


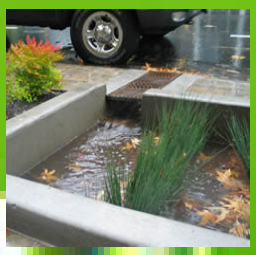


Managing Wet Weather with Green Infrastructure

Municipal Handbook

Green Infrastructure Retrofit Policies

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Green Infrastructure Retrofit Policies

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The Municipal Handbook is a series of documents
to help local officials implement green infrastructure in their communities.

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Front Cover Photos
Top: rain garden; permeable pavers; rain barrel; planter; tree boxes.
Large photo: bioretention and permeable concrete, Olympia WA

Green Infrastructure Retrofit Policies

Introduction

Existing development, especially in urbanized and urbanizing areas, is responsible for currently degraded water quality and stream conditions. Changes in land cover and the increased imperviousness of the urban environment have resulted in larger volumes of runoff traveling at faster velocities. This has caused serious streambank erosion and has compromised aquatic habitat. Many of these areas were developed without adequate stormwater controls and must be addressed if urban streams are to be restored and water quality is to be improved nationwide. It should be noted that most stormwater regulations are intended to limit the increases in pollution associated with new development, or to curb flooding, but do not specifically address the hydrologic modifications associated with runoff from existing development.

Nationally, 40% of assessed waters fail to meet water quality standards and urban streams have tended to fare worse than the national averages.[1] USGS studies of urban streams find that concentrations of total phosphorus exceed EPA's goal for nuisance growth in 70% of streams, insecticides are usually at a higher concentration than in agricultural areas, and fecal coliform bacteria commonly exceed recommended standards for water recreation.[2] In addition, combined sewer systems in nearly 750 municipalities deliver 850 billion gallons of untreated overflows to urban waters each year.[3]

Retrofits to stormwater infrastructure will be necessary to reduce runoff and pollution, but the capital investment is daunting. Upgrades to stormwater and combined sewer systems, like other utilities, are capital intensive projects. EPA estimates current wastewater infrastructure needs an investment in excess of $200 billion, with $10 billion needed for stormwater management and $60 billion needed for combined sewer overflow (CSO) correction.[4] While this needed investment presents a significant economic burden, it also presents an opportunity to re-evaluate the most efficient way to invest in infrastructure and environmental programs.

Using green infrastructure for urban stormwater retrofits can reduce stormwater pollution while simultaneously reducing the burden and demand on existing infrastructure. However, water quality and quantity benefits are not the only advantages green infrastructure has to offer. Green infrastructure enhances communities by bringing aspects of the natural environment into inhabited space. Trees provide shade, act as wind breaks and noise barriers, and improve air quality. In many instances, green infrastructure has been found to be less costly than or cost competitive with traditional infrastructure. Green infrastructure provides additional environmental and economic benefits for the investment rather than traditional stormwater management approaches that literally bury the investments out of sight. The additional benefits that green infrastructure provides include:

- Green infrastructure effectively counteracts urban heat island by substituting soils and vegetation for hard, heat absorbing materials common in urban areas, creating shade, and emitting water vapor.
- Green roofs and other vegetation incorporated on and around buildings, help shade and insulate buildings from wide temperature swings, decreasing the energy needed for heating and cooling.
- Green infrastructure improves air quality as vegetation absorbs gaseous air pollutants and adsorbs particulates.
- Research indicates that property values increase when street trees are planted and vacant lots are greened, providing private benefits to homeowners, increased property tax revenue, and more livable communities.

The distributed green infrastructure network is designed to limit the conversion of precipitation to runoff by capturing rainwater where it falls, managing stormwater at the surface, and maximizing soil and vegetation contact during treatment. This combination allows green infrastructure to reduce stormwater volumes, peak flow rates, and pollutant concentrations.

Traditional stormwater controls have focused almost exclusively on reducing pollution without addressing the increased volume of stormwater discharged from urbanized areas. The benefits gained from removing pollutants are often overshadowed by the magnitude of the runoff volume. Even with stormwater controls and high rates of pollutant removal, absent volume reductions, urban areas will contribute more pollution than pre-development conditions making it difficult to achieve water quality standards. Table 1 highlights this condition with the familiar example of the runoff from a one-acre meadow and one-acre parking lot after one-inch of rain.

Table 1. Runoff Volume and Pollutant Load from One-Acre Parking Lot with Treatment and Meadow for a One-Inch Rain Event.[5, 6]

Land Use	Pollutant	Concentration (mg/L)	% Removal	Effluent Concentration (mg/L)	Runoff Volume (gal)	Pollutant Load (lbs)
Paved Parking Lot with Treatment	TSS	130	80	26	25,800	5.6
Meadow		25	0	25	1,600	0.34

Table 1 demonstrates that even when treatment measures are able to achieve pollutant concentrations similar to pre-development conditions, the large difference in runoff volume produces a pronounced increase in pollutant load from urbanized areas. And with the lack of any controls in many urban areas, the pollutant loadings are much greater than displayed in Table 1. Green infrastructure's ability to reduce both stormwater volumes and pollutant concentrations is critical to reducing pollutant loads from urban areas and improving water quality.

This paper will explore the policies and incentives that municipalities have used to facilitate the use of green infrastructure within their stormwater programs. While the benefits of green infrastructure are increasingly understood, incorporating green retrofits into municipal infrastructure has presented institutional and regulatory challenges. The solutions to overcome these barriers are often dependent upon the water quality objectives and technologies employed. The policies are presented in this paper by technology type, but often approaches used for one green infrastructure practice are applicable to another or there is overlap among goals and outcomes.

Green Roof Retrofit Policy

There are two types of public policy currently in place concerning the implementation of green roofs for retrofit applications: incentives and regulations. Although many jurisdictions are currently using incentives alone in the early stages of garnering widespread municipal support for green roofs, these two policy approaches work well in tandem. An incentive program can initiate a green roof regulation by introducing the technology and its application on private property before implementing a mandate.

A combination of both incentives and regulation has been effective in Basel-City, Switzerland. Their incentive program had good publicity and raised awareness of green roof benefits such as energy savings and biodiversity protection, issues that were important to the community. Consequently, their green roof regulations did not meet resistance.[7]

Excerpt from the City of Toronto Green Roofs Pilot Program
Green Roof Incentive Pilot Program

Program goals

The Green Roof Incentive Pilot Program supports the City's stormwater plan known as the Wet Weather Flow Master Plan. The overall goal of the Green Roof Pilot Program is to encourage green roof construction in the City. In addition, the program will:

- Result in the construction of a variety of green roof types which could be used for education and promotional purposes.
- Provide an opportunity to showcase various green roof technologies and planting styles.
- Provide a grant of $50 per square meter of eligible green roof area up to a maximum of $10,000 for single family homes and a maximum of $100,000 for all other property owners in the City of Toronto.

Who is eligible

Any private property owner in the City of Toronto with a water account with the City is eligible, regardless of building size and type, so long as the building is capable of supporting a green roof that meets the specifications and requirements. Each green roof applicant must demonstrate that the proposed green roof:

- Has a continuous coverage of growing media over at least 50% of the roof footprint (roof area) of the building.
- Has a vegetation mix as opposed to a monoculture and a sustainable organic growing medium that replenishes nutrients and retains moisture.
- Has a maximum slope of 10 percent.
- Has a depth of at least 150 mm (6 inches) for a new building. The depth will permit greater flexibility in terms of the type and variety of vegetation that can be incorporated and will help ensure greater survival of plants (existing buildings with a lesser growing medium thickness may be considered for the pilot program if the applicant (or manufacturer) submits test data indicating the performance of the system with respect to water runoff coefficient and plant survival ability.
- Is installed over heated spaces (non-heated spaces, such as underground garages will not be considered for the pilot program).

Incentives

A green roof can have up to twice the lifespan of a conventional roof, making the long-term cost of the two comparable.[8] However, since the initial cost of a green roof is significant, a policy that focuses on alleviating that initial cost burden appears to be most successful.

Subsidy

The most common way to reduce the initial cost burden is through a subsidy program. Subsidies are usually provided per square foot of green roof area, up to an established maximum amount or percent of the total cost. For example, the City of Toronto's Green Roof Incentive Pilot Program will fund $50 per square meter of green roof up to a maximum of $10,000 for single family homes and $100,000 for other building types (Canadian dollar values).[9]

The funding for subsidy programs often comes from stormwater fees collected by the municipality to mitigate for post-construction levels of runoff quantity and pollutants. By investing in green roofs, the municipality is eliminating runoff before it enters the municipal stormwater system. The use of public money on private land is validated because of the reduced municipal facility cost, size, and maintenance burden.

After the first year of Toronto's Green Roofs Pilot Program, the incentive offered for building green roofs was found to not be high enough to attract broad interest.[10] Consequently, the financial incentive was raised from $10 (CAD) to the current $50 (CAD) per square meter. However, this amount is more than the cost of the stormwater benefit to the city and alternative funding sources have to be found in order to sustain the program. Since green roofs also reduce energy use in buildings making more energy available for other users and delaying the need for capacity upgrades, Toronto is considering funding the Green Roof Incentives Program with energy conservation funds as well as stormwater management funds.[11]

Local market development is an additional benefit of financial incentives. As more property owners elect to build green roofs, the demand for local green roof services will increase and the cost of the technology will eventually decrease as a result of a competitive market. This may eventually reduce or eliminate the need for a financial incentives program.

Consultation

Lack of information about the site-specific costs, maintenance needs, and benefits of a green roof can discourage property owners considering retrofitting an existing roof. Providing a free consultation with a green roof professional can allow property owners who are interested in green roof retrofits to overcome initial uncertainty. Stuttgart, Germany has a financial incentives program, and also provides free consultations and informative brochures that detail benefits, weight, waterproofing issues, and maintenance considerations.[12]

Excerpt from the City of Minneapolis Stormwater Utility Fee

Applying for Stormwater Quantity Credits

Property owners can apply for either the "Standard Quantity Reduction Credit" or the "Additional Quantity Reduction Credit."

- **Standard Quantity Reduction Credit.** The Standard Quantity Reduction Credit is a 50 percent credit on a property's stormwater fee. The "Standard Quantity" credit is based on a property's stormwater quantity management tools/practices being able to retain the *10-year, 24-hour type II SCS* storm event to pre-developed conditions. To qualify for this credit, the property owner must demonstrate that stormwater from the property is controlled with an on-site constructed stormwater quantity management tool/practice (BMP).
- **Additional Quantity Reduction Credit.** The Additional Quantity Reduction Credit is a 100 percent credit on a property's stormwater fee. To be eligible for the "Additional Quantity" credit, a property's stormwater quantity management tools/practices must be able to retain the *100-year, 24-hour type II SCS* storm event to pre-developed conditions. To qualify for this credit, the property owner must demonstrate that stormwater from the property is controlled with an on-site constructed stormwater quantity management tool/practice (BMP).

Fee Reduction

An incentive that can be used to ensure the long-term effectiveness of a green roof is a stormwater fee reduction. In areas where stormwater utility fees are in place, credit for reducing impervious area, and thereby runoff volume, can be given to property owners who install and maintain green roofs. In Minneapolis, Minnesota, 50% of the stormwater fee can be waived if the property owner can demonstrate that the runoff from a 10-year, 24-hour storm event can be managed on site. If a property owner can demonstrate that the runoff from a 100-year, 24-hour storm event can be managed on site, the entire stormwater fee is waived.[13]

Regulation

There are very few cities in North America that directly mandate the use of green roofs. The City of Chicago has requirements in place to mitigate urban heat island effects by addressing the solar reflectance of roofs. These requirements set a minimum reflectance for low and medium sloped roofs. However, green roofs are exempt. By installing a green roof, the solar reflectance requirements are met.

Excerpt from the City of Chicago Energy Conservation Code Revised January 9, 2003.
303 URBAN HEAT ISLANDS

18-13-303.1 Roof Reflectance. To minimize the undesirable "urban heat islands effect," low and medium sloped roofs shall comply with the following requirements when tested in accordance with ASTM E408. The roof surface of low sloped roofs (2:12 or less) shall have an initial solar reflectance greater than or equal to 0.65 and shall maintain a reflectance equal to greater than 0.50 for three years after installation. Medium-sloped roofs (greater than 2:12 and less than or equal to 5:12) shall have a solar reflectance equal to or greater than 0.15 initially and for three years after installation. Minimum emissivity shall be 0.9.

Exception: Roofs or portions of roofs that utilize photovoltaic, solar thermal or roof garden systems.

Urban heat island provisions. The reflectance and emittance requirements of Sections 18-13-303.1 through 18-13-303.2.1 are intended to minimize the urban heat island effect, as defined in Section 18-13-202, Definitions.

1. The portion of the roof that is covered by a rooftop deck covering 1/3 or less of the aggregate area of the roof, or a rooftop garden, or a green roof, is exempted from the requirements of this section.
2. An area including and adjacent to rooftop photovoltaic and solar thermal equipment, totaling not more than three times the area that is covered with such equipment, may be exempted from the requirements of this section.

18-13-303.2 Solar Reflectance. All roof exterior surfaces shall have a minimum solar reflectance as specified in 18-13-303.2.1 when tested in accordance with ASTM E903, ASTM E1918 or by testing with a portable reflectometer at near ambient conditions.

18-13-303.2.1 Roofing materials used in roofs with slopes of 0 in 12 to 2 in 12 shall meet the following requirements:

1. Roofs installed prior to and including 12/31/08 shall have a minimum solar reflectance, both initial and weathered, of 0.25.
2. Roofs installed after 12/31/08 shall utilize roofing products that meet or exceed the minimum criteria to qualify for an Energy Star label as designated by the USEPA Energy Star program.

Downspout and Impervious Cover Disconnection Retrofit Policy

There are various reasons why municipalities pursue a downspout or impervious cover disconnection program. Disconnection refers to the practice of breaking the direct link between impervious areas such as roofs or paved surfaces and the storm or combined sewer system. Disconnection can reduce combined sewer system overflows; reduce potable water demand when the runoff from roofs is used for applications such as landscape irrigation and toilet flushing; recharge ground water, helping to restore the natural hydrologic cycle; reduce stormwater discharges to waterways; and reduce or eliminate the need for large, municipally owned stormwater management facilities.

Using a combination of incentives, compliance assistance and regulations seems to be very effective at obtaining a high rate of retrofit disconnection. The regulation sets the timeframe for compliance. Incentives and assistance programs make compliance easily attainable for the target audience.

Incentives

Fast-track Project Review

Philadelphia has implemented a fast track review process for redevelopment projects with 95% or more of the impervious area disconnected from the combined or separate storm sewer. The Philadelphia Water Department will review the stormwater management portion of a project submittal within five business days for projects that qualify for the Green Project Review.[14] This is a low or no cost program for the City and it provides the project with a time savings that usually also translates into a financial savings. Because of the low cost of implementing this program, it is not subject to budget cuts or lapses in grant funding, and is not likely to be met with tax payer opposition.

City of Philadelphia Stormwater Management Guidance Manual Version 2.0

4.2.1 Green Project Review

PWD (Philadelphia Water Department) offers a Green Project Review for redevelopment projects that are able to disconnect 95% or more of the impervious area in the post construction condition. When performing a Green Project Review, PWD is committed to providing review of the stormwater management component within 5 business days of receipt of a complete project submittal. A Green Project Review may not necessarily include review of additional elements outside stormwater management such as Private Cost or Act 537 review. To be eligible for a Green Project Review a project must meet the following criteria**:**

- Project is redevelopment;
- 95% or more of the post construction impervious area is disconnected;
- Project may not adversely impact or further exacerbate rates and quality of runoff contributing to public infrastructure; and
- Public Health and Safety issues may preclude a project from a Green Project Review.

The submittee **MUST** identify their project as eligible for a Green Project Review in the letter of transmittal sent with the technical submittal. PWD may not be able to provide review comments within 5 business days without this notification.

Stormwater Utility Fee Discount

Portland, Oregon uses a stormwater utility fee discount as an incentive to encourage residential and commercial property owners to manage stormwater on site. Property owners with disconnected downspouts are able to apply for fee discounts. For example, residential property owners pay a monthly stormwater charge of $17.33. A discount of $6.07 applies to properties with disconnected downspouts, reducing the monthly charge to $11.26. A Residential Discount Calculator and a Commercial Discount Calculator can be found on the Clean River Rewards website.[15]

Compliance Assistance

The cities of Bremerton, Washington and Portland, Oregon elected to implement similar compliance assistance programs to achieve retrofit disconnection.

Reimbursement

Bremerton developed brochures and self-help videos describing how to separate roof drain leaders from the sewer system and offered free site assessments and technical assistance. In addition, Bremerton simplified their permit process and eliminated the fees for work done to disconnect downspouts. They also reimbursed residential property owners ($25 to $500) for materials used in the disconnection effort.[16]

As a result, 417,000 square feet of impervious area were disconnected. The program lasted 34 months and cost $270,000. The city obtained a grant for $150,000 from Washington Department of Ecology, and used $120,000 of its stormwater and wastewater utility funds. The use of wastewater utility funds was easily justified because the disconnection project reduced combined sewer overflows by 99%; the grant money was earmarked for public projects so the utility money was directed towards private property.[17] The program also reduced, and in some situations eliminated, the need for large scale, municipally owned stormwater management facilities, further justifying the use of stormwater and wastewater utility funds. Bremerton estimates that the cost per gallon of stormwater removed was $1.04 for a one inch rain event, whereas the cost of municipally owned stormwater management facilities is $5-$10 per gallon.[18]

Free Disconnection

Portland, Oregon implemented a similar compliance assistance program that offered reimbursement of $53 per disconnected downspout for property owners wanting to disconnect their own downspouts. Alternatively, property owners could apply to the City to do the disconnection work for free.[19] This flexibility provides compensation for property owners who want to do the work themselves, and free disconnection service for those who can not or do not want to. Portland's program is responsible for

successfully disconnecting over 50,000 downspouts and removing 1.5 billion gallons of stormwater a year from the combined sewer system.[20]

Portland City Code
Chapter 17.37.050 Disconnection Reimbursement in Voluntary and Mandatory Program Areas

(Amended by Ordinance No. 170113, effective May 15, 1996.) Disconnection reimbursement will be paid in the following manner:

A. Disconnection reimbursement will be made for the least expensive method of disconnection that will be effective, as determined by the Director. Reimbursements will not be processed until the new disposal system has been inspected and approved. Owners will not be reimbursed for downspouts disconnected prior to receiving official notification from the Downspout Disconnection Program that they are eligible for downspout disconnection reimbursement. Reimbursement will only be provided within the target areas identified in section 17.37.030 B.1. and 2.

B. Downspout disconnection to surface systems will be reimbursed as follows:

1. Owners who complete the disconnection work themselves or use their own contractor and receive a satisfactory inspection will be compensated according to the following unit costs per downspout:

a. $25 per downspout disconnected for supplies;

b. $13 per downspout for time and effort;

c. $15 per downspout for landscaping and miscellaneous;

Owners who receive free supplies from the City for their disconnection work will not receive the $25 amount for supplies.

Regulation

Both the Bremerton and Portland programs were successful in part because they required that downspouts be disconnected by a specified future date. Portland's regulations require that downspouts be disconnected one year after notification from the City.[21] This provides the incentive for property owners to participate in the compliance assistance program. In Bremerton, the regulations required that property owners disconnect their downspouts by 2005.[22] Their compliance assistance program began around 2001 giving property owners time to become informed about the issue, get involved in the compliance assistance program, and comply with the regulation before the disconnection requirement date.

Portland City Code
Chapter 17.37.030 Establishment of Downspout Disconnection Program

B.3. Owners of eligible property located in mandatory program areas are required to disconnect their downspouts within one year following written notice from the City. For purposes of this section, notice shall be deemed to have been received upon the mailing of said notice by first class mail or upon delivery of the notice in person.

Chapter 17.37.090 Enforcement Charges

(Added by Ordinance No. 170113, effective May 15, 1996.) In the event that the City needs to enforce the terms of the Code Hearings Officer's order referred to in Section 17.37.080, an administration fee of $300 for each occurrence shall be made a lien on the property in accordance with the provisions of Chapter 22.06.

Bremerton Municipal Code Title 15.04.130
ELIMINATION OF IMPROPER STORMWATER INFLOW TO THE WASTEWATER SYSTEM.

(a) Purpose.
The purpose of this section is to significantly reduce improper stormwater inflow to the wastewater system in order to eliminate or reduce instances of combined sewer overflow events and surcharged sanitary sewers due to the improper inflows, which are detrimental to public health and welfare; and to maximize efficient operation of the wastewater collection system and treatment plant.

(b) Disconnection Required by 2005.
Disconnection of all improper stormwater inflow to the wastewater system shall be made by January 1, 2005, unless continued connection is authorized by the Director where no practicable alternative for elimination of the improper stormwater inflow is available.

(c) Director's Authority to Order Early Disconnection.
(1) Purpose. The Director has the authority to order the disconnection of improper stormwater inflow to the wastewater system prior to January 1, 2005, where that disconnection is necessary to meet combined sewer overflow reduction plans and for elimination of sanitary sewer surcharging. The Order of Early Disconnection will generally be in target areas as defined elsewhere in this section.
(2) Notice. Notice of a Director's Order for Early Disconnection will be provided in writing. The notice will establish an effective date by which the improper stormwater inflow shall be discontinued. The effective date shall be no sooner than ninety (90) days from the date of the letter. The effective date may be extended in writing by the Director.

(d) Target Areas.
The Director may identify target areas within the wastewater service area (sewer or storm drainage basins or subbasins) which have the highest priority for reduction of improper stormwater inflow to the wastewater system based upon combined sewer overflow events and sanitary sewer surcharge problems.

Permeable Pavement Retrofit Policy

With so many paved surfaces in the urban environment, there are plenty of opportunities to retrofit sidewalks, driveways, parking lots, plazas, roads, and alleys with permeable materials. Paved surfaces fall into two categories from a retrofit policy perspective: paved surfaces on private property and publicly owned paved surfaces.

Public Property Retrofit

Publicly owned paved surfaces account for a large portion of the impermeable cover in urban areas. The City of Chicago, for example, has over 1,900 miles of alleys. Because many of these alleys were not built with connections to the combined or storm sewer system, stormwater pools on paved surfaces, often flooding nearby garages and basements.[23]

The Chicago Green Alley Handbook
About the Green Alley Program

While one solution to this problem is to install expensive connections to the City sewer system, the Green Alley Program also looks at other more sustainable solutions. In particular, where soil conditions are appropriate, water is allowed to infiltrate into the soils through permeable pavement or infiltration basins, instead of being directed into the sewer system or onto adjacent property. This not only solves a persistent problem, but it also provides an environmental benefit by cleaning and recharging the ground water. Furthermore, by not sending additional water to the combined sewer system a green alley can help alleviate basement and other flooding issues.

In 2006, Chicago piloted the Green Alley Program using permeable pavers, permeable concrete, and permeable asphalt to manage stormwater and recharge groundwater. Approximately 20 alleys are resurfaced each year. Costs vary depending on material use, soil type, and size of the paved area. The sometimes higher cost of construction is offset by the avoided costs of maintenance and sewer improvements that would have been needed if the alleys were redesigned and resurfaced with impermeable pavement. In addition, the cost of alternative paving materials is decreasing as they become more common. The 2008 cost of permeable concrete in Chicago is about $100 less per cubic yard than it was when the program began in 2006.[24]

In addition to water quality and quantity benefits, the use of light colored pavers and concrete reduces both the urban heat island effect and smog levels, improving outdoor air quality. The program also uses recycled materials, reducing the burden on landfills and conserving natural resources. For these reasons, the Green Alley Program was given the Chicago Innovation Award in 2007, sponsored by the *Chicago Sun-Times* and Kuczmarski & Associates.[25]

Philadelphia Code § 14-1603.2. Environmental Controls for the Wissahickon Watershed

(4) *Special Environmental Controls.* The following special environmental controls are imposed (in addition to any applicable provisions of Section 1603.1) to regulate: setbacks from water courses, construction and earth moving activity on slopes, impervious cover, and, earth moving plans.

(a) *Setbacks from Water Courses Within the Watershed.* There shall be no new impervious ground cover constructed or erected within 200 feet of the bank of a surface water body or within 50 feet of the center line of a swale within the Watershed

(b) ….

(c) *Impervious Coverage.*

(.1) *Basic Impervious Coverage.* No building, paving, street or other impervious ground cover shall be constructed or placed on any property within the Watershed in excess of the requirements of the following categories as designated on Map "B" cited in Paragraph (4)(c)(.4):

Category 1: There shall be no impervious ground coverage in excess of twenty (20) percent of the lot area or subdivision.

Category 2: There shall be no impervious ground coverage in excess of twenty-seven (27) percent of the lot area or subdivision.

Category 3: There shall be no impervious ground coverage in excess of thirty-five (35) percent of the lot area or subdivision.

Category 4: There shall be no impervious ground coverage in excess of forty-five (45) percent of the lot area or subdivision.

Category 5: There shall be no percentage limitation of impervious ground coverage on land deemed to be developed or otherwise disturbed from its natural state, provided that parcels in excess of one-half acre may be further developed only as follows:

(.a) The increased surface water runoff leaving the site shall not adversely affect adjacent property.

(.b) The method of handling runoff on the site shall be in accord with sound engineering practices and shall not significantly accelerate on-site erosion.

(.c) Such development shall not significantly diminish the infiltration capacity of the site.

Private Property Retrofit

As Chicago "greens" its alleys in the public right-of-way, it invites residents to participate in "greening" the City by retrofitting their properties through The Chicago Green Alley Handbook.

The handbook describes the environmental benefits of recycling, composting, planting trees, and using native landscaping. It also explains the benefits, costs and uses of rain gardens, rain barrels, permeable pavement and green roofs. The American Society of Landscape Architects gave the handbook a 2007 Communications Honor Award for its clear and user-friendly content and graphics.

As residents experience environmental improvements in their neighborhood, awareness increases. In addition, exposure to stormwater management increases the likelihood that residents will consider the use of other complementary practices such as rain barrels and rain gardens on their property.

Chicago Green Alley.
Photo: Chicago Department of Transportation

While Chicago has taken a "lead by example" approach to private property retrofits, Philadelphia requires limited imperviousness by way of local code. Property owners in the Wissahickon Watershed are required to meet impervious ground cover percentage maximums based on location. Since impervious cover includes buildings and pavement, the requirement acts as an incentive to reduce impervious cover through whatever means work best for the site. For example, a property owner may install permeable pavement if new paved surfaces are desired, or retrofit impermeable paved surfaces with permeable pavement in order to increase building size. The code allows for additional impervious coverage if stormwater is managed such that the infiltration capacity of the site is not diminished and runoff leaving the property does not have negative impacts off site. Because Philadelphia's impervious coverage regulation does not specify the manner of compliance, it leaves room for flexibility and creative solutions while achieving the desired environmental performance.

Philadelphia Code § 14-1603.2.(4)
Environmental Controls for the Wissahickon Watershed

(.1) …

(.2) *Additional Impervious Coverage.* Additional impervious coverage shall be permitted by the City Planning Commission, after review and comments by the Water Department and other appropriate City agencies according to the standards and regulations adopted by the Commission and the Water Department. Such standards and regulations shall assure that:

(.a) Storm water leaving the property shall be substantially similar in effect to that under the basic impervious coverage limitation.

(.b) Countermeasures shall not require excessive or significant maintenance.

(.c) Design of countermeasures shall take account of storm water runoff that enters the property from adjacent land.

(.d) The method of handling runoff on the site shall be in accord with sound engineering practices and shall not significantly accelerate on-site erosion.

(.e) Such development shall not significantly diminish the infiltration capacity of the site.

(.3) …

(.4) The map designated as "Impervious Coverage Categories" shall define the areas where the restrictions imposed under this Section shall apply and is made part of this ordinance (Map "B"). Where a parcel crosses category lines, each portion of the parcel shall be governed by the controls applicable to that portion.

Bioretention Retrofit Policy

Bioretention retrofit applications fit largely into two categories: those aimed at treating runoff from private property such as roofs and driveways, and those focused on treating runoff from the public right-of-way such as roadways. The policy approaches are different based on the constraints and opportunities of each. Policies governing public right-of-ways tend to be in the form of regulation and policies used for private property more often takes the form of incentives.

When implementing bioretention in the right-of-way, the constraint is most often space. The advantages are easy access and adequate authority. So while a narrow, linear space may be difficult to retrofit, a municipality usually has ample access, both physically and legally, to the property. Bioretention practices, such as rain gardens on private property usually have fewer space limitations. However, gaining access to build or maintain rain gardens on private property is a constraint.

Public Property Runoff Retrofit

Public Right-of-Way Retrofits

The Green Street Policy adopted in Portland, Oregon defines a "Green Street" as one that manages stormwater on site through the use of vegetated practices that provide water quality benefit and infiltration capacity. The policy requires that infrastructure projects incorporate these practices or be subject to an off-site project or off-site management fee requirement.[26]

Portland's Green Streets have been successful in many respects. The SW 12th Avenue retrofit project that introduced bioretention planter boxes into the landscaping strip between the sidewalk and the street, manages 180,000 gallons of runoff annually. The planters reduce the peak flow of a 25-year storm event by 70%.[27]. And at a cost of only $30,000 for the construction of the SW 12th Avenue bioretention planters, the project demonstrates a cost-effective solution. For these reasons, the American Society of Landscape Architects awarded the project the General Design Award of Honor as part of the 2006 Professional Awards.[28]

Portland Streetside Infiltration Planters.
Photo: Martina Frey.

Using Easements

Burnsville, Minnesota solved a similar problem of managing road runoff in a slightly different way. Lacking space in the right-of-way to implement bioretention practices, Burnsville launched a one month long public outreach campaign in an effort to get residents involved in the solution. Eighty-five percent of the residents agreed to participate in the rain garden retrofit project and allow the city to build rain gardens on the edge of their property to treat road runoff. The city obtained an $117,000 grant from the Metropolitan Council and contributed $30,000 of the City's funds to build the rain gardens. Each rain garden cost $7,500: $500 for plants, $8.00/square foot for construction, and $4.50/square foot for education, design and construction supervision. The City has easements to maintain the rain gardens, which have been successful at reducing runoff by 90%.[29]

City of Portland, Oregon
Green Streets Policy

Goal: City of Portland will promote and incorporate the use of green street facilities in public and private development.

City elected officials and staff will:

1. Infrastructure Projects in the Right of Way:
   a. Incorporate green street facilities into all City of Portland funded development, redevelopment or enhancement projects as required by the City's September 2004 (or updated) Stormwater Management Manual. Maintain these facilities according to the May 2006 (or updated) Green Streets Maintenance Policy.

      If a green street facility (infiltrating or flow through) is not incorporated into the Infrastructure Project, or only partial management is achieved, then an off site project or off site management fee will be required.

   b. Any City of Portland funded development, redevelopment, or enhancement project, that does not trigger the Stormwater Manual but requires a street opening permit or occurs in the right of way, shall pay into a "% for Green" Street fund. The amount shall be 1% of the construction costs for the project.
   c. …

   d. …

   e. Develop standards and incentives (such as financial and technical resources, or facilitated permit review) for Green Streets projects that can be permitted and implemented by the private sector. These standards and incentives should be designed to encourage incorporation of green street facilities into private development, redevelopment, and enhancement projects.

Findings

A "Green Street":

- Handles stormwater on site through use of vegetated facilities;
- Provides water quality benefits and replenishes groundwater (if an infiltration facility);
- Creates attractive streetscapes that enhance neighborhood livability by enhancing the pedestrian environment and introducing park-like elements into neighborhoods;
- Serves as an urban greenway segment that connects neighborhoods, parks, recreation facilities, schools, mainstreets, and wildlife habitats; and
- Meets broader community goals by providing pedestrian and where appropriate bicycle access.

Private Property Runoff Retrofit

Grant Program

In an effort to protect Lake Michigan and increase the number of rain gardens in Milwaukee County, the Milwaukee Metropolitan Sewerage District launched the Lake Michigan Rain Gardens Initiative. Grants are offered to property owners who are interested in planting their own rain garden. Grantees receive appropriate plants at a "two for one" discounted price. Applicants apply in January and, if awarded the grant, pick up their plants in June. An additional incentive is available for those who provide the total square footage of their roof, number of downspouts, and number of downspouts to be redirected. Their application is fast-tracked and they may be awarded early grant approval.[30]

This program not only encourages the creation of more rain gardens by reducing the cost to homeowners, but also provides a useful mechanism for tracking the size of rain gardens and the amount of impervious area that is disconnected within the watershed.

Excerpt from the Milwaukee Metropolitan Sewerage District
Rain Garden Grant Information

WHAT DOES THE GRANT PROVIDE?

Grants will be awarded in the form of plants for your rain garden. For every 2.5 inch plant purchased at $3.60, grantees will receive a second plant for free, about a 50% discount compared to retail prices. The number of plants required is typically one per square foot of rain garden installed.

EXAMPLE: the application is for a 10 x 10 foot rain garden, or 100 square feet. The number of plants needed is 100. The applicant orders 50 plants from GMF at a price of $3.60 each. The grantee receives 100 plants and pays $180.00.

There are no cash awards.

Costs for planning, design and construction of the rain garden are not grant eligible.

Voluntary Offset Program

The Mt. Airy Rain Catchers program is a pilot project administered by U.S. EPA as part of an effort to better understand the effectiveness of incentive programs. The objective of this voluntary offset program is to provide the largest benefit to the environment for the least amount of money spent. Participation in this unique program is voluntary and the offset (monetary compensation) received is determined by the individual property owner.

The pilot program is being conducted in the Shepherd Creek Watershed of Cincinnati, Ohio. Since residential roofs and driveways account for 50% to 72% of the total impervious area in the relevant subwatersheds, rain barrels and rain gardens are the desired solution.[31] Using an auction-based method, property owners place a bid for a rain garden or rain barrels to be installed on their property for free, and a dollar value they would like to be compensated for accepting these practices on their property. The bids are weighted according to cost, soils, and percent imperviousness of the site. Then the bids are ranked according to least cost and largest environmental benefit, and projects are awarded until available money is expended. In the summer of 2007, 50 rain gardens and 101 rain barrels were installed. They will be maintained for the property owner until 2010. Homeowners received an owner's manual and will continue to receive quarterly emails during the establishment phase explaining maintenance protocols. This helps the homeowners become familiar with the activities they will become responsible for in 2010.[32] The program also has a user-friendly web page that keeps residents up to date by providing seasonally appropriate information.

The program held a second auction in May 2008 followed by installation of the second phase of rain barrels and rain gardens. Most applicants did not request monetary compensation in exchange for theses practices being installed on their property.[33] The program has been successful in implementing rain barrels and rain gardens on private property at a low cost.

Excerpt from the Mt. Airy Rain Catchers Brochure
U.S. EPA is offering Mt. Airy homeowners a free rain garden and rain barrel!

U.S. EPA is sponsoring a limited number of rain gardens and rain barrels in the Mt. Airy neighborhood. Interested households must bid in an auction to receive them. Houses will be chosen based on **lowest bids** coupled with some environmental factors.

Bid forms will be coming in the mail next week. Send in bid-forms early! **Put in a low bid to increase your chances of receiving a free rain garden and/or rain barrel.** Winning households will receive their bid amount as a one-time payment after the installation is complete. U.S. EPA's contractor Tetra Tech, Inc., and its partner Horticultural Management, Inc., will **install** and **maintain** the gardens and barrels for three years.

This unique opportunity is a one-time offer only for Mt. Airy homeowners in the spring of 2007. During this summer and for the next three summers, U.S. EPA will monitor local streams for changes in runoff quantity and water quality resulting from the combined effects of individual rain gardens and rain barrels.

Visit the model rain garden planted at the bottom

Green Lot Retrofit Policy

Part of the difficulty in implementing green infrastructure practices in dense urban environments is finding the space and having the influence to make changes in a static built environment. One way around this dilemma is the conversion of vacant lots into "Green Lots." Green Lots are vacant or abandoned lots that have had debris and paved surfaces removed and vegetation and trees added to deliver economic, social, and environmental benefits.

Vacant lots can attract dumping, harbor toxic chemicals, depress property values, and attract criminal activity.[34] In contrast, Green Lots can increase property values, reduce urban heat island effect, improve air quality, provide habitat for small wildlife, increase infiltration, and recharge groundwater.

Vacant Lot Stabilization

Philadelphia began the process of vacant lot transformation in 1995 when the Pennsylvania Horticultural Society (PHS) partnered with the New Kensington Community Development Corporation to address the 1,100 parcels of abandoned land in the New Kensington neighborhood. The strategies included stabilizing vacant lots with grass, trees, and wood fencing; creating community gardens; planting trees; renovating parks; and transferring vacant lots to adjacent homeowners for private use. Funded by the City's Office of Housing and Community Development, with support from the Pew Charitable trusts and the William Penn Foundation, from 1995 through 2002, 480 new trees were planted, 145 side yards were settled, 217 lots were stabilized, and 15 community gardens were created.[35]

While the intangible benefits can often be hard to quantify, a study done by the Wharton School of the University of Pennsylvania evaluated the economic value of Philadelphia's Green Lot pilot project in New Kensington. *The Determinants of Neighborhood Transformation in Philadelphia: Identification and Analysis—The New Kensington Pilot Study* by Professor Susan Wachter found that Green Lots increased adjacent property values by as much as 30%. Tree plantings increased the collective value of property in the community by $4 million and lot improvements by $12 million. In addition,

Excerpt from the Vacant Land Management Pennsylvania Horticultural Society

There are two basic ways in which the City contracts with Philadelphia Green to revitalize vacant spaces. The first is known as the *Vacant Land Stabilization Program.* Philadelphia Green begins stabilization by cleaning and mowing the grounds, laying topsoil, planting seeds, and adorning the area with new trees and fencing. In the past six years, nearly 4 million square feet of land have undergone this treatment and continue to receive care.

The second approach is a project called *Community LandCare*, in which vacant land receives routine cleaning and mowing, but isn't refurbished with topsoil, trees, or fencing. Nine community groups oversee the maintenance of vacant land in 16 Philadelphia neighborhoods. Currently 4 million square feet are regularly cleaned through this program.

the more desirable the neighborhood becomes, the more people will move in to the community, providing a higher tax base for the City.[36]

Concerns about how to keep the lots clean remained after the initial effort to transform vacant properties into Green Lots. A maintenance program was established by hiring and training community residents. This not only provides local jobs, but also provides informal community education as employees tell neighbors about their work.

Excerpt from the article "Seeing Green: Study Finds Greening is a Good Investment" on the Pennsylvania Horticultural Society webpage (taken July 7, 2008)

Key Findings of the Wharton School Study

- Cleaning and greening of vacant lots can increase adjacent property values by as much as 30%.
- Planting a tree within 50 feet of a house can increase its value by about 9%.
- Location of a house within 1/4 mile from a park increased values by 10%.
- Neighborhood blocks with higher concentrations of unmanaged vacant lots displayed lower house prices, about 18%.

Before and after conditions of a lot in Philadelphia treated under the Vacant Land Stabilization program.
Photo: Cooperative Conservation America.

Before: Lot at 2300 North 3rd Street Green Lot, Philadelphia, PA.
Photo: The Pennsylvania Horticultural Society

After: Lot at 2300 North 3rd Street Green Lot, Philadelphia, PA.
Photo: The Pennsylvania Horticultural Society

Stormwater Offsets

The Maryland Chesapeake and Atlantic Coastal Bays Critical Area 10% Rule Guidance Manual allows abandoned lots to be converted to Green Lots, and set aside in perpetuity as mitigation for development projects elsewhere in the watershed that can not treat their stormwater on site. The Manual defines an offset as "structures or actions that compensate for undesirable impacts"[37] and lists four options, one of which is reducing the imperviousness of an existing property. This means that as compensation for adding impervious area elsewhere in the watershed, an abandoned lot can be restored to a Green Lot by removing impermeable pavement and revegetating the site, returning it to its natural hydrologic function within the watershed. The Green Lot remains a permanent open space. Green Lots provide a creative way to use abandoned properties to restore infiltration rates in the watershed and address urban runoff quantity and quality.

Excerpt from the Maryland Chesapeake and Atlantic Coastal Bays Critical Area 10% Rule Guidance Manual Option 4: Reducing the Imperviousness of an Existing Property

Some older waterfront areas are so intensely developed that there is no available land for most offset options. As an alternative, these jurisdictions may consider the option of reducing or eliminating impervious cover on publicly or privately owned lands. Some jurisdictions have acquired tax-delinquent properties within the Critical Area. These abandon properties may be purchased by a developer seeking an offset and can be subsequently converted to vegetated open space and maintained in a perpetual easement. Developers also have the option of purchasing private land for this purpose.

Conclusions and Recommendations

Regardless of whether a community expects high rates of growth in the future or very little growth, existing development and its impervious surfaces will continue to dominate water quality and quantity problems in urban areas. Just as green infrastructure approaches should be pivotal components of all new and redevelopment, policies that focus on retrofitting the built environment with green infrastructure should be a major element in any community's plans for addressing urban stormwater challenges.

Because green infrastructure provides benefits in many arenas, such as climate change, air quality, water quality and quantity, urban heat island effect reduction, and energy conservation, creative solutions can be found through cross-disciplinary partnerships. As organizations with different focuses come together to resolve their concerns through a common solution, funding and other resources can be leveraged to accomplish multiple goals.

Two common themes seem to arise from successful green infrastructure retrofit policy: removing obstacles and creating incentives. As demonstrated by the examples discussed in this paper, when selecting a retrofit policy option, the first step involves determining the most significant barriers to implementation and using an incentive program, a compliance assistance program, or regulation to target and overcome that obstacle.

Overcoming Green Infrastructure Retrofit Obstacles

1. Determine the actual, local obstacles to green infrastructure implementation.

There can be perceived obstacles and/or real obstacles. Obstacles may be common to many locations or specific to a particular location. Consequently, taking the time to accurately identify the biggest local obstacle to implementation will give credibility to an incentive or compliance assistance program when seeking approval or funding since the likelihood of success will be greater. (See "Determining Green Infrastructure Retrofit Goals")

2. Determine what will bridge the gap.

Once the biggest obstacle is known, a creative solution to fill the gap between the current rate of installation and the desired rate of installation can be invented. (See "Steps to Creating a Successful Green Infrastructure Retrofit Policy")

3. Establish funding sources for the incentive or compliance assistance program.

Since Green Infrastructure helps achieve many environmental, social and economic objectives, there are diverse funding options that may be possible. Some include:

- Stormwater Utility Fees
- Sanitary Sewer Fees (where the program addresses CSOs)
- Flood Control District funds
- Grants
- Energy Companies (where the green infrastructure practice reduces energy demand)

4. Conduct a pilot test.

Obstacles can only be overcome by an incentive program if the program is targeting the right obstacle and to the right degree. For this reason, a short term pilot that implements the incentive in a limited area or to a limited audience for a limited amount of time, helps determine if the incentive program is worthy of more funding or if it needs to be modified to accomplish the environmental goals.

5. Assess the success of the incentive or compliance assistance program.

The use of the pilot program should be measured to determine if the rate of green infrastructure installation is increasing to the level necessary to meet the environmental or watershed goals.

6. Modify, continue, or expand.

After the pilot period, based on the results of the use of the implementation program, either the incentive program may need to be modified to better fill the implementation gap, continued because it is successful, or expanded to cover an even broader audience or wider area of application.

Retrofit policies can gain greater community support when they directly address local needs or concerns. For example, if water supply is a local concern, the infiltration capacity of green infrastructure practices to recharge groundwater and/or the benefits of rainwater harvesting in conserving potable water sources should be emphasized. If energy costs are a local concern, energy savings associated with green roofs should be clearly communicated.

To date, green infrastructure retrofit policies have largely been driven by municipalities' immediate regulatory concerns with CSOs and stormwater runoff. However, future programs to encourage retrofits should capitalize more fully on the multiple benefits provided by green infrastructure. Chicago's Energy Conservation Code is a good example of this approach. By granting an exception for green roofs from the reflectance and urban heat island provisions, the City is simultaneously encouraging broader adoption of green roofs and recognizing the multiple benefits they provide.

In addition to water quality problems, municipalities will be increasingly challenged by sustainably managing infrastructure and addressing potential impacts of climate change. More than 700 mayors have signed on to the Mayors Climate Protection Agreement with the goal of a local 7% reduction in carbon dioxide emissions compared to 1990 levels. That goal, coupled with multi-billion dollar infrastructure

needs, creates a challenging environment in which to craft policy. Future policies should look beyond the compartmentalization of traditional media and establish criteria for urban sustainability.

Green infrastructure implementation can be encouraged by establishing codes and regulations that mandate reductions in both energy usage and discharges of stormwater. This integrated approach would lead to a more comprehensive system of environmental management but would also require coordination across departments to facilitate funding and compliance assurance. This approach would also more fully establish a policy framework that recognizes the relationship between water conveyance and treatment, energy, and climate.

Setting Green Infrastructure Retrofit Goals

1. Identify watershed goals.

Identifying the watershed goals that green infrastructure will be used to meet helps determine which practices to use and how many will need to be implemented in order to achieve the environmental goals. This ensures that the green infrastructure retrofit policy being created is focused on real environmental improvement, from the outset. Watershed goals can include obtaining a particular level of:

- Volume reduction
- Pollutant load reduction
- Reduced flooding
- Groundwater recharge
- Water supply/ reduced energy demand

2. Identify applicable green infrastructure practices.

Land use is a critical criterion for selecting appropriate practices. Some green infrastructure practices are better suited for urban application, and some are more appropriate for rural use. Also, some are better at removing certain pollutants than others, and some allow for infiltration, whereas others don't. A particular green infrastructure practice, or combination of practices, can be selected depending upon the goals and application conditions.

3. Determine the level of implementation that will meet the watershed goals.

Once the most applicable green infrastructure practices have been selected, the degree of implementation that will accomplish the environmental goals should be determined. For example, how many square feet of green roofs need to be installed to accomplish the volume reduction necessary to protect the receiving water? Or, how many square feet of bioretention practices are needed in order to maintain natural groundwater aquifer levels?

4. Measure goal attainment.

The most important measure of green infrastructure retrofit success is evidence of beneficial impacts in the environment (e.g., healthy groundwater aquifers, healthy stream habitat, or reduced pollutant levels in receiving waters). A method to measure environmental improvement should be a part of a green infrastructure retrofit effort. If a green infrastructure retrofit incentive program or regulation is not resulting in measurable environmental improvement, the program and/or regulation should be reevaluated and modified to better achieve the watershed goals. In addition, it is useful to compile the number of green infrastructure practices installed or number of square feet of functioning green infrastructure practices in order to determine the effectiveness of the retrofit incentive program or regulation at increasing the number. However, success in implementing green infrastructure practices should not be mistaken for the importance of confirming the achievement of watershed goals.

Policies should also make use of the economic advantages that green infrastructure provides. Simultaneously addressing several environmental requirements with one program uses municipal resources more efficiently; reducing the burden on infrastructure can limit additional capital investments. These savings can be incorporated into incentive programs. Tax abatements have been used to encourage development in economically distressed urban areas. This concept could also be applied to green redevelopment efforts. A predetermined period of tax abatement could be provided to projects that meet certain green infrastructure requirements. The reductions in tax revenue from this type of policy can be justified by the decreased demand on municipal services provided by green infrastructure.

Each jurisdiction has its own set of unique challenges and opportunities, and successful green infrastructure retrofit policies capitalize on those opportunities to develop creative and sustainable solutions.

Steps to Creating a Successful Green Infrastructure Retrofit Policy

1. Establish the local green infrastructure objectives.

Determine which green infrastructure practices should be implemented, and to what extent, in order to meet local watershed goals for stream health. (See "Setting Green Infrastructure Retrofit Goals")

2. Identify the biggest implementation obstacle.

There is often more than one obstacle to implementation. However, by targeting the most prevalent obstacle, the largest audience is reached. Taking the time to understand the real, local obstacle is important as each community has different perceptions about green infrastructure and different levels of available resources, such as funding, technical expertise, and local contractors. (See "Overcoming Green Infrastructure Retrofit Obstacles")

3. Target the biggest implementation obstacle with an incentive or compliance assistance program.

Create an incentive program that targets the biggest obstacle to implementation. Where the biggest obstacle is initial investment, the incentive program should provide money for installation costs. Where the biggest obstacle is technical knowledge, providing technical expertise would be an appropriate incentive. Operating the incentive program Years 1 through 3 allows time for the program to be publicized, and modifications to be made if the incentives aren't effective, and also provides enough time for people to take advantage of the incentives before the regulation takes effect.

4. Check local regulations or ordinances for internal obstacles.

Before launching an incentive program or a compliance assistance program, local regulations and ordinances may need to be modified to allow compliance. For example, if the incentive program involves disconnecting downspouts and under the current requirements a permit is needed to do the work, a solution such as creating a waiver and/or eliminating the permit fee may help the incentive program operate as intended.

5. Create regulations that become effective at a future date.

Creating regulations that go into effect in Year 5 provides the ultimate incentive to take advantage of the opportunities for early implementation.

6. Publicize the incentive or compliance assistance program and regulation.

Use targeted outreach, as well as press releases, to ensure that the regulations, and the incentive program that helps people meet the regulations, is known and utilized by a broad audience. Targeted outreach helps reach those most likely to utilize the incentive program. For example, giving a presentation about a rain garden incentive program to Garden Club members who are likely to be interested in utilizing gardens for rainwater treatment can help jump start the program so that it can spread by word of mouth. Other mechanisms, such a press releases that may result in newspaper articles, communicate the purpose and benefits of the program and regulations to a wider audience and increase awareness about program and future requirements.

7. Monitor the success of the incentive or compliance assistance program, and modify if necessary.

A true incentive program provides an actual "incentive" to implement the green infrastructure practice. If an incentive program is underutilized, either the "incentive" is not enough, or not enough people are aware of the program. After a year of implementing the incentive program, the success of the program should be evaluated. If the program goals have not been met, the incentive program should be modified to better meet the program goals in Year 2.

Where to Start (or Starting on Public Property)

Starting green infrastructure retrofitting on public property such as community centers, public parking lots, plazas, schools, City Hall, public libraries, public roads and sidewalks can provide benefits, including:

1. The public develops familiarity with green infrastructure practices.

By implementing green infrastructure practices in the public realm, members of the community have an opportunity to come in contact with them, perhaps frequently, and even learn about the practices from educational signs. Public areas provide high visibility locations for green infrastructure applications. As the public is exposed to these practices and can witness them functioning through out the changing seasons, they become more familiar and more comfortable with the practices.

2. The private sector can monitor success of green infrastructure applications.

Individuals or organizations interested in installing green infrastructure practices on their property, but unsure of its level of effectiveness or maintenance needs can observe or inquire about applications they see installed on public space.

3. Costs decrease as a local market for green infrastructure is created.

As more and more green infrastructure practices are installed, efficiencies and improvements to the process bring cost savings and often a better product. For example, as Chicago DOT utilized more porous concrete, the price decreased making it a more viable alternative for private property owners to install.

4. Growing local supplies and local business.

As the public sector invests in green infrastructure, it is investing in local, green businesses. This allows those businesses to grow and provide an even better product with more experienced installers.

5. Giving the municipality first hand experience with design, construction, and maintenance before requiring it of others.

As municipalities begin to require green infrastructure practices in their jurisdictions, property owners will ask questions about design, construction, and maintenance related to local climate, soil types, local suppliers and labor, and other local or regional variables. If the municipality has green infrastructure applications that they own, operate, and maintain, they will be able to answer questions and help private property owners to successfully implement green infrastructure approaches.

6. Easy access for monitoring and tours.

Public property applications of green infrastructure practices are easily accessible to the public for monitoring by students or tours by those interested in implementing something similar in their community or on their property.

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