BLUEPRINT INTERGOVERNMENTAL AGENCY

Technical Coordinating Committee Meeting

Monday, May 2, 2022
1:00 pm
Location: Blueprint Grand Conference Room

Facilitator: Autumn Calder

Agenda

Citizens desiring to speak must fill out a Speaker Request Form. The Chair reserves the right to limit the number of speakers or time allotted to each speaker.
All comments received will be part of the record.

NEXT TCC MEETING: Monday, August 29, 2022 at 1:00 PM

In accordance with the Americans with Disabilities Act and Section 286.26, Florida Statutes, persons needing a special accommodation to participate in this meeting should contact Susan Emmanuel, Public Information Officer, 315 South Calhoun Street, Suite 450, Tallahassee, Florida, 32301, at least 48 hours prior to the meeting. Telephone: 850-219-1060; or 1-800-955-8770 (Voice) or 711 via Florida Relay Service.

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Blueprint Intergovernmental Agency
Technical Coordinating Committee
Agenda Item # 1

May 2, 2022

Title:	Approval of the September 7, 2021 Blueprint Intergovernmental Agency Technical Coordinating Committee Meeting Minutes
Category:	Consent
Department:	Blueprint Intergovernmental Agency
Lead Staff / Project Team:	Benjamin H. Pingree, Director, Department of PLACE Autumn Calder, Director, Blueprint Daniel Scheer, Design and Construction Manager, Blueprint

STATEMENT OF ISSUE:

This Agenda Item presents the summary meeting minutes of the September 7, 2021, Blueprint Intergovernmental Agency Technical Coordinating Committee (TCC) meeting and requests the TCC review and approval of the minutes as presented.

FISCAL IMPACT

This item has no fiscal impact.

TCC OPTIONS:

Option 1: Approve the September 7, 2021, Blueprint Intergovernmental Agency Technical Coordinating Committee meeting minutes.

Option 2: Do not approve the September 7, 2021, Blueprint Intergovernmental Agency Technical Coordinating Committee meeting minutes.

TCC RECOMMENDED ACTION:

Option 1: Approve the September 7, 2021, Blueprint Intergovernmental Agency Technical Coordinating Committee meeting minutes.

Attachments:

1. September 7, 2021, Blueprint Intergovernmental Agency Technical Coordinating Committee meeting minutes

Blueprint Intergovernmental Agency
Technical Coordinating Committee
Meeting Minutes

Date: September 7, 2021
To: Technical Coordinating Committee
From: Benjamin H. Pingree, PLACE Director
Subject: Summary of the Minutes for the BP & OEV Budget and Orange-Meridian Place Making Project Stormwater Conveyance System

Committee Members present:

Ken Morris	Ben Pingree
Steve Shafer	Brent Pell
Cherie Bryant	Nawfal Ezzagaghi
Autumn Calder	Wayne Tedder
Greg Slay	Artie White
Jodie Cahoon	

**substitute*

I. AGENDA MODIFICATIONS

There were no agenda modifications.

II. CONSENT

The TCC is a non-voting committee serving to provide professional advice and technical expertise on Blueprint Intergovernmental Agency projects.

ACTION TAKEN: There were no objections to the presented Consent items or staff recommendations.

III. PRESENTATIONS

1. Blueprint and OEV Budget Summary

2. Orange-Meridian Place Making Project Stormwater Conveyance System

Blueprint Director, Autumn Calder began the meeting by going over the two presentations: Budget Presentation Summary and the Orange-Meridian Place Making Project Summary.

She gave a brief summary on the BP & OEV Revenue, Bonds, & Loan figures for the next 20 years. She discussed the infrastructure program for the next five years for sales tax collection, bonds, & loans to be issued along with grants anticipated. She concluded by going over the CIP infrastructure draft for FY 2022-2026 and the 5-year metrics with 31 active projects and subprojects currently.

Autumn gave the background & origin of the Orange-Meridian Placemaking project as it relates to the current budget amount. She explained that this project was prioritized by the IA Board of Directors starting back in 2018, and that it is a top ranked CCQ (Community Enhancement Connectivity & Quality of Life) project. She reviewed the three components of the project. The component that was the primary topic of this meeting was the East Ditch Stormwater Improvements. She discussed the goals of the East Ditch improvements.

Mark Llewellyn, Halff, presented the challenges, issues, and alternatives of this project from a hydrologic and hydraulic perspective. He discussed the FEMA Current Effective Model, the Duplicate Effective Model, and the process to reach the Existing Conditions Model. Within the project area, the floodplain is expanded in the Existing Condition Model versus the Duplicate Effective Model. He also identified ownership issues with the East Ditch in the project area and the need to acquire right of way.

Mark Llewellyn discussed three alternatives for the East Ditch improvements; two with box culvert enclosure of the ditch and one open conveyance alternative. Halff's overall assessment was that from the three alternatives given, they believe they can show a no rise with all three alternatives as it relates to Existing Conditions model.

Ms. Calder then said that none of the three alternatives will achieve the original 2014 goal of redevelopment in that area and then asked what can be done to reduce the flood levels in that area. Mark then went over the pros and cons of the alternatives. He said that the main issue with this project is the constriction at Adams Street and if future improvements are made at Adams Street, what will happen downstream. Because once it is open it up, the water has to go somewhere. He stated that the open conveyance option provides more flexibility for the future.

Assistant City Manager, Wayne Tedder asked for another alternative showing the ditch opened up into a pond amenity in the floodplain between Polk Drive and the shopping center. Mark said it could be done, but they have not analyzed it yet.

Jodie Cahoon, City of Tallahassee Stormwater Manager, stated that the no rise for permitting has to be done on the effective FIS. He further commented that if you create a pond instead of a channel improvement, that there would not be any noticeable impacts downstream because the pond would be relatively small compared to the volume of water in the system. The pond would have to be larger and deeper to create a community amenity with water quality benefits to be further analyzed. He also suggested that to reduce the floodplain, the conveyance and constriction at Adams Street and downstream impacts would have to be analyzed and addressed.

Mr. Tedder recommended lifting the area aesthetics up without having any negative impact on the floodplain possibly by purchasing properties in the floodplain and turning it into a shallow, treatment area as a park, but didn't agree with the alternative of a wall on one side and opening up a ditch.

Ms. Calder said that purchasing properties in the floodplain for the floodplain reduction (if possible), beautification, tree mitigation, or other ideas would be worth exploring.

Mr. Cahoon suggested that the alternatives should provide the equivalent hydraulic area as that existing at Monroe Street. Then an analysis of what would happen if you carried those same improvements through Adams Street to see what the downstream and upstream impacts are should be conducted. Then you can determine how much more storage is needed to offset the downstream impacts. Mr. Tedder agreed with Jodie's comments. Autumn agreed that it would be a step in the right direction to have the data.

Ms. Calder said that the project team will continue to refine the stormwater analysis and find ways to improve the area aesthetics and amenities.

Nawfal requested that Blueprint include the small storm events in the stormwater modeling.

Ms. Calder then went over the next steps for the project starting from July-Sept. 2021 through Fall 2022.

IV. CITIZENS TO BE HEARD

Mr. Webster from the PSA Management Team commented that as long as you present the alternatives as mitigation to the community for storms, then you are putting your best foot forward.

V. ADJOURN

The meeting adjourned by consensus at 2:23pm.

Blueprint Intergovernmental Agency
Technical Coordinating Committee
Agenda Item #2

May 2, 2022

Title:	Review of the Capital Cascades Trail Segment 4 Stormwater Management System Design and Innovative Stormwater Technologies White Paper
Category:	Presentation
Department:	Blueprint Intergovernmental Agency
Contact:	Benjamin H. Pingree, Director, Department of PLACE Autumn Calder, Director, Blueprint Infrastructure Program

STATEMENT OF ISSUE:

This agenda item presents the draft Stormwater Management System Design and Innovative Stormwater Technologies White Paper (White Paper) developed by the consulting team, George and Associates Consulting Engineers, Inc. and Jones Edmunds and Associates, Inc., as part of the preliminary engineering for the Capital Cascades Trail Segment 4 project. The White Paper is included as Attachment #1. This item is presented to the TCC to receive its collective professional input and expertise.

FISCAL IMPACT:

This item does not have a fiscal impact.

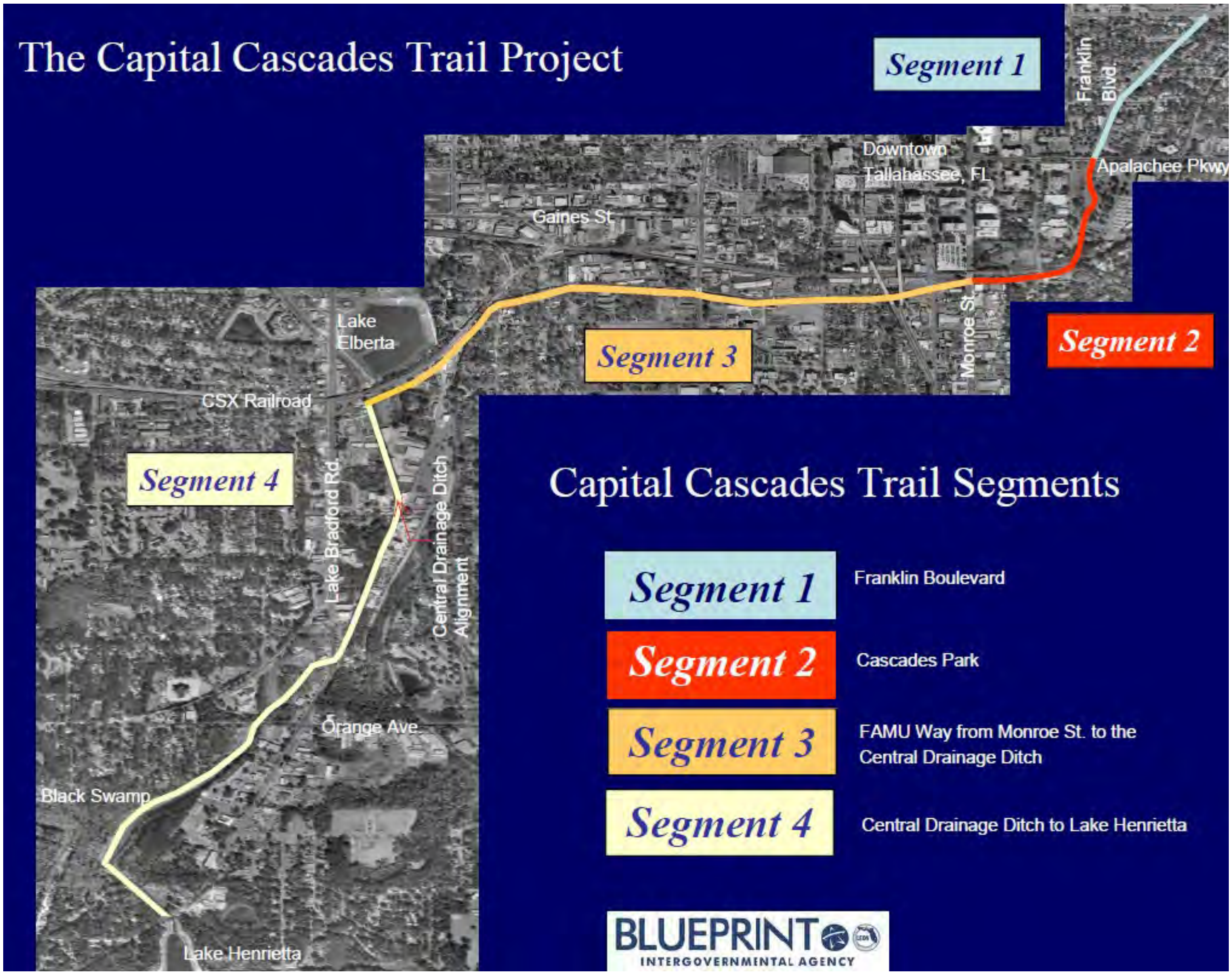
SUPPLEMENTAL INFORMATION

Capital Cascades Trail Segment 4 Project Background and Goals

Capital Cascades Trail Segment 4 (CCT 4) completes the Capital Cascades Trail Project as contemplated in the Capital Cascades Master Plan (Master Plan) approved by the Blueprint Intergovernmental Agency on January 31, 2005. CCT 4 will complete the stormwater and amenity improvements for the portion of the Capital Cascades Trail from the convergence of the Central Drainage Ditch and the St Augustine Branch south to Munson Slough at Springhill Road, as shown in Figure 1 below. The Capital Cascades Trail in its entirety, commences at Leon High School in downtown Tallahassee, traveling along Franklin Blvd to Cascades Park. Upon exiting Cascades Park, the project follows the St Augustine branch drainage ditch parallel to FAMU Way to the convergence of the St Augustine branch and Central Drainage ditch where CCT 4 begins.

From that convergence, the project follows the Central Drainage ditch south to terminate at Lake Henrietta on the south side of Orange Ave.

Figure 1: Capital Cascades Trail Project Alignment



The 2005 Master Plan includes a wide range of improvements for CCT 4 with the goal of improving water quality, providing habitat restoration and the creation of park-like areas. CCT 4 will provide connectivity to adjoining neighborhoods along the project corridor including the Bond Community, Jake Gaither, Liberty Park and Callen. As CCT 4 is the only segment of the Cascades Trail along the Central Drainage Ditch (CDD) it provides the unique opportunity to directly improve and enhance the CDD. Attachment #2 includes the most recent project snapshot for the CCT 4 project and includes the current project status.

Cascades Trail Completed and Under Construction Stormwater Improvements

Since the IA Board's approval of the Capital Cascades Master Plan in 2005, Blueprint has completed, a substantial number of stormwater improvements along the Cascades Trail corridor improving both water quality and reducing area flooding. In all, these stormwater improvements represent a total investment of more than $138,000,000 and stretch approximately 2.5 miles. The open ditch conveyance along Franklin Boulevard was enclosed with a box culvert system. This improvement improved safety, reduced area flooding, and reduced erosion. The Cascades Park improvements provide flood relief for the area, water quality improvements and a world class public gathering space with open spaces, walking trails, historical, cultural, and educational features.

Downstream improvements from Cascades Park along Segment 3, have been closely coordinated with the construction of FAMU Way by the City of Tallahassee. Blueprint improvements along this corridor include the replacement of an open ditch with a box culvert to reduce erosion, construction of stormwater facilities to improve water quality, construction of a technologically advanced trash trap and installation of community amenities including a skateable art park, history and culture trail and a restroom. The construction of the 3DB stormwater facility was recognized through two grants by the Florida Department of Environmental Protection in excess of $700,000 as a project that will improve the quality and quantity of the state's water resources in addition to reducing nonpoint source (polluted runoff) pollution from land use activities. The 3DB stormwater facility is currently under construction with completion anticipated in July 2022.

The improvements along Cascades Trail have won numerous awards and received accolades from many professional organizations. Cascades Park has won two national awards, one in 2015 from the American Public Works Association, and the second in 2016 from the American Planning Association. Franklin Boulevard, Cascades Park, the pedestrian bridge, and Segment 3 have won many awards over the last 10 years from local and state sections from organizations such as the Urban Land Institute, Florida Landmarks Council and the National Association for the Preservation of African-American History and Culture, American Public Works Association, American Planning Association, and the American Institute of Architects.

Beyond the Blueprint projects listed above, numerous other projects have been built upstream of the CCT 4 project by the City of Tallahassee and Leon County. This includes the armoring of the CDD by the City of Tallahassee greatly reducing erosion and sedimentation and the construction of the Tallahassee Junction stormwater facilities along the CDD to enhance water quality. In addition to these improvements, various facilities were constructed in the late 1990's and early to 2000's including Lake Elberta, Carter-Howell Strong pond, Lake Henrietta and the lakes stormwater facility located west of Lake Bradford Road and south of Epps Drive.

Collectively, these projects implemented by Blueprint, the City, and County have helped reduce flooding, sedimentation and nutrient loads while providing community amenities where possible. As presented in the White Paper, and discussed in more detail below, the improvements completed to date have significantly reduced the measured ambient load of total nitrogen, total phosphorus, total suspended solids and to a less quantifiable extent, trash.

CCT 4 Planned Stormwater Improvements

The CCT 4 project will include a broad range of improvements and enhancements along and in the general vicinity of the corridor. A final determination of the most functional and appropriate improvements and enhancements will be completed as part of the ongoing preliminary engineering taking into consideration past analysis, environmental constraints, hydraulic analysis, public outreach, and cost considerations.

As recommended in the Master Plan, improvements and enhancements that may be implemented include but are not limited to creation of open water lakes to still higher velocities, treat runoff, and provide sediment deposit sites, side bank stabilization, installation of in-channel steps and riffles, installation of trash collection systems, construction of park and greenway enhancements including an interconnected multiuse trail system. With a goal to implement innovative technologies, techniques and designs one of the first tasks undertaken by the consulting team was to develop the White Paper, included as Attachment 1, to review innovative techniques and technologies and recommend for CCT 4, based on the site constraints and project watershed, the most effective stormwater management system designs for further analysis through the project preliminary engineering effort.

Stormwater Management System Design and Innovative Stormwater Technologies White Paper

The White Paper was developed as part of the preliminary engineering efforts for CCT 4. It provides a comprehensive overview of the current state of stormwater design in Florida including engineering stormwater design criteria, traditional designs, low impact design (LID), green stormwater infrastructure (GSI), and innovative technologies. The White Paper also includes summary of the CCT 4 watershed characteristics and a discussion of potential stormwater improvements that are most relevant based on the project's stormwater characteristics. The White Paper provides the following information and key findings:

- A brief overview of stormwater design criteria and traditional designs commonly used in Florida.
- A summary of low-impact, green infrastructure and innovative designs.
- A watershed evaluation for CCT 4 including a review of the watershed, land uses, existing major stormwater infrastructure, and a review of the flood characteristics including the FEMA established flood elevations and a review of available water quality data.
    - **Key Finding:** Flood conditions near CCT 4 are primarily controlled by peak water-surface elevations in Munson Slough. Given that the CCT 4 basin is a relatively small portion of the Munson Slough watershed, 10% by area, it is not possible to mitigate peak water-surface elevations in Munson Slough through CCT 4. Stated differently, the CCT 4 improvements could not retain a large enough volume of water to reduce the flood stages in the Munson Slough watershed.
    - **Key Finding**: Although areas along CCT 4 are within the FEMA 100-year flood plain, because of the CCT 4 basin size compared to the land available for CCT 4 improvements and hydraulic conditions, flood reduction will not be achievable through CCT 4.

- Water quality information based on water sampling data collected by the City from 2016 to 2020 to review the pollutant load carried by the CDD through the CCT 4 project area.
    - **Key Finding**: Data collected over the last five years shows a decreasing pollutant loads trend along the CCT 4 corridor.
    - **Key Finding**: Decreasing pollutant load trends are a credit to past stormwater retrofits completed within the project watershed.
- A review of the available stormwater techniques and their applicability to achieve the CCT 4 project goals.
    - **Key Finding:** The recommendation for CCT 4 includes a design that will primarily focus on trash, sediment and nutrient reductions.

In summary, several traditional, innovative and green infrastructure techniques have been identified as possibly suitable to be incorporated within the CCT 4 treatment train. The recommendations are based on watershed characteristics and site constraints. Given the size of the basin in comparison to the project size and the peak flow volumes, flood reduction is not achievable through CCT 4. Instead, the recommendation is to focus on potential trash, sediment and nutrient load reduction that can be achieved considering the success of prior implemented stormwater improvements.

NEXT STEPS:

The White Paper will be revised as necessary to incorporate any feedback provided at the May 2, 2022 TCC meeting. Concurrently, preliminary engineering, data collection and modeling will continue on the CCT 4 project. The recommendations from the White Paper combined with the results from the stormwater modeling and the collected data will be utilized to guide the design of CCT 4 to best meet the project goals. Preliminary concepts are anticipated to be prepared by fall 2022 and a recommended concept to the IA Board for approval by December 2022.

Attachment:

1. Capital Cascades Trail Segment 4 Stormwater Management System Design and Innovative Stormwater Technologies White Paper
2. Project Snapshot

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Attachment #1

CAPITAL CASCADES TRAIL SEGMENT 4

STORMWATER MANAGEMENT

SYSTEM DESIGN AND INNOVATIVE

STORMWATER TECHNOLOGIES

A WHITE PAPER PREPARED FOR

BLUEPRINT
INTERGOVERNMENTAL AGENCY

JonesEdmunds

GEORGE & ASSOCIATES
CONSULTING ENGINEERS

STORMWATER MANAGEMENT

SYSTEM DESIGN AND INNOVATIVE

STORMWATER TECHNOLOGIES

A WHITE PAPER PREPARED FOR

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April 2022

TABLE OF CONTENTS

PREFACE

Blueprint Intergovernmental Agency is committed to creating holistic infrastructure solutions to improve the local community. One of Blueprint's highlight projects is the Capital Cascades Trail, which will reach completion with the implementation of Segment 4. As part of the George and Associates project team for Capital Cascades Trail Segment 4, Jones Edmunds developed this White Paper on behalf of Blueprint to provide a common level of understanding of potential stormwater management system designs for the project by overviewing the practice of stormwater design in Florida. Within this White Paper, the overview of stormwater design practice in Florida is followed by a summary of known stormwater characteristics for the Capital Cascades Trail Segment 4 project watershed and a discussion of potential stormwater improvements included in the overview that are most relevant to the project based on the established characteristics.

Readers may not be aware of all the traditional stormwater designs discussed in this White Paper, meaning your definition of innovative will likely vary by individual experience. As presented here, we define traditional stormwater designs as those that have most commonly been implemented throughout Florida and are considered standard stormwater design practice. The practice of stormwater design is evolving such that low-impact design (LID), green stormwater infrastructure (GSI), and other innovative stormwater technologies are becoming more commonplace. But we recognize that while LID, GSI, and some innovative technologies continue to gain in popularity, they are often still collectively considered to be innovative by most readers.

The breadth of potential material to be covered in this White Paper is immense. For simplicity, this White Paper presents a comprehensive, but not exhaustive, overview of the current state of stormwater design in Florida including engineering stormwater design criteria, traditional designs, LID, GSI, and innovative stormwater technologies. Any one of these overviews could be expanded to include more detail than presented here.

Specific to the Capital Cascades Trail Segment 4 project, further study of the project's stormwater characteristics is planned, including the development of a new stormwater model to aid in preliminary engineering of the project. This White Paper is not intended as a substitute for Capital Cascades Trail Segment 4 preliminary engineering, which needs to be completed before more definitive stormwater management system design recommendations are appropriate than presented here.

GLOSSARY

Stormwater Management System	The appurtenances, facilities, and designed features that collect, convey, channel, hold, treat, detain, or divert stormwater runoff. These systems may include traditional stormwater design components, LID techniques, GSI, and/or innovative stormwater technologies.
Land Development	A site improvement such as construction, reconstruction, demolition conversion, structural alteration, relocation, or enlargement of any structure, whether residential, commercial, industrial, office, professional, institutional, or recreational. This term is also generally used to include any use or extension of the use of land beyond its current state, including redevelopment. Stormwater management systems for land development are typically designed based on presumptive criteria.
Presumptive Criteria	Stormwater design criteria, which are presumed to meet regulatory goals and objectives based on prior studies and industry-accepted assumptions. A presumptive approach provides reasonable assurance that systems operate as expected without requiring monitoring or burdensome amounts of site-specific information.
Stormwater Retrofit	Stormwater management systems, or portions of a system that append an existing system and that do not serve land development but are focused on community improvement. These systems may include traditional stormwater design components, LID techniques, GSI, and/or innovative stormwater technologies. Stormwater retrofits may be focused on flood control, pollutant removal, or both. Stormwater retrofits are typically designed based on demonstrative criteria.
Demonstrative Criteria	Stormwater design criteria that are directly demonstrated to meet regulatory goals and objectives via detailed engineering calculations, monitoring, and/or performance testing.
Stormwater Attenuation	Stormwater attenuation is the capture and release of floodwaters, typically controlled via an engineered control structure, to protect downstream waters. Attenuation volume based on existing-condition discharge is required for stormwater designs to meet presumptive criteria.
Stormwater Treatment	Stormwater treatment is the removal of pollutants from stormwater runoff by physical, chemical, or biological means. Stormwater treatment is synonymous with water-quality improvement and is typically focused on nutrient and sediment removal. Treatment volume based on the proposed-condition rainfall-runoff-response is required for stormwater designs to meet presumptive criteria.

Control Structure	Control structures regulate discharge of stormwater runoff and are used to establish stormwater attenuation and treatment volumes.
Existing Condition	The drainage condition of the project site before activities related to land development have been constructed.
Proposed Condition	The drainage condition of the project site after activities and construction related to proposed land development have been completed.
Low-impact Design (LID)	A land development practice that stives to maintain green space, existing condition hydrology, and natural habitats to the greatest extent practical. LID stormwater management systems commonly include GSI in a treatment train but may also include traditional stormwater design components or innovative stormwater technologies.
Green Stormwater Infrastructure (GSI)	Stormwater design components intended to mimic nature by providing stormwater attenuation and treatment near the runoff source. GSI is commonly considered as an alternative to traditional stormwater design but is often coupled with traditional stormwater design and/or innovative stormwater technologies to meet design criteria.
Treatment Train	A series of complementary stormwater designs when combined meet or exceed stormwater treatment goals. A treatment train may include multiple traditional stormwater designs, GSIs, and/or innovative technologies.

BLUEPRINT
INTERGOVERNMENTAL AGENCY

1 BACKGROUND

Blueprint Intergovernmental Agency is a joint City of Tallahassee-Leon County agency within the Department of Planning, Land Management and Community Enhancement. Blueprint is committed to holistic infrastructure planning and community redevelopment. These efforts are highlighted by the Capital Cascades Trail (CCT) projects, which include multi-use stormwater and recreation facilities and a connected trail network. The CCT projects are divided into four segments and the final segment, Segment 4, is currently being developed. Goals for the Segment 4 project include flood protection, water-quality improvement, habitat restoration, and creation of park-like areas for public recreation.

Blueprint contracted George & Associates, Consulting Engineers, Inc. (GAC) to complete Task 1 of CCT Segment 4, which includes stormwater analysis and the development of preliminary design concepts. Jones Edmunds is part of the GAC project team for Task 1 and will be primarily responsible for stormwater analysis and the stormwater design portion of concept development.

Before developing stormwater design concepts for CCT Segment 4, Blueprint has requested this White Paper to overview to current state of stormwater design practice in Florida and discuss stormwater design components and innovative technologies that are applicable to the CCT Segment 4 project.

2 PURPOSE

This White Paper will provide readers with a common level of understanding of the current state of stormwater design practice in Florida, followed by a summary of stormwater characteristics for the Capital Cascades Trail Segment 4 project, and lastly a discussion of the most relevant potential stormwater improvements based on these characteristics.

The breadth of potential material to be covered in this White Paper is immense. For simplicity, this White Paper presents a comprehensive, but not exhaustive, overview of the current state of stormwater design in Florida including engineering stormwater design criteria, traditional designs, low-impact design (LID) and green stormwater infrastructure

(GSI), and innovative stormwater technologies. Any one of these overviews could be expanded to include more detail than presented here. Instead, focus throughout is given to topics most applicable for the CCT Segment 4 project, and was based on our judgment and understanding of the project goals at the time of this White Paper.

This White Paper is organized as follows:

- Section 3 provides the basics of stormwater design criteria in Florida.
- Section 4 overviews traditional stormwater design components and approaches.
- Section 5 overviews LID techniques and GSI.
- Section 6 overviews innovative stormwater technologies.
- Section 7 summarizes the CCT Segment 4 watershed characteristics to establish potential limitations of the project design.
- Section 8 discusses potential stormwater designs, technologies, and techniques that are most relevant to the CCT Segment 4 project.

3 STORMWATER DESIGN CRITERIA

In general, a stormwater management system design should consider service life, cost, public safety, and ease of maintenance. Stormwater management systems must comply with local, state, and federal stormwater design (permit) criteria. For land development, including redevelopment, these permit criteria are often presumptive and due to their prescriptive nature, highly dependent on traditional stormwater designs for compliance. Importantly, improving the watershed is not a goal of presumptive criteria. Instead, presumptive criteria in Florida were established with two goals:

1. Minimizing flooding and subsequent damage to life and property by providing adequate flood control.
2. Reducing 85 percent or more of pollutant loading from land development.

Demonstrating compliance with presumptive criteria requires stormwater analysis of existing and proposed conditions but does not require direct calculation of project impacts at the community level, such as flood-risk reduction or pollutant-load reduction.

By comparison, stormwater management systems that do not serve land development and are designed to improve the community, also known as *stormwater retrofits*, are typically held to design criteria that demonstrate net improvement to the community, either through flood-risk reduction or pollutant-load reduction. This so-named demonstrative approach requires more complex analyses to demonstrate project impacts at the community level.

The CCT Segment 4 project's stormwater management system is expected to serve proposed project improvements and as a stormwater retrofit for the project watershed. The project's ability to provide a net improvement to the community will be dictated by watershed characteristics and site constraints, which include the land available for improvements and hydraulic conditions at the site. Simplistically, the watershed characteristics dictate what type of stormwater improvements are warranted while the site constraints dictate what level of stormwater improvement is practical. The combination of watershed characteristics and site constraints places a practical limit on the net improvement to the community the CCT Segment 4 project can be reasonably expected to achieve.

The CCT Segment 4 project's stormwater management system will be regulated at the state level by the Northwest Florida Water Management District (NWFWMD) through the Environmental Resource Permitting Rules in the Florida Administrative Code, Chapter 62-330, and at the local level by City Growth Management through the City's Land Development Code. The project's stormwater management system will be regulated at the federal level by the United States Army Corps of Engineers (USACE) and Federal Emergency Management Agency (FEMA) per the Federal Register.

4 TRADITIONAL STORMWATER DESIGNS

Traditional stormwater designs that use wet detention or infiltration for stormwater treatment have well-established presumptive criteria in Florida. Although wet detention is almost always associated with a wet-detention pond, several varieties of infiltration-based designs exist. The appropriateness of these two practices to a site are usually dictated by soils and depth to the groundwater table. Presumptive design criteria typically include:

1. Limiting discharge of attenuation volumes to the existing condition peak discharge or less from infrequent, large storms.
2. Providing treatment volumes based on the proposed condition rainfall-runoff-response from more frequent, smaller storms.
3. Requiring discharge of these volumes within prescribed recovery times.

A few traditional stormwater designs exist that are not as commonly used to support land development but that do have established presumptive design criteria. Two notable examples are constructed wetlands and stormwater harvesting. These stormwater designs can be designed to serve only stormwater treatment goals, not stormwater attenuation, and operate as variations on wet-detention or infiltration-based designs.

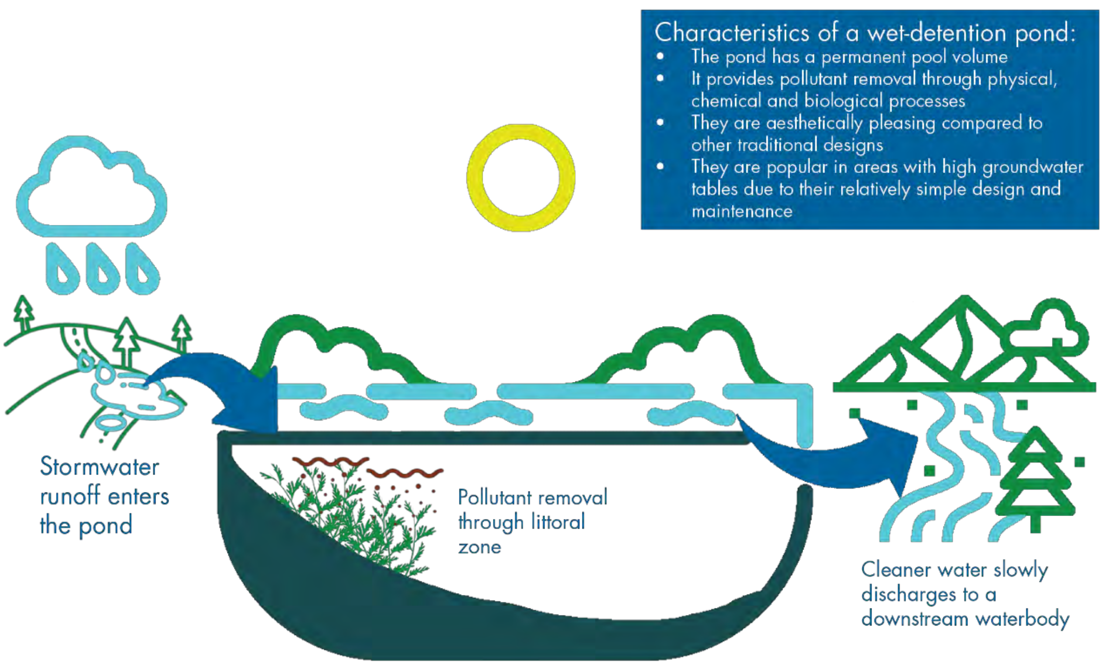
Several more traditional stormwater designs exist that are not typically used to support land development because they do not have associated presumptive criteria and do not provide stormwater attenuation. These designs include but are not limited to sediment traps, trash traps, chemical treatment, and erosion control. These stormwater designs are used to only provide stormwater treatment.

While the most common application of traditional stormwater design components is a single component serving a single site, other stormwater design approaches worthy of mention are over design, off-site design, and combination designs. These stormwater design approaches rely on one or more of the previously mentioned traditional stormwater designs to meet project goals. Overviews of the most relevant traditional stormwater designs are provided in this Section.

4.1 Wet Detention

Wet-detention designs are typically a man-made pond that receives stormwater runoff from a storm-drain or swaled system and slowly discharges the captured runoff through a control structure to a downstream waterbody as shown in Figure 1. The pond volumes and control structure discharge rates are engineered to meet presumptive design criteria. The *wet* portion of the pond is also known as the permanent pool volume.

Figure 1 Wet Detention Pond Example



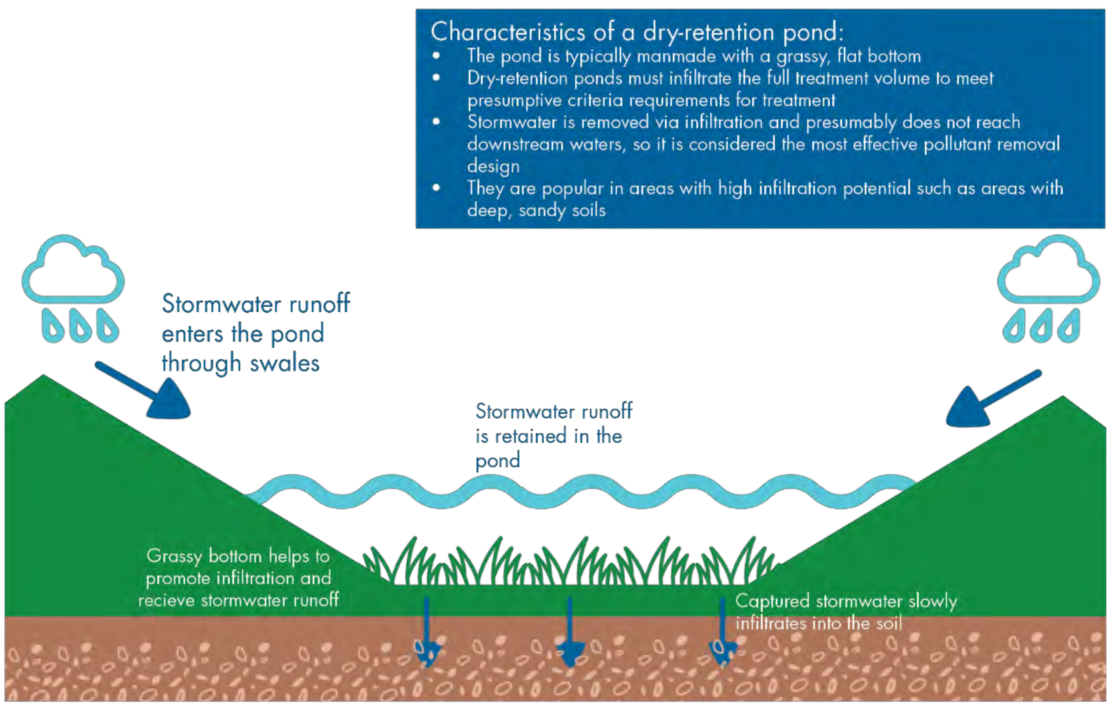
Wet-detention ponds often incorporate a littoral zone to further facilitate pollutant removal. The littoral zone is a portion of the pond that is designed to be shallow and contain rooted aquatic plants. The aquatic plants promote nutrient removal primarily by providing a habitat for microorganism activity and provide limited direct nutrient uptake. However, several studies have shown most pollutant removal from wet-detention ponds occurs within the permanent pool volume and that pollutant-removal potential is well correlated to the hydraulic residence time of this volume. Simply stated, the bigger the wet-detention pond the higher potential pollutant removal.

4.2 Retention

The most common infiltration-based design is a dry-retention pond. These ponds are typically manmade with a grassy flat bottom to promote infiltration as shown in Figure 2 and receive stormwater runoff from a storm drain or swaled system. Dry-retention ponds typically infiltrate the full volume of runoff received from smaller storm events and slowly release the attenuation volume through an engineered control structure to meet presumptive criteria requirements for attenuation for larger storm events.

Since volumes discharged via infiltration and their associated pollutant load presumably do not reach downstream waters, retention is traditionally considered the most effective pollutant-removal design. These designs are popular in areas with high infiltration potential such as areas with deep, sandy soils. However, these designs must consider potential localized impervious layers or high groundwater tables that would limit the infiltration potential.

Figure 2 Dry Retention Pond Example



4.3 Exfiltration

An exfiltration system is another infiltration-based design and performs similarly to a dry-retention pond, except that the system is entirely subsurface. Exfiltration systems include perforated drainage pipes that are surrounded underground by porous aggregate or media to promote infiltration. The main advantage of exfiltration systems is that they are completely subsurface, which makes these systems popular in areas that are very space limited. Exfiltration systems may be designed to infiltrate the full storm volume or discharge the attenuation volume to downstream waters. However, periodic replacement of the aggregate is required due to sediment accumulation within the system to maintain infiltration rates and can often be expensive compared to maintenance of other traditional stormwater designs.

4.4 Swales and Vegetated Strips

Swales and vegetated strips are two more infiltration-based designs. These designs slowly convey stormwater runoff through a small channel (swale) or via sheet flow (vegetated strip) over grassy areas with high-infiltration potential. For these designs, the attenuation volume is typically discharged overland or through a storm pipe at the system's outfall to downstream waters. The treatment volume is discharged via infiltration. These designs are popular when only a small amount of runoff needs to be managed or as pre-treatment components within a stormwater treatment train.

4.5 Detention with Filtration

Some dry-pond designs include under-drains or side-drains to facilitate infiltration. These drains are perforated drainage pipes that are installed in a bed of porous media, most commonly sand. The drains collect and convey stormwater flows from underneath or the side of the pond. Stormwater collected by the drain system is not infiltrated to a groundwater system but is filtered before discharge to downstream waters. For this reason, these systems are considered detention systems since the full treatment volume is not discharged via infiltration. Discharge of filtered flows and the attenuation volume typically occurs through an engineered control structure and then to downstream waters.

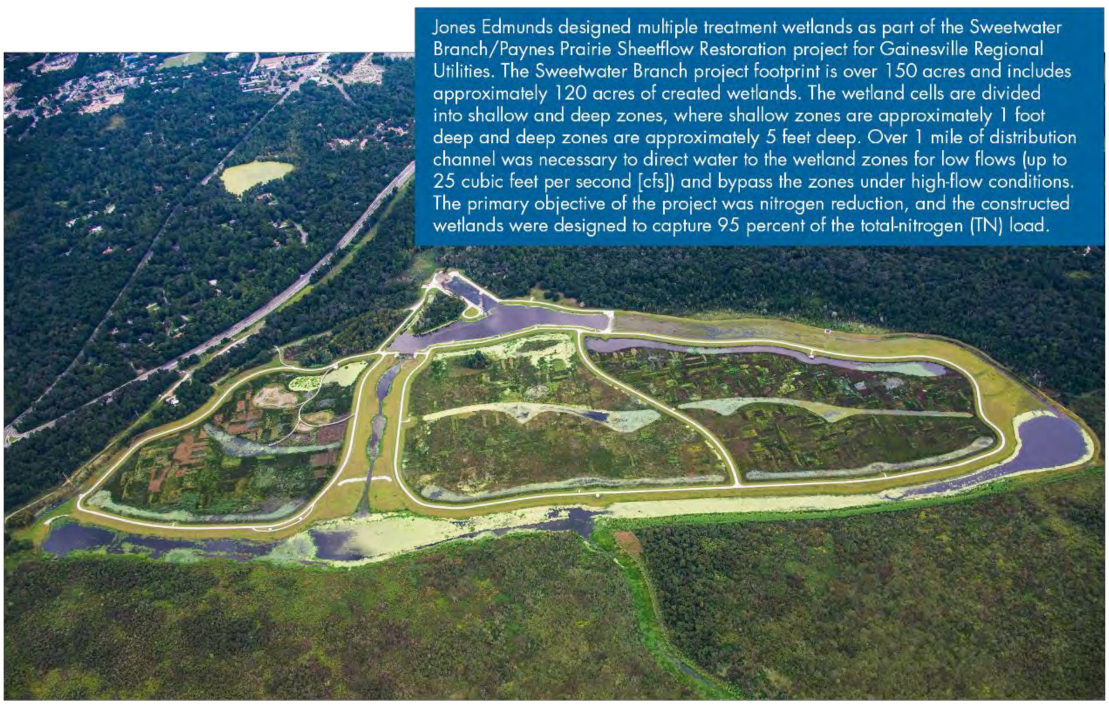
In practice, these systems often operate as hybrid systems where some of the treatment volume is infiltrated and some filtrated and discharged downstream. Although some pollutant removal is provided during filtration between the pond and the drains, studies show pollutant removal from the filtration process to be limited and unreliable, particularly for dissolved pollutants like nitrogen. Accordingly, these designs are not as effective at pollutant removal as retention systems unless coupled with engineered media. These stormwater designs also typically require more maintenance.

4.6 Constructed Wetlands

Constructed wetlands use wetland vegetation, soils, and associated microbial activity to improve water quality. These systems are sometimes referred to as treatment wetlands or created wetlands and are as varied as the available vegetation, including surface flow, subsurface flow, and combination systems. When properly designed, constructed wetland are very effective at stormwater treatment. An example of a large-scale constructed wetland is the Sweetwater Branch treatment wetland, which was designed by Jones

Edmunds and is pictured in Figure 3. The Sweetwater Branch treatment wetland serves an urban watershed of approximately 3 square miles and was designed to primarily treat inflows less than 10 cfs and can capture storm flows up to 25 cfs. Sweetwater Branch also has the relative benefit of treating WWTP effluent that is mixed in with storm flows, meaning incoming nutrient concentrations higher than typical storm flow, which allows the wetland components to remove nutrient loads very efficiently.

Figure 3 Constructed Wetland Example – Sweetwater Branch



However, inflow and velocity through a constructed wetland are typically limited to avoid damaging vegetation, to avoid resuspending captured pollutants, and to allow time for the rate-dependent biological treatment processes to occur. In short, properly designed constructed wetlands are excellent for stormwater treatment of the accepted flows when sufficient nutrient concentrations are present, but often bypass a significant portion of flow from larger storm events. In comparison to other types of stormwater treatment types, constructed wetlands require a much larger area to achieve a similar pollutant load reduction.

4.7 STORMWATER HARVESTING

From a stormwater design perspective, stormwater harvesting (or stormwater reuse) is an improvement to wet detention for stormwater treatment, but typically does not directly provide stormwater attenuation since stormwater is harvested between storm events.

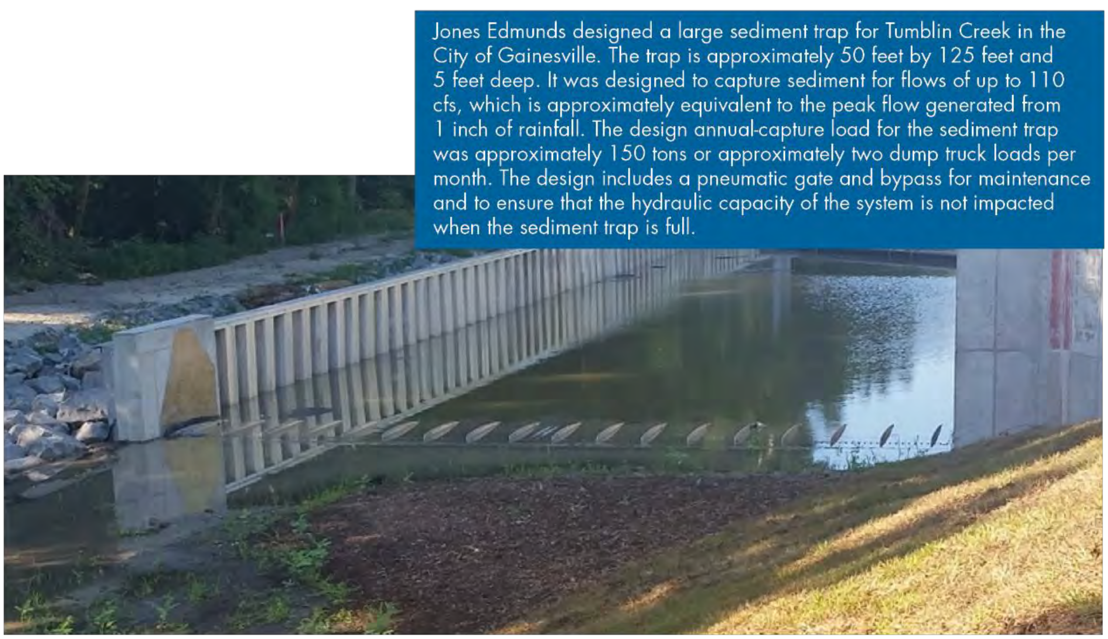
Unlike a traditional wet-detention pond where the treatment volume is slowly released downstream, stormwater harvesting removes some or all of the treatment volume for another non-potable use, most commonly irrigation. In this way, the concept is very similar to residential rainwater harvesting.

Stormwater harvesting is slowly gaining popularity to increase pollutant removal and to offset potable supply demands from non-potable uses, such as on-site irrigation needs. However, the timing of storm flows needs to be considered when stormwater harvesting is used as an alternative irrigation source. Seasonal rainfall patterns often necessitate a backup irrigation source or a very large storage volume.

4.8 Sediment Traps

Sediment traps promote sediment deposition by sufficiently reducing flow velocity to allow time for most of the sediment to settle before stormwater flows and their sediment load are released downstream. An example of a large sediment trap is shown in Figure 4.

Figure 4 Sediment Trap Example



Sediment deposition also occurs in other stormwater designs, but with sediment traps the focus is on sediment removal. Accordingly, sediment traps typically do not provide stormwater attenuation. Sediment traps differ from sediment sumps, which are manmade pits to temporarily store runoff commonly associated with construction activities and designed to last only as long as the construction activities. By comparison, sediment traps are designed as permanent improvements and typically hardened so that maintenance activities can easily remove accumulated sediment over time without damaging the trap.

Baffle boxes are a type of self-contained sediment trap. They are so-named since the prefabricated boxes include a series of sediment settling chambers separated by baffles. Baffle boxes are typically positioned at outfalls and though simple, can be difficult to maintain due to access issues.

4.9 Trash Traps

The most effective method of anthropogenic (human-caused) trash reduction is source reduction or collection nearest the source as practical. However, larger trash collection designs can be engineered to serve large stormwater conveyance systems. The design components are commonly referred to as trash traps. An example of a large trash trap is shown in Figure 5 and as seen in the figure, trash traps are commonly supplemented with a floating boom that directs trash on the surface to the trap. Baskets and bags typically float and capture trash directly. By comparison, a trash screen typically does not float and captures trash within most or all of the water column.

Figure 5 Trash Trap Example

Simply stated, trash traps are capture points for trash that allow relatively easy removal and maintenance compared to removing trash from a larger stormwater system, such as an open channel or pond. Trash traps do not provide stormwater attenuation. Two primary complicating factors exist with all trash traps:

1. Trash traps, particularly screens, are inherent hydraulic constrictions and commonly require bypass designs to allow high storm flows without adverse impacts. This hydraulic need will increase the footprint of the design or limit its function.

2. Trash traps will capture more than just anthropogenic trash. Trash traps will capture any large debris carried by storm flows. Accordingly, trash traps are more appropriately named *gross pollutant* removal designs since the anthropogenic trash is likely to be mixed with organic debris and, depending on the characteristics of the system, may only be a small portion of the captured load, even in urban watersheds where tree cover can potentially generate high loads of leaf litter.

4.10 Erosion Control

One of the most common improvement goals for an urban stream is erosion control. Permanent erosion control measures come in several varieties including but not limited to concrete, sheet pile, geotextile, and gabion designs. These types of stormwater designs eliminate or greatly reduce the erosive potential of an urban stream segment, but do not by themselves remove sediment loads that are conveyed through the segment to downstream waters, improve water quality downstream relative to upstream, or provide attenuation. These designs do provide stormwater treatment by preventing degradation of water quality within the improved segment. An example of erosion control for an urbanized system is just upstream of CCT Segment 4 in the City's *Lower Central Drainage Ditch Improvements*, which is a gabion design.

4.11 Over Design, Off-Site Design, and Combination Designs

In some situations, physical limitations such as property availability or access points make construction of a single traditional stormwater design component impractical. In other situations, one design component is not sufficient to meet permit criteria. To address these limitations, a few approaches have become more commonplace to stormwater design, but are all dependent on one or more of the traditional stormwater designs.

One approach is to provide stormwater attenuation or stormwater treatment to a greater extent than required by rule, commonly known as over design. This approach uses the over design of one element to offset the under design of another. For example, some communities have capitalized on the over design provided by stormwater retrofits to support a single site development, such as coupling a stormwater retrofit project with a community park, or supporting multiple future developments, such as stormwater design that provides enhanced attenuation and/or treatment of the watershed's existing condition but also provides credits for future land development so that future on-site stormwater designs are minimized or potentially not required. In these cases, the stormwater management system is over designed relative to permit criteria.

A similar approach is to design a stormwater management system off site, commonly known as off-site compensation. In our experience, off-site compensation for land development is typically not allowed by regulatory agencies unless coupled with over design so that a net community improvement is demonstrated. Accordingly, although over design does not require off-site compensation, off-site compensation typically does require over design. A stormwater retrofit project that also serves future land development would be considered over design and off-site compensation for future development.

The last approach is a combination system, which is a very popular option for stormwater retrofit projects and is gaining popularity to support land development. A combination system approach uses multiple design components in a treatment train to meet permit criteria. A LID stormwater management system is an example of a combination system.

5 LOW-IMPACT DESIGNS

The concept of LID was popularized almost 30 years ago and for most of that time was commonly known as *low-impact development*. Recently, *low-impact design* has replaced *low-impact development* as the more accepted term for LID within the industry. LID as a planning or engineering approach is often used synonymously with other terms such as smart development, sustainable development, and new-urbanism. As related to stormwater management system design, we have defined LID as a design practice that strives to maintain existing-condition hydrology and natural habitats to the greatest extent practical and is therefore distinct from traditional stormwater design practice. GSI design components are commonly included in LID stormwater management systems.

5.1 WHAT IS LID?

A LID stormwater design typically uses GSI design components integrated as a treatment train to replicate stormwater treatment and attenuation provided by the natural landscape. Although traditional stormwater designs collect, control, and treat stormwater runoff to meet presumptive criteria using an *end-of-pipe* solution, such as a stormwater pond, a LID stormwater management system includes nature-based retention, detention, treatment, and harvesting design components, i.e., GSI, distributed across the site to promote stormwater attenuation and treatment at or near the source of stormwater runoff. LID goals include:

- Preserve or conserve existing site features as much as possible to mimic existing conditions.
- Distribute stormwater attenuation and treatment design components, typically GSI, across the project site and as near to large sources of runoff (typically an impervious area) as possible.
- Reuse captured rainwater or stormwater on site.
- Minimize potential soil compaction from site development and promote stormwater infiltration.

LID and GSI are also well known for benefits beyond stormwater attenuation and treatment. Preserving natural areas creates aesthetically pleasing environments, provides wildlife habitat, and can limit landscape maintenance needs. GSI design components also make use of natural features, which helps maintain connectivity of green spaces on site and within the community. The source control provided by GSI can also reduce capital costs compared to traditional stormwater design.

However, including GSI within a stormwater management system typically does not completely offset the need for a traditional stormwater design to meet project goals or regulatory objectives. Also, a significant difference between GSI and traditional stormwater design components is that from a regulatory perspective, well-established design criteria may not be available for GSI design components. Although improved in recent years, these limitations of GSI have slowed the adoption of LID stormwater management systems as standard practice. To promote LID and GSI, some local communities have provided guidance for LID and developed design criteria for GSI, commonly within community manuals. Some examples of these include the *Pinellas County Stormwater Manual*, *Duval County LID Design Manual*, *Alachua County LID Manual*, and the *Sarasota County LID Guidance Document*. Readers interested in learning more about LID and GSI are encouraged to review those manuals.

5.2 What is GSI?

GSI design components are intended to mimic nature by providing stormwater attenuation and treatment near the runoff source. GSI is commonly considered as an alternative to traditional stormwater design but in practice GSI is often coupled with traditional stormwater design and/or innovative stormwater technologies to meet permit criteria. Some of the most well-known GSI design components are the various forms of bioretention and permeable pavement. Other design components considered to be GSI when associated with LID stormwater management systems were previously discussed in this document, including swales, baffle boxes, and exfiltration systems.

The potential confusion between GSI and traditional stormwater design regarding LID is an artifact of LID being an approach-based practice that is not limited by design components. Any number of stormwater design components may be included in a LID stormwater management system if they help meet the fundamental goals of LID. To help the reader, we offer the following simplified distinction. The difference between a traditional stormwater design and LID is often a matter of the design component(s) size, location, and vegetation. Smaller, nature-based design components are often considered GSI and when GSI design components are included in the treatment train, the stormwater management system is often considered to be LID.

Table 1 provides a list of stormwater design components that are commonly considered to be GSI when associated with LID stormwater management systems, along with the Section of this White Paper where the design component is more fully discussed. Overviews of potential GSI design components not previously discussed are provided in this section.

Furthermore, many innovative stormwater technologies, which are discussed in Section 6, are also often considered GSI.

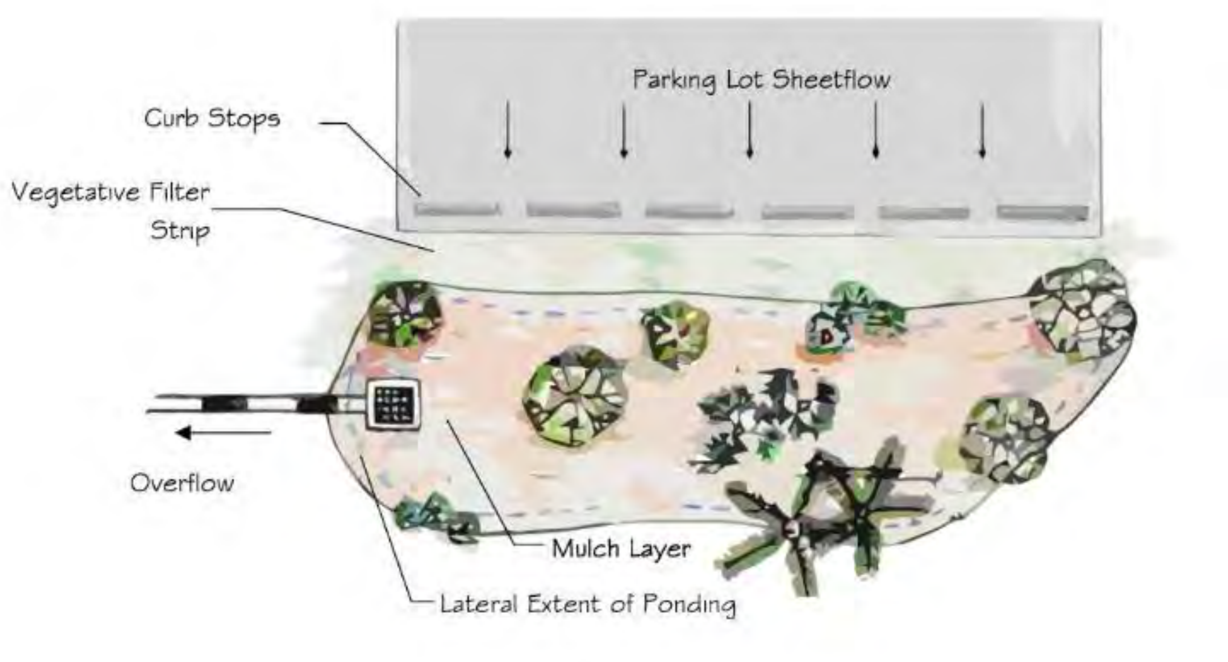
Table 1 Previously Mentioned GSI Design Components

Design Component	Document Reference
Exfiltration	Section 4.3
Swales	Section 4.4
Vegetated Strips	Section 4.4
Constructed Wetlands	Section 4.6
Stormwater Harvesting	Section 4.7
Baffle Boxes	Section 4.8

5.2.1 Bioretention

Bioretention is an infiltration-based design component that provides the same engineering function as a retention design, but instead of only grass within the retention area, bioretention includes engineered media, soils, mulch, and/or native plants to facilitate infiltration and enhance pollutant removal. An example of a bioretention system is shown in Figure 6.

Figure 6 Bioretention Example



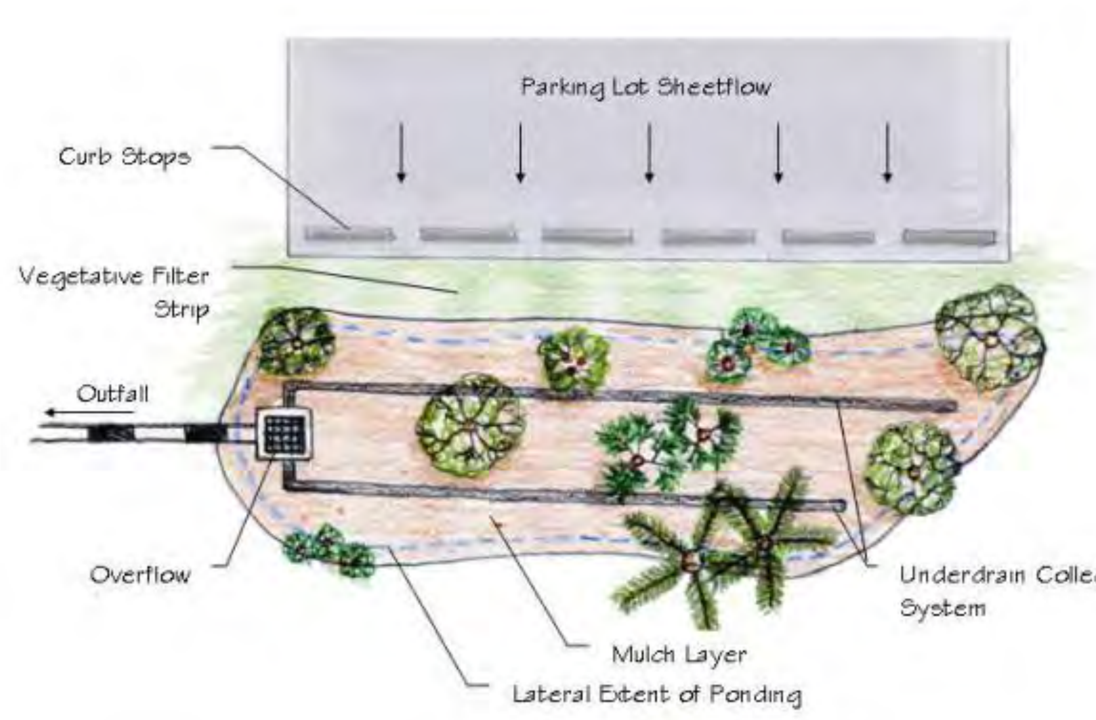
When stormwater attenuation is solely provided through infiltration, these systems are sometimes referred to as shallow bioretention. When properly designed, bioretention systems are more effective than conventional retention systems due to the increased interaction of stormwater runoff with soil, microbes, and vegetation enhancing biogeochemical processes that remove pollutant loads.

Bioretention is often used synonymously with a bioswale, rain garden, or planter box. The distinction typically is in the size and service area. In practice, bioretention areas usually refer to systems of relative size serving a large parking lot or building. Bioswales are bioretention systems that also serve as a swale conveyance, typically associated with a road or pedestrian path. Rain gardens are bioretention systems that serve a smaller parking lot or building, such as a single-family home. Planter boxes are bioretention areas that serve a very small area. A specific example of a planter box is a tree box, which uses a tree for uptake.

5.2.2 Detention with Biofiltration

Like detention with filtration (Section 4.5), biofiltration systems can be designed to function in areas with high ground water tables by using underdrains to facilitate infiltration via filtration from the surface to the drain. An example of a biofiltration system is shown in Figure 7.

Figure 7 Detention with Biofiltration Example



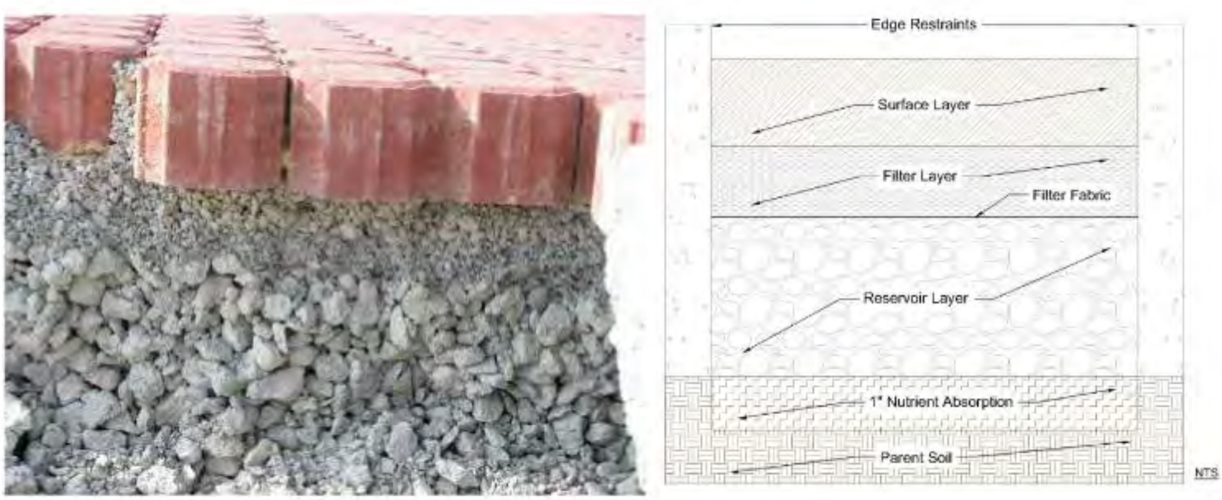
The difference between detention with filtration and with bioretention is in the filtration process and design filtration rates. Like bioretention, biofiltration systems increase interaction of stormwater runoff with soil, microbes, and vegetation, which enhances biogeochemical processes that remove pollutant loads. Detention with biofiltration systems have much lower infiltration (filtration) rates compared to bioretention and therefore typically include vegetation that thrive in wet conditions for prolonged periods. In biofiltration systems, stormwater is intentionally slowly filtered through the system to maximize pollutant-load reductions from the biogeochemical process.

Due to the slow rate of filtration, detention with biofiltration systems typically provide relatively high levels of stormwater treatment but can capture only small volumes and provide only limited stormwater attenuation. As with bioretention systems, detention with biofiltration is often used synonymously with a bioswale, rain garden, or planter box and the distinction typically is in the size and service area.

5.2.3 Permeable Pavement

Permeable pavement is an infiltration-based design component that uses gray infrastructure. The pavement, concrete, pavers, turf, or other manufactured surface type is porous and allows runoff to infiltrate through the surface to a below-grade system where stormwater attenuation and treatment are provided. Accordingly, permeable pavement systems are more than just the manufactured surface and typically include multiple layers that make a modular system, such as permeable pavement, filter layer(s), reservoir, and subgrade/parent soil as shown in Figure 8. Permeable pavement is most applicable in areas with infrequent traffic and light loads.

Figure 8 Permeable Pavement Example



Permeable pavement systems may also include underdrains, where the system will perform like detention with filtration. Stormwater that passes through the permeable pavement system but is ultimately discharged to downstream waters via underdrains typically receives only minimal treatment unless the modular system includes engineered media.

5.2.4 Rainwater Harvesting

Rainwater harvesting serves the same engineering function as stormwater harvesting except that the harvesting occurs close to the source collection. Harvested rainwater typically comes from a building rooftop and is stored in a cistern near landscaping that will be the benefactor of the harvested rainwater via irrigation. These systems are typically small but are also popular primarily to offset potable supply demands for irrigation. However, seasonal rainfall patterns may necessitate a backup irrigation source depending on the landscaping.

5.2.5 Green Roofs

A green roof functions as a specialized detention system with biofiltration that is on the roof of a building and is typically coupled with a cistern or other storage design component. Green roofs are quickly gaining popularity in heavily urbanized areas where other green spaces are limited due to their aesthetic appeal and long design life, which is commonly twice that of traditional roofing material. However, green roof design can be quite complex due to structural considerations especially when public access is allowed.

6 INNOVATIVE STORMWATER TECHNOLOGIES

For this White Paper, innovative technologies are improvements on traditional stormwater and GSI design components. These technologies are commonly associated with stormwater retrofit projects but have also been used to support land development.

6.1 Engineered Media

Engineered media, sometimes called green media, is incorporated into stormwater designs to enhance pollutant removal through a filtration-like process that also includes biological treatment. The most well-known engineered media for stormwater design is biosorption-activated media (BAM). BAM is generally designed to remove nitrogen and phosphorus and is commonly customized to site-specific conditions for incoming nutrient loads and design flows. Like filtration processes, the design flux rate through BAM is limited; therefore, treatment of even moderately high flows requires a very large BAM surface area.

BAM is perhaps best known for application within a modified baffle box where BAM is used within an upflow filter, the baffles collect sediment, and a trash trap collects floatable debris. This type of combined system design is very popular since it is prefabricated, but it is also limited to relatively low treatment flows through the upflow filter for a single unit. These systems are also often considered to be GSI even though they are not nature-based. A similar BAM system is planned as part of the CCT Segment 3D-B project.

BAM is also commonly incorporated into infiltration-based designs such as dry-retention ponds, exfiltration trenches, permeable pavement, or bioretention. The stated design life of a BAM system varies from a few years to over 20 years depending on the site-specific application; however, since the technology is still relatively new, the upper end of design life has not been fully tested for many applications.

6.2 Chemical Treatment

Chemical treatment of stormwater typically refers to an alum system designed to remove nutrients, although there are other chemical treatment methods besides alum. These systems are typically an improvement on wet-detention ponds where the chemical treatment is applied to pond inflow to promote nutrient removal within the pond.

Chemical treatment systems that use alum are very effective at phosphorus removal but are relatively expensive and require significant maintenance. They are most applicable immediately upstream of a protected waterbody and are often considered as a last resort when all other treatment options have been exhausted. The City operates multiple alum treatment facilities, including one of the largest facilities in Florida, in the Upper Lake Lafayette watershed, known as the Upper Lake Lafayette Nutrient Reduction Facility (ULLNRF) and pictured in Figure 9.

Figure 9 Chemical Treatment Example – ULLNRF Contact Chambers

6.3 Floating Orifices

Floating orifices, sometimes called self-skimmers, have traditionally been associated with temporary sediment sumps, since the design can significantly decrease sediment discharge to downstream waters. From an engineering perspective, a floating orifice provides a few advantages over a more traditional static orifice, most notable being maintenance of a single discharge rate over a wide range of operating conditions and reduced potential for sediment discharge. Although this type of stormwater design is not commonly used to support land development, these designs are increasing in popularity in Florida as a stormwater retrofit to an existing wet-detention pond, since the retrofit from a static orifice to a floating orifice can provide significant gains in pollutant-load reduction for a relatively low cost. These benefits are most demonstrable for existing wet-detention ponds with relatively short residence times and/or relatively high sediment loads.

6.4 Floating Wetlands

Floating wetlands, sometimes called managed aquatic plant systems (MAPS), improve on traditional designs of wet-detention ponds. Floating wetlands are named appropriately, since these systems are floating mats strategically planted with wetland plants. From an engineering perspective, the floating wetland will increase pollutant-load removal from the pond through nutrient uptake from the plants and nutrient removal from increased biological activity within the root zone. Although this type of stormwater design is not commonly used to support land development, these designs are increasing in popularity in Florida as a stormwater retrofit to an existing wet-detention pond. However, these systems may carry a high maintenance burden depending on site constraints impacting the wetland function.

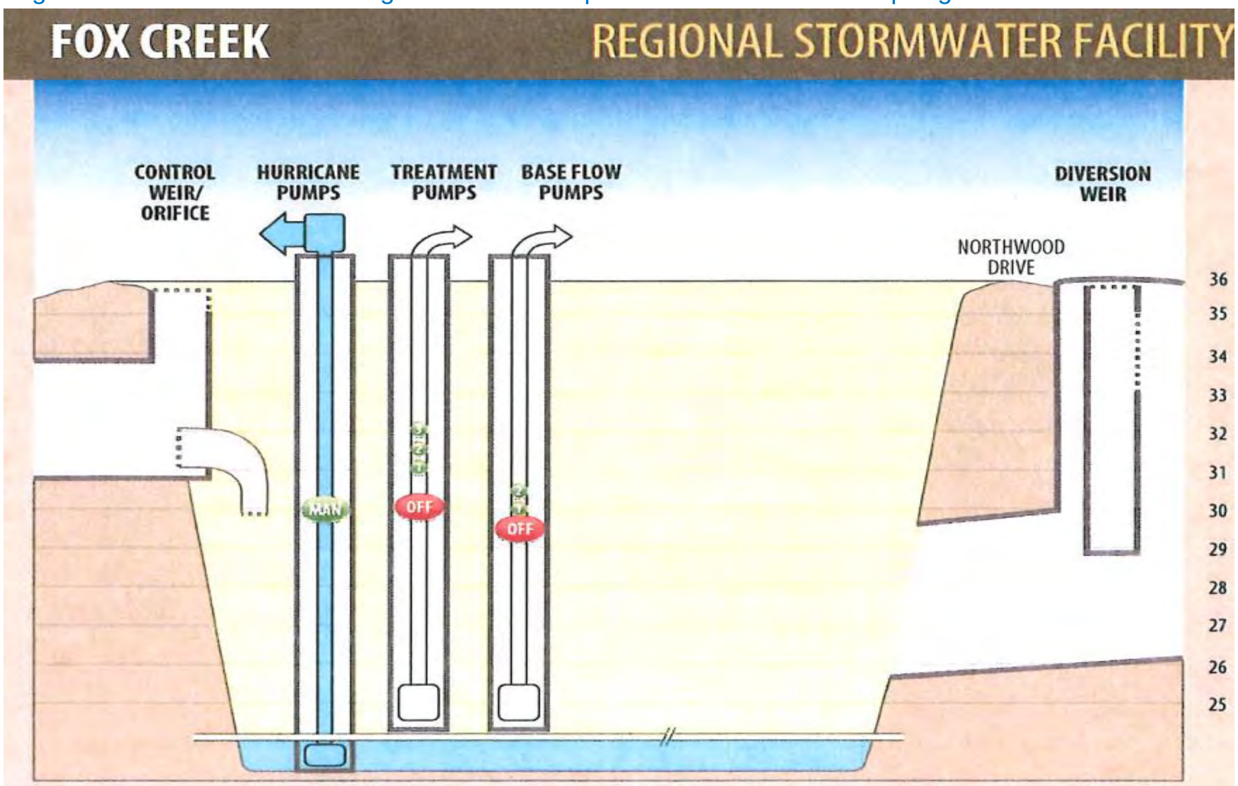
6.5 Active Management

Most stormwater designs use passive infrastructure components, such as ponds, pipes, and channels. The passive infrastructure is intended to only require maintenance between storm events so that the system is prepared to function as designed when a storm begins, will function similarly throughout the storm, and continue to function when the next storm begins, regardless of when the storm events occur. By comparison, active stormwater infrastructure components change how the system performs during a storm, from storm-to-storm, between storms, or during maintenance activities. The most common active components are pumps, which are typically designed to actively control water levels within the system or convey storm flows against gravity.

Active control of water levels can enhance treatment volume recovery, provide additional attenuation volume before large rainfall events, and/or allow more effective maintenance. For example, Jones Edmunds helped St. Johns County optimize the design of the *Fox Creek Regional Stormwater Treatment Facility*, which is an over 30-acre wet-detention pond that uses pump stations to control base flow, control the release of treatment volume, and to draw down water levels over 15 feet within 72 hours before large storms – also known as *hurricane pumps*. Figure 10 provides a schematic sketch of how the pumps actively manage water levels for the Fox Creek facility.

Pumps can also be used to increase wet-detention pond inflow and treatment. For example, Jones Edmunds designed a new pump system to increase inflow to the St. Johns River Water Management District's Deep Creek West facility (a wet-detention pond) from an adjacent below-grade agricultural ditch, which in turn increased the annual pollutant-load reduction through capture and treatment of previously untreated runoff.

Figure 10 Active Management Example – Fox Creek Pumping Schematic



A more unique implementation of stormwater pumps is recirculation of captured flow to provide inter-event or low-flow treatment. For example, Jones Edmunds recently designed a retrofit treatment project for Volusia County, known as the Ariel Canal Treatment Facility, that uses inter-event treatment. This facility diverts stream flows that occur following up to a 1-inch storm event to a wet detention pond. The permanent pool volume within the pond is continuously pumped through a BAM treatment system, which establishes a much lower nutrient concentration within the pond when compared to a typical wet detention pond. The low-concentration (permanent pool) volume is discharged at the start of the next storm event and replaced with new stream flow. The inter-event treatment significantly and cost-effectively increases the pollutant load reduction of the system.

Jones Edmunds, in conjunction with Pegasus Engineering, also designed the Gabordy Canal Treatment Facility for Volusia County, which continuously pumps low flows from the canal into a BAM treatment system before discharging the flows into a flood compensation pond for additional reaeration prior to discharge back to the Canal. This facility eliminates nearly 6,000 pounds of phosphorous per year using only a 1-acre facility footprint, which is very efficient compared to more traditional stormwater designs of similar size and associated pollutant load inflow.

Another example of an active management system is a mechanical rake designed to self-clean a trash trap. The City operates a mechanical rake for a trash trap near the Florida State University/City of Tallahassee (FSU-COT) Regional Stormwater Facility (RSF) and Blueprint has included a mechanical rake with the trash trap currently being constructed as part of CCT Segment 3D-B. These mechanical rakes help remove trash collected on a screen to a more convenient location for disposal (such as a dumpster). They also help maintain storm flows through the trash trap by cleaning the collection screen automatically during and after storm events.

6.6 Real-Time Adaptive Controls

Stormwater technology has advanced during the past decade commensurate with advancements and cost reductions of novel sensors, wireless communications, rainfall forecasting, and data management platforms. The merging of active management designs with real-time, adaptive control technology has resulted in *smart* stormwater designs. Smart systems can be included in a new stormwater design or retrofitted into an existing system. Smart systems are most often associated with wet-detention and chemical treatment systems in Florida but have many applications. Some of the potential benefits include, but are not limited to:

- Increasing available attenuation volume before storm events.
- Increasing pollutant-load reduction between storm events by extending residence times.
- Improving stormwater-harvesting potential by retaining more water after storms.
- Recreating a more natural hydroperiod and flow characteristics to support natural systems.

Smart systems are commonly controlled through a supervisory control and data acquisition (SCADA) system. The City operates a SCADA system that controls existing active management stormwater systems, such as the ULLNRF, FSU-COT RSF mechanical rake, and planned CCT Segment 3D-B mechanical rake. Although the capital cost for these types of technologies has become more affordable, they carry unique maintenance and operation needs compared to traditional stormwater design components. Therefore, the operation and maintenance of smart systems needs to be strongly considered before implementation and is one reason why the industry has been slow to adopt these technologies.

Though more complex, the advantages of stormwater management systems that can adapt in real-time are too numerous to ignore when considered against the increasing scarcity of water resources. Smart systems are widely acknowledged to be the future of community-wide stormwater management.

7 SEGMENT 4 WATERSHED EVALUATION

The CCT Segment 4 project footprint is near the downstream end of the Central Drainage Ditch (CDD). The watershed (area of contributing stormwater flows) for the project includes the CDD watershed and the historical Saint Augustine Branch (SAB) watershed. The SAB drains to the CDD and has been enclosed within large box culverts as part of prior CCT projects. The project watershed covers approximately 8 square miles and is sandwiched between the aptly named West Ditch and East Ditch. These three urban ditch systems converge near Lake Henrietta to form the headwaters of Lake Munson (also known as Munson Slough); however, the CCT Segment 4 watershed is only a small portion (approximately 10 percent) of the headwaters by area.

The project watershed is generally depicted in Figure 11, which includes a color ramp of ground surface elevations, roadway map, an approximate outline of the project watershed, and some notable locations.

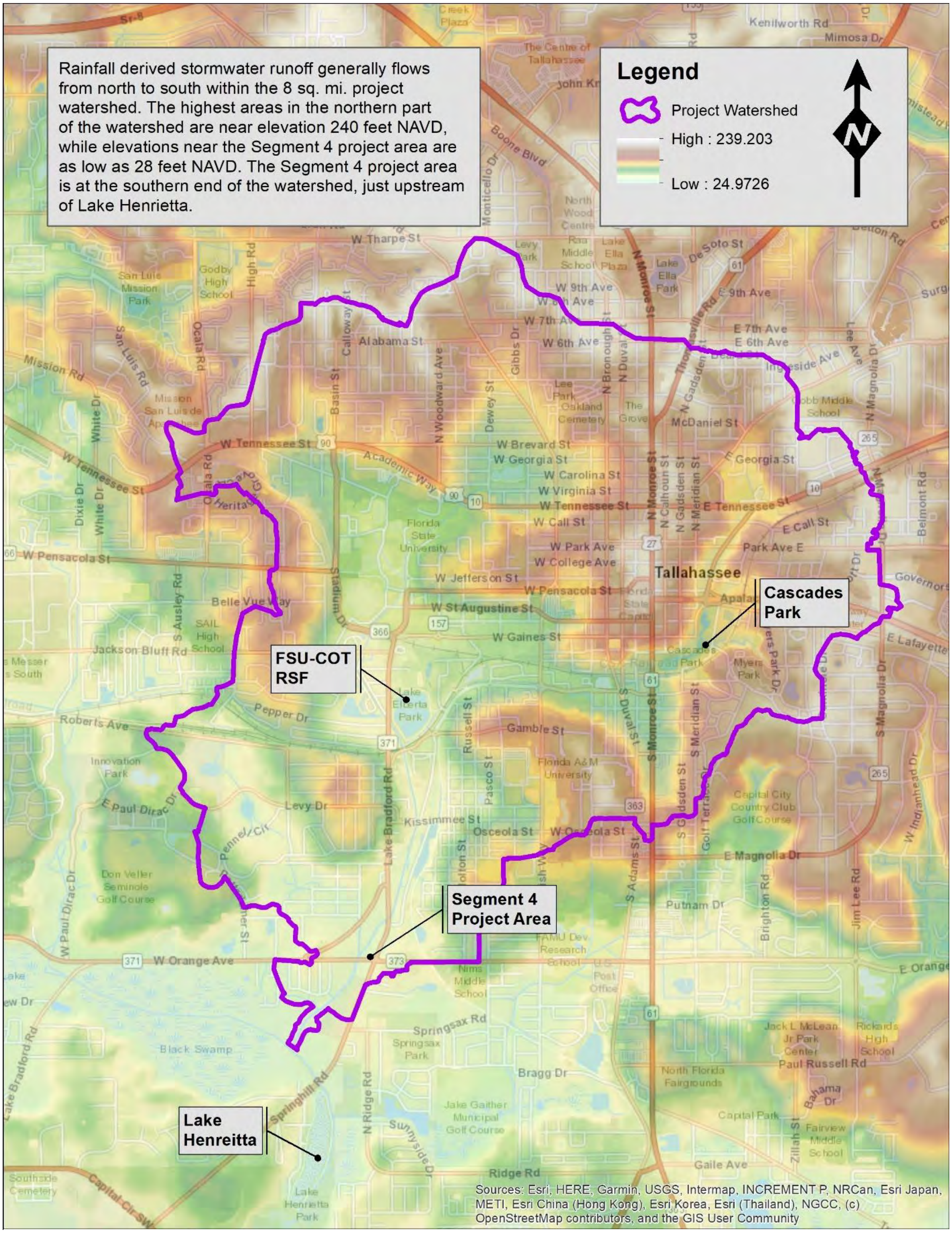
The physical landscape of the project watershed is best described as heavily urbanized and includes much of downtown Tallahassee, FSU, Florida A&M University (FAMU), and surrounding residential and commercial areas. Much of the urbanized area was developed before modern stormwater regulations; therefore, relatively little on-site stormwater attenuation or treatment is provided at the watershed scale. The stormwater runoff and pollutant-load potential for this type of watershed is relatively high; however, the community has invested in several stormwater retrofit projects in the area that provide stormwater attenuation and treatment. Significant stormwater retrofit facilities include the FSU-COT RSF, Coal Chute Pond, Smokey Hollow Pond and Boca Chuba Pond in Cascades Park, and Lake Anita to name a few. Blueprint is also currently constructing a new stormwater retrofit facility as part of the CCT Segment 3D-B project, which includes a wet-detention pond, trash trap, and BAM treatment system.

7.1 Flood Risk

As common to heavily urbanized watersheds, stormwater runoff generated within the project watershed is rapidly conveyed to the primary drainage features, which include the SAB, CDD, and large storm drain systems. This type of watershed is commonly referred to as *flashy* since peak storm flows and stages occur within only a few hours after peak rainfall and recede just as quickly. Based on previous modeling efforts, peak flows through the CDD near the CCT Segment 4 location will exceed 3,000 cfs during large storm events or approximately one semi-trailer full of stormwater every second.

The ability of a stormwater management system to manage flood risk is defined through peak stage and commonly referred to as the system's level-of-service. The level-of-service provided is the designed frequency of flood risk occurrence. For example, most urban drainage systems constructed before modern stormwater standards, like many within the project watershed, provide an approximate 10-year level-of-service. This means these systems are expected to fail (result in flooding) once every 10 years. Statewide presumptive stormwater attenuation criteria are based on a 25-year level-of-service. Meanwhile, FEMA flood maps are developed to reflect the flood risk that occurs once every 100 years.

Figure 11 Project Watershed



When discussing flood risk within the project watershed, it is important to define what level of risk is being considered. Areas at risk of flooding following frequently occurring storm events, such as only a few inches of rain, can be located anywhere within the watershed when local drainage systems are under-designed or in need of maintenance. This type of flooding is common in residential areas developed before modern stormwater regulations, but not common for the watershed's major stormwater conveyance systems. Areas at risk of flooding from infrequent storms events, such as once in a 25-year or 100-year occurrence, are commonly more widespread and may include major conveyance systems.

Residential areas near the downstream portion of the CDD, near the CCT Segment 4 project, are known to be susceptible to flooding. Flood conditions in this area are exemplified by the homes along McPhearson Drive, which are elevated on stilts as shown in Figure 12. Residents in Liberty Park have also experienced flood conditions in the past.

Figure 12 Flood Protection Example – Elevated Homes Along McPhearson Drive

The NWFWMD has recorded 15-minute stage data since 1989 for the CDD at Orange Avenue, which is within the CCT Segment 4 project footprint. The highest recorded stage during the period of record is 40.7 feet North American Vertical Datum of 1988 (NAVD88), and only two dates recorded stages above 40 feet – June 12, 2001, and March 3, 2002. CDD stages near 40 feet are approximately 3 feet below the CDD top-of-bank and 4 feet below Orange Avenue. The available stage data suggest that the CDD has not exceeded its banks near Orange Avenue during the last 30 years. However, prior stormwater analyses have suggested the CDD will exceed its banks during a 100-year storm event upstream of Orange Avenue.

Additionally, we can reasonably assume that downstream conditions within Munson Slough associated within the recorded stages within the CDD near 40 feet are likely indicative of flood conditions in Liberty Park, where some home finished-floor elevations appear below 39 feet, and along McPhearson Drive where the roadway elevation is below 35 feet in stretches. This assumption is based on the limited predicted headloss (peak stage reduction) from Orange Avenue to Munson Slough from past stormwater analyses.

It is also known that during large storms the timing of stormwater flows from the three urban ditch systems that converge at Munson Slough can cause flows to reverse direction, from south to north. This *backwater effect* has been observed in real-time by City and County staff but has not been well studied during prior stormwater analyses.

Based on available stage gauge data, past modeling efforts, and observations relayed by City and County staff, the known flood conditions in Liberty Park and along McPhearson Drive are more likely driven by hydraulic conditions within Munson Slough rather than hydraulic conditions within the CDD. A more robust stormwater analysis will be performed as part of the CCT Segment 4 project to better understand the potential backwater effect from Munson Slough on the project and adjacent residential areas.

Based on available information it appears that while the CDD is characterized by very high flows following storm events, the existing flood conditions present near the project are mostly controlled by peak water-surface elevations in Munson Slough. Ultimately, the project watershed is a relatively small contributor (10 percent by area) to Munson Slough and improvements associated with the project are unlikely to demonstrably impact future peak stages within Munson Slough.

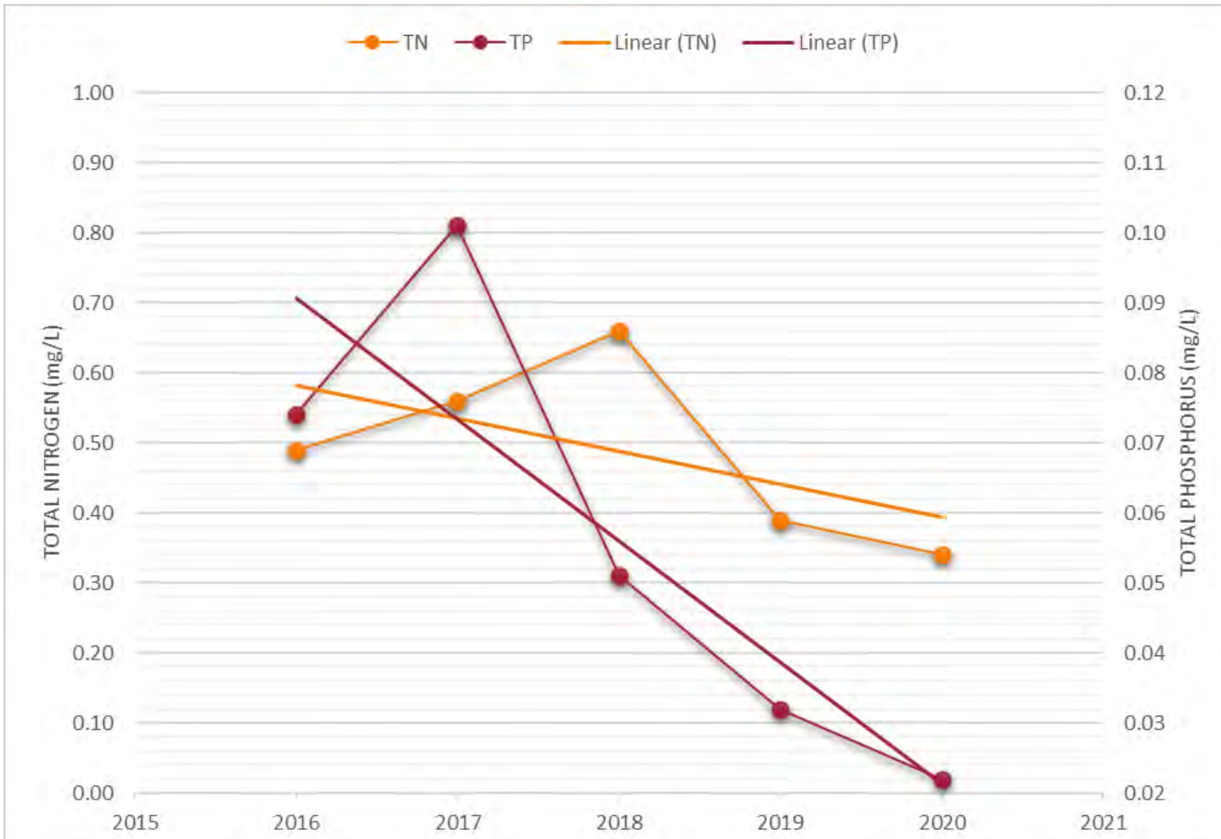
7.2 Water Quality

Stormwater runoff naturally collects and conveys pollutants downstream. Given that the watershed is mostly urbanized with development predominately occurring prior to modern stormwater treatment requirements, potentially high dissolved nutrient loads from over fertilization and high anthropogenic trash loads may be generated across the watershed. Since the project watershed is known to be a flashy system, a high potential for erosive conditions within natural conveyances also exists, which generates high sediment loads and particle-bound nutrient loads like phosphorus.

To better understand the potential pollutant load carried by the CDD through the CCT Segment 4 project area, we reviewed water-quality sampling data collected by the City to support their municipal separate storm sewer system (MS4) program. The most relevant available data are ambient water samples collected near the terminus of the CDD, which is in the downstream portion of the CCT Segment 4 project area. Ambient conditions are generally defined as the normal operating condition for the system and are more reflective of base flow than of storm flow.

Annual geometric means (AGMs) of ambient conditions over the last five reporting periods at this location are shown in Figure 13 and suggest that the nutrient load within the CDD is limited. The current ambient conditions of the CDD include total nitrogen (TN) concentrations near 0.5 milligram per liter (mg/L) and total phosphorus (TP) concentrations near 0.05 mg/L. The TN and TP AGMs for the CDD within the CCT Segment 4 project area are near the lower limit, least potential nutrients, of what is achievable from traditional stormwater designs, LID and GSI, and even most innovative stormwater technologies. We also observed a decreasing trend for TN and TP AGMs over time. Nutrient concentrations at this level and the decreasing trends over time suggest that although relatively limited on-site stormwater treatment is provided within the project watershed, the stormwater retrofit projects implemented upstream by the City and Blueprint are effective at reducing the ambient nutrient load within the CDD.

Figure 13 Trend in CDD Nutrient Concentrations



We also observed ambient total suspended solids (TSS) concentrations to be similarly low, generally near 5 mg/L, and exhibit the same decreasing trend. Although the cause-and-effect relationship of TSS with stormwater retrofits of the watershed is complex and often takes multiple years after project completion to manifest completely, we can logically infer from the reported TSS concentrations that the 2+ miles of ditch enclosure completed by Blueprint and 1 mile of gabion improvements completed by the City have significantly reduced the in-stream erosion potential of the watershed.

The anthropogenic trash load of any watershed is difficult to estimate, limited data are available, and available data may not be transferable from one location to another. We assume that some amount of anthropogenic trash load will be present at the project due to the urban characteristics of the watershed. However, we are also aware of multiple trash traps within the watershed, including a boom and screen within the CDD near Eppes Drive, a mechanical trash trap recently constructed at the FSU-COT RSF, and a mechanical trash trap currently being constructed as part of the CCT Segment 3D-B project. Given the collective recency of these improvements, we can reasonably expect the downstream trash load from the watershed will follow a similar decreasing trend in the coming years as observed in the water quality monitoring data.

Based on available information, nutrient concentrations and suspended sediments will be very limited under ambient and low flow conditions, which are typically the focus of retrofit treatment systems. Moreover, the most immediate downstream waterbody, Munson Slough, is no longer considered impaired for nutrients based on the Florida Department of Environmental Protection (FDEP) draft 2020–2022 Biennial Assessment of Impaired Waters released in December 2021. In general, the available information suggest the project watershed is mostly healthy, which is a credit to past community improvement projects.

8 DISCUSSION

Based on the goals for CCT Segment 4, the project's stormwater management system will serve proposed project improvements and create a net stormwater improvement for the community. Since the stormwater management system will be operated by the City following construction, the stormwater management system design should consider service life, cost, public safety, and ease of maintenance.

8.1 CURRENT PROJECT UNDERSTANDING AND CONSIDERATIONS

The permit criteria for the CCT Segment 4 project will be established in coordination with City Growth Management and NWFWMD during future project stages but we expect the project will need to demonstrate a net stormwater improvement for the community. At this time, we can judge the potential to provide a net stormwater improvement for the community based on the watershed characteristics, site constraints, and our experience developing stormwater management solutions throughout Florida.

Based on the available CDD stage records near Orange Avenue, previous stormwater analyses, and City/County staff accounts, it is unlikely that the CCT Segment 4 project's stormwater management system can be feasibly designed to significantly mitigate flood conditions at the project or within adjacent neighborhoods. To better assess flood conditions near the project, Jones Edmunds is developing a stormwater model, which will build upon stormwater analyses completed by others as part of past Blueprint projects and will be developed with particular attention to the known backwater effects from Munson Slough that can impact flood conditions near the project.

Based on available information, it appears that existing flood conditions present near the project are mostly controlled by peak water-surface elevations in Munson Slough. Given the relatively small project footprint compared to Munson Slough and the relatively small contribution from the project watershed (10 percent by area) to Munson Slough, it is likely that future analysis using the stormwater model being developed for this project will also demonstrate that potential stormwater management system designs for this project are not capable of mitigating peak water-surface elevations in Munson Slough sufficiently to mitigate existing flood conditions. For comparison, the FSU-COT RSF is over 25 acres, Lake Henrietta is over 40 acres, and Black Swamp within Munson Slough is over 300 acres. Meanwhile, within the CCT Segment 4 project area less than 5 acres are available for potential stormwater improvements north of Orange Ave and less than 10 acres south of Orange Avenue.

Based on the available water-quality data for the CDD near the project location, which is representative of ambient conditions insufficient nutrient concentrations appear to be available for the project's stormwater management system design to reasonably achieve relatively large nutrient load reductions from CDD flows under ambient and low-flow conditions. Moreover, the most immediate downstream waterbody, Munson Slough, is no longer considered impaired for nutrients based on the Florida Department of Environmental Protection (FDEP) draft 2020–2022 Biennial Assessment of Impaired Waters released in December 2021. The ambient sample results and change in impairment status for Munson Slough are representative of a healthy watershed and are a credit to past stormwater retrofits completed within the project watershed.

There are also significant site constraints for large scale design components within the CCT Segment 4 project area beyond low inflow concentrations. These additional constraints include very large peak flows within the CDD, current flood conditions upstream, potential hydraulic depth within the CDD (i.e., the vertical distance from the CDD hydraulic grade line to adjacent land), and available land for engineering improvements. Given the site constraints and improved downstream condition for nutrients, we can reasonably assume large scale design components focused on nutrient-load reduction will carry a prohibitively high cost per pound of removal.

Design components that are commonly used to maximize nutrient load reductions include stormwater ponds, constructed wetlands, engineered media (such as BAM), and chemical treatment. All these design components would require very large footprints to achieve large nutrient load reductions for CCT Segment 4. A constructed wetland would likely require the largest footprint of these components to achieve a similar pollutant load reduction since flows and velocities through a constructed wetland are intentionally limited to avoid damaging vegetation, to avoid resuspending captured pollutants, and to allow time for the rate-dependent biological treatment processes to occur. All these design components would need to bypass a significant portion of flow from larger storm events, meaning most storm flows carrying sufficiently high nutrient concentrations for removal will bypass the treatment system by hydraulic necessity.

To help overcome hydraulic constraints, stormwater management systems that provide treatment can be designed as offline systems. Offline systems divert low flows from the primary conveyance system but allow moderate and high flows to bypass the treatment system. The treatment volume for offline systems typically needs to be below the existing hydraulic grade line, such that flow diversion can occur by gravity and not adversely impact upstream flood conditions, and typically requires a large available footprint to achieve significant load reductions. For CCT Segment 4, a gravity-based diversion system would require extensive land excavation and the pollutant load removal effectiveness of the offline treatment system will still likely be limited by low inflow nutrient concentrations.

A relevant out-of-watershed treatment system comparison that illustrates these constraints is the Sweetwater Branch treatment wetland, which was designed by Jones Edmunds. The Sweetwater Branch treatment wetland serves an urban watershed of approximately 3 square miles and was designed to primarily treat inflows less than 10 cfs. The service area is less than 50% of the CCT Segment 4 project watershed and yet the required treatment wetland footprint was over 150 acres or 10 times larger than the CCT Segment 4 area available for stormwater improvements. Sweetwater Branch also has the relative benefit of treating WWTP effluent that is mixed in with the storm flows, meaning incoming nutrient concentrations are much higher than those expected for the CDD.

However, smaller scale nutrient-focused design components deserve consideration for inclusion in the project's treatment train. Small scale examples include the traditional stormwater design components mentioned above but also many GSI design components. In all cases, the achievable nutrient load reduction is limited according to the scale and site constraints. To reduce land excavation cost for a smaller scale system that treats CDD flows, low flows could be diverted from the CDD via a small stormwater pump instead of gravity. However, stormwater pump systems will carry a higher recurring maintenance cost.

Similar to nutrient concentrations, the potential for project inflow to include high sediment concentration appears limited. Furthermore, past projects within the project watershed that either enclosed or hardened open-cut ditches make it very likely that historically occurring in-stream erosion has also been greatly reduced. On the other hand, unlike the demonstrated improving condition for nutrients downstream, the County continues to experience sedimentation issues at Lake Henrietta. In our opinion, design components focused on sediment-load reduction deserve consideration for inclusion in the project's treatment train, but achievable sediment load reduction will be limited by site constraints.

Due to the lack of representative data, the potential to reduce anthropogenic trash load is the least certain of the water-quality constituents reviewed. Multiple trash collection improvements have been constructed upstream, which should significantly reduce the downstream trash load, but it is likely that a trash load will continue to be present at the project. Design components focused on trash-load reduction deserve consideration for inclusion in the project's treatment train, but the achievable trash load reduction is uncertain and will be limited by site constraints.

8.2 Design Component Applicability

In our opinion, the most effective stormwater management system designs include multiple design components in a treatment train. For this reason, our recommendation is that the CCT Segment 4 project stormwater management system be based on a LID-like approach, including traditional design components, GSI, and innovative stormwater technologies to achieve a net stormwater improvement for the community.

Based on our current understanding of the project watershed, existing site constraints will prohibit capture of moderate and high storm flows and therefore significantly limit the net stormwater improvement achievable by the project. Moreover, it is very unlikely that mitigation of existing flood conditions or large nutrient load reductions are achievable through this project given the site constraints. Instead, our recommendation is that the project's stormwater management system should focus on potential trash, sediment, and nutrient load reductions that can be reasonably achieved under low flow conditions.

Several traditional stormwater designs, GSIs, and innovative technologies were mentioned in this White Paper that could be incorporated into the project's treatment train. All the design components mentioned in this White Paper are categorized in Table 2 based on their applicability to the watershed characteristics and site constraints.

Table 2 Project Applicable Design Components

Design Component	Likely Applicable	May Be Applicable	Unlikely Applicable
Wet Detention			X
Retention			X
Exfiltration			X
Swales		X	
Vegetated Strips		X	
Detention w/Filtration			X
Constructed Wetlands		X	
Stormwater Harvesting			X
Sediment Traps	X		
Trash Traps	X		
Erosion Control		X	
Bioretention	X		
Detention w/Biofiltration	X		
Permeable Pavement	X		
Rainwater Harvesting		X	
Green Roofs			X
Engineered Media		X	
Chemical Treatment			X
Floating Orifices			X
Floating Wetlands			X
Active Management	X		
Real-time Adaptive Controls		X	

Preliminary engineering needs to be completed before more definitive stormwater management system design recommendations are appropriate.

Project Website: blueprintia.org/projects/capital-cascades-trail/
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Capital Cascades Trail Segment 4

Project Highlights

- This project will complete the Capital Cascades Trail network, which provides connectivity, water quality, stormwater, and recreational improvements linking Leon High School in Downtown Tallahassee to Lake Henrietta.
- Capital Cascades Trail Segment 4 is approximately 1.7 miles in length commencing at the confluence of the St. Augustine Branch and the Central Drainage Ditch (CDD), and continues to the CDD's confluence with Munson Slough.
- The goals of the project include achieving water quality improvements, greenway interconnectivity, and possible wetland creation.

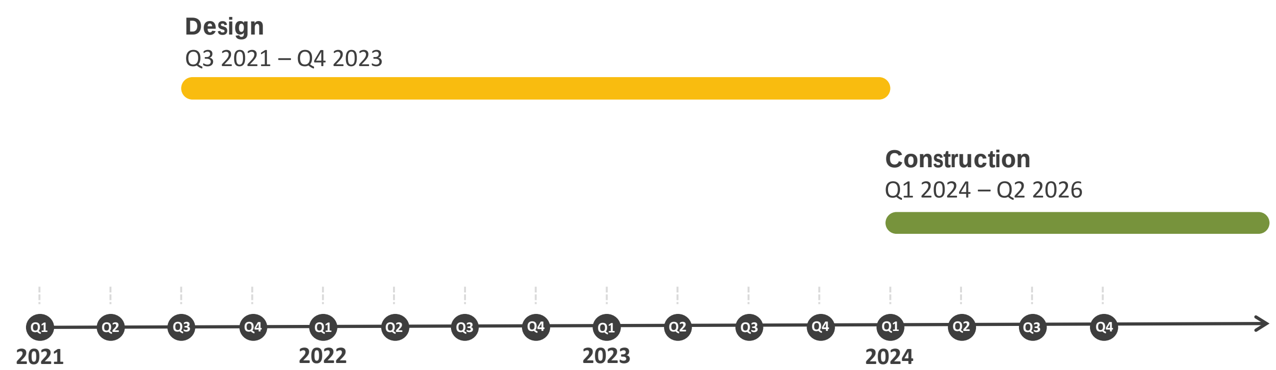
Current Status

- The initial planning and engineering phase of the project is underway as of September 2021.
- The community outreach and engagement plan is being finalized.
- The field survey is complete and the natural feature inventory is underway.
- Blueprint is pursuing a leveraging opportunity with a City of Tallahassee sidewalk project to implement additional connections from the Greater Bond Neighborhood to the St. Marks Trail and Capital Cascades Trail Segment 4. These connections are included as a Tier 1 Bicycle and Pedestrian Master Plan Neighborhood Network Project and will help fulfill an Action Item from the Greater Bond Neighborhood First Plan.

Next Steps

- Initiate community engagement with organizations and communities along the project.
- The project consultant team will perform a technical analysis on innovative water quality treatment options.
- Continue project data collection including previous completed surveys, reports, plans and available monitoring data along the project corridor.
- Develop existing conditions stormwater model.
- Develop stormwater concept plans.

Timeline



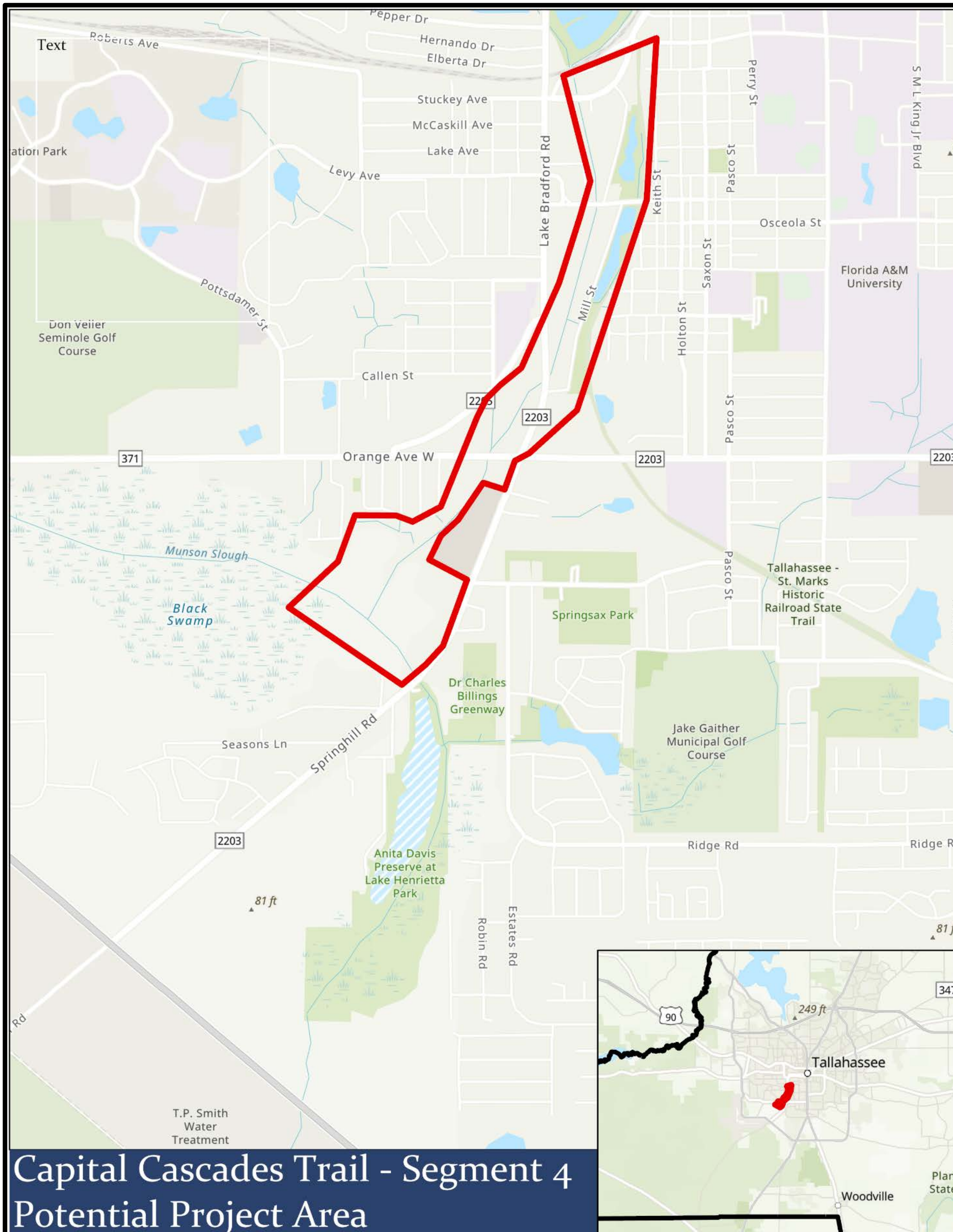
Community Engagement: Public engagement is ongoing through all phases of a project, from concept to construction, programming, and maintenance. Public engagement is two-way communication inclusive of all decision-makers and stakeholders. Each Blueprint project will have a customized Public Engagement Plan that is developed at the start of the project, and outreach activities and techniques will vary from project to project, as each project's outcome and stakeholder community character is unique.

Design: The design phase includes development of final plans and construction documents for Capital Cascades Trail Segment 4 and associated facilities (stormwater, multimodal facilities, etc.).

Right of Way Acquisition: This phase will consist of efforts to acquire any right of way fee and/or easement parcels necessary to complete the project. Any right of way acquisitions necessitated will be undertaken consistent with Blueprint Real Estate Policy and Florida State Statutes.

Construction: Construction work will fully implement the final design plans for the Capital Cascades Trail Segment 4.

BLUEPRINT
INTERGOVERNMENTAL AGENCY



Capital Cascades Trail - Segment 4
Potential Project Area