Jefferson Parish
Green Infrastructure Plan

A sustainable strategy for balancing water.

JEFFERSON PARISH
OFFICE OF THE PRESIDENT

CYNTHIA LEE SHENG
PARISH PRESIDENT

December 6, 2022

Fellow Jefferson Parish residents, businesses, and community organizations:

This Green Infrastructure Plan is part of Jefferson Parish's continuing efforts to balance our stormwater management strategies and improve our resilience as a community. Our objective was to create a plan that emphasizes the importance of balancing stormwater management between traditional gray infrastructure and new green infrastructure, and to highlight existing green infrastructure success stories within the Parish. The information in this plan will provide important guidance to the Parish Council and Administration on best practices for integrating stormwater management and green infrastructure on public and private property.

The Green Infrastructure Plan:

- Addresses flooding, hazards, and other challenges that impact how JP balances water;
- Explains the benefits of green infrastructure and how a mixed approach of grey and green infrastructure can help mitigate flooding now and in the future; and
- Utilizes previous studies and reports to establish a vision statement, goals, and objectives, and recommendations for incorporating green infrastructure into public projects and private development throughout the Parish.

This plan is important for Jefferson Parish because we are a coastal community, and green infrastructure provides our economy, environment, and society with many direct and indirect benefits.

In addition to stormwater and flood management, green infrastructure helps mitigate subsidence and recharge groundwater by allowing water to infiltrate soil. Green infrastructure also can improve the quality of surface waters, which protects and preserves our fishing industries. Utilizing trees and landscaping improves air quality, reduces the urban heat island effect, improves health and provides opportunities for recreation. Green infrastructure reduces the strain on our existing drainage system and adds natural beauty. In many cases green infrastructure is also more cost-effective than building traditional drainage systems. As a result of these benefits, our community becomes more livable and resilient, and our property values increase.

The work within this document is an integral part of Jefferson Parish's future and my administration looks forward to embracing the information and strategies to guide best practices across the Parish.

Sincerely,

Cynthia Lee Sheng
Parish President

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FUND SOURCE AND AUTHORIZATION

In 2016, the State of Louisiana's Office of Community Development - Disaster Recovery Unit approved funding to update Jefferson Parish's Comprehensive Plan from unallocated Community Development Block Grant (CDBG) Gustav/Ike Disaster Recovery dollars. In 2018, the Jefferson Parish Council initiated the development of a Green Infrastructure Plan as part of this Comprehensive Plan update, including an integrated stormwater management strategy to improve drainage on the east and west banks of the Parish by balancing the need for pumping with holding stormwater on site.

Development of the **Green Infrastructure Plan (GI Plan)** is CDBG-eligible corresponding to 24 CFR §570.205, Eligible Planning, Urban Environmental Design and Policy-Planning Management Capacity Building Activities, Paragraph (a), which stipulates that CDBG funds may be used for planning activities which consist of all costs of data gathering, studies, analysis and preparation of plans and the identification of actions that will implement such plans.

Jefferson Parish Planning Department

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ACKNOWLEDGEMENTS

Jefferson Parish and the project team extend a special thanks to members of the public who participated and provided input on the Green Infrastructure Plan (*see Appendix E - Citizen Participation & Outreach for more detail*), and to members of the Green Infrastructure Technical Advisory Committee that met over the course of 15 months from October 2020 to December 2021 in support of plan recommendations.

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Cover photo of Bucktown Boardwalk in Jefferson Parish, LA and all section photos courtesy of Samuel Mercier. All other photos credit as sourced.

The Jefferson Parish Green Infrastructure Plan uses the Public Sans family of typefaces.

EXECUTIVE SUMMARY

The increased rate of flooding from rainfall events, debilitating effect of subsidence on our infrastructure, and negative effects of stormwater on our water bodies require strategic action. The Intergovernmental Panel on Climate Change (IPCC) projects that extreme heat will continue to affect the hydrologic cycle, amplifying the strength and frequency of storm systems (IPCC, 2021). To accommodate this reality, Jefferson Parish ("the Parish") must plan to reduce flooding impacts, protect the integrity of our drainage system, and stabilize our natural environments.

We are largely dependent on forced drainage and engineered flood protection, which makes residents' safety reliant on engineered structures within the Hurricane Storm Damage Risk Reduction System (HSDRRS, often referred to as the "levee system") that are subject to failure in events exceeding their design strength. Heightened flood losses and risk have required Parish leaders to master flood control planning and take advantage of flood risk mitigation opportunities such as home elevations and retrofitting structures. But this alone is not sufficient to position Jefferson Parish for the future.

Many local and national communities acknowledge that traditional "gray" drainage systems (pumps and pipes) are inadequate to handle stormwater management needs on their own. Instead, these communities combine "gray" and "green" infrastructure in a way that effectively manages stormwater by enhancing drainage system capacity and improving its long-term performance. The benefits of this balanced approach are manifold:

1. When used in conjunction with gray infrastructure, green infrastructure can effectively manage the "first flush" of stormwater by slowing the speed of runoff and decentralizing its absorption into the soil.
2. Green infrastructure produces significant cost savings because it tends to require less maintenance than gray infrastructure.
3. The incorporation of green infrastructure elements has environmental, economic, and equity benefits (often called the "triple bottom line") that provide layered benefits for the community.

In 2016, Jefferson Parish began implementing a regulatory and institutional focus on incorporating green and gray drainage methods, affirming that using land, soil, and vegetation to hold and filter water in combination with traditional pumps and pipes is more effective at managing water quality and flood risk than gray infrastructure alone. To support this balanced approach, the Parish Council in 2018 authorized the development of an integrated stormwater management plan, herein referred to as the Green Infrastructure Plan, GI Plan, or the Plan.

The Green Infrastructure Plan is the result of a comprehensive review of existing studies, approaches, plans, and efforts aimed at balancing water throughout the Parish; research specific to local parking requirements; best practices in green infrastructure and water management; a review of over 20 other community codes; local data collected and analyzed; and review and analysis of existing stormwater data. These result in over 30 recommended actions, categorized broadly as "Day-to-Day Operations," "Regulatory Recommendations," and "Funding and Next Steps." The Plan builds on previous and ongoing efforts related to smart growth initiatives, low impact development, parking management, landscaping standards, and flood risk mitigation. It seeks to foster livable, sustainable, and economic infrastructure within the Parish by focusing on green infrastructure applications at multiple scales to improve drainage and water quality.

Completion of the Plan fulfills the objectives of the Parish's Multijurisdictional Hazard Mitigation Plan (Objective 10.2 and 2020 Action ID's PP-1, SP-1) and Municipal Separate Storm Sewer System (MS4) permit program implementation of green infrastructure elements (Element 13: Green Infrastructure/Low Impact Development). The Plan further includes recommendations with the goal of implementing green stormwater infrastructure within the Parish's environments, where flooding from high energy runoff is creatively slowed, stored, and cleaned before entering stormwater systems, environmental quality is improved, public spaces are created or enhanced, and technical, regulatory, financial, and institutional obstacles are overcome.

The Plan's recommendations are summarized below:

1. **Day-to-Day Operations** include policies or programs aimed at integrating green infrastructure project development into current processes and systems Parish-wide, including:
    a. Develop Technical Design Guidance Manuals for private sites and public spaces
    b. Review and integrate green infrastructure elements into public projects
    c. Create a Construction Inspection Program to ensure appropriate design and construction
    d. Create an Inspections and Maintenance Program to ensure long-term performance as designed
    e. Select, train, and consistently utilize software or tools to assess site specific cost reasonableness
    f. Enable and maintain clear tracking, evaluation, and reporting
    g. Support Continued outreach, education, and training
2. **Regulatory Framework** recommendations include text amendments to the Code of Ordinances to affect development processes in a way that decreases stormwater runoff, supports the drainage system, enhances public and private spaces, and improves on site design techniques and low impact development practices.
    a. Where possible, consolidate stormwater management, parking requirements and Low Impact Development (LID) standards in a single location
    b. Reduce imperviousness of parking areas and parking lot runoff through LID incentives
    c. Add consolidated guidance for Parish officials, such as the Department of Environmental Affairs, to implement and enforce sedimentation and erosion control measures
    d. Reduce parking ratios and create flexibility for off-street parking requirements
    e. Clarify off-site and shared parking requirements and support parking alternatives when appropriate
3. **Funding and Next Steps:** Supporting improved project planning, creation of sustainable funding sources, and enabling more competitive green infrastructure project designs, including:
    a. Development of Green Infrastructure Project Area Criteria
    b. Public Investment in Pilot Projects for Public Education
    c. Development of a Green Infrastructure Capital Improvement Program

I. INTRODUCTION

WATER, WATER, EVERYWHERE

Jefferson Parish has always been shaped by its relationship with water. The Parish, located immediately south and west of New Orleans in southeastern Louisiana, is a coastal community bordered by the Gulf of Mexico and Lake Pontchartrain, and bisected by the mighty Mississippi River. Jefferson Parish's economy, culture, and identity are tightly tied to its location at the end of the Mississippi watershed. Water shapes many aspects of life here. Residents enjoy this environment, endowed with tremendous beauty and productivity, for employment, recreation, and sustenance. Local weather patterns are influenced by nearby wetlands and water bodies. A diverse array of plants and animals thrive within Jefferson Parish's ecological landscape. Even the land on which the Parish sits owes its existence to the movement of water: as part of a vast deltaic floodplain, it was built with river sediment carried from upriver and deposited during floods.

Likewise, weather events in Jefferson Parish's subtropical climate influence its landscape. Prior to development of the Parish's built environment, most precipitation was stored in a decentralized manner through natural processes. In low-lying areas, standing water was detained in marshy wetlands where it filtered into the soil, nurtured local flora and fauna, or evaporated. Areas with a higher natural elevation could slow and detain precipitation through similar processes, limiting the speed of water runoff. Before human development, Jefferson Parish's water tended to be stored and absorbed near where it fell.

Marshlands are excellent at retaining water, but this same characteristic makes them an impediment to roads and buildings. Early settlers and developers made engineering accommodations so Jefferson Parish's marshy soil and poor natural drainage were suitable for expansion. Those accommodations first took the form of ditches and dikes that were designed to convey water away from built developments**.** Later infrastructure used pipes and pumps to transport stormwater from the source of precipitation through enclosed or open drainage systems. Such centralized measures are sometimes known as "traditional" or "gray infrastructure," after the color of their concrete structures.

Gray infrastructure development accelerated as Jefferson Parish grew following World War II. In this period, rapid suburbanization pushed the Parish's population from 100,000 residents in 1950 to 450,000 by 1980. Like other communities in Greater New Orleans, heightened development brought water management challenges and increased the strain on drainage systems. With an expanding population came more impervious surfaces as homes, roads, and parking lots were built. Rather than being absorbed near where it fell, precipitation was now funneled into traditional gray infrastructure.

Today, the Parish's drainage system is dependent on the same engineering accommodations used in previous decades: forced drainage and engineered flood protection. This makes the safety of most Jefferson Parish residents reliant on engineered structures within the Hurricane Storm Damage Risk Reduction

CASE STUDY

ELMWOOD | JEFFERSON PARISH, LOUISIANA

Figure 1. Photos of 2004 Elmwood flooding (Credit: JP Planning Dept)

In May 2004, rainstorms overwhelmed the drainage system in Elmwood and sent stormwater flooding onto the streets. Standing water on roads stranded some Parish employees working in the Joseph S. Yenni Building. Subsequent drainage improvements, including a pumping station and retention ponds at the Clearview & Earhart Expressway interchange, have lessened periodic flooding. However, Elmwood's combination of paved surfaces and growth (its population grew by 21.9% between the 2010 - 2020 Census) make it a key strategic location for new green infrastructure.

Not coincidentally, Elmwood is highlighted in the 2013 Greater New Orleans Urban Water Plan, the product of the "Dutch Dialogues" with water experts in the Netherlands. That plan increases green space by reimagining the Yenni Building parking lot, one of the lowest elevations in the area, as a center for underground water detention. A 2016 concept plan similarly increases green space in the Yenni parking lot and adds a walking path. The vision in both plans is a more beautiful and flood-resistant Elmwood that balances traditional drainage with natural water infiltration.

System that are subject to failure in events exceeding their design strength. When gray infrastructure is overwhelmed, it backs up and sends stormwater flooding into nearby neighborhoods. This was seen to dramatic effect in the 2004 Elmwood floods. For residents within and outside the levee system, heightened flood losses and risk have required Parish leaders to master flood control planning, which protects residents through traditional flood risk mitigation opportunities such as home elevations and structural retrofitting.

But this alone cannot position the Parish to respond to the challenges it faces from increasingly frequent rain events and projected sea level rise. Jefferson Parish's past is defined by its relationships with water, weather, and the southeast Louisiana coast. Its future will be no different.

NEW PROBLEMS NEED NEW SOLUTIONS

In Jefferson Parish, rain events are becoming more frequent and intense. At the same time, new buildings, roads, and parking lots increase the amount of land covered by impervious surfaces. This causes stormwater to run off at faster rates and increased volumes, which leads to less infiltration to replenish groundwater and to water quality issues in Parish waterways. Accelerating subsidence rates, increased flooding, overwhelmed flood control structures, degraded channel embankments, and impaired local water resources are the natural consequences of these weather and environmental changes. To make matters worse, the Intergovernmental Panel on Climate Change (IPCC) projects that extreme heat will continue to affect the hydrologic cycle, amplifying the strength and frequency of storm systems. Accommodating these new realities requires Jefferson Parish to take strategic action to reduce flooding impacts, protect the integrity of its drainage system, and stabilize its natural environments.

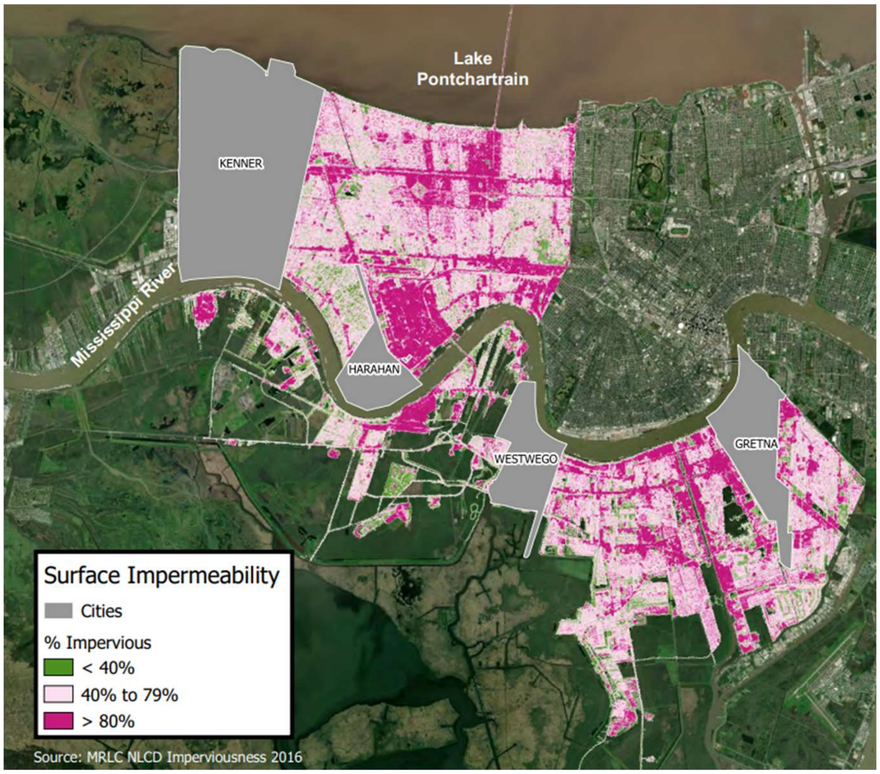


Figure 2. Measured surface impermeability within unincorporated Jefferson Parish.

Best practices acknowledge that gray infrastructure alone is ineffective at managing both water quality and flood risk. Better, more resilient drainage comes from a balance between traditional pump and pipe methods and using natural processes to hold and filter water. Many communities have balanced gray and green infrastructure as a way to cost-effectively manage stormwater while achieving layered benefits for their residents.

LOOKING TO OUR NEIGHBORS

Green infrastructure has already been built in cities around the nation. Because of this, Jefferson Parish has a robust set of lessons from which to draw the best practices that guide this Plan. We highlight national case studies in how communities implement green infrastructure, but for some of the most cutting-edge work, we need look no further than our own region. The wake of Hurricane Katrina brought an increased recognition to southeastern Louisiana's unique environment and need for resilient water management. In almost two decades after Katrina, Greater New Orleans has become a nationwide hub of knowledge on green infrastructure best practices.

When possible, case studies highlight green infrastructure examples in Jefferson Parish. However, recommendations draw on the experiences of other communities. One of these is the city of Hampton, VA, which recently completed a "Living with Water Hampton" resiliency plan aimed at assessing that community's strengths, challenges, and threats associated with sea level rise and increased weather events. Like Jefferson Parish, Hampton has a largely suburban built fabric that reflects its post-World War II population growth.

A key aim of this Plan is to highlight that innovative green infrastructure is not just limited to major cities: this document identifies coastal suburban leadership in green stormwater management.

OUR VISION: THE WATER BALANCING ACT

This Green Infrastructure Plan acknowledges the technical, regulatory, financial, and institutional obstacles Jefferson Parish faces that could limit widespread implementation of green infrastructure. Considering these, the Plan plots a feasible path forward so the local drainage system can better work to balance water for Parish residents and businesses. To this end, the Plan proposes the following vision statement:

> Jefferson Parish residents are served by an exceptional state-of-the art drainage system that uses pipes and pumps—and works with nature— to protect their property during flood events, advancing a sustainable approach to effectively reduce risk to people and property over time.

This vision is consistent with local background, input and recommendations gathered by the project team, as well as existing plans, policies, and regulations (*additional details in* ***Appendix E*****).**

WHAT DOES THIS PLAN DO?

The Jefferson Parish Green Infrastructure Plan has four primary aims:

Support goals advancing green infrastructure and low impact development (LID) principles.

- Reduce flooding and improve environmental quality by slowing, storing, and cleaning high energy runoff
- Create or enhance public spaces
- Overcome technical, regulatory, and institutional obstacles

Explain high-risk hazards and other challenges.

- Subsidence
- Increased flood risk
- Increasing rain events

Present solutions at an individual and community scale to reduce instances of nuisance flooding, prolong the life of gray infrastructure, lessen the likelihood that flooding will continue to worsen due to subsidence, and reduce the flooding impacts of hurricanes.

- Permeable pavement and paving alternatives
- Rain barrels, native plants, and detention ponds
- Other best management practices (BMPs)

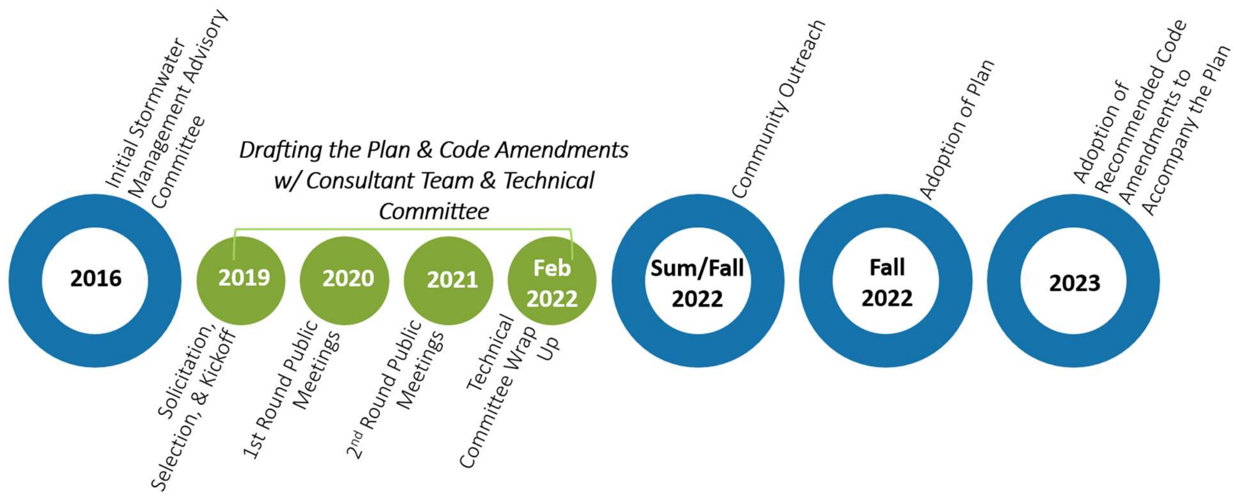
Establish recommendations and next steps.

- Adopting policies or programs aimed at integrating green infrastructure development into current processes and systems Parish-wide
- Amend development regulations and processes to decrease stormwater runoff, enhance public and private spaces, and improve on-site design techniques and low impact development practices
- Support improved project planning, the creation of sustainable funding sources, and more competitive green infrastructure project design.

WHAT SHAPED THIS PLAN?

Successful plans respond to community needs and fit within the landscape of existing studies. They expand on directions outlined in previous strategic documents and tie together many threads to chart a clear path forward. The Jefferson Parish Green Infrastructure Plan is no different, and many community voices helped shape this document.

To create the Plan, the project team engaged in a comprehensive review of existing studies, approaches, plans, and recent efforts aimed at balancing water within the Parish. We also engaged in Parish-specific research into infrastructural requirements already contained in the Jefferson Parish Unified Development Code, including low impact development incentives and parking requirements. To contextualize this information, we reviewed over 20 other community codes, analyzed all available Parish stormwater data, and researched national best practices in stormwater management (*for additional information on background studies, plans, and approaches, please see **Appendix F***).



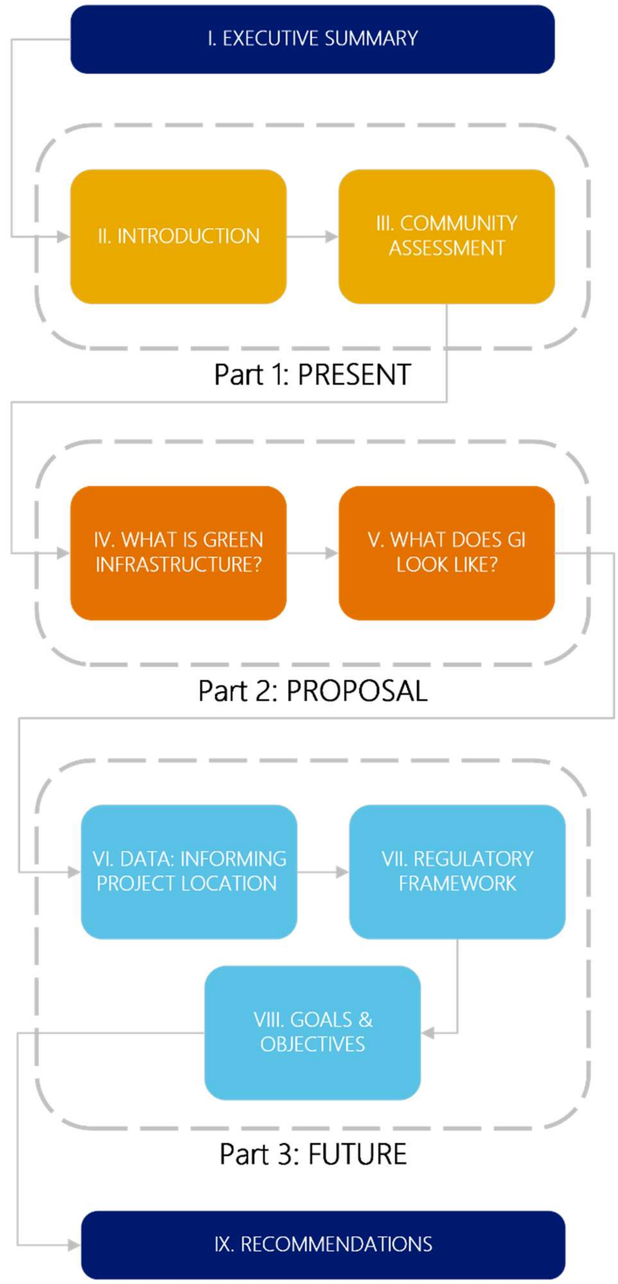
Finally, the project team engaged in a robust outreach and public comment process with local stakeholders. The path to this Plan's creation began in May 2016 with the formation of the Jefferson Parish Stormwater Management Committee, which delivered its recommendations to create an integrated stormwater management plan to the Parish Council in December 2016. Funding for the Plan became available in 2019, at which point consultants were selected and drafting began. Public outreach took place in 2020-2022 (*for additional details on timeline and outreach efforts, please see **Appendix E***).

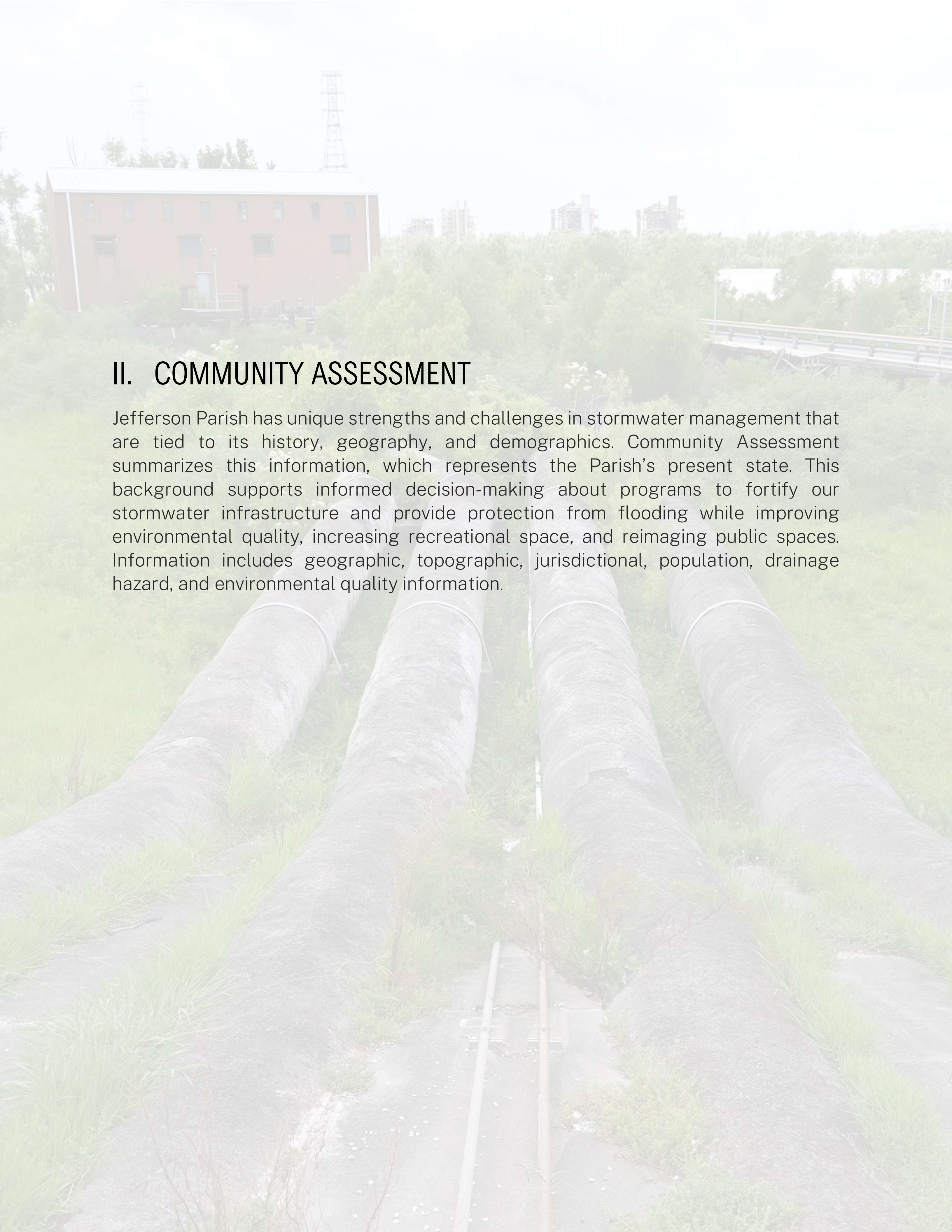
HOW IS THIS PLAN ORGANIZED?

The information in the Green Infrastructure Plan is organized into three core sections: Present, Proposal, and Future. First, the Plan introduces Jefferson Parish's **present** state by outlining its demographic and geographic trends, drainage infrastructure, hazards, and other background information. Then, it provides information on the **proposal** to incorporate green infrastructure into the Parish's drainage systems. This section is animated by two common questions "What is Green Infrastructure?" and "What Does Green Infrastructure Look Like?" The third section analyzes the factors that will influence a successful **future** green infrastructure strategy, including Parish-wide data on elevation, impervious surfaces, the Parish's current regulatory framework, and the objectives that will guide the implementation of green infrastructure elements.

Finally, the Plan synthesizes information from the first three sections as the basis for its **recommendations**, which provide actionable, data-driven steps the Parish can take to incentivize green infrastructure use and balance gray and green stormwater strategies.

Taken together, these recommendations provide a path for Jefferson Parish to begin sustainably balancing its water needs.





II. COMMUNITY ASSESSMENT

Jefferson Parish has unique strengths and challenges in stormwater management that are tied to its history, geography, and demographics. Community Assessment summarizes this information, which represents the Parish's present state. This background supports informed decision-making about programs to fortify our stormwater infrastructure and provide protection from flooding while improving environmental quality, increasing recreational space, and reimaging public spaces. Information includes geographic, topographic, jurisdictional, population, drainage hazard, and environmental quality information.

A. GEOGRAPHY & EXISTING LAND DEVELOPMENT

Jefferson Parish is a narrow parish located in southeastern Louisiana adjacent to the City of New Orleans (**Figure 1)**. From Lake Pontchartrain to the Gulf of Mexico and everywhere in between, bodies of water are interwoven throughout the Parish: total water area (336 square miles; 215,358 acres) exceeds land area (305 square miles; 195,793 acres). Further, the Parish is split by the Mississippi River into an East and West Bank 14 miles south of from its northern border.

In March of 1979, the Jefferson Parish Council adopted an ordinance establishing a Growth Limit Line in the area south of Crown Point on the West Bank as part of an agreement with the federal government to limit the availability of potable water and similar infrastructure in these sensitive areas. The Growth Limit Line limits the types of structures and uses that can be established in wetland areas.

Figure 2, which is a map of the U.S. Army Corps of Engineers levees located in Jefferson Parish, illustrates how for the remainder of the Parish, the 100-year hurricane storm damage risk reduction system (HSDRRS) or levee system functions as the de-facto growth limit line, where the East Bank (or northern portion) of the Parish is considered urbanized and part of the New Orleans Metropolitan Area.

The southern part of the Parish, outside of the HSDRRS on the West Bank, is less populated and is characterized by estuarine systems that lead in from the Gulf of Mexico. The coastal marshes, wetlands, and estuaries contain numerous bodies of shallow water. These bodies of water and wetlands make up over 85 percent of the Parish and provide 234,320 acres of beneficial natural floodplain functions such as water storage and filtration.

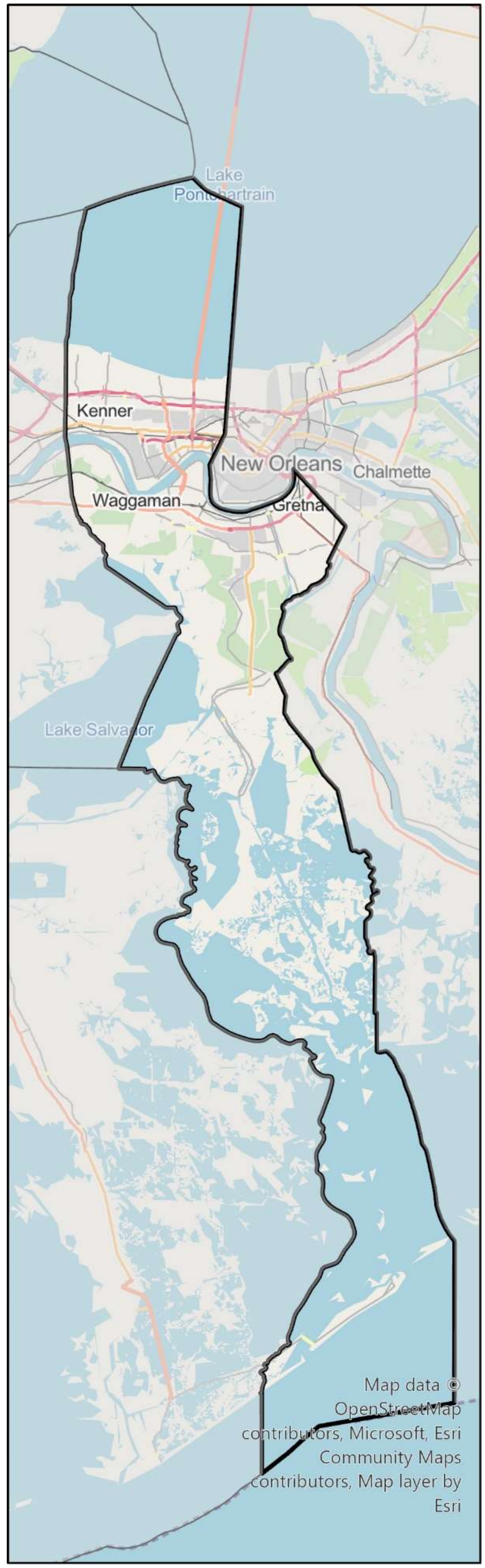


Figure 1. Map of Jefferson Parish

Within the HSDRRS, land area tends to be fully developed or "built out," which leaves limited opportunities to preserve or protect interconnected networks of natural areas and other open spaces.

Due to a lack of available space, the Parish must look to location-based, data-driven solutions that strategically prioritize resources based on a common set of criteria, such as heightened flood risk, social vulnerability and maximizing effectiveness of existing public spaces. The Parish should also consider opportunities to retrofit and integrate existing traditional drainage infrastructure as part of green infrastructure plans and specifications.

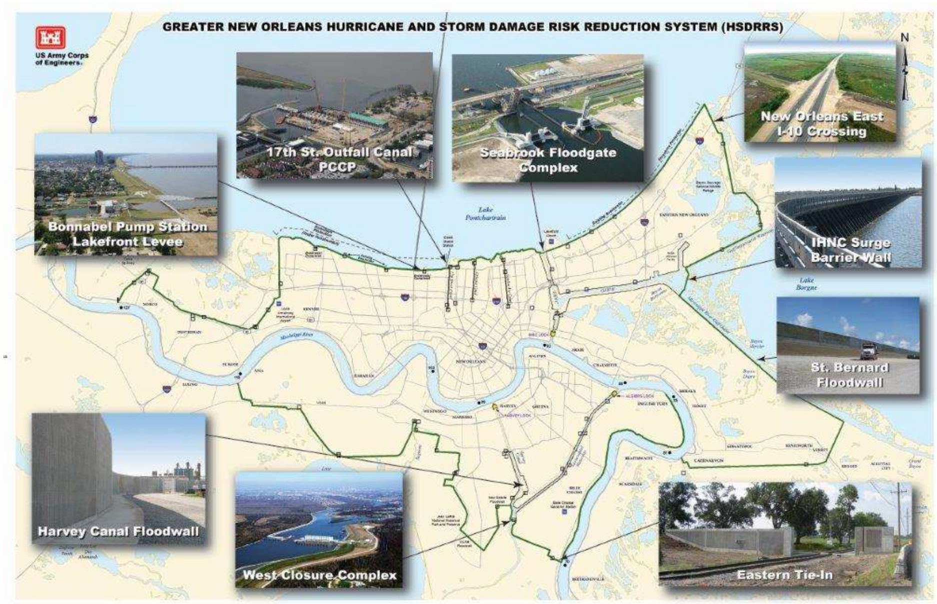


Figure 2. U.S. Army Corps of Engineers Levees and Protected Areas

B. INCORPORATED AREAS

Within the Parish, there are six incorporated municipalities: Grand Isle, Gretna, Harahan, Jean Lafitte, Kenner, and Westwego. Jefferson Parish government currently maintains all drainage canals and pump stations, which includes service of the incorporated areas.

C. POPULATION AND REDEVELOPMENT

The Census Bureau estimates the 2020 population in Jefferson Parish was 440,781, a growth of 1.9% since the 2010 Census. The Parish currently projects that this growth rate will continue within unincorporated areas and lead to a stable or decreasing housing need over the next two decades. The future population is likely to be older and have fewer children, which will increase demand for higher density residences that require less yard maintenance and more mixed-use walkable developments to provide mobility and amenities.

Green infrastructure elements help make neighborhood streets and greenways pleasant and safe for walking and biking and reinforce a sense of place. Integrating green infrastructure into existing smart growth sub area plans can reduce runoff, strengthen efforts to preserve open space and natural areas, and encourage redevelopment of existing communities.

Smart growth regulatory tools used to facilitate clustering, planned development, and compatible connectivity between neighborhood-scale commercial development and neighborhoods are supported by Parish comprehensive planning efforts. These tools could be improved with the inclusion of neighborhood-scale green infrastructure projects aimed at reducing rainwater runoff when redevelopment occurs to restore water management balance and mitigate long-term flood risk.

D. DRAINAGE

Intense rainfall, clayey and loamy soils, and land mass that is primarily below sea level define characteristics of Jefferson Parish's drainage system. This system experienced a significant buildout between 1970 and 2000, when the Parish had an influx of approximately 100,000 new residents. System buildout has continued and evolved into one of the most sophisticated drainage systems in the country. There is no question that this system serves the community well and should continue to be invested in, maintained and operated. However, it stands to benefit from the support of complimentary green infrastructure designs aimed at reducing maintenance costs and improving system performance over time.

Because most of Jefferson Parish's land mass is below sea level, its drainage system incorporates infrastructure that is not typically found in most urban areas including pumping stations, levees, floodwalls, and canals. Runoff is collected and pumped over the levees into the outlying water bodies. The Parish has 340 miles of canal waterways, drainage ditches, cross drains, culverts, and internal levee systems. There are also 53 drainage pump stations containing 154 pumps installed throughout the Parish drainage system for a total capacity of 47,100cfs (Source: Jefferson Parish Drainage Department).

There is an opportunity to integrate sustainable green infrastructure solutions that add storage capacity to existing, traditional infrastructure and more effectively offset drainage challenges during extreme rainfall events.

E. HAZARDS

According to the updated 2020 Multijurisdictional Hazard Mitigation Plan, flooding, hurricanes and tropical storms, storm surge, subsidence, sea level rise, and coastal erosion are classified as high-risk hazards, causing significant infrastructure damage in the Parish over the last several decades, and exposing weaknesses in the critical drainage infrastructure that residents rely on to maintain the safety and security of their lives and personal property.

1. Subsidence

The traditional approach to rainwater management removes runoff as fast as possible through underground pipes and pumping stations, quickly drying out the Parish's loamy soils and sinking the land (also referred to as subsidence). The sinking land cracks pipes, warps and destabilizes existing built infrastructure, including drainage infrastructure, compromising its integrity and reliability during a flooding event.

Rising to this challenge, Jefferson Parish's Floodplain Management and Hazard Mitigation Department created the "Balancing Water" Campaign to rethink how Jefferson Parish addresses runoff and combats subsidence. One of the ideas of Balancing Water includes modifying the drainage system slightly so that it balances the storage and pumping of stormwater, and to advise Parish citizens that it is okay that water lingers for a short time before it gets pumped out. Emphasizing that water needs to soak into the ground and fill the soil with moisture so that the ground "stays plump like a wet sponge" is vitally important to slowing down the rate at which the land subsides.

Figure 3. Green Infrastructure Educational Signs (Source: Volkert)

Implementing green infrastructure projects with educational components at the neighborhood and community scale will further this mission and provide more opportunities for residents to gain a better understanding of how to live with water.

2. Increased Flood Risk

Floods have been and continue to be the most frequent, destructive, and costly natural hazard facing Jefferson Parish. There have been 54 floods recorded in Jefferson Parish during the period from January 1996 to May 2018. The principle sources of flooding are rainfall ponding, levee overtopping, and hurricane or tropical storm surges originating in the Gulf of Mexico from Lake Pontchartrain on the East Bank and Lakes Salvador and Cataouatche on the West Bank.

Figure 4 FEMA repetitive loss *(left)* shows the individual FEMA flood insurance property-level claims made within each census district. FEMA Flood Zones *(right)* shows those areas located in a FEMA special flood hazard area. Areas with the lowest elevations and deepest flood water depths also have the most repetitive loss claims.

This heightened level of flood losses has required Parish leaders to attain mastery of flood control planning and infrastructure investments to sufficiently protect residents and take full advantage of traditional flood risk mitigation opportunities such as raising home elevations and retrofitting structures.

Residents are similarly paying into risk mitigation though the purchase of flood insurance. With the exception of some areas inside the levee protected section of northern Jefferson Parish, much of the land in the Parish is located within FEMA's 100-year floodplain (**Figure 5),** with approximately 73 percent of all structures having flood insurance policies (JUMP, 2020). Areas in light blue (Flood Zone X) are least flood prone, but are highly encouraged to purchase flood insurance.

In development of this Green Infrastructure Plan, it is important to emphasize that green infrastructure alone cannot provide residents and businesses with protection from significant flooding that occurs during and immediately following a hurricane event.

Green infrastructure can reduce instances of nuisance flooding, prolong the life of gray infrastructure, lessen the likelihood that flooding will continue to worsen due to subsidence, and reduce the flooding impacts of hurricanes.

FEMA FLOOD ZONES

The Federal Emergency Management Agency (FEMA) is responsible for releasing maps that define flood risk factors for floodplains across the country. They are used by governments, property owners, lenders, and insurance agents when making choices about land management practices, infrastructure, and insurance costs. The various flood zones (e.g. X, VE, A, etc.) are determinations made by FEMA about the general risk of a large area and do not consider individual risk factors that may increase or decrease a specific property's flood risk within that zone. Further explanation of the differences in FEMA flood zones shown in relation to Jefferson Parish in ***Figure 5***. is provided below.

X: Shown on the map in light blue, represents the lowest flood risk. Properties within an "X" zone carry a moderate chance of flooding, approximately 0.2-1% on FEMA's 100-year floodplain risk assessment. This means that these properties stand a 6-26% chance of experiencing flooding over the course of a 30-year mortgage. As was mentioned above, even though properties in an "X" zone are at lower risk of flooding than those in other zones, owners are still strongly encouraged to purchase flood insurance as the risk of flooding is still significant.

AE: Shown on the map in a medium shade of blue, represents a larger flood risk. Properties within an "AE" zone carry a significant chance of flooding, approximately 1% on FEMA's 100-year floodplain risk assessment. This means that "AE" zone properties stand a 26% chance of experiencing flooding over the course of a 30-year mortgage. Mandatory flood insurance coverage is required for any federally backed mortgage within this zone as the chance of flooding is high.

V & VE: Shown on the map in the darkest shade of blue, presents the highest flood risk. Properties within a "V" or "VE" zone are generally located outside of the levee and pump system, along coastal areas in the southern end of Jefferson Parish. A large percentage of these zones consist of uninhabited marshland, and occupied properties that do exist stand an extremely high chance of experiencing serious flooding.

(Sources: FEMA/National Flood Insurance Program. "What is a flood map?" https://www.floodsmart.gov/all-about-flood-maps; LA County: https://pw.lacounty.gov/wmd/floodzone/docs/FZD_Legend.pdf)

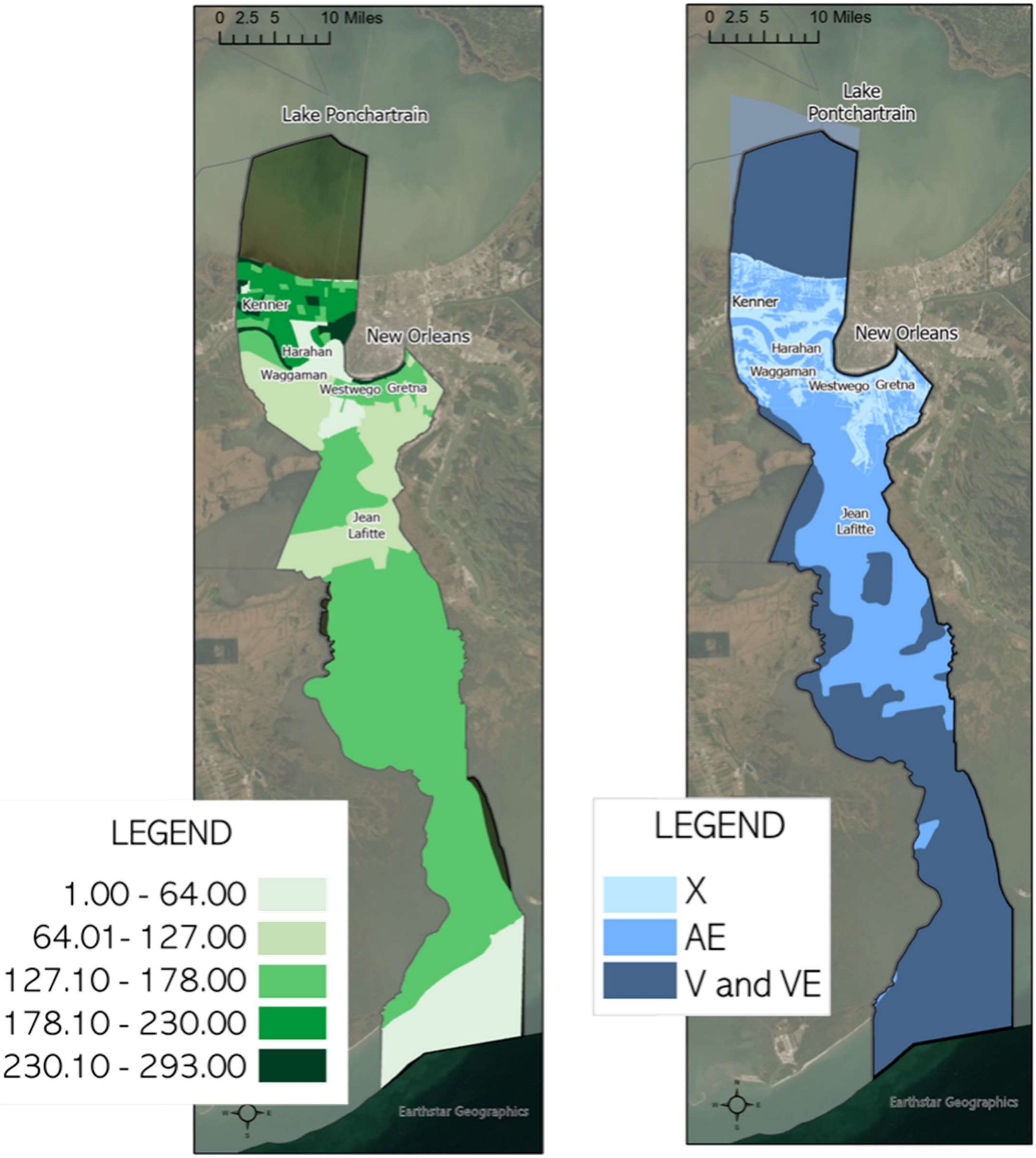


Figure 4. FEMA Repetitive Loss (left) and FEMA Flood Zones (right) (Source: FEMA)

F. ENVIRONMENTAL QUALITY

The natural landscape of Jefferson Parish is largely covered with buildings, paved roads and parking lots. Raindrops land on and collect on its hard impervious surfaces (pavements and rooftops), instead of soaking into the ground or being captured and evaporated on trees and plants. As runoff travels across impervious surfaces, it picks up and transports pollutants. These may include oils and grease, sediment, metals, bacteria and viruses from wildlife and pets. Subsequently, those pollutants are washed into Parish waters, where they impact water quality, aquatic habitat, and fish and other wildlife[1].

Figure 5 - Effects of Stormwater Pollutant Runoff (Source: EPA Stormwater Smart Outreach)

These water resources provide critical habitats needed for survival of endangered, threatened, and rare animal and plant species, which are primarily located in existing, protected wetland areas of Jefferson Parish (see Section IV (A), re: Growth Limit Line in the area south of Crown Point). More than ensuring these areas remain physically intact, green infrastructure designs located upstream of receiving water bodies can help to reduce non-point source pollution entering these environments and help them to thrive and grow.

Jefferson Parish is home to a significant amount of high-quality wetland habitat including brackish marsh, cypress forest, and seasonally flooded marsh habitat. Efforts to restore and protect the Louisiana's coast are pursued in a coordinated manner made possible by the Louisiana Coastal Master Plan.

[1] https://www.epa.gov/npdes/stormwater-smart-outreach-tools accessed on 11/17/22.

G. BRINGING IT ALL TOGETHER

Stormwater runoff can cause local flooding, compromise flood control structures and channel embankments, destabilize channels, impact aquatic habitat, clog navigation channels, and increase water treatment costs. Further, the Parish's dependence on forced drainage and an engineered flood protection system, makes the safety of many residents highly reliant on man-made structures subject to failure in events that exceed their design strength.

Local hazards (subsidence and increased flood risk) are projected to worsen as climate change affects the hydrologic cycle and continues to amplify the strength and frequency of storm systems. The issues of subsidence, flood risk and environmental quality are linked and many communities are now looking to combine gray and green infrastructure approaches to manage stormwater to achieve multiple community goals.

To this end, there is an immediate need to develop recommendations that prioritize the incorporation of Green Infrastructure within the Parish's environments, where flooding from high energy runoff is creatively slowed, stored and cleaned before entering stormwater systems, environmental quality is improved, and recreational spaces are created or enhanced.

Street flooding along Metairie Road during a heavy rainfall event

Figure 6. Local Flooding (Credit: Richard Gillen)

Because the future of Jefferson Parish is dependent on effective water management, it is imperative that the Parish adopt measures to embed rainwater management techniques in various types of development such as:

1. Permeable pavement and improved infiltration and drainage performance in road and construction projects
2. Onsite retention or detention within public parks, grassed neutral grounds, and similar improvements
3. Low Impact Development (LID) principles on private property, including:
   a. Improved parking lot runoff with stormwater treatment alternatives integrated into required landscaping areas and traffic islands
   b. Reduced imperviousness within on- and off-street parking areas
   a. Natural channel design in canal maintenance projects
4. Future tree planting efforts that incorporate low-cost green infrastructure best practices through partnerships with non-profits and civic associations

   ***Note**: See Section X for full list of recommendations.*

To achieve each of these outcomes, a process to review, evaluate and identify proposed local project designs is needed to improve drainage system performance. To this effect, establishment of a process by which work conducted by the Departments of Planning, Parks and Recreation, Parkways, and Drainage as well as local nonprofit groups are reviewed for potential water management opportunities is recommended.

III. WHAT IS GREEN INFRASTRUCTURE?

A. COMMON QUESTIONS

What is green infrastructure? The term can mean different things to different people. Sometimes, green infrastructure refers to natural areas that provide ecological benefits in urban areas; other times, it may refer to post-construction stormwater management practices. “Green” indicates that the infrastructure uses natural elements versus traditional “gray” infrastructure.

For the purposes of this Plan, “green infrastructure” has the same definition as Congress’s 2019 Water Infrastructure Improvement Act, which defines it as "the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspirate stormwater and reduce flows to sewer systems or to surface waters" (EPA, 2021).

What is the difference between green infrastructure (GI) and low impact development (LID)? While the terms are sometimes used interchangeably, low-impact development is an approach to delivering infrastructure that minimizes impacts to the natural environment. Green infrastructure describes the elements of a built or natural environment.

What does green infrastructure do? In its broadest sense, the term green infrastructure refers to an interconnected network of natural areas and open space that helps preserve the ecological function of our watersheds. This network of aquatic and terrestrial resources supports a wide range of resident and migratory organisms, maintains air and water quality, and contributes to a community’s beauty, economic well-being, and quality of life.

Green infrastructure practices address rainwater management goals to reduce runoff flow rates and minimize the pollutant loads entering waterways — the same goals addressed by traditional stormwater infrastructure. But green infrastructure offers valuable layered benefits not provided by conventional infrastructure, such as groundwater recharge, runoff volume reduction, improved air quality, temperature moderation, energy cost savings, and increased open space for recreation and wildlife.

A primary focus of this Plan is placed on low impact site planning and design techniques, green stormwater infrastructure implementation, and the development of “green space” designed to rehabilitate urban and suburban environments that help decrease post-construction stormwater runoff rates. The project team recommends a watershed-based update to this plan to identify and protect aquatic and terrestrial resources from the impacts of land development as part of our proposed next steps.

How can green infrastructure be incorporated into pre-construction planning? An opportunity to incorporate green infrastructure practices on site is in the form of better pre-development site preparation, planning and design. These are often aimed at maintaining pre-development site hydrology and reducing post-construction runoff rates, volumes, and pollutant load.

In other words, the way a developer lays out their site plan can have positive or negative impacts on rainwater management. Planning principles, including integrating hydrology during site planning, applying small-scale stormwater control measures (or SCMs) throughout the site, and controlling rainwater at the source to mitigate the effects of development are important to the effectiveness of the Parish drainage system. These tools are important considerations for design professionals. Pre-development site preparation can help communities shift the focus of their local post-construction stormwater to *prevention*, rather than the *mitigation*, of the negative impacts of land development.

What are examples of green infrastructure? Green infrastructure includes natural and built infrastructure elements that promote retention, infiltration, and slow the release of rainwater runoff. These smaller-scale runoff

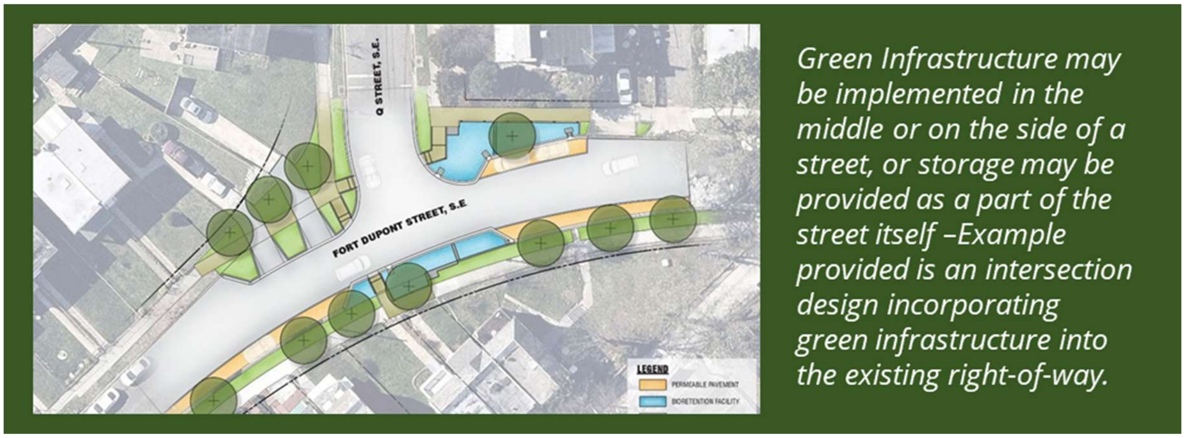


Figure 7. Example of green infrastructure incorporated into right-of-way at an intersection (Source: Volkert).

management measures attempt to mimic the natural water cycle and are used to manage the quantity and quality of runoff in the built environment. Elements of green infrastructure may provide rainwater management services on their own or may be used in conjunction with traditional infrastructure to enhance its effectiveness, increase its capacity, and extend its lifespan.

What does green infrastructure look like compared to traditional infrastructure? While drainage pipes and other types of gray infrastructure are below ground, much of green infrastructure is visible at the ground level as sunken gardens, planter boxes, grassed swales, strategically planned landscaping, tree-lined boulevards, and permeable pavements.

Is this a new, untested approach? No. The term “green infrastructure” was coined nearly 30 years ago and has been applied nationwide. However, communities have used natural processes to provide rainwater-related infrastructure for centuries through the use of canal overflow areas, rain harvesting, infiltration-promoting practices, and other low-tech solutions.

In green infrastructure elements like rain gardens and bioswales, how do you prevent mosquito breeding? Design and some maintenance are necessary to prevent standing water in rain gardens and bioswales. Since both elements are designed to drain after rain events, they are not suitable habitats for mosquito breeding if built correctly. In Jefferson Parish, as of this report writing, the Engineering Department specifies that green infrastructure elements must be designed to drain within 48 hours. But if green infrastructure elements are installed in locations with unsuitable soils type or improperly maintained (by periodically cleaning litter/debris/etc.), it will not drain at the necessary rate, which can cause issues. For more information, please reference this handout by EPA (2005): https://www3.epa.gov/npdes/pubs/sw_wnv.pdf.

How is this relevant to Jefferson Parish? Why are we considering this strategy? Jefferson Parish leadership recognizes we must balance our approach to managing rainwater to make our drainage system work better for us. The increased rate of flooding from intense rainfall events, negative effects of runoff on our water bodies, and the debilitating effects of subsidence on our infrastructure require strategic action to reduce flooding, protect the integrity of our drainage system, and stabilize our natural environments.

B. LAYERING VALUE: THE BENEFITS OF GREEN INFRASTRUCTURE

Green infrastructure has benefits that extend beyond stormwater management **(Figures 7 and 8).** It can reduce the long-term capital and operational costs of public facilities, alleviate floods, lessen the urban heat island effect by shading streets from the hot summer sun, save energy, and purify the air. It assists with the filtration, absorption, and transpiration of water, which cleans it of harmful chemicals and pollutants before it runs off into waterways. By filtering this runoff, green infrastructure helps improve the quality of our surface waters, which protects and preserves our fishing industries.

Green infrastructure provides direct and indirect benefits in the areas of **economy, society, and environment.** In addition to stormwater and flood management, green infrastructure helps mitigate subsidence and recharge the groundwater by allowing water to infiltrate into the soil.

The aesthetic benefits of green infrastructure elements can aid economic development by attracting business, providing jobs, increasing tourism, and raising property values. Even food security is improved through local food production in allotments, gardens, and urban and suburban agriculture space. Habitat is made available for wildlife, which allows people to enjoy unspoiled natural areas, and provides environmental learning and training opportunities.

Green infrastructure enhances communal sense of place through improved public spaces, creating leisure and recreation opportunities and helping people to improve well-being by lowering stress levels. And while some may see parks and trees as a luxury, it is important to understand how vulnerable areas in the Parish can benefit from decreased flood risks, improved food security and water quality. By embracing green infrastructure, the Parish can continue to thrive by providing a vibrant and economically dynamic environment that is also healthy, happy, and sustainable; thus, providing a high standard of living for all its residents.

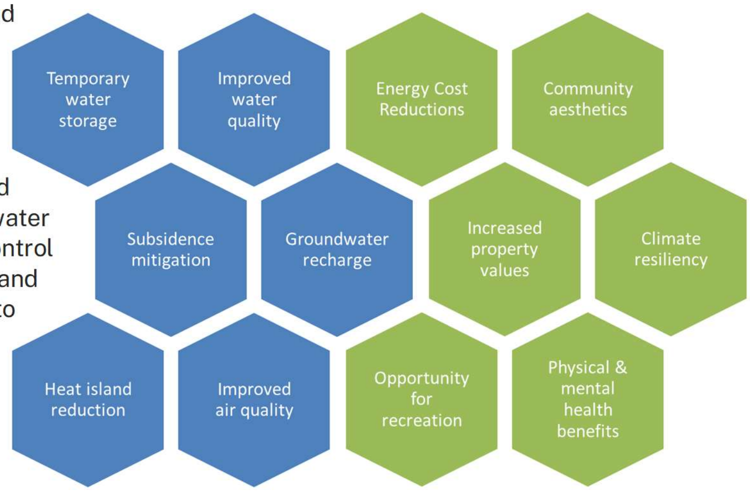


Figure 8. Benefits of green infrastructure.

Through the implementation of this GI Plan, the Parish can reduce the negative impacts associated with new and re-development, make better use of water assets, and fund and implement major flood control projects, all of which will be critical to the survival and economic prosperity of the Parish in the years to come.

Understanding the benefits and effectiveness of green infrastructure helps reduce confusion and build support for implementation, but for the GI Plan to meaningfully impact management of the Parish's drainage system, the Parish must also overcome barriers to implementing Green Infrastructure. The EPA has extensive research and materials to support overcoming barriers to implementing green infrastructure, including a factsheets series and a number of sources specific to stakeholder groups or claims made regarding conflicting laws. The project team incorporated findings and recommendations from this substantial effort into the GI Plan, and recommends these resources be continuously referenced throughout implementation to more successfully implement green infrastructure in Jefferson Parish.

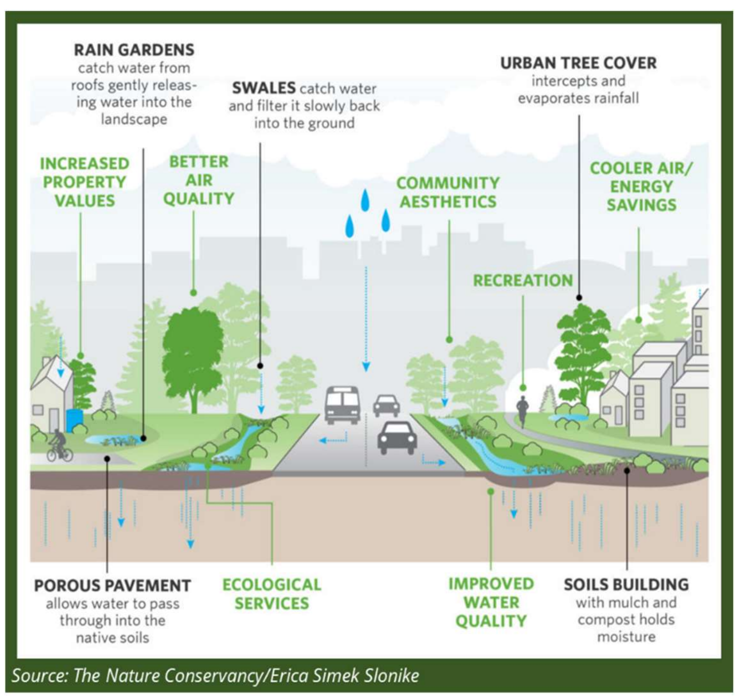


Figure 9. Green Infrastructure project types and benefits

C. COST EFFECTIVENESS

A Georgetown Climate Center (2021) analysis found that "green infrastructure can effectively manage the "first flush" of stormwater while producing significant cost savings for local governments," and in some cases implementing green infrastructure has saved local governments billions of dollars. An EPA report (2007) on seventeen (17) projects using site-scale green infrastructure found that in most cases, green infrastructure was cheaper and performed better environmentally than conventional stormwater management. A report by the Natural Resources Defense Council (2013) reviewing published research on the benefits to owners of commercial buildings incorporating well-designed green infrastructure found that they can command higher rents and property values, increase retail sales, save energy, reduce maintenance costs, reduce flood damage costs, reduce water bills, lower crime, and improve health and job satisfaction for employees.

CASE STUDY
BELLINGHAM, WASHINGTON

Bellingham, WA-
Bloedel Donovan Park

All of the water from the west end of the parking lot and the ball field drain to this point where most of it soaks into the ground and is absorbed by the plants here.

Any extra water flows through a pipe and to a filter system at another infiltration area before flowing into the lake.

Source: https://stormwater.cob.org/tour-bloedel-donovan-park/site-electric-ave-rain-garden/

One case study worth pointing out due to its simplicity in work is the City of Bellingham. The City retrofitted two parking lots, one at City Hall and one at Bloedel Donovan Park, with rain gardens in lieu of installing underground vaults to manage stormwater. At the first location, a rain garden was installed in three parking spaces (out of a total of 60 spaces). The second location involved converting a 550-square-foot area near a catch basin to a rain garden. Both installations required excavation, geotextile fabric, drain rock, soil amendments, and native plants. Flows were directed to the rain gardens by curbs, and an overflow system was installed to accommodate higher flows during heavy rains.

The City compared actual rain garden costs to estimates for conventional underground vaults based on construction costs for similar projects in the area. Rain garden costs included labor, vehicle use/rental, and materials. The first location rain garden saved the City $22,000 (80%), over the underground vault option; and the second location rain garden installation saved $40,000 (76%).

Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices

The 2007 EPA Report, *Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices*, concluded that in a vast majority of cases, implementing well-chosen LID practices saves money for developers, property owners, and communities, while also protecting and restoring water quality.

Table 1. Summary of Cost Comparisons Between Conventional and LID Approaches					
Project	**LID Technique**	**Conventional Development Cost**	**LID Cost**	**Total Capital Cost Savings When Using LID vs Conventional Development** [a]	
				$	**%**
2nd Avenue SEA Street	Bioretention; reduced impervious area; swales	$868,803	$651,548	+ $217,255	+25%
Auburn Hills	Bioretention; reduced impervious area; swales; vegetated landscaping; wetlands	$2,360,385	$1,598,989	+$761,396	+32%
Bellingham City Hall	Bioretention	$27,600	$5,600	+$22,000	+80%
Bellingham Bloedel Donovan Park	Bioretention	$52,800	$12,800	+$40,000	+76%
Gap Creek	Reduced impervious area	$4,620,600	$3,942,100	+$678,500	+15%
Garden Valley	Bioretention; cluster building; swales; permeable pavement; wetlands	$324,400	$260,700	+$63,700	+20%
Kensington Estates	Cluster building; reduced impervious area; permeable pavement; vegetated landscaping; wetlands	$765,700	$1,502,900	–$737,200	-96%
Laurel Springs	Bioretention; cluster building; reduced impervious area; swales	$1,654,021	$1,149,552	+$504,469	+30%
Mill Creek [b]	Cluster building; reduced impervious area; swales	$12,510	$9,099	+$3,411	+27%
Prairie Glen	Bioretention; cluster building; reduced impervious area; swales; vegetated landscaping; wetlands	$1,004,848	$599,536	+$405,312	+40%
Somerset	Bioretention; swales;	$2,456,843	$1,671,461	+$785,382	+32%
Tellabs Corporate Campus	Bioretention; swales; vegetated landscaping; wetlands	$3,162,160	$2,700,650	+$461,510	+15%

[a] Negative values denote increased cost for the LID design over conventional development costs.
[b] Mill Creek costs are reported on a per-lot basis.

Case studies of 17 specific developments included a variety of LID practices, such as bioretention, cluster building, reduced impervious area, swales, permeable pavement, vegetated landscaping, wetlands, and green roofs. In most cases, LID practices were shown to be both fiscally and environmentally beneficial to communities, and in the vast majority of cases, significant savings were attributed to reduced costs for site grading and preparation, stormwater infrastructure, site paving, and landscaping. Total capital cost savings ranged from 15 to 80% when LID methods were used, with a few exceptions in which LID project costs were higher than conventional stormwater management costs (**Table 1**). Note that some case studies were not included in the summary table because the results did not lend themselves well to a traditional vs. LID cost comparison.

The one case study that cost more using LID practices consisted of entirely replacing conventional stormwater management practices with LID practices. Kensington Estates, a 24-acre development, consisting of single-family homes on 103 lots, integrated rooftop rainwater collection systems on each house, permeable parking along the roadside, three wetlands, and much more. The LID practices may have cost the project more money initially, but in the long run, the study anticipated that the use of LID would reduce the cost of stormwater utility bills, stormwater peak flow discharge rates, and soil erosion.

The report found that LID practices can help reduce project costs, improve environmental performance, and benefit communities. The higher LID costs within the case studies were due to green roofs, increased preparation costs, or more expensive landscaping practices. However, significant savings were found in the majority of cases due to the reduced costs for site grading and preparation, stormwater infrastructure, site paving, and landscaping.

In addition, green infrastructure approaches improve air quality, increase habitat and green space, enhance human health, and reduce flooding. Where green infrastructure solutions have been widely adopted, communities have found that the enhanced aesthetic experience of local residents has improved quality of life as well as property values. Local waters improved by reducing runoff can provide healthier aquatic habitats and water supplies, becoming resources that provide environmental and public health benefits to all residents.

Maintenance cost comparisons have also shown that green infrastructure practices can be less expensive than conventional gray infrastructure, although more research is needed to help communities make informed decisions based on their particular context and the types of green infrastructure approaches used.

According to the Illinois Green Infrastructure Study (2010), green infrastructure is frequently 5 to 30 percent less costly to construct and about 25 percent less costly over its life cycle when compared with traditional infrastructure. These cost values assume that recommended maintenance is conducted on schedule and that green infrastructure is performing as expected; the same assumptions are applied to gray infrastructure. The study also found that over time green infrastructure allows for more flexibility in adapting to changes in conditions and/or knowledge, whereas once gray infrastructure is built, it becomes costlier to reverse or modify.

Tools are also available to help communities evaluate the potential cost savings and economic benefits of green infrastructure. For single buildings or larger neighborhood and community scale efforts, the Center for Neighborhood Technology developed a National Green Values Stormwater Management calculator (sample in **Figure 10**) to quickly estimate the performance, costs, and benefits of green infrastructure compared to conventional stormwater management practices. The calculator allows a user to define one or more properties and then evaluate what combination of Green infrastructure elements meet the necessary volume capacity capture goal in a cost-effective way. The project team recommends use of The Green Values Calculator or a similar cost evaluation tool to ensure the cost effectiveness of green infrastructure implementation at site, neighborhood, and community scales.

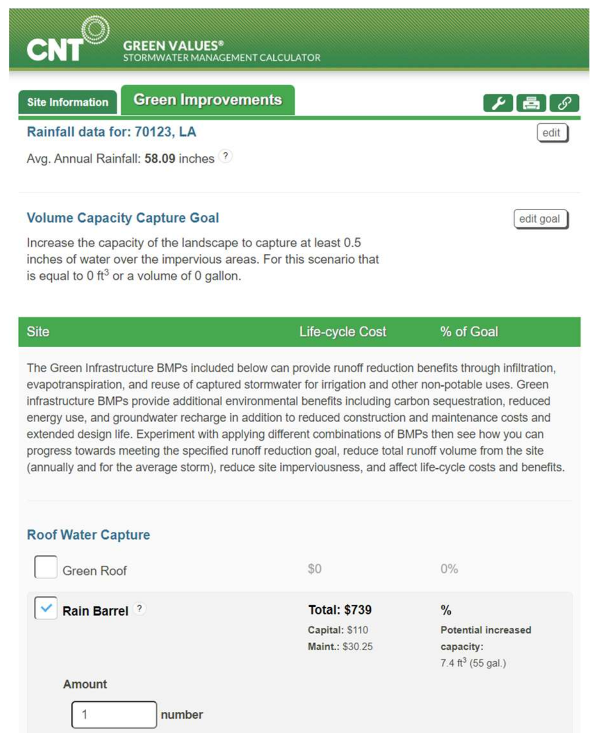


Figure 10. Green Values Stormwater Calculator Sample

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IV. WHAT DOES GREEN INFRASTRUCTURE LOOK LIKE?

A. APPLICATION AND FUNCTION

The project team reviewed several elements of Green Infrastructure and LID approaches and found a large degree of variation in terms, definitions, types, and applications. The terminology for elements used in this chapter were determined to be most reflective of the state of practice and most consistent with the functions of each element.

Green Infrastructure may be employed at site, neighborhood, and watershed scales and may include a variety of techniques. It should be implemented as a part of a low impact development approach and with local conditions and context in mind. Green Infrastructure should be used to complement other elements of traditional stormwater infrastructure, not replace them. Together — when designed and applied properly — gray and green infrastructure can work in tandem to create a unified, balanced drainage network that will deliver sustainable, cost-effective benefits at scale and over time.

Literature consistently holds that two basic processes are facilitated by Green Infrastructure – pollutant removal and hydrologic mimicry. Pollutant removal is facilitated by *filtration, deposition, and retention*. Hydrologic mimicry attempts to replicate predevelopment stormwater runoff peak discharges and volumes through *infiltration, evapotranspiration, retention and detention*.

Elements of Green Infrastructure presented in this chapter may be sorted into four categories. These include *filtration, surface infiltration, subsurface infiltration, and retention/detention*.

CASE STUDY

BAYOU METAIRIE PARK | JEFFERSON PARISH, LOUISIANA

Figure 11. (Left) New entrance sign. (Middle) Bioretention Area at Bayou Metairie Park. (Right) Walking path and native plantings. (Credit: Richard Gillian, Alena Gesser)

Located on what was once an empty lot between Metairie Lawn and Labarre Drive in Old Metairie, Bayou Metairie Park is the latest addition to Jefferson Parish's park system. Completed in the spring of 2021, this new community gathering space is situated in a popular and quickly developing commercial and residential corridor. Key design elements incorporate a variety of green infrastructure methods targeted at addressing localized flooding on nearby streets and private property, something which has been an ongoing issue in the area. In addition to preserving the already open space, elements such as permeable pavements for walking paths and parking lots, the installation of multiple bioretention areas (commonly referred to as rain gardens), and the inclusion of water loving native plants all help to increase the water storage capacity of the park. Thanks to the addition of these green infrastructure elements, Bayou Metairie Park can capture and retain up to 32,000 gallons of stormwater runoff that would otherwise be channeled into the gray water storm sewer system and contribute to localized flooding during heavy rainfall events. The park has been a welcome addition to the community, serving as a gathering hub for events as well as a traditional recreation area. In addition to its social role, the park also serves as an opportunity to educate Parish residents on the benefits of green infrastructure. Signs placed across the park explain how each of the implemented elements works, and how they can help create a better system for managing water when applied at a larger scale. Implementation of effective and attractive green infrastructure such as Bayou Metairie Park is an excellent example of how this plan seeks to transform publicly owned property across the Parish to better align land uses with best water management practices.

1. Filtration/Deposition Elements (F/D) utilize vegetation, soil media, biofiltration, and sometimes manufactured devices to physically slow and separate runoff from suspended or floating pollutants. Deposited and filtered pollutants may require removal and disposal by hand or mechanical means or may degrade over time with exposure to sunlight and oxygen. Mechanical elements include proprietary manufactured litter traps, storm drain inserts, and separators. Filtering and deposition can also be promoted by the runoff encountering pools of slower moving water, vegetation, and/or various filtering media, aggregates, and soils.
2. Surface Infiltration Elements (SI) serve as inlets to intercept and direct surface runoff into the ground or into a subsurface Green Infrastructure element. These elements may take the form of pervious and permeable pavements and infiltrative ground covers. Vegetated ground covers may also provide the benefit of volume loss through a process of evapotranspiration where plants facilitate and promote evaporation to the atmosphere.
3. Subsurface Infiltration Elements (SSI) help to retain collected and stored runoff by facilitating and promoting volume loss into surrounding soils. As runoff is stored awaiting infiltration, an amount of detention is provided. Elements that promote subsurface may include permeable pavement sub elements, bioretention elements, and some types of underground detention. Subsurface infiltration can take place only if the groundwater table is some distance below the bottom of the element and if the surrounding soils can accept passing water at a fairly rapid rate. Due to the majority of soils and groundwater conditions in Jefferson Parish being unsuitable for subsurface infiltration, an underdrain should always be incorporated into all implemented green infrastructure elements that attempt to provide subsurface infiltration.
4. Retention/Detention Elements (R/D) are intended to help replicate predevelopment hydrology by temporarily storing a portion of the runoff for a given storm, then releasing the stored water over a determined period. Release may be in the form of reuse when there is an appropriate application nearby. Detention elements are designed to fully drain in between rain events. Retention elements permanently hold or store an amount of water even after the stored storm volume has been released.

B. RECOMMENDED GREEN INFRASTRUCTURE ELEMENTS

Dozens of green infrastructure elements were reviewed to arrive at a recommended collection that consider the unique nature of Jefferson Parish's climate, topography, soils, and groundwater conditions. Elements that were heavily dependent upon deeper water tables and surrounding soils with the capacity to receive and transmit stored water and those requiring significant soils manipulation were deemed to not be appropriate for use in Jefferson Parish.

Table 2 lists green infrastructure elements recommended for Jefferson Parish and provides information regarding the function and applicability of each for different site types and constraints.

Table 2. Green Infrastructure Elements

Element	Functional Categories	Scale Applicability	Constraints Considerations	Pretreatment or Underdrain Required	Notes
Bioretention Areas	F/D, SI, SSI	Individual Street Neighborhood Regional	Soils, groundwater	P, U	Maintenance effort similar to traditional planters
Constructed Wetlands	F/D, R/D	Neighborhood Regional	Space, vectors	P	Highly context-sensitive
Detention Basins	F/D, R/D, SSI	Street Neighborhood Regional	Space, groundwater		Traditional
Downspout Disconnection	SI	Individual	Structural (foundation)		Need positive drainage from building
Green and Blue Roofs	D/R	individual	structural, capacity		Structural analysis required
Permeable Pavements	SI	individual street	groundwater	P, U	Requires vacuum equipment
Rainwater Harvesting	R/D	Individual	Capacity	P	Non-potable uses only
Retention Basins	F/D, R/D	Street Neighborhood Regional	Space, groundwater, vectors	P	Aesthetic, place-making benefits
Urban Reforestation	F/D	Individual Street Neighborhood Regional	Space		Many benefits not related to stormwater
Vegetated Swales and Areas	F/D	All	None		Can provide pre-treatment

Jefferson Parish has design constraints, but also immediate opportunities to implement green infrastructure. Recommended elements for consideration and potential application in Jefferson Parish listed above and described the potential for application based on economy, likely limitations, and implementation site scale with the following notations:

- Design and construction specifications and details are not provided for simple elements and those that may require unique context applicability or specialized design analysis.
- Those with available design and construction specifications and details are called out with the descriptions.
- Site applicability and limitations are provided in the description for each element.

Bioretention Areas are shallow basins (bioretention cells) or linear conveyances (bioswales) that utilize vegetation and engineered soil media to slow, filter, detain, and infiltrate stormwater runoff. Bioretention Areas are also referred to as rain gardens or stormwater planters in some settings.

Constructed Wetlands are intended to mimic natural wetlands to provide stormwater runoff detention, retention, pollutant removal by filtering and deposition, and some evaporation and evapotranspiration. Constructed wetlands also provide wildlife habitat and educational and aesthetic benefits. Constructed wetlands may also be referred to as stormwater wetlands or extended wet detention ponds.

Detention Basins are facilities intended to provide temporary storage and release of stormwater runoff to mimic predevelopment runoff characteristics.

Downspout Disconnection diverts rooftop runoff from direct discharge into a storm sewer system and spreads flows across lawns, vegetated areas, and other pervious areas, where runoff may be slowed, filtered, and possibly infiltrated before reaching collection systems. This seemingly insignificant element, if applied across a neighborhood or community can provide meaningful relief to a struggling closed storm sewer system.

Green and Blue Roofs provide stormwater capture, detention, and other water quality-related benefits on the roofs of buildings and structures using some or all of the available rooftop area. Green Roofs incorporate vegetation and a growing medium, planted over a waterproofing membrane. Green Roofs may also include additional features such as a root barrier and drainage and irrigation systems.

Permeable Pavements are porous surfacing materials, pavers, or blocks that enable stormwater runoff to move below the surface for detention and/or subsurface infiltration. In addition to intercepting surface flows, Permeable Pavements also may provide an amount of pollutant removal as the runoff passes through them. Permeable Pavements are commonly used on roads, paths, and parking lots subject to pedestrian and light vehicular traffic.

Rainwater Harvesting is the ancient stormwater management practice of intercepting, diverting, and storing rainfall to provide detention and potential reuse. Stored water may be used for irrigation, firefighting, toilet flushing, and other non-potable uses. Typically, gutters and downspout systems are used to collect rainwater from roof tops and direct it to a storage tank or cistern.

CASE STUDY

BUCKTOWN BOARDWALK | JEFFERSON PARISH, LOUISIANA

Figure 12. (Left) Bucktown Boardwalk with a view of Lake Pontchartrain (Right) Wildlife enjoying the constructed wetland as viewed from the boardwalk (Credit: Samuel Mercier)

Located along the shores of Lake Pontchartrain, the Bucktown Boardwalk provides parkgoers 1,000 feet of walkway through a 3.4-acre man-made living shoreline, a type of constructed wetland. Built with silt dredged from the lake bottom, the living shoreline is designed to provide recreational and resiliency benefits. Coastal grasses in the marsh give structure to the soil and prevent it from erosion. The wetlands create a natural barrier to protect Jefferson Parish's levees from storm surge by slowing waves from the lake. Opened in May 2020, the boardwalk and marsh are part of a $1.7 million coastal resiliency project that also includes benches along the boardwalk, bird watching stands, two recreational pavilions, and educational signs informing residents about the importance of working towards a sustainable relationship with water through the construction of resilient green infrastructure elements.

When a funding source is identified, planned expansions to the park include a children's playground, space for the Bucktown Seafood Market, a great lawn similar to the one at New Orleans City Park, and a footbridge across the nearby 17th Street Canal connecting Jefferson and Orleans Parishes. In addition, an expansion of the marsh into a "living shoreline" between Bonnabel Boat Launch and the Boardwalk and construction of an offshore breakwater with native aquatic plants is also planned. This new constructed wetland will provide storm surge protection, create a pleasant recreation area for boaters and kayakers, and build new habitat for local wildlife such as birds, crabs, and fish. Bucktown Boardwalk and the planned expansion are prime examples of how green infrastructure can provide more resilient water infrastructure while also expanding recreational opportunities for the residents of Jefferson Parish.

Retention Basins are facilities intended to provide temporary storage and release of stormwater runoff to mimic predevelopment runoff characteristics. Unlike Detention Basins, Retention Basins are designed with a stored volume surface elevation that is above the bottom elevation of the basin. Linings and other provisions may be necessary to ensure that collected and stored water is retained.

Urban Reforestation involves planting trees, shrubs, and other vegetation, typically on a large scale, in urban environments. Urban Reforestation provides abstraction of rainfall which helps to minimize the volume of runoff by providing surfaces to wet, processes to evaporate, and places for storage.

Vegetated Swales and Areas are shallow conveyances and open spaces typically lined or stabilized with turfgrass. These more traditional elements provide a benefit over impervious channel linings and pavements by increasing the time of concentration of runoff by reducing runoff velocities and helping to remove suspended and floating pollutants through filtering and deposition. Vegetated areas may also be referred to as Vegetated Filter Strips, although technically that element typically incorporates infiltration trenches and/or level spreaders to help disperse flows.

CASE STUDY

PONTIFF PLAYGROUND | JEFFERSON PARISH, LOUISIANA

Figure 13. (Left) View of Pontiff Playground water retention immediately following a heavy rainfall event; (Right) Jefferson Parish Balancing Water Ambassadors learning about stormwater retention in Pontiff Playground (Source: Waggonner & Ball and Catherine DeLeon)

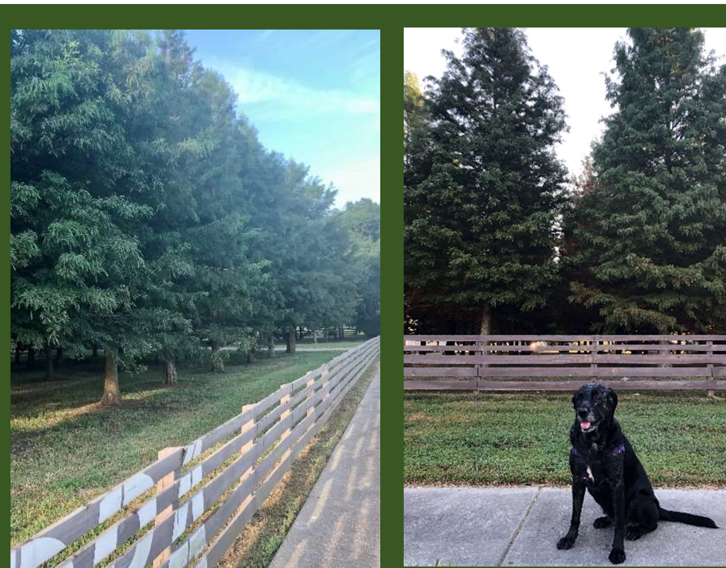
An example of green infrastructure Jefferson Parish residents may already be familiar with is Pontiff Playground, located in Old Metairie. Operated by the Jefferson Parish Parks & Recreation Department, Pontiff Playground offers a variety of activities for residents. Youth athletics such as basketball, football, volleyball, and cheerleading are offered on a seasonal basis, while year-round activities and facilities are offered to all residents. These include tennis courts, a dog park, baseball diamond, batting cages, walking trails, and a children's playground, among other amenities. Crucially, even on rainy days when the park is not being utilized as it normally would, this public space still provides an important service to residents through its function as a green infrastructure element.

Designed to work in conjunction with the Parish's traditional gray water infrastructure, a system of 3-foot-high earthen berms surround the southern end of Pontiff Park near the playground, allowing it to act as a retention basin. During intense rainfall events, pumps redirect water from the stormwater drainage system for temporary storage and detention within the park. This helps to relieve stress on the storm sewer system and reduce the amount of flooding experienced by nearby streets and homes by as much as 6 inches. Opportunities to convert and better utilize Parish owned property to assist in the mitigation of flooding through the use of green infrastructure such as Pontiff Park is a prime example of the goals this plan hopes to accomplish.

C. LOCATION AND SCALE

As illustrated in **Table 2** (Page 32), the scale at which at green infrastructure elements are applied depends largely on design, site conditions and the amount of runoff and drainage area intended to be treated or sourced. Even apparent site scale designs (like green or blue roofs or rainwater harvesting) could be applied at a neighborhood or community scale if administered across multiple sites.

For this reason, the project team groups projects into three categories, but describes them independently to avoid limiting creative applications long-term. The project team also considers special circumstances and opportunities to incorporate green infrastructure elements in local road, highway and bridge development projects.



Vacant lots reforested by New Orleans Redevelopment Authority (NORA), creating pocket green spaces - Credit: Amanda Ponti

Figure 14. Site scale application example in New Orleans, LA

1. Site and Neighborhood

At the site and neighborhood scale, green infrastructure strategies include low impact developement and smart designs that aim to preserve or restore the natural hydrology of a site to the greatest extent possible, such as encouraging cluster development that minimizes impervious surfaces. Distributed stormwater management practices are often built into a site, corridor or neighborhood and can be fit to support individual development, redevelopment or retrofit projects, and include:

- Vegetated Swales and Areas
- Urban Reforestation
- Downspout Disconnection
- Rainwater Harvesting
- Detention Basins
- Retention Basins
- Bioretention Areas
- Permeable Pavements
- Constructed Wetlands
- Green and Blue Roofs
- Infiltration Basins

2. Regional or Watershed

On a regional or watershed scale, green infrastructure and low impact development can be implemented as an interconnected network of natural areas or a series of capital improvements that connect systems of natural areas and open space, involving:Land conservation

- Wetland restoration and protection
- Floodplain and stream restoration
- Detention/retention basins
- Upstream land management and conservation
- Greenways
- Preserving or restoring floodplains, open space
- Natural channel design

3. Coastal Areas

Within coastal areas, green infrastructure elements and low impact development approaches may include shoreline stabilization, reducing erosion and buffering the coast from storm impacts, involving:

- Coastal wetlands
- Dunes
- Living shorelines
- Oyster reefs

4. Local Road, Highway and Bridge Development Projects

Within local road, highway and bridge development projects, many of the natural resource protection, stormwater management practices and, techniques discussed above can be successfully applied.

In existing street layouts there are often opportunities to reduce the extent of paved areas and narrow street widths to decrease the total impervious area. Eliminating curbs and gutters along streets and including curb cuts around parking areas, where appropriate and consistent with Parish standards, can promote drainage to pervious areas. Other options include replacing curbs and gutters with roadside vegetated swales and directing runoff from the paved street or parking to adjacent green infrastructure. Specific examples of transportation options that provide for other multi-beneficial purposes such as traffic calming and pedestrian safety, increased parking spaces, and improved aesthetics, include:

Street Application

Figure 15. Street Bioretention in Tampa, FL (Credit: Richard Gillen)

a. **Narrowed paved travel lanes** can help reduce impervious area and infrastructure costs, calm traffic in pedestrian-oriented areas, and create room for stormwater facilities. Existing roadways can be narrowed to minimum widths in accordance with established roadway standards. Residential street crossings are often combined with traffic-calming measures, which reduce street width and are designed to maintain low vehicle speeds, such as raised crosswalks, chicanes, and gateway narrowing.

b. **Consolidated travel lanes** or converting unused pavement next to travel lanes into landscape areas can result in reduced imperviousness. The increased landscape space could be used for stormwater facilities and create space for bike lanes, wider sidewalks, and a more balanced and vibrant streetscape. Parking lanes can also be converted to permeable paving that can be used for stormwater management.

c. **Horizontal deflectors (chicanes).** A chicane is a traffic channelization technique that combines narrowing a street's width and creating a serpentine path to slow traffic. On new streets, chicanes narrow the street by widening the sidewalk or landscaped parkway. On streets considered for retrofit, raised islands can be installed to narrow the street. Advantages of chicanes include reduced traffic speeds, opportunities for landscaping, and created spaces for stormwater management facilities. Chicanes are inappropriate for use on streets classified as collector or higher, bus routes, emergency response routes, where there is a grade that exceeds 5 percent, or where stopping sight distance is limited.

d. **Bulb-Outs** are curb extensions that narrow the street at intersections by widening the sidewalks at the point of crossing. They are sometimes are used to make pedestrian crossings shorter and to provide traffic calming by reducing the visual width of long, straight streets (**Figure 16**). Where intersection pop-outs are constructed by widening the landscaped planting strip, they can improve the aesthetics of the neighborhood and provide more opportunities for stormwater controls at the site by facilitating interception, storage, and infiltration. Intersection pop-outs should be designed to properly accommodate bicyclists, transit vehicles, and emergency response vehicles. Intersection pop-outs can be installed on local streets; however, pop-outs are inappropriate on major streets and primary arterials.

Street Bulb-Out in Decatur, GA

Figure 16. Street Bulb-Out with Bioretention (Source: City of Decatur)

CASE STUDY

ZUPPARDO'S & REPUBLIC DISTRIBUTING | JEFFERSON PARISH, LOUISIANA

Figure 17a. (Left) Parking lot island retention area at Zuppardo's Market. (Right) Installation of subsurface detention infrastructure at Republic National Distributing. (Credit: Richard Gillian)

Two excellent examples of how local private businesses can help forward the goal of more sustainable water management throughout the Parish are recent projects completed by Zuppardo's Family Market, a locally based family owned supermarket located on Veteran's Boulevard, and Republic National Distributing Company, a wholesale liquor distributor headquartered in Atlanta, GA with their New Orleans Metro hub located on Jefferson Highway near the eastern edge of the Parish.

During the construction of a new building to accommodate an expansion and modernization of their store, Zuppardo's included grass detention areas which were incorporated into the median islands of their parking lot. This was completed by the owners voluntarily and prior to the current green infrastructure incentives being written into the code as a way to reduce the impact of stormwater runoff generated by their new parking lot on the surrounding homes, provide a more aesthetically pleasing environment through the inclusion of grass, trees, and landscaping, and even to save money on construction costs by reducing the need for traditional gray stormwater management infrastructure.

Similarly, Republic National Distributing was also looking for a way to better manage water. Their liquor distribution warehouse creates a large area of impermeable surface which contributed to the inundation of the traditional drainage system during heavy rainfall events. To mitigate the effects of this, Republic installed an on-site water retention system which directs stormwater runoff from the roof of their warehouse and other impervious surfaces on property into a subsurface retention vault located beneath their parking lot. The inclusion of landscaping and grass islands also assist by introducing vegetated areas which can absorb additional water. This helps to ease the flooding of roads both on site and in the surrounding area, ensuring that their trucks have clear access to and from the warehouse avoiding costly delays.

Both of these projects provide immediate and long-term benefits to the implementing businesses, while also having the overall effect of reducing the strain on parishwide stormwater management systems. This also saves the Parish money and ensures a more resilient and robust economy for Jefferson Parish by eliminating costly transportation delays and damage caused by flooding.

CASE STUDY
FUNDING GREEN INFRASTRUCTURE PILOT PROJECTS WITH ENVIRONMENTAL IMPACT BONDS | HAMPTON, VIRGINIA

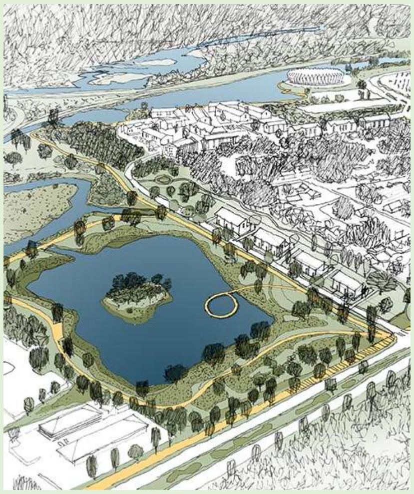


Figure 17b. (Left) Lake Hampton Stormwater Park, VA. (Right) Big Bethel Blueway. (Credit: Waggonner & Ball)

A roadmap for innovative green infrastructure funding comes from southeastern Virginia. The city of Hampton (pop. 137,148) is a community on the Chesapeake Bay that, like Jefferson Parish, saw its highest population growth after World War II. Similarly, the city has a largely single-family suburban character. In 2015, Hampton took part in a Dutch Dialogues Virginia planning effort by Waggonner & Ball, who first pioneered that approach to managing water in New Orleans with the Greater New Orleans Water Plan. The results of this process led to a city-wide Living with Water Hampton plan, followed by a Phase 2 plan that identified pilot projects in the frequently-flooded Newmarket Creek watershed. With the help of a $12M environmental impact bond, an innovative financing tool that provides capital for sustainability projects and adjusts investor returns based on project performance, Hampton began constructing three prototype projects that add 8.6 million gallons of stormwater storage capacity. These include the Big Bethel Blueway, which expands a drainage canal, constructs weirs to slow water flow, and adds bioswales, and Lake Hampton, which transforms a detention pond into a stormwater park with increased storage and filtration capacity through detention basins and wetland plantings.

V. DATA: INFORMING PROJECT LOCATION

In order to narrow project alternatives and frame appropriate next steps for the Parish and/or its Departments to advance the implementation of GI recommendations in the built environment, the project team reviewed and summarized key findings associated with the following data:

1. Local topography
2. Calculated flood depths
3. Current impervious surfaces and parking data throughout the Parish
4. Historic rain volumes
5. Current conditions and specifications of the drainage system
6. Depth to water table
7. Social vulnerability
8. FEMA NFIP flood claim history
9. FEMA flood insurance rate maps
10. Parish Smart Growth Subarea Plans
11. Current Parish-Owned Property
12. Opportunities to educate the public
13. Current Road Classifications, Zoning and Future Land Use Classifications
14. Parish Critical Facilities
15. 50-yr Projected Coastal Inundation Maps

Analysis of these data supports a better understanding what sites and SCM designs will provide the most effective green infrastructure solutions parishwide while aligning with best practices in long-term stormwater planning, previous planning efforts, available funding, ongoing mitigation efforts, and community development initiatives.

A. RAIN VOLUME

Extreme rainfall precedes flash flooding. This can occur with little warning, exhausting municipal resources and causing property damage and business interruption. **Figure 18** illustrates average annual rainfall in the Parish, from the National Resource Conservation Service (NRSC) annual rainfall averages as measured from 1981 to 2010 and the real-time data collected by the Parish SCADA system from approximately 2007 to 2019.

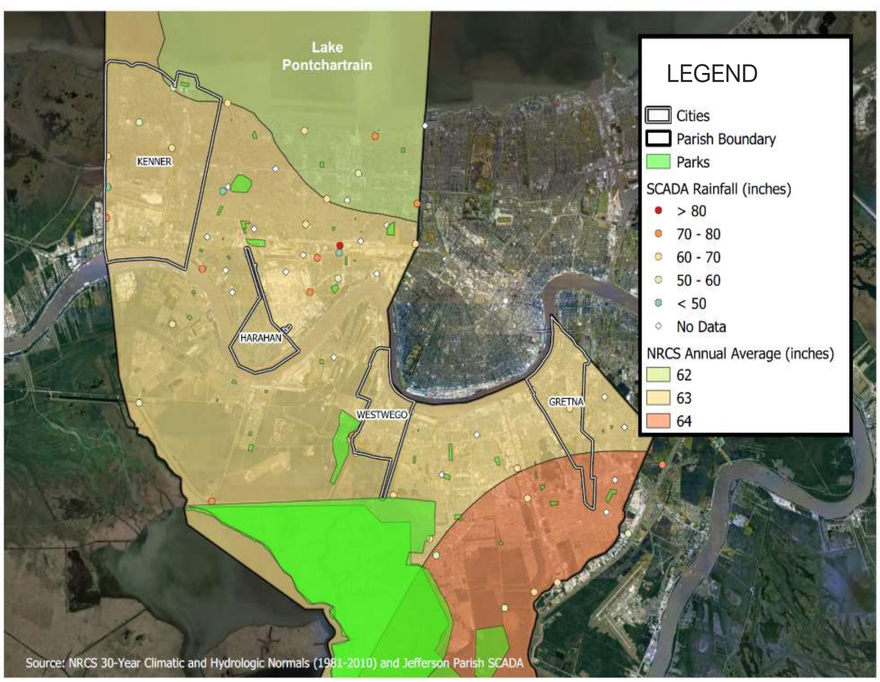


Figure 18. Average Annual Rainfall, Jefferson Parish

These data indicate that Jefferson Parish experiences some of the highest average rainfall rates in the state and the country, with a high degree of spatial variability. Some areas in the Parish reach as high as 80-inches of mean annual rainfall. The local trend towards more intense and frequent rainfall events echoes those in the nation (Cameron, 2017), where since 1958, the amount of precipitation during heavy rainstorms has increased by 27 percent in the southeast, and the trend toward increasingly heavy and frequent rainstorms, including a significant increase in extreme precipitation events, is projected to continue with high confidence (US Global Change Research Program, 2017).

Anticipating this increase in rainfall and incorporating green infrastructure to address the 'first flush' of stormwater will help to prepare communities for intense and frequent rain events—keeping businesses open and fostering long-term resilience. Storing floodwaters from more frequent storms can also reduce the effects of subsidence by replenishing local soils with water and keeping them stabilized.

B. CALCULATED FLOOD DEPTHS

Figure 19, entitled "Calculated Flood Depths," shows the anticipated depth of flood waters during a 100-year storm event and helps denote areas of significant ponding. Consistent with topographic (**Figure 20**), FEMA Repetitive Loss (**Figure 5,** Page 19) and Flood Zone maps (**Figure 19**, right); analysis of calculated flood depths demonstrates that areas having the lowest elevations experience higher flood risk and deeper projected flood water depths.

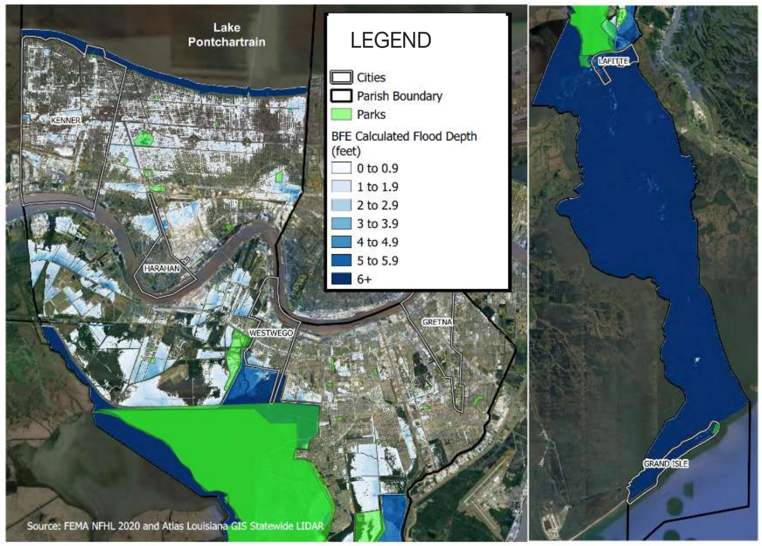


Figure 19. Calculated Flood Depths, Jefferson Parish

One goal of implementing green infrastructure is to absorb the 'first flush' of stormwater and reduce the burden of intense rainfall events on the existing drainage system. As shown in **Figure 19,** white and light blue areas having projected flood water depths of 0 to 1.9 feet are areas that could see significant improvement in nuisance flooding should green infrastructure measures be employed consistently on-site and/or within public spaces.

Those areas in darker blue with anticipated flood depths of 2 to 6+ feet, given the depth of flood waters, would benefit from combined solutions (gray and green) or larger site (25 acres+) green infrastructure SCMs designed to retain and absorb floodwaters across a larger area of land.

C. TOPOGRAPHY

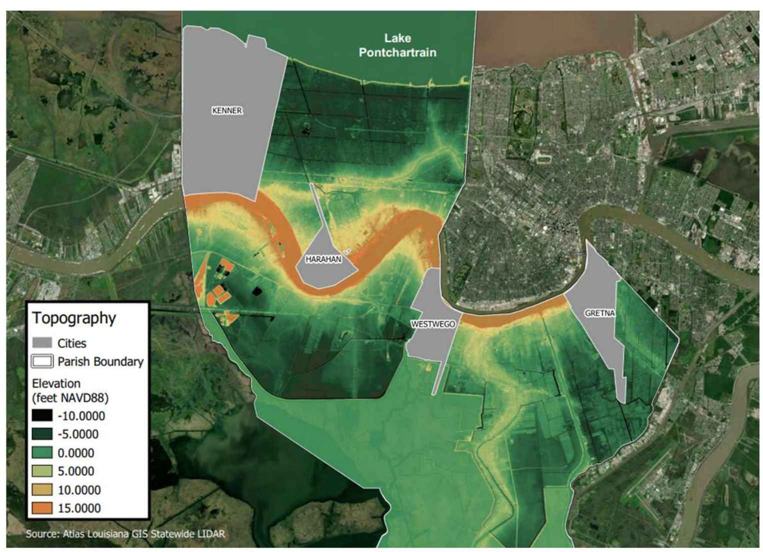


Figure 20. Topography, Jefferson Parish

Topographic maps help to illustrate how high or low land is across the Parish (i.e. elevation). Typically, water flows to the lowest elevation and enters a body of water. In Jefferson Parish, when water flows to the lowest point it then has to be conveyed (through pipes and pumps) up and over the levee system (HSDRRS) to enter either the Mississippi River or Lake Pontchartrain. Light yellow and orange areas illustrated in **Figure 20** depict natural ridges that were formed prior to development of the external levee system (HSDRRS). These areas are the highest (i.e. 10-15 ft) land area in the Parish and are generally less prone to flooding. They also represent areas where GI projects could be implemented to catch and store flood waters before they inundate drainage systems located in lower elevations, where floodwaters may not be effectively stored due to challenges related to soil impermeability or depth to water table ratios.

Areas in light and dark green areas are lower in elevation and are more prone to flooding as illustrated by (**Figure 5,** Page 27*):* FEMA Repetitive Loss and **Figure 19** Calculated Flood Depths. The success of green infrastructure elements in these areas depends on an area's soil impermeability, depth to water table ratios and available space.

D. IMPERVIOUS SURFACES

Impervious Cover: A surface composed of any material that greatly impedes or prevents the natural infiltration of water into the underlying native soils. Impervious surfaces include, but are not limited to, rooftops, buildings, sidewalks, driveways, streets and roads.

Impervious urban development exchanges slower natural processes for an engineered system of culverts and canals. This results in larger volumes of water moving across the impermeable surface, and if the system capacity is exceeded can cause flooding, water quality issues, increased erosion, and decreased groundwater storage.

One strategy to implement green infrastructure principles includes 'peeling back pavement' or removal of hard or impervious surfaces where long-term benefits to reduce flood risk are highly likely. **Figure 22,** "Surface Impermeability," demonstrates how land use is tied to land cover, which is important when developing policies that affect large sites with significant amounts of paved parking areas, and when developing treatments trains that considers a series of projects that work together to mitigate the impacts of stormwater runoff.

Figure 22 categorizes the extent to which land is developed with impervious cover into three categories: High (>80%), Medium (between 40-79%) and Low (<40%). On the east bank, areas having low surface impermeability are shown in green and include land uses like golf courses, interstate on/off ramps, school campuses, playgrounds, and ball fields. Similar land uses are located on the west bank, as well as large areas of undeveloped, forested wetlands in the southwestern portion of the Parish within and outside the levee protection system. Areas with low surface impermeability are relatively rare and elevate a parishwide challenge associated with a general lack of green space to and utilize for stormwater runoff storage and filtration.

Areas developed with residential land uses are generally categorized as having medium surface impermeability and are shown in **Figure 22** in light pink. These areas are widespread throughout the Parish.

Areas with major commercial, industrial and/warehousing land uses are generally classified as having a high surface impermeability, including — but not limited to — the Louis Armstrong Airport, Lakeside Mall, Clearview Mall, Oakwood Malls, and Elmwood. These areas, which are composed of over 80% impervious surfaces, also have 0 to 1.9-foot calculated flood depths and more than 200 repetitive loss claims. Implementation of policies that peel back pavement in these areas could provide needed support to the existing drainage system to sustain its performance.

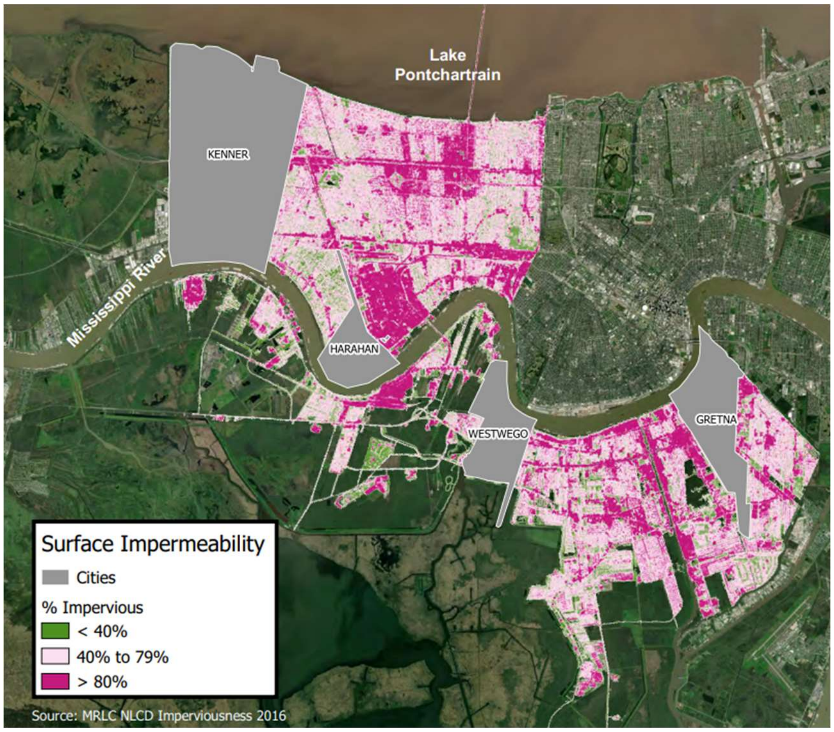


Figure 22. Surface Impermeability, Jefferson Parish

E. SOIL PERMEABILITY & TYPOLOGIES

Green infrastructure leverages the inherent permeability of cityscapes to mimic natural soils — slowing, holding, and improving stormwater quality. By managing stormwater where it falls, runoff to natural waters and wastewater treatment facilities can be reduced.[2]

And yet — sometimes green infrastructure is not suitable due to the physical characteristics of the land. Since green infrastructure techniques rely heavily on stormwater infiltration, locations in which infiltration is poor may create a physical barrier. Soil characteristics, specifically soil permeability, can indicate which areas in Jefferson Parish are appropriate for certain green infrastructure elements.

For example, redirecting water away from gray infrastructure towards soils that are insufficiently permeable may worsen flooding conditions. In Jefferson Parish, it is widely understood that the drainage system is able to pump up to a half an inch of stormwater per hour out of the Parish drainage system into a receiving body of water. How to best couple this system's performance with green infrastructure relies on building green elements on soils that can facilitate the performance of tools such as permeable pavement, green roofs, urban forests, wetlands, and rain gardens.

To this end, the project team reviewed and analyzed two comprehensive soil surveys of Jefferson Parish that were completed in 1978 through a cooperative effort by the United States Department of Agriculture (USDA) Soil Conservation Service, Louisiana Agricultural Experiment Station, Louisiana State Soil and Water Conservation Committee, and other state and federal agencies.

One characteristic of interest to the study was "permeability," which is influenced by depth below ground. For instance, layers closer to the surface may be more permeable than deeper and more compact stratigraphic layers within the same soil classification.

The US Environmental Protection Agency (EPA) has established native soil infiltration guidelines that designate infiltration rates above 0.25 to 0.5 inches per hour as "permeable soils." This determination is affected by a soil's performance at various depths. **Figure 23** indicates soil permeabilities throughout Jefferson Parish at a 25" depth, which was chosen under the assumption that green infrastructure element construction involves clearing the top 18" to 25" of soil. Permeability rates were sourced from 1978 soil surveys of Jefferson Parish by USDA et al.

Figure 23 indicates that areas furthest from the river, including historic bayous, are the most permeable soils in the Parish and are shown in the darkest blue. These areas have less compacted soils, are able to absorb two or more inches of rainwater an hour and are often at lower elevations. Green infrastructure designs in these areas at the site, neighborhood and corridor scales should focus on opportunities to retain and stabilize soils. This will reduce flood risk, improve water quality and prevent further subsidence. Opportunities in these areas include constructing open swales, retaining unpaved grass channels in drainage canals, regrading front yards, rainwater harvesting, constructing small stormwater wetlands (i.e., pocket wetlands) or wet swales, and simple downspout disconnections to spread rooftop runoff.

[2] https://www.soils.org/about-soils/green-infrastructure

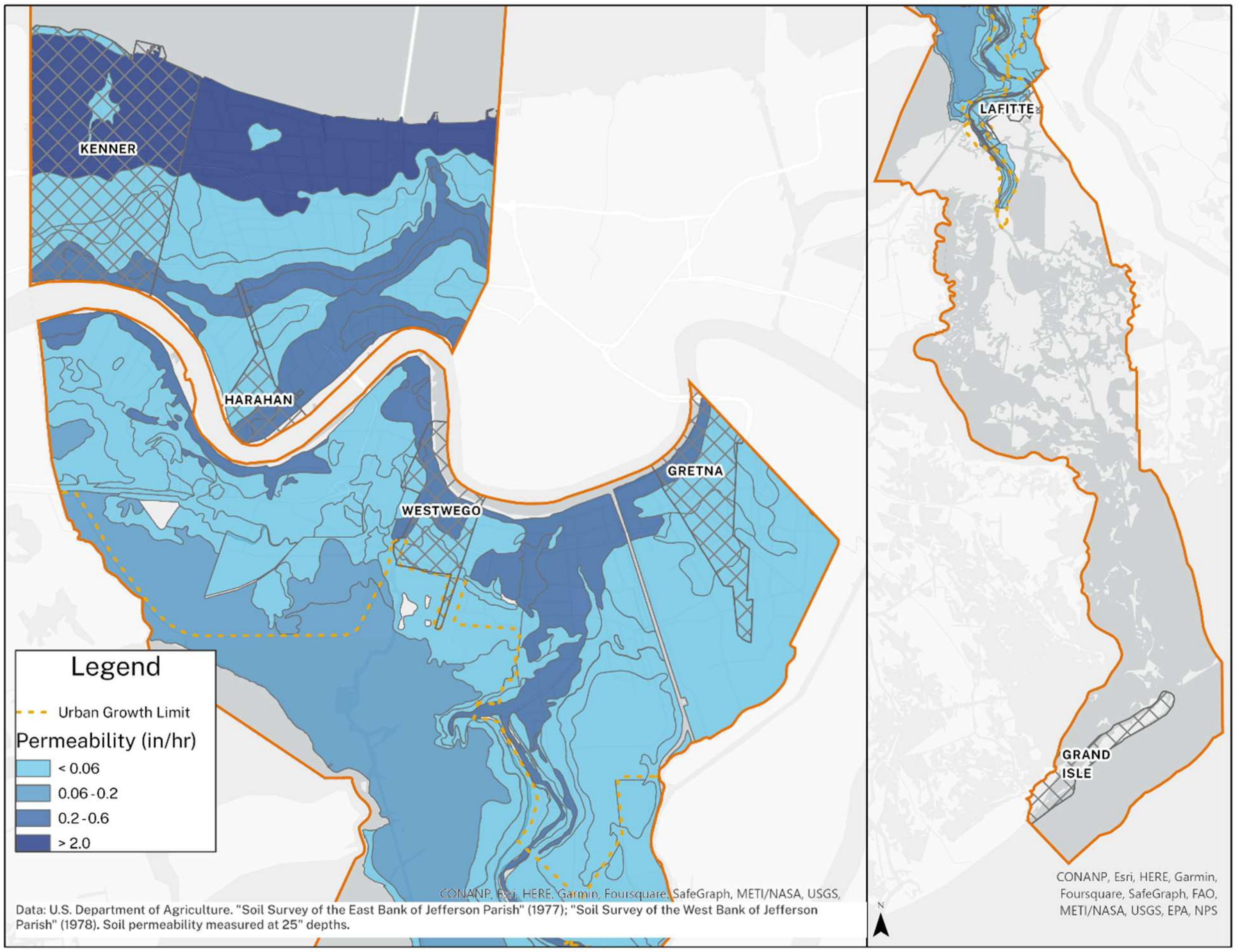


Figure 23. Measured soil permeability, Jefferson Parish (Credit: Jefferson Parish Planning Department).

Within areas shown in green and orange in **Figure 23,** infiltrative practices may not be practical due to the slower absorption rates. In these cases, alternative green infrastructure measures should be considered that do not rely on infiltration, such as green roofs, rain barrels, and cisterns. Given the larger depth to the water table in these areas, buried storage tanks could similarly provide an alternative solution. Alternatively, soil restoration on large vacant lots could help to reduce compaction, improve soil permeability, and provide for development of stormwater lots where there is a significant need for increased flood risk reduction measures.

It is important to also recognize the misperception that intense rainfall and clay soils in Louisiana are an impediment to green infrastructure because they do not allow sufficient infiltration and ponding might occur. This problem has been addressed in literature, but remains poorly understood. This can lead many in the state to underestimate post construction reduction in stormwater runoff volumes compared to traditional gray infrastructure.

To address this misperception, it is important to elevate solutions and design alternatives to apply in Jefferson Parish that acknowledge challenges associated with clay soils. Some design alternatives and program solutions include:

1. Before green infrastructure practices are implemented the suitability of the site should evaluated.
2. Ensure the project design is appropriately sized, constructed, and designed to minimize clogging.
3. Ensure proper drainage is provided; in some cases, this may involve including an underdrain.

With these considerations rain gardens, permeable pavements, and bioretention cells can perform well on sites with clay soils (Buster, 2014).

Existing soil conditions can also be “reconditioned” to be more suitable for a particular practice. In the longer term, making available local, accessible, performance data could improve stormwater designs and change this perception over time.

F. DEPTH TO WATER TABLE

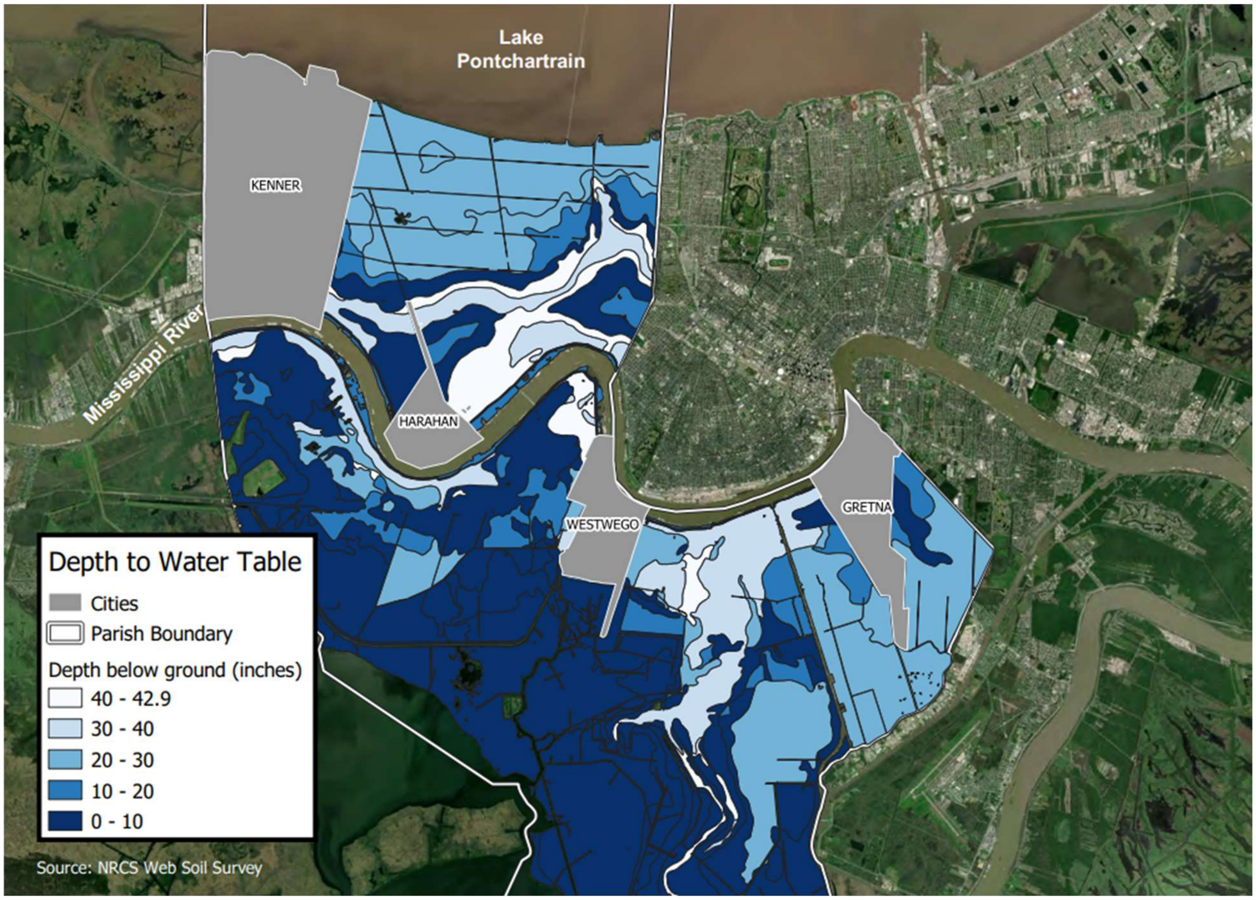


Figure 24. Depth to Water Table, Jefferson Parish.

Figure 24 illustrates the depth below ground surface to the average annual high-water table. This could also be explained as the depth of a hole (in inches) when water would begin to pool in its bottom.

Depth to water table is similar to soil permeability in that a site's availability to retain water is limited in how deep you can construct green infrastructure before hitting the water table and compromising the GI system's integrity.

A minimum of 2 feet is often recommended between the bottom of a bioretention or filtration system and the water table. This distance helps to prevent seepage of pollutants or contaminants that settle at the bottom of the system into ground water sources. When less than 2 feet of clearance is available, reducing the distance to 18 inches, including a barrier (like a pond liner) at the bottom of the system, or installing an alternative GI design that is better suited to this type of site constraint is recommended.

The water table is at a fairly constant elevation across the Parish, and the primary factor for depth to water table is ground surface elevation, previously discussed as part of the project team's review of parishwide topographic data. Together, these data and the reduced permeability of the soils present along the natural ridges throughout the Parish suggest the following:

Areas shown in white (40-42.9 inches) and light blue (30-40 inches) have the largest space between the ground surface elevation and the water table.

These areas are best suited for below-ground storage in cisterns or covered reservoirs, which can help to slow the rate at which water enters the drainage system and improve its performance during extreme rainfall events. For example, development of larger cisterns that extend above the ground surface elevation, designed to create enhanced landscapes (hills and swales) and connect with other GI systems, such as a downspout from a large commercial rooftop, could store more water, create more inviting green spaces and offer a higher return on investment than would confining storage to only the space between the ground surface and water table.

Areas shown in medium blue (20-30 inches) are suited for a range of green infrastructure alternatives. Specifically, permeable pavements and other storage and infiltration systems where stormwater runoff is captured before flowing into the drainage system or within areas having lower elevations. These areas are best suited for stormwater planters, rain gardens, dry and wet swales when coupled with high soil permeability.

Areas shown in dark blue (0-20 inches) are not suited for rain gardens (depth to water table should be at least 18 inches to 2 feet), permeable paving systems (should ensure the distance from the bottom of the permeable pavement system to the top of the water table is at least 2 feet). These areas are better suited for stormwater ponds and stormwater wetlands to intercept and treat stormwater runoff in these areas.

G. WATER QUALITY DATA

In order to prioritize green infrastructure elements, it is important to capture the input of local efforts, concerns or needs and provide a path forward that advances the mission of the Parish and its departments. To this end, local input is summarized from meetings of the Green Infrastructure Technical Committee, as well as data collected and analyzed on the effectiveness of specific green infrastructure elements on improving water quality. By aligning the needs identified by local officials with data that support project solutions, the Parish can optimize limited resources for maximum public benefit.

1. Local Data

Discussions with the Green Infrastructure Technical Committee helped to identify efforts that could improve water quality across the Parish. It is important to note that the Parish currently does not have a significant problem meeting Municipal Separate Storm Sewer System Total Maximum Daily Load (MS4 TMDL) requirements. TDMLs highlighted by the Technical Committee that could be addressed as part of a Green Infrastructure Plan included:

1. Managing construction site runoff
2. Ensuring proper water quality controls are reinstated after major storms
3. Identifying personnel responsible for implementing GI Plan recommendations
4. Focusing solutions on the East Bank on redevelopment and West Bank on new development
5. Acknowledging the “No Growth Line” around the Parish that protects coastal areas
6. Understanding drainage system complications, including how during dry periods the dissolved oxygen drops and the pumps must be reversed
7. Reducing TMDLs for total dissolved solids (TDS) on the West Bank near the landfills.
8. Preventing or reducing the instance of chlorides leeching from groundwater on the West Bank

Note: Solutions explored should acknowledge that Sauls Canal on the West Bank is a naturally salty aquifer, which is an added challenge.

Note: TMDLs listed are based on the 2020 303(d) list, which is subject to future changes.

2. Project Data

Since 1996, or over the past 25 years, the International Stormwater BMP Database Project has updated their performance monitoring research of stormwater management systems approximately every two years. Following an upload of new data sets, the BMP Database team generates performance summary reports focused on commonly monitored water quality analytics including solids, bacteria, metals and nutrients, summarized in **Table 3** and the BMP or SCM categories included in the analysis are summarized in **Table 4.**

As part of Jefferson Parish’s stormwater monitoring program, all elements listed below are sampled in rain event samples with the exception of *E. coli*, arsenic, Chromium and iron. Enterococcus TMDLs are sampled on the East Bank only. Sulfate TDMLs are sampled on the West Bank.

Solids	Bacteria	Nutrients	Metals
Total suspended solids (TSS) Total dissolved solids (TDS)	Fecal coliform *Escherichia coli* (*E. coli*) Enterococcus	Total phosphorus Orthophosphate Dissolved phosphorus Total nitrogen Total Kjeldahl nitrogen (TKN) Nitrate and nitrate plus nitrite (NOx) Ammonia as N	Arsenic (total and dissolved) Cadmium (total and dissolved) Chromium (total and dissolved) Copper (total and dissolved) Iron (total and dissolved) Lead (total and dissolved) Nickel (total and dissolved) Zinc (total and dissolved)

Table 3. Constituent Analyzed by Pollutant Category

BMP Category	Code	Description
Detention Basin	DB	Dry extended detention grass-lined and concrete lined basins that empty out after a storm.
Retention Pond	RP	Surface wet pond with a permanent pool of water, may include underground wet vaults.
Wetland Basin	WB	Similar to a retention pond (with a permanent pool of water), typically with more than 50 of its surface covered by emergent wetland vegetation.
Wetland Channel	WC	A continuously wet channel with wetland vegetation and slow velocities.
Grass Swale	BS	Shallow, vegetated channel, also called bioswale or vegetated swale.
Grass Strip	BI	Vegetated areas designed to accept laterally distributed sheet flow from adjacent impervious areas, also called buffer strips or vegetated buffers.
Bioretention	BR	Shallow, vegetated basins with a variety of planting/filtration media and often including underdrains. Also called rain gardens and biofiltration.
Media Filter	MF	Filter bed with granular media, typically sand.
High Rate Biofiltration	HRBF	Manufactured devices with high rate filtration media that support plants.
High Rate Media Filtration	HRMF	Manufactured devices with high rate filtration media consisting of a variety of inert and sorptive media types and configurations (e.g., cartridge filters, upflow filters, membrane filters, vertical bed filters).
Hydrodynamic Separation Devices	HDS	Manufactured devices providing gravitational settling using swirl concentrators, screens, and baffles.
Oil/Grit Separators and Baffle Boxes	OGS	Manufactured devices including oil/water separators and baffle chambers designed for removing floatables and coarse solids.
Permeable Friction Course (Overlay)	PF	Open-graded bituminous mixture placed over an impervious road base.
Porous Pavement	PP	Full-depth pervious concrete, porous asphalt, paving stones or bricks, reinforced turf rings, and other permeable surface designed to replace traditional pavement.

Table 4. BMP or SCM Categories Included in 2020 Performance Analysis

Findings from the International Stormwater BMP Database Project's most recent 2020 performance analysis suggests that the type and application of a stormwater management solution be tailored to the specific pollutant category requiring reduction, as performance varies depending on the individual pollutant and unit treatment processes provided by the BMP or SCM. According to the International Stormwater BMP Database, 2020 Summary Statistics:

Solids: While all of the BMP or SCM types evaluated demonstrated statistically significant reduction in total suspended solid (or TTS), the lowest effluent concentrations observed for TSS include bioretention, media filters, high rate biofiltration devices, and retention basins. These BMPs or SCMs enable sedimentation and filtration, which are effective treatment processes for sediment removal.

Bacteria: Bioretention, wetland basins, retention ponds, media filters and dry extended detention basins show the ability to significantly reduce currently recommended fecal indicator bacteria concentrations.

Phosphorous: The best performing BMPs or SCMs for total phosphorus reduction are media filters, high-rate biofiltration, and high-rate media filtration with total phosphorus median effluent concentrations of 0.05 to 0.09 mg/L. The best performing BMPs or SCMs for orthophosphate are retention ponds and media filters. Retention ponds also show reductions for dissolved phosphorus.

Nutrients – Nitrogen: For the removal of nitrate, the best performing BMPs or SCMs are retention ponds, wetland basins, and wetland channels.

Metals: Most of the BMPs or SCMs evaluated showed statistically significant reduction of total copper, lead and zinc, however the 2020 report advises additional research is needed on other urban stormwater analytes with limited data sets including heavy metals other than copper, lead, and zinc.

Given recent findings of the BMP or SCM database team, long-term applications of green infrastructure design alternatives should be closely coordinated with Parish pollutant reduction priorities both in location and type of pollutant category to ensure maximum effectiveness and long-term benefits.

H. DATA FINDINGS

1. Jefferson Parish experiences some of the highest average rainfall rates in the state and the country with a high degree of spatial variability: some areas in the Parish reach as high as 80 inches of mean annual rainfall. Anticipating this increase in rainfall and designing the Parish drainage system to incorporate green infrastructure will help **prepare communities for more intense and frequent rainfall events**—keeping businesses open and fostering long-term resilience. Storing floodwaters from more frequent rain events can also reduce the effects of subsidence by replenishing local soils with water and keeping them stabilized.

2. Available space is the most significant challenge to implementing green infrastructure elements parishwide. For this reason, the Parish should look to creative, location-based, data-driven solutions. One of the most promising of these is **reducing impervious surfaces throughout Jefferson Parish, especially in over-paved and under-utilized parking areas.** Additional criteria could focus on improving site planning and design techniques, low impact development practices, and planning “greenways” designed to rehabilitate urban and suburban environments to reduce post-construction stormwater runoff rates, volumes, and pollutant loads. Integrating green infrastructure solutions into available public space and strategically requiring green infrastructure on private development sites will be key in overcoming this challenge.

3. Areas having projected flood water depths of 0 to 1.9 feet are areas that could see significant improvement in nuisance flooding should green infrastructure measures be employed consistently **on-site and/or within public spaces**.

4. Those areas with anticipated flood depths of 2 to 6+ feet, given the depth of flood waters, would benefit from **combined solutions** (gray and green) or larger site (25 acres+) green infrastructure SCMs designed to retain and absorb floodwaters across a larger area of land.

5. The highest land area in the Parish (i.e. 10-15 ft) is less prone to flooding, located along natural ridges, has low soil permeability rates, and represents areas where infiltrative practices may not be practical due to the slower absorption rates. In these cases, alternative green infrastructure measures should be considered that do not rely on infiltration, such as **green roofs, rain barrels, and cisterns**. Given the larger depth to the water table in these areas, buried storage tanks could similarly provide an alternative solution. Alternatively, soil restoration on large vacant lots could help to reduce compaction, improve soil permeability, and provide for development of stormwater lots where there is a significant need for increased flood risk reduction measures.

6. Lower elevations are more prone to flooding, have higher soil permeability rates, and are constrained by limited depth to water table ratios and available space. Green infrastructure designs in these areas should look to **site, neighborhood and corridor projects**, focus on opportunities to retain and stabilize soils to reduce flood risk, improve water quality and prevent further subsidence, such as open swales and grass channels in canals, front yard regrading/open swale incentive program, use of rainwater harvesting, small stormwater wetlands (i.e., pocket wetlands) or wet swales, and simple downspout disconnections to spread rooftop runoff from individual downspouts across lawns and other pervious areas.

7. Areas developed primarily with residential land uses are generally categorized as having medium surface impermeability, are more widespread across the Parish, and could support **development of residential programs** that demonstrate economy of scale.

8. Areas with major commercial, and industrial/warehousing land uses are generally classified as having a high surface impermeability, including — but not limited to — the Louis Armstrong Airport, Lakeside Mall, Clearview Mall, Elmwood Park, and Oakwood Mall. These areas also have 0 to 1.9ft calculated flood depths, over 200 repetitive loss claims, and over 80% impervious surfaces. **Implementation of policies** that peel back pavement, including reducing or enabling more flexible parking requirements in these areas, could provide needed support to the existing drainage system to sustain long-term performance.

9. Long-term applications of green infrastructure design alternatives should be closely coordinated with Parish **pollutant reduction priorities** both in location and type of pollutant category to ensure maximum effectiveness and long-term benefits.

10. To maximize the benefit of data reviewed and support data-based decision-making as part of next steps, this Green Infrastructure Plan proposes **draft project area criteria be developed** to better support project development that will provide the most benefits and be best aligned with Parish assets and opportunities. Proposed draft project area criteria could begin to narrow the development of green infrastructure elements to specific areas within the Parish and are described in more detail in Section IX (C).

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VI. REGULATORY FRAMEWORK

Land use development in Jefferson Parish has historically favored gray over green infrastructure through its land use regulation, which, includes minimum parking requirements that can lead to over-paved, unused parking lots and requires that parking be made of impervious materials. Adjusting these barriers are key to the success of a properly integrated Green Infrastructure Plan. Reducing impervious pavement in parking lots, permitting the installation of bioswales or sunken gardens in the public right-of-way, and providing regulatory incentives for builders to incorporate green infrastructure elements into their developments are important steps towards a greener Parish.

A. BACKGROUND

This section summarizes the regulatory framework around green infrastructure and stormwater management in Jefferson Parish; it focuses on the standards required locally in the Parish's Code of Ordinances. While recent changes to the Code of Ordinances have acknowledged the benefit of green infrastructure and Low Impact Development (LID), opportunities exist to amend, enhance, and clarify the code. Future text studies could decrease stormwater runoff, support the drainage system, enhance public and private spaces, and improve on site design techniques and low impact development practices.

Momentum Leads to Parish-wide Voluntary LID Standards

Over the past decade, considerable momentum around green infrastructure has led to changes within Jefferson Parish Government's approach to regulating how developments store and filter water. The first of these efforts, the Jefferson Parish Stormwater Management Advisory Committee (JPSWMAC) presented their recommendations to the Parish Council in December 2016 via Resolution 128317, summarized below (see Appendices B and C for full details):

a. Encourage LID approaches to planning and design

b. Include pervious pavement in development standards

c. Further study the Parish's stormwater regulations and performance standards

d. Enhanced LID policies that ensure the long-term sustainability and resilience of the Parish promote the health, safety and general welfare of Jefferson Parish residents

Furthering these recommendations, the Jefferson Parish Planning Department proposed amendments to the Jefferson Parish Code of Ordinances in 2017 as part of a study of landscaping standards (TXT-1-17). The Parish Council adopted these landscaping standards in 2017, which included incentives for voluntary Low Impact Development (LID) approaches.

The Planning Department also conducted a parking study, wherein amendments to the parking requirements of the UDC enabled flexibility in the provision of parking for commercial sites including parking within garages and shared parking spaces among uses[3]. Previous parking text amendments encouraged responsible development patterns that allow for limited impermeable pavement and efficient use of space for development and paved parking areas.

A Regional Leader in Hazard and Flood Mitigation

Jefferson Parish also maintains a strong position both regionally and statewide in mitigating future flood risk for its residents and business through the following activities:

a. Adoption and maintenance of accurate flood maps (FIRMS or Flood Insurance Rate Maps) and advisory base flood elevation (ABFE) maps, which were most recently updated in 2014.

b. Participation in the National Flood Insurance Program (NFIP)'s Community Rating System (CRS) Program, which allows the Parish to earn points for implementing flood reduction activities above and beyond the NFIP's minimum standards. Jefferson Parish has participated in the CRS since 1992.

c. Adoption of new CRA freeboard requirements affecting building elevation requirements and taking flood safety into account when new housing or commercial units are provided within the Parish (Ordinance No. 26263). This activity allowed the Parish to (1) maintain its Class 5 CRS Community Rating and (2) continue to provide flood insurance policyholders in unincorporated Jefferson Parish a 25 percent discount on policies in the Special Flood Hazard Area, which saves policyholders $10M annually.

[3] https://library.municode.com/la/jefferson_parish/ordinances/code_of_ordinances?nodeId=846776. 11/5/21.
[4] https://library.municode.com/la/jefferson_parish/codes/code_of_ordinances?nodeId=PTIICOOR_CH14F LDAPROR accessed on 11/5/21.

B. STATE AND FEDERAL REGULATIONS

State and federal programs provide oversight to ensure adequate drainage and limit unlawful stormwater discharges. Relevant organizations and processes are summarized in **Table 5**.

Table 5. State and Federal Regulation Review

AGENCY	PERMIT	PURPOSE AND APPLICABILITY
Louisiana Department of Environmental Quality (LDEQ)	**Individual Municipal Separate Storm Sewer System or MS4 Permit**	Addresses water quality issues associated with stormwater discharges. Requires the Parish to implement a Stormwater Management Program (SWMP), including a Green Infrastructure/Low Impact Development program in conjunction with Construction Site Runoff minimum control measures. The Construction Site Runoff element requires the Parish to review construction and development requirements to use green infrastructure/low impact development to minimize water quality degradation and reduce potential flooding caused by increased runoff volumes and rates associated with development.
Louisiana Pollutant Discharge Elimination System (LPDES) via LDEQ	**General Permit for Construction Activities, including clearing, grading, and excavation operations**	Addresses water quality issues associated with stormwater discharges. *Large sites:* Requires the development of a stormwater pollution prevention plan (SWPPP) in order to authorize discharges of stormwater from construction activities that disturb five (5) acres or more of land. *Small sites:* Authorizes stormwater discharges from construction activities that disturb equal to or greater than one acre and less than five acres of land, provided they file the required Notice of Intent with LDEQ. Operators who meet the applicability requirements and conditions have automatic permit coverage and are authorized to discharge stormwater from construction activities in alignment with the terms of the general permit.
Louisiana Department of Transportation and Development (DOTD)	**Hydraulics Manual (2011)**	Addresses state-wide drainage design standards for DOTD projects, including methods for calculating stormwater runoff and hydraulic design methods for open channels, culverts, side and median drains, storm drain systems, grate and curb inlets, stormwater pumping stations, and bridges.

C. JEFFERSON PARISH CODE OF ORDINANCES

The Jefferson Parish Planning Department regulates development through two primary chapters: Chapter 33, the Unified Development Code and Chapter 40, the Comprehensive Zoning Ordinance. While both chapters govern zoning and development regulations, stormwater management regulations appear in Chapter 8 Buildings and Building Regulations, Chapter 14 Flood Damage Prevention Ordinance, Chapter 16 Garbage and Other Solid Waste, and Chapter 27 Water, Sewerage, and Drainage.

At the time of this writing, it is the Parish's intent to move its development regulations from Chapter 40 to Chapter 33. Where possible, the Parish should seek to streamline stormwater management and low impact development regulations by consolidating them in a single location.

Section 33-6.26(d) Greenspace: Low impact development: standards

The current LID standards adopted by Jefferson Parish recognizes that the Parish "promotes the general welfare through sustainable, low impact development which reduces the long-term capital and operational costs of public facilities and minimizes adverse effects on the environment, public works infrastructure, and public health." It incentivizes LID but does not require it by authorizing the Planning Director to ministerially approve reductions in dimensional requirements including minimum setbacks, required parking, and landscape minimums should an applicant meet the following LID thresholds:

> "An application for low impact development shall, in addition to all other applicable requirements, achieve the following standards, as applicable: for new developments, retain and filter the first one and one-quarter (1.25) inch rainfall event through the utilization of BMPs; or, for redevelopment, either filter the first one and one-quarter (1.25) inch rainfall event through the utilization of BMPs, reduce existing imperviousness by fifty (50) percent, or a combination of the two."

Section 33-7.4.4 Stormwater: Assessment of adequacy

"For all proposed developments, other than single-family residential, totaling ten thousand (10,000) square feet or more (all phases), and all single family residential developments totaling five (5) acres or more (all phases), the ten (10) year storm event post-development rate of run-off shall not exceed the ten (10) year storm event pre-development rate of run-off. To ensure that the post-development rate of run-off does not exceed the pre-development rate of run-off, on-site detention will be required in a manner approved by the Jefferson Parish Public Works Department. The detention system cannot release water from the site at a rate greater than the pre-development rate of run-off."

D. PARISHWIDE PARKING AND IMPERVIOUS SURFACES

The regulations that govern parking represent a key opportunity to decrease the amount of impermeable surface throughout Jefferson Parish. Because there is limited space for new private developments, setting aside space for green infrastructure may compete with developers' financial interest to maximize the amount of buildable land. There may also be space limitations when installing green infrastructure in the public right-of-way. However, a focus on peeling back *existing* impervious surfaces, especially underutilized paved parking lots, and on ensuring *new* parking helps slow, filter, and detain stormwater are significant areas on which the Parish should focus its attention.

To that end, this section focuses on the research and high-level findings of the project team, which are presented here to inform future amendments to the Parish's parking regulations. A review of existing parking standards, two in-person parking surveys, a Parish-wide mapping analysis, and a review of recommendations associated with the Planning Department's TXT-1-17 Landscaping and Buffering Study were completed to remove barriers to implementing green infrastructure elements. Findings from this effort are summarized below:

1. **General Recommended Improvements to Parking Requirements** In 2020, Volkert conducted parking studies across Jefferson Parish that identified several key points:

    a. Current minimum off-street parking regulations can be challenging to interpret, administer and enforce. They can also lead to an oversupply of parking. Required parking ratios should contain **both a minimum and a maximum amount** in order to curb excess parking construction.

   a. Jefferson Parish **should reduce parking requirements where mass transit is available or enforceable shared parking arrangements are made**. Off-site, shared, and on-street parking regulations should be clarified to reduce the need for construction of new impervious surfaces.
   b. Jefferson Parish should **reduce the overall imperviousness associated with parking lots** by providing compact car spaces, minimizing stall dimensions, incorporating efficient parking lanes, and using permeable materials in spillover parking lots
   c. Jefferson Parish should **provide meaningful incentives to encourage structured parking (i.e. parking garages)** to make them more economically viable for developers. Structured parking garages allow an increased number of parking spaces across a smaller impermeable area than surface parking lots.
   d. Jefferson Parish should **provide stormwater treatment for parking lot runoff** by using bioretention areas, filter strips, and/or other practices that can be integrated into the required landscape areas and traffic islands.
2. **Organization of Stormwater and Parking Regulations**: there is an opportunity to consolidate stormwater management, parking requirements and LID standards in Chapter 33 Unified Development Code to reflect how standards impact the amount of impervious surface on site and contribute to a site's stormwater runoff total, as well as clarify standards for ease of interpretation.

3. **Parking Lot Impervious Cover**
   a. The Parish's LID and permeable paving standards could be clarified to reduce confusion as to when standards are required vs. encouraged.
   b. The Parish limits the amount of compact spaces permitted in parking areas.
   c. The Parish right of way (ROW) lease agreements for parking are currently not required to be permeable in the Code, but have been in practice. Lease parking areas are not allowed to count towards the required parking for adjacent land uses.
4. **Parking Ratios-Off Street Parking Requirements**
   a. Research and recommendations from a previous Planning Parking Study (Sept. 2011) addressed the reduction or elimination of parking minimums in order to address parking oversupply.
   b. Updating this report could support creation of an updated off-street parking minimum table and adoption of reduced minimum parking requirements and a parking maximum.
5. **Off-site and Shared Parking**
   c. Similar to parking ratios, research and recommendations from a previous Planning Parking Study (Sept. 2011) included recommendations to update the shared parking table.
   d. Building from previous efforts, there is an opportunity to expand off-site, shared, and on-street parking Parish-wide in order to reduce impervious surfaces and implement green infrastructure elements.

E. EROSION AND SEDIMENT CONTROL

In 2022, Digital Engineering & Imaging Inc. (DE) conducted the Erosion and Sediment Control Regulatory Assessment for the JP Department of Environmental Affairs. The goal of this assessment was to "determine how effectively the Parish addresses and enforces erosion and sedimentation control measures throughout their jurisdiction" and provide recommendations for ordinance improvements (Digital Engineering & Imaging, 2022).

To assess the Parish's approach to controlling erosion and sediment, DE reviewed the Code of Ordinances and used the Center for Watershed Protection Code and Ordinance Worksheet (COW) to rank the comprehensiveness of regulations: Jefferson Parish received 16 of 34 possible points. DE also compared the Parish's regulatory controls to communities regionally and state-wide. Among their findings and recommendations are the following:

1. Jefferson Parish **enforces erosion and sediment control measures on a complaint-based system**, which does not keep developers or contractors accountable for their contribution of pollutants from construction sites.
2. **Proposed Erosion and Sedimentation Control Section.** Jefferson Parish code contains sedimentation and erosion language within five chapters and lacks statements clarifying the importance of these controls, clear technical definitions, enforcement mechanisms, responsible parties, and fines for non-compliance.
3. **Proposed Increase of Enforcement and Regulations.** Jefferson Parish should consider increasing the erosion and sedimentation control measures for construction sites, developments, and land disturbing activities.

F. COMMUNITY COMPARISON

1. Lot Coverage Ratio

To prevent excessive impermeable surfaces on Jefferson Parish sites, twenty-three (23) communities across Louisiana and the United States were reviewed to better understand how the Parish's peers set limits on impervious surface coverage and permeable open space minimums. Of the communities reviewed:

- 7 set limits on impervious surface coverage and permeable open space minimums
- 6 limit impervious surface alone
- 6 set minimum regulations for permeable open space.
- 4 set no standard in the code for either research area.

Maximum impervious surface applies to all surfaces, including building foundation. Of those communities with restrictions on impervious surface, most set a maximum of around 40 percent (**Figure 25**), including all foundation and external items, such as driveways, walkways and, in some cases, swimming pools[5]. Across communities having standards for impervious surface, 39 percent is the average maximum lot coverage within low and medium density single-family residential districts.

There is an opportunity to incorporate maximum lot coverage requirements parishwide in the short-term that reflect site characteristics, such as lot size and land use. Due to a lack of available space throughout the Parish, site design flexibility is more limited on residential sites. Should lot coverage maximums be applied parishwide, these standards should focus on opportunities to peel back pavement in commercial and industrial districts, where practicable

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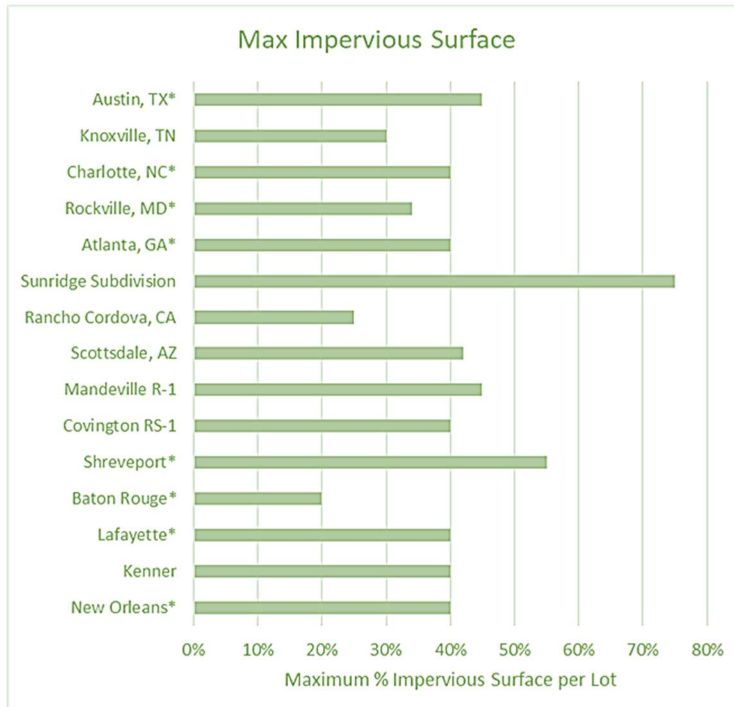

Figure 25. Comparison of Community Maximum Impervious Surface Requirements

[5] Note: Swimming pool permitted within the "Open Space" and not counted toward impervious surface restrictions: Caddo Parish, New Orleans, Lafayette (pool decking is counted toward impervious materials/ water area is not), Alexandria, Mandeville

VII. GOALS AND OBJECTIVES

Like the benefits of green infrastructure, our goals are wide-reaching. They directly inform the recommendations offered in this Plan and encompass three domains:

1) Reduce flooding and improve environmental quality by slowing, storing, and cleaning high-energy runoff before it enters the drainage system;

2) Create or enhance public spaces; and

3) Overcome technical, regulatory, financial and institutional obstacles.

If applied, these domains ensure that green infrastructure in Jefferson Parish is implemented in a way that improves residents' quality of life, targets Parish-owned public right of ways and parkland as "proof of concept" developments, and streamlines the existing efforts the Parish government has made to encourage green infrastructure. This makes it easier for Parish residents to access and enjoy the layered benefits of widespread green infrastructure adoption.

1. Reduce flooding and improve environmental quality by slowing, storing and cleaning high energy runoff before it enters the drainage system

- **Advance Low Impact Development (LID) principles on public and private property**
  - Improve parking lot runoff with stormwater treatment alternatives that can be integrated into required landscaping areas and traffic islands
  - Support the development of a comprehensive drainage and flood risk mitigation system that incorporates a network of multi-functional green space and green features to reduce flood risk and pollution

2. Create or enhance public spaces

- **Pursue cost effective projects**
  - Create visually appealing green corridors, support net reduction in urban heat islands, and reduce the area of impervious surfacing in commercial districts
- **Ensure green infrastructure is easily accessible for the public**
  - Create recreational and economic opportunities through the promotion of walkable communities and integration of existing trails for walking, jogging, and cycling
- **Educate the public about the benefits of green infrastructure**
  - Raise awareness to encourages public and private investment within and around a planned network of green space and green features

3. Overcome techncial, regulatory, financial, and institutional obstacles

- **Align and advance similar Parish efforts**
  - Advance goals of the Parish's Municipal Separate Storm Sewer System (MS4) permit issued by USEPA's Region VI
  - Support requirements for the Community Rating System Activity 450: Storm Water Management and LID as per the 2021 Addendum to the 2017 CRS Coordinator's Manual
  - Further implementation of the Parish's Multijurisdictional Hazard Mitigation Plan
    - Evaluate opportunities to reduce imperviousness through amendments to on- and off-street parking requirements, including but not limited to opportunities to:
      - Increase flexibility for off-site parking requirements when unique conditions exist and when LID is applied on site, such as where mass transit, alternative, or shared parking is available
      - Reduce parking lot imperviousness by enforcing maximum parking ratios for particular land uses, reducing parking space dimensions where appropriate, and identifying incentives to encourage structured parking, both of which can reduce the likelihood for excessive parking lot construction over time
- **Enable a unified approach to green infrastructure reflected across the Parish Code of Ordinances**
- **Ensure fair and enforceable subdivision standards for new development that performs well in flood events and helps to support future growth in the Parish**

Figure 26. GI Plan Goals and Objectives

A. CURRENT EFFORTS

Balancing Water Ambassadors

Jefferson Parish's Green Infrastructure Plan will allow Parish departments, residents, and developers to better understand how our land use planning and regulations can lead to a sustainable approach that reduces flood risk to people and property over time.

In an effort to align the Parish's day to day operations with the Plan and future regulations, the Ecosystem & Coastal Management Department and the Planning Department worked with Parish department directors to create an internal group known as the Balancing Water Ambassadors. The Balancing Water Ambassadors are leading the Parish's efforts at implementing green infrastructure strategies that boost their visibility and educate the public about their importance. This group is composed of one to two individuals per invited department and meets once a month.

Prioritizing Sites for Green Infrastructure Investment

The Environmental Protection Agency stresses that green infrastructure is an integral component of sustainable communities (EPA, 2014). These communities promote smart growth principles by balancing their economic assets, natural resources, and social priorities to ensure residents' needs can be met now and in the future. They prosper through the application of a range of strategies that protect the environment and public health, support economic development, create strong neighborhoods with diverse housing and transportation options, and improve residents' quality of life.

Jefferson Parish's Envision Jefferson 2040 comprehensive plan and subarea plans promote smart growth principles. Identifying opportunities to enhance these plans with green infrastructure will help these areas adapt to grow and thrive.

To this effect, existing, mapped subareas highlighted in **Figure 27** represent unique opportunities to create sustainable environments by incorporating green infrastructure to support and enable long-term growth. Enhancements could include corridor-scale green infrastructure projects aimed at reducing stormwater runoff when redevelopment occurs to restore water management balance and mitigate long-term flood risk.

The bottom map highlights Parish-owned land with measured soil permeability. This is intended to showcase sites for "low-hanging fruit" investments in public facilities using green infrastructure elements. Such investments could make green infrastructure more visible to Parish residents and demonstrate its viability as a proof of concept

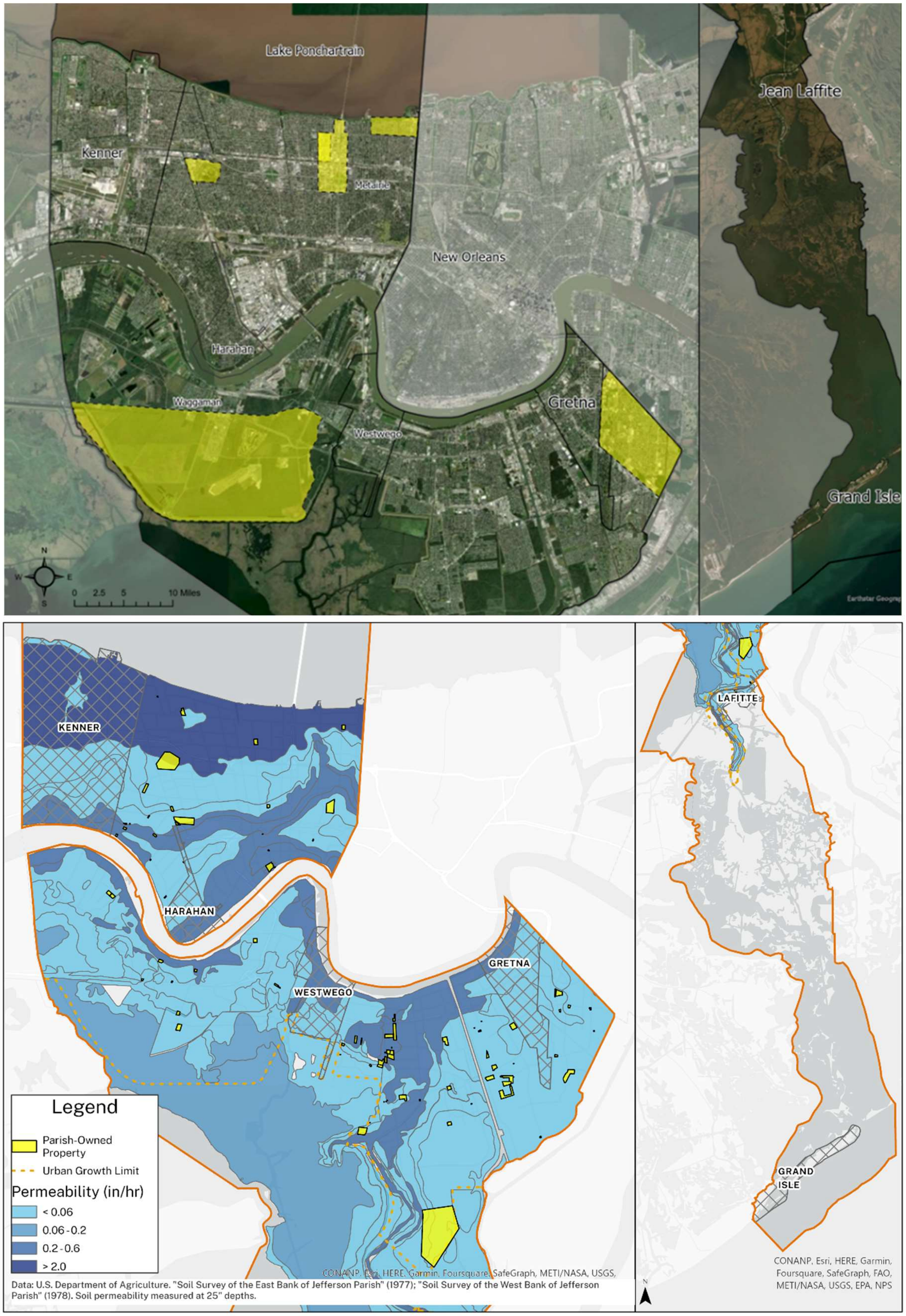

Figure 27. (Above) Jefferson Parish 2040 Comprehensive Plan Subarea Plans in yellow. (Below) measured soil permeability overlaid with select Parish-owned properties with data obtained in April 2021 (yellow).

VIII. RECOMMENDATIONS

The Green Infrastructure Plan has outlined the current state of Jefferson Parish, from high percentages of impermeable surface within the Parish to ongoing issues with drainage, subsidence, and flooding. Through a series of case studies, the Plan has addressed how the Parish has already begun to build green infrastructure elements to balance water, and provided examples of green infrastructure that is well-suited to our southeast Louisiana environment. It has also outlined details about the Parish's current regulatory environment and the steps it has already taken to embrace Low Impact Development within its Code of Ordinances. Our recommendations chart a path forward to a future where Jefferson Parish implements green infrastructure broadly while building on our past success.

The Plan includes recommendations to implement green stormwater infrastructure within the Parish's environments by addressing all three goal domains identified by the project team: (1) flooding from high energy runoff is creatively slowed, stored, and cleaned before entering stormwater systems, (2) environmental quality is improved, (3) public spaces are created or enhanced, and (4) technical, regulatory, financial, and institutional obstacles are overcome.

After reviewing existing plans and studies, approaches, and recent efforts aimed at balancing water throughout the Parish; research specific to local parking requirements; best practices in green infrastructure and water management; nearly 100 other community codes; local data; and review and analysis of existing stormwater data, the project team recommends over 30 actions, categorized broadly as:

DAY-TO-DAY OPERATIONS → Recommendations for new policies and programs designed to change current processes within Jefferson Parish government.

REGULATORY → Recommended directions for text amendments to the Code of Ordinances to affect development processes.

FUNDING and NEXT STEPS → Recommendations designed to improve project planning, create sustainable funding sources, align with regional planning, and enable more competitive project designs.

A. DAY-TO-DAY OPERATIONS

The following processes, activities and partnerships are recommended for the Parish and its departments to pursue in their day-to-day operations:

1. **Develop a Low Impact Development Technical Design Guidance Manual in coordination with a Technical Review Team.** The Manual should provide guidance beyond design specifications discussed in Appendix H, focus on site-scale pre-and post-construction low-impact development SCMs, and include project summary sheets that provide information for both Parish staff and developers regarding:
    a. Site applicability
    b. Design criteria
    c. Benefits provided
    d. Stormwater management incentives available
    e. Ideal applications
    f. Alternative installation methods
    g. Maintenance required
    h. Performance metrics regarding runoff reduction and pollutant removal
2. To provide ideas for manual development and review of its content, **the Technical Review Team should consist of engineers, architects, landscape architects, resource managers, scientists, policy and planning managers, vendors and designers having experience implementing green stormwater infrastructure**.
3. To realize the full potential of green infrastructure in existing street retrofits and road, highway and bridge development projects, **the Parish should incorporate green infrastructure alternatives into the Parish Capital Improvements Program and develop standards for the consistent design of green infrastructure in public spaces.**
4. To ensure consistent interpretation and avoid delay in implementation of project alternatives, **green infrastructure standards for public spaces should be developed collaboratively with local public works, utilities, and engineering departments, as well as state and regional transportation agencies.**
5. **Elevate opportunities with the Parish Drainage Department to integrate sustainable green infrastructure solutions through neighborhood and corridor-scale green infrastructure projects in public** spaces that add storage capacity to traditional stormwater infrastructure and more effectively offset drainage challenges during extreme rainfall events.
6. **Adapt existing Plan Review and Approval Processes to account for review of GI project design alternatives.**

    Recommendations in Section IX B. – Specific Text Amendments will necessitate refinements to the existing Parish plan review and approval process, permit applications, instructions and checklists. The Parish should plan to forecast staff needs, acquire necessary plan review staff to avoid delays, and provide training for plan reviewers in advance of the effective date of required detention implementation. In addition, the Parish should establish a process by which regular work conducted by the drainage department is reviewed for potential stormwater integration opportunities.
7. **Create procedures for maximum lot coverage requirements**, including a pavement permit, inspection, and review procedures; and forecasting and acquiring inspection staff, and providing training for inspectors.
8. **Create a Construction Inspection Program** to ensure SCMs are designed and constructed according to Parish specifications.

    To ensure the appropriate SCMs are selected and designed according to Parish specifications, development of a Construction Inspection Program is recommended, wherein Parish staff can make available and disseminate recommended Technical Design Guidance Manuals, create and disseminate additional relevant outreach materials for responsible parties, create checklists and as-built certification forms, forecast and acquire inspection staff, and provide training for inspectors and contractors. Whether SCMs are developed on public property or private land, it is recommended the Parish set up a performance bond process, forms and tracking system and this be incorporated as an activity coordinated within the Construction Inspection Program.
9. **Create an Inspections and Maintenance Program** to ensure GI SCMs designs continue to perform as designed.

    Implementing green infrastructure involves assigning new roles and responsibilities for ongoing maintenance to both public agencies and private landowners who may have limited knowledge, experience or funding to support. Clearly identifying responsibility for O&M early in the planning and permitting process, training staff (and the public) and implementing operating standards and procedures is recommended to avoid confusion and support long-term success. These processes could include development of an Inspection and Maintenance Program, (which could be combined with the Construction Inspection Program) that addresses functions including, but not limited to creating checklists, inspection forms and enforcement tools; forecasting and acquiring inspection staff.

10. **Select, train, and consistently utilize software or tools to assess site-specific cost reasonableness.**

    When considering barriers to implementing green infrastructure principles in day-to-day operations, cost effectiveness often makes its way to the top of the list of "Why we think this won't work." Issues related to cost are two-fold. First, there is a cost to adapting business models and Parish operations (discussed above), and — second — there is a general skepticism associated with the cost reasonableness of site-specific stormwater management approaches. Once a green infrastructure approach is determined to be appropriate to mitigate risk and improve water quality based on local conditions, use of free or low-cost software is recommended to refine designs, evaluate and choose green infrastructure alternatives. This will create consistency in resource prioritization and improve the quality of green infrastructure projects.

    Specifically, the project team recommends use of the Green Values Calculator or a similar cost evaluation tool (discussed in Section III. E.) to ensure the cost effectiveness of Green Infrastructure implementation at site, neighborhood, and community scales.

11. **Create accountability and transparency through clear tracking, evaluation, and reporting.**

    To support long-term assessment of local systems' cost effectiveness and performance over time, it is important to develop a framework for program tracking, evaluation, and reporting. This includes assignment of responsibility, standardized metrics, establishing a local clearinghouse for data, data evaluation protocols, and annual reporting. Annual reports should capture the effectiveness of SCMs by highlighting demonstrated success of projects, opportunities for improved designs and associated revised criteria, as well as quantifying the benefits of improvements, the effectiveness of enforcement tools, and recommendations for continued performance enhancements.

12. **Engender long-term support and community awareness through outreach, education and training that brings together local and regional stakeholders** to plan, engineer, study, manage, and maintain green infrastructure.

    Local utility, engineering and inspection staff, as well as industry stakeholders in development and consulting would benefit from regular engagement and educational opportunities on green infrastructure design, maintenance, and benefits. This will help to mitigate an industry culture that is skeptical of green infrastructure (i.e. believe it will stop growth) or that it produces poor designs.

    - *Outreach*: Conduct outreach to ASCE, AIA and other local chapters of professional organizations to provide an overview of this Plan and collect feedback. Focused discussions on what they perceive to be barriers to Plan implementation can help to support and refine next steps.
    - *Education:* Engage civic groups and school-based education programs to support local understanding of green infrastructure benefits. Implement in coordination with environmental education program (Action ID PEA-5) to help build an informed populace that better understand how to mitigate risks.
    - *Training:* Host neighborhood level trainings in coordination with public works, planning, and environment departments on site specific SCMs recommended throughout the Parish, focused on the most effective SCMs for the area that could be installed with relative ease, and providing a review of how to implement these alternatives in support of a more sustainable drainage system. For example, review could include implementation of rain gardens, rain barrels, simple downspout disconnections, wet swales, and development of stormwater planters.

13. **Maintain, recognize, and support current provision of best practices.**

    To avoid the practice of "robbing Peter to pay Paul," resources should be maintained to support the continuation of successful, existing best practices with regards to the management of flood damage prevention ordinances, stormwater management programs, and hazard mitigation initiatives.

14. **Continue to align SCM project selection with pollutant reduction goals and priorities.**

    The Parish maintains compliance with required MS4 permit requirements. Short- and long-term applications of green infrastructure design alternatives should continue to be aligned with local pollutant reduction priorities both in location and type of pollutant category to ensure maximum effectiveness and long-term benefits. This can be achieved through plan review and approval processes for private development and a capital improvement planning process for public projects.

15. **Continue to strengthen ties to regional networks to improve coastal and watershed ecosystem health.**

    The Parish's natural environments are constrained by both a man-made growth boundary (levee system) and limited availability of land area for green infrastructure projects. Increased coordination is recommended with regional and state stakeholders to better assess opportunities for larger scale, regional mitigation projects and to isolate opportunities to support migratory (birds, etc.) and other species through the creation of green corridors and additional green space throughout the Parish's built environment.

B. REGULATORY RECOMMENDATIONS

Regulatory recommendations reflect findings summarized in Section VII and include suggested amendments to the Jefferson Parish Code of Ordinances and strategic directions for future plans. These changes include development processes that decrease stormwater runoff, support the drainage system, enhance public and private spaces, and improve on site design techniques and low impact development practices.

1. **Enhance the existing flood damage prevention ordinance and portions of the Code of Ordinances relevant to drainage** to implement a comprehensive drainage and flood risk mitigation system in Jefferson Parish, including the following amendments:
   a. Reduce the size threshold for stormwater runoff detention related to development
   b. Clarify and consolidate the regulations for the filling of improved property.
2. **Implement standards that support natural drainage functions and allow flexibility for developments to drain**, such as:
   a. Enhance permeable pavement standards
   b. Maintain and inspect stormwater management site components
   c. Add flexibility to accommodate site designs that use green infrastructure elements
   d. Add requirements for infiltration standards, performance of permeable pavement for vehicular use, and regular recertification of green infrastructure performance.
3. **Add guidance to the Code of Ordinances for Parish officials to implement and enforce sedimentation and erosion control measures.** This could be incorporated into an existing section, such as Chapter 33, or added to a new erosion and sedimentation control section:
   a. Clearly outline the need for erosion and sedimentation control
   b. Define a responsible party for enforcing erosion and sedimentation controls, such as the Jefferson Parish Department of Environmental Affairs
   c. Add detailed definitions to facilitate enforcement with appropriate technical language
   d. Outline approved methods of erosion and sedimentation control through appropriate BMPs
   e. Clarify when these methods are required and add or outline consequences when they are breached
   f. This information is consistent with the 2022 Jefferson Parish Erosion and Sediment Control Assessment, which contains a detailed ordinance review and draft text of a potential Erosion and Sedimentation section
4. **Reorganize and consolidate stormwater regulations.**
   a. Consolidate stormwater management and Low Impact Development (LID) regulations into a single section in Chapter 33
5. **Reduce parking lot runoff by allowing more flexibility for existing LID incentives.**
6. **Reduce imperviousness of parking areas.**
   a. Establish a parking maximum ratio
   b. Require any overflow parking to be permeable
   c. Establish permeable paving provisions for automobile or vehicle dealerships
   d. Allow right-of-way lease parking to count towards required parking
   e. Encourage pervious concrete or pavers.

7. **Reduce off-street parking requirements and add parking maximums** to better utilize existing green space on site to store, retain and filter water.
8. **Clarify how off-site shared parking provisions apply parishwide.**
9. **Support parking alternatives including bicycle parking.**
10. **Add provisions for required maximum lot coverage (or impervious surfaces) on residential lots, and stormwater control measures for commercial and industrial sites.**

There is an opportunity to incorporate staggered lot coverage requirements parishwide in the short-term that reflect site characteristics, such as lot size and land use. Due to a lack of available space throughout the Parish, site design flexibility is more limited on residential sites. Should lot coverage maximums be applied parishwide, these standards should focus on opportunities to peel back pavement in commercial and industrial districts, where practicable.

In addition to the above, the following measures are recommended for the Parish's ongoing consideration related to the adoption and maintenance of the *Envision Jefferson 2040* Comprehensive Plan:

1. **Smart Growth Subarea Plans:** Enhance existing subarea plans with the incorporation of green infrastructure SCMs to support sustainable infrastructure and enable growth in these areas, while also making available additional funding opportunities associated with flood risk reduction FEMA mitigation grants and HUD CDBG-DR recovery funds (*discussed in more detail in Section X, C*). Enhancements could include improving regulatory tools that facilitate connectivity between commercial development and neighborhoods with the inclusion of corridor-scale green infrastructure projects aimed at reducing stormwater runoff to restore water management balance and mitigate long-term flood risk.
2. **Corridor Redevelopment Plans:** Amend the existing Stage "0" Access Management David Drive Corridor Plan to incorporate integrated green stormwater infrastructure as a corridor scale green infrastructure pilot project. Require that design proposals include calculation of BCAs for flood risk reduction and water quality benefits in support of applying for state and federal grant opportunities.
3. **Incorporation into the Jefferson Parish Comprehensive Plan:** A plan or strategy is only as good as the people who believe in it and are willing to support its implementation. For this reason, the review and adoption of the GI Plan as a Strategic Plan of the *Envision Jefferson 2040* Comprehensive Plan is recommended.

C. NEXT STEPS AND FUNDING

1. Develop Green Infrastructure Project Area Criteria

Building upon data findings outlined in Section VI, development of Project Area Criteria is the next step to develop a parishwide Green Infrastructure Capital Improvement Plan and Map in furtherance of constructing projects that demonstrate effectiveness of green infrastructure benefits parishwide.

Development of a common set of project area selection criteria is recommended to strategically begin to narrow the development of Green Infrastructure Elements to areas (*potentially*):

- Located within a FEMA Floodplain
- Located within a Strategic Smart Growth Subarea of the Parish Comprehensive Plan
- Located within a Census Block having over 200 FEMA Repetitive Loss Claims
- Located in an area having over 79% Impervious Surfaces
- Located within an area having 0 to 1.9 Feet Calculated Flood Depths
- Located within an area having -5 or less feet in elevation
- Located within an area having Soil Permeability of at least 6 inches per hour
- Located in an area able to provide benefits to socially vulnerable populations

Project Area Criteria recommendations acknowledge that the Parish is constrained by a lack of available space to implement green infrastructure elements, while also having a high demand for these project types because of its heightened flood risk profile. To balance increased demand and lack of space, project area criteria must support data-driven decision-making that strategically prioritizes resources to build green infrastructure parishwide.

2. Develop Green Infrastructure Capital Improvement Program

- Development of a Green Infrastructure Capital Improvement Program is recommended to create predictability in Green Infrastructure project decision-making processes, increase project funding opportunities, build public trust, and provide a roadmap for predictable progress towards the community's vision.
- Development of Project Maps and a Capital Improvement Program will continue to build momentum for the application of green stormwater infrastructure in Jefferson Parish and should include finalized project area selection criteria, a weighting and evaluation process, prioritization of potential green infrastructure project locations, and project designs aimed at isolating solutions to nuisance flooding, reducing flood claims, improving water quality, and supporting and improving traditional drainage system capacity over the long-term.
- Map and Capital Improvement Program deliverables should build from the data and findings of this Plan and position the Parish to narrow project alternatives as part of a community engagement process that will produce final Project Site Maps.

3. Align Capital Improvement Plans with Federal Grant Program Eligibility Criteria

Align Capital Improvement Plan with federal grant program eligibility criteria to make Jefferson Parish projects more competitive for federal funding. In particular, the Bipartisan Infrastructure Law (BIL), also known as the Infrastructure Investment and Jobs Act of 2021, represents a significant new source of federal funding above the previous baseline and contains programs incentivizing resilience and green infrastructure. One program, Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) makes funding available to states for projects focusing on resilience improvements to existing transportation assets, including at a community drainage level (FHWA, 2022).

a. The New Orleans Regional Planning Commission (RPC), the region's Metropolitan Planning Organization, is actively working to identify funding for resilience projects, including through PROTECT or similar programs, and developing planning processes to further the same.

b. Jefferson Parish should work closely with the RPC and other regional stakeholders to identify state and federal funding opportunities for green infrastructure projects.

4. Invest in Public "Showcase" GI Projects for Awareness and Education

To further narrow project alternatives and frame appropriate next steps that advance the implementation of this Plan and previous plans, the project team recommends the Parish develop the following projects and related programs/efforts:

c. Neighborhood-scale projects within existing public sites and in coordination with local nonprofit organizations, including water storage in strategic parklands and consolidating travel lanes along residential collector corridors and pedestrian oriented neighborhood commercial collector corridors, where pedestrian and cycling activities are likely, flooding is significant, nearby impervious surfaces is greater than 80% of land cover, and low water table and permeable soil enable filtration and absorption of stormwater into local soils, including swaths of vacant land along corridors to provide water storage as wetlands, waterways, and floodable open spaces.

d. Canals and Boulevards in commercial districts reimagined as vital assets with improved water level management, enhanced aesthetics, and spaces for significant public access and recreation.

e. Development of a Coordinated Rain Barrel Neighborhood Program in predominately residential areas where flooding is significant, impervious surfaces is greater than 70% of land cover, and high water tables and low soil permeability reduce the effectiveness of infiltration and retention systems. The program should make available rain barrels and associated equipment, as well as provide education outreach to participating residents, and incentives provided to residents who implement stormwater management on-site.

f. Development of a Front Yard Neighborhood Swale/Regrade Program in predominately residential areas where flooding is significant, impervious surfaces is greater than 70% of land cover, and high water tables and high soil permeability enhance the effectiveness of infiltration and retention systems. The program should map areas eligible for front yard swale installation by block, include a 100% voluntary participation rate, educate residents and collect neighborhood applications. Upon 100% interest on a block, the Parish should move forward with neighborhood designs, attaining required easements on private property, and construction.

5. Develop Financial Incentives for Property Owners to Implement Green Infrastructure

a. Widespread adoption of green infrastructure in Jefferson Parish is essential to the success of this Plan. Parish government can (and should) showcase green infrastructure on public property and incentivize it in new developments, but implementation must come from businessowners and residents who incorporate green infrastructure elements into their existing businesses and homes.

b. One of the main impediments to this goal is access to capital and the perception that green infrastructure costs more than traditional gray infrastructure.

c. Jefferson Parish should coordinate with JEDCO, its economic development arm, or another suitable entity to develop a program that reduces the barrier to funding green infrastructure elements on commercial and residential properties throughout the Parish.

d. A successful program could take the form of grants towards green infrastructure improvements at all scales; a revolving loan program applicable to specific green infrastructure, or technical assistance from the Parish.

IX. FIND THE PLAN ONLINE & CONTACT INFORMATION

Electronic copies of this Plan can be downloaded from https://www.jeffparish.net/departments/planning/green-infrastructure-plan.

If you have any questions or comments about this plan, please contact the Jefferson Parish Planning Department at JPPlanning@jeffparish.net

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APPENDIX A - ACRONYMS AND ABBREVIATIONS

ASTM American Society for Testing and Materials

ASCE American Society of Civil Engineers

BOD Biological oxygen demand

BMP Best management practice, more recently referred to by EPA as Stormwater Control Measures or **SCM**s

CFU Colony forming units

CI Confidence interval

COD Chemical oxygen demand

DO Dissolved oxygen

EPA U.S. Environmental Protection Agency

EMC Event mean concentration

EWRI Environmental and Water Resources Institute

FHWA Federal Highway Administration

GI Green infrastructure

HDS Hydrodynamic separator

HRBF High rate biofiltration

HRMF High rate media filtration

IQR Interquartile Range

LID Low impact development

mg/L milligrams per liter

MPN/100 mL Most probable number per 100 milliliters

MS4 Municipal Separate Storm Sewer System

N Nitrogen

NA Not applicable

NCHRP National Cooperative Highway Research Program

ND Non-detect

NOx Nitrate + nitrite and nitrate

NSQD National Stormwater Quality Database

OGS Oil-grit separator

ORP Oxidation-reduction potential

P Phosphorus

PAH Polycyclic aromatic hydrocarbons

PCB Polychlorinated biphenyls

QMRA Quantitative microbial risk assessment

ROS Regression on statistics

SRP Soluble reactive phosphorus

SCM Stormwater Control Measure

TOC Total organic carbon

TDS Total dissolved solids

TMDL Total maximum daily load

TKN Total Kjeldahl nitrogen

TPH Total petroleum hydrocarbons

TSS Total suspended solid

TVS Total volatile solids

TVSS Total volatile suspended solids

µg/L Micrograms per liter

µm Micrometer

USGS U.S. Geological Survey

APPENDIX B – RESOLUTION NO. 128317

On motion of **Mr. Roberts,** seconded by **Ms. Lee-Sheng,** the following resolution was offered:

RESOLUTION NO. 128317

A resolution providing the findings and recommendations of the Stormwater Management Advisory Committee (the Committee); authorizing the Planning Department and the Planning Advisory Board to conduct a text study of Chapter 2 Administration, Chapter 2.5 Administrative Adjudication of Public Health, Housing, Fire Code, Environmental and Historic District Violations, Chapter 8 Buildings and Building Regulations, Chapter 14 Flood Damage Prevention Ordinance, Chapter 19 Nuisances, Chapter 25, Article VI Comprehensive Plan, Chapter 27 Water, Sewerage and Drainage, Chapter 29 Roads and Bridges, Chapter 33 Unified Development Code, Chapter 37 Vegetation, and Chapter 40 Zoning of the Code of Ordinances, as a recommendation of the Committee and with the intent of enhancing and creating standards and regulations that promote low-impact development and integrated stormwater management; continuing the work of the Committee until December 31, 2017 and revising its functions or membership as needed at a later date; and providing for related matters. (Parishwide)

WHEREAS, the Parish Council established the Storm Water Management Advisory Committee on May 11, 2016 (Resolution No. 127038) and the Committee met three times during its tenure; and

WHEREAS, the Council authorized the Committee to advise it on amending the Code of Ordinances for the purposes of developing a sustainable Jefferson Parish, reducing urban runoff, mitigating the effects of new development, redevelopment, or infill development on the existing drainage system, increasing compatibility between abutting land uses and between land uses and public rights-of-way, providing for the conservation of water resources, reducing the urban heat island effect, enhancing the local micro-climate, increasing species biodiversity, reducing consumption of energy by proper placement of shade trees, and incorporating tree canopy concepts; and

WHEREAS, the Council also authorized the Planning Department and the Planning Advisory Board to conduct a text study of the chapters of the Code of Ordinances related to landscaping and buffering requirements (Resolution No. 123668), which promote similar purposes of sustainability, compatibility, and the enhancement of the public health, safety, and general welfare; and

WHEREAS, at its meetings the Committee considered broader sustainable water management principles and best practices articulated in the Greater New Orleans Urban Water Plan and some specific strategies for managing water proposed in the parish's landscaping study; and

WHEREAS, the Committee finds that encouraging low impact development (LID) through the use of LID Best Management Practices (BMPs), such as pervious paving, bioretention, dry wells, filter/buffer strips, grass swales, and infiltration trenches, is desirable, and recommends that development standards encouraging these practices be included in the text amendments proposed in the landscaping study; and

WHEREAS, the Committee finds that advances in design and technology have expanded the suitable application of pervious paving in development and redevelopment projects, and recommends that development standards allowing pervious paving be included in the text amendments proposed in the landscaping study; and

WHEREAS, achieving broader sustainable water management principles and best practices necessitates further study of the Parish's current stormwater regulations, methods used to achieve requirements, and performance standards related to stormwater quality, groundwater infiltration, or other environmental issues; and

WHEREAS, Jefferson Parish is under the regulations of a Municipal Separate Storm Sewer System (MS4) permit issued by USEPA's Region VI which requires the Parish to address water quality issues associated with stormwater runoff from the drainage areas included in the MS4 permit; and

WHEREAS, the Parish's 2017-2021 Storm Water Management Plan (SWMP), in draft form as of May 2016, sets out thirteen different types of strategies, each with measurable goals, to fulfill the requirements of the MS4 permit; and

WHEREAS, the SWMP includes goals related to green infrastructure, low impact development, and integrated, low-impact stormwater management; and

WHEREAS, the Parish's Multijurisdictional Hazard Mitigation Plan profiles subsidence as a natural hazard but does not identify mitigation actions to alleviate the risks associated with subsidence, actions such as LID BMPs; and

WHEREAS, the Federal Emergency Management Agency (FEMA) has provided the Parish with a Pre-Disaster Mitigation grant to include climate resilience mitigation measures in the Parish's Hazard Mitigation Plan to alleviate subsidence risks to property and infrastructure; and

WHEREAS, the Parish's Comprehensive Plan, *Envision Jefferson 2020*, adopted by Ordinance No. 21939 on August 6, 2003, includes policies related to stormwater runoff quantity and quality and flood protection; and

WHEREAS, on October 19, 2016 (Resolution No. 128051), the Parish Council authorized the Parish Clerk to advertise for Statements of Qualifications to update the Comprehensive Plan and resiliency and sustainability are planning objectives; and

WHEREAS, the update to the Comprehensive Plan will include new or updated goals, objectives, policies, and tasks to promote the parish's resilience and sustainability, which together will be woven throughout the discrete Plan elements; and

WHEREAS, the Committee finds that, given these ongoing and imminent planning initiatives, a continued focus on integrated stormwater management is desirable so that these issues can be addressed comprehensively and collaboratively with other concerns, and recommends that this committee, revised in membership or function as needed at a later date, be continued; and

WHEREAS, actions related to enhancing the Parish's LID policies, practices, standards, and regulations for its long-term resilience and sustainability will promote the health, safety, and general welfare of the parish's residents and businesses.

NOW, THEREFORE, BE IT RESOLVED by the Jefferson Parish Council, acting as governing authority of Jefferson Parish, Louisiana:

SECTION 1. That the Planning Department and the Planning Advisory Board are hereby authorized to conduct a text study of Chapter 2 Administration; Chapter 2.5

Administrative Adjudication of Public Health, Housing, Fire Code, Environmental and Historic District Violations; Chapter 8 Buildings and Building Regulations; Chapter 14 Flood Damage Prevention Ordinance; Chapter 19 Nuisances; Chapter 25, Article VI Comprehensive Plan; Chapter 27 Water, Sewerage and Drainage; Chapter 29 Roads and Bridges; Chapter 33 Unified Development Code; Chapter 37 Vegetation; and Chapter 40 Zoning of the Code of Ordinances as a recommendation of the Stormwater Management Advisory Committee (the Committee) and with the intent of enhancing and creating regulations related to low-impact development and integrated stormwater management, and providing for related matters.

SECTION 2. That the Committee is hereby continued until December 31, 2017, with its functions or membership revised as needed at a later date.

SECTION 3. That the Council Chairman or in his absence the Vice-Chairman be and is authorized to execute any and all documents necessary to give full force and effect to this resolution.

The foregoing resolution having been submitted to a vote, the vote thereon was as following:

YEAS: 7 **NAYS: None** **ABSENT: None**

The resolution was declared to be adopted on this the **7th day of December, 2016.**

THE FOREGOING IS CERTIFIED
TO BE A TRUE & CORRECT COPY

Eula A. Lopez

EULA A. LOPEZ
PARISH CLERK
JEFFERSON PARISH COUNCIL

APPENDIX C - JPSWMAC

Jefferson Parish Stormwater Management Advisory Committee (JPSWMAC)

This Committee was established by the Jefferson Parish Council by resolution in May 2016. The committee met six times from May to November 2016. Its purpose was to advise the Council on amending the Code of Ordinances to encourage sustainable development practices, reduce runoff, and generally "…protect public health, safety, and welfare by preserving and enhancing the positive visual experience of the built environment, promoting urban forestry, providing appropriate transition between different land uses, preserving neighborhood character, and enhancing pedestrian and vehicular traffic safety."

Chaired by then-Council Member, now Parish President, Cynthia Lee-Sheng, the Committee was composed ten (10) voting members with a combination of Parish Directors of relevant departments - Planning, Inspection and Code Enforcement, Engineering, Parish Attorney, JEDCO, and professionals from the private sector who are leading experts in stormwater, landscape architecture, and construction.

TIMELINE:

ACTION	DATE	RESULT
• Resolution 127038 -	May 11, 2016	Council Establishes JPSWMAC
• Resolution 127305 -	June 22, 2016	Council Appoints 8 members
• Committee Meeting	July 21, 2016	
• Resolution 127475 -	July 27, 2016	Council Appoints 2 members
• Committee Meeting	Sept. 15, 2016	
• Committee Meeting	November 3, 2016	

VOTING MEMBERS (2016) – As per Council Resolutions No. 127305 and No. 127475

Council Member, now Parish President Cynthia Lee-Sheng Chaired (no meeting minutes after Nov. 3, 2016 received)

1. Planning Director - Terri Wilkinson
2. Dir. Inspection/Code Enforcement- Aimee Vallot
3. Engineering Director Mark Drewes
4. Parish Attorney - Mike Power
5. JEDCO Representative - Jerry Bologna
6. Private Sector David Waggonner
7. Private Sector Nathan Lott
8. Private Sector Brady Garrity
9. Private Sector Terri Hogan Dreyer
10. Private Sector Dana Brown

SUMMARY OF ACTIONS AND RECOMMENDATIONS

- Planning Dept. Landscaping Study – led to UDC revisions in Parish's landscaping requirements.
- Committee suggestions:

  - Relax the requirement that parking areas be "hard and impervious".
  - Permeable paving should be allowed but what types and under what circumstances? Developer would propose and the Engineering Department would approve.
  - Encourage optional use of low-impact stormwater management practices
  - Administrative approval or BZA variance would simplify the approval process.
  - The use of landscape beds is a good tool to reduce stormwater discharge.
  - Stormwater management requirements and their costs are a concern ("perceived challenge") for developers.
    - New requirements should be incentive based and not have requirements that cause the price of development to increase dramatically.
    - Greenfield development using LID techniques could be cheaper than traditional stormwater management techniques.
    - Retrofitting a site can be challenging, including cost issues.
  - A performance-based approach provides greater flexibility for creative design.
    - Example: tradeoffs could be offered in the form of a variance on height restrictions or required parking spaces if more permeable surfaces are incorporated into the design and/or incentivizing the design process. Discussion only, no official action
  - Parish parking requirements need to be revised.
- Provide a credit toward parking requirements for additional landscaping and LID techniques. No specific "credits" were proposed. There was also discussion on possibly permitting shared parking.

APPENDIX D - DEFINITIONS

Adsorption: Adsorption is the adhesion of atoms, ions or molecules from a liquid to a surface via a loose electrical bond.

Ammonia: Inorganic form of nitrogen; product of hydrolysis of organic nitrogen and denitrification. Ammonia is preferentially used by phytoplankton over nitrate for uptake of inorganic nitrogen

Aquatic Buffer: An area of land located around or near a stream, wetland, or waterbody that has intrinsic value due to the ecological services it provides, including pollutant removal, erosion control and conveyance and temporary storage of flood flows.

Aquatic Resource Protection: Measures taken to protect aquatic resources from negative impacts of the land development process, including complete loss or destruction, stream channel enlargement and increased salinity fluctuations.

Bacteria: Single-celled microorganisms that lack a fully defined nucleus. Bacteria of the coliform group are considered the primary indicators of fecal contamination and are often used to assess water quality.

Best Management Practice (BMP) or **Storm Water Control Measure (SCM)**: Any man-made or natural structure, system, landscape feature, channel, or improvement designed, constructed, installed, and/or used to detail, retain, infiltrate, filter, or otherwise control stormwater runoff quality, rate, or quantity.

Better Site Design Techniques: Site design techniques that can be used during the site planning and design process to minimize land disturbance and the creation of new impervious and disturbed pervious cover. Better site design techniques include reducing clearing and grading limits, reducing roadway lengths and widths, and reducing parking lot and building footprints. “Better Site Planning Techniques” means site planning techniques that can be used during the site planning and design process to protect valuable aquatic and terrestrial resources from the direct impacts of the land development process. Better site planning techniques include protecting primary and secondary conservation areas.

Bioaccumulation: Biological sequestering of a substance at a higher concentration than that at which it occurs in the surrounding water. Metals in biologic tissue can be biomagnified at higher trophic levels.

Channel: A natural or artificial watercourse with a definite bed and banks that conducts continuously or periodically flowing water.

Conservation Areas: Permanently protected areas of a site that are preserved, in perpetuity, in an undisturbed, natural state.

Conservation Easement: A legal agreement between a land owner and a local, state or federal government agency or land trust that permanently protects conservation areas on the owner’s land by limiting the amount and type of development that can take place within them but continues to leave the conservation areas in private ownership.

Dedication: The deliberate appropriation of property by its owner for general public use.

Detention: The temporary storage of stormwater runoff in a stormwater management practice for the purpose of controlling the peak discharge rates and providing gravitational settling of pollutants.

Developer: A person who undertakes a land development project.

Development Project: A new development or redevelopment project.

Development Site: A parcel of land where land disturbing activities have been or will be initiated to complete a land development project.

Dissolved Metals: (more correctly referred to as "filtered" metals). Refers to metals present in a water quality sample that has been filtered through a 0.45 µm to 2 µm filter, acidified to a pH of 2, then analyzed in a laboratory. A "true" dissolved sample requires field-filtering; however, in practice, dissolved metals samples are often filtered and acidified in a laboratory.

Dissolved Phosphorus: That portion of total phosphorus that passes through a 0.45-micron membrane filter.

Drainage Easement: A legal right granted by a land owner to a grantee allowing the grantee to convey, treat or manage stormwater runoff on the private land subject to the drainage easement.

Easement: A legal right granted by a land owner to a grantee allowing the use of private land for conveyance, treatment and management of stormwater runoff and access to green infrastructure and stormwater practices.

Escherichia coli ("E. coli") and **enterococcus**: Subgroups of fecal coliform bacteria that are part of the normal intestinal flora in humans and animals; used as indicators of fecal contamination in the 2012 EPA Recreational Water Quality Criteria. E. coli O157:H7: A specific enteropathogenic strain of E. coli that can cause serious infection resulting in gastroenteritis. Presence of the E. coli subgroup does not necessarily mean that this pathogenic strain of E. coli is present.

Evapotranspiration: The loss of water to the atmosphere through both evaporation and transpiration, which is the evaporation of water from the aerial parts of plants.

Extended Detention: The temporary storage of stormwater runoff in a stormwater management practice for an extended period of time, typically 24 hours or greater.

Extreme Flood Protection: Measures taken to protect downstream properties from dangerous extreme flooding events and help maintain the boundaries of the existing 100-year floodplain.

Fecal Coliform: A subset of total coliform bacteria that are present in the intestines or feces of warm-blooded animals; historically used as indicators of the sanitary quality of water.

Fecal Indicator Bacteria: Bacteria present in the intestines or feces of warm-blooded animals that are used to indicate the potential presence of other organisms such as pathogenic bacteria and viruses. Fecal indicator bacteria are more easily sampled/measured as opposed to monitoring for the many individual pathogens potentially present in receiving waters.

Fee in Lieu Contribution: A payment of money in place of meeting all or part of the stormwater management criteria often required by a post-construction stormwater management ordinance.

Flocculation: The process by which suspended colloidal or very fine particles combine into larger masses.

Flooding: The accumulation of water within a water body and the overflow of excess water onto adjacent floodplain lands. The floodplain is any land area susceptible to flooding.

Green Infrastructure Practices: The combination of three complementary, but distinct, groups of natural resource protection and stormwater management practices and techniques, including better site planning and design techniques and low impact development practices, that are used to protect valuable terrestrial and aquatic resources from the direct impacts of the land development process, maintain pre-development site hydrology and reduce postconstruction stormwater runoff rates, volumes and pollutant loads.

Gross Solids: Litter, trash, leaves, and coarse sediment that travel either as floating debris or as bedload in urban runoff conveyance systems.

Hydrologic Soil Group (HSG): A Natural Resource Conservation Service classification system in which soils are categorized into four runoff potential groups. The groups range from group A soils, with high permeability and little runoff produced, to group D soils, which have low permeability rates and produce much more runoff.

Impaired Waters: Those streams, rivers, lakes, estuaries and other water bodies that currently do not meet their designated use classification and associated water quality standards under the Clean Water Act.

Impervious Cover: A surface composed of any material that greatly impedes or prevents the natural infiltration of water into the underlying native soils. Impervious surfaces include, but are not limited to, rooftops, buildings, sidewalks, driveways, streets and roads.

Industrial Stormwater Permit: A National Pollutant Discharge Elimination System (NPDES) permit issued to an industry or group of industries that regulates the pollutant levels associated with industrial stormwater discharges or specifies on-site pollution control strategies.

Infill Development: Land development that occurs within designated areas based on local land use, watershed and/or utility plans, where the surrounding area is generally developed, and where the site or area is either vacant or has previously been used for another purpose.

Infiltration: The process of allowing stormwater runoff to percolate into the underlying native soils.

Infiltration Practice: A green infrastructure or stormwater management practice designed to provide infiltration of stormwater runoff into the underlying native soils. These stormwater management practices may be above or below grade.

Inspection and Maintenance Plan: A written agreement and plan providing for the long-term inspection and maintenance of all green infrastructure practices, stormwater management practices, stormwater conveyance features and stormwater drain infrastructure on a development site.

Interception: The process by which precipitation is caught and held by foliage, twigs and branches of trees, shrubs and other vegetation, and lost by evaporation, never reaching the surface of the ground.

Jurisdictional Wetland: An area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

Land Development: Any project undertaken to change or improve a site that involves one or more land disturbing activities.

Land Disturbing Activity: Any activity that changes stormwater runoff rates, volumes and pollutant loads on a site. These activities include, but are not limited to, the grading, digging, cutting, scraping, or excavating of soil, the placement of fill materials, paving, construction, substantial removal of vegetation and any activity that bares soil or rock or involves the diversion or piping of any natural or man-made watercourse.

Land Owner: The legal or beneficial owner of land, including those holding the right to purchase or lease the land, or any other person holding proprietary rights in the land.

Low Impact Development Practice: Small-scale stormwater management practices that are used to disconnect impervious and disturbed pervious surfaces from the storm drain system and reduce post-construction stormwater runoff rates, volumes and pollutant loads. Low impact development practices include soil restoration, site reforestation/revegetation, green roofs, vegetated filter strips and rain gardens

National Pollutant Discharge Elimination System (NPDES) Stormwater Discharge Permit: A permit issued by the EPA, or by a State under authority delegated pursuant to 33 USC § 1342(b), that authorizes the discharge of pollutants to waters of the State, whether the permit is applicable on an individual, group, or general area-wide basis. "New Development" means a land development project undertaken on a previously undeveloped or unimproved site.

Nitrate and Nitrite: Oxidized inorganic nitrogen species. Nitrate is the form of nitrogen preferred by aquatic plants.

Nonpoint Source Pollution: Pollution from any source other than from a discernible, confined and discrete conveyance, such as a wastewater treatment plant or industrial discharge. Sources of nonpoint source pollution include, but are not limited to, agricultural, silvicultural, mining and construction activities, subsurface disposal and urban stormwater runoff.

Nonstructural Stormwater Management Practice: Any natural resource protection or stormwater management practice or technique that uses natural processes and natural systems to intercept, convey, treat and/or manage stormwater runoff. Nonstructural stormwater management practices include, but are not limited to, protecting primary and secondary conservation areas, reducing clearing and grading limits, reducing roadway lengths and widths, reducing parking lot and building footprints, soil restoration, site reforestation/revegetation, green roofs, vegetated filter strips and rain gardens.

Nutrients: Primary elements necessary for the growth of living organisms.

Off-Site Stormwater Management Practice: A green infrastructure or stormwater management practice located outside the boundaries of a development site.

On-Site Stormwater Management Practice: A green infrastructure or stormwater management practice located within the boundaries of a development site.

Organic Matter: Plant and animal residue at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population.

Owner: The legal or beneficial owner of a piece of land, including, but not limited to, a mortgagee or vendee in possession, receiver, executor, trustee, lessee or other person, firm, or corporation in control of the site.

Particulate Phosphorus: That portion of total phosphorus that does not pass through a 0.45-micron membrane filter.

Permanent Stormwater Management Practice: A green infrastructure or stormwater management practice that will be operational after the land disturbing activities are complete and that is designed to become a permanent part of the site for the purposes of managing post-construction stormwater runoff.

Post-Development Hydrology: Refers to the set of hydrologic conditions that may reasonably be expected to exist on a development site, after the completion of all land disturbing and construction activities.

Pre-Development Hydrology: Refers to the set of hydrologic conditions that exist on a development site prior to the commencement of any land disturbing activities and at the time that plans for the land development project are approved by the local development review authority.

Receiving Stream or Receiving Aquatic Resource: The body of water or conveyance into which stormwater runoff is discharged.

Recharge: The replenishment of groundwater aquifers.

Redevelopment: A change to previously existing, improved property, including but not limited to the demolition or building of structures, filling, grading, paving, or excavating, but excluding ordinary maintenance activities, remodeling of buildings on the existing footprint, resurfacing of paved areas and exterior changes or improvements that do not materially increase or concentrate stormwater runoff or cause additional nonpoint source pollution.

Stormwater Management System: The entire suite of green infrastructure, stormwater management practices, and stormwater conveyance features that are used to intercept, convey, treat and manage stormwater runoff on a development site.

Stormwater Retrofit: A green infrastructure or stormwater management practice designed for an existing development site that previously had no green infrastructure or stormwater management practice in place or had a practice that was not meeting local stormwater management criteria.

Stormwater Runoff: Surface water resulting from precipitation.

Stormwater Runoff Reduction: Providing for the interception, evapotranspiration, infiltration, or capture and reuse of stormwater runoff to help maintain pre-development site hydrology and help protect aquatic resources from several indirect impacts of the land development process, including decreased groundwater recharge, decreased baseflow and degraded water quality.

Regional Stormwater Management Practice: A stormwater management practice designed to control stormwater runoff from multiple properties, where the owners or developers of the individual properties may participate in providing land, financing, design services, construction services and/or maintenance services for the practice.

Sediment: Material in suspension in water or recently deposited from suspension. In the plural, the word is applied to all kinds of deposits in waterbodies.

Soluble Reactive Phosphorus: Phosphorus in a form that is most readily available to plants, including various forms of orthophosphate (e.g., H2PO4 1– , HPO4 2– , and PO4 3–).

Stormwater Hotspot: An area where land use or pollution generating activities have the potential to generate highly contaminated runoff, with concentrations of pollutants in excess of those typically found in stormwater runoff. Stormwater hotspots include, but are not limited to, fueling stations (including temporary fueling stations during construction), golf courses, public works yards and marinas.

Stormwater Management: The interception, conveyance, treatment and management of stormwater runoff in a manner that is intended to prevent increased flood damage, channel erosion, habitat degradation and water quality degradation and to enhance and promote the public health, safety and general welfare.

Stormwater Management Plan: A written document that details how stormwater runoff will be managed on a development site and that shows how the stormwater management criteria that apply to the development project have been met.

Stormwater Management Practice: A practice or technique, either structural or nonstructural, that is used to intercept stormwater runoff and change the characteristics of that runoff. Stormwater management practices are used to control post-construction stormwater runoff rates, volumes and pollutant loads to prevent increased flood damage, channel erosion, habitat degradation and water quality degradation.

Suspended Sediment Concentration (SSC): A measure of sediment suspended in the water column resulting from analytical methods that use the entire water sample (i.e., ASTM D3977-97(B)). This method is recommended by the USGS.

Total coliform bacteria: A group of bacteria found in the feces of warm-blooded animals; historically used as indicators of possible sewage pollution in surface water. Still used for drinking water standards. Many common soil bacteria are also included in total coliforms.

Total Dissolved Solids (TDS): A measure of solids in the water column that pass through a 0.45 to 2 µm membrane filter. EPA’s operational definition of "dissolved" includes particles less than 0.45 µm.

Total Suspended Solids (TSS): A measure of solids suspended in the water column that is commonly used to refer to results from a variety of test methods for suspended sediment. The term is most correctly applied to analytic methods that use a subsampling technique for analysis (i.e., EPA 160.2, SM 2540D).

Pathogen: Disease-causing agent, especially microorganisms such as bacteria, protozoa, and viruses.

Watercourse: A permanent or intermittent stream or other body of water, either natural or man-made, which gathers or carries surface water.

APPENDIX E – CITIZEN PARTICIPATION & OUTREACH

1. Stormwater Management Committee Input and Recommendations

In May 2016, via Resolution No. 127038, the Parish Council established the **Stormwater Management Advisory Committee** to provide advice on:

- Developing a sustainable Jefferson Parish
- Reducing urban runoff
- Mitigating the effects of new development, redevelopment, or infill development on the existing drainage system
- Increasing compatibility between abutting land uses and between land uses and public rights-of-way
- Providing for the conservation of water resources
- Reducing the urban heat island effect
- Enhancing the local micro-climate
- Increasing species biodiversity
- Reducing consumption of energy by proper placement of shade trees, and
- Incorporating tree canopy concepts

The Committee met six (6) times and presented its recommendations to the Council, via Resolution No. 128317 (see Appendix B) on December 7, 2016, including:

- Consider broader sustainable water management principles and best practices articulated in the Greater New Orleans Urban Water Plan, as well as strategies for managing water proposed in the Parish's landscaping study
- Encourage LID approaches to planning and design and incorporate green infrastructure elements such as pervious paving, bioretention, dry wells, filter/buffer strips, grass swales, and infiltration trenches
- Development standards encouraging LID practices is desired
- Include pervious paving in development standards
- Further study of the Parish's current stormwater regulations, methods used to achieve requirements, and performance standards related to stormwater quality, groundwater infiltration, or other environmental issues is needed to achieve broader sustainable water management principles and best practices
- Continued focus on integrated stormwater management so that issues can be addressed comprehensively and collaboratively with other concerns
- Enhanced LID policies, practices, standards, and regulations for the Parish's long-term resilience and sustainability will promote the health, safety, and general welfare of the Parish's residents and businesses.

For more information on the committee's meetings, actions, and members, refer to Appendix C.

2. Drainage Advisory Committee Feedback and Concerns

In addition to the Stormwater Management Advisory Committee, two (2) drainage advisory committees meet regularly to discuss community related drainage issues: the Old Jefferson Citizens Drainage Advisory Board (OJCDAB) and Soniat Canal Drainage Basin Citizens' Advisory Board.

The OJCDAB represents an area of eastern and central Metairie on the East Bank of Jefferson Parish, from the Orleans Parish line and 17th Street Canal. The Soniat Canal Drainage Basin Citizens' Advisory Board represents the area within the drainage basin of the Soniat Canal, which drains numerous neighborhoods in Harahan and Metairie, generally running along the Soniat Canal north-south from Harahan north to its intersection with Canal No. 3 on the south side of Interstate Highway 10.

These committees were formed to foster communication between the Parish and the neighborhoods, especially for drainage issues and projects. Upon review of their meeting minutes, agenda and project update sheets (as available), common themes of their discussions include:

- Reports of major street flooding during heavy rain events.
- Discussion and updates on Parish drainage control projects in the area
- Miscellaneous smaller / routine street drainage projects
- Funding sources for future projects

3. Project Technical Committee

Members of the Technical Code Committee met over the course of 15 months from October 2020 to December 2021 in support GI Plan Recommendations.

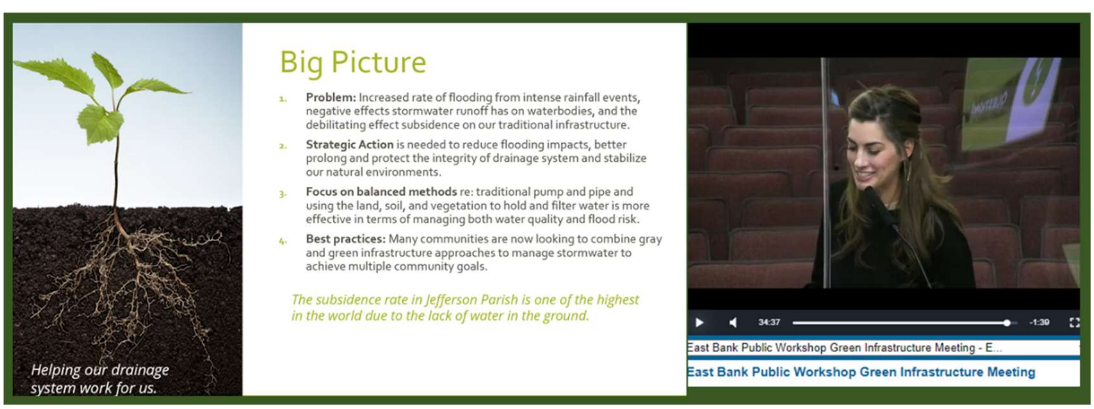
Technical Advisory Committee members include:

- Aimee Vallot, Former Director Inspection and Code Enforcement
- Angela Desoto, Director Department of Engineering
- Bessie Martin, Director Planning Department
- Brooke Tolbert, Planning Department
- Christi Langoni, Former Director Community Development
- Clinton Hotard, Professional Engineer IV, Drainage Department
- Cynthia Lee Sheng, Parish President
- Diane Coughlin, Environmental Quality Technician II, Environmental Affairs
- Juliette Cassagne, CAA Land Use and Development
- Kathy Russo, Department of Environmental Affairs
- Maggie Talley, Director Floodplain Management and Hazard Mitigation
- Mark Drewes, Director Public Works
- Michelle Gonzales, Director Ecosystem and Coastal Management
- Mitch Theriot, Former Director Drainage
- Nicole Fontenot, Director Community Development
- Nolan Carreras, Department of Engineering
- Sami Khalil, Stormwater Management Supervisor, Environmental Affairs
- Seamus Riley, Department Floodplain Management and Hazard Mitigation
- Terri Wilkinson, Former CAA Land Use and Development
- Walter Brooks, Former Chief Administrative Assistant – Internal Services

4. Public Meetings

Three (3) meetings were held to engage the public during the development of the GI Plan. A virtual public meeting was held on November 17, 2020, where the public was introduced to the concept of green infrastructure, advised of the GI project, and provided the opportunity to submit input, suggestions and questions to the project team. Participants were provided examples of how green infrastructure currently enhances the Parish drainage system, an overview of the project, and contact information to share their thoughts about green infrastructure and how it should be implemented within the Parish.

On December 1st and 7th 2021, the Parish hosted in-person meetings on the East and West Banks (respectively), where the project team presented and reviewed the draft GI Plan context, approach, goals, preliminary findings, and recommendations. The Parish provided one-pager plan summaries (right) for the public's review and reference, copies of the presentation, and time for comments and discussion. There was no comment provided, and the project team advised participants of the opportunity to comment via emails submitted to planning@jeffparish.net



The project team incorporated public comments received via email into the draft Plan, which involved:

- Increased public education on water management within primary and secondary school programs
- The opportunity to engage civic associations in next steps
- Programs regarding storm drains pigged for cleanliness and smart-pigged to ensure structural integrity
- Opportunities for blight remediation and green lots

The Parish live-streamed the first of the two in-person meetings on the Parish's Facebook account (top right).

The video recording, presentation, and one-pager remain available for viewing and comment online at: https://jeffparish.net/departments/planning/green-infrastru cture-plan

August 2022

JEFFERSON PARISH GREEN INFRASTRUCTURE PLAN

A Sustainable Strategy for Balancing Water

"Jefferson Parish residents are served by an exceptional state-of-the art drainage system that uses pipes and pumps—and works with nature to protect their property during flood events—advancing a more sustainable approach to more effectively reduce risk to people and property over time."

The Green Infrastructure Plan…

Supports goals of continued advancement of green infrastructure and low impact development (LID) principles.

- Reduce flooding and improve environmental quality by slowing, storing, and cleaning high energy runoff
- Create or enhance public spaces
- Overcome technical, regulatory, and institutional obstacles

Explains high-risk hazards and other challenges.

- Subsidence
- Increased flood risk
- Increasing rain events

Presents solutions to reduce instances of nuisance flooding, prolong the life of gray infrastructure, lessen the likelihood that flooding will continue to worsen due to subsidence, and reduce the flooding impacts of hurricanes.

- Permeable pavement and paving alternatives
- LID principles
- Best MPs and SCMs

Recommendations and Next Steps

- Adopt policies or programs aimed at integrating green infrastructure development into current processes and systems Parish-wide
- Amend development regulations and processes to decrease stormwater runoff, enhance public and private spaces, and improve on site design techniques and low impact development practices.
- Support improved project planning, the creation of sustainable funding sources, and enable more competitive green infrastructure project designs

Innovative Above Ground Detention Area in Retrofitted New Orleans Stormwater Lot

Permeable Pavement Typical Cross-Section

Bioretention with High Flow Rate Media Combined with Detention Basin Lined with Turfgrass in a Residential Setting

A results-oriented stormwater management strategy to support local drainage by balancing water.

DRAFT

APPENDIX F – LOCAL PLANS, STUDIES, & REPORTS

Specific plans, studies, and reports listed below, along with continued dialogue with the Parish Technical Advisory Committee, supported identification of pertinent plan elements to incorporate into the GI Vision, Goals, and Objectives.

1. **The Envision Jefferson 2040 Comprehensive Plan** envisions a parish that protects and preserves natural resources, promotes LID practices, protects waterways from pollutants or erosion caused by stormwater runoff, and invests in structural and green infrastructure to manage flood risk and mitigate the impacts of extreme weather events. Residents, businesses, and governments are envisioned as embracing environmental and technological changes with innovative, resilient approaches for renovation, construction, and use of structures and land. Specific goals aligned with the GI Plan include:
   a. Balancing environmental quality needs, economic sustainability, and resilience
   b. Reducing risks to life and property from hazards
   c. Embracing new technologies, and innovative, resilient approaches
   d. Promoting low-impact development approaches for design, construction, fill, drainage, landscaping, and parking
   e. Designing and building infrastructure that is less vulnerable to flooding and includes low-impact development measures or integrated stormwater management where practical
   f. Providing regulatory or other incentives for construction methods and designs that minimize environmental impacts, promote environmental quality, or mitigate climatic changes and extreme weather events
   g. Protecting waterways from pollutants or erosion caused by stormwater runoff or wastewater discharge
   h. Collaborating with Federal and State agencies and neighboring parishes and cities to preserve natural resources and enhance environmental protection and quality
   i. Engaging in programs and projects that safeguard natural processes and resources and promote environmental protection and quality for the long-term sustainability of the Parish
2. **The Multijurisdictional Hazard Mitigation Plan** prioritizes investments in structural and green infrastructure projects to manage future flood risk. It is one component of the Natural Hazards and Resources Element of the Comprehensive Plan and was most recently adopted in June 2020. Much of the information contained in Section VII. Summary of Local History, Conditions and Challenges are summarized from the 2020 update. Specific goals aligned with the intent of the GI Plan include:
   a. Increase open space areas (Action ID P-5) to help provide additional pervious surface areas to allow for infiltration and reduce flooding
   b. Update the Parish's capital improvements plan (Action ID P-7) to help direct funding to the highest priority projects and ensure projects that reduce risk are being identified
   c. Update Stormwater Management Regulations (Action ID FR-2) to provide more cost-effective stormwater management solutions and help manage water in a way that reduces localized flooding which is a major issue in many areas of the Parish.
   d. Increase storm water protection management (Action ID SP-1) including retention and detention basins, completion of applicable Parish code amendments, and continued development of stormwater management plans, application, and installation of green infrastructure for storm water detention modifications on residential lots. *Note: 194 residential sites approved and 79 applied in FMA 2018 as of 2020 annual plan.*
   e. Improve water quality (Action ID NRP-4) to improve ecosystem conservation as well as impacts to public health and well-being and recreational use
   f. Implement drainage improvement projects in flood-prone areas (Action ID SP-2) to reduce flooded structures and therefore, lessen the mental and physical stress, displacement days, and flood damage for Parish residents, as well as decrease the number of NFIP flood claims
   g. Install reservoirs and storage tanks (Action ID SP-5) to provide a means of controlling water flow volumes to reduce flood risk
   h. Modify channels (Action ID SP-6) to help control the flow and volume of water and reduce flooding in certain areas

i. Encourage and educate the public regarding small-scale flood mitigation projects (Action ID PEA-1) to empower homeowners to protect themselves with low-cost, DIY projects and suffer less flood damage

3. **The Greater New Orleans Urban Water Plan.** This resiliency planning study develops sustainable strategies for managing the water resources of St. Bernard and the east banks of Jefferson and Orleans Parishes. The project addresses three basic issues: flooding caused by heavy rainfall, subsidence caused by pumping of stormwater, and the misuse of water resources. The plan was reviewed to evaluate proposals aimed at reducing the region's flooding and subsidence issues. One goal of the GI Plan is to advance implementation of The Greater New Orleans Urban Water Plan recommendations, including pursuit of stage "0" feasibility studies for the following project types:
   a. Reimagined Canals and Boulevards - Many of Jefferson's canals have low water levels and are reimagined as vital assets with improved water level management, enhanced aesthetics, and spaces for significant public access and recreation.
   b. Peeling Back Pavement in Commercial Districts - Improvements to streets, parking lots, and other underutilized spaces are the basis for retrofits that increase stormwater infiltration rates, reduce runoff, and provide cooler, improved air quality in commercial areas.
   c. Water Storage in Strategic Parklands - Swaths of vacant land along corridors and in lowlands provide water storage as wetlands, waterways, and floodable open spaces.
   d. Street Retrofits - Small scale retrofits - Includes the insertion of bioswales and permeable pavement in public rights-of-way, catching rain where it falls, reducing the burden on neighborhoods and drainage pump stations downstream.
4. **LA SAFE: Jefferson Parish Adaptation Strategy** – This project portfolio includes a wide range of adaptation strategies that respond to community impacts caused by increasing flood risk and the needs across five adaptation categories that residents and stakeholders from the six LA SAFE parishes identified during the engagement process. The Jefferson Parish Adaptation Strategy was reviewed with an interest in feedback from community meetings related to localized flooding issues, proposed project types incorporating green infrastructure principles, and stakeholders' interest in enhancing traditional stormwater management.
5. **The Stormwater Management Plan**, along with the **Jefferson Parish Flood Insurance Study**, assesses the complex drainage system in place in the Parish that controls stormwater during hurricanes, thunderstorms, and other heavy rain events.
6. **Phase I Feasibility Study for a Parishwide Drainage Storage Area Evaluation.** In November 2004 and May 2005, as per Council Resolution No.'s 102337 and No. 103409 (respectively), authorization and funding was provided to prepare a Phase I Feasibility Study for a parishwide drainage storage area evaluation, which included a feasibility analysis of utilizing existing public green spaces as potential detention ponds as well as classifying unused or underutilized public green spaces as possible pond sites in order to handle the runoff generated by a 10-year storm event.
7. **Comprehensive Drainage Master Plans – East Bank and West Bank Master Drainage Plans** help to determine, prioritize, and optimize drainage projects to reduce local flooding and propose drainage facilities, construction priorities, multi-use canal facilities, as well as funding sources and capital improvements.
8. **Jefferson Parish Watershed Management Plan** presents an analysis of existing and future conditions on over 50-percent of the Parish inside the levees for 10-year, 25-year, and 100-year storm events using a hydrograph approach based on EPA SWMM model analysis. Consultation was performed with FEMA coordinators in scoping the specific hydrologic and hydraulic analyses, which include, but are not limited to, findings relevant to pumping capacity, use of sustainable principles of green infrastructure in future development and redevelopment, minimizing effective impervious areas to create functional and appealing site drainage, which are further explored in Section IX. C – Identify Assets, Opportunities and Approaches of the GI Plan.

APPENDIX G - DESIGN MANUAL REVIEW

Green infrastructure design standards help ensure professionals and engineers are appropriately considering opportunities to incorporate green infrastructure elements, while also planning the more familiar measures of pipes, basins, and ditches.

Development of Design Specifications is a necessary step to raise awareness of the strategies and standard practices associated with green infrastructure elements within the professional community. Upon review of Jefferson Parish's current Stormwater Drainage Design Manual, the following additional specifications were developed by the project team to support green infrastructure implementation efforts.

The following drawing details and specifications tie into and support development of stormwater management solutions parishwide and are under review by the Parish for incorporation into standard requirements.

- PP 1.1 Permeable Pavement - Key Map
- PP 2.2 Permeable Pavement – Material Sections Permeable Unit Pavers
- PP 3.1 Permeable Pavement – Material Sections Previous Concrete
- PP 4.1 Permeable Pavement – Material Sections Porous Asphalt
- PC 1.1 Pavement Components – Underdrain
- BB 1.1 Bioretention Basin/Bioswale
- SP 1.1 Stormwater Pond - Constructed Wetlands
- SP 2.1 Storm Water Pond – Detention Basin
- SP 2.2 Underground Detention Basin
- SP 3.1 Storm Water Pond – Retention Basin
- SP 4.1 Storm Water Pond – Embankment outlet drain

APPENDIX H – STORMWATER FEE STRUCTURE EXAMPLE

To provide a dedicated funding source that meets the potential demand for green infrastructure project development, the Parish could elect to implement a stormwater fee, similar to those in many other municipalities. While implementation of this fee is not a recommendation of the Green Infrastructure Plan, it is a possibility for future consideration.

Because Jefferson Parish is largely built out and most development is within existing neighborhoods, there is an increasing pattern of paving of overbuilding existing sites, which significantly reduces pre-development site hydrology and pushes more water into the Parish drainage system. Proposed text amendments address maximum lot coverage requirements aimed at limiting this behavior to help maintain drainage system performance. This approach is a necessary first step in ensuring the drainage system is not overwhelmed by the cumulative impact of development within a neighborhood or corridor. However, less administratively burdensome solutions should be considered and implemented long-term for the drainage system's performance to not only be maintained, but improved.

To this end, in addition to a comparison of community standards regarding LID and green infrastructure, 74 jurisdictions were examined in support of isolating effective methods of funding public stormwater improvements through methods such as stormwater fees. Best practices support long-term stormwater management parcel fees based on a site's imperviousness to support funding projects, inspections, and maintenance.

Stormwater fees that are scaled to a site's impact on the drainage system not only generate funding to improve the system, but also affect the decision-making of residents and developers when approaching site designs or when considering improvements on their property. Stormwater fees should be tied to land use and tiered, as in Table 7 below, to provide an incentive for residents to reduce their impervious surface lot area: at the lowest tier level for detached single-family residential construction (less than 2,000 square feet of impervious surface), residents do not pay any stormwater fees.

Table 7. Possible Tiered Stormwater Fee Structure, Jefferson Parish

Use type	Tier	Size	Monthly Fee
Detached Single-Family Residential	Tier 1	< 2,000 s.f. of impervious surface	$0.00 per month
	Tier 2	2,000 to 2,999 s.f. of impervious surface	$4.42 per month
	Tier 3	3,000 to 4,999 s.f. of impervious surface	$6.10 per month
	Tier 4	5,000 + s.f. of impervious surface	$10.36 per month
All others	N/A	All sizes	$59.65 per month per acre of impervious surface

Benefits of this fee structure include:

- All users will be incentivized to reduce existing permeable pavement to reduce stormwater fees without direct interaction with the Parish (i.e. via permitting requirements, applications, etc.)
- Site permeability can be established from current LiDAR data and validated by site visits as needed. A process to acknowledge resident-driven efforts to reduce the amount of impervious surface on their sites to receive a credit and reduce monthly fees should be set up in advance of implementation.
- Processes to collect fees can be streamlined with the collection of water bills, which often include utilities.
- Fees are distributed proportional to the impact of a site's imperviousness, which is directly related to the amount of stormwater runoff contributing to the Parish drainage system.

Challenges associated with the proposed fee structure include:

- Requires substantial outreach and education to ensure the proposal is understood by residents and stakeholders

- Requires parishwide vote to enact
- Requires consistent and transparent capital improvement planning activities to prioritize projects amongst competing interests

These challenges can be overcome, and stormwater fees are widely accepted as a best practice in funding sustainable flood risk reduction projects (2016, Black & Veatch Management Consulting, LLC). This approach has the dual benefit of both encouraging site-level retention and green infrastructure and providing a dependable source of revenue for the construction and maintenance of the flood control system.

APPENDIX I – GREEN INFRASTRUCTURE ELEMENT ONE-PAGERS

Rainwater Harvesting Fact Sheet

Summary

Rainwater Harvesting is the ancient stormwater management practice of intercepting, diverting, and storing rainfall to provide detention and potential reuse. Stored water may be used for irrigation, firefighting, toilet flushing, and other non-potable uses. Typically, gutters and downspout systems are used to collect rainwater from roof tops and direct it to a storage tank or cistern.

Site Applicability

Appropriate for use in rural, urban, and suburban environments. Ideal for use in conjunction with Green and Blue Roofs as well as Downspout Disconnection.

Reference

"Rainwater Harvesting" (EPA, 2013)

Hydrologic Function: Provides for volume control

Habitat Value: Provides no significant benefit to wildlife

Pollutant Removal: Varies on the harvesting system and when used in conjunction with other green infrastructure elements

Community Value: Provides a for a variety of uses of non-potable water such as gardening, firefighting, and flushing of toilets

Soil Suitability: Soil is non-applicable, however once in place rain harvesting could help slow or prevent erosion of loose soils.

More Info: For more information please see: Pg. 33 of the Jefferson Parish Green Infrastructure Plan or email giplan@jeffparish.net

Top Left: Decorative Residential Rain Barrels

Top Right: Large scale harvesting

Bottom: Decorative rain harvesting tanks on a commercial property

Retention Basins Fact Sheet

Summary

Sometimes referred to as Wet Ponds or Wet Basins, Retention Basins are facilities intended to provide temporary storage and release of stormwater runoff to mimic predevelopment runoff characteristics. Unlike Detention Basins, Retention Basins are designed with a stored volume surface elevation that is above the bottom elevation of the basin. Linings and other provisions may be necessary to ensure that collected and stored water is retained.

Site Applicability

Areas with highly variable groundwater levels should be avoided due to the potential for the intended permanent water levels to drop during dry seasons, or basin linings floating as the groundwater level rises during wetter seasons.

Reference

"National Pollutant Removal Performance Database" (CWP, 2007)

"Stormwater Best Management Practices" (EPA, 2021)

"Stormwater Runoff Treatment by Filtration System and Wet Pond in Tampa Florida" (Southwest Florida WMD, 2005)

Hydrologic Function: Provides volume control

Habitat Value: Plants & vegetation provide shelter and food for birds, reptiles and small mammals

Pollutant Removal: Removes up to 99% of Total Suspended Solids, 97% of Nitrates, and 91% of Total Phosphorus

Community Value: Properly maintained retention basins provide aesthetic value and opportunities for fishing

Soil Suitability: Permeable soils are not well suited for retention. A liner may be necessary to properly retain water depending on pool depth

More Info: For more information please see: Pg. 34 of the Jefferson Parish Green Infrastructure Plan or email giplan@jeffparish.net

(Source: Southwest Florida WMD, 2005)

(Source: EPA, 2021)

Top Left: Retention Basin near a parking garage

Top Right: Retention Basin in a residential apartment complex

Bottom: Recreational Retention Basin at Lafreniere Park

(Source: lafrenierepark.org)

Green & Blue Roofs Fact Sheet

Summary

Green & Blue Roofs provide stormwater capture, detention, and other water-quality related benefits on the roofs of buildings and structures using some or all of the available rooftop area. Green Roofs incorporate vegetation and a growing medium, planted over a waterproofing membrane. Green Roofs may also include additional features such as a root barrier and drainage and irrigation systems. Blue Roofs collect and manage water without the use of vegetation through a system of dams and weirs, providing for the detention and slowing of water flows off the roof.

Site Applicability

Appropriate for rural, urban, and suburban environments. With green roofs, vegetation may be difficult to establish in the harsh growing conditions found on rooftops in Jefferson Parish.

Reference

"National Pollutant Removal Performance Database" (CWP, 2007)

Hydrologic Function: Provides for volume control

Pollutant Removal: Green Roofs can have a positive impact on local air quality

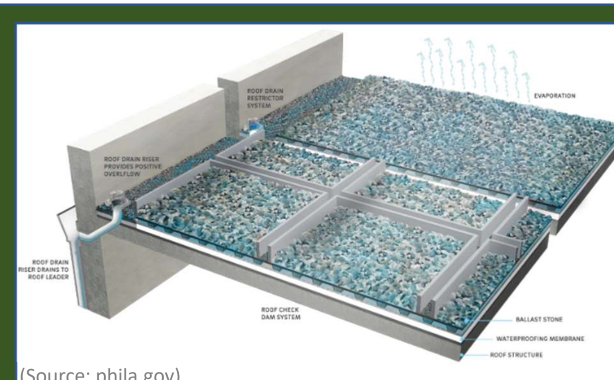
Soil Suitability: Soil suitability is non-applicable, however suitability of the structure for such application should be considered

Habitat Value: Green Roofs provide habitat for insects and certain species of bird

Community Value: Provides a pleasing aesthetic to improved structures, and helps reduce the urban heat island effect

More Info: For more information please see: Pg. 33 of the Jefferson Parish Green Infrastructure Plan or email giplan@jeffparish.net


(Source: uswateralliance.com)



(Source: phila.gov)


(Source: evans-lighter.com)

Left & Bottom Right: Green Roof
Top Left: Diagram of Blue Roof

Permeable Pavements Fact Sheet

Summary

Permeable Pavements are porous surfacing materials, pavers, or blocks that enable stormwater runoff to move below the surface for detention and/or subsurface infiltration. In addition to intercepting surface flows, Permeable Pavements also may provide an amount of pollutant removal as the runoff passes through them. Permeable Pavements are commonly used on roads, paths, and parking lots subject to pedestrian and light vehicular traffic.

Site Applicability

Permeable Pavements are appropriate for urban development and redevelopment sites to construct sidewalks, parking lots, overflow parking areas, private streets and driveways and parking lanes on public streets and roadways. Dedicated specialty cleaning equipment is required to maintain most types of permeable pavement materials.

Reference

"National Pollutant Removal Performance Database" (CWP, 2007)

Hydrologic Function: Provides volume and flow control while promoting groundwater infiltration

Pollutant Removal: Median removal efficiency of 89% of Total Suspended Solids, and 65% of Total Phosphorus

Soil Suitability: Most soil types, groundwater table must be at least 18" below bottom of the storage area.

Habitat Value: Provides no significant benefit to wildlife

Community Value: Permeable pavers and grass combinations can be an attractive alternative to asphalt or concrete lots

More Info: For more information please see: Pg. 33 of the Jefferson Parish Green Infrastructure Plan or email giplan@jeffparish.net

Permeable parking lot located in Elmwood

Downspout Disconnection Fact Sheet

Summary

Downspout disconnection diverts rooftop runoff from direct discharge into a storm sewer system and spreads flows across lawns, vegetated areas, and other pervious areas, where runoff may be slowed, filtered, and possibly infiltrated before reaching collection systems. Downspout disconnection may be combined with other water management methods such as rainwater harvesting. This seemingly insignificant element, if applied across a neighborhood or community can provide meaningful relief to a struggling storm sewer system by reducing the volume of water introduced during a rainfall event.

Site Applicability

Implementation of this strategy is applicable wherever downspouts are in use through a variety of different methods. Outflows should be directed away from foundations and sidewalks and avoided in areas where it may cause soil erosion.

Reference

"National Pollutant Removal Performance Database" (CWP, 2007)

Hydrologic Function: Primarily concerned with volume control, but can provide infiltration or detention depending on method used.

Habitat Value: No significant benefit to the natural environment

Pollutant Removal: Downspout disconnection can remove pollutants in conjunction with other green infrastructure elements

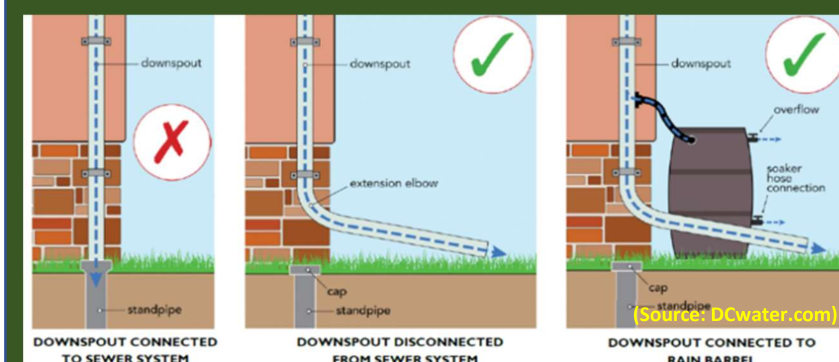
Community Value: Reduction in volume means less strain on pumps which reduces potential flooding and property damage

Soil Suitability: Directing downspout outflows directly onto loose soil susceptible to erosion should be avoided.

More Info: For more information please see: Pg. 33 of the Jefferson Parish Green Infrastructure Plan or email giplan@jeffparish.net

(Source: prosprinkler.com)

(Source: prairielandsgcd.org)



(Source: DCwater.com)

Top Left: Downspout connected to a French drain

Top Right: Downspout connected to rain barrel

Bottom: Diagram of how disconnection works

Detention Basins Fact Sheet

Summary

Detention Basins are facilities intended to provide temporary storage and release of stormwater runoff to mimic predevelopment runoff characteristics. Unlike Retention Basins, Detention Basins are designed to fully drain after a rain event. Detention Basins may be in the form of above ground open facilities or subsurface vaults or tanks that may or may not also promote infiltration.

Site Applicability

Detention basins can be applied at street, neighborhood, and even regional scales when physical space is available. If space is constrained, the detention basin can be placed below ground provided the water table is low enough to accommodate such use.

Reference

"National Pollutant Removal Performance Database" (CWP, 2007)

Hydrologic Function: Provides for volume control and some infiltration

Habitat Value: Provides no significant benefit to local habitat or wildlife.

Pollutant Removal: Removes up to 90% of Total Suspended Solids, 79% of Nitrates, and 48% of Total Phosphorus

Community Value: Reduction in volume means less strain on pumps which reduces potential flooding and property damage

Soil Suitability: Must be situated high enough above the water table to prevent infiltration *into* the detention basin

More Info: For more information please see: Pg. 33 of the Jefferson Parish Green Infrastructure Plan or email giplan@jeffparish.net

Innovative Above Ground Detention Area in Retrofitted New Orleans Stormwater Lot

Constructed Wetlands Fact Sheet

Summary

Sometimes referred to as stormwater wetlands or extended wet detention ponds, constructed wetlands are intended to mimic natural wetlands to provide stormwater runoff detention, retention, pollutant removal by filtering and deposition, and evaporation/evapotranspiration.

There are 4 types of constructed wetland:

Shallow Wetlands: Storage volume contained in relatively shallow high marsh & low marsh areas.

Shallow Extended Detention (ED): Similar to shallow wetlands but with more space for retention.

Pond Wetland Systems: 2 separate cells: one a wet pond, the other a shallow wetland.

Pocket Wetlands: Manage with smaller areas, typically interact with the groundwater table.

Site Applicability

Constructed Wetlands are appropriate for rural and suburban environments. Contributing drainage area of 25 acres or more is typically needed for shallow and shallow extended detention wetlands. Five to 10 acres or more is typically needed for pocket wetlands. Constructed wetlands are ideal for use in flat terrain and would be suitable for areas with shallow groundwater levels

Hydrologic Function: Provides volume and flow control while promoting groundwater infiltration

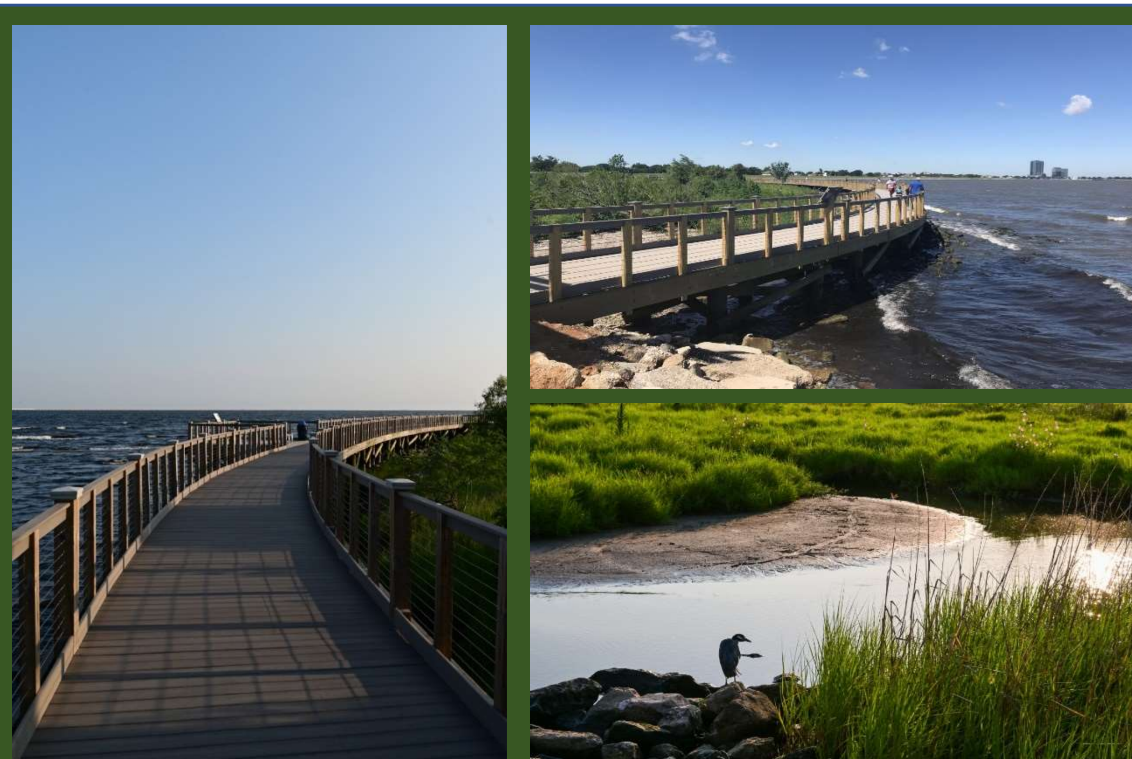
Pollutant Removal: Removes up to 100% of Total Suspended Solids, 99% of Nitrates, and 100% of Total Phosphorus (CWP, 2007)

Soil Suitability: Water table should be close enough to maintain permanent pool. Higher areas necessitate less permeable soil

Habitat Value: Plants, vegetation, and water provide shelter and food for birds, amphibians, fish, and invertebrates

Community Value: Plants and vegetation provide visual beautification, as well as educational opportunity

More Info: For more information please see: Pg. 33 of the Jefferson Parish Green Infrastructure Plan or email giplan@jeffparish.net



Example of constructed wetlands & boardwalk located in Bucktown (Credit: Samuel Mercier)

Urban Reforestation Fact Sheet

Summary

Urban Reforestation involves planting trees, shrubs, and other vegetation, typically on a large scale, in urban environments. Urban Reforestation provides abstraction of rainfall which helps to minimize the volume of runoff by providing surfaces to wet, processes to evaporate, and places for storage. The vegetation also provides surface roughness and irregularities that increase the time of concentration of runoff.

Site Applicability

Context is important when selecting plant types and densities. Plant heights, widths, root growth, shading, and leaf litter should be considered and weighed against land use, maintenance availability, and community benefits.

Reference

"City Plan Land and Water Analysis" (Charleston, 2021)

Hydrologic Function: Provides for both volume and flow control

Pollutant Removal: Removes approximately 85% of Total Suspended Solids, 50% of Nitrates, and 85% of Total Phosphorus

Soil Suitability: Good for all soil types. Plant type suitability for location must be taken into consideration

Habitat Value: Reforestation provides habitat for a large variety of animals and reconnects fragmented parcels of habitat

Community Value: Reforestation helps to reduce the urban heat island effect and provide a variety of recreational opportunities

More Info: For more information please see: Pg. 34 of the Jefferson Parish Green Infrastructure Plan or email giplan@jeffparish.net

Top Left: Tree lined street in New Orleans

Top Right: Newly planted vegetation in Bayou Metairie Park

Bottom: Tree lined street in Old Metairie

Vegetated Swales Fact Sheet

Summary

Sometimes referred to as Vegetated Strips or Open Channels, Vegetated Swales and Areas are shallow conveyances and open spaces typically lined or stabilized with turfgrass. These more traditional elements provide a benefit over impervious channel linings and pavements by increasing the time of concentration of runoff by reducing runoff velocities and helping to remove suspended and floating pollutants through filtering and deposition. Vegetated Swales and Areas can provide pre-treatment of runoff before it enters other green infrastructure elements or traditional storm sewer systems.

Site Applicability

Appropriate for residential, commercial, industrial, and other land uses in rural and suburban environments wherever space is available.

Reference

"National Pollutant Removal Performance Database" (CWP, 2007)

"Swale Terminology for Urban Stormwater Treatment" (NCSU, 2020)

Hydrologic Function: Provides flow control while promoting some groundwater infiltration

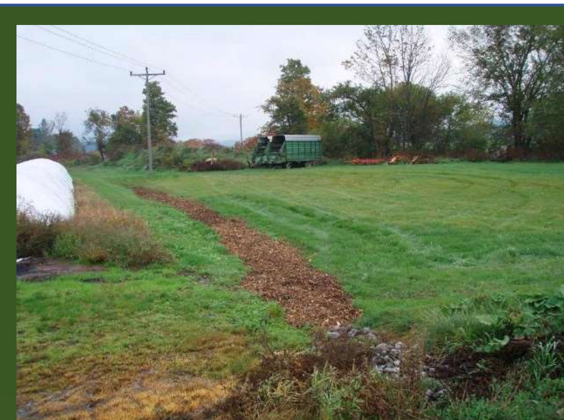
Habitat Value: Tall grass and vegetation provide shelter and food for birds, reptiles and small mammals

Pollutant Removal: Median removal efficiency of 81% of Total Suspended Solids, 39% of Nitrates, and 24% of Total Phosphorus

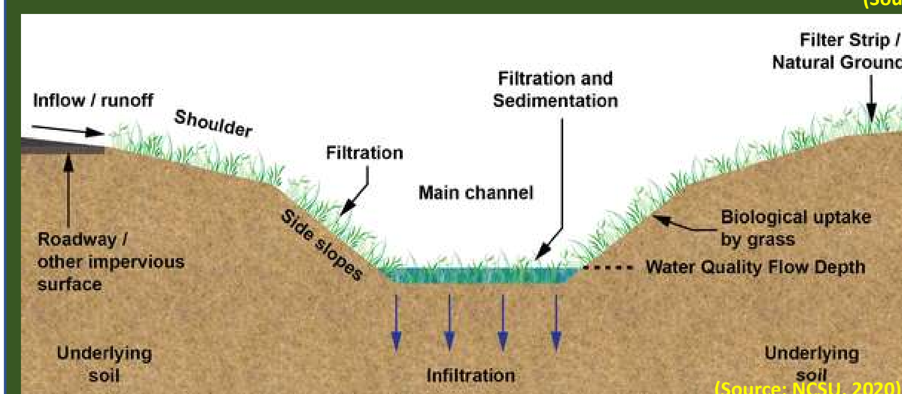
Community Value: Vegetated swales provide aesthetic interest, while helping reduce the urban heat island effect.

Soil Suitability: Most soil types, a distance of at least ½ foot from the water table is recommended.

More Info: For more information please see: Pg. 34 of the Jefferson Parish Green Infrastructure Plan or email giplan@jeffparish.net



(Source: US Department of Agriculture)



Top Left: Roadside Vegetated Swale

Top Right: Vegetated Area

Bottom: Diagram of how Vegetated Swales functions

Bioretention Areas Fact Sheet

Summary

Commonly referred to as rain gardens or stormwater planters in some settings; bioretention areas consist of shallow basins (bioretention cells) or linear conveyances (bioswales) that utilize vegetation and engineered soil media to slow, filter, detain, and infiltrate stormwater runoff.

Site Applicability

Bioretention may be appropriate for rural, urban, and suburban environments and in varied types of land uses. Bioretention areas can work well in spaces where other types of vegetated planters would traditionally be located, so long as runoff can be directed to them. Application areas may include urban planters, street bulb-outs, parking lot islands, roadside swales, and residential yards. Bioretention areas incorporating high flow rate media may be incorporated into Detention Basins for additional storage or runoff.

Reference

"National Pollutant Removal Performance Database" (CWP, 2007)

Hydrologic Function: Provides volume and flow control while promoting groundwater infiltration

Habitat Value: Plants & vegetation provide shelter and food for birds, reptiles and small mammals

Pollutant Removal: Removes up to 98% of Total Suspended Solids, 76% of Nitrates, and 65% of Total Phosphorus

Community Value: Plants & vegetation provide visual beautification, reduce urban heat island effect & help clean the water

Soil Suitability: Most soil types, a distance of 2 feet or more is recommended between the bottom of the feature and the water table

More Info: For more information please see: Pg. 33 of the Jefferson Parish Green Infrastructure Plan or email giplan@jeffparish.net


(Image Source: small.tulane.edu)


(Image Source: Ankenyiowa.gov)


(Credit: Richard Gillen)

Top Left: Rain Garden installation in Hollygrove completed by the Small Center at Tulane University, in partnership with the Carrollton Hollygrove Community Development Corporation.

Top Right: Recessed Rain Garden located in Ankeny, Iowa.

Bottom: Rain garden with a permeable footpath located in Bayou Metairie Park.