

## INTRODUCTION

One of the principal objectives of the Mill River Project is to provide locally gathered, scientifically sound research on the watershed's natural resources to municipal officials, planners, and local residents so that planning and policy decisions can be effectively analyzed and implemented. To date, most of the research efforts have related to water quality (geology, water chemistry, aquatic macroinvertebrate assessment) and the factors that might adversely affect the populations of rare freshwater mussels, in particular the federally endangered dwarf wedge mussel. These studies indicate that the water quality of the Mill River mainstem is fairly good, that of its three western tributaries (Great Swamp Brook, West Brook and Roaring Brook) is above average to excellent, while the quality of its two lowland tributaries (Bloody Brook and Great Swamp Brook) is degraded (Newton & Rhodes, 1998). The most probable sources of water quality degradation include road runoff (especially salt), agricultural runoff, livestock access to water bodies, failing septic systems, illegal dumps, and runoff from residential pesticide and fertilizer use (Newton & Rhodes, 1998; Newsted, 1998).

Surveys of the riparian buffer can help pinpoint pollution "hotspots" by linking incompatible land use practices, erosion, stormwater discharge pipes, and forested buffer width to water quality changes (Wear, 1998). With a better understanding of these factors, local officials and residents can plan strategically to maintain and improve water quality, as well as identify potential recreational areas and protect significant habitats.

## **THE MILL RIVER RIPARIAN BUFFER SURVEY**

Water quality in a watershed is strongly influenced by the nature of the upland immediately adjacent to bodies of water, an area referred to as the riparian buffer zone (RBZ). The RBZ plays an important role in filtering runoff, transforming harmful substances, and acting as both a source and sink for nutrients (Wear, 1998; Fraser, 1998; Rothbock et al, 1998; Osborne, 1993; Lawrence, 1984; Peterjohn, 1984). Surveying the RBZ helps identify both potential or existing problems, as well as areas worthy of long-term protection due to the presence of rare species, recreational benefits, wildlife habitat, or other desirable attributes. During 1998, a riparian buffer survey was conducted in the Mill River watershed. The locations of historic and active dumps and where livestock have access were noted. In addition, the following was assessed:

- The erodibility potential of the banks,
- Riparian buffer width,
- Major vegetation patterns along the Mill River,
- State-listed plant and animal species, and
- Invasive plant locations

These data, along with the Land Use and Potential Non-Point Pollution Survey conducted by the Franklin Regional Council of Governments will be provided to the Mill River watershed communities to help them prioritize management activities.

### **Dump Sites and Hazardous Waste Sites**

Eleven “dump” sites were observed along the banks of the mainstem and its tributaries (Map 1).

All but three appear to be historic farm dumps, and consist of a mix of farm equipment debris

and household items. These are in various stages of decay, but all appear to be relatively small (< 400m<sup>2</sup>). The three active sites include:

- 1) a private house where riprap and yard wastes are being deposited to apparently stabilize the bank,
- 2) an area adjacent to a parking lot that is receiving fill and miscellaneous debris,
- 3) a site where yard waste, white goods, construction debris and other miscellaneous waste is being illegally dumped.

**Locations of Dumps:**

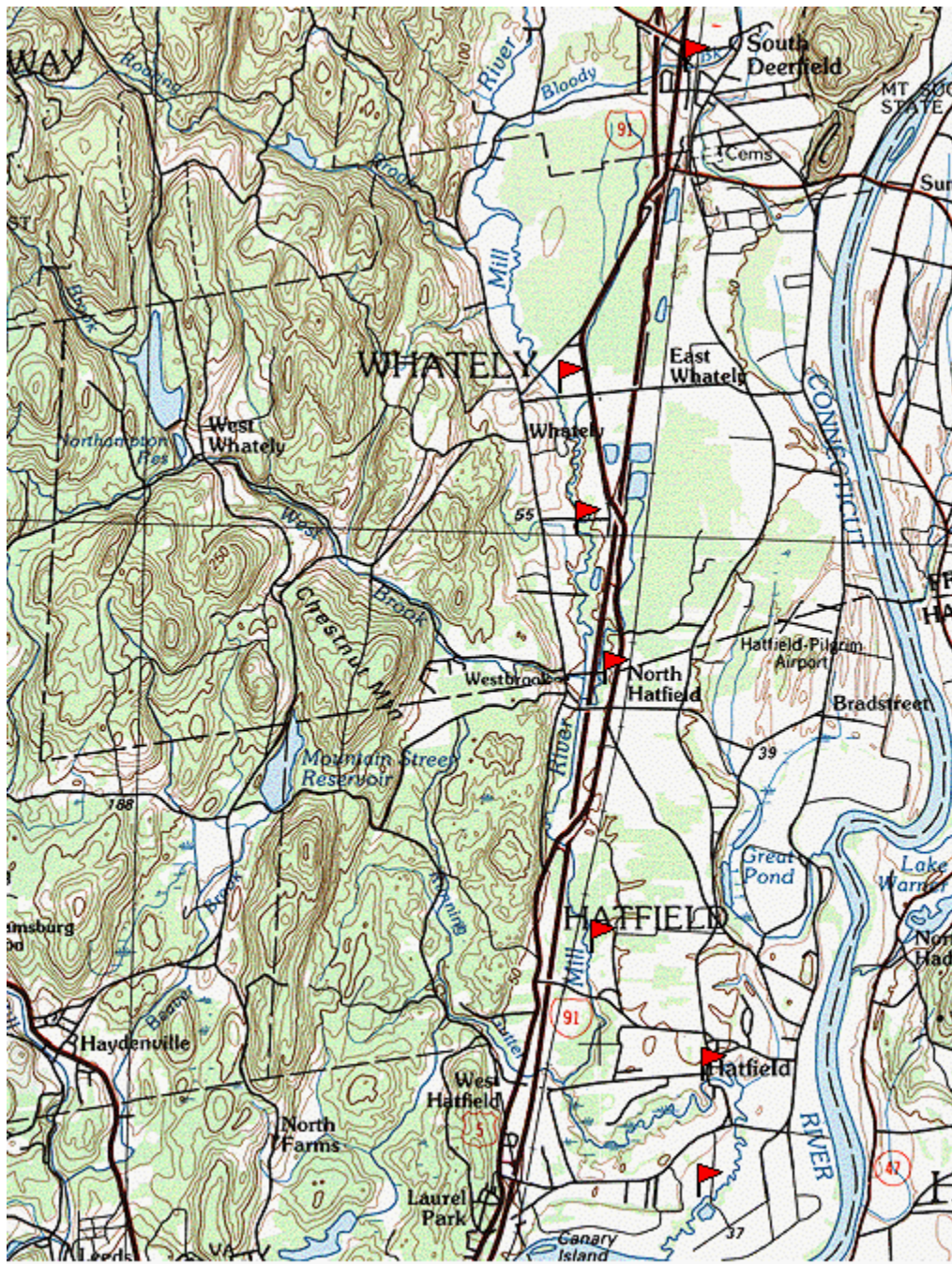
Mill River: (1) immediately above Christian Lane, east side; (2) below Christian Lane, east side adjacent to farm field; (3) immediately above Claverack road, east side; (4) below Claverack Road bridge, west side; (5) between RR and Chestnut Street, east side (active; private); (6) immediately below Advocate dam, north side; (7) below Prospect Street and Advocate Dam, south side; (8) farm meadows; Shepherd's Hollow Road, south side (active).

Running Gutter Brook: between confluence with Broad Brook and first house, south side

Bloody Brook: Between RR and Route 5, south side

West Brook: Opposite gravel pit on West Brook Road, near Chestnut Plain Road, north side

In addition, one confirmed hazardous waste site occurs in a wetland area along the Mill River in Hatfield. Discovered in 1986, the site has petroleum hydrocarbons and excessively high lead levels (24,000 ppm) due to historic dumping. Six monitoring wells are currently installed in the upper aquifer, and the half-acre site is fenced and locked. To date, no groundwater contamination has occurred; the MA Department of Environmental Protection intends to remediate the site during fiscal 1999-2000.



Map 1: Locations of dump sites and hazardous waste site in the Mill River watershed.

### **Direct Livestock Access**

Recent cases of drinking water contamination by pathogens have underscored the importance of preventing livestock waste from entering surface waters (Fraser, et al. 1998). In addition, livestock destroy riparian vegetation and damage the banks, increasing the amount of total suspended solids, which can adversely affect aquatic organisms.

Although livestock plays a minor role within the watershed’s extensive agricultural operations, ten sites were observed where livestock have direct access to surface waters (Map 2). Efforts to address this issue should take advantage of public programs that provide free fencing and alternate watering systems for livestock.

**Locations for Livestock Access to the Mill River & its Tributaries**

Mill River: (1) Rt. 116, So. Deerfield; (2) Rt. 116 and South Mill River Road, Deerfield; (3) North Street, Whately; (4) North of the Whately Wells, Whately; (5) Bridge Road, Hatfield

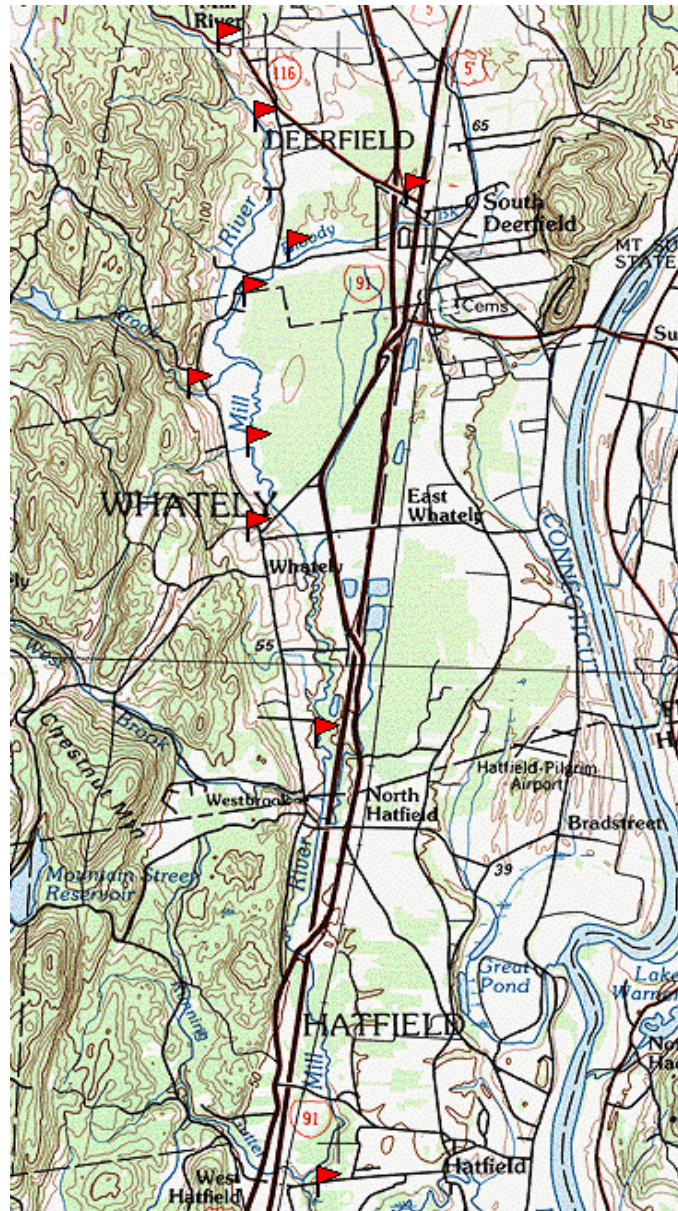
Bloody Brook: (1) Adjacent to Route 91, Deerfield; (2) Whately Road and South Mill River Road, Deerfield; (3) White Birch Campgrounds, Whately<sup>1</sup>

Whately Dingle: Intersection of North Street and Christian Lane, Whately

Roaring Brook: Near intersection with North Street

**Assessing Bank Erodibility**

Understanding the susceptibility of a river’s banks to erosion can play a valuable role in management decisions—from regulating logging and farming activities, to protecting fisheries and wildlife interests, to evaluating the need for stabilization projects.



<sup>1</sup> As of 1999, no livestock is pastured at the campground property.

Map 2: Direct livestock access in the Mill River Watershed.

Riverbank stability depends on several factors (Simons, 1998), including: bank height (i.e. the first break in slope); bankfull height (the height of water at flood stage); root depth; root density; bank angle; and the percentage and composition (grasses, shrubs, trees) of vegetation protecting the bank. In addition, the bank material (bedrock, boulders, cobbles, gravel, sand, or silt/clay) plays a significant role in a riverbank's susceptibility to erosion.

### The Mill River

The Mill River in Whately, Northampton, Conway, Deerfield, and Hatfield, MA is a sinuous, low-gradient river that is stable, but dynamic. Above the falls near Route 116, the river has a rocky bed, is cold, shaded and fast flowing, and contains numerous riffles and pools. Below the waterfall, the river meanders irregularly across the lakebed of former Glacial Lake Hitchcock, and over time has created numerous oxbows, river cutoffs and backwaters. In this stretch, the riverbed ranges from sands and gravels to silts and clays. It is almost entirely absent of riffles, and any change in habitat is typically the result of a beaver dam or fallen woody debris. Within this low-lying stretch, the river passes through a mix of agricultural land and forest before reaching the Connecticut River. Above the waterfall, the Mill River drops 150 meters in 4.2 kilometers (35 m/km); below the falls, the river drops only 83 m in its 36 km course (2.3 m/km). During normal flow, its channel ranges from 10-30 meters until behind the Valley Advocate Dam, where a larger mill pond has been created.

During the 1960's approximately 2 km of the Mill River's channel was straightened as part of the construction of interstate Route 91. Additional rock riprapping has occurred along Route 116

and near many of its bridge crossings. Aside from these and a few other small stabilization projects, the majority of the river meanders naturally.



Map 3: Location of Whately Wells and Erosion noted by arrow

During 1997, extensive bank erosion near Whately's drinking water wells triggered a public health concern and initiated conversations about stabilizing approximately 100 meters of bank. The eroding bank is located within 10 m of a monitoring well and within 50 m of the

Whately public drinking wells (Map 3).

This proposed stabilization project prompted the question: How common is this type of erosion on the Mill River? Knowing this information would help planners assess the relative severity of erosion at the well sites, as well as help develop a policy position to address requests by private landowners to stabilize their riverbanks.

## Methods

During September and October, 1998, the erodibility potential of the banks was rated along the mainstem of the Mill River. Ninety-four stations were distributed along the entire length. Stations were randomly stratified and were located 50 m and 100 m above and below every road crossing (See Figure 6). These distances were used to avoid sampling areas with artificially higher rates of scouring induced by undersized or misplaced culverts, or bridge abutments. In

addition to the 94 sampling points, four additional sites that were known to be eroding were evaluated: the Whately Well site, two sites behind Pekarski's Sausage Mill, and a site above Chestnut Road in Hatfield.

At each station, a transect line was established across the river to determine bankfull width and estimate depth. The erosion potential of both banks was evaluated using the methodology proposed by Rosgen (1990). The length of bank assessed was approximately 20 meters. The likelihood of erosion was based on bank angle, bank height (first break in slope), bankfull height (height at flood stage), root depth, root density, and vegetative cover. Measurements for bank height, bankfull height and root depth were made to the nearest 0.1 meter (Table 1).

Table 1: The criteria and indices used in calculating bank erodibility potential. (Rosgen, 1990)

Criteria	Very Low		Low		Moderate		High		Very High		Extreme	
	Value	Index	Value	Index	Value	Index	Value	Index	Value	Index	Value	Index
Bank Ht/Bkf Ht	1.0-1.1	1.0-1.9	1.0-1.19	2.0-3.9	1.2-1.5	4.0-5.9	1.6-2.1	6.0-7.9	2.1-2.8	8.0-9.0	>2.8	10
Root Depth/Bank Ht	1.0-0.9	1.0-1.9	.89-0.5	2.0-3.9	.49-0.3	4.0-5.9	0.29-0.15	6.0-7.9	1.14-0.5	8.0-9.0	.05	10
Root Density %	80-100	1.0-1.9	55-79	2.0-3.9	30-54	4.0-5.9	15-29	6.0-7.9	5-14	8.0-9.0	<5	10
Bank Angle (Degrees)	0-20	1.0-1.9	21-60	2.0-3.9	61-80	4.0-5.9	81-90	6.0-7.9	90-119	8.0-9.0	120+	10
Surface Prot. (% Veg)	80-100	1.0-1.9	55-79	2.0-3.9	30-54	4.0-5.9	15-29	6.0-7.9	10-15	8.0-9.0	<10	10
<b>TOTALS</b>												
		5-9.5		10-19.5		20-29.5		30-39.5		40-45	46-50	

These data were combined and indexed to calculate the potential for erosion as very low, low, moderate, high, very high, or extreme. Bank material (bedrock, cobbles, gravels, sand, or silt/clay) was visually assessed.

## Results and Discussion

The collected data indicate that the Mill River, in spite of its sinuous pattern, exhibits a high degree of stability. Of the randomized samples, 82% exhibited very low to low amounts of erosion, 17% exhibited moderate erosion potential, while only 1% exhibited a high likelihood of erosion. Pre-selected sites exhibited high amounts of erosion, but none were very high or extreme. The principal soils along the Mill River are sandy loams and silt loams (Rippowam fine sandy loam, Pootatuck fine sandy Loam, and Limerick silt loams). Other soils along the riparian corridor include: Freetown mucks, Swanson mucks, Winooski Silt Loam, Hadley Silt loam, Hinckley loam sand, Agawam fine sandy loam, Saco Silt loam and Scarboro muck (Soil Survey, 1967; Soil Survey, 1995). Sites with sandier soil, however, were typically those where moderate to high amounts of erosion was evident (pers. obs).

Overall, nearly all the evaluated metrics fell into the category of low to very low erosion potential (Figure 1).

**Bank height/Bankfull Height:** In 63% of the sites, the bank height was equivalent to bankfull height, which correlates with a very low potential for erosion. Other sites (17%), however, had drastically different ratios, with bank height being significantly above bankfull height. These sites, because of the risk of undercutting and mass wasting, have a high, very high or extreme erosion potential (Figure 2).

**Root depth/Bank Height:** Nearly 90% of the sampled sites had roots extending to water line (Figure 3). Although forest trees can lead to destabilization of banks when they collapse, the extensive amount of vegetative cover and their deep roots helps bind the soil, making it less susceptible to erosion. Along the Mill River, reed canary grass (*Phalaris arundinacea*) mixes with silky dogwood and other low-lying brush to form

dense vegetative borders; in these areas, the roots of the grasses often extend down to the waterline.

**Root density** was more evenly distributed across the sample sites, but no sites had less than 15% root density. Forty percent of the sites observed had root densities of 80-100% (Figure 4). The density of the roots is another important factor when considering the bank's susceptibility to mass wasting and erosion by scouring.

**Banks angle** along the Mill River ranged from low, virtually level to steep and undercut (Figure 5). Most of the banks (45%) were between 21-60 degrees, while another 28% were slightly steeper and exhibited 61-80 degree slopes. These angles are generally low to moderate in the hazard rating for erosion.

In general **surface cover** was very high, with 64% of the sampled sites having 80-100% surface vegetation (Figure 6). Only 8% of the sampled sites had less than 55% surface cover along the banks. Of these, most were in heavily forested settings where forest shade limited the growth of understory herbaceous plants.

Of the preselected sites, our findings indicate that areas with high erosion are rare, and are linked with poor land use practices, such as poor pasture management, inadequate forest buffers, intensive agriculture, or in the case of erosion behind the Pekarski Sausage Mill, a catastrophic event (dam collapse, erosion of accumulated Mill Pond sediments and confining the upper river by armoring the bank). At the Whately well site, sandier soils in combination with routine mowing to the very edge of the riverbank have contributed to the susceptibility of the bank.

Fig. 1. Erosion potential on the Mill River, Hampshire & Franklin Counties, MA.

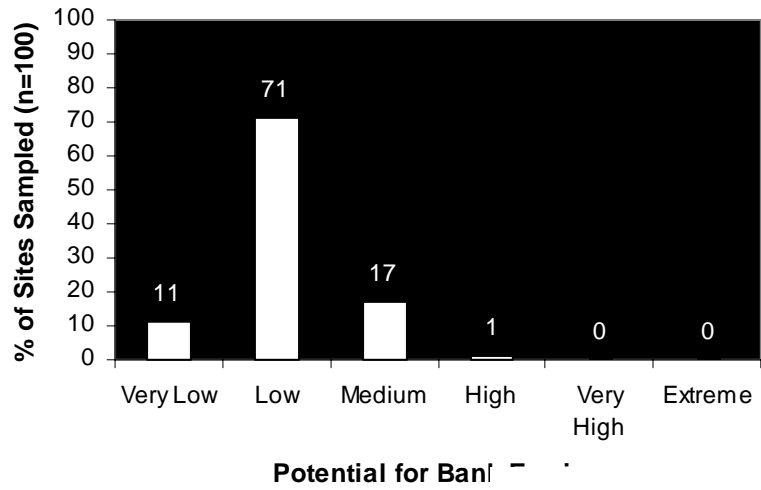


Fig. 2. Bank erosion potential given ratio of bank height/bankfull on the Mill River

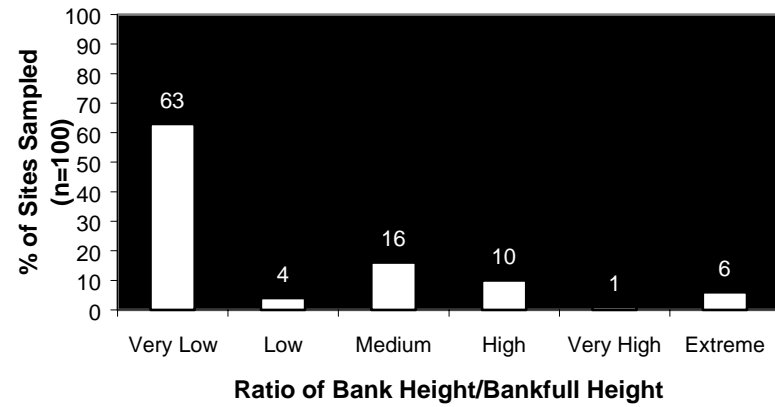


Fig. 3: Erosion potential based on root depth/bank height on the Mill River

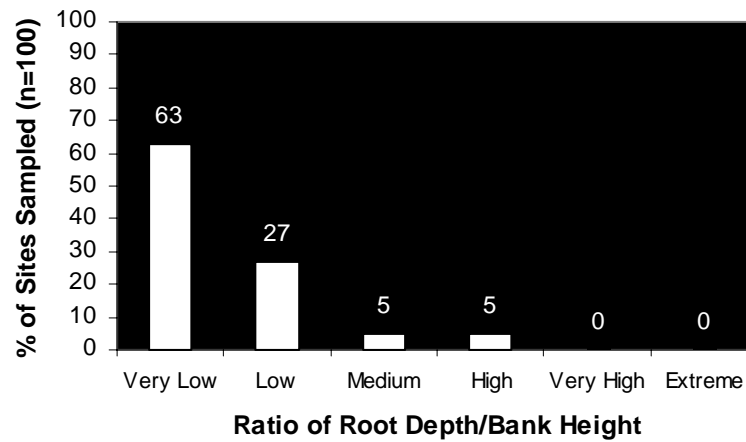


Fig. 4. Erosion potential given root density (%) on the banks of the Mill River.

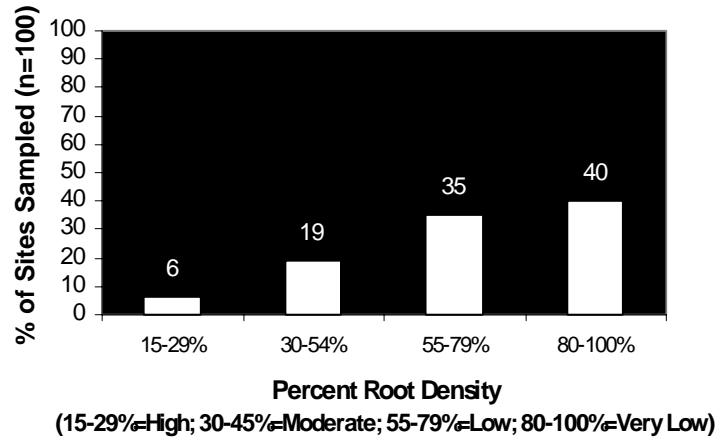


Fig. 5. Erosion potential based on bank angle along the Mill River.

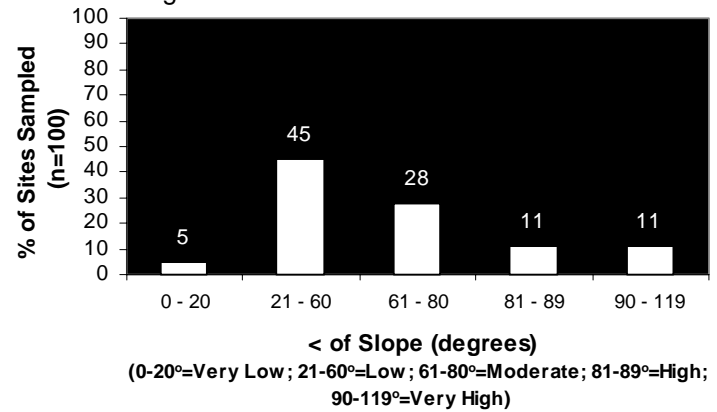
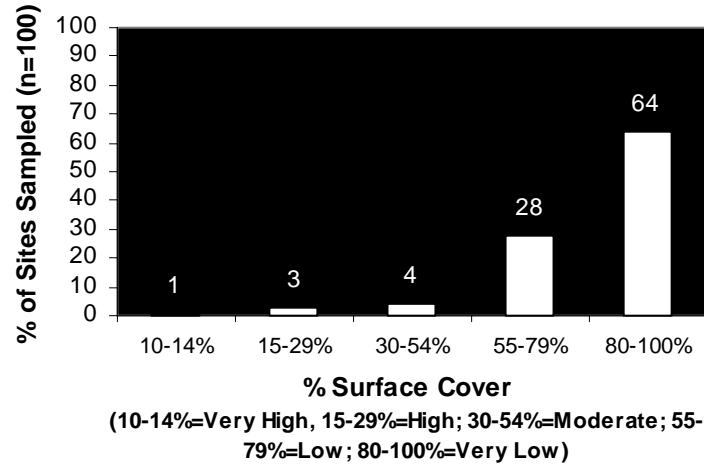


Fig. 6. Erosion potential based on surface cover along the banks of the Mill River



## **Riparian Buffer Width**

Forested riparian buffers are recognized as important areas for wildlife and water quality improvements (Osborne et al, 1993). For wildlife, they provide food, habitat, migratory stopovers and important dispersal routes within a fragmented landscape (Vander Haegen et al, 1996; Osborne, 1993), and they also help maintain ambient stream temperatures (Osborne, 1993). Moreover, the surrounding vegetation contributes to the food supply for fish and aquatic macroinvertebrates. For water quality interests, forested riparian trap sediments and, through bacterial action and plant uptake, significantly reduce concentrations of nitrogen and phosphorus run-off (Cooper, 1987b; Peterjohn, 1984; Lawrence 1984). Depending on the slope and the quantity and concentration of pollutants, a 10-20 m buffer is often recommended as an effective distance for significant improvements in water quality.

## **Methods, Results and Discussion**

Using 1997 aerial photographs (1:30,000), a map depicting a 15 m buffer (50') along the mainstem of the Mill River was created using Adobe Photoshop and Illustrator. Of the Mill River's total bank length (80.4 km), 85% had a forested buffer width of 15 m or greater. Much of the 15% (12.1 km) of riverbank that has less than a 15m forested buffer is located in Whately, where hayfields are common along the Mill River. The fields support dense grasses, however, and so still function to trap sediments and nutrients (Cooper et al, 1987 a).

When considering water quality in the Mill River, it will be important to maintain the currently vegetated areas and work cooperatively with landowners where buffer widths are less than 15-meters, especially where livestock have direct access or other land uses threaten the integrity of

the water. For instance, historic tile drains, storm drains or gullies can circumvent the benefit of a forested buffer.

In general, wildlife habitat values increase when the forested buffer is greater than 50 m (Dickson 1989). Vander Haegen et al (1996) observed high rates of nest predation in riparian buffer strips adjacent to forest clearcuts, and narrow corridors support edge species like cardinal, starlings and species. Keller et al. (1993) found that wider corridors were likely to provide key habitats for area-sensitive species such as wood thrushes and reduce nest predation and brood parasitism. With respect to maintaining biological diversity, Spackman et al (1995) found that, although 10 to 30 meter corridors included 90% of the plant species, widths of 75-175 meters were needed to include 90% of the bird species.

Interested riparian landowners might want to explore the possibility of tree plantings in areas with narrow forested buffers, or consider the possibility of setting aside conservation easements. These actions, which have been shown to be cost efficient and effective methods of reducing nutrient loads (Osborne, 1993), might have the added benefit of increasing the abundance of roots, which would help stabilize eroding banks.

By combining forest buffer width data with land use, sites can be ranked to enable the communities to address those sites where improvements for water quality and wildlife will be the greatest. Interested landowners can take advantage of state and federal incentive programs (free fencing, alternate water sources, EQIP, Conservation Restriction Program, Restore) to expand their riparian buffers.

## Vegetation Patterns

Another objective of the Riparian Buffer Survey was to classify major plant communities along the mainstem of the Mill River. Riparian plant communities are key components of the natural landscape, providing a transition zone between a terrestrial and aquatic environments (Nilsson, 1994).

Visual assessment was used to determine the dominant plants and distinguish plant associations within a 20-200 meter corridor along the Mill River. Using this approach, ten major plant associations were observed along the mainstem of the Mill River. The plant associations that follow are listed in order, from the confluence of the Mill River and the Connecticut in Hatfield to its headwaters in Conway. They are the result of past and current land use, geology and hydrology.

1. **Silver Maple Floodplain Forest:** Silver maple dominates, with red ash (*Fraxinus pennsylvanica* var. *subinterima*), cottonwood (*Populus deltoides*) as important constituents. Other canopy trees include black willow (*Salix nigra*) and Pin Oak (*Quercus palustris*). The understory is dominated by Ostrich Fern (*Matteucia struthiopteris*) and Sensitive Fern (*Onoclea sensibilis*), with inclusions of Stinging nettle (*Laportea canadensis*) and Poison Ivy (*Toxicodendron radicans*). There is virtually no shrub layer; vines (*Vitis labrusca*) are common. This community is recognized by the Massachusetts' Natural Heritage and Endangered Species Program as Exemplary. It supports at least four state-listed species. On the levees above the current floodplain, red oak (*Quercus rubra*) and sugar maple (*Acer saccharum*) frequently occur.

It extends from the confluence of the Mill River and the Connecticut to Elm Street, Hatfield.

2. **Silver Maple Dominated, with Red Oak, Sugar Maple and occasional Butternut (*Juglans cinerea*) on adjacent levees.** This plant association occurs from Elm Street, Hatfield to the Advocate Dam. The width of the forest buffer is narrow, and is bordered by either agricultural activity or residential uses. Other common canopy species include cottonwood, pin oak and red maple. The shrub layer includes both box elder (*Acer negundo*) and Staghorn sumac (*Rhus typhina*). Herbs include Touch-Me-Not (*Impatiens capensis*) and

Poison Ivy; other common herbs are Virginia creeper (*Parthenocissus virginiana*), Glassweed (*Pilea pumila*), and *Leersia virginica*.

3. **Red Maple and Silver Maple Forest, with abundant Pin Oak:** This association extends from the Advocate Dam to Chestnut Street. Other important canopy species include Hickory (*Carya* spp.), Green Ash (*Fraxinus pensylvanica*); sycamore is occasional. Silky dogwood (*Cornus amomum*) is common in the shrub layer; beaked hazelnut (*Corylus cornuta*), ironwood (*Carpinus caroliniana*) and Elm (*Ulmus rubra*) are occasional. Sensitive fern, poison ivy and touch-me-not are the most abundant herbs. Other common herbs include ostrich fern, groundnut (*Apios americana*), jumpseed (*Tovara virginiana*), interrupted fern (*Osmunda claytoniana*), Royal Fern (*Osmunda regalis*), Lady Fern (*Athyrium felix-femina*), New York fern (*Thelypteris novaeboracensis*), Virginia creeper, *Leersia virginica*, and Asiatic bittersweet (*Celastrus orbiculatus*). Above the Advocate Dam, the impounded area is an emergent marsh dominated by water willow (*Decodon verticillata*), touch-me-not, and isolated clusters of speckled alder (*Alnus rugosa*).
4. **Red Maple/Pin Oak Forest** extends from Chestnut Street to Route 91, and then again above the channelized portion of the Mill River to the hayfields north of Swamp Road, Whately. Other common canopy species include white pine (*Pinus strobus*), red oak, butternut, silver maple, and green ash. Drier upland areas, which are infrequent, support hemlock (*Tsuga canadensis*) and beech (*Fagus grandifolia*). The shrub layer is dominated by silky dogwood, with some northern arrowwood (*Viburnum recognitum*). Grape (*Vitis labrusca*, *V. riparia*) is common. The most abundant herbs are touch-me-not, sensitive fern, poison ivy, Virginia creeper, false nettle, Virgin's bower (*Clematis virginiana*) and *Elymus riparius*. *Eupatorium rugosum*, Smooth goldenrod (*Solidago canadensis*), False nettle (*Boehmeria cylindrica*), Arrow-leaved tearthumb (*Polygonum arifolium*), zigzag goldenrod (*Solidago arguta*) and jumpseed. Also present lady fern and, in muddy areas, moneywort (*Lysimachia nummularia*) and rice cut grass (*Leersia oryzoides*) are frequent. Multiflora rose (*Rosa multiflora*) is localized and abundant; Asiatic bittersweet is found frequently along the river edge. See Silky Dogwood Shrub Swamp for the plant community below Claverack Road.
5. **Black locust/cottonwood/red maple/ cottonwood/black willow** dominate the edges along the channelized section of the Mill River. Silver maple and green ash occur infrequently. The shrub layer is dominated by silky dogwood and speckled alder; elderberry (*Sambucus canadensis*) is common. Abundant herbs include touch-me-not, reed canary grass (*Phalaris arundinacea*), and cattail (*Typha latifolia*). False nettle, Joe Pye weed (*Eupatorium maculatum*), groundnut, false nettle, *Cinna arundinacea*, arrow-leaved tearthumb, *Eupatorium rugosum* is common. Purple loosestrife (*Lythrum salicaria*), Asiatic bittersweet, and Japanese knotweed (*Reynoutria japonica*) are also occasional. Both *Vitis riparia* and *V. labrusca* are common. Back from the river's edge, the forest is dominated by red maple in the canopy and an understory mix of witch hazel, northern arrowwood, and cinnamon fern (*Osmunda cinnamomea*).
6. **Silky Dogwood Shrub Swamp**, which occurs below Claverack Road, is characterized by dense tangles of silky dogwood, along with Virgin's Bower, touch-me-not, arrow-leaved

tearthumb, sensitive fern, and Joe Pye weed. Beaver activity is common here. Pin oak and red maple are common canopy trees along the upland edges.

7. **Reed canary grass/Carex** Wet Meadows characterize the hayfields along the Mill River where it parallels North Street, Whately.
8. **Black Willow/Silky Dogwood/Speckled Alder** dominate the riparian buffer that extends from Town Farm Road to .5 km north of Stockbridge Road. The canopy, which also includes red maple, is sparse. The wet meadows below are dominated by tangles of silky dogwood and speckled alder. Broad patches of reed canary grass and sensitive fern dominate the diverse herb layer. Hayfields or row crops border this narrow band of vegetation.
9. **Cattail/Beaver Marsh:** A large marsh is dominated by cattails, reed canary grass, rice cut grass (*Leersia oryzoides*) and islands of speckled alder. Smartweeds (*Polygonum* spp.) are abundant. The beaver pond lies below the cow pasture on South Mill River Road.
10. **Hemlock/Hardwood Forest**, consisting of sugar maple, yellow birch, basswood (*Tilia americana*), beech, white ash, black birch and white pine, forms the canopy in the headwaters of the Mill River along Route 116. The understory is thin, with interrupted fern, sensitive fern and scattered herbs.

### **Rare Plant Species**

Another element of a Riparian Buffer Survey is to identify rare species locations. During 1998 populations of five state-listed plant species were observed: Approximately 90 individuals of Winged Monkey Flower (*Mimulus alatus*) (MA Endangered) were found along the muddy shores of the Mill River and its flood channels; several dozen fruiting stems of Deergrass (*Deschampsia cespitosa*) (MA Endangered) occurred in one small floodplain area between Chestnut Street and the railroad tracks near C & S Wholesalers; a new station of Green Dragon (*Arisaema dracontium*) (MA Threatened) (20 stems) was observed in the silver maple floodplain forest ; Variegated Horsetail (*Equisetum variegatum*) (MA Special Concern) was found in abundance near the large dam on the South Deerfield Water Supply, with approximately 36 Fringed Gentian (*Gentiana crinita*) (MA Special Concern) growing nearby. In addition, a

small population of Floating Burreed (*Sparganium fluctuans*—Watch-Listed) was also observed in a wetland within The Rocks section of Hatfield.

### **Non-Native Plants**

The most abundant aggressive, invasive plants in the Mill River Watershed are Asiatic bittersweet (*Celastrus orbiculatus*), Multiflora Rose (*Rosa multiflora*), Japanese knotweed (*Reynoutria japonica*), and Russian Olive (*Eleagnus angustifolia*). All four are so extensive that only control--and not eradication—can be considered. Efforts to slow the spread of these species should begin as soon as possible. Asiatic bittersweet is found throughout the watershed, and is especially common along the river and stream corridors. Multiflora rose is found throughout, but is most often in old pastures; it is particularly common in a few sections of the Mill River, most notably near Chestnut Street in Hatfield and below Christian Lane in Whately. Japanese knotweed occurs along the river and many of its tributaries (especially West Brook), as well as in isolated patches along many of the watershed's roads. Russian olive is most abundant in West Whately, where it grows along the roads and in local pastures.

Several other of the state's most aggressive non-natives are also present in the watershed, but at much lower levels:

- Giant Reed (*Phragmites australis*) is found along the highway and in isolated wetland areas.
- Moneywort (*Lysimachia nummularia*) occurs in the floodplain of the Mill River
- Wild Garlic (*Alliaria officinalis*) occurs along West Brook and the Mill River
- Purple Loosestrife (*Lythrum salicaria*) is found along Bloody Brook (So. Mill River Road) and in scattered locations along the Mill River

- Wild Honeysuckle (*Lonicera morrowii*) is widely scattered
- Japanese Barberry (*Berberis thunbergii*) occurs sporadically throughout the watershed in forested areas
- Winged Euonymus (*Euonymus alatus*) is naturalizing along Roaring Brook below Deerfield's new filtration plant and in scattered locations in Hatfield.
- Glossy Buckthorn (*Rhamnus frangula*) is known only in Hatfield along the Mill River near Route 5 and in the Rocks area

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