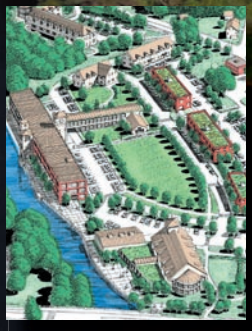
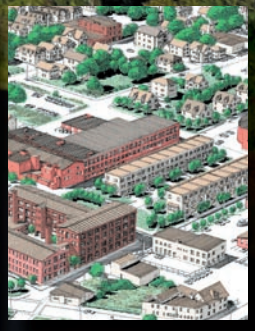
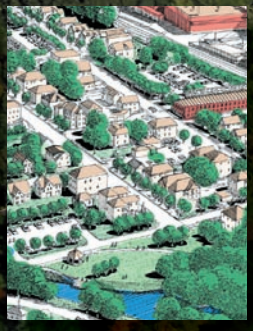
Urban Environmental Design Manual

Appendix - Development Criteria



The Urban Environmental Design Manual

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INTRODUCTION

The development or redevelopment of urban sites is often constrained by a wide variety of factors that have been covered in several sections of this Urban Environmental Design Manual. The history of development on an urban site or on adjacent sites often leaves developers and local officials facing the challenges endemic to brownfield restoration, development within a floodplain, antiquated infrastructure and many others. As an added challenge, these concerns must be weighed within the context of goals for economic development, neighborhood revitalization and maintaining historic integrity. Because of the complex interplay of existing constraints and future goals, local officials must be able to approach redevelopment with a creative mindset in order to envision a future use that is suited to a particular community. Bringing such a vision to reality requires careful consideration of a wide variety of planning and design criteria that will ultimately determine the viability of a redevelopment concept.

The following section of the Urban Environmental Design Manual is designed to provide a detailed overview of several "development criteria" that can significantly influence the quality and the eventual success of any redevelopment concept. These considerations were developed over the course of the project through discussions with the Urban Design Manual Advisory Committee and represent a mix of legal, planning, aesthetic and engineering considerations. Because of the wide variety of material, the presentation format of these criteria can vary. In some cases, concrete language for zoning codes has been included based on past guidance developed by RIDEM. In other cases, more general guidance on basic planning considerations has been included for general objectives such as maintaining open space. And finally, where appropriate, detailed environmental or engineering criteria have been developed for considerations that address the more detailed aspects of site layout and design. Because of the level of detail required to provide adequate stormwater BMP criteria, this lengthy section is preceded by its own table of contents.

As many of these topics represent enormous fields of study in and of themselves, efforts were made to distill the content of each summary down to the most important aspects. This information can be incorporated into applicable community land use ordinances or used as guidance by community officials and developers. Where appropriate, references and citations of useful materials were provided at the end of each section to guide interested readers to more detailed literature.

BUFFER ZONES

Findings

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.

Table 1: Twenty Benefits of Urban Stream Buffers
(*f*) = Benefit Amplified by or Requires Forest Cover

1. **Reduces watershed imperviousness by 5%.** An average buffer width of 100 feet protects up to 5% of watershed area from future development.
2. **Distances areas of impervious cover from the stream.** More room is made available for placement of stormwater practices, and septic system performance is improved. (*f*)
3. **Reduces small drainage problems and complaints.** 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.
4. **Stream "right of way" allows for lateral movement.** Most stream channels shift or widen over time; a buffer protects both the stream and nearby properties.
5. **Effective flood control.** Other, expensive flood controls not necessary if buffer includes the 100-yr floodplain.
6. **Protection from streambank erosion.** Tree roots consolidate the soils of floodplain 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 provides 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 ponds.** When properly placed, structural stormwater practices within the buffer can be an ideal 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.

The condition of existing buffers will vary greatly depending on the land use history of the area. In some cases, virtually pristine buffers still border Rhode Island shores and wetlands and provide excellent water quality protection and habitat. In others, older industrial areas have drastically altered buffer zones and replaced them with paved areas, bulkheads, buildings or large quantities of fill. In between these two extremes, a common occurrence throughout Southern New England is buffer areas that have been overrun by invasive or noxious plant species such as Japanese knotweed or multi-flora rose.

Because the condition of buffer zones will vary so considerably from one site to the next, it is difficult to develop uniform standards for maintenance or restoration that can be applied to all sites. Separate guidelines should therefore be developed for new development versus redevelopment situations to account for the variability in existing conditions. Furthermore, it is critical to consider what benefits are expected to be provided from buffer areas when considering any restoration design or management objective. Buffers that are meant to stabilize slopes or provide habitat may be subject to fewer technical requirements than those meant to treat runoff from upland sources, for example.

In some cases, buffers may be within areas designated as floodplain and rivers and stream buffers may contain areas of wetland habitat. Avoiding potential wetland impacts within the context of urban redevelopment must be adequately addressed. Urban wetlands are important from a preservation point of view and will trigger additional requirements for state-level permitting. Local officials should pay particularly close attention to potential impacts to on-site wetlands during design, construction and post-development phases.

Definition

Buffer Zone

An area of undeveloped, generally vegetated land which can be retained in its natural undisturbed condition, created to resemble a naturally occurring riparian area, or provided as a carefully designed landscaped amenity. This zone serves to mitigate impacts from human activities to the function and values of wetlands and waters.

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 "best practicable solution" approach. Where the following criteria suggest minimum buffer widths, 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. If the objective is to treat urban storm water runoff, then riparian buffers by themselves will not be effective. An applicable storm water treatment best management practice should be placed upland of the riparian buffer to achieve improved water quality objectives. 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 set backs.

General Guidelines

1. *Minimum Width*: According to a national survey of 36 stream buffer programs by the Metropolitan Washington Council of Governments, urban stream buffers range from 20 to 200 feet from each side of the river or stream, with a median of 100 feet. To protect water quality and aquatic habitat a minimum of 100 feet is recommended as a "best practice" guideline. A target width for restoration of vegetated buffers in urban areas should be 100 feet (typically measured from the bank of the resource). 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. **It should also be noted that both DEM and CRMC have regulatory jurisdiction for fresh and coastal wetlands and surface waters including buffer requirements that may be greater than 100 feet.**

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 site designs below the stage of 25% complete. Site designs for master plan review or beyond the level of 25% should include mapping of buffer delineations performed by a qualified wetland scientist in conjunction with a registered surveyor.

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. The Rhode Island Stormwater Manual should be referenced for applicable state level guidance on these issues. 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 silt or snow 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 local commission and the person who was responsible for delineating the resource areas.

- Third party inspectors can be hired by the community, at the applicant's expense, to conduct site visits during and post construction to insure construction activity does not impair surface waters, wetlands, or buffers. Refer to third party review fees for further information and model ordinance language.

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. The Rhode Island Wild Plant Society also publishes lists of native species along with nurseries that can readily supply native species for landscaping. The NRCS Plant Attribute Database provides lists of species and planting or environmental constraints. More comprehensive guidelines for landscaping criteria are provided in the Landscaping section of this chapter.

5. *Prohibited Activities*: Activities 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 limited access paths and canoe launches can be allowed. The second zone should be limited to passive management and consist of shrub land, trees and limited water quality BMP's. 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 larger BMP's.

6. *Public Access or Recreation*: Urban 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 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:

   - To the maximum extent practicable, re-establish vegetation in areas of the buffer that were previously developed or impervious. A minimum of 25 feet is recommended.
   - 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.
   - Consolidating access points and restoring 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.

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:

   - *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. Further guidance regarding public access is provided in the Open Space section of this chapter.

   - *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 a specific target, such as the 100-foot criteria mentioned above.

- *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).

- *Waiver*: As a rule of thumb with any ordinance, language should provide the permitting authority the power to waive a portion of, or all of a particular criteria 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. In any case the restoration should be in the same watershed. This requirement should be based on clearly stated public needs and policy goals within the Local Comprehensive Plan and clear standards would need to be specified in community land use 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.

References and Useful Resources

1. Schueler, et al., *Site Planning for Urban Stream Protection*, The Center for Watershed Protection. December 1995.
2. Schueler, et al., *The Practice of Watershed Protection*, The Center for Watershed Protection. 2000.
3. The Center for Watershed Protection uses the Stormwater Center webpage as a repository for technical papers on watershed and stormwater management: http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool3_Buffers/BufferZones.htm
4. The Maine Department of Environmental Protection offers excellent guidance for establishing new buffers and managing existing buffers. The website provides a very accessible overview of the central issues involved with buffer management as well as a comprehensive list of further references: http://www.maine.gov/dep/blwq/docwatershed/bufa2.htm#intro
5. Rhode Island Stormwater Installation and Standards Manual.
6. Rhode Island Coastal Resource Management Council, *The State of Rhode Island Coastal Resources Management Program, as Amended,* a.k.a. "The Red Book".
7. Rhode Island Coastal Resource Management Council, *Public Rights of Way: CRMC's Designation Process,* in *Coastal Briefings.*
8. Rhode Island Wild Plants Society, www.riwps.org.

PRESERVATION OF HISTORIC RESOURCES

Findings

Many areas of Rhode Island are rich in cultural resources, including historic sites and buildings. Although many of these buildings have been officially registered and enjoy protection, many have not been inventoried and are subject to demolition during redevelopment efforts without the proper oversight of local authorities. If a building subject to a demolition request is within a Local Historic District, then the Local Historic Commission must review and approve of the demolition via a certificate of appropriateness prior to the issuance of a demolition permit by the local Building Official. Unfortunately, in the event that demolition is taking place outside an established Local Historic District, local Building Officials often do not have the resources to determine if a proposed demolition will result in the loss of historically significant structures.

Most of the design or planning criteria discussed in this Urban Design Manual are best enforced through amendments to zoning ordinances or subdivision regulations. In the case of historic preservation, any special zoning provisions would have to be crafted within the context of an established Historic District in order to provide the proper, legally binding of authority to a reviewing historical agency.

Development Criteria

Local officials in communities where significant historical buildings exist are encouraged to seek the guidance of the Rhode Island Historical Preservation and Heritage Commission for establishing a Local Historic District (http://www.rihphc.state.ri.us). The requirements established by the community under the district would make it illegal for any building within the district to be razed without approval from the local Historic District Commission.

Other Considerations

When thinking of historic resources in an urban environment, discussions tend to focus on existing structures that were constructed within the last three centuries. Moving farther back in time and discussing archeological resources is generally reserved for new development proposals on sites that have remained virtually undisturbed since the time of European settlement. It is worth mentioning that the Rhode Island Historical Preservation & Heritage Commission has surveyed over 2,000 archeological sites across the state and can use these studies to predict the likelihood that significant materials might be located on a particular site. More information can easily be obtained on their website: http://www.rihphc.state.ri.us/archaeology/index.html.

DEVELOPMENT IN A FLOODPLAIN

Findings

Floodplains are characterized by lands adjacent to surface water bodies that are subject to periodic flooding from larger rain events or snow melts. As a result, these areas are characterized by wetlands that can detain and slowly release large volumes of storm flow under extreme conditions. Floodplains therefore play a critical role in storing volumes of water that could otherwise present hazardous flood conditions to developed areas adjacent to rivers and streams. Beyond their capacity to store or convey water, floodplains often present unique habitat opportunities for both animals and vegetation. Disruptions to the floodplain can cause significant environmental damage including:

- Displacement of water during extreme rainfall conditions that results in localized drainage and flooding problems in downstream developed areas;
- Loss of adjacent wetlands or flooded areas that historically provided habitat for a diverse range of species;
- Channeling of rivers and streams disrupts the natural meandering quality of the surface water and alters its hydraulic response to rain events;
- Increased levels of untreated pollutant discharge from stormwater runoff which can contain high levels of Total Suspended Solids (TSS), heavy metals, toxins, bacteria and nutrients;
- Loss of coastal wetland resources including shellfish habitat; and
- Increased levels of bank erosion and subsequent sediment loading to rivers and streams.

The performance standards associated with floodplain development will vary from inland to coastal areas. In either case, however, the performance criteria will overlap with those for vegetative buffer zones. Where these buffers exist, planning officials should reference the standards provided for buffer zones in this section of the manual.

Federal regulations under the National Flood Insurance Program require that all participating municipalities adopt and enforce floodplain management criteria. In Rhode Island, the federal criteria that address construction requirements have been incorporated into the Rhode Island State Building Code. The federal criteria dealing with allowed land uses, site design and utilities, mobile home siting, and other land management factors have been incorporated into the local land management regulations (zoning and subdivision/land development review ordinances) of participating municipalities. Regulation of flood plain areas is also administered at the state level by either the Rhode Island Department of Environmental Management (RIDEM) or the Rhode Island Coastal Resources Management Council (RICRMC) depending on the location and characteristics of the flood plain area. Proposed development activities within 50 feet of the established 100-year flood plain are subject to state level jurisdiction and any applicable permits.

The tiers of potential floodplain regulation in Rhode Island are:

Rhode Island State Building Code (variances require a public body meeting)
Local Zoning Ordinances (Floodplain Districts in Compliance with federal law)
Land Development and Subdivision Regulations (Land Development projects will be in compliance with federal law)
State regulatory powers in DEM and CRMC (may exceed but may not be less than the requirements within local ordinances and do not supersede the State Building Code)

Definition

Floodplain
The land area adjacent to a river or stream or other flowing body of water which is, on the average, likely to be covered with flood waters resulting from a 100-year frequency storm and which is subject to regulation in order to safeguard the functions and values of fresh water wetlands and flood plains. A one-hundred year frequency storm is one that may be said to have a one percent probability of being equaled or exceeded in any given year. Rainfall intensity data for a one hundred year frequency storm are those established for New England locations by the National Weather Service.

Base flood elevation (BFE)
These are rounded, whole-foot elevations of the one-percent (100-year) annual chance flood at selected intervals that have been studied in detail. Communities issuing building permits for structures should refer to BFE, for example, so that living space in residential structures is elevated at or above that level by a specified amount, such as one foot.

Flood insurance rate map (FIRM)
This is a map developed by FEMA to illustrate the extent of flood hazards in the community. It may include risk zones for flood insurance, the 100-year and 500-year floodplains, floodways, base flood elevations, and the physical features of the floodplain.

Freeboard
Any additional height above a flood elevation is called the freeboard. A community may use this to determine, for building permits, for example, the required level of elevation for a structure's lowest floor, in accordance with floodplain management regulations.

Regulatory floodway
Also known simply as the floodway, shown on the FIRM, this is the channel of a stream and any adjacent floodplain areas that must remain free of encroachment in order to allow the 100-year flood to move downstream without substantial increases in flood heights.

Special flood hazard area (SFHA)
This is the area included within the 100-year floodplain as shown on the flood insurance rate map.

Development Standards

The following standards are considered to be "best practice" standards based on current research and the experience of the consultants. Readers should reference appropriate state-level regulations within the State Building Code to compare existing Rhode Island standards to the recommended measures below.

New Development

1. Anti-degradation: No proposed development within a floodplain should impair the capacity of the area to provide storage or conveyance of flood waters, protection of the resource area from stormwater runoff, or wildlife habitat.
2. New development should not encroach into the floodway.
3. Post-development flood storage within a floodplain should be, at a minimum, equal to pre-development conditions. Where necessary, this may be accomplished through the use of compensatory storage.
4. The lowest floor elevation should be at least one foot higher than the 100-year floodplain elevation.
5. Development should not cause the long-term groundwater levels beneath the site to be significantly altered. This criteria can be met by demonstrating that recharge across the site is taking place in a similar fashion from pre- to post-development. The similarity in recharge should include both the annual volume and dispersal across the site.

Redevelopment

1. Net Improvement: In addition to improved protection from flood hazards for life and property, any proposed redevelopment or expansion of a site within the 100-year floodplain should demonstrate that post-development conditions will improve the capacity of the area to provide storage or conveyance of flood waters, protection of the resource area from stormwater runoff, and/or wildlife habitat.

   Improvement strategies can include, but would not be limited to:

   - To the maximum extent practicable, re-establishing natural areas and topography along the surface water resource.
   - Elevating or flood-proofing structures to meet minimum requirements.
   - Retrofitting existing structure foundations within the floodplain to accommodate flowage under 100-year conditions.
   - Stabilizing banks that display erosion from deforestation or other development activities.
   - Managing stormwater to mimic natural recharge conditions to the greatest practicable extent.

General

1. All pedestrian and vehicular access ways on a site should be at least two feet higher than the 100-year floodplain elevation unless use of the site is highly unlikely during and immediately after a storm (i.e., for recreational facilties).

2. Areas should not be filled beyond three feet in vertical elevation nor should the slope of filled areas exceed 30% where avoidable. Fill should be composed of clean material and should be compacted to 95% of the maximum obtainable density using the Standard Proctor Test or an acceptable equivalent method.

3. Filling within the floodplain should not displace more than 30% of the flood volume that exists prior to development, redevelopment or expansion of an existing use.

4. Newly developed or altered support structures or foundations should be certified by a registered professional engineer as designed in accordance with ASCE 24, Flood Resistant Design and Construction per the Rhode Island State Building Code.

Other Considerations

Floodplain Overlay District

All communities which participate in the National Flood Insurance Program (NFIP) are required by federal regulations to adopt and enforce local floodplain land management requirements. Many communities in Rhode Island have incorporated floodplain overlay districts within their zoning ordinances as a means to establish and enforce these requirements. In addition to the minimum requirements of the NFIP, municipalities could utilize the floodplain overlay and/or modify other zoning ordinance provisions to establish more stringent requirements within flood hazard areas. Specific areas that would fall within these provisions include:

- Structures designed for human habitation
- Storage of any materials that are capable of floating, are flammable, explosive or might otherwise be injurious to property water quality, human health and safety or wildlife.
- Private or public sewage systems
- Public or private water supply wells
- Sanitary sewer or stormdrain infrastructure

References and Useful Resources:

FEMA References for Foundation Design

- FEMA 102, Floodproofing Nonresidential Structures
- FEAM 85, Manufactured Home Installation in Flood Hazard Areas
- FEMA 312, A Homeowner's Guide to Retrofitting
- FEMA Technical Bulletin Series

State Level Regulations, Guidance and Case Studies

- Rhode Island State Building Code (Section 8)
- Rhode Island Emergency Management Agency (www.riema.ri.gov)

PEDESTRIAN ACCESS, PARKING LOT DESIGN AND INTERMODAL TRANSPORTATION

Findings

The socio-economic vitality of urban neighborhoods is integrally tied to access and circulation issues both within the neighborhood on a localized level and outside the neighborhood on a more regional scale. Within the neighborhood, the way in which pedestrians, bicyclists and automobiles interact at street level can have a profound effect on the viability of local business and the land use patterns that develop over time. The degree to which people feel safe traveling by foot or bicycle can dictate whether or not they choose to use amenities in close proximity to their home. A walking and bicycle friendly community is a more livable community where people of all ages and abilities can travel freely.

On a regional scale, the ease with which people can access a neighborhood will affect the types of commercial and industrial development and the degree to which mixed use can be established. Access at this scale is determined not only by roadway layout, but the degree to which different demographic groups have the opportunity to visit different neighborhoods and the level at which drivers can find parking. Those areas accessible by more means of transport—including busses, trains, bikeways, or trolleys—have a greater potential to become vibrant activity centers that support a wide array of land uses. Other tangible advantages to enhanced pedestrian and vehicular access include:

- Providing access both to and within neighborhoods through a variety of transport reduces our general dependency on the automobile. Reduction in vehicular trip generation lowers overall emissions and limits traffic congestion in otherwise heavily traveled areas.
- Enhanced pedestrian and bicyclist amenities increase the general public safety.
- Reduction of wasted impervious area resulting from stringent parking requirements that do not consider mixed use environments.

The design of particular pedestrian or bicycle amenities can compete with other planning objectives such as stormwater management, traffic circulation or parking lot design if a piecemeal planning approach is applied to the neighborhood scale. For example, conventional urban street improvements might require five-foot wide granite curbed sidewalks along all residential streets. Although this requirement seems to favor pedestrian movement and general public safety, it limits the application of some very effective surface stormwater management techniques for roadway runoff and pushes developers toward the use of conventional catch basin systems. Another example of competing needs can include extensive parking requirements under existing zoning that consume the majority of a retail site and do not leave space for pedestrian walkways to be incorporated into the overall parking design. These competing needs should be carefully considered at the outset of all site design in urban neighborhoods so that a balance between circulation issues and other planning objectives can be established. It is

important to also remember legal requirements relative to access such as the Americans with Disabilities Act (ADA), which requires accessible pedestrian routes along all public ways.

Definitions

Pedestrian Access

Pedestrian access can be defined as the condition under which neighborhoods are walkable and amenities are easily accessible by foot. Common elements of pedestrian access planning include crosswalks, sidewalks, traffic controls, buffers, maintenance, land use selection, signage, public transportation, and length and directness of pedestrian routes.

Intermodal Transportation

In the context of this Urban Design Manual, intermodal transportation is defined by conditions in which residents or workers within a neighborhood can travel to and/or within that neighborhood using a variety of transportation means. It is not used to define conditions whereby freight or cargo are moved from one place to another, but rather defines how people can travel from one location to another using more than one means of transport, often within a single trip.

Level of Service

Level of Service (LOS) is a generic phrase that can be used to describe the relative efficacy of different transportation environments. LOS ratings are often developed through a series of complex mathematical equations, but are expressed using a progressive single-letter rating system; "A" for the most effective system and "F" for the worst. Rating systems have been developed for vehicular traffic on a particular street, passenger service on public transportation, bicycle travel and pedestrian movement in public areas. Discussion of particular development standards listed below will deal exclusively with bicycle and pedestrian levels of service.

Design Standards and Considerations

General Urban Site Design

When discussing intermodal transportation and pedestrian access, this Urban Design Manual is generally focused on high density areas that may include a mix of commercial and residential use. It is easier to plan for a mix of transportation options in these areas because of the large, concentrated population of residents, commuters and shoppers. Many established transportation nodes such as train stations, bus stations, or ferry stations are created as part of state or regional efforts and, as a result, it can be difficult for local communities to change or add locations in response to increases in development. A more

effective way to facilitate intermodal transportation, especially in the urban environment, is to enhance existing connections between transportation nodes that have already been established.

With regard to general pedestrian circulation within activity centers, it critical to provide clear direction to and from transportation facilities. Furthermore, movement from residential building to commercial areas and between different commercial structures must be thoughtfully designed to encourage people to spend time walking the streets and visiting the shops. Some general site design criteria are provided below that help to facilitate circulation throughout activity centers and encourage a variety of transport option both to and from and within these urban centers.

1. Retail storefronts should be located adjacent to sidewalks with parking offered on the street and behind the building where possible. Continuous rows of retail storefront facilitate pedestrian access to multiple commercial facilities in an uninterrupted fashion. These storefronts should be well designed and reflect the character of the community as well as the diversity of retail desired.

2. Parking areas should have multiple pedestrian egress points with adequate lighting and signage for pedestrians. At a minimum, an egress point should be provided for each non-residential abutting property. Commercial properties in retail centers should provide off-street connections for both bicyclists and pedestrians.

   Note: Parking Ratios are being developed by EPA and ITE to better represent the mix of uses and density characteristic of urban areas. These standards were not yet available at the time this manual was drafted but will likely be made available through http://www.epa.gov/smartgrowth/ . Another source of standards relative to mixed use parking ratios can be found in *Smart Growth Zoning Codes: A Resource Guide* written by Steve Tracy and available through http://www.smartgrowth.org/library/ .

3. Adequate signage should be provided directing pedestrians to and from existing public transportation nodes.

4. Municipal parking facilities should be strategically situated to intercept traffic before it enters the commercial center or should otherwise facilitate efficient entry and exit from the commercial center.

5. Landscaping in parking areas should be used to treat stormwater wherever possible through the use of bioretention facilities or grassed swales. More specific guidance relative to siting and designing these facilities is provided in the **Stormwater** section of this chapter.

6. Larger parking facilities should incorporate different parking stall sizes for compact cars to reduce the amount of impervious cover needed to accommodate

peak demands.

7. "Spill over" parking areas should be used where retail establishments expect high but infrequent peak demands. These lower traffic areas should incorporate porous pavers or some other permeable parking surface where subsurface conditions allow to reduce the gross area of impervious surface and provide treatment of stormwater runoff.

Specific Design Considerations for Pedestrian and Bicycle Amenities

1. Sidewalks and Walkways

   As with many features of residential or commercial development, the design and intensity of use of sidewalks will vary from rural to suburban to urbanized areas. The needs of pedestrians relative to circulation should be weighed against the impacts from developing impervious surfaces and increased consumption of developable space. Other important design considerations include landscaping requirements for sidewalk areas, the potential to integrate these areas into stormwater management plans, and the use of sidewalk features as a traffic calming device. The National Center for Bicycling and Walking serves as an excellent source of information relative to pedestrian design, traffic calming and bicycle amenities (www.bikewalk.org).

   With regard to sidewalk design, revising existing codes to provide greater design flexibility can incorporate a variety of criteria. These include speed limit of the adjacent road, vehicular trip generation, road classification (e.g. principal and minor collectors or arterials), vehicular level of service (LOS), pedestrian and bicyclist LOS, and the perceived recreational needs of the bicyclist community. The level of analysis required to accompany a proposed development can increase in complexity as the scale of development increases or the mix of uses becomes more diverse. The simplest forms of analysis will involve a review of readily available information such as the speed limit, roadway category, and a qualitative assessment of what the expected bicycle traffic will be. More detailed quantitative assessments will involve pedestrian, bicyclist, and traffic LOS. A more detailed description of pedestrian and bicyclist LOS analysis is provided below.

   In areas with high levels of pedestrian and vehicular traffic, where the speed of cars is likely to exceed 35 miles per hour, or where steep grades can create hazardous winter conditions, conventional 4 to 15-foot wide concrete sidewalks that use raised granite or concrete curbs and have adequate ramp access are generally appropriate. Where outdoor seating is desired for cafés and restaurants, sidewalk widths should be designed at a minimum of 15 feet. It is important

to remember that these raised sidewalks are the highest impact option for roadside walkways as they create large areas of impervious cover and generally channel stormwater flow along the lengths of streets to subsurface stormdrain networks. Conventional subdivision specifications often require these sidewalks regardless of traffic expectations and therefore significantly increase impacts from development in areas that otherwise do not require raised concrete sidewalks for adequate pedestrian circulation.

Other options for sidewalk or off-street walkway development include grade-level facilities. Grade-level sidewalks are constructed flush with the existing grade along the sides of lower traffic streets and are most commonly implemented in suburban settings. Where open space is a central feature of any subdivision design (see discussion of Cluster Development and Conservation Subdivision Design in Open Space Chapter), grade-level off-street walkways can be used to connect neighborhoods through areas of preserved open space. These facilities will provide a more pleasant, low-impact means to circulate both pedestrians and bicyclists depending on the needs of the community.

In more urbanized settings, grade-level walkways can be used in large parking lots to provide a lower cost means of removing pedestrians from the areas designated for vehicular traffic. Off-street walkways can also provide an effective means for pedestrians to travel between commercial properties in established retail centers. Off-street connections between these properties can vary significantly in scale depending on the layout of a commercial area, designed in some cases as large courtyards or in others as small concrete footpaths. In either case, vegetated stormwater swales can be used to provide more pronounced separation from the walkway and the roadway or parking lot. This additional design element not only increases pedestrian safety but incorporates low-maintenance stormwater management into the overall circulation design.

A final design point to consider relative to sidewalks is the potential use of grid pavers instead of standard concrete construction for the walking surface. Grid pavers act as a type of "pervious pavement" and can increase the level of stormwater infiltration on sidewalks and will generally be more effective due to low sediment loads. During winter conditions, the businesses or individuals who maintain these walkways would need to limit the amount of sand that would be applied to these surfaces in order to maintain their performance.

2. Crosswalks

The use of crosswalks is a widely accepted strategy for controlling pedestrian circulation through busy streets or across roads where vehicular speeds or sight lines could create dangerous conditions. More recently, developments in crosswalk design have enhanced performance of these areas and have served other

planning objectives beyond providing safe pedestrian circulation. Where painted crosswalks were once the industry standard and brick pavers and cobblestones were reserved for affluent communities, cost-effective stamped concrete treatments that use a brick or cobblestone imprints are becoming more common. These crosswalks not only provide aesthetic appeal but significantly decrease the maintenance burden associated with conventional crosswalks that require annual repainting. Raising crosswalks slightly above the roadway grade is another more widely applied strategy for specific areas. These designated crosswalks provide traffic control as physical humps in areas where pedestrian movement cannot be concentrated toward established intersections due to the roadway layout or the sheer volume of expected sidewalk traffic.

Specifications for crosswalk design can easily be incorporated into local development codes by listing acceptable materials and other general aesthetic preferences. As with any other codified design specification, as long as developers have a list of viable options that include cost effective treatments, communities will experience little resistance from the development community. It is important, however, to research the materials that will be used for crosswalks to properly address issues of durability, maintenance and safety.

3. Tree Placement

Proper tree placement and planting can significantly enhance the look of pedestrian facilities and provide much needed shade in the summer months. In general, trees must have an adequate root zone, proper drainage and appropriate soil mixture in order to flourish in urban conditions. A detailed description of tree planting and other urban landscaping considerations is provided in the Landscape Standards section of this appendix.

4. Bicycle Facilities

In recent years, there has been considerable effort in local and regional planning toward enabling safer travel and increased opportunity for bicycle travel in urban environments. The widespread consensus that reductions in automobile use can reduce social and environmental stress has resulted in many communities specifically including increased bicycle access as a goal within their comprehensive plan as well as actual specifications being included within development regulations.

Bicycle facilities that may appear in subdivision rules and regulations or as part of commercial zoning generally include bike racks (sometimes with awnings as an amenity), signage, and bicycle lanes on roadway shoulders. Where a community has a well-established bike path as a recreational amenity, regulations could also require access to a site from the bike path with accompanying signage. In many cases, developing access to and from individual sites will be difficult

to codify and might be better administered "one project at a time". General criteria that can build the capacity of local boards or commissions to negotiate appropriate amenities for bicyclists include the provision of bicycle lanes or extended shoulders for bicycle travel and adequate bicycle docking facilities in all commercial parking lots determined by LOS analysis.

5. Level of Service

   LOS analyses for pedestrian and bicycle traffic will involve using a detailed set of calculations to produce a ranking for a particular site or neighborhood based on proposed land use and site layout. Similar to vehicular traffic ratings, a pedestrian or bicycle LOS will generally be expressed as a single letter rating from "A" to "F", with "A" being the best rating and "F" being the worst. LOS calculations have been developed using different criteria based upon the characteristics of a particular site or neighborhood. In some instances, LOS calculations will simply rate the capacity of a particular sidewalk to effectively and efficiently provide passage alongside a street. In other cases, LOS models have been developed to measure the level of service to and from different public transportation facilities. In all cases, specific features or facilities can add or subtract to the overall rating depending on factors like conflicts with other users or physical obstructions along travel routes. The wide array of methodologies used to develop pedestrian and bicyclist LOS ratings is too extensive to summarize for the purposes of this manual. However, Linda B. Dixon provides an excellent survey of different LOS methods in *Bicycle and Pedestrian Level-of-Service Performance Measures and Standards for Congestion Management Systems* (Dixon, 1996).

Other Considerations

District Management Authorities

Once a dynamic streetscape has been envisioned by a community and potential improvements have been identified for activity centers, the challenge is to implement these improvements in a timely manner. Allowing even the most well crafted plans for access improvements sit on a shelf can create a destructive inertia. In most cases, the limiting factors for implementing localized improvements are funding and human resources. A potential solution to this problem is being implemented more frequently across the United States and Europe in the form what are commonly referred to as Business Improvement Districts (BIDs).

The State enabling legislation in Rhode Island provides for the establishment of District Management Authorities (DMAs), which provide the same essential services as most BIDs across the country (RIGL Chapter 45-59). As this legislation is currently written, only the City of Providence would qualify for these provisions based on the population threshold of 100,000 people. Another piece of legislation that enables a similar public/

private partnership is the Westerly Downtown Center Special Services District (RIGL Chapter 45-56). Although this statute applies exclusively to Westerly, it provides an excellent example of how a specific district can be empowered to levy taxes, contract improvements, borrow money and conduct other general business transactions toward the maintenance and improvement of their district. Based on the needs of a particular community, amendments to state legislation can be sought by municipalities to allow for BIDs in communities throughout Rhode Island.

References and Useful Resources

Dixon, Linda B. *Bicycle and Pedestrian Level-of-Service Performance Measures and Standards for Congestion Management Systems*, Transportation Research Record 1538, TRB, National Research Council, 1996.

Jacobs, Allan B., *Great Streets*, MIT Press, 1995.

Musser, Terri; Susan Anderson Pinsof, *Bicycle Facility Planning,A Resource for Local Governments*, APA Planning Advisory Service, 1995.

Morris, Mayra *Creating Transit-Supportive Land-Use Regulations*, *A Compendium of Codes Standards and Guidelines*, APA Planning Advisory Service, 1996.

National Center for Bicycling and Walking (www.bikewalk.org)

Pedestrian and Bicycle Information Center (www.walkinginfo.org; www.bicyclinginfo.org; www.pedbikeinfo.org)

Walk and Bike to School (www.walktoschool.org)

LANDSCAPE STANDARDS

Findings

Standards for landscaping are beneficial for establishing the required standards for planting areas that enhance the environmental, functional and aesthetic impacts of the built urban environment. The effect of landscape standards on streets, parking lots, pedestrian areas and commercial development in urban areas is to provide a human scale and atmosphere in a tightly conformed space. When incorporated into new and re-use development projects, landscape standards can soften and enhance building facades, provide a "green" network of planting throughout the city, reduce impervious surface areas, contribute to best stormwater management practices and provide an improved microclimate for those who work and live in urban areas.

Landscape standards for urban areas relate most significantly to street/parkway corridors, parking lots and new or re-use development projects. There are overreaching techniques that then contribute to successful landscape standards for all of these areas. These include the use of vegetative screening and native species and the principles of bio-retention and xeriscaping. Bio-retention and xeriscaping can also help to effectively establish best water management practices into new and existing urban landscapes.

Definitions

Xeriscape
Landscape design that incorporates drought tolerant native plants to conserve water.

Bio-retention
Landscaped areas that detain stormwater runoff through the use of plantings such as grasses, wildflowers and trees and shrubs. Stormwater will pond temporarily and then eventually seep through an underground filter system.

Development Standards

Landscape standards are meant to create a cohesive, attractive vegetative environment within urban areas that might otherwise be hard and uninviting. The standards should apply to all new and re-use industrial and commercial development projects and multi-unit residential development projects. These standards do not apply to landscaping installed by homeowners in single-family residences but environmentally friendly practices such as rain gardens and the use of native species should be encouraged.

The use of standards for landscape design in urban areas should provide architectural and environmental enhancement in the following areas:

- Screening of parking, storage and service areas and unsightly objects.
- Creating buffer zones between residential, commercial and industrial areas.
- Erosion control.

- Wind and noise barriers.
- Streetscape enhancement.
- Improving the relationship of the site to the structures.

General Criteria

1. *Street Trees:* The growing area for street trees in an urban environment is critical to their long-term health. The trees must have an adequate root zone, proper drainage and appropriate soil mixture in order to flourish in urban conditions. The following are general guidelines for street tree planting:

    a. Trees planted along a street/parkway should have a 3" caliper minimum.
    b. Trees should be planted approximately 25-30' apart depending on site conditions.
    c. Continuous planting strips should be as wide as possible with a recommended width of 6'. In no case should the planting strip for a tree be less than 4'.
    d. Grates should be used only where absolutely necessary and considered as a temporary structure with a 5-10 year life span. They should only be allowed where sidewalk area is limited and pedestrian traffic is high, such as at building entrances and outdoor dining areas.
    e. Trees on a continuous strip or block should be of a variety of species to protect against widespread losses in the case of blight. For aesthetics, planners may want to consider the different growth rates and heights of trees at maturity so that a mature streetscape with different species has a sense of continuity.
    f. Ground cover for street tree plantings should be shredded hardwood bark mulch, seasonal plantings or ground cover.

2. *Parking Lots:* In order to mitigate the effects of heat in the summer and unattractiveness all of the time, parking lots should be landscaped with shade trees, planting beds and bio-retention areas for runoff wherever possible. Parking lot islands and perimeters planted with trees, shrubs and herbaceous perennials will help to alleviate the heat effects of broad expanses of paving as well as improve the aesthetic environment and manage stormwater. The following are general guidelines for planting in and around parking lots:

    Interior Landscaping:

    a. A minimum of (1) canopy shade tree and (3) shrubs for every (10) parking spaces. Shrubs shall be no taller than 30" at maturity.
    b. Required landscaping must be contained in planting beds no smaller than (9) feet by (17) feet for every twenty spaces. Alternatively, an equivalent square footage may be clustered within larger planting beds or designed as "landscape strips" that separate aisles from spaces.

c. There shall be no more than (20) spaces in a single row without an intervening planting bed. Planting beds may be utilized to delineate pedestrian and vehicular traffic flows.

Perimeter Landscaping:

a. Perimeter area of all parking lots less than 15,000 sq.ft. shall have a minimum paving setback from the street or alleyway property line of (7) feet, except at points of ingress or egress.
b. All parking lots between 15,000 sq. ft. and 99,999 sq. ft. shall have a minimum paving setback of (10) feet.
c. Parking lots larger than 100,000 sq.ft. shall have a minimum paving setback of (20) feet.
d. All parking lot perimeters shall be landscaped consisting on (1) canopy shade tree and (3) shrubs per (50) lineal feet of paved parking area generally parallel to the property line. The balance of the landscape strip may consist of grass, mulch, or other vegetative cover.

Landscaped Islands and Medians:

a. Provide a minimum of (6) foot wide landscaped island at the end of every row of parking, equal in length to the length of the parking space.
b. Provide a minimum of (2) canopy shade trees in each island with a minimum canopy of (20) feet.
c. Place landscaped medians between every other parking bay in lots for more than 100 vehicles.
d. Wherever possible landscaped islands and medians should be designed as bio-retention areas using appropriate plantings to retain and filter stormwater runoff.
    - Trees used in these areas must be able to withstand both drought and periodic flooding of their root systems and should be deep-rooted.
    - Trees should not drip sap or have large messy fruit that falls on cars.
    - All shrubs and perennials used under trees in bio-retention areas should be shade and salt tolerant.

3. *Xeriscaping:* Water can be conserved in urban areas by utilizing alternative means for maintaining a suitable landscape environment. Xeriscaping involves the use of certain plant materials that are more drought tolerant and will require less water throughout a growing season. The following are general xeriscaping concepts and guidelines:

a. Plant materials with low water requirements should be utilized.
b. Plants with similar water requirement should be grouped together on the same irrigation system.

c. Native plants should be utilized when applicable and for transitional zones.
d. All shrub and ground cover areas should be top-dressed with a minimum of 2” depth of shredded bark mulch to retain soil moisture.

References and Useful Resources

1. Arlington County Street Tree Focus Group*, Standards for Planting and Preservation of Trees on Site Plan Projects*, December, 2002.
2. City of Des Moines, *Landscape Standards*, August, 2003.
3. City of La Mesa, *Landscape Standards*, Undated.
4. Quigley, Martin et al., *Multi-Functional Landscaping: Putting Your Parking Lot Design Requirements to Work for Water Quality*, Ohio State University Extension. 2001
5. Integrated Waste Management Board*, Xeriscaping: Establishing a Waste Efficient Landscape*, March, 2004.

MIXED USE DEVELOPMENT

Findings

Creating vital communities and neighborhoods within the context of urban redevelopment involves fostering a self-sustaining social dynamic between a variety of land uses. In order to serve the existing neighborhood population, urban neighborhoods should provide an array of commercial amenities to satisfy the everyday needs of residents including groceries, restaurants, and various retail establishments. Public amenities such as library facilities, community centers or park areas can also greatly enhance the urban experience and can attract people from outside of the neighborhood to contribute to the localized economy and overall social diversity.

In ideal situations, centers of urban mixed use evolve spontaneously and foster the classic "village" or "urban neighborhood" dynamic often touted by urban planners as the overarching goal for all redevelopment projects. Unfortunately, a variety of factors such as restrictive zoning, general economic slowdown, or poor circulation design can work to limit the capacity of neighborhoods to develop vibrant mixed use centers and serious restructuring of both physical and regulatory elements is necessary to revitalize depressed or homogenous neighborhoods.

The criteria listed as part of this section are examples of bulk zoning provisions relative to land use profile and associated parking requirements. Amendments to zoning could be codified within the existing bulk requirements or could be instituted as part of a more flexible development approach depending on the desired result. These zoning based criteria represent potential areas of opportunity or thresholds that may not be applicable to all urban areas or commercial centers. The specific needs of neighborhoods and municipalities relative to issues such as affordable housing, economic development, and the need for recreational amenities should be carefully considered through a public planning process before setting any specific bulk use thresholds that require a mixed use profile.

Although the effect of mixed use is intended to create vibrant self-sustaining communities, unforeseen negative impacts can include traffic congestion and poor pedestrian circulation resulting from an increase in density. These design issues are addressed in greater detail in the **Pedestrian Access, Parking Lot Design and Intermodal Transportation** section of this chapter. For further information, refer to *Smart Growth Zoning Codes: A Resource Guide* written by Steve Tracy and available through http://www.smartgrowth.org/library/ .

Definitions

Accessory use

A use of land or of a building, or portion thereof, customarily incidental and subordinate

to the principal use of the land or building. An accessory use may be restricted to the same lot as the principal use. An accessory use shall not be permitted without the principal use to which it is related.

Ancillary structure

A structure that is subordinate and incidental to and serves a principal building or principal use, is generally located on the same lot as the principal building or principal use served, and contributes to the comfort, convenience or necessity of occupants of the principal building or principal use served.

Non-competing uses

Uses that share an asset without mutual interference. For example, a parking lot may be shared for land uses with non-competing hours of operation, such as commercial office space and restaurants.

Principal use

The main or primary purpose for which a structure or lot is designed, arranged or intended, or for which it may be used, occupied or maintained under this Ordinance.

Standards and Considerations for Zoning Amendments

Encouraging Commercial Use in High Density Residential Areas

The high-density multi-family housing demographic so prevalent in urban Rhode Island communities affords certain opportunities for mixed use by virtue of their density. Local zoning codes can expand the "by-right" uses within these structures, or create low-burden Special Use Permit requirements to include specific home office or small business uses. Any uses involving food sale or service would also require permits from the Department of Health. Commercial uses that to be considered within residential neighborhoods could include, but would not be limited to:

By-right (could be within existing multifamily unit or within a newly constructed ancillary structure)

- Artisanal workspace
- General office use
- Production and sale of arts and crafts
- Production and sale of baked goods
- Small scale specialty retail

Special Use Permit

- Medical offices including dental
- Convenience stores
- Café's or galleries
- Antique stores
- Bed and breakfast operation

Encouraging or Requiring Residential Use in Non-Residential Areas

Where commercial and/or industrial uses have dominated particular neighborhoods, amended zoning can encourage residential development through density bonuses or by requiring a specific percentage of a development footprint to incorporate residential units. Density bonuses can be offered simply as housing units added beyond the allowable commercial space for a particular site. Affordability criteria could also be incorporated into density bonuses with more housing units being allowed as they become affordable to households of moderate to low incomes. Other incentives include simply expanding the by-right uses to include converting existing commercial or industrial structures to residential primary use.

Requiring residential components in areas conventionally zoned for commercial use is generally relegated to projects of a larger scale. A sample threshold for this requirement could be for proposed commercial development exceeding 8,000 square feet. These development or redevelopment proposals could trigger a Special Use Permit process wherein residential components are required for a certain percentage of the building's useable floor space.

Other Considerations

Bulk Parking Requirements

Mixed use development creates a series of challenges and opportunities relative to general vehicular and pedestrian access throughout these areas. From the perspective of developing and enforcing zoning ordinances, one of the most critical challenges involves establishing bulk parking requirements in mixed use environments. In order to develop viable bulk requirements in these areas, a more sophisticated analysis must be performed beyond referencing "typical" requirements for individual uses. Factors that can affect mixed use requirements include alternating peaks in demand for different uses, the potential mix of uses, proximity to municipal parking, population demographics, and the presence of public transportation. Other considerations more specific to parking lot design are covered in the **Pedestrian Access, Parking and Intermodal Transportation** section.

Non-Competing Uses

The general guiding principle behind mixed use parking requirements involves calculating the highest peak demand over the course of a 24-hour period based on the mix of use and designing to that level. The idea is that non-competing uses or uses with minimal overlap can share parking areas thereby reducing the gross coverage of impervious area that would be needed to serve the uses independently. A commonly used example is for office use that has housing located above on a second level of the building. Residents would generally be out at work during the normal operating hours of the office space thereby creating a situation where these non-competing uses could share a designated parking area.

In areas with a more complex mix of uses and a higher volume of commercial establishments, a more comprehensive planning exercise may be required to determine if the expected buildout of a commercial center will require extensive municipal parking or if private entities can be expected to collectively satisfy the needs of the area. On-street parking, overnight parking, resident permit parking, parking garages and shuttle services are all significant planning issues that should be considered by a community before any significant redevelopment efforts take place on a neighborhood scale. Similar to wastewater disposal or communications networks, urban planners should think of parking as "infrastructure" that will play a significant role in enabling overall mixed use opportunities.

Maximum Parking Ratios

Bulk parking requirements are traditionally viewed as "minimum" requirements based on zoning standards for a particular use. As a result, it is not uncommon for commercial uses to provide more parking than is required by zoning in an effort to improve peak access to retail establishments. Financial lending institutions foster this dynamic by making loans contingent on what a bank may perceive to be adequate parking. It is important for local commission to consider setting parking requirements as a "maximum" to avoid situations where unnecessary parking stalls consume areas that would otherwise be well-suited to stormwater management, landscaping or bicycle facilities.

Incentives to Reduce Parking Needs

Communities can allow for reductions to parking requirements based on incentives offered by individual business owners or based on the existence of public transportation. Incentives that can be offered by individual business owners include:

- Providing public transportation passes as part of standard employee benefits;
- Providing locker and shower amenities on-site;
- Constructing bicycle parking facilities; and
- Providing a gasoline stipend to employees that carpool.

With regard to existing public transportation facilities, local review boards can expect to see a reduction in the need for parking in a commercial area that is well served by public transit. Standards for allowing reductions in parking requirements will vary depending on the expected number of commuters. However, a typical threshold for proximity that has been used to justify decreasing parking requirements is 1,000 feet (CWP, 1998).

References and Useful Resources

Several books and guidance documents have been written that provide a level of detail beyond what is appropriate in this Urban Design Manual. Some notable examples include:

1. American Planning Association, *Effective Community Parking Standards*, Planners Training Service, 2001.

2. Center for Watershed Protection, *Better Site Design:A Handbook for Changing Development Rules in Your Community* 1998.

3. Davidson, Michael and Fay Dolnick, *Parking Standards*, APA Planning Advisory Service, 2002

4. U.S. EPA, *Parking Alternatives: Making Way for Urban Infill and Brownfield Redevelopment*, EPA 231-K-99-001, November 1999.

   Note: Parking Ratios are being developed by EPA and ITE to better represent the mix of uses and density characteristic of urban areas. These standards were not yet available at the time this manual was drafted but will likely be made available through http://www.epa.gov/smartgrowth/ .

5. Tracy, Steve *Smart Growth Zoning Codes: A Resource Guide* 2003.

OPEN SPACE

Findings

Conventional zoning and development patterns often create communities or neighborhoods where very little open space is available to wildlife or general public access. Preserved open space provides natural amenities that reduce the effects of pollution, rise property values and significantly enhance residents' quality of life. Although open space or "green" space is most commonly associated with rural and suburban development, opportunities for developing and maintaining urban green space are critical to identify. In areas of high-density development and high impervious cover, urban green space provides amenities that are essential to relieving the environmental and social stresses endemic to densely populated areas. Regardless of the density, there is widespread consensus that loss of open space has numerous adverse impacts both on a local and regional scale. These impacts include:

- Loss of wildlife habitat;
- Loss of buffer zones to surface water resources;
- Decreased attenuation levels of air and stormwater pollution;
- Increased heat island effects in developed areas;
- Fragmentation of forest belts;
- Loss of historic public access points to surface water resources; and
- Significant decreases in the natural recharge of groundwater resources.

Definition of Open Space

Open space can be defined differently depending upon the goals of an individual community. In suburban areas where development is predominantly driven by subdivisions and isolated large-scale commercial operations, open space will generally be defined as natural undisturbed areas set aside for preservation. In more developed areas, open space could also be defined to include park and recreation areas even if actual "green" space is only a small percentage of the overall area. Community Centers, public commons, and golf courses are a few examples of developed areas that have historically been accepted as open space depending on the needs of an individual community.

In the context of an Urban Design Manual, it is important to define open space broadly to consider all of the opportunities that might present themselves within the context of urban redevelopment.

Techniques for Preserving or Creating Open Space

Creating or preserving open space is a development technique generally addressed by zoning controls or incentives. However, it is important that these regulatory controls are framed by a well-constructed local comprehensive plan. These controls can take many different forms depending on the character of the community, the need for resource

protection, and the scale of development expected to occur.

Open Space and Resource Protection

One of the more common ways communities have historically protected open space is through the use of resource protection controls. Areas regulated under this approach are those that have been shown to provide critical habitat for wildlife or those that provide resources for public health, safety and welfare (i.e. aquifers, zones of contribution to well fields or flood storage zones). The areas of land that area preserved under these provisions are usually mapped by an environmental professional or agency and serve as areas of "no disturbance" or areas where allowable density of development is significantly reduced. In the case of wetlands or flood zones, there are thresholds for the maximum amount of these areas that can be impacted by development. However, if wetland areas or flood storage are impacted by development, new areas should be provided by the developer to compensate for impacts.

Because habitat or public welfare is generally the justification behind these controls, incentives or compensation to applicants is not required.

Open Space "Set-Asides" as a Percentage of Land Area

Another common technique for creating more open space in developed areas involves mandating a percentage of the developed land be set aside as open space through the zoning code. Historically, these provisions have been applied to new subdivisions and have included "flexible development" or "clustering" provisions that allow developers to maintain or exceed the original density allowed by right in the underlying zoning district while using a much more compact subdivision design. The more compact design not only allows for open space to be preserved, but also reduces costs for developing and maintaining infrastructure and roads.

In the context of urban development and redevelopment, setting aside a percentage of individual lots for open space can be effective as long as the definition of open space considers the opportunities and constraints of the highly urbanized environment. Where rural or suburban communities will generally define open space as natural undisturbed areas, urbanized communities should also consider recreational amenities, stormwater management areas, public courtyards, plazas and parks. This more inclusive approach will provide developers with a wider array of choices for providing open space including green rooftops, landscaped islands in parking areas, plantings in streetscapes or landscaped sitting areas. In urbanized areas, these open space strategies provide significant incentives for reducing impervious surface cover and providing innovative stormwater management techniques.

Typical set-aside thresholds will vary depending on the scale of development expected and the degree of urbanization that has already occurred. In rural or suburban areas where subdivisions are the driving force behind new development, values ranging from

25%-50% are reasonable as long as there is enough flexibility in the site design standards to accommodate more compact development. In ultra-urbanized settings, where redevelopment is the goal and many lots may already exist as 100% impervious, this same range of values can still be applied as long as the definition of open space provides the developer with enough options to meet the threshold. Zoning codes for urban settings should provide the permit granting authority the power to waive or reduce the open space requirements provided this authority is legal and if it is in the best interest of the community. In all cases, zoning language for open space set-asides must be carefully crafted to withstand potential legal challenge. A Local Comprehensive Plan should also support the use of these techniques to lay a strong foundation for revised ordinances.

A final important criterion relative to open space "set-asides" involves the issue of connecting open space and access from one site to another. It is critical that local development criteria require site plans to include exiting open space or access ways on adjacent properties as part of their application. This will allow review bodies to assess the level to which proposed open space reserves fit into the larger context of undeveloped areas surrounding the site.

Open Space in Conservation Design

One of the difficulties with cluster zoning is that provisions often do not look beyond the boundaries of individual lots or subdivisions and fail to consider opportunities on adjacent lands. As a result, the open space areas created under the cluster provisions can lack continuity, creating a fragmented patchwork of undisturbed areas that bear no physical relationship to one another and simply come to resemble another form of suburban sprawl. In an effort to address this issue, many planners or communities have promoted larger scale coordinated development efforts that deliberately consider the provision of open space in a larger context.

From a resource point of view, a more sophisticated technique for preserving open space is "Conservation Subdivision Design" or "Conservation Zoning", which is described in detail in the works of Randall Arendt and DEM Conservation Development Guidance Manual (see references below). In general, the technique for site layout involves the following design process:

1) Identify natural features where no development should occur.
2) Place homes in the developed area to optimize density and access for residents.
3) Locate roads in accordance with the layout of homes.
4) Draw lot lines for each residence.

Although this technique is generally more applicable to rural and suburban areas, it is important to include the approach since even small urban areas can have significant existing natural features worth preserving. The important general feature in this approach, which can be applied to urban as well as rural environments, is the use of existing resources to dictate overall site design. The role of the Local Comprehensive

Plan in identifying outstanding resources can be a critical component of the success of this approach.

Other Considerations

Public Access to Surface Water Resources

Development of vacant land adjacent to surface water resources can not only consume vital vegetated buffer zones, but can also restrict historic public access to recreational resources. It is important, therefore, that local planning commissions and other review bodies be aware of these access points within their community and incorporate them into discussions with developers. In the context of Open Space requirements under zoning, local authorities can establish as a criteria that existing access points to surface water bodies be prioritized in any open space set asides. Site plans submitted as part of any application should require an inventory of existing public access ways for the benefit of the reviewing agencies. Where CRMC has designated a right-of-way to coastal waters, local boards cannot permit development.

It is important for local officials to be able to effectively communicate the different options private developers have relative to preserving access ways on their site. In the context of land dedication, developers can offer areas of the site to municipal control, where they will most likely be managed by the local Conservation Commission. Another option for private developers is to provide an easement across the property by registering the easement on the deed and potentially providing signage on the property. The developer should also be made aware that Rhode Island General Law provides specific measures to limit the owner's liability for any injury that takes place on private land set aside for public recreation (RIGL Chapter 32-6).

References and Useful Resources

Arendt, Randall *Conservation Design for Subdivisions, A Practical Guide to Creating Open Space Networks*, Island Press 1996.

Arendt, Randall *Growing Greener, Putting Conservation into Local Plans and Ordinances*, Island Press 1999.

Arendt, Randall *Rural By Design*, APA Planners Press 1994.

Pogue, Pamela and Virginia Lee, *Public Access to the Rhode Island Coast,* Sea Grant Advisory Service, 1993.

Rhode Island Department of Environmental Management, *Conservation Development Guidance Manual* 2004.

www.greenneighborhoods.org A website for the Green Neighborhoods Alliance that provides guidance for conservation subdivision development.

THIRD PARTY REVIEW FEES

Introduction

As development standards begin to diverge from more routine practice in areas of stormwater management, general site design, bulk requirements and issues surrounding pedestrian circulation, local review authorities and commissions may find it difficult to provide the level of technical scrutiny required for some proposals. In these cases, it is imperative that local boards be empowered to hire third party review services at the expense of the applicant. This process will streamline permitting and ensure that a high level of design is provided in areas of special community concern.

The *South County Design Manual* (Flinker, et al. 2001) previously developed by RIDEM and selected consultants contains several model zoning ordinances designed to address development issues specific to rural areas in Rhode Island. Within one of the ordinances developed by attorney Mark Bobrowski, the issue of third party review is addressed with very specific model language which empowers the Planning Board to hire review consultants within the context of Major Subdivisions and Major Land Developments. Although the scale of these developments is generally suited to rural environments, the legal language enabling the Planning Board to hire outside consultants would remain essentially the same for urban redevelopment. The model text below is adopted directly from the ordinance provided by Bobrowski with minor substantive changes to reframe the discussion in terms of urban redevelopment. Other minor editorial changes were performed to renumber the sections and remove specific reference to other material in the *South County Design Manual*.

Model Language

SECTION 1 PROJECT REVIEW FEES.

1.1 Applicability. In addition to an Administrative Fee, for all Major Subdivisions, Major Land Developments, and proposals requiring Development Plan Review the Planning Board shall impose a Project Review Fee on those applications which require, in the judgment of the Authority, review by outside consultants due to the size, scale or complexity of a proposed project, the project's potential impacts, or because the Town lacks the necessary expertise to perform the review work related to the permit or approval. In hiring outside consultants, the Board may engage engineers, planners, lawyers, landscape architects, architects, licensed site professionals or other appropriate professionals able to assist the Board and to ensure compliance with all relevant laws, ordinances and regulations. Such assistance may include, but shall not be limited to, analyzing an application, engineering design review, risk assessment, or monitoring or inspecting a project or site for compliance with the Authority's decisions or regulations, or inspecting a project during construction or implementation. The selection of a consultant and the imposition of fees shall be approved through a public meeting.

1.2 Submittal. Project Review Fees shall be submitted at the time of the submittal of the application for deposit in an account established by the Town Treasurer (Escrow Account). Any application filed without this fee shall be deemed incomplete and no review work shall commence until the fee has been paid in full.

1.3 Schedule of Project Review Fees. Upon notification from the Authority that a third-party review shall be performed, the Applicant shall submit $3,000 to the Town Treasurer for deposit into the escrow account. This requirement supersedes all previous review fee schedules as they may have appeared in the Zoning Ordinance, the Subdivision and Land Development Regulations, and any listings which may have been compiled from time to time for the benefit of applicants. Where more than one type of application has been submitted for review by the Authority, only the largest of the applicable Project Review Fees shall be collected for deposit into the Escrow Account, and not the sum of those fees.

The initial deposit of $3,000 shall serve to begin the review process. Any funds not spent during the review process shall be returned to the applicant in full. Should the review process require additional funding, these funds shall be provided pursuant to section 1.4 below

Again, technical review fees cannot exceed the actual costs of expert assistance. The legal standard requires the fee to be "roughly proportional" to the Town's costs. Where unexpended funds are returned to the payer, this should not be an issue.

1.4 Replenishment. When the balance in an applicant's Escrow Account falls below twenty-five percent (25%) of the initial Project Review Fee, as imposed above, the Planning Board shall consider whether to require a supplemental Project Review Fee to cover the cost of the remaining project review.

If the initial deposit is used, review should cease until replenishment occurs. If there is no replenishment, the project should be denied for failure to submit necessary information lest it be constructively approved.

1.5 Inspection Phase. After the granting of a Special Permit, site plan approval or Final Plan approval, the Planning Board may require a Supplemental Project Review Fee for the purpose of ensuring the availability of funds during the inspection phase of the review process.

1.6 Handling of Project Review Fees. The Project Review Fee is to be deposited into a special account as established by the Town Treasurer.

Boards are advised to consult with the Town Treasurer and Town Manager or Administrator, before establishing a fee schedule. Treasurers of neighboring communities are often willing to share information.

A. Outside consultants retained by the Planning Board to assist in the review of an application shall be paid from this account.

B. Project Review Fees shall be turned over to the Town Treasurer by the Planning Board for deposit into an Escrow Account.

C. A copy of the latest statement from the banking institution handling the Escrow Account shall be forwarded from the office of the Town Treasurer to the Planning Board office as soon as it is received for timely and accurate accounting.

D. The Town Treasurer shall prepare a report on activity in the Escrow Account on an annual basis.

1. This report shall be submitted to the Planning Board and Town Council for review.

2. This report shall be printed in the Annual Report for the Town.

E. An accounting of an applicant's funds held in the Escrow Account may be requested by the applicant at any time.

1. The Planning Board shall respond to the request in a timely fashion.

2. This accounting shall include the following information:

a. The latest statement from the banking institution handling the account, which should include an accurate accumulated interest portion to the closing date of the statement if such statements are subdivided into individual applicants' accounts. Otherwise, a statement of principal and interest, prepared by the Planning Board office, based on the latest statement from the banking institution.

b. A report of all checks authorized for issuance since that last banking statement.

F. An applicant may request an estimate of bills pending from consultants for work completed, or in progress, but not yet invoiced.

G. Excess fees in the Escrow Account, including accumulated interest, shall be returned to the applicant or the applicant's successor in interest, at the conclusion of the review process, as defined below. For the purpose of this section, any person or entity claiming to be an applicant's successor

in interest shall provide the Board with documentation establishing such succession in interest.

1. With the disapproval of a Plan at any stage. Subsequent reinstatement or re-application shall require redeposit of fees by the applicant.

2. With the approval of a Final Subdivision Plan.

3. With the release of the performance bond at the end of construction of an approved Final Subdivision Plan.

4. With the final inspection or the approval or disapproval on all other types of applications under the Zoning Ordinance or Subdivision and Land Development Regulations, whichever comes later.

7.7 Appeal. The choice of a consultant selected by the Planning Board for the review of an application, having been made through a public meeting, may be appealed in writing to the Zoning Board sitting as the Board of Appeal by the applicant, providing such appeal is initiated within twenty (20) days of the initial selection.

A. Two circumstances may disqualify the selected consultant. These conditions of constitute the *only* grounds for an appeal.

1. Conflict of interest: A consultant shall not have a financial interest in the project under review, or be in a position to financially benefit in some way from the outcome of the pending review process. Consultants must be in compliance with the Rhode Island Ethics Law.

2. Lack of appropriate qualifications: A consultant shall possess the minimum required qualifications. The minimum qualifications shall consist of either an educational degree in, or related to, the field at issue or three or more years of practice in the field at issue or a related field.

The cap on grounds for appeal prevents political fights over the sympathies of the consultant. Nonetheless, the choice of a consultant is a very visible and significant one. The professionalism of the consultant is a reflection upon the board. Boards are advised to make sure that its consultants understand that the representation of private clients before the Board is ethically unacceptable, although not illegal.

B. The required time limits for action upon an application by the Planning Board shall be extended by duration of the appeal.

C. This appeal shall not preclude further judicial review, as an appeal of the Board of Appeal's decision.

SECTION 2. DELINQUENT ACCOUNTS. The following rules apply to fees owed to the Planning Board by applicants:

2.1 Monthly Interest Charge. All fees past due by one month from the date of invoice shall be subject to a monthly interest charge based upon an annual interest rate of eighteen percent (18%).

2.2 Costs of Collection. All costs of collection associate with past due accounts shall be borne by the applicant.

2.3. Current Delinquents. All applicants owing fees to the Planning Board at the time of any amendment to these provisions of the regulations shall be sent the following:

A. A duplicate notice of the amount past due.

A copy of the applicable sections of these regulations with all amendments clearly indicated.

Notice of a 30 day grace period before the commencement of any changes in interest rates or charges.

SECTION 3. REVISION OF FEE SCHEDULES AND REGULATIONS GOVERNING FEES.

3.1 Amendment. The Planning Board may review and revise its regulations and fee schedules, from time to time, as it sees fit.

A. Amendments shall be preceded by a public hearing.

B. Any new regulations or alterations to the fee schedule shall take affect upon filing a copy of the amendments with the Town Clerk.

C. The Planning Board will review its regulations and fee schedule on an annual basis.

ADEQUATE PUBLIC FACILITIES

Findings

Some citizens and municipal staff may attribute congestion and facility inadequacy to a "lack of planning" or "poor planning". In many situations planning does occur, but the ability to target facility investment to the appropriate location at the appropriate time is hampered because very few communities can afford to build facilities in advance of the need.

Adequate public facilities efforts become necessary when a local government's coordination of development and public facility construction fails. Fast-growing jurisdictions, in particular, often find themselves suddenly in situations where intersections are congested, school classrooms are overcrowded, inadequate water supply is available during summer drought periods, or sewer pumping stations overflow during peak periods.

The purpose of these development guidelines is to help local officials build a sound basis for incorporating issues surrounding public facilities into the review process. With the right information and good planning, officials will be prepared to compare development proposals against accurate information to ensure that the issuance of plan approvals will be consistent with a municipality's capacity to accommodate new development. This test of municipal capacity is appropriate where it has been demonstrated through the Local Comprehensive Plan process that the municipality's present infrastructure and services (e.g. roads, schools, police and fire protection, water supply, wastewater treatment facilities) cannot sustain projected growth rates without detrimental impacts on the environment and/or character of the municipality.

Definition/Scope

The scope of an adequate public facilities investigation should include, at a minimum, the following facilities:

School System Capacity
Drinking water supply
Wastewater Disposal
Trash Removal and Disposal
Fire and Police Department Capacity
Stormwater Management Facilities
Indoor/Outdoor Recreational Facilities
Roadway Capacity
Affordable Housing

Development Tools

The most potent tool for a community to have relative to facility assessment is a well written Local Comprehensive Plan that specifically addresses each of the facility items listed above. At the Local Comprehensive Plan stage, long range planning evaluates the location of anticipated growth and the public facility infrastructure necessary to support it. Beyond the development of a plan, local planning agents and municipal officials should have a continuous dialogue regarding facilities in an effort to update their understanding of where utilities, roadways, and recreational amenities stand in terms of capacity and maintenance requirements.

With the Local Comprehensive Plan in place, a land use plan that describes the location and intensity of growth can be followed by a "community facilities plan" which describes the existing facilities, and a list of new and upgraded/expanded facilities which will be required to provide the services which the community will require in the coming years. This document can serve as an invaluable resource for agents charged with reviewing Land Development Projects or who might be involved in Development Plan Review. Questions that will be answered with either a Local Comprehensive Plan or a community facilities plan include:

1) How many children can be accommodated by local schools and when are these schools scheduled to reach capacity?
2) What will the impact of new development be on existing school bus routes?
3) Is the volume of drinking water available from groundwater or surface water sources adequate to accommodate new development? Does the community already experience regular summer shortages of water?
4) What is the condition of the existing water distribution system? Are there complaints regarding pressure and have there been many reported watermain leaks?
5) How close to capacity is the existing sewage disposal facility? What is the condition of the existing collection system?
6) Can the existing trash collection system accommodate new development or will new employees and/or trucks be required?
7) What are the technical specifications of the local fire trucks (e.g., truck height, ladder height, and turning radius) and how should these come to bear on the design of homes and roadways within proposed development? What will the response time be for fire trucks?
8) Is the existing Police Department at or near capacity?
9) Are stormwater facilities adequate to receive additional volumes of runoff from an increase in impervious cover?
10) With potential localized increases in population from proposed development, will neighborhoods be adequately served by open space and/or recreational facilities? Have the needs of specific demographic groups been met (e.g., children, the elderly, people with disabilities).

11) Is there an adequate understanding of traffic conditions on both a regional and local level? Can roadways in proposed designs handle traffic and also provide adequate pedestrian and bicycle infrastructure?
12) Will a proposed development impair a community's ability to meet their affordable housing needs by adding a significant level of exclusively market rate units?

References or Useful Materials

Rhode Island State Planning Council. Handbook on the Local Comprehensive Plan, 1989, as amended through 2004. http://www.planning.ri.gov/comp/handbook16.pdf

STORMWATER MANAGEMENT, IMPERVIOUS SURFACE REDUCTION, AND EROSION AND SEDIMENT CONTROL

Table of Contents:

I. Findings

Stormwater runoff, particularly from urban land uses, is widely viewed as one of most significant contributors to water quality impairment (Burton & Pitt, 2002). Many believe the cause of impairment is a result of pollutant delivery to receiving waters. While pollutants in stormwater runoff are certainly ubiquitous, and frequently at concentrations that do contribute to water quality impairment, impacts from reduced groundwater recharge, accelerated stream channel erosion, and increased flooding all are part of the stormwater "problem."

In urban areas, many of these "problems" already exist from prior development decisions. Streams may have been enclosed, little stormwater infiltration occurs, and most runoff is conveyed in pipes that discharge directly to receiving waters. In some cases, older municipal piping networks include combined systems where stormwater runoff and domestic and industrial wastewater are within the same pipe system. These typical situations create both opportunities and constraints for stormwater management.

Two fundamental principles must be understood in order to gain a grasp of the wide topic of stormwater management. The first is to understand how the basic water balance changes as a result of altered land use. The second is to understand that precipitation is widely variable and the probability of a given precipitation event occurring governs how that event, or range of events, can be effectively managed.

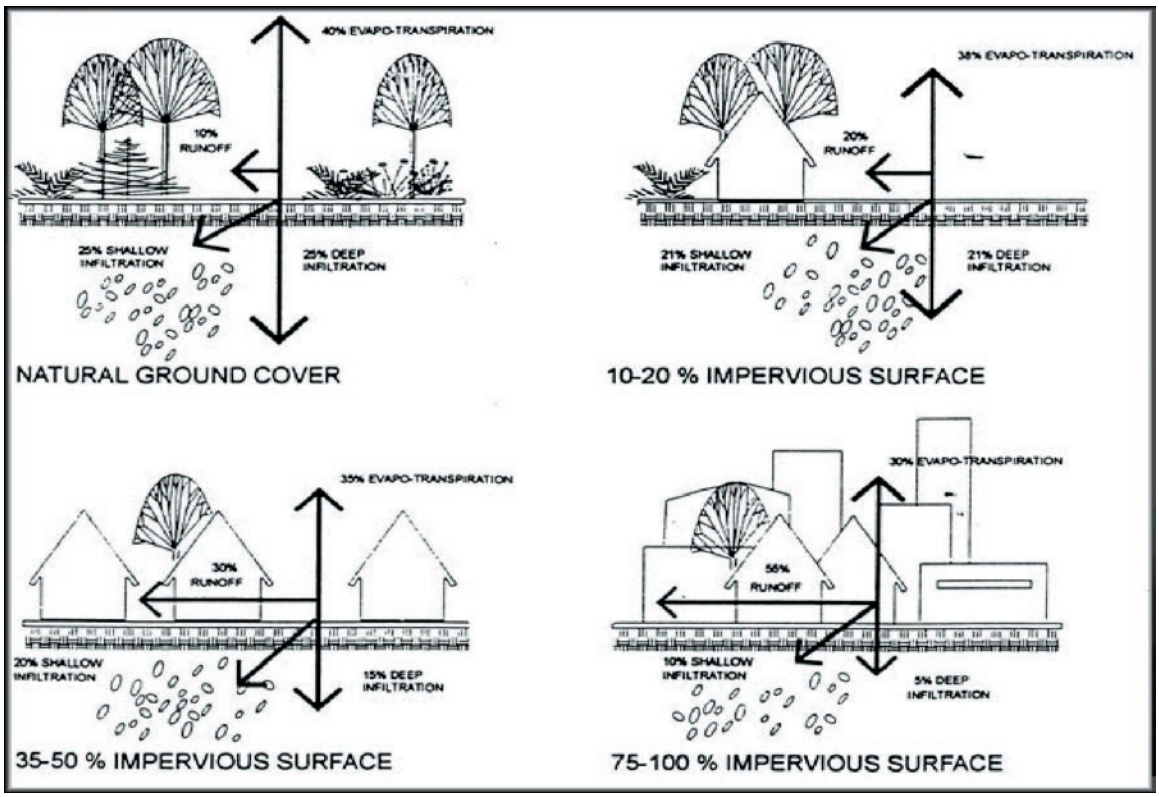

Figure 1 *Water Balance Alteration with Increasing Impervious Cover* (source: PGDER, 1999)

Figure 1 illustrates the shift in the water balance as land use intensity increases. In relatively undeveloped or rural areas, total precipitation is divided into three principal components: evapo-transpiration, infiltration, and runoff. The quantity of each of these variables is dependent on the amount of precipitation, the climate, the vegetative cover, the soils, the land slope, the amount of impervious area, and the characteristics of precipitation events (e.g., intensity of rainfall). As land is altered from less intensive uses to more intensive uses, impervious cover increases and the relative balance of these three variables is changed, with the most dramatic effect being that runoff volume increases and infiltration decreases. The consequence of more runoff occurring more frequently results in accelerated overland and stream channel erosion, increased pollutant washoff from the land, and increased flooding frequency leading to property damage and potential threats to public safety. Decreased infiltration reduces the amount of groundwater recharge and leads to a loss of total water volume to supply streams, wetlands, ponds, and lakes during dry weather. In many urban areas, streams that were once perennial under past more rural conditions become intermittent as a watershed develops.

In most urban redevelopment areas, this disruption in the natural water balance has already occurred, resulting in reduced groundwater levels, reduced flow in urban streams, and elevated pollutant concentrations to receiving waters. Other activities in urban areas may have contributed to contaminated subsurface conditions (either in soils, groundwater or both), and compacted urban soils retain little of the infiltrative capacity of natural soil systems. Consequently, a return of the water balance to a more natural condition may not be feasible or even desirable, if prior soil contamination exists. The implementation of any stormwater management approach for urban areas must first include an assessment of existing conditions before management objectives are established.

Many urban redevelopment projects can be designed to reduce the net impervious cover, and help reduce pollutant load delivery to receiving streams, reduce flooding and stream channel erosion, and increase groundwater recharge. The effects of impervious cover reduction means stormwater runoff volume is reduced and structural stormwater management measures can be reduced in size and cost.

Lastly, most urban redevelopment projects will involve at least some demolition and land disturbance activities. In many cases, drainage infrastructure already exists that can easily convey untreated construction site runoff to receiving waters. Communities implementing stormwater management standards must also employ strict erosion and sediment control provisions to ensure that redevelopment projects will not cause additional impacts during the reconstruction phase.

II. Definition

Stormwater Management is a generic term used to encompass the very broad field of managing runoff from precipitation events to control or mitigate a range of issues, including: drainage or *conveyance* of runoff from one location to another; *treatment*

of runoff to capture and remove a variety of pollutants prior to discharge to receiving waters; *recharge* of precipitation into underlying groundwater to maintain supplies for drinking water, irrigation and dry weather flow to streams, wetlands and ponds; mitigation of accelerated overland and stream channel *erosion* caused by either a disruption in hydrology or sediment supply, or both; *reuse* of precipitation for a range of beneficial uses such as drinking water and irrigation; and finally, control or management of large precipitation events to reduce the risk of downstream *flooding*.

Stormwater runoff is also directly related to the amount of impervious and compacted pervious surfaces on the land, and consequently, one of the best stormwater management measures is good site design. Project designs that maintain undisturbed natural areas, reduce impervious cover, and provide more vegetative areas result in less overall runoff and pollutant loading and more annual recharge.

Erosion and sediment control encompasses a series of management practices to reduce the amount of disturbed earth that is exposed to precipitation and provide specific measures to trap and retain construction site generated sediments on-site and keep sediment born runoff from discharging to receiving waters.

Stormwater management is often divided into two broad categories as either stormwater quantity control, or stormwater quality control. Quantity controls have historically employed a peak flow reduction strategy, where post-developed peak flows for a range of storms are attenuated to pre-development levels. In Rhode Island, proposed projects must control and maintain post-development peak discharge rates from the **2-year and 25-year storm events** at pre-development levels. A downstream analysis is required for the **100-year storm event** to ensure no adverse impacts. When deemed necessary, control of the peak discharge rate for the 100-year storm shall be required (RIDEM, 1993 or latest edition).

Quality control is the other broad category for stormwater control, where pollutant loading is reduced to an established level for all new development. In Rhode Island, a standard of 80% reduction in the total suspended solid (TSS) load is required as measured on an annual basis. This standard was derived from Section 6217(g) of the federal Coastal Zone Act Reauthorization Amendments (CZARA) of 1990. To achieve the 80% TSS removal rate, structural stormwater management measures must be designed to capture and treat **one-inch of runoff from impervious surfaces**. The key to achieving a pollutant reduction target, such as the 80% TSS removal rate, is to have a set of specific stormwater practices with a proven track record of pollutant removal, specific design standards for each type of practice, and mechanisms for ensuring that practices are properly constructed and maintained over time.

Planners, designers and municipal staff are directed to review the latest edition of the State of Rhode Island Stormwater Design and Installations Standards Manual (in Press) for stormwater management sizing criteria as well as specific criteria for the design of stormwater water quality best management practices.

III. Development Standards

A. Impervious cover reduction

One of the most effective stormwater management strategies is to employ site design techniques to reduce total site imperviousness while still achieving site development objectives. These include a variety of site design techniques that primarily target reduction in pavement for roads, parking lots, driveways and sidewalks, including:

- Narrower, shorter streets and smaller turn-arounds;
- Smaller parking lots (through lower parking ratios, shared parking arrangements, reductions in parking ratio in conjunction with mass transit, utilizing a percentage of spaces for compact cars, and structure parking garages);
- Relaxed building setbacks to reduce driveway and/or access road length;
- Flexible design standards for sidewalks; and
- Use of alternative pavement treatments to reduce the net amount of totally impervious surfaces (i.e., porous asphalt/concrete, grid pavers, cobblestone/ brick, and crushed aggregate/gravel).

In urban redevelopment situations it is often possible to reduce existing impervious cover through design measures that employ some or all of the techniques listed above. However, many communities have local regulations that prohibit or strongly discourage impervious cover reduction. Rhode Island communities must review and modify their local subdivision rules and regulations and/or zoning ordinances to allow or even require impervious cover reduction. Some typical impervious cover reduction standards are listed in Tables 1 and 2 below:

Table 1: Example of Road Travel Widths for Local Streets

Minimum Road Width	*Parking*	*Average Daily Trips (ADT)*	*# of Dwellings Units Served*
20 feet	Parking on both sides*	< 200	20
22 feet	Parking on one side*	200-400	20-40
26 feet	Parking on both sides	400-2000	40-200
28 feet	Parking on one side	> 2000	> 200
32 feet	Parking on both sides	> 2000	>200

* parking is restricted to one side during a snow emergency. No parking is permitted if road is a designated fire lane.
(Source: CWP, 2000)

Table 2: Example of Minimum Parking Ratios

Land Use	*Parking Ratio*	*Actual Average Demand*
Single Family Homes	2 spaces/dwelling unit	1.11 spaces/dwelling unit
Shopping Center	5 spaces/1000 sq ft GFA[1]	3.97 spaces/1000 sq ft GFA
Office	3 spaces/1000 sq ft GFA	-
Convenience Store	3.3 spaces/1000 sq ft GFA	-
Industrial	1 space/1000 sq ft GFA	1.48 spaces/1000 sq ft GFA
Medical/dental Office	5.7 spaces/1000 sq ft GFA	4.11 spaces/1000 sq ft GFA

[1] GFA = gross floor area
(Source: ITE, 1987)

B. Erosion and Sediment Controls:

The Rhode Island Soil Erosion and Sediment Control Handbook (1989) contains the latest erosion and sediment control standards and practice details. This section includes general soil erosion and sediment control criteria that would be applicable to urban infill and redevelopment projects.

To prevent adverse impacts from construction site runoff, the following general performance standards (designated as erosion and sediment control standards or E&SC Standards) are recommended for all new development and redevelopment construction sites. These narrative performance criteria shall be applied to the maximum extent practicable. If in the view of the approving authority, it is impracticable or infeasible to apply one or more of the E&SC criteria to a given project, a waiver may be granted on a case-by-case basis.

1) General Performance Criteria for Construction Site Runoff Control

E&SC Standard 1 — Minimize unnecessary clearing and grading from all construction sites. Clearing and grading shall only be performed within areas needed to build the project, including structures, utilities, roads, recreational amenities, post-construction stormwater management facilities, and related infrastructure.

E&SC Standard 2 — Rivers, streams and waterways shall be protected by limiting clearing within the riparian corridor and applying perimeter sediment controls between disturbed areas and this riparian corridor. Existing and proposed drainage ways should also be protected by ensuring that flow velocities are non-erosive.

E&SC Standard 3 — Whenever practicable and feasible, construction shall be phased to limit disturbance to only one area of active construction at a time. Future phases shall not

be disturbed until construction of prior phases are complete and the land area is stabilized.

E&SC Standard 4 — Disturbed areas shall be stabilized as soon as feasibly possible after construction is completed within a designed construction area.

E&SC Standard 5 — Steep slopes shall be protected from erosion by limiting clearing of these areas in the first place or, where grading is unavoidable, by providing special techniques to prevent upland runoff from flowing down a steep slope and through immediate stabilization to prevent gullying.

E&SC Standard 6 — Perimeter sediment controls shall be applied to retain or filter concentrated runoff from disturbed areas to trap or retain sediment before it leaves a construction site.

E&SC Standard 7 — Sediment trapping and settling devices shall be employed to trap and/or retain suspended sediments and allow time for them to settle out in cases where perimeter sediment controls (e.g., silt fence and hay bales) are deemed to be ineffective in trapping suspended sediments on-site.

E&SC Standard 8 — All construction site managers (or superintendents) shall provide documentation that they have received adequate training in the application and maintenance of erosion and sediment control practices.

E&SC Standard 9 — All construction site managers must participate in a pre-construction meeting with the applicable authority to review the provisions of the erosion and sediment control plan and make any field adjustment necessary to implement the intent of the plan to minimize erosion and maximize sediment retention on-site throughout the construction process.

IV. Other Considerations

A. Groundwater Recharge Criteria

Groundwater recharge is the volume of precipitation that is infiltrated into underlying soils that supports and maintains groundwater levels and is not either directly released as evapotranspiration or conveyed downstream as runoff or interflow.

Several stormwater management permit programs have recently instituted groundwater recharge criteria to account for the disruption to the natural water balance that occurs with development. The problem is that it is uncertain as to how much recharge is necessary to mimic natural conditions? One approach is to try to measure what occurs naturally, and then derive criteria to meet that condition. If the natural rate of recharge is 50% of the precipitation volume at a given location, then a regulatory program should strive to infiltrate half the total precipitation volume. This is accomplished by setting a design criterion that requires infiltration of a set precipitation value that ensures half the total long-term precipitation is directed back into the ground.

Unfortunately, regulatory programs often do not have data on the amount of annual recharge that occurs at a given location, and more importantly, natural recharge varies dramatically as a function of soil type. Clay soils have far less recharge capabilities than sandy soils.

Stormwater management regulatory programs must consider several constraints and opportunities in implementing a recharge criterion. These include an array of physical limitations, some cautions on infiltration of runoff from certain land uses, and having a firm understanding of the methods and techniques used to foster infiltration of stormwater runoff.

Physical stormwater recharge limitations include several of those for infiltration systems, and as more generally described below:

- Extremely fine-grained soils that exhibit very slow infiltration rates
- Shallow depth to groundwater
- Larger drainage areas where runoff volumes become modest to large
- Steeper slopes where runoff velocities exceed four to five feet per second
- Cold winter climates where large quantities of sand/salt are applied to road surfaces

Examples of land uses that represent a potential threat to groundwater contamination include those so-called “hotspots,” including the following:

- Vehicle salvage yards and recycling facilities
- Vehicle repair and refueling stations
- Vehicle and equipment cleaning facilities

- Fleet storage areas (bus, truck, etc.)
- Marina service and maintenance facilities
- Public works storage areas
- Certain industrial sites that manufacture, store or transport toxic soluble pollutants

The above land uses have the potential to generate high concentrations of soluble pollutants that can threaten groundwater quality if infiltrated directly. Stormwater program managers must carefully evaluate this threat prior to employing groundwater recharging techniques. In many instances, managers can employ complex pretreatment measures to reduce and/or remove pollutants and then safely apply recharging techniques.

There are a variety of stormwater practices that can meet recharge objectives, including:

- Infiltration practices (basins, trenches, vaults, and chambers)
- Soil-based filtration systems (bioretention facilities, rain gardens, sand filters, peat-sand and compost filters)
- Open vegetative channels and swales
- Filter strips and aquatic buffers
- Preservation of natural undisturbed areas
- Disconnection of rooftop runoff

B. Construction

Successful stormwater management programs must have a viable mechanism to ensure that practices are installed correctly and maintained over the long term. As presented above, all stormwater treatment practices must have an enforceable operation and maintenance plan and agreement. In addition, many potential problems that affect stormwater practice performance are caused during the construction phase, and consequently, construction inspection is a vital component of the stormwater management implementation process. This section provides some guidance and references to the topic of stormwater management construction and maintenance.

There are a number of elements that contribute to a successfully constructed facility. The following lists some of the key considerations that warrant attention by stormwater management regulatory personnel:

1) Design drawings, details and specifications need to be clear, concise, unambiguous and correct. Engineers and plan reviewers must take extra caution to produce plans that are error-free. Details should be easy to interpret and free of vague information.
2) The design engineer should be involved in the construction process, if possible. Where it is not possible, or not preferable to retain the original designer, then an equally qualified engineer, who has design experience with the specific stormwater practice being constructed, should be involved in the project. "Involved with the project" means that the

engineer supervises construction inspections, reviews shop drawings, participates in construction progress meetings, and coordinates directly with the contractor on critical construction issues.

3) The contractor should have prior experience building the specific stormwater management practice being proposed. Most construction contracts go to the low bidder. In fact, most municipal laws require that contracts go the "lowest qualified bidder." The key word is "qualified." Bidding documents should contain specific requirements for contractors to submit prior work experience that are used as part of a "qualified bidder" assessment process. Many construction problems can be attributed to the fact that a contractor has never built a particular practice before. Conversely, a qualified contractor can solve many unforeseen problems, often before they become problems.

4) Do not start construction in the late fall. Many stormwater practices involve earth moving operations, dewatering, and or stream diversions. Winter construction complicates almost everything. It is nearly impossible to meet compaction specifications due to excessive soil moisture content, construction equipment can be routinely mired in muck, concrete curing often requires tenting, and stabilization of disturbed areas is extremely difficult.

5) "Work in the dry." Many stormwater practices are constructed at the bottom of a drainage system of one kind or another, and projects are not usually completed before at least a few precipitation events. Designers and contractors need to work together to divert storm flows around construction stages to prevent costly delays and/or downstream sediment transport.

6) Make sure a professional land surveyor stakes out the project. Many projects end up being constructed with just a small variance from the original design drawings. In most cases, this is all right, but in some it means the difference between a successful project and a failure. For example, shallow marsh wetlands require the maintenance of extremely tight tolerances to foster the different depth zones required for a complex wetland plant community. Sand Filters, which also rely on the distribution of flow across a level filter bed, need to be built to within very tight tolerances.

7) Provide construction inspections to ensure facilities are built in accordance with approved design plans. This involves a commitment from the approving regulatory agency to develop inspection standards, train personnel on how to perform inspections, and provide enforcement mechanisms for those facilities that are not constructed in accordance with approved plans.

C. Long Term Maintenance

The key to successful stormwater practice implementation is to provide needed maintenance in a manner that ensures that facilities will remain effective over the long term. There at least three major components to a successful maintenance program:

- one that involves the inspection of facilities to identify and document material deficiencies
- one that provides technical resources on how to correct facility deficiencies, and
- one that provides enforcement provisions on how to deal with owners/operators who are unwilling or unable to correct material deficiencies.

In practice, the key to a successful maintenance program is to develop an adequate funding source to perform inspections, correct facility deficiencies, and provide technical capabilities to owners/operators. Adequate funding is perhaps the greatest single hurdle for small municipalities that seek to implement successful stormwater management programs. The few communities that have succeeded have developed either aggressive fee structures funded by new development, stormwater utilities that collect fees from existing residents and businesses that contribute to stormwater runoff impacts, or stormwater tax systems.

V. Resources

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ENABLING BROWNFIELD REDEVELOPMENT

Findings

Development of a property where oil or hazardous materials (OHM) were once spilled or inappropriately disposed can create a number of serious predevelopment site assessment considerations. Many of these sites in Rhode Island, otherwise known as "brownfields", have a long history of varied industrial use that may have resulted in the contamination of underlying soils and/or groundwater with a variety of noxious chemicals. Recent federal and state programs have been specifically geared toward enabling brownfield restoration through such measures as revolving grants, clean up funding, demonstration study financing, tax breaks, and job training. The movement to restore these urban areas has significant momentum and can provide local officials with unique opportunities to turn blighted areas into showcase developments.

Aside from the planning issues surrounding brownfield restoration, the technical issues can be difficult to understand, are generally highly specialized, and can lead to costly remediation programs. Fortunately, the regulations governing site assessment and remediation build upon decades of research and experience and set forth very clear and specific standards for reuse. Local planners are generally less active in the more technical aspects of assessment and remediation but should be aware of some key issues when faced with a potential redevelopment situation within their community.

The American Society of Standard Testing Materials (ASTM) has adopted the *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process E1527-00, and the Standard Practice for Environmental Site Assessments: Transaction Screening Process E-1528-00.* The purpose of these standards is to establish a customary practice for conducting an environmental site assessment of a parcel of commercial real estate to determine the presence and/or absence of the range of hazardous contaminants as defined in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, commonly known as "Superfund" and administered by U.S. EPA), as well as petroleum products. The assessment is intended to allow for the user of the practice to satisfy the "innocent land owner" defense in CERCLA.

Definition

CERCLA defines material as hazardous pursuant to CERCLA USC§ 9601(14) as any element, mixture, compounds, solution or substance designed pursuant to section 9602 of this title, any hazardous waste having characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act (42 USC§ 6921), any toxic pollutant listed under section 112 of the Clean Air Act (42 USC§ 7412), and imminently hazardous chemical, substance, or mixture with respect to which the EPA has taken action pursuant to section 2606 of Title 15. As defined in the above regulations, hazardous does not

include petroleum, crude oil, liquefied natural gas, or synthetic gas.

The Resource Conservation Recovery Act (RCRA), in 42 USC§ 6903 as a solid waste, or combination of solid wastes, which because of its quantity, concentration, physical, chemical, or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious irreversible illness, or pose a substantial present or potential hazardous to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

Hazardous materials are regulated by the Occupation Safety and Health Administration (OSHA) through 29 CFR 1910.

Development Tools

Local agents interested in potential redevelopment of specific brownfields should expect a similar investigation process for any brownfield parcel. A Phase I Environmental Assessment should be completed in accordance with standards described above. If the presence of oil or hazardous materials is detected, additional assessment investigations should be completed. ASTM also has standards for the completion of a Phase II Environmental Site Assessments. Phase II assessments may include the collection of soil, groundwater and/or air samples. Samples should be submitted to a certified laboratory for analysis of potential contaminants of concern (COCs). Potential COCs can be preliminarily identified based on past land use. Investigations should be completed by a qualified environmental professional. All laboratory results should be compared to applicable Rhode Island Department of Environmental Management (DEM) soil, groundwater or air standards.

It is important to note that the type and quantity of hazardous materials discovered in subsurface investigations will eventually dictate the type of use that can developed after remediation. Some contaminants are volatile and hazardous to human health after prolonged exposure and therefore, the presence of these materials may preclude residential use on a site. In these instances, it may be unrealistic or financially impossible to remediate a site to the standards necessary for a non-transient use. However, it may be possible to restore the subsurface region to a level suitable to transient uses such as light industry or recreational areas. It is also important to note that although Superfund does not specifically address contamination from petroleum products, the 2002 Small Business Liability Relief and Brownfields Revitalization Act allows funds to be spent on sites contaminated with oil.

Because state and federal regulations unequivocally provide the standards by which brownfields sites will be assessed and cleaned, it is not necessary for local regulations to contain extensive development criteria for these situations. The role of local officials in brownfield restoration is to enable redevelopment to greatest extent possible by providing the private sector with information and a regulatory structure that enables a flexible approach to these sites. Of paramount concern, of course, is public health and safety and,

as such, local officials should track the results of each stage of investigation and should be confident in the credentials of those environmental professionals involved in the process.

Specific issues that a local official should track or examine during a site investigation include:

- What were the prior uses on the site?
- Have any prior investigations been performed or have any reports been prepared for selected sites throughout the community?
- Is the site in close proximity to drinking water or water-based recreation areas?
- Based on existing data, what type of use might be suitable for a particular site and does existing zoning allow for that use?
- How will the presence of hazardous materials affect ability to maintain or restore any existing historic structures? Will extensive excavation or soil capping be required?
- Are there any local incentives in place to encourage brownfield restoration such as tax incentives or flexible development provisions?
- Is the community in a financial position to post bonds toward such measures as tax increment financing?
- What are the existing federal and state incentives that can be applied to brownfields within the community and can the community use its "non-profit" status to act as a partner with the private sector toward specific redevelopment efforts?

References and Useful Resources

www.epa.gov/region1/brownfields/index.html This U.S. EPA website provides a wealth of information about brownfield restoration, the policies and programs associated with this development and many case studies that document the success of the program

www.epa.gov/region1/brownfields/pdfs/hr2869benefits This U.S. EPA website provides more comprehensive information on the 2002 Small Business Liability Relief and Brownfields Revitalization Act.

http://www.state.ri.us/dem/brownfields/default.htm This Rhode Island DEM provides considerable information regarding the state's involvement in these projects and many of the success stories in Rhode Island.

HAZARDOUS MATERIALS STORAGE AND HANDLING

Findings

A facility in which oil and/or hazardous materials (OHM) are stored and or handled may require a specific management plan to prevent the release of said OHM. Storage and handling could include above ground storage of materials of greater than typical household quantities or may include underground storage tanks (USTs) generally designed for petroleum products. As is the case with issues surrounding site assessment and remediation, state and federal regulations are strict and often highly technical with regard to storage, handling, transport and disposal of OHM. On the federal level, the transport of hazardous materials is regulated by the federal Department of Transportation through 40 CFR 171 and 172. Hazardous wastes are regulated by the Environmental Protection Agency through 40 CFR 260.

On the local level, storage and handling of hazardous materials in existing structures can be monitored through periodic inspections that may be scheduled by the fire department, building inspector, or other safety official. At a minimum, regulations under the jurisdiction of the Occupation Safety and Health Administration (OSHA) through 29 CFR 1910 should be maintained. Local officials can also provide criteria for the handling and storage of hazardous materials through specific local regulations in commercial/industrial zones or in protective overlay districts for aquifer or habitat resources.

Definitions

CERCLA defines material as hazardous pursuant to CERCLA USC§ 9601(14) as any element, mixture, compounds, solution or substance designed pursuant to section 9602 of this title, any hazardous waste having characteristics identified under or listed pursuant to section 3001 of the Solid Waste Disposal Act (42 USC§ 6921), any toxic pollutant listed under section 112 of the Clean Air Act (42 USC§ 7412), and imminently hazardous chemical, substance, or mixture with respect to which the EPA has taken action pursuant to section 2606 of Title 15. As defined in the above regulations, hazardous does not include petroleum, crude oil, liquefied natural gas, or synthetic gas.

The Resource Conservation Recovery Act (RCRA), in 42 USC§ 6903 as a solid waste, or combination of solid wastes, which because of it's quantity, concentration, physical, chemical, or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious irreversible illness, or pose a substantial present or potential hazardous to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

Materials Safety Data sheet (MSD sheet): Information sheets available from the manufacturer, prepared in accordance with the requirements of 29 CFR 1910.1200, which contain data on the physical characteristics, flammability, explosivity, reactivity and safety and health hazards of specific chemicals or products. The MSD sheet also provides

information on proper handling procedures, personal protective gear, spill control measures and recommended disposal methods.

General Storage Design Standards

The following standards can be considered by local officials for predevelopment conditions in areas that allow for storage of hazardous materials. These standards can be listed as part of general commercial/industrial zone requirements or may constitute a checklist with a required Hazardous Materials Management Plan as part of a Special Use Permit process.

1) Hazardous materials and hazardous wastes shall be stored in tight containers with leak detection if applicable.

2) Storage of OHM in containers located outdoors should include protection from the elements, accidental damage or vandalism, contain releases or spills of not less than 150% of the volume of any one containment vessel, and not be located in areas that may lead to discharge to soils, drains or surface water.

3) Designs of containers located indoors shall include a berm, dike or other containment to contain a release of a minimum of 150% of the volume of any one containment vessel. The storage vessel shall also be designed and located in areas that may lead to discharge to soils, drains or surface water. Hazardous materials shall be stored so as to separate incompatible materials.

4) Containers shall be inspected and maintained on a regularly scheduled basis. Inspections shall include containers, piping, and dispensing equipment. Inspection and maintenance shall be recorded on forms that are compiled and stored in a designated location.

5) OHM storage containers are regulated primarily by the Fire Code, Department of Public Safety, and Federal requirements. Federal requirements mandated that by September 23, 1998, all unprotected steel USTs must either be upgraded or removed from service.

6) Owners of commercial, industrial or institutional facility which uses, treats, generates, stores or disposes of hazardous wastes or hazardous materials in any quantity shall register with the Board of Health. Registrations shall include the type, quantity and location of the OHM being stored, a DEM/EPA hazardous waste generator identification number, copies of any MSDS sheets, and the name of any licensed transporter used by the facility. The information compiled related to OHM storage should be updated every year.

7) Containers of OHM shall be clearly labeled as is required in OSHA labeling

requirements regulations 29 CFR 1910.1200. OHM and MSDS sheets shall be stored in a single location.

8) An owner or operator of a commercial, industrial or institutional facility that uses, treats, generates, stores or disposes of hazardous wastes or hazardous materials shall create and maintain a Spill Prevention Control and Countermeasures Plan in accordance with Federal Regulation 40 Code of Federal Regulations (CFR) 112 . This plan shall include a designated spill response supervisor and assistant supervisor with 24-hour contact information.