The SW Ecodistrict

STORMWATER INFRASTRUCTURE STUDY

National Capital Planning Commission

DECEMBER 2014

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The *SW Ecodistrict Plan* was prepared through the collaboration of the federal government and the District of Columbia.

The National Capital Planning Commission had primary responsibility for oversight of the project and ZGF Architects LLP served as the principal consultant with HR&A Advisors, Inc. providing economic analysis.

Executive Summary

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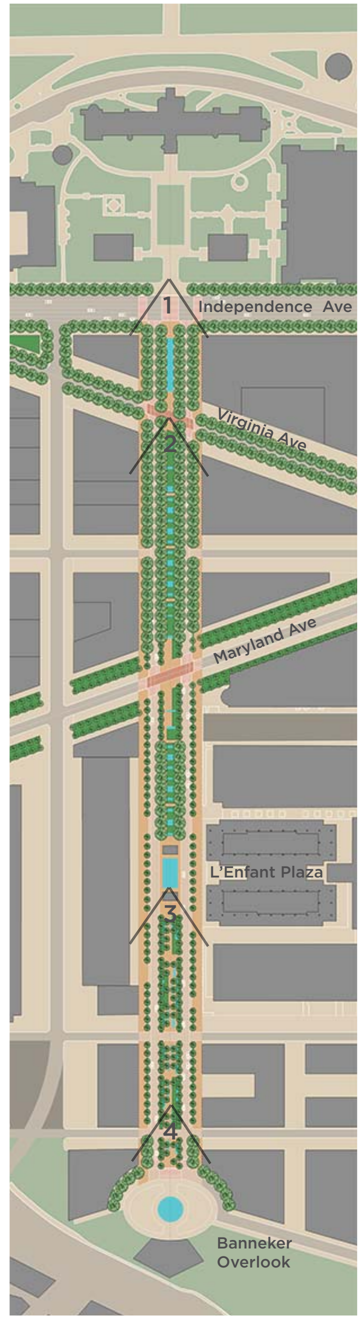
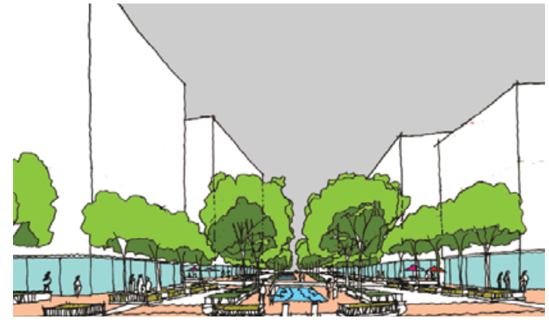
The SW Ecodistrict (Ecodistrict) has an aggressive plan to reduce water, waste, and energy by 2030 in order to meet Executive Order 13514: Federal Leadership in Environmental, Energy, and Economic Performance and serve as a national showcase of sustainability. The *SW* Ecodistrict *Plan* provides a pragmatic framework to accomplish these goals through redevelopment.

This report investigates a new kind of district stormwater system which has the potential to meet U.S. Environmental and Protection Agency (EPA) regulations, as administered through the District of Columbia Department of Environment, while contributing to the transformation of the area.

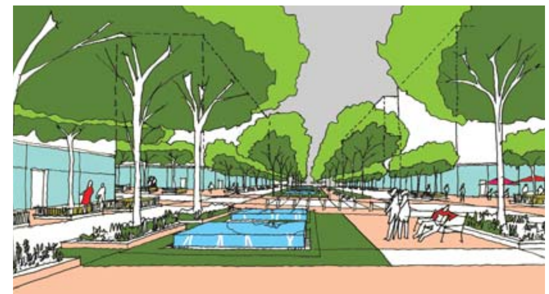
The mix of uses and population density in the SW Ecodistrict creates a unique demand for potable and non-potable water. The Ecodistrict occupant's demand for water outpaces the supply that could be collected from naturally occurring rainfall. Part of the gap between the supply and demand for water in the district can be met by collecting rain water. With intentional design of planned improvements for buildings and streets, reuse of all water can be achieved in a cost efficient manner. Costs can be kept low when improvements are incremental and shared between public and private investments. These costs can ultimately be offset by long-term operational costs that are reduced. Fewer costs from municipal water treatment plus credits received for collecting stormwater make for a very cost effective payback period.



10th Street, SW
Conceptual Design Diagram



1. View south from Independence Avenue, SW



2. View between Virginia and Maryland Avenues, SW

3. View from L'Enfant Plaza toward the Southwest Waterfront

4. View at Banneker Overlook looking toward the National Mall

PRELIMINARY CONCLUSIONS

Due to the District's stormwater credit market, there is a significant financial advantage to collect and treat rainwater beyond the minimum requirements. The credits generated provide an annual revenue stream to the district that can finance physical improvements and operational expenses. Even without the credits, the avoided costs in municipal water and waste water treatment can be used to finance the project improvements but over a significantly longer payback period.

The permitting process limits how water may be reused. The SW Ecodistrict's design could achieve an 11 percent reduction in municipal water by using rainwater for toilet flushing. To meet the SW Ecodistrict's 70 percent reduction in municipal potable water use goal, it will be necessary to both recycle waste water and use well water. Recycling waste water entails treating and reusing sink, shower, bath, and toilet water—a practice that is growing in popularity to generate a non-potable resource when other sources are not available. Well water is a potential source because historically Washington, DC was not an industrialized city, therefore the contamination of surface and subsurface water tables is relatively low. If policy barriers could be removed, it will be cost feasible to reduce the municipal water supply by 100 percent using the untapped aquifer below the city. This is a similar approach used in the Groundwater Replenishment System operating in Orange County, California. Waste water is given tertiary treatment and then injected into the subsurface aquifer to balance withdrawal for potable water purposes. If this is indeed the goal, the municipal water system serving the Ecodistrict could be limited to fire protection—as a back-up water source—and as a back-up waste treatment system if needed.

The opportunities to pursue this new approach to urban water management are within the jurisdictions that have authority of the SW Ecodistrict. The District of Columbia does not have legislation to manage use of surface or well water resources for potable purposes. Maryland, by contrast, has developed policies with supporting legal construct and management plans for well water use within the same aquifer as DC. In the SW Ecodistrict, great value is being placed on an entity that would finance and operate the district water system. That entity might be a Business Improvement District which is responsible for meeting the stringent requirements of a small water utility.

Financing and operating a district water system will require a separate entity which will be responsible for fronting the capital, building the system, and meeting the stringent requirements of a small water utility. This entity could be similar to a business improvement district or created through a public private partnership. This paper explores what could work for this area.

FINDINGS

- Not only is the district water system technologically feasible, it has a reasonable payback period.
- At a minimum, collecting all the stormwater, reusing it for non-potable water use, and earning stormwater credits should be a given.
- Treating stormwater and using well water to meet the Ecodistrict's potable water needs is more complicated but still technologically feasible with a payback similar to a LEED Platinum building.
- The most challenging aspect of the district water system is figuring out who will manage it.
- If "aggregators" of stormwater credits are emerging in Washington, DC in response to the new stormwater regulations, could they be a likely entity to manage this system?

The Purpose of the Study

The purpose of this study is to look at the technical and financial feasibility of developing the district water system as proposed in the *SW* Ecodistrict *Plan*.

The study looks at the following study components:

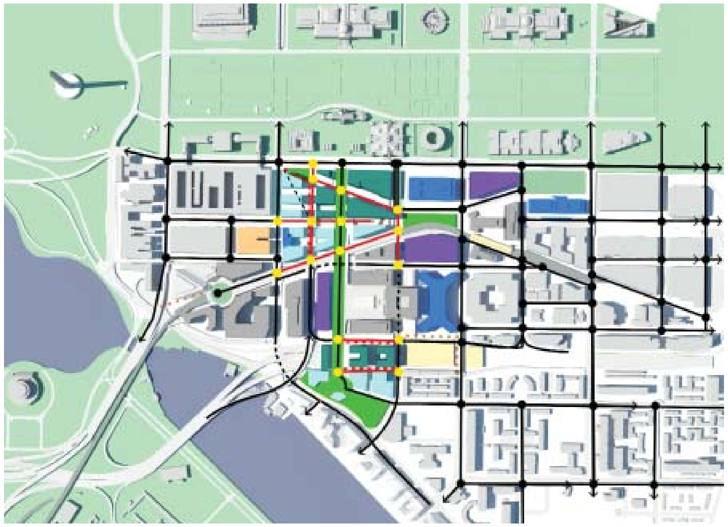
- Climate and seasonal rainfall
- Per capita water demand by use
- Capital costs
- Operational costs
- Jurisdictional requirements
- Public open space improvements

This study weighs the value of strategies that would close the gap between the availability of seasonal rainfall and potable water demand reductions in the SW Ecodistrict. There are three primary aspects to this investigation.

- Establish the role of the 10th street Corridor to store and convey captured and treated stormwater.
- Determine the incremental value for stormwater capture and reuse between 10th Street Corridor alternatives through transformational investments in the SW Ecodistrict.
- Identify potential pathways to reduce the gap in capital and operational costs.

THE PROJECT

The *SW Ecodistrict Plan* establishes a future vision for a 15-block area of the Southwest Rectangle in the District of Columbia. It is a 110-acre area bounded by 12th street to the west, Independence Avenue to the north, Maine Avenue to the south and 4th Street to the east.



SW Ecodistrict Plan

WATER GOALS

The water goal includes the management and reduction of water use in the district. The project goal is a 70 percent reduction in municipal water use. Vital to the success of these goals, the project must identify strategies that would meet the SW Ecodistrict targets to use water more efficiently.

To accomplish this, the flow and use of water on the site needs to be changed to:

- Minimize stormwater run-off
- Maximize the green area ratio
- Maximize non-potable water use
- Minimize municipal potable water use

OPPORTUNITY

This project considers the tradeoffs present in the collection and reuse of water to meet the *SW Ecodistrict Plan* goals. There is an increase in value brought to the Ecodistrict due to the performance of water system improvements. These are both visible, with a qualitative value, and financially feasible, with a quantitative value. The quantitative value of the proposed district water system includes:

- A reduction in avoided fees such as stormwater and impervious area fees.
- A reduction in stormwater pollutants and runoff, while generating stormwater credits.
- The ability to use credits and avoid fees to offset capital costs.
- The ability to share costs with other improvements made in the Ecodistrict.

The Qualitative Value of the proposed district water system includes:

- Cleaner stormwater from using plant media
- Improved environmental quality:
  - Enhanced thermal comfort
  - Enhanced biophilic attributes
  - A showcase of successful natural systems implemented in the urban environment.
- Placemaking for the district

From an economic perspective these values are achievable when a governance structure is implemented to equitably distribute the costs to beneficiaries. A new water system is an incremental cost in the redevelopment and rehabilitation of the buildings along the 10th Street Corridor. The cost effective project is due to the value of the impervious area credits generated in the district as planned by the District Department of the Environment's (DDOE) stormwater credit market to trade and sell credits.

STUDY AREA

This Stormwater Infrastructure Project focuses on the redeveloping areas of the 10th Street Corridor. Improvements here are intended to be a catalyst that transforms the district's use of resources and occupant's experience. A key driver in the design of the water system for the area is the regulations adopted to control stormwater. Currently, the majority of rainwater falling in the district flows as stormwater to the Potomac River Basin. The proposed plan is intended to control stormwater within the right of ways, open spaces, and private properties to achieve maximum collection and reuse. This involves balancing the demands and the sources of water to optimize conformance with stormwater regulations, avoid operational costs, and bring value to the district.

EXISTING CONDITIONS

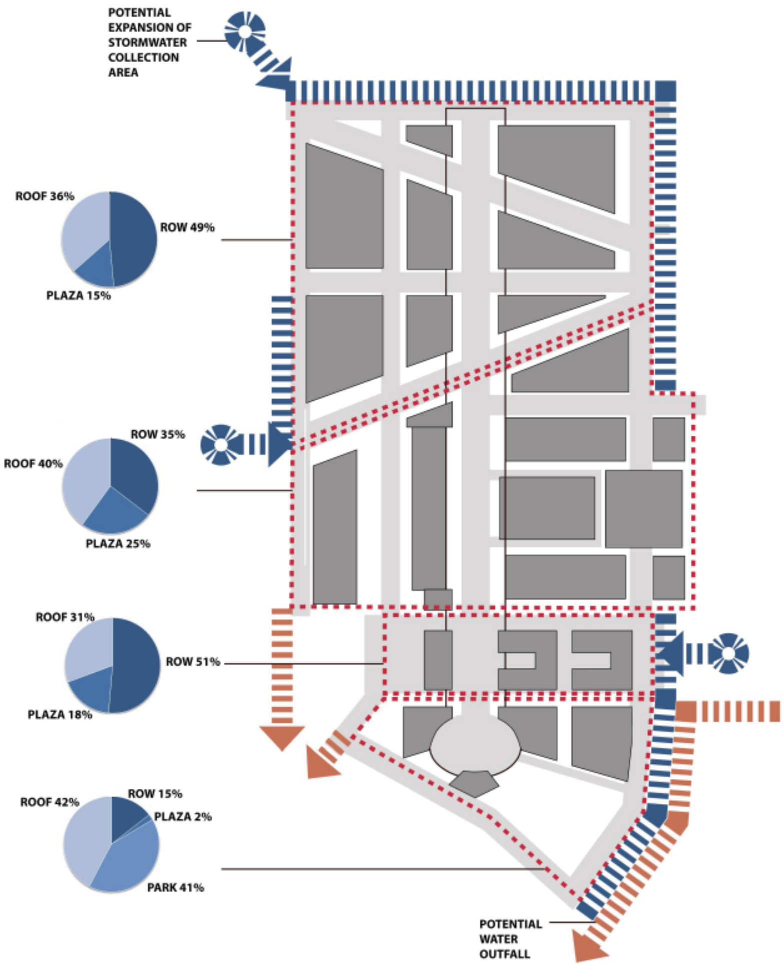
The water system of the existing site uses municipal drinking water and produces waste water for municipal treatment. Irrigation is not prevalent and the green area ratio is extremely low. The contributing area of the 10th Street Corridor is predominantly impervious and served by stormwater drainage system that is separated from the sanitary sewer system. The dominant land use in the area is office.

PROPOSED CONDITIONS

Major redevelopment is planned along 10th Street with a greater diversity of uses. The water system will be updated to collect and reuse stormwater to the greatest degree possible. The impervious area will not be reduced significantly. Green street and green roof technologies will be used to treat stormwater before collection and reuse. The plants and soil will be uniquely selected to clean stormwater while maximizing evapotranspiration. This will be due to the amount of added plant material in the district, drastically improving its green area ratio.

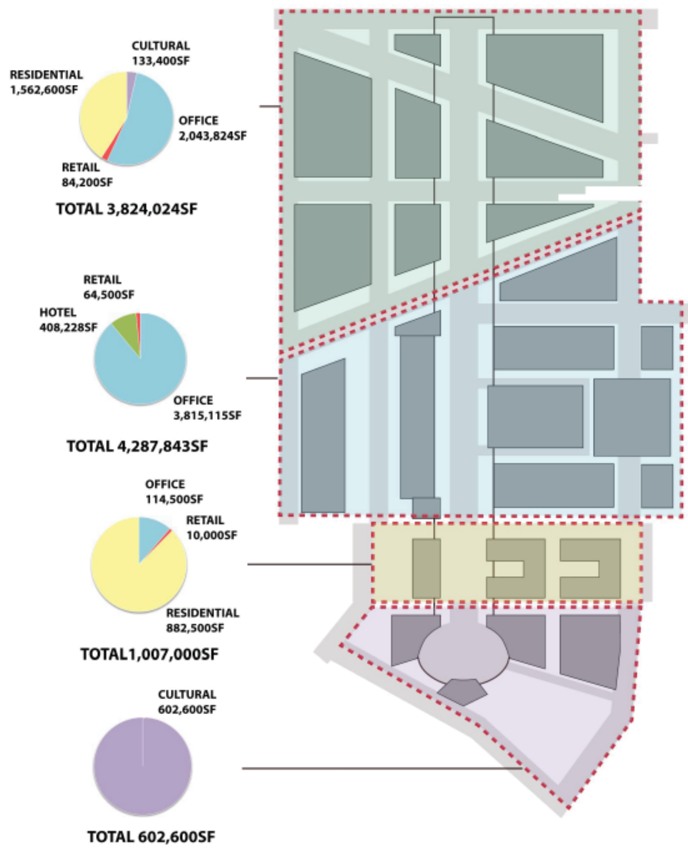
It is anticipated that the mix of uses will change dramatically. A greater demand for water for residential uses will increase potable water demand but will also increase the availability of waste water which can be treated and reused.

District Stormwater Basins

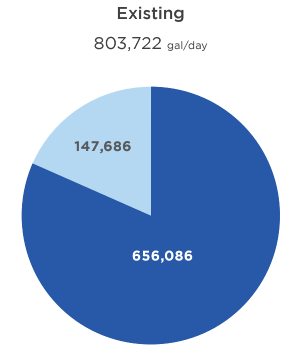


The stormwater basins within the Ecodistrict contain stormwater from roofs, plazas, and the right-of-way. The breakdown differs by basin.

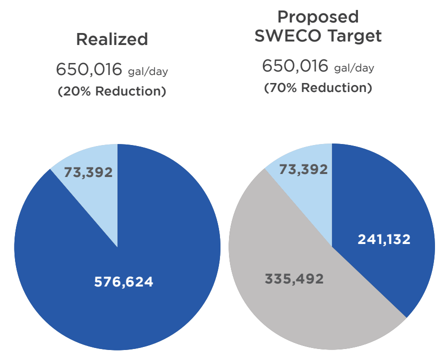
District Uses



The redevelopment of the streets and properties would contribute to an increase in trees and plantings as well as the opportunity to capture, clean, and reuse rainwater and stormwater. Proportion of uses includes a mix of office, residential, retail, and cultural uses.



There is currently an 804,000 gallon per day demand for municipal water for existing properties along the 10th Street Corridor.



In addition to meeting a 20 percent reduction in overall water use, to meet the 70 percent reduction in municipal potable water target in the *SW Ecodistrict Plan*, other water resources for potable water would be required. There is a potable water gap between the rainfall that can be collected and reused for non-potable uses and the total potable need.

- Potable Demand
- Flush Demand
- Gap

STORMWATER REGULATIONS

The DDOE Stormwater Management Rule and Guidebook outlines regulations to manage stormwater on building sites.

The guidebook describes incentives to manage stormwater to meet the District of Columbia's MS4 permit with EPA. For every property in the Ecodistrict, ongoing fees must be paid to make and maintain stormwater system improvements in addition to site improvements to control surface runoff. These fees include an Impervious area charge and a stormwater fee. Both fees can be reduced by meeting the minimum site improvements in the DDOE Guidebook and are applied on a square foot basis by the amount of impervious surfaces.

The District Department of the Environment also proposes a stormwater credit trading system. This would allow private development that cannot be in conformance with the DDOE Stormwater Management Guidebook to buy credits instead of pay an in lieu fee. Credits are given for each net gallon retained per year from impervious areas, within the limits described by DDOE. The requirements are applied to private development and not to the public rights of way. To the extent that a private entity can capture and treat surface runoff from public areas, additional credits can be collected and traded.

1. There are three ways one can earn credits on private property:

- Major Improvement
  - Retention of stormwater on private properties between the 1.2" storm event in 24 hours and the 1.7" storm event in 24 hours. (The minimum requirement is for each property to retain up to the 1.2" storm event in 24 hours.)
- Substantial Improvement
  - Retention of stormwater on private properties between the .8" storm event in 24 hours and the 1.7" storm event in 24 hours. (The minimum requirement is for each property to retain up to the .8" storm event in 24 hours.)
- Voluntary
  - Retention of stormwater on private properties between the 0" storm event in 24 hours and the 1.7" storm event in 24 hours. (There are no minimum requirements and all stormwater treated and reused is creditable up to 1.7" storm event.)

2. Stormwater collected and treated from public areas is a voluntary and therefore generates significant credits.

- Retention of stormwater on public areas between the 0" storm event in 24 hours and the 1.7" storm event in 24 hours.

DDOE FEE & REDUCTION CREDITS

ANNUAL FEE FOR IMPERVIOUS AREAS	RATE / YEAR	10 YEAR PROJECTED INCREASE	POTENTIAL TO AVOID FEE
Impervious area charge	$144/1,000gsf	200 to 300 percent	4 percent (with treatment above 1.2"-1.7" storm event)
Stormwater fee	$32/1,000gsf	100 to 200 percent	55 percent (with treatment above 1.2"-1.7" storm event)

ANNUAL FEE FOR IMPERVIOUS AREAS	RATE / YEAR	10 YEAR PROJECTED INCREASE	POTENTIAL TO GENERATE CREDITS
Stormwater retention credits	$710/1,000gsf	100 to 300 percent	With treatment above 1.2"-1.7" storm event

Source: District Department of the Environment

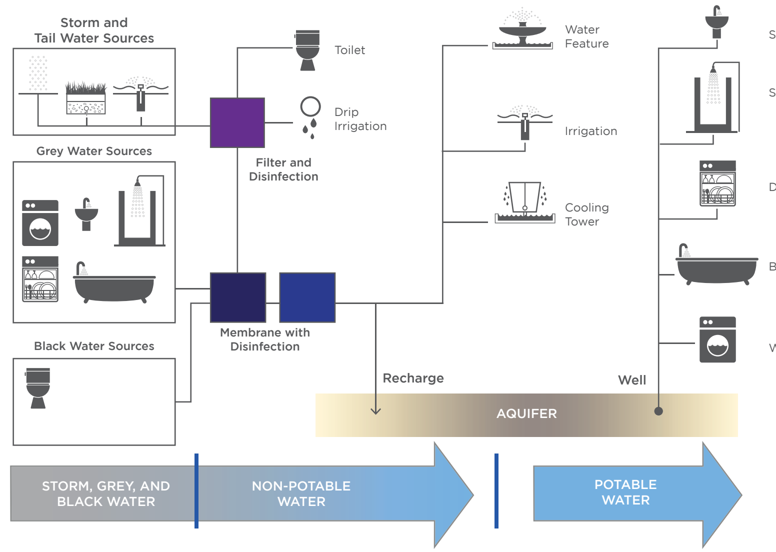
Strategies

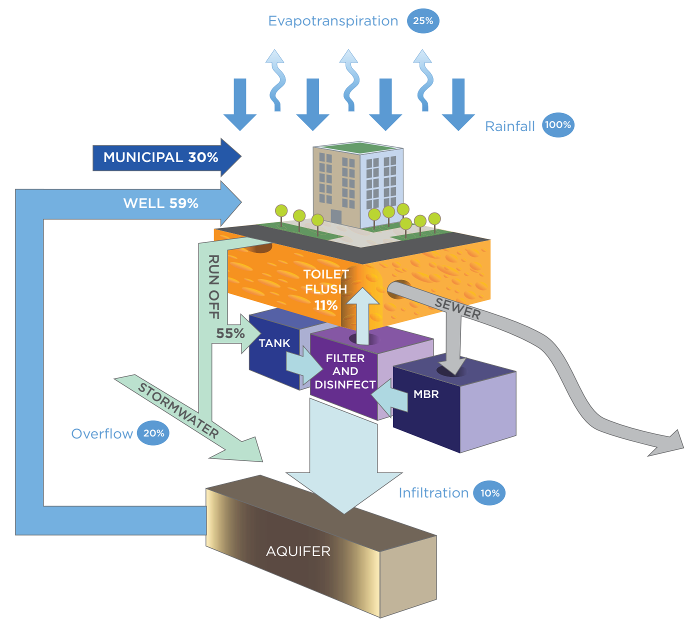
The selected strategy must be cost efficient. This is the foundation for choosing the treatment strategy for the intended use of the water. Treated rainwater (stormwater), well water (or other comparable surface water), and condensate are candidate sources for potable uses. Treated, grey water (or treated waste water) are candidate sources for non-potable water uses. If the Ecodistrict were to use well water or river water for its potable water use, it would need to replenish the well or river with waste water that was treated to a tertiary level. This contributes to a sustainable water balance within the watershed. The following approach fits the best use of the various waters on the site:

- Part of stormwater, grey water, and black water are combined and treated in a tertiary standard through a membrane bio reactor or with Green Machine Technology as a part of an indirect reuse scheme. Tertiary treatment is intended to clean water to the standard for discharge into public rivers and streams.
- Tertiary treated water is injected into the groundwater or to nearby surface water through approved aquifer storage and recovery plan.
- Well water or surface river water is collected and mixed with condensate, roof water, and municipal water and treated for potable water use.
- Remaining stormwater is used for non-potable water uses.

A cistern is sized with adequate capacity to retain stormwater for reuse and infiltration commensurate with the water demand for adjacent building use. Within this concept, the study evaluated the following approaches.

Potable Treatments





This scheme injects treated water into the aquifer to indirectly provide potable water.

NO ACTION

No investments would be made in the Ecodistrict coordinating reuse between buildings and blocks. Building and block treatment and reuse would occur within each building on private properties. Each private project would pay DDOE stormwater fees and receive credits for treatment above the 1.2” storm event up to the 1.7” storm event. Catchment of rainwater is stored in cisterns on site. Water from cisterns would be disinfected for toilet flushes and make up water. Because no water is collected or reused in this option from the surrounding streets, no credits are generated due to collection from the street. Therefore, Green Street system improvements would not be proposed.

70 PERCENT REDUCTION IN MUNICIPAL WATER

A district collection system would be built to capture and reuse rainwater from public and private areas. Water from cisterns under 10th Street would be consolidated into communal storage vessels. Water would be disinfected for toilet flushes and mechanical systems. The remainder would be treated with reclaimed sewer water ground water replenishment through as part of an aquifer storage and recovery strategy. Use surface treatment improvement and stormwater credits in the district to maximize avoided costs of municipal water systems up to a 70 percent reduction in municipal water.

100 PERCENT (TOILET FLUSH AND WELL WATER) RELIANCE DISTRICT ACTION - “100 PERCENT REDUCTION IN MUNICIPAL WATER”

A district collection system would be built to capture and reuse rainwater from public and private areas. Water from cisterns under 10th Street would be consolidated into communal storage vessels. Water would be disinfected for toilet flushes and mechanical system make up water. The remainder would be treated with reclaimed sewer water ground water replenishment through as part of an aquifer storage and recovery strategy. Use surface treatment improvement and stormwater credits in the district to maximize avoided costs of municipal water systems up to a 100 percent reduction in municipal water.

Strategies

SITE	NO ACTION	70 PERCENT REDUCTION IN MUNICIPAL WATER	100 PERCENT REDUC-TION IN MUNICIPAL WATER
Potable Treatment	No	Yes	Yes
Flush Treatment	Yes	Yes	Yes
Site Area	65 acres	65 acres	65 acres
Population	26,000	26,000	26,000
Return of Capital	3 years	4 years	5 years
BUILDING/BLOCK			
Recycled Water Pipe	Yes	Yes	Yes
Rain Collection	Yes	Yes	Yes
Cistern	Yes	No	No
DISTRICT			
Green Streets	No	Yes	Yes
Cistern	No	Yes	Yes
Recycled Water	Yes	Yes	Yes
Well Water	No	Yes	Yes
COST OFFSETS			
Operational Savings	0	$$$	$$$
Avoided Fees	0	$$	$$$
Credit Generation	0	$$$$	$$$$

*Presuming $2/SRC (Stormwater Retention Credit)

GOVERNANCE

To implement this innovative water system at a district scale, an entity will be required to plan, build, and maintain it. There are several types of entities that might be well suited to build and maintain such a system. These include: local government, a local utility, a water service company, a business improvement district, or a public private partnership. In light of DDOE's new stormwater regulations and stormwater credit market, aggregators are forming to bundle stormwater credits and sell to developers/property owners that are in the market. There could be an opportunity for aggregators to get involved at the front end of developing a district water system. In each case, a business plan would be devised to finance the cost of capital improvements through repayment in the fees paid by district subscribers.

It could be developed over time through successive development. Each building would need to be "purple pipe" ready. This means that each building would be able to connect a non potable water pipe system in the building to a district non-potable water system. Through successive building improvements, the blocks should be able to connect to the district water collection and supply system. The cistern serving this system would be sized, divided, and ultimately connected for each development area such as the U.S. Department of Energy (DOE), L'Enfant Plaza, Freeway Lid, and Overlook. The entity managing the installation and the operation of such a system would coordinate ongoing investments by public and private interests.

Precedents for such a system as this are numerous as institutional municipal non-potable water systems. Dockside Green in Victoria, Canada has an advanced water treatment system that uses stormwater and waste water to provide for non potable uses in this private development. The advanced water system and heating system are owned and operated by the developer.

Dockside Green, Victoria, Canada

For more information -
http://www.docksidegreen.com/Sustainability/Ecology.aspx
www.werf.org/c/Decentralizedproject/Dockside_Green.aspx

CAPITAL COSTS

To receive the stormwater credits, retention of stormwater is required. If the stormwater is not reused, the tank size, degree of evapotranspiration and infiltration back into the ground would need to increase through additional site development improvements. Thus if stormwater is not reused, the cost for each credit is very high. In this study, the cost attributable to the Aquifer Storage and Recovery system to provide potable water to the district is comparable when the additional costs and avoided costs are weighed.

AVOIDED OPERATIONAL COST

The more water that the SW Ecodistrict can treat, the greater the amount of avoided costs. These include costs associated with;

- Potable water use
- Water connection fees
- Stormwater fees
  - Impervious area charge
  - Stormwater fee
- Waste water treatment fees

Relative comparison of potentials cost and savings presuming stormwater credit are valued at $2 per treated gallon per year. This compares the performance of alternative approaches to increase stormwater collection as well as generate stormwater credits.

Water Cost Analysis - Strategies and Cost Factors

SITE	NO ACTION	70 PERCENT REDUCTION IN MUNICIPAL WATER	100 PERCENT REDUCTION IN MUNICIPAL WATER
Potable Treatment	No	Yes	Yes
Flush Treatment	Yes	Yes	Yes
Site Area	65 acres (28)*	65 acres	65 acres
Population	26,000	26,000	26,000
COST FACTORS			
Return of Capital	3 years	4 years	5 years
Capital Cost Efficiency	$5.77/treated area	$7.88/treated area	$9.46/treated area
Operational Avoided Cost Efficiency	$1.70/sf treated area per year	$1.55/sf treated area per year	$1.79/sf treated area per year
Credit Efficiency	$.65/sf treated area per year	$1.54/sf treated area per year	$1.54/sf treated area per year

Presuming $2/SRC (Stormwater Retention Credit)

NOTE:
Relative comparison of potential costs and savings presuming stormwater credits are valued at $2 per treated gallon per year. This compares the performance of alternative approaches to increase stormwater collection as well as generate stormwater credits.

*Wet site area attributable as required stormwater treatment (minus street right of ways).

SENSITIVITY ANALYSIS

The value of a stormwater credits within the emerging market place will vary over time. If the stormwater retention credits (SRC) vary in value from $1 to $2 per year, the payback would vary from 11 to 4 years to meet the SW Ecodistrict Water goal to include a 70 percent reduction in municipal water. If the credits increase in value overtime, it would be possible to increase the reduction from 70 to 100 percent at an incremental operating cost.

Sensitivity Analysis

SITE	NO ACTION	70 PERCENT REDUCTION IN MUNICIPAL WATER	100 PERCENT REDUCTION IN MUNICIPAL WATER
$1/SRC	5 Years	11 Years	16 Years
$2/SRC	3 Years	4 Years	5 Years
$3/SRC	2 Years	3 Years	3 Years
$3.50/SRC	1 Year	2 Years	3 Years

FINANCING

An important tool in financing the project includes applied savings in avoided operational costs to pay for upfront water system capital costs. In this study, the larger the project area and the greater the population density:

- The lower the cost per treated area of stormwater;
- The greater the credits received for treated stormwater; and
- The greater the avoided operational costs due to improvements.

This contributes to a quick payback of capital. The value of the District Department of Environment's stormwater credits contributes greatly to this payback. The value of the credit will be determined through a market place where credits can be bought and sold. The greater the credit value, the quicker the payback. In this study, we assumed that the stormwater credit would be worth $1 per treated gallon per year.

VALUE PROPOSITION

Based on a comparison of the performance of a LEED Platinum certified building, it is evident the costs increase for great degrees of water treatment for potable water, but the return of capital is approximately the same.

Although the construction cost per capita for an Ecodistrict is twice as much as a toilet flush only water system at a building scale, they have the same payback. Bear in mind that the savings beyond the payback of capital in the Ecodistrict concept is much higher. This anticipated revenue beyond the pay back period can be used to finance other projects in the district. Here the value proposition is:

QUALITATIVE

Water system improvements at a district scale leads to a transformation of the environmental character of the Ecodistrict.

QUANTITATIVE

The potable water system has the greatest avoided costs and generates enough credits to finance the improvements in the district with an affordable payback period.

Water Cost Analysis - Building Versus District Comparison

SITE	PLATINUM BUILDING	ECODISTRICT
Potable Treatment	No	No
Flush Treatment	Yes	Yes
Site Area	0.5 acres	65 acres
Population	500	26,000
COST FACTORS		
Cost Efficiency	$7.49/treated area	$5.34/treated area
percent Construction	0.38 percent	0.64 percent
Credits Generated	$.65/treated area	$1.54/treated area
Avoided Costs	$.84/treated area	$.36/treated area
Return of Capital	5 Years	3 Years
Cost Per Capita	$350/capita	$584/capita

Note: $2/SRC is assumed to be the value of each treated gallon of stormwater per year in the SRC market in DC.

Conclusions and Next Steps

RECOMMENDATIONS

1. Preliminary Recommendations:

- Use rain and well waters to close the gap on potable water demand.
- Treat grey water and remnant stormwater for the small amount of non-potable (flush) demand.

2. Preliminary Conclusion:

- We can finance capital as well as meet operating costs with subscriber fees, avoided fees, and stormwater credits which contribute to the beauty of 10th Street

NEXT STEPS

Promote private initiative in partnership with agencies having authority to remove policy barriers to achieving the SW Ecodistrict goals.

2

Appendix Technical Report

The SW Ecodistrict is a diverse amalgamation of city, federal, and private properties that are working together to address energy, waste, and water at a district scale. With adoption of the District of Columbia Department of Environment (DDOE) stormwater regulations, rainfall is currently a shared liability and opportunity. After rainfall lands on the area it becomes stormwater that flows directly to the Potomac River, carrying pollutants that settled on impervious areas. This water can be separated, cleaned, and reused while generating revenue for the Ecodistrict. This revenue can offset the cost to make public improvements that transforms the human experience in the Ecodistrict.

The *SW Ecodistrict Plan* Task Force adopted the goal to reduce existing municipal water use by 70 percent in 2030 for all the properties in the plan area. This was an aggressive goal that exceeded Executive Order 13514's goals for federal properties to reduce existing water use by 26 percent by 2020. All were to occur as the development intensity increased by 30 percent; creating a greater demand for water and providing an opportunity to use water more efficiently. Modeling the sources and uses of water on an annual basis demonstrated the potential of collecting stormwater from rainfall and additional sources.

Since the Ecodistrict is planned to redevelop with a greater mix of uses and increased development intensity, efficient water fixtures, rainwater harvesting, and grey water use, as well as other water reclamation approaches, would be required. This study considers how stormwater can be captured and reused, in the context of other available water sources, to satisfy the larger SW Ecodistrict water goals.

This study also assesses the impact of future improvements in the SW Ecodistrict. It focuses on new development planned along the 10th Street Corridor including redevelopment of the Department of Energy, building renovations and new construction on L'Enfant Plaza, building a lid over the freeway for residential development, as well as development of the Banneker Overlook for cultural uses. These improvements are intended to make a new place in the city that respects the *Monumental Core Framework Plan* and a neighborhood that holds the aspirations of a new emerging community in and around 10th Street.

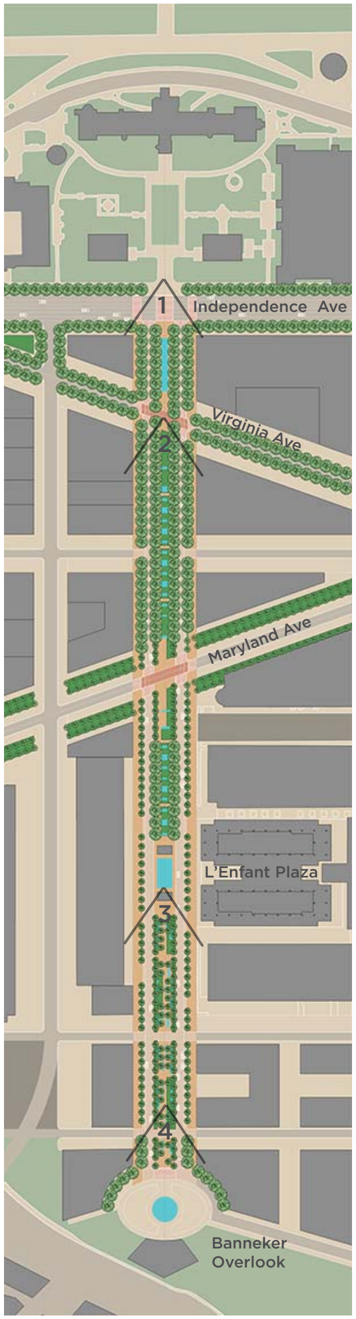
The DDOE is instituting policies that create incentives to collect and reuse stormwater. These requirements parallel the *SW Ecodistrict Plan* goals. Through capture and reuse of stormwater, building demand for water can be met while pollutants from stormwater are being removed from stormwater, destined to the Potomac. Compliance with these policies leads to long term avoided costs in annual service charges for stormwater treatment, potable water, and waste water treatment. This study identifies the avoided fees and the achievable credits for treating stormwater at a district scale. To the extent that a market is created for stormwater credits that can be resold for water treatment in excess of the minimum requirements, these credits can offset the capital cost of a district water catchment, treatment and reuse system to meet the intended 70 percent reduction in municipal water use. The credits are achieved through a combination of vegetated best management practices for stormwater treatment and through non-vegetated mechanical cleaning and storage devices.

These areas are part of a physical connection between Independence Avenue and The Potomac Basin. This corridor is intended to be revitalized with remarkable improvements through redevelopment of the aforementioned project areas. These measures can be formulated to increase the value of the experience and enjoyment of the 10th Street Corridor and the redevelopment along its length. In many cases, the cost to capture, treat and reuse waters on the site can be a shared cost with planned property development and public right of ways.

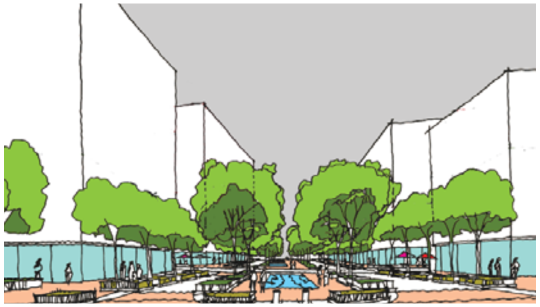
10TH STREET DESIGN

The proposed plan for 10th Street is intended to establish a landscape that envisions the use of water as a central theme. In this plan, the display of water is to be linked to the district water and energy plan for the SW Ecodistrict. In so doing, it is integral to operational infrastructure, without which water and energy could not be shared or reused.

Many of the strategies identified to meet the *SW Ecodistrict Plan*'s 70 percent reduction in municipal water use are technically feasible. However the governance structure envisioned for a district scaled water system would likely require policy modification, at that scale. It would also need to be implemented by a business improvement district or other non-governmental entity to be effective and enduring. In this newly defined paradigm, the federal government could participate as a stakeholder. Thus, federal properties could participate with private interests in collection and use of waters within the project boundary.



10th Street, SW
Conceptual Design Diagram



1. View south from Independence Avenue, SW

2. View between Virginia and Maryland Avenues, SW

3. View from L'Enfant Plaza toward the Southwest Waterfront

4. View at Banneker Overlook looking toward the National Mall

PURPOSE

The purpose of this study is to:

- Evaluate strategies to close the gap between availability of stormwater and the *SW Ecodistrict Plan* municipal water demand in the area around the planned 10th Street redevelopment.
- Establish the role of the 10th Street Corridor to store and convey captured and treated stormwater.
- Determine the incremental value for stormwater capture and reuse between the 10th Street Corridor alternatives through transformational investments in the SW Ecodistrict.
- Identify potential pathways to reduce the gap in capital and operational costs.

PRELIMINARY CONCLUSIONS:

- We can finance capital as well as meet operating costs with subscriber fees, avoided fees, and credits while contributing to the beauty of 10th Street
- A district water system has the potential to:
    - Capture the greatest amount of rainwater across rights-of-way and private properties.
    - Share costs of cleaning and conveyance with more subscribers,
    - Contribute to the environmental character of 10th street and other areas of the Ecodistrict, and
    - Generate stormwater credits that may be sold in the market place to finance improvements.
- There are significant water resources within the 10th Street Corridor in addition to rainwater harvesting. Condensate water, grey water, and black water, can all make a contribution to meeting the demand for potable water with proper treatment and reuse regimes.
- Technology exists to achieve the SW Ecodistrict goals but the policy context and governance structure to use that technology needs to be created. The SW Ecodistrict governance structure can contribute to the operation and maintenance of local water system improvements. The entity can finance, monitor, and maintain facilities to take lead responsibility away from the local utilities.

PRELIMINARY RECOMMENDATIONS:

- Use rain and well waters to close the gap on potable water demand.
- Treat condensate, grey water, and remnant stormwater for the small amount of non-potable demand (flush).
- Use treated waters from waste water streams to replace waters taken from well-through aquifer storage and recovery - or other nearby surface water sources.
- Use municipal water to supplement on site water reuse regime, for fire response, and emergency back up.

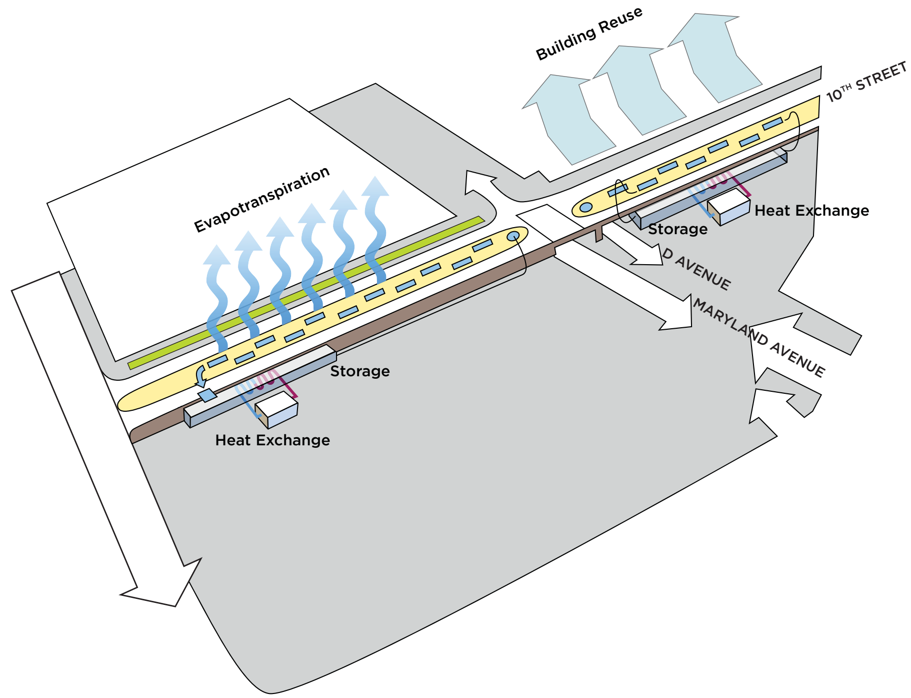
10th Street

THE IMPORTANT ROLE OF 10TH STREET

10th Street design can contribute to several strategies that help the SW Ecodistrict achieve water use goals. It can play a significant role in the storage of water in a phased development plan. Aerobic water treatment can occur through water circulation across its length in planters and other mechanisms. Through planted media and spray of water, water can be evapotranspirated and evaporated across its surface to reduce run off and provide a direct return to the hydrologic cycle. Thermal exchange with water during the summer and winter months can be coordinated with seasonal cooling and heating needs of buildings. But most important, the tanks below the street can be used to store water collected across the district for reuse.

The role of 10th Street is critical to the successful redevelopment. On the one hand, it is a critical connection between the National Mall and the Southwest Waterfront. On the other, its transformed character is planned to define the value of this place in the city and to adjacent neighborhood. Like all streets in the SW Ecodistrict, 10th Street will need to play a role in the treatment, storage, and conveyance of stormwater. 10th Street is special because of the opportunity to develop an unusually wide street, enhance mobility, celebrate and store stormwater, and create places that contribute as a focus for neighborhood activities. The surface improvements related to water are intended to be a signature element of the place. Below grade improvements, although hidden are equally important. Where treatment, storage, and display of water can be highlighted in the design of the street, it is possible for improvements to share costs with surface landscaping improvements. Governance structure can contribute to the operation and maintenance of local water system improvements. This entity can finance, monitor, and maintain facilities to take lead responsibility away from the local utilities.

10th Street Water Resources



The design of 10th Street can integrate water and energy strategies for the corridor and adjacent development.

Analysis of Stormwater

EXISTING CONDITIONS

This infrastructure study considered the amount of stormwater available for harvesting and reuse. A key hypothesis is the degree that plant materials would reduce the volume of water harvested due to evapotranspiration or infiltrations. Of these, infiltration would be relatively negligible due to the high concentration of impervious services and roof top garden areas. The existing condition of the 10th Street Corridor lacks significant plant material on grade. That which is on grade, such as the Overlook area surrounding Banneker Fountain, is mostly compacted grass that contributes to the sheet flow of stormwater. In the future, the hardscape would likely increase due to proposed museums and/or memorials for the site. But, spaces would be designed with the surface flow of stormwater in mind.

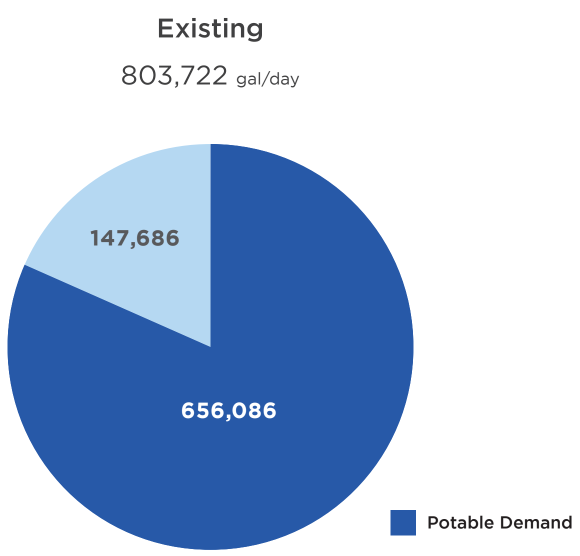
- Plantings would be organized to be a part of the stormwater cleaning system;
- Trees would provide shade and outdoor comfort;
- Planters would provide organized space for programmed activities and circulation. Each would contribute to a degree of reduction in stormwater runoff as water moves to its eventual collection and reuse along the 10th Street Corridor.

EXISTING WATER SOURCE DISTRIBUTION BREAK DOWN

- The stormwater system is separate from the sanitary sewer system and flows directly into the Potomac Basin.
- Rainfall sheets off building sites and streets into the stormwater drainage system.
- Minimal tree and discontinuous plant communities make a limited contribution to the stormwater reduction volume.
- 100 percent municipal water is used to meet the 10th Street Corridor demand.

Modeling of the daily water demand includes both the existing source and use of water. This can be compared to what is proposed in the 10th Street Corridor, as stated in the *SW Ecodistrict Plan*. Currently, the source of water is potable water from the municipal water utility—DC Water. Non-potable water is not used in the district but could offset the municipal water used for toilet flushes, irrigation, and other process waters in the district.

Existing Municipal Water Demand



There is currently an 804,000 gallon per day demand for municipal water for existing properties along the 10th Street Corridor. Since the area is predominately office uses, the potential to use non potable water would require 148,000 gallons per day for the toilet flush demand.

FUTURE NEEDS

Development within the study area is intended to grow by 33 percent in the *SW Ecodistrict Plan*. Currently the district is predominantly office and is intended to expand with a greater mixture of residential, retail, and cultural uses. The modeled demand for water is based on the future occupancy density presumed in the SW Ecodistrict for the 10th Street Corridor.

As the area increases in population density by 33 percent and the mix of uses includes housing and cultural uses, there would be the opportunity to reduce overall demand for water. Through the use of efficient fixtures, population behavior modeled by use, there would be a 20 percent reduction in overall water use to 650,000 gallons per day demand. Of this, 73,000 gallons per day could be assigned for toilet flushes.

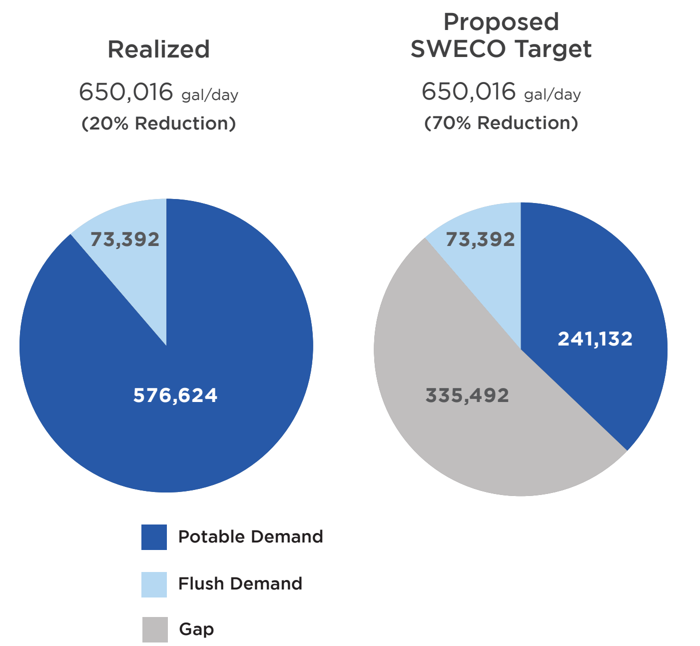
DISTRICT OF COLUMBIA POLICIES AND FEES

The EPA requires that the District of Columbia control pollution from stormwater runoff under the National Pollutant Discharge Elimination System (NPDES). Under NPDES, the EPA has issued permits for all sewer and stormwater outfalls because they discharge directly into the District's waterways.

Two types of municipal sewer systems exist in Washington. The combined sewer system (CSS) joins wastewater and stormwater into the same sewer pipes and covers nearly one third of the city. During heavy storms the system often overflows and sends untreated sewage and stormwater into waterways. The municipal separate sanitary and stormwater sewer system (MS4) separates wastewater and stormwater and covers the remaining two-thirds of the city. Although wastewater and stormwater are not mixed in this system, all stormwater proceeds untreated into waterways, carrying with it any pollutants it has picked up.

The District must complete capital improvement projects to comply with EPA permits and reduce water pollution. To fund these improvements the District currently assesses two fees: the Impervious Area Charge (IAC) and the Stormwater fee. Each of these fees is based on square footage of impervious area and assessed monthly on water bills. Two agencies are responsible for realizing these capital improvements in addition to their primary functions: DC Water and the DDOE.

Municipal Potable Water Target



In addition to meeting the 20 percent reduction in overall water use, to meet the 70 percent reduction in municipal potable water target in the *SW Ecodistrict Plan*, other water resources for potable water would be required. There is a potable water gap between the rainfall that can be collected and reused for non potable uses and the total potable need.

DC WATER

DC Water is the water and sewer authority in the District of Columbia that oversees and collects several fees established for District water users. The fees discussed here are those that directly contribute to and fund DC Water projects, operations, and the conveyance and treatment of water. Fees addressed includeretail water, retail sewer and the Impervious area charge (IAC). DC Water instituted the $2.6 billion dollar Clean Rivers Project in order to comply with the District's NPDES permit issued by the EPA. To fund the project DC Water has adopted a "polluter pays" philosophy that puts the burden of payment directly onto the users through the IAC. DC Water determined that the IAC is the most equitable way to recover the costs of the Clean Rivers Project as opposed to a volumetric charge for water used, because the IAC is based on a property's contribution to rainwater runoff.

The IAC will rise over time to fund the Clean Rivers Project in its entirety. Over the last five years, DC Water instituted annual increases for retail water and sewer services. Of DC Water fees, the IAC has the most aggressive increase at nearly 672 percent for non-residential customers over this period. According to DC Water's rate and fee projections, the IAC could rise from the current rate of $9.57 to $28.77/Equivalent Residential Unit (ERU) by 2019. See Tables 1.2 and 1.3 for fee escalation details.

While all fees are rising, the IAC is rising exponentially, indicating that the IAC presents significant current and future costs to consumers in proportion to standard retail water and sewer fees. This stresses the opportunity for cost savings that can be realized through instituting low impact development (LID) strategies that reduce impervious surfaces. Additional savings on retail water fees can also be realized if LID strategies capture and use stormwater.

Table 1.2 Water Rates and fees for Non-Residential Customers FY 2009-2013[1]

FEE TYPE	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	PERCENT INCREASE 2009-2013
Water / CcF *	$2.30	$2.51	$3.10	$3.24	$3.42	48.69 percent
Sewer / CcF	$3.31	$3.61	$3.79	$4.18	$5.59	68.88 percent
IAC / ERU **	$1.24	$2.20	$3.45	$6.64	$9.57	671.77 percent

* 1CcF – 100 Cubic Feet

** 1ERU – 1 Equivalent Residential Unit or 1,000 Square Feet

Table 1.3 Projected Retail Water Rates and Fee Changes for Non-Residential Customers FY 2014–2019[2]

FEE TYPE	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	PERCENT INCREASE 2009-2019
Water / CcF	$3.42	$3.66	$3.88	$4.13	$4.38	$4.58	$4.74	106.08 percent
Sewer / CcF	$5.59	$4.47	$4.74	$5.05	$5.35	$5.59	$5.79	71.90 per-cent
IAC / ERU	$9.57	$14.52	$17.66	$20.33	$23.19	$25.49	$28.77	2,220.16 percent

THE DISTRICT DEPARTMENT OF THE ENVIRONMENT

The District Department of the Environment (DDOE) is the leading authority on energy and environmental issues affecting the District of Columbia. DDOE levies the stormwater fee of $2.67 per 1,000 square feet of impervious area on District property. The stormwater fee applies to all properties in the District of Columbia including residential, commercial, and Federally-owned sites.

Policies regulating stormwater and associated fees show no sign of abating. The fees will remain the same at least until October 2016 but could be raised by DDOE if the EPA permit requirements for DC's MS4 become more stringent, forcing DDOE to make further capital improvements and pass these costs on to property owners.

At present, no program exists to reduce stormwater fees. However DDOE is in the process of developing a stormwater fee discount program called RiverSmart Rewards. The program "will provide water and sewer ratepayers the opportunity to receive up to a 55 percent discount off the stormwater fee to property owners who implement measures to manage and reduce stormwater runoff." Once the program goes into effect, ratepayers will be able to apply for discounts that could be retroactively assessed back to May 1, 2009, the implementation date of the stormwater fee. This program is expected to become active following final rulemaking in late summer 2013.

Because both the Impervious area charge and stormwater fee are based on the amount of impervious surface on properties it can levy large monthly fees on heavily developed commercial areas. By acting now to reduce impervious area and stormwater runoff, property owners and managers including the federal government can take advantage of rebate programs to reduce both fees currently being levied on every square foot of impervious area on the site. Taking action now will protect those properties from potential escalating costs in the future. Since RiverSmart Rewards rebates can be applied retroactively, the sooner impervious area is converted the sooner potential savings could begin to accrue.

DDOE is also proposing a stormwater retention credit (SRC) trading system which has the potential to provide environmental and monetary benefits to the 10th Street Corridor. By certifying LID projects that retain stormwater through the SRC program, public and private facilities can mitigate the environmental effects associated with excess runoff, qualify for the RiverSmart Rewards stormwater fee discounts mentioned above, and generate a profit by selling SRCs on the market.

A stormwater retention credit-trading program works similarly to an emissions cap-and-trade program. Regulated entities must meet certain levels of stormwater retention but to improve the flexibility and cost savings of such ecological requirements, credits are awarded and then can be traded accordingly. A DDOE SRC is equal to one gallon of stormwater retention volume over one year and DDOE will certify the stormwater retention volume of any retrofits installed in the District since May of 2009.

The SRC program is set up as a way for sites to comply with the Proposed Rulemaking on Stormwater Management and Soil Erosion and Sediment Control put forth by DDOE in August 2012. Any buildings that undergo redevelopment projects disturbing 5000 square feet or more in the future will be regulated by the new stormwater requirements. Once a site becomes regulated, it must retain at least a 1.2" rain event, but it can accrue and sell SRCs if retrofits are designed to meet the standards of a 1.7" rain event. To the extent that a private entity can capture and treat surface runoff from public areas such as streets, additional credits can be collected and then sold. If the building cannot retain a 1.2" rain event, it must buy credits on an annual basis to make up the difference.

The following four scenarios discuss the stormwater requirements and the potential for credit generation for various building/site redevelopments.

1. Major Improvement on Private Sites

- For a major improvement on a private site the minimum stormwater requirement is for a property to retain up to the 1.2" storm event in 24 hours. Retention of stormwater between the 1.2" storm event and the 1.7" in 24 hours generates stormwater credits that can be sold.

2. Substantial Improvement on Private Sites

- For a substantial improvement on a private site the minimum stormwater requirement is for a property to retain up to the .8" storm event in 24 hours. Retention of stormwater between the 1.2" storm event and the 1.7" in 24 hours generates stormwater credits that can be sold.

3. Voluntary Stormwater Management on Private Sites

- When no site improvements are made on private sites and voluntary stormwater management occurs, all stormwater that is treated and reused is creditable up to the 1.7" storm event.

4. Voluntary Stormwater Management of Public Areas on Private Sites

- Private sites can manage stormwater runoff from public areas. All stormwater runoff from public areas that is treated and reused is creditable up to the 1.7" storm event.

Significantly more credits for stormwater can be generated via treatment of voluntary public and voluntary private lands. The stormwater credits create a revenue stream to finance the needed capital improvements for the stormwater management systems.

DDOE FEE & REDUCTION CREDITS

ANNUAL FEE FOR IMPERVIOUS AREAS	RATE / YEAR	10 YEAR PROJECTED INCREASE	POTENTIAL TO AVOID FEE
Impervious area charge	$144/1,000gsf	200 to 300 percent	4 percent (with treatment above 1.2"-1.7" storm event)
Stormwater fee	$32/1,000gsf	100 to 200 percent	55 percent (with treatment above 1.2"-1.7" storm event)

STORM EVENT	MAJOR IMPROVEMENT	SUBSTANTIAL IMPROVEMENT	VOLUNTEER IMPROVEMENT
0.8" Storm Event	Stormwater management required	Stormwater management required	Credits generated up to 0.8" volume
1.2" Storm Event	Stormwater management required	Credits generated for 0.4" volume	Credits generated up to 1.2" volume
1.7" Storm Event	Credits generated for 0.5" volume	Credits generated for 0.9" volume	Credits generated up to 1.7" volume

Strategies to Close the Water Gap

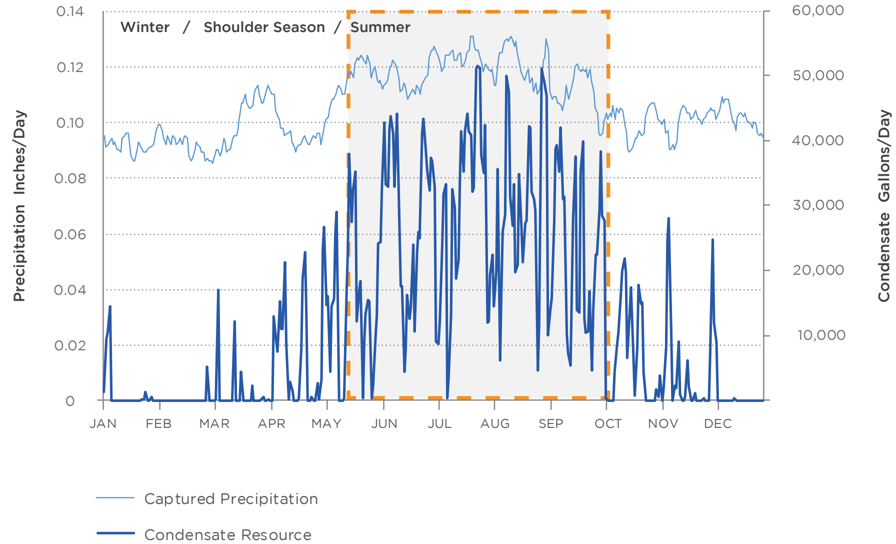
CLIMATE OPPORTUNITIES

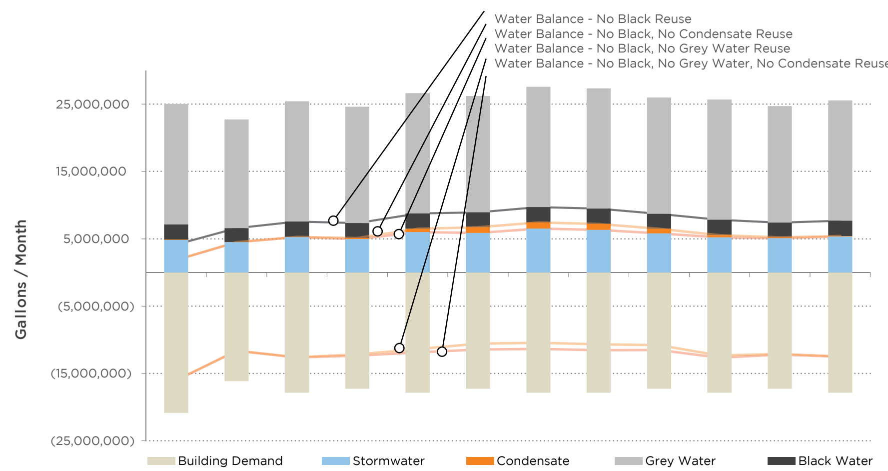
Rainfall is variable through the year. The most intense rainfall occurs during the summer months. Other times of the year, the storm events are more persistent but provide less of a resource. One aspect of the climate is the intense humidity during the summer months. Here there is the opportunity to collect a significant volume of water. When hot and humid laden air is cooled for indoor use, the water condenses on the cool surfaces and then drains to the sewer. This water can be collected and used.

The condensate also represents an opportunity for cooling or heat rejection and can be leveraged to reduce cooling needs within the district.

Each potential source of water varies through out the year. Rainwater is relatively constant throughout the year with an increase in summer months. Condensate is also a significant potential source during the summer, but not the winter. These waters can be treated to an acceptable water standard for potable water. In addition, grey water is abundant through out the year, primarily due to the addition of residential uses which generate significant volumes of gray water, when compared to office or cultural uses. Gray water is generated from sinks, showers, and laundry. It does not contain toilet flush waste but requires special permitting and treatment if reclaimed for potable water reuse.

District Yearly Water Demand





Demand for water is relatively constant but the supply of water is higher in the summer than the winter. This is in large part due to the presence of humid air during the summer that generates condensate when cooled for indoor air use. There is more condensate and rainwater in the summer which can be treated easily for potable uses. During the winter, there is less rainfall to collect.

VEGETATED SYSTEMS

The DDOE's draft Stormwater Guidebook provides assumptions that can be used to model the potential to capture rainfall after it falls on impervious areas and pervious areas. In the pervious areas, DDOE assigned values that presume the potential for volume reduction associated with the capture of water that might be processed through differing planting and soil conditions. For example, flow through stormwater planters and infiltration planters have different stormwater reduction values because the infiltration planter presumes greater volume reduction through infiltration. These values are assigned to material areas along the 10th Street Corridor and define the amount of stormwater that is being collected. From this, we can presume what volume of water can be collected based upon historic annual rainfall

The planted (pervious) areas serve multiple purposes. In the aggregate, they create a profoundly new image for spaces between buildings along the 10th Street Corridor. They can be arranged to organize circulation, provide shade, and create space for programed events. They can also be located to treat surface water for soluble metals, insoluble hydrocarbons, as well as other biological contaminants. Evapotranspiration, evaporation, and irrigation are intended to contribute to the use and reduction of surplus water in planted areas during the summer, when there is an abundance of water on the site.

Green Areas for Water Processing

Flow through swale

20 percent reduction

Flow through planter

20 percent reduction

Roof intensive

40 percent reduction

Roof extensive

20 percent reduction

Tree

Reduction 15 cf/year

Impervious

0 percent reduction

Compacted

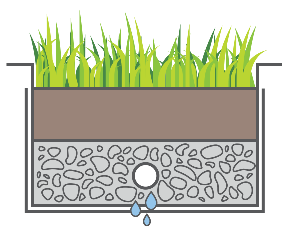
20 percent reduction

Natural

40 percent reduction

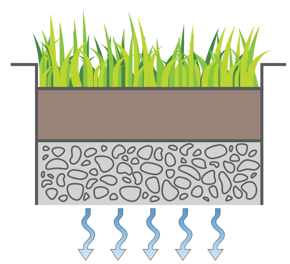
Each surface configuration type in the 10th Street Corridor contributes to the run off, infiltration, evapotranspiration, and treatment of stormwater.

Types of Green Infrastructure used in the SW Ecodistrict



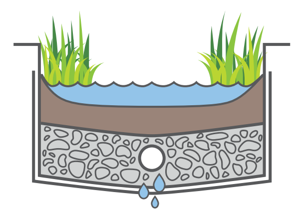
Flow through planter

20 percent reduction



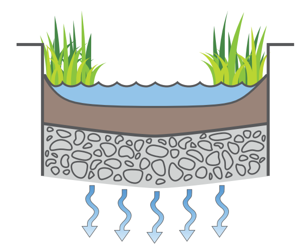
Infiltration planter

40 percent reduction



Flow through swale

20 percent reduction



Infiltration swale

40 percent reduction

CISTERN STORAGE

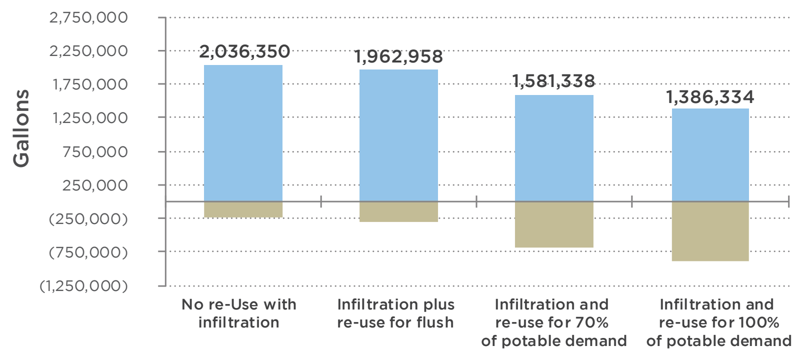
At the urban densities considered for the area, the demand for water is significantly higher than the amount of available rainfall. Adding the capture and treatment of stormwater from adjacent streets and open space, including the volume reduction due to evapotranspiration and infiltration, does not close the gap. Tank sizing is directly related to the volume needed to collect the DDOE required storm events on site to maximize credit opportunities. With the objective of collecting stormwater to gain the greatest number of credits, tank size depends on the amount of reuse. Reuse draws down the collected water in the tank on a daily basis, making room for the subsequent catchment of rainwater volume to meet the DDOE requirements. The modeling presumed to maximize the stormwater credits one could receive between categories of credits that might be received in the DDOE Stormwater Management Rule and Guidebook.

This guidebook identifies the gallon per credit can be achieved between the volume collected in storm events. Major improvement gives you the least range of collection (when you disturb more than 5,000sf of impervious area). When one volunteers to manage their stormwater or those of an adjacent property, you receive a credit for each collected gallon. Modeling of the tank size is based on achieving this regime.

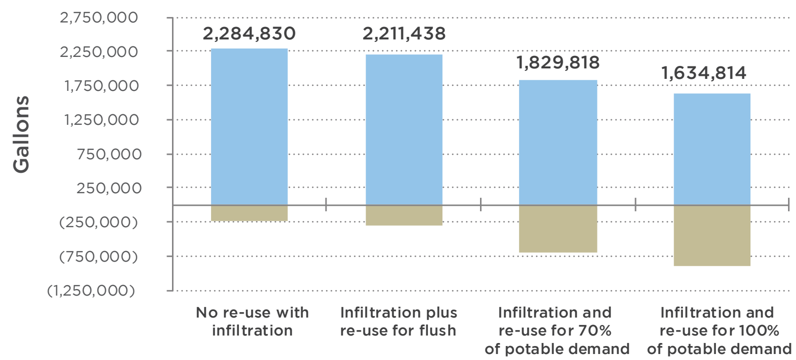
The 1.7" storms are most frequent during the summer and a large tank is needed. In the winter, the rainfall events are considerably smaller and more persistent rather than heavy downpours. As a result the tank size for the winter event is about half the needed size of the summer event.

During the summer months, the 1.7" storm event requires a tank approximately 2.3 million gallons to maximize credit generation. This would presume no reuse of collected water but dissipation of stormwater from infiltration and evapotranspiration. If a significant water reuse regime is used, the tank size could be reduced to 1.6 million gallons. A 1.6 million gallon tank is equivalent to a 20' high by 20' wide tank that is 534' long. This can be accommodated beneath 10th Street. It could be built in segments with adjacent development. For example, this tank could be built in segments with the redevelopment of the DOE site, the redevelopment of the L'Enfant Properties, and Banneker Overlook. They could be interconnected over the redevelopment of the site.

Tank Size for 1.2" Storm Event and Re-Use Scenarios



Tank Size for 1.7" Storm Event and Re-Use Scenarios



The tank size required to capture stormwater credits depends on the demand for recycled water reuse of nearby development. The minimum sized tank and the tank sized to maximize stormwater credits are a 10 percent to 15 percent difference in size.

SEPARATING WATER SOURCES

Consideration was given to several systems to separate water for the appropriate purpose of use. A prominent conclusion of the study was based on concerns within the SW Ecodistrict Taskforce that recognized the barriers to regulatory approval for the treatment of black water (or grey water) for direct potable water use. The following systems were considered:

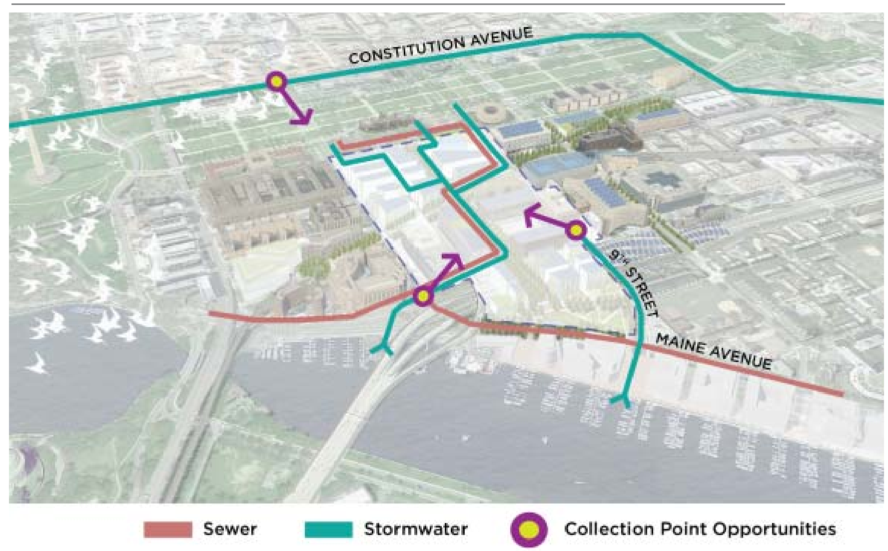
- A system to separately collect, treat, and store grey water from black water is an additional cost that was not considered in this study. In this study, waste water—also known as black water—would be collected (inclusive of grey waters) treated and reused in combination with an aquifer storage and recovery system as a part of an indirect water reuse concept. DC would require water management legislation around an aquifer storage and recovery system.
- Collection of rainwater and condensate water would require regulatory approval for use as potable water. Though, with further study and policy changes it is hypothetically possible to reuse.
- Collection of condensate water would require regulatory approval for use as potable water. Like rainwater in Washington, further study is required but it is hypothetically possible to reuse. Condensate has a relatively low temperature that can contribute to cooling in the area through heat exchange.
- Collection of storm water off site
  - 9th Avenue Storm Sewer contains tidal waters of the Potomac. This source contains both storm water (stormwater credit generator) and river water. This source of water is on site at 9th Street and E Avenue. This water would require treatment.
  - Constitution Avenue contained dewatering, stormwater, and some combined sewer overflow from the approximate location of the Tiber Creek. To capture this water a 1,200' long pipe and pump would be required, which is quite expensive. This water would require treatment.
- Collection of waste water off site
  - Waste water is prevalent on the site due to a large main located in Maine Avenue. This water could be used for non potable water uses after treatment.

Stormwater Infrastructure Study

OTHER WATER RESOURCES	GAL / DAY	CAPITAL COSTS	OPERATING COSTS	STORMWATER CREDITS	AVOIDED COSTS
ON SITE					
On Site Rainwater	♦♦	$	$	+++ **POTABLE**	$$$ (Impervious Area, SW Discount, SW Retention Credit, Municpal Water)
Well Water*** *(Aquifer)*	♦♦♦	$$$	$$$**	**POTABLE**	$$ (Municpal Water and Waste Water)
Gray, Storm, and Condensate Water	♦♦♦	$$$$	$$$	**NON POTABLE**	$$ (Municpal Water and Waste Water)
OFF SITE					
9th Street*** *Potomac and Stormwater*	$$$	$$$	$$$**	+	$$ (Municpal Water and Waste Water)
Constitution Ave*** *Dewater and Stormwater*	$$	$$$$	$$$	+	$$ (Municpal Water and Waste Water)
Treated Waste Water***	$$$	$$$	$$$$		$$ (Municpal Water and Waste Water)

NOTE: ♦= Volume; $=Cost; + = Credit
** Replacing Non Waste Waters, ***Permitting Risks

Stormwater Resources Catchment Locations



TREATMENT REGIMES

The key to meeting the 70 percent reduction in municipal water use is to treat and reuse other water on site. As discussed, capturing and reusing stormwater is best for toilet flushes since EPA guidelines accept direct reuse with filtration and disinfection. This is relatively cost effective. Treatment can be expanded to capture grey water.

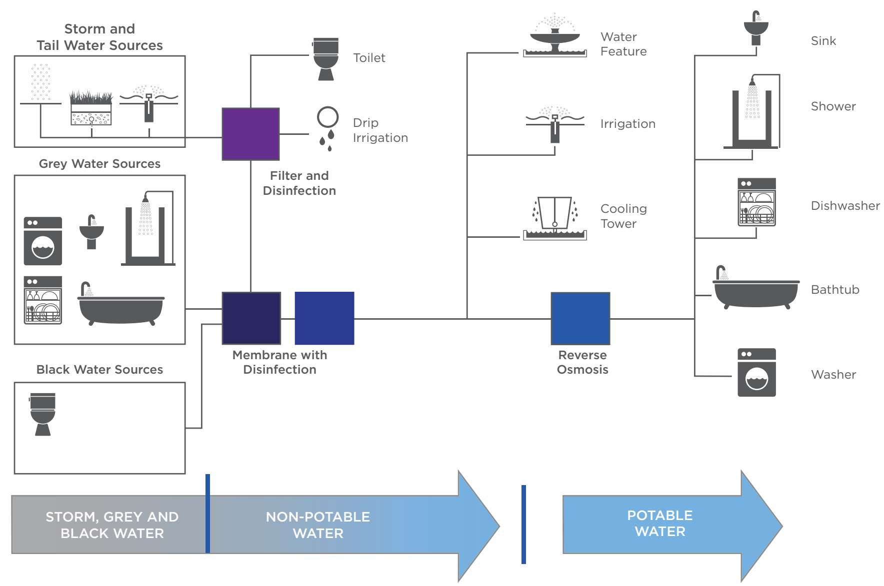
Grey water is from sources such as machine washers, sinks, showers, disposals, and tubs but excludes water from toilet flushes. These waters can be treated through bio membrane reactor or green machine and then disinfected for use in washing machines and above grade irrigation. However, greywater, by itself, has few nutrients and is more difficult to clean.

Use of blackwater may be more cost effective as it has enough nutrients to stimulate beneficial biologic cleansing. Similarly, water originating from dehumidification of air during the summer (due to cooling of humid air) can be collected, disinfected, and reused for washing machines and above grade irrigation. These waters can be treated again with reverse osmosis process to achieve a level of treatment suitable for potable reuse. Hypothetically, this water would be fit for drinking. However, the policy context for direct use drinking water through this treatment scheme (after reverse osmosis) is not formalized to allow adoption of implementing regulations at the municipal level.

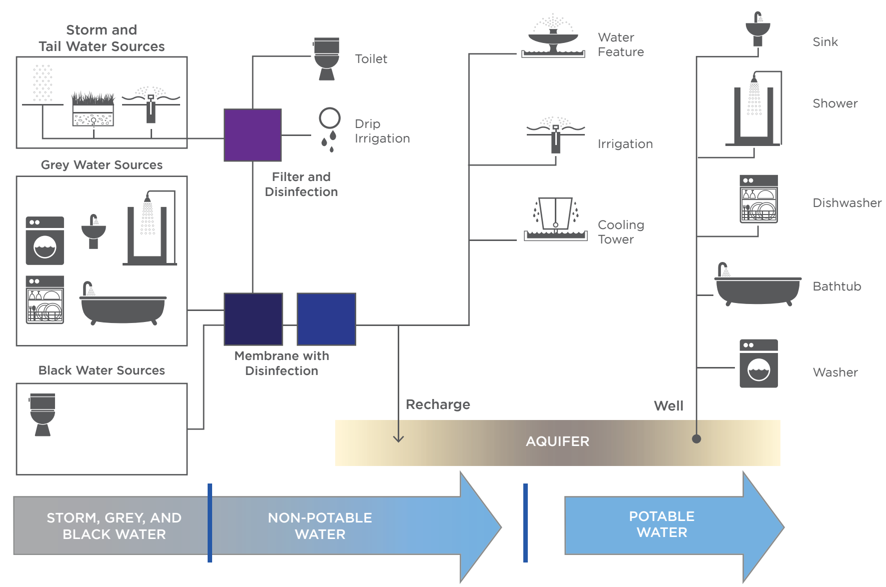
Given the level of treatment needed for different sources of water, a "fit for purpose" strategy could be used to apply the dirtiest waters for non-potable uses and the cleanest waters for potable use. Rainwater and condensate could be relatively clean sources of water for treatment and reuse. Grey water could be used for non-potable uses with little treatment compared to that needed to meet a safe drinking water standard.

Collected waters have potential reuse based on the treatment received.

Potable Treatments



This scheme uses reverse osmosis to produce potable water.



This scheme injects treated water into the aquifer to indirectly provide potable water.

Recommended Concept

The sources of water in and nearby the SW Ecodistrict vary in quality. Some are relatively clean and nearby. Others are considerably dirty and would need to be treated extensively to be reused. Stormwater can be cleaned using filtration and disinfection and be reused for toilet flushes. Waste water is also prevalent but requires significant treatment for non potable uses and even more treatment is required for potable water uses. With that in mind, using well water and Potomac River water has distinct advantages but they do not reduce the generation of waste water to save on waste treatment costs. They are permitted. But treating storm or waste water (black or grey water) for potable water is only permitted in special cases. The recommended concept for the SW Ecodistrict contains strategies for potable water and non-potable water.

POTABLE WATER

Today the area uses municipal potable water to meet 100 percent of its water demand. The infrastructure currently in place will need to be upgraded to support 33 percent increase in development in the area.

To realize the *Ecodistrict* goals, there are several approaches for use of ground and surface water.

- Ground water
  - Aquifer storage and recovery. Treated well water is a permitted water source. Based on review of the 1993 Groundwater Resource Assessment Final Report by the DC Water Resource Research Center, the aquifers below DC are not degraded and are a potential potable water source, with recommended protections. Ground water reuse is regulated by Title 21, District of Columbia Municipal Regulations, section 1150 Groundwater. Through this regulation, ground water is being protected for downstream water quality and potable water use. For more information, see the following websites: http://water.epa.gov/type/groundwater/uic/aquiferrecharge.cfm#uicregulations, http://www.udc.edu/docs/dc_water_resources/technical_reports/report_n_145.pdf and http://green.dc.gov/sites/default/files/dc/sites/ddoe/publication/attachments/groundwaterquality.pdf.
- Surface water
  - The Potomac River is a partial source of water for Washington, DC. Since it passes nearby the site, it is conceivable it could be treated for potable water use.

NON POTABLE WATER

- Existing
  - Non potable water is not used in the 10th Street Corridor.
- Potential
  - Rain water can be collected from roofs and used for a non-potable water use. It is rarely permitted for potable water uses.
  - Stormwater from roofs and streets, plazas, and planted areas can be collected and used for toilet flushes and irrigation. This is the most cost effective reuse of water.
  - Waste water treatment
    a. Treat waste water via membrane bioreactor or “Green Machine Technology” for non potable purposes.
    b. Use of either the above treatments with injection into aquifer or surface waters to balance extraction for indirect potable water use.

APPROACHES TO CLOSING THE GAP

It is cost efficient to use water on a fit for purpose basis to minimize treatment costs where ever possible. Treated rainwater (stormwater), well water (or other comparable surface water), and condensate are candidate sources for potable uses. Treated grey water (or treated waste water) are candidate sources for non-potable water uses. To use well water or river water and achieve a water balance, waste water would be need to be treated to an advanced level to replace potable water removed. The following approach summarizes the recommended use of the various waters on the site:

- Part of stormwater, grey water, and black water are combined and treated through a membrane bio reactor or with Green Machine Technology as a part of an indirect reuse scheme.
- The treated water is injected into the groundwater or to nearby surface water, through an approved aquifer storage and recovery plan.
- Ground water or river water is collected and mixed with, condensate, roof water and municipal water and treated for potable water use.
- Remaining stormwater is used for non-potable water uses.

Within this concept, the study evaluated the following approaches.

1. No Action

No investments would be made in the Ecodistrict coordinating reuse between buildings and blocks. Building and block treatment and reuse would occur within each building on private properties. Each project would pay DDOE stormwater fees and receive credits for treatment above the 1.2” storm event that does not exceed 1.7” storm event. Catchment of rainwater is stored in cisterns on site. Water from cisterns would be disinfected for toilet flushes and make up water.

2. 70 percent (Toilet Flush and Well Water) Reliance on District Action

A district collection system would be built to capture and reuse rainwater from public and private areas. Water from cisterns would be disinfected for toilet flushes and make up water with the remainder being treated for aquifer storage and recovery. Use surface treatment improvement and stormwater credits in the district to maximize avoided costs of municipal water systems up to a 70 percent reduction in municipal water.

3. 100 percent (Toilet Flush and Well Water) Reliance on District Action

A district collection system would be built to capture and reuse rainwater from public and private areas. Water from cisterns would be disinfected for toilet flushes and make up water with the remainder being treated for aquifer storage and recovery. Surface treatment improvement and stormwater credits would be used in the *Ecodistrict* to maximize avoided costs of municipal water systems up to a 70 percent reduction in municipal water.

SITE	NO ACTION	70 PERCENT REDUCTION IN MUNICIPAL WATER	100 PERCENT REDUCTION IN MUNICIPAL WATER
Area	65 acres	65 acres	65 acres
Population	26,000	26,000	26,000
BUILDING/BLOCK			
Recycled Water Pipe	Yes	Yes	Yes
Rain Collection	Yes	Yes	Yes
Cistern	Yes	No	No
DISTRICT			
Green Streets	No	Yes	Yes
Cistern	No	Yes	Yes
Recycled Water	Yes	Yes	Yes
Well Water	No	Yes	Yes
COST OFFSETS			
Operational Savings	0	$$$	$$$
Avoided Fees	0	$$	$$$
Credit Generation	0	$$$$	$$$$

NO DISTRICT ACTION

No investments would be made in the Ecodistrict water system. Building and block treatment and reuse would occur within each building on private properties. Each project would pay DDOE stormwater fees and receive credits for treatment above the 1.2" storm event up to a 1.7" storm event. Catchment of rainwater is stored in cisterns on site. Water from cisterns would be disinfected for toilet flushes and make up water.

STRATEGIES

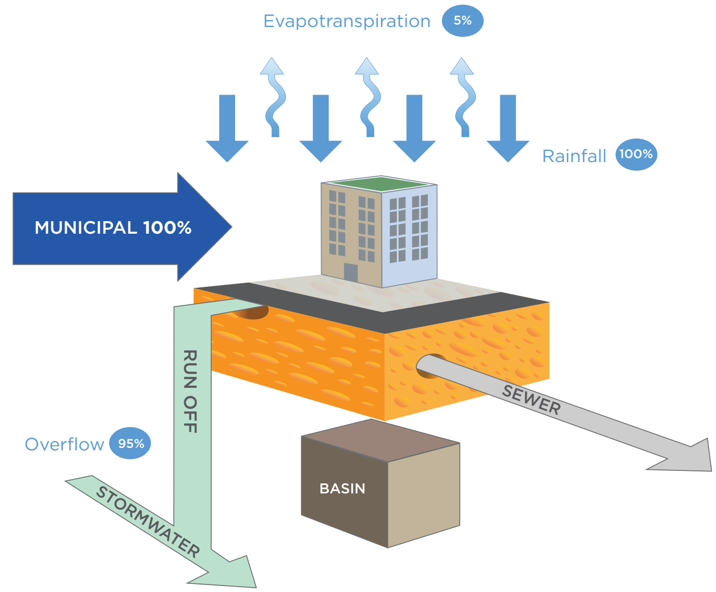
Through evapotranspiration, plants in the 10th Street corridor reduce the total amount of water available. Private properties store and reuse captured water from the 1.7" storm event.

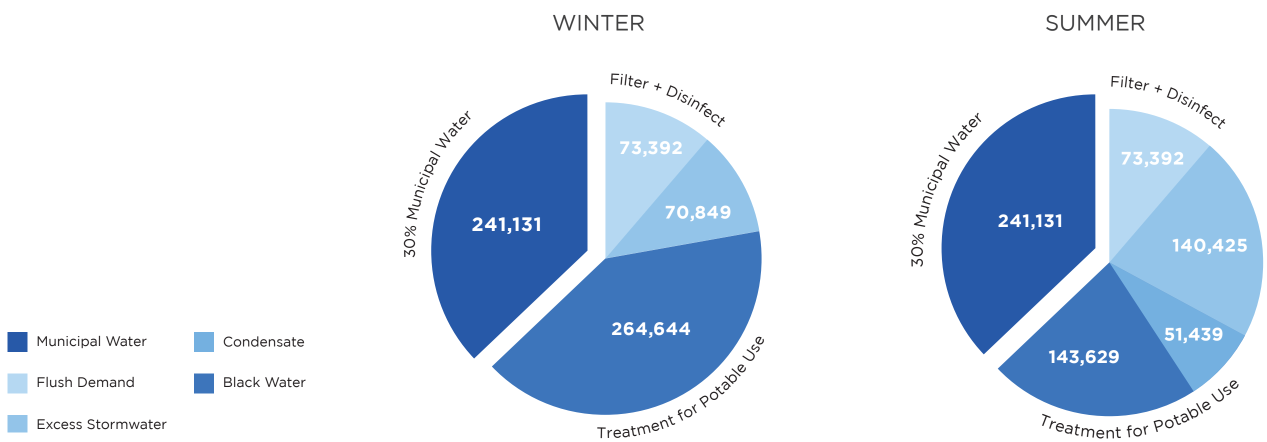
RESULTS

11 percent of water demand for toilet flushed is from captured rainwater, building by building.

89 percent municipal water is needed to meet 10th Street Corridor demand.

Existing Stormwater Infrastructure Management





70 PERCENT REDUCTION IN MUNICIPAL WATER

To achieve the goals of the SW Ecodistrict, which includes a 70 percent reduction in municipal water use, additional water sources available are needed to close the gap between rain water reuse for toilet flushes and the other potable water demand in the 10th Street Corridor.

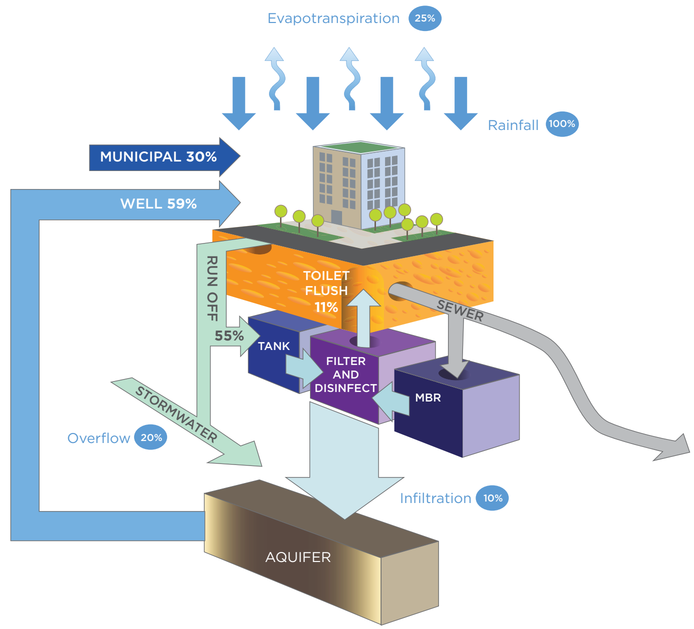
It is possible to adapt this system to be part of an indirect reuse system for potable water. After the water is treated by membrane bioreactor, it is feasible to inject in to the groundwater or into surface waters and reclaim water from these sources. However, this would only be necessary during the winter months when there is a lack of rainfall and condensate to collect. For this water reuse scheme, there is a regulatory framework that would permit water to be used from well or river water, provided—among other things—that there was a water balance in the flow in and out of the resource. Through this, it is possible to achieve the SW Ecodistrict water goal of a 70 percent reduction in municipal water use. But in fact, it is also possible to achieve a 100 percent reduction in municipal water use if a closed loop of treated waste water injection and potable water is made with either adjacent surface waters or ground water.

The surplus summer resource opens the opportunity to create a more lush environment for areas within the district that are not directly part of the treatment expression on 10th Ave, by applying surplus water as an irrigation resource.

100 PERCENT (TOILET FLUSH AND WELL WATER) RELIANCE DISTRICT ACTION

A district collection system would be built to capture and reuse rainwater from public and private areas. Water from cisterns would be disinfected for toilet flushes and make up water with the remainder being treated for aquifer storage and recovery. The reuse of surface treatment improvement and stormwater credits in the SW Ecodistrict would maximize avoided costs of municipal water systems up to a 70 percent reduction in municipal water.

Treating Waters to Close the Gap: Meeting a 30 Percent Municipal Water Target



- Volume reduction from plants is due to additional evapotranspiration for areas beyond the 10th Street Corridor.
- Storage and reuse of the 1.7” storm event
- 11 percent of water demand for toilet flushed is from treated stormwater.
- 30 percent municipal water is needed to meet 10th Street Corridor demand.
- 59 percent of water demand is from treating storm, condensate, and well water for potable uses.

Governance and Phasing

To implement this innovative water system at a district scale, an entity will be required to plan, build, and maintain the system. This could be the role of government to do this. It could be the role of a utility. It could be the role of a water service company. It could also be the role of a local business improvement district. In each case, a business plan could be devised to finance the cost of capital improvements through repayment in the fees paid by district subscribers.

It could be developed over time through successive development. Each building would need to be "purple pipe" ready. Each block should be able to connect to the district water collection and supply system. The cisterns would be sized, divided, and ultimately connected for each development area such as DOE, L'Enfant Plaza, Freeway Lid, and Overlook.

Cost Analysis

Using the prevalence of water during the summer and finding a way to use indirect water reuse for the winter months provides a pathway to meeting the *SW Ecodistrict Plan* goals that includes a 70 percent reduction in municipal water use. It is also possible to meet a 100 percent reduction in municipal water reduction by the same system-while maximizing the amount of condensate and rain water used.

The basis of the economic analysis considered the additional cost savings or increase above the building renovation or new construction presumed in the *SW Ecodistrict Plan*. The buildings modeled in the economic analysis were all platinum plus buildings. Regarding water, they were presumed to have low flow fixtures and recycled water use for toilet flushes. These features were included in the building costs in the *SW Ecodistrict Plan*.

The building costs assumed in the *SW Ecodistrict Plan* were compared to potential improvements at a district scale. The district improvements were modeled that would meet the 70 percent municipal water reduction goal for the Ecodistrict.

Although there were initial capital cost investments up front that needed to be financed, at a district scale there benefits that could be shared between stakeholders in the Ecodistrict. For example modeling demonstrated that there is a potential 72 percent increase in avoided fee cost per square foot at the district scale than possible at the building scale. (Building Toilet Flush compared to *SW Ecodistrict Plan* goal of 70 percent reduction in municipal water use).

Modeling of improvements for stormwater demonstrated that there were cost savings in controlling and using water at the district scale.

Collect 1.7" storm, no reuse.
100 percent municipal water for occupant demand

- High collection cost but no avoided water use cost due to lack of reuse.
- High carbon utilization

Collect 1.7" storm, to offset potable water demand.
30 percent municipal water for occupant demand

- High collection cost and high avoided water use cost due to reuse.
- Lower carbon utilization

Collect 1.7" storm, to offset potable water demand. 0 percent municipal water for occupant demand.

- High collection cost and high avoided water use cost due to reuse.
- Lowest carbon utilization.

The cost to meet the 70 percent municipal water reduction by these means will add significant capital and operational cost. Some of this is balanced by the transformation of the environmental character of the district. Also, the capital cost of the improvements would be a small incremental cost to the overall redevelopment cost. The operational cost would be significant. Another annual source of revenue would be needed to offset the financial gap. Among other things, the potential to collect stormwater credits play a central role in closing this gap.

Financing

An important tool in closing the financing gap would be to apply savings in avoided operational costs to pay for upfront water system capital costs. In this study, the greater the magnitude of project area, density of population, the lower the cost per treated area of stormwater, the greater the credits received for treated stormwater, and the greater the avoided operational costs due to improvements. This contributed to a quick payback of capital. The value of the DDOE's stormwater credits contributes greatly to this payback. The value of the credit will be determined through a market place where credits can be bought and sold. The greater the credit value, the quicker the payback. In this study, we assumed that the stormwater credit would be worth $1 per treated gallon per year.

CAPITAL COST

To receive the stormwater credits, retention of stormwater use is required. If the stormwater is not reused, the tank size, degree of evapotranspiration and infiltration would be maximized. In this study, the cost attributable to the Aquifer Storage and Recovery system to provide potable water to the district contributed to additional costs and avoided costs.

AVOIDED OPERATIONAL COST (UTILITY FEES AND SERVICES)

To the extent that the SW Ecodistrict can treat water in the district determines the avoided costs in potable water, stormwater, waste water. These avoided costs include:

- Potable water usage
- Water connection fees
- Stormwater fees
    - Impervious area charge
    - Stormwater fee
- Stormwater retention credits (in lieu of making stormwater improvements on site)
- Waste water treatment fees

There are annual fees that for impervious areas and annual credits for stormwater treated above the minimum requirement. They are likely to increase beyond the rate of inflation.

Comparing district costs and credits, the costs increase but so do the credits and avoided costs.

Water Cost Analysis - Strategies and Cost Factors

SITE	NO ACTION	70 PERCENT REDUCTION IN MUNICIPAL WATER	100 PERCENT REDUCTION IN MUNICIPAL WATER
Potable treatment	No	Yes	Yes
Flush treatment	Yes	Yes	Yes
Site area	65 acres	65 acres	65 acres
Population	26,000	26,000	26,000
COST FACTORS			
Return of capital	5 years	3 years	5 years
Capital cost efficiency	$2.10/treated area	$7.70/treated area	$8.40/treated area
Operational avoided cost efficiency	$.40/sf treated area per year	$1.10/sf treated area per year	$1.30/sf treated area per year
Credit efficiency	$.30/sf treated area per year	$1.50/sf treated area per year	$1.50/sf treated area per year

*Presuming $2/SRC (Stormwater retention credit)

SENSITIVITY ANALYSIS

The value of a stormwater credit within the emerging market place will vary over time. If the stormwater retention credits (SRC) vary in value from $1 to $2 per year, the payback would be 11 and 4 years respectively to meet the SW Ecodistrict water goal to include a 70 percent reduction in municipal water. If the credits increase in value overtime, it would be possible to increase the reduction from 70 percent to 100 percent at an incremental operating cost.

A comparison of potentials cost and savings presuming stormwater credits are valued at $1 per treated gallon per year suggests that a 10 year payback is achieveable.

If the credit value is high (over $2 per treated gallon per year), it generates a high return on capital investment. Above this price it contributes to a fast payback and can offset other costs in water treatment and reuse to meet the SW Ecodistrict 70 percent reduction in municipal water use. This savings is magnified when consideration is given to the potential increase in fees and credits in the next 10 years.

Comparing the district scale and the building scale, we find that the costs to achieve just the standards for DDOE are comparable to the costs to create potable water at a district scale. Hence, there is great value of spending approximately 227 percent more (as a percentage of construction cost) at the district scale than at the building scale. This is due to a significant increase in avoided costs and credits.

Based on a comparison of the performance of a LEED Platinum certified building, it is evident that the cost per capita served is higher but the return of capital is approximately the same.

Sensitivity Analysis

SITE	NO ACTION	70 PERCENT REDUCTION IN MUNICIPAL WATER	100 PERCENT REDUCTION IN MUNICIPAL WATER
$1/SRC	5 Years	11 Years	16 Years
$2/SRC	3 Years	4 Years	5 Years
$3/SRC	2 Years	3 Years	3 Years
$3.5/SRC	1 Year	2 Years	3 Years

SITE	LEED PLATINUM BUILDING	*ECODISTRICT*
Potable treatment	No	No
Flush treatment	Yes	Yes
Site area	0.5 acres	65 acres
Population	500	26,000

COST FACTORS		
Cost efficiency	$7.20/treated area	$7.07/treated area
% Construction	0.37 percent	0.84 percent
Credits generated	$.65/treated area	$1.50/treated area
Avoided costs	$.85/treated area	$1.12/treated area
Return of capital	5 Years	5 Years
Cost per capita	$340/capita	$770/capita

CARBON

When water is collected and treated on site, it reduces the amount of carbon laden fuel used to make energy that pumps and treats water to and from the district. Because we are intending to offset the carbon fuel used in the combined heating, cooling, and power plant the electricity used for pumping and treatment solely within the district will be carbon free. That will reduce the carbon foot print in the water we would need to offset through payment of carbon credits.

VALUE PROPOSITION

Based on a comparison of the performance of a LEED Platinum certified building, it is evident the costs increase for great degrees of water treatment for potable water, but the return of capital is approximately the same.

Although the construction cost per capita for an *Ecodistrict* is twice as much as a toilet flush only water system at a building scale, they have the same payback. Bear in mind that the savings beyond the payback of capital in the *Ecodistrict* concept is much higher. This anticipated revenue beyond the pay back period can be used to finance other projects in the district. Here the value proposition is:

QUALITATIVE

Water system improvements at a district scale leads to a transformation of the environmental character of the district.

QUANTITATIVE

The potable water system has the greatest avoided costs and generates enough credits to finance the improvements in the district with an affordable payback period.

Conclusions and Next Steps

RECOMMENDATIONS

1. Preliminary Recommendations:

- Use rain and well waters to close the gap on potable water demand.
- Treat grey water and remnant stormwater for the small amount of non-potable (flush) demand.

2. Preliminary Conclusion:

- We can finance capital as well as meet operating costs with subscriber fees, avoided fees, and stormwater credits which contribute to the beauty of 10th Street

NEXT STEPS

Promote private initiative in partnership with agencies having authority to remove policy barriers to achieving the SW Ecodistrict goals.

3

Effects of District-Wide Stormwater Management Investment on Real Estate Values

ZGF Architects, on behalf of the National Capital Planning Commission (NCPC), evaluated the potential for a centralized stormwater retention facility in the SW Ecodistrict study area. Based on ZGF's analysis of capital investment requirements and ongoing operating and maintenance costs associated with the necessary infrastructure, HR&A then evaluated the economic and financial conditions that must be met in order to incentivize private property owners in the SW Ecodistrict to participate in a multi-property stormwater management district. The analysis presented below builds on HR&A's previous work for NCPC that evaluated the costs and benefits accruing to the various stakeholders that will drive future redevelopment in the SW Ecodistrict.

Methodology

The District Department of the Environment (DDOE) released a Stormwater Management Guidebook in July 2013 that requires regulated development projects to retain the volume resulting from a 1.7-inch storm. Conventionally, individual parcel owners respond to this requirement by investing in on-site infrastructure to manage stormwater volume. Alternatively, multiple property owners could collectively invest in a centralized stormwater management system that has the potential to exceed the minimum aggregate retention requirement. A primary benefit of this district-wide approach is the potential to retain and process significant stormwater volume that falls in the public right-of-way, which in turn can be monetized through the sale of Stormwater Retention Credits (SRC) to property owners unable to fulfill minimum stormwater retention requirements.

For purposes of this assignment, we assume that in order for a private property owner to wish to participate in the funding of a centralized stormwater retention facility, the total, pro rata cost of the shared infrastructure, including additional administrative burden resulting from a bond issuance and other financing expenses, must be outweighed by the financial benefits resulting from increased operational efficiencies and revenue from the sale of SRCs. At a minimum, such an investment must have a neutral impact on real estate values so that property owners and developers are indifferent toward a site-specific or districtwide approach to stormwater management.

HR&A, in collaboration with ZGF, developed three scenarios to evaluate the incremental costs and benefits associated with a districtwide approach to stormwater management in the SW Ecodistrict study area. The three scenarios vary based on how stormwater is collected and processed (i.e. on-site vs. a centralized facility) as well as in the amount of volume collected from the public right-of-way. The scenarios are summarized as follows:

- A Baseline Scenario that assumes the development of LEED Platinum buildings capable of processing a certain level of excess stormwater on-site. This scenario assumes buildings process in excess of the 1.7 inches of stormwater required to trigger the earning of stormwater tax credits by virtue of their LEED Platinum certification. However, there is no additional processing of stormwater due to off-site, district-wide infrastructure;
- A 70 percent Reduction Scenario, in which the conditions of the Baseline Scenario are met with additional investment in a centralized stormwater management facility that is capable of capturing and processing 70 percent of the stormwater accumulated in the public right of way; and
- A 100 percent Reduction Scenario, in which the conditions of the Baseline Scenario are met with the addition of investment in a system that reduces 100 percent of the stormwater accumulated in the public right of way and processes this stormwater within the district system.

For each of the scenarios, ZGF developed an estimate of incremental capital costs for the stormwater management infrastructure, total stormwater retention capacity, potential revenue from the sale of SRCs, and operational benefits and costs. HR&A then utilized this information to develop a stabilized operating pro forma for a prototypical commercial office development project in the SW Ecodistrict study area. While commercial office was selected for illustrative purposes, the same analytical approach could also apply to multifamily and other income-producing assets. The pro forma analysis provided insight into how the varying levels of investment in stormwater management could potentially impact real estate values in the SW Ecodistrict.

HR&A constructed its pro forma model based on the following set of assumptions:

Stormwater Infrastructure Capital Costs

For the scenarios that contemplate a centralized stormwater retention facility, HR&A relied on capital costs provided by ZGF that ranged from $25 million to slightly more than $30.1 million for the 70 percent Reduction and 100 percent Reduction scenarios, respectively. In the case of the first scenario where stormwater is collected and processed on-site, HR&A assumed no additional capital investment above the typical development costs for a LEED Platinum building.

Stormwater Infrastructure Bond

For the two scenarios that contemp late a centralized stormwater retention facility, HR&A assumed that a Special Assessment District (SAD) would need to be established that has the authority to issue a bond to fund the construction of shared stormwater infrastructure. Affected properties located within the SAD would then be subject to an additional tax levy that would be used to service the bonded debt. Based on the estimated capital cost for the centralized stormwater facility, HR&A quantified the total cost for a 20-year bond with an interest rate of five percent.

Stormwater Retention Credits

For each of the three scenarios, ZGF quantified the potential for SRCs based on estimated volume of retained stormwater that would exceed the 1.7-inch retention requirement. Estimated potential for SRCs ranged from 396,000 gallons in the Baseline Scenario, to 2.2 million gallons in both the 70 percent and 100 percent Reduction Scenarios.

Adjusted Net Operating Income.

Based on HR&A's previous analysis that projected real estate values in the SW Ecodistrict study area, we calculated potential net operating income (NOI) for a prototypical commercial office development on a per square foot basis. Estimates of NOI were derived from high-level real estate performance metrics, including gross rent potential, ancillary revenues, stabilized vacancy, operating expenses and real estate taxes. HR&A then adjusted the estimated NOI for each scenario to account for the costs and benefits associated with the varying levels of investment in stormwater infrastructure.

Figure 1: Stormwater Infrastructure Bond Calculations

	STORMWATER INFRASTRUCTURE SCENARIO		
BOND ISSUE	BASELINE	70 PERCENT REDUCTION	100 PERCENT REDUCTION
Capital Investment	–	$ 22,300,000	$ 26,800,000
Issuance Cost	–	$ 50,000	$ 50,000
Underwriter Risk	–	$ 223,000	$ 268,000
Interest Reserve Fund (1)	–	$ 2,509,000	$ 3,014,000
Total Bond Issuance	–	$ 25,082,000	$ 30,132,000

Notes: 1) Assumes two years of capitalized interest reserve at annual rate of five percent

Source: ZGF Architects; HR&A Advisors

[1] Two types of activities are regulated under current DDOE regulations, including major land improvements that disturb more than 5,000 square feet of land, and substantial improvement. Projects whose cost equals or exceeds 50 percent of the structure's pre-project assessed value and have a footprint of 5,000 square feet or greater.

These adjustments and their impact on NOI are summarized as follows:

- Sale of Stormwater Retention Credits (positive impact on NOI.) HR&A assumed an SRC value of $3.50 per credit based on the in-lieu fee shown in DDOE's 2013 Stormwater Management Guidebook. This assumption applies to all three scenarios.
- Avoided Costs (positive impact on NOI.) Includes impervious area and stormwater fees, as well as costs associated with water processing that result from buildings meeting LEED Platinum design standards and the incremental benefits of a centralized stormwater facility. The Baseline Scenario assumes that the previous SW Ecodistrict analysis took into account the avoided costs of the various fees, as expressed in relatively low operating expense assumptions. Meanwhile, the "avoided cost" calculated for the 70 percent Reduction and 100 percent Reduction Scenarios represent the incremental savings relative to the Baseline scenario.
- Centralized Stormwater Facility O&M (negative impact on NOI.) Operating and maintenance costs—including labor, water treatment, and ongoing maintenance—for the centralized stormwater facility assumed in the 70 percent Reduction and 100 percent Reduction Scenarios.
- Infrastructure Bond Debt Service (negative impact on NOI.) The cost of servicing bonded infrastructure debt, which is reflected as a "stormwater district assessment charge" to property owners benefiting from the centralized stormwater facility. This assumption only applies to the 70 percent and 100 percent Reduction Scenarios.

Figure 2: Adjusted Annual Net Operating Income Calculations ($/SF)

	STORMWATER INFRASTRUCTURE SCENARIO					
	BASELINE		70 PERCENT REDUCTION		100 PERCENT REDUCTION	
GROSS POTENTIAL RENT	**$**	**52.80**	**$**	**52.80**	$	**52.80**
Less vacancy @ 7.50 percent	$	(3.96)	$	(3.96)	$	(3.96)
EFFECTIVE RENT	**$**	**48.84**	**$**	**48.84**	**$**	**48.84**
Less Op Ex ($/SF/Year)	$	(6.00)	$	(6.00)	$	(6.00)
Less RE Tax ($/SF/Year)	$	(4.85)	$	(4.85)	$	(4.85)
UNADJUSTED NET OPERATING INCOME	**$**	**37.99**	**$**	**37.99**	**$**	**37.99**
STORMWATER INFRASTRUCTURE ADJUSTMENTS						
Annual sale of off-site stormwater credits	$	0.15	$	0.80	$	0.80
Incremental annual avoided cost	$	–	$	0.24	$	0.32
Less annual stormwater Ecodistrict operating cost	$	-	$	(.037)	$	(0.47)
Less stormwater Ecodistrict assessment charge	$	-	$	(0.21)	$	(0.25)
TOTAL ADJUSTMENTS	**$**	**0.15**	**$**	**0.46**	**$**	**0.39**
ADJUSTED NET OPERATING INCOME	**$**	**38.14**	**$**	**38.45**	**$**	**38.38**

Source: ZGF Architects; HR&A Advisors

Key Findings

Assuming Stormwater Retention Credits can be sold at $3.50 per credit, shared investment in a centralized stormwater facility that serves all properties in the SW Ecodistrict study area will have a small positive impact on real estate market values. At $3.50 per SRC, property owners participating in a districtwide approach to stormwater management could potentially realize $0.25 to $0.30 per square foot in additional net operating income. Capitalized at a rate of 6.75 percent, this translates into incremental property value ranging from $3.00 to $5.00 per square foot. While this represents an increase in real estate value of less than one percent, it does suggest that property owners would be willing to participate in the funding of a centralized stormwater facility and/or that they would not seriously contest a mandate to do so, assuming modest or non-existent administrative burdens.

Figure 3: Estimated Market Value by Stormwater Infrastructure Scenario ($/SF)

	STORMWATER INFRASTRUCTURE SCENARIO		
	BASELINE	70 PERCENT REDUCTION	100 PERCENT REDUCTION
Adjusted net operating income	$38.14	$38.45	$38.38
Market capitalization rate	6.75 percent	6.75 percent	6.75 percent
Capitalized market value	$565.00	$569.66	$568.56
$ Increment relative to baseline	N/A	$4.66	$3.56
% Increment relative to baseline	N/A	0.82 percent	0.63 percent

Source: HR&A Advisors

Although the economic rationale for districtwide stormwater management is sensitive to the market price of the Stormwater Retention Credits, significant price volatility can be accommodated before participation in a district system becomes disadvantageous for property owners. As the value of a SRC decreases from $3.50 per credit, there is less revenue from the sale of SRCs to offset the operating costs and debt service for a centralized stormwater facility. If the market value of an SRC were to drop to below $1 per credit, the loss in revenue from credit sales would result in a negative impact on a property's net operating income and overall market value. This suggests that any mandate imposed by the District ought to include the District's commitment to establishing and maintaining a credit floor price that ensures both trading efficiency and incentives for property owner participation.

The timing of investment in the centralized stormwater facility relative to the phasing and absorption of new development will also be a key determinant in ensuring property owner participation and/or acquiescence to a mandate. HR&A's analysis is based on 9.5 million square feet of development, which is the estimated total building area once all of the SW Ecodistrict study area is fully redeveloped. Centralized stormwater management infrastructure will require significant investment at the front end of the area's redevelopment so as to facilitate property owners' ability to plan for future connections to the districtwide system. The challenge is that the study area's total density will be built in several phases, and as a result, underutilized properties awaiting redevelopment will have to shoulder some of the initial infrastructure cost burden. However, the special assessment charged to property owners will be offset by future economic benefits including the sale of SRCs and reduced on-site capital investment in stormwater infrastructure.

SW Ecodistrict

National Capital Planning Commission