EPA United States Environmental Protection Agency



Using Smart Growth Techniques as

Stormwater Best Management Practices

About the Image on the Cover

The cover illustration depicts development that might occur as a result of the recently updated West Hyattsville (Maryland) Transit Oriented Development Overlay Zone. This area is served by the Metrorail (subway) and is home to the West Hyattsville Green Line station. The elements of the plan include many common features of transit oriented development (TOD): a compact footprint, development intensity focused on the station area, a rich mix of uses and housing types, and a variety of transportation options. These features, as illustrated in this publication, also have benefits related to preventing and managing stormwater, in particular, when considered at the watershed, neighborhood, and site levels simultaneously. The compact design can accommodate a higher intensity of development on a smaller footprint. This format, oriented toward transit and pedestrian travel, also lessens the imperviousness related to automobile-only travel. By accommodating a higher intensity of development in this preferred area, demand that might go elsewhere in the undeveloped parts of the watershed is absorbed.

The West Hyattsville TOD Plan goes further to address water and stormwater throughout the planning area. There is a heavy emphasis on open space, active parks, and integrated stormwater management. In developing the plan, use of natural drainage patterns and habitat restoration were coupled with development of parks, fields, and trails.

Image courtesy of PB PlaceMaking and the Maryland National Capital Parks and Planning Commission - Prince George's County Planning Department.

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Table of Contents

Executive Summary **7**

SECTION 1: Why Stormwater? The Nexus Between Land Development Patterns and Water Quality and Quantity **11**

Summary of How Stormwater Runoff Is Regulated 12
Connecting Stormwater Management and Smart Growth 15
Smart Growth Techniques as Best Management Practices 20

SECTION 2: Specific Smart Growth Techniques as Stormwater Best Management Practices **25**

1. Regional Planning 27
2. Infill Development 37
3. Redevelopment 48
4. Development Districts 51
5. Tree and Canopy Programs 61
6. Parking Policies to Reduce Number of Spaces Needed 64
7. "Fix It First" Infrastructure Policies 71
8. Smart Growth Street Designs 75
9. Stormwater Utilities 81

SECTION 3: Resources **89**

SECTION 4: New Jersey—A Case Study in Weaving Stormwater and Smart Growth Policies Together **99**

Goals for Smart Growth 99
Goals for Water and Stormwater 100
Specific Policies that Meet Both Water and Smart Growth Goals 100

Acronyms & Glossary **105**



Image: PB PlaceMaking, Stull and Lee

EXECUTIVE SUMMARY

Communities around the country are adopting smart growth strategies to reach environmental, community, and economic goals. The environmental goals include water benefits that accrue when development strategies use compact development forms, a mix of uses, better use of existing infrastructure, and preservation of critical environmental areas. While the water quality and stormwater benefits of smart growth are widely acknowledged, there has been little explicit regulatory recognition of these benefits to date.

Regulations under the National Pollutant Discharge Elimination System (NPDES) stormwater program offer a structure for considering the water quality benefits associated with smart growth techniques. Compliance with federal, state, and local stormwater programs revolves around the use of "best management practices" (BMPs) to manage stormwater. Given the water benefits of smart growth at the site, neighborhood, and watershed levels, many smart growth techniques and policies are emerging as BMPs.

The goal of this document is to help communities that have adopted smart growth policies and plans recognize the water benefits of those smart growth techniques and suggest ways to integrate those policies into stormwater planning and compliance. Taking credit for the work a community is already doing can be a low-cost and practical approach to meeting water quality goals and regulatory commitments.

This document is related to a series of primers on smart growth. In 1999 and 2001, the International City/County Managers Association (ICMA) and the U.S. Environmental Protection Agency (EPA) released two primers that each listed 100 smart growth policies. In 2004, EPA released *Protecting Water Resources with Smart Growth*, which presented 75 policies directly related

to water resources. This document also complements the EPA's National Management Measures to Control Nonpoint Source Pollution from Urban Areas (2005).

Who Can Use This Report?

Stormwater and Water Quality Professionals: This document is written to help water professionals understand urban planning documents to determine where stormwater improvements might already be included. This document can also be helpful to consultants who are helping communities develop comprehensive stormwater and planning documents, outreach programs, and compliance tracking.

Communities Regulated Under Phases I & II of the NPDES Stormwater Program: More than 6,000 communities are now required to develop stormwater management plans to comply with the NPDES requirements. As NPDES permits issued since 1990 under Phase I come up for renewal, this document offers innovative measures for further improving stormwater management through redevelopment, infill, urban parks, and green building techniques. Communities under Phase II are likely to be developing their stormwater management plans, guidance materials, and ordinances.

Local Land Use and Transportation Planners: Just as stormwater engineers are taking on more of an urban planning role, land use and transportation planners should consider the practice of stormwater control in ways that go beyond pipes, ponds, and gutters. This document introduces the concept of joint land use, transportation, and water planning as a way of providing water quality protection and satisfying regulatory commitments for compliance with local stormwater management plans and NPDES permits.

Zoning Administrators: Language in many federal and state model stormwater ordinances call for the development of "ordinances or other regulatory mechanisms" for implementation of new stormwater rules.

Most stormwater that is collected from curbs and gutters flows untreated into local waterways. Smart growth seeks to limit the number of outfalls in a watershed with compact development.



Photo: NRCS

The elements related to stormwater ordinances are likely to address the same aspects of project design as zoning codes, for example, setbacks, street widths, landscaping and parking requirements. Zoning administrators should be involved in the development of stormwater ordinances so that conflicts do not arise among codes.

City and County Managers: The stormwater requirements have focused attention on improving communications across various departments, from public works to transportation to subdivision planning. As new and revised stormwater rules are written at the local level, NPDES implementation has revealed the importance of pulling together traditionally autonomous departments to determine where separate departmental policies might pose barriers to efficient planning, investment, and environmental protection. City and county managers are often in a unique position to bridge planning and budgets and broker solutions where requirements developed by one department run counter to new smart growth plans.

Developers: Developers, particularly those building within urbanized areas affected by NPDES stormwater rules, are facing new requirements for water quality and quantity. This document will help developers assess their smart growth projects, improve the stormwater handling on site, and define how their projects meet stormwater goals and the site, neighborhood, and regional level.

Smart Growth Practitioners: Whether you are with a nonprofit organization, a local government office, or in private practice, your skills in reviewing and writing comprehensive environmental plans and policies can play a role in shaping joint smart growth and stormwater plans. Emerging stormwater programs offer a framework for constructive involvement.

Talking About Compact Development – Homebuilders

In 2005, the National Association of Homebuilders (NAHB) released talking points on compact development. They note that compact forms can include cluster development, higher-density development, mixed-used projects and traditional neighborhood developments. The Association encourages builders to review local ordinances to see where rules on set backs, infrastructure, street widths and the approval processes pose barriers or opportunities for compact development. In particular, the talking points mention alternative stormwater approaches to help support a more compact development form.
See <www.nahb.org/generic.aspx?sectionID=628&genericContentID=17373>.

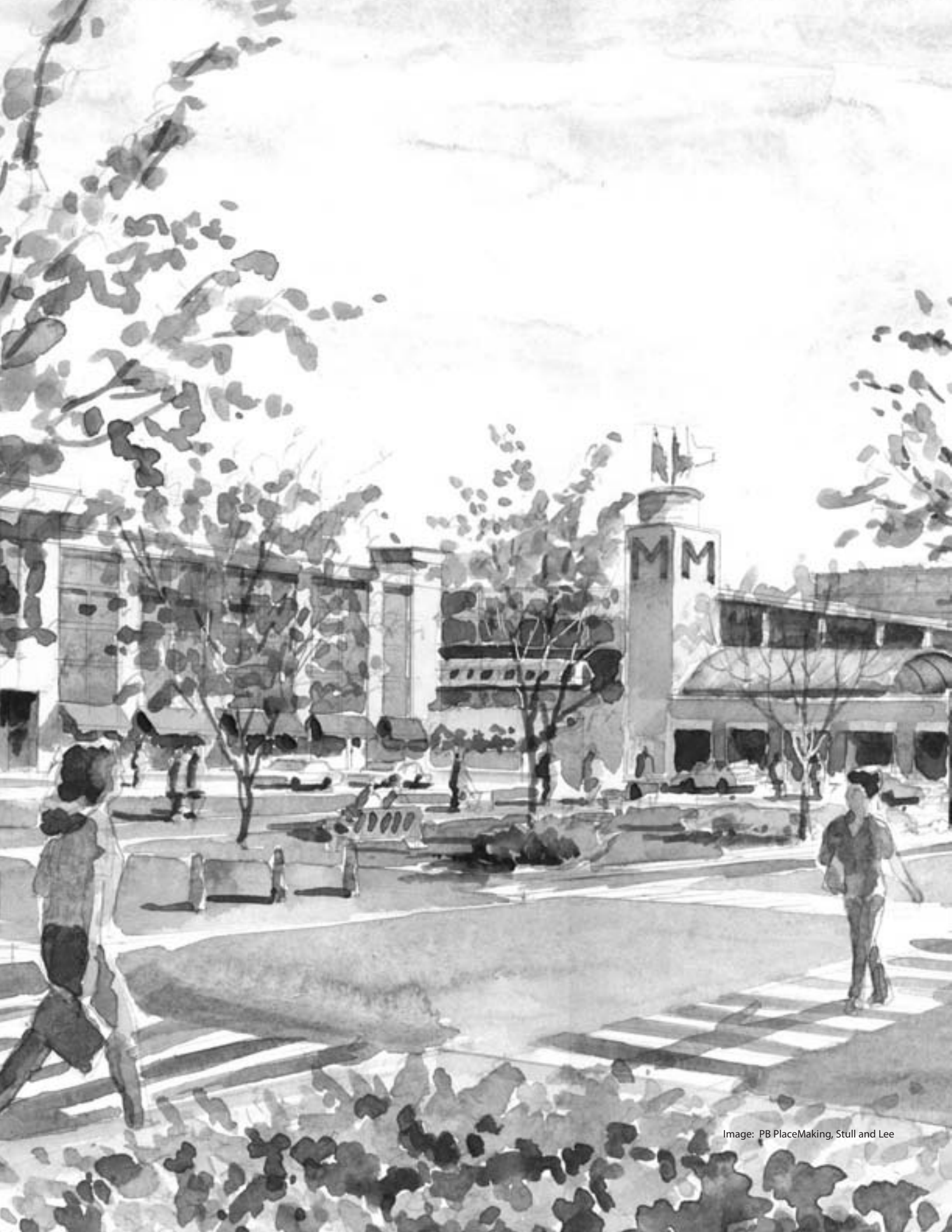


Image: PB PlaceMaking, Stull and Lee

SECTION 1

Why Stormwater? The Nexus Between Land Development Patterns and Water Quality and Quantity

Since 1972, implementation of the Clean Water Act (CWA) has shown success in controlling water pollution from point sources such as municipal wastewater treatment plants and industrial discharges. This progress is overshadowed, however, by the emergence of nonpoint source pollution as a main contributor to water quality problems.

Nonpoint source (NPS) pollution comes from many diffuse sources. NPS pollution originates when rainfall or snowmelt moves over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even underground sources of drinking water.

These pollutants include:

- Excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas.
- Oil, grease, and toxic chemicals from urban runoff.
- Sediment from improperly managed construction sites, crop and forest lands, and eroding stream banks.
- Bacteria and nutrients from livestock, pet wastes, wildlife, and faulty septic systems.
- A myriad of other pollutants originating with a side variety of land based activities.
- Atmospheric deposition and hydromodification are also sources of nonpoint source pollution.[1]

For urban and urbanizing areas, these problems can largely be traced to activities that occur on the land. Whether the problem arises from lawn care chemicals, or motor oil and toxic metals from parking lots and streets, stormwater plays a large role in transporting pollutants to streams, drinking water sources, and other receiving water bodies.

While land development necessarily involves creation of impervious surfaces, how and where development takes place can influence the ultimate degree of environmental impact from the streets, rooftops, and yards. Where development has occurred on forest and undeveloped land, critical areas for infiltration and aquifer recharge that soaked up rainwater prior to development now export runoff to lower lying areas and local receiving water bodies. Water flowing over pavement absorbs heat, which impacts waterways that support cold water species. It also flows faster, thus delivering water in pulses. The faster flows can scour stream banks and accelerate erosion, while increased temperatures can spur excessive algal growth. The higher rate of vegetative growth can interfere with a variety of ecological, industrial and water filtration processes. Conventional construction practices have relied on mass clearing and grading. This practice compacts the soil surface and further prevents infiltration, even on lots overlain with turf. Thus, the generation of stormwater volume, as well as the pollutant load carried in that volume, is very much tied to how and where land is developed.



Preserving open space, farmland and critical environmental areas is one of the 10 smart growth principals.

Summary of How Stormwater Runoff Is Regulated

In 1972, Congress amended the Federal Water Pollution Control Act (subsequently referred to as the Clean Water Act) to control the discharges of pollutants to waters of the United States from point sources. Initial efforts to improve water quality using the National Pollution Discharge Elimination System (NPDES) focused primarily on reducing pollutants from industrial process wastewater and municipal sewage discharges. These sources were easily identified as responsible for poor—often drastically degraded—water quality conditions.

As pollution control measures for industrial process wastewater and municipal sewage were implemented and refined, it became increasingly evident that more diffuse sources of water pollution were also significant causes of water quality impairment. Specifically, stormwater runoff was found to cause serious pollution problems. As a result Congress added section 402(p) of the Clean Water Act, which established a comprehensive, two-phase approach to stormwater control using the NPDES program.

In 1990 EPA issued the Phase I stormwater rule (55 *FR* 47990; November 16, 1990) requiring NPDES permits for operators of municipal separate storm sewer systems (MS4s) serving populations greater than 100,000 and for runoff associated with industrial activity, including runoff from construction sites 5 acres and larger. In 1999 EPA issued the Phase II stormwater rule (64 *FR* 68722; December 8, 1999) that expanded the requirements to small MS4s in urban areas and to construction sites between 1 and 5 acres in size.

EPA has delegated NPDES permitting authority to all but five states, several territories, the District of Columbia, federal facilities in four states, and federal tribes. NPDES permits are reissued every five years to allow for modifications to meet changing conditions both with the discharge and with discharge standards and regulations. There are two standard types of NPDES permits: 1) An individual permit is issued to a single discharger, with customized requirements for that particular discharge. All Phase I MS4 permits are individual permits. 2) General permits are usually statewide permits with requirements that apply to all discharges of a particular type or category. Most Phase II MS4 permits are general permits and require each permittee to develop a stormwater management plan that details how stormwater discharges from that particular MS4 will be controlled. Though they are not framed identically, the stormwater management requirements for Phase I and Phase II MS4s are very similar. The recommendations in this publication are applicable to all communities subject to the stormwater regulations.

Evaluations of Phase I have shown that BMP maintenance continues to be a problem.[2] Both structural BMPs (e.g., sand filters) and nonstructural BMPs (e.g., swales) require periodic maintenance and care, which should be budgeted for and scheduled. As you read this document, think about the long-term maintenance program for smart growth techniques as BMPs to ensure that stormwater benefits are supported over time.

To learn more, visit EPA's stormwater program site at <www.epa.gov/npdes>.

What Is an MS4?

A municipal separate storm sewer system (MS4) is a conveyance or system of conveyances (e.g., roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, storm drains) that are:

- Owned or operated by a state, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to state law) having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under state law such as a sewer district, flood control district, or drainage districts, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges to waters of the United States.
- Designed or used for collecting or conveying stormwater.
- Not a combined sewer.
- Not part of a publicly owned treatment works.

Though not explicit, many larger institutions, such as hospitals, universities, military bases, and school districts fall under the definition, and thus must develop stormwater management plans. If these institutions have been involved with local smart growth efforts, check with them to see if there are smart growth elements in their stormwater management plan.

Elements of a NPDES Stormwater Permit – What Stakeholders Should Look For

States and municipalities are responsible for developing a suite of information under the NPDES stormwater program. As you look for the documents that will govern stormwater rules and policies, be aware that there are several permit types within the NPDES stormwater program, including industrial, multi-sector, and construction permits. While these are important permits for environmental protection, the MS4 NPDES stormwater permits are the focus of this document. Section 2 includes guidance on what to specifically look for within these materials.

At the Federal Level:

EPA has issued many guidance documents to assist states and localities. These publications include:

- Sample and General Permits
- Fact Sheets and Outreach Materials
- Permit Applications and Forms
- Policy and Guidance Documents
- Program Status Reports
- A Menu of Best Management Practices
- Technical and Issue Papers
- Case Studies
- See <http://cfpub.epa.gov/npdes/stormwater/swphases.cfm>. For information, go the link on "Publications."

At the State Level:

Under the NPDES program, delegated states are required to develop and implement stormwater management plans to reduce pollutant loadings to the maximum extent practicable. Delegated states oversee both Phase I and Phase II of the stormwater program, so plans may be listed as medium and large MS4s (Phase I) and small MS4s (Phase II). The Web site <www.stormwaterauthority.org> lists links to each state's MS4 stormwater program. The elements to look for include the following:

- **A state permit**: Most states have developed a General MS4 permit, which establishes minimum requirements for permit coverage. Some states have also developed alternatives to the general permit, such as watershed permitting, to allow for customization and innovation. The permit lists the elements required to obtain permit coverage, which typically include: time tables; the minimum components of a stormwater management plan; and legal language defining responsibilities, enforcement, and penalties.
- **Guidance documents**: These documents are developed to assist localities as they write their stormwater management plans and develop menus of BMPs.
- **State requirements**: Many states have additional requirements to address special environmental needs; for example, special resource waters, water quality control in cold climates, or merging NPDES stormwater permitting with total maximum daily loads (TMDLs).
- **Forms and maps**

At the Local Level:

Check with your local environmental management or public works department to see if your locality has obtained NPDES permit coverage, or whether it is in the process of obtaining coverage. Although state requirements vary, most MS4s are required to submit the following documents:

- **A Stormwater Management Plan (SWMP) or Stormwater Pollution Prevention Plan (SWPP)**: For localities covered under Phase II, there are six minimum control measures. The SWMP should include strategies and BMPs for those measures:
  - Outreach
  - Education
  - Construction
  - Post-Construction
  - Illicit Discharges Elimination
  - Pollution Prevention

  Under the new rules, MS4s need to include measurable goals, and show how the SWMP relates to water quality goals. The minimum measures listed above were not part of the original permit structure for Phase I permits, though the general tasks were required. In reissuing stormwater permits, many permitting authorities are modifying the permits to more closely dovetail Phase I and Phase II requirements to make it easier for these communities to work together.
- **Stormwater Ordinances**: Most states require that MS4s develop ordinances or other regulatory mechanisms to implement stormwater management controls. As you read draft language for ordinances, be prepared to compare the proposed legal language with language in your local smart growth codes and alert stormwater managers to inconsistencies.
- **Schedules for public meetings, regulation development, milestones and training.**

For more detailed information on water regulations and the Clean Water Act, see the River Network's "Understanding the Clean Water Act" at <www.cleanwateract.org>.

Connecting Stormwater Management and Smart Growth

Not so long ago, the predominant philosophy of stormwater control focused on flood control and directing water off an individual piece of property as quickly as possible. As towns grew, curbs, gutters, trenches, and pipes assisted the land use and stormwater planner alike in meeting this goal. While this turned out to be a successful strategy for individual properties, the additive effects of runoff from these individual properties on a watershed scale contributed to flooding and water quality problems. This has led water quality professionals to rethink stormwater control.

As a result, water professionals began to look at development site plans for opportunities to lessen the volume of stormwater generated from individual development projects. Better site design practices, such as low impact development, emerged as mechanisms to retain a site's natural hydrology and infiltrate stormwater within the boundaries of the development project. The conservation development movement was established—in particular, for new residential subdivisions.

These new subdivisions sparked debate over the overall environmental attributes of conservation development projects, however. Observers noted that, while these developments offer water-handling benefits on site, they can contribute to wider land disturbance activities, transportation impacts, and other quality problems related to the growth that follows housing subdivisions. At the same time, urban developers increasingly encountered resistance to infill and redevelopment projects based on predictions of additional stormwater-related impacts to urban streams. These discussions revealed the need for a more comprehensive view of the water quality impacts related to development, one that also considers a broader watershed context.

This new view poses challenges to how states and localities approach stormwater control, whether the topic is measuring performance or issuing permits. Typically, the performance of stormwater control is assessed site by site, or project by project in the site plan approval process for subdivisions or commercial districts. Thus, a conservation subdivision might rate high for stormwater management based on certain performance criteria, even when it brings unanticipated growth to sensitive reaches of a watershed. Likewise, a new apartment building and retail complex might get a low rating for creating impervious surface on an urban lot, even though the project absorbed development demand that would have gone to a "greenfield" site on a much larger footprint. In both these examples, a complex set of environmental considerations relate to the project's impact at the site, in the neighborhood, and at the watershed level.

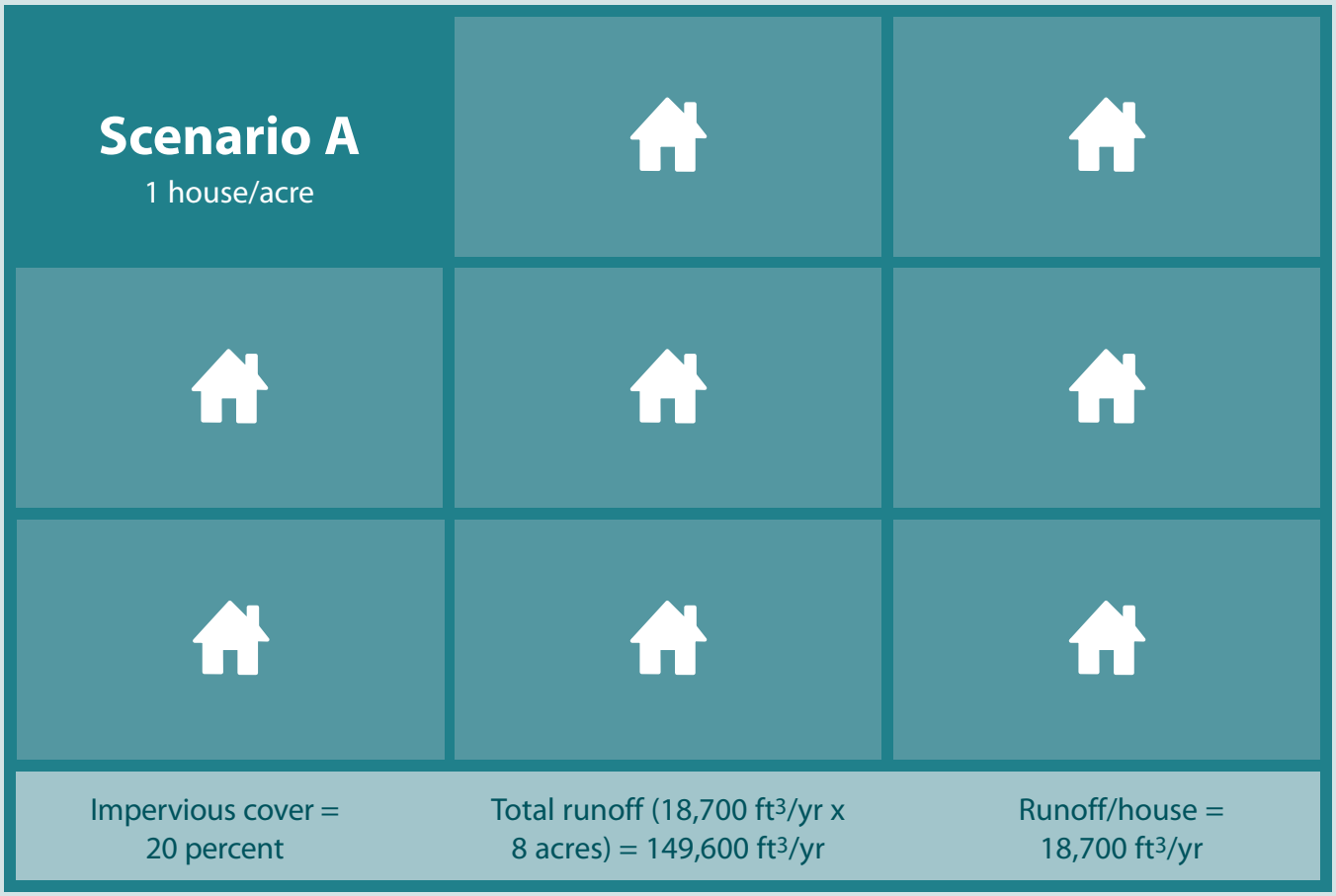
Photo: EPA



This supermarket in West Palm Beach Florida was part of a downtown redevelopment project. The store, which brings everyday uses closer to in-town residential areas, is a smaller format and is accessible by several modes of transportation.

How Does Density Relate to Runoff? The Site Level

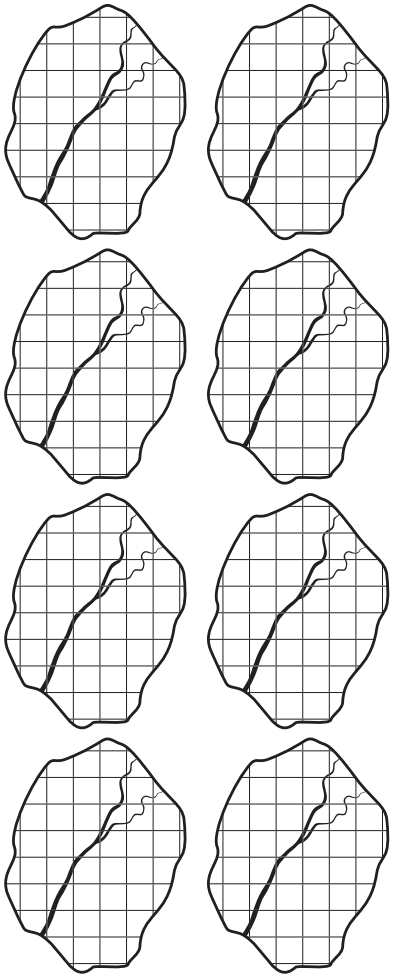
These three scenarios show how different housing densities on one acre can affect not only total runoff, but also runoff per house. Although the higher-density scenarios generate more stormwater per acre, they generate less total stormwater runoff and less stormwater runoff per house. Since most watershed growth is expected to be in the range of several thousand houses, not four or eight, the estimation of runoff based on per unit of housing is important. In addition, this illustration looks only at the lot and impervious cover related to the house footprint and driveway.



How Does Density Relate to Runoff? The Watershed Level

Housing density also affects the number of acres required to accommodate growth. At the site level, most regional and watershed managers are facing household growth estimates of several thousand units. By limiting housing production to one unit/acre, growth pressures do not cease, but rather growth goes elsewhere in the watershed, or expands to additional watersheds. Here, the higher-density scenarios consume fewer watersheds to accommodate the same number of houses. A fuller discussion of density and build-out is presented in EPA's 2005 document *Protecting Water Resources with Higher-Density Development*.

Scenario A



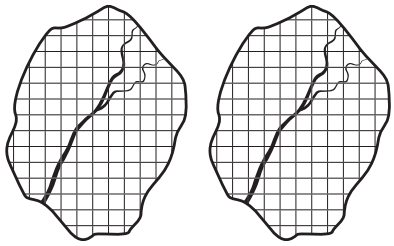
At one house per acre, 80,000 houses require 80,000 acres, or *8 watersheds*, translating to:

80,000 acres x 1 house x 18,700 ft^3 /yr of runoff

1.496 billion ft^3 /yr of stormwater runoff

8 watersheds at 20 percent impervious cover

Scenario B



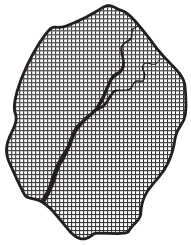
At four houses per acre, 80,000 houses require 20,000 acres, or *2 watersheds*, translating to:

20,000 acres x 4 houses x 6,200 ft^3 /yr of runoff

496 million ft^3 /yr of stormwater runoff

2 watersheds at 38 percent impervious cover

Scenario C



At eight houses per acre, 80,000 houses require 10,000 acres, or *1 watershed*, translating to:

10,000 acres x 8 houses x 4,950 ft^3 /yr of runoff

396 million ft^3 /yr of stormwater runoff

1 watershed at 65 percent impervious cover

Many states and communities are using smart growth planning as a way to deal with the complex analysis for future growth and development. Smart growth is best described as a set of 10 principles, presented in Table 1.

While better stormwater management is not explicit in the 10 principles of smart growth, the water quality benefits are, quite literally, built in. These benefits typically emerge from policies that integrate local and regional decisions on transportation, housing, natural resources, and jobs. The interrelated benefits of smart growth are highlighted throughout this document and include:

- **Compact Project and Community Design:** One of the more powerful strategies for reducing the footprint of development, and hence the stormwater impacts, is to focus on compact development. For existing communities, policies to encourage infill and redevelopment can result in a smaller development footprint within the region. For new communities, compact designs that mix uses and cluster development help to accommodate development demand in a smaller area. Reducing the footprint of individual buildings can also be a strategy, though there are circumstances that call for greater lot coverage in districts where a higher development intensity is needed (for example, near transit stations). The compact form can also lend itself to more environmentally friendly transportation options, such as walking and biking.
- **Street Design and Transportation Options**: Well designed, compact communities are served by a highly connected street and trail system designed for multiple modes of transportation. The pattern need not be a grid, and in some areas, topography and environmentally sensitive areas will influence where roads go. Providing connections is the key to allow walking or bike trips, or to or to allow a "park once" trip for combining errands, recreation, and/or commuting. A compact district also provides for more efficient use (and reuse) of existing infrastructure.
- **Mix of Uses**: Another element that can contribute to decreasing the amount of stormwater generation lies in the development mix. By pulling a mix of jobs, housing, and commercial activities closer

Table1: Smart Growth Principles

1. Create a range of housing opportunities and choices.
2. Create walkable neighborhoods.
3. Encourage community and stakeholder collaboration.
4. Foster distinctive, attractive places with a strong sense of place.
5. Make development decisions predictable, fair, and cost effective.
6. Mix land use.
7. Preserve open space, farmland, natural beauty, and critical environmental areas.
8. Provide a variety of transportation choices of smart growth.
9. Strengthen and direct development toward existing communities.
10. Take advantage of compact building design.

together, not only do you increase the transportation options for a community, but the requirements for transportation and infrastructure also change. The need to accommodate fewer auto trips supports a reduction in standard parking requirements. A mix of daytime and nighttime uses, or weekday and weekend uses, increases the chance that parking spaces can be shared among businesses.

- **Use of Already-Developed Land**: Most literature on conservation development is focused on clustered housing in greenfield residential projects; however, reuse of existing impervious surfaces can be regarded as a powerful form of conservation development. First, redevelopment conserves land by absorbing demand that could go into undeveloped parts of the watershed. Second, there is typically no net increase in runoff since impervious cover is essentially replaced by impervious cover. When low impact techniques and creative landscape design accompany a redevelopment project, the water quality performance at the watershed and site level is enhanced. Finally, there are less obvious factors associated with redevelopment that drive stormwater outcomes. In older parts of cities and towns, the development standards used for the original development were likely to have called for fewer parking spaces, a zoning mix, less roadway and less dispersed infrastructure. Thus, a new 10-unit building on the urban edge will likely have more related impervious surface than a 10-unit redevelopment project, even if the two have the same building footprint.
- **Better Models for New Development**: Where development continues to take place in undeveloped areas, smart growth designs can be used to improve the environmental aspects of that new growth compared to conventional, separated designs. While conservation design principles are important, smart growth development incorporates connections to jobs, schools, and other existing economic centers. A mix of housing types can alleviate the pressure to build affordable housing on more distant parcels of land. New town models such as Traditional Neighborhood Design or New Urbanist communities are advanced, in particular for transportation improvements. When combined with traditional water quality BMPs, the connected, compact, and efficient neighborhood designs can amplify the water quality benefits.

Photo:. EPA



This mixed use center in Gainesville, Florida is served by a parking lot constructed of pavers, which helps support the street trees. The trees also provide shade for outdoor seating nearby.

Smart Growth Techniques as Best Management Practices

What do states and localities need to do to qualify smart growth policies as stormwater BMPs under stormwater permitting programs? Permitting authorities around the country are already introducing smart growth concepts into their guidance documents and permits. Some of the general concepts include:

- Coupling smart growth planning with site design criteria to further improve the watershed-wide benefits of the growth and redevelopment plans.
- Implementing watershed-wide or regional policies to consider simultaneously areas for growth and those for conservation.
- Better designs for reducing the impervious surfaces associated with development, such as compact street designs and lower parking requirements.

Notable examples include the following:

New Jersey has developed a successful strategy for considering both smart growth and stormwater in its state water quality and growth plans. In seeking to meet the dual goals of reducing runoff and replenishing aquifers, the state has developed policies to encourage growth in targeted areas while protecting environmentally sensitive areas and open space. The state's regulations are divided into requirements for runoff control and requirements for infiltration. Redevelopment and infill in designated urban areas are exempt from the stormwater infiltration rules. The reasons supporting the policy are: (1) recharge regulations can pose a regulatory barrier to redevelopment, (2) the regulations can be impractical in highly urbanized areas and (3) recharge is not always desirable in areas with environmentally compromised soils.

In **California**, the Santa Clara Valley Urban Runoff Pollution Prevention Program's (SCVURPPP's) 2001 Phase I permit renewal recognized that there could be cost-effective opportunities to implement stormwater control during the land use approval process. In particular, SCVURPPP noted several smart growth options, including neo-traditional street design standards and more effective use of existing parking spaces. The permit goes further, noting that certain development projects, such as transit villages, are likely to be exempt from several requirements because they are typically built in areas already covered with impervious surfaces.[3]

The SCVURPPP permit lists numerous criteria for onsite stormwater control requirements, but also include flexibility by allowing its permitees to document where standard criteria would be impractical, where compensatory mitigation would be allowed, and where localities could use alternative strategies to better match stormwater control techniques to the local condition.



Supplying workforce housing closer to job and activity centers often helps relieve development pressure to build more affordable housing further out.

Photo: EPA

San Jose, California, is one of the co-permitees under the SCVURPPP program. The city sought to incorporate the new guidance from the 2001 permit into its local stormwater ordinance and into its smart growth initiative, the San Jose 2020 Plan.

The two main areas that allow consideration of smart growth include:

- **Finding of Impracticality**: San Jose structured its policy to take advantage of the SCVURPPP permit's flexibility, as noted above. Under the permit, deviations from the standard requirements could be established through a finding of impracticality. San Jose's policy includes some of the more common reasons for a finding of impracticality, such as soil type, but also recognized that the natural onsite measures for infiltration and runoff control can be impractical in built-out, urban areas.
- **Flexibility**: If there is a finding of impracticality, the San Jose policy allows several alternatives to the permit's standards that recognize the water benefits of smart growth projects. The city established a category of smart growth projects that exhibit water benefits by virtue of the development of the site itself, the nature of the site design, and its location in the watershed.

Smart growth projects are defined by the city to be:

a. Significant redevelopment within the urban core;

b. Low-income, moderate income, or senior housing development project, meeting one of the criteria listed in other sections of the city's code; and/or

c. Brownfields projects.

While affordable housing may seem like an unconventional BMP, the city recognized the demand for low-income and senior housing would not go away, but likely relocate in remote regions where jobs and services were not as likely to be close at hand. Incentivizing construction through redevelopment thus became not only a housing strategy, but a watershed one as well.

Another California city, **Poway**, has defined BMPs to include redevelopment and development projects that improve stormwater performance as compared to conventional designs. The ordinance reads:

> *"Site design BMP" means any project design feature that reduces the creation or severity of potential pollutant sources or reduces the alteration of the project site's natural flow regime. Redevelopment projects that are undertaken to remove pollutant sources (such as existing surface parking lots and other impervious surfaces) or to reduce the need for new roads and other impervious surfaces (as compared to conventional or low-density new development) by incorporating higher densities and/or mixed land uses into the project design, are also considered site design BMPs.*

(Ord. 569 § 2, 2002) See <www.codepublishing.com/ca/poway/Poway16/Poway16101.html#16.101.200>.

In **Texas**, the North Central Texas Council of Governments (NCTCOG) is helping its local MS4s by identifying useful techniques for stormwater control. NCTCOG's guidance also directs readers to the various local regulations or ordinances that control how and

North Central Texas Council of Governments Guidance

Minimize Impervious Surfaces

Impervious surfaces are roads, parking lots, driveways, and rooftops that do not allow infiltration of stormwater into the ground. The increase in stormwater runoff, along with the pollutants the runoff picks up from impervious surfaces, cause major problems for our waterways. Narrower streets and smaller parking lots benefit the environment and can make a development more attractive as well.

- Develop residential street standards for the minimum required pavement width needed to support travel lanes, on-street parking, and emergency vehicle access. *Street Specifications, Subdivision Ordinance*
- Consider limiting on-street parking to one side of the street. *Street Specifications, Subdivision Ordinance*
- Incorporate sunken landscaped islands in the middle of cul-de-sac turnarounds. *Street Specifications, Drainage Manual*
- Minimize street length by concentrating development in the least sensitive areas of site. *Zoning Ordinance*
- Reduce parking lot size by lowering the number of parking spaces (minimum and maximum ratios) and by sharing parking among adjacent businesses. *Zoning Ordinance, Development/Engineering Standards*
- Reduce parking requirements for developments in proximity to public transportation. *Zoning Ordinance*
- Provide incentives or opportunities for structured parking rather than surface parking. *Zoning Ordinance*
- Use pavers or porous pavement in parking overflow areas. *Development/Engineering Standards*
- Reduce frontage requirements in residential areas to reduce road length. *Zoning Ordinance*
- Reduce the rooftop area of buildings by constructing multiple level structures where feasible. *Zoning Ordinance*[4]

where impervious surfaces, such as parking lots or driveways, are located. (See box.)

The NCTCOG examples show that many of the most promising techniques for effectively managing runoff are often included in existing regulations and guidance traditionally associated with land development and transportation regulations, not stormwater control. In addition, the examples show that flexibility is needed, since not all regulations work equally well in all contexts. The North Carolina Smart Growth Alliance has pointed this out as well. In comments to the North Carolina Division of Water Quality on proposed stormwater rules, the Alliance notes that language in the state's 2003 proposal to establish impervious surface limitations on a site-by-site basis would have the effect of making sprawl-type developments easier to build, while making it more difficult to develop compact, walkable communities.[5] Blanket regulations that appear to make sense at the individual lot level can often have the unintended outcome of promoting development in areas of watersheds unable to handle new growth.

So, how do stormwater managers and their planning counterparts choose strategies and BMPs that serve the interrelated goals of watershed protection and successful growth and development? Matching the BMP (or

Table 2: Best Management Practices and Development Context

BMP Strategies	Urban/High Density Settings	Suburban/ Urbanizing Areas	Rural and Conservation Areas
Strategies for individual buildings and building sites	Bio-infiltration cells, rooftop rain capture and storage, green roofs, downspout disconnection in older residential neighborhoods, programs to reduce lawn compaction, stormwater inlet improvements	Disconnecting downspouts, green roofs, programs to reduce lawn compaction, bio-infiltration cells, rooftop rain capture and storage	Green roofs, housing and site designs that minimize soil disruption
Low impact development (LID) or better site design strategies	Ultra-urban LID strategies: high-performing landscape areas, retrofitting urban parks for stormwater management, micro-dentention areas, urban forestry and tree canopy, green retrofits for streets	Swales, infiltration trenches, micro-detention for infill projects, some conservation design, retrofitting of parking lots for stormwater control or infill, tree canopy, green retrofits for streets. Depending on location, larger scale infiltration.	Large scale LID: forest protection, source water protection, water protection overlay zoning, conservation, aquifer protection, stormwater wetlands
Infrastructure	Better use of gray infrastructure: repair and expansion of existing pipes, installation of stormwater treatment, fix it first policies, improve street and facilities maintenance	Priority funding areas to direct development, better street design, infrastructure planning to incentivize smart growth development, improve street and facilities maintenance	Smart growth planning for rural communities using onsite systems
Structural BMPs	Commercially available stormwater control devices, urban drainage basins, repair of traditional gray infrastructure	Rain barrels, bio-infiltration techniques, constructed wetlands	
Design strategies	Transit districts, parking reduction, infill, improved use of curbside parking and rights of way, brownfields, urban stream clean-up and buffers, receiving areas for transfer of development rights	Infill, greyfields redevelopment, parking reduction, policies to foster a connected street system, open space and conservation design and rural planning, some impervious surface restrictions, stream restoration and buffers, targeted receiving areas for transfer of development, planned unit developments	Regional planning, use of anti-degradation provision of Clean Water Act, sending areas for transfer of development, watershed wide impervious surface limits, water protection overlay zoning districts
Watershed-wide or regional strategies	Transfer of development rights, waterfront restoration, participation in regional stormwater management planning/infrastructure	Regional park and open space planning, linking new transit investments to regional system, participation in regional stormwater management planning/infrastructure	Regional planning, use of anti-degradation provision of Clean Water Act, sending areas for transfer of development, watershed wide impervious surface limits, water protection overlay zoning districts, water supply planning and land acquisition

combination of BMPs) to the development context is important. Some BMPs, such as green roofs, will work in almost any setting. Infiltration requirements pose challenges in urban areas, however, where legacy pollutants remain and/or where land costs are high. They also pose challenges in the development of new town centers or other compact districts that are constructed in greenfields.

Table 2 illustrates a breakdown of BMPs with respect to setting. It is not intended to serve as a fixed menu, but rather to provide a framework for refining the match of conventional stormwater BMPs to the development context. In fact, some of the measures that seem most fitting in suburban and rural areas, like stormwater wetlands, often have a role in ultra-urban settings. The Elizabeth River Project in Virginia is working with stakeholders to bring constructed wetlands and riparian buffers to urban areas and military facilities in the Portsmith/Norfolk area of the Chesapeake Bay.

Finally, and most importantly, BMPs are rarely used in isolation, but rather are strategically combined to achieve water quality goals and address target pollutants of concern. For example, a city may install a first line of BMPs to filter large debris, while a series of infiltration and filtering techniques are used to allow sediment to settle, improve infiltration, and reduce runoff. For smart growth techniques as BMPs, there are also strategic combinations of policies that serve to increase the environmental performance of development projects. For example, a plan for transit-oriented development may require that the mix of uses and density be coupled with better parking strategies so that walking and automobile travel are equally attractive. The ability to develop effective combinations of BMPs is among the most important features in developing joint stormwater and smart growth plans.

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[1] U.S. Environmental Protection Agency. 1994. EPA-841-F-94-005. http://www.epa.gov/owow/nps/qa.html

[2] Kosco, John, Wes Gunter, and James Collins. Lessons learned from in-field evaluations of Phase I Municipal Stormwater Programs. Presentation prepared for the 2003 National Conference on Urban Stormwater. Chicago, Illinois, February 17-20, 2003. www.epa.gov/owow/nps/natlstormwater03/19Kosco.pdf

[3] http://www.scvurppp-w2k.com/pdfs/other/NPDES_Permit_C3New_Finalodrtransltr.PDF

[4] Stormwater Management in North Central Texas. Post-construction runoff control, EPA recommendations. www.dfwstormwater.com/Storm_Water_BMPs/post-construct.asp#rec

[5] North Carolina Smart Growth Alliance. May 16, 2003. Comments to the Division of Water Quality, Re: Proposed NPDES Phase II Stormwater Rules. www.ncsmartgrowth.org/archive/stormwater%205%2016%2003.html

SECTION 2

Specific Smart Growth Techniques as Stormwater Best Management Practices

The purpose of this section is to present common smart growth techniques, their water quality attributes and how to present them within local, state, or federal stormwater requirements. The NPDES stormwater requirements—in particular the Post-Construction Minimum Measure—have focused attention on how development projects, both individually and collectively, impact a watershed after projects are built. This section is geared toward the post-construction measure under Phase II, though any city or county renewing a permit under Phase I can use them. Additionally, cities, counties, and townships that are not regulated, but that are proactively developing stormwater, flooding, or watershed plans, can use the information to meet water quality goals.

The following list contains smart growth techniques that have been adopted by state, regional, and local governments for a variety of benefits, including environmental quality. This section will look at each of these techniques in depth, though this list is not exhaustive.

1. Regional planning
2. Infill development
3. Redevelopment policies
4. Special development districts (e.g., transit oriented development and brownfields redevelopment)
5. Tree and canopy programs
6. Parking policies to reduce the number of spaces needed or the footprint of the lot
7. "Fix It First" policies
8. Smart growth street designs
9. Stormwater utilities

Each subsection provides information and examples that:

- Define the smart growth technique.
- Give an overview of who to talk to about the techniques and relating it to stormwater.
- Define the stormwater benefits and provide tips on how to list the technique in your plan.
- Provide, if available, estimates of the costs associated with the technique.
- Provide examples where the technique has been adopted, or is in the development stage.
- Provide suggestions on "Measurable Goals," a requirement for all BMPs.
- Give "points to consider" in adopting the technique as a stormwater management strategy.

Outreach, Public Education, and Public Participation

Most smart growth initiatives include outreach to stakeholders, processes to integrate comments on plans, and schedules for gathering input. Stormwater managers should reach out to their counterparts in planning, zoning, transportation, and growth management departments to see where their established processes can integrate successful stormwater management. Ask the planning department or city/county manager if the following types of meetings are planned and whether they are open to a module or segment on growth and stormwater:

- Planning charrettes
- Visioning exercises
- Planning sessions on alternative growth scenarios
- Smart growth training sessions
- Transportation alternatives meetings with the public
- Watershed meetings

1. Regional Planning

Definition

Regional planning is the process of considering community development options across a particular area that can include several political jurisdictions. For the purposes of stormwater quantity and quality, a watershed can be thought of as a region. If smart growth is a cornerstone of your stormwater planning efforts, regional planning is critical. A watershed or regional effort can facilitate discussions that reduce impacts by directing growth while preserving critical areas. EPA encourages watershed planning as a way to comprehensively prevent and control water quality and quantity impairments.

Local governments are encountering a complex, and growing, array of requirements to meet various state and federal rules, as well as growing public demand for "quality of life" benefits such as open space, transportation options, and amenities at the neighborhood level. The planning requirements can include transportation at a regional level, growth management plans, source water protection plans, economic development planning, emergency response and evacuation plans, and updated floodplain mapping. Many elements of the various planning exercises are similar and rely on the same data sets, such as population projections and GIS mapping of natural resources.

For water quality, regional cooperation and planning is crucial for aligning smart growth and water quality approaches such as:

- Minimizing imperviousness at the watershed level by targeting and redirecting development
- Identifying and preserving critical ecological areas and contiguous open space areas
- Making maximum use of existing infrastructure and previously developed sites



Photo: Local Government Commission

Effective stakeholder participation is a cornerstone of both stormwater and regional planning.

Regional Visioning and Scenario Planning



Illustration 1
Kane County/Gilberts Present Day



Illustration 2
Kane County/Gilberts Build Out Under Conventional Planning and Development



Illustration 3
Kane County/Gilberts Build Out Under Smart Growth Planning and Development

Plans by Dodson Associates, Ltd.; Illustrations by Jack Werner

This series of illustrations was developed for the Chicago Regional Environmental Planning Project to show development alternatives at the western edge of the Chicago suburbs in Kane County. This agricultural area is characterized by poorly drained soils and the presence of the Fox River, which was once viewed as a natural boundary for growth. Illustration 1 shows the emergence of some housing in the background.

Kane County expects growth to emerge with the further expansion of housing, roadways and their use. Office and research are the prime industries that are expected to expand into the area first. Housing and retail are expected to follow. Illustration 2 shows that current planning trends would dictate separated land uses, large set-backs, and individual parking lots. The stormwater runoff from the large parcels and parking lots would eventually impact the streambed illustrated in the foreground.

Illustration 3 shows an alternative future using smart growth practices. The industrial uses are placed in the background closer to existing infrastructure and development. Housing developments are connected to services and retail. Illustration 3 envisions a county plan where certain areas are preserved for agriculture and drainage while accommodating growth in village centers. For more information, see the Environmental Law and Policy's "Visions" report at <www.elpc.org/trans/visions/visions.htm>.

Who Do I Talk to About Regional Plans?

If your state has developed smart growth planning requirements, contact the state department of planning or community affairs. The Metropolitan Planning Organization (MPO) has the responsibility to develop master transportation plans. Subsection 8 (Smart Growth Street Designs, page 75) goes into more detail about planning for roads and transportation infrastructure. Your local Council of Governments (sometimes referred to as a COG) might also have information on planning efforts that span several jurisdictions. Although these may not be water plans per se, the population forecasting, maps showing undevelopable parcels, and vacant properties can all be helpful in developing a comprehensive stormwater management plan.

If your community is under the Phase II rules, and you are located near larger cities and/or counties covered by Phase I, determine if you can team up with them in developing plans. Since these communities are more than 10 years into planning and implementation, do not hesitate to contact the stormwater managers or public works department to see where you can share or expand upon plans and programs. Your area may also have other regional agreements that can be used to initiate stormwater plans, such as agreements on infrastructure or flooding prevention.

The Coastal Zone Management Act of 1972 (CZMA) and subsequent amendments have established a program for states and territories to voluntarily develop comprehensive programs to protect and manage coastal resources (including the Great Lakes). To receive federal approval and implementation funding, recipients are required to demonstrate that they have programs, including enforceable policies, that are sufficiently comprehensive and specific to regulate and resolve conflicts among land uses, water uses, and coastal development. There are currently 29 federally approved state and territorial programs. These plans may have elements and funding in place, and may include smart growth practices that can help develop elements of a stormwater management plan. For a link to state programs go to <http://coastalmanagement.noaa.gov/czm/>.

EPA's Office of Wetlands, Oceans, and Watersheds hosts a Web site called "Surf Your Watershed." This site allows users to enter their zip code, local stream name, or locality to find information about their watershed, as well as planning efforts and relevant watershed organizations. Visit <www.epa.gov/surf>.

Stormwater Benefits

Regional efforts to encourage development in strategic areas are one of the strongest approaches to coordinating growth and resource protection in a watershed. Regional efforts are often needed to effectively coordinate local approaches to development and achieve better watershed-wide results. Communities should determine areas where they want growth to occur and areas they want to preserve. When such areas are clearly defined and articulated within a region,

New Jersey Highlands: Regional Planning for Water and Growth

The 800,000+-acre New Jersey Highlands Region covers more than 1,250 square miles and 88 municipalities in seven counties (Bergen, Hunterdon, Morris, Passaic, Somerset, Sussex and Warren). The Highlands Region is an essential source of drinking water for half of the residents of New Jersey. In 2004, the Highlands Water Preservation and Planning Act (The Act) was adopted to balance the management of water resources and growth.

The Highlands Act documents the geographical boundary of the Highlands region and establishes both the Highlands preservation area and the Highlands planning area. The Highlands Act requires the New Jersey Department of Environmental Protection to establish regulations to limit land disturbance in preservation areas, while creating a regional master plan to direct growth to desired areas within the region. To carry out the Act, the Highlands Water Protection and Planning Council was formed and charged with preparing the regional master by June 2006. While the focus of the regional plan is seen as land preservation for water quality and supply, the council was also charged with including elements to encourage appropriate development, redevelopment and economic growth for areas so designated.

In the Planning Area, municipal compliance with the Plan is voluntary. The Act provides incentives for conformance to the Regional Master Plan, however. The incentives include planning grants to assist in preparing local master plans and land use ordinances, technical assistance, tax stabilization funding for funding decreases accorded by participating in the plan, enforcement of the regional Master Plan and legal assistance to meet challenges to new master plans and zoning.

The council established several categories for grants, including grants to participate in Municipal Partnership Pilot Programs, Zoning and Parcel Analysis, Wastewater Capacity Analysis, and Affordable Housing. In 2005, Washington Borough was awarded a Municipal Partnership Pilot Program grant, which will be used to plan for three distinct areas: town center redevelopment, historic preservation, and stream corridor preservation (to include stormwater management). For more information on the New Jersey Highlands Council, visit <www.highlands.state.nj.us/index.html>.

For more information on the state of New Jersey's innovative state planning, see New Jersey's Web site on the Highlands Act, <www.state.nj.us/dep/highlands/faq_info.htm>.

development is encouraged on land with less ecological value, such as previously developed areas (as described in subsequent chapters for redevelopment, brownfields, greyfields, and vacant properties). Land with higher ecological value, such as aquifer recharges areas, wetlands, marshes, and riparian corridors, is then preserved or otherwise set aside for ecological services.

A 2004 study conducted by researchers at Texas A&M University evaluated development in a watershed in the greater Houston Texas area. The study tracked development trends over a 50-year period to evaluate watershed performance—in particular, as it relates to flooding. The study evaluated common indicators of development (e.g., impervious cover) and how various land development scenarios during that time period might have altered water flows and flooding.

The study found that the impervious cover alone was an inadequate indicator, but when considered with other indicators, such as indicators of development dispersal, these measures together proved to be a better predictor of flooding. In assessing total developed area, the researchers looked not at estimates of impervious surface area per lot, but rather whether the lot had any development at all.

The researchers also evaluated off-site development features such as roads and highways. Over a 50 year period, the researchers mapped total developed areas, with special attention to roadway lengths, and the ratio of commercial and residential units. The risk of flooding increased exponentially once the percentage of developed properties in the watershed reached 25 percent. From a regional perspective, the authors suggest that the percentage of impervious surface cannot be used as an indicator independent of other factors such as the configuration of infrastructure, development form, and a total proportion of properties that have been developed.[6]

In evaluating the environmental performance of successful smart growth planning on a regional basis, some localities and states are using build-out and capacity analyses to predict the condition of water resources once developable parcels are developed. Build-out analyses can be conducted based on existing land use regulations, or according to conventional development practices that could shape future proposals. The goal is to compare a smart growth development plan or project to a conventional model under *status quo* zoning, and compare the stormwater benefits.

For example, many communities are updating floodplain maps. Suppose a review identifies 1,000 acres of sensitive land critical for water filtration, absorption, and flood prevention. As a result of the review, the local government alters scenarios in planning documents to upzone land in the floodplain for development. The city and county confer, and as a result, the two jurisdictions revise planning and zoning documents to redirect growth to an area of the watershed that is more appropriate for development. In this case, the stormwater benefits are not only environmental in nature, but also avert the costs associated with property damage from flooding. Thus, the benefits extend beyond typical environmental measures of water quality and quantity to economic factors as well.

Typical Costs

The costs of regional planning are related to administration and research, and vary significantly depending on the resources already available in your community. Before estimating the costs of developing or fine-tuning an existing plan, it is helpful to understand the elements of the plan, the data needed to develop the various plans, the shape of the final product, and details on how the plan will be implemented.

The costs associated with aligning multiple plans are typically driven by staff or consultant time. The Southeastern Watershed Forum estimates, as a rule of thumb, that analysis, review, and coordination takes two to three staff working over one year to 18 months.

Once your community has decided to hire a consultant, the next step involves developing a Request for Proposals (RFP) or a Request for Qualifications (RFQ). The University of Wisconsin has developed a concise guidance document on the process of hiring a consultant. One step in the process can be issuing an RFQ to get a manageable pool of the most qualified consultants. As you draft your RFP or RFQ, keep in mind some of the unique challenges that will arise in drafting a joint stormwater and smart growth planning process, a comprehensive plan, and an implementation course. For example, you might want to have consultants review the comprehensive plan and NPDES permit (or permit renewal) and ask where there are barriers and flexibility. In addition, aligning multiple plans might reveal conflicting land use, transportation, and resource protection scenarios. Ask consultants how they would resolve these issues—in particular, where several jurisdictions are involved. Finally, ask them what elements of your strategic or smart growth plan can be borrowed for water quality and stormwater planning. These additional steps might add to the scope of work and budget; however, reviews of existing plans might reveal that work needed for comprehensive stormwater planning has already been completed. See <http://cecommerce.uwex.edu/pdfs/G3751.pdf> for more information.

Measurable Goals

The NPDES municipal stormwater program requires Phase II MS4s to include measurable goals in their program for each BMP. Increasingly, cities covered under Phase I MS4 permits are beginning to include measurable goals to track their performance in meeting water quality goals. Participation in a regional planning effort can be one way to track measurable goals, as can specific activities and steps outlined in a regional planning process. Information on counting participation in a regional group for meeting the requirements of the six minimum measures is described in the rest of this subsection, as are examples of specific activities that can count in the post-construction minimum measure.

Adoption of a regional master plan or watershed plan, as well as supporting policies and ordinances, are good candidates by which to measure progress in managing stormwater. These activities can also be documented to meet requirements on public education and outreach on stormwater impacts, as well as public involvement/participation. The key is to make sure you can track progress and relate the success back to the water quality goals in your regional stormwater management plan. For example, if a parcel of land identified for a regional park system is also contained in your regional aquifer protection plan, coordinate the acquisition and park design to meet stormwater and recreation goals. Include the acquisition in your monitoring and BMP maintenance plans as well.

In addition, efforts to coalesce common items among plans can be included in a stormwater management plan (e.g., merging plans to repair streets and sidewalks to spur redevelopment on a regional transportation corridor can be coupled with installation of microdetention areas between the curb and sidewalk). This effort can also help align capital spending decisions and be included in meeting regional stormwater goals to direct development.

Arlington, Virginia's high-density approach around the Rosslyn and Court House subway stations directs a large amount of growth to a small footprint. The county allows for high densities around stations, with a formula that tapers development intensity down to existing neighborhoods. This area, which stretches three miles from the Potomac River to the Ballston station, will ultimately absorb 8 million square feet of development on 2 square miles of land. This smaller footprint not only has regional stormwater benefits, but also has resulted in higher transit use and traffic counts that are far less than originally projected.



Photo: Arlington County, Virginia

Many areas across the country have identified specific plots of land to acquire. Buying parcels that have water-handling characteristics can provide a region with specific, measurable targets within a stormwater management plan.

For post-construction measures, the build-out analyses mentioned previously can be used to establish a baseline for setting measurable goals. Most states or regions develop build-out scenarios to assess how much developable land is available, whether the existing or planned infrastructure is likely to meet the needs of a built-out region, and to develop alternative planning scenarios. Most build-out analyses look at sewage capacity, source water, and water supply. With slight modifications, the build-out analysis can be used to also assess impervious surface coverage within a watershed and areas with the potential to effectively handle growth. If your city or county (or a regional organization) is developing build-out analyses, see if you can add a stormwater component so that alternative scenarios chosen include stormwater runoff parameters as well. EPA hosts a Web site with information on build-out analyses and other tools at <www.epa.gov/greenkit/2tools.htm>.

For meeting the post-construction minimum control measure, regional organizations might be called upon to develop model ordinances or individual policies to carry out regional plans. For example, the transfer of development rights is a tool used across the country to direct development away from environmentally sensitive lands while shifting the development to areas targeted for growth. This type of program might require setting measurable goals in a series. For example, in the first four years, the measurable goals might include (1) a formal agreement among participating jurisdictions, (2) a final comprehensive plan for the receiving area (3) a completed legal framework to administer trades and (4) software to track the number of trades. Given the complexity of each component, there are likely to be detailed sub-goals spelled out as well. To have a long-term effect on stormwater, your community should be prepared to count the numbers of transfers, not just the existence of a program.

Many regional organizations rely on voluntary participation in regional planning. As such, regional growth and/or watershed plans offer incentives (see the box on page 30, New Jersey Highlands, for more information). In addition to taking advantage of the incentives, make sure to also count the steps taken for the regional plan into your Phase I or Phase II municipal NPDES permit.

Examples

Within **New Jersey**, the Regional Planning Partnership (RPP) has developed tools to compare smart growth versus conventional development impacts, including stormwater runoff. The partnership has developed a sketch tool called Goal Oriented Zoning. In 2003, RPP developed a comparison for Delaware River Basin communities. This analysis compared four scenarios and set an overall watershed impervious cover goal at 10 percent. From there, RPP developed different development scenarios based on the 10 percent coverage goal to compare watershed-wide impacts. The exercise also served to show graphically what build-out is allowed under current zoning. While the use of the tool was meant to focus on zoning and transportation issues, RPP was able to include several environmental indicators, which could be further explored with air and water quality-specific models on other scales. For more information, visit <www.planningpartners.org/services.html>.

The Association of New Jersey Environmental Commissions (ANJEC) has issued a series of reports to assist its member communities with tools needed to comply with New Jersey's planning laws. These reports include information on conducting build-out and capacity plans, increasing the supply of affordable housing and implementing master plans. Its "Smart Growth Survival Kits" contain information on the data needed, methods available, and additional contacts. Though New Jersey–specific, the information can be useful for other states. Visit <www.anjec.org> and click on "Smart Growth Survival Kit."

In 2005, the Southwestern Regional Planning Council, covering the southwest counties in the state of **Connecticut**, released its regional planning strategy. The goals of the regional plan focus on transportation, housing, and directing development to areas with existing infrastructure and investment. For more information on implementation and other related objectives, visit <www.swrpa.org/projects/regplan2005.htm#project_team>.

To assist the regulated municipalities in the **Syracuse** Urban Area in complying with Phase II stormwater regulations, the Central New York Regional Planning Board (CNY RPDB) has launched a unified, regional assistance program. Its Web site, which was developed specifically for decisionmakers, includes several layers of maps, including MS4 boundaries, watershed boundaries, and political boundaries. The CNY RPDB is also providing unified assistance in the areas of public education, outreach and participation, municipal training, research assistance, and efforts to secure funding for compliance. For more information, visit <www.cnyrpdb.org/stormwater-phase2/>.

The 1996 Amendments to the Safe Drinking Water Act resulted in a focus to protect drinking water sources to complement the original goal of removing contaminants from

drinking water. To meet the new requirements, states must ensure that each water system has a Source Water Assessment. Once the assessments are complete, states and localities work on action plans to address any issues found in the assessment. Source Water Assessments must include four basic elements:

- A delineation (or mapping) of the source water assessment area.
- An inventory of actual and potential sources of contamination in the delineated area.
- An analysis of the susceptibility of the water supply to those contamination sources.
- A mechanism for sharing the results widely with the public.

While the traditional sources of contaminants arise from agriculture or industrial uses, more and more communities are concerned about the cumulative effects of development and runoff on source water.

If you are developing a regional or comprehensive plan, check to see if there is a source water protection plan or ordinance in your area. A link to state programs can be found at <www.epa.gov/safewater/source/contacts.html>. In addition, the Trust for Public Land has issued a report called *Protecting the Source*, which contains information on joint land and water planning. Visit <www.tpl.org/tier3_cd.cfm?content_item_id=1337&folder_id=195>.

Points to Consider

In many parts of the country, local government boundaries have served more to foster competition than cooperation. Growth pressures, economic conditions, and the underlying structure for assessing taxes all put pressure on the local funding base. In addition, there are few incentives to plan across boundaries, much less develop interlocal agreements involving tax sharing, growth, or annexation laws. Nonetheless, some areas faced with mounting water-related problems are finding that shared solutions among counties and cities offer efficient options. Newspaper headlines on flooding, beach closures, and emergency water restrictions are motivating discussions on how to analyze problems and forge solutions that transcend boundaries. EPA has recognized the importance of watersheds as an effective organizing unit. A good resource for approaching interlocal agreements is the Joint Center for Sustainable Communities. The center represents an important collaboration between the National Association of Counties (NACo) and the U.S. Conference of Mayors (USCM). Its web site is <www.naco.org>.

Onsite Wastewater Treatment Systems (also referred as septic systems, package plants, or cluster systems) pose challenges to local governments trying to manage growth in rural counties, vacation areas with second homes, or in fringe areas where water infrastructure cannot be extended. In the past, soil percolation rates, drainage fields, and overall perceptions of septic tanks were limiting factors to widespread use. New technologies, growing demand for housing in rural areas, and changing perceptions have reduced barriers to their use, however. According to EPA's 2002 *Onsite*

Wastewater Treatment Systems Manual, nearly one-third of new housing construction is served by onsite wastewater treatment systems.[7] The University of Rhode Island's Cooperative Extension Agency has released a new handbook entitled *A Creative Combination: Merging Alternative Wastewater Treatment with Smart Growth*. The aim of the handbook is to help local governments address growth and wastewater handling at the same time. In addition, the handbook addresses the important role of management, oversight, and enforcement in areas where a large percentage of households use onsite systems to treat wastewater. For more information, visit <www.uri.edu/ce/wq/mtp/PDFs/manuals/Creative%20Combination%203-10.pdf>.

As noted in this section, regional planning can result in decisions that direct growth to certain areas of the watershed. These identified growth centers might be in existing communities, or in undeveloped areas. Efficiently handling growth in these areas eventually leads to discussions on density. Commonly held views on density among stormwater engineers and environmental advocates tend to equate density with imperviousness, which is then equated with poor water quality outcomes. Stormwater ordinances that discourage "connected impervious surfaces" might run counter to smart growth plans that call for a compact, but connected, street development form. Even where localities understand the need to direct density, there may be discussions about requiring automatic "offsets" of open space tied to redevelopment decisions. While some communities will establish programs to connect infill development with land conservation, a blanket, inflexible requirement to obtain land might, in the end, stifle a region's ability to meet both growth and water goals. To address the issue, EPA has issued a report called *Protecting Water Resources with Higher-Density Development*. [8]

Comparing the environmental impacts of various development options can require an extensive amount of baseline data and resources to analyze the various build-out scenarios. The baseline data needed include an inventory of natural resource lands, an inventory of developable lands, an inventory of undevelopable land in both private and private hands, and comprehensive zoning maps. Even where these data are available and show opportunities for redevelopment and reuse of vacant properties, further work might be needed to determine which properties are market-ready and which are contaminated, or where ownership is uncertain. In some communities, incomplete data may be a huge constraint. In these situations, communities might want to canvass state, university, and conservation district offices to see where GIS work has been conducted.

A community that does not have all of the information listed above might want to begin work in a targeted area. For example, if your state is updating transportation plans, a city or county may want to update local zoning maps to support the redevelopment of parcels in proximity to the study area. Information from this type of review can be used to assess development potential, transportation impacts, and scenarios of how that same level of development might look if built elsewhere in an undeveloped portion of the watershed. A carrying capacity report can then evaluate the stormwater generated by each scenario. The targeted

Photo: www.pedbikeimages.org/Dan Burden



Main Street Programs have been successful in directing development to older downtowns.

review can reveal not only environmental information, but also economic barriers and transportation investments that need to be addressed before growth is redirected.

If you are a Phase II community and decide to team up with Phase I community, keep in mind that some of the requirements for Phase I can be more restrictive than Phase II. Some Phase I communities use numeric goals for BMPs or might have implemented rigorous water quality monitoring schedules. The additional requirements may be offset by the efficiencies of using an established program, however.

Finally, regional or watershed plans, like any other plan, are only meaningful if implemented. When identifying measurable goals, be sure to distinguish where development of a plan is a suitable short-term outcome and which actual policy changes are needed to ensure the long-term environmental outcomes desired.

2. Infill Development

Definition

For purposes of this document, infill is defined as development that occurs on previously undeveloped lots within existing developed areas (the following section on redevelopment covers development that occurs on previously developed lots). Infill development takes advantage of built-out areas that are already served by a variety of transportation modes and by infrastructure. Infill development also accommodates development that might otherwise occur on greenfields sites. EPA's model permit for Phase II <www.epa.gov/npdes/pubs/modpermit.pdf> states that communities can use policies that promote infill development and development in areas with existing infrastructure to meet the post-construction minimum control measure. This section describes how infill development is typically regulated, how infill is treated within smart growth plans, and special points to consider for infill and stormwater control. Much of the information presented here is also relevant for Subsections 3 (Redevelopment) and 4 (Development Districts) as well.

Who Do I Talk to About Infill Plans?

Decisions about where to develop are influenced by numerous factors. While the final decision nearly always is left to the local jurisdiction, regions and states also influence the decisions of both developers and the localities through incentives and policies. This subsection therefore addresses policies at all three levels of government.

Green roofs can help manage stormwater for infill development projects.



Photo: University of Connecticut Cooperative Extension System

Local Jurisdictions: To understand who to talk to and where to find the land use plans that guide infill development, it is helpful to understand the two ways that localities manage development activities. The most common method in urbanized and urbanizing areas is through zoning, which places limits on the use, type, size, and design of allowed development. Zoning can be either "by-right," meaning that developers can build any development provided it meets zoning standards, or conditional, meaning that developers must seek approval for specific proposals. Within zoning codes, there are standards, called "bulk regulations," that govern the maximum size of structures on a lot and how the building is located on the site (e.g., lot coverage, setbacks, parking, floor area ratio, and landscaping requirements). Localities often use a variance process where deviations from the standards are deemed acceptable.

A second method of steering development is through use of incentives. Local jurisdictions seeking specific types of development might give financial or other incentives to developers willing to build within desired parameters. Zoning and incentive programs are typically drafted by the planning and/or building departments of a city and codified in city land use and zoning ordinances. If you are in a smaller municipality without zoning, the city or county engineer might be the best person to explain development rules, since building standards—not zoning—guide where development can be located and how it is built. Some larger cities have separate entities to encourage redevelopment, so personnel in the economic development division are likely to have the best understanding of whether there are special business development zones, special tax zones, and maps showing the boundaries of these areas.

If you are unfamiliar with the terminology used for zoning and comprehensive planning, visit the Wisconsin Department of Natural Resources Web site, which posts a list of general land use terms to help natural resource professionals. See <http://dnr.wi.gov/org/es/science/landuse/education/GPZ.htm>.

Regions: Metropolitan planning organizations (MPOs) are inter-governmental institutions formed to handle transportation planning in areas with a population of 50,000 or more. They also have the responsibility of allocating transportation funding for areas with populations greater that 250,000. MPOs might seek to better match development and transportation investments through educational tools; for example, maps showing 20-year growth projections. Some MPOs are involved in water and stormwater planning. To find out if your area is served by an MPO, contact your planning staff, or go to <www.ampo.org>, which lists member MPOs.

States: A number of states have passed statewide smart growth legislation, recognizing that, while development decisions are made locally, state policies often guide the decisionmaking process through financial incentives and policy decisions. Responsibility for statewide smart growth policies generally lies in a statewide smart growth office or planning office, or in a department of consumer or environmental affairs. In states that do not have a formal statewide plan, there may be separate policies that seek to streamline policies on growth. States that have embarked on growth management efforts might also have developed baseline data on natural resource lands and larger infrastructure programs. Contact the state office to see if you can make use of the GIS mapping or other data for making decisions on directing growth and infill. If your state has passed legislation, enabling legislation or programs to promote infill as a smart growth policy, but your locality has not adopted them, you might want to work with your zoning or economic development director to take advantage of the program for water and growth goals.



Photo: www.pedbikeimages.org/Dan Burden

Infill development can help a community grow over time. For example, a row of "liner shops" can be added to surround a surface or structured parking lot. This adds development intensity, reduces the overall amount of parking required for the district as a whole, and improves the pedestrian environment.

Stormwater Benefits

Infill can reduce potential runoff by ensuring that growth does not create additional impervious surfaces on the developed fringe and in environmentally sensitive areas. The impacts of such development can be considerable. Growth on the undeveloped fringe results in less groundwater flow into streams and less aquifer recharge as water runs over the surface. The 20 regions with the greatest amounts of land development over the period 1982 to 1997 now lose between 300 billions and 690 billion gallons of water annually that would otherwise have been captured in groundwater supplies through natural percolation.[9]

A modeling study conducted by Purdue University estimated that placing a hypothetical low-density development at the Chicago fringe area would produce 10 times more runoff than a mixed-use development in the urban core.[10] In Virginia, a Chesapeake Bay Foundation study found that clustered development across the state would convert 75 percent less land, create 42 percent less impervious cover, and produce 41 percent less runoff.[11]

In addition, infill development can make use of existing infrastructure. Guiding development to existing areas also increases the economic activity and tax base needed to support the maintenance, repair, and/or expansion of the water infrastructure in place. This investment can help repair areas prone to sewer overflows, or enhance treatment facilities in order to meet more stringent water quality standards.

The following measures are the types of regulations and programs that are used to promote infill, and thus facilitate stormwater improvements. In your permit application or plan for Post-Construction Minimum Control Measures, you can list these out separately, or include them under a general measure such as "infill policies."

Setbacks: Setback requirements can be one of the most important factors shaping the built environment—and hence impervious cover—in your community. Conventional codes often call for minimum setbacks: for example, requiring a building to be *at least* 50 feet from the street or adjacent properties. Smart growth codes often use maximum setbacks, which stipulate a maximum distance a building may be situated from the street or sidewalk. A maximum setback brings the building closer to the street and sidewalk, promoting a more interesting and efficient pedestrian environment. Alternatively, your smart growth code may stipulate a "build to" line. This requires that the building footprint meet a certain line along or within the property, such as up to the edge of a sidewalk. Check with your zoning, planning, or public works office to see if your community has minimum setbacks, or if it has made modifications to allow for maximum setbacks. The convention of setting minimum distances from the roadway can result in excess impervious cover and be ripe for reform to obtain stormwater benefits. Setback requirements can be found under individual zoning codes or apply to entire districts.

Mixed Use Zoning: Mixed use zoning allows (or sometimes requires) buildings with different uses (e.g., residential, office, retail) in the same area or in the same building. This mix allows for a greater intensity of development on a more compact scale, which reduces the amount of land needed on a per unit basis. Mixing uses also supports a range of transportation options and facilitates shared parking, thereby reducing the amount of surface needed for roads and parking lots.

Smart Growth Lot Sizes: In some areas, zoning codes and subdivision standards have been rewritten to allow for greater density and more efficient use of the land. Instead of requiring a minimum of a quarter acre per residential lot, as many current codes do, new smart growth codes allow smaller lots. This practice consumes less land per unit. The smaller lot sizes can also be instrumental to drawing development to smaller or oddly shaped infill lots within an older city. Large lots not only consume more land, but the lawns covering those lots handle less stormwater than undisturbed land. Under typical subdivision construction practices, sod is laid over highly compacted soil, so that water does not percolate. Where mass grading is a typical practice, the compaction of the underlying soil further reduces the potential for infiltration. Lawns treated with fertilizers and chemicals further add to stormwater problems, particularly if treatment occurs right before a rain event. Smart growth can minimize some of these impacts. When looking for language governing lot sizes, the zoning code may refer to "maximum lot sizes," or be presented as zoning categories, such as R-8 (or eight residential units per acre).

Density Bonuses: Density bonuses are used to provide incentives for developers who agree to integrate desired features into development projects. There can be stormwater benefits to increasing the development density in existing

communities (e.g., less land consumption, more efficient use of existing impervious surfaces such as roads and sidewalks). One can also provide density bonuses to developers who agree to treat stormwater on site or who agree to replace older infrastructure serving the project. A density bonus may be used to reduce the footprint of the building by allowing the development intensity to be expressed through height. Density bonuses are typically part of a larger planning process that determines how much incentive is needed, what the amount of the bonus will be, enforcement to ensure both parties adhere to the arrangement, and other planning needs that accompany the added density (e.g. parking, fire protection). Density bonuses are typically listed in the zoning code or plans, or in footnotes to the plan.

Financial Incentives: Common incentives include the use of tax-increment financing, tax and economic incentives for redevelopment, and promotion of cost-of-service utility fees (instead of average cost pricing, which can subsidize dispersed development at a cost to higher density development). Tax increment financing (TIF) is a system whereby property taxes in a particular district are frozen at a certain level; when property values rise, the additional tax that would have been paid is instead directed back into redevelopment projects in the district. TIFs are built on the concept that new value will be created, and that the future value can be used to finance the initial investment.

Typical Costs

Both conventional development and infill involve costs to the public sector, because any new development requires public services or upgrades. Most research, however, finds that in the long run, there are fewer public costs to provide services to infill and redevelopment, because existing infrastructure is used or repairs or upgrades were needed whether infill took place or not.[12]

Measurable Goals

An initial goal might be to direct some percentage of growth into areas that are already developed, or to initiate a selected number of policies to encourage infill development. To ensure measurability, your community can establish a system to track building permits within an area designated for infill. In addition, your community can institute a priority system for infill and redevelopment projects that further improves stormwater management with features such as green building techniques. A longer-term goal might be to increase the overall density of developed areas and preserve open spaces from development. A locality may want to do a "code checkup" every so often to make sure that



Photo: EPA

Landscaping can be used to handle stormwater in tight infill projects. While native plants are often recommended, there may be other factors to include in plant selection, such as maintenance, canopy, root depth, and water uptake.

the requirements for infill are not more - onerous than those established for new development on greenfields sites.

Examples

The state of **Washington** has developed a Phase II application that explicitly lists infill development as an option for fulfilling the post-construction minimum control measure. To view the Department of Ecology's permit application, go to: <www.ecy.wa.gov/programs/wq/stormwater/phase_2/Phase%20II%20Application.pdf> (see page 14 within the document for the language on infill development).

Clark County, Washington, adopted an infill ordinance in fall 2002. Its infill guidelines are applicable only in certain residential zoning districts for lots under 2.5 acres that adjoin existing development and can be served by existing infrastructure. The ordinance allows for two tiers of infill development. Tier 1 allows only detached single-family housing, but lot sizes can be smaller than existing zoning. Tier 2 allows attached and detached single-family housing, as well as duplexes and multi-family housing. Developers may also receive density bonuses. Infill projects are exempt from stormwater regulations if they create less than 5,000 square feet of new impervious surface. For more information on the infill ordinance and Clark County's comprehensive plan, visit <www.co.clark.wa.us/longrangeplan/review/index.html>.

In its state model stormwater ordinance, **New Jersey** has identified areas slated for redevelopment and infill. Rather than devote resources to establishing new boundaries for water policy documents, the state used definitions that already exist for economic planning. Thus, parcels in areas designated as "Urban Redevelopment Zones," such as "Urban Enterprise Zones" and "Urban Coordination Council Empowerment Neighborhoods," are exempt from infiltration requirements. By using the existing designations, the office overseeing stormwater efforts need not devote resources to drawing new boundaries. In addition, the use of economic development boundaries helps to tie environmental protection to economic development efforts. For more information, see <www.njstormwater.org> and go to the Tier A model permit.

Austin, Texas, has established a variety of water policies for its Desired Development Zones (DDZs) and Water Protection Zones (DWPZs). In the past, the city provided reimbursement for certain water and wastewater facilities over a three-year period. Under updated smart growth policies, major water and wastewater facilities located in the DDZ will be reimbursed in a single payment. Within the DWPZ, reimbursement for wastewater facilities will be discontinued, and the reimbursement schedule for water facilities will increase from three years to four. For more information on Austin's smart growth incentives page, see <www.ci.austin.tx.us/smartgrowth/incentives.htm>.

Some states have adopted priority funding areas (PFAs), which are areas designated for growth and, as such, gain priority for grants, infrastructure, and transportation investments. In creating these zones, the states typically inventory how funding is allocated, and create (or adjust) the funding formulas

Incorporating Infill into Stormwater Regulations: Wisconsin Department of Natural Resources

The Wisconsin Department of Natural Resources has developed technical materials and guidance for the post-construction minimum measure under Phase II, which address new development, redevelopment, and infill separately.

Definitions

The definitions help establish the development and regulatory context.

- "New development" occurs on undeveloped area including cropland and other vegetated areas.
- "Redevelopment" describes an area where impervious surfaces (e.g., buildings, parking lots, and roads) already exist.
- "Infill area" describes undeveloped land in existing sewer service areas that is surrounded by developed land or man-made features where development cannot occur.

The Post-Construction Rules

The rules focus on three aspects of stormwater-related impacts: 1) total suspended solids (TSS), 2) infiltration, and 3) peak runoff rates.

TSS refers to a measure of the amount of solids in the wastewater—in this case stormwater. TSS is a way to determine water "cloudiness," which has implications for the biological functions of aquatic species. To assess TSS, water samples are passed through a filter, and the amount of material captured is measured relative to the amount of water filtered.

Wisconsin's requirements for the percent reduction of TSS are measured from a "typical development pattern with no controls" or "no BMP" baseline and are tiered as follows. For new development, an 80 percent reduction from "no control." For redevelopment, a 40 percent reduction from "no control."

For infill, the requirements are:

- Less than 5 acres and developed prior to October 2014, a 40 percent reduction from "no control"
- Otherwise an 80 percent reduction from "no control"
- The 5-acre in-fill threshold is based on undeveloped area available (not amount of land disturbed).

For the infiltration standards, redevelopment sites are exempt. Otherwise, new residential development projects are required to infiltrate at least 90 percent of the water falling on the site and non-residential development infiltration volumes are required to be at least 60 percent.

Peak runoff rates (or peak discharge rates) refer to the maximum volume flow rate passing a particular location during a storm event. Peak discharge is typically increased with increased development as more water is collected and conveyed across impervious surfaces. For example water from two adjacent parking lots is collected and flows to a common gutter. This additive volume gathers energy as it flows downhill toward a discharge pipe. This increased volume can scour riverbanks and increase the risk for flooding. Peak discharge is typically expressed in units of volume/time (e.g., ft3/sec). Within Wisconsin's rules, the peak discharge for post-construction conditions are to be reduced to the pre-development conditions for the two-year, 24-hour storm (though some local ordinances may vary).

The peak discharge standards do not apply to:

- Sites classified as redevelopment
- Infill development less than 5 acres

For more information on Wisconsin's post-construction requirements, presented as PowerPoint presentations, visit <www.dnr.state.wi.us/org/water/wm/nps/stormwater/post-constr>.

Courtyards and landscaped areas are common features of site plans. Small modifications in drainage and plant selection can improve the water handling performance of infill projects.



Photo: City of Portland, Washington

to support development in these targeted areas. **Maryland's** Smart Growth Initiative, passed in 1997, directs state infrastructure funds into PFAs. The initiative identified areas automatically included, and also allowed counties to designate certain areas within their boundaries as PFAs. Under this policy, local jurisdictions may allow development in non-PFAs, but must fund all infrastructure improvements locally. Phase II communities located in a PFA should make sure local stormwater policies complement the state plan. For example, a complementary plan would make sure that (1) comprehensive plans, zoning codes, and standards are in place to foster infill, (2) local funding investments match the state's commitment, including sewers, stormwater, and transportation, and (3) permitting processes do not pose barriers to infill.

Rather than require stormwater handling for each individual project, the city of **San Diego** adopted a policy in 2002 to allow infill developers to share in the cost of stormwater abatement. The Standard Urban Stormwater Mitigation Plan allows developers to contribute to stormwater mitigation that serves the entire drainage basin. Engineers estimate that individual developments projects can achieve savings of up to $40,000 by participating in a shared stormwater control program. For more detailed information on the Localized Equivalent Area Drainage program, (LEAD) visit <www.sannet.gov/stormwater> and type "Localized Equivalent Area Drainage" into the site's search engine.

Some of the best advocates for infill are developers themselves. The Center for Watershed Protection has two programs, Builders for the Bay and the Site Design Roundtable, which gather information from developers on the best ways to build stormwater-friendly developments. For more information, visit <www.cwp.org>.

Points to Consider

Lots slated for infill can be the last open spaces in a built-out community. In some instances, they may be the remaining open lots that handle urban stormwater. There is

no one method for determining whether these lots should be kept open for stormwater control or developed. The local development context is a critical consideration that comes into play. Green spaces and parks serve a multitude of purposes in urban areas for aesthetic purposes, recreation, and environmental benefits.

Some lots may not be critical for natural handling of stormwater, but may be in an area with waterways that are already compromised by development-related stormwater runoff. In this case, there are an increasing number of green building techniques and low impact development (LID) options for onsite stormwater control. Developers and their landscape architects should look at common urban development features, such as courtyards, small water features, and tree planting areas for stormwater control. Since these features are likely to already be included in site plans, small design modifications to handle runoff can improve your project's performance. The Center for Watershed Protection has developed several documents under its "Smart Sites" initiative, which can be found at <www.cwp.org/smartsites.pdf>.

As discussed elsewhere in this subsection, investments from infill development may be able to support improved stormwater handling by way of gray infrastructure. Localities should look at infrastructure financing plans, and how they can be used to attract infill investments. A mitigation plan for development projects can lessen stormwater impacts related to infill. Maryland's *Guide to BMP Selection and Location* includes tables of BMPs and in which setting they perform best. See <www.mde.state.md.us/assets/document/chapter4.pdf>.

Finally, even where there is strong consensus among the stormwater engineer and other planning departments on strategies for infill, local residents may oppose any new development project in their community. In a growing number of circumstances, the arguments are based on increased stormwater runoff. Several organizations have developed tools to help design better infill projects and develop community consensus early on. In addition, the low impact and site design options listed in this document may help developers, community members, and zoning officials understand the options for handling infill development in a way that also protects the local environment. The Greenbelt Alliance in California <www.greenbelt.org> has produced *Smarter Infill* and Smart Growth America <www.smartgrowthamerica.org> has released *Choosing Our Community's Future*.

Language to Look for in Ordinances

It is important to keep in mind that the language in your city or county's stormwater ordinances and guidance will be part of a regulatory and legal framework in the same manner that zoning ordinances are. Thus, the particular wording can have implications for whether the stormwater policies will work in concert with, or against, your smart growth policies. Most communities will have to balance the need for language that is legally binding, flexible, and designed to deliver stormwater benefits to the maximum extent practicable.

Language Fostering Creation of Joint Smart Growth and Stormwater Policies

Language specifying that post-development hydrology match the pre-development hydrology: Language to this effect may foster redevelopment. Because the pre-development state of the parcel was already developed, a redevelopment project with the same lot coverage will essentially have no effect. When you write your ordinance, however, you may want to avoid confusion by specifying that the pre-development condition refers to the site immediately prior to redevelopment.

Language classifying a smart growth technique as a BMP: This language will verify that your smart growth policies are recognized as stormwater practices. Note that your guidance or ordinance may also require maintenance and operation for the BMPs. For example, if your "Fix It First" policy is adopted by reference as a stormwater BMP, the BMP maintenance requirements are also likely to apply. If you have established a BMP maintenance fund, this could establish a new source of funding for priority repairs.

Adding "prevention" of stormwater to your ordinance's purpose or goals section: Stormwater BMPs have traditionally been designed for mitigation; that is, to lessen stormwater once it is generated. Adding stormwater prevention to your goals, however, can help support the prioritization of redevelopment, compact development plans, and "Fix It First" programs.

Language that includes smart growth policy techniques in the definitions: The "Definitions" section of your ordinance is an important feature. The legal definition will establish how narrow or broad your options can be, or even what measures can be classified as BMPs. In addition, having smart growth policy terms in the definition can assist you in cross-referencing other plans, which can save time and resources. For example, many cities are exempting projects in dense, urban areas from infiltration requirements. Rather than delineate new areas, some cities are using established districts, such as "Business Improvement Districts" or "core downtown" or boundaries set in economic development plans. Adopting these districts into the "Definitions" section of your stormwater plan automatically delineates where policies apply. Even if the policy is not fully used in the ordinance or guidance during the first five-year permit, establishing the definition can serve as a placeholder as your community works out the full details.

Language that refers to design manuals: Because the stormwater management aspects of a development project can be comprised of many interrelated elements, ordinances often refer to design manuals. The reference to a manual will allow localities to develop and maintain manuals that reflect their smart growth programs. You may want to see where a local manual and/or ordinance on "traditional neighborhood design" or "Main Street Redevelopment District" can be customized to add stormwater management criteria for hydraulic sizing and performance standards.

Language Hindering Creation of Joint Smart Growth and Stormwater Policies

Language specifying that post-development hydrology match the pre-development hydrology: This language, which can help incentivize redevelopment as noted above, can block infill on undeveloped sites or smart growth on greenfields sites. Make sure there is flexibility within your stormwater and urban design plans so that the requirement for maintaining natural hydrology delivers projects that work in all contexts within a watershed.

Language requiring that BMPs replicate natural systems or non-structural natural BMPs: This might be a desired strategy in rural areas or those with pristine water resources. If this is a strict statement that covers all development projects in your city, county, or township, however, your community might face difficulties in directing growth to areas specifically targeted for a higher intensity of development. In addition, some strategies for replicating natural systems require large areas of land for infiltration or filtration of pollutants, which might consume land needed in a traditional town center or new urbanist plan to create a compact, walkable town center. Make sure there is flexibility so that there are options for stormwater management that are context-sensitive.

Language that classifies the intensity of control based on "housing units per acre": Most land use plans classify the intensity of residential development based on housing units per acre. This system is based on zoning conventions that tend to separate uses, and hence, can disperse development. Stormwater regulations based on units per acre will not only reinforce this system, but are likely to miss the importance of looking at water impacts on a "per unit" basis. Many watershed managers are faced with growth estimates over the next decade that range from several hundred households, to thousands of new households. Looking solely at "housing units per acre" on given acreage within a watershed may produce an unrealistically low picture of the planning and investment needed. Looking at impacts on a "per unit" basis may help communities—in particular, growing communities—fully assess water impacts of expected growth in total number of households in the watershed.

Language to tie priority funding to adoption of a model ordinance: Many states are developing model ordinances for local communities as a way to reduce the resources needed to develop and implement NPDES permit programs. These model ordinances are, by their nature, written to a minimum level of compliance, and written broadly as to be applicable in many different environmental settings. As an alternative to a model ordinance, states are also allowing communities to develop innovative alternative plans. When priority funding is given for adoption of the model ordinance, there is less incentive for a community to choose options for developing innovative and multi-objective plans. In addition, many communities will likely choose an option that is as simple and spelled-out as possible. By developing specialized manuals for Traditional Neighborhood Design and redevelopment areas, localities have a ready-to-use option for smart growth. Localities and state should look for ways to make a variety of options attractive through technical assistance and/or funding priorities.

Impervious coverage limitations: Many state and local permits have incorporated impervious surface limitations (or lot coverage limitations) based on studies that show that a watershed begins to deteriorate when 7 to 10 percent of the watershed is covered by impervious surface. This concept has been translated to the site level through ordinances that limit coverage of rooftops and parking to no more than 10 to 20 percent of the site. While this may be an effective strategy in some circumstances (for example, to protect pristine waters), in others, this type of ordinance serves to spread out development even more. Larger lots are needed for all development projects, which serves to extend the distances among uses. This, in turn, requires longer stretches of roadway and more water and sewer infrastructure per unit of development.

3. Redevelopment

Definition

Redevelopment is development of a site that has been previously developed and is typically covered with impervious or compacted surface. For purposes of this subsection, the reader can assume that the lot is covered with compacted or impervious surface and has minimal to no value in handling stormwater. These projects can include development of vacant buildings, lots where a building has been torn down and replaced with gravel parking lots, or older malls.

Who Do I Talk to About Redevelopment Plans?

In most instances, redevelopment is left to market forces. Developers and real estate investors seek out available property and either redevelop by-right or petition for a variance or rezoning. In other jurisdictions, special entities are formed to foster redevelopment. There are often barriers to redevelopment, including complex approval processes and the perception from lenders that the deal will pose more risk than new development projects.

Thus the best resources for learning about redevelopment plans can be private sector organizations, or public/private partnerships. Economic entities, such as redevelopment authorities, "Main Street" programs and brownfields offices, often work to line up financing, zoning reforms, shared parking arrangements, and other incentives to overcome the barriers and perceptions that suppress market interest. Talk to your economic development director, chamber of commerce, or city manager to see if there are established redevelopment districts that can be added to your stormwater management plans. If you are the head of a redevelopment agency, talk to local experts on land development to develop scenarios of watershed growth. In this way, you can present not only the economic benefits of redevelopment, but also the regional water benefits that can accrue from successful implementation of your Main Street or brownfields program.

As a stakeholder in the stormwater process, you may also want to consult with commercial real estate brokers to investigate why a commercial district, mall, or older downtown is underperforming, and what steps are likely to revive interest.

Examples of programs that you can ask about include:

Vacant Property Reform: According to the National Vacant Properties Campaign, vacant and abandoned properties occupy about 15 percent of the area of a typical large city—more than 12,000 acres on average. Vacant property reforms are designed to encourage the redevelopment of vacant properties, allowing the utilization of existing buildings in potentially desirable urban and suburban locations. For more information, see <www.vacantproperties.org>. The International City/County Managers Association has researched and reported on successful local efforts to bring vacant commercial and residential properties back into use. For more information, see <www.icma.org/vacantproperties>.

Greyfields: Greyfields are a subcategory of vacant or underperforming properties. Greyfields are large, previously developed properties, such as older shopping malls and

warehouses. These sites tend to be large and well-served by transportation and stormwater infrastructure. These properties differ from brownfields in that they are not contaminated or perceived to be contaminated. To see if your community is working on a redevelopment strategy for old malls or other greyfield sites, contact the department of economic development or the local chamber of commerce. This strategy may include mixed-use rezoning, enhancing transportation on the site, and/or redevelopment incentives. Because these sites are so large and are not contaminated, you may be able to negotiate for better control of stormwater on site, and thus increase the stormwater benefits of the redevelopment project. The Congress for the New Urbanism published *Greyfields into Goldfields*, which presents information on common reasons behind the decline in malls and large properties and development options for reusing the sites. See <www.cnu.org/cnu_reports/Executive_summary.pdf>.

Renovation Codes: Renovation, or rehabilitation, codes are commonly developed to replace inflexible building codes with a set of coordinated standards for renovation and rehabilitation in older areas. For example, renovation of an old downtown might be prohibitively expensive, or impossible under building codes created for new development. Renovation codes meet safety objectives while setting workable standards for renovation. Renovation codes also help towns revitalize the economy of their downtowns, while relieving development pressure on greenfield sites (and thus retaining the stormwater benefits of open space). The United States Department of Housing and Urban Development published a report, *Smart Codes in Your Community: A Guide to Building Rehabilitation Codes*, describing various redevelopment codes and examples of rehabilitation codes from across the country. See <http://www.huduser.org/publications/destech/smartcodes.html>. If your community or state offers support for renovation and rehabilitation, also check to see if historic tax credits are allowed, and count this toward your stormwater credit for redevelopment. Check with your historic preservation office or local nonprofits that deal with historic preservation.

Typical Costs

The costs of redevelopment are distributed among several stakeholders. For a city or county, fostering redevelopment can include (1) the costs of redevelopment planning and stakeholder outreach, (2) the costs of any incentives provided, (3) upgrading and repair of existing street and water infrastructure, and (4) staff time if specific programs have been established. These costs, however, cannot be appraised without looking at the costs associated with vacant or underused commercial and residential properties. The Vacant Properties campaign has compiled information on these costs and are available at <www.vacantproperties.org>.

For developers, redevelopment projects in already-developed areas are typically more complex, and thus can be more expensive. These developers must work with existing street and circulation patterns, building configurations, and zoning and regulatory codes, many of which are decades or even centuries old. Developers look at the time and cost involved to see if projects "pencil out" economically. Local incentives and regulations play into cost, including stormwater management. Review your smart growth plan (and state programs) to see if funding mecha-

nisms, open space and park funds, tax incentives, or permit review incentives are available. When packaged strategically, these incentives may serve not only as economic development incentives, but stormwater program incentives as well.

Measurable Goals

Since redevelopment projects are discrete and are typically tracked through permits, stormwater managers may be able to use databases that are already in use. Since many stormwater consultants are establishing tracking software, work with them to establish new fields to track the impervious surface reused through redevelopment. One example of a measurable goal would be to create an inventory of vacant properties and set goals for redeveloping them.

As noted in the previous section, you may also be able to track the amount of impervious surface avoided through your redevelopment programs. This approach would translate how the square footage, building footprint, parking and associated infrastructure would compare under conventional development standards elsewhere in the watershed. As a first step, the stormwater or planning office would need to estimate (1) where the development might go were it not for redevelopment programs, (2) the average parameters for conventional development (e.g., likely number of parking spaces, new road and access designs), and (3) any other secondary impacts that might come from new growth.

Examples

Comparing build-out scenarios was used to assess the transportation and water and air quality impacts of Atlantic Station, a brownfields redevelopment project in Atlanta.[13] The site design for Atlantic Station, located on a former steel factory, includes several stormwater improvements. The developer, Jacoby Development Inc., built stormwater handling features on the site, upgraded the storm and sanitary sewer network for the project, and addressed groundwater contamination.

As part of EPA's analysis, the Agency compared how the same intensity of development would perform if built according to conventional development standards in other parts of the Atlantic metropolitan region farther from the urban core.

This lake, located in the central part of the Atlantic Station redevelopment project in Atlanta, Georgia, is a development amenity, but also assists in stormwater management.



Photo: Paul Muldawer

Compared to a greenfields site, the redevelopment scenario had lower total phosphorous and nitrogen loadings, as well as reduced volume. In some cases, the comparative reductions were orders of magnitude lower. To learn more about this project, visit <www.epa.gov/projectxl/atlantic/index.htm>.

Points to Consider

Most of the "Points to Consider" listed under the previous section on "Infill Development" also apply. As noted above, many cities and counties are adding onsite water handling requirements to all development and redevelopment projects. Even where there is flexibility in stormwater ordinances, cities and counties should make sure that the BMP requirements for all projects are established on a "level playing field." Stormwater engineers and planners should compare the costs, the permitting process, and predictability of the BMPs required for development and redevelopment projects. For example, stormwater management programs that rely heavily on infiltration techniques might tilt the playing field in favor of large, dispersed projects on less expensive land. Typically, this land is located farther out in undeveloped reaches of the watershed, where infiltration on a larger scale is already taking place. Even with requirements for infiltration on site, the disturbance that takes place can be a net loss for the watershed. Thus, stormwater and watershed managers may want to assess the balance of requirements and incentives to make sure stormwater rules are not inadvertently pushing development to undeveloped land.

4. Development Districts

Definition

Development districts (or in some cases special zoning districts) are created to achieve comprehensive planning and urban design objectives in a specified area. While the previous subsections reviewed policies for individual sites and smaller projects, development districts are characterized by a larger site area and the need for complex and coordinated rezoning, transportation, and planning efforts. Examples of special zoning districts include transit oriented zoning districts (TOD), business improvement districts (BIDs), new urbanist projects, traditional neighborhood development (TNDs), brownfields redevelopment, and "Main Street" revitalization districts.

Who Do I Talk to About District Plans?

If an area is incorporated, any such district would be found in the city's zoning ordinance. If an area is unincorporated, county zoning applies. In some cases, the zoning regulations carefully delineate the sub-area plans or special districts and show them on a map.

If you are in a county that does not have zoning, or has not yet reviewed zoning codes for redevelopment areas, your locality may have developed special plans for certain areas, for example a BID or "Main Street" redevelopment plan. Check to see if there is a document listing specific policies or planned zoning changes related to development or redevelopment in the district. Many of the policies listed in Subsection 2 (Infill

Development) might be listed and can be included in your SWMP.

Innovations in zoning and building codes have emerged under a variety of names. The Smart Code, TND codes, form-based codes, unified development ordinances (UDOs), and model development codes are examples. These codes may apply to the entire municipality, to new development only, or in the form of an overlay zone. The Congress for New Urbanism has collected examples of various code innovations at <www.cnu.org/pdf/code_catalog_8-1-01.pdf>.

In reviewing codes with your local planning office or economic development department, make sure that the *all* pieces are in place to deliver on the smart growth benefits. For example a unified development ordinance might require sidewalks on both sides of the street; however, if state transportation and local zoning policies result in highly separated uses with mandated turning lanes and wide intersections, pedestrian trips may be reduced, if not eliminated. The stormwater benefits are likewise diminished. Thus, you may need to consult with the zoning and planning office, together with a transportation engineer. If one set of codes supercedes another, you may want to consult with the city or county manager to find flexibility and list all the benefits, including stormwater, that come from a smart growth development district.

Subdivision codes are a common method incorporated and unincorporated communities use to control development. Most subdivision codes establish how many housing units can be built by-right on undeveloped land. Over time, subdivision codes have evolved to control development-related aspects such as street widths, septic requirements, and/or infrastructure planning. Some subdivisions may also be governed under drainage districts, which place limits on impervious surface coverage and map development restrictions in areas of significant drainage flows. In some cases, subdivision requirements will govern the street network and control the number of connections required between the subdivision and surrounding parcels (see Subsection 8, Smart Growth Street Designs for more information). Consult your city or county's engineer or planning office to see if smart growth policies have been added to your subdivision codes.



Photo: www.pedbikeimages.org/Dan Burden

This path allows safe pedestrian and bike passage, but is also designed for access by emergency and service vehicles.

Check to see if your community has formed public/private partnerships or alliances to facilitate planning and implementation for these districts. Also check with a local historical society, the downtown business association, or the local chamber of commerce to see if they are aware of special planning or economic development districts.

Brownfields are properties with real or perceived contamination from prior uses and, in some cases, are classified as districts for the purposes of cleanup, financial incentives, and coordinated redevelopment. Larger brownfields can include former military bases, transportation facilities, and institutions. These large properties are often located in areas near existing transportation and infrastructure. The larger parcels pose opportunities to redesign a development program that includes smart growth features, like multi-modal street design, advantageous use of existing transportation routes, and open space. EPA estimates that for every acre of brownfields redevelopment, 4.5 acres of greenfields can be preserved.[14] Check to see if your community has developed plans for brownfields identification, cleanup and/or development plans. There may be opportunities to design large scale, onsite stormwater handling in areas where the contamination will not be transported after redevelopment has taken place.

Stormwater Benefits

As noted in the previous subsections, special zoning districts can limit overall stormwater runoff by directing development away from greenfields at the urban fringe into existing urban areas. (See Subsections 2, Infill Development, and 3, Redevelopment, for further information on the impacts of encouraging infill.) Coordination of planning, investment, and infrastructure for a district can also result in a more efficient site plan. Development decisions are made at a larger coordinated scale, which can facilitate efficient street layouts, a smaller footprint for parking facilities, and less expensive options for collecting and handling stormwater for the district.

In addition, mixed-use districts can support a wider variety of transportation options, which lessens the impacts of transportation on water quality. Auto emissions have deleterious effects through deposition of exhaust and accumulation of automotive related materials (brake linings and tire tread wear) that are carried into waterways through stormwater runoff.

A 2004 study conducted by Asad J. Khattak and Daniel Rodriguez of the University of North Carolina, Chapel Hill, suggests that households in the neo-traditional development substitute driving trips with walking trips. The study examined differences in travel behavior in a matched pair of neighborhoods (one conventional and one neo-traditional) in Chapel Hill and Carrboro, North Carolina. The survey and study of 453 households suggest that single-family households in the neo-traditional development make a similar number of total trips, but significantly fewer automobile trips, fewer external trips, and shorter trips than households in the conventional neighborhood, even after controlling for demographic characteristics of the households and for resident self-selection.[15] One term that transportation professionals often use to describe trip-making within a set district is “internal capture rate.” When urban planners talk about a high internal capture rate for a proposed district, this forecast relates to a higher percentage of multi-modal and/or combined trips within the district. This is something stormwater professionals should look for when evaluating plans.

Paved Area per Dwelling Unit – a Comparison

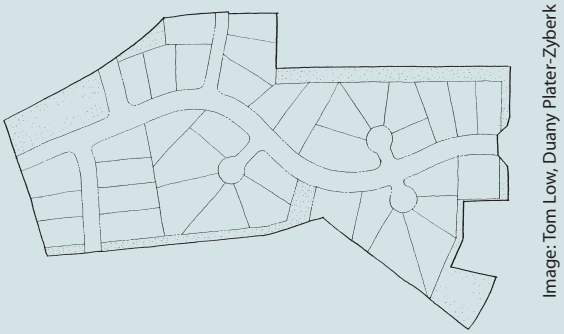


Image: Tom Low, Duany Plater-Zyberk

Conventional Residential Subdivision

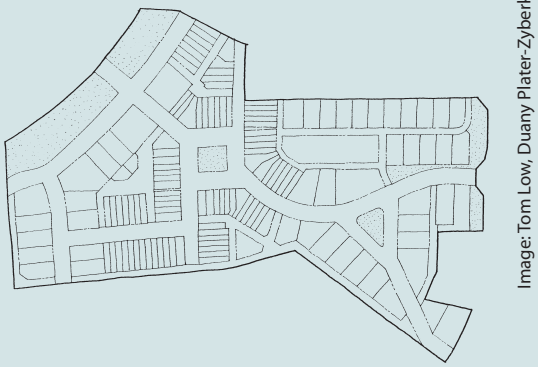


Image: Tom Low, Duany Plater-Zyberk

Mixed Use, Traditional Neighborhood Design

Vermillion is a traditional neighborhood outside Huntersville, North Carolina. The town enacted a TND ordinance to coordinate the approval process for TNDs. The two maps were drawn to compare the TND design and a more conventional, residential-only design.

In the new urbanist street plan, the greater part of the paved areas is taken up by narrow 18 feet roadway widths, whereas the conventional plan relies on wider 30 feet streets. Although the roadway area is higher in the TND plan, the street component per dwelling unit is far less, as indicated in the following tables.

Conventional Design

- 38 single family homes

Street Width (feet)	Street Length (feet)	Street Imperviousness (ft^2)
18	275	4,950
24	350	8,400
30	2111	63,330
		76,680
76,680/38 dwellings = 2,018 square feet street imperviousness/dwelling unit		

Traditional Neighborhood Design

- 40 single family homes
- 16 studio apartments
- 16 live/work dwellings
- 74 townhouses

Total 146 residential dwelling units

- One office building (4,400 square feet)
- Two medium sized office buildings (30,000 square feet total)
- Three smaller commercial buildings (15,000 square feet total)
- One restaurant (5,000 square feet)
- One church (10,000 square feet)

Street Width (feet)	Street Length (feet)	Street Imperviousness (ft^2)
18	3,270	58,860
24	750	18,000
30	525	15,750
		92,610
92,610/146 dwellings = 634 square feet street imperviousness/dwelling unit		

The analysis did not look at sidewalk lengths, or the street imperviousness related to commercial buildings.[16]

Development and redevelopment plans that are based on districts might also allow stormwater officials to meet requirements under the Illicit Connection Minimum Control under Phase II. Many large redevelopment parcels are near waterways and offer the potential to correct stormwater and infrastructure problems. Many illicit connections are found in older manufacturing districts, so you may be able to also meet requirements to find and eliminate illicit discharges.

Finally, the stormwater performance of a site is the result of, or enhanced by, the additive effect of several redevelopment policies. For example, in a TOD district, policies to require higher density development are combined with maximum setback rules and reduced parking requirements. All three of these policies work together to support transit use and higher density projects on a smaller development footprint. It is worth noting that under current practice, development districts such as office and industrial parks do not carry these advantages. The dispersed arrangement, large surface parking lots and predominance of a single use (e.g., office only) serve to spread development—and the associated impervious surfaces—out further.

Typical Costs

For the public sector, the cost of planning a special district and setting or revising zoning is the staff time required to research, adopt, and implement the new codes. Some communities hire consultants to help gather and coordinate stakeholder input, draft design alternatives, and create final plans. The range of costs varies. You may be able to tap the expertise of a local university or nonprofit at a lower cost for gathering input and narrowing the scope of items that need the specialized skills of a consultant.

While brownfields redevelopment can be costly, new regulations and programs are in place to assist localities and developers. The variety of activities related to financing and redeveloping brownfields sites is beyond the scope of this publication, but you may have brownfields redevelopment activity underway which you can cite in your stormwater guidance materials. EPA has a comprehensive site on how to remediate, market, and develop brownfields sites at <www.epa.gov/swerosps/bf/index.html>.

Some communities may already have design manuals in place for transit districts, TNDs, or new urbanist communities. These can serve as a starting point for developing a joint smart growth/stormwater BMP manual. These manuals typically include detailed information on streets, building envelopes, the use mix, and transportation connections. Stormwater, zoning, and planning departments may be able to cost-effectively create a BMP manual for development districts from work that has already been completed. For example, a stormwater engineer could take the city's manual on TND and insert information on siting stormwater handling facilities within the TND, on using water features for stormwater control, and sizing criteria for various BMPs and performance criteria at the site and neighborhood scales.

Measurable Goals

For a jurisdiction without comprehensive zoning for development districts, a short-term goal could include adoption of a special district ordinance. For a jurisdiction that already has special zoning districts in place, goals would depend on the type of ordinance adopted. For jurisdictions with TOD zoning, a goal might be to raise the percentage of new development built in already-developed areas by a certain percent over a specified time period. If detailed information is available on transit use, one can estimate the reduction in automobile-related deposition and runoff pollution.

As listed above, communities may also want to estimate stormwater performance of smart growth projects not only on the site level, but on the watershed or regional level as well. Redevelopment of an entirely developed site basically results in no net increase in stormwater at the local level, but also absorbs development demand that would otherwise result in the addition of impervious cover in an undeveloped portion of the watershed. Subsection 1, Regional Planning gives information on the methods for comparing smart growth and conventional development plans.

Examples

San Diego has launched a "City of Villages" plan to direct development via infill and redevelopment to certain neighborhoods. The planning update and the stormwater management cross-reference the City of Villages infill plan as a water strategy. To see more on the planning efforts, visit <www.sandiego.gov/cityofvillages>. For more on the Urban Runoff Management Plan, visit <www.sandiego.gov/stormwater>.

LEED Neighborhood Design

Check with your zoning or environmental works department to see if your locality has adopted the U.S. Green Building Council's (USGBC's) scorecards. These scorecards, called LEED (for Leadership in Environmental and Energy Design), contain rating systems for development and redevelopment projects. USGBC is developing a new scorecard called LEED Neighborhood Design – or LEED ND. This scorecard includes not only green aspects of individual buildings, but of their location as well. Thus, the scorecard takes into consideration the smart growth principles based on transportation options, a mix of housing types, and connections to the broader community. LEED scorecards, including LEED ND, include rating points for how the project or district handles stormwater, and might provide a template for measuring your locality's performance under NPDES. For more information on the LEED scorecards, visit <www.usgbc.org/leed/leed_main.asp>.

An example of creative stormwater financing comes from **Elm Grove**, **Wisconsin**. Flooding has been a significant problem for the city—in particular, for the downtown area. In 2001, the city developed an economic development plan for the downtown, with a focus on reducing the flooding. To address the flooding issue, the city has developed a stormwater mitigation plan with many elements, including restoration of concrete-lined creeks to their natural state, improving stormwater retention areas and redesigning the city's park with water control in mind. Because the flood management plan is expected to reduce the size of the 100-year floodplain, properties that are no longer in the floodplain as a result of the improvements will increase in value. The town is

creating a TIF district to capture this value, and invest in the targeted stormwater improvements. The town is also creating a stormwater utility because the monies raised through the TIF are not expected to cover the costs of all of the needed improvements. The town is coordinating the water planning with the revised Master Plan for its downtown, which will include retaining a small town feel, creating a pedestrian friendly environment, and incentivizing redevelopment in the downtown area. For more information, visit <www.elmgrovewi.org>.

The Trust for Historic Preservation sponsors the Main Street Program to spur investment in older downtowns. Enterprise Zones and Elm Street Programs are other programs established to attract investment to older downtowns. These programs are evidence of growing interest in historic areas and what they offer, such as unique older buildings, a walkable layout, and economic potential. Stormwater professionals should look to these programs in their communities as a way to manage stormwater runoff within their watersheds. To learn about the specific policies and programs, visit <www.mainstreet.org>.

The **Mountain View, California**, transit station, called The Crossings, is an example of how redevelopment of a greyfields site into a transit district can include better stormwater management. Prior to redevelopment, the 16-acre site was 98 percent impervious cover and home to an underperforming shopping mall. Because the California Department of Transportation planned to build a commuter rail station immediately adjacent to the site, the city of Mountain View envisioned making the station a success through a higher density and mixed-use development program. As redevelopment occurred, planners were able to build in onsite handling of stormwater for more than 45 percent of the site. Open spaces designed to absorb water are complemented by compact building sites, a grid of narrow streets and a space-efficient parking plan. For this and other case studies, visit the Natural Resources Defense Council's "Stormwater Strategies" at <www.nrdc.org/water/pollution/storm/stoinx.asp>.

More information on the transportation and land use performance of the station area in Mountain View can be found at <transitorienteddevelopment.dot.ca.gov>; follow the links to "The Crossings."

Points to Consider

One type of special district that requires particular attention is the use of impervious surface coverage districts. Impervious surface zoning districts generally set maximum ratios on the amount of impervious surface within a zone or, more commonly, on a parcel. For example, an ordinance might state that no more than 20 percent of a lot may be covered with impervious surfaces such as rooftops, driveways, or accessory buildings. Often, the purpose behind impervious surface districts



Photo: EPA

A mixed-use district is used at The Crossings, in Mountain View, California.

is based on studies that show watershed decline begins once impervious surface coverage exceeds 10 percent.[17] The 10-percent figure has been applied to the individual site level within the watershed, suggesting that limiting development to lower densities that only cover a portion of the site will translate across the watershed to more pervious surfaces for stormwater control and preserved ecological function.

However, application of an impervious surface district on a parcel-by-parcel basis, might not help meet stormwater objectives, and in fact, might result in worsened water quality, particularly on a watershed scale. The following are points to consider regarding impervious surface districts that apply only to the site level:

Impervious surface ordinances consider only site cover, not the ultimate goal of reducing stormwater runoff volumes: For example, suppose a homeowner would like to build an addition to his/her house, which is located in an older urban area that the city has designated for economic redevelopment. The homeowner also would like to disconnect the downspouts and develop a rain garden and other features to handle all of the stormwater on site. An impervious surface code, read strictly, would prohibit that homeowner from building the addition, even though the homeowner would improve stormwater management on the lot. The impervious surface district has the effect of creating a low-density district, which may run counter to a community's wish to accommodate more density in certain neighborhoods to make use of transit, foster redevelopment, or respond to market demand.

Much of the "pervious" surface in low-density development acts like impervious surface for handling stormwater: Development practices can involve wholesale grading of a site, removal of topsoil, severe erosion during construction, compaction by heavy equipment, and filling of depressions. Research now shows that the runoff from highly compacted lawns is almost as high as runoff from paved surfaces.[18] The turfgrass planted in a typical new residential project does little to reverse the impacts to the soil by construction. Further, turfgrasses have shallow roots that do not provide the same soil anchoring, water uptake, and other ecological processes as deep-rooted native grasses and plants.

Low-density developments tend to be accompanied by more offsite impervious infrastructure: Development in a watershed is not simply the sum of the parcels within it. Rather, total impervious area in a watershed is the sum of site developments plus all of the infrastructure (e.g., water utility, transportation) supporting those sites. For example, the hard cover of a parking space with dimensions of 18 feet by 9 feet is not the only imperviousness associated with that space. Drive or access aisles are also typically coded into parking standards; a parking lot with 90-degree parking typically is served by a 24-foot drive aisle that spans the length of the parking lot and ties into other access lanes. Additionally, many modern street codes require additional lanes for turning, deceleration, and service lanes. An impervious surface coverage district that considers only development of individual sites might miss much of the impervious surface that is leading to degradation of water quality in the entire watershed.

Growth is coming to the region; limiting density on a given site doesn't eliminate that growth. Density limits are responses to—and attempts to manage—growth: Yet these limits do not, in fact, manage growth; they only manage the growth on the density-limited area. The rest of the growth that was going to come to the region still comes, but spreads throughout or across the watershed.

From a water resource protection perspective, defining the balance of developed areas and open space requires a broader look at watershed management, rather than limits on a parcel-by-parcel basis. A first step is to plan for strategic preservation of continuous tracts of open space. Second, preservation of critical ecological areas such as riparian corridors, stream buffers, flood plains, and wetlands is needed. These parcels are of critical importance in developed areas to absorb and filter stormwater. Third, for land that is to be developed, smart growth strategies such as higher density and more compact development serve to disturb less land and accommodate more development. As mentioned elsewhere in this publication, redevelopment sites are particularly attractive when considering development and stormwater mitigation options since they use already-developed sites and are likely to use existing infrastructure.

There is a spirited debate about the performance of impervious surface limitations and how they should be structured to achieve the intended water quality goals. One result of the debate is a better focus on comprehensive strategies needed in a watershed. Organizations like the Center for Watershed Protection <www.cwp.org> and Project NEMO's research division <nemo.uconn.edu/impervious_surfaces/index.htm> are fine-tuning the mapping, measurement, and characterization of impervious surface coverage and the relationship to water quality.

If an impervious surface special district is in your plan, one suggestion is to make sure the program looks at a watershed scale and the individual parcel, and includes all supporting impervious surfaces in the watershed. Another strategy involves modifying or eliminating the coverage limitations for certain districts to which you want to direct growth. You may want to conduct a survey of imperviousness per unit of development for conventional and smart growth plans. Impervious surface limitations may make sense in one part of the watershed (for example in headwater areas) or when applied watershed wide, but only when carefully reviewed with other subwatershed and subareas plans where redevelopment and development is desired.

If your locality has a smart growth plan, make sure your impervious surface zoning does not act as a barrier to that plan. If your plan calls for higher density in certain districts, such as TOD districts and downtown redevelopment areas, then your impervious surface district should have enough flexibility to allow such density. Many areas are exploring the possibility of trading systems that coordinate development and preservation efforts. Trading programs might be found within a total maximum daily load (TMDL) program, for trading of impervious surfaces on a watershed-wide basis, or through a "payment in lieu of" program for installing BMPs. EPA has launched efforts to facilitate trading as a way to improve water quality. To learn more about EPA policy and the steps involved in establishing a trading program, visit <www.epa.gov/OWOW/watershed/trading.htm>.

TMDLs, Stormwater, and Smart Growth

Across the country, more than 40 percent of waterways are impaired by pollutants, sediment, temperature (typically heat), and nutrients. These waterways can be stream segments, bays, estuaries, and lakes. Once a waterway is listed as an impaired waterbody, localities are responsible for developing a "budget" for how much of a pollutant load the waterbody can experience. This budget is referred to as a TMDL, or total maximum daily load. A process typically follows to identify major sources (e.g., agriculture, urban runoff) and allocate a portion of the pollutant load to each source. The goal of a TMDL program is to restore a waterway by reducing pollutant sources. Thus, sources often face reductions in how much pollutant they contribute.

Stormwater can be a major contributor to impairments due to the heat, nutrients, metals, and other pollutants carried in runoff. Thus, reducing stormwater runoff in areas with impaired waterbodies is often at the center of the TMDL process.

As discussed throughout this document, smart growth techniques can help prevent and/or reduce stormwater volume and the pollutants carried within the runoff. In other words, smart growth can offer load reductions. By encouraging designs with lower impacts, the locality has taken steps not only to lessen development's effect related to transportation and infiltration, but also to provide an incremental reduction in the pollutant load from stormwater discharges. Though not required, some states and localities are including budgets within TMDLs for future growth. Communities that adopt growth management strategies that encourage smart growth and discourage sprawl are in a better position to control pollutant loadings from stormwater discharges, soil erosion, wastewater treatment systems, and many other sources of pollutants.

Some states have expressed concern that implementation of TMDLs could impede smart growth strategies because TMDLs will prohibit additional sources, which is assumed to be a prohibition on redevelopment and infill for urban areas. The fear is that developers will be inclined to focus their proposals on "greenfields" on the urban fringe, where TMDLs are not in place. Consider, however, that (1) many vacant and unused properties in urban cores already are largely impervious as a result of paving and soil compaction, so putting new buildings on these sites is unlikely to make runoff outcomes worse, (2) as described elsewhere in this publication, green building and site design options present the potential for actually reducing runoff volume and pollutant loadings from infill and redevelopment sites, and (3) greenfields development projects commonly have their own stormwater requirements so that a developer of any site will need to think about appropriate controls.



Photo: NRCS

5. Tree and Canopy Programs

Definition

Urban forestry programs are not typically considered stand-alone smart growth policies; however, tree programs are increasingly appearing as elements of larger urban design plans for landscaping or aesthetic purposes. In addition, tree policies are evolving to include abatement of urban heat island effects, or as part of transportation plans to improve the pedestrian environment. There are different types of plans and ordinances, from those that protect historically significant trees to tree planting programs. Street tree ordinances generally cover the planting and removal of trees within the public right-of-way.

These new urban forestry policies are also evolving to target tree canopy and shade cover, rather than policies that focus on numbers of individual trees. In other communities, trees are becoming part of the "public utility" as new methods are developed to measure and account for the environmental attributes of mature trees. The "utility" approach also recognizes that trees, like power lines and pipes, require maintenance and have costs associated with that maintenance. Whether it's the pedestrian environment, aesthetics, or air quality, the result of an effective urban forestry policy translates into stormwater benefits.

Who Do I Talk to About Tree and Canopy Programs?

Tree ordinances are typically overseen by public works departments or departments of environmental quality; however, also check with your local extension agent. The International Society of Arboriculture has a Web site describing the development, implementation, and evaluation of tree ordinances; go to <www.isa-arbor.com> and type "ordinances" into the site's search engine. Scenic America also lists a model tree ordinance, at <www.scenic.org>. American Forests' Web site at <www.americanforests.org> tracks tree policies and ordinances, as well as innovations in technology, research, and non-regulatory methods for supporting urban forestry.

Stormwater Benefits

A well maintained tree canopy can provide a variety of environmental benefits. Trees provide erosion control and help reduce the costs of structural stormwater management, including land acquisition costs and construction of stormwater retention facilities. Strategically preserving or planting trees along urban rivers, streams, and creeks can reduce water temperatures. Increased temperatures affect certain native aquatic species, can increase nuisance algae populations, and impact commercial activities that rely on stable water temperatures for recreation, industrial use, or aesthetics. Tree canopy intercepts rainwater, which provides for gradual release of rainwater into streams, thereby preventing flooding, filtering toxins and impurities, and extending water availability into dry months when it is most needed.

Examples from selected cities include:

- At a south **Miami** residential study site the existing tree canopy reduces stormwater runoff by 15 percent.[19]

Photo: www.pedbikeimages.org/Dan Burden



On-street parking can be coupled with tree wells in a downtown setting.

- In **Milwaukee**, the existing tree canopy cover reduces stormwater flow by up to 22 percent and provides the city an estimated $15.4 million in benefits. On average, trees in Milwaukee sample sites reduced total stormwater runoff volume by 5.5 percent and reduce peak flow by 9.4 percent. At the residential study site, the 42 percent existing tree canopy reduces stormwater runoff by 22 percent. If all trees in the Milwaukee study were removed, the additional stormwater flow would be enough to require the construction of an estimated 357,083 cubic feet of retention capacity valued at approximately $15.4 million.

For information on other environmental benefits from trees, visit <www.treesatlanta.org>.

Typical Costs

Tree programs and ordinances have costs mainly associated with development, implementation, and enforcement. Maintenance of older trees can be expensive, particularly since the goal of your program is to nurture trees to maturity for maximum stormwater benefit. When these costs are considered as part of a community's stormwater infrastructure, however, they may prove worthwhile when compared to other water control expenses. Garland, Texas, used American Forests' software package CITYGreen to measure the cost savings associated with its tree canopy. Garland's trees provide 19 million cubic feet in avoided storage (for the average maximum two-year 24-hour storm event). The city estimated that it saves $2.8 million annually, calculating the cost of construction funding over the 30-year life of a facility.[20]

Measurable Goals

Short-term goals can include the establishment of a tree program that tracks the number of trees that have been saved or the number of trees planted in your jurisdiction.

As noted previously, maximum stormwater benefits come from tree canopy cover. Urban forest groups have established the environmental performance of tree cover. Software programs can help establish your baseline tree canopy and estimate the dollar value of the services provided to a community by its tree cover. Establishing a baseline and tracking cover with a software package can translate into numeric expressions of stormwater performance. For more information on one such program CITYGreen, visit <www.americanforests.org/download.php?file=/graytogreen/stormwater.pdf>.

Examples

The U.S. Department of Agriculture's **U.S. Forest Service–Southern Region** maintains information on trees and tree cover, including research, PowerPoint presentations, and model tree programs at <www.urbanforestrysouth.org>.

The **City of Roanoke, Virginia**, used CITYGreen to measure cost savings associated with its tree canopy. Roanoke's 32 percent tree canopy provides 64 million cubic feet in stormwater retention capacity, valued at $128 million (based on construction costs estimate at $2 per cubic foot). Based on the study results, the city council passed a 40 percent tree canopy goal as part of the city's comprehensive plan.

Points to Consider

Different trees have different absorption rates, growing condition needs, growth rates and life spans. Consult an arborist to determine which trees will suit the needs of your community. In the Pacific Northwest, Metro (Portland Oregon's regional government) has published a guide to the stormwater benefits associated with different trees. For specific interception rates for different types of trees and analysis of the benefits of different tree species, see *Trees for Green Streets: An Illustrated Guide*, (order from <www.metro-region.org/article.cfm?articleid=263>). Note that many climates in the United States are too arid to support a full canopy; these areas can use xeriscaping and other landscaping means to control runoff. Additionally, deciduous trees are far less effective at capturing stormwater once they shed their leaves in the winter.

When developing a tree ordinance, clearly outline your goals, methods of coordination and enforcement, and evaluation procedures. At least one tree ordinance has been successfully challenged in court as unenforceable by a developer because the language was too vague. In 1999, a Fulton County Superior Court Judge ruled in favor of developer against the city of Atlanta because a section of the city's tree ordinance lacked "sufficient" objective standards.

If you include urban forestry in your stormwater program as a BMP, think long term about maintenance requirements and be creative in finding funds for maintenance. If there are funds dedicated to funding all types of stormwater BMP maintenance, consider using these funds for tree pruning, tree care, and replacement programs. The state of Pennsylvania has proposed a BMP maintenance program that allows developers to pay a fee to cover maintenance for 10 years. For urban forestry programs, this can be an effective funding mechanism for getting a tree program started.



Photo: NRCS

Students at an elementary school in Des Moines, Iowa, plant a tree during Arbor Day celebrations.

6. Parking Policies to Reduce Number of Spaces Needed

Definition

Parking lots are one of the more visible aspects of imperviousness within the built landscape, and managing stormwater through better parking lot design is contained in many of EPA's guidance documents on improving water quality. Retrofitting parking lots is emerging as a popular BMP; however, an equally effective approach is to reduce the footprint associated with parking spaces before they are actually built. Thus a parking policy that updates land development standards and zoning codes to reduce the parking footprint is a BMP.

This subsection looks at two broad techniques for reducing the amount of imperviousness associated with parking:



Photo: www.pedbikeimages.org/Dan Burden

This streetscape design ties together retail activity, landscaping and parking. Tree grates were designed to capture water and provide shade while also providing easy access for pedestrians and motorists as they exit the parking area along the street.

- **Structured parking**: Instead of surface lots, parking can be provided in garages. The same number of spaces can thus be provided on considerably less land. While parking can also be provided below grade, for most areas this is prohibitively expensive. Therefore, this subsection will discuss items mainly related to structured parking.
- **Reductions in number of spaces**: Reducing the number of parking spaces involves two main techniques:

  1) Reduce parking requirements which mandate a certain amount of parking. These requirements often require too many spaces but can be retooled to reduce spaces, provide flexibility for TOD, or change from minimum to maximum ratios.

  2) Encourage shared parking, by which users of two nearby facilities can share the same parking spaces at different times. For example, a church, which generally needs parking on Sunday mornings could share parking spaces with a movie theater, which needs parking spaces in the evenings. Shared parking can also apply to better use of on-street parking spaces.

This section does not include information on retrofitting parking lots with infiltration strips and landscaping since the focus is on the sizing and footprints for parking. There are links in the "Resources" section to more information on using infiltration techniques on new and existing parking lots.

Who Do I Talk to About Parking Plans and Requirements?

In general, parking requirements are contained in land use and zoning documents, and are typically expressed as minimum numbers of spaces per unit of development. They may be in plans held in the department of public works or in the office of planning. On-street parking is typically governed within the local traffic engineering office or in the department of public works. There are various types of parking and policies related to parking as discussed below.

Parking Requirements: Most zoning codes have detailed specifications of parking requirements by use (e.g., a commercial district may specify four parking spaces per 1000 ft^2 of office space). A residential district may require two off-street spaces per unit. Within a district, there may be further parking specification by use; for example, for a church or for fast food restaurants. Localities enacting smart growth plans are changing their parking standards in recognition that fewer spaces are needed when there are transportation options and a mix of uses. They are also changing policies to permit more flexible programs. For example, some jurisdictions are beginning to use maximum parking requirements instead of minimums. Review the parking requirements in your zoning codes, within special use permits, and in parking guidelines and stormwater ordinances that may serve as a barrier to flexibility. For example, language might require a business to satisfy its parking requirements within 400 feet and reserve parking only for that business. This could prohibit shared parking, as discussed below.



Photo: EPA

Transforming parallel spaces to diagonal ones on this wide retail street increases the amount of parking without adding impervious surface.

Parking Overlay Districts: Overlay districts introduce new requirements. Parking overlays are good for transit districts, where policies are needed to support several modes of travel. For example, a TOD district may have a parking overlay that reduces the number of spaces needed based on proximity to a transit stop. Combining a parking overlay district with complimentary policies, such as shared parking agreements among several building owners, can help to balance demand for spaces throughout the day in a parking overlay district. In this case of TOD districts, you may need to also consult the transit agency.

On-Street Parking: One of the most overlooked resources for parking is one that already exists—use of the street. There are a variety of management techniques to help use this resource, such as meters, permit parking and angled parking. These spaces

Photo: City of Boulder, Colorado



In Boulder, Colorado, downtown developers are discouraged from building parking for individual projects. Instead, they pay a parking and transportation in-lieu fee. These fees are then used to build public garages, as well as to fund transit, bicycle, and pedestrian improvements.

can be governed by the Public Works departments, or by a special parking office.

Site Plan Conditions or Proffers: If your jurisdiction negotiates site-specific development requirements, check the office that oversees site plan conditions or proffers. Often the number and location of parking spaces is a negotiated element on a project-by-project basis.

Structured parking: Structured parking can either be a multi-level lot or underground parking. Because of the expense involved, structured parking typically occurs in downtown areas, districts with higher densities, or near arenas and stadiums.

Shared parking: Some shared parking plans may be drawn by local redevelopment organizations or business improvement districts, or by large institutions like universities or hospitals. In larger cities, private parking companies may also exist, so check with them as you gather information on opportunities to improve parking policies.

Parking Pricing: Parking pricing introduces a fee for parking. Pricing typically serves as a transportation demand strategy (to reduce vehicle use), a parking management strategy (to reduce problems in specific locations), and/or as a means to raise money for parking and other projects.

Determining how much parking to provide for retail, offices and residential areas is a balancing act to make sure there is enough parking to support the range of intended uses, but not so much as to undermine good community design and stormwater improvements. As shown in Table 3, the decision on how many spaces to provide is more often than not tilted toward an oversupply.

Stormwater Benefits

Reducing the amount of surface parking reduces the quantity, speed, and impurities of the runoff. For example, one researcher calculated that a one-inch rainstorm on a one-acre meadow would produce 218 cubic feet of runoff, while a parking lot the same size would produce 3,460 cubic feet.[21] Among the pollutants that accumulate on parking lots are cadmium, copper, lead, zinc, nickel, cobalt, and iron, which are found in gasoline, grease and oils, antifreeze, brake linings, and rubber.

Under most parking standards, the number of spaces required is often dictated by times of "peak use," such as holiday shopping, which tends to be heavier than at other times

Table 3: Conventional Minimum Parking Ratios

Land Use	Parking Requirement		Actual Average Parking Demand
	Parking Ratio	Typical Range	
Single family homes	2 spaces per dwelling unit	1.5 - 2.5	1.11 spaces per dwelling unit
Shopping center	5 spaces per 1000 ft^2 GFA	4.0 - 6.5	3.97 per 1000 ft^2 GFA
Convenience store	3.3 spaces per 1000 ft^2 GFA	2.0 - 10.0	--
Industrial	1 space per 1000 ft^2 GFA	0.5 - 2.0	1.48 per 1000 ft^2 GFA
Medical/dental office	5.7 spaces per 1000 ft^2 GFA	4.5 - 10.0	4.11 per 1000 ft^2 GFA
GFA: Gross floor area of a building without storage or utility spaces			

Source: *Parking Generation, 2nd edition*. Institute of Transportation Engineers, Washington, DC. 1987; Smith, Thomas. *Flexible Parking Requirements*. Planning Advisory Service Report No. 377. American Planning Association, Chicago, IL. 40 pp. 1984; Wells, Cedar. Impervious Surface Reduction Technical Study. Draft Report. City of Olympia Public Works Department. Washington Department of Ecology, Olympia, WA. 1994.

of year. By reducing the number of spaces and integrating flexibility to handle peaks, there can be an overall reduction in the amount of impervious surface.

In 1993, the city of Olympia, Washington, launched its impervious surface reduction study to simultaneously address water quality concerns and a growing population. As part of this larger study, the city conducted a comprehensive study of parking. The city found that, on average, 53 percent of commercial sites were taken up by parking lots. As part of the impervious surface reduction study, the researchers studied the feasibility of reducing commercial parking. They found that, while business owners did not think they provided too much parking, the typical occupancy rate in parking lots was only 46 to 67 percent. Eighteen of 31 representative sites had less than 75 percent occupancy rates during the busiest peak hours surveyed. The city also calculated that during a two-year rain event (2.8 inches in 24 hours), approximately 38 cubic feet of runoff would be generated by a 9-foot by 18.5-foot surface parking space (not including drive aisles and turn lanes).[22]

Typical Costs

Surface vs. structured parking: For a given parcel of land, structured parking is always more expensive than surface parking. According to one industry estimate, construction costs for parking spaces range from $1,500 to $1,800 per space for surface parking, and from $12,000 to $20,000 for structured parking (costs in 2000 dollars).[23]

Parking requirements: Although there is no hard cost to changing parking requirements, municipalities will need to devote staff time or resources to hire a consultant to write new

Photo: EPA



In Saint Louis, Missouri, rush hour lanes along a main arterial are converted to diagonal parking on Sunday for nearby churches. This system allows many more cars to use on-street parking for the limited hours on Sunday when demand for spaces is high and traffic volumes are less than that generated on weekdays during rush hour.

parking ordinances. If a locality wants to add more on-street metered parking, there are supply and administrative costs, though these can be offset by meter revenue. Note that some localities are using meter revenue to support the costs of planning and supporting parking for downtown and retail districts.

Shared parking: In situations that lend themselves to shared parking, there are two main costs to making it happen. First, the parties involved generally draw up an agreement, which may present costs in terms of researching what to include and legal fees. Second, ongoing maintenance costs must be divided. Providing on-street parking makes use of an asset that is technically paid for and shared, and thus adds no additional cost to the developer or user. In addition, supplying parking in a lot requires more impervious surface to provide drive aisles, entrances and ramps. On-street parking does not require this extra infrastructure, thus lowering the amount of land, and thus cost, to provide parking.

Measurable Goals

One quantifiable goal could be reducing the amount of parking in new developments or redevelopment projects; for example, reducing the percentage of surface parking in new developments' footprints by 5 percent. Another measurable goal could include changing ordinances to require maximum parking ratios instead of minimum ratios, adjusting downward the number of spaces used in a locality's standards for parking, and encouraging the use of shared parking.

Another measurable goal could be a surface lot replacement program. Where excess capacity is identified, the city can assess which lots are candidates for infill and which lots could be retrofitted with infiltration techniques. The decisions will likely be based on development trends, water quality goals and the availability of incentives. As with the discussion on infill and redevelopment, characterizing the performance should be conducted on a site, neighborhood, and watershed scale.

Examples

Surface vs. structured parking: Montgomery County, Maryland, contains four parking districts around rail stations. Special taxes are levied on development within the districts, and the zoning ordinance encourages structured parking by exempting parking garages from those taxes.

On-street Parking: In **Arlington County, Virginia**, the redevelopment plan for Columbia Pike places minimum requirements for providing public parking and maximums for the provision of private parking. A developer may pay an "in lieu of fee" if the parcel is too small to meet the standards. One innovative aspect of the plan is the ability to count adjacent on-street public spaces toward the parking requirement. The parking plan also includes a focus on centralized, shared parking that will create a "park once; then walk" environment for visitors who choose to drive.

Santa Rosa, California, is conducting a parking project in its downtown area with "back-in" diagonal parking. In the pilot phase, 22 spaces replaced 15 parallel on-street spaces. With these spaces, motorists traveling along a street would drive past a diagonal parking space and then back into it. This layout makes easing back into traffic safer, since the motorist can see oncoming traffic and bicyclists.

Parking requirements: A number of **California** jurisdictions have innovative parking requirements that effectively reduce the number of spaces required for residential development. For example, San Diego allows housing built in a transit-intensive area or designated for low-income residents to have 0.25 fewer spaces per unit. Sunnyvale allows 0.3 or 0.4 fewer spaces per unit if parking is unassigned (as opposed to available in private garages). Concord allows developers to request a variance from existing codes if housing will be occupied by seniors or disabled persons.

San Antonio, Texas, has both minimum and maximum parking requirements. For example, most retail uses must provide at least one space for each 300 square feet of gross floor area, but no more than one space per 200 square feet. In addition, structured parking and lots paved with pervious materials are exempted from maximums, providing an incentive for developers to reduce parking impacts.

The **University of Washington** has initiated a pay-per-use parking program that replaces monthly parking passes with a per-hour fee. University employees are electronically charged each time they park rather than paying a flat monthly fee. Users also receive a free bus pass and Flexcar membership.

Shared parking: The city of **Tualatin, Oregon**, granted a 25-percent reduction in parking spaces required by mixed-use development Tualatin Commons in return for shared parking.

Points to Consider

Once you have decided on new parking strategies like the ones outlined in this subsection, an important consideration is what to do with the land that is no longer dedicated to parking spaces. Water quality specialists might think the most obvious choice is to dedicate the land to absorbent open space. However, this open space may serve to scatter development and result in unwalkable "office parks." From a redevelopment position, the obvious answer might be to fill it up with development, though this action could eliminate options for handling more water on site. The answer will depend on your community's goals and site constraints.

Good urban planning will consider a compact form that addresses stormwater, a walkable and viable development program, and how people move in and around the site.

Surface vs. structured parking: Structured parking incentives can be coupled with parking regulations that allow a maximum parking footprint (or impervious area) per residential unit.

Parking requirements: Many neighborhoods oppose reducing parking requirements under the assumption that this will result in more commercial "spillover" parking in the neighborhoods. Some jurisdictions have adopted "zone" parking that only allows residents to park on streets in the affected neighborhood. These zones can be limited to rush hours or 24 hours if the neighborhoods are experiencing severe spillover pressure for parking. In addition, developers might wish to reduce the number of spaces they are required to supply, but feel pressure from their financial backers to oversupply parking. An ample supply of parking is often viewed as a necessity for financial success or the ability to sell the property in the future. As the Washington State study shows, this view may overlook the financial penalty that comes with building spaces that ultimately are rarely (or ever) used.

Shared parking: Although there are many potential instances in which shared parking can be used, there are several reasons why it is not as common as it might be. First, if the uses do not share a common property manager, they need formal or informal agreements to share parking. Second, they may not agree on whose responsibility it will be to maintain parking lots. Third, many business owners worry that their customers will stop patronizing them if they do not perceive that parking is adequate. Fourth, developers may fear that businesses will be less likely to lease their space or residents less likely to live there if they perceive the parking supply to be inadequate.

To overcome these problems, local jurisdictions can draw up shared parking guidelines to get the business community behind such plans. To see what a model shared parking agreement looks like, go to Metro-Portland's *Shared Parking Handbook* at <www.metro-region.org/article.cfm?articleid=435>.

Car sharing: Car sharing has emerged as a viable transportation option in many areas. Car sharing works best in urban environments that have a fairly high density of residential units (so that there are enough potential members to use the service) and other transportation options, such as transit and the ability to make pedestrian trips. Most of these cities were covered under Phase I of NPDES, but university towns developing plans and ordinances under Phase II might be good candidates for introducing a car sharing program. The Car Sharing Network publishes an updated list of all cities where car sharing is underway at <www.carsharing.net/where.html>.

The company Flexcar has studied the issue and estimates one shared car can take up to six cars off of the road (see <www.flexcar.com/vision/impact.asp>). The stormwater benefits are achieved when one car can be used to meet the needs of several drivers. These benefits include reduced demand for parking and car storage, as well as a reduction in automobile-related deposition on roads that can pollute runoff.

"**Green Parking:**" New technologies for pervious pavers and porous pavement are advancing rapidly. This technology is particularly attractive for low traffic areas and for spillover parking needed for athletic events, churches, fairs, and episodic activities. Replacing existing impervious cover for parking with pervious pavers has appeal and can provide water quality improvements where urban runoff is a main contributor to water quality problems. Replacing existing parking spaces with green technology and materials can help abate stormwater runoff and the pollutants carried in that runoff.

Green parking materials may not, however, lessen all of the environmental effects related to excess parking. Decisions on the total transportation system will be made to consider road design, number of turning lanes, drive aisles, and parking. In areas where your local transportation department is trying to balance transportation choices, the addition of new spaces, no matter the material, may work at cross purposes with smart growth plans aimed at making pedestrian trips as attractive as driving. In addition, green pavers require periodic maintenance. Fine debris and dirt accumulate in the drainage openings and reduce the pavement's flow capacity. It is natural for settling and clogging to occur over time, so maintenance schedules require vacuum sweeping several times per year.[24] When adopting policies for green pavement and materials, review the overall development design and transportation goals to find the right incentives or program for emerging technologies related to parking.

7. "Fix It First" Infrastructure Policies

Definition

"Fix It First" infrastructure policies place spending priorities on repair of existing infrastructure over installation of new infrastructure. Generally these refer to transportation infrastructure (e.g., roads, bridges, and rail systems) and water infrastructure (e.g., sewers and drinking water treatment/distribution), but may also apply to use of existing schools or other public buildings.

Who Do I Talk to About "Fix It First" Policies?

The first stop in any discussion about infrastructure is typically the public works department or city/county engineer, though your inquiries may be specific to a certain type of infrastructure.

Transportation: Your local public works department generally has a division devoted to streets, which would have information on projects underway or that are in the last stages of planning. The public works director or city/county manager might also know



Photo: Dan Burden

Reducing the amount of stormwater that enter curbs and gutters can be an effective means of lessening the effects of urban form on local waterways.

whether your locality has a framework for how transportation budgets are allocated for new construction and repair. On a regional level, the MPO or regional planning agency has knowledge of large-scale transportation planning and projects. MPOs are regional multi-jurisdictional organizations created for areas with a population greater than 50,000. They are mandated to make transportation spending decisions for metropolitan areas over 250,000 in population and would have information on any regional or state policies that prescribe funding priorities and allocation. At the state level, the department of transportation would have information on any such policies, though departments of community affairs or smart growth offices may have the most comprehensive information on statewide "Fix It First" policies.

Water: On a local level, the responsibility over water infrastructure (e.g., drinking water and sewer service) is typically shared by the local government and water utilities. New infrastructure, increases in capacity, and larger repairs are typically included in Capital Improvement budgets. Once installed, water utilities cover operation and maintenance for treatment plants and conveyance systems. Local and county governments often have the most control over the extension of water and sewer service into new development areas. These extensions can be governed by annexation rules, interlocal agreements among cities and counties, planning documents, or can be made on a case-by-case basis. You may need to talk to someone in the planning office to see how extensions and prioritization of repair decisions are governed.

Increasingly, infrastructure specific to handling stormwater is handled through a stormwater utility, though most funding lies within local capital improvement or operating budgets. Stormwater utilities are discussed in Subsection 9.

Because water infrastructure investments are large, funding might include state and federal money. How those funds are spent can rely on requirements established through a state revolving fund, a state capital improvement project or other programs. Thus, your local water infrastructure manager is likely to refer you to state offices and other Web sites. Further explanations may also be available through the city/county attorney, since the funding requirements are often established in regulations.

In some areas, large water projects may be planned and funded as part of large state and federal projects such as dams, canals and reservoirs. Though not a widespread practice, there are also some private water suppliers and engineering firms that could have control over capital and repair decisions.

Stormwater Benefits

"Fix It First" policies have long-term effects on stormwater management and can be a smart growth technique to encourage infill construction and redevelopment. In addition, "Fix It First" policies encourage replacement of older infrastructure, which can be a significant source of stormwater-related problems, particularly in older urban and suburban areas. In particular, sewer overflows during wet weather events can have severe environmental impacts. Inadequate or degraded sys-

tems can also increase the chances or severity of property damage from flooding.

"Fix It First" programs also can include new treatment technologies to improve the performance of existing systems. Many people are unaware that most stormwater runoff entering storm drains is not filtered and flows untreated into waterbodies. Oil/grit separators and in-pipe systems can be incorporated into the repair or routine maintenance of storm drains and pipes. For even stronger results, "Fix It First" policies can be coupled with techniques listed in Table 2 on page 23 to handle and filter as much stormwater as possible on individual properties.



Photo: City of Portland, Bureau of Environmental Services

As part of Portland's "Green Streets Program," the city launched the Siskiyou project to add water-absorbing curb extensions. These vegetated extensions intercept some of the stormwater flow before it enters storm sewers. This type of feature can be added as part of a street repair program in older parts of town where a reduction in stormwater flow is needed.

Typical Costs

"Fix It First" policies are built on the assumption that funds for infrastructure are limited and thus rely on shifting spending rather than increasing available funds. The costs are therefore measured in both short-term and long-term impacts, since they shift spending from new infrastructure (new capital spending) to existing infrastructure (repair, operations, and maintenance).

Even in cases where cities are developing strong programs to attract redevelopment, the poor condition of pipes and water handling facilities can be a barrier. The cost to repair water infrastructure around the country has been the subject of discussion and review—in particular, the funding needs to replace aging infrastructure. EPA recently launched a Sustainable Water Infrastructure initiative to complement the traditional funding programs with management techniques to lower costs, add efficiencies to water distribution and treatment systems and use a watershed approach for managing water infrastructure. Localities that are developing or fine-tuning smart growth plans will recognize parallels in this sustainable approach. Common themes include efficient use of land and water resources, a focus on existing infrastructure and investments, and the use of a regional approach to manage resources. See <www.epa.gov/water/infrastructure>.

Measurable Goals

For a jurisdiction that has a "Fix It First" policy, a goal might be to rehabilitate 25 percent of existing water infrastructure, roads, and bridges over a five-year period. A locality could also express goals in terms of linear feet of pipes replaced. For a jurisdiction without such a program, the goal might be to adopt a "Fix It First" policy at the state level.

Examples

Beaufort County, North Carolina, is part of a multi-county program to reduce nitrogen and phosphorous loadings to the Tar and Pamlico Rivers. The county has submitted a stormwater management plan to the state to meet both state laws governing nutrient reductions and Phase II. Its August 2004 draft stormwater plan includes the opportunity to allow an exemption from nutrient reduction requirements for projects included in redevelopment areas with a "Fix It First" policy. For more information, see <h2o.enr.state.nc.us/nps/TarPamlico_Nutrient_Trading_Program_files/documents/BeaufortPgm8-13-04.doc>.

New Jersey passed legislation in 2000 requiring its Department of Transportation (NJDOT) to reduce the backlog of bridges and pavement needing repair by half over a five-year period. It also forbids construction of new road investments unless approved by a joint resolution of the state legislature. The NJDOT must report annually on its progress in achieving these and other goals. Michigan and Massachusetts have adopted "Fix It First" legislation over the past two years as well.

Sometimes "Fix It First" policies are not explicitly called such, but are embedded in other programs. Directing a percentage of funds to priority spending areas can turn out to be a "Fix It First" policy. Many water utilities also have CMOMs, or "Capacity, Management, Operations and Maintenance" plans. These plans are used to ensure efficient use of water and wastewater distribution systems to ensure adequate baseflow into streams, to avoid overflows, and allocate resources to strained lines and connections in the system. Utility mangers establish policies to direct funding. If you are a developer or work in an economic development department, contact your local utility to see if the budget policies are aligned with your city's redevelopment or economic development plan to direct development to existing activity centers.

Points to Consider

States like New Jersey are finding that smart growth policies to direct development and

Keep Water Out

Even if your storm sewers are not in need of repair, one way to stay off of the "Fix It First" list is to "keep water out." EPA is developing tools to help municipalities lessen the amount of stormwater that flows into combined and separate stormwater systems. The reduced volume of water has many advantages, including a reduction in the risk of overflows, less stress on pipes and conveyance systems, and lowered pollutant loadings.

Some of the management practices to reduce the amount of water flowing into storm sewers are the same as many practices listed in this publication, including the promotion of better site designs and reduction of impervious surfaces, such as lowering the parking standards in your municipality's codes. Portland, Oregon, is a leader in implementing both smart growth and water policies. The city has instituted, among other things, a downspout disconnection program, discounts on stormwater utility bills for homeowners who handle stormwater on site, and a pilot stormwater credit trading program.

Once your "Fix It First" program has completed the investment in new infrastructure, you can prolong the investment by reducing stormwater flows that enter your gray infrastructure.

redevelopment are complicated by the fact that workable infrastructure is sometimes not in place. This highlights the importance of having infrastructure in place as you implement plans for redevelopment and infill. Implementing a "Fix It First" policy before other policies are in place may help your community realize redevelopment on a more predictable track. Likewise, a strict "Fix It First" policy may have the unintended consequence of prohibiting development in "greenfields" that are desired growth areas. New Jersey recently included language in infrastructure grants to give priority to infrastructure funding in preferred growth areas. A successful joint policy may include the pairing of redevelopment and "Fix It First" programs in order to synchronize public and private smart growth investments.

The redrawing of funding allocations creates redistribution of existing funds (or has the appearance of doing so). Communities might find it helpful to consider the economic and environmental goals of infrastructure policy on a watershed wide basis.

Finally, much of the evolution in thinking on water and stormwater has turned to green infrastructure, or using natural systems to handle stormwater. Green infrastructure need not be isolated to rural or suburban areas, as pointed out in Subsection 5 (Tree and Canopy Programs). States and localities should recognize, however, that policies to prioritize green infrastructure should not come at the expense of fixing aging pipes in areas served by gray infrastructure. Communities may want to seek out where the green and gray infrastructure support each other, or better, where green infrastructure can alleviate stormwater flow into both combined and separated systems.

8. Smart Growth Street Designs

Definition

Smart growth street designs are based on a network of well-connected streets that support multiple modes of transportation. Some smart growth approaches to street design include multiple route choices, alternative street and sidewalk designs, adjusting the vehicular level of service (LOS) and/or creating LOS for other modes of transportation, and designing connected street networks and sidewalks to support multiple uses.

Increasingly, stormwater guidance manuals list "green" techniques to mitigate the runoff from existing streets or those in the preliminary design phase, such as swales and elimination of curbs and gutters. The main emphasis in this section is the underlying street patterns, the connecting of transportation networks and the retrofitting of existing streets for multiple uses. The "Resources" section lists green techniques for streets which may be used to complement your smart growth street plans.



Photo: Anacostia River Business Coalition Washington, DC.

Street and curb designs can be modified so stormwater flows into natural areas for treatment. Grates to handle overflow can reduce the chances of street flooding during heavy wet weather events.

Who Do I Talk to About Street Designs?

The rules that govern local street designs are most likely to be found at the local level in the public works department or in subdivision guidelines. Check with your department of transportation or planning to find out what policies are in place. In addition, individual developers may develop their own street networks for planned unit developments (PUDs).

For streets that are already in place, there may be opportunities to improve connectivity and make better use of the existing street right-of-way. These may be included in long range comprehensive plans or redevelopment plans. Some of the improvements were listed in the previous subsection on parking. Other plans for streets may also be housed in the department that governs environmental improvements.

Subdivision codes may also have requirements about street design. Where the codes are not explicit about street design, check to see if there are requirements regarding connections to surrounding parcels, streets, or developments. Some jurisdictions require multiple connections, while others may limit the number of connections. For example, a code may require no more than two connections from the subdivision.

State departments of transportation play a role in building or improving state-controlled roads. In many growing areas, smaller highways and rural state roads are the main thoroughfares identified to serve new housing and commercial growth.

Stormwater Benefits

Because streets constitute the largest share of impervious cover in residential developments (about 40 to 50 percent), a shift to narrower streets can result in a 5- to 20-percent overall reduction in impervious area for a typical residential subdivision.[25] As nearly all the pollutants deposited on street surfaces or trapped along curbs are delivered to the storm drain system during storm events, this reduced imperviousness translates into a lower volume of stormwater runoff and pollutant loadings from the development. For stormwater quality factors, residential streets rank as a major source for many pollutants, including sediment, bacteria, nutrients, hydrocarbons, and metals.[26]

Understanding how a connected street network works to control stormwater on a watershed basis requires a review of how roadway design has evolved. Beginning in the 1960s, typical roadway design practices favored a less networked, "hierarchical" street design. This design begins at the lot level, with numerous unconnected streets, in particular for residential areas. Aerial photographs of subdivisions reveal common unconnected layouts, such as "lollipop" designs with cul de sacs, or communities with only one entrance. Within housing subdivisions, the individual, smaller streets feed into collector roads, which then lead, often through only one intersection, to arterials. The arterials (which in some cases are highways) link large, centralized trip generators, such as shopping centers, office parks, and subdivisions. Because there are few alternative routes of travel, the road system is designed to handle the collective flow of travel through key intersections onto other large

arterials. This road and intersection system features multiple turning lanes, wide intersections, and access lanes designed to minimize congestion with the collected and concentrated flow of traffic. This type of system increases the amount of land needed to handle collected traffic, concentrates traffic onto fewer roads, increases the pressure to widen the roads that handle collected traffic, and creates barriers to travel options, such as pedestrian trips.

Communities developing alternatives for multi-modal networks often turn to the 10 smart growth principles (see page 18) for guidance. The principles of creating walkable neighborhoods, mixing land uses, providing transportation options, directing development to existing communities and taking advantage of compact building design all come into play. The street systems that make this combination of features possible are characterized by multiple connections, as well as appropriately sized streets and intersections to support safe travel for vehicle drivers, bicyclists, and pedestrians. These street patterns can be in grids, but may also include paths and other connections. Although cul-de-sacs and dead-end streets are discouraged, there are a variety of street designs that can provide the slower traffic and privacy that homebuyers prefer, with the connections that help avoid the chokepoints and large feeder routes built into a hierarchical system. For stormwater engineers, the most beneficial point for a watershed lies in the compact form, which facilitates a higher intensity of development and mix of uses on less land.

The stormwater performance of smart growth street systems can be further enhanced by policies to reduce the amount of runoff entering the curbs and gutters, mentioned throughout this document. Likewise, developers and landscape architects can plan for intermittent retention areas to collect and treat some of the road runoff prior to discharge into a storm sewer system.

Finally, the notion of better stormwater management related to a tighter, connected network of streets with sidewalks may seem counterintuitive. Most literature on water quality highlights the detrimental effect of "connected impervious surfaces." Most efficient urban layouts are just that—highly connected streets and blocks. Thus, when making the case for the stormwater benefits of smart growth street designs, urban planning and water resource professionals should establish the framework for considering the site, neighborhood, and region simultaneously, in the same way that has been presented for development districts. For most regions, the question of growth—and underlying road design—is not whether there will be growth or no growth, but rather what the growth (and roadway system) will look like and where it is located.

Typical Costs

Cost estimates vary widely. When building new street networks, narrower streets may cost less to build than wider streets. Considering that the cost of paving a road averages $15 per square yard, shaving even 4 feet from existing street widths can yield cost savings of more than $35,000 per mile of residential street. In addition, because narrower streets produce less impervious cover and runoff than wider streets, additional

savings can be realized in the reduced size and cost of downstream stormwater management facilities.[27]

The costs will not necessarily always be lower, because specialized features like sidewalks, curb and gutter, street tree areas, and pavers are often included in the overall street design. These amenities, however, carry benefits for stormwater, transportation and community design, so a raw assessment of costs per mile or per trip might not capture the full range of benefits.

Installation of stormwater-friendly streets can also involve additional costs over streets constructed according to standard practices. Portland, Oregon, estimated a higher cost due to planting and maintaining landscaped buffers.[28] Where permeable or porous pavement is used, the site preparation for water storage involves additional costs. The cost savings these techniques bring for handling stormwater from streets can be hidden, however, because the budget for transportation and stormwater can be in separate accounts in different departments' budgets. In deliberations over stormwater utility rates, Portland estimated that 70 percent of its runoff could be attributed to transportation-related surfaces.[29] City and county managers should look to see where the higher costs of better street design are offset by lower demands on stormwater infrastructure.

Measurable Goals

Appropriate measurable goals for street design modifications are emerging. Like earlier discussions on development districts, local build-out analyses can help compare a "business as usual" scenario of build-out with one that contains more compact villages or districts. The streets component may be included with estimates of parking lanes, turning lanes, and other impervious surface coverage associated with roads and streets.

Another measurable goal might be the reuse—or new uses—of existing streets. For example, adding bike lanes, adding on-street parking, or adding medians could be included in your stormwater management plan.

Examples

The Institute for Transportation Engineers has developed two recommended practice guidelines: *Traditional Neighborhood*

Sidewalks on One Side of the Street – or Both?

Some states and localities are recommending that sidewalks be limited to one side of the street to reduce impervious cover, however, most smart growth plans endorse a network of sidewalks. Which is correct?

The answer lies not so much in stormwater control as it does in transportation. If sidewalks are designed as a prominent feature for handling a variety of trips (e.g., commuting, shopping, school travel, and recreation) and providing connections throughout the neighborhood, then placing them on both sides makes sense. If your project or plan envisions only recreational trips, however, then sidewalks on one side of the road makes sense. If you choose to only place sidewalks on one side, review the plan to make sure that future plans for growth and a mix of uses are taken into consideration so that sidewalks might be added later to meet the demand for pedestrian trips.



Photo: Local Government Commission.

This street and sidewalk in Hercules, California, shows how multiple objectives can be met at once. The streets are narrow; however, the rounded curb allows extra width in case emergency response vehicles need extra room. The sidewalk is constructed of pavers, and slopes toward the grassy areas on the straightaway.

Development Street Design Guidelines (1999) and *Neighborhood Street Design Guidelines* (2003). These are available through ITE's bookstore at <www.ite.org>.

The metropolitan region around **Portland, Oregon** (Metro), has a regional street design manual, specifying stream treatments, street width, and associated water quality benefits. See <www.metro-region.org> and type "street design" into the site's search engine.

North Carolina's Department of Transportation (NCDOT) approved street design guidelines to make it easier for local governments to implement traditional neighborhood street networks in new developments. The guidelines specify street width and the provision of bicycle and pedestrian facilities. See <www.doh.dot.state.nc.us/operations/tnd.pdf> for more information and a link to the NCDOT *Traditional Neighborhood Development Guidelines*. The town of Cary, North Carolina, has adopted policies requiring street connections.

The Congress for New Urbanism (CNU), EPA, the Federal Highways Administration (FHWA) and the Institute of Transportation Engineers (ITE) are developing *Context Sensitive Solutions for the Design of Major Urban Thoroughfares*, which will provide alternatives for communities seeking smart growth street standards. Publication is expected in 2006. In the meantime, a literature review was developed in 2005 and is available at <cnu.org/pdf/lit_review_assigned.pdf>.

Dane County, **Wisconsin**, has established *Street Standards for its Traditional Neighborhood Design Ordinance*. See <www.co.dane.wi.us/plandev/build/pdf/tnd/20040225_append_C.pdf>.

Points to Consider

Street designs have traditionally been established through sets of commonly recognized standards. Standard-setting organizations, such as the Institute of Transportation Engineers and the American Association of

State Highway and Transportation Officials have issued standards that govern street designs, recommended road widths and design for turn lanes and access roads. These organizations are aware that the standards do not fit all situations, and are developing alternative standards and guidelines for communities that have smart growth plans. Because the alternative standards are new or in draft form, local transportation officials might be reluctant to adopt them. Stormwater and planning officials may want to meet with their transportation counterparts in developing a streets plan for joint stormwater and smart growth efforts.

Building green streets, narrower streets, and multi-purpose streets can cause citizen concern and raise objections from emergency service providers. In Portland, Oregon, engineers, planners, and emergency response providers made test runs of various street widths to come to a decision on a street width that meets both smart growth and emergency response needs. The Local Government Commission has developed fact sheets on designing multi-use streets, available at <www.lgc.org> (look under "Free Resources" for the fact sheets).

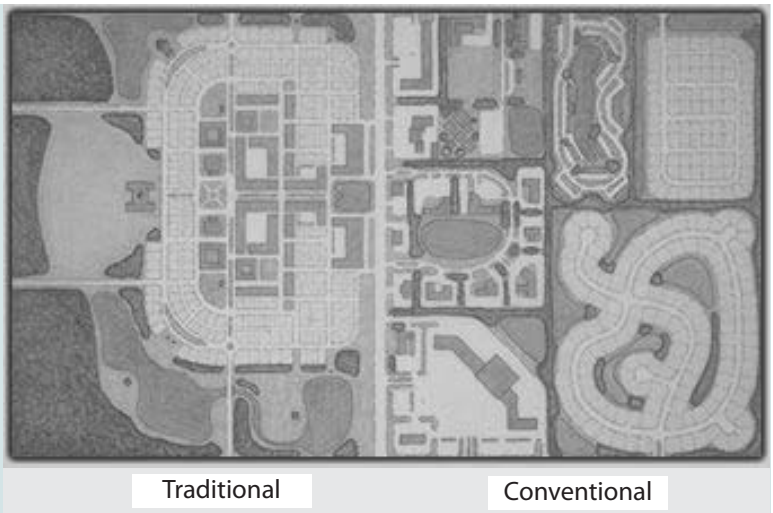


Image: Local Government Commission.

This diagram compares a traditional street layout with the unconnected streets associated with conventional subdivisions.

As noted earlier, a denser network of narrower streets can involve as much or more impervious surface within a concentrated district. This is where evaluating imperviousness on a "per unit" basis of development is helpful. This might be per unit of housing, or per square foot of development footprint. In redeveloping districts, smart growth designs often call for the addition of streets to break up larger blocks or connect centers of activity and the addition of sidewalks to promote walking. While these measures add impervious surface coverage, evaluating the environmental performance of this design requires a broader approach, as mentioned above.

Finally, street design and construction is increasingly delegated to the developer and his or her site planners. For conventional residential or commercial development projects, the main requirements for connecting the development project deal with access to state highways or local roads. As noted above this access point is typically the only point of ingress and egress for the project. Local governments might experience resistance from developers who are not used to planning multiple connections to neighboring developments, or providing connections to commercial areas. Communities with smart growth street plans that require multiple connections will find that early and constant outreach is necessary so builders, developers, and land owners are aware of the requirements. In addition, local governments and real estate agents need to make potential homebuyers aware of streets that will be connected to future development projects to avoid conflicts.

9. Stormwater Utilities

Definition

Like urban forestry programs, stormwater utilities are not typically listed as smart growth policies. Many states and localities, however, have investigated where the rate structure of other utility programs, such as electricity, cable, and gas service, might be unintentionally subsidizing new growth at the expense of more cost-efficient service areas. A stormwater utility, like other utilities, establishes an organization where a user pays for municipal services, such as water, trash pick-up and sewer. This subsection includes suggestions for communities that have already made the decision to establish a utility to finance stormwater improvements.

Stormwater regulations have spurred interest in stormwater utility creation as localities seek new ways to fund drainage and flooding projects. The legal structure and rate system for stormwater utilities vary around the country, and can depend on state legislative or enabling language. The legal aspects of establishing a stormwater utility are beyond the scope of this publication, but there are several things to look for in setting up a utility in coordination with smart growth goals. The mission statement, rate structure, and planning can all have influence over a locality's ability to shape a comprehensive approach to handling stormwater.

Who Do I Talk to About Stormwater Utilities?

Stormwater utilities are typically set up by a local government (as mentioned above, most states must first pass enabling legislation allowing localities to establish these utilities). Thus, the first step is to make sure that the legal framework exists for the creation of a utility. For ease of billing, stormwater utility fees typically appear on the same bill issued for water and sewer, so you might find contact information there or in your local government directory. The stormwater utility may also be located in the public works department. The local government will typically post information on how the stormwater utility is organized, the billing structure and the stormwater master plan on a Web site.

Photo: University of Connecticut Cooperative Extension System



Stormwater utility rates can be adjusted to add incentives for homeowners who collect and handle rainwater on their properties. Municipalities that have impaired waterways and are experiencing high rates of infill can use this approach to reduce stormwater volumes.

Typical Costs

While costs vary, rates are typically in the $2 to $5 per month per household range. The main consideration for a stormwater utility is that all costs collected for the utility only be spent on stormwater projects. The costs of establishing a utility also vary. Most communities have created the stormwater utility within water and sewer departments for ease of administration. Where localities decide to introduce variable pricing and incentives within the rate system, resources will be needed to establish baseline rates and create maps and verification systems so that incentives are properly instituted. The "Resources" section includes several Web sites with more details on the costs associated with establishing and operating a stormwater utility.

Stormwater Benefits

Stormwater utilities have been established to provide a fair and predictable source of funding for stormwater projects. As towns experience growth, they need to fund systems to handle the stormwater that flows from newly developed parcels, as well as from older areas. Larger cities may need to repair and/or expand sewer and water systems to support redevelopment. Some older cities are also separating their old combined sewer pipes into two systems: one that handles stormwater from the streets and a second system to deliver sanitary sewerage to a wastewater treatment plant. A stormwater utility can provide stable funding to address the runoff problems associated with development and redevelopment.

Stormwater utilities also recognize that all properties within the utility district have a role in both producing and mitigating stormwater. For most municipalities affected by Phases I and II of the NPDES stormwater permitting program, improvements are tied to project approvals for development and redevelopment projects. Thus, the improvements for controlling post-construction runoff are made only when a building permit is issued for a site.

For many watersheds, however, the negative impacts of stormwater runoff arise from existing development that was constructed prior to adoption of improved site designs and construction practices. Where existing properties are the main source of stormwater volume and/or pollutants, the improvements enacted through Phases I and II are not likely to bring immediate relief to stressed or impaired waterways. However, when there is a program and/or dedicated source of revenue for improvements, stormwater problems for the entire community can be accomplished in a predictable fashion. Keep in mind a community need not have a stormwater utility to begin making improvements on existing properties.

Examples

Maturing stormwater utilities are experimenting with ways to structure rates to recognize property owners' actions that result in less burden on the public stormwater system. This can include reduced rates or tradable credits where the property owner (or manager) demonstrates that a BMP has been added and handles stormwater on site.

Many municipalities with stormwater utilities are developing credit manuals. The manuals assist property owners in assessing

(1) the types of activities that can receive a credit (2) how to apply for the credit, and (3) other factors, such as continuing maintenance. The most common activities that qualify for credits include onsite retention and detention and small scale BMPs, such as rain barrels.

The recently approved Stormwater Utility Credit Manual for non-residential users from **Lake County, Ohio**, recognizes that some non-traditional approaches can have stormwater benefits. In their manual, the county notes there are creative ways to reduce the pressure for additional impervious surfaces:

> *"Non-residential customers seeking a credit may request unique opportunities or approaches to improving water quality. For instance, a non-residential customer may also be an NPDES MS4 permitee that must implement a Stormwater Management Plan for its facility. Another example might be a retail outlet that provides "Park and Ride" space to encourage use of the transit system, thereby minimizing the growth of impervious area by reducing the need for additional parking lots and travel lanes on roadways. The LCSMD will review and evaluate these types of unique requests on a case-by-case basis to determine the credit value for a site to which the BMP is being applied."*[30]

The city of **Maryville, Tennessee**, allows smaller homes to qualify where total imperviousness on the site is less than 1,800 square feet. To view Maryville's manual, see <www.ci.maryville.tn.us/epc/IMAE.pdf>. Variations on this type of credit can be used for higher density development projects where the footprint of buildings is smaller in a district.

To recognize the site level and watershed level impacts that come with development, **Eugene, Oregon**, has split its stormwater utility rate into three components: impervious surface, administrative, and street-related. Homeowners can claim a credit only on the impervious surface portion of the fee when they adopt beneficial practices such as use of rain barrels or installation of rain gardens.

Points to Consider

At a basic level, the purpose of a stormwater utility is clear: to assess a charge for handling the stormwater runoff generated from a given piece of property. Measuring the exact volume of runoff from distinct properties is time and resource intensive, however. In addition, some properties are more vulnerable to the impacts of stormwater than others; even if the utility applies a rate evenly, the benefits can vary across the landscape. And third, much of the runoff (up to 40 percent) comes from publicly owned impervious surfaces such as roads and schools. So, what should you look for in a stormwater utility?

Residential properties: Most localities use some sort of simplified system for assessing rates. The easiest is a flat fee. This, however, would not provide homeowners with an incentive to handle more stormwater on their lots. For administrative ease, some localities have allowed homeowners to appeal for a rate reduction if they have installed rain gardens, added rain barrels, or disconnected downspouts.

Of particular smart growth interest is the method of charging based on the percent of impervious surface coverage. A fee based on the percent of impervious surface coverage might not recognize the benefits of smaller lots in a compact district. Where densities are higher, the individual plots are likely to have a greater percent of impervious surface coverage. As explained in Subsections 3 (Redevelopment, page 48) and Subsection 4 (Development Districts, page 51), this design has a lowered impact overall when one considers the per unit impact in a watershed. A rate that recognizes the overall water benefits of higher density housing can help recognize the lowered impact on a per unit basis. An alternative to charges based on percent impervious surface is to develop a charge based for the development district which recognizes the lowered impact for the watershed. Fees can then be assessed per house within the district.



The redevelopment of older commercial corridors often begins with streetscape improvements, which can be designed to capture stormwater, provide tree canopy and complement the redevelopment goals of more walkable and economically vibrant districts.

Photo: NRCS

Commercial properties: Assessing rates for commercial properties is a bit more predictable and straightforward, but it is important to examine for any barriers to developement projects that have benefits for the watershed. Commercial properties are generally assessed a fee based on impervious surface coverage. One of the more important smart growth considerations is accounting for the stormwater impacts of redevelopment of vacant or underperforming commercial properties. As these parcels are redeveloped, they often generate the same amount of runoff as before, but as noted elsewhere in this report, they take on development demand that could go to undeveloped areas elsewhere in the watershed. To further improve the performance of these sites, look for opportunities to handle water on site or disconnect the impervious surfaces with neighboring parcels. In addition, a locality may want to introduce a stormwater fee credit for improving "gray" infrastructure, particularly when a developer agrees to fix combined sewer pipes that overflow. With these modifications in the rate structure, a property is fairly assessed its contribution to local impacts, but gets a credit based on the watershed benefits.

Depending on specific legal requirements, a utility may be able to split the rate into other types of categories to recognize smart growth benefits. This is where it is important, in the development of your utility's charter and planning, to develop a "purpose" statement to describe the adverse impacts of stormwater and establish a framework for recognizing better practices within the utility and its rate structure.

Summary and Conclusion

Cities, counties, towns and campuses around the country are well on their way developing stormwater plans under the Clean Water Act. What many local water quality managers might not realize is that their colleagues in the transportation and zoning departments are engaged in planning and development activities that parallel—and often overlap with—watershed and stormwater planning. Embedded in land use and comprehensive plans are features at the site, neighborhood, and even regional level that have a great impact on the quantity and quality of stormwater. Where the locality is pursuing smart growth development strategies and techniques, they are often unknowingly developing "best management practices" (BMPs) for Phases I and II.

This document was developed to help water quality practitioners, developers, smart growth advocates, and local/state government officials think in new ways about the overlapping demands of water planning and local comprehensive planning.

The Clean Water Act's stormwater permitting program offers opportunities to meet these overlapping demands. The water quality features of smart growth have not traditionally appeared in BMP menus or lists of stormwater performance measures. This document has taken common smart growth techniques, explained their water and stormwater benefits, and provided examples. Understanding the benefits, though, requires a new view of stormwater—one that considers multiple levels of environmental and development context. Thus, development projects must be evaluated at the site, neighborhood, and watershed levels to fully assess environmental performance.

In conclusion, the stormwater permitting program is designed to foster innovation and adaptive management. Over the next five years, your community is likely to observe opportunities for improvement. As your town engages in planning for transportation, regional planning, and development, pay attention to areas that are amenable to better water quality and stormwater management. You may find that you can gain water quality improvement while addressing transportation, housing, economic development, and community goals all in the same community.

Next Steps – Guidance and Technical Assistance for Municipalities

EPA also expects to improve its guidance and technical assistance on implementation of the NPDES stormwater permitting program for MS4s. For communities developing smart growth programs and stormwater management plans, the Agency is exploring activites that:

- Provide more information and assistance on watershed permitting for communities that want to integrate their smart growth plans.
- Support development of BMP manuals for common smart growth techniques and development districts, such as TNDs.
- Develop model codes, stormwater ordinances, and permit language that recognize the stormwater performance of smart growth and/or offer flexibility for redevelopment, infill, and smart growth site design for new development.
- Develop decision support tools to help localities and developers estimate the amount of stormwater pollution prevented through compact development and redevelopment.
- Develop information on strategic combinations of BMPs for urban infill and redevelopment that include smart growth and traditional stormwater BMPs

EPA's Guidance on Post-Construction Stormwater Controls – Through a Smart Growth Lens

On December 8, 1999, EPA published the Phase II rules in the *Federal Register*, along with model language that could be adopted. EPA's language, presented below, was adopted in part or whole by many states and permitting authorities. The examples listed in the notice include a combination of traditional stormwater control techniques, as well as several smart growth techniques and concepts. If your state or locality has adopted some or all of the model language, here are some tips for integrating your existing smart growth plan with this guidance.

From the 1999 *Federal Register* Notice:

Post-construction storm water management in new development and redevelopment.

(i) You must develop, implement, and enforce a program to address stormwater runoff from new development and redevelopment projects that disturb greater than or equal to one acre, including projects less than one acre that are part of a larger common plan of development or sale, that discharge into your small MS4. Your program must ensure that controls are in place that would prevent or minimize water quality impacts.

(ii) You must:

(A) Develop and implement strategies which include a combination of structural and/or nonstructural best management practices (BMPs) appropriate for your community;

(B) Use an ordinance or other regulatory mechanism to address postconstruction runoff from new development and redevelopment projects to the extent allowable under state, tribal or local law; and

(C) Ensure adequate long-term operation and maintenance of BMPs.

(iii) Guidance: If water quality impacts are considered from the beginning stages of a project, new development and potentially redevelopment provide more opportunities for water quality protection. EPA recommends that the BMPs chosen: be appropriate for the local community; minimize water quality impacts; and attempt to maintain pre-development runoff conditions. In choosing appropriate BMPs, EPA encourages you to participate in locally based watershed planning efforts which attempt to involve a diverse group of stakeholders including interested citizens. When developing a program that is consistent with this measure's intent, EPA recommends that you adopt a planning process that identifies the municipality's program goals (e.g., minimize water quality impacts resulting from post-construction runoff from new development and redevelopment), implementation strategies (e.g., adopt a combination of structural and/or nonstructural BMPs), operation and maintenance policies and procedures, and enforcement procedures. In developing your program, you should consider assessing existing ordinances, policies, programs, and studies that address stormwater runoff quality. In addition to assessing these existing documents and programs, you should provide opportunities to the public to participate in the development of the program. Non-structural BMPs are preventative actions that involve management and source controls such as: policies and ordinances that provide requirements and standards to direct growth to identified areas, protect sensitive areas such as wetlands and riparian areas, maintain and/or increase open space (including a dedicated funding source for open space acquisition), provide buffers along sensitive water bodies, minimize impervious surfaces, and minimize disturbance of soils and vegetation; policies or ordinances that encourage infill development in higher density urban areas, and areas with existing infrastructure; education programs for developers and the public about project designs that minimize water quality impacts; and measures such as minimization of percent impervious area after development and minimization of directly connected impervious areas. Structural BMPs include: storage practices such as wet ponds and extended-detention outlet structures; filtration practices such as grassed swales, sand filters and filter strips; and infiltration practices such as infiltration basins and infiltration trenches. EPA recommends that you ensure the appropriate implementation of the structural BMPs by considering some or all of the following: preconstruction review of BMP designs; inspections during construction to verify BMPs are built as designed; postconstruction inspection and maintenance of BMPs; and penalty provisions for the noncompliance with design, construction, or operation and maintenance. Stormwater technologies are constantly being improved, and EPA recommends that your requirements be responsive to these changes, developments, or improvements in control technologies. (Citation: 64 *FR* 68843, December 8, 1999).

For communities that have embarked on smart growth planning, there are several overlapping themes:

"EPA recommends that the BMPs chosen: be appropriate for the local community; minimize water quality impacts; and attempt to maintain pre-development runoff conditions."

Listing your smart growth accomplishments and their water quality impacts is one way that your BMPs can be appropriately chosen. As mentioned in this document, maintaining pre-development runoff conditions for redevelopment projects is typically neutral since impervious cover replaces existing impervious cover. In some areas, localities have defined pre-development conditions as the **undeveloped** state. There may be water quality imperatives that call for this increased standard. The key is to ensure that all development projects in the watershed are held to standards that lead to increased protection so that redevelopment rules do not unintentionally penalize redevelopment compared to new development.

"…implementation strategies (e.g., adopt a combination of structural and/or non-structural BMPs)… "

For smart growth and stormwater goals, the most effective BMPs will be strategic combinations of mutually supportive policies. For example, policies to create better sidewalks might lead to pedestrian improvements at intersections, which in turn are supported by plans for a more compact town center to bring uses within walking distance of each other. These policies act to support each other and are synergistic, so that the end result is the cumulative benefits of the individual policies. Many comprehensive plans recognize the combinations or urban design policies; make sure that your stormwater plan reflects the same links among policies.

"…Non-structural BMPs are preventative actions…"

Note that prevention of stormwater-related problems is integral to EPA's guidance. As noted in this document, reusing existing developed areas and compact building forms prevent much of the stormwater generated from development activity.

"…and measures such as minimization of percent impervious area after development..."

EPA's guidance does emphasize reducing impervious area. When considering reductions, however, the development context for smart growth and stormwater are important. While each individual property may meet impervious surface caps, the development "footprint" becomes enlarged as individual development sites grow to include the required land set-aside. This, in turn disperses uses and the infrastructure needed to serve it, including roads and other impervious surfaces. Thus, while the narrow objective of minimizing impervious surface coverage on the development site level is met, the watershed can actually see an increase in land disturbance and impervious surface coverage. Water quality practitioners should recognize that while land development approvals are made on a site-by-site basis, the impact of the individual development project transcends boundaries. This is not to say that impervious surface caps do not have a place in protecting water quality. In some places, watershed-wide caps have been put into place, followed by assessments of the land conservation/development balance. Like other aspects of development decisions, the scale, location, and interrelationship with other policies are important.

"...minimization of directly connected impervious areas…"

Communities that are seeking to add a street to connect an older downtown to new residential areas might find that strict policies to reduce connected, impervious surfaces prohibit the connections that are needed for economic development and transportation improvements. Screen your impervious surface policies to see where improvements to make compact development work might be prohibited.

"EPA recommends…preconstruction review of BMP designs."

Preconstruction reviews can identify where there is disagreement among details in various land development policies. The preconstruction review should include several departments to identify where a city or county's smart growth policies and stormwater regulations run counter to each other, and to develop alternative site designs to accomplish the goals of all programs.

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[29] Bureau of Environmental Services, Portland, Oregon . January 6, 2000. Report to Mayor Vera Katz memo.

[30] County of Lake, Ohio. January 26, 2005. Lake County stormwater utility fee: Credit manual for non-residential users. . www2.lakecountyohio.org/smd/Credit%20Manual%20Level%202%20%20Advisory%20Board%20Approved.pdf

SECTION 3

Resources

This section lists resources for general smart growth, for water resources by smart growth technique (as listed in the document for easy reference) and by state. A listing of these sites is not an EPA endorsement, and as materials are finalized and updated, links may change. Many stormwater programs at the state and local levels are being revised, so keep these keywords in mind if you need to use a search engine to find updated links:

"NPDES"

"Phase I" or "Phase II"

"MS4"

"stormwater"

"BMP"

"ordinance"

"design manual"

"post construction"

"redevelopment"

"infill"

These terms used singly or in various combinations, coupled with the name of your state and/or municipality, should take you to Web sites that contain information on the progress of stormwater programs, schedules for public meetings, drafts for review, opportunities for incorporation of smart growth techniques, and other information.

Many of these links cite regulatory documents, and thus are necessarily long; an electronic version can be found at <www.epa.gov/smartgrowth> to copy and paste Web addresses to your internet browser.

Smart Growth

For more information on making the integrated smart growth and water case, visit
www.epa.gov/smartgrowth or www.smartgrowth.org.

A good introductory primer is "Why Smart Growth: A Primer"
www.epa.gov/smartgrowth/pdf/WhySmartGrowth_bk.pdf

"Our Built and Natural Environments: A Technical Review of the Interactions between Land Use, Transportation and Environmental Quality"
www.epa.gov/smartgrowth/pdf/built.pdf

Planetizen, a planning and smart growth Web site, lists 50 good Web sites:
www.planetizen.com/websites

The Congress for New Urbanism has a compendium of model codes on a variety of subjects, including street design, rehabilitation, and urban design. The compendium also includes place-specific codes.
www.cnu.org/pdf/code_catalog_8-1-01.pdf

Water and Smart Growth

EPA has issued several helpful resources on growth and water resources:

"Protecting Water resources with Smart Growth"
www.epa.gov/smartgrowth/water_resource.htm

EPA's Watershed Academy hosts an online training course.
www.epa.gov/watertrain/smartgrowth

EPA's Region 6 has compiled an exhaustive list of water resources that are applicable throughout the country. The site also lists the Web sites of state stormwater offices for each of the 50 states and U.S. territories.
www.epa.gov/region6/water/npdes/sw/resources.pdf

The Met Council has released a series of documents on controlling stormwater in cold climates.
www.metrocouncil.org/environment/watershed/bmp/manual.htm

Stormwater Sites

EPA's main site for NPDES permits:
http://cfpub.epa.gov/npdes/index.cfm

EPA's stormwater program home page
http://cfpub.epa.gov/npdes/home.cfm?program_id=6

EPA Fact Sheet on Phase II
www.epa.gov/npdes/pubs/fact2-0.pdf

State stormwater programs
http://cfpub.epa.gov/npdes/linkresult.cfm?program_id=6&link_category=2&view=link

Resource List for Stormwater Management Programs and Phase II
www.epa.gov/npdes/pubs/sw_resource_list.pdf

Menu of Best Management Practices (BMPs)
http://cfpub.epa.gov/npdes/stormwater/menuofbmps/menu.cfm

The Stormwater Authority lists state programs, news, white papers, and articles
www.stormwaterauthority.org/

The Natural Resources Defense Council's "Stormwater Strategies"
www.nrdc.org/water/pollution/storm/stoinx.asp

Project NEMO (Non-point Education for Municipal Officials)
http://nemo.uconn.edu

EPA's National Management Measures to Control NonPoint Source Pollution from Urban Areas
www.epa.gov/nps/urbanmm/

Innovations in Phase II Guidance and Permits to Include Smart Growth

EPA's model permit for Phase II includes language on specific smart growth techniques (e.g. infill), as well as flexibility to custom design ordinances and guidance.
www.epa.gov/npdes/pubs/modpermit.pdf

The Michigan Environmental Council is developing materials on smart growth and Michigan's innovative stormwater and watershed permitting.
www.michiganenvironmentalcouncil.org

The Santa Clara Valley Urban Runoff Pollution Prevention Program has developed a new Phase I permit to include many smart growth innovations. Under the reissued permit, the city of San Jose revised local ordinances to incentivize smart growth projects, such as affordable housing and redevelopment.

- The regional permit:
  www.scvurpppw2k.com/pdfs/other/NPDES_Permit_C3New_Finalodrtransltr.PDF
- The San Jose Policy changes:
  www.sanjoseca.gov/planning/stormwater/pol_stormwater.pdf

The city of Poway, California, has defined BMP to include redevelopment and development projects that improve stormwater performance as compared to conventional designs.
www.codepublishing.com/ca/poway/Poway16/Poway16101.html#16.101.200

Resources by Smart Growth Technique

Regional Planning

EPA's Surf Your Watershed
www.epa.gov/surf

EPA hosts a page on build-out tools
www.epa.gov/greenkit/2tools.htm

EPA link to source water protection plans
www.epa.gov/safewater/protect.html

The Trust for Public Land published "Protecting the Source" on regional source water protection efforts.
www.tpl.org
www.tpl.org/tier3_cd.cfm?content_item_id=1337&folder_id=195

New Jersey's program for regional and integrated planning
www.smartgrowthgateway.org

For information on the Highlands (New Jersey) water protection plan
www.highlands.state.nj.us/index.html and
www.state.nj.us/dep/highlands/faq_info.htm

New Jersey's Regional Plan Association hosts research and position papers.
www.planningpartners.org

RPA developed a paper on goal oriented zoning using smart growth techniques.
www.planningpartners.org/projects/wma11/sg_alt/smartgrowthalt_text.pdf

The Association of New Jersey Environmental Commissions' Smart Growth Survival Kit
www.anjec.org

The Central New York Regional Planning Board's regional assistance program for Phase II communities
www.cnyrpdb.org/stormwater-phase2/

The University of Rhode Island's Cooperative Extension's A Creative Combination: Merging Alternative Wastewater Treatment with Smart Growth
http://www.uri.edu/ce/wq/mtp/PDFs/manuals/Creative%20Combination%203-10.pdf

The Planning Commissioners Journal hosts a page on transfer of development rights programs, including examples, common challenges, and resources.
www.plannersweb.com/wfiles/w370.html

Appalachian Regional Commission's site on strategic planning and best practices.
www.arc.gov/index.do?nodeId=44

Infill

The Washington State Phase II permit application
www.ecy.wa.gov/programs/wq/stormwater/phase_2/Phase%20II%20Application.pdf
(see page 14 for the language on infill development).

The Greenbelt Alliance published "Smart Infill" with information on zoning codes, design, and public participation
www.greenbelt.org (go to "Resource Center" and "Reports")

The Metro Council published the Urban Small Sites Best Management Practice (BMP) Manual.
www.metrocouncil.org/environment/Watershed/bmp/manual.htm

Association of Metropolitan Planning Organizations
www.ampo.org

The Local Government Commission, the REALTORS, and EPA co-published "Creating Great Neighborhoods: Density in Your Community"
www.lgc.org/freepub/PDF/Land_Use/reports/density_manual.pdf

Smart Growth America produced "Choosing Our Community's Future" to assist neighborhood leaders in shaping growth in their neighborhoods.
www.smartgrowthamerica.org

Wisconsin developed post-construction standards that vary for development type (i.e., new development, redevelopment, infill).
www.dnr.state.wi.us/org/water/wm/nps/stormwater/post-constr/

Clark County's (Washington) comprehensive plan
www.co.clark.wa.us/longrangeplan/review/index.html

Wisconsin Department of Natural Resources' list of general land use terms
dnr.wi.gov/org/es/science/landuse/education/GPZ.htm.

New Jersey's two-tiered permit system for infiltration requirements
www.njstormwater.org

Austin, Texas, smart growth incentives for infill
www.ci.austin.tx.us/smartgrowth/incentives.htm

San Diego's Localized Equivalent Area Drainage program (LEAD) for sharing stormwater costs across projects
www.sannet.gov/stormwater

The Center for Watershed Protection sponsors Builders for the Bay, "Smart Site," and the Site Design Roundtable
www.cwp.org

Maryland's Guide to BMP Selection
www.mde.state.md.us/assets/document/chapter4.pdf

Redevelopment

The National Vacant Properties Campaign has information on the most common conditions leading to vacated properties, and ways to develop programs that can bring unproductive property back.
www.vacantproperties.org/

The Congress for the New Urbanism's Greyfields into Goldfields
www.cnu.org/cnu_reports/Executive_summary.pdf

The U.S. Department of Housing and Urban Development's Smart Codes in Your Community: A Guide to Building Rehabilitation Codes
http://www.huduser.org/publications/destech/smartcodes.html

The Smart Growth Leadership Institute has a Web site devoted to code audits to identify barriers to redevelopment.
www.sgli.org/implementation.html

The U.S. Green Building Council's (USGBC's) scorecards, called LEED (for Leadership in Environmental and Energy Design), contain rating systems for development and redevelopment projects. USGBC has a new scorecard under development call LEED Neighborhood Design (LEED ND).
www.usgbc.org/leed/leed_main.asp

EPA's case study of the Atlantic Steel redevelopment project
www.epa.gov/projectxl/atlantic/index.htm

Development Districts

The state of Oregon created a design manual for development districts, which can serve as a base example for developing a joint smart growth and stormwater design manual.
egov.oregon.gov/LCD/docs/publications/wqgbchapter4dsnstan.PDF

Emeryville, California, developed design guidelines for highly urbanized areas with limited opportunities for infiltration – Design Guidelines for Green, Dense Redevelopment. The final document will be released in 2006.
www.ci.emeryville.ca.us/planning

Elm Grove, Wisconsin, has developed plans to include downtown revitalization, stormwater control, and open space planning.
www.elmgrovewi.org

Chesterfield, Burlington County, in New Jersey has a code for transfer of development rights, including a "Planned Village Development" district ordinance for receiving areas.
www.smartgrowthgateway.org/ordinances/chesterfield.pdf

EPA Brownfields site
www.epa.gov/swerosps/bf/index.html

San Diego's "City of Villages" planning initiative
www.sandiego.gov/cityofvillages

San Diego's Urban Runoff Program
www.sandiego.gov/stormwater

The Trust for Historic Preservation sponsors the Main Street Program
www.mainstreet.org/

Caltrans has a site dedicated to transit oriented development. This site describes each project, giving information on land use plans, transportation performance, and project details.
transitorienteddevelopment.dot.ca.gov

The Congress for New Urbanism's compilation of code innovations
www.cnu.org/pdf/code_catalog_8-1-01.pdf.

New Urban News developed New Urbanism: Comprehensive Report & Best Practices Guide, which contains analyses, best practices, and examples. To order, go to
www.newurbannews.com.

Tree Programs

Treelink has a page with links to tree preservation, urban forestry, and urban design ordinances.
www.treelink.org/linx/?navSubCatRef=25

Casey Trees is developing detailed information on the amount of stormwater that can be intercepted by tree cover and green roofs.
www.greenroofs.org/resources/greenroofvisionfordc.pdf

American Forests has information on research, ordinances, and CITYGreen software.
www.americanforests.org

International Society of Arboriculture
www.isa-arbor.com

Scenic America has a model tree ordinance and supporting information
www.scenic.org/portals/0/trees%20-%20ordinance.doc

Trees Atlanta's assessment of the benefits of tree canopy
www.treesatlanta.org

The USDA Forest Service Southern Region
www.urbanforestrysouth.org

Metro's Trees for Green Streets: An Illustrated Guide
www.metro-region.org/article.cfm?articleid=263

Parking Reduction Strategies

Parking Spaces/Community Spaces is set for release in 2006 from EPA.
www.epa.gov/smartgrowth.

The Stormwater Center has a fact sheet on planning, designing and retrofitting parking lots.
www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool4_Site_Design/GreenParking.htm

Olympia, Washington's Impervious Surface Reduction Study
depts.washington.edu/cwws/Research/Reports/ipds.pdf

Model agreement for shared parking
www.metro-region.org/article.cfm?articleid=435

The North Central Texas Council of Governments developed guidance, which includes parking reduction strategies.
www.dfwstormwater.com/Storm_Water_BMPs/post-construct.asp#rec

Information on car-sharing
www.carsharing.net/where.html

"Fix It First"

The National Governors Association issued an Issue Brief on "Fix it First."
www.nga.org/cda/files/0408FIXINGFIRST.pdf

EPA's Sustainable Water
www.epa.gov/water/infrastructure.

Smart Growth Street Design

The Institute for Transportation Engineers developed two recommended practice guidelines: "Traditional Neighborhood Development Street Design Guidelines" (1999) and "Neighborhood Street Design Guidelines" (2003).

www.ite.org

The Victoria Transport Policy Institute hosts an online transportation encyclopedia. This frequently updated site includes many details on transportation and street networks and includes examples from across the country, as well as international examples.

www.vtpi.org/tdm/index.php

The American Planning Association has issued a report, Planning for Connectivity: Getting from Here to There, Report PAS #515, written by Susan Handy, Robert Paterson, and Kentt Butler.

www.planning.org.

The metropolitan region around Portland, Oregon (Metro) developed a regional street design manual, specifying stream treatments, street width, and associated water quality benefits.

www.metro-region.org (type "street design" into the site's search engine)

North Carolina's Department of Transportation (NCDOT) approved street design guidelines for Traditional Neighborhood Development Design.

www.doh.dot.state.nc.us/operations/tnd.pdf

The Local Government Commission developed fact sheets on designing multi-use streets.

www.lgc.org (under "Free Resources")

The Congress for New Urbanism published a literature review of street designs for traditional neighborhood design and smart growth projects. This literature review will be used to support further work with the Institute of Transportation Engineers on the subject.

cnu.org/pdf/lit_review_assigned.pdf

Dane County, Wisconsin, adopted traditional street standards.

www.co.dane.wi.us/plandev/build/pdf/tnd/20040225_append_C.pdf

Seattle launched the Siskiyou Green Street Project to add vegetated curb extensions. These extensions handle some of the stormwater that would otherwise enter the storm sewer.

www.portlandonline.com/bes/index.cfm?c=dhfjc

Stormwater Utilities

The Center for Urban Policy and the Environment at Indiana University-Purdue University Indianapolis (IUPUI), in cooperation with EPA, hosts a page dedicated to stormwater finance. Some of the case studies provide examples on how to creatively match the rate structure with impacts.

http://stormwaterfinance.urbancenter.iupui.edu/

Lake County (Ohio) Credit Manual for Tier 2 Cities, Lake County Stormwater Management Department.

www2.lakecountyohio.org/smd/Credit%20Manual%20Level%202%20%20Advisory%20Board%20Approved.pdf

SECTION 4

New Jersey – A Case Study in Weaving Stormwater and Smart Growth Policies Together

The state of New Jersey has one of the most fully developed smart growth programs of any state. In 1985, the state adopted the State Planning Act, which led to the creation of a State Development and Redevelopment Plan (the State Plan). This plan was created through a statewide planning process called cross-acceptance, which ensures that governments at all levels, as well as stakeholders and the public, participate in deciding the future of New Jersey's growth. Early accomplishments included farmland protection, a land acquisition program, and comprehensive brownfields redevelopment policies.

In the early 1980s New Jersey passed its stormwater management rules. As attention to smart growth and the awareness of the environmental impacts of development increased, so did interest in updating stormwater rules. In the 1990s, with the new Phase II requirements on the horizon, the state developed rules with both growth and stormwater goals in mind. In 2003, the state passed two companion laws, one called the "MS4 Law" to establish a statewide permitting system, and the other called the "Stormwater Management Rule," which modernized the state's original stormwater laws and forged closer links between stormwater and other growth management plans.

Goals for Smart Growth

The purpose of the State Plan is to coordinate planning activities and establish statewide planning objectives in the following areas: land use, housing, economic development, transportation, natural resource conservation, agriculture and farmland retention, recreation, urban and suburban redevelopment, historic preservation, public facilities and services, and intergovernmental coordination

New Jersey uses the goals in the State Plan as a guide. The state is divided into five regions, with different goals based on the existing development profile, as well as plans for growth in that area. The accompanying State Plan Policy Map serves as the underlying land use-planning and management framework that directs funding, infrastructure improvements, and preservation for programs throughout New Jersey.

Goals for Water and Stormwater

The new stormwater rules are meant to complement other environmental and economic goals. The new rules place an emphasis on ground water recharge, though that requirement would be waived for urban areas. In urbanizing areas, LID techniques are to be used to maintain existing vegetation and drainage patterns. In all areas of the state, BMPs would be chosen to achieve an 80 percent reduction in certain pollutant loads. Areas along waterways designated as Category One (C1) water resources have special protections, such as the Highlands area of the state.

Specific Policies that Meet Both Water and Smart Growth Goals

This section describes policy areas that have both water and smart growth goals.

Tiered Stormwater Requirements:

Instead of creating blanket requirements for all areas of the state, New Jersey adopted two tiers to administer stormwater requirements. Municipalities within the state are assigned to either Tier A or Tier B. Tier A municipalities are generally located within the more densely populated regions of the state or along the coast. Tier B municipalities are generally more rural and in non-coastal regions. The Tier B Permit includes basic requirements and concentrates on new development and redevelopment projects and public education. The Tier A Permit includes the requirements found in the Tier B Permit, plus BMPs aimed at controlling stormwater pollutants from existing development.

Meeting Smart Growth Goals: By establishing tiers instead of general requirements, the state recognizes that the requirements based on development context can help create a level playing field so that greenfields development is not unintentionally favored due to less strict requirements.

Meeting Stormwater Goals: Tier A rules address stormwater problems found in urbanized areas, such as pet waste and litter. The infiltration requirements are tied to areas of the state critical for recharge, but are not required in urbanized areas where legacy pollutants may enter underground water systems.

"Fix It First:"

The New Jersey State Development and Redevelopment Plan and Infrastructure Needs Assessment, both adopted in March 2001, are used to encourage smart infrastructure investments. The "Fix It First" rules are particularly strong for transportation investments. For water and sewer infrastructure, the rules are not as explicit, but there are other policies that help direct funds for repair and replacements of water infrastructure. The State Planning Act links the state's annual capital budget recommendations to the State Development and Redevelopment Plan, and makes the Infrastructure Needs Assessment an integral part of the State Plan.

One concern voiced by developers is the poor condition of infrastructure in many of the designated growth areas. The state has responded through its "Water Quality Management Planning and Smart Growth Implementation Process" grant.

Meeting Smart Growth Goals: By focusing infrastructure investments in existing cities, towns, and suburbs, New Jersey can encourage downtown revitalization, decrease development pressures on farmland and other open space, and conserve limited funds by taking advantage of past infrastructure investments.

Meeting Stormwater Goals: Combined sewer overflows account for much of the pollution in New Jersey's waterways and harbors. Fixing aging infrastructure can mitigate —or eliminate—this source of pollution. Over a third of Newark's 170-mile collection system is brick. Fixing the infrastructure not only helps with overflows, but also decreases the strain on the system caused by inflow and infiltration (I/I). In addition, upgrades to infrastructure in designated growth areas can attract development that may go elsewhere in sensitive watersheds.

Utility Policies:

The New Jersey Board of Public Utilities (NJBPU) is the state's utility regulatory authority with oversight over the state's energy, telecommunications, water/wastewater, and cable television industries. Following the creation of a board-wide Smart Growth Policy Team, the NJBPU looked at its infrastructure extension formula and the extent to which developers will be required to pay for the necessary infrastructure. The formula was established to accommodate growth based on where development is occurring and how infrastructure improvements can best be financed to support increased development in designated growth areas. As stated in the 2005 strategic plan, NJBPU wants to make developers constructing on greenfield sites bear the full cost of gas, electric, and water line extensions, while reimbursing older communities and designated growth areas for laying utilities on their own.

Meeting Smart Growth Goals: Currently, builders negotiate the amount they contribute to gas, electrical, and water line extension on a case-by-case basis often with large reimbursements, while the total cost of service expansion to new subdivisions is subsidized by ratepayers in cities and older suburbs. Adjusting the formulae for rates and extensions to reflect actual costs brings transparency to the costs of various development patterns. Denser, older communities are more efficiently served per unit that dispersed development, thus holding down both installation and long term maintenance costs.

Meeting Stormwater Goals: The BPU's adjustments to extension and rate policies complement "Fix It First" policies and those geared to directing growth to designated growth areas. Funds can be targeted to repair, replacement, and capacity upgrades rather than installation to serve new, dispersed development. Holding down utility costs in urban areas can attract residents and commercial entities.

Infill and Redevelopment Districts:

New Jersey has several programs and policies geared toward redevelopment and revitalizing existing neighborhoods. The list is long, and the accompanying policies, grant programs and incentives are too long to list here. Among the programs are:

- New Jersey's Office of Brownfield Reuse
  www.state.nj.us/dep/srp/brownfields/obr/

- Rehabilitation Subcode
  www.nj.gov/dca/codes/rehab/index.shtml
- Transit Village Initiative
  www.state.nj.us/transportation/community/village

Meeting Smart Growth Goals: The recycling of brownfields and vacant sites allows the state to meet its smart growth goals of protecting open space by clustering development on existing sites, already served by infrastructure. In addition, the state has taken strides to provide affordable housing and save historic buildings through redevelopment. The transit villages and older areas that are served by multiple modes of transit offers options and reduces the amount of infrastructure needed to support automobile dependent types of development.

Meeting Stormwater Goals: Both public and private sector investment in older areas provides funding for infrastructure upgrades. The focus on larger sites (brownfields, transit station areas) allows localities to better plan for handling stormwater on site.

Agricultural Smart Growth Plan:

New Jersey's 2003 Agricultural Smart Growth Plan provides a roadmap for the future of agriculture across the state. The plan consists of five components: 1) farmland preservation, 2) innovative conservation planning, 3) economic development, 4) natural resource conservation, and 5) agricultural industry sustainability. Other components of the plan aim to preserve 20,000 acres of farmland per year through 2009 and integrate economic development and smart growth into the agricultural industry. The future of agriculture in an expanding, global market also depends upon innovative planning techniques, economic development, natural resource conservation, and programs and policies which keep the industry viable. For more information visit <www.nj.gov/agriculture/smartgrowthplan.pdf>.

Meeting Smart Growth Goals: The Agricultural Smart Growth Plan primarily strives to achieve the goal of preserving farmland, but the plan also involves community and stakeholder participation in the decisionmaking process and encourages a sense of place in rural communities by strengthening their economies.

Meeting Stormwater Goals: The Agricultural Smart Growth Plan brings innovative conservation goals to protect stream buffers and target land best suited for infiltration and forestry. In addition the agricultural smart growth plan provides better tools to design commercial and residential growth. Targeting commercial entities to existing downtowns and encouraging rural housing development designs can help minimize the development footprint overall.

Transfer of Development Rights:

The transfer of development rights (TDR) is a tool used to encourage a shift in growth away from agricultural, environmentally sensitive, or historic open space to designated areas where new development is desired. By incorporating TDR provisions in their land-use regulations, municipalities can encourage the protection of open space at a far lower cost than outright purchase. In a TDR program, a community identifies a conservation area within its boundaries where it would like to see protected from development (the sending zone) and another area where the community

desires more growth (the receiving zone) as identified in the municipality's land-use plan. Landowners in the sending zone are allocated a number of development credits, which can be sold to developers, speculators, or the community itself. In return for selling his or her development credits, the landowner in the sending zone agrees to place a permanent conservation easement on his or her land. Meanwhile, the purchaser of the development credits can apply them to develop at a higher density than otherwise allowed on property under the base zoning.

On March 29, 2004, then-Governor McGreevey signed a bill authorizing all municipalities in New Jersey to adopt TDR programs, making New Jersey the first state in the nation to make TDR available statewide. TDRs typically work best when they are used in combination with other policies. Receiving areas must be ready to accept the density being sent, which means the zoning and infrastructure must be in place.

Meeting Smart Growth Goals: New Jersey's TDR program meets several of the state's smart growth principles, most notably the protection of open space, farmland, and scenic resources; compact, clustered community design; and locating future growth in communities with existing infrastructure. The state has a well-developed program in the Pinelands. To see more on the details of how the TDR program has been established, see <www.nj.gov/dca/osg/resources/tdr/index.shtml>.

Meeting Stormwater Goals: Much of the land identified as sending areas are also critical for water and recharge. That water would become urban runoff if developed under conventional standards and would result in stream degradation throughout larger segments. Receiving areas, which can then be developed more intensively, can accommodate more development on a smaller footprint, thus making more efficient use of land on a per unit basis. While most TDR programs are geared toward farmland preservation, they can also be designed for erosion control and water quality. For example, a TDR program can be implemented along with a source water protection plan.



Acronyms & Glossary

Acronyms

BID—Business Improvement District

BMP—Best Management Practices

COG—Council of Governments

CWA—Clean Water Act

CZMA—Coastal Zone Management Act

ICMA—International City/County Managers Association

LID—Low Impact Development

LOS—Level of Service

MPO—Metropolitan Planning Organization

NACO—National Association of Counties

NAHB—National Association of Homebuilders

NPDES—National Pollutant Discharge Elimination System

NPS—Nonpoint Source Pollution

NRCS—Natural Resource Conservation Services

PFA—Priority Funding Area

SWMP—Stormwater Management Plan

SWPP—Stormwater Prevention Plan or Stormwater Pollution Prevention Plan

TIF—Tax Increment Financing

TDR—Transfer of Development Rights

TMDL—Total Maximum Daily Load

TND—Traditional Neighborhood Development

TOD—Transit Oriented Development

UDO—Unified Development Ordinance

USEPA—United States Environmental Protection Agency

Glossary

BMPs (Best Management Practices): Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from non-point sources, such as pollutants carried by urban runoff. These methods can be structural (e.g., devices, ponds) or non-structural (e.g., policies to reduce imperviousness). BMPs classified as "non-structural" are those that rely predominantly on behavioral changes rather than construction in order to be effective. "Structural" BMPs are engineered or constructed to prevent or manage stormwater.

Biofiltration: The use of vegetation such as grasses and wetland plants to filter and treat stormwater runoff as it is conveyed through an open channel or swale.

Buffer Zone: A designed transitional area around a stream lake or wetland left in a natural, usually vegetated, state so as to protect the waterbed from runoff-related pollution. Development is typically prohibited or restricted in a buffer zone.

Charrette: A French word meaning "cart"; often used to describe the final, intense work effort expended by art and architecture students to meet a project deadline. In modern terms, a charrette is an intense community workshop, typically held over several consecutive days, conducted to gather ideas and develop feasible community design options.

Combined Sewer Overflows (CSOs) and Sanitary Sewer Overflow (SSOs): Overflows occur when pipes carrying sewage and/or stormwater are overwhelmed by a high volume of water, typically during rainstorms. Older cities tend to have combined sewers (stormwater and sewage are carried in the same pipe); however, sanitary sewers can overflow as well.

Detention: The storage and slow release of stormwater following a precipitation event by means of an excavated pond, enclosed depression, or tank. Detention is used both for pollutant removal, stormwater storage, and peak flow attenuation.

Exfiltration: The downward flow of water into the soil.

Floodplain: A natural or statistically derived area adjacent to a stream or river where water overflows its banks at some frequency during extreme weather events.

General Permit: A permit issued under the NPDES program to cover a certain class or category of stormwater discharges. These permits reduce the administrative burden of permitting stormwater discharges. Most permitting authorities also allow for individual permits, which are tailored to meet unique needs.

Hydrology: The science dealing with the properties, distribution, and circulation of water on and below the Earth's surface and in the atmosphere.

Impervious Surface: A hard surface area that either prevents or retards the entry of water into the soil mantle as occurs under natural conditions (prior to development), and from which water runs off at an increased rate of flow or in increased volumes. Common impervious surfaces include but are not

limited to rooftops, walkways, patios, driveways, parking lots, compacted soil, and roadways. "Effective impervious surface" is commonly used to describe impervious surfaces connected to receiving water directly or with a conveyance device (e.g., curbs, pipes, gutters).

Infiltration: The process or rate at which water percolates from the land surface into the ground. Infiltration is also a general category of BMPs designed to collect runoff and allow it to flow through the ground for treatment.

Infiltration/Inflow (I/I): Clean storm and/or groundwater that enters the sewer system through cracked pipes, leaky manholes, or improperly connected storm drains, down spouts and sump pumps. Most inflow comes from stormwater and most infiltration comes from groundwater. I/I affects the size of conveyance and treatment systems and, ultimately, the rate businesses and residents pay to operate and maintain them.

Maximum Extent Practicable (MEP): A standard that applies to all MS4 operators under NPDES permits. The standard has no exact definition, as it was intended to be flexible to allow operators to tailor their stormwater programs to their particular site

MS4 (Municipal Separate Storm Sewer System): A publicly owned conveyance or system of conveyances that discharges to waters of the United States or waters of the state, and is designed or used for collecting or conveying storm water. Conveyances can include any pipe; ditch or gully; or system of pipes, ditches, or gullies, that is owned or operated by a governmental entity and used for collecting and conveying storm water. For purposes of implementing NPDES, regulated communities have been divided into small, medium and large MS4s:

- **Large MS4**: all municipal separate storm sewers that are located in an incorporated place with a population of 250,000 or more according to the latest Census.
- **Medium MS4**: all municipal separate storm sewers that are located in an incorporated place with a population of more than 100,000 but less than 250,000.
- **Small MS4**: any municipal separate storm sewer that is not defined as being "large" or "medium," but which meets certain criteria on density or other factors used locally for designation.

National Pollutant Discharge Elimination System (NPDES): A provision of the Clean Water Act that prohibits the discharge of pollutants into waters of the United States unless a special permit is issued by EPA, a state (where designated), a tribal government or Indian reservation.

Nonpoint source (NPS) pollution: Pollution that is caused by or attributable to diffuse sources. Typically, NPS pollution results from land runoff, precipitation, atmospheric deposition, or percolation.

Notice of Intent (NOI): An application to notify the permitting authority of a facility's intention to be covered by a general permit; exempts a facility from having to submit an individual or group application.

Permitting Authority: The NPDES-authorized state agency or EPA regional office that

administers the NPDES program, issuing permits, providing compliance assistance, conducting inspections, and enforcing the program.

Pollution-generating pervious surfaces: A non-impervious surface with vegetative ground cover subject to use of pesticides and fertilizers. Such surfaces include, but are not limited to, the lawn and landscaped areas of residential or commercial sites, golf courses, parks, and sports fields.

Post-Construction BMPs: A subset of BMPs including source control and structural treatment BMPs that detain, retain, filter, or educate to prevent the release of pollutants to surface waters during the final functional life of development.

Retention: The process of collecting and holding surface and stormwater runoff with no surface outflow.

Runoff: Any drainage that leaves an area as surface flow.

Sanitary Sewer: An underground pipe system that carries sanitary waste and other wastewater to a treatment plant

Stormwater Sewer System: A system of pipes and channels that carry stormwater runoff from surfaces of building, paved surfaces, and the land to discharge areas

Stormwater Management: The prevention, control, and mitigation of the effects of stormwater runoff. Management programs include regulatory and non-regulatory aspects, but are typically integrated with other water quality programs.

Stormwater Management Plan (SWMP): A plan, which may be integrated with other land development plans or regulations, that spells out how a regulated entity intends to prevent and treat stormwater runoff.

Stormwater Pollution Prevention Plan (SWPPP): A plan to describe a process though which a facility thoroughly evaluates potential pollutant sources at a site and selects and implements appropriate measures designed to prevent or control the discharge of pollutants in stormwater runoff.

Total Maximum Daily Load (TMDL): A regulatory limit of the greatest amount of pollutants that can be released into a body of water without adversely affecting water quality.

Water Quality Standards: State-adopted and EPA-approved ambient standards for waterbodies. The standards cover the use of the waterbody and the water quality criteria that must be met to protect the designated use or uses.

Watershed: A geographic area in which water flowing across the surface will drain into a certain stream or river and flow out of the area via that stream or river. All of the land that drains to a particular body of water.

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