Greenville
NORTH CAROLINA

8.25.2016

Watershed Master Plan Workshop

Find yourself in good company

Greenville
NORTH CAROLINA

Agenda

- Background on Stormwater Utility
- Recap 2013 State of the Stormwater Utility Fund
- Watershed Master Plan (WSMP) Overview
- Highlights from watersheds
- Implementation
- Operational Impacts (Maintenance/Ordinance)
- Utility Impacts

Greenville
NORTH CAROLINA

Clean Water Act

- Established 1948 – (overhauled in 1972) regulates the discharge of pollutants into the waters of the United States
- Unlawful to discharge pollutants into navigable waters
- Criminal charges possible for violations

Greenville
NORTH CAROLINA

Clean Water Act

Former Owner of American Waste, Inc. Sentenced to 18 Months Imprisonment for Illegal Dumping

Columbia, South Carolina---- Acting United States Attorney Beth Drake stated today that , age 51, of Greer, South Carolina was sentenced yesterday in federal court in Anderson, South Carolina, for Violating Pretreatment Standards of the **Clean Water Act**, in violation of 33 U.S.C. § 1317 and 1319.

Greenville
NORTH CAROLINA

Stormwater Utility Fund

- Stormwater Utility Ordinance established the enterprise fund May 2001 to address pending mandates of the Clean Water Act
- Greenville has a Phase II NPDES permit that regulates the discharge of stormwater
- Nutrient control of Nitrogen and Phosphorus required

Greenville
NORTH CAROLINA

Stormwater Utility Fund

- Intent of Fund

"SEC. 8-3-3(A) There is hereby established a stormwater management utility…which shall provide for the management, protection, control, regulation, use and enhancement of stormwater and drainage systems."

- The fee was implemented July 2003

Greenville
NORTH CAROLINA

Stormwater Management Program

- Funded by the Stormwater Utility
- Stormwater Management Control Ordinance Approved September 2004
- Required per:
  - Tar-Pamlico Stormwater Rule
  - NPDES Phase II Stormwater Regulations

Greenville
NORTH CAROLINA

Stormwater Management Program

Requirements of the Program:

- Public Education and Outreach
- Public Involvement and Participation
- Illicit Discharge Detection and Elimination
- Construction Site Runoff Controls
- Post-Construction Site Runoff Controls
- Pollution Prevention and Good Housekeeping for Municipal Operations

Greenville
NORTH CAROLINA

Potential Stormwater Issues

Ditch Flooding

Greenville
NORTH CAROLINA

Street Flooding

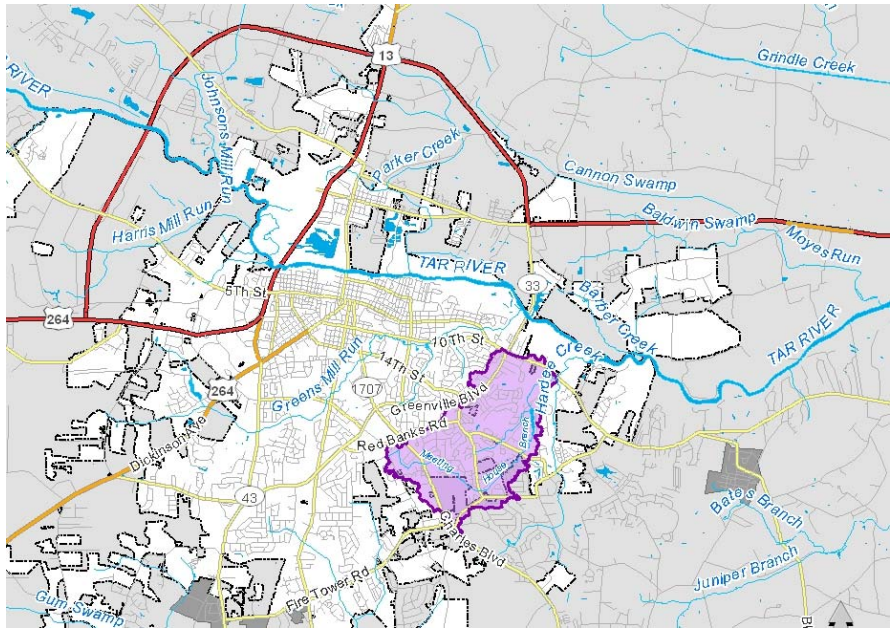
Greenville
NORTH CAROLINA

Erosion

Greenville
NORTH CAROLINA

Recap of 2013 State of the Stormwater Utility Fund

Meetinghouse Branch Pilot Project



Find yourself in good company

Greenville
NORTH CAROLINA

Summary

- Watershed Characteristics
  - 3 square miles, 90%+ build out
  - Entire basin is within city limits
- Capital Projects
  - Flood Control
  - Stream Bank Stabilization
  - Water Quality Retrofits

Greenville
NORTH CAROLINA

Results

- Modified Maintenance Practices to be better aligned with City Ordinance
  - No mowing
  - Focus on obstructions in flow line
  - Contracting herbicide spraying

Greenville
NORTH CAROLINA

Results

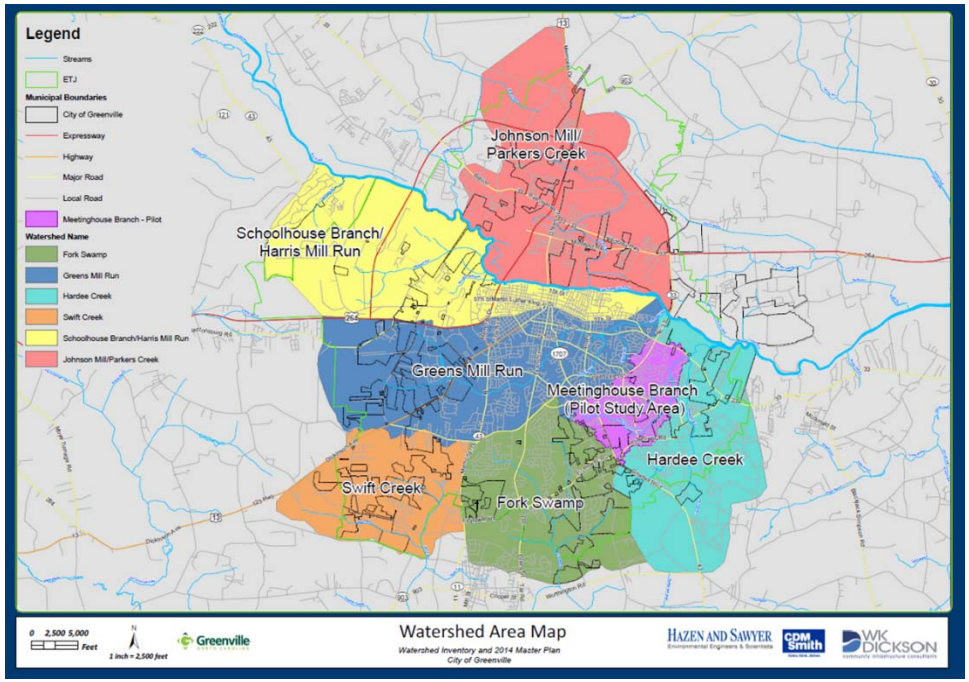
- Revised Development Regulations
  - Detention of the 2, 5 and 10 year storm events
  - Detention of the 25 year storm event as deemed necessary by the City Engineer

Greenville
NORTH CAROLINA

Results

- Utility Fee Increase
  - $0.50/ERU per year for 5 years
  - Equates to $1.00/month for typical house
- Commitment to expedite and complete citywide Master Planning

Citywide Master Plan
WSMP Overview

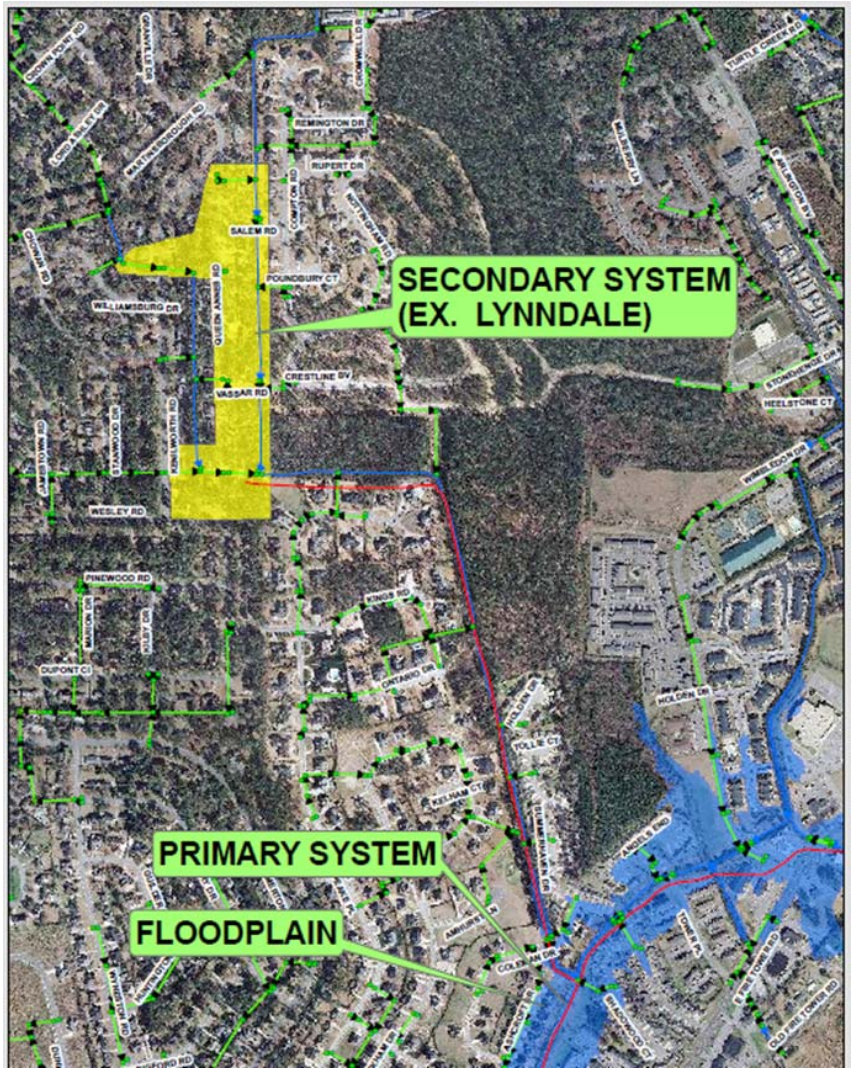


Tom Murray, PE
WK Dickson, Program Manager

Greenville
NORTH CAROLINA

Project Types

- Flood Control Projects
  - Primary Systems
  - Secondary Systems
- Stream Stabilization
- Water Quality



Greenville
NORTH CAROLINA

Level of Service

- Closed Pipe Systems – 10-year
  (10% chance/year, 5.8” rainfall/24 hrs)
- Minor Thoroughfare Crossings – 25-year
  (4% chance/year, 7.2” rainfall/24 hrs)
- Major Thoroughfare Crossings – 50-year
  (2% chance/year, 8.5” rainfall/24 hrs)
- Railroads Crossings– 100-year
  (1% chance/year, 9.8” rainfall/24 hrs)

Greenville
NORTH CAROLINA

Data Collection

No inventory of the closed system and had just begun mapping open system being maintained by the City…

The following was collected for project:

- 1.25 M linear feet (lf) of pipe – 237 miles
- 17,000 drainage structures
- 236,000 lf of stream walks – 44 miles

Greenville
NORTH CAROLINA

Benefits of Inventory

Moving from reactive to proactive

- Debris blockages removed
- Broken structures repaired
- Illicit discharges
- System connectivity
- Increased efficiency for maintenance and service calls

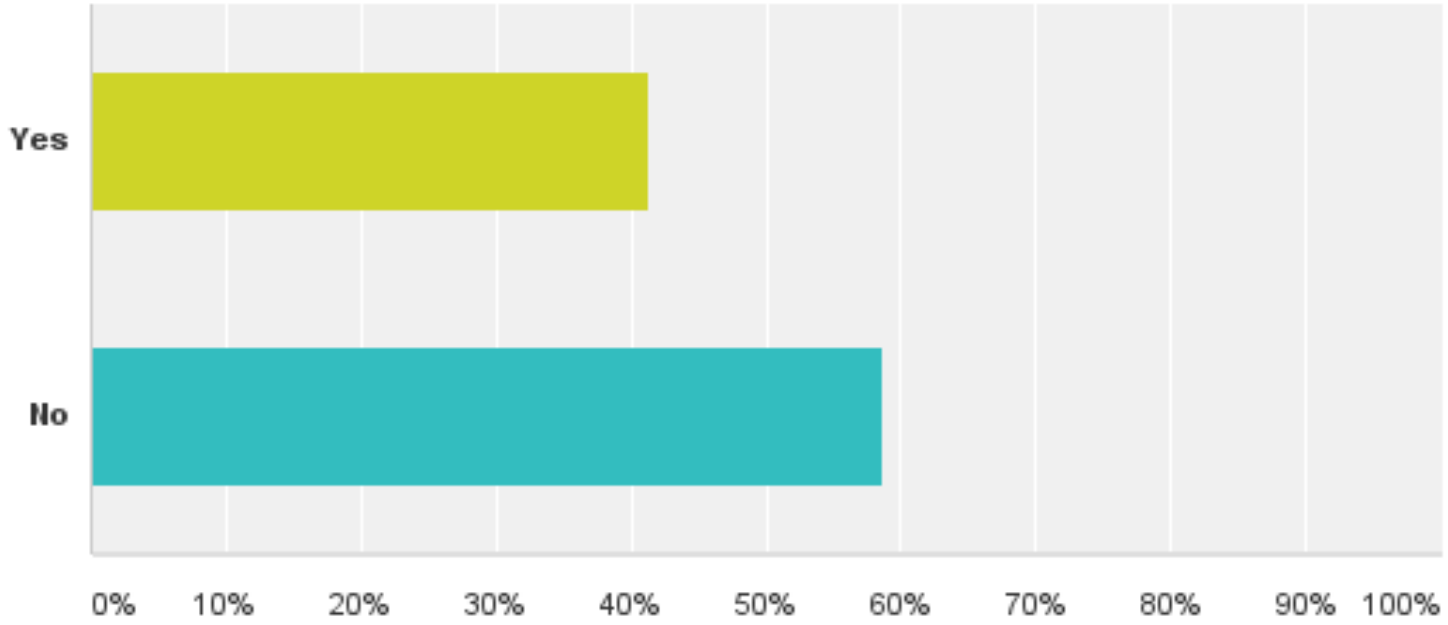
Public Outreach

- Stakeholder Meetings
- Project website
- Public meetings - 9
- Local events
  - Sunday in the Park
  - Freeboot Fridays
- Neighborhood Advisory Board
- Survey questionnaires - 230

Greenville
NORTH CAROLINA

Q1 Have you ever experienced flooding on your property during a (non-Hurricane) storm?

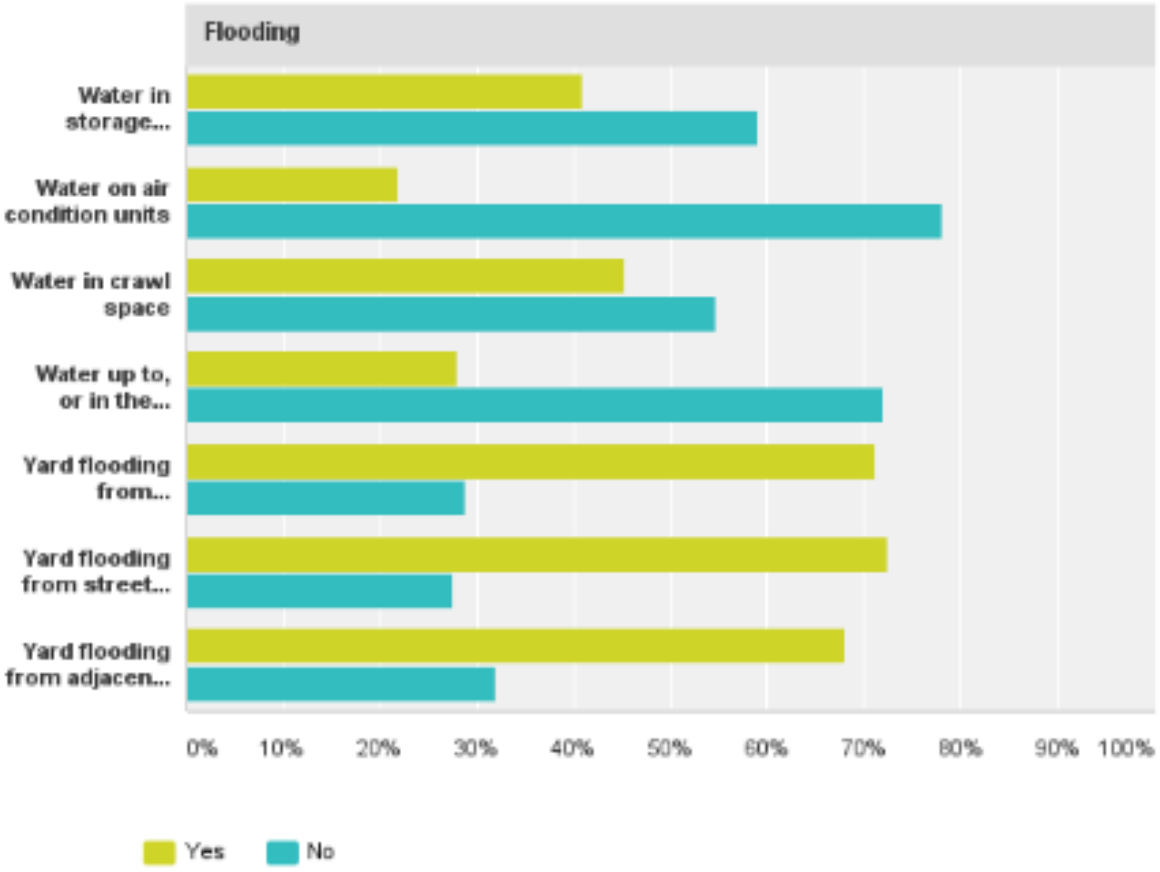
Answered: 223 Skipped: 7



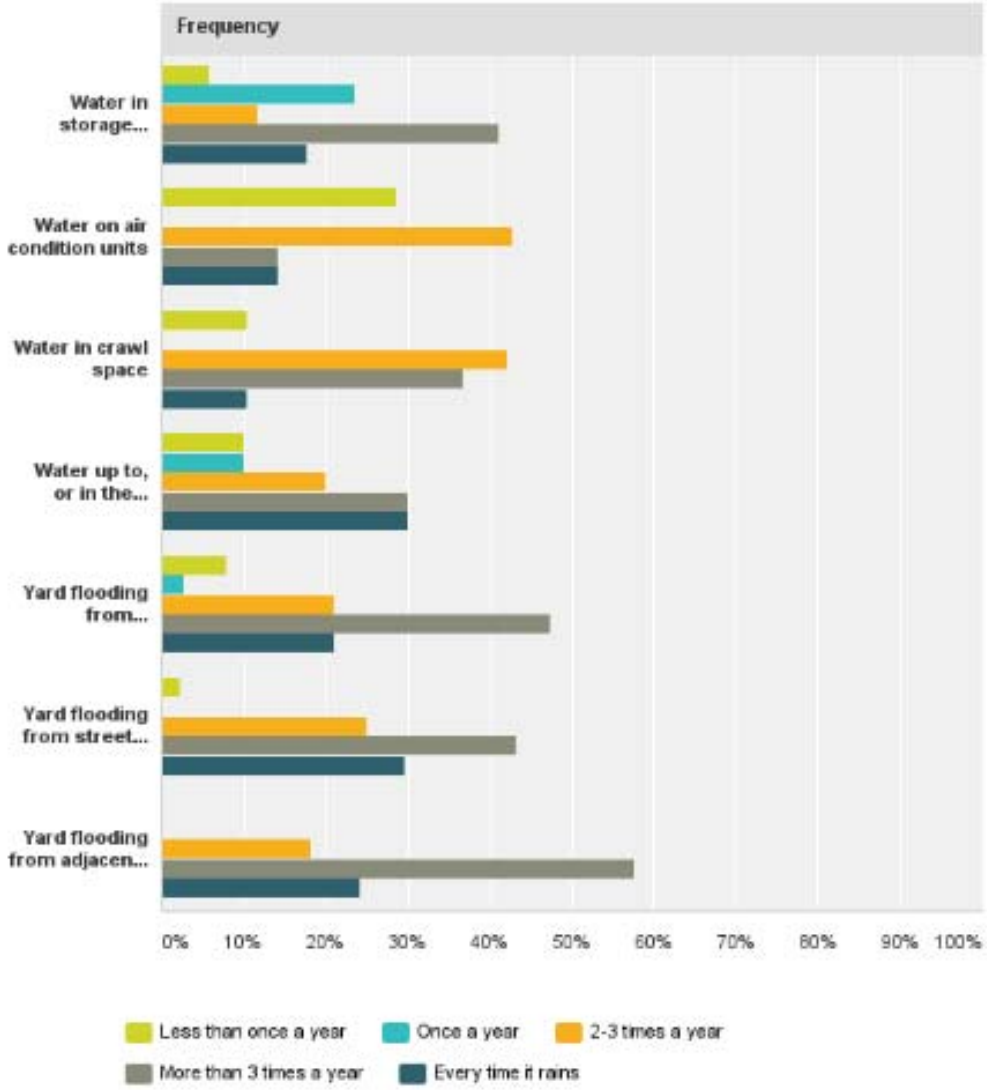
Greenville
NORTH CAROLINA

Q2 If yes, which of the following would apply and what is the frequency?

Answered: 105 Skipped: 125



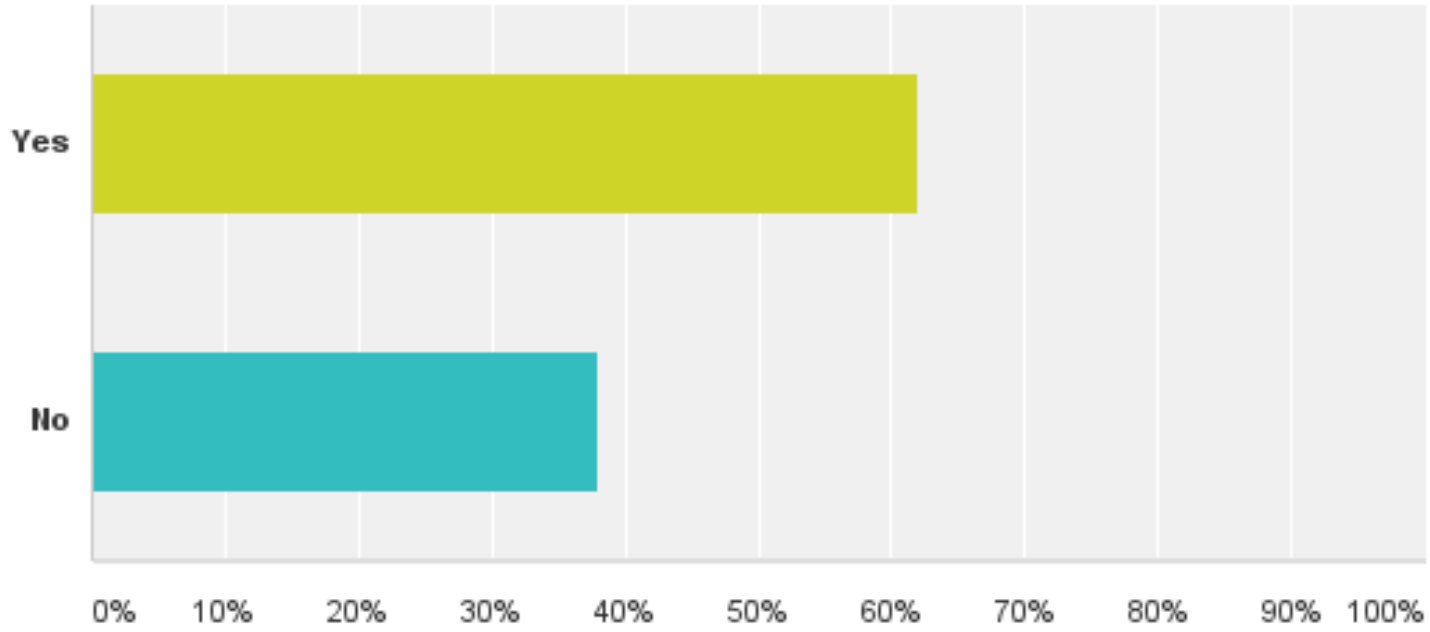
Greenville
NORTH CAROLINA



Greenville
NORTH CAROLINA

Q4 Have you ever noticed flooded streets in your neighborhood?

Answered: 213 Skipped: 17



Greenville
NORTH CAROLINA

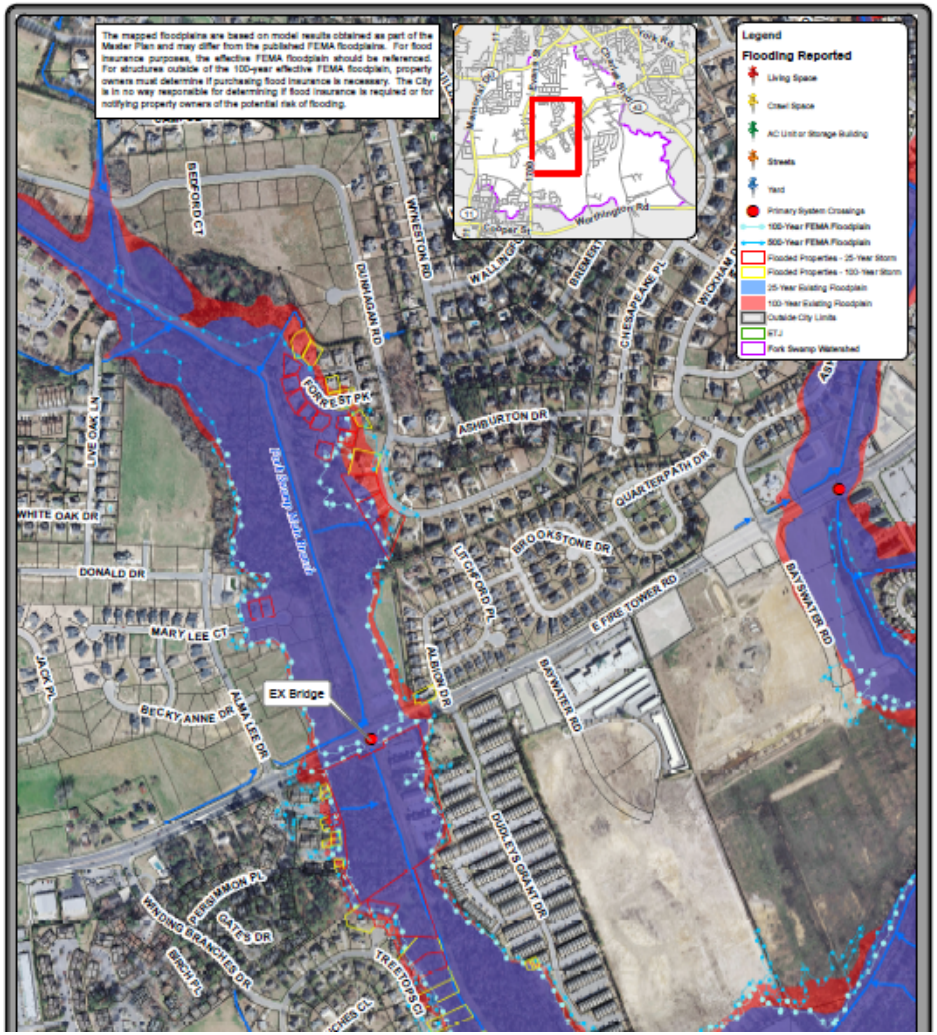
Existing Conditions

- Modeling of storm events completed for all primary systems and selected secondary systems
- Secondary systems selected based on stakeholder feedback (City and Public)
- Model results show existing level of service of conveyance system

Greenville
NORTH CAROLINA

Existing Conditions

- 25-yr and 100-yr floodplains mapped for primary systems
- Results validated against data collected in public outreach efforts



Greenville
NORTH CAROLINA

Future Conditions

- Primary and selected secondary systems evaluated under future build-out conditions
- Build-out conditions based on City and County zoning, land use plans, and feedback from City Planning
- Proposed improvements based on future build-out conditions in City and ETJ

Greenville
NORTH CAROLINA

Recommendations

Culvert/Bridge Improvements

Greenville
NORTH CAROLINA

Recommendations

Floodplain Storage / Benching

Greenville
NORTH CAROLINA

Recommendations

Closed System Improvements

Greenville
NORTH CAROLINA

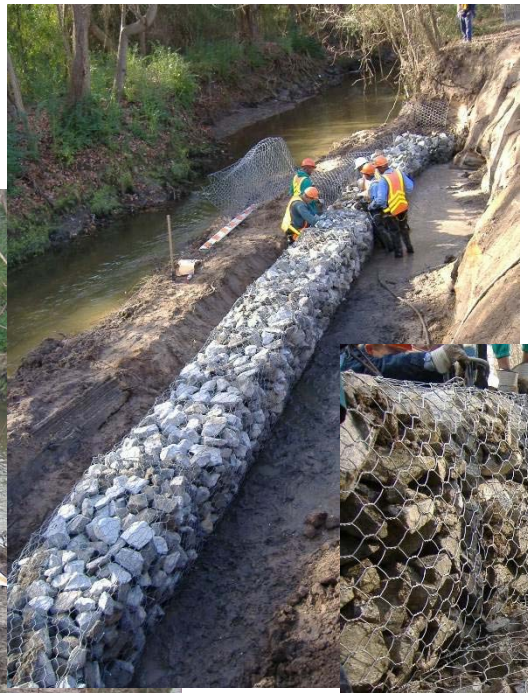
Recommendations

Detention

Greenville
NORTH CAROLINA

Recommendations

Stream Stabilization



Greenville
NORTH CAROLINA

Recommendations

Stream Stabilization

Greenville
NORTH CAROLINA

Recommendations – 25-yr Detention

- Considered for new development upstream of well documented water quantity problems
  - Defined as validated historical structural flooding or;
  - Model results indicate structural or roadway flooding.
- 25-year detention considered if areas upstream of documented water quantity problems increase future flows by more than 10%

Greenville
NORTH CAROLINA

Impaired Waters

Swift Creek and Greens Mill Run considered impaired by the State and EPA for benthos

Tar-Pamlico River Basin

2014 AU Number:	AU Name:	AU Length Area:	AU Units:	Classification:
	AU Description:			
28-96	Greens Mill Run	7.3	FW Miles	C;NSW
	From source to Tar River			

IRCategory:	ACS:	Parameter Of Interest:	Collection Year:	303(d) yr:
5	EC	Benthos Severe (Nar, AL, FW)	2004	2008

27-97-(0.5)a1	Swift Creek	19.3	FW Miles	C;Sw,NSW
	From source to 5.3 miles upstream of Clayroot Swamp			

IRCategory:	ACS:	Parameter Of Interest:	Collection Year:	303(d) yr:
5	EC	Benthos Poor (Nar, AL, FW)	1995	1998

Greenville
NORTH CAROLINA

What are Benthos?

- Insects, crustaceans, mollusks, and worms
- Spend at least part of their lifecycle underwater
- Require suitable habitat for stable, diverse population
- Sensitive to pollution typically associated with stormwater runoff

Greenville
NORTH CAROLINA

Impaired Waters

- Impaired waters ultimately require TMDLs by EPA, although no timeline established for these waterbodies
- TMDLs include costly implementation actions and likely stricter development regulations on impervious areas
- TMDLs enforced by State and EPA

Greenville
NORTH CAROLINA

Likely TMDL Requirements

- Recurrent monitoring to measure progress
- Stringent new development regulations
- Implementation of retrofit stormwater control measures
- Additional maintenance and inspection requirements
- Routine reporting of progress
- Performance based – TMDL in effect until monitoring shows goals are met

Greenville
NORTH CAROLINA

Impaired Waters

- Additional monitoring completed as part of Master Plan to better define extents and potential causes of impairment
- Swift Creek monitoring results indicate potential for delisting
- Greens Mill Run monitoring results indicate likely continued impairment listing
- Management actions exist that can preempt need for TMDL

Greenville
NORTH CAROLINA

Prioritization

- Projects within each watershed prioritized based on 9 categories
- Four prioritization lists for each watershed created based on project type
- Primary flood control projects may be grouped based on dependency on other projects
- Prioritization consistent across watersheds to create Citywide Prioritization lists

Greenville
NORTH CAROLINA

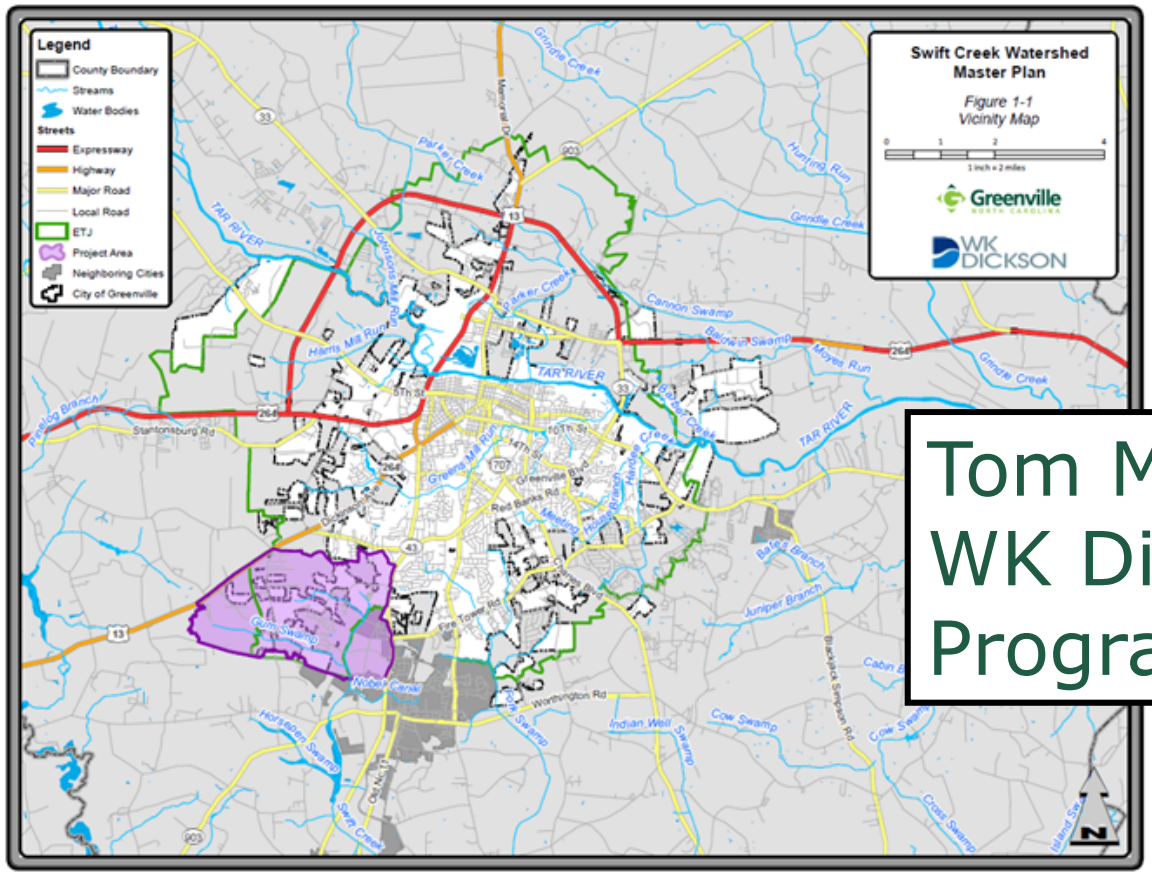
Prioritization

Prioritization can be adjusted for numerous reasons:

- Development
- Failures
- Funding (MOAs, grants, loans, etc.)

Greenville
NORTH CAROLINA

Swift Creek WSMP



Tom Murray, PE
WK Dickson
Program Manager

Find yourself in good company

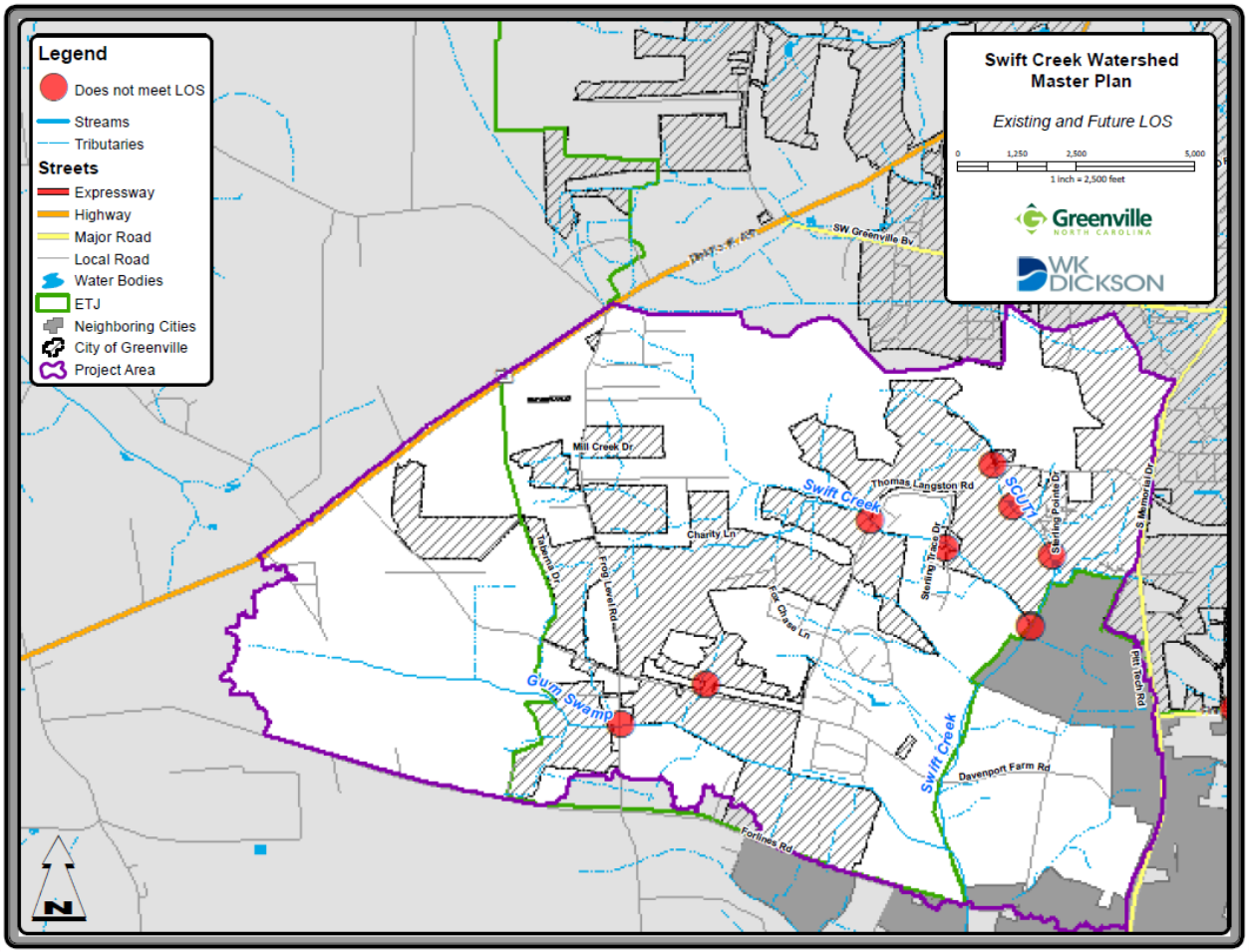
Greenville
NORTH CAROLINA

Watershed Characteristics

- 6.4 sq mile watershed area in Neuse basin
- Forlines Road is downstream limit
- 33% of watershed in City limits
- 55% developed predominantly as residential land use

Greenville
NORTH CAROLINA

Existing Conditions



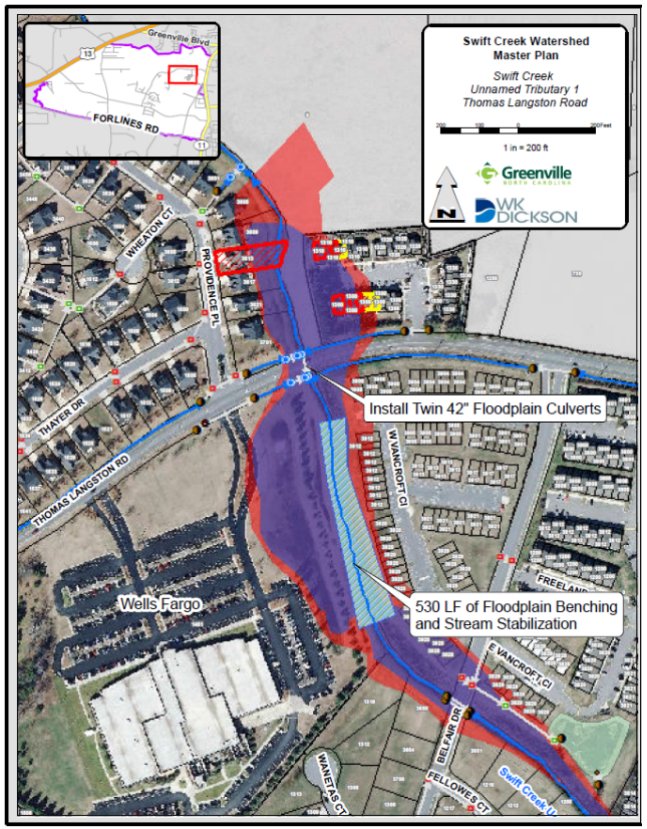
Greenville
NORTH CAROLINA

Thomas Langston Road

- Existing 2-year LOS
- Flooding reported in Langston Townhomes
- Culvert undersized
- Edge of roadway embankment eroding
- Maintained by NCDOT

Thomas Langston Road

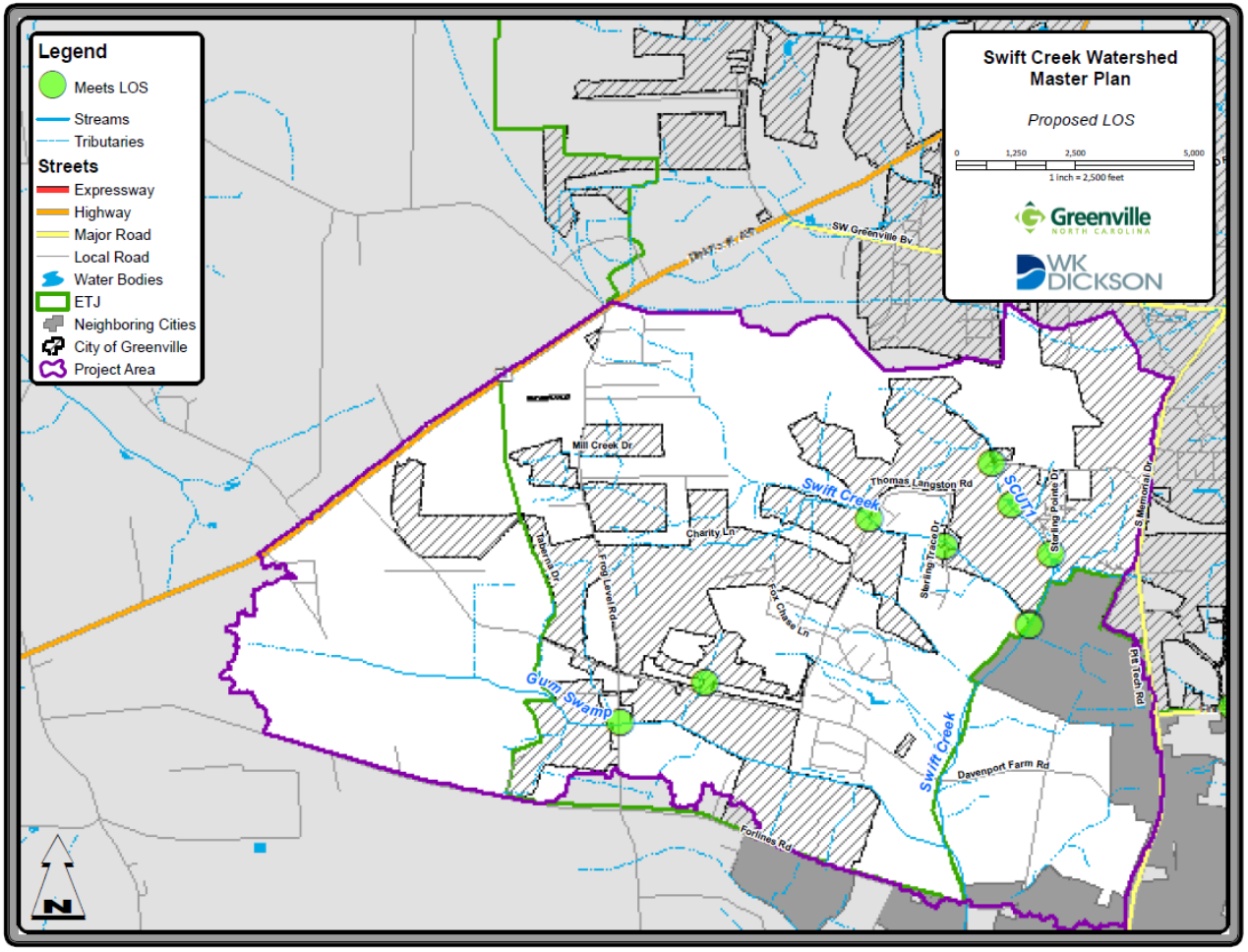
- Additional twin 42” culverts and headwall
- Downstream floodplain benching and stabilization
- Proposed 25-year LOS
- Removes 8 properties from 25-year floodplain and 3 properties from 100-year floodplain



Cost - $370,000

Greenville
NORTH CAROLINA

Future w/ Improvements



Potential Contributors of Benthic Impairment

Habitat

- Limited buffers
- Maintenance (cleaning) of streams for flood control

Stormwater runoff

Greenville
NORTH CAROLINA

Benthic Results

- Swift Creek shows clear downstream improvement from original collection yr (1995)
- Sampling in 2015 focused on 2 most downstream locations
- Ratings suggest a Good-Fair to Fair rating at sample site 7 depending on the methodology used.

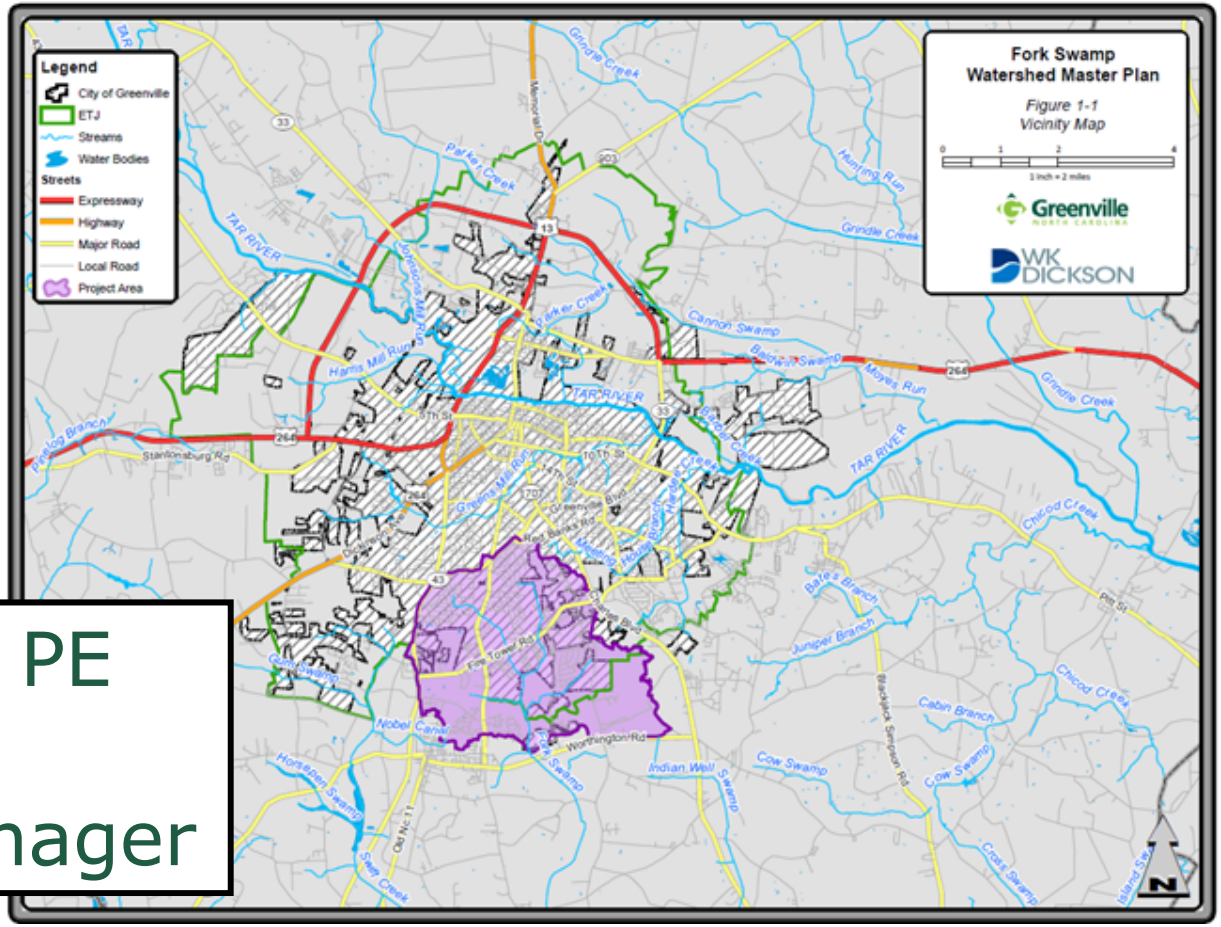
Greenville
NORTH CAROLINA

Next Steps

- Submit monitoring data to State for review
- Potential for de-listing
- De-listing potentially saves the City $300,000/year

Greenville
NORTH CAROLINA

Fork Swamp WSMP



Tom Murray, PE
WK Dickson
Program Manager

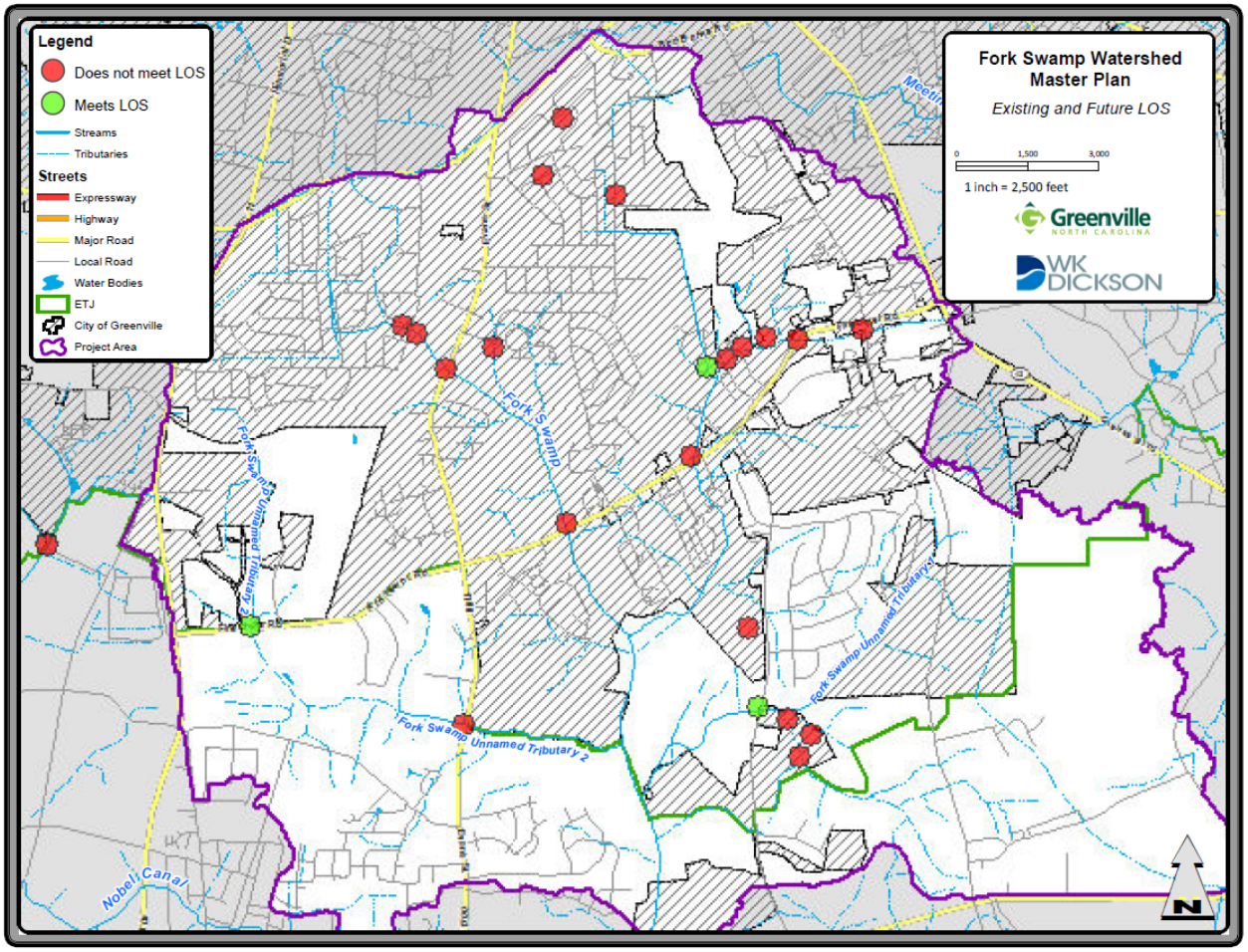
Greenville
NORTH CAROLINA

Watershed Characteristics

- 10.6 sq mile watershed area in Neuse basin
- Worthington Rd. is downstream limit
- 60% of watershed in City limits
- 75% developed predominantly as residential land use

Greenville
NORTH CAROLINA

Existing Conditions



Greenville
NORTH CAROLINA

Railroad - Westhaven

- Existing 2-year LOS at East Baywood Ln
- Flooding reported in Westhaven subdivision
- Majority of area upstream of railroad at or below railroad elevation

- East Baywood Ln approximately 5’ lower than railroad

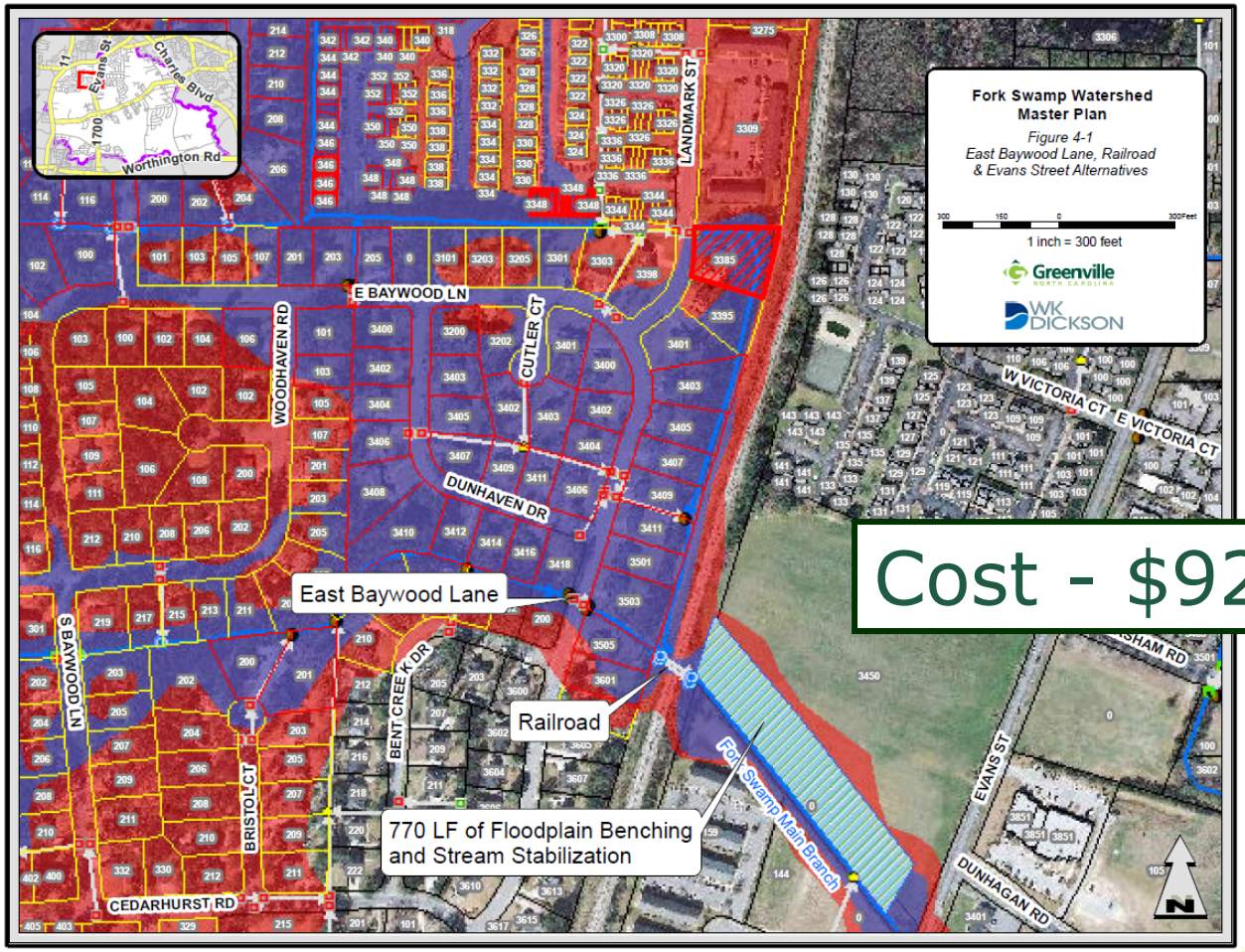
Greenville
NORTH CAROLINA

Railroad - Westhaven

- Increased culvert size provides minimal improvement
- Downstream floodplain storage/benching allows more flow through culverts
- Proposed 10-year LOS at East Baywood Ln
- Lowers 25-year water surface elevation by 2.2’ at East Baywood Ln
- Removes 15 properties from 25-year floodplain and 18 properties from 100-year floodplain

Greenville
NORTH CAROLINA

Railroad - Westhaven

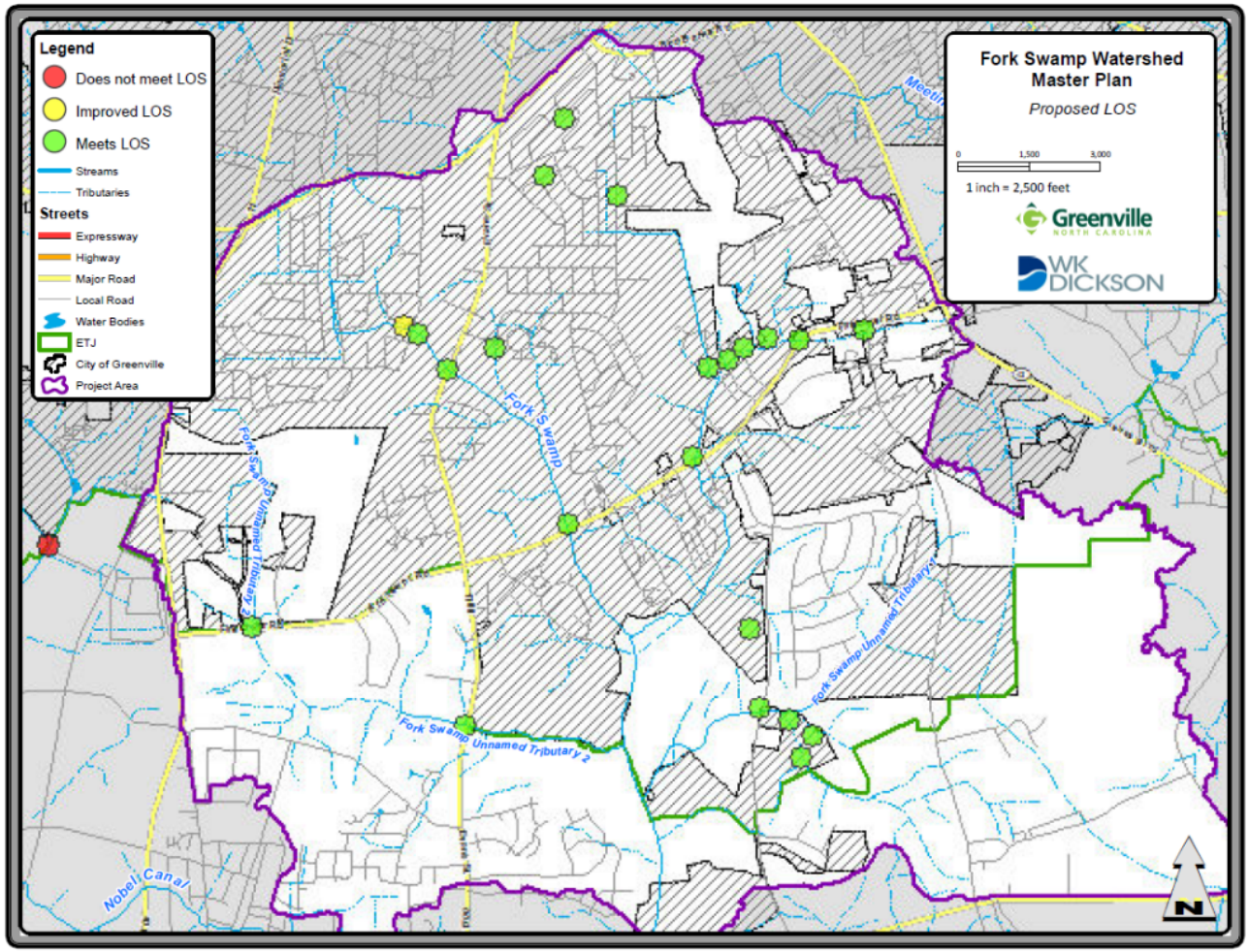


Cost - $920,000

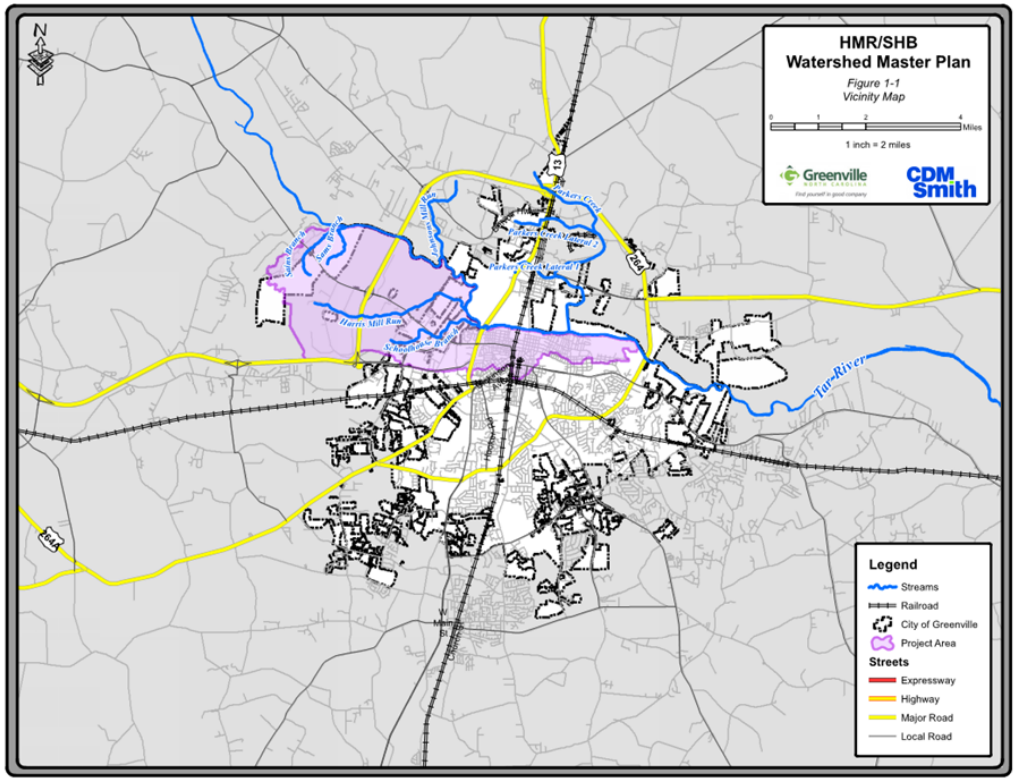
Find yourself in good company

Greenville
NORTH CAROLINA

Future w/ Improvements



Harris Mill Run / Schoolhouse Branch WSMP



Rob Hopper, PE
CDM Smith
Project Manager

Greenville
NORTH CAROLINA

Watershed Characteristics

- Combined 12 square miles
- Along Tar River from Ironwood to Greens Mill Run
- Vidant and Downtown Area

Greenville
NORTH CAROLINA

Watershed Characteristics

Jurisdiction:

- 5.8 square miles (15%) of City is in HMR/SHB
- 10.5 square miles (17%) of ETJ is in HMR/SHB

Land Uses:

- HMR - about 50% built-out, remaining 50% to be developed
- SHB - about 75% built-out, remaining 25% to be developed

Greenville
NORTH CAROLINA

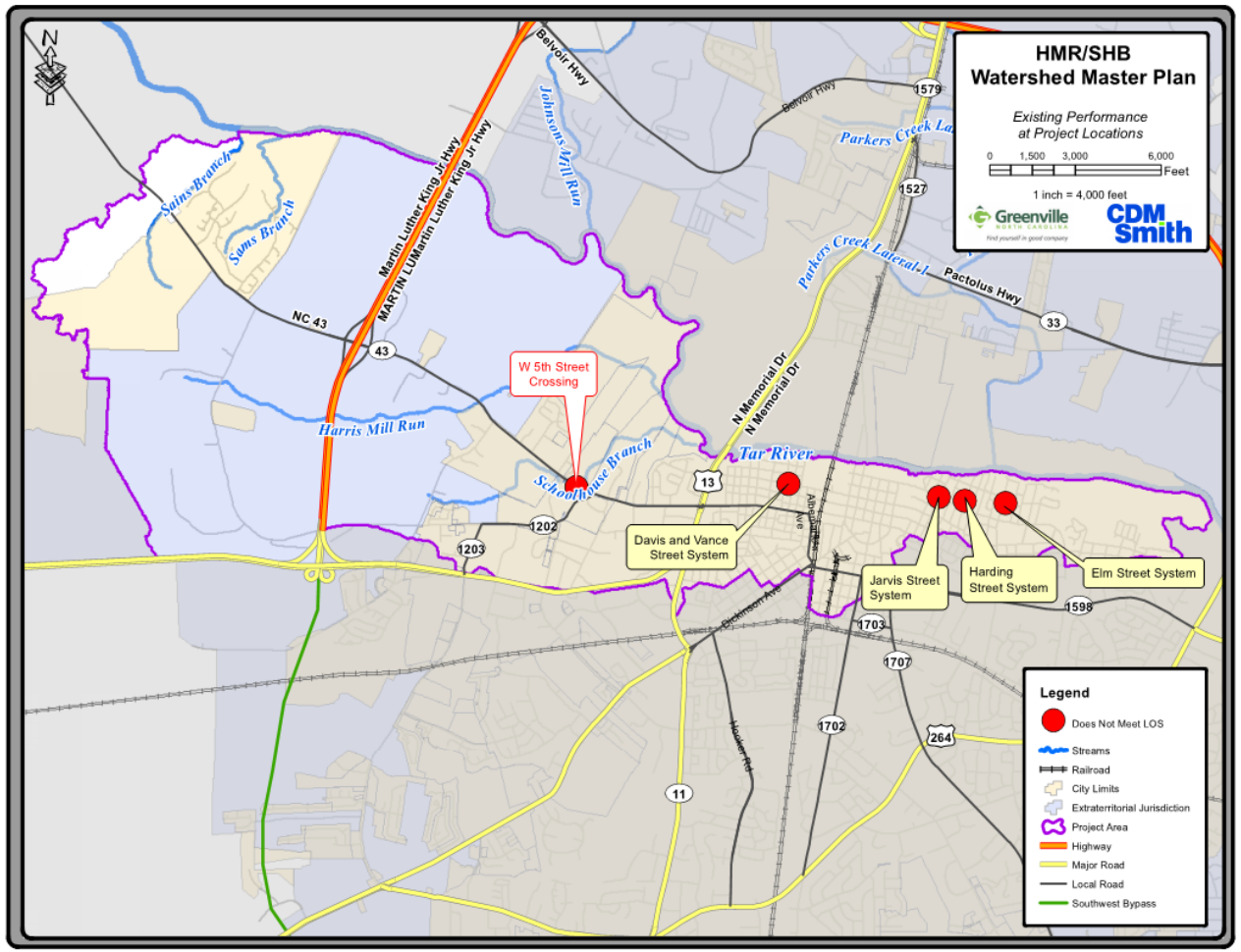
Watershed Characteristics

Infrastructure Inventory:

- 41 miles of 12 to 66 inch pipe and 2,948 stormwater structures
- Difficulties in mapping system due to blind boxes and parallel or abandoned pipes
- Much older infrastructure

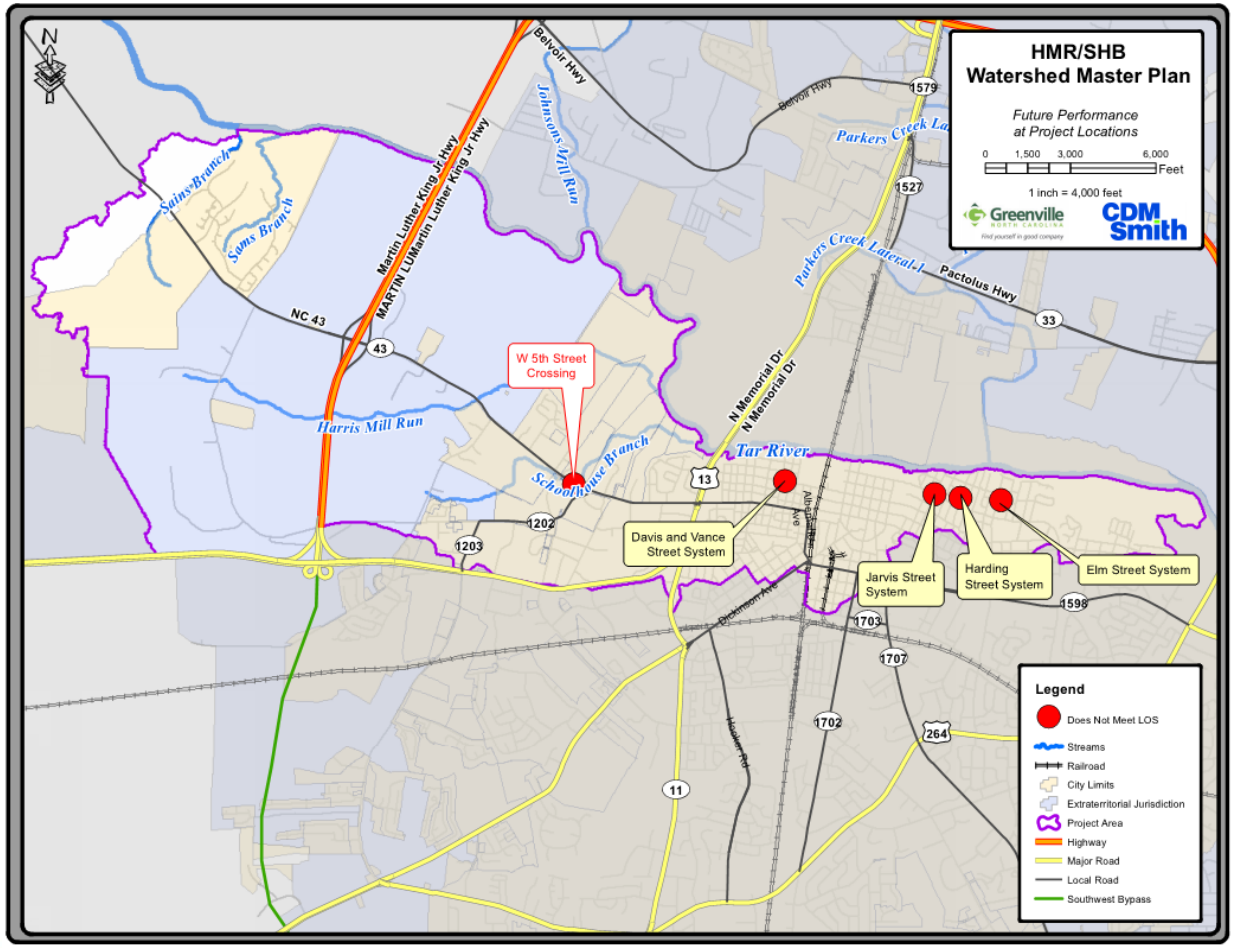
Greenville
NORTH CAROLINA

Existing Conditions



Greenville
NORTH CAROLINA

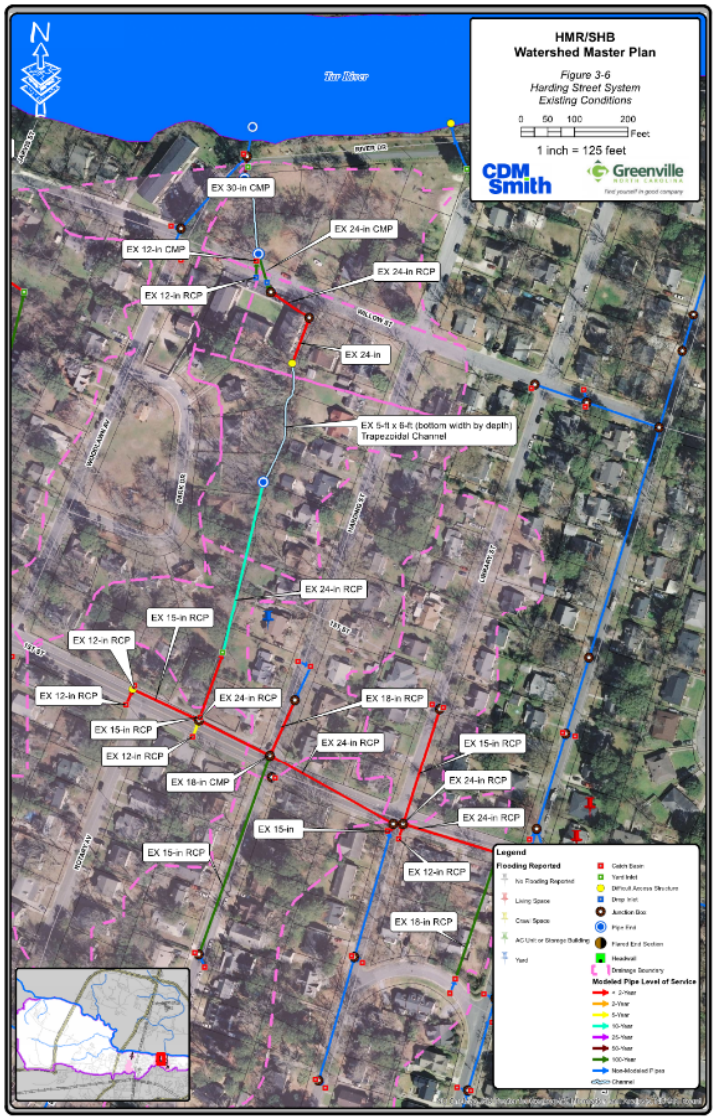
Future No Improvements



Greenville
NORTH CAROLINA

Harding Street

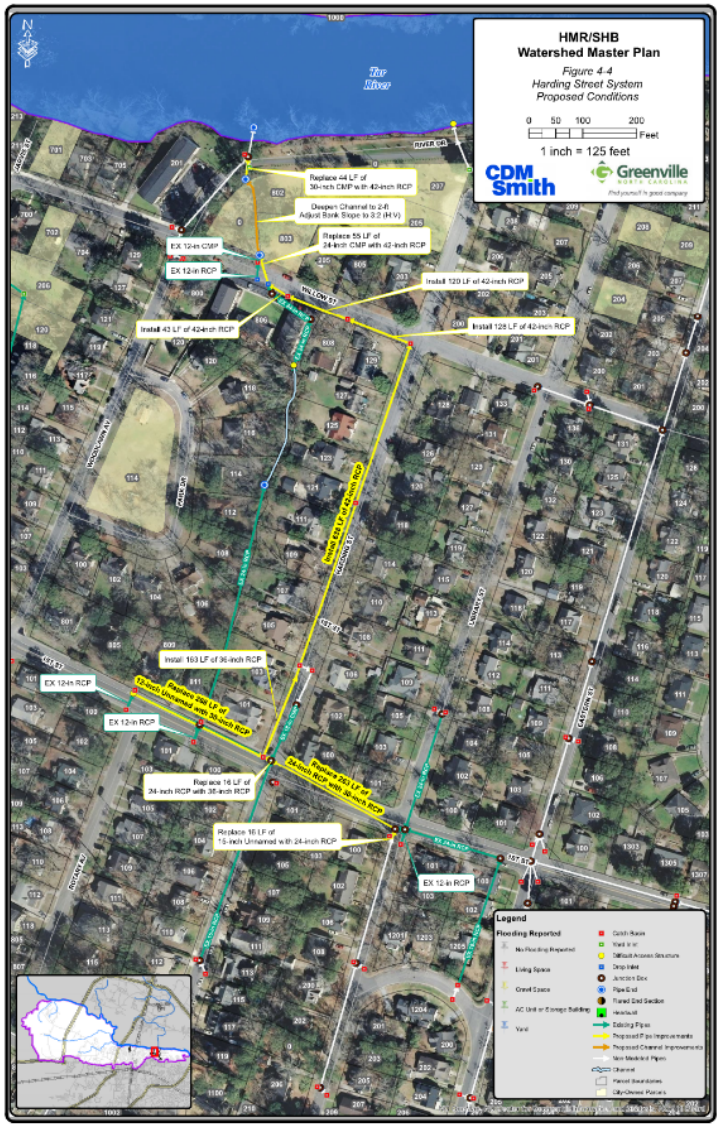
- Drainage System not meeting desired 10yr LOS
- Along 1st Street not meeting 2yr LOS
- Open channel parallel to Harding Street



Greenville
NORTH CAROLINA

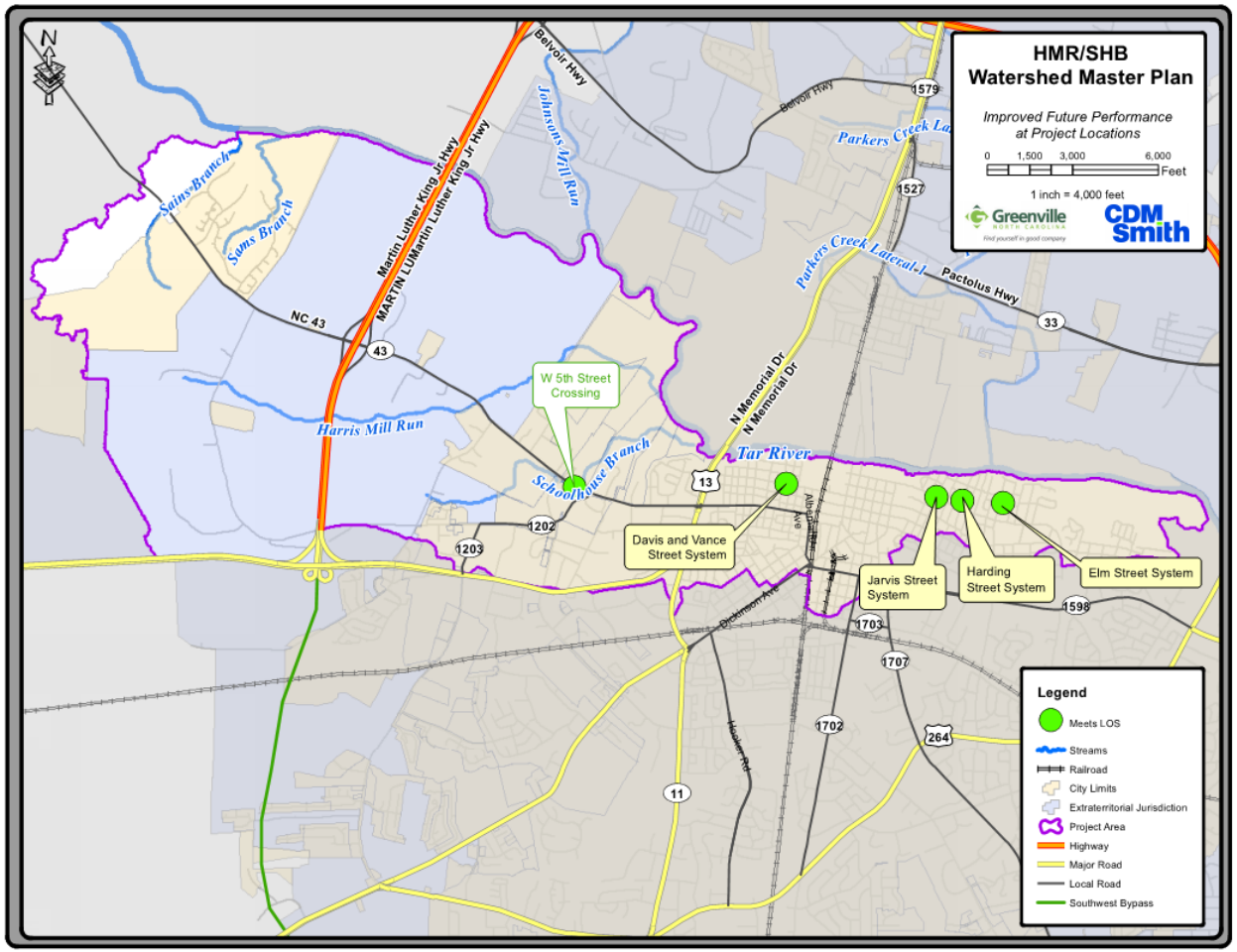
Harding Street

- Relocate drainage system from backyards to right of way
- Install 1,500 linear feet of pipe for estimated cost of $1,240,000



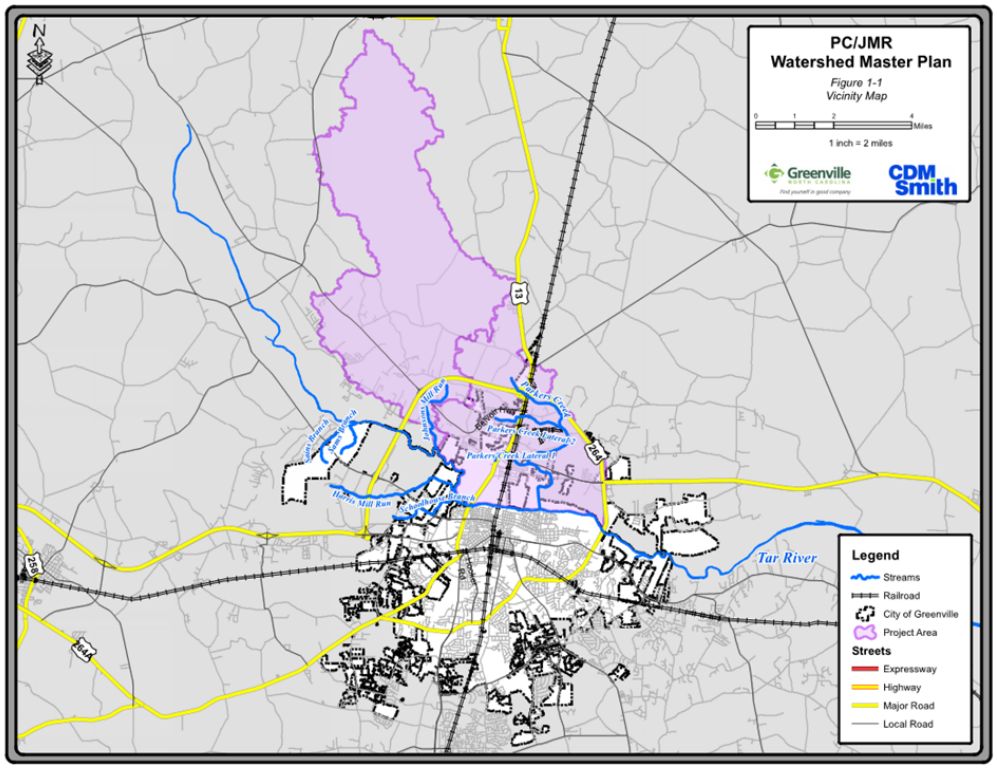
Greenville
NORTH CAROLINA

Future w/ Improvements



Parkers Creek / Johnsons Mill Run WSMP

Rob Hopper, PE
CDM Smith
Project Manager



Greenville
NORTH CAROLINA

Watershed Characteristics

- Combined 40 square mile Drainage Area
- North of and Draining to Tar River
- Jurisdiction:
  - 2.3 square miles (6%) of City is in JMR/PC
  - 9.2 square miles (15%) of ETJ is in JMR/PC

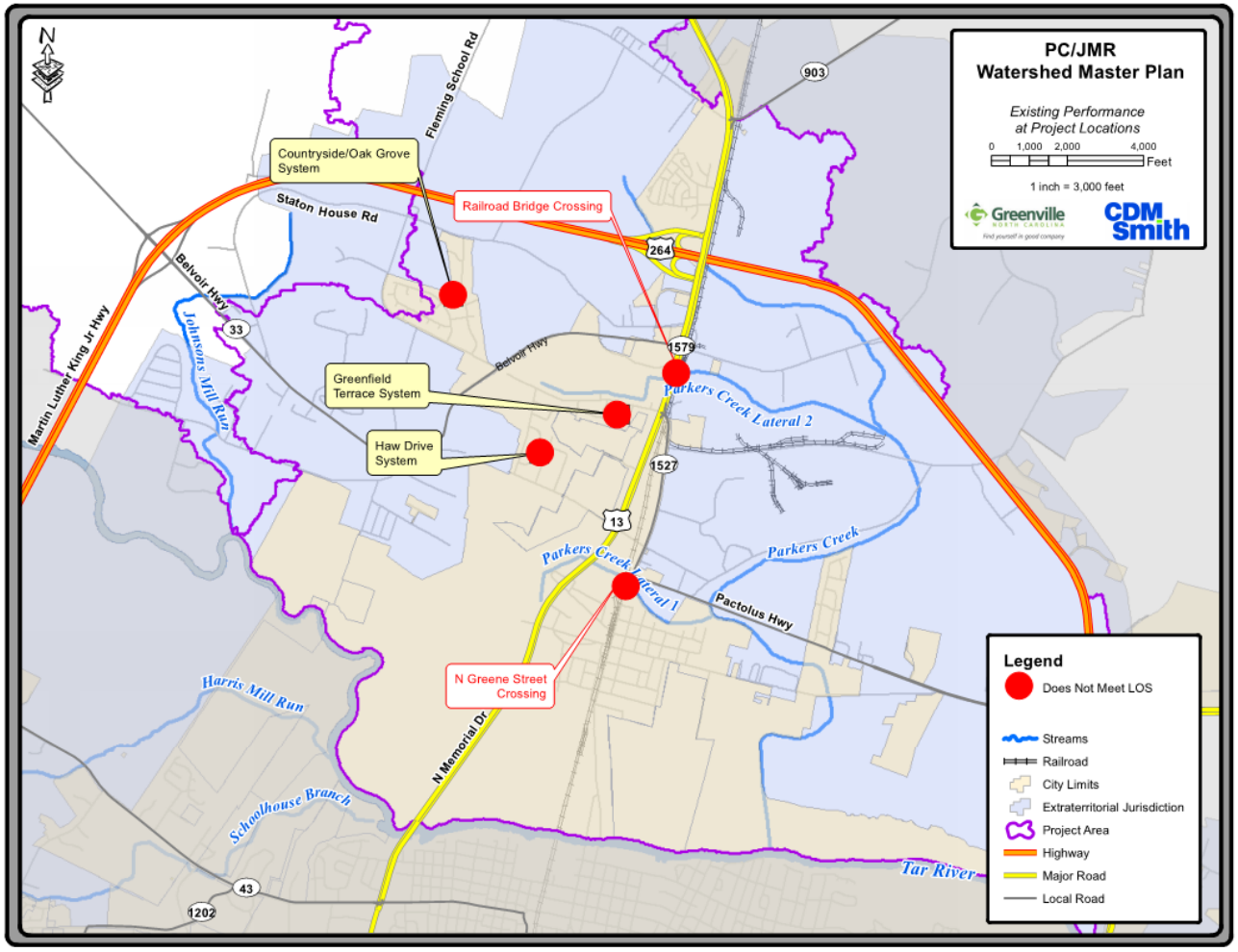
Greenville
NORTH CAROLINA

Watershed Characteristics

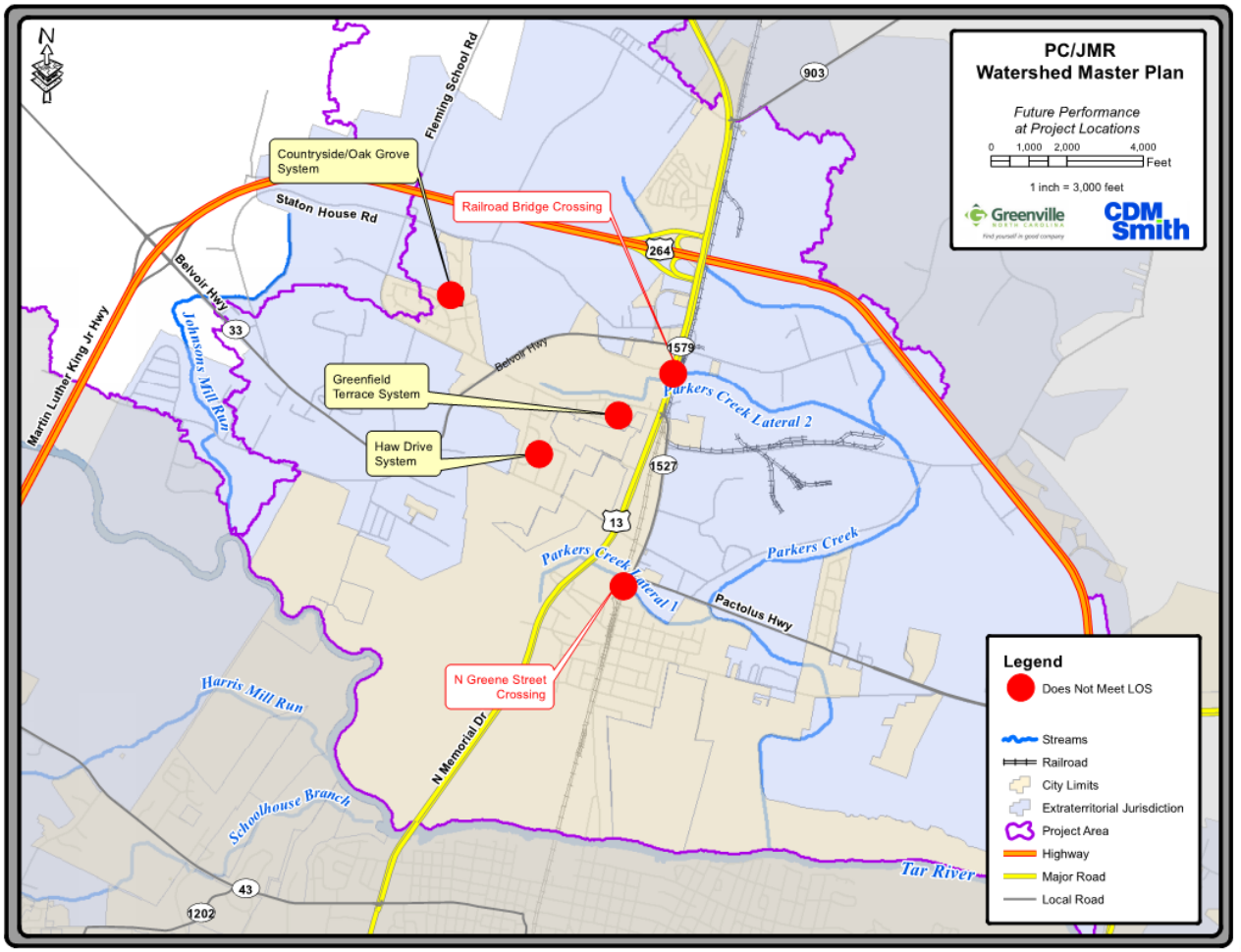
- Land Use:
  - PC - about 40% developed, another 50% to be developed for total of 90% at build-out
  - JMR - about 2% developed, another 30% to be developed for total of 32% at build-out
- Infrastructure Inventory:
  - 15 miles of 12 to 66 inch pipe and 1,046 stormwater structures
  - Also inventoried areas to east of JMR/PC Watershed within City boundaries

Greenville
NORTH CAROLINA

Existing Conditions



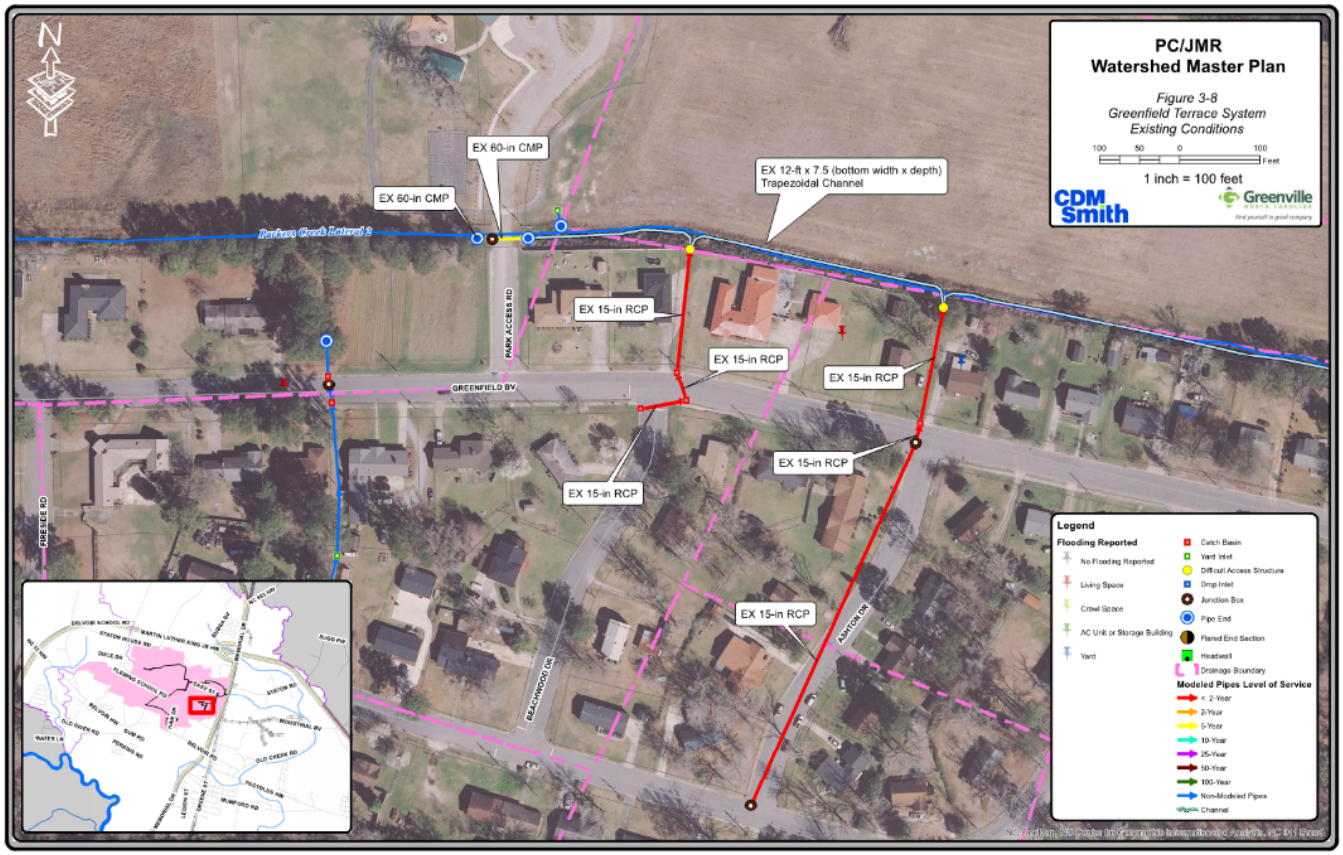
Future No Improvements



Greenville
NORTH CAROLINA

Greenfield Terrace

Drainage System not meeting 2-year LOS



Find yourself in good company

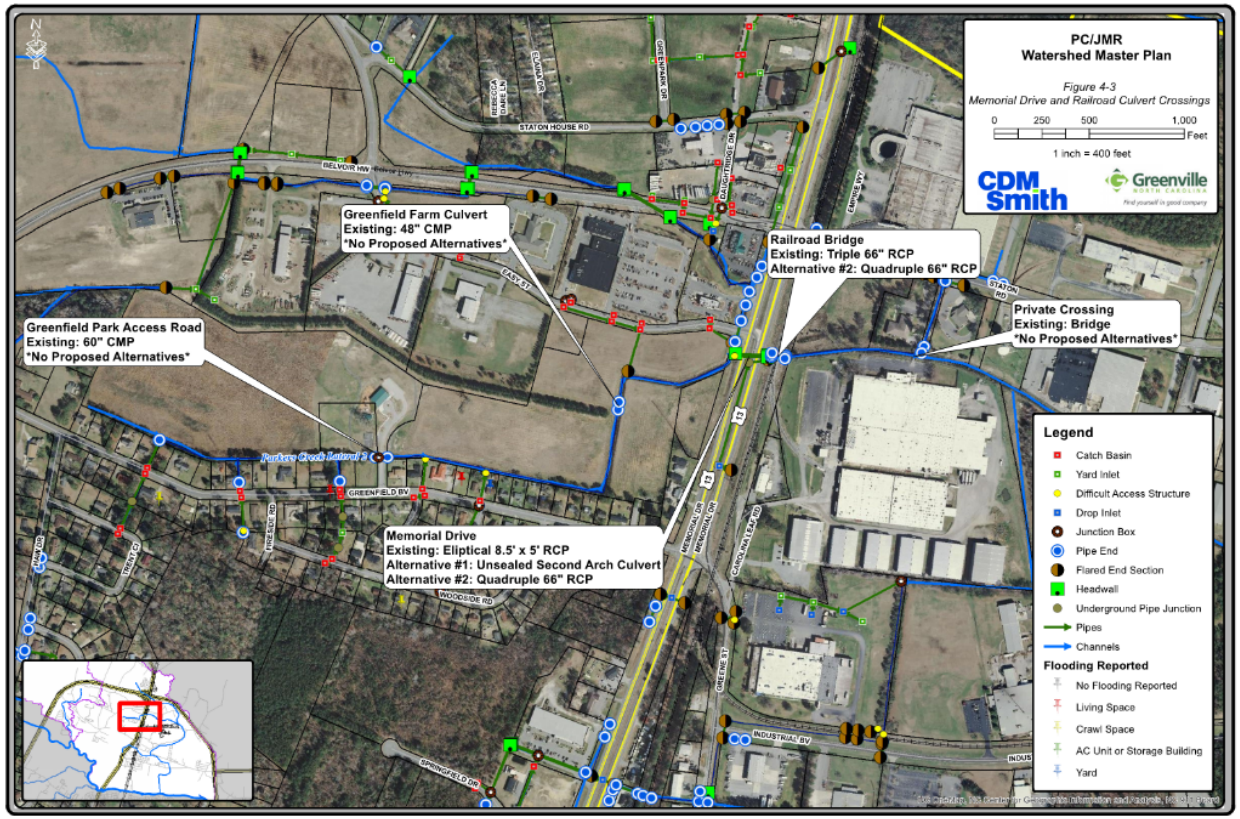
Greenfield Terrace

- Immediate issue due to blocked drainage
- Backwater at Memorial Drive culverts for larger storms

Greenville
NORTH CAROLINA

Greenfield Terrace

- Capacity increase at Memorial Drive
- Greenfield Terrace Drainage System 920 LF



- 13-acre Detention Pond at Greenfield Terrace Park

Greenville
NORTH CAROLINA

Greenfield Terrace

- Memorial Drive Culverts

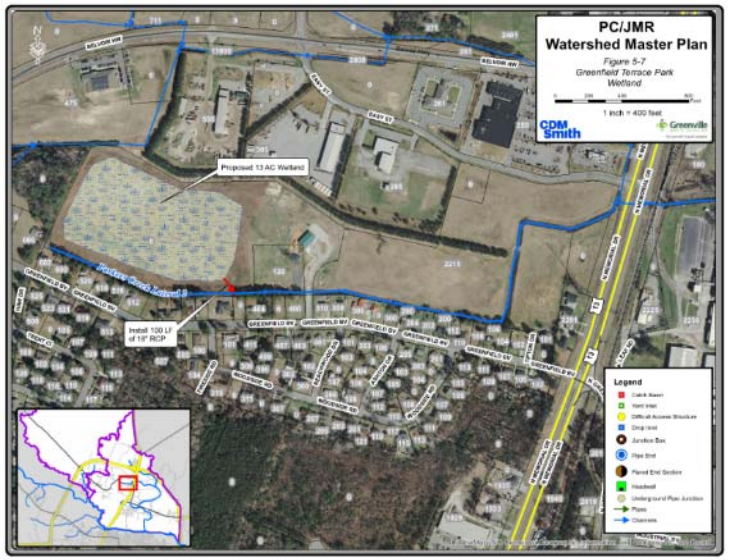
  $1,170,000

- Greenfield Terrace Drainage

  $450,000

- 13-acre Detention Pond

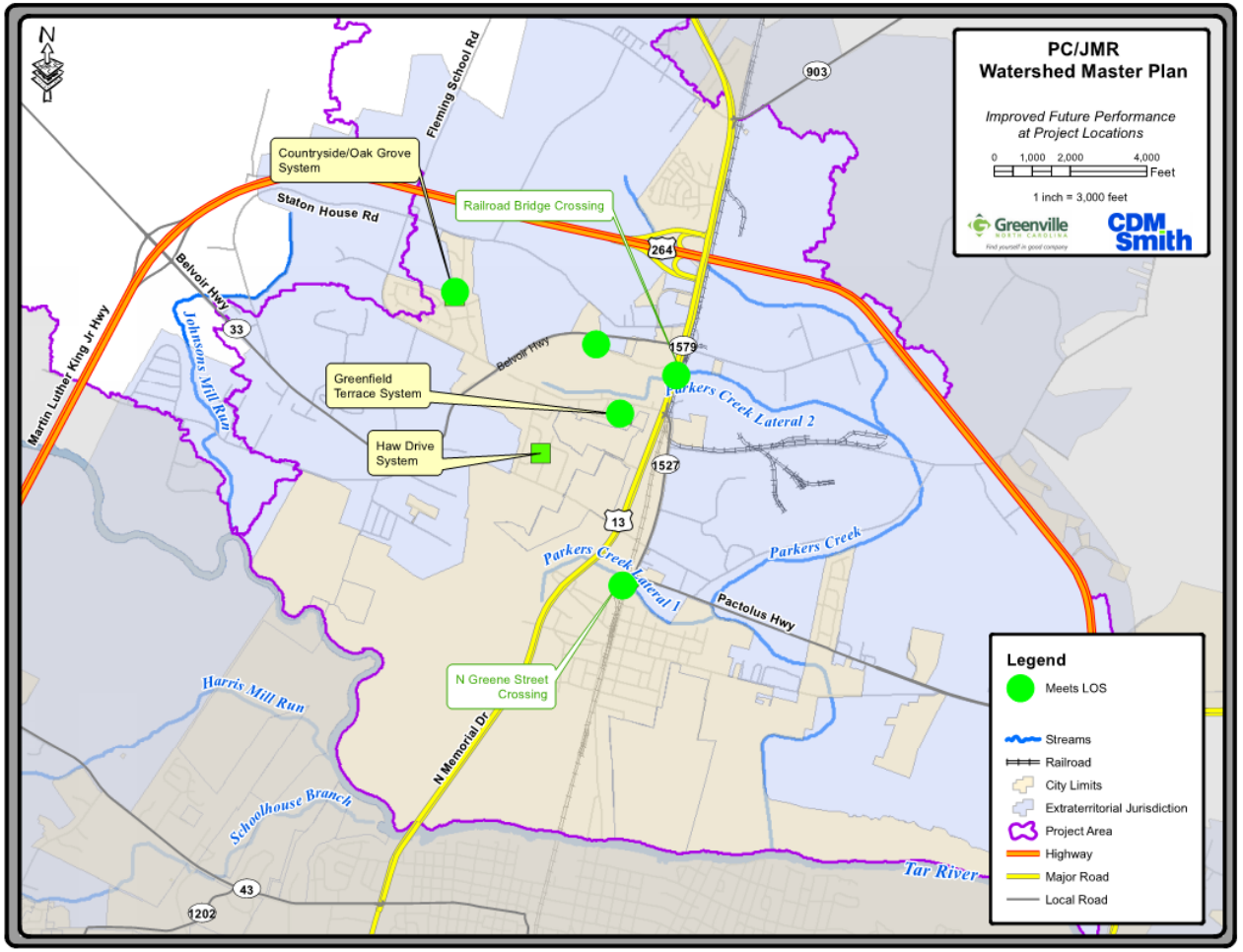
  $4,960,000



Find yourself in good company

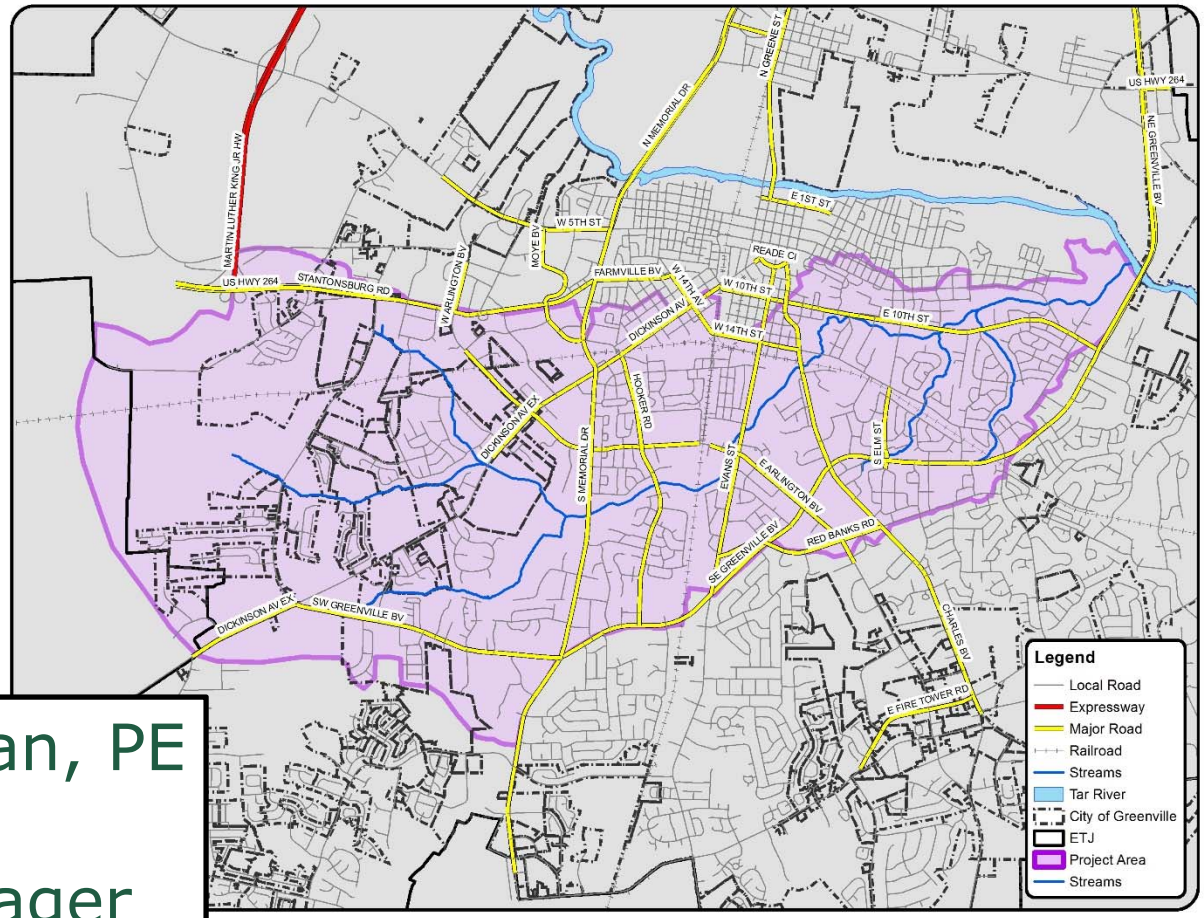
Greenville
NORTH CAROLINA

Future w/ Improvements



Greenville
NORTH CAROLINA

Greens Mill Run WSMP



Travis Crissman, PE
Hazen
Project Manager

Greenville
NORTH CAROLINA

Watershed Characteristics

- Includes ECU and downtown
- Drains to Tar River
- Drainage Basin is 13.8 square miles
  - 29% of City is in GMR basin
  - 11% of ETJ is in GMR basin

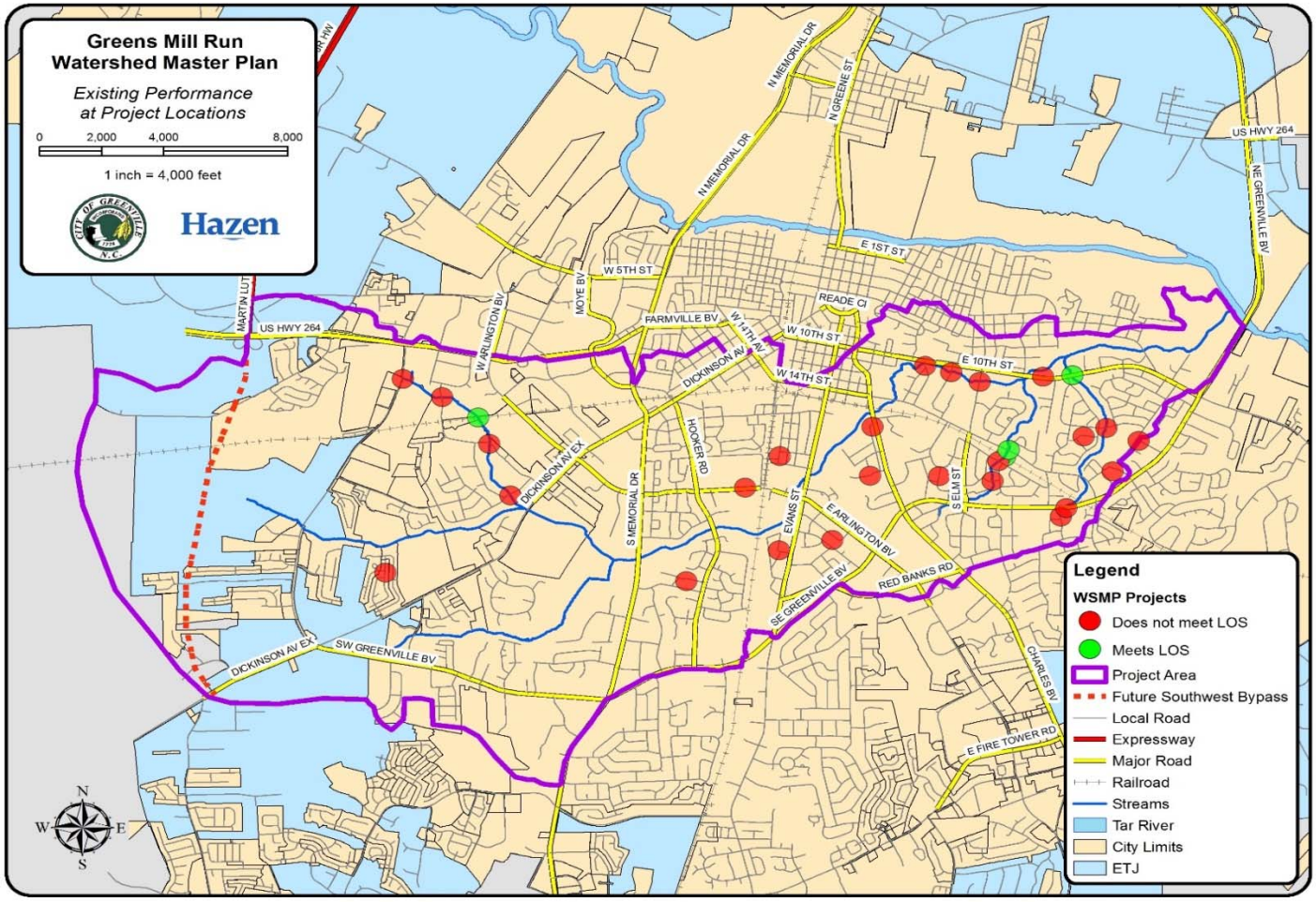
Greenville
NORTH CAROLINA

Watershed Characteristics

- Land Use:
  - Approximately 63% built out
  - Imperviousness trending up
- Stormwater Inventory:
  - 76 miles of 12 to 84 inch pipe
  - 4717 structures

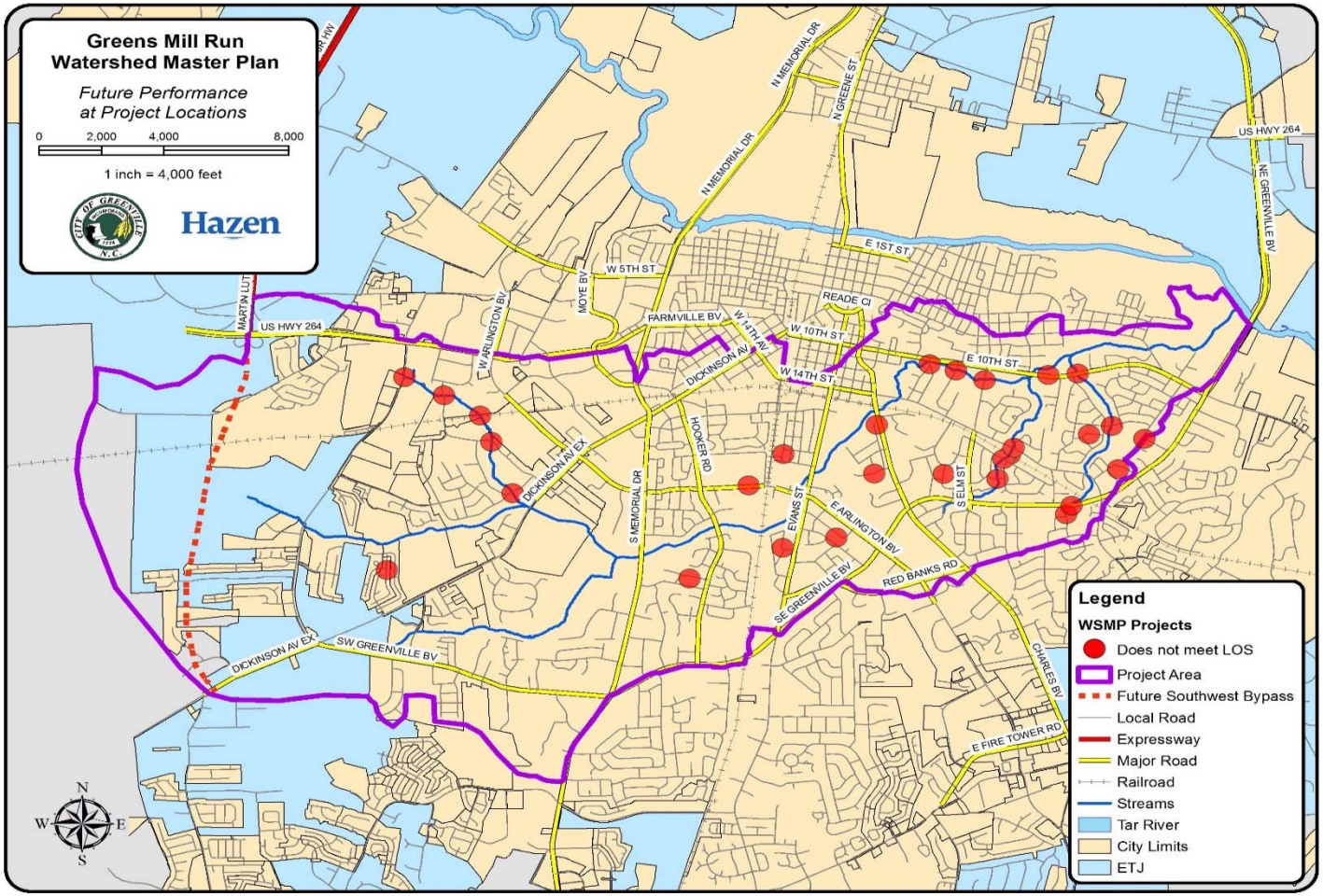
Greenville
NORTH CAROLINA

Existing Conditions



Greenville
NORTH CAROLINA

Future No Improvements



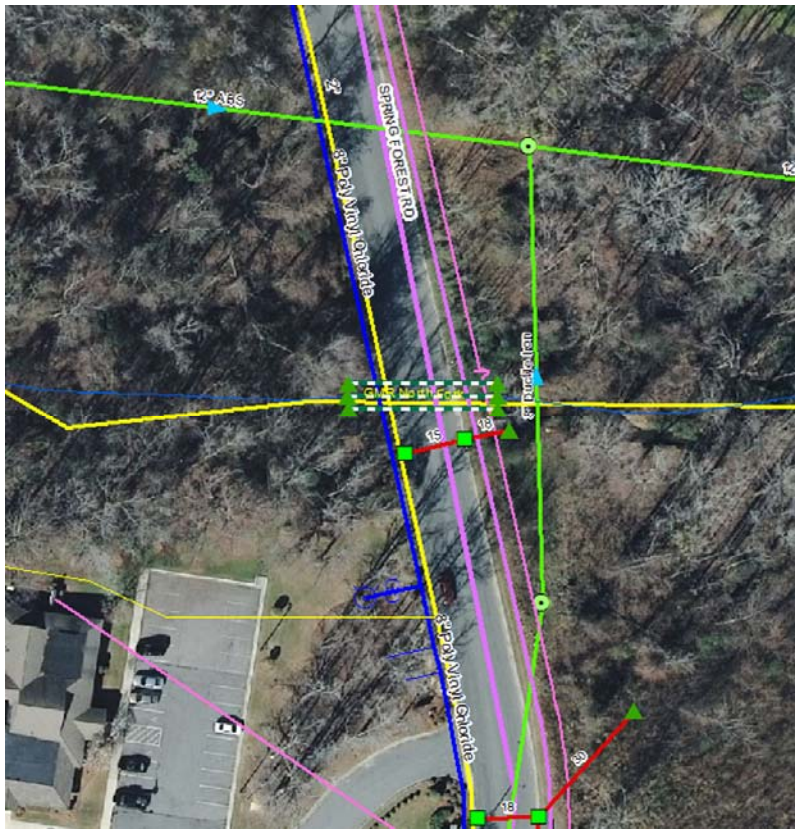
Analysis Overview

- Crossings close together
- Hydraulic interaction
- Iterative analysis / design

Greenville
NORTH CAROLINA

GMRNF Spring Forest Rd.

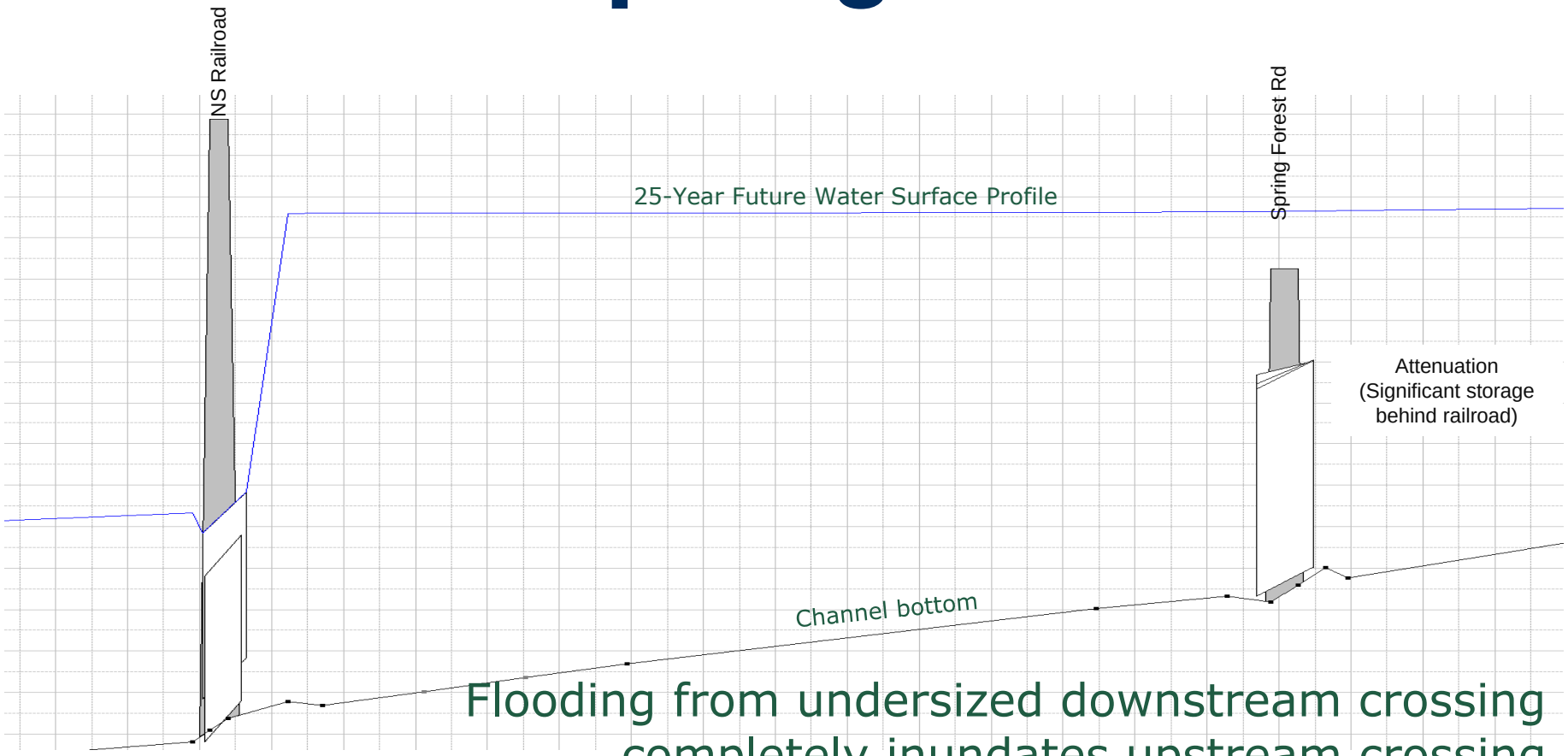
- Level of Service
  - COG, 25-Yr desired LOS
  - Existing = 10-Year
  - Future = 2-Year
  - Future w/ Imp. = 10-Yr
- 3@ 60” RCPs → 3@ 8’x6’ RCBCs
- Utility impacts
- Hydraulic interactivity



Cost (alone): $1.1M

Greenville
NORTH CAROLINA

GMRNF Spring Forest Rd.



Flooding from undersized downstream crossing completely inundates upstream crossing

Greenville
NORTH CAROLINA

GMRNF Spring Forest Rd.

- 3 influences: inflow, tailwater, structure dimensions
- RR backs up water on Spring Forest
- Cannot improve LOS without imp. at RR and downstream
- RR imp. release more water downstream
- Increased flows downstream:
  - Must be accounted for in imp. designs
  - Will result in increased WSE which must be mitigated with channel imp.

Greenville
NORTH CAROLINA

GMRNF Spring Forest Rd.

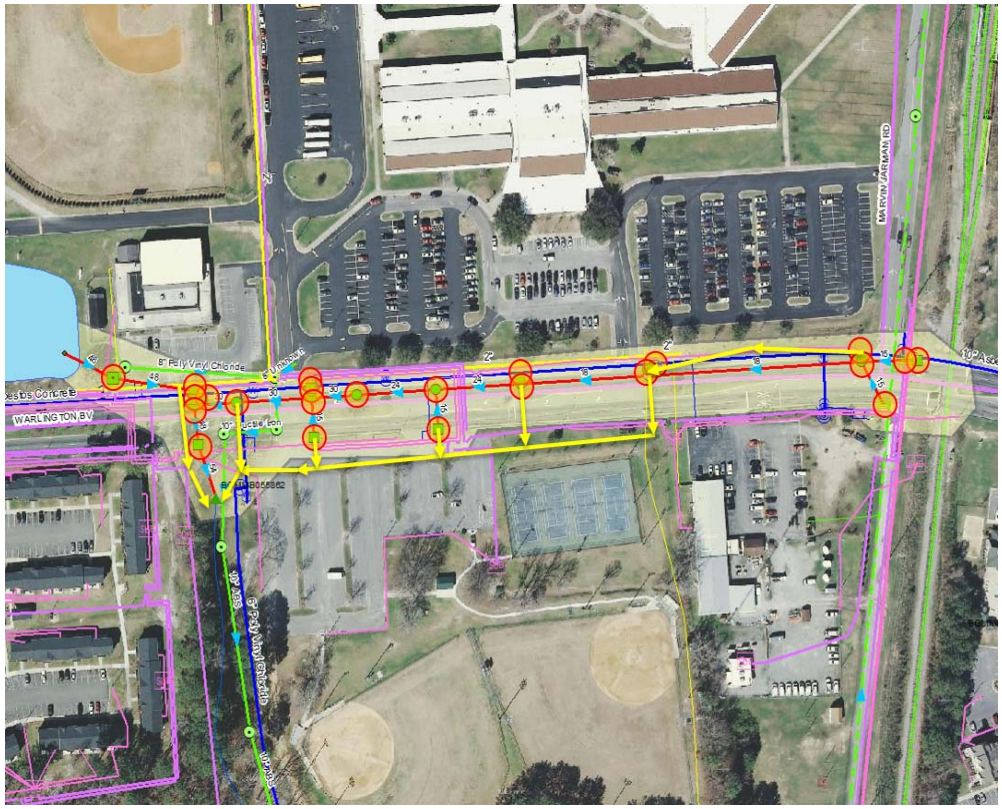
- Norfolk Southern RR
  - No LOS violation
  - Cost $1.4M
- Spring Forest Rd (DS)
  - Cost $2.3M
- Ellsworth Drive
  - Cost $1.9M
- Floodplain Benching
  - Mitigate increased WSE
  - Cost $1.4M

TOTAL COST: $8.1M

Greenville
NORTH CAROLINA

Arlington Boulevard

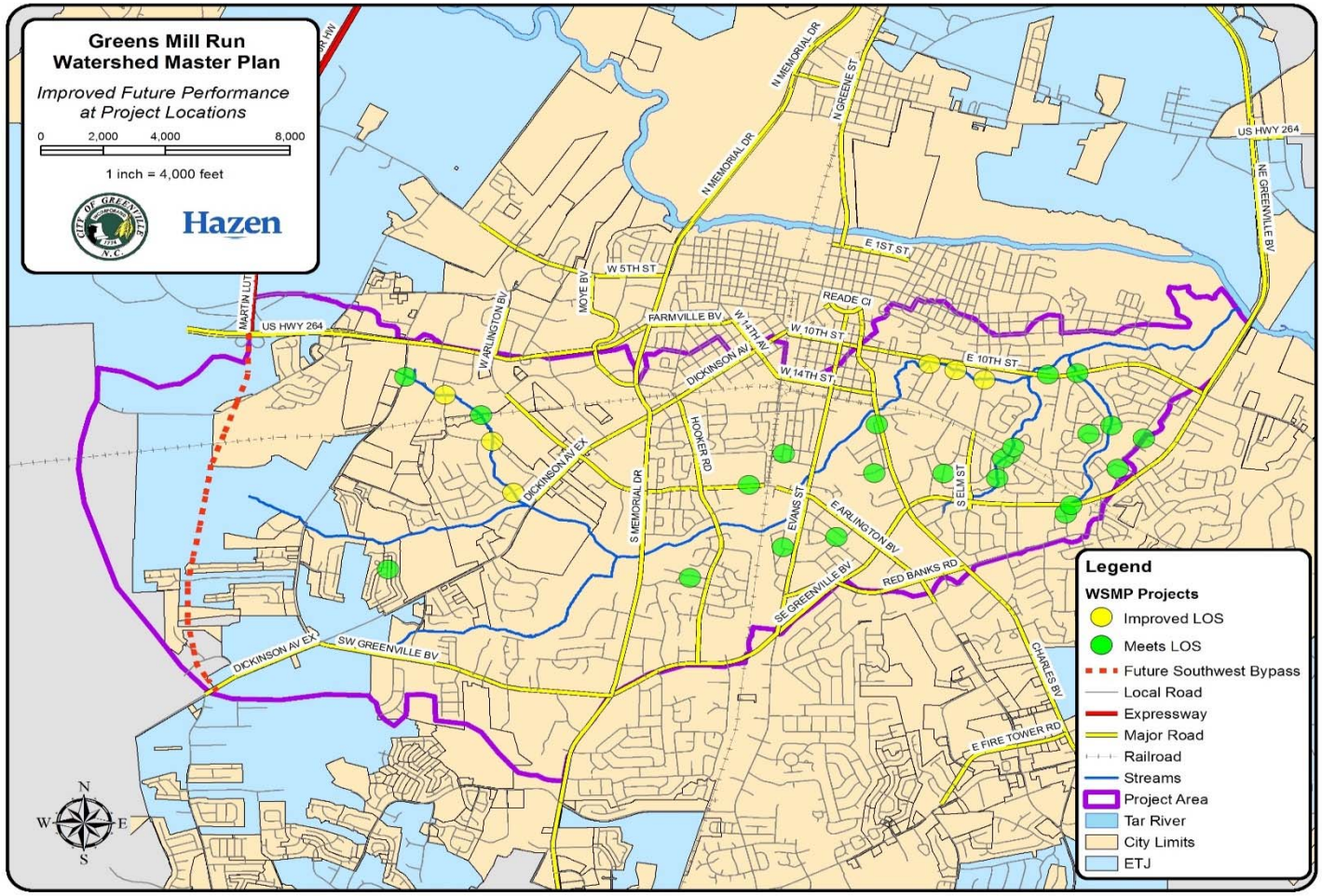
- Existing <2-Yr LOS
- Desired 10-Yr LOS
- 23 inlets surcharging
- Install new parallel system: 1,400LF of 15”-48” piping, 5 inlets, 12 junctions, 2 outlets
- Utility crossings



Cost - $920,000

Greenville
NORTH CAROLINA

Future w/ Improvements



Greenville
NORTH CAROLINA

Impaired Waters

- Current Status of Impairment
  - NCDEQ 303(d) List, Category 5
  - Subject to TMDL development
  - Poor benthic community ratings.
  - No specific pollutant identified
  - Listing based on single event in 2004

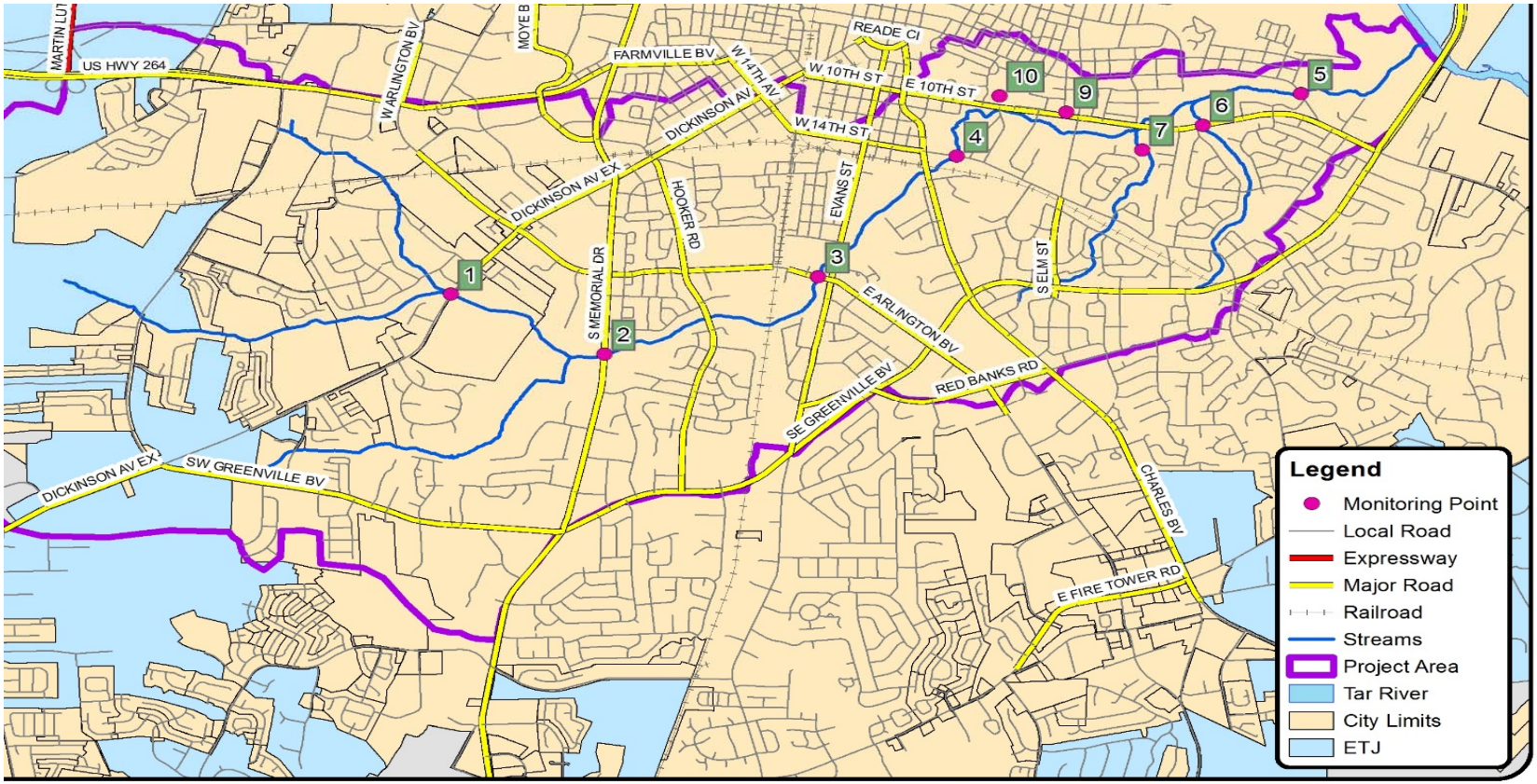
Greenville
NORTH CAROLINA

Drivers of Impairment

- Excessive Sediment Deposition
- Channel Modification and Instability
- Loss of Physical Habitat

Greenville
NORTH CAROLINA

Monitoring (Ambient & Benthic)



Greenville
NORTH CAROLINA

Impaired Waters Strategy

- Water Quality Recommendations
  - BMP retrofits
  - Detailed source investigations (sample pts. 9 and 10)
  - Pet waste awareness program
- Benthic Health Recommendations
  - Stream restoration and bank stabilization
  - Introduce woody structures and debris (habitat)
  - Import desired benthic macroinvertebrates
  - Continue monitoring for improvements

Greenville
NORTH CAROLINA

Impaired Waters Strategy

Request Category 4C designation

- For general "pollution" (USEPA)
- For entrenched and unstable streams
- Category 4C are not subject to TMDL development
- Instigated by formal letter to NCDEQ (referring recent USEPA guidance).

Greenville
NORTH CAROLINA

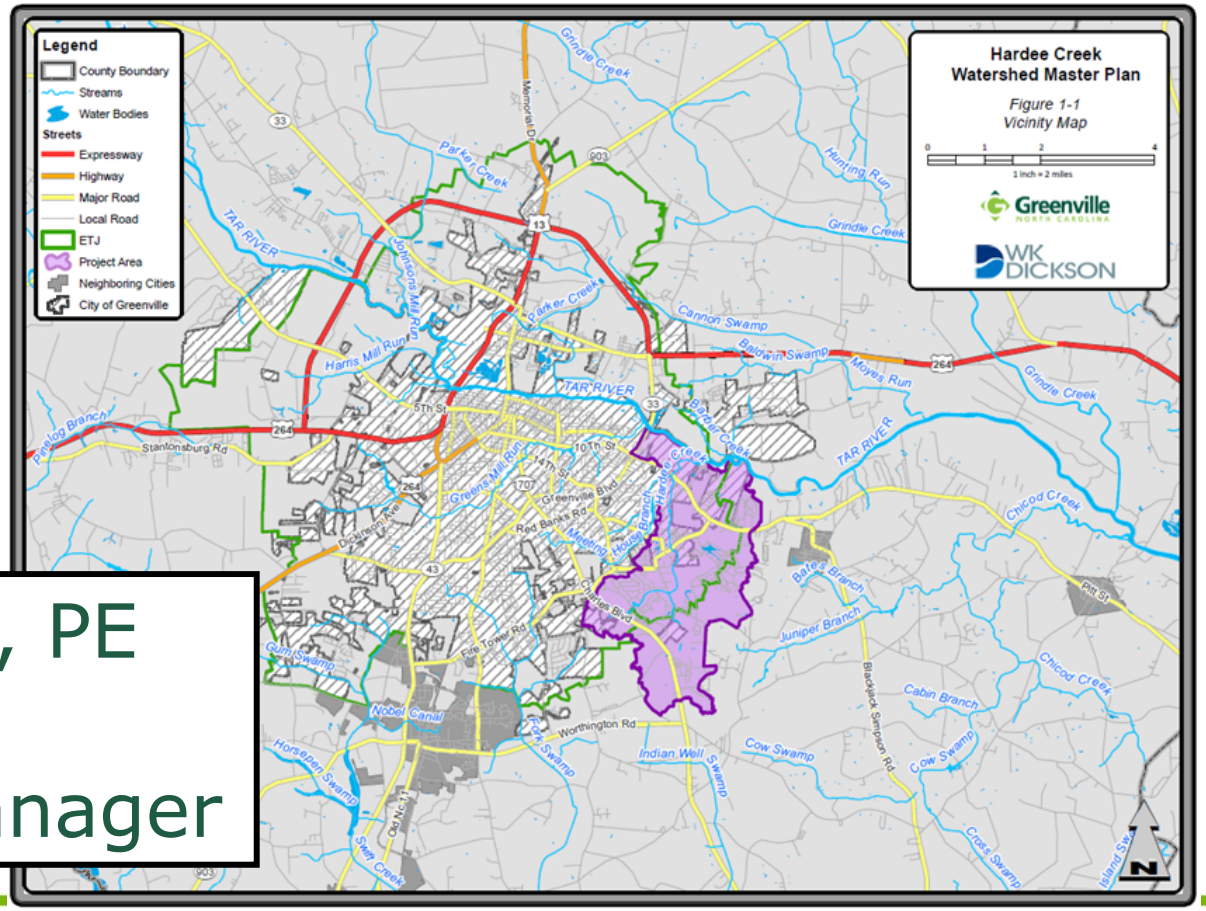
Impaired Waters Strategy

Request Category 4B designation (fall back)

- Voluntary controls to correct impairment
- Still requires quantifiable load
- Requires EPA concurrence
- Requires regular reporting to DWR
- Requires Action Plan to achieve WQ standard
- Submit condensed version of WSMP to NCDEQ for review

Greenville
NORTH CAROLINA

Hardee Creek WSMP



Tom Murray, PE
WK Dickson
Program Manager

Find yourself in good company

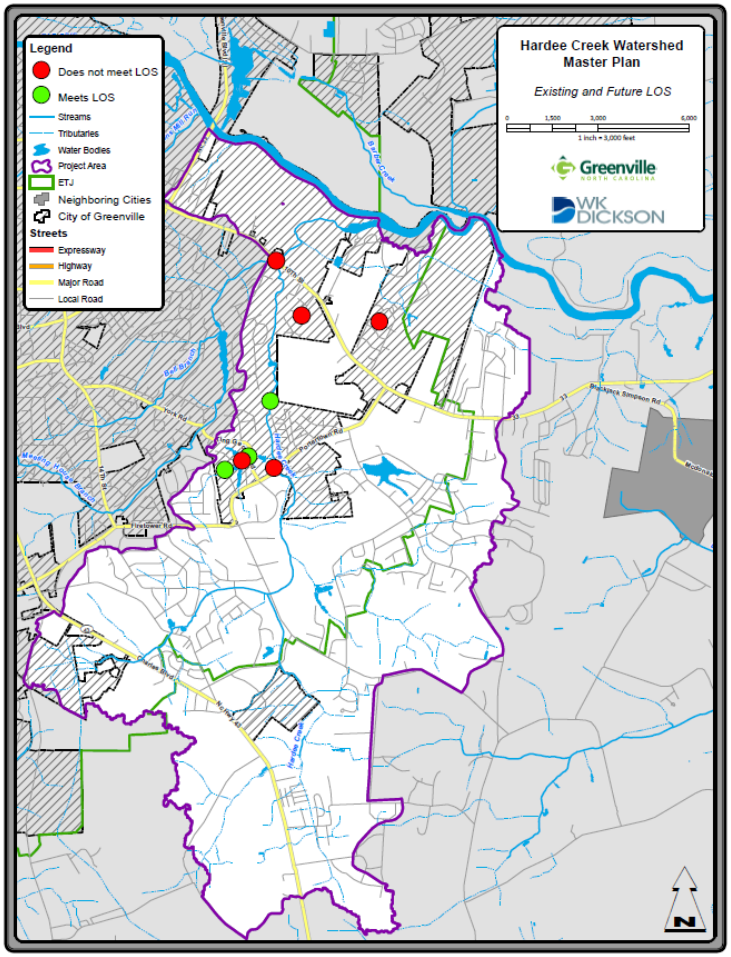
Greenville
NORTH CAROLINA

Watershed Characteristics

- 8 sq mile watershed area in Tar River Basin
- 30% of watershed in City limits
- 65% developed predominantly as residential land use

Greenville
NORTH CAROLINA

Existing Conditions

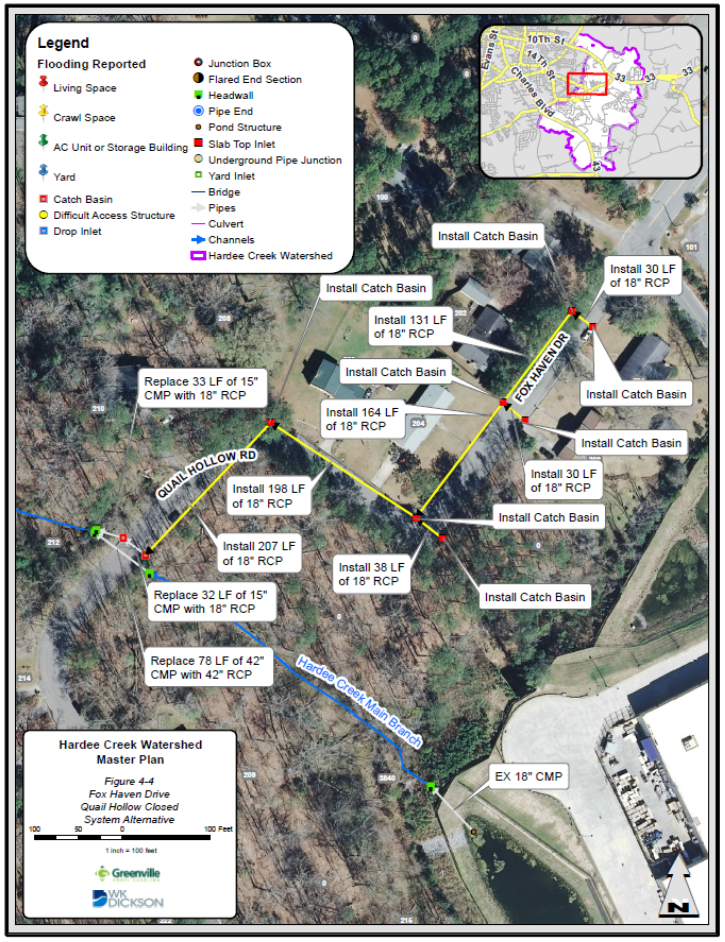


Fox Haven – Quail Hollow

- Existing 10-year LOS at Quail Hollow Road, but crossing in poor condition
- Flooding reported near Fox Haven Drive and Quail Hollow Road
- Limited infrastructure cause of flooding and spread issues

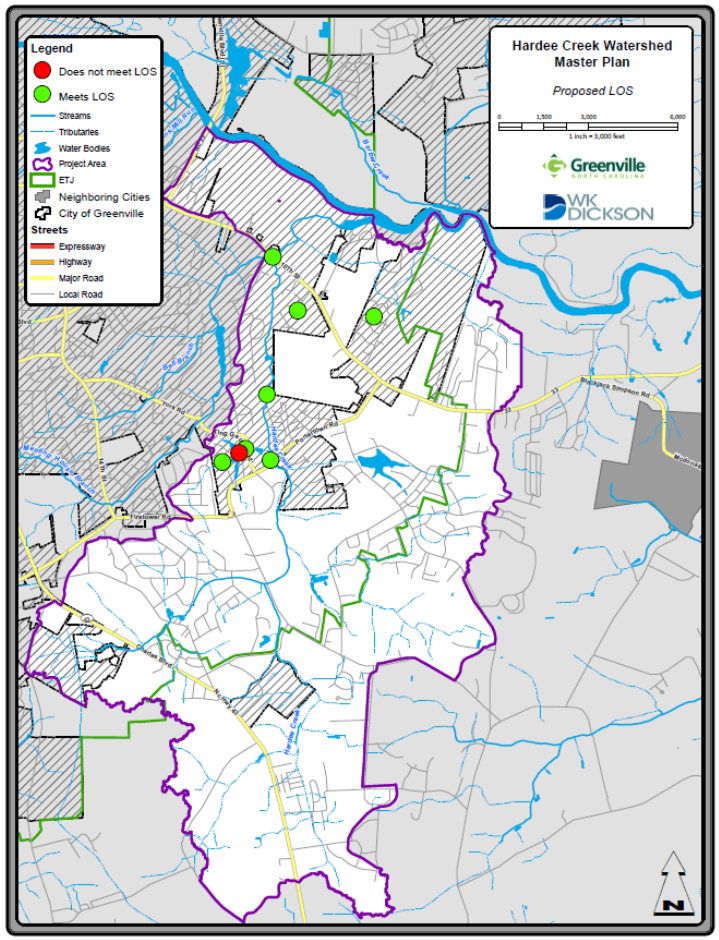
Greenville
NORTH CAROLINA

Fox Haven – Quail Hollow



Greenville
NORTH CAROLINA

Future w/ Improvements



Greenville
NORTH CAROLINA

Implementation

- Total **Capital Imp. Costs** $ 150-170M
  - Flood Control Primary $ 80-95M
  - Flood Control Secondary $ 40M
  - Streambank Stabilization $ 12.5M
  - Water Quality $ 20.5M
- Timeline 25+ yrs

Greenville
NORTH CAROLINA

Implementation

- Total **Maintenance Costs** $ 230M
  - 237 miles of pipe $ 219M
  - 17,000 structures $ 51M
  - Less secondary projects $ -40M
- Timeline 40 yrs

Greenville
NORTH CAROLINA

Summary of Implementation

- Maintenance Costs $ 230M
- Capital Costs $ 150M
- Operational Costs $ 3M

Annual Needs = $15M annually

Annual Utility Revenue = $5.5M

Prioritization is paramount!

Greenville
NORTH CAROLINA

Project Implementation

Establish a stakeholders group to discuss and select projects from the prioritized list

The list of projects would come from the high priority projects in all categories

Greenville
NORTH CAROLINA

Next Steps?

- Impacts to Operations
- Impacts to Storm Water Ordinance
- Impacts to Utility Rate Structure

Operational Impacts

- Inventory/Video
- Condition Assessment
- Infrastructure Inspection
- Asset Management

Greenville
NORTH CAROLINA

Ordinance Impacts

- Potential Modifications
  - Increase design storm requirements
  - Clarification on exemptions from detention
  - Define "common plan of development"
  - Identify areas for 25 year detention
  - Require inspections during construction
- Develop a stakeholders group
- Balancing Act between developer requirements and utility fee increases

Greenville
NORTH CAROLINA

Utility Impacts

- New fee structure
  - Utility Rate Study
- Revenue Bonds
  - Stakeholders Group to package projects