

April 2023
FINAL

MIDTOWN WATERFRONT PARK

design ideation

prepared by
Nick Musarra

advised by
Chuck Flink, FASLA

NC STATE
UNIVERSITY



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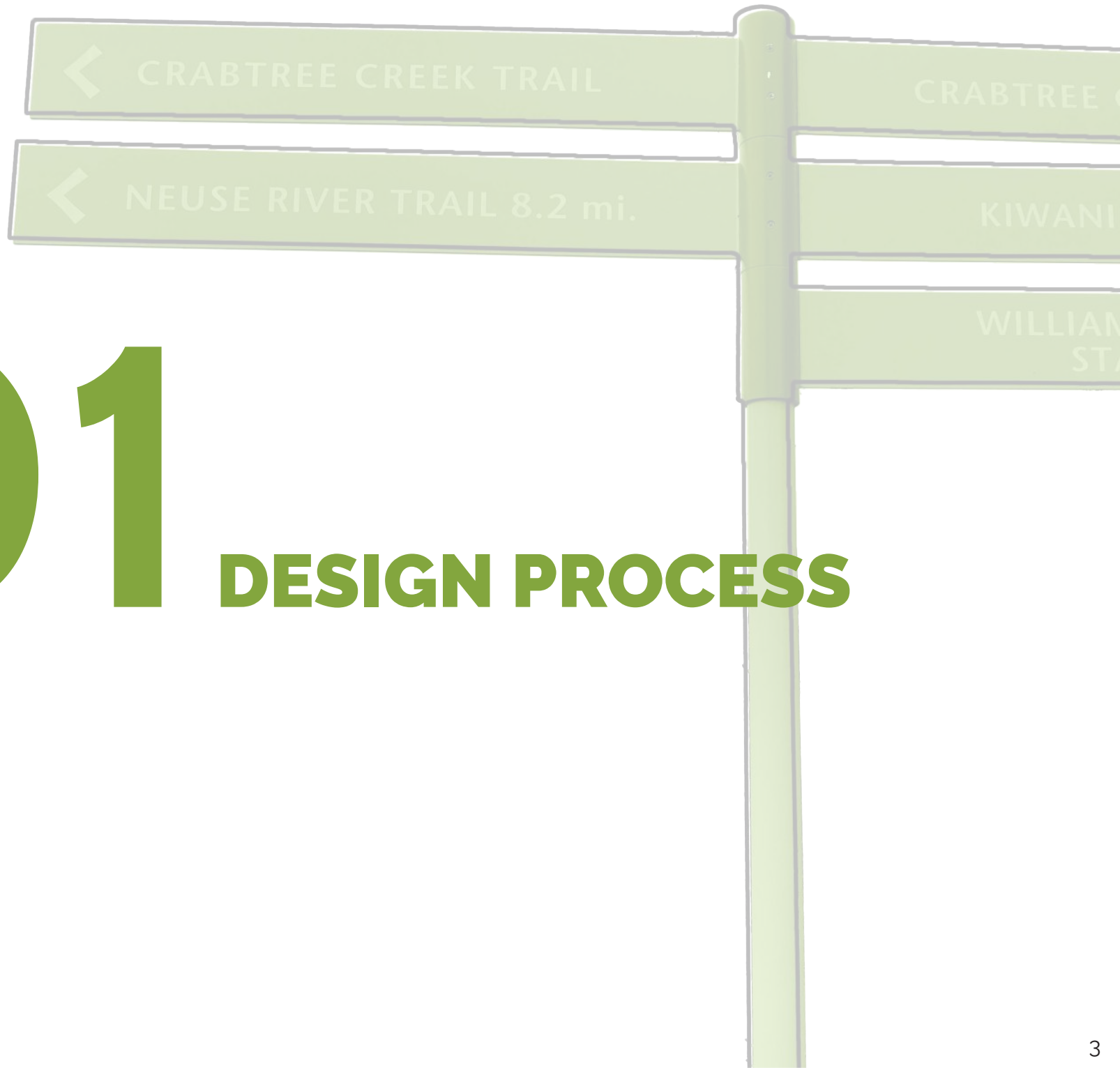
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01 DESIGN PROCESS



PURPOSE OF THIS REPORT

The City of Raleigh adopted the Midtown-St. Albans Area Plan “Walkable Midtown” in May 2020. One of the “Seven Big Moves” from this plan is the creation of a waterfront district and storm-resistant park at Crabtree Creek in an area of underutilized land frequently flooded during rain events.

Under the Direction of Chuck Flink, FASLA, Director, the NC State University Initiative for Community Growth and Development is working with University faculty and students to evaluate and propose design ideas for the Midtown Waterfront Park element of the Walkable Midtown Plan. Master of Landscape Architecture candidate Nick Musarra has completed necessary research and prepared this report. The goal of NC State’s contribution is to provide the City of Raleigh, and the Appearance Commission, with design ideas and case studies for how a waterfront park might be developed along the midtown stretch of Crabtree Creek. The work to be completed by NC State University is for **informational purposes only** and does not bind the City of Raleigh to any future design, development, or programming commitments.

WHAT TO EXPECT

This report is a continuation of a previous site analysis and case studies document completed in December 2022 and will outline the design process undergone during the 2023 Spring semester including schematic concepts, a more refined conceptual master plan vision, descriptions of various conceptual elements, and considerations for future studies.

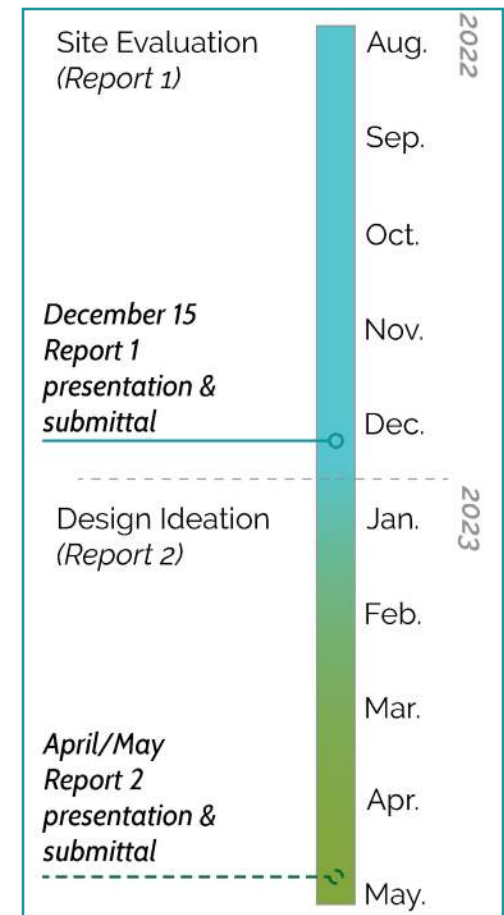




Figure 1 - Report 1 Study Area

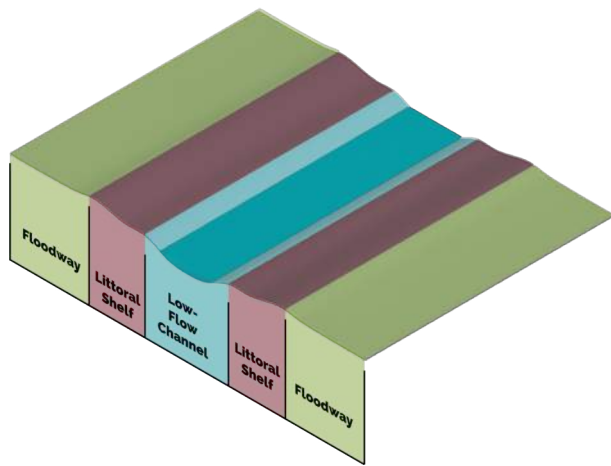
STUDY AREA REVIEW

The study area in the previous report initially encompassed about 80 acres surrounding Crabtree Creek loosely bounded by Wake Forest Road, Creekside Drive, the CSX Railroad, and Hodges Street. The design concepts explored in this report expand beyond this initial study area, primarily to the west to incorporate additional property that may be strategic in the development of the park.

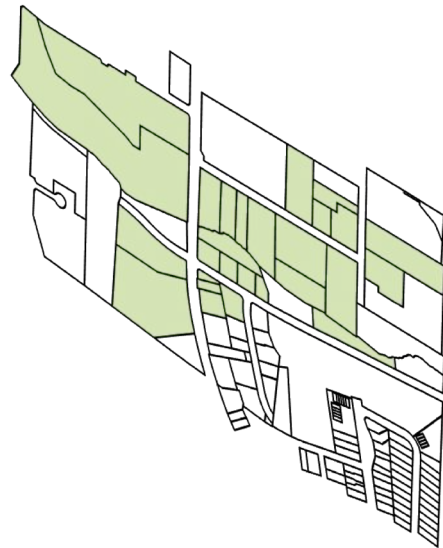


DESIGN GOALS

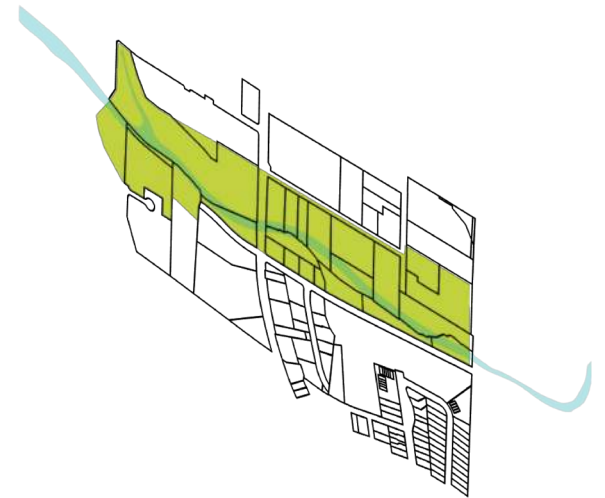
During this phase, the design concepts focus primarily on elements that would pursue restoring hydrologic function and how to arrange them in a conceptual plan with a high-level understanding of those elements.



How much room would a stream/
floodplain restoration require?



What properties would help serve
the function of this park?



Conceptual arrangement of park
elements

STREAM RESTORATION

According to the NCSU Stream Restoration Extension Program, “stream restoration is the re-establishment of the general structure, function and self-sustaining behavior of the stream system that existed prior to disturbance.” This treatment would be appropriate for this reach of Crabtree Creek as the stream was channelized in the 1980’s when a natural meander in the stream was straightened. These interventions on stream form can detrimentally impact the hydrologic and ecological function of streams.

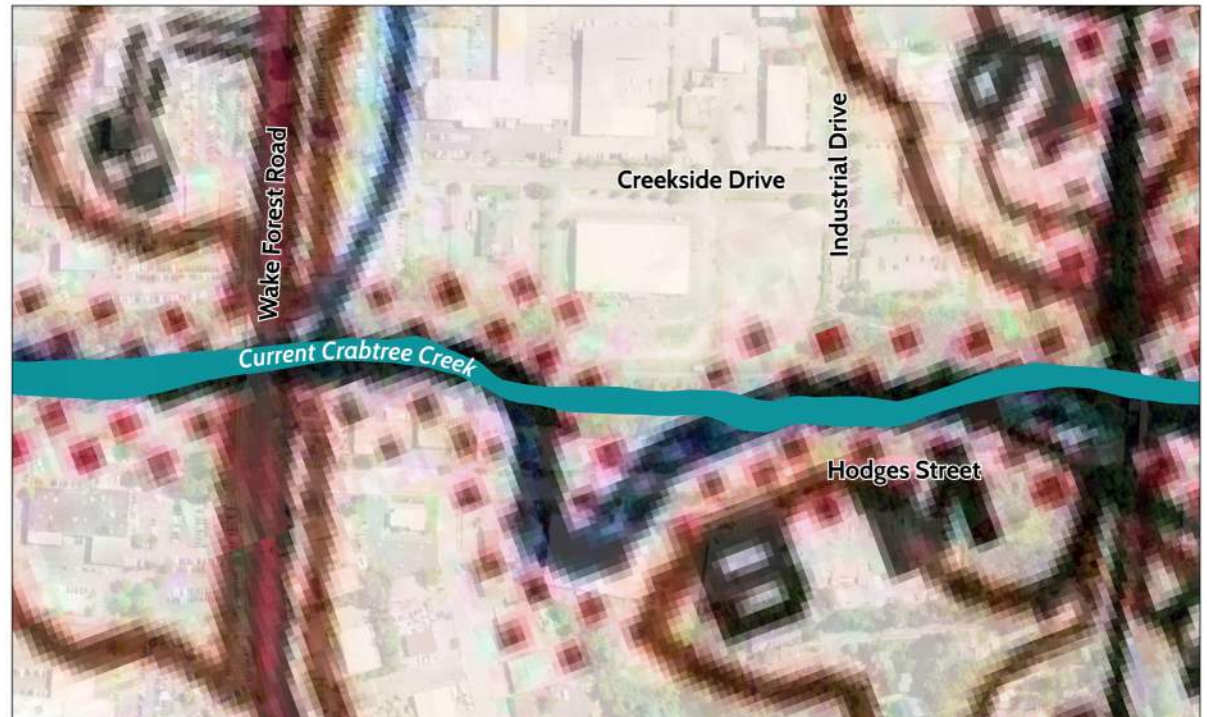
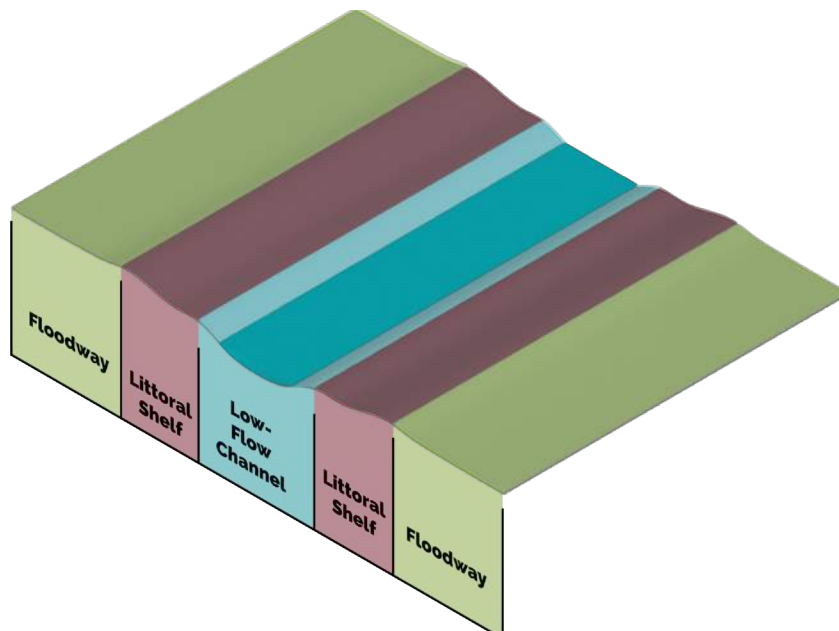


Figure 2 - Historic meander (Source: FEMA Flood Map Service Center)



In rebuilding the stream to restore these functions, the cross-section of the stream should include the following elements:

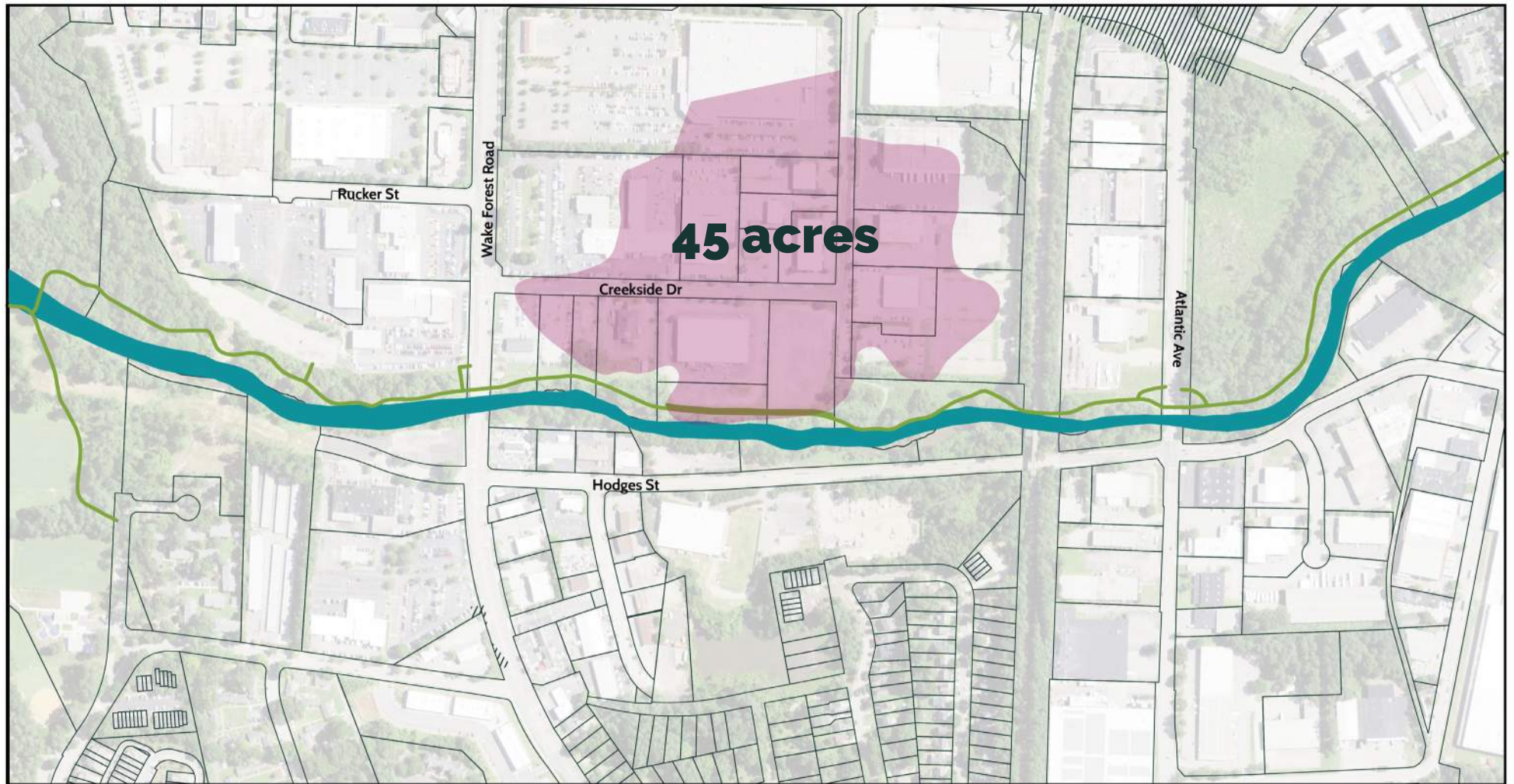
Low-Flow Channel: designed to carry up to the most frequent stormwater levels

Littoral Shelf: a planted edge along the stream that serves to filter pollution from stormwater flowing into the creek as well as providing wildlife habitat.

Floodway: relatively flat area of land to retain higher flood waters that cannot be held within the stream channel.

PRE-REGULATORY LANDFILL

Future considerations should be given to the Old Raleigh Landfill #8, a pre-regulatory landfill that currently sits underneath several parcels north of the stream. The NC Department of Environment and Natural Resources is currently undergoing a vapor study to determine regulations for future development on the land. A larger remediation effort will likely be necessary to pursue a stream/floodplain restoration project in the creation of this waterfront park, and coordination with NCDENR is encouraged in moving forward with design ideation.



 Old Raleigh Landfill #8



PRE-REGULATORY LANDFILL

Figure 3

STRATEGIC PROPERTY

Figure 4 identifies land ownership that informed the initial design concepts of this phase. Land adjacent to the stream is primarily owned and/or managed by the City of Raleigh. This land would be strategic in developing a phased approach to the park as it would require little acquisition to facilitate improvements. During previous conversations with city staff, the groupings of parcels shown in red hatching were identified as strategic since they are held by just 9 different property owners - a relatively manageable number to coordinate with in developing a vision for the park and considering property acquisitions.

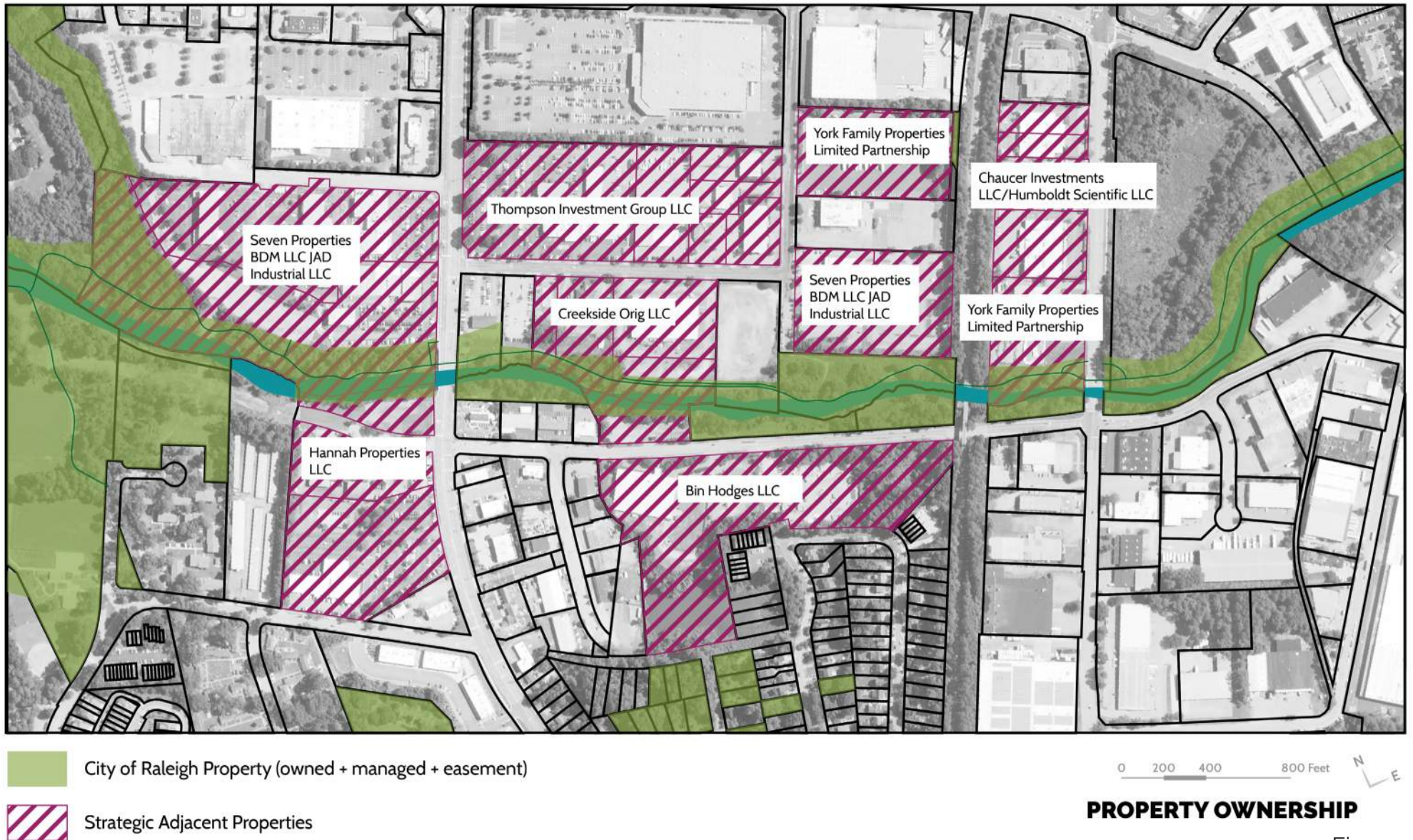


Figure 4

CONCEPT GENERATION

A workshop with invited city staff was held at NC State's campus on February 27, 2023 to discuss initial concepts that had been developed. The schematic concepts explored a range of potential park sizes based off of the strategic properties identified in Figure 4. ***Note that potential storage capacities cross-sectional dimensions were purely conceptual at this stage - additional calculations are carried out in the final design concepts.***



Option 1 - Minimum (25 acres)

Maximize ecological/hydrological function within land already owned/managed by the City

Estimated capacity: 50 million gallons

Existing conditions: 5 million gallons



Figure 5 - Schematic Option 1 boundary

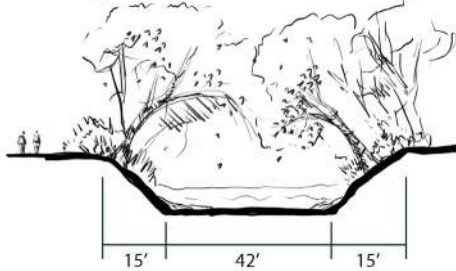
OPTION 1

This option aims to work within the minimum amount of space available to the City without large amounts of acquisition; this includes land the City already owns and easements. Using the larger parcels of land owned by the City were considered to allow room for water to slow and pool before moving downstream where the stream becomes more constrained. It was proposed that additional easement could be taken to relocate the greenway trail to the outside of the stream improvements.

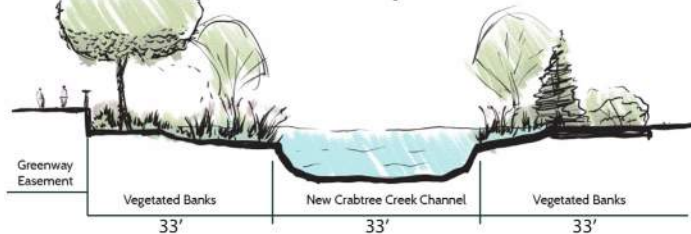


Figure 6 -Schematic Option 1 diagram

Existing Crabtree Creek Cross-Section



Conceptual Minimum Option Cross-Section



Option 2 - Medium (57 acres)

Begin reclaiming floodway and enhancing stream restoration

Estimated capacity: 260 million gallons



Figure 7 - Schematic Option 2 boundary

OPTION 2

Option 2 considers opportunities to incorporate some of the strategic groups of parcels from Figure 4. This would allow the stream banks to begin to be widened to achieve more floodable space within the park; however, this effort would likely require a replacement of Wake Forest Road bridge (see workshop discussions). Additionally, a realignment of the stream could include some minor meanders to help restore stream function. More room can be created to the west of Wake Forest Road to capture water from upstream, as well as room for programmable spaces on the east side. There would also be opportunities to intercept major stormwater pipes before they empty directly into the stream as they do today, and to instead daylight stormwater into retention ponds to create engaging landscapes for people and allow the water to infiltrate into the ground naturally.

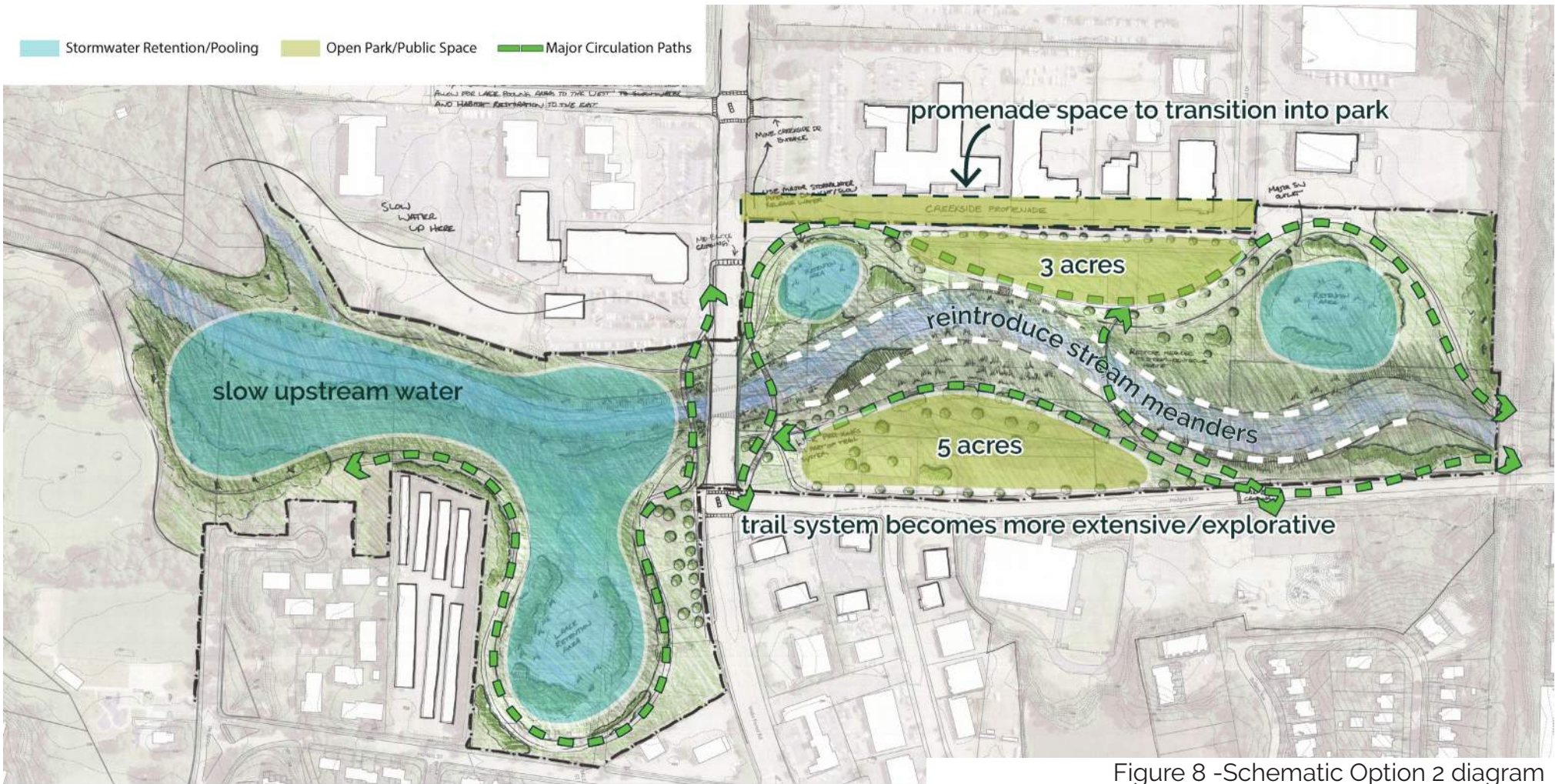


Figure 8 -Schematic Option 2 diagram



Option 3 - Maximum (110 acres)

Nearly reclaim 100-year floodplain for maximum flood absorption

Estimated capacity: 540 million gallons



Figure 9 - Schematic Option 2 boundary

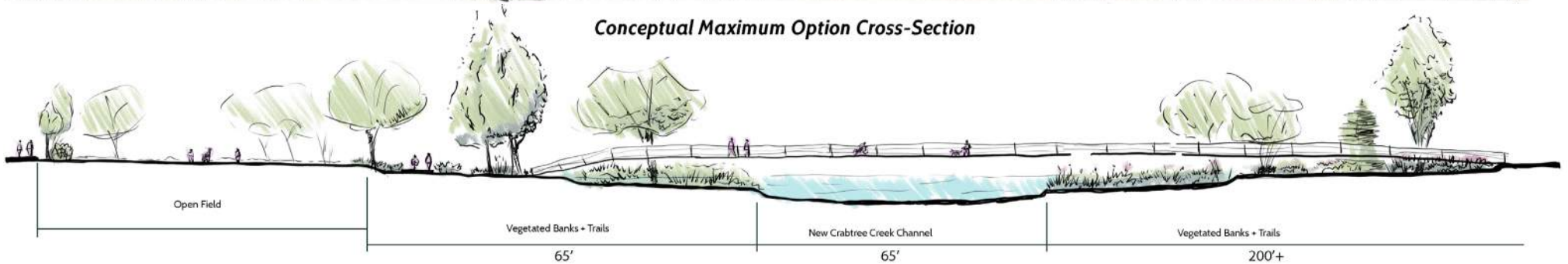
OPTION 3

The final option presented at the February workshop explored a potential maximum amount of land the park could incorporate. Elements from the previous options could be expanded, including a hefty stream restoration effort.

Nearly reclaim 100-year floodplain for maximum flood absorption



Figure 10 -Schematic Option 2 diagram

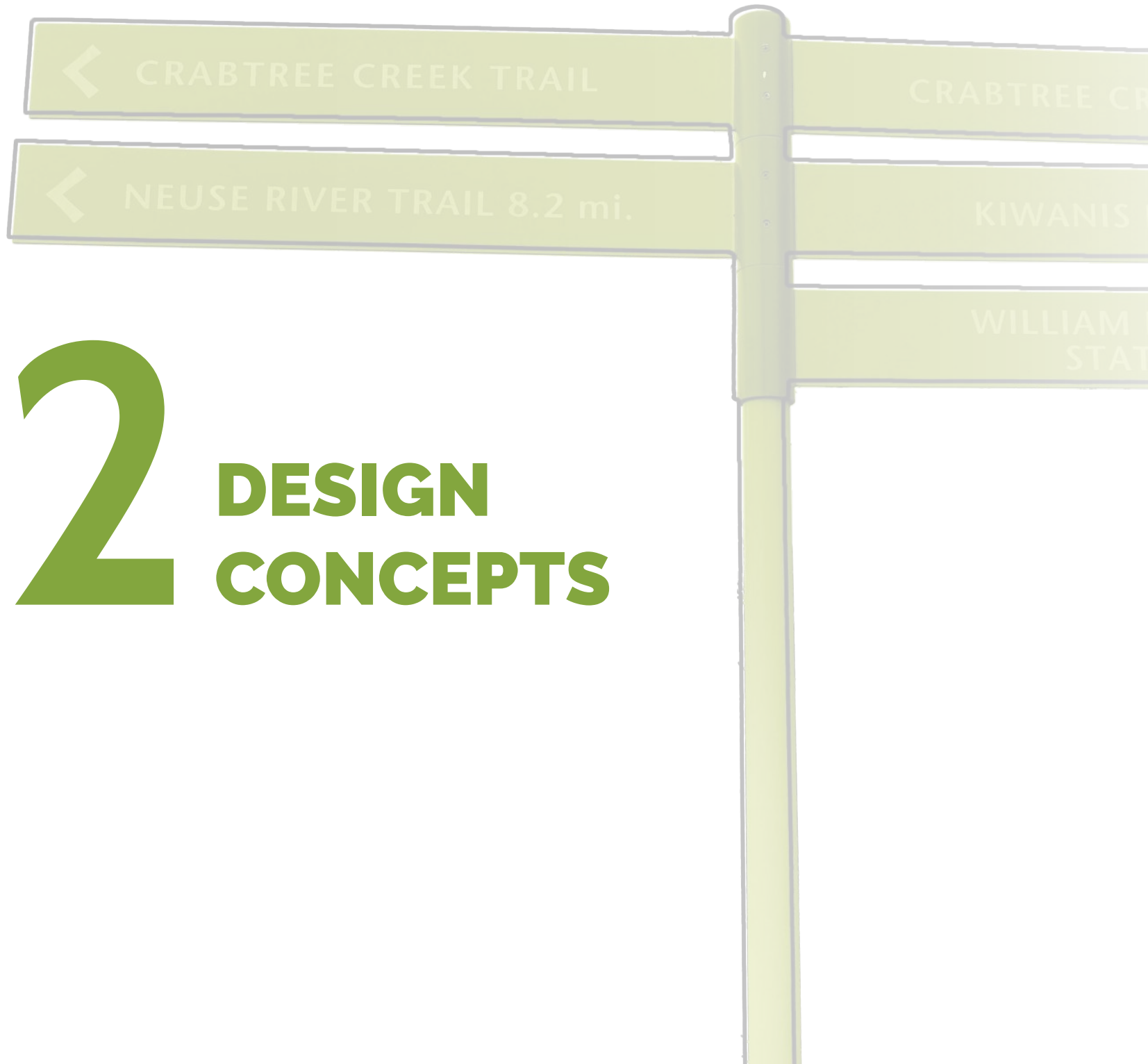


WORKSHOP DISCUSSIONS

The following points of discussion, in addition to others, were had during the workshop and were helpful in developing a refined vision for the park:

- Consider the 3 options as phases so that the park may be taken in a measured sequence over time
- A replacement of Wake Forest Road bridge would occur adjacent to the existing bridge so as not to entirely close it during construction. This would likely require a realignment of Wake Forest Road.
- Discussions were prompted regarding a pedestrian bridge that has now been approved to be built in association with a planned development just south of Hodges Street. The bridge will cross Crabtree Creek from bank to bank as they exist today and represents a fairly heavy investment from the city. A realignment of the stream/rebuilding of the floodplain should consider how to incorporate the bridge into an extended connection across the park.
- While flood storage capacity calculations were high-level and conceptual, the stream should not be included as storage area in the calculations.





02 DESIGN CONCEPTS

PURPOSE OF THESE DESIGN CONCEPTS

The following design concepts are intended to explore a potential phased approach ending with a conceptual vision for a waterfront park. These concepts should provide a stepping off point for the City and community partners to begin developing a further vision.

Design elements including structures, circulation, and open space are presented as high-level concepts and should be explored more deeply through design iteration. Assistance from a stream restoration specialist was sought for estimates for cross-section dimensions for a restoration of Crabtree Creek. Those dimensions guided the realignment of Crabtree Creek shown in “Phase 3,” but should undergo further modeling and study.

PHASE 1

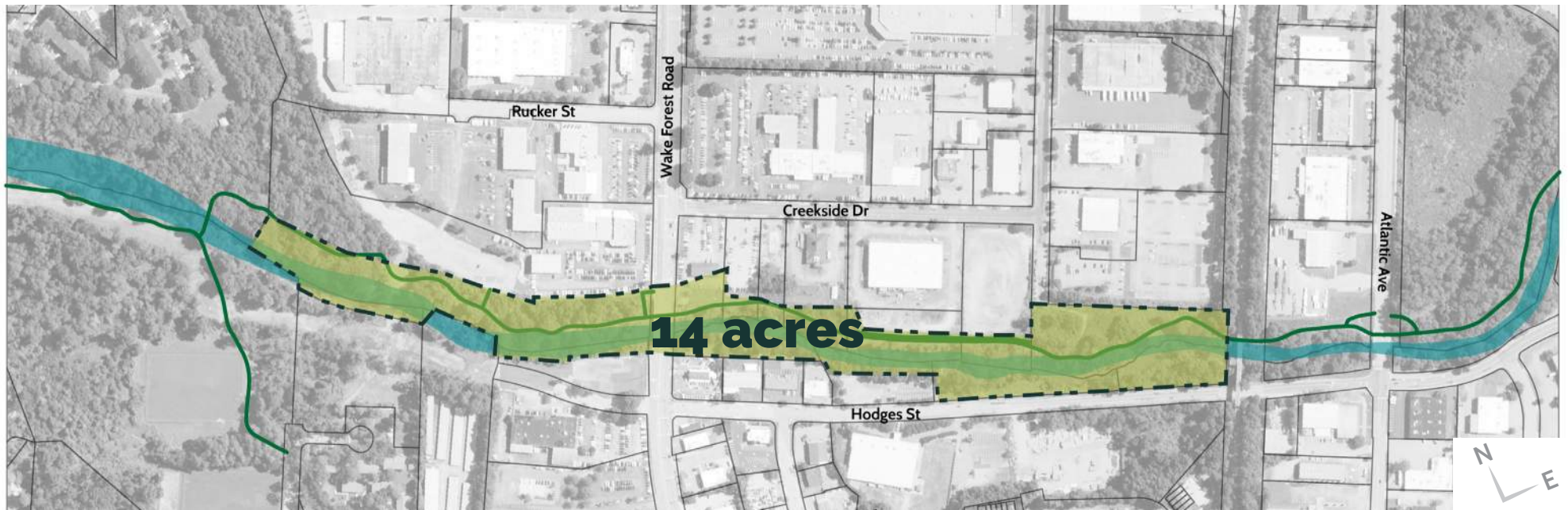


Figure 11 - Conceptual Phase 1 boundary

OBJECTIVES:

- Rebuild Crabtree Creek in current alignment
- Relocate greenway trail
- Rebuild littoral shelf adjacent to creek
- Begin landfill remediation

This phase resembles the first option presented at the February workshop with the objective of utilizing land already owned by the city to begin stream improvements. In this effort, the stream banks would be rebuilt to plant a littoral shelf to aid with bank stabilization and water quality. This would also open an opportunity to relocate the greenway to the outside of the reconstruction area to make room for bank improvements. Consideration should be given to the incoming pedestrian bridge and potential landfill impact.

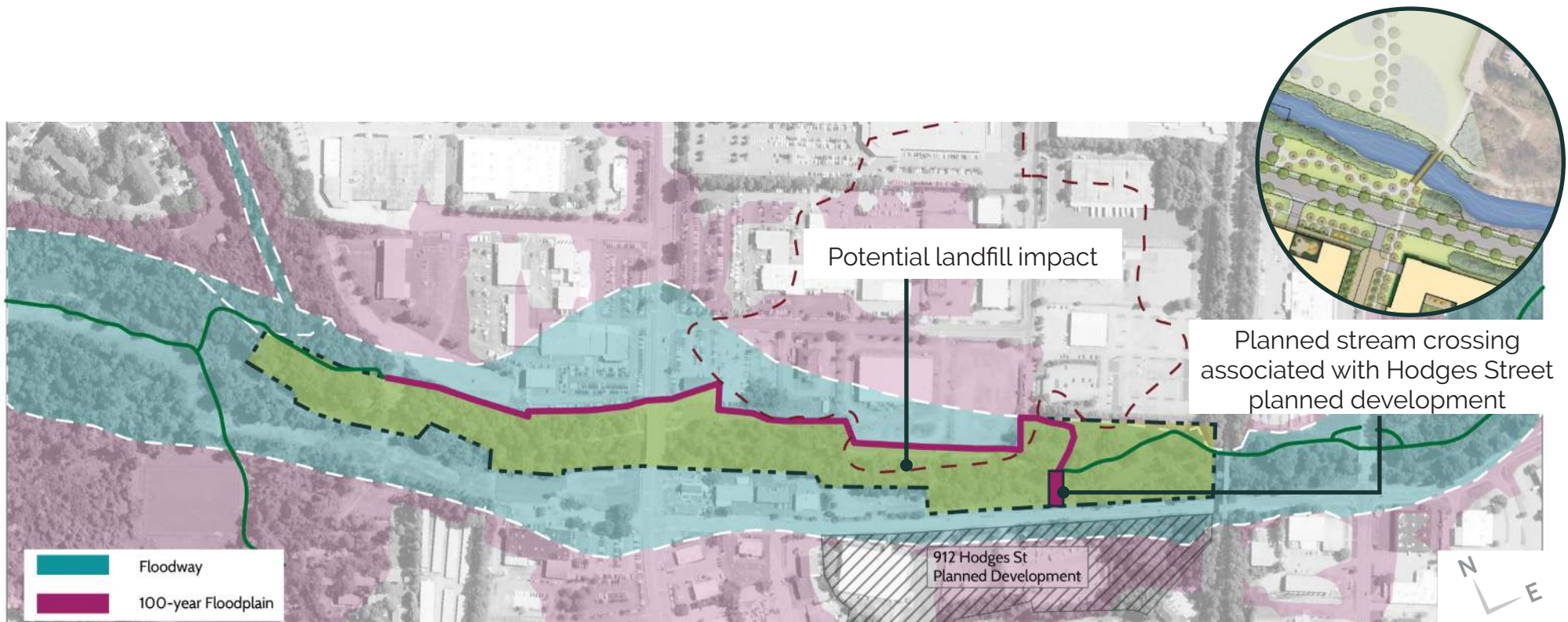
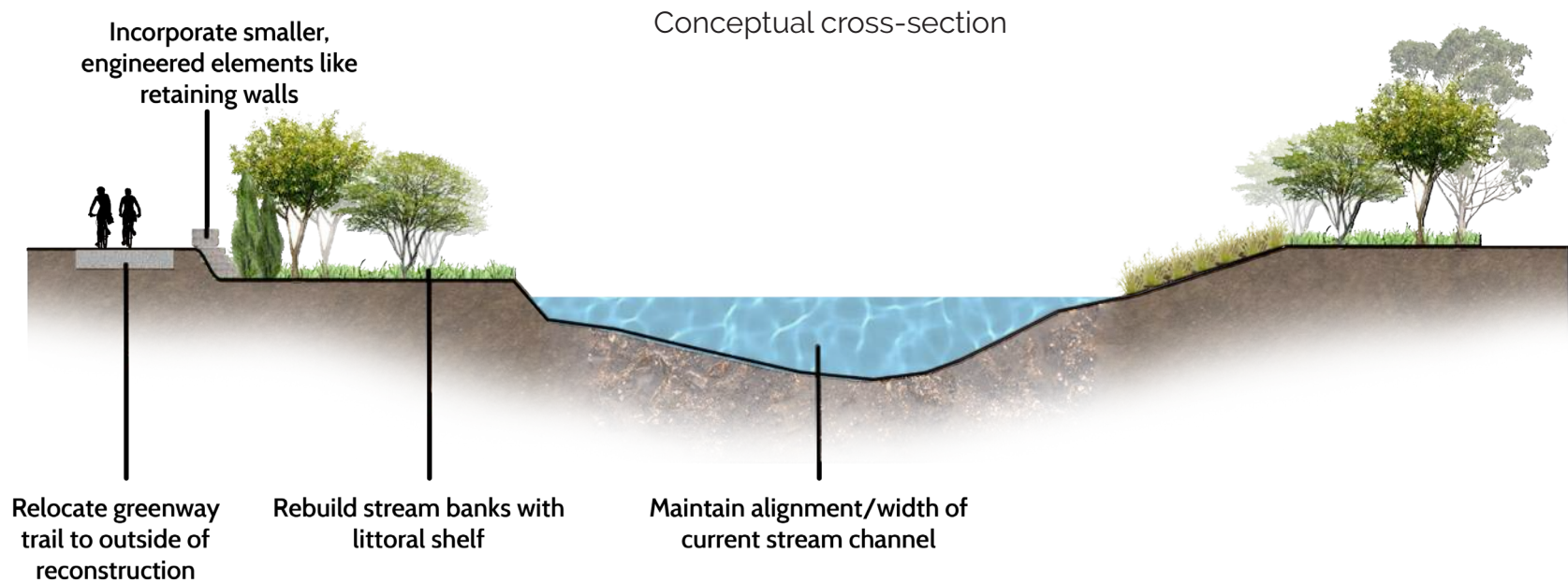


Figure 12 - Conceptual Phase 1 diagram



PHASE 2



Figure 13 - Conceptual Phase 2

OBJECTIVES:

- Landfill remediation (~1 year process)
- Acquire additional parcels to West/South

The second phase is an intermediate one in which the City would begin landfill remediation as well as acquisition of additional properties need to fill out the final phase of the park (Fig. 14). The City should anticipate at least 1 year of remediation process for the landfill.

PHASE 3

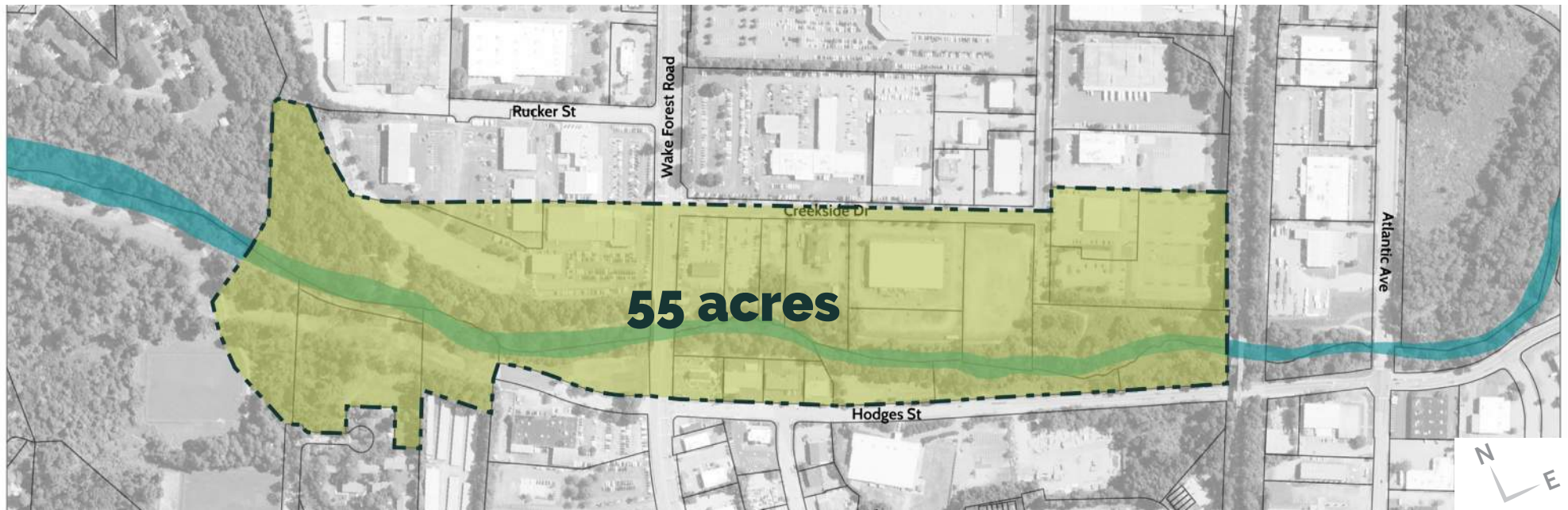


Figure 14 - Conceptual Phase 3 boundary

OBJECTIVES:

- Realign stream/rebuild floodplain
- Replace Wake Forest Road bridge
- Build out park

The final phase includes a realignment and rebuilding of Crabtree Creek and the floodway area for stream restoration, a replacement of Wake Forest Road bridge, and completing build-out of the 55-acre park landscape. Replacement of Wake Forest Road bridge would be necessary as a realignment of the stream and widening of floodable area will likely impact the infrastructure of the existing bridge. It was noted by city staff that the bridge is likely nearing an age appropriate for replacement by NCDOT, and should anticipate being responsible for funding additional improvements beyond the base replacement of the bridge. The timeline for a bridge replacement to begin will likely exceed 10-15 years - coordination with NCDOT should be carried out. As previously mentioned, a bridge replacement would likely occur adjacent to the existing bridge to maintain traffic flow during construction.

PHASE 3 cont.



Figure 15 - Conceptual Phase 3 properties

Figure 15 identifies privately owned parcels that would fall within the final conceptual boundary, and additional partial acquisitions may be necessary to fill out the boundary. Dr. Barbara Doll, Ph.D., PE provided guidance in calculating an estimation of the cross-section necessary for a 3,500-foot reach of a restoration for Crabtree Creek. The dimensions come out to an 88-foot wide stream channel (at bankfull), 6-foot deep stream channel, and 176-foot wide floodplain on either side. A rough stream alignment was fitted to the proposed boundary using these dimensions to develop a conceptual park plan. This boundary also begins to encapsulate a large portion of the existing floodway in this area, hopefully maximizing flood storage capacity. A rough calculation of stormwater storage comes out to about 72.5 million gallons, compared to about 31 million gallons that could normally inundate the same 55 acres as it current exists which would cause flood damage to structures and infrastructure. Future hydraulic modeling and analysis should be undertaken to inform a more refined alignment.

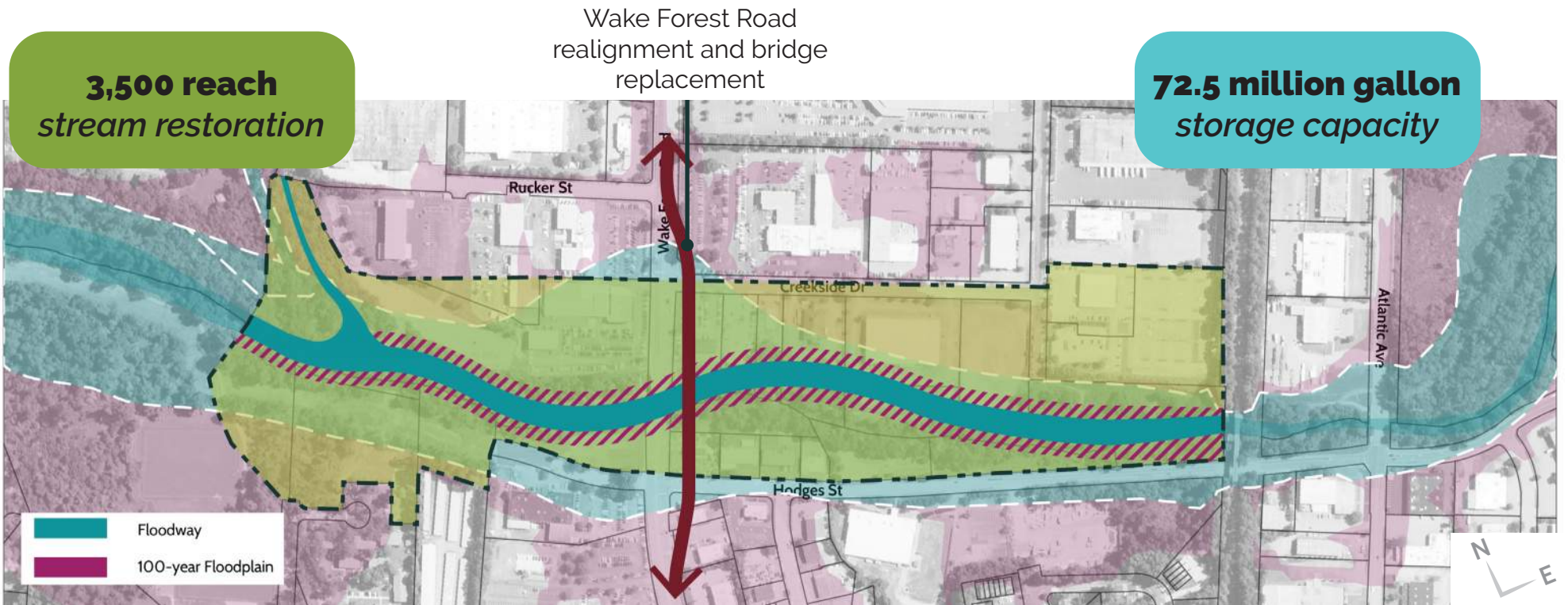
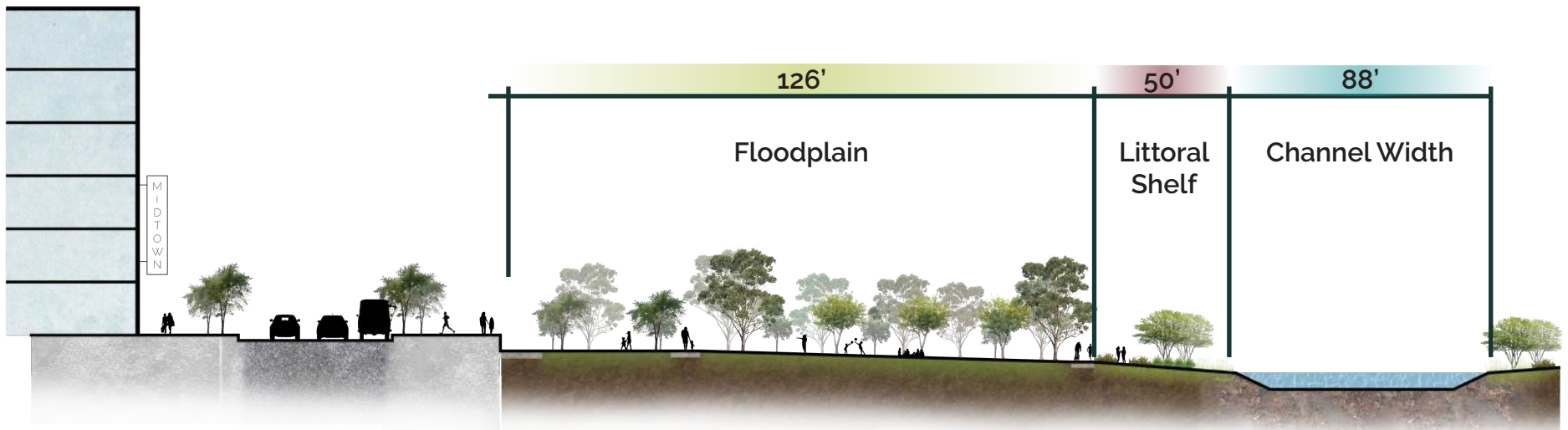


Figure 16 - Conceptual Phase 3 diagram



Based on high-level estimates/calculations using data from USGS Streamstats and guidance from Dr. Barbara Doll, Ph.D., PE

Conceptual Master Plan



Figure 17 - Conceptual Rendered Master Plan

Stormwater retention areas to capture stormwater pipe discharge



Concept Sketch

Creekside Promenade



Little Sugar Creek

Elevated pedestrian crossing expanded from planned bridge



Neuse River Bridge

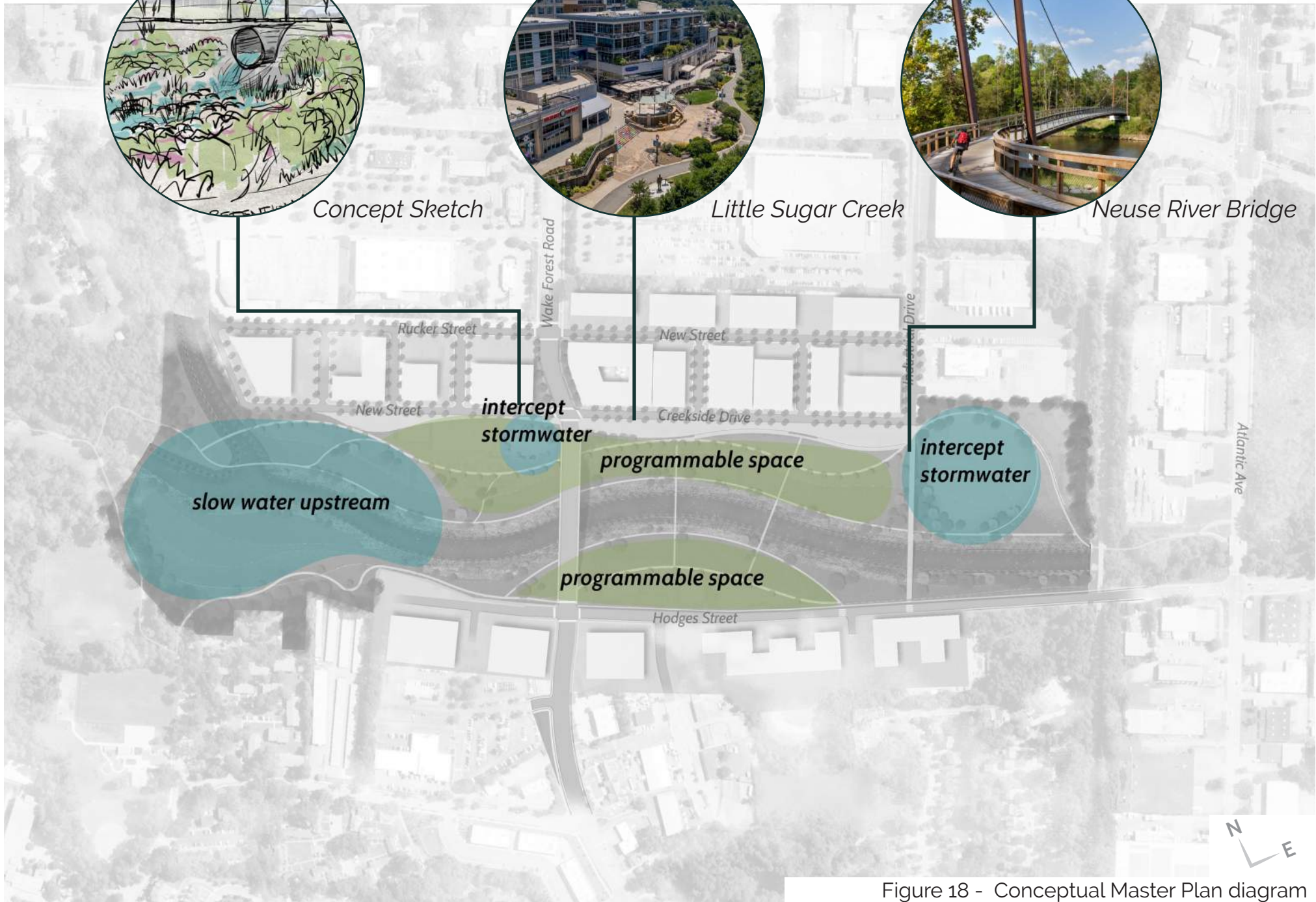
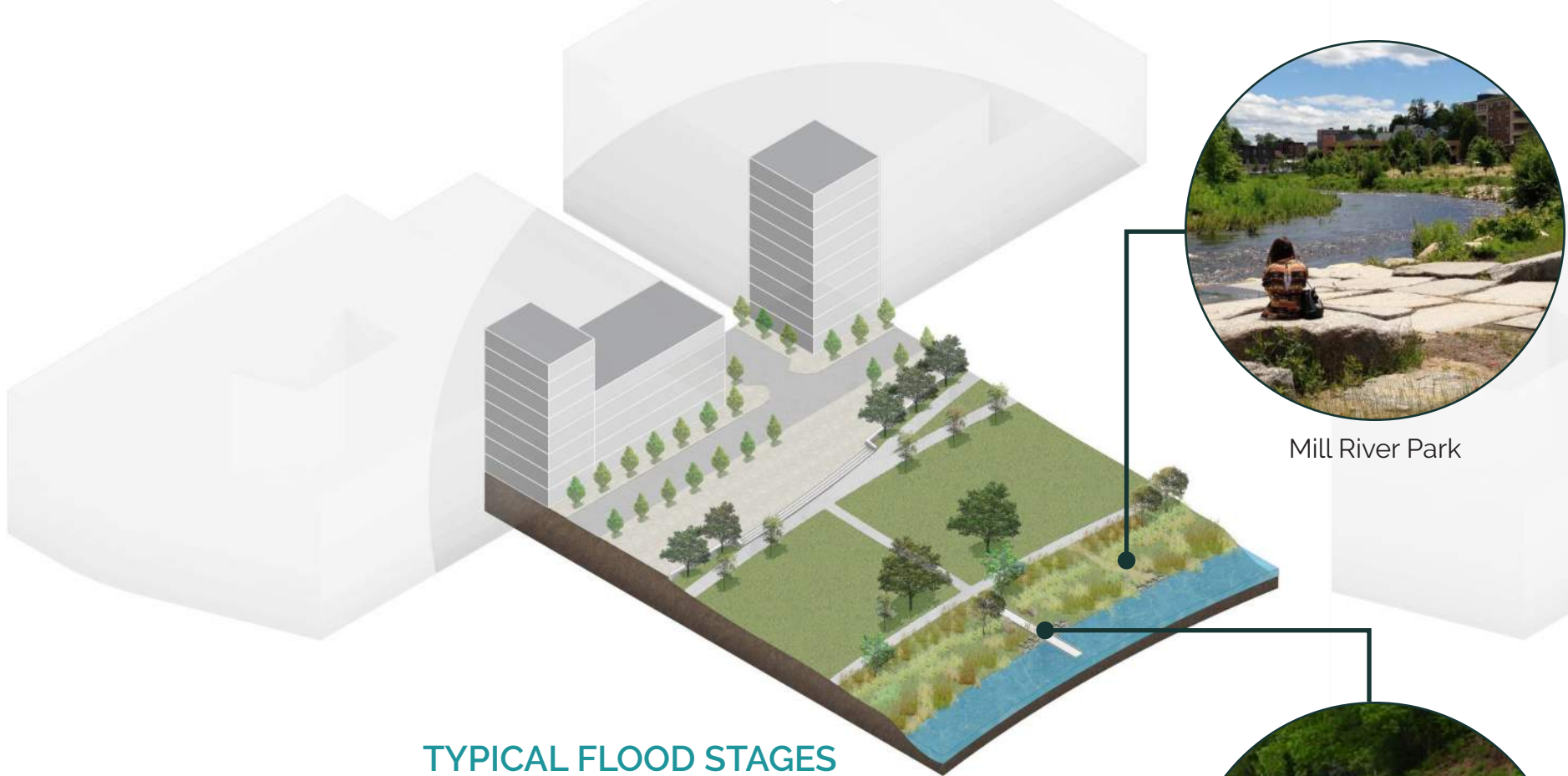


Figure 18 - Conceptual Master Plan diagram



TYPICAL FLOOD STAGES

Figure 19

PARK USAGE AT FLOOD LEVELS

At typical stream stages (Fig. 19), usually just a few feet, the full park area should be open for activity including opportunities to interact with water. Informal paths weaving through the littoral shelf can lead people to the stream, and low water bridges can be allow people to cross over the water. These bridges can be engineered to withstand the force of water as water levels rise. At medium flood stages (Fig. 20), the littoral shelf may become inundated but plenty of the park and circulation are still accessible to use. At the highest flood stages (Fig. 21), access to a majority of the park will be limited but engineered structures like retaining walls at the park edges will help to contain water so that flooding on adjacent development is mitigated. The open park spaces should be build up with an engineered soil and reinforced turf that can withstand the load of recreational activity but allow for flood waters to infiltrate into the ground during flood events.

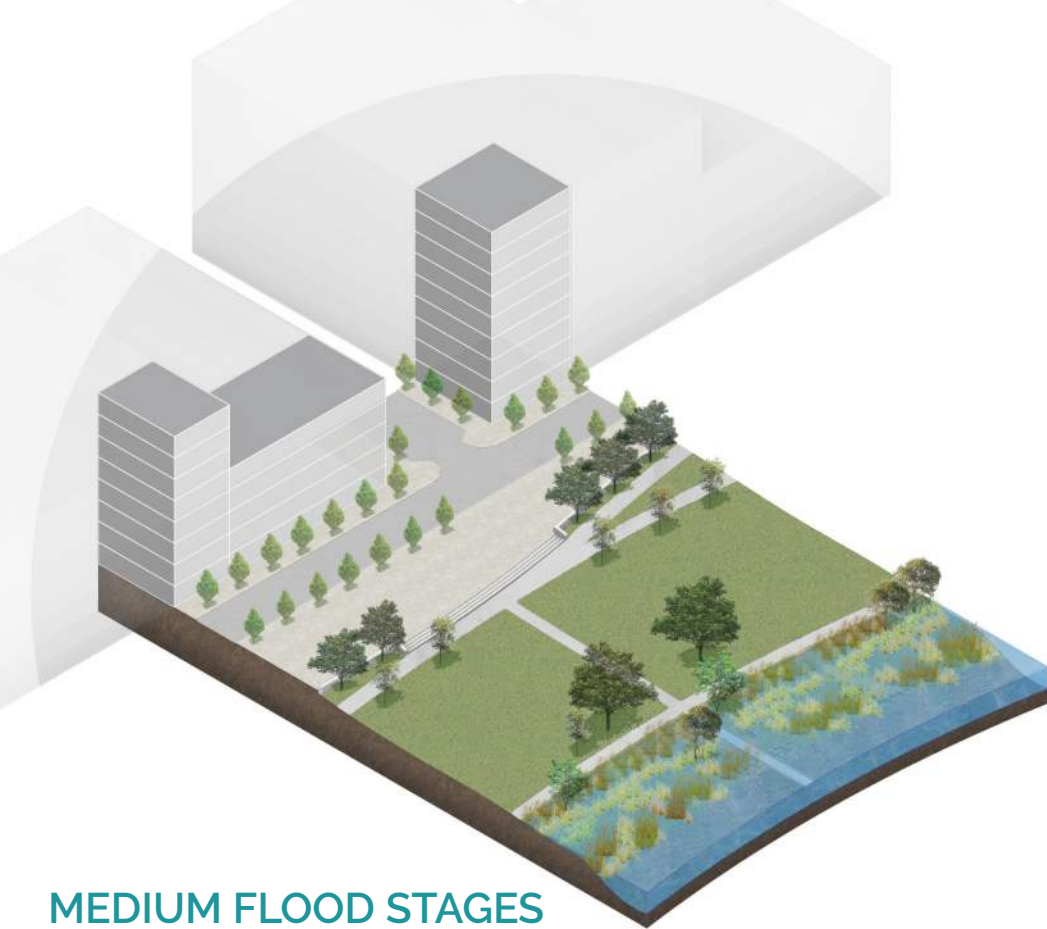


Little Sugar Creek



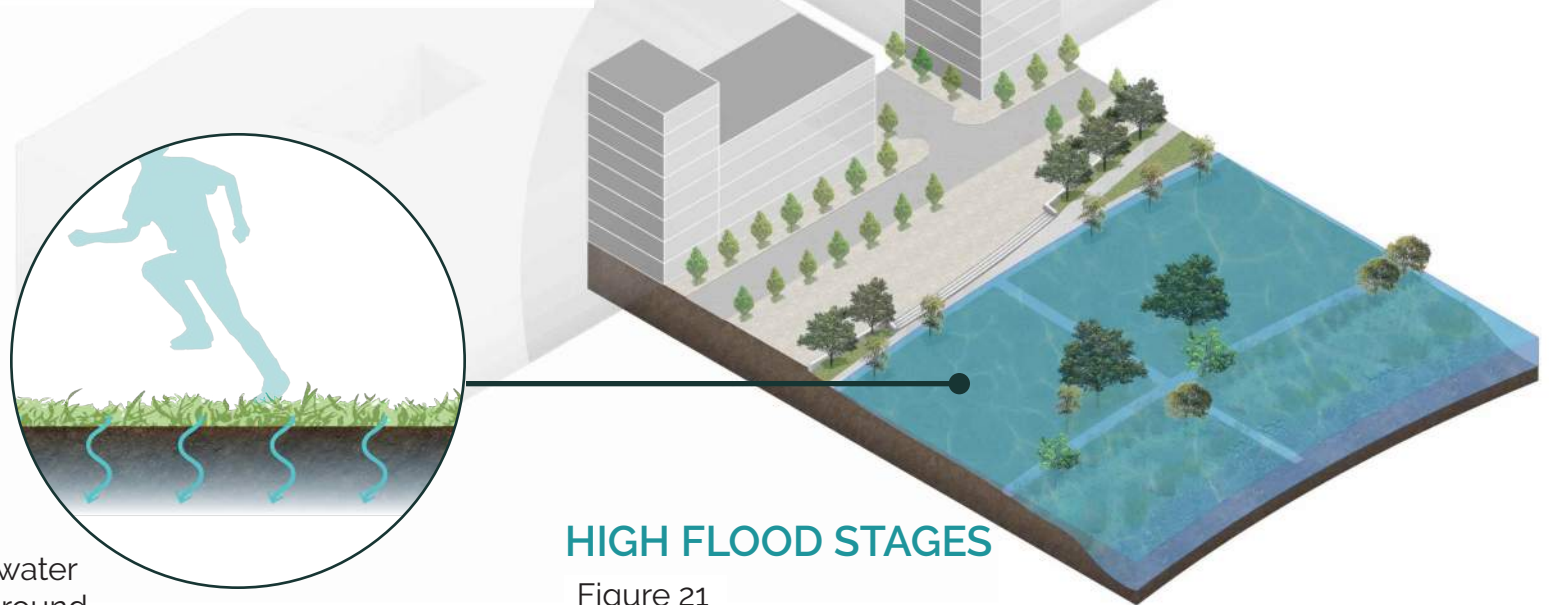
Mill River Park





MEDIUM FLOOD STAGES

Figure 20



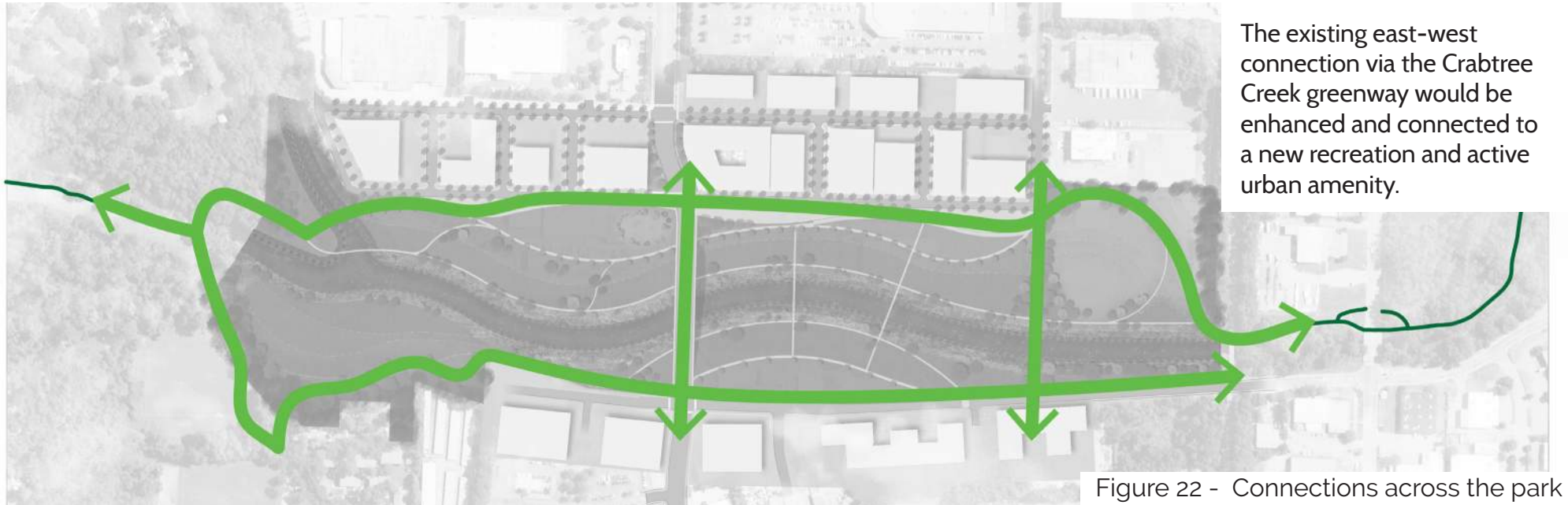
HIGH FLOOD STAGES

Figure 21

Engineered soil can sustain the load of recreational activity while allowing floodwater to infiltrate into the ground

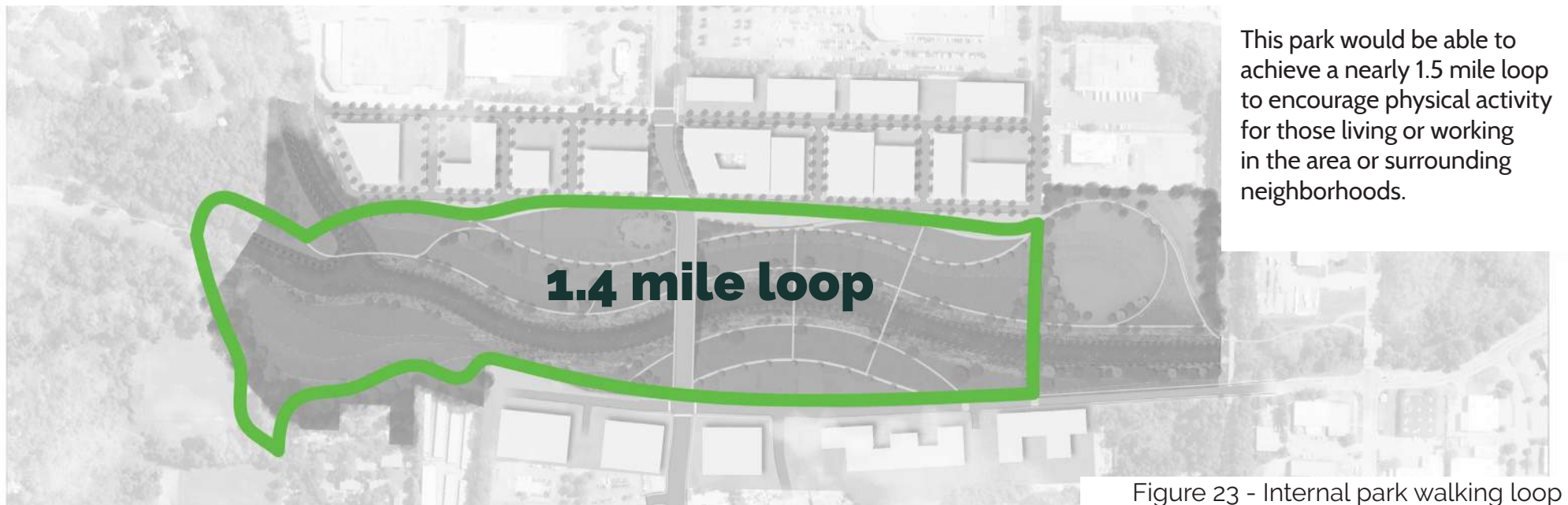
CREATING CONNECTIONS

This park will have opportunities to enhance existing connections as well as create new ones for the surrounding context.



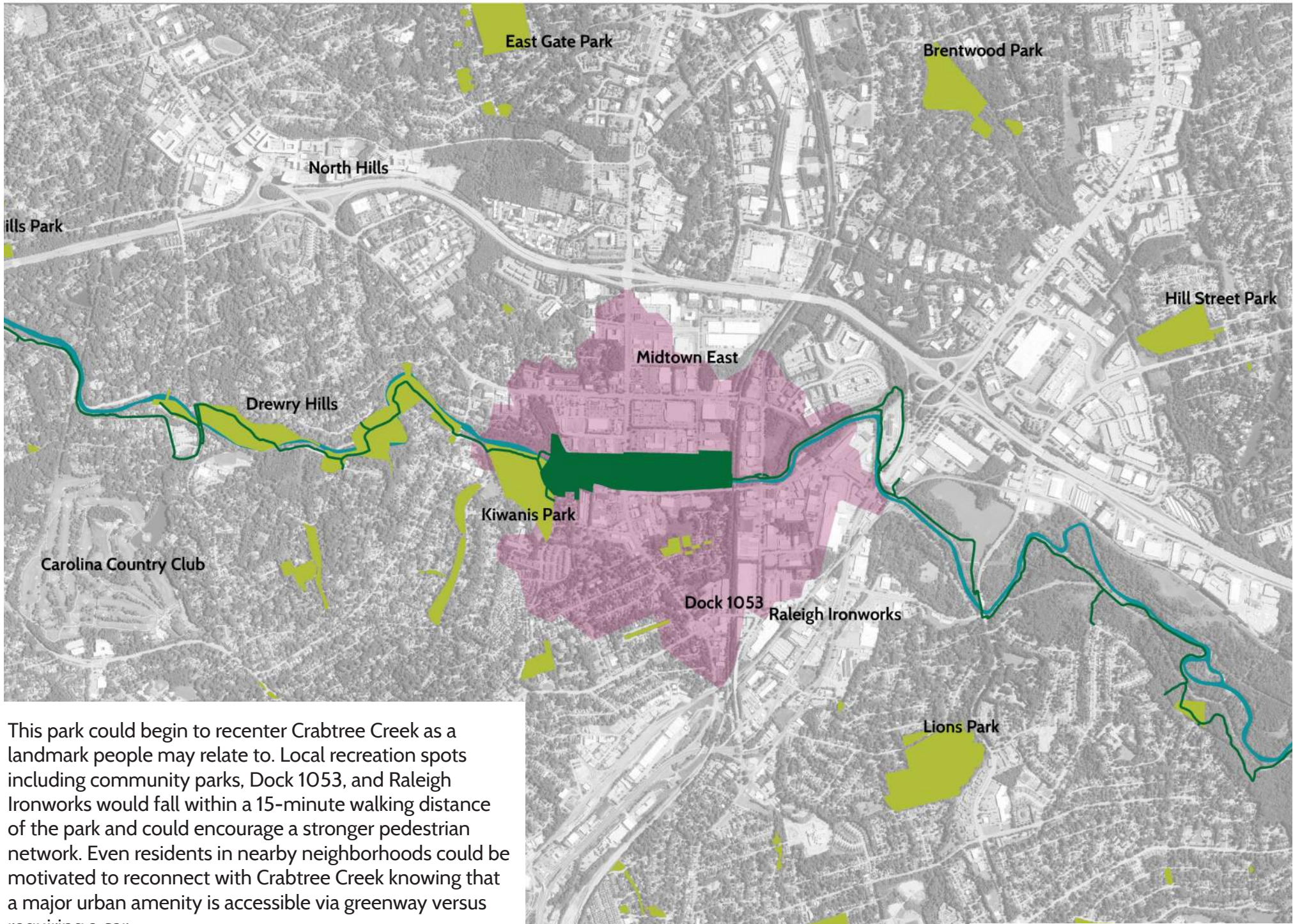
The existing east-west connection via the Crabtree Creek greenway would be enhanced and connected to a new recreation and active urban amenity.

Figure 22 - Connections across the park



This park would be able to achieve a nearly 1.5 mile loop to encourage physical activity for those living or working in the area or surrounding neighborhoods.

Figure 23 - Internal park walking loop



This park could begin to recenter Crabtree Creek as a landmark people may relate to. Local recreation spots including community parks, Dock 1053, and Raleigh Ironworks would fall within a 15-minute walking distance of the park and could encourage a stronger pedestrian network. Even residents in nearby neighborhoods could be motivated to reconnect with Crabtree Creek knowing that a major urban amenity is accessible via greenway versus requiring a car.

Figure 24 - 15-minute walkshed



03

CONSIDERATIONS & NEXT STEPS

WHAT'S NEXT?

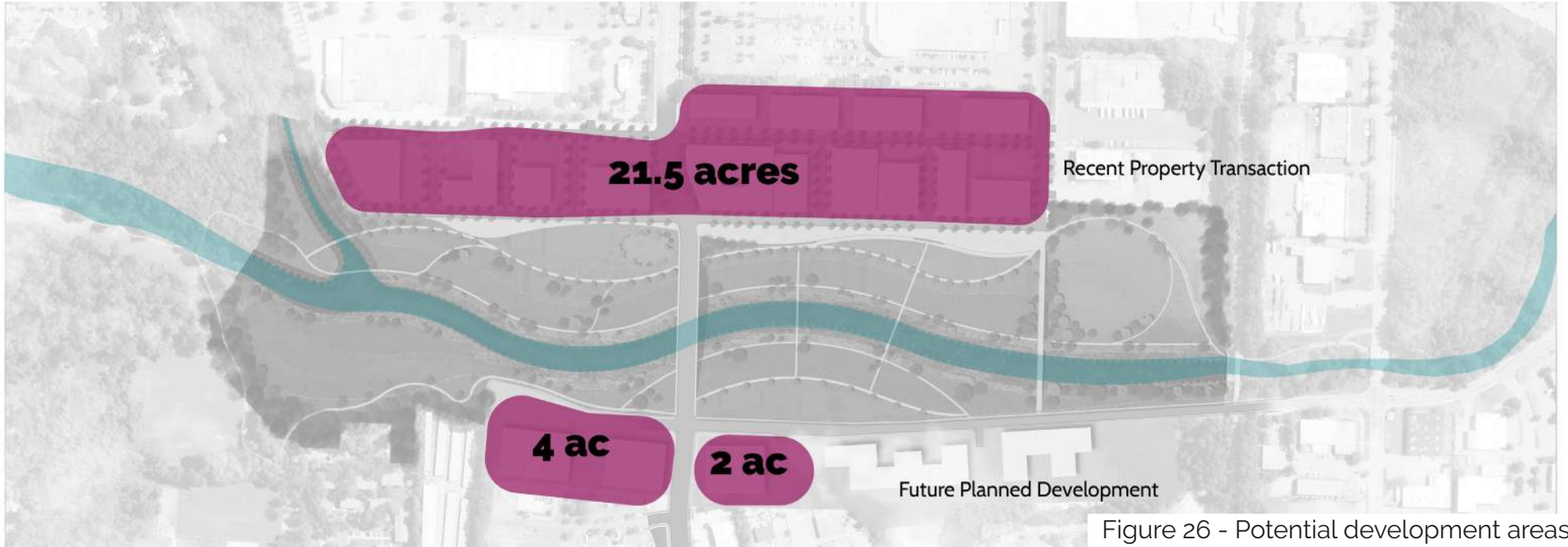
The final section outlines some conceptual precedents for building out the park including potential budget comparisons. There are many additional factors that should be studied in future project development but this report offers some potential stepping off points from which a future plan for this park may be informed.

DEVELOPMENT PRECEDENT

The City of Raleigh should conduct a site visit and tour of the Little Sugar Creek Greenway and stream restoration project in Charlotte, North Carolina, specifically the Metropolitan (https://metropolitanclt.com) which is located in the heart of Charlotte’s “midtown” area. The Metropolitan was jointly developed by Peter Pappas, Pappas Properties, and the City of Charlotte, and offers a good example of how the City of Raleigh might encourage future public-private real estate development along Crabtree Creek.



Figure 25 - Metropolitan Site Plan (Peter Pappas)



The conceptual plan presented in this report allows for nearly 22 acres for redevelopment opportunity to the north side of the park, with potentially 6 additional acres to the south. Comparatively, the Metropolitan development measure about 14 acres in size.



STRATEGY PRECEDENT

Another Charlotte area project involved a buy-out of repetitive flooded properties along Briar Creek. The buyout program was accomplished by the Charlotte-Mecklenburg Stormwater Services (CMSS). As of 2023, the program has acquired 700 households, resulting in the creation of 185 acres of greenway open space. CMSS partnered with the North Carolina Division of Emergency Management to obtain hazard mitigation funding to acquire the flood-prone housing. The Chantilly neighborhood in Charlotte has been completely transformed by this project. Two of the large housing complexes in this neighborhood, including Cavalier Apartments and Doral Apartments, sustained damage five times over two decades. The 24 acres of land resulting from the buyouts were transformed into the Chantilly Ecological Sanctuary. Overall, the ecological restoration project cost approximately \$4.9 million to build. The Charlotte-Mecklenburg Storm Water Fees contributed \$4.8 million and the 319 grants from the NC Department of Environment & Natural Resources contributed \$100,000. For more information visit: <https://developingresilience.uli.org/case/charlotte-mecklenburg-floodplain-buyout-program/>

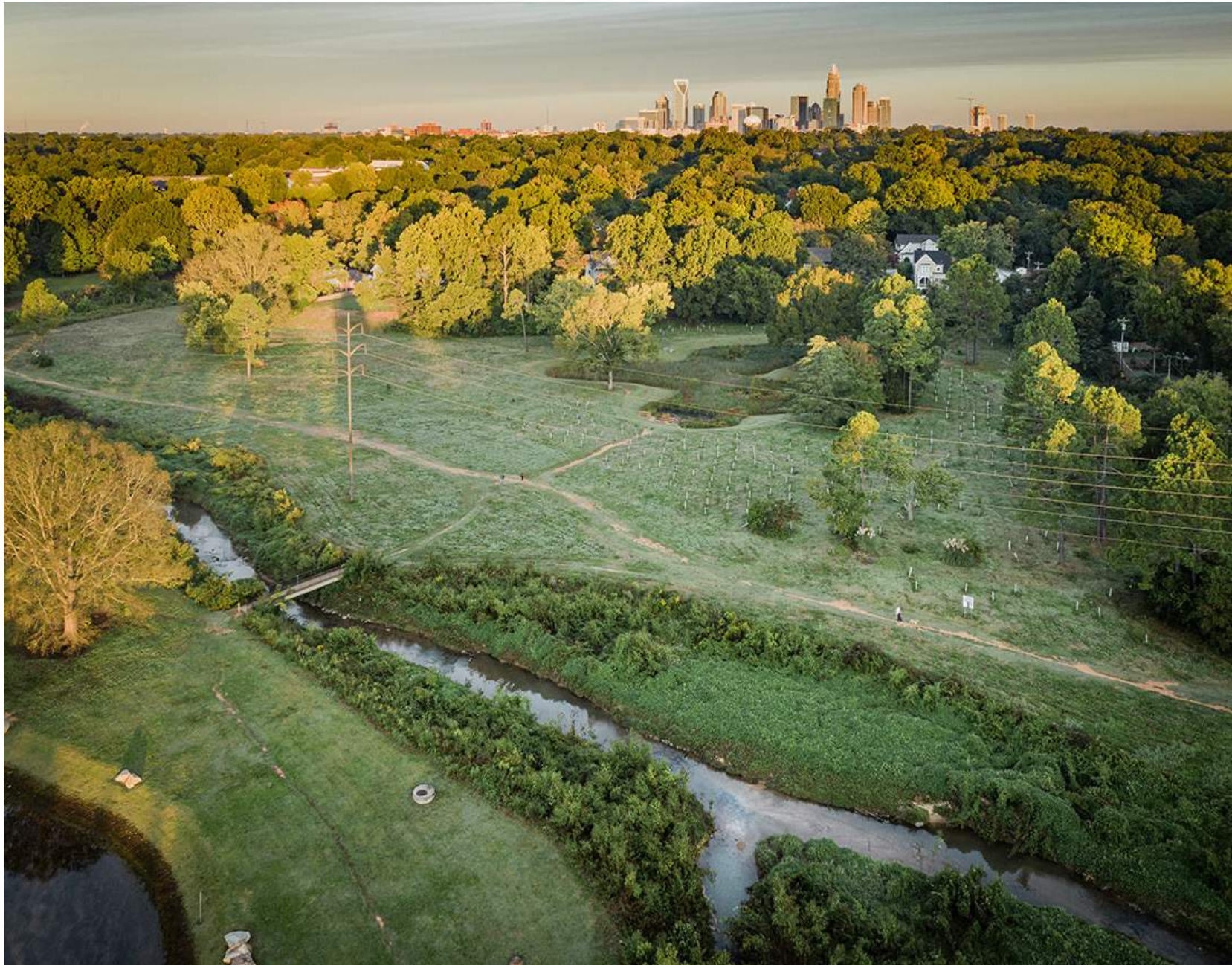



Figure 27 - Chantilly Ecological Sanctuary, (Wildlands Engineering)

POTENTIAL BUDGETS

This report offers potential budgets based on a comparison of similar project costs. These recommendations do not represent cost estimates in any capacity and are highly dependent on various factors to be studied in the future.

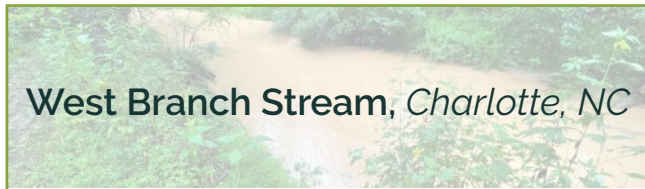
Stream Restoration

While the proposed reach of restoration for Crabtree Creek in this plan is shorter than the comparative projects, Crabtree Creek is a larger urban stream with higher streambanks and would likely have a higher cost per foot of restoration.




Rocky Branch, NCSU Campus

Completed:	2010
Type:	Urban
Length:	6,000 linear feet
Cost per linear foot (adjusted for 2023):	\$2,250/ft
Total project cost (adjusted for 2023):	\$13.5 million



West Branch Stream, Charlotte, NC

Completed:	2022 (phase 1)
Type:	Rural
Length:	8,976 linear feet
Cost per linear foot:	\$1,200/ft
Total project cost:	\$7.5 million



Crabtree Creek, Raleigh, NC

<i>Proposed</i>	
Type:	Urban
Expected stream realignment:	3,500 linear feet
Potential cost/ft:	\$2,250 - 2,500
Potential Recommended Budget:	\$8 - 10 million


Landscape Build-Out

Landscape built-out estimates are most likely on the low-end as it is relatively unknown how much remediation work to the landfill is expected. For Mill River Park, a combination of federal funds (\$3.6 million) and city funds (\$2.4 million) were used to build the park. Smoky Hollow is an ongoing urban project that includes stream restoration and landscape remediation and serves as a valuable comparison for a local project.



Mill River Park, Stamford, Ct

Completed:	2006
Size:	58 acres
Cost per acre: (adjusted for 2023):	\$172,000
Operating costs/year (adjusted for 2023):	\$10,000
Total project cost (adjusted for 2023):	\$10 million



Smoky Hollow, Raleigh, NC

Completed:	Ongoing
Size:	14 acres
Cost per acre:	\$1.4 million
Total project budget:	\$20 million



Midtown Waterfront Park
Raleigh, NC

Proposed

Proposed size:	55 acres
Potential cost per acre:	\$1 - 1.4 million
Potential Recommended Budget:	\$55 - 75 million

FUTURE CONSIDERATIONS

This report has primarily focused on how a conceptual plan may be built by focusing on restoring hydrologic function, and how associated development may occur based on comparable projects within the region. The success of this park as a recreational destination, catalyst for a new urban core, and world class stormwater management project depends on a holistic and interdisciplinary understanding of many additional considerations, including but certainly not limited to the following:

- Further hydraulic modeling and studies to further understand the potential for stormwater management and stream restoration, including a refined alignment of Crabtree Creek.
- Continued landfill studies to inform the scope of remediation efforts.
- Recognition of Raleigh as a Biophilic Cities partner (<https://www.biophiliccities.org/raleigh>) to motivate green development in association with this park
- Affordable housing needs and opportunities to promote a more socially equitable Raleigh

This report represents just one step in a soon-to-be significant legacy of planning and advocacy for a future icon of Raleigh symbolic of its dedication to advancing climate resiliency in the southeast region.



Figure 28 - Conceptual perspective rendering

NC STATE UNIVERSITY

About NC State University

NC State University began as a land-grant institution grounded in agriculture and engineering. Today, we're a leading public research university that excels across disciplines. NC State is a powerhouse in science, technology, engineering and math. We lead in agriculture, education, textiles, business and natural resources. We're at the forefront of teaching and research in design, the humanities and the social sciences. And we're home to one of the planet's best colleges of veterinary medicine. Our more than 36,000 undergraduate and graduate students learn by doing. They pursue research and start new companies. They forge connections with top employers and serve local and global communities. And they enjoy an outstanding return on investment.

The Initiative for Community Growth and Development

The NC State University Initiative for Community Growth and Development (ICGD) addresses issues, challenges and opportunities facing North Carolina communities related to real estate development, economic growth, infrastructure build-out, ecosystem conservation and other associated community development matters. The Initiative unites world-class scholarship, academic research, and community-based application contributing to a vibrant, prosperous, equitable, and inclusive quality of life in North Carolina. The Initiative strives to research and test various community growth and development strategies, particularly in areas that intersect with economic, social and environmental impact and benefit.

NC State University Faculty Advisor



Charles A. Flink II, FASLA, Director, Initiative for Community Growth and Development; Professor of the Practice in Landscape Architecture and Environmental Planning

The Faculty Advisor for this sponsored research project is Chuck Flink, FASLA, PLA. Mr. Flink is an award-winning author, landscape architect, and planner. He is the Director of the NC State University Initiative for Community Growth and Development. Flink is a Fellow in the American Society of Landscape Architects and has completed project work in more than 250 communities within 37 states. He has provided consulting services to international clients in Asia, Canada, Europe, and South America. Flink has been featured in National Geographic, Landscape Architecture China, American Planning and Business Journal. He is the author/co-author of three books: *The Greenway Imperative: Connecting Communities and Landscapes for a*

Sustainable Future (University Press of Florida), *Greenways A Guide to Planning, Design and Development* (Island Press) and *Trails for the Twenty-First Century* (Island Press). Flink received both his undergraduate (1982) and graduate (2017) degrees from NC State. He is a 2019 recipient of the Watauga Medal, the highest non-academic award bestowed by the University; the 2006 Distinguished Alumnus of the College; and one of the original 50 recipients of the Wings-on-Wings award from the College of Design. He currently serves as Professor of the Practice and Executive-in-Residence at the College. Flink is past Chair of the NC State University Board of Visitors (advisory to the Chancellor), Immediate Past President of the Alumni Association, and member of the College of Design Leaders Council. He is a member of the University Capital Campaign Committee, the Chancellor's Circle, a Lifetime Member of the Alumni Association, a Lifetime Member of the Friends of the NCSU Libraries, and a member of the Stanhope Pullen Society.

NC State University Student Researcher



Nick Musarra, AICP Candidate, MLA Candidate, Department of Landscape Architecture and Environmental Planning

The student researcher and lead author for this sponsored research is Nick Musarra, an MLA candidate in his final year in the College of Design, Department of Landscape Architecture and Environmental Planning. Mr. Musarra has a background in Urban and Regional Planning and is a member of the American Planning Association through which he has earned awards for his academic group and solo work including 2018 and 2019 NC-APA Marvin Collins awards for Outstanding Student projects, and the 2018 AICP Outstanding Planning Student Award. He has gained professional experience in transportation planning and landscape architecture with firms in Charlotte and Raleigh, and he is an active student leader through NC State's Student American Society of Landscape Architects. Following his 2023 graduation, Mr. Musarra plans to continue his passion for topics related to this research as a landscape designer with a firm located in Charlotte.