ASSESSING THE MARKET SIZE FOR LARGE-SCALE ADOPTION OF GREEN INFRASTRUCTURE IN THE GREAT LAKES BASIN

Prepared by:

ECT Environmental Consulting & Technology, Inc.
www.ectinc.com

Corvias

encourage capital

January 2017

This page intentionally left blank as this report is meant to be printed double-sided.

ACKNOWLEDGEMENTS

Environmental Consulting & Technology, Inc., (ECT) extends our sincere appreciation to the individuals whose work and contributions made this project possible. We thank Russell Van Herik, David Rankin, and Shannon Donley of the Great Lakes Protection Fund for funding this project and providing valuable guidance, direction, and oversight throughout the process.

Many experts contributed their time, effort, and talent in the preparation of this report. The Project Team acknowledges the contribution of each of the following, and thanks them for their efforts:

- Dean Amhaus, The Water Council, Wisconsin
- James Gephardt, Finance and Resiliency Center, U.S. Environmental Protection Agency, Washington D.C.
- Keith Haas, Racine Water Utility, Wisconsin
- Mami Hara, Seattle Public Utilities, Washington
- Juli Beth Hinds, Consultant and University of California – San Diego, California
- Dominique Lueckenhoff, U.S. Environmental Protection Agency, Maryland
- James McGoff, Indiana Finance Authority, Indiana
- Scott Royer, Veolia Water, Wisconsin
- Kevin Shafer, Milwaukee Metropolitan Sewerage District, Wisconsin
- David Ullrich, Great Lakes and St. Lawrence River Cities Initiative, Illinois

.

In addition to the above, thanks are due to Seth Brown (of Storm and Stream Solutions, LLC) and John Andersen (of Greenleaf Advisors, LLC) for their careful reviews and thoughtful comments.

For the purposes of citation of this report, please use the following:

"Assessing the Market Size for Large-scale Adoption of Green Infrastructure in the Great Lakes Basin", S. K. Sinha, R. Pettit, J. Ridgway, A. Eidson, J. Silfen, G. Peralta, and G. Cannito, Environmental Consulting & Technology, Inc., Report, 46 pp, January 2017.

Lastly, any related communications can be directed to the following.

Sanjiv K. Sinha, P.E., Ph.D. (Project Director)
Environmental Consulting & Technology, Inc. (ECT)
2200 Commonwealth Blvd, Suite 300
Ann Arbor, MI 48105
734-769-3004
ssinha@ectinc.com

TABLE OF CONTENTS

List of Figures

List of Tables

1.0 EXECUTIVE SUMMARY

This report presents the initial findings of an initiative to expand the use of green infrastructure in the Great Lakes Basin through the use of private financing and/or private delivery. The Great Lakes Basin includes parts of the states of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin. This work is funded by the Great Lakes Protection Fund (GLPF).

This report attempts to assess the market size for large-scale adoption of green infrastructure in the Great Lakes Basin. By "large-scale", the report assumes at least $50 million in green infrastructure investment. A set of regulatory and other drivers are identified, and a decision tree is presented that can be used to answer two questions: 1) what conditions enable a community to look to the private sector for the delivery or finance of their green infrastructure needs, and 2) which communities can attract private sector interest.

This report assesses the market size for large-scale adoption of integrated green infrastructure, with an emphasis on communities that could best benefit from utilizing green infrastructure to address their stormwater management challenges. For the purposes of this report, "large-scale" is an investment of at least $50 million in green infrastructure for a single or multiple projects in a region. This is the entry level cost point for many service delivery vendors and/or the private finance community. A set of regulatory and other drivers are identified, and a decision tree is presented that can be used to answer two questions: 1) what conditions enable a community look to the private sector for the delivery or financing of their green infrastructure needs, and 2) which communities can attract private sector interest. These relatively simple questions are complicated by multiple technical and financial constraints that vary from community to community and state to state. However, in spite of the locally specific challenges, the report shows that private delivery or (full or part) financing of large-scale green infrastructure can be the least cost approach for addressing a community's stormwater challenges.

For the purposes of this work, green infrastructure is defined as *an engineered stormwater management solution that mimics natural ecosystem processes and services*. By improving stormwater management, groundwater recharge, and flood mitigation, communities have used green infrastructure to effectively enhance community safety and quality of life. Utilizing both natural and engineered systems, a comprehensive green infrastructure program can minimize and clean stormwater runoff, increase groundwater recharge, conserve ecosystem functions, and provide a wide array of benefits to people and wildlife. Green infrastructure solutions can be implemented on differing scales ranging from site-level installations to broader, watershed-level efforts. On the local scale, green infrastructure practices include rain gardens, permeable pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting systems. At the largest scale, the preservation and restoration of natural landscapes (such as forests, floodplains, and wetlands) provide additional benefits to the larger green infrastructure program.

A series of interconnected topics are addressed below which influence both the governmental and private parties that may be considering a partnership.

<u>Market-size of large-scale green infrastructure in the Great Lakes states</u>

The states of Ohio, Minnesota, Wisconsin, Illinois, and Indiana, collectively, have a large and growing number of stormwater utilities that generate a dedicated revenue stream, a portion of which could be used to support private financing/delivery of large-scale green infrastructure. Assuming a 4 percent rate of return and a 30-year term, Lueckenhoff and Brown (2016) state that every million dollar in stormwater utility fee can be leveraged to an additional $13.5 million in capital that can be used to fund both soft costs (programmatic) and hard costs (implementation and maintenance of green infrastructure). At 13.5 leverage, a community that generates $3.7 million every year can raise $50 million in additional capital.

Accordingly, if the existing stormwater utilities with annual revenues more than $3.7 million were to direct a third of their fees to green infrastructure implementation, these five states alone could support a $912 million investment in green infrastructure. In addition, an additional $225 million market exists for communities that can support an investment between $10 million and $50 million. Thus, cumulatively, *assuming a third of the fees can indeed be allocated to green infrastructure*, these five states alone can support well over a billion dollar investment.

Note if lower rate interest capital is accessed, say through a Clean Water State Revolving Fund (CWSRF) loan of 1.25 percent over the same 30-year term, every million dollar in stormwater utility fee can now be leveraged to an additional $19.3 million in capital. In that case, a third of the annual fees from communities that generate enough fees to access a $10 million investment, can now support a $1.6 billion green infrastructure market.

A word of caution is necessary here. Market size valuation models are, at best, approximate, and typically rely on the assumption that the future will look like the past (Gurley 2014). The truth is changes in regulatory and other policies, adoption, price points, and new use cases, can significantly change the market size.

What is also important to note is that states such as New York, Pennsylvania, and Michigan have no or very few stormwater utilities in place, and are thus harder to assess. While these states can use CWSRF loans as a potential revenue source for large-scale implementation, they are at a disadvantage due to less-friendly stormwater utility environment.

Market drivers for large-scale adoption of green infrastructure

Based upon our analyses, key drivers of market size of large-scale adoption of green infrastructure include:

- *Leadership:* The communities that have made the most progress on green infrastructure implementation have been those communities that have innovative leadership. These communities include the cities of Philadelphia and Washington D.C., and Prince George's county, all of which also have significant stormwater challenges. Private sector delivery firms as well as investors seek opportunities where leadership has proven to be successful at guiding the disparate levels of government to embrace a new, different, yet cost effective approach to stormwater management.
- *Cost effectiveness of adopting green infrastructure at a large-scale*: Significant cost savings are also a key driver of market size. On an individual scale, for nearly 500 projects, survey data published by American Society of Landscape Architects (ASLA 2011) shows cost savings by using green infrastructure over gray infrastructure. On a large-scale, implementations of green infrastructure in the cities of Philadelphia, New York City, Portland, and Milwaukee, clearly show the benefits of mass-scale implementation. Based on these comparisons, the following conclusions are made:
    - For individual projects, the costs and savings vary with the type of BMPs used. Still, in a majority of

Large scale adoption of green infrastructure provides significant economies of scale, and in the case studies presented here-in, savings of using large-scale green infrastructure ranged from 40 percent to 96 percent of the total project cost.

the instances reported by ASLA (2011), green infrastructure is cheaper to use than engineered gray solution.
    - Large scale adoption provides significant economies of scale, and thereby allows for large savings. Savings for case studies reported here-in ranged from 40 percent to 96 percent of the overall cost.
- *Availability of a dedicated revenue stream through an existing or future storm water utility:* Once a community chooses to commit to large-scale stormwater improvement, its ability to repay the investor is key to its ability to move forward. Similar to public bonds or CWSRF loans, private investors must be assured of repayment the initial capital as well as a return on the initial capital invested. Accordingly, a review of a community's ability to finance a project is a good, first-step guide for a community as well as an investor.
- *Strong regulatory drivers:* Communities rarely rebuild their infrastructure without something or someone causing them to make the financial commitment. Regulatory programs have served as significant drivers for green infrastructure. At the federal level, these programs primarily relate to the Clean Water Act and its amendments. At the state and local levels, these programs include local stormwater management standards and/or fees that require/incentivize flow and quality management.
- *Efficient and cheaper project delivery that can be credit-positive:* A key driver of large-scale adoption is also mass-scale delivery leading to cheaper installations and maintenance. Among delivery options, community based public private partnerships (CBP3) can design, build, finance, operate, and maintain (DBFOM) infrastructure sustainably by aggregating thousands of individual stormwater management projects. This arrangement creates economies of scale and efficiencies that assures resiliency while addressing large-scale stormwater treatment needs in compressed timeframes through a more efficient project delivery system. A CBP3 also allows the public partner to maintain ownership and control over the infrastructure while delivering a community-based, socio-economic outcome.
- *Performance-based risk transfer:* Among innovative private financing options, large scale adoption may require private capital/finance where returns are based on performance. Backed by public credit worthy commitments in contracted revenue streams, framed carefully, these partnerships (such as an Environmental Impact Bond or an EIB) could include returns commensurate with the risk assumed and competitive resource/expertise delivered by the private sector. This type of investment de-risks the innovation for a municipality and allows them to install large scale demonstration projects for green infrastructure with which they can gather metrics on its effectiveness.

A report on the use of CBP3 in Prince George's County in Maryland showcases nearly 30 percent savings in project implementation due to lowered transaction costs, reduced retained risk, savings related to construction, and O&M (PGC DOE 2016).

A key benefit of a P3 is its ability to be credit-positive for a public entity. For example, evaluating a 2016 agreement between Wayne State University and Corvias, Moody's Investors Service rated the partnership as credit positive for the university because it allowed them to free-up $102 million of their balance sheet for other borrowing needs (Colomer 2016).

Among private financing vehicles, EIB offer returns based on performance, significant data gathering, and allowing a municipality to make smarter planning decisions in the future. As a consequence, it can be used a first step to a long-term CBP3 framework.

This sort of financing offers multiple benefits to a municipality. The primary benefit is that by altering the return based on performance, the municipality is essentially able to pay a more accurate price for the cost of the project, and the cost per gallon managed is held to a reasonably constant rate. The second benefit is that projects financed in this way naturally churn off considerable amounts of data, and the municipality can accurately assess the most effective types of green infrastructure for their geography and the cost that it takes to construct it. Lastly, the ultimate benefit is that it allows a municipality to make smarter capital planning decisions in the future.

- *Constraints and barriers to the use of green infrastructure:* Green infrastructure is only effective when the selected practice matches the site specific needs. Green infrastructure practices must be selected that: 1) preclude impact on local flooding; 2) allow regular maintenance to ensure long term performance; 3) collect information on green infrastructure's performance, especially over the long-term; 4) comply with the differing (often competing) policy frameworks at local, regional, and state levels; and, 5) and be implemented within the local budgeting constraints. Lastly, there are significant differences between budgeting for green and gray infrastructure that can further limit the ability to fund green infrastructure.
- *Enabling legislations:* The contractual relationship between a community and a private entity is controlled and facilitated by state and local legislations. The eight Great Lakes states have varying public-private partnership (P3) legislative histories and legal standards. Only two Great Lakes states, Michigan and Indiana, have enacted P3 legislation for non-transportation projects. The nature of these legislations allows for construction of many types of non-traditional P3 engagements, which can include stormwater projects that benefit the public. The state of New York, on the other hand, has no existing P3 legislation. The remaining five Great Lakes states (Illinois, Ohio, Wisconsin, Minnesota, and Pennsylvania) have P3 enabling legislations focused on the transportation sector.

  Absence of a stormwater P3 legislation is not entirely prohibitive but its presence greatly facilitates the enactment of a CBP3. Other ways to enact CBP3s include the use constitutional amendments that the Great Lakes states have adopted, that grant Home Rule status to their cities; and in New York, the use of 2011 Infrastructure Investment Act, both to be discussed in later sections.

In the Great Lakes, only the states of Michigan and Indiana have enacted P3-enabling legislations that allow for non-transportation projects. In other states, so long as it is not specifically prohibited by state law, cities can use Home Rule to enact CBP3 frameworks.

Next Steps

This document serves as a roadmap for both private-sector and governmental entities to effectively determine if implementation of large-scale green infrastructure will meet their needs and benefit both parties. The document summarizes the current legislative environment, defining what is possible under current regulations throughout the basin, and identifies where additional legislation would be helpful. The information is consolidated in an assessment of the market size for private delivery/financing for green infrastructure in the region today.

A decision tree was developed and is presented in Figure 1-1 that can be used as a *preliminary* filter to assess the viability of a P3, and can assist communities as well as private companies. The decision tree combines the enabling legislation, home/Dillon rule areas, and regulatory drivers in the context of both municipal separate storm sewer system (MS4s) and combined sewer overflows (CSOs) communities.

Among CSO communities, the top five communities in the Great Lakes Basin that are good prospects for multi-decade P3s include Milwaukee, Cleveland, Toledo, Fort Wayne, and Lima Township in Ohio. Prospects for smaller scale private-sector engagement, on the other hand, include cities of Valparaiso, Superior, Marion, and Warren. Communities with smaller utility revenues such as Goshen, Ossian, Oak Harbor, and Norwalk, may also attract interest so long as they are able to coalesce the needs of their stormwater programs with other communities,

Among MS4 communities, the top five communities that are good prospects for multi-decade P3 type frameworks include Lake County, Oshkosh, Ann Arbor, Appleton, and Kenosha. Prospects for smaller scale engagement include Painesville, Marinette, Elkhart county, and Manitowoc.

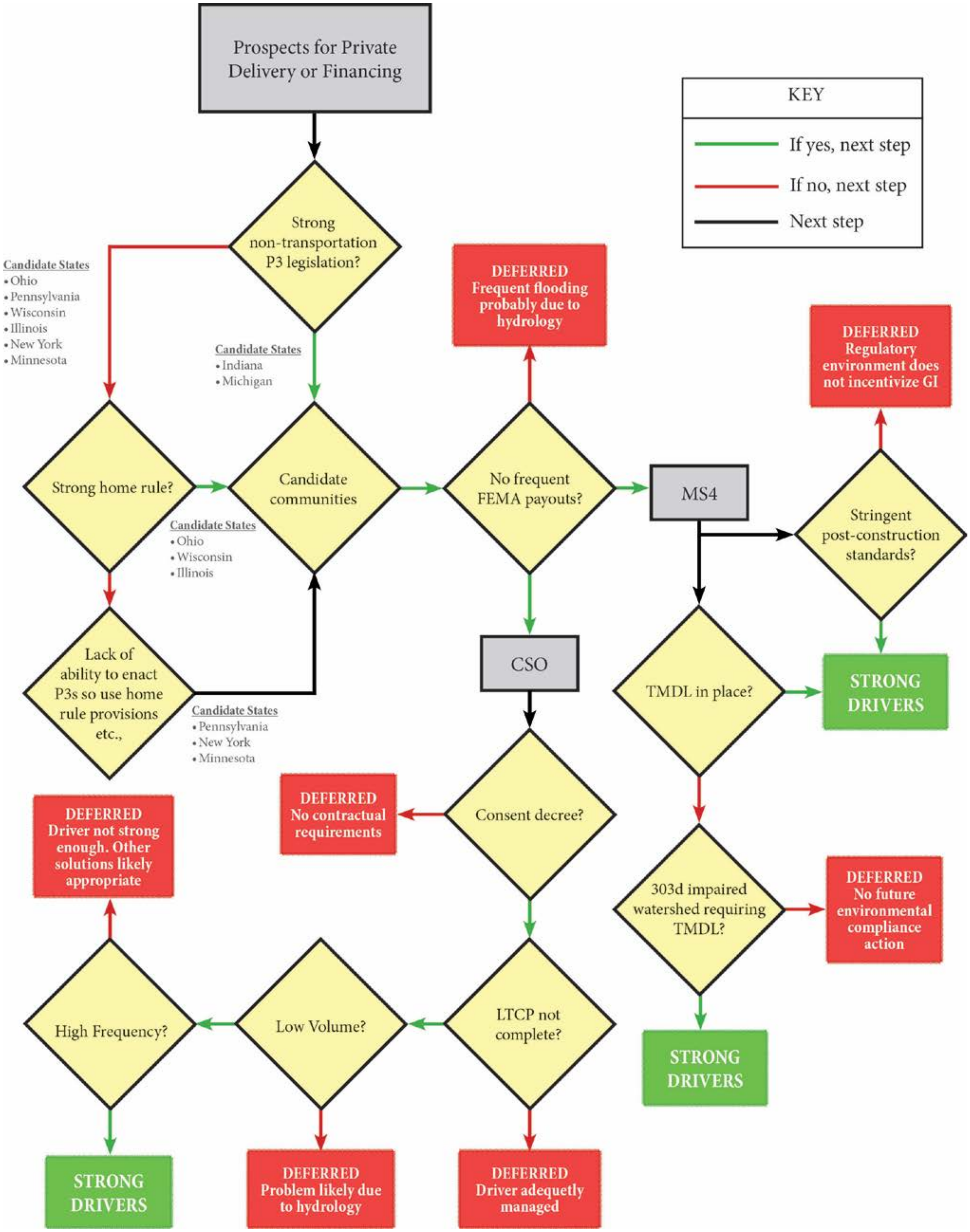
Finally, a set of next steps to further encourage the use of large-scale implementation of green infrastructure are outlined below:

- Assess stormwater infrastructure funding needs and available funds in the Great Lakes Basin as a clear understanding of this investment gap may drive public policy.
- Develop and execute a coordinated campaign to enact similar P3-enabler legislations across the Great Lakes Basin (as well as the country).
- Provide guidance to the United States Environmental Protection Agency (EPA) in future regulatory updates that continue to promote green infrastructure as a controlling technology on a large-scale.
- Develop a One-Water Champions framework which promotes smaller communities to use green infrastructure by pairing them with a larger one, like a mentor-mentee relationships.
- Develop a Green Infrastructure Funders Collaborative that seeks to connect private delivery/finance companies with municipalities and other groups.
- Promote the adoption of stormwater utilities across the Great Lakes Basin.
- Promote the use of consistent green infrastructure ordinances across the Great Lakes Basin.
- Assess the use of green infrastructure in rust belt communities that plan to reduce their footprint.

Based solely on the amount of revenues from existing stormwater utilities, top five CSO communities in the Great Lakes that may be good prospects for CBP3s are Milwaukee, Cleveland, Toledo, Fort Wayne, and Lima Township.

Among MS4 communities, good prospects include Lake County, Oshkosh, Ann Arbor, Appleton, and Kenosha.

Figure 1-1: A composite decision tree describing the P3 statutes and regulatory drivers



2.0 LARGE-SCALE ADOPTION OF GREEN INFRASTRUCTURE: BENEFITS, CONSTRAINTS, AND BARRIERS

This chapter summarizes the benefits a community can recognize through the implementation of large scale green infrastructure with full recognition of the constraints and barriers imposed on them. Many communities have underinvested in stormwater infrastructure for decades, and have competing needs that make full financial commitment difficult. The few communities that are on the path of successful implementation of large scale green infrastructure programs have done so through progressive leadership, regulatory insistence, and/or judicial direction. However, as more and more communities are looking for ways to improve their outdated drainage systems and transform them into resilient, cost effective community assets, green infrastructure has gained substantial momentum.

Large scale implementation of green infrastructure allows a community to rapidly enjoy the environmental (and financial) benefits offered by innovative stormwater management. In recognition of the massive impact that urban stormwater has on water quality, regulators and municipalities are seeking better, more cost effective ways of managing stormwater. This is shifting the stormwater management practice from rapid conveyance of peak stormwater events to measures that capture these peak events, infiltrate a significant portion, and release the captured stormwater in a controlled manner. Green Infrastructure has an important role in this conversion. The conversion from traditional practices to innovative stormwater management can take decades to accomplish if implemented in a piece-meal manner. This, of course, means that the environmental benefits and community co-benefits realized are also delayed by decades. A more aggressive and cost effective approach is to deliver large scale conversion of the (often aging) drainage system and finance the conversion over the period of realized benefits.

To date, a large number of the installed green infrastructure has been implemented by municipalities that have relied on grant funds for construction. The small, often uncoordinated nature of these installations makes measurement of benefits inconsequential. The benefits become meaningful (and measurable) when the practice is installed at large-scale. Creating large-scale, integrated infrastructure using a mix of natural systems and constructed systems has many challenges, that include: 1) lack of sufficient funds into stormwater maintenance/restoration – a traditionally underfunded portion of municipal infrastructure, 2) lack of policies that encourage private property owners to store, infiltrate, and slowly discharge stormwater – through regulation and/or stormwater fees, and 3) changing the practices of municipal planners and operations staff in how stormwater is cooperatively managed - including roads, parks, buildings & safety, and sewer authorities.

To realize the maximum environmental – and financial – benefits, green infrastructure solutions should be implemented by various entities on differing scales ranging from site-level installations to broader, watershed-level efforts. On the parcel level scale, green infrastructure practices include rain gardens, permeable pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting systems. Large-scale green infrastructure, however, refers to much larger parcels that government can build, such as managing road drainage in a manner that encourages infiltration and utilizing public lands to store and infiltrate rainfall. The use of appropriately designed green infrastructure can build support by providing attractive green spaces. At an even larger scale, the preservation and restoration of natural landscapes (such as forests, floodplains, and wetlands) provides additional benefits to the total stormwater management program.

2.1 INDIVIDUAL GREEN INFRASTRUCTURE PROJECTS VERSUS LARGE-SCALE ADOPTION: CONTRASTING THE BENEFITS

The implementation of green infrastructure to date has rarely been optimized to match green practice to sites that yield the largest benefit in terms of quantity captured and pollution removed. Instead, grants were provided to willing participants with available sites. Measurable benefits are typically neither required nor measured. A larger adoption will need better planning and buy-in from a larger group of stakeholders.

Early reports produced by national groups, including the U.S. Environmental Protection Agency's (EPA) *Reducing Stormwater Cost through Low Impact Development (LID) Strategies and Practices (EPA 2007),* suggested that green infrastructure was less costly in nearly all situations. Subsequent works by municipalities and the EPA have concluded that the most resilient solution with the least cost is a combination of gray infrastructure augmented by green infrastructure (*Odefey 2012*). Some notable work products on this topic include (see additional bibliography details at the end of this report):

- Banking on Green (Odefey et al 2012).
- Northeast Ohio Regional Sewer District Green Infrastructure Plan, 2012.
- The Value of Green Infrastructure, 2010.
- Milwaukee Metropolitan Sewer District Regional Green Infrastructure Plan, 2013.
- A Business Model Framework for Market-Based Private Financing of Green Infrastructure, 2014.

While all communities support a healthy environment, financial constraints pose a very practical challenge for public works professionals. Much of the economic analysis performed to-date to substantiate the investment in green infrastructure has relied on "triple bottom line benefits", realized by three interrelated categories of benefits: economic, social, and environmental. This analysis has value when measuring the sustainability of a given project, but is largely irrelevant to a public works official working within a very constrained budget (unless their constituents value and demand it) and/or a private investor seeking a return on their investment (including entities funding "social impact" efforts).

Green infrastructure can provide multiple other benefits for municipalities, other than reduced costs for treating large amounts of polluted runoff. A 2011 compilation that American Society of Landscape Architects (ASLA) developed included input on 479 case studies from 43 states, the District of Columbia, and Canada, and the value of promoting green infrastructure policies to policymakers. The report's findings included the following:

- Green infrastructure can help municipalities reduce energy expenses.
- Green infrastructure can reduce localized flooding and related flood damage.
- Green infrastructure improves public health — it reduces bacteria and pollution in rivers and streams, preventing gastrointestinal illnesses in swimmers and boaters.

Projects reported in ASLA (2011) varied greatly in reported cost savings. On the high end, over 50 percent cost reduction was reported in a project in Ohio, while a Minnesota green pavement project was 50 percent more expensive than gray infrastructure (see Table 2-1). The type of green infrastructure and the specific location chosen for any individual application was shown to dictate whether or not the practice is cost-effective.

Table 2-1: Analyses of green versus gray costs in Great Lakes states (ASLA 2011)

green infrastructure COST SAVINGS	STATE	DETAILS	PROJECT TYPE	GRAY OR GREEN INFRASTRUCTURE COST-EFFECTIVE?
High	Ohio	Green infrastructure is 20 percent of cost of Gray infrastructure	Bioretention, green roof, bioswales, permeable pavers, CSO avoidance and compliance instrument	Green
	Ohio	Green infrastructure is 50 percent of cost of Gray infrastructure	Bioretention, green roof, bioswales, permeable pavers, CSO avoidance and compliance instrument	Green
	Illinois	Significantly cheaper per avoided gray installations	Pervious pavers	Green
	Minnesota	Avoided incurring stormwater fees	Bioretention, green roof, bioswales, permeable pavers	Green
Moderate	Indiana	90 percent of cost of Gray infrastructure	Rain gardens, porous pavers, curb cuts	Green
	Indiana	Lower overall cost	Bioretention, green roof, bioswaler, permeable pavers, CSO avoidance and compliance instrument	Green
	Illinois	Lower overall life cycle costs	Bioretention, green roof, bioswales, permeable pavers	Green
	Indiana	Green capital costs higher, but long term costs less	Bioretention facility and bioswale	Green
Low	Indiana	Savings in maintenance and site development	Bioretention facility and bioswale	Green
	Indiana	Slightly reduced costs	Rain gardens, porous pavers, curb cuts	Green
N/A	Minnesota	Construction and site development restrictions made G.I. the only option	Bioretention, green roof, bioswales, permeable pavers	Green
None (G.I. more expensive)	Wisconsin	Slightly more expensive overall	Bioretention, green roof, bioswales, permeable pavers	Gray
	Minnesota	Slightly increased costs	Bioretention, green roof, bioswales, permeable pavers	Gray
	Minnesota	Green costs 9 percent higher than gray	Bioretention, green roofs, bioswales, permeable pavers	Gray
	Minnesota	Green pavement 40 percent more	Pervious pavement and other treatment options	Gray

Overall, however, even in the instance of individual projects, ASLA (2011) reported that the use of green infrastructure resulted in costs that were less or the same in nearly 75 percent of the projects (see Figure 2-1).

The potential benefits offered by large-scale green infrastructure implementation are available for regulation-driven projects that require specific and substantial volume reductions. In these cases, the volume reduction is known and the cost of the "gray" solution is substantial so the community has an incentive to quickly identify the least cost green infrastructure program and begin implementation. CSO consent decrees have generated data on the use and benefits especially in large urban settings. A comparison table of CSO related costs/benefits in cities of Philadelphia, New York City, Portland, and Milwaukee is presented in Table 2-2. These cities range in their level of investments in green infrastructure, with Portland investing nearly $9 million on the low end while the city of Philadelphia investing nearly $3 billion. At these scales, the savings-to-cost ratio exceeded 0.63 for all the cities.

Figure 2-1: Cost implications of using small-scale green infrastructure (ASLA 2011)

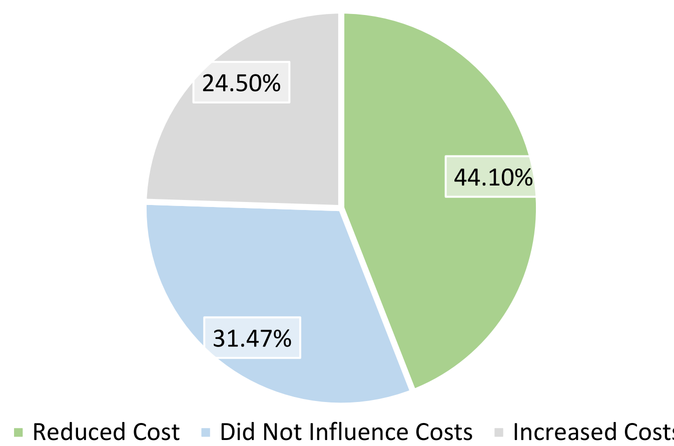


Table 2-2: A comparison of projected savings-benefits/costs of the large-scale use of green infrastructure in Philadelphia, New York City, Portland, and Milwaukee (EPA 2010, Milwaukee Metropolitan Sewerage District 2013, New York City Department of Environmental Protection (n.d.), and Philadelphia Water Department 2011).

MEASURE	MILWAUKEE, WISCONSIN	NEW YORK CITY, NEW YORK	PHILADELPHIA, PENNSYLVANIA	PORTLAND, OREGON
Stormwater volume detained (annual gallons)	14.8 billion	12.1 billion	19.9 billion	116 million
Cost of green infrastructure investment	$1.3 billion	$2.4 billion (public and private funding)	$3.0 billion committed (public and private funding)	$9 million in green infrastructure
Cost savings by the use of green infrastructure (dollars)	$850 million	$1.5 billion	$5.6 billion over 25 years	$224 million (CSO maintenance and repair)
(Savings)/ (Cost of green infrastructure Investment + Cost Savings)	40 percent	38 percent	65 percent	96 percent
Economic benefits	Service area property value increase of $667 million due to greening of region	$139-418 million over the 20 year life of the project	$390 million in property value of homes near parks and green areas over 45 years	13.6 percent - 17 percent increase in home values near sites

Overall, the following conclusions can be drawn:

- For individual projects the costs and savings are specific to the type of practice chosen for a given site. In a majority of the instances, green is cheaper than gray solution.
- Large scale adoption allows economies of scale to generate large savings-to-cost ratios. In the case studies presented above, these ratios range from 0.65 to 5.6.

For individual projects, the costs and savings are specific to the type of practice chosen for a given site. In a majority of the instances in the ASLA reported study (2011), green was cheaper than gray solution. On the other hand, because large scale adoption allows economies of scale, costs of using green infrastructure ranged from 60 percent to 4 percent of the total project cost

2.2 SITUATIONAL CONSTRAINTS OF GREEN INFRASTRUCTURE

Green infrastructure is only a portion of a larger drainage system which will always include natural drainage courses and engineered drainage systems. Green infrastructure increases infiltration, filters/cleans stormwater runoff, captures nutrients, and provides a number of co-benefits like green space, wildlife habitat, and reduction of urban heat island effects. Still, it requires more land than simply draining a site rapidly. If there are drivers that preclude rapid runoff, the regional financial benefits become apparent – even in areas with high property values. These drivers often take the form of permit requirements, stormwater ordinances, stormwater fees, and consent orders.

Other, less obvious constraints include reluctance to change. Green infrastructure transitions a high capital cost, low maintenance gray drainage system into a low capital cost, higher maintenance green system. This transition requires public works staff (or their contractors) to modify and adapt their contracting methods, the standard operating procedures, and their skill sets. The best programs allow green infrastructure to be built on public and private land in places where it does not compete with other uses and provides valuable green space, thus creating an opportunity cost of land in a way that gray infrastructure does not because it is buried. At the same time, this need for maintenance can create new opportunities for "green jobs" in communities surrounding green infrastructure.

Finally, some areas remain inappropriate for a solely green solution. Flood control and public safety remains the highest priority for public works professionals. In this regard, while green infrastructure offers multiple advantages, it may require augmentation using traditional gray infrastructure solutions.

Situational constraints to its use include:

- *Green infrastructure practice must be selected to preclude impact on local flooding* – Most green infrastructure practices are designed to capture and infiltrate stormwater, but care must be taken to assure that the modification does not exacerbate existing on-site and off-site flooding. For areas with significant flooding issues, use of green infrastructure may be a constraint.
- *Regular Maintenance is required to ensure long term performance* – Green infrastructure requires less up front capital but maintenance is required to extend the life of the chosen practice. Failure to perform maintenance decreases storage volume, infiltration, and more importantly, can create an eye-sore that is not supported by residents and neighbors. Regular maintenance also supports plant species/diversity.
- *Site specific constraints (like high ground water table) require special consideration and sometime require additional enhancements that add to the cost of implementation* - Site specific constraints limit the types of applicable green infrastructure practices to adequately address challenges like highly saturated soils and very low infiltration rates. While these challenges can be addressed with specialty practices (like infiltration enhancement and/or plant selection with high levels of evapotranspiration), these additional

enhancements can add to costs and may make traditional drainage practices more cost-effective.

2.3 BARRIERS TO LARGE-SCALE ADOPTION OF GREEN INFRASTRUCTURE

Beside the situational constraints outlined above, the largest barrier to full scale implementation remains the perception that green infrastructure is insufficient to address stormwater management across the entire range of flow conditions – from droughts to floods to repeated low frequency events. Some of these (unfounded) perceptions of the limitations of green infrastructure persist because:

- *Information on green infrastructure's performance, especially over the long-term, is lacking*: As in all stormwater management practices, pollutant removal effectiveness can vary within cities or watersheds, between different types of infrastructure, and even depending on the season and storm intensity. In addition, application-specific efficiencies of various practices are typically reported in the literature as average removal rates. Lastly, the pollutant removal data for heavy metals and toxics are not available as they are for pollutants such as nutrients and sediments.
- *Institutional hurdles make any type of change difficult:* These hurdles include lack of interdepartmental coordination and funding, and inadequate technical capacity and expertise among municipal leadership and government.
- *Concerns that changing climate could cause BMPs to lose their effectiveness over time*: For instance, a bio-swale that may be designed to handle rainwater from a low intensity rain event over a long period of time, may not function well during shorter, high intensity rain events. This concern, of course, is the same for gray infrastructure practices and can be addressed in design.
- *Competing policy frameworks at local, regional, and state levels*: In the United States, the existing drainage network is owned and operated by a large variety of public and private entities that respond to different drivers and units of governments. Traditional drainage practices are also subject to change, but not consistently or simultaneously. Lastly, some newer regulations and guidance serve to dissuade municipalities and/or private property owners from using the most environmentally beneficial practices.
- *Lack of overarching stormwater ordinances or incentives for private land owners dissuade them from building green infrastructure on their property*: Enactment of progressive, technically sound stormwater regulations and fees are the most effective means of driving green infrastructure on private property. Unfortunately, many municipalities have yet to seize upon this opportunity, and traditional drainage programs encourage private landowners to rapidly transport rainwater off their property leading to a number of environmental problems downstream.
- *Budgeting constraints and lack of capital, for initial installation as well as long-term maintenance*: Stormwater management has been underfunded for decades, and more often than not, upfront capital needed for large-scale investments are lacking. In addition, there are significant differences between budgeting for green and gray infrastructure that can further limit the ability to fund green infrastructure. There are significant differences between budgeting for green and gray infrastructure (see Table 2-3) that can limit the ability to fund green infrastructure.

Table 2-3: Contrasting gray and green infrastructure for budgeting considerations (Berahzer 2014, Sinha et al 2016)

FACTOR	GRAY	GREEN
Initial capital costs	Variable	Variable but typically less – Depends on the type of green infrastructure (e.g., green roof installation tends to be much higher than traditional roof; porous pavement can be more comparable to cost of traditional roads).
Frequency of O&M	Usually less	Usually more
Intensity of O&M	Usually more	Usually less
How standard is O&M regime?	Generally more routine and based on manufacturer's guidelines; less variability	May need to adapt to growth rate, weather, soil conditions, etc.
Precedence on O&M	Long history of O&M data to draw on	Limited long-term data on O&M costs
Level of skills involved in O&M	More specific skills may be necessary for maintenance	Usually more general skills, can even include community involvement in maintenance
Lifecycle costs	Usually higher	Usually lower
Design contingency costs	Tend to be lower	Tend to be higher
Construction contingency costs	Tend to be higher	Tend to be lower
Community willingness to pay	Usually lower	Usually community more willing to pay for maintenance
External costs to consider	More salting and plowing on traditional roads	Permeable pavements reduce public road maintenance expenses
Eliminates need for other infrastructure line items in budget?	Most often does not reduce need/cost for other types of gray infrastructure	Often eliminates need for other "gray" costs such as curbs, drains and stormwater conveyance tanks, pipes etc.
Triple bottom line benefits – social and recreational	Limited or no social and recreational benefits	While some costs can be quantified more easily (e.g., reduction in capital and O&M costs, or reduced fines for CSOs) there are also social and recreational benefits that are less easy to quantify, but may be worth considering.
Triple bottom line benefits – environmental and long term financial benefits		Potential avoided capital costs for treatment processes like flocculation and sedimentation, membrane filtration, etc. based on enhanced source water quality. Ernst (2004) found that water treatment costs for utilities decrease by approximately 20 percent for every 10 percent increase in forest cover across a watershed.

3.0 DELIVERY AND FINANCING OF LARGE-SCALE ADOPTION OF GREEN INFRASTRUCTURE: STATUTES, HURDLES, AND FEDERAL ASSISTANCE

Private financing and/or delivery of green infrastructure can allow a municipality to rapidly expand its green infrastructure implementation plans. These deals can be structured to allow municipalities to hand off various portions of control for green infrastructure to private parties – from financing alone, to construction, operation, and maintenance. Many private financing/delivery structures allow for municipalities to maintain ownership and control over the infrastructure, while delivering a community-based, socio-economic outcome. In these cases, private financing allows municipalities to create economies of scale and efficiencies that assures resiliency while addressing large-scale stormwater treatment needs in compressed timeframes through a more efficient project delivery system.

Among delivery (and financing, if desired) options for large-scale adoption, one innovative delivery option is a CBP3 that can be a viable alternative for municipalities that are seeking to quickly fund and implement large-scale green infrastructure all at once (See Figure 3-1) (EPA 2015). Generally, private sector players interested in CBP3 seek opportunities that are at least $50 million in size. In addition, CBP3s are designed to be in place for two or more decades at a time. The investment of time and energy required to create the partnership can yield valuable benefits for decades. Benefits of a CBP3 are many and include:

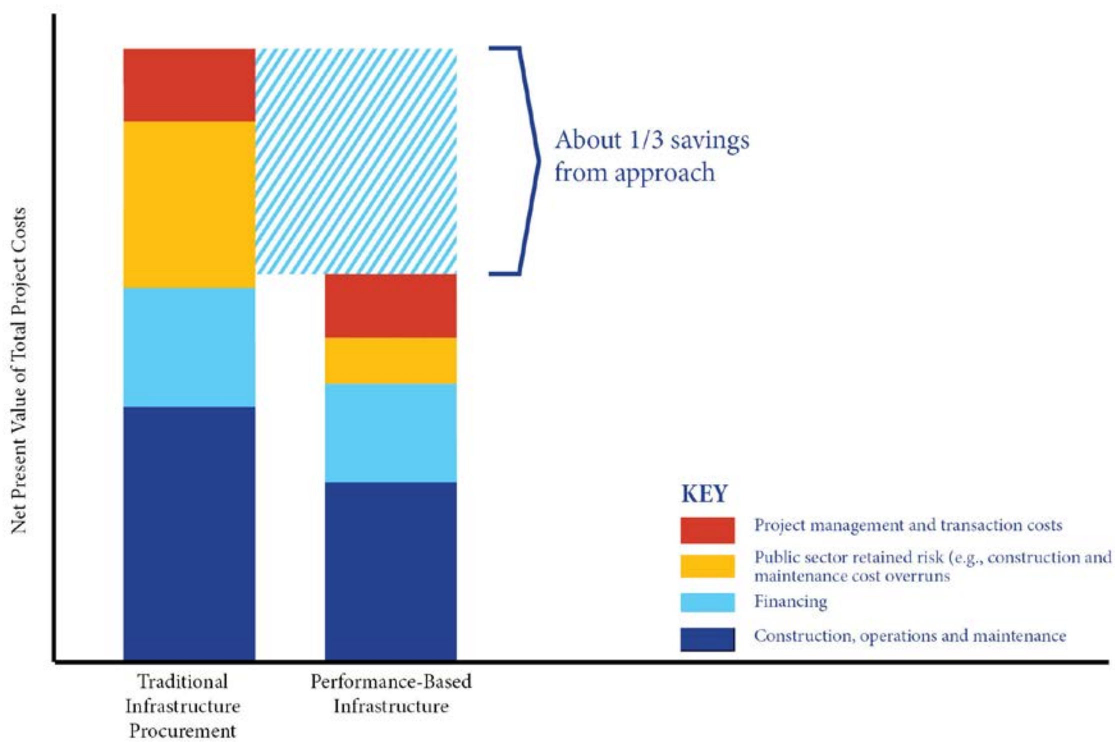
- Performance-based contracting provides assurances to the governmental entity.
- The public partner retains governance and decision authority.
- The private partner only receives the fixed, incentive-based fee upon performance. Fees are aligned with public entity interests and program goals such as local workforce inclusion and local hiring requirements.
- Financial risk can be transferred to the private sector in exchange for the dedicated revenue stream by the public partner.
- All program savings and residual cash-flow are returned to the public partner.
- Upfront capital investments can be obtained from the private partner. Public and private financing can be blended to reduce the cost of capital.
- Long-term operation and maintenance (O&M) remains the responsibility of the CBP3/private partner.
- Long term contracting encourages innovation and creates the incentive for adaptive management and operational flexibility.
- Utilizing a design/build delivery methodology limits construction risk and thereby reduces costs.
- Long-term contracts encourage rapid scale-up to meet project demands and financial funding requirements.
- Public and private financing can be blended to reduce capital costs.
- CBP3 drives local workforce development and creates long-term economic development for residents, at-scale.

Challenges of using a CBP3 include:

- Legal or statutory authority to establish a CBP3 varies state by state.
- Public perception can hinder institutional acceptance of a CBP3, based on past P3 projects.
- Fear of shifting regulatory requirements that would change performance requirements after entering a long term contract.

Figure 3-1: Example legal framework structure of a CBP3 partnership (EPA 2015)

Figure 3-2: Schematic showing the reduction of costs through the use of performance-based infrastructure offered through a CBP3 (based on CWP 2016)



Unwillingness or inability of private entity to invest substantial upfront costs associated with establishing a partnership framework and contract with little or no assurance of consummating a partnership.

Among smaller-scale options (between $10 million and $50 million) for municipalities who are either unable or uninterested in entering into long term contracts such as a CBP3, an innovative approach being piloted in the stormwater space that addresses this concern is an Environmental Impact Bond (EIB). Benefits of an EIB are many and include:

- Performance-based contracting de-risks innovative infrastructure projects for public partner.
- The private partner only receives a variable results-based return based on performance.
- Financial risk is transferred to private partner, who bears responsibility for the project's success.
- Project can be structured as a capital expenditure or an operating expenditure.
- Project provides rich data to public partner who can make long term capital planning decisions more wisely.
- Short term contracting allows for less commitment from public partner.
- Public and private financing can be blended to reduce capital costs.
- Public partner can maintain control of various parts of project, including design, build, and operations.
- Opportunity to lead, as EIBs are relatively new concepts for green infrastructure.

Challenges of using an EIB include:

- Legal or statutory difficulty of pay-for-success contracts.
- Successful projects can result in higher costs of capital.
- Short time frame may not allow for full data on operations and maintenance costs.

Both CBP3 and EIB options present opportunities for municipalities to accelerate their green infrastructure projects and accrue the benefits of enhanced stormwater management in their communities. Among stormwater CBP3s, while nationally there is only one stormwater CBP3 in place in Prince George's county in MD (a $100 million effort), there is also evidence that others may be adopting it soon. For instance, in 2016, Anne Arundel County, MD (adjacent to Prince George's) announced its intent to engage in a P3 for stormwater. Among EIBs, in September of 2016, DC Water and Sewer Authority (DC Water) issued the nation's first EIB to fund the initial green infrastructure project in its DC Clean Rivers Project, a $2.6 billion program to control stormwater runoff and improve the District's water quality. The $25 million, tax-exempt EIB was sold in a private placement to the Goldman Sachs Urban Investment Group and Calvert Foundation. The proceeds of the bond will be used to construct green infrastructure practices designed to mimic natural processes to absorb and slow surges of stormwater during periods of heavy rainfall, reducing the incidence and volume of CSOs.

Among examples of CBP3s, aside from a $100 million engagement in Prince George's county in Maryland, in 2016, Anne Arundel County announced its intent to engage in a P3 for stormwater.

Among examples of EIBs, in September of 2016, a $25 million, tax-exempt EIB was sold in a private placement to the Goldman Sachs Urban Investment Group and Calvert Foundation, by DC Water.

The EIB allows DC Water to attract investment in green infrastructure through an innovative financing technique whereby the costs of installing the green infrastructure are paid for by DC Water, but the performance risk of the green infrastructure in managing stormwater runoff is shared amongst DC Water and the investors. As a result, payments on the EIB may vary based on the proven success of the environmental intervention as measured by a rigorous evaluation. By financing this project through the EIB, DC Water is helping create a model funding mechanism that other municipalities can leverage to advance the use of green infrastructure to address stormwater management in their communities.

The following are excerpts from "Prince George's County's Approach to Meeting Regulatory Storm Water Management Requirements – Using a Community-based Public-Private Partnership Business Model" by Prince George's County Department of the Environment, April 2016.

Why did they do it?

Prince George's County is implementing hundreds of water quality improvement projects to meet state and federal regulatory water quality requirements, with deadlines as soon as 2017 to remove pollutants from stormwater runoff from currently untreated impervious areas. The magnitude of stormwater treatment needs and compressed timeframe to complete the requirements called for a more efficient project delivery system. The County therefore determined it needed a business model to accelerate implementation, increase affordability, improve program administration, and better address long-term operation and maintenance requirements, as well as promote social and economic development.

…. Under urban stormwater management strategies, the County's Watershed Implementation Plan (WIP) indicates that approximately 8,000 acres of untreated impervious area needs to be retrofitted to meet the 2017 goals, and an additional approximately 7,000 acres (for a total of 15,000 acres) of untreated impervious area needs to be retrofitted by 2025 to meet the Chesapeake Bay TMDL goals.

…. About $1.2 billion will be required to retrofit the approximately 15,000 acres of untreated impervious area according to the County's final WIP. Even though the County has a steady source of funding through its Clean Water Act Fee via the Clean Water Program, it would be difficult to meet the restoration requirements if the stormwater projects or BMPs were implemented through its Capital Improvement Program (CIP).

…. Additionally, upon implementation of the BMPs, the County also needed to maintain them to keep them functioning properly throughout their lifecycle, which is approximately 30 years.

…. In addition, as these projects are funded through the County's Clean Water Act Fee, which is provided by County residents, the County needed to develop a process that obtained the maximum benefit by driving down the implementation costs for the BMPs and included economic development, environmental protection, and educational opportunities. The County determined that it was riskier to continue doing things the same way in stormwater management versus trying something different, and therefore had to explore other options.

What is new about it?

The Clean Water Partnership (CWP) follows a Design-Build-Operate-Maintain CBP3 process, which is a breakthrough from the County's traditional business model of Design-Bid-Build, which consists of individual contracting phases for design, construction, and maintenance. The CWP was developed in order to reduce the cost of stormwater management retrofits, reduce the implementation timeframe, promote innovative technologies in the field of stormwater management, and apportion the financial and legal risks while promoting a green economy to preserve County resources and encourage sustainability.

Where is the money coming from?

The capital costs for implementing the BMPs are provided by the County through the Clean Water Act Fee. Other sources of financing, such as bonds, the State Revolving Fund, private financing sources, and grant proceeds, may also be considered by the County in the future.

Do they save money?

Streamlining the CWP processes will reduce the cost by at least 30 percent per treated impervious acre. These processes include more efficient construction practices, greater flexibility to improve operational efficiencies based on lessons learned, and reduced resources due to overlapping design and construction schedules of multiple projects. Since the private partner is also responsible for the maintenance of constructed BMPs, the overall lifecycle costs should be considered when selecting BMP designs. …. In addition, the County is collaborating with the private partners to use their technological resources to develop a toolbox of BMPs with high pollutant removal rates that can be implemented throughout the County. Creating this toolbox of standard BMP designs will reduce timeframes and costs for planning, design, and permit approval and enable multiple high-performance BMPs to be implemented. With standard BMP designs being used at the County level, the material, design, construction, and maintenance costs are anticipated to go down over the contract period due to economy of scale.

…. The CWP also requires the development of more efficient construction, maintenance, and program administration practices, which will also drive down the costs. With a high-volume, long-term maintenance program, the maintenance cost per unit will tend to decrease as the number of units to be maintained increases. In addition, the private partners' systems are more efficient than the County's in procuring supplies, construction and maintenance equipment, and services, and the significant cost and time savings are passed on to the County. The County will continue to monitor contractual requirements such as local and small business use.

3.1 P3 RELATED LEGISLATIONS ACROSS THE GREAT LAKES STATES

One major hurdle for implementing a CBP3 is the legislation that allows a municipality to pursue one. The eight Great Lakes states have varying P3-related legislative histories and legal standards. Only two Great Lakes states, Michigan and Indiana, have enacted P3 legislation for non-transportation projects in the region. The nature of these legislations allow for construction of many types of non-traditional P3 engagements, which can include stormwater projects that benefit the public.

New York, on the other hand, has no existing P3 legislation. The remaining five Great Lakes states (Illinois, Ohio, Wisconsin, Minnesota, and Pennsylvania) have P3 enabling legislations focused on the transportation sector. In these states, a special act of the state legislature would greatly facilitate a green infrastructure focus P3.

A summary of P3 legislation and the relevant civil statutes is presented in Table 3-1.

3.2 OVERCOMING THE LACK OF P3 RELATED LEGISLATIONS BY DILLON'S AND HOME RULES

To overcome narrow P3 legislations, local governments use Home Rule authorities granted by their state's constitution. Accordingly, a brief review of various forms of municipal governance is warranted. Home Rule and Dillon's Rule are two forms of municipal governance, and all municipalities within the U.S. fall somewhere on the spectrum between these two extremes.

In the United States, the legislative authority granted to local governments by the state is quite variable. In some states, with a strong tradition of Home Rule, states' constitutions grant cities, municipalities, and/or counties the ability to pass laws to govern themselves as they see fit (within the constraints of the state and federal constitutions). In other states, Dillon's Rule is used where local governments have little autonomy outside the specific legislative authority that a state has granted them. In these states, the legislature must pass a law that explicitly allows a

Table 3-1: Public-private partnership statutes by state (as of 2013) (Pula 2016, Lick 2011)

STATE	DESCRIPTION	STATUTE
Michigan	Currently has enabling legislation for diverse public entities	MCL 125.1871
Indiana	Law is focused on "public facilities" that could be used if expanded definition of facilities is assumed	Ind. Code Ann. §§ 5-23- 1-1 - 5-23-7-2
Illinois	Has many different P3 laws, but all are focused on transportation projects and in some cases, explicitly on targeted projects	605 ILCS § 5/10-802 605 ILCS §
Ohio	State DOT may enter into P3s, but legislation is transportation focused and not broadly applicable	Ohio Rev. Code Ann. § 5501.71
Wisconsin	Law explicitly authorizes state DOT to enter into agreements	Wis. Stat. Ann. § 84.01 (30)
Pennsylvania	Law permits P3s for transportation projects	Pa. Cons. Stat. 74 §§ 9101 thru 9124
Minnesota	Narrow legislation focused on road authorities, with stringent requirements on what can and cannot be built under the aegis of this legislation	Minn. Stat. §§ 160.84 thru 98
New York	Currently no P3 legislation	N/A

city or a county to enact the legislation. To put simply, under Dillon's Rule, cities must make their case to state governing authorities for enacting legislation, while Home Rule cities may be able pass the legislation locally so long as there aren't laws explicitly forbidding it.

Cities in states that lack P3-enabling legislations may be able to use Home Rule to enact legislation so long as it is not specifically prohibited by state law.

In the Great Lakes, all eight states grant Home Rule status to their cities. As a consequence, cities in states that lack P3 enabling legislations can use Home Rule to enact legislation (so long as it is not specifically prohibited by state law). Aside from Great Lakes cities, a summary of various units of government and types of rule they follow, is presented in Table 3-2. According to Table 3-2, a township in the state of New York (that doesn't have any P3-enabling legislation) will have a harder path to enacting a CBP3 because it is not home rule and hasn't been granted the authority by the legislature. Further description of the difference between Home Rule and Dillon's Rule can be found on the National League of Cities (2016).

Based upon the legislative framework and the discussion on Home/Dillon's rules, a decision tree can now be formulated that can assist communities and interested private parties in assessing if a CBP3 makes sense. This decision tree is presented in Figure 3-3.

Implementing P3 Initiatives in Non-P3 Legislation States – State of New York

The State of New York has not adopted P3 enabling legislation to support large-scale infrastructure programs. The 2011, Infrastructure Investment Act, extended in 2015 through March of 2017 allows for certain New York public authorities to enter into design-build contracts pursuant to a two-step design-build (DB) procurement method. The Investment Act is not specifically a P3 statute, but does contemplate use of DB contracts to encourage private sector investment in New York. While the Investment Act goes a long way to streamline the procurement of certain projects, it has not yet attracted the investment community ready and willing to commit private funds and expertise into this market. Nonetheless, there are viable and potential approaches to structure P3s related to green infrastructure through a service-delivery model.

A service contract in the public sector generally refers to a negotiated contract which gives an entity the right to do business with government assets, with some specific requirements. Service contracts or agreements are not new to the public sector. Typically these take on the form of landscaping contracts, maintenance agreements, and other service-oriented functions. Taking this delivery model to implement a P3 allows for the public entity to contract with a private entity to deliver a service such as delivery of green infrastructure, through a service-oriented model, without requiring the public entity to commit funding or a revenue stream. For green infrastructure, as an example, the private entity would be required to deliver green infrastructure projects in a holistic approach through an availability payment format. The specific requirements for the service contract may include items such as financing, project delivery and identification, as well as maintenance and operations for long-term sustainment.

This model offers multiple benefits such as:

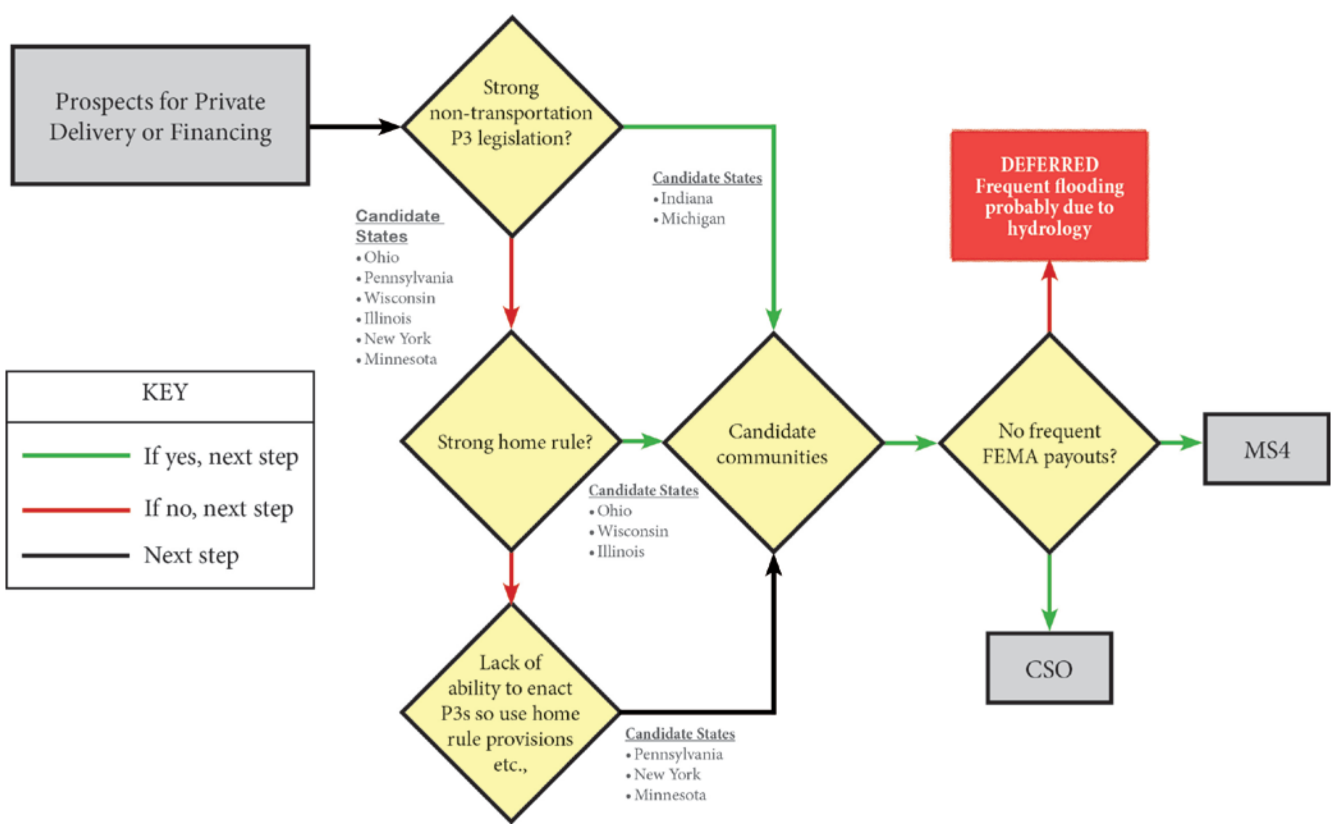
- *The government entity to provide specialized service to the citizens by having qualified private operators manage the operations of the asset*
- *Service provider is bound by a set of negotiated standards and agreed upon payment that may be contingent on performance incentives*
- *Program operation and financial risks are transferred to the private entity*

Overall, although New York State legislation may limit the utilization of P3s to deliver green infrastructure projects, it certainly is not prohibitive in restricting public entities to structure P3 programs creatively.

Table 3-2: Dillon's Rule versus Home Rule in Great Lakes states (Dyson 2014, Gotherman 1972, Murphy 2009, New York Department of State 1998, United States Census Bureau 2007, Wisconsin Council 2013; Citizen Advocacy Center 2004, Richardson et al 2016, Liberty 2016)

STATE	VILLAGE	TOWN	CITY	TOWNSHIP	COUNTY
Ohio	Home Rule	Home Rule	Home Rule	Home Rule if adopted	Home Rule if opted by the county (such as Summit and Cuyahoga counties)
Michigan	Home Rule	Home Rule	Home Rule	Dillon's Rule	Home Rule if opted by the county (such as Macomb and Wayne counties)
Indiana	Home Rule	Home Rule	Home Rule	Dillon's Rule	Home Rule if opted by the county
Illinois	Any municipality with a population over 25,000 is automatically "Home Rule"			Dillon's Rule	Home Rule if adopted (such as Cook county)
New York	Home Rule	Home Rule	Home Rule	Dillon's Rule	Home Rule if opted by the county
Pennsylvania	Dillon's Rule	Dillon's Rule	Home Rule	Home Rule	Home Rule if opted by the county (such as Alleghany, Delaware, Erie, Lackawanna, Lehigh, Luzerne, and Northampton counties)
Wisconsin	Home Rule	Dillon's Rule	Home Rule	Dillon's Rule	Home Rule if opted by the county
Minnesota	Dillon's Rule	Home Rule	Home Rule	Dillon's Rule	Home Rule if opted by the county (such as Ramsey County)

Figure 3-3: A decision tree that showcases P3 related frameworks for the Great Lakes states



3.3 FUNDING GREEN INFRASTRUCTURE THROUGH STORMWATER UTILITY FEES

CBP3s are established to address public problems for which there is insufficient capital to rapidly implement a solution, as well as to deal with lack of capacity at many municipalities. The capacity restriction is both for resources as well as a platform that can deliver high-rates of implementation within an accelerated timeframe. The problem is well defined, the solution quantifiable, and the means of repaying the capital known. However, in stormwater management, an additional impediment to enacting CBP3s in many states is the public's resistance to enact stormwater utility (SWU) fees. A SWU fee is imposed upon land owners for properties that contribute to larger stormwater challenges that require management. These funds pay for stormwater infrastructure operation, maintenance, and improvement required to service the general population. The fees are very attractive to capital providers because:

- They are based on volume of stormwater,
- They provide a dependable, identifiable revenue stream, and
- They are separate and bondable units of government.

In the Great Lakes, all states except Michigan and New York, have a large number of SWUs (Figure 3-4). New York has no such utilities, and Michigan has only seven (Ann Arbor (established in 1984), Harper Woods (1992), Saint Clair Shores (1993), Berkley (1994), Marquette (1994), Chelsea (1997), and New Baltimore (1997)).

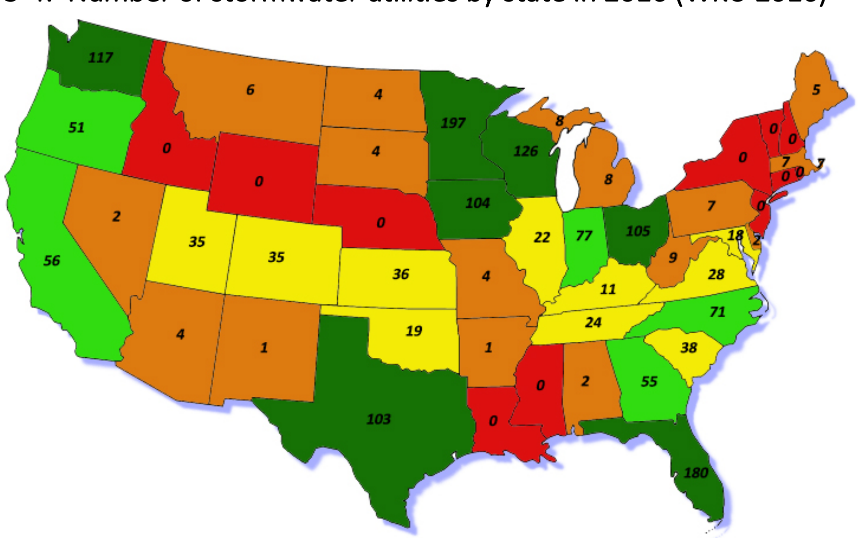
A summary of Michigan's SWUs provides a good background of the challenges of setting them up

All of the Michigan SUFs were established prior to the "Bolt Decision." (Bolt v. City of Lansing 1998). In December 1998, the Michigan Supreme Court decided that Lansing's stormwater utility charge was a tax, rather than a fee, and therefore in conflict with the Headlee Amendment – a 1978 amendment that precludes tax increases without the vote of the people. The Lansing stormwater fee was subsequently rescinded. In making this ruling, the Judge created a three-part test to distinguish between a fee and a tax:

1. *A user fee serves a regulatory purpose rather than a revenue-raising purpose*
2. *A user fee is proportional to the necessary costs of the service*
3. *A user fee must be voluntary – property owners must be able to voluntarily refuse or limit the use of the commodity or service.*

The Michigan Supreme Court decided that the Lansing fee failed the first two parts of this test. Thus from 1997 to 2010, no new Michigan SWFs were implemented. In 2011, Jackson implemented a user fee funded stormwater utility but the city was sued in 2013 and subsequently lost. While there is some resistance to such fees, it is highly dependent on a community. This stigma can change if community stakeholders are well-informed of the benefits of stormwater fees. There are also ongoing efforts to revise the state law to make stormwater fees easier to establish.

Figure 3-4: Number of stormwater utilities by state in 2016 (WKU 2016)



Per Lueckenhoff and Brown (2016), annual fee charged by SWUs also serve as the prerequisite collateral for raising debt and funding comprehensive stormwater programs at a very low cost. For instance, a municipality that collects $2 million in stormwater utility fees can leverage them into an additional $27 million of capital, assuming a 4 percent rate of interest and a 30-year term, that can be used to fund both soft costs (programmatic) as well as hard costs (implementing and maintaining green infrastructure).

Delivery of high-rate of implementation of green infrastructure can be limited to, both the lack of capital as well as a delivery platform. A Stormwater Utility can provide a flexible means to pay for stormwater infrastructure operation, maintenance, and improvement required to service the population.

3.4 FEDERAL FINANCING ASSISTANCE FOR CBP3s: WATER INFRASTRUCTURE FINANCE AND INNOVATION ACT (WIFIA) PROGRAM AND CLEAN WATER STATE REVOLVING FUND (CWSRF) LOANS

Private capital is typically costlier than public capital as the interest rates are subject to income tax. However, innovative use of public funding can reduce the cost of private capital. In addition, operational efficiencies provided by a CBP3 can significantly reduce costs of projects, and make the overall value proposition quite attractive. The ability to utilize these federal funds is defined both in federal guidance as well as state specific regulations created when the individual states established their state revolving funds. Thus, access to the funding varies from state to state. The CWSRF was established by the 1987 amendments to the Clean Water Act (CWA) as a financial assistance program for a wide range of water infrastructure projects, under 33 U.S. Code §1383. The program is a partnership between EPA and the states that replaced EPA's Construction Grants program. States have the flexibility to fund a range of projects that address their highest priority water quality needs. The program was amended in 2014 by the Water Resources Reform and Development Act (WRDA).

Using a combination of federal and state funds, state CWSRF programs provide loans to eligible recipients to:

- Construct municipal wastewater facilities,
- Control nonpoint sources of pollution,
- Build decentralized wastewater treatment systems,
- Create green infrastructure projects,
- Protect estuaries, and
- Fund other water quality projects.

Building on a federal investment of over $39 billion, the state CWSRFs have provided more than $111 billion to communities through 2015. States have provided more than 36,100 low-interest loans to protect public health, protect valuable aquatic resources, and meet environmental standards benefiting hundreds of millions of people.

According to the U.S. EPA's Environmental Finance Advisory Board (EFAB), each dollar of recycled SRF program equity can generate $3 to $14 of SRF guarantee capacity for green infrastructure projects. Nationwide, this translates into $6 billion to $28 billion in added potential green infrastructure funding capacity (Lueckenhoff and Brown 2016).

Most states have chosen to used CWSRF to "buy down" interest rates for regulated communities (50 percent of market rates of public debt) and offer even lower interest rates to disadvantaged communities (25 percent of market rates). Depending on a state, sometimes the interest rates can be forgiven altogether.

The success of the program has created strong cash balances and excess credit capacity. Per Lueckenhoff and Brown (2016), in addition to the State Revolving Fund (SRF) loan program, states

Use of CWSRF financial tools to support and help underwrite water infrastructure projects

The CWSRF offers a number of financial tools to support and help underwrite water infrastructure projects. Specifically, CWSRF balance sheet strength affords states the means and the option to offer additional financial assistance to eligible projects by making use of the guarantee authority provided by the Clean Water Act. This tool may be ideal for dealing with new types of projects, such green or distributed infrastructure, which may be secured by private owners or developers that states are not inclined to offer below market loans or simply does not have sufficient lending capacity. Credit structures now exist that can both protect the credit strength and lending capacity of an SRF loan program while positioning an SRF guarantee product that can assure triple-A rated access for financing on behalf of eligible projects, including those that are privately delivered or owned.

exhibiting excess credit capacity are capable of offering an ''triple-A'' rated SRF ''bond insurance'' program in which a third party guarantees payment of scheduled principal and interest in the event of a default on a bond. For example, a green infrastructure SRF-insured bond provides investors with the added security of an SRF guarantee to pay them principal and interest even if the project ceases to pay debt service. According to the U.S. EPA's Environmental Finance Advisory Board (EFAB), each dollar of recycled SRF program equity can generate $3 to $14 of SRF guarantee capacity for green infrastructure projects. This translates into $6 billion to $28 billion in added potential green infrastructure funding capacity nationwide.

In 2016, Prince George's County led the nation in the first-ever stormwater CBP3 financing through a private partner using CWSRFs – at current cost of $48 million. Since Prince George's County met the disadvantaged community criteria, it was able to access the CWSRF debt to:

- Retain control or oversight of the financing while ensuring faster payment and processing to the local subcontractors dictated by county defined construction requisition protocols.
- Gained relief of responsibility for all loan compliance reporting requirements (handled through the partnership).
- Since principal and interest payments are not paid until after the first year of construction, Fiscal Year 2017 appropriated budget funds were not required to apply for the financing.
- Residual savings reinvested back into project scope and/or long term maintenance.
- Create non-recourse debt to Prince George's County's balance sheet.

The aggregated nature of the partnership's delivery structure and their ability to execute larger scopes in a shorter period of time enabled a large loan application. The combination of cost of capital, flexible terms, and its unique characteristics made it the optimal source of financing available to fund the large volume of stormwater projects.

In 2016, Prince George's County led the nation in the first-ever stormwater CBP3 financing through a private partner using CWSRFs – at a cost of $48 million. Since Prince George's County met the disadvantaged community criteria, it was able to access the CWSRF debt at a discounted rate of around 1.1 percent.

Success of the SRF has provided impetus for the creation of the ''Water Infrastructure Finance and Innovations Act'' (WIFIA) to lower the cost of capital for larger-scale water infrastructure projects. In 2014, the Water Resources Reform and Development Act (WRRDA) was signed into law by President Barack Obama. WIFIA establishes a new financing mechanism for water and wastewater infrastructure projects to be managed by EPA Headquarters. The WIFIA program provides low interest rate financing for the construction of water and wastewater infrastructure. Funded projects must be nationally or regionally significant. Individual projects must be reasonably anticipated to cost no less than $20 million.

WIFIA works separately from, but in coordination with, the State Revolving Fund (SRF) programs to provide subsidized financing for large dollar-value projects. Eligible assistance recipients include corporations, partnerships, municipal entities, and SRF programs.

Eligible projects include:

- Clean Water SRF eligible projects
- Drinking Water SRF eligible projects
- Projects for enhanced energy efficiency at drinking water and wastewater facilities
- Brackish or seawater desalination project, an aquifer recharge project, water recycling project
- Acquisition of property if it is integral to the project or will mitigate the environmental impact of a project
- Bundled SRF projects submitted under one application by an SRF program
- A combination of projects secured by a common security pledge

Outside of Prince George's county CBP3, no other P3 projects have yet been funded by the federal government. Prince George's county has long been a leader in progressive stormwater management. They were one of the first communities that required developers to analyze and minimize the impact of the quantity and quality of runoff from proposed developments. The county imposed impact fees to assure that the cost of stormwater and the staff required to manage it, were borne by the developers that caused the impact. Yet, as the environmental challenges of the Chesapeake Bay became increasing apparent, Prince George County understood that an additional, substantial investment would be required. Rather than take a piecemeal approach, the County chose to implement the needed/required improvement rapidly with the additional goal of targeting the needed services to people/businesses within the County. This lead to the formation of the CBP3.

As other communities are driven to improve their stormwater management, they may find that a CBP3 may indeed be an appropriate path forward. The drivers will vary. Some communities will need to control/eliminate combined sewer or sanitary sewer overflows. Other will be like Prince George's, and need to improve the quality of their stormwater. Still other may need an innovative means of complying with increasingly stringent stormwater regulations. Regardless of the driver, the ability to finance the needed improvements is always a challenge and private financing and the CBP3 delivery model can be attractive. As mentioned before, CBP3 can also deliver – community development, increasing green space, employment opportunities – and is a good overall package.

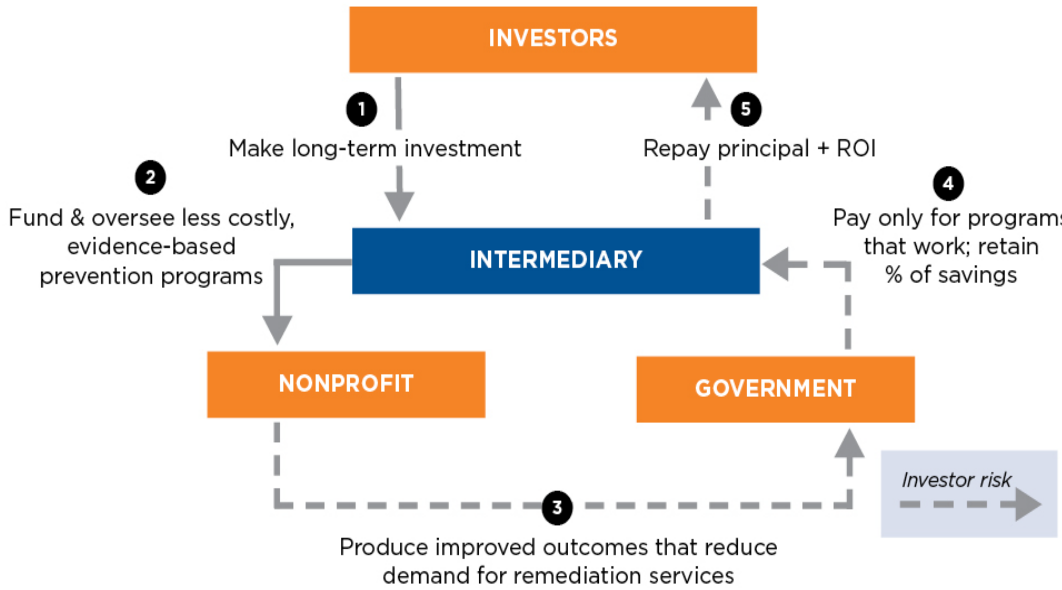
3.5 OPPORTUNITIES FOR ENVIRONMENTAL IMPACT BONDS

An Environmental Impact Bond is an innovative financing structure that allows municipalities to de-risk their infrastructure investments by linking the municipality's repayment obligation to the project's success. For innovative infrastructure (Figure 3-5), such as green infrastructure, this allows a municipality to test projects they otherwise would not want to finance and allows them to gather meaningful project data on a large scale. This can then inform a larger capital expenditure program.

One example for an EIB's applicability to green infrastructure is to test various large scale demonstration projects in multiple watersheds. The data gathered could then be compared to a baseline gray infrastructure cost per gallon managed. In watersheds with lower than average costs, the municipality could choose to invest more heavily in green infrastructure, while in more expensive watersheds they could resort to a heavier allotment of gray infrastructure.

This data is immensely helpful for municipalities considering large stormwater infrastructure programs – either by choice or as a result of an EPA Consent Decree. By giving the municipality the tools to make wiser capital expenditure plans, the

Figure 3-5: Social impact bond for non-profit service delivery to a government (Hartley 2014)



EIB could eventually save a municipality money over the course of its infrastructure spending.
A summary of the advantages of EIBs is presented below:

- Flexible Execution: Projects funded by impact bonds can be delivered publicly or privately, can include or exclude a component of operations and maintenance funding, and can be negotiated on one or more impact metric. This flexibility of execution will be reflected in the cost to a municipality as a lower risk transfer from municipality to private investors will result in a lower cost of capital.
- Flexible Scaling: Impact bonds are not intended to finance large projects at scale, or to transfer long-term project rights to the private sector. The municipality retains discretion as to how and when to incorporate successful innovations into an overall capital plan, and can retain flexibility as to the type of financing.
- Financial Transparency: This model is based on the private partner receiving a variable performance-based fee, based upon (a) key impact metric(s) as agreed to by the partners. The partners work together jointly to agree upon impact metric(s) and the return to the private partner. The objective is to reduce the long-term capital program cost to the borrower. An EIB is a more expensive form of financing than a municipality public debt or, possibly, a CBP3. However, it is intended to finance smaller projects, which provide data allowing a municipality to make more cost-effective decisions in the future, ultimately resulting in cost savings.
- Flexibility of Partnership: A municipality remains an active participant in the partnership throughout the term.
- Shared Values: Through a relationship built on long-term trust, the partners discuss and develop a common set of values used to establish performance metrics, which may include socio-economic targets.
- Limited Commitment: The term of an impact bond is flexible and driven by the project timeline and time the partners determine necessary to test performance. In general, however, impact bonds are a much shorter contractual relationship than P3s, typically 3-7 years including construction, if any. As with the flexible execution component, this allows a municipality to test the potential benefits of a public-private partnership prior to committing to a long-term concession.

4.0 MARKET SIZE OF LARGE-SCALE ADOPTION OF GREEN INFRASTRUCTURE: DRIVERS AND FILTERS

This chapter assesses drivers that can encourage large-scale green infrastructure implementation and determine the market size for adoption of practice within the Great Lakes Basin. Three considerations are key determinants in whether private entities are willing to invest in these programs. They are:

- Leadership – Private investors must rely on progressive public works professionals to lead the efforts to implement large scale programs. Visionaries and early adopters that accept new approaches to old problems are more likely to lead communities toward adoption of large scale, sustainable, and cost-effective green infrastructure solutions to traditional stormwater management challenges.
- Regulatory drivers – Various regulatory programs have served as significant drivers for green infrastructure. At the federal level, these programs primarily relate to Clean Water Act and its amendments. State and local programs also encourage green infrastructure through local stormwater management standards for flow and quality management. These changing regulations vary from locale to locale, and are summaries in the sections below.
- Financial Ability – Once a community chooses to commit to largescale stormwater improvement, its financial ability is key to its ability to execute. If the funding source is private capital, it must provide a return on the initial capital invested. A review of a community's financial ability to finance a project is discussed later in this section.

These three topics are addressed below.

4.1 LEADERSHIP

Not surprisingly, the communities that have made the most progress on green infrastructure implementation have been those communities with innovative leadership (for example, in Prince George's county, the city of Philadelphia, and D.C. Water). Private investors seek opportunities where leadership has proven successful of guiding the disparate levels of government to embrace a new, different, yet cost effective approach to stormwater management. These leaders provide the comfort to investors that the upfront investment of time and resources will not be derailed by forces other than the financial benefits offered by large scale implementation. Some of these leaders have looked to green infrastructure as a cost effective means to comply with federal requirements. Others have fulfilled their regulatory requirement and look to green infrastructure to exceed requirements but continue to improve water quality and quality of life in their communities. In either case, engineering staffs, elected officials, regulatory agencies and stakeholders must welcome the approach to assure a successful partnership.

The profile of community's leadership and citizenship is a direct reflection of its commitment to how innovative it is when it comes to the management of stormwater. There are no readily available metrics to evaluate leadership's commitment to these issues. Nor are there analytics that illustrate the likelihood of a community's preference of green infrastructure. However, anecdotally, the following provides a partial list of attributes that may encourage private investment on large scale green infrastructure.

- *The preference of a Mayor's (or equivalent leader) interests in serving on committees of groups that rate/certify environmental responsibility*: Examples include the local climate leaders circle, the U.S. Council of Mayors Climate Protection Agreement, etc. Cities such as Grand Rapids in Michigan, Oshkosh in Wisconsin, and Toledo in Ohio, all have executives that participate in these national level environmental programs.

- *Number of B-Corps per capita*: B Corps are for-profit companies certified by the nonprofit B Lab to meet rigorous standards of social and environmental performance, accountability, and transparency. As of 2016, there were more than 2,003 B-Corps-certified communities from 50 countries, and that number continues to grow. Communities with more B-Corps certifications per capita may be in an advantageous position to implement innovative technologies. Grand Rapids is a host to nine B-Corps, more than any other city in Michigan, and almost a quarter of the number as in the city of New York.
- *Number of LEED certified buildings per capita*: Leadership in Energy and Environmental Design (LEED) is a third-party certification program. It is a nationally accepted organization for design, operation and construction of high performance green buildings. Chicago, for example, is routinely cited as one of the cities in the nation with the most LEED projects per capita. Similar to the number of B-Corps per capita, communities with more LEED building per capita may be in an advantageous position to implement innovative technologies

These metrics provide some insight into the both the vision in the public sector and the willingness of the private sector to engage in forward looking planning.

4.2 REGULATORY DRIVERS OF LARGE-SCALE ADOPTION OF GREEN INFRASTRUCTURE

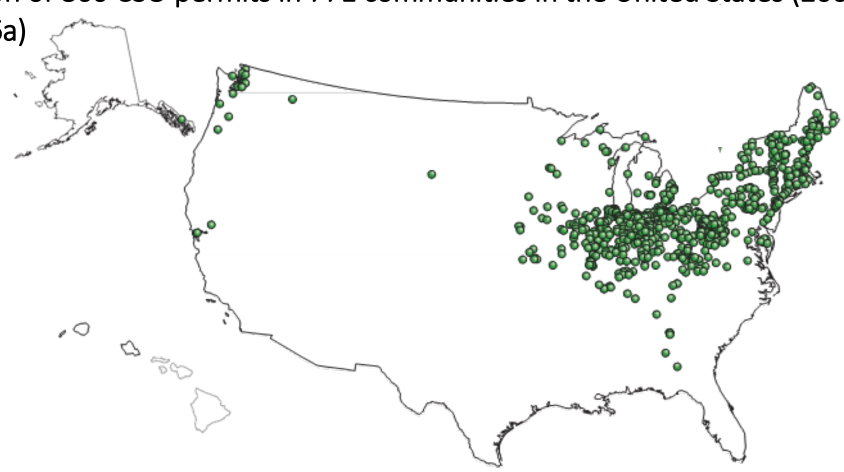
Private investors are always looking for assurances that project will proceed before investing time and effort on crafting a project delivery or financial package. Regulatory programs can be key motivator and thus provide assurances to private investors that timely implementation of stormwater improvements will occur. Two such key areas are outlined below.

4.2.1 COMMUNITIES WITH COMBINED SEWER OVERFLOW (CSO) CONTROL PLANS

Combined sewer overflows occur when the flow volume within a sewer exceeds capacity, and large volumes of raw sewage and urban stormwater are allowed to escape from sewer systems during rain events to negatively impact urban streams. In the past 20 years, the USEPA has focused on eliminating untreated CSOs, by focusing on managing the volume and rate of stormwater delivery. Large scale green infrastructure is a cost effective approach for achieving these outcomes.

Concentrated almost entirely in the Northeast and the Great Lakes, about 860 US communities, serving about 40 million people, have combined sewer systems (Figure 4-1). CSO discharges, during heavy storms, can cause serious water pollution problems in these communities. Pollutants from CSO discharges include pathogens, oxygen demanding materials, toxic chemicals, and debris. Accordingly, in 1994, EPA issued a policy under

Figure 4-1: Location of 860 CSO permits in 771 communities in the United States (2001 data) (USEPA 2001, USEPA 2016a)



NPDES that required municipalities to make improvements to reduce or eliminate CSO-related pollution problems. The policy defined water quality parameters for the safety of an ecosystem, and allowed for action that are site specific to control CSOs in most practical way for community. The CSO Control Policy required all states to implement the "nine minimum controls" by January 1, 1997, and decrease the effects of sewage overflow by making improvements in existing processes.

> ***Green City, Clean Waters*** is Philadelphia's plan to reduce stormwater pollution currently entering their Combined Sewer System through the use of green infrastructure. ***Green City, Clean Waters*** represents a major shift in the way we think about and deal with stormwater in Philadelphia. They are recreating the living landscapes that once slowed, filtered, and consumed rainfall by adding green to our streets, sidewalks, roofs, schools, parks, parking lots and more—any impermeable surface that's currently funneling stormwater into our sewers and waterways is fair game for greening. It's going to take decades of work, but when it's all done, they claim to have reduced the stormwater pollution entering our waterways **by a stunning 85 percent.**
> Philadelphia Water (2016)

In the context of the Great Lakes, as of 2015, the states of Ohio and Michigan had the largest numbers of CSO permits (Figure 4-2). Green infrastructure as an element of CSO long-term control plans (LTCPs) began in earnest in 2008 (WEF 2014). Early consent decrees primarily include green infrastructure in supplemental environmental projects in addition to traditional structural controls. Coupled with growing environmental awareness and understanding, addressing CSO controls has proven to be a financial challenge for many, if not most, older communities. In recognition of these, the EPA began negotiating permits and consent orders to reduce CSO under these financial constraints. Accordingly, in 2012, EPA issued a memorandum on integrated municipal stormwater and wastewater planning (USEPA 2012a). The primary objective of this approach was to help identify efficiencies in implementation of wastewater, and stormwater programs, including prioritization of capital investments.

A summary of significant CSO enforcement actions with green infrastructure elements is presented in WEF (2014), and is reproduced in part in Table 4-1. A key milestone was the use of green infrastructure as a primary CSO control technology in Philadelphia's LTCP (PDEP 2011). Prior to 2011, cities like Philadelphia would have continued to install massive gray infrastructure to try and comply, usually by digging tunnels underground to store wastewater until it could be treated by the wastewater treatment plant. Philadelphia could simply not afford this traditional approach. Instead, Philadelphia proposed and are now implementing an innovative solution that consisted of blending grey and green infrastructure leading to improvements in water quality while drastically cutting the cost of compliance. The negotiated green infrastructure program reportedly saves the rate payers $5.6 billion dollars (PDEP 2011).

Figure 4-2: Number of NPDES permits covering combined sewer systems in the Great Lakes watershed (USEPA 2016a)

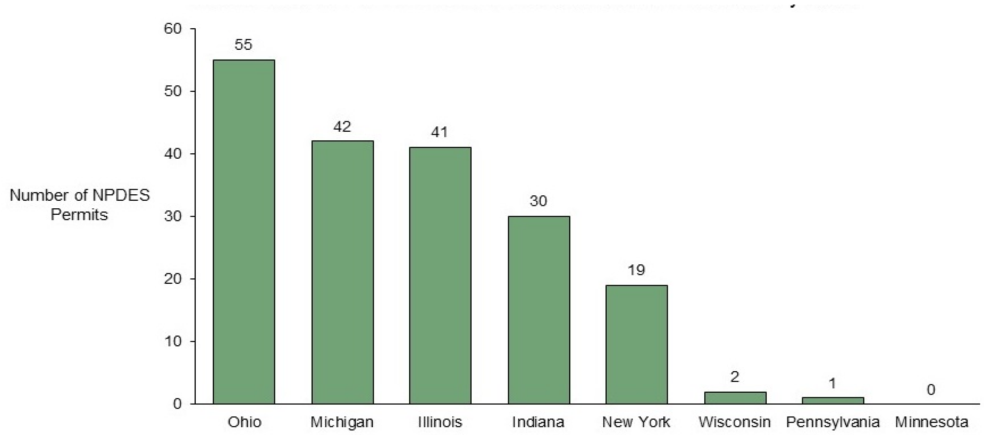


Table 4-1: Significant CSO enforcement actions with green infrastructure elements (reproduced from WEF 2014)

SEWERAGE AGENCY	YEAR	GREEN INFRASTRUCTURE COMPONENTS
Multiple (U.S. EPA, 2012b)	Before 2009, federal consent decrees	Green infrastructure was included in multiple consent decrees as a supplemental environmental project. Consent decrees of this type include District of Columbia Water and Sewer Authority. In these consent decrees, green infrastructure was not used to comply as a base technology to reduce CSO discharges.
Louisville and Jefferson County Metropolitan Sewerage District (U.S. EPA, 2012b)	Plan approval and consent decree amendment (April 2009), federal consent decree	Plan proposed a component that green infrastructure be piloted and evaluated. Based on effectiveness, gray infrastructure components could be reduced in scale or eliminated. First acceptance of green infrastructure as an alternative to gray infrastructure, rather than an enhancement. Combined sewer overflow compliance targets were based on frequency of overflow goals (0, 4, and 8 per year based on location).
Onondaga County, New York (U.S. District Court for the Northern District of New York, 2009)	Fourth Stipulation of the Amended Consent Judgment (November 2009), state consent decree	Amendment specifically identifies green infrastructure as an acceptable technology for CSO control. Allowed for deferment of planned traditional wastewater infrastructure projects. Performance standard for CSO program is based on an annual volumetric control level, gradually increasing to 95 percent capture for treatment or elimination.
Kansas City, Missouri, Water Services Department (U. S. EPA, 2012b)	LTCP (2009) consent decree (May 2010), federal consent decree	Consent decree provides for piloting of green infrastructure in a 301.1-ha (744-ac) basin, from which the results can be used to propose further implementation of green infrastructure for later stages of implementation.
Northeast Ohio Regional Sewer District (U.S. EPA, 2012b)	Consent Decree (2011) Federal consent decree	Specifically required an investment in green infrastructure as well as an annual volumetric reduction that would be accomplished in addition to the base CSO control projects that included more traditional infrastructure. Required measures to ensure sustained performance of practices. Overall level of control is 2 to 4 overflows/year (approximately 98 percent capture for treatment).
Philadelphia (Pennsylvania Department of Environmental Protection, 2011)	Consent Decree (June 2011), state consent decree	Green infrastructure as primary CSO control technology. Level of control is elimination of the mass of pollutants associated with capture of 85 percent of wet weather volume.
New York, New York (City of New York, 2012)	Modified Consent Order (March 2012), state enforcement order	Green infrastructure will be used to control the first inch of rainfall on 10 percent of the impervious area in the city over 18 years.
Seattle and King County, Washington (U. S. District Court for the Western District of Washington, 2013)	Consent decree (April 2013), federal consent decree	The integrated planning process may be used to propose the integration of water quality improvement projects with LTCP. The municipalities can propose that green infrastructure projects be substituted for several proposed gray infrastructure projects.

Following's Philadelphia's lead, other communities have begun to seek ways to amend their original consent decrees. In 2015, DC Water, for example, sought an amendment to their consent decree to include requirements of green infrastructure in the CSO control plan. Specifically, their amended decree includes the construction of green infrastructure to manage a 1.2-inch storm event from nearly 500 impervious acres in two combined sewer areas of Washington, DC, with the intention of reducing the centralized tunnel storage. It is important to note that the amended decree has the same overflow requirements as the original decree.

Overall, it appears clear that a model is now in place for CSO communities that can be used to help establish a prioritization process of communities with a need to reduce CSOs:

- *CSO community that has yet to complete their LTCP:* Cities that are in the process of addressing their CSO issues (such as Toledo and Akron in Ohio) may find greener options for dealing with CSOs to be compelling. The market size for these communities is large and, as of September 2014, over seventy percent of Ohio's CSO communities were under this category. For these cities, the following two drivers provide further prioritization:
    - *High frequency and low volumes dischargers during CSO events*: Cities looking for help in controlling a relatively low volume of wastewater, are more likely to benefit from installing integrated green infrastructure solutions to supplement their existing systems. Among these cities, those with relatively high frequency, are the ideal candidates for installing large scale green infrastructure.
    - *Low frequency or high volumes dischargers during CSO events*: These cities are expected to have smaller benefits of green infrastructure installations, and as a consequence, may be less motivated to amend their LTCP.
- *CSO communities that already have completed requirements under their LTCP*: All CSO control measures have already been taken, and a community likely has little incentive to undertake large-scale adoption of green infrastructure. Example cities include Bluffton and Forest in Ohio.

These observations are summarized in Figure 4-3 as a flow chart to prioritize CSO communities.

As an example use of this prioritization process for Michigan communities (one of the few Great Lakes states with comprehensive data on annual discharges and number of CSO events), one would rank the cities of Dearborn and Lansing as more motivated than Wayne County and Manistique. This is represented in Figure 4-4.

Figure 4-3: A prioritization process for CSO communities to determine the appropriateness of large-scale of green infrastructure

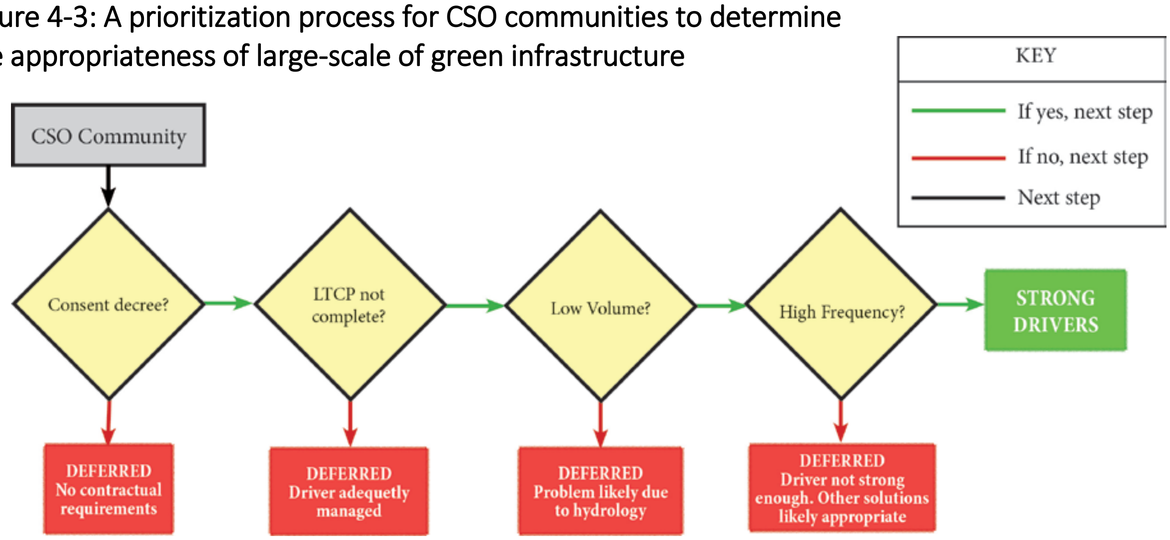
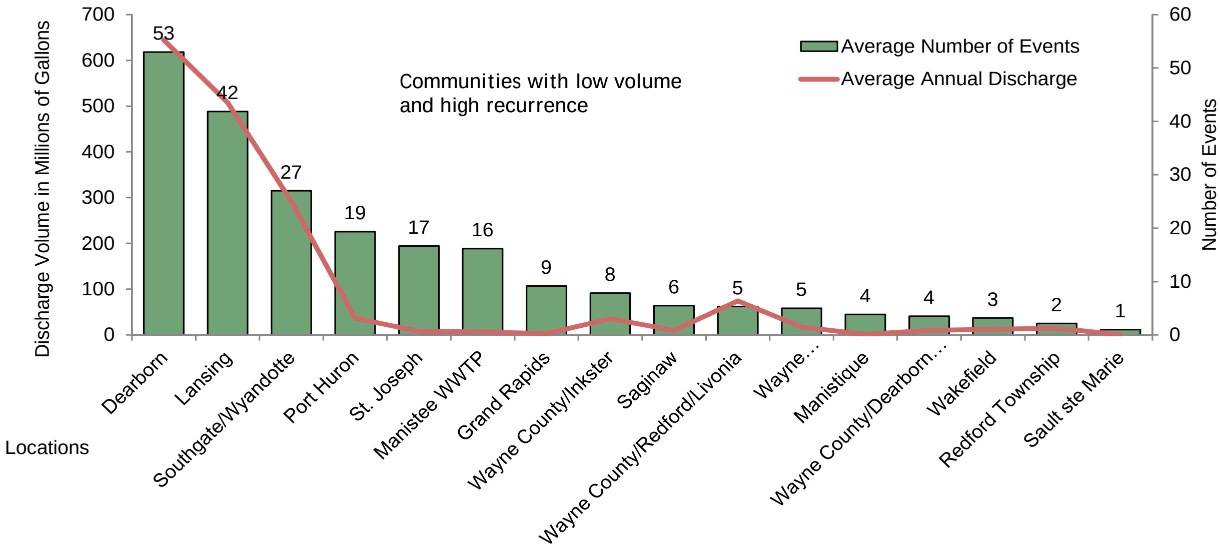


Figure 4-4: Ranking cities in Michigan so far as possible use of green infrastructure as a solution (MDEQ 2014)



4.2.2 MUNICIPAL SEPARATE STORM SEWER SYSTEMS (MS4) PERMIT COMMUNITIES

Since 1987, municipalities have also been subject to regulations under the National Pollutant Discharge Elimination System (NPDES), if they have municipal separate storm sewer systems (MS4s). Before the MS4 program, a number of municipalities had begun to implement site development standards that required volume control, primarily for the objective of flood protection. This resulted in detention basins that were activated during large wet weather events. With MS4 requirements for post-construction stormwater controls, and with an increasing awareness of water quality issues, many local jurisdictions have developed or modified standards and regulations. These standards have resulted in a transition from dry detention basins to wet detention basins to various practices of low impact development and green infrastructure.

Since 1987, four key programs affect permits for stormwater discharges. They include post-development stormwater management controls, stormwater pollution prevention for industrial activities, sediment and erosion control for construction activities, and Total Maximum Daily Load (TMDL) implementation. Of these, post-development stormwater management controls and TMDL implementations, can be key drivers for large-scale adoption of green infrastructure. TMDLs establish numeric limits on pollutant loads in receiving waters, and their implementation plans may call for various measures to control stormwater pollutant discharges, including green infrastructure practices. In some locations, these plans may include requirements to retrofit previously developed sites with green infrastructure. Post-development stormwater management controls, depending on a community, can have similar impact.

Designed appropriately, local stormwater ordinances can become a significant driver of large-scale adoption of green infrastructure. Washington DC's Stormwater Retention Credit (SRC) Program is one such innovative program that motivates property owners by allocating SRCs for voluntary green infrastructure that reduces stormwater runoff. Owners can trade their SRCs in an open market to others who use them to meet regulatory requirements for retaining stormwater. Revenue creates incentives to install green infrastructure that protects rivers and provides other benefits. Other incentive programs are in place in Seattle, Minneapolis, and other cities across the country.

A key challenge to nation-wide adoption of large-scale use of green infrastructure in MS4 context remains the wide variety of local interpretations and regulations in place. Activities regulated under MS4 include construction, municipal, and industrial. Table 4-2 below showcases the wide variation in how the regulatory environment in each state is framed for these three sectors.

Table 4-2: Prevalent NPDES permits and permit provisions in Great Lakes states

STATE	GOVERNING BODY	CONSTRUCTION	MUNICIPAL	INDUSTRIAL
Illinois	Illinois Environmental Protection Agency	Stormwater NPDES Permit, NOI, SWPPP	General Stormwater Permit for MS4, NOI, NPDES Permit ILR40, NOT	Stormwater Industrial Activity Permit (ILR00), SWPPP, NOI
Indiana	Office of Water Quality (OWQ)	General Permit 327 IAC 15-5, Rule 5 if disturbing one acre or more	MS4 Phase 1 General Permit 327 IAC 15-13, Rule 13	NOI, Industrial Stormwater Permit 327 IAC 15-16, Rule 6
Michigan	Department of Environmental Quality (DEQ)	R 323.2190 Permit	MS4 General Permit for Watershed and Jurisdiction	General Permits MIS110000, MIS210000, MIS310000, MIS510000
Minnesota	Minnesota Pollution Control Agency (MPCA)	NPDES/SDS General Permit	SWPPP, General NPDES/SDS Permit MNR040000, develop BMP	NPDES General Permit
New York*	Department of Environmental Conservation (DEC)	File NOI with DEC, submit SWPPP	Public Entities: File NOI, inform public, submit SWPPP, community outreach	Non-regulated communities, privately owned/operated institutions: No MS4 requirements, construction permit requirements apply when disturbing one acre or more
Ohio	Ohio Environmental Protection Agency (OEPA)	SWPPP, NOI, NPDES Permit	NPDES General Permit OHQ000003, MS4 NOI	NOI, NPDES General Permit OHR000005
Pennsylvania	Department of Environmental Protection (DEP)	NPDES General Permit for Construction Activities PAG-02	NPDES General Permit for Construction Activities PAG-02	NPDES General Permit for Industrial Activities PAG-03
Wisconsin	Department of Natural Resources (DNR)	WRAPP NOI Permit required when disturbing one acre or more under General Permit WI-S067831	MS4 NR 216 Permit	Industrial: Tier 1 Permit WI-S067849-3 or Tier 2 Permit WI-S067857-3

In the Great Lakes Basin, shown in Figure 4-5, states of Michigan and Ohio lead the number of MS4 permitted cities.

New York and Michigan have the most MS4 communities in 303(d) impaired waters that include cities such as St. Clair Shores, MI, and Buffalo, NY. (Figure 4-6).

The progress of the development of TMDLs for impaired waters across the Great Lakes Basin is not uniform, and New York and Ohio lead the states with most un-developed TMDLs (Figure 4-7). That is to say that Ohio and New York have many water courses that do not meet water quality standards but they have yet to determine how the required pollutant reductions will be allocated.

Large, well-documented water quality challenges require large investments and better delivery models, and therefore make CBP3s a viable alternative for many municipalities. Utilizing the information presented in Figures 4-6 and 4-7, one could conclude that the states of Ohio, Michigan, and New York have significant water quality challenges that have been documented, and their municipalities will require significant investments to come into full compliance with their permits. The large cost and relatively short timeframes of these remediation efforts may make these communities more amenable to the use of CBP3s.

Overall, for MS4 communities, the following observations can help establish a prioritization process of communities with a strong need to adopt green infrastructure:

Figure 4-5: Number of MS4 permitted communities in the Great Lakes states (2015 data) (MDEM 2011; Alwin (n.d.); Bump 2008; USEPA 2015; USGS 2015)

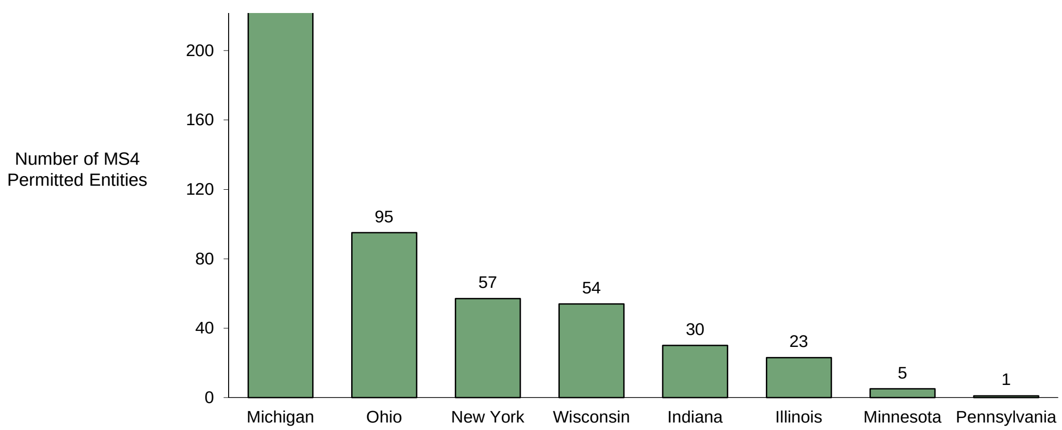


Figure 4-6: Number of MS4 communities in 303(d) list impaired waters (Batty 2015; NYDEC 2010; USEPA 2015, 2016b-e; IDEM 2015; MDEQ 2015; MPCA 2016)

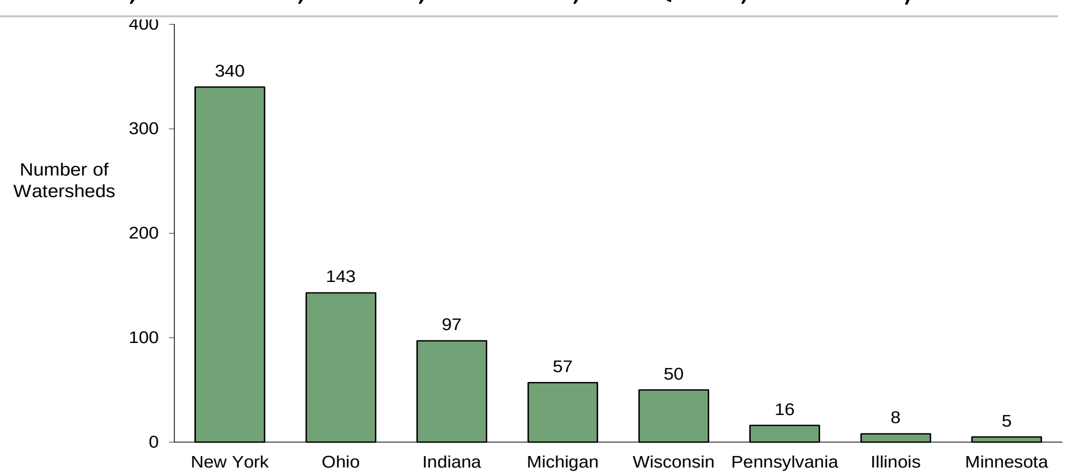
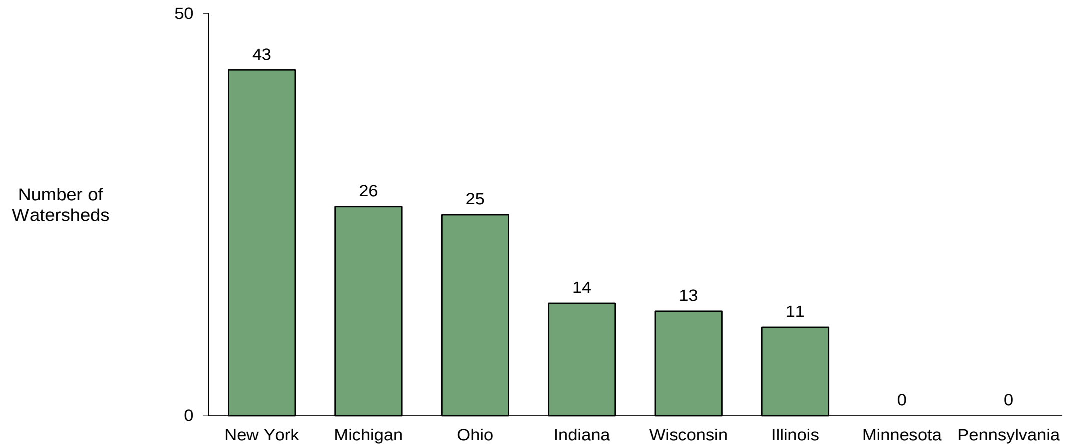


Figure 4-7: MS4 communities within 303(d) impaired watersheds without a TMDL in Great Lakes states (USEPA 2015, 2016 b-e; IDEM 2015; MDEQ 2015; MPCA 2016; OEPA 2016; WDNR 2016)



Overall, for MS4 communities, the following observations can help establish a prioritization process of communities with a strong need to adopt green infrastructure:

- *MS4 community with TMDLs in place*: These communities (such as Cleveland or Grand Rapids), have a stronger incentive in place to leverage CBP3s, and states with largest number of TMDLs in MS4 communities may be best suited.
- *MS4 community that place strong emphasis on post-construction standards/needs:* Proactive communities with stronger emphasis on post-construction standards are better suited to CBP3s. Wisconsin, in its general MS4 permit, requires developers to infiltrate 75-90 percent of pre-development hydrology when breaking ground on new development or redeveloping a site. https://www3.epa.gov/npdes/pubs/sw_ms4_compendium.pdf
- *MS4 community with a potential future TMDL:* While these watersheds are not currently subject to the regulatory limits of a TMDL, they will be in the future. A CBP3 represents an opportunity to put in place infrastructure to remediate issues with impacted watersheds before a TMDL is enacted, lowering the ultimate cost of compliance and allowing the communities to align compliance actions with their existing long term plans.

These observations are summarized in Figure 4-8 as a flow chart to prioritize CSO communities. Finally, merging Figures 3-3, 4-3, and 4-8, a composite decision tree is presented in Figure 4-9 that presents the legislative and regulatory drivers within one framework.

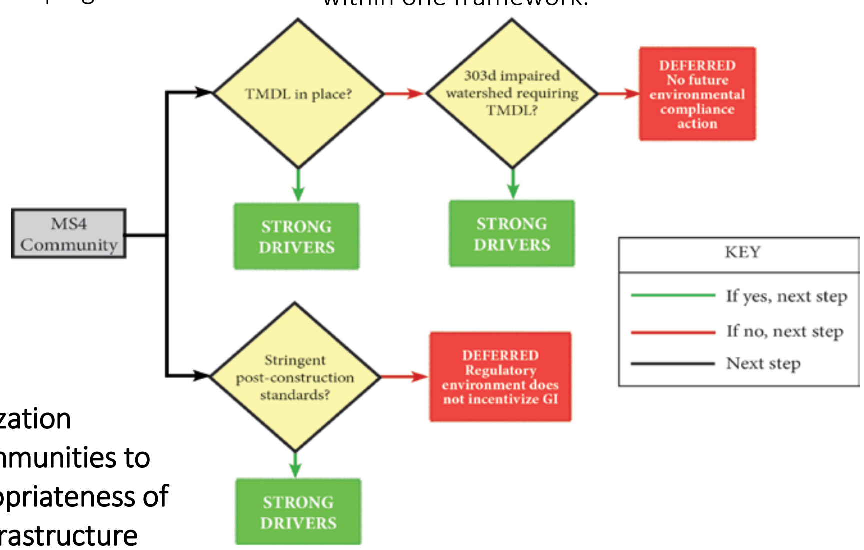
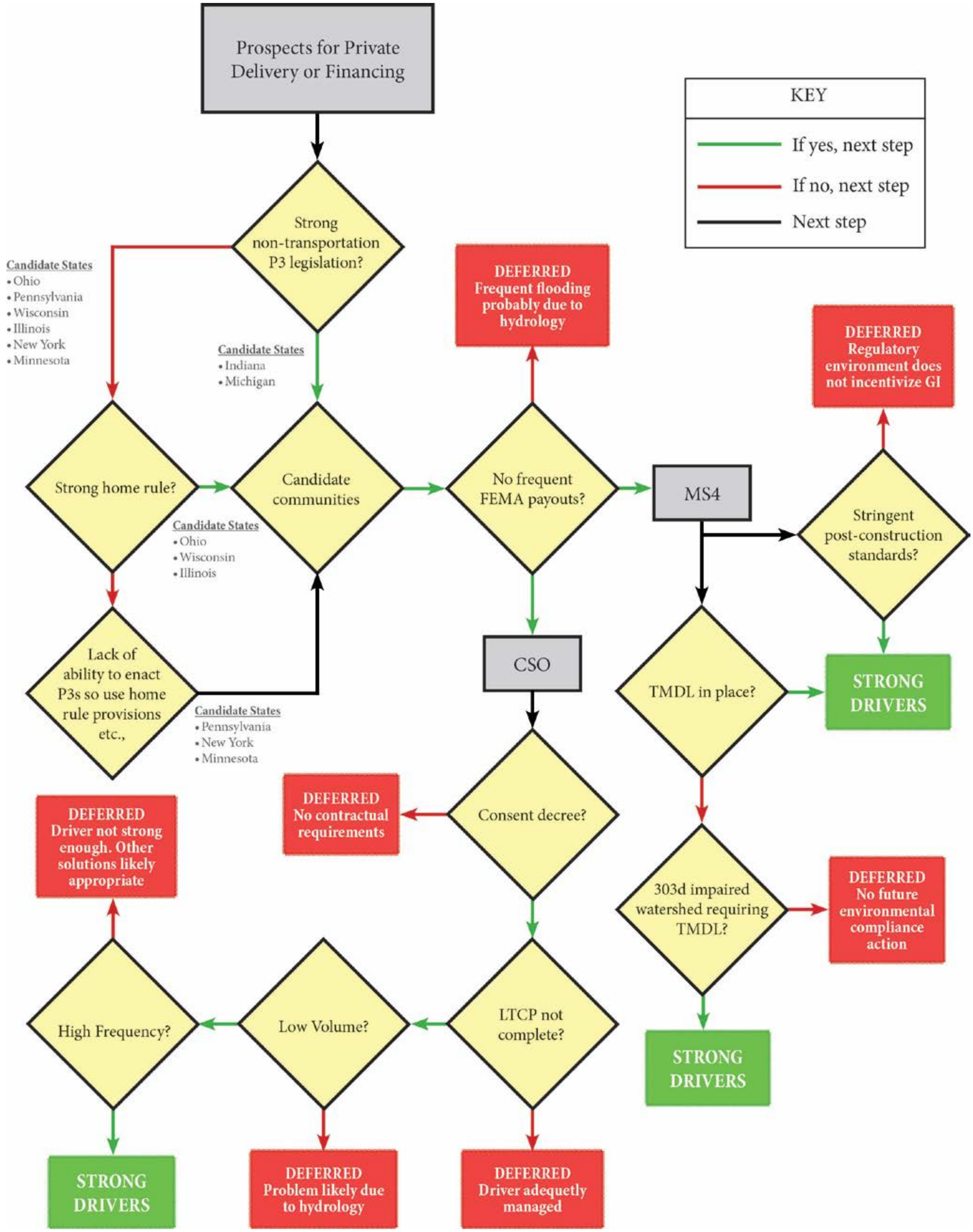


Figure 4-8: A prioritization process for MS4 communities to determine the appropriateness of large-scale green infrastructure

Figure 4-9: A composite flow chart describing the P3 statutes and regulatory drivers



4.3 FINANCIAL ABILITY TO PAY FOR LARGE-SCALE ADOPTION OF GREEN INFRASTRUCTURE

Large scale implementation of green infrastructure is costly and requires a substantial investment by a community whether the effort is privately financed or publically financed. Access to dedicated funds for stormwater/green infrastructure is required in all three scenarios:

- Public financing typically involves selling bonds and assuring the bondholders that their investment will be repaid.
- If private capital is used, a return on the initial capital provided by the private sector investor is needed. To be cost effective, it may be best to combine private financing with CBP3 to provide efficiencies not found in public programs (Chapter 3).
- Funds can be used as grants to provide incentives for the installation of green infrastructure on private parcels (NEORSD 2012). Lastly, the largest readily available funding source for many communities is the sewage rates. While there are many demands on these funds, green infrastructure is often the lowest cost approach to addressing CSO and SSO permit compliance issues. Thus, many wastewater utilities have used cash on hand to install green infrastructure (MMSD 2013 and NEOSRD 2012).

A key access to public funding can be through stormwater utility fees. These are fees charged to property owners to manage stormwater leaving their property. To estimate the availability of stormwater-related funds for communities in the Great Lakes, the annual survey from Western Kentucky University (WKU) was reviewed (WKU 2016). This survey is considered to be the most comprehensive survey nationally, but, as the data primarily comes from internet sources, WKU acknowledges that it is prone to errors. Utilizing online municipal codes, such as Municode, AmLegal, Sterling, LexisNexis, and others, WKU searched key terms, such as “stormwater utility,” “stormwater fee,” and “drainage fee,” and identified nearly 1,600 United States and Canadian stormwater utilities.

WKU’s 2016 survey included:

- Community name and state
- Type of fee type (one of 11 types, including fixed rate, ERU, tier system, residential equivalence factor, etc.)
- Amount of fee
- Year the data was accessed
- Population of the community
- Annual revenues where available

To develop an understanding of the funds available for stormwater infrastructure in Great Lakes Basin communities, the WKU survey data was used to find the equivalent residential unit (ERU) charges for cities. An ERU is defined as the amount of stormwater exiting the site of an average residential building within the city. For ease of implementation, many stormwater utilities use ERUs to set a benchmark to assess charges for parcels within a city. For any community, the number of households can be obtained from the American Communities Survey (ACS). For the purposes of this exercise, each household was assumed to be one rate-payer.

A significant amount of income for most stormwater utilities comes from non-residential customers, such as industrial, institutional, and commercial stakeholders. The percentage of non-residential customers in a community is not easy to find. Individual studies were identified to aid is estimating this breakdown. In 2007, a stormwater utility survey was done for Jefferson, Wisconsin, and indicated that nearly 63.8 percent of the revenues came from non-residential customers.

Fully acknowledging the limitations of using data point from one study, this allocation was applied to all Great Lakes communities. Overall, if,

WKU stormwater rate = W/month

Number of residential housing units = A

Percentage of stormwater utility income for Jefferson Wisconsin that comes from institutional, commercial, and industrial sector = 63.2 percent

Percentage of stormwater utility income for Jefferson (Wisconsin) that came from multi-family residential, and single-family residential housing = 36.8 percent

Total annual income of a stormwater utility in a community

= residential income + non-residential income

= WxAx12 + 63.2xWxAx12/36.8

Based on the assumptions presented above, Table 4-3 was assembled to showcase income from stormwater utilities for Great Lakes Basin communities that can be used as a simple assessment of their ability to engage in CBP3s or fund stormwater infrastructure:

- Communities in green are able to (likely) generate $50M over a ten-year period. These communities are best suited for a long-term CBP3 type arrangement.
- Communities in yellow are able to (likely) generate $10M but less than $50 million over a ten-year period.
- Communities in red are able to (likely) generate less than $10M over a ten-year period. These communities, unless they combine their efforts with others or rely on SRF type funding, may not be motivated to enact a CBP3 type arrangement.

Table 4-3: Conservative estimate of SWU funds available over a ten-year period for CSO communities in the Great Lakes with SWUs

	State	Type of income	Estimated Residential ERUs (American community survey, U.S. Census Bureau, 2009-2013)	Annual utility fees (in Millions of Dollars)	Tier
Milwaukee	WI	ERU	257,857	$53.8	At 4 percent rate of return and a 30-year term, these communities can generate $50 million or more in additional capital
NEORSD	OH			$35.0	
Toledo	OH	ERU	138,382	$17.1	
Fort Wayne	IN	ERU	113,145	$13.5	
Lima	OH		17,062	$6.7	
Valparaiso	IN	Fixed Rate	13,095	$4.7	
Superior	WI	ERU	12,792	$2.5	At 4 percent rate of return and a 30-year term, these communities can generate between $10 and $50 million in additional capital
Crown Point	IN	Dual	11,449	$2.2	
Marion	OH	ERU	14,844	$2.0	
Warren	OH	ERU	20,577	$2.0	
Findlay	OH	Tiered	19,087	$1.9	
Fostoria	OH	Residential Units	6,307	$1.4	
Berne	IN	Fixed Rate	1,747	$1.2	
New Haven	IN	ERU	6,377	$1.1	
Chesterton	IN	Fixed Rate	5,321	$1.1	
Bucyrus	OH	ERU	6,019	$0.8	
Goshen	IN	ERU	12,808	$0.5	Fees can be leveraged to generate less than $10 million in capital
Ossian	IN	Fixed Rate	1,354	$0.4	
Oak Harbor	OH	ERU	9,808	$0.3	
Norwalk	OH	ERU	7,453	$0.3	
Angola	IN	Fixed Rate	3,777	$0.3	

Table 4-4: Conservative estimate of SWU funds available over a ten-year period for MS4 communities in the Great Lakes states with SWUs

	State	Type of income	Estimated Residential ERUs (American community survey, U.S. Census Bureau, 2009-2013)	Total Annual Utility Fees (in Millions of Dollars)	Tier
Lake County	IN	Fixed Rate based on land use class	209,005	$22.5	At 4 percent rate of return and a 30-year term, these communities can generate more than $50 million in additional capital
Oshkosh	WI	ERU	27,880	$10.3	
Ann Arbor	MI	Tiered	49,838	$8.5	
Appleton	WI	ERU	30,417	$8.0	
Green Bay	WI	ERU	45,812	$7.9	
Kenosha	WI	Equivalent Hydraulic Unit	40,967	$6.7	
Painesville	OH	ERU	45,958	$4.1	
Marinette	WI	ERU	30,296	$4.0	
Elkhart County	IN	ERU	77,672	$3.2	At 4 percent rate of return and a 30-year term, these communities can generate between $10 and $50 million in additional capital
Manitowoc	WI	ERU	16,180	$3.2	
Winnetka	IL	ERU	4,198	$3.0	
Munster	IN	Fixed Rate	9,095	$3.0	
Highland	IN	Tiered	10,064	$2.9	
Highland Park	IL	ERU	12,226	$3.2	
Merrillville	IN	Tiered	14,554	$2.4	
Crown Point	IN	Dual	11,449	$2.2	
Brunswick	OH	ERU	13,771	$0.8	
City of St Clair Shores	MI		28,723	$0.7	
Griffith	IN	Fixed Rate	6,750	$0.6	
Little Chute	WI	ERU	4,518	$0.4	
Ashland	OH	ERU	8,735	$1.0	
Kent	OH	ERU	12,655	$0.9	
Howard	WI	ERU	7,188	$0.9	
Bellevue	WI	ERU	6,304	$0.8	
Medina	OH	ERU	10,847	$0.8	
Neenah	WI	ERU	10,966	$0.7	Fees can be leveraged to generate less than $10 million in capital
Greenville	WI	ERU	3,834	$0.7	
Ravenna	OH	ERU	5,425	$0.5	
Galion	OH	ERU	4,907	$0.5	

As indicated in Figure 3-4, Ohio, Minnesota, Wisconsin, Illinois, and Indiana, collectively, have a large number of stormwater utilities that generate a dedicated revenue stream, a portion of which could be used to support large-scale green infrastructure. Assuming a 4 percent rate of return and a 30-year term, Lueckenhoff and Brown (2016) state that every million dollar in stormwater utility fee can be leveraged to an additional $13.5 million in capital that can be used to fund both soft costs (programmatic) and hard costs (implementation and maintenance of green infrastructure). At 13.5 leverage, a community that generates $3.7 million every year, can raise $50 million in capital.

Accordingly, if the existing stormwater utilities with annual revenues more than $3.7 million were to direct a third of their fees to green infrastructure implementation, these five states alone could support a $912 million investment in green infrastructure. In addition, an additional $225 million market exists for communities that can support an investment between $10 million and $50 million. Cumulatively, *assuming a third of the fees can indeed be allocated to green infrastructure*, these five states alone can support well over a billion dollar investment.
Note that if lower rate interest capital is accessed, say through a CWSRF loan of 1.25 percent over the same 30-year term, every million dollar in stormwater utility fee can be leveraged to an additional $19.3 million in capital. In that case, a third of the annual fees from communities that generate enough fees to support a $10 million investment can support a $1.6 billion green infrastructure market.

A word of caution is necessary here. Market size valuation models are, at best, approximate, and typically rely on the assumption that the future will look like the past (Gurley 2014). The truth is changes in offerings, new features, experiences, price points, and new use cases, can significantly change the market size. In the case of large-scale adoption of green infrastructure, the market will also almost certainly change because policy makers may simplify practices, cost effectiveness may have better proofs, etc.

What is also important to note is that states such as New York, Pennsylvania, and Michigan have no or very few stormwater utilities in place, and are thus harder to assess. While these states can use CWSRF loans as a potential revenue source for large-scale implementation, they are at a disadvantage due to less-friendly stormwater utility environment.

5.0 SUGGESTED NEXT STEPS

This document attempted to assess the market size of large-scale implementation of green infrastructure in the Great Lakes Basin. It attempted to develop and present a decision chart that included variables such as availability of P3 legislations, impact of home/Dillon's rules, regulatory drivers for MS4 and CSO communities, and frequency/volume of flooding events. It also attempted to assess the size of storm water utility revenues in the municipalities that have them.

Outside of the scope of this report, recommendations for future work based upon this report include the following:

- **Assess stormwater infrastructure funding needs and available funds in the Great Lakes Basin**: Over the last couple decades, deteriorating infrastructure across the country has received increased focus. However, no quantifiable numbers are available that assess the gap between funding needs and available funding. A clear understanding of this investment gap may drive public policy towards P3s across the Great Lakes, as well as the country.
- **Develop and execute a coordinated campaign to enact similar P3-enabler legislations across the Great Lakes Basin (as well as the country)**: To facilitate public-private partnerships across the Great Lakes Basin, there is a need for comprehensive P3-enabling legislations at the state level in all but two states within the basin. While these legislations may not grow the market of green infrastructure, they would lead to faster adoption. These legislations would provide public agencies the assurance that a partnership is acceptable in a given state while providing guidance on the state-specific needs for a partnership. In addition, they would also provide easier frameworks for private companies to assess their risks.
- **Provide guidance to the EPA in future regulatory updates to promote large-scale implantation of green infrastructure as a controlling technology**: The EPA should strive for an improved stormwater management program that discourages uncontrolled stormwater discharge while encouraging peak flow mitigation and increasing infiltration. These improvements can take many forms – green roofs, pervious pavement, use of deep-rooted plant species, infiltration improving technology, etc. Successful, large-scale implementation can be further guided by regulatory improvements in measuring progress/success.
- **Develop a One-Water Champions framework that provides mentor-mentee relationships, and promotes use of green infrastructure by smaller communities in the basin:** There is a need to better share the experience of progressive communities with smaller, resource limited communities. Unfortunately, there are many practical and commercial forces that make this difficult. From a practical point of view, all municipalities are understaffed and overworked. Asking them to take time out of their day to share their experiences and/or seek input from other communities is unrealistic. Should they choose to commit the time to seek or share their experience, it is critical that the information be succinct, targeted, and informative. From a commercial perspective, most communities rely on trusted advisors (consultants, trade groups, local experts) to guide their decisions. These experts have little interest in bringing new parties to the table. Thus the over-worked municipal staff tends to continue to rely on their "old" advisors even as new approaches are introduced.

  The One-Water Champions framework could be introduced to first, provide information to the consultant community that is available to them and their clients in a non-competitive, non-threatening manner. This information should be targeted to reducing municipal cost of compliance while improving the quality of life in that community.

- **Develop a green infrastructure funders collaborative that seeks to connect private delivery/finance companies with municipal and other groups:** To advance the use of P3s throughout the Great Lakes Basin, there is a need to connect interested municipalities with the private entities willing to compete for their business via an informed collaboration. This will allow municipal leaders to make an informed decision as they seek to rebuild the critical infrastructure.
- **Promote the adoption of stormwater utilities across the Great Lakes Basin**: Stormwater utilities, if crafted well, can provide dedicated funding for stormwater management, and can also be used as return on principal of any private finance that is engaged in large-scale implementation.
- **Promote the use of consistent green infrastructure ordinances across the Great Lakes Basin:** There is a need for "model" green infrastructure-oriented stormwater ordinance that is consistent and local ordinances can be built off of. Currently the effectiveness of green infrastructure ordinances is inconsistent – typically for the ease of the municipal staff. For ease of administration, some ordinances target "acres of green infrastructure" or "acres of impervious acres" – both important indicators, but not necessarily the best measure for restoring hydrology. There is a need to assemble the "best" ordinances across the nation, modify them to assure compliance yields the optimal hydrological response, verify that they would pass judicial scrutiny, and then provide these models to municipalities as they seek to address their stormwater management challenges.
- **Assess the use of green infrastructure in rust belt communities that plan to reduce their footprint**: Vacant land is relatively inexpensive in rust belt communities. Thus, these communities have a specific opportunity to utilize green infrastructure to address a number of their environmental challenges. For all urban areas, green infrastructure (sometimes coupled with gray infrastructure) is the least cost means of reducing runoff volume, reducing peak discharge rates, and increasing infiltration. The three measures of success restores the natural hydrology and improves water quality, assures permit compliance, and improves the quality of life in a very real way. If chosen appropriately, green infrastructure can reduce CSOs, SSOs, urban flooding, and water quality challenges.

6.0 CITATIONS

Alwin, C. (n.d.). Michigan Department of Environmental Quality [DEQ Unpublished Draft List of MS4 Permitted Communities]. Unpublished raw data.

American Society of Landscape Architects (2011). https://www.asla.org/stormwateroverview.aspx (accessed September 2016).

Batty, S. (2015). Integrated Water Quality Report and 303d Lists. Retrieved October 25, 2015, from http://www.epa.illinois.gov/topics/water-quality/watershed-management/tmdls/303d-list/index

Berahzer, S. I. (2014). Environmental Finance Center, University of North Carolina – Chapel Hill

Bolt v City of Lansing, 459 Michigan 152, 161 162; 587 NW2d 264 (1998) Article IX, Sections 24 - 34

Bump, K. (2008). Designated MS4 Communities Currently Permitted. Retrieved October 25, 2015, from http://www.in.gov/idem/stormwater/files/rule_13_ms4_permitted.xls

Center for Neighborhood Technology and American Rivers. (2010). *The Value of Green Infrastructure, A Guide to Recognizing Its Economic, Environmental and Social Benefits.* http://www.americanrivers.org/wp-content/uploads/2013/09/Value-of-Green-Infrastructure.pdf?388ec0

Citizen Advocacy Center (2004). *Home Rule and You*. Retrieved September 15, 2015, from http://www.citizenadvocacycenter.org/uploads/8/8/4/0/8840743/homerulebrochure.pdf

City of New York (2012). DEC and DEP Announce Groundbreaking Agreement to Reduce Combined Sewer Overflows Using Green Infrastructure in New York City. http://www.dec.ny.gov/press/80919.html (accessed September 2016).

Colomer, N. (2016). Michigan's Wayne State Strikes P3 Housing Deal. http://www.bondbuyer.com/news/regionalnews/michigans-wayne-state-strikes-p3-housing-deal-1115809-1.html (accessed September 2016).

Dyson, D. A. (2014). *State Local Relations* (United States, Research Department for the Minnesota House of Representatives, Madison, WI).

Ernst, C. (2004). Protecting the Source, the Trust for Public Land

Gotherman, J. E. (1972). Municipal Home Rule in Ohio Since 1960. *Ohio State Law Journal, 33*(3), 589-605. (accessed September 12, 2015).

Gurley, B. (2014). How to Miss By a Mile: An Alternative Look at Uber's Potential Market Size. http://abovethecrowd.com/2014/07/11/how-to-miss-by-a-mile-an-alternative-look-at-ubers-potential-market-size/ (accessed January 2017).

Hartley, Jon (2014). Forbes. *Social Impact Bonds are Going Mainstream*. Retrieved November 4, 2016 from http://www.forbes.com/sites/jonhartley/2014/09/15/social-impact-bonds-are-going-mainstream/#5b78f8d317d5

Indiana Department of Environmental Management (2015). Retrieved October 25, 2015, from https://secure.in.gov/idem/nps/2647.htm

Lick, D. M. (2011). New Law Allows Public Private Partnerships at Municipal Level-A Potential Option to Help Pay for Public Projects. *Municipal Law News*.

Lueckenhoff, D., and S. Brown (2016). Financing Integrated Green Stormwater Infrastructure to Improve Community Health. ISSN 1060-2976. October 13, 2016. Bloomberg BNA, Volume 198 (B-1).

Michigan Department of Environmental Quality (2014). Combined Sewer Overflow (CSO), Sanitary Sewer Overflow (SSO), Retention Treatment Basin (RTB) Discharge Annual Report. Retrieved October 25, 2016. Reports from 2000-2014

Michigan Department of environmental Quality. Water Lakes & Streams Water Quality Monitoring. (n.d.). Retrieved October 25, 2015, from http://www.michigan.gov/deq/0,4561,7-135-3313_3681_3686_3728-12711--,00.html

Michigan Department of Environmental Quality. 303d list MDEQ Water Lakes & Streams Water Quality Monitoring. (n.d.). Retrieved October 25, 2015, from http://www.michigan.gov/deq/0,4561,7-135-3313_3681_3686_3728-12711--,00.html

Milwaukee Metropolitan Sewerage District (2013). *Milwaukee Metropolitan Sewerage District: Regional Green Infrastructure Plan*. Milwaukee, WI: MMSD

Milwaukee Metropolitan Sewerage District (2013). *Regional Green Infrastructure Plan.* Pg. 52, *5. Green Infrastructure Benefits and Costs*. http://www.freshcoast740.com/PDF/final/06_MMSDGIP_Final_Benefits_and_Costs.pdf

Minnesota Department of Environmental Quality (2011). Management General Permit Authorization To Discharge Stormwater Associated With Small Municipal Separate Storm Sewer Systems Under The National Pollutant Discharge Elimination System/State Disposal System (NPDES/SDS) Permit Program. Retrieved October 28, 2015, from https://www.pca.state.mn.us/sites/default/files/wq-strm4-59h.pdf

Minnesota Pollution Control Agency (2016). Total maximum daily load (TMDL) projects. (2016). Retrieved October 25, 2016, from https://www.pca.state.mn.us/water/total-maximum-daily-load-tmdl-projects

Murphy, K. (2009). *County Government Structure: A State by State Report* (Rep.). Washington, DC: National Association of Counties.

National League of Cities, Local Government Authority. Retrieved from http://www.nlc.org/build-skills-and-networks/resources/cities-101/city-powers/local-government-authority (accessed October 24, 2016).

New York Department of Environmental Protection Designation Criteria for Identifying Regulated Municipal Storm Sewer System. (2010). Retrieved October 28, 2015, from http://www.dec.ny.gov/docs/water_pdf/ms4gpdescrit.pdf

New York City Department of Environmental Protection (n.d.) *NYC Green Infrastructure Plan: A Sustainable Strategy For Clean Waterways*. New York City, New York: NYC DEP

Northeast Ohio Regional Sewer District. (2012). *Green Infrastructure Plan*. https://www.neorsd.org/I_Library.php?a=download_file&LIBRARY_RECORD_ID=5526)

Odefey, J., S. Detwiler, K. Rousseau, A. Trice, R. Blackwell, K. O'Hara, M. Buckley, T. Souhlas, S. Brown, and P. Raviprakash *(2012). Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide.* American Rivers, American Society of Landscape Architect, ECONorthwest and Water Environment Federation. http://www.asla.org/uploadedFiles/CMS/Government_Affairs/Federal_Government_Affairs/Banking%20on%20Green%20HighRes.pdf

Pennsylvania Department of Environmental Protection (2011). Consent Order and Agreement. http://phillywatersheds.org/doc/LTCP_COA_2011.pdf (accessed September 2016).

Philadelphia Water Department (n.d.). Green City, Clean Waters, http://www.phillywatersheds.org/what_were_doing/ documents_and_data/cso_long_term_control_plan (accessed October 2016)

Philadelphia Water Department (2011). *Green city, clean waters: The City of Philadelphia's program for combined sewer overflow control*. Philadelphia, PA: PWD.

Prince George's County Department of the Environment, Clean Water Partnership Report (2016). Prince George's County's Approach to Meeting Stormwater Management Requirements. http://icma.org/Documents/Document/Document/308320 (accessed September 2016). 30 pp.

Pula, K. (2016). Public Private Partnerships for Transportation Categorization and Analysis of State Statutes. *National Conference of State Legislatures,* 14-22. Retrieved August 16, 2015, from http://www.ncsl.org/Portals/1/Documents/transportation/P3_State_Statutes.

Richardson, J. J., Jr., Farris, J. O., & Harrison, G. A. (2016). *The Law Behind Planning and Zoning in Indiana* [Pamphlet]. West Lafayette, IN: Purdue University Extension Service. https://www.extension.purdue.edu/extmedia/ID/ID-268.pdf (accessed December 2016)

Sinha, S.K., J. W. Ridgway, J.E. Edstrom, J. Andersen, P. Mulvaney, M. Quigley, and E. Rothstein. (2014). A Business Model Framework for Market-Based Private Financing of Green Infrastructure. Environmental Consulting & Technology, Inc., Report, 47 pp.

Sinha, S. K., P. Schools, J. Silfen, A. Eidson, R. Pettit, and J. Ridgway (2017) Environmental Consulting & Technology, Inc., Report, Public-private engagement options to implement green infrastructure by the Milwaukee Metropolitan Sewerage District, January.

United States Board of Geographic Names (2015). GNIS for States, Territories, Associated Areas of the United States, Shapefile, United States: US Geological Survey, GNIS

United States Census Bureau (2007). *United States Census of Government Illinois*.

U.S. District Court for the Northen District of New York (2009). Atlantic States Legal Foundation, State of New York, and Alexander B. Grannis v. Onondoga County Department of Drainage and Sanitation and

Onondoga County, New York. 88-CV-0066. Filed 11/16/2009. http://law.justia.com/cases/federal/district-courts/FSupp2/233/335/2310025/ (accessed December 2016).

U.S. District Court for the Western District of Washington (2013). United States of America and the State of Washington (Plaintiffs) v. the City of Seattle, Washington. Civil Action No. 2:13-cv-678. Filed 4/16/2013. https://www.epa.gov/sites/production/files/documents/cityofseattlewashington-cd_0.pdf (accessed September 2016).

New York Department of State, Albany, New York. (1998). *Adopting Local Laws in New York State*. New York City, NY.

Wisconsin Legislative Council (2013). *Constitutional Home Rule*. https://docs.legis.wisconsin.gov/misc/lc/information_memos/2013/im_2013_01.pdf

U.S. Environmental Protection Agency (2016a). Report to Congress – Combined Sewer Overflows into the Great Lakes Basin. https://www.epa.gov/npdes/combined-sewer-overflows-great-lakes-basin (accessed September 2016).

U.S. Environmental Protection Agency. (2016b) *Final Action Renewal/NOI Final Community County Date*. Retrieved October 25, 2016, from http://www.epa.state.il.us/water/permits/storm-water/ms4-status-report.pdf

U.S. Environmental Protection Agency (2016c). *Ohio Integrated Water Quality Monitoring and Assessment Report*. Retrieved October 2016, from http://epa.ohio.gov/dsw/tmdl/OhioIntegratedReport.aspx

U.S. Environmental Protection Agency (2016d). *MS4 RDW Storm Water General Permit List* - Retrieved October 2016, from http://wwwapp.epa.ohio.gov/dsw/permits/MS4_RDW.pdf

U.S. Environmental Protection Agency (2016c). MS4 Storm Water General Permit List - Ohio EPA Retrieved October 27, 2016, from http://wwwapp.epa.ohio.gov/dsw/permits/MS4_baseline.pdf

U.S. Environmental Protection Agency (2015). 303(d) Listed Impaired Waters NHD Plus Indexed Dataset with Program Attributes, Shapefile, United States: US Environmental Protection Agency

U.S. Environmental Protection Agency (2015). Flood Loss Avoidance Benefits of Green Infrastructure for Stormwater Management. Atkins Report. https://www.epa.gov/sites/production/files/2016-05/documents/flood-avoidance-green-infrastructure-12-14-2015.pdf (accessed September 2016).

U.S. Environmental Protection Agency Region 3 (2015). Community-based Public-Private Partnerships and Alternate Market-Based Tools for Integrated Stormwater Infrastructure. Atkins Report. https://www.epa.gov/sites/production/files/2015-12/documents/gi_cb_p3_guide_epa_r3_final_042115_508.pdf (accessed September 2016).

U.S. Environmental Protection Agency (2012a). Integrated Municipal Stormwater and Wastewater Approach Framework. https://www3.epa.gov/npdes/pubs/integrated_planning_framework.pdf (accessed September 2016). 9 pp.

U.S. Environmental Protection Agency (2012b). Consent Decrees That Include Green Infrastructure Provisions. https://www.epa.gov/sites/production/files/2015-10/documents/epa-green-infrastructure-supplement-1-061212-pj.pdf (accessed September 2016). 8 pp.

U.S. Environmental Protection Agency (2010). Green Infrastructure Case Studies – Municipal Policies for Managing Stormwater with Green Infrastructure. http://www.sustainablecitiesinstitute.org/Documents/SCI/Report_Guide/Guide_EPA_GICaseStudiesReduced4.pdf (accessed September 2016). 76 pp.

U.S. Environmental Protection Agency (2007). *Reducing Stormwater Cost through Low Impact Development (LID) Strategies and Practices.*

U.S. Environmental Protection Agency, Washington D.C. (2001). Report to Congress: Implementation and enforcement of the combined sewer overflow control policy (pp. 2-3). Washington, D.C.: U.S. Environmental Protection Agency, Office of Water.

Water Environment Federation Report (2014). Green Infrastructure Implementation. 485 pp.

Western Kentucky University Stormwater Utility Survey (2016). https://www.wku.edu/engineering/civil/fpm/swusurvey/swus2016.pdf (accessed September 2016).

Liberty Township Ohio Bulletin (2016). What Does It Mean To Be A Home Rule Township?. Retrieved from http://www.libertytwp.com/LibTwp/Bulletins/HomeRuleforWebSite.pdf (accessed December 2016)

Wisconsin Department of Natural Resources List of Municipalities Covered Under WPDES General Permit WI-S050075-2 (2014). Retrieved October 27, 2016, from http://dnr.wi.gov/topic/StormWater/documents/MS4sPermittedList.pdf

Wisconsin Department of Natural Resources Impaired Waters. (n.d.). Retrieved October 25, 2016, from http://dnr.wi.gov/topic/ImpairedWaters/

APPENDIX A
FINANCING AND DELIVERY OF LARGE-SCALE ADOPTION OF GREEN INFRASTRUCTURE

Implementing ambitious green infrastructure plans require significant financial investment. Tax-exempt public financing is one option, but there are several additional public and private financing options available to municipalities that can help accelerate their implementation plans. Public funding options include establishing new revenue sources like stormwater user fees, accessing State Revolving Funds, utilizing newer 'green' bonds, or obtaining grants.

In addition to these public sources, there are a number of private financing structures to consider. While private financing has traditionally been more expensive than public financing, it offers several advantages including:

1. Risk transfer to private sector
2. Access to broader variety of financing options
3. Significantly more scalable then public financing
4. Quicker access to innovative practices

3.1 PUBLIC FINANCING OF GREEN STORMWATER INFRASTRUCTURE

All public sponsors seek to maximize the non-debt financing sources available to them for green infrastructure, including grants, loans, and state or federal funding. In addition, public sponsors which enjoy strong balance sheets and rate bases have the option of funding green infrastructure through tax-exempt municipal bonds, repaid as a general obligation of the issuer or as a revenue bond from system-wide user fees. One positive factor in implementing a large-scale green infrastructure program in today's low interest rate environment, shown in Figure 3-1, is reduced interest costs, making all forms of infrastructure including green infrastructure, more affordable (Howard 2007).

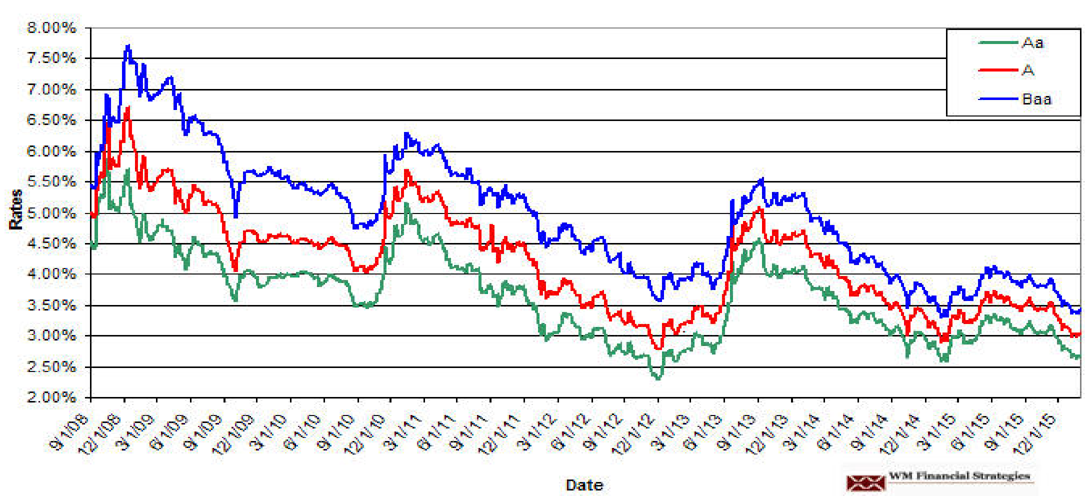
For municipal borrowers, a new class of bond called a "green bond" may be particularly attractive. Green bonds target investors who wish to fund environmentally beneficial projects, and can be issued in the form of tax-exempt municipal bonds (Ceres 2014). These bonds are addressed more carefully in Section 3.1.3.3.

In addition to financing, public sponsors may have the option to increase existing revenues by enhancing or implementing a regulatory system to allow for a fee collection specifically for green infrastructure, which can be used to repay a public sponsor's revenue bonds as well as to operate and maintain the green infrastructure. This may take the form of implementing or increasing stormwater dedicated fees or similar configurations.

3.1.1 STORMWATER MANAGEMENT RULES

An alternate financing option is to shift the cost of stormwater management to private developers by requiring them to pay for their own stormwater runoff. This benefits municipalities by limiting increases in their stormwater fees, reduces the need to access debt markets, and preserves bonding capacity for other projects. Public sponsors can establish or strengthen regulation requiring developers to

Figure 3-1: Municipal market data index 20th year maturity by rating grade



manage a certain amount of rainfall, either by installing BMPs on-site or by paying an "in-lieu fee." This regulation works well in a situation where there is sufficient demand for new development or redevelopment to overcome the incremental costs (often modest) to developers.

As an enhancement to a stormwater management ordinance, public sponsors may also choose to build an off-site allowance and/or in-lieu fee into the regulation. This allows developers to assess both the cost of compliance and potential design implications, and to achieve compliance through on-site green infrastructure or paying for off-site retention. This is often an attractive option for site-constrained developers. This fee can be pooled and used by the public sponsor to implement green infrastructure projects in priority areas. However, the regulation must be sufficiently stringent (and the in-lieu fee affordable enough) to make off-site compliance an attractive financial option. Implementing an off-site allowance is also a fundamental component of establishing stormwater retention credit trading, a private financing tool available to public sponsors addressed in Section 3.2.3.

3.1.2 GRANTS AND LOW-INTEREST LOANS

Stormwater management grants and low interest rate loans are available for various types of projects on a state-by-state basis. Clean water or drinking water state revolving fund (SRF) dollars can be used to develop capital projects. In many states, clean water programs provide subsidized interest rate loans to municipalities seeking to fund wastewater and stormwater infrastructure projects.

3.1.3 NEWER "GREEN" FINANCING OPTIONS

3.1.3.1 Qualified Green Building Sustainable Design Project Bonds

Other bond options have arisen recently. Qualified Green Building Sustainable Design Project Bonds ("Green Bonds") have been created to generate increased investment in LEED rated building projects and redevelopment of brownfield sites.

3.1.3.2 Qualified Public Infrastructure Bond (QPIB)

In January 2015, the White House announced the creation of a new type of bond vehicle, the Qualified Public Infrastructure Bond (QPIB), which has been tailored to enhance CBP3 investments. QPIBs are similar to Private Activity Bonds, however, they are expected to have no expiration dates, no issuance caps, and the interest on these bonds is not subjected to the alternative minimum tax with the overall effect of lowering financing costs for private participation in public infrastructure investments (EPA 2015). More detailed information is expected from the White House in the near future.

3.1.3.3 Green Bond Issuance

Public sponsors can issue a green bond to fund green infrastructure projects in their area. Similar to a regular bond issuance, private investors would buy the green bond that would provide up-front capital to build or maintain green infrastructure projects. If the issuer has a strong credit rating, issuing the bond under the full faith and credit of the organization will generally allow the organization to access a better cost of capital. Alternatively, repayment could be based on revenues generated by the project or by a particular revenue stream, assuming investors had enough confidence in the stability of the revenue stream. If the bond would be financing a park or recreational area that would involve charging a fee to users, the income created could be allocated to serve as repayment for the bond. However, depending on the size of the project and the project usage levels, it may be unlikely that usage fees alone would generate enough reliable revenue to fully cover bond repayment.

As an indication of the appetite for green bonds, some investors have been willing to support very long-dated bonds because of their environmental benefit. One example of this approach in the water sector is the Green

Century Bond. The District of Columbia Water and Sewage District announced the issuance of $350 million in taxable Green Century Bonds in July 2014, which extend the maturity date to 100 years compared to the usual 30 or 35 years for municipal bonds.

3.2 PRIVATE FINANCING OF STORMWATER INFRASTRUCTURE

Private capital is attracted to projects that are of sufficient scope, include a dedicated source of repayment, and offer an attractive risk-return profile. Private financing structures are typically more flexible than traditional public financing, and can easily be structured to include long-term operation and maintenance. The aggregation of many projects into a stormwater infrastructure program that provides long-term maintenance based on the BMPs lifecycle transforms green infrastructure into an asset that can be capitalized.

There are several unique benefits associated with private financing. First, private financing offers municipalities the ability to choose from a variety of repayment sources to best meet the needs of the program at its various stages. For instance, private financing can be used to fulfill project needs if there is a gap between an existing grant and when an SRF is applied. This would allow a public sponsor to begin broader implementation immediately. Second, private financing enables program implementation at scale, which maximizes savings, efficiencies, and socio-economic benefits.

In addition, private financing can reduce price and inflation risk. By funding at scale, private financing allows the public sector to accelerate delivery of green infrastructure, which reduces price risk and hastens the realization of environmental and social co-benefits.

Another advantage of private financing is the ability to incorporate, at scale, private property owners. This would allow the public sponsor to ensure that private residents were installing the most effective practice, instead choosing the least expensive to implement.

Private financing, through a CBP3, stormwater credit trading, or the creation of a stormwater bank, would enable a municipality to target the most cost effective and high-impact private parcels for inclusion in their green infrastructure plan. Conversely, an EIB would allow a municipality to gather metrics for green infrastructure costs and effectiveness at a smaller scale to allow it to make more informed capital spending decisions in the future.

Other considerations of private financing include risk transfer and the inclusion of performance-based metrics.

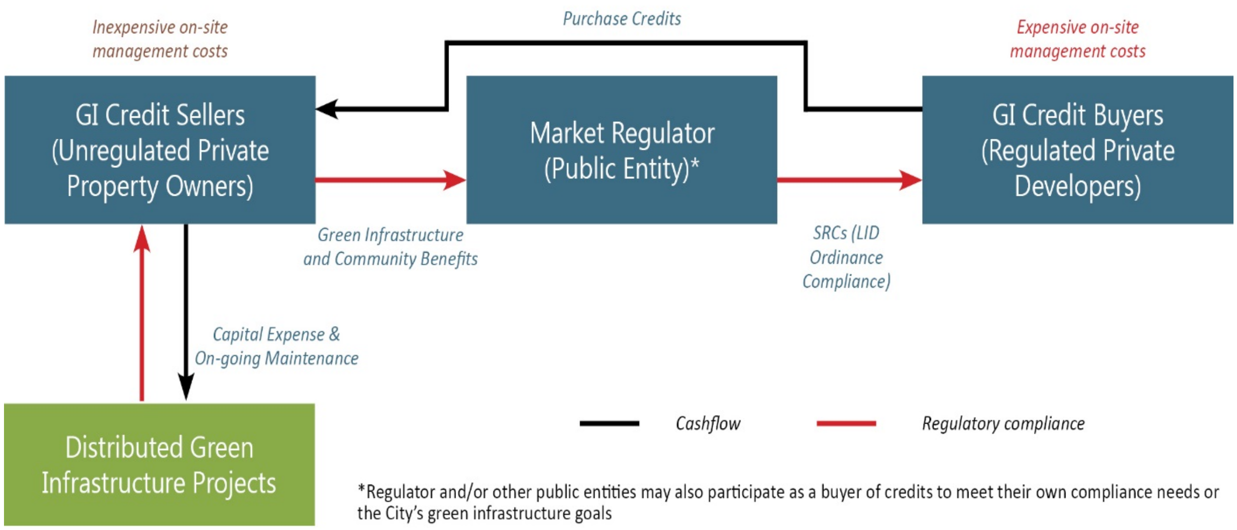
The following section highlights two private financing alternatives which could accelerate or enhance a green infrastructure plan. For information on EIBs and CBP3s, please refer to Chapter 3.

3.2.3 <u>STORMWATER CREDIT TRADING</u>

Credit trading (see Figure 3-5) is an innovative approach to reduce the environmental degradation caused by stormwater through a market mechanism that encourages least-cost mitigation. This approach has been implemented in Washington, D.C., and is similar to nutrient credit trading systems in the Ohio River Valley and other watersheds. This mechanism uses an open market in which developers are able to purchase off-site stormwater mitigation credits to achieve a high level of stormwater mitigation at the lowest cost possible.

As described above, implementation of a stormwater management ordinance with the potential for off-site compliance is necessary for stormwater credit trading. In general, the more stringent this regulation, the greater demand for off-site compliance and the more feasible credit trading. For example, Washington, D.C., implemented stormwater credit trading as part of its 2013

Figure 3-5: Stormwater credit trading program



Stormwater Rule. The 2013 rule quadrupled the requirement for on-site retention, increasing the regulatory retention requirement for new projects from 0.3 inches to 1.2 inches and, for the first time, required that projects undergoing major renovations also be subject to stormwater retention requirements.

In strict Low Impact Development (LID) ordinance environments, stormwater credit trading allows developers to either build green infrastructure BMPs entirely on-site, which may add meaningful costs to a project, or to purchase equivalent credits on a market where off-site, lower-cost options may exist. In the Washington, D.C., market, developers must build at least 50 percent of their mitigation requirement on-site, but are able to pursue off-site mitigation through buying credits or paying an in-lieu fee for the remaining half.

Regulators that implement credit trading programs must also develop an in-lieu fee option for the market to be feasible. This is because regulated developers who choose to go off-site need to know that, should there be no off-site retention available for purchase, they can achieve compliance through paying a fee to their regulator. Absent an in-lieu fee, developers are unlikely to take advantage of an off-site option, regardless of the cost-savings, due to concerns about inability to remain compliant in the future. The in-lieu fee also serves as a cap on the market, which allows developers going off-site to assess their future cost of compliance in a worst-case scenario.

In addition to a strong regulatory environment, other key value drivers for stormwater credit trading are a healthy pace of real estate (re)development, variability of land cost, and variability of BMP installation costs. A strong real estate market may drive density, land cost variability, and, potentially, BMP installation cost variability. Each of these are value drivers for credit trading by widening the spread between the price regulated developers are willing to pay for off-site retention. Developers are facing limited site flexibility and high costs to use the land for something other than stormwater retention.

A municipality could pursue a stormwater credit trading system through revisions to its Storm Water Rules placed on new developments.

Additional key aspects of credit trading include:

- Minimal public sector cost: The only public investment required for credit trading is establishing and running the market itself, a cost which can often be absorbed into the regulator's budget. There is no public financial contribution required to green infrastructure projects or their maintenance, although municipalities may consider committing additional funding to a stormwater credit trading program in the form of a purchase guarantee (price floor) or public buying program, described in more detail below.

- Accesses private property: Credit trading incentivizes voluntary installation of green infrastructure on private property in areas that would not otherwise benefit from the stormwater management ordinance. This is often an attractive element as it incentivizes green infrastructure on private property without requiring the public sector to encumber private property through easements. For example, the municipality could purchase credits from private property owners who developed voluntary sites. These owners would, through the sale process, commit to maintaining their green infrastructure for a period of time. This would mimic a municipality's funding green infrastructure capital spending on private property, without requiring an easement. In this example, should the private property owner who sold credits redevelop the property to remove the green infrastructure, they would be required to pay the in-lieu fee. Fee revenues could fund additional green infrastructure projects undertaken by the municipality or be used to fund more credit purchases.

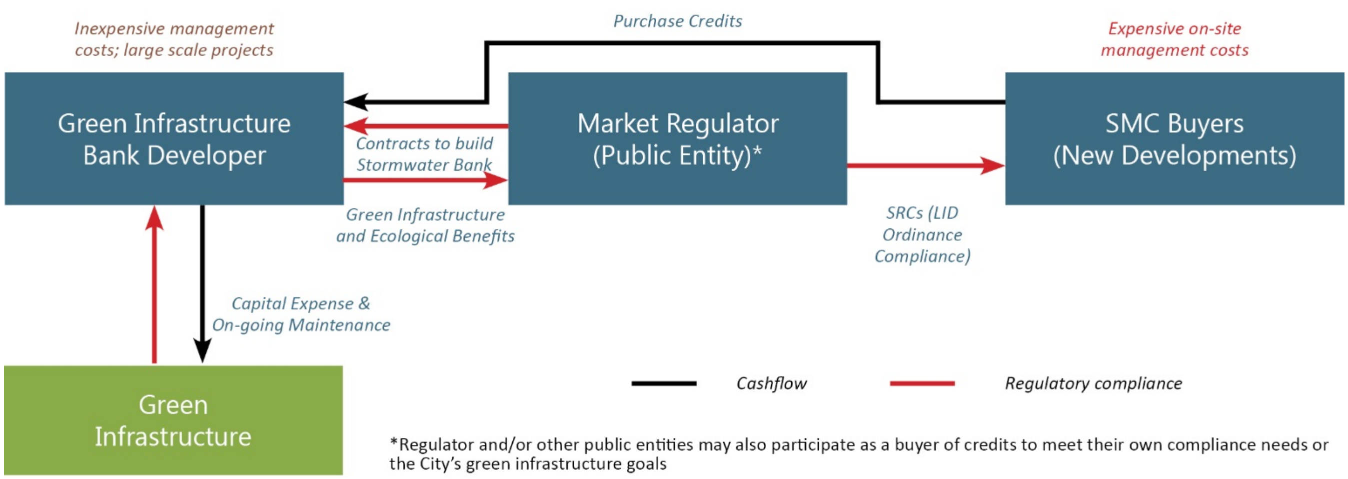
3.2.4 STORMWATER BANK

A stormwater bank (see Figure 3-6) is another mechanism regions can use to attract private capital to build green stormwater infrastructure. Similar to stormwater credit trading, a stormwater bank requires a stormwater management requirement and benefits from strong real estate (re)development demand. However, unlike stormwater credit trading, under a stormwater bank, regulated developers must achieve compliance on their own site or pay the in-lieu fee.

By offering the in-lieu fee as the only off-site alternative for developers, utilities or municipalities would control all of the revenue generated from off-site credit purchases, increasing its scope. With this pool of money, the municipality can then pursue the green stormwater infrastructure projects it values most.

The municipality could either manage the stormwater bank by itself, contract parts of it out to private developers and managers, or the entire fund could be externally managed by a private manager/developer tasked with developing a certain amount of stormwater mitigation credits each year.

Figure 3-6: Stormwater bank mechanism



Supported by:

Great Lakes Protection Fund