EXECUTIVE SUMMARY

When rainwater rushes off Philadelphia’s buildings and other impervious structures, it strains the city’s combined sewer system, causing approximately 13 billion gallons of untreated sewage mixed with polluted runoff to overflow into city waterways each year. Philadelphia’s expansive stormwater runoff problem is no anomaly. It is one of nearly 800 communities nationwide that are required by the Clean Water Act to reduce raw sewage overflows from combined sewer systems, and thousands more have obligations to reduce pollution from separate storm sewer systems. Philadelphia is also one of many cities nationwide that is increasingly turning to green infrastructure solutions as a key part of the stormwater runoff solution. Green infrastructure includes installations such as rain gardens, swales, and green roofs, which capture runoff from impervious cover before it reaches overburdened sewer systems.

Philadelphia has made an unprecedented commitment to using green infrastructure to address its stormwater runoff problems through its ambitious Green City, Clean Waters plan. To achieve compliance with the Clean Water Act, the plan establishes binding targets, over the next 25 years, to transform approximately 10,000 acres (about one-third) of the impervious area in its combined sewershed into “greened acres,” on which the first inch of rainfall from any given storm is managed on-site. The city plans to reach its goal through a combination of greened public spaces and regulatory changes intended to induce private investment in green infrastructure development.

A 2012 NRDC paper, Financing Stormwater Retrofits in Philadelphia and Beyond, outlined how Philadelphia’s new stormwater fee and credit structure could encourage private parcel owners to invest in stormwater retrofits, thereby leveraging private capital to help meet the city’s greened acre targets. Building on that paper, this report provides more detailed analysis and action-oriented recommendations to stimulate investment in green infrastructure on the part of municipalities and private investors. Although the analysis and recommendations are directed toward the case of Philadelphia, the aim of the report is much broader: to shed light on strategies that a wide range of cities can use to identify economical green infrastructure retrofit opportunities and, where possible, leverage private capital in efforts to “green” their urban space.
Chapters 1 and 2 of the report analyze stormwater retrofit economics and financing challenges that might apply to greening of private parcels in Philadelphia. In addition to identifying existing barriers, the conclusions of Chapter 1 and 2 provide suggestions for how PWD could improve the economic viability of greened acre investments on private parcels through additional policy measures—such as improved regulatory certainty, enhanced transparency in the credit renewal process, creation of an offsite mitigation market, facilitating project aggregation, and direct subsidies for green infrastructure projects on private parcels. Chapters 3 and 4 outline approaches to developing project aggregation and offsite credit trading systems in an effort to enlarge the universe of financially attractive retrofit projects by reducing transaction costs and directing available private capital to the lowest-cost projects. Chapter 5 explores the benefits that private-public-partnership structures could generate by encouraging the development of the most economical greened acres, including retrofits on public or private lands.

Taken together, the chapters suggest that although Philadelphia’s parcel-based fee system is a good first step toward drawing private investment to green infrastructure, many economic barriers remain. In the current market environment, the discounted payback periods of most green infrastructure retrofits on private parcels stretch beyond ten years, which is longer than most investors would be willing to accept. However, the report indicates that a range of strategic policy interventions that PWD and other local stakeholders could undertake would substantially expand the market for viable private investment in green infrastructure. Finally, the authors find that implementation of the policy interventions explored in this report are likely to be in PWD’s and local tax payer’s best economic interest, as the cost to PWD to implement these policies are likely to reduce the City’s total costs to meet its green acre goals.

### I. HOW TO SPUR INVESTMENT IN GREEN INFRASTRUCTURE RETROFITS ON PRIVATE PARCELS

The City of Philadelphia has already taken a key step towards developing a market for greened acres on private parcels by implementing a stormwater billing system that charges nonresidential customers a monthly stormwater fee based on the impervious area on their parcel. To encourage reductions in runoff through the adoption of infiltrating green infrastructure, Philadelphia offers substantial fee discounts to owners who “green” their parcels by reducing impervious area or otherwise managing runoff onsite. As a result, Philadelphia has created an environment where an investment in green infrastructure retrofits provides ongoing operating savings to nonresidential property owners in the form of reduced stormwater bills.

Utilizing avoided stormwater fees as the sole measure of project payback, the authors estimate that a retrofit project on a given parcel in Philadelphia would need to cost less than $36,000 per acre ($0.82 per square foot) in order to achieve full payback within 10 years. Cost estimates for stormwater management practices (SMPs) indicate that sites that are suitable for downspout disconnections or low-cost swales would be the most economically attractive candidates for privately-financed retrofit projects. Under the current market environment, SMPs that are suitable for a wider range of sites, such as porous pavement, rain gardens, green roofs, and flow-through planters, have higher retrofit costs that would not achieve a 10-year payback.

PWD can improve the economic viability of such retrofits on private parcels through policy measures, such as subsidizing retrofits, facilitating project aggregation, and creating an offsite mitigation program. For example, if a subsidy program offering $3.50/ft² for green infrastructure retrofits on private parcels were combined with offsite mitigation and aggregation programs, projects totaling up to 73 percent of the city’s long-term greened acre targets could become economically viable for private investors. Philadelphia can count these greened acres toward Clean Water Act compliance, and these acres would still come at lower cost than the city would likely be able to achieve through green infrastructure investments in the public right-of-way alone.

### Financing Challenges and Enabling Policy Measures

Attractive retrofit economics are a necessary, though not sufficient, lever to attract large-scale investment in stormwater retrofits on private parcels. Current questions surrounding regulatory and revenue certainty will need to be resolved before investors are likely to finance long-term projects where future avoided stormwater fees figure prominently in project payback. For example, PWD has not made available projections of Philadelphia’s long-term stormwater fee schedule (and corresponding credit). Making such a projection available would be important, given that changes to the fee structure or credit could have negative impact on an investor’s payback period. Similarly, early investors in stormwater retrofit projects may find that risk of regulatory change and project performance risk in general are too high, making financing terms unattractive to property owners. These regulatory and revenue certainty challenges are not insurmountable. Publishing a projected 10-year utility rate schedule and improving information flow about stormwater retrofit credit re-approval are two steps that PWD could take immediately to resolve some of the uncertainty around future parameters of project economics.

In addition to regulatory risk, the very nature of green infrastructure financing presents novel questions for both property owners and project financiers. NRDC’s Financing Stormwater Retrofits report identified lack of collateral, high transaction costs in relation to 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, models similar to those that have been developed in
the energy efficiency finance sector may be well-suited to the green infrastructure space.

Under these financing models borrowed from the energy sector, the retrofit capital provider acts as a project developer, not only providing the financing but also arranging for the design, construction, and ongoing maintenance of the installed projects. In return for the up-front capital and maintenance services, the capital provider/developer enters a long-term service contract with the parcel owner, assuring the developer a portion of the owner’s avoided stormwater fees for a fixed period. From the project developer’s perspective, the control over the retrofit installation and maintenance provides assurance that the project will receive the optimal stormwater fee reductions, providing a basis for the project developer to be repaid. From the parcel owner’s perspective, these financing arrangements are preferable to traditional debt for a number of reasons. In addition to providing most or all of the capital up front, for accounting purposes the long-term service contract with the project developer can be treated as an operating expense, removing the stormwater management practice asset from the owner’s balance sheet.

Interviews with members of the investment community revealed that, although technical performance risks for stormwater management practice investments may be acceptable, the limited repayment track record for stormwater retrofits in Philadelphia, coupled with the unsecured nature of the financing, would render most projects unfinanceable at interest rates that would be attractive to parcel owners. Moreover, the investment community suggested that, in the absence of additional financial backstops against potential losses on green infrastructure investments, only a handful of stormwater projects would succeed in securing private financing.

In addition to taking steps to reduce risks associated with stormwater retrofit investment, PWD could create programs that would reduce project risk and therefore improve financing terms for parcel owners seeking capital for a
stormwater retrofit. Strategies that have proven effectiveness in enabling energy-efficiency retrofit investments include the creation of a loan loss reserve fund, enabling repayment for retrofits on water bills, and utilizing municipal tax liens to collect repayment. PWD would need to carefully evaluate the potential costs and benefits of each of these programs in turn.

Facilitating Project Aggregation

Even where financing is available on attractive terms to both parcel owners and investors, questions of retrofit economics still loom large in determining how successfully private capital will be drawn into Philadelphia’s nascent green infrastructure market. Encouraging private capital to finance stormwater retrofit projects on private parcels will be difficult in part because many projects tend to be small with relatively high fixed costs and transaction costs. Project aggregation, whereby numerous stormwater projects are packaged into an aggregate portfolio, can help overcome many of the barriers to financing smaller projects.

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 (for example, with respect to permitting, design, and the acquisition of parts/materials). Third, aggregation may 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 a group of smaller projects operate somewhat like one larger project, which may help to overcome the barriers that usually inhibit private investment in small projects. Potential aggregators include government agencies, special-purpose non-profit organizations, Business Improvement Districts, and for-profit project developers.

Given the benefits of project aggregation, there are several steps that PWD can take to encourage aggregation in the field of stormwater retrofits. These include:

- **Identifying the costs of retrofits.** Develop Philadelphia-specific cost ranges for stormwater retrofits that could be used on educational materials.
- **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 parcel owners.** Include information on billing statements regarding the cost and potential savings of SMP retrofits as well as potential options for retrofit financing. This will provide ratepayers with a clear understanding of project costs and savings, as well as potential financing options.

- **Soliciting interested parcel owners.** Through billing statements, encourage interested ratepayers to sign up for stormwater retrofits. PWD could then pass on lists of these interested customers to appropriate aggregators.
- **Permit streamlining.** In order to reduce project implementation costs and encourage aggregation, explore how permitting rules might be streamlined to simplify the permitting process for aggregated projects.
- **Encouraging nongovernmental organizations to engage in project aggregation.** PWD should explore working with foundations and nonprofits to channel capital (grants, subsidies, etc.) toward potential aggregators that originate, negotiate, and group stormwater retrofit projects.
- **Encouraging Business Improvement Districts (BIDs) to act as aggregators of stormwater management projects.** BIDs have an inherent interest in undertaking the sort of beautifying neighborhood improvements that many stormwater retrofits entail. In addition, they are already connected with relevant landowners; they are set up to conduct outreach to local property owners and, based on the authors’ initial discussions, have an interest in serving as greened acre project aggregators.

- **Creating processes that facilitate economies of scale.** PWD could 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. There may also be ways of helping retrofit project developers purchase items and materials in bulk, though it is unclear how governments and others might help in that regard.

Establishing an Offsite Mitigation Program

Under Philadelphia’s stormwater fee system, non-residential property owners may reduce their fees only by retrofitting their own property to manage runoff on-site. However, given the economics of stormwater retrofits under Philadelphia’s fee and credit structure, only a small portion of non-residential properties are likely to be suitable for retrofits for which the available stormwater fee savings provide an attractive return on investment.

For example, although downspout disconnections are one of the lower-cost retrofit opportunities available, these opportunities exist mainly on residential properties where owners do not receive a discount on their stormwater fees if they implement green infrastructure practices. 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. The authors estimated that residential downspout disconnections could provide approximately 638 greened acres if property owners could earn credit for investing in them.

In addition to enabling offsite retrofits on residential parcels, an offsite mitigation program could offer credit
to two kinds of non-residential retrofits: redevelopment projects or retrofit projects that oversize their stormwater management facilities. Under local regulations, redevelopment projects more than 15,000 square feet must 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.

Adding an off-site mitigation program to the existing stormwater fee structure could deliver several important benefits, including:

- Greater flexibility for constrained property owners by providing a lower-cost option for constrained owners who want to reduce their stormwater fees.
- System-wide cost savings by leveraging the market to find least-cost stormwater management practices.
- An increase in private sector participation by incentivizing property owners not currently covered by the parcel-based stormwater fee structure (i.e., residential properties) to invest in mitigation.
- Maximization of retrofits on commercial properties by incentivizing property owners to retrofit beyond what is required to receive stormwater fee reductions.
- Establishing a market price to reveal low-cost mitigation opportunities, thereby attracting private capital to the most cost-effective retrofits.
- Creation of transparency and a market price for stormwater management practices retrofits.

Establishing an off-site mitigation program would create new administrative burdens for the PWD, 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. The report offers recommendations on how to design such a program to ensure that it yields greened acres that can be counted toward the PWD’s compliance with its Clean Water Act obligations. The report also examines the potential size of the market for tradeable credits; it concludes that demand would likely be high enough to spur a functioning market, but recommends further research to refine initial estimates of the potential supply of credit-generating projects, before a decision is made to launch an off-site mitigation credit program.

II. HOW TO ACHIEVE GREENED ACRES ON A LARGE SCALE ON PUBLIC OR PRIVATE LANDS THROUGH PUBLIC-PRIVATE PARTNERSHIPS

Although there is a significant opportunity to obtain greened acres on private parcels at lower cost than Philadelphia’s anticipated costs to green in the public right-of-way, there are likely to also be cost-effective green infrastructure opportunities on a broader set of land types, including school campuses, parks, and vacant lands in the city. With this in mind, the final chapter of this report explores how public-private partnership approaches can be used to finance large-scale green infrastructure that can be applied to a wide range of land types.

In order to meet its Clean Water Act requirements, Philadelphia Water Department will need to finance, design, build, operate, maintain, and monitor compliance for a vast portfolio of greened acres. PWD has budgeted at least $1.67 billion on an inflation-adjusted basis over a 25-year period, to be financed through debt issuance, to green thousands of acres across the city.

As an alternative to a primarily bond-financed approach to achieving its greened acre obligations, the PWD should consider use of a public-private partnership. Such arrangements have been used extensively by governments across the nation and around the world as a means to meet the growing demand for infrastructure construction and maintenance. In an environment of constrained federal and state budgets, these partnerships are seen as a way to engage the private sector more deeply in funding infrastructure projects to meet public service needs. The partnerships 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.

Although the application of a public-private partnership structure to green infrastructure would be a first if achieved in Philadelphia, the PWD has established a track record of successful partnership projects. Since 1995, the PWD has implemented three public-private partnership structures that are widely thought to be successful projects. Most recently, in 2011, the PWD awarded a contract to finance, install, maintain, and own a new $35 million 5.6 MW cogeneration plant.

The Availability Payment model may be best suited to help the PWD 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, is under the terms of the partnership contract, will design, build, and maintain a specified number of greened acres. This framework would require the 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 the PWD to reduce the level of its payment amount or eliminate payments altogether in the event that performance is inadequate.
A public-private partnership structure may be able to reduce greened acre costs, as compared to ordinary PWD capital projects, by providing a private partner with opportunities to:

- focus on technical designs and property types where it has a competitive advantage and thus deliver greened acres in a cost-effective manner;
- minimize conflicts between design and maintenance decisions to deliver a portfolio with a lower cost over its lifetime, as compared to a design or practice implemented by one party and then maintained by another;
- achieve economies of scale in the 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 PWD would not otherwise have access to, or have access to at reasonable cost.

The private partner contracted to finance and deliver greened acres under the partnership 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. The authors discussed the concept of a Greened Acre public-private partnership 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 partnership project:

- **Performance Risk:** If partnership financing relies on a PWD contractual obligation for repayment, an institution's comfort with the likelihood of performance becomes a critical element of risk assessment. For green stormwater mitigation, there are two types of performance risk: failure to complete construction according to design specifications, and failure to provide ongoing maintenance of infrastructure particularly as related to compliance with environmental regulations and requirements.

  These performance-related risks stand as the largest impediment to a cost-effective pricing of the strategy and will need to be carefully evaluated and structured around in order to satisfy the needs of PWD and potential investors in green infrastructure. Such concerns do not suggest that investors would not have interest in a green stormwater infrastructure partnership. However, if left unmitigated, these concerns would increase the required return associated with financing the structure and project implementation.

- **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 partnership product. Around $75 million to $100 million would be an ideal amount of capital to attempt to rise 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 partnership efforts.

- **Pricing:** A partnership structured between the 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 the 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 the PWD contractual obligation, the higher the return required. The stronger the obligation, the lower the return required. At the same time, the contract terms cannot be so strict as to mimic a traditional bond instrument in terms of the 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 the PWD's credit rating and debt ceiling.

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