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Issue Brief: Creating Clean Water Cash Flows

Developing Private Markets for Green Stormwater Infrastructure in Philadelphia

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The problem of stormwater runoff can be summed up in a lament from Joni Mitchell's song lyrics—"they paved paradise and put up a parking lot" (and roofs, sidewalks, and streets). Today, polluted stormwater runoff is a primary cause of urban flooding and water pollution—totaling nearly 10 trillion gallons of dirty water dumped into our nation's waterways and coastal waters annually. In response to stormwater problems, many cities are developing ambitious plans to effectively *unpave* city land as a way to stop directing polluted runoff into municipal waterways and begin managing rainwater on-site through "green infrastructure" practices. These practices include trees, rain gardens, permeable pavement and other green development that mimic natural processes to infiltrate, clean, evapotranspire, or reuse stormwater on or near the site where it falls.

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Cities that are developing green infrastructure plans to manage stormwater runoff can face challenges funding these initiatives through traditional means such as federal or state funds or municipal bond issuance. As a response, the Natural Resources Defense Council, the Nature Conservancy, and EKO Asset Management Partners have joined forces to create "NatLab"—the Natural Infrastructure Finance Laboratory. For the past year, NatLab has undertaken pathbreaking work to uncover and analyze the fundamental economics of green infrastructure investment on private land and identify enabling mechanisms for cities to leverage private capital to attain their clean water goals through green infrastructure investment on a range of land types. In January 2013, NatLab published its findings in two reports, "Creating Clean Water Cash Flows," and "Greening Vacant Lots." This document summarizes those findings.

DEVELOPING PRIVATE MARKETS TO DELIVER LOWER-COST GREENED ACRES

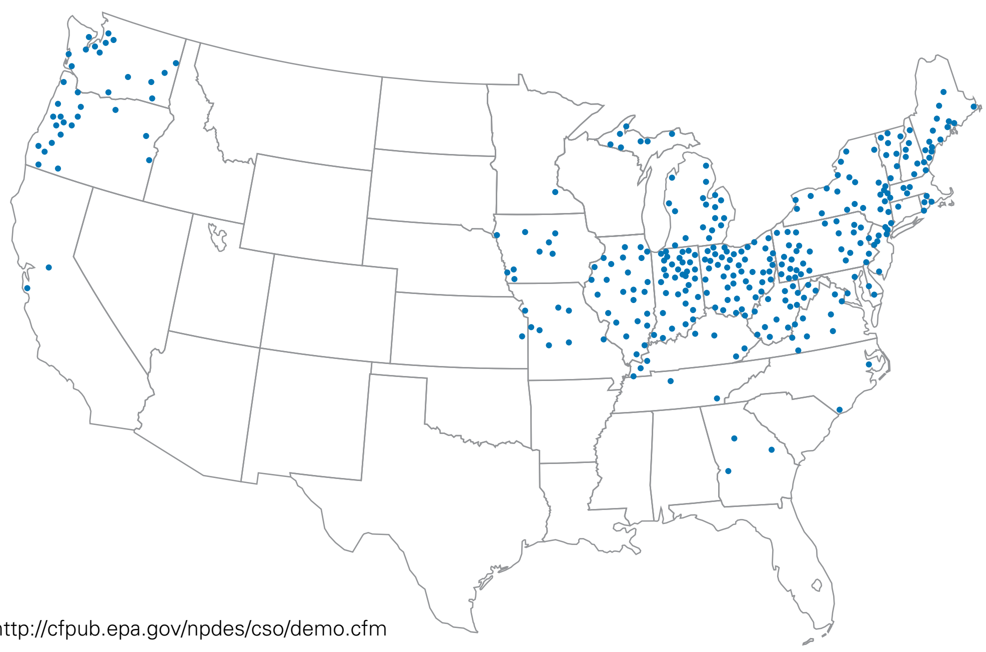
NatLab conducted its first pilot in Philadelphia where, nearly every time it rains, a mix of stormwater and raw sewage flushes into local waterways. Unfortunately, Philadelphia's combined sewer overflow problem is no anomaly: Nearly 800 communities nationwide have combined sewer overflow (CSO) systems that dump sewage into local waterways when it rains.

The map below, while not an exhaustive depiction of combined sewer systems, illustrates the prevalence of combined sewer systems in the U.S.

In an effort to reduce their stormwater runoff problems, cities including Seattle, Milwaukee, Cleveland, and New York have begun to invest in distributed green infrastructure solutions. However, no city has gone as far as Philadelphia's bold *Green City, Clean Waters* plan, which identifies green infrastructure as the primary means of meeting the city's obligation to reduce sewer overflows. Specifically, over the next 25 years, Philadelphia plans to transform at least 9,654 impervious acres (nearly one-third of the City's combined sewershed) into "greened acres"—areas with enough green infrastructure to capture the first inch of rainfall from any given storm. While Philadelphia's decision to use green infrastructure on a city-wide scale will also help lessen damage from urban flooding, reduce urban temperatures in the summer, improve property values and beautify urban neighborhoods, the city's decision to "go green" was fundamentally based on economic logic. The primarily "green" solution is expected to cost approximately $2.4 billion, whereas achieving the same clean water goals with traditional "gray" infrastructure would have cost the city billions more.

Moreover, there may be an even cheaper path forward for cities like Philadelphia to finance their clean water goals. Under its current plan, Philadelphia intends to raise $2.4 billion, primarily through bond issues, using most of these funds to "green" space in the public right-of-way at a estimated cost of $250,000 per greened acre. However, the analysis in NatLab's "Creating Clean Water Cash Flows" report suggests that by leveraging *private* investment and facilitating green infrastructure installation on *private* as well as public land, the City could meet the same Clean Water Act requirements at lower cost to the City and its utility customers.

Cities are very interested in understanding the role private investment could play in implementing green infrastructure as a means of dramatically reducing the cost of *public* investment needed to maintain healthy waterways. Although the analysis and recommendations in NatLab's reports focus on Philadelphia, the goal is to shed light on strategies that a wide range of cities can use to identify the most economical green infrastructure opportunities and leverage private capital to "green" their urban community.



Source: http://cfpub.epa.gov/npdes/cso/demo.cfm

Stormwater regulations play an essential role in encouraging private investment in green infrastructure. Cities across the country, including Philadelphia, have instituted design standards that require significant on-site retention of runoff when a threshold number of square feet are redeveloped. In addition, stormwater fee structures can be designed to provide a financial incentive for private property owners to invest in green infrastructure retrofits on *existing* developed properties. Many cities charge stormwater fees based on the amount of potable water used by a property—even though this bears no correlation to the amount of stormwater runoff the property generates. Philadelphia, Seattle, and Washington, D.C., among others, have adopted stormwater fee structures where customer fees *do* correlate to stormwater runoff volume. In these cities, stormwater fees are based on the amount of impervious area on customers' parcels, with fee reductions available to those who reduce the impervious area on their parcels or otherwise mange runoff onsite—for example, by retrofitting with green stormwater infrastructure.

Adoption of progressive stormwater fees is a good start. But in order to provide adequate incentive for investment in green infrastructure retrofits, there must be substantial fee reduction opportunities available to those owners, who otherwise would face relatively high stormwater rates.

NatLab analyzed Philadelphia's current and projected stormwater fee rates to understand the relationship between stormwater retrofit project cost and project payback based on avoided stormwater fees. For this analysis, it was assumed that third-party investors in stormwater retrofits would desire a payback within a ten-year period, similar to investors in the energy retrofit market. NatLab found that for a stormwater retrofit project initiated in Philadelphia in 2014, the project would likely need to cost less than $0.82 per square foot, or $36,000 per acre in order for an investor to simply break even on their initial investment within ten years, assuming an eight percent discount rate. If payback on avoided fees must be achieved within four years (the likely maximum time horizon for owners who self-finance retrofits), the project must cost half as much, approximately $0.40 per square foot ($17,400 per acre).

Green infrastructure retrofit costs can vary greatly according to conditions on a given property. When NatLab evaluated cost data (derived primarily from literature reviews) for nine city-approved green infrastructure practices, the data suggest that only residential downspout disconnections and lower-cost vegetated swales would likely pay back in terms of avoided fees within ten years. However, the downspout disconnection opportunities NatLab evaluated exist primarily on residential properties. Moreover,

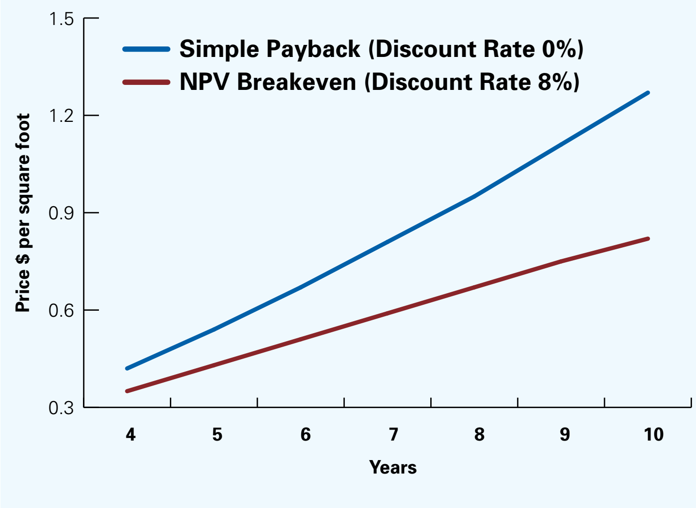
Stormwater Management Practice Retrofits (SMP)—Estimated Cost Ranges[1]

Stormwater Management Practice	SMP COST RANGE $/square foot of impervious area managed		SMP COST RANGE $/acre of impervious area managed	
	Mid-range	25% and 75% Quartiles	Mid-range	25% and 75% Quartiles
Downspout Disconnection (1)	$0.35	$0.33 - $0.38	$15,246	$14,377 - $16,450
Swales (2) (Vegetated Filtration, Retention, and Conveyance Structure)	$1.20	$0.64 - $2.13	$52,272	$27,878 - $92,783
Infiltration Trenches (3)	$1.46	$1.38 - $1.58	$63,598	$59,973 - $68,622
Rainwater Harvest & Reuse (2)	$3.28	$1.28 - $5.33	$142,877	$55,757 - $232,175
Rain Gardens (4)	$4.11	$3.88 - $4.43	$179,032	$168,827 - $193,175
Reducing Impervious (Hard) Surfaces (2)	$4.37	$3.94 - $4.58	$190,357	$171,626 - $199,505
Flow-Through Planters (2)"	$5.90	$3.84 - $7.68	$257,004	$167,270 - $334,541
Porous Pavements (5)	$5.17	$4.88 - $5.58	$225,205	$212,369 - $242,996
Green Roofs (2)	$34.98	$30.70 - $63.97	$1,523,729	$1,337,292 - $2,786,533

The above costs include materials, installation, design, and engineering, but do not include operations and maintenance costs. Cost ranges can vary greatly depending on site constraints. Data Soures:

1. AKRF Cost Estimate. Assumes disconnect is constructed as a do-it-yourself homeowner project.
2. Center for Watershed Protection 2007. *Urban Stormwater Retrofit Practices Manual.* CWP report costs were adjusted to 2012 dollars using a regional construction index. In addition, 20% was added for design and engineering and another 50% for contingency costs.
3. EPA 2004. "The Use of Best Management Practices (BMPs) in Urban Watersheds." EPA report costs were adjusted to 2012 dollars using a regional construction index. In addition, 20% was added for design and engineering and another 50% for contingency costs.
4. AKRF Cost Curve derived from built projects.
5. Urban Design Tools, Permeable Pavers, 2012. Low Impact Development Center, Inc. Urban Design Tools report costs were adjusted to 2012 dollars using a regional construction index. In addition, 20% was added for design and engineering and another 50% for contingency costs. In addition, it was assumed that any porous pavement retrofits would occur on previously paved areas. As a result, the cost of porous pavement installations also includes asphalt removal costs, which are anticipated to be $2.77/ft^2 of impervious area managed. Asphalt removal costs were derived from CWP 2007 Report Appendix E; costs were adjusted to 2012 dollars using a regional construction index. In addition, 20% was added for design and engineering and another 50% for contingency costs.

Break-even Analysis: Projects Beginning in FY14



even for swales, only projects at the lower end of the cost range would meet the ten-year payback threshold.

Other green infrastructure practices that are suitable for a wider range of sites, such as porous pavement, rain gardens, green roofs, and flow-through planters, are estimated to have higher cost ranges that would generally exceed a 10-year payback threshold.[2]

However, private markets for green infrastructure can be improved through public policies that drive down the upfront capital cost and improve the payback period of green acre retrofits. Through policy measures that encourage project aggregation, create an offsite mitigation and credit trading program, and subsidize a portion of retrofit costs, Philadelphia could substantially grow the market of economically viable green infrastructure projects on private parcels.

As indicated in the table below, Philadelphia could increase the market of economically viable green acres to projects totaling up to 73 percent of the city's long-term

Building a Greened Acre Market

	Off-site Mitigation	Aggregation	$0.50/ft² Subsidy	$1.00/ft² Subsidy	$3.00/ft² Subsidy	$3.50/ft² Subsidy
Downspout Disconnection	■■■■	■■■■	■■■■	■■■■	■■■■	■■■■
Swales		■□□□	■■□□	■■■■	■■■■	■■■■
Infiltration Trenches			■■□□	■■■■	■■■■	■■■■
Rainwater Harvest & Reuse			■□□□	■□□□	■■□□	■■□□
Rain Gardens					■■□□	■■■■
Reducing Impervious (Hard) Surfaces					■□□□	■■■■
Flow-Through Planters					■□□□	■□□□
Porous Pavements						
Green Roofs						
New Potential Greened Acres	658	215	2,532	2,252	1,015	344
Total Potential Greened Acres	658	873	3,405	5,656	6,671	7,015
Progress to 9,564 Greened Acres Goal	7%	9%	36%	59%	70%	73%

Guide to Building a Greened Acre Market

Distinct policy strategies are listed across the top, and stormwater management practice (SMP) are listed down the left-hand column. "Off-site mitigation" refers to a program whereby nonresidential property owners could receive stormwater fee credits for investing in retrofits on residential properties. "Aggregation" refers to the use of governmental or quasi-governmental resources to aggregate projects, assuming that such aggregation would substantially reduce transaction costs and would yield economies of scale that reduce capital costs by about 10 percent.[29] *"Subsidy" refers to a direct payment by PWD to a property owner to offset a portion of the up-front capital costs of a greened acre retrofit project.*

The greened acre bars in each cell illustrate when a specific SMP retrofit type becomes economically viable for private investors, assuming implementation of the policy strategies listed across the top. An "economically viable" project is defined as one that reaches a discounted payback within 10 years, assuming a discount rate of 8 percent. A full acre bar (■■■■) indicates that a substantial majority of projects—that is, those at or below the 75th percentile cost for a given SMP category—become economically viable when the policy strategy indicated is implemented. For example, all downspout disconnect projects would become economically viable if an off-site mitigation program were created. The quarter-acre bar (■□□□) and half-acre bar (■■□□) indicate that only 25 percent or 50 percent of retrofit projects for a given SMP category become economically viable when the policy strategy is implemented. For example, aggregation could make one-quarter of swale projects economically viable. The subsidy columns assume that aggregation programs have already been implemented, as this is considered a prerequisite to creation of a private investment market in stormwater retrofits.

greened acre targets. Philadelphia could accomplish this by combining a subsidy program offering $3.50 per square foot for green infrastructure retrofits on private parcels, as well as implementing offsite mitigation and aggregation programs. Given that the city is spending an estimated $250,000 per acre ($5.74 per square foot) to install green infrastructure in the public right-of-way, Philadelphia could deploy strategic policy measures in order to prime a market for private green infrastructure development. In doing so, the city could reach its greened acre goals at a lower cost than could be achieved through investment in projects in the public right-of-way alone.

TOOLS FOR BROADENING THE MARKET FOR GREEN INFRASTRUCTURE INVESTING

Project Aggregation Can Reduce Upfront Capital Costs

Green infrastructure projects aimed at reducing the runoff from a city's paved surfaces are small in scale and distributed in nature. These features can make project implementation challenging, particularly in cases where individual property owners are seeking outside project financing for the retrofit. Packaging numerous stormwater projects into an aggregate portfolio could help increase the financial attractiveness of stormwater retrofit projects in a number of ways. First, aggregation can present opportunities to work through intermediaries that are willing and able to reduce and/or absorb transaction costs. Second, by efficiently managing many projects simultaneously, aggregation can reduce project development costs through economies of scale. Third, aggregation can help investors manage risk by diversifying the quantity and character of projects in a stormwater investment portfolio. In essence, aggregation, when done correctly, can help reduce the transaction and material costs, as well as the risk exposure that could be expected to inhibit private investment in small projects.

Offsite Mitigation and Credit Trading Programs Can Expand the Green Infrastructure Retrofit Market

Under Philadelphia's current stormwater fee system, non-residential property owners can reduce their stormwater fees only by constructing stormwater retrofits on their own properties. Unfortunately, due to their properties' physical constraints, many property owners may lack on-site options for retrofits at a cost low enough to provide an attractive return on investment. To encourage maximum private investment in stormwater retrofits and provide greater flexibility for site-constrained property owners, Philadelphia could consider creating a market of tradable credits for stormwater retrofits.

Development of a tradable credit system, with appropriate regulatory safeguards, could encourage investment in green infrastructure and help deliver stormwater mitigation at the lowest possible cost per green acre. For example, NatLab's analysis indicates that downspout disconnections are one of the lower-cost retrofit opportunities available in Philadelphia. However, downspout disconnection project opportunities largely exist on residential properties—and residential properties are not eligible for stormwater fee reductions if they install green infrastructure. If *non-residential* owners could receive credit against their own stormwater fees in exchange for paying to install downspout disconnections on *residential* properties, it would allow both residential and non-residential owners to reap economic benefits from the lowest-cost retrofit opportunities.

Steps that cities can take to encourage aggregation of green infrastructure retrofit projects

- **Informing interested parties of local stormwater opportunities.** Make publicly available information detailing which properties face large stormwater fee increases and which properties show promise as sites for low-cost green infrastructure retrofits.
- **Educating and encouraging parcel owners.** Include information on billing statements showing the cost and potential savings of green infrastructure retrofits. Note potential options for retrofit financing. Billing statements can also be used encourage interested ratepayers to sign up to be contacted by stormwater retrofit aggregators.
- **Permit streamlining.** In order to reduce project implementation costs and encourage aggregation, permitting rules might be streamlined to simplify the permitting process for aggregated projects.
- **Encouraging nongovernmental organizations and Business Improvement Districts (BIDs) to engage in project aggregation.** Foundations and NGOs to can be encouraged to channel capital (e.g., grants, subsidies, etc.) toward potential aggregators that originate, negotiate, and bundle stormwater retrofit projects. BIDs are already set up to facilitate cooperation among local property owners and, particularly where cost savings can be attained, will likely have an interest in serving as green infrastructure project aggregators.
- **Creating processes that facilitate economies of scale.** Preliminary research shows that the most important factors in achieving economies of scale include permitting, design, and the acquisition of parts/materials. Cities can ensure that permitting requirements don't inadvertently discourage aggregation, and/or write rules to permit aggregators to submit retrofit designs across a broad array of small properties.

This downspout disconnection drains to a driveway with pervious pavement. Pervious pavement allows the rainwater to soak into the ground instead of running off.

This downspout disconnection drains to a grassy area that absorbs the runoff into the ground.

In addition to enabling offsite retrofits on residential parcels, an offsite mitigation program could offer tradeable credits to non-residential redevelopment projects or voluntary retrofit projects that oversize their stormwater management facilities. Under local regulations, redevelopment projects of over 15,000 square feet are required to capture one inch of runoff over their entire parcel. For cases of voluntary retrofits on existing developed property, the one-inch capture standard is also used to determine whether a retrofit qualifies for credit against a property owner's stormwater fee. In the case of both redevelopment projects as well as voluntary non-residential retrofit projects, it may be possible to cost-effectively manage *more* than one inch of on-site runoff or manage additional runoff from the adjacent public right-of-way. The surplus management volume could generate a tradeable credit.

How an off-site mitigation program would benefit local stakeholders

- Greater flexibility for constrained property owners by providing a lower-cost option for those who want to reduce their stormwater fees.
- System-wide cost savings by leveraging the market to find least-cost stormwater management practices (SMPs).
- Establishing a market price to reveal low-cost mitigation opportunities, thereby attracting private capital to the most cost-effective retrofits.

Establishing an off-site mitigation program would create new administrative burdens for Philadelphia, such as certifying credits on credit-generating properties, maintaining a public credit registry (along with serial numbers for individual credits), and setting up a system to ensure that credit-generating sites continue to be maintained post-certification. Moreover, since the environmental harms of stormwater runoff are very time- and place-specific, strong credit trading rules would be necessary to protect urban water quality over time and across communities. To address such issues, "Creating Clean Water Cash Flows" offers NatLab's recommendations on how to design an off-site mitigation program to ensure that it yields greened acres that can be counted toward a city's compliance with its Clean Water Act obligations.

Taking Advantage of Green Infrastructure Opportunities on Vacant Lands

Many of the older Midwestern and Northeast cities that have combined sewer overflow problems also face challenges with vacant or abandoned urban lands. These parcels, which dot the communities of older cities, are often viewed as a liability—eyesores that depress local property values. As under-developed and unconstrained properties, vacant parcels can represent a low-cost supply of potential green acres. In addition to being more cost effective than retrofits on developed parcels, greened acre development on vacant lands provides broader benefits to local communities via beautification and increased property values.

Due to the attractiveness of addressing multiple urban issues at once—namely community beautification, open space development, and stormwater management—a number of cities across the US have already begun to utilize vacant lands to increase community open space and stormwater services. To consolidate best practices in vacant land development, NatLab worked with the New York Soil and Water Conservation District to compile case studies from ten U.S. cities. Each case study traces a city program from the planning stage through implementation. These case studies, available in NatLab's "Greening Vacant Lots" report, illustrate how leading cities are planning, administering, financing, and implementing programs that convert vacant lots into green spaces that provide recreational use and stormwater services. Taken together, the ten case studies offer the following most effective practices utilized by cities to green vacant lots:

- **Development of a New Department or Organization.** Cities developed specialized departments or organizations to green vacant lots, which often entailed work that spanned numerous public agency objectives and missions. New organizations focused on greening vacant lots had the greatest level of success, by bridging planning and/or implementation gaps, as well as cultivating partnerships and coordination across organizations.
- **Community First/Multiple Use Design.** Successful green infrastructure development seeks to improve quality of life by incorporating multiple public uses, such as public parks, trails, greenways with pedestrian and bicycle paths, and public education. In contrast, a narrow focus on stormwater-specific designs can result in unforeseen public reactions and maintenance challenges.
- **Strong Organization to Aggregate Sites.** A single lead organization is needed to help guide a community through creation and execution of a regional vacant lot acquisition strategy. In addition, nimbler non-governmental third-party organization (such as land banks) can play a critical role in assisting local governments with acquisition of promising stormshed properties.
- **Property Transfer and Acquisition.** Effective green space programs include mechanisms for transferring properties from other public agencies and for acquiring tax-delinquent and tax-current privately owned properties. Many cities focus on the use of eminent domain and condemnation to acquire properties with limited development potential. Because of liability and maintenance costs, public ownership is primarily confined to larger sites, while smaller sites are frequently owned by non-profit land trusts with a collaborative relationship with the city agency.
- **Finance and Planning.** There is no shortage of effective financing strategies that have been utilized to forward vacant lot development. Foundation grants often lay the groundwork for development of regional green stormwater and vacant land conversion planning. As a second step, acquisition and construction of green acre projects are financed through property tax levies, tax increment financing and ratepayer fees. Finally, revolving loan funds have been used by third party acquisition organizations to facilitate accelerated purchase and aggregation of strategic properties.

REDUCING RISK FOR PRIVATE INVESTMENT IN GREEN INFRASTRUCTURE

As discussed above, subsidies, aggregation, offsite mitigation, and utilization of vacant lands can all help drive down upfront capital costs and improve the economic viability of private green infrastructure projects. However, in addition to these cost-reduction policy measures, policies aimed at encouraging third-party financing will remain crucial to driving will remain crucial to driving development of greened acres on private properties. However, before parcel owners are likely to undertake voluntary retrofits based on expectations of future avoided fees, and before third-party investors are likely to finance those long-term projects, questions surrounding regulatory and revenue certainty will need to be resolved.

Reducing regulatory uncertainty

In a market such as green infrastructure project finance, where future avoided stormwater fees may figure prominently in payback timeline and repayment to capital providers, important questions around revenue certainty will need to be resolved to help build investor confidence in long-term green infrastructure investments.

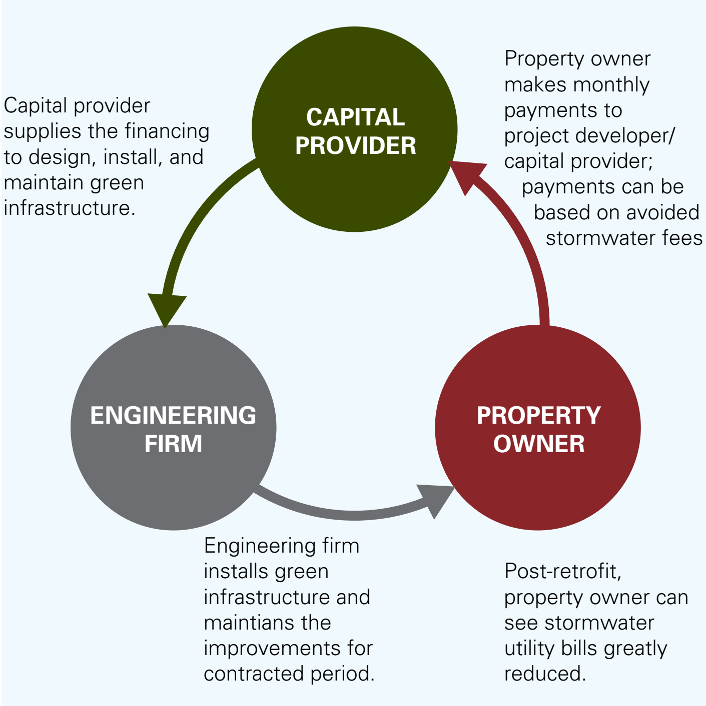
Within Philadelphia, the Water Department has not made available projections of Philadelphia's long-term stormwater fee schedule (and corresponding credit). Making such a projection available would be important, because changes to the fee structure or credit could have a negative impact on an investor's payback period.

There remains some additional uncertainty around the renewal process for stormwater fee discounts, since initial permits for stormwater fee reductions expire after four years. Increased transparency around the re-approval process and re-approval criteria—including examples of projects that would or would not meet re-approval thresholds—are steps that could aid in resolving some of the uncertainty around long-term project economics.

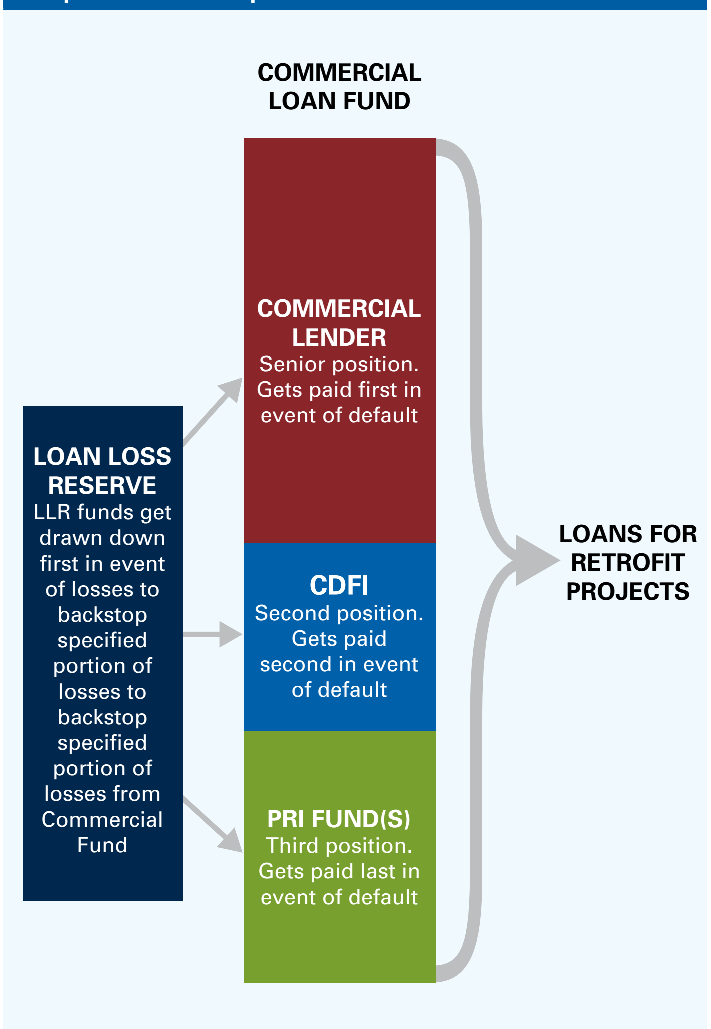
Reducing Project Risk

In addition to regulatory risk, the very nature of green infrastructure financing presents novel questions for both property owners and project financiers. Natlab's analysis has identified lack of collateral, high transaction costs relative project size, and lack of a track record for stormwater retrofit financing repayment as key project risk elements. Because many nonresidential parcel owners have existing mortgages or other encumbrances on their assets and may be unable to obtain lender consent for additional debt, traditional lending mechanisms may not fit the needs of parcel owners interested in stormwater retrofits. Instead, third party "project developer" models similar to those that have been developed in the energy efficiency finance sector may be well-suited to the green infrastructure space.

Third Party Project Developer Model



Sample Loan Fund Capitalization Structure



Under third party project developer-style models, the capital provider also acts as a project developer, providing the financing as well as arranging for the design, construction, and ongoing maintenance of installed projects. In return for up-front capital and maintenance services, the capital provider/developer enters a long-term service contract with the parcel owner—the capital provider/developer is assured a portion of the owner's avoided stormwater fees for a fixed period. From the project developer's perspective, control over the retrofit installation and maintenance provides assurance that the project will receive the optimal stormwater fee reductions, and this in turn increases the likelihood that the project developer will be repaid. From the property owner's perspective, these financing arrangements are preferable to traditional debt because they reduce the business' upfront capital outlay, and can be filed as an ongoing operating expense instead of an asset/liability on the owner's balance sheet. Using the energy retrofit sector as a guide, successful project developer financing in the stormwater sector will likely require strong property owner credit and debt service coverage ratios, and owners will likely seek consent from existing lenders before project implementation.

Interviews with members of the investment community suggest that the limited repayment track record for stormwater retrofits in Philadelphia, coupled with the unsecured nature of the financing, will lead to high initial project risk and exposure for the financier. As a result, one could expect early project loan interest rates to hover in the double digit range, well outside the range that would be attractive to parcel owners. Moreover, the interviewees suggested that for the third-party financing market to develop and mature, there would likely need to be financial backstops against potential losses on green infrastructure investments.

Third-party investors could be insulated from revenue-related risk through the creation of a loan loss reserve fund. Utilizing proven revenue collection streams like property taxes and utility bills could also help to protect investors. Reduction in these risks can ultimately improve the financing terms available to property owners seeking third-party financing for retrofits.

Reducing Risk With a Loan Loss Reserve

Creation of a loss reserve facility has proved to be an effective mechanism to draw investors into a new and unproven sector by reducing potential financial losses. A loan loss facility, which serves to backstop a larger pool of investment capital, insulates investors from a specified amount of project risk and thus encourage private capital financing of projects that otherwise might not have received funding. Over time, the investments that benefit from the initial credit support provided by the loan loss reserve would create a track record of repayment/performance in the sector. Future investors would therefore be better able to assess projects on a more specific, empirical basis.

The fund structure presented above represents only one way of addressing credit enhancement through a loan loss reserve fund. Alternatively, concessionary capital from PWD and other institutions could be used in a credit enhancement program to individual lenders. Although lending could be originated by a local Community Development Financial Institution, a commercial lender or other aggregators could also play origination roles as long as agreed-upon underwriting criteria are met that would minimize repayment risk.

ACHIEVING CITY-SCALE PRIVATE INVESTMENT THROUGH PAY-FOR-PERFORMANCE STRUCTURES

In order to meet its Clean Water Act obligations, Philadelphia will need to finance, design, build, operate, maintain and monitor compliance for a vast portfolio of greened acres. A pay-for-performance structure, which could be modeled on the private-public partnership (PPP) arrangements that are common in traditional infrastructure projects, may provide an exciting opportunity to accelerate large-scale private investment in the most economically attractive greened acre retrofits on both public and private lands.

In an environment of constrained federal and state budgets, PPPs are seen as a way to engage the private sector more deeply in funding infrastructure projects to meet public service needs. Successful PPPs can lower the costs of construction and maintenance, accelerate implementation, access new sources of investment capital, preserve balance sheet capacity, and incentivize optimal performance by shifting performance risk to private partners where payments are tied directly to performance.

The 'Availability Payment' PPP model may be best suited to help Philadelphia meet its green infrastructure requirements. Under the Availability Payment model, a government entity contracts to make a regular periodic payment to a private sector entity which, under the terms of the PPP contract, will deliver and manage a specified number of greened acres. This framework would require PWD to make a quarterly or other regular payment for use of the infrastructure in question. The payment can be subject to performance standards that would allow PWD to reduce the level of its payment amount or eliminate payments altogether in the event that performance is inadequate.

A pay-for-performance structure may be able to reduce greened acre costs, as compared to ordinary city capital projects, by providing a private partner with opportunities to:

- Focus on technical designs and property types where it has a competitive greened acres in a cost-effective manner
- Minimize project lifetime cost by combining design and maintenance obligations under one contractor
- Achieve economies of scale by sequencing and organizing a large portfolio of work, rather than small project-specific contracts
- Deploy green infrastructure in a cost-effective manner on property types that the city would not otherwise have access to

The private partner contracted to finance and deliver greened acres to Philadelphia under a PPP can consider a variety of capital structures that incorporate nontraditional sources of funding, including philanthropic capital, impact-oriented capital held by those interested in achieving environmental objectives alongside financial ones, and traditional institutional capital sources.

There is enormous capital capacity to fund infrastructure in the United States and beyond. PPPs are attractive to investors because they can provide a high level of transparency and generally offer investment premiums compared to municipal bonds for similar risks. A PPP arrangement for green infrastructure could allow PWD to leverage private capital to fund an innovative solution for stormwater mitigation, defer some of its up-front costs, and provide a compelling opportunity to investors, offering good value to the city on a relative basis.

Benefits of PPPs

Potential Benefit	Description
Lower Construction and Maintenance Costs	Private-sector entities may be able to deliver lower-cost projects through more efficient implementation and operation. Where projects are constructed and maintained by the same private-sector entity, there is greater incentive at the point of construction to take steps to lower future operations and maintenance costs. Efficiencies may also be gained through economies of scale by contracting for multiple projects.
Access to New Sources of Funding	PPPs can be financed using off-balance-sheet funding mechanisms that can reduce the impacts on a public agency's balance sheet, depending on the type of liabilities embedded in the PPP contract. In addition, PPPs' higher financing risk has a ready demand from investors willing to absorb the risk in exchange for investment premiums relative to typical municipal bond spreads.
Shifting of Performance Risk to Private Investors and Companies	PPP contracts can be structured with a range of features to reduce risks to the public agency involved, including caps on payment for construction, payment only upon completion of projects according to specifications and time lines, payments over time only upon ongoing performance, and compliance of the project with specific standards and other metrics.

Considerations for a Greened Acre PPP Project

NatLab discussed the concept of a "Greened Acre" PPP in Philadelphia with a range of professionals involved in infrastructure investing and transaction structuring, corporate sustainability efforts, and corporate foundation grant-making. Those investors suggested a number of considerations on the part of the potential investment base for a Greened Acre PPP project, such as:

- **Performance Risk.** If PPP financing relies on a PWD contractual obligation for repayment, performance becomes the critical risk factor evaluated by investors. There are two types of performance risk for green infrastructure: failure to complete construction according to design specifications, and failure to provide ongoing maintenance of infrastructure to comply with environmental regulatory standards.
- **Scale.** For most investors, the scale required to attract mainstream institutional capital into a single investment entity is likely at least $20 million, and ideally $50 million or more. Mainstream institutional capital is defined here as pension funds, sovereign wealth funds, foundations/endowments, family offices, and private banks. Below the $20 million level, there are certain foundations, family and multifamily offices, and impact-oriented investors who are potential sources of capital. Infrastructure funds would need to make at least a $25 million commitment of resources to any potential PPP product. Around $75 million to $100 million would be an ideal amount of capital to attempt to raise, based on local demand for the capital in terms of project need and potential institutional supply of investment capital. These data are encouraging in that they indicate institutional-scale investors could be approached to finance PPP efforts.
- **Pricing.** A PPP structured between PWD and a private-sector partner would have off-balance-sheet financing. Payments made through a contractual obligation do not imply the same liability to PWD as an on-balance-sheet loan obligation or bond issuance. Therefore, the return required by investors will necessarily need to incorporate the lower standard of obligation written into the contract. The weaker PWD's contractual obligation, the higher the return required. At the same time, the contract terms cannot be so strict as to mimic a traditional bond instrument in terms of PWD's liabilities therein, or the contract will be perceived by PWD's rating agencies to be debt-like, possibly resulting in a highly undesired impact on PWD's credit rating and debt ceiling.
- **PWD credit risk.** Given that the contemplated PPP structure would involve availability payments made by PWD to the private partner and supported by PWD's general ratepayer revenue collections, investors would evaluate the credit risk of PWD, and financing premiums would be benchmarked against PWD bonds currently trading in the market.

CONCLUSION

The federal "Clean Water Needs Survey" has identified over $100 billion of infrastructure investment needed over the next twenty years to address stormwater and sewage overflows. As a result, Philadelphia's work to address stormwater runoff through green infrastructure is being closely watched by cities nationwide, as well as by federal and state clean water agencies.

As Joni Mitchell said when she lamented the paving over of paradise, "You don't know what you've got 'till it's gone." Fortunately, we can build green spaces in our cities that mimic the functions of natural watersheds and, through development of strategic policies and programs, cities can facilitate roles for private capital in meeting urban clean water goals.

1 Conversion from cost per square foot to cost per acre was calculated by multiplying cost per square foot by the number of square feet in an acre (43,560).

2 It must be emphasized that these cost ranges are most useful to broadly compare economics across project types, rather than as an absolute indication of the economic feasibility of any given project category. A case-by-case property assessment would be needed to determine true retrofit costs for any given project.