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GREENING UP

Strategies to Advance Green Infrastructure in San Francisco

SPUR WHITE PAPER

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Introduction

Managing stormwater and wastewater in urban environments is essential to public health, safety and quality of life. But keeping water infrastructure in a state of good repair is complicated and expensive; challenges include aging assets, new water quality regulations, rising construction costs, declining water use and less predictable (and possibly more severe) weather patterns due to climate change. Newer technologies and advances in science and engineering have revealed new ways to manage urban water resources, improving resilience, reliability and sustainability. But alternative design and treatment infrastructure cannot simply be implemented overnight: Cities need to deploy it in a smart way, with a clear understanding of efficacy and cost-effectiveness.

San Francisco has a very successful wastewater utility that meets all current regulations. In the 1980s, the city invested in treatment and collection facilities that maintain good water quality in surrounding waters and beaches. However, many parts of the system are over 100 years old, seismically vulnerable and occasionally overwhelmed during major storms, causing localized flooding.

In recognition of this, and building on the success of a multi-billion dollar program to upgrade the city's water system in the 2000s, the San Francisco Public Utilities Commission (SFPUC) launched another major capital program in 2010: the Sewer System Improvement Program (SSIP). The SSIP is a major reinvestment of more than $6.9 billion in wastewater infrastructure. It aims to strengthen the system and prepare for future earthquakes, regulations and climate change, all while providing community benefits. Though costly, the SSIP's implementation has been planned in a way that maintains affordability for ratepayers (who are paying for it) and will provide a cost-effective solution to sewer system reliability over time.

A parallel effort to the SSIP has been evolving over many years within the SFPUC to approach urban water management from an integrated, watershed-based perspective. This planning approach views stormwater as a resource rather than as waste: something to be captured and reused, or used to improve the environment instead of being shunted into the sewer system. It seeks opportunities to redesign the urban landscape, minimize runoff and reduce flows to wastewater treatment plants. A number of existing programs and policies — such as the SFPUC's rainwater harvesting program, small grant program, stormwater design guidelines, green street pilot projects and watershed planning charrettes — have advanced these ideas and built public interest within the city over the last decade.

One of the goals of the urban watershed approach is to deploy an appropriate mix of traditional "grey" infrastructure along with new kinds of "green" infrastructure, which utilizes soil, plants and natural processes to manage stormwater, reduce flooding and improve the urban environment. SPUR has supported this integrated, watershed-based planning approach for more than 10 years.[1] We believe this view is more expansive than achieving a basic level-of-service for sewage treatment and provides an overall benefit per dollar invested. Some of the long term benefits that can be realized by an urban watershed approach, and the deployment of green infrastructure, include:

- increasing hydraulic capacity in the conveyance and treatment system
- reducing energy and chemical costs of pumping and treating
- offsetting potable water demand through rainwater harvesting and reuse
- reducing the quantity and frequency of combined sewer discharges
- reducing local flooding, especially in small to mid-size storms
- improving streetscape appearance and safety

[1] *http://www.spur.org/publications/spur-report/2006-11-07/integrated-stormwater-management, http://www.spur.org/publications/article/2008-05-01/getting-sustainability-out-gutters*

- providing habitat and accessible green space
- reducing urban heat island effect
- improving air quality
- increasing property values

The SSIP is poised to channel significant new investment to integrated urban watershed planning and green infrastructure through a planning process called the Urban Watershed Assessment (UWA). The UWA, to be completed by the end of 2015, will evaluate and recommend opportunities for grey and green infrastructure projects and "scaled-up" programs — longer-term, funded and staffed programs to support better citywide water management. Implementation of these projects, along with all of the major construction in the SSIP, will increase rates for customers. The combination of rate increases and visible construction projects, including new green infrastructure pilot projects, provides an opportunity to deepen public engagement and support for watershed planning. As the city prepares to increase investment and focus attention to its wastewater system, SPUR — in partnership with the SFPUC — convened a small advisory group to address the question: **What is needed to scale up green infrastructure in San Francisco?**

The SPUR Green Infrastructure Advisory Group, supported by the Surdna Foundation and launched in May 2014, sought to support the UWA with strategic advice, identify new or expanded policies, programs and opportunities to support green stormwater management, and determine how to build external support and public engagement. Over the course of eight months, the advisory group discussed:

- existing policy and the current state of urban watershed planning
- the SFPUC's new Triple Bottom Line evaluation tool
- stormwater economics and strategic public policies
- case studies of scaling up green infrastructure in Philadelphia and Portland
- capital planning and the challenge of asset maintenance
- special financing districts as a way to pay for greening through public-private partnerships

This paper summarizes what we learned, and what we recommend to the City of San Francisco as the SFPUC scales up both its investment and the visibility of San Francisco's wastewater treatment system while piloting new technologies and alternative ways of managing urban water resources. We do not see these recommendations as something to be implemented overnight. Rather, they present a policy and programmatic direction to guide opportunities for an adaptive and holistic approach to urban water resource management, which can be developed and tested over the course of the 20-year timeline for the SSIP.

Key Strategies and Recommendations

1. Develop an integrated vision of urban water resources and establish numeric goals.

The city does not have a clearly defined goal for stormwater management or for water capture and reuse in terms of acres managed, runoff reduced or improved, or potable water demand offset. Although the SFPUC is planning through the SSIP to control flooding from a specific storm size at high-risk locations[2], San Francisco does not have a unified city stormwater management goal that would achieve benefits beyond a certain level of flood control. Articulating such goals — and what the city achieves at various levels of reaching them — would make the value proposition of the SSIP, UWA and other water reuse programs clear and publicly accessible and would create the basis for a broader, partnership-based and

[2] *The SFPUC aims to control and manage flows from a three-hour duration storm that delivers 1.3 inches of rain.*

programmatic approach. These goals would also implore other city departments, when planning infrastructure or capital projects, to study and implement sustainable onsite water management.

For example, the City of Philadelphia established a goal of 10,000 "greened acres"[3] over 25 years as part of its Green City, Clean Waters program adopted in 2012. (See case study "Learning from Philadelphia" below.) In 2013, the City of Seattle adopted a goal of treating 700 million gallons of stormwater annually through green infrastructure by 2025. And in 2014, Mayor Eric Garcetti issued an executive directive that requires Los Angeles to reduce water use 20 percent by 2017, with an additional requirement that the city cut imported water use in half by 2024. Water reuse and stormwater capture are essential ways to achieve these goals.

As an example from the SFPUC's own history, in 2008 when the Water System Improvement Program was adopted, the city agreed that by 2018 it would develop 10 million gallons per day of local alternative water supplies to supplement Tuolumne River and other imported supplies. This created the basis and drive to develop strong conservation programs, build brand-new water recycling facilities, pilot onsite nonpotable reuse (which included regulatory changes necessary to make the program scalable), and develop groundwater projects in the city, which are currently underway.

On the sewer side, having a clear goal with defined benefits would help drive development and implementation of programs, policy and a variety of project types to address stormwater. The piloting of green infrastructure technologies through Phase 1 of the SSIP provides an opportunity to study performance and impacts that could inform a broader city-wide goal.

Recommendation: The city should establish numeric goals for runoff reduction, potable water savings, non-potable reuse, groundwater recharge and/or greened acres (or square feet) in order to align and advance a more integrated view of urban water resource management across departments. Such goals would create a basis for better coordination across all stakeholders, public sector programs and capital projects. As the SFPUC gains performance information from its Early Implementation Green Infrastructure Projects, this will help the city understand and develop reasonable goals based on specific urban watershed characteristics. Through technical analysis, the public and private benefits of meeting citywide goals could be identified in terms of:

- providing climate resilience (water supply and flood prevention) under a range of scenarios
- better resource utilization, especially considering new uses of groundwater supplies and the opportunity to recharge these supplies with stormwater retention
- better and safer streets
- water-use savings (potable offsets)
- improved property values
- improved air quality
- reduced incidences and/or volume of combined sewer discharges

2. Encourage private investment in stormwater facilities.

The UWA will include recommendations for programs and incentives to facilitate more green stormwater management and retrofits on private properties. These may include a sustainable roof program, a watershed improvement program, a residential stormwater program and technical services. The SFPUC is also considering including a stormwater fee as part of its 2018 rate package, since about 20 percent of SFPUC wastewater system costs may currently be attributed to wet weather. SPUR has long believed that

[3] *A "greened acre," by Philadelphia's definition, is an acre of land that goes from impervious to managing at least the first inch of runoff onsite through stormwater infrastructure. The acre includes the stormwater infrastructure itself and the area that drains to it. For more information: http://www.phillywatersheds.org*

a separate stormwater fee will improve ratepayer equity by basing a portion of customers' wastewater fees on the direct impacts that their properties have on the sewer system and the environment.[4] It would create an incentive to manage stormwater onsite for properties that currently contribute significant runoff into the combined sewer system.

Other cities, such as Philadelphia and Seattle, have found that it can be cheaper to get more green acres on private land than in the public right of way. (See case study "Learning from Philadelphia" below.) This requires a stormwater fee set high enough that there is an incentive to retrofit land (in order to reduce fees) and to pay for maintaining it that way. Because San Francisco's experience with building green infrastructure is limited, for the most part understanding of project costs is based on public right-of-way projects, which are both expensive and difficult in a dense urban setting. Because San Francisco doesn't have a stormwater fee, we don't know what kind of demand there could be for an incentive program designed to encourage retrofits on private property.

In addition, because there is currently insufficient existing green infrastructure in the city to know how well various types of assets perform in the variety of urban watershed conditions, as well as insufficient maintenance assurance, there is a sense that public investment in private-land projects is risky. This creates a bias in favor of building city-owned capital assets, even though privately implemented projects could be a more cost-effective way to scale up green infrastructure. Although shifting any burden of management and maintenance from public to private requires building the capacity of property owners and managers — and takes time — it could be valuable to develop a pilot program that would lead toward effective greened acres acquisition. The pilot program could also help the city obtain better information about the costs to build or retrofit sites with green infrastructure, which would be necessary to a scaled-up program's design.

Recommendation: The city should develop a programmatic and incentive-based approach to encourage private investment in rainwater capture, water reuse and removing stormwater from the system. These programs and partnerships should be rolled out with the stormwater fee program being implemented in 2018, and ideally piloted even sooner. They should be funded at a sustained level for at least 10 years to demonstrate commitment and stability, to be able to staff the programs, and to help the programs succeed. By incentivizing private-land projects, the city can cost-effectively advance its number of greened acres and other integrated water management goals, and build capacity in the private sector. Funding could be made available from a variety of sources, including the SFPUC.

One idea would be to encourage proposals for "early implementation projects" on private property, like the SFPUC is currently doing in the public right of way as part of Phase 1 of the SSIP. The SSIP's eight early implementation projects, which pilot different technologies in each of the city's urban watersheds, are expected to provide valuable data for scaling up publicly funded green infrastructure. A counterpart private program, partially supported by the SFPUC through either funding or technical/design support, could aid in understanding the performance, maintenance and operational needs for scaling up and incentivizing private sector participation in retrofitting properties for stormwater capture.

[4] *http://www.spur.org/publications/spur-report/2012-12-04/stormwater-fees*

Case Study: Learning From Philadelphia

Philadelphia's Green City, Clean Waters program, launched in 2012, is a long-term control plan for stormwater that uses green infrastructure to meet the Environmental Protection Agency's water quality requirements. The city aims to retrofit 10,000 acres with green infrastructure over the next 25 years. Philadelphia adopted a stormwater fee structure in 2010 that created incentives for using green infrastructure in residential and commercial properties. Philadelphia found that the costs to green[5] one acre of impervious area in the public right-of-way were approximately 2.5 times greater than on private land. To capture these savings while expanding their program, the Philadelphia Water Department developed a program to use stormwater fees to provide incentives to property owners to manage stormwater on site.

But a fee-reduction program that provided up to 80 percent reductions in stormwater fees for on-site stormwater management was only successful in stimulating private property participation when accompanied by a generous grant program. Because retrofit costs far exceeded fee-reduction levels on a square foot basis, the grant program was needed to eliminate or minimize out-of-pocket expenses to property owners.

Philadelphia's current program, the Greened Acre Retrofit Program,[6] is unique. It provides incentives for contractors and developers to find cost-effective "greenable" properties and compete for grant funding for construction. It also requires property owners to sign 45-year maintenance agreements with the city. Because property owners can receive an 80 percent fee reduction if they manage the first inch of stormwater onsite, owners are able to use fee savings to pay for operations and maintenance. Philadelphia is obtaining low-cost greened acres this way by offering a subsidy or grant of approximately $2 per square foot.

A key lesson learned from Philadelphia: to catalyze private investment, a price signal is needed so that private property owners bear the cost of their impervious area on a pro rata basis. Additionally, to increase wastewater system capacity, a programmatic approach is needed to accompany any incentives that exist through the rate structure.

3. Improve public accessibility and citywide use of triple bottom line planning.

For many years, the SFPUC has been committed to the idea of "triple bottom line" (TBL) planning for sewer system infrastructure investments.[7] This means understanding and optimizing economic, environmental and social benefits for any one project or problem area within the system. The SFPUC has conducted outreach to the public with this idea, and it has strong support from the community. To model the economic, environmental and social benefits of a project's alternatives, the SFPUC has invested in a TBL decision-support evaluation tool that facilitates project selection transparency for the many project alternatives developed through the SSIP. The tool has 19 indicators in three categories — economic, environmental and social — and determines for each indicator whether a project is significantly negative or significantly positive. A sample of indicators include: habitat, noise, construction impacts, bicycle and pedestrian environment, affordability, water use, and operations and maintenance costs. This sophisticated tool has been used to support internal decision-making on alternative project designs.

The tool is also highly visual, which would make it useful to the public. Ratepayers could benefit from

[5] *"Greening" here refers to using distributed practices to manage the first inch of stormwater over a given site.*
[6] *For a description of Philadelphia's program, See http://www.nrdc.org/water/files/philadelphia-green-infrastructure-retrofits-IB.pdf.*
[7] *For example, the TBL is described on page 1 of the SFPUC's Urban Watershed Framework report in 2012: http://sfwater.org/Modules/ShowDocument.aspx?documentid=2552*

using TBL information to compare project ideas and consider tradeoffs in making infrastructure investments. Beyond the public, other city departments could benefit from the SFPUC's investment in this tool as they consider how to build public projects in streets, in parks and on the waterfront.

Recommendation: The SFPUC should continue to make its TBL tool more accessible so the public can better understand and compare alternatives for green infrastructure and urban water management projects. The public would be able to see the many benefits of integrated water projects and understand how the SFPUC is making choices with ratepayer funds. The SFPUC should also consider leveraging its investment in the tool to make it accessible and useful for other city departments, such as the Department of Public Works, the Municipal Transportation Agency and the Capital Planning Program, as they consider and compare project alternatives for infrastructure investments beyond those that manage water and wastewater.

4. Partner with other city departments to optimize urban water goals, use consistent engineering guidelines and incubate district-scale shared infrastructure.

Although it is the SFPUC's job to manage water that is imported into or falls on the city, other city departments are engaged in activities and projects that interact with water in some way. Some of these programs and projects could be optimized for water management or treatment through partnerships and/or small changes to design. Some current efforts underway in the city that relate to green infrastructure and water management and could enhance the SSIP include:

- **Urban Forest Master Plan (Planning Department)** This master plan aims to grow, protect and maintain the city's street trees. Currently, the city does not consider trees to be viable stormwater infrastructure, either in the Urban Watershed Assessment or the Stormwater Management Ordinance, which requires new development to do onsite detention and retention of stormwater. This is unusual among leading cities on green infrastructure, like Seattle and Philadelphia, and should be resolved.
- **Better Roofs Task Force (Planning Department, SF Environment)** This task force is articulating goals for better roofs that include solar, green and blue roofs[8], which detain or retain onsite the rainfall they receive.
- **Central SOMA, Civic Center and Chinatown eco-district/neighborhood planning (Planning Department)** These projects aim to channel both private and public investment to manage resources at the district scale, potentially including water and wastewater.
- **Groundwater supply project (SFPUC)** This project seeks to use groundwater from the Westside Basin aquifer, currently used only for irrigation, to supplement imported water supplies for drinking. Recharging the Westside Basin aquifer with stormwater, through green infrastructure or rainwater harvesting, is not currently an explicit goal of the SFPUC but it could be.
- **Onsite nonpotable water capture and reuse program (SFPUC)** This program provides a permit process and grant funding to do onsite reuse of captured water at the commercial building or district scale. Resources to expand it could be supported through reduced sewer capacity fees, improving the return on investment for developers choosing to install onsite reuse systems.

Understanding how all of these programs could contribute to numeric goals and an integrated vision of urban water resources and management (Recommendation 1) could leverage public investment.

Recommendation: The SFPUC should partner with other city departments such as the Planning Department, SF Environment, the Department of Public Works and others, to help develop and advance

[8] *SPUR's 2013 report Greener and Better Roofs contains recommendations on implementing better roofs in San Francisco: https://www.spur.org/sites/default/files/publications_pdfs/SPUR_Greener_and_Better_Roofs.pdf*

urban water management goals, and to measure the potential contributions of existing programs and policies to achieve these goals. For example, SFPUC and the Planning Department could partner with the Department of Public Works to understand the water capture and reuse and greened acre benefits of increasing the city's urban forest, which is currently not seen as a stormwater management asset. The SFPUC could work with the Planning Department and private partners to pilot green streets and a green roof program within the city's nascent ecodistricts. Information obtained through pilot projects about costs, technical challenges, asset maintenance and more could help inform the right levels of incentives for green infrastructure necessary to scale up a citywide programmatic approach in 2018.

Finally, the SFPUC has developed standards and guidelines for maintaining and installing green infrastructure. Other city departments, such as the Department of Public Works and the Municipal Transportation Agency, should be required to use these guidelines for their investments in green infrastructure or green streets, to ensure consistent engineering performance, to maximize benefits and to advance citywide stormwater management goals.

Recommendation: The city should support and incubate district and neighborhood-scale shared infrastructure for water reuse and stormwater capture and treatment, such as in Central SOMA and Civic Center. Certain managed resources, such as water and renewable energy, can be best optimized at the district scale, while shared infrastructure generally can result in lower development costs, reduced capital and operating costs, and higher property values. San Francisco does not have much experience doing this for water resources and green infrastructure, but a multi-agency city partnership, possibly together with a private partner, could help pilot such an approach, enabling better understanding of its costs and benefits.

Case Study: Learning From Portland

Portland, Oregon, is a national leader in green stormwater management. Portland has had a stormwater fee program since 1977 and began requiring stormwater management on private property in 1999. By 2014, Portland had established 1,500 rain gardens in the public right of way and more than 10,000 installations on private property. In the early 1990s, there was still a lot of debate among city engineers about whether green infrastructure was an effective alternative to grey infrastructure. Once it was widely recognized that green infrastructure could contribute to reducing the city's stormwater overflow and flooding problems, the city planned, built and managed numerous green infrastructure projects. But paying for maintenance for stormwater assets on public land is still a challenge 20 years later. On private land, Portland has found that the public costs of asset maintenance are typically extremely low or zero (because the private entity pays).

Portland's program experience revealed three key lessons for San Francisco:

1. It is essential to use models and technical design to understand what's achievable, and to evaluate the potential gains from green acres goals/projects, before changing policy and establishing programs. Evidence makes the best case for programmatic change and new public investment.
2. Projects that combine green and grey infrastructure can be more cost-effective that just the all-grey solution. For example, in 2006, Portland launched the Tabor to the River Basin Project in its combined sewer area to rehabilitate aging pipes. The grey project alternative cost $144 million. But an investment of $11 million in green infrastructure reduced the grey cost estimate to $75 million, because certain existing pipes would convey less water and not need replacing. This suggests an additional lesson: Don't plan solutions in a vacuum or try to pre-determine the right mix.
3. Even after more than 30 years of a robust green stormwater program, public engagement and awareness of green infrastructure is low. In spite of the broad benefits of combined green and grey infrastructure, people are just not that concerned about how water is managed in a city. As a result, it is even more important to plan projects based on cost-effectiveness and the best design for the job.

5. Conduct scenario planning for resilience, especially in larger storms.

City residents and the business community are increasingly concerned about extreme weather resiliency, especially as new information is revealed about the potential impacts of climate change, including drought, heat, fire, stronger storms, sea level rise and more. Currently, very large storms are not part of the design of the SSIP, and conveyance improvements to address local flooding — such as pipe upsizing and replacement, or larger, more complex projects such as creek uncovering and restoration — are not addressed or planned to be funded until Phase 3, which is in 20 years. (An exception is the restoration of the Yosemite Slough, which is being addressed as an early implementation project.)

The SFPUC is currently studying the impacts on the system of 5-year, 25-year, 50-year and 100-year storms. However, the intensity, duration and frequency of storms is changing due to global climate change. Design and capacity changes to the conveyance system should not be planned to manage 100 percent of stormwater from a very large but low-likelihood storm. But climate change scenarios could be used to help understand how resilient the system will be to potential future floods. The SFPUC could study and model, for example, the impacts of flooding and damage sustained under a 100-year storm, a 200-year storm, etc., and project how frequently such storms could occur in the future. There could be a strategy to implement a combination of grey and green infrastructure in areas that need extra assurance to meet the SSIP's standards for level of service and, where possible, to provide resilience beyond that. Changing the city's "design storm" — the storm size around which most infrastructure retrofits are being planned — or requiring certain areas to be built to handle super storms of the future may require significant grey infrastructure, as many of the city's most flood-prone areas today have poor soil for water infiltration and are low-lying. This future investment in the collection system could be made over time.

Recommendation: The SFPUC should continue to evaluate the wastewater system's existing and planned capacity to provide resilience in larger storms, especially in light of expected changes in storm intensity and frequency due to climate change. The city should update its rainfall models and conduct scenario planning to understand which areas within the city may be more vulnerable to flooding under different storm scenarios. This would identify which areas need extra assurance to meet the SSIP's level of service goals and could benefit from an optimized combination of green and grey infrastructure. It could also identify areas that would benefit from nearer-term efforts to reduce the size or consequences of flooding, especially those that may be more vulnerable and less able to cope with damages.

Conclusion

Scaling up green infrastructure in San Francisco and implementing the urban watershed approach could benefit the city in a host of ways. San Francisco could more efficiently, effectively and sustainably manage water resources across multiple city departments. It could improve climate change resilience, the quality of surrounding waters, and the resource efficiency of buildings and streets. Achieving this will require gaining momentum from piloting and incubating programs, then rolling them out with a long-term commitment. It will mean working with other departments toward unified city goals around water; engaging the public to build local support and participation in programs; and harnessing resources from the private sector to amplify planned but limited public investment. The city is already making strides in this area with the development of the Urban Watershed Assessment and with the deployment of early implementation projects to better understand how certain technologies perform in San Francisco's watersheds, how much they cost and how they need to be maintained.

The city's current capacity to build and maintain green infrastructure does not enable it to scale up without an additional commitment of resources. The SFPUC is currently understaffed in design review and project construction oversight, and while the agency is developing best practices for maintenance, it does not have the staff to conduct maintenance or the resources to issue increasingly more work orders to the Department of Public Works to do so. It will require some combination of public and private resources and partnerships to increase investment, but it is the city's responsibility to set a clear and engaging vision first. Our urban water resources are valuable in many ways; we must do more to optimize their use through public-private partnership, and steward them into the future.