REGIONAL AND MUNICIPAL STORMWATER MANAGEMENT: A COMPREHENSIVE APPROACH

HARVARD LAW SCHOOL
Emmett Environmental Law & Policy Clinic
and the Environmental Policy Initiative

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The Emmett Environmental Law and Policy Clinic at Harvard Law School is directed by Wendy B. Jacobs and is dedicated to addressing major environmental issues in the United States and abroad and to providing its students an opportunity to do meaningful, hands-on environmental legal and policy work. Students and clinic staff work on issues such as climate change, pollution reduction, water protection, and smart growth.

The Environmental Policy Initiative at Harvard Law School is directed by Kate Konschnik and applies rigorous legal inquiry and creative problem solving to today's environmental challenges. It provides independent analysis of tough legal questions and targeted policy recommendations to decision-makers at all levels of government.

Cover Image: Photo of the 3.4 acre Alewife Constructed Wetland which was completed on October 15, 2013, *available at* the Massachusetts Water Resources Authority (MWRA) website, http://www.mwra.com/01news/2013/101513-eea-wetland-cambridge.html.

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EXECUTIVE SUMMARY

This report analyzes options for addressing stormwater pollution at both the regional and municipal level. After exploring the problem of stormwater pollution and the existing legal framework for addressing it, we recommend that municipalities adopt green infrastructure as a stormwater pollution reduction strategy. Based on our research into five Massachusetts municipalities, we present exemplary code provisions that best encourage local green infrastructure development.

In addition, we recommend that municipalities consider addressing stormwater pollution in a more comprehensive manner through participation in a regional program. Of the numerous options for regionalizing stormwater management, we recommend a hybrid approach that collects a fee for basic maintenance/installation costs and sets up a cap and trade system. The hybrid system combines the benefits of a cap and trade program with the funding sources of a fee program, helps to ensure the goal of decreased stormwater pollution in a comprehensive and cost-effective manner, and best deals with the differences in legal codes between municipalities. By accounting for differences in municipalities, a hybrid approach allows for growth by making it easier to add new municipalities and large property owners to the program.

PART I: INTRODUCTION

A. Overview of Federal Stormwater Regulation

Stormwater runoff is a significant source of water pollution in the United States. In the most recent National Water Quality Inventory, states reported that stormwater pollution has impaired more than 22,559 miles of rivers, 701,024 acres of lakes, and 867 square miles of estuaries.[1] As stormwater travels over land, it picks up pollutants and deposits them into nearby bodies of water. Some pollution flows directly into rivers, lakes, and estuaries, while other pollution flows indirectly to water bodies through storm drains, culverts, pipes, and other point sources of pollution. The problem is exacerbated by the destruction of wetlands, heavy application of road salts and fertilizers, and the conversion of open space to impervious surfaces such as roads, parking lots, and buildings.[2]

Amendments made to the Clean Water Act in 1987 provide the current legal framework for federal stormwater regulation. Section 402(p) of the amended Clean Water Act requires EPA to establish permitting requirements for certain stormwater discharges.[3] The statutory language focuses largely on discharges from industrial and municipal separate storm sewer systems. EPA has permitted these point sources in two phases: Phase I required National Pollutant Discharge Elimination System (NPDES) permits for stormwater discharges from large and medium municipal separate storm sewer systems (MS4s) serving populations of over 100,000.[4] Phase II required NPDES permits for "small" MS4s serving urbanized populations of fewer than 100,000.[5]

In 2010, EPA Region 1 issued a draft Massachusetts North Coastal Small MS4 permit designed to cover all urbanized areas within this region.[6] (EPA's New England office has also issued draft general permits for small MS4s in the Interstate, Merrimack, and South Coastal region of Massachusetts, and for New Hampshire.) If finalized, the permit would require each small MS4 in the

1 EPA, *National Water Quality Inventory: Report to Congress, 2004 Reporting Cycle*, at 16, 19, and 23 (2009).

2 EPA, *Causal Analysis/Diagnosis Decision Information System Vol. 2: Sources Stressors & Responses, What is Urbanization?*, http://perma.cc/8SV7-VDBG.

3 33 U.S.C. § 1342(p).

4 *National Pollutant Discharge Elimination System Permit Application Regulations for Storm Water Discharges; Final Rule*, 55 Fed. Reg. 47,990 (Nov. 16, 1990).

5 *National Pollutant Discharge Elimination System – Regulations for the Revision of the Water Pollution Control Program Addressing Stormwater Discharges*, 64 Fed. Reg. 68,781 (Dec. 8, 1999).

6 General Permits for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems in Massachusetts North Coastal Watersheds, Authorization to Discharge under the National Pollutant Discharge Elimination System, *available at* http://perma.cc/6UST-ARR6.

North Coastal region to develop a Stormwater Management Plan[7] and meet discharge goals so as not to cause or contribute to an exceedance of water quality standards for the receiving waters. Further, small MS4s discharging into some rivers would have to implement control plans to meet phosphorous and pathogen Total Maximum Daily Load (TDML) limits. For instance, towns in the upper Charles River watershed such as Milford, Franklin, and Bellingham would need to reduce their discharges of one or both pollutants.[8]

In addition to regulating industrial and municipal discharges, section 402(p)(2)(E) also provides that a state—or the EPA Regional Administrator, if, like Massachusetts, the state does not have an approved permit program—can designate additional, or "residual," stormwater discharges for NPDES permitting. Residual designations may be made when "storm water controls are needed for the discharge based on wasteload allocations that are part of 'total maximum daily loads' (TMDLs) that address the pollutant(s) of concern," or where "the discharge, or category of discharges within a geographic area, contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States."[9]

In 2008, EPA Region 1 issued a preliminary Residual Designation (RD) for water quality problems in the upper Charles River.[10] The Charles River starts in Hopkinton, Massachusetts, and flows through Milford, Franklin, and Bellingham before flowing north through Cambridge, Boston, and into Boston Harbor. By addressing stormwater pollution from large property owners near the headwaters of the Charles River, EPA aims to stop the contamination from stormwater runoff in these upstream towns before it has a chance to travel the length of the river.

Based on the RD, EPA issued a draft general permit covering owners of two or more acres of impervious surface who discharge stormwater directly into the upper Charles River or indirectly through the MS4s of Milford, Franklin, or Bellingham.[11] Some properties are excluded, such as sporting and recreational camps and detached single-family homes located on individual lots.[12] The draft general RD permit would authorize all covered owners of large impervious surfaces to

7 *Id.* at 10.

8 *Id.* at 13.

9 40 C.F.R. § 122.26(a)(9)(i)(C), (D).

10 EPA Region 1, *Residual Designation Pursuant to Clean Water Act: Region I* (Nov. 12, 2008), *available at* http://perma.cc/S9EN-664C.

11 General Permit for Designated Discharges in the Charles River Watershed within the Municipalities of Milford, Bellingham, and Franklin, Massachusetts, Authorization to Discharge under the National Pollutant Discharge Elimination System, *available at* http://perma.cc/GZA5-34NN.

12 *Id.* at 3-4.

discharge only on the conditions that they implement a stormwater management plan[13] and reduce the phosphorous load of their stormwater by 65% before discharging. Property owners could opt to achieve this load reduction target either by implementing onsite Best Management Practices (BMPs) or by "participating in a Certified Municipal Phosphorous Program."[14] EPA would require that each property owner submit an Annual Certification of Compliance to the federal agency.[15] EPA could require additional documentation to be submitted in support of the certification.[16]

B. Summary of Recommendations

This paper recommends ideas municipalities and large impervious surface owners within their borders can adopt to comply with federal stormwater discharge permit requirements in the draft MS4 and draft RD permits. The recommendations fall under two broad categories: promotion of GI and participation in a regionalized stormwater management system. Part II explains why promotion of GI would be an effective way for the municipalities and their large impervious surface owners to reduce stormwater discharges. It also identifies existing legal and non-legal barriers to GI implementation and discusses what actions municipalities can take to eliminate those barriers. Part III reviews possible designs for a regionalized stormwater management system that municipalities could use to address the problem of stormwater pollution collaboratively across municipalities and with the large impervious surface owners within their borders. We recommend a hybrid approach to stormwater management that incorporates features of both a stormwater fee system and a cap and trade system. In addition to incentivizing landowners to reduce stormwater discharges, the proposed hybrid system has the potential to generate revenue that the municipalities can use to fund the implementation of the GI strategies discussed in Part II.

13 *Id.* at 6-10.

14 *Id.* at 10.

15 *Id.* at 12-14.

16 *Id.* at 6, 9.

PART II: PROMOTION OF GREEN INFRASTRUCTURE

A. Green Infrastructure and its Advantages

For the last 100 years, New England communities have relied on conventional or "grey" infrastructure (pipes, pumps, tunnels, storage basins, treatment plants, etc.) to manage stormwater.[17] However, grey infrastructure has largely failed to provide cost-effective solutions to the persistent problem of stormwater discharges. Aging infrastructure and increased runoff rates that result from development cause many existing grey infrastructure systems to be overwhelmed by heavy precipitation.[18] Many municipalities face expensive overhauls to meet existing and upcoming Clean Water Act requirements. Consequently, many governments have begun to consider GI as an alternative method for addressing urban water pollution issues.[19]

GI refers to natural, designed, or engineered systems "that use soil and vegetation to capture water, reduce ambient temperatures, and otherwise protect and enhance both environmental quality and public health."[20] Urban GI uses "trees, rain gardens, vegetated swales, pocket wetlands, constructed wetlands, open space, urban agriculture and farming, and vegetated median strips—essentially soil and vegetation incorporated into the urban landscape—and engineering techniques which foster such incorporation such as green roofs, tree boxes, infiltration planters, and permeable pavement."[21] Rain barrels and cisterns, which capture and reuse rainfall, complement landscaped GI approaches.[22] Together, these methods treat stormwater not as waste, but as a resource.[23] Sited correctly and maintained appropriately, GI can divert water from the sewer system and allow stormwater to be absorbed and filtered before entering bodies of water.[24] "Low impact development" (or LID) is a site planning process used to identify the appropriate type of GI for the particular site and circumstances.[25]

17 Clean Water American Alliance, *Barriers and Gateways to Green Infrastructure* 2 (2011) [hereinafter *Barriers and Gateways*].

18 *See, e.g.*, Jenny Caldwell et al., *Supporting Green Infrastructure* at i-ii (2012).

19 *Id.*

20 Alexandra D. Dunn, *Siting Green Infrastructure: Legal and Policy Solutions to Alleviate Urban Poverty and Promote Healthy Communities*, 37 B.C. Envtl. Aff. L. Rev. 41, 43 (2010).

21 *Id.* at 43-44.

22 *Id.* at 46.

23 Karen M. Hansen, *Green Infrastructure and the Law*, Planning & Envtl. L., Aug. 2013, at 43; *Barriers and Gateways*, *supra* note 17, at 2.

24 *Barriers and Gateways*, *supra* note 17, at 2.

25 *See, e.g.*, Massachusetts Executive Office of Energy & Envtl. Affairs, Smart Growth/Smart Energy Toolkit:

GI has been shown to provide social, economic, and environmental benefits to communities.[26] For example, GI helps municipalities adapt to climate change "by moderating the impacts of extreme precipitation and temperature;" reduces incidents of combined storm and sewer overflows; captures and conserves water; prevents flooding; improves human health; lowers energy demand and expense; creates recreational spaces; and even enhances property values, among other benefits.[27] Despite the numerous benefits of GI, a number of obstacles create barriers to its wide-spread implementation.

B. Overcoming Common Barriers to Green Infrastructure

Municipalities can play an important role in promoting GI, but their laws may also impede GI development. On the one hand, favorable municipal code provisions may remove obstacles to GI by providing more certainty to the development community and steering the siting of GI to appropriate places. On the other hand, municipal rules can hinder GI implementation by their silence on the issue, or if they can be read so as to conflict or restrict GI measures.[28]

We examined the codes of five Massachusetts municipalities—Springfield, Cambridge, Milford, Bellingham, and Franklin—to identify common legal barriers to the implementation of GI. We also analyzed these municipalities' ordinances and bylaws to extract provisions that provide model examples of ways a municipal code can incentivize GI implementation. In addition, we consulted local officials, engineers, and architects in these municipalities to identify the most common non-legal issues they have confronted when implementing GI designs, and we have attempted to identify what municipalities can do to remove those barriers.

Our recommendations center around three key ways in which municipalities may encourage local GI development: 1) provide site-specific flexibility to maximize the potential of GI; 2) provide clarity to the development community; and 3) educate developers and public officials about the benefits of GI. The remainder of this section discusses specific ways that municipalities can engage in these "GI friendly" actions to overcome common legal and non-legal barriers to GI.

1) Common Legal Barriers

Although we found few insurmountable legal barriers to the implementation of GI in the five municipalities studied, there is potential for improvement in the following areas:

Low Impact Development, http://perma.cc/QK48-QNBC.

26 *Barriers and Gateways*, *supra* note 17, at 2.

27 *Id.* at 8.

28 *See id.* at 19.

Municipal code requirements that disfavor green infrastructure – parking lots and tree protection

Many municipal codes contain mandates that disfavor GI. A prime example is excessive parking space and lot size requirements, which can create more impervious surface area than necessary.[29] Paved surfaces that inhibit percolation of stormwater can lead to increased stormwater runoff and greater volumes of pollution into area surface waters. The Metropolitan Area Planning Council, a regional planning commission for the greater Boston area, recommends 3 parking spaces per 1,000 sq. ft. in its Low Impact Development (LID) guidelines.[30] Milford, Bellingham, and Franklin all currently require more off-site parking spaces than this target.

The codes in these municipalities could also adopt the parking lot size set forth in the LID guidelines, to reduce runoff. Alternatively, and perhaps more easily, the municipalities could adopt a code provision similar to Springfield's § 7.1.32, which allows for parking lot size requirements to be reduced based upon a consideration of various factors and an evaluation of the site. Springfield's code provision does not include stormwater management in its non-exhaustive list of factors; however, a code that explicitly references stormwater discharge as a consideration could alert developers and municipal agencies to the importance of stormwater management.

Municipal codes can also reduce impervious pavement for parking lots in other ways. First, the codes could reduce the size of some of the parking spaces. For example, Bellingham's Zoning By-Laws reserve 10% of the spaces in large lots for small cars or motorcycles in order to "reduce overall impervious surface." Second, municipalities could follow Bellingham's lead and expressly encourage "permeable or porous paving" in large parking lots. Provisions such as these provide clarity to developers who can be certain that municipal officials and permitting authorities will look favorably on the use of permeable paving. A developer could include the language from this provision directly in a permit application, ensuring that permeable pavement has a normal or even privileged status during the permitting process and preventing proposed use of this new technology from causing delay or confusion.

Third, municipal code provisions relating to parking lot landscaping requirements can encourage GI development by incorporating permeable "rain friendly" features into a parking area. Milford's Zoning By-Laws, for instance, contain a provision that requires landscaping in parking areas and mandates that a substantial portion of the landscaped area be pervious in order to allow for

29 Metropolitan Area Planning Council, *Fact Sheet: Roadways and Parking Lot Design*, http://perma.cc/JE88-YXE3.

30 Metropolitan Area Planning Council, *Massachusetts Low Impact Development Toolkit*, *available at* http://perma.cc/LR7U-4GHU.

stormwater infiltration. For more on these municipal codes and recommended revisions that would further promote stormwater management, see **Appendix A, Section I**.

Another important example of municipal code provisions that may hinder GI development are strict tree protection bylaws. These rules can hamper certain GI projects, such as construction of swales or rain gardens, which require tree removal to construct and operate effectively. The tree protection provisions in Cambridge's zoning code illustrate how municipalities can safeguard their communities' tree populations while still encouraging the implementation of GI. Cambridge's Tree Protection Ordinance, established in 2004, institutes a tree replacement plan that requires a developer removing trees of certain dimensions to replace the tree or pay into the Tree Replacement Fund.[31] Most developers choose a mixed solution, replacing some trees and paying a fee into the Tree Replacement Fund for the others. According to engineers who have worked or lived in the City, the tree protection provisions do not pose a barrier to GI implementation because the code contains sufficient flexibility and developers can often incorporate trees into their GI designs.

For more on Cambridge's Tree Protection Ordinance, see **Appendix A, Section II**.

Unwieldy permitting processes

Unwieldy municipal permitting processes can also deter new GI development. In many municipalities, the requirement that developers seek multiple permits from multiple public agencies can slow down new development and cause continued reliance on outdated grey infrastructure. Obtaining a permit for new development may become even more difficult when the project requires a zone change or a variance or special permit for a particular zone. Lack of coordination in municipal permitting processes can slow down the implementation of GI projects. Municipalities can alleviate these burdens by implementing "one-stop shopping," through which developers receive all necessary permits for a project from one public agency.[32] The state could also offer streamlined permitting, for instance by modeling a new program after Massachusetts' streamlined permitting process for low-income and affordable housing.[33]

Reforming permitting processes, however, should not merely be about removing obstruction. Rather, the permitting process can also serve as an opportunity to promote GI. In many municipal

31 Cambridge Health and Safety Ordinance § 8.66.030.

32 Interview with Chris Cignoli, City Engineer, Springfield MA (Nov. 12, 2013). Cignoli identified the "one-stop" nature of Springfield's permitting as one of the most important ways that Springfield has managed to keep the permitting process for GI projects streamlined and efficient for developers.

33 M.G.L. c. 40B, § 21.

governments, Public Works—the department tasked with encouraging BMPs—can play a central role in this promotion. However, in many communities, Public Works is bypassed in the development process. As a result, many municipalities design and approve projects before BMPs are even considered.[34] An improved permitting process might task a single public agency with approving permits and taking affirmative measures to implement BMPs. For example, Springfield has successfully imposed a site plan review requirement as part of the permitting process, in which the City Engineer educates developers about opportunities to incorporate cost-neutral or cost-saving GI projects into their site plan.[35]

For more on Springfield's interesting code language and its success in educating developers about the benefits and possibilities of GI, see **Appendix A, Section III**.

Inflexible procurement codes

When municipalities in Massachusetts purchase materials or supplies worth less than $5,000, municipal procurement rules and procedures apply.[36] The City of Cambridge has established local rules that encourage the purchase of environmentally friendly products where it is feasible and cost-effective.[37] Municipalities aiming to encourage GI development should revise their local procurement rules to follow that model.

However, above the $5,000 threshold, a state-wide procurement code imposes a strict requirement that municipalities award contracts to the lowest bidder. Because there is a perception (often incorrect) that grey infrastructure is cheaper at the outset than GI,[38] this policy can be challenging for municipalities wishing to implement GI projects.[39] To enable GI bids to prevail, a municipality may need to specify that to qualify for a project, the bid must include GI.

34 *Barriers and Gateways*, *supra* note 17, at 20. Cambridge is an exception; there, developers often meet and consult with the DPW before finalizing their project plans.

35 Interview with Chris Cignoli, *supra* note 32.

36 *See* Gregory W. Sullivan, Mass. Inspector General, *The Chapter 30B Manual,* 5, 71 (2011), *available at* http://perma.cc/YAD6-HESJ.

37 Memo from Cynthia Griffin, Purchasing Agent, City of Cambridge, to Department Heads, Re: Local/Small Businesses Purchases Under $5000 Environmentally Preferable Procurement Practices (May 16, 2012).

38 Particularly in new developments, the benefits of green infrastructure often outweigh its cost and make it a more economic choice than using only grey infrastructure. *See, e.g.*, R.M. Roseen, et al., *Economic and Adaptation Benefits of Low Impact Development,* Conference Proceedings, 2011 Low Impact Development Symposium, March 2012, *available at* http://perma.cc/T3WA-2NXV.

39 *Barriers and Gateways*, *supra* note 17, at 23.

2) Common Non-legal Barriers

We also identified several non-legal barriers to GI implementation, and ways that municipalities can help overcome them. These barriers include:

Cost uncertainty

It is often presumed that GI is more costly than grey infrastructure.[40] This presumption is tied to a number of facts. First, many municipalities lack the funding—or their departments have difficulty coordinating funds for—GI projects.[41] Second, there is currently "[n]ot enough data about upfront and ongoing maintenance costs and economic benefits" of GI.[42] This uncertainty drives the perception that GI projects entail higher cost than does grey infrastructure.[43] In some of the municipalities analyzed, one local agency would agree to provide the upfront cost for a GI project, but refuse to pay for its maintenance. When other local departments also refused to cover the maintenance costs, the projects failed to materialize.

Municipalities across the country have begun to conduct studies aimed at combating the perception that GI is costlier than grey infrastructure. Some of these studies incorporate benefits that have already been assigned a market value. For example, Alachua County, Florida used data provided by its local property assessor to calculate the impact of new recreational spaces on property values. The county concluded that "proximity to open space adds about $8,000 to $10,000 to parcel value" and that, in some "medium-density areas that touch open space and parcels of vacant land, the increase in value is as high as $25,000 per parcel."[44]

Other cost-benefit analyses explore GI benefits that are difficult to monetize. Most notably, the Philadelphia Water Department's (PWD) "Green Cities Clean Waters" program introduced the concept of a "triple bottom line analysis" (TBL), an approach that "has become recognized in municipal asset management to emphasize the financial-social-environmental aspects of a complete

40 *Id.*

41 Municipalities may have already budgeted for grey infrastructure, or have secured grants and low-income loans from state revolving funds for grey infrastructure. Moreover, they may be bound under consent decrees to upgrade, make changes to, or maintain their grey infrastructure. *See, e.g., United States of America v. City of Revere, Massachusetts*, Civil Action No. 1:10-cv-11460, Consent Decree, *available at* http://perma.cc/4LBD-45M5. Compared to these "embedded costs," green infrastructure may look like an additional expense.

42 *Barriers and Gateways*, *supra* note 17, at 22.

43 *Id.*

44 *Id.* at A-14.

benefit-cost analysis."[45] The PWD's TBL analysis assigned a market value to such benefits as increased recreational user days, wetlands created or restored, reduced carbon emissions, heat-stress mortality reduction, and increased green collar jobs.[46] Many other local governments—including those in Milwaukee, Los Angeles, Seattle, and Portland, Oregon—have incorporated TBL analysis into their cost-comparison studies.[47]

Finally, it may not always be necessary to assign a market value to the social and environmental benefits of GI. As the Milwaukee Metropolitan Sewage District has noted, "social marketing studies show that to motivate change, one must first illustrate how a desired action improves people's daily lives," such as creating "more beautiful neighborhoods" and "improved safety."[48] Education about these benefits may not require a sophisticated economic analysis so much as meaningful community engagement and examples. Municipalities have an opportunity to demonstrate that GI is more than a purely "technological" innovation. The great aesthetic appeal of GI often lies in its relationship to the natural landscape, allowing GI projects to interact seamlessly with footpaths, parks, and other recreational areas. Citizens find these projects appealing for a variety of reasons, irrespective of the costs of GI relative to grey infrastructure.[49]

For more on the strategies employed by municipalities to address cost uncertainty, see **Appendix B**. Additionally, to offset the cost of GI maintenance, municipalities may raise revenue through a regional stormwater fee program. For recommendations related to such a program, see **Section III.**

Maintenance and durability concerns

Several municipalities mentioned that maintenance is one of the primary challenges they confront when attempting to promote GI projects. One reason, as discussed above, is related to

45 *Id.* at 2.

46 Jeffrey Featherstone et al., *Creating a Sustainable City: Philadelphia's Green City Clean Water Program* 10 (2011), *available at* http://perma.cc/H46B-SDXA.

47 EPA Office of Wetlands, Oceans and Watersheds, *Case Studies Analyzing the Economic Benefits of Low Impact Development and Green Infrastructure Programs* 27-28 (2013) [hereinafter, *Case Studies*].

48 Milwaukee Metropolitan Sewer District, *Determining the Potential of Green Infrastructure to Reduce Overflows in Milwaukee* at ix (2011) [hereinafter *Determining the Potential*] , *available at* http://perma.cc/R8V4-Y9CR?type=pdf.

49 *See infra* at pp. 20-21 (description of Cambridge's Alewife Wetlands construction project); *see also* Anne Whiston Spirn, *Constructing Nature: The Legacy of Frederick Law Olmsted*, in Uncommon Ground: Rethinking the Human Place in Nature 91,102-110 (William Cronon ed. 1995) (describing how Frederick Law Olmsted originally designed the Fens and Riverway in Boston's Back Bay neighborhood to 'purify water and protect adjacent land from flooding'").

uncertainty about the long-term cost of maintaining GI. Another reason is the lack of clarity regarding how to maintain GI. GI is often located on private property, making it difficult for public agencies to determine if maintenance is being performed.[50] For larger projects, municipalities may want to consider making access a condition of permit and zoning decisions, to facilitate monitoring and GI education efforts. Municipalities may have little experience directly implementing GI and lack data to determine the durability of GI.[51] Budget tools, informed by long-term studies that track performance and maintenance costs, can raise the comfort level around these projects.[52]

Unavailability of land

Limited space, especially in dense urban areas, is an important physical barrier to the implementation of GI.[53] Unlike traditional systems that use underground pipes, some GI projects require additional land area in order to allow stormwater to infiltrate into the ground onsite.[54] These space requirements can be challenging when designing new development in dense urban areas that may lack adequate buildable land.[55]

Some municipalities have municipal code provisions designed to overcome this barrier by encouraging GI projects where they make the most sense. For instance, municipalities can encourage private developers to be creative in the use of small-scale landscaping by using code language to point out new possibilities for permeable landscaping. Bellingham's subdivision regulations, for example, contain a provision educating developers about the possibility of incorporating GI landscaping into a cul-de-sac. Additionally, Cambridge's Code of Ordinances includes a section on green roofs, with the purpose of removing "potential impediments to the development of green roof systems on new and existing buildings."[56] The provisions also create an additional incentive by not counting usable space created by green roofs against a building's Gross Floor Area.

For more on Bellingham's landscaping provision and Cambridge's green roof provision, see

50 *Barriers and Gateways*, *supra* note 17, at 16.

51 *Id.* at 15.

52 The Water Environment Resources Foundation, in partnership with the U.S. EPA, has developed Best Management Practices and Low Impact Development "Whole Life Cost Models" that help users estimate up front and maintenance costs for different types of green infrastructure. *See* BMP and LID Whole Life Cost Models: Version 2.0, *available at* http://perma.cc/EU93-TNUH.

53 Center for Energy and Environmental Policy, *Supporting Urban Green Infrastructure* 13 (2012).

54 *Barriers and Gateways*, *supra* note 17, at 16.

55 *Id.* at 17.

56 Cambridge Zoning Ordinance § 22.31.

Appendix A, Sections IV and V.

Alternatively, municipalities could address the land suitability issue by building large-scale GI projects where they would be most effective in preventing pollution from entering water bodies. For instance, as discussed at the end of this section, Cambridge, Massachusetts, worked with state agencies to site a large wetland project on state land abutting the Alewife Brook. And, as discussed in the next section, a "cap and trade" stormwater management program that enabled municipalities and large impervious surface owners to "trade" their phosphorous pollution credits could facilitate the development of large, aggregate GI projects along rivers, to stop runoff, stabilize river banks, and perhaps provide ecosystem and recreational benefits.

General unfamiliarity with green infrastructure

Community resistance to GI often springs from a lack of familiarity. Relatedly, many municipalities have indicated that one of the chief roadblocks to implementing GI is finding engineers who have adequate knowledge and expertise about the practice.

To incentivize the implementation of GI, it is vital to educate state authorities, municipalities, the public, and engineers about GI's benefits, limitations, and adaptability to local conditions.[57] Municipal governments can use their municipal codes to aid in this educational process. First, the use of non-binding, precatory language in a code can alert developers and city officials to stormwater concerns and the benefits of GI. Application forms can be revised to ask applicants for information about and otherwise encourage use of GI. In the meantime, private developers can lift language encouraging GI from the code and place it directly into existing permit applications. For developers, knowing that a municipality is already thinking about these issues means knowing that public officials will support them should they choose to implement GI. In addition, landscape architects can use language from the codes to encourage their clients to pursue GI options.[58] Our conversations with public officials and landscape architects indicated that one of the biggest impediments to GI development is uncertainty about the practice in the private development community.[59] Codes

57 *See* Regional Plan Association, *9 Ways to Make Green Infrastructure Work for Town and Cities* 26 (2012).

58 Interview with Patrick McGeough, PTM Design (Nov. 13, 2013). McGeough is a landscape architect with experience working on GI projects in Springfield who has had several clients who adopted GI into their projects at his suggestion.

59 *Id.*; Interview with Frank Sleegers, Assistant Professor of Landscape Architecture at UMassAmherst and landscape architect with experience working on GI in Springfield (Nov. 13, 2013). McGeough and Sleegers emphasized that in their experience developers were willing and sometimes enthusiastic about incorporating GI into their projects once they were made aware of its benefits. Sleegers mentioned that concerns about additional permitting time and bureaucratic hurdles remained significant for developers.

that explicitly encourage GI development can help to alleviate this uncertainty by normalizing and legitimizing GI.

Second, by allowing and encouraging flexible and site-specific GI development, municipal codes can focus development efforts on the most cost-effective projects that carry the lowest risk of failure, even if not properly maintained. The gradual expansion of successful, small-scale GI projects in a municipality can raise the local development community's comfort level with GI projects. Once GI is normalized in this way, there is the potential for new local and state regulations that lock in the new standards.

Municipalities can also seek changes in the engineering certification systems for stormwater management, which test primarily traditional practices.[60] In Massachusetts, the Board of Registration of Professional Engineers and Professional Land Surveyors administers licenses for engineers.[61] The guidance and advisory notes promulgated by this Board could be altered to encourage GI explicitly. More research in this area is needed to determine precisely what changes are advisable, but such alterations could effectively expose more engineers to the importance of GI.

In sum, GI can be an effective way for municipalities to achieve stormwater discharge reductions, further environmental amenities for citizens, and lower costs. All municipalities can benefit from ensuring that their local legal background is amenable to GI development and drives it forward.

C. A Success Story—The Alewife Constructed Wetland

In October 2013, Cambridge opened one of the largest constructed wetlands in New England: the Alewife Constructed Wetland, a 3.4-acre site located in the Alewife Brook Reservation.[62] The construction of the wetland will help reduce combined sewer overflows (CSOs) in the Alewife Brook by 86%.[63]

60 The National Council of Examiners for Engineering and Surveying (NCEES) creates the licensing exams used by state engineering licensing boards. The exam specifications for the Water Resources and Environmental component of the Civil Engineering exam are available at http://perma.cc/6L6C-VYNQ.

61 Massachusetts Office of Consumer Affairs and Business Regulation, *Board of Registration of Professional Engineers and Professional Land Surveyors*, http://perma.cc/HBE-4J4Y. For more on existing GI certifications, *see* Ryland Li, *Certifications for Green Infrastructure Professionals*, Emmett Environmental Law & Policy Clinic and the Environmental Policy Initiative, Harvard Law School, Cambridge, Mass.: June 2014.

62 Mystic River Watershed Association, *Alewife Constructed Wetlands Unveiled*, http://perma.cc/9UXH-UZZU.

63 *Id.*

This project is an important case study of how municipalities can overcome some of the common barriers to the implementation of GI. In particular, the Alewife Constructed Wetland demonstrates four factors that can help achieve successful implementation of GI in other municipalities:

1) Land availability

As discussed earlier, a lack of available, adequate land can inhibit the implementation of GI.[64] The City of Cambridge has little available open land. The Alewife project overcame this barrier by using state land for the creation of the wetland. This is an example of how states and public agencies can help provide municipalities the resources they need to implement GI in their communities.

2) Cooperation with the state

To enable construction of the wetland, the City of Cambridge worked with state authorities, including the Massachusetts Water Resources Authority and the Department of Conservation and Recreation.[65] According to the City, the cooperation of state authorities was a key factor in bringing the project to fruition, both because of the resources they provided and the general support they brought.

3) Opportunity for the creation of other amenities

The Alewife Constructed Wetland provides wildlife and plant habitat as well as recreational amenities, such as a boardwalk and links to the Alewife Greenway Extension's bike and pedestrian paths.[66] These added benefits show that GI does not have to be constructed in isolation; it can also provide opportunities to enhance, expand or implement other amenities in line with local priorities, such as updating the transportation system or creating a new recreational area.

4) Modification of codes

The project required the creation of six new districts, known collectively as the Alewife Overlay Districts, which were added to Cambridge's Code of Ordinances.[67] Although the area covered by these districts had been historically developed as a low-density retail and industrial area, the City

64 *See Barriers and Gateways*, *supra* note 17, at 16-17.

65 *Id.*

66 Mystic River Watershed Association, *Alewife Constructed Wetlands Unveiled*, *supra* note 62.

67 *See* Figure 1.

aimed to utilize and develop the area in new ways.[68] Specifically, the new ordinances encourage developments in the districts that "preserve and enhance the capacity to store floodwater, recharge groundwater and manage the collection and disposal of stormwater in ways that add to the quality and visual appeal of the built environment as well as to the quality of the water itself."[69] The provisions from this section made it easier for the City to create the wetland by modifying some of the zoning requirements for that area, such as allowing an increase in the maximum ratio of floor area to lot area by special permit.[70]

The creation of the Alewife Overlay District and the accompanying modification in Cambridge's zoning bylaws are instructive examples of how a municipal code can be modified to accommodate GI.

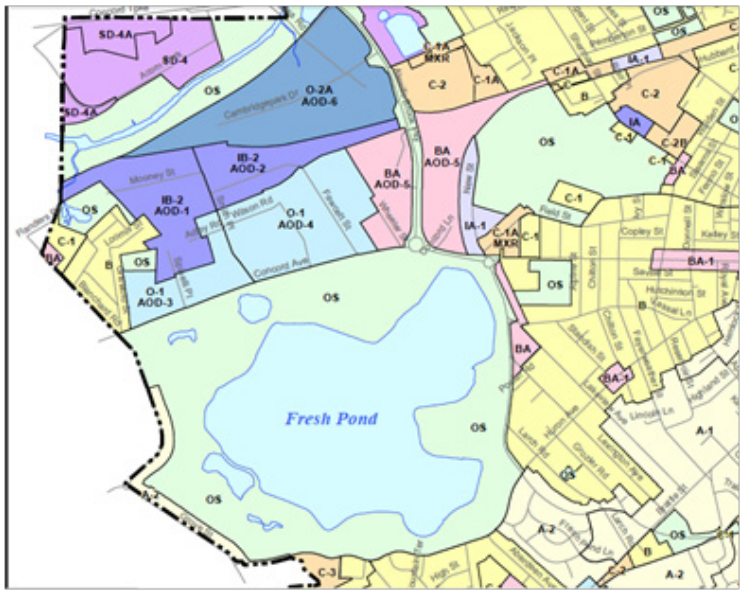

Figure 1. Areas labeled "AOD" denote the six Alewife Overlay Districts.

68 Cambridge Zoning Ordinance § 20.91.

69 Cambridge Zoning Ordinance § 20.92.

70 Cambridge Zoning Ordinance § 20.95.1.

PART III: REGIONALIZED STORMWATER MANAGEMENT SYSTEM

Under the draft small MS4 permit described in Part I, municipalities in the Massachusetts North Coastal region must implement stormwater management plans and meet phosphorous TMDL limits in the receiving water bodies. Under the draft RD permit, owners of large impervious surfaces in these towns must also limit the phosphorous loads in their stormwater discharges. As noted, the owners may achieve compliance with the limits by participating in a Certified Municipal Phosphorous Program. When designing such a program, municipalities may find it more cost-effective to work with other municipalities and with the large impervious surface owners to forge a regional strategy. This type of approach benefits municipalities by addressing the stormwater runoff problem in a more comprehensive, cost-effective way than any single municipal body could on its own.

A comprehensive approach to stormwater management reflects the physical realities of the issue. Precipitation travels from wherever it lands to a nearby water body with no regard for property boundaries or the limits of a municipality's jurisdiction. Further, receiving waters are often regional in scope. For example, the Charles River Watershed comprises thirty-five municipalities in Massachusetts.[71] The Chesapeake Bay watershed extends through thirteen states. The effort of a single municipality to tackle the management of stormwater is therefore unlikely to improve the quality of the watershed.

Municipalities have a number of design options. They might consider a program that requires residents to pay fees, which could be used to fund regional GI and other stormwater management projects at sites where they will be most effective in reducing runoff and phosphorus pollution loading. Residents could reduce or eliminate their fee by implementing GI on their own property. Likewise, large impervious surface owners wishing to participate in a Municipal Phosphorus Program could have the option of paying into a municipal stormwater management fund, or hosting a large GI project on their property and agreeing to maintain the project over a set time period, to achieve compliance with the general RD permit. In the following section, we describe these options in more detail, offering examples of programs where they exist.

71 Charles River Watershed Association, *Charles River Watershed*, http://perma.cc/KQ8J-XRAW.

A. Analysis of Regional Programs

Existing regional programs that address stormwater pollution are based on either a stormwater fee or cap and trade system. We analyze each of those types of programs in turn, and then suggest a possible hybrid solution consisting of both a stormwater fee and a cap and trade system.

1) Stormwater Fee Regional Plan

In a stormwater fee program, all landowners must pay fees into a common fund that is used to address the problems of stormwater management, including maintenance, monitoring, and construction of new infrastructure. In this section, we describe and provide recommendations regarding several considerations in the design of a fee program: the nature of the fee structure; who pays the fee; what entity is responsible for collecting the fee and distributing the proceeds; and the incorporation of performance incentives into the program.

Fee Structure

The fee can be assessed in various ways:

- One method is a flat fee that is set annually. Under this model, every covered landowner pays the same amount regardless of how much property or impervious surface is owned.

- A second method is a "consumption-based" fee. In this approach, every covered landowner pays a pro-rated share determined by the amount of property or impervious surface owned. For example, if the pre-determined rate is $100 per year per acre of impervious surface, a landowner with two acres of impervious surface will owe $200. Different rate structures could exist for types of property owners; for instance, while a residential property owner might pay the rate of $100 per year per acre of impervious surface, a commercial property owner might pay $250 per year per acre. Or, the fee could kick in above a threshold acreage of impervious surface.

- A third method is a compound model, in which property owners are assessed both a flat fee and a consumption-based pro-rated fee.

The first method, a flat fee, provides no incentives for a landowner to decrease the impervious surface on his or her property. It also seems to be inequitable in that owners of many acres of impervious surface will pay the same amount as a property owner who owns relatively little impervious surface. For these reasons, it appears that options two and three are better choices.

Alternatively, a flat fee could work if residents could achieve credits against that fee for reducing impervious surface or implementing GI on their properties.

Who Pays?

Again, there are several options:

The first option is that only large landowners (or owners of more than X acres of impervious surface) in the watershed pay the fee. The Long Creek Watershed Management Plan, which aims to reduce runoff from contaminiated surfaces, uses this approach across four municipalities in Maine: Westbrook, Portland, South Portland, and Scarborough.[72] Although the plan aims to reduce pollution via a number of BMPs, the centerpiece of the plan is a requirement that all landowners who own one acre or more of impervious surface pay into a permitting system or obtain their own permit for their impervious surface.[73] In effect, the Long Creek plan is a stormwater fee with a bright line drawn at ownership of one or more acres of impervious surface.

The second option is to have all town or region residents pay. The Narragansett Bay Commission (NBC), for example, imposes a fee on nearly all commercial, industrial, and residential properties in Rhode Island.[74] The NBC's mission is to enhance the water quality of the Narragansett Bay and its tributaries by collecting and treating wastewater,[75] which includes sewage and stormwater. Hence, these fees are used to fund future improvement projects and operate and maintain current treatment facilities. Properties in three categories—residential, commercial, and industrial—are assessed using a flat fee plus a consumption charge. For example, the flat fee for a residential property was most recently $202.47 per year with an additional consumption charge of $3.267 per hundred cubic feet of water used.[76] Commercial and industrial properties both have a different flat rate and a different consumption charge.

The ostensible advantage of the first option, as illustrated by the Long Creek example, is that this fee structure targets the largest impervious surfaces and thus the largest potential sources of stormwater runoff. While this may seem fair and efficient, it fails to account for the aggregate impact of small sources of stormwater pollution. An extreme illustration of this problem would be a town

72 FB Environmental Associates, Inc., *Long Creek Watershed Management Plan*, at 2 (2009) [hereinafter *Long Creek Watershed Management Plan*].

73 *Id.* at 69.

74 Narragansett Bay Comm'n, *Service Area*, http://perma.cc/9YVV-JY9F.

75 Narragansett Bay Comm'n, *Organization*, http://perma.cc/QVN7-LJGM.

76 Narragansett Bay Comm'n, *Sewer Rates*, http://perma.cc/7NFN-QDTM.

with one landowner whose property is above the threshold and three hundred landowners whose properties sit just below the threshold. Surely, holding the single landowner responsible for all of the town's stormwater pollution would be inequitable. Moreover, in a situation where some of the largest impervious surface owners are subject to their own permit requirements, and are not obligated to meet these requirements by joining the municipal program, a low opt-in rate could leave the municipality with insufficient funds. Therefore, unless a municipality has a lot of impervious surface owners and significant buy-in from that sector to join the municipal plan, we recommend that a stormwater fee apply to all town residents or regional residents for whom the fee is being utilized.

Who Receives and Distributes the Fees?

Still another design element for stormwater fee programs is designation of an entity to receive the fees and implement the program. If a program is run by a single municipality, a local agency or utility board may play this role. However, in a regional program spanning multiple jurisdictions, the appropriate entity is less obvious, or may not exist at the outset of the planning process.

Sometimes a regional entity already exists to do the job. For instance, in Maine, the four towns in the Long Creek watershed created a Steering Committee comprised of representatives from each town, large landowners, state officials, and nonprofit organizations. The Steering Committee convened meetings to design a stormwater management program.[77] Now, the towns are entering into an interlocal agreement, which would contract with the Cumberland County Soil and Water Conservation District to administer the stormwater management program.[78] The Conservation District will act under the direction of a governing board, made up of the same stakeholder groups as are represented on the Steering Committee.

Other times, a new entity must be created to meet the need. In 1980, the Rhode Island legislature created NBC as a public corporation of the state, "for the purposes of acquiring, planning, constructing, extending, improving, and operating and maintaining publicly owned sewage treatment facilities."[79] As noted above, the utility is empowered to set and collect rates to cover construction, operation, and maintenance costs.[80]

In the face of budget cuts and resistance to growing government, it may be difficult for a local or state government to create a new public entity to manage regional stormwater. Therefore, we

77 *Long Creek Watershed Management Plan*, *supra* note 72, at 2.

78 *Id.* at 73-74.

79 R.I. Gen. Laws § 46-25-4.

80 R.I. Gen. Laws § 46-25-21.

recommend that, at least at first, municipalities follow the Long Creek model and look for existing regional entities that might have the capacity to collect and receive stormwater fees and manage a stormwater program. If no such entity exists, then the municipalities have a stronger case for creating a new institution. Alternatively, municipalities might consider entering into an agreement that allocates fees and responsibilities among each participating municipality.

Can a Reduction in Fees Operate as an Incentive?

If municipalities create a fee-based program, they can use the resulting revenue to implement GI and other stormwater management approaches that will reduce runoff in the watershed. However, municipalities may also reduce fees for small and larger landowners who adopt GI and other BMPs on their properties. These performance incentives may drive private sector BMP innovation, and help to alleviate the burden on a regional stormwater manager of maintaining every project in the region.

Under the Long Creek plan, large landowners who opt in to the regional control plan will have the opportunity to offset their fees by employing a number of BMPs.[81] One example is that the fee can be reduced by 16% for a landowner who implements projects that control runoff volume and timing.[82]

In Portland, Oregon, the city's Clean River Rewards Incentive and Discount Program (CRID) provides landowners with a similar incentive structure. The program discounts the City's stormwater utility fee, up to 100% of the original assessment, for owners who manage their stormwater runoff onsite.[83] CRID simplifies the discount program for residential property owners by calculating the reduction based on the owners' roof runoff management, whereas more complex commercial property owners are required to manage runoff from all impervious surfaces.[84]

The Village of Downers Grove, Illinois, further distinguishes between "incentives" and "credits" in calculating the financial benefits afforded to landowners who engage in BMPs. The "incentives" received by landowners represent a one-time reduction in the owner's account balance in order to address "the cost of materials, construction and installation of qualifying stormwater facilities."[85] For example, property owners can receive a $250 one-time discount to help finance the

81 *Long Creek Watershed Management Plan*, *supra* note 72, at 71-73.

82 *Id.* at 73.

83 City of Portland, Environmental Services, *Stormwater Discount Program*, http://perma.cc/TF83-AVZQ.

84 Water Environment Research Foundation, *Using Incentive Programs to Promote Stormwater BMPs*, http://perma.cc/U576-8RAP.

85 Village of Downers Grove, *Stormwater Utility*, http://perma.cc/BC2L-VDM2.

construction of a rain garden. On the other hand, "credits" are ongoing reductions in the owner's stormwater utility fee in "recognition of onsite systems, facilities, or other actions taken to reduce the impact of stormwater runoff."[86] Landowners can receive a credit of up to 20% for engaging in BMPs that achieve stormwater volume reduction, and up to 100% if owners provide land or facilities to the Village in order to manage stormwater.[87]

These and similar incentive structures, coupled with an equitable fee structure, provide a balanced strategy for mitigating stormwater discharges. On the one hand, an original "consumption-based" fee accounts for discrepancies in the amount of impervious surface on a landowner's property. On the other hand, an added incentive program looks beyond a mere calculation of impervious surface area, focusing instead on strategies to encourage landowners to engage in BMPs.

2) Advantages and Disadvantages of a Stormwater Fee Regional Plan

Stormwater fees are a useful way to generate revenue to fund new GI projects, maintenance, oversight, monitoring, and enforcement of a stormwater management plan. The revenue stream from a stormwater fee is steady and thus injects stability into the regional plan.

Second, a stormwater fee is relatively easy to implement. Most municipalities already assess various fees. Adding a stormwater fee to the existing fee structure can be simple and effective.

Third, a stormwater fee gives municipalities the leverage they need to encourage landowners to employ BMPs. As previously mentioned, integrating an incentive structure into a stormwater fee program allows municipalities to address both (a) the amount of impervious surface on a landowner's lot and (b) the owner's incentive to manage stormwater discharges using BMPs.

However, a stormwater fee does have its disadvantages. Primarily, a stormwater fee may not allow for sufficient flexibility. If a fee is assessed against all landowners with X acres of impervious surface, landowners whose land is on top of fill or environmental contaminants will find it much more difficult to implement BMPs than landowners whose land allows for such practices. If the cost of implementing BMPs far exceeds the benefits received through the regional program's incentive structure, some landowners may simply pay the fine and fail to engage in BMPs of any kind. While this would raise some revenue for the municipality to engage in public property GI, it is not clear it would drive reductions as effectively as a structure that incentivizes BMPs. Thus, a cap and trade program may also be necessary to encourage all landowners to contribute positively to the region's

86 *Id.*

87 *Id.*

stormwater management program, and enable the most sensible and cost-effective siting of GI projects.

3) Cap and Trade

A cap and trade program is a market-based approach to stormwater management. Under this approach, a region could cap the total amount of pollutant runoff allowed, based on permit requirements, and then municipalities and large impervious surface owners could implement GI and other BMPs based on where the projects would be most effective.

In these programs, the governing body auctions or distributes credits that represent how much pollution is allowed; the sum of these credits is equal to the cap. For example, the Draft Small MS4 General Permit for the North Coastal Region requires the towns of Milford, Franklin, and Bellingham to reduce their phosphorous runoff into the Charles by 57%, 52.1%, and 51.8%, respectively.[88] The Draft RD Permit for large impervious surface owners requires that each private landowner reduce its phosphorous runoff by 65%.[89] The cap could be calculated by determining the acreage that each permitted entity represents and their permitted reduction rate.

The number of initial credits could be equal to the amount of phosphorous that is permitted to enter the Charles River. Or, if regions established these programs before the Draft Permits become final, they could begin with current pollution levels and then gradually ratchet down towards the permitted pollution limit. This would give market participants time to become familiar with the market mechanics before having to make reductions.

After the credits are distributed, landowners who can most cheaply reduce the size of their impervious surface will do so and sell their superfluous credits to landowners who cannot decrease their impervious surfaces in a cost-effective manner. Assuming low transaction costs and open access to information, this should result in achieving the pollution reductions in the cheapest and most efficient manner possible. In this model, the market acts as a means of sorting out the most efficient way of achieving compliance with the cap.

Examples

The Maryland Department of the Environment has set up a voluntary Nutrient Trading Program (NTP). The NTP capped the total amount of nitrogen and phosphorus that could enter

88 Horsley Witten Group, *Sustainable Stormwater Funding Evaluation for the Upper Charles River Communities of Bellingham, Franklin, and Milford, MA*, at E1 (Sept. 30, 2011), *available at* http://perma.cc/ZED3-7QMV.

89 *See supra* at p. 9.

the Chesapeake Bay, and then established a public marketplace for the selling and buying of nutrient pollution credits.[90] Landowners can use the online tool set up by the Maryland Department of the Environment to survey their land and determine which nutrients their land discharges and what BMPs are available to reduce those discharges. If, by incorporating certain BMPs, a landowner reduces his or her nitrogen or phosphorus discharges to a level below the state-set baseline, that landowner can sell those extra credits on the market. The theory is that this will encourage landowners to utilize BMPs and sell these credits to other landowners for whom such BMPs are more costly.

Although a trading program does not yet exist for the Charles River, the Charles River Watershed Association has established a trading program tool that will educate market participants in a future pollution market. The Blue Cities Exchange program[91] is an online tool that allows landowners to assess stormwater management on their property, thereby familiarizing them with the mechanics of a future pollution market. It also suggests the most cost-effective BMPs to reduce pollution runoff from the property. The program thus gives landowners the ability to fully understand the variety of choices available and the associated costs. Such a tool is a powerful and potentially very effective means of educating landowners about BMPs and ensuring that the cap is achieved in the least expensive way possible. An online program of this nature is a helpful tool to create open access to information and reduce transaction costs.

As noted above, neither the Maryland NTP nor the Blue Cities Exchange is a mandatory trading program. As of April 2014, no credits had yet been traded on the Maryland NTP marketplace. This may be because the program is new and not well known, or because it is strictly voluntary. Or, it may be that Clean Water Act permit holders are able to achieve the nutrient caps in their permits without resorting to purchasing third party pollution credits. Further research into this program could suggest ways to encourage its use.

Trading Liability

A set of thorny legal issues for a cap and trade program relates to the liability that is created or transferred when a credit is bought or sold. There are at least two kinds of liability at issue here: 1) liability for a failed GI project or BMP and 2) responsibility of subsequent landowners for maintaining a project or practice that was installed by a previous owner.

The first liability question relates to a project that fails to achieve the promised pollution

90 *Maryland Nutrient Trading,* http://perma.cc/E2MF-DDX5.

91 Charles River Watershed Ass'n, *Blue Cities Exchange*, http://perma.cc/G6XB-ZCQ3.

reductions during the compliance period. For example, if an industrial facility buys pollution credits from a landowner who installs a rain garden, where does the liability for the failure of that rain garden lie? There are a few ways to address this kind of trading liability:

1. The seller retains the liability;

2. The purchaser and the seller are jointly liable; or

3. The purchaser assumes the liability but also enters into a contractual agreement with the seller, potentially exchanging liability for maintenance responsibilities. Payment of any penalties for non-compliance with the Clean Water Act requirements could be determined based on the contract provisions.

The second liability question relates to the long-term responsibility for a project or approach. What if the landowner that generated credits with a GI project moves or sells his property? Is the new landowner liable for the maintenance and continued existence of that rain garden?

To ensure stability in the system, the GI/BMP operation and maintenance may need to run with the land. Municipalities or states might consider this as a requirement for offering credits on the market exchange. There are a few ways municipalities might enforce the retention of a GI project or BMP. One possibility is a negative covenant, which could serve to prevent a successive landowner from destroying the GI project or BMP.[92] However, a negative covenant might not impose any proactive duty on the subsequent landowners, such as to maintain the GI project or BMP. Such ongoing duties are likely to be necessary to ensure the integrity of the project. Hence, a municipality might consider employing a conservation easement or watershed prevention restriction, which would impose proactive duties as well as prohibitions.[93]

The issue of liability may not arise for large impervious surface owners who comply with the draft RD permit by participating in a municipal program. In those cases, the large impervious surface owner would only need to establish that it had "participated" in the municipal program to meet its Clean Water Act obligations. Municipalities, whether on their own or working together, should think

92 State law would need to be consulted to determine how to craft an enforceable negative covenant. *See, e.g.*, *Well-Built Homes, Inc. v. Shuster*, 64 Mass. App. Ct. 619, 626-27 (2005) (*citing Whitinsville Plaza, Inc. v. Kotseas*, 378 Mass. 85 (1979)).

93 *See, e.g.*, M.G.L. c. 184, § 31. The process for acquiring one of these types of easements under Massachusetts law can be somewhat burdensome; states may want to consider a streamlined version for GI projects, to encourage their deployment.

about how to define "participation" to ensure that large impervious surface owners are committed to the municipal pollution control plan.

Penalties

Penalty provisions help to encourage compliance with a cap and trade program. There are two types of penalties associated with these programs. First, particularly when credits are generated by numerous projects that a municipality may not be able to inspect, civil and criminal penalties may need to be assessed for records fabrication, or misrepresentations about the effectiveness of a GI project or BMP. Second, market participants may be required to pay an "alternative compliance payment" if, despite good faith efforts, they fail to obtain a sufficient number of credits to cover their pollution.

Alternative compliance payments need to be set at a level that will incentivize a market participant to comply with the cap and trade system. In other words, these payments create a ceiling for how much the market's pollution credits are worth. A landowner faced with a very minor fine for having too much impervious surface would likely pay the fine rather than obtain a credit. Thus, when calculating the amount of the penalty it is important to keep in mind that it needs to be high enough to encourage compliance and low enough to keep the price of credits manageable.

4) Advantages and Disadvantages of a Cap and Trade Program

A cap and trade program is advantageous in a number of ways. First, it is highly flexible. Under such a program, those who can most easily and cheaply implement BMPs will do so, assuming that they perceive enforcement to be meaningful and real. Thus, a cap and trade program accommodates variations in site-specific circumstances and focuses projects in the most sensible, cost-effective locations.

Second, a cap and trade program provides some certainty in the result. The cap that is set limits the amount of pollution that will be produced, ensuring that there is an environmental benefit to the program.

However, a cap and trade program can pose some disadvantages. First, a cap and trade program where credits are initially distributed for free will not provide the participating municipalities with funding for maintenance and oversight costs. Municipal leaders we spoke with expressed concern for stormwater management programs that did not address these costs. A cap and trade program, particularly if the program includes many small residential properties, could also be burdensome for local governments to supervise and enforce. There may be opportunities for municipalities or even states to aggregate their resources and implement a regional cap and trade

program, perhaps with a focus on protection of particular waterbodies.

Second, cap and trade programs are dependent on low transaction costs and readily accessible information. If everyone in a region has not been adequately educated on the benefits and relative cost-effectiveness of GI and BMPs, market players may be reluctant to embrace new technologies and may be more willing to make the alternative compliance payments than to take action to make reductions in stormwater pollution. Moreover, actors will be differently situated in their ability to absorb information about GI and BMP—while large developers may be able to hire consultants to identify the best and most cost-effective way to achieve stormwater reductions in the regions, small landowners in the municipality are unlikely to have this luxury.

5) Hybrid Approach

Each of the two conceptual models described above has its advantages and disadvantages. In fact, some of the disadvantages of a stormwater fee are the very advantages of a cap and trade program, and vice versa. A hybrid approach to stormwater management incorporates features of a stormwater fee system and a cap and trade program. It assesses fees on smaller landowners to provide stable revenue to the municipalities, while offering larger landowners the flexibility of a cap and trade program.

Our recommended model consists of three pieces:

1. **A central decision-making body**. This body is tasked with collecting funds, issuing the tradeable credits, and registering all sales of credits. There are various ways to compose such a body but one method is to choose representatives from each municipality.

2. **A stormwater fee for landowners in each municipality**. Landowners would be required to pay an annual fee into a common fund. This steady revenue stream will go towards maintenance, building BMPs on public land, good housekeeping measures, outreach to the communities, and the implementation process.

As discussed above, there are several options for assessing the fee: a pro-rated fee based on the size of a property, a pro-rated fee based on the amount of impervious surface, or a variable flat fee for residential, commercial, and industrial landowners. We recommend a pro-rated fee based on the amount of impervious surface on an owner's property. The municipality could also determine whether to charge the largest impervious surface owners in addition to or instead of some of their responsibilities under the trading program described below.

3. **A cap and trade program for the large impervious surface owners and public lands**

in the municipality. A central body would institute a cap for the region based on the aggregate pollution reduction rates required under the permits. The program would then enable participating landowners to trade and sell credits and ascertain where to site GI projects and BMPs across the region. The municipalities could use the revenue raised by the fee system to fund public lands GI projects and BMPs, while the large impervious surface owners could pay for projects to generate the appropriate number of credits for their level of pollution. Smaller landowners in the municipalities could choose to generate credits for sale in the market as well, either in addition to payment of their fee or in lieu of (if the fee system offered credits for GI projects and BMPs). An online modeling system like the one set up by the Charles River Watershed Association's Blue Cities Exchange would be ideal. Any penalties for unpermitted impervious surface or for misrepresentation would be paid to the common fund.

Municipalities could decide whether to allow smaller landowners to aggregate properties and participate in this program as if they were a single larger property. Alternatively, as noted above, municipalities could encourage smaller landowners to generate on-site projects that could be sold as credits into the regional trading system.

B. Implementation of a Regionalized Program

Regardless of the particular design, there are a few general features that municipalities should incorporate into any stormwater management program:

1) Building Public Support

A key part of a successful regionalized stormwater management program is building public support. Communities are more likely to accept, participate in, and utilize a system that has strong proponents.

One option is the creation of a Watershed Stewardship Program. Such a program could have a recognizable trademark that participating companies and individuals can "earn" if they utilize BMPs for stormwater management. Much like the Energy Star Program run by EPA, the Watershed Stewardship Program could promote visibility for and compliance with the regionalized program. The idea is that it makes effective stormwater management a normative goal and raises awareness of the issue.

Successfully reducing stormwater pollution will also require actively engaging and educating the communities it affects. In order to increase compliance and ensure the best end results, effective education is a necessity. This can be accomplished through information pamphlets, newsletter emails, and phone calls. The goal is to let town citizens know about the town's initiatives, their aims, and the

way they work. It is crucial to disseminate this information before citizens are responsible for assessed fees or permit compliance.

2) Planning Process

Community Involvement

The success of a regionalized stormwater management plan depends in great part on community acceptance. The most effective way to ensure acceptance is to actively seek community involvement in the planning process. This includes the education and advocacy pieces addressed above as well as planning meetings that are recorded and open to the public.

In addition, a successful program should engage state and municipal leaders through collaboration and soliciting their input and comments. Municipal leaders should be shown hands-on examples of GI and other stormwater management practices so they can tangibly understand what the regionalized plan requires. There is some anecdotal evidence that such walkthroughs help make municipalities more willing to adopt GI. It offers these BMPs as an ascertainable goal and not just some on-paper requirements. It also helps address a "mindset" problem. Many municipalities have been operating a certain way for decades. Reducing stormwater pollution will take innovation and a change in mindsets for many municipalities. Involving municipal leaders in the planning process is a great way to accomplish this.

Implementation Schedule

The implementation of the regionalized plan needs to be predictable. Such stability and certainty in the program allows businesses and individuals to rely on the program and better prepare for the upcoming changes. Progress reports, done on an annual, bi-annual, or semi-annual basis, should be completed to monitor, assess, and tweak the plan as it is implemented. The overall goal is accountability in the implementation of the plan.

PART IV: CONCLUSION

Stormwater pollution remains a large problem in the United States. A meaningful approach to the problem is a comprehensive stormwater management program consisting of municipal action and a regional program. At the municipal level, we recommend stormwater management through implementation of GI in new development. In addition, municipalities must address stormwater pollution in a more comprehensive, cost-effective manner through participation in a regional program. Of the options for regionalizing stormwater management, we recommend a hybrid approach that collects a fee from smaller landowners and establishes a cap and trade system for the larger landowners: it combines the flexibility and environmental outcomes of a cap and trade program with the funding sources of a fee program, enables municipalities to site GI projects where they will do the most good, and best deals with the differences in legal codes and physical landscape between municipalities. By accounting for differences in municipalities, a hybrid approach allows for growth by making it easier to add new municipalities and large impervious surface owners to the program.

APPENDIX A: EXEMPLARY MUNICIPAL CODE PROVISIONS

The following examples of code language — from the five Massachusetts municipalities of Springfield, Cambridge, Milford, Bellingham, and Franklin — expand on ideas introduced in Section II, Part B as ways that municipal codes may help remove common legal and non-legal barriers to GI in order to facilitate its greater adoption.

I. Parking

Because many municipal codes require a minimum number of off-site parking spaces for businesses, large parking lots are a common feature of commercial areas. As currently constructed, many parking lots are large, flat areas of impermeable surface interspersed with planted strips. Pollutants from cars accumulate on the surface of the lot and are washed into the municipality's stormwater system.[94] Municipal codes can therefore aid in stormwater management by keeping off-site parking to a minimum (by reducing total space requirements and the dimensions of individual spaces) and by allowing the use of permeable pavement and GI planting such as swales and rain gardens, to enable onsite infiltration of the stormwater.

Off-site parking requirements

In order to ensure appropriate volume of parking, municipal codes in all five municipalities establish a schedule of off-site parking requirements based on square footage. There are different requirements for different types of developments.

The parking requirements for office space in the four cities are as follows:

- Springfield: 2 spaces per 1,000 sq. ft. (Springfield Zoning Code § 7.1 Table 7-1)
- Cambridge: 1 space per 1,000 sq. ft. (Cambridge Zoning Ordinance § 6.36.4)[95]
- Milford: 4 spaces per 1,000 sq. ft. (Milford Zoning Code § 3.4.1(a))
- Bellingham: 5 per 1,000 sq. ft. (Bellingham Zoning Code § 3320 (h))
- Franklin: 4 spaces per 1,000 sq. ft. (Franklin Zoning Code § 185-21 (B)(2)(c))

94 Dunn, *supra* note 11, at 42.

95 This is the minimum parking requirement for offices located in the zoning category with the largest requirement. Cambridge also provides maximums (2 per 1,000 sq. ft.).

The Metropolitan Area Planning Council (MAPC), a regional planning commission for the greater Boston area, recommends 3 spaces per 1,000 sq. ft. in its Low Impact Development (LID) guidelines, geared towards stormwater management. Milford, Bellingham, and Franklin all currently require more off-site parking spaces. The codes in these municipalities could be made more flexible and amenable to stormwater management by the addition of a code provision similar to Springfield's § 7.1.32, which allows for parking requirements to be reduced based upon a consideration of various factors and an evaluation of the site. We offer this as a code provision that other municipalities might consider adopting, and suggest one change that would add stormwater management as a specific factor for reducing parking capacity.

Exemplary Code Language:

Springfield Zoning Code § 7.1.32:

The requirements in Table 7-1 may be reduced in the course of Site Plan or Special Permit review based upon information presented by the applicant and city agencies. The applicant's own estimate of parking demand, based upon the type of USE involved and its location, shall be given substantial deference. Other relevant considerations include:

A. The availability of public transportation;

B. Whether the subject property lies within walking distance from shopping, employment, restaurants, housing, schools, and other trip destinations;

C. The availability of shared parking with binding agreements to secure its long-term availability; where adjoining parking areas are connected directly to one another or to a service road or alley to reduce turning movements onto roads.

D. The availability of safely usable on-street parking,

E. The provision of bicycle storage facilities, showers, lockers and related facilities to encourage bicycling; and

F. The establishment of transportation demand management measures to reduce automobile use.

Suggested Change:

The list of "other relevant considerations" is not exhaustive, and leaves open the possibility that a city agency could reduce off-site parking requirements based on stormwater management considerations. It would be preferable, however, to identify stormwater management specifically as a relevant consideration. This approach would both provide clarity and serve an educational function by alerting developers or city agencies to the relevance of stormwater considerations. The following language could be added to the code to make it an even more effective tool to encourage GI development:

> "G. The stormwater management requirements of the area, including proximity to rivers and streams, total outflow from the immediate area, and potential contamination from the area's outflow."

Parking space dimensional requirements

Municipal codes can also discourage excess impervious pavement used for parking by ensuring that parking space dimensional requirements are not unnecessarily large. Bellingham's Zoning By-Laws provide flexibility by allowing 10% of the spaces in large parking lots to be designated for small cars or motorcycles, with a corresponding reduction in size. The small car and motorcycle dimensional requirements, as well as those for standard-sized cars, all line up with the MAPC LID suggestions, ensuring that they are not unnecessarily large.

The provision also serves an educational function by highlighting that the purpose of the allowance is to "reduce overall impervious surface," thereby alerting developers to Bellingham's priorities and encouraging plans that take them into account.

Exemplary Code Language:

> Bellingham Zoning By-Laws § 240-64 – Alternative Dimensional Requirements:
>
> In order to reduce overall impervious surface of larger paved off-street parking, small vehicle and motorcycle parking spaces may have reduced dimensional requirements and still count toward the overall number of spaces required as follows:
>
> A. In off-street parking facilities with more than 50 parking spaces, a maximum of 10% of the spaces may be dedicated for small car and/or motorcycle use. Small car and/or motorcycle parking shall be grouped in one or more contiguous areas and with appropriate signage.

(1) Small car parking space stall dimensions: eight feet wide by 16 feet long; 128 square feet.

(2) Motorcycle parking space stall dimensions: four feet wide by eight feet long; 32 square feet or approximately four motorcycle spaces for one small car space.

(3) Standard car parking space stall dimensions: nine feet wide by 18 feet long; 162 square feet.

Parking lot surface material requirements

Code provisions related to parking lots can aid in stormwater management not only by limiting unnecessary impermeable space, but also by encouraging permeable pavement in low traffic areas.[96] Because permeable paving generally has a lower load-bearing capacity than conventional paving, its use is generally limited to low-speed, low-volume areas such as pedestrian walkways, overflow parking, parking stalls, alleys, and residential driveways.[97] Bellingham's Zoning By-Laws explicitly encourage "permeable or porous paving" in such areas. This language educates both public officials and developers to the possibility of using such paving by including a list of possible areas in which permeable paving is especially suitable.

This provision also provides clarity to developers who can be certain that Bellingham city officials and permitting authorities will look favorably on the use of permeable paving in a development. Proposed commercial developments may need to navigate multiple municipal agencies in a variety of permitting and regulatory settings. Any one of these entities may not be familiar with permeable paving. A developer could include the language from this code provision directly in a permit application, ensuring that permeable pavement has a normal or even privileged status during the permitting process and preventing this novel technology from causing delay or confusion.

Exemplary Code Language:

Bellingham Zoning By-Laws § 240-61-Parking Area Design and Location:

Permeable or porous paving is encouraged in low traffic areas such as reserve parking, painted parking lines, parking pullouts, crosswalks, etc.

96 *See* Metropolitan Area Planning Council, Fact Sheet #6: Permeable Paving, *available at* http://perma.cc/VZ5K-UZZF.

97 *Id.* at 1.

Parking lot landscaping requirements

GI developments such as swales and rain gardens can be incorporated into existing patterns of landscape architecture. To whatever extent possible, municipal code provisions related to parking lot landscaping requirements should encourage GI development by giving developers the flexibility to take advantage of an individual site's capacity for such projects.

Milford's Zoning By-Laws contain a provision that requires landscaping in parking areas and mandates that a substantial portion of the landscaped area be pervious in order to allow for stormwater infiltration. Although Milford's parking lot landscaping requirements are not specifically designed for stormwater management, they provide an example of how GI can be encouraged in a variety of local by-laws.

Exemplary Code Language:

Milford Zoning By-Laws § 3.4.4(d)(4)(a):

> The minimum size (area) of each individual landscaped area within a parking lot shall be a minimum average width of eight (8) feet and have a minimum area of one hundred fifty (150) square feet. The minimum area of individual landscaped areas shall be calculated excluded any curbing or other edging material greater than four (4) inches in width. A landscaped area may be up to thirty-three per cent (33%) impervious surface, provided that all such area is used for pedestrian walkways and that such walkways are adequately buffered from the parking areas.

Suggested Change:

While this provision currently provides clarity by directly mandating a certain amount of landscape area and requiring that 67% of that area be pervious, it could be changed to allow for increased flexibility. Certain parking lot sites may be able to accommodate additional landscaped areas if the code allowed for a series of smaller, disconnected lots by requiring a minimum amount of landscaped area for the entire parking lot in the aggregate. The provision could be rewritten to require a percentage of the entire parking lot site to be made up of pervious landscaping, while allowing developers the flexibility to spread that total across a series of smaller, disconnected areas if needed.

II. Tree Protection

The tree protection provisions in Cambridge's zoning code provide a great example of a code that was not designed to incentivize GI, but nevertheless contains enough flexibility to allow for GI development.

GI projects, particularly projects involving swales or rain gardens, may occasionally require tree removal. Excavation is required to construct rain gardens or swales, and trees might need to be relocated in this process.[98] Municipalities with strict tree protection laws may therefore create barriers to GI if they prohibit any construction within a certain distance from trees or prohibit the removal of trees.

By building flexibility into the tree protection provisions, Cambridge has effectively safeguarded its tree population while still allowing for the implementation of GI. The Tree Protection Ordinance, established in 2004, institutes a tree replacement plan that requires a developer removing trees of certain dimensions to either replace the tree or pay into the Tree Replacement Fund.[99]

Moreover, although the code states that a developer must include in his proposed plan a Tree Save Area (the area that must remain undisturbed so as not to damage the tree), the code does not mention a specific number of feet, giving developers the flexibility to analyze a project site by site.[100]

According to David Lefcourt, the City's arborist, paying into the Tree Replacement Fund is more expensive than replacing the trees; the fee that goes into the fund varies depending on the changes that the developer needs to make. Most developers choose a mixed solution, replacing some trees and paying a fee into the Tree Replacement Fund for the rest. According to engineers who have worked or lived in the City, the tree protection provisions do not pose a barrier to the implementation of GI because the code provides sufficient flexibility and trees can be incorporated into GI designs. For example, as shown in Figure 2, trees and swales are not incompatible; if the tree can be removed and relocated, a developer can excavate and create a swale and then relocate the tree to the side of the swale. The tree protection plan can also be modified to encourage project developers to use GI by adjusting the fees charged in the event that GI cannot be implemented with trees in place.

98 *See, e.g.*, Takoma Park Tree Ordinance, *available at* http://perma.cc/EDF9-R2G4.

99 Cambridge Health and Safety Ordinance § 8.66.030.

100 *See id.*

Figure 2.

Exemplary Code Language:

Cambridge Zoning Code § 8.66.030 (definitions):

DBH (Diameter at Breast Height). The diameter of a tree trunk measured in inches at a height of four (4) feet above the ground.

Mitigation Plan. A document to be included within any Tree Study submitted for a project where any Significant Trees are proposed to be removed from a lot, stating (i) why any Significant Trees are proposed to be removed from a lot, (ii) a description of the Replacement Trees proposed to replace the Significant Trees to be removed or the value of which is proposed to be paid to the City to be deposited into the Tree Replacement Fund, (iii) an estimate from a local nursery for the cost of purchasing, planting, watering and maintaining said Replacement Trees for a period of not less than five years or the value of which is proposed to be paid to the City to be deposited

into the Tree Replacement Fund, and (iv) certification from a Certified Arborist that the proposed Replacement Trees and cost estimates for purchasing, planting, watering and maintaining said Trees are appropriate and reasonable.

Replacement Trees. A tree or trees to be planted on a lot to replace any Significant Trees to be removed from the lot, or whose equivalent value is proposed to be paid to the City to be deposited into the Tree Replacement Fund instead of planting Replacement Trees on the lot. The total DBH of Replacement Trees, or equivalent value, as applicable, shall be equal to or exceed the total DBH of the Significant Trees to be removed from the lot.

Significant Trees. Any tree or trees larger that 8" DBH which is on a lot or which has been removed from the lot within one year prior to the submission of a Tree Study to the City Arborist.

Cambridge Zoning Code § 8.66.060:

If Significant Trees are to be removed from a lot in connection with the development of a project subject to the provisions of this Chapter, upon approval of any project subject to the provisions of §8.66.050(a) of this Chapter by grant of a special permit from the Planning Board, or submission to the Inspectional Services Department of certification from the City Arborist under the provisions of §8.66.050(b) of this Chapter, the owner of the lot shall either plant Replacement Trees on the same lot in accordance with the schedule set forth in the Tree Study, or he shall pay the estimated cost of Replacement Trees and associated costs for the maintenance of said trees pursuant to the Mitigation Plan, if applicable, to the City to be deposited into the Tree Replacement Fund. In addition, the owner of the lot shall, prior to the issuance of a building permit, post and file a bond with the City Clerk in the amount of the total costs set forth in the Mitigation Plan, but in no event less than five thousand dollars ($5,000.00), with one or more sureties conditioned to the faithful observance of the conditions and specifications of the Tree Protection Plan and, if applicable, the Mitigation Plan.

III. Site Plan Review Requirements

Code provisions that require or encourage meetings with municipal officials prior to the submission of construction permit applications and building plans can be very powerful tools to encourage local GI development. Springfield's site plan review requirement has been used to require pre-submission meetings with the City Engineer.[101] These meetings provide an opportunity for the City Engineer to educate developers about opportunities to incorporate cost-neutral or cost-saving GI projects into their site plan. Because of the enormous benefits that can accrue from these relatively short meetings, Springfield has found them to be an incredibly efficient method to encourage GI development.[102]

These meetings are more effective than a list of requirements because they bring together knowledge from both the public and private sides. The City Engineer and planning department contribute an in-depth knowledge of specific features of the site, such as its history of ground contamination, the priorities or needs of neighbors, and local stormwater management priorities. The developers provide an outline of their site plan, their cost and scheduling priorities, and information on how the development will be used. This dialogue allows the City Engineer to suggest a GI project that takes maximum advantage of the site and matches the needs of the municipality and the developer.

In recent years the Springfield City Engineer has used these meetings to encourage developers of 30-40 commercial properties to incorporate stormwater infiltration systems into their site plans. These infiltration systems are usually a good option in Springfield because of its relatively low level of soil contaminants. Developers have enthusiastically embraced the infiltration systems because they obviate the need for onsite water treatment facilities that are expensive and take up valuable space, or for undertaking an expensive connection to the city's sewer system.

Exemplary Code Language:

> Springfield Zoning Code § 12.1.21:
>
> The following list provides the sequence of steps for the applicant as summarized in Diagram 12.1:
>
> A. An applicant for any type of DEVELOPMENT review is advised to first contact the BUILDING COMMISSIONER 'S Office for advice as to which type of review is

101 Interview with Chris Cignoli, *supra* note 32.

102 *Id.*

required, as provided in Section 11.1.11. The BUILDING COMMISSIONER'S Office will make an initial screening review of the proposed project and indicate to the applicant whether one of the TIERED REVIEWS will apply to the application, and if so, which one.

IV. Landscaping

Municipalities can encourage small-scale GI projects such as swales and rain gardens by ensuring that local codes allow such projects in all areas that are normally landscaped, or by encouraging landscaping in areas that are not usually landscaped. The proliferation of GI landscaping requires adaptive, creative thinking that takes advantage of small opportunities for stormwater infiltration. Municipalities can encourage private developers to be creative in the use of landscaping by using code language to point out new possibilities for permeable landscaping. Bellingham's subdivision regulations contain a provision that educates developers about the possibility of incorporating landscaping into a cul-de-sac.

Exemplary Code Language:

Bellingham Subdivision Regulations § 245-12-Streets-(C)(3)(c):

Cul-de-sac may have landscaped islands to reduce impervious surface and runoff.

V. Green Roofs

Cambridge's Code of Ordinances includes a section on green roofs, with the purpose of removing "potential impediments to the development of green roof systems on new and existing buildings."[103] These provisions provide a great example of how a particular type of GI can be incorporated into a code in order to facilitate its implementation.

The green roof provisions setting out the purpose of the section (§ 22.31, see below) provide clarity by letting developers know that Cambridge is in favor of green roofs and will be accommodating to developers seeking to include them in projects. Adding language that makes a municipality's GI priorities clear is an effective, no-cost way to create incentives to GI development. The provisions also create an additional incentive by not counting usable space created by green roofs against a building's Gross Floor Area.

103 Cambridge Zoning Ordinance § 22.31.

Exemplary Code Language:

Cambridge Zoning Code § 22.31:

Purpose. The purpose of this Section is to remove potential impediments to the development of green roof systems on new and existing buildings by clarifying that such systems should not count against a building's Gross Floor Area, and by providing for limited access and enjoyment of green roofs by occupants of a building.

Cambridge Zoning Code § 22.32:

Functional Green Roof Area shall be defined as area atop a roof surface on a building, open to the sky and air, which is surfaced with soil and living plant materials for the purpose of retaining rainwater and absorbing heat from sunlight. The depth of soil and planted material shall be at least two (2) inches to be considered Functional Green Roof Area. For the purposes of maintaining the plant material, Functional Green Roof Area may be accessible by means of a roof entrance.

APPENDIX B: COST CASE STUDIES

The following case studies highlight ways that local governments can address the cost uncertainty surrounding GI projects:

(1) In order to pacify local concerns about the loss of property tax revenue resulting from the acquisition of open space for GI projects, **Alachua County, Florida** compared the cost of reduced tax revenue to the benefits of increased property values. Using data provided by the local property assessor, the county conducted a regression analysis of property sales. The assessor's data provided information regarding an individual property's age, size, type, heating and air-conditioning systems, and number of bathrooms and bedrooms.[104] The county then merged these data with information regarding each property's location, including its proximity to the downtown business district and water or open space. By incorporating all of this information into its ultimate calculus, the county was able to assess the impact of new recreational spaces on property values. The county concluded that "proximity to open space adds about $8,000 to $10,000 to parcel value" and that, in some "medium-density areas that touch open space and parcels of vacant land, the increase in value is as high as $25,000 per parcel."[105]

More recently, Alachua County collaborated with the University of Florida to conduct additional research regarding the effects of land acquisition on property values. In a study to be published later this year, a student at the University of Florida found that "new purchased conservation lands in Alachua County from 2002 to 2010 [have had a] positive influence on single family property values."[106] The study further found that, "the earlier the conservation lands were purchased, the more positive influence they [had]."[107]

(2) The **City of Aurora, Illinois** implemented a Naturalized Stormwater Management Corridor Plan, which seeks, in part, to prioritize sites where future GI projects will be the most cost-effective. The City found, for example, that the capital cost of constructing three bioretention basins in a local park would be $70,000 less than installing a sewer system in the same location.[108] Additionally, the City planned to install rain gardens at 28 intersections in 2013. These intersections were chosen both "because they would eliminate the need for future storm sewer [systems]" and

104 *Case Studies*, *supra* note 47, at A-13.

105 *Id.* at A-14.

106 E-mail correspondence with Dan Chen, University of Florida student (Mar. 4, 2014).

107 *Id*.

108 Lisa Balcerak, *No Gray Area*, Municipal Sewer & Water (Oct. 2012), *available at* http://perma.cc/3AX-8JXT.

"because there is a need to reduce traffic speeds at those intersections."[109] The GI development at the intersections also included "a reworking of the curb lines," which contributed to "a traffic calming benefit."[110] Originally, the estimated capital cost of constructing these gardens was $1.7 million, while the estimated cost of installing grey infrastructure to provide a similar level of discharge reduction was $3.5 million.[111] These initial estimates proved to be lower than the actual cost of construction; however, the City "also constructed several conventional storm sewer projects recently, and costs for both approaches have increased by about the same factor."[112] These increases totaled $2.6 million for green infrastructure and $5.4 million for grey."[113]

(3) The **Los Angeles County Department of Public Works (LACDPW)** examined the benefits of implementing GI/LID programs to address local flooding problems. In conducting this analysis, LACDPW de-emphasized the capital costs of investing in GI/LID. Instead, it highlighted the mosaic of future benefits associated with GI development, "including water conservation, recreational opportunities, improved community aesthetics, increased wildlife habitat, and reduced stormwater pollution."[114] LACDPW's examination indicated that, although the capital costs of implementing GI/LID were greater in this context than those required to implement grey infrastructure, the long-term benefits justified the higher initial expenditure. This conclusion served two purposes. First, "[b]y looking at the benefits per unit cost, rather than just lowest capital cost, LACDPW was able to provide a solution with more long-term value to the community."[115] Second, "[b]y quantifying the large number of benefits associated with projects incorporated into the plan, LACDPW has been able to engage the support of a wide range of agencies and stakeholders that might not otherwise have been interested in participating in, or providing funding for, the plan."[116]

The challenges intrinsic to such long-term forecasting, however, should not be overlooked. The cost of private land acquisition, for example, proved to be much higher than LACDPW first projected. Because many costs have increased since LACDPW's original 2004 analysis, the department recognizes the need to continue conducting case-by-case cost-benefit analyses for new

109 Interview with Eric Schoeny, Drainage and Underground Coordinator, City of Aurora (Mar. 3, 2014).

110 *Id*.

111 Balcerak, *supra* note 108.

112 Interview with Eric Schoeny, *supra* note 109.

113 *Id*.

114 *Case Studies*, *supra* note 47, at A-2.

115 *Id.*

116 *Id.* at A-8.

development.[117] This uncertainty also underscores the need for long-term projections to anticipate many potential scenarios and provide the flexibility local governments need to account for unforeseen costs and budgetary constraints.

(4) In a 2011 cost-benefit analysis, the **Milwaukee Metropolitan Sewage District (MMSD)** monetized a number of cost reductions associated with GI development. These benefits included a present worth savings of $46,000 over 20 years due to reduced tunnel pumping costs, property value increases totaling $2.7 million, and energy savings of up to $5,700 over 20 years due to energy use reductions resulting from increased shade.[118] The MMSD noted that, although these cost reductions appeared relatively small, the pilot area studied was also small. If such studies were applied to a larger nearby area, the MMSD projected that "the benefits [would] increase accordingly."[119] Like the PWD in Philadelphia, the MMSD also attempted to monetize the social and environmental benefits associated with GI development. These benefits included increased recreational spaces, job creation, carbon sequestration, and improved quality of life and aesthetics.[120]

(5) The **Philadelphia Water Department's (PWD)** $1.6 billion "Green Cities Clean Waters" program introduced the concept of a "triple bottom line analysis" (TBL), a phrase that "has become recognized in municipal asset management to emphasize the financial-social-environmental aspects of a complete benefit-cost analysis, rather than only the financial."[121] The PWD's TBL analysis assigned a market value to such benefits as increased recreational user days, wetlands created or restored, reduced carbon emissions, heat-stress mortality reduction, and increased green collar jobs.[122] The plan indicated that, over a 20-year period, these TBL benefits would "add up to a present value of $2.2 billion dollars."[123]

(6) An 80-acre subdivision in **Prince George's County, Maryland** installed open drainage swales on single lots in order to mitigate runoff, thereby avoiding the need to construct detention ponds or gutters. Installation of the swales cost $500 per lot, or $100,000 total for all 200 homes. The projected cost of constructing new detention ponds would have been $400,000.[124] Further,

117 *Id.*

118 *Determining the Potential*, *supra* note 48, at x.

119 *Id.*

120 *Id.* at 59.

121 *Case Studies*, *supra* note 47, at 2.

122 Featherstone, et al., *supra* note 46, at 10.

123 Brian Phelps, *Triple Bottom Line of Green Infrastructure*, Green Infrastructure Digest (Nov. 18, 2009), http://perma.cc/PMF4-SUF9.

124 Susan D. Kocher, et al., *Living Among the Fish*, University of California Division of Agriculture and Natu-

because the swales required significantly less surface area than the detention ponds, the space savings allowed the subdivision to construct six additional lots.[125]

(7) In 2001, **Seattle Public Utilities (SPU)** piloted a GI program known as the Street Edge Alternative project. The program reduced the amount of impervious surfaces on streets to 11 percent less than a traditional roadway, promoted surface retention in swales, and planted 100 trees and over 1,000 bushes along street edges.[126] The City concluded that, by eliminating the capital cost of installing conventional stormwater control designs, it garnered savings of approximately $100,000 per block while maintaining the same level of porosity.[127] SPU also emphasized the long-term savings associated with the project, including the natural maturation process of many GI systems; for example, the efficacy of planted vegetation may actually increase as it grows, whereas grey infrastructure is more likely to degrade and require rising O&M costs.[128]

RAL RESOURCES PUBLICATION 8279, at 18 (2008), *available at* http://perma.cc/NY3U-SB7Z.

125 *Id.*

126 Seattle Public Utilities, *Street Edge Alternatives*, http://perma.cc/M9K3-7PKL.

127 Center for Neighborhood Technology, *The Value of Green Infrastructure* 23 (2010), *available at* http://perma.cc/U2DC-3EHY.

128 *Id.*

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