Fact Sheet #2: Functions of Riparian Areas for Storm Damage Prevention

[This fact sheet was prepared by *Russell Cohen, Rivers Advocate,* **Division of Ecological Restoration, Massachusetts Department of Fish and Game**. This document is intended for educational purposes only and does not necessarily represent the viewpoint of agencies and commissions having regulatory authority over riparian lands. Last updated: June 11, 2014.]

How do riparian areas prevent storm damage?

Riparian areas are the lands adjacent to, and/or interacting with, rivers and streams. Rivers and streams, serving as conduits of gravitationally-induced energy in the form of streamflow, are constantly in a state of flux. Storm events typically cause rivers to swell in size and velocity, frequently spreading out over adjacent lands and even changing direction and cutting new channels within the floodplain. The volume and erosive force of storm flows can cause substantial damage to homes, businesses, cropland and roads and other infrastructure. This damage is not restricted to the floodplain, as surging, swollen rivers can dig into and undermine steep streambanks, causing slope subsidence (also known as slumping) and subsequent damage to homes and other property that lie at a considerable height above the water.

Retaining a floodplain in an undeveloped, vegetated condition reduces the force, height and volume of stormwaters by providing ample opportunity for them to spread out horizontally and relatively harmlessly across the floodplain. Vegetation on and above the streambank provides friction against moving water, which slows it down so water is not delivered downstream as quickly. Riparian vegetation also intercepts and detains runoff from adjacent upland areas that would otherwise flow directly into rivers and exacerbate storm damage downstream. In addition, vegetated streamside buffers help block storm debris (e.g., flotsam and jetsam) carried along by stormwater from entering cropland, pastures and other riparian areas, thereby minimizing the need for post-storm cleanup.

Keeping riparian areas naturally vegetated allows the vegetation itself to absorb much of the storm's fury. Vegetated areas dissipate the energy of storm-generated waves and provide considerable resistance to streambank erosion. Plants are endowed by nature with considerable capacity to withstand storm-driven winds, waters and ice. Leaves, branches, even whole trees uprooted in storms maintain their usefulness as they become food and shelter for aquatic organisms and the many forms of terrestrial wildlife inhabiting riparian areas. In the meantime, the streamside forest heals itself through the regrowth of vegetation in storm-damaged areas. Furthermore, the natural sinuosity and complexity of river and stream channels helps to dissipate the rampaging energy of stormwater.

What alterations to riparian areas impair their ability to prevent storm damage?

The two major types of alterations to riparian areas that impair their ability to prevent storm damage are: (1) the placement of buildings and other damageable property within floodplains, steep slopes or other locations that are susceptible to storm damage, and (2) the clearing of vegetation, particularly if it is replaced with impervious surfaces such as roofs and parking lots.

The placement of buildings or other structures within the floodplain or floodway portion of the riparian area is likely to reduce floodwater storage and conveyance, thereby increasing the risk of storm damage to that or other preexisting buildings or structures.

Removing vegetation from riparian areas and replacing it with impervious surfaces eliminates the benefits vegetated areas provide in moderating the severity of storm events. While storm runoff from vegetated areas tends to be attenuated both in speed and volume, runoff from impervious surfaces occurs much more quickly, with negligible reductions in volume. The result is that runoff from paved areas tends to be much "flashier" than vegetated areas, leading to a "spikier" discharge curve. In other words, impervious surfaces can actually amplify the effect of storms and the subsequent risk of serious damage to lives and property. Even if the proposed alteration is on a portion of the riparian area that lies uphill from the 100-year floodplain, any alteration that decreases the riparian area's ability to absorb precipitation through gradual infiltration into the ground, such as the removal of forest cover or an increase in impervious surfaces, will contribute to an increased likelihood of storm damage downstream.

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Levees, retaining walls and other man-made devices intended to prevent storm-related damage to riverside development are often ineffective, as the immense property damage caused by the 1993 floods along the Mississippi River and the subsequent costly floods in the Pacific Northwest will attest. Attempts to constrict the water into a channel have the effect of constricting this excessive energy into an increasingly powerful current. When the river breaks its restraints its capacity for destructive action has been magnified. Channelization of meandering streams cuts the water storage capacity of those streams and causes water to flow more rapidly downstream, exacerbating flooding and storm damage problems downstream. An increase in water velocity also increases a river's erosive power, placing bridge supports, embankments and other vulnerable areas at greater risk of being undermined.

Even if channelized river segments or storm sewer collection systems have the effect of conveying storm flows quickly away from that particular location, they will nevertheless likely result in increasing peak flows downstream. In other words, alteration to riparian areas for the purpose of accelerating the rate at which storm waters move downstream is likely to exacerbate the severity, duration and frequency of storm-related damage downstream.

Last but not least, the increased speed and volume of storm water discharge running off pavement and other unvegetated surfaces is likely to result in a serious degradation in downstream water quality. This is due not only to the washing off of accumulated oil, gasoline and other pollutants from parking lots, but also due to an increase in the frequency and severity of combined sewer overflows ("CSOs"). The more impervious surfaces, the more stormwater; the more stormwater, the greater risk that stormwater will get into and overwhelm sewer pipes and treatment plants, increasing the likelihood that raw or partially treated sewage will be discharged into rivers and coastal embayments.

Why are vegetated riparian areas along smaller brooks and streams as significant for preventing storm damage as along the larger rivers?

A large proportion of the water in the state's rivers is contributed by the smaller tributaries. If riparian areas along these brooks and streams are altered in a manner that impairs their ability to absorb and detain stormwater, the cumulative impact of streams discharging storm runoff into rivers at a greater volume and velocity will result in worsening stormwater-related damage to vulnerable structures and river communities downstream. In addition, the fragility of riparian areas is often accentuated in small headwater stream reaches. These small streams are the most vulnerable to human disturbance because they respond dramatically and rapidly to alterations on adjacent lands and are the most sensitive to changes in riparian vegetation in the surrounding watershed. Furthermore, many of the smallest headwater tributaries tend to be located on some of the steepest-sloping and erosion-prone lands within the watershed.

What are some best management practices (BMPs) for riparian areas to maintain and enhance their storm damage prevention function?

Riparian areas prevent storm damage most effectively when they are retained in a naturally vegetated state and kept relatively free of buildings, roadways and other man-made structures and activities vulnerable to storm-related damage. Rivers need room to swell in size and change shape and location within the floodplain in response to storm events. Vegetated areas along rivers help to absorb the force as well as volume of storm waters, thereby lessening the severity of impacts downstream. Locating structures or other vulnerable land uses within the riparian area simply places them in harm's way and increases the likelihood that they'll suffer storm-related damage. The best way to prevent such damage is to avoid it in the first place, by keeping activities vulnerable to storm damage as far away from rivers and streams as possible.

Where alteration in riparian areas is unavoidable, projects should maximize the amount of land retained in and/or restored to a naturally vegetated condition, to minimize the volume and speed of any storm-related runoff from those properties. BMPs (Best Management Practices) intended to address stormwater management issues resulting from riparian land development may, unless carefully designed, implemented and maintained, nevertheless fail to serve other recognized functions of riparian areas, such as fisheries and wildlife habitat protection, pollution prevention and groundwater aquifer recharge.

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