Greater New Orleans
Urban Water Plan

Implementation

Waggonner & Ball *Architects*

September 2013

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Greater New Orleans always has been surrounded by water and has thrived for nearly 300 years. Today the region faces new challenges, both outside the levee walls from rising seas and inside from land subsidence and regular flooding. A new approach to water - the region's most abundant natural asset - is the foundation for building a safe and sustainable future on the Mississippi River delta.

Waggonner & Ball *Architects*

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Background

Greater New Orleans Urban Water Plan

In 2010, the State of Louisiana's **Office of Community Development - Disaster Recovery Unit** funded **Greater New Orleans, Inc. (GNO, Inc.)** to develop a Comprehensive, Integrated and Sustainable Water Management Strategy for the east banks of Orleans and Jefferson Parishes and St. Bernard Parish using federal Community Development Block Grant - Disaster Recovery funds from the **Department of Housing and Urban Development**. The study was developed over the course of two years by **Waggonner & Ball Architects** and a team of local and international, including Dutch, water management experts. The outcome is the Greater New Orleans Urban Water Plan, a vision for long-term urban water management in the 21st century, and effectively the first regional urban water plan of its kind in the United States. The Urban Water Plan provides a roadmap for better management of flood and subsidence threats, while creating economic value and enhancing quality of life. This plan seeks to work in tandem and create multiple lines of defense with the region's levee system and Louisiana's 2012 Coastal Master Plan.

Greater New Orleans, Inc.

GNO, Inc. is the regional economic development organization that serves to coordinate, consolidate, and catalyze economic development activity in Southeast Louisiana. The GNO, Inc. mission is to create jobs and wealth in the Greater New Orleans community. The GNO, Inc. vision is for the Greater New Orleans region to fulfill its potential as one of the best places in the country to grow a company, and raise a family. GNO, Inc. supports a multi-faceted approach, including advocating for federal, state and regional policies and programs, to mitigate the effects of stormwater on the region's safety, quality of life and economic vitality. Moreover, GNO, Inc. is working with government, industry, economic development, and education partners to nurture and grow a vibrant emerging environmental industry sector that will create jobs and revenues locally while addressing environmental challenges in the region and nation.

Waggonner & Ball Architects

Waggonner & Ball Architects is a broad-based architectural and planning firm with 30 years experience on a wide variety of projects. The firm is deeply invested in New Orleans' future as one of the nation's most resilient cities. Following Hurricane Katrina, Waggonner & Ball developed the Recovery Framework for St. Bernard Parish, the most devastated portion of the Greater New Orleans region, and generated plans for four of the thirteen planning districts in the Unified New Orleans Plan. The firm's water-focused work began shortly after Hurricane Katrina, with David Waggonner's trip to the Netherlands in early 2006 as part of a delegation led by U.S. Senator Mary Landrieu. After seeing first-hand the value of the Dutch approach to stormwater management and climate adaptation, Waggonner & Ball initiated a series of **Dutch Dialogues** workshops, co-sponsored by the **Royal Netherlands Embassy** and the **American Planning Association**. These collective efforts and extended interactions between Dutch and American architects, engineers, urban designers, landscape architects, city planners and soils/hydrology experts grew from the participants' unwavering belief that the Greater New Orleans region can survive, prosper, and grow only with a fundamentally different approach to urban water management. Many of the same parties continued this collective effort and formed the **Project Team** for the Urban Water Plan. A full list of firms, institutions, and individuals involved is included the "References & Project Team" section.

GREATER NEW ORLEANS INC
REGIONAL ECONOMIC DEVELOPMENT

Waggonner & Ball *Architects*

Acknowledgments

Louisiana Office of Community Development Disaster Recovery Unit (OCD-DRU)

In the aftermath of Hurricanes Katrina, Rita, Gustav, and Ike, the OCD-DRU commissioned the Louisiana Resiliency Assistance Program (LRAP) to establish a comprehensive collection of resiliency resources. The LRAP program is mandated to develop, house and disseminate planning efforts, resources and local best practices to promote, assist and build networks around resilience planning in Louisiana. As the state's central point for hurricane recovery, OCD-DRU manages the most extensive rebuilding effort in American history, working closely with local, state and federal partners to ensure that Louisiana recovers safer, stronger, and smarter than before.

U.S. Department of Housing & Urban Development (HUD)

HUD is working to strengthen the housing market to bolster the economy and protect consumers; meet the need for quality affordable rental homes; utilize housing as a platform for improving quality of life; build inclusive and sustainable communities free from discrimination; and transform the way HUD does business. HUD's CDBG-Disaster Recovery grants are intended to confront housing, business and infrastructure needs beyond those addressed by other forms of public and private assistance.

GNO, Inc. and Waggonner & Ball Architects also wish to acknowledge the regional **Water Management Strategy Advisory Council**, made up of industry, government, economic development, and nonprofit leaders that guided the two-year process. A full list of the individuals and organizations involved is included in the "References & Project Team" section.

Finally, we would like to thank the **Royal Netherlands Embassy**, the **American Planning Association**, and **Senator Mary Landrieu** for their tireless dedication to seeing this effort through from its genesis to its completion.

Dutch *Dialogues*

Kingdom of the Netherlands

American Planning Association

Making Great Communities Happen

Orleans Avenue is one of New Orleans' three outfall canals that presents a missed opportunity. Currently walled off by remnant floodwalls, properties adjacent to canals can transform into waterfront properties with spectacular views and access to water.

Report Organization

The Greater New Orleans Urban Water Plan is a set of reports with cross-referenced information as outlined below. All project information and links to related projects are also available online at **www.livingwithwater.com**.

Vision presents an overview of the Urban Water Plan.

Urban Design is geared towards planning and design professionals. This report tests water planning principles through design drawings at the system, basin, district, and demonstration project scales.

Implementation is geared towards policy-makers, water system managers, and other stakeholders interested in effecting change. The report presents the value and economic impact of the Water Plan and outlines an action plan for implementation that includes prioritization and phasing of proposed strategies, financing tools, policy and community action recommendations, existing jurisdictions and potential partners.

System Design & Analysis is a set of individual reports geared towards engineers and scientists that describes and analyzes the existing water system, and presents the envisioned framework of the integrated water system. The set includes the following reports:

Water System Design	H+N+S Landscape Architects; Waggonner & Ball
Water System Analysis	Royal Haskoning
Ecological Services Metrics	Dana Brown & Associates; FutureProof
Groundwater Monitoring Network	Deltares
Atlas of Greater New Orleans	Deltares; H+N+S Landscape Architects

Demonstration Projects is a set of individual reports geared towards potential implementers that includes schematic designs and cost estimates.

Mirabeau Water Garden	Waggonner & Ball Architects; FutureProof
Lakeview Floating Streets	Bosch Slabbers Landscape + Urban Design
Lafitte Blueway	Bosch Slabbers; Waggonner & Ball
Elmwood Fields and Water Lanes	Robbert de Koning; Dana Brown & Associates
Canal Street Canal	Dana Brown & Associates
Eastern Water Walk	Dana Brown & Associates
Forty Arpent Canal Zone	Dana Brown & Associates

Design Districts & Urban Opportunities is a set of individual reports geared towards planners and designers that elaborates further the urban design opportunities and district scale designs discussed in the Urban Design report.

Metropolitan Park Zone	Palmbout Urban Landscapes
Palmetto Canal	Palmbout Urban Landscapes
Monticello Canal	Bosch Slabbers Landscape + Urban Design
London Ave. Canal Wetland Park	FutureProof
Hollygrove District	Bosch Slabbers Landscape + Urban Design
Lakeview District	Bosch Slabbers Landscape + Urban Design
Elmwood District	Robbert de Koning Landscape Architect
Veterans District	Robbert de Koning Landscape Architect
Jefferson Basin	Robbert de Koning Landscape Architect
Michoud District	Dana Brown & Associates

Resources & Urban Analysis is a set of individual reports geared towards planners and designers that describes and analyzes the existing urban fabric and provides prototypical solutions replicable under similar topographic, geologic and hydrologic conditions.

Urban Analysis	Palmbout Urban Landscapes
Roadway Retrofits	Dana Brown & Associates
Parking Retrofits	Dana Brown & Associates
Canal Vocabulary	Dana Brown & Associates

New Orleanians engaging and enjoying bayou St. John, the primary example of attractive and accessible waterway in the area - Bayou Boogaloo festival, May 2013
[photo credit: Lucy Colville]

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Executive Summary

Attracting investment and people to the Greater New Orleans region requires the reduction of long-term risk. This is a primary proposition: we must create a water environment that inspires market confidence and innovation. While levees and drainage are necessary for our safety, a new and innovative approach to risk reduction is warranted, one that introduces water into the landscape making it key to economic vitality and a better quality of life.

Water can be made accessible and beautiful, rather than walled away

The current approach of pumping every drop contributes to substantial land settlement and requires significant subsidy from governments and taxpayers. The Greater New Orleans Urban Water Plan presents an opportunity to the region to seize upon new economic opportunities and become a living showcase for innovative water management.

Problems

The Greater New Orleans Urban Water Plan addresses three critically important issues in St. Bernard parish and the east banks of Orleans and Jefferson parishes in Southeast Louisiana:

- **Flooding** caused by heavy rainfall common to this region. This occurs frequently when the catch basins, pipes, and pumps of our current drainage systems are overwhelmed. Flooding causes not only property and economic damage but is potentially harmful to residents.
- **Subsidence** is the sinking of the ground that damages our buildings, our streets, and other infrastructure, and makes the challenge of pumping stormwater out of the region more difficult. Subsidence is a result of dry soils, largely caused by current drainage practices that pump out every drop of water that falls, as quickly as possible.
- **Wasted Water Assets** are a missed economic opportunity. Water can be made accessible and beautiful, rather than walled away.

Recommended Solutions

The Urban Water Plan proposes a set of cost-effective water management strategies for the region that include:

- **Slowing** stormwater by using bio-retention and infiltration strategies, including rain gardens and bio-swales
- **Storing** stormwater in the landscape longer by retrofitting canals and finding space for new canals and ponds
- **Using** the water to enhance and connect neighborhoods, and draining it only when necessary

Implementation of these strategies will not

only lead to **improved safety** but also to **economic vitality and enhanced quality of life** in one of the most economically productive, culturally vibrant, and densely populated areas in Louisiana.

Report Summary

"Why Invest: Creating Shared Value", the report's first chapter, presents the challenges and opportunities that arise in implementing an integrated water management system, and the costs of not doing so.

The region is rife with opportunities for infrastructure renovation and landscape repair: from legacy infrastructure like hidden unattractive canals that can be transformed into attractive and accessible waterways, to thousands of vacant lots and public rights-of-way that can provide space for water storage and create amenities and economic opportunities along the way. Over the next 50 years, inaction will cost our community nearly $8 billion in stormwater flood damage, a conservative $2.2 billion in subsidence damage, and another $600 million in avoidable insurance costs.

Stormwater best management practices can reduce load demands on our aging infrastructure, clean the water, cool the air, create recreational amenities, contribute to raising the standard of living for all residents in an equitable way, and provide valuable real estate development opportunities. Good stormwater management practices can reduce the health risks to residents from excessive heat, and to our waterways and to habitats from pollutants washed by large quantities of urban runoff. The Urban Water Plan provides the evidence that integrated water management - as defined by the strategy of slowing, storing and using water - is not a nicety but a necessity.

Chapter 2, **"Building Value: The Economics of Integrated Water Management,"** assesses the economic benefit of implementing the Urban Water Plan's long-term vision by analyzing five quantitative factors and listing multiple qualitative benefits.

Quantifiable benefits include economic


WATER OVERWHELMS SYSTEMS


GROUNDWATER IMBALANCE CAUSES SUBSIDENCE


WATER IS EXCLUDED FROM PUBLIC SPACES

impact and job creation, reduced flooding and subsidence damage, reduced insurance premiums, and increased property values for a total economic benefit of $22.3 billion. As large as this number is, it is not comprehensive, as there are aspects of flooding and subsidence that are difficult to quantify.

Qualitative benefits improve safety, economic vitality, and quality of life in profound ways that stretch beyond dollar values, from increased potential for business attraction and retention to enhanced water and air quality, from better uses of blighted properties to reduced energy consumption region-wide.

"The Water Plan: Strategies, Phasing, and Cost," the report's third chapter, defines integrated water management, details the incremental and cost-effective process of "smart retrofits", and breaks down the costs associated with implementing the proposed strategies.

Integrated water management's major tenets - slow, store, and use water, drain only when necessary - are illustrated in the Urban Water Plan's "toolbox" of strategies, which includes both locally-accepted practices like rain gardens and permeable pavement, and more ambitious interventions like improved canals, large-scale storage basins, internal wetlands, and redirected drainage. The seven demonstration projects selected by this plan for schematic design and cost estimation are briefly described and illustrated here and further detailed in the set's second report, "Urban Design."

Chapter 4, **"Financing Tools: Sources and Mechanisms,"** emphasizes the importance of creative financing that blends common investment tools with policy change and diverse funding sources, and focuses on social and environmental benefits to expand funding options. The chapter then outlines a menu of possibilities, from funding sources like grants and awards from various government entities, to innovative funding mechanisms like public-private partnerships; regulatory structures; fees, credits, and incentives; and other means to stimulate private investment and pay for public projects.

"Policy and Action: Next Steps," the report's fifth chapter, introduces an existing framework of policies and principles that share and support the Urban Water

Existing

Floodwalls, no longer necessary for flood protection, hide valuable water assets

Plan's objectives: FEMA's National Flood Insurance Program, the State of Louisiana's Coastal Master Plan, and the New Orleans Master Plan.

The Urban Water Plan details nine key policy recommendations for local governments to mitigate flood risk and maximize investment in integrated water management:

- Adopt a more comprehensive and dynamic approach to flood risk assessment and management
- Adopt a minimum 500-year flood protection level per the New Orleans Master Plan
- Adopt with the force of law a long-term integrated water management plan
- Create a stormwater and groundwater management unit within each parish's drainage entity
- Develop and enforce a strong retention standard for stormwater in urban development and redevelopment
- Require the use of green infrastructure practices to reduce runoff from existing impervious surfaces
- Provide incentives for private use of green infrastructure
- Provide guidance or other affirmative action to accomplish stormwater management goals
- Ensure dedicated funding sources for integrated water management

Additionally, the following policy recommendations are made at the regional and state levels:

- Establish a Regional Water Management Authority to facilitate inter-parish collaboration
- Implement a policy that requires stormwater management in all transportation projects that involve federal or state funding or approval
- Expand the Emerging Environmental industry sector to implement integrated water management projects and to ensure that local businesses and local residents have the capacity and skills to do the work

At the federal level, it is also important to:

- Provide guidance and funding to address the significant contributions of runoff and pollutants caused by road and highway construction

Chapter 5 also lays out a framework for community action that engages the citizens of the Greater New Orleans region to meet goals in design and planning, research and

Potential

Removing remnant floodwalls can add safety and value to surrounding neighborhoods

development, and outreach and education. In the near term, these goals include:

- Inspire the public with high-impact, high-visibility demonstration projects at every scale
- Expand existing research efforts into soils, water, design, planning, operations, financing, and policy, and develop ways to share this knowledge
- Launch coordinated public outreach efforts, symposiums on topics of critical interest, and other forums for discussion, participation, and direct action
- Inspire others through water-centric conversations, journalism, social media, teaching, art, writing, and music
- Establish centers for water-focused job training, innovation, and business incubation to make possible the growth of new industries and new jobs
- Position the Greater New Orleans region as a global leader in water management that exports local expertise and technologies and partners with other delta cities in climate change adaptation efforts

Taking the next steps toward comprehensive spatial, political, and social change will require an unprecedented degree of collaboration. Local, regional, state, and federal actions must be coordinated. Public and private sectors must work together on policies and partnership structures that benefit both. And policy and community actions must be synchronized to ensure public buy-in and the best possible use of limited resources. Altogether, these steps constitute a departure from the status quo. But executed together, they will lead to a safer and more prosperous future for the Greater New Orleans region.

The report's sixth and last chapter, **"Collaboration: Jurisdictions and Potential Partners,"** recommends collaboration among existing organizational structures and stakeholders with shared interest. It identifies current water managers and their roles and illustrates the existing flood protection and drainage systems they govern in each of the three jurisdictions within the project area. It also identifies potential partners who may not have traditionally been involved in water management but who will have a shared interest in the envisioned integrated water system and likely play a role in its operation and management

Project Area

St. Bernard parish and the east banks of Orleans and Jefferson parishes

Preface

Greater New Orleans grew and prospered because those who built the water system we now have, which set worldwide standards, understood and embraced it. New technologies were developed, hard choices were made, and public and private rights and duties were aligned to make it possible to build and pay for, without the hope or expectation that the federal government or the state of Louisiana would bear the primary cost and responsibility. Most importantly this represented civic commitment.

Coming Full Circle

New Orleans - and the parishes, towns, and cities around it - form the functional intersection of the continent's greatest river and the Gulf of Mexico. Historically, the region has been a celebration of the value and possibilities of water. Over time, the economy and population of the region ebbed and its orientation toward water changed, leaving the region more vulnerable. Now, as the region is experiencing exponential economic growth and a resurgence of purpose, the time is ripe to recognize and capitalize on its water assets.

Once again New Orleans is poised to embrace and benefit from the very thing that has threatened its existence.

In many ways, the region has come full circle. Once again, the Greater New Orleans region is recognizing the value of its water assets and its potential to be a leader in the emerging environmental economy, where addressing environmental issues,

Founded on water and controlling the mouth of the Mississippi River, New Orleans and its port symbolize the region's importance to the trade and security of the American mid-west. The city and its environs are critically vital to the economy.

The Westersingel canal in central Rotterdam serves both as a sculpture park and as extra water storage during heavy rains

such as water, can be the source of jobs and innovation. Once again, it is honestly acknowledging the comprehensive nature of managing water risk in a dynamic landscape. Greater New Orleans is poised to embrace and benefit from the very thing that has threatened its existence.

Every day the current course is maintained, the region's lands and levees sink, pipes break, streets decay, and building foundations weaken.

Fulfilling that promise depends on the development and implementation of a comprehensive water management strategy that is integrated across geographic, political, and agency boundaries. This strategy must be governed by the principle that every drop of water has value and that the management of water is a community-wide endeavor. Now developed, the Greater New Orleans Urban Water Plan must be adopted and set into motion.

Steps to Implementation

Successful implementation of the Urban Water Plan will depend on many factors, including the capacity and commitment of partners, financial and human resources, and continuity and flexibility in policy and action.

Implementation is the purposeful, informed, committed, and effective set of actions that achieve the goal of minimized water risk and optimized water value.

Capacity: Every critical element of the Urban Water Plan must be someone's responsibility. If a critical task is not presently under someone's direct oversight, then it is the community's job to change that.

Commitment: Success in any endeavor comes from seeing things through to a good result, including making good choices and setting priorities.

Resources: Implementing this plan will take resources—dollars, time, and talent. Some of these will come from the public sector, some from private sources. Some already exist and can be applied with relative ease while others will have to be found.

Continuity: Integrated water management is not a one-time project nor a temporary partnership. It will require the ongoing cooperation and coordination between and among governments and citizens.

Flexibility: Few things are as dynamic as water and any planning for stewarding water to optimize value and minimize risk must also be dynamic, even while staying true to the purposes of those plans.

Lower Risk, Shared Value

The choice facing the residents and communities of this region is not whether to implement an integrated water system

or to keep things as they are. Every day the current course is maintained, the region's lands and levees sink, pipes break, streets decay, and building foundations weaken.

Even investments in repairs and improvements made by one community will produce little lasting value if not coordinated with and supported by those across the region. As the growing number of boil-water advisories and the rising costs of insurance demonstrate, established methods are not affordable or sustainable.

Integrated water management, on the other hand, reconnects communities with water and with each other to enhance the prospects and well being of all. It is based upon economies of scale, hydrologic and demographic reality, and the tenet that water sustainability will be a key driver of community success and vitality in the coming years. Accordingly, integrated water management is more about investing in our future than just about moving water, though that will remain a crucial component.

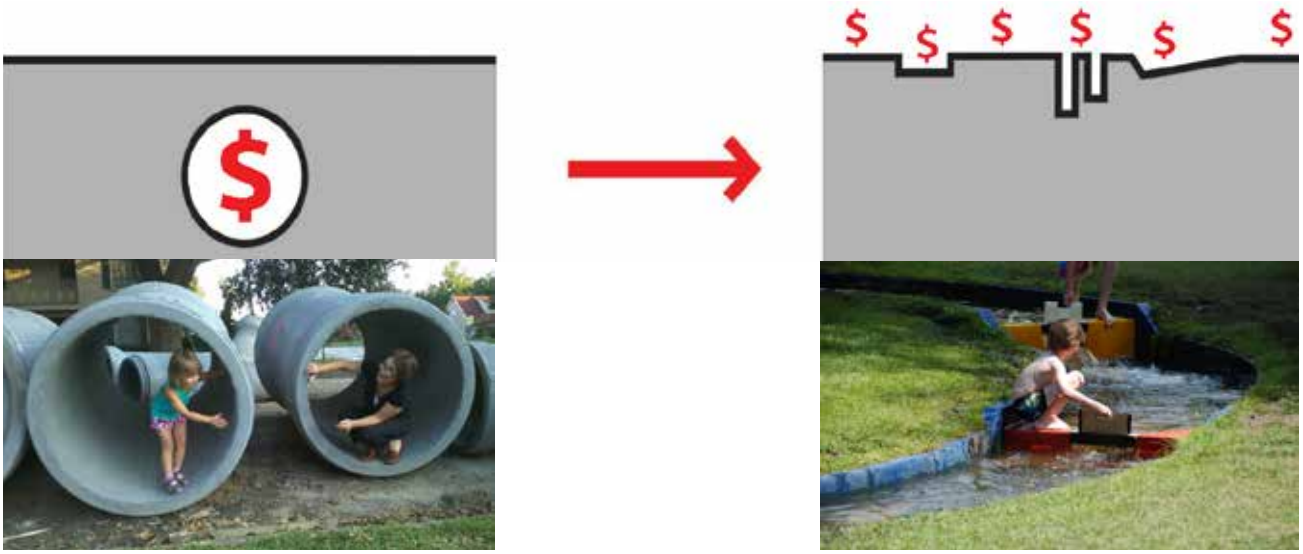
There is no low cost option on the table. There is just high value represented by the Urban Water Plan, and low value represented by established methods. There are, however, a number of ways to approach the implementation and financing of this new strategy.

There is no low cost option on the table. There is just high value, represented by the Water Plan, and low value represented by established methods.

This report lays out and discusses a number of these options with the full understanding that these, like everything else, are dynamic and subject to change. The goal is to establish a firm foundation and direction for future action. Indeed, the architects of this region's past prosperity knew full well that water stewardship and prosperity are not singular destinations but means to an end. Vision and commitment made Greater New Orleans a shining example of how to live with water. The bar has been raised since then, but with renewed vision and commitment, the region can regain its rank as a worldwide standard-setter. Indeed, it cannot afford not to.

Smart infrastructure investments expose value

Storing excess water on the surface vs. burying it underground creates amenity and value



Hiding water in buried culverts is a missed opportunity

It is time to let our children play with water

Recognizing the Value of Integrated Water Management

Decision-makers at all levels of government state their opinions on the Water Plan's objectives

"The New Orleans area has a unique topography that requires a complex drainage system. Flood control and settlement are two sensitive issues for this area that needs delicate balance."

"The more we pump the more we sink, and the more we sink, the more we have to pump."

-- Kazem Alikhani, Jefferson Parish Public Works Director

Kazem Alikhani and his team meeting with the Water Plan team during the January 2012 workshop series to discuss alternative drainage practices that consider subsidence control

Marcia St. Martin at Drainage Pump Station #1
[Photo credit: Lloyd Dennis Photography]

"We have to change our emphasis from evacuating every drop that falls to keeping water in the ground to avoid subsidence. We also need to be concerned about the quality of water we pump out to the lake."

"We need a combination of both pipe and retention systems and, in order to achieve this, we have changed our mindset."

-- Marcia St. Martin, Director of the New Orleans Sewerage and Water Board

"Engineered solutions are a critical component but, truthfully, that's only one piece of the puzzle."

"People have to understand that there are long term changes that need to happen and everyone plays a part."

-- Nick Cali, Lake Borgne Basin Levee District Director

Nick Cali at the Jefferson Parish Basin community meeting said the Greater New Orleans Water Plan is "a consolidation of common sense", August 2013

Mayor Landrieu with then Dutch Ambassador Renée Jones-Bos and the Embassy's Senior Economist Dale Morris, and David Waggonner at a Dutch Dialogues 3 workshop, April 2010

"New Orleans is the most immediate laboratory for innovation in America"

"It is appropriate that this initiative will look to the entrepreneurship of our people to find new solutions to systemic water management challenges. It's important for our safety and quality of life."

-- New Orleans Mayor Mitch Landrieu

"We offer our support to Waggonner & Ball in developing a wide-ranging approach to

effective water management and planning in order to protect our precious natural resource."

-- Jefferson Parish President John Young

Photo Credit: The Advocate

Photo Credit: nola.com

"Many areas in St. Bernard Parish and the east banks of Orleans and Jefferson parishes depend on a large-scale pumping system susceptible to failure even during normal rainfall, resulting in flooding that divides these neighborhoods. Additional threats, such as subsidence and rising sea levels, also contribute to the need for a solution-based approach to an integrated Water Plan that is

vital to the continued recovery, growth, and development of the region."

-- Paul Rainwater, Louisiana Commissioner of Administration

"It is critical that the Greater New Orleans region has a comprehensive water management plan that can

mitigate risk while enhancing economic opportunities and improving the quality of life for our citizens"

-- US Senator Mary Landrieu

US Senator Mary Landrieu and EPA Administrator Lisa Jackson with City of Rotterdam's Strategic Advisor on Water Management Daniël Goedbloed, Netherlands May 2009

1 Why Invest

CREATING SHARED VALUE

The lowlands in the Greater New Orleans region have subsided as much as 8 to 11 feet over the past century and some of that land is predicted to sink another half to two feet over the next 25-40 years. Left unchecked, this trend, largely caused by the pumping of stormwater, will result in more flooding and property loss, and higher insurance rates.

According to a study funded by FEMA, a dollar spent on mitigation saves society an average of four dollars (MMC 2005). Mitigating this trend requires balanced soils and this area's soft soils need solid water management.

Water can be this region's greatest asset. The Greater New Orleans Urban Water Plan provides a vision for our region to establish a new relationship with this fundamental resource. But to make this vision a reality, a set of effective, informed, and committed actions must be set in motion to achieve the critical goal of minimizing the risk and optimizing the value of water.

Seeing the Opportunity

The Urban Water Plan envisions an integrated system that provides safety within the flood protection perimeter, improves living conditions and public spaces, spurs reinvestment, and attracts much-needed new residents and jobs.

Embrace Your Treasure

Properties adjacent to canals, currently walled off by divisive infrastructure, have the opportunity to be transformed into waterfront properties with spectacular views and access to water.

Using vacant and blighted properties adjacent to canals for extra water storage and lowering superfluous flood walls can add safety and value to surrounding neighborhoods. The canals themselves could evolve from purely utilitarian grey infrastructure to corridors of water and greenery that connect neighborhoods, become popular destinations for relaxation and recreation, and spur new economic activity.

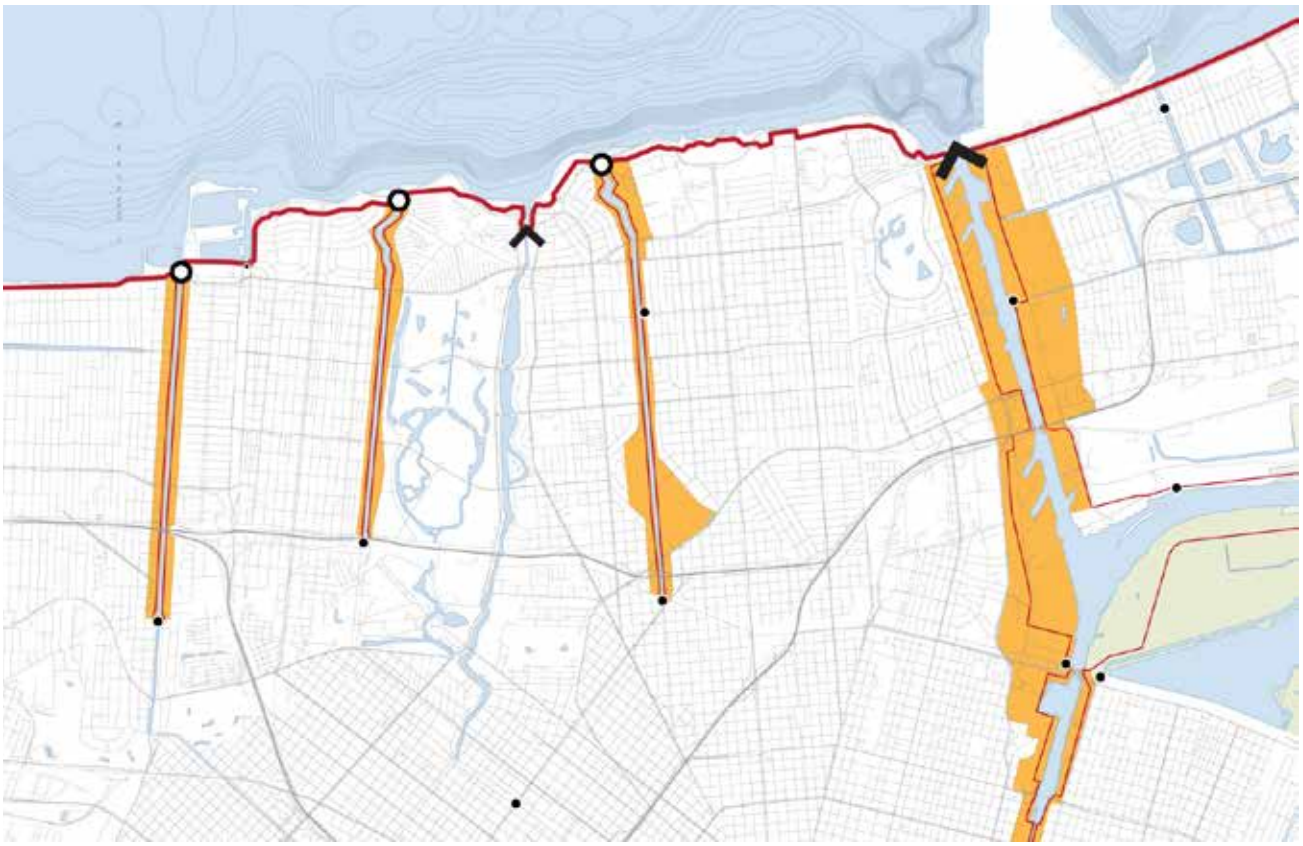
Dual-purposing these public lands by making water storage and conveyance structures visible, accessible and attractive injects vibrancy into urban and suburban corridors and sites, reconnects neighborhoods and people, and adds significant value to the city and region.

Existing

Canal floodwalls prevent the development of desirable waterfront property

Rediscovered Waterfronts

26 miles of potential waterfront economic development



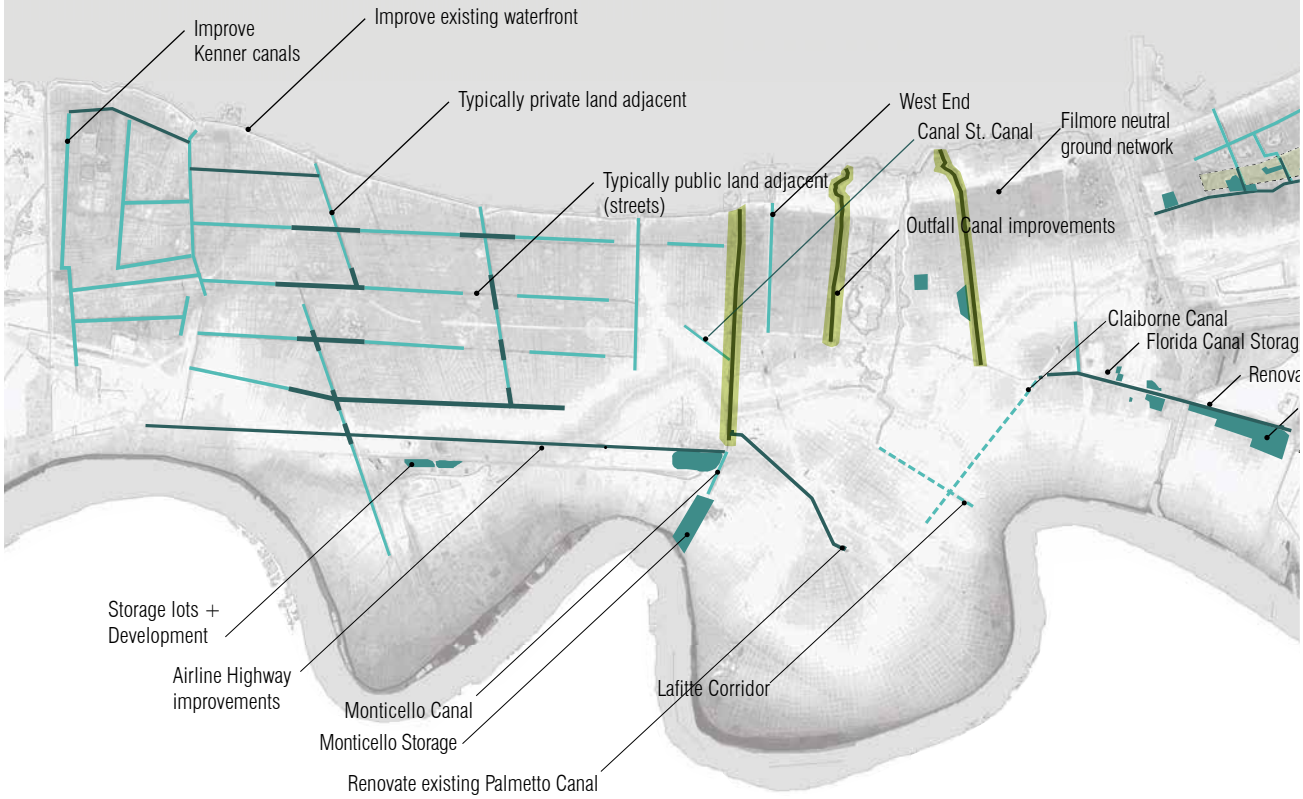
Potential

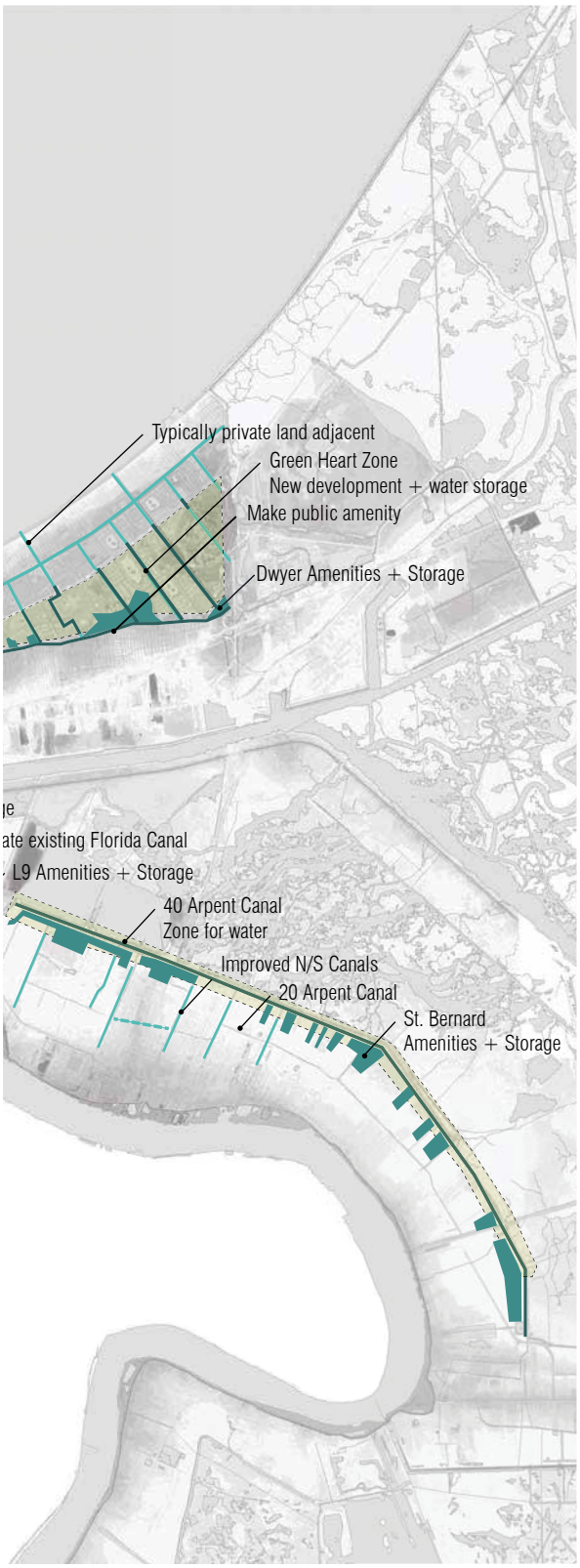
Canals can transform into corridors of water and greenery that reconnect neighborhoods

Potential Corridors of Economic Activity

Proposed interventions that will have a positive impact on adjacent property and investment

Over the next 50 years, property values will increase by $183 Million for over **41,500 properties within 200 meters** of proposed water management interventions.





Transforming Outfall Canal into Waterfront

Outfall canals are transformed from a drainage-only function into accessible waterfront. An additional phase to development would include potential property buyouts and property swaps along the new waterfront to create public green-blue corridors.

Improved Canal Adjacent to Public Streets

These canals typically exist adjacent to public streets and commercial areas presenting the opportunity to create habitabledge conditions and provide recreational features, such as pathways.

Improved Canal Adjacent to Private Property (residential)

Canals present the same opportunities for aesthetic improvements but would primarily impact directly adjacent residential properties.

New waterways

Lafitte Corridor, Claiborne Avenue, and the 20 Arpent Canal present an opportunity for new attractive waterways to spur neighborhood redevelopment.

Water park storage

These large plots will provide stormwater storage in conjunction with new development to maintain and operate the site. These may provide new urban and suburban public recreation and parks.

Metairie's Pontiff Park: Water Management in Public Spaces

Wally Pontiff Jr. Park, located in the Old Metairie section of Jefferson Parish, is a high-performance landscape that maintains the appearance of a traditional suburban park. In addition to providing significant stormwater retention, it offers recreational opportunities for local residents including ball fields and a gymnasium. Pontiff Park flooded after Hurricane Katrina and subsequent levee failures, damaging facilities and necessitating near total reconstruction.

The most striking strategy of the reconstruction of Pontiff Park is a three foot tall earthen berm which was constructed around the perimeter of the park, creating a 40-acre stormwater retention area that is designed to retain water for up to a day before being siphoned into the 17th Street or Suburban canals. The bermed area accommodates approximately 6.9 million cubic feet (52 million gallons) of stormwater. This is sufficient to drain six inches of standing water from a surrounding area totaling 180 acres, with the goal of mitigating a ten-year rain event (9.4 inches in a 24 hour period) During heavy rainfall, the park can be intentionally flooded to help alleviate the burden on surrounding drainage systems. The berm, additional drainage modifications, and required pumps were financed by the Jefferson Parish Department of Drainage for approximately $6 million. Enhancing the pre-Katrina park infrastructure with a cost-effective and high-capacity integrated landscape water management system has reduced risk of flooding in Old Metairie, dual-purposed public land, and has created a popular destination that improves the quality of life for Jefferson Parish residents.

Make Space for Water

Unlike denser urban areas, the opportunities for water storage in New Orleans and its environs abound. Space for both small-scale distributed interventions like stormwater best management practices (BMPs) and larger-scale water storage solutions necessary to address the severe flooding problem can be found at least in the following spaces:

- Vacant and blighted properties
- Existing parks
- Streets and neutral grounds (medians)
- Rights-of-way along major infrastructure
- Brownfields (polluted industrial properties that have been abandoned)

There are over 40,000 vacant, blighted, and adjudicated properties across Orleans and St. Bernard parishes (Plyer and Ortiz 2012, SBPG and SDT 2011). The investment required to provide basic maintenance and code enforcement with no return makes these properties a liability to local governments but prime candidates for water management. Existing parks should work harder too, starting by retaining their own runoff and making more space for water retention. Corridors of space, especially rights-of-way along major infrastructure, can be used to both retain water and create new water connections across the region. Streets and neutral grounds may individually manage a relatively small volume of stormwater, but collectively can have a significant impact. Incorporating integrated water management practices into planned reconstruction and retrofit projects can place local governments in the lead of a sustainability movement that helps build public awareness and buy-in.

For example, in Jefferson Parish stormwater detention ponds have been constructed in multiple locations, such as Pontiff Playground, the Woodland West area (on the West Bank), and Earhart Expressway at Clearview and at Causeway. In the event of severe rains, water can be diverted to and temporarily detained within these areas to remove rainwater from neighboring streets.

Water Storage Opportunities

Vacant and blighted properties, streets and neutral grounds, rights-of-way, improved parks and canals

Vacant (above left and right) and blighted properties (above middle) exist in different patterns and allow for a variety of uses

Neutral grounds (left) have the potential of storing water as shown in this example of Canal Blvd's "sunken gardens"

When rebuilding broken streets (above) new standards should be used to delay and infiltrate water

Rights-of-way along major infrastructure (left) can be used to store water and create new connections

Orleans Ave. Canal at City Park (right) and Monticello Canal at Hollygrove Greenline (far right) have the potential of being widened to store more water

Build on Existing Momentum

Securing funding, designing financial policies and mechanisms, and employing these in ways that are equitable and just may seem difficult to accomplish. However, with funds made accessible through unique public and private collaborations, political momentum, and inspiring national and international examples to draw on, opportunities abound. Financial mechanisms and policies - though inherently challenging - can serve as generators of public and private wealth in addition to being catalysts for green infrastructure investment. Financing structures can be tailored to fit each area's specific conditions to incent the right types of public and private investment while discouraging unsustainable development practices. Achieving socially just outcomes - equal protection and amenities for all and avoidance of undesired demographic shifts and extreme changes in culture and character - also presents a great opportunity in a city and region where the most disadvantaged often live in the areas most prone to flooding. Financing opportunities include:

- Capitalizing on existing funding sources granted to the region as a result of recent events like hurricanes Katrina, Gustav and Ike, and following the development of potential sources from the RESTORE Act as a result of the 2010 Gulf oil spill.
- Adopting new regulations that generate revenue dedicated to stormwater best management practices (BMPs) and better the region as a whole.
- Creating programs and incentives that stimulate investment in green infrastructure for the private sector.
- Developing innovative financing structures by studying and learning from other cities that have successfully implemented green infrastructure projects (i.e. Philadelphia, PA, Washington, D.C., Portland, OR, etc.)

Building consensus among policy makers, water system managers, and local and state government officials - representing socially and hydrologically diverse areas of the city and region - is both a challenge and an opportunity. Garnering their support and feedback will be essential to the delivery of a plan that best serves their constituents and, at the same time, looks beyond the limits of jurisdictions and localized interests to consider the well-being of the entire region.

Policy makers and water system managers can work together to develop diverse and sometimes complex solutions - including stormwater fees, developer incentives, water credit trading programs, and public-private partnerships - that other cities have used to secure funding for the implementation of water management best

Jefferson Parish Basin Meeting, Lafreniere Park, August 2013

practices. Non-traditional collaborative structures will need to be established to achieve common goals through shared resources and expertise. Policy opportunities include:

- Building on initiatives with shared objectives like the National Flood Insurance Program's Community Rating System, the Louisiana Coastal Master Plan, the New Orleans Master Plan and draft Comprehensive Zoning Ordinance, and the Sewerage and Water Board's wetlands assimilation program.
- Capitalizing on a collective sense of urgency to address our water risks to establish fundamental collaborations and expand water management roles to include subsidence control.
- Developing a set of policy actions that ultimately lead to enforceable codes, benchmarks, and stormwater retention standards in urban development and redevelopment.

Transforming our water culture is a critical step toward living with water. Perhaps the Urban Water Plan's greatest opportunity is to influence the people who can make it a reality: the citizens of Greater New Orleans. Though awareness of integrated water management and its benefits is spreading thanks to many affiliated and unaffiliated outreach events, conferences, and organizations, catalyzing action in the public realm will depend heavily on ongoing coordinated outreach, education, and marketing. Moving from awareness to action is a critical next step. By providing the tools and framework for progressive, results-oriented public engagement, the Plan can translate ideas into citizen action. Community engagement opportunities include:

- Building on the shared knowledge of public and private partners and invested stakeholders in water-based design, engineering, science, economic development, education, civic engagement, and other fields.
- Improving public water literacy and education in water-related subjects including subsidence, topography, and drainage systems.
- Creating world-class scientific and arts initiatives and institutions around water issues.

Engaging a class of 4th graders at KIPP Central City about basic concepts of water management, May 2013

St. Bernard and Lower 9th Basin Meeting, Nunez College, July 2013

New Orleans East Basin Meeting, Read Library, July 2013

New Orleans Basin Meeting, Xavier University, August 2013

Cost of Inaction

Despite the billions of dollars invested in our flood protection and drainage systems, streets continue to be inundated by frequent downpours. After decades of fortifying levees and draining our lowest-lying areas, subsidence has become a major issue in our region. And population numbers are below pre-Katrina levels.

April 2013: Street flooding, Garden District
Frequent flooding in areas with many businesses and high population density suggest substantial economic damage

The costs of maintaining the status quo are myriad and they are dispersed in ways that are not always obvious or easy to quantify. But by looking at problems and costs independently - flooding, subsidence, aging infrastructure, population, and degraded ecosystems - the cumulative toll of passivity becomes apparent. Addressing these issues is essential to the region's prosperity, as they affect livability, infrastructure, and insurability.

Flooding

Over the next 50 years, the three-parish study area will sustain an alarming amount of damage due to flooding from rainfall: an estimated $8 billion. This figure does not include the effects of climate change and the increased frequency and intensity of storms that will come with it. Despite the area's massive pumping capacity, heavy downpours overwhelm drainage systems causing frequent localized flooding. These rainfall events, which do not include "named" storms, create significant disturbances in our lives and have a trickle-down effect on the regional economy. Flooding causes damage to property, displaces households, generates tons of debris, and interrupts businesses and cultural events, resulting in property depreciation in these vulnerable areas and, more importantly, low citizen, visitor, and investor confidence.

Subsidence

Adding to our system's weakness, the current approach of pumping stormwater out as fast as possible has an adverse secondary effect. It causes organic soils to dry and oxidize, causing many areas that have already settled several feet below sea level to sink even lower. Subsidence-induced damage to personal property alone will cost home and business owners in the study area over $2.1 billion dollars over the next half century. Not included in this figure is the costly impact subsidence has on the region's infrastructure. The City of New Orleans' Department of Public Works acknowledges that most of the damage to streets, sidewalks, and subsurface pipes is due to subsidence and the shrink/swell effect that occurs when soils get wet and then dry. This adds millions of public dollars every year in preventable expenses

Flooding

60 inches per year
Average rainfall in Louisiana

6 to 8 inches per hour
Peak rainfall

1 to 5 times a year
Peak storm occurrence

Drainage systems cannot handle peak storms
According to water system managers of the three-parish study area, the drainage systems can handle one inch of rain the first hour and, as the ground becomes saturated, one-half inch per hour thereafter. Rainfall at a greater rate than that, a frequent occurrence in our area, causes flooding.

Doubling the pumping capacity would only solve 40% of the problem
This is based on our team's hydraulic model results. In addition to only solving 40% of the problem, doubling the pumping capacity would be cost prohibitive and, most importantly, it would exacerbate subsidence. This is not a viable solution.

Impervious surfaces increase flooding
Development in urban areas increases stormwater volume and velocity and decreases permeability. New measures that allow water to infiltrate into the ground are necessary to stabilize soils and prevent extensive damage to structures and infrastructure.

July 2012: Street flooding in East Jefferson along Airline Highway

Subsidence results are evident in depressed driveways and exposed foundations in Village de l'Est, New Orleans East

July 2012: Street flooding in the Seventh Ward

July 2012: Street flooding in the Seventh Ward

July 2012: Circle Food Store on St. Bernard Avenue and Claiborne Avenue

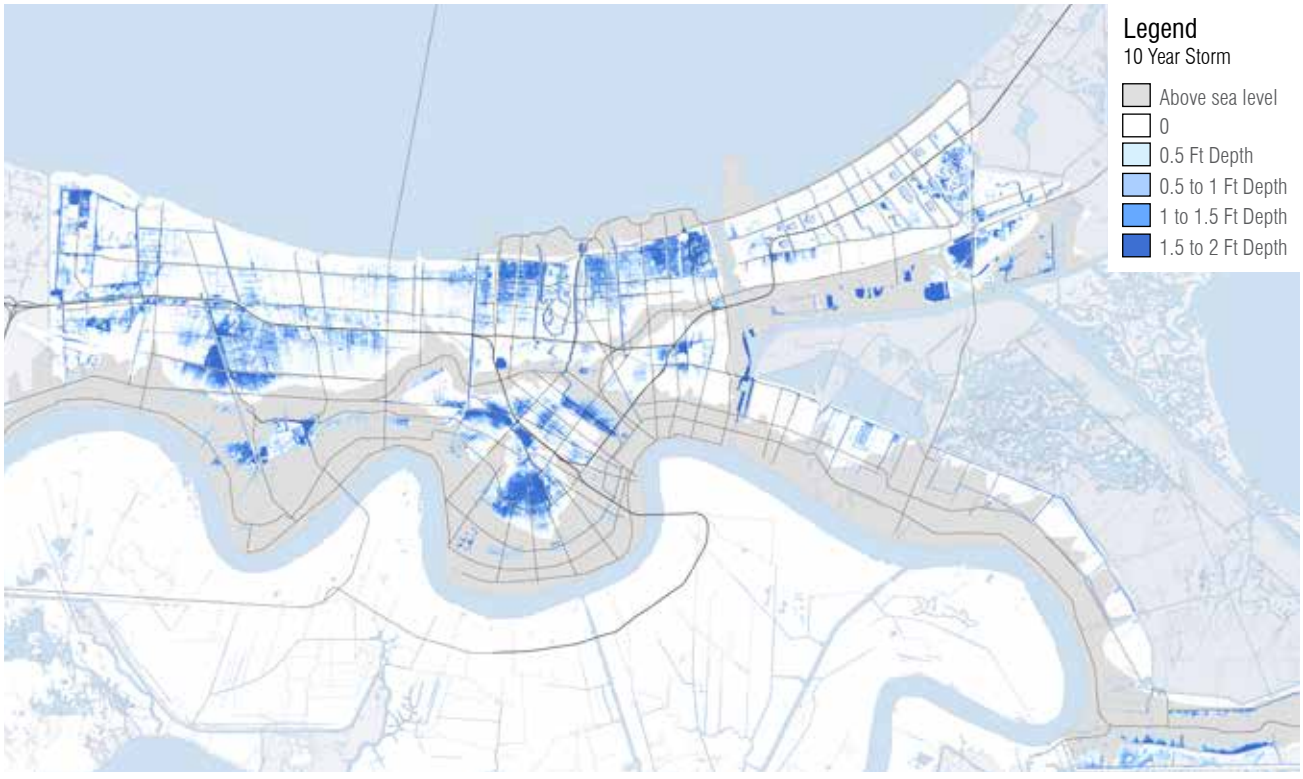
across all parishes. Subsidence also drastically raises the cost and frequency of repairs to levees, canals, and floodwalls that have been compromised by degradation or lowered elevations. According to the Southeast Louisiana Flood Protection Authority - East, the U.S. Army Corps of Engineers could largely avoid the costly process of levee lifts, which occur three or more times over 50 years in some places, if subsidence were not a factor. Finally, half or more of the city's drinking water is lost in transmission before it ever reaches a tap, largely due to infrastructure made leaky by subsidence (The Editorial Board 2011).

Water Quality

Regional ecosystems - air, water, soil quality, and biodiversity - also are under-served by the current system, which does little to improve them. Our municipal separate stormwater sewer systems (known as MS4s) wash large quantities of stormwater across urban surfaces that contain a mix of pollutants, posing a threat to the health of our waterways and habitats. As MS4 permittees, and to avoid looming penalties, Orleans and Jefferson parishes are required to develop and implement a Stormwater Management Plan that addresses all the components required by the permit.

Flooding

10-year storm flood model: problem areas



Cost of Flooding

$8 billion
Estimated flood damage from rainfall in the three-parish study area over the next 50 years.

Repeated flooding is costly
Homes or businesses with two or more claim payments over $1,000 from the National Flood Insurance Program within a 10-year period are considered Repetitive Loss (RL) structures (NFIP 2007). Properties with four or more claims over $5,000 each are considered Severe Repetitive Loss (SRL) structures (FEMA). The map below indicates the severity of our problem.

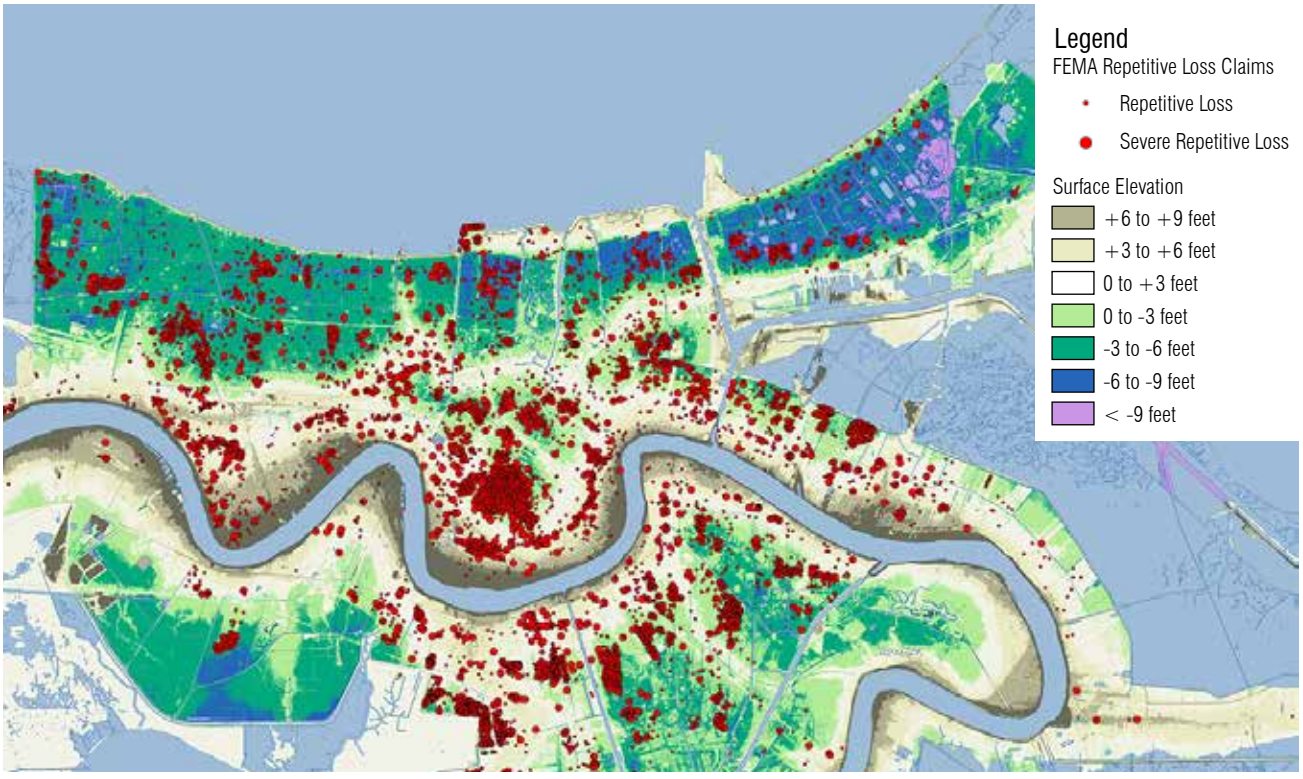
Citizens bear the cost
Every flood occurrence has a significant impact on taxpayers, either through physical damage to property, business interruption, lost productivity and wages, or rising insurance rates.

July 2012: Street flooding in Mid-City (Hagan Street)

July 2012: Street flooding on Jackson Avenue, Garden District

Repetitive Loss

FEMA Repetitive Loss Claims



Severe street damage due to subsidence in St. Bernard Parish

Buckled sidewalk due to subsidence

Subsidence

The area sits below sea level

Approximately half of the study area is below sea level.

The more water is pumped, the more the ground sinks

The areas already below sea level have subsided over the years due to soils with high organic content that require water to remain stable.

Highest rates of settlement occur during dry weather

Canal operation levels in Orleans and Jefferson are kept as low as -12 to -14 feet below sea level, drawing down water tables and causing soils to dry out and settle at varying rates.

Subsidence control falls under no one's jurisdiction

Currently no entity is responsible for groundwater management.

Living Below Sea Level

Vulnerable low-lying areas indicated in feet below sea level

Cost of Subsidence

$2.2 billion
Estimated damage to structures due to subsidence in the three-parish study area over the next 50 years.

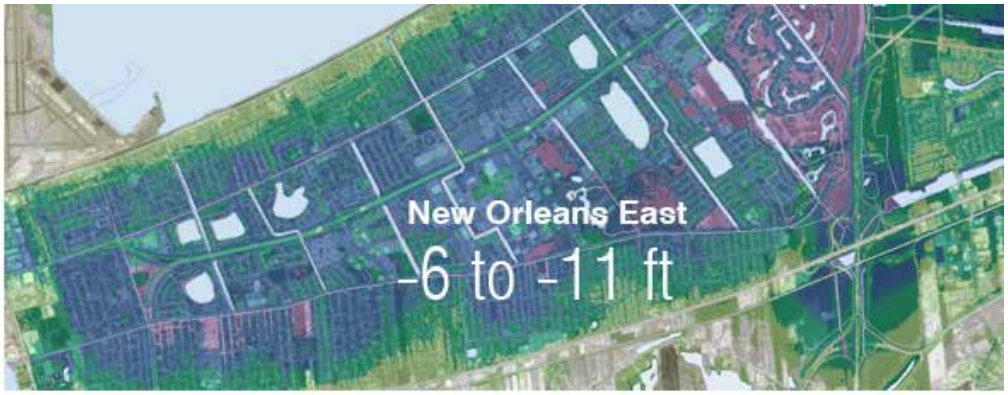
Broken infrastructure
The inestimable cost of infrastructure repairs and required levee lifts is not included in the figure above.

Low groundwater levels cause wood pile decay
Lowered water tables have caused billions of euros in wood pile damage in Dutch cities. The Dutch response: a monitoring well every 100 meters. The New Orleans region faces a similar issue but lags in awareness and response.

Citizens bear the cost
The cost of subsidence-induced damage is borne by residents and businesses in repairs to buildings, cars and utilities, and increased utility rates to pay for broken public infrastructure.

Exposed foundation and wood pile decay risk due to subsidence

Broken streets common in the Lakeview area (pictured here) and elsewhere due to differential ground settlement



Drainage Operating Budgets

Fiscal Year 2012	
NEW ORLEANS	
Sewerage & Water Board	$ 44.5M
Department of Public Works*	$0.3M
JEFFERSON PARISH	
DPW Drainage Department	$ 20.0M
City of Kenner	$ 1.5M
ST. BERNARD	
Lake Borgne Basin Levee District	$ 4.5M
Department of Public Works	$ 2.0M
Drainage Total	**$ 72.8M**

* DPW budget for drainage point repairs and to support the staffing/ operation of 3 vacuum trucks

Aging Infrastructure

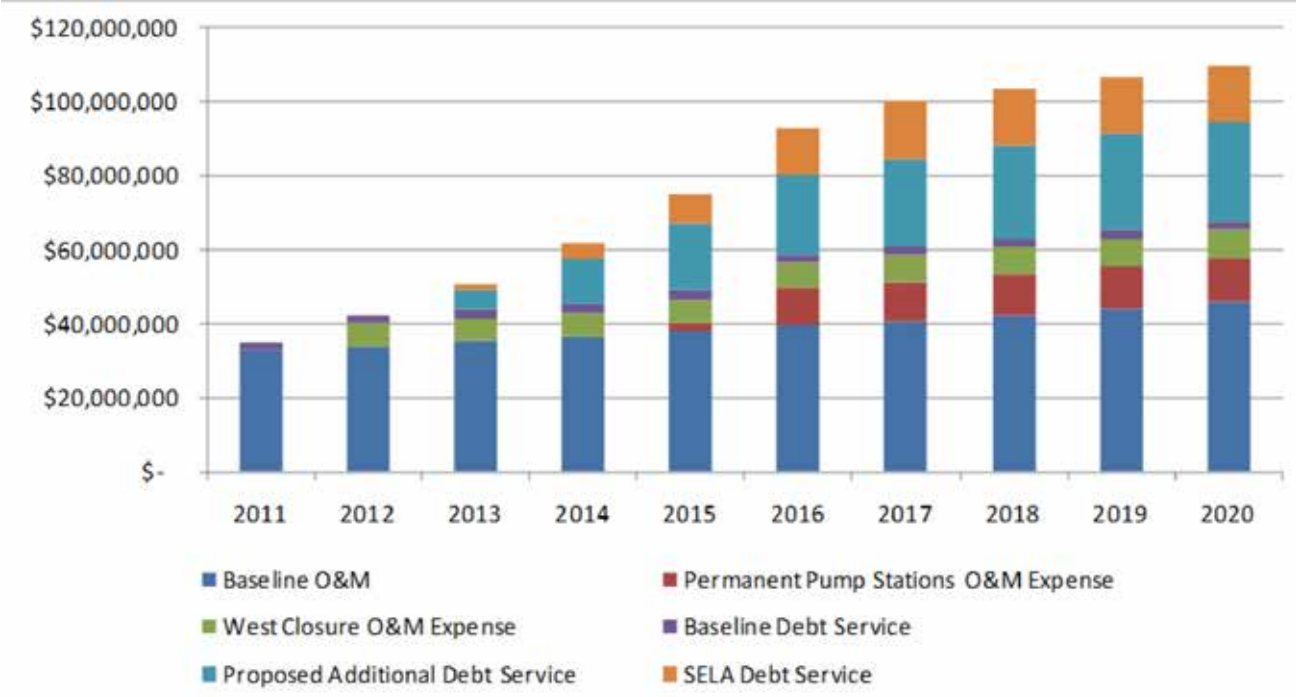
The region's aging drinking water, sewer and drainage systems face serious risk without significant infrastructure investments. In New Orleans, this resulted in a vote by the City Council in late 2012 to raise water and sewer rates 10% a year for the next eight years (Krupa 2012). According to the Sewerage and Water Board of New Orleans' projected revenue requirements illustrated below, in addition to the increased rates, a monthly parcel-based fee will be needed to support the city's colossal drainage system.

Population

The three-parish study area has 25% fewer people today than it did at its peak in 1980 (U.S. Census Bureau). New Orleans' population has been declining for several decades, shrinking 27% by July 2005 from its 1960 peak and notching a 45% decrease by 2010. While Jefferson and St. Bernard parishes saw a significant increase in population in the 1980s and 1990s respectively, they too have experienced downward patterns since then. Post-Katrina, St. Bernard lost 46% of its peak population and Jefferson approximately 5%.

Projected Drainage Revenue Requirements 2011-2020

Sewerage and Water Board of New Orleans



Cost of Established Methods

$72.8 million
Annual cost of operating the study area's drainage system, which dates back to the turn of the century. (Source: 2012 operating budgets published on the drainage authorities' websites).

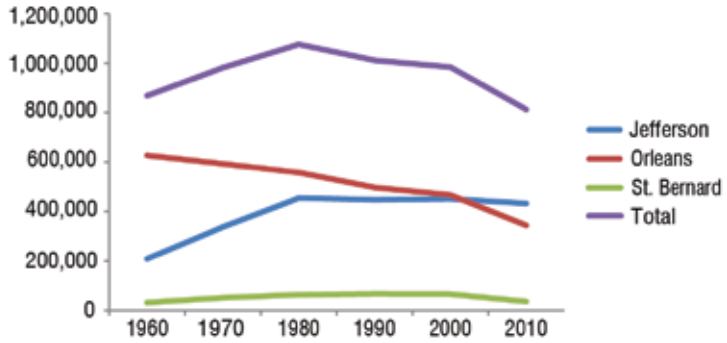
Increased rates and new fees are necessary
As indicated by the New Orleans example, future revenue requirements are projected to be much higher than they are today, requiring increased rates and new fees.

More people are needed
Current population numbers and the shrinking tax base they represent cannot support the massive drainage systems needed to keep up with rainfall frequency and intensity.

Vacancy and Blight
Over 40,000 vacant, blighted, and adjudicated properties across Orleans and St. Bernard parishes continue to use up public funds with no return on investment.

MS4 penalties
In 2010 the Sewerage & Water Board reinstated its 1998 consent decree agreement with the U.S. Environmental Protection Agency to reduce the raw sewage overflows that plagued the city's municipal water system, streets, and waterways. The city complied with the agreement, spending over $200 million, until Katrina struck and the program was put on hold. Resumption of the program will likely bring overall costs to $400 million to $500 million. Non-compliance costs vary but could reach into the tens of thousands of dollars per day.

Declining Population



	1960	1970	1980	1990	2000	2010
Jefferson Parish	208,769	337,568	454,592	448,306	451,109	432,552
Orleans Parish	627,525	593,471	557,515	496,938	467,033	343,829
St. Bernard Parish	32,186	51,185	64,097	66,631	66,441	35,897
Total	870,440	982,224	1,076,204	1,011,875	984,583	812,278

Population figures according to US Census Bureau

Abandoned properties in Filmore, near London Avenue canal

May 04, 2009: St. Charles Avenue (high ground) in the Lower Garden District; High concentration of businesses and people suggests substantial economic damage [Photo: Waldemar S. Nelson and Company, Inc.]

Vulnerability

Vulnerable areas

These are high-risk areas with high subsidence and flooding potential. Though typically areas with organic soils and low surface elevations, they can also be found on high ground due to overwhelmed drainage systems.

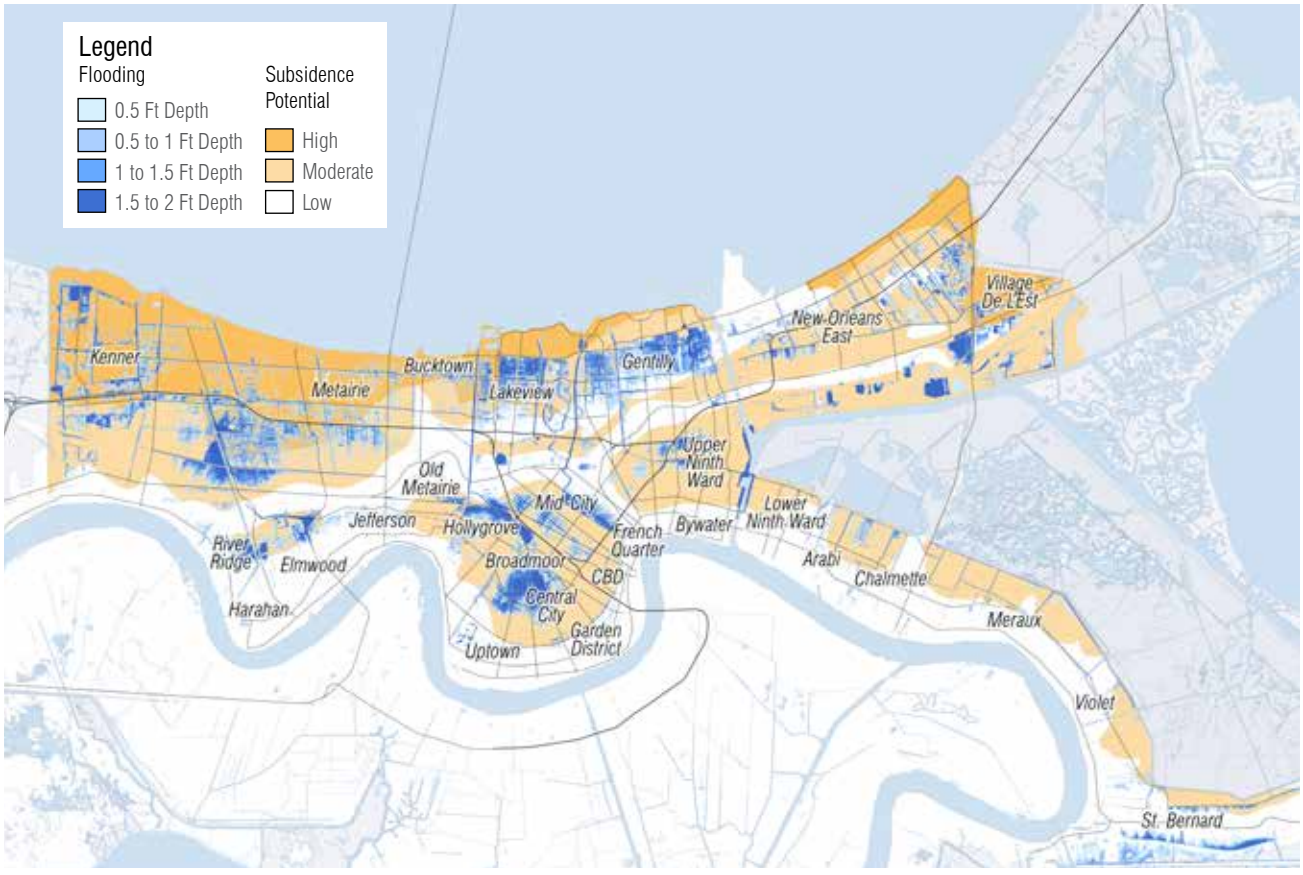
Population density in vulnerable areas

While original settlement patterns concentrated populations on higher ground, today many live in vulnerable areas.

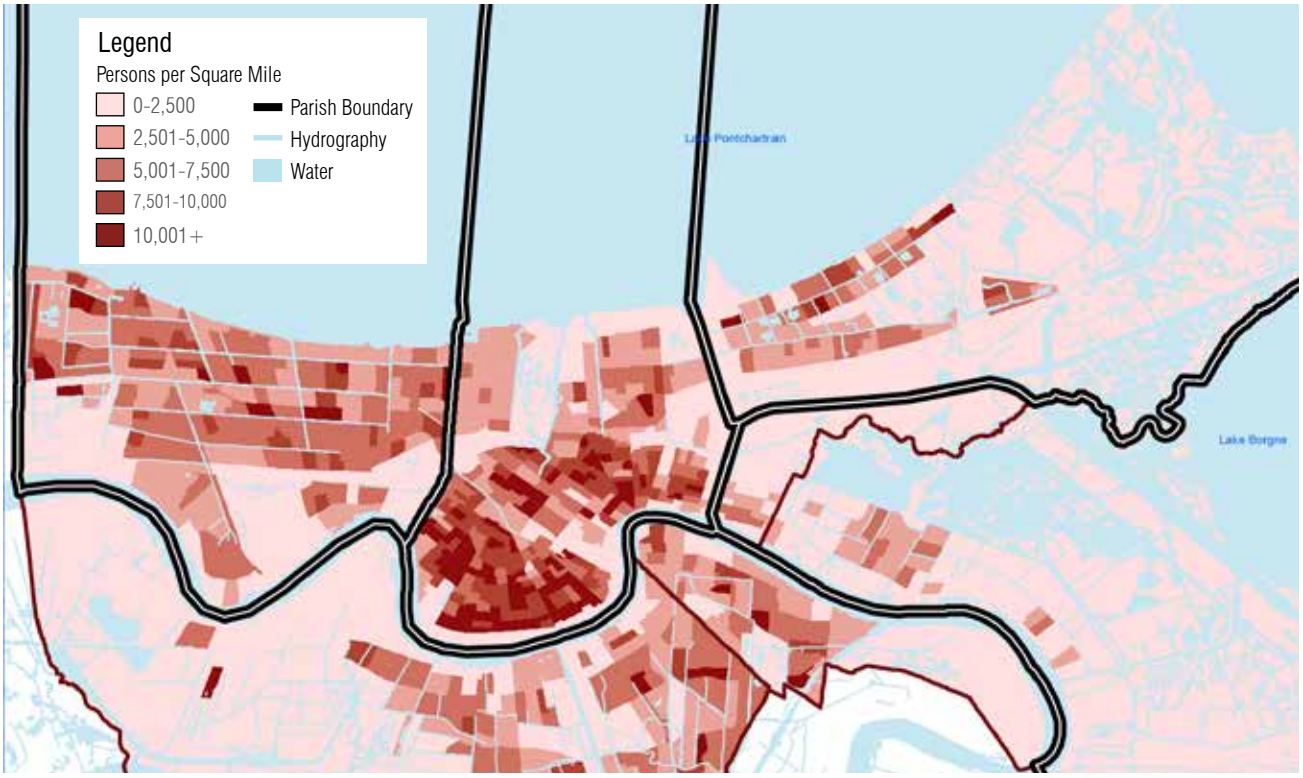
Businesses in high-risk areas

A substantial number of businesses are located in vulnerable areas with high subsidence potential, suggesting higher future economic damage.

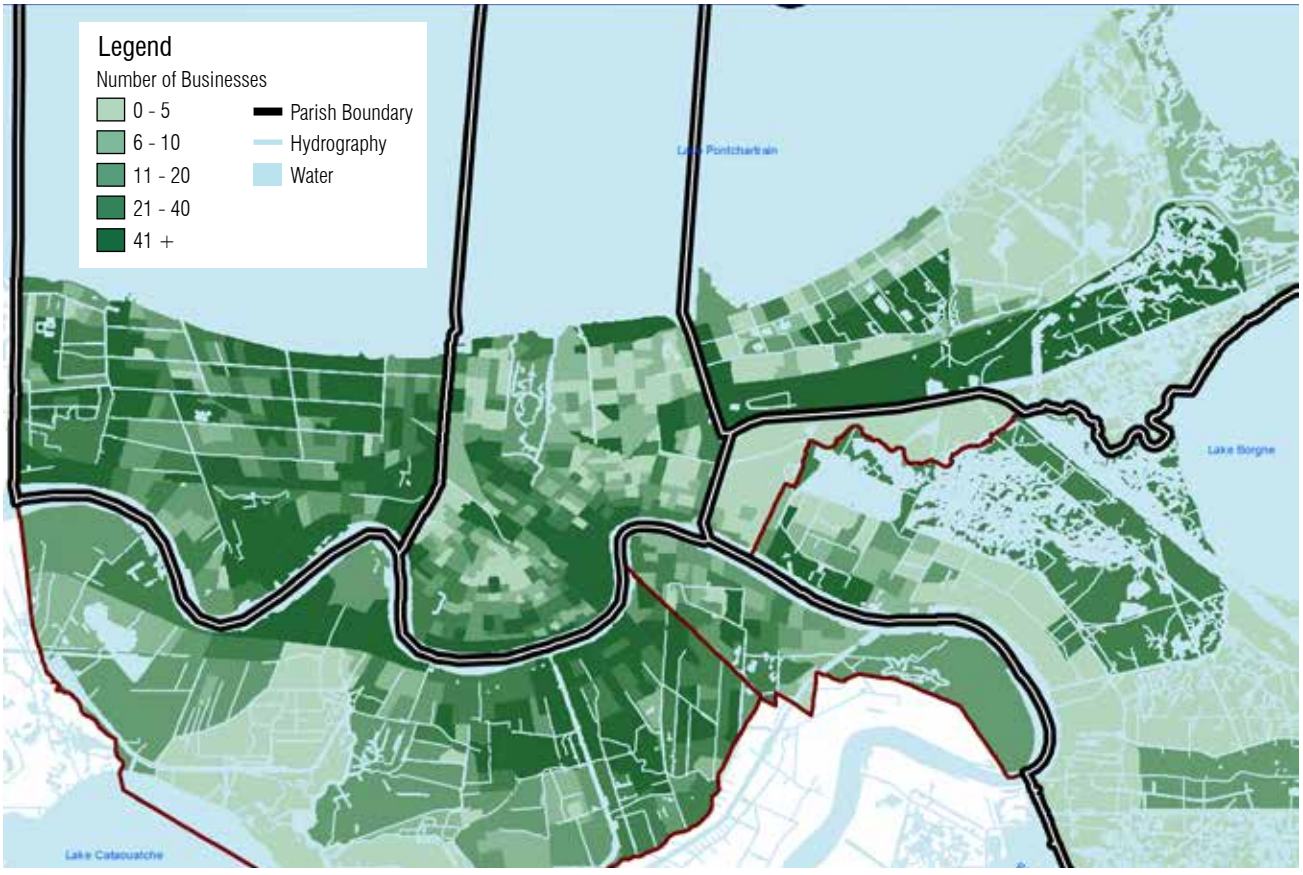
Problem Areas 10-Year Flood Model and Subsidence Potential



Population Density by Census Block Group



Business Units by Census Block Group



Towards a New Era

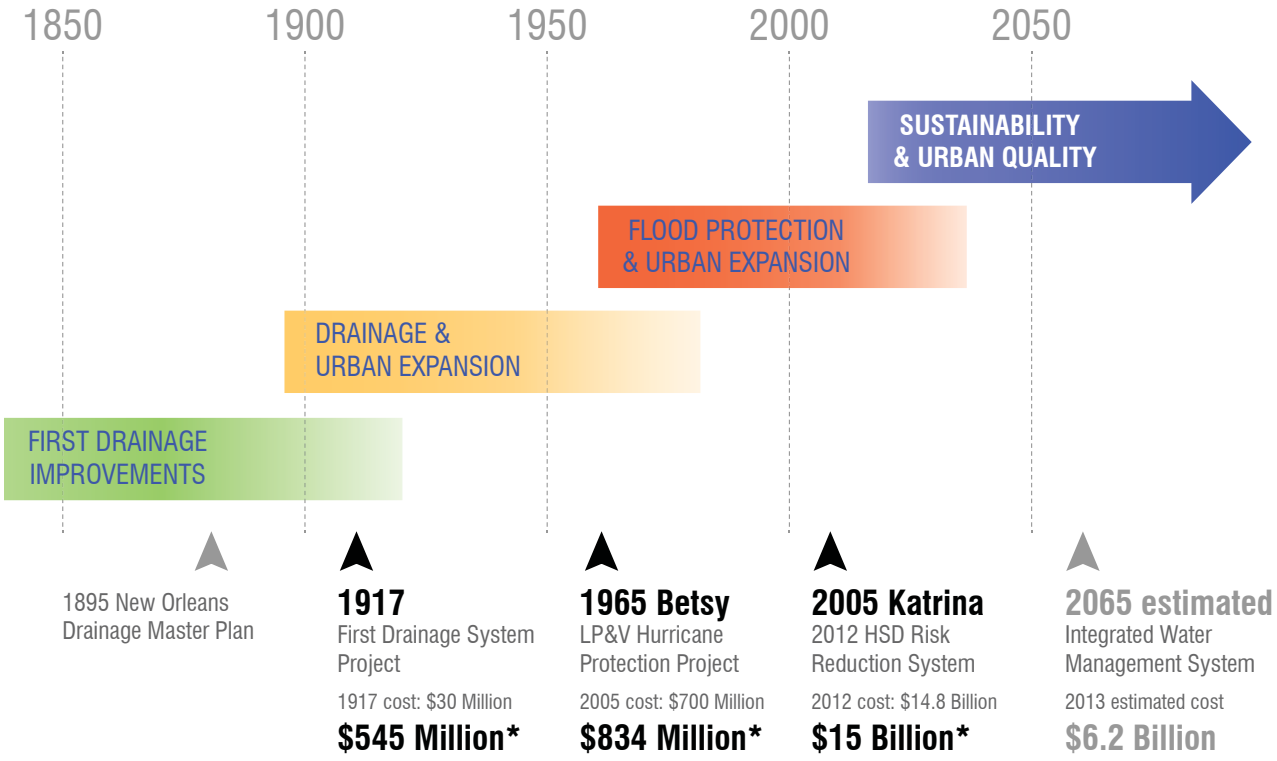
Significant investments have been made over the decades to deal with water and manage risk. But the current course of pumping every drop that falls exacerbates subsidence and flooding, causing immeasurable damage to communities. We must alter our approach if we want this to be a safe place to live, work, and invest in.

Change Is Inevitable

Key findings of the New Orleans Index at Six, a report released by the Greater New Orleans Community Data Center in August 2011, suggest that while the area continues to recover from Hurricane Katrina and in some ways is rebuilding better than before, several economic, social, and environmental trends remain troubling and indicate the region faces significant challenges and unmet needs. The report, which presents data on the region's recovery from Katrina, concludes that "while growing the economy and lifting up opportunities for all residents is essential, perhaps more important still are additional flood risk reduction efforts."

The good news is that plans and initiatives are underway to revive coastal wetlands, our first line of defense, which act as a buffer against storm surges. Meanwhile, the multi-billion dollar perimeter defense system, our second line of defense, is complete and more robust than before Katrina. What is missing is a critical third line of defense, which can be found in a new integrated and sustainable approach to our urban water management to supplement, build upon, and amplify our baseline defenses in the years and decades ahead.

Water Management Eras and Investments



1718-1895
First Water Improvements
River & Canal City

In the past, residents, without comprehensive floodwalls and powerful pumping systems, had to live with water. From lakefront camps to raised buildings in the quarter, residents knew how to live above the water and provide spaces where water could flow.

1895-1965
Pipes & Pumps
Waterworks Era

The city's first drainage master plan, adopted in 1895, called for the construction of huge new pump stations and gigantic buried concrete culverts. In 1913, New Orleans' own A. B. Wood designed a pump that revolutionized urban development and allowed New Orleans to expand into drained marsh along Lake Pontchartrain.

1965-2013
Keeping Water Out
Walled City

As the city expanded to the north, a levee at Lake Pontchartrain became necessary to block storm surge and high tides. As a result, the city is sealed off from nature. In many parts of Jefferson and New Orleans East, levees render sections of the lakefront inaccessible for public use.

2013 -
Letting Water In
Sustainability Era

Today, nearly 100 years since the introduction of the first drainage system, it is time for the region to reinvent itself. Now is the time to adopt a new approach to stormwater management that is safer, smarter, and more cost-effective.


HEALTH
CONFIDENCE
JOBS
PUBLIC SPACE
RECREATION
SUSTAINABILITY
WEALTH
INVESTMENT
SAFETY
GROWTH
BALANCE
BIODIVERSITY
INSURABILITY
INSURABILITY VALUE ECOSYSTEMS WETLANDS INVESTMENT COOL BIODIVERSITY MARKETABILITY STABILITY QUALITY COMMERCE
ABILITY QUALITY COMMERCE ECOSYSTEMS WETLANDS INVESTMENT BIODIVERSITY

2 Building Value

THE ECONOMICS OF INTEGRATED WATER MANAGEMENT

"Our forefathers had a choice: to invest in the future, to put the 'cost before the benefit', or to ignore the past. Without public investment, engineering, and innovation, the Dutch would now be living in Germany, or Belgium." (Jones-Bos 2012)

As former Dutch Ambassador Renée Jones-Bos notes, the Dutch have been forced to approach large infrastructure and planning projects head on, given that 60% of the country's population lives below sea level. American cities may learn from their ally's proactive embrace of cost-benefit analysis. Like the Dutch, whose canals provide unparalleled beauty and protection simultaneously, the Urban Water Plan achieves a universality of outcomes through proven, inclusive, and sustainable design.

In the envisioned water era, water is a tool for the creation of wealth, new industries, inviting places to play and stroll, and environmental restoration. In this plan, value is also shared more equitably region-wide, by those in both low- and high-risk areas. Everyone can appreciate lowered flood risk and reduced subsidence costs, while all share in the new spatial qualities created by the proposed interventions. And as the numbers show, these strategies pay for themselves many times over.

Economic Value

To assess the economic benefit of implementing the Urban Water Plan's long-term vision, five factors have been analyzed: construction impact and job creation; reduced flooding cost; reduced subsidence cost; potential savings in flood insurance premiums; and increased property values. While the plan's full economic impact cannot be quantified at this preliminary stage, these five factors alone total **$22.3 billion over the next 50 years.** [see Appendix A for full methodology]

Second line in honor of Uncle Lionel Batiste in the flooded streets of New Orleans, July 20, 2012. Photo by Kim Welsh.

Economic Impact & Job Creation

The implementation of the Urban Water Plan will require a significant investment in labor and materials, with initial estimates ranging from $2.9 billion for basic implementation to $6.2 billion for intensive implementation. Using the U.S. Bureau of Economic Analysis Regional Input-Output Modeling System, it is estimated that this investment will have direct and indirect impacts ranging from **$5.29 billion to $11.32 billion** and will support **between 44,040 and 101,790 jobs**. Many of these jobs will stem from existing labor and include part-time and temporary positions, but given the growth of nascent green industries, there is significant potential to foster a new economic driver in the region, one that is anticipated to grow nationally and provides quality jobs with living wages.

Value of Reduced Flooding

Based on hydraulic modeling conducted by the team's engineers and hydrologists, full implementation of the WMS would eliminate flooding from a five-year storm event and substantially reduce the effects of a ten-year event. Costs associated with a five-year flood event were estimated using FEMA's Hazards-United States (HAZUS) model, which indicates that each event costs the New Orleans region over $942 million in building damage, lost wages and business interruption. Over a 50-year period, these costs add up to an estimated **$8 billion.**

Value of Reduced Subsidence

By actively managing the region's groundwater levels, the Urban Water Plan can mitigate subsidence and thereby reduce the need for property owners to periodically shore and repair foundations. Based on available soil data as well as physical soil borings taken throughout the study area, a subsidence potential map was generated to identify vulnerable areas. Using housing counts provided by the U.S. Census Bureau and a preliminary structural assessment of the costs associated with subsidence-related repairs in the identified zones, an estimated 35,000 homes are impacted by high and moderate rates of subsidence, costing property owners nearly **$2.2 billion** over the next 50 years.

Lower Flood Insurance Premiums

Through the National Flood Insurance Program's Community Rating System (CRS), communities can make investments that earn lower flood insurance premiums for residents. To estimate the potential savings in insurance premiums, three areas aligned with the Urban Water Plan were identified that increase CRS scoring: open space preservation, stormwater management and flood plain management planning. Using the CRS Coordinator's Manual, two scoring scenarios - an average and a maximum - were developed, and a discount percentage was assigned to the average of the two scores. This methodology resulted in an average 10% increase in discount for all three jurisdictions and a total estimated savings of nearly **$609 million** over 50 years.

Increased Property Values

Numerous studies analyzing the link between public waterways and property values have found a positive causal relationship between the two. By making a significant public investment in improved and new open canals, water storage basins, constructed wetlands, and green space, the Urban Water Plan stands to have a positive impact on property values around areas of new investment. To estimate this impact, a 1.9% increase in property values to properties within a 200 meter buffer of the Plan's interventions or improvements was assumed, based on similar studies across the country. Over 41,500 properties were identified within the 200 meter zone of impact, resulting in an estimated increase in property values of **$183 million** over the next half century.

Other Economic Benefits

Integrated stormwater management delivers multiple other economic, social and environmental benefits to the community. Other economic benefits that are difficult to quantify are discussed in greater detail in following sections. They include creating new industry and jobs, attracting and retaining business and investment, reducing energy consumption, and transforming blight and vacant land from a liability into an asset.

In the three-parish study area, each five-year flood event...

Produces **59,124** tons of debris

Displaces **27,086** households

Costs businesses **$8.4 million** in lost productivity

Costs employees **$3.7 million** in lost wages

Causes **$930 million** in flood damage to structures

A Total Economic Loss of over $942 million per event

Over the next 50 years, these frequent flood events add up to...

600,000 tons of debris

270,000 households in need of shelter

$8 billion in flood damage

$2.2 billion in subsidence damage to structures

Total Avoidable Costs of $10.2 billion

Estimated Economic Value: Quantitative Benefits

Economic Impact and Job Creation

The Urban Water Plan introduces a new industry, creating jobs in the design, construction, and maintenance of stormwater management practices. In addition to the wages paid to individual workers, these new jobs create an economic benefit to society in expanding the tax base and reducing poverty-related costs. Intensive implementation of the plan would create up to 101,790 direct and indirect jobs (full and part-time) over the next 50 years and have a regional economic impact of $11.3 Billion.

Value of Reduced Flooding

Common two-year, five-year, and ten-year storm events in the New Orleans area (with 50%, 20%, and 10% chance of occurring each year, respectively) impose an economic drain on local businesses and property owners. Beyond the structural damage and lost worker productivity, these flood events, over 50 years, produce approximately 600,000 tons of debris and leave over 270,000 households in need of temporary shelter.

Value of Reduced Subsidence

By actively managing the region's groundwater levels, the Plan minimizes land subsidence, thereby reducing damage to structures and infrastructure, including levee improvement costs. Only costs associated with building structural damage are presented here. Infrastructure costs due to subsidence, such as damage to streets, sidewalks, utilities, etc, which are not quantified within the scope of this project, will be significantly higher.

Lower Flood Insurance Premiums

The National Flood Insurance Program allows cities and counties to earn discounts on flood insurance premiums for their residents through the Community Rating System. The CRS awards points to communities that implement technical solutions and outreach campaigns that mitigate flood risk. Analysis of the credits currently earned by Orleans and Jefferson Parish communities, and the range of credits available, reveals that there is potential for significant savings in all three parishes.

Increased Property Values

By investing in new open canals, storage areas and green space, the Urban Water Plan stands to have a positive impact on property values and new investment. Over 41,500 properties lie within 200 meters of a proposed intervention or improvement. Using assessed values for these parcels, it is estimated that with intensive implementation, property values would increase by $183 million.

$11.3 Billion

+

$8.0 Billion

+

$2.2 Billion

+

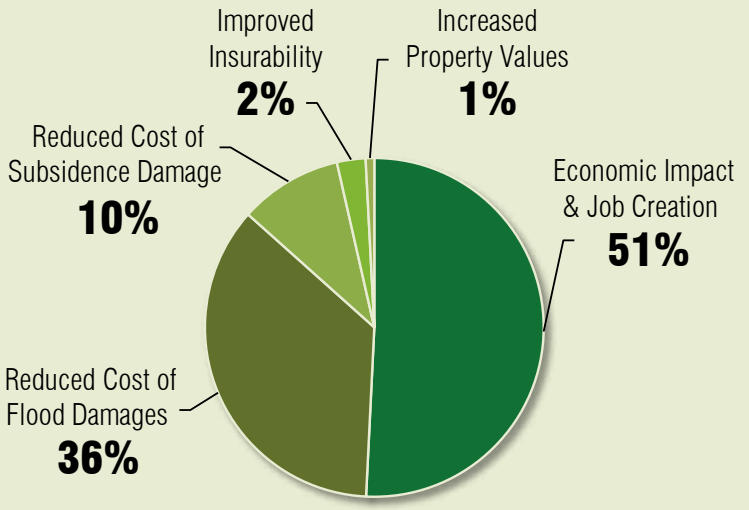
$609 Million

+

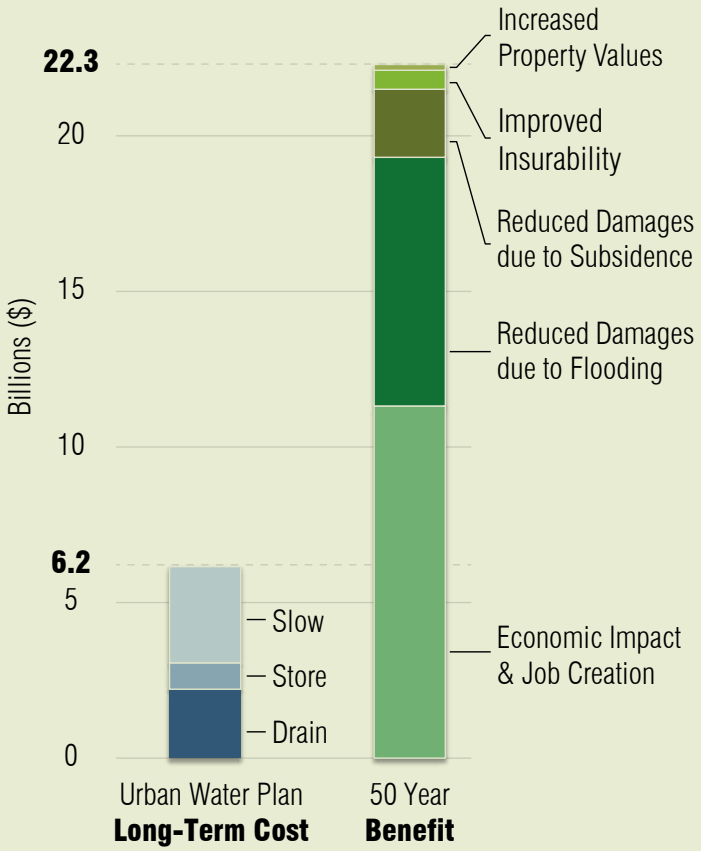
$183 Million

=

>$22.3 Billion ← Total Economic Benefit



Quantitative Benefit Ratios



Plan Costs vs. Benefits

Estimated Economic Value of Green Infrastructure in Other US Cities

In Philadelphia, managing impervious surface runoff through green infrastructure will likely result in a

benefit of around $2.8 billion

- versus only $122 million for the traditional "grey infrastructure" option.

-The Center for Neighborhood Technology, The Value of Green Infrastructure - A Guide to Recognizing Its Economic, Environmental and Social Benefits, 2010

Photo Credit: Grid Magazine

Photo Credit: University of Chicago

Since its Green Streets and Green Roof programs were established, Chicago has added more than

600,000 trees and 4 million sqare-feet of green roofs.

-EPA Office of Wetlands, Oceans and Watersheds, "Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure," 2010

The City of Portland, Oregon estimates that its green infrastructure investment of $9 million has

saved over $224 million in maintenance and repair costs.

-EPA Office of Wetlands, Oceans and Watersheds, "Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure," 2010

Photo Credit: American Society of Landscape Architects

Photo Credit: Seattle Daily Journal of Commerce

New York City officials estimate that planting public rights-of-way will create

between $139 million and $418 million in benefits

due to energy savings, increased property values, improved health, and reduced carbon dioxide emissions over the next 20 years.

-Natural Resources Defence Council, "Rooftops to Rivers II: Green strategies for controlling stormwater and combined sewer overflows," 2011

The City of Portland, Oregon, estimates that fully implementing its 43-acre green roof program will

save 63,400 kWh of electricity.

-The Center for Neighborhood Technology, The Value of Green Infrastructure - A Guide to Recognizing Its Economic, Environmental and Social Benefits, 2010

Photo Credit: Ecoroofs Everywhere

Photo Credit: Chesapeake Stormwater Network

When Philadelphia's revised stormwater regulations are in place, the City estimates combined sewer loads will be reduced by 25 billion gallons,

saving $170 million annually.

-EPA Office of Wetlands, Oceans and Watersheds, "Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure," 2010

Seattle's Street Edge Alternative (SEA) project

saves $100,000 per block

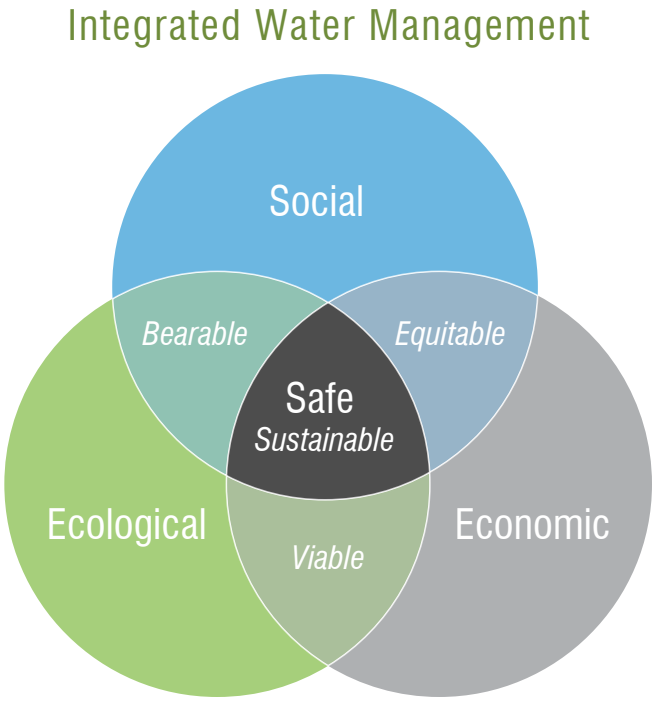
compared to traditional street design, its public utilities agency estimates.

-The Center for Neighborhood Technology, The Value of Green Infrastructure - A Guide to Recognizing Its Economic, Environmental and Social Benefits, 2010

Photo Credit: Seattle Daily Journal of Commerce

Benefits

The benefits of integrated water management are diverse, mutually reinforcing, and inclusive. Safety improvements, boosts to economic vitality, and quality-of-life enhancements go hand-in-hand, positively impacting citizens, businesses, and government agencies across the Greater New Orleans area.



The benefits of the Urban Water Plan touch almost every aspect of urban life. For the sake of simplicity, here they have been grouped into three categories: safety, economic vitality, and quality of life. This structure differs from the more common "triple-bottom-line" approach, which measures social, economic, and environmental outcomes. This deviation is largely due to the Plan's focus on safety. The Urban Water Plan also looks at "life" and "ecology" more holistically. "Quality of life" includes improvements to human, animal, and vegetable life - the entire biome - while accounting for commonly accepted ecological measures (CO2, water quality, etc.). Finally, "economic vitality" is a broadened account of financial outcomes, as it looks at economic considerations beyond those that are calculable.

Safety

"Safety first" is one of the strategy's guiding principles. While economic vitality and quality of life are of utmost importance, providing for the safety of our people and their valuables is primary. For the Greater New Orleans region, this means reinforcing and adding to our existing flood protection system. The proposed integrated water system adds multi-level protection by strengthening our perimeter defenses, reducing loads on them, and creating new ways to manage water internally. Stormwater management strategies make our region's residents safer by managing urban stormwater and groundwater, thereby reducing damage caused by flooding and subsidence. They also lessen the threat to life and property posed by regular street flooding and improve insurability by reducing repetitive loss rates and lowering premiums. Balancing groundwater stabilizes soils and minimizes subsidence rates, which helps to maintain levee and floodwall integrity, a safer water supply and an effective drainage system. At the same time, this minimizes the significant costs associated with repairs to subsurface utilities, roadways, and buildings.

Economic Vitality

In order for integrated water management to be sustainable in the long term, it must protect our region's valuable economic

assets and create new opportunities for wealth creation. The region must be a place where businesses can safely thrive, where flood-induced business interruption is not a constant worry, and where property values are unfettered by the threat of flooding or subsidence. Economic development imperatives like growth of the region's population and tax base are intimately tied to the public's sense of our region's safety and economic vitality. By reducing damages due to flooding and subsidence, storm-water management strategies make big strides in protecting private interests. They also reduce related market inefficiencies by improving insurability and reducing energy costs, which save private citizens and municipalities millions of dollars. However, integrated water management does more than preserve value; it creates it. By enhancing the region's marketability, it attracts business, talent, and new real estate investment to the area. It also necessitates the creation of an entirely new water management industry, much like the Netherlands', which is valued at $57 billion. At street level, these kinds of infrastructure strategies convert vacant and blighted properties into safe, welcoming assets and boost the surrounding property value - value shared by the entire community.

Quality of Life

Our region has long been blessed with a high quality of life: unique natural beauty, weekly festivals, and disarmingly good food and music. However, we are far from perfect when it comes to preserving these features. We have walled ourselves off from one of our greatest assets - water - and as a result have shortchanged our environment and hindered our ability to enjoy and utilize our surroundings. We also have been slow to build the new assets that will provide the cultural framework for future generations. We are constantly reminded of the precariousness of our customs and ways of life; in the middle of a second line, we are waiting for the other shoe to drop. Integrated water management goes beyond safety and economic vitality to touch quality of life. It builds value with water, creating waterfronts, accessible public spaces, and recreational opportunities where there were none. By delivering protection from floods and subsidence, it preserves those ways of life that we all depend on for our identity. A comprehensive approach to water management is also a sustainable one: it enhances water and air quality through blue-green strategies; enriches our region's diverse and vibrant ecosystems; and reduces the heat we all know too well. Integrated water management treats water as an asset, as something to be carefully conserved, but also as something to be appreciated and used to the fullest.

Quality of Life

Left: Kids play soccer on the Lake Ponchartrain lakefront. Right: A Mardi Gras Indian on Bayou St. John.

Stormwater Management Benefits and Practices

This matrix provides a list of proposed water management strategies discussed in more detail in the Vision and Design reports and examines the breadth of benefits this type of integrated approach can offer. The matrix is an illustrative summary of how these strategies can produce different combinations of benefits.

○ Little Impact ◒ Some Impact ● High degree of impact

		DELAY							STORE			RECHARGE	DRAIN
		Green Roofs	Plants	Bioretention & Infiltration	Exfiltration	Pervious Paving	Water Harvesting	Subsurface Storage	Improved Canal	Storage Basin	Constructed Wetland	Circulating Network	Redirected Discharge
SAFETY	Provides Multi-Level Protection	○	◒	●	●	◒	○	◒	●	◒	●	◒	●
	Reduces Flood Risk	●	●	●	●	●	○	●	●	●	●	◒	●
	Limits Subsidence	○	◒	●	●	●	●	●	◒	●	○	●	○
ECONOMIC VITALITY	Reduces Damages due to Flooding and Subsidence	●	◒	●	●	●	◒	●	●	●	●	●	●
	Improves Insurability	◒	◒	◒	○	○	○	●	●	●	◒	○	◒
	Attracts & Retains Businesses and Investment	○	◒	○	○	○	○	◒	●	◒	◒	◒	◒
	Creates New Industry and Jobs	◒	○	◒	○	◒	●	●	●	●	◒	◒	○
	Uses Vacant & Blighted Properties	○	●	●	○	○	●	●	○	●	○	○	○
	Increases Property Values	○	◒	◒	○	○	○	◒	●	◒	○	◒	○
	Reduces Energy Consumption	●	●	◒	◒	◒	○	◒	◒	◒	◒	○	○
QUALITY OF LIFE	Uses Water to Improve Urban Quality and Value	○	○	●	○	○	●	●	●	●	●	●	◒
	Increases Citizen Wellbeing and Confidence	○	○	○	○	○	○	●	●	●	◒	◒	○
	Enhances Water & Air Quality	●	●	●	●	◒	○	○	●	○	●	●	○
	Reduces Heat Island Effect	●	●	●	●	●	○	◒	◒	◒	◒	○	◒
	Enriches Ecosystems	●	●	●	◒	◒	◒	◒	●	◒	●	○	○

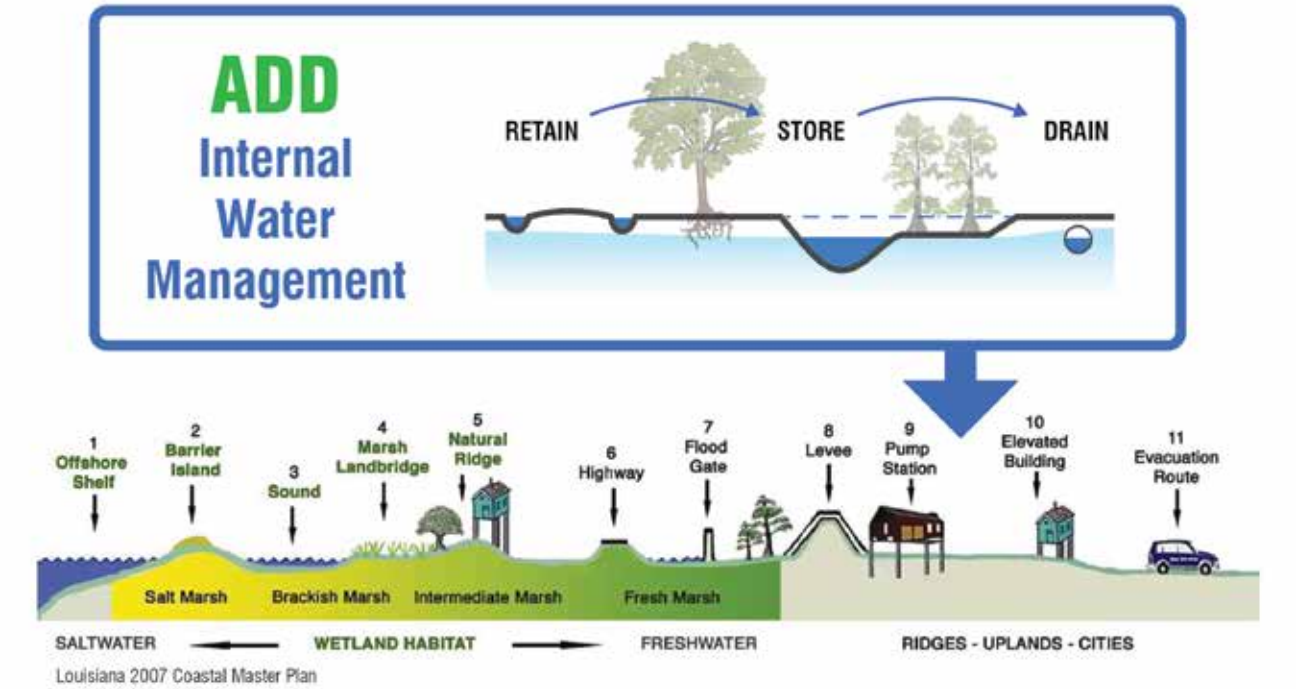
Provides Multi-Level Protection

- Strengthens lines of defense
- Reduces loads on existing drainage systems

Multiple lines of defense - healthy wetlands, a strong levee system, and urban water management - are essential to our region's future. An integrated urban water system supplements the region's existing flood defenses in a symbiotic way, protecting the surrounding infrastructure and reducing the load on the drainage systems, while relying on the integrity of these systems to ensure existing and new urban assets are themselves protected from catastrophic events. Through this strategy of layering, strengthening, and reinforcing, the region will experience myriad benefits, the primary of which is safety.

The levee system is not sufficient to protect our coastal communities over the long term... The landscape along the coast is drastically changing, which threatens an entire way of life for the people who live and work there. Adaptation is essential.

- Marco Cocito-Monoc, Greater New Orleans Foundation



Reduces Flood Risk

- Manages urban stormwater
- Reduces threat to life and property
- Improves insurability

New Orleans experiences incalculable losses each year from flooding caused by relatively common storm events. Integrated water management drastically reduces flood risk in a way that ensures the long-term safety and economic competitiveness of our city. Flooding does not only occur when a named storm comes ashore. Because of our sinking soil, antiquated and overtaxed drainage system, and unsustainable development practices, floods are an unfortunately common event that can be brought on by relatively common rain showers. These storm events impose significant safety risks and a major economic drain.

The quantitative costs of these events are alarming. Beyond structural damage and lost worker productivity, over 50 years these flood events produce over 450,000 tons of debris, displace over 639,000 people, and leave over 241,000 households in need of temporary shelter, with major implications for public health and safety. Local businesses bear economic costs that others in drier cities do not and property owners must shoulder costs that imply a trade-off with quality of life, reducing their overall happiness and prosperity. This reality is felt in municipality coffers too, as the flood events thwart the population and tax growth of the region. An integrated water system's signature techniques - slowing, storing, circulating, and recharging - directly manage urban water to lower the risk of water creeping in the front doors of homes or businesses.

Flood damage to structures and total economic loss to businesses and employees from frequent storm events is estimated to be **$7.9 billion** over 50 years.

Limits Subsidence

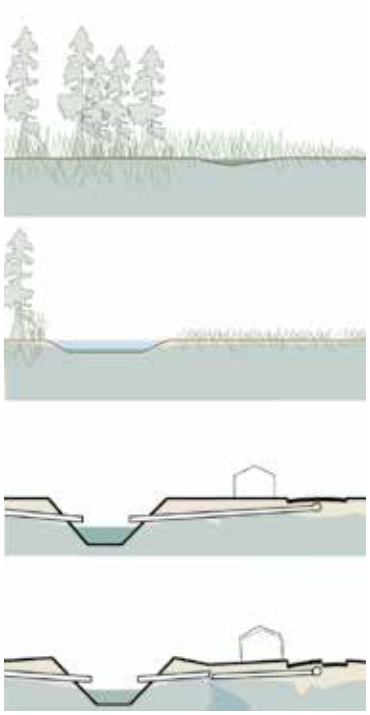
- Balances groundwater and stabilizes soils
- Helps maintain levee and floodwall integrity
- Helps maintain safe water supply
- Protects subsurface utility infrastructure

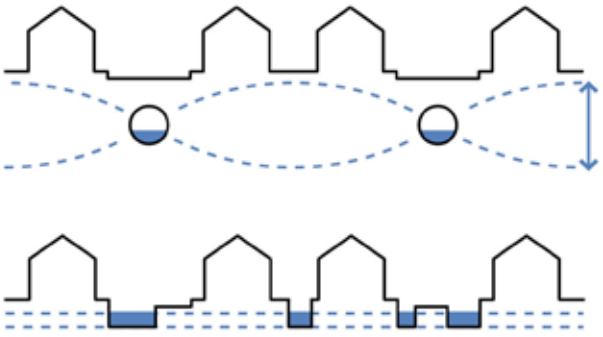
By slowing down stormwater and allowing it to infiltrate the ground, integrated water management balances groundwater, stabilizes soils, and limits subsidence. By actively managing the region's groundwater levels, the Urban Water Plan minimizes land subsidence, thereby reducing damage to structures and infrastructure, including levee improvement costs.

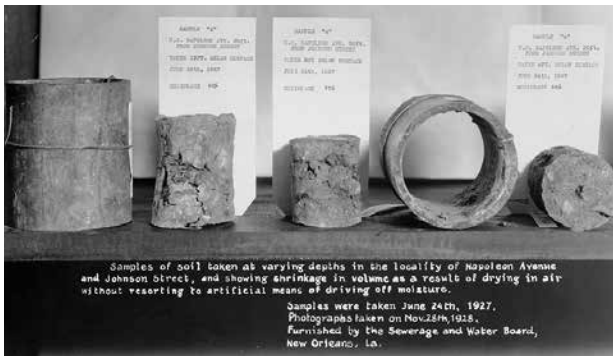
Property owners stand to gain significantly from anti-subsidence measures. Integrated water management could prevent up to $2.2 billion dollars in subsidence-related maintenance costs over the next 50 years. However, the 35,000 homes in the most subsidence-prone areas would also benefit from increased home values and the safety and peace of mind of living on stabler land.

Subsidence has profound effects on the water delivery system in New Orleans. According to the City of New Orleans' Department of Public Works, subsidence is responsible for the majority of their system's overall maintenance costs. Yearly repairs due to subsidence amount to millions of dollars, money that would be saved with an integrated urban water system. By stabilizing the ground around the regions's water delivery systems, quality, safety, and reliability would be improved.

Integrated water management can save property owners an estimated **$2.2 billion** in subsidence costs, impacting approximately 35,000 structures over the next 50 years.







Reduces Damages Due to Flooding and Subsidence

- Reduces flood-related property damage
- Reduces subsidence-related damage to structures and infrastructure
- Reduces cost of levee improvements

Integrated water management drastically reduces the economic impact of flooding and subsidence, resulting in billions of dollars in savings and creating conditions with profound secondary and tertiary economic benefits.

Integrated water management significantly reduces the direct costs of flooding and subsidence by curtailing flood-related property damage for residents and businesses and damage to structures and infrastructure. The direct savings of these improvements are staggering: $7.9 billion in reduced flood damage and $2.2 billion in savings due to reduced subsidence damage. And the ten-plus billion dollars in savings applies to structures alone; this total does not even account for infrastructure damage.

Integrated water management is a long-term solution, with long-term benefits. The costs of maintaining the status quo also stretch far into the future, but their distance makes them no less real. The value of the proposed solutions to subsidence will grow exponentially over the long term, as subsidence would have broader and more costly effects on the region if left unchecked. In a recent report by the U.S. Geological Survey, scientists hammered home this point saying that "within the next century, if nothing is done to modify New Orleans' existing infrastructure, some areas of the city that did not flood as a result of Hurricane Katrina will likely flood in a future storm due to subsidence and sea-level rise." (USGS 2007)

By radically reducing damages due to flooding and subsidence, **$10.1 billion** will be saved over the next 50 years.

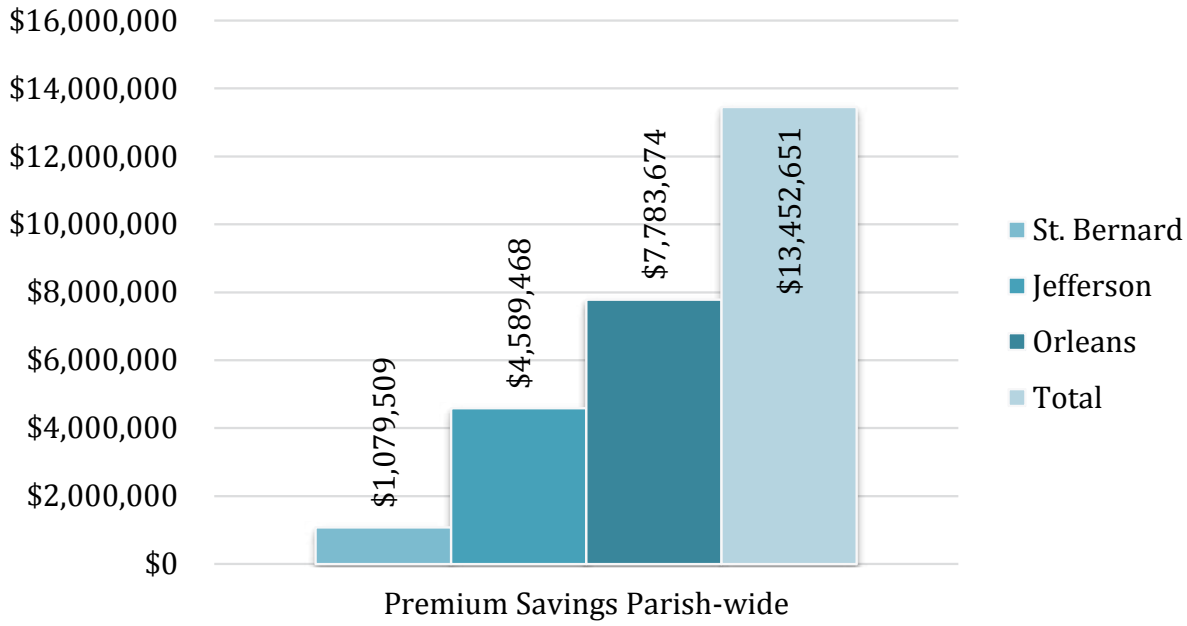
Improves Insurability

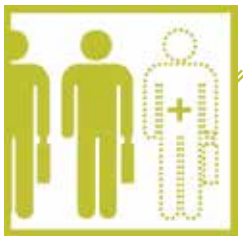
- Lowers insurance premiums and payouts
- Reduces repetitive loss claims
- Increases investor confidence

Ensuring the protection of our region's prized physical assets is essential. Integrated water management restores the confidence of insurers and policy holders by lowering flood risk, repetitive loss, and insurance rates.

Confidence is essential both to markets and to the people that sustain them. Currently insurance rates and repetitive loss ratios in the New Orleans area are alarming - they signal a major breach in confidence for premium holders, for insurance companies, and for the increasingly burdened National Flood Insurance Program. By mitigating flood risk and improving the NFIP's Community Rating System score, and thereby lowering insurance premiums, integrated water management proves that renovating our water infrastructure to be more sustainable can create real and direct economic benefits for our businesses and communities and restore confidence in the region.

A total estimated savings of nearly **$609 million** in insurance premiums can be realized over 50 years through NFIP's Community Rating System





Attracts & Retains Business and Investment

- Enhances region's marketability
- Attracts business and talent
- Attracts new real estate investment

Becoming America's premier water city would require the help of thousands of skilled workers and massive industrial might. However, with the safety and quality of life benefits of an integrated water system in place, this stimulus would give way to an economic renaissance.

An integrated urban water system signals the commitment of its citizens to safety and quality of life - two major considerations for knowledge workers seeking a new home or businesses looking for headquarters. This commitment benefits already established businesses - one need only to look at a regional map of oil and gas infrastructure to see how deeply dependent that industry is on our area. It also attracts others to the area, growing our population and our tax base. Finally, it signals to investors and populations at home and abroad that we are equally innovative and committed when it comes to our physical infrastructure and preserving the human, economic, and cultural capital that we depend on.

New York City has prioritized similar outcomes in its development of the High Line Park, on Manhattan's West Side. In 2002, planning commenced to create an elevated, linear park along the tracks of a disused railroad. In anticipation of this major urban intervention, the City of New York rezoned the adjacent neighborhoods to allow for higher density development, resulting in a 60% increase in population between 2000 and 2010. Mayor Michael Bloomberg has credited the High Line with attracting at least $2 billion of private investment. This figure includes over 2,500 residential units, 1,000 hotel rooms, and nearly 500,000 square feet of office space. About 8,000 construction jobs were created in addition to 12,000 permanent jobs.

"We view water management as critical to protecting our economic base."

- Robin Barnes, Executive Vice President & Chief Operating Officer of GNO Inc.

Creates New Industry and Jobs

- Creates an integrated water management industry
- Adds jobs and expertise
- Expands tax base

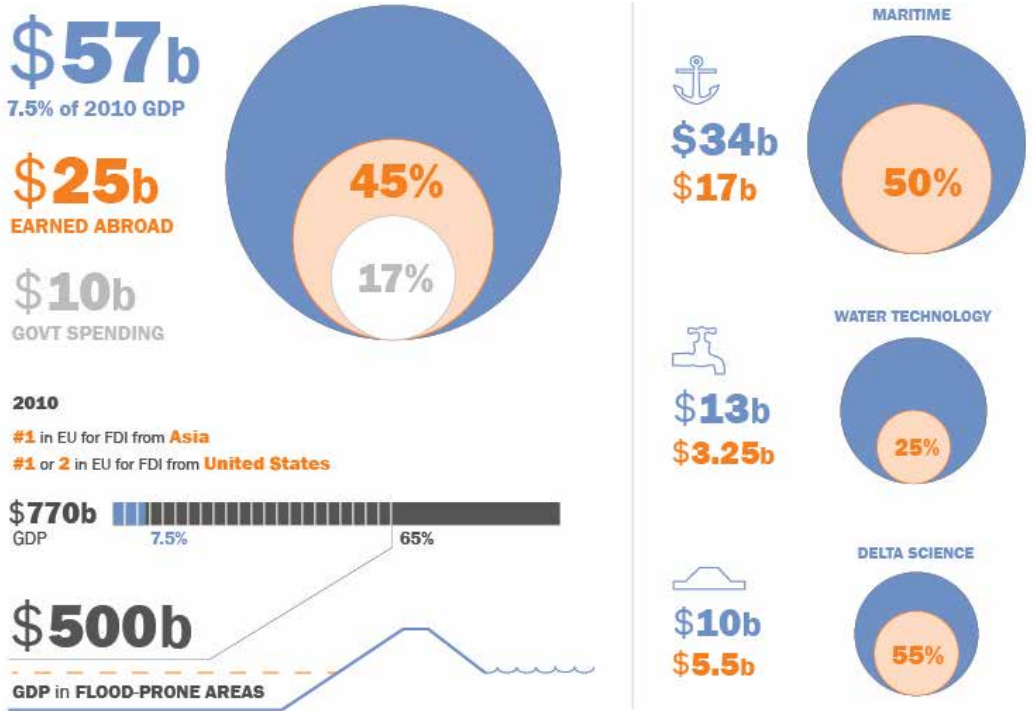
Integrated water management creates a "living lab" for developing and promoting advanced technologies, and builds a local base of highly skilled workers, technological expertise, and water management best practices, all primed for export to markets facing similar challenges.

The water sector in the Netherlands contributes 7.5% of that nation's gross domestic product and Dutch expertise is exported around the world. By developing industry-leading capabilities in supplementing and renovating existing water systems to meet the challenges of the environment, our region too can build a water sector that is a significant contributor to the area's gross domestic product.

Southern Louisiana has the potential to be an exporter and world leader in the field. Louisiana's Blue Ocean Study estimates that, by becoming a leader in a "nascent industry domestically with no clear regional leader," water management could account for 10,000 to 20,000 direct jobs and 20,000 to 45,000 indirect jobs in the state (McKinsey and Company 2010).

The Urban Water Plan can be a catalyst for change across the local workforce and economy. It immediately creates "green" and "blue" jobs in design, construction, and maintenance. In addition to the wages paid to individual workers, these new jobs create an economic benefit to society by reducing poverty and expanding the tax base.

The construction impact alone is estimated at **$11.3 billion** over the next 50 years, creating over **100,000 direct and indirect jobs** across the region.



Uses Vacant & Blighted Properties

- Reduces the burden of maintaining vacant & blighted properties
- Increases safety
- Facilitates residential and commercial market clearing
- Reduces cost of code enforcement

Integrated water management establishes a safer, more appealing use for the area's vacant and blighted properties, turning a liability into an asset and freeing public funds for more productive uses.

By reusing vacant property across the region to slow, store, and infiltrate water into the ground, integrated water management cuts public costs associated with no-gain maintenance while creating both a regional network and a neighborhood fabric of amenities. The New Orleans Redevelopment Authority, the entity responsible for maintaining New Orleans' vast vacant and blighted holdings, shoulders a large burden of the costs of maintaining properties, including mowing, clearing, code enforcement, and other tasks. A comprehensive approach to water management would reduce these costs, replacing unproductive assets with those that add value and safety to communities.

Over the next 50 years, city and parish governments will spend an estimated **$130 million** on no-gain maintenance costs. Using these properties for water management turns liability into an asset and makes better use of public funds.

Increases Property Values

- Creates and revitalizes commercial corridors
- Develops accessible waterfronts and parkland
- Supports improvement of adjacent neighborhoods

Integrated water management holds spatial issues as one of its primary concerns; enhanced scenic value is a necessary dividend of safety-first planning.

By directly improving the aesthetics and appeal of targeted areas, blue-green strategies create and revitalize commercial corridors and attract new real estate development. Yet the benefits radiate outward too. Adjacent neighborhoods will reap many of the benefits of decreased stormwater and flooding while sharing in access to world-class recreational and scenic amenities. Land adjacent to system interventions also will be ripe for new kinds of development previously unseen in the region.

Numerous studies show that access to natural space and water are desirable qualities for the development of real estate in urban areas, and drive up the value of properties with access to those amenities. For areas benefitting from the Urban Water Plan's proposed interventions, property values would increase by an estimated 1.9%, or $183 million, assuming intensive implementation. This value is not captured by any single developer or government entity - it is shared by all.

Implementation of the Urban Water Plan is expected to increase property values across the region by an estimated **$183 million** over 50 years.

Existing

Potential

Reduces Energy Consumption

- Alleviates loads on drainage infrastructure
- Cuts operating and maintenance costs
- Reduces energy use in air conditioning

Pumping water out of New Orleans after a rain storm is an incredible technological feat, but it is also very energy intensive and costly. Our region's pumps consume vast amounts of electricity, which is expensive and leads to poorer air quality via higher CO2 levels. The Urban Water Plan proposes strategies that alleviate loads on pumps and drainage infrastructure, reducing the costs and negative side effects associated with their operation. Furthermore, it does so in a way that relies on natural means, alleviating loads on drainage systems by storing water in the landscape and infiltrating the soil.

An integrated water system's energy-saving benefits also extend to homeowners and business owners. Some of the smaller, but equally important, tactics employed - green roofs, bioswales, permeable pavement, etc. - can greatly reduce the energy that residences and businesses use, saving them many dollars on electric bills. Green roofs, for example, reduce the amount of heat a building retains from the sun, reducing cooling needs. Trees, bioswales, and permeable pavement cool the air around buildings, similarly reducing dependence on air conditioning. All of these tactics achieve these secondary benefits while serving their primary purpose of slowing down and storing water.

"The more proactive steps taken, the fewer the consequences requiring adaptation."

- New Orleans Master Plan - City of New Orleans Carbon Footprint Report

Uses Water to Improve Urban Quality and Value

- Develops and enhances waterfronts and accessible public spaces
- Creates recreational opportunities
- Reduces water demand for irrigation and other low-end uses

Instead of pushing water to the margins as we have historically, integrated water management embraces it to build spatial, aesthetic, and recreational assets and a vibrant sense of place.

Trees, parks, and vegetation can transform an urban neighborhood into an inviting, exciting place to live, work and play. Water has a similar effect. One need only walk along Bayou St. John or around the ponds in City Park on a weekend to see this principle in action. Greater New Orleans residents clearly recognize and value this benefit, but from a planning perspective, these types of assets imply a radical redefinition of the region's relationship to water. A comprehensive approach to water management draws on the beauty and appeal of highly valued and appreciated spaces like Bayou St. John, Old Metairie, the Garden District, and St. Bernard's bayous to create new waterfronts and public spaces accessible to a broader, more diverse public.

By creating environments that foster interaction with water and green space, blue-green strategies have many tangential benefits. These newly accessible spaces improve recreational opportunities and encourage physical activity, from bike and pedestrian paths to water-focused playgrounds. They provide visual stimulation and enhance natural beauty, taking a waterway that once resembled a trash-strewn ditch and turning it into a canal worthy of Amsterdam. Studies have shown that providing access to open space, water, and nature increases the value of nearby vacant land, spurring new housing and commercial development.

By treating water as an asset, instead of as something to be expelled as quickly as possible, blue-green strategies encourage a sense of ownership and stewardship by the public. It develops infrastructure that is worth loving instead of hiding.

"Vibrant urban waterways play an important role in attracting small businesses and entrepreneurs to a region... [and] enhance America's scenic value while promoting economic and job growth."

- John Fernandez, U.S. Assistant Secretary of Commerce for Economic Development

Increases Citizen Well-being and Confidence

- Decreases risk of disruptions to life and work
- Protects unique local customs, existing ways of life and the cultural economy

By helping to build a safer, more productive, and more successful region, integrated water management increases citizen confidence with positive effects upon our economy and our culture.
At the most obvious level, integrated water management builds confidence by decreasing disruptions to life and work. By eliminating the majority of damages from flood events, it greatly improves the New Orleans region's resiliency. This will impact the daily life of citizens, who will no longer need to move their vehicles to neutral grounds or close their businesses during heavy rains.

The proposed strategies also link increased economic stability and lower property risk to a host of less easily quantifiable benefits, like long-term commitment to the area, happiness, and even improved overall physical and psychological health. Our city's cultural economy - one of the richest in the world by any measure - depends on the confidence and safety both of local cultural groups (from Mardi Gras Indians to Frenchmen Street musicians) and of tourists. It shows visitors that we are proactively preserving the cultural institutions they fall in love with, while building a dynamic environment in which they can safely enjoy jazz and creole cooking for years to come.

The Urban Water Plan builds this confidence through the immediate safety impacts of infrastructure improvements, but it also provides for present and future policies and social programs that build water literacy. Educational components tied to integrated water management would provide the foundation for sustaining a homegrown water management industry. Perhaps most importantly, this educational focus would create a more informed and confident public that is better able to address the future challenges of sea-level rise and increasingly severe storms.

"Three main qualities attach people to place: social offerings, such as entertainment venues and places to meet; openness (how welcoming a place is); and the area's aesthetics (its physical beauty and green spaces)."

- Knight Foundation, "Soul of the Community" study, 2011

Enhances Water & Air Quality

- Filters runoff
- Reduces health costs
- Makes water habitable

Instead of actively expelling water as the existing drainage system does, blue-green strategies - new trees, bioswales, green roofs, rain gardens, and the envisioned circulating canals - interact with water in a way that purifies it and makes it safe for play, all while producing cleaner air.

These strategies filter pollutants, detain, and infiltrate runoff while generating clean air in the process. They make water habitable (creating fun places to splash around during the hot summer months) and reduce the health costs associated with dirty water. The benefits spread into the soil too: blue-green strategies increase permeability and groundwater recharge, combatting subsidence and ensuring that existing drinking water delivery systems are not compromised by the structural failures that subsidence causes.

The air quality benefits of trees and plants stretch even further. By cooling the surrounding areas, they reduce the amount of electricity needed to cool nearby buildings and the amount of CO2 generated. By reducing the amount of water needed to be pumped, vegetation has a similar effect on the region's pumps: less pumping equals less accumulation of CO2.

"The New Orleans area's urban forest provides ecological benefits for managing stormwater and mitigating air pollution."

- American Forests, Urban Ecosystem Analysis for New Orleans Metro Area

Reduces Heat Island Effect

- Facilitates comfortable outdoor activity
- Reduces cooling requirements
- Cuts energy consumption

Because the materials of our built environment (asphalt, concrete, and steel) retain so much more heat than the natural environment does, on hot days the metropolitan area experiences a spike in temperatures relative to less-developed surrounding areas, creating a "heat island." The heat in our region is bad enough without our help and will get worse; record-breaking temperatures will be more frequent and severe in the future due to climate change. This type of heat poses serious health risks and economic and ecological costs.

The stormwater management best practices proposed in the Urban Water Plan reduce the severity of extreme heat events in a number of ways. By creating shade, planted trees reduce ambient air temperature and provide a naturally cool refuge for pedestrians. These best practices also reduce the amount of heat-absorbing pavement, substituting plants and water for asphalt. And the system's waterways emit surface-cooling water vapor, thereby serving as neighborhood air conditioners.

All of these factors make outdoor activity more comfortable, increasing the likelihood of exercise and its associated health benefits. Lowering heat also decreases the likelihood of severe heat-related medical issues. By combatting hot days through natural means, integrated water management also reduces our dependence on artificial air conditioning, an enormous factor in high summer energy bills and increased C02 levels.

"Hard surfaces like parking lots and rooftops can be 50–90°F hotter than the surrounding air, causing higher temperatures in urban areas compared to more rural areas"

- US EPA, "What is an Urban Heat Island?"

Enriches Ecosystems

- Restores and creates habitats
- Improves wetlands and fisheries
- Attracts ecotourism
- Supports biodiversity
- Controls mosquitoes

By restoring habitats and rebuilding the natural environment around us, integrated water management nourishes the ecosystems that our region's economy, culture, and well-being depend on. The health of these ecosystems - its animals, plants, and the systems that sustain them - are critically important.

In order to ensure that we help sustain our natural environment (instead of detracting from it), proposed interventions in the Urban Water Plan restore and create habitats within and around the study area by building newly habitable green and blue spaces and by improving the health of wetlands. These new habitats in turn support biodiversity, which is essential to the regional environment's health and sustainability and to establishing resilience in the face of storms.

An important benefit is that these strategies reduce standing water and circulate water in newly established waterways, thereby preventing mosquitoes from reproducing.

"Quality of place does not occur automatically; it is an ongoing, dynamic process that engages a number of disparate aspects of a community."

- Richard Florida, author of *The Rise of the Creative Class*

3 The Water Plan

STRATEGIES, PHASING, AND COST

The Greater New Orleans Urban Water Plan is a water-based landscape and urban design proposal that illustrates how the region can live with water rather than fight against it. It employs a multi-layered, ground-up approach that is science-based, place-based, and adaptable, and proposes variably scaled strategies that can be implemented incrementally, starting right away.

Building on existing infrastructure one step at a time, the long-term vision of the Urban Water Plan is to increase water storage capacity by layering a system of waterways on street grids that supplements the current drainage system. In the near term, a series of cost-effective, smart retrofits that employ sustainable, or "blue-green," stormwater practices can help balance traditional cost-prohibitive stormwater management solutions ("grey infrastructure"). This, in turn, achieves flood and subsidence reductions while enhancing the region's identity. Providing clean and accessible waterways, the Urban Water Plan offers not only a transformative vision for sustaining our region, but a comprehensive investment strategy for coordinated infrastructure and development based on our water system.

This chapter summarizes proposed strategies and demonstration projects, outlines prioritization criteria and phasing, and provides an order-of-magnitude cost for the long-term Urban Water Plan vision.

Integrated Water Management

This is the practice of managing water on a community scale in ways that produce amenity values and increase the effectiveness of the existing public water infrastructure by relieving it of the burden of handling peak flows and events that go beyond its design capacity.

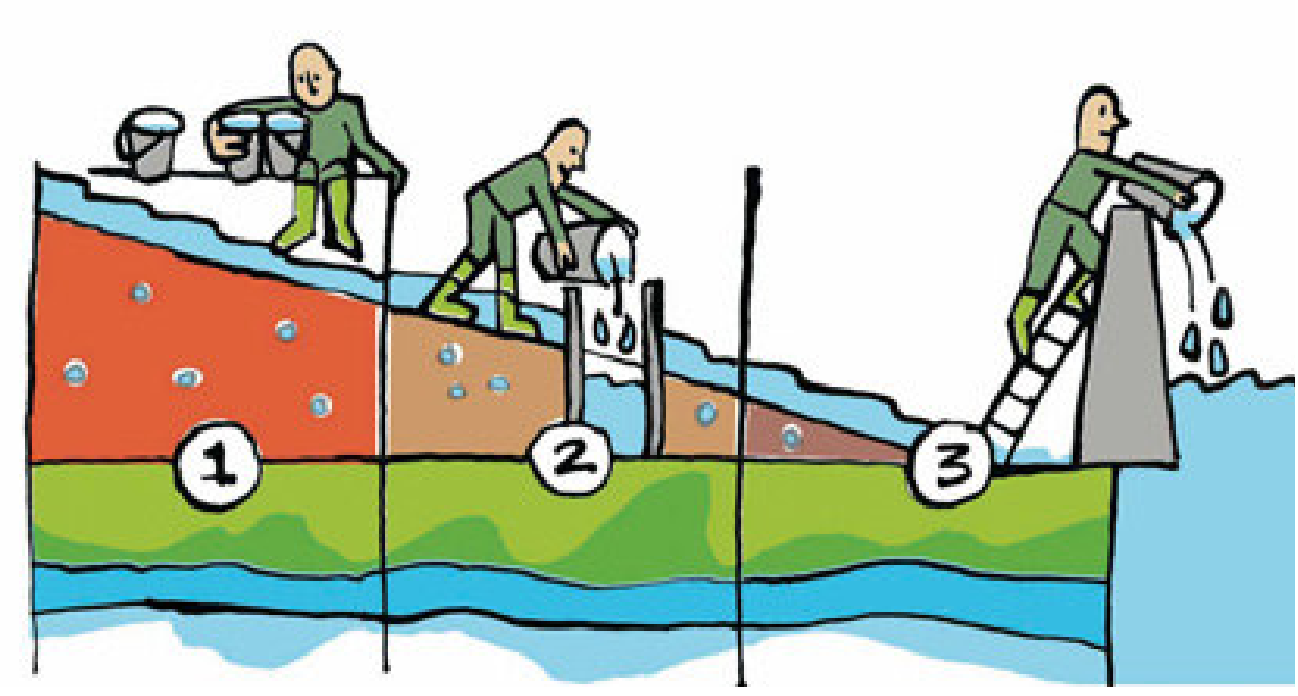
While no city in the United States has a comprehensive water plan of this type, Amsterdam and Rotterdam are currently implementing the second versions of their water plans. The Netherlands is a flood-prone nation that earns 60% of its GDP below sea level and has gained valuable knowledge through centuries of trial and error. The Dutch owe their survival and success to multiple lines of flood defenses and to their sustainable approach of living with water and building with nature. They have shown delta cities with issues similar to those of the Greater New Orleans region that living below sea level is possible, but requires adaptation.

A key tenet of the Dutch model is the **slow, store & use, and drain** approach. Rather than pumping away every drop that falls as quickly as possible, this paradigm entails slowing down the water using bioretention and infiltration strategies like rain gardens and bioswales, storing it in the landscape longer by retrofitting canals and finding space for new canals and ponds, and draining it only when necessary. When properly designed, these water features add value to communities and facilitate redevelopment in their environs.

The Dutch also have developed the principles of **circulate & recharge** that are

Dutch Model

Slow Store & Use Drain only when necessary



operative during dry times. A circulating system allows water to filter through blue-green infrastructure and enables groundwater to be recharged, controlling subsidence, preventing mosquitoes from breeding, and improving water quality.

System Components

The Urban Water Plan describes seven interdependent components that join together the capacity of existing systems with that of the region's open spaces, soils, plants, and wetlands:

Small-scale Retrofits in streets, on individual properties, in parks, and in squares and plazas slow and store stormwater, catching and infiltrating water where it falls. Interceptor streets on high ground are a critical subset of small-scale retrofits.

Circulating Canals in the region's bowls and lowlands recharge groundwater and sustain local habitats. During wet weather, they continue to serve as drainage conduits.

Strategic Parklands at key junctures of the integrated living water system contain vast quantities of stormwater during heavy rains, while providing valuable open space and recreational amenities.

Integrated Wetlands located within strategic parklands and distributed throughout the region store and filter stormwater and dry weather flows. Existing wetlands are restored with treated wastewater and filtered stormwater.

Integrated Waterworks are the water treatment plants, drainage pumps, siphons, sluices, weirs, and gates that contain, draw, redirect, and filter stormwater, surface water, groundwater, drinking water, sewage, and industrial wastewater. They are the components that establish the flows and rhythms of the living water system.

Regional Monitoring Networks for surface water and groundwater provide system managers with real-time data that are necessary to address immediate drainage needs and long-term trends in water levels and water quality, and to maintain higher water levels without compromising safety.

Waterfront Development Zones around key waterways and parklands anchor the development of higher-density, multi-use districts defined by urban water assets.

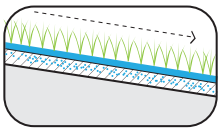
Existing drainage ditches are often unsightly and dangerous and detract from surrounding neighborhoods

Water infrastructure can become attractive and valuable

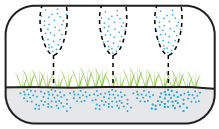
Following the Dutch model, canals can become community assets where families can gather and children can play

Slow

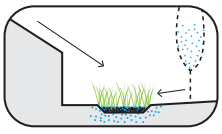
GREEN ROOFS



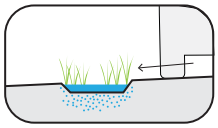
TREES & PLANTS



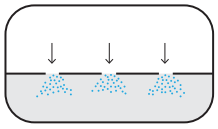
RAIN GARDEN



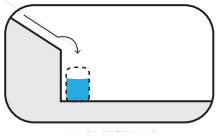
BIOSWALE



PERVIOUS PAVING



WATER HARVESTING



Slow, Store, Drain, and Circulate & Recharge are the practices and strategies that comprise the toolbox of the Urban Water Plan and are defined and discussed in more detail in the Plan's System Design report. Some are familiar and widely used, while others are specific and unique to this project. Familiar practices are listed and illustrated in this section without definition, while specific strategies are illustrated and briefly described.

Slow

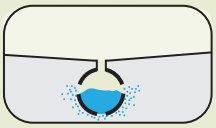
"Slow" strategies, otherwise known as stormwater best management practices (BMPs) or green infrastructure, include rain gardens and bioswales, trees and plants, pervious paving, green roofs, and water harvesting. Relatively small in scale compared to store and drain measures, these practices can have significant impact when distributed over a large area. Increasingly popular in recent years, these strategies capture and infiltrate rain where it falls, thus delaying the water's journey to drainage systems and reducing polluted stormwater runoff. Long-term green infrastructure plans are in use in numerous cities around the country, including Philadelphia, Portland, Ore., Seattle, Milwaukee, New York, Syracuse, NY, and Washington, DC.

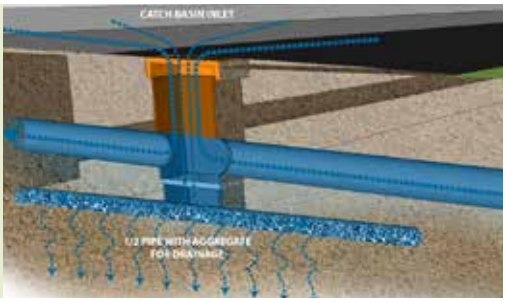
These and other case studies (a few of which are included in Appendix D) have shown that implementation of these practices relies largely on local actions. These include establishing strong water retention standards for new development and redevelopment, providing incentives for private parties to reduce existing impervious surfaces and install green infrastructure, a commitment by local governments to incorporate best practices in public works projects, a dedicated funding source, and close collaboration among agencies.

Store & Use

Generally larger in scale, "store" measures include both well-known practices like storage basins, constructed wetlands, and subsurface storage, and specific recommendations like widening existing canals and finding space for new canals to store excess water longer in the region's

EXFILTRATION BASINS are a redesign of typical catch basins and manholes found throughout the region. The basins enable water to gradually enter the groundwater system through a pervious bottom and a spread aggregate base. A system of these basins provides for a distributed method of recharging groundwater.

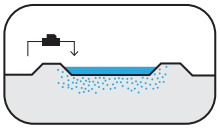




landscape. According to our team's hydraulic model that tested various scenarios, water storage has the biggest impact on flood reduction in the region. These interventions also do more to address subsidence as they allow water to infiltrate the ground and balance water levels. More information on the hydraulic model and its results can be found in the Plan's Water System Analysis report.

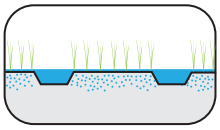
Store

STORAGE BASINS

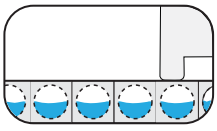


In addition to the action needed for the implementation of strategies that slow down water, the establishment of a stormwater/groundwater management unit in each parish will be key to the implementation of store strategies. Beyond MS4 (municipal separate stormwater sewer systems) compliance, this unit would be dedicated to finding and funding softer and more cost-effective water storage solutions, as well as operating and maintaining them.

CONSTRUCTED WETLAND



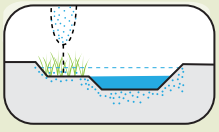
SUBSURFACE STORAGE



Drain

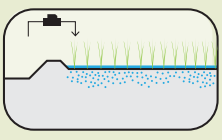
With the progressive installation of slow and store practices, loads on current drainage systems are reduced significantly,

IMPROVED CANAL is an existing canal that has been renovated to widen its banks and provide a stepped platform, where possible, that can serve as an inviting public space during dry weather and as extra water storage during heavy rains. This practice of controlled flooding is widely used in the Netherlands.

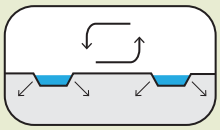


REDIRECTED DISCHARGE is a strategy that provides a shorter drainage route by redirecting some of the discharge to the river, the Industrial Canal, and the natural wetlands. This will relieve currently overloaded canals, allow for raised water levels in proposed circulating networks, and contribute to wetland restoration.

Drain



Circulate & Recharge



CIRCULATING NETWORK is a connected system of canals where water is pumped out only when necessary, allowing water to circulate and groundwater to recharge, while maintaining beautiful waterways throughout the project area. In dry times, siphons can replenish water levels in the canal system by pulling water from outlying sources.

allowing them to handle more efficiently any remaining rainfall that is not absorbed or stored in the landscape. The proposed drain strategies redirect discharge to shorter routes and make the proposed circulating system and raised water levels possible.

In addition to the implementation steps discussed, and with stormwater/groundwater management units in place, an upgraded drainage system and circulating network will largely rely on inter-parish collaboration. This regional cooperation, in turn, will be facilitated by the establishment of a regional water management authority. This new authority can coordinate integrated water management initiatives, help generate funding, and monitor progress to ensure water quantity and quality objectives have been met. Meanwhile, risk assessment and management agencies at the state and federal levels will need to adopt a more comprehensive approach to flood risk and provide guidance and funding for integrated water management.

Circulate & Recharge

A circulating network of canals is part of the long-term vision of the Urban Water Plan and a key strategy for combating subsidence while adding value to the region's landscape.

The operation of this system will require an upgraded pumping and treatment system with real-time controls and a groundwater monitoring network to manage surface water levels and control subsidence.

Solutions at Multiple Scales

The implementation of an integrated water management system will occur in phases and at multiple scales.

At the lot level, homeowners and businesses can disconnect downspouts, collect and use water in cisterns, plant native and hydrophilic (water-loving) trees and vegetation, install rain gardens and bioswales, and use pervious paving on driveways and parking lots.

Underdeveloped blocks with vacant and blighted properties can aggregate unused lots where possible, and use them to slow down or store stormwater and enhance neighborhoods.

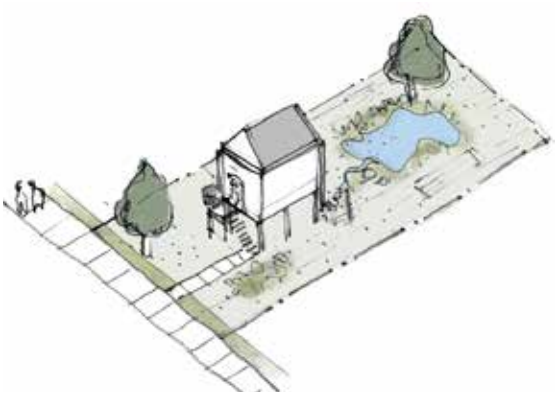
Districts - defined in terms of neighborhoods, street patterns, density, landscape type, land use, and land cover - can be used to test and showcase stormwater management principles at a prototype scale.

Sub-basins exist within a larger basin but exhibit variable landscape and hydraulic characteristics and are defined either by the Metairie or Gentilly Ridge in Jefferson and Orleans respectively, or by the Violet Diversion in St. Bernard. At this scale, various strategies can be implemented including redirecting discharge to optimize drainage systems.

Basins are individually protected by perimeter levees and separated from each other by water bodies. Within the project area, three basins have been identified: Jefferson/Orleans, New Orleans East, and St. Bernard/Lower 9th Ward. Basins require a combination of strategies specific to their landscape and hydraulics.

Finally, the regional scale is comprised of the three defined basins and it illustrates the vision and potential of structural renovation and innovation with the common goal of improving safety, economic vitality, and quality of life region-wide.

Solutions at Multiple Scales



1 Lot

Houses & Gardens Slow the Flow

4 Sub-basin

Redirected Discharge Optimizes Current Drainage System

2 Block

Vacant Lots Store Water

5 Basin

Redirected Discharge Restores Natural Wetlands

3 District

Street Retrofits Slow the Flow

6 Region

Integrated Water System Builds Safety and Value

Phasing

The Urban Water Plan's vision is not about a single solution. It is a long-term strategy that identifies short-term and long-term projects and prototypes that can be repeated and incrementally distributed throughout the region. Some solutions can be implemented immediately and produce immediate benefits, and others can be rolled out over time.

Building an integrated living water system one step at a time

Smart Retrofits

System implementation is best described as a series of "smart retrofits," or design interventions that build on legacy infrastructure to create something transformative. Though these retrofits are independent of one another, they eventually connect to form an integrated system. Because of the phased retrofit approach, project costs are spread out over decades, even as benefits start to accrue immediately. Each project will entail an iterative process:

- **Design**: employ site-specific best management practices and special consideration for spatial quality
- **Build**: use state of the art, sustainable building materials and practices
- **Monitor**: collect data on site performance
- **Feedback**: solicit community input

Prioritization Criteria

Each project developed by the Urban Water Plan is prioritized according to the following criteria:

- **Feasibility**: the presence of, or a project's ability to draw, committed stakeholders, advocates, and funding.
- **Opportunity**: the extent to which a project can influence and incorporate water management practices into projects already planned and underway, and possibly leverage existing funding opportunities.
- **Water Objectives**: the extent to which a project contributes to the Urban Water Plan's basic objectives of water quantity, water quality, and subsidence control, and positively impacts surrounding areas and larger water systems.
- **Spatial Objectives**: the extent to which a project exhibits innovation and can become a leading example of spatial quality and urban identity.
- **Project Goals**: the extent to which a project contributes to the three principal goals of the Urban Water Plan: improved safety, economic vitality, and quality of life.

Near Term

2013-2020

Smart Retrofits

Water management strategies are incorporated into projects already planned and underway, with a priority on demonstration projects that either build on current efforts or have committed stakeholders to help move them forward. Community outreach, educational initiatives, and advocacy for recommended policies and funding mechanisms are launched.

Medium Term

2020-2030

Improved Flows and Connectivity

As demonstration projects are assessed and planning principles refined, the Urban Water Plan expands beyond demonstration projects to establish improved water flows and connectivity and to test new standards and best practices for both public works and private properties. Pilot programs for funding, policy, and education are implemented and begin to position the region as a water management industry leader.

Long Term

2030-2065

New policies and broad buy-in

As new policies are adopted, regulations are put in place, broader water literacy and understanding are achieved, and public and private commitment is established, the Urban Water Plan's strategies will continue to adapt and spread over the long term to achieve sustainability and resiliency throughout the region.

Aerial view of Lafitte Greenway existing (top) and potential Blueway (above)

Demonstration Projects

The first step toward implementation is the design and installation of site-specific projects that can serve as proofs-of-concept and inspiration. The Urban Water Plan includes seven demonstration projects developed at the schematic design level and include corresponding estimates of probable cost.

This section provides a brief description of each demonstration project, illustrating the existing condition and envisioned potential for each site. These are discussed further in the Urban Design and individual Demonstration Project reports that provide each project's full design details.

Mirabeau Water Garden Plan

MIRABEAU WATER GARDEN

Twenty-five acres of land rests unused in the heart of the Filmore neighborhood, between Bayou St. John and the London Avenue Canal. Owned by the Sisters of St. Joseph, who wish to "partner with others to facilitate systemic change" in the region, this parcel remains one of the few large properties in the city under single ownership. By diverting water from a drainage pipeline on Mirabeau Avenue into the site and creating a water plaza and wetland filtration system to hold and manage stormwater, the load on Pump Station #4 is significantly reduced, enabling it to function more efficiently.

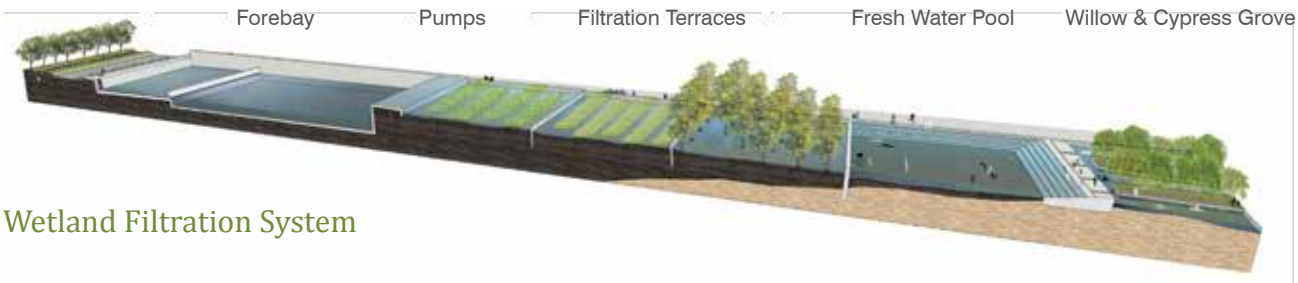
In addition to the wetland filtration zone, the site includes rain gardens and bioswales, channels and pathways, as well as eco-classrooms, building space, athletic fields, and a memorial to the congregation, thereby providing water education and recreation, as well as a prototypical solution for the low-lying lakeside region.

Demonstration Projects and Districts

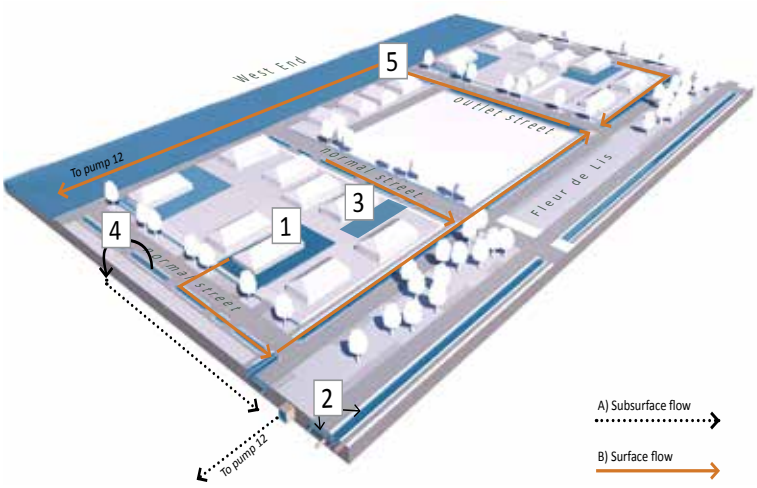
Mirabeau Water Garden

Existing

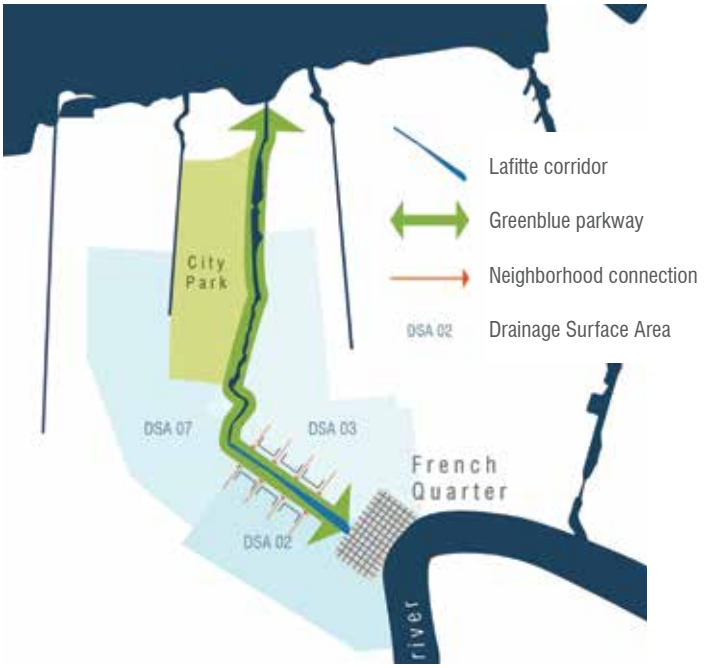
Potential



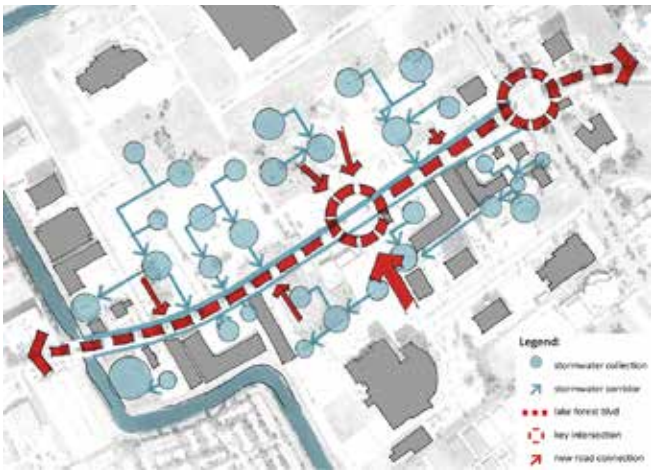
Wetland Filtration System



Lakeview Floating Streets Concept



Lafitte Blueway Context Map



Eastern Water Walk Stormwater Strategy

LAKEVIEW FLOATING STREETS

Many streets throughout the project area are in poor condition due to weak organic soils and low water tables. “Floating streets” is a proposal for a new standard street that allows water to infiltrate the ground and help raise groundwater levels to stabilize the soils. It includes integrated water management strategies, an organized subsurface utility system, and safe transportation including bicycles and pedestrians. The new standard street is part of a larger comprehensive system that includes infiltration zones, storage areas, surface and subsurface drainage. The complete system is tested in a demonstration project area in Lakeview.

LAFITTE BLUEWAY

The Lafitte Corridor is a 3.1 mile linear open space that was once the Carondelet Canal and the historical entry to the French Quarter from Lake Pontchartrain via Bayou St. John. Now filled and ignored, the former navigation canal and an abandoned railway remain as a public right-of-way. The current Lafitte Greenway is a City of New Orleans project that includes a pedestrian trail, bicycle path, and recreational amenities. The proposed Lafitte Blueway incorporates and builds upon the city’s master plan and provides an opportunity for a restored water identity within the heart of the city. With its connection to one of the city’s few open waterways, the Blueway is a key element of a sustainable water management system, necessary for mitigating flooding, recharging groundwater, and improving water quality.

EASTERN WATER WALK

Sited in a commercial area of New Orleans East, the Eastern Water Walk seeks to address the design conflict between economically viable development and stormwater management by threading together traditionally distinct program elements to provide multiple functions on the same square footage. To address stormwater demands on-site, the project integrates a vascular system of stormwater collection throughout existing and proposed commercial development with Lake Forest Boulevard operating as the main spine. Adjustments within the boulevard’s right-of-way allow for

Lakeview Floating Streets

Existing

Potential

Lafitte Blueway

Existing

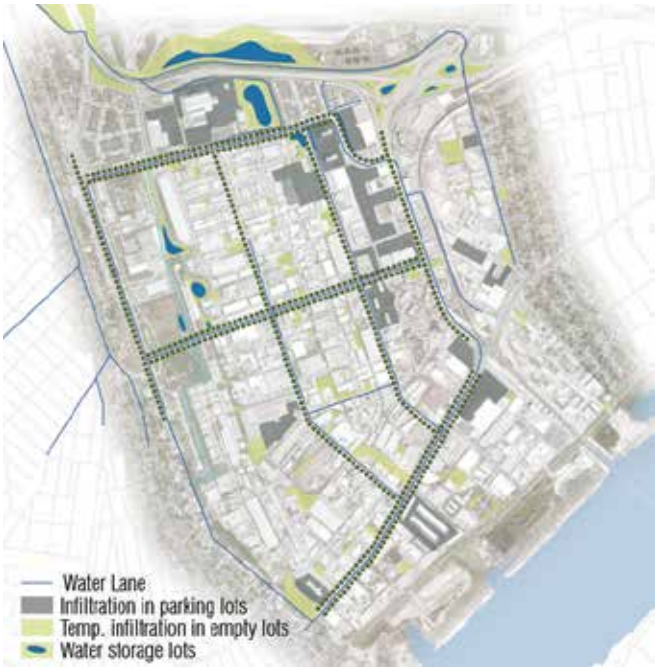
Potential

Eastern Water Walk

Existing

Potential

Canal Street Canal Plan



Elmwood Water Lanes & Fields Plan

40 Arpent Canal Zone Plan

designated bicycle and pedestrian areas, while bioswales on either side of the street turn Lake Forest into a major stormwater corridor for the project area.

CANAL STREET CANAL

Canal Street Canal is a small neighborhood canal in Old Metairie, the first suburb of New Orleans, with a manually operated gate that closes when water levels are high to protect the neighborhood from flooding and opens when levels are low to drain larger areas beyond the neighborhood. By closing the gate, water levels and infiltration scenarios in this isolated system can be tested. The renovation of this canal seeks to increase water storage capacity and groundwater recharge, as well as improve its aesthetic quality and transform the corridor into a neighborhood asset and amenity.

ELMWOOD FIELDS AND WATER LANES

Once called Elmwood Park and now a heavily paved commercial district, Elmwood is the source of much of the flooding from runoff that occurs not only within its bounds but also throughout the riverside portions of Jefferson Parish. By peeling back pavement where possible and transforming street edges, rights of way and parking lots into an interconnected network of water storage spaces, value will be added to retail and commercial developments while limiting flooding within the district and beyond.

FORTY ARPENT CANAL ZONE

The 40 Arpent Canal, a system-scale outfall canal, forms the northern boundary between St. Bernard parish and the Central Wetlands Unit. Separated from the wetlands by a flood protection levee, the study area is where the 40 Arpent meets an earthen lateral canal, the Chalmette Vista. Characterized by single-family residences, more than half of the area is still vacant due to Hurricane Katrina. This demonstration aims to meet water storage and subsidence control objectives by retrofitting the canals, thereby transforming the area into a productive destination landscape for residents and visitors.

Canal Street Canal

Existing

Potential

Elmwood Fields and Water Lanes

Existing

Potential

Forty Arpent Canal Zone

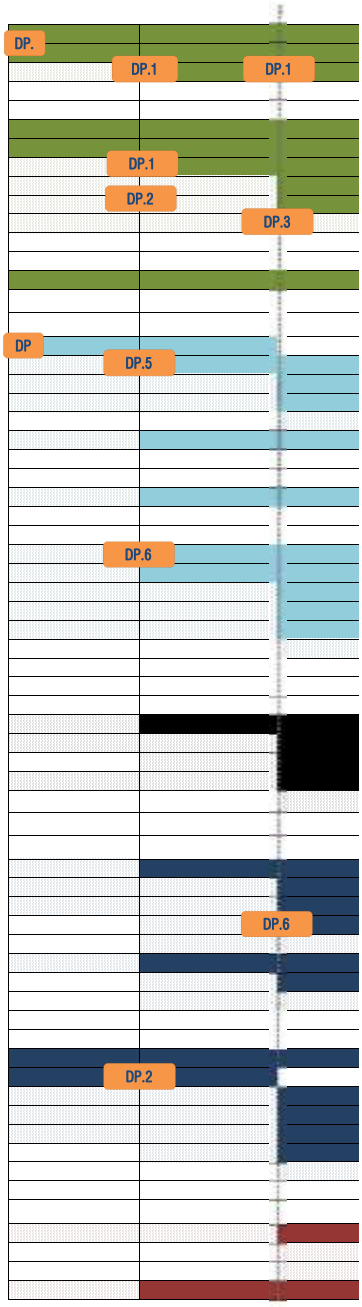
Existing

Potential

System Phasing Schedule

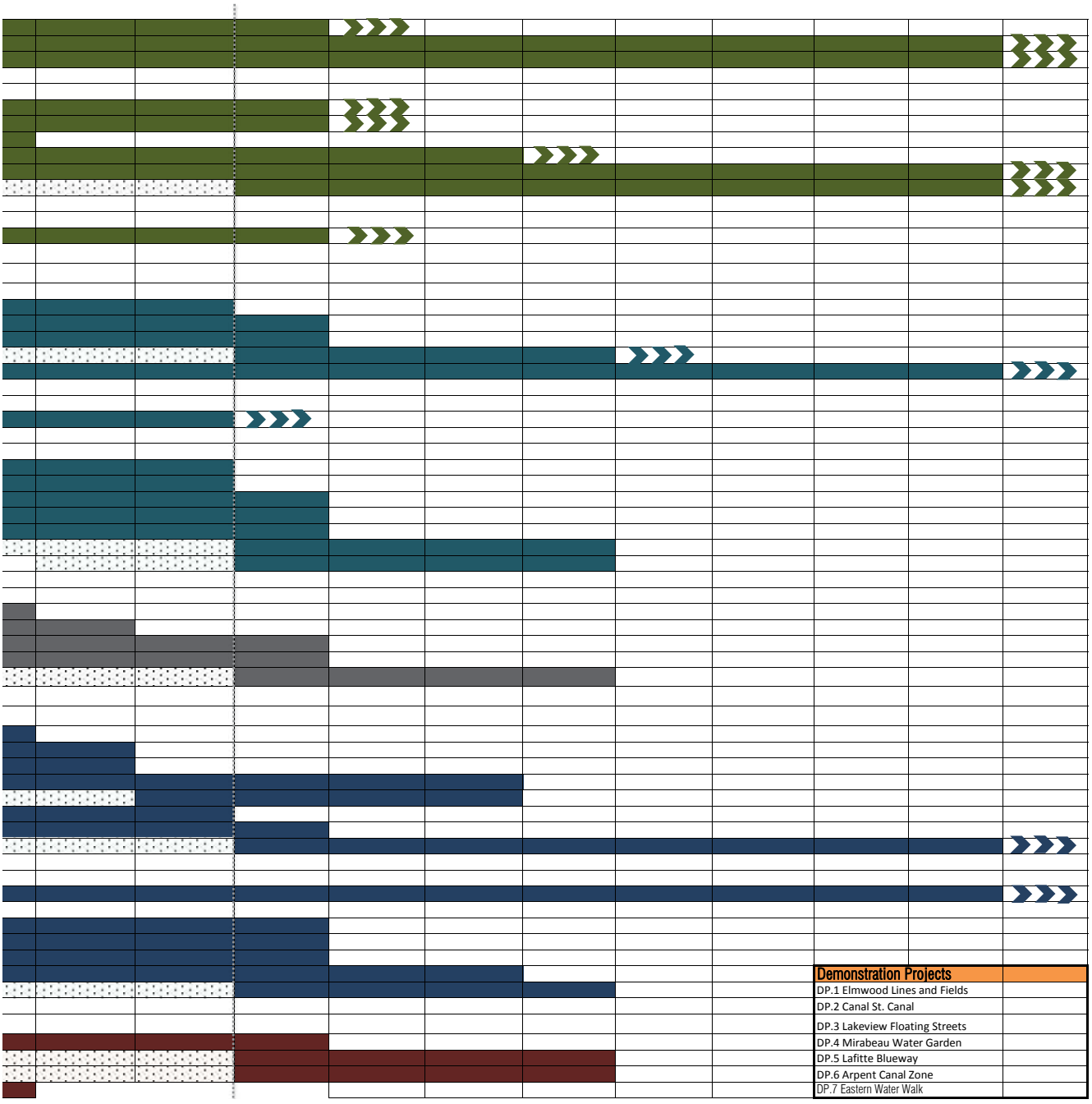
Phasing of the long-term Water Plan Vision

	PROJECT/PROGRAM/OPERATION	NEAR TERM 2013-2020
SLOW	**Objective: 1.25" of detention/retention on properties** SL.1 tree planting and rainwater harvesting SL.2 on-site detention, pervious surfaces SL.3 green roofs **Objective: rebuilt street infrastructure** SL.4 street trees SL.5 roadside swales, rain gardens, pervious pavement SL. 6 Elmwood water lanes SL.7 backslope interceptor streets SL.8 exfiltrating catch basins and pipes SL.9 floating streets **Objective: 20% of vacant lots with 3' of storage** SL.10 vacant lot retrofits (stormwater lots)	
STORE	**Objective: neighborhood/district scale water parks** ST. 1 Mirabeau Water Garden, 7th Street ST. 2 Lafitte Blueway ST.3 Chalmette Blueway, Valero Buffer ST.4 West End Blueway ST.5 connect Orleans East canals to lakes ST.6 parks network; NORD (and equivalent) partnership **Objective: detention/retention next to and below highways** ST.7 interchange and underpass basins **Objective:system scale storage and filtration** ST.8 parklands (St. Bernard 40 Arpent Zone) ST.9 parklands (Airport) ST.10 parklands (Earhart) ST.11 parklands (Kenner) ST.12 parklands (Florida) ST.13 parklands (Monticello) ST.14 parklands (Orleans East)	
DRAIN	**Objective: split at the ridge** DR.1 Harahan Pump to the River expansion DR.2 Orleans PS 19 expansion DR.3 Claiborne and Florida Canal Downriver DR.4 Monticello Pump to the River DR.5 Claiborne Canal Upriver	
CIRCULATE & RECHARGE	**Objective: re-establish and enhance flows** CR.1 L9 to St. Bernard connection CR.2 Dwyer to Bayou Michoud connection CR.3 Kenner (Parish Line) Pump Station expansion CR.4 Orleans East lateral canals CR.5 Morrison Pump Station to Bayou Sauvage CR.6 brackish water sources (Lake and Bayou St. John) CR.7 freshwater sources (River) CR.8 freshwater sources (treated wastewater and industrial effluent) **Objective: enhanced water level management** CR.9 water levels monitoring network (ground and surface) CR.10 raise water levels: phase 1 (seasonal/pilot programs) CR.11 raise water levels: phase 2 (Upper St. Bernard canals) CR.12 raise water levels: phase 2 (Orleans East circulating canals) CR.13 raise water levels: phase 2 (Jefferson circulating canals) CR.14 raise water levels: phase 2 (Orleans circulating canals) CR.15 raise water levels: phase 2 (Lower St. Bernard Bayou Terre Aux Boeufs)	
ORLEANS OUTFALL CANALS	**Objective: develop outfall canals as waterfront zones** OOC.1 Orleans Ave. Outfall Canal OOC.2 Seventeenth Street Outfall Canal OOC.3 London Avenue Outfall Canal OOC.4 London Avenue Urban Wetland	



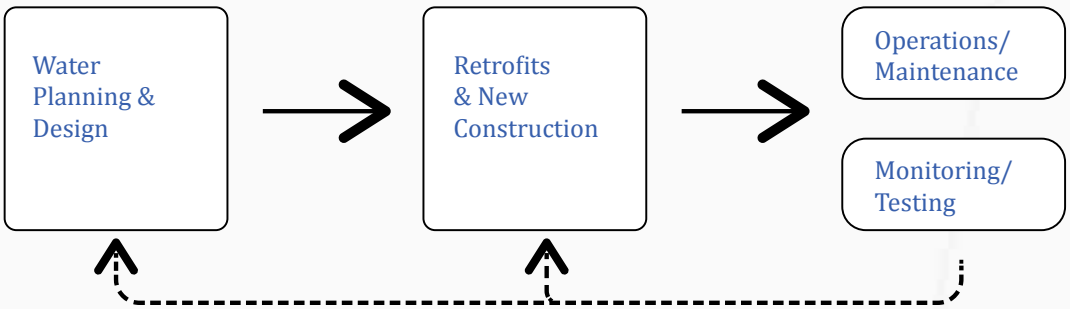
MID TERM 2020-2030

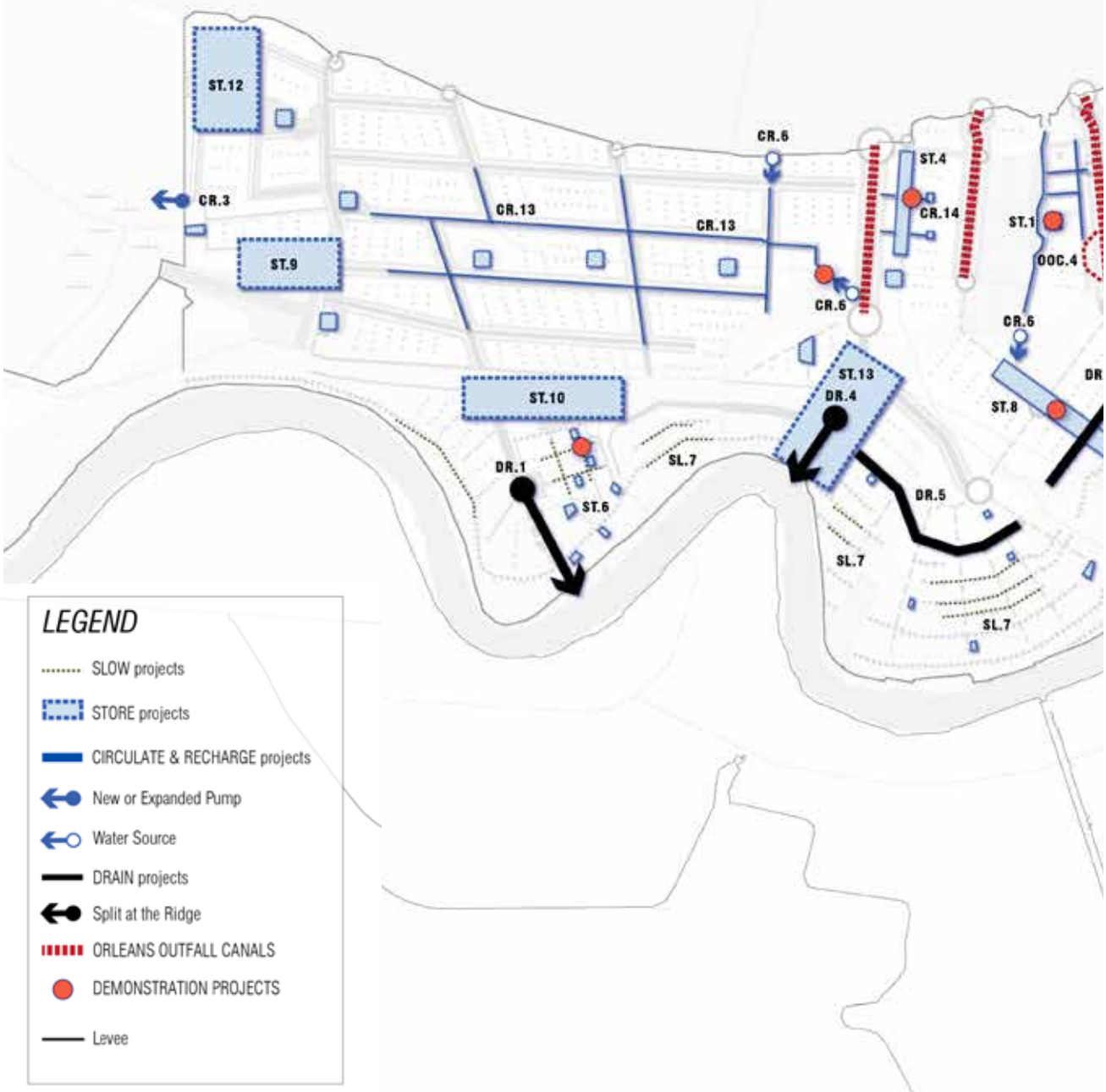
LONG TERM 2030-2065

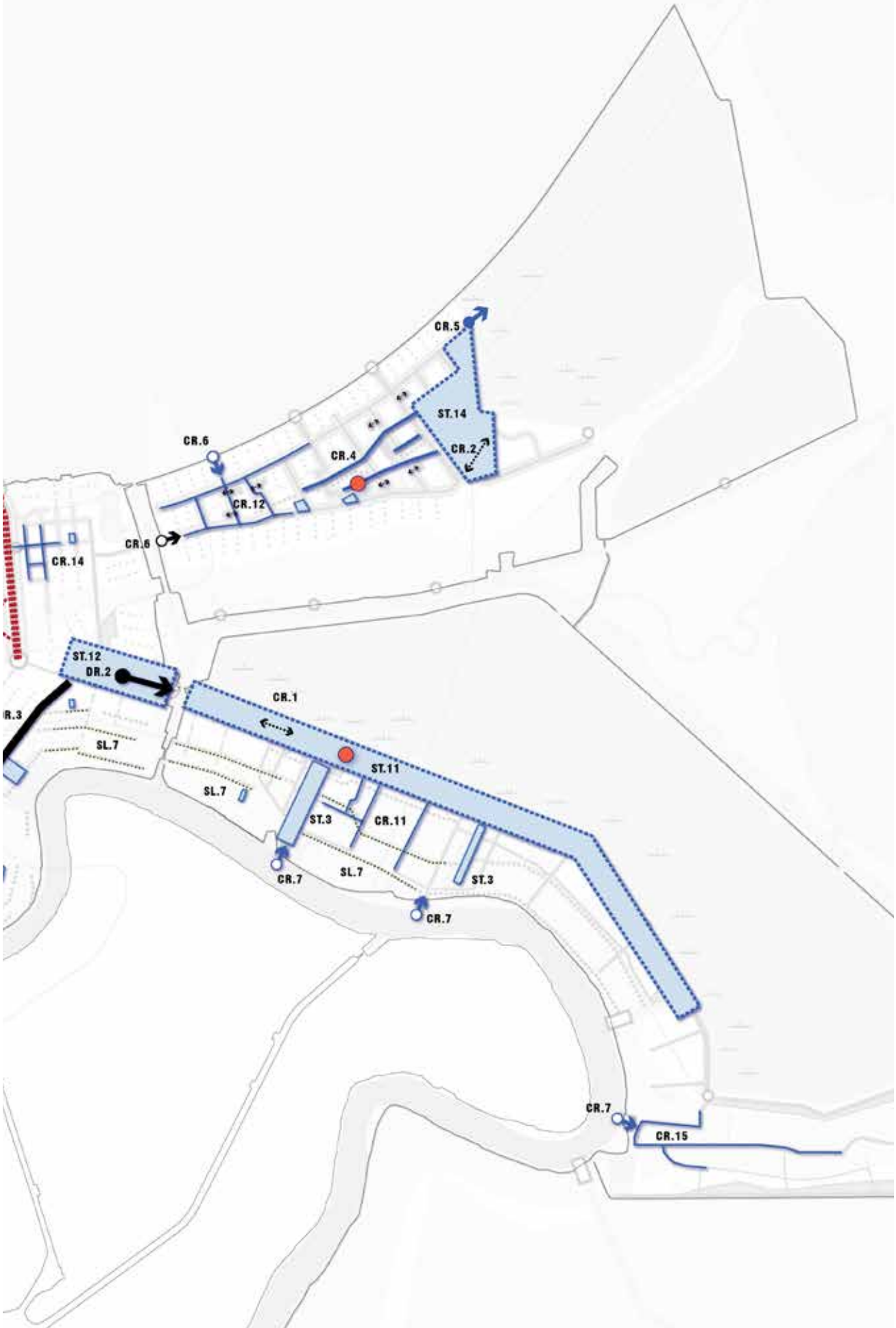


Water System Phasing Map

Phasing across all Plan Interventions

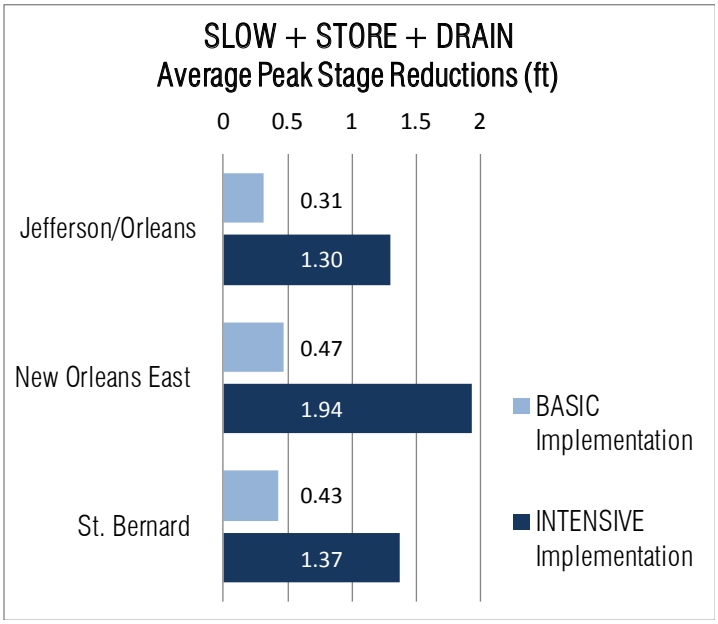





CR.5
ST.14
CR.6
CR.4
CR.2
CR.12
CR.6
CR.14
ST.12
DR.2
CR.1
SL.7
ST.11
SL.7
ST.3
CR.11
CR.7
SL.7
ST.3
CR.7
CR.7
CR.15

Cost

Implementing the Urban Water Plan is costly, but inaction is even costlier. With an estimated $6.2 billion to implement this plan, the proposed integrated water system is expected to save the three-parish study area more than $10.8 billion in avoidable flooding, subsidence, and insurance costs over the next 50 years. Additionally, this investment is estimated to have a direct and indirect regional economic impact of up to $11.3 billion, spur between 44,000 and 100,000 jobs, and increase property values by $183 million. Added together, the total economic benefit of the Urban Water Plan is estimated at over $22.3 billion over a 50-year period, more than three times the investment.



The Urban Water Plan is a conceptual framework of a 50-year vision that comprises multiple design and engineering interventions, at multiple scales, over a three-parish region with diverse topographical and hydrological conditions. Due to its nature and complexity, placing a realistic cost on the implementation of the Urban Water Plan and all its components at this stage of design is premature. However, in order to provide a framework for decision-makers to weigh costs against benefits and decide on current and future investments, an order-of-magnitude estimate of probable cost is provided based on certain assumptions and a more narrowly defined scope.

Methodology

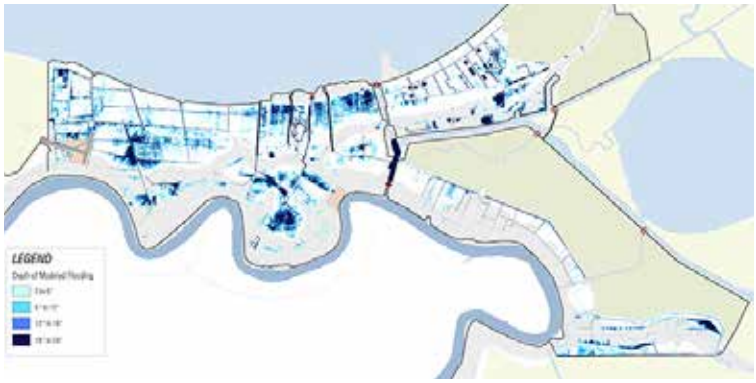
Specific design proposals in the Urban Water Plan, including water districts, urban opportunities, and demonstration projects are not included in this estimate. The costs of demonstration projects, which represent the finest level of design detail in the plan, have been estimated separately. Additionally, the cost estimate does not include components of the "circulate & discharge" strategies, though rough estimates for elements of the proposed groundwater monitoring network are listed in the "Groundwater Monitoring Network for Greater New Orleans" report by Deltares.

Instead, the overall vision estimate is based solely on the water system elements of **slow, store, and drain** modeled by the team's engineers. "Slow" interventions work at the scale of the street and vacant lot; "store" strategies include large-scale storage interventions; and "drain" components relate to system-scale water conveyance and discharge. Costs are therefore calculated according to the type and level of intervention as detailed in the charts that follow, and totals for **basic and intensive implementation** are presented both for the scope area as a whole and by hydrologic basin. The hydraulic model, as detailed in the "Water System Analysis" report by Royal Haskoning, tests two scenarios: **Scenario 1** corresponds to basic implementation and assumes basic street and lot interventions (as defined in the "Roadway Retrofits" report by Dana Brown & Associates), lower volumes of

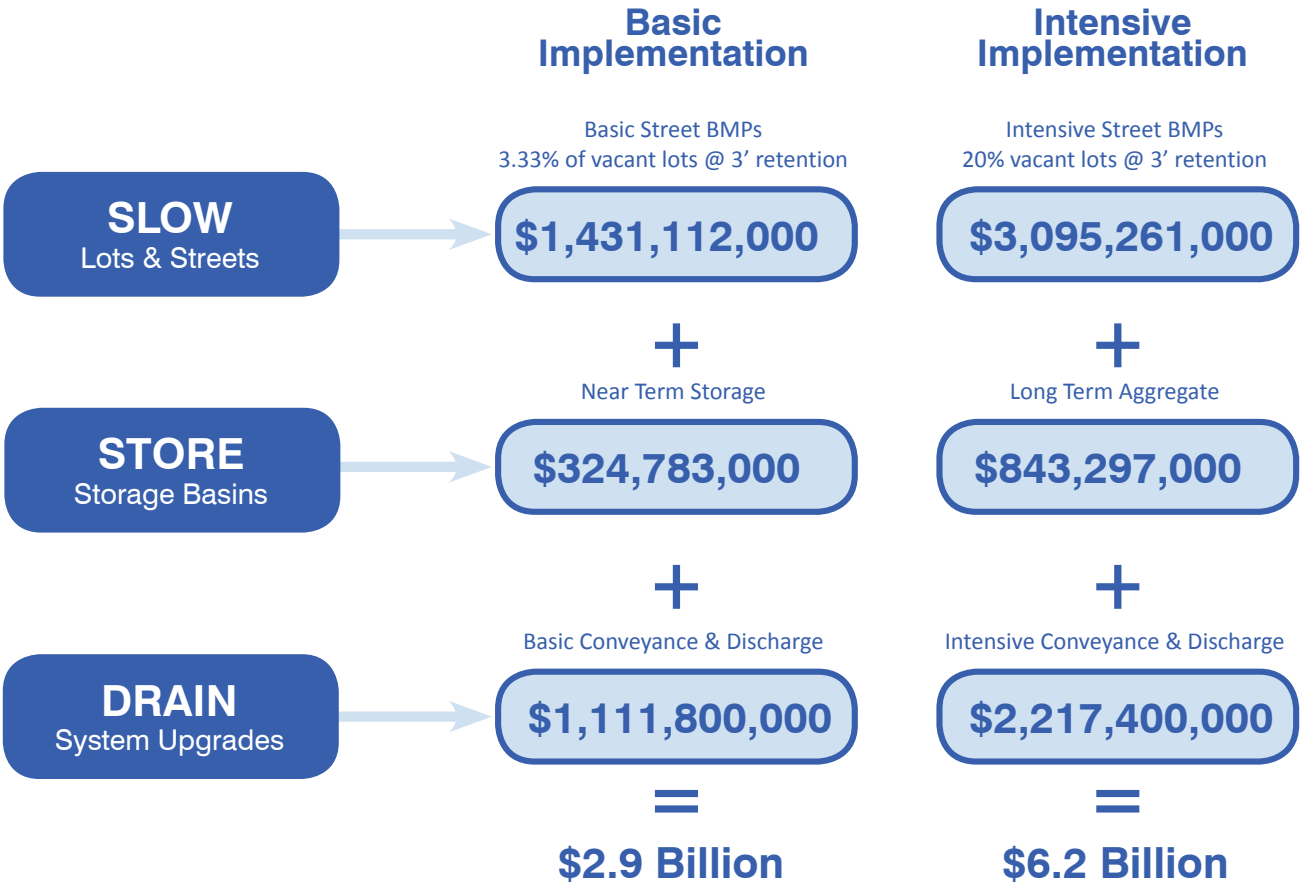
large-scale storage, basic drainage system upgrades, and 50% of properties holding the first 1.25" of stormwater during a rain event. The cost for the latter is not included in this estimate. **Scenario 2** corresponds to intensive implementation and assumes intensive street and lot interventions, maximum volumes of large-scale storage, intensive drainage system upgrades, and 100% of properties holding the first 1.25" of stormwater during a rain event. The first scenario is likely feasible within the near and middle terms, while the second is a long-term ambition.

The model, which tests the scenarios against a 10-year storm event, demonstrates that basic interventions result in considerable average peak stage reductions, shown in feet on the opposite page, while intensive interventions substantially reduce flooding from a 10-year storm.

10-Year Flood Model Existing



10-Year Flood Model Intensive Scenario



Cost Estimates by Basin

Basic and Intensive Implementation

Jefferson/Orleans Basin — Basic Implementation

	Model Scenario 1	Area	Unit	Unit Cost	Total
SLOW Lots & Streets	3.33% of Vacant Lots @ 3' Retention (1)	243.00	acres	$152,460	$37,047,780
	Basic Street BMPs (2)	598.00	acre-ft	$1,568,160	$937,759,680
STORE Storage Basins	Near Term Storage (3)	695.90	acres	$150,000	$104,385,000
DRAIN System Upgrades	Basic Conveyance and Discharge (4)	*order-of-magnitude cost provided by Arcadis US*			$969,410,000

Basic Jefferson/Orleans: $2,048,602,460

New Orleans East Basin

	Model Scenario 1	Area	Unit	Unit Cost	Total
SLOW Lots & Streets	3.33% of Vacant Lots @ 3' Retention (1)	165.00	acres	$152,460	$25,155,900
	Basic Street BMPs (2)	101.00	acre-ft	$1,568,160	$158,384,160
STORE Storage Basins	Near Term Storage (3)	325.12	acres	$150,000	$48,768,000
DRAIN System Upgrades	Basic Conveyance and Discharge (4)	*order-of-magnitude cost provided by Arcadis US*			$105,780,000

Basic New Orleans East: $338,088,060

St. Bernard Basin

	Model Scenario 1	Area	Unit	Unit Cost	Total
SLOW Lots & Streets	3.33% of Vacant Lots @ 3' Retention (1)	22.00	acres	$152,460	$3,354,120
	Basic Street BMPs (2)	171.80	acre-ft	$1,568,160	$269,409,888
STORE Storage Basins	Near Term Storage (3)	1,144.20	acres	$150,000	$171,630,000
DRAIN System Upgrades	Basic Conveyance and Discharge (4)	*order-of-magnitude cost provided by Arcadis US*			$36,610,000

Basic St. Bernard: $481,004,008

Basic Total*: $2,867,694,528

General Assumptions

1. "Slow" strategies in vacant lots use the highest unit cost (approx. $3.50/square foot), converted to cost per acre, from the Pontilly HMGP precedent project by CDM Smith currently in the construction document phase.
2. "Slow" strategies in streets use the highest unit cost (approx. $36/cubic foot) from the "Roadway Retrofits" report, by Dana Brown & Associates, converted to cost per acre-foot.
3. "Store" elements use an average unit cost from the "WMS System Cost Estimate: Large Storage Basins" by Arcadis US, included in Appendix X of the System Design report.
4. "Drain" interventions include only "major" conveyance and discharge components, as detailed in the "WMS System Cost Estimate: Technical Memorandum" by Arcadis US, included in Appendix X of the System Design report.

Intensive Implementation

Model Scenario 2	Area	Unit	Unit Cost	Total
20% of Vacant Lots @ 3' Retention (1)	512.11	acres	$152,460	$78,076,291
Intensive Street BMPs (2)	1,196.00	acre-ft	$1,568,160	$1,875,519,360
Long Term Aggregate of All Storage (3)	2,134.12	acres	$150,000	$320,118,000
Intensive Conveyance and Discharge (4)	*order-of-magnitude cost provided by Arcadis US*			$2,075,010,000
			Intensive Jefferson/Orleans:	$4,348,723,651

Model Scenario 2	Area	Unit	Unit Cost	Total
20% of Vacant Lots @ 3' Retention (1)	987.95	acres	$152,460	$150,622,857
Intensive Street BMPs (2)	216.60	acre-ft	$1,568,160	$339,663,456
Long Term Aggregate of All Storage (3)	937.86	acres	$150,000	$140,679,000
Intensive Conveyance and Discharge (4)	*order-of-magnitude cost provided by Arcadis US*			$105,780,000
			Intensive New Orleans East:	$736,745,313

Model Scenario 2	Area	Unit	Unit Cost	Total
20% of Vacant Lots @ 3' Retention (1)	130.40	acres	$152,460	$19,880,784
Intensive Street BMPs (2)	402.70	acre-ft	$1,568,160	$631,498,032
Long Term Aggregate of All Storage (3)	2,550.00	acres	$150,000	$382,500,000
Intensive Conveyance and Discharge (4)	*order-of-magnitude cost provided by Arcadis US*			$36,610,000
			Intensive St. Bernard:	$1,070,488,816

Intensive Total*: $6,155,957,780

* All costs are provided in present cost regardless of actual stage of expenditure and does not account for cost escalation. Additionally, the following costs are not included in the estimate:

- Interventions for properties to hold the first 1.25" of stormwater during a rain event.
- Operations and maintenance or training.
- Real estate (land acquisitions) and/or right-of-way utility easements.
- Environmental impact statements, wetlands delineation, utility relocations, permits and coordination with regulatory agencies for design and construction approval.
- Soft costs, contractor mark-ups, or contingencies.

4 Financing Tools

SOURCES AND MECHANISMS

New and creative designs and plans for building resilience will require similarly creative and innovative financing mechanisms.

Nationwide, innovative public and private collaborations have broadened financing options and created new opportunities to bring social, economic and environmental benefits to communities. New approaches to leveraging dollars and human capital from multiple sources can significantly reduce the cost burden on municipalities and individual taxpayers.

The unique nature of the Urban Water Plan and the current budget-challenged environment will require a creative approach and multiple avenues of funding. To make up for funding shortfalls, the financing of integrated water management projects require the development of new investment tools such as those common to the real estate market combined with other financing methods. In many cases, policy changes are required. By measuring social, economic and environmental benefits, the return on investment can attract new investors and funding mechanisms.

Toward High Value

Financing the Greater New Orleans Urban Water Plan should not be viewed as an add-on to our current infrastructure budgets. Integrated water management offers an alternative approach to how we manage our water resources, therefore its implementation requires an alternative and not additional investment. An investment that not only addresses the urgent issues of subsidence and flooding, but returns high value.

Aging infrastructure, declining numbers of rate-payers, and new regulatory demands will command massive expenditures in the Greater New Orleans region. A fundamental premise of this new approach is to transform those costs into investment opportunities that produce lasting value, safety, economic growth , and that distribute the costs of implementation and maintenance in the most sustainable and equitable manner possible.

An additional premise of this Urban Water Plan is to better integrate public and private actions into a comprehensive approach to managing stormwater and groundwater. The City of New Orleans is already moving in this direction with the incorporation of stormwater management into the New Orleans Master Plan and the accompanying Comprehensive Zoning Ordinance.

The region's Hurricane Katrina experience with levees, pumps, and flood walls stands as a stark reminder of the danger of assuming functionality rather than ensuring it. Infrastructure must be paid for throughout its operable life; funds must be secured for both construction and long-term maintenance. The region's receipt of a stunning amount of public investment in water infrastructure since Katrina creates a firmer foundation upon which to build comprehensive and integrated water management. Yet it also creates new operational and maintenance challenges - challenges that are not being adequately addressed.

Not all sources and types of funding are suitable or even eligible for all phases of water management. Hurricanes Katrina, Rita, Gustav, and Isaac have brought both focus and funding to water system improvements in the region. Much of the funding that came following those storms was for new construction, renovation and reconstruction of the traditional water infrastructure system. However, many of those funds are limited by laws such as the Stafford Act to functionally replacing the system that was destroyed or damaged by those storms. They are not available for general operations and maintenance or for designing and creating new water management systems. That is not the case for FEMA's Hazard Mitigation Grant Program whose funds can be used more

flexibly to reduce future water driven risk. Hurricane Sandy has prompted new and innovative thinking on the part of the federal government about building back better and in a more resilient fashion.

Since the Urban Water Plan is fundamentally about creating a long-term, value-driven approach to water management and stewardship, any financing strategy must consider both currently available sources and those that may exist in the future; what the funding sources are at each level of government; what funding mechanisms can be leveraged at the local level; and how these sources and mechanisms can be used to build, renovate, and replace Urban Water Plan projects and to operate and maintain them over their lifetime. Fortunately, there are funding sources and mechanisms at hand that could serve to launch the Plan.

Diverse Funding for Diverse Projects

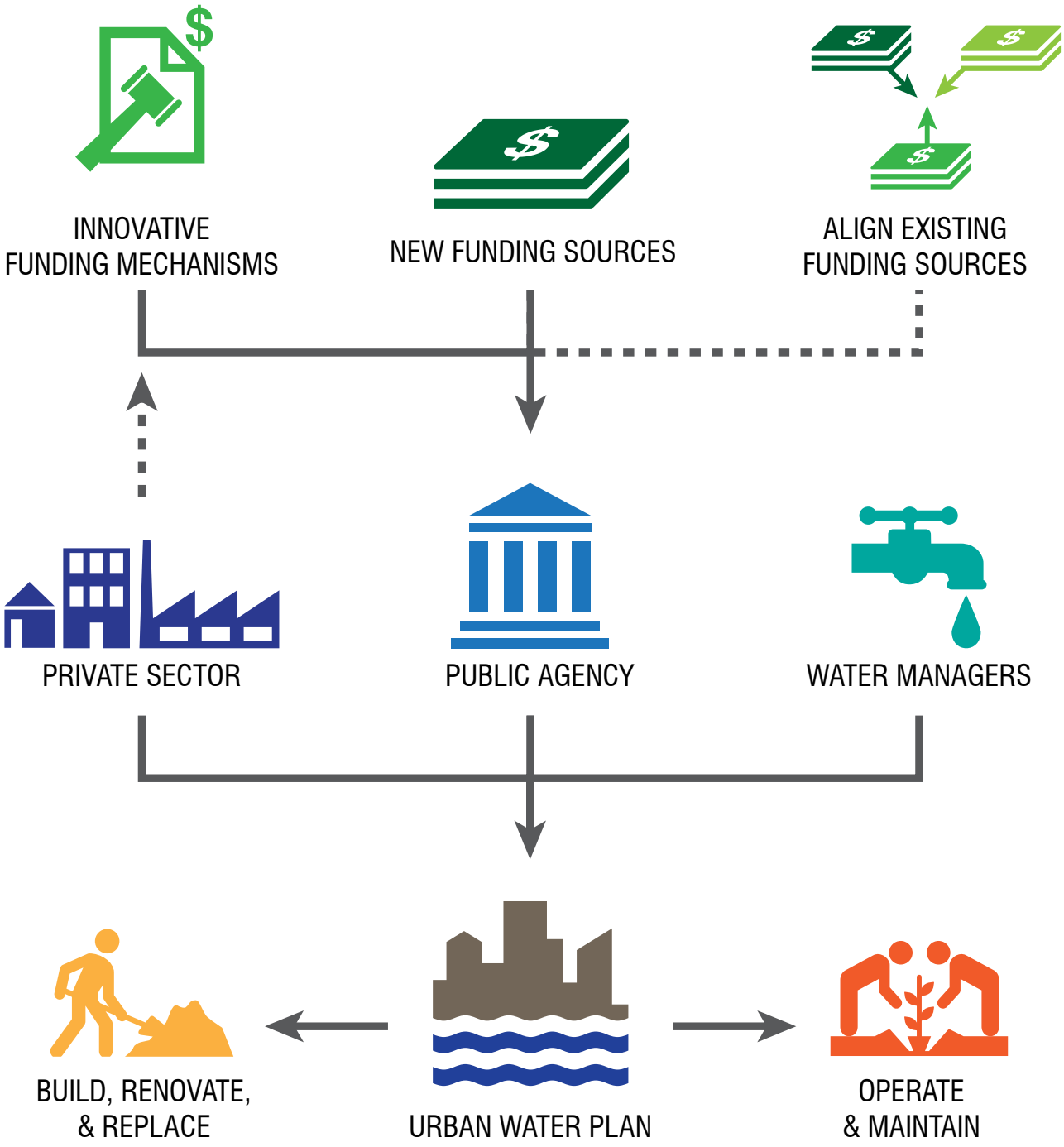
Top: Tax Increment Financing at San Francisco's Transbay Center (photo courtesy of Steelblue LLC)

Middle: Openlands land trust's Lakeshore Preserve in Chicago (photo courtesy of Openlands)

Bottom: The High Line in NYC, which depends on volunteer labor (photo courtesy of Downtown Magazine NYC)

Stormwater Infrastructure Financing

The diagram below shows how various funding sources can be leveraged to execute water management projects. New funding sources combine with funds generated through mechanisms (including new policies and regulations), while existing funding sources are "aligned" with Plan objectives. These combined funds then flow through the public agencies responsible for future planning, design, and implementation. These public agencies, working with their system operating partners and members of the private sector (businesses, developers, architects, etc.), collaborate on implementing the blue-green strategies of the Plan. Because the Plan includes both construction and maintenance components, funds will need to be both short- and long-term.



Funding Sources

Funding sources come from a variety of different agencies and organizations within the public and private sectors, but federal and state sources will likely contribute the majority of the funding. These are covered in greater detail in the next section. Most federal and state sources are subject to annual appropriations, so available funds are always in flux. Compatible funds with the greatest likelihood of near-term availability include:

- FEMA's Hazard Mitigation Grant Program (HMGP) funds
- FEMA's Recovery Roads Program
- RESTORE Act Funds - The amount of these funds and the allowable uses is still in flux as the civil liability exposure of BP and others under the Clean Water Act is still not completely resolved nor are the procedures for disbursing and accounting for those funds. A portion of those funds will come directly to the three parishes in the project area.

Funding Mechanisms

Capital to build and maintain water infrastructure can also be generated locally through various financial mechanisms. Economic incentives and fees, taxes and rebates, and volunteering and training are some of the myriad practices that can be employed in addition to seeking grants from public and private sources. Mechanisms are also covered in greater detail in a following section and a table in Appendix B.

New York, NY: Financing Strategy

"The city has made significant progress with many of the initiatives set forth in PlaNYC and the Sustainable Stormwater Management Plan. In the last several years, city agencies have implemented (or planned) more than 30 green infrastructure demonstration projects and added 65 acres to the Bluebelt system on Staten Island while designing two new Bluebelt locations in Queens. Through the state Environmental Facilities Corporation's Greening Innovation Grant Program, the city also secured $2 million in federal stimulus funding to install at least 26 Greenstreets designed specifically to maximize stormwater capture, and another $15 million to restore 38 acres of wetlands and natural grasslands abutting Jamaica Bay, which will also serve to capture and filter stormwater.

"While city agencies worked on implementing pilots, DEP [NYC's Departnment of Environmental Protection] focused on developing a comprehensive approach to substantial, long-term, citywide investment in green infrastructure. The result was the NYC Green Infrastructure Plan, released in September 2010. In the plan, the city proposed to use decentralized stormwater retention and detention measures to manage, on-site, runoff from at least 10 percent of the impervious surfaces in combined sewer watersheds. These decentralized measures would combine $1.6 billion in public investment with $900 million in private investment to reduce CSOs by an estimated 1.5 billion gallons. Most of the public investment ($1.1 billion) would be in the public right-of-way, where the city would rely primarily on vegetated approaches to retain runoff. The city estimates that, over a 20-year period, new vegetated spaces created under this approach would generate between $139 million and $418 million in benefits through reduced energy bills, increased property values, improved health, and mitigation of carbon dioxide emissions.

"[The DEP] established a new Green Infrastructure Task Force in December 2010, composed of city agencies, to identify the best opportunities to systematically incorporate green infrastructure into capital projects on an ongoing basis, using DEP capital funds and other available funding. The Task Force is also developing approved specifications for green infrastructure techniques to streamline design and permitting processes. By the end of 2012, the city plans to install more than 100 bioswales in combined-sewer areas and begin design on green infrastructure projects for public schools, New York Housing Authority (NYCHA) properties, and other publicly owned land.

"The city has also used direct grants to stimulate innovation in green infrastructure, both on private property and in the public right-of-way. In two rounds of grantmaking, DEP has provided more than $6 million to nonprofit organizations, community groups, and private property owners for projects such as curbside bioswales, rain gardens, porous sidewalks and parking lots, and a number of green roofs, some of which will also serve as rooftop farms or gardens."

-Natural Resources Defense Council, "Rooftops to Rivers II: Green strategies for controlling stormwater and combined sewer overflows," 2011

Funding Sources

Grants and disbursements come from a variety of different agencies and organizations within the public and private sectors. For the Urban Water Plan, federal investment will be essential.

Federal and state funding takes priority in paying for the implementation of green infrastructure, primarily because they award the most money. Federal and state agencies play a variety of roles when it comes to funding, and they have great potential to collaborate with local agencies. The following organizations are likely to provide the bulk of funds:

Federal

- Federal Emergency Management Agency (FEMA)
- Environmental Protection Agency (EPA)
- The Department of Housing and Urban Development (HUD)
- U.S. Army Corps of Engineers (USACE)

State

- Louisiana Department of Environmental Quality
- Louisiana Department of Transportation and Development

The State of Louisiana is moving toward a more integrated approach to water infrastructure management. For example, the Louisiana Coastal Protection and Restoration Authority has helped to promote the integrated water management movement in New Orleans by developing the Coastal Restoration and Protection Master Plan. This plan encourages coastal restoration and protection projects with an emphasis on "non-structural" strategies that alleviate flooding risks.

Federal Emergency Management Agency (FEMA)

Presentation of the largest single Hazard Mitigation Grant Program Project (HMGP) obligation. The $96.5 million dollar funding will help elevate nearly 3,000 homes devastated by hurricanes Katrina and Rita. (Photo courtesy of FEMA)

Local public sources and private funding at all levels also are essential to successful green infrastructure. Local agencies can be valuable partners in securing funding and support from the large national and state sources, while private foundations from across the country provide substantial grant monies for targeted water management projects like the Urban Water Plan. Federal funding sources are covered in detail in the following paragraphs and summarized in a table in Appendix B.

Federal Emergency Management Agency (FEMA)

Hazard Mitigation Assistance (HMA)

FEMA's HMA grant programs provide funding for eligible mitigation activities that reduce disaster losses and protect life and property from future disaster damages. The HMA program reduces the risk to individuals and property from natural hazards while simultaneously reducing reliance on federal disaster funds.

Hazard Mitigation Grant Program (HMGP)

The HMGP provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. The HMGP is authorized under Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act.

"We have hundreds of millions of dollars of drainage and storm water flood mitigation projects that are critical as we move to develop a more sustainable water management system modeled after the Dutch."

-- Mayor Mitch Landrieu in a 2011 letter to Governor Bobby Jindal

Environmental Protection Agency (EPA)

Below: Portland, Oregon, used EPA Clean Water State Revolving Funds to pay for its benchmark "green street" planters. (Photo courtesy of EPA)

Pre-Disaster Mitigation Grant Program (PDM)

The PDM program provides funds to states, territories, Indian tribal governments, communities, and universities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event. Funding these plans and projects reduces risks to the population and structures, while also reducing reliance on funding from actual disaster declarations. PDM grants are to be awarded on a competitive basis and are independent of state allocations, quotas, or other formula-based allocation of funds.

Flood Mitigation Assistance (FMA)

The FMA program was created to reduce or eliminate claims under the National Flood Insurance Program (NFIP). The Federal Emergency Management Agency (FEMA) provides FMA funds to help states and communities implement measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the NFIP.

Repetitive Flood Claims (RFC)

Up to $10 million is available annually for FEMA to provide RFC funds to help states and communities reduce flood damages to insured properties that have filed one or more claims to the NFIP.

Severe Repetitive Loss (SRL)

The SRL grant program was authorized to provide funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss structures insured under the NFIP. This program is funded on an annual basis and can cover up to 90% of the cost of eligible projects.

Environmental Protection Agency (EPA)

Clean Water State Revolving Funds (CWSRF)

Described as "America's largest water quality funding source," CWSRF programs provided more than $5 billion annually in recent years to fund water quality protection projects for wastewater treatment, nonpoint source pollution control (to reduce pollutants carried by stormwater runoff from many diffuse sources as it moves over and through the ground), and watershed and estuary management. Created in 1987 as an amendment to the Clean Water Act, the CWSRF is a vehicle for providing predictable, low cost financing for water infrastructure projects.

National Wetland Program Development Grants (WPDGs)

WPDGs include grants meant to develop or refine wetland programs to increase quantity and quality of wetlands, conserve and restore acreage and improve wetland conditions.

Five Star Restoration Program

The Five Star Restoration Program provides challenge grants, technical support, and opportunities for information exchange to enable community-based restoration projects.

Community Action for a Renewed Environment (CARE) Grants

CARE is a competitive grant program that offers an innovative way for a community to organize and take action to reduce toxic pollution in its local environment. Through CARE, a community creates a partnership that implements solutions to reduce releases of toxic pollutants and minimize people's exposure to them. By providing financial and technical assistance, the EPA helps CARE communities get on the path to a renewed environment.

Brownfields Revolving Loan Fund Grants

These grants provide funding to a grant recipient to capitalize a revolving loan fund that provides loans and sub-grants to carry out cleanup activities at brownfields sites. Through these grants, the EPA

seeks to strengthen the marketplace and encourage stakeholders to leverage the resources needed to clean up and redevelop brownfields. When loans are repaid, the loan amount is returned into the fund and re-lent to other borrowers, providing an ongoing source of capital within a community.

Environmental Education Grants (Region Six)

The purpose of the Environmental Education Grants is to provide money to support environmental education projects that increase the public's awareness about environmental issues and provide them with the skills to take responsible actions to protect the environment. This grant program funds environmental education (EE) projects. Environmental information and outreach may be important elements of EE projects, but these activities by themselves are not environmental education. Outreach involves information dissemination and requests or suggestions for action on a particular issue (sometimes without the critical thinking, problem solving and decision making steps in between). EE covers the range of steps and activities from awareness to action with an ultimate goal of environmental stewardship.

Science to Achieve Results (STAR)

The EPA STAR program is seeking applications proposing to conduct research on and demonstration of the performance and effectiveness of green infrastructure practices in the urban watershed. The STAR program also is seeking applications to establish a center to conduct innovative and sustainable water research and demonstration projects using a systems approach for nutrient management in the nation's waters.

Clean Water Act (CWA)

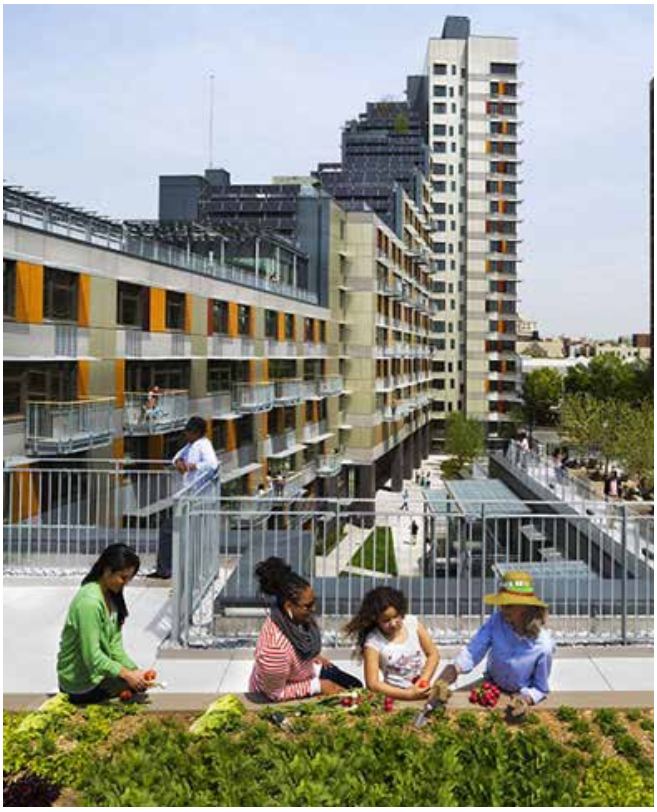
The Clean Water Act is one of the foundations of American environmental stewardship and law and the EPA is its chief administrator. Beyond the CWSRF and wetlands protection dimensions discussed above, the CWA contains provisions that address important features of water management, including maintaining water quality and storm water management. The EPA's role can be that of an enforcer and a facilitator. Violating the CWA's water quality and stormwater management standards can be costly, but the prospect of enforcement action can spur state, local, and private action. On the facilitative side, enforcement actions, such as those against BP stemming from the Deep Water Horizon disaster can also produce innovative approaches to funding local water improvements, community outreach, and education, if a portion of any settlements are directed at specific community needs. Such a settlement was the source of the Greater New Orleans Foundation's environmental fund.

Environmental Protection Agency (EPA)

In 2006, EPA reported that 58,777 acres of wetland were restored and improved through the Five Star Restoration Grants, the National Estuary Program, Section 319 Nonpoint Source Grants, Brownfield Grants, and EPA Great Waterbody Programs. (Photo courtesy of EPA)

Department of Housing and Urban Development (HUD)

Above & Below: Via Verde ("the green way") is a 222-unit mixed-income and tenure housing development in the South Bronx area of New York City. It received $12 million in financing through the HOME Investment Partnership Program. (Photos courtesy of David Sundberg/ESTO)



Safe Drinking Water Act (SDWA)

The SDWA is intended to ensure universal access to clean, and safe drinking water. In the Water Project area, one the main threats to drinking water is an aged, over-burdened and under-maintained water treatment and delivery system. To assist with these challenges, the EPA administers the Drinking Water State Revolving Fund (DWSRF) program to help finance water infrastructure improvements. In fiscal 2010, Louisiana's allotment under the DWSRF was $25.6 million.

Department of Housing and Urban Development (HUD)

Sustainable Communities Regional Planning Grants

HUD's Sustainable Communities Regional Planning Grant Program supports metropolitan and multi-jurisdictional planning efforts that integrate housing, land use, economic and workforce development, transportation, and infrastructure investments. The efforts must empower jurisdictions to consider the interdependent challenges of: economic competitiveness and revitalization; social equity, inclusion, and access to opportunity; energy use and climate change; and public health and environmental impact.

Sustainable Communities Challenge Planning

The $28 million program promotes affordable, economically vital, and sustainable communities by funding revisions to local master plans, zoning codes, and building codes. These revisions should encourage mixed-use development, affordable housing, the reuse of older buildings and structures for new purposes, and sustainability.

Community Development Block Grant (CDBG) Entitlement Communities Grants

The CDBG program works to ensure decent affordable housing, provide services to the most vulnerable members of our communities, and create jobs through the expansion and retention of businesses.

CDBG-financed projects could incorporate green infrastructure into their design and construction. Chicago, for example, used a CDBG grant to put a new green roof on its historic Cultural Center.

HUD Section 108 Loan Guarantee Program

The Section 108 Loan Guarantee Program allows future CDBG allocations to be used to guarantee loans for neighborhood revitalization projects, including construction or installation of public facilities and infrastructure. Section 108-guaranteed projects could incorporate green infrastructure into their design and construction.

Choice Neighborhoods

The Choice Neighborhoods program supports locally driven strategies to address struggling neighborhoods with distressed public or HUD-assisted housing through a comprehensive approach to neighborhood transformation. Local leaders, residents, and other stakeholders, including public housing authorities, cities, schools, police, business owners, nonprofits, and private developers, come together to create and implement a plan that transforms distressed HUD housing and addresses the challenges in the surrounding neighborhood. The program is designed to catalyze critical improvements in neighborhood assets, including vacant property, housing, services, and schools.

Choice Neighborhoods Initiative Planning Grants

Choice Neighborhoods Initiative Planning Grants support the development of comprehensive neighborhood revitalization plans that focus on directing resources to address three core goals: housing, people, and neighborhoods. To achieve these core goals, communities must develop and implement a comprehensive neighborhood revitalization strategy, or "transformation plan." This plan becomes the guiding document for the revitalization of the public and/or assisted housing units while simultaneously directing the transformation of the surrounding neighborhood and promoting positive outcomes for families.

Capacity Building for Sustainable Communities (in partnership with the EPA)

The first purpose of the Capacity Building for Sustainable Communities Program is to assemble a collection of capacity building service providers to work directly with the FY2010, and FY2011 HUD Sustainable Communities Regional Planning and Community Challenge grant recipients, HUD Preferred Sustainability Status Communities, and EPA Sustainable Community Technical Assistance recipients and Brownfield Area Wide Planning grant recipients. The second purpose of the program is to build a national coalition and leadership network of Sustainable Communities Grantees. The network facilitates the exchange of successful strategies, lessons learned, emerging tools, and public engagement strategies.

HOME Investment Partnerships Program

HOME is the largest federal block grant to state and local governments designed exclusively to create affordable housing for low-income households. It allocates approximately $2 billion annually among the states and hundreds of localities nationwide. The program was designed to reinforce several important values and principles of community development. HOME could be applicable with regard to green infrastructure on buildings (green roofs, rainwater cisterns, etc.).

Funding Mechanisms

A diverse range of fundraising methods available to a locality can spread project costs, incentivize sustainable practices, and encourage the participation of the private sector in water management.

Above: The Staten Island Blueway, funded through New York's Adopt-a-Blueway program, which works much like Adopt-a-Highways programs across the US. (Photo courtesy of Urban Omnibus)

Below: New Orleans' Grow Dat Youth Farm trains and employs young community members. (Photo courtesy of The Dreamkeeper Garden)

Construction of civil works projects often involve a blend of federal, state, and local funds, leading to a public perception that large-scale infrastructure projects are largely funded by various types of tax revenue. While this is usually true, current financial models for municipal-scale and smaller interventions tend to be complex and diverse. In order to make up for funding shortfalls, green infrastructure projects often blend common real estate market investment tools with policy changes, incentives for private participation, and diverse finance sources.

A focus on economic development and social and environmental benefit can greatly expand the funding mechanisms available to any given project. Creative finance has been driving billions of dollars towards sustainably built environments that benefit both local and regional ecosystems and economies. Unique collaborations of public, private, non-profit, and grassroots entities have broadened the framework and reach of funding possibilities, bringing with them social and environmental benefits. Heavy engineering projects are shifting to infrastructure interventions that provide space for a variety of participants to contribute, and in so doing create the opportunity for citizens to be more engaged and connected with their environment. This boosts political support for designing communities to be more resilient to climate change and other risks.

Resiliency planning, which helps prepare communities to manage challenges, is focused on long-term economic, environmental and social stability. This requires embracing true cost pricing -- the notion of including negative externalities into the cost of goods and services -- and the valuation of factors like resource depletion, environmental damage, ecosystem services, and other factors that impact community productivity and quality of life. It also requires an agile management framework that allows for continual analysis and strategy evolution in the face of changing and unexpected circumstances.

Resiliency planning urges authorities managing complex civil works projects to take a fully integrated, multiple-benefit approach when considering infrastructure

investments. In doing so, a "least-cost approach" can factor in avoided costs and leverage dollars and human capital collected from multiple sources. This can lead to reduced cost burdens on municipalities to install and maintain infrastructure projects. It also allows for non-traditional funding mechanisms such as carbon trading to be explored.

Private sector activities such as volunteering, community sponsorship, youth employment, community partnerships, entrepreneurship, technical assistance, and civic leadership can support the larger project goals by improving economies of scale, boosting wide-scale implementation, and providing important opportunities to fund maintenance.

Various potential funding mechanisms are fully explained below and summarized in tables in Appendix B. These mechanisms are drawn from many sources and, when available, cite specific instances of their use to fund sustainable infrastructure projects. Additional tables and resources can be found in the appendix.

Technical Assistance

Above: Chicago Green Corps provides technical assistance, education, garden materials and training for ex-offenders and others in horticulture. (Photo courtesy of Chicago Greencorps)

Seattle: Points and Rebates

Because of the sensitivity of nearby waterways like Puget Sound and salmon-supporting creeks, Seattle and the Washington state have some of the nation's most stringent stormwater management standards. Yet Seattle has thrived, with developers embracing the city's stormwater policies and the economic benefits they can bring. Seattle's "Green Factor" program is a flexible scoring system that grants developers points for incorporating various green infrastructure, from permeable pavement to food-producing vegetation, in new development projects. The City's stormwater codes and manuals now require green infrastructure analysis in the first stages of all development, while a fee-in-lieu policy provides non-conforming developers a way to opt-out of incorporating green infrastructure while helping pay for public improvements. At the scale of the individual homeowner, the city's successful Rainwise Incentives Program provides residents with rebates of up to $3.50 for each square foot of stormwater strategies like cisterns and rain gardens on their properties.

Seattle's "Natural Drainage System" (NDS) approach, which is embraced in its Street Edge Alternatives (SEA) projects, provides the city with a methodology for incorporating bioswales and other green practices that aim to emulate pre-development conditions in public street design and ultimately saves the city money versus traditional grey options. (Photos courtesy of US Dept. of Transportation)

Creative Funding in Lenexa, Kansas

"Lenexa uses creative and long-term funding for these major land purchases and projects, as well as for the day-to-day staffing and management of the Rain to Recreation program. In 2000, Lenexa taxpayers voted for a ballot to add a 1/8 cent sales tax to support building stormwater facilities that repair existing infrastructure problems and protect against future flooding events. In addition, Lenexa established a stormwater utility to provide sustainable funding for its new programs. The stormwater utility charge is based on the amount of runoff surface on each parcel of land. Each property is charged $5.50 (in 2008) per equivalent dwelling unit (EDU), which is measured at 2,750 square feet, or about the average runoff surface area of a house with a driveway. Commercial and non-residential properties are charged based upon amount of stormwater runoff generated and rates are calculated by dividing total runoff surface area by the number of square feet in an EDU (2,750) to more closely charge these larger properties by runoff contributions to the public system. In 2004, the Lenexa City Council adopted the Systems Development Charge to require new developments to pay a one-time fee at the time of the building permit as a means for recovering costs for capital improvement activities. This charge works like a fee-in-lieu mechanism where developers are paying the City to manage water quantity that is created by the addition of new impervious surfaces.

Continued grants from state and federal sources, such as Clean Water Act Section 319 Nonpoint Source funding for park construction and Surface Transportation Project funding for roadway projects, have assisted with capital and demonstration projects like Lake Lenexa. Other sources of funding also support Lenexa's stormwater program, including Johnson County Stormwater Management Advisory Council funding supported by a 1/10 cent sales tax and basic permitting fees charged to developers. Together, these funding sources ensure long-term watershed protection through the continued creation, operation and maintenance of green infrastructure practices."

-EPA Office of Wetlands, Oceans and Watersheds, "Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure," 2010

(Photos courtesy of City of Lenexa, Kansas)

PRIMARY FUNDING MECHANISMS

General Fund

Sales taxes have been very successful in generating a vast amount of funding when it comes to funding mechanisms. The city of Tallahassee raised almost $200 million solely through the establishment of a 1% "extra penny" local sales tax dedicating 80% of the sales tax revenue to the funding of green infrastructure projects. The other 20% would be split in half and given to both the city and county. Tallahassee's organization BluePrint 2000 is a special purpose agency that was established to help fund transportation and environmental infrastructure in the city. By implementing this 1% sales tax, an estimated $30 million per year of revenue is generated. As a result, the city was able to generate $80 million for the Capital Cascade Trail Project solely generated by the 1% sales tax. This 1% sales tax also solely funded the city's entire stormwater infrastructure as well. In Philadelphia, the Pennsylvania Horticulture Society (PHS) and Philadelphia LandCare partnered in an effort to help stabilize and benefit neighborhoods by keeping lots "clean and green." Site maintenance is performed by the partners and includes community organizations and landscape architects. Preliminary results from the program suggest that PHS lots impact the property value of homes up to ¼ mile away by 2% to 5% annually. This generates an estimated $100M increase in annual property taxes. For Philadelphia, this represents a return of over seven dollars for each dollar invested.

Bonds

A bond is a debt instrument that entails an investor loaning money to a corporation or governmental entity, which borrows the funds for a defined period of greater than a year at a fixed interest rate. Some bonds are tax exempt and are typically issued by the government. In Chicago, the Chicago Park District issued between $30 million to $40 million a year in general obligation bonds. This funding was allocated for acquisition and capital improvements. In Los Angeles, residents passed Proposition O, a $500 million bond initiative for water quality, flood protection, and water and habitat conservation. The Capital Assistance

program was instituted by the federal government to promote financial stability and confidence in the financial industry. Under this plan, which is similar to a debt-issuance program, the U.S. Treasury makes capital available for financial institutions to borrow in order to enable them to continue to serve the public. Milwaukee's Economic Development Corporation (MEDC) is a nonprofit corporation which provides financial resources and support to public and private entities, including access to low-interest capital to support projects that aid economic growth in the State. For example, MEDC assisted in creating a tax increment district to generate funds for the transformation of a vacant property into a park. Menomonee Valley Partners, Inc., a non-profit organization, participated by writing supporting grant proposals and served as a 501 © 3 pass through organization for two grants the project received, equaling a total of $250,000 from the EPA and Wisconsin Department of Natural Resources. In return, the MEDC required that the site remain a green open space for a minimum of 20 years.

Stormwater Utility Fees

A stormwater remediation fee is a utility service fee which is being applied by municipalities all across the country to raise funds for infrastructure maintenance and improvements, as well as provide a

Stormwater Remediation Fees

Top: Menomonee Valley Industrial Center and Community Park, which employs stormwater management fees and credits. (Photo courtesy of Wenk Associates)

Above: These fees helped build the Urban Ecology Center, where kids learn about responsible water management. (Photo courtesy of Nancy M. Aten)

Below: text: A detail of the wetland at the Community Park (Photo courtesy of Landscape Architecture Foundation)

steady revenue source for integrated water management, implementation, renovation, maintenance, operations, and education. Typical residential fees range from $2 to $40 per month depending on the amount of impervious surface on each property. Property owners may claim credits that ultimately can eliminate the fee altogether if they can show that the property has been designed to detain and otherwise manage a specified amount of stormwater onsite, or receive credits for exceeding the requirements. There are numerous variations on this model. An innovative scheme for commercial properties was created by Milwaukee's Department of Public Works, which maintains the city's storm and sewer conveyance. This city agency initiated a commercial stormwater management charge that is applied to all developed properties and vacant extensions, with fees paid into a fund managed by impacted businesses. For example, the Menomonee Valley Industrial Center and Community Park is a publicly owned, privately managed public space and former brownfield project led by the Redevelopment Authority of the City of Milwaukee (RACM) and the Menomonee Valley Partners (MVP), a nonprofit economic development agency with strong ties to non-governmental entities. This consortium includes a Business Improvement District and multiple foundations that are responsible for funding MVP's staff of four. The Industrial Center boasts 40 acres of recreational green space, a 30-acre treatment center, and a 63-acre manufacturing center. The site was purchased by the local redevelopment agency, with additional assistance provided in the form of a forgivable loan from an economic development agency. All businesses receive a storm water credit fee, which is applied against a maintenance easement agreement as part of the RACM's land sale agreement. The easement controls maintenance standards and provides a dedicated source of maintenance revenue. This has proven to be a model for creating a successful public, private and non-profit consortium.

Special Assessments

A special assessment tax is a unique charge that the government can assess against real estate parcels to fund public projects. The charge is levied in a specific region known as a special assessment district. A special assessment may only be levied against parcels of real estate that have been identified as having received a direct and unique benefit from the public project. This can apply to a specific stormwater project that affects individuals who live or work within the surrounding area. For example, in Butler County, a stormwater district was created to fund a specific stormwater control project.

Development Fees

Development fees are paid when new stormwater infrastructure development construction begins. In Colorado, the Southeast Metro Stormwater Authority charges a fee to all developers to fund new stormwater management infrastructure.

Impact Fees & Tax Levies

Above: Wet Meadow at Seattle's Hubbard Homestead Par was paid for by the city's Parks and Green Spaces Tax Levy of 2008. (Photo courtesy of City of Seattle)

Below: Chicago's Open Space Impact Fee Program (OSIF) has provided necessary funding for the future Bloomingdale Trail redevelopment. (Photos courtesy of Chicago Tribune, Biophilic Cities, and WBEZ)

Public/Private Partnerships at Citygarden

The 2.9 acre Citygarden in St. Louis, Mo., was developed under a public-private partnership between the city and the non-profit Gateway Foundation. The foundation funded the design, construction, and soft costs associated with development, as well as ongoing operations and maintenance costs. The improvements and real estate remain under municipal ownership.

Citygarden has been cited as a catalyst for both increased development in the downtown area and expansion of programmed park space along the Gateway Mall. In addition to leveraging public private partnership structures, the project leverages partnerships from local institutions including Washington University in Saint Louis, the Saint Louis Art Museum, and the Contemporary Art Museum Saint Louis. (Photos courtesy of Flickr, Fast Company, and W. Haun)

Impact Fees

Impact fees are one-time fees collected when there is uncertainty how a potential development might impact an area. One example is open space impact fees, typically imposed as a condition of building permit approval for new residential or commercial development. The fees collected can be applied towards the creation of public open space or other specific features that create public benefit, and which can offset negative impacts from development. The Open Space Impact Fee Program (OSIF) in Chicago, for example, requires developers to pay a per-unit fee for new dwelling units. This fee generates an average $4.5 million annually. It has enabled the creation or expansion of 55 parks, 11 “NeighborSpace” community gardens, five trail projects, and 14 school gardens.

Permit and Inspection Fees

These fees aid in covering the cost of permitting and inspecting the physical condition of a property, and can include a variable cost factor for additional burden imposed on municipalities by development. The Sussex District in Delaware, for example, determines the fee on all new private and public developments by basing it on the size of the project and its ability or inability to contribute to stormwater and erosion control.

Property Assessed Clean Energy (PACE) Program

The PACE program is a revenue bond issued by municipalities. The funding for this is used to help participating property owners pay for property improvements. The payments are made through property taxes.

On-Bill Financing

On-bill financing allows for a utility to provide the initial capital for site improvements. This only applies to private property, and loan repayment is made through low-interest or interest-free payments on monthly utility bills.

Off-Balance-Sheet Project Financing

Off-balance-sheet project financing is used when a third-party firm acts as the developer of specific project components

using best practices, and on which they hope to realize all or a portion of the savings created by efficiencies. This third-party entity covers all initial costs for development or retrofit of specified features, allowing the owner to remove these costs from their balance sheet. The third party firm realizes their initial investment and profit through return of their specified portion of realized savings, which is paid to them by the owner.

Credit Enhancements

A credit enhancement is a method that provides last-resort financial support for specific percentage losses in a debt-financed project. Credit enhancements generally provide lenders with greater assurance that a borrower will repay a loan, via additional collateral, insurance or third-party guarantees. They also attract lenders that might otherwise not take the risk. This allows for a wider range of borrowers to be eligible, but at lower interest rates and with longer repayment periods.

Environmental Tax Shifts

By placing a tax on certain undesirable items, environmental tax shifts enable cities to significantly reduce qualities that they want to minimize, including as air pollution or stormwater runoff. Tax shifts are commonly used in other countries. Massachusetts proposed an environmental tax shift referred to as "pay to pave" in an attempt to reduce paving and minimize impervious surfaces. At publication time, the tax has yet to actually be implemented.

Reverse Auction

A reverse auction occurs when there are many sellers and one buyer. This method can be used to find a reasonable price for the installation of a particular piece of stormwater infrastructure. The lowest bidder is notified that the stormwater authority will pay the final bid amount for the project. In the Midwest, a procurement auction for rain gardens and barrels resulted in a much lower market price per unit than a stormwater control plan.

Public-Public and Public-Private Collaborations

Cross-entity partnerships can offer a solution for stormwater feature maintenance and operations funding , and can be a method for accessing upfront funding. Detroit's non-profit organization partnership The Greening aims to create a 'greener' city through tree planting, educational programs, environmental leadership, advocacy, and building community capacity. The program has educated residents about rain barrels

Tax Increment Financing (TIFs)

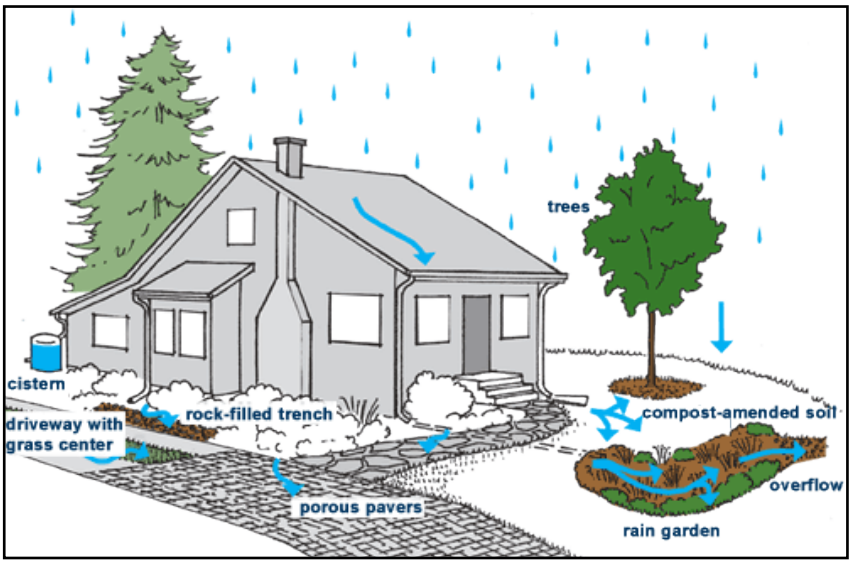
San Francisco's Transit Bay Center, with its massive green roof and interactive water features, is financed through TIFs. (Photo courtesy of PWP Landscape Architecture)

Development Incentives

Above: Portland's Ecoroof Incentive Program was established with the goal of creating over 40 acres of lightweight, low-maintenance green roofs. The city has approved $1.9 million in projects, offering property owners reimbursements of $5 per square foot. (Photos courtesy of Ecoroofs Everywhere, Jenny Cestnik)

Economic Incentives

Below: Seattle's Rainwise Program provides information on building and stormwater codes, design guidance, code requirements for projects applying for a Stormwater Facility Credit, and the city's cistern and rain garden rebates. (Photos courtesy of Sustainable Ballard, Ecoyards)



and rain gardens and has greened and maintained vacant lots and installed community gardens. The Greening is funded by corporate donors as well as other foundations. In Cleveland, Green "Leaves Behind" Program, a partnership between the Northeast Ohio Regional Sewer District, the Cleveland Foundation and a non-profit organization improves neighborhoods by design and public art. The partnership aims to create community benefit on areas surrounding gray infrastructure tunnels in hopes of invigorating neighborhoods. Examples of other "Leaves Behind" work include pocket parks, community gardens, open green space, and vacant land.

Private Grants and Loans

Grants to private property owners and community groups can be successful in encouraging uptake of integrated water management features. Cities can provide incentives in the form of money paid directly to private entities for water management and other green infrastructure improvements, as well as promote features indirectly through low-impact development competitions and similar initiatives. The Green Improvement Fund in New York's Onondaga County provides grant funding to commercial properties that install green infrastructure in targeted sewer districts. The program is part of a larger combined sewer overflow abatement program that seeks to eliminate 250 million gallons of CSOs (combined sewer overflows) by 2018. Private-sector participation can also be successful, and is often necessary, in achieving this type of goal. Currently, 28

projects capture approximately 11 million gallons of stormwater in Onondaga County. Engineering firms can implement their choice of green infrastructure techniques, but grants are determined by the amount of stormwater captured. Property owners are obligated to provide maintenance under a 10-year agreement.

Tax Credits

One-time rebates or continuing (long-term) tax reductions are a widely used incentive for motivating private installation and maintenance of green infrastructure. Many states including Maryland offer tax credits for property owners who remove impervious surfaces. In Philadelphia, businesses can receive a rebate of 25% on the cost of implementing a green roof up to $100,000 through the City's Green Roof Tax Credit

Fee Reductions

Stormwater fee discounts on water utility charges are the most common type of incentive program. Reducing runoff from private property decreases burdens on the city stormwater system. A reduction in service demands can be quantified to benefit property owners through a reduction in the fees charged by the utility. In other words, if a property owner can reduce the amount of stormwater entering the public stormwater system, they will be charged less by the city. In Philadelphia, apartment buildings faced costly stormwater bills due to high rates of drinking water consumption. Meanwhile, commercial parking lots, which generate significant runoff, often paid nothing because they did not consume drinking water. Philadelphia's new stormwater fee system is based on impervious area determined by geographic information systems (GIS), and discounts are given based on decreases in impervious surfaces, installation of particular controls, or by volume or pollutant-reduction performance. The city offers a stormwater fee discount of up to 80% of the impervious area charge or gross area charge, or both for customers who reduce impervious cover with green infrastructure. In Milwaukee, the city enables stormwater rebates if a business agrees to fund a maintenance plan for a project. This agreement can result in a financial "net-zero" scenario in which

Tax Rebates & Grants

Above: Green roofs in Nashville, which are eligible for tax rebates. (Photos courtesy of City of Nashville, RD Herbert & Sons)

Below: A woman paints a cistern as part of the "Save the Rain" program, an initiative of the Green Improvement Fund in Onondaga County in New York, which provides grant funding to commercial properties that install green infrastructure practices in specific sewer districts. (Photo courtesy of Onondaga County)

their financing of the maintenance would be equal to the value of the storm water rebate.

SUPPLEMENTAL FUNDING MECHANISMS

Tax-Based Fees

Tax Increment Financing

Tax increment financing (TIF) is a public financing method that is used as subsidy for redevelopment infrastructure or other community-improvement projects. The method is to use predicted future gains in taxes to subsidize current improvements. The completion of the improvements often increases the value of surrounding real estate, which in turn boosts tax revenue to the projected level. An increase in site value paired with private investment generates an increase in tax revenue, or a tax "increment." TIF dedicates tax increments within a certain defined district known as Tax Increment District (TID) to finance the debt that is issued to pay for the project. TIF was developed to assist in funding infrastructure improvements in underutilized areas where development might otherwise not occur. In Chicago's City Space program, which was supported by the Chicago Community Trust, four public entities collaborated with over 100 public, non-profit and private organizations to identify opportunities to convert specific tax delinquent properties to usable open, recreational space. In just over 10 years, the program acquired over 5,000 delinquent properties, which were transformed into parks and open space. Project implementation funds for acquisition and development of open space projects include an Open Space Impact Fee (Department of Community Development) which has raised $53 million since 1998 by charging developers a per-unit fee for new dwellings. Also contributing to the program's funding are property assessments by the Chicago Park District, which raises its operating budget primarily from property taxes, general acquisition bonds, tax increment financing, and concession revenues. Michigan's Genesee County, on the other hand, employs a countywide TIF to cross-subsidize development of various low-value properties. When Milwaukee established its TIF, it also implemented a site-specific tax increment district (TID) which raised $16 million.

Ad Valorem Tax Revenue

Revenue gathered from a broad-based assessment of real property value that is used to address utility operating and/or capital funding needs. Typically used today only by special water districts.

Economic Incentives

Rebates and Installation Financing

Rebates and installation financing include tax credits or reimbursements to property owners who install water management mechanisms. These programs typically offer a list of specific practices, such as the installation of cisterns, permeable pavement, or green roofs. Maryland's Montgomery County established

Rebates and Installation Financing

Below: As at Randall's Island Learning Garden, New York's GrowNYC Program provides installation funding for community gardens to help build and maintain rain-harvesting systems. GrowNYC also works with surrounding property owners to divert downspouts into a barrels that collect up to 15,000 gallons of rainwater a year. (Photos courtesy of GrowNYC)

RainScapes Rewards, a rebate program used to meet part of its municipal separate storm sewer system permit goals. The county provides rebates based on the amount of runoff captured. Through these practices, Montgomery County has treated runoff from about 12 acres of impervious area. One of the county's most effective strategies for increasing participation in RainScapes Rewards has been an installation training program for professionals. Similar to other programs, Montgomery County prescreens applicants, performs final inspections, and requires a maintenance agreement. Both commercial and residential properties are eligible for rebates, but the most common commercial applications have been for private schools and home owner's association common areas. In New York, the GrowNYC program was the first organization, which provided installation funding for community gardens to help build and maintain rain-harvesting systems. GrowNYC manages all gardens along the Bronx River. When there is a neighboring building with a downspout, gardeners who work for GrowNYC enter into an agreement with property owner to divert the downspout into a barrel. These systems combined collect 15,000 gallons of rainwater a year.

Awards, Certification and Recognition Programs

Awards and recognition programs reward innovation and increase awareness of integrated water management projects by both the public and decision makers. For example, Vermont non-profit Lake Champlain International (LCI) established BLUE certification for watershed-friendly homes. Certified homeowners receive a BLUE certification lawn sign and the satisfaction of improving local water quality. LCI is also working with cities to implement a stormwater utility discount for certified homeowners. This is the one of the most effective programs for combating residential stormwater pollution by incentivizing homeowners to take action not just in the short term, but by taking a long-term approach to reducing runoff. LCI evaluators work with homeowners on a checklist of both behavioral and physical practices that help lead to a BLUE certification. Behavioral changes include

Richmond's Canal Walk: Cultural Implications of Integrated Water Management

Richmond is situated on the James River, at the fall line dividing the Virginia Tidewater region and the Virginia Piedmont region. Early in the city's history, a canal structure was engineered to bypass the waterfall that exists on this fall line. The canal allowed Richmond to command western trade by allowing boats to travel further inland. In response to Clean Water Act violations, the canal system was improved and expanded to accommodate a canal walk in 1999 in conjunction with Richmond's Department of Public Utilities. A large-diameter pipeline was installed, rerouting stormwater to a fifty million gallon retention basin during overflow events. Richmond previously experienced 32 untreated effluent discharge events per year prior to 1999; it now averages one.

The benefits of building this system are clear from an environmental perspective, but the Canal Walk maintains other implications for the area. Notably, it has leveraged private-sector development. The assessed value of real estate in the riverfront area has tripled since the introduction of the Canal Walk, and now totals $722 million. The Canal Walk also serves as a historic corridor, drawing visitors and strengthening the city's ties to its past. Attractions include a river cruise, the Civil War Center, and exhibits depicting African-American history. These benefits are the result of a $26 million investment in the Canal Walk itself and $20 million for combined sewerage overflow projects. Private land valued at $6 million was donated. Additionally, the Federal Highway Administration awarded a $1.7 million grant to the project for reconstruction of the canal walls and floor. Without investment in integrated stormwater management solutions, the Canal Walk and resulting benefits would not have been possible. The previous environmental state of the canal left it in no condition for the sort of additional investment necessary for the area to become an open promenade or to appreciate in assessed real estate value. (Photos courtesy of Shawn Dreelin and Shockoe Design District)

using phosphorus-free detergent and disposing of pharmaceuticals properly. Physical practices include runoff prevention features, such as redirected downspouts, rain gardens, and rain barrels. For features requiring installation, LCI provides funding to help offset the cost of the project. Homeowners are required to sign a legally binding, three-year maintenance agreement, and also agree to an annual audit and a home inspection every three years for recertification. The BLUE program is owned by Tethys Environmental and is available to nonprofits, municipalities, and private companies nationwide. This program can also satisfy the public education and outreach and public participation involvement minimum control measures of EPA's MS4 (municipal separate storm sewer system) permit.

Land Trusts

Top: The Chicago Park District developed a land trust with Openlands, a regional nonprofit, which purchases land using a revolving fund and ultimately turns properties over to the city, transformed into community gardens maintained by neighborhood residents or other uses. One of these projects, Hackmatack National Wildlife Refuge, provides a haven for wildlife.

Bottom: Hackmatack National Wildlife Refuge, a project of Openlands and the Chicago Park District

(Photos courtesy of Openlands)

"Trading" Ecosystem Services

While many of the roles of plant life in an ecosystem are increasingly recognized (biodiversity, recreational and aesthetic benefits, shade, evapotranspiration, etc.), the role of urban forests and wetlands in carbon sequestration is less frequently discussed. Forests remove carbon from the atmosphere through photosynthesis and store the carbon as biomass in vegetation and soils. On a smaller scale, valuation of urban ecosystem services (the benefits, or "services," people derive from ecosystems)

through afforestation and reforestation projects, in the form of carbon offsets, offers the opportunity to raise funds to install and maintain landscape-integrated water management features if planned at significant scale. Typically, there are three ways that government can charge for the consumption of ecosystem services. It can create a subsidy for conservation; it can develop a trading scheme that measures and verifies a reduction in loss of services; or it can fine those responsible for the loss of ecosystem services. New York City recently applied an ecosystem services approach to compliance with federal drinking water standards by taking steps to protect the Catskills watershed instead of building a new water filtration plant. In so doing, they traded the watershed, an ecosystem service provided by the land, for the filtration plant, a technology-based service.

Development of Land Trusts

Under a land trust, an organization agrees to acquire land in order to actively conserve it. The New York Restoration Project (NYRP) developed a land trust after acquiring community property. Funding was achieved by a private donation to the NYRP of $1.2 million from actress Bette Midler's foundation. This private donation has established a $2.5 million endowment from other private donations for capital improvements and maintenance needs in the city. Similarly, the Chicago Park District developed a land trust with NeighborSpace that relies on volunteers for maintenance, sustained community support to maintain open spaces, as well as providing liability insurance for sites. Additional partners include Openlands, a regional nonprofit, which purchases land using a revolving fund and ultimately turns over to the city properties that have been transformed into community gardens maintained by neighborhood residents.

Gap Ownership

Gap ownership allows for grant funding to be received while the ownership of a property is being transitioned from an existing owner to a new owner. This can, in some circumstances, be a lengthy process but it creates opportunities for temporary uses such as public open space. Openlands provides gap ownership of properties to public organizations using a revolving $1.5 million fund to assist local, county and state government. This temporary ownership proved to be beneficial to Chicago by allowing for more accurate site assessment costs, assistance to municipalities in the avoidance of project delays, as well as an ability to acquire multiple neighboring properties quickly. This enabled the acceleration of potential large scale development.

Fee-Based Funding

Developer Exaction

Exaction requires a land developer to mitigate the negative effects of construction and provide a particular service benefit to that development. The Montana Department of Transportation, for example, uses exaction to lessen the impact of new development on existing public facilities and to fund water and sewer lines, roads, schools, and parks.

Tap Fees

A tap fee is a one-time charge to new utility connections made for the purchase and installation of water meters, or for connecting a water or wastewater customer to the utility. South Carolina's Charleston Water System employs a tap fee.

Availability of Service (Stand-By) Fees

A stand-by fee is a monthly charge to utility customers to recover costs incurred when it constructs facilities for the benefit of future customers. The City of Irvine, California uses a stand-by fee that appears on property tax bills but can sometimes be billed to a local agency.

Contract Demand Charges

Similar to stand-by fees, contract demand charges are periodic payments where high-volume customers agree ahead of time to pay fixed charges related to the amount of utility capacity they expect to use. Kinston, N.C., uses demand contract charges to pay for fixed costs and to control energy use and associated costs.

Green Roofs and Green Jobs

"Wide-scale design, construction, and operation of green roofs can result in increased employment opportunities, which can in turn reduce urban unemployment or underemployment. Covering even 1 percent of large buildings in America's medium to large-sized cities with vegetated roofs could create over 190,000 jobs and provide billions in revenue to suppliers and manufacturers that produce or distribute green-roof related materials. Through collaborative job training and placement programs, these new jobs could further stimulate the local economy. For example, the New York non-profit Sustainable South Bronx provides training for green infrastructure jobs in landscaping, green roof installation and brownfield remediation. The organization reports that prior to training, nearly all students were on public assistance and half had prison records and afterwards 85% of graduates hold well-paying, steady jobs."

-American Rivers, "Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide," 2012 (Photos courtesy of Green Jobs Now, Sustainable Building San Francisco, Make It Right)

In-lieu Fee Mitigation

With in-lieu fee mitigation, natural resources are restored through funds paid to a governmental or non-profit natural resources management entity instead of conducting project-specific environmental mitigation. Washington's King County implemented a mitigation reserves program that enables permit applicants to buy mitigation credits for projects that result in unavoidable impacts to natural water resources.

Other Tactics

Land Banks

A land bank is a non-governmental, third-party organization that assists local governments with the acquisition of promising stormwater management properties. Michigan's Genesee County created a land bank to acquire, maintain, and transfer foreclosed vacant land and advance its green development goals.

Eminent Domain and Condemnation

These are mechanisms to acquire properties with limited development potential. Dade City, Florida considered eminent domain for water retention purposes.

Revolving Loan Funds

Revolving loan funds finance new multi-year operations through loans that are replenished by repayments from prior fund beneficiaries. The funds are used by third-party acquisition organizations to speed the purchase and aggregation of strategic properties.

Consent Decree Funds

Consent degree funds are made available through a legal ruling that exculpates one party in exchange for payment of damages. These funds pertain to private companies and public entities.

Volunteering

Volunteer programs are a popular mechanism for maintenance funding because they offset project costs through unpaid, private labor and encourage

community involvement and a sense or ownership which inspires loyalty to ongoing maintenance requirements. New York, for example, has established a series of volunteer clean-up days hosted by the Department of Environmental Protection (DEP). DEP is a large supporter of this initiative because this maintenance strategy saves the DEP an estimated $100,000 annually. Similarly, in Michigan, the Genesee County Adopt-a-Lot program leases to community members, free of charge, vacant lots that are up for sale, or sells them for a nominal amount. The program also provides technical assistance with gardening and similar activities. The lot becomes the responsibility of the participant, who is typically the resident living adjacent to the lot. This policy also allows for aggregation of multiple lots maintained by more than one resident towards a common use, such as an urban farm. The program is funded by grants, property sales, and a Land Reutilization Fund. Lastly, Stewardship Partners, in partnership with Washington State University, is leading a campaign to

Land Trust

Above: Swinder's Cove, a project of the New York Restoration Project (NYRP) land trust. (Photo courtesy of AIA New York)

Volunteering

Below: Genesee County Adopt-a-Lot program leases community members vacant lots. The lot becomes the responsibility of the participant, who maintains the lot or uses it for a garden or other approved use. (Photo courtesy of MLive).

The High Line

New York City's High Line is a model of cross-community collaboration. The non-profit Friends of the High Line have raised a total of $44 million from private sources to pair with funds from the city and state. In anticipation of this major urban intervention, the City of New York rezoned the adjacent neighborhoods to allow for higher density development, resulting in a 60% increase in population between 2000 and 2010. Mayor Michael Bloomberg has credited the High Line with attracting at least $2 billion of private investment in response to the two phases of development. This figure includes over 2,500 residential units, 1,000 hotel rooms and nearly 500,000 square feet of office space. The project created 8,000 construction jobs in addition to 12,000 permanent jobs.

The operations and maintenance costs associated with the High Line are paid through a conservancy model. The Friends of the High Line take responsibility for daily operations including gardening, cleaning, and graffiti removal, and the City of New York covers security and structural maintenance. A High Line Improvement District, similar to a Business Improvement District, is also under consideration to cover future maintenance costs. (Photos courtesy of Friends of the High Line)

provide technical assistance and support to neighborhoods to install rain gardens through volunteer activity. Their goal is to facilitate the installation of 12,000 community-built rain gardens in the Puget Sound Region by 2016 in order to avoid millions of dollars in pollution clean-up and expensive stormwater projects. The program is projected to mitigate 160 million gallons of polluted runoff, a significant portion of the excess flow in the region affected by toxic runoff into the Sound. Project partners include watershed non-profits Salmon-Safe, Collaborative Conservation, Washington State University's Master Gardener Program and Stewardship Partner's Snoqualmie Stewardship Program for improved land stewardship and habitat restoration.

Civic Leadership

Civic leadership can be defined as a passion for promoting the quality of life in one's community. Civic leaders are community members who help to inspire others by their enthusiasm and passion. Civic leaders also tend to be those who think "outside the box" and are not satisfied with the status quo. The Yu Ying Chinese Charter School in Washington, D.C., for example, has implemented the first phase of a stormwater master plan designed to retain, cleanse, and store water from a 1.2-inch rain event. Located on the peak of the second highest hill in the district, the leadership of this language-immersion elementary school chose to mitigate its impact on the properties below them, and in so doing to teach the more than 160 students there about the ethics of resource management. On their own initiative, the school was one of the first to use the District's 2012 pilot program for stormwater retention trading. The performance of their system has generated sufficient credit to cover the projected annual maintenance costs of their bioswales and retention ponds.

Technical Assistance and Job Training

Technical assistance is a form of education that can be critical to maintaining water infrastructure. In New York, a program that manages more than 600 community gardens provides technical assistance and

temporary ownership to participants. This program helps community gardeners enter licensing agreements and hosts workshops on training and supplies materials and tools. The program is funded by a Federal Community Development Block Grant and city tax levy revenues. Similarly, in Chicago, Greencorps Chicago provides horticultural technical assistance, education, garden materials, and training for ex-offenders and others. The estimated $1.32 million of funding for this entity came from city general obligation bond funding, corporate donations, and the local power utility, as part of settlement funding. Additional HUD CDBG funding was used in the program.

Sponsorship

Sponsorship is a powerful tool that can be leveraged to help subsidize maintenance and operation funding through donations. New York's Bluebelt, a sustainable storm water management system established on both public and private acquired property, links a series of wetland corridors to receive stormwater from impermeable surfaces on Staten Island. These wetland corridors served to remove pollutants, capture stormwater, and enhance the surrounding area. The Bluebelt not only avoided an estimated $20 million in costs associated with sewer infrastructure construction, but also restored natural areas of land and water while managing storm water in an effective and sustainable way. The "Adopt-a-Bluebelt" program was established to help with maintenance funding. It allows community members, local businesses, and government sectors to "sponsor" a part of the Bluebelt, similar to the "Adopt-a-Highway" program that hired private maintenance companies. As of 2009, over 110 sites have been adopted by sponsors.

Civic Leadership

A volunteer harvests fruit as part of the New Orleans Fruit Tree Project. (Photos courtesy of N.O. Fruit Tree Project)

5 Policy and Action

NEXT STEPS

Good ideas and good intentions do not turn into meaningful actions by themselves. They require a supporting framework of guiding policies, legal jurisdiction, program authorizations, and funding. Those will necessarily evolve over time but must begin with the framework and options that exist today.

The importance, even the necessity, of managing water in an integrated manner to emphasize value and reduce risk is not new. It is an essential element of the National Flood Insurance Program, the State of Louisiana's 2012 Comprehensive Master Plan for a Sustainable Coast, and the City of New Orleans' Master Plan.

Though these policies and principles are clear, some of long standing, and some with the force of law - specifically the Louisiana Coastal Master Plan and the New Orleans Master Plan - they have not been translated into coherent and effective programs and actions. Recent events such as the floods of 2011, the drought of 2012 and Hurricanes' Katrina, Rita, Isaac and Sandy have drawn renewed attention to the importance of managing water in comprehensive and integrated ways that almost certainly will shape the futures of the region.

Guiding Policies and Principles

"I cannot overemphasize that very great responsibility for success of the program rests upon state and local governments and upon private property owners in hazard areas. The key to resolving the problem lies, above all else, in the intelligent plan for, and state and local regulation of, use of lands exposed to flood hazard."

-- President Lyndon Johnson urging local involvement in flood protection in 1966.

National Flood Insurance Program

FEMA's National Flood Insurance Program (NFIP) makes federally-backed flood insurance available in communities that agree to adopt and enforce floodplain management ordinances to reduce future flood damage. After hurricanes Katrina, Rita, and Wilma in 2005, the program was forced to borrow $18 billion from the U.S. Treasury and will likely need to borrow an additional $8 billion to pay claims from Hurricane Sandy. To put the program on a path to fiscal stability, Congress passed the Biggert-Waters Reform Act of 2012, which increased the limit on annual rate hikes from 10% to 20% and phased out subsidies. With political uncertainty about the program's future financial viability, the cost of insurance has steadily increased and will likely continue to do so, affecting coastal cities around the country.

Flood Insurance Rate Maps

A key product of the NFIP are Flood Insurance Rate Maps (FIRMs), which are prepared and maintained by FEMA. They provide the basis for regulating development in special flood hazard areas

VISION: NEW ORLEANS IN 2030

It has become an incubator of innovation among river delta cities worldwide. Recognizing that modern economies depend first and foremost on people and their skills, New Orleans has invested in lifelong workforce training, effective and cost-efficient government, and enhanced quality of life. Better education, expanded job training, workforce readiness, and similar programs have extended new opportunities to native New Orleanians as well. From culture, tourism, and maritime trade, to life sciences and media, to alternative energy and coastal protection and restoration technology, New Orleans has diversified and created a new era of jobs, built both on the skills brought by new residents attracted to the city's creativity and quality of life and the on the innovative work of city natives.

New Orleans can become a city that celebrates its relationship to water and uses water-management strategies to provide amenities to neighborhoods wherever possible.

SUSTAINABILITY
A MORE RESILIENT CITY WITH SHARED ENVIRONMENTAL RESPONSIBILITY AT EVERY LEVEL

In 2030, New Orleans has become one of America's greenest cities: resource-efficient, environmentally healthy, and resilient. The city's building and zoning codes are national models for preservation and sustainability. The city's success has drawn new regional growth into enhanced neighborhoods from Audubon to a thriving New Orleans East, reversing regional sprawl. A global center of knowledge about managing natural and man-made systems to prevent flooding in low-lying cities, the city now boasts landscaped canals, parks with water features, and shady, tree-lined streets that contribute to its unique beauty while reducing subsidence and managing water from storms.

A PLAN FOR THE 21ST CENTURY: NEW ORLEANS 2030, ADOPTED AUGUST 2010 | EXECUTIVE SUMMARY | **15**

and determining rates for flood insurance. The maps for the New Orleans area dated back to the 1980s. Following Hurricane Katrina, FEMA embarked on an effort to restudy and update the maps to account for improvements in the US Army Corps of Engineers' Hurricane and Storm Damage Risk Reduction System (HSDRRS) and other improvements to interior drainage by local governments. In late 2012, preliminary flood insurance rate maps were provided to local officials for review prior to making the maps effective, which is expected by the end of 2014. While still preliminary at this report's publication time, flood heights and depths as a result of interior drainage have generally been lowered due to these improvements. Yet considerable areas remain subject to flooding from potential 10-year and 100-year rainfall events. The water assignment, or excess water that needs to be stored to eliminate flooding, from the more common 10-year event was calculated and became the basis for the Urban Water Plan's flood reduction objectives. Additional hydraulic modeling illustrates that intensive implementation of envisioned improvements reduce the 10-year flood hazard significantly. Though determining the extent to which these improvements reduce the 100-year flood hazard will require further detailed modeling, by mitigating flooding from a 10-year event, these strategies will also reduce the impact of a 100-year flood.

Community Rating System

The CRS is a voluntary incentive program that recognizes and encourages community floodplain management activities that exceed the minimum NFIP requirements. The more points a community earns, the lower the NFIP rates. Local governments can also lose points if they do not reevaluate regulations under the 2012 Reform Act criteria. Currently, Orleans Parish receives a 10% discount, Jefferson Parish a 20% discount, and the City of Kenner a 15% discount. At the time of publication of this report, St Bernard Parish has begun the process of participating in the CRS Program. According to analysis conducted as part of the Urban Water Plan, additional insurance discounts can be realized by all three jurisdictions in the project area with the full implementation of the plan, resulting in a total estimated savings of $609 million over 50 years.

Louisiana's Coastal Master Plan

In 2012 the State of Louisiana approved an update of its Coastal Master Plan as required every five years. This plan is grounded in the recognition that the ongoing collapse of Louisiana's coastal ecosystems poses a survival threat to the entire lower third of the State, including the Greater New Orleans region. This Master Plan sets forth a suite of actions aimed at restoring functional sustainability to that landscape while also providing a realistic level of protection to the communities of the region. Critically, the Master Plan acknowledges that community sustainability is dependent on the successful integration of coastal conservation and restoration, structural protection such as levees, and non-structural measures such as elevation, building codes, and land use planning. By acknowledging the existence and nature of both risk and opportunity, the Master Plan can guide and reinforce actions such as those set forth in the City's Master Plan, including integrated water management.

New Orleans Master Plan

In 2010 the City of New Orleans adopted a sweeping plan to guide its path for decades to come. This comprehensive approach, referred to as the "Plan for the 21st Century", was approved by a city-wide referendum and addresses the challenges of creating livability, sustainability, and opportunities -- including those associated with living with water, a task addressed in Chapter 12 of the city plan, "Resilience: Living with Water and Natural Hazards".

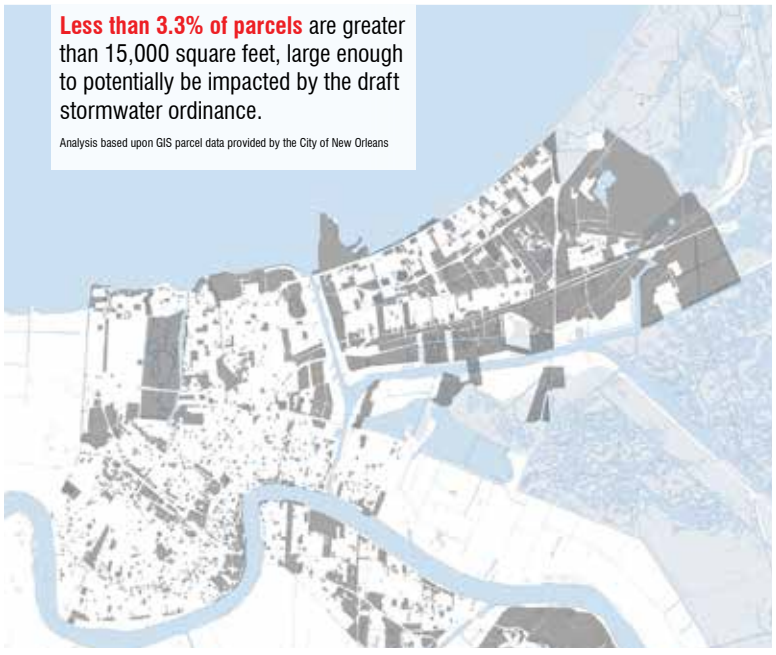
Transcending current approaches to water planning, the Master Plan sets the goal for the minimal standard of acceptable flood protection at the 1-in-500 year level and acknowledges that land-use planning, building practices, elevation, storm water, and groundwater and subsidence management at the local level will be critical to moving toward that target. Most importantly, the Master Plan is firmly grounded in the realization that water driven risks and the opportunities they present are dynamic and equally important, and should be addressed together. Integrated water management is essential to achieving the goals of this plan.

Public Policy

Local, regional, state and federal commitment is critical to the successful implementation of integrated water management practices that can build resilience; enhance safety, quality of life and economic vitality; and decrease the need for more costly stormwater controls and emergency response. The following recommendations have been researched and developed by the Urban Water Plan team and are provided to the policy makers, advocates, and other readers of this report as international best practice actions for integrated water management.

Zoning Impact

Development Parcels affected by the City's Draft CZO



RECOMMENDATIONS FOR LOCAL ACTION

Recommendation 1

Adopt a more comprehensive and dynamic approach to flood risk assessment and management (per the National Academies 2012)

- Collaborate with FEMA, the US Army Corps of Engineers, the state, and regional stakeholders to develop a comprehensive approach to flood risk management and assessment
- Adopt new standards and techniques that respond to this new approach and account for climate change and anticipated sea level rise

Recommendation 2

Adopt a minimum 500-year flood protection level in each parish (per the New Orleans Master Plan 2010)

- Advocate for funding and the expeditious implementation of a flood protection system that will handle a 500-year or stronger storm event

Recommendation 3

Adopt a long-term Integrated Water Management Plan

- Lay out a vision for how the Integrated Water Management Plan will be implemented across the city or parish
- Issue an executive order requiring city/parish departments to incorporate stormwater best management practices in the design and construction of all public projects
- Develop and adopt a "Complete Streets" program, as in the case of New Orleans, that also incorporates strong stormwater management practices; implement new rules whenever a street is overlaid or rebuilt
- Coordinate department roles to ensure there is enough capacity to review and implement stormwater management projects that meet MS4 requirements
- Establish a methodology that, in addition to construction costs, capital costs and life cycle costs,

considers safety, economic, social, and environmental benefits in the selection and approval of stormwater management projects

Recommendation 4

Create a stormwater/ groundwater management unit within each city's or parish's drainage department

- Employ blue-green infrastructure practices to mitigate flooding, combat subsidence and comply with MS4 requirements
- Install a groundwater monitoring network and employ real-time controls to manage surface water levels for subsidence control
- Monitor and record stormwater and groundwater quantity and quality, as well as land subsidence, to ensure objectives are being met
- Establish close collaboration with other local and state entities that manage groundwater within the perimeter defense system

Recommendation 5

Develop and enforce a strong retention standard for stormwater in urban development and redevelopment

- Introduce stormwater management requirements in city/parish zoning ordinances, exempting only single- and double-family residential, to minimize the volume of runoff discharged from developed sites
- Encourage or require blue-green infrastructure practices in construction permits with incentives and non-compliance fees
- Apply fees towards building and maintaining blue-green infrastructure that benefits the same community where the fee is collected
- Create 'water credits' to encourage developers to exceed stormwater management requirements
- Establish a Stormwater Management Authority to manage fees and 'water credits' and a Stormwater Advisory Committee to review stormwater management projects and advise on fee

Philadelphia

"Over the next 25 years, Philadelphia is committed to deploying the most comprehensive urban network of green infrastructure in the United States. Philadelphia's Green City, Clean Waters plan, recently approved by state regulators, requires the retrofit of nearly 10,000 acres (at least one-third of the impervious area served by a combined sewer system) to manage runoff on-site; relies on green infrastructure for a majority of the required CSO reductions; calls for the investment of more public funds in green infrastructure (at least $1.67 billion) than in traditional gray approaches; and leverages substantial investments from the private sector, primarily through application of a one-inch retention standard for new development and redevelopment projects citywide. The city will fund its share of the costs with a stormwater fee based on impervious area, supplemented by state and federal grants as available. To encourage retrofits on private property beyond that required by the retention standard, the city offers incentives such as reduced stormwater fees, free design assistance and low-interest loans to owners of large impervious properties, a green roof tax credit, rain barrel giveaways, and expedited permit reviews. Philadelphia also has installed dozens of green infrastructure demonstration projects, has published a technical design manual, and is developing a maintenance manual."

-EPA Office of Wetlands, Oceans and Watersheds, "Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure," 2010

(Photos courtesy of Hidden City Philadelphia and WRT)

Reduce impervious surfaces by installing stormwater management best practices including green roofs and pervious paving

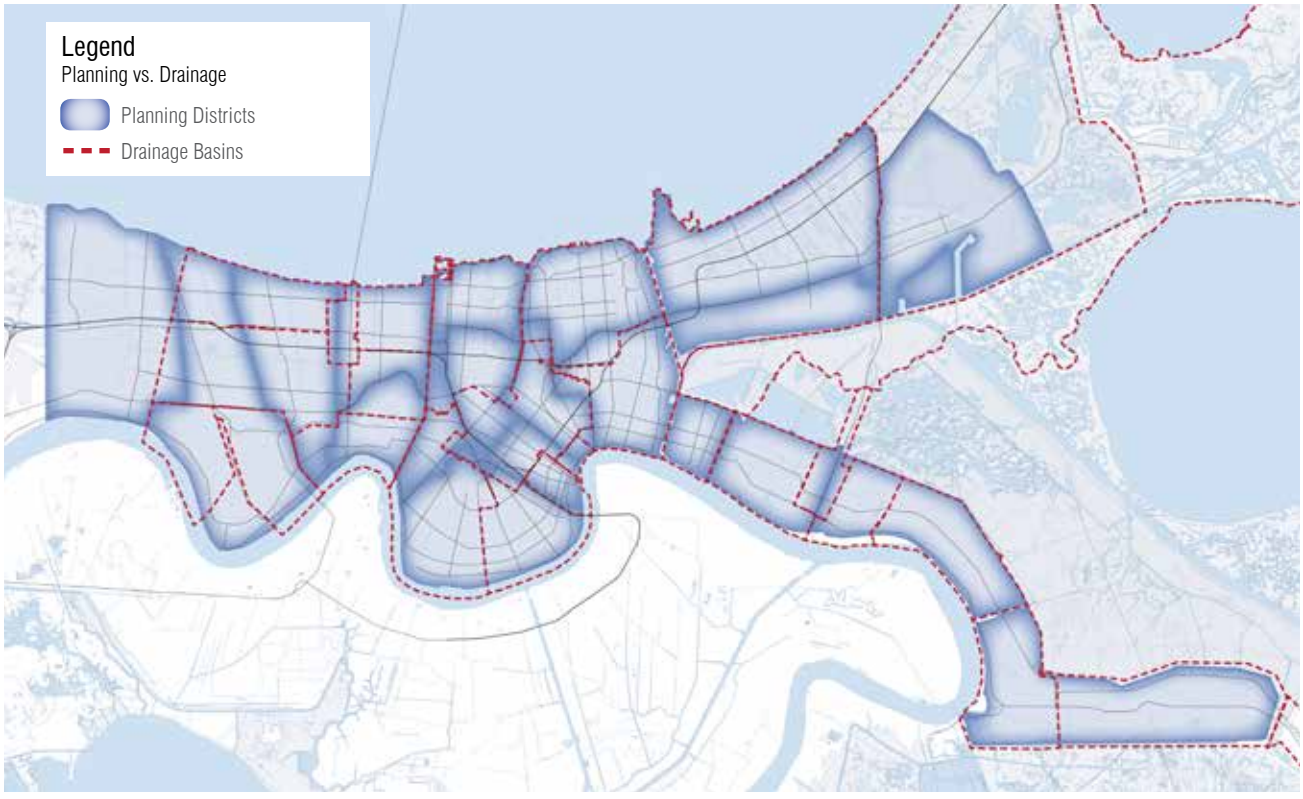
allocations
- Align planning districts with water management districts based on the physical landscape

Recommendation 6

Require the use of stormwater management practices to reduce runoff from existing impervious surfaces

- Develop a program designed to reduce impervious surfaces along streets and on roofs of public buildings
- Introduce a stormwater service fee that requires the use of blue-green infrastructure to replace a portion of impervious surfaces or otherwise mitigate runoff from those areas
- Revise zoning rules and building codes to discourage paving over green space and to encourage downspout disconnections and green roofs

Align Planning Districts with Drainage Basins



Recommendation 7

Provide incentives for private use of blue-green infrastructure

- Offer zoning and permitting advantages (i.e. density, land use, floor area, and building height "bonuses") to projects that incorporate or exceed certain stormwater requirements
- Offer other incentives (i.e grants, low-interest loans, permit fee reductions, property tax credits, and stormwater fee credits or discounts) that directly or indirectly finance projects that incorporate or exceed certain stormwater requirements

Recommendation 8

Provide guidance or other actions to accomplish stormwater management goals

- Include in guidance demonstration projects, planning workshops and technical manuals that decrease the gap in public knowledge and experience concerning design, construction, maintenance, and benefits of green and blue infrastructure
- Identify and overcome code and zoning barriers
- Develop and enforce design guidelines adopted in building and zoning codes
- Provide workforce training to contractors so they can build stormwater management projects per design guidelines
- Educate permitting agency reviewers and inspectors
- Provide citizens with assistance (some agencies also provide volunteers, tools and materials) towards implementation of stormwater management projects

Recommendation 9

Prepare a stormwater financing plan to ensure dedicated funding sources for integrated water management

- Dedicate stormwater fee to blue-green infrastructure implementation, operation and maintenance
- Establish water management guidelines and requirements to ensure that funds are being used for the intended purposes of a program or act

Washington, D.C.

"Thanks to its newly issued federal stormwater permit, Washington, D.C., has the makings of a very strong green infrastructure program. Containing a 1.2-inch retention standard for new development and redevelopment—to be achieved through evapotranspiration, infiltration, and harvesting—and numeric retrofit targets for street trees and green roofs, the permit will strongly encourage the use of green infrastructure on properties throughout the District. Washington's Department of the Environment is considering implementing the permit's retention standard through an innovative credit market that would be the first of its kind. Even prior to the new permit's issuance, D.C. agencies had begun a vigorous public education and assistance campaign, providing subsidies and technical help for the installation of a wide array of green infrastructure practices. A stormwater fee based on impervious area, along with a proposed discount program for on-site retention of runoff, provide an additional incentive for green infrastructure implementation."

-Natural Resources Defense Council, "Rooftops to Rivers II: Green strategies for controlling stormwater and combined sewer overflows," 2011

(Photos courtesy of American Society of Landscape Architects)

Portland, Ore.

"Through a combination of requirements and voluntary measures Portland has initiated, green infrastructure is a central component of the community's program for reducing stormwater runoff and its efforts to address overflows from the parts of the city covered by the combined sewer system. In particular, a runoff retention standard with a priority for green infrastructure implementation is in place and applies to new and redevelopment projects involving as little as 500 square feet of impervious area. Portland also has a requirement to develop a retrofit plan for existing impervious areas, and has programs designed to replace city-owned impervious areas along streets and on municipal building roofs. Its 2011 Public Facilities Plan specifies particular intersections for green infrastructure installation—more than 2,200 facilities for green infrastructure are targeted. The city has an impressive array of incentives for private parties to implement green infrastructure, including its "treebate" program, development area bonuses and grant programs for ecoroofs, and the ability to reduce applicable stormwater fees by implementing green infrastructure practices. The city is working in a number of ways to facilitate green infrastructure. For instance, the city reviews local codes to identify and work to remove barriers to green infrastructure, conducts training programs for a variety of stakeholders whenever it updates its stormwater manual, and sponsors green-roof workshops to educate those working in the local marketplace: designers, suppliers, and contractors.

"Finally, there are sewer and stormwater fees paid by ratepayers and developers that help supply funding to keep these programs running. A key to the success of Portland's program has been its willingness to experiment with green infrastructure initiatives, adapt its programs based on implementation experience, and explore solutions that are tailored to the needs of particular watersheds in the city."

-Natural Resources Defence Council, "Rooftops to Rivers II: Green strategies for controlling stormwater and combined sewer overflows," 2011 (Photos courtesy of City Club of Portland and American Society of Landscape Architects)

RECOMMENDATIONS FOR REGIONAL/STATE ACTION

Recommendation 1

Adopt a more comprehensive and dynamic approach to flood risk assessment and management (per the National Academies 2012)

- Collaborate with FEMA, the US Army Corps of Engineers, and local stakeholders to develop a comprehensive approach to flood risk management and assessment
- Adopt new standards and techniques that respond to this new approach and account for climate change and anticipated sea level rise

Recommendation 2

Adopt a minimum 500-year flood protection level regionally (per the New Orleans Master Plan 2010)

- Advocate for funding and the expeditious implementation of a flood protection system that will handle a 500-year or stronger storm event

Recommendation 3

Adopt a long-term Integrated Water Management Plan with force of law

- Lay out a vision for how the Integrated Water Management Plan will be implemented across the region

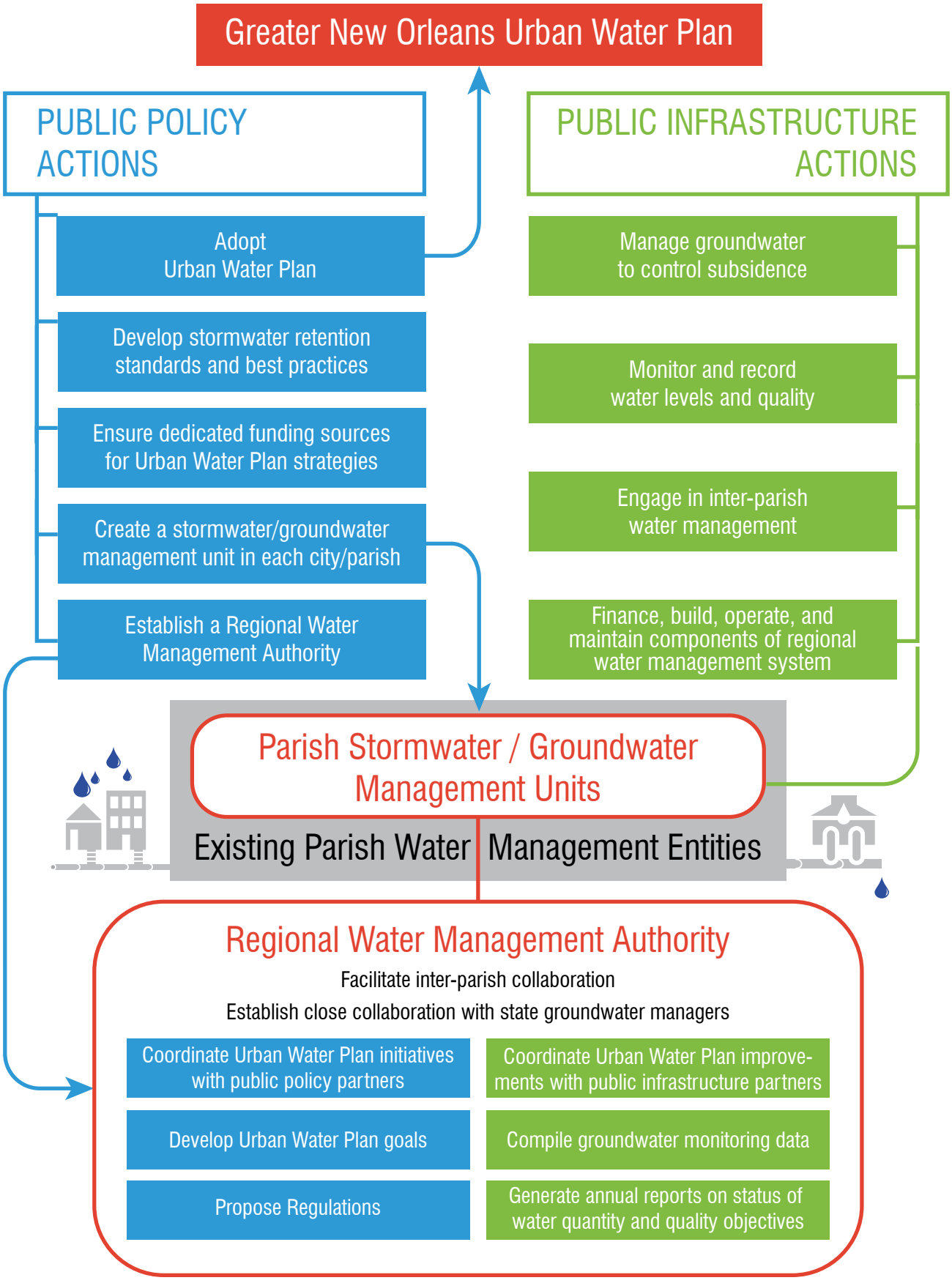
Recommendation 4

Establish a Regional Water Management Authority to facilitate inter-parish collaboration

Consult existing regional models like the Southeast Louisiana Flood Protection Authority and the Regional Planning Commission

- Coordinate integrated water management improvements and initiatives
- Establish close collaboration with state water managers

Recommended Public Policy and Infrastructure Action



Chicago

Chicago - plagued by large areas of impervious surfaces, aging stormwater infrastructure, and the resulting urban heat island effect - has reworked its approach to urban stormwater management policy into one of the nation's most comprehensive and progressive. The city's Stormwater Management Ordinance, the cornerstone of this new policy, requires that all new developments manage on-site stormwater. Its Green Permit Program takes a different approach, incentivizing developers who incorporate green infrastructure with lower permitting costs and shorter permitting times.

Chicago has also espoused more targeted programs that focus on its streets, alleys, and roofs - from the ground up. The Sustainable Streetscapes Program requires green stormwater management practices - bioswales, permeable concrete, and piping that allows for infiltration - in street construction. Similarly, its Green Alley Program, created by transportation officials in response to the numerous impervious public alleys throughout the city, established best practices for retrofitting these alleys with pervious pavement that would reduce localized flooding and increase groundwater regeneration. Its Green Streets Program has resulted in over 600,000 new trees, better air quality, and filtered runoff. Finally, the Green Roof Program, which offers developer incentives of up to $5,000 per project, has resulted in over 4 million square feet of green roofs, which reduce both runoff and energy bills.

(Photos courtesy of Our Green Home and City of Chicago)

- Compile groundwater, surface water, and land subsidence monitoring data
- Generate annual reports that detail whether water quantity and quality objectives have been met

Recommendation 5

Implement a policy that requires stormwater management in all transportation projects that involve federal or state funding or approval

- Revise state transportation design manuals to require stormwater best management practices

Recommendation 6

Ensure dedicated funding sources for integrated water management

- Establish water management guidelines and requirements to ensure that funds are being used for the intended purposes of a program or act

Recommendation 7

Expand the Emerging Environmental industry sector to implement integrated water management projects and to ensure that local businesses and local residents have the capacity and skills to do the work

- Establish and fund skills training programs at schools of higher education; engage K-12 in internship and other career development programs
- Create a specialized business retention and expansion program for companies engaged in the emerging environmental sector, including the development of policies that will help these businesses expand and create jobs

RECOMMENDATIONS FOR FEDERAL ACTION

Recommendation 1

Adopt a more comprehensive and dynamic approach to flood risk assessment and management (per the National Academies 2012)

- Collaborate with local, regional and state stakeholders to develop a comprehensive approach to flood risk management and assessment
- Revise NFIP eligibility standards and flood risk assessment methods to respond to this new approach and account for climate change and anticipated sea level rise
- Revise the criteria for hazard mitigation funding to consider the economic benefits of subsidence control

Recommendation 2

Provide guidance and funding to implement a minimum 500-year flood protection level (per the New Orleans Master Plan 2010)

- Collaborate with local, regional and state stakeholders to plan for expeditious funding and implementation of a flood protection system that will handle a 500-year or stronger storm event

Environmental Protection Agency (EPA)

Above: Michigan State University has been granted over $3 million by the EPA to focus on restoration of the Great Lake.

Below: Portland, Oregon, used EPA Clean Water State Revolving Funds to pay for its benchmark “green street” planters.

Recommendation 3

Provide guidance and funding to address the significant contributions of runoff and pollutants caused by road and highway construction

- Require that a portion of highway funds be used for water management and environmental protection

Recommendation 4

Ensure dedicated funding sources for integrated water management

- Establish water management guidelines and requirements to ensure that federal funds are being used for the intended purposes of a program or act
- Align federal policies and funding to allow for the acquisition of land and blighted or adjudicated properties for stormwater management use

Community Engagement

"The first lesson of civics is that efficient government begins at home." - Charles Evans Hughes

Successful communities are best built from the ground up, based upon notions of shared opportunity and responsibility. Even with the full support of governmental institutions, the need for an integrated approach to water management would demand broad and informed community engagement.

New Orleans Basin Meeting, August 1, 2013

Urban Water Plan Outreach

In conjunction with developing research, planning, design and engineering solutions, the Urban Water Plan team developed and completed a three-phase outreach strategy with distinct goals set for each phase. The strategy came out of discussions with GNO, Inc., and the Water Management Strategy Advisory Council's Outreach Subcommittee, the team's outreach consultants Bright Moments, and meetings with community umbrella groups such as the Committee for a Better New Orleans and the Neighborhood Partnership Network. The three outreach phases were as follows:

Phase I
Conducted a series of meetings with neighborhood group leaders, referred to as "the grasstops", throughout the project area to communicate, via presentations and discussions, basic Urban Water Plan concepts and principles. The goal was to enable neighborhood leaders to communicate knowledge and principles on sustainable integrated water management to their respective communities.

Phase II
Conducted a series of design workshops on specific districts and urban opportunities proposed in the Urban Water Plan, with Dutch and American team members and key stakeholders participating. The goal was to solicit stakeholder input to shape outcomes and process, to help with demonstration project selection, and to inform the development of the plan as a whole. These interactions built on previous efforts to advance the development of informed and invested advocates throughout the project area.

Phase III
Held four community meetings towards the plan's completion, one per water basin, with presentations and discussions targeting interested stakeholders and open to the public. The goal was to communicate findings and design work, encourage the adoption of the Urban Water Plan by policymakers, water system managers, designers, planners, and the community as a long-term vision and framework for implementation, and inspire action toward a safer, more beautiful, and economically vibrant region envisioned by the plan.

In addition to these three distinct phases of outreach, there have been ongoing efforts over the last two years and throughout the project area to communicate regularly with policymakers, system managers, key stakeholders, potential investors, real estate professionals, and planning, design, and engineering professionals. Urban Water Plan team members also participated in regional and national planning, design, and coastal resiliency conferences, contributed to local and national magazines, and curated an exhibition on "Living With Water" at the AIA New Orleans Center that brought the Water Plan's principles to a broad local audience. A vision with urgency and significance to so many sectors, agencies, and people, the Urban Water Plan requires wide-ranging efforts to achieve the necessary knowledge and support needed for its implementation.

Next Steps

A broader and better informed community can share the opportunity and responsibility to build on existing momentum, and take action toward a safer and more sustainable future. There are various levels and capacities of engagement. Below is a partial list of recommended actions organized under three broad categories: planning, design, and engineering; research and development; and education and civic engagement.

RECOMMENDED ACTIONS FOR PLANNING, DESIGN, AND ENGINEERING

Action 1

Incorporate integrated water management practices into ongoing planning and design projects where possible

- Coordinate closely with projects already planned and underway at the local, regional, state, and federal levels. Examples of relevant ongoing projects include: The Southeast Louisiana Urban Flood Damage Reduction Project (SELA) by the US Army Corps of Engineers; Louisiana's Department of Transportation and Development (LDOTD) projects programmed by the Regional Planning Commission; and public works projects that use FEMA's Hazard Mitigation Grant Program (HMGP) and Recovery Roads Program funds, including city and parish street reconstructions
- Use stormwater practices to address federal MS4 requirements on water quality to avoid looming penalties, and NFIP standards for flood risk mitigation to reduce insurance premiums for area residents

Action 2

Develop demonstration project designs from schematics to construction documents

- Start with high impact, high visibility demonstration projects at every scale: a lot, a street, a park, a neighborhood, a district, a canal
- Develop construction documents and feasibility studies, including cost-benefit analyses, for selected demonstration projects
- Develop detailed designs for operational pilots projects such as the raising of water levels in drainage canals

Action 3

Expand on the research compiled in the Urban Water Plan and provide access to data and other resources

- Expand planning, design, and engineering research on soils, surface water, groundwater, operations, policy, and financing, and develop a method of sharing this knowledge as the basis for planning and decision-making
- Build a physical model or traveling exhibit of the Urban Water Plan's long-term vision to help educate children and adults about water-related issues and opportunities

Houston's Buffalo Bayou: District-scale Economic Transformations

In 1986, in response to a mayoral initiative, Houston's Buffalo Bayou Master Plan was published. It called for a solution that integrated recreation, environmental quality, urban development, and economic benefit. That same year the non-profit Buffalo Bayou Partnership was established to oversee and raise funds for the implementation of the plan as well as the updated Buffalo Bayou and Beyond Master Plan, which was released in 2002. The latter plan is expected to cost $5.6 billion over the next twenty years, with at least $800 million in publicly-funded hard costs.

The significant scale of the Buffalo Bayou initiatives necessitates a phasing of component projects. Notable among these projects is the Buffalo Bayou Promenade, a 1.4 mile development connecting the Central Business and Arts districts. It opened as a public space in 2006 and includes trails, kayaking, sculpture, and special event space designed to accommodate flood waters when the riverbanks overflow. Other plans call for a new canal along the right-of-way occupied by Allen Street, an ecological park at Turkey Bend, and an improved sewage treatment plant near the shipping channel. Buffalo Bayou connects two regionally important areas while showcasing waterways and rights-of-way in a fashion that reconnects neighborhoods and people at the intersection of urban and natural environments.

(Photos courtesy of American Society of Landscape Architects)

Action 4

Refine principles and strategies and expand on scales of integrated water management interventions

- Track and measure the performance of demonstration projects and pilot programs to refine planning principles and strategies, and to inform program development
- Build upon demonstration projects to establish improved water flows and connectivity, and to test new standards and best practices both for public works and private properties

Action 5

Incorporate circulate & recharge strategies into project design and construction

- Integrate stormwater management practices into design and construction specifications at the local, regional, state, and federal levels
- Establish system-scale circulatory and groundwater recharge networks that integrate the region's streets, waterways, parks, wetlands, and pump stations into a 21st century living water infrastructure.

RECOMMENDED ACTIONS FOR RESEARCH AND DEVELOPMENT

Action 1

Encourage partnerships and knowledge exchange

- Explore national and international best practices and research and economic development models and develop information sharing, knowledge transfer, and partnership opportunities
- Consider Dutch models such as the RDM Campus for research, design, and manufacturing, TU Delft, and Deltares, and initiatives such as the Rotterdam-Brooklyn Waterfront Exchange that connects two port and delta cities in a knowledge exchange to promote pro-active climate adaptation

Action 2

Test the applicability of blue-green solutions for urban drainage

- Test and improve the performance of blue-green drainage solutions; Adapt these solutions to local conditions

Action 3

Establish a research and innovation campus in the Greater New Orleans region focused on water management technologies

Form a strong link between research and local industry by introducing advanced research and innovation topics in water planning, design, and engineering, as well as providing job training and business incubation and acceleration to help grow a new industry and position the New Orleans region as a national and global leader in water management. Research topics of a water-focused campus may include:

- Integrated water management
- Water-based urban and economic planning that further develops "building with nature" solutions to reduce reliance on hard infrastructure
- Flood protection technologies
- Blue-green technologies
- Wetland restoration
- Resilient urban development
- Operational aspects of urban flood management
- Technologies and practices for low-cost maintenance of sewers, canals, and roads
- Land subsidence control techniques
- Stormwater infiltration technologies
- Harbor and landing technologies
- Market research

Action 4

Develop application tools to monitor and manage surface water and groundwater

- Develop and improve modeling tools for surface water and groundwater management, as well as a real-time control system to strengthen pro-active

Deputy Mayors of New Orleans Cedric Grant and of Rotterdam Alexandra Van Huffelen signing a Letter of Intent as part of the Connecting Delta Cities Initiative

Dutch team member Daniel Goedbloed measuring water quality at Citrus Canal pump station, January 2012

Left top and bottom: Engaging children and adults to enhance water literacy

Left middle: Knowledge exchange between American and Dutch water management experts in a Dutch Dialogues workshop

operations and management of the drainage system
- Develop, implement and operate a monitoring network for surface water and groundwater levels and quality, as well as land levels (subsidence). Analyze the data collected to establish an appropriate water balance for the area
- Develop integrated modeling that includes water, ecology, economics, and urban development for decision-making

RECOMMENDED ACTIONS FOR EDUCATION AND CIVIC ENGAGEMENT

Action 1

Enhance water literacy in the region by integrating water topics into the curriculum in schools of higher education as well as K-12

- Enrich school curricula at every level and in many subjects including ecology, biology, history, social sciences, business, economics and political science by introducing water education topics
- Provide educational and research opportunities in water management design, planning, and engineering, as well as teach technical skills building in green infrastructure construction, operations, and maintenance
- Teach children about water through play, literature, arts and science education, and encourage them to understand the role of the environment in their safety, quality of life and that it can offer economic opportunity

Action 2

Build on existing momentum to develop an outreach campaign that will bring water education to the wider public

- Build upon the Urban Water Plan's planning and outreach efforts as well as existing projects, research, networks, organizations, and advocacy through coordinated public outreach efforts, symposiums on topics of critical interest, and the development of forums for discussion, participation, and direct action
- Convene people across political boundaries, present information with accessible graphics, and provide translated materials to transcend language barriers and be inclusive of all communities
- Inspire others through daily conversations, journalism, social media, teaching, art, writing, music, and through pilot programs, so that water planning becomes an essential part of life and culture in the region

Action 3

Provide training and utilize social media to promote volunteer citizen engagement

- Provide training in groundwater level monitoring
- Create social media opportunities, building on GNO, Inc.'s iPad app that is based on the Urban Water Plan, to communicate and inform about and to encourage real-time reporting of groundwater levels, flooding and subsidence instances, and enable knowledge of exact surface elevation at property locations (by census tract, or street, or address, for example)

Pittsburgh: Neighborhood and Grassroots Initiatives at a District Level

The Pittsburgh Water and Sewer Authority has partnered with the City of Pittsburgh to coordinate stormwater best-management practices with blight remediation. In 2007, Mayor Ravenstahl began a pilot program named Green Up Pittsburgh with $50,000 in Community Development Block Grants. The program provides a framework by which the city remediates blighted properties and lots with the assistance of residents and volunteers. The city takes responsibility for materials cost and liability, while volunteers provide installation and maintenance of small-scale stormwater infrastructure.

A subsequent $500,000 grant from the Pennsylvania Department of Community and Economic Development has given the program capacity to complete projects on 120 parcels. The program successfully works to remediate blighted parcels and alleviate the burden placed on aging stormwater infrastructure. In 2010, Green Up Pittsburgh worked with the East Liberty Development Corporation to complete the nation's first "green overlay plan for a distressed urban district". Named the East Liberty Green Vision, the plan assesses current conditions within the East Liberty neighborhood and recommends a series of actionable solutions and strategies aimed at benefiting both environmental sustainability and quality-of-life concerns. The goal of this collaboration was to build upon the impact of the pilot program and meet the needs of the particular neighborhood.

More importantly, concerns are addressed on a grassroots level. Residents are engaged to identify and take action regarding impediments to growth and development in their respective communities. This creates a regenerative model of improvement that forms a foundation for additional initiatives or programs. Furthermore, the model provides a framework for citizen involvement in the ongoing operations and maintenance of stormwater infrastructure that reduces long term financial liabilities through in-kind contributions of monitoring and labor.

New Orleans East field trip with the Sewerage & Water Board of New Orleans where Dutch and American team members observe the open canal and lake systems and consider water management opportunities - part of a workshop series, January 2012

6 Collaboration

JURISDICTIONS AND POTENTIAL PARTNERS

"There is no endeavor more noble than the attempt to achieve a collective dream. When a city accepts as a mandate its quality of life; when it respects the people who live in it; when it respects the environment; and when it prepares for future generations, the people share the responsibility for that mandate. This shared cause is the only way to achieve that collective dream." (Lerner 1995)

This section summarizes the major elements of the implementation architecture that govern water management on the East Banks of Orleans and Jefferson Parishes and in St. Bernard Parish. Some of the implementation partners will be familiar and experienced water managers. Others may have played little or no role as a water steward in the past but could be important actors in implementing a comprehensive water strategy that optimizes the value of water as an asset while recognizing and minimizing water related risks.

The Need for Collaboration

The successful implementation of an integrated water management system will rely on the productive collaboration between current water managers and potential partners.

Integrated water management will expand the cast of water actors, though not so much by adding to their responsibilities as by more purposefully meshing their traditional missions and programs to achieve greater benefits and efficiencies. In addition to the suite of current water managers, new entities whose work touches water management will be drawn to the table. These are the potential partners. Some of these new players will be active water managers in the mould of the current generation while others will be more engaged in crafting or implementing policies that better manage the area's water risks or, perhaps most importantly, that develop and emphasize the area's strategic water advantages.

Many of these partners will be governmental but certainly not to the exclusion of non-governmental entities. Additionally, the list will change over time as water management must ultimately be as dynamic and multifaceted as the water resource it seeks to manage. The names of these water actors may be different from parish to parish and community to community, but descriptively these actors will most likely include those with responsibilities in the following areas.

Current Water Managers

Local

- Flood Protection Entities
- Drainage Authorities
- Public Works

Regional/State

- Southeast Louisiana Flood Protection Authority - East (SLFPA-E)
- Louisiana Coastal Protection and Restoration Authority (CPRA)

Federal

- US Army Corps of Engineers (USACE)

Potential Partners

Local

- Stormwater/Groundwater Management Units
- Parks and Green Spaces
- Planning and Zoning
- Building Codes and Permitting
- Environmental
- Economic and Community Development
- Public Health
- School Boards
- Oversight Bodies

Regional/State

- New Orleans Regional Planning Commission (NORPC)
- Louisiana Department of Transportation and Development (DOTD)
- Governor's Office of Homeland Security & Emergency Preparedness (GOHSEP)
- Louisiana Water Resources Commission (LWRC)
- Office of State Inspector General
- Louisiana Office of Community Development (OCD)

Federal

- Federal Emergency Management Agency (FEMA)
- U.S. Environmental Protection Agency (EPA)
- U.S. Department of Housing and Urban Development (HUD)
- U.S. Department of the Interior (DOI)
- U.S. Department of Commerce (DOC)

New York

New York City, facing rapid population growth, vast areas of impervious surfaces, and combined sewerage overflow issues, has adopted a comprehensive "Green Infrastructure Plan" and a "Sustainable Stormwater Management Plan" as part of the city's PlaNYC 2030 planning initiative. The plans call for incentives for and regulation of private development combined with an aggressive agenda of public water management projects that supplement the city's planned traditional water infrastructure. Green-roof tax credits, grant programs, stormwater management rules, and developer guidelines make up part of the suite of tools that target private construction. The city's Bluebelt program, which conserves open spaces along waterways, is one of the its more popular public strategies and has been shown to increase nearby property values. New York has also made significant investments in preserving the Catskill and Delaware watersheds, which helps assure the safety, longevity, and affordability of the city's drinking water; reduce flooding; and improve surrounding habitats and quality of life.

New York City's organizational innovations are perhaps more illustrative than any single policy. The city has successfully leveraged existing human and physical resources by creatively redefining roles. It established an Interagency Best Management Practices Task Force that works specifically to include infrastructure-focused agencies that have not traditionally had water management roles. It also synchronized water management initiatives with plans from other departments, like the city's parks and green spaces department, which have strategic overlap. It also established an Office of Long-Term Planning and Sustainability and an active outreach plan to ensure the long-term commitment of the public. (Photos courtesy of Seattle Daily Journal of Commerce and Fast Company)

Current Water Managers

Any plan for implementing a comprehensive water management must begin with the entities currently responsible for the water that falls on the three parishes within the scope of the Urban Water Plan. These are the current "water managers."

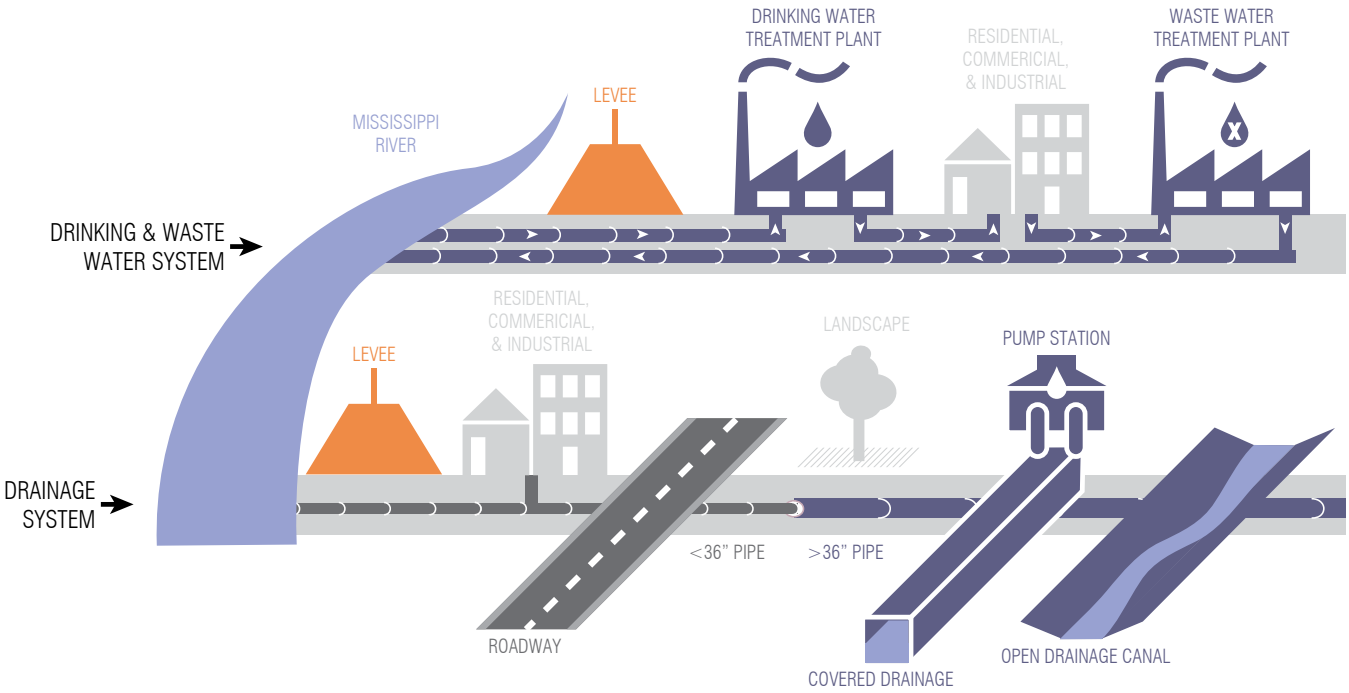
Since these entities have handled discrete parts of the region's water management, it is not surprising that there are important parts of this Urban Water Plan that do not fit neatly within any of their fields of play. For example, even though subsidence is an acknowledged major cause of flooding risk and infrastructure failure, the monitoring and managing of ground water is not actually anybody's job. Ultimately, it will have to be.

Following are the current water managers that have jurisdiction over storm water at the local, regional or state, and federal levels.

LOCAL

Orleans Parish

Since the city's boundaries are the same as those of Orleans Parish, the local management of water is largely consolidated under city government, though there are important gaps and overlaps to consider. The following are the main agencies and authorities that manage water in the parish.



Sewerage and Water Board of New Orleans (SWBNO)

The SWBNO serves the water supply, sewerage, and some of the drainage needs of New Orleans but is actually an independent agency created by the state legislature in 1899 (LA Leg. 1899 and 1903). The vast system of pumping stations and pipes serves all of Orleans Parish and was built to serve a much larger population than currently lives in the parish. On the drainage side, the SWBNO is responsible for the drainage canals, pumping stations, and all drainage pipes 36 inches in diameter or larger. It shares responsibility for the drainage system with the city's Department of Public Works and neither of the entities has responsibility for managing stormwater before it reaches the street.

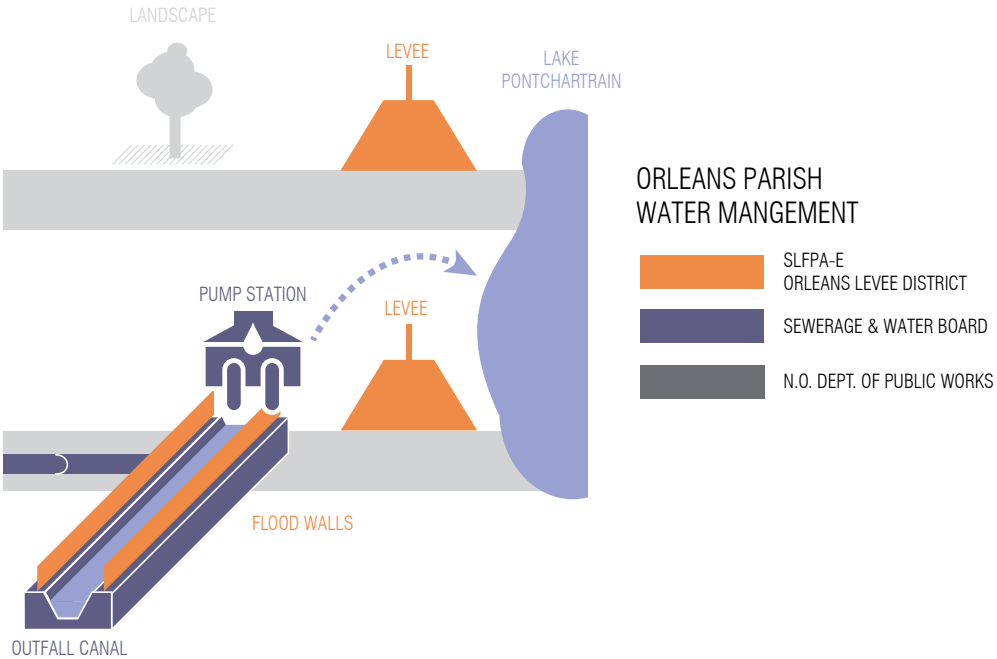
The SWBNO's autonomy from the City is not as complete as its legislative charter might suggest, since the SWBNO does not have taxing or independent rate-making or bonding authority. Taxes must be levied on its behalf by the New Orleans City Council and it can only raise rates and issue bonds with the approval of the City Council and the Board of Liquidation (BGR 2011 and LA Rev. Stat. 33). There is an important exception to that rate-making limitation in the case of a rate increase that is necessary to meet existing debt obligations. In that event, the SWBNO may override the Council and raise rates unilaterally (LA Rev. Stat. 33).

New Orleans Department of Public Works (NO DPW)

The NO DPW has direct responsibility for roughly two-thirds of the local drainage system. This system encompasses more than 19,000 catch basins and 1,200 miles of drainage pipes that are less than 36 inches in diameter.

Orleans Levee District (OLD)

Like the SWBNO, the Orleans Levee District is a creature of the Louisiana Legislature, dating back to 1890. For more than a century the OLD was an important and influential entity that was responsible for much of the City's flood protection system including the integration of storm protection and real estate development on the City's lakefront (the sale of reclaimed/ elevated lots were used to finance the construction of the seawall and the pre-



Army Corps of Engineers Levee along Lake Pontchartrain).(Campanella 2002) Following Hurricane Katrina the OLD was folded into the Southeast Louisiana Flood Protection Authority (East and West).(LA Rev. Stat. 38)

The District is responsible for flood control on the east bank of Orleans Parish including operation and maintenance of earthen levee systems (approximately 105 miles across three independent polders), floodwalls, floodgates, and drainage valves. It is a tax levying body that establishes millage rates on real estate and personal property within Orleans Parish and has an annual operating expense budget of approximately $11.2 million.

Jefferson Parish

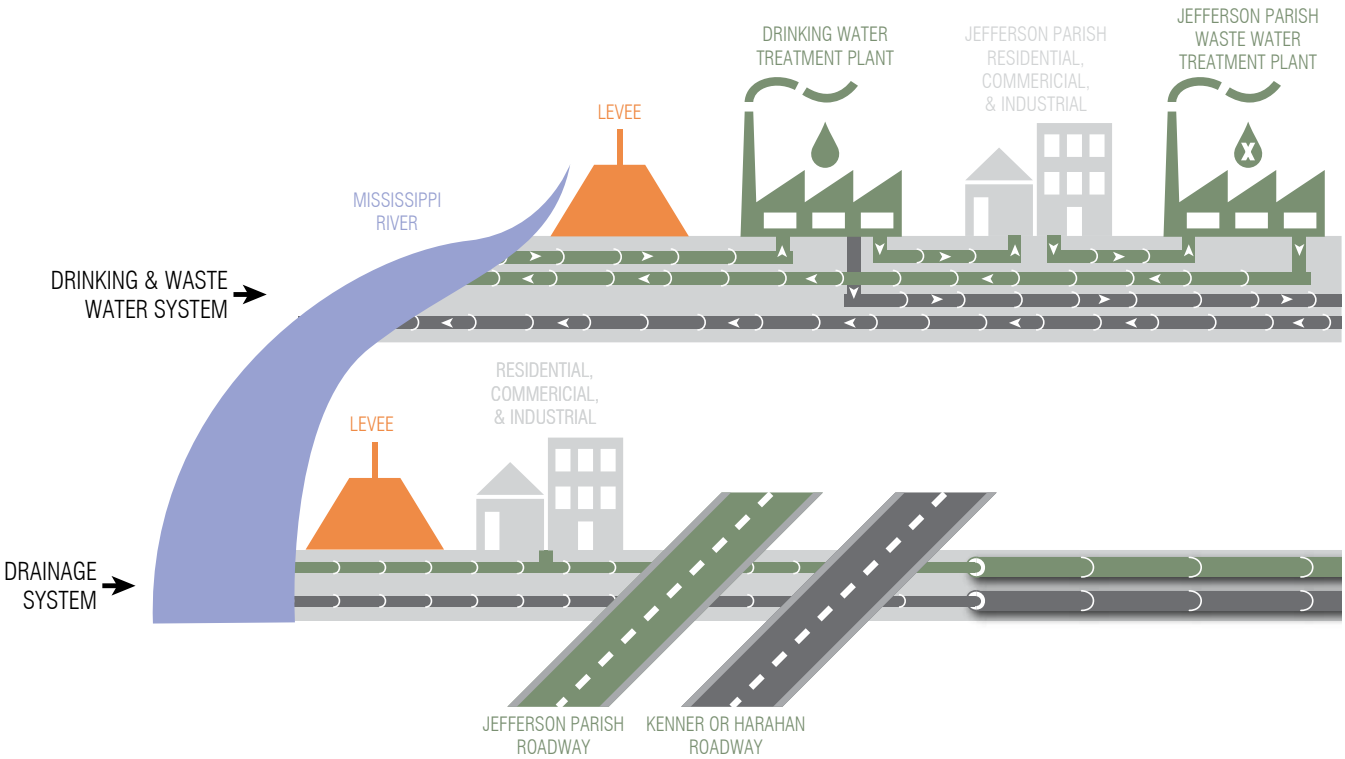
Unlike Orleans Parish, the East Bank of Jefferson Parish includes both incorporated areas (Kenner and Harahan) and unincorporated, though thoroughly developed, areas such as Metairie. Water services and drainage are largely administered at the parish level however, the exception being Harahan's Sewerage District.

Jefferson Parish Department of Public Works (JP DPW)

The Department of Public Works is an umbrella agency that has broad responsibility for water management in Jefferson. Within it are the following departments with discrete responsibilities that bear on water management.

Department of Drainage
This department is responsible for the complex system of canals, drain lines, pumps, levees, and floodwalls on the East Bank of the parish, with the exception of street drains with a diameter of 24 inches or less and internal street drains in Kenner and Harahan. The department works collaboratively with the Jefferson Parish Department of Environmental Affairs, the U.S. Army Corps of Engineers, and the Louisiana Department of Transportation and Development on aspects of this system.

Department of Capital Projects
The Department of Capital Projects provides support to other public works departments, including drainage, sewerage, water, streets, and engineering, by assisting in planning, programming, and managing the engineering and construction of capital improvements.



Department of Streets
This department is responsible for road surfaces, bridges, and street drainage (those that incorporate pipes 24 inches in diameter or less) across the parish with the exception of the incorporated areas of Kenner and Harahan.

Department of Water
This department provides drinking water to all parts of Jefferson Parish in the project area. The system administered by the Department of Water includes approximately 1,600 miles of pipes.

Department of Sewerage
The Department of Sewerage oversees sewage and industrial waste water for the East Bank of Jefferson Parish, except in the City of Harahan. The sewerage system includes a complex system of pumps, pipes, and treatment facilities.

City of Kenner Public Works Department

As a separately incorporated municipality, Kenner's Public Works Department is responsible for local streets, street drainage (catch basins and pipes 24 inches or less in diameter), parks, and parkways within its city limits.

City of Harahan Sewerage and Water District

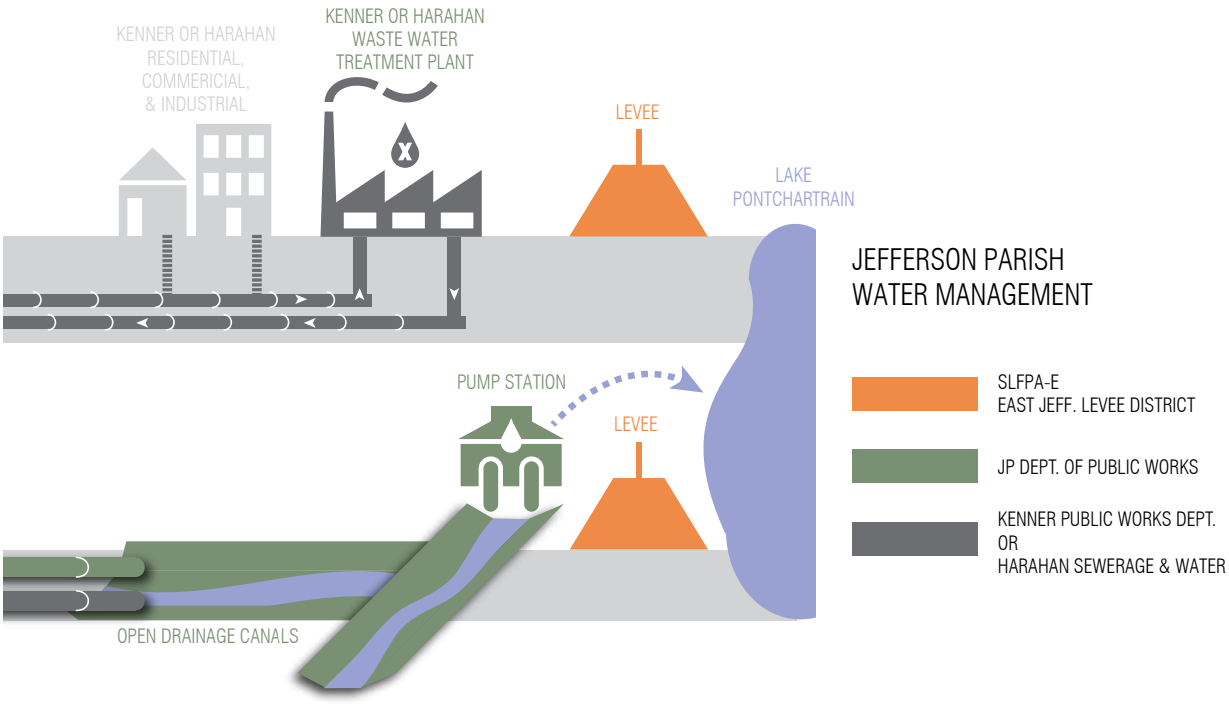
The city of Harahan maintains its own internal street drainage system for pipes 24 inches in diameter or less.

East Jefferson Levee District (EJLD)

The East Jefferson Levee District was created in 1979 by the Louisiana legislature. It was originally part of the Pontchartrain Levee District created in 1895. Following Hurricane Katrina, the EJLD was folded into the Southeast Louisiana Flood Protection Authority-East (LA Rev. Stat. 38). The district maintains and operates 30 miles of federal hurricane and flood protection levees and its annual operating budget is approximately $8 million.

St. Bernard Parish

St. Bernard Parish is the most rural parish in the project area but has a long and complex relationship with water. The victim of near complete inundation by Hurricane Katrina, the parish has been forced to consider and accept changes to how and why water is managed more than any



other parish in the project area. Without any incorporated towns or cities, water and land use are handled by St. Bernard Parish Government. Within the parish's government, the following departments are currently responsible for water management:

Lake Borgne Basin Levee District (LBBLD)

The LBBLD is somewhat unique in that, in addition to its levee operation and maintenance responsibilities, it is also responsible for the operation and maintenance of all major internal drainage canals and pumping stations for an entire parish. The land within the District naturally slopes away from the river toward the marsh areas to the north and east. Stormwater runoff is channeled through the district's network of 21 drainage canals to the drainage pump stations, where it is pumped over the levee system into the marsh. The Levee District is responsible for operating and maintaining eight major storm water drainage pump stations, providing a total pumping capacity of more than 3 million gallons per minute. The levee district operates and maintains the Violet Freshwater Siphon located in Violet, La. The siphon draws fresh water from the Mississippi River and discharges it into the Central Wetlands through the Violet Canal. The purpose of the siphon is to combat salt water intrusion and introduce nutrients and sediment into the Central Wetland marsh areas destroyed by the construction and operation of the Mississippi River Gulf Outlet channel, which was built by the federal government during the 1950s and 1960s. Following Hurricane Katrina, the LBBLD was folded into the Southeast Louisiana Flood Protection Authority-East (LA Rev. Stat. 38).

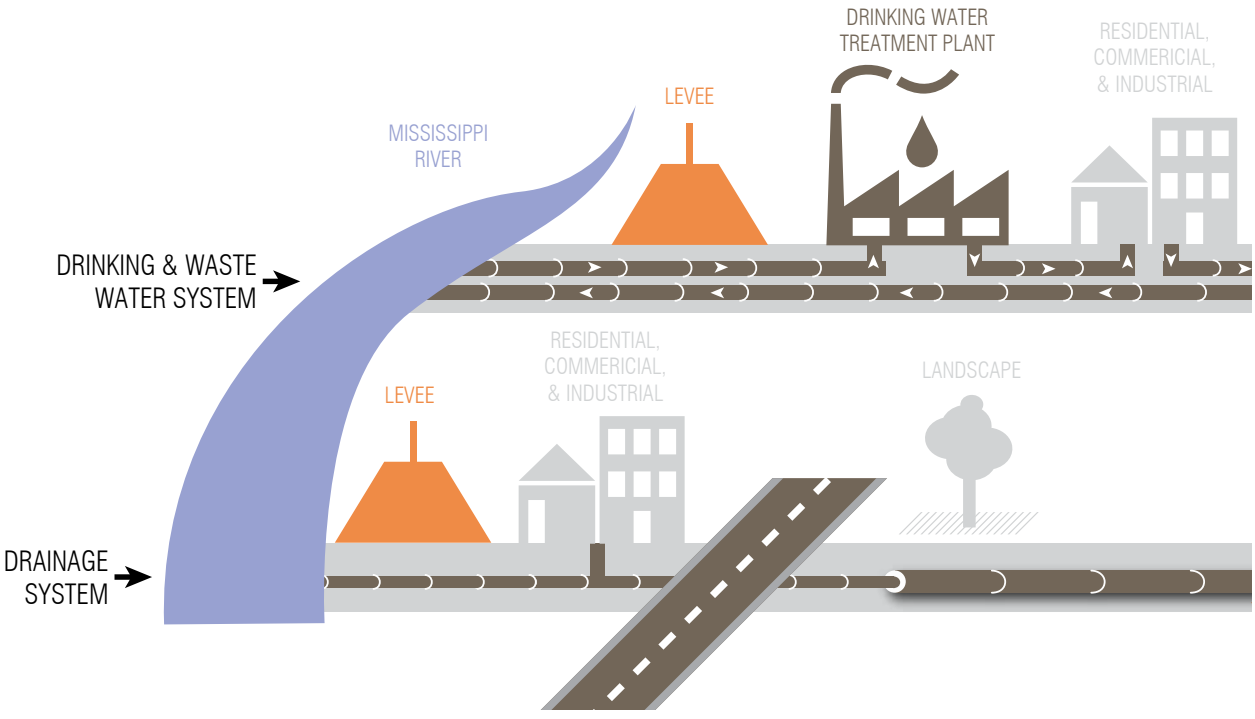
St. Bernard Department of Public Works (DPW)

The St. Bernard DPW shares responsibility for water management in the parish with the LBBLD and includes the following departments, among others:

- Water and Sewer Department
- Road Department
- Drainage Permitting

REGIONAL/STATE

Water management at the regional and state levels reflects both the importance of water to the broader interests and priorities of Louisiana, and the disjointed - and at times conflicting - nature of those interests and priorities. In recent years



there have been encouraging moves in the direction of a more integrated and comprehensive approach to water management, such as the consolidation of coastal restoration, conservation and protection under the Louisiana Coastal Protection and Restoration Authority, the consolidation and refocusing of levee districts under the Southeast Louisiana Flood Protection Authority, and the creation of the Louisiana Water Resources Commission to assist with groundwater management and to begin the development of more comprehensive water management options. These measures hardly exhaust the spectrum of necessary changes but they clearly indicate that the state currently places a greater importance on purposeful, result-oriented water management.

Southeast Louisiana Flood Protection Authority - East (SLFPA-E)

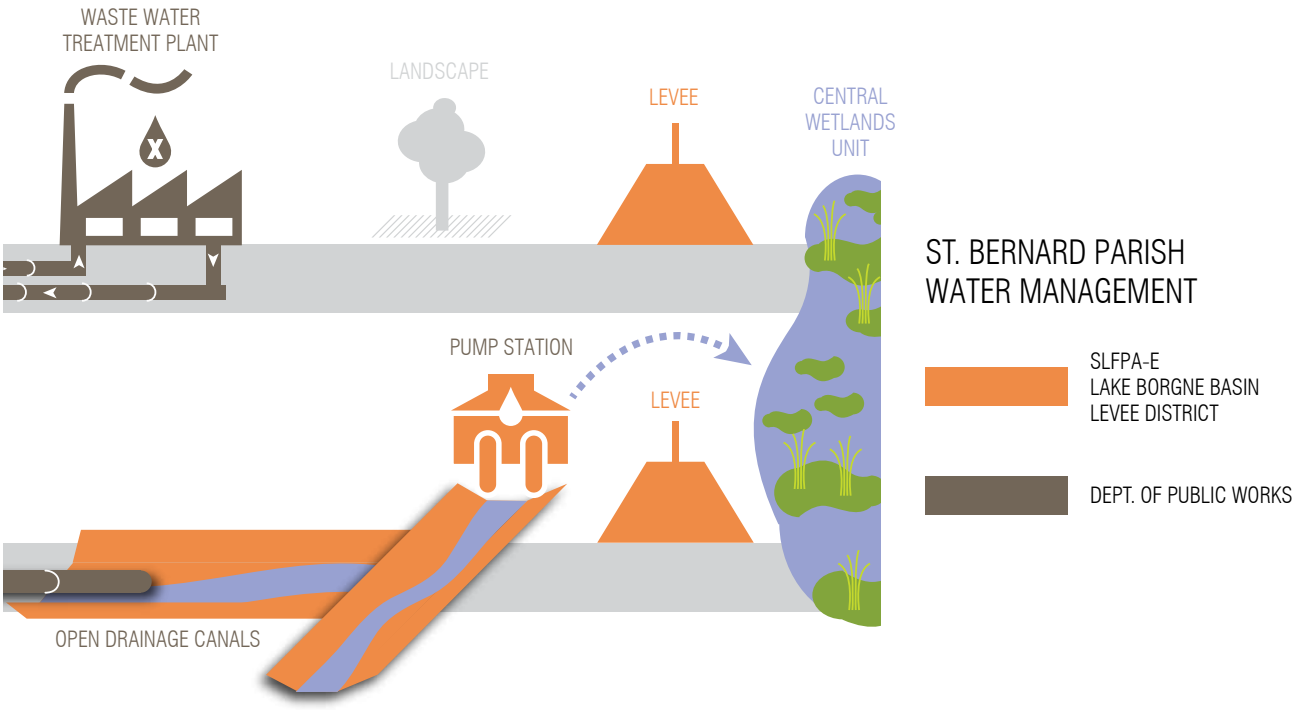
This authority came into existence Jan. 1, 2007, as a result of the reorganization of flood protection agencies in Louisiana following hurricanes Katrina and Rita (LA Leg. 2006). The authority covers three consolidated levee districts on the East Bank of the Mississippi River:

- Orleans Levee District
- East Jefferson Levee District
- Lake Borgne Basin Levee District

The SLFPA-E receives an annual appropriation of $500,000 to fund its operations from the Coastal Protection and Restoration Fund. The authority has operation and maintenance responsibilities for the flood protection levees, gates, and walls in the region, other than those on the river. Since the effectiveness of that system is in many ways a function of how subsidence and land use is managed, the authority has a direct interest in those issues, even if its direct authority to act is limited.

Louisiana Coastal Protection and Restoration Authority (CPRA)

The CPRA was created in the wake of the destruction done by hurricanes Katrina and Rita, and out of the recognition that coastal protection and restoration were intimately linked. Also, for the first time the state expressly recognized the dynamics of shifting coastal risk and the need to embrace "multiple lines of defense," including changes to the ways and places we build our lives and communities. The



CPRA, which was reconstituted in 2012, is charged with developing a Coastal Restoration and Protection Master Plan every five years, and with developing and pursuing coastal restoration and protection projects. The current master plan contains an important emphasis on "non-structural" approaches to reduce storm flooding risks. These measures include elevating buildings, flood proofing, changes to building codes, and land use planning. For many of these projects, the CPRA is the non-federal partner agency with the U.S. Army Corps of Engineers.

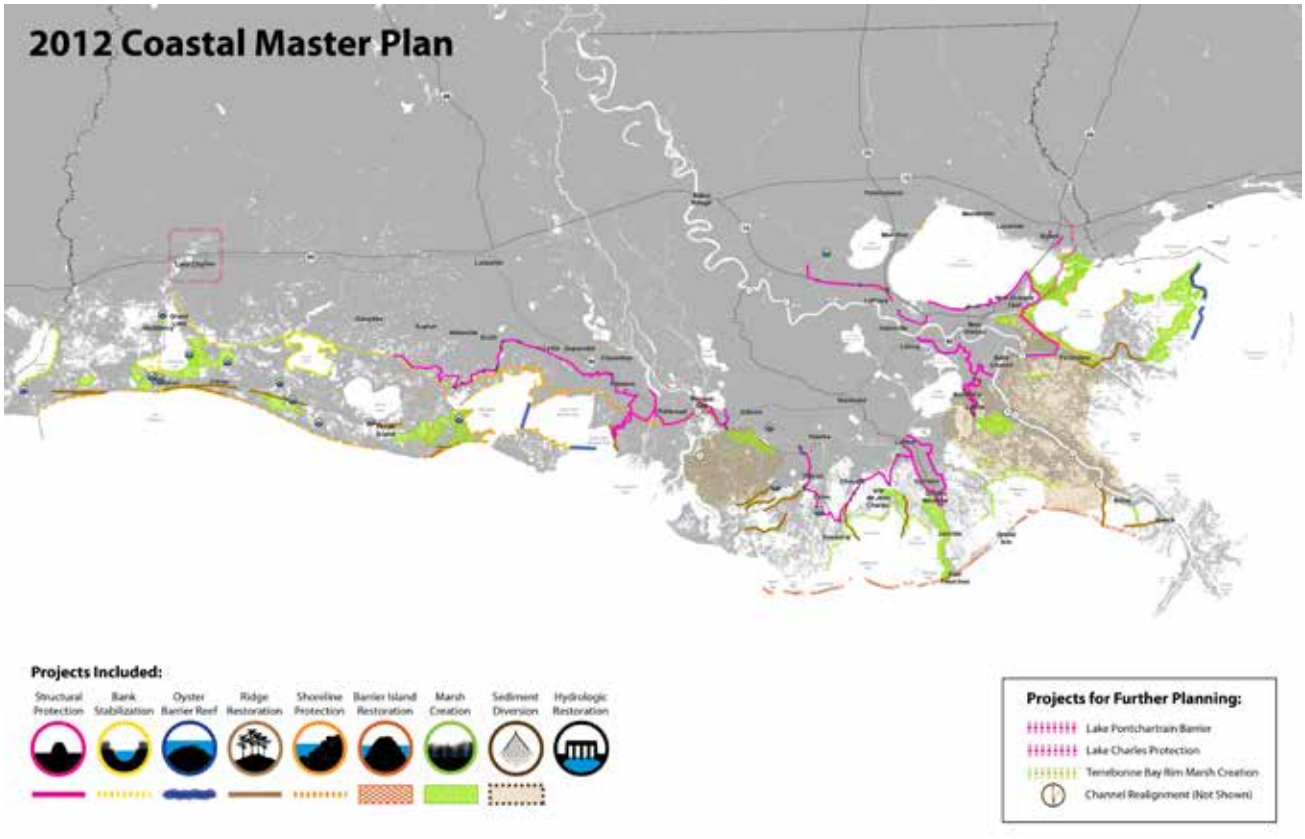
FEDERAL

The principal federal water implementer is the U.S. Army Corps of Engineers. Other federal entities like the Environmental Protection Agency and the Federal Emergency Management Agency play widely divergent roles, but those roles have significant capacity for being better coordinated, particularly in connection with more focused and integrated local actions.

US Army Corps of Engineers (USACE)

Since 1928 the USACE (or the Corps) has come to play a significant - indeed the leading - role in flood protection planning and implementation. Starting with the Flood Control Act of 1928 and continuing through such major additional authorizations as the Lake Pontchartrain and Vicinity Hurricane Protection Project and the Southeast Louisiana Urban Flood Protection Authority (SELA), the Corps has moved from protecting the area from river flooding to hurricane protection to rain storm flooding.

While it was once possible, even common, to have the Corps and the federal government pick up the entire cost of building and maintaining water management systems, those days are past. The general practice now is to have the local project sponsor share part of the construction cost and all of the operation and maintenance costs. The realities of coastal change, local subsidence, and



sea level rise have also recently shifted the focus of the Corps away from purely structural approaches to water risk management with more non-structural and distributive approaches.

The Corps also plays the leading role, with oversight from the EPA, in administering the provisions of the Clean Water Act that protect wetlands and waters from discharges of dredged or fill material. This role also has the Corps taking the lead in determining how damage to those waters and wetlands must be mitigated. Since the project area contains a significant amount of water and wetlands under its jurisdiction, the Corps can play an important role in shaping how water is managed in the region.

"The mission of delivering the HSDRRS has been, and continues to be, a team effort. It has required a lot of hard work, determination, and close collaboration with our stakeholders and partners to get to this point."

-- Mike Park, chief of Task Force Hope, the forward division cell in New Orleans created by the U.S. Army Corps of Engineers (USACE) Mississippi Valley Division (MVD), and responsible for overseeing management of the $14.5 billion Hurricane and Storm Damage Risk Reduction System (HSDRRS) program (USACE 2011-2012)

Potential Partners

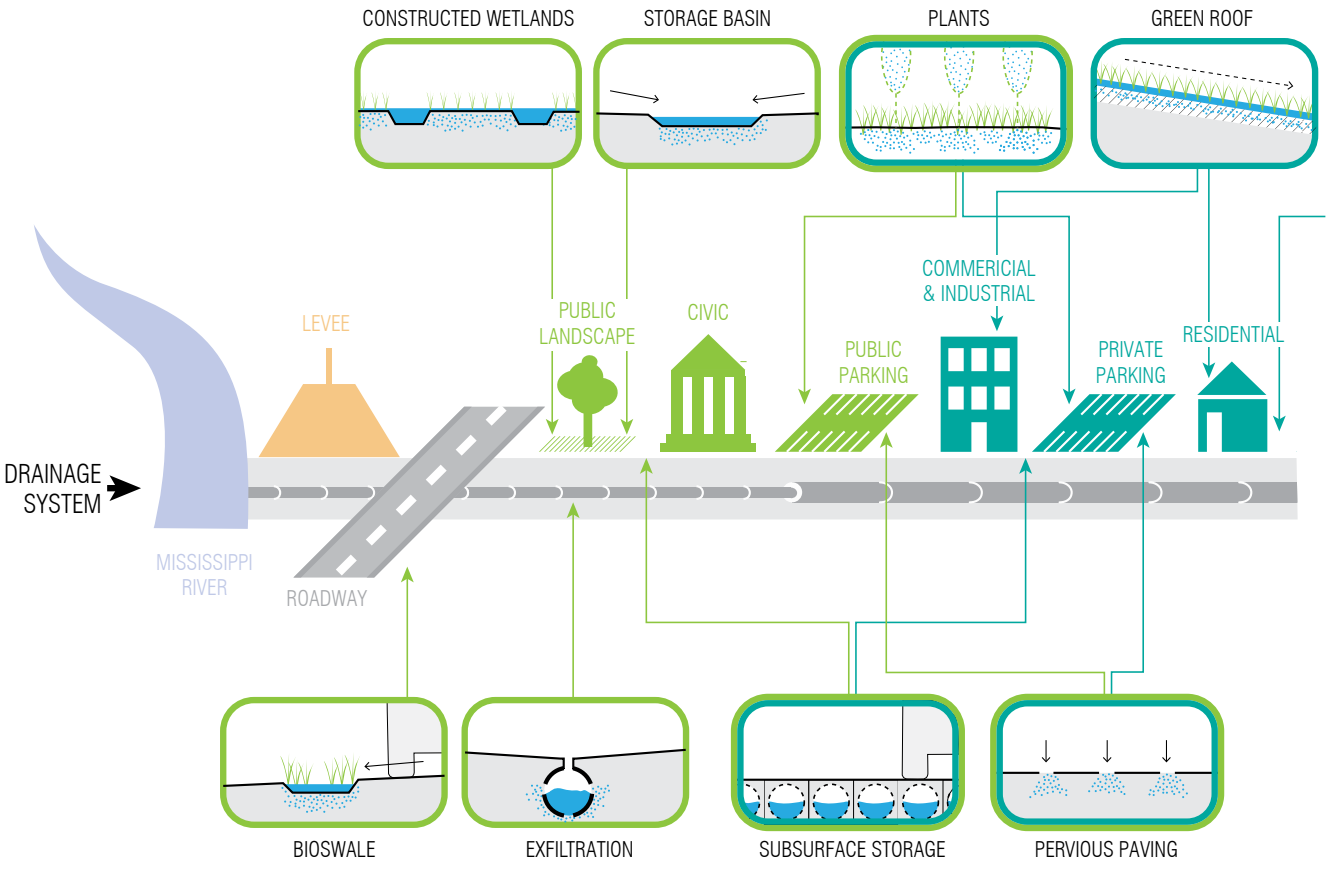
Integrated water management will depend on the buy-in and assistance of many government departments that have not historically managed groundwater or rainwater. Potential water management partners come from all levels of government, perform diverse functions related to their areas of expertise, and form critical elements of the integrated system.

LOCAL

Stormwater/Groundwater Management Units

Stormwater is managed from the curb to the pump with the sole aim of removing every drop as quickly as possible. Despite improvements in drainage infrastructure, much of the region remains chronically at risk of rain-induced flooding. Real solutions to addressing these risks will come only from a "slow, store and drain" approach that not only moves water but slows its flow, retains it where appropriate, and integrates drainage with subsidence management. This will require the creation or designation of stormwater and groundwater management units in each community. In addition to traditional drainage activities, these units should be responsible for:

- Employing or incentivizing the use of stormwater management strategies to reduce flooding, combat subsidence, and comply with MS4 requirements
- Installing a groundwater monitoring network and employing real-time controls to manage surface water levels for subsidence control
- Monitoring and recording stormwater



quality and quantity
- Establishing close collaborations with other governmental bodies that have stormwater and groundwater responsibilities

Parks and Green Spaces

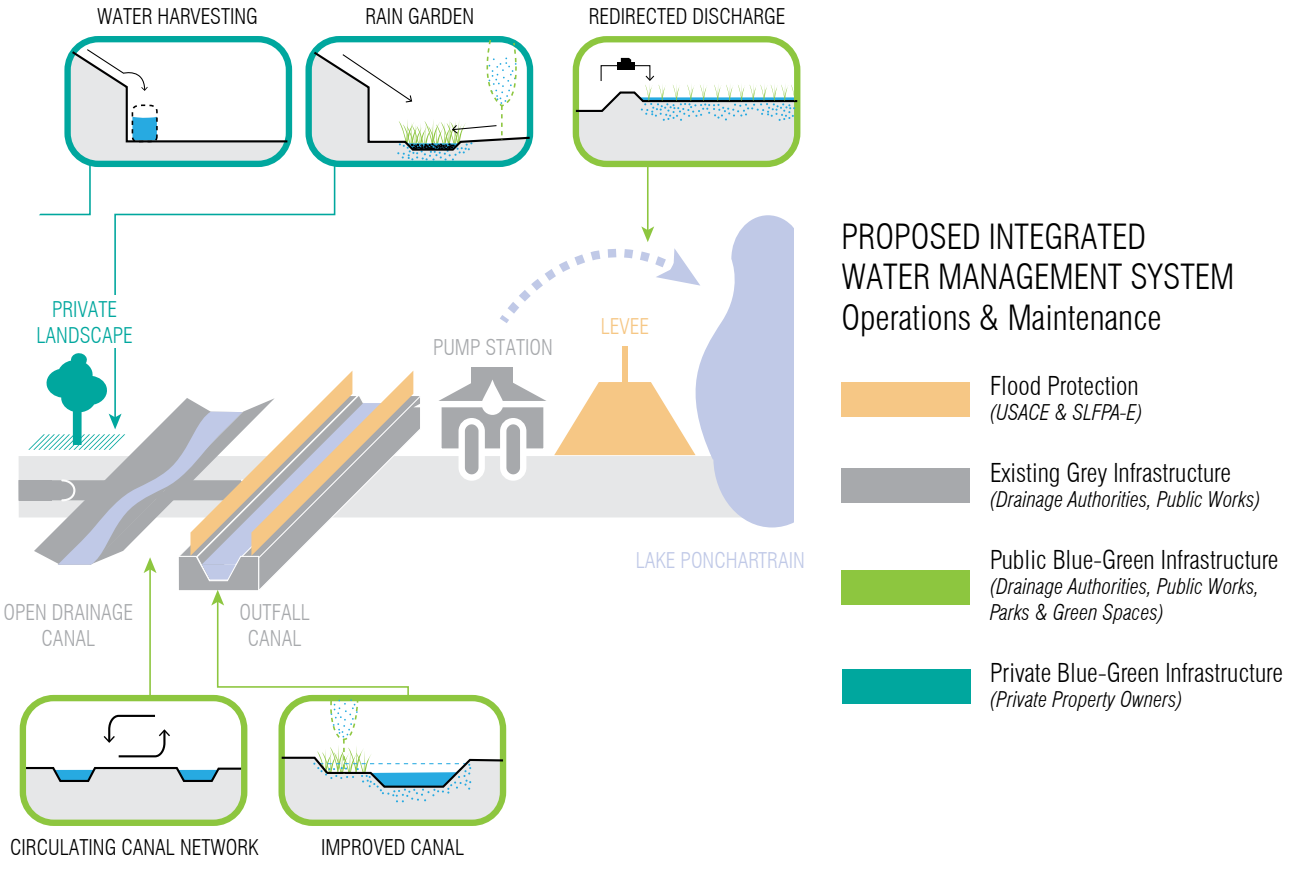
Parks and green spaces are important public amenities that can play a significant role in managing water for greater value. Today their role is mostly passive, either storing or cleaning stormwater, or speeding its flow to surrounding streets with little acknowledgement of their contribution, good or bad. By optimizing their ability to contribute to water management, parks and green spaces can realize greater values from existing drainage infrastructure and expand the range of options for complying with federal stormwater regulations without compromising the fundamental uses of these spaces. To accomplish this, the roles and capabilities of the agencies that plan and manage parks and green spaces will need to be expanded.

Planning and Zoning

Each development and redevelopment project brings change to the region's waterscape. More importantly, each project offers the opportunity to more effectively and efficiently manage the region's water resources, to increase the asset value of the water, and to reduce water-related risk. To achieve these benefits, storm water management strategies need to be integrated into the planning and zoning codes at the local and parish levels.

Building Codes and Permitting

The allowable choices of construction techniques and materials can make or break any effort to implement an integrated water strategy. It is not enough to urge or even mandate certain water management outcomes if there is not a corresponding range of approved building techniques and materials that can affordably and effectively deliver those outcomes. It is also essential to have a fair and effective inspection and enforcement process. Accordingly, it will be necessary for the appropriate agencies to periodically update their building codes and permitting practices to ensure that they are crafted to achieve the comprehensive goals of the Urban Water Plan.



Environmental

The human environment is part and parcel of the broader environment, a relationship that is inescapably clear to the residents of this region. The condition of our water, soil, and air are fundamental factors to the question of how and why we manage our water. Water resources that support wildlife and public use add significant economic and aesthetic values beyond those associated with traditional water supply, flood protection and drainage. By including those broader values and the agencies with existing environmental management responsibilities in the Urban Water Plan, it will be possible to take advantage of natural synergies and multiply the value delivered by our environmental programs.

Economic and Community Development

Economic and community development define and drive community transformation and economic growth and stability. At their best, they shape a better future by cultivating and building upon the natural and cultural resources of a region and its communities in a way that stresses their values as assets and honestly addresses their limitations. In this region, water is both a defining and ascending asset, and a persistent risk factor. By integrating values and risks into economic and community development plans and programs, the region can better reach its full potential in an economy where water management will increasingly determine success or failure.

Public Health

Water and public health are old friends. Few aspects of life in this region have deeper roots than those involving the management of water to improve public health. The successes of those efforts can often obscure the importance and ever-changing nature of this relationship. From disease control to safe drinking water, the comprehensive management of our waters is fundamental to the well being of the region's residents and its ability to attract desirable new business and residents.

School Boards

The public schools in the region are managed by some of the most complex and dynamic governing bodies in the nation. Regardless of the names and structures of those boards, they are responsible for planning, constructing, and maintaining significant landscapes and structures that could play a powerful role in any integrated water system, particularly when combined with the educational and civic missions of those school systems and their individual schools.

Oversight

Effective water management only happens when every critical task is someone's responsibility. It will always make sense to concentrate some tasks in certain departments, agencies, communities, or persons in order to take maximum advantage of areas of expertise and to respect jurisdictional and legal boundaries. But it is also just as essential to have oversight over those various actors and their actions. The purpose of this oversight, whether it be at the governmental (mayor, parish presidents, city ,and parish councils) or civic level, should not be to second guess but rather to ensure that acceptable levels of benefits, services, and accountability are being delivered.

REGIONAL/STATE

Louisiana Department of Transportation and Development (DOTD)

The DOTD has traditionally been the agency at the state level that carried (alone or in partnership with federal agencies) water resources development projects and that provides technical assistance to local levee districts.3 The DOTD is the non-federal counterpart to the U.S. Army Corps of Engineers for such programs as the Mississippi River Levee Raising Project.4 Over time, some things that were traditionally within the DOTD's sphere of action have been transferred to or shared with other agencies such as the Coastal Protection and Restoration Authority and the Water Resources Commission (groundwater management in the latter case). The DOTD still plays an important role in cooperating with the U.S. Geological Survey in monitoring the state's water resources, including groundwater.5

The DOTD's role in the design, construction, and maintenance of state highways in the Greater New Orleans area is perhaps its most important role in water management, yet it has not traditionally been considered to be a water-related agency. The integration of DOTD's broader transportation mission into comprehensive management is one of the greatest latent opportunities, one that perhaps could be more fully explored through the New Orleans Regional Planning Commission.

New Orleans Regional Planning Commission (NORPC)

The NORPC serves the five-parish Greater New Orleans area.6 In addition to its transportation and economic development missions, the NORPC provides land use and environmental planning services in the area. The NORPC can also assist with economic development proposals to the Delta Regional Authority, a partnership between the federal government and the eight Mississippi River delta states to foster economic development. Though water management has not recently been seen as "economic development", the holistic nature of water as a driver of value and smart development could make this program and the NORPC bigger players in the future.7 Finally, the NORPC is the managing and programming authority of DOTD transportation funds for the region, and could play an important role as a future implementer of integrated water management in arterial roadway repairs and reconstructions through its Transportation Improvement Plan.

Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP)

GOHSEP was created to assist the state and its citizens in planning and responding to threats from terrorism and natural disasters. Mitigating the exposure of Louisiana communities to the risks from natural hazards is one of the office's responsibilities. The primary tool used by GOHSEP is a suite of hazard and pre-disaster hazard mitigation programs Local governments are eligible to compete for

RPC's Transportation Improvement Plan (TIP) map

financial assistance under any of following five pre- and post-disaster programs:

- Hazard Mitigation Grant Program (post-disaster)
- Pre-Disaster Mitigation Grant Program
- Flood Management Assistance Program (pre-disaster)
- Repetitive Flood Claims (pre-disaster)
- Severe Repetitive Loss Pilot Program (pre-disaster)

Louisiana Water Resources Commission (LWRC)

Created by the Louisiana legislature in 2012 as an expansion of the Louisiana Ground Water Commission, the LWRC is charged with assessing the condition of Louisiana's water resources and recommending improvements to Louisiana's laws and policies to ensure their sustainable stewardship. Among the LWRC's aims is the development of a framework for the comprehensive management of the state's waters, including those embraced by the Urban Water Plan.

Inspector General

There are Inspectors General at both the state and local levels where they serve important law enforcement and public accountability functions. Possessing both investigative power and the ability to pursue prosecutions, the Office of the Inspector General has an important role to play in ensuring that any integrated water system is fairly and appropriately administered.

FEDERAL

Federal Emergency Management Agency (FEMA)

Since its creation in 1978, FEMA has had the mission of helping communities plan for and respond to disasters and managing the National Flood Insurance Program. FEMA is not a direct implementer of water management activities. But it is a substantial director of state, local, and private water management policies and actions through its National Flood Insurance Program and hazard mitigation program, which are aimed at reducing the risk of damaging floods and other natural induced catastrophes. Maintaining eligibility for the NFIP is essential for the economic viability of the region, but it is becoming less feasible and affordable through traditional approaches that rely almost exclusively on levees, walls, pumps, and pipes. Transitioning to more comprehensive and ultimately more affordable and sustainable approaches of risk management is the purpose of FEMA's various Hazard Mitigation Assistance (HMA) grant programs. Currently, FEMA administers several funding opportunities for pre- and post-disaster mitigation and will be of particular importance to the future of the region. The "Funding Sources" section in Chapter 4 provides more detail on each of the following programs:

- Hazard Mitigation Grant Program (HMGP)
- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)
- Repetitive Flood Claims (RFC)
- Severe Repetitive Loss (SRL)

Environmental Protection Agency (EPA)

Charged with overseeing the protection of America's water quality, EPA administers a variety of regulatory and cooperative programs aimed at protecting and improving the quality of our water resources. Similar to FEMA, EPA is not generally a direct actor in the area of water management but, through a suite of programs and its role in defining and enforcing water quality standards, EPA is a major shaper of water management. Among its more important programmatic or statutory drivers in this area are:

The Clean Water State Revolving Loan Fund (CWSRLF)
The CWSRLF can be used in a wide range of water related projects including wetland restoration, brownfield rehabilitation, and groundwater management.

Clean Water Act (CWA)
The CWA is one of the foundations of U.S. environmental stewardship and law, and EPA is its chief administrator. Beyond the Clean Water State Revolving Loan Fund, the CWA contains provisions that address such important features of water management as maintaining water quality and storm water management. EPA's role can be both

as an enforcer and a facilitator. Violating the CWA's water quality and stormwater management standards can be costly but the prospect of enforcement action can spur state, local and private action. On the facilitative side, enforcement actions - such as those against BP associated with the Deep Water Horizon tragedy - can also produce innovative approaches to funding local water improvements and community outreach and education, if a portion of any settlements is directed at specific community needs. Such a settlement was the source of the Greater New Orleans Foundation's environmental fund. Section 106 of the CWA allows EPA to provide federal assistance to states to develop and implement water pollution control measures.

Safe Drinking Water Act (SDWA)
The SDWA is intended to ensure that all Americans have access to clean, safe drinking water. In the project area, one of the main threats to drinking water is an aged, over-burdened, and under-maintained water treatment and delivery system. To assist with these challenges, EPA administers the Drinking Water State Revolving Fund (DWSRF).

US Department of Housing and Urban Development (HUD)

Not a direct water manager, but an important partner, HUD is requesting in fiscal 2013 $250 million to fund sustainable, community-driven solutions. It is requesting $100 million in Sustainable Housing and Communities funding through the Community Development Fund (CDF), and $150 million for the Choice Neighborhoods Program.

Central to providing more choices to families and to creating a more balanced federal housing strategy is the Partnership for Sustainable Communities, a landmark interagency effort between the Department of Transportation (DOT), EPA, and HUD. The partnership is grounded by six "livability principles" that include supporting existing communities by improving the efficiency of public works investments, aligning federal policies and funding, and enhancing the unique characteristics of all urban, suburban, and rural communities by investing in healthy, safe and walkable neighborhoods.

The following grant programs, discussed in more detail in Chapter 4, will be of particular importance to the future of the region:

- Community Development Block Grant (CDBG) - includes the Neighborhood Stabilization Program (NSP) grants
- Community Development Fund (CDF) - includes Sustainable Housing and Communities
- Choice Neighborhoods program

Appendices

Appendix A

ESTIMATED ECONOMIC BENEFIT METHODOLOGY

Estimated Economic Benefit to Implementing the Urban Water Plan

In the fall of 2012, GCR Inc. (GCR) developed a summary of economic benefits associated with the implementation of the Greater New Orleans Urban Water Plan. This plan – developed by a team of architects, engineers and sustainability experts, and managed by Waggonner and Ball Architects – calls for strategically investing in stormwater retention and detention projects to mitigate damage caused by frequent flood events. These projects – namely the enhancement and development of wetlands, canals, waterways, water storage basins, and upgraded drainage systems – substantially reduce repetitive flood loss, thereby enhancing the region's economic vitality.

To assess the economic benefit of implementing the Urban Water Plan, GCR analyzed four factors. Three of the four factors examine the costs associated with frequent flooding and poor water retention. This includes the damage caused to buildings and businesses in storm events; higher insurance premiums; and the subsidence of structures in vulnerable areas with organic soils. The implementation of the Urban Water Plan would greatly reduce these costs, which are translated as economic benefits within this study.

Additionally, there is a positive economic impact associated with physically building the projects outlined in the Urban Water Plan, including increased property values and new jobs. This study specifically addresses real estate values and the jobs and economic impacts that result from construction activities, but there are numerous additional benefits that may be further explored as the plan moves toward implementation. Additional benefits include real estate development opportunities adjacent to parks and waterways and the reuse of publicly owned vacant land that creates additional economic value to a neighborhood. In analyzing these four factors, GCR concluded that intensive implementation of the Urban Water Plan has a potential economic benefit of approximately $11 billion over a 50-year period.[1]

Table 1: Estimated Benefits of Implementing the Urban Water Plan

Indicator	***Potential Benefit over 50-Year Period***
Value of Reduced Flooding	**$7,989,653,231**
Value of Reduced Subsidence	**$2,147,636,257**
Lower Flood Insurance Premiums	**$608,998,357**
Increased Property Values	**$183,227,490**
Total Benefit	**$10,929,515,335**

[1] See Table 5 for a more detailed matrix with methodology. Cost estimates were discounted at 3.5% over a 50-year period.

This study demonstrates that there are significant costs associated with frequent flood events that can be avoided under stormwater best management practices. Additionally, implementing the Urban Water Plan will add new public space and enhance the natural landscape in a sustainable manner, thereby increasing property values and mitigating the costs associated with maintaining public land. And while the list of benefits is neither exhaustive nor definitive, it does illustrate the scale to which citizens, businesses and public entities pay for avoidable flood loss. When the plan enters into the next stage of development, a Stage 0 Feasibility Study, a full cost-benefit analysis will take into account the costs of implementing the plan in comparison with projected savings to develop a final development scenario.

Value of Reduced Flooding

Rain events in New Orleans can be severe and sudden. The immediate impacts are often simple inconveniences: meetings and appointments are cancelled due to flooded roads, buses and streetcars run late, and flooded gutters and sidewalks discourage some people from stepping outside. Larger events, however, inflict detrimental and costly impacts on residents and businesses. The Urban Water Plan's hydraulic modeling results indicate that intensive implementation of the plan could eliminate negative effects associated with 5-year storm events and substantially reduce the effects of 10-year events. For the purpose of this analysis, GCR focused on the costs associated with a 5-year flood event.

To estimate the costs associated with a 5-year flood event, GCR employed frequency analysis[2] and the Federal Emergency Management Administration (FEMA) Hazards-United States (HAZUS)[3] tool. Frequency analysis is based on the statistical probability that an event will occur within a given time frame. For example, a 5-year storm is one which has a 5% chance of occurring in any given year. For this analysis, GCR assumes that a 5-year flood event will occur once every five years. Under this assumption, data provided by the HAZUS model indicates that each 5-year flood event costs the New Orleans region over $942 million. These cost estimates are an aggregate of damage to buildings (residential and commercial); lost wages; and business interruption. Over a 50-year period, GCR estimates that minor flooding caused by 5-year flood events would cost the region an estimated **$7.9 billion**.[4] Storm waters would displace between an estimated **16,000 to 27,000 households** per event and produce nearly **60,000 tons of debris** per event.

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[2] Frequency analysis estimates the probability of the occurrence of a given precipitation event. The recurrence interval is based on the probability that the given event will be equaled or exceeded in any given year. (United States Geological Survey, "Floods: Recurrence intervals and 100-year floods" 2013)

[3] HAZUS is a nationally applicable standardized methodology that models potential losses from natural disasters such as flooding, earthquakes, and hurricanes. Using Geographic Information Systems technology, HAZUS estimates the physical, economic, and social costs of disasters and is more frequently being used to perform economic loss scenarios for a variety of natural hazards (Federal Emergency Management Administration, 2012, http://www.fema.gov/hazus)

[4] GCR generated models using HAZUS modeling software for the East Banks of Jefferson and Orleans parishes and all of St. Bernard Parish. Using economic impact figures provided by the HAZUS model, GCR projected costs over a 50 year period, assuming their statistical frequency will occur. Costs were assigned a 3% inflation rate and total costs were discounted at 3.5% following 2012 1-year LIBOR rate.

Value of Reduced Subsidence

Many parts of the New Orleans region are built on former wetlands, whose organic soils require moisture to maintain their shape and volume. Development in this environment has altered the balance of liquid to solid matter. With every rain event, drainage pumps remove moisture that is needed to prevent shrinkage in the highly porous soils, resulting in land subsidence that has lowered elevations of much of the New Orleans region relative to sea level.

By actively managing the region's groundwater levels, the Urban Water Plan can help slow subsidence and thereby reduce the need for property owners to periodically shore and repair foundations. The project team identified zones in Jefferson, Orleans, and St. Bernard parishes that suffer from severe subsidence and high costs of maintenance from poor soil conditions or inadequate pilings.[5] A preliminary structural assessment estimated that, over 50 years, each structure within most zones would require two major repairs at $50,000 each, with the exception of structures within New Orleans East. In this area, it was assumed that properties would require two repairs at $7,500 over a 50-year period.

Using the assumptions outlined above, GCR estimated the cost of subsidence for homes within these zones, using housing counts provided by the U.S. Census that are within the six identified zones.[6] Through this analysis, it is estimated that 32,226 homes are impacted by high rates of subsidence and 3,071 homes are at risk of moderate subsidence. According to the project team, implementation of the proposed water management strategy would mitigate subsidence issues for these properties.

The costs associated with repairs for high and moderate risk of subsidence were applied to 35,297 structures located within the most vulnerable areas and inflated at 3% over a 50 year period, then discounted to present value. Based on this assessment, the Urban Water Plan can potentially save property owners up to **$2.15 billion** over the next 50 years.

Table 2: Costs associated with a 5-year flood event (FEMA HAZUS MODEL)

	5-Year Event
Debris Generated (tons)	59,124
Shelter Required (Households)	27,086
Business Interruption	$ 8,406,128
Lost Wages	$ 3,713,503
Building Loss	$ 930,321,966
Total Economic Loss (per event)	**$ 942,441,597**

*Cost figures are estimated in 2012 dollars. GCR Inc. modeled flood scenarios with FEMA HAZUS data.

[5] Based on a cursory structural engineering assessment provided by the Urban Water Plan Team, Broadmoor, Lakeview, Village De L'Est, Viavant/Venetian Isles, and Jefferson Parish between Lake Pontchartrain and Veterans Boulevard were determined to be at a high risk of subsidence.

[6] US Census Bureau 2010 Decennial Census, housing counts, block group-level data.

Lower Flood Insurance Premiums

Over 215,000 homeowners in the study area hold policies with the National Flood Insurance Program (NFIP). Regional flood loss coverage topped $51 billion in 2012 and policyholders paid over $175 million in premiums.[7] With political uncertainty about the future financial viability of the NFIP, the severity of annual rate increases has steadily increased in recent years. With the enactment of the "Biggert-Waters Flood Insurance Reform Act of 2012" signed by President Obama July 6, 2012, the limit on annual rate hikes was increased from 10% to 20%, further enabling the NFIP to precipitously increase rates.

Through the NFIP's Community Rating System (CRS), however, communities can make investments that earn lower flood insurance premiums for residents. By participating in the CRS program, cities and counties that implement technical solutions and conduct outreach campaigns that mitigate flood risk earn credits based on the effectiveness and reach of their efforts. These credits correlate to direct discounts for policyholders of between 5% and 45%, depending on the level of implementation. GCR, with Dewberry, analyzed the participation of local jurisdictions in the CRS program and discovered that participation within the study area can be increased. According to the current credit scoring system, communities in Jefferson Parish and the City of New Orleans are under-performing and have room to increase their scores, thereby lowering insurance premiums. St Bernard Parish does not currently participate in the Community Rating System program and stands to earn significant premium savings over the status quo. Analyzing the various scoring categories, GCR identified three criteria that would most likely provide the greatest discount with the implementation of the Urban Water Plan. The NFIP provides guidance on scoring including the maximum score possible by category and the National average score awarded to all communities.[8]

Table 3: NFIP CRS Credits most likely to net savings from implementation of the Urban Water Plan

Category	*Description*	*Maximum*	*Average*
420	Open Space Preservation	900	191
450	Storm water Management	670	98
510	Flood Plain Management Planning	359	115

To estimate the potential savings in insurance premiums, GCR identified three areas aligned with the Urban Water Plan that increase CRS scoring: open space preservation, storm water management, and flood plain management planning. GCR developed three scenarios (see Table 4 below). The first scenario assumes that the three parishes would achieve the average national rating within each category if the plan were implemented. The third scenario assumes that the three parishes would achieve the highest

[7] Federal Emergency Management Administration BureauNet Statistics, figures current as of 7/31/2012, http://bsa.nfipstat.com/reports/1011.htm#LAT

[8] National Flood Insurance Program Community Rating System State Profile, Louisiana, 2011.

possible rating within each category and maximizes their scores for all three categories. The second scenario was used to model the final cost savings figures. In this case, GCR took the average of the scores from scenario 1 and 2 to achieve a mid-level score. This score was assigned a discount percentage according to the scoring guidance provided in the CRS Coordinator's Manual for 2007 and a premium discount was calculated based on 2012 premium figures[9] less the new assumed discount rate.

Table 4: NFIP Premium Cost Savings Scenarios by Parish

Parish	*Policies (2012)*	*Premium (2012)*	*Premium Savings Scenario 1: National Average Score*	*Premium Savings Scenario 2: Assumed Score[ii]*	*Premium Savings Scenario 3: Maximum score*
Orleans	88,335	$ 77,836,736	$ -	$ 7,783,674	$ 11,675,510
Jefferson[i]	115,068	$ 90,272,670	$ -	$ 4,589,468	$ 13,540,901
St Bernard	11,889	$ 7,196,726	$ 1,079,509	$ 1,079,509	$ 1,079,509
Total	**215,292**	**$ 175,306,132**	**$ 1,079,509**	**$ 13,452,651**	**$ 26,295,920**

i: Based on the sum of policies in unincorporated Jefferson Parish and the municipalities of Harahan and Kenner.
ii: GCR calculated this scenario by taking the average of the scores assigned to scenarios 1 and 3 and assigning these scores a discount percentage based on guidance provided by the NFIP CRS Coordinator's Manual for 2007.

This methodology resulted in an average increase in discount of **10%** for all three jurisdictions. Using the assumed discount rate, proposed annual premium totals were calculated for each jurisdiction and inflated assuming a conservative annual NFIP rate increase of 5%[10], for 50 years. Estimated premiums were also adjusted for the rate of inflation at 3% and discounted to present value, resulting in a total estimated savings of nearly **$609 million** over 50 years.

Increased Property values

Implementation of the Urban Water Plan stands not only to improve stormwater infrastructure in the study area but also to benefit those living in close proximity to major interventions. Numerous studies that use hedonic regression models to analyze the link between public waterways and property values have found a positive causal relationship. By making a significant public investment in new open canals, storage areas and green space, the Urban Water Plan stands to have a positive impact on property values around areas of new investment.

To estimate the potential positive effects, GCR examined multiple hedonic regression analyses for similar studies across the country, specifically looking at the change in property values directly caused by

[9] Federal Emergency Management Administration BureauNet Statistics, figures current as of 7/31/2012, http://bsa.nfipstat.com/reports/1011.htm#LAT

[10] Estimated using historic rate increase figures from NFIP Actuarial Rate Review in Support of the Recommended October 1, 2011, Rate and Rule Changes.

public investment in publicly accessible water features. This includes lakes, water retention basins and canals, and constructed wetlands. Based on this review, GCR assumed a 1.9% increase in property values to properties within a 200-meter buffer.[11] In the study area, over 41,500 properties lie within 200 meters of a proposed intervention or improvement. Using assessed values for these parcels[12], it is estimated that with intensive implementation, property values can increase by **$183 million**.

Economic Impact and Job Creation

The implementation of the Urban Water Plan will require significant investment in labor and materials, with initial estimates ranging from $2.9 billion (for basic implementation) to $6.2 billion (for intensive implementation). Using the U.S. Bureau of Economic Analysis Regional Input-Output Modeling System (RIMS II), GCR estimates that the direct and indirect impacts of this investment would have an **economic impact of $5.29 - $11.32 billion** and would **support between 44,040 and 101,790 jobs**. Many of these jobs will stem from existing labor and is inclusive of part-time and temporary positions, but given the nascent and growing green industries, there is significant potential to foster a new economic driver in the region– one that is anticipated to grow nationally and provides quality jobs with living wages.[13]

Other Economic Benefits

Green Economy: A 2010 Louisiana Economic Development study focused on new industries in the state of Louisiana. Based on the State's coastal location and years of experience dealing with wetland loss and rising sea levels, the study found Louisiana to be well positioned to lead in the sustainable water management industry. Implementation of the Urban Water Plan positions New Orleans to lead the state in innovation and job growth in this new green industry.

Wetland Restoration: Although the primary scope of the Urban Water Plan is within the levee-protected portions of St Bernard parish and the east banks of Jefferson and Orleans parishes, many other water-related challenges threaten the economic vitality of Southeast Louisiana. Significant coastal land loss combined with more frequent and intense hurricanes pose a significant threat to the safety and survival of the New Orleans region. To that end, without supporting the coastal wetlands so crucial to the resiliency of New Orleans, the Urban Water Plan would have little long term success.

The plan's potential impact on wetland health is significant. The proposed system, by design, rethinks the way stormwater is expelled from the levee-protected area. Redirecting some of the drainage to targeted wetlands outside of the perimeter protection system can help restore the freshwater/saltwater balance, supporting vegetative growth and improving wetland health. This is critical to the protection of the Greater New Orleans area and its residents against hurricane storm surge and rising sea levels.

[11] Cheryl Doss and Steven Taff, "The Influence of Wetland Type and Wetland Proximity on Residential Property Values", 1996.

[12] Assessed values for Orleans, Jefferson, and St Bernard Parishes were acquired from the Louisiana State Tax Commission. Values for St Bernard and Jefferson are from 2009, and Orleans for 2010.

[13] Louisiana Economic Development, Blue Ocean Study, 2010.

Fisheries: A critically important activity to the economy of Coastal Louisiana, both by commercial fishermen and for recreation, fishing accounts for over $4 billion and supports over 35,000 jobs.[14] The overall health of fisheries depends on the health of all bodies of water within the region. Improving water quality and expanding wetlands through implementation of the Urban Water Plan can increase biodiversity in Coastal Louisiana and the surrounding Gulf Coast region and contribute to the overall health of the fishing industry.

Recreation: Investment in open space that fosters interaction with water has been shown to improve recreation opportunities, provide visual stimulation, enhance natural beauty, encourage physical activity and increase the desirability of neighboring communities. Improving existing canals and creating new ones would not only affect how local residents and visitors view water, but also provide new opportunities to interact with water and each other. By making the region more desirable, the Urban Water Plan can retain existing and attract new businesses and talent, thereby enhancing the economic vibrancy the region already enjoys.

Real Estate Investment: Studies show that access to natural space and water are desirable qualities for the development of real estate in urban areas. Under current market conditions, where the Greater New Orleans population is growing and real estate development is active, implementation of the Urban Water Plan has the capacity to spur new development. The land adjacent to new green and blue corridors and spaces will likely become assets to neighborhoods, thereby increasing property values and turning vacant land into viable sites for new housing and commercial space.

Table 5: Matrix of Benefits, Implementing the Urban Water Plan

Benefit	*Value*	*Source*	*Methodology*	*Savings*
Economic Impact and Job Creation	The Urban Water Plan will create a number of direct and indirect jobs through construction activity and support to green industries	US Bureau of Economic Analysis RIMS II Multipliers; Project Team Cost Estimates	Cost estimates for intensive implementation of the Urban Water Plan were provided by the project team; GCR used the US Bureau of Economic Analysis RIMS II Multipliers to model direct and indirect economic impacts of the investment. The model resulted in a $11.32 billion output and up to 101,790 jobs (direct and indirect, full and part-time).	-
Value of Reduced Flooding	The Urban Water Plan aims to effectively eliminate flooding from frequent storm events, thereby eliminating damage to structures and economic loss associated with disrupted business activity	FEMA HAZUS Flood Modeling	GCR modeled a 5-year flood scenario for the project area using HAZUS modeling software resulting in $786.17 million in economic loss. GCR assumed this event would occur 10 times over a 50-year period. Costs were inflated at 3% and total estimated costs were discounted at 3.5%.	$ 7,989,653,231

[14] Southwick Associates Inc., 2008 "The Economic Benefits of Fisheries, Wildlife and Boating Resources in the State of Louisiana- 2006"

Value of Reduced Subsidence to Structures	By actively managing the water table throughout the project area, the Urban Water Plan can reduce subsidence to structures. A higher water table results in more stable soils and less subsidence.	Structural Engineer; US Census Building Counts	Preliminary structural assessment identified six areas at risk of moderate and severe subsidence issues. These areas were mapped and structure counts were estimated. Each structure was assumed to incur costs for subsidence-related repairs twice over a 50-year period. Future costs were discounted 3.5% to present value.	$ 2,147,636,257
Lower Flood Insurance Premiums	The Community Rating System (CRS), a FEMA program, provides communities with discounts on flood insurance premiums provided that they institute certain "best practices" in flood management, planning, and education. Many of the measures that the Urban Water Plan recommends qualify for CRS points, thereby reducing flood insurance premiums.	FEMA National Flood Insurance Program and CRS Program materials	GCR analyzed the current allotment of CRS credits in the study area and created a low, medium and high scenario of potential scoring under intensive implementation of the Urban Water Plan. The figure provided represents the medium scenario over a 50-year period, representing annual savings of $13.5 million. Annual insurance premiums were inflated at 5%, and the savings over a 50-year period were discounted at 3.5%.	$ 608,998,357
Increased Property Values	Implementation of the Urban Water Plan will likely have a positive impact on property values in certain parts of the study area by making drainage infrastructure more attractive and by introducing water-related amenities to areas where they do not currently exist.	Assessed Values for study area, Multiple Hedonic Regression Analyses	GCR assumed properties within 200 meters of the Urban Water Plan projects would see a net increase in property values by 1.9%. This was based on the analysis of several hedonic regression models analyzing change in property value for properties adjacent to or in proximity to publicly accessible water features.	$ 183,227,490
Total				**$ 10,929,515,335**

Appendix B

FINANCING TABLES

FUNDING SOURCES

Federal Funding Sources

Source	Program	Purpose	Eligibility
Federal Emergency Management Agency (FEMA) *(w/ Governor's Office of Homeland Security & Emergency Preparedness (GOHSEP))*	Hazard Mitigation Assistance (HMA)	Funding for eligible mitigation activities that reduce disaster losses and protect life and property from future disaster damages	State; Parish
	Hazard Mitigation Grant Program (HMGP)	Grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration	State; Parish
	Pre-Disaster Mitigation Grant Program (PDM)	Funds states and communities for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event.	State; Parish
	Flood Mitigation Assistance (FMA)	Provides FMA funds to help States and communities implement measures that reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program.	State; Parish
	Repetitive Flood Claims (RFC)	To help states and communities reduce flood damages to insured properties that have had one or more claims to the National Flood Insurance Program (NFIP).	State; Parish
	Severe Repetitive Loss (SRL)	Funding to reduce or eliminate the long-term risk of flood damage to severe repetitive loss structures insured under the National Flood Insurance Program.	State; Parish
	Emergency Management Performance Grant (EMPG) Program	Provides grants, necessary direction, coordination, guidance, and other assistance to states to assist state and local governments in preparing for the protection of life and property in the United States from hazards	State; Parish
Environmental Protection Agency (EPA)	Clean Water State Revolving Funds (CWSRF) *(w/ Louisiana Department of Environmental Quality)*	A vehicle for providing predictable, low cost financing for water quality protection projects, including wastewater treatment, nonpoint source pollution control, and watershed and estuary management.	
	National Wetland Program Development Grants	Grants meant to develop or refine wetland programs (in National Priority Area 1) to increase quantity and quality of wetlands, conserve and restore acreage, improve wetland condition, etc.	Non-Profit Entity
	Five Star Restoration Program	Challenge grants, technical support and opportunities for information exchange to enable community-based restoration projects.	Non-Profit Entity
	Community Action for a Renewed Environment (CARE) Grants	A competitive grant program that offers communities financial and technical assistance to reduce releases of toxic pollutants and minimize people's exposure to them.	Partnership Among Multiple Entities
	Brownfields Revolving Loan Fund Grants	Funding for a grant recipient to capitalize a revolving loan fund and to provide sub-grants to carry out cleanup activities at brownfield sites	Local Governmental Entity or State
	Environmental Education Grants (Region Six)	Provides money to support environmental education (EE) projects that increase the public's awareness about environmental issues and provide them with the skills to take responsible actions to protect the environment.	Educational Institution or Non-Profit Entity
	STAR Program: Centers for Water Research on National Priorities Related to a Systems View of Nutrient Management.	Seeks applications to establish a center to conduct water research and demonstration projects that are innovative and sustainable and use a systems approach for nutrient management in the Nation's waters	
	STAR Program: Performance and Effectiveness of Green Infrastructure (REGION III ONLY)	Seeks applications proposing to conduct research on and demonstration of the performance and effectiveness of green infrastructure (GI) practices at the urban watershed.	
	Clean Water Act	Contains provisions that address such important features of water management as maintaining water quality and storm water management. Can produce innovative approaches to funding local water improvements and community outreach and education through the direction of legal settlements to specific community needs.	
	Safe Drinking Water Act	Helps finance water infrastructure improvements intended to ensure that all Americans have access to clean, safe drinking water.	

Federal Funding Sources

Source	Program	Purpose	Eligibility
Department of Housing and Urban Development (HUD)	Sustainable Communities Regional Planning Grants	Supports metropolitan and multijurisdictional planning efforts that integrate housing, land use, economic and workforce development, transportation, and infrastructure investments to encourage economic competitiveness and revitalization; social equity, inclusion, and access to opportunity; energy use and climate change; and public health and environmental impact.	City, Parish or Regional Planning Agency; Universities
	Sustainable Communities Challenge Planning	Awards up to $75 million in funding to help foster planning for more livable, sustainable communities – places where transportation, housing and commercial development investments are coordinated to better serve the people living in those communities.	
	Community Development Block Grant Entitlement Communities Grants (CDBG)	Works to ensure decent affordable housing, provide services to the most vulnerable in our communities, and create jobs through the expansion and retention of businesses.	
	HUD Section 108 Loan Guarantee Program	Allows future Community Development Block Grant (CDBG) allocations to be used to guarantee loans for neighborhood revitalization projects, including construction or installation of public facilities and infrastructure.	
	Choice Neighborhoods	Supports locally driven strategies to address struggling neighborhoods with distressed public or HUD-assisted housing through a comprehensive approach to neighborhood transformation	Governmental Entity; Non-Profit Entity
	Choice Neighborhoods Initiative Implementation Grant	Choice Neighborhoods Implementation Grants support those communities that have undergone a comprehensive local planning process and are ready to implement their program-defines “Transformation Plan” to redevelop the neighborhood.	Governmental Entity; Non-Profit Entity
	Choice Neighborhoods Initiative Planning Grant	Support the development of comprehensive neighborhood revitalization plans which focus on directing resources to address three core goals: Housing, People and Neighborhoods.	Governmental Entity; Non-Profit Entity
	Capacity Building for Sustainable Communities (in partnership with the EPA)	Assembles a collection of capacity building service providers to work directly with HUD and EPA grant recipients and builds a national coalition and leadership network of the Sustainable Communities Grantees to facilitate the exchange of successful strategies, lessons learned, emerging tools and public engagement strategies, and approaches for avoiding or minimizing pitfalls.	Governmental Entity; Non-Profit Entity and Universities
	HOME Investment Partnerships Program	Provides formula grants to States and localities (often in partnership with local nonprofit groups) to fund a wide range of activities that build, buy, and/or rehabilitate affordable housing for rent or homeownership or provide direct rental assistance to low-income people.	Governmental Entity
Army Corps of Engineers (USACE)	Water Resources Development Act (WRDA)	The main vehicle for authorizing water projects to be studied, planned and developed by the U.S. Army Corps of Engineers; also the legislative vehicle for implementing policy changes with respect to the Corps’ water resource projects and programs.	Local Governmental Entity
	Environmental Infrastructure Program (Section 219)	Section 219 allows the Army Corps of Engineers to provide planning, design, and construction assistance for water-related environmental infrastructure projects providing to non-Federal interests	State or Parish
	Planning Assistance for the State	The USACE is available to assist states and local governments in the preparation of comprehensive plans for the development and conservation of water and related resources.	Non-Federal Entities
	State and Tribal Assistance Grant	Intended to forge strong partnerships with States through improved coordination, joint work planning and specialized assistance to promote greater compliance with environmental laws and regulations.	Governmental Entity; Non-Profit Entity in “Special Circumstances”

Federal Funding Sources

Source	Program	Purpose	Eligibility
Economic Development Administration (EDA)	Strong Cities Strong Communities Visioning Challenge	Seeks to strengthen neighborhoods, towns, cities, and regions by enhancing the capacity of local governments to develop and execute their economic vision and strategies, providing necessary technical assistance and access to federal agency expertise, and creating new public and private sector partnerships.	Governmental Entity
	Disaster Recovery Funding	Disaster prevention and relief; this investment assistance will help communities and regions devise and implement long-term economic redevelopment strategies through a variety of projects to address economic development challenges.	
	Public Works and Economic Development Assistance	Construction, non-construction, and revolving loan fund investments intended to support the implementation of regional economic development strategies designed to create jobs, leverage private capital, encourage economic development, and strengthen America's ability to compete in the global marketplace.	
	Second Supplemental Appropriations Disaster Relief Opportunity	Awards investments for expenses related to disaster relief, long-term recovery, and restoration of infrastructure related to the consequences of hurricanes, floods and other natural disasters	
US Small business Administration (SBA)	Small Business Investment Corporation (SBIC)	Connects venture capital with businesses. Businesses apply for funding and the SBIC helps connect them with approved private funds.	Private entities
National Park Service	Land and Water Conservation Fund	Provides matching grants to States and local governments for the acquisition and development of public outdoor recreation areas and facilities (as well as funding for shared federal land acquisition and conservation strategies).	State; Local
National Resources Conservation Services	Watershed and Flood Prevention Operations Program (WFPO)	Provides technical and financial assistance to States and local governments to plan and implement authorized watershed project plans for the purposes of water management, watershed protection, flood mitigation, water quality improvements, and more.	Local Governmental Entity
	Emergency Watershed Protection Program	Intended to assist in the undertaking of emergency measures to safeguard lives and property from floods following a natural disaster.	Local Governmental Entity; Public and Private Landowners
National Fish and Wildlife Service (NFWS)	Coastal Impact Assistance Program (CIAP)	Provides federal grant funds for conservation, protection, or restoration of coastal areas including wetlands, mitigation of damage to natural resource, planning assistance, and more.	State or Coastal Parish
	Coastal Program	Provides incentives for voluntary protection of threatened, endangered and other species on private and public lands alike.	Governmental Entity; "Public Non-Profit" Entity
Department of Energy (DOE)	The Weatherization Assistance Program	Provides funding to states that manage the day-to-day details of WAP programs that improve the energy performance of dwellings of needy families using the most advanced technologies and testing protocols available in the housing industry.	
	Energy Efficiency and Conservation Block Grant	Assists eligible entities in implementing energy efficiency and conservation strategies.	
	Weatherization Innovation Pilot Program	Provides $30 million for competitively selected innovative weatherization projects promoting innovative ways to weatherize homes of low-income customers.	
	Sustainable Energy Resources for Consumers	Created to allow local weatherization agencies to install weatherization materials and technologies that have promise for energy savings and benefits to customers, however cannot currently be installed under the traditional Weatherization Assistance Program (WAP).	
	State Energy Program (loan fund)	Provides financial and technical assistance to states through formula and competitive grants for the purpose of developing state strategies and goals to address their energy priorities	

Federal Funding Sources

Source	Program	Purpose	Eligibility
Department of Transportation (DOT)	Recreational Trails Program	Provides funds to the States to develop and maintain recreational trails and trail-related facilities for both nonmotorized and motorized recreational trail uses.	
	Transportation Enhancement Activities	Offer funding opportunities to expand and enhance transportation choices, including pedestrian and bicycle infrastructure and safety programs, scenic and historic highway programs, landscaping and scenic beautification, historic preservation, and environmental mitigation.	
	Transportation, Community and System Preservation Program	Research and grants for investigating the relationships between transportation, community, and system preservation plans and practices and identify private sector-based initiatives to improve such relationships	
	TIGER IV Grants	Provides investment in road, rail, transit and port projects that promise to achieve critical national objectives.	
Department of Commerce	FY 2013 Coastal Resilience Networks	Funds the implementation of activities that enhance resilience of coastal communities to natural hazard and climate risks through a regional or national network.	
National Oceanic and Atmospheric Administration (NOAA)	Sea Grant Community Climate Adaptation Initiative	Provided for a national competition to fund climate adaptation efforts for FY 2013-2014 as part of an overall plan to enhance climate adaptation in coastal communities.	Sea Grant University (LSU, USM, Auburn, Ole Miss)
Treasury Department	New Market Tax Credit	Attracts investment capital to low-income communities by permitting individual and corporate investors to receive a tax credit against their Federal income tax return in exchange for making equity investments in specialized financial institutions called Community Development Entities (CDEs).	
Miscellaneous	CWPPRA (Coastal Wetlands Planning, Protection, and Restoration Act) PL 101-646 (1990). 16 USC 3951.	The Coastal Wetlands Planning, Protection and Restoration Act, (CWPPRA pronounced kwĭp-rŭh), is federal legislation enacted in 1990 that is designed to identify, prepare, and fund construction of coastal wetlands restoration projects.	

State Funding Sources

Source	Program	Purpose	Eligibility
Louisiana Department of Transportation	Statewide Flood Control Program	Uses state funds allocated each year by the Legislature to assist in the construction of flood control infrastructure projects that reduce existing flood damages.	Local Governmental Entity
Louisiana Department of Environmental Quality	Section 319	Funds statewide and watershed projects that address nonpoint source pollution and support the removal of listed water bodies from the impairment list	Parish and Local Governmental Entity; Non-Profit Entity
Louisiana Department of Health and Hospitals (LDHH) Office of Public Health (OPH)	LA Drinking Water State Revolving Fund (DWSRF)	Provides low-interest loans for construction of eligible public drinking water infrastructure improvements (e.g., treatment plant, distribution main replacement, storage facilities)	
Delta Regional Authority	Strategic Economic Development Plans	Developed to provide funding to enhance the economic development activities taking place in the Delta region.	States; Local governments; Non-profit entities

Table 3-2 below is from the Natural Resources Defense Council's Rooftops to Rivers II: Green strategies for controlling stormwater and combined sewer overflows, 2011 and has been included for reference

Table 3-2: Funding Generation: Methods for raising funds for green infrastructure

Financing Source	General Description	Example
State & Federal Loans	A number of federal and state programs provide low and no-interest loan options, including EPA's Clean Water State Revolving Fund, which distribute federal funds to states and then communities.	Much of traditional water infrastructure.
General Fund	Property and sales tax revenue paid into a general fund can be used for stormwater management activities. However, as stormwater needs increase, it puts more pressure on general fund budgets, which has led to more fee-based programs.	Much of traditional water infrastructure.
Bonds	Selling bonds is a traditional approach for public financing of capital projects. Functionally, it is the equivalent of taking loans from bond purchasers.	Voters in the City of Los Angeles passed a $500 million bond initiative for water quality, flood protection, water conservation, and habitat protection.
Stormwater Utility Fees	A type of public enterprise fee charged as part of a standard utility bill. Property owners are charged based on estimated contribution of stormwater runoff	Cities such as Philadelphia, Pennsylvania, Lenexa, Kansas and Portland, Oregon calculate user fees for commercial, multi-family residential and industrial properties by their total lot size and percentage of imperviousness.[4] When establishing user fees, it is important to set the price appropriately at the first opportunity, as it may be years before enough political support can be garnered to warrant a rate hike.[5]
Special Assessments	When a specific stormwater project is implemented and only benefits a particular area, property owners within that area can be levied an assessment in proportion to the benefit each receives.	Butler County, Ohio enacted a stormwater district in order to fund required stormwater controls.[6]
Development Fees	System development charges or stormwater development fees are one-time fees which are assessed in connection with construction of a new impervious area or a new development to pay for necessary (new) stormwater infrastructure	The Southeast Metro Stormwater Authority in Colorado charges a System Development Fee to developers to pay for new stormwater infrastructure that the developers make necessary.[7]
Drinking Water/ Wastewater Fees	Drinking water and wastewater fees are usually based on metered water flow, though this bears little relationship to stormwater runoff.	Common financing tool.
Impact/Facility Fees	Impact fees are one-time fees related to the impact generated by the new development project, they require special local enabling legislation.	The Lenexa City Council adopted a Systems Development Charge, which requires new development to pay a one-time fee at the time of building permit as a means for recovering costs for capital improvement activities within the Rain to Recreation program so that growth pays for growth.[8]
Permit And Inspection Fees	Local governments can set regulatory fees to cover the cost of permitting and inspection programs.	The Sussex Conservation District in Delaware charges a construction inspection fee on all new development, both public and private, based on the size of the project to contribute to stormwater and erosion control.[9]
Property Assessed Clean Energy (PACE) Program	A municipality issues special revenue bonds; the proceeds are used by participating property owners to pay for improvements to their property. Payments are made through property taxes.	No example yet available for green infrastructure.
On-bill financing	A utility provides the upfront capital for improvements to private property and the utility collects repayment, typically with low to no interest, through the monthly billing process.	No example yet available for green infrastructure.

Table 3-2 below is from the Natural Resources Defense Council's Rooftops to Rivers II: Green strategies for controlling stormwater and combined sewer overflows, 2011 and has been included for reference

Table 3-2: Funding Generation: Methods for raising funds for green infrastructure

Financing Source	General Description	Example
Off balance sheet project financing	An outside firm covers all upfront costs for a retrofit and the building owner repays this investment based on a portion of the savings resulting from the retrofit.	No example yet available for green infrastructure.
Credit enhancement to accelerate private investment in retrofits	Credit enhancement refers to methods that provide a financial backstop for a specified percentage of losses in a portfolio of debt-financed projects. Because credit enhancement facilities take responsibility for initial losses, credit enhancement can help bring lenders to the table for projects that otherwise may be considered too risky, allowing a wider range of borrowers to gain access to capital at lower interest rates and with longer repayment periods than would otherwise be available.	No example yet available for green infrastructure.
Environmental tax shifts	Used in other countries to place taxes on things society wants to reduce, such as air pollution or stormwater runoff.[g]	A "pay-to-pave" tax was introduced in Massachusetts, but not implemented.[h,i]
Reverse auction	Homeowners compete to offer the lowest price at which they will install green infrastructure, and then the stormwater authority pays the winning, lowest bid.	A procurement auction of rain gardens and rain barrels in the Midwest was found to promote more participation in green infrastructure than education alone and at a cheaper per-unit control cost than a flat stormwater control plan.[j]
Funding Allocation: Methods for implementing green infrastructure projects and targeting funding		
Public Works	The standard means for managing grey infrastructure, through public construction and ownership, is still likely the most direct approach for green infrastructure as well, particularly for large-scale projects on dedicated sites.	Common.
Public-Public Collaborations	There are opportunities for multiple public agencies to meet goals through green infrastructure, such as collaborations with parks, schools, and other publicly-owned potential sites. This is most promising when green infrastructure provides benefits such as education and aesthetics that are beneficial on-site.	Schools, such as Thurston Elementary in Ann Arbor, Michigan, have installed rain gardens for both water quality and education benefits.[k]
Public-Private Collaborations	Similar to public-public collaboration, many private institutions and businesses experience benefits sufficient to support on-site green infrastructure, which might be partially expanded via public cost-sharing.	Businesses in Portland, Oregon's Tabor to the River Corridor such as New Seasons Market and Fred Meyers have constructed rain gardens in their parking lots with support from the city.[l]
Private Grants and Loans	Public and private groups are providing low and deferred interest loans as well as grants to homeowners and businesses for on-site green infrastructure capital costs. Often, the private recipients stay involved by providing operation and maintenance.	Lexington, Kentucky provides Stormwater Quality Project Incentive Grants to businesses, non-profits, and residences for onsite stormwater projects like installation of permeable pavements. The Water Quality Management Fee funds the program.[m]
Tax Credits	One-time or continuing tax reductions are a means to motivate private installation and maintenance of green infrastructure.	Anne Arundel County, Maryland offers property tax credits for owners who implement onsite stormwater control such as removal of impervious surfaces.[n]
Fee Reductions	Various fees, such as sewer fees, can be reduced as a means of motivating private green infrastructure. If the green infrastructure provides private benefits as well, there are opportunities for cost-sharing.	In Philadelphia, Portland and Seattle, fee discounts and credits provide an opportunity for property owners to reduce the amount they pay by decreasing impervious surfaces or by using green infrastructure techniques that reduce the amount of stormwater runoff.

Supplemental Funding Mechanisms

Type	General Description	Example
Tax-Based Fees		
Tax Increment Financing (TIFs)	Dedicates tax increments (property taxes that result when a project increases the value of surrounding areas) to finance the debt that is issued to pay for a project.	Genesee County, in Michigan, uses TIFs to cross-subsidize developments of various low value properties. The City of Milwaukee also uses TIFs and tax increment districts (TIDs). Also used by the Chicago Park District.
Ad Valorem Tax Revenue	Revenue gathered from a broad based assessment of real property value that is used to address utility operating and/or capital funding needs.	Typically used today only by special water districts.
Economic Incentives		
Rebates and Installation Financing	Include tax credits or reimbursements to property owners who install eligible green infrastructure, such as permeable pavement or green roofs.	RainScapes Rewards in Montgomery County, Maryland, a rebate program; In New York, the GrowNYC program provides installation funding.
Awards, Certification, and Recognition Programs	Awards and recognition programs reward innovation and increase awareness of green infrastructure projects by both the public and decision-makers.	Lake Champlain International (LCI) in Vermont established BLUE certification for watershed-friendly homes.
"Trading" Ecosystem Services	A tradable credit system that provides economic incentives (allowances or credits) for sustainable investments.	California's Cap-and-Trade Program; The European Union Emissions Trading Scheme (EU ETS); Kyoto Protocol Clean Development Mechanism (CDM)
Development of Land Trusts	An agreement where an organization agrees to acquire land in order to actively conserve it.	The Chicago Park District developed a land trust with non-profit NeighborSpace.
Gap Ownership	Allows for grant funding to be received while still maintaining ownership in a “gap period.” It also helps with the creation of open space.	Openlands, a non-profit, provides “gap ownership” of properties to public organizations like the City of Chicago.
Fee-Based Funding		
Developer Exaction	Requires a land developer to mitigate the negative effects of construction and provide a particular service benefit to that development.	The Montana Department of Transportation uses exaction to lessen the impact of new development on existing public facilities and to fund water and swear lines, roads, and new schools and parks.
Tap Fees	A one time charge to new utility connections made for purchase/installation of the water meter and/or making the water or wastewater customer service connection to the utility.	The Charleston Water System, in South Carolina, employs a tap fee.
Availability of Service (Stand-By) Fees	A monthly charge to utility customers to recover costs incurred by a utility when it is constructing facilities for the benefit of future customers.	The City of Irvine, CA, uses a stand-by fee, which appears on property tax bills but can sometimes be billed to the local agency.
Demand Contract Charges	Similar to availability of services fees; periodic payments where high volume customers contract to pay fixed costs related to the share of utility capacity attributable to their use.	The City of Kinston, NC, uses demand contract charges to pay for fixed costs and to control energy use and associated costs.
In-lieu Fee Mitigation	A program involving the restoration of natural resources through funds paid to a governmental or non-profit natural resources management entity to satisfy compensatory mitigation requirements.	King County, Washington, has implemented a Mitigation Reserves Program.

Other Tactics		
Land Banks	A non-government third party organization that assists local government with acquisition of promising stormshed properties.	Genesee County, in Michigan, created a land bank to acquire, maintain, and transfer foreclosed vacant land and advance its green development goals.
Eminent Domain and Condemnation	A mechanism to acquire properties with limited development potential.	Dade City, FL, considered eminent domain for water retention purposes.
Revolving Loan Funds	Finances new multi-year operations through loans that are serviced by repayments from prior fund beneficiaries.	Used by third party acquisition organizations to gain accelerated purchase and aggregation of strategic properties
Consent Decree Funds	Funds made available through a legal ruling that exculpates one party in exchange for payment of damages.	Sewerage & Water Board of N.O
Volunteering	When community members contribute labor at no cost to a project.	New York's Bluebelt Volunteer Cleanup; Adopt-a-Lot in Genesee County; Salmon Safe in Pullman, WA.
Civic Leadership	When community members lead by example and inspire others to follow.	Yu Ying Chinese Charter School in Washington D.C. was the first school in D.C. to implement stormwater masterplan on their own initiative.
Technical Assistance and Job Training	Education and training for specific water management and landscaping jobs and operations.	The Chicago Green Corps for ex-offenders; GrowDat Youth Farm, in New Orleans, trains local children in responsible farming practices; Green Thumbs in New York; Clean & Green in Genesee County.
Sponsorship	When an organization, often private, exchanges funding for naming rights or other promotions.	New York's “Adopt a Bluebelt” program allows community members and local businesses to pay to sponsor the state's Bluebelt; The Menomenee Valley Industrial Center in Milwaukee, WI.

Appendix C

POLICY AND ACTION TABLES

POLICY RECOMMENDATIONS Table 1

Near Term 2013-2020 | Medium Term 2020-2030 | Long Term 2030-2065

RECOMMENDATIONS FOR **LOCAL ACTION**			
	What	**How**	**Who**
Recommendation 1	**Adopt a more comprehensive and dynamic approach to flood risk assessment and management (per the National Academies 2012)**	• Collaborate with FEMA, the US Army Corps of Engineers, the state, and regional stakeholders to develop a **comprehensive approach** to flood risk management and assessment	Water Management entities; Oversight bodies; Levee Districts
		• Adopt new standards and techniques that respond to this new approach and **account for climate change and anticipated sea level rise**	
Recommendation 2	**Adopt a minimum 500-year flood protection level in each parish (per the New Orleans Master Plan 2010)**	• Advocate for funding and the expeditious implementation of a flood protection system that will **handle a 500-year or stronger storm event**	Water Management entities; Oversight bodies; Levee Districts; Civic and Business Organizations; Citizens
Recommendation 3	**Adopt a long-term Integrated Water Management Plan**	• Lay out a vision for how the Integrated Water Management Plan will be **implemented across the city or parish**	Water Management entities; Oversight bodies; Levee Districts
		• Issue an executive order requiring city/parish departments to incorporate stormwater best management practices **in the design and construction of all public projects**	
		• Develop and adopt a **"Complete Streets" program**, as in the case of New Orleans, that also incorporates strong stormwater management practices; implement new rules whenever a street is overlaid or rebuilt	
		• Coordinate department roles to ensure there is **enough capacity to review and implement** stormwater management projects that meet MS4 requirements	
		• Establish **a methodology that**, in addition to construction costs, capital costs and life cycle costs, **considers safety, economic, social, and environmental benefits** in the selection and approval of stormwater management projects	
Recommendation 4	**Create a stormwater/ groundwater management unit within each city's or parish's drainage department**	• Employ blue-green infrastructure practices to **mitigate flooding, combat subsidence and comply with MS4 requirements**	Water Management entities; Oversight bodies
		• Install a **groundwater monitoring network** and employ real-time controls to **manage surface water and groundwater levels** for subsidence control	
		• Monitor and record **stormwater and groundwater quantity and quality, as well as land subsidence,** to ensure objectives are being met	
		•Establish **close collaboration** with other local and state entities that manage groundwater within the perimeter	

RECOMMENDATIONS FOR **LOCAL ACTION** (continued)			
	What	**How**	**Who**
Recommendation 5	**Develop and enforce a strong retention standard for storm water in urban development and redevelopment**	•Introduce stormwater management requirements in **city/parish zoning ordinances**, exempting only single- and double-family residential, to minimize the volume of runoff discharged from developed sites	Planning, Zoning and Permitting departments; Redevelopment authorities; Oversight bodies
		• Encourage or require blue-green infrastructure practices in **construction permits** with incentives and non-compliance fees	
		• Apply **fees towards building and maintaining** blue-green infrastructure that benefits the same community where the fee is collected	
		• Create **'water credits'** to encourage developers to exceed stormwater management requirements	
		• Establish a **Stormwater Management Authority** to manage fees and 'water credits' and a Stormwater Advisory Committee to review stormwater management projects and advise on fee allocations	
		• **Align planning districts** with water management districts based on the physical landscape	
Recommendation 6	**Require the use of stormwater management practices to reduce runoff from existing impervious surfaces**	• Develop a program designed to **reduce impervious surfaces** along streets and on roofs of public buildings	Public Works departments; Water Management entities; Planning, Zoning and Permitting departments; Parks and Green Spaces departments; School Boards
		• Introduce a **stormwater service fee** that requires the use of blue-green infrastructure to replace a portion of impervious surfaces or otherwise mitigate runoff from those areas	
		• Revise **zoning rules and building codes** to discourage paving over green space and to encourage downspout disconnections and green roofs	
Recommendation 7	**Provide incentives for private use of blue-green infrastructure**	• Offer **zoning and permitting advantages** (i.e. density, land use, floor area, and building height "bonuses") to projects that incorporate or exceed certain stormwater requirements	Planning, Zoning and Permitting departments; Water Management entities; Public Works departments
		• Offer **other incentives** (i.e grants, low-interest loans, permit fee reductions, property tax credits, and stormwater fee credits or discounts) that directly or indirectly finance projects that incorporate or exceed certain stormwater requirements	
Recommendation 8	**Provide guidance or other actions to accomplish stormwater management goals**	• Include in guidance **demonstration projects, planning workshops and technical manuals** that decrease the gap in public knowledge and experience concerning design, construction, maintenance, and benefits of green and blue infrastructure	Planning, Zoning and Permitting departments; Public Works departments; Oversight bodies
		• Identify and **overcome code and zoning barriers**	
		• Develop and **enforce design guidelines** adopted in building and zoning codes	
		• Provide **workforce training** to contractors so they can build stormwater management projects per design guidelines	
		• **Educate** permitting agency reviewers and inspectors	
		• **Provide citizens with assistance** (some agencies also provide volunteers, tools and materials) towards implementation of stormwater management projects	
Recommendation 9	**Prepare stormwater financing plan to ensure dedicated funding sources for integrated water management**	• **Dedicate stormwater fee** to blue-green infrastructure implementation, operation and maintenance	Water Management entities; Oversight bodies
		• Establish water management guidelines and requirements to **ensure that funds are being used for the intended purposes** of a program or act	

POLICY RECOMMENDATIONS Table 2

Near Term 2013-2020 | Medium Term 2020-2030 | Long Term 2030-2065

RECOMMENDATIONS FOR **REGIONAL/STATE ACTION**			
	What	**How**	**Who**
Recommendation 1	**Adopt a more comprehensive and dynamic approach to flood risk assessment and management (per the National Academies 2012)**	• Collaborate with FEMA, the US Army Corps of Engineers, and local stakeholders to develop a **comprehensive approach** to flood risk management and assessment	CPRA; LADOTD; GOHSEP; SLFPA-E
		• Adopt new standards and techniques that respond to this new approach and **account for climate change and anticipated sea level rise**	
Recommendation 2	**Adopt a minimum 500-year flood protection level regionally (per the New Orleans Master Plan 2010)**	• Advocate for funding and the expeditious implementation of a flood protection system that will **handle a 500-year or stronger storm event**	CPRA; SLFPA-E
Recommendation 3	**Adopt a long-term Integrated Water Management Plan with force of law**	• Lay out a vision for how the Integrated Water Management Plan will be **implemented across the region**	CPRA; GOHSEP
Recommendation 4	**Establish a Regional Water Management Authority to facilitate inter-parish collaboration**	• **Consult existing regional models** like the Southeast Louisiana Flood Protection Authority and the Regional Planning Commission	CPRA; GOHSEP; SLFPA-E; RPC
		• **Coordinate** integrated water management improvements and initiatives	
		• Establish **close collaboration** with state water managers	
		• Compile **groundwater, surface water and land subsidence monitoring data**	
		• Generate **annual reports** that detail whether water quantity and quality objectives have been met	
Recommendation 5	**Implement a policy that requires stormwater management in all transportation projects that involve federal or state funding or approval**	• Revise **state transportation design manuals** to require stormwater best management practices	CPRA; GOHSEP; LADOTD; RPC
Recommendation 6	**Ensure dedicated funding sources for integrated water management**	• Establish water management guidelines and requirements to **ensure that funds are being used for the intended purposes** of a program or act	CPRA; LADOTD; GOHSEP; RPC; Inspector General
Recommendation 7	**Expand the Emerging Environmental industry sector to implement integrated water management projects and to ensure that local businesses and local residents have the capacity and skills to do the work**	• Establish and fund **skills training programs** at schools of higher education; engage K-12 in internship and other career development programs	GNO, Inc.; other Economic Development Organizations
		• Create a **specialized business retention and expansion program** for companies engaged in the emerging environmental sector, including the development of policies that will help these businesses expand and	

POLICY RECOMMENDATIONS Table 3

Near Term 2013-2020 | Medium Term 2020-2030 | Long Term 2030-2065

RECOMMENDATIONS FOR **FEDERAL ACTION**			
	What	**How**	**Who**
Recommendation 1	**Adopt a more comprehensive and dynamic approach to flood risk assessment and management (per the National Academies 2012)**	• Collaborate with local, regional and state stakeholders to develop a **comprehensive approach** to flood risk management and assessment	FEMA; USACE
		• Revise **NFIP eligibility standards** and flood risk assessment methods to respond to this new approach and **account for climate change and anticipated sea level rise**	
		• Revise the criteria for hazard mitigation funding to **consider the economic benefits of subsidence control**	
Recommendation 2	**Provide guidance and funding to implement a minimum 500-year flood protection level (per the New Orleans Master Plan 2010)**	• Collaborate with local, regional and state stakeholders to plan for expeditious **funding and implementation** of a flood protection system that will **handle a 500-year or stronger storm event**	FEMA; USACE
Recommendation 3	**Provide guidance and funding to address the significant contributions of runoff and pollutants caused by road and highway construction**	• Require that a **portion of highway funds** be used for water management and environmental protection	USDOT; EPA
Recommendation 4	**Ensure dedicated funding sources for integrated water management**	• Establish water management guidelines and requirements to ensure that federal **funds are being used for the intended purposes** of a program or act	FEMA; EPA; USACE
		• Align federal policies and funding to allow for the **acquisition of land and blighted or adjudicated properties** for stormwater management use	

COMMUNITY ENGAGEMENT RECOMMENDATIONS Table 1

Near Term 2013-2020 | Medium Term 2020-2030 | Long Term 2030-2065

RECOMMENDED ACTIONS FOR **PLANNING, DESIGN, AND ENGINEERING**			
	What	**How**	**Who**
Action 1	**Incorporate integrated water management practices into ongoing planning and design projects where possible**	• Coordinate closely with **projects already planned and underway** at the local, regional, state, and federal levels. Examples of relevant ongoing projects include: The Southeast Louisiana Urban Flood Damage Reduction Project (SELA) by the US Army Corps of Engineers; Louisiana's Department of Transportation and Development (LDOTD) projects programmed by the Regional Planning Commission; and public works projects that use FEMA's Hazard Mitigation Grant Program (HMGP) and Recovery Roads Program funds, including city and parish street reconstructions	Planners, Designers, Engineers
		• Use stormwater practices to address federal **MS4 requirements** on water quality to avoid looming penalties, and **NFIP standards** for flood risk mitigation to reduce insurance premiums for area residents	
Action 2	**Develop demonstration project designs from schematics to construction documents**	• Start with high impact, high visibility **demonstration projects** at every scale: a lot, a street, a park, a neighborhood, a district, a canal	Planners, Designers, Engineers
		• Develop **construction documents and feasibility studies**, including cost-benefit analyses, for selected demonstration projects	
		• Develop detailed designs for **operational pilots** projects such as the raising of water levels in drainage canals	
Action 3	**Expand on the research compiled in the Urban Water Plan and provide access to data and other resources**	• Expand planning, design, and engineering **research** on soils, surface water, groundwater, operations, policy, and financing, and develop a **method of sharing** this knowledge as the basis for planning and decision-making	Planners, Designers, Engineers
		• Build a **physical model or traveling exhibit** of the Urban Water Plan's long-term vision to help educate children and adults about water-related issues and opportunities	
Action 4	**Refine principles and strategies and expand on scales of integrated water management interventions**	• Track and measure the performance of demonstration projects and pilot programs to **refine planning principles and strategies**, and to inform program development	Planners, Designers, Engineers
		• Build upon demonstration projects to establish **improved water flows and connectivity**, and to test new standards and best practices both for public works and private properties	
Action 5	**Incorporate circulate & recharge strategies into project design and construction**	• Integrate stormwater management practices into **design and construction specifications** at the local, regional, state, and federal levels	Planners, Designers, Engineers
		• Establish **system-scale circulatory and groundwater recharge networks** that integrate the region's streets, waterways, parks, wetlands, and pump stations into a 21st century living water infrastructure	

COMMUNITY ENGAGEMENT RECOMMENDATIONS Table 2

Near Term 2013-2020 | Medium Term 2020-2030 | Long Term 2030-2065

RECOMMENDED ACTIONS FOR **RESEARCH AND DEVELOPMENT**			
	What	**How**	**Who**
Action 1	**Encourage partnerships and knowledge exchange**	• Explore **national and international best practices and research and economic development models** and develop information sharing, knowledge transfer, and partnership opportunities	Higher Education Institutions; Researchers; Scientists; Industry; Local Governments
		• Consider Dutch models such as the **RDM Campus** for research, design, and manufacturing, **TU Delft,** and **Deltares**, and initiatives such as the **Rotterdam-Brooklyn Waterfront Exchange** that connects two port and delta cities in a knowledge exchange to promote pro-active climate adaptation	
Action 2	**Test the applicability of blue-green solutions for urban drainage**	• Test and improve the performance of blue-green drainage solutions; Adapt these solutions to local conditions	Higher Education Institutions; Researchers; Scientists; Industry
Action 3	**Establish a research and innovation campus in the Greater New Orleans region focused on water management technologies**	• Form a **strong link between research and local industry** by introducing advanced research and innovation topics in water planning, design, and engineering, as well as providing job training and business incubation and acceleration to help grow a new industry and position the New Orleans region as a national and global leader in water management	Higher Education Institutions; Researchers; Scientists; Industry
Action 4	**Develop application tools to monitor and manage surface water and groundwater**	• Develop and improve **modeling tools** for surface water and groundwater management, as well as a **real-time control system** to strengthen pro-active operations and management of the drainage system	Higher Education Institutions; Researchers; Scientists; Industry
		• Develop, implement and operate a **monitoring network** for surface water and groundwater levels and quality, as well as land levels (subsidence). Analyze the data collected to establish the area's water balance	
		• Develop **integrated modeling** that includes water, ecology, economics, and urban development for decision-making	

COMMUNITY ENGAGEMENT RECOMMENDATIONS Table 3

Near Term 2013-2020 | Medium Term 2020-2030 | Long Term 2030-2065

RECOMMENDED ACTIONS FOR **EDUCATION AND CIVIC ENGAGEMENT**			
	What	**How**	**Who**
Action 1	**Enhance water literacy in the region by integrating water topics into the curriculum in schools of higher education as well as K-12**	• Enrich **school curricula at every level** and in many subjects including ecology, biology, history, social sciences, business, economics and political science by introducing water education topics	Schools at every level; Higher Education Institutions
		• Provide **educational and research opportunities** in water management design, planning, and engineering, as well as teach technical skills building in green infrastructure construction, operations, and maintenance	
		• **Teach children about water** through play, literature, arts and science education, and encourage them to understand the role of the environment in their safety, quality of life and that it can offer economic opportunity	
Action 2	**Build on existing momentum to develop an outreach campaign that will bring water education to the wider public**	• Build upon the Urban Water Plan's planning and outreach efforts as well as existing projects, research, networks, organizations, and advocacy through **coordinated public outreach efforts**, symposiums on topics of critical interest, and the development of forums for discussion, participation, and direct action	Community Organizations; Advocates
		• Convene people **across political boundaries**, present information with **accessible graphics**, and provide translated materials to **transcend language barriers** and be inclusive of all communities	
		• **Inspire others** through daily conversations, journalism, social media, teaching, art, writing, music, and through pilot programs, so that water planning becomes an essential part of life and culture in the region	
Action 3	**Provide training and utilize social media to promote volunteer citizen engagement**	• Provide **training in groundwater level monitoring**	Groundwater management professionals; Community Organizations; Advocates; Industry
		• Create **social media opportunities**, building on GNO, Inc.'s iPad app that is based on the Urban Water Plan, to communicate and inform about and to encourage **real-time reporting** of groundwater levels, flooding and subsidence instances, and **enable knowledge** of exact surface elevation at property locations (by census tract, or street, or address, for example)	

Appendix D

CASE STUDIES

INTEGRATED WATER MANAGEMENT CASE STUDIES

PRIMARY MATRIX	financial	economic	social	environmental
pilot	CANAL PARK (D.C.)	CITYGARDEN	CANAL WALK (Va.)	PONTIFF PARK
system	GOWANUS SPONGE PARK	TRUCKEE WHITEWATER PARK	CAÑO MARTÍN PEÑA	SAN ANTONIO RIVER
district	HIGH LINE	BUFFALO BAYOU	PITTSBURGH	CHEONGGYECHEON CANAL
regional	PHILADELPHIA	GLENDALE NARROWS	GRAND FORKS GREENWAY	ROUGE RIVER WATERSHED

SECONDARY MATRIX	financial	economic	social	environmental
pilot		CANAL WALK (Va.)	CITYGARDEN	
system	TRUCKEE WHITEWATER PARK			CAÑO MARTÍN PEÑA
district	BUFFALO BAYOU	CHEONGGYECHEON CANAL	HIGH LINE	
regional		ROUGE RIVER WATERSHED	SAN ANTONIO RIVER	GRAND FORKS GREENWAY

PHILADELPHIA

Incentive and Fee Based Stormwater Management

In response to Clean Water Act mandates, the City of Philadelphia implemented the *Green City, Clean Waters* plan. When fully realized, the plan will convert 10,000 acres of impervious surfaces to pervious or open surfaces over the next quarter-century. This goal will be achieved through parcel-based drainage fees. Such fees incentivize private property owners to install stormwater retention features on their respective properties, whether through personal investments or third-party loan programs. Owners who forgo retrofits to their properties are required to pay drainage fees which contribute to the construction of public works necessary to compliance with the Clean Water Act.

The plan entails a total public investment of $1.67 billion in green infrastructure projects in addition to $345 million in public funds being allocated to traditional infrastructure projects throughout the city of Philadelphia. A remaining pool of $420 million in public funding will be available for discretionary infrastructure projects, whether green or traditional. These discretionary funds will be allocated based on cost-benefit analysis between the two types of infrastructure, including their ability to reduce system overload. City officials have projected that these drainage infrastructure projects will realize a positive return on investment within 45 years.

The *Green City, Clean Waters* plan is also notable for its integration with city zoning codes. This coordination ensures successive developments will conform to higher standards and expectations regarding stormwater management.

The *Green City, Clean Waters* plan wisely leverages public and private financing, both predicated on codified structures, towards successful implementation of a regional stormwater program.

http://www.nrdc.org/water/pollution/rooftopsII/files/rooftopstoriversII.pdf

http://www.nrdc.org/water/files/StormwaterFinancing-report.pdf

ROUGE RIVER WATERSHED

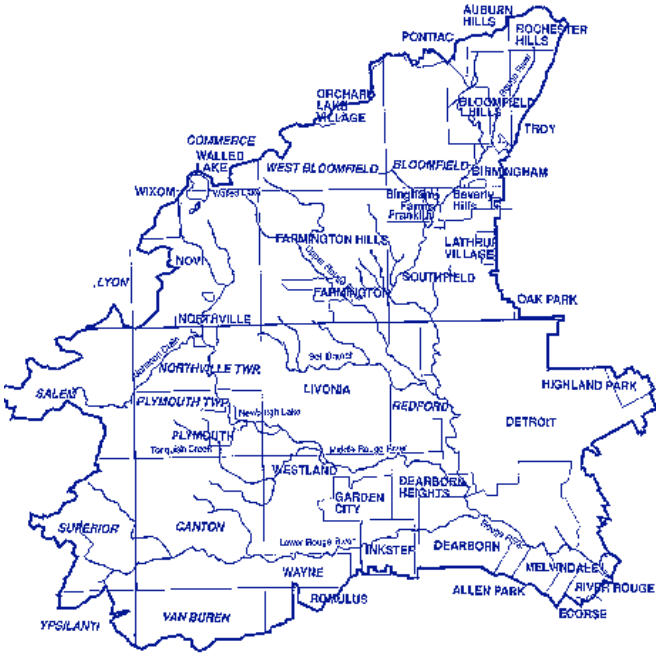


Photo Courtesy: Rouge River Project

Regional Approaches to Water Management

Michigan has taken a watershed-based approach to green infrastructure that addresses stormwater runoff, sewage overflow and other concerns such as urban blight. As part of this strategy, included in its combined National Pollution Discharge Elimination System permit, the Rouge River Watershed initiative follows natural hydrologic boundaries rather than political jurisdictions, providing an integrated model that respects the totality of its watershed and ecosystem.

Neighborhood Stabilization Program funds have been contributed to an integrated program which oversees the demolition of blighted properties, after which the parcels are disconnected from the sewage and drainage systems and transformed into pervious surfaces able to detain stormwater. As part of this $50 million plan, the next twenty years will see the Detroit Water and Sewerage Authority (the authority for the entire watershed area) continue to work to disconnect residential downspouts and install bioswales, rain barrels and water integrated landscapes. This initiative alone is expected to reduce urban stormwater inputs by approximately 15% throughout the watershed.

Since the initiative has began, combined sewerage overflows have been cut by more than 90% and erosion of river banks has been addressed and mitigated. Water quality indicators have improved, and dissolved oxygen levels now meet acceptable standards for 99% of samples taken. Local officials are moving towards removing the Rouge River from the 303(d) list of impaired waterways.

http://www.nrdc.org/water/pollution/rooftopsII/files/rooftopstoriversII.pdf

PITTSBURGH

Photo Courtesy: East Liberty Community Plan

Neighborhood and Grassroots Initiatives at a District Level

The Pittsburgh Water and Sewer Authority has partnered with the City of Pittsburgh to coordinate stormwater best-management practices with blight remediation. In 2007, Mayor Ravenstahl began a pilot program named *Green Up Pittsburgh* with $50,000 in Community Development Block Grants. The program provides a framework by which the city remediates blighted properties and lots with the assistance of residents and volunteers. The city takes responsibility for materials cost and liability, while volunteers provide installation and maintenance of small-scale stormwater infrastructure.

A subsequent $500,000 grant from the Pennsylvania Department of Community and Economic Development has given the program capacity to complete projects on 120 parcels. The program successfully works to remediate blighted parcels and alleviate the burden placed on aging stormwater infrastructure.

In 2010, *Green Up Pittsburgh* worked with the East Liberty Development Corporation to complete the nation's first "green overlay plan for a distressed urban district". Named the *East Liberty Green Vision*, the plan assesses current conditions within the East Liberty neighborhood and recommends a series of actionable solutions and strategies aimed at benefiting both environmental sustainability and quality-of-life concerns. The goal of this collaboration was to build upon the impact of the pilot program and meet the needs of the particular neighborhood.

More importantly, concerns are addressed on a grassroots level. Residents are engaged to identify, align themselves with, and take action regarding, impediments to growth and development in their respective communities. This creates a regenerative model of improvement that forms a foundation for additional initiatives or programs.

Furthermmore, the model provides a framework for citizen involvement in the ongoing operations and maintenance of stormwater infrastructure that reduces long term financial liabilities through in-kind contributions of monitoring and labor.

http://www.nrdc.org/water/pollution/rooftopsII/files/rooftopstoriversII.pdf

http://www.eastliberty.org/community-planning

CITYGARDEN

Photo Courtesy: Aaron Renn, Urbanophile

Stormwater Management and Economic Benefit through Public Spaces

In 1999, the non-profit organization *Downtown Now* commissioned a master plan for downtown Saint Louis calling, in part, for a public sculpture garden on two blocks of the Gateway Mall. The 2.9 acre park was developed under a public-private partnership in conjunction with the City of Saint Louis and the non-profit *Gateway Foundation*. The foundation funded the design, construction and soft costs associated with development, as well as ongoing operations and maintenance costs. The improvements and real estate remain under municipal ownership.

The $30 million project, funded by the *Gateway Foundation* includes six rain gardens used to mitigate stormwater runoff and feature native plantings. The three fountains in Citygarden use rainwater collected from the site, which is filtered through a hi-tech system so that chlorine treatments are unnecessary.

The physical design celebrates the geology and unique physical characteristics of Saint Louis, including contours that express the relationship between the city and the Mississippi River. The park features 24 sculpture installations in addition to outdoor living areas featuring restaurant space and a large scale projection screen, creating a popular urban plaza.

Citygarden has been cited as a catalyst for both increased development in the downtown area and expansion of programmed park space along the Gateway Mall, which runs for approximately eight blocks in either direction.

The project, in addition to leveraging public-private partnership structures, leverages partnerships from local institutions including Washington University in Saint Louis, the Saint Louis Art Museum and the Contemporary Art Museum Saint Louis.

While Citygarden itself maintains a small physical footprint, the collaborative effort behind the creation of the park demonstrates that these pilot projects can offer significant economic impact. Citygarden is best known for injecting vibrancy into downtown Saint Louis, drawing visitors to the area and supporting the growth of the downtown economy.

http://www.citygardenstl.org/

http://www.asla.org/2011awards/522.html

GOWANUS SPONGE PARKS

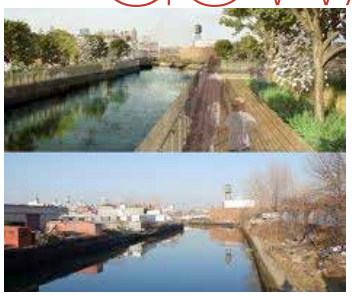


Photo Courtesy: dlandstudio

Financial Benefits of Stormwater Management in System-scale Public Spaces

In January 2012, the New York City Design Commission approved a plan for *sponge parks* that include a series of bioswales, stormwater remediation and retention areas along the Gowanus Canal in Brooklyn.

The navigational canal was dredged from the former Gowanus Creek during the Civil War and attracted heavy industry, becoming a superfund site. While remediation of the canal is a separate project, the planned sponge parks will prevent additional non-point source contamination of the Gowanus Canal, and will negate the need for additional grey infrastructure and associated costs. As part of a larger initiative, similar infrastructure may help realize up to $2.4 billion over the next twenty years in avoided infrastructure needs related to the mitigation of 27 billion gallons of untreated sewage that overflows from the combined system into New York Harbor.

Initial plans for the Gowanus Canal Sponge Parks have leveraged approximately $1,000,000 in financing, including the City of New York. Plans ultimately call for up to 1.8 miles of green infrastructure along the entirety of the canal, resulting in sixteen acres of reclaimed former public streets that currently dead-end into the canal which will be transformed into seven acres of esplanade, 4.5 acres of open space and 3.5 acres of retention area costing an estimated total of $108.7 million. This investment will manage stormwater runoff from an adjacent 326-acre urban area, and have impact upon the adjacent Park Slope, Carroll Gardens and Boerum Hill neighborhoods.

http://www.huffingtonpost.com/2012/02/07/gowanus-canal-sponge-park_n_1260125.html

http://www.asla.org/2010awards/064.html

PONTIFF PARK

Photo Courtesy: GNO Water Management Strategy

Environmental Management in Public Spaces

Wally Pontiff, Jr. Park, located in the Old Metairie section of Jefferson Parish, Louisiana is a high-performance landscape that maintains the appearance of a traditional suburban park. In addition to providing significant stormwater retention, it offers recreational opportunities for local residents including ball fields and a gymnasium.

Pontiff Park flooded after Hurricane Katrina and subsequent levee failures, damaging facilities and necessitating near total reconstruction.

The most striking strategy of the reconstruction of Pontiff Park is a four foot tall earthen berm which was constructed around the perimeter of the park, creating a 40-acre stormwater retention area that is designed to retain water for up to a day before being siphoned into the 17th Street or Suburban canals. The bermed area accommodates approximately 6.9 million cubic feet (52 million gallons) of stormwater. This is sufficient to drain six inches of standing water from a surrounding area totaling 180-acres, with the goal of mitigating a ten year rain event (9.4 inches in a 24 hour period) During heavy rainfall, the park can be intentionally flooded to help alleviate the burden on surrounding drainage systems.

The berm, additional drainage modifications and required pumps were financed by the Jefferson Parish Department of Drainage for approximately $6 million.

Enhancing the pre-Katrina park infrastructure with a cost-effective and high-capacity integrated landscape water management system has reduced risk of flooding in Old Metairie, dual-purposed public land and has created a popular destination that improves the quality of life for Jefferson Parish residents.

http://blog.nola.com/times-picayune/2007/07/a_new_vision_for_pontiff_play g.html#Scene_1

http://www.nola.com/katrina/pdf/041606_metairiefloodplan.pdf

CHEONGGYECHEON CANAL

Stormwater Management and Environmental Impact of District-scale Canals

The Cheonggyecheon River was a natural waterway flowing 3.6 miles through the Central Business District of Seoul, Korea. In 1958, owing to pressures for growth, industrialization and transportation, the river was channeled into a concrete culvert. By the late 1970s, an elevated expressway was built within the right-of-way.

In 2003, a mayoral initiative sought to demolish the expressway and reintroduce a canal. Once the canal bed was constructed, a pump channeled 120,000 tons of water into the $900 million canal.

After completion in 2005, the Cheonggyecheon Canal project was lauded for its provision of public space and integration of ecological components. Species diversity has increased. There are now six times as many species of fish and birds than before the restoration. Air pollution has decreased along with adjacent automobile traffic, all while the number of pedestrian visitors has increased to 90,000 per day. The ambient temperature immediately surrounding the canal now averages 6° lower than other areas of downtown Seoul. Furthermore, the canal project has been successful in reestablishing connectivity between the northern and southern portions of the Central Business District. Previous iterations of the space acted as a psychological barrier, the new canal includes provisions for pedestrian connectivity both along and across the blue-green corridor.

http://www.gsd.harvard.edu/#/projects/deconstruction-construction-cheonggyecheon-river-project.html

http://www.nytimes.com/2009/07/17/world/asia/17daylight.html?_r=2&pagewanted=1&hp

CANAL WALK

Photo Courtesy: Landscape Architecture Foundation

Cultural Implications of Integrated Water Management

Richmond is situated on the James River, at the fall line dividing the Virginia Tidewater with the Virginia Piedmont. Early in the city's history, a canal structure was engineered to bypass the waterfall that exists on this fall line. The canal allowed Richmond to command western trade by allowing boats to travel further inland.

In response to Clean Water Act violations, the canal system was improved and expanded to accommodate a canal walk in 1999 in conjunction with Richmond's Department of Public Utilities. A large-diameter pipeline was installed, rerouting stormwater to a fifty million gallon retention basin during overflow events. Where Richmond previously experienced 32 untreated effluent discharge events per year prior to 1999, it now averages one.

The benefits of building this system are clear from an environmental perspective, but the Canal Walk maintains other implications for the area. Notably, it has leveraged private-sector development. The assessed value of real estate in the riverfront area has tripled since the introduction of Canal Walk, and now totals $722 million. Canal Walk also serves as a historic corridor, drawing visitors and strengthening the city's ties to its past. Attractions include a river cruise, the Civil War Center and exhibits depicting African-American history.

These benefits are the result of a $26 million investment in the Canal Walk itself and $20 million for combined sewerage overflow projects. Private land valued at $6 million was donated. Additionally, the Federal Highway Administration awarded a $1.7 million grant to the project for reconstruction of the canal walls and floor.

Without investment in integrated stormwater management solutions, the Canal Walk and resulting benefits would not have been possible. The environmental state of the canal left it in no condition for the sort of additional investment necessary for the area to become an open promenade or appreciate in assessed real estate value.

http://www.lafoundation.org/research/landscape-performance-series/case-studies/case-study/390/

http://www.greeley-hansen.com/project9.htm

BUFFALO BAYOU

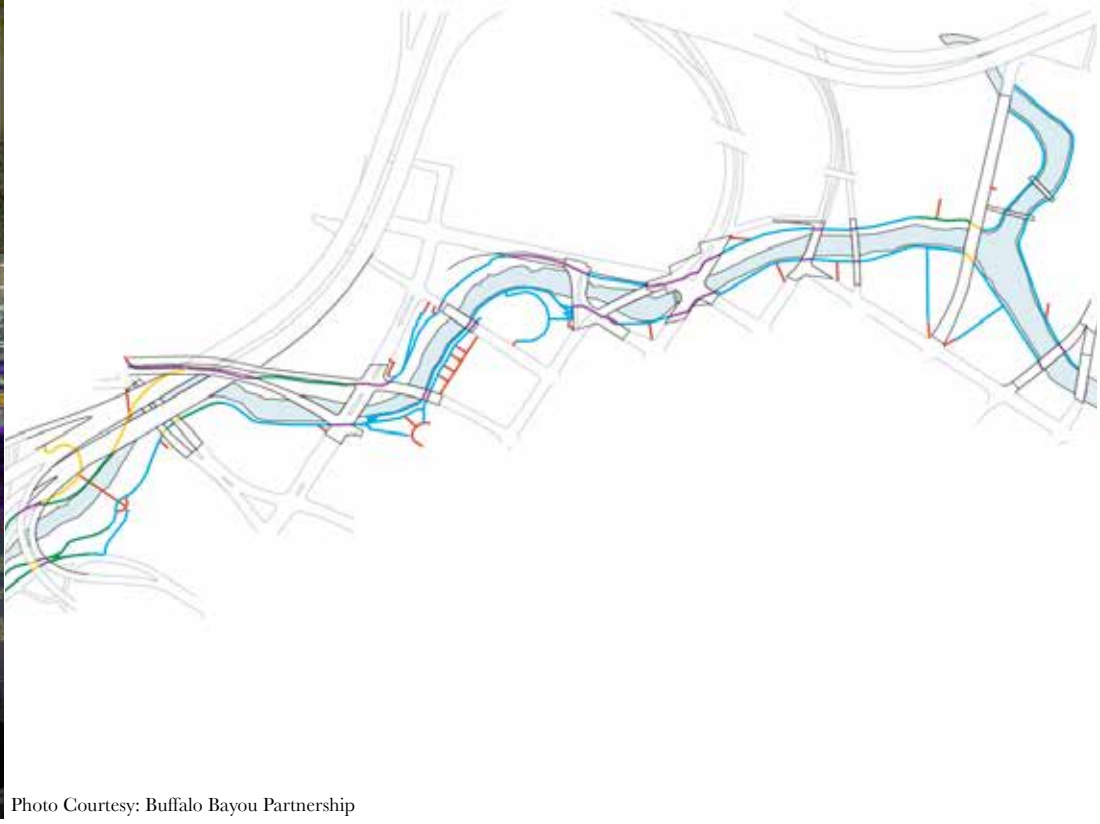


Photo Courtesy: Buffalo Bayou Partnership

District-scale Economic Transformations

In 1976, the City of Houston was sued by the State of Texas due to the introduction of sewerage in, and the resulting pollution of, Buffalo Bayou. This suit resulted in $3 billion in sewerage system upgrades.

In 1986, in response to a mayoral initiative, the Buffalo Bayou Master Plan was published. It called for an solution which integrated recreation, environmental quality, urban development and economic benefit.

That same year the non-profit Buffalo Bayou Partnership was established to oversee, and raise funds for, the implementation of the plan as well as the updated Buffalo Bayou and Beyond Master Plan was released in 2002. The latter plan is expected to cost $5.6 billion over the next twenty years, with at least $800 million in publicly-funded hard costs.

The significant scale of the Buffalo Bayou initiatives necessitates a phasing of component projects. Notable among these projects is the Buffalo Bayou Promenade, a 1.4 mile long development connecting the Central Business and Arts Districts which opened as a public space in 2006 and includes trails, kayaking, sculpture and special event space that are designed to accommodate flood waters when the riverbanks overflow. Other plans call for a new canal along the right-of-way occupied by Allen Street, an ecological park at Turkey Bend and an improved sewerage treatment plant near the shipping channel. Buffalo Bayou connects two regionally important areas while showcasing waterways and rights-of-way in a fashion which reconnects neighborhoods and people at the intersection of urbanity and the natural environment.

http://www.buffalobayou.org/

SAN ANTONIO RIVER

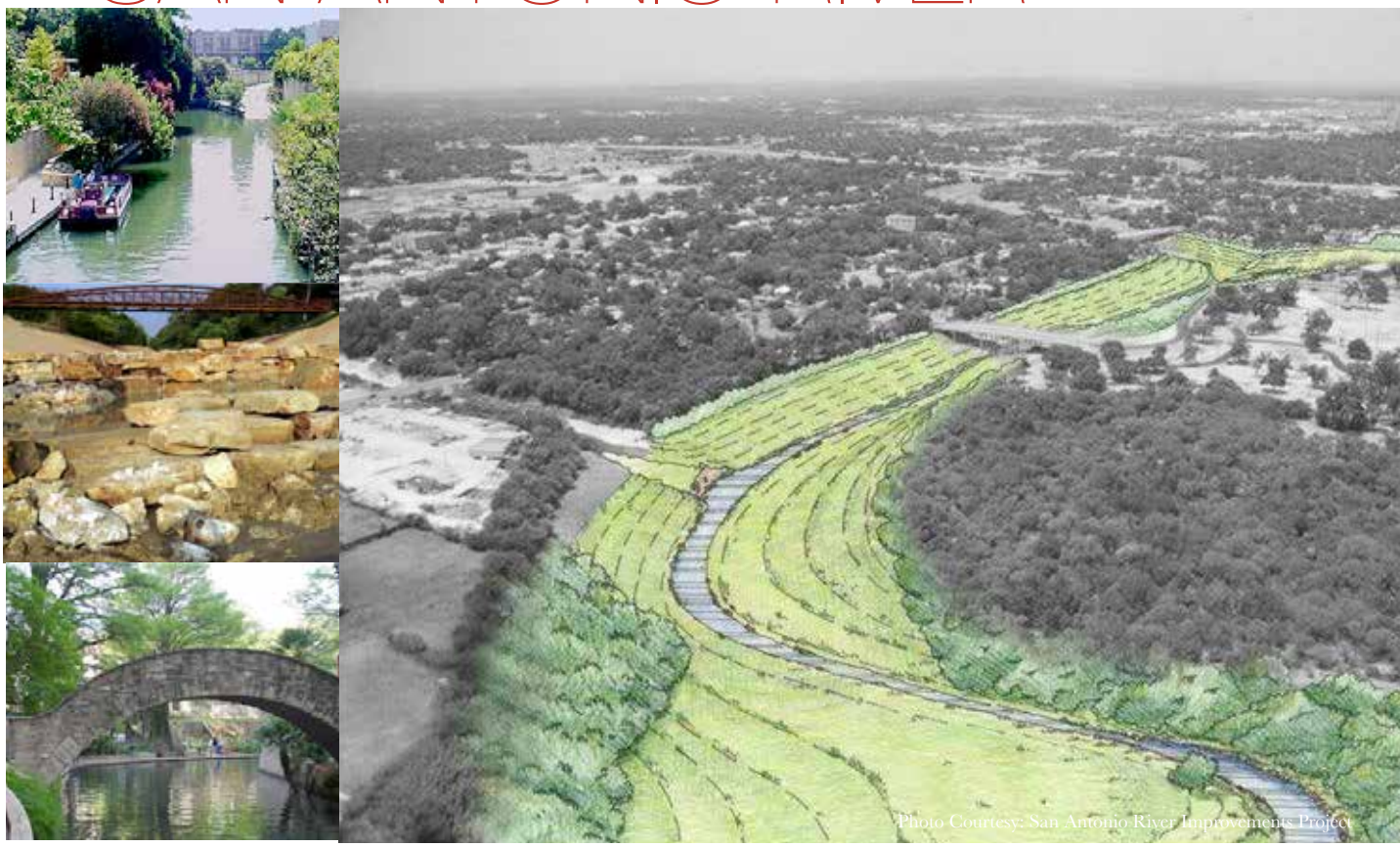


Photo Courtesy: San Antonio River Improvements Project

Ecological Management and Natural Waterways

San Antonio is renowned for its 'Riverwalk', a 2.5 mile promenade along the San Antonio River in downtown. Began in 1939 to control the recurring flooding of adjacent blocks, it has become a focal point of the city for locals and visitors alike.

Owing to the success of the Riverwalk, local authorities have begun a restorative transformation of the entirety of the river as it flows through the city. Investments have been made by Bexar County, the City of San Antonio, the U.S. Army Corps of Engineers and the non-profit San Antonio River Foundation.

Most recently, work has begun in phases on the Mission Reach segment. The segment of river will be engineered to mimic its natural riparian flow while mitigating flood risk and promoting recreational opportunities. Furthermore, the project will provide a natural corridor connecting three historic Spanish missions which were recently nominated as a World Historic Site. The total project cost for all three phases of the Mission Reach is $245.7 million. Approximately $113 million is contributed through the *Bexar County Flood Tax and Venue Tax*, with additional funding committed by Bexar County. The City has pledged $6.5 million, and the San Antonio River Foundation $4.7 million. $6 million has been contributed to the project by the San Antonio Water System. $51.9 million of federal funding will come through the U.S. Army Corps of Engineers. This investment is expected to incentivize tourism in the area and position surrounding land to attract new development

Just as the Riverwalk remedied flooding in downtown, the ecologically astute projects comprising the San Antonio River Improvements will remedy a liability in a way that adds significant value to the city and region.

http://www.sanantonioriver.org/

CANAL PARK

Photo Courtesy: Topos

Public-Private Partnerships and Integrated Water Management for Pilot Projects

The site of Canal Park maintains an established history with water and the District of Columbia. Beginning in 1815, the right-of-way constituting what is now Canal Park in Southeast Washington, D.C. was part of the Washington City Canal. After its economic importance waned before the Civil War, it served as a impromptu sewerage and stormwater drainage system before being filled in the late 19th century.

This portion of the former canal is three linear blocks adjacent to the Washington Navy Yard and near the Nationals Park baseball stadium. The area has hosted numerous new residential and commercial developments in the last decade. After the demolition of 700 public housing units, the D.C. Housing Authority allocated $3.9 million from a new-markets tax credit deal to provide 1,800 units of mixed income housing.

To complement this up-and-coming area of development, a public-private partnership was created to plan and construct a new urban park. In the year 2000, local real estate developers matched a $2.5 million federal grant. With the addition of $13.5 million from the District of Columbia, the park was constructed.

The park features a LEED certified pavilion. The landscape reflects a similar level of environmentally sensitive design. Stormwater initiatives undertaken include an 80,000 gallon underground cistern and a large rain garden that will allow the park to retain its stormwater for reuse as irrigation. These initiatives will both save over a million gallons of potable water annually and accommodate runoff from surrounding blocks and developments.

The public-private strategies that lead to the creation of Canal Park yields public investment in a physical asset in a manner which reinforces the momentum of development in an neighborhood witness to large-scale private investment.

http://www.canalparkdc.org/about/sustainability

http://articles.washingtonpost.com/2012-11-16/local/35503508_1_canal-park-ice-rink-pilot-project

TRUCKEE WHITEWATER PARK

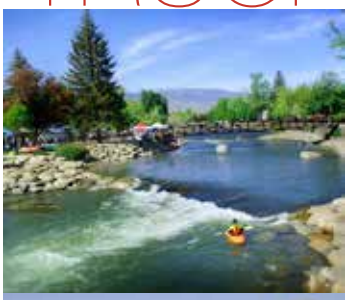


Photo Courtesy: Reno-Sparks Convention and Visitors Authority

Economic Impacts of Pilot Projects

In 2002, Nevada voters passed a $200 million bond referendum for improvement projects statewide. Disbursement of this funding proved slow, and two local casinos lent $1.5 million to the introduction of a whitewater rafting run on the Truckee River in downtown Reno. This loan was repaid through funds from a separate bond referendum approved by voters in Washoe County in 2000. The Truckee River Whitewater Park, completed in 2003, has become a year-round attraction featuring eleven drop pools over the half-mile long course.

With a minimal investment, the whitewater park has become a focal point on the Reno's waterfront. It is a bourgeoning tourist attraction, gaining popularity with each successive year. The Reno River Festival now draws 40,000 attendees.

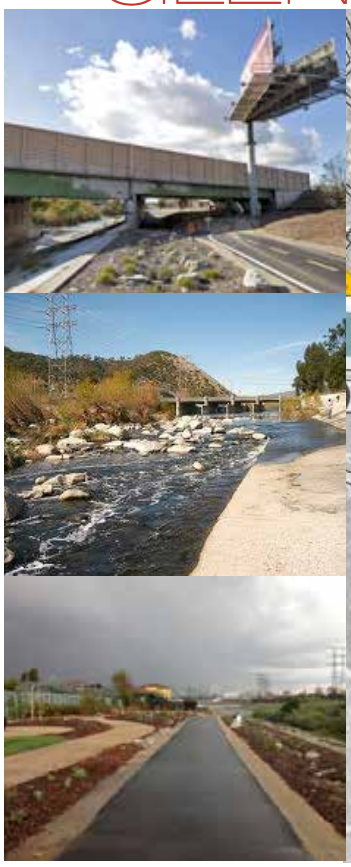
At least $18 million in direct economic impact is credited to the development of the Truckee River Whitewater Park. Additionally, the project has been catalytic to investment and development in the downtown area. Over the past decade, downtown Reno has welcomed new residential and commercial development, new cultural venues and infrastructure improvements even as local casinos (the economic mainstay of the region) have waned.

The whitewater park is an example of a pilot project which, for minimal investment, produces a powerful economic and cultural impact.

http://regions.worldkayak.com/chicago/2012/05/14/cool-news-article-on-whitewater-parks-in-michigan/

http://www.reno.gov/index.aspx?page=311

GLENDALE NARROWS



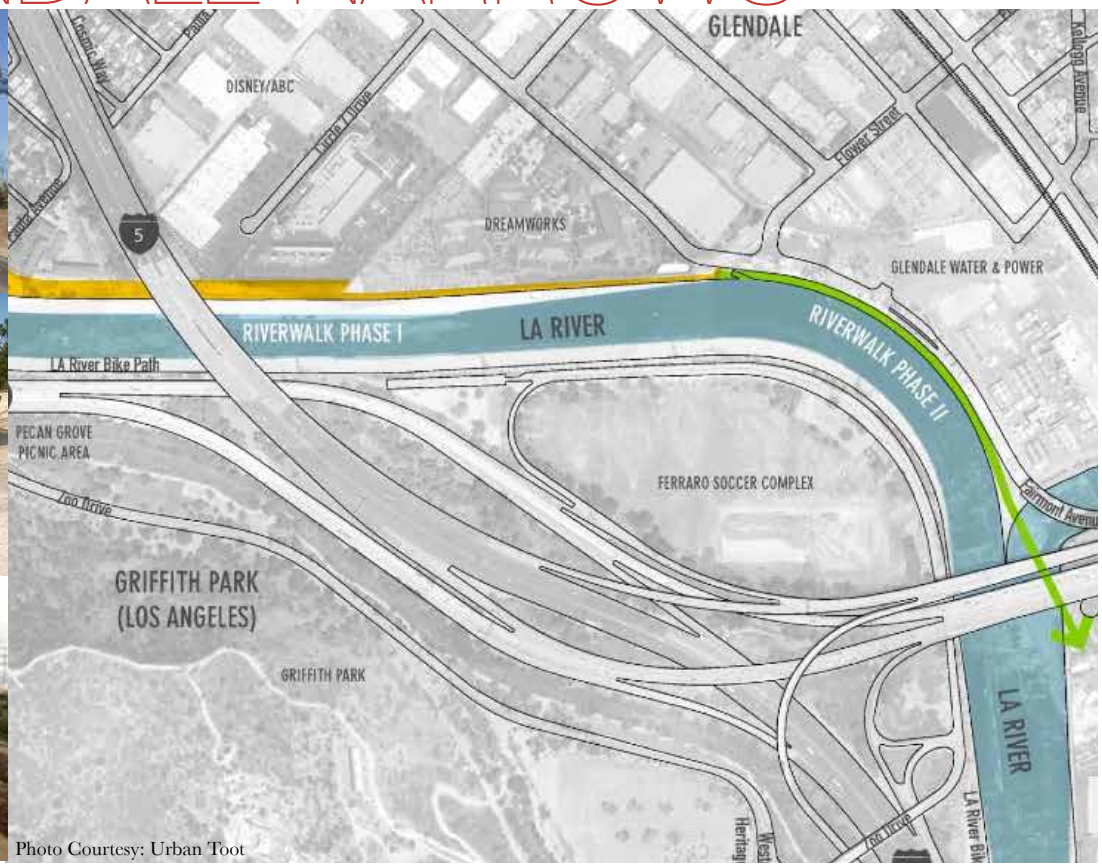


Photo Courtesy: Urban Toot

Economic Impact of Integrated Water Management at Regional Scales

The city of Glendale, California fronts the only natural segment of the Los Angeles River. The riverfront area, known as the Glendale Narrows, lays across from Los Angeles' Griffith Park. While the Glendale Narrows and Griffith Park maintain a prime geographic location within the Los Angeles area, the two have long been disconnected from one another.

Cognizant of the potential to connect these two areas, Glendale leaders embarked on a project to reconfigure its waterfront. Phase one of the Glendale Narrows Riverwalk cost $2.1 million and opened in 2012. It offers one half-mile of trails, public art and equestrian facilities. The landscape features drought-tolerant, native California plants and has become a habitat for herons and cormorants. Phase two is partially funded through a $450,000 contribution from 'Measure R', a 2008 referendum which approved $40 billion in transportation improvements in Los Angeles County and $975,000 from funds established through Proposition 84, a 2006 statewide measure which raised $5.4 billion through general obligation bonds for flood control and water supply improvements.

Phase three will entail at least one bridge spanning the Los Angeles River, creating a long-awaited connectivity to Griffith Park, as well as regional attractions including the Los Angeles Zoo and the Autry National Center museum. The introduction of access to these attractions is expected to enhance Glendale's appeal as an attractive place to live and conduct business by creating a basis for economic development and capitalizing on existing assets.

http://articles.latimes.com/2012/dec/15/local/la-me-1216-riverwalk-20121216

http://www.kcet.org/socal/departures/lariver/confluence/river-notes/phase-one-of-glendale-narrows-riverwalk-opens.html

http://la.curbed.com/tags/glendale-narrows-riverwalk

CAÑO MARTÍN PEÑA

Societal Impacts of Integrated Water Management on a System-scale

The Martín Peña Canal flows for 3.5 miles through San Juan, Puerto Rico and connects two lagoons. During the first half of the twentieth century, the former mangrove swamps quickly developed into illegal settlements. The unplanned urbanization of the area resulted in widespread environmental degradation, as 27,000 residents attempted to create a habitable area by filling the swamps with refuse and fill. No sewerage system existed in the area, compounding environmental and public health concerns throughout the San Juan Bay Estuary.

In 2001, remediation of the canal began the Environmental Protection Agency provided a organization serving area residents, ENLACE, with a grant to begin remediation initiatives. The group collaborated with public and private entities while strengthening existing relationships with residents.

Through a combination of environmental improvements and economic development initiatives, ENLACE has improved conditions in the neighborhoods surrounding the canal through reliance on transparency, public participation and collaboration.

Cognizant of the needs and wishes of existing residents, the Caño Martín Peña Community Land Trust was established. This historic legislation created an entity charged with responding to affordable housing needs, managing land ownership, and ensuring that area residents benefit financially and in quality-of-life from improvements.

This strategy has garnered widespread recognition, including the National Achievements in Environmental Justice award from the Environmental Protection Agency;

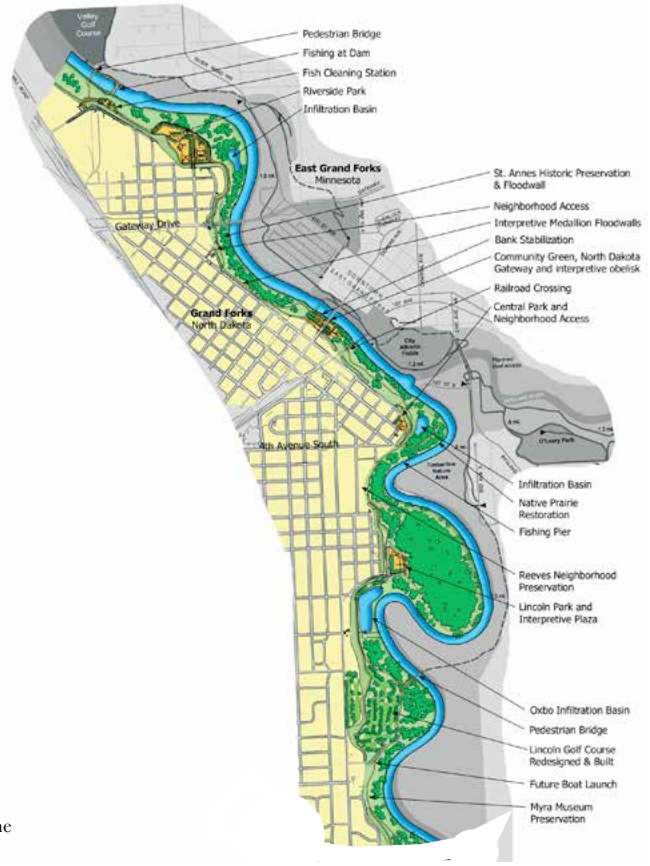
http://www.epa.gov/environmentaljustice/resources/publications/awards/2010/enlace.pdf

http://yosemite.epa.gov/opa/admpress.nsf/0/21D0329F0FEA30288525786B0062EB75

http://www.dialogodigital.com/index.php/Restauracion-de-730-cuerdas-de-la-laguna-San-Jose.html

GRAND FORKS GREENWAY

Photo Courtesy: Landscape Online



Societal Impacts of Integrated Water Management on a Regional Scale

Grand Forks, North Dakota is prone to catastrophic flooding due to its location on the plains surrounding the Red River. In 1997, the city was devastated by a historic crest on the river, which subsequently breached flood barriers. In response, the levees and floodwalls surrounding the college town were relocated and fortified. In response to proposals by the U.S. Army Corps of Engineers and the North Dakota congressional delegation, the expanded batture was transformed into a greenway whose purpose is to mitigate flooding risk in especially vulnerable areas and provide open space for habitat restoration and recreational use.

The plan created 2,200-acres of park land along both banks of the Red River. After planning by the North Carolina firm *Greenways Incorporated,* the urban corridor between Grand Forks and East Grand Forks, Minnesota was activated as a series of public parks operated by the Grand Forks Park District and the Minnesota Department of Natural Resources, respectively.

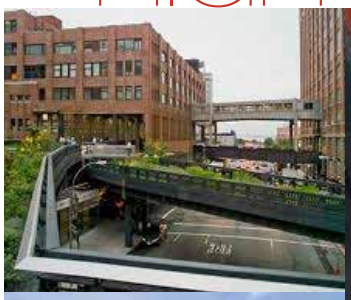
Designated a National Recreation Trail in 2007, the greenway offers walking trails, athletic fields, gardens, two golf courses, campgrounds and habitat that supports .

Originally financed through a traditional model of federal, state and local funds, the ongoing maintenance of the greenway is funded city-wide through a line item on utility bills.

In response to a catastrophe in 1997, the Grand Forks Greenway now provides the dual benefit of flood mitigation and ecologically sensitive initiatives which elevates the health, safety and sustainability of a community.

http://www.grandforksgov.com/greenway/Pages/History.html

HIGH LINE



Economic Benefit of Investments Made at District Scales

Before the Civil War, the West Side of Manhattan was host to on-grade railroad tracks servicing the Meatpacking District. By 1929, the City of New York implemented the West Side Improvement Project, one of the largest public works project the city had implemented in its history. As part of these improvements, an elevated right-of-way was constructed to accommodate railroad traffic. Due to a subsequent decline in industrial activity, this elevated railroad fell into disuse before closing in 1980.

In 2002, planning commenced to create an elevated, linear park on the former railroad. The first segment, between Gansevoort and Twentieth streets, opened in 2009. The second segment, extending to Thirtieth Street, opened in 2011.

Combined, the first and second segments cost $152 million. $112 million was funded by the City of New York and an additional $20 million came through federal funding. The non-profit Friends of the High Line have raised a total of $44 million from private sources.

In anticipation of this major urban intervention, the City of New York rezoned the adjacent neighborhoods to allow for higher density development, resulting in a 60% increase in population between 2000 and 2010.

Mayor Bloomberg has credited the High Line with attracting at least $2 billion of private investment in response to the two phases of development. This figure includes over 2,500 residential units, one thousand hotel rooms and nearly 500,000 square feet of office space. 8,000 construction jobs were created in addition to 12,000 permanent jobs.

The operations and maintenance costs associated with the High Line are paid through a conservancy model. The Friends of the High Line take responsibility for daily operations including gardening, cleaning and graffiti removal, and the City of New York covers security and structural maintenance. Annual maintenance costs are estimated between $3.5 and $4.5 million by the Firends of the HIgh Line. A High Line Improvement District, similar to a Business Improvement District, is also under consideration to cover future maintenance costs

http://www.nytimes.com/2011/06/06/nyregion/with-next-phase-ready-area-around-high-line-is-flourishing.html?_r=0

http://www.thehighline.org/about/high-line-history

http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pageID=mayor_press_release&catID=1194&doc_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2011a%2Fpr194-11.html&cc=unused1978&rc=1194&ndi=1

Measuring Groundwater Levels

Measuring groundwater levels is a simple and cost-effective process. A monitoring network for the region would ensure that water management strategies could be targeted precisely when and where needed.

Glossary

TALKING ABOUT WATER

Discussions about water and the landscape require a new vocabulary. Some terms, like runoff, describe well-known problems. Others, like subsidence, are terms that all citizens should learn in order to better understand issues facing the region and advocate for effective solutions.

The following glossary includes technical terms for water-related problems and water-based solutions, including the names of important natural and man-made features that affect the flow of water.

Glossary

TALKING ABOUT WATER

10-year storm
an event that has a 10% chance of occurring or being exceeded any given year. In New Orleans, a 10-year storm has an average total rainfall of 8.5 inches, with a peak hour total of 3.43 inches. Also known as a **T10 storm**, where the "T10" refers to the return period.

100-year storm
an event that has a 1% chance of occurring or being exceeded any given year. The US Army Corps of Engineers levees and floodwalls are meant to protect against this level of storm. Hurricane Katrina was a 75-year storm, meaning it was less intense than a 100-year storm. Also known as a **T100 storm**, where the "T100" refers to the return period.

acre foot
the volume of water needed to cover one acre to a depth of one foot, equal to 325,851 gallons or 43,560 cubic feet of water.

adaptation
adjustments to a changing climatic characteristics such as rising sea levels. These may include structural changes such as the lifting of levees or the raising of homes, as well as changes in policy and management practices that reduce vulnerability and risk to communities. See also **climate change**.

aquifer
an underground layer of permeable rock or soil layer that holds water that can be extracted for human use. The Gonzales-New Orleans Aquifer is a 100-300 feet thick sand layer underlying southeastern Louisiana that serves as the primary source of fresh groundwater for Jefferson Parish and Orleans Parish.

bald cypress (taxodium distichum)
the dominant tree species in Louisiana's native swamps as well as Louisiana's official state tree. Cypress swamps play an important as natural buffers to storm surges. Logging, development, subsidence, and saltwater intrusion have damaged cypress swamps throughout Greater New Orleans.

base flood
a flood with a 1% chance of being equaled or exceeded in any given year. This regulatory standard is used by the National Flood Insurance Program (NFIP) and other federal agencies for determining flood insurance rates and regulating new development.

base flood elevation (BFE)
an elevation set by the Federal Emergency Management Agency (FEMA) that measures the elevation to which floodwater is anticipated to rise during a base flood. To receive FEMA funds in the case of storm damage, FEMA requires the lowest floor of the building to be at or above BFE.

bayou
a slow-moving creek or swampy body of water, which may be brackish (mixed fresh- and saltwater) and home to a rich diversity of wildlife. Bayous are often associated with the southeastern part of the United States and can be found throughout coastal Louisiana and Greater New Orleans.

berm
a raised barrier dividing space, which may be used to prevent flooding or erosion. Berms can be incorporated into landscape designs to create detention and retention basins.

best management practice (BMP)
a method or technique that consistently yields outcomes superior to those achieved by other means and generally agreed upon by a community of experts to be the most effective means of delivering a particular outcome.

bioswale
A linear depression in the landscape constructed to slow and filter stormwater with vegetation and soil media. Bioswales can remove silts, pollutants, and pathogens, and reduce the quantity of runoff from a site.

blight
the impact of a slowed or depressed economy on the built environment, where the abandonment of properties, lack of maintenance, and other destructive forces lead to dilapidated buildings and overgrown lots, along with other health and safety challenges.

blueway
a waterway, typically with landscaped banks, and used as a recreational and aesthetic amenity that can benefit the communities and stakeholders that use and access it.

bottomland hardwood forest
a wetland ecosystem found throughout the Gulf Coast states, typically in floodplains alongside rivers and streams that periodically flood. Gum, oak, and bald cypresses are common tree species, along with other plants that can survive periodic flooding or standing water for much of the year.

brackish water
a mix of freshwater and seawater found in places like estuaries and deltas. Sources of brackish water in Greater New Orleans include Lake Pontchartrain and Bayou St. John.

canal
a manmade channel for water, often built as connections to larger bodies of water. Throughout Greater New Orleans, canals both convey and store stormwater.

catch basin
also known as a **storm drain** or **curb inlet**, is a receptacle that captures solids and large sediment, typically at the point where water passes from a gutter into a piped drainage system.

catchment area
an area where all runoff is conveyed to the same outlet, with boundaries typically defined by ridges or other topography. In Greater New Orleans, catchment area refers to an area drained by a pump station. See also **watershed**.

circulating canals
a system that maintains the flow of water through drainage canals even during dry weather, in order to improve water quality, recharge groundwater, and allow canals to serve as recreational and aesthetic assets.

climate change
changes in temperatures, precipitation patterns, and the frequency of extreme weather events commonly linked to human activity. In New Orleans, climate change has resulted in some of the highest rates of sea level rise in the world, and is likely to increase the intensity of storms as well as instances of drought.

culvert
a closed drain, pipe or channel used to carry water, for example, from beneath a roadway from one side to another. In New Orleans, concrete box culverts store and convey massive quantities of stormwater to drainage pump stations.

detention
the holding of stormwater temporarily in a swale, **detention basin**, or other features. Detention reduces peak discharge by allowing the slower and more controlled release of runoff, and does not allow for the permanent pooling of water.

1895 Drainage Master Plan (New Orleans)
In response drainage crises that escalated in the 1880s, the newly created Drainage Advisory Board of 1895 recommended a modern drainage system featuring improved collection, conveyance, and discharge, using street gutters, storm drains, underground pipes, canals, and large new pump stations. This plan led to the creation of the New Orleans Sewerage and Water Board, the invention of the Wood screw pump, and enabled the draining and settling of wetland areas.

evapotranspiration
the transfer of water from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants. Solar radiation, atmospheric vapor pressure, temperature, wind, and soil moisture are some of the factors that affect the rate of evapotranspiration.

delta
the flat low-lying plain that sometimes forms at the mouth of a river emptying water and sediment into another body of water, such as an ocean or lake. Greater New Orleans is situated on the Mississippi River Delta.

drainage canal
an artificial channel built to drain an area with no natural outlet for runoff. In Greater New Orleans, aboveground and underground drainage canals move runoff to and from drainage pump stations.

drought
below-average precipitation over an extended period of time that results in a water shortage, most commonly measured by a season or longer.

Dutch Dialogues
a series of workshops between 2006 and 2009 that focused on sustainable water management and regional planning in Greater New Orleans. The workshops were initiated by Waggonner & Ball Architects with the American Planning Association and the Royal Netherlands Embassy in Washington D.C., and brought together US and Dutch experts trained in engineering, urban design, architecture, landscape architecture, city planning, and geohydrology. The workshop results were the basis for the Greater New Orleans Urban Water Plan.

elevation
the altitude of a place above or below sea level.

estuary
a partially-enclosed body of water where freshwater from rivers and streams flows into the ocean, mixing with seawater and forming brackish water. Estuaries such as Lake Pontchartrain are rich habitats influenced by tides but protected from the direct impact of ocean waves and winds by surrounding land, wetlands, and barriers islands.

flood
the temporary condition of inundation of what is usually dry land. It can be caused by an overflow of inland or tidal waters, or the rapid accumulation of runoff in drainage ditches or inland waterways. **Flash floods** are floods that subside in fewer than six hours.

floodplain
an area of typically flat land that is susceptible to inundation by water from any source. Floodplains are typically fertile agricultural areas as a result of nutrient-rich sediments deposited by floodwaters.

floodwall
A vertical barrier, usually made of concrete, constructed to contain floodwaters from a river, lake, or sea to prevent flooding in urbanized areas. They are used in densely developed areas where building levees is not feasible, or atop levees in order to increase the level of safety provided by the levee.

floodgate
a structure that can be opened or closed in order to adjust the flow of water through a sluice or canal, or to prevent the flow of water as part of a levee and floodwall system. **Sector gates**, **lift gates**, and **barge gates** are forms of floodgates integrated into Greater New Orleans' perimeter levees and floodwalls that allow waterborne navigation through those hurricane defenses when the region is not under threat from a tropical depression or hurricane.

fluvial
of or relating to rivers and streams, and the flooding, erosion, and soil deposition associated with these waterways.

freeboard
the distance between operating and maximum water levels, such as in a drainage canal or a retention basin. The freeboard is used to calculate the capacity of a given water feature.

geohydrology, hydrogeology
the study of groundwater, including its flow and its physical and chemical interactions with soils and surface water.

gray infrastructure
traditional mechanisms for storm water management and wastewater treatment, such as pipes and sewers.

graywater
wastewater generated from domestic activities such as dishwashing, laundry, and bathing. Properly treated, it can be recycled for other uses like irrigation.

green infrastructure
an approach to stormwater management that utilizes natural processes, soils, and vegetation to filter and reduce runoff. In contrast to gray infrastructure, green infrastructure can provide additional benefits such as improved air quality and streetscapes.

green roof
a man-made roof system of soil media and vegetation that helps to absorb and store stormwater that falls on the roof. Green roofs lessen roof runoff, improve water quality, and reduce heat gain through evapotranspiration.

groundwater
water held in underground permeable rock or soil layers. When these layers hold enough water to be usefully extracted for human use, it is called an aquifer.

groundwater monitoring network
a system of wells, gauges, and data collection for tracking groundwater levels and quality. Such a network allows for a more comprehensive understanding existing groundwater issues such as subsidence and saltwater intrusion, and the management of soils and groundwater.

harden
to make structures and utilities resistant to storms and natural hazards.

hazard mitigation
sustained action taken to reduce or eliminate long-term risk to people and their property from hazards and their effects, such as the building of levees, elevating of structures, or the relocation of assets. Improving urban water management is a form of hazard mitigation.

hydraulics
an applied science that studies the properties of water and other fluids, especially in relation to the application of mechanical forces. Hydraulics are fundamental to the operation of forced drainage systems in Greater New Orleans. The term **hydraulic** indicates a system or activity involving fluid under pressure.

hydrograph
a chart that graphically describes the rate of flow—of water, for example—relative to a specific point over a period of time. A hydrograph can help in describing the contours of a rain event, and in the planning and design of waterways and water control structures.

hydrology
the study of the distribution, flow, and quality of water. This includes the water cycle, water resources, and watershed sustainability. The term **hydrologic** refers to the movement of water between land areas, waterways, water bodies, and the atmosphere.

impervious surface

a material or area that cannot be penetrated by water. This includes most rooftops and structures like roads, sidewalks, and parking lots that are paved with concrete, asphalt, or stone. Impervious surfaces prevent rainfall from infiltrating into the ground and recharging groundwater, and accelerate runoff.

infiltration
the passage of water into below-ground soil layers. The velocity at which this occurs is called the infiltration rate, which is dependent on the composition of surface soil layers. Infiltration replenishes groundwater and raises the water table.

infrastructure
foundational systems and installations necessary to maintain and enhance basic social, economic, governmental, economic, and military functions. These include drinking water systems, drainage systems, sewers, hurricane defenses, schools, transportation networks, electrical grids, and telecommunications networks.

inundation
flooding, the overwhelming of an area by floodwaters.

levee
a linear earthen ridge that divides areas hydrologically, and can be used to protect inhabited areas from flooding. Greater New Orleans has both naturally occurring levees and manmade levees. Many natural levees have been reinforced with additional soil, rock, concrete, and/or grass. Levees are also known as **dikes**.

LIDAR
stands for Light Detection and Ranging and is a remote sensing method that uses a pulsed laser to measure variable distances to the Earth. LIDAR systems help scientists and mapping professionals examine both natural and manmade environments with greater accuracy. In Louisiana, LIDAR is one of many tools used to create more accurate shoreline maps and digital elevation models.

Louisiana Coastal Master Plan
a framework created by the state's Coastal Protection and Restoration Authority (CPRA) focused on protecting and restoring the state's deteriorating coastline. Threats to many of Louisiana's coastal assets led to the passing of Louisiana Legislature Act 8 in 2006, which created the CPRA and required it to develop a coastal master plan every five years. The latest edition was adopted by the state legislature in 2012.

marshes
wetlands that are frequently inundated with water and characterized by soft-stemmed vegetation adapted to saturated soil conditions. Nutrients are typically abundant, allowing plant and animal life to thrive in these areas. Marshes help reduce flood damage by slowing and storing flood water. As water moves slowly through a marsh, sediments and other pollutants settle to the marsh floor. Municipalities are now building urban wetlands to harness these natural processes in cleaning stormwater and wastewater.

Mississippi River Gulf Outlet (MRGO)
built by the Army Corps of Engineers in the 1960s, this route provided a shorter shipping passage from the Gulf of Mexico to the Inner Harbor Navigation Canal and also an emergency outlet from the Mississippi River. Its construction allowed saltwater intrusion that damaged to local wetlands, and channeled Hurricane Katrina's storm surge into New Orleans. The channel was closed by a rock barrier in 2009.

Multiple Lines of Defense
a core concept of both the Louisiana Coastal Master Plan and the Best Practices Manual for Development in Coastal Louisiana, developed by the Lake Pontchartrain Basin Foundation. MLOD describes the importance of naturally-occurring and manmade features in protecting inhabited areas from the direct impact of hurricanes in southeast Louisiana. Manmade features include levees, flood gates, pump stations, elevated structures, highways that serve as ridges, and hurricane evacuation routes. Natural features external to perimeter levees include offshore shelves, barrier islands, sounds, marsh land bridges, and natural ridges. The Greater New Orleans Urban Water Plan introduces urban water management to the MLOD concept as a means of addressing risks associated with rainfall in order a achieve a higher factor of safety overall.

network
a group of interrelated elements connected by lines, conduits, or channels, and where the function of one network component is dependent on the function of other components. Networks are common within infrastructural systems, such as road networks, telecommunications networks, sewer networks, or canal networks.

outfall
the pipe, channel or opening through which water is emptied into another body of water, or the location where such discharge occurs.

oxidation
the decomposition and compaction of organic matter that occurs in the presence of oxygen. Oxidation is a

primary cause of subsidence in Greater New Orleans, in areas where highly organic soils with lowered water tables are exposed to oxygen.

peak rainfall
the duration or point in a rain event when rain is falling at its highest intensity.

pervious paving
a material for walkways, roadways, and parking lots that allows stormwater to be absorbed by the ground where it falls, reducing runoff into the drainage system.

pluvial
of or relating to rainfall.

polder
a Dutch term for land that is surrounded by embankments that is dependent on mechanical drainage systems for inhabitation. Polders are created when low-lying areas are enclosed by levees, groundwater is drained and removed from within the polder, and the enclosed land subsides, eventually sinking below the surrounding level of water. They are commonly found in river deltas. The hydrological basins of New Orleans are examples of polders.

pump, pumping
the mechanical removal of water from an area. This is how stormwater has been traditionally managed in Greater New Orleans, but is also the primary cause of subsidence in the region.

pumping capacity
the volume of water that a pump station can move over a given period of time, typically measured in cubic feet per second (cfs). Some of the pump stations in Greater New Orleans have a capacity of over 10,000 cubic feet per second.

rain garden
a shallow excavated basin that collects and cleans storm water runoff on a small scale. Soil layers and plantings are designed for infiltration and the removal of pollutants.

resilience
the capacity to anticipate potential threats, reduce a community's vulnerability to hazard events, respond to and recover from specific hazard events when they occur, and adapt to changing risks and hazards. In Greater New Orleans, resilience refers to the region's ability to withstand and recover from major flooding and hurricanes. With the loss of coastal wetlands and climate change, the long-term future of Greater New Orleans depends on the region's ability to enhance its resiliency.

retention
the holding of stormwater permanently in basins, ponds, and cisterns. **Retention basins** allow stormwater to infiltrate the ground, and for the collected stormwater to be repurposed for other uses such as irrigation.

retrofit
a measure taken to adapt existing infrastructure to operate more efficiently and effectively, without having to completely rebuild existing systems.

risk
a predictive measure of harm or loss due to the likelihood of a hazard occurring, and the consequences of such an event.

runoff (surface runoff)
Stormwater flowing from rooftops, streets, and other surfaces that neither infiltrates into the ground or nor evaporates, but collects instead and must be drained away in order to prevent flooding.

sea level rise
most simply defined as an increase in the mean sea level, caused by changes in air temperatures that are linked to global climate change. Sea level rise poses a growing risk to low-lying coastal communities. With land subsiding at high rates as well, coastal Louisiana is experiencing some of the highest rates of sea level rise in the world.

sinkhole
a cavity in the ground which is caused by the weight and movement of water. In Greater New Orleans, sinkholes can be caused by broken pipes and/or subsidence.

siphon
a conduit for drawing water from a water source at a higher level into a water body or waterway at a lower level. Siphons can be used to pull water into circulating canal systems from outlying sources, such as the Mississippi River or Lake Pontchartrain.

slow, store, drain
a new approach to stormwater management fundamental to the Greater New Orleans Urban Water Plan: slow water as it hits the ground, create spaces in the city to store water and use it as a resource, and drain using pumps only as a last resort to prevent flooding.

sluice
a water-conveyance channel where the flow of water is controlled by a gate or other device at the head.

soil organic content, soil organic matter
component of a soil layer comprised of plant and animal residues at different stages of decomposition, cells and tissues of microorganisms, and living organisms along with the organic residues that they produce. Soil organic content is a critical measure of a soil's ecological function, quality, and stability.

stormwater management
techniques, methods, or policies that control planning, maintenance, and regulation of stormwater (rainfall). Stormwater management is critical in precipitation-rich Greater New Orleans in order to prevent flooding and reduce subsidence.

subsidence
the sinking of land relative to sea level. In Greater New Orleans, the primary cause of subsidence is the excessive pumping of groundwater. As groundwater is removed, the soil from which it is drawn compresses and highly organic soil layers are able to oxidize. Subsidence damages buildings, streets, and other infrastructure, and its effects are irreversible.

swamp
a shallow body of water and wetland habitat, typically dominated by woody vegetation such as cypresses. Swamps have highly organic soils that provide a nutrient-rich environment for the growth of a rich variety of water-tolerant species of flora and fauna.

topography
the position and elevation of natural and artificial features in an area, and also the study of the surface shape and features of an area. Topographic maps and models provide graphic representations of features that appear on the Earth's surface, including infrastructure and development, waterways and water bodies, relief (mountains, valleys, slopes, depressions) and vegetation.

water assignment
the volume of stormwater for a given rain event that exceeds the total storage and pumping capacity of a catchment area. The water assignment provides a rough measure of flooding that may occur if such an event were to occur, without taking into account finer variations in rainfall intensity and distribution that determine the actual impact of each rain event.

water balance
the calculation of the various inputs and outputs of water in an area, including rainfall, groundwater withdrawals, drinking water withdrawals, and both stormwater and sewage discharges.

water literacy
an understanding of how water impacts and functions in a given landscape—where water is coming from, how it is used, how it is stored, and risks and opportunities associated with water. Water literacy is an important aspect of a sustainable water future for New Orleans.

water quality
a measure of how suitable water is for a particular type of use (such as drinking and bathing) based on physical, chemical, and biological characteristics such as temperature, turbidity, mineral content, and the presence of bacteria.

water table
the boundary between water-saturated soils and unsaturated soils. Typically, deeper soil layers are saturated with water while those closer to the surface are drier. In wet areas like Greater New Orleans, the water table is high and often reaches the surface of the ground.

watershed
a land area, and distinct hydrological entity, where all water drains to the same point. See also **catchment area**.

weir
barriers that alter the flow of waterways to prevent flooding, to store water, or for navigation purposes, while allowing the steady flow of water over the top of the structure.

wetlands
ecosystems that are saturated with water, including bottomland hardwood forests, swamps, marshes, and bayous. The presence of water drives the nature of soil development, as well as characteristic plant and animal communities living in and above the soil. Wetlands are natural storm buffers that store and filter runoff. They are also habitats that support hundreds of thousands of species of plants and animals, as well as myriad fishing, hunting, agriculture, and recreational uses. Much of Greater New Orleans' natural ecosystems are comprised of wetlands.

References & Project Team

References

WORKS CITED AND OTHER INFLUENTIAL TEXTS

Unless otherwise noted, all photos and drawings were produced by the Urban Water Plan project team.

American Forests. 2002. Urban Ecosystem Analysis of New Orleans, Louisiana: Calculating the Value of Nature. Washington, DC: American Forests.

Black & Veatch Corporation. 2009. Sewerage & Water Board of New Orleans, Louisiana: Report on Operations For 2009. New Orleans, LA: Sewerage & Water Board of New Orleans.

Bureau of Governmental Research (BGR). 2011. Making the Waterworks Work: Fixing the Sewerage & Water Board's Governance Problems. New Orleans, LA: Bureau of Governmental Research.

Campanella, Richard. 2002. Time and Place in New Orleans: Past Geographies in the Present Day. Gretna, LA: Pelican Publishing.

Center for Neighborhood Technology (CNT) and American Rivers. 2010. The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits. Washington, DC: Center for Neighborhood Technology.

City of New Orleans. 2012. 2012 Operating Budget. New Orleans, LA: City of New Orleans.

City of Rotterdam. 2007. Waterplan 2 Rotterdam: Working on Water for an Attractive City. Rotterdam, Netherlands: City of Rotterdam.

City of San Francisco. 2009. San Francisco Stormwater Design Guidelines. San Francisco, CA: City of San Francisco.

Coastal Protection and Restoration Authority of Louisiana. 2012. Louisiana's Comprehensive Master Plan for a Sustainable Coast. Baton Rouge, La.: Coastal Protection and Restoration Authority of Louisiana, State of Louisiana.

Crompton, John L. 2010. Measuring the Economic Impact of Park and Recreation Services. Ashburn, VA: National Recreation and Park Association.

Davis, Mark. 2007. Hazard Mitigation and Land Use Planning in Coastal Louisiana: Recommendations for the Future. Baton Rouge, LA: Louisiana Sea Grant Program, Louisiana State University.

Davis, Mark. 2009. "Not by Accident." The American Prospect March 2009.

Davis, Mark. 2009. "To What End: Resilience, Tradeoffs, and the Lessons of Katrina." Journal of Contemporary Water Research and Education 141, March 2009.

Dawes, Margo. 2012. Funding Sources: Integrated Water Management Strategy. New Orleans, LA: The New Orleans Redevelopment Authority (NORA)

Federal Emergency Management Agency (FEMA). 2007. Talking Points: Repetitive Loss. New Orleans, LA: Greater New Orleans Community Data Center. Washington, DC: Federal Emergency Management Agency.

Federal Emergency Management Agency (FEMA). 2013. "Floods". Ready: Prepare, Plan, Stay Informed. http://www.fema.gov/severe-repetitive-loss-program.

Federal Emergency Management Agency (FEMA). 2013. "Severe Repetitive Loss Program". http://www.fema.gov/severe-repetitive-loss-program.

Garrison, Noah, and Karen Hobbs. 2007. Rooftops to Rivers II: Green Strategies for Controlling Stormwater and Combined Sewer Overflows. New York, NY: Natural Resources Defense Council.

Geosyntec Consultants. 2010. Stormwater BMP Guidance Tool: A Stormwater Best Management Practices Guide for Orleans and Jefferson Parishes. Baton Rouge, LA: Bayou Land RC&D.

Goody, Clancy & Associates, Inc. 2010. Plan for the 21st Century: New Orleans 2030. New Orleans, LA: New Orleans City Planning Commission.

Grant, Joe and Danielle Gallet. 2010. The Value of Green Infrastructure: A Guide to Recognizing Its Economic, Environmental and Social Benefits. Chicago, IL: The Center for Neighborhood Technology.

Green Roofs for Healthy Cities (GRHC). 2013. http://www.greenroofs.org.

Higbee, Melissa, Kathy Lin, and Colleen McHugh. 2012. Financing Green Stormwater Infrastructure: A Demonstration Project in Elmwood, Jefferson Parish. Cambridge, MA: Massachusetts Institute of Technology.

Jefferson Parish Government. 2011. 2011 Comprehensive Annual Financial Report. Gretna, LA: Jefferson Parish.

Johnson, Lyndon. 1966. Communication from the President of the United States Transmitting a Report by the Task Force on Federal Flood Control Policy. Washington, DC: U.S. Government Printing Office.

Jones-Bos, Renée. 2012. "Dutch Ambassador Renée Jones-Bos: 'The Cost Comes Before the Benefit'." The Planning Report, May 2012.

Kennaugh, Alex, et al. 2013. Creating Clean Water Cash Flows: Developing Private Markets for Green Stormwater Infrastructure in Philadelphia. Washington, DC: Natural Resources Defense Council.

Kloss, Christopher, Crystal Calarusse, and Nancy Stoner. 2006. Rooftops to Rivers: Green Strategies for Controlling Stormwater and Combined Sewer Overflows. New York, NY: Natural Resources Defense Council.

Krupa, Michelle. 2012. "Proposed Sewerage & Water Board rate increases get public discussion." The Times-Picayune, January 23.

Lerner, Jaime. 1995. “Toward a Rechargeable City.” Whole Earth Review, Spring 1995.

Louisiana House Bill 471, Regular Session. 2012. LegiScan. http://legiscan.com/LA/bill/HB471/2012.

Louisiana Revised Statute 33:4096 A

Louisiana Revised Statute 33:4096 D and E

Louisiana Revised Statute 33:4121 A

Louisiana Revised Statute 33:4121 D and E

Louisiana Revised Statute 38:291

McKinsey and Company. 2010. Getting There First: Louisiana’s Blue Ocean Initiative. New Orleans, LA: Greater New Orleans Community Data Center. Baton Rouge, LA: Louisiana State University Center for Energy Studies.

Multihazard Mitigation Council (MMC). 2005. Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities. Washington, DC: National Institute of Building Sciences.

The National Academies, Committee on Increasing National Resilience to Hazards and Disasters, and Committee on Science, Engineering, and Public Policy. 2012. Disaster Resilience: A National Imperative. Washington, DC: The National Academies Press.

New Orleans Citizen Sewer, Water & Drainage System Reform Task Force. 2012. Assessing the City & SWBNO Drainage System: Recommendations for Enhancing New Orleans Stormwater Protection. New Orleans, LA: Thomas Strategies, LLC.

New Orleans Citizen Sewer, Water & Drainage System Reform Task Force. 2012. Assessing the SWBNO Water & Sewerage System Improvement Plan: Recommendations for Improving Efficiency, Quality & Sustainability. New Orleans, LA: Thomas Strategies, LLC.

New Orleans Citizen Sewer, Water & Drainage System Reform Task Force. 2012. Assessing the Sewerage & Water Board of New Orleans: Recommendations for Sustainable and Cost-Effective Power Generation. New Orleans, LA: Thomas Strategies, LLC.

New Orleans Citizen Sewer, Water & Drainage System Reform Task Force. 2012. Assessing the Sewerage & Water Board of New Orleans: Recommendations for Enhancing Governance, Management & Strategic Planning. New Orleans, LA: Thomas Strategies, LLC.

New Orleans City Planning Commission. 2011. City of New Orleans Comprehensive Zoning Ordinance (Draft CZO-2011). New Orleans, LA: New Orleans City Planning Commission, City of New Orleans.

New York City Department of City Planning. 2011. Vision 2020: New York City Comprehensive Waterfront Plan. New York, NY: New York City Department of City Planning.

Odefey, Jeffrey, et al. 2012. Banking on Green: A Look at How Green Infrastructure Can Save Municipalities Money and Provide Economic Benefits Community-wide. Washington, DC: American Rivers.

Parish of East Baton Rouge Planning Commission. 2007. Stormwater Best Management Practices: East Baton Rouge Parish - Master Development Program. Baton Rouge, LA: City of Baton Rouge, Parish of East Baton Rouge Planning Commission.

PBS&J Corporation. 2010. Sustainable Water Resource Management: a plan for restoring and protecting the water resources of the Peace Creek watershed and Winter Haven, Florida. Winter Haven, FL.

Philadelphia Water Department. 2011. Philadelphia Stormwater Management Guidance Manual: Version 2.0. Philadelphia, PA: City of Philadelphia, Philadelphia Water Department, Planning & Environmental Services Division.

Plyer, Allison and Elaine Ortiz. 2012. Benchmarks for Blight: How much blight does New Orleans have? New Orleans, LA: Greater New Orleans Community Data Center.

Plyer, Allison and Richard Campanella. 2010. Job Sprawl in Metro New Orleans. New Orleans, LA: Greater New Orleans Community Data Center.

Plyer, Allison, Elaine Ortiz and Kathryn L.S. Pettit. 2010. Optimizing Blight Strategies Deploying Limited Resources in Different Neighborhood Housing Markets. New Orleans, LA: Greater New Orleans Community Data Center.

Plyer, Allison. 2010. What Census 2010 Reveals about Population and Housing in New Orleans and the Metro Area. New Orleans, LA: Greater New Orleans Community Data Center.

Plyer, Allison. 2013. The Greater New Orleans Community Data Center. http://www.gnocdc.org.

Second Modified Consent Decree, USA vs. Sewerage & Water Board of New Orleans. 2013. http://www.swbno.org/documents/Consent%20Decree/SecondModifiedConsentDecree.pdf.

Sewerage and Water Board of New Orleans (SWBNO). 2012. Adopted 2012 Operating Budget. New Orleans, LA: Sewerage and Water Board of New Orleans.

St. Bernard Parish Government (SBPG) and SDT Waste and Debris Services (SDT). 2011. Unpublished data on waste removal services in St. Bernard Parish. http://www.sbpg.net/images/stories/HRQLagendas/llt%20disposition%20plan%20revised%207%205%2012.doc.

St. Bernard Parish Government (SBPG). 2011. Financial Report for the Year Ended December 31, 2011. Chalmette, LA: St. Bernard Parish.

St. Bernard Parish Government (SBPG). 2012. Redevelopment and Disposition Plan for Louisiana Land Trust Properties. Chalmette, LA: St. Bernard Parish Government. http://www.sbpg.net/images/stories/HRQLagendas/llt%20disposition%20plan%20revised%207%205%2012.doc.

The Editorial Board. 2011. “New Orleans water system needs a systemwide fix: An editorial.” The Times-Picayune, January 25, sec. A.

U.S. Census Bureau. 2010. U.S. Census: State and County QuickFacts. Washington, DC: Government Printing Office.

United States Environmental Protection Agency (EPA). 2012. “National Menu of Stormwater Best Management Practices”. http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/.

United States Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds. 2010. Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure. Washington, DC: United States Environmental Protection Agency.

United States Geological Survey Office of Communications (USGS). 2007. “Science Picks”. Press Release. http://www.usgs.gov/newsroom/leads_pf.asp?ID=1649.

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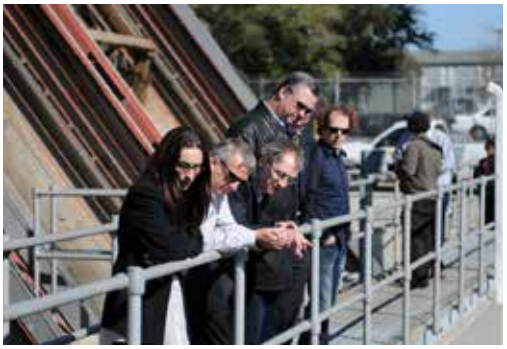

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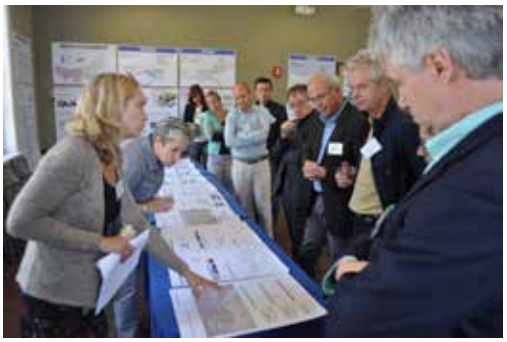

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