GOLDSBORO COMMUNITY FLOODPRINT

BIG DITCH + MUNICIPAL GOLF COURSE + WASTEWATER TREATMENT PLANT

www.coastaldynamicsdesignlab.com

CREDITS + THANKS

This report was completed by the NC State University Coastal Dynamics Design Lab (CDDL). Grant funding for this project was generously provided by the U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant-Mitigation program, which is administered at the state-level by the North Carolina Office of Recovery & Resiliency (NCORR). This document represents the second of five "Floodprint" reports to be completed as part of the grant agreement with NCORR and HUD.

We would also like to thank our project partners, technical advisors, and participating community members who guided the development and refinement of the information presented herein. You invited us into your community, donated your time, and offered invaluable expertise that helped to make this report locally relevant and broadly transferable. This document would not have been possible without your support.

NC State University College of Design Publication

PROJECT TEAM

01. NC STATE UNIVERSITY COASTAL DYNAMICS DESIGN LAB (CDDL): PROJECT LEAD

The mission of the CDDL is to lead trans-disciplinary research and design teams that address critical ecological and community development challenges facing vulnerable coastal regions and shoreline communities. The CDDL is a team of architects, landscape architects, and environmental planners who collaborate with communities that lack the local capacity and/or financial resources to secure long-term design and planning services. Increasingly, the work of the CDDL has focused on providing technical assistance to North Carolina communities that are grappling with the impacts of severe flood events.

ANALYSIS, PLANNING, DESIGN & PUBLIC ENGAGEMENT (BIG DITCH + MUNICIPAL GOLF COURSE + WWTP)

Andy Fox, PLA, FASLA: Professor, Department of Landscape Architecture and Environmental Planning + Co-Director, Coastal Dynamics Design Lab

As Co-Director of the CDDL and a licensed landscape architect, Andy specializes in the development and management of high-performing public landscapes, with expertise in natural infrastructure, resiliency planning, community design, and land/water conservation assessment.

Travis Klondike, PLA, ASLA: Associate Director, Coastal Dynamics Design Lab + Assistant Research Professor, Department of Landscape Architecture and Environmental Planning

Travis is both a licensed landscape architect and serves as the Associate Director of the CDDL. Much of his work focuses on hazard mitigation assistance and long-term resilience planning through using contemporary methods of geospatial analysis, community engagement, visual narration, and grant-writing as catalysts for public good.

Madalyn Baldwin, PLA, ASLA: Assistant Research Professor, Coastal Dynamics Design Lab + Department of Landscape Architecture and Environmental Planning

Madalyn specializes in the assessment of large-scale landscape systems, including geospatial analytics, planning for complex environmental networks, and ecological integration of native and threatened plant communities. Her current research interests include working lands, rural landscapes and economies, and high-performing landscapes.

Marybeth Campeau, Associate ASLA, SITES AP: Research Associate, Coastal Dynamics Design Lab

Marybeth has a background in design management, publication design, and communications. Her work is focused on social and ecological resilience, biodiversity conservation, and adaptive management.

Evan Holliday: Graduate Student Research Assistant, Coastal Dynamics Design Lab

02. PROJECT PARTNERS

In addition to CDDL staff, multiple project partners were specifically identified for their knowledge and expertise in topics relevant to the Goldsboro Community Floodprint, and were intimately involved in advancing the project's impact and applicability.

HYDRAULIC MODELING (BIG DITCH + MUNICIPAL GOLF COURSE)

Barbara Doll, PhD, PE: Extension Associate Professor, Department of Biological & Agricultural Engineering + Extension Specialist, NC Sea Grant

Dr. Doll is a licensed professional engineer with over 20 years of experience in ecological restoration. She teaches professional development workshops and academic courses in fluvial geomorphology and ecological restoration. As part of her dual appointment, Barbara has conducted design, permitting, bidding and construction oversight for numerous restoration projects throughout North Carolina.

Jack Kurki-Fox, PhD, PE: Research Associate, Department of Biological & Agricultural Engineering

Dr. Kukri-Fox is a licensed professional engineer who conducts monitoring, modeling and engineering analysis to support research and extension efforts related to water quality, flooding and water management. He supports training programs for professionals focused on stream morphology assessment, restoration and hydraulic modeling. He has conducted extensive modeling and analyses to identify flood mitigation options for communities in eastern NC, evaluate infrastructure improvements to increase resiliency, and test the flood mitigation potential of natural infrastructure.

COST ESTIMATING (BIG DITCH) **+ WASTEWATER TREATMENT PLANT** (WWTP) **CONSULTING**

Gresham Smith

Cost Estimating: Licensed landscape architects and engineers from Gresham Smith provided planning support services - specific to the Big Ditch focus area - through the: i) development of opinions of probable project cost; ii) financial and feasibility evaluations; iii) economic analysis of alternative solutions; and iv) consideration of operations and maintenance costs.

Wastewater Treatment Plant Consulting: Licensed engineers from Gresham Smith provided planning support services - specific to the Wastewater Treatment Plant (WWTP) focus area - through the identification of major scope elements required of a potential flood mitigation study, including the: i) development of a preliminary opinion of consultant fee ranges; ii) identification of major qualifications and criteria for selecting prospective consultants; and iii) integration of scope, fee, qualifications, and selection criteria into a draft Request for Qualifications (RFQ) solicitation.

03. TECHNICAL ADVISORY COMMITTEE (TAC)

Lastly, a group of local and state representatives provided content feedback, facilitated public engagement events, and supported project development at various intervals throughout the duration of this study.

CITY OF GOLDSBORO:

Obie Agbasi: Golf Director, Parks and Recreation
Felicia Brown: Director, Parks and Recreation
Bobby Croom: Director, Engineering (former)
Richard Hamilton: Deputy Director, Public Utilities
Jonathan Perry: Project Manager, Engineering
Matthew Livingston: Assistant City Manager
Tim Salmon: City Manager
Robert Sherman: Director, Public Utilities

HOUSING AUTHORITY OF THE CITY OF GOLDSBORO (HACG)

Matilda Bedford: Director of Asset Management
Jessica Goldman: Compliance / Property Manager II
Anthony Goodson, Jr.: Chief Executive Officer

EASTERN NORTH CAROLINA SENTINEL LANDSCAPE PARTNERSHIP

Christopher Baillie: Resilience / Climate Adaptation Coordinator

NORTH CAROLINA OFFICE OF RECOVERY & RESILIENCY (NCORR):

Maggie Battaglin: Director of Mitigation

EXECUTIVE SUMMARY

Purpose of the Project. The City of Goldsboro regularly experiences flooding from routine flood events. Aside from the historic levels of flooding experienced during Hurricanes Matthew (2016) and Florence (2018), more frequent and severe flooding has become an ongoing, cyclical issue in neighborhoods that border adjacent swamps, wetlands, and tributaries.

For many homes and businesses built in the floodplain, the increasing frequency and severity of precipitation events is being exacerbated by public infrastructure that is either undersized or outdated for present-day standards (and projected future conditions).

While the City and State have been partnering to serve Goldsboro residents through various public utility and hazard mitigation efforts (e.g., two (2) NCDEQ Asset and Inventory Assessment grants; NCORR's Strategic Buyout Zone program), there still remain broad portions of the City that remain vulnerable to future flood losses. **The Goldsboro Community Floodprint aims to bolster these efforts through planning and design recommendations that reduce flood risk, improve public safety, and enhance long-term environmental function within historically flood-prone areas.**

This study used an environmental and community planning approach referred to as "floodprinting," which specifically highlights the use of place-based approaches as a response to natural hazards and climate change. As part of the Goldsboro Community Floodprint, discrete project phases and scope items included: inventory and analysis, public outreach and engagement, hydraulic modeling, schematic planning and design, three-dimensional modeling, photorealistic rendering, benefit-cost analysis, and grant-writing.

Created over a 16-month project period, the resulting document is meant to both provide direction regarding feasible and sustainable practices within the identified focus areas, while also providing actionable collateral that can be used to attract external resources (e.g., competitive grants) towards these projects.

An abbreviated summary of the proposed projects included in the Goldsboro Community Floodprint include:

Big Ditch: Stream Restoration + Infrastructure Improvements. Large sections of Big Ditch have been straightened and armored, with many segments of the stream channel confined to either rectangular or trapezoidal concrete channels. A functioning floodplain no longer exists for most of the stream, which results in a wide range of social, environmental, and economic impacts that cascade through the community.

This project will: i) restore approximately 2,300 linear feet of stream; ii) upgrade three (3) culvert/bridge conditions; and iii) create a "floodplain park" within the Elmwood Terrace community that borders Big Ditch.

Hydraulic modeling of the proposed scope of work indicates that these improvements will reduce flood-related damages throughout the project area. Specifically, (14) single-family residential units, (63) multi-family residential units, and (3) public/private entities will benefit from reductions in projected flood heights, and, two (2) of the three (3) road crossings will be able to withstand flood conditions equivalent to modeled 100- and 500-year flood events.

Municipal Golf Course: Low Flow Wetlands. Prior to the construction of the Municipal Golf Course in 1941, the course and surrounding residential areas were used primarily for agricultural purposes - containing an intricate network of ditches and channels that served as a drainage system for croplands. In many cases, however, these important drainage systems have been heavily modified, filled in, or covered up, and now contribute to nuisance flooding observed throughout the golf course, along surrounding neighborhood streets, and within residential properties during smaller, more frequent storm events.

The proposed intervention calls for daylighting, widening, and vegetating two (2) previously buried drainage channels within the golf course property. The connected chain of linear wetlands, when combined with infrastructure improvements at inlet and outlet locations of the site, will: i) reduce nuisance flooding in the residential neighborhood north of the golf course; ii) improve drainage within the golf course; iii) enhance water quality prior to infiltrating the ground or discharging south of the golf course; and iv) enrich over 11.4 acres of newly established wildlife habitat at a property located within the Neuse River floodplain.

Wastewater Treatment Plant (WWTP): Project Scoping for a Flood Mitigation + Feasibility Study. The WWTP is a public infrastructure facility operated by the City of Goldsboro which treats raw waste from the City, its residents, and Seymour Johnson Air Force Base (SJAFB). However, the WWTP's location within the Neuse River floodplain presents vulnerable conditions during hurricanes and other large-scale flooding events, as the elements needed to ensure the ongoing operation of wastewater treatment systems become susceptible to damages, and potentially, system failure. An incidental wastewater discharge to surface waters would result in a significant environmental hazard affecting people, the environment, and military operations.

The need for a flood mitigation and feasibility study has been determined as an appropriate next step to better understand potential mitigation alternatives and their associated trade-offs. As part of this report, major scope elements required of a potential flood mitigation study for the WWTP have been identified, including the: i) development of a preliminary opinion of consultant fee ranges; ii) identification of major qualifications and criteria for selecting prospective consultants; and iii) integration of scope, fee, qualifications, and selection criteria into a draft Request for Qualifications (RFQ) solicitation.

A summary of the final report is scheduled to be presented to Goldsboro's City Council on November 6, 2023, where a vote to support the recommendations within the Goldsboro Community Floodprint will be held at the conclusion of the presentation.

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01 | BACKGROUND + APPROACH

This study used an environmental and community planning approach referred to as "floodprinting," which specifically highlights the use of place-based approaches as a response to natural hazards and climate change.

As part of the Goldsboro Community Floodprint, discrete project phases and scope items included: inventory and analysis, public outreach and engagement, hydraulic modeling, schematic planning and design, three-dimensional modeling, photorealistic rendering, benefit-cost analysis, and grant-writing. Created over a 16-month project period, the resulting document is meant to both provide direction regarding feasible and sustainable practices within the identified focus areas, while also providing actionable collateral that can be used to attract external resources (e.g., competitive grants) towards these projects.

AT THE CONFLUENCE OF THE NEUSE AND LITTLE RIVERS

The City of Goldsboro regularly experiences flooding from routine flood events. Aside from the historic levels of flooding experienced during Hurricanes Matthew (2016) and Florence (2018), more frequent and severe flooding has become an ongoing, cyclical issue in neighborhoods that border adjacent swamps, wetlands, and tributaries.

LOCAL IMPACTS OF FLOODING

Located approximately 50 miles southeast of Raleigh, the City of Goldsboro sits at the confluence of the Neuse and Little Rivers in Wayne County.

The city (population: 33,657) and county (211.8 people / square mile) are host to long-held agricultural and military roots, including a significant presence in the poultry and hog industries, as well as in the U.S. Air Force (Seymour Johnson Air Force Base (SJAFB), located in southeast Goldsboro along the Neuse River, was established five months after the U.S entered WWII in 1942 and was annexed by the City of Goldsboro in 1977).

The City of Goldsboro, SJAFB, and surrounding county lands regularly experience flooding from routine flood events. Aside from the historic levels of flooding experienced during Hurricanes Matthew (2016) and Florence (2018), more frequent and severe flooding has become an ongoing, cyclical issue in neighborhoods that border adjacent swamps, wetlands, and tributaries.

Image: Goldsboro Community Floodprint existing context collage.

THE SEVERITY AND FREQUENCY OF FLOODS ARE INCREASING

The Goldsboro Community Floodprint aims to bolster on-going efforts led by City and State leadership through planning and design recommendations that reduce flood risk, improve public safety, and enhance long-term environmental function within historically flood-prone areas.

UNMET NEEDS

For many homes and businesses built in the floodplain, the increasing frequency and severity of precipitation events is being exacerbated by public infrastructure that is either undersized or outdated for present-day standards (and projected future conditions).

While the City and State have been partnering to serve Goldsboro residents through various public utility and hazard mitigation efforts (e.g., two (2) NCDEQ Asset and Inventory Assessment grants; NCORR's Strategic Buyout Zone program), there still remain broad portions of the City that remain vulnerable to future flood losses. The Goldsboro Community Floodprint aims to bolster these efforts through planning and design recommendations that reduce flood risk, improve public safety, and enhance long-term environmental function within historically flood-prone areas.

Photo: Debris removal and clean-up of Big Ditch in Elmwood Terrace (Doll, B., 2020).

2016
+ DR-4285-NC: HURRICANE MATTHEW

2016

2018
+ DR-4364-NC: TORNADO & SEVERE STORMS
+ DR-4393-NC: HURRICANE FLORENCE
+ DR-4412-NC: TROPICAL STORM MICHAEL

2019
+ DR-4465-NC: HURRICANE DORIAN

2020
+ DR-4543-NC: SEVERE STORMS & FLOODING
+ DR-4568-NC: HURRICANE ISAIAS

2021
+ DR-4588-NC: TROPICAL STORM ETA
+ DR-4617-NC: TROPICAL STORM FRED

MOST IMPACTED AND DISTRESSED (MID) CRITERIA

REQUIREMENTS TO QUALIFY FOR 'MID' DESIGNATION

GEOGRAPHIC EXTENT
REQUIRED

SUB-COUNTY AREA
within a county declared by the President to be a major disaster area under the Stafford Act for a disaster event occurring in 2011, 2012, or 2013.

This sub-county area can be a census designated place **or** a tribal area **or** a census tract

+

DEMONSTRATING "MOST IMPACTED"
AT LEAST ONE:

HOUSING
Damage to **either** a minimum of 100 homes **or** serious damage to a minimum of 20 homes

INFRASTRUCTURE
Damage to permanent infrastructure estimated at $2 million or greater

ECONOMIC REVITALIZATION
Significant employment loss and extended harm to the local economy

ENVIRONMENTAL DEGRADATION
Threatening long-term recovery of critical natural resources

+

DEMONSTRATING "MOST DISTRESSED"
AT LEAST ONE:

LOW- AND MODERATE-INCOME HOUSEHOLDS
> 50% of the people at < 80% of median income

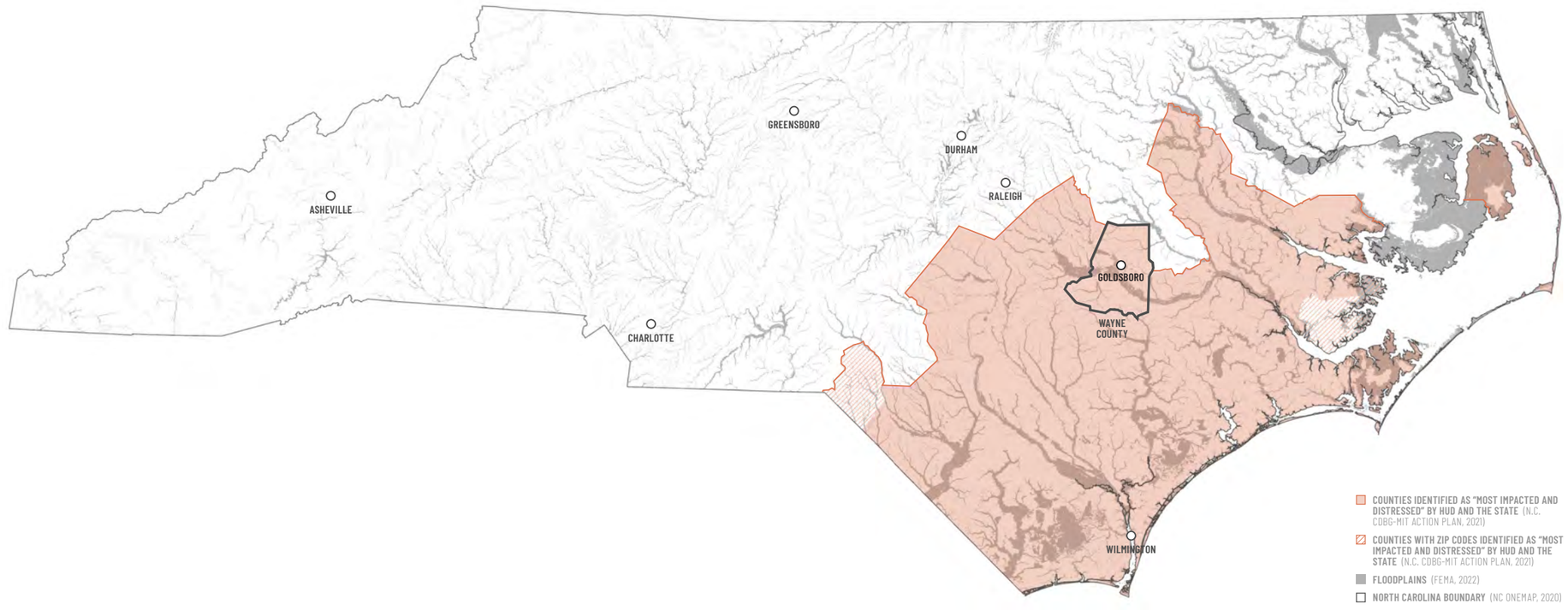
LOSS OF AFFORDABLE RENTAL HOUSING
A minimum of 100 renters with income < 50% of median **and** 60% or more of these have a severe housing problem

FEDERAL TARGET AREA OR ECONOMICALLY FRAGILE AREA
Tribal area **and/or** contains a Promise Zone **and/or** is in a Strong Cities Strong Communities site, **and/or** unemployment rate more than 125% of the national avg. unemployment rate

PRIOR DOCUMENTED ENVIRONMENTAL DISTRESS
Contains a ontaminated property cleaned **or** under-going cleanup **or** proposed for cleanup

OR

A COUNTY that was previously determined by HUD to be most impacted



"MOST IMPACTED AND DISTRESSED" COMMUNITIES

As part of the state-level response to Hurricanes Matthew and Florence, the North Carolina Office of Recovery and Resiliency (NCORR) has been consistently engaged with elected officials, residents, and stakeholders of Goldsboro. Through allocations of funding provided by the U.S. Department of Housing and Urban Development (HUD) Community Development Block Grant Mitigation program (CDBG-MIT), NCORR has been able to offer a variety of services to counties designated as "most impacted and distressed" (MID) from the two storms. These services range in scope, but most pertinent to the Goldsboro Floodprint effort are:

+ A Strategic Buyout Program; and
+ Planning and Technical Assistance

A newly established agreement between NCORR and the NC State University Coastal Dynamics Design Lab (CDDL) is allowing for the creation of five (5) new "Floodprint" reports, in five communities, over a three year time span as part of the planning and technical assistance scope of work being administered by NCORR.

Partner communities must satisfy certain criteria in order to be eligible for this focused planning assistance, including:

+ The community resides within a MID county, as identified by HUD (first priority), or by NCORR (second priority);

+ Interest/willingness to participate by community leadership;

+ Population distribution, with priority given to communities fitting the FEMA definition of "economically disadvantaged and rural" and/or "small and impoverished;"

+ Quantity and spatial distribution (higher concentrations preferable) of flood-vulnerable properties; and

+ Availability of existing HEC-RAS models and hydraulic data.

WHAT IS A "FLOODPRINT?"

A FRAMEWORK FOR BUILDING RESILIENCE

FOUR KEY STRATEGIES

"Floodprint" is a term coined by the NC State University Coastal Dynamics Design Lab (CDDL) to describe a specific form of analysis and land planning that focuses on the recovery and resilience-building needs of flood-prone communities. Based on a body of work initiated post-Hurricane Matthew in 2016, Floodprint processes and resultant outcomes are strategically organized to bridge gaps and leverage opportunities related to project: **scoping, scaling, communicating, and implementing** that often pose significant challenges to communities attempting to recover from or prepare for natural hazards.

SCOPING

Scope with the Scorecard. Many small, rural communities face financial challenges that make the implementation of resilience-building projects cost prohibitive. In these cases, externally funded grant programs offer a critical lifeline to support projects that may not otherwise receive enough local funding. In recognizing this reliance on grants, a project team and associated scopes of work have been assembled to best align community needs with the required deliverables and scoring metrics of relevant grant programs. Overall, this strategy aims to help communities better position themselves to secure grant funding for implementing projects of scale.

SCALING

Nest Small Projects within Bigger Plans. Lengthy time horizons associated with implementing projects are commonplace in disaster recovery and/or preparedness situations. Therefore, it is critical to address both the timing of project phasing and the ways various physical scales of projects – small to large – are unified under a single vision, mission, and purpose. Nesting smaller projects within broader plans offers opportunities for more financially nimble, "shovel-ready" projects to quickly move forward while projects requiring longer development, review, and award timelines can simultaneously process in the background.

COMMUNICATING

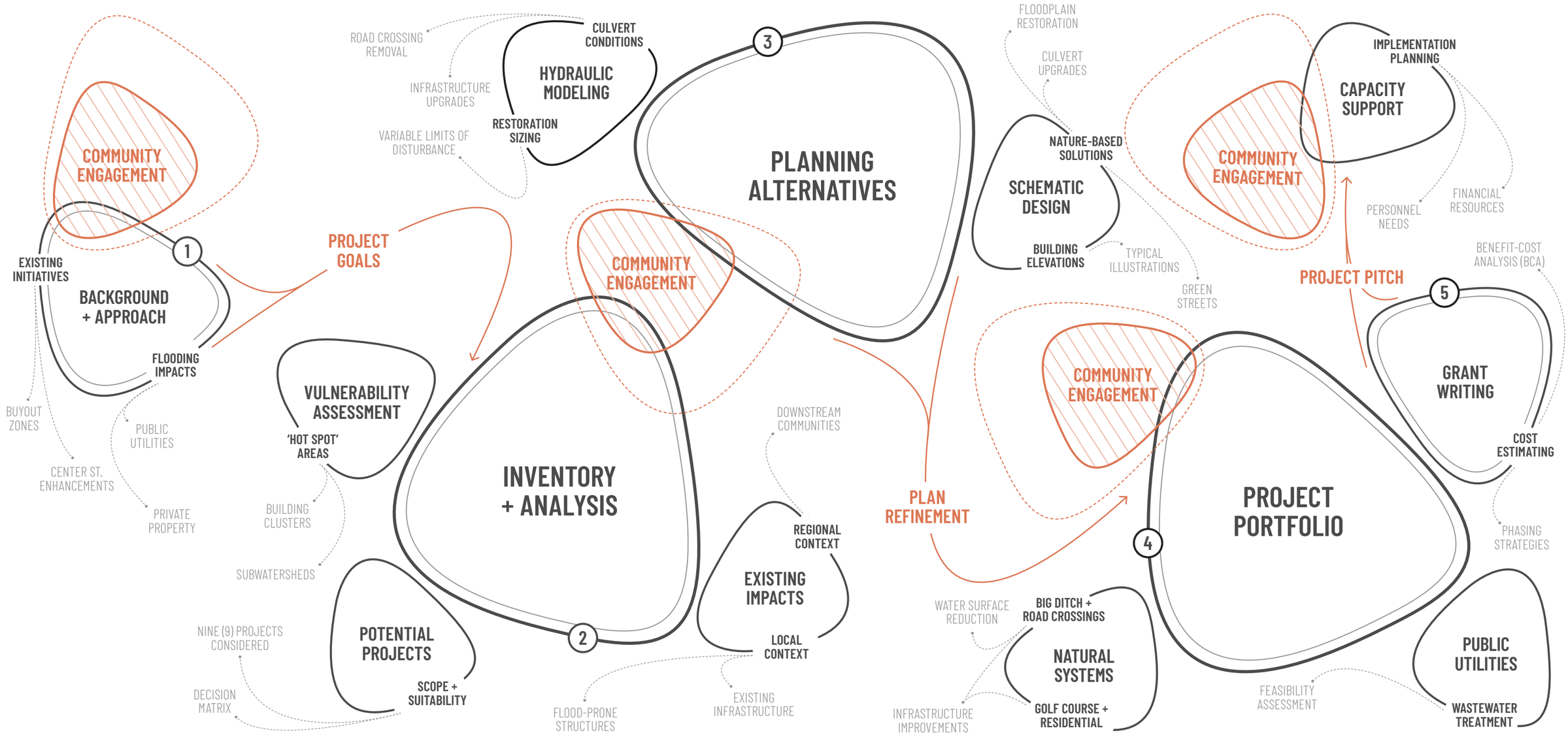
Create Collateral. It is typically the responsibility of local governments to assemble the required materials for grant applications. While larger municipalities are more likely to have either the internal personnel or available financial resources to hire consultants for this purpose, smaller units of governments are less likely to have access to these critical resources. In an effort to equalize the competitiveness of communities like Goldsboro, the final documentation package of a Floodprint report is intentionally curated to serve as collateral for local government staff to submit to specific grant programs.

IMPLEMENTING

Close Capacity Gaps. If any combination of proposed Floodprint projects are to receive funding for implementation, specific capacity limitations must be well understood in order to ensure projects are successfully constructed and sustained. A local government's ability to: manage and administer concurrent grant agreements, coordinate with technical expertise before and during construction, and to maintain new infrastructure post-construction is highly variable community to community. Acknowledging each community's capacity ceilings during the creation of a Floodprint report allows for the advanced planning of project types, scopes of work, implementation teams, and maintenance plans that address specific gaps in local capacity.

As part of the CDDL grant agreement with the North Carolina Office of Recovery and Resiliency (NCORR), these strategies are being assembled in a Floodprint report specific to Goldsboro, at no direct cost to the City or its residents.

Photo. Princeville (NC) workshop (CDDL, 2017).



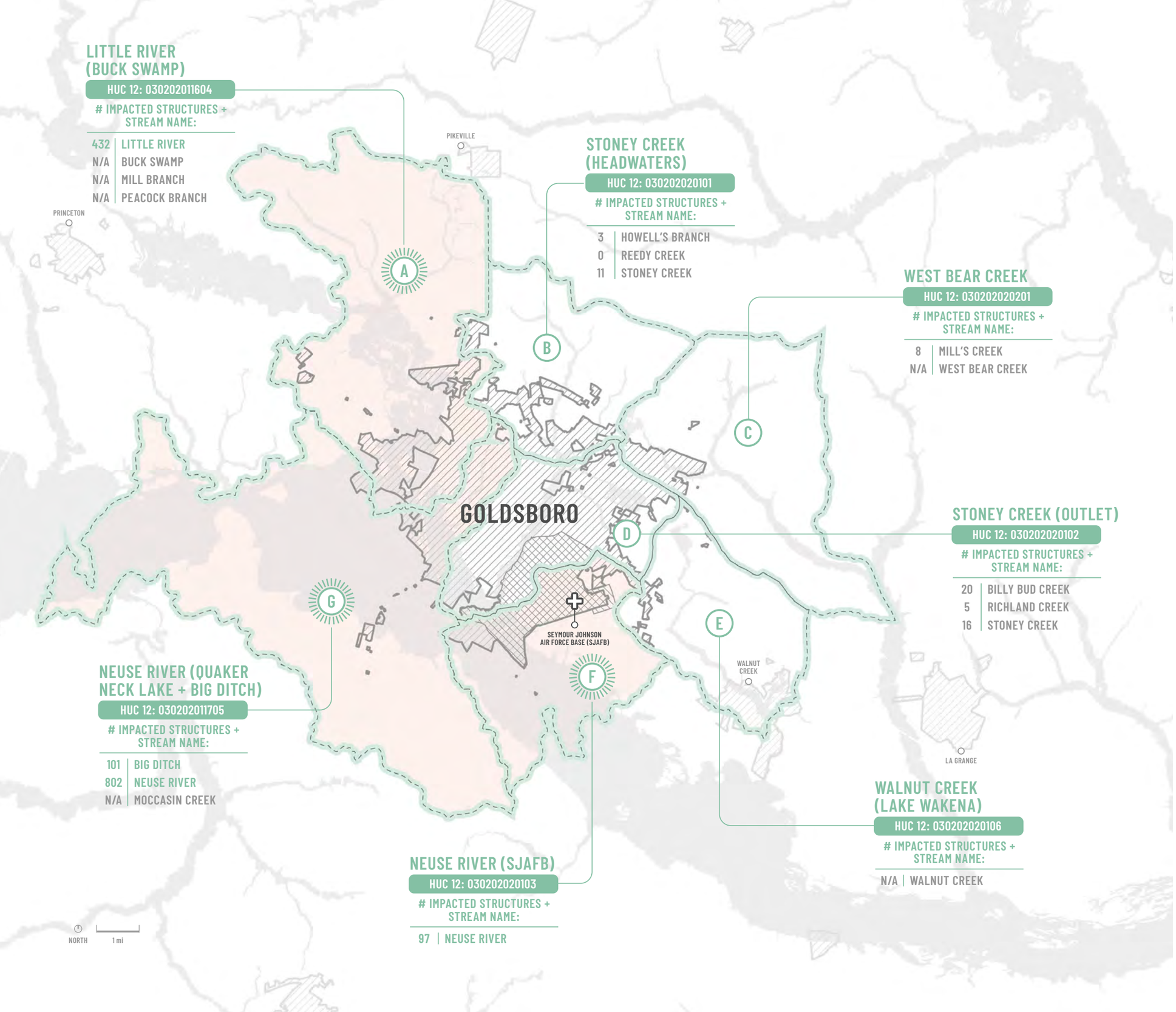
PROJECT APPROACH + REPORT CONTENTS

While the goals of a Floodprint study are uniquely defined by each community, the Floodprint process has important methodological consistencies across communities that include: i) inventory and analysis; ii) community outreach and engagement; iii) hydraulic modeling; iv) schematic planning and design; v) three-dimensional modeling / photorealistic rendering; vi) benefit-cost analysis; and vii) grant-writing. As in each precedent Floodprint report, the Goldsboro Community Floodprint process was guided by communicated project goals from local leadership and attention to focus areas that emerged during the early phases of due diligence. Once these parameters were established, the aforementioned scope of work was used to develop the portfolio of projects and overall recommendations included in the Goldsboro Community Floodprint. While deviations from the proposed Floodprint projects are expected to occur as local conditions and priorities shift, it is the aspiration of each Floodprint report to serve as a guiding framework for recovery and rebuilding across a range of scales (e.g., county, city/town, neighborhood, individual), and timeframes (e.g., immediate versus long-term).

02 | INVENTORY + ANALYSIS

Various modes of data collection, analysis, and public engagement were all used throughout the Goldsboro Community Floodprint project timeline in order to more holistically understand the existing conditions, context, and characteristics of the city, its people, and the environment. Items assessed include topics such as: the flood vulnerability of buildings and infrastructure, community demographics, and municipal capacity.

Findings from these initial assessments were confirmed and more acutely framed after the first public engagement session with local stakeholders and project partners. This feedback alongside subsequent follow-up actions established the basis for prioritizing neighborhoods and project types in need of additional analysis, modeling, and planning recommendations.



VULNERABILITY ASSESSMENT

Seven (7) subwatersheds (HUC-12's) divide Goldsboro's footprint into unique hydrological units. Preliminary analysis compared the FFE's (finished floor elevations) of each structure in these subwatersheds against the projected WSE (water surface elevation) of a 500-year flood event. These results identified three (3) subwatersheds (A, G, and F; shaded in orange) as being the most vulnerable to damages due to a high quantity of impacted structures. Subsequent analysis assessed the potential for suitable project typologies within these highlighted areas.

POTENTIAL PROJECT AREAS

Nine (9) potential projects were identified within portions of the mapped floodplain that are inside both: a) Goldsboro city limits; and b) Subwatersheds 'A,' 'G,' and 'F' from the previous vulnerability assessment. These potential projects include (from north to south):

+ Feasibility Study of the Municipal Water Treatment Plant;

+ Land Use / Management of the former Cherry Hospital Site;

+ Land Use / Management of the existing 'buyout zone' in the West Haven Neighborhood;

+ Stream Restoration and Infrastructure Improvements along Big Ditch;

+ Feasibility Study of the Municipal Waste Transfer Station;

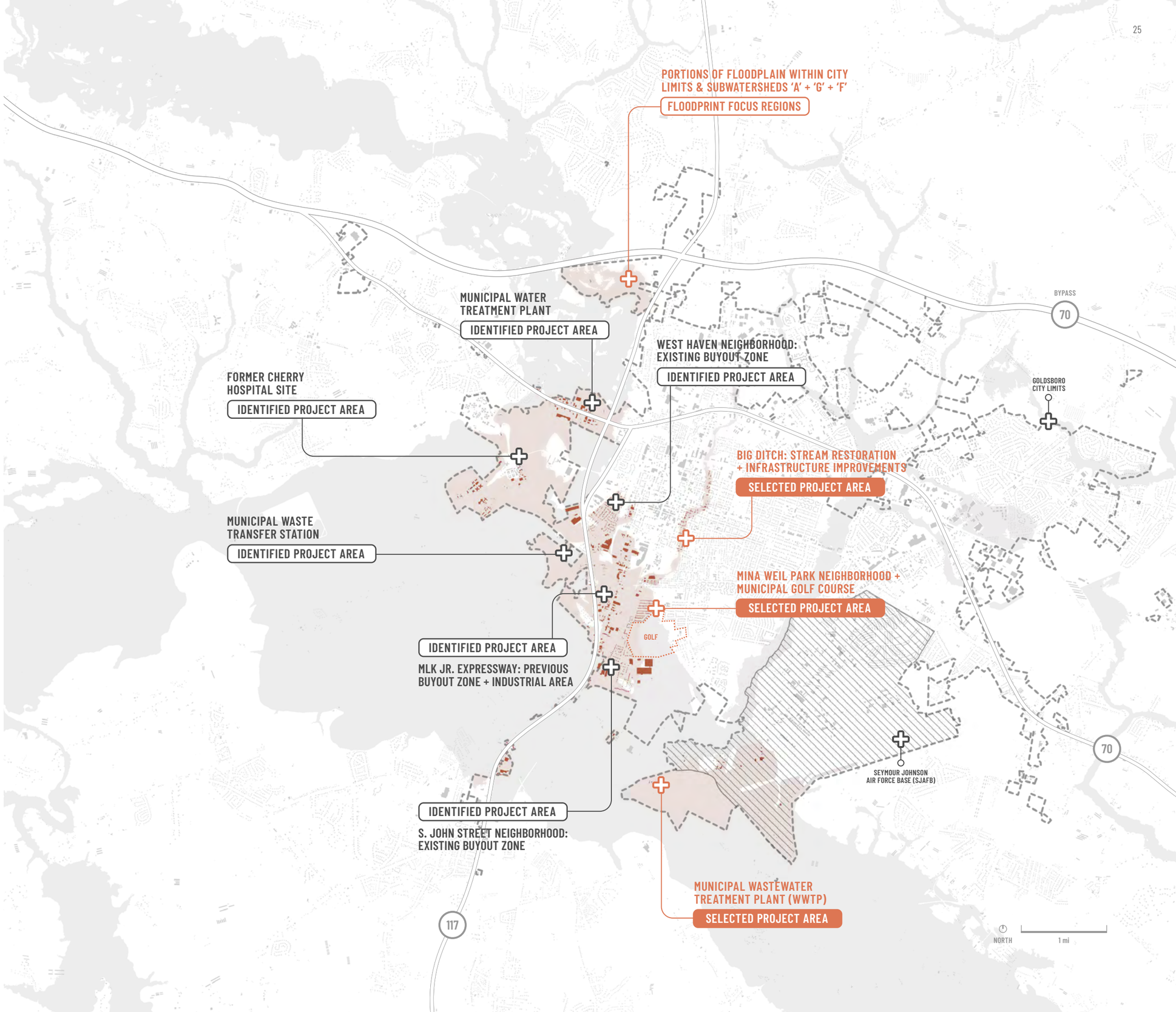
+ Land Use / Management of previously completed 'buyouts' in the MLK Jr. Expressway area;

+ Elevations and Nature-Based Solutions in the Mina Weil Park area and the Municipal Golf Course;

+ Land Use / Management of the existing 'buyout zone' in the South John Street area; and

+ Feasibility Study of the Municipal Wastewater Treatment Plant (WWTP).

All potential projects were recommended for consideration by either members of the project team (CDDL) or by Goldsboro city staff, and were each assessed through a combination of: geospatial analysis, site visits, collected field data, review of precedent studies / reports, and for potential compatibility with the scoring metrics of state- and federal-level grant programs (e.g., NC Environmental Enhancement Grant (EEG); FEMA Building Resilient Infrastructure and Communities (BRIC), etc).



	POTENTIAL PROJECTS	COMMUNITY LIFELINES	RISK REDUCTION	POPULATION IMPACTED	NATURE-BASED	LEVERAGE PARTNERS
PUBLIC UTILITIES	WASTE TRANSFER STATION	✓	✓	✓		
	WATER TREATMENT PLANT	✓	✓	✓		✓
	WASTEWATER TREATMENT PLANT	✓	✓	✓	✓	✓
LAND MANAGEMENT	MLK JR. AREA: PREVIOUS BUYOUTS			✓	✓	
	WEST HAVEN: EXISTING BUYOUTS			✓	✓	✓
	S. JOHN STREET: EXISTING BUYOUTS			✓	✓	✓
	FORMER CHERRY HOSPITAL SITE			✓	✓	✓
NATURAL SYSTEMS	BIG DITCH: STREAM RESTORATION	✓	✓	✓	✓	✓
	MINA WEIL AREA + GOLF COURSE	✓	✓	✓	✓	✓

POTENTIAL PROJECT AREAS: DECISION MATRIX

The identified projects for potential inclusion in the Goldsboro Community Floodprint generally fit within three (3) categories: Public Utilities, Land Management, and Natural Systems. In understanding the reliance on external grant programs to fund all or part of each of the potential projects, each were assessed for their compatibility to score favorably within the review criteria of the FEMA BRIC (Building Resilient Infrastructure and Communities) grant program that directly concern project scoping. These sections include five (5) of the fourteen (14) total review criteria for FEMA BRIC, and include:

+ Community Lifelines. These represent "the most fundamental services in a community that, when stabilized, enable all other aspects of society to function (FEMA, 2023)." These are typically assets that support the day-to-day, recurring needs of a community.

+ Risk Reduction. Many grant programs, including FEMA BRIC, require for the amount of risk aversion (e.g., flood damage reduction) to be quantifiable and translated into dollar equivalents for "benefits" and "costs." Determining the potential cost-effectiveness of a project during this preliminary scoping phase relied on each project having both: a reasonable likelihood of yielding monetary reductions in expected damages, and data available to support required analyses.

+ Population Impacted. There is growing momentum for state- and federal-level investments to support various definitions of "underserved communities," In the case of FEMA BRIC, the CDC SVI (Social Vulnerability Index) is used in order to determine if the population impacted by a project is "underserved" (census tract containing a SVI rating of at least 0.6 on a 0-to-1 scale), and thereby eligible to receive more points during review.

+ Nature-Based Solutions. Recognizing the many ancillary benefits of natural infrastructure (e.g., improved water quality, ecological habitat, etc.), additional points are allotted if projects have the potential to incorporate nature-based solutions in the scope of work.

+ Leverage Partners. Project locations or features that contain clear partnership potential outside of City departments have been prioritized, and will subsequently score higher during review if these external partnerships are formalized prior to grant application.

After review of each potential project through the five (5) review criteria, one (1) Public Utilities project (Wastewater Treatment Plant), and two (2) Natural Systems projects (Big Ditch and the Mina Weil Park Neighborhood + Golf Course), satisfied all of the decision matrix conditions and were selected as Floodprint projects.

"After review of each potential project through the five [FEMA BRIC] review criteria, one Public Utilities project (Wastewater Treatment Plant), and two Natural Systems projects (Big Ditch and the Mina Weil Park Neighborhood + Golf Course), satisfied all of the decision matrix conditions and were selected as Floodprint projects."

FOCUS AREA #1: BIG DITCH

Big Ditch is a stream that runs through the center of Goldsboro, draining a 3.1-square mile area. The watershed that drains into Big Ditch is 93% developed and 35% of the area is impervious (Doll and Kurki-Fox, 2020). Large sections of Big Ditch have been straightened and armored, with many sections of the stream channel confined to either rectangular or trapezoidal concrete channels (see photo, below). A functioning floodplain no longer exists, aside from a small section between South John Street and Elm Street (adjoining Willow Dale Cemetery) where previous restoration activities have been completed over the past couple of decades. Within the reach of Big Ditch included in this study's extents, there are twelve (12) road or railroad crossings along the stream between South John Street and the railroad tracks that parallel Royall Avenue. Local officials have reported severe flooding along the stream; which is evidenced through resultant property damages and road closures that are becoming more commonplace during even more frequent, and less severe rainfall events. In addition to the heavily modified nature of the stream channel contributing to increased flood vulnerabilities, there are a number of contextual conditions that must be considered alongside any potential stream restoration and/or infrastructure improvements along Big Ditch:

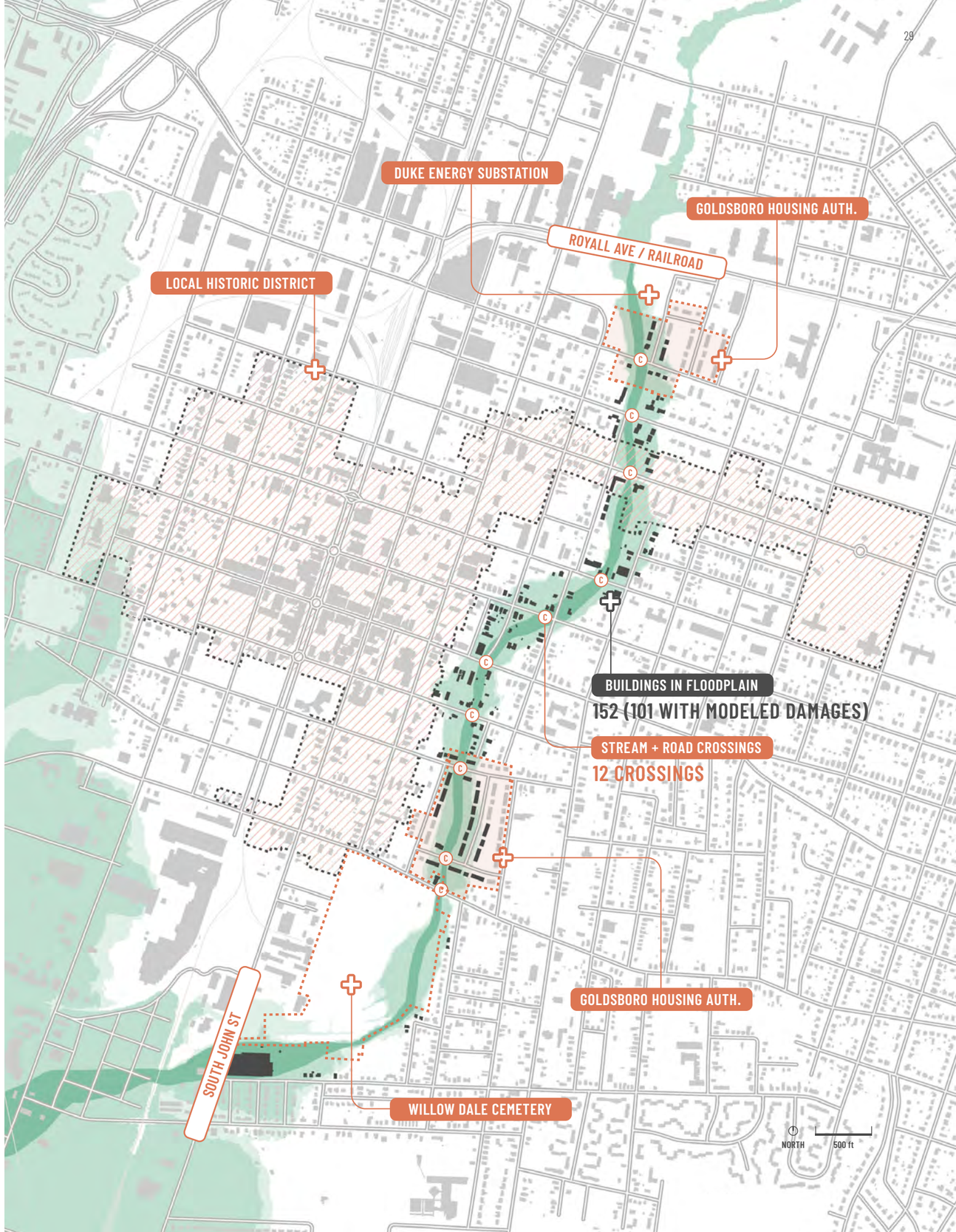
+ The Goldsboro Housing Authority actively manages two (2) multi-family housing neighborhoods that adjoin Big Ditch: Elmwood Terrace (south) and Woodcrest Terrace (north);

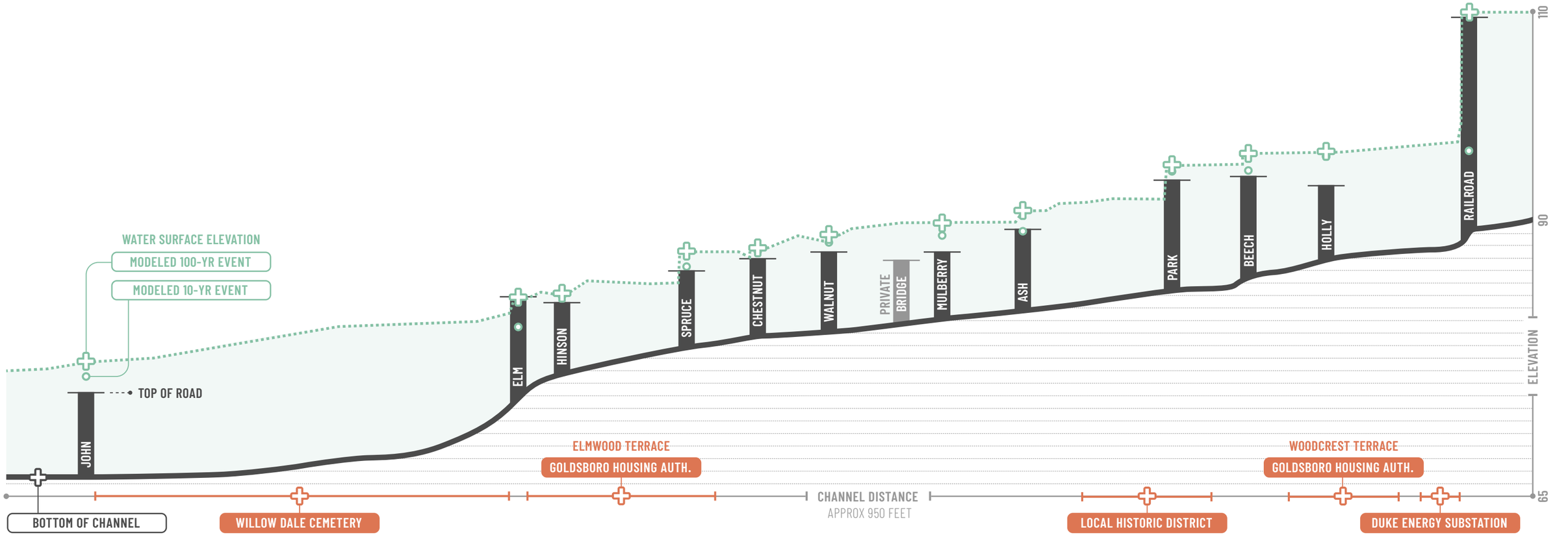
+ There is a federally-recognized Local Historic District that includes Goldsboro's downtown core (west of Big Ditch) and along Park Avenue, which intersects the stream channel;

+ There is a Duke Energy Substation that, due to its location in the floodplain, is susceptible to flood damages; and

+ 152 buildings intersect Big Ditch's 500-year floodplain (FEMA, 2022), and of these, over two-thirds (101 buildings) are expected to be damaged during a modeled 500-year event based on a comparison of FFE and the 500-year WSE.

> "Large sections of Big Ditch have been straightened and armored, with many sections of the stream channel confined to either rectangular or trapezoidal concrete channels. A functioning floodplain no longer exists, aside from a small section between South John Street and Elm Street where previous restoration activities have been completed."





(2) 7'x8' CONC BOX

JOHN STREET

18' BRIDGE SPAN

ELM STREET

(2) 6'x5' CONC BOX

HINSON STREET

(2) 7'x5$^{1/2}$ CONC BOX

SPRUCE STREET

14'x5$^{1/2}$ CONC BOX

CHESTNUT STREET

14'x6' CONC BOX

WALNUT STREET

12'x5' CONC BOX

MULBERRY STREET

(3) 7'x5' CONC BOX

ASH STREET

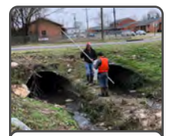
10'x5' CONC BOX

PARK AVENUE

(2) 6' CMP

BEECH STREET

(2) 6' ARCH CMP



HOLLY STREET

5'x8' CONC BOX

RAILROAD

FOCUS AREA #1: BIG DITCH

Along Big Ditch between South John Street and Royall Avenue, all twelve (12) of the road / railroad crossings are susceptible to overtopping to due elevated floodwaters. The above cross section diagram compares the Top of Road elevation as each road / stream intersection against the water surface elevation (WSE) of modeled 10-year (teal dots) and 100-year (teal crosses and dashed line) flood events.

These results show that during a 100-year flood event, all twelve (12) of the roads / railroads would ovetop due to floodwaters, and that even during a 10-year flood event, nine (9) of the roads would overtop with floodwaters (all crossings except for Elm, Ash, and the Railroad parallel to Royall Avenue).

Impervious streambank conditions (e.g., concrete walls) and undersized culvert conditions (see provided photos of each condition, for reference) are two of the primary contributors to these vulnerabilities, as they: i) do not allow for the appropriate absorption of floodwaters into historically floodplain lands; and ii) do not allow for enough volume of water to pass through the designed openings underneath the roadbed.

The resulting effect of the systemic under-performance of roadway infrastructure along Big Ditch poses a threat to human health and public safety during extreme weather events, but also has significant monetary impacts on local municipal budgets and staff. Increased operating costs on governmental services to monitor, staff, and equip road closures -- which in this base, is accountable for approximately 30,800 daily vehicular trips (South John Street: 3,900 daily trips; Elm Street: 5,400 daily trips; Ash Street: 12,500 daily trips; Beech Street: 1,200 daily trips; and Royall Avenue: 7,800 daily trips; NCDOT, 2019).

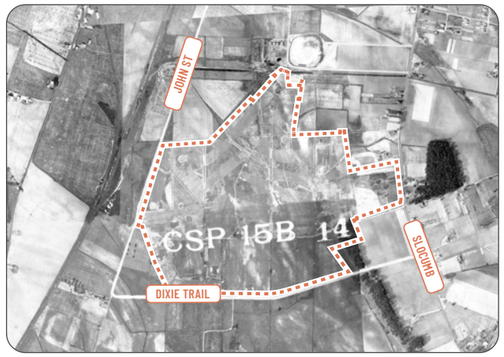
FOCUS AREA #2: MINA WEIL PARK NEIGHBORHOOD + GOLF COURSE

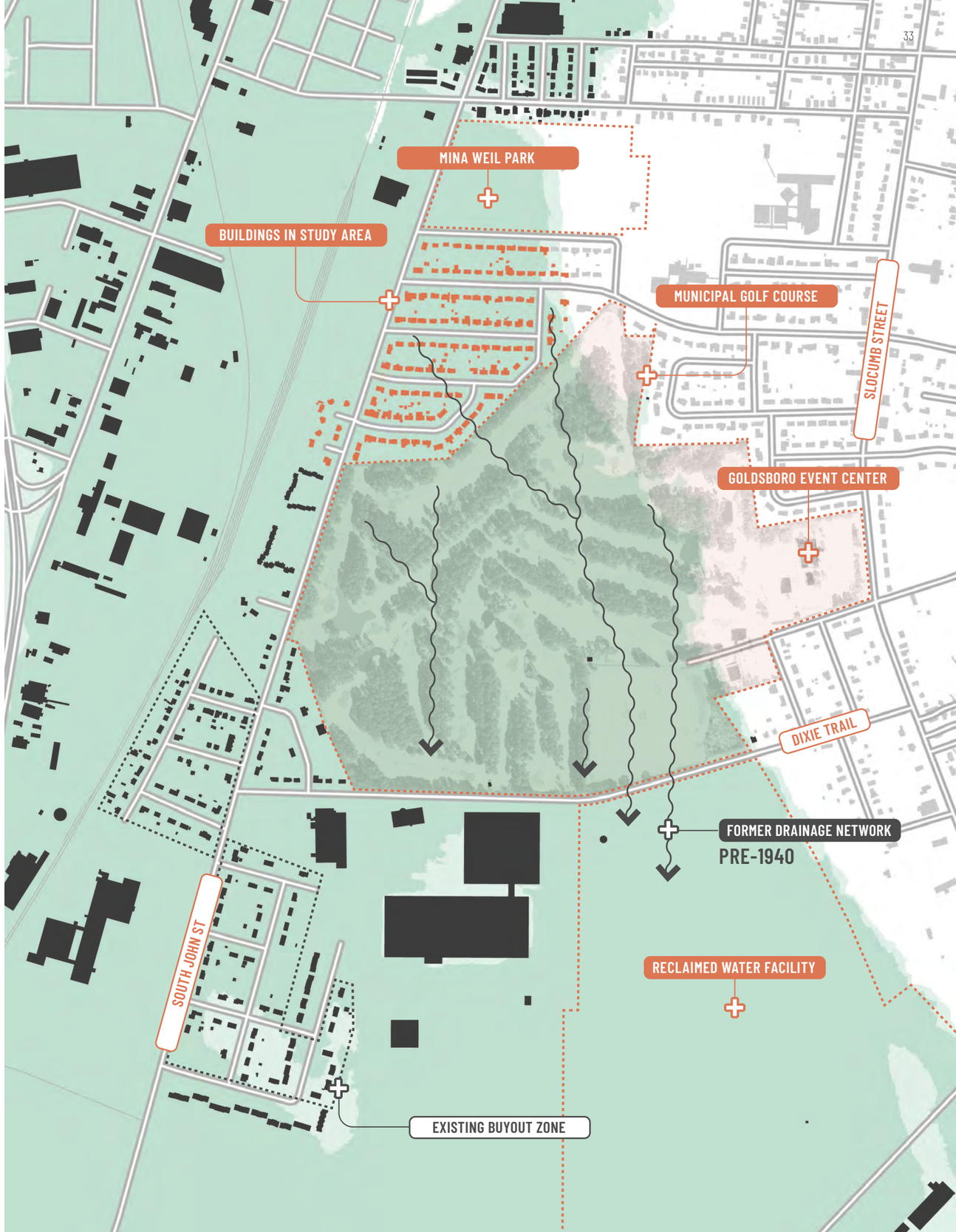
The Goldsboro Municipal Golf Course encompasses an approximately 126-acre area, and is owned and operated by the City of Goldsboro Parks & Recreation Department. Prior to construction in 1941, the course (and surrounding residential neighborhood area) was primarily used for agricultural purposes -- containing an intricate network of ditches and channels in order to provide adequate drainage to the croplands. These drainage networks can be seen in historic aerial imagery of the property (see photo from 1940 with an outline of the golf course property and present-day roads labeled, State Archives of North Carolina), however, in many cases these drainage systems have been heavily modified, filled in, or covered up -- likely as part of the course's initial construction, during subsequent renovation of the golf course in 1999, and/or during construction of the residential houses and supporting infrastructure in the 1960's.

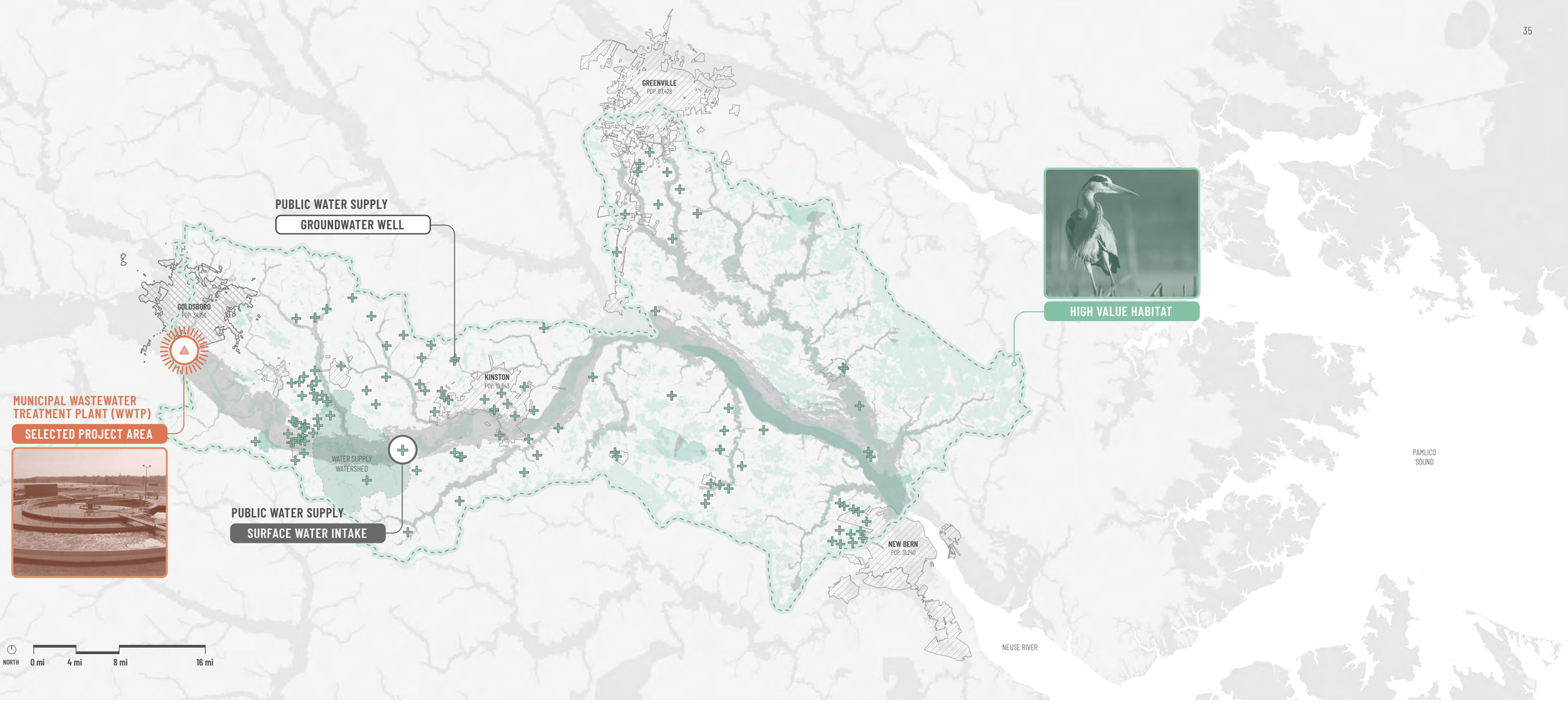
While heavy rainfall and water backing up from the Neuse River causes significant flooding through the mapped floodplain (shaded in teal), testimonial from homeownership in the "Mina Weil Park Neighborhood" (north of the golf course) and City staff from the Parks & Recreation Department also report semi-regular nuisance flooding observed throughout the golf course, along neighborhood streets, and within residential property during smaller, more frequent storm events.

"In many cases, these drainage systems have been heavily modified, filled in, or covered up [and contribute to] nuisance flooding observed throughout the golf course, along neighborhood streets, and within residential property during smaller, more frequent storm events."

While more traditional forms of hazard mitigation practices (e.g., acquisitions or elevations) are most likely to offer the most substantive risk reduction benefits to homeowners in the surrounding residential neighborhoods for large-scale flood events (e.g., 100-year flood), combining these practices with nature-based solutions to handle the smaller-scale return periods (e.g., 10-year flood) could yield additional flood reduction benefits; such as: improved drainage capabilities within the neighborhood streetscape and through the golf course, enhanced play at the golf course, and additional ecosystem services to the broader community (e.g., water quality, habitat, etc).







FOCUS AREA # 3: WASTEWATER TREATMENT PLANT

The Goldsboro Wastewater Treatment Plant (WWTP) takes in raw waste from the City and its residents for treatment before eventually being discharged back into the environment. However, the WWTP's location within the Middle Neuse Subbasin (dashed boundary above) floodplain creates vulnerable conditions during hurricanes or other large-scale flooding events, as the elements needed to ensure the ongoing operation of wastewater treatment systems become at risk for sustaining damages.

When floodwaters rise at pump location, motors could be knocked out, a result that threatens to compromise the entire wastewater treatment system. If the pump at the Goldsboro WWTP were to fail, the waste may run out into the Neuse River, traveling downstream.

This is particularly problematic for both local adjacencies to the WWTP and to regional downstream assets that would be impacted by a breach in the WWTP system. The WWTP is located:

+ Directly across the river channel from Seymour Johnson Air Force Base (SJAFB);
+ Approx. 30 miles upstream from the City of Kinston (population: 19,843);
+ Approx. 50 miles upstream from the City of New Bern (population: 31,240); and
+ Criss-crosses multiple public and private water supply intake locations and vast swathes of high-value habitat within the Neuse River floodplain, moving downstream into the estuarine waters of the Pamlico Sound.

As the Neuse was declared "nutrient sensitive" by the State of North Carolina (in 1995), a wastewater discharge to surface waters could create a significant, regional-scale environmental hazard for people and the environment.

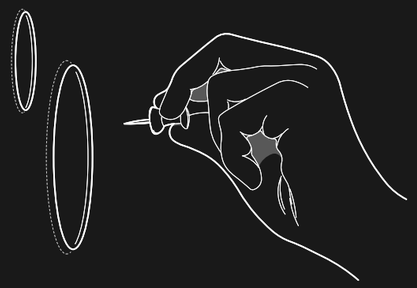
PUBLIC ENGAGEMENT #1

DECEMBER 2022

The purpose of this public engagement session was to solicit community feedback and preferences for potential flood reduction strategies within the Big Ditch and Golf Course focus areas. Of the eight (8) flood reduction strategies presented, seven (7) of them were generally supported by stakeholders via push-pin votes and were collectively viewed as being a betterment to existing conditions.

FLOOD REDUCTION STRATEGIES

The purpose of this public engagement session was to solicit community feedback and preferences for potential flood reduction strategies within the Big Ditch and Golf Course focus areas. Leading up to the event, advertisement efforts included use of: i) traditional City-led communication strategies through the Public Information Officer (PIO); ii) pre-engagement meetings with representatives from each



focus area (City of Goldsboro, Goldsboro Housing Authority, City Parks & Recreation Department); and iii) direct mail flyers to 900+ property addresses nearest the focus areas.

The event was held at the W.A. Foster Recreation Center (1012 South John Street) in Goldsboro, and was structured as a "drop-in" event, where stakeholders could attend for any preferred allotment of time between 4:00 - 6:00pm.

Representatives from the CDDL, the North Carolina Office of Recovery and Resiliency (NCORR), and project partners from the City were present to engage with stakeholders via conversation and information presented on posters. During the session, participants were asked to interact with the posters through use of provided push-pins at a voting mechanism, and through post-it note comments to provide any additional remarks.

Key Takeaways: of the eight (8) flood reduction strategies presented, the only one that elicited any negative response was acquisition of flood-prone properties ("buyouts"). Of the remaining seven (7) flood reduction strategies, some yielded more positive votes than others; however, they were collectively supported and viewed as a betterment to existing conditions.

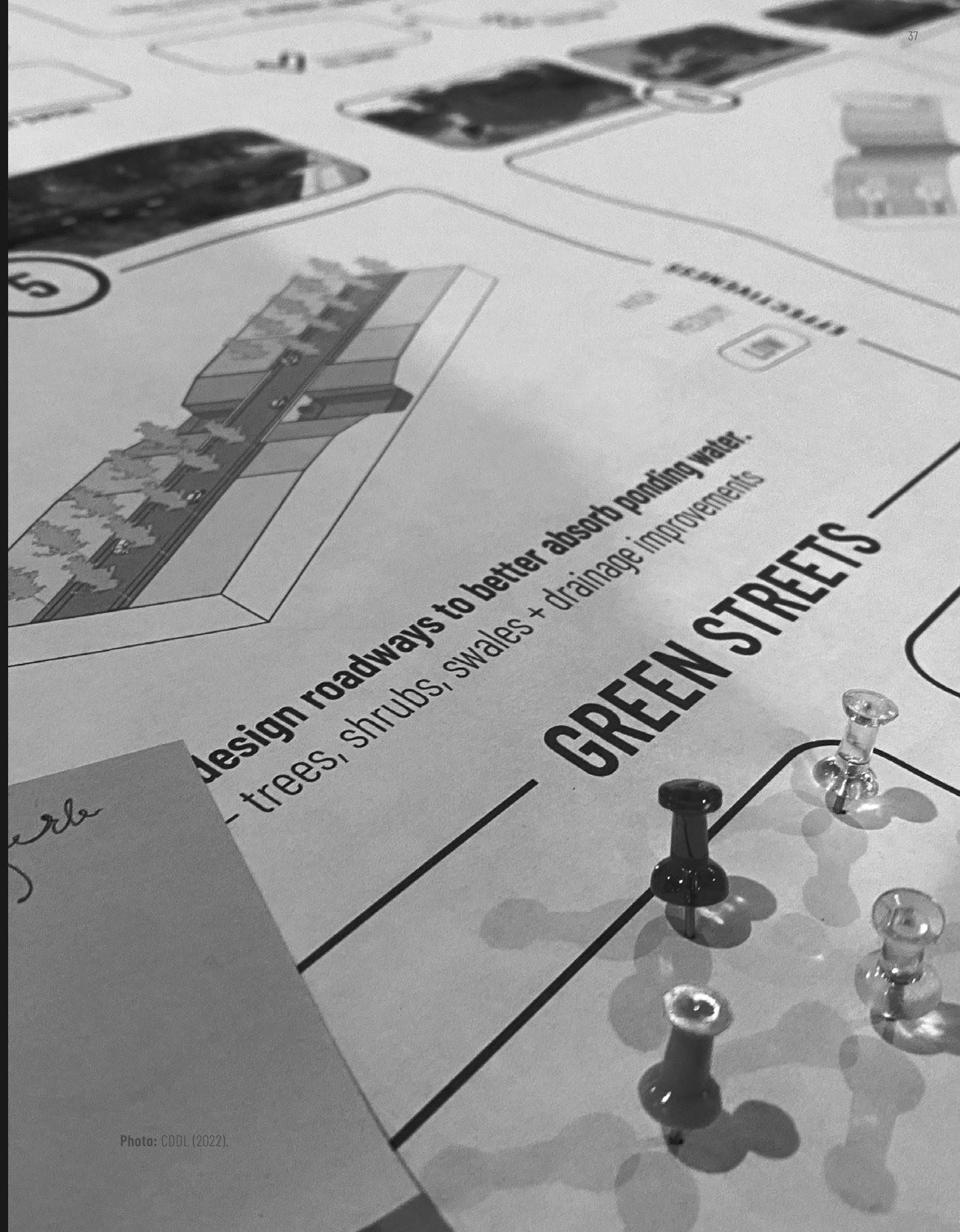


Photo: CDDL (2022).

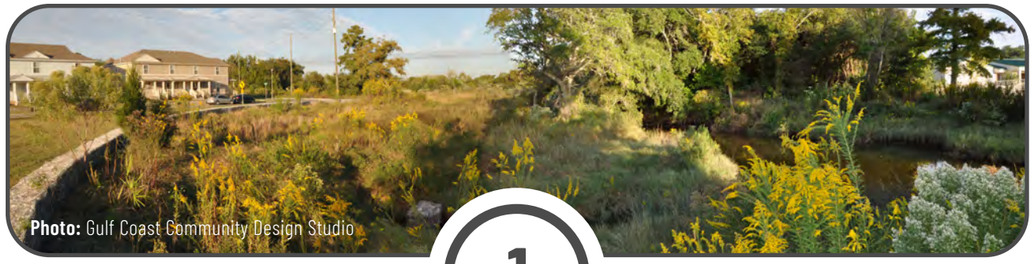
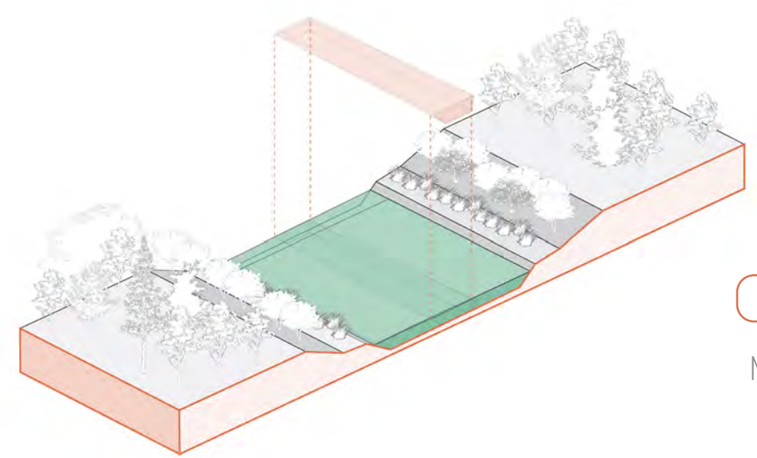


Photo: Gulf Coast Community Design Studio

1



HIGH

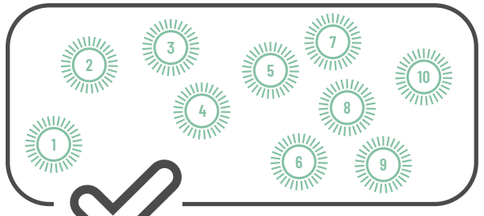
MEDIUM

LOW

EFFECTIVENESS

+ Replace concrete channel with a wider, more natural stream.
- secondary focus: ecological function

FLOODPLAIN RESTORATION



YES, SUPPORT

OR

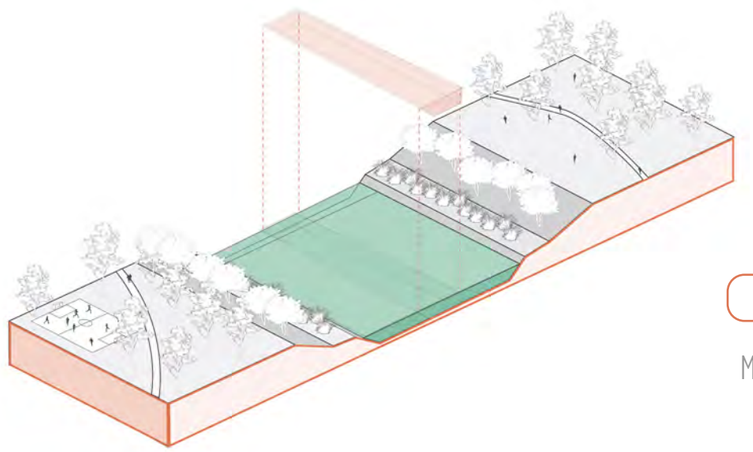
DO NOT SUPPORT

"Wetland Restoration" was communicated as a potentially suitable flood mitigation strategy for: i) Big Ditch between Elm and Spruce Streets; ii) Big Ditch between Ash Street and Royall Avenue; and iii) within the Municipal Golf Course.

Photo: Forest Preserves of Cook County

Photo: City of Minneapolis

2



HIGH

MEDIUM

LOW

EFFECTIVENESS

+ Replace concrete channel with a wider, more natural stream.
- secondary focus: public use + recreational spaces

FLOODPLAIN PARK

YES, SUPPORT

OR

DO NOT SUPPORT

"Floodplain Park" was communicated as a potentially suitable flood mitigation strategy for: i) Big Ditch between Elm and Spruce Streets; and ii) within the Municipal Golf Course.

Photo: Daily Bulldog, The

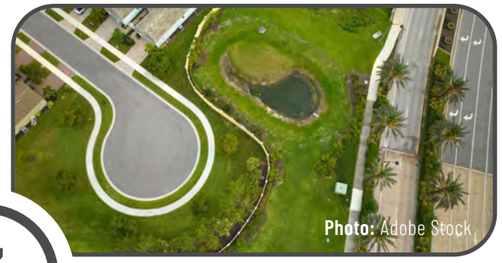
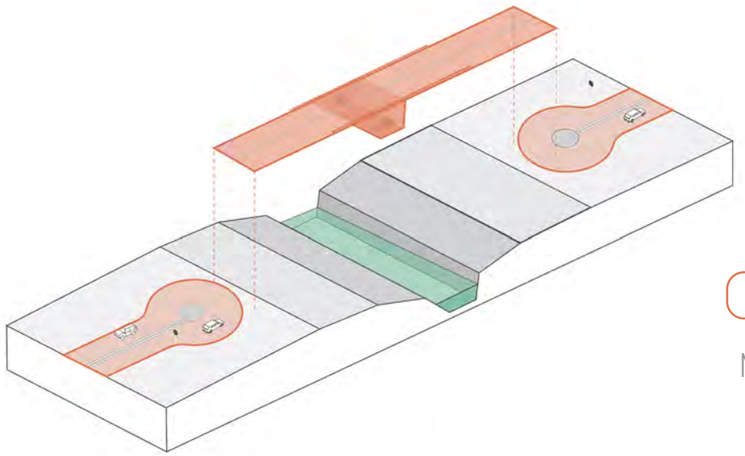


Photo: Adobe Stock

3



HIGH

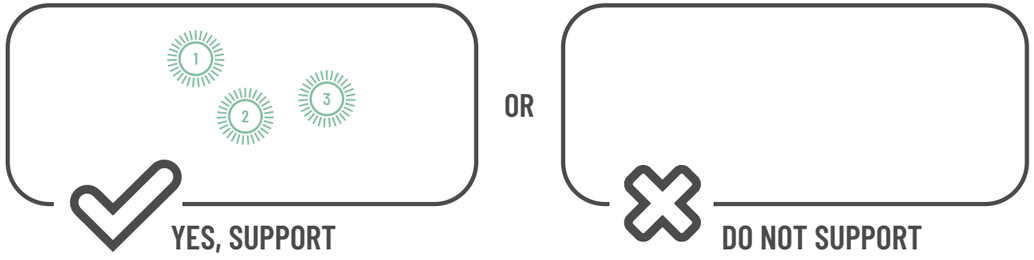
MEDIUM

LOW

EFFECTIVENESS

+ Remove portions of non-critical roads that cross the stream.
- convert roads to cul-de-sacs with round-a-bouts for cars

REMOVE SELECT ROADS



"Remove Select Roads" was communicated as a potentially suitable flood mitigation strategy for: i) Big Ditch between Spruce and Ash Streets; and ii) Big Ditch between Ash Street and Royall Avenue.

Photo: Ayres Associates

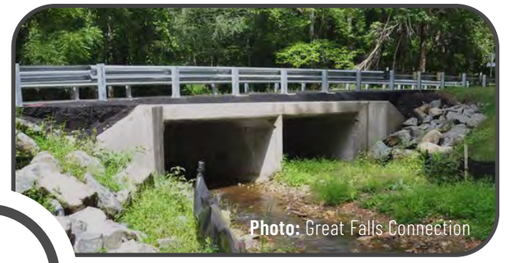
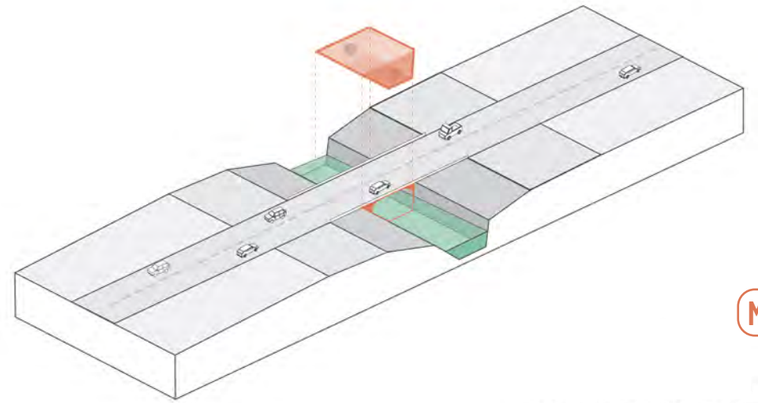


Photo: Great Falls Connection

4



HIGH

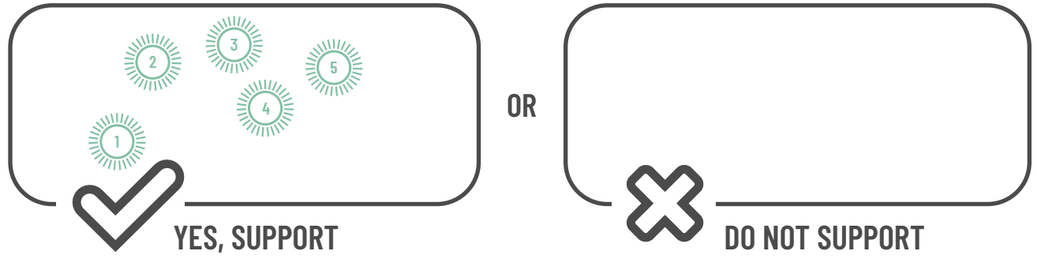
MEDIUM

LOW

EFFECTIVENESS

+ Upgrade undersized pipes beneath road for better water flow.
- no change to traffic pattern

INCREASE CULVERT SIZE



"Increase Culvert Size" was communicated as a potentially suitable flood mitigation strategy for all segments of Big Ditch (Elm Street to Royall Avenue).

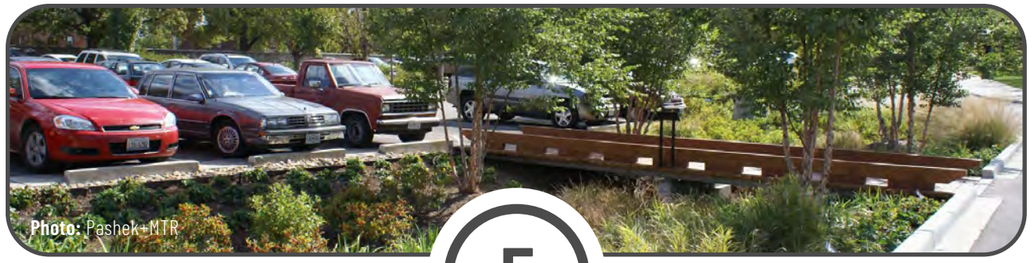
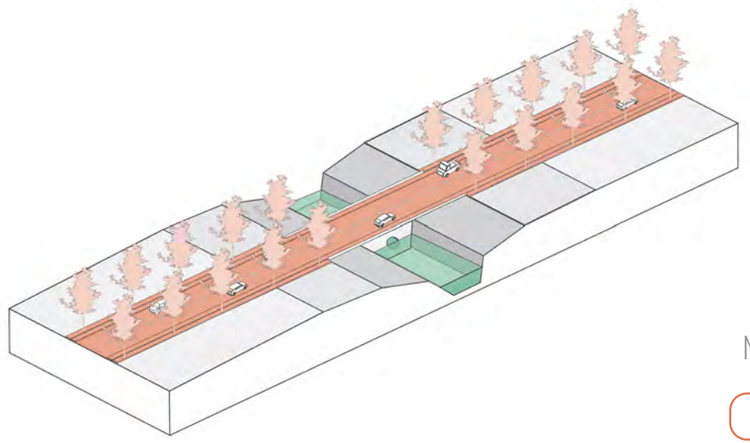


Photo: Pashek+MTR

5



HIGH

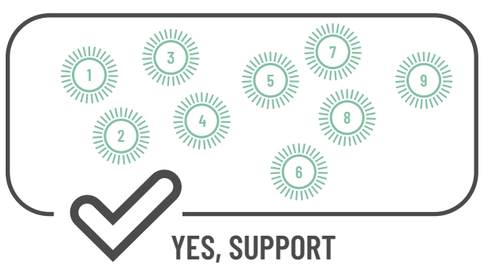
MEDIUM

LOW

EFFECTIVENESS

+ Re-design roadways to better absorb ponding water.
- trees, shrubs, swales + drainage improvements

GREEN STREETS



YES, SUPPORT

OR

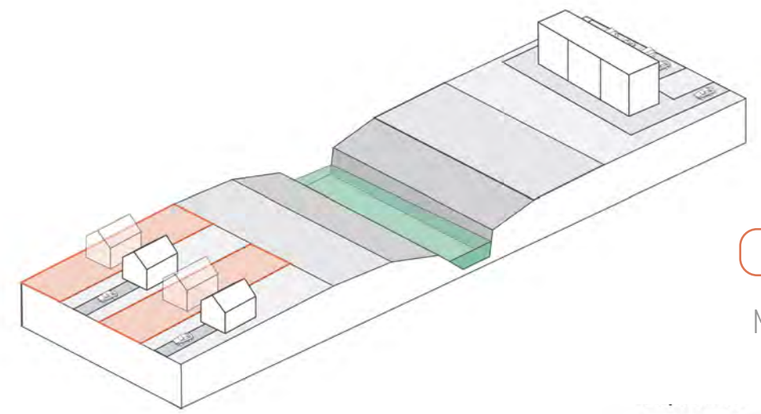
DO NOT SUPPORT

"Green Streets" was communicated as a potentially suitable flood mitigation strategy for: i) Big Ditch between Elm and Spruce Streets; and ii) the residential neighborhoods surrounding the Municipal Golf Course.


Photo: FEMA


Photo: CDDL

6



HIGH

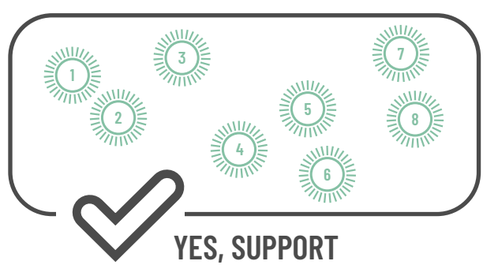
MEDIUM

LOW

EFFECTIVENESS

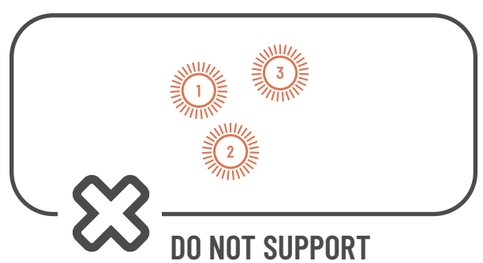
+ Participating homes are acquired at fair market value.
- buildings are demolished and land must be left as open space

ACQUISITIONS



YES, SUPPORT

OR



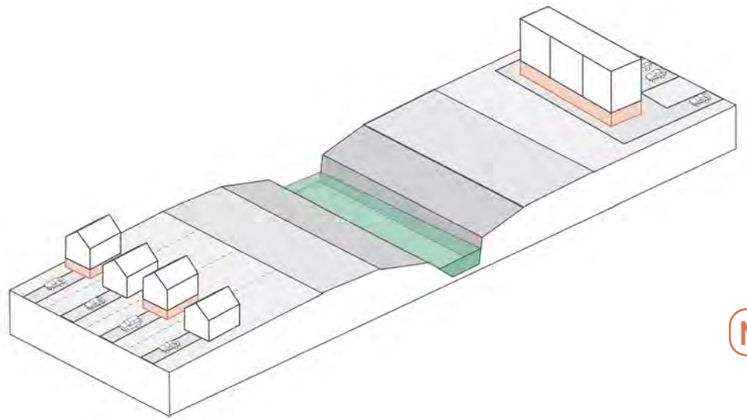
DO NOT SUPPORT

"Acquisitions" was communicated as a potentially suitable flood mitigation strategy for: i) all segments of Big Ditch (Elm Street to Royall Avenue); and ii) the residential neighborhoods surrounding the Municipal Golf Course.

Photo: Gulf Coast Community Design Studio

Photo: SmithGroup

7



HIGH

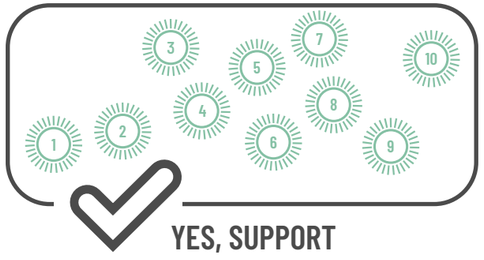
MEDIUM

LOW

EFFECTIVENESS

+ Participating homes are elevated above flood elevation.
- greatly reduces future flood damages, but some risks remain

ELEVATIONS



YES, SUPPORT

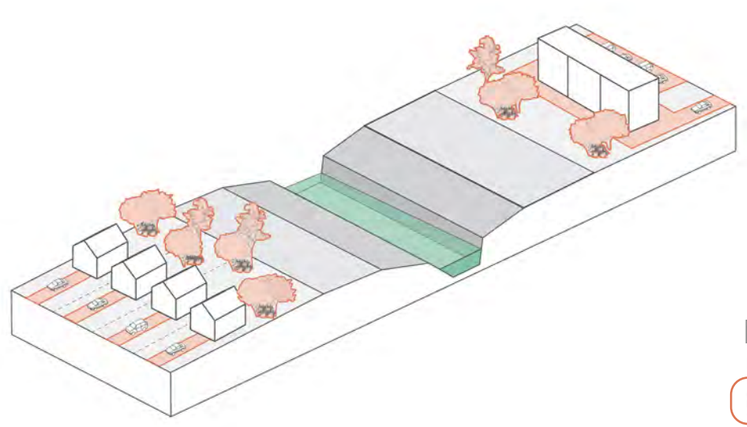
OR

DO NOT SUPPORT

"Elevations" was communicated as a potentially suitable flood mitigation strategy for: i) all segments of Big Ditch (Elm Street to Royall Avenue); and ii) the residential neighborhoods surrounding the Municipal Golf Course.

Photo: Prieskorn

8



HIGH

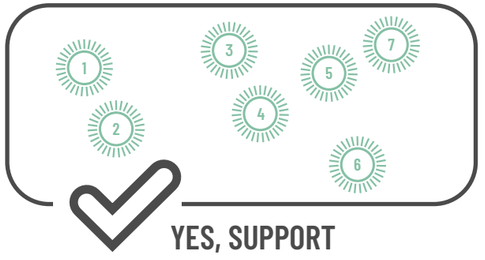
MEDIUM

LOW

EFFECTIVENESS

+ Install low-maintenance rain gardens to better absorb water.
- plant palette and permeable paving designed to suit each property

RAIN GARDENS



YES, SUPPORT

OR

DO NOT SUPPORT

"Rain Gardens" was communicated as a potentially suitable flood mitigation strategy for: i) all segments of Big Ditch (Elm Street to Royall Avenue); and ii) the residential neighborhoods surrounding the Municipal Golf Course.

PUBLIC ENGAGEMENT #2

DECEMBER 2022

This engagement event served as an opportunity to partake in workshop-style discussion and "overlay drawing" specific to the Municipal Golf Course property. During the open session, members of the project team worked with partners from the Parks & Recreation Department to identify nuisance flooding areas, drainage patterns, and play considerations that need to be considered as part of any potential flood reduction strategies including the golf course.

WORKSHOP / CHARRETTE

This engagement session served as an opportunity to partake in workshop-style discussion and "overlay drawing" specific to the Municipal Golf Course property.

This event used the same advertisement campaign as Workshop #1 (Goldsboro Public Information Officer and direct mail flyers), and also included a pre-engagement meeting with representatives from the City Parks &

Recreation Department. The event was held at the Goldsboro Event Center (GEC), which is located on the Municipal Golf Course property (1501 South Slocumb Street). Similar to Workshop #1, this was advertised as a "drop-in" event, where stakeholders could attend for any preferred allotment of time between 4:00 - 6:00pm.

During the workshop, members of the project team worked with partners from the Parks & Recreation Department to identify nuisance flooding areas, drainage patterns, and play consideration that need to be considered as part of any potential flood reduction strategies including the golf course.

Key Takeaways: as the golf course is nearly entirely in the Neuse River floodplain, much of the course gets inundated during extreme weather events. While this is generally an appropriate use of flood-prone lands, drainage improvements to several problematic areas could help reduce maintenance and play burdens on the course during smaller storm events, while also better capturing the historic drainage network from the residential neighborhoods upstream (north) of the golf course.

Photo: CDDL (2022).

03 | PROJECT PORTFOLIO

This section of the report illustrates the development and refinement of: preliminary schematic plans, hydraulic models, cost estimates, and technical information as applicable to each of the three (3) focus areas identified in the "Inventory + Analysis" phase of this study: i) Big Ditch; ii) the Municipal Golf Course; and iii) the Wastewater Treatment Plant (WWTP).

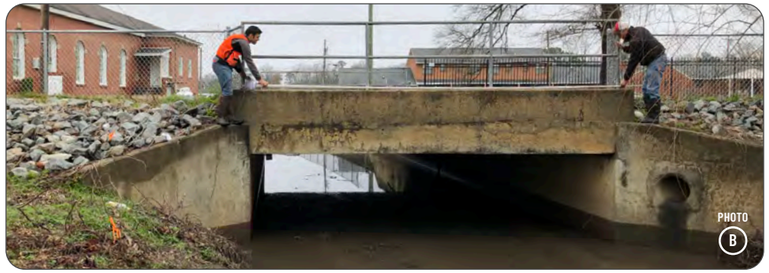
The project team combined the initial geospatial findings and field-colelcted data with the stakeholder feedback and preferences gathered during the first two (2) public engagement events in order to establish parameters for project scope and programmatic fit at each location. To supplement the development of WWTP focus area, engineers specializing in the assessment and design of wastewater treatment facilities were added to the project team to advise and support the development of WWTP-specific deliverables.

Collectively, the resulting documentation is meant to both provide direction regarding feasible and sustainable practices within the identified focus areas, while also providing collateral that can be used to attract external resources (e.g., competitive grants) towards actionable next steps for these projects.

STREAM RESTORATION + INFRASTRUCTURE IMPROVEMENTS

BIG DITCH

This project will: i) **restore approximately 2,300 linear feet of stream**; ii) **upgrade three (3) culvert/bridge conditions**; and iii) **create a "floodplain park" within the Elmwood Terrace community**. Hydraulic modeling of the proposed scope of work indicates that these improvements will reduce flood-related damages throughout the project area. Specifically, (14) single-family residential units, (63) multi-family residential units, and (3) public/private entities will benefit from reductions in projected flood heights, and, two (2) of the three (3) road crossings will be able to withstand flood conditions equivalent to modeled 100- and 500-year flood events.



Photos: Doll, B., Kurki-Fox, J. & Line, D. (2020)

CONTEXT + DESIGN INTENT

The specific location of the proposed scope of work along Big Ditch has been identified because it:

+ Correlates with areas along the stream that are modeled to receive **damaging floodwaters on a frequent, recurring basis;**
+ Is predominantly in a Census Tract (37191001500) with **socioeconomic factors historically associated with a lack of investment** in resilience-building projects; and
+ Contains the spatial and land ownership conditions required of a project to be **technically feasible.**

The area encompassing and immediately surrounding the project site is in a residential area with a history of disturbance. Typical site vegetation includes extensive areas of lawn mown right up to the channel edge (Photo D), residential landscaping, and some areas of early succession forest with a mix of native and invasive species (Photo A). 50-meter resolution land cover data from the U.S. Geological Survey (USGS) describes the area within the proposed Limit of Work boundary as being 94.5% "Developed / Other Human Use" and 5.5% "Agricultural & Developed Vegetation."

Full restoration of Big Ditch to a pre-disturbance state is not possible due to the surrounding urban context (e.g., road crossings and buildings shown in Photos B, C, and D), **but the proposed scope of work will increase the stream's sinuosity, widen the floodplain, and modify naturalized areas to more appropriately serve environmental functions.**

SUMMARY OF PROJECT DEVELOPMENT

Development of the preliminary designs for Big Ditch followed guidance outlined in FEMA's "8-step process" (44 CFR Part 9.6.) to support scope refinement, public engagement efforts, and the consideration of design alternatives. A step-by-step summary description of the processes and methods used in alignment with 44 CFR Part 9.6. is provided below:

"A total of seven (7) practical alternatives for the Big Ditch project were identified and evaluated. The preferred alternative ("Scenario C") offers the most substantial levels of flood reduction without relying on contingencies or commitments external to the City and project partners (e.g., participation in voluntary buyouts)."

Step One: Project Location Within or Affecting a Floodplain or Wetland. *§ 9.7. "Determine whether the proposed action is located in a wetland and/or the 100-year floodplain (500-year floodplain for critical actions); and whether it has the potential to affect or be affected by a floodplain or wetland."*

Yes. The project located along the Big Ditch stream channel is within the waterbody's 100-year floodplain (Special Flood Hazard Area; SFHA) between Willow Dale Cemetery and Spruce Street, and will affect a classified 'R5UBH' wetland (the main stream channel) identified by the U.S. Fish and Wildlife Service (USFWS).

Step Two: Preliminary Public Notification and Involvement in Decision-Making. *§ 9.8. "Notify the public at the earliest possible time of the intent to carry out an action in a floodplain or wetland, and involve the affected and interested public in the decision-making process."*

Yes. During a December 2022 public workshop, "floodplain restoration" (described as "replacing concrete channels with a wider, more natural stream") received the most votes from stakeholders out of eight (8) flood mitigation program alternatives presented. The event was advertised via direct mail flyers to residents in the community and by the City's Public Information Officer.

Step Three: Identify and Evaluate Alternatives. *§ 9.9. "Identify and evaluate practicable alternatives to locating the proposed action in a floodplain or wetland (including alternative sites, actions and the "no action" option)."*

Yes. A total of seven (7) practical alternatives for the Big Ditch project were identified and evaluated. The preferred alternative ("Scenario C") offers the most substantial levels of flood reduction without relying on contingencies or commitments external to the City and project partners (e.g., participation in voluntary buyouts). Alternatives:

+ **'No Action' Alternative:** The existing condition can only convey <5-year discharge levels before flooding begins to affect adjacent properties (Doll and Kurki-Fox, 2023).

  If left unchanged, the fourteen (14) single-family residential units, sixty-three (63) multi-family residential units, three (3) public/private entities, and three (3) road crossings containing modeled benefits will remain vulnerable to damages from flood events on a frequent, recurring basis (per the existing condition).

+ **Alternative Sites:** Previous studies of flooding along Big Ditch (e.g., Doll et al., 2020) indicated that flooding in the project area cannot be alleviated unless the stream channel and intersecting road crossings are both modified to better control and convey floodwaters.

+ **Alternative Action - Scenario 'A':** Restoration of channel and floodplain along Big Ditch from Spruce Street to Elm Street + Culvert upgrades at Elm and Spruce Streets + Removal of Hinson Street and replacement with a pedestrian bridge.

+ **Alternative Action - Scenario 'B':** Scenario 'A' + Extension of floodplain cut six-hundred (600) linear feet downstream (south) of Elm Street.

+ **Alternative Action - Scenario 'C':** Scenario 'A' + Extension of floodplain cut one-thousand two-hundred (1,200) linear feet downstream (south) of Elm Street.

+ **Alternative Action - Scenario 'D':** Scenario 'C' + Extension of channel and floodplain restoration to Chestnut Street + Wider floodplain cut (90-100 feet) and bridge / road crossings + Voluntary buyouts of select residential properties at locations most critical to support optimal floodplain function.

+ **Alternative Action - Scenario 'E':** Scenario 'B' plus modifications to select upstream road crossings where either upgraded or removed culvert conditions are feasible.

Step Four: Identify Potential Direct and Indirect Impacts. *§ 9.10. "Identify the potential direct and indirect impacts associated with the occupancy or modification of floodplains and wetlands, and the potential direct and indirect support of floodplain and wetland development that could result from the proposed action."*

Yes. The proposed project is estimated to positively impact 30% of the total population within a combined census tract area around the project site (3,586 out of 11,958 buildings). Populations potentially impacted by the proposed scope of work include those that are within the project's:

+ **Subwatershed Area:** The proposed scope of work is anticipated to reduce flooding within and around the project area, most specifically within the 12-Digit HUC (Hydrologic Unit Code; 030202011705) Subwatershed that contains upstream and downstream portions of Big Ditch from the proposed limit-of-work boundary.

+ **Traffic Impact Area:** Areas anticipated to be either: i) temporarily impacted during construction of the project (e.g., temporary re-routing of traffic); or ii) permanently impacted as a result of the project (post-construction) through increased vehicular safety and accessibility during / after flood events.

+ **Park Access Area:** Areas within a 10-minute walking distance from the centerpoint of the site; "Safe Routes to Parks," National Recreation and Park Association (NRPA), 2016). The proposed scope of work includes many ancillary benefits (e.g., increased quality of recreational spaces, access to nature, etc.) that will offer park-like amenities to stakeholders.

These three (3) geographic areas intersect seven (7) census tracts in Goldsboro, all of which have Centers for Disease Control and Prevention (CDC) Social Vulnerability Index (SVI) values that satisfy the FEMA definition of a "disadvantaged" community (CDC SVI values greater than 0.8 out of 1.0).

Step Five: Minimize Potential Adverse Impacts and Restore / Preserve Beneficial Values. *§ 9.11. "Minimize*

SUMMARY OF PROJECT DEVELOPMENT (cont'd)

the potential adverse impacts and support to or within floodplains and wetlands to be identified under Step Four, restore and preserve the natural and beneficial values served by floodplains, and preserve and enhance the natural and beneficial values served by wetlands."

Yes. Multiple "bioengineering strategies" (i.e., techniques that mimic natural floodplain processes, such as: streambank stabilization and the installation of native riparian plant communities) are being proposed in the scope of work. These actions are anticipated to reduce the threat of flood-related hazards while also restoring the beneficial values of wetlands and floodplains that have been heavily impaired adjacent to Big Ditch. Additional protective measures (e.g., traffic control, erosion and sediment control, etc.) have been included in this report's Professional Opinion of Probable Cost in effort to minimize potential adverse impacts to local and surrounding communities during construction.

Step Six: Re-evaluate the Proposed Action and Reconsider Alternatives. *"Re-evaluate the proposed action [and alternatives preliminarily rejected at Step Three] to determine if it is still practicable in light of its exposure to flood hazards, the extent to which it will aggravate the hazards to others, and its potential to disrupt floodplain and wetland values."*

Yes. The preferred design alternative, Scenario 'C', has been further refined to reflect: optimal floodplain function, existing site-level conditions (e.g., utilities), and specific gaps in local needs relating to park access. During a door-to-door campaign at Elmwood Terrace in March 2023, 97.5% of residents surveyed (40 out of 41) supported the elements included in the refined plan for Scenario 'C'.

Step Seven: Provide the Public with Findings and Explanations. *§ 9.12. "Prepare and provide the public with a finding and public explanation of any final decision that the floodplain or wetland is the only practicable alternative."*

Yes. Coinciding the final submittal of the "Goldsboro Floodprint" report, a final presentation of the proposed project at Big Ditch, as a subset of multiple projects included in this report, will be held in a public setting during an open Goldsboro City Council Meeting (anticipated November 2023).

Step Eight: Review Implementation and Post-Implementation Phases. *"Review the implementation and post-implementation phases of the proposed action to ensure that the requirements stated in § 9.11 are fully implemented. Oversight responsibility shall be integrated into existing processes."*

Yes. Construction administration (CA) and site monitoring (SM) have been incorporated into the recommended Project Schedule for Big Ditch. The anticipated start month for CA and SM is intentionally placed within the schedule to: i) coincide with the start of mobilization and construction sequences; ii) parallel construction benchmarks; and iii) last for two (2) months beyond the recommended 100% completion date of construction for initial post-occupancy evaluation.

The development and refinement of Scenario 'C' reflects the preferences of community stakeholders, highlights the use of nature-based solutions, and has been determined to be cost-effective.

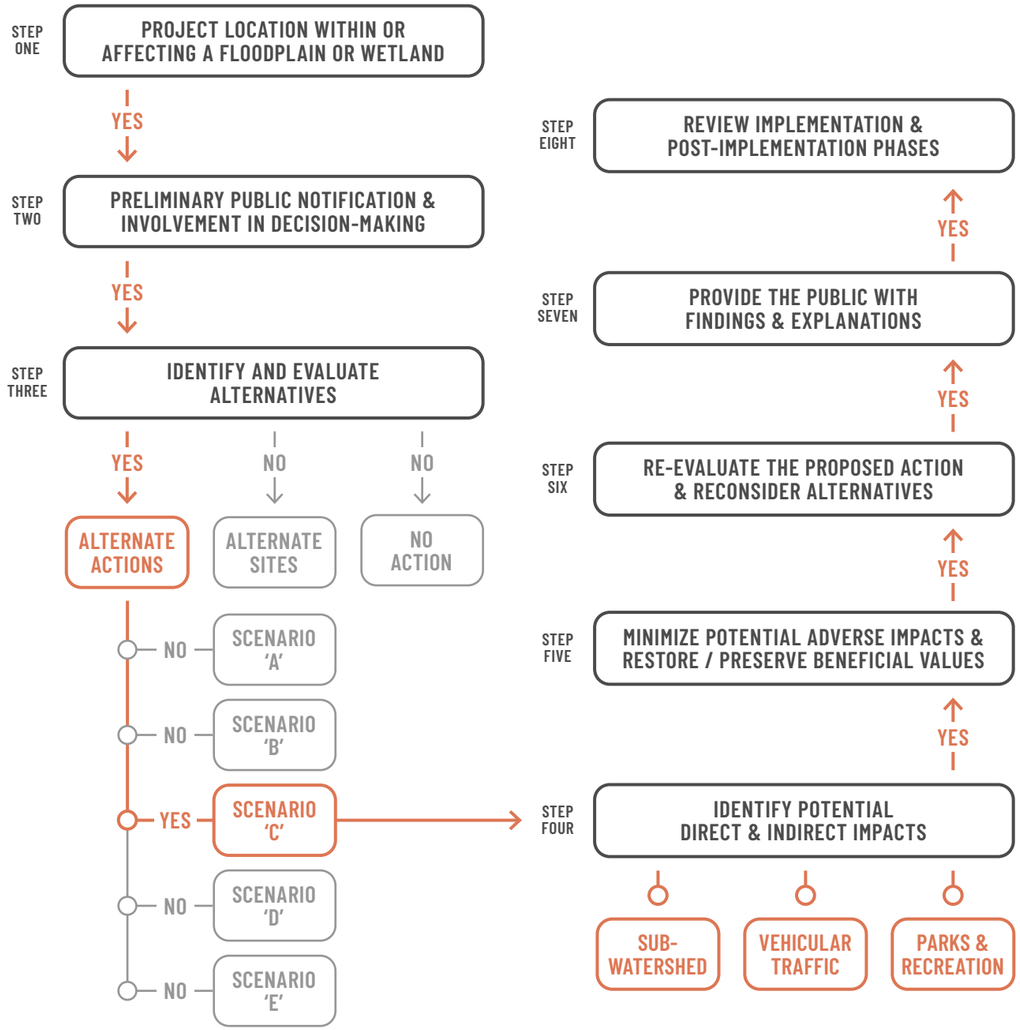
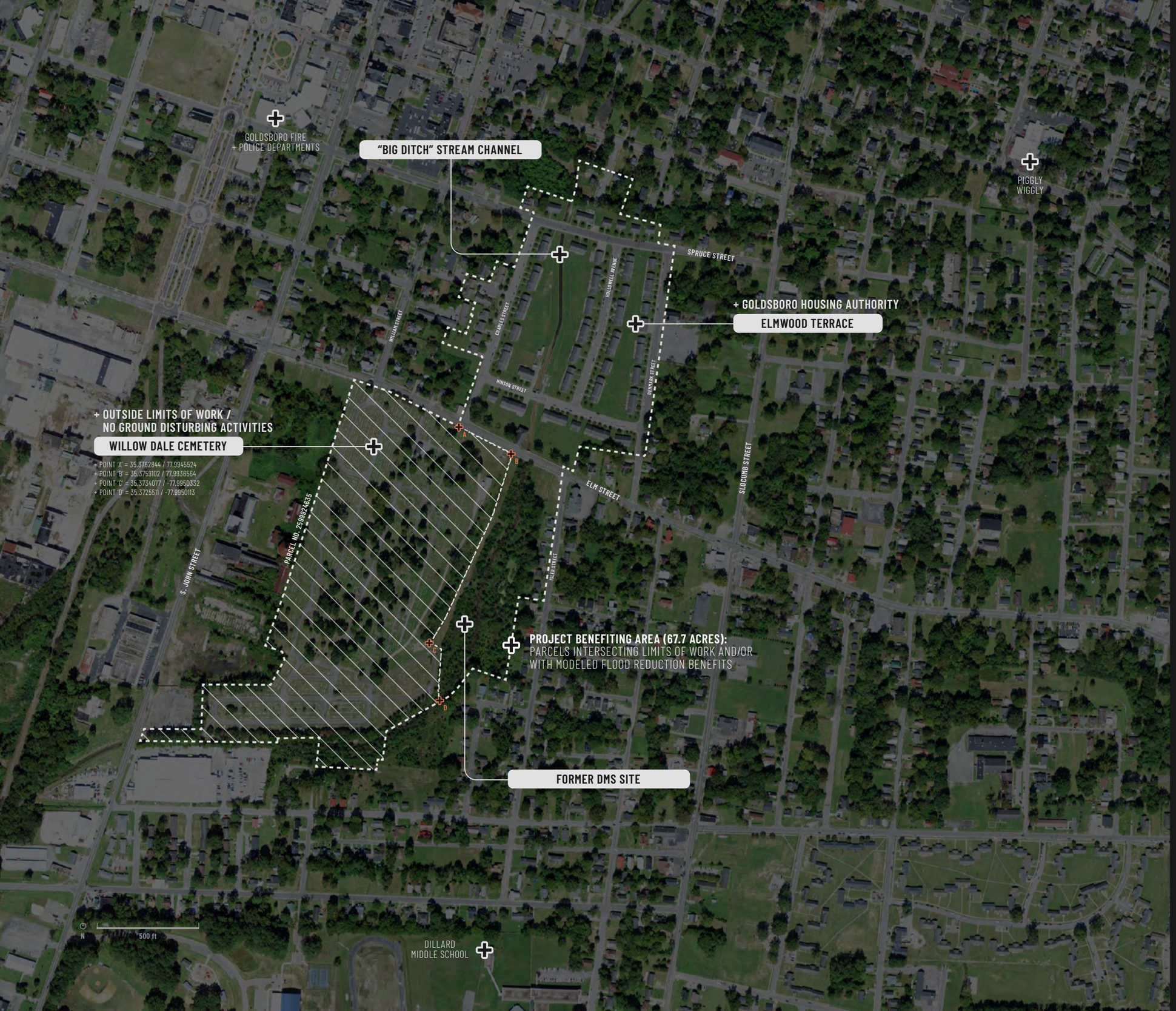


DIAGRAM: Visual summary of the "8-Step Process" used for developing the "preferred alternative" design scheme for Big Ditch.



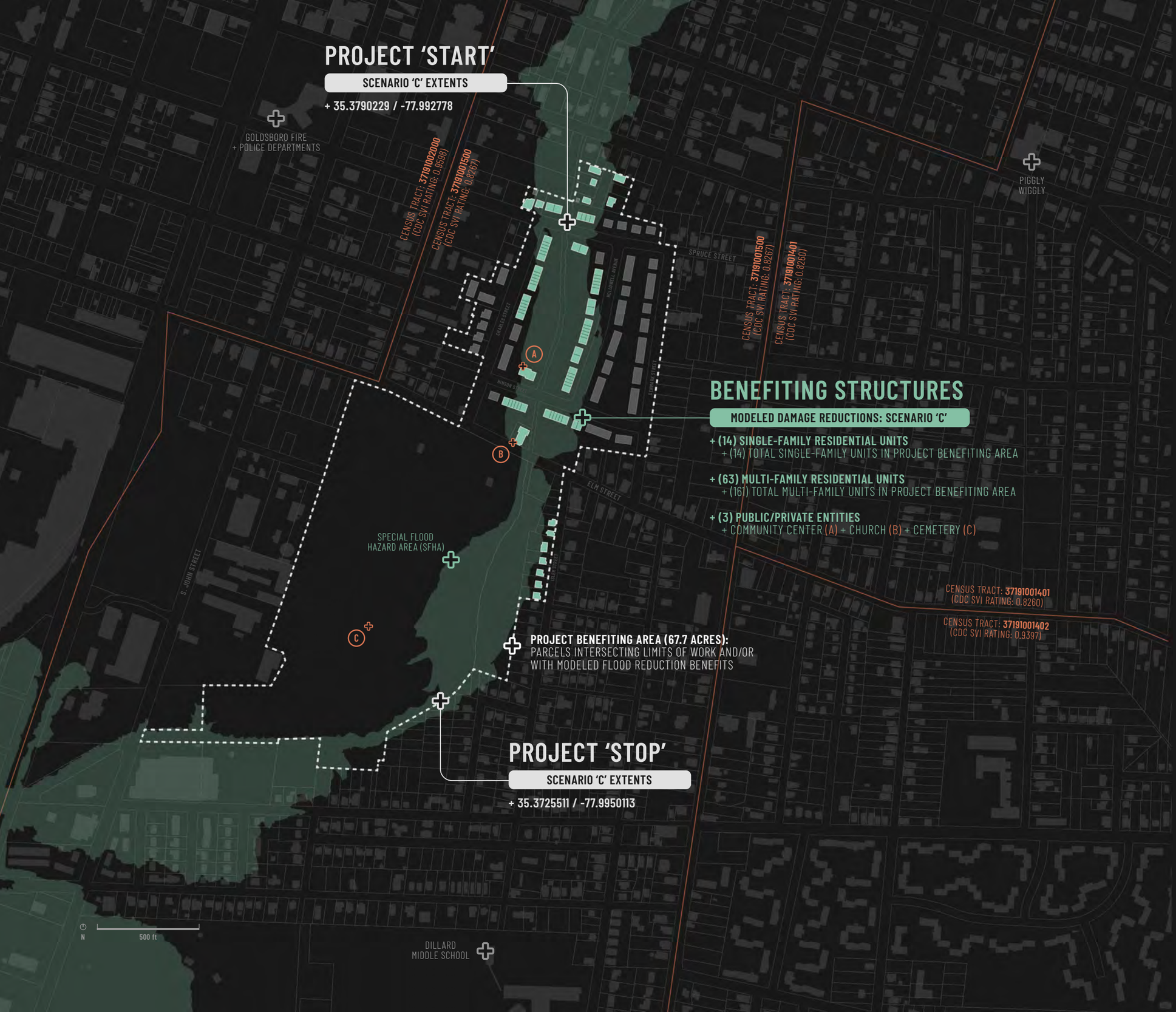
EXISTING CONDITIONS MODEL

The North Carolina Floodplain Mapping Program Effective HEC-RAS model for Big Ditch was used for hydraulic analysis of the existing condition. The effective model was obtained from the North Carolina Flood Risk Information System (NC FRIS) database (NCFMP, 2019), and the project team surveyed elevations at the culverts and roads near the Elmwood Terrace community to validate / update the model.

Updating the model revealed that the previously completed Division of Mitigation Services (DMS) stream mitigation project downstream (south) of Elm Street was not reflected in the effective model geometry and the culvert at Elm Street was shown as a bridge with a lower invert rather than the existing box culvert. The culvert at Elm Street was corrected to reflect the as-built condition, new cross sections were added, and the previously completed DMS restoration project was added to the model using cross-section data from the DMS annual monitoring reports, LiDAR data, and data collected on-site (2023).

The effective hydraulic model was updated to reflect more accurate conditions in the project area.

Adding the DMS restoration project geometry and updating roughness values in the model resulted in a rise in Water Surface Elevation (WSE) in the upper half of the DMS restoration project and upstream in the vicinity of Elmwood Terrace community. Further investigation showed that the project initially resulted in a violation of FEMA rules. However, the restoration project was permitted based on a reinterpretation of the flood study model results, even though the modifications to the channel appear to increase the risk of flooding relative to the existing condition.



MODELED SCENARIOS + PREFERRED ALTERNATIVE

A total of seven (7) practical alternatives for the Big Ditch project were identified and evaluated. These included a "No Action Alternative," a consideration of "Alternative Sites," and five (5) "Alternative Actions." The "No Action Alternative" and "Alternative Sites" options were not selected as neither of these scenarios would yield desired reductions in future flood damages. Previous studies of flooding along Big Ditch (e.g., Doll et al., 2020) indicated that flooding in the project area cannot be alleviated unless the stream channel and intersecting road crossings are both modified.

The five (5) remaining "Alternative Actions" ("Scenarios A - E") – each containing a unique combination of "green" and "gray" infrastructure modifications - were evaluated by examining the modeled decrease in Water Surface Elevation (WSE) and spatial extent of flooding for a range of flood return periods (5-, 10-, 25-, 50-, 100-, and 500-year events). **In general, Scenario 'A' assessed the least extensive project footprint (from Spruce Street to Elm Street), and then each subsequent scenario increased the spatial extent of project reach.** Similar to Scenario 'A,' Scenarios 'B' and 'C' also started at Spruce Street, however, both of these conditions extended proposed modifications further south (past Elm Street) into the DMS site – at 600 and 1,200 linear feet, respectively. Scenario 'D' used a similar north/south boundary as Scenario 'C,' but increased the floodplain width to promote optimal floodplain function (in doing so, Scenario 'D' is only feasible if combined with voluntary acquisitions of property). Lastly, Scenario 'E' combined the Scenario 'B' project boundary with additional roadway crossing modifications that extended further north (past Spruce Street) to Royall Avenue (approximately 1.2 miles away).

The preferred alternative (Scenario 'C') offers the most substantial levels of flood reduction without relying on contingencies or commitments external to the City and project partners (e.g., participation in voluntary buyouts).

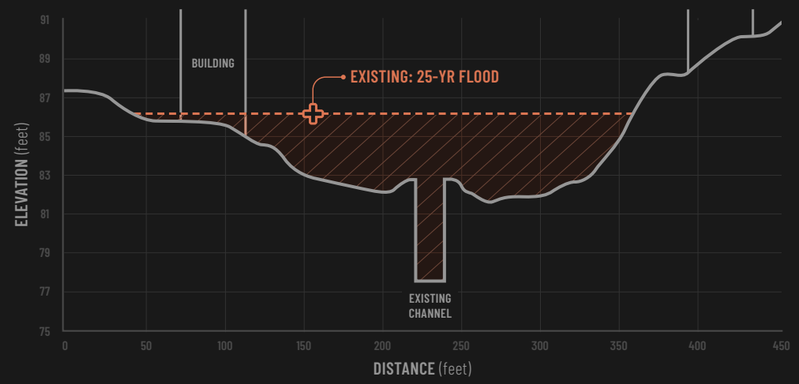
EXISTING CHANNEL + FLOODPLAIN: ELMWOOD TERRACE

The lack of a functional floodplain upstream, within, and downstream of Elmwood Terrace all contribute to the vulnerabilities observed during flood events. In the existing condition, the modeled Water Surface Elevation (WSE) exceeds the First Floor Elevation (FFE) of at least thirty-eight (38) residential units during a 500-year event.

During existing flood events in Elmwood Terrace, the modeled Water Surface Elevation (WSE) exceeds the First Floor Elevation (FFE) of **(17)** residential units during a 50-year event, **(23)** residential units during a 100-year event, and **(38)** residential units during a 500-year event.

In order to reduce these impacts while also being mindful of cost-effectiveness, technical feasibility, and stakeholder needs across the Elmwood Terrace landscape, the Scenario 'C' scheme considered numerous factors as part of the development and refinement of the schematic plan – such as: **i) demolition costs for removing the existing channel condition** (i.e., the entire stream segment from Spruce Street to Elm Street is an open, rectangular culvert made of reinforced concrete); **ii) utility locations** (e.g., sanitary sewer and water lines will need to be re-routed as a result of proposed earthwork); **iii) resident safety** (i.e., currently, a chain link fences parallels both sides of Big Ditch throughout Elmwood Terrace to act as a deterrent); and **iv) perceptions of "private" versus "public" space** (i.e., the proposed features will likely draw more users into a space that currently serves as a shared "backyard" among residents).

Cross Section. Water Surface Elevation (WSE) of a modeled 25-year flood event in Elmwood Terrace: EXISTING



Data. Number of impacted units in Elmwood Terrace.

+ 10-YR WSE > FFE
  - 1 unit

+ 50-YR WSE > FFE
  - 17 units

+ 100-YR WSE > FFE
  - 23 units

+ 500-YR WSE > FFE
  - 38 units

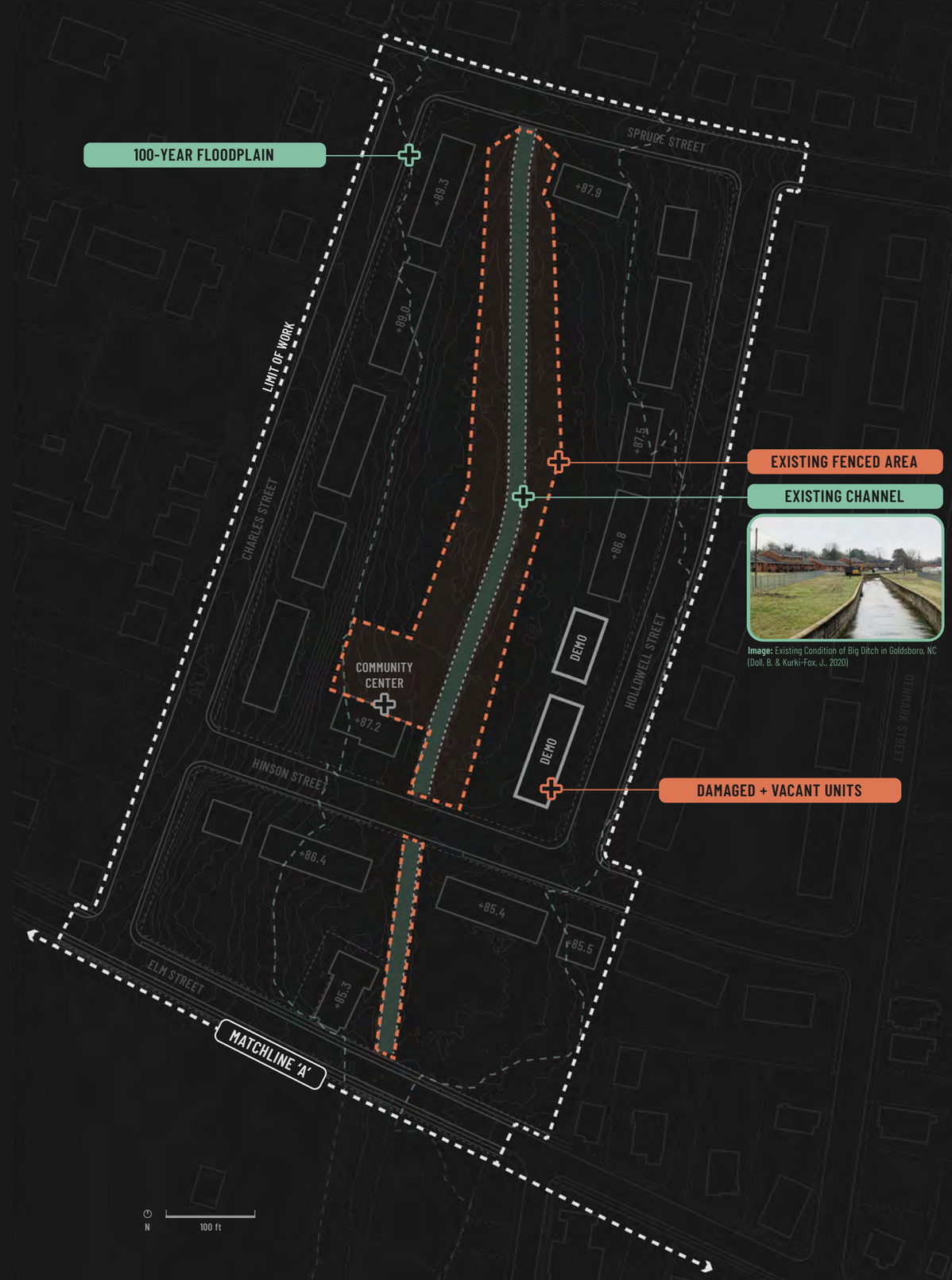


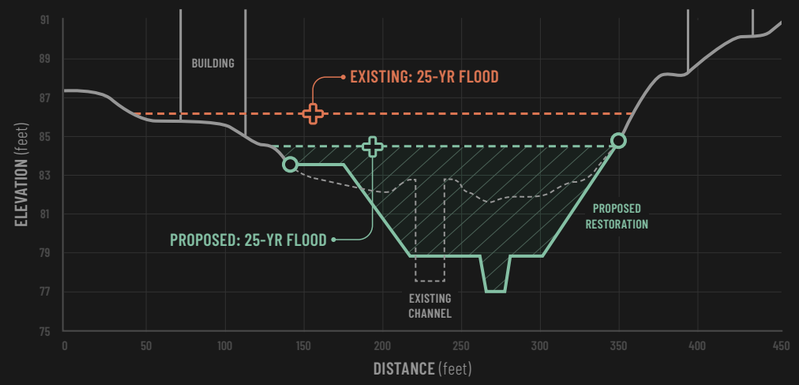
Image: Existing Condition of Big Ditch in Goldsboro, NC (Doll, B. & Kurki-Fox, J., 2020)

PROPOSED SCENARIO ‘C’ PLAN: ELMWOOD TERRACE

Scenario ‘C’ draws upon FEMA guidance (“Building Community Resilience with Nature-Based Solutions,” 2021) for implementing several “watershed scale” practices (e.g., “floodplain restoration” and “stormwater park”) as part of an interconnected suite of nature-based solutions along Big Ditch. Specifically, the proposed ‘Scenario C’ scheme calls for: **i) removing the existing culvert condition; ii) excavating approximately 9,600 cubic yards of “cut” from Spruce Street to Elm Street** (with additional floodplain widening to occur south of Elm Street in the DMS site); and **iii) bordering the proposed floodplain enhancements with a series of low-impact recreational amenities** to better serve the needs of the community. Altogether, the proposed scope of work in Scenario ‘C’ includes: i) 9.64 acres of land classified as “Riparian” enhancements (i.e., areas of restored floodplain); and ii) 1.64 acres of land classified as “Urban Green Open Space” enhancements (i.e., public gathering areas). In this proposed condition, the modeled Water Surface Elevation (WSE) exceeds the First Floor Elevation (FFE) in only nine (9) residential units during a 500-year event (compared to 38 residential units in the existing condition).

In the proposed Scenario ‘C’ plan, the modeled Water Surface Elevation (WSE) exceeds the First Floor Elevation (FFE) of **(0)** residential units during a 50-year event, **(7)** residential units during a 100-year event, and **(9)** residential units during a 500-year event.

Cross Section. Water Surface Elevation (WSE) of a modeled 25-year flood event in Elmwood Terrace: PROPOSED



Data. Number of impacted units in Elmwood Terrace.

+ 10-YR WSE > FFE
  - None

+ 50-YR WSE > FFE
  - None

+ 100-YR WSE > FFE
  - 7 units

+ 500-YR WSE > FFE
  - 9 units

Image: Goose Creek Stream Restoration in Durham, NC (Biohabitats, 2009)

SUMMARY OF RESULTS: ELMWOOD TERRACE

Results from hydraulic modeling and subsequent data analysis of all five (5) "Alternative Action" scenarios, but specifically of the preferred alternative (Scenario 'C'), illustrate the following findings:

The modeled reductions in Water Surface Elevation (WSE) as a result of Scenario 'C' would prevent the displacement of an additional: **(17)** residential units during a 50-year event, **(16)** residential units during a 100-year event, and **(29)** residential units during a 500-year event, compared to the existing condition.

+ Only upgrading road crossing structures (e.g., culverts) or restoring the floodplain as standalone actions would have limited impact on flooding along Big Ditch. Instead, a combined approach ("green" and "gray" infrastructure improvements) is needed to reduce flooding;

+ Only limited flood reduction benefits can be achieved without excavating additional floodplain along the upstream portion of the DMS site. To maximize benefits, the floodplain expansion should extend approximately one-thousand two-hundred 1,200 linear feet into the DMS site to where the floodplain widens (as illustrated in Scenario 'C');

+ Scenario 'C' is projected to reduce the Water Surface Elevation (WSE) in Elmwood Terrace during a 10-year flood event by approximately 2-feet, and by approximately 1.5-feet during a 100-year flood event (without the removal of any existing buildings); and

+ Comparing the modeled WSE of various flood return periods to the First Floor Elevations (FFE) of residential units in Elmwood Terrace illustrates that the projected Scenario 'C' improvements to floodplain function would prevent the displacement of an additional: seventeen (17) residential units during a 50-year event, sixteen (16) residential units during a 100-year event, and twenty-nine (29) residential units during a 500-year event compared to the existing condition.

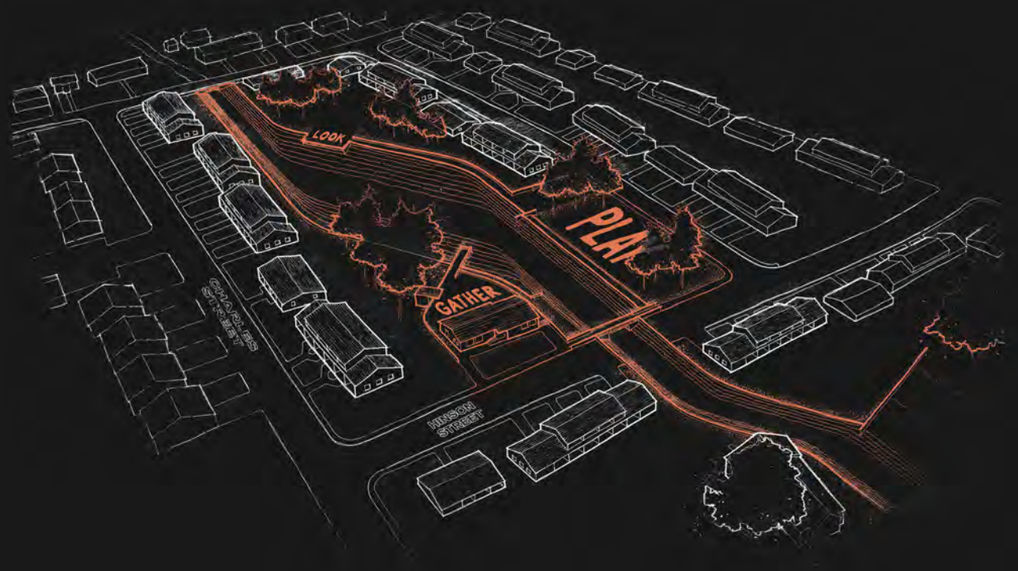
While none of the "Alternative Actions" assessed would completely eliminate flooding outside of the newly created floodplain, **the modeled reductions in both WSE and spatial extents of flooding will significantly reduce the severity of associated social, environmental, and economic impacts during future flood events.**

	EXISTING WSE > FFE	PROPOSED WSE > FFE	CHANGE
10-YR	1 UNIT	NONE	-1
50-YR	17 UNITS	NONE	-17
100-YR	23 UNITS	7 UNITS	-16
500-YR	38 UNITS	9 UNITS	-29

Table. Number of Elmwood Terrace residential units where the modeled Water Surface Elevation (WSE) is greater than the First Floor Elevation (FFE).

PUBLIC ENGAGEMENT #3

MARCH 2023



During a door-to-door campaign at Elmwood Terrace in March 2023, **97.5%** of residents surveyed (40 out of 41) supported the elements included in the refined plan for Scenario C.

DOOR-TO-DOOR CAMPAIGN

During the December 2022 public engagement event, "floodplain restoration" (described as "replacing concrete channels with a wider, more natural stream") received the most votes from stakeholders out of eight (8) flood mitigation options presented for the Big Ditch project. Building off this support, the primary purpose of the March 2023 door-to-door campaign was to gather feedback on the Scenario 'C' floodplain restoration plan prior to initiating final refinement. Prior to the event, printed mail flyers were distributed to residents which showed a three-dimensional view of the Scenario 'C' plan (see illustration above), as well as precedent imagery of the proposed design elements. Using the printed flyers as a conversation guide, 97.5% of Elmwood Terrace residents surveyed during the March 2023 event (40 out of 41) supported the elements included in the Scenario 'C' plan.

Key Takeaway: this level of support further validated Scenario 'C' as the preferred alternative, and only minor modifications to the plan were made after March 2023 for feasibility and cost-effectiveness purposes.

BENEFIT-COST ANALYSIS

FEMA's Benefit-Cost Calculator (version 6.0) was used to estimate the damage reduction for each of the impacted structures, and the value of the project's social and ecosystem services. The inputs used to develop the BCA are outlined below:

The final benefit-cost ratio (BCR) for the proposed scope of work is 1.30 - meaning the monetary equivalents of modeled damage reductions, ecosystem services, and social benefits exceed the anticipated costs of construction and long-term maintenance.

1. Modeled Damages:

1.a. Residential & Non-Residential Structures

To assess the current expected flood damages and the expected damage reductions from the proposed mitigation activities, each structure currently impacted by flooding up to the 500-year flood event was input into the Benefit-Cost Calculator as a separate line item using 'Modeled Damages' from the 'Floodplain and Stream Restoration' module. Hydraulic modeling conducted in March 2023 provided a detailed analysis of the water surface elevations (WSE) for 10-, 50-, 100-, and 500-year flood events for current conditions and conditions after mitigation. The following inputs and sources were used to complete the 'Floodplain and Stream Restoration' module for each of the structures:

+ **Project Cost:** $0 - each impacted structure was included only to estimate damage reduction from the mitigation action. The full cost of the project was included as a separate line item.

+ **Lowest Floor Elevation:** North Carolina Emergency Management (NCEM) manages a dataset containing all building footprints in the state. The data was developed for the North Carolina Floodplain Mapping Program (fris.nc.gov) as part of its effort to modernize FEMA Flood Insurance Rate Maps (FIRM) statewide. Data for structures located within the Special Flood Hazard Area (SFHA; 100-year floodplain) includes an accurate measure of FFE collected by laser inclinometer.

+ **Hazard Probability Parameters (Flood):** Raw data from the hydraulic model was used to identify streambed elevations, WSEs (before and after mitigation), and discharge values for each structure.

+ **Building Information:** Property tax cards from the Wayne County Online GIS database were used to obtain property and building information. For buildings within the Elmwood Terrace apartment complex, supplemental building information was provided by the Housing Authority of the City of Goldsboro (HACG).

+ **Standard Benefits (Building + Contents + Displacement):** Property tax cards from the Wayne County Online GIS database, building information providing by the HACG, FEMA BCA default values, and a value of one (1) resident was used as a minimum occupancy standard for all non-vacant structures in the study area (Note: the HACG provided the number of residents for each unit within the Elmwood Terrace property).

2. Expected Damages:

2.a. Non-Residential Structures - Social Benefits

Results of the hydraulic modeling indicated that the greatest flood-reduction impacts would benefit structures at Elmwood Terrace. Since multi-family residential structures are input into the BCA calculator as 'non-residential buildings', social benefits were not included for the Elmwood Terrace units in the 'modeled damages' module. In order to capture the social benefits of the stream and floodplain restoration project, the following method was used per the recommendation of a FEMA BCA Helpline representative:

Step One: An additional 'dummy' mitigation action was created for each occupied unit within the Elmwood Terrace complex using the 'Professional Expected Damages' module.

Step Two: The project cost was set to $1 and the project useful life was set to 1 year.

Step Three: In the table for 'Professional Expected Damages before Mitigation', a damage event was entered with a 1-year recurrence interval and $2 of damages.

Step Four: The number of residents and workers for each unit were entered into the 'Additional Social Benefits' section.

Step Five: All other fields were left blank.

Accordingly, the following inputs and sources were used to calculate the social benefits for each of the units:

+ **Project Cost:** $1 - per the recommendation of BCA Helpline for capturing the social benefits of the multifamily residential structures.

+ **Project Useful Life:** 1 year - per the recommendation of BCA Helpline for capturing the social benefits of the multifamily residential structures.

+ **Professional Expected Damages Before Mitigation:** $2 for a 1-year storm event - per the recommendation of BCA Helpline for capturing the social benefits of the multifamily residential structures.

+ **Additional Benefits - Social:** Total number of residents per unit and number of employed residents per unit provided by the HACG.

2.b. Floodplain and Stream Restoration

A separate line item was created in the Benefit-Cost Calculator to account for the ecosystem services benefits from the proposed mitigation actions. All of the project costs and maintenance costs were included in this section. A 50-year project useful life (PUL) was used per guidance in the "FEMA Ecosystem Service Value Updates" June 2022 publication: "when determining an appropriate PUL for all land cover categories [the] subapplicant can use a standard value of 50 years without the need for justification or documentation" (p. 23-24).

Since the expected damage reduction for each impacted property had already been calculated as a separate line item, the 'Professional Expected Damages' inputs were left blank, and only the 'Standard Benefits - Ecosystem Services' section was completed. The information below summarizes the inputs and sources used to calculate ecosystem service benefits:

+ **Project Area:** 17.68 acres - Calculated from preliminary conceptual designs for the Big Ditch scope of work (inclusive of Elmwood Terrace parcels containing proposed project and the limits of work for stream / floodplain restoration and roadway modifications).

+ **Urban Green Open Space:** 1.64 acres (9.27%) - Estimated from proposed land cover delineations per preliminary conceptual designs for the Big Ditch scope of work.

+ **Riparian:** 9.64 acres (54.52%) - Estimated from proposed land cover delineations per preliminary conceptual designs for the Big Ditch scope of work.

BENEFIT-COST ANALYSIS (cont'd)

3. Discussion:

3.a. Ecosystem Services

FEMA's "Ecosystem Service Value Updates" report (June, 2022) was referenced to determine how to best define land cover categories contributing ecosystem services within the project site. Areas within the project site that have been determined to contribute ecosystem services are described below:

Urban Green Open Space (1.64 acres):
Project areas meeting the FEMA definition of urban green open space include publicly accessible open space surrounding the floodplain and stream restoration. These areas will serve as community park space for residents of Elmwood Terrace apartments and the broader community. These will be predominantly pervious areas with lawn, trees, and mixed plantings, and will include park amenities like community gathering spaces, a playground, a shaded overlook of the restored stream, and a pedestrian bridge. Impervious areas will be limited to ADA-compliant pedestrian path systems connecting the various amenities. For reference, the FEMA definition of "Urban Green Open Space" is provided below:

"Green open space areas are those in which vegetated pervious surfaces account for at least 80% of total cover (impervious surfaces account for less than 20% of total cover) and include a mixture of some constructed materials. Green open space is considered "urban" if it meets the criteria specified in the U.S. Census Bureau's "2010 Census Urban and Rural Classification and Urban Area Criteria," which includes both Urbanized Areas (population of 50,000 or more) and Urban Clusters (population between 2,500 and 50,000) Examples of urban green open space include urban parks and recreational sites, neighborhood green spaces, pocket parks, green corridors and lawns."

Riparian (9.64 acres):
As a highly altered urban waterbody, large sections of Big Ditch have been straightened and armored – a functioning floodplain no longer exists and much of the stream is confined to concrete channels. As the primary mitigation action, stream and floodplain restoration of Big Ditch will achieve the following:

+ Reduction of water surface elevations and associated flood damages during modeled 10-, 50-, 100-, and 500-year flood events.

+ Restoration of the stream channel to accommodate a more natural meandering flow pattern.

+ Creation of a wider floodplain area more consistent with the pre-urbanized condition of Big Ditch, thereby increasing flood storage capacity and enhancing biodiversity potential.
+ Water quality and habitat enhancement through re-establishment of the native riparian ecotone with native plant species and communities.

For reference, the FEMA definition of "Riparian" is provided below:

"Areas where plant communities are contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent lotic and lentic waterbodies (rivers, streams, lakes or drainage ways). Riparian areas are usually transitional between wetland and upland.

Riparian areas have one or both of the following characteristics: (1) distinctly different vegetative species than adjacent areas, (2) species similar to adjacent areas but exhibiting more vigorous or robust growth forms."

Green Infrastructure - Urban Trees
In addition to the land cover contributing ecosystem services within the project area, the staging area along Elm Street will be planted with approximately eighteen (18) trees upon project completion. This area will not be programmed as public open space, thus it was not included in the acreage totals for 'Urban Green Open Space' above. However, the trees will reduce stormwater runoff through improved infiltration, slowing runoff rates, and evapotranspiration. Collectively, this will improve water quality in Big Ditch by reducing erosion and sediment loads, and will further reduce downstream flooding.

3.b. Elmwood Terrace Information Provided by the HACG

In total, staff from the Housing Authority of the City of Goldsboro (HACG) provided the following data in May 2023 - for each requested address (n=63) within Elmwood Terrace - to support data needed for accurately completing the BCA:

+ **Stories per Address:** 1 or 2 stories
+ **Square Feet per Address:** 950 sq ft, on average
+ **Residents per Address:** 133 people, in total
+ **Employed Residents per Address:** 21 people, in total
+ **Active NFIP Policy per Address:** 57 (currently), in total

3.c. Professional Opinion of Probable Cost

A concept-level cost estimate was generated for the project that reflects the scope of work illustrated in the 'Scenario C' plan for Big Ditch. The data used to prepare the projected cost of construction included, but was not limited to: RS Means Wilmington 2022 (Q3), NCDOT Bids, and recently completed construction projects with similar components. Consultation with a team of licensed landscape architects and civil engineers regarding the feasibility and constructibility of specific components of the 'Scenario C' plan also guided the refinement of the preliminary schematic design, and are represented in the final cost estimate.

The total cost of design / engineering and construction (not including additional costs associated with long-term maintenance) was estimated to be: **$7,587,039** as of September 2023. A categorical summary of the cost estimate includes the following information:
+ **General Requirements:** $144,514
+ **Erosion and Sediment Control:** $287,500
+ **Site Demolition:** $234,876
+ **Clearing and Grubbing:** $47,800
+ **Earthwork:** $501,816
+ **Utility Relocation:** $1,369,700
+ **Vehicular Drives and Lots:** $139,322
+ **Walkways, Stairs, and Ramps:** $389,000
+ **Site Walls and Fencing:** $1,153,700
+ **Site Furnishings:** $12,000
+ **Landscape:** $70,882
+ **Structures:** $1,616,464
+ **Signage:** $3,000
+ **Water Quality / Stream Restoration:** $851,867
+ **Design / Engineering and Permitting:** $705,600

3.c. Annual Maintenance Costs

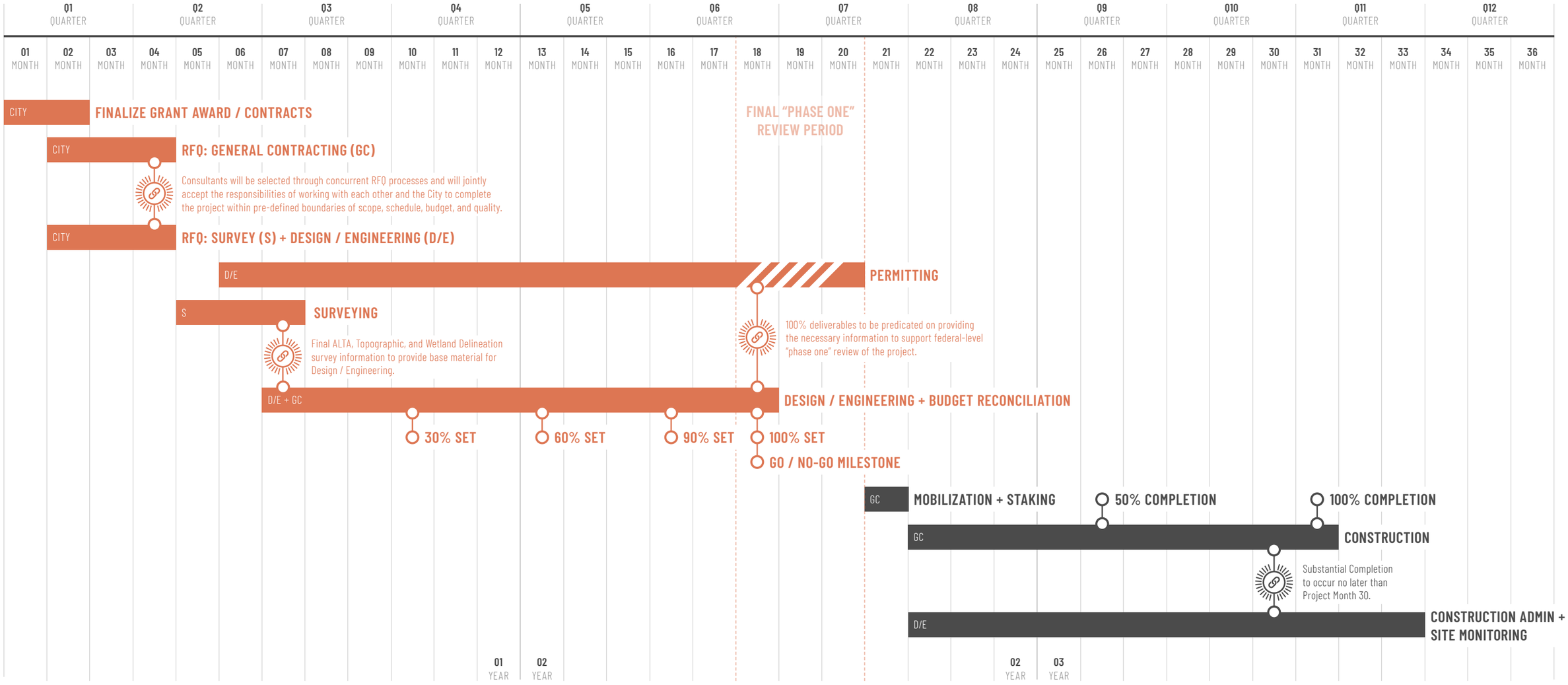
In total, maintenance costs are estimated to equal **$37,936** annually (calculated at 0.5% of the total project cost per FEMA guidance included in the "Supplemental Guidance for Conducting a Benefit-Cost Analysis for a Floodwater Diversion and Storage Project," 2016).

4. Results

4.a. Preliminary Cost-Effectiveness

Using the **3% discount rate** per FEMA's October 2022 memorandum, the combined monetary equivalent from modeled damage reductions, ecosystem services, and social benefits expected from the Big Ditch stream / floodplain restoration project totaled $11,164,791. With an estimated total project cost of $8,563,147 (inclusive of long-term maintenance costs), **the final benefit cost ratio (BCR) for the proposed scope of work was calculated to be 1.30, which establishes cost effectiveness for the project.** In summary:

+ **Benefits:** $11,164,791
+ **Costs:** $8,563,147
+ **Benefit-Cost Ratio (BCR):** 1.30



PROJECT SCHEDULE + DELIVERY METHOD

A "Design-Build Bridging" project delivery method (pursuant to NC General Statutes - Chapter 143 Article 8) **is recommended to complete the project within a 36-month period of performance.** Under this structure, Designers / Engineers and a General Contractor will be selected through concurrent Request for Qualifications (RFQ) processes, and will jointly accept the responsibilities of working with each other and the City to complete the project within pre-defined boundaries of scope, schedule, budget, and quality (recommended in conjunction with a 'phased' approach):

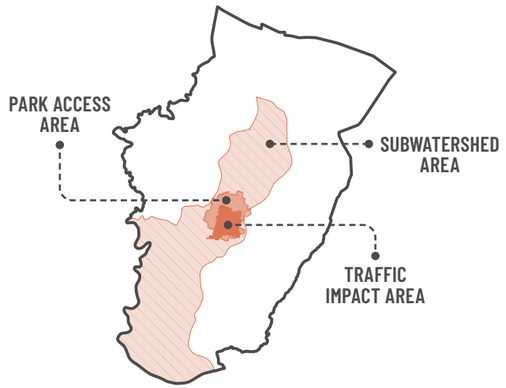
Phase One: Design / Engineering + Permitting. This aspect of the project is anticipated to require up to twenty (20) months to complete, and is primarily concerned with completing all pre-construction drawings, reports, permit sets, and cost estimates. Deliverables associated with this phase are predicated on providing the necessary technical data, engineering designs, milestones, and refined cost-effectiveness assessments to support a federal-level "Phase One" review of the project before a full construction approval can be issued. Selected Designers / Engineers are responsible for overseeing the completion of all deliverables required of "Phase One," with revisions to anticipated construction costs being continuously refined through simultaneous budget reconciliation exercises undertaken by both the Designers / Engineers and the selected General Contractor.

Phase Two: Construction. The second aspect of the project is anticipated to require up to thirteen (13) months to complete, and is primarily concerned with the construction and monitoring of the project site. The selected General Contractor is responsible for overseeing the completion of activities associated with "Phase Two," with additional construction administration (CA) services provided by the Designers / Engineers to observe construction progress, answer requests-for-information (RFI's) from the General Contractor (e.g., drawing set clarifications, field discrepancies, potential change order requests, etc.), and to ensure conformance with the final construction documentation (100% CD) design sets and specifications provided at the conclusion of "Phase One."

PROJECT IMPACTS + BENEFITS

While the purpose of the proposed Big Ditch restoration project is primarily intended to better control and manage floodwaters, it was also offer a wide breadth of ancillary benefits, such as: i) improved water quality throughout the project's "Subwatershed Area" (HUC-12: 030202011705); ii) increased safety within the road network that will benefit from modeled flood reductions ("Traffic Impact Area"); and iii) improved access to recreational amenities for residents living within a ten-minute walking distance of the site ("Park Access Area," National Recreation and Park Association (NRPA), 2017). Merged together, the proposed improvements to roadway safety, more equitable access to public parkspace, and enhancements to ecosystem services are estimated to positively impact 30% of the total population within the combined census tract area adjoining the project site (approximately 3,586 out of 11,958 buildings).

"The proposed improvements to roadway safety, more equitable access to public parkspace, and enhancements to ecosystem services are estimated to positively impact 30% of the total population within the combined census tract area adjoining the project site (3,586 out of 11,958 buildings)."



Map. Geographic areas included within the Project Impact Area.

Community Lifelines.

These projected outcomes of the Scenario 'C' plan work together to reduce risks and strengthen multiple "Community Lifelines" in Goldsboro (i.e., "fundamental services, assets, and capabilities that support recurring needs of the community," per FEMA's "Lifelines Implementation Toolkit v2.1," 2023). Specific benefits to lifelines include:

+ **Community Lifeline #1: Food, Hydration, Shelter.** This project supports the "Shelter" component of this lifelines by: **avoiding physical damages** (to residential properties and contents;

+ **Community Lifeline #2: Transportation.** This project supports the "Highway / Roadway / Motor Vehicle" component of this lifeline by: **lowering the risk of road closure** due to flood (two (2) of the three (3) road crossings in the project area will be able to withstand

IMAGE: Existing channel and floodplain condition within Elmwood Terrace.

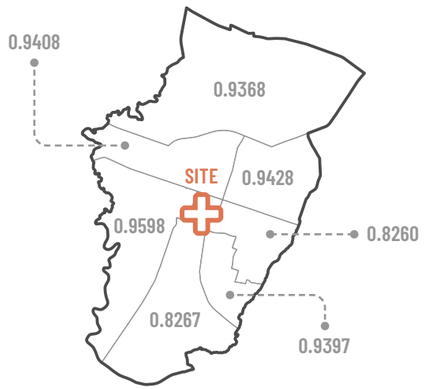
PROJECT IMPACTS + BENEFITS (cont'd)

flood conditions equivalent to modeled 100- and 500-year flood events); and

+ Community Lifeline #3: Safety and Security. This project supports the "Community Safety," and "Search and Rescue" components of this lifeline by: i) **avoiding loss-of-function costs** associated with the temporary or permanent displacement of staff and residents at Elmwood Terrace; and ii) **avoiding emergency management costs** (i.e., evacuation and/or debris removal efforts typically undertaken by emergency response units.

Future Conditions.
This project responds to anticipated effects of climate change outlined in the "North Carolina Climate Risk Assessment and Resilience Plan" (2020) by utilizing "bioengineering" techniques (i.e., mimicking natural floodplain processes) designed to increase: i) the **absorption and filtration potential of landscapes** subjected to increases in annual total precipitation; ii) the **ability of infrastructure to withstand hazards** associated with projected increases in hurricane intensities; and iii) **reductions in the severity of future property damage** stemming from projected increases in riverine flooding.

The project's "Subwatershed Area," Traffic Impact Area," and "Park Access Area" collectively intersect seven (7) census tracts in Goldsboro, all of which have CDC Social Vulnerability Index (SVI) values that meet the FEMA definition of a "disadvantaged" community (CDC SVI values greater than 0.8 out of 1.0).



Map. CDC SVI values for census tracts (n=7) adjoining Project Impact Area.

Disadvantaged Populations.
These outcomes are both important to building long-term community resilience in an underserved portion of Goldsboro, and have historically been challenging to attain and achieve in the areas surrounding Big Ditch, because the seven (7) census tracts intersecting the "Project Impact Area" all have **CDC Social Vulnerability Index (SVI) values that meet the FEMA definition of a "disadvantaged" community** (CDC SVI values greater than 0.8 out of 1.0)."

IMAGE: Proposed floodplain restoration within Elmwood Terrace.

LOW FLOW WETLANDS

MUNICIPAL GOLF COURSE

This project calls for **daylighting, widening, and vegetating two (2) previously buried drainage channels within the City of Goldsboro Municipal Golf Course.** The connected chain of linear wetlands, when combined with infrastructure improvements at inlet and outlet locations of the site, will: i) reduce nuisance flooding in the residential neighborhood north of the golf course; ii) improve drainage within the golf course; iii) enhance water quality prior to infiltrating the ground or discharging south of the golf course; and iv) enrich over 11.4 acres of newly established wildlife habitat at a property located within the Neuse River floodplain.

EXISTING CONDITION + PROPOSED RESTORATION APPROACH

Existing Condition. The Goldsboro Municipal Golf Course and the Mina Weil Neighborhood to the north of the course are located almost entirely within the Neuse River's 100-year floodplain, with many buildings' first floor elevations (FFE) well below the base flood elevation (BFE). In addition to the flood hazard from the Neuse River, the neighborhood also experiences frequent, nuisance pluvial flooding during smaller, more frequent rainfall events. This flooding is likely due to the natural drainage pathways being filled when the golf course was constructed, and the presence of undersized (and underperforming) infrastructure in place of the natural drainage pathways that would otherwise exist throughout the golf course.

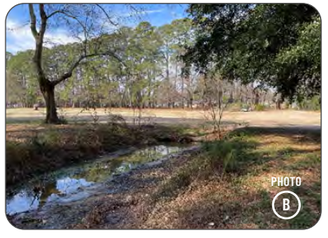
Proposed Restoration Approach. The proposed restoration approach calls for re-establishing historical drainage patterns to the greatest extent possible, as this will allow for water to flow from the upstream residential neighborhood more quickly and move downstream. Specifically: i) the existing main culverts and drainage ditch through the center of the golf course will be removed and replaced with a linear wetland / floodplain feature with a low flow channel; ii) additional linear wetlands and vegetated swales will be incorporated to improve drainage from the neighborhood streets to the golf course; iii) the culvert at Graham Street will be lowered; iv) the culvert at Dixie Trail will be enlarged; and v) the abandoned walking path at the downstream end of the golf course (near Hole 8) will be removed.

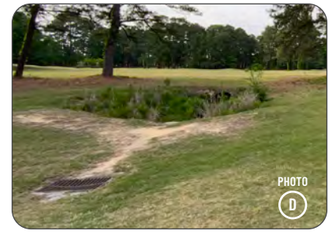
The main drainage culverts throughout the golf course are not able to convey the peak discharge volumes from even a 2-year flood event, which causes nuisance pluvial flooding during smaller, more frequent rainfall events in the residential neighborhood north of the golf course.

The main drainage culverts (two 30" RCP; Photo 'C') at the north end of the course which serve as the only outlet for stormwater leaving the Mina Weil Neighborhood, are designed to only convey about 80% of the 2-year peak flood discharge. However, the pipes are partially filled with sediment and backwatered, so the actual capacity is substantially lower. Moving downstream, near the middle of the golf course, the main drainage pipe (42" RCP; Photos 'A' and 'D') can only convey about 50% of the 2-year peak flood discharge.

At the furthest downstream portion of the golf course, there is a weir along the main drainage ditch that partially blocks the outlet culvert, and the culvert at Dixie Trail is also

This approach is targeted at smaller rainfall events that cause nuisance flooding (e.g., 2-, 5-, and 10-year flood return periods). For larger events where the flooding source is directly from the Neuse River (or backwater conditions from the Neuse River that prevent drainage), restoration activities on the golf course will have negligible impact on peak flood levels.



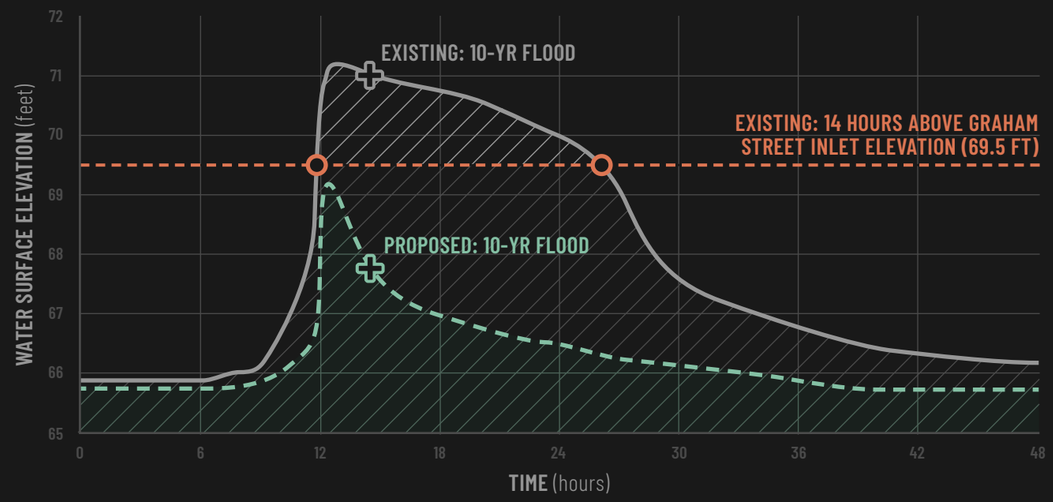


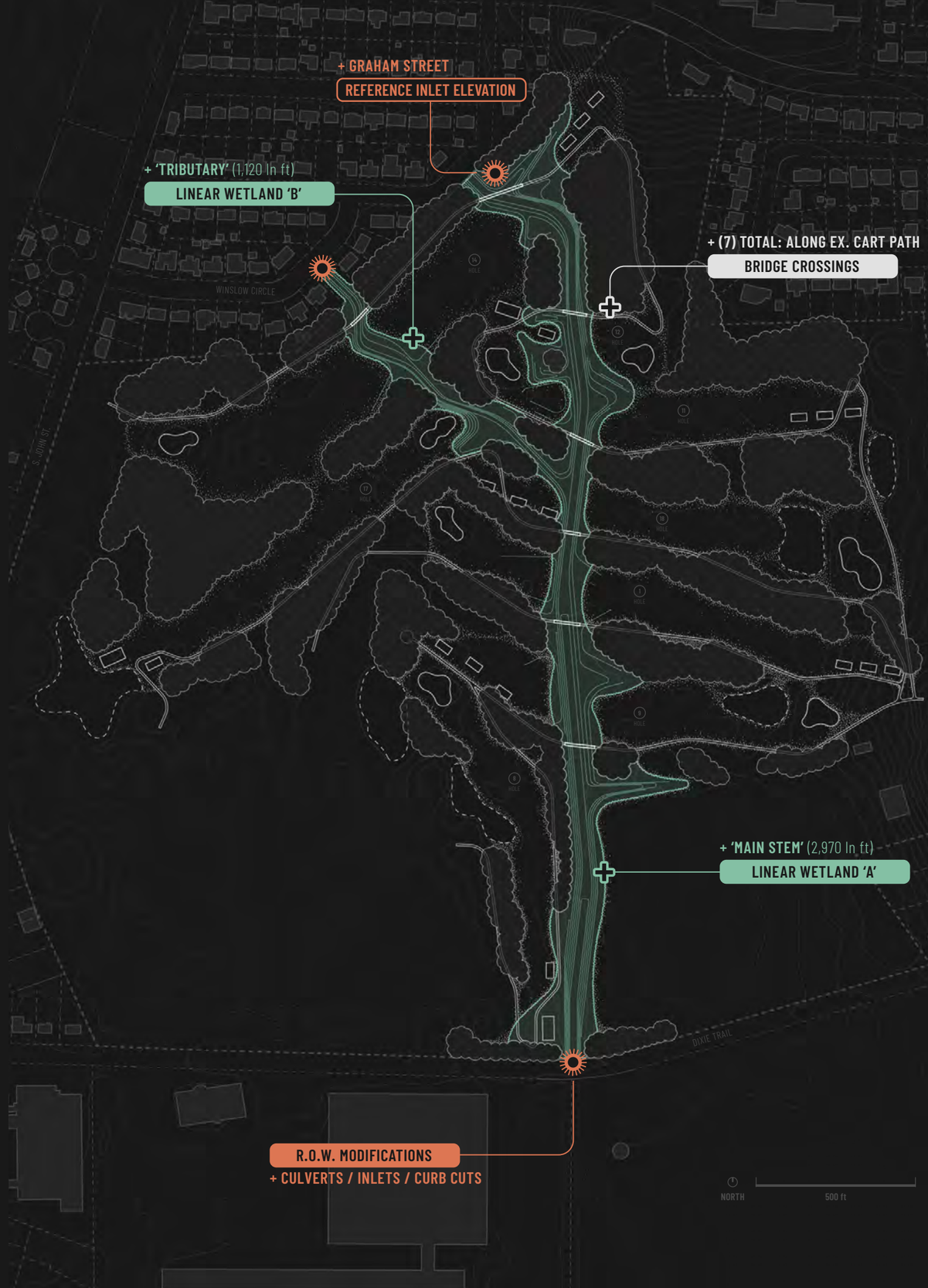
Photos: CDDL, Doll, B., and Kurki-Fox, J. (2023).

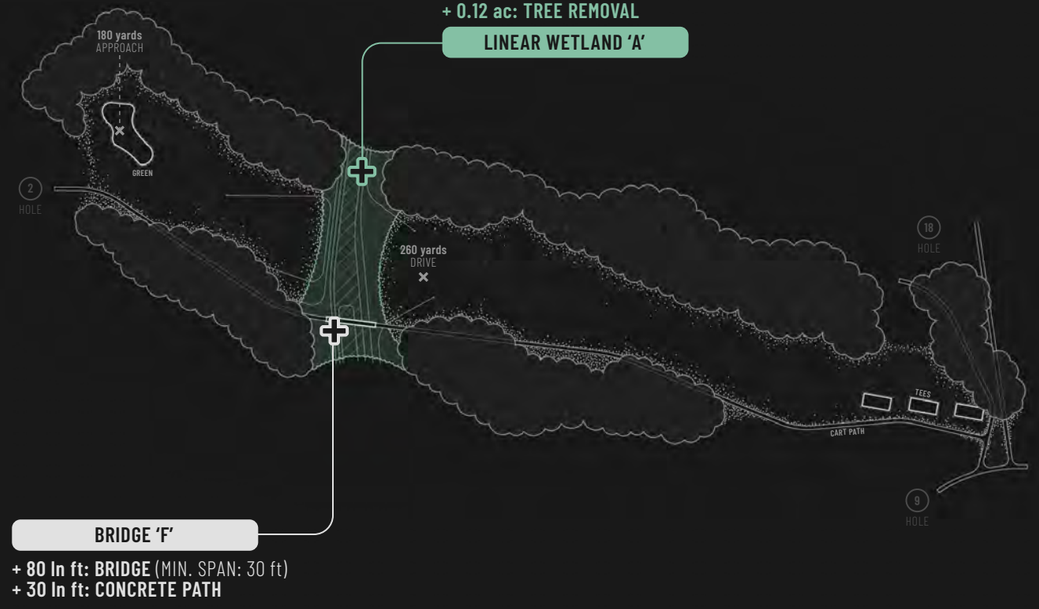
SUMMARY OF METHODS + RESULTS

To evaluate the impacts of the proposed restoration approach, a HEC-RAS 2D rain-on-grid model was used. The topography data for the model was based on LiDAR digital elevation model (DEM) elevations (NCEM, 2018) and on-site survey data collected with an RTK device. Analyzing model results in peak Water Surface Elevation (WSE) at the neighborhood's storm sewer outlet (to the golf course main drainage ditch) showed the existing WSE for the 2- to 10-year rainfall return period is above the elevation of the stormwater grate inlets along the neighborhood streets, causing water to back up in streets and properties. By implementing the restoration, the peak WSE at the neighborhood's main drainage outlet could be lowered by 2- to 2.5-feet during the 2- to 10-year rainfall return period.

Modeling of the proposed restoration scheme shows a reduction of peak Water Surface Elevation (WSE) at the reference street drainage inlet by 2.0 - 2.5-feet during smaller storm events (e.g., 10-year flood), resulting in greater roadway accessibility and protection of private property upstream of the Municipal Golf Course.





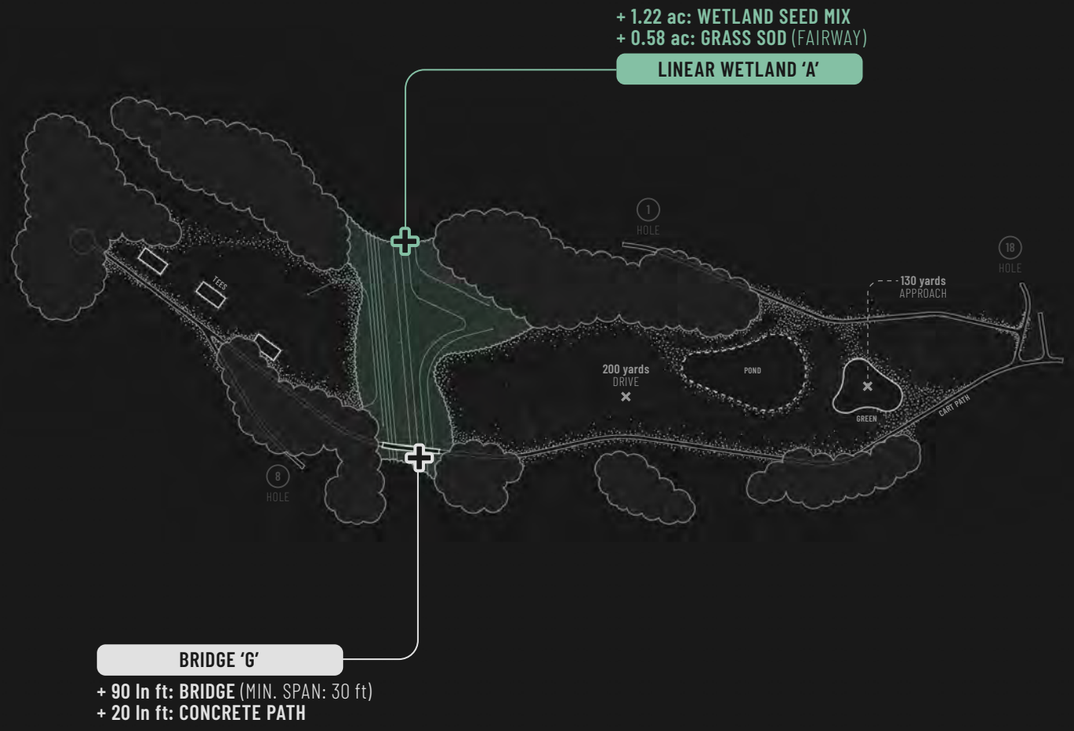


HOLE 1: PAR 5

Impacts on Play: While most shots from the Hole 1 tee boxes are unlikely to reach Linear Wetland 'A' (approx. 260 yards), approach shots from the fairway to the green will need to carry approx. 40 yards over the newly restored area.

HOLE 8: PAR 4

Impacts on Play: Proposed improvements along Hole 8 will have a minimal impact on play (i.e., only errant shots from the tee boxes), as existing tree canopy and streambed currently occupy a similar area as the newly restored area.

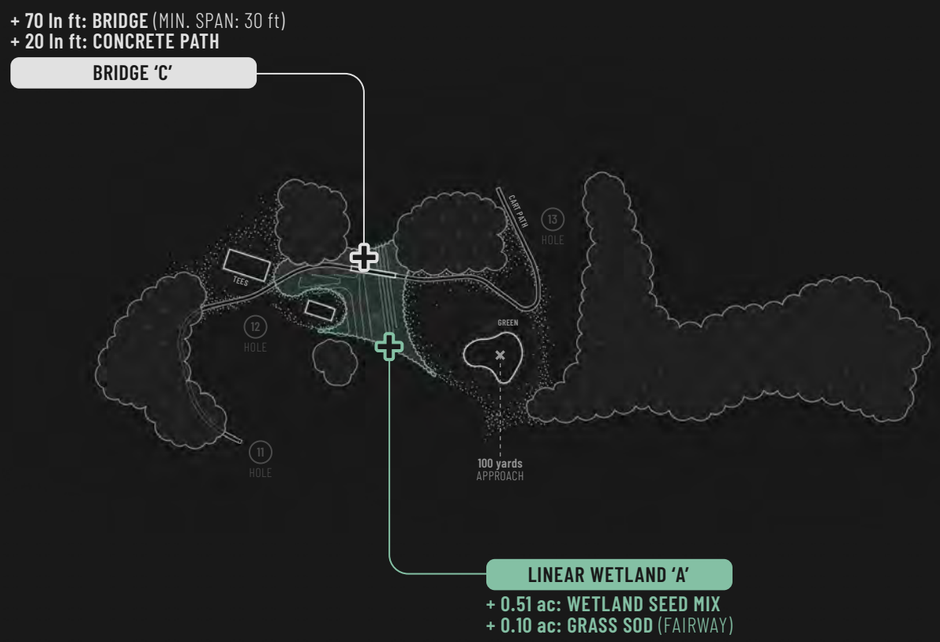


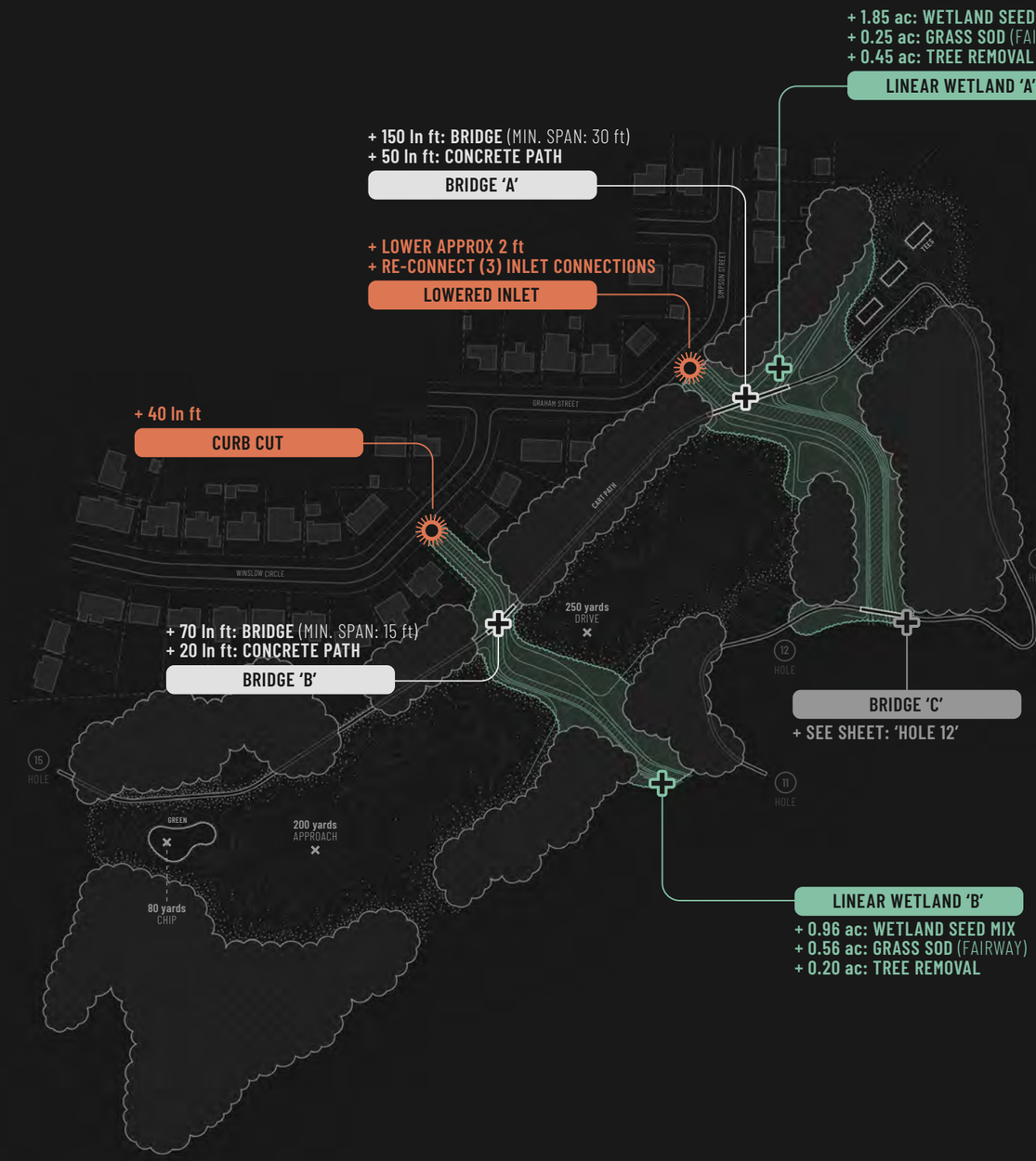
HOLE 9: PAR 5

Impacts on Play: Shots from the Hole 9 tee boxes will need to carry approx. 55 yards over the newly restored area, however, the extents of Linear Wetland 'A' are not within the typical landing area of driver-range shots from the tee boxes.

HOLE 11: PAR 4

Impacts on Play: Shots from the Hole 11 tee boxes will need to play "short" of Linear Wetland 'A' (approx. 160 yards), and approach shots from the fairway to the green will need to carry approx. 50 yards over the newly restored area.





HOLE 12: PAR 3

Impacts on Play: Shots from the Hole 12 tee boxes to the green will need to carry approx. 40 yards over the proposed improvements within Linear Wetland 'A.'

HOLE 14: PAR 5

Impacts on Play: Shots from the Hole 14 tee boxes will need to carry approx. 85 yards over Linear Wetland 'A,' and approach shots from the fairway to the green will need to carry approx. 40 yards over Linear Wetland 'B.'

HOLE 17: PAR 4

Impacts on Play: Shots from the fairway to the Hole 17 green will need to play "short" of the proposed improvements to the rear of the green (i.e., errant shots that go beyond the green will be inaccessible).

HOLE 18: PAR 5

Impacts on Play: Shots from the Hole 18 tee boxes will need to carry approx. 30 yards over the newly restored area, however, the extents of Linear Wetland 'A' are not within the typical landing area of driver-range shots from the tee boxes.

PRECEDENT EXAMPLES + 'PHASE ONE' PROJECT SCOPING

Nationally, the United States Golf Association (USGA) has recognized constructed stormwater wetlands as a viable solution for reducing drainage outflow volumes and improving downstream water quality. The USGA is now increasingly offering programs to support the implementation and long-term management of landscapes yielding these types of water quantity and quality benefits.

In North Carolina, NC State Cooperative Extension and the Department of Biological and Agricultural Engineering have been involved with multiple constructed stormwater wetland projects on golf courses. More recent examples include: Eagle Point Golf Club in Wilmington, NC (Photo 'A'), Chowan Country Club in Edenton, NC (Photo 'B'), and the Lonnie Poole Golf Course in Raleigh, NC (Photo 'C').

"It is recommended that the design / engineering scope be inclusive of at least a 12-month period for water quality sampling. This will allow design schemes to best fit existing baseline conditions, and for the performance of the post-construction landscape to be adequately compared against the pre-construction condition."

For each of these projects, water quality sampling and data collection have been integral in meeting specific environmental protection goals. To apply a similar approach to the Municipal Golf Course in Goldsboro, it is recommended that part of the pre-construction design / engineering sequence be inclusive of at least a 12-month period for water quality sampling.

Since measuring the effectiveness of the post-construction landscape is only possible through the measurement of existing baseline conditions, the: i) installation of monitoring equipment; ii) establishment of data collection procedures; and iii) reporting of current water quality conditions will allow for:

+ Design schemes to best fit existing baseline conditions; and
+ The performance of the post-construction landscape to be adequately compared against the pre-construction condition.

Estimated costs associated with completing anticipated deliverables for concurrent "Water Quality Sampling" and "Design / Engineering" phases include:

+ Water Quality Sampling + Data Collection: $51,146
+ **Personnel:** estimated percent of effort over a sixteen (16) month equipment setup and sampling period.
+ **Supplies:** ISCO 6712 samplers; bubbler flow meters; sensors, modules, and probes + travel allowance for installation, sampling, and maintenance trips (n = 17).
+ **Lab Analysis:** TKN, NH3, NOx-N, TP, TSS

+ Survey + Design / Engineering + Permitting: $208,740
+ **Professional Services:** industry standard billable rate schedules for anticipated professional services. Estimated timelines include: up to four (4) months for surveying, and up to eighteen (18) months for design / engineering and permitting.

+ Project Management + Technical Assistance: $18,192
+ **Personnel:** estimated percent of effort over a twenty-four (24) period of performance inclusive of both "Water Quality Sampling" and "Design / Engineering" phases.
+ **Supplies:** travel allowance for site visits, meetings, and ground-truthing (n = 5).

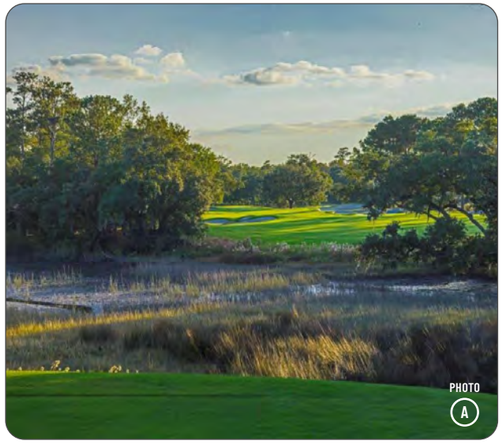
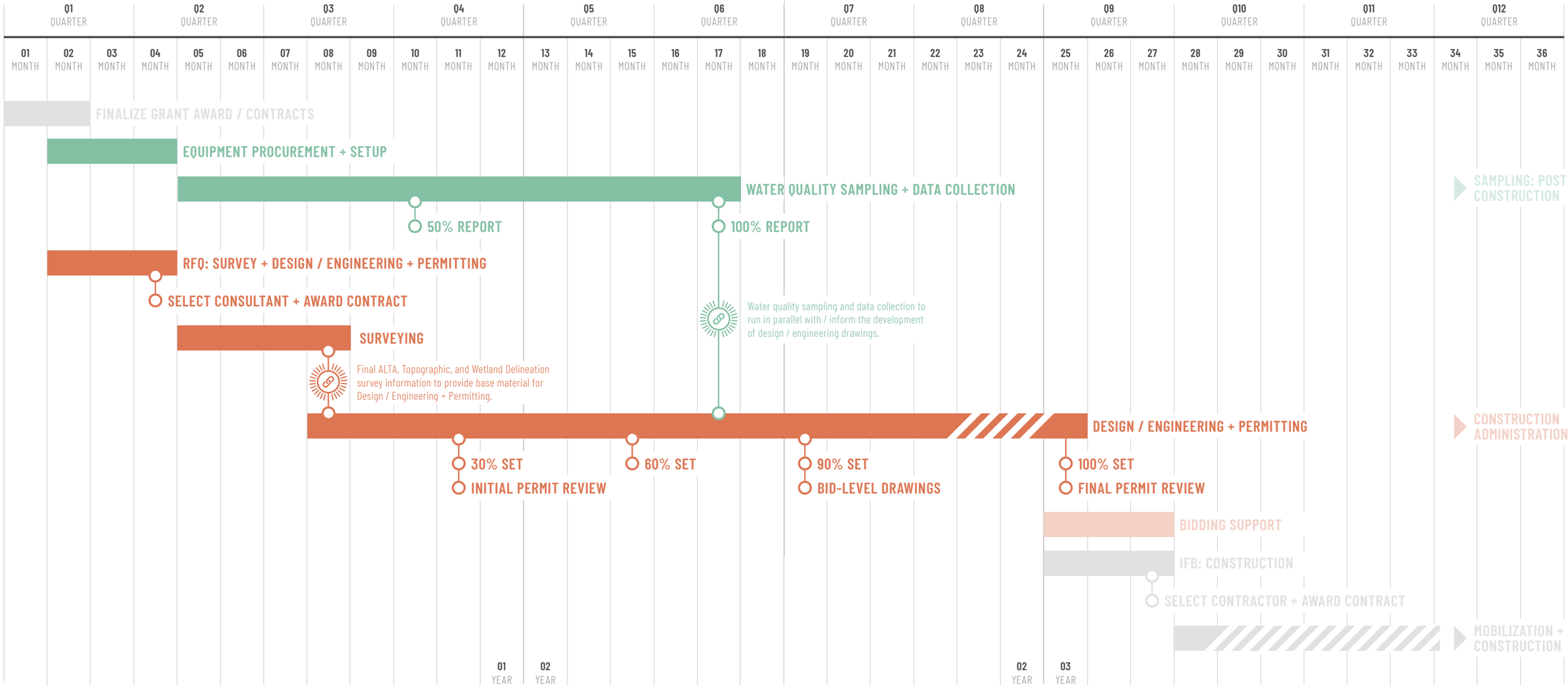


Image. Eagle Point Golf Club in Wilmington, NC (Golf Digest).

Image. Chowan C.C. in Edenton, NC (NC State Extension).

Image. Lonnie Poole Golf Course in Raleigh, NC (USGA).



PROJECT SCHEDULE + DELIVERY METHOD

Prior to seeking monies for construction, an appropriate series of next steps to advance the development of this project include:

+ **Determine a baseline condition for water quality in the project area** (pre-construction);
+ **Use the water quality data collected to inform the refinement of design / engineering plans;** and
+ **Deliver a set of bid- and permit-level drawings** for the restoration scope of work.

As outlined in the timeline graphic above, it is recommended that the "Water Quality Sampling" phase of the project (shown in green) run concurrent with the "Design / Engineering" phase (shown in orange).

In doing so, the 50% Water Quality Report will be delivered to the Design / Engineering team prior to the 30% Drawing Set due date, and the 100% Water Quality Report delivered prior to the 90% Set due date. These intersecting benchmarks will enable the design plans to be refined as real-time data is being captured and analyzed on the project site.

Should additional funds be made available for construction, the timing of fund availability will be crucial in forming the subsequent project delivery method. Construction monies made available during the "Design / Engineering" phase could allow for a selected General Contractor to join the project team in a "Design-Build" format - aiding in budget reconciliation processes prior to final permitting. However, assuming construction funds come later, the graphic above illustrates a "Design-Bid-Build" delivery method. Under this structure, the City will advertise an Invitation for Bid (IFB) for the project, and select the lowest bid among qualified General Contractors that respond to the IFB.

IMAGE: Existing buried channel condition at the Municipal Golf Course.

PROJECT FEATURES + BENEFITS

The current preliminary schematic plans, used as the basis for conceptual-level hydraulic modeling and initial "phase one" scoping, include the following quantity summaries for each landscape feature:

+ **Total Wetland Area:** 11.43 acres
+ **Total Sod Area (Fairways):** 4.28 acres
+ **Total Seed Area (Driving Range):** 0.88 acres
+ **Total Tree Removal:** 2.38 acres
+ **Concrete Cart Path:** 190 linear feet
+ **Bridge Crossings:** 7 units (ranging from 70 linear feet to 150 linear feet in length; with minimum spans over wetland channels typically 30 feet)
+ **Right-of-Way Modifications:** 40 linear feet of curb cut at Winslow Circle; one (1) lowered inlet at Graham Street; and one (1) upgraded culvert at Dixie Trail.

While the primary, targeted benefits of implementing this mix of "green" and "gray" infrastructure is intended to reduce nuisance flooding, enhance water quality, and enrich newly established wildlife habitat, secondary benefits of the project include:

+ **Environmental education opportunities** for users of the golf course and/or through facilitated events by the City Parks and Recreation Department;
+ **Reductions in labor demands** (i.e., irrigation and mowing) for golf course staff; and
+ **Enhanced aesthetic value** for property owners surrounding the golf course.

However, similar to the Big Ditch proposal, this project is located in a neighborhood with elevated environmental justice concerns - which historically, has translated to a lack of external investment in capital improvement projects of the scale or containing the potential benefits as being proposed at the Goldsboro Municipal Golf Course. Offering a slight deviation from the FEMA definition of

IMAGE: Proposed restoration condition at the Municipal Golf Course.

PROJECT FEATURES + BENEFITS (cont'd)

"disadvantaged community," this project is located within a census tract and subwatershed that satisfy the U.S. Environmental Protection Agency (EPA) definitions of **"overburdened"** and **"underserved"** communities. Specific data to support these classifications include:

+ **Median Household Income:** $38,186 (below the NC figure of: $60,516; U.S. Census Bureau, 2021)

+ **Minority Population:** 96.0% (higher than the NC figure of: 33.1%; U.S. Census Bureau, 2021)

+ **Environmental Risks:** 80.7% of the land area in this census tract is within the mapped 100-year floodplain of the Neuse River (FEMA, 2020).

Collectively, the overlap of economic, racial, and geographic factors illustrate the need for external infusions of project capital to support the proposed scope of work.

"Similar to the Big Ditch proposal, this project is located in a neighborhood with elevated environmental justice concerns - which historically, has translated to a lack of external investment in capital improvement projects of the scale or containing the potential benefits as being proposed at the Goldsboro Municipal Golf Course."

SCOPING: FLOOD MITIGATION + FEASIBILITY STUDY

WASTEWATER TREATMENT PLANT

The need for a flood mitigation and feasibility study for the WWTP has been determined as an appropriate next step to better understand potential mitigation alternatives and their associated trade-offs. As part of this report, **major scope elements required of a potential flood mitigation study for the WWTP have been identified,** including the: i) development of a preliminary opinion of consultant fee ranges; ii) identification of major qualifications and criteria for selecting prospective consultants; and iii) integration of scope, fee, qualifications, and selection criteria into a draft Request for Qualifications (RFQ) solicitation.

BACKGROUND + SCOPE

The City of Goldsboro owns and operates a 14.2 million gallon per day (MGD) water reclamation facility for treatment of wastewater. Effluent is either discharged to the Neuse River or pumped to City-owned farmland, the Municipal Golf Course, or constructed wetlands; solids are taken to a composting facility.

The WWTP is the sole treatment facility for the City, and also receives flow from Fremont, Wayne County, Walnut Creek, Case Farms, Fork Township and Seymour Johnson Air force Base (SJAFB). The WWTP's national pollution discharge elimination system (NPDES) permit is written such that facility can be expanded to 17.6 MGD without a major permit modification.

The WWTP is located entirely within the regulatory floodway of the Neuse River. Hurricanes Matthew (2016) and Florence (2018), and other events, have caused significant flooding which interrupted operations and have had negative environmental impacts. The proposed engineering study will be focused on the feasibility of mitigating flood risk at the WWTP, including an option to relocate the facility from its current location.

BACKGROUND + SCOPE (cont'd)

Existing WWTP Process. The City of Goldsboro WWTP uses a biological nutrient removal process (A2O) to treat 14.2 MGD through four (4) process basins. The Facility was originally constructed with extended aeration oxidation ditches, but was retrofit in 1994 for nutrient removal. The plant has been expanded incrementally over the years to its current capacity. The most recent upgrades were in 2002, and addition of a fifth basin / clarifier is planned to bring the Facility capacity to 17.6 MGD. This expansion requires filling in part of the south lagoon and will also require upgrades to grit removal, influent flow measurement, filtration, disinfection, and effluent measurement and disposal.

The plant and adjacent ponds are located entirely within a perimeter levee that is elevated to prevent floodwaters from inundating the facility (the Base Flood Elevation (BFE) for the plant area is approximately 72-feet).

flume. An equalization pond is used for temporary storage during high flow events by diverting from the Influent Structure. During typical operation, flow is split between two grit chambers, with heavy solids being pumped to the equalization pond. From the grit chambers, flow is split and measured into four Aerator/Clarifier splitter boxes. This is the beginning of the biological process, which has built-in flexibility for various treatment schemes. The system typically operates as an A2O process, with an Anaerobic-to-Anoxic-to-Oxic progression. Nitrate recycle is returned from the aerobic zone to the anoxic zone.

After flowing through the outer ring treatment basins, the A2O discharge enters a control box and the clarifiers located in the center of the circular basin structure. The four structures collect settled biological solids and send them to a common RAS/WAS pump station. Wasted biosolids

Qualified firms capable of performing the desired study should have demonstrated experience in the evaluation, siting, and design of wastewater treatment and collection infrastructure located in or near floodways and flood-prone areas (with experience in the evaluation and design for retrofit and flood-proofing of existing water and wastewater utility infrastructure being preferred).

Flow to the plant is received primarily through the Westbrook Pump Station (WPS) Force Main, which underwent a 2002 expansion from 24-inch to 42-inch. The WPS system now has pipeline capacity for future expansions, and a firm pumping capacity of 32 MGD. Wastewater is screened at the WPS prior to conveyance to GWRF. Flow is received from the WPS force main and other smaller pump stations into the Influent Structure, where it is measured in a Parshall

are dewatered in belt filter presses, stored onsite, and hauled to an offsite composting facility.

Clarified effluent enters control boxes and an Intermediate Pump Station, where it is pumped to the filtration system. Four traveling bridge sand filters polish the effluent and pass flow to a UV disinfection system. Final effluent passes through a Parshall flume and cascade aerator before being discharged by gravity to the Neuse River. An effluent pump station is available for discharge during high river periods, and a reuse pump station diverts some flow for use in the plant and for irrigation and wetlands treatment offsite. The plant has two diesel generators that can run the entire facility for approximately seven days.

Anticipated Scope of Study. Firms qualified to perform desired study of potential flood mitigation measures should have demonstrated experience in the following:

+ The study, evaluation, preliminary engineering, design, and construction of municipal wastewater treatment systems; and
+ The evaluation, siting, and design of wastewater treatment and collection infrastructure located in or near floodways and flood-prone areas (with experience in the evaluation and design for retrofit and flood-proofing of existing water and wastewater utility infrastructure being preferred).

The anticipated scope of the study is likely to include:

+ Review of existing flood maps and models, existing operating data, plant drawings and surveys
+ Additional site and levee survey, and other needed geotechnical investigations
+ Identification of critical impacted equipment, systems, and areas, including:
  - Vulnerability
  - Consequence of failure
  - Cost impact of failure (replacement and operational impacts)
  - Mitigation priority level
+ Establishment of criteria and risk potential for flood protection, redundancy, and resiliency, including design storms, levee freeboard, etc.
+ Development of concepts for facility improvements and/or relocation, including:
  - Rehabilitate / improve existing protection of plant facilities / critical systems
  - Reconfiguration of plant protection at existing site
  - Construction of new plant at new, unidentified site
+ Evaluation of concepts related to:
  - Collection system and influent conveyances
  - Power supply and reliability
  - Discharge permitting
  - Reuse streams and conveyance
  - Solids disposal
  - Capital and operating costs
  - Flood risk reduction
  - Future expansion capability
  - Project schedule
+ Deliver a report of the review and evaluation, including recommendations and executive summary.

The fee for completing the aforementioned scope of work is estimated to be $352,000 (using September 2023 values for anticipated professional services).

SCHEDULE + EVALUATION PROCESS

Anticipated RFQ + Project Milestones. After issuance of the RFQ, the anticipated schedule includes the following milestones (listed durations are from completion of previous activity):

+ **Statement of Qualifications (SOQ) Due:** 1 month
+ **Qualified Respondents Notified:** 1 month
+ **Request for Proposal (RFP) Issuance:** 3 months
+ **Notice of Selection for Study:** 2 months
+ **Notice to Proceed (NTP) with Study:** 2 months
+ **Final Report:** 12 months

Evaluation Process. A selection committee, comprised of City staff and management, will review and evaluate the Statement of Qualifications (SOQ's) received. The selection committee will identify respondents that may advance to the Request for Proposal (RFP) stage, and will notify respondents accordingly. The evaluation of submissions will be based on the following:

+ The contents of the submission
+ Any clarifications provided in writing in response to questions asked by the selection committee;
+ Interviews, as necessary.

It is recommended that responses to the Request for Qualifications (RFQ) be evaluated using the following criteria set on a 100-point maximum scale:

+ **Prior Experience (40 points):** Presentation of experience with projects of similar size, scope, use, and complexity. Details of past record and past performance, as well as the number and size of projects completed in the last five years. It is recommended that the respondent present five (5) wastewater treatment projects and three (3) flood mitigation projects. Selected projects should include concept development, alternative evaluation, and life-cycle cost based process decisions.
+ **References (20 points).** References provided by clients that would recommend the respondent for similar services. Notable comments provided from references and evidence of a good past performance record with other clients should be encouraged.
+ **Project Management Approach (15 points).** Demonstration of the ability to meet time and budget requirements on delivery of comparable WWTP projects. Description of the skill of workload balancing for recent, current, and projected workload of the firm, and the personnel proposed for work on this project should be provided.
+ **Staff (15 points).** Descriptions of the skill, capability, and experience level of professional personnel, in personnel resumes and project descriptions on areas relevant to this project. Appropriate qualifications, experience, and capabilities of the management team assigned to this project, and evidence of prior successful projects are to be listed. An adequate amount of personnel assigned, or access to sufficient personnel with appropriate project experience to accelerate the project schedule, if necessary should be referenced. This section of the RFQ response should focus on key staff and how they will integrate with the City's staff and project management team to provide value to the project.
+ **Local Experience and Proximity to the Work Location (10 points).** Descriptions should detail ability to furnish the required services that best serve the needs of the City and the project. In this category, the familiarity of the local area and the amount of business performed in North Carolina is significant. Also, the presence of local staff and design professionals that will perform the work primarily near the site should be encouraged.

RECOMMENDED RFQ SUBMISSION GUIDELINES

Firms that respond to the Request for Qualifications (RFQ) should include the following information in their Statement of Qualifications (SOQ) package:

Letter of Interest. A letter must be submitted that states the interests of the respondent in this project and shall be signed by a person who will have contract authority over the entire project indicating that the contents of the submittal are true and accurate. It shall also include contact information regarding the applicant's principal office and organization.

The respondent, sub-contractors and individuals must hold current licenses as required by the State of North Carolina to perform architectural and engineering services and contractor's license to perform the work.

Respondent Experience. The respondent must present five (5) wastewater treatment projects and three (3) flood mitigation projects. The respondent shall provide information to demonstrate its individual member and collective team qualifications including design for similar WWTP facilities processing municipal wastewater. Preference will be given to water reclamation facilities of similar size executed in the last five years (from the date of RFQ issuance).

The intent of this section is to determine if the Respondent has adequate experience in dealing with Publicly Owned Treatment Works (POTWs). The respondent shall demonstrate their ability to undertake the project by providing evidence of their technical experience and qualifications related to the design, construction, performance testing, outfit, start-up, and obtaining of governmental approvals for treatment projects comparable to the project. The following information shall be included:

+ Project name
+ Detailed description of the project
+ Date completed and original duration of the contract
+ Owner's name, contact name, and telephone number

Structure of Respondent. The intent of this section is to characterize the respondent's team that will be used on this project and how the various entities will function together. The following information must be provided:

+ Name the respondent firms and key team members that will – if selected – form the team that will be assigned to the project. Organizational charts to illustrate how the key team members will function together and the reporting structure is required.
+ Indicate whether this type of work has been performed with this team and indicate the relationship of the firms (for example, joint venture, or prime).

Personnel Experience. This section requests details of the experience of specific personnel that the respondent intends to use on this project. Professional profiles or résumés must be submitted (recommended maximum of two pages for key team members) and indicate the office location for each individual. Additional personnel information should include their office / area of residence, details regarding education and training, experience, and major projects, at a minimum. An individual's participation on referenced projects included in the "Respondent Experience" section shall be identified.

The total number of résumés shall not exceed ten (10) and should be organized in order of management personnel, design personnel, and construction personnel as follows:

+ Project principal-in-charge
+ Project manager
+ Quality control manager
+ Leader for each technical discipline

04 | APPENDIX + RESOURCES

APPENDIX: HUD / NCORR DEFINITION OF "MOST IMPACTED AND DISTRESSED" (MID) COMMUNITIES

Qualifying for a Most Impacted and Distressed (MID) designation by the North Carolina Office of Recovery and Resiliency (NCORR) is a result of a combination of three components: i) location; ii) qualities demonstrating that the area is "most impacted;" and iii) qualities demonstrating the area is "most distressed."

The location of the area is critical to the MID designation. It must be a sub-county area within a county declared by the President to be a major disaster area under the Stafford Act. This sub-county area can be a census-designated place, a tribal area, or a census tract.

The sub-county area must demonstrate that it is "most impacted" by qualifying under at least one of these factors: i) housing; ii) infrastructure; iii) economic revitalization; and/or iv) environmental degradation. To qualify under the "housing" factor, there must be damage to either a minimum of 100 homes or there must be serious damage to a minimum of 20 homes. To qualify under the "infrastructure" factor, there must be damage to permanent infrastructure estimated at $2 million or greater. To qualify under the "economic revitalization" factor, there must be significant employment loss and extended harm to the local economy. To qualify under the "environmental degradation" factor, the damage must threaten the long-term recovery of critical natural resources.

In addition to qualifying as "most impacted," the area must also demonstrate that it is considered "most distressed" by qualifying under at least one of these factors: i) low- and moderate-income households; ii) loss of affordable rental housing; iii) it is a federal target area or economically fragile area; and/or iv) the area has prior documented environmental distress. To qualify under "low- and moderate-income households," greater than 50% of the people living in the area must make less than 80% of the Area Median Income (AMI). To demonstrate that the area qualifies under "loss of affordable rental housing," there must be a minimum of 100 renters with less than 50% of the median income. 60% or more of these renters must have a severe housing problem. To qualify as a federal target area or economically fragile area, the area must be: i) a tribal area; and/or ii) is a Strong Cities Strong Communities site; and/or iii) the area's unemployment rate is more than 125% of the national average unemployment rate. To qualify under "prior documented environmental distress, the area must contain a contaminated property that has been cleaned, or is undergoing cleanup, or is proposed for cleanup.

Another avenue for qualifying for MID designation by NCORR is by simply being a county that was previously determined by the US Department of Housing and Urban Development (HUD) to be "most impacted."

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