

WETLAND CONVERSION UPPER DURANT LAKE

VISION PLAN

October 2024

The information contained in this document is for planning purposes and should not be relied upon for final design of any project. Readers are cautioned that this is a preliminary report and that all results, recommendations, concept drawings, cost opinions, and commentary contained herein are based on limited data available at the time of preparation. Further engineering analysis and design are necessary prior to implementing any of the recommendations contained herein.

Prepared by:



Supported by:



**Raleigh
Stormwater**



**Raleigh
Parks**

CONTENTS

Executive Summary	<u>4</u>
Background	4
Project Overview	4
Project Timeline	5
1. Introduction	<u>6</u>
Project Purpose and Goals	7
Public Engagement Process	8
2. Investigations	<u>10</u>
Existing Conditions.....	11
Summary of Analyses and Design Considerations	12
3. Proposed Design	<u>14</u>
Wetland Design Overview	15
Wetland Schematic Design.....	16
Mobility Recommendations.....	18
Design Elements.....	20
4. Appendix	<u>23</u>
Previous Analysis and Findings.....	24

EXECUTIVE SUMMARY

Background

In 2013, an engineering firm, contracted by the City of Raleigh, deemed the dam and spillway of the 6-acre Upper Lake at Durant Nature Preserve to be deficient and in need of repair. In 2018 and 2019, under contract with the City, North Carolina State University (NCSU) conducted a study to explore alternatives to stabilize the structure and improve the nature preserve. The university conducted public outreach including a Multi-Criteria Decision Analysis - see Appendix, Page 24, for more information.

In 2020, City staff recommended, and City Council approved, the wetland conversion alternative. This alternative will accomplish dam and spillway repairs, improve water quality in the Perry Creek watershed, improve mobility throughout the nature preserve, and increase the diversity of habitats to be enjoyed by park patrons. In 2023, the City hired WK Dickson and Toole Design Group to create a concept design for the wetland conversion.

Project Overview

The Wetland Conversion of Upper Durant Lake project builds on previous work completed by City of Raleigh staff and NCSU. The primary goal of this project is to create a concept plan for converting the lake into a habitat wetland. This Vision Plan is not a final construction plan; rather, it represents Phase 1 of design that showcases the aspirational concept for converting the Upper

Durant Lake into a habitat wetland complete with new features that contribute to the experience of the Preserve.

During Phase 2 of design, the City will work with a consultant to conduct additional site investigations, as needed, and to produce construction documents. The intentions of Phase 2 are to maintain the essence of this Vision Plan while refining the design through adjustments to the layout, arrangement, and scale of proposed design elements, as well as to refine the engineering analyses needed.

Building directly on previous efforts, Phase 1 of this project kicked off with an Open House on April 26, 2023, to provide information on previous technical findings, explain the purpose of the project, and verify previously stated community goals for Upper Durant Lake. Over 25 community members attended this event.

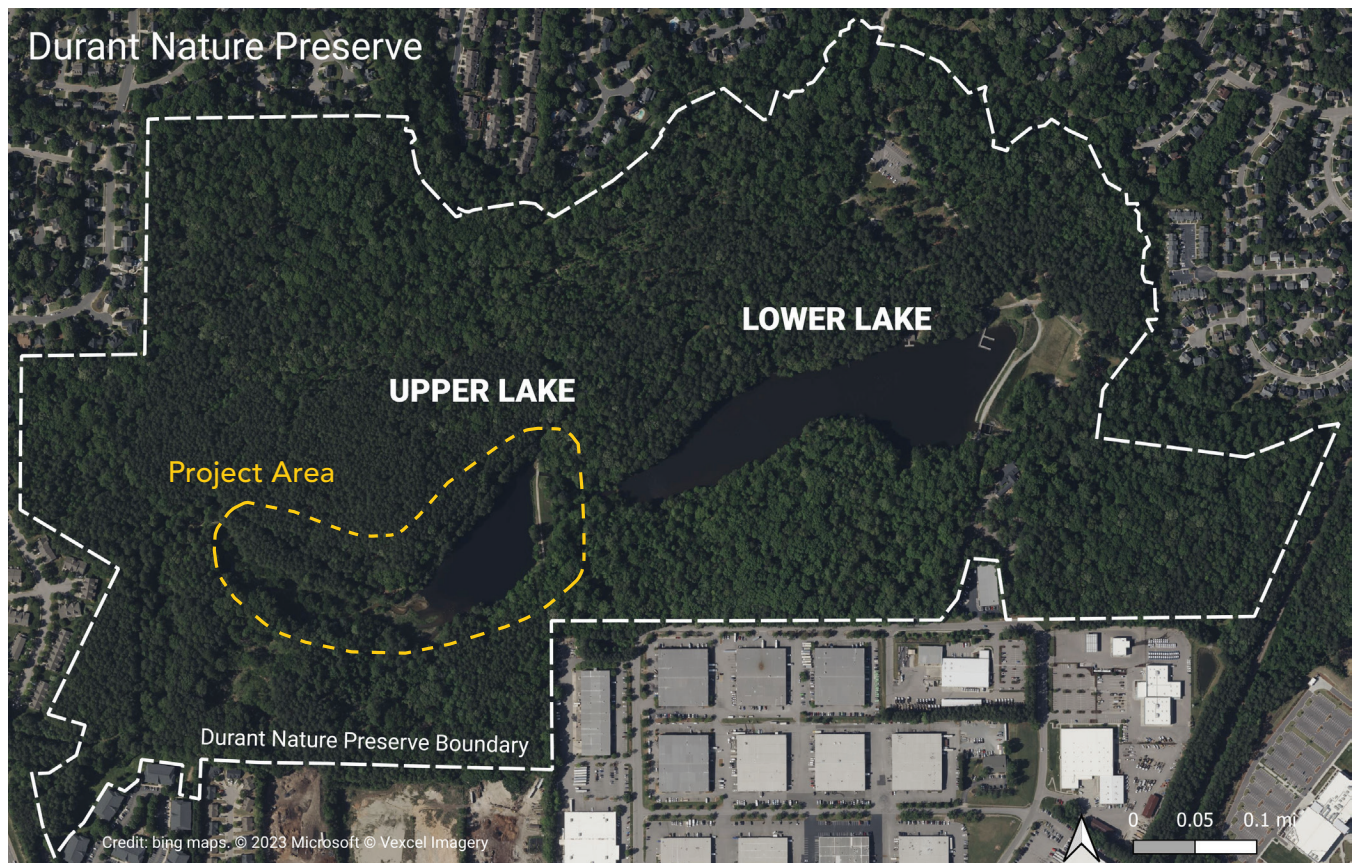
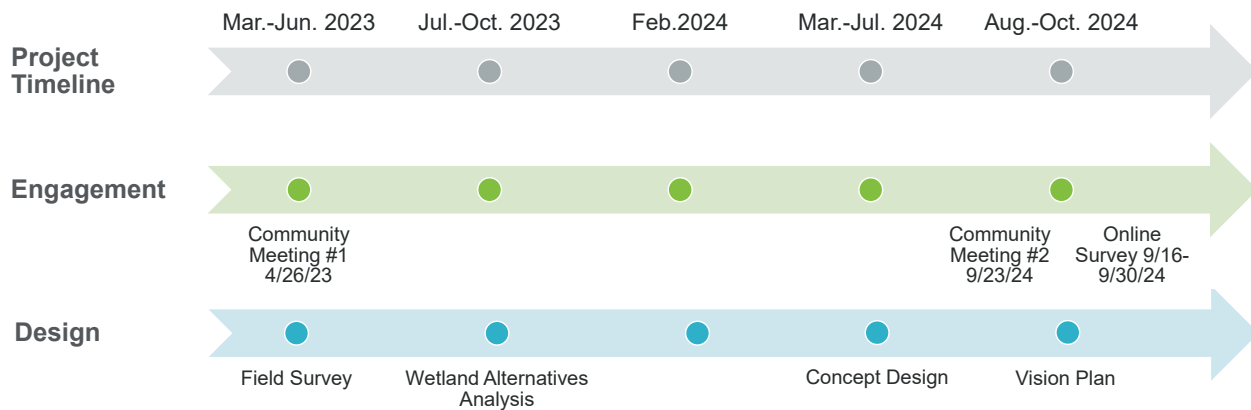
Other initial steps involved analysis of existing site conditions. Analysis included topographic and bathymetric surveys, geotechnical borings of the dam, hydrologic modeling of the lake system, and assessing barriers to and opportunities to improve mobility around the Upper Lake. Major findings included the need to lower the dam and spillway, the need to make the trail system more legible and accessible, and the potential to establish multiple types of wetland habitats by controlling hydrology and varying elevations.

City staff worked in partnership with WK Dickson and Toole Design to create a proposed

concept design that reflects the project goals and addresses constraints and assets identified during site investigations. The concept includes over ten habitat types with associated trail improvements and up to four wildlife viewing platforms. The second Open House, held on

September 23, 2024, provided an overview of the design concepts and gathered input on design elements such as interpretive signage and seating. Over 35 community members attended this event. Construction is not expected to begin until Spring 2026.

Project Timeline



Location of the proposed Upper Durant Wetland (currently the Upper Durant Lake).

1

INTRODUCTION

The project began with a public engagement process involving two rounds of community input, which helped define the project's purpose and goals based on their feedback and prior analysis findings (see appendix). Goals for the wetland conversion include diversifying ecological habitat, improving water quality, expanding environmental education opportunities, ensuring long-term viability, and addressing the deficient dam infrastructure.

PROJECT PURPOSE AND GOALS

The priorities and goals below were initially identified in previous community engagement efforts and were verified at the first Open House. These values helped guide the concept design.

Priorities & Uses

UPPER DURANT WETLAND

- » Creation of new habitat for more wildlife diversity
- » Water quality
- » Recreation
- » Hiking, wildlife viewing
- » Programming

LOWER LAKE

- » Preservation of habitat & wildlife
- » Water quality
- » Recreation
- » Hiking, fishing, gathering
- » Programming

Community Goals for Upper Durant Lake

More recreational programming

Preserve wildlife and habitat

Limit fishing to the Lower Lake

More accessible walking trails

Water quality

Hiking trails with viewing areas

Wildlife refuge preservation

Goals of Nature Preserves in Raleigh

- 1 Serve as examples of high-quality plant or animal populations, natural communities, landscapes or ecosystems
- 2 Contribute to biodiversity and environmental health
- 3 Protect and manage significant natural resources
- 4 Provide opportunities for the public enjoyment of natural resource-based recreation and environmental education

Goals of the Upper Durant Lake Wetland Conversion

- 1 Diversify ecological habitat
- 2 Improve water quality
- 3 Expand environmental education opportunities
- 4 Ensure long-term viability
- 5 Address deficient dam infrastructure

PUBLIC ENGAGEMENT PROCESS

Public engagement was crucial for defining goals and priorities and determining design elements and preferences. Two rounds of public engagement, promoted on the project website and social media, occurred over the course of the project.

Round 1 of Engagement

The first round of engagement consisted of a public meeting in an “open house” format, where participants were invited into a casual environment in which they guided themselves through various stations of informative and engaging material. This Open House:

- » Introduced the project team and how to reach out to the City
- » Explained the purpose of the wetland conversion to the public
- » Shared project background, schedule, project webpage, and other options to stay informed
- » Provided a summary of previous engagement and verified previous analysis and findings
- » Presented preliminary existing conditions analysis findings
- » Shared wetland habitat basics overview and preservation activities
- » Invited people to participate throughout the project

Open House 1

Wednesday,
04/26/23
5:30 - 7:30 p.m.

Round 2 of Engagement

The second round of engagement included an Open House and an online survey. Over 35 community members attended the Open House and the survey had 36 participants. The survey consisted of an online version of the visual preference survey that was administered during the in-person Open House. This round of engagement:

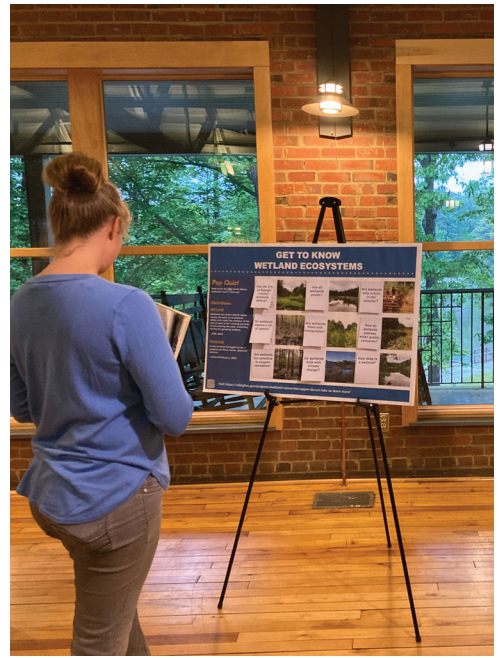
- » Provided an update on the project progress and remaining schedule
- » Explained the process and analysis used to develop design alternatives for the nature preserve
- » Presented the preferred alternative recommended by the design consultant and chosen by the City of Raleigh
- » Sought participation in a visual preference survey to provide feedback on design details and programming

Open House 2

Monday, 09/23/24
6:00 - 7:30 p.m.

Online Survey

Open from 9/16 to
9/30/24



2

INVESTIGATIONS

This stage involved an investigation of existing conditions in and around the Upper Durant Lake. An evaluation was conducted of the dam, lake system, sediment data, vegetation, mobility, and user experience. The first Open House gathered public feedback on project goals and priorities. Design considerations were defined based on the analyses conducted.

EXISTING CONDITIONS

The photos below show existing conditions in and around Upper Durant Lake.



Upper Durant Lake viewed from Beaver Pond Trail



Compromised existing dam



Border Trail creek crossing is an accessibility barrier



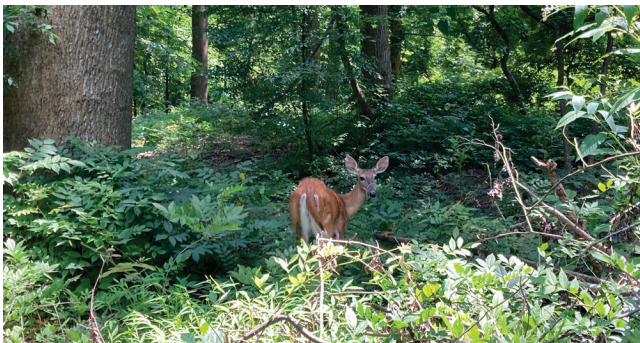
Sedimentation visible from Beaver Pond Trail



Presence of prolific invasive species



Existing sewer easement is maintained



Wildlife sighting on Beaver Pond Trail



Wayfinding is inconsistent and not easily identifiable

ANALYSIS AND DESIGN

Table 1 (below) shows how site analysis directly influenced the proposed design of the wetland.

TABLE 1. Summary of analyses and design considerations

Analysis

Stream and Lake System Assessment

- The project area has two major landform types: the upper floodplain and the lake system.
- Recent construction of I-540 and land development in the upper watershed have introduced an unusually high volume of sediment into the system and created a large alluvial valley in the upper floodplain. This landscape can support a relatively large wetland system.

Sediment Data

- Collected sediment data indicates a relatively stable alluvial stream through the upper floodplain.
- However, because of the dam, sediment cannot move downstream as it naturally would. The structure of the stream and floodplain will change slowly over time and the system will continue to deliver moderate amounts of sediment to the constructed wetlands.
- The sediments in the lake that will be used to form the wetland surface are of poor quality.

Vegetation Assessment

- Plant community data were collected at two locations in the project area and at two similar wetland locations at Lake Crabtree and Crabtree Creek.
- The upper floodplain area is mostly covered with prolific invasive species.
- Installation of habitat features presents an opportunity to reduce the dominance of pine monoculture on the north side of the lake.

Dam Evaluation

- The Upper Durant Lake dam riser structure (which drains water to maintain the water level of the lake) has trees growing out of it and appears to have failed, as the concrete spillway is serving as the primary outlet for overflow water.
- The structure of the dam itself is compromised. It is necessary to remove large portions where structural integrity is compromised by organic materials and low levels of compaction.

Public Open House

- Collection of public feedback was part of the design process as we made adjustments to the design based on the feedback received
- People are excited about creation of new habitat to support greater diversity of wildlife.
- People expressed concerns about how construction will impact trail access.

Mobility and User Experience Assessment

- Wayfinding is inconsistent and insufficient for helping user get oriented and make decisions. There are many informal access points.
- There are few elements that interpret ecology and history.
- The Border Trail has a creek crossing that is a compelling feature but poses a barrier to mobility.

Design Considerations



The primary design challenge is controlling water entering the system from large storm events, as these have the potential to disrupt the land surface of the wetland habitat.



The dam and spillway will need to be lowered to convert the pond into a wetland in a cost effective manner that limits imported soil.



The system will require controls to manipulate the water level for maintenance. Manual controls are cost effective and require less upkeep.



The design needs to manage the sediment the watershed delivers to the wetland system. Options include reducing the sediment supply, creating a sediment sink, and accommodating access for sediment removal.



Controlling the energy of flowing water is crucial to maintaining a stable landscape. Constructed landforms, such as berms, should be integrated in to the design to direct and manage the water's energy.



The soils forming the wetland surface will require soil amendments to support wetland vegetation.



The City has determined that a variety of wetland habitats be designed for the site. The communities chosen should be informed by the assessment performed at similar sites.



Use a mix of maintenance strategies to manage invasive species including chemical (herbicide applications), mechanical and manual removal, and biological (periodic flooding) controls.



Water level control is a critical tool for controlling invasive plant species. Diverse native vegetation can be introduced in select areas to reduce pine monoculture.



The most important factor for managing water entering the system is correctly configuring the outlet structures of the rehabilitated dam.



The elevation of the spillway impacts water heights, extents of boardwalk, and types of wetland habitats.



Conduct additional geotechnical analysis of the dam as needed to help refine the design during phase 2.



Maintain user access during construction by rerouting trails and creating temporary trails.



Viewing platforms should accommodate educational groups and highlight the Preserve as a demonstration site for ecological processes.



Viewing platforms should support intended uses and activities, and should not be within casting distance of open water.



Create a dynamic and engaging environment through creation of a variety of habitat types, trails, and viewing platforms.



Minimize site disturbance by ensuring trails avoid environmentally sensitive areas and by using in-situ materials as much as possible for construction.



Identify new creek crossing location with a bridge for the Border Trail.

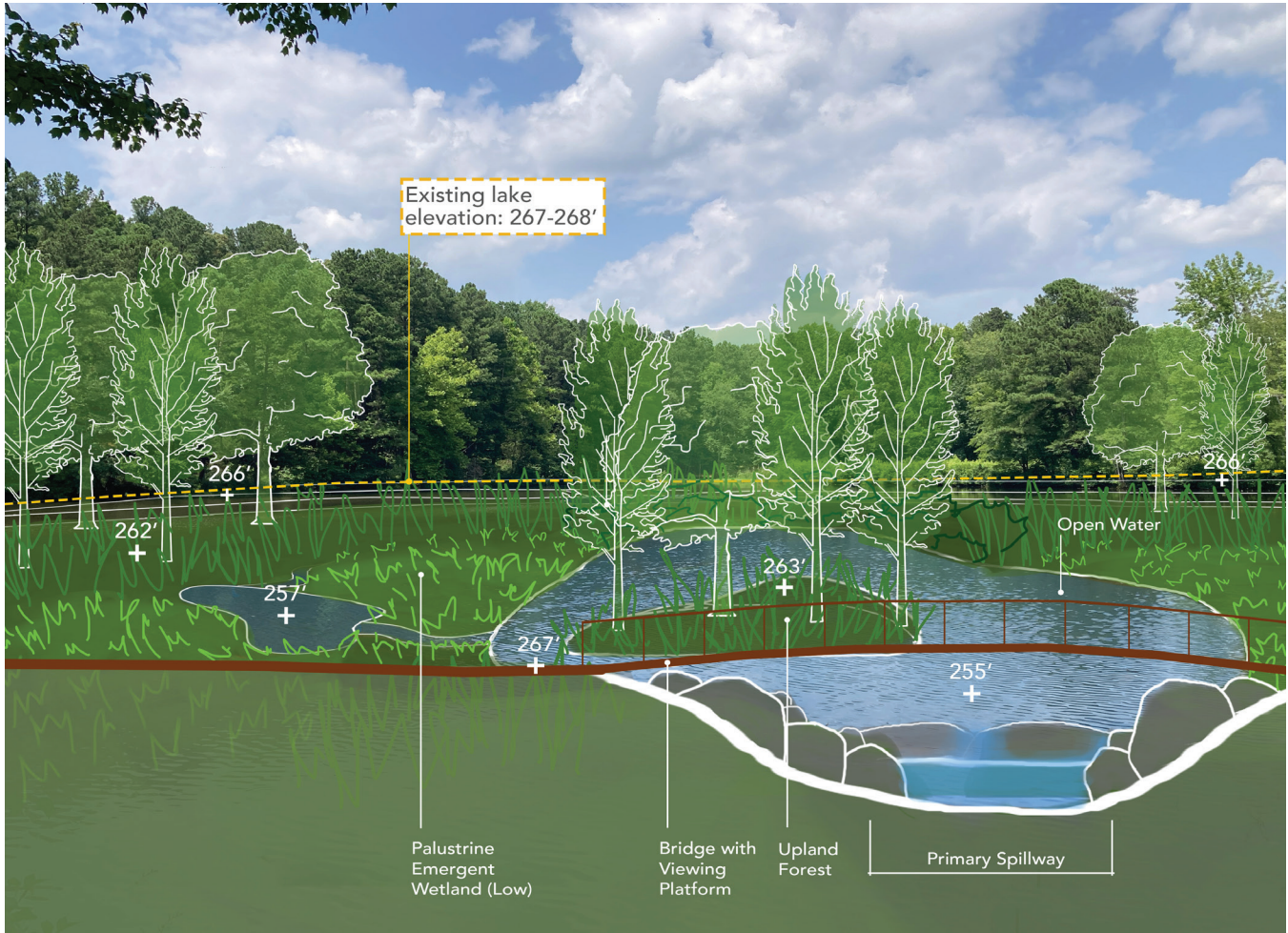
3

PROPOSED DESIGN

The analysis and design considerations from the previous phase directly informed the proposed design, which includes the wetland schematic design, mobility recommendations, and design elements proposed along the trails and viewing platforms. The second open house gathered public feedback on these design elements.

WETLAND DESIGN OVERVIEW

The proposed wetland will be lower in elevation than the existing lake. The graphic below shows the parts of the wetland that visitors will be able to see from the proposed bridge and viewing platform.



Wildlife Supported

The proposed wetland will support a variety of species, including amphibians, reptiles, and birds. The public has expressed interest in birding in particular, and the birds below are all expected to increase in prevalence as the wetland is established.



Great blue heron¹



Red winged black bird²



Kingfisher³



Wood duck⁴

WETLAND SCHEMATIC DESIGN

Design Intent

The primary goal of the wetland concept is to establish a durable system of habitats that contribute to water quality while sustaining the storm flows delivered by the stream. This system would establish several different plant communities that blend together across varying water depths established across the site. Structures made out of natural materials will be used to dissipate and absorb energy from storm flows while also providing habitat features.

Design Elements



Engineered Log Jam⁵

A series of logs that are intentionally and precisely arranged to control the flow of water and dissipate energy. Other log structures used in the system provide habitat niches for multiple trophic levels.



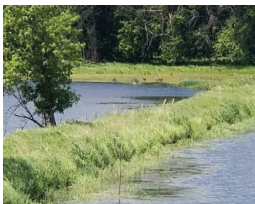
Sediment Forebay⁶

An excavated area at the transition point between the upper floodplain and constructed wetland. Slows incoming water and captures sediment, keeping it from entering the wetland.



Rock Cascades

These park amenities direct water flowing into and out of the wetland system. They serve as visual and auditory points of interest while simultaneously providing vital habitat and structural functions. There is a rock cascade at the sediment forebay and at the primary outlet.



Proposed Berm⁷

These earthen mounds absorb and redirect energy of water moving through the system. They also provide maintenance access and increase habitat diversity.

Plant Communities

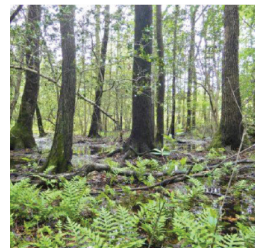
Upland Forest



Natural Succession



Forested Wetland



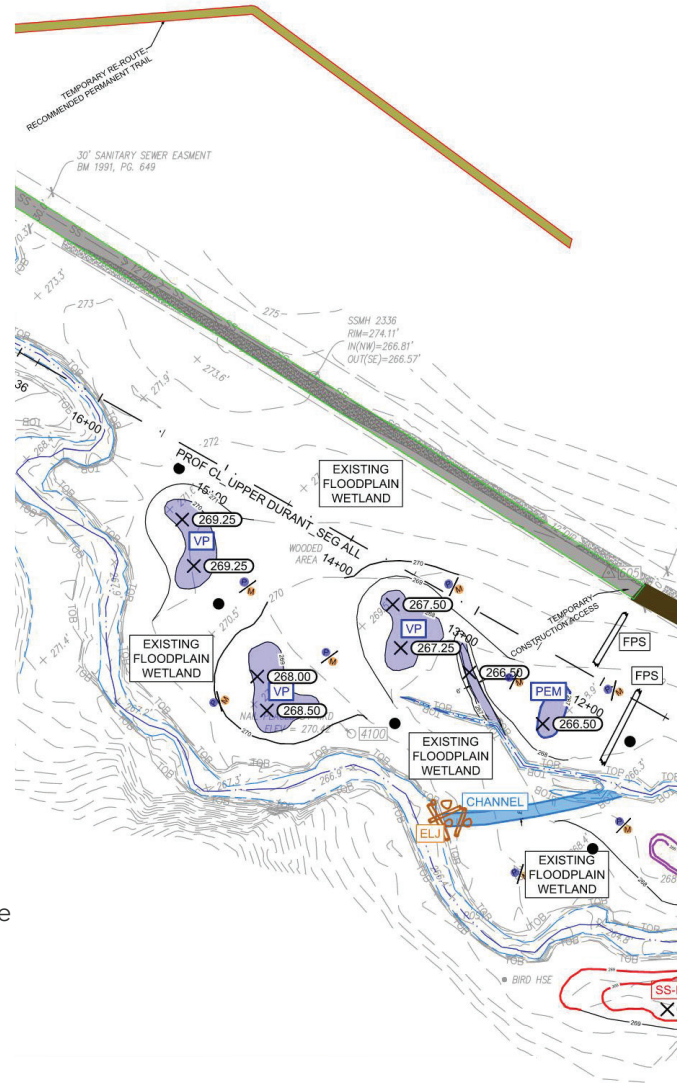
Scrub-Shrub Wetland



Palustrine Emergent Wetland



Proposed Concept Plan



LEGEND

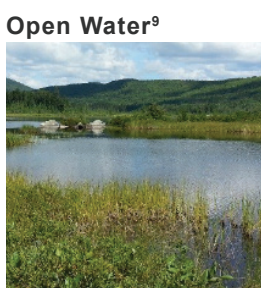
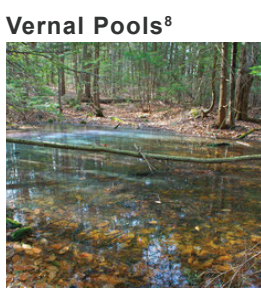
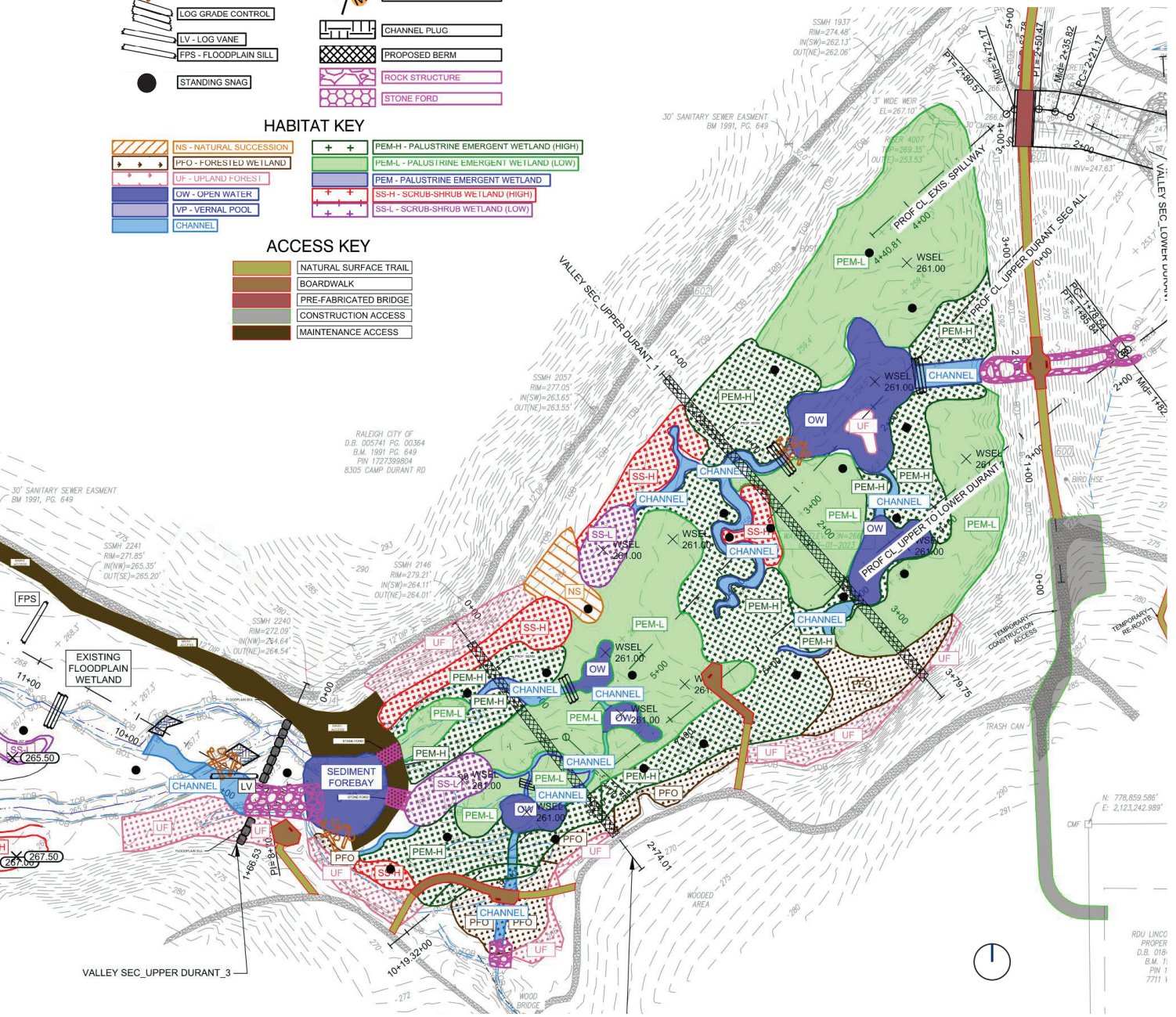
	ENGINEERED LOG JAM		PIT AND MOUND
	LOG GRADE CONTROL		CHANNEL PLUG
	LV - LOG VANE		PROPOSED BERM
	FPS - FLOODPLAIN SILL		ROCK STRUCTURE
	STANDING SNAG		STONE FORD

HABITAT KEY

	NS - NATURAL SUCCESSION		PEM-H - PALUSTRINE EMERGENT WETLAND (HIGH)
	PFO - FORESTED WETLAND		PEM-L - PALUSTRINE EMERGENT WETLAND (LOW)
	UF - UPLAND FOREST		PEM - PALUSTRINE EMERGENT WETLAND
	OW - OPEN WATER		SS-H - SCRUB-SHRUB WETLAND (HIGH)
	VP - VERNAL POOL		SS-L - SCRUB-SHRUB WETLAND (LOW)
	CHANNEL		

ACCESS KEY

	NATURAL SURFACE TRAIL
	BOARDWALK
	PRE-FABRICATED BRIDGE
	CONSTRUCTION ACCESS
	MAINTENANCE ACCESS



Note: Number of boardwalk features is for representative purposes only. Final quantity, size, shape, and location of boardwalk features to be determined in design stage.

MOBILITY RECOMMENDATIONS

Goals and Intent

The mobility recommendations presented here create a legible and comprehensive trail system in and around the project area. The accompanying map shows the recommended changes, which accomplish the following:

Ensure user access during construction:

- Temporary trail re-routes on the Border Trail and the Lakeside Trail enable users to make easy connections while sections of the trail are closed.

Establish an interconnected trail system:

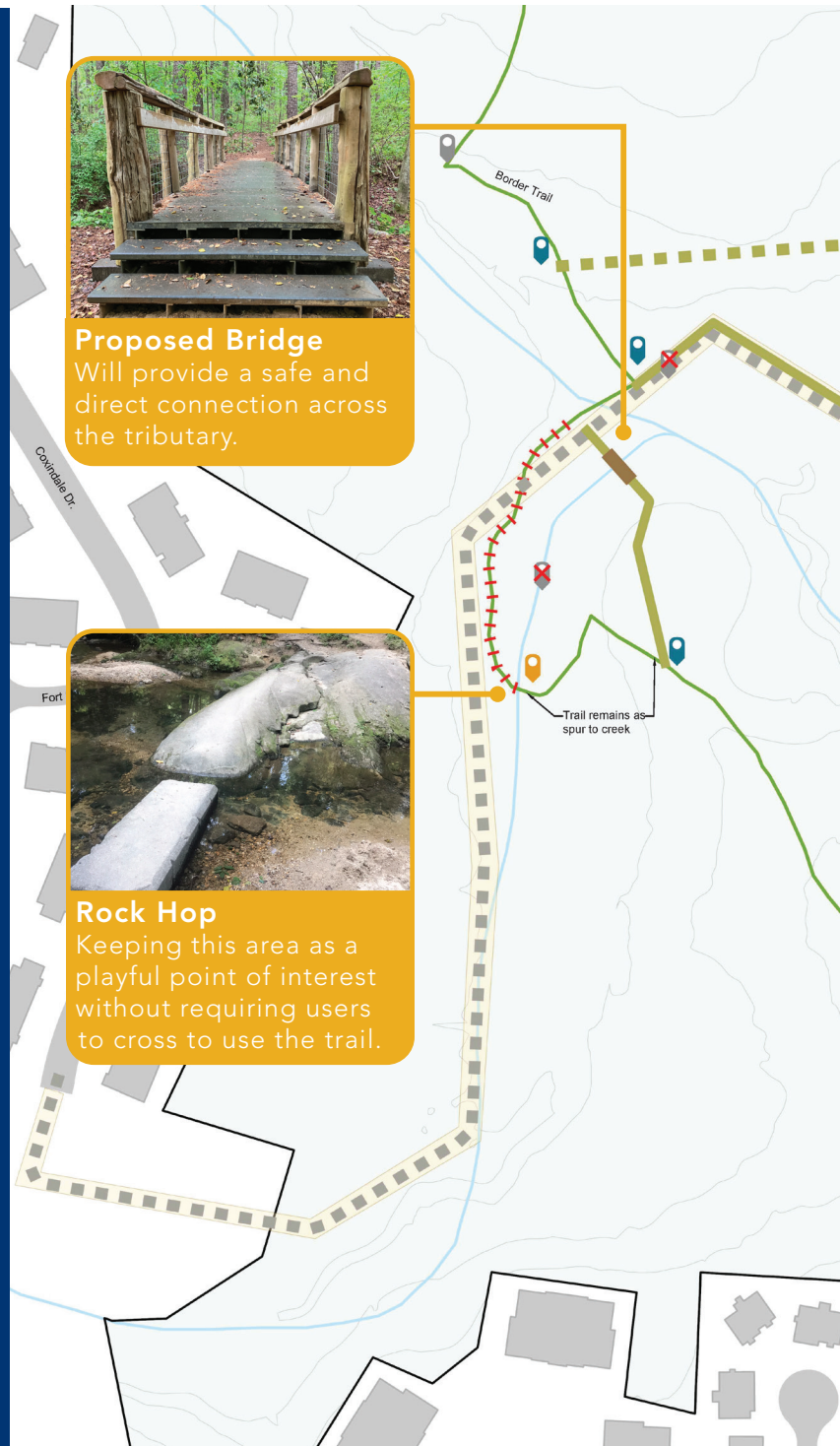
- Opening up the sewer easement between the Border Trail and White House Rd for patron use provides access to the northern side of the wetland area and creates opportunities for a variety of different trail loops.

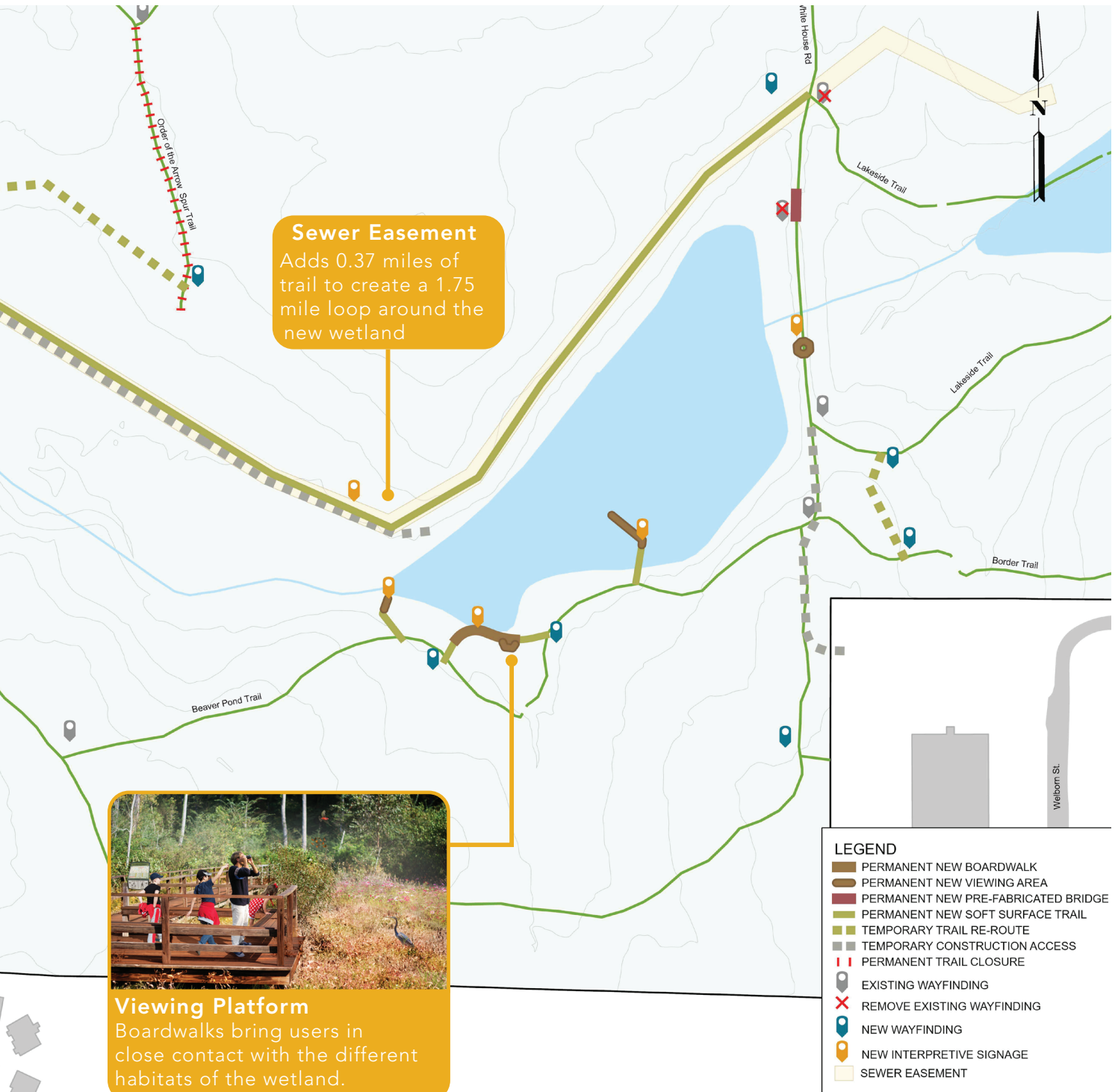
Provide a variety of opportunities to experience the wetland:

- One or more viewing platforms are envisioned to bring users close to different wetland habitats. Locations shown on the map will be refined in future design phases.
- These platforms would be sized to accommodate tours and educational groups and will include educational signage.

Create a legible and navigable trail system:

- New wayfinding signs at all new and existing decision points ensure that users can confidently make decisions about their journey.
- Interpretive signs at key locations throughout the project area give users a greater understanding of their experience and surroundings.





Note: Number of boardwalk features is for representative purposes only. Final quantity, size, shape, and location of boardwalk features to be determined in design stage.

DESIGN ELEMENTS

At the second Open House, along with the online survey, the community had the opportunity to provide input regarding various design elements. The following pages showcase the questions that were asked to the public, combined number of responses from the Open House and online survey, and an overview of the feedback provided.

The public showed support and excitement for the project, and a strong preference for elements such as curvilinear boardwalks, visually permeable railings such as wood and metal, and wooden benches with backs for comfort. Some residents showed concern for right sizing the boardwalks to be budget conscious and emphasized the need to protect existing plants and wildlife such as the lady slippers and kingfishers.

BOARDWALKS

One or more boardwalks with viewing platforms are envisioned. Indicate your preference by marking like(check)/dislike(X) for all of the following photos.



Curvilinear boardwalk



Angular boardwalk¹¹



Boardwalk with wood railing



Boardwalk with wood and metal railing¹²



Simple backless wooden bench



Wooden bench with back



Curvy backless wooden bench¹³



L-shaped wooden bench with back¹⁴



BIRD BLINDS¹⁵



The wetland will attract more birds of different species. A bird blind is a structure used to conceal a person while they observe or photograph birds.

How long would you like to use a bird blind?

- 15 Not going to use it
- 12 Less than 10 minutes
- 16 10 - 30 minutes
- 2 Greater than 30 minutes

TRAIL RE-ROUTE SIGNAGE

Trail re-route signage will be provided while trails are temporarily affected by construction.

What kind of information is needed on trail re-route signs?

- 43 Trail names and distances
- 37 Maps
- 27 Level of difficulty

Other:

Where do you want to see re-route information?

- 22 Online
- 30 At every decision point
- 33 Trailhead kiosk
- 14 Informal neighborhood access points

PHOTO POINTS¹⁶



This is a dynamic landscape that will change over time. Photo points include a support for phones that allows you to take pictures of the same location over time.

What kind of scene do you want to photograph over time?

- 34 Large view of the wetland
- 29 Animals
- 25 Water features
- 13 Me & my friends in the landscape

Other:

INTERPRETIVE SIGNAGE

Interpretive signage is planned to enhance user experience and provide more information about the site.

Which topics should be addressed with interpretive signage?

- 22 Ecosystem services (e.g., water quality, carbon sequestration)
- 24 Cultural history of the site
- 32 Plant communities
- 38 Wildlife

Image List

1. <https://tx.audubon.org/great-blue-heron-0>
2. <https://www.audubon.org/field-guide/bird/red-winged-blackbird>
3. https://animals.sandiegozoo.org/animals/kingfisher?qt-animals_page_content_tabs=2
4. https://www.johnharveyphoto.com/Life/01_2009/MaleWoodDuck.html
5. <https://www.fws.gov/media/engineered-log-jam>
6. https://swbmpvwrrc.wp.prod.es.cloud.vt.edu/wp-content/uploads/2017/11/Introduction_App-D_Sediment-Forebays_03012011.pdf
7. <https://www.riceswcd.org/crep-restored-wetland-planned-near-millersburg/>
8. <https://mnlnd.org/2018/04/03/whats-a-vernal-pool/>
9. <https://dec.vermont.gov/watershed/wetlands/functions/open-space>
10. <https://princetonhydro.com/project/mullica-river-wetland-mitigation-site/>
11. <https://goodstock.photos/boardwalk-surrounded-by-tall-grass-and-plants/>
12. <https://www.permatrak.com/permatrak-project-profiles/crabtree-lake-greenway>
13. <https://www.countrycasualteak.com/curved-backless-teak-garden-bench-circa-4520>
14. <https://www.countrycasualteak.com/windermere-corner-bench-4550>
15. <https://wildbirdtrust.org/2021/02/17/analysis-bird-blind-designs/>
16. <https://brightside.me/articles/18-creative-designs-that-left-our-heads-swimming-805177/>

All other photos provided by Toole Design, WK Dickson, and City of Raleigh.

APPENDIX

The following pages summarize previous analyses that were conducted at Durant Nature Preserve to assess the condition of the Upper and Lower lakes and identify alternatives to address the identified issues.

Previous Analysis and Findings

2013

LAKE ASSESSMENT

Conclusion

- » The dams and spillways of the Upper Lake and the Lower Lake are structurally and hydraulically deficient.
- » Something must be done to preserve the wildlife habitat in and around both lakes.

2019

LOWER LAKE CONSTRUCTION

Overview

- » Construction on the Lower Lake was completed in 2019, including its dam, spillway, and downstream channel, removing its deficiencies.

2020

UPPER DURANT LAKE RETROFIT ALTERNATIVE ANALYSIS

Findings

- » Accumulated sediment is not hazardous.
- » Existing dam spillway does not provide adequate flood control.
- » The existing lake provides moderate water quality benefits (removes nitrate nitrogen, phosphorus, and sediment).
- » Habitat is limited upstream for macroinvertebrates (classified as Poor to Fair).

Conclusion

- » After scoring four scenarios for restoring the Upper Durant Lake, the Habitat Wetland was identified as the best solution.

Table 20. MCDA Summary.

MCDA Decision Criteria Variables	MCDA Rating (1-4)*								MCDA Score***	MCDA Rank****
	Water Quality	Flood Control	Habitat Enhancement	Educational/ Interpretive Opportunities	Risk to Downstream Lake	Project Implementation Time	Initial Capital Cost	Yearly Ongoing Cost		
Weighting Factor (1-4)	3	1	3	3	4	1	3	2		
Habitat Wetland	3	1	3	4	4	1	2	1	56	1
Stormwater Wetland	4	1	2	3	4	1	2	1	53	2
Stream Restoration	1	1	3	4	1	2	2	3	43	3
Lake As Is	2	1	1	1	4	3	1	2	39	4

*MCDA rating represent a relative rating of the retrofit alternatives. Ratings range from 1 (less favorable) to 4 (more favorable).

**Weighting factors represent the importance of the decision criteria variables to the City. Higher values represent more important variables.

***Represents weighted score for each retrofit alternative.

****MCDA rank represents the final ranking of the retrofit alternative based on the MCDA score (1 represents the most favorable and 4 the least favorable).

Figure 1. The chart above shows the results of a multi-criteria decision analysis (MCDA). The eight evaluation criteria were determined by the public during the engagement process led by NCSU to compare four scenarios for Upper Durant Lake.

This current project

2023

WETLAND CONVERSION OF UPPER DURANT LAKE

Preliminary Findings

- » The wetland conversion does not have to use concrete structures. Natural materials such as wood, rocks, and earthwork (e.g., grading) can be used to construct the wetland.
- » There is potential to sustainably harvest some on-site materials for constructing the wetland (e.g., downed trees, easily propagated plants).
- » Exotic, invasive plant species are dominant directly upstream from the Upper Durant Lake. This project is an opportunity to increase diversity of plant communities.

Future Findings

- » The project team will package the findings from investigating specific wetland design alternatives into a technical memo for the City's review.
- » The City of Raleigh's preferred alternative will be showcased in a Habitat Wetland Vision Plan.

Examples of habitat features for ecosystem design within the wetland

Figures 2-3. Wetlands are prime habitat for a variety of birds including many species of waterfowl

Figure 1.



Figure 1.



Figure 1. Beaver Dams naturally create wetland habitats by naturally slowing water flow, preventing erosion and extreme flooding



Figure 1. Snags provide habitat for bugs which are eaten by local birds

**WETLAND CONVERSION
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VISION PLAN**