THE EARTH'S BEST DEFENSE

OUT OF THE GUTTER

Reducing Polluted Runoff in the District of Columbia

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Urbanization has dramatically altered the earth's natural hydrology, and this has resulted in serious problems with stormwater whenever it rains or snows. The process of urbanization begins with construction, which eliminates trees, vegetation, and topsoil—key components of the natural hydrologic system that otherwise controls the overflow of precipitation (stormwater runoff). After construction, problems continue. Development usually replaces native meadows, forested areas, and other natural landscape features with lawns, pavement, and rooftops—and these largely impervious surfaces generate substantial quantities of surface runoff.

Engineers traditionally design drainage systems to move rainwater as quickly as possible by directing it over the ground toward curbs, gutters, streets, and sewers. But these conventional drainage systems prevent water from flowing into the ground and filtering through soil before being released into surface and ground waters. Instead, they create more surface runoff, and this results in increased flooding, erosion, and pollution. Today, there is more stormwater runoff—and more pollution in the runoff—than ever before.[1] As a result, the health of our water bodies, and the people and wildlife that rely upon them, is in jeopardy.

STORMWATER RUNOFF IN THE NATION'S CAPITAL

As in other cities, the hydrologic impacts of development have contaminated waters in the District of Columbia (District). Approximately 65 percent of the District's natural groundcover has been replaced with impervious surfaces, such as roads, buildings, and parking areas.[2] These impervious surfaces dominate the landscape and generate large volumes of surface runoff when it rains and are exacerbated by significant urban forest canopy losses.

Neither the natural drainage systems nor the built stormwater infrastructure in the District is capable of adjusting to the dramatic hydrologic changes wrought by urban development. The District has both separate and combined stormwater and sanitary sewerage systems. The separate storm sewer system collects and discharges polluted stormwater into area surface waters, adding volume, speed, and thermal shock as well as contaminants to those waters. In the combined sewer system, stormwater entering the system on rainy days is mixed with untreated sewage, and the mixture is discharged directly into waterways when the total volume exceeds the capacity of the system. Discharges from storm sewers and combined sewer systems are leading sources of pollution for the city's three rivers (the Potomac, the Anacostia, and Rock Creek),

Stormwater runoff frequently overwhelms the urban infrastructure, causing local flooding and neighborhood sewer backups, which create public nuisances and health hazards.

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responsible for almost 70 percent of their impairment.[3,4] The bulk of those discharges go into the Anacostia River, which is one of the most severely polluted rivers in the nation.

The District's current stormwater management system adversely impacts not only public health and the environment, but also the economy: the increase in the magnitude and frequency of sewer backups and flooding in city streets, polluted rivers, loss of aquatic habitat and recreational opportunities after storm events creates a nuisance and costs citizens and the District money.[5] To maintain and improve the environmental, economic, and social conditions of the District, officials must address both contaminated stormwater and combined sewer overflows.

THE SOLUTION: LOW-IMPACT DEVELOPMENT

Low-Impact Development (LID)—a new way of thinking about stormwater management—is a highly effective strategy for controlling contaminated urban runoff. LID employs lot-level techniques that reduce the impact of development through the use of multiple systems that retain, detain, filter, treat, use, and reduce stormwater runoff. LID is grounded in a core set of principles based on a new paradigm: first, that stormwater management should not be seen as stormwater disposal; second, that numerous opportunities exist within the developed landscape to control stormwater runoff close to the source.[6] The primary goals of LID design are: first, to reduce runoff volume through infiltration, retention, and evaporation; and second, to find beneficial uses for water rather than exporting it as a waste product down storm sewers. Ultra-urban environments afflicted with stormwater ailments—such as the District of Columbia—are ideal settings in which to put LID methods to work to benefit the environment, water quality, and public health.

Cities afflicted with stormwater ailments—such as the District of Columbia—are ideal settings in which to put LID methods to work to benefit the environment, water quality, and public health.

LID practices can be applied to all elements of the urban environment, turning parking lot islands, street medians, planter boxes, and landscaped areas near buildings into specialized stormwater treatment systems.[7] Innovative designs for urban areas may also include roof gardens, methods for capturing and using rainwater, and use of permeable pavement in low-traffic areas, parking areas, and walking paths.[8] Furthermore, LID strategies can help beautify the urban environment and create desirable public open space.

The adoption of LID practices requires a basic paradigm shift involving and educating many interested parties on these new principles, and removing regulatory barriers that stand in the way of progress. Unfortunately, designers, developers, and contractors are often unfamiliar with LID practices and benefits. And even if they do understand the principles, quite often there are legal, institutional, and political obstacles that reinforce status quo stormwater or sewage management practices and behavior—and even prohibit the use of certain LID practices.

PUTTING LID TO WORK IN THE DISTRICT OF COLUMBIA

In this report, we assess how LID strategies can mitigate runoff problems in the District of Columbia, and we scrutinize development regulations that pose potential impediments to the voluntary application of LID strategies, policies, and programs. To do so, NRDC developed the attached checklist (Appendix A, Legal Review Checklist: Impediments to Voluntary Low-Impact Development in the District of Columbia) for use by the District of Columbia—as well as communities across the country—to identify and address these potential legal obstacles to voluntary LID. We then used the checklist to evaluate existing District of Columbia development regulations, identify sections of those regulations that pose impediments to the voluntary use of LID techniques, and suggest ways in which the regulations could be modified to encourage LID practices, which will ultimately produce myriad benefits for the environment and the public.

Lastly, NRDC explored several major areas of policy-making, planning, and management that affect stormwater management; these deserve renewed attention in developing an LID strategy for the District. NRDC recommended a number of changes that will facilitate consideration and implementation of LID in strategic planning, redevelopment, provision of municipal services, and environmental management decisions in the District. These changes include four general areas of recommendations.

1. Leadership by Example

Stormwater management in the District of Columbia is a responsibility shared jointly among four District agencies: the Department of Health (DOH), the Water and Sewer Authority (WASA), the Department of Public Works (DPW), and the District Division of Transportation (DDOT). District of Columbia interagency and interdepartmental cooperation is crucial to the successful promotion and implementation of LID in the District. The other D.C. agencies involved in land-use planning and development need to understand the multiple benefits of LID and take active roles in its promotion.

With the signing of the Chesapeake Bay Executive Council agreement in December 2001, the District of Columbia will take the lead role in meeting Anacostia River restoration goals and objectives. In this context, an Executive Order for District stormwater management and low-impact development could promote LID efforts, expand the responsibility for stormwater management, and have tremendous impact not just in "home-building" activities but also in "housekeeping" activities. Leadership can include:

- issuing state-of-the-art technical guidelines for LID
- promoting high-visibility LID demonstration projects
- developing a large-scale "sewershed" LID application as part of a long-term control plan for combined sewer overflows

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Forested buffers in riparian areas are an important part of the urban forest and protect rivers and streams from adjacent runoff and erosion.

▸ creating commercial incentives to reverse the trend of unsustainable construction activities
▸ fostering coordination between District agencies and utility companies (including water, gas, electricity, etc.) to accomplish the goals of stormwater management and improve our urban green infrastructure.

2. Stormwater Rate Revision

The most logical starting point for creating economic incentives lies within the existing stormwater utility fee collected by WASA. Once the stormwater fee is revised to take into account impervious area, economic incentives—such as those that encourage and credit land conservation and reforestation efforts, low-impact development, and other site-specific stormwater management techniques—can easily be incorporated. Appendix B is an overview of stormwater rates from across the country.

3. Conservation and Management of Existing Open Spaces

Much of the remaining open space in the District of Columbia is either National Park Service property or D.C. Department of Parks and Recreation property; it is confined to areas of sensitive environmental significance, including riverfront and riparian areas, wetlands, and areas of extremely steep slopes. Future development and redevelopment efforts must be conducted very carefully; they must be sensitive to the context of the remaining surrounding natural areas and cognizant of ongoing stewardship efforts. Sound strategic planning and decision-making must be coordinated with environmental management efforts across the numerous District and federal agencies and jurisdictions. These efforts must focus on the restoration of the urban forest and street tree canopy; the protection of riparian corridors and steep slopes to control erosion; and optimization of city parks and public spaces for stormwater management.

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Strategic grading and use of pervious pavement as shown here in the Washington Navy Yard can be used effectively to treat and infiltrate parking lot runoff.

4. Water Conservation

There are many water conservation opportunities to be gained in the District of Columbia that warrant investigation and policy analysis; these include opportunities in building plumbing and maintenance, appliances, irrigation practices, and stormwater management.

Water reuse techniques (such as rain barrels and cisterns) represent simple and inexpensive ways we can trap, store, and reuse stormwater; they also provide a measurable level of storage during storm event peak flows, use water more efficiently for landscape maintenance and irrigation, and save consumers money. Low-flow shower heads, horizontal-axis clothes washers, and on-demand hot-water systems represent untapped opportunities to significantly impact dry-weather river

James Woodworth

Rain barrels and cisterns are simple and inexpensive techniques to trap, store, and reuse stormwater for efficient landscape irrigation.

flows, reduce ratepayers' water bills, and make strides toward the District's inter-municipal water allocation and consumption goals. These techniques need to be implemented broadly throughout the District.

CONCLUSION

Low-impact development is emerging as a highly effective approach to managing polluted stormwater runoff. It is particularly effective in ultra-urban settings and should be included as part of a new paradigm for managing stormwater runoff generated from development and redevelopment. LID should be integrated into the broad context of economic redevelopment and stormwater management to help restore the District of Columbia's urban green infrastructure and its valuable waterfront resources, including the Anacostia River. The District and federal governments have significant roles to play in developing broad-based institutional support for LID. They must lead by example in their own projects and management activities; by providing effective technical guidance, education, outreach, and economic incentives, they can prompt and guide residential and commercial entities to follow suit. LID is a valuable and complementary watershed management tool that should be used in conjunction with ongoing land conservation, urban forest management, riparian and wetlands restoration, and water conservation efforts.

CHAPTER 1

Introduction and Background to Low-Impact Development

Low-Impact Development (LID)—a new way of thinking about stormwater management—is a highly effective strategy for controlling contaminated urban runoff. In contrast to traditional stormwater management practices, which carry run-off away to be dealt with (or not dealt with) elsewhere, LID seeks to mitigate runoff on-site to the greatest extent possible. LID employs lot-level techniques that reduce the impacts of development through the use of multiple systems that retain, detain, filter, treat, use, and reduce stormwater runoff. Ultra-urban environments afflicted with stormwater ailments—such as the District of Columbia—are ideal settings in which to put LID methods to work to benefit the environment, water quality, and public health.

The adoption of LID practices will require a basic paradigm shift that will involve educating many interested parties on these new principles and lifting regulatory barriers that stand in the way of progress. Designers, developers, and contractors are often unfamiliar with LID practices and benefits. And even if they might understand the principles, quite often there are legal, institutional, and political obstacles that reinforce status quo stormwater or sewage management practices and behavior—and even prohibit the use of certain LID practices. Development standards, building codes, and zoning regulations are the most likely source of such legal impediments. Public health and safety regulations may also limit LID practices such as street storage, stormwater infiltration systems near drinking water sources, and reduced road widths. Removing the unnecessary regulatory impediments to voluntary LID, consistent with public health and safety goals, is an essential first step toward fostering the use of these techniques.

In this report, NRDC attempts to put LID to work in the District of Columbia: we evaluate the city's current stormwater management practices; assess how LID strategies can mitigate runoff problems; and scrutinize development regulations that pose potential impediments to the voluntary application of LID strategies, policies, and programs. To do so, NRDC developed the attached checklist (Appendix A, Legal Review Checklist: Impediments to Voluntary Low-Impact Development in the District of Columbia) for use by the District of Columbia—as well as communities across the country—to identify and address these potential legal obstacles to voluntary LID. We then used the checklist to evaluate existing District of Columbia development regulations and identify sections of those regulations that pose impediments to the voluntary use of LID techniques. Finally, we suggested ways in which the regulations could be modified to encourage LID practices, which will ultimately produce myriad benefits for the environment and the public.

THE PROBLEM OF URBAN RUNOFF

Causes and Consequences

Precipitation is an essential ingredient in the earth's natural hydrology: under predevelopment conditions, trees, vegetation, and soil capture and filter most rainwater through the processes of interception, infiltration, and groundwater recharge. Through urbanization, however, we have dramatically altered the natural landscape and natural hydrology, and this has resulted in serious stormwater problems from urban runoff. Today, there is more stormwater runoff—and more pollution in the runoff—than ever before.[9] As a result, the health of our water bodies, and the people and wildlife that rely upon them, is in jeopardy.

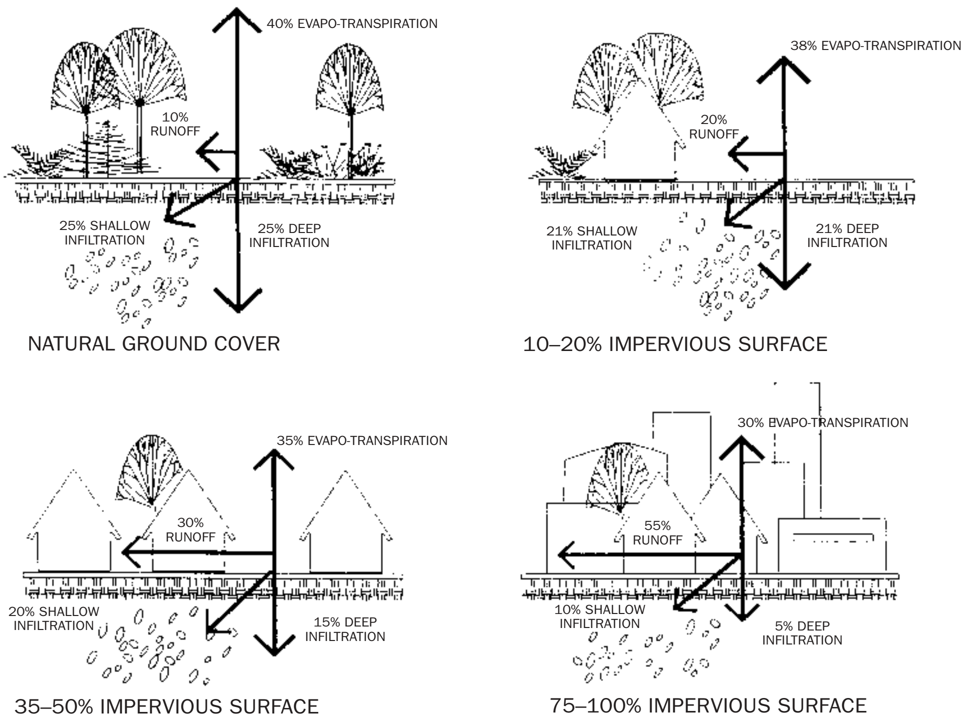
The process of urbanization begins with construction, which alters and eliminates trees, vegetation, and topsoil—key components of the natural hydrologic system that otherwise control runoff. Construction also exposes sediment and construction materials to precipitation, which then washes materials into storm drains or directly into nearby bodies of water. After construction, problems continue. Development usually replaces native meadows, forested areas, and other natural landscape features with lawns, pavement, and rooftops, and these largely impervious surfaces generate substantial quantities of surface runoff. Engineers traditionally design drainage systems to move rainwater as quickly as possible by directing it over the ground toward curbs, gutters, streets, and sewers. But these conventional drainage systems prevent water from flowing into the ground and filtering through soil before being released into surface and ground waters. Instead, they create more surface runoff—and this results in increased flooding, erosion, and pollution. Studies have found a direct correlation between the loss of forest cover and the increase of impervious cover in a watershed and increased water quality degradation; reduced stream stability and loss of habitat and biological diversity are also by-products of urbanization.[10]

Traditional "curb and gutter" drainage systems rapidly move polluted stormwater runoff to streams and rivers, causing increased flooding, erosion, and water pollution downstream.

James Woodworth

Development not only increases runoff, but it also increases the amount of pollutants that pour

Water Cycle Changes Associated with Urbanization



Source: Environmental Protection Agency, *Guidance Specifying Management Measures for Sources of Nonpoint Source Pollution in Coastal Waters*, #840-B-92-002, 1993.

Approximately 65 percent of the District's natural groundcover has been replaced with impervious surfaces—such as roads, buildings, and parking areas—that dominate the landscape and generate large volumes of surface runoff.

into runoff. Most stormwater pollution is derived from diffuse sources closely related to everyday municipal and personal activities.[11] Automobiles, for example, are major sources of environmental releases of petroleum products, nutrients, toxic fluids, and heavy metals; home and yard maintenance contribute nutrients, chemicals, and pesticides; industrial and transportation activities generate airborne pollutants that settle upon urban surfaces. In addition, failure to pick up after pets can lead to high levels of bacteria in runoff. Without management or treatment, polluted runoff degrades streams, lakes, wetlands, and drinking water supplies.

Urban Runoff in the District of Columbia

The District provides an excellent example of the dire environmental and public health consequences associated with conventional stormwater management practices. As in other urban areas, the hydrologic impacts of development have contaminated District waters. Discharges from storm sewers and combined sewer systems are leading sources of pollution for the city's three rivers (the Potomac, the Anacostia, and Rock Creek), responsible for almost 70 percent of their impairment.[12,13] Urbanization is a main culprit. Approximately 65 percent of the District's natural groundcover has been replaced with impervious surfaces, such as roads, buildings, and parking areas.[14] These impervious surfaces dominate the landscape and generate large volumes of surface runoff when it rains or when snow melts.

James Woodworth

The city's combined sewer system was designed to overflow stormwater and raw sewage at 58 different discharge points throughout the three rivers of the District of Columbia—including here on the Potomac River, between the Kennedy Center for Performing Arts and the Georgetown waterfront.

Increases in impervious surfaces have also corresponded with significant tree canopy losses. Over a 30-year period, the District's tree canopy declined from 37 percent to 21 percent, while stormwater runoff increased an estimated 34 percent during that time period.[15] In addition, everyday activities—such as driving cars and maintaining homes and lawns—deposit significant quantities of oils, sediments, nutrients, materials that deplete dissolved oxygen in bodies of water as well as bacteria and viruses, toxins, and other pollutants onto the land surface. Their presence is as ubiquitous in the District as it is in other urban areas.[16] Pollutants from urban activities degrade the rivers, posing health risks, destroying habitat, and limiting citizen and visitor enjoyment.

Neither the natural drainage systems nor the built stormwater infrastructure in the District is capable of adjusting to the dramatic hydrologic changes wrought by urban development. The District has separate and combined stormwater and sanitary sewerage systems. The separate storm sewer system collects and discharges polluted stormwater into area surface waters, adding volume, speed, and thermal shock as well as contaminants to those waters. In the combined sewer system, stormwater entering the system on rainy days contributes directly to sewer overflows and treatment plant bypasses; untreated sewage is then mixed with stormwater and discharged directly into waterways. The bulk of those discharges go into the Anacostia River, which is severely polluted.[17] Not only does this river receive the lion's share of sewer overflow loadings, but because it is a slow moving tidal estuary, the Anacostia takes longer than either the Potomac River or Rock Creek does to flush out pollution.[18] In fact, dissolved oxygen levels in the Anacostia River in the summer months are low enough to result in fish kills.[19] Bacteria levels are sometimes hundreds, even thousands, of times greater than the allowable levels, putting the health of those who come in contact with the water at risk.[20]

District waters have been listed as impaired for organics, pathogens, metals, total suspended solids, oil and grease, dissolved oxygen, pH, and toxics.[21] Trash, debris, and strong odors make the rivers unsightly and unpleasant for local residents. Water quality is too poor to fully support a healthy aquatic ecology. Currently, all three rivers are too polluted to allow swimming.[22] There is a public health advisory against the consumption of bottom-feeding fish caught in D.C. waters.[23]

The current stormwater management system is a drain not only to public health but also to the economy: the increase in the magnitude and frequency of flooding in city streets after storm events creates a nuisance and costs citizens and the District money.[24] To maintain and improve the environmental, economic, and social conditions of the District, officials must address both contaminated stormwater and combined sewer overflows.

LOW-IMPACT DEVELOPMENT: AN EFFECTIVE AND ECONOMICAL SOLUTION TO STORMWATER MANAGEMENT

LID has emerged as a highly effective and attractive approach to control stormwater pollution and protect developing watersheds and already urbanized communities throughout the country. As urbanization continues to degrade our lakes, rivers, and coastal waters, LID is increasingly being used to reverse this trend, resulting in cleaner bodies of water and greener urban neighborhoods.

Goals of LID

LID aims to work within the developed and developing environment to find opportunities to reduce runoff and prevent pollution. LID controls stormwater runoff at the lot level, using a series of integrated strategies that mimic and rely on natural processes.[25] By working to keep rainwater on site, slowly releasing it, and allowing natural physical, chemical, and biological processes to do their job, LID reduces adverse environmental impacts and the cost of treatment.

LID is grounded in a core set of principles based on a new paradigm: first, that stormwater management should not be seen as stormwater disposal; second, that numerous opportunities exist within the developed landscape to control stormwater runoff close to the source.[26] Underlying these principles is an understanding of natural systems and a commitment to work within their limits whenever possible. Doing so creates an opportunity for development to occur with low environmental impact. The core set of principles is as follows:[27]

- To integrate stormwater management early in site planning activities;
- To use natural hydrologic functions as the integrating framework for site development;
- To focus on preventing problems associated with runoff before they happen rather than mitigating problems after they occur;

The Anacostia River receives the lion's share of sewer overflow loadings. And because it is a slow moving tidal estuary, it takes longer than either the Potomac River or Rock Creek does to flush out pollution.

THE BENEFITS OF LID

Uncontrolled urban runoff degrades streams, habitat, and biological diversity. LID provides an optimal way to control stormwater runoff—and this practice will, in turn, have the following benefits:[28]

- minimizing disturbance from development;
- preserving and recreating natural landscape features, including forest and vegetated areas and native soils;
- reducing effective impervious cover;
- increasing drainage flow paths and "hydrologic disconnects";
- enhancing "off-line" storage;
- facilitating detention and infiltration opportunities

Top Ten Ways to Put LID to Work

LID is easy, inexpensive, and can be applied even at the household level to reduce runoff, through:

1. Rain Gardens and Bioretention
2. Rooftop Gardens or Simple Roof Storage
3. Tree Preservation and Planting
4. Vegetated Swales, Buffers, and Strips
5. Roof Leader Disconnection
6. Rain Barrels and Cisterns
7. Impervious Surface Reduction and Disconnection
8. Soil Amendments
9. Permeable Pavers
10. Pollution Prevention and Good Housekeeping

- To emphasize simple, nonstructural, low-tech, and low-cost methods of on-site stormwater management;
- To manage runoff as close to the source as possible;
- To distribute small-scale stormwater management practices throughout the landscape;
- To rely on natural landscape features and processes to slow and filter runoff and encourage groundwater recharge;
- To create a multifunctional landscape.

The net effect of using multiple LID techniques is a landscape that is functionally equivalent to predevelopment hydrologic conditions.

Conventional, centralized stormwater management systems (such as stormwater ponds) can be expensive; furthermore, while they can be effective at removing pollutants, they often fail to address elevated surface water temperature, runoff peaks, and critical hydrologic functions, such as groundwater recharge.[29] Instead of making large investments in centralized stormwater management practices, LID applies a decentralized approach that integrates runoff treatment techniques into every part of the urban landscape. Rather than piping water to low spots as quickly as possible, LID uses micro scale techniques to manage precipitation as close as possible to where it hits the ground. This involves strategic placement of linked lot-level controls that are customized to address specific pollutant load as well as stormwater timing, flow rate, and volume issues.

Two primary goals of LID design are: first, to reduce runoff volume through infiltration, retention, and evaporation; and second, to find beneficial uses for water rather than exporting it as a waste product down storm sewers. The net effect of using multiple LID techniques is a landscape that is functionally equivalent to predevelopment hydrologic conditions. There is less surface runoff and less pollution routed to receiving waters.

Techniques of LID

LID offers a wide variety of structural and nonstructural techniques to reduce runoff speed and volume and improve runoff quality. LID works in urban infill or retrofit

LID Works Naturally

LID practices use natural functions to trap and treat runoff.

Physically: LID increases interception, infiltration, and evapotranspiration; facilitates sediment removal, filtration, and volatilization; stabilizes soils to reduce sedimentation and erosion.

Chemically: LID facilitates adsorption, chelation, ion exchange, and organic complexing.

Biologically: LID increases transpiration, nutrient cycling, direct uptake, and microbial decomposition.[30]

projects, as well as in new developments. In areas with a combined sewer system, LID can reduce both the number and the volume of sewer overflows.[31] Opportunities to apply LID principles and practices are numerous; almost any feature of the landscape can be modified to control runoff (*e.g.*, buildings, roads, walkways, yards, open space). When integrated and distributed throughout a development, watershed, or urban drainage area, these practices can substantially reduce the environmental impacts of development.

A wide selection of runoff control strategies, combined with common sense and good housekeeping practices, are the essence of a LID approach to stormwater solutions.

LID uses a systems approach that emulates natural landscape functions. A wide selection of runoff control strategies, combined with common sense and good housekeeping practices, are the essence of a LID approach to stormwater solutions. These basic strategies (also known as integrated management practices) rely on the earth's natural cycles to reduce land development impacts on hydrology, water quality, and ecology. Integrated management practices combine a variety of physical, chemical, and biological processes to capture runoff and remove pollutants at the lot level (see "LID Works Naturally," above). LID also strives to prevent the generation of runoff by reducing the impervious footprint of a site, thereby reducing the amount of water that needs treatment. The end hydrological result is reduced volume of runoff, increased time of concentration, reduced peak flow and duration, and improved water quality.

Developers apply most LID strategies on the micro scale, distributed throughout the site near the source of runoff. They customize strategies according to site conditions in order to reduce specific pollutants and to control runoff, a technique known as site footprinting. LID is particularly effective when practices are integrated into a series of linked, strategically placed and designed elements that each contributes to the management of stormwater.

LID integrates land and infrastructure management. Activities such as street sweeping, toxic-free and low-impact landscaping, frequent cleaning of catch basins, sediment control, and downspout disconnection all reduce runoff contamination. LID works equally well in new development and redevelopment projects and is easily customized to complement local growth management, community revitalization, and watershed protection goals.[32] LID can also be used in conjunction with other techniques, such as land use planning, land conservation, watershed planning, and traditional stormwater control techniques; this results in a diverse and effective approach to stormwater management.

LID is much more than the management of stormwater—it is rethinking the way we plan, design, implement, and maintain development projects. Comprehensive programs usually complement LID practices with broader issues such as: considering where growth disturbance should occur; increasing awareness of the cumulative impacts of development; involving the community and raising watershed awareness; developing direct social marketing of LID retrofit actions to households, institutions, and commercial establishments; creating a rational institutional framework for implementing stormwater management; and establishing an authority to guide and administer stormwater management activities.[33]

Six Benefits of LID

LID technology expands the toolbox available to stormwater managers and developers for protecting receiving waters. Research has demonstrated it to be a simple, practical, and universally applicable approach for treating urban runoff.[34] By addressing runoff close to the source with multifunctional systems, LID can enhance the local environment, provide a multitude of benefits to the community, and protect public health while saving developers and local governments money.

Nuts and Bolts of Biorerention, A Core LID Practice

Bioretention provides a good example of how LID management practices work. Bioretention areas (also known as "rain gardens") use vegetation and soil to trap and treat petroleum products, metals, nutrients, and sediments. As a result, pollutants are trapped and taken up in plant tissue rather than carried away in runoff.

A bioretention cell in the parking lot of the Washington Navy Yard.

Bioretention areas are relatively inexpensive to build, easy to maintain, and can add aesthetic value to a site without limiting large amounts of valuable land area to only stormwater management.[35] They work as follows: in what appears to be merely a nicely landscaped area—a parking lot island, the edge of a paved area, or the base of a building, for example—is instead a highly engineered system that facilitates depression storage, infiltration, and biological removal of pollutants. Runoff is directed to these low-tech treatment systems rather than to conventional stormwater infrastructure. By distributing bioretention areas throughout a site as part of the existing landscape and design, developers do not have to sacrifice a significant amount of space for stormwater management.

Effective. By reproducing predevelopment hydrology, LID effectively reduces runoff and pollutant loads.[36] Researchers have shown the practices to be successful at removing common urban pollutants, including nutrients, metals, and sediment. Furthermore, since many LID practices infiltrate runoff, which helps recharge groundwater and, in turn, improves stream baseflows during dry weather, LID can also help to reduce the heat pollutant loadings from runoff and maintain lower surface water temperatures.

Economical. Because of its emphasis on natural processes and micro scale management practices, LID is often less costly than conventional stormwater controls. LID practices can be cheaper to construct and maintain and may have a lower life-cycle cost than centralized stormwater strategies.[37] Because LID emphasizes simple, small-scale practices, it is less likely to involve large-scale rehabilitation. Furthermore, routine maintenance should cost no more than conventional property management since the practices are commonly part of the existing landscape. Developers also benefit by spending less on pavement, curbs, gutters, piping, and inlet structures.[38] LID creates a desirable product that often sells faster and at a higher price than equivalent conventional developments.

But the benefits do not stop here. The associated vegetation also offers human "quality of life" opportunities by greening the neighborhood and thus contributing to livability, value, sense of place, and aesthetics. Environmental benefits include wildlife habitat improvements, thermal pollution reduction, energy savings, smog reduction, enhanced wetlands protection, and decreased flooding.[39] These too can lead to enhanced property values, greater redevelopment potential, and increased marketability of properties.

LID is much more than the management of stormwater—it is rethinking the way we plan, design, implement, and maintain development projects.

Flexible. Working at a small scale allows volume and water quality control to be tailored to specific site characteristics. Since pollutants vary across land uses and from site to site, the ability to customize stormwater management techniques and the degree of treatment offer a significant advantage over conventional management methods. Almost every site and every building can apply some level of LID and integrated management practices that contribute to the improvement of urban and suburban water quality.[40]

Adds value to the landscape. LID makes efficient use of land for stormwater management, and therefore, interferes less than conventional techniques do with other uses of the site. It promotes less disturbance of the landscape and conservation of natural features, thereby enhancing the aesthetic value of a property and thus its desirability to home buyers, property users, and commercial customers. Developers may even realize greater lot yields when applying LID techniques.[41]

Achieves multiple objectives. Practitioners can integrate LID into other urban infrastructure components and save money. For example, there is a direct overlap between stormwater management and combined sewer overflow control—such that municipalities can use LID to help remedy both problems.[42] Lot-level LID applications and integrated stormwater management practices combine to provide substantial reductions in peak flows and improvements in water quality for both combined and separated systems. Other benefits include habitat enhancement, flood control, improved recreational use of receiving waters, drought impact prevention, and urban heat island effect reduction.

Makes sense. New environmental regulations geared toward protecting water quality and stabilizing our now degraded streams, rivers, lakes, and estuaries are encouraging a broader thinking than centralized stormwater management. Developers and local governments continue to find that LID saves them money, contributes to public relations and marketing benefits, and improves regulatory expediencies. LID connects people, ecological systems, and economic interests in a desirable way.

An infiltration trench, as pictured below, can be used effectively in a parking lot, with no net loss of parking space. This and other LID techniques are equally suited for retrofitting and redevelopment in urban areas.

James Woodworth

Retrofitting the Ultra-Urban Environment Through LID

Several LID practices and principles—particularly the source-control approach and the use of micro scale integrated management practices—have the potential to work effectively as stormwater quality retrofits in existing ultra-urban areas.[43] The fundamental approach of using micro-scale management practices and source control has great potential to generate substantial benefits in existing urbanized watersheds.[44] LID principles and practices are particularly well suited to ultra-urban areas because most LID techniques, such as rain gardens and tree/vegetation planter boxes, use only a small amount of land on any given site.[45] Many LID practices—including bioretention (see "Nuts and Bolts of Bioretention, A Core LID Practice," page 8)—are good for urban retrofit projects since they are easily integrated into existing infrastructure, such as roads, parking areas, buildings, and open space.

LID practices can be applied to all elements of the urban environment. For example, bioretention technology can effectively turn parking lot islands, street medians, planter boxes, and landscaped areas near buildings into specialized stormwater treatment systems.[46] Developers can redesign parking lots to reduce impervious cover and increase stormwater infiltration while optimizing parking needs and opportunities. Innovative designs for urban areas may also include roof gardens, methods for capturing and using rainwater, and use of permeable pavement in low traffic areas, parking areas, and walking paths.[47] Furthermore, LID strategies can help beautify the urban environment and create desirable public open space.

APPLYING LID TECHNIQUES IN THE DISTRICT OF COLUMBIA

LID could be a key element in solving the District's water pollution problems. LID could reduce the volume, temperature, and speed of stormwater flows; decrease the magnitude and frequency of combined sewer overflows; and improve the quality of the stormwater that is discharged into our rivers and creeks. Reducing the amount of sewer overflow would directly improve the District's compliance with water quality standards for bacteria and dissolved oxygen. LID could be effective at removing from polluted runoff contaminants known to be impairing District waters.[48] In addition, the LID approach could also offer numerous quality-of-life benefits: compliance with water quality standards would make it safe to swim and kayak and would eliminate fish kills; ameliorating general stormwater pollution would reduce toxic pollution, oil and grease, and trash in the District's waterways.

LID is currently being piloted in several places in the District along the Anacostia waterfront. Initial changes to municipal regulations and building codes are under consideration to accommodate LID techniques. Effective implementation and widespread adoption of LID practices and techniques will require the elimination of unnecessary regulatory impediments. Notwithstanding the potential benefits of LID, in many municipalities, existing development codes prohibit even their voluntary use in new development and redevelopment projects. Such prohibitions are often carry-overs from the past that do not reflect a municipal policy against LID. To the contrary: once problem areas have been specifically identified, municipalities may be happy to update their development codes to allow the use of LID techniques.

LID strategies can help beautify the urban environment and create desirable public open space.

To facilitate the code review and update process, NRDC developed the attached *LID Checklist* (Appendix A, Legal Review Checklist: Impediments to Voluntary Low-Impact Development in the District of Columbia), which identifies key ways in which municipal development regulations may conflict with LID techniques. Development standards, site preparation requirements, construction codes, zoning regulations, and public space regulations are the most likely source of such conflicts. Public health and safety regulations may also limit LID practices.

The *LID Checklist* was then used to evaluate District of Columbia Municipal Regulations and standards that govern the following aspects of development: zoning, construction, environment, water and sanitation, public health, public space and safety, and soil erosion and sediment control. Uncodified design standards for public infrastructure projects—for example, the District Division of Transportation's *Standard Specifications for Highways and Structures* (1996)—were not included in the analysis. The code review focused on regulations and standards that would inherently block the use of LID practices. Where regulatory impediments were discovered, we have drafted proposed language to introduce flexibility into the relevant standard or regulation (Appendix C, Impediments to Voluntary Low-Impact Development in the District of Columbia: Legal Review Appendix, available under separate cover. Contact NRDC's Washington, D.C. office to obtain a copy). The proposed changes are not designed to create a comprehensive system of incentives for the use of LID, although incentive systems are briefly discussed in the final chapter of the report.

As discussed in more detail in the technical Legal Review Appendix C, the District of Columbia's development regulations satisfied most of the *LID Checklist* items. Site preparation standards in the District, for example, are generally consistent with LID. Likewise, District of Columbia site design requirements appear to be sufficiently flexible to allow most of the LID practices identified in the *Checklist*. With the exception of strict limits on downspout disconnections for nonresidential uses, District building design and construction requirements generally allow LID.

Nevertheless, some sections of the District of Columbia development regulations pose potential impediments to the voluntary use of LID practices. The following section briefly discusses those sections, as well as NRDC's general suggestions for changes.

CHAPTER 2

Review of District of Columbia Municipal Regulations

More than 60 percent of the land area in the District of Columbia comprises impervious surfaces that cause high volumes of polluted runoff to flow to area waterbodies during rainstorms. Herein lies the problem: impervious areas—which include roads, parking lots, driveways, sidewalks and walkways, roofs, patios, courts, and courtyards—do not allow moisture to penetrate through them to infiltrate into the soil below. Traditional drainage designs cause runoff from these surfaces to be concentrated and moved away as quickly as possible by a system of gutters, curbs, pipes, sewers, and channels. This results in large amounts of fast-moving and highly polluted water discharging into rivers, causing erosion, flooding, and other problems.

REGULATIONS PERTAINING TO IMPERVIOUS AREAS

Allowing impervious areas to drain directly to nearby vegetated areas—before runoff is concentrated and collected—will encourage more infiltration and groundwater recharge and result in less impact on downstream waterbodies.

LID Goal: To Disconnect Impervious Areas to Allow Water to Infiltrate On-Site

Existing language: D.C. Plumbing Code, Section 1101.2. Section 1101.2 of the current D.C. Plumbing Code governs runoff from "[a]ll roofs, paved areas, yards, courts and courtyards." According to the Department of Consumer and Regulatory Affairs (DCRA), this language—intended for land uses other than one- and two-family dwellings—has been interpreted to require sewer connections for stormwater discharge whenever storm or combined sewers are available. For such land uses, discharge to "an approved place of disposal" that is not a sewer is permitted only when no sewer connection is available. For one- and two-family dwellings, "stormwater is permitted to discharge onto flat areas provided the stormwater will flow away from the building, will not flow over sidewalks, parking areas or other walkways, and will not flow over property lines onto adjacent lots unless it runs into existing natural water courses."

James Woodworth

Where practical, downspouts should be allowed to drain directly to nearby vegetated areas; this encourages more infiltration and groundwater recharge.

Problem: The problem with the existing language is that it requires all impervious surfaces to drain into either the storm sewer system or the combined sewer system. This quickly overwhelms the District's streams and rivers, causing severe erosion, dangerously high flow volumes, high pollution loadings, and overflows of untreated sewage into rivers during wet weather.

Recommendation: The language NRDC proposes would: (1) allow stormwater discharge to vegetated areas for all land uses, not just one- and two-family dwellings, so long as certain conditions are met; (2) allow stormwater discharges to any other "approved place of disposal"; and (3) require submission of stormwater management plans prior to receipt of a building permit for projects not exempt from the D.C. Stormwater Regulations. These changes would allow the necessary flexibility for appropriate LID techniques to store and infiltrate stormwater on-site and decrease both the amount (volume) and pollutant load of stormwater discharged into the sewer system.

The Plumbing Subcommittee of the District of Columbia Building Code Advisory Committee has proposed similar language for the next update to the District of Columbia Building Codes, planned for sometime later this year.[49] The subcommittee's proposed amendment would require DCRA approval for stormwater discharges to vegetated areas. If the amendment is adopted, NRDC encourages DCRA and the District of Columbia Department of Health (DOH) to work together to develop more detailed guidelines and approval procedures, so that developers can easily determine in advance when non-sewer stormwater disposal options will be allowed.

NRDC's understanding is that the specific terms of Section 1101.2 would govern downspout disconnection, even if other sections of the code establish a generic sewer connection requirement.[50]

LID Goal: To Minimize Impervious Surfaces

Driveways—Shared Driveways

Driveways constitute a large percentage of impervious surface per individual building lot. Shared driveways, currently permissible in certain parts of the District, reduce the total amount of impervious area; therefore, they should be allowed and even encouraged throughout the District.

Existing language: Shared driveways are not specifically prohibited, but the zoning ordinance requires that in general, "each required parking space shall be accessible at all times directly from improved streets or alleys or shall be accessible from improved streets and alleys via graded and unobstructed private driveways."[51] Shared driveway openings with a maximum width of 14 feet are mandated for row dwellings. In addition, the *Downtown Streetscape Regulations* expressly allow the use of shared driveways and parking and loading facilities within the Downtown Streetscape Area (DSA).

Recommendation: NRDC proposes a provision clarifying that shared driveways are allowed in other parts of the District of Columbia for accessory parking spaces. Such flexibility would allow more efficient use of existing impervious areas and help minimize new impervious areas.

Driveways—Surfacing

Existing language: The District of Columbia Zoning Ordinance expressly requires the use of all-weather impervious surfacing materials for parking spaces and driveways.[52] The requirement encompasses private driveways; open parking spaces, including access aisles, driveways, and ramp areas; loading berths and service/delivery loading spaces, including access aisles, driveways, and maneuvering areas; private driveways providing access to loading berths and service/delivery loading spaces; parking lots; and the queuing lanes for drive-through uses. The impervious surfacing requirement also appears to preclude the use of two-track driveway design.

The *Downtown Streetscape Regulations* provide that within the DSA, "driveways and their aprons shall be poured concrete and flush with grade of sidewalk."[53] In addition, the Public Space and Safety Code provides that for parking lots, "driveways shall be constructed of concrete, and shall meet the specifications of the Department of Public Works."[54]

Allowing impervious areas to drain directly to nearby vegetated areas will encourage more infiltration and groundwater recharge and result in less impact on downstream waterbodies.

Recommendation: NRDC proposes the following changes: (1) allow the use of porous pavement for driveways outside of the DSA, and (2) allow the use of two-track driveway design for one-family dwellings. This could be accomplished by changing the zoning ordinance requirement for an "all-weather impervious surface" to a requirement that driveways, parking spaces, access aisles, etc., be "designed to support vehicular traffic," and by supplementing the list of allowed surfacing materials to include "where allowed by the District of Columbia Department of Health's Storm Water Manual, porous pavement designed to support vehicular traffic and certified by a professional engineer licensed in the District of Columbia." NRDC also recommends including a new zoning code provision that expressly allows two-track driveway design for one-family dwellings.

These changes are intended to introduce flexibility into the District of Columbia's paving requirements. For some land uses, however, porous pavement is inappropriate. In areas where there is a risk of chemical, oil, or gasoline spills—for example, fuel dispensing facilities, areas where liquid materials are stored above ground, solid waste storage areas, warehouses, and high-traffic areas—impervious pavement may be preferable. The proposed language relies on the District of Columbia Department of Health's Storm Water Manual to establish standards for where

James Woodworth

Pervious pavement can be used effectively in a variety of situations, particularly in low-traffic areas, in conjunction with tree planting, and in parking lots, as pictured above.

pervious pavement would be permitted. NRDC's understanding is that the amended zoning ordinance provisions would not change surfacing requirements within the DSA unless the *Downtown Streetscape Regulations* mandating particular driveway and sidewalk construction techniques are also changed. Although NRDC is not proposing specific changes to these sections of the *Downtown Streetscape Regulations* now, it encourages the District of Columbia to consider allowing pervious pavement within the DSA and to develop pervious pavement standards that are consistent with the other design goals of the *Downtown Streetscape Regulations*.

Parking Spaces

Existing language: The minimum size of standard off-street accessory parking spaces in the District of Columbia is 9 feet in width and 19 feet in length, exclusive of access drives, aisles, ramps, columns, and office or work areas. This requirement is slightly larger than the minimum recommended in the *LID Checklist*, which is 9 feet in width and 18 feet in length.

Recommendation: NRDC proposes language that would decrease the existing minimum parking space size to 9 feet in width and 18 feet in length.

As discussed above, the District of Columbia Zoning Ordinance appears to preclude the use of porous pavement for accessory parking spaces:

> *All open parking spaces, including access aisles, driveways, and ramp areas shall be paved and maintained with bituminous, concrete or brick materials, or a combination of these materials or other materials approved by the District of Columbia Department of Public Works as structurally equivalent or better,* which form an all-weather impervious surface, *and which is at least four inches (4 in.) in thickness.*[55]

The changes proposed above to allow the use of porous pavement for driveways would also allow the use of porous pavement for accessory parking spaces. As discussed above, additional provisions or regulation may be needed to ensure that porous pavement is not used in areas where chemical, oil, or gasoline spills may occur.

Sidewalks

Existing language: The District of Columbia development codes restrict the use of porous pavers in some parts of the city. In the Anacostia, Capitol Hill, Georgetown, LeDroit Park, and Logan Circle historic districts, the pavement material for new sidewalk installations and substantial repairs on streets zoned R or SP shall be brick and sand. For streets in those areas zoned for commercial purposes, the pavement material shall be brick and concrete.

According to District Division of Transportation staff and the *Downtown Streetscape Regulations*, pressed concrete or brick pavers placed on a sand-cement bed of Portland Cement Concrete Base are required within the DSA.

Recommendation: These regulatory requirements currently prohibit the use of porous pavers in significant parts of the District of Columbia. Although NRDC is not recommending specific changes to these provisions at this time, it encourages the District to consider allowing pervious sidewalk pavements and below-sidewalk storage solutions that satisfy the aesthetic requirements of the DSA and historic districts, as well as providing the durability needed for urban pedestrian volumes.

REGULATIONS PERTAINING TO THE USE OF VEGETATION TO STORE AND FILTER RUNOFF

LID Goal: To Use Vegetation on Roofs to Temporarily Store, Evaporate, and Filter Runoff

Roof area comprises approximately 20 percent of the total impervious area in the District. Finding cost-effective ways to ameliorate the runoff generated by roofs will substantially decrease the impact and volume of stormwater discharging to area waterbodies.

Green roofs—such as this one at the Earth Conservation Corps's Matthew Henson Center in the District of Columbia—have enormous, untapped potential to store and treat roof runoff.

James Woodworth

Green Roofs

"Green roofs" (also known as "eco-roofs") utilize soil and vegetation layers to filter, store, and absorb rainwater before releasing it back into the atmosphere through evapotranspiration. Such practices are very common in parts of Europe and Japan; they are also being implemented with increased frequency across the country.

Existing language: "Landscaped roofs" and "roof gardens" are currently permitted under the District of Columbia Building Code, and there are several structures with such roofs in the District.

Although green roofs and eco-roofs are not separately discussed in the District of Columbia Building Code, the code does address the roof loads that should be used to design buildings with landscaped roofs:

> **Landscaped Roofs.** *Where roofs are to be landscaped, the uniform design live load in the landscaped area shall be 20 pounds per square foot (psi) or 958 Pascals (Pa). The weight of the landscaping materials shall be considered as dead load and shall be computed on the basis of saturation of the soil.*[56]

James Woodworth

Several green roofs do exist in Washington, D.C., including this parking garage at the Brandywine Apartments on Connecticut Avenue, NW.

The term "landscaped roof" does not appear to be defined in the building code. Nevertheless, green roofs and eco-roofs would arguably fall within the ordinarily accepted meaning of a "roof that is landscaped"; and if there is general agreement that roof landscaping encompasses those techniques, there may be no need to modify or expand the building code to allow them.[57]

Recommendation: Another approach would be to propose a new definition of the term "Landscaped Roof" and to tie that definition to the Department of Health's (DOH) stormwater regulations. DOH would also be the agency responsible for review of design and certification.

Roof Gardens

The District of Columbia Building Code also includes standards for roofs "designed for roof gardens or assembly or educational occupancies:"

> **Special-purpose roofs.** *Where occupied for incidental promenade purposes, roofs shall be designed for a minimum live load of 60 psf (2,873 Pa) and 100 psf (4,788 Pa) where designed for roof gardens or assembly or educational occupancies.*[58]

Existing language: The term "roof garden" does not appear to be defined.

Recommendation: Since the live load standard for roof gardens is higher than that for landscaped roofs, it may be worthwhile to explore the difference between those terms with the Building Code Committee. If a technical problem emerges during that discussion, it may be necessary to propose changes or clarifications to the building code. For example, if a building code official would treat a lightweight eco-roof that is inaccessible to pedestrians as a "roof garden," and if the live load standard for roof gardens is excessive for that technique, it may be appropriate to change that standard by incorporating express definitions into the building code (*e.g.*, by including lightweight "eco-roofs" in the definition of "landscaped roof"), or cross-referencing standards to be established in the future by the DOH.

Though landscaped roofs and roof gardens are indeed permitted in the District of Columbia, there are only a few existing examples of green roof applications throughout the District. Complexities in design and implementation arise with structural constraints unique to a particular building, as well as the expertise of the design and construction firm. Increased technical guidance is recommended.

LID Goal: To Maximize Trees and Vegetation

Parking

Existing Language: The District of Columbia Municipal Regulations define "public parking" as

> *that area of public space devoted to open space, greenery, parks, or parking that lies between the property line, which may or may not coincide with the building restriction line, and the edge of the actual or planned sidewalk that is nearer to the property line, as the property line and sidewalk are shown on the records of the District.*[59]

The Public Space and Safety regulations also provide that "Nothing in this section shall be construed to prevent the person having control of the premises abutting on a public parking from sodding or beautifying it with flowers."[60] Grading, paving, construction of a wall or structure, or planting of hedges in a public parking, however, requires a permit.

Problem: The permit requirement is a potential obstacle to LID; for example, it could limit grading by an abutting landowner that would convert public parking into a grassy swale or raingarden or other LID technique.

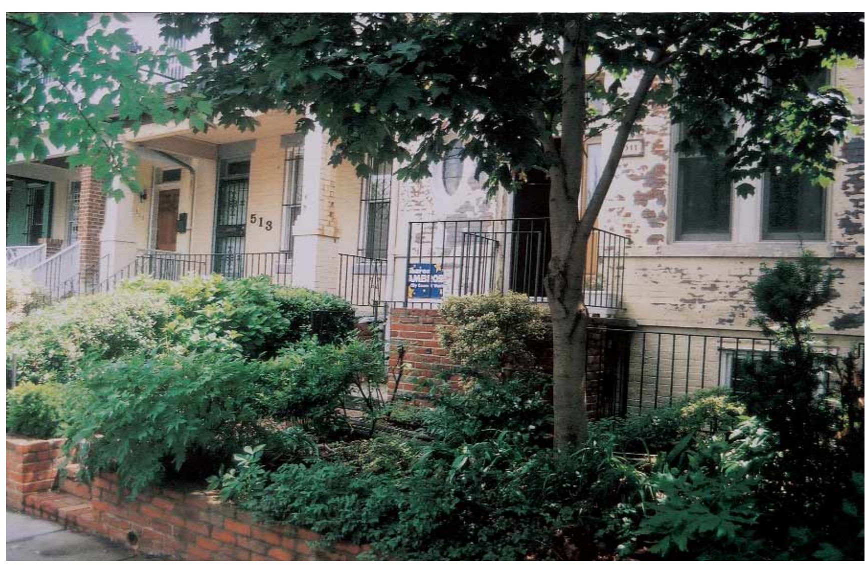
Recommendation: NRDC is not recommending a change to the public parking provision. However, it encourages the DOH and DCRA to work together to develop standards for issuing permits consistent with LID principles to facilitate the use of rain gardens, grassy swales, and other LID techniques where appropriate.

Tree Spaces

Existing Language: The District of Columbia Municipal Regulations define "tree spaces" as the "unpaved area of public space that lies between the street curb and the sidewalk, which is commonly reserved by the District government for planting trees."[61] The District of Columbia Public Space and Safety regulations provide that:

> *The beautification of a tree space may be undertaken at the discretion of the owner or occupant of the property that abuts the tree space, and shall be under the immediate care and keeping of the owner or occupant of the property that abuts the tree space.*[62]

The code, however, imposes a number of restrictions on the size and placement of "beautification areas" in public tree spaces, including: (a) beautification shall not



JIM SCHULMAN

Low-impact development techniques can optimize the functions of the urban landscape—including a space defined as public parking. Here, roof runoff captured in a rainbarrel (hidden) helps create a lush and attractive front yard.

extend over the curb or the sidewalk; (b) beautification shall not extend within three feet of a crosswalk or paved bus stop; (c) beautification shall not extend within six feet of an entrance to an alley; (d) beautification shall not extend within six feet of a street corner; (e) beautification shall not extend within four feet of a parking meter or a fire hydrant; and (f) beautification areas shall be not more than four feet wide and nine feet long, and at least six feet shall separate each beautified area.[63] In addition, planting material used to beautify a tree space "shall have a shallow root system and shall not be allowed to grow to a height in excess of eighteen inches (18 inches)."[64]

The District imposes additional restrictions within the Downtown Streetscape Area (DSA) (see *Downtown Streetscape Regulations* in Appendix C, Impediments to Voluntary Low-Impact Development in the District of Columbia: Legal Review Appendix, available under separate cover in NRDC's Washington, D.C., office). In the DSA, one row of trees is required on each side of the street, and

> *The tree space shall be protected by the installation of plantings with ground cover to be maintained by the adjacent property owner. The types of ground cover and plantings in a tree space shall be specified by the applicant and are subject to [Downtown Streetscape Review] Committee approval . . .*[65]

The regulations establish different tree space dimensions for different streets within the DSA. In general, the dimension of the tree spaces on streets south of Massachusetts Avenue is four feet by ten feet, with a minimum depth of three feet. Streets north of Massachusetts Avenue are generally required to have a tree space adjacent to the curb that is "four feet wide and continuous and shall have a minimum depth of three feet." On Massachusetts Avenue, the tree space "shall be six feet (6′) wide and continuous."[66] The regulations impose specific restrictions on the placement of trees and tree spaces, and they require that drainage be provided from beneath the tree space where an enclosed tree space is required due to the below grade restrictions. Downtown streetscape plans must be approved by the director of the Department of Public Works, after consultation with a plan review committee.

Trees in the city suffer from a variety of stresses including lack of growing space and poor soil conditions.

James Woodworth

Problem: The size and placement limits on public tree spaces probably preclude the use of land-intensive LID practices in those areas. Conventional grassy swales, for example, would not fit within the Title 24 "beautification areas" or the Downtown Streetscape Area's tree spaces. Nevertheless, the specifications appear to provide sufficient latitude for the voluntary use of at least some LID practices in public tree spaces, and the code language does not preclude applicants from voluntarily submitting public space plans that include other landscaping elements.

Recommendation: While the regulations on beautification provide specific guidelines for landscaping and do not necessarily preclude certain LID practices, these provisions should be revised to improve the primary function of providing tree habitat. The size constraints for the tree spaces are too small to accommodate mature canopy trees. The regulations should be altered to increase tree space dimensions and allow the connection of adjacent tree spaces and the use of new planting technologies, including structural soils and root channels. It should also be noted that beautification planting in the tree space around the base of the tree actually creates additional competition for limited water and root space, causing the tree undue stress. The regulations should instead encourage mulching in the tree space and provide for planting space outside the tree space for additional landscaping.

LID Goal: To Use Vegetation to Filter Runoff

As compared to typical lawns or landscaped flower beds, certain LID practices—including rain gardens, bioretention areas, and preserved open spaces such as forest buffers and wildflower meadows—will have vegetation growing above certain heights and will employ different maintenance requirements.

LID practices—including rain gardens, bioretention areas, and preserved open spaces such as forest buffers and wildflower meadows—will have vegetation growing above certain heights.

Existing Language: As discussed above, the District of Columbia public space regulations require that the planting material used to beautify a tree space "shall have a shallow root system and shall not be allowed to grow to a height in excess of eighteen inches (18 inches)." In addition, D.C. Code § 8-2103.5, rodent harborage prohibited, provides that "[I]t shall be unlawful for any person to cause or permit the accumulation of debris on public or private property or cause or permit weeds or grass to grow to a height of 8 inches or more on private property which they own." And D.C. Code § 8-301 provides that[67]

> *It shall be the duty of the owner, occupant, or agent in charge of any land in the City of Washington, or in the more densely populated suburbs of said City, to remove from such land any weeds thereon of 4 or more inches in height within 7 days (Sundays and legal holidays excepted) after notice from the Department of Human Services so to do . . .*

Problem: Strict interpretation of these regulations could preclude the use of certain LID practices, such as "no mow zones," "forest buffers," "butterfly gardens," or "wildflower meadow areas," in some areas.

Recommendation: In situations where the use of "uncultivated" or wild vegetation in excess of four inches in height is an appropriate or desirable stormwater management practice, education efforts and a statement of official policy may be required to clarify that such vegetation will be allowed as part of an LID feature where appropriate and when not posing a public health hazard or nuisance.

REGULATIONS PERTAINING TO TEMPORARY PONDING

Temporary ponding of rainwater on rooftops provides temporary storage and slows down the peak flows—the largest volumes of water runoff that discharge to rivers during and immediately after the height of a storm.

LID Goal: To Use Rooftop Storage to Mitigate Peak Flows

Existing Language: Existing regulatory provisions appear to allow the use of roofs for temporary storage of water as part of a controlled flow roof drain system. According to DCRA staff, temporary storage systems for stormwater would be acceptable from the perspective of the building code, so long as the roof structure is properly designed to support the increased weight and Secondary (Emergency) Roof Drains are incorporated into the design to prevent the depth of ponding from exceeding that for which the roof was designed.

As an alternative to green roofs, rooftop storage systems may be simpler and easier to install, retrofit, maintain, and operate—all the while providing a similar level of stormwater volume control benefit.

Disconnecting impervious surface areas, minimizing impervious surfaces, and allowing pervious surfacing materials—these are the most significant regulatory areas that require greater flexibility in LID implementation.

LID Goal: Temporary Ponding to Allow Stormwater Infiltration

Existing Language: We have not identified any District of Columbia development code provisions that specifically prohibit the temporary ponding of stormwater on yards and landscaped areas. Particular ponding designs, however, could create a common law nuisance or health nuisance. No specific time or depth limits for ponding of water are identified in the District of Columbia Code or Municipal Regulations.

As a matter of practice, DOH conducts preventative public education to encourage vigilance and awareness of standing water hazards, including vectors for mosquito-borne diseases. Mosquito gestation requires three to four days of standing water. To help control mosquitoes, temporary bodies of standing water should have a detention time factor of less than three days.

Recommendation: It should be possible to design LID systems that do not raise nuisance or mosquito control concerns. In general, on-site stormwater should not be highly contaminated with waste or pollutants; and if LID is properly designed, ponding of stormwater should be relatively brief.

CONCLUSION

Although the District's development regulations already accommodate the voluntary use of many LID techniques, NRDC has identified several significant regulatory issues that must be addressed to facilitate the implementation of LID. Most notably, allowing the disconnection of impervious surface areas, minimizing impervious surfaces, and allowing pervious surfacing materials are the most significant regulatory areas that require greater flexibility. Additionally, creating more technical guidance for green roofs and revising street tree space regulations are necessary.

Providing a greater level of flexibility in D.C. municipal regulations for LID is relatively straightforward, but nonetheless a crucial first step. There are relatively few regulatory impediments. The greater challenge is in creating a supportive policy framework—including strategic planning, education and technical support, and economic incentives. In the final section, we explore a variety of policy areas and issues that warrant close inspection.

OUT OF THE GUTTER

Reducing Polluted Runoff in the District of Columbia

July 2002

CHAPTER 3

Additional Recommendations for Implementation of LID in the District of Columbia

In Chapter 2 and Appendix C (under separate cover, Impediments to voluntary low-impact development in the District of Columbia: Legal Review Appendix), we identify the most significant regulatory impediments in the District of Columbia development codes to the voluntary use of LID. District officials and agency staff have been receptive to NRDC's suggestions to introduce flexibility into development codes. Some of the report's recommended building code changes are already being considered in the District's Building Code Advisory Committee review process. We hope that others, such as NRDC's proposed changes to the D.C. Zoning Ordinance, will be introduced and adopted through similar municipal regulation revision and update processes.

While they are important first steps, these changes will not guarantee the widespread adoption and application of LID techniques. LID's decentralized approach, which seeks to integrate runoff treatment techniques into every part of the urban landscape, is one of its greatest strengths—but a lot-level, highly localized program can also be a weakness when it comes to introducing the concept to the public. Nonetheless, it remains critical that the public be made aware of the potentially significant system-wide stormwater management opportunities of LID; this is the only way we can implement the techniques and reap their benefits.

This chapter explores several major areas of policy-making, planning, and management that affect stormwater management; these deserve renewed attention in developing an LID strategy for the District. NRDC recommends a number of changes that will facilitate consideration and implementation of LID in strategic planning, redevelopment, provision of municipal services, and environmental management decisions in the District. These changes include four broad areas of recommendations: first, policy changes and management practices of D.C. agencies that lead by example; second, revising the stormwater rate structure and creating economic incentives for implementation of voluntary LID practices; third, managing open space, including the urban forest, riparian areas, and wetlands; and fourth, conserving water.

DEDICATED INSTITUTIONAL COMMITMENT

Education, promotion, leadership by example, and technical and institutional support are vital to championing LID implementation in the District of Columbia.

Multi Agency Coordination and Cooperation

Stormwater management in the District of Columbia is a responsibility shared jointly among four District agencies: the Department of Health (DOH), the D.C. Water and Sewer Authority (WASA), the Department of Public Works (DPW), and the District Division of Transportation (DDOT). District of Columbia interagency and interdepartmental cooperation is crucial to the successful promotion and implementation of LID in the District. At this time, there is limited (but growing) support for LID within the DOH and WASA. WASA has recently taken the lead role in coordinating the stormwater management program. It has proposed implementing LID techniques at WASA-owned facilities and has supported regulatory changes to D.C. building codes, but it has not yet committed to incorporating LID throughout the stormwater management program. DOH, DPW, and DDOT (recently reorganized as a separate agency) also have major roles and responsibilities.

LID can use the opportunity afforded by development and redevelopment to practice stormwater management in a better way.

It is crucial that these four agencies understand and promote LID, both in principle and in practice. Charged with many District functions (*e.g.*, street sweeping, leaf collection, hazardous and solid waste management) and management of District property (especially roads and highways, streetscape, and street trees), DPW and DDOT have enormous stormwater management responsibilities in which LID can play a prominent role. To be most effective, stormwater management in general and LID techniques in particular should be incorporated into *all* development—not just in property owned or controlled by the District government. The other D.C. agencies involved in land-use planning and development need to understand the multiple benefits of LID and take active roles in its promotion. LID can use the opportunity afforded by development and redevelopment to practice stormwater management in a better way. Therefore, the agencies with the most important roles to play in leading the charge for river restoration and sound environmental management include the DCRA, Office of Planning, Office of Zoning, and the Office of Economic Development.

Cooperation among these agencies can facilitate LID as soon as development begins and can marry sound economic development policy with strong environmental protection. Creating economic incentives (see Appendix B, Stormwater Utility Fee Structures) will facilitate district-wide planning efforts and strategies; in turn, this will allow stormwater management to be identified early in the design process and result in more holistic, comprehensive environmental planning.

There are many opportunities within the development and implementation of the District's Municipal Separate Storm Sewer System (MS4) permit, which is nearing the completion of its first permitting phase. As the District's stormwater management plan is refined and developed for its new permit to be issued in 2003, LID should be more thoughtfully and thoroughly incorporated into the overall plan.

Leadership by Example

With the signing of the Chesapeake Bay Executive Council agreement in December of 2001, the District of Columbia will take the lead role in meeting Anacostia River restoration goals and objectives. In this context, an Executive Order signed by the mayor for District stormwater management and low-impact development could have enormous impact, generating awareness, enthusiasm, and creativity, and promoting LID efforts in both the public and private sector. An Executive Order could effectively overcome the institutional inertia and interagency barriers that exist in the District government. It could expand the responsibility for stormwater management from DOH, DPW, DDOT, and WASA to include all of the relevant D.C. agencies.

An Executive Order signed by the mayor for District stormwater management and low-impact development could have enormous impact, generating awareness, enthusiasm, and creativity, and promoting LID efforts in both the public and private sector.

For example, the Department of Community Outreach, the Department of Housing and Community Development, and the D.C. Housing Authority should be enlisted to cooperate with DOH in educating the public about stormwater management and implementing a downspout (roof gutter) disconnection program. These departments could be instrumental in LID implementation as it pertains to D.C.-owned properties undergoing maintenance and redevelopment, as well as to residential, private-property LID initiatives.

The Office of Planning, the Office of Property Management, the Department of Parks and Recreation, and the D.C. Public School System can link environmental education efforts with recreation, existing school programs, and building maintenance. In this way, basic principles of LID—including retrofitting, rain gardens, downspout disconnections, new landscaping, and tree plantings—can be incorporated into classroom science curriculums, adopt-a-park projects, and other hands-on, environmental education and nature programming.

The Office of Planning and the Office of Economic Development should assist WASA, DPW, DDOT, and DOH in working collaboratively with the Sports and Entertainment Authority. The management of extensive impervious surfaces and popular, high-profile, high-visibility, large-attendance venues have great potential for LID applications and broad-based environmental education. Construction of large new D.C. destination properties—such as the MCI Center, the Convention Center, and the Grand Prix—represented opportunities to showcase the benefits of LID. By planning now, we can take advantage of upcoming projects of a similar scale, such as the Anacostia Waterfront Redevelopment Initiative and the possible construction of a major league baseball stadium and Olympic park in which to feature LID.

Putting LID into Practice

Throughout the District and the federal government, opportunities abound in which we can raise the prominence and presence of LID—through upgrading operations and maintenance, good housekeeping practices, and redevelopment and retrofitting. For example, when an agency undergoes reorganization, that occasion can offer a rare opportunity to reevaluate "business-as-usual" practices and, in their place, adopt LID into day-to-day operations and capital-intensive investments and undertakings. DPW is a case in point: the agency is now undergoing several extensive facility relocations that present ideal occasions in which to fold LID retrofitting into planning and design efforts.[68]

Regularly scheduled property reconstruction and maintenance can also create fine opportunities in which to retrofit the city with LID techniques; these include regrading, using permeable pavement, reconfiguring parking lots, redesigning water retaining and filtering landscaping, and adding rain barrels and cisterns to store and reuse water. In addition, municipally owned buildings present a host of opportunities in which to conduct routine building maintenance and repair; for example, replacing an existing roof with a green or eco-roof can double or even triple the lifetime of an ordinary roof.[69] They also mark excellent occasions in which to re-examine existing maintenance policies, including sidewalk cleaning, pesticide use, plantings, etc.

An Executive Order from the mayor for LID could have tremendous impact over the longterm—not just in "home-building" activities (such as capital investments, redevelopments, and retrofits) but also in "housekeeping" activities, including regular maintenance of buildings, grounds, and vehicle fleets; management of day-to-day operations; and implementation of best-management practices. An Executive Order should also extend to DDOT and the development of LID-friendly standards and specifications for highways and structures, and the incorporation of LID into streetscape projects.

When an agency undergoes reorganization, that occasion can offer a rare opportunity to reevaluate "business-as-usual" practices and, in their place, adopt LID into day-to-day operations.

Technical Guidance

Because LID practices are not widely known or understood, there is a tremendous need for the issuance of state-of-the-art technical guidelines, as well as for accessible and knowledgeable LID technical support staff to help interested parties understand and implement LID strategies. Developers need to be equipped with designs, specifications, and standards for urban LID practices. The most appropriate place for technical guidance would initially be in the *Storm Water Management Manual* and the *Standards and Specifications for Soil Erosion and Sediment Control*—both of which are being developed and/or revised. NRDC believes these publications should be updated to include design criteria for the range of suitable LID practices, including both pre- and post-construction techniques.

Permitting and planning efforts should be conducted with the support of a knowledgeable field inspection staff; ideally, the experts will be able to identify the particular constraints unique to a development site and proactively avoid past LID implementation mistakes. DOH is making initial progress by offering several introductory LID workshops. It has also sought the guidance of the Center for Watershed Protection in the development of its *Storm Water Management Manual*.

It is important to note that early mistakes in LID implementation have been acknowledged by DOH. These present potentially critical stumbling blocks and highlight the need for sound institutional support from the four agencies charged with stormwater management—WASA, DOH, DPW, and DDOT.

LID-type approaches have been implemented in several parts of the country—notably in the Pacific Northwest, New England, and the Chesapeake Bay area in Maryland. In fact, Prince George's County, Maryland, has led efforts pioneering LID in this region, so the District of Columbia can turn to its neighbors for leadership. Nonetheless, there must be a thorough transfer of technical knowledge that can help the District of Columbia over a steep learning curve, short-circuit early mistakes, and avoid potentially financially and politically costly setbacks within the development community.

PROMOTION OF LID

High-profile LID demonstration projects and educational and promotional support will encourage and attract environmentally friendly developers and capitalize on current opportunities in proposed development and redevelopment opportunities. The Anacostia Waterfront Initiative (AWI) is one notable example: in this planning effort, environmentally sensitive development will benefit the Anacostia River as it limits and controls polluted runoff; at the same time, it will create improved passive recreation opportunities, offer greater public access to the river, and provide an increased public stakeholder community.

The next step is to take what we have learned in the demonstration projects and incorporate LID techniques into mainstream development efforts.

Demonstration Projects

There is a need for state-of-the-art, high-visibility demonstration projects that showcase the best available technology from around the country while highlighting the unique climate, conditions, and constraints of a highly urbanized setting such as the District of Columbia. Pilot projects need to be sponsored and championed by public and private entities in order to demonstrate the full range of LID applications. A pilot project program should include demonstrations on larger commercial, industrial, and federal sites, as well as on smaller-scale residential and neighborhood commercial sites. Public schools, libraries, city parks, traffic circles, and other small parcels of public space represent additional opportunities to implement LID. All such projects should have public education components and monitoring protocols to track results.

Demonstration projects should be prioritized based on a number of factors, including:

- cost;
- potential educational impact;
- projected maintenance and capital improvement schedules;
- type of land-use zoning;
- geographic location with respect to the combined sewer system or a particular sub-sewer basin;
- type and variety of LID techniques employed;
- potential to reduce runoff volumes in the CSO area;
- potential for pollutant removals in a specific water body, watershed, or tributary.

To date, LID demonstration projects along the Anacostia waterfront include initiatives at the Washington Navy Yard and the nearby former pump house, which is now the Matthew Henson Earth Conservation Corps (ECC) building. Both sites highlight several LID techniques. The Matthew Henson building has a demonstration green roof, as well as on-site infiltration techniques and riparian restoration plantings. The Navy Yard LID applications include pervious parking lot pavers, infiltration trenches, a bioretention raingarden, rain barrels, and curb-cut bioretention cells.

James Woodworth

Because of their locations, both sites have relatively limited visibility and public education potential. The Navy Yard was the proud host of numerous site tours until heightened security measures were introduced last year (guided tours are available upon request). The Matthew Henson building is located at Buzzard's Point and is an out-of-the-way destination for all but the most curious visitors. This should quickly change, however, as plans unfold for the AWI and interest in waterfront development brings attention to these areas.

James Woodworth

Demonstration projects—such as the green roof at the Matthew Henson Center—are important models for advancing LID. Now we must incorporate LID into mainstream development.

The AWI represents an important opportunity for the District that should not be missed. The Naval Yard and the ECC building are two LID models for retrofit and redevelopment. The next step is to take what we have learned in the demonstration projects and incorporate LID techniques into mainstream development efforts.

There are many places in the D.C. suburbs (watersheds for D.C. waters) where we can look for ideas. Across the Potomac, the Pentagon Renovation Program has included as part of the design and development of its Personal Fitness and Readiness Facility (PFRF) a number of environmentally friendly features—including, among other elements, a landscaped green roof to control "rainwater runoff and extend the life of the roof."[70]

THE LONG TERM CONTROL PLAN (LTCP) FOR COMBINED SEWER OVERFLOWS (CSOS)

The Long Term Control Plan (LTCP) for combined sewer overflows (CSOs) is a major capital investment in wet-weather stormwater management. While it is a necessary and large-scale investment in centralized infrastructure, the LTCP also represents a key opportunity to develop mechanisms to increase investment in decentralized, distributed, lot-level techniques such as LID.

The combined sewer system drains approximately one-third of the land area of the District of Columbia. When it rains, the system is frequently overwhelmed by stormwater runoff, causing polluted runoff and untreated sewage to discharge directly into the District's rivers. LID can reduce combined sewer overflows by reducing the volume of stormwater entering the system in the first place through infiltration to vegetated areas and temporary storage. While the LTCP represents a necessary and large-scale investment in centralized infrastructure, it is also a key opportunity to develop mechanisms to increase investment in decentralized, distributed, lot-level techniques such as LID. There are several opportunities of different scale and magnitude that should be included in the LTCP.

The Long Term Control Plan for combined sewer overflows represents a key opportunity to develop mechanisms to increase investment in decentralized, distributed, lot-level techniques such as LID.

Development of a Model "Sewershed" LID Project

LID should constitute an integral part of the LTCP, as a near-term, large-scale sewershed application in a discrete, measurable, and defined portion of the CSO area. Selection of a particular sewershed should be based on several criteria, including:

- ▸ the greatest potential for CSO reduction per dollar;
- ▸ potential for economic revitalization;
- ▸ potential to increase and enhance existing open space for local communities;
- ▸ potential to overlap with ongoing redevelopment activities of District departments and agencies.

An application of this scale—which is much larger than the typical "pilot project"—must be accompanied by a comprehensive monitoring and evaluation plan. Data on CSO reduction volumes and pollutant removal rates must be collected in order to allow further revision and predictability of an LTCP based on these results. Relatively little scientific and economic data have been collected for LID applications at this scale and magnitude, so an initiative of this type would be invaluable and serve as a case study of national importance.

Economic Incentives and Promotion of Commercial LID

Economic incentives and promotion of commercial LID could also be focused within the CSO area that includes two of the three key downtown business improvement districts (BIDs): the Downtown D.C. BID and the Golden Triangle BID. (The recently formed Georgetown BID lies outside the CSO area.) LID projects in these highly visible areas would showcase the potential of LID to cost-effectively manage stormwater runoff volumes and relieve CSO discharges into surrounding District waters.

Other LID efforts outside the CSO area could be linked to specific sub-watersheds and promoted in conjunction with priority restoration areas (*e.g.*, Kingman Island, Watts Branch, Anacostia waterfront). A building certification initiative, such as the U.S. Green Building Council's Leadership in Energy & Environmental Design

(LEED) "Green Building" certification program, could be incorporated into the Anacostia Waterfront Initiative and expanded to other parts of the District (see "Revision of the Stormwater Utility Fee," below).

Other LID Opportunities Should Also Be Prioritized in the CSO Area

Federal projects where site contamination cleanups of federal facilities are being conducted with the Anacostia Toxics Alliance program can leverage funds for LID projects.[71] LID can be folded into site construction work as part of these cleanups, as was the case with the Washington Navy Yard.

A strategy of prioritizing in the CSO area should also include LID retrofitting of District government facilities, where opportunities occur within the schedule of normally planned redevelopment, relocation, and maintenance operations (as indicated in Promotion of LID, above). These projects should be prioritized for maximum visibility, public education, and promotional potential, as well as for cost and volume of CSO discharge reduction.

LID at WASA Facilities

Lastly, as part of a comprehensive CSO plan, LID should be incorporated into the retrofitting of WASA facilities. As a matter of principle and to lead by example, WASA should incorporate the suite of LID techniques in its scheduled capital investments, upgrades, and reconstruction of its own facilities. These facilities should then serve as model demonstration sites, open and accessible to the public and the development community. In addition to these, there is a need for an LID "training ground," or demonstration construction site, to display LID design and construction in the various stages of construction site development.

There is a need for an LID "training ground," or demonstration construction site, to display LID design and construction in the various stages of construction site development.

REVISION OF THE STORMWATER UTILITY FEE

The most logical starting point for the creation of economic incentives lies within the existing stormwater utility fee currently collected by WASA and paid into the Storm Water Permit Compliance Enterprise Fund (the stormwater fund). (See Appendix B for examples of stormwater utility fee structures from municipalities around the country.)

The Current Fee

The stormwater fee and the stormwater fund were created by enactment of the "Storm Water Permit Compliance Act of 2000." The current fee uses a rate structure with three components: (1) a flat fee of $1.75 per quarter for residential customers, (2) a volume-based fee of 2 percent of the water rate/per ccf [one hundred cubic feet] used for commercial, federal, municipal, D.C. Housing Authority, and (3) a volume-based fee of 1.4 percent of the water rate/per ccf used for multifamily. While this fee has been successful in generating a dedicated source of income to fund stormwater management programs, it is limited in a number of ways. Assessing this fee as a flat rate per user or basing it on the amount of drinking water consumed is not truly a "user fee," since it bears no relationship to the actual amount of stormwater runoff generated by the property or the use of stormwater management services.[72]

Stormwater fees should be based "not merely on acreage owned, but on estimates of the actual demand each parcel of property places on the stormwater system."[73] Until the District and WASA develop the information system capabilities and other in-house resources to determine impervious coverage at the lot-level scale, an index based on parcel size, soil type, and slope may be a reasonable interim measure of stormwater runoff contributions. Even this approach, however, is flawed. More developed parcels of property will be relatively undercharged, and less-developed properties will be overcharged.[74] To serve as an incentive for LID, impervious area—specifically *directly connected* impervious area—must be accounted for.

The ERU Concept

Under the Equivalent Residential Unit (ERU) approach, the stormwater charge is based on impervious cover measured in ERUs, where the ERU is the median impervious area for residential properties. In Takoma Park, Maryland, for example, the ERU was determined to be 2,406 square feet.[75] The stormwater fees of all other ratepayers are expressed in terms of ERUs. Townhomes, apartments, row houses, and condominiums can be calculated as a fraction of the ERU (½ or ⅓ of an ERU, for example). Larger residential, commercial, and federal buildings and properties could be billed as multiples of ERUs, or based directly on total impervious area. Rates would be calculated based on total costs of the jurisdiction's stormwater management program, divided by the total sum of ERUs in the stormwater system.

Once the stormwater fee is revised, economic incentives can easily be built into the stormwater fee.

Many other municipalities have determined their own specific residential ERU to be in the ballpark of 2,000 square feet. In the District of Columbia, the ERU may be different. Who should pay? Every property owner who pays a water bill in the District pays a stormwater fee. This includes residential, commercial, religious, nonprofit, and District and federal government properties.

Build Economic Incentives into the Stormwater Fee

Once the stormwater fee is revised, economic incentives can easily be built into the stormwater fee. Incentives can take on several forms, but the incentive should appropriately be matched to the scale and magnitude of LID techniques employed, the degree of stormwater management provided, and the relative cost and technical difficulty of employing them. To encourage stormwater management activities, especially among individual property owners, there must be a fair, equitable, and accurate method of measuring stormwater runoff. This must include incentives to encourage and credit land conservation and reforestation efforts, low-impact development, and other site-specific stormwater management techniques.

A relatively easy way of encouraging owners of developed properties to implement site-specific stormwater management practices is through an incentive program that would provide financial or other benefits to property owners who implement techniques and practices that would otherwise not be required. Incentives can take the form of a one-time rebate or credit—or a permanent percentage rate reduction of the stormwater utility fee—for the implementation of measures that reduce impacts of peak discharge, reduce total volume of runoff, and reduce annual pollutant loads.

Incentive programs will have a better chance of succeeding if they are promoted with effective public education programs and if they include simple, low-cost techniques that require minimal work. For example, residential customers could receive rebates and coupons for disconnecting downspouts, planting trees, installing rain barrels, converting to two-track driveways, installing pervious patios, and planting rain gardens. Government and commercial properties can be given water rate reductions or credits for disconnecting downspouts, installing rain gardens in existing landscaping, making use of pervious paving and surfaces, and installing eco-roofs, cisterns, and infiltration trenches during new construction and redevelopment.

A common mechanism employed by many municipalities is to offer a permanent reduction in rates, from 20 percent to 100 percent in some situations, depending on the scale and magnitude of LID techniques employed.

Residential Incentives

In Portland, Oregon, the stormwater management charge is made up of two separate costs. Most of the charge pays for managing stormwater runoff from the city streets, as well as for programs to protect the environment and clean up watersheds. The remainder of the charge pays for managing stormwater runoff from private property. The rate discount applies only to the private property portion of stormwater charges, with up to a 35 percent reduction in current stormwater management charges. Portland made several important realizations in developing its rate reduction policy:

Incentive programs will have a better chance of succeeding if they are promoted with effective public education programs and if they include simple, low-cost techniques that require minimal work.

(a) Streets represent half of all impervious areas in the City of Portland;
(b) All ratepayers benefit from, and are responsible for, the city street system and the environment;
(c) Street drainage is significantly more polluted and harmful to water quality than is runoff from private property.

However, Portland also identified the multiple benefits of controlling private property stormwater runoff:

- reducing total volumes of CSOs (in this case, to the Anacostia River and other D.C. water bodies);
- improving local hydrology, groundwater recharge, and stream base flows;
- reducing levels of nutrient and chemical pollution from lawn fertilizers and pesticides that drain into area waterbodies;
- preventing oil, gas, grease, other leaking fluids, and cleaning products from parked automobiles from contaminating nearby rivers and streams.

Other municipalities offer percentage rate reduction credits based on water quantity and/or water quality treatment, while others may be tied specifically to a particular pollutant of special concern.[76] Budgeting for a stormwater program can account for this rate reduction by assuming that a certain percentage of users subscribe to the rate incentive, and by adjusting the rate-per-ERU accordingly.[77]

Another mechanism to encourage stewardship and voluntary employment of LID techniques is to offer a one-time cash rebate. This can work very effectively in implementing a downspout disconnection program or a street-tree planting program. For example, cash rebates can be disbursed upon inspection or certification by a delegated official from DOH or WASA.

In a model program in Portland, Oregon, the Bureau of Environmental Services offers extensive institutional support for downspout disconnections and a comprehensive combined sewer overflow mitigation plan in its “Clean River Works” campaign. Residential participants can earn $53 per individual downspout disconnection. Additionally, as an extension of this program, neighborhood associations, school groups, housing associations and agencies, churches, and other groups can earn $13 per downspout disconnection toward their organization when performed as contractual community service for the city of Portland.[78]

This incentive mechanism provides a powerful vehicle for public education and participation that literally drives itself; it is, dollar-for-dollar an efficient use of public resources leveraged against not-for-profit benefit and environmental management. In Portland, from 1996 to 2001, more than 3,300 volunteers from different groups

Many municipalities offer a permanent reduction in rates, from 20 percent to 100 percent, depending on the scale and magnitude of LID techniques employed.

Downspout disconnections are a simple and inexpensive way for a homeowner to reduce polluted runoff. Here, a roof leader has been discretely routed under a porch to drain (left) into a concealed rain barrel (right) and mounted on cinder blocks to facilitate garden irrigation.

Jim Schulman

disconnected downspouts and earned more than $140,000 for local projects, and AmeriCorps members provided work-crew leadership.[79]

Complementing the incentive program, Portland identified small sewer basins that were priority disconnection areas requiring an 80 percent disconnection rate of total residential roof areas to reduce combined sewer overflows CSOs (see Appendix B).

Portland also combined a tree-planting effort with a downspout disconnection program in targeted disconnection areas. Residential "procrastinators" were mailed postcard reminders to disconnect their downspouts; if disconnections were completed by a certain date, residents were then eligible for coupons to use toward the purchase of native trees and shrubs to plant in their yards.[80]

Commercial Incentives

Commercial incentives should initially be focused within the Anacostia Waterfront Initiative. A building certification initiative, such as the U.S. Green Building Council's Leadership in Energy & Environmental Design (LEED) "Green Building" certification program, could be an effective catalyst for voluntary LID and stormwater management.

Green building practices can substantially reduce negative environmental impacts and reverse the trend of unsustainable construction activities. As an added benefit, green-design measures reduce operating costs, enhance building marketability, increase worker productivity, and reduce potential liability resulting from indoor air quality problems.[81] The LEED program offers technical guidance on every aspect of the design of an environmentally sensitive development, including, in particular: (a) stormwater management, (b) water efficient landscaping, (c) innovative wastewater technologies, and (d) water use reduction. LEED has also devised four levels of certification (medals ratings) for the extent of environmental design incorporated into the building project: Certified, Silver, Gold, and Platinum.

Green building practices can substantially reduce negative environmental impacts and reverse the trend of unsustainable construction activities.

One option for developing a green building certification program would be for the District of Columbia and the business improvement districts to adopt the LEED program wholesale. If meeting even the lowest LEED rating ("Certified") proved too cumbersome a first leap, an alternative would be for the District to develop its own program of certification tailored to the Anacostia waterfront restoration. By adapting the four stormwater and water conservation-related principles as a foundation for an Anacostia restoration building certification, such an initiative could build enthusiasm, good public relations, and a vision for sewage-free recreation, fishing, and swimming opportunities in the District of Columbia. A building certification program need not be limited to waterfront redevelopment, but applicable to all redevelopment in the CSO area and throughout the District as a whole. A certification program could also be targeted to the three key downtown business improvement districts (BIDs): the downtown D.C. BID, the Golden Triangle BID, and the recently formed Georgetown Partnership BID.

These stormwater management projects should showcase their potential to manage stormwater runoff pollutant concentrations and runoff volumes cost-effectively, and to relieve CSO discharges into surrounding District waters. Other efforts outside the CSO area could be linked to specific sub-watersheds, park, and tributary restorations—for example, promoted in conjunction with priority restoration areas, such as Kingman Island, Watts Branch, or Fort DuPont Park (see sections following).

GREEN INFRASTRUCTURE AND STRATEGIC MANAGEMENT OF OPEN SPACE

Conservation of Existing Open Spaces

Much of the remaining existing open space in the District of Columbia is either National Park Service property or D.C. Department of Parks and Recreation property. The federal government has jurisdiction over approximately 8,000 acres of open space in the District of Columbia.[82] There are some remaining tracts of privately owned open space and urban forest land that remain vulnerable to private development.[83] But by and large, the remaining open space in D.C. is confined to areas of sensitive environmental significance, including riverfront and riparian areas, wetlands, and areas of extremely steep slopes—in short, areas that have not been developed because, historically, it did not make sound economic or environmental sense to do so.[84]

The remaining open spaces in the District should be preserved, and efforts should be made to encourage and prioritize redevelopment as opposed to new development.

In accordance with the Chesapeake 2000 Agreement, each jurisdiction of the Chesapeake Bay is committed to protecting 20 percent of its land area by 2010.[85] Future development and redevelopment efforts must be conducted very carefully: such efforts should be sensitive to the context of the remaining surrounding natural areas and cognizant of ongoing stewardship efforts. In addition, if the remaining open space in the District is to be preserved, maintained, and enhanced, efforts should be made to encourage and prioritize redevelopment—rather than new development—whenever and wherever possible.

James Woodworth

Sound strategic planning and decision-making must be coordinated with environmental management efforts across the numerous District and federal agencies and jurisdictions. The Office of Planning's comprehensive plan must strive to address the complicated balancing of redevelopment goals with environmental management goals. Aggressive redevelopment initiatives often are imposed on the public entities that own and lease open space. Instead, provisions must be made for the protection of D.C.'s last remaining open spaces, and development agencies should work cooperatively and proactively with the agencies charged with environmental management. This is especially important when considering that the existing, intact natural resources—including riparian areas, steep slopes, and wetlands—that play important roles in stormwater management are more effective in protecting water quality than are restored natural resources or man-made substitutes. Future redevelopment efforts—such as the potential development of Olympic Park—should be more environmentally sensitive than past endeavors have been.

Urban Forestry and Street Tree Canopy

The urban forest plays a prominent and central role in stormwater management. Trees are the backbone of our urban "green infrastructure." A comprehensive stormwater management strategy must take into account the status of the urban forest and help drive political, financial, and technical urban forestry management decisions and policies.

Over the past three decades, tree losses from mortality, land clearing, and development have far outpaced canopy replacement efforts. From 1973 to 1997, the tree canopy in the District suffered an estimated decline from 37 percent to 21 percent; at the same time, stormwater runoff increased an estimated 34 percent. The lost tree cover would have removed approximately 354,000 pounds of pollutants.[86] In addition to the loss in services provided for stormwater management, the decline in tree canopy represents losses in assessed property values, increases in heating and cooling energy expenditures, impaired air quality, as well as less-easily quantifiable losses in community character, pride, and security.

Not only do replanting and reforestation efforts need to be redoubled to make up for these past losses, but tree protection regulations are also required in order to provide a measure of protection for existing trees on public and private property. (See related discussion in "Conservation of Existing Open Spaces," page 36). The pending Urban Forest Preservation Act, now before the D.C. Council, provides many important provisions for a measured level of protection, including: the establishment of an urban forestry standards manual; a tree fund; a tree advisory board; a voluntary registry of "exceptional" trees; public notification requirements for removal of street trees; limits on the destruction and removal of trees in the "public parking" space; multi year master planning; and a street tree inventory. Approval of this bill would be a significant, dramatic step in the right direction for both urban forest management and stormwater management in the District of Columbia.

Current D.C. tree planting policies, guidelines, standards, and specifications also need technical revision in order to be consistent with the best available forestry practices and stormwater management knowledge. In order to ensure that the District is getting the greatest return on its future

Planter box filters utilizing curb cuts are highly effective at treating polluted stormwater runoff from the street.

JAMES WOODWORTH

urban reforestation investments, efforts must be made to maximize the life expectancy of our urban street trees and to make the necessary long-term investment in landscape planting spaces and conditions in order to ensure their maturity and longevity. Current estimates of life expectancy for street trees in dense urban areas are 13 years, while residential trees last on average 37 years; citywide, the average lifespan is 32 years.[87] While there are many stress factors affecting urban trees, physical stresses such as limited growing space and soil compaction are the most widely recognized and best understood.[88] Competition with utilities for underground root space makes strategic planning and design of planting spaces essential for long-term tree survival.

Efforts also need to be made to address the inconsistencies, institutional disconnects, and technical divisions among land-use planners, urban forestry professionals, and stormwater management professionals. District planning officials and urban forestry professionals acknowledge that, as a matter of informal policy, street trees are typically planted only after a curb and sidewalk have been installed on a streetscape. The rationale for this practice is that it provides a significant measure of protection for the street tree from automobile traffic and parking.

The urban forest plays a prominent and central role in stormwater management. Trees are the backbone of our urban "green infrastructure."

There are two unintended consequences to this practice that affect the tree's longevity and dramatically alter stormwater runoff. The majority of a tree's roots exist in the top 6–12 inches of topsoil. A concrete (impervious) sidewalk acts as a barrier to lateral root growth into the front yard or public parking area of a privately owned lot, restricting root growth to the narrow area remaining in between the sidewalk and curb.[89] In areas that are not subject to high pedestrian traffic, particularly residential and park areas, consideration should be given to alternative pervious sidewalk and pathway materials, including brick underlain with sand, pervious blocks or pavement, as well as gravel, stonedust, or woodchip walking paths.

Although it provides a measure of tree (as well as pedestrian) protection from automobiles, the curb has profound impacts on local hydrology. "Curb-and-gutter" systems collect, concentrate, and transport stormwater runoff generated from the street surface into the sewer system. This curb-and-gutter engineering design effectively concentrates stormwater generated from large surface areas in high volume, high velocities, and extremely high pollutant concentrations. All the garbage, nutrients, heavy metals, animal wastes, automobile fluids, oils, and gas are washed off the street surface and directly discharged into the nearest stream or river. In areas of the combined sewer system, this stormwater mixes with untreated sewage discharge into the Rock Creek, Anacostia, and Potomac rivers.

Where feasible, alternatives to curbing and carefully selected "curb cuts" can allow street runoff to drain directly to adjacent vegetated areas and specially designed LID techniques before stormwater becomes highly concentrated and more difficult to manage.

Riparian Corridors, Steep Slopes, and Erosion Control

Tree and slope protection (TSP) overlay zones exist for only two riparian areas in the District of Columbia: the TSP Overlay District (also known as the Woodland-

Normanstone Overlay) and the Chain Bridge Road/University Terrace (CB/UT) Overlay District.[90] A third Tree and Slope Protection Overlay District is under consideration in the Forest Hills neighborhood of Rock Creek, east of Connecticut Avenue, between Melvin Hazel Park and Fort Circle National Park.[91]

All three TSP overlay districts have been developed in the northwestern part of the District and historically have been strongly correlated with affluence and political and social capital. Within these overlay districts, impervious ground coverage and tree removal are limited, providing a powerful tool for protection of riparian areas and watershed management. Where opportunities exist, and where privately owned forested areas and steep slopes warrant protection abutting adjacent National Park Service and District-owned park land in riparian areas, development of TSP overlay districts should be facilitated through grassroots efforts.

Throughout the District, but particularly in the Anacostia watershed and its heavily degraded tributaries, TSP overlay districts should be included as a powerful watershed management tool in the ongoing riparian restoration efforts managed by DOH. Grassroots community groups ought to receive the technical outreach support necessary to understand and appreciate the many environmental and property value benefits of the TSP zoning overlays.

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Forested buffers, along the edge of rivers and on steep slopes, are an important part of the urban forest. They help prevent erosion and protect rivers and streams from polluted runoff.

Technical assistance will be required to adapt the generic TSP zoning language to a particular zoning district. Assistance is also required in order to facilitate the proper political and community-based consensus process required by Office of Zoning to approve such TSP provisions. This is a very valuable preventative watershed management tool, which is much more cost-effective than the riparian restoration "day-lighting" and rehabilitation projects currently under way.

Where the damage has already been done, however, these engineering-intensive tributary riparian restoration projects are essential—and they are long overdue in the Anacostia watershed. Multi agency restoration efforts in Fort Chaplin, Fort Dupont Creek, Hickey Run, Oxen Run (a Potomac tributary), Pope Branch, and Watts Branch are essential in mitigating the massive erosion problems, contaminant and sediment loadings, and historic loss of habitat that all of these Anacostia tributaries have suffered. However, these restoration efforts are indicative of the legacy of development practices and a reliance on traditional but outmoded "curb-and-gutter" stormwater management.

Bioengineered bank stabilization, "day-lighting," and fish dam engineering feats—while absolutely necessary for long-term ecosystem restoration—are only part of the solution to restoration. As long as we continue to rely on "curb-and-gutter" technology, we will not solve the pernicious upstream problems of voluminous, erosive, and contaminated runoff.

These restoration projects should be starting points and catalysts, from which we must head upstream into the watershed to treat polluted runoff at the source. A complete long-term solution necessitates the use of upstream source controls distributed throughout the watershed, including land conservation through zoning regulation, as well as technical protection through LID applications. Here, TSP overlay zones and residential and commercial LID techniques—at the individual lot level, phased-in over time, and dispersed throughout the watershed—offer a one-two combination approach to complement intensive in-stream riparian restoration efforts.

Wetlands Restoration

In precolonial times, the Anacostia River watershed had more than 100,000 acres of freshwater and tidal wetlands.[92] By the early part of the twentieth century, however, officials launched a major effort to reshape the natural hydrology and change the landscape in the name of progress. In the early 1900s, in what was considered state-of-the-art practice at the time, tidal marshes and wetlands along the entire length of the Anacostia River in the District were dredged by the Civilian Conservation Corps and replaced with stone retention sea walls in an effort to protect the public from mosquito-borne diseases. Between 1902 and 1940, more than 1,000 acres of mudflats and wetlands were filled by the corps.[93]

As long as we continue to rely on "curb-and-gutter" technology, we will not solve the pernicious upstream problems of voluminous, erosive, and contaminated runoff.

Only recently has the tide shifted. In the early 1990s, the Army Corps of Engineers took its first step toward undoing the destructive efforts of the past and embarked on its first freshwater wetland restoration in history, restoring the 32-acre mud flat called Kenilworth Marsh.[94] With that restoration, the total wetlands acreage is now a mere fraction of historical acreage. The restoration of Kenilworth Marsh was a small step in the right direction.

Efforts by the D.C. Department of Health, the Army Corps of Engineers, and other federal agencies to restore tidal wetlands in the Anacostia watershed have been under way for several years. These efforts should be expanded. Mitigation from other future redevelopment efforts and transportation infrastructure projects should continue to build on this valuable restoration work. The wetlands and vernal pool work at Kingman and Heritage Island, for example, should continue to be informed by adaptive management techniques and expanded throughout the watershed where feasible and practicable. Passive, "voluntary" wetland reestablishment (*i.e.*, natural recolonization) is potentially the most cost-effective restoration strategy, but efforts should be monitored and augmented as resources permit. Active management of nonnative invasive plant species and nuisance and nonmigratory wildlife species impacts is absolutely necessary for long-term restoration success.

City Parks and Public Spaces

District agencies and the National Park Service have jurisdiction over many pocket parks, squares, traffic circles, islands, triangles, courtyards, and assorted non-transportation impervious surfaces distributed throughout the District. These areas are, in large measure, underutilized, and many are completely covered in impervious surfaces or compacted soils. Herein lies potential to redevelop, retrofit, and optimize these sites with LID techniques—to collect, store, infiltrate, and treat stormwater runoff from roads, sidewalks, parking lots, and municipal facilities. Locations for LID features can be prioritized based on factors such as cost, public visibility, and accessibility, for popular, heavily trafficked locations. Possible sites include the now closed-off portions of 1600 Pennsylvania Avenue and the Ellipse, as well as National Park Service lands with water features, such as Franklin Square Park and the Mall reflecting pools.

Rights-of-Way, Underground Utilities

There is a need for a greater level of coordination between and among District agencies and the utility companies (including water, gas, electricity, etc.) to accomplish the goals of stormwater management and improve our urban green infrastructure. Landscaping and urban forestry are typically after thoughts in the design and construction of our developments. Where there are opportunities for strategic redevelopment, utilities should be designed and laid out with enough space set aside for canopy trees and LID and other stormwater management techniques. The combined utilities upgrade along M Street in Georgetown is one recent example where good intentions were made for providing extensive streetscaping, but initial designs did not incorporate the best available technology. Modifications have since been incorporated to the plan to upgrade street tree specifications. Fewer trees will be planted than originally anticipated, but resources and root space will be more strategically allocated to each tree. The project in Georgetown is a noteworthy case study for future large-scale streetscape endeavors.

These restoration projects should be starting points and catalysts, from which we must head upstream into the watershed to treat polluted runoff at the source.

WATER CONSERVATION

Water conservation has been given little serious attention in the humid mid-Atlantic region. But we need not look far beyond the Chesapeake Bay region, or even beyond the District, to be reminded of several important reasons why water conservation matters and why it warrants discussion in a stormwater management report.

The drought along the eastern seaboard during the winter and spring of 2002 reminded us that we cannot predict seasonal climatic patterns. There is also considerable uncertainty regarding the long-term effects that global climate change will bring to this region. Continued long-term reliance on the Potomac River as the District's sole drinking water source has been assumed. But how much consideration has been given for suburban sprawl, upstream growth, and increased upstream water withdrawals? What are the net long-term ecosystem impacts? Thinking downstream, what are the net impacts for the Chesapeake Bay?

The Blue Plains Waste Water Treatment Plant is nearing its maximum capacity, and it is expected to meet or exceed design flows by 2020.[95] Additionally, the District annual average water consumption is 12 million gallons above its Inter-municipal Allocation (IMA) amount of 158 million gallons.[96] These two important facts are powerful incentives that could motivate the District to embrace water conservation measures and develop an aggressive and holistic water conservation and flow-reduction program.

The District of Columbia has taken some initial steps, with current building codes requiring 1.6-liter low-flow toilets.[97] But there are many other water conservation opportunities to be gained in building plumbing, appliances, building maintenance, irrigation practices, and stormwater management that warrant investigation and policy analysis.

Low-flow shower heads, horizontal-axis clothes washers, and on-demand hot-water systems represent untapped opportunities to significantly impact dry weather flows, reduce ratepayer's water bills, and make strides toward the District's Inter-municipal Allocation (IMA) water consumption goals. New York City adopted an aggressive incentive program installing about 1.34 million low-flush toilets[98] through the allocation of public funds in the form of $300 rebates per household for the first toilet conversion, plus $150 for each additional toilet.[99]

In contrast, WASA's water conservation plan offers rebates of only $85 per resident,[100] which is inadequate to cover the cost of a single toilet purchase and plumbing installation costs. Horizontal-axis clothes washers also have the potential to reduce water usage by as much as 40 percent per load. The City of Austin, Texas, was able to bring the price down and make such units attractive to buyers through bulk purchasing and distribution, coupled with utility and manufacturer rebates.[101] The District and WASA should create meaningful incentive programs for the retrofitting of low-flow toilets, appliances, and conservation fixtures to replace old, leaky, inefficient, and obsolete appliances, devices, and fixtures.

Rain barrels provide measurable storage during storm event peak flows, use water more efficiently for landscape maintenance and irrigation, and save consumers money.

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WASA has implemented a pilot project for the use of rain barrels to trap roof runoff.[102] Water reuse techniques (such as rain barrels and cisterns) represent simple, inexpensive opportunities to trap, store, and reuse stormwater; they also provide a measurable level of storage of and relief from storm event peak flows, use water more efficiently for landscape maintenance and irrigation, and save consumers money. Maintenance practices create a clean, welcoming environment and minimize accumulations of dust, debris, and odors. But the fact that commercial and municipal buildings continue to sweep sidewalks and paved courtyards with garden hoses during the height of a regional drought is embarrassing consumerism and poor environmental stewardship. The use of cisterns and other water reuse devices and best management practices should be encouraged for purposes of building maintenance and irrigation.

These techniques need to be implemented broadly throughout the District and especially adopted in commercial areas where landscape irrigation and sidewalk cleaning are common (not to mention wasteful and unregulated) practices.

CONCLUSION

Low-impact development is emerging as a highly effective approach to managing polluted stormwater runoff. LID should be integrated into the broad context of economic redevelopment and stormwater management to help restore the District of Columbia's urban green infrastructure and its valuable waterfront resources, including the Anacostia River—all of which are severely polluted from stormwater runoff. LID is particularly effective in ultra-urban settings and should be included as part of a new paradigm for managing stormwater runoff generated from development and redevelopment. The District and federal governments have significant roles to play in developing broad-based institutional support for LID. They must lead by example in their own projects and management activities; by providing effective technical guidance, education, outreach, and economic incentives, they can prompt and guide residential and commercial entities to follow suit. LID applications should also be employed in concentrated, targeted sewersheds to manage the enormous burden that stormwater runoff volumes contribute to combined sewer overflows. LID is a valuable and complementary watershed management tool that should be used in conjunction with ongoing land conservation, urban forest management, riparian and wetlands restoration, and water conservation efforts.

The District and federal governments have significant roles to play in developing broad-based institutional support for LID.

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Base flow The portion of stream flow that is not runoff and results from seepage of water from the ground into a channel slowly over time; the primary source of running water in a stream during dry weather.

Best Management Practice (BMP) A practice, or combination of practices, that is the most effective and practicable means of controlling, treating, or preventing stormwater runoff pollution-taking into account all technological, economic, and institutional considerations.

Biochemical Oxygen Demand (BOD) The amount of oxygen used by microorganisms in the breakdown or decay of organic matter in a water body.

Bioengineering Restoration and stabilization techniques that use plants, often native species, to mimic natural features and benefits.

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

Bioretention The use of vegetation in retention areas designed to allow infiltration of runoff into the ground. Plants provide additional pollutant removal and filtering functions, while infiltration allows the temperature of the runoff to be cooled.

Buffer zone 1) A vegetated zone adjacent to a stream, wetland, or shoreline where development is restricted or controlled to minimize the effects of development; 2) A designated transitional area around a stream, lake, or wetland left in a natural, usually vegetated state so as to protect the water body from runoff pollution. Development is often restricted or prohibited in a buffer zone.

Catchbasin An inlet to a storm or combined sewer equipped with a sediment sump, and sometimes a hood, on its outlet pipe to the sewer. Catchbasins can collect some of the sediment and debris washed off the streets and help provide a water seal against the venting of sewer gases. Catchbasins should be cleaned out regularly so that they function properly.

Combined sewer overflow (CSO) During rainfall events, the volume of stormwater entering a combined sewer system often is far greater than the capacity of the interceptor (large collector pipe) and sewage treatment plant; as a result, the untreated sewage and stormwater mixture empties directly into receiving waters through designated overflow points.

Combined sewer system A sewer system that conveys stormwater runoff along with sanitary sewage and industrial waste.

Curbs Concrete barriers on the edges of streets used to direct stormwater runoff to an inlet or storm drain and to protect lawns and sidewalks from vehicles.

Design storm A rainfall event of specific size, intensity, and return frequency (*e.g.*, the one-year storm) that is used to calculate runoff volume and peak discharge rate.

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 for pollutant removal, stormwater storage, and peak flow reduction. Both wet and dry detention methods can be applied.

Dry well Small excavated trenches filled with stone to control and infiltrate rooftop runoff.

Erosion The process of soil detachment and movement by the forces of water.

Estuary A semi-enclosed coastal water body such as a bay, mouth of a river, salt marsh, or lagoon, where freshwater and saltwater mix. These waters support a rich and diverse ecology.

Evapotranspiration The loss of water to the atmosphere through the combined processes of evaporation and transpiration, the process by which plants release into the atmosphere water they have absorbed.

Filter strip Grassed strips situated along roads or parking areas that remove pollutants from runoff as it passes through, allowing some infiltration and reducing velocity.

Green building or Green design Building design that yields environmental benefits, such as savings in energy, building materials, and water consumption, or reduced waste generation.

Groundwater Water that flows below the ground surface through saturated soil, glacial deposits, or rock.

Habitat An area or type of area that supports plant or animal life.

Hydrology The science addressing the properties, distribution, and circulation of water across the landscape, through the ground, and in the atmosphere.

Impervious surface A surface that cannot be penetrated by water, such as pavement, rock, or a rooftop, and thereby prevents infiltration and generates runoff.

Imperviousness The percentage of impervious cover within a defined area.

Infill development Development of vacant lots or enhancement of existing urban properties.

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

Integrated Management Practice (IMP) An LID practice, or combination of practices, that is the most effective and practicable means of controlling the predevelopment site hydrology-taking into account all technological, economic, and institutional considerations.

Nonpoint source pollution Water pollution caused by rainfall or snowmelt moving both over and through the ground and carrying with it a variety of pollutants associated with human land uses. A nonpoint source is any source of water pollution that does not meet the legal definition of point source in section 502(14) of the Federal Clean Water Act.

Open space Land set aside for public or private use within a development that is not built upon.

Overlay districts Zoning districts in which additional regulatory standards are superimposed on existing zoning. Overlay districts provide a method of placing special restrictions in addition to those required by basic zoning ordinances.

Peak discharge The greatest volume of stream flow occurring during a storm event.

Permeable Soil or other material that allows the infiltration or passage of water or other liquids.

Performance standard An established amount or limit of a specified pollutant that can be discharged from a land-use activity or BMP.

Polluted runoff Rainwater or snowmelt that picks up pollutants and sediments as it runs off roads, highways, parking lots, lawns, agricultural lands, logging areas, mining sites, septic systems, and other land-use activities that can generate pollutants.

Porous pavement and Pavers Alternatives to conventional asphalt that utilize a variety of porous media, often supported by a structural matrix, concrete grid, or modular pavement, which allow water to percolate though to a subbase for gradual infiltration.

Rain barrels Barrels designed to collect and store rooftop runoff.

Recharge area A land area in which surface water infiltrates the soil and reaches the zone of saturation or groundwater table.

Retrofit The creation or modification of a stormwater management practice, usually in a developed area, that improves or combines treatment with existing stormwater infrastructure.

Riparian area Vegetated ecosystems along a water body through which energy, materials, and water pass. Riparian areas characteristically have a high water table and are subject to periodic flooding.

Runoff Rainfall, snowmelt, or otherwise discharged water that flows across the ground surface instead of infiltrating the ground.

Sanitary sewer system Underground pipes that carry only domestic or industrial wastewater to a sewage treatment plant or receiving water.

Sedimentation A solid-liquid separation process utilizing gravitational settling to remove soil or rock particles from the water column.

Siltation A solid-liquid separation process utilizing gravitational settling to remove fine-grained soil or rock particles from the water column.

Site fingerprinting Development approach that places development away from environmentally sensitive areas (wetlands, steep slopes, etc.), future open spaces, tree preservation areas, and buffer zones. Ground disturbance is confined to areas where structures, roads, and rights-of-way will exist after construction is complete.

Storm sewer system A system of pipes and channels that carry stormwater runoff from the surfaces of buildings, paved surfaces, and land to discharge areas.

Stormwater Water derived from a storm event or conveyed through a storm sewer system.

Stormwater Treatment Train™ A series of BMPs or natural features, each designated to treat a different constituent, component, or aspect of runoff, implemented together to maximize pollutant removal effectiveness.

Stormwater utility A utility established to generate a dedicated source of funding for stormwater pollution prevention activities where users pay a fee based on land-use and contribution of runoff to the stormwater system.

Structural soils A term that refers to soil mixes that have been developed mainly to help promote the welfare of street tress, it is a highly compactable medium that retains a high level of porosity allowing for better infiltration of water and higher oxygen levels than typical sub-grades used under pavement. Consists of a controlled mixture of angular-shaped aggregate of similar size, topsoil, sometimes with the addition of porous aggregate fertilizer, and a soil stabilizer.

Subdivision The process of dividing parcels of land into smaller building units, roads, open spaces, and utilities.

Surface water Water that flows across the land surface, in channels, or is contained in depressions on the land surface (*e.g.* runoff, ponds, lakes, rivers, and streams).

Swale A natural or human-made open depression or wide, shallow ditch that intermittently contains or conveys runoff. Can be used as a BMP to detain and filter runoff.

Urbanization Changing land-use from rural characteristics to urban, or city-like, characteristics.

Urban sprawl Development patterns where rural land is converted to urban uses more quickly than needed to house new residents and support new businesses. As a result people become more dependent on automobiles and have to commute farther. Sprawl defines patterns of urban growth that include large acreage of low-density residential development, rigid separation between residential and commercial uses, residential and commercial development in rural areas away from urban centers, minimal support for nonmotorized transportation methods, and a lack of integrated transportation and land-use planning.

Urban (metropolitan) runoff Runoff derived from urban or suburban land-use that is distinguished from agricultural or industrial runoff sources.

Water (hydrologic) cycle The flow and distribution of water from the sky to the earth's surface, through various routes on or in the earth, and back to the atmosphere. The main components are precipitation, infiltration, surface runoff, evapotranspiration, channel and depression storage, and groundwater.

Watershed The land area, or catchment, that contributes water to a specific water body. All the rain or snow that falls within this area flows to the water bodies as surface runoff, in tributary streams, or as groundwater.

Zoning Regulations or requirements that govern the use, placement, spacing, and size of land and buildings within a specific area.

NRDC
The Earth's Best Defense

OUT OF THE GUTTER

Reducing Polluted Runoff in the District of Columbia

July 2002

APPENDIX A

Legal Review Checklist

Impediments to Voluntary Low Impact Development in the District of Columbia

DEVELOPMENT STANDARDS

- ■ Do the District's codes and regulations guiding construction and development explicitly restrict any core LID principles and practices (*e.g.*, infiltration, exfiltration, vegetative controls, open drainage, temporary surface storage)?
- ● Are there officially adopted model designs, standards, or guidance documents that encourage certain types of development and/or site design that incorporate LID principles?
- ● Do the codes and regulations incorporate, encourage, or recommend any multi-functional LID principles or practices?

Site Preparation and Restoration

Site Disturbance and Clearing

- ■ Does the Erosion and Sediment Control (ESC) ordinance require widespread clearing of construction sites?
- ■ Does the ESC ordinance require removal of all trees and woody vegetation as part of site preparation?
- ● Does the ESC ordinance encourage phasing and scheduling of site clearing activities?
- ● Does the ESC ordinance place limits on the size and extent of material storage areas and stockpiles exposed to precipitation and runoff?

Key

■ Potential legal impediments that were evaluated by NRDC for the District of Columbia

● Critical issues that do not constitute potential legal impediments to voluntary LID practices and were not evaluated by NRDC for the District of Columbia.

- Does the ESC ordinance provide for the protection of sensitive soil, sensitive slopes, wetlands, waterways, and other critical areas?
- If forest or specimen trees are present at a development site, does some of the stand have to be preserved?

Grading/Slope Requirements

- Do grading and slope requirements limit or impede the use of post-construction LID practices?
- Do codes and regulations require conventional drainage practices, or is there flexibility for alternatives (*e.g.*, do sites have to be graded toward the street or municipal drainage infrastructure, or can existing natural drainage patterns be used)?

Site Restoration

- Does the ESC ordinance encourage or mandate any revegetation with woody plants?

Building Standards

Disconnection of Impervious Surfaces/Areas

- Are there District regulations that require runoff to be directed toward the street?
- Do sites have to be connected to the District's stormwater sewer system?
- Are gutters and downspouts required to be connected to the stormwater sewer system?
- Is there a prohibition on the discharge of rooftop runoff to yards/landscaped areas?

Lots

Driveways

- Is the minimum driveway width specified in the District greater than 18 feet for residential properties?
- Are shared driveways prohibited in residential developments?
- Is the use of pervious materials prohibited for residential properties?
- Is the use of pervious materials prohibited for commercial, industrial, and institutional properties?
- Is the use of "two-track" design prohibited for single-family properties?

Post-Construction Natural Resource Protection

- Are there any tree preservation/reforestation requirements in the District?
- Are there any requirements for property owners to protect sensitive soils, slopes, wetlands, recharge areas, buffers, and/or waterways?*Grading Requirements*

Grading Requirements

- Do current grading or drainage requirements prohibit temporary ponding of stormwater on yards, landscaped areas, or rooftops?

Key

■ Potential legal impediments that were evaluated by NRDC for the District of Columbia

● Critical issues that do not constitute potential legal impediments to voluntary LID practices and were not evaluated by NRDC for the District of Columbia.

Building Codes

Storage

■ Do District codes and regulations restrict the temporary storage of stormwater on rooftops?

■ Do District codes and regulations restrict the temporary storage of stormwater on the sides of buildings (planter boxes, type of material used as siding)?

■ Do District codes and regulations restrict the use of roof gardens?

■ Are there roof weight bearing requirements that restrict the use of roof gardens?

Transportation Infrastructure

Roads

Drainage

■ Do municipal regulations require curbs and gutters for all street classes?

■ Do municipal regulations require curbs and gutters in parklands and parkways?

■ Are there regulations that prevent the use of any type of open drainage channels or overland flow of runoff?

Medians

■ Are there requirements that limit the maximum width of medians and their use for treating runoff?

Surfacing Materials

■ Are pervious surfaces prohibited? If yes, on what street classes?

● Are there guidelines on acceptable types and uses of pervious surface materials?

Maintenance and Repair

■ Are there public works maintenance regulations that limit the use of alternative road surfaces and alternative street design?

■ Are there public works repair regulations that limit the use of alternative road surfaces and alternative street design?

● Are there appropriate regulations to ensure property maintenance?

Tree/Vegetation Planter Boxes (also applies to sidewalks and all streetscapes discussed below)

■ Do municipal regulations prevent the use of tree/vegetation boxes in certain streets?

■ Are there municipal regulations requiring tree planter boxes to be raised above grade?

Sidewalks

■ Do municipal regulations require a minimum sidewalk width in the District?

■ Are sidewalks always required on both sides of residential streets?

■ Do sidewalks have to be sloped so they drain to the street?

■ Are pervious surfaces prohibited?

■ Can runoff be stored under sidewalks?

Parking

Parking Lots

- ■ Does the District require standard parking spaces to be larger than 9 x 18 feet?
- ■ Are parking lots prohibited from having a percentage of smaller dimension spaces for compact cars?
- ■ Is the use of pervious materials for parking areas prohibited?
- ■ Is there a prohibition on greenspace/landscaping in parking lots or are there limits on landscaping that would preclude the use of LID?
- ■ Are there requirements to direct runoff to the street or existing drainage infrastructure?
- ● Is there a requirement for a percentage of the parking lot to have tree cover/green space/landscaping?

Parking Codes

- ■ Are there restrictions limiting the use of shared parking arrangements in the District?

Structured Parking

- ● Are there any incentives for developers to provide parking within garages rather than surface lots?

Rights-of-Way

- ■ Are LID practices, including natural landscape surfaces, restricted in transportation ROWs?
- ■ Are landowners and developers restricted from using ROWs to implement and maintain LID-type stormwater management?

PUBLIC HEALTH AND SAFETY

Standing Water

- ■ Do any codes or regulations prohibit intentional ponding of water on yards and landscape areas?

Open Drainage

- ■ Do any building, development, or public health and safety codes or regulations prohibit or otherwise limit the use of open drainage channels, swales, ditches, or other conveyances for stormwater?

Noxious Weeds and Weed Control

- ■ Are there weed control regulations that limit or impede the use of vegetated channels, bioretention areas, swales, tree planter boxes, or other LID practices that incorporate vegetation on public or private property?
- ■ Are there weed control regulations that limit or impede the use of certain LID practices on private property?

Key

- ■ Potential legal impediments that were evaluated by NRDC for the District of Columbia
- ● Critical issues that do not constitute potential legal impediments to voluntary LID practices and were not evaluated by NRDC for the District of Columbia.

Pest Control (Mosquitoes, Vermin)

- ■ Are there pest control regulations that limit or impede the use of vegetated channels, bioretention areas, tree planter boxes, or other LID practices that incorporate vegetation on public and private property and ROWs?

POST-CONSTRUCTION STORMWATER MANAGEMENT

Stormwater Requirements (Stormwater Management Plan and CSO Long Term Control Plan)

- ● Are any LID techniques expressly prohibited?
- ● Are any nonstructural LID BMPs expressly prohibited?
- ● Are LID techniques recommended in the District's stormwater manual?
- ● How is LID incorporated into the District's MS4 Stormwater Management Plan?
- ● Does the District's CSO Long Term Control Plan incorporate LID principles and practices?
- ● Are the CSO Long Term Control Plan and Stormwater Management Plan integrated?
- ● Are there incentives for residential property owners to use LID techniques such as Rain Gardens and pollution prevention?

Stormwater Management Issues

Water Conservation

- ● Do the District's Plumbing Codes restrict or prohibit water conservation measures?

Buffers

- ● Is there guidance for the protection or creation of stream buffers?
- ● If so, are there any limitations to their application?
- ● Are there limitations on allowable uses/activities within the buffer?
- ● Is the recommended buffer width at least 35 feet?
- ● Is there any guidance as to the use of native vegetative species, or other species specific requirements, or restrictions for riparian buffer or plantings that promotes or limits LID application?

Homeowner Association Rules

- ● Do homeowner associations have the authority or ability to require or restrict LID-type practices?

Maintenance and Land Management Rules for Property Owners (Private and Public including commercial areas, office parks, and public institutions)

- ● Are there maintenance requirements for property owners that may limit the use of LID practices?
- ● Are there land management requirement for property owners that may limit the use of LID practices?

- Can maintenance and land management requirements be enforced in the District of Columbia? If so, by whom?

COMPREHENSIVE ISSUES

Zoning

Special Areas

- Does current zoning allow uses incompatible with special watershed districts or other environmentally sensitive land?
- Has the District identified areas where LID practices may not be technically feasible (*e.g.*, areas where water table is too high for infiltration practices)?

Building and Development Review

- Does the District's Master Planning process consider drainage, CSO, and source water resource protection issues?
- Does site plan review include stormwater management and LID? If so, at what point in the process are these issues considered?
- Do building inspections, construction inspections, and maintenance inspections consider drainage, development patterns, and pollution prevention?

Planning

Transportation Planning

- Does the District consider water quality, drainage, development patterns, and pollution prevention in its transportation planning activities?
- Does the District have a standard suite of LID design practices that will allow these practices to be implemented during construction, maintenance and reconstruction of roadways.

Interagency Cooperation

- What framework exists for fostering multiagency cooperation, coordination, and planning?
- Are there any apparent roadblocks to multiagency cooperation, coordination, or planning?

Infill and Brownfield Development Issues

- Do the guidelines for infill development and/or brownfields development directly address stormwater (*e.g.* , does the District have any special procedures for brownfields and infill development projects that relate to drainage and stormwater management)?

Natural Resource Protection

- Does the District discourage creating open space in redevelopment projects? Is there a percentage of open space required for a development permit?

Key

- ■ Potential legal impediments that were evaluated by NRDC for the District of Columbia
- ● Critical issues that do not constitute potential legal impediments to voluntary LID practices and were not evaluated by NRDC for the District of Columbia.

- ● Can open space be managed by a third party using land trusts or conservation easements?
- ● Are there mechanisms or incentives in place to encourage open space protection?
- ● Are there any incentives to developers or landowners to conserve land (open space design, density bonuses, stormwater credits, or lower property taxes)?
- ● Is flexibility offered to developers to meet regulatory or conservation restrictions (density compensation, buffer averaging, transferable development rights, off-site mitigation)?

Applicability to Other Water Quality Regulations

- ● Does the District incorporate LID into other activities related to water quality (TMDLs, SDWA, wetlands, CWA Sec. 404 permits, Dredging, C&D Regulations)?

Financial Incentives/Disincentives

- ● Is there a framework for fee reduction and/or subsidy programs to encourage the use of LID techniques?
- ● Is there an LID guidance document for developers that highlight financial advantages of LID practices?

APPENDIX B

Stormwater Utility Fee Structures

Following are examples of stormwater utility fee structures from municipalities around the country:

BOULDER, COLORADO (POPULATION 94,637)

Boulder established a utility in 1973 under the control of the city manager in the Department of Public Works. The city now owns and operates three water utilities: water, wastewater, and stormwater/flood management, which together are responsible for public education, detection of illicit connections and dumping, water quality monitoring, and routine maintenance.

Residential user fees are based on property area. For owners of single-family dwellings within the city limits, the monthly fees for stormwater and flood management are as follows: properties up to 15,000 square feet pay $5.70; properties from 15,000 to 30,000 square feet pay $7.15; and properties of 30,000 square feet and greater pay $8.55. These fees reflect rate increases determined by the city council as part of the 2002-2003 budget process. The approved rate changes, effective January 2002, raised the residential customer's typical utility bill by approximately $50 per year, or $4.20 per month. The proposed 2003 rate changes will be considered in the fall of 2002 and will increase a typical residential bill approximately $33 per year, or $2.75 per month. The fee for all non-single-family dwellings is individually calculated. Commercial fees are based on a percentage of impervious and pervious surface area.

All owners of developed property are required to pay user fees. Undeveloped parcels are exempt from this fee.

The utility also charges one-time fees for the development of previously undeveloped property, annexation of developed property, and changes or additions to developed property. These fees are used solely for capital improvements, reconstruction, or expansions.

Sources:
http://www.ci.boulder.co.us/publicworks/depts/utilities/about/2000rate.htm
http://www.ci.boulder.co.us/publicworks/depts/adminfleet/utbilling/2002rates.htm

TAKOMA PARK, MARYLAND (POPULATION 17,799)

Takoma Park established a utility in 1996. Its primary responsibilities are construction and maintenance of the stormwater drainage system, review of stormwater management plans, inspection and enforcement activities, watershed planning, and water quality monitoring.

User fees are based on the amount of impervious area on a property. In 2001, single-family residential properties paid a fixed annual rate of $28.68. Non residential and multifamily properties are charged a fee based on their actual impervious area as compared to the average single-family property. Tax-exempt properties are not exempt from the stormwater management fee, but property used for public purposes and owned by the federal government, a state, county or city agency, or a volunteer fire department are exempt. The rate is established by the city council, and fees are collected annually.

Source:
http://www.cityoftakomapark.org/finance/documents/swques.html

LOUISVILLE AND JEFFERSON COUNTY, KENTUCKY (POPULATION 693,604)

The county established a utility in 1987. As of August 2001, the single-family residential charge rate is $3.65 per month for each parcel having one or two residential dwelling unit(s). This flat rate fee is based on each single-family residential parcel being equal to one Equivalent Service Unit (ESU). The county determines the number of single-family residential parcels in the drainage service area and designates each as a single ESU, irrespective of the size of the parcel, the use of the land, or if it is modified as other than single-family.

The charge for all other parcels within the drainage service area is based upon the number of square feet of measured impervious surface, as determined by the county through aerial photography and surface feature evaluation processes, expressed in whole ESUs by rounding to the next highest ESU (an ESU has been determined to be 2,500 square feet of impervious surface). The charge for such property is computed by multiplying the number of ESUs for a given parcel by the unit rate of $3.65 per month, established by the county. Any owner of this class of property may request a drainage charge credit adjustment for approved on-site stormwater retention or detention facilities provided:

1. the property owner remains responsible for all costs of operation and maintenance of the facility;
2. the facility has been constructed in accordance with all approved plans;
3. the owner has obtained county required permits for the facility; and
4. the county has access to the facility for purposes of inspecting for compliance with design, maintenance, and operating standards.

If a drainage charge credit is approved for on-site stormwater retention or detention facilities, the credit is applied by reducing the number of billable ESUs by the percent of reduction in stormwater runoff due to such on-site facilities, as determined by the county. The net billable ESUs after such credit is applied is expressed in whole ESUs by rounding to the next highest ESU, and the adjusted drainage service charge shall not be less than 18 percent of the drainage service charge before the credit adjustment.

Most of the money generated is used for drainage system maintenance and improvements. In addition to responding to problems, the utility routinely maintains drainage systems such as cleaning catchbasins, mowing and cleaning ditches, and repairing pipes and culverts. The utility is also responsible for flood protection, developing a design manual to guide the elimination and prevention of conditions that cause drainage and flood problems, and water quality monitoring. In 2001, user fees generated $19.4 million in revenue for the county.

Sources:
http://www.msdlouky.org/insidemsd/rates3.htm
http://www.msdlouky.org/aboutmsd/pdfs/an2001c.pdf

ANN ARBOR, MICHIGAN (POPULATION 114,024)

Ann Arbor established a utility in 1984 when stormwater operation and maintenance improvements were needed, but the city did not have the funds to implement these improvements. The utility is responsible for detecting illicit connections, water quality monitoring, chemical storage surveys, public education, and complaint and spill response, as well as system maintenance.

Property owners pay user fees. Exemptions are granted to public lands open to the general public for recreation, public streets, and sites discharging all stormwater via private storm sewers directly into the Huron River. Fees are based on "hydraulic acreage," derived by multiplying the acreage of impervious and pervious area by theoretical hydrological response factors-rate of stormwater runoff, rainfall intensity, and rate of runoff modified by retention. Impervious and pervious areas were measured using remote sensing.

As of July 1, 2001, the quarterly stormwater service charge for a single-family or two-family dwelling is $13.75 per dwelling unit, or, with adequate stormwater retention, $11.70 per dwelling unit. All property owners are charged $147.31 quarterly per acre multiplied by the following factors for the following types of land area: 0.20 for pervious area, 0.95 for impervious area, or 0.30 for impervious area with adequate stormwater retention. The minimum quarterly fee per parcel is $11.70.

Source:
Rate sheet provided by Ann Arbor Water Utilities Department (734-994-2666).

CINCINNATI, OHIO (POPULATION 331,285)

Cincinnati formed a utility in 1985, not because of one dramatic event but because the city's infrastructure was more than 100 years old, and the city did not have the money to fix its many failures. In 2002, the residential rate for one and two-family houses under 10,000 square feet is $26.52 annually; one- and two-family houses more than 10,000 square feet are billed $37.13 annually. These fees are based on how much average runoff is contributed by these properties. All other property, including multi-family residences and commercial and industrial lots, is billed $2.21 per equivalent runoff unit (ERU). The ERU is determined by multiplying the Intensity Development Factor (IDF), which is assigned according to the property's level of development (with 0.85 being the highest IDF, for commercial use), by the Area Range Number (ARN), with 1 ARN representing 2,000 square feet of property. Billing is on a quarterly basis.

While some of the utility's resources are devoted to responding and reacting to problems, much of its efforts focus on prevention, such as maintaining flood protection structures, preparing city and regional master plans, and initiating capital improvements.

Source:
John Morrell of the Cincinnati Stormwater Management Office (513-244-1329).

PORTLAND, OREGON (POPULATION 529,121)

The Environmental Services Department of the City of Portland provides water quality protection, wastewater collection and treatment, and sewer installation services, serving approximately 150,000 residential sewer customers. Stormwater fees are included in the city's sewer rates, the most recent version of which took effect on July 1, 2001, and represented an average increase of 9.1 percent. The residential stormwater charge is $10.97 per month, based on an average 2,400 square feet of hard surface area. The commercial rate is $5.00 per month per 1,000 square feet. In addition to the monthly charge, the city also imposes a one-time stormwater system development charge on new development, collected at the time of permitting. Currently, the development charge rates are: for a single- or two-family home, $449; for a triplex, $520; and for a fourplex, $712. For commercial and multiple family dwellings with five or more units, the rate is $102.00 per 1,000 square feet of impervious areas, plus an additional monthly charge of $2.77 per linear foot of frontage. The development charges are adjusted annually at the beginning of each fiscal year.

In December 2000, the city council adopted Ordinance No. 175160 to create the Clean River Incentive and Discount Program. The program provides stormwater discounts to ratepayers for existing private stormwater management facilities. Also, the program provides financial incentives, technical assistance, and public education resources to ratepayers who wish to add or upgrade private stormwater management facilities. Customers may qualify for as much as a 35 percent reduction in their current monthly stormwater management charge. The stormwater management charge covers two separate types of costs. Most of it pays for managing stormwater runoff from city streets and programs to protect the environment. A smaller portion pays the cost of managing stormwater runoff from private property. The discount will apply only to the private property portion of the stormwater charges. The rules governing the application process are available at: http://www.cleanrivers-pdx.org/get_involved/stormwater_discount.htm.

The City of Portland has eliminated Combined Sewer Overflows (CSOs) to the Columbia Slough and plans to eliminate a significant amount of overflows to the Willamette River by 2011. In order to promote this effort, the Bureau of Environmental Services offers a Downspout Disconnection Program to involve residents more directly in controlling stormwater runoff. Residents of selected neighborhoods disconnect their downspouts from the combined sewer system and allow their roof water to drain to gardens and lawns. The city provides an incentive to residents: if residents disconnect the downspout themselves, they earn $53; community groups earn $13 for each downspout they disconnect. According to Portland's Bureau of Environmental Services, nearly 32,000 residential downspouts at 14,500 homes have been disconnected through the program, removing more than 290 million gallons of stormwater per year from the combined sewer system.

Source:
http://www.cleanrivers-pdx.org/residential_svc/index.htm

AUSTIN, TEXAS (POPULATION 642,994)

The utility established a fee structure in 1982 in response to a severe flood. The watershed protection department is responsible for stormwater maintenance operations. Its primary responsibilities are erosion control, flood control, and improving water quality. The monthly residential fee, effective as of October 2001, is $5.21 per residential dwelling unit based on the average acreage of residential property. The commercial and industrial monthly fee is $70.73 per impervious acre.

Fee exemptions are granted to properties owned by the state, county, and school districts. A rate reduction is available to commercial customers with well maintained ponds who request a reduced rate, although participation in this program is limited to about 15 percent of those eligible. While fees fund most of the city's stormwater projects, additional financing comes from annual storm sewer discharge permit fees (which are imposed on certain commercial and industrial properties), development fees, and federal grants.

Source:
Jose M. Guerrero, Austin Watershed Engineering Department, (512-974-3386).

HAMPTON, VIRGINIA (POPULATION 146,000)

The City of Hampton collects a stormwater fee, established by the city council in 1994, because no federal or state funding was provided to implement water quality measures required by the Clean Water Act of 1987. The fees are used to fund programs related to water quality, including environmental education, street sweeping, capital improvements to the system, drainage maintenance, administration, review of permits, inspection, and monitoring activities.The stormwater fee is $42 per year for a residential property, regardless of size. The fee for commercial property is $42 per year, multiplied by the number of ERUs, with the average ERU being 2,429 square feet. For vacant lots larger than 12,000 square feet, regardless of size or classification, owners are billed at ½ an ERU, or $21 per year. The fee is charged to the property owner and is collected as a portion of the real estate property tax bill due in June and December of each year. The city offers relief from a percentage of the fee if the property owner follows Best Management Practices—such as retention ponds, detention areas, infiltration facilities, 20 percent green space area, and regular parking lot sweeping—on the property. Relief is available for commercial properties only, is subject to review by an engineer, and must be renewed on an annual basis.

Sources:
http://www.hampton.va.us/publicworks/storm_water_billing.html and customer call center (757-727-8311).

CHESAPEAKE, VIRGINIA (POPULATION 204,470)

The City of Chesapeake owns or maintains all of its public stormwater systems, including 450 miles of roadside ditches, 870 miles of storm sewers, and 275 miles of culverts. The stormwater management program provides increased maintenance, analysis of pollutants in stormwater runoff, lake dredging, inspection of construction sites for erosion, sediment controls, inspection for illegal connections into the storm drain system, and public education.

The stormwater management program is funded by a stormwater utility fee paid by all developed properties. Each residential property, including single-family homes, mobile homes, multi-family dwellings, and condominiums, is charged a flat rate of $30.60 per year, billed in two increments during the course of the year. A property owner may opt to pay the entire fee at once and will receive a 4 percent discount, reducing the fee to $29.38. Non-residential property owners are billed using a formula that multiplies the total impervious area (for Chesapeake, one ERU is considered to be 2,112 square feet) by the residential flat rate. All property owners will be charged for at least one ERU, regardless of property size. Commercial property owners may be eligible for a stormwater utility credit based on their use of Best Management Practices, and subject to approval by the Department of Public Works. The stormwater utility fee is set by the city council and also applies to tax-exempt properties.

Sources:
http://www.chesapeake.va.us/services/depart/pub-wrks/pub-wrks/stormwaterutility.html and Public Works Stormwater Utility at (757-382-3330).

NEWPORT NEWS, VIRGINIA (POPULATION 180,150)

Newport News calculates its stormwater fee based on an ERU of 1,777 square feet. Property owners are charged $3.10 per ERU per month. Rates may differ according to the configuration of the property, such as in the case of apartments or condominiums. For apartments, the rate is multiplied by a factor of 0.42 to compensate for a decreased contribution to stormwater runoff. Two-family homes (*i.e.,* two units that share a wall in one building), however, are charged for 1 ERU per unit.Newport News does charge federally owned properties and tax-exempt properties at the same rate as residential and commercial properties. The fees are collected every six months, on June 5 and December 5, as part of residents' real estate bills. Waivers are available in certain instances when discharge permits are obtained from the Corps of Engineers. The city offers discounts for the use of certain environmentally sound elements, such as Best Management Practices, 15 percent green space, or a "betterment situation" that improves drainage or lowers the need for maintenance. The discount may not exceed 25 percent of the total bill.Newport News estimates that it currently bills 54,000 parcels and raises $5.2 million in revenue on an annual basis.

Source:

Howard Nelson, Newport News Engineering Department, (757-926-8801).

NORFOLK, VIRGINIA (POPULATION 234,403)

Norfolk implemented its environmental stormwater management program and stormwater utility in July 1991. The stormwater system consists of 349 miles of pipes, 137 miles of ditches, 13 stormwater ponds, 10 stormwater pump stations, and 1,100 outfalls discharging to waterways. The program, overseen by the Division of Environmental Storm Water Management, addresses both pollution reduction and flood control, deriving its revenue from stormwater fees.Norfolk calculates its stormwater fees based on impervious area averages. The charge for residential property, which can include a maximum of four units, is charged at a daily rate of $.18, regardless of size. Commercial property, including residential parcels with more than four units, is charged at the daily rate of $.164 for every 2,000 square feet of property. Properties with one water meter and an active account are charged stormwater fees directly with their water charges, which are billed approximately every 30 days. Properties without an active water meter or with multiple meters are billed separately for stormwater maintenance every 60 days.

Sources:

Norfolk Public Works Finance Management (757-664-4633)
http://www.norfolk.va.us/publicworks/stormwater.htm

VIRGINIA BEACH, VIRGINIA (POPULATION 425,257)

The City of Virginia Beach implemented a stormwater management service fee in 1993 to help address flooding problems, improve drainage, and reduce pollutants in stormwater runoff. The rate for residential property, considered to be 1 Equivalent Residential Unit if it contains fewer than four dwelling units, is $.131 per day, or $47.82 per year. Multi-family dwellings and commercial property rates are calculated based on the amount of impervious area on-site divided by the average amount of impervious area on all residential properties, which is currently considered to be 2,269 square feet. The resultant number (*i.e.* the number of Equivalent Residential Units) is multiplied by the $.131 per day residential rate to provide the commercial property fee. The city collects stormwater fees on a semiannual basis, in January and July, in a bill that is separate from other water charges.Virginia Beach estimates that 93.4 percent of its Storm Water Management Service customers are residential customers. The remaining 6.6 percent of all accounts belong to non-residential customers who provide 46.5 percent of total revenue, which is approximately $9.4 million annually. This amount is supplemented by approximately $3.1 million more from revenues received by the city from other sources.The city does provide certain discounts for Best Management Practices, up to 50 percent in some cases. These are considered on a case-by-case basis, must be field verified, and continually maintained.

Source:
http://www.vbgov.com/dept/pw/stormwater/swfaq.asp#talkto; Storm Water Customer Service (757-426-5859).

BELLEVUE, WASHINGTON (POPULATION 110,000)

Bellevue established a utility in 1974 in response to severe flooding. The utility's primary responsibilities include flood control, water quality monitoring, public education, and routine maintenance. Residential and commercial user rates are determined based on the amount of impervious surface divided by the total square footage. Credit is given if a detention facility is on the property. Wetlands are exempt from fees, and undeveloped property is charged a small fee.

Bellevue's most recent rate increase took effect January 1, 2002, as set by the city council. The city measures property in 2,000 square feet increments, and has five rate categories for determining storm and surface water service charges:

Category 1	Undeveloped land	Undeveloped	$0.39 per 2,000 square foot increment
Category 2	Lightly developed	Up to 20 percent lland developed	$2.87 per 2,000 square foot increment
Category 3	Moderately developed	20–40 percent land developed	$3.58 per 2,000 square foot increment
Category 4	Heavily developed	40-70 percent land developed	$5.38 per 2,000 square foot increment
Category 5	Very heavily developed	More than 70 percent land developed, commercial	$7.17 per 2,000 square foot increment

These fees are collected on a bimonthly basis. An additional $2.39 billing charge applies to all service charges. (For wetlands, the entire service charge will be that $2.39 billing charge, regardless of the size of the property.) The total revenue produced by stormwater fees for 2001 was $8.4 million.

Source:
Bellevue, WA Utility Billing Office (425-452-6973).