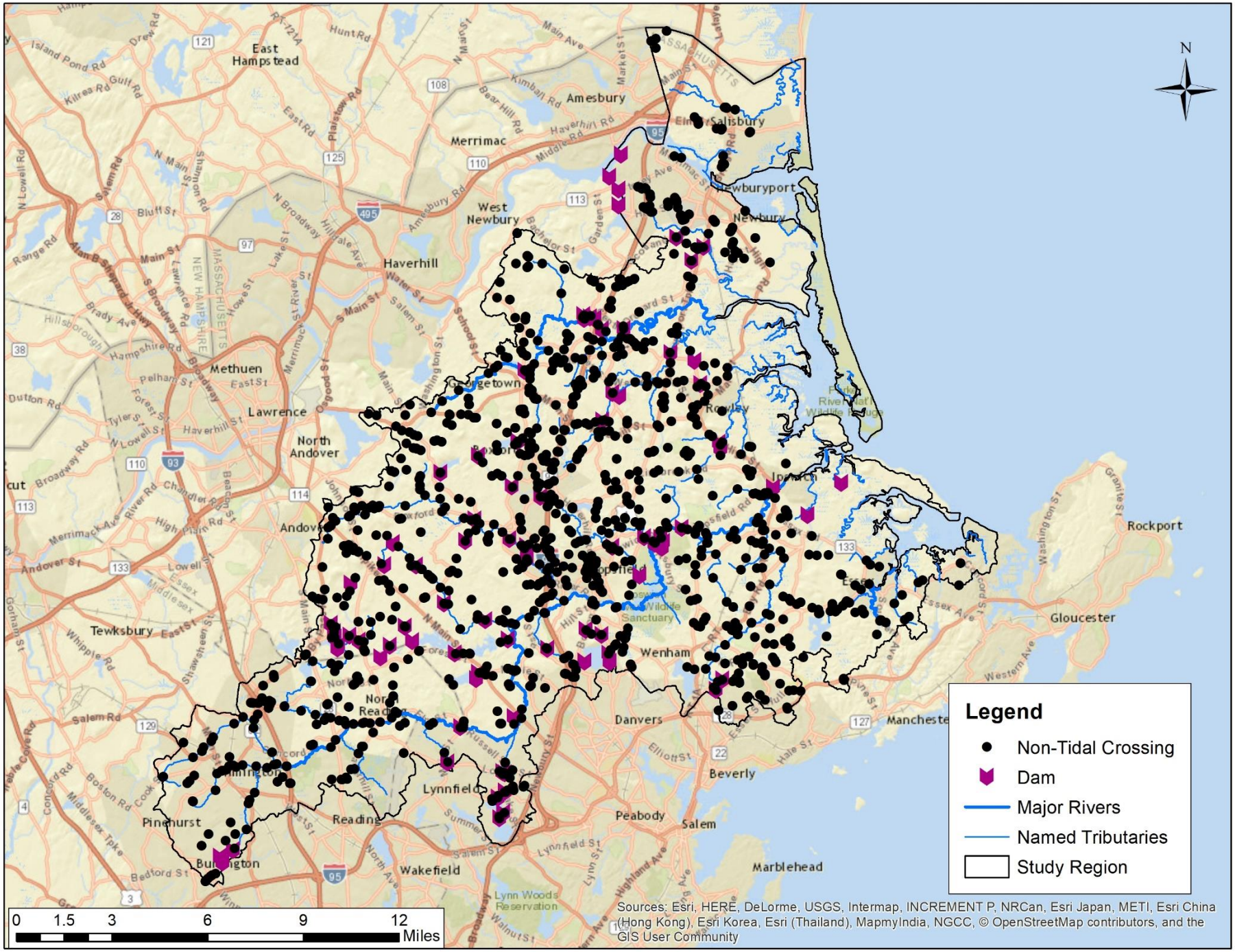
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Legend
Non-Tidal Crossing
Dam
Major Rivers
Named Tributaries
Study Region
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Miles
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Rockport
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Wenham
Tewksbury
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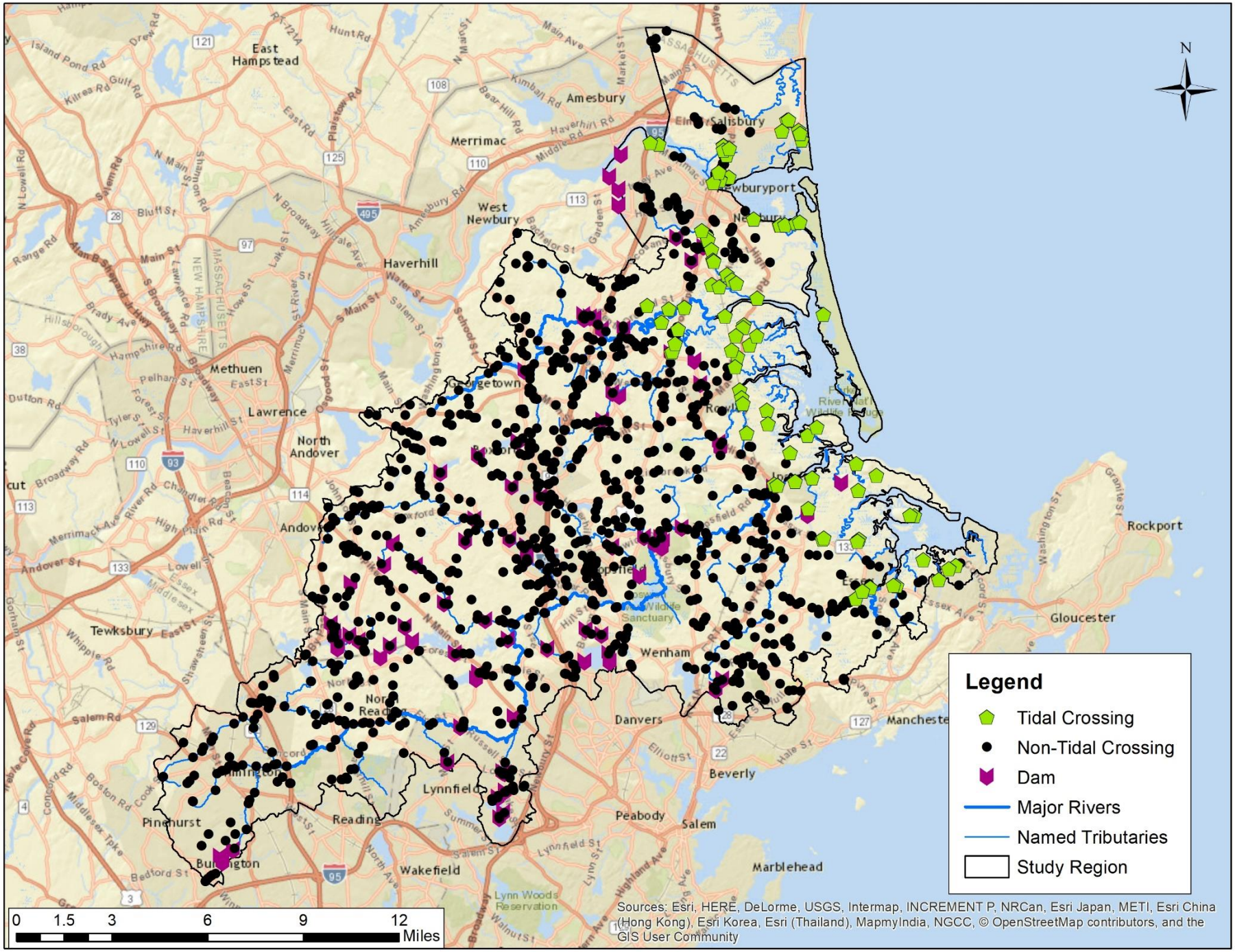
Lynnfield
Reading
Pinehurst
Burlington
Wakefield
Lynn Woods Reservation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Legend
Tidal Crossing
Non-Tidal Crossing
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Major Rivers
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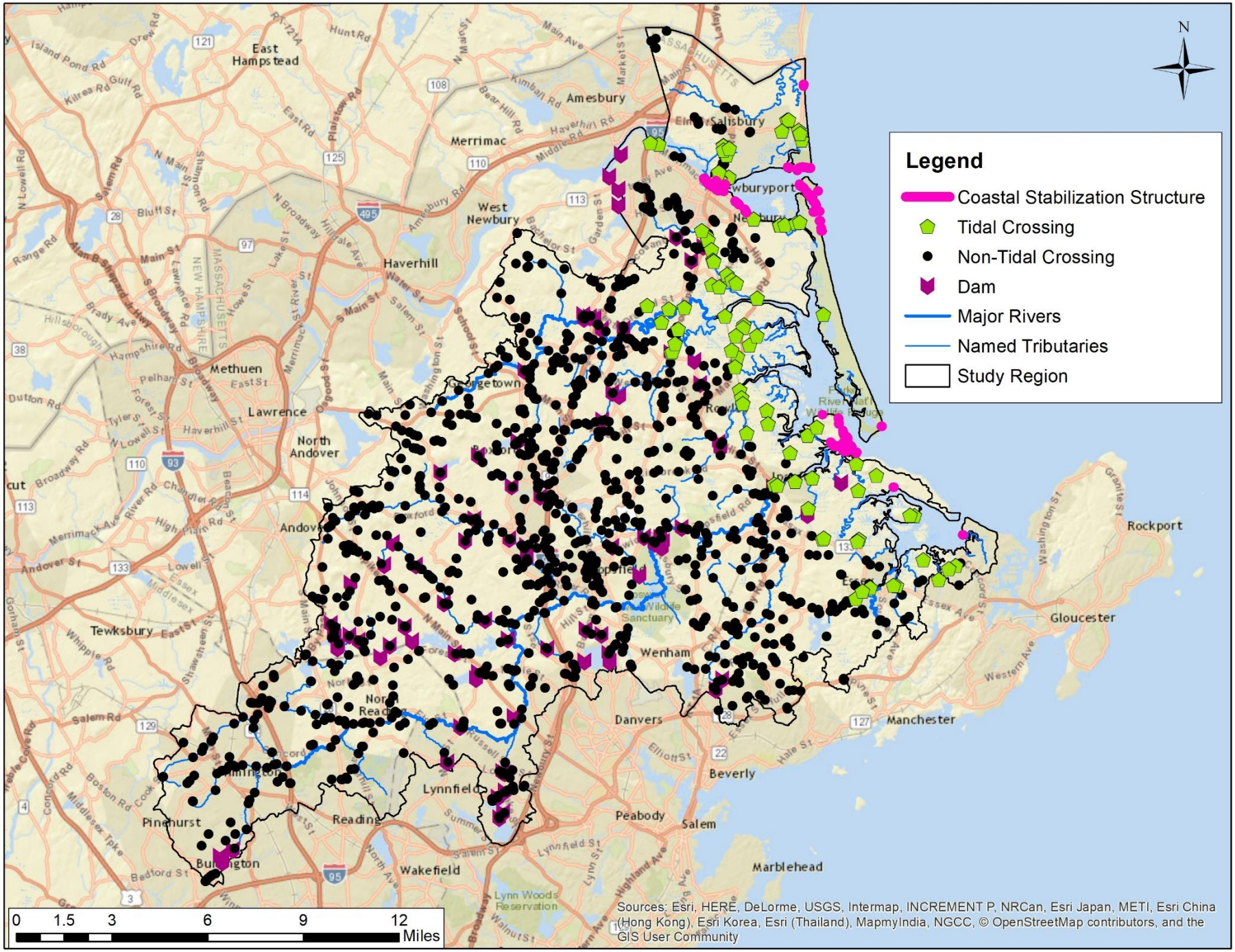
Gloucester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Coastal Stabilization Structure
Tidal Crossing
Non-Tidal Crossing
Dam
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Wakefield
Rockport
Gloucester
Manchester

Great Marsh Barrier Assessment

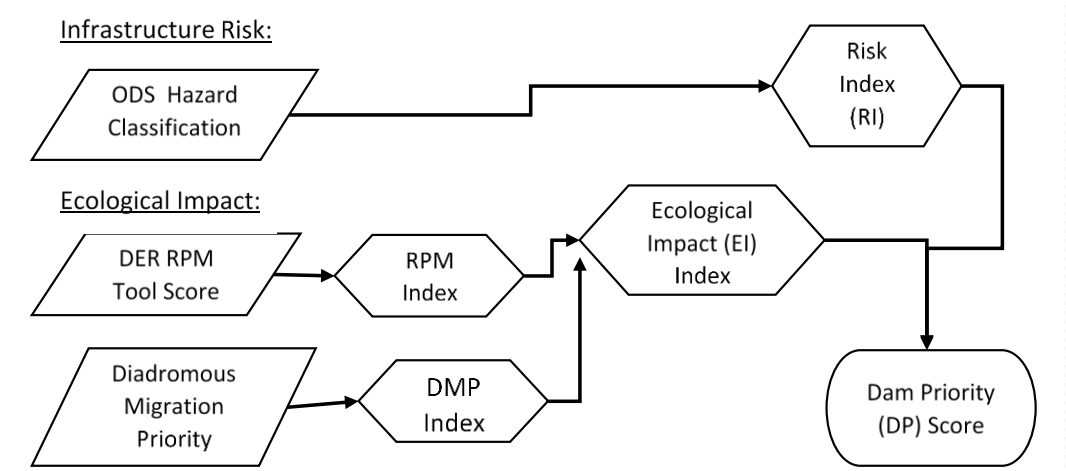
- Screening tool intended to help towns and owners set repair/upgrade schedules
- ~ 1,000 structures
- 280 square miles (parts of 29 towns)
- Infrastructure/public safety risk AND ecological impact
- Funding: National Fish and Wildlife Foundation – Hurricane Sandy Sandy Coastal Resiliency Grant

Project Deliverables

- Region-wide report summarizing results
- Town-specific reports identifying priority sites for further investigation
- Freely available maps and data sets
- Conceptual designs for replacement of 103 high priority sites in the region
- Links to resources to guide future work

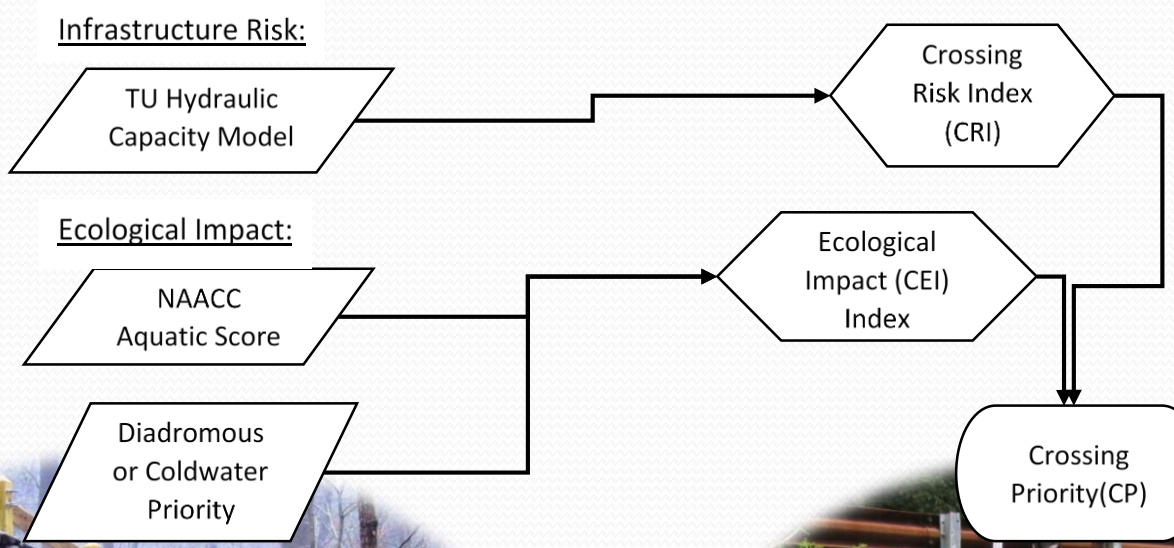
Methods

- Multiple data sources for each structure type
  - Existing studies
  - New data as needed
  - Local knowledge
- Combined screening assessments
- Prioritized regionally and by municipality



Adjusted Priority Rank*	Dam ID	Dam Name	Town	Risk Index (RI)	Eco Index (EI)	Dam Priority (DP)	Active Project or Local Priority
1	MA01137	Ipswich River Dam (South Middleton)	Middleton	1	1.5	2.5	Active
2	MA00159	Howe Pond Dam	Boxford	1	1	2.0	
2	MA00261	Pentucket Pond Outlet Dam	Georgetown	1	1	2.0	
2	MA01604	Jewel Mill Dam	Rowley	1	1	2.0	
5	MA01198	Baldpate Pond Dam	Boxford	0.5	1.5	2.0	
5	MA00231	Ipswich Mills Dam	Ipswich	0.5	1.5	2.0	Active
5	MA00241	Parker River Dam #1	Newbury	0.5	1.5	2.0	
8	MA01610	Howletts Brook Dam	Topsfield	0	2	2.0	
9	MA00181	Norwood Pond Dam	Beverly	1	0.5	1.5	
9	MA00158	Stiles Pond Outlet Dam	Boxford	1	0.5	1.5	
9	MA03006	Mill Pond Dam	Middleton	1	0.5	1.5	
9	MA01613	Bethune Pond Dam	Topsfield	1	0.5	1.5	
20	MA00276	Willowdale Dam	Ipswich	1.5	1.5	1.5	Active
45	MA00240	Parker River Dam #2 (Larkin Road)	Newbury	0	0.5	0.5	Priority

Example: Non-Tidal Crossings



Infrastructure Risk

Parker-Ipswich-Essex Watersheds Stream Crossing Vulnerability Assessment Project

Final Report

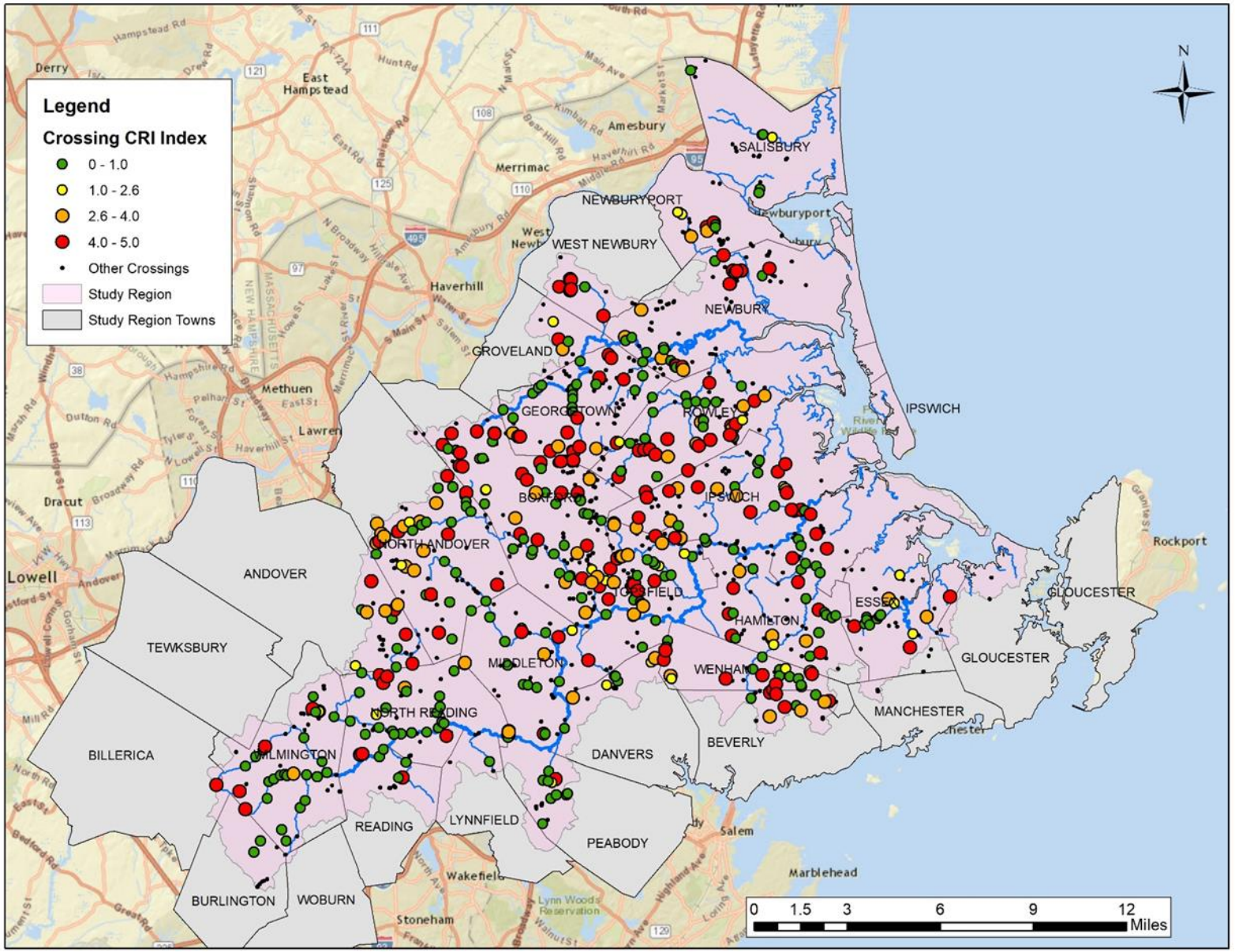
A Partnership between Ipswich River Watershed Association and Trout Unlimited

Structure Type	Est. Bankfull	Effective Structure width	% Bankfull	Estimated minimum geomorphic crossing width	AOP Coarse Screen	GC Screen	Culvert Rating 2-yr	Culvert Rating 10-yr	Culvert Rating 25-yr	Culvert Rating 50-yr	Culvert Rating 100-yr
Bridge	203.2	4.5	2.21	243.84	GREEN	YELLOW	Pass	Pass	Pass	Pass	Transitional
Multiple Culvert	127.6	5	3.92	153.12	GRAY	YELLOW	Pass	Pass	Pass	Pass	Pass
Multiple Culvert	300.0	7	2.33	360.00	GRAY	LEMON LIME	Pass	Pass	Pass	Pass	Transitional
Bridge	121.7	41	33.70	146.00	GREEN	ORANGE	Pass	Pass	Pass	Transitional	Fail
Bridge	82.0	48.2	58.78	98.40	GREEN	ORANGE	Pass	Pass	Pass	Pass	Fail
Single Culvert	16.3	2	12.24	19.61	GRAY	LEMON LIME	Pass	Pass	Pass	Pass	Transitional
Bridge	130.6	81.65	62.52	156.72	GREEN	LEMON LIME	Pass	Pass	Pass	Pass	Pass
Multiple Culvert	24.8	10	40.32	29.76	GRAY	YELLOW	Pass	Pass	Pass	Pass	Pass
Single Culvert	12.5	4.9	39.30	14.96	GREEN	LEMON LIME	Pass	Pass	Pass	Pass	Pass
Single Culvert		3.6			GRAY	#DIV/0!				Fail	Fail
Bridge	48.5	2	4.12	58.25	GRAY	LEMON LIME	Pass	Pass	Fail	Fail	Fail
Single Culvert	10.0	4.2	41.96	12.01	RED	YELLOW	Pass	Pass	Fail	Fail	Fail
Single Culvert	12.6	2.8	22.24	15.11	GRAY	YELLOW	Pass	Pass	Pass	Pass	Transitional
Single Culvert	3.8	3.5	92.92	4.52	GRAY	LEMON LIME	Pass	Pass	Pass	Transitional	Fail
Single Culvert		3.2			GRAY	#DIV/0!				Pass	Pass
Single Culvert	22.8	2.1	9.21	27.36	GREEN	LEMON LIME	Pass	Pass	Pass	Fail	Fail
Single Culvert	6.4	1	15.65	7.67	RED	YELLOW	Pass	Pass	Pass	Fail	Fail
Single Culvert	66.0	2	3.03	79.20	GRAY	LEMON LIME	Transitional	Fail	Fail	Transitional	Fail
Single Culvert	28.4	1.3	4.58	34.08	GRAY	YELLOW	Pass	Pass	Fail	Fail	Fail
Multiple Culvert	8.9	3	33.58	10.72	GRAY	YELLOW	Pass	Pass	Transitional	Fail	Fail
Open Bottom Arch	461.3	25.3	5.48	553.60	GREEN	LEMON LIME	Pass	Pass	Pass	Transitional	Fail
Multiple Culvert	37.4	12	32.06	44.92	GRAY	LEMON LIME	Pass	Pass	Pass	Transitional	Fail
Bridge	23.4	10.6	45.36	28.04	GRAY	LEMON LIME	Pass	Pass	Pass	Pass	Transitional
Multiple Culvert	23.8	5	21.05	28.50	GRAY	YELLOW	Pass	Pass	Pass	Fail	Fail
Multiple Culvert	100.0	3	3.00	120.00	RED	YELLOW	Fail	Fail	Fail	Fail	Fail
Single Culvert	100.0	3	3.00	120.00	GRAY	YELLOW	Pass	Transitional	Fail	Fail	Fail
Bridge	200.0	2.6	1.30	240.00	GREEN	YELLOW	Pass	Pass	Pass	Pass	Transitional

TROUT UNLIMITED

IPSWICH RIVER WATERSHED ASSOCIATION
The Voice of the River

Infrastructure Risk – Non-tidal crossings

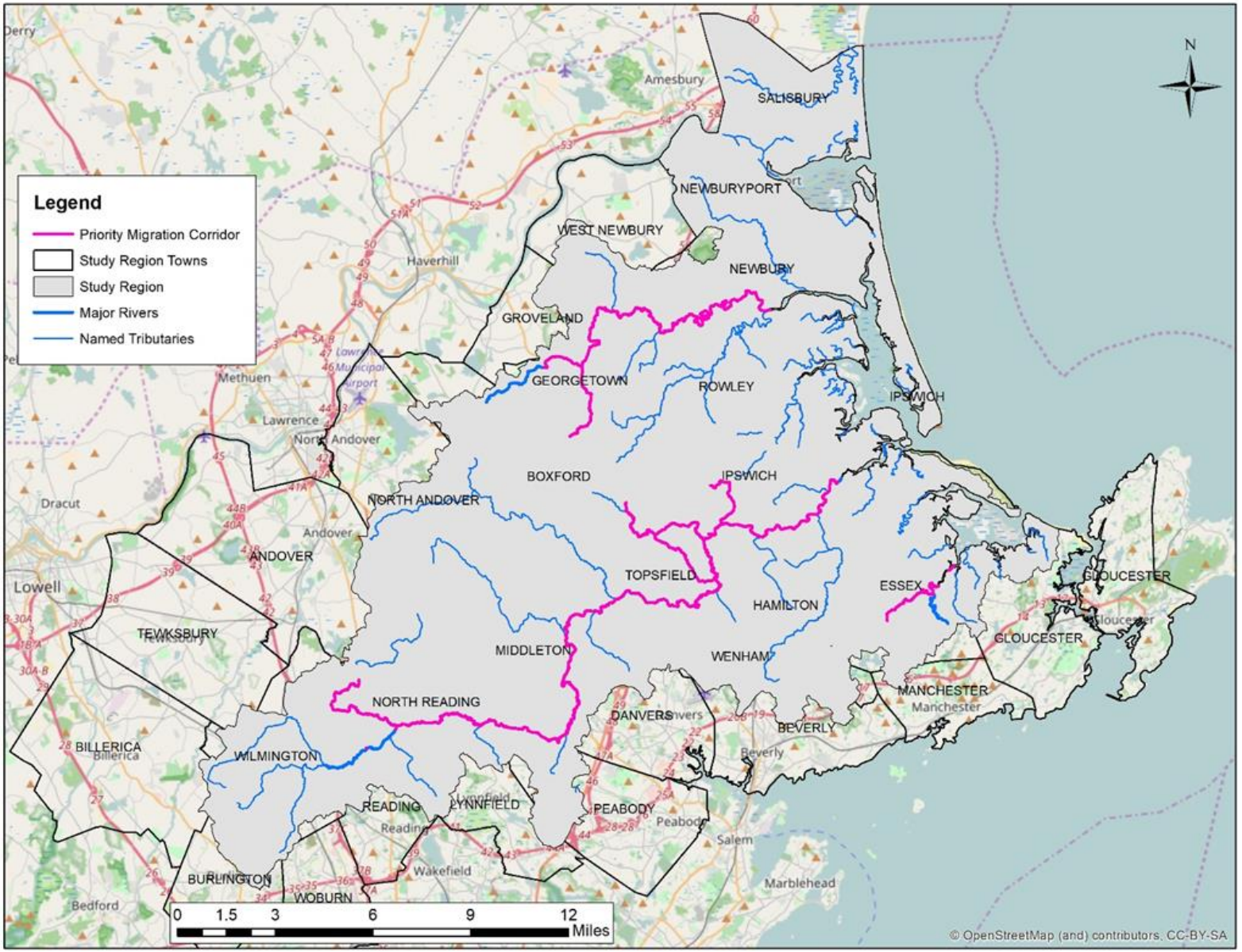


The North Atlantic Aquatic Connectivity Collaborative

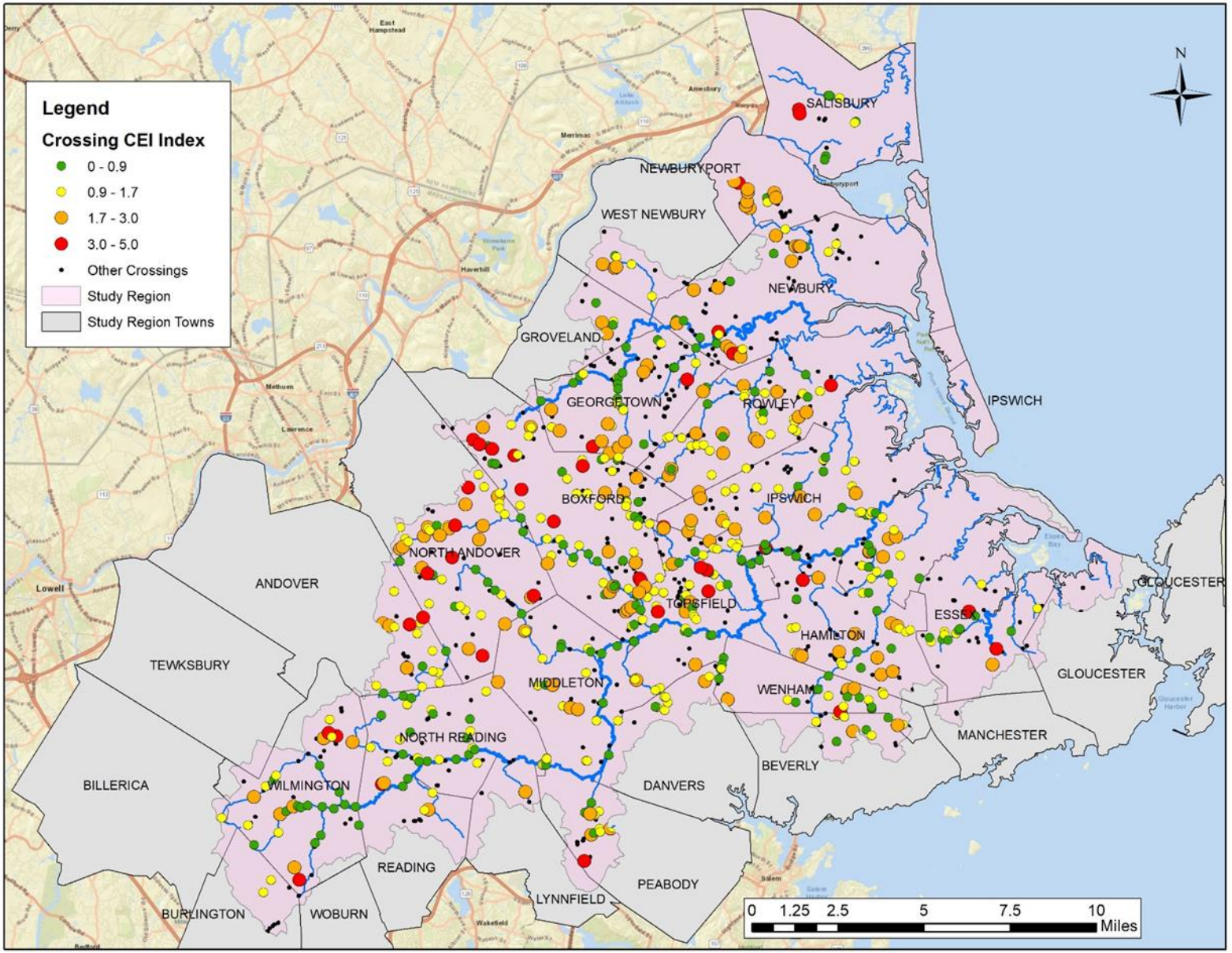
Unified Stream Crossing Assessment Protocols

https://streamcontinuity.org/

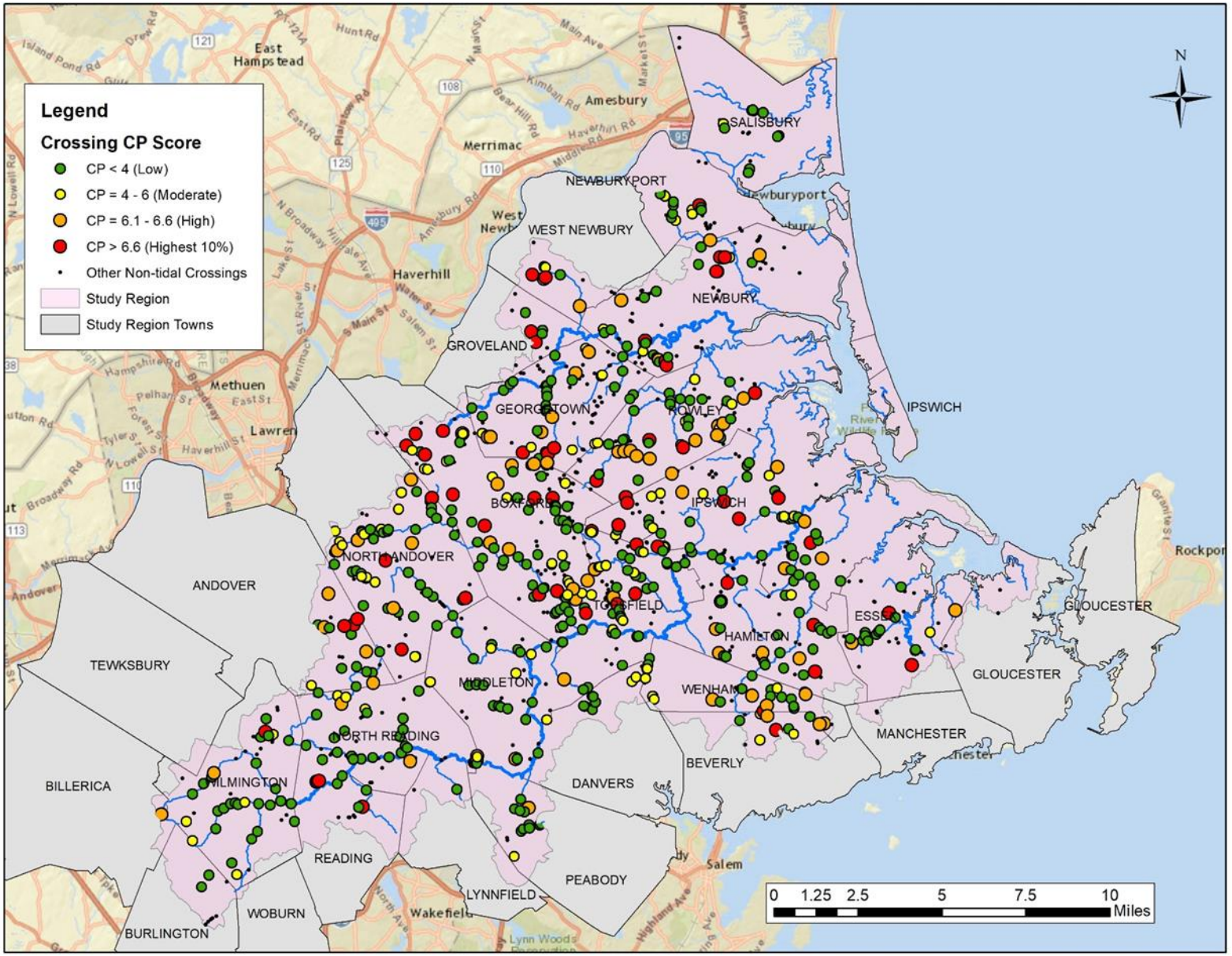
Ecological Impact– Non-tidal crossings



Ecological Impact – Non-tidal crossings



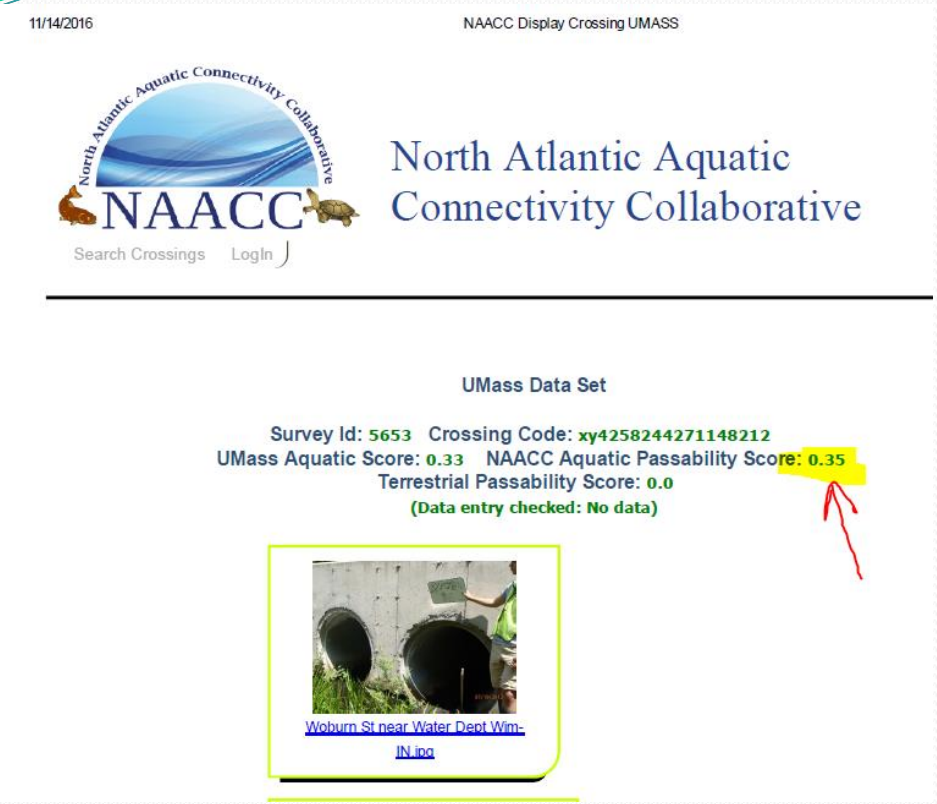
Non-tidal crossings – Combined Priority

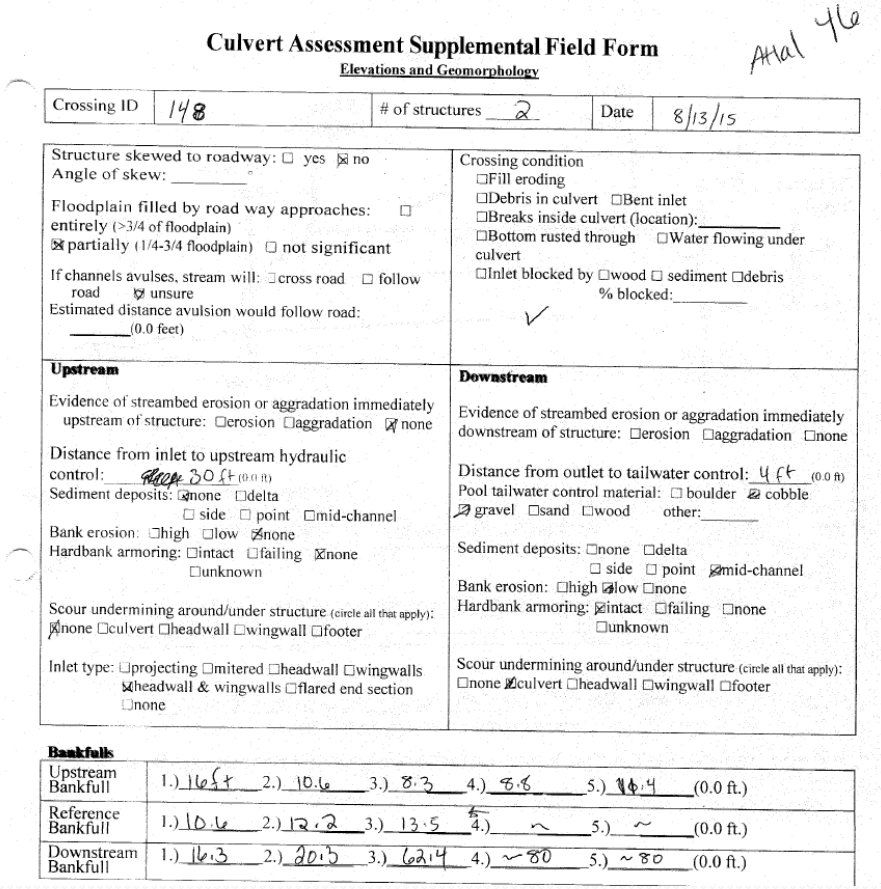


Example Road-Stream Crossing Site

- 2 cell design – prone to collect debris
- Not embedded – perched outlet – prone to scour

Example Site (Cont)





Culvert Assessment Supplemental Field Form

Elevations and Geomorphology

Attal 46

Crossing ID	148	# of structures	2	Date	8/13/15

Structure skewed to roadway: ☐ yes ☒ no
Angle of skew: _____°

Floodplain filled by road way approaches: ☐ entirely (>3/4 of floodplain) ☒ partially (1/4-3/4 floodplain) ☐ not significant

If channels avulses, stream will: ☐ cross road ☐ follow road ☒ unsure
Estimated distance avulsion would follow road: _____(0.0 feet)

Crossing condition
☐Fill eroding
☐Debris in culvert ☐Bent inlet
☐Breaks inside culvert (location):_____
☐Bottom rusted through ☐Water flowing under culvert
☐Inlet blocked by ☐wood ☐ sediment ☐debris
% blocked:_____

✓

Upstream

Evidence of streambed erosion or aggradation immediately upstream of structure: ☐erosion ☐aggradation ☒ none

Distance from inlet to upstream hydraulic control: ~~Ratio~~ 30 ft (0.0 ft)
Sediment deposits: ☒none ☐delta ☐ side ☐ point ☐mid-channel
Bank erosion: ☐high ☐low ☒none
Hardbank armoring: ☐intact ☐failing ☒none ☐unknown

Scour undermining around/under structure (circle all that apply): ☒none ☐culvert ☐headwall ☐wingwall ☐footer

Inlet type: ☐projecting ☐mitered ☐headwall ☐wingwalls ☒headwall & wingwalls ☐flared end section ☐none

Downstream

Evidence of streambed erosion or aggradation immediately downstream of structure: ☐erosion ☐aggradation ☐none

Distance from outlet to tailwater control: 4 ft (0.0 ft)
Pool tailwater control material: ☐ boulder ☒ cobble ☒ gravel ☐sand ☐wood other:_____

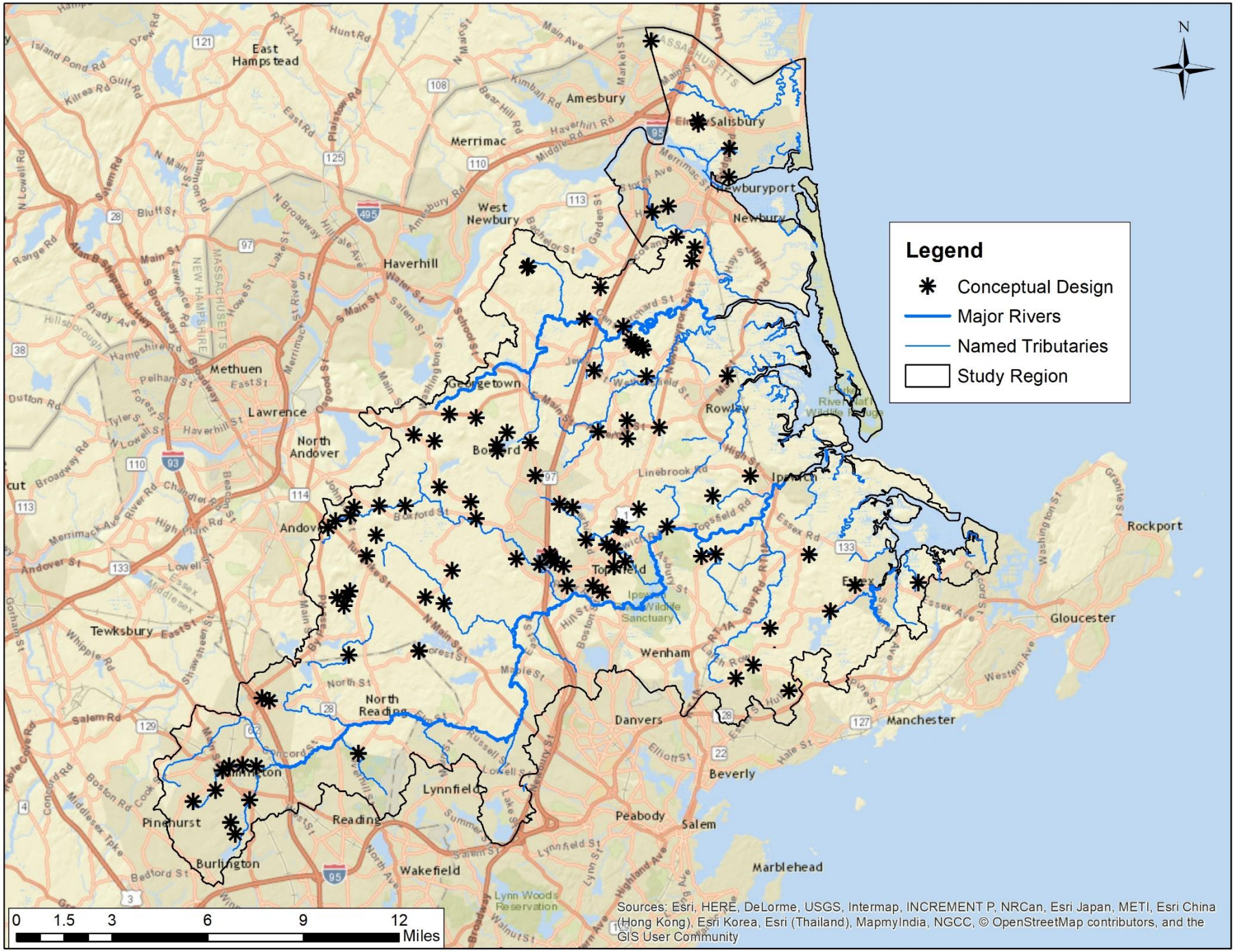
Sediment deposits: ☐none ☐delta ☐ side ☐ point ☒mid-channel
Bank erosion: ☐high ☒low ☐none
Hardbank armoring: ☒intact ☐failing ☐none ☐unknown

Scour undermining around/under structure (circle all that apply): ☐none ☒culvert ☐headwall ☐wingwall ☐footer

Bankfulls

Upstream Bankfull	1.) 16.4	2.) 10.6	3.) 8.3	4.) 8.8	5.) 10.4	(0.0 ft.)
Reference Bankfull	1.) 10.6	2.) 12.2	3.) 13.5	4.) ~	5.) ~	(0.0 ft.)
Downstream Bankfull	1.) 16.3	2.) 20.5	3.) 62.4	4.) ~80	5.) ~80	(0.0 ft.)

- Screening results:
  - NAACC = 0.35/1 (significant barrier)
  - TU HC Screen = Fail @ 50 year storm
  - CP (Combined Priority) Score = 5.4 (Moderate)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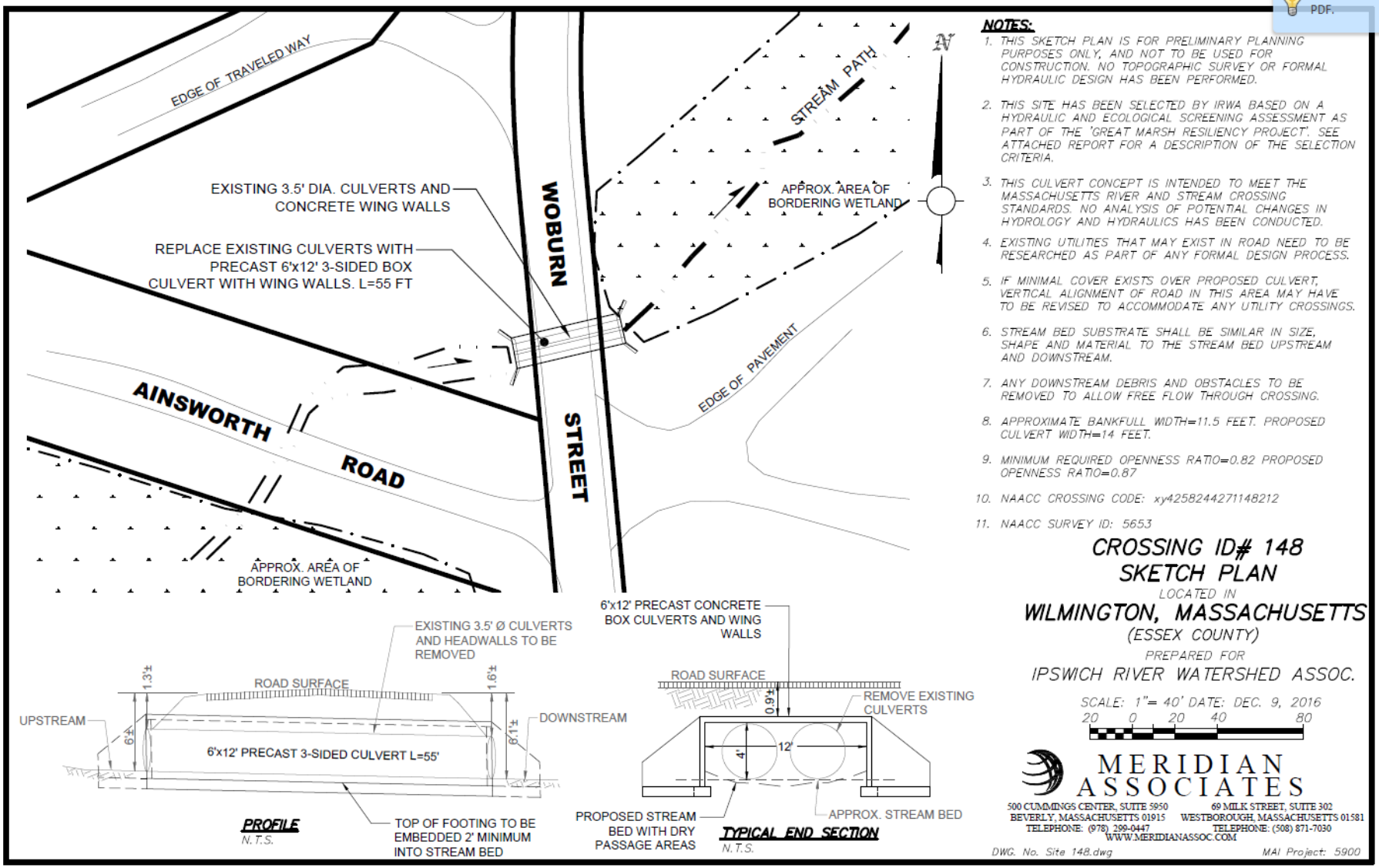
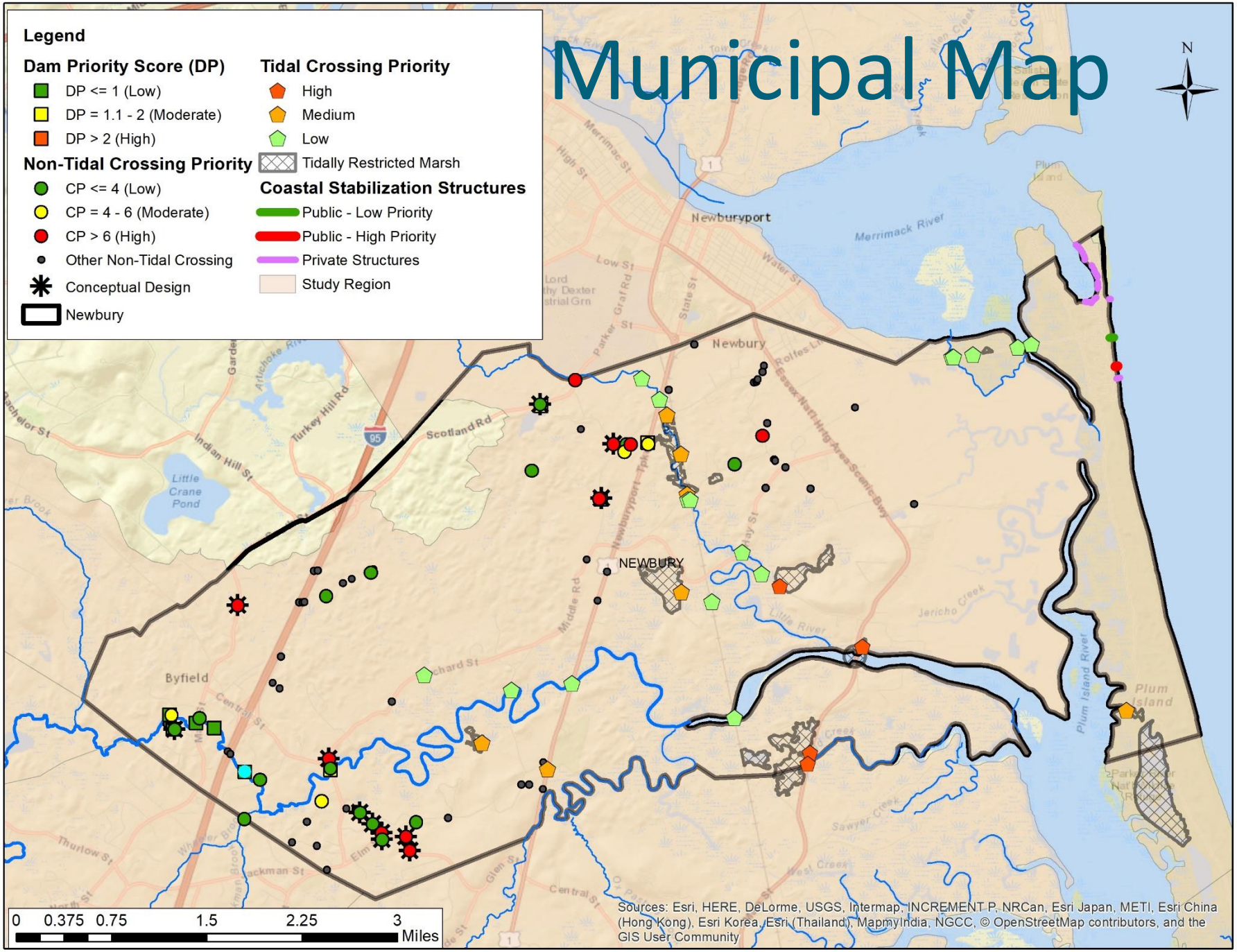
Example Concept Plan



Municipal Map



Online Resources

- MA Division of Ecological Restoration Dam Restoration Potential Model is now online https://www.mass.gov/service-details/ders-restoration-potential-model-tool
- NAACC Non-tidal crossing database: https://streamcontinuity.org/cdb2
- NAACC Tidal crossing database – maybe 2018
- Many other resources at MassGIS: https://www.mass.gov/service-details/massgis-data-layers


Questions?
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