East Branch Piscataqua River Watershed Survey Report

Prepared by:

Presumpscot River Watch

with assistance from the

Cumberland County Soil and Water Conservation District

and the

Maine Department of Environmental Protection

May 2008

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INTRODUCTION

The East Branch Piscataqua River (EBPR) **Watershed** report is intended to provide community members with specific strategies for helping to improve this important local resource. The report is based on a watershed survey that was mostly conducted in April and May of 2005. Local volunteers and technical staff from various governmental agencies and nonprofit organizations identified 73 sites within the EBPR watershed that were potential contributors of **polluted runoff**. Given the considerable extent of development in the watershed, it is likely that the Piscataqua River and its tributaries have been degraded by polluted runoff. This runoff can contain:

> A ***watershed*** describes an area of land that contains a common set of streams and rivers that all drain into a single larger body of water, such as a larger river, lake or ocean.

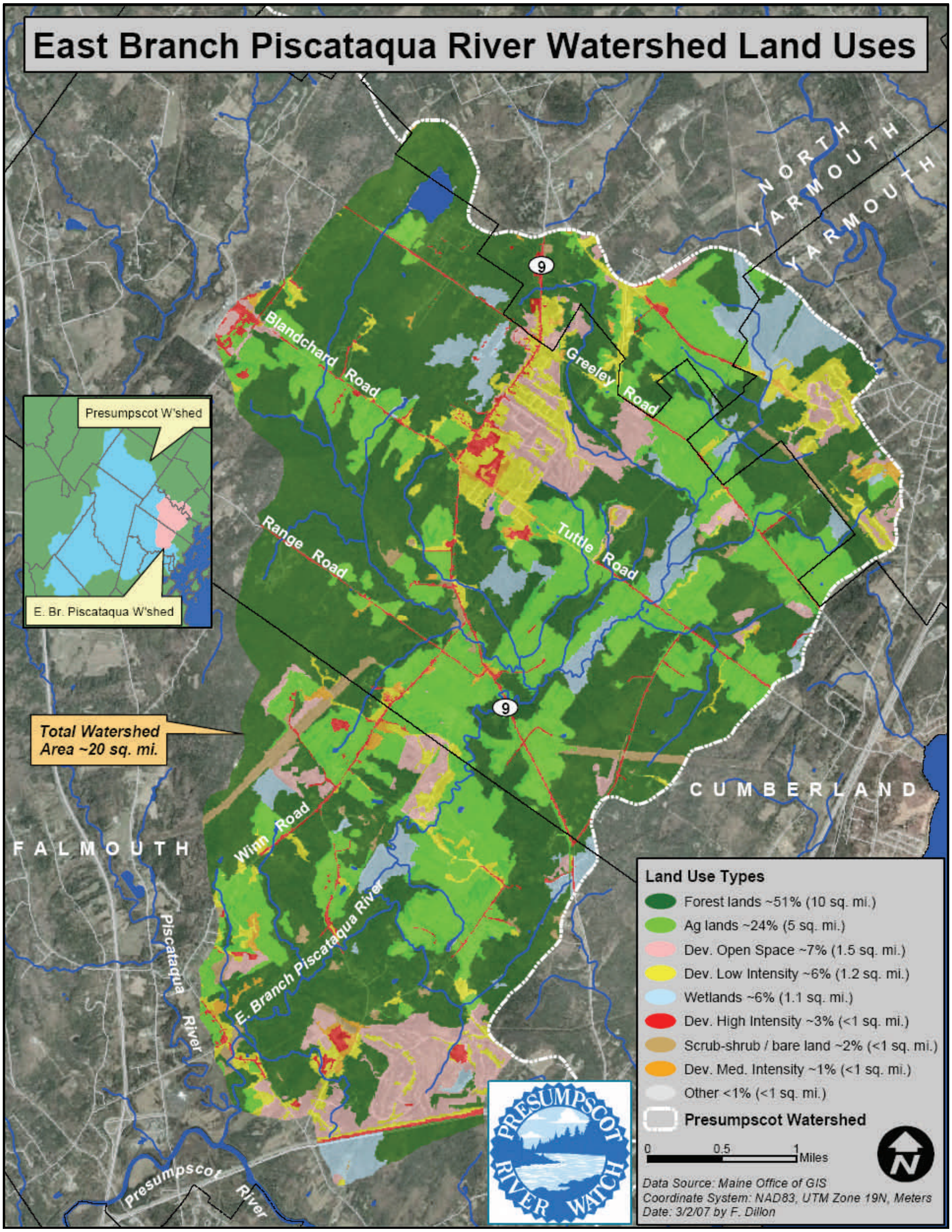
- Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas;
- Oil, grease, and toxic chemicals from urban runoff;
- Soil erosion from improperly managed construction sites, crop and forest lands, and eroding stream banks; and
- Bacteria and nutrients from livestock, pet wastes, and faulty septic systems.

> ***Polluted Runoff*** - also known as nonpoint source (NPS) pollution - comes from many diffuse sources and is transported by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human made pollutants, finally collecting in lakes, rivers, wetlands, coastal waters.

In recent years the EBPR Watershed has been increasingly impacted by development and is part of the larger Piscataqua River watershed, which has been named a Nonpoint Source Priority Watershed by the Maine Department of Environmental Protection (DEP). NPS Priority Watersheds are identified for restoration by DEP through the development of watershed management plans. Overall development in the EBPR Watershed as indicated by the extent of **impervious surfaces** is limited (~ 7% of the watershed is covered by impervious surfaces). However, localized higher intensity development, particularly in and around Cumberland Center, Falmouth High School and the Woodlands Golf Course and housing development, has an increased concentration of impervious surfaces and is therefore of greater concern due to the associated potential impacts to nearby surface waters. Water quality monitoring data collected from the EBPR by the Presumpscot River Watch over the past several years suggest a cause for concern. Bacteria results exceeded DEP water quality standards for 5 of 7 years from 2000-2006 and minimum dissolved oxygen results were below state standards for all the years during this period (Appendix A).

> ***Impervious surfaces*** are constructed surfaces (parking lots, roads, driveways, rooftops, etc.) that prevent the infiltration of precipitation and snowmelt. The amount of polluted runoff increases in relation to the extent of impervious surfaces and results in surface water degradation.

Map 1: East Branch of the Piscataqua River Watershed



All of the land in the shaded area (~ 20 square miles) drains into the Piscataqua River before draining into the Presumpscot River.

GENERAL WATERSHED CHARACTERISTICS

The EBPR Watershed is located in the towns of Falmouth, Cumberland, Yarmouth and North Yarmouth in Cumberland County, Maine and has a drainage area of approximately 20 square miles (see Map 1 on previous page). The EBPR flows in a south-westerly direction into the Piscataqua River, which flows into the Presumpscot River (also listed as a Nonpoint Source Priority Watershed), which then flows into Casco Bay. As Figure 1 indicates, the land cover in the watershed consists primarily of forested areas and agricultural lands with a scattering of wetlands and developed open spaces. There are also several smaller areas of higher intensity development.

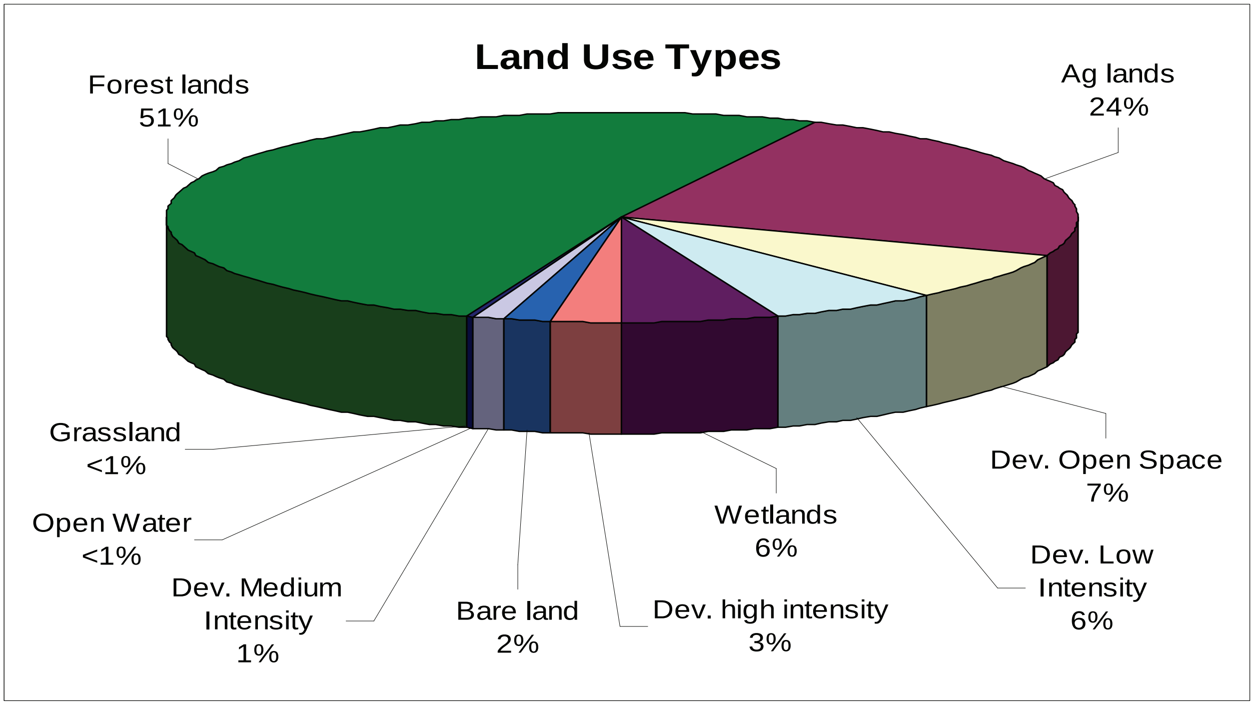


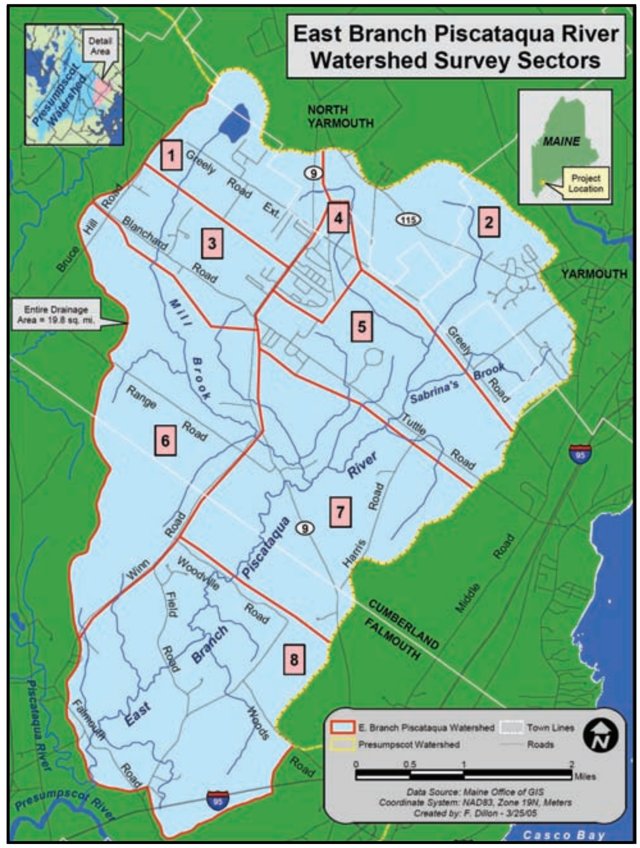
Figure 1: *East Branch Piscataqua Watershed Land Cover Types & Areas*

WATERSHED SURVEY PURPOSE

The primary purpose of the EBPR watershed survey was to find and prioritize nonpoint source (NPS) pollution sites in the watershed. Perhaps even more importantly, the EBPR Watershed survey contributed to an increased awareness among participants (particularly the Waynflete students) who will be more likely to promote active stewardship throughout the larger Presumpscot watershed community.

The EBPR Watershed survey aided in forming collaborative relationships with local municipal officials and landowners, who can help resolve the water quality issues identified by the survey. Rather than adopting a regulatory approach, the Steering Committee decided upon a collaborative approach to promote greater community involvement.

WATERSHED SURVEY METHODOLOGY



***Map 2**. Watershed Survey Sectors*

Prior to the survey, notification letters were sent to landowners (abutting the river or tributaries) that provided an opportunity for them to exclude their property from the survey. A fact sheet was also included that described the project. The EBPR watershed was divided into eight sectors (Map 2) to provide an approximately equal number of potential polluted runoff sites in each sector. Binders containing maps and standardized watershed survey field sheets (see Appendix B) were assembled for each sector.

Volunteers (primarily high school students from the Waynflete School in Portland) were an instrumental part of the watershed survey and were contacted by Steering Committee members and technical staff. Prior to the initial watershed survey, volunteers received two hours of classroom training on field survey techniques to identify various sources of polluted runoff. On May 2, 2005, survey teams traveled throughout the watershed documenting polluted runoff from roads, parking areas, fields, stream banks and footpaths using hand-held global positioning systems (GPS), cameras and the standardized field data sheets. To ensure accurate data collection, technical staff members served as leaders for each team. In all, forty (40) polluted runoff sites were identified by the survey teams on May 2, 2005. Technical staff identified thirty three (33) additional problem sites in the EBPR Watershed on April 19, 2005 and November 20, 2006 for a total of seventy three (73) sites. Surveyors developed preliminary recommendations for the remediation of each identified site and ranked sites based the following criteria:

- Impact to surface water quality
- Technical skill level to install **Best Management Practices (BMPs)**
- Estimated cost to install BMPs

Best Management Practices (BMPs) are techniques used to reduce or prevent polluted runoff.

Project staff used these criteria to develop an associated scoring system that roughly prioritizes problem sites. Scores were assigned as indicated in Table 1 (following page) and Table 2 provides an example of scoring for a hypothetical site. Thus, a problem site rated with a high impact to water quality, low technical skill level to fix and low BMP installation cost was scored as a high priority since fixing it would result in the "biggest bang for the buck." Sites with lower scores (including those with high impacts that will be more expensive to remediate) are also worthy of consideration but should receive attention after the higher priority sites are addressed.

	WQ Impact	Technical Skill	Cost
High	6	1	1
Medium	4	2	2
Low	2	3	3

Table 1: *Range of possible scores for each assessment category. (Impact to water quality was assigned the greatest weight to emphasize sites with high amounts of polluted runoff).*

	WQ Impact	Technical Skill	Cost
High	6		
Medium			
Low		3	3
		Total Score:	12

Table 2: *A site with a high WQ impact, low technical skill level and low cost would result in the highest possible "score" of 12.*

WATERSHED SURVEY RESULTS

Observations for all 73 sites were transferred from the standardized field data sheets into a computer spreadsheet (Appendix C) and the physical locations were plotted on maps using GIS (Geographic Information Systems). The summarized results are as follows.

Land Uses

Most of the documented sites were associated with town roads and residential areas (44% town owned roads, 15% residential). The remaining 41% of sites were associated with a variety of other land use types (Figure 2). To avoid trespassing on private property, survey teams mostly avoided private roads, so some sites may not have been documented.

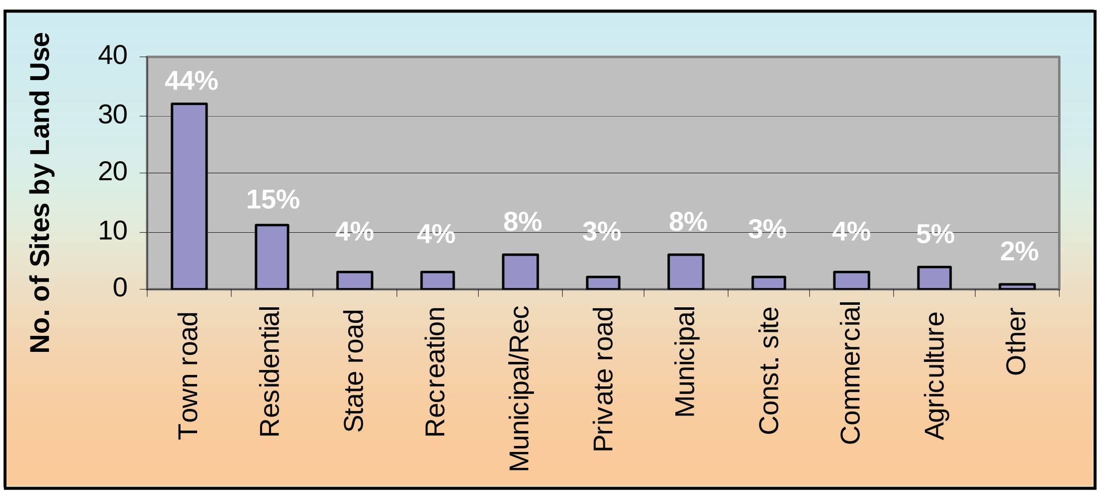


Figure 2*: observed land use types for polluted runoff sites in EBPR Watershed Survey*

Types of Problems Identified

Survey teams identified a variety of problem types (Figure 3). The most commonly observed problems were related to soil erosion (Figure 4), which is the single largest pollutant source by volume to Maine's surface waters. Soil erosion can originate from a number of places, including unpaved roads and road shoulders, ATV trails and unstable stream banks to name just a few. Because the nutrient phosphorus is often attached to soil particles, erosion can result in algal blooms.

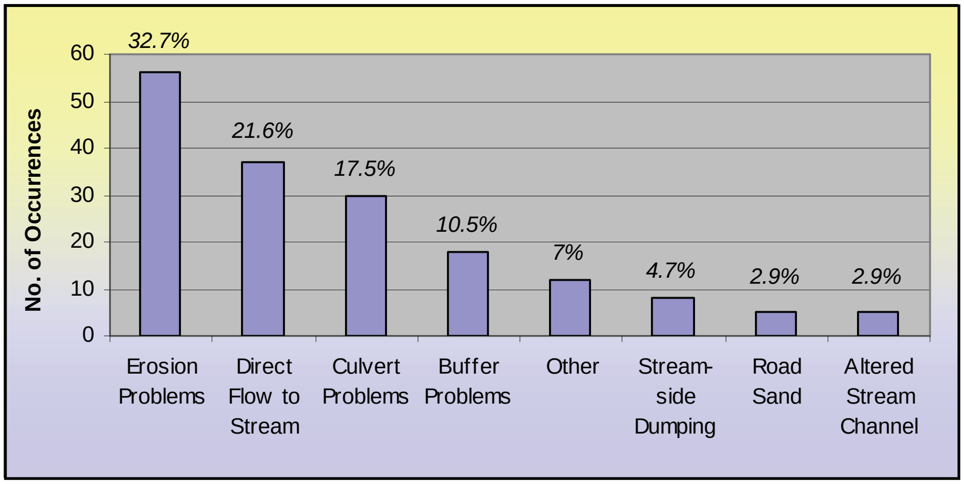


Figure 3: *Frequency and percentage of polluted runoff problems by type.*

Figure 4*: example of erosion on a road shoulder*

Figure 5*: example of residential impact (and an inadequate vegetated buffer between pollution source and stream).*

The next most commonly observed problems were due to direct overland flow of polluted runoff to the stream (Figure 5). As rainwater or melting snow flows across paved or unpaved surfaces it can carry a variety of pollutant types into nearby streams. Pollutants can include oil and grease from roads and parking lots; pesticides and herbicides from lawns, gardens and playing fields; and bacteria and viruses from improperly handled animal waste or malfunctioning septic systems (see Appendix D for a more complete list).

The next most frequently observed problems were culvert related (Figure 6). Culverts are underground pipes that convey water from one area to another, usually under a road or driveway. They are an important part of the storm water collection system because they can help alleviate roadway flooding and soil erosion. However, culverts can also be sources of polluted runoff if not properly designed, installed and maintained by altering the water flow characteristics of stream channels and resulting in stream bank erosion. Inadequate shoreline buffers were the next most commonly observed problems (Figures 7 and 8). Shoreline buffers are strips of vegetated land that are left in their "natural" state and are important because they stabilize soil and prevent or reduce other pollutants from entering a stream.

The remainder of observed polluted runoff problems included stream side dumping, excess road sand (Figure 9), stream channel alteration and several others (algae in stream, stream bank instability, overflowing drainage ditch, thermal pollution, stream siltation, and a nearby horse paddock).

***Figure 6**: example of a hanging culvert.*

***Figure 7**: example of inadequate shoreline buffer.*

***Figure 8**: example of a manicured lawn utilizing high impact fertilizer.*

***Figure 9**: excess sand left on the road following a cold Maine winter.*

Prioritization of Problem Sites

As discussed earlier, project staff developed a method to prioritize all sites that were rated for the 3 assessment categories: impact to surface water quality, technical skill level needed to install remedial BMPs and BMP installation cost. All three of these categories were combined so that relative "scores" could be established for each polluted runoff site. The range of scored values for all the sites was from 6 to 12. Low priority sites were those with scores of 6 or 7; medium priority sites were those with scores of 8 or 9; and high priority sites were those with scores of 10 to 12. Sites that were not rated could not be prioritized for remediation. Table 3 summarizes the results for all scored sites by landuse type. A map of prioritized sites is presented in Appendix E and the full table for all prioritized polluted runoff sites is included in Appendix F.

Landuse Type	**High Priority**	**Medium Priority**	**Low Priority**	**Not Rated**	Totals
Town road	11	16	5		*32*
Residential	5	5	1		*11*
State road		2	1		*3*
Recreation	3				*3*
Municipal/Rec		6			*6*
Private road	2				*2*
Municipal	1	4	1		*6*
Const. site		2			*2*
Commercial	1	2			*3*
Agriculture	1	2		1	*4*
Other			1		*1*
Totals	**24**	**39**	**9**	**1**	**73**

Table 3: *prioritized polluted runoff sites by landuse type. High priority sites generally have greater water quality impacts and can be fixed with lower technical skill and cost. Medium and low priority sites tend to have less severe water quality impacts and will require greater technical skill and cost to fix.*

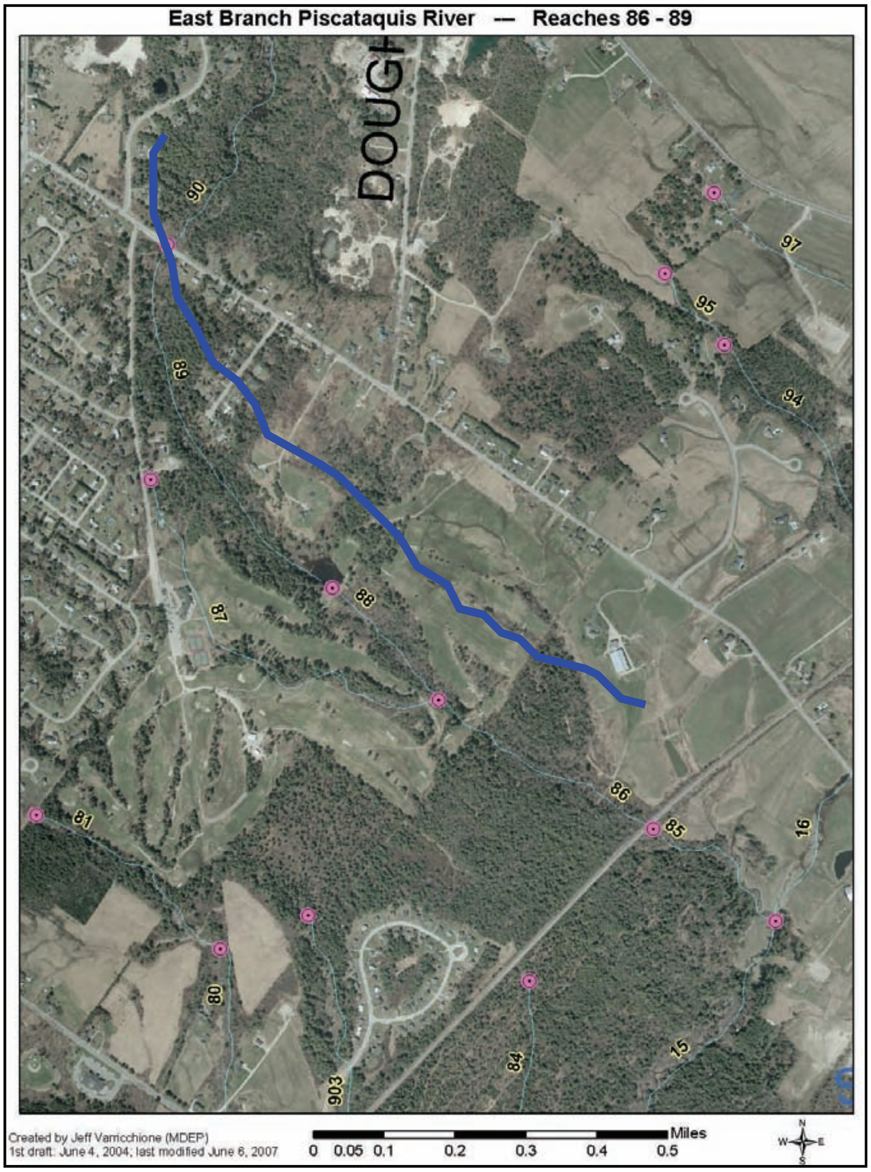
RAPID GEOMORPHOLOGY SURVEY RESULTS

As part of this project, technical staff completed a one-day rapid geomorphic assessment under the leadership of Jeff Varricchione on June 25, 2005 of three reaches (#86-89 on Map 3 on the following page) of the East Branch of the Piscataqua River. The purpose of this exercise was twofold: 1) to provide training for project partners on geomorphic assessment techniques and 2) assess stream channel dynamics to be able to gain a better understanding of the riparian corridor and substrate conditions for a representative stretch of the river. General findings of this survey indicate that:

PRW and partners participate in the East Branch PR rapid geomorphic assessment.

1. There was a fairly substantial riparian zone even though much of the river was bordered by agricultural fields.
2. Streambanks were generally stable.
3. The substrate conditions were sandy and clayey and for the most part did not appear to provide valuable salmonid habitat.

If restoration is considered viable for the East Branch Piscataqua River, it is recommended that further geomorphic assessment and investigation be conducted.



***Map 3**: reaches for rapid geomorphic assessment by project partners in 2004*

PROJECT CONCLUSIONS

The watershed survey indicates that the EBPR is being adversely affected by adjacent land uses. Over 85% of the identified polluted runoff sites were rated as medium or high priorities for remediation (Table 3, page 8). The majority of sites were located on town roads (Figure 2, page 5), which is to be expected since they were preferentially used for site access to minimize crossing private property. As indicated by Figure 3 (page 6), over 50% of the identified polluted runoff problems were erosion-related (32.7%) or resulted from direct runoff flow to the stream (21.6%), with smaller percentages related to a variety of other problems. Finally, the greatest concentration of medium and high priority sites were located in the more developed area of the watershed, primarily around Cumberland Center (see Appendix D, on page 17). While the initial emphasis for remediating problem sites should focus on those with higher priorities, it will also be important to eventually consider the cumulative impacts of low priority sites and the sites that were not rated for various reasons.

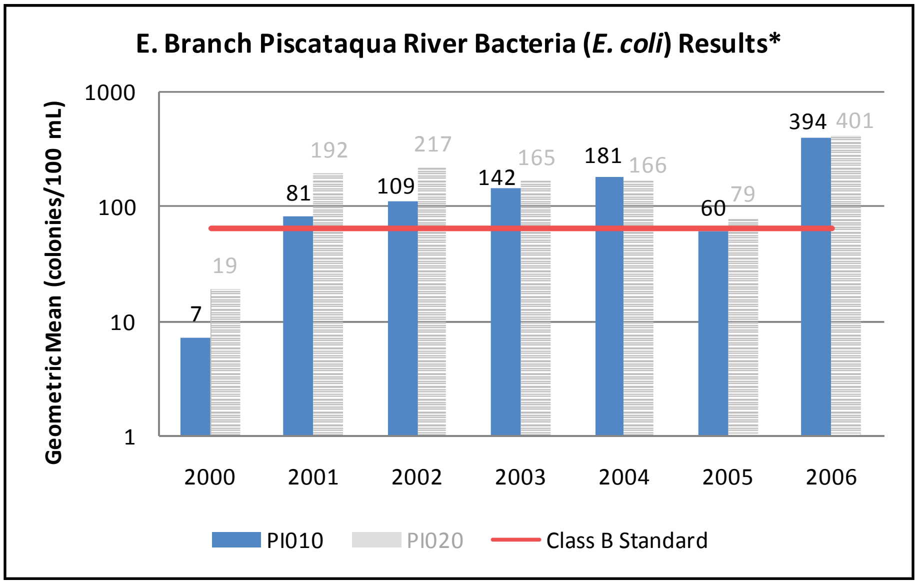
RECOMMENDATIONS/ PRELIMINARY ACTION PLAN

As mentioned above, erosion problems are the most common causes of polluted runoff and the greatest concentration of medium and high priority sites are located in the more intensely developed portions of the EBPR watershed. Best Management Practices to mitigate polluted runoff in highly developed areas generally focus on addressing two broad concerns: storm water flow control and pollutant load reduction. BMPs will also vary depending on whether the developed area under consideration is new or existing. The most effective flow control measures in newly developing areas limit the amount of rainfall that is converted to runoff. Areas with existing development tend to be more complicated since an existing drainage system is already in place, though reducing runoff volume is still usually the primary emphasis. In cases where it is not feasible to reduce runoff volumes due to the density of development, BMPs are implemented to reduce pollutant generation and/or facilitate pollutant removal. Remediating polluted runoff in the EBPR watershed will require a combination of BMPs. However, a number of tasks must be completed before BMP implementation can begin. Table 4 (below) summarizes a preliminary action plan for this process.

TASK	WHO	WHEN
Present survey findings to Town officials and EBPR Watershed Coalition Steering Committee	PRW / CCSWCD	Summer 2008
Develop soil loss estimates and / or BMP designs for all high and medium priority sites and include in watershed management plan.	CCSWCD	2009
Monitor health of EBPR	PRW	Ongoing
Develop grant proposal from multiple funding sources to address high priority BMPs.	EBPR Steering Committee *	Spring 2008
Develop plan to address all medium and low priority sites in EBPR watershed.	EBPR Steering Committee *	2009
Complete watershed management plan.	EBPR Steering Committee *	Fall 2008
Implement BMPs.	EBPR Steering Committee *	2008-2010

Table 4*: preliminary action plan to remediate polluted runoff sites in the East Branch of the Piscataqua River watershed*

APPENDIX A: Presumpscot River Watch Water Quality Monitoring Data



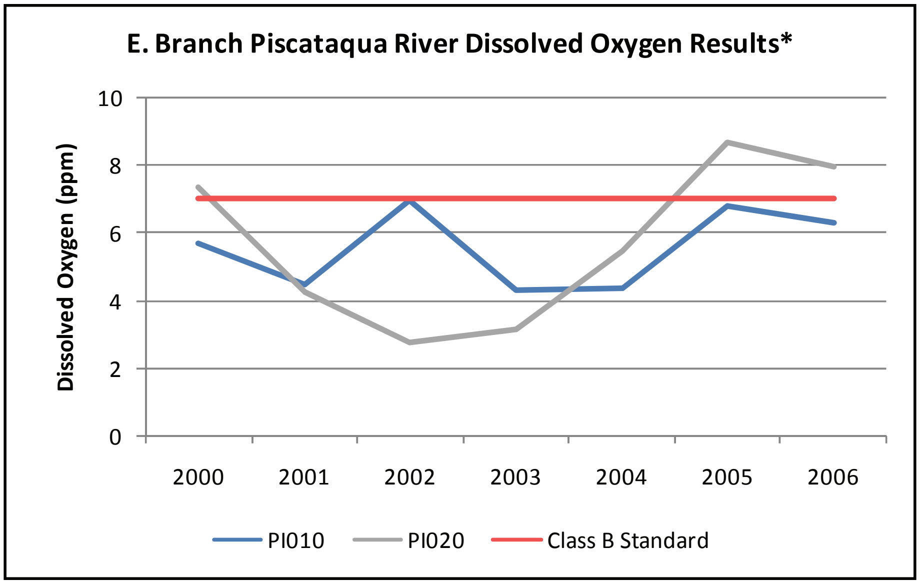
** PI020 results included for comparison*

PI010							
Sample	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*
1		62	59	14	35	15	649
2	1	38	201	115	83	19	
3	3	147		2419		491	155
4	200	68		79	90	91	194
5	1	118		205	261		548
6	200	66		89	148		2419
7	8	135		228	2419		308
8	1	77		130	260		185
N	7	8	2	8	7	4	7
Min	1	38	59	14	35	15	155
Max	200	147	201	2419	2419	491	2419
Geomean	7	81	109	142	181	60	394

PI020							
Sample	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*
1		201	165	29	99	25	261
2	1	201	201	104	63	34	
3	2	167	172	2419		225	172
4	200	397	435	166	122	205	238
5		165	194	201	88		435
6	1000	135		138	256		1553
7	116	172		125	2419		1986
8	1	178		130	83		116
N	6	8	5	8	7	4	7
Min	1	135	165	29	63	25	116
Max	1000	397	435	2419	2419	225	1986
Geomean	19	192	217	165	166	79	401

Pink cells for instantaneous exceedances (427 col/100 mL until 2005; 236 col/100 mL thereafter); yellow cells for geomean exceedances (64 col/100 mL).

APPENDIX A (continued)



** PI020 results included for comparison*

PI010							
Sample	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***
1	9.7	8.7	9.1	10.3	7.3	9.8	10.4
2	6.5	9.1	6.9	7.5	8.9	8.8	-
3	7.4	4.7	8.2	6.9	-	8.9	8.2
4	6.4	-	-	4.7	6.5	6.8	7.9
5	5.7	4.5	-	6.2	6.3	-	7.5
6	6.7	7.5	-	5.4	6.4	-	6.3
7	5.7	-	-	8.0	5.7	-	7.7
8	7.2	-	-	4.3	4.4	-	8.1
N	8	5	3	8	7	4	7
Min	5.7	4.5	6.9	4.3	4.4	6.8	6.3
Max	9.7	9.1	9.1	10.3	8.9	9.8	10.4
Mean	6.9	6.9	8.1	6.7	6.5	8.6	8.0

PI020							
Sample	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***
1	10.5	-	-	10.2	8.7	10.5	11.2
2	7.4	9.8	7.7	8.6	9.9	9.0	-
3	8.1	8.1	2.8	8.3	-	10.0	9.6
4	8.1	-	4.2	7.6	8.0	8.7	9.2
5	7.5	6.8	6.7	8.5	8.3	-	8.8
6	8.3	4.2	-	7.8	5.5	-	8.0
7	7.7	-	-	5.5	6.0	-	9.3
8	7.9	-	-	3.2	8.3	-	9.5
N	8	4	4	8	7	4	7
Min	7.4	4.2	2.8	3.2	5.5	8.7	8.0
Max	10.5	9.8	7.7	10.2	9.9	10.5	11.2
Mean	8.2	7.2	5.3	7.5	7.8	9.5	9.4

Pink cells for failure to meet minimum standard (7 ppm)

APPENDIX B: EBPR Watershed Survey Field Sheet

Sector # ____________	Date ____________________	Surveyor Initials ________________
Site # ____________ Photo taken? Y N	Location ____________________________________ *(house number, road name,* **number of nearest telephone pole**, *etc.)*	
GPS Lat. ____________	Name of Waterbody Affected ____________________________	
GPS Long. ____________	Building Color ____________________________________	
Landowner Contacted? Yes No		

____

Land Use: **Description of Problem:**

Beach Access		**Roof runoff**
Boat access	**Culvert**	**Soil**
Commercial	Unstable culvert inlet/outlet	Bare soil / fields
Driveway	Clogged culvert	Stockpiled soil
Private road	**Direct flow**	**Shoreline**
State road	To lake	Erosion
Town road	To stream	Lack of buffer
Trail or path	To ditch	**Surface Erosion**
Residential	**Ditch**	Slight
Logging	Slight erosion	Moderate
Agriculture	Moderate erosion	Severe
Construction Site	Severe erosion	**Unstable**
	Ditch capability exceeded	Beach access
	Livestock in Stream	Boat access
	Road Shoulder Erosion	Construction site
	Slight	**Other**
	Moderate	____________________
	Severe	____________________

Area Affected (length & width): ________________________________

This site is linked (cause or result) to Site # : ________________________________

Recommendations:

Culvert	**Road or Driveway**	**Vegetation**
Clean out culvert	Add new surface material	Establish buffer
Enlarge culvert	Build up road	Extend buffer
Install plunge pool	Install turnout(s)	Plant trees & shrubs
Replace culvert	Remove grader berms	Seed and mulch
Lengthen	Remove winter sand	**Other**
Stabilize inlet and/or outlet	Reshape/veg shoulder	Detention basin
Ditch	Reshape or crown road	Establish new slope
Armor with stone or grass	Pave	Infiltration trench
Install ditch	Install runoff diverter(s)	Mulch
Install turnout	• Broad-based dip	No raking
Reshape	• Open top culvert	Rip rap
Erosion Controls (e.g., silt fence)	• Rubber razor	Steps
Roof Runoff	• Waterbar	Define path for foot traffic
Install stone-filled dripline trench		Terrace
Install dry well at gutter spout		Runoff diverters (prev. col.)

Impact: High Medium Low

Tech. Level to Install: High Medium Low

Cost: High Medium Low

Technical Level to Install Recommended Practices

High: site requires an engineered design

Medium: technical person should visit the site & make recommendations

Low: property owner can accomplish the BMP with proper reference materials and/or access to technical advice

Impact Consider size of impact, slope, amount of soil eroded, proximity to waterbody or buffer

High: large area with significant erosion and direct flow to stream, ditch or lake (e.g., bank or road failure, sediment delta, severe gully and/or rill erosion)

Medium: sediment transported off site but does not reach high magnitude

Low: eroding site with limited transport off site, or small site with no evidence of rills or gullies

Cost

High: greater than $2,500
Medium: $501-$2,500
Low: $500 or less

APPENDIX C: EBPR Watershed Survey Results and Recommendations

SECTOR	SITE	DATE	LANDUSE	PROBLEM	AREA SIZE
1	1	5/2/05	Const. site	Bare soil; unstable construction site	30' x 20'
1	2	5/2/05	Town Rd	Road shoulder/ditch erosion	
1	3	5/2/05	Town Rd	Unstable culvert inlet/outlet	5, x 5'
1	4	5/2/05	other	streambank erosion/exposed roots	6' x 3'
1	5	5/2/05	Town Rd	Bare soil; road shoulder/ditch erosion; unstable culvert inlet/outlet	25' x 5'
1	6	5/2/05	Town Rd	Bare soil; unstable outlet; streambank erosion	10' x 5'
1	7	5/2/05	Residential	Strambank erosion	20' x 2'
1	8	5/2/05	Residential	bare soil; streambank erosion	20' x 3'
1	9	5/2/05	State road	Road shoulder/ditch erosion	
2	1	5/2/05	Agriculture	livestock/improper manure storage; lack of stream shading	200' x 100'
2	2	5/2/05	Town Rd	Road shoulder/ditch erosion; lack of stream shading	10' x 4'
2	3	5/2/05	Residential	bare soil/fields; streambank erosion; lack of stream shading	20' x 5'
2	4	5/2/05	Agriculture	bare soil/fields; livestock/improper manure storage; pet waste; lack of stream shading	
2	5	5/2/05	Town Rd	road shoulder/ditch erosion; chemlawn/fertilizer flags;	2' x 2'
2	6	5/2/05	Town Rd	road shoulder/ditch erosion	
2	7	5/2/05	Residential	Bare soil; unstable construction site	75' x 2'
2	8	5/2/05	Commercial	ATV trail	100' x 50'
2	9	5/2/05	Town Rd	chemlawn/fert. Flags; lack of stream shading	
2	10	5/2/05	Recreational	chemlawn/fert. Flags; lack of stream shading	75' x 500'
2	11	5/2/05	Town Rd	chemlawn; algae mats in stream; lack of stream shading	
3	1	5/2/05	Town Rd	streambank erosion, exposed roots	50' x 15'
3	2	5/2/05	Town Rd	streambank erosion, exposed roots	25' x35'
3	3	5/2/05	Town Rd	road shoulder/ditch erosion	10' x20'
3	4	5/2/05	Town Rd	shoulder/ditch erosion; unstable culvert; culvert crushed by pavement (right side)	10' x 20'
3	5	5/2/05	Town Rd	shoulder/ditch erosion; unstable culvert; culvert crushed by pavement (left side)	10' x 20'
3	6	5/2/05	Town Rd	road shoulder/ditch erosion; unstable culvert inlet/outlet	10' x 20'
4	1	5/2/05	Town Rd	winter sand; chemlawn; manicured lawn	
4	2	5/2/05	Town Rd	streambank erosion; chemlawn; lack of stream shading; road drainage; wintersand; manicured lawn	
4	4	5/2/05	Residential	winter sand; chemlawn; algae mats in stream; lack of shade; streambank erosion; chemlawn; drainage	200'
4	5	5/2/05	Municipal/Rec	chemlawn; lack of stream shade;	
4	6	5/2/05	Residential	piles of soil/brush; chemlawn; lack of streamshading;	
4	7	5/2/05	Residential	road shoulder/ditch erosion; unstable culvert inlet/outlet	
4	8	5/2/05	Town Rd	road shoulder/ditch erosion; unstable culvert inlet/outlet; non-maintained riprap; winter sand build up; culvert misaligned	
5	1	11/20/06	Municipal/Rec	chemlawn/fert. Flags	400' x 200'
5	2	11/20/06	Town Rd	road shoulder/ditch erosion	4' x 4'
5	3	11/20/06	Municipal	unstable bank	6' x 30'
5	4	11/20/06	Municipal	bare sand; stockpiled sand; dich erosion	20' x 10'
5	5	11/20/06	Municipal	ditch erosion;	8' x 50'
5	6	11/20/06	Commercial	chemlawn; lack of stream shade	75' x 300'
5	7	11/20/06	Town Rd	road shoulder/ditch erosion	50' x 25'
5	8	11/20/06	Residential	livestock/improper manure storage; bank down cutting; streambank erosion	100' x 75'
5	9	11/20/06	Municipal	streambank erosion	10' x 10'
5	10	11/20/06	Municipal/Rec	chemlawn; lack of stream shading	100' x 75'
5	11	11/20/06	Municipal/Rec	lack of shading; chemlawn; erosion	75' x 50'
5	12	11/20/06	Municipal/Rec	lack of shading; chemlawn	75' x 75'
5	13	11/20/06	Municipal/Rec	lack of shading; chemlawn	75' x 100'
6	1	4/19/05	Agriculture	improper manure storage;	1 acre
6	2	4/19/05	Residential	chemlawn; lack of stream shading; manicured lawn	5 acres
6	3	4/19/05	Town Rd	road shoulder erosion; culvert outlet blocked	30'
6	4	4/19/05	Town Rd	excess sediment in ditch	15'
6	5	4/19/05	Recreational	chemlawn; lack of stream shading; channel straightened; manicured lawn	?
6	6	4/19/05	Recreational	chemlawn; lack of stream shading; drainage from pond/ dammed area;	big
6	7	4/19/05	Agriculture	bare soil/fields; livestock/improper manure storage	2 acres
6	8	4/19/05	Town Rd	unstable culvert outlet; culvert misaligned; hanging culvert; bank downcutting; streambank erosion	1/2 acre
6	9	4/19/05	Town Rd	culvert misaligned; hanging culvert; downcutting; streambank erosion	
7	1	4/19/05	Town Rd	road shoulder erosion; winter sand	100' x 25'
7	2	4/19/05	Town Rd	road shoulder erosion	150' x 5'
7	3	4/19/05	State road	road shoulder erosion; culvert misaligned	140' x 5'
7	4	4/19/05	State road	road shoulder erosion; unstable culvert inlet	150' x 10'
7	5	4/19/05	Town Rd	ditch erosion; hanging culvert	100'
7	6	4/19/05	Town Rd	road shoulder erosion	100' x 20'
7	7	7/8/05	Residential	winter sand	10' x 30'
8	1	4/19/05	Const. site	bare soil; unstable cont. site; unstable culvert inlet/outlet	100' x 35'
8	2	4/19/05	Residential	manicured lawn	6000 sq ft
8	3	4/19/05	Town Rd	winter sand in ditch	500' x 3'
8	4	4/19/05	Municipal	lack of stream shading; drainage from parking lot	1500 sq ft
8	5	4/19/05	Municipal	streambank erosion; drainage from parking lot; bank downcutting;	big area
8	6	4/19/05	Town Rd	unstable culvert outlet; culvert misaligned; hanging culvert; bank downcutting; streambank erosion	12' x 12'
8	7	5/31/06	Town Rd	Bank downcutting; streambank erosion	
8	8	5/31/05	Town Rd	streambank erosion; road shoulder/ditch erosion; unstable culvert; lack of stream shading; culvert misaligned;	125' x 10'
8	9	5/31/05	Private Rd	failing silt fence; unstable cont. site; severe road shoulder erosion	25' x 10'
8	10	5/31/05	Commercial	unstable cont. site; manicured lawn; waterfowl gathering area; lack of stream shading; drainage from parking lot	1/4 mile of stream
8	11	5/31/05	Private Rd	Bare soil; unstable const. site; road shoulder erosion; unstable culvert;	50' x 25'

APPENDIX C (continued)

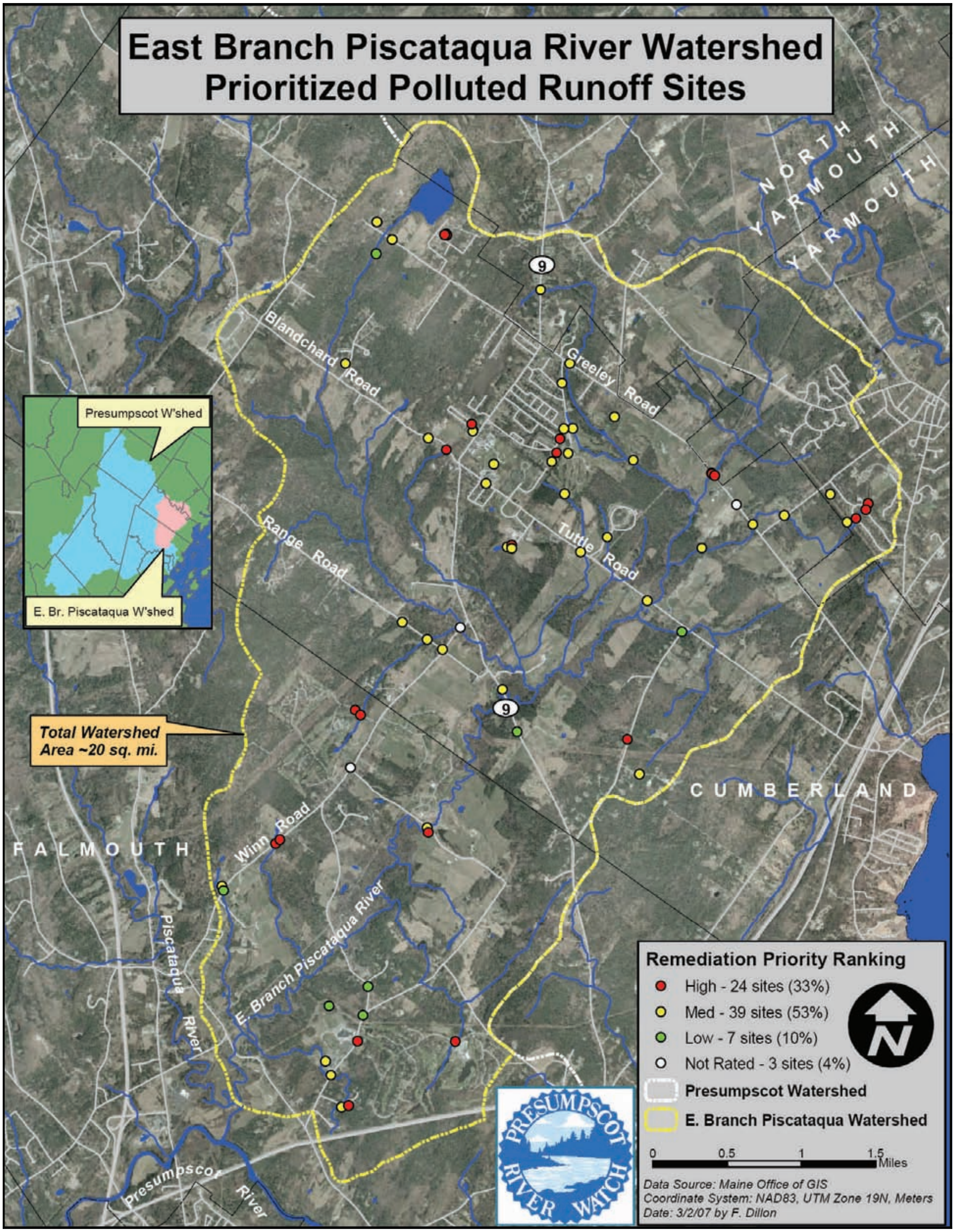
SECTOR	SITE	RECOMMENDATIONS	IMPACT	DIFFICULTY	COST
1	1	Install erosion controls	Low	Low	Low
1	2	Install plunge pool, reshape ditch	Low	Low	Low
1	3	Replace culvert, stabilize inlet and/or outlet	Low	Low	Low
1	4	bank stabilization	Low	Med	Med
1	5	stabilize inlet and/or outlet; armor with grass; reshape shoulder	High	Low	Low
1	6	stabilize outlet; plant trees and shrubs	Med	Low	Low
1	7	plant trees and shrubs; seed and mulch; stormwater controls	Med	Low	Low
1	8	plant trees and shrubs; seed and mulch; stormwater controls	Med	Low	Low
1	9	remove winter sand	Low	Low	Low
2	1	ag waste management; stream fencing	High	Low	Med
2	2	armor ditch with stone or grass; reshape/veg shoulder	Med	Low	Low
2	3	armor ditch with stone or grass	Med	Low	Low
2	4				
2	5	low impact fertilizing	Low	Low	Low
2	6		Low	Low	Low
2	7	armor ditch with stone or grass	Low	Low	Low
2	8		Low	Low	Low
2	9	low impact fertilizing; stencil storm drains	Med	Low	Low
2	10	low impact fert; establish buffer; extend buffer; plant trees and shrubs; low impact turf care	Med	Low	Low
2	11	low impact fert; establish buffer; plant trees and shrubs	Med	Low	Low
3	1	establish buffer, plant trees and shrubs, seed and mulch	High	Med	Med
3	2	stabilize inlet and/or outlet; plant trees ans shrubs; bank stabilization	Med	Med	Low
3	3	reshape/veg shoulder; seed and mulch	Low	Low	Low
3	4	clean out culvert; install plunge pool; lengthen and stabilize culvert; reshape/veg shoulder	Med	Med	Med
3	5	clean out culvert; install plunge pool; lengthen and stabilize culvert; reshape/veg shoulder	Med	Med	Med
3	6	install plunge pool; stabilize inlet/outlet; fine tune turnout; reshape/veg shoulder	Med	Low	Low
4	1	low impact fert.; stencil storm drains; low impact turf care	Low	Low	Low
4	2	reshape and riprap; remove winter sand; veg. shoulder; low impact fert; stencil storm drains; establish buffer; low impact turf care	Med	Low	Low
4	4	clean out culvert; remove winter sand; low impact fert.; stencil storm drains; establish buffer;	Med	Low	Low
4	5	low impact fert; establish buffer	Low	Low	Low
4	6	remove soil/brush; low impact fert.;	Low	Low	Low
4	7	stabalize inlet /outlet; armor ditch; reshape and riprap	Low	Low	Low
4	8	enlarge culvert; stabilize inlet/outlet; armor ditch; reshape and riprap; remove winter sand; re-align culvert	High	High	High
5	1	low impact fert; stencil storm drain; clean out catch basin	Low	Low	Low
5	2	armor ditch; add new surface material	Low	Low	Low
5	3	install erosion controls; add new surface material	Low	Low	Low
5	4	install plunge pool; armor ditch; install erosion controls	Med	Low	Low
5	5	install plunge pool; armor ditch; install turnout	Med	Med	Med
5	6	low impact fert.; extend buffer; plant trees and shrubs	Med	Low	Med
5	7	armor ditch; reshape and riprap	Med	Med	Med
5	8	ag waste management	Med	Low	Med
5	9	reshape and riprap; reshape bridge crossing	Low	Low	Low
5	10	low impact fert.; establish buffer; plant trees and shrubs	Med	Low	Med
5	11	low impact fert.; establish buffer; plant trees and shrubs	Low	Low	Low
5	12	low impact fert.; establish buffer; plant trees and shrubs	Med	Low	Med
5	13	low impact fert.; establish buffer; plant trees and shrubs	Med	Low	Med
6	1	ag waste management; stream fencing	Low	Low	Low
6	2	low impact fert.; establish buffer; plant trees and shrubs	Low	Low	Med
6	3	clean out culvert; reshape or crown rd	Med	Low	Low
6	4	clean out ditch	Med	Low	Low
6	5	low impact fert; establish buffer; plant trees and shrubs; restore channel;	High	Low	Med
6	6	low impact fert.; establish buffer; plant trees and shrubs	Med	Low	Low
6	7	ag waste management; stream fencing	Low	Low	Low
6	8	stabalize outlet; re-align culvert; bank stabalization; restore channel	High	High	High
6	9	enlarge culvert; re-align culvert and lower; bank stabilization; restore channel	High	High	High
7	1		Low		
7	2		Med		
7	3	armor ditch; reshape shoulder	Med	Low	Med
7	4	extend culvert; reshape and rip rap; reshape shoulder	Med	High	High
7	5	replace culvert; lengthen; armor ditch; reshape and rip rap	Med	High	High
7	6	armor ditch	Med	Low	Low
7	7	remove winter sand	Low	Low	Low
8	1	stabalize inlet/outlet; intall check dams in ditches; install detention basin	High	High	High
8	2	low impact fert.	Med	Low	Low
8	3	reshap shoulder; remove winter sand; install check dams	Med	Med	Med
8	4	remove winter sand; plant trees and shrubs; stormwater controls; stencil storm drain; low impact turf care	High	High	High
8	5	check dams; detention structures	Med	High	High
8	6	lengthen culvert sleeve; remove winter sand	Low	Med	Med
8	7	check dams; detention structures	Med	High	High
8	8	install plunge pool; stabilize inlet/outlet; reshape and rip rap; reshape/veg shoulder; establish buffer	High	High	High
8	9	reestablish silt fence; reshape shoulder	Med	Low	Low
8	10	improve erosion controls; low impact fert.; wildlife management; establish buffer; low impact turf care	High	Med	Med
8	11	stabalize inlet/outlet; erosion controls; reshape/veg shoulder	Med	Low	Low

APPENDIX D: Common Storm Water Runoff Pollutant Sources[1]

Contaminant	Contaminant Sources
Sediment and Floatables	Streets, lawns, driveways, roads, construction activities, atmospheric deposition, drainage channel erosion
Pesticides and Herbicides	Residential lawns and gardens, roadsides, utility right-of-ways, commercial and industrial landscaped areas, soil wash-off
Organic Materials	Residential lawns and gardens, commercial landscaping, animal wastes
Metals	Automobiles, bridges, atmospheric deposition, industrial areas, soil erosion, corroding metal surfaces, combustion processes
Oil and Grease/ Hydrocarbons	Roads, driveways, parking lots, vehicle maintenance areas, gas stations, illicit dumping to storm drains
Bacteria and Viruses	Lawns, roads, leaky sanitary sewer lines, sanitary sewer cross-connections, animal waste, septic systems
Nitrogen and Phosphorus	Lawn fertilizers, atmospheric deposition, automobile exhaust, soil erosion, animal waste, detergents

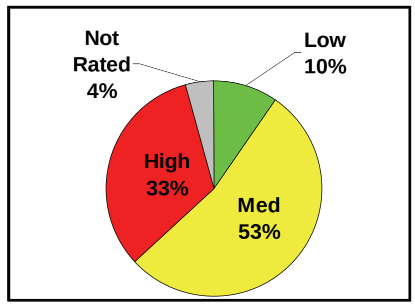
1. Preliminary Data Summary of Urban Storm Water Best Management Practices. EPA, 1999.

APPENDIX E: Prioritized Polluted Runoff Site Map



APPENDIX F: EBPR Watershed Polluted Runoff Site Prioritization

SITE	IMPACT	DIFFICULTY	COST	I-Rank	D-Rank	C-Rank	Total Rank	Priority	Land Use
2-1	High	Low	Med	6	3	2	11	High	Agriculture
8-10	High	Med	Med	6	2	2	10	High	Commercial
5-4	Med	Low	Low	4	3	3	10	High	Municipal
8-9	Med	Low	Low	4	3	3	10	High	Private Rd
8-11	Med	Low	Low	4	3	3	10	High	Private Rd
2-10	Med	Low	Low	4	3	3	10	High	Recreational
6-5	High	Low	Med	6	3	2	11	High	Recreational
6-6	Med	Low	Low	4	3	3	10	High	Recreational
1-7	Med	Low	Low	4	3	3	10	High	Residential
1-8	Med	Low	Low	4	3	3	10	High	Residential
2-3	Med	Low	Low	4	3	3	10	High	Residential
4-4	Med	Low	Low	4	3	3	10	High	Residential
8-2	Med	Low	Low	4	3	3	10	High	Residential
1-5	High	Low	Low	6	3	3	12	High	Town Rd
1-6	Med	Low	Low	4	3	3	10	High	Town Rd
2-2	Med	Low	Low	4	3	3	10	High	Town Rd
2-9	Med	Low	Low	4	3	3	10	High	Town Rd
2-11	Med	Low	Low	4	3	3	10	High	Town Rd
3-1	High	Med	Med	6	2	2	10	High	Town Rd
3-6	Med	Low	Low	4	3	3	10	High	Town Rd
4-2	Med	Low	Low	4	3	3	10	High	Town Rd
6-3	Med	Low	Low	4	3	3	10	High	Town Rd
6-4	Med	Low	Low	4	3	3	10	High	Town Rd
7-6	Med	Low	Low	4	3	3	10	High	Town Rd
6-1	Low	Low	Low	2	3	3	8	Med	Agriculture
6-7	Low	Low	Low	2	3	3	8	Med	Agriculture
2-8	Low	Low	Low	2	3	3	8	Med	Commercial
5-6	Med	Low	Med	4	3	2	9	Med	Commercial
1-1	Low	Low	Low	2	3	3	8	Med	Const. site
8-1	High	High	High	6	1	1	8	Med	Const. site
5-3	Low	Low	Low	2	3	3	8	Med	Municipal
5-5	Med	Med	Med	4	2	2	8	Med	Municipal
5-9	Low	Low	Low	2	3	3	8	Med	Municipal
8-4	High	High	High	6	1	1	8	Med	Municipal
4-5	Low	Low	Low	2	3	3	8	Med	Municipal/Rec
5-1	Low	Low	Low	2	3	3	8	Med	Municipal/Rec
5-10	Med	Low	Med	4	3	2	9	Med	Municipal/Rec
5-11	Low	Low	Low	2	3	3	8	Med	Municipal/Rec
5-12	Med	Low	Med	4	3	2	9	Med	Municipal/Rec
5-13	Med	Low	Med	4	3	2	9	Med	Municipal/Rec
2-7	Low	Low	Low	2	3	3	8	Med	Residential
4-6	Low	Low	Low	2	3	3	8	Med	Residential
4-7	Low	Low	Low	2	3	3	8	Med	Residential
5-8	Med	Low	Med	4	3	2	9	Med	Residential
7-7	Low	Low	Low	2	3	3	8	Med	Residential
1-9	Low	Low	Low	2	3	3	8	Med	State road
7-3	Med	Low	Med	4	3	2	9	Med	State road
1-2	Low	Low	Low	2	3	3	8	Med	Town Rd
1-3	Low	Low	Low	2	3	3	8	Med	Town Rd
2-5	Low	Low	Low	2	3	3	8	Med	Town Rd
2-6	Low	Low	Low	2	3	3	8	Med	Town Rd
3-2	Med	Med	Low	4	2	3	9	Med	Town Rd
3-3	Low	Low	Low	2	3	3	8	Med	Town Rd
3-4	Med	Med	Med	4	2	2	8	Med	Town Rd
3-5	Med	Med	Med	4	2	2	8	Med	Town Rd
4-1	Low	Low	Low	2	3	3	8	Med	Town Rd
4-8	High	High	High	6	1	1	8	Med	Town Rd
5-2	Low	Low	Low	2	3	3	8	Med	Town Rd
5-7	Med	Med	Med	4	2	2	8	Med	Town Rd
6-8	High	High	High	6	1	1	8	Med	Town Rd
6-9	High	High	High	6	1	1	8	Med	Town Rd
8-3	Med	Med	Med	4	2	2	8	Med	Town Rd
8-8	High	High	High	6	1	1	8	Med	Town Rd
8-5	Med	High	High	4	1	1	6	Low	Municipal
1-4	Low	Med	Med	2	2	2	6	Low	other
6-2	Low	Low	Med	2	3	2	7	Low	Residential
7-4	Med	High	High	4	1	1	6	Low	State road
7-5	Med	High	High	4	1	1	6	Low	Town Rd
8-6	Low	Med	Med	2	2	2	6	Low	Town Rd
8-7	Med	High	High	4	1	1	6	Low	Town Rd
2-4	nr	nr	nr	nr	nr	nr	0	nr	Agriculture
7-1	Low	nr	nr	2	nr	nr	2	nr	Town Rd
7-2	Med	nr	nr	4	nr	nr	4	nr	Town Rd



Priority	# of sites	% Total
Low	7	10%
Med	39	53%
High	24	33%
Not Rated	3	4%
Total	**73**	100%