



Wood-Pawcatuck Watershed Flood Resiliency Management Plan

Community Meeting H.L. Arnold Fire & Safety Complex 208 Richmond Townhouse Road Carolina, RI 02812

October 13, 2016

Ι.	Introductions and Meeting Goals	10:00 am
2.	Project Background and Watershed Planning Process	10:05 am
3.	 Summary of Watershed Conditions and Issues Baseline Assessment Culverts, Bridges, and Dams Assessment Geomorphic Assessment Wetlands Assessment Green Infrastructure Assessment 	10:15 am
4.	Next Steps	11:15 am
5.	Questions and Group Discussion	11:20 am
6.	Closing Remarks	11:45 am
7.	Adjourn	By 12:00 pm



Wood-Pawcatuck Watershed Association

203 Arcadia Road, Hope Valley, RI02832; 401-539-9017; info@wpwa.org; www.wpwa.org

Wood-Pawcatuck Flood Resiliency Management Plan **Community Meeting**

October 13, 2016

Name	Association	Contact	
Thomas Buck	Hopkinton Town Council		1
Jim Lamphere	Hopkinton Town Planner		King
Karen Pinch	Richmond Town Administrator		7
Denise Stetson	Richmond Town Planner	pudpinter en	
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CHRIS FOX	WPWA	CHRISCUPUA.ORG	milen
Sandra Bockes	W. Greenwich Cons. Comm.		Z
Thomas E. Buch	Hopkinton Town Council		\wedge
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"To preserve and protect the lands and waters of the Wood-Pawcatuck watershed for natural and human communities"

Richmond Public Meeting October 13, 2016 Richmond Volunteer Fire Station

Questions

- <u>Senator Elaine Morgan</u>: Elaine voiced concerns about the Wyoming Pond Dam regarding wells, aquatic organisms, property values etc.
 - <u>Erik Mas</u>: There are several benefits and barriers to dam removal. The intention of this study is to provide a preliminary assessment for each dam which would require a follow up feasibility study. This is a screening level analysis of several dams, and consideration of all the concerns you listed would be necessary during a future feasibility assessment phase.
 - Denise: DEM was planning on doing repairs without completing an alternatives assessment, so we provided them with our preliminary results
- <u>Senator Elaine Morgan:</u>Why does State want to destroy Exit 1 if we have pristine wetlands and watershed characteristics? (Referring to potential rest stop over the groundwater aquifer)
 - o <u>Erik Mas:</u>This study didn't look at groundwater aquifers
- <u>Judy Mendelson</u>: Lives on Wyoming Dam. Judy brought up catastrophic flooding in CT, where ACOE built series of dams to control flood water. Judy asked if that was an option here. Judy offered that if the Wyoming Pond Dam functioned, they might be able to control flooding upstream.
 - <u>Erik Mas</u>: Explained that we did consider repurposing for several of the dams and determined that because the dams are run of the river dams, they were found to not provide a significant flood storage benefit. Explained that ACOE just did an assessment of repurposing Potter Hill Dam and determined that it was economically infeasible. When asked about constructing new dams to provide flood storage benefits, Erik discussed regulatory issues and disruption of free flowing rivers, which would go against several competing goals. Erik recognized there are several competing demands.
 - O Chris Fox: This issue is exactly what this project is about; the goal is to have these conversations. We want to hear from the public to provide commentary on our preliminary recommendations. It is now up to the Towns and dam owners to take the recommendations and start these conversations. This meeting is not just about the Wyoming Pond Dam.
- <u>Bill Day</u>: Brought up issue at Valley Lodge and asked if the watershed is doing anything to help with the issue.
 - Erik Mas: We have been involved and following the issue since it relates to our study. We know about the concerns and the Town is pursuing options.
 - <u>Chris Fox</u>:WPWA is watching the issue and seeing if they can support it. They understand the issue needs to be looked at holistically. This study is a high level study, and provides a great platform to continue the discussion about this issue.

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- Georgia Ure: Voiced that the community was not aware of what was happening and wanted the dam repaired because they are having issues with their wells going dry, quality of the pond, etc. She said this study should have been done a long time ago. People didn't know about the meeting.
 - o <u>Denise</u>: Our part is done. Our recommendation has been adjusted with a summary of the recent conversations.
 - Henry Oppenheimer: The meeting information is public, it is on the Town website, as all agenda items are.

- <u>Chris Shields</u>: Voiced concern that it is a conflict of interest that Henry is on the steering committee. Asked if it would be more feasible to start addressing bridges and culverts to alleviate flooding than it would be to work on dams
 - Erik Mas: We are going to be looking at phasing recommendations
- O Chris Shields: If other watersheds are affected more by flooding, why are we working in the Wood Pawcatuck? Why aren't we pursuing other avenues?
 - <u>Erik Mas:</u> We will be discouraging development in flood zones and are looking at other avenues
- <u>Chris Shields:</u> How was the steering committee selected? And do members of the steering committee have property in the affected areas?
 - o Denise: WPWA sent letters to all Town councils, Planners, DPWs, inviting attendees.
 - o <u>Chris Fox</u>: Yes, and we want them to be part of the process
 - o <u>Chris Shields</u>: If you wanted us to be involved why weren't we involved in the steering committee? Who invited Jim to steering committee?
 - o <u>Jim Lamphere</u>: Bill told Jim to attend meetings.
- Thomas Buck: We spent a long time trying to get funding for the repair.
- Georgia Ure: You should encourage DEM to fix the dam faster and the meeting should have been done earlier and scheduled at a different time.
 - o Denise: You have to do a study first, and then get input. That is what we are doing.
- Sandra Bockes: Have there been any dam removals with residential areas behind them?
 - <u>Erik</u>: Listed a few dam removals and discussed that the goal here is to look for options, start discussion and determine what the best option is for each case. That is why we have this meeting.
- <u>Man in front row wearing palm tree print</u>: We had no notification about this. There should be no recommendation about the Wyoming Pond Dam in the Report.
- <u>Bill Day</u>: Brought up Valley Lodge and stormwater runoff from 95. Bill asked what WPWA is doing about it.
- Georgia Ure: Why is money being spent on flooding and not other things like water quality? Don't dams prevent salt water from mixing upstream?
 - o Erik: We are looking at water quality as another part of the study.
- <u>Chris Shields:</u> What is the recommendation about the Hope Valley DOT?
 - o <u>Erik:</u> That issue has not been included in our study, but we want to hear what other issues are going on so that we can include them. We want to hear your comments on these issues.
- Georgia Ure: Why are you recommending removal? Did you consider other implications of dam removal?
 - <u>Chris Fox</u>:All of the other considerations will have to be addressed for each of our dams in the feasibility assessment phase. Everything you are concerned about would need to be addressed in the permitting process.
- <u>Thomas Buck:</u> The letter about this meeting discussed Wyoming Pond dam, so that is what we are here to do. 10-12 is not a good time for a public meeting. Why is WPWA not doing anything about Loves Truck Stop?
 - <u>Chris Fox</u>: WPWA has a two person staff and cannot address all issues, but WPWA has been involved and has asked to see more studies moving forward. WPWA has invested time in that project.
- <u>Chris Shields</u>: Where does Wyoming Pond dam rank in terms of water quality? His well produces good quality water.

- o Chris Fox: You well water is filtered through sand.
- o <u>Erik</u>: Water quality is a piece of what we are doing and it is considered in our report.
- <u>Denise</u>: Are there other areas of concern? Comments on the plan?
 - Valley Lodge Roadway Runoff should be discussed
 - o Sandra: How do you determine the size and cost of culvert replacement projects?
 - Erik and Denise: There are regional standards and the goal of this study is to help provide Towns with prioritized structures needing replacement so that they can apply for and receive grant money to complete their projects.
- Man in front row wearing palm tree print: Why doesn't WPWA remove downed trees?
 - Denise: WPWA does for navigation purposes, but they leave some parts of the trees in for habitat reasons.
- Georgia Ure: Asked if another meeting in could be set up so that Richmond residents could discuss the Wyoming Pond Dam
 - o <u>Denise</u>: That would be up to the Richmond Town Council
 - Woman in Grey Sweatshirt: Meetings need to be communicated more effectively through the Robo calls at the Towns.
 - Denise: We inform the Towns and it is the Town's decision how they want to communicate information.
 - o <u>Doug Mclean:</u> Appreciates the work and thoroughness of the plan. Believed plan will be helpful for the town of South Kingstown in planning resiliency projects.

After meeting Sandra mentioned that she thinks there is a deed that designated Hazard Pond Dam as a public structure.

Wood-Pawcatuck Watershed Flood Resiliency Management Plan

Community Meeting

October 13, 2016







Meeting Agenda

10:00 – 10:05 Introductions and Meeting Goals

10:05 – 10:15 Project Background and Watershed Planning Process

10:15 – 11:15 Summary of Watershed Conditions

11:15 – 11:20 Next Steps

11:20 – 11:45 Questions and Discussion

11:45 – 12:00 Closing Remarks and Adjourn





Introductions

Project Team

- Wood-Pawcatuck Watershed Association
- Fuss & O'Neill, Inc.

Project Steering Committee

- Municipal representatives from the most heavily-impacted watershed communities
- State and federal agencies
- Other organizations





Meeting Goals

- 1. Describe the watershed planning process and work completed to date
- 2. Summarize study findings and preliminary recommendations
- 3. Provide a forum for public input and discussion
 - Issues of concern
 - Local priorities
 - Project ideas







Hurricane Sandy Coastal Resiliency Grant

 U.S. DOI & National Fish and Wildlife Foundation (NFWF) competitive grant program



- Communities affected by Hurricane Sandy
- Increase flood resilience
- Focus on strengthening natural ecosystems that also benefit fish and wildlife
- NFWF Grant awarded to Wood-Pawcatuck Watershed Association in June 2014
 - "Flood Resiliency Management Plan" for the Wood-Pawcatuck watershed
 - \$720K grant award and \$200K matching funds





What is Flood Resilience or Resiliency?

A community's ability to plan for, respond to, and recover from floods



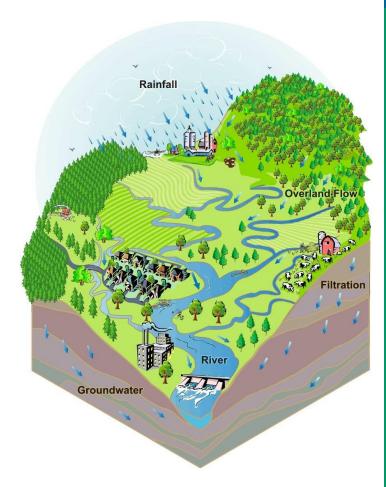




Project Goals

 Assess the vulnerability of the Wood-Pawcatuck Watershed to flooding

- Develop a watershed-based management plan
 - Enhance flood resilience
 - Strengthen natural ecosystems
 - Improve/protect water quality







Watershed Planning Process

Technical Assessments

Evaluate current conditions and opportunities for restoration and protection projects that will enhance flood resiliency and provide related benefits



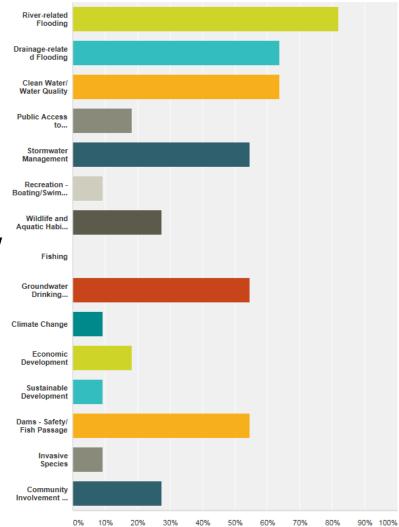


Watershed Planning Process

- Stakeholder and Community Involvement
- Collaborative Process with WPWA and Project Stakeholders
 - Steering Committee
 Workshop Meetings
 - Watershed Planning Survey
 - Community Meetings
 - Municipal Training and Outreach

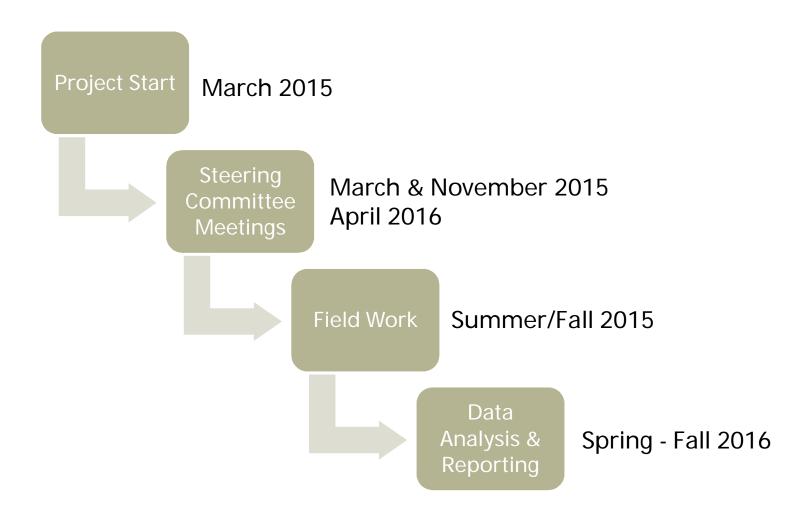
From the list below indicate your top five concerns/issues/priorities regarding the Wood-Pawcatuck Watershed.

Answered: 11 Skipped: 2





Timeline for Work Completed







Watershed Conditions and Issues





Watershed Baseline Assessment

- Document existing watershed conditions
- Build upon previous and ongoing work in the watershed
 - USGS-FEMA Risk MAP Project
 - USACE Pawcatuck River Flood Risk Feasibility Study
 - RI River & Stream Continuity Project
 - Pawcatuck Dam Removals
 - USFWS Wild & Scenic Reconnaissance Survey
 - RIDEM Water Quality Basin Planning
 - Local Hazard Mitigation Planning



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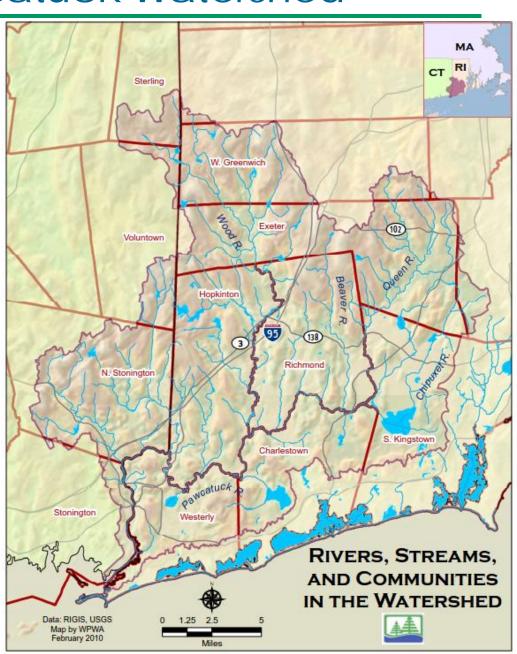
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Wood-Pawcatuck Watershed

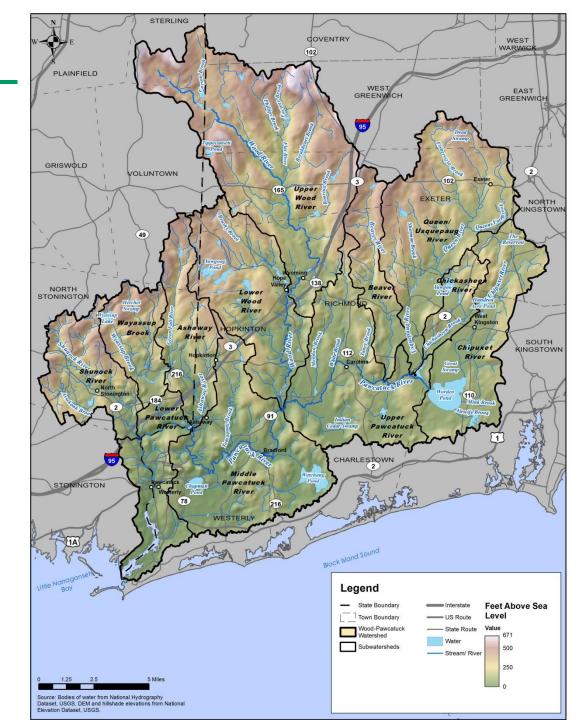
- 317 square miles in RI and CT
- Major portions of 11 municipalities
- 84,000 population
- 380 stream miles
- Drains to Pawcatuck
 River Estuary and
 Little Narragansett
 Bay





Subwatersheds

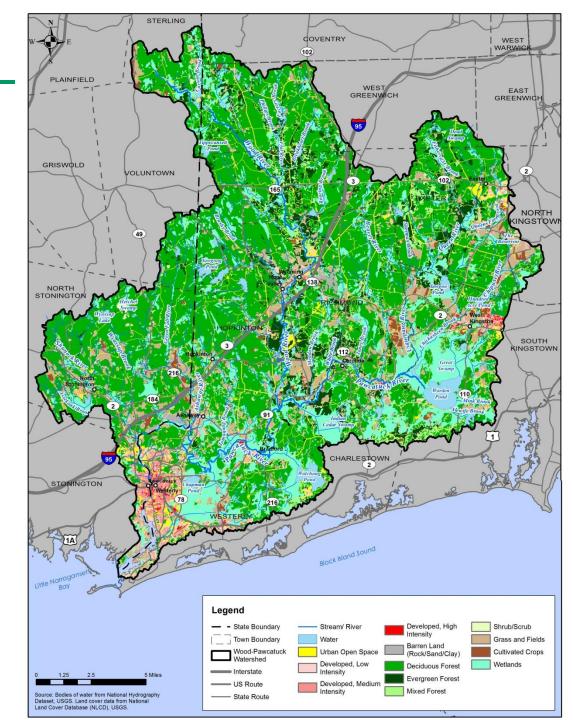
- Pawcatuck River
- Wood River
- Beaver River
- Queen-Usquepaug River
- Chickasheen Brook
- Chipuxet River
- Ashaway River
- Wyassup Brook
- Shunock River





Land Use

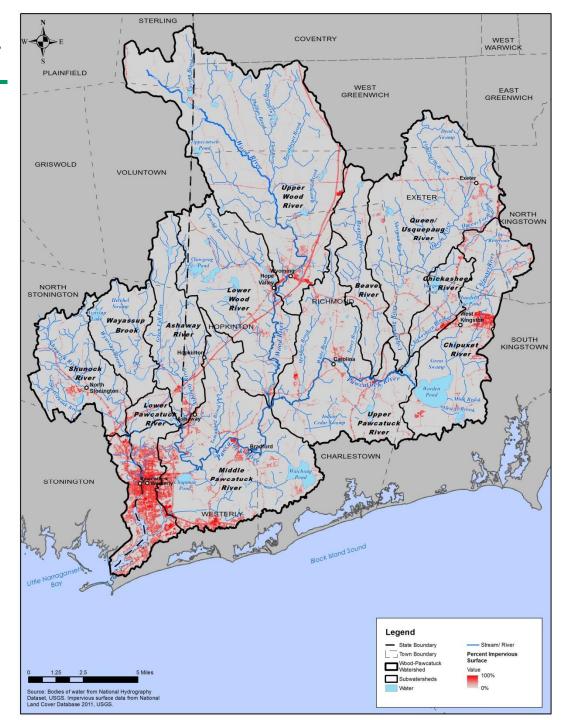
- Mostly rural, forested, and agricultural land
- 80% undeveloped
- 60% forested
- Development concentrated in lower watershed and town/village centers





Impervious Cover

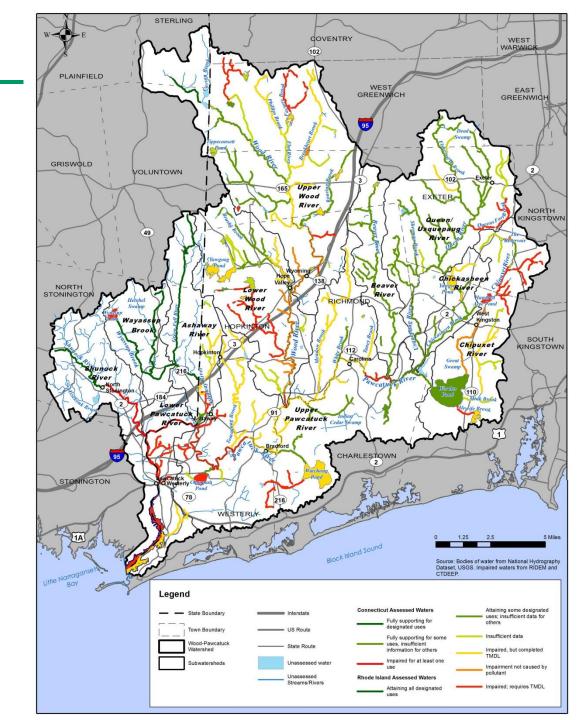
- Less than 5% of land area overall
- Indicative of healthy streams and good water quality
- 20% IC in Lower Pawcatuck, water quality issues





Water Quality

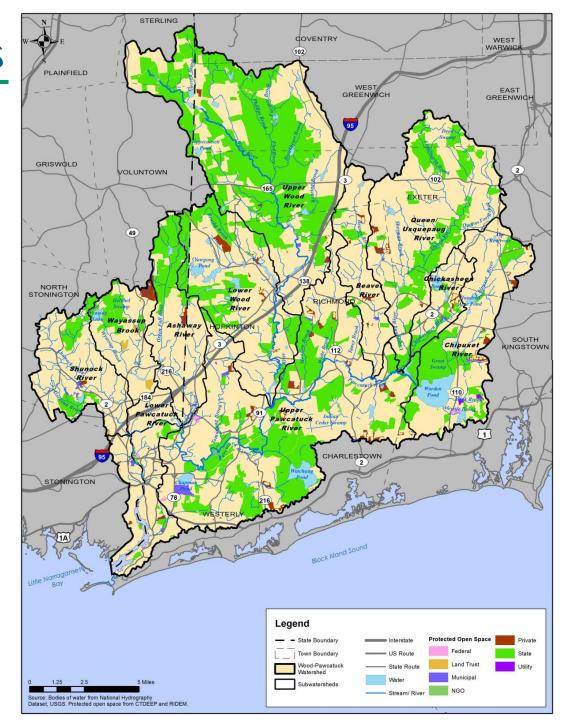
- High Quality Surface and Groundwater
- Supporting Cold-Water River habitat
- Sole Source Aquifer
- Threats from Nonpoint Source Pollution
 - Development potential
 - Stormwater discharges



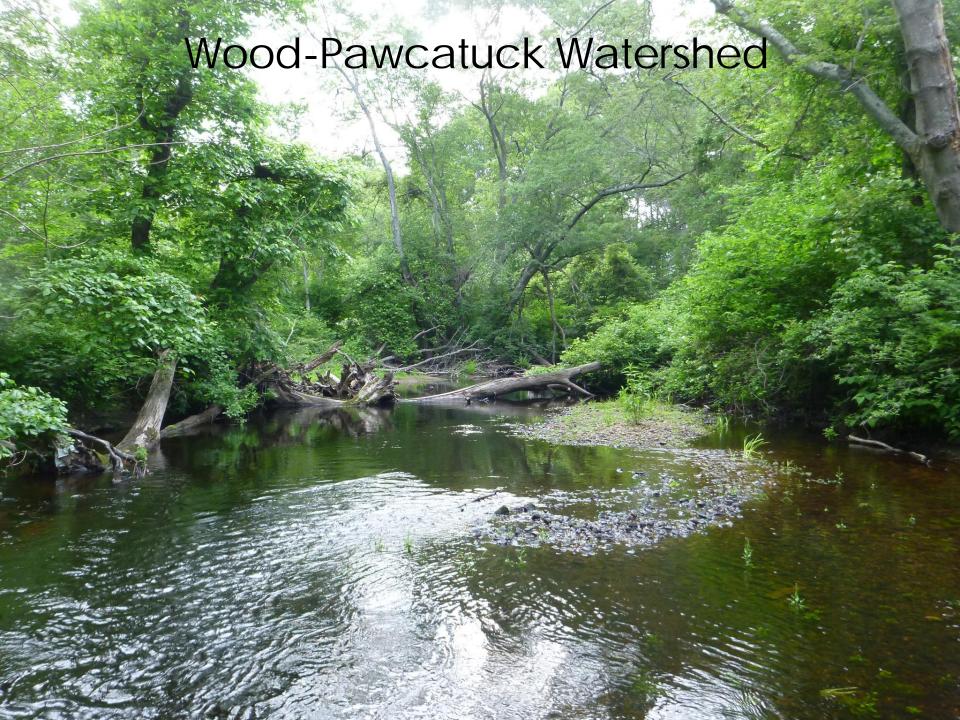


Natural Resources

- High diversity of habitat and species
- Intact, unfragmented forests
- Large wetlands ("Great Swamp")
- Under Study for Wild & Scenic Designation

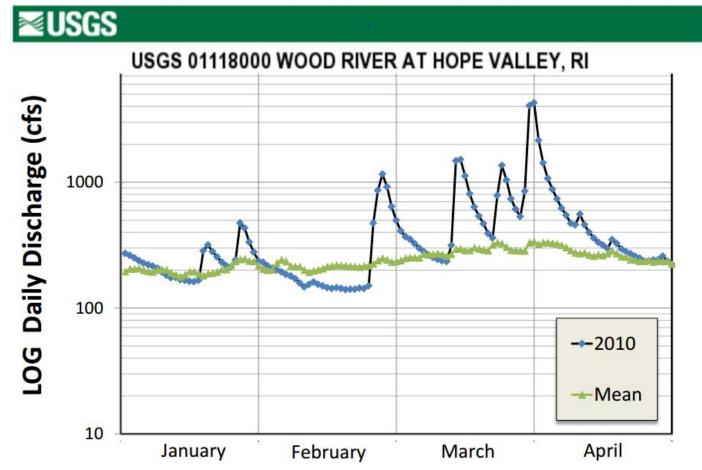






Flooding in the Wood-Pawcatuck

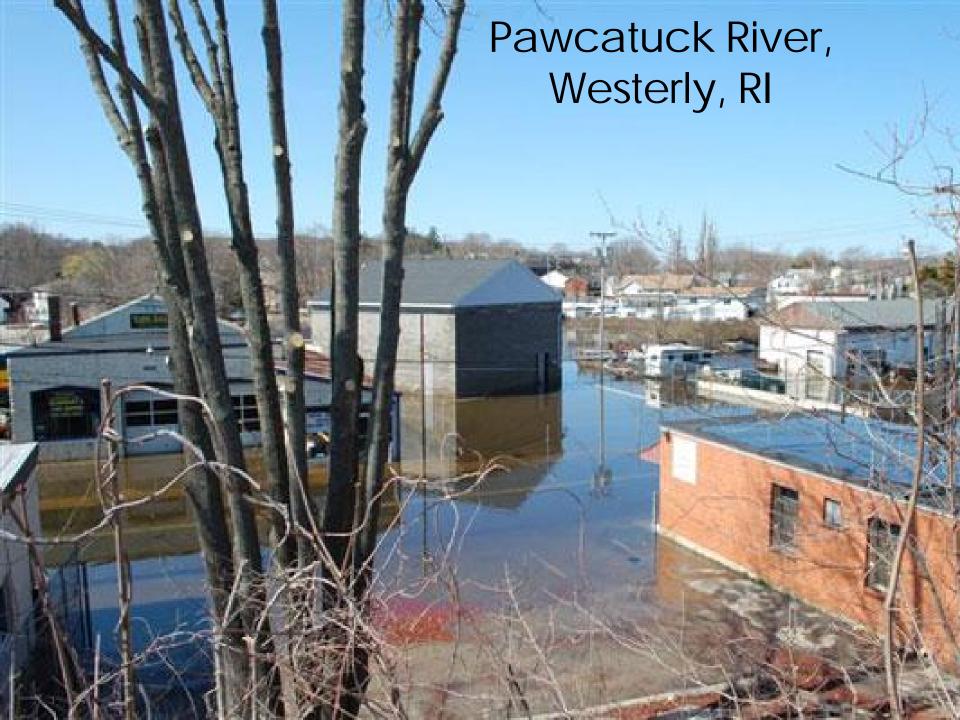
- History of flooding in the watershed
- The Great Flood of 2010 (>"500-Year Flood")

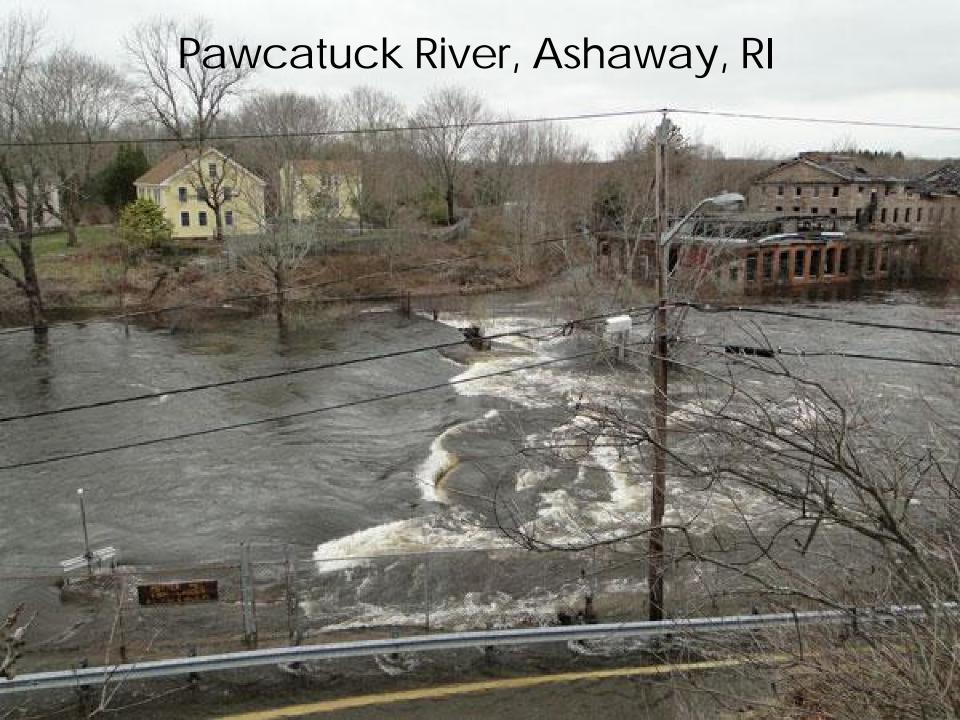






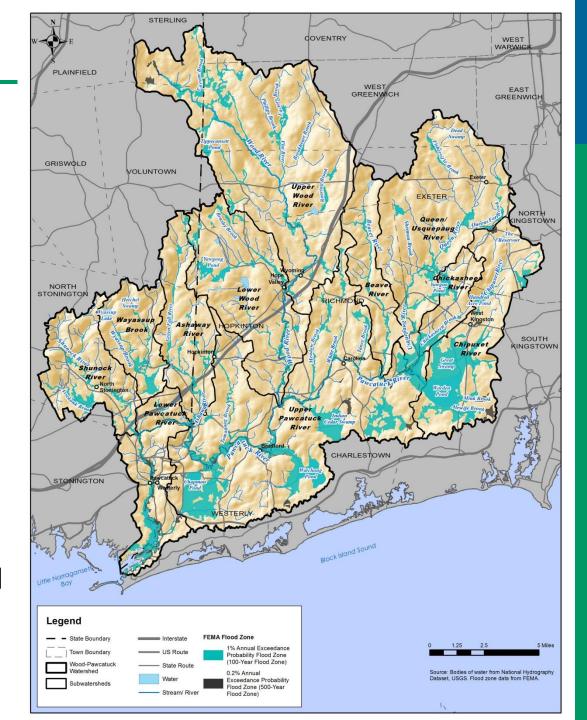






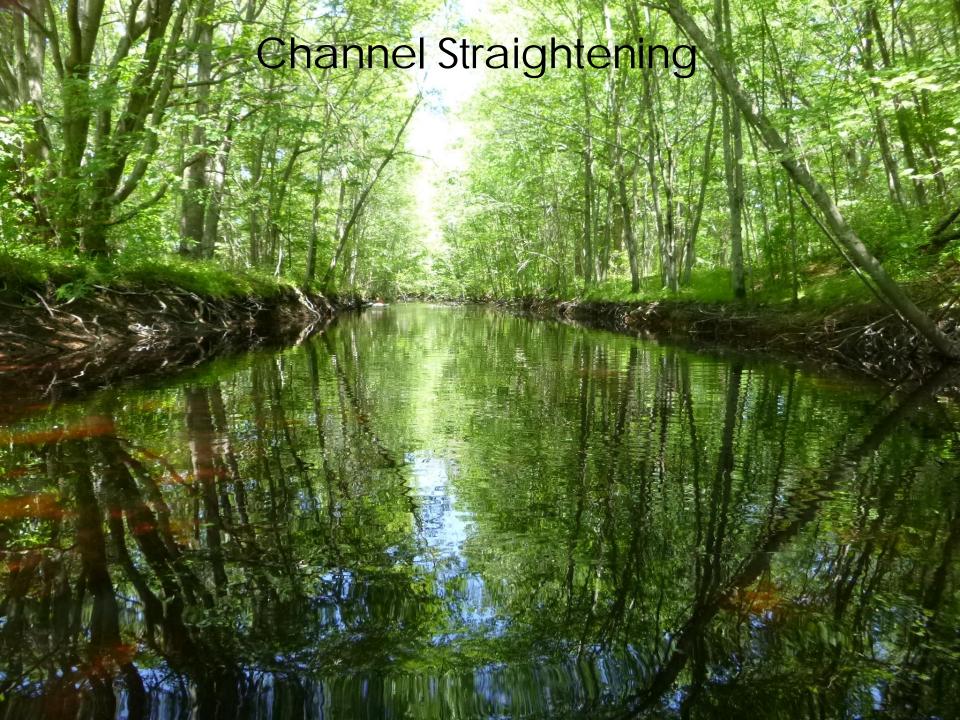
Flooding

- Factors Related to Increased Flooding
 - Floodplain development
 - Channel encroachment (dams, bridges, culverts)
 - Channel straightening
 - Watershed impervious cover
 - Climate change: more frequent and intense storms





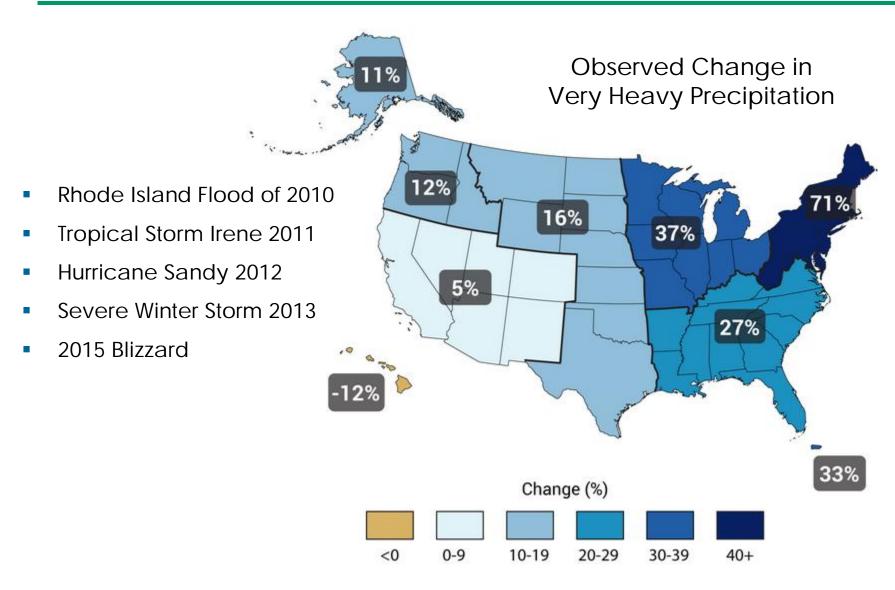








More Frequent Extreme Storms







Problems with Road Stream Crossings

Hydrologic/Flooding









Problems with Road Stream Crossings

Geomorphic

- Sediment
- Woody debris
- Culvert blockage/failure
- Channel adjustment









Problems with Road Stream Crossings

Ecological

- Barriers to physical passage by aquatic organisms
 - Perched culverts
 - Excessive velocities
 - Insufficient water depths
 - Inadequate openness









Bridges and Culverts - Analysis

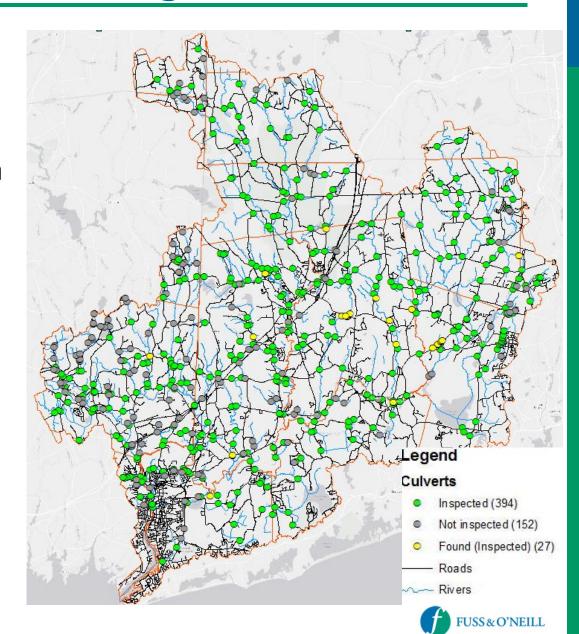
How can decision-makers prioritize the repair and replacement of stream crossing infrastructure to increase flood resiliency and enhance aquatic organism passage?





Wood-Pawcatuck Bridges and Culverts

- 573 structures identified using GIS
 - Intersected roads, rails, and trails with mapped streams
 - Reviewed aerial imagery
 - RI Stream
 Continuity Project
- 421 structures were inspected (May – September 2015)





Bridges & Culverts Assessment Approach

- Adapted from Vermont's Stream Geomorphic Protocols and others used in the Northeast
- Information gathered
 - Site characteristics (e.g. sketch, street name, stream name)
 - Structure dimensions needed to assess hydraulic capacity
 - Deficiencies and condition of the structure
 - Upstream and downstream geomorphic conditions





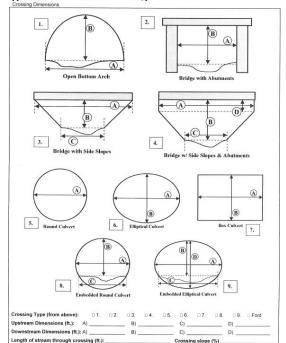








Appendix 2 Field data collection form, p. 3 of 5



Bridges & Culverts - Assessment Criteria

Hydraulic Capacity

- Conveyance
- Design Storms
- Climate Change

Geomorphic Vulnerability

- Invert/Bed Material
- Culvert/Channel Width
- Culvert Material/Condition

Prioritization

Aquatic Organism Passage

- Inlet/Outlet
- Substrate
- Physical Barrier

Flooding Impact Potential

- Development/Land Use
- Road Crossing Type
- Flood Prone Areas





Bridges and Culverts - Findings

- 38% are <u>presently</u> hydraulically undersized (less than 25-year design flow capacity)
- 49% will be undersized under a Year 2070 climate change scenario
- Only 40% of stream crossings provide for full passage of aquatic organisms

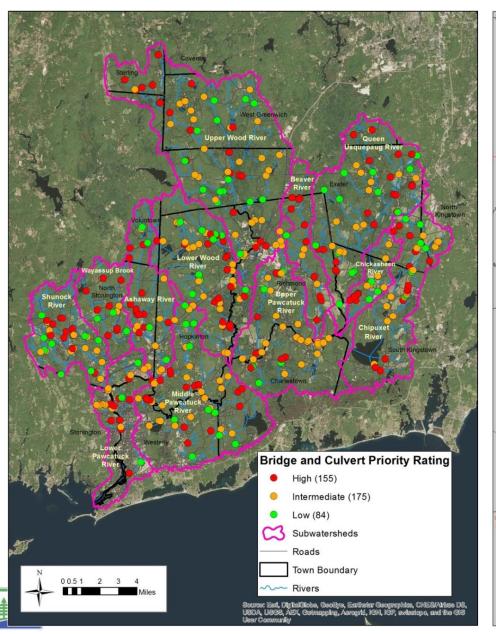


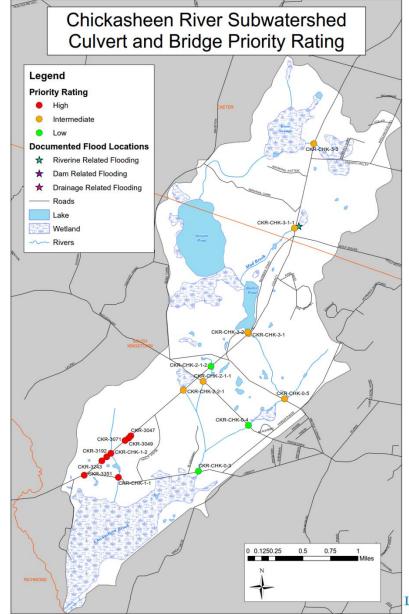






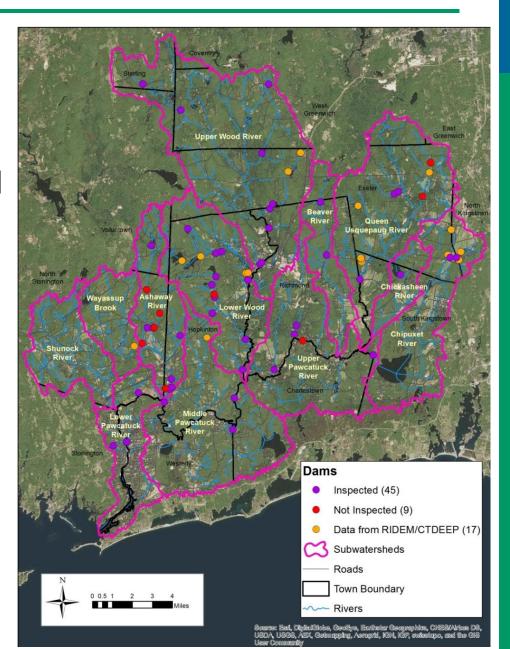
Culvert & Bridge Priority Ratings





Wood-Pawcatuck Dams

- Initially identified 150 dams
- Identified 70 highest priority dams for visual inspection
- Inspected 43 dams
- Denied access to 27 dams





Dams - Field Inspections

 Dam inspection protocols modified from the Massachusetts Office of Dam Safety (Phase 1 Formal Dam Safety Inspection Checklist)



Inspection Items

Name, Location, Uses

Size

Hazard Classification

Condition and Deficiencies:

- Embankment
- Dikes
- Upstream Face
- Downstream Face
- Appurtenances
- Concrete Structures
- Masonry Structures
- Spillway





Dams - Alternatives Assessment

Removal/Breach

Repair

Repurposing

Aquatic Organism Passage

No Action/ Maintain **Evaluation Criteria**

Hazard Classification

Dam Condition

Owner's Ability to Maintain

Capacity

Benefits vs Loss of Current Uses

Downstream Continuity

Cost effectiveness

Ease of Permitting

Feasibility of Repurposing

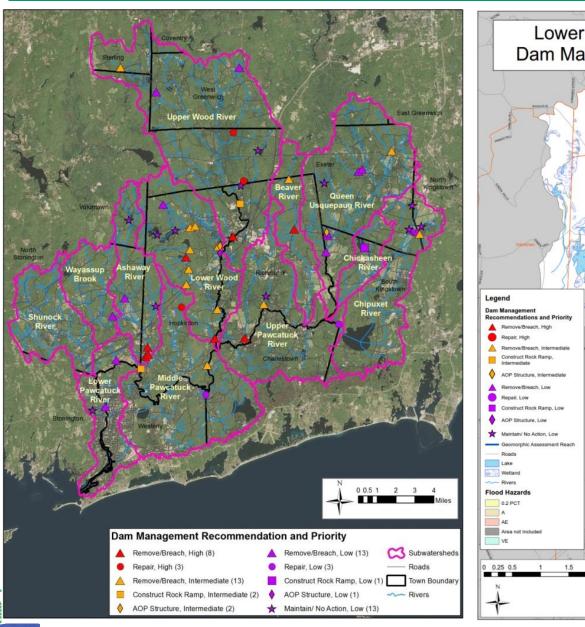
Hydraulic Impacts

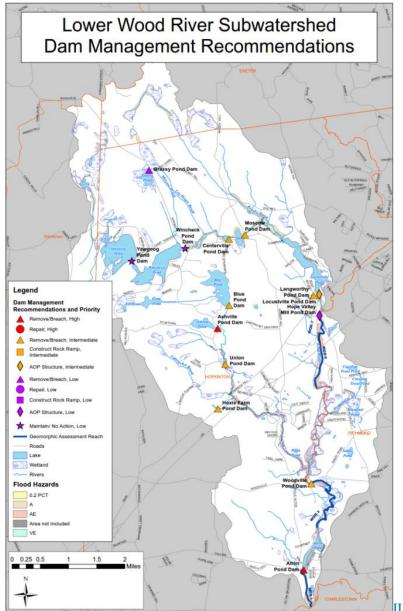
Wetland Impacts





Dam Assessment Results





Assessment Recommendations

- Watershed plan will identify prioritized recommendations for bridges, culverts, and dams
 - Recommendations by subwatershed
 - Typical design and permitting considerations
 - Approximate costs
 - Potential funding sources
- More detailed evaluation needed to confirm feasibility of recommendations and to support design and permitting





Geomorphic Assessment

John Field, Field Geology Services





Green Infrastructure Assessment

- Identify Opportunities for Green Infrastructure (GI) Retrofits
 - Enhance resiliency
 - Provide water quality and ecosystem benefits
- Approach
 - GIS Screening evaluation



Field inventories



Concept designs



Parcel or Site-Based Retrofits

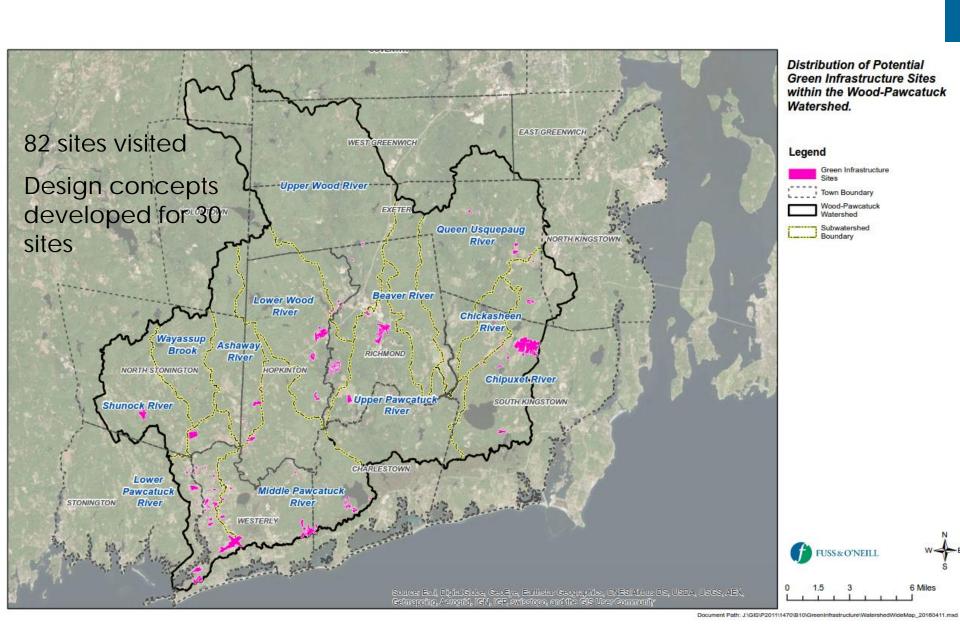


ROW/Street Retrofits





Potential GI Retrofit Sites



Retrofit Site 286 – Richmond Elementary School Bioretention

Kingstown Road, Richmond, Rhode Island

Site Description

The proposed retrofit concept is located at the Richmond Elementary School located on Kingstown Road in Richmond, Rl. The site consists of two large drainage areas that run east/west along Kingstown Road, centered at the intersection of Kingstown Road and Richmond Townhouse Road. Catch basins located along the roadside in several locations. The connectivity and outlet location of the drainage infrastructure is currently unknown.

Proposed Concept

Install bioretention/infiltration basins in the lawn area near the school entrance and driveway/bus loop. An additional bioretention/infiltration system could be installed in the triangular traffic island bordered by Richmond Townhouse Road and Kingstown Road. These bioretention areas would be sized to infiltrate the 1" water quality volume and outlet/overflow to existing infrastructure where possible. It should be noted that a large infiltration practice exists across the street at the Richmond Town Hall property. The effectiveness of this practice and treatment area should be evaluated prior to final design of the proposed retrofit at the Richmond Elementary School.



Image 1: Location of proposed bioretention basins in front of Richmond Elementary School, Richmond, Rl.

Retrofit Concept Summary

Total Drainage Area: 16.0 acres
Total Impervious Area: 3.9 acres
Total Water Quality Volume: 13,999.4 ft³
Runoff Reduction Volume: 5,557.4 ft³

Estimated Pollutant Removal

Bioretention Area

Total Phosphorus ≈ 3.9 lbs/year

Total Nitrogen ≈ 58.8 lbs/year

Total Suspended Solids ≈ 3,629.0 lbs/year

Bacteria (FC) ≈ 504.9 billion colonies/year

Estimated Cost

Bioretention Area: \$188,298



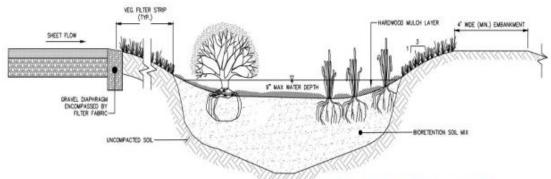
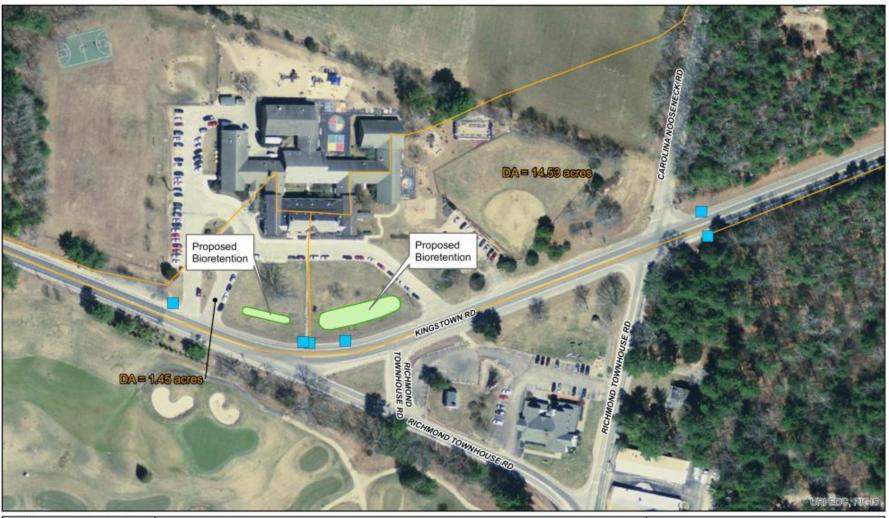


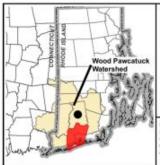
Image 2: Typical detail of a bioretention area.



Image 3: View of typical bioretention area with mature plantings. (Image source: http://www.installitdirect.com/wp-content/uploads/2015/01/how-to-build-a-rain-garden.jpg)







Legend Existing Catch Basin Proposed Level Spreader Bioretention Pervious Pavers Proposed Catch Basin Proposed Storm Drain Raingarden Structure BMP Drainage Area Boundary Green Roof Articulating Concrete Matting N

Disclaimer: This map is not the product of a Professional Land Survey, it was created by Puss & O'Nelf, inc. for general reference, informational, planning and guidance use, and is not a legally authoratative source as to location of natural or mammade features, Proper interpretation of this map may require the assistance of appropriate professional services. Fass & O'Nelf, inc. makes no warrance, express or implied, related to the spotial accuracy, reliability, completeness, or currentess of this map.

Data Source)s: Drainage Areas by Fuss & O'Nelli, 2016; Aerial Photography; April 2014 US6S 0.3 m multispectral ortho imagery, downloaded from AroGiS Online; Contour Lines from Northeast LIDAR Project 2011, RIGIS

Stormwater Retrofit Concept

Richmond Elementary School

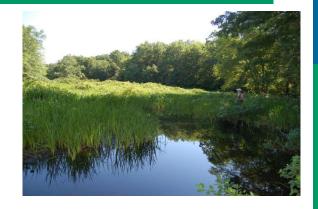
Retrofit Site No. 286

Richmond Rhode Island



Watershed Wetlands Assessment

- Wetlands can provide flood mitigation, habitat, water quality, and other functions
- Identify and prioritize conservation and restoration opportunities
 - GIS-based screening
 - USFWS NWI Plus Dataset for RI and CT
 - Rhode Island Freshwater
 Wetland Restoration Strategy
 (Miller and Golet, 2001- URI)



U.S. Fish & Wildlife Service

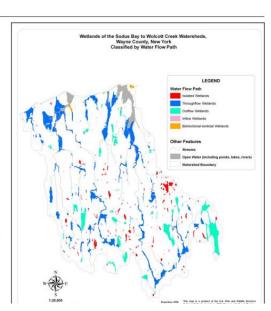
NWIPlus: Geospatial Database for Watershed-level Functional Assessment

While much government attention has focused on creating methods for site-specific analysis of wetland functions for evaluating the impacts of proposed development and for predicting the condition of wetlands through probabilistic sampling, the U.S. Fish and Wildlife Service has been developing techniques to use its National Wetlands Inventory (NWI) data to predict wetland functions for watersheds.

What is NWIPlus?

Recognizing the value of adding hydrogeomorphic properties to the NWI database (i.e., increased functionality), the NWI created a set of hydrogeomorphic-type descriptors that could be added to NWI types to facilitate predicting wetland functions. The combination of these attributes with traditional NWI types can be called "NWIPlus" resulting in an enhanced NWI database.

The new attributes describe landscape position (relation of a wetland to a waterbody if present: marine - ocean, estuarine - tidal brackish, lotic - river/stream, lentic - lake/reservoir, and terrene - not affected by such waters), landform (physical shape of the wetland - basin, flat, floodplain, fringe, island, and slope), water flow

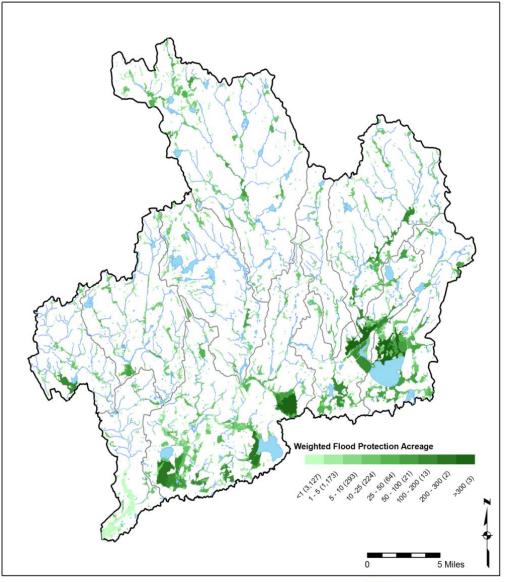






Watershed Wetlands Assessment

- 80 wetland complexes with flood protection function and human modification
- 24 assessed in the field for functions and values
- Several impoundments/dams with high conservation potential (Hazard Pond, Dolly Pond, Kasella Farm Pond)
- Other wetland restoration opportunities identified







Watershed Plan Development

- Integrate findings and recommendations of technical assessments (see the boards around the room)
- Integrate input from the municipalities and the public
- Develop actions, schedule, lead groups, costs, funding sources, etc.

Potential Management Actions

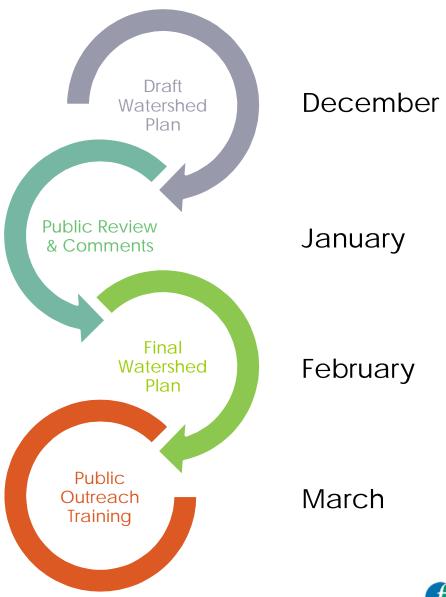
- Land use regulatory controls
- Active restoration
 - Elevating and flood proofing structures
 - Dam removal
 - Aquatic connectivity obstruction removal
 - Bridge and culvert retrofits and replacements
- Passive restoration
 - Riparian buffer restoration and protection
 - Stream bank stabilization
 - Corridor easements
- Reach-scale river restoration
- Green infrastructure stormwater management
- Wetland and habitat restoration
- Related water quality mitigation





Next Steps

- Draft technical assessment reports are available for download and review
- Comments are welcome and encouraged







Questions and Discussion

 What are your main concerns regarding the Wood-Pawcatuck watershed?

2. What would you most like to see as outcomes of the Wood-Pawcatuck Watershed Flood Resiliency Management Plan?

3. Do you have any specific project ideas or recommendations for your area of the watershed?





Project Contacts

Contact Information

Erik Mas, P.E. Fuss & O'Neill, Inc. 800-286-2469 emas@fando.com

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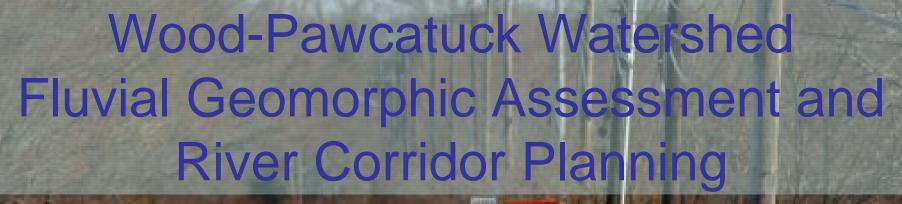
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chris@wpwa.org



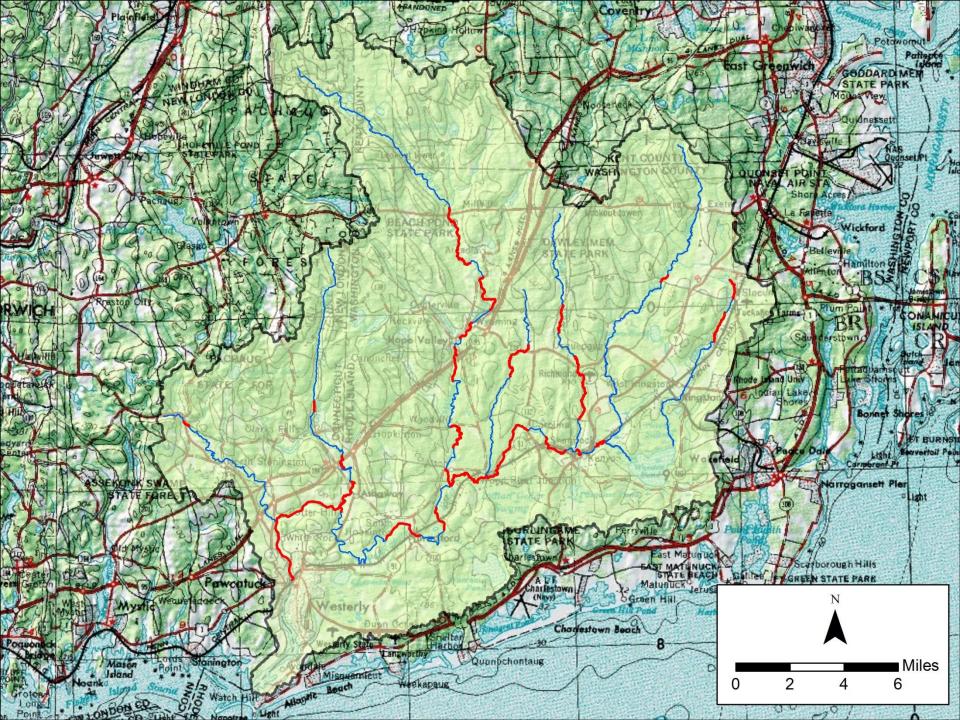














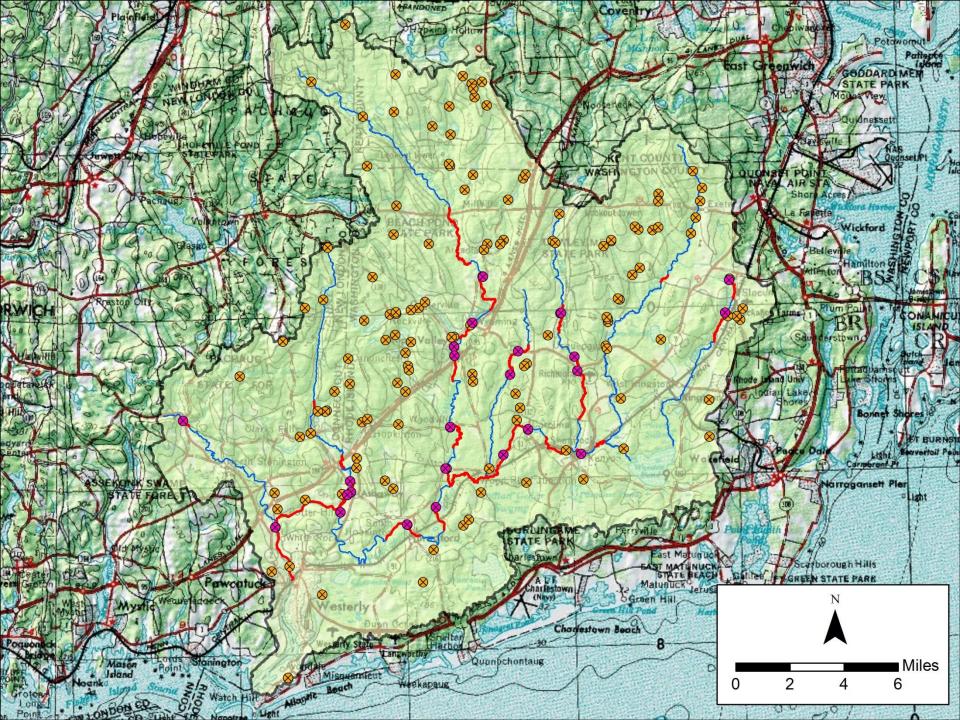




Stream	Reach /	Stream	Stream	Channel	Ent	Mean	W/D	RGA	Stream
	Segment	Length	Type	Width	Ratio	Depth	Ratio	Condition	Sensitivity
Pawcatuck River	PAR-28	4075	C5 Rip-Dune	41	16.3	3.2	12.8	Reference	High
Pawcatuck River	PAR-26	1943	C4 Rif-Pool	64	8.1	4.7	13.6	Fair	Very high
Pawcatuck River	PAR-24	2455	C3 Rif-Pool	71	3.8	3.0	24.1		
Pawcatuck River	PAR-23	4487	C4 Rif-Pool	52	11.6	3.0	17.3	Fair	Very high
Pawcatuck River	PAR-21a	2215	C4 Rif-Pool	52	3.5	3.3	15.8	Fair	Very high
Pawcatuck River	PAR-21b	1298	C4 Rif-Pool	33.5	9.8	2.2	15.0	Fair	Very high
Pawcatuck River	PAR-20	2103	C5 Rif-Pool	62.5	3.2	3.2	19.6	Fair	Very high
Pawcatuck River	PAR-19	3738	C4 Rif-Pool	61	5.1	3.0	20.3		
Pawcatuck River	PAR-18	7443	C5 Rif-Pool	68.1	0.3	3.2	21.3	Fair	Very high
Pawcatuck River	PAR-17	11816	C5 Rip-Dune	64	11.6	3.3	19.4	Fair	Very high
Pawcatuck River	PAR-15	5619	C4 Rip-Dune	101.6	7.2	7.1	14.3	Fair	Very high
Pawcatuck River	PAR-13	4053	C5c Plane Bed	120	2.5	6.3	19.2	Good	High
Pawcatuck River	PAR-12	5954	C5 Rip-Dune	86	16.2	7.0	12.3	Fair	Very high
Pawcatuck River	PAR-7	1024	C4 Rif-Pool	97	2.9	6.5	14.9	Fair	Very high
Pawcatuck River	PAR-6	10200	C4 Rif-Pool	112.5	2.8	4.6	24.5	Fair	Very high
Pawcatuck River	PAR-5	3398	B4 Rif-Pool	160	1.4	3.5	45.7	Fair	High
Pawcatuck River	PAR-4	3053	C5 Rif-Pool	147	4.8	5.7	25.8	Good	High
Pawcatuck River	PAR-3	4431	C4 Rif-Pool	154	4.1	3.0	51.3	Fair	Very high
Pawcatuck River	PAR-2	4574	C4 Rif-Pool	125.7	2.7	4.1	30.7	Fair	Very high
Pawcatuck River	PAR-1	3051	C4 Rif-Pool	131	2.4	3.9	33.6	Fair	Very high
Wood River	WOR-16	5565	C4 Rif-Pool	49	11.2	2.1	23.1	Fair	Very high
Wood River	WOR-15	3831	C4 Rif-Pool	53	3.1	3.6	14.9	Fair	Very high
Wood River	WOR-14	6882	C4 Rif-Pool	52.5	14.2	3.0	17.5	Fair	Very high
Wood River	WOR-12	4911	C4 Rif-Pool	44	2.5	2.2	20.1	Fair	Very high
Wood River	WOR-11	5461	C4 Rif-Pool	60	4.7	4.3	14.0	Good	High
Wood River	WOR-9	4989	C4 Rif-Pool	67	3.9	3.2	20.9	Fair	Very high
Wood River	WOR-7	2478	C4 Rif-Pool	60.5	4.0	2.6	23.3		
Wood River	WOR-6	5181	C4 Rif-Pool	61.2	2.9	4.0	15.5		
Wood River	WOR-3	8998	E5-Rip-dune	63	12.7	7.0	9.0	Fair	Extreme
Wood River	WOR-1	3905	C4 Rif-Pool	72.5	4.9	4.0	18.3	Fair	Very high

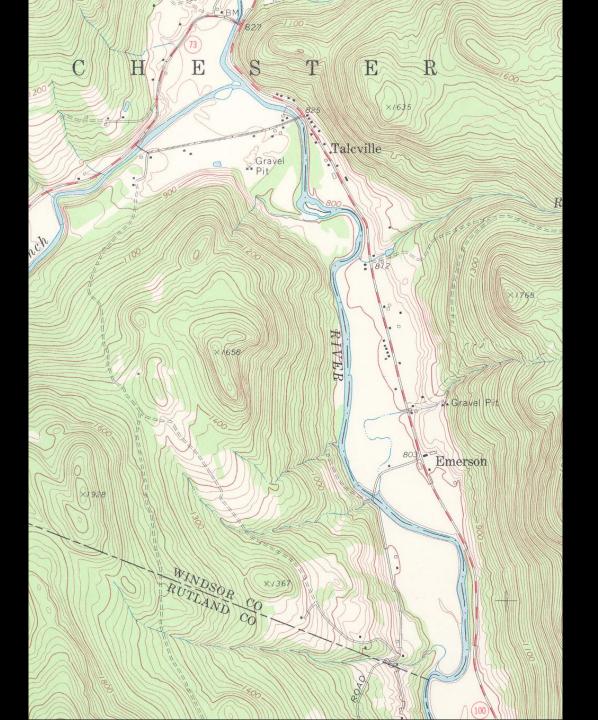


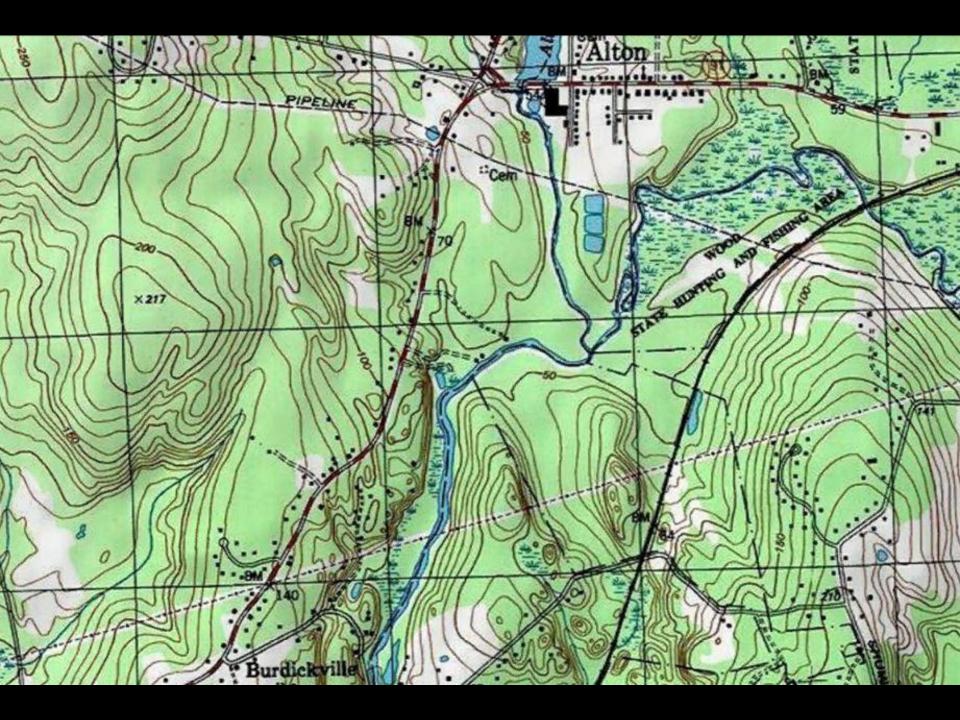




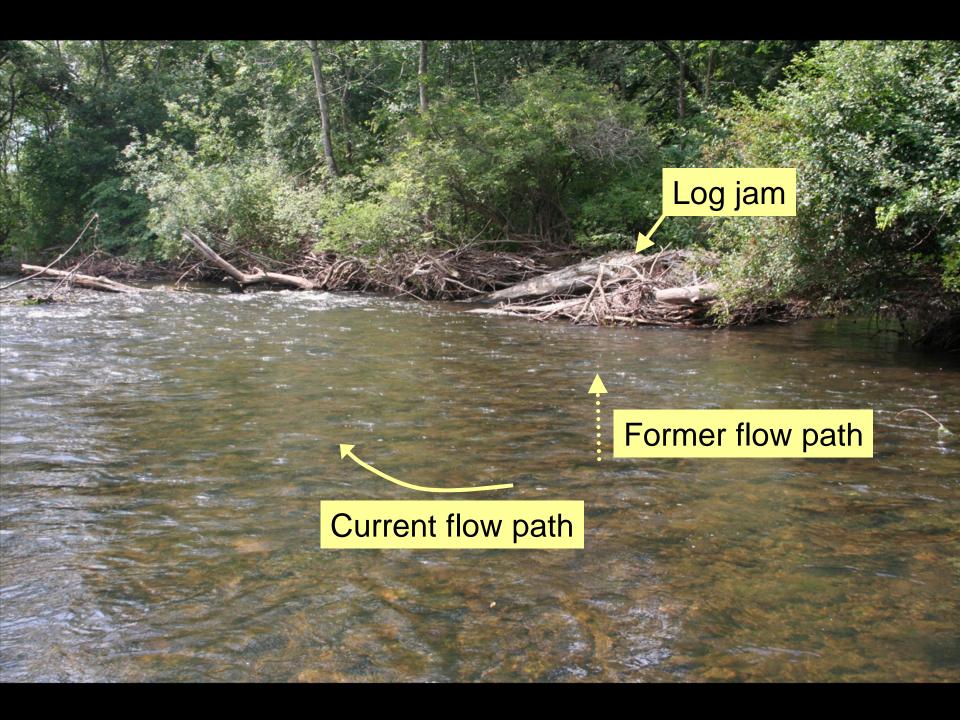


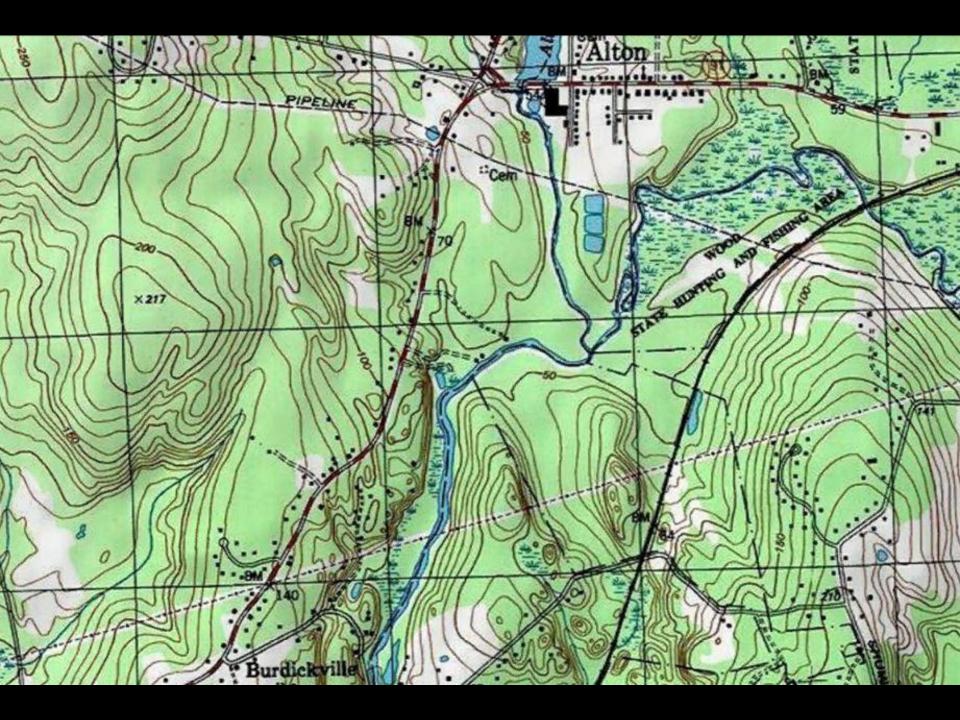


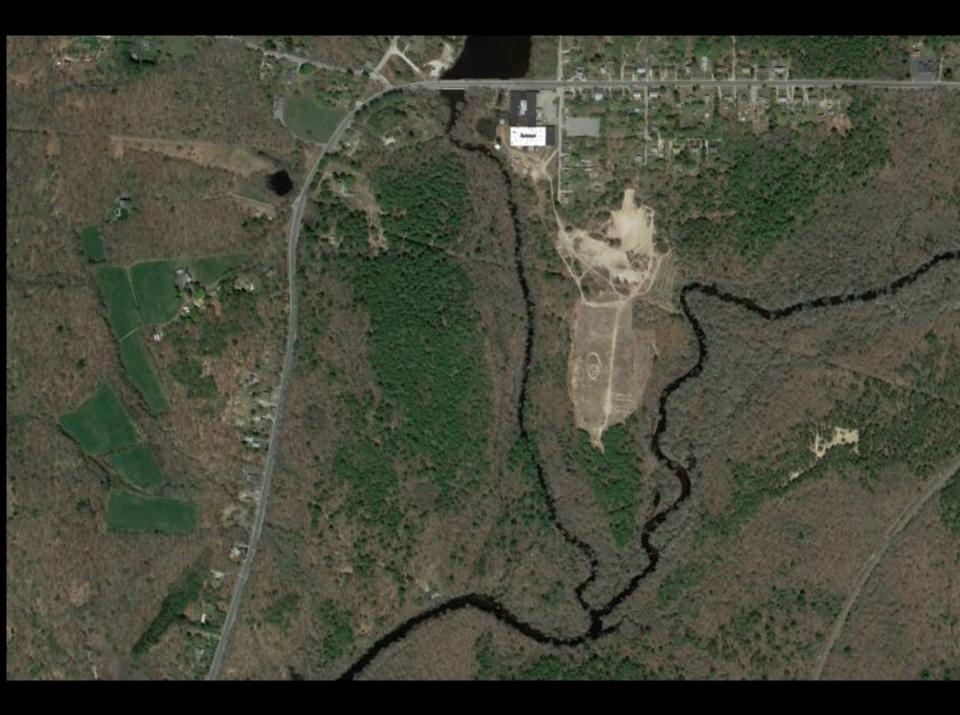






























Wood-Pawcatuck Watershed Flood Resiliency Management Plan

Community Meeting Westerly Library 44 Broad Street Westerly, RI 02891

October 20, 2016

1.	Introductions and Meeting Goals	10:00 am
2.	Project Background and Watershed Planning Process	10:05 am
3.	 Summary of Watershed Conditions and Issues Baseline Assessment Culverts, Bridges, and Dams Assessment Geomorphic Assessment Wetlands Assessment Green Infrastructure Assessment 	10:15 am
4.	Next Steps	11:15 am
5.	Questions and Group Discussion	11:20 am
6.	Closing Remarks	11:45 am
7.	Adjourn	By 12:00 pm



Wood-Pawcatuck Watershed Association

203 Arcadia Road, Hope Valley, RI02832; 401-539-9017; info@wpwa.org; www.wpwa.org

Wood-Pawcatuck Flood Resiliency Management Plan Community Meeting

October 20, 2016

Name	Association	Contact
Derrik Kennedy	Westerly Town Manager	
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FRED WAGNER	TOUN OF STONINGTON	furderickwagner Och
Scot Deledda	Town of Stonington	Sdeledda estonington-ca
		860 535 5076
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[&]quot;To preserve and protect the lands and waters of the Wood-Pawcatuck watershed for natural and human communities"

Wood-Pawcatuck Watershed Flood Resiliency Management Plan Community Meeting October 20, 2016 Westerly Public Library

Questions and Discussion

- <u>Gregory Pezza</u>: How can you make a recommendation to have a dam removed if you haven't done the analysis to see if it would increase flooding downstream?
 - <u>Erik Mas</u>: Removal of the dam would eliminate the downstream hazard associated with dam failure or breach during a large storm event and could potentially alleviate backwater flooding upstream of the dam. The scope of the study included semi-quantitative evaluation of flooding potential upstream and downstream of the assessed dams by reviewing existing flood studies and associated hydraulic analyses. The dams assessment was a screening-level evaluation to identify and prioritize dams to be considered further for removal, repair, and other management recommendations, with the understanding that any dam recommended for potential removal would need to be evaluated in more detail including hydraulic analysis, impacts to natural resources, cultural resources, property value, community acceptance, drinking water wells, etc.
- <u>GP</u>: So you are making a guess?
 - <u>Erik Mas</u>: We are not making a guess, but basing our recommendations on semiquantitative, screening-level information. A detailed hydraulic analysis would be performed as part of a feasibility evaluation and in support of future design and permitting.
- GP: Why did you go to RIDEM to try to stop the Wyoming dam repair?
 - O Chris Fox: We did not try to stop the repair of the dam. We wanted the dam owner (RIDEM) and the towns that our data collection indicated that there may be benefits to looking at options other than dam repair. We also wanted the communities to be aware of what the repair may entail, such as replacement or elimination of the gates, which may actually increase the chance of flooding upstream.
- <u>GP</u>: Does Wild and Scenic designation require that dams (like the Wyoming Dam) be removed?
 - o <u>Denise Poyer</u>: No, Wild and Scenic designation can be made with all of the existing dams.
- <u>Blanche Higgins</u>: During the 2010 floods I heard that the north section of Westerly had a pulse of water, possibly from the dam breaching at Blue Pond or possibly from the water overtopping Stillman Bridge.
 - <u>Erik Mas</u>: The partial breach of Blue Pond caused damage to roads and bridges downstream of the dam. It is possible that the water and debris from the dam breach could have impacted flooding on the lower Pawcatuck, although I do not believe that this has been confirmed. Dam failure can result in a cascade effect by causing failure of downstream dams.

- <u>Fred Wagner</u>: Will the revised FEMA Flood Maps show a reduction in flood prone areas due to recent changes in the Pawcatuck River?
 - <u>Erik Mas and Jessica Henry</u>: Not necessarily. The maps had not been updated in 40 years and will reflect only current conditions. The maps will be more accurate than the previous maps due to the use of current topographic information (i.e., survey of channel sections and structures) and rainfall data.
- FW: Will they update the maps based on the recommendations in this report?
 - o <u>Erik Mas</u>: No, only the current conditions are used to develop the maps. And because this is the first update in 40 years, it is unknown when the next update would be.
- <u>GP</u>: Will the watershed towns have access to all the information on culverts and bridges generated by the study?
 - Erik Mas: Yes. The information will be made available with the watershed management plan and associated technical documents. We will be having training sessions for municipal employees to help them use the recommendations in the plan.
- <u>FW</u>: Will there be specific recommendations for each town regarding projects for culverts?
 - <u>Erik Mas</u>: Yes, each town will have access to the field work information and the culvert replacement recommendations. That information will be made available for use by each community and integration into their local hazard mitigation and infrastructure planning.
- <u>FW</u>: Will the watershed plan include recommendations about regulations towns could adopt to minimize flooding?
 - <u>Erik Mas</u>: Yes, we are reviewing each town and states regulations concerning construction near flood prone areas. There will be both general recommendations and town by town recommendations, depending on their current regulations.
- <u>FW</u>: Suggests that we have an executive summary for each town with references to specific recommendations for that town. Also suggested that we hold a public workshop with each town counsel.
 - o <u>Erik Mas:</u> We could incorporate an executive summary for each town in the final watershed management plan.
- <u>GP</u>: The scope of this project was not made clear to the residents of Hopkinton. They have a big mistrust of the Association (WPWA) and this project. You should have an evening meeting for the residents to explain.

Wood-Pawcatuck Watershed Flood Resiliency Management Plan

Community Meeting

October 20, 2016







Meeting Agenda

10:00 – 10:05 Introductions and Meeting Goals

10:05 – 10:15 Project Background and Watershed Planning Process

10:15 – 11:15 Summary of Watershed Conditions

11:15 – 11:20 Next Steps

11:20 – 11:45 Questions and Discussion

11:45 – 12:00 Closing Remarks and Adjourn





Introductions

Project Team

- Wood-Pawcatuck Watershed Association
- Fuss & O'Neill, Inc.

Project Steering Committee

- Municipal representatives from the most heavily-impacted watershed communities
- State and federal agencies
- Other organizations





Meeting Goals

- 1. Describe the watershed planning process and work completed to date
- 2. Summarize study findings and preliminary recommendations
- 3. Provide a forum for public input and discussion
 - Issues of concern
 - Local priorities
 - Project ideas







Hurricane Sandy Coastal Resiliency Grant

 U.S. DOI & National Fish and Wildlife Foundation (NFWF) competitive grant program



- Communities affected by Hurricane Sandy
- Increase flood resilience
- Focus on strengthening natural ecosystems that also benefit fish and wildlife
- NFWF Grant awarded to Wood-Pawcatuck Watershed Association in June 2014
 - "Flood Resiliency Management Plan" for the Wood-Pawcatuck watershed
 - \$720K grant award and \$200K matching funds





What is Flood Resilience or Resiliency?

A community's ability to plan for, respond to, and recover from floods



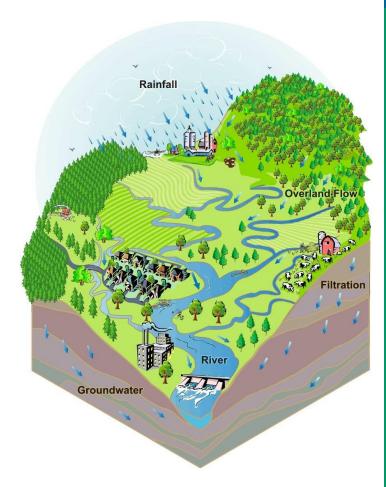




Project Goals

 Assess the vulnerability of the Wood-Pawcatuck Watershed to flooding

- Develop a watershed-based management plan
 - Enhance flood resilience
 - Strengthen natural ecosystems
 - Improve/protect water quality







Watershed Planning Process

Technical Assessments

Evaluate current conditions and opportunities for restoration and protection projects that will enhance flood resiliency and provide related benefits



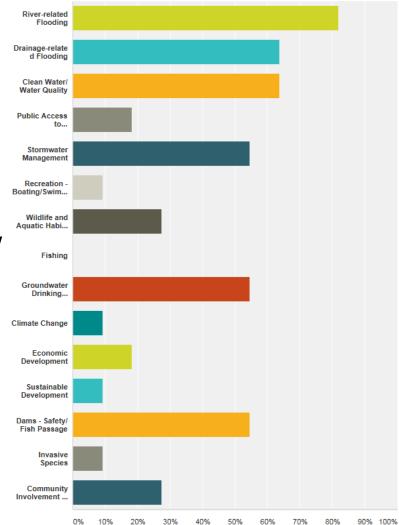


Watershed Planning Process

- Stakeholder and Community Involvement
- Collaborative Process with WPWA and Project Stakeholders
 - Steering Committee
 Workshop Meetings
 - Watershed Planning Survey
 - Community Meetings
 - Municipal Training and Outreach

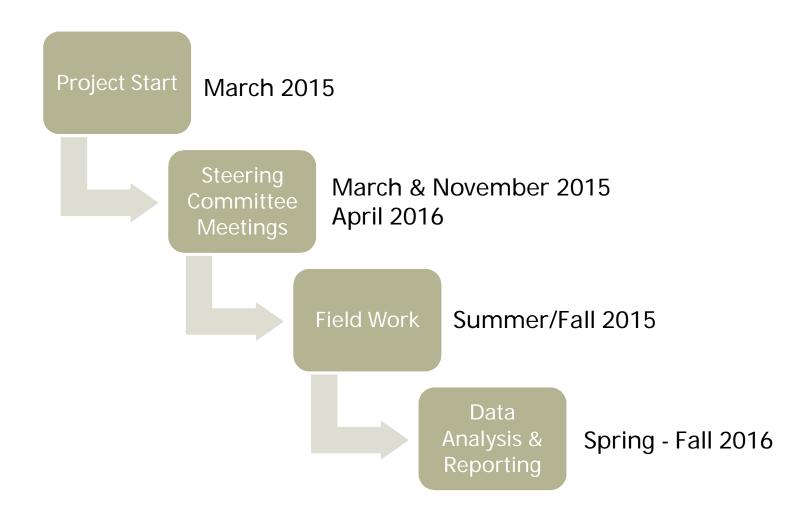
From the list below indicate your top five concerns/issues/priorities regarding the Wood-Pawcatuck Watershed.

Answered: 11 Skipped: 2





Timeline for Work Completed







Watershed Conditions and Issues





Watershed Baseline Assessment

- Document existing watershed conditions
- Build upon previous and ongoing work in the watershed
 - USGS-FEMA Risk MAP Project
 - USACE Pawcatuck River Flood Risk Feasibility Study
 - RI River & Stream Continuity Project
 - Pawcatuck Dam Removals
 - USFWS Wild & Scenic Reconnaissance Survey
 - RIDEM Water Quality Basin Planning
 - Local Hazard Mitigation Planning



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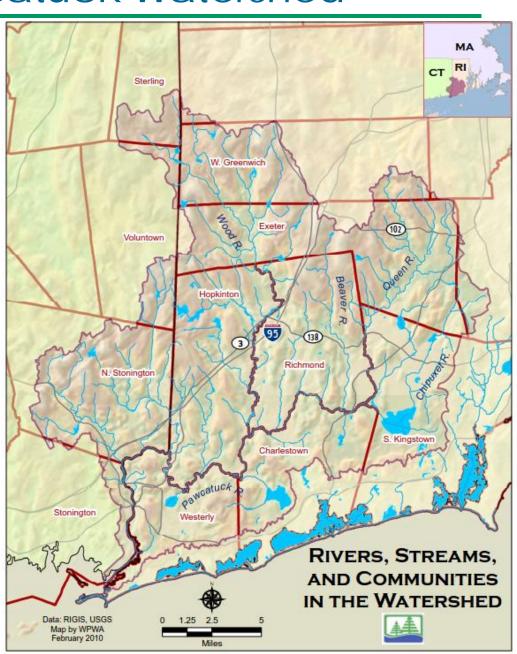
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Wood-Pawcatuck Watershed

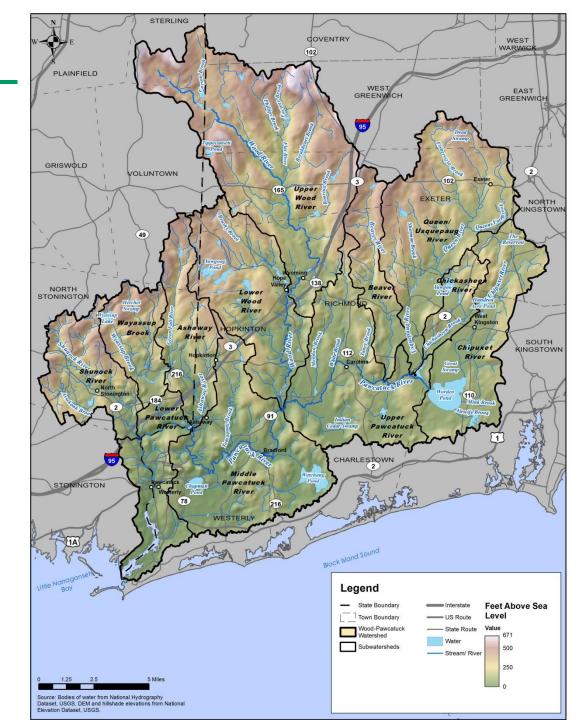
- 317 square miles in RI and CT
- Major portions of 11 municipalities
- 84,000 population
- 380 stream miles
- Drains to Pawcatuck
 River Estuary and
 Little Narragansett
 Bay





Subwatersheds

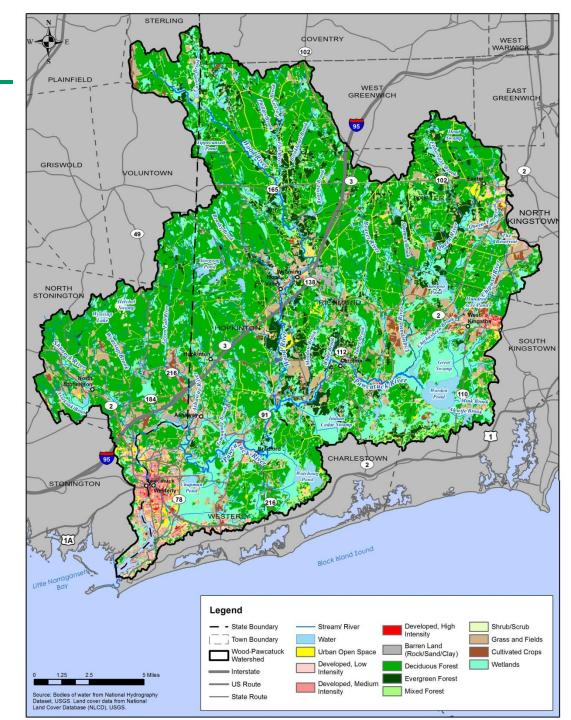
- Pawcatuck River
- Wood River
- Beaver River
- Queen-Usquepaug River
- Chickasheen Brook
- Chipuxet River
- Ashaway River
- Wyassup Brook
- Shunock River





Land Use

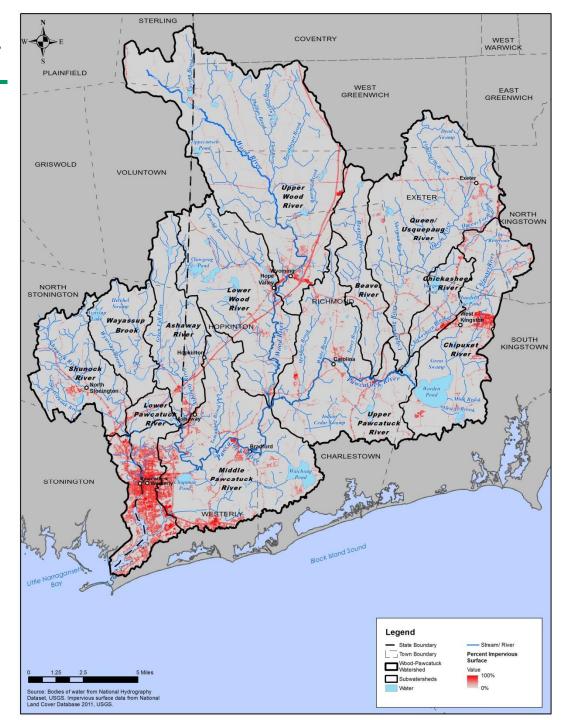
- Mostly rural, forested, and agricultural land
- 80% undeveloped
- 60% forested
- Development concentrated in lower watershed and town/village centers





Impervious Cover

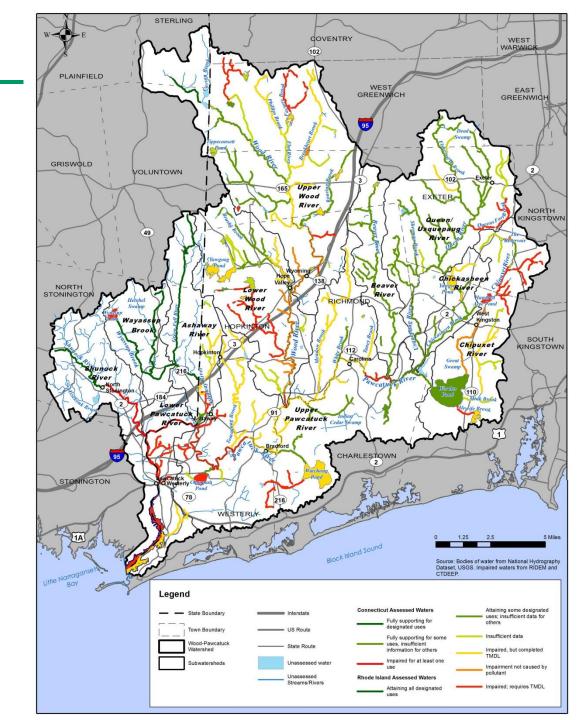
- Less than 5% of land area overall
- Indicative of healthy streams and good water quality
- 20% IC in Lower Pawcatuck, water quality issues





Water Quality

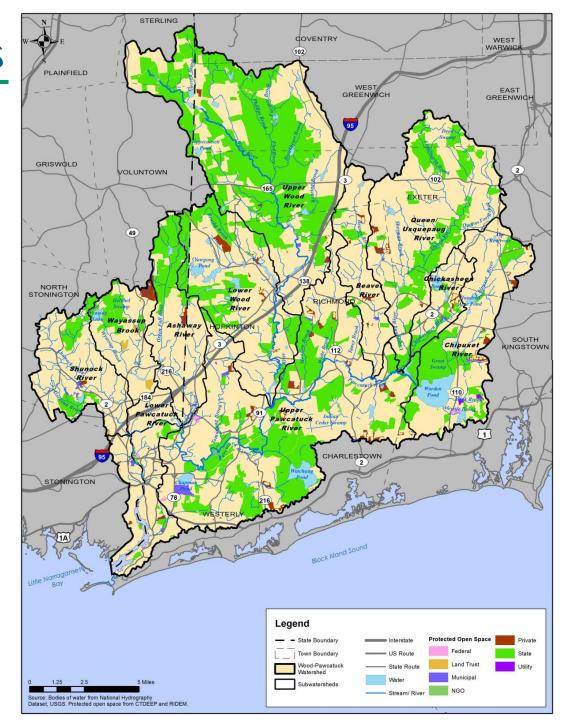
- High Quality Surface and Groundwater
- Supporting Cold-Water River habitat
- Sole Source Aquifer
- Threats from Nonpoint Source Pollution
 - Development potential
 - Stormwater discharges



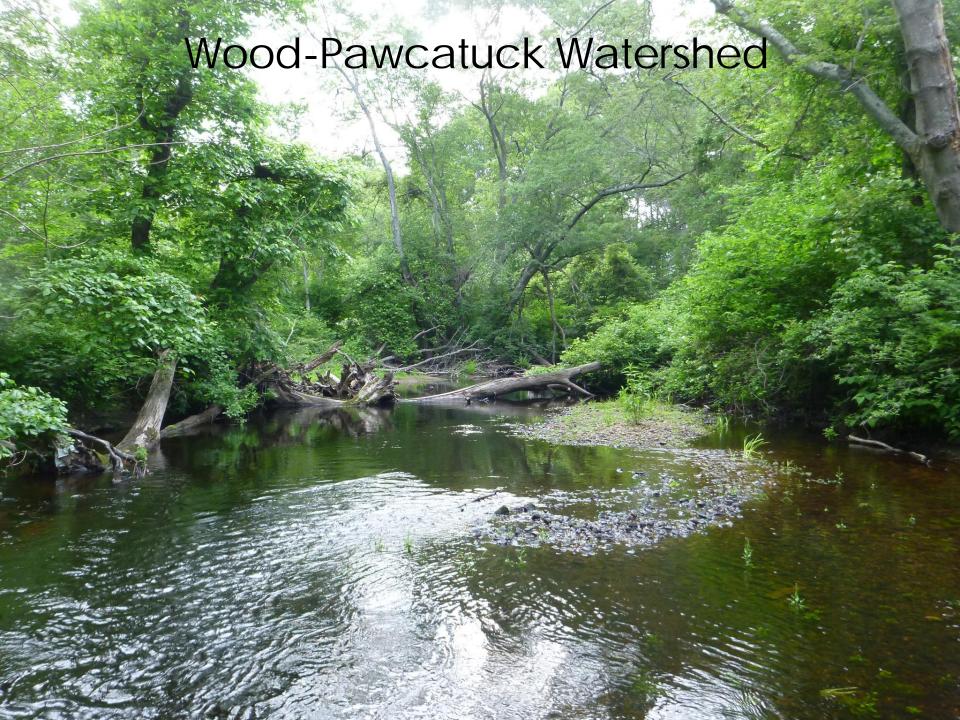


Natural Resources

- High diversity of habitat and species
- Intact, unfragmented forests
- Large wetlands ("Great Swamp")
- Under Study for Wild & Scenic Designation

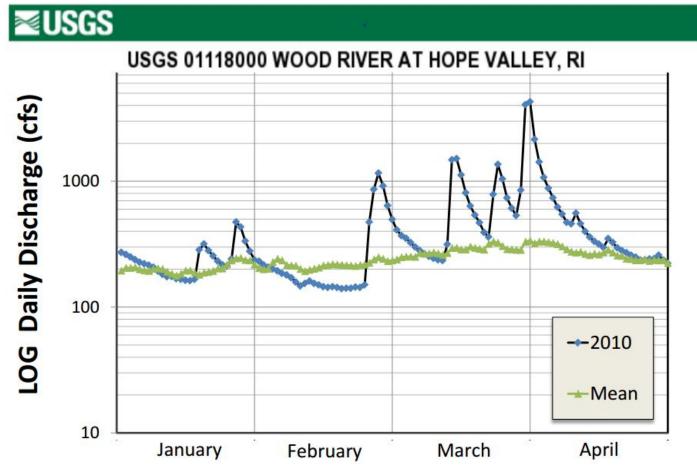






Flooding in the Wood-Pawcatuck

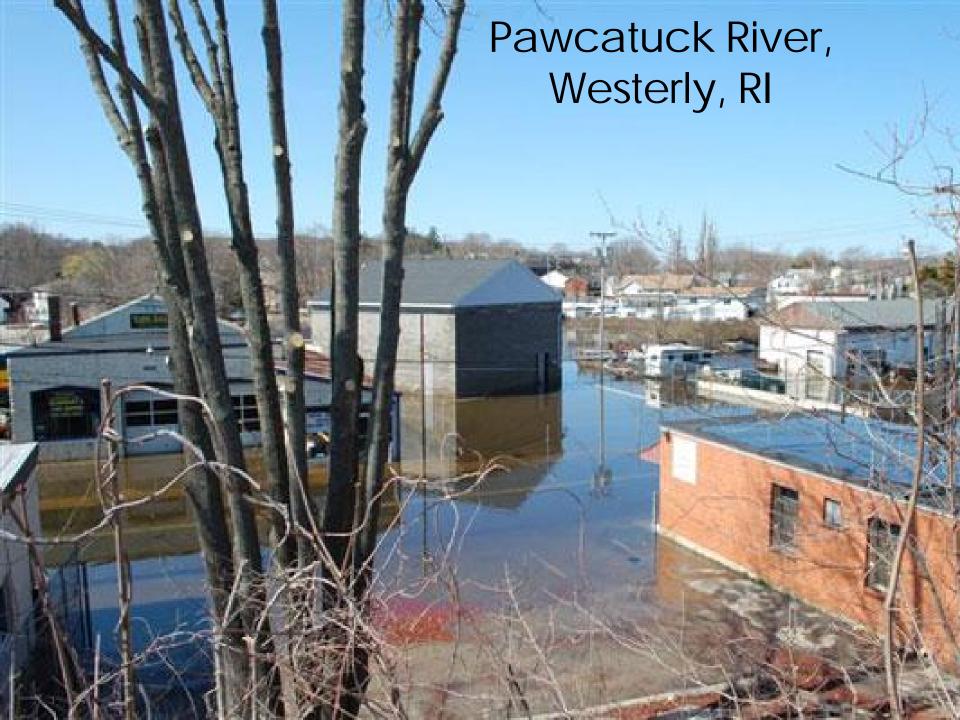
- History of flooding in the watershed
- The Great Flood of 2010 (>"500-Year Flood")

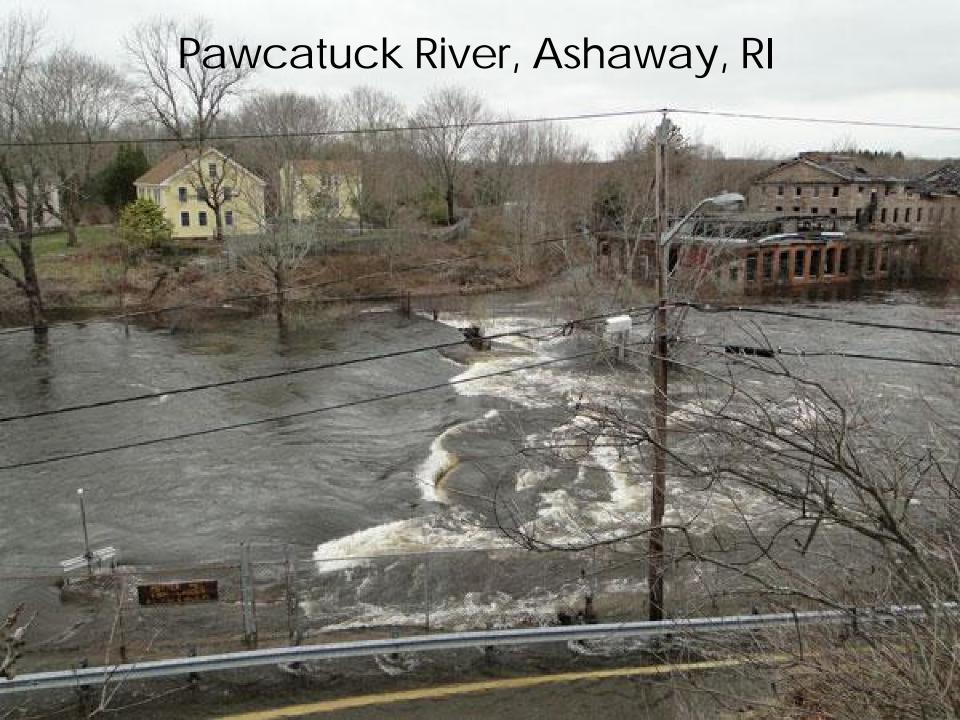






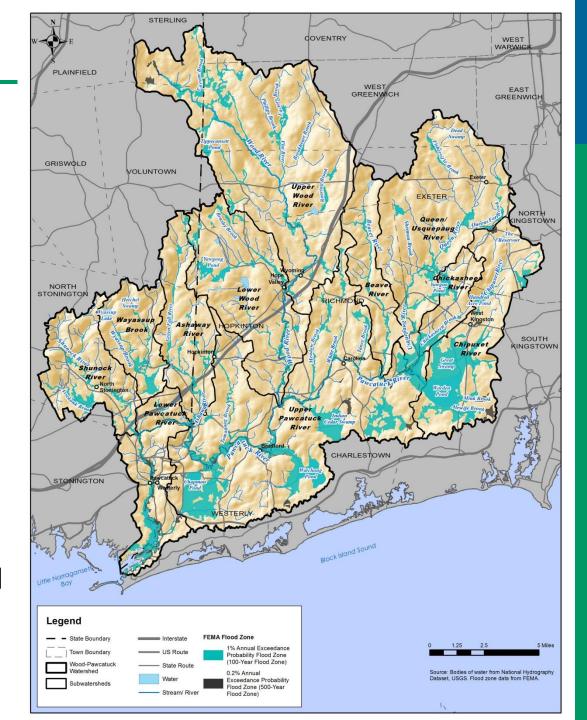






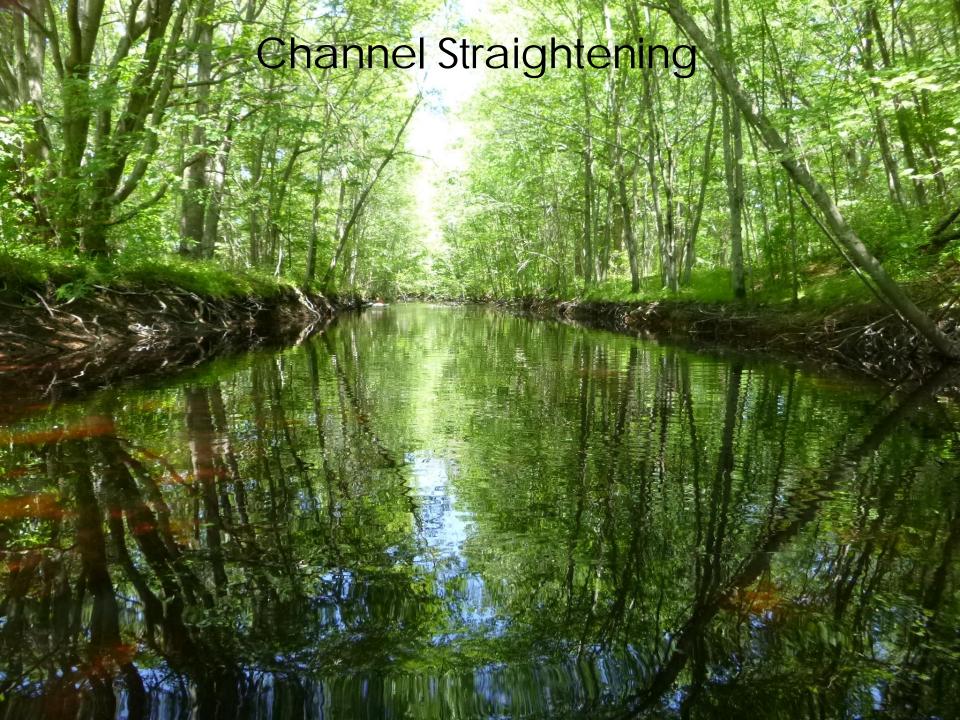
Flooding

- Factors Related to Increased Flooding
 - Floodplain development
 - Channel encroachment (dams, bridges, culverts)
 - Channel straightening
 - Watershed impervious cover
 - Climate change: more frequent and intense storms





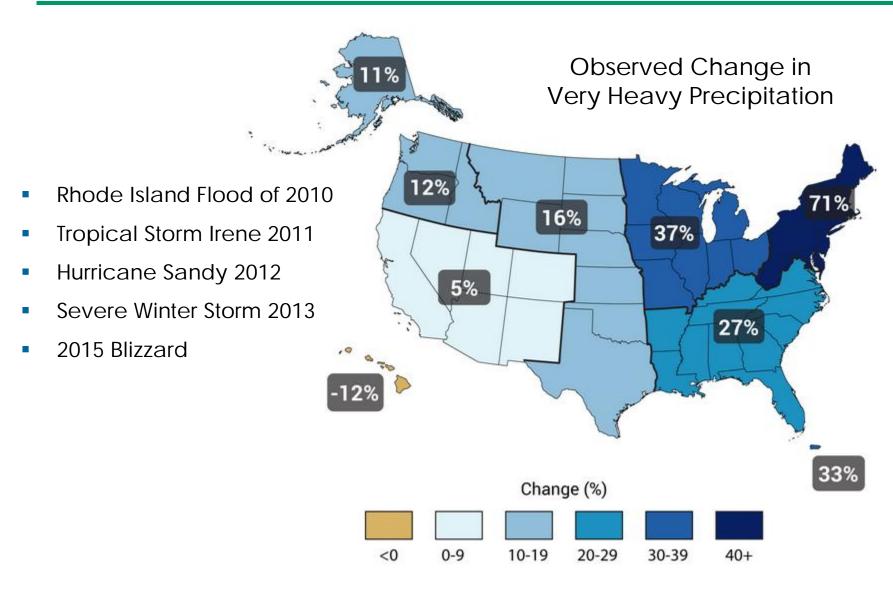








More Frequent Extreme Storms







Problems with Road Stream Crossings

Hydrologic/Flooding









Problems with Road Stream Crossings

Geomorphic

- Sediment
- Woody debris
- Culvert blockage/failure
- Channel adjustment









Problems with Road Stream Crossings

Ecological

- Barriers to physical passage by aquatic organisms
 - Perched culverts
 - Excessive velocities
 - Insufficient water depths
 - Inadequate openness









Bridges and Culverts - Analysis

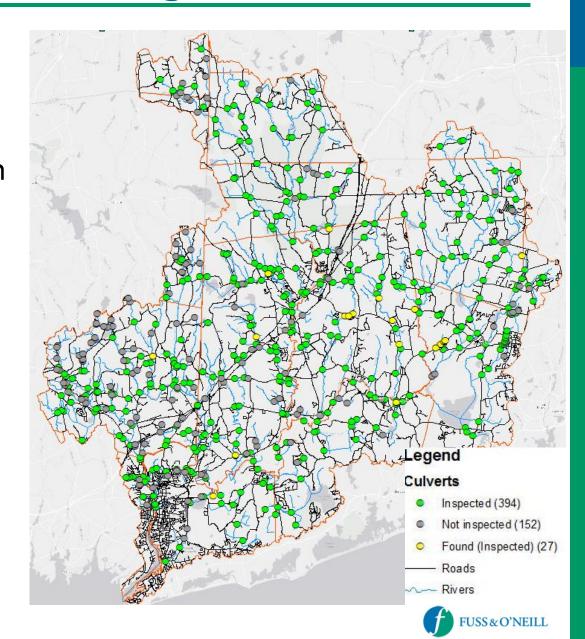
How can decision-makers prioritize the repair and replacement of stream crossing infrastructure to increase flood resiliency and enhance aquatic organism passage?





Wood-Pawcatuck Bridges and Culverts

- 573 structures identified using GIS
 - Intersected roads, rails, and trails with mapped streams
 - Reviewed aerial imagery
 - RI Stream
 Continuity Project
- 421 structures were inspected (May – September 2015)





Bridges & Culverts Assessment Approach

- Adapted from Vermont's Stream Geomorphic Protocols and others used in the Northeast
- Information gathered
 - Site characteristics (e.g. sketch, street name, stream name)
 - Structure dimensions needed to assess hydraulic capacity
 - Deficiencies and condition of the structure
 - Upstream and downstream geomorphic conditions





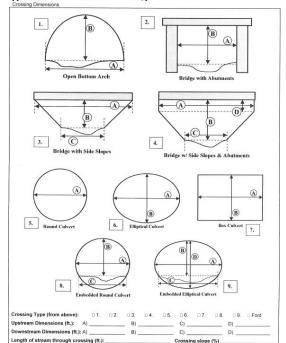








Appendix 2 Field data collection form, p. 3 of 5



Bridges & Culverts - Assessment Criteria

Hydraulic Capacity

- Conveyance
- Design Storms
- Climate Change

Geomorphic Vulnerability

- Invert/Bed Material
- Culvert/Channel Width
- Culvert Material/Condition

Prioritization

Aquatic Organism Passage

- Inlet/Outlet
- Substrate
- Physical Barrier

Flooding Impact Potential

- Development/Land Use
- Road Crossing Type
- Flood Prone Areas





Bridges and Culverts - Findings

- 38% are <u>presently</u> hydraulically undersized (less than 25-year design flow capacity)
- 49% will be undersized under a Year 2070 climate change scenario
- Only 40% of stream crossings provide for full passage of aquatic organisms

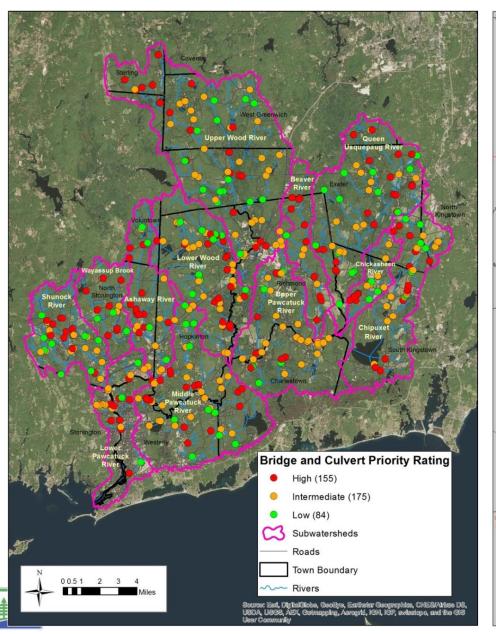


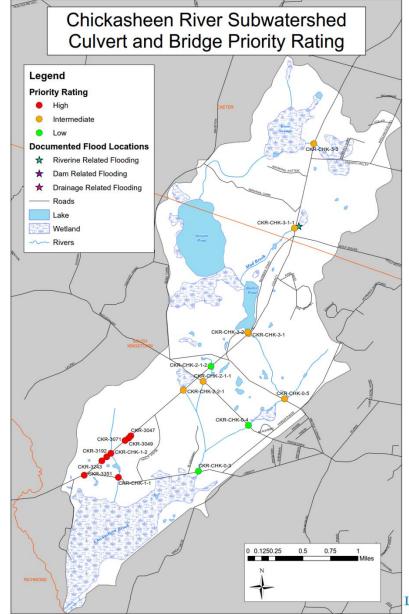






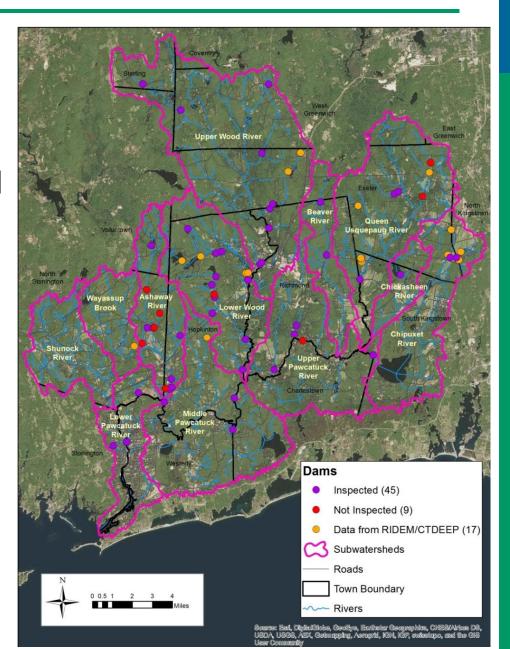
Culvert & Bridge Priority Ratings





Wood-Pawcatuck Dams

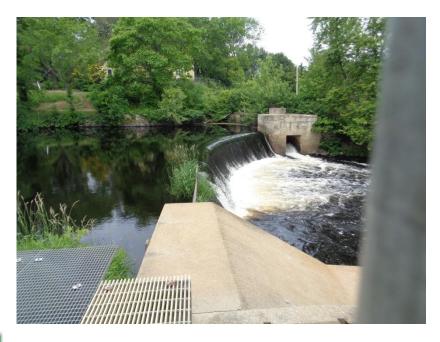
- Initially identified 150 dams
- Identified 70 highest priority dams for visual inspection
- Inspected 43 dams
- Denied access to 27 dams





Dams - Field Inspections

 Dam inspection protocols modified from the Massachusetts Office of Dam Safety (Phase 1 Formal Dam Safety Inspection Checklist)



Inspection Items

Name, Location, Uses

Size

Hazard Classification

Condition and Deficiencies:

- Embankment
- Dikes
- Upstream Face
- Downstream Face
- Appurtenances
- Concrete Structures
- Masonry Structures
- Spillway





Dams - Alternatives Assessment

Removal/Breach

Repair

Repurposing

Aquatic Organism Passage

No Action/ Maintain **Evaluation Criteria**

Hazard Classification

Dam Condition

Owner's Ability to Maintain

Capacity

Benefits vs Loss of Current Uses

Downstream Continuity

Cost effectiveness

Ease of Permitting

Feasibility of Repurposing

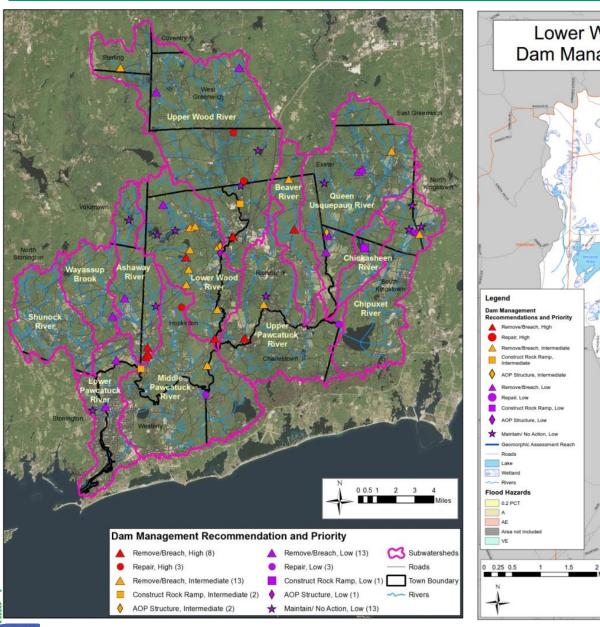
Hydraulic Impacts

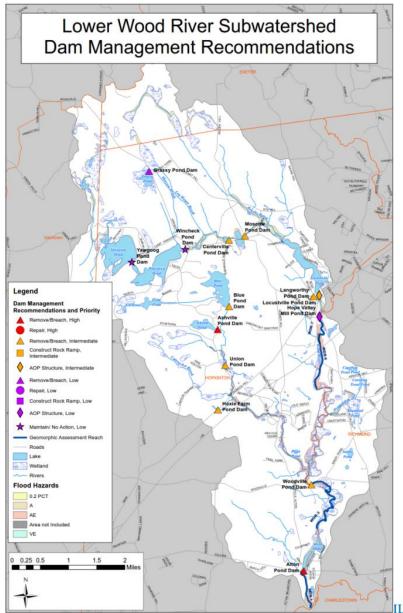
Wetland Impacts





Dam Assessment Results







Assessment Recommendations

- Watershed plan will identify prioritized recommendations for bridges, culverts, and dams
 - Recommendations by subwatershed
 - Typical design and permitting considerations
 - Approximate costs
 - Potential funding sources
- More detailed evaluation needed to confirm feasibility of recommendations and to support design and permitting





Geomorphic Assessment

John Field, Field Geology Services





Green Infrastructure Assessment

- Identify Opportunities for Green Infrastructure (GI) Retrofits
 - Enhance resiliency
 - Provide water quality and ecosystem benefits
- Approach
 - GIS Screening evaluation



Field inventories



Concept designs



Parcel or Site-Based Retrofits

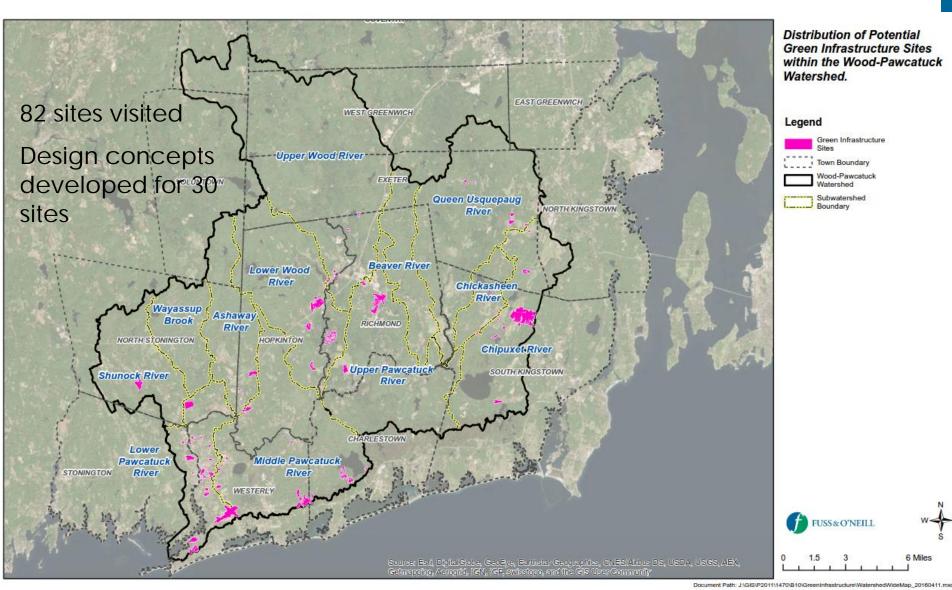


ROW/Street Retrofits





Potential GI Retrofit Sites



Retrofit Site 272A – Westerly Senior Center Bioretention

State Street, Westerly, Rhode Island

Site Description

The proposed retrofit concept is located at the Westerly Senior Center near the intersection of Westminster and State Streets in Westerly, RI. The site consists of an asphalt parking lot divided into multiple parking areas. There is a swale located between two sections of the parking lot, and some runoff is directed to the swale but no overflow or formal BMP exists, nor does the swale capture all of the runoff that could be directed to it.

Proposed Concept

Retrofit the current swale as a bioretention/infiltration practice. The practice would be designed to accept runoff from the surrounding parking lot and additional areas of the site and parking lot. If desired, an overflow structure could be incorporated into the design and connected to current stormwater drainage infrastructure located on Westminster Street.



Image 1: Close-up view of proposed bioretention/infiltration area.

Retrofit Concept Summary

Total Drainage Area: 1.2 acres
Total Impervious Area: 1.0 acres
Total Water Quality Volume: 3,794.0 ft³
Runoff Reduction Volume: 379.4 ft³

Estimated Pollutant Removal

Bioretention Area

Total Phosphorus ≈ 0.5 lbs/year

Total Nitrogen ≈ 10.5 lbs/year

Total Suspended Solids ≈ 410.2 lbs/year

Bacteria (FC) ≈ 307.5 billion colonies/year

Estimated Cost

Bioretention Area: \$51,032



Image 2: Rendering of a typical bioretention area. (Image source: Johnson County Soil and Water District)



Image 3: View of proposed bioretention/infiltration area and some of the parking area that would drain to it.







Legend Existing Catch Basin Pervious Pavers Proposed Level Spreader Bioretention Forested Buffer Proposed Catch Basin Proposed Storm Drain Raingarden BMP Drainage Area Underground Infiltration Articulating Concrete Matting Proposed Overflow Boundary Structure Green Roof 180 Feet Disclaimer: This map is not the product of a Professional Land Survey. It was created by Fuss & O'Neill, Inc. for general Data Source(s): Drainage Areas by Fuss & O'Well, 2016; Aerial Photography.

Disclaimer: This map is not the product of a Professional Land Survey. It was created by Fus & O'Nell, Inc. for general reference, informational, planning and guidance use, and is not a legally authoristative source as to location of natural or mammade features. Proper interpretation of this map may require the assistance of appropriate professional services. Fuss & O'Nell, Inc. makes no warrance, express or implied, related to the spatial accuracy, reliability, completeness, or currentness of this map.

Data Source(s): Drainage Areas by Fuss & O'Neill, 2016; Aerial Photography. April 2014 USGS 0.3 m multispectral ortho imagery, downloaded from AroGIS Online; Contour Lines from Northeast LIDAR Project 2011, RIGIS

Stormwater Retrofit Concept

Westerly Senior Center (272 A)

Retrofit Site No. 272

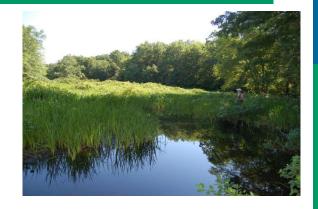
Westerly Rhode Island



317 Iron Horse Way, Suite 204 Providence, RI 02908 401.861.3070 | www.fando.com

Watershed Wetlands Assessment

- Wetlands can provide flood mitigation, habitat, water quality, and other functions
- Identify and prioritize conservation and restoration opportunities
 - GIS-based screening
 - USFWS NWI Plus Dataset for RI and CT
 - Rhode Island Freshwater
 Wetland Restoration Strategy
 (Miller and Golet, 2001- URI)



U.S. Fish & Wildlife Service

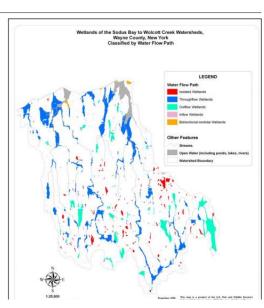
NWIPlus: Geospatial Database for Watershed-level Functional Assessment

While much government attention has focused on creating methods for site-specific analysis of wetland functions for evaluating the impacts of proposed development and for predicting the condition of wetlands through probabilistic sampling, the U.S. Fish and Wildlife Service has been developing techniques to use its National Wetlands Inventory (NWI) data to predict wetland functions for watersheds.

What is NWIPlus?

Recognizing the value of adding hydrogeomorphic properties to the NWI database (i.e., increased functionality), the NWI created a set of hydrogeomorphic-type descriptors that could be added to NWI types to facilitate predicting wetland functions. The combination of these attributes with traditional NWI types can be called "NWIPlus" resulting in an enhanced NWI database.

The new attributes describe landscape position (relation of a wetland to a waterbody if present: marine - ocean, estuarine - tidal brackish, lotic - river/stream, lentic - lake/reservoir, and terrene - not affected by such waters), landform (physical shape of the wetland - basin, flat, floodplain, fringe, island, and slope), water flow

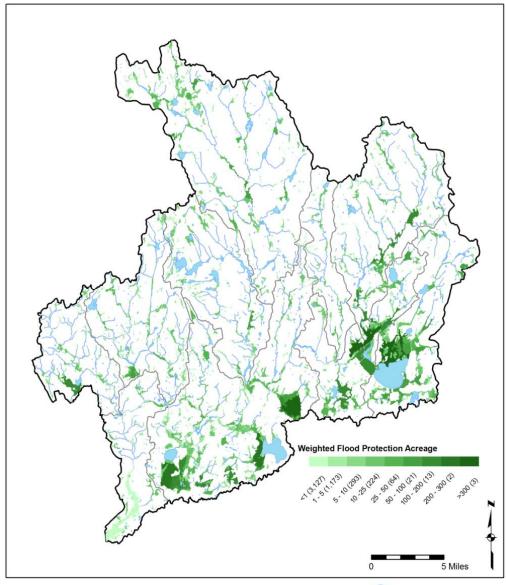






Watershed Wetlands Assessment

- 80 wetland complexes with flood protection function and human modification
- 24 assessed in the field for functions and values
- Several impoundments/dams with high conservation potential (Hazard Pond, Dolly Pond, Kasella Farm Pond)
- Other wetland restoration opportunities identified







Watershed Plan Development

- Integrate findings and recommendations of technical assessments (see the boards around the room)
- Integrate input from the municipalities and the public
- Develop actions, schedule, lead groups, costs, funding sources, etc.

Potential Management Actions

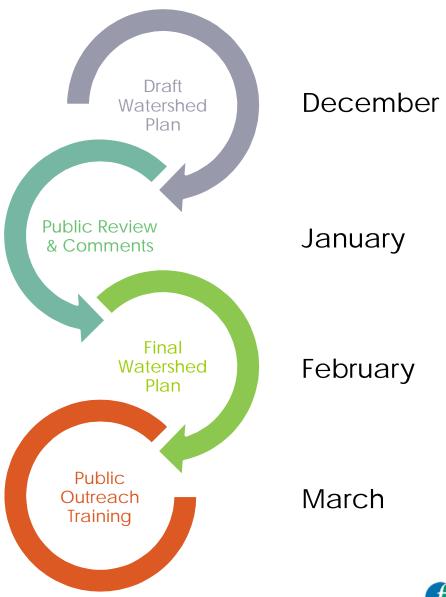
- Land use regulatory controls
- Active restoration
 - Elevating and flood proofing structures
 - Dam removal
 - Aquatic connectivity obstruction removal
 - Bridge and culvert retrofits and replacements
- Passive restoration
 - Riparian buffer restoration and protection
 - Stream bank stabilization
 - Corridor easements
- Reach-scale river restoration
- Green infrastructure stormwater management
- Wetland and habitat restoration
- Related water quality mitigation





Next Steps

- Draft technical assessment reports are available for download and review
- Comments are welcome and encouraged







Questions and Discussion

 What are your main concerns regarding the Wood-Pawcatuck watershed?

2. What would you most like to see as outcomes of the Wood-Pawcatuck Watershed Flood Resiliency Management Plan?

3. Do you have any specific project ideas or recommendations for your area of the watershed?





Project Contacts

Contact Information

Erik Mas, P.E. Fuss & O'Neill, Inc. 800.286.2469 emas@fando.com

Denise Poyer
Program Director
Wood-Pawcatuck Watershed Association
401.539.9017
denisep@wpwa.org

Christopher Fox Executive Director Wood-Pawcatuck Watershed Association 401.539.9017

chris@wpwa.org





From: Denise Poyer <denisep@wpwa.org>
Sent: Thursday, June 08, 2017 1:07 PM

Cc: Erik Mas

Subject: Community Meetings for the Wood-Pawcatuck Flood Management Plan

Greetings!

The Wood-Pawcatuck Watershed Association (WPWA), with a grant from the Hurricane Sandy Community Resiliency Grants Program, has developed a Flood Resiliency Management Plan to help communities in the Wood-Pawcatuck watershed become more resilient to the impacts of flooding, while also benefitting water quality, fish and wildlife, and habitat. The draft of the final plan has been completed! It can be downloaded from the WPWA website: http://wpwa.org/flood_resiliency.html. Please share this information with anyone you think appropriate.

WPWA is holding two community meetings for municipal staff and the public to present the plan and to obtain feedback from the watershed communities that will help shape the final plan. The meetings will be held on:

- 1. Friday, June 23, 2017 from 10 a.m. to noon at the Westerly Library, Third Floor Terrace Room, 44 Broad Street, Westerly, RI 02891.
- Wednesday, June 28, 2017 from 6 p.m. to 8 p.m. at the Richmond Community/Senior Citizen Center, 1168 Main Street, Wyoming, RI 02898.

Project Background

The Pawcatuck River watershed covers an area of approximately 317 square-miles in southern Rhode Island and southeastern Connecticut, including all or portions of 14 communities. The history of flooding and flood damages in the Wood-Pawcatuck River watershed is well-documented. The landmark 2010 flood remains the flood of record for the region, with extreme precipitation and flooding events becoming more frequent in the northeast as a result of climate change.

The primary objectives of this watershed planning project are to:

- Assess the vulnerability of the Wood-Pawcatuck River watershed to flooding and storm-related damages,
- Develop a comprehensive, watershed-based management plan to help communities become more resilient to the impacts of flooding (i.e., enhance flood resilience) and
- Focus on strengthening natural ecosystems that also benefit water quality, fish and wildlife, and habitat.

The management plan builds upon and integrates information from previous and ongoing work within the watershed. It identifies watershed-wide and site-specific project recommendations throughout the Pawcatuck River watershed. It includes potential management alternatives such as land use policies and regulations, active and passive restoration (i.e., bridge and culvert retrofits or replacement, stream buffer restoration, stream bank stabilization, river restoration, corridor easements), green stormwater infrastructure, wetland and habitat restoration, and related water quality mitigation. Many of these recommendations are town specific, and can be used by planners and officials to apply for funding for projects.

If you have any questions about the plan or the community meetings please contact me by email (denisep@wpwa.org) or by calling (401) 539-9017.

Denise J Poyer Project Coordinator Wood-Pawcatuck Watershed Association 203 Arcadia Road Hope Valley, RI 02832 (401) 539-9017 denisep@wpwa.org

Climb the mountains and get their good tidings. Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you, and the storms their energy,

while cares will drop off like autumn leaves.

-- John Muir



Wood-Pawcatuck Watershed Association

203 Arcadia Road, Hope Valley, RI02832; 401-539-9017; info@wpwa.org; www.wpwa.org

Wood-Pawcatuck Flood Resiliency Management Plan **Community Meeting**

June 23, 2017

Name	Association	Contact	
Denise Payer	WPWA	denisepayone	1015
Benjamin Delany	Tony of Westerly	bde loney a westerlyring.	• 77
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Sean Henry	Tom of Hopkinton	Sherry hopkinton riving	
Julian Berry	Town of Kichmond	tounplanner@nichn	andn-
Doug McLean	Town of South Kingston		com
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[&]quot;To preserve and protect the lands and waters of the Wood-Pawcatuck watershed for natural and human communities"

Wood-Pawcatuck Watershed Flood Resiliency Management Plan Community Meeting

June 23, 2017 Westerly Public Library

Questions and Discussion

- Jon Zwarg (RIDEM): After the presentation, Jon provided an update on the status of RIDEM's effort to prepare a water quality watershed management plan for the Wood-Pawcatuck watershed. The watershed plan addresses EPA's nine elements for watershed-based plans and will focus on water quality, as opposed to flooding. The water quality plan builds upon much of the baseline watershed information included in the flood resiliency management plan, and will include a framework and high-level recommendations for the watershed communities and other stakeholders to use as a starting point from which refined, site-specific recommendations can be developed. A draft for public review is expected to be issued by RIDEM in the coming weeks.
- Juliana Berry (Richmond Town Planner): Regarding the RIDEM Section 319 Nonpoint Source Grant Program funds for FY2016 and FY2017 (which have been announced jointly with the Narragansett Bay and Watersheds Restoration Fund (BRWF) grant program), will RIDEM award 319 grant funding to an applicant if the applicant is not the property owner? This has been a challenge for towns and other groups such as the Wood-Pawcatuck Watershed Association to use 319 funds for projects on land not owned by the town.
 - o <u>Jon Zwarg (RIDEM)</u>: Was not sure and recommended contacting Sue Kiernan at RIDEM for clarification.
- Sean Henry (Town of Hopkinton): The Town of Hopkinton is in the process of updating its Comprehensive Plan, Hazard Mitigation Plan, and land use ordinances/regulations. These updates will incorporate policy and other recommendations from the Wood-Pawcatuck Watershed Flood Resiliency Management Plan. Does the land use regulatory review document from the Wood-Pawcatuck study include town-specific recommendations?
 - <u>Erik Mas (Fuss & O'Neill)</u>: Yes. The Land Use Regulatory Review (Appendix K of the watershed plan) includes more detailed recommendations specific to each community's land use regulations and policies, in addition to general recommendations that are broadly applicable to many of the watershed communities. The town-specific recommendations will need to be refined by local planning staff but are a good starting point to begin the regulatory update process. The Land Use Regulatory Review also provides links to sources of model regulatory language.
- Dennis Unites (Stonington): Does the Wood-Pawcatuck Watershed Flood Resiliency Management Plan consider coastal resiliency and sea level rise, and what is the more

critical concern for the estuarine portion of the Pawcatuck River in Westerly and Stonington/Pawcatuck – coastal flood risk or inland/riverine flood risk?

- <u>Erik Mas (Fuss & O'Neill)</u>: It depends on the specific location of interest. In mapped coastal flood hazard zones and inundation zones under future climate change scenarios, such as along the coast and the estuarine portion of the Pawcatuck River, coastal flooding is the primary flood hazard. Outside of these areas, such as along tributary streams that flow into the estuary, riverine flooding is likely the more significant flood hazard. The Wood-Pawcatuck Watershed Flood Resiliency Management Plan study primarily focused on the inland/riverine portion of the Pawcatuck River.
- Joseph MacAndrew (Wood-Pawcatuck Watershed Association): With the removal of several dams along the lower Pawcatuck River including most recently White Rock Dam, Potter Hill Dam, the downstream-most dam remaining on the Pawcatuck River, poses a significant flood risk to downtown Westerly. Water and debris that would be released in the event of failure of Potter Hill Dam could damage the downstream bridges over the lower Pawcatuck River at Boom Bridge Road, Stillman Avenue, Route 3, Route 1, etc. Potter Hill Dam is also one of the last remaining barriers to migratory fish passage along the Pawcatuck River, with the construction of a rock ramp fishway at Bradford Dam underway. Potter Hill Dam should be removed to enhance flood resiliency and migratory fish passage along the lower Pawcatuck River. Furthermore, the mill building at Potter Hill is dilapidated and continues to deteriorate.
 - O Denise Poyer (Wood-Pawcatuck Watershed Association): The owner has not been willing to consider dam removal but has proposed various types of site redevelopment over the years, including several unsuccessful attempts to obtain FERC licensing to install a hydropower facility at Potter Hill Dam. If approved by Congress, Wild and Scenic Designation of the Wood-Pawcatuck River would preclude hydropower installations along the Wood-Pawcatuck River system, as well as make the Wood-Pawcatuck, including the watershed communities, potentially eligible for National Park Service funding for certain types of restoration projects in the watershed such as stream and floodplain restoration.
- Doug McLean (Town of South Kingstown): Does the watershed plan recommend a strategy for the order in which infrastructure upgrades are completed? For example, replacing an undersized, upstream culvert with a larger structure could potentially put more hydraulic stress on undersized infrastructure downstream. Has any hydraulic modeling been performed as part of the watershed plan development process to examine these issues?
 - o <u>Erik Mas (Fuss & O'Neill)</u>: The watershed plan includes a recommended strategy for upgrading/replacing undersized road stream crossings on the same river system. Upgrades should generally proceed from downstream to upstream to avoid exacerbating downstream flooding problems. The study did not include hydraulic modeling given the preliminary, planning-level nature of the assessment and recommendations. Hydraulic modeling would be needed to support the design and permitting of specific culvert or bridge replacements. On a related note, FEMA and USGS are in the process of updating the flood hazard mapping for the

Wood-Pawcatuck watershed through the RiskMAP process. The updated mapping is based on refined hydraulic modeling, which incorporates more detailed topographic information, surveyed river cross sections, and more recent precipitation data. The new flood mapping has not been released to the public yet, and FEMA did not share the draft mapping with WPWA and the Fuss & O'Neill project team for the watershed planning effort since it had not gone through the required internal QA/QC process.

- Juliana Berry (Richmond Town Planner): Does the plan address the flooding issues in the Valley Lodge neighborhood? The area experiences flooding associated with the Wood River and stormwater runoff from Interstate 95. The issues have been examined by various groups, but the specific causes of the flooding are unclear.
 - Erik Mas (Fuss & O'Neill): The plan will include recognition of the flooding issues, and possibly mitigation approaches, associated with the Valley Lodge neighborhood.
- <u>Juliana Berry (Richmond Town Planner)</u>: Has RIDOT been involved in the development of the flood resiliency management plan? Will identification of specific priority infrastructure projects that are included in the plan influence decision-making relative to projects that are included in the Transportation Improvement Program (TIP)?
 - <u>Erik Mas (Fuss & O'Neill)</u>: RIDOT was not a formal member of the project steering committee, but RIDOT staff attended a recent meeting with RIDEM staff and others to learn more about the project and to coordinate planning efforts. RIDOT has reached out to us requesting the project database on the state-owned culverts and bridges that were assessed as part of our study. We anticipate that RIDOT will consider the plan recommendations in the transportation funding decision-making process.
- <u>Dennis Unites (Stonington)</u>: Suggested including the WPWA web link address to the watershed plan on the Town Summary Sheets.

Wood-Pawcatuck Watershed Flood Resiliency Management Plan

Community Meeting

June 23, 2017







Meeting Agenda

10:00 – 10:05 Introductions

10:05 – 10:15 Project Background and Watershed Planning Process

10:15 – 10:30 Summary of the Issues

10:30 – 11:15 Draft Watershed Plan Recommendations

11:15 – 12:00 Questions and Discussion*

*Update by RIDEM on Water Quality Planning Process





Project Team

- § Wood-Pawcatuck Watershed Association
- § Fuss & O'Neill, Inc. and Field Geology Services
- § Project Steering Committee
 - Municipal representatives from the most heavily-impacted watershed communities
 - State and federal agencies
 - Other organizations





Purpose of Today's Meeting

- 1. Summarize watershed issues and planning process
- 2. Review draft watershed plan recommendations
- 3. Provide opportunity for public input and discussion







Project Objectives

- Assess the vulnerability of the Wood-Pawcatuck Watershed to flooding
- 2. Develop a watershed-based management plan
 - Enhance flood "resilience"
 - Strengthen natural ecosystems
 - Habitat
 - Water quality
 - Prioritized actions and implementation projects
- 3. Encourage local decision-makers to think more strategically about natural systems approaches





What is Flood Resilience or Resiliency?

A community's ability to plan for, respond to, and recover from floods

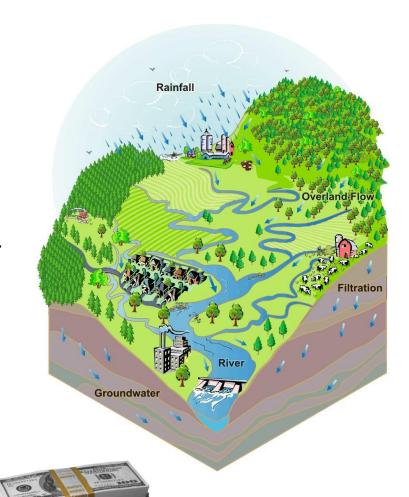






Why Develop a Watershed Plan?

- § Water flow does not follow political boundaries
- § Upstream activities affect downstream flooding
- § Watersheds are logical frameworks to address water resource issues
- § A comprehensive, sciencebased management plan developed with public input improves chances of success and future funding

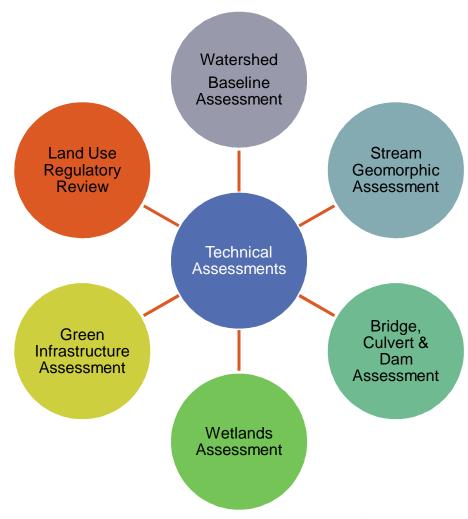






Watershed Planning Process

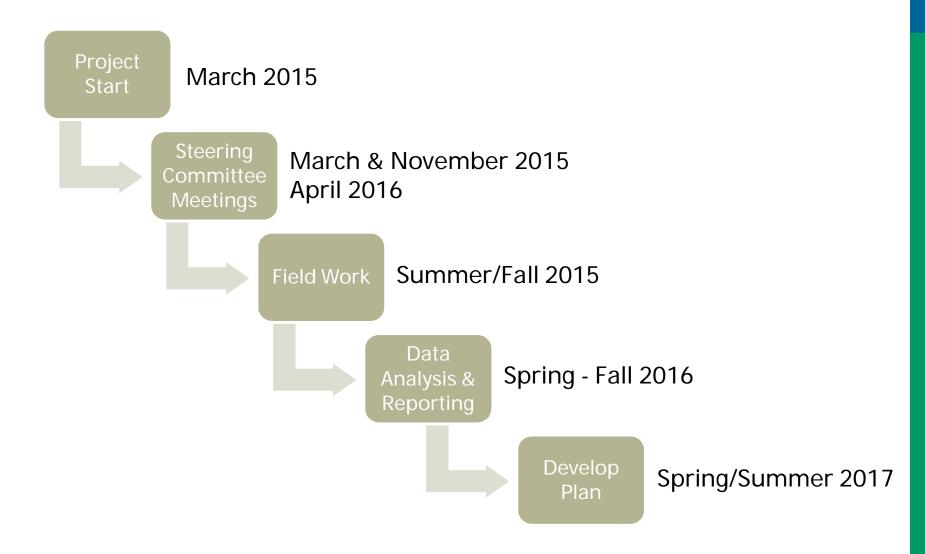
- § Stakeholder and Community Involvement
 - Steering Committee
 - Watershed Survey
 - Community Meetings
 - Coordination with RIDEM
- § Technical Assessments
 - Series of technical reports
 - Included in Plan Appendices







Project Timeline







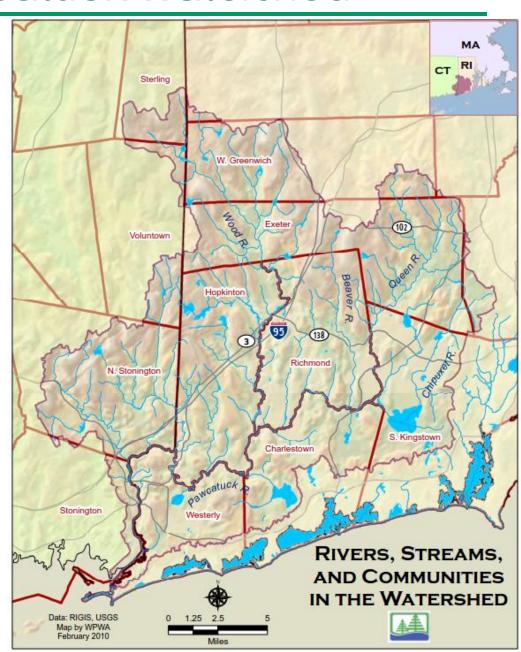
Watershed Conditions and Issues





Wood-Pawcatuck Watershed

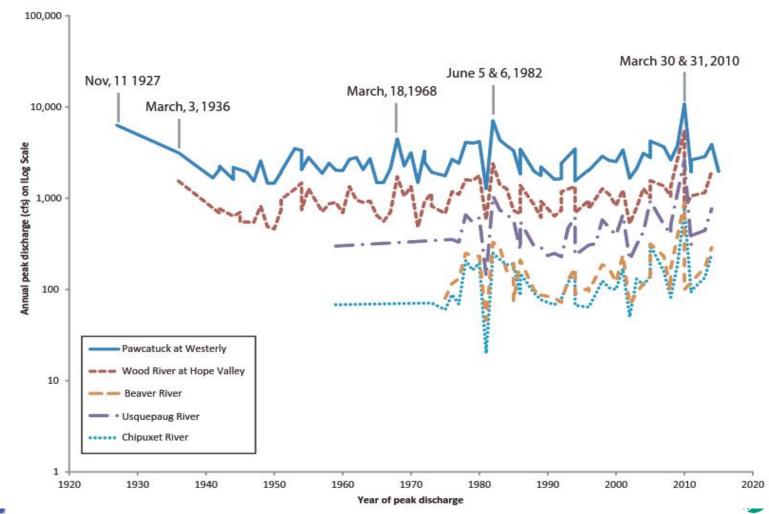
- § 317 square miles in RI and CT
- § Major portions of 11 municipalities
- § 84,000 population
- § 380 stream miles
- § Drains to Pawcatuck River Estuary and Little Narragansett Bay
- § Mostly rural and forested with development in villages/town centers



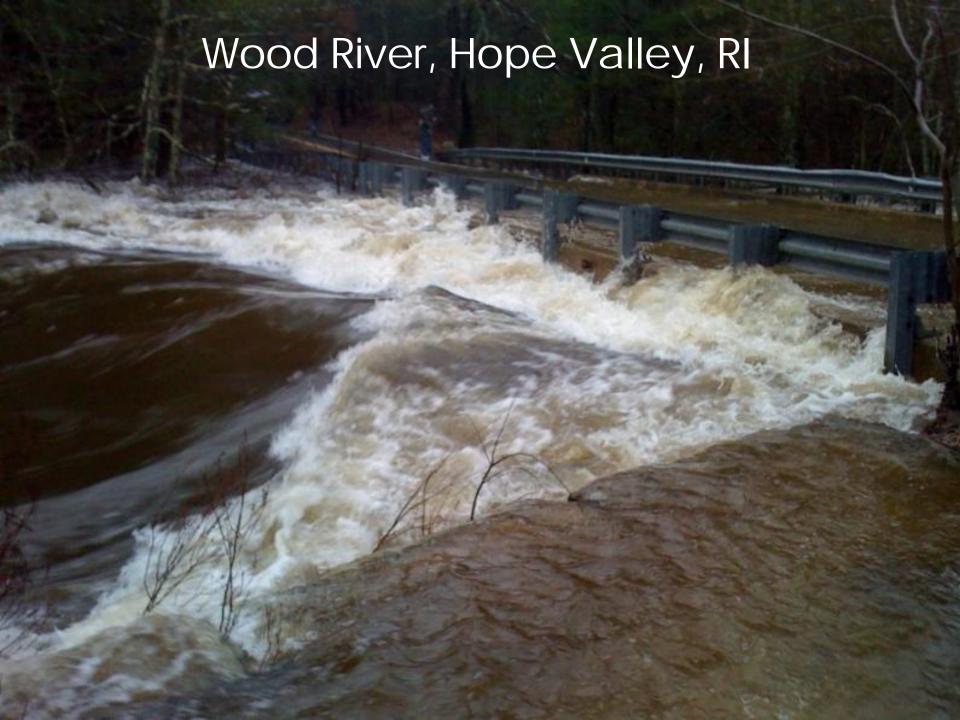


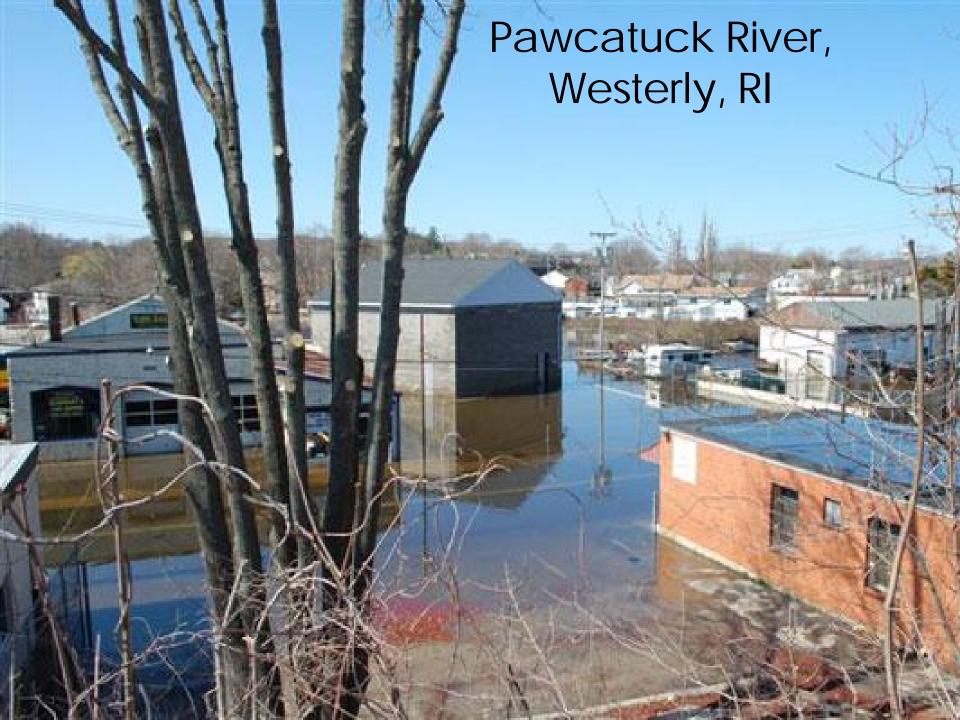
Flooding in the Wood-Pawcatuck

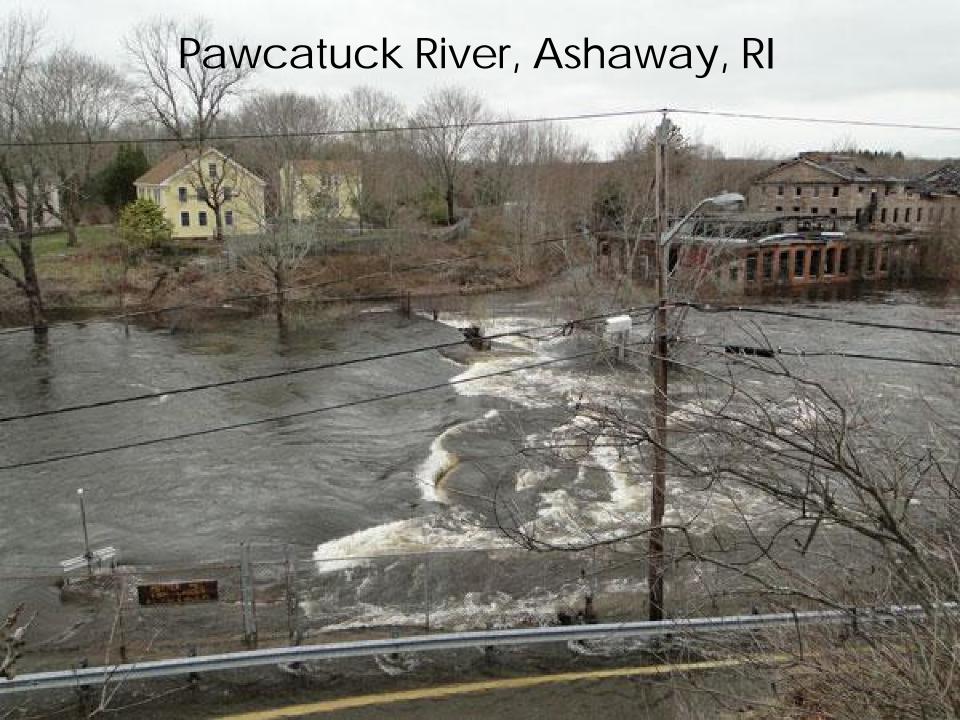
- § History of flooding in the watershed
- The Great Flood of 2010 (>"500-Year Flood")











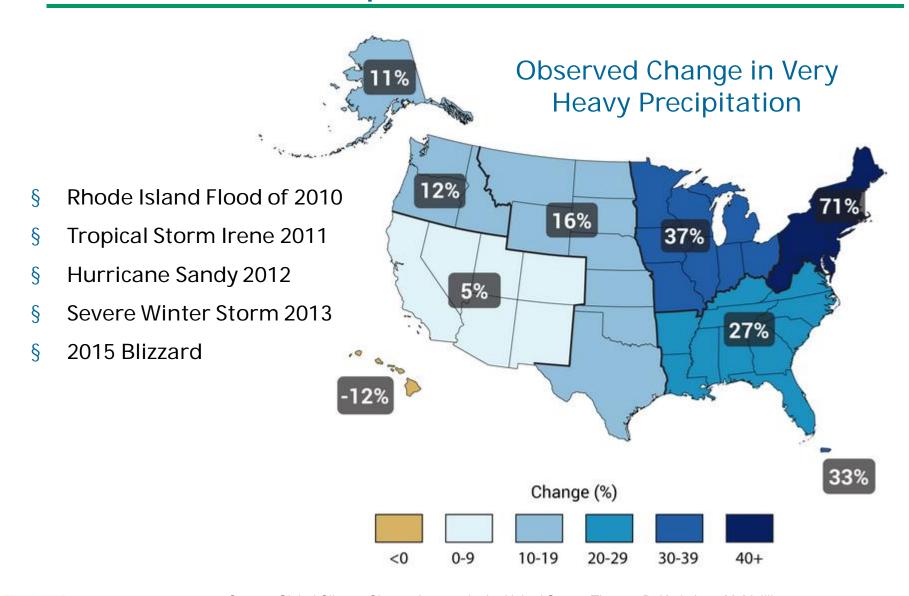
River Corridor & Floodplain Development







More Frequent Extreme Storms

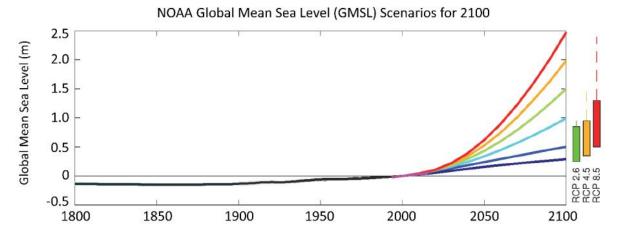






Future Development Pressure

- § Sprawl from nearby urban areas
- § Inland "retreat" in response to sea level rise



NOAA Technical Report NOS CO-OPS 083

GLOBAL AND REGIONAL SEA LEVEL RISE SCENARIOS FOR THE UNITED STATES



Photo: Ocean City, Marylana

Silver Spring, Maryland January 2017











ational Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF COMMERCE
National Ocean Service
Center for Operational Oceanographic Products and Services





Baseline Assessment (Appendix A)

- § Existing watershed conditions
- § Previous and ongoing work in the watershed
 - USGS-FEMA Risk MAP Project
 - USACE Pawcatuck River Flood Risk Feasibility Study
 - RI River & Stream Continuity Project
 - Pawcatuck Dam Removals
 - USFWS Wild & Scenic Reconnaissance Survey
 - RIDEM Water Quality Basin Planning
 - Local Hazard Mitigation Planning



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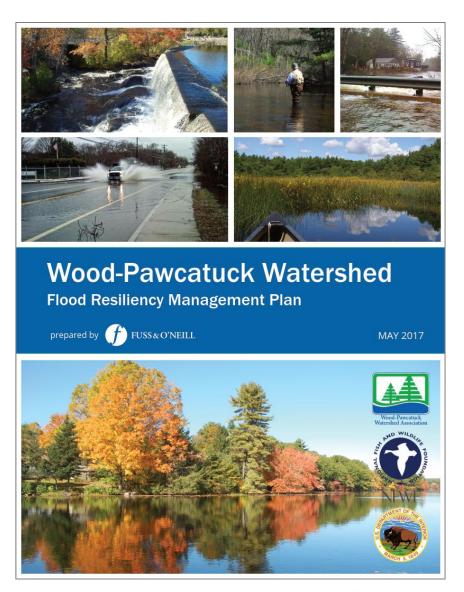
Draft Watershed Plan Recommendations





Flood Resiliency Management Plan

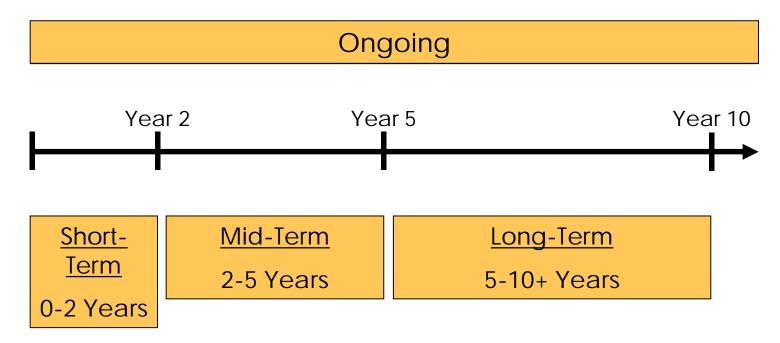
- § Plan Development Process
- § Watershed Overview
- § Management Recommendations
 - Actions
 - Lead entities
 - Timeframe
 - Relative costs
 - Possible funding sources





Recommendations Framework

- § Watershed-wide and targeted/site-specific
- § Timeframe



§ Requires a coordinated effort by many groups





Town Summaries

Wood-Pawcatuck Watershed Flood Resiliency Management Plan

August 2017

Wood-Pawcatuck Watershed Flood Resiliency Management Plan

August 2017

Recommended Actions Summary Town of Charlestown, RI

The Wood-Pawcatuck watershed is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a watershed-based management plan to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a summary of key findings and recommendations of the watershed plan for the Town of Charlestown.

Ouick Facts - Charlestown

- 66% of town within watershed Includes portions of the Pawcatuck River (Charlestown's northern boundary), smaller tributaries, freshwater ponds, and their associated watersheds
- 27 stream crossings assessed
- 1 dam assessed

Road Stream Crossings

- 7 crossings are hydraulically undersized
- 12 crossings have high geomorphic vulnerability 11 crossings have high flood impact potential
- 9 crossings limit or restrict aquatic passage

Recommendations:

- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

Priority Stream Crossings

(Sorted in Order of Priority)				
Road	Stream	Crossing Type		
Burlingame State Park - Management Area	Unnamed	Double 24" Concrete Circular Conduit		
Burlingame State Park - Management Area	Unnamed	12" Concrete Circular Conduit		
Narragansett Trail	Unnamed	12" Concrete Circular Conduit		
Buckeye Brook Road	Poquiant Brook	38" and 12" Concrete Circular Conduit (2 total)		
Shumankanuac Hill Road	Unnamed	36" Concrete Circular Conduit		
Saw Mill Road	Unnamed	12" Concrete Circular Conduit		
Kings Factory Road	Pawcatuck River	57'W x 9'H Concrete Bridge		
Shannock Road	Pawcatuck River	67.5'W Concrete Bridge; openings 3.3'H 7.8'H		
Old Shannock Road	Pawcatuck River	48'W X 9.4'H Concrete Bridge		

Dams

 A single low hazard dam – Burdickville Dam – was assessed in Charlestown, on the Charlestown/ Hopkinton border

Recommendations:

Burdickville Dam (Pawcatuck River)

- Consider dam removal
- Burdickville Dam has been partially breached but may currently prevent passage of some fish species, such as shad
- The impoundment does not appear to support any active uses



Burdickville Dam



Dual concrete culverts at a high priority stream crossing in Burlingame State Park Management Area





Green Infrastructure

A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed. GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

Sites Identified for GI Retrofits:

- Vin Gormley Trailhead Parking
 - Retrofit parking lot with underground infiltration and a bioretention basin o Cost: \$123,000
- * St. Mary's Catholic Church
 - Install a bioretention practice in the grassed island at the Carolina Back Road and Old Carolina Back Road intersection
 - o Cost: \$143,000



Typical installation of underground infiltration system below an existing parking lot.



View of a typical bioretention cell with mature plantings.

Land Use Policy and Regulations

Municipal land use policies and regulations can help communities become more resilient to flooding by:

- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:

A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:

River Corridor

A detailed geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat.

Recommendations:

- Remove granite blocks confining channel downstream of Route 112 to allow floodplain access; use granite blocks to build in-stream habitat structures
- Protect wetlands, including Indian Cedar Swamp, as well as stream connections to wetlands and floodplains
- Install log iams in select locations along the stream corridor to protect banks, create habitat, and reform meanders



Granite-lined, straightened mill-race channel with restricted floodplain access, located downstream of Route 112.

- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend zoning ordinance to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Consider amendments to the existing conservation/cluster development provisions in the zoning ordinance and subdivision regulations to strengthen flood management provisions
- Amend street and parking lot design standards to reduce impervious cover and remove barriers to LID
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges





Recommendations by Category

- 1. Dams
- 2. Culverts and Bridges
- 3. Floodplains and River Corridors
- 4. Wetlands
- 5. Stormwater

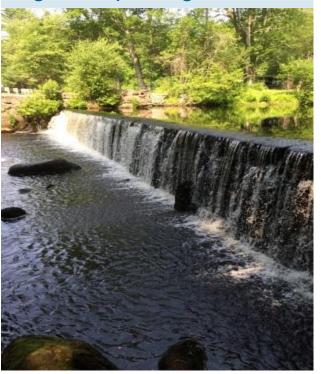




Dams

- § Over 160 documented dams in watershed
- § Many no longer used for original purpose and are in poor condition
- § None constructed for flood control
- § Backwater during floods and downstream hazard in event of dam failure
- § Barriers to fish and other aquatic life
- § Important recreational, habitat, and cultural values

Objective: Reduce the flood risk posed by dams in the watershed, and restore the connectivity of streams for fish and other aquatic organism passage.







Dams - Field Inspections

§ Dam inspection protocols modified from the Massachusetts Office of Dam Safety (Phase 1 Formal Dam Safety Inspection Checklist)



Inspection Items

Name, Location, Uses

Size

Hazard Classification

Condition and Deficiencies:

- Embankment
- Dikes
- Upstream Face
- Downstream Face
- Appurtenances
- Concrete Structures
- Masonry Structures
- Spillway





Dams - Alternatives Assessment

Removal/Breach

Repair

Repurposing

Aquatic Organism Passage

No Action/ Maintain

Evaluation Criteria

Hazard Classification

Dam Condition

Owner's Ability to Maintain

Capacity

Benefits vs Loss of Current Uses

Downstream Continuity

Cost effectiveness

Ease of Permitting

Feasibility of Repurposing

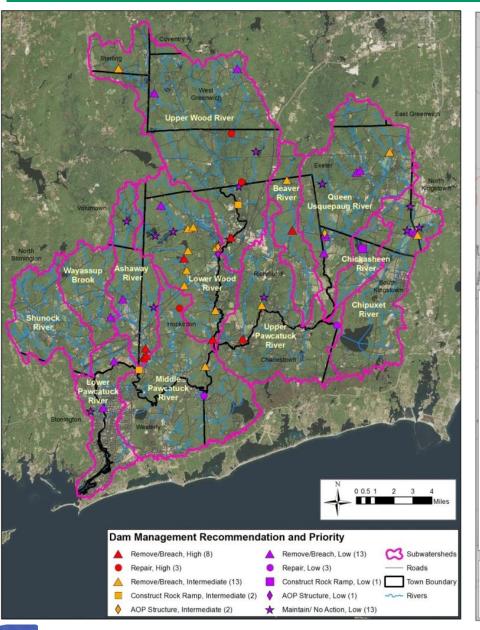
Hydraulic Impacts

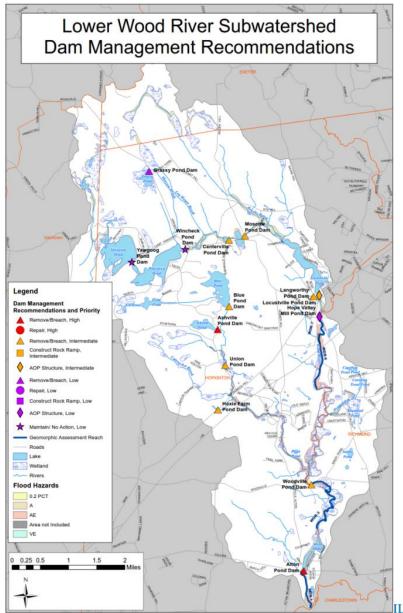
Wetland Impacts





Dams Assessment Results





Dams - Recommendations

- § Incorporate priority dam management recommendations into local hazard mitigation plans
- § Perform site-specific feasibility studies to confirm feasibility of recommendations and to support design and permitting
- § Obtain funding for and implement dam removal projects
- § Dam removal costs are highly site-specific
 - Most projects: \$100,000 to \$1 million
 - Lower Shannock Falls Dam (2011): \$825,000
 - White Rock Dam (2015): \$950,000





Road Stream Crossings

- § Undersized crossings (culverts and bridges) can be flooding and washout hazards
- § Barriers to fish and other aquatic life

Objective: Reduce the flood risk and erosion hazards posed by culverts and bridges in the watershed, and restore the connectivity of streams for fish and other aquatic organism passage.





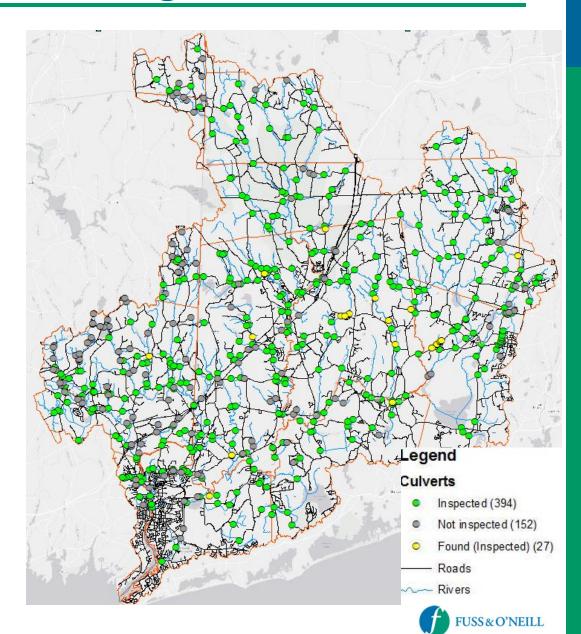






Wood-Pawcatuck Bridges and Culverts

- § 573 structures identified using GIS
- § 421 structures were inspected (May September 2015)





Assessment Approach

- § Adapted from Vermont's Stream Geomorphic Protocols and others used in the Northeast
- § Information gathered
 - Site characteristics (e.g. sketch, street name, stream name)
 - Structure dimensions needed to assess hydraulic capacity
 - Deficiencies and condition of the structure
 - Upstream and downstream geomorphic conditions





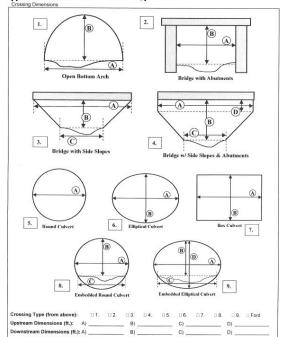








Appendix 2 Field data collection form, p. 3 of 5



Prioritization Criteria

1. Hydraulic Capacity

- Conveyance
- Design Storms
- Climate Change

2. Geomorphic Vulnerability

- Invert/Bed Material
- Culvert/Channel Width
- Culvert Material/Condition

Prioritization

3. Aquatic Organism Passage

- Inlet/Outlet
- Substrate
- Physical Barrier

4. Flooding Impact Potential

- Development/Land Use
- Road Crossing Type
- Flood Prone Areas





Road Stream Crossings - Findings

- § 38% are <u>presently</u> hydraulically undersized (less than 25-year design flow capacity)
- § 49% will be undersized under a Year 2070 climate change scenario
- § Only 40% of road stream crossings provide for full passage of aquatic organisms

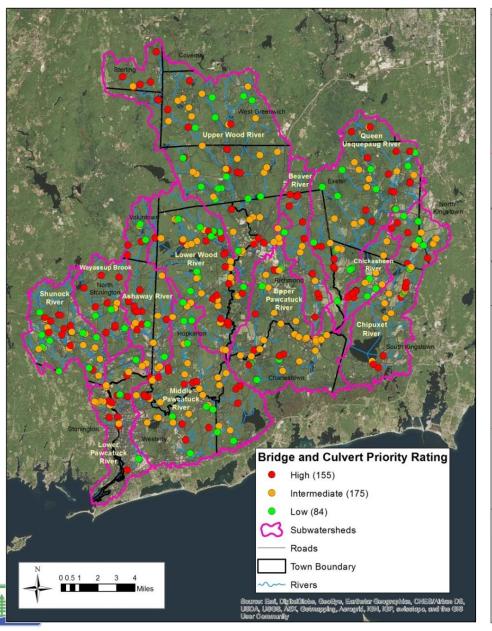


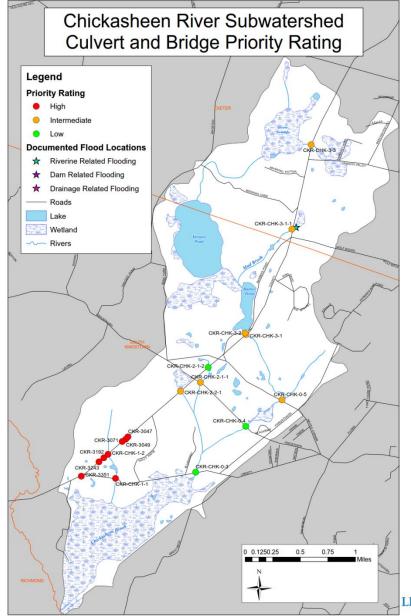






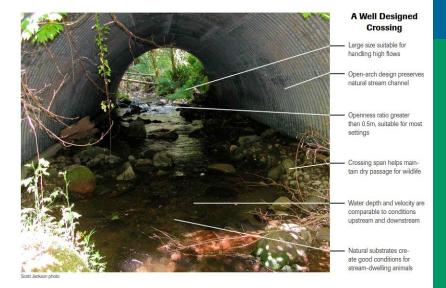
Road Stream Crossings - Priority Ratings





Stream and Flood Friendly Culverts

- § Stream crossing standards MA, NH, NY, CT, VT, ME
- § Well-designed crossings
 - Span the stream and banks
 - Maintain comparable water velocities
 - Have a natural streambed
- § Can be more expensive short-term (50% to 100% more)
- § Long-term costs are reduced due to longer life-span and less maintenance









Road Stream Crossings - Recommendations

- § Incorporate priority stream crossings into local hazard mitigation plans and Capital Improvement Plans
- § Strategically upgrade existing vulnerable stream crossings
- § Implement local and state stream crossing standards modeled after neighboring states
- § Update design storm precipitation amounts in local and state design requirements
- § Provide training to highway departments
- § Implement ongoing inspection and maintenance program





Floodplains and River Corridors

- § Areas along rivers and streams subject to flooding and erosion hazards
- § Most stream reaches sensitive to change
- § Channel straightening and bank armoring
- § River corridor development
- § Floodplain and channel restrictions

Objective: Conserve and restore floodplains and river corridors in a natural condition to mitigate flood and erosion hazards, attenuate sediment loads, and create and enhance habitat.

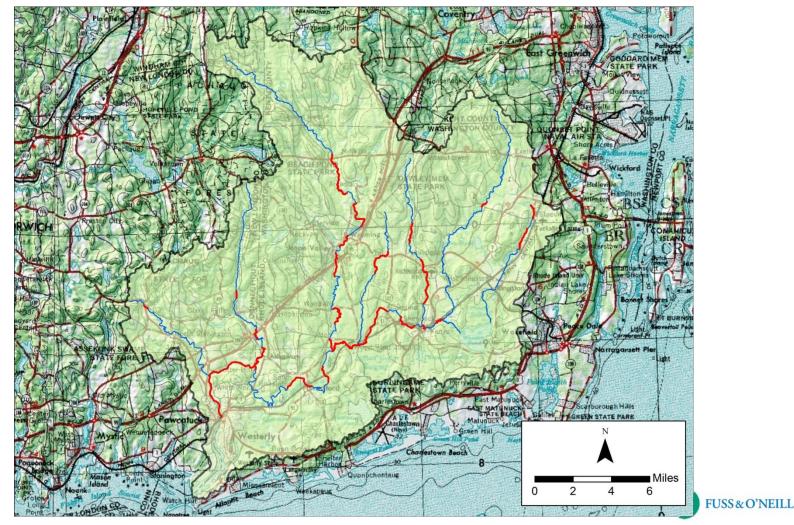
Restore impacted stream channels to an equilibrium condition by addressing the underlying causes of channel instability.





Geomorphic Assessment

- § Phase 1 (desktop) 111 stream miles
- Phase 2 (field) 39 stream miles





Stream Restoration



Marginal Log Jams



Root Wad Revetments



Boulder and Log Deflectors

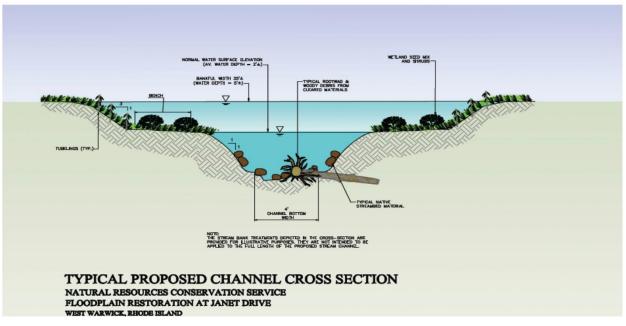


Willow Stakes above Root Wad Revetments





Floodplain Restoration







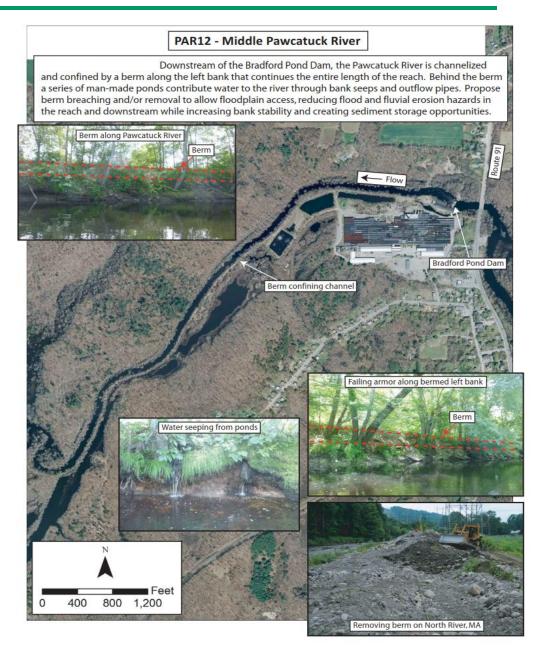


Wood Addition

FUSS&O'NEILL

Floodplain & River Corridor - Recommendations

- § Implement stream and floodplain restoration projects identified in *River Corridor Plan* (Appendix I)
- § Over 40 potential projects identified (10 concepts)
- § Costs highly site specific
 - \$200 to \$1,000 / LF
 - Recent projects (\$300K - \$800K)





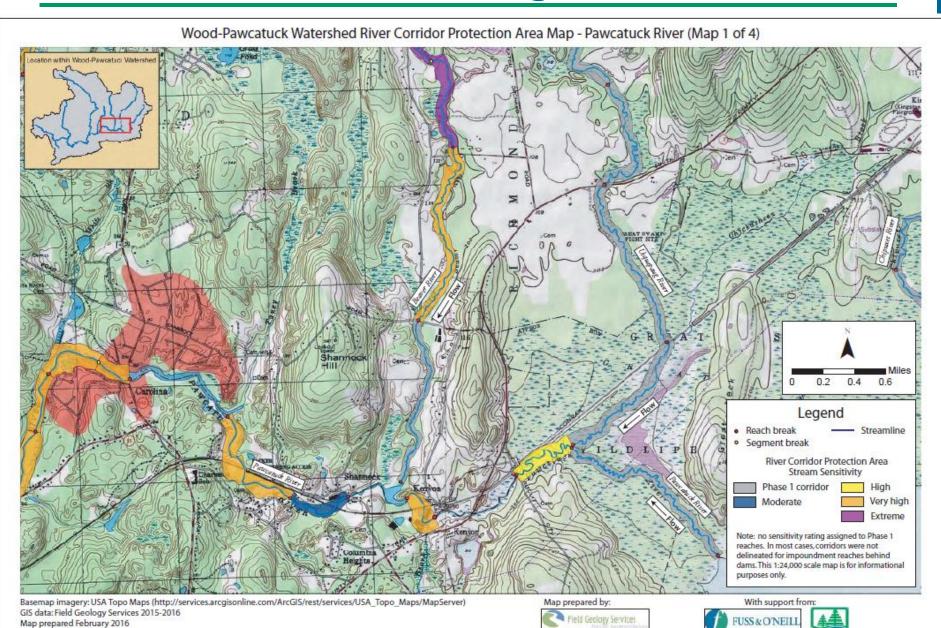
Floodplain & River Corridor - Recommendations

- § Purchase land or acquire conservation easements in floodplains and river corridor
- § Consider Transfer of Development Rights (TDR) ordinance to discourage floodplain development
- § Consider fluvial erosion hazard zoning, or less formal adoption in local hazard mitigation and comprehensive plans





River Corridor Management Areas



Floodplain & River Corridor - Recommendations

- § Review and amend existing conservation or cluster development ordinances & subdivision regulations
- § Consider changes to zoning and subdivision ordinances/regulations to go beyond minimum NFIP standards
 - Incorporate ASFPM "No Adverse Impact Floodplain Management" Policy
 - Increase participation in NFIP Community Rating System
 - Adopt more stringent flood management standards
- § See Land Use Policy and Regulatory Review (Appendix K) for more details





Wetlands

- § Wetlands make up 18% of the watershed
- § Natural sponges reduce flooding and provide many ecological functions

Objective: Conserve and restore watershed wetlands to benefit flooding, water quality, and wildlife habitat.

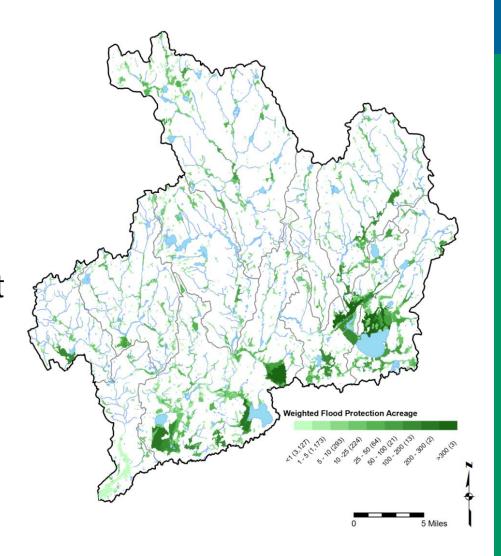






Watershed Wetlands Assessment (Appendix L)

- § Headwater impoundments and associated wetlands provide greatest flood benefit
- § Most "undisturbed" wetlands with significant flood benefit are less than 5 acres in size
- § Riverine wetlands conservation and restoration opportunities







Wetlands - Recommendations

- § Prioritize flood protection functions of wetlands in land use regulations and policies
- § Strategically incorporate wetland restoration into other river corridor restoration projects
 - Large-scale wetland restoration can be very expensive and technically challenging

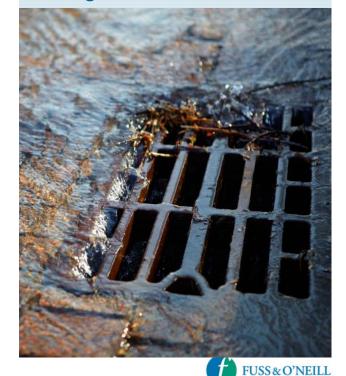




Stormwater

- § Stormwater runoff contributes to drainage-related and riverine flooding
- § Source of water quality problems
- § Communities using green stormwater infrastructure to alleviate drainage-related flooding and improve water quality

Objective: Reduce runoff volumes, flooding, and water quality impacts through improved stormwater management and the use of green stormwater infrastructure throughout the watershed.





Green Stormwater Infrastructure

- § Identify Opportunities for Green Infrastructure (GI) Retrofits
 - Enhance resiliency
 - Provide water quality and ecosystem benefits
- § Approach
 - GIS Screening evaluation



Field inventories



Concept designs



Parcel or Site-Based Retrofits

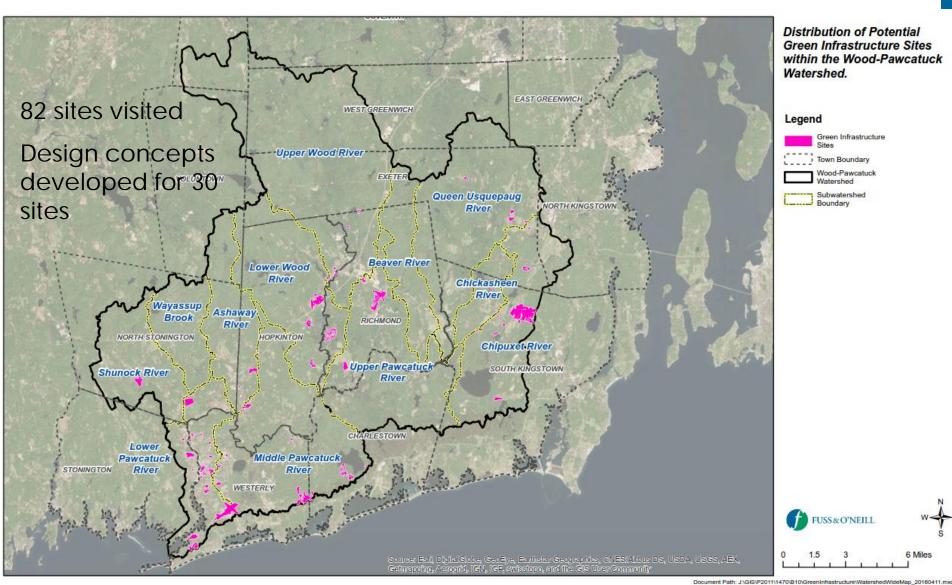


ROW/Street Retrofits





Potential GI Retrofit Sites



Retrofit Site 272A – Westerly Senior Center Bioretention

State Street, Westerly, Rhode Island

Site Description

The proposed retrofit concept is located at the Westerly Senior Center near the intersection of Westminster and State Streets in Westerly, RI. The site consists of an asphalt parking lot divided into multiple parking areas. There is a swale located between two sections of the parking lot, and some runoff is directed to the swale but no overflow or formal BMP exists, nor does the swale capture all of the runoff that could be directed to it.

Proposed Concept

Retrofit the current swale as a bioretention/infiltration practice. The practice would be designed to accept runoff from the surrounding parking lot and additional areas of the site and parking lot. If desired, an overflow structure could be incorporated into the design and connected to current stormwater drainage infrastructure located on Westminster Street.



Image 1: Close-up view of proposed bioretention/infiltration area.

Retrofit Concept Summary

Total Drainage Area: 1.2 acres
Total Impervious Area: 1.0 acres
Total Water Quality Volume: 3,794.0 ft³
Runoff Reduction Volume: 379.4 ft³

Estimated Pollutant Removal

Bioretention Area

Total Phosphorus ≈ 0.5 lbs/year

Total Nitrogen ≈ 10.5 lbs/year

Total Suspended Solids ≈ 410.2 lbs/year

Bacteria (FC) ≈ 307.5 billion colonies/year

Estimated Cost

Bioretention Area: \$51,032



Image 2: Rendering of a typical bioretention area. (Image source: Johnson County Soil and Water District)



Image 3: View of proposed bioretention/infiltration area and some of the parking area that would drain to it.



Stormwater - Recommendations

- § Incorporate GI into municipal stormwater infrastructure planning and capital projects (see concepts in Appendix M)
- § Implement TMDL Implementation Plan for Pawcatuck River and Little Narragansett Bay (Westerly)
- § Update municipal land use policy and regulations to require GI/LID for new development and redevelopment and to meet MS4 Permit requirements
- § Update design storm precipitation amounts and design standards for climate change in coastal areas
- § Pursue sustainable, long-term funding for GI





Plan Implementation Strategy

- "Low-hanging fruit" land use policy/regulatory recommendations
 - Conserve undeveloped land
 - Site development in locations less vulnerable to flooding
 - Promote designs that reduce runoff and less likely to be damaged in a flood
- 2. Obtain funding for and implement priority restoration projects
 - Dam repair and removal
 - Upgrading road stream crossings
 - Other stream corridor and floodplain projects
- 3. Stormwater retrofits and wetland restoration



Funding Sources

Rhode Island

 Narragansett Bay and Watersheds Restoration Fund (BWRF)

Connecticut

- CIRCA Municipal Resilience Grant Program
- STEAP

Federal

- FEMA Hazard Mitigation
- NOAA Coastal Resiliency/Habitat
- USDA NRCS
- Southeast New England Program (SNEP)



In addition to traditional municipal funding sources (i.e., the use of General Funds and municipal bonds), a variety of state and federal sources are also available to provide financial assistance for implementation of the plan recommendations. The funding sources highlighted in this section provide the best opportunities for funding of projects associated with the short- and mid-term plan recommendations. The sources should be re-evaluated periodically to account for potential changes to existing funding programs (i.e., priorities, eligibility, funding cycles, and amounts) and to identify new or emerging sources of funding for flood mitigation, climate resiliency, and habitat restoration projects.

5.1 State Funding Sources

Narragansett Bay and Watersheds Restoration Fund (BWRF)

RIDEM has proposed changes in its regulations that govern the financial assistance program known as the Narragansett Bay and Watersheds Restoration Fund. The goal of the Narragansett Bay and Watersheds Restoration Fund is to restore and protect the water quality and enhance the economic viability and environmental sustainability of Narragansett Bay and the state's watersheds. This established fund provides financial assistance on a competitive basis in the form of grants for various projects that protect and restore water quality and aquatic habitats.

Under the new Flood Prevention and Mitigation Sub-fund of the BWRF, RIDEM is seeking proposals for projects that will address the flooding of coastal or inland areas in a manner that incorporates and enhances natural ecosystem functions including the maintenance of natural hydrologic regimes. These projects would be expected to mitigate a known flooding problem while also delivering ecological cobenefits. Examples of projects eligible for the Flood Prevention and Mitigation Sub-fund include:

- Restoration of floodplains
- . Restoration/re-vegetation of stream banks that reduce peak flows and/or velocities
- Removal of impervious surfaces and associated re-vegetation to increase the on-site retention of stormwater in flood-prone areas
- Replacement of culverts that prevent flooding through improved management of peak flows and enhanced stream continuity
- Creation of floodplain storage capacity
- Aquifer recharge that reduces flooding while maintaining a natural hydrologic regime
- Repairs/enhancements to dams that result in increased capacity for upstream flood storage
- Removal of dams to reduce the risk of flooding in flood-prone areas
- Projects that enhance the resiliency of vulnerable coastal and inland habitats in specific locations that mitigate flooding risks to building, structures or other infrastructure.

Proposed projects submitted for funding should be consistent with approved local hazard mitigation plans or updated hazard mitigation plans that have been formally submitted to the Federal Emergency Management Agency (FEMA) for review and approval. RIDEM will award grants of up to fifty percent





Comments on Draft Plan

Draft plan and appendices available for download:

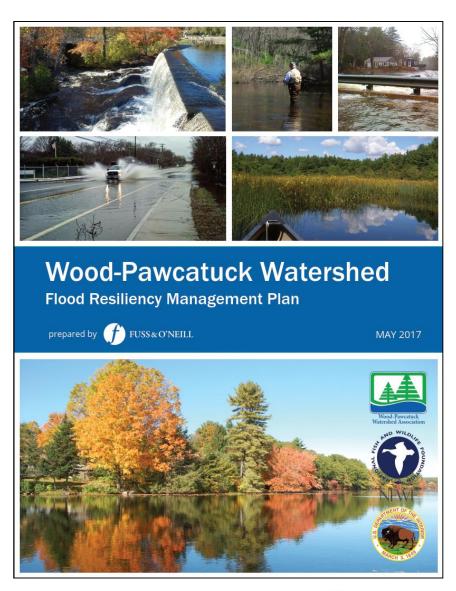
http://wpwa.org/flood_resiliency.html

Submit comments to:

Denise Poyer
Program Director
Wood-Pawcatuck Watershed
Association
401.539.9017

Plan to be finalized in August 2017

denisep@wpwa.org





From: Denise Poyer <denisep@wpwa.org>
Sent: Thursday, June 08, 2017 1:07 PM

Cc: Erik Mas

Subject: Community Meetings for the Wood-Pawcatuck Flood Management Plan

Greetings!

The Wood-Pawcatuck Watershed Association (WPWA), with a grant from the Hurricane Sandy Community Resiliency Grants Program, has developed a Flood Resiliency Management Plan to help communities in the Wood-Pawcatuck watershed become more resilient to the impacts of flooding, while also benefitting water quality, fish and wildlife, and habitat. The draft of the final plan has been completed! It can be downloaded from the WPWA website: http://wpwa.org/flood_resiliency.html. Please share this information with anyone you think appropriate.

WPWA is holding two community meetings for municipal staff and the public to present the plan and to obtain feedback from the watershed communities that will help shape the final plan. The meetings will be held on:

- 1. Friday, June 23, 2017 from 10 a.m. to noon at the Westerly Library, Third Floor Terrace Room, 44 Broad Street, Westerly, RI 02891.
- Wednesday, June 28, 2017 from 6 p.m. to 8 p.m. at the Richmond Community/Senior Citizen Center, 1168 Main Street, Wyoming, RI 02898.

Project Background

The Pawcatuck River watershed covers an area of approximately 317 square-miles in southern Rhode Island and southeastern Connecticut, including all or portions of 14 communities. The history of flooding and flood damages in the Wood-Pawcatuck River watershed is well-documented. The landmark 2010 flood remains the flood of record for the region, with extreme precipitation and flooding events becoming more frequent in the northeast as a result of climate change.

The primary objectives of this watershed planning project are to:

- Assess the vulnerability of the Wood-Pawcatuck River watershed to flooding and storm-related damages,
- Develop a comprehensive, watershed-based management plan to help communities become more resilient to the impacts of flooding (i.e., enhance flood resilience) and
- Focus on strengthening natural ecosystems that also benefit water quality, fish and wildlife, and habitat.

The management plan builds upon and integrates information from previous and ongoing work within the watershed. It identifies watershed-wide and site-specific project recommendations throughout the Pawcatuck River watershed. It includes potential management alternatives such as land use policies and regulations, active and passive restoration (i.e., bridge and culvert retrofits or replacement, stream buffer restoration, stream bank stabilization, river restoration, corridor easements), green stormwater infrastructure, wetland and habitat restoration, and related water quality mitigation. Many of these recommendations are town specific, and can be used by planners and officials to apply for funding for projects.

If you have any questions about the plan or the community meetings please contact me by email (denisep@wpwa.org) or by calling (401) 539-9017.

Denise J Poyer Project Coordinator Wood-Pawcatuck Watershed Association 203 Arcadia Road Hope Valley, RI 02832 (401) 539-9017 denisep@wpwa.org

Climb the mountains and get their good tidings. Nature's peace will flow into you as sunshine flows into trees. The winds will blow their own freshness into you, and the storms their energy,

while cares will drop off like autumn leaves.

-- John Muir



Wood-Pawcatuck Watershed Association

203 Arcadia Road, Hope Valley, RI02832; 401-539-9017; info@wpwa.org; www.wpwa.org

Wood-Pawcatuck Flood Resiliency Management Plan Community Meeting

June 23, 2017

Name	Association	Contact
Venise Goyer	WPMA	denisep. Dwin c
JIM LAMPHERE	1-6 PKINTON	
Jon Zwary Ernie Panciera	RIDEM	
Ernie Panciera	RIOGM	
Stelan Banetson	RICHMONS	
Nics wight	T NIL	
Virginia Lee	Charlestown Town Council	President Vivania. Lee
<u> </u>		Claritestrangi,
·		
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[&]quot;To preserve and protect the lands and waters of the Wood-Pawcatuck watershed for natural and human communities"

Wood-Pawcatuck Watershed Flood Resiliency Management Plan Community Meeting

June 28, 2017 Richmond Senior Center

Questions and Discussion

- <u>Ernie Panciera (RIDEM)</u>: Why does the watershed plan include local land use and policy recommendations related to wetlands since wetlands in RI are regulated at the state level?
 - Erik Mas (Fuss & O'Neill): The wetland-related land use recommendations are primarily for the Connecticut communities, where wetlands are regulated at the local level.
- <u>Jim Lamphere (Town of Hopkinton)</u>: What is RIDOT's role in implementing the watershed management plan? Will state-owned priority culverts that are identified in the watershed plan be included in the Transportation Improvement Program (TIP)?
 - <u>Erik Mas (Fuss & O'Neill)</u>: RIDOT was not a formal member of the project steering committee, but RIDOT staff attended a recent meeting with RIDEM staff and others to learn more about the project and to coordinate planning efforts. RIDOT has reached out to us requesting the project database on the state-owned culverts and bridges that were assessed as part of our study. We anticipate that RIDOT will consider the plan recommendations in the transportation funding decision-making process.
- <u>Virginia Lee (Charlestown Town Council President)</u>: Virginia arrived after the formal
 presentation and group discussion. Denise Poyer and Erik Mas provided Virginia with a
 brief overview of the project and answered questions about project implementation and
 funding, including the Narragansett Bay and Watersheds Restoration Fund.
- Ernie Panciera/Jon Zwarg (RIDEM): Ernie and Jon provided an update on the status of RIDEM's effort to prepare a water quality watershed management plan for the Wood-Pawcatuck watershed. The watershed plan addresses EPA's nine elements for watershed-based plans and will focus on water quality, as opposed to flooding. The water quality plan builds upon much of the baseline watershed information included in the flood resiliency management plan, and will include a framework and high-level recommendations for the watershed communities and other stakeholders to use as a starting point from which refined, site-specific recommendations can be developed. A draft for public review is expected to be issued by RIDEM in the coming weeks.

Wood-Pawcatuck Watershed Flood Resiliency Management Plan

Community Meeting

June 28, 2017







Meeting Agenda

6:00 – 6:05 Introductions

6:05 – 6:15 Project Background and Watershed Planning Process

6:15 – 6:30 Summary of the Issues

6:30 – 7:15 Draft Watershed Plan Recommendations

7:15 – 8:00 Questions and Discussion*

^{*}Update by RIDEM on Water Quality Planning Process





Project Team

- § Wood-Pawcatuck Watershed Association
- § Fuss & O'Neill, Inc. and Field Geology Services
- § Project Steering Committee
 - Municipal representatives from the most heavily-impacted watershed communities
 - State and federal agencies
 - Other organizations





Purpose of Today's Meeting

- 1. Summarize watershed issues and planning process
- 2. Review draft watershed plan recommendations
- 3. Provide opportunity for public input and discussion







Project Objectives

- Assess the vulnerability of the Wood-Pawcatuck Watershed to flooding
- 2. Develop a watershed-based management plan
 - Enhance flood "resilience"
 - Strengthen natural ecosystems
 - Habitat
 - Water quality
 - Prioritized actions and implementation projects
- 3. Encourage local decision-makers to think more strategically about natural systems approaches





What is Flood Resilience or Resiliency?

A community's ability to plan for, respond to, and recover from floods

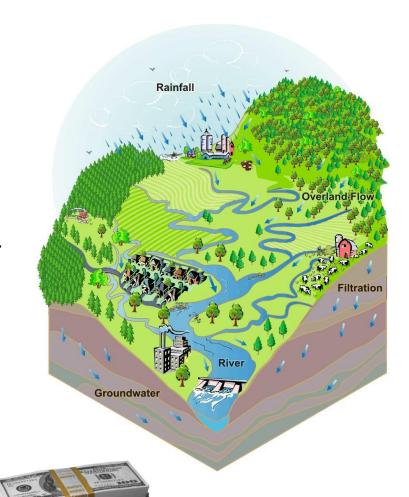






Why Develop a Watershed Plan?

- § Water flow does not follow political boundaries
- § Upstream activities affect downstream flooding
- § Watersheds are logical frameworks to address water resource issues
- § A comprehensive, sciencebased management plan developed with public input improves chances of success and future funding

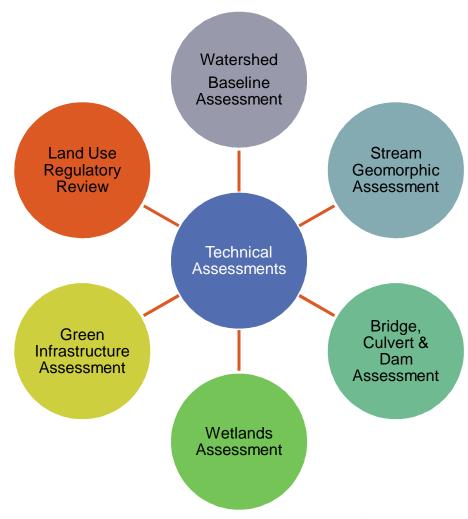






Watershed Planning Process

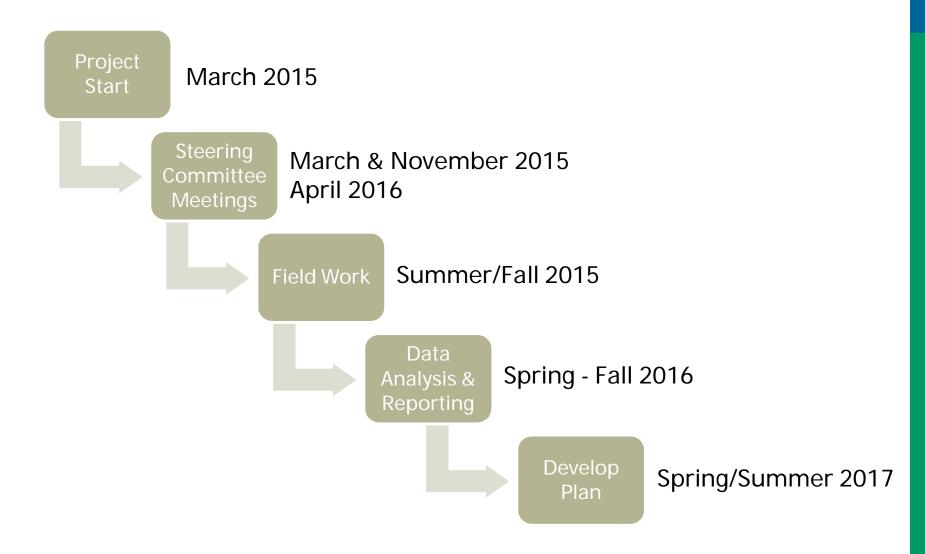
- § Stakeholder and Community Involvement
 - Steering Committee
 - Watershed Survey
 - Community Meetings
 - Coordination with RIDEM
- § Technical Assessments
 - Series of technical reports
 - Included in Plan Appendices







Project Timeline







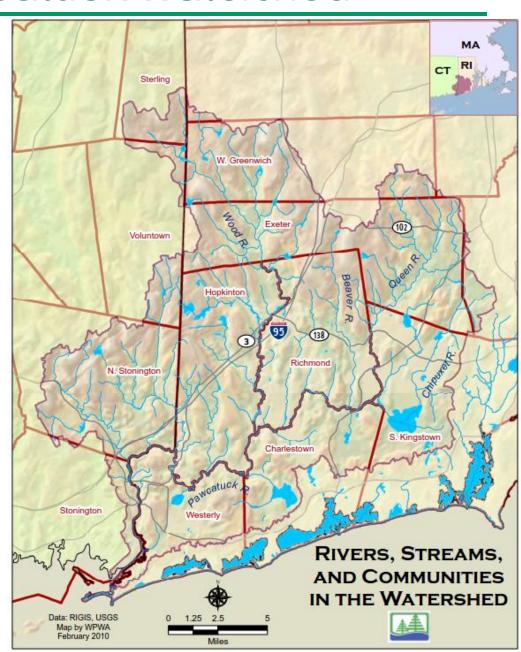
Watershed Conditions and Issues





Wood-Pawcatuck Watershed

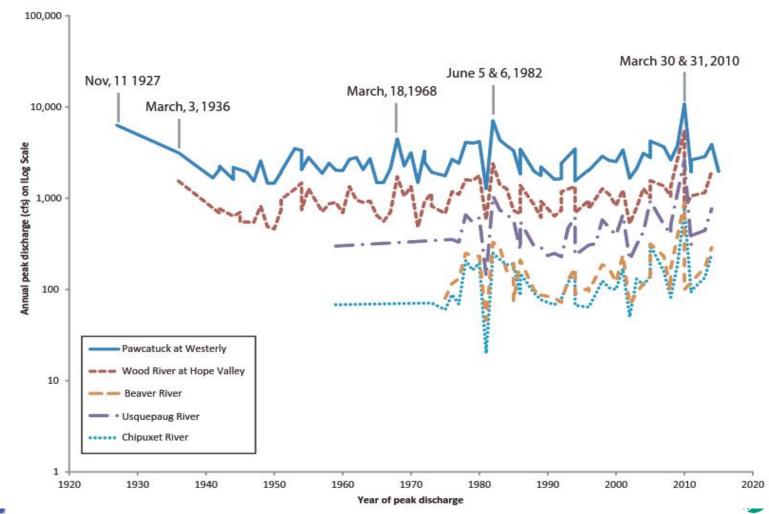
- § 317 square miles in RI and CT
- § Major portions of 11 municipalities
- § 84,000 population
- § 380 stream miles
- § Drains to Pawcatuck River Estuary and Little Narragansett Bay
- § Mostly rural and forested with development in villages/town centers



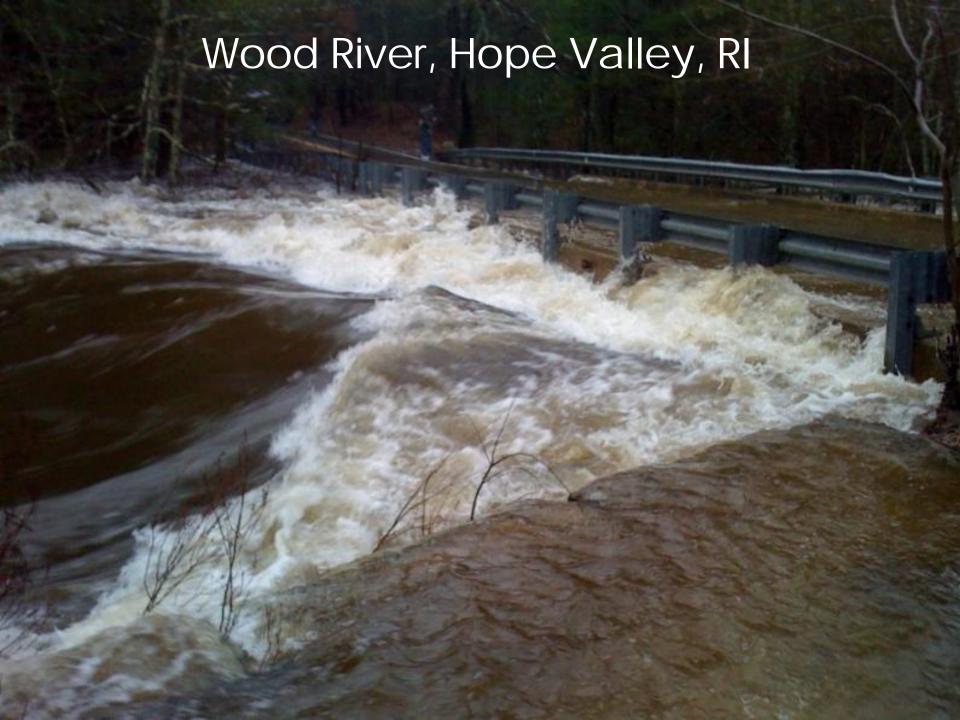


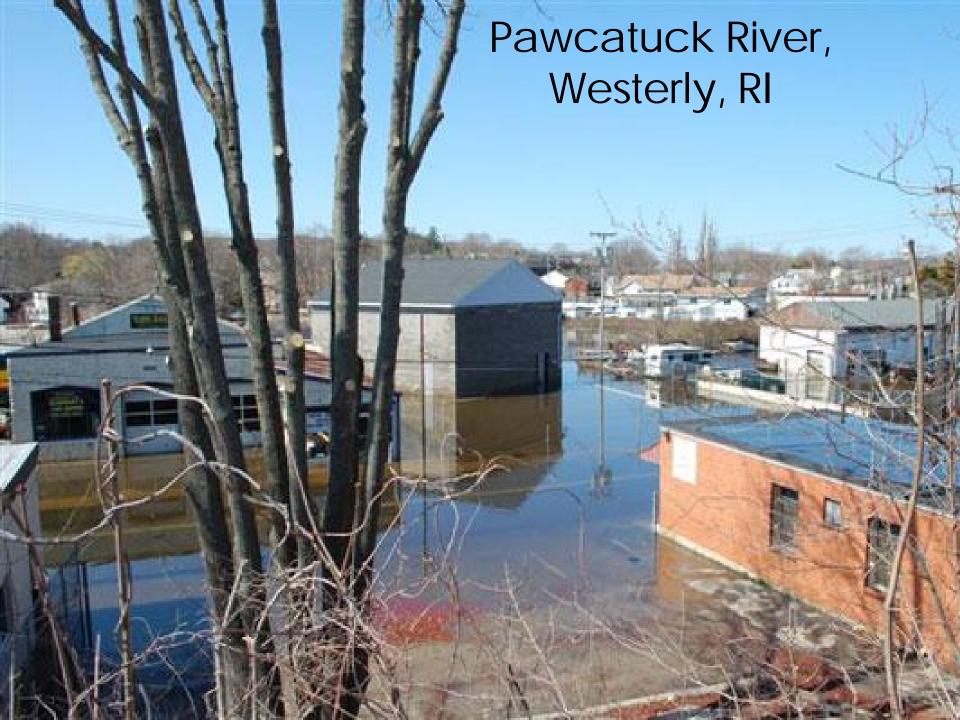
Flooding in the Wood-Pawcatuck

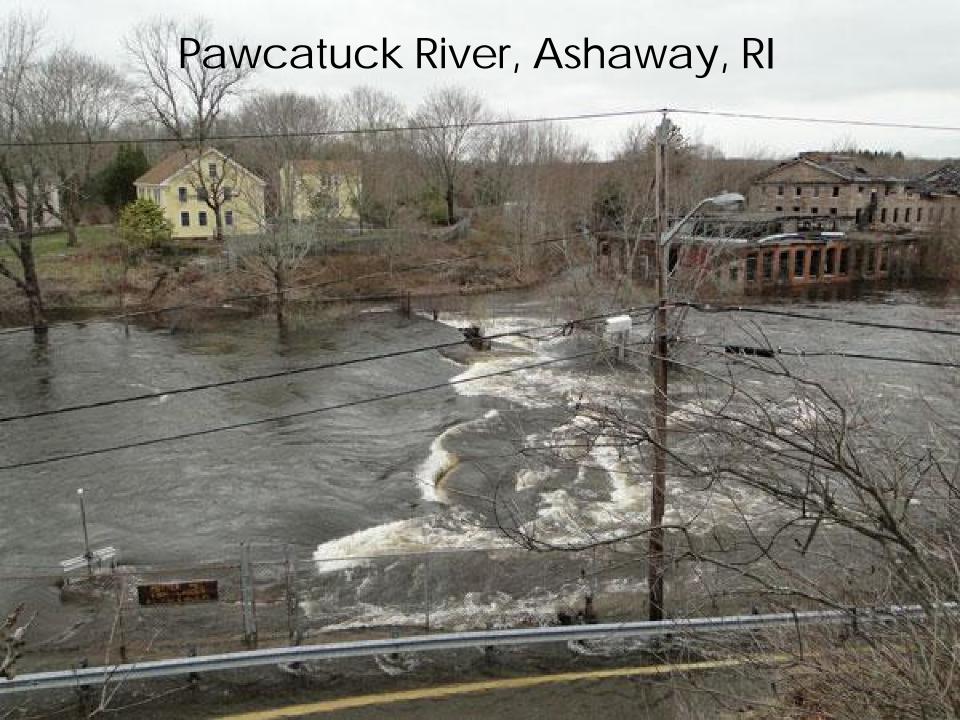
- § History of flooding in the watershed
- The Great Flood of 2010 (>"500-Year Flood")











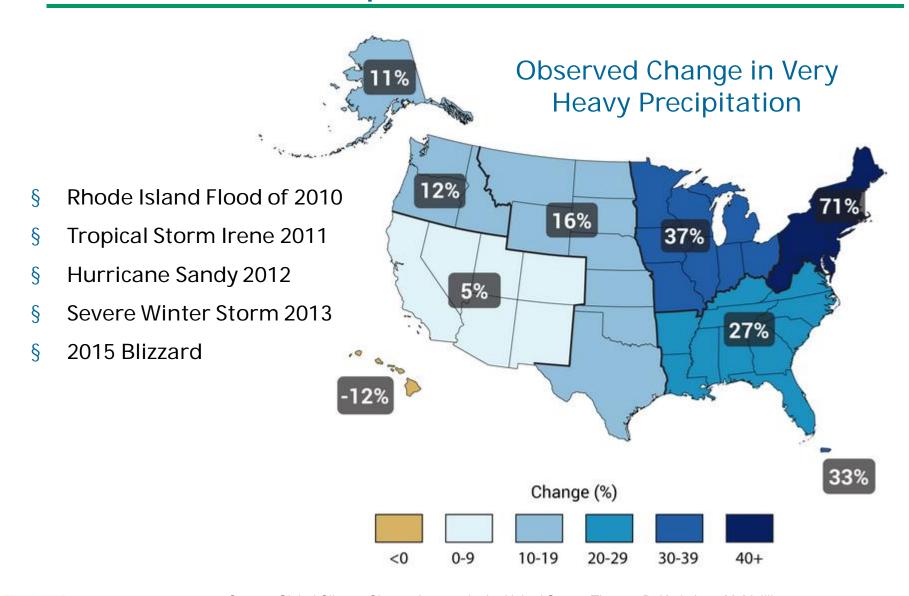
River Corridor & Floodplain Development







More Frequent Extreme Storms

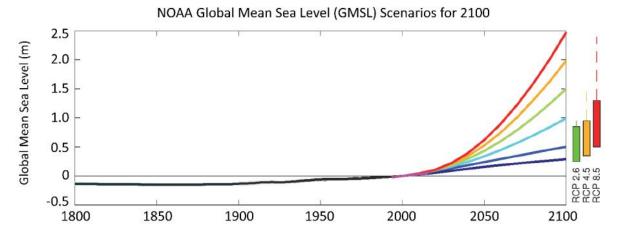






Future Development Pressure

- § Sprawl from nearby urban areas
- § Inland "retreat" in response to sea level rise



NOAA Technical Report NOS CO-OPS 083

GLOBAL AND REGIONAL SEA LEVEL RISE SCENARIOS FOR THE UNITED STATES



Photo: Ocean City, Marylana

Silver Spring, Maryland January 2017











ational Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF COMMERCE
National Ocean Service
Center for Operational Oceanographic Products and Services





Baseline Assessment (Appendix A)

- § Existing watershed conditions
- § Previous and ongoing work in the watershed
 - USGS-FEMA Risk MAP Project
 - USACE Pawcatuck River Flood Risk Feasibility Study
 - RI River & Stream Continuity Project
 - Pawcatuck Dam Removals
 - USFWS Wild & Scenic Reconnaissance Survey
 - RIDEM Water Quality Basin Planning
 - Local Hazard Mitigation Planning



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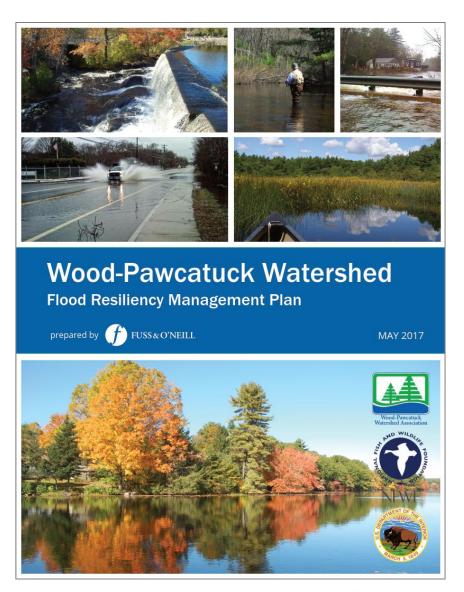
Draft Watershed Plan Recommendations





Flood Resiliency Management Plan

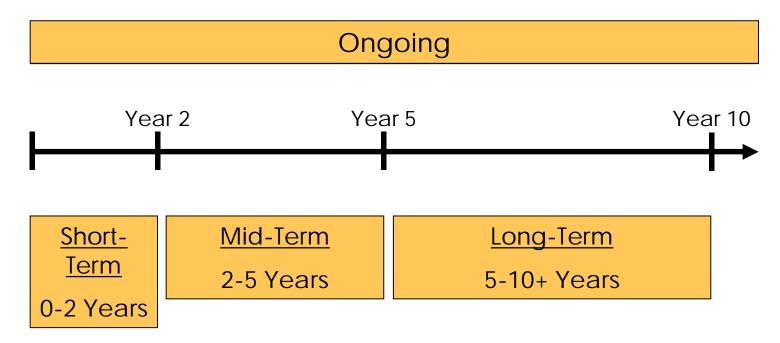
- § Plan Development Process
- § Watershed Overview
- § Management Recommendations
 - Actions
 - Lead entities
 - Timeframe
 - Relative costs
 - Possible funding sources





Recommendations Framework

- § Watershed-wide and targeted/site-specific
- § Timeframe



§ Requires a coordinated effort by many groups





Town Summaries

Wood-Pawcatuck Watershed Flood Resiliency Management Plan

August 2017

Wood-Pawcatuck Watershed Flood Resiliency Management Plan

August 2017

Recommended Actions Summary Town of Charlestown, RI

The Wood-Pawcatuck watershed is vulnerable to flood-related damages, as evidenced by the devastating flooding that occurred in 2010. The Wood-Pawcatuck Watershed Association, working with the watershed municipalities and partner agencies, has developed a watershed-based management plan to enhance the resiliency of the watershed communities to future flooding and protect river and stream ecosystems, including water quality and habitat. The following is a summary of key findings and recommendations of the watershed plan for the Town of Charlestown.

Ouick Facts - Charlestown

- 66% of town within watershed Includes portions of the Pawcatuck River (Charlestown's northern boundary), smaller tributaries, freshwater ponds, and their associated watersheds
- 27 stream crossings assessed
- 1 dam assessed

Road Stream Crossings

- 7 crossings are hydraulically undersized
- 12 crossings have high geomorphic vulnerability 11 crossings have high flood impact potential
- 9 crossings limit or restrict aquatic passage

Recommendations:

- Replace and upgrade priority crossings (see table below) to meet flood resilience and aquatic organism passage (AOP) goals
- Consider other upstream and downstream crossings and dams on the same river system
- In general, replace downstream crossings first
- Perform site-specific data collection, geotechnical evaluation, hydrologic and hydraulic evaluation, and structure type evaluation to support design

Priority Stream Crossings

(Sorted in Order of Priority)				
Road	Stream	Crossing Type		
Burlingame State Park - Management Area	Unnamed	Double 24" Concrete Circular Conduit		
Burlingame State Park - Management Area	Unnamed	12" Concrete Circular Conduit		
Narragansett Trail	Unnamed	12" Concrete Circular Conduit		
Buckeye Brook Road	Poquiant Brook	38" and 12" Concrete Circular Conduit (2 total)		
Shumankanuac Hill Road	Unnamed	36" Concrete Circular Conduit		
Saw Mill Road	Unnamed	12" Concrete Circular Conduit		
Kings Factory Road	Pawcatuck River	57'W x 9'H Concrete Bridge		
Shannock Road	Pawcatuck River	67.5'W Concrete Bridge; openings 3.3'H 7.8'H		
Old Shannock Road	Pawcatuck River	48'W X 9.4'H Concrete Bridge		

Dams

 A single low hazard dam – Burdickville Dam – was assessed in Charlestown, on the Charlestown/ Hopkinton border

Recommendations:

Burdickville Dam (Pawcatuck River)

- Consider dam removal
- Burdickville Dam has been partially breached but may currently prevent passage of some fish species, such as shad
- The impoundment does not appear to support any active uses



Burdickville Dam



Dual concrete culverts at a high priority stream crossing in Burlingame State Park Management Area





Green Infrastructure

A screening-level assessment of potential green infrastructure (GI) retrofit sites was performed within the Wood-Pawcatuck watershed. When applied throughout the watershed. GI can help mitigate flood risk resulting from outdated and undersized storm drainage systems and increase flood resiliency, as well as improve water quality.

Sites Identified for GI Retrofits:

- Vin Gormley Trailhead Parking
 - Retrofit parking lot with underground infiltration and a bioretention basin o Cost: \$123,000
- St. Mary's Catholic Church
 - Install a bioretention practice in the grassed island at the Carolina Back Road and Old Carolina Back Road intersection
 - o Cost: \$143,000



Typical installation of underground infiltration system below an existing parking lot.



View of a typical bioretention cell with mature plantings.

Land Use Policy and Regulations

Municipal land use policies and regulations can help communities become more resilient to flooding by:

- Preserving undeveloped land
- Siting development in locations less vulnerable to flooding, and
- Promoting designs that reduce runoff and are less likely to be damaged in a flood

Recommendations:

A review was conducted of the land use policies, plans, and regulations of the watershed municipalities. Key recommendations of this review include:

River Corridor

A detailed geomorphic assessment was performed for approximately 40 miles of rivers and streams in the watershed. Based on the results of the geomorphic assessment, river corridor planning recommendations were developed to identify restoration projects that will reduce flood hazards and downstream sediment loading and improve aquatic habitat.

Recommendations:

- Remove granite blocks confining channel downstream of Route 112 to allow floodplain access; use granite blocks to build in-stream habitat structures
- Protect wetlands, including Indian Cedar Swamp, as well as stream connections to wetlands and floodplains
- Install log iams in select locations along the stream corridor to protect banks, create habitat, and reform meanders



Granite-lined, straightened mill-race channel with restricted floodplain access, located downstream of Route 112.

- Consider adopting a No Adverse Impact (NAI) Floodplain Management policy
- Amend zoning ordinance to strengthen flood management standards
- Consider implementing fluvial erosion hazard zoning to address riverine erosion hazards
- Consider amendments to the existing conservation/cluster development provisions in the zoning ordinance and subdivision regulations to strengthen flood management provisions
- Amend street and parking lot design standards to reduce impervious cover and remove barriers to LID
- Update design storm precipitation amounts
- Implement road stream crossing standards for new and replacement culverts and bridges







Recommendations by Category

- 1. Dams
- 2. Culverts and Bridges
- 3. Floodplains and River Corridors
- 4. Wetlands
- 5. Stormwater





Dams

- § Over 160 documented dams in watershed
- § Many no longer used for original purpose and are in poor condition
- § None constructed for flood control
- § Backwater during floods and downstream hazard in event of dam failure
- § Barriers to fish and other aquatic life
- § Important recreational, habitat, and cultural values

Objective: Reduce the flood risk posed by dams in the watershed, and restore the connectivity of streams for fish and other aquatic organism passage.







Dams - Field Inspections

§ Dam inspection protocols modified from the Massachusetts Office of Dam Safety (Phase 1 Formal Dam Safety Inspection Checklist)



Inspection Items

Name, Location, Uses

Size

Hazard Classification

Condition and Deficiencies:

- Embankment
- Dikes
- Upstream Face
- Downstream Face
- Appurtenances
- Concrete Structures
- Masonry Structures
- Spillway





Dams - Alternatives Assessment

Removal/Breach

Repair

Repurposing

Aquatic Organism Passage

No Action/ Maintain

Evaluation Criteria

Hazard Classification

Dam Condition

Owner's Ability to Maintain

Capacity

Benefits vs Loss of Current Uses

Downstream Continuity

Cost effectiveness

Ease of Permitting

Feasibility of Repurposing

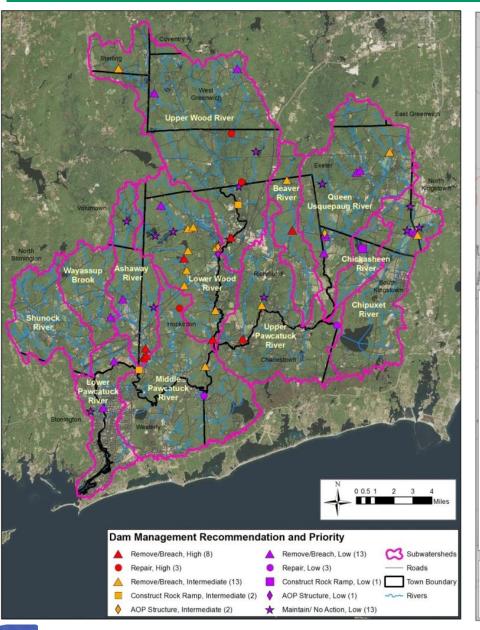
Hydraulic Impacts

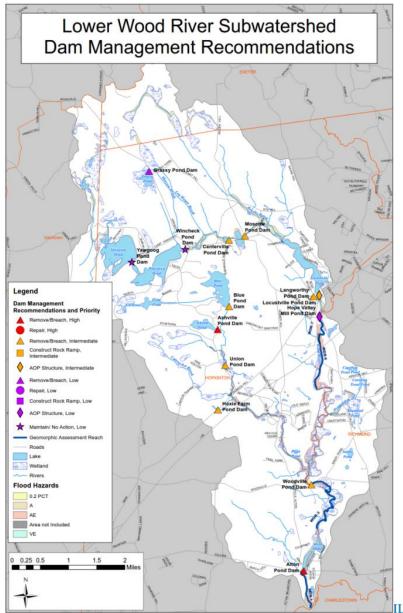
Wetland Impacts





Dams Assessment Results





Dams - Recommendations

- § Incorporate priority dam management recommendations into local hazard mitigation plans
- § Perform site-specific feasibility studies to confirm feasibility of recommendations and to support design and permitting
- § Obtain funding for and implement dam removal projects
- § Dam removal costs are highly site-specific
 - Most projects: \$100,000 to \$1 million
 - Lower Shannock Falls Dam (2011): \$825,000
 - White Rock Dam (2015): \$950,000





Road Stream Crossings

- § Undersized crossings (culverts and bridges) can be flooding and washout hazards
- § Barriers to fish and other aquatic life

Objective: Reduce the flood risk and erosion hazards posed by culverts and bridges in the watershed, and restore the connectivity of streams for fish and other aquatic organism passage.





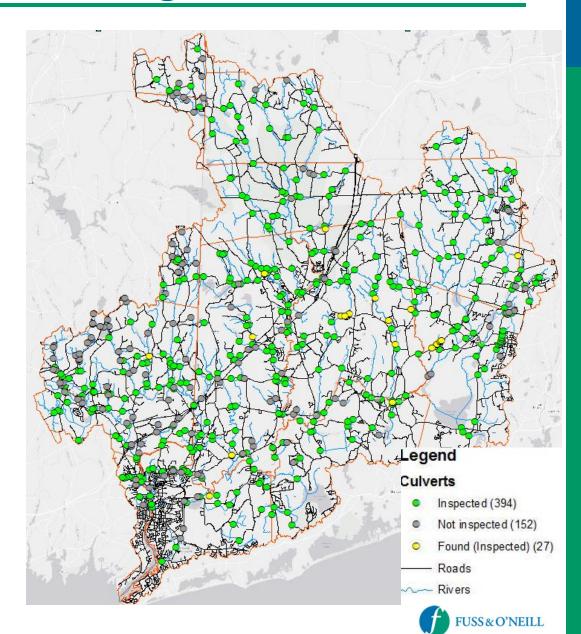






Wood-Pawcatuck Bridges and Culverts

- § 573 structures identified using GIS
- § 421 structures were inspected (May September 2015)





Assessment Approach

- § Adapted from Vermont's Stream Geomorphic Protocols and others used in the Northeast
- § Information gathered
 - Site characteristics (e.g. sketch, street name, stream name)
 - Structure dimensions needed to assess hydraulic capacity
 - Deficiencies and condition of the structure
 - Upstream and downstream geomorphic conditions





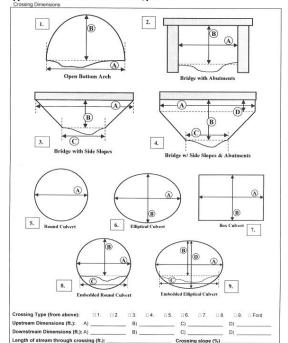








Appendix 2 Field data collection form, p. 3 of 5



Prioritization Criteria

1. Hydraulic Capacity

- Conveyance
- Design Storms
- Climate Change

2. Geomorphic Vulnerability

- Invert/Bed Material
- Culvert/Channel Width
- Culvert Material/Condition

Prioritization

3. Aquatic Organism Passage

- Inlet/Outlet
- Substrate
- Physical Barrier

4. Flooding Impact Potential

- Development/Land Use
- Road Crossing Type
- Flood Prone Areas





Road Stream Crossings - Findings

- § 38% are <u>presently</u> hydraulically undersized (less than 25-year design flow capacity)
- § 49% will be undersized under a Year 2070 climate change scenario
- § Only 40% of road stream crossings provide for full passage of aquatic organisms

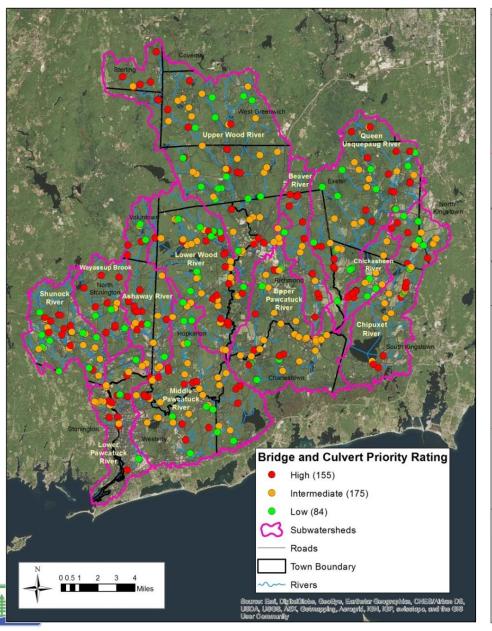


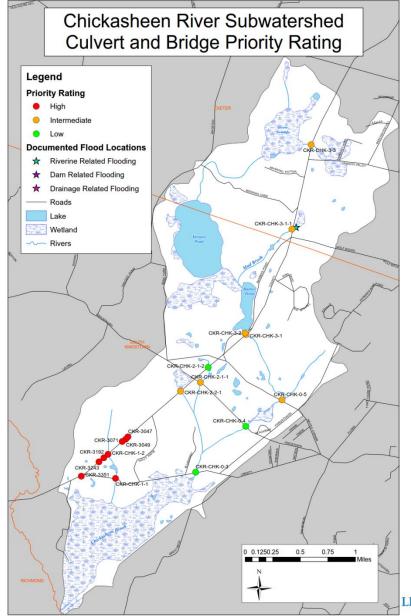






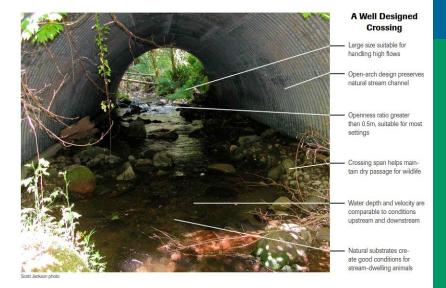
Road Stream Crossings - Priority Ratings





Stream and Flood Friendly Culverts

- § Stream crossing standards MA, NH, NY, CT, VT, ME
- § Well-designed crossings
 - Span the stream and banks
 - Maintain comparable water velocities
 - Have a natural streambed
- § Can be more expensive short-term (50% to 100% more)
- § Long-term costs are reduced due to longer life-span and less maintenance









Road Stream Crossings - Recommendations

- § Incorporate priority stream crossings into local hazard mitigation plans and Capital Improvement Plans
- § Strategically upgrade existing vulnerable stream crossings
- § Implement local and state stream crossing standards modeled after neighboring states
- § Update design storm precipitation amounts in local and state design requirements
- § Provide training to highway departments
- § Implement ongoing inspection and maintenance program





Floodplains and River Corridors

- § Areas along rivers and streams subject to flooding and erosion hazards
- § Most stream reaches sensitive to change
- § Channel straightening and bank armoring
- § River corridor development
- § Floodplain and channel restrictions

Objective: Conserve and restore floodplains and river corridors in a natural condition to mitigate flood and erosion hazards, attenuate sediment loads, and create and enhance habitat.

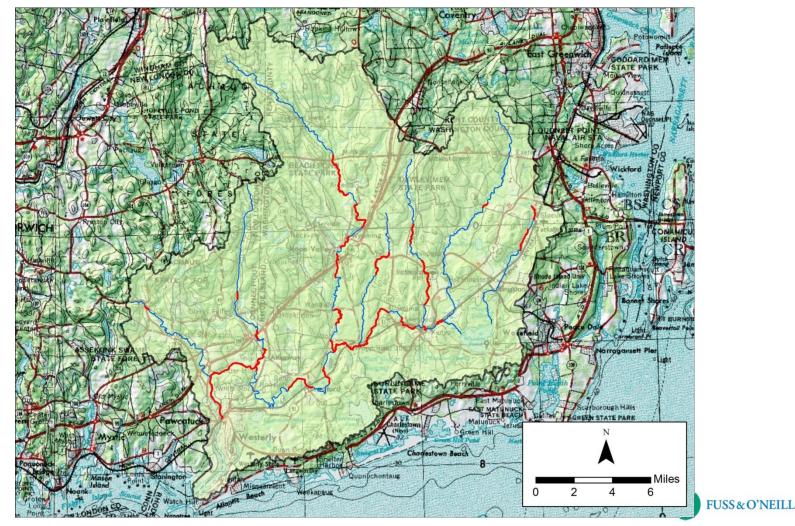
Restore impacted stream channels to an equilibrium condition by addressing the underlying causes of channel instability.





Geomorphic Assessment

- § Phase 1 (desktop) 111 stream miles
- § Phase 2 (field) 39 stream miles





Stream Restoration



Marginal Log Jams



Root Wad Revetments



Boulder and Log Deflectors

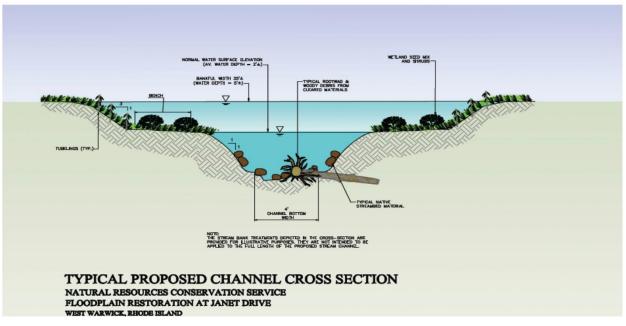


Willow Stakes above Root Wad Revetments





Floodplain Restoration







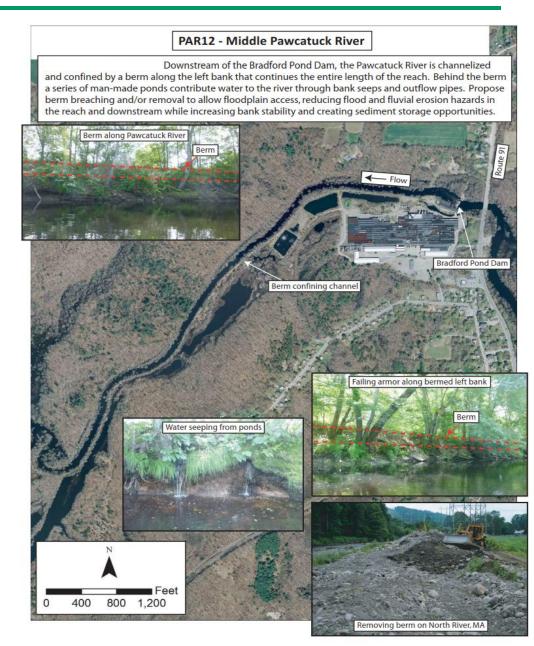


Wood Addition

FUSS&O'NEILL

Floodplain & River Corridor - Recommendations

- § Implement stream and floodplain restoration projects identified in *River Corridor Plan* (Appendix I)
- § Over 40 potential projects identified (10 concepts)
- § Costs highly site specific
 - \$200 to \$1,000 / LF
 - Recent projects (\$300K - \$800K)





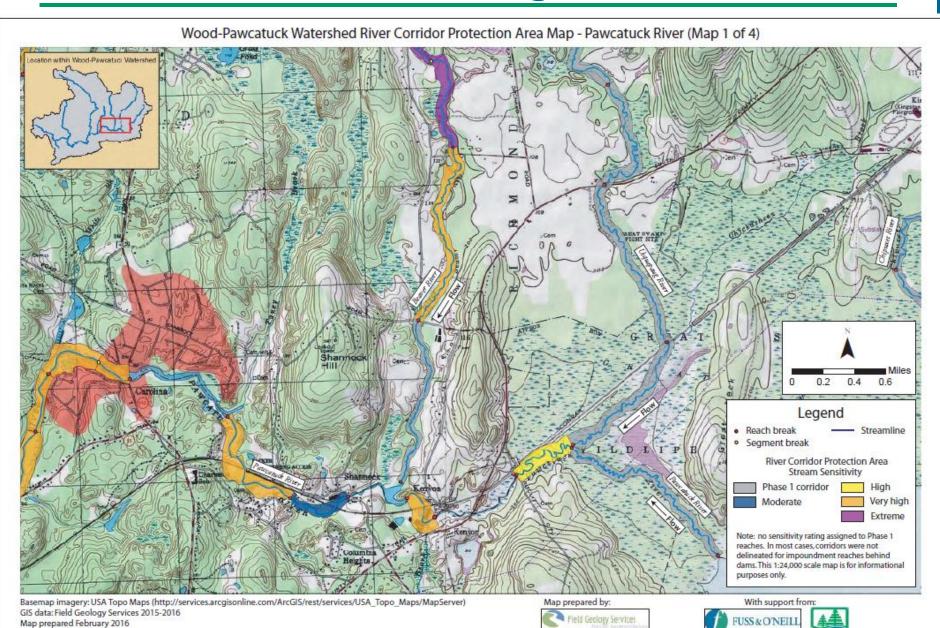
Floodplain & River Corridor - Recommendations

- § Purchase land or acquire conservation easements in floodplains and river corridor
- § Consider Transfer of Development Rights (TDR) ordinance to discourage floodplain development
- § Consider fluvial erosion hazard zoning, or less formal adoption in local hazard mitigation and comprehensive plans





River Corridor Management Areas



Floodplain & River Corridor - Recommendations

- § Review and amend existing conservation or cluster development ordinances & subdivision regulations
- § Consider changes to zoning and subdivision ordinances/regulations to go beyond minimum NFIP standards
 - Incorporate ASFPM "No Adverse Impact Floodplain Management" Policy
 - Increase participation in NFIP Community Rating System
 - Adopt more stringent flood management standards
- § See Land Use Policy and Regulatory Review (Appendix K) for more details

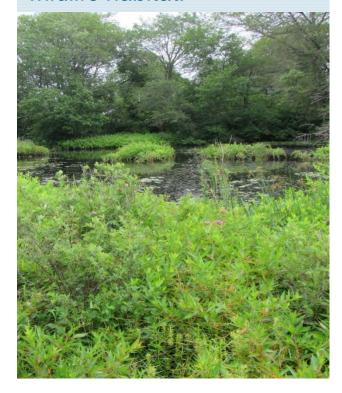




Wetlands

- § Wetlands make up 18% of the watershed
- § Natural sponges reduce flooding and provide many ecological functions

Objective: Conserve and restore watershed wetlands to benefit flooding, water quality, and wildlife habitat.

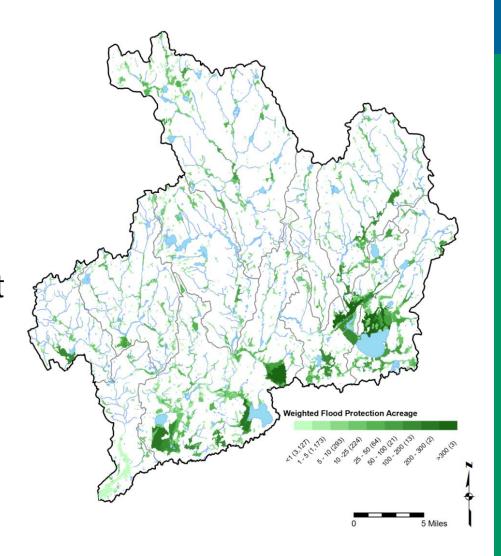






Watershed Wetlands Assessment (Appendix L)

- § Headwater impoundments and associated wetlands provide greatest flood benefit
- § Most "undisturbed" wetlands with significant flood benefit are less than 5 acres in size
- § Riverine wetlands conservation and restoration opportunities







Wetlands - Recommendations

- § Prioritize flood protection functions of wetlands in land use regulations and policies
- § Strategically incorporate wetland restoration into other river corridor restoration projects
 - Large-scale wetland restoration can be very expensive and technically challenging

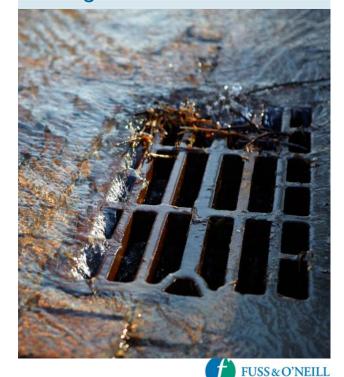




Stormwater

- § Stormwater runoff contributes to drainage-related and riverine flooding
- § Source of water quality problems
- § Communities using green stormwater infrastructure to alleviate drainage-related flooding and improve water quality

Objective: Reduce runoff volumes, flooding, and water quality impacts through improved stormwater management and the use of green stormwater infrastructure throughout the watershed.





Green Stormwater Infrastructure

- § Identify Opportunities for Green Infrastructure (GI) Retrofits
 - Enhance resiliency
 - Provide water quality and ecosystem benefits
- § Approach
 - GIS Screening evaluation



Field inventories



Concept designs



Parcel or Site-Based Retrofits

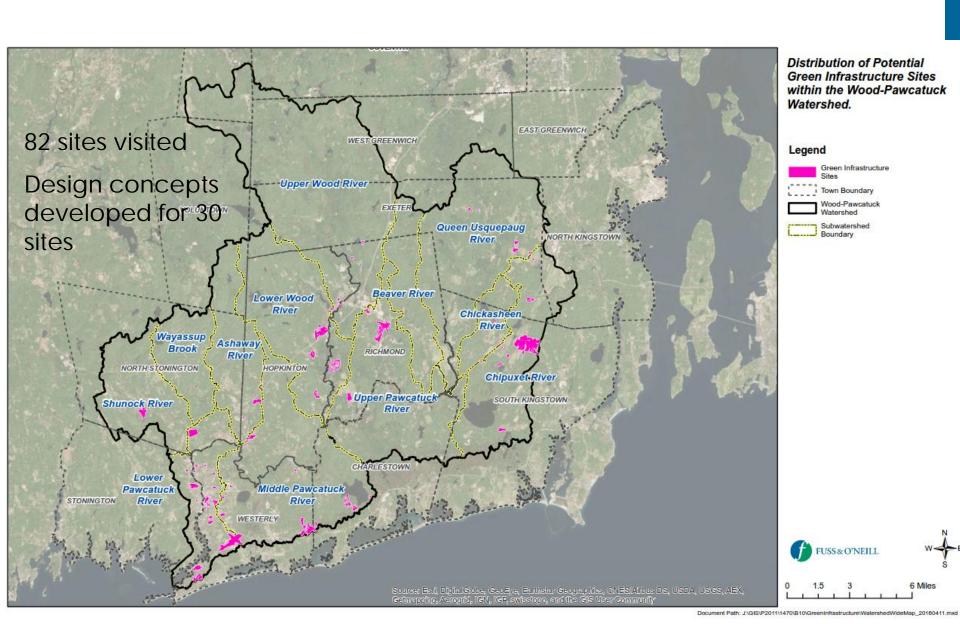


ROW/Street Retrofits





Potential GI Retrofit Sites



Retrofit Site 272A – Westerly Senior Center Bioretention

State Street, Westerly, Rhode Island

Site Description

The proposed retrofit concept is located at the Westerly Senior Center near the intersection of Westminster and State Streets in Westerly, RI. The site consists of an asphalt parking lot divided into multiple parking areas. There is a swale located between two sections of the parking lot, and some runoff is directed to the swale but no overflow or formal BMP exists, nor does the swale capture all of the runoff that could be directed to it.

Proposed Concept

Retrofit the current swale as a bioretention/infiltration practice. The practice would be designed to accept runoff from the surrounding parking lot and additional areas of the site and parking lot. If desired, an overflow structure could be incorporated into the design and connected to current stormwater drainage infrastructure located on Westminster Street.



Image 1: Close-up view of proposed bioretention/infiltration area.

Retrofit Concept Summary

Total Drainage Area: 1.2 acres
Total Impervious Area: 1.0 acres
Total Water Quality Volume: 3,794.0 ft³
Runoff Reduction Volume: 379.4 ft³

Estimated Pollutant Removal

Bioretention Area

Total Phosphorus ≈ 0.5 lbs/year

Total Nitrogen ≈ 10.5 lbs/year

Total Suspended Solids ≈ 410.2 lbs/year

Bacteria (FC) ≈ 307.5 billion colonies/year

Estimated Cost

Bioretention Area: \$51,032



Image 2: Rendering of a typical bioretention area. (Image source: Johnson County Soil and Water District)



Image 3: View of proposed bioretention/infiltration area and some of the parking area that would drain to it.



Stormwater - Recommendations

- § Incorporate GI into municipal stormwater infrastructure planning and capital projects (see concepts in Appendix M)
- § Implement TMDL Implementation Plan for Pawcatuck River and Little Narragansett Bay (Westerly)
- § Update municipal land use policy and regulations to require GI/LID for new development and redevelopment and to meet MS4 Permit requirements
- § Update design storm precipitation amounts and design standards for climate change in coastal areas
- § Pursue sustainable, long-term funding for GI





Plan Implementation Strategy

- "Low-hanging fruit" land use policy/regulatory recommendations
 - Conserve undeveloped land
 - Site development in locations less vulnerable to flooding
 - Promote designs that reduce runoff and less likely to be damaged in a flood
- 2. Obtain funding for and implement priority restoration projects
 - Dam repair and removal
 - Upgrading road stream crossings
 - Other stream corridor and floodplain projects
- 3. Stormwater retrofits and wetland restoration



Funding Sources

Rhode Island

 Narragansett Bay and Watersheds Restoration Fund (BWRF)

Connecticut

- CIRCA Municipal Resilience Grant Program
- STEAP

Federal

- FEMA Hazard Mitigation
- NOAA Coastal Resiliency/Habitat
- USDA NRCS
- Southeast New England Program (SNEP)



In addition to traditional municipal funding sources (i.e., the use of General Funds and municipal bonds), a variety of state and federal sources are also available to provide financial assistance for implementation of the plan recommendations. The funding sources highlighted in this section provide the best opportunities for funding of projects associated with the short- and mid-term plan recommendations. The sources should be re-evaluated periodically to account for potential changes to existing funding programs (i.e., priorities, eligibility, funding cycles, and amounts) and to identify new or emerging sources of funding for flood mitigation, climate resiliency, and habitat restoration projects.

5.1 State Funding Sources

Narragansett Bay and Watersheds Restoration Fund (BWRF)

RIDEM has proposed changes in its regulations that govern the financial assistance program known as the Narragansett Bay and Watersheds Restoration Fund. The goal of the Narragansett Bay and Watersheds Restoration Fund is to restore and protect the water quality and enhance the economic viability and environmental sustainability of Narragansett Bay and the state's watersheds. This established fund provides financial assistance on a competitive basis in the form of grants for various projects that protect and restore water quality and aquatic habitats.

Under the new Flood Prevention and Mitigation Sub-fund of the BWRF, RIDEM is seeking proposals for projects that will address the flooding of coastal or inland areas in a manner that incorporates and enhances natural ecosystem functions including the maintenance of natural hydrologic regimes. These projects would be expected to mitigate a known flooding problem while also delivering ecological cobenefits. Examples of projects eligible for the Flood Prevention and Mitigation Sub-fund include:

- Restoration of floodplains
- . Restoration/re-vegetation of stream banks that reduce peak flows and/or velocities
- Removal of impervious surfaces and associated re-vegetation to increase the on-site retention of stormwater in flood-prone areas
- Replacement of culverts that prevent flooding through improved management of peak flows and enhanced stream continuity
- Creation of floodplain storage capacity
- Aquifer recharge that reduces flooding while maintaining a natural hydrologic regime
- Repairs/enhancements to dams that result in increased capacity for upstream flood storage
- Removal of dams to reduce the risk of flooding in flood-prone areas
- Projects that enhance the resiliency of vulnerable coastal and inland habitats in specific locations that mitigate flooding risks to building, structures or other infrastructure.

Proposed projects submitted for funding should be consistent with approved local hazard mitigation plans or updated hazard mitigation plans that have been formally submitted to the Federal Emergency Management Agency (FEMA) for review and approval. RIDEM will award grants of up to fifty percent





Comments on Draft Plan

Draft plan and appendices available for download:

http://wpwa.org/flood_resiliency.html

Submit comments to:

Denise Poyer
Program Director
Wood-Pawcatuck Watershed
Association
401.539.9017

Plan to be finalized in August 2017

denisep@wpwa.org

