A riparian buffer is the area of land along streams and rivers and other open water bodies. Riparian buffers are essential to the ecology of aquatic systems. Riparian buffer zones, due to their location between surface waters and adjacent land areas, provide a range of important functions such as:

- Trapping/removing sediment, phosphorus, nitrogen, and other nutrients from runoff, as these pollutants lead to eutrophication of aquatic ecosystems;
- Trapping/removing other contaminants, such as pesticides;
- Providing habitat and contiguous travel corridors for wildlife;
- Stabilizing stream banks and reducing channel erosion;
- Storing flood waters, thereby decreasing damage to property;
- Maintaining habitat for fish and other aquatic organisms by moderating water temperatures and providing woody debris;
- Improving the aesthetics of stream corridors (which can increase property values); and
- Offering recreational and educational opportunities.

Because they maintain all of these services, riparian buffers can be thought of as a "conservation bargain." Preserving a relatively narrow strip of land along streams and rivers, which is frequently unsuitable for other uses can help maintain good water quality, provide habitat for wildlife, protect people and buildings against flood waters, and extend the life of reservoirs. The preservation and restoration of natural riparian buffers is considered to be the single most important management practice to protect water resources.

**Figure 3-1 Healthy Riparian Buffers.**

The Clean Water Act goal that all waters should be fishable and swimmable is not achievable in Rhode Island's waters without the careful protection of riparian buffers (RI Rivers Council 2005 Establishment of Riparian and Shoreline Buffers: A Report to the Governor). (HW photo)
In Rhode Island, most freshwater wetlands, and the buffer areas protecting them, are regulated by the Freshwater Wetlands Act, administered by the RI DEM. In addition, the RI CRMC regulates both fresh and tidal water resources and their buffers within the coastal zone of Rhode Island. The RI DEM Wetlands Program framework does not protect riparian buffers around all wetlands. Both programs protect the minimum buffers as defined by the Act. Some weaknesses in the current regulatory program are as follows:

- RI DEM is not able to protect riparian buffers around all wetland systems. Special aquatic sites (vernal pools), small ponds less than one-quarter acre in size, and small forested/shrub wetlands less than three acres in size do not have regulated buffer zones;
- Authors of the Wetland Act had the foresight to protect adjacent buffer areas for other wetlands; however, the science regarding the importance of buffers has grown in the last 30 years, and we know that current buffer zones regulated by law are often not large enough (e.g., the buffer zone width should consider sensitivity of wetland type and the land use that is proposed in both urban and suburban settings, as well as other factors); and
- State regulatory programs can be limited where substandard lots of record have been created and property use is grandfathered.

Most communities rely on RI DEM or RI CRMC to regulate buffers instead of exercising their zoning authority to help guide new development away from these sensitive areas. Eighteen RI municipalities have their own setbacks from wetland edges. Of these, seven communities regulate all disturbances within the setback; three communities regulate all buildings, structures and onsite wastewater treatment systems (OWTS), and the remaining eight regulate only OWTS location. In most cases the setbacks apply community-wide. A few communities either apply the setback only within a critical resource area or establish more stringent setbacks and/or performance standards for the critical area. R.I. General Law 45-24-30, the RI Zoning Enabling Act, enables communities to regulate development through a municipal zoning ordinance that has the ability to protect environmental resources while providing for the orderly growth and development which recognizes:

3(ii) The natural characteristics of the land, including its suitability for use based on soil characteristics, topography, and susceptibility to surface or groundwater pollution.
3(iii) The values and dynamic nature of coastal and freshwater ponds, the shoreline and freshwater and coastal wetlands.

**Objective**

Communities should use their land use regulatory power to require the preservation or restoration of a naturally vegetated buffer along all jurisdictional wetland resources to the maximum extent practicable in both new development and redevelopment. The

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5 Rhode Island General Law 2-1-18 et seq.
6 Refer to Perimeter Riverbank and Floodplain Wetlands Fact Sheet No.9 (RI DEM, 2007)
7 For all references to “maximum extent practicable” in this guide, an applicant must demonstrate the following: (1) all reasonable efforts have been made to meet the standard in accordance with current local, State, and Federal regulations, (2) a complete evaluation of all possible management measures has been performed, and (3) if full compliance cannot be achieved, the highest practicable level of management is being implemented.
determination of buffer widths may require extra consideration in different locations depending on site specific characteristics, such as the presence of hydric soils and steep slopes.

**Figure 3-2 Example of Vegetated Riparian Buffers.**

The green area in the figure above represents the vegetated riparian buffer and the shaded blue area indicates a buffer zone of 100 feet on either side of the stream as a reference. (HW graphic)

**Recommended Practice**

A community buffer program should be created to establish a naturally vegetated buffer system along all streams and wetlands to supplement and expand upon the minimum requirements of the RI DEM and RI CRMC programs where applicable. Other important environmental features important to water quality preservation and enhancement should be included within the buffer, such as the 100-year floodplain and steep slopes. Communities implementing buffer programs should consider issues such as minimum width, target vegetation, allowable uses, and performance standards to avoid and minimize impact, as discussed below.

**Minimum Buffer Width**

The effectiveness of various buffer widths has received much attention from the scientific and regulatory community, particularly in relation to water quality and local land use policy. A summary of over 150 scientific studies of effective buffer widths for a variety of biological, hydrologic, and physical functions is summarized by the Environmental Law Institute (2003). The Army Corps of Engineers (Corps) released national recommendations for riparian buffer design in 2000 (Fischer and Fischneich, 2000). Desbonnet, et al. (1994) published material specific to Rhode Island that can also be used to shed light on site specific buffer issues. Table 3-1 summarizes a wide range of buffer widths reported by these studies and provides a recommended minimum width to support a variety of buffer functions. A minimum buffer of 100 feet seems to be the most widely recommended width for protection of most buffer functions. Critical resources, such as public drinking water supplies may have larger...
buffer requirements for enhanced protection and should be clearly identified in the buffer regulations. The values recommended represent the distance from the edge of a resource (e.g., stream bank, not the centerline).

**Table 3-1 Recommended Minimum Buffer Widths (adapted from Environmental Law Institute, 2003).**

<table>
<thead>
<tr>
<th>Function</th>
<th>Range of Riparian Buffer Widths</th>
<th>Minimum Recommended Buffer Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stream Stabilization</td>
<td>30-170 ft</td>
<td>30-65 ft</td>
</tr>
<tr>
<td>Water Quality Protection</td>
<td>15-300 ft (remove nutrients)(^2)</td>
<td>10-400 ft (remove sediment)</td>
</tr>
<tr>
<td>Flood Attenuation</td>
<td>65-500 ft</td>
<td>65-500 ft</td>
</tr>
<tr>
<td>Riparian/Wildlife Habitat</td>
<td>10 ft-1 mile</td>
<td>100 ft-0.3 mile</td>
</tr>
<tr>
<td>Protection of Cold Water Fisheries</td>
<td>&gt;100 ft (5 studies)</td>
<td>50-200 ft (1 study)</td>
</tr>
</tbody>
</table>

1. Larger buffers may be necessary based on steep slopes and highly erodible soils.
2. Different buffer designs should be considered for protection of different resources (coastal vs. inland).
3. Larger buffers may be necessary based on land use, resource goals, slope, and soils.
4. Additional buffer recommended to compensate for variability in flood model results at a site level and due to a changing climate.
5. Larger buffers may be necessary based on species and vegetation.
6. Larger buffers are necessary as the impervious cover in the watershed exceeds 8%.

In developed areas, as stormwater runoff flows over impervious surfaces such as asphalt and concrete, it increases in temperature before reaching a stream or other water body. Water temperatures are also increased due to shallow ponds and impoundments along a watercourse as well as fewer trees along streams to shade the water. Since warm water can hold less dissolved oxygen than cold water, this “thermal pollution” further reduces oxygen levels in suburban and urban streams. As described in the RI Stormwater Manual, temperature changes can severely disrupt certain aquatic species, such as trout and stoneflies, which can survive only within a narrow temperature range.
For the specific protection of trout habitat, a number of researchers have demonstrated that a larger protective buffer is needed. A 150-foot minimum "no touch" buffer zone seems to be the most widely recognized width for protection of cold water streams. Effective riparian buffer widths reported for protecting trout stream habitat range from 50 to 200 feet. Meyer et al. (2005) studied the correlation between forested buffers, in stream temperature, and benthic substrate conditions in over 8,000 trout streams to evaluate the impact of a State policy to reduce required buffer widths from 100 to 50 feet. They found that the reduction of forested riparian buffers widths from 100 to 50 feet resulted in a 3-4 degree increase in stream temperatures and 11% increase in sediment in riffle habitats. While this change seems insignificant, this shift is expected to reduce the young trout populations by 81-88%.

**Vegetative Target**

The ultimate target for the vegetation in the buffer should be specified. In general, this target should reflect the predevelopment, natural vegetative community present in the area. The target can be met by either preserving the existing vegetation or managing a disturbed buffer. To preserve existing buffers, these areas should be well marked on site plans, as well as in the field during construction. Disturbed areas should be either planted with native species or allowed to revert to the natural vegetation over time, with an aggressive invasive species management plan. Some selective clearing may be allowed in the outer portion of a buffer; in particular, to allow owners to remove dead or diseased trees that endanger personal property.

**Buffer Uses**

While the ultimate goal of a community buffer program is to create a continuous vegetated area adjacent to resources, certain uses can be allowed. Buffer crossings (by utilities, roadways or pedestrian bridges) will be necessary in certain areas, and a buffer program should specify performance criteria that address items such as crossing width, angle, frequency, and elevation. The allowable crossing width should be the minimum required for maintenance. Direct right angles are preferred since they require the least amount of clearing in the buffer. Only one road crossing per project should be allowed, and all utility crossings should be at least three feet below the streambed to prevent exposure by future channel erosion. The road
crossing should be designed to pass the flow from the 100-year flood event. Bridges should be used for the crossing to the maximum extent practicable and if culverts are unavoidable, arch or box culverts should be used to minimize impact on wildlife. Communities must understand that all crossings are subject to RI DEM/CRMC review. For more information regarding techniques to avoid and minimize impacts to riparian buffers and wetlands refer to the *Wetland BMP Manual: Techniques for Avoidance and Minimization* (RI DEM, 2010).

Another potentially acceptable use within the buffer is for stormwater treatment; however, it is important to note that small scale LID practices located upgradient of buffer areas are preferable. Stormwater Best Management Practices (BMPs) should not be used in buffers where they significantly compromise the buffer’s existing functions, and should only be used when no practical alternative exists. The outer portion of buffers can be utilized for stormwater management facilities, as long as sites are chosen carefully, located outside of State jurisdictional areas, and clearing of vegetation is minimized. One potentially effective way to use the edge of the buffer areas is to disperse channelized stormwater flow, which can be accomplished with small amounts of grading. Stormwater facilities should be designed with LID techniques and use the natural topography and undulating features that incorporate existing trees. See the RI Stormwater Manual for more information on how to properly design stormwater treatment practices.

*Figure 3-4 Example of Stormwater BMP in the Outer Buffer Zone.*

The red triangles in the graphic below represent the location of stormwater BMPs. Some of these have been effectively implemented in the very outer edge of the vegetated buffer (green area) along the riparian corridor in Montgomery County, MD. The shaded blue area indicates a buffer zone of 100 feet on either side of the stream as a reference.
Figure 3-5 Locations of Stormwater BMPs Relative to Stream Buffers.

The red triangles represent stormwater BMPs; the green area represents the vegetated riparian buffer; and the shaded blue area indicates a buffer zone of 100 feet on either side of the stream as a reference. (HW graphic)

Development Standards

When discussing development criteria for buffer zones in the context of the urban environment, it is important to understand many of the site limitations that could exist by virtue of an existing development. Industrial structures that were developed many decades ago were constructed as close as possible to adjacent waters in order to take advantage of hydraulic power opportunities and the ability to dispose of waste into rivers and streams. In these cases, existing structures may severely inhibit the ability to restore any vegetated buffer adjacent to surface waters.

Due to these potential constraints, it is important for local review agencies to approach redevelopment situations with a flexible mindset. Re-establishing buffers where there are severe site restrictions should be considered under the ‘maximum extent practicable’ approach. Where minimum buffer widths are in place, these values should be seen as guidance principles within the context of urban redevelopment and should not preclude the possibility of redevelopment if specific buffer standards cannot be attained. Moreover, communities should be very flexible with other local regulations that may force development into buffer areas. These local regulations include, but are not necessarily limited to, parking requirements and front yard setbacks.
Uniform requirements for lot size and setbacks cause small subdivisions like the one in this aerial photo to consume far more land than necessary. This subdivision has encroached into wetland and pond buffer areas causing visible signs of eutrophication. (Google Maps)

General Guidelines

1. **Minimum Width:** See Table 3-1 for recommended minimum widths to achieve various buffer functions.

   As mentioned above, this width represents an “ideal” condition that may not be achievable on all urban sites. However, the greatest buffer width that is practical should be maintained and restored and should not be reduced to less than 25 feet from wetland edge or below State regulatory requirements. **It should also be noted that both RI DEM and RI CRMC have regulatory jurisdiction for fresh and coastal wetlands and surface waters including buffer requirements that may be greater than 100 feet. Local buffer programs should augment existing requirements.**

2. **Buffer Delineation and Mapping:** Preliminary mapping of surface water buffers can be performed through the use of readily available data from Rhode Island Geographic Information Systems (RIGIS, www.edc.uri.edu/rigis/). Although the accuracy of these features from RIGIS is not adequate for site-specific design, it can be used as an indicator of the presence of hydrologic features and can be useful during a pre-application conference or other preliminary discussions with municipal officials. These delineations are appropriate for conceptual site designs. Site designs for master plan review or beyond should include mapping of buffer delineations performed by a qualified wetland scientist in conjunction with a registered surveyor and be field verified by RI DEM or RI CRMC. Communities may want to consider requiring a RI DEM verified wetland edge at the pre-application phase, depending on the extent of potential impacts and scale of the project. A verified wetland edge should be required for any variance or special use permit application.
3. **Protecting Buffers During Construction:** Although buffer areas can be set aside as “undisturbed” on site plans and development applications, it is important for local officials and developers to understand the construction process and what risks could be posed to on-site vegetated buffer zones. **See Chapter 4 for more information on clearing and grading guidance.** To minimize risks during the construction phase, the following precautionary measures can be required as part of a construction plan:

- Buffer zones and limits of disturbance should be required on every drawing within every set of construction plans including, but not limited to, clearing and grading plans and sediment control plans;
- Buffer limits should be staked out in the field prior to any construction activity;
- Limits of disturbance can be marked with orange construction fence barriers with accompanying signs to prevent storage of construction materials and intrusion of vehicles, or any work beyond the limit;
- A pre-construction walk-through should be performed with the municipal official or representative responsible for construction inspections and the person who was responsible for delineating the resource areas; and
- Third-party inspectors can be hired by the community, at the applicant’s expense as authorized within the Subdivision and Land Development Regulations, to conduct site visits during and after construction to insure construction activity does not impair surface waters, wetlands, or buffers. **Refer to third-party review fees guidance in Chapter 9.**

4. **Landscaping:** Landscaping on a site already containing an existing vegetated buffer should use only plant and tree varieties specifically cited as native species in Sustainable Trees and Shrubs for Southern New England, prepared by the University of Rhode Island, University of Massachusetts, and the United States Department of Agriculture, 1993 or in another credible scientific document that
specifically lists any proposed planting (genus and species) as being indigenous to the region. Appendix B in the RI Stormwater Manual also provides guidance on native landscaping. In addition, refer to Chapter 8 for guidance on how to implement landscaping requirements on the local level.

5. **Prohibited Activities:** Activities which can be typically prohibited by a local ordinance in the buffer include: land disturbing activities that may result in erosion or sedimentation, structures, impervious surfaces, application of fertilizers, herbicides and pesticides (except as needed to restore a buffer), storage tanks for petroleum products, septic system tanks/leach fields (where applicable), clear cutting of vegetation other than maintenance mowing. Different levels of restriction can be placed in different regions of a buffer depending on how wide and densely vegetated the buffer zone is. In general, the shoreline region should serve as a “no-touch” zone, though uses such as passive recreation, including limited access paths for walking and canoe launches, can be allowed. The second zone should be limited to passive management and consist of shrub land and trees. The third and final zone, farthest from the surface water resource, would consist primarily of wooded canopy and can be managed for heavier foot and bicycle traffic and may be acceptable for stormwater BMPs with an LID design.

6. **Public Access or Recreation:** In both urban and rural settings, river corridors provide good opportunities for trails, or where appropriate, canoe/kayak launch sites. No proposed development adjacent to a vegetated buffer should prevent existing and, where appropriate, new public access to the resource. Any proposed public access or recreation should be consistent with the Community Comprehensive Plan, the State Comprehensive Outdoor Recreation Plan (SCORP) State Guide Plan 152 (RI DEM, 2009), and applicable State regulations.

7. **Redevelopment Criteria:** Any proposed redevelopment of a site containing a buffer zone to an existing surface water or wetland resource should demonstrate that post-development conditions will improve the capacity of the buffer to provide continued public access to the resource (assuming access exists), protection of the resource area from stormwater runoff, and/or wildlife habitat. Improvement strategies can include, but would not be limited to:

- The maximum extent practicable, re-establish vegetation in areas of the buffer that were previously developed or impervious. A minimum of 25 feet beyond jurisdictional wetlands is recommended. This can be accomplished by requiring a mitigation planting ratio based on new impervious area proposed within an existing degraded buffer (e.g., 3:1).
- Provide pre-treatment of stormwater runoff directed to the buffer zone, and design site runoff to enter the buffer as sheet flow. Where necessary, incorporate water quality BMP’s into the buffer zone to treat concentrated inflow.
- Maintain historic public access points to surface water resources.
- Consolidate access points and restore the buffer zones in old access areas.
- Enhance the existing buffer vegetation with native vegetation and remove exotic and invasive species. Special care should be taken when removing invasive species to compensate for any loss of pollutant attenuation or habitat.
Invasive species removal should be performed by a qualified professional and only if a sustainable future condition with native species is assured.

*Figure 3-8 Buffer Zone Planting.*

Careful placement and installation of native vegetation is required for restoring buffer areas that were cleared. ([http://www.shorelandmanagement.org/s2s/category/care-of-shoreland-property/](http://www.shorelandmanagement.org/s2s/category/care-of-shoreland-property/))

8. **Buffer Flexibility:** Building flexibility into buffer zone guidelines allows developers to creatively address existing site constraints and, by providing developers with different options, avoids any claims that buffering criteria are too restrictive. Provisions for flexibility relative to buffer zone criteria can include one or more of the following:

- **Preserving or Restoring Buffer Zones as Open Space:** The applicant may enter into negotiations with the municipality to dedicate a buffer area to the City or Town along with access rights across the property as a potential improvement to the buffer. This situation may be particularly attractive in areas where the resource already provides a significant level of recreational opportunity to the general public. Conservation easements are also an option that a landowner could use as a tax benefit by either donating the land to a land trust or to the community.
- **Buffer Averaging:** Local criteria for buffer zones can use an averaging approach where the average width of the buffer across the site is either optimized or reaches the specific target.
- **Density Compensation:** If buffer restrictions render a significant amount of land as “undevelopable,” provisions in local zoning could allow for increased density on the remainder of the site to add value to the development provided that there is adequate infrastructure (water, sewer, and stormwater) to support the increase. An example of density credit calculations can be found in Article 39 of The Practice of Watershed Protection “The Architecture of Urban Stream Buffers” (Schueler et al., 2000).
- **Waivers or Deviations:** As a rule of thumb with any ordinance or land

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8 A qualified professional has the educational background and/or experience to properly identify and remove invasive species.
development regulations, language should provide the permitting authority the power to waive a portion of, or reduce a particular criterion where legally permitted by an enabling local ordinance.

- **Off-Site Buffer Restoration**: If the establishment of a buffer on an existing site is not possible, communities can consider requiring a developer to restore a buffer area off-site or place money for restoration in a restricted receipt account, referred to as “fee-in-lieu.” In any case the restoration should be in the same watershed. This requirement should be based on clearly stated public needs and policy goals outlined for the community buffer program within the Comprehensive Plan and clear standards would need to be specified in the subdivision and land development regulations.

- **Net-Improvement to the Site**: Examine the quality of existing stormwater discharge or other conditions such as hardened shorelines to find other areas that might be improved in lieu of enforcing stringent buffer width restriction.

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**Perceptions and Realities about Buffer Programs**

<table>
<thead>
<tr>
<th>Perception</th>
<th>Reality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer standards will result in a loss of developable land.</td>
<td>A 100-foot wide stream buffer typically consumes only 5% of land in a watershed. In addition, flexibility can be incorporated into local regulations to protect property owners.</td>
</tr>
<tr>
<td>Landowners with buffers are required to provide public access.</td>
<td>Public access is not necessary for an effective buffer program; instead, they can be maintained in private ownership through deed restrictions and conservation easements.</td>
</tr>
<tr>
<td>Buffer programs will be a hardship on a community’s staff and resources.</td>
<td>In a survey by Heraty (1993), most government participants stated that their staff spent only 1 – 10% more time to administer a buffer program.</td>
</tr>
<tr>
<td>RI DEM and RI CRMC already protect all buffers</td>
<td>RI DEM regulations are limited in some cases, and enforcement of buffers over time is challenging when lots are created adjacent to sensitive buffers.</td>
</tr>
</tbody>
</table>

**Successful Buffer Programs**

The key to a successful buffer program is education and flexibility. Buffers should be well demarcated by permanent boundaries and/or signage and also clearly noted on all deeds and recorded site plans and subdivision / land development plans. Buffer owners should be educated about their responsibilities and the benefits of buffers. Most encroachment issues are due to ignorance about the buffer program rather than complete disregard. In addition, flexible measures can be incorporated in a buffer program with many of the techniques described above (e.g., buffer averaging, conservation easements, and variances) and can go a long way to gaining the support of the public.
Figure 3-9 Wetland Buffer Signage.

Benefits of Resource Buffer Program

Buffer zones to fresh and saltwater resources—whether they are rivers, streams, bays, ponds, or wetlands—play an integral role in both protecting these resources and providing habitat for wildlife. The use of local land use authority to preserve or restore vegetated buffers is critical to the overall health of watershed systems and to public health and safety. The following table is taken from the Center for Watershed Protection’s The Practice of Watershed Protection (Schueler et al., 2000) and clearly illustrates the myriad of benefits derived from proper buffer management and restoration. Specific benefits as related to stormwater and economics are listed below Table 3-2.

Table 3-2: Twenty Benefits of Urban Stream Buffers

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reduces watershed imperviousness by 5%</td>
<td>An average buffer width of 100 feet protects up to 5% of watershed area from future development.</td>
</tr>
<tr>
<td>2. Distances areas of impervious cover from the stream</td>
<td>More room is made available for placement of stormwater practices, and septic system performance is improved.</td>
</tr>
<tr>
<td>3. Reduces small drainage problems and complaints</td>
<td>When properties are located too close to a stream, residents are likely to experience and complain about backyard flooding, standing water, and bank erosion. A buffer greatly reduces complaints.</td>
</tr>
<tr>
<td>4. Stream “right of way” allows for lateral movement</td>
<td>Most stream channels shift or widen over time; a buffer protects both the stream and nearby properties.</td>
</tr>
<tr>
<td>5. Effective flood control</td>
<td>Other, expensive flood controls not necessary if buffer includes the 100-yr floodplain.</td>
</tr>
<tr>
<td>6. Protection from streambank erosion</td>
<td>Tree roots consolidate the soils of floodplain</td>
</tr>
</tbody>
</table>
and stream banks, reducing the potential for severe bank erosion. (f)

7. **Increases property values.** Homebuyers perceive buffers as attractive amenities to the community. 90% of buffer administrators feel buffers have a neutral or positive impact on property values. (f)

8. **Increased pollutant removal.** Buffers can provide effective pollutant removal for development located within 150 feet of the buffer boundary, when designed properly.

9. **Foundation for present or future greenways.** Linear nature of the buffer provides for connected open space, allowing pedestrians and bikes to move more efficiently through a community. (f)

10. **Provides food and habitat for wildlife.** Leaf litter is the base food source for many stream ecosystems; forests also provide woody debris that creates cover and habitat structure for aquatic insects and fish. (f)

11. **Mitigates stream warming.** Shading by the forest canopy prevents further stream warming in urban watersheds. (f)

12. **Protection of associated wetlands.** A wide stream buffer can include riverine and palustrine wetlands that are frequently found along the stream corridor.

13. **Prevent disturbance to steep slopes.** Removing construction activity from these sensitive areas is the best way to prevent severe rates of soil erosion. (f)

14. **Preserves important terrestrial habitat.** Riparian corridors are important transition zones, rich in species. A mile of stream buffer can provide 25-40 acres of habitat area. (f)

15. **Corridors for conservation.** Unbroken stream buffers provide “highways” for migration of plant and animal populations. (f)

16. **Essential habitat for amphibians.** Amphibians require both aquatic and terrestrial habitats and are dependent on riparian environments to complete their life cycle. (f)

17. **Fewer barriers to fish migration.** Chances for migrating fish are improved when stream crossings are prevented or carefully planned.

18. **Discourages excessive storm drain enclosures/channel hardening.** Can protect headwater streams from extensive modification.

19. **Provides space for stormwater BMPs.** When properly placed, the outer zone of the buffer can be an acceptable location for stormwater practices that remove pollutants and control flows from urban areas.

20. **Allowance for future restoration.** Even a modest buffer provides space and access for future stream restoration, bank stabilization, or reforestation.

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**Stormwater Benefits**

Effective resource buffers minimize the need for flood control by helping to attenuate stormwater flows before they reach a water body and allowing the lateral movement of streams. By preventing development in the buffer area, the overall quantity of stormwater in the watershed is reduced, which will also help to reduce streambank erosion and flooding. Finally, vegetated buffers function as a natural filtering mechanism for removing sediment, nutrients, bacteria and other pollutants typically found in stormwater runoff.
Buffers can be very important for coldwater trout streams in particular, not only providing shade for the stream itself but also by helping to cool and infiltrate stormwater before it reaches the stream, and as a source for large woody debris, which is very important for trout habitat. By infiltrating stormwater runoff, buffers increase groundwater recharge, which in turn helps to maintain the baseflow of the stream.

Economic Benefits

Stream and wetland buffers can actually have economic benefits to communities in the long run. The presence of buffers improves the market value of adjacent properties. As listed in the Better Site Design Handbook (1998), examples of the positive market influence of buffers include:

- When managed as a “greenway,” stream buffers can increase the value of adjacent parcels as illustrated by several studies. Pennypack Park in Philadelphia is credited with a 33% increase to the value of nearby property. A net increase of more than $3.3 million in real estate is attributed to the park (Chesapeake Bay Foundation, 1996).
- Nationally, buffers were thought to have a positive or neutral impact on adjacent property in 32 out of 39 communities surveyed (Schueler, 1995).
- Effective shoreline buffers can increase the value of urban lake property. A recent study in Maine found that increased water clarity (visibility depth increased by three feet) resulted in $11 to $200 more per foot of shoreline property, potentially generating millions of dollars in increased value per lake (Michael et al., 1996).

In addition, buffers help save municipalities money by reducing the need for floodwater storage and stormwater treatment. Drainage problems and thus complaints from the public are reduced by buffers, which saves municipal staff time and money. Examples of cost saving which may be realized due to buffer presence include:

- The Minnesota Department of Natural Resources (MN DNR) estimated cost savings of $300 per acre-foot associated with a minimized need for floodwater storage due to the preservation of riparian wetlands;
- Forested stream and shoreline buffers situated on the flat soils of the coastal plain have been found to be effective in removing sediment, nutrients, and bacteria from stormwater runoff and septic system effluent in a wide variety of rural and agricultural settings along the East Coast (Desbonnet et al., 1994);
- Buffers can sharply reduce the number of drainage complaints received by municipal public works departments; and
- Buffers are often an effective means to mitigate or even prevent stream or shoreline erosion.

Case Studies

Within Rhode Island, most communities rely on RI DEM or RI CRMC to regulate buffers to wetlands and surface waters instead of exercising local regulatory authority to
help guide new development away from these resources. However, there are some communities that are applying unique strategies within the regulation of wetland, riparian or coastal areas to increase protective measures. There are a variety of approaches for regulating buffers such as: enforcement through zoning overlay districts, applying additional standards on certain uses through special use permits, or addressing the various impacts of wastewater within the buffer area. The standards from two Rhode Island communities, Barrington and South Kingstown, are reviewed here as two different approaches to wetlands protection in local ordinances.

Barrington, Wetlands Overlay District

The Town of Barrington has adopted an overlay district within its zoning ordinance to provide additional protection to its wetland areas. The overlay is described as follows:

The Wetlands Overlay District shall consist of coastal wetlands, defined as salt marshes bordering on tidal waters, and freshwater wetlands, defined as those areas of 1/2 acre or greater, that are inundated or saturated with surface and/or ground water at a frequency or duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. (Zoning Ordinance Section 185-171)

The regulations within the overlay are triggered by new construction, reconstruction, or expansion of existing buildings, or new, expanded, or modified uses of property within 100 feet of the overlay district. One of the primary mechanisms used to protect wetland resources is the list of prohibited activities including:

A. The discharge or introducing of any organic or inorganic chemical or biological pollutants.
B. The storage of any hazardous, toxic or infectious materials or wastes.
C. The placing or depositing of any solid waste or debris.
D. The discharging of any effluent creating a thermal gradient deleterious to indigenous plants, fish or wildlife.

In addition to the prohibited activities, any activity that falls within 100 feet of the overlay district must meet several development standards to be eligible for a special use permit under the overlay regulations. These development standards are provided to minimize, to the degree possible, any negative impacts to the wetlands through the following provisions:

A. All new structures and expansions, paved areas, and land disturbances will be set back at least 100 feet from the wetland edge.
B. The proposed project will not obstruct floodways in any detrimental way, or reduce the net capacity of the site and adjoining properties to retain floodwaters.
C. The proposed project will not cause any sedimentation of wetlands, and will include all necessary and appropriate erosion and sediment control measures.
D. The proposed project will not reduce the capacity of any wetland to absorb pollutants.
E. The proposed project will not directly or indirectly degrade the water quality in
any wetland or water body.
F  The proposed project will not reduce the capacity of any wetland to recharge groundwater.
G  The proposed project will not degrade the value of any wetland as a spawning ground or nursery for fish and shellfish or habitat for wildlife or wildfowl.

These regulations provide an additional layer of protection above and beyond the jurisdiction of RI DEM and RI CRMC. The overlay district method is a very straightforward approach for local communities that have the capacity for a comprehensive wetlands mapping process to determine appropriate boundaries for the district.

Readers interested in looking more closely at this suite of strategies can review the ordinance through the Town’s website: http://www.ci.barrington.ri.us/. The applicable text of the Zoning Ordinance begins in ARTICLE XXV, § 185-169 — § 185-179.

South Kingstown, Special Use Permits

The Town of South Kingstown provides additional protection to wetlands through identifying uses that trigger a special use permit within the Town's Zoning Ordinance. Several items have been identified for this additional permitting requirement, such as: individual sewage disposal systems (ISDS), hazardous waste management facilities, and accessory apartments. The regulations for such uses are as follows:

No ISDS shall be allowed within:
• 150 feet from a fresh water wetlands
• 150 feet from a river
• 200 feet from a flowing body of water having a width of 10 feet or more
• 150 feet from a floodplain
• 150 feet from a coastal wetland

No hazardous waste management facility shall be allowed within 500 feet of areas identified as freshwater wetlands or areas in a special flood hazard district.

An accessory apartment which is not serviced by a public sewer system may be established by special use permit only, and the accessory apartment along with the associated ISDS must meet heightened standards relative to its location near wetland resources.

Readers interested in looking more closely at this suite of strategies can review the ordinance through the Town’s website: http://www.southkingstownri.com/town-government/municipal-departments/building-inspection-and-zoning. The applicable text of the Zoning Ordinance begins in Section 504.

Since the adoption of this ordinance, RI DEM has changed their official name for septic systems from Individual Sewage Disposal Systems (ISDS) to On-site Wastewater Treatment Systems (OWTS).
Suggested Resources


Wenger, Seth. 1999 (revised). *A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation*. For the Office of Public Service & Outreach Institute of Ecology University of Georgia.